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RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT
FINAL ZONE D CNC CHARLESTON SC

7/17/1997

ENSAFE

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY
NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA
CTO-029

FINAL ZONE D
RCRA FACILITY INVESTIGATION REPORT

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
Charleston, South Carolina

SOUTHDIV Contract Number:
N62467-89-D-0318

Prepared by:

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

JULY 17, 1997

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY
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The Contractor, EnSafe/Allen & Hoshall, hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0318 is complete, accurate, and complies with all requirements of the contract.

Date	7/17/97
Signature	Todd Haverkost, P.G.
Name:	Todd Haverkost
Title:	**Task Order Manager**

July 17, 1997

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 190010
2155 EAGLE DRIVE
NORTH CHARLESTON, S.C. 29419-9010

5090/11
Code 1877
21 July 1997

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: ZONE D RCRA FACILITY INVESTIGATION REPORT CORRECTIONS AND RESPONSE TO COMMENTS

Dear Mr. Litton:

The purpose of this letter is to submit responses and page changes to the Zone D RCRA Facility Investigation for Naval Base Charleston. The Report is submitted to fulfill the requirements of condition IV.C.6 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and U.S. Environmental Protection Agency.

Comments made by the Department and the EPA on the February 19, 1997 submittal have been addressed and included in this submittal. We request that the Department and the EPA review the report and provide comment or approval as appropriate. If you should have any questions, please contact Reece Batten or myself at (803) 820-5578 and (803) 820-5525 respectively.

Sincerely,

M.A. Hunt

M.A. HUNT
Environmental Engineer
Installation Restoration III

Encl: (1) Zone D RFI Report changes, response to comments, and filing instructions, dated 17 July 1997

Copy to:
SCDHEC (Paul Bergstrand, Johnny Tapia), USEPA (Jay Bassett)
SOUTHDIV (Matthew Hunt), CSO Naval Base Charleston (Billy Drawdy, Daryle Fontenot)
SPORTENVDETCHASN (Dearhart)

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY
NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA
CTO-029

RESPONSE TO COMMENTS FOR DRAFT ZONE D RCRA FACILITY INVESTIGATION REPORT

(Dated February 19, 1997)

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
Charleston, South Carolina

SOUTHDIV Contract Number:
N62467-89-D-0318

Prepared by:

EnSafe/Allen & Hoshall
5720 Summer Trees Drive, Suite 8
Memphis, Tennessee 38134
(901) 383-9115

July 17, 1997

South Carolina Department of Health and Environmental Control
Response to Comments
For Draft Zone D RFI Report
Dated February 19, 1997

Comments by Johnny Tapia:

COMMENT

1. This document does not include a lithologic cross section of the area (Zone D). The final document should include lithologic cross sections.

RESPONSE

1. **Due to the limited number of subsurface control points in Zone D only one cross section has been included. Figure 2-2 presents a lithologic cross section of Zone D. This figure can be found on page 2-6.**

COMMENT

2. This document does not include an analytical hits list. The final document should include an analytical hits list.

RESPONSE

2. **Tables 5.4 (page 5-7), 5.7 (page 5-18), and 5.8 (page 5-19) reflect all parameters detected in soil samples, shallow monitoring well samples and deep well samples, respectively in Zone D.**

COMMENT

3. The objective of this RFI is to characterize the nature and extent of contaminants associated with releases, and to evaluate contaminant migration pathways. There are no Solid Waste Management Units (SWMUs) or Area of Concern (AOCs) associated with Zone D. The stated purpose of the Zone D RFI was to ensure that no potential sites are present which were not identified during the RCRA Facility Assessment process.. Analytical data from the lower level sample of grid soil boring #6 indicated extremely low concentrations of Chlorobenzene and 1,1,2,2-Tetrachloroethane. (1.0 and 2.0 parts per billion, respectively). The presence of these chemicals was not discussed in the text. They were presumably dismissed from consideration because the levels detected were below risk based concentrations. This sample location, however, is from a clean grid based location and not associated with a SWMU or AOC. The questions are then;

   A. is this location at the center or edge of the contamination, and
   B. has groundwater been impacted?

The questions are complicated because there are no wells associated with the grid soil boring location #6 and both chemicals have a density greater than water. Before this location may be dismissed and the RFI becomes finalized, shallow and deep groundwater samples should be collected and analyzed for VOCs and SVOCs. CNAV has the responsibility to prove groundwater has not been impacted by an unknown SWMU or AOC at grid soil boring location #6. The use of a Direct Push Technology well would be acceptable. CNAV should submit a monitoring well request no later than two weeks before well construction is to begin.

RESPONSE

3. To address this comment two additional groundwater samples have been collected at the GDDSB006 location. The discussion of the chlorobenzene and 1,1,2,2-tetrachloroethane detected in soil is contained in Section 5.2, page 5-13. The methodolgy used to collect the groundwater samples can be found in Section 3.2.5, page 3-8. No organic compounds were detected in either the deep or shallow DPT groundwater samples collected. These results are discussed in Section 5.5, page 5-20.

Response to Comments
Environmental Protection Agency
for Draft Zone D RFI Report
Dated February 19, 1997

Comments by Jay Bassett:

COMMENT

1. Section 4.3 - Zone D Data Validation Reports: Section gives a list of deficiencies and problems but does not give a summary of impact to data and data analysis. Example is if MEK, acetone, chloroform, and MC were found to be lab contaminants, would like to know detected level in blanks, were any media samples screened due to blanks (method or field) and what samples were screened or rejected. Since in two paragraphs, statements were made reflecting blank contamination parameters, need to include effect on data presented in the report.

RESPONSE

1. **Section 4.3 - Data Validation Reports - includes a brief summary of the analytical and validation results of the environmental samples for Zone D. The data validation reports, which are included in Appendix E, give a description of any deficiencies and problems of the field and laboratory method blanks which were noted during the validation process and how they may impact the data of the corresponding samples reviewed.**

COMMENT

2. Table 5.4 - 1,1,2,2-Tetrachloroethane was detected as shown in Table 5.2 at 2 ppb. Table 5.4 does not reflect this contaminant or associated screening levels. In reviewing RBC table, this contaminant exceeds the SSL (soils to gw) number of 2 ppb. While this is a minor exceedance, it needs to be reflected in the table and discussed in the text in Section 5.5.

RESPONSE

2. **Table 5.4, page 5-7 includes 1,1,2,2-tetrachloroethane and has been revised to include associated soil to groundwater screening levels. The USEPA Soil Screening Guidance: Technical Background Document (May 1996) provided soil to groundwater SSLs (DAF=20) for 1,1,2,2-tetrachloroethane of 3 ppb. Based on these values, the chromium detection in GDDSB00502 of 40.7 ppm was the only exceedance. This exceedance is discussed on page 5-14.**

COMMENT

3. I reviewed your inorganic background determination for this zone and accept the rationale and values as final. For this zone I do not believe a meeting or additional data is required for resolution of background as is being conducted for other zones.

RESPONSE

3. Agreed.

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 190010
2155 EAGLE DRIVE
NORTH CHARLESTON, S.C. 29419-9010

5090/11
Code 1877
26 February 1997

Mr. G. Randall Thompson
Director, Division of Hazardous and Infectious Waste Management
Bureau of Solid and Hazardous Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201

Subj: SUBMITTAL OF ZONE D RCRA FACILITY INVESTIGATION REPORT

Dear Mr. Thompson,

The purpose of this letter is to submit the Zone D Final RCRA Facility Investigation Report for Naval Base Charleston. The Report is submitted to fulfill the requirements of condition IV.B.2 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and U.S. Environmental Protection Agency.

The results of Zone D RFI field work was reviewed with Department and EPA representatives during the Project Team meeting of February 12th, 1996, and concerns incorporated into this draft report. We request that the Department and the EPA review the report and provide comment or approval as appropriate. If you should have any questions, please contact Bill Drawdy or Matthew Hunt at (803) 743-9985 and (803) 820-5525 respectively.

Sincerely,

P. M. ROSE
LCDR, U.S. Navy
Caretaker Site Officer
by direction

Encl: Zone D Final RFI Report, dated 19 February 1997

Copy to:
SCDHEC (Bergstrand, Tapia)
USEPA (3) (Brittain)
SOUTHNAVFACENGCOM (Hunt, Stockmaster)
CSO Naval Base Charleston (Drawdy, Fontenot)
SPORTENVDETCHASN (Dearhart)

FILING INSTRUCTIONS

The following is a list of pages in the *Final Zone D RFI Report*, dated July 17, 1997, that have been revised. The obsolete pages presently in your binders are listed in the column headed "Remove". New and replacement pages are listed in the column headed "Replace". Please file this instruction cover sheet preceding the Table of Contents of the *Final Zone* D RFI Report.

If you have any questions, please call 803-884-0029.

List of Changes/Revisions	**Remove** **<u>Pages</u>**	**Replace** **<u>Pages</u>**
Front cover, spine and front sheet	Entire	New
Table of Contents and Acronym List - updated.	i-iii	i-iii
Section 1.0	1-1	1-1
Section 2.0	2-1 to 2-27	2-1 to 2-28
Section 3.0	3-1 to 3-9	3-1 to 3-10
Section 4.0	4-1 to 4-18	4-1 to 4-19
Section 5.0	5-1 to 5-22	5-1 to 5-22
Section 6.0	6-1	6-1
Section 7.0	7-1	7-1
Section 9-0	9-1 to 9-3	9-1 to 9-4
Appendix D	-	Add to the end

Table of Contents

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ACRONYM LIST

% D	Percent difference
%R	Percent recovery
%RPD	Relative percent difference
%RSD	Percent relative standard deviation
%Solid	Percent Solids Content
AA	Atomic absorption
AL	Action Level
AOCs	Areas of Concern
BEQs	benzo(a)pyrene equivalent
bgs	Below ground surface
BRA	Baseline Risk Assessment
BRAC	Base Realignment and Closure (Base Closure and Realignment Act)
BRL	Below reportable level
BEST	Building Economic Solutions Together
CF	Calibration factors
CHASP	Comprehensive Health and Safety Plan
CLEAN	Comprehensive Long-Term Environmental Action Navy
CLP	Contract Laboratory Program
cm	Centimeters
cm/sec	Centimeters per second
CMS	Corrective Measures Study
CMI	Corrective Measures Implementation
CSAP	Comprehensive Sampling and Analysis Plan
DPT	Direct Push Technology
DQO	Data Quality Objectives
E/A&H	EnSafe/Allen & Hoshall
E&E	Ecology & Environment, Inc.
EPA	U.S. Environmental Protection Agency
ft^2/day	square feet per day
GC/MS	gas chromatography/mass spectroscopy
gpm	gallons per minute
GPS	Global positioning system
HSWA	Hazardous and Solid Waste Amendments

ACRONYM LIST (CONTINUED)

ICAP	inductively coupled argon plasma
ICMs	Interim Corrective Measures
IDL	instrument detection limit
IRP	Installation Restoration Program
IS	internal standard
kph	kilometers per hour
LCS	laboratory control samples
ml	milliliter
msl	mean sea level
MCLs	maximum contaminant levels
MS/MSD	matrix spike/matrix spike duplicate
NAVBASE	Naval Base Charleston
NTUs	nephelometric turbidity units
OP	organophosphorus pesticides
OSWER	Office of Solid Waste and Emergency Response
PCBs	Polychlorinated biphenyls
PE	Performance evaluation
PEMs	Performance evaluation mixtures
PVC	Polyvinyl chloride
QA/QC	Quality assurance/quality control
RAGS	*Risk Assessment Guidance for Superfund*
RBCs	Risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RPD	relative percent difference
RRF	relative response factor
SAS	Special analytical services
SCDHEC	South Carolina Department of Health and Environmental Control
SDG	Sample delivery group
SOP/QAM	Standard Operating Procedures and Quality Assurance Manual
SQLs	sample quantitation limits
SSLs	soil screening levels

ACRONYM LIST (CONTINUED)

SVOCs	semivolatile organic compounds
SWMUs	Solid waste management units
TAL	Target Analyte List
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total dissolved solids
TEF	toxicity equivalency factor
TEQs	2,3,7,8-TCDD equivalents
THQ	target hazard quotient
USEPA	U.S. Environmental Protection Agency
VOA	Volatile Organic Analysis
VOCs	Volatile Organic Compounds

1.0 INTRODUCTION

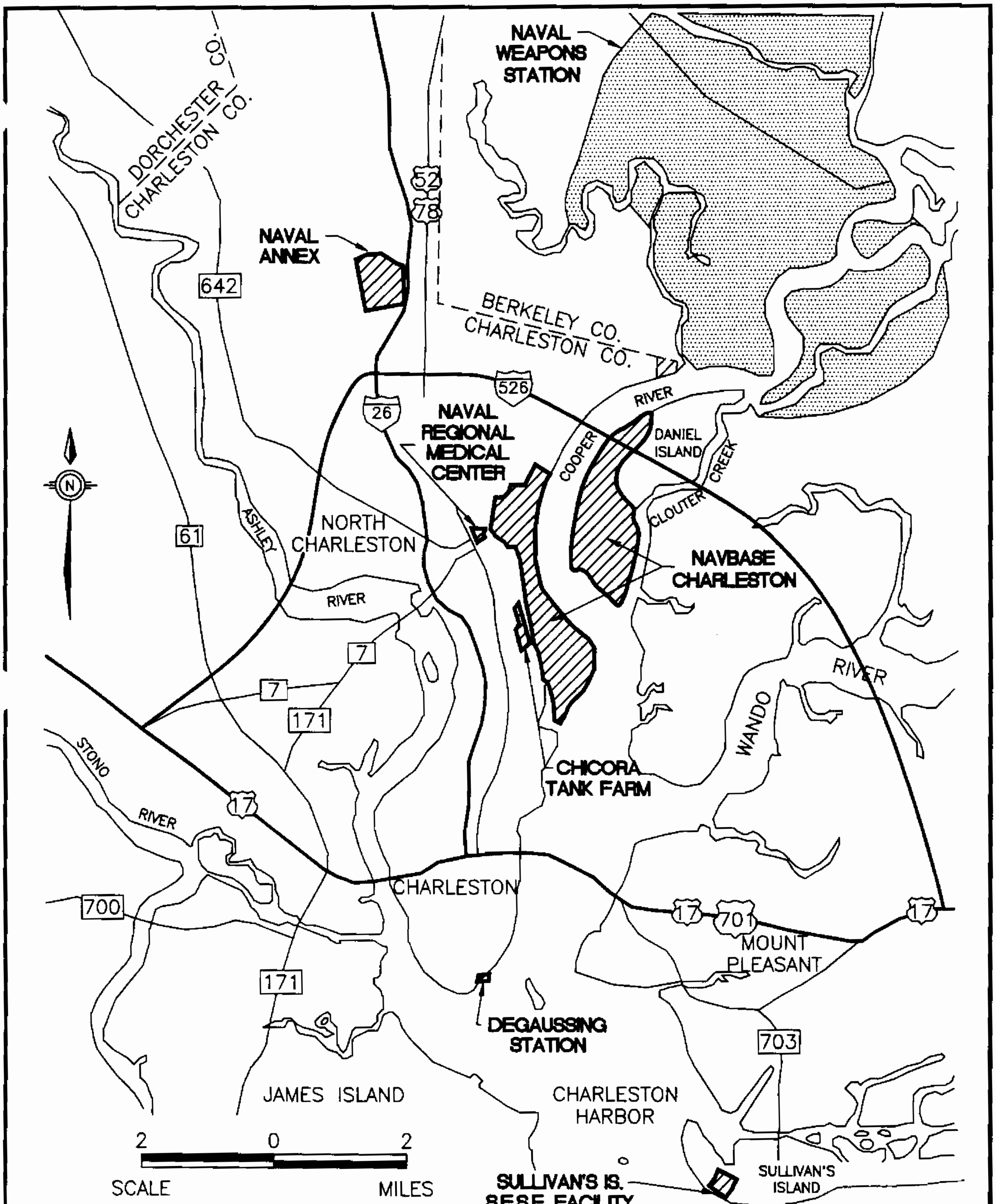
The environmental investigation and remediation at Naval Base Charleston (NAVBASE) are required by the Hazardous and Solid Waste Amendments (HSWA) portion of the Resource Conservation and Recovery Act (RCRA) Part B permit. These requirements are consistent with the RCRA Corrective Action Program, whose objectives are to evaluate the nature and extent of any hazardous waste or constituent releases, and to identify, develop, and implement appropriate corrective measures to protect human health and the environment. The scope of the RCRA Facility Investigation (RFI) includes the entire naval base, which has been divided into Zones A through L to accelerate the RFI process. This Zone D RFI Report, prepared by EnSafe/Allen & Hoshall (E/A&H), has been abridged to address the background conditions evaluated in Zone D. Zone D contains no areas of concern (AOCs) or solid waste management units (SWMUs); therefore the HSWA portion of the Part B permit may not apply to the Zone D RFI.

1.1 NAVBASE Description and Background

Location

NAVBASE is in the city of North Charleston, on the west bank of the Cooper River in Charleston County, South Carolina (Figure 1-1). This installation consists of two major areas: an undeveloped dredged materials area on the east bank of the Cooper River on Daniel Island in Berkeley County, and a developed area on the west bank of the Cooper River (Figure 1-2).

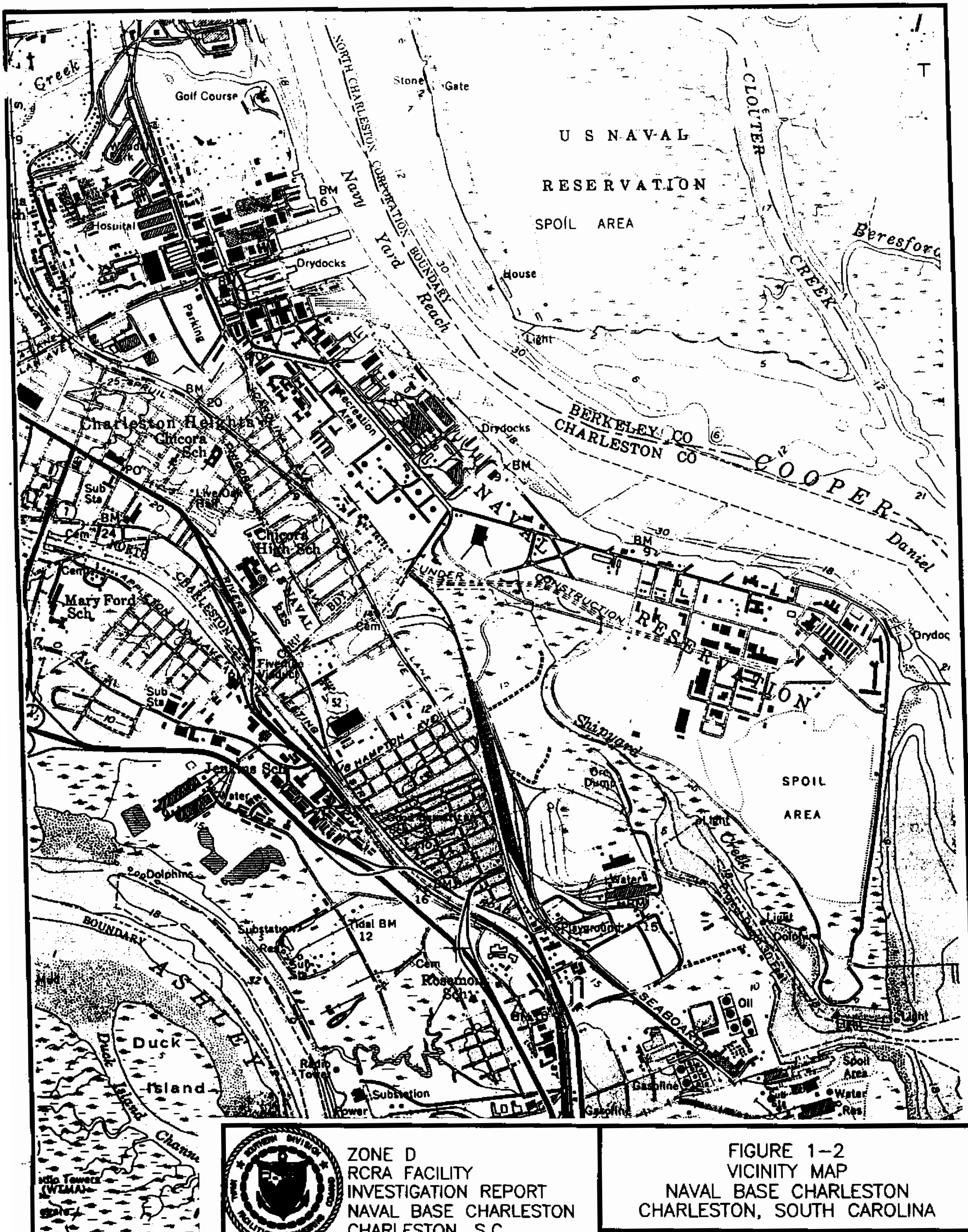
The developed portion of the base is on a peninsula bounded on the west by the Ashley River and on the east by the Cooper River. Major commands that occupy areas of the base include Charleston Naval Shipyard, Fleet Ballistic Missile Submarine Training Center, Fleet and Industrial Supply Center, Fleet and Mine Warfare Training Center, Naval Hospital Charleston, and Naval Station (Figure 1-3). NAVBASE also includes the degaussing facility in downtown Charleston, the Shipboard Electronics System Evaluation Facility on Sullivan's Island, and the Naval Station Annex adjacent to the Charleston Air Force Base.



ZONE D
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 1-1
LOCATION MAP
NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA

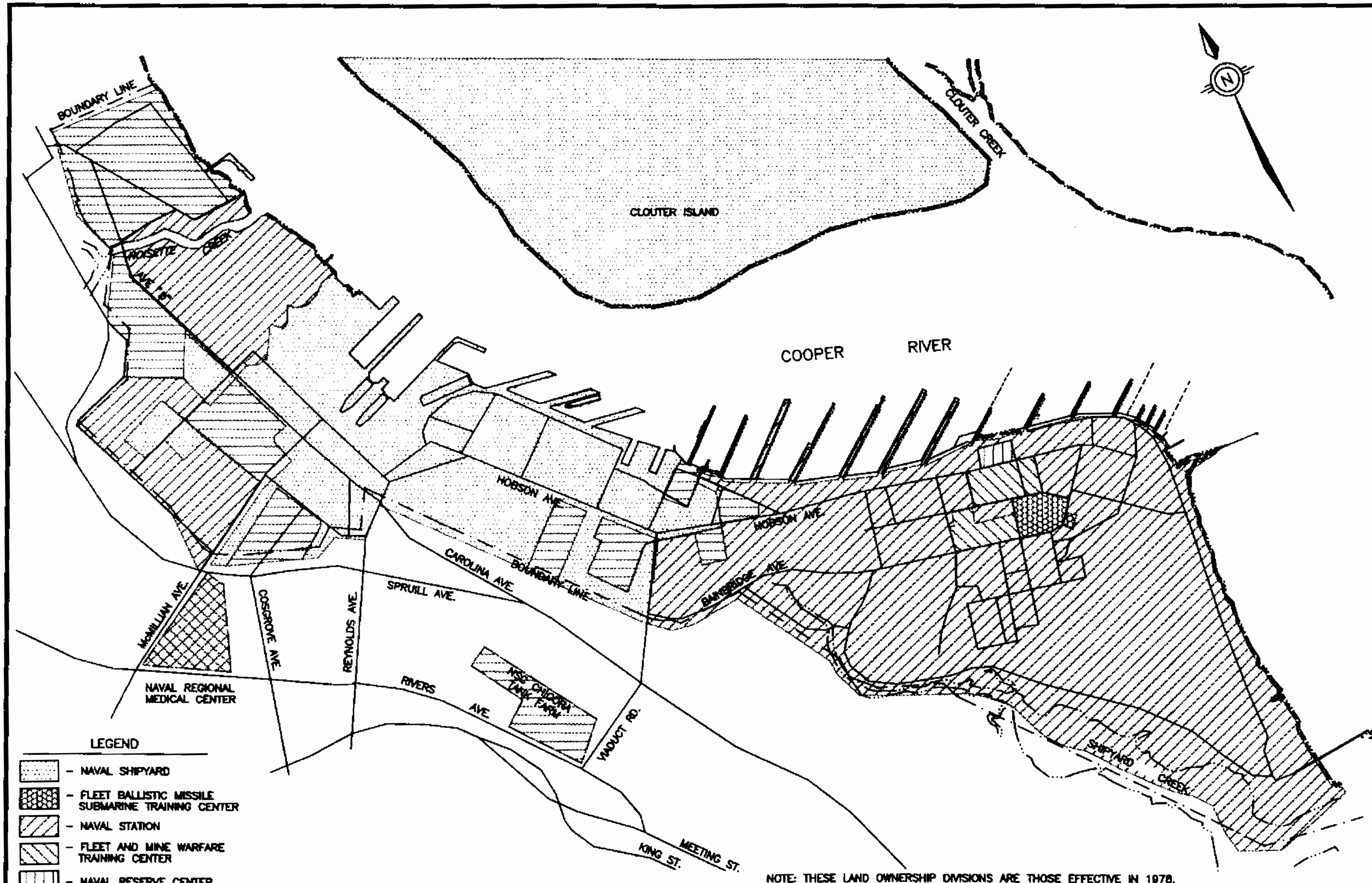
DWG DATE: 02/13/97 | DWG NAME: 29EBSSA



ZONE D
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 1–2
VICINITY MAP
NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA

DWG DATE: 02/13/97 | DWG NAME: BOARD



ZONE D
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 1–3
LOCATIONS OF
LAND HOLDINGS AND OCCUPANTS
NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA

DWG DATE: 02/13/97 | DWG NAME: 29EBSLO

The areas surrounding NAVBASE are *mature urban*, having long been developed with commercial, industrial, and residential land uses. Commercial areas are primarily west of NAVBASE; industrial areas lie primarily north of NAVBASE and along the west bank of Shipyard Creek.

Industrial uses have dominated the area west of Shipyard Creek for many years. Railways have served the area since the early 1900s. The presence of railways, when combined with nearby waterways, has made the area ideal for industry. While ownership has changed from time to time, the land adjacent to NAVBASE remains dedicated to chemical, fertilizer, oil refining, metallurgy, and lumber operations.

In contrast, the east bank of the Cooper River is undeveloped and contains extensive wetlands, particularly along Clouter Creek and Thomas Island. Active dredged materials disposal areas are located on Navy property between the Cooper River and Clouter Creek.

History

In 1901, the U.S. Navy acquired 2,250 acres near Charleston to build a naval shipyard, and the first naval officer was assigned duty in early 1902. A work force was organized, the navy yard surveyed, and construction of buildings and a drydock began. The drydock was finished in 1909, along with several other brick buildings and the main power plant, which are still in use today. With a work force of approximately 300 civilians, the first ship was placed in drydock and work began on fleet vessels in 1910. World War I brought about an expansion of the yard, land area, and work force. Employment levels dropped following the war. Work increased at the yard beginning in 1933, when a larger workload, principally in construction of several Coast Guard tugs, a Coast Guard cutter, and a Navy gunboat, created the need for more facilities and a much larger work force.

Civilian employment peaked in 1943 with almost 26,000 employees divided among three daily shifts. In 1956, construction began on new piers, barracks, and buildings for mine warfare ships and personnel. Later in the decade, Charleston became a major homeport for combatant ships and submarines of the U.S. Atlantic Fleet.

Base Closure

In 1993, NAVBASE Charleston was added to the list of bases scheduled for closure under the Defense Base Closure and Realignment Act (BRAC), which regulates the closure and transition of property to the community. NAVBASE was closed on April 1, 1996. Operations have since ceased and environmental cleanup has begun to make the property available for redevelopment.

1.2 Base Closure Process for Environmental Cleanup

The Installation Restoration Program

In 1980, the Department of Defense established the Installation Restoration Program (IRP) to investigate and clean up contamination which may have resulted from past operations, storage, and disposal practices at federal facilities around the country. The Navy adopted this program, which has regulatory requirements similar to those developed under the Comprehensive Environmental Response, Compensation, and Liability Act. Although federal installations were not required to comply with this act until it was amended in 1986, the Navy has, in effect, been complying with its environmental regulations through participation in the IRP since 1980.

Resource Conservation and Recovery Act

The primary focus of NAVBASE environmental cleanup activities, are required under RCRA, which was passed by Congress to control the handling of hazardous materials and wastes and to set standards for hazardous waste generation, transportation, treatment, storage, and disposal. NAVBASE was issued a hazardous waste permit in 1990 in accordance with this act, allowing the base to operate within these guidelines. Hazardous materials include substances such as chemicals, pesticides, petroleum products, paints, and cleaners identified by the

U. S. Environmental Protection Agency (USEPA) as being potentially harmful to human health or the environment.

The NAVBASE hazardous waste permit covers the investigation and cleanup of individual sites, called SWMUs and AOCs, resulting from past hazardous waste spills. SWMUs and AOCs are defined in the Part B permit as follows:

- **SWMU** — "Any unit which has been used for the treatment, storage, or disposal of solid waste at any time, regardless of whether the unit is or ever was intended for the management of solid waste. RCRA-regulated hazardous waste management units are also solid waste management units. SWMUs include areas that have been contaminated by routine and systematic releases of hazardous constituents, excluding one-time accidental spills that are immediately remediated and cannot be linked to solid waste management activities (e.g., product or process spills)."

- **AOC** — "Any area having a probable release of a hazardous waste or a hazardous constituent which is not from a solid waste management unit and is determined by the Regional Administrator to pose a current or potential threat to human health or the environment. Such areas of concern may require investigations and remedial actions as required under Section 3005(c)(3) of the Resource Conservation and Recovery Act and 40 CFR §270.32(b)(2) in order to ensure adequate protection of human health and the environment."

Where appropriate in this document, SWMUs and AOCs are collectively referred to as *sites.*

The investigation and cleanup activities are referred to as "corrective measures."

The main steps of the corrective measures process are outlined below.

- *RCRA Facility Assessment (RFA)* identifies potential or actual contaminant releases through a records review and visual examination of every SWMU and AOC.

- *RCRA Facility Investigation (RFI)* confirms contamination and determines its nature. This investigation also examines the extent and rate of any migration and provides baseline data to evaluate corrective measures.

- *Corrective Measures Study (CMS)* determines and evaluates cleanup alternatives for the site. This study also recommends a preferred cleanup option or corrective measure.

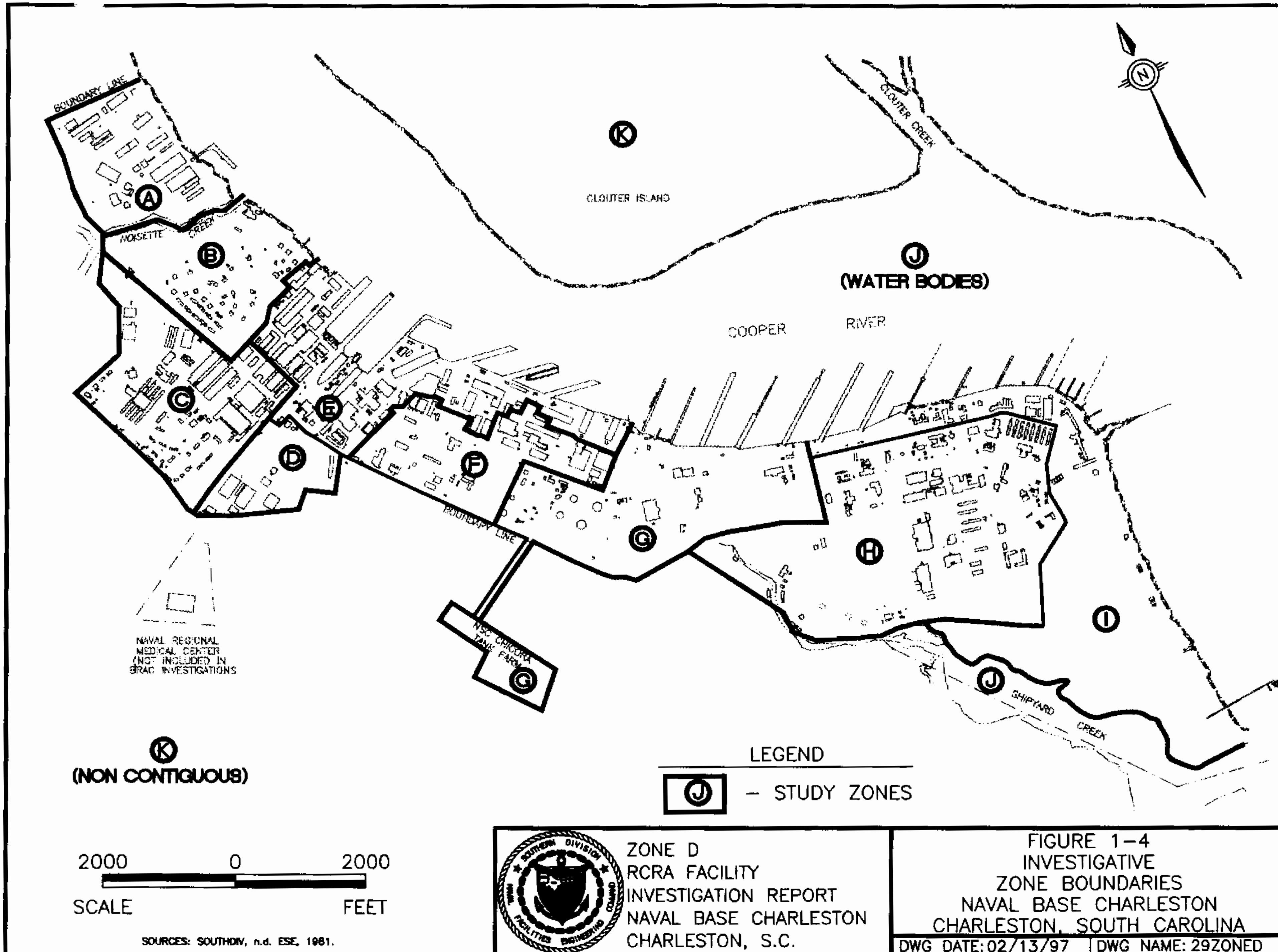
- During *Corrective Measures Implementation (CMI),* the selected corrective measure is designed, constructed, operated, maintained, and monitored for performance.

- *Interim Corrective Measures (ICMs)* are used to stabilize, control, or limit further releases from a site. Interim measures can be imposed at any point in the process.

1.3 Investigative Zone Delineation

Due to the size of the base and the level of detail required for investigations, NAVBASE has been divided into 12 investigative zones, identified as A through L, as shown in Figure 1-4.

The zone investigations and cleanups were ranked by the Restoration Advisory Board and the BEST (Building Economic Solutions Together) committee, a board authorized by the state to study and report on the best reuse options for the property being transferred. In 1994, BEST was replaced by the Charleston Naval Complex Redevelopment Authority, which has authority to establish leases for the transferred property.



ZONE D
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 1-4
INVESTIGATIVE
ZONE BOUNDARIES
NAVAL BASE CHARLESTON
CHARLESTON, SOUTH CAROLINA

DWG DATE: 02/13/97 | DWG NAME: 29ZONED

Zone D, on the northwestern portion of NAVBASE, consists of property and facilities between Reynolds and McMillan avenues. Zone C lies to the north, and Zone E to the east. Zone D, which borders the city of North Charleston to the west and south, contains primarily parking areas and warehouses, as identified in the *Final Environmental Impact Statement for Disposal and Reuse of the Charleston Naval Base* (Ecology and Environment, Inc., June 1995).

1.4 Current Investigation

Objective

RFI objectives are to characterize the nature and extent of contaminants associated with releases, and to evaluate contaminant migration pathways to identify both actual and potential receptors. The ultimate goal is to determine whether an ICM or a CMS is needed. This determination will be based on results of a baseline risk assessment (BRA) conducted to assess the risks posed to human health within the zone.

Scope

No SWMUs or AOCs were identified in Zone D through the RFA process, as discussed in the *Final RCRA Facility Assessment* for Naval Base Charleston (E/A&H, June 6, 1995). Identification of potential SWMUs and AOCs was based on the best information available at that time and is subject to change should more information become available. By investigating Zone D separately from areas of the base known to contain SWMUs or AOCs, it was thought that this zone could be prepared for transfer more quickly. The *Final Zones D, F and G RFI Work Plan* (E/A&H, June 1996) outlined an investigative strategy for these zones.

1.5 Previous Investigations

In addition to data generated during this investigation, information from previous investigations was reviewed for this report. Pertinent data have been incorporated as appropriate.

1.6 RFI Report Organization

The RFI report is laid out as follows:

- 1.0 INTRODUCTION
- 2.0 PHYSICAL SETTING
- 3.0 FIELD INVESTIGATION
- 4.0 DATA VALIDATION
- 5.0 NATURE OF CHEMICALS DETECTED IN GRID-BASED SAMPLES
- 6.0 ANALYTICAL DATA EVALUATION AND BACKGROUND REFERENCE CONCENTRATIONS
- 7.0 CONCLUSIONS
- 8.0 REFERENCES
- 9.0 SIGNATORY REQUIREMENT

The entire investigation sequence, including conclusions, is contained within a specific tabbed section for easy reference.

2.0 NAVBASE PHYSICAL SETTING

2.1 Geology

2.1.1 Regional Physiographic and Geologic Description

NAVBASE is in the Lower South Carolina Coastal Plain Physiographic Province, on the Cooper River side of the Charleston Peninsula, which is formed by the confluence of the Cooper and Ashley rivers. Topography in the area is typical of the South Carolina lower coastal plain, having low-relief plains broken only by the meandering courses of sluggish streams and rivers which flow toward the coast past occasional marine terrace escarpments. NAVBASE is essentially flat. Elevations range from just over 20 feet above mean sea level (msl) in the northwest part of the base to sea level at the Cooper River. Most of the original topography at NAVBASE has been modified by anthropomorphic activities, primarily dredge spoil deposition. The southern end of the base was originally tidal marsh drained by Shipyard Creek and its tributaries. The original elevations in other portions of the base were only slightly higher. The land surface at NAVBASE has been elevated with increments of both solid wastes and dredged materials (primarily the latter) over the last 93 years. Most of NAVBASE remains within the 100-year flood zone of less than 10 feet above msl.

Charleston area geology is typical of the southern Atlantic Coastal Plain. Cretaceous and younger sediments thicken seaward and are underlain by older igneous and metamorphic basement rock. Surface exposures at NAVBASE, in the limited areas which remain undisturbed, consist of Quaternary-age sands, silts, and clays of high organic content (Weems and Lemon, 1993). Tertiary-age sediments immediately underlie the younger Quaternary-age deposits. Erosional remnants of late Tertiary (Pliocene to Miocene) formations may be encountered at various locations. However, the mid Tertiary-age (Oligocene to Eocene) Cooper Group is pervasive beneath the study area. The Cooper Group consists of the following in increasing age: the Ashley, Parker's Ferry, and Harleyville formations. The formation of particular importance in the Cooper Group is the Ashley Formation, which was formerly referred to as the Cooper Marl in most NAVBASE reports and regional geologic literature. The Ashley Formation is a pale green to olive-brown, sandy, phosphatic limestone or marl, locally muddy and/or sandy. In the Charleston vicinity, the Ashley Formation is generally encountered at a depth of approximately 30 to 70 feet below ground surface (bgs). The relief of the top of the Ashley Formation is associated with an erosional basin (Park, 1985). Park identifies the entire Cooper Group, of which the Ashley Formation is a member and hydrogeologically similar, as being approximately 300 feet thick.

Surface soil at NAVBASE has been extensively disturbed. Much of NAVBASE, particularly the southern portion, has been filled using dredged materials from the Cooper River and Shipyard Creek. The dredged materials are an unsorted mixture of sands, silts, and clays. Most of the remainder of the base has been either filled or reworked. Native soil is the fine-grained silt, silty sand, and clay typical of terrigenous tidal marsh environments. Sand lenses are present in localized areas, but are generally only a few feet thick in the upper 5 to 10 feet of the subsurface.

2.1.2 NAVBASE Geologic Investigation

Geological and stratigraphic information has been obtained from soil and monitoring well borings installed during the RFIs for Zones A, B, C, D, E, H and I. Data for the Zone D investigation have been included in the geologic and hydrogeologic assessment presented in this report. Lithologic samples were classified and logged by an E/A&H geologist as described in the *Final Comprehensive Sampling and Analysis Plan RCRA Facility Investigation* (E/A&H, July 1996) (CSAP). Shelby tube samples collected during drilling were analyzed for porosity, bulk density, grain size, specific gravity, percent moisture, and vertical permeability.

Zone D Geologic Investigation

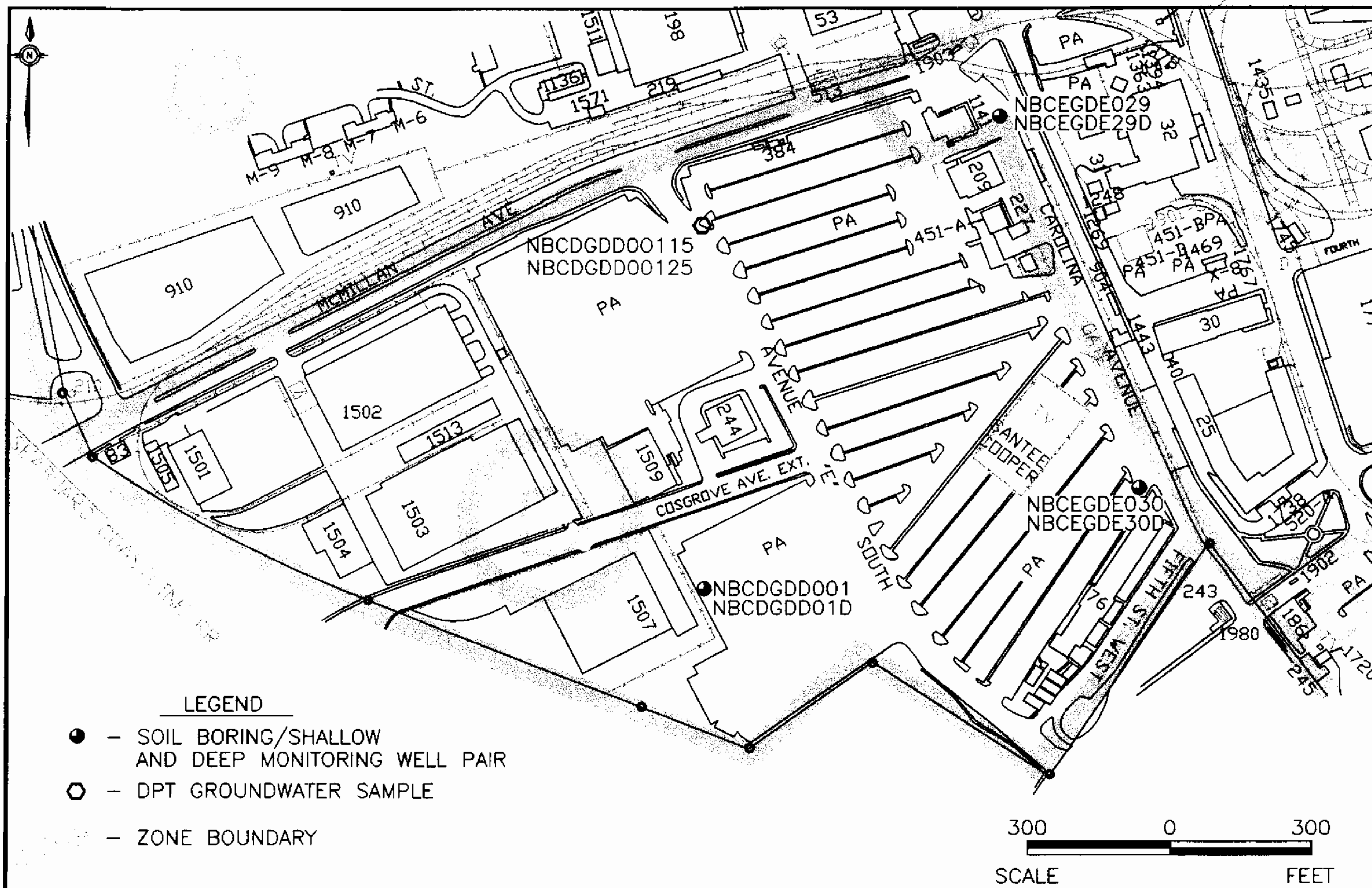
A monitoring well pair consisting of one shallow (NBCDGDD001) and one deep (NBCDGDD01D) well were installed in Zone D between August and September 1996 as part of the RFI. Subsequently, two well pairs (NBCEGDE029/29D and NBCDGDE030/30D) were installed along the northeastern boundary between Zones D and E as part of the ongoing RFI in Zone E. Since these wells lie within Zone D, they provide useful lithologic and hydrogeologic data that will be used in this report in order to fully assess the geologic and hydrogeologic characteristics of Zone D. The depth of the deepest borehole in Zone D limited the information to the upper 35 feet of unconsolidated sediments at location NBCEGDE29D. Table 2.1 summarizes the monitoring wells and their well construction data.

Table 2.1
Zone D Monitoring Well Construction Data

Monitoring Well ID	Date Installed	TOC elevation (msl)	Ground elevation (msl)	DRILLED DATA (bgs)			Depth to Groundwater* (below TOC)
				TOS	BOS	BOW	
ZONE D RFI MONITORING WELLS							
NBCDGDD001	8/27/96	14.42	11.7	2.0	11.4	12.0	6.90
NBCDGDD01D	9/10/96	11.45	11.7	21.7	25.7	26.5	3.80
ZONE E RFI MONITORING WELLS							
NBCEGDE029	9/3/96	7.32	7.5	3.3	12.3	13.3	4.50
NBCEGDE29D	9/11/96	7.36	7.5	17.7	21.7	22.5	4.47
NBCEGDE030	9/4/96	12.10	12.3	2.0	11.0	12.0	5.09
NBCEGDE30D	9/10/96	12.34	12.3	21.7	25.7	26.5	5.38

Notes:
TOC = Top of well casing
TOS = Top of screened interval
msl = mean sea level
bgs = below ground surface
BOS = Bottom of screened interval
BOW = Bottom of well (end cap)
* = Depths to groundwater vary seasonally and diurnally. These depths should only be considered approximate (10/16/96 and 12/18/96 data presented for Zones E and D wells, respectively).

Figure 2-1 shows the Zone D and E monitoring wells. Monitoring well construction diagrams and associated lithologic boring logs for these locations are included in Appendix A.



ZONE D
RCRA FACILITY
INVESTIGATION REPORT
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CHARLESTON, S.C.

FIGURE 2-1
GROUNDWATER SAMPLE
ZONE D

DWG DATE: 07/16/97 | DWG NAME: 2904ZDMW

Of the stratigraphic formations described in Section 2.1.1, only Quaternary and Tertiary-age sediments were encountered during the Zone D RFI. The lowermost stratigraphic unit identified in Zone D is the Oligocene-age Ashley Formation of the Tertiary Cooper Group. Above the Ashley lies undifferentiated Tertiary-age deposits, which are overlain by Quaternary and Holocene-age (Recent) sediments. This stratigraphic relationship is illustrated in Figure 2-2, a cross section generated with data from logging of monitoring well boreholes in Zone D.

2.1.3 Tertiary-Age Sediments

2.1.3.1 Ashley Formation

The oldest sediment encountered during the Zone D RFI investigation has been the Ashley Formation, the youngest member of the Oligocene-age Cooper Group. The Ashley Formation (Ta) was deposited in an open-marine shelf environment during a rise in sea level in the late Oligocene (Weems and Lemon, 1993). The Ashley Formation is an olive-yellow to olive-brown, tight, slightly calcareous, clayey silt with varying amounts of very fine to fine grained sand that decrease rapidly with depth. It is firm to stiff, low in plasticity, and moist to wet. One Shelby tube sample of the Ashley Formation was taken from location NBCDGDD01D. The porosity of this sample was 56.3% with a mean grain size distribution of 19% sand, 57% silt, and 24% clay.

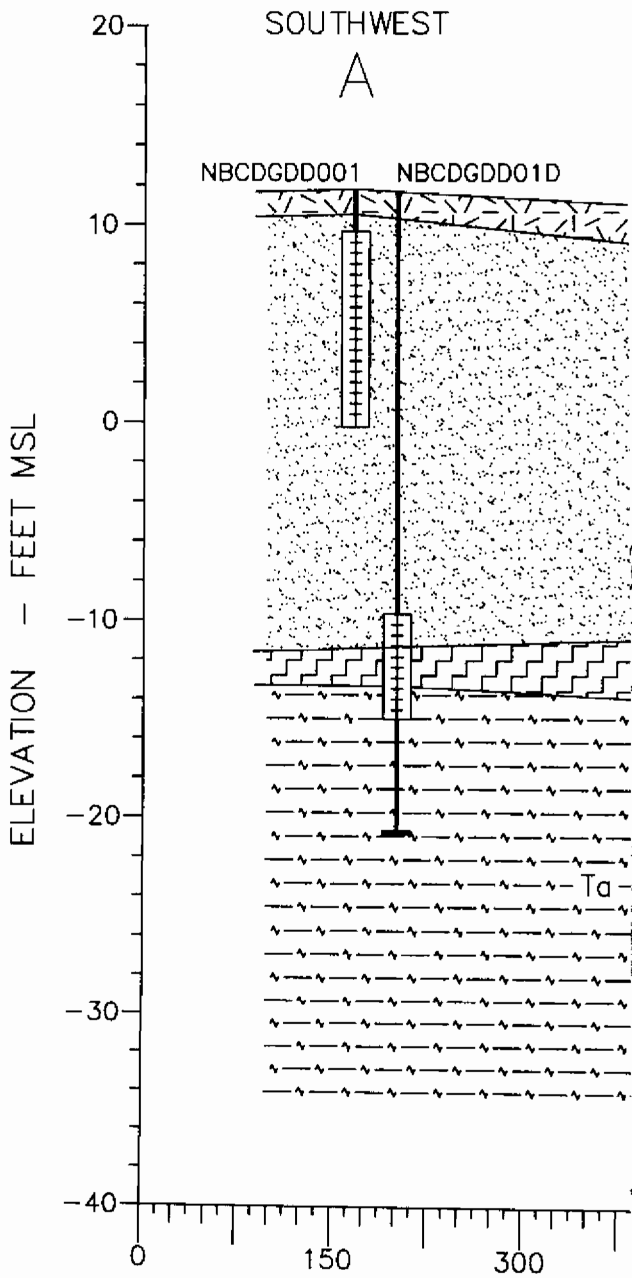
Due to successive sea level transgression-regression (rise and fall) sequences during late Tertiary and early Quaternary time, extensive erosion has removed many of the marine and terrigenous deposits overlying the Ashley Formation (Weems and Lemon, 1993).

2.1.3.2 Undifferentiated Late Tertiary-age Units

Several late Tertiary-age units were deposited unconformably over the Ashley Formation (Ta). From oldest to youngest, these are the late Oligocene-age Chandlers Bridge Formation, the late

LEGEND

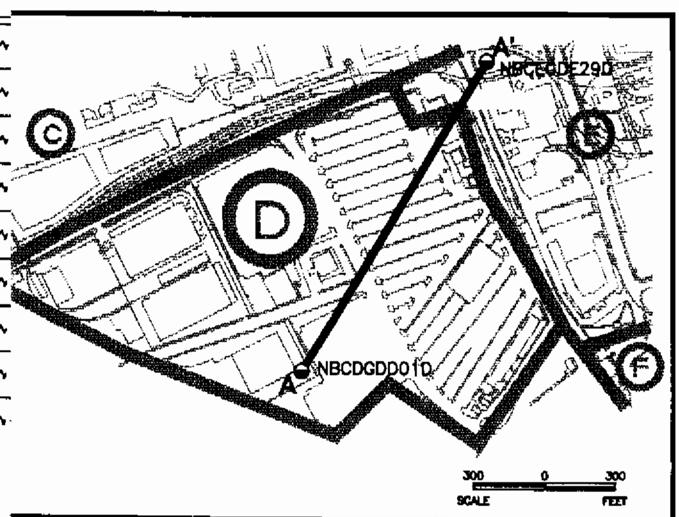
FILL	Undifferentiated mixture of medium to high plasticity clays, fine sand, silt, gravel and ROC. Varies greatly with location.
Qc	QUATERNARY CLAYEY SAND AND SILTY SAND--brown, orange-brown, gray, green, and tan, very fine to fine sand often with trace medium grains, varying amounts of silt and inorganic gray clay; often interbedded with medium plasticity, soft gray clay laminae; sand occasionally unconsolidated and loose. AQUIFER
Qs	QUATERNARY SAND--undifferentiated olive-brown, gray, and orange sand; primarily very fine to fine and moderately to well-sorted but typically increases in grain size with depth (from fine to medium with some coarse); clean to silty sand. AQUIFER.
Tu	TERTIARY - UNDIFFERENTIATED--olive-gray to gray-green silt with varying amounts of very fine to fine quartz and phosphate sand with some clay; low plasticity, soft; intermixed with small subrounded phosphate pebbles, coarse shell hash, and oyster shells. AQUIFER.
Ta	TERTIARY ASHLEY FORMATION--olive-green to olive-brown silt with varying amounts of clay and very fine sand, medium plasticity, firm to stiff, trace calcareous. CONFINING UNIT.



NBCFDGDD01D — MONITORING WELL IDENTIFICATION

SCREENED INTERVAL OF WELL

TOTAL DEPTH OF BORING



ZONE D
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-2
LITHOLOGIC CROSS SECTION
A - A'

DWG DATE: 07/10/97 | DWG NAME: 29ZDAA

Oligocene-early Miocene-age Edisto Formation, and the Miocene-age Marks Head Formation (Weems and Lemon, 1993). These deposits appear very similar in the field and often differ on the basis of micro-fossils and mineralogy. Successive erosive events have removed some or all of these units at various locations at NAVBASE and the Charleston area. Furthermore, accurate identification of any of these late Tertiary-age units is complicated by reworking during Quaternary time. As a result, it was decided that these units would be referred to as undifferentiated late Tertiary-age units (Tu) for the purposes of this report, and represent any sediment overlying the Ashley Formation thought to be of Tertiary-age.

Undifferentiated late Tertiary-age units (Tu) were present in two of the three deep borings in Zone D. Three feet of Tu was encountered at a depth of 22 feet (-10.5 ft elev. msl) at NBCDGDD01D; the unit apparently thickens to 8.5 feet at NBCEGDE29D, where it was encountered at a depth of 16.5 feet (-9 ft elev. msl). In general, the undifferentiated late Tertiary-age units are characterized as a olive-green to olive-gray sandy silt with varying amounts of quartz sand, phosphatic sand, oyster shells, and subrounded to rounded phosphate pebbles.

2.1.4 Quaternary-Age Sediments

The Quaternary Period began 1.6 million years ago with the Pleistocene Epoch and continues with the Holocene (Recent) Epoch from 65,000 years to present. During Quaternary time, several sea transgressions-regressions resulted in a jumbled network of terrace complexes composed of varied depositional environments such as barrier islands, backbarrier lagoons, tidal inlets, and shallow-ocean-marine shelf systems. Due to regional crustal uplift that occurred in the Charleston region during the Quaternary, many barrier to backbarrier deposits from high sea level stands are preserved as terraces; however, succeeding transgressions reworked the shallow-marine shelf deposits on the seaward side of each older barrier ridge or island (Weems and Lemon, 1993). The result of this erosional and re-depositional process of older sediments is a subsequently younger sequence of deposits on the seaward side of the previous coastal deposit (Weems and Lemon, 1993). Therefore, it can be difficult to determine discrete formational units within the Quaternary system.

Throughout Zone D, Quaternary-age sediments extend from the top of Tertiary-age sediments to just below ground surface. These sediments appear to be approximately 24, 16.5 and 22 feet thick at locations NBCEGDE30D, NBCEGDE29D, and NBCDGDD01D, respectively. These sediments are thought to be primarily comprised of the Pleistocene-age Wando Formation (deposited 70,000 to 130,000 years ago), which are overlain by Holocene-age sand and clay deposits. In general, the Wando deposition encompasses three distinct high sea-level stands in the late Pleistocene (Weems and Lemon, 1993). As a result, Wando composition consists of repeating sequences of clayey sand and clay deposits overlying barrier sand deposits which, in turn, overlie fossiliferous shelf-sand deposits. In Holocene time, rivers and streams have downcut these sediment sequences leaving scours that have become filled with clay and silty sand deposits typical of low energy environments. These younger deposits may resemble Wando-age deposits and further complicate the interpretation of local geology.

Weems and Lemon (1993) have identified and correlated several formations of Quaternary-age sediments. However, field identification of these formational units is difficult since many characteristics may only be evident at the microscopic level. Consequently, only six distinct Quaternary-age stratigraphic units have been correlated in recent lithologic cross sections prepared for the *Draft-Zone A RCRA Facility Investigation Report* (September 12, 1996). Of the six, only three were encountered in Zone D: Qc (Quaternary clayey sand), Qs (Quaternary sand), and Qdm (Quaternary dewatered marsh clay).

Description of Zone D Quaternary-age Stratigraphic Units

- ***Quaternary clayey sand (Qc):*** This unit generally comprises those sand deposits that have enough intermixed silt and clay or obvious clay lenses that they cannot confidently be considered to be true Quaternary sand (Qs) deposits. The Qc deposits generally consist of gray to brown, very fine to fine grained sand with an appreciable amount of silt and clay present within the matrix to give the sand a soft and sticky texture. Oftentimes, clay casts and occasional shell fragments are present. The Qc unit also includes deposits of brown, silty, sandy, plastic clay.

- ***Quaternary sand (Qs):*** This unit may generally be described as gray, orange, and brown, very fine to medium, well to moderately well-sorted, loose sand to silty sand. Occasional laminae of brown to black silt are often present as well as small shell fragments.

Two Shelby tubes samples were taken of the Qs sediments from the shallow subsurface (less than 11 feet bgs) at location NBCDGDD001. These samples exhibited an average porosity of 43% and mean grain size distribution of 88.5% sand and 4.5% silt and 7.0% clay. The Shelby tube sample analyses are included as Appendix B.

- ***Quaternary dewatered marsh clay (Qdm):*** This deposit was only encountered in the deep boring at NBCEGDE30D at a depth of 16.5 feet bgs. The dewatered marsh clay is dark gray, silty, stiff, plastic, and often thinly laminated with sand and shelly lenses.

2.1.5 Soil

Due to extensive surface soil disturbance at NAVBASE during its operational history, approximately the upper 5 feet of the subsurface are typically a mixture of artificial fill and native sediments. However, the Zone D area is somewhat higher in elevation and is generally considered to have undergone less extensive fill placement.

2.2 NAVBASE Hydrogeology

2.2.1 Regional Hydrologic and Hydrogeologic Background

Parts of the southern portion of NAVBASE are drained by Shipyard Creek, while northern areas are drained by Noisette Creek. The drainage basins of both waterways are tributaries of the Cooper River, which include areas other than NAVBASE. Surface drainage over the remainder of NAVBASE flows directly into the Cooper River, which discharges into Charleston Harbor.

Shipyard Creek, a small tidal tributary approximately two miles long, flows southeast along the southwestern boundary of NAVBASE to its confluence with the Cooper River opposite the southern tip of Daniel Island. Piers line the western shore of the Cooper River's lower mile, while the entire length of the eastern shore is bounded by tidal marshland.

Noisette Creek, which transects the northern portion of NAVBASE and separates Zones A and B, is a tidal tributary approximately 2.5 miles long. The creek flows nearly due east from its headwaters in the city of North Charleston and empties into the Cooper River. Surface water elevations in the creek recorded during February and August 1996 groundwater level measurement events showed an average of 5 feet change in elevation from low to high tide.

Groundwater occurs under water table or poorly confined conditions within the Quaternary deposits overlying the Tertiary-age Cooper Group. Aquifer transmissivities are generally less than 1,000 square feet per day (ft^2/day), and well yields range from 0 to 200 gallons per minute (gpm). This groundwater contains high concentrations of iron and is commonly acidic at shallow depths (Park, 1985).

The Cooper Group is hydrogeologically significant mainly because of its low permeability. In most locales, its sandy, finely granular limestones produce little or no water and act as confining material that produces artesian conditions in the underlying Santee Limestone (Park, 1985).

The Santee Limestone aquifer is typically artesian, except in outcrop areas. Yields from wells in the Santee are typically less than 300 gpm (Park, 1985).

2.2.2 NAVBASE Hydrogeologic Investigation

Hydrogeological information was obtained from slug test analyses and water-level measurements conducted during the Zone D RFI. Estimates of vertical permeability, grain-size distribution, and porosity were obtained from laboratory analysis of Shelby tube samples collected during drilling. Only data pertinent to the Quaternary deposits and the Tertiary Marks Head and Ashley Formations are discussed since they were the only deposits encountered in Zone D.

2.2.3 Tertiary-Age Sediments

2.2.3.1 Ashley Formation

The Ashley Formation is important because of its role as a confining unit between the lower members of the Cooper Group and the Eocene-age Santee Limestone and the overlying water-bearing strata of the Quaternary sediments (Park, 1985). Lithologic cross sections presented by Weems and Lemon (1993) show the Ashley Formation to have a laterally consistent overall thickness. Samples taken from this unit at NAVBASE have shown high clay and silt contents and varying sand contents depending greatly upon depth. One Shelby tube sample collected from the Ashley in Zone D exhibited a vertical permeability of 1.19×10^{6} cm/sec (3.37×10^{-3} feet/day). According to Fetter (1988), sediments with permeabilities of 10^{5} centimeters per second (cm/sec) (0.03 feet/day) or less can be considered confining units. All deep borings in Zone D were terminated when the Ashley Formation was encountered.

2.2.3.2 Undifferentiated late Tertiary-age Units

The hydrogeologic role of the undifferentiated late Tertiary-age units at NAVBASE are unclear due to their intermittence. Weems and Lemon (1993) show the unit to be much less pervasive on the west side of the Cooper-Wando river system than on the east side. No Shelby tube samples of this unit were taken during the Zone D RFI; however, five samples were taken during the Zone E RFI. Three of the five samples were collected near the Zone E and D boundary. The vertical permeabilities of the five samples had a significant range in values, from 2.87×10^{-6} to 1.11×10^{-3} cm/sec (8.14×10^{-3} to 3.15 feet/day, respectively) with a geometric mean of 5.18×10^{-5} cm/sec (0.147 feet/day). The average porosity was 42% and average grain size distribution of 58.6% sand and 41.4% silt and clay. Based on this data, the unit has a vertical permeability approximately 44 times as great at that of the Ashley Formation.

2.2.4 Quaternary-Age Sediments

The heterogeneous nature of the Quaternary-age sediments makes it difficult to summarize their bulk role in the hydrogeologic system. The Qc, Qs, and Qdm deposits encountered in Zone D are the remnants of widely diverse depositional systems, and consequently influence the hydrogeologic system at the local scale. This diversity is plainly evident when considering the vertical permeability data gathered from these sediments. For example, a Shelby tube sample of Qs material from 8-10 feet bgs at NBCDGDD001 revealed a vertical permeability of 9.00×10^{-5} cm/sec (0.255 feet/day). This value is considerably lower than those calculated from three Qs samples collected during the Zone E RFI that ranged between 1.18×10^{-3} cm/sec and 1.95×10^{-3} cm/sec (3.34 to 5.53 feet/day) and had a geometric mean of 1.48×10^{-3} cm/sec (4.21 feet/day). Three samples of Qc deposits from Zone E revealed even lower permeabilities, ranging between 7.95×10^{-8} and 1.55×10^{-6} cm/sec (2.25×10^{-4} and 4.39×10^{-3} feet/day) and having a geometric mean of 6.37×10^{-7} cm/sec (1.81×10^{-3} feet/day). Dewatered marsh clay deposits (Qdm) also collected in Zone E were slightly more permeable, ranging between 1.21 x 10--6 and 2.67×10^{-5} cm/sec (3.43×10^{-3} and 7.57×10^{-2} feet/day) and having a geometric mean of 3.84×10^{-6} cm/sec (1.09×10^{-2} feet/day).

Despite these variabilities on a local scale, it is believed that the Zone D Quaternary-age sediments are hydraulically connected and behave as one surficial aquifer, which may have locally semi-confined, confined, and perched zones. The undifferentiated late Tertiary-age units, when present, are also thought to contribute to the hydrogeologic system, although the magnitude of their contribution is unknown.

2.2.5 Surficial Aquifer

Based on the three deep borings in Zone D, the surficial aquifer is approximately 25 feet thick. Along the southwestern portion of Zone D, the boring log of GDD01D reveals that the aquifer, from the bottom to top, consists of approximately 3 feet of undifferentiated late Tertiary-age units (Tu) overlain by approximately 22 feet of Qs. The lack of significant clay beds and lenses suggests that the aquifer is unconfined in this region of Zone D. The aquifer characteristics differ somewhat along the northeastern portion of Zone D where the deep borings GDE29D and GDE30D are located. At GDE29D the aquifer is composed of 8.5 feet of Tu ,which is, overlain by 4 feet of clay considered to be Qc and likely reworked Tertiary-age sediments. The upper 8 feet of the aquifer is Qs deposits, which is overlain by 5.5 feet of fill. The presence of the 4 foot clay bed may introduce semi-confined conditions to the aquifer below it. At GDE30D the geology appears more complicated. The 4.5 feet overlying the Ashley Formation appears to be either Tu deposits or a Quaternary-age reworking of the Tu. The next 4 feet consists of Qdm, followed by 15.5 feet of Qs, and the last 1 feet of fill. The aquifer is likely confined at depths below the Qdm deposit. The Qdm deposit apparently pinches out to the northwest in the direction of GDE29D and to the southwest in the direction of GDD01D.

2.2.6 Groundwater Flow Direction

Water levels in the shallow and deep wells were measured during low and high tides on December 18, 1996, in Zone D and at selected locations in Zone E. The water level data were grouped by well depth and tidal stage.

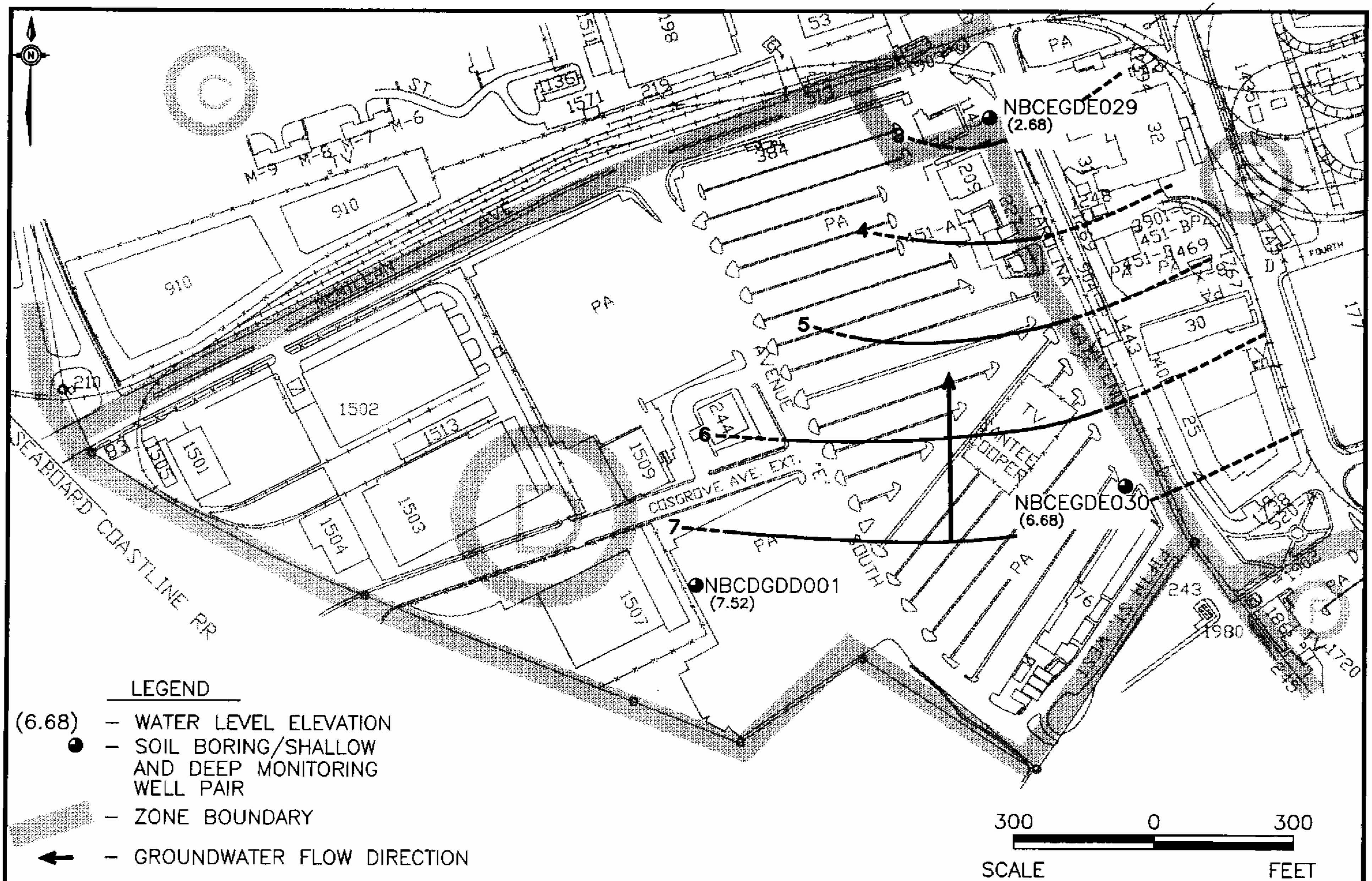
Figures 2-3 and 2-4 depict groundwater elevation contours in shallow wells at low and high tide, respectively. These figures represent the water table in the surficial aquifer. Groundwater generally flows to the North. The change in shallow groundwater elevation from high to low tide is contoured in Figure 2-5. Small, but measurable differences between low and high tide events in the shallow wells were observed. These water table contour maps depict no measurable change in groundwater flow direction within Zone D in response to tidal changes.

Figures 2-6 and 2-7 are contour maps of groundwater elevation data from the deep wells during low and high tide, respectively. These data reflect the hydraulic conditions at the base of the surficial aquifer. The general direction of groundwater flow in the base of the surficial aquifer is also to the north.

Changes in deep groundwater elevation from high to low tide are contoured in Figure 2-8. While measurable differences in water level elevations between low and high tide events were observed, there was no appreciable change in overall groundwater flow direction.

2.2.7 Vertical Hydraulic Gradient

Water levels were measured in three shallow/deep well pairs (NBCDGDD001/01D, NBCEGDE029/29D, and NBCEGDE030/30D) on December 18, 1996. Table 2.2 presents the calculated vertical hydraulic gradients between shallow/deep well pairs during that event. The vertical gradients were calculated by dividing the difference between water levels in the shallow and deep wells by the vertical distance between the bottom of each respective well pair screen. Positive values indicate downward vertical gradients whereas negative values indicate an upward vertical gradient. The Zone D well pair (GDD001/01D) exhibited an upward vertical gradient at low and high tides. The two Zone E well pairs exhibited a reversal in vertical gradient with tides.



ZONE D
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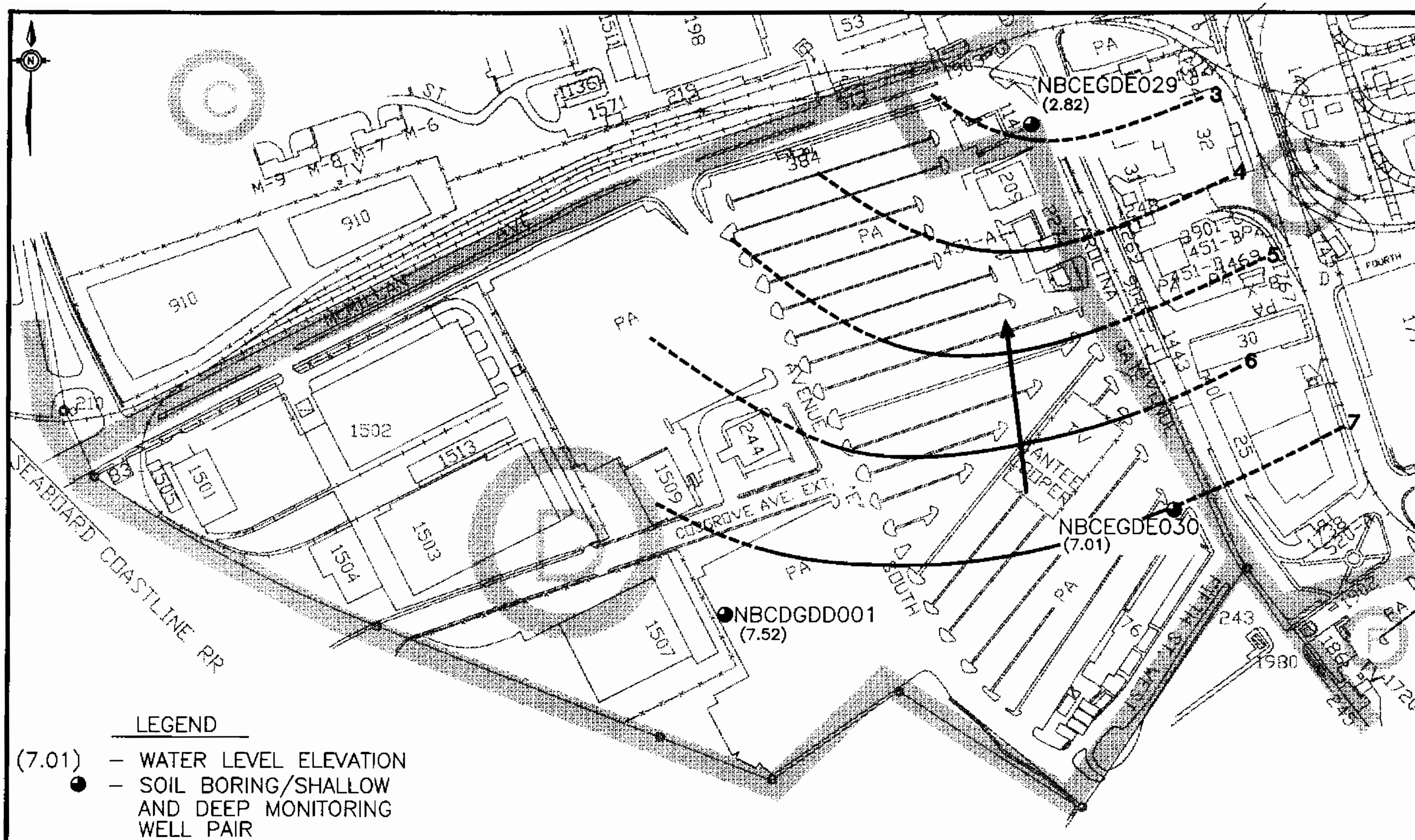
FIGURE 2–3
SHALLOW GROUNDWATER FLOW
LOW TIDE
ZONE D

DWG DATE: 07/10/97 | DWG NAME: 2904ZDSG



LEGEND

(7.01) – WATER LEVEL ELEVATION

● – SOIL BORING/SHALLOW AND DEEP MONITORING WELL PAIR

– ZONE BOUNDARY

← – GROUNDWATER FLOW DIRECTION

300 0 300

SCALE FEET

ZONE D
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
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FIGURE 2–4
SHALLOW GROUNDWATER FLOW
HIGH TIDE
ZONE D

DWG DATE: 07/10/97 | DWG NAME: 2904ZDHT

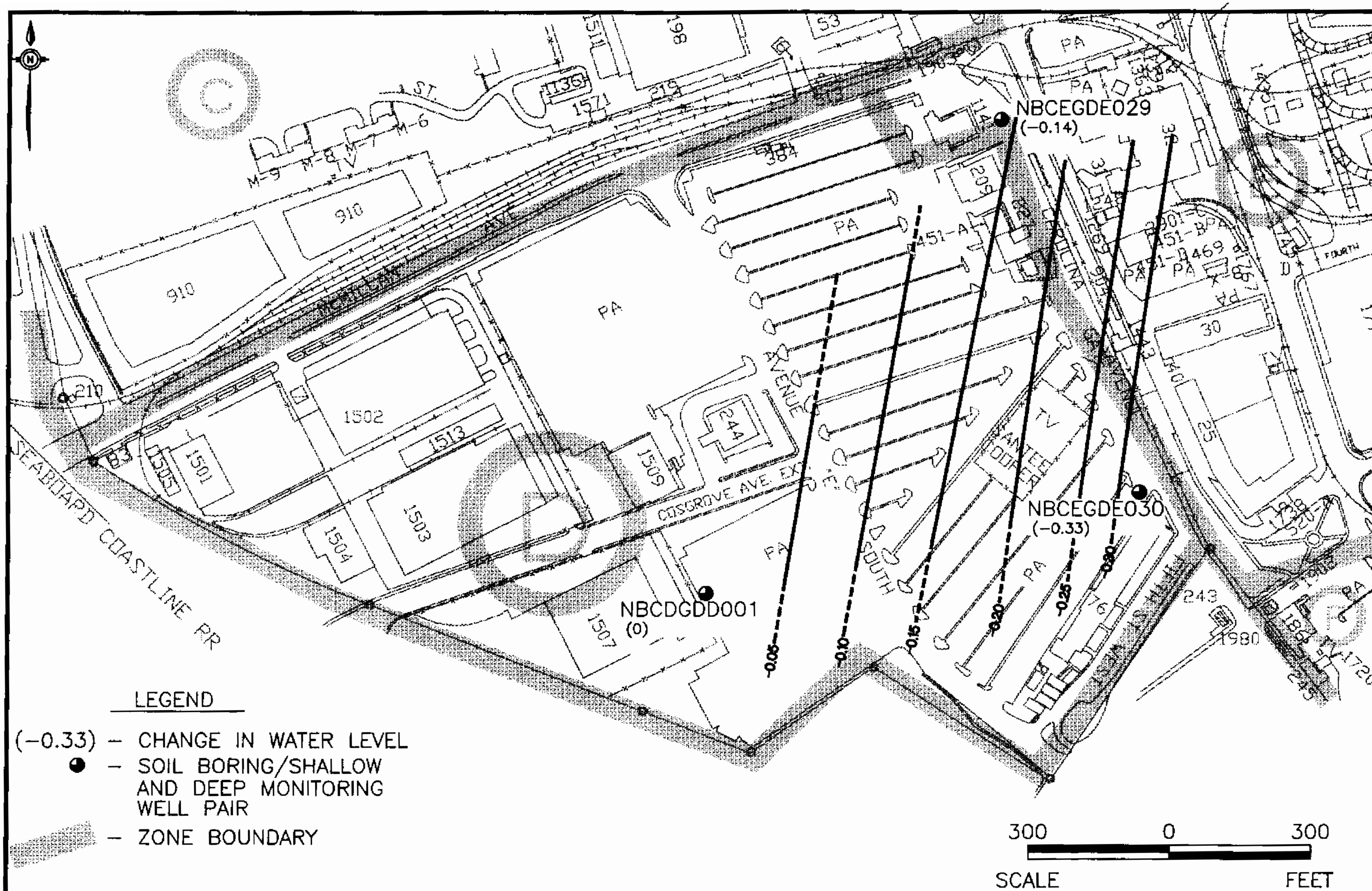

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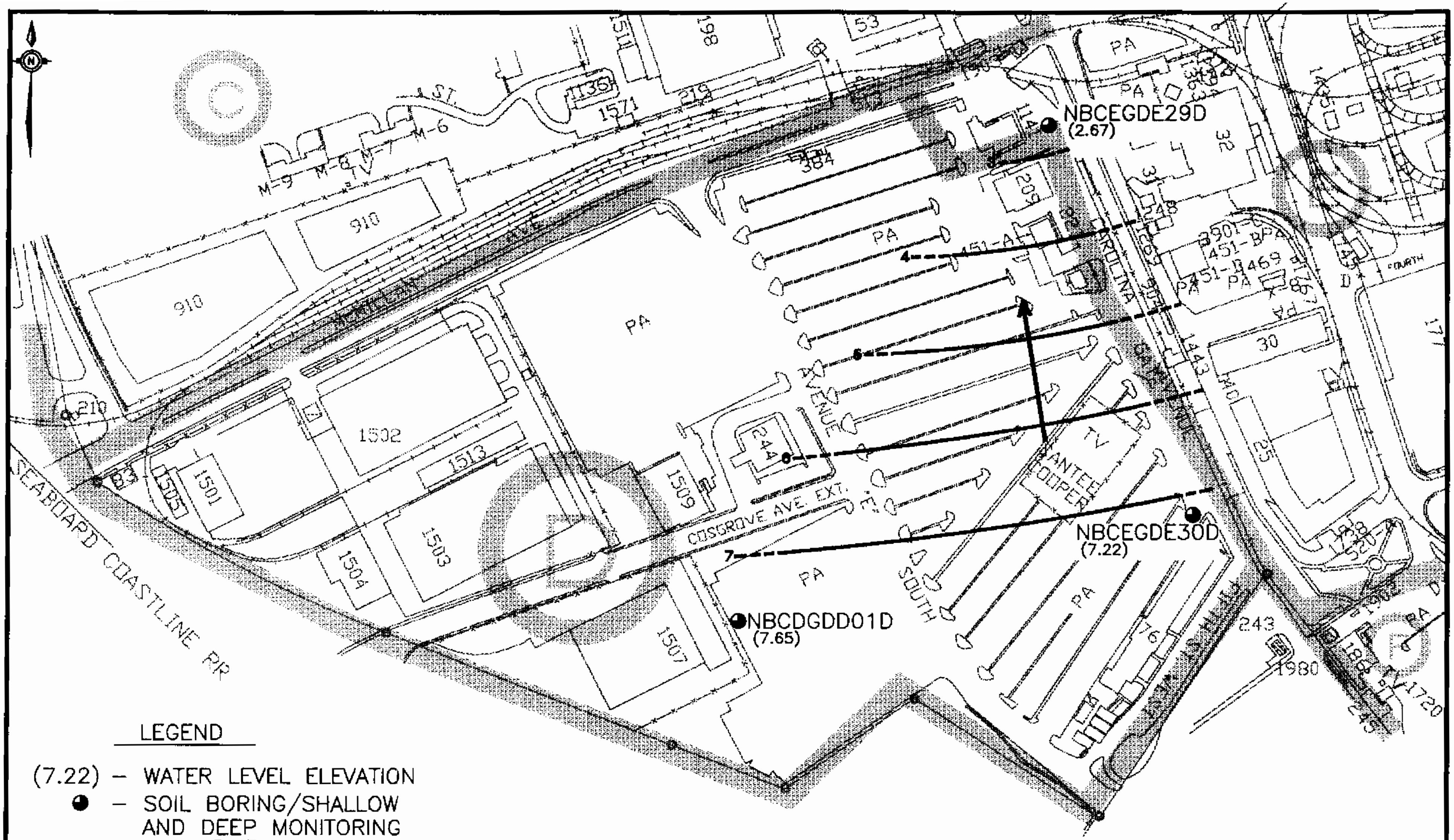
FIGURE 2–5
TIDAL VARIATION
SHALLOW WELLS
ZONE D

DWG DATE: 07/10/97 | DWG NAME: 2904TVSW



LEGEND

(7.22) – WATER LEVEL ELEVATION

– SOIL BORING/SHALLOW AND DEEP MONITORING WELL PAIR

– ZONE BOUNDARY

– GROUNDWATER FLOW DIRECTION

300 0 300

SCALE FEET

ZONE D
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
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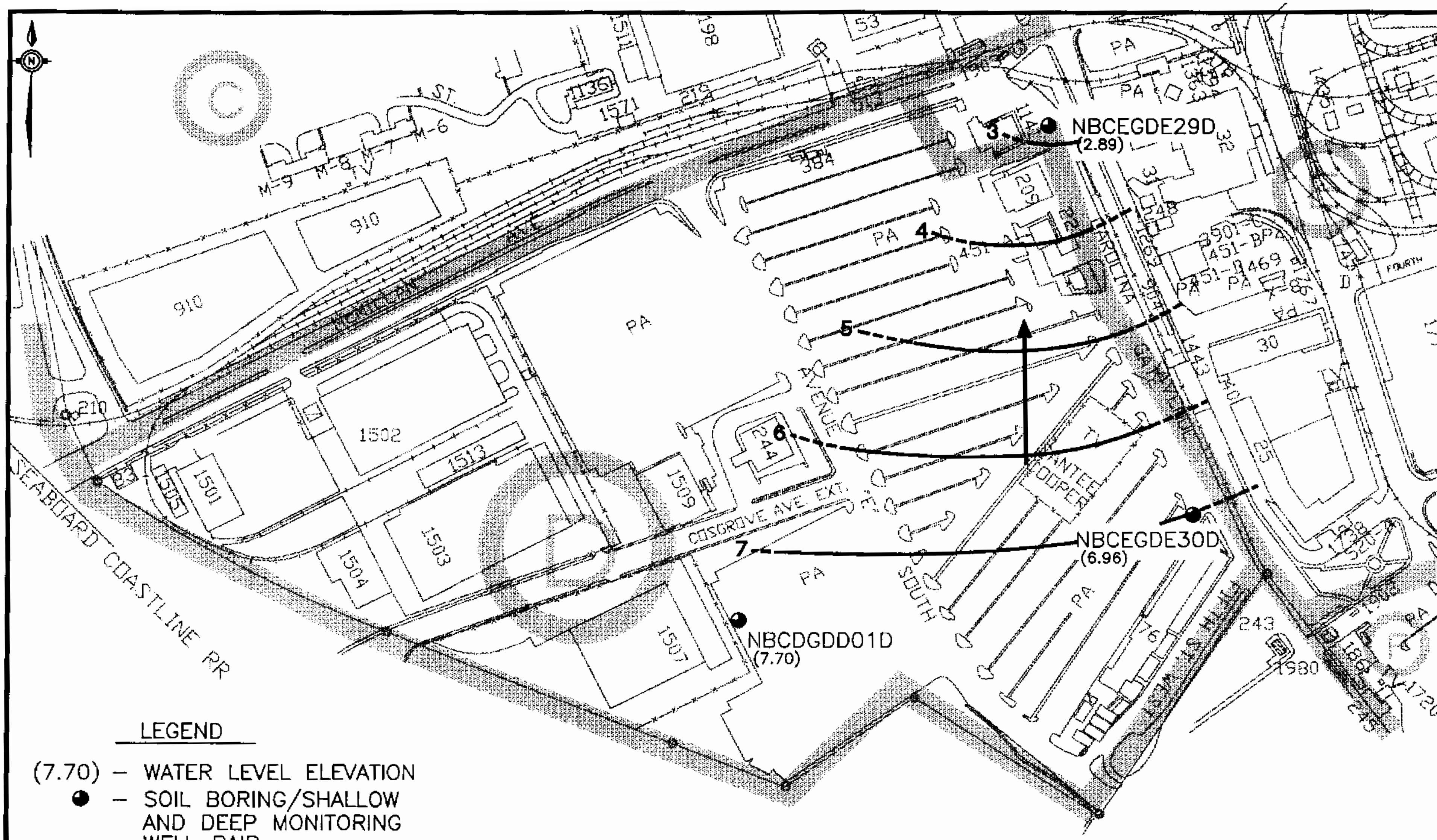
FIGURE 2–6
DEEP GROUNDWATER FLOW
LOW TIDE
ZONE D

DWG DATE: 07/10/97 | DWG NAME: 2904DGLT



LEGEND

(7.70) – WATER LEVEL ELEVATION

● – SOIL BORING/SHALLOW AND DEEP MONITORING WELL PAIR

– ZONE BOUNDARY

← – GROUNDWATER FLOW DIRECTION

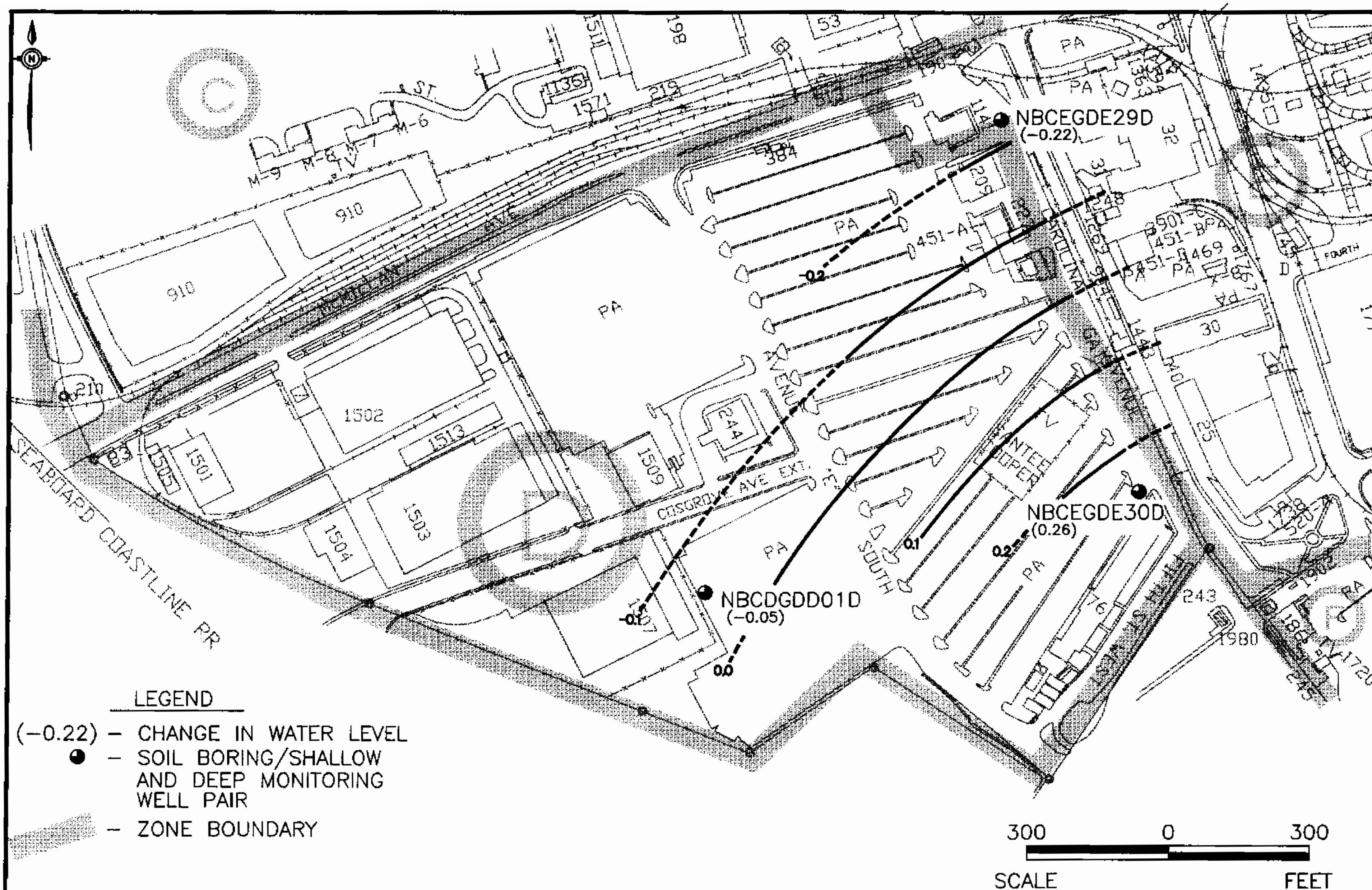
300 0 300

SCALE FEET

ZONE D
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2-7
DEEP GROUNDWATER FLOW
HIGH TIDE
ZONE D

DWG DATE: 07/10/97 | DWG NAME: 2904DGHT



ZONE D
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FIGURE 2-8
TIDAL VARIATION
DEEP WELLS
ZONE D

DWG DATE: 07/10/97 | DWG NAME: 2904TVDW

A downward vertical gradient was measured at well pair GDE029/29D during low tide; however, the magnitude of this gradient is negligible and within measurement error. During high tide, an upward vertical gradient was observed at this well pair. At well pair GDE030/30D an upward vertical gradient, the largest of all gradients recorded during the event, was measured at low tide while a downward gradient was observed at high tide.

Table 2.2
Vertical Hydraulic Gradients

			LOW TIDE		HIGH TIDE	
Well Pair	**Vertical Distance (ft)**	**Date**	**GW Elev. Diff. (ft)**	**Vertical Hyd. grad (ft/ft)**	**GW Elev. Diff. (ft)**	**Vertical Hyd. grad. (ft/ft)**
NBCDGDD001 and 01D	14.3	12/18/96	-0.13	-0.009	-0.18	-0.013
NBCEGDE029 and 29D	9.4	12/18/96	0.01	0.001	-0.07	-0.007
NBCEGDE030 and 30D	14.7	12/18/96	-0.54	-0.036	0.05	0.003

2.2.8 Horizontal Hydraulic Gradient

The horizontal hydraulic gradient (*i*) is a measurement of the difference in hydraulic head (Δh) (i.e., change in groundwater elevation) between two points divided by the distance between the points (Δx). It is a unitless value and is used to quantitatively determine the magnitude of potential groundwater flow. The groundwater contour maps for the shallow wells (Figures 2-3 and 2-4) and the deep wells (Figures 2-5 and 2-6) were examined to find the highest horizontal hydraulic gradient at both low and high tide for the shallow and deep wells.

The calculated hydraulic gradients for Zone D are presented in Table 2.3. It is important to recognize that the end points used in these gradient calculations do not necessarily represent a true groundwater flowpath and are merely a means to quantify the magnitude of potential groundwater flow within Zone D.

Table 2.3
Horizontal Hydraulic Gradients
Measurements taken 12/18/96

Measurement Points	Tide	Δh	Δx	i
SHALLOW WELLS				
NBCD-GDD-001 to NBCE-GDE-029 (steepest gradient)	Low	4.84	1200	0.004
	High	4.7	1200	0.004
NBCD-GDD-001 to NBCE-GDE-030 (shallowest gradient)	Low	0.84	925	0.0009
	High	0.51	925	0.0005
DEEP WELLS				
NBCD-GDD-01D to NBCE-GDE-29D (steepest gradient)	Low	4.98	1200	0.004
	High	4.81	1200	0.004
NBCD-GDD-01D to NBCE-GDE-30D (shallowest gradient)	Low	0.43	925	0.0005
	High	0.74	925	0.0008

2.2.9 Horizontal Hydraulic Conductivity

Slug test data were used to evaluate the horizonal hydraulic conductivity of an aquifer at a single point. A slug test is initiated by inserting a 1-7/8" diameter Teflon cylinder below the static water level in the well, creating an instantaneous change in the water level. The change in water level over time is monitored as the aquifer attempts to reach equilibrium in response to the artificial stress. This procedure is known as a falling head slug test since the water level (hydraulic head) declines back to its original static level. Once equilibrium is re-established, the slug is quickly removed, dropping the static water level. This procedure is a rising head slug test since the water level in the well rises back to its original static level as the test progresses. The resulting horizontal hydraulic conductivity (K_h) values of the falling and rising head slug tests are presented below in Table 2.4 for both the upper and lower aquifers.

Table 2.4
Zone D
Shallow-Well Slug Test
Horizontal Hydraulic Conductivity
Results in feet/day

Well	Falling Head Hydraulic Conductivity	Rising Head Hydraulic Conductivity	Geometric Mean[a]
NBCD-GDD-001	5.04	6.00	5.5
NBCD-GDD-01D	0.76	0.78	0.77

Note:
a = Average calculated using the falling and rising head values.

Because hydraulic conductivity data are often log normally distributed, the geometric mean is the best measure of central tendency. Therefore, the average hydraulic conductivity for each well is presented as the geometric mean of the falling and rising head values.

The Waterloo Hydrogeologic Institute's AQUIFERTEST 2.0 software, which includes the Bouwer and Rice (1976) method and Bouwer update (1989), was used in analyzing the Zone D slug test data. The test results and output from the program are included in Appendix C.

The Bouwer and Rice method assumes the following conditions:

- A homogeneous, isotropic aquifer of uniform thickness.
- Horizontal water table/potentiometric surface prior to test.
- Instantaneous change in head.
- Negligible well losses.
- Well storage is not negligible and is accounted for.
- Fully or partially penetrating wells.
- Steady state flow.

Since the method can be used for unconfined, semiconfined, or leaky conditions, it was deemed appropriate for both the deep and shallow wells. Both were analyzed as if they were fully penetrating wells. Since slug tests impart an instantaneous but relatively low overall stress to the system, the aquifer thickness (D) was generally taken as that length adjacent to the filter pack in the deep well NBCDGDD01D. This also reflects the assumption that the horizontal contribution to recovery far outweighs the vertical contribution. In the shallow well, NBCDGDD001, which straddles the water table, D was set equal to the saturated interval (b). By doing so, the well becomes fully penetrating and all flow is assumed to be horizontal. Additionally, the intake length (L) is set equal to b and D since water may only enter the well through the same saturated interval.

Since the shallow well is screened in the water table, it is important to account for filter pack drainage effects (not required in deep well since filter pack is fully saturated). This is done by determining an effective radius (r_{eff}) of influence for the test, which equals

$$r_{eff} = [r^2(1\text{-}n) + nR^2]^{0.5}$$

where n is the estimated porosity of the filter pack, r is the well casing radius, and **R** is the borehole radius. A line of best fit was matched to the h(t) vs. T data that was thought to best represent the "true" aquifer response. Given all the above qualifiers, it has been typical to only present the hydraulic conductivity data from these tests to 2 significant figures.

2.2.10 Horizontal Groundwater Velocity

Horizontal groundwater velocity was calculated using the following formula:

$$V = \frac{K_h * i}{n_e}$$

Where:

V = horizontal groundwater velocity — K_h = hydraulic conductivity

i = horizontal hydraulic gradient — n_e = effective porosity

Shelby tube samples provide spatially discrete porosity values to be used as effective porosity estimates. A Shelby tube taken from the screened interval in well NBCDGDD001 revealed a porosity of 42%.

Due to the limited differences in the horizontal hydraulic gradient (i) with respect to tidal ranges as seen in Table 2.3, only the highest value for each measurement point was used to compute groundwater velocity. Table 2.5 presents estimated maximum groundwater velocities for each of the selected or calculated gradients.

Table 2.5
Groundwater Velocity Results

Flow path	n	K_h (ft/day)	Maximum i	Estimated Maximum Velocity (ft/day)
NBCD-GDD-001 to NBCE-GDE-029	0.42	5.5	0.004	0.052
NBCD-GDD-001 to NBCE-GDE-030	0.42	5.5	0.0009	0.0120
NBCD-GDD-01D to NBCE-GDE-29D	0.42	0.77	0.004	0.007
NBCD-GDD-01D to NBCE-GDE-30D	0.42	0.77	0.0008	0.0015

2.3 Climate

Data in this section, including temperature and wind data in Tables 2.6 and 2.7 are from the S.C. SEA Grant Consortium, 1992. Charleston Harbor area climate is typically mild compared to other areas farther inland. The mountains in the northern portion of the state block cold air masses from the northwest, and the Bermuda high-pressure system limits the progress of cold fronts into the area. These conditions produce relatively mild, temperate winters. Summers are hot and humid, but relatively moderate with regard to temperature extremes. Moderate summer temperatures are largely due to the influence of the Gulf Stream.

The average monthly air temperatures for the Charleston area are presented in Table 2.6. The temperatures are generally moderated by marine influences and are often 2°C to 3°C lower in the summer and 3°C to 8°C higher in the winter than areas farther inland. Temperatures higher than 38°C and lower than -6.5°C are unusual for the area (S.C. SEA Grant Consortium, 1992).

Table 2.6
Mean Temperature and Wind Data
for Charleston Harbor between 1970 and 1985

Month	Daily Max (°C)	Daily Min (°C)	Mean Speed (km/hr)	Prevailing Direction
January	16.4	3.1	14.8	SW
February	16.8	4.5	16.6	NNE
March	20.0	7.3	16.7	SSW
April	24.9	11.5	16.1	SSW
May	28.8	16.6	14.3	S
June	31.6	20.6	13.7	S
July	31.6	22.2	13.0	SW
August	31.5	21.4	12.1	SW
September	29.2	18.8	13.0	NNE
October	25.1	12.7	13.2	NNE
November	19.9	6.6	13.2	N
December	16.1	3.5	14.0	NNE
Annual	24.3	12.4	14.2	NNE

Table 2.7

Monthly and Annual Mean Precipitation, Relative Humidity, and Cloud Cover for Charleston Harbor between 1960 and 1985

		Relative Humidity by Time (%)				Cloud Cover % Number of Days		
Month	**Precipitation (cm)**	***0100***	***0700***	***1300***	***1900***	***Clear***	***Partly Cloudy***	***Cloudy***
January	6.45	82	84	55	73	8	8	15
February	8.36	79	82	52	68	9	6	13
March	9.98	81	83	50	67	9	9	13
April	7.32	84	84	50	67	11	8	11
May	9.17	88	84	54	72	8	12	11
June	12.65	90	86	59	75	6	12	12
July	19.58	91	88	64	79	4	13	14
August	16.79	92	91	63	80	5	14	12
September	14.81	91	91	63	82	7	11	12
October	7.21	88	89	56	80	12	8	11
November	5.31	85	87	51	77	13	6	11
December	7.24	82	84	54	74	9	8	14
Annual	124.87	86	86	56	75	101	115	149

The wind direction and velocity in the Charleston area are highly variable, and rather evenly distributed in all directions. The inland portions of the region are subjected to a southwest-northeast wind. Winds prevail to the north in the fall and winter and to the south in spring and summer. The monthly average wind velocities and directions for the area range from a low of 12.1 kilometers per hour (kph) in August to a high of 16.7 kph in March. The average monthly wind speeds and prevailing wind directions are also presented in Table 2.6.

The Charleston area averages 124.9 centimeters (cm) of precipitation annually, almost exclusively rainfall. Very little precipitation is recorded as snow, sleet, or hail. The greatest mean monthly precipitation is normally received in July while the smallest amount normally occurs in November.

Relative humidity in the Charleston Harbor area is normally very high and fluctuates greatly. Generally, it is higher during the summer months than other times of the year, and the coastal areas exhibit a lower relative humidity than inland areas. The monthly mean relative humidity for four different times of day is presented in Table 2.7.

Cloud cover varies widely for Charleston, with annual averages of 101 clear days, 115 partly cloudy days, and 149 cloudy days. The mean monthly clear, partly cloudy, and cloudy days for the area are also presented in Table 2.7.

The primary concern in climate extremes is the occurrence of tropical cyclones or hurricanes. Hurricanes frequent the east coast of the United States and almost always have some effect on the weather around Charleston Harbor. Hurricanes normally occur between August and December. The last hurricane to make landfall in the Charleston area was Hurricane Hugo, a class IV hurricane which struck Charleston in September 1989 causing severe damage. Tornados are extremely rare in the vicinity but have occurred in the inland portions of Charleston County.

File Path: SAN:/bexar/EESBG/Charleston_CNC/cnc_ph4_zone_maps_new.apr

07/03
Final

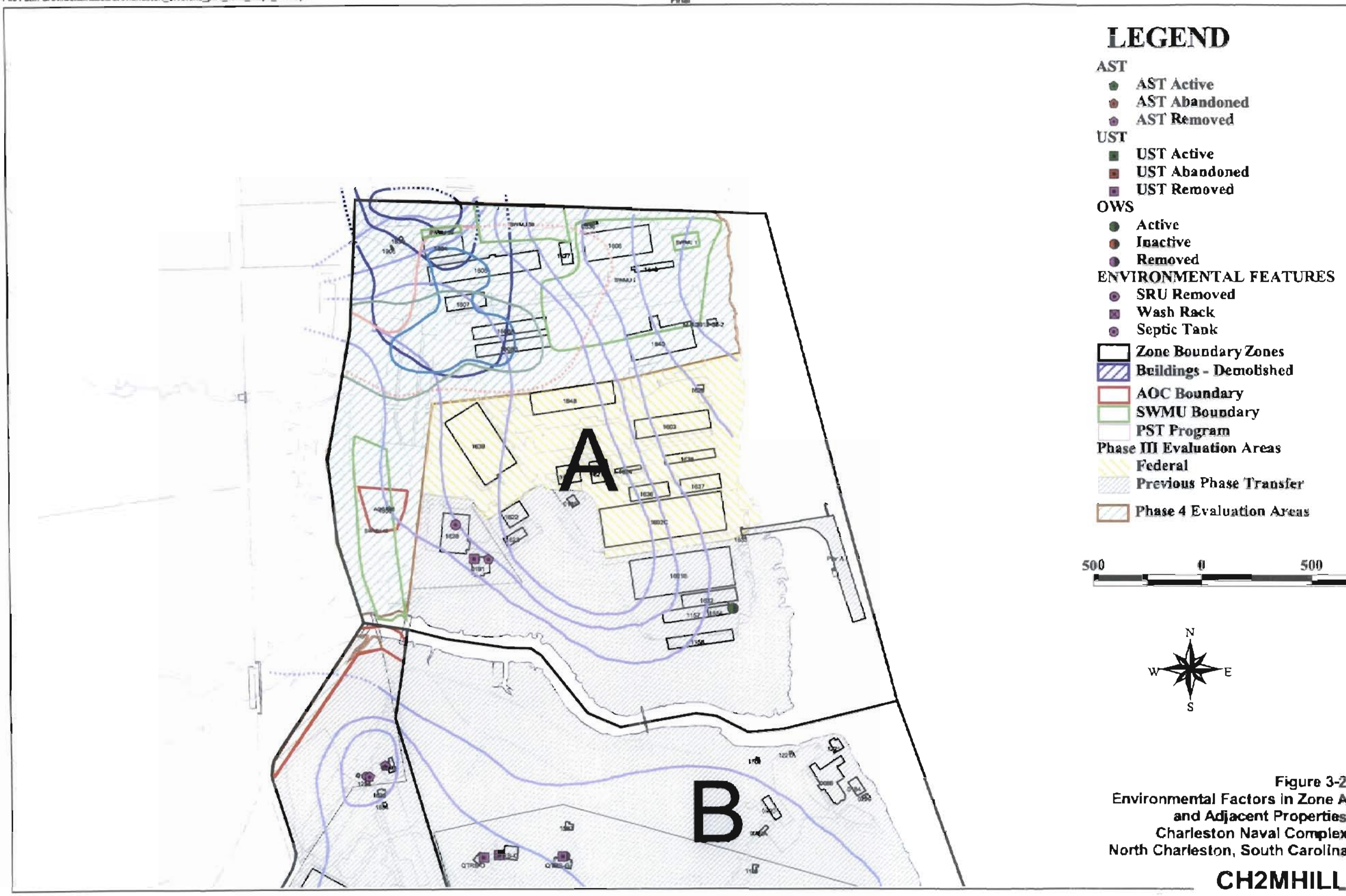

Figure 3-2
Environmental Factors in Zone A
and Adjacent Properties
Charleston Naval Complex
North Charleston, South Carolina

CH2MHILL

File Path: SAN:/bexar/eebsg/charleston cnc/cnc ph4 zone maps new.apr

07/03
FINAL

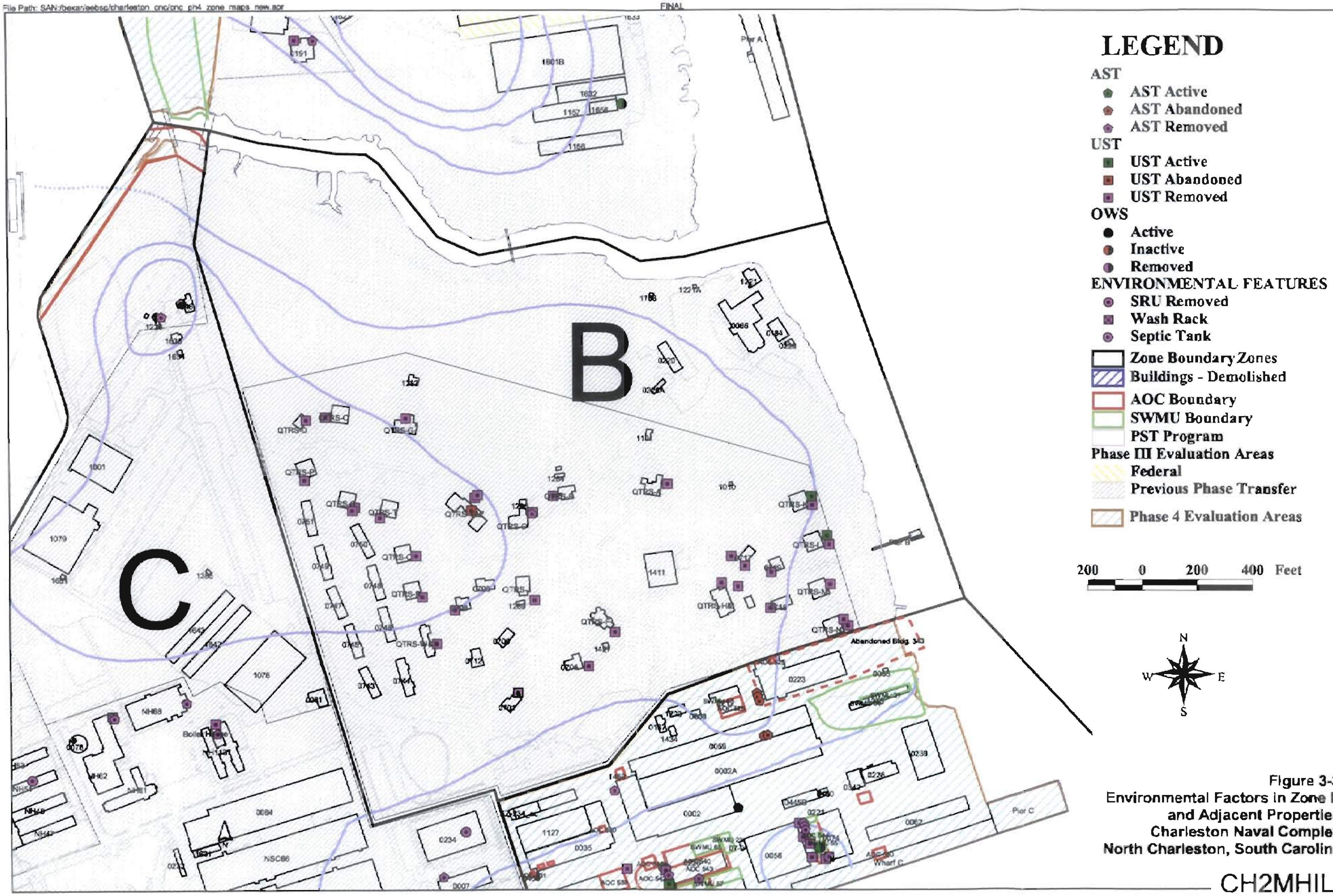

Figure 3-3
Environmental Factors in Zone B
and Adjacent Properties
Charleston Naval Complex
North Charleston, South Carolina

CH2MHILL

File Path: SAN:/bexar/eesbg/charleston_cnc/cnc_ph4_zone_maps.apr

07/03
FINAL

Figure 3-4
Environmental Factors in Zone C
and Adjacent Properties
Charleston Naval Complex
North Charleston, South Carolina

CH2MHILL

File Path: SAN:/bexar/eesbg/charleston_cnc/cnc_ph4_zone_maps_new.apr

07/03
FINAL

LEGEND

AST
- AST Active
- AST Abandoned
- AST Removed

UST
- UST Active
- UST Abandoned
- UST Removed

OWS
- Active
- Inactive
- Removed

ENVIRONMENTAL FEATURES
- SRU Removed
- Wash Rack
- Septic Tank
- Zone Boundary Zones
- Buildings - Demolished
- AOC Boundary
- SWMU Boundary
- PST Program

Phase III Evaluation Areas
- Federal
- Previous Phase Transfer
- Phase 4 Evaluation Areas

200 0 200 400 600 800 Feet

N E S W

Figure 3-7
Environmental Factors in Zone F
and Adjacent Properties
Charleston Naval Complex
North Charleston, South Carolina

CH2MHILL

File Path: SAN\\bexar/eesbg/charleston_cnc/cnc_ph4_zone_maps_new.apr

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FINAL

Figure 3-8
Environmental Factors in Zone G
and Adjacent Properties
Charleston Naval Complex
North Charleston, South Carolina

CH2MHILL

File Path: SAN:/bexar/eesbg/charleston_cnc/cnc_ph4_zone_maps_new.apr

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FINAL

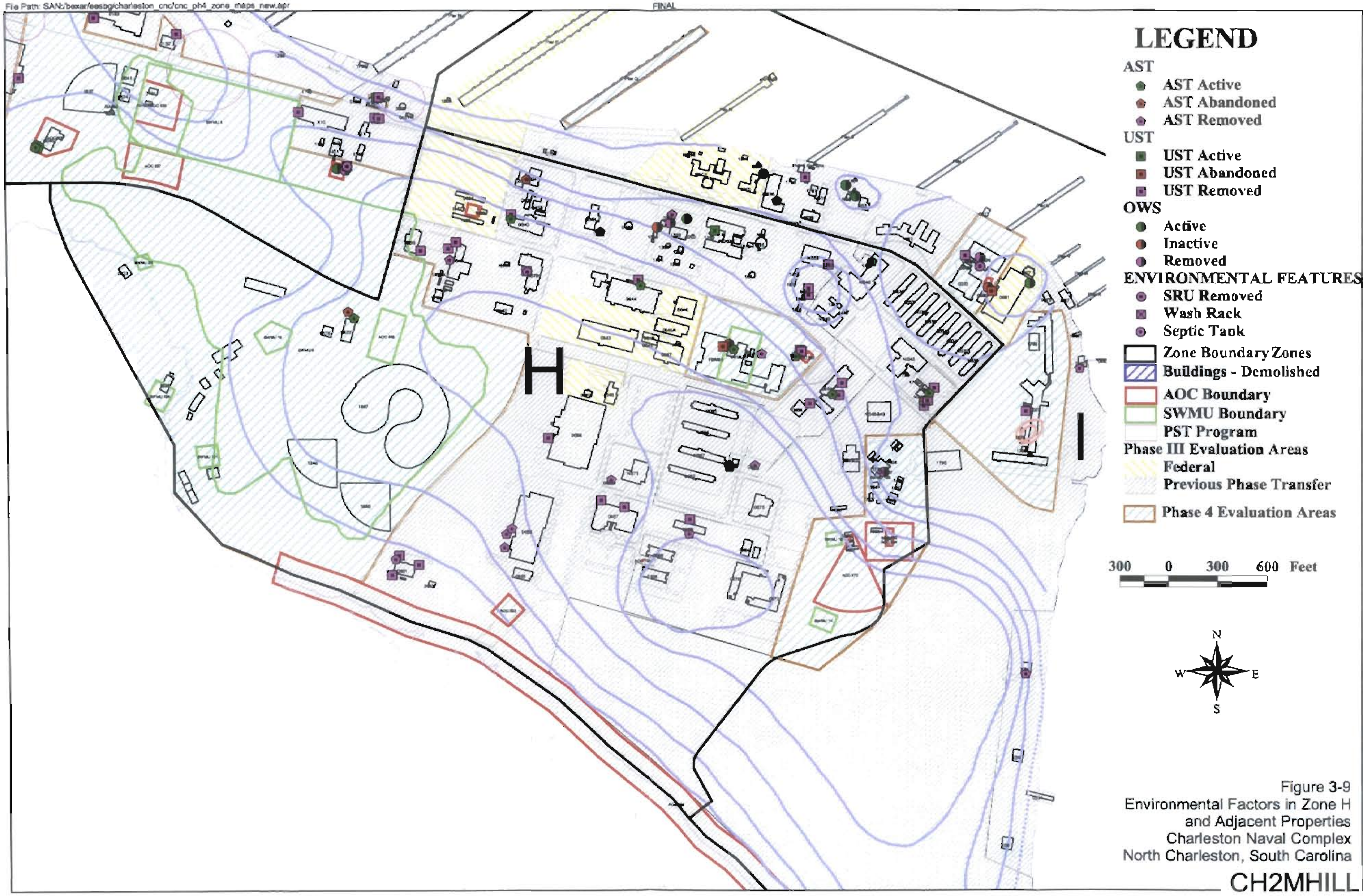

Figure 3-9
Environmental Factors in Zone H
and Adjacent Properties
Charleston Naval Complex
North Charleston, South Carolina

CH2MHILL

Figure 3-12
Environmental Factors in Zone K
and Adjacent Properties
Charleston Naval Complex
North Charleston, South Carolina

CH2MHILL

Summary of Facility No. 76 & 76A

Property Description

The building is a vacant three-story structure located on 1450 Fifth Street, on the western side of the Naval Complex. The building is 39,776 square feet in area and was constructed in 1942 (refer to **Photo 1**). The building was an administration facility. On the southern side of the facility is a wooden building that was remodeled in 1993 and used as a conference area.

A central stairwell separates the building into a northern and southern wing. Offices are located on either side of the stairwell. During building occupancy, the first floor was used for administrative offices, a laboratory, and a canteen. The second floor was used as the Civil Service Testing and Administration office, which moved into the facility during the 1960s. The third floor was occupied in 1989 by personnel of the Safety and Environmental office, and by ship supervisors. Prior to 1989, the third floor was used as a storage area. A reproduction room was located in the facility with a 250-gallon tank that stored ammonia. The reproduction unit including ammonia storage tank was removed.

Prior to the 1960s, a bank was located in the wooden building on the southern side of the facility. The wooden building has since been converted to offices and conference area. During the 1940s to the 1950s, the Personnel Department of the Labor Board was located in the facility. During the mid 1990s, the first floor was refurbished due to termite damage, and in 1980-1981, the building was remodeled which included asbestos abatement.

The building is accessible from McMillan Avenue, south onto Avenue E South, and east onto 5th Street West.

Environmental Condition of Property

Major Findings

Major findings for the facility are as follows:

- The facility had a print reproduction unit with an ammonia storage tank. The unit and tank have been removed without impacting the environmental condition of the facility. There were no reported releases from the tank (Category 1).
- In the adjacent properties to the north and in a downgradient direction, are AOCs 569, 570 and 578, which are a former gasoline station, a former coal storage area, and a former vehicle transportation shop and garage, respectively. The shallow groundwater in the AOC area is being further investigated to characterize contaminants of concern. A CMS is planned followed by a CMIP/OMP to monitor the natural attenuation of VOCs in groundwater (Category 1).
- A base wide background study was performed at the CNC to identify potential areas of concern. The results from the investigation indicate that there are some elevated levels of contaminants such as PAHs and metals in practically all areas previously or currently used for commercial or industrial use but at levels below those requiring remedial

action. As this facility is located in such an area, the property is considered to have been impacted (Category 3).

Data Gaps

No data gaps preventing property categorization were found.

Categorization

Based on the results of the EBS, the property has been assigned an overall DoD Environmental Condition Category 3.

Property Findings

Hazardous Substances and Petroleum, Oil, and Lubricants (POLs)

There are no hazardous or POL products stored at this facility. However, an ammonia tank was located in the facility and was part of the document reproduction unit that has since been removed.

There are no hazardous substances or POLs associated with this facility.

Hazardous and Non-hazardous Waste Satellite Accumulation Areas (SAAs)

There are no hazardous or POL wastes stored or generated at this facility. Nor did this facility house any satellite accumulation areas.

Installation Restoration Program (IRP) Sites

There are no IRP sites associated with this facility.

Solid Waste Management Units (SWMUs) or Areas of Concern (AOCs)

There are no SWMUs or AOCs associated with this facility.

In the adjacent properties to the north, in an upgradient direction, are AOCs 569, 570 and 578, which are a former gasoline station, a former coal storage area, and a former vehicle transportation shop and garage, respectively. The shallow groundwater in the AOC area is being further investigated to characterize contaminants of concern. A CMS is planned followed by a CMIP/OMP to monitor the natural attenuation of VOCs in groundwater.

A base wide background study was performed at the CNC to identify potential areas of concern. The results from the investigation indicate that there are some elevated levels of contaminants such as PAHs and metals in practically all areas previously or currently used for commercial or industrial use but at levels below those requiring remedial action. As this facility is located in such an area, the property is considered to have been impacted.

Oil/Water Separators (OWSs)

Base plan maps and available building files were reviewed and there are no indications of any OWSs currently or formerly located at this facility. None were observed during the VSI/PSI.

Ordnance and Explosives

The Charleston Naval Complex included specific ordnance storage and handling areas. This facility was not part of the designated areas; therefore, the presence of ordnance at this building is unlikely.

Underground and Aboveground Storage Tanks (USTs and ASTs)

No ASTs or USTs are associated with this facility.

Asbestos-Containing Materials (ACMs)

The 1990 Asbestos Inventory Assessment and Survey identified friable asbestos in the building. ACMs were found in pipe insulation, floor tile, and debris. Approximately 1,225 liner feet of pipe insulation, 650 square feet of floor tile, and 39,776 square feet of debris was found at the facility. The basement was locked and marked with "Hazardous Friable Asbestos" warning signs, which were observed during this VSI/PSI.

During the VSI/PSI, all pipe insulation in the mechanical room appeared to have non-ACMs.

Lead-Based Paint (LBP)

Public works personnel indicated that lead-containing paint was used throughout the base as standard operating procedure. All facilities constructed prior to 1981 are likely to have been treated with lead-containing paint. The exterior painted surface was in good condition. The interior painted surfaces varied from good condition to chipping and peeling, mainly in the restrooms.

Polychlorinated Biphenyls (PCBs)

One pad-mounted transformer is located on the northern side of the building. The transformer was installed by SCE&G and was labeled with a green sticker, indicating that the transformer fluid has less than 50-ppm PCB content.
Another pad-mounted transformer was previously located on the southeastern side and has since been removed. There was no historic release of fluids observed at this site.

Radon

There are no radon concentrations above EPA action levels associated with this facility. Several radon surveys have been performed and results indicate the Naval complex is in compliance with EPA background values. The surrounding area, including Charleston County, also has radon values that fall in the range no greater than 2 picocuries per liter. EPA action levels nationwide are 4 picocuries per liter (EPA Publication 402-R-93-071).

Air Permits and Air Emissions

No permitted operations were identified for this facility, and none were observed during the VSI/PSI. Based on inquiries and observations, there are no potential sources of air emissions at this facility.

Floodplain

Based on a recent topographic map (Davis & Floyd, 1998), Facility No. 76 & 76A is located above the 12-foot NGVD contours elevation at the Naval Complex, and therefore is above the 100-year floodplain elevation.

Historic Property

Although this facility is more than 50 years old, it does not qualify for consideration as a historic structure under the National Register of Historic Places, due to renovations made to the building.

Industrial Wastewater Collection System (IWCS)

The facility does not generate wastewater because it has always been an administration facility.

Sanitary Sewer Systems (Wastewater)

Sanitary wastes from this facility were discharged to the North Charleston Sewer District (reference Drawings H410-234 through 247, Sewage Collection System) during the operation of this facility.

Septic Tanks

This category is not applicable to this type of facility.

Threatened and Endangered Species

An endangered plant survey completed in 1993 (by Richard D. Porcher, The Citadel) determined that there were no endangered species. However, the sea purslane has been identified as a confirmed resident of the Naval Base and is a listed species of concern by the South Carolina Wildlife and Marine Resources Department.

The osprey and least tern have been identified as confirmed residents of the Naval Base. The osprey is recognized as a species of concern and the least tern is recognized as a threatened and endangered (T&E) species by the South Carolina Wildlife and Marine Resources Department and the U.S. Fish and Wildlife Service.

Wetlands

According to the 1988 U.S. Fish and Wildlife Service National Wetlands maps, the U.S. Army Corps of Engineers 1988 Wetland Delineation Survey of Charleston Naval Base, and visual observations, no wetlands were observed or appear to be associated with this facility.

References:

U.S. Department of the Interior, Fish and Wildlife Service, National Wetland Inventory Maps–5050 III SW and 5049 IV NW.

Drawing H606-268, Map of Charleston Naval Shipyard Naval Station and Contiguous Activities Extended and Planned–as Modified by the U.S. Army Corps of Engineers, Charleston District, February 2, 1988.

VISUAL SITE INSPECTION AND PHYSICAL SITE INSPECTION(VSI/PSI) FORM

GENERAL INFORMATION

Facility Number 76/76A | **1450 5th Street West** | **Charleston Naval Complex**

Date Inspected	08/25/2002		
Type of Building	Human Resources and Safety/Environmental Offices (Vacant)	**Area (Sq. Ft.)**	39,776
Type of Construction	Cinder Block on Concrete Foundation	**Year of Construction**	1942

Points of Contact

Name	Title	Years Associated with Building	Shop Name	Telephone Number
Rick Nielsen	Caretaker Site Officer	7	Caretaker Site Office	843-743-2987

Description of Facility

Description of Facility (Construction and Use)

- The building is a vacant three-story structure located on 1450 Fifth Street, on the western side of the Naval Complex. The building was used as an administration facility.
- On the southern side of the facility is a wooden building that was remodeled in 1993 and used as a conference area.
- The building is separated into a northern and southern wing by a central stairwell. Offices are located on either side of the stairwell.
- The first floor consisted of administration offices, a laboratory, and a canteen. The second floor was used for Civil Service testing and administration; and the third floor comprised offices for Safety and Environmental personnel, and ship supervisors.
- See **Figure 1**.

Permitted Operations (Air and Radioactive Materials)

- No permitted operations were identified for this facility, and none were observed during the VSI/PSI.

PHYSICAL SETTING

Current Uses of the Property

Are any current uses likely to involve treatment, storage, disposal, or generation of hazardous substances or petroleum products? _ Yes __X__ No

Report current uses based on observation, interviews, and records review.

The building is currently vacant and out of service.

Past Uses of the Property

Were any past uses likely to have involved treatment, storage, disposal, or generation of hazardous substances or petroleum? _X__Yes ___No

Report all past uses based on observation, interviews, and records review.

The building has been vacant since Base closure in 1995. During building occupancy, the first floor was used for administrative offices, a laboratory, and a canteen. The second floor was used as the Civil Service Testing and Administration office who moved into the facility during the 1960s. The third floor was occupied in 1989 by personnel of the Safety and Environmental office, and by ship supervisors. Prior to 1989, the third floor was used as a storage area. A reproduction room was located in the facility with a 250-gallon tank that stored ammonia. The reproduction unit including ammonia storage tank was removed.

Prior to the 1960s, a bank was located in the wooden building on the southern side of the facility. The wooden building has since been converted to offices. During the 1940s to the 1950s, the Personnel Department of the Labor Board was located in the facility.

During the mid 1990s, the first floor was refurbished due to termite damage, and in 1980-1981, the building was remodeled which included asbestos abatement.

Current and Past Uses of Adjoining Properties

Report all past and present uses of adjoining properties within one-quarter mile based on observations, interviews and record review. Report only information on activities likely to cause a recognized environmental impact.

Adjoining properties adjacent to the facility include:

- North– a former paved vehicle parking lot for shipyard personnel.
- South–Fifth Street and the southern boundary of the Naval Complex.
- East–Kephart Street and Facility 25, the offices of the Environmental Enterprises Group.
- West–a former paved vehicle parking lot for shipyard personnel.

Roads

Describe all thoroughfares adjoining the property and any roads, streets, and parking lots adjacent to the property.

The facility is accessible from McMillan Avenue, then south onto Avenue E South to the end of the Base boundary.

PROPERTY FINDINGS

Air Emissions Sources

Describe all air emissions sources.

Based on inquiries and observations, there are no potential sources of air emissions at this facility.

Shallow Groundwater

Describe condition of shallow groundwater.

There is no contamination of the shallow groundwater at this site or contaminant migration from adjacent properties, based on available records.

Hazardous and Petroleum, Oil, and Lubricant (POL) Substances

Describe uses, waste generation, and storage within facility.

Hazardous and POL Products

There are no hazardous or POL products stored at this facility.

Hazardous and POL Wastes

There are no hazardous or POL wastes stored or generated at this facility.

Spill Related Information

Describe the occurrence of spills associated with facility.

None noted.

Installation Restoration Program (IRP) Sites

Describe IRP sites located at the facility.

There are no IRP sites associated with this facility.

Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs)

Describe SWMUs located at the facility.

There are no SWMUs or AOCs associated with this facility.

In the adjacent properties to the north are AOCs 569, 570 and 578, which are a former gasoline station, a former coal storage area, and a former vehicle transportation shop and garage, respectively. The shallow groundwater in the AOC area is being further investigated to characterize contaminants of concern. A CMS is planned followed by a CMIP/OMP to monitor the natural attenuation of VOCs in groundwater.
A base wide background study was performed at the CNC to identify potential areas of concern. The results from the investigation indicate that there are some elevated levels of contaminants such as PAHs and metals in practically all areas previously or currently used for commercial or industrial use but at levels below those requiring remedial action. As this facility is located in such an area, the property is considered to have been impacted.

Storage Tanks and Related Systems

Describe all underground and aboveground tanks, vent pipes, fuel pipes, stored material refueling and loading and unloading areas, and capacity.

Underground Storage Tanks (USTs)

There are no USTs associated with this facility.

Aboveground Storage Tanks (ASTs)

There are no ASTs associated with this facility.

Industrial Waste Discharges

Describe the industrial wastewater collection system for the facility.

No industrial wastewater is generated or discharged by this facility.

Drains and Sumps

Describe the occurrences of drains and sumps at the facility.

One drain is present on the northeast side of the facility. This drain is located at the base of the stairwell that leads down to the basement. In addition, floor drains were located in all the restrooms.

Sanitary Sewer and Disposal Systems

Describe the occurrences of sewer and disposal systems at the facility.

Waste water and sanitary wastes from this facility are discharged to the North Charleston Sewer District sanitary sewer system (Reference Drawing H410-234 thru 247, Sewage Collection System).

Surface/Stormwater Systems

Describe the occurrences of surface/stormwater systems at the facility.

Storm water collection for this facility drains to outfall number 30. (Ref Public Works Drawings No. H409-70 thru 84).

Silver Recovery Units

Describe the occurrences of silver recovery units at the facility.

This category is not applicable to this type of facility.

Oil/Water Separators (OWSs)

Describe the occurrences of oil/water separators at the facility.

Base plan maps and available building files were reviewed and there are no indications of any OWSs currently or formerly located at this facility. None were observed during the VSI/PSI.

Washracks

Describe the occurrences of washracks at the facility.

Base plan maps and available building files were reviewed and there were no indications of any washracks currently or formerly located at this facility. None were observed during the VSI/PSI.

Septic Tanks

Describe the occurrences of septic tanks at the facility.

Interviews with Public Works personnel indicated that, with few exceptions, all facilities on the base are currently connected directly to the North Charleston Sewer District sanitary sewer system. No known septic system is now or has been associated with this facility.

Grease Traps

Describe the occurrences of grease traps at the facility.

This category is not applicable to this type of facility and is associated with food preparation facilities.

PROPERTY DISCLOSURE FACTORS

Asbestos-Containing Material (ACM)

Describe any occurrences of asbestos containing materials at the facility.

The 1990 Asbestos Inventory Assessment and Survey identified friable asbestos in the building. ACMs were found in pipe insulation, floor tile, and debris. Approximately 1,225 liner feet of pipe insulation, 650 square feet of floor tile, and 39,776 square feet of debris was found at the facility. The basement was locked and marked with "Hazardous Friable Asbestos" warning signs, which were observed during this VSI/PSI.

During the VSI/PSI, all pipe insulation in the mechanical room appeared to have non-ACMs.

Deicing Agents

Describe any occurrences and uses of deicing agents at the facility.

This category is not applicable to this type of facility.

Lead-Based Paint (LBP)

Describe any occurrences of Lead Based Paint at the facility.

Public works personnel indicated that lead-containing paint was used throughout the base as standard operating procedure. All facilities constructed prior to 1981 are likely to have been treated with lead-containing paint. The exterior painted surface was in good condition. The interior painted surfaces varied from good condition to chipping and peeling, mainly in the restrooms.

Mercury

Describe any occurrences of mercury at the facility.

A Mercury Control Program was in place at the Charleston Naval Complex, under the direction of the Director of Occupational Safety and Health (Code 106). Certifications, periodic inspections, and annual inventories were required. This facility was not under this program because it did not store or use mercury.

Medical/Biohazardous Waste

Describe any occurrences of medical/biohazardous waste at the facility.

This category is not applicable to this type of facility.

Ordnance and Explosives

Describe any occurrences of ordnance or explosives at the facility.

The Charleston Naval Complex included specific ordnance storage and handling areas. This facility was not part of the designated areas, therefore, the presence of ordnance at this building is unlikely.

Potable Water Quality and Air Quality

Describe any occurrences of potable water and/or air quality issues at the facility.

Potable water to this facility has been disconnected. During the operation of this facility, water samples were analyzed for lead-in-water levels. Results ranged from 0.0006 mg/l (ppm) to 0.6180 mg/l(ppm). Federal guidelines for the maximum contaminant level (MCL) for lead in drinking water is 0.015 mg/l(ppm). According to "Report on Screening of Drinking Water Coolers for Lead at Charleston Naval Base", four out of eight samples tested exceeded contamination levels. A 1991 Lead in Drinking Water Book III revealed that the lead content was from the piping and not the cooler.

Polychlorinated Biphenyls (PCBs)

Describe any occurrences of polychlorinated biphenyls at the facility.

Transformers

There is one pad-mounted transformer located on the northern side of the building. The transformer was installed by SCE&G and was labeled with a green sticker, indicating that the fluid has less than 50-ppm PCB content.
Another pad-mounted transformer was previously located on the southeastern side and has since been removed.

Capacitors

This category is not applicable to this type of facility.

Hydraulic Units

This category is not applicable to this type of facility.

Light Ballast/Miscellaneous

None noted.

Pesticides/Herbicides

Describe any occurrences of pesticides/herbicides at the facility.

Since base closure in 1995, routine pesticide and herbicide use at this facility has been discontinued.

Radiological Substances

Describe any occurrences of radiological substances at the facility.

There were no radiological substances stored at this facility.

Radon

Describe any occurrences of radon at the facility.

There are no radon concentrations above EPA action levels associated with this facility. Several radon surveys have been performed and results indicate the Naval complex is in compliance with EPA background values. Charleston County has radon values that fall in the range no greater than 2 picocuries per liter. EPA action levels nationwide are 4 picocuries per liter (EPA Publication 402-R-93-071). Facilities that stored radiac equipment tend to have higher values of radon accumulation in poorly ventilated rooms; however, these conditions were remediated with better ventilation.

Other Tanks (Nonhazardous and Non-POL)

Describe any aboveground or underground tanks at the facility that are not considered to contain hazardous materials or POLs.

Based on inquires and observations during the VSI/PSI, there are no other tanks located at this facility.

During the operation of this facility, there was a blue print reproduction room where ammonia was stored in a 250-gallon steel tank prior to mid-1990s. This tank has since been removed.

OTHER PROPERTY DISCLOSURES

Dry Wells

Describe all wells that are not sources of water of known mineral extraction and are used or suspected to be used for disposal of liquid wastes.

Based on inquiries and observations, no wells are known to be present or to have been present on the property or on adjoining property.

Electrical Supply

Describe main electrical outlets and locations.

The electrical supply to this facility has been disconnected.

Heating/Cooling System

Describe the means of heating and cooling of the facility (fuel source).

The heating and cooling system was provided from a central unit that used natural gas.

Foundation of Building

Describe foundation type and locate areas of subsidence.

The facility foundation consists of concrete slab.

Odors

Report any strong, pungent, or noxious odors. If possible, indicate the sources.

With the exception of the intermittent odor of the nearby paper mill, no other odors were detected.

Pits, Ponds, and Lagoons

Describe all pits, ponds, and lagoons on the property, especially if they are or were used in conjunction with waste disposal or waste treatment. Also, describe pits, ponds, or lagoons on adjoining properties.

There is a sump with steam valves and piping on the eastern side of the building. The system is no longer in operation.

Pools of Liquid

Report all standing surface waters. Describe all pools or low areas containing liquids likely to be hazardous substances or petroleum products.

Based on inquiries and observations, no pools of liquid have been noticed .

Stained Soil

Describe any significant areas of stained soil found on the property. Note on plot plans.

There was no visual evidence of stained soil on the property surrounding this facility.

Stains

Describe all significant stains or etchings on floors, walls, and ceilings.

Besides numerous water stains on the floor due to water leaking through the ceiling tile, no stains that would constitute a release to the environment were observed during VSI/PSI.

Stressed Vegetation

Describe any areas of stressed vegetation (from a cause other than insufficient water).

There was no visual evidence of stressed vegetation on the property surrounding this facility.

Non-Stormwater Discharges

Describe any wastewater or other liquids, other than stormwater, which discharge into a ditch or stream on or adjacent to the property.

No ditches or streams were on or adjacent to this property.

Wetlands

Describe location and approximate size.

According to the 1988 U.S. Fish and Wildlife Service National Wetlands maps, the U.S. Army Corps of Engineers 1988 Wetland Delineation Survey of Charleston Naval Base, and visual observations, no wetlands were observed or appear to be associated with this facility.

References:

U.S. Department of the Interior, Fish and Wildlife Service, National Wetland Inventory Maps–5050 III SW and 5049 IV NW).

Drawing H606-268, Map of Charleston Naval Shipyard Naval Station and Contiguous Activities Extended and Planned–as Modified by the U.S. Army Corps of Engineers, Charleston District, February 2, 1988.

NATURAL AND CULTURAL RESOURCES

Cultural Resources

Describe any cultural resources.

Although this facility is more than 50 years old, it does not qualify for consideration as a historic structure under the National Register of Historic Places, due to renovations made to the building.

Biological Resources

Describe any biological resources that may affect the facility.

An endangered plant survey completed in 1993 (by Richard D. Porcher, The Citadel) determined that there were no endangered species. However, the sea purslane has been identified as a confirmed resident of the Naval Base and is a listed species of concern by the South Carolina Wildlife and Marine Resources Department. The osprey and least tern have been identified as confirmed residents of the Naval Base. The osprey is recognized as a species of concern and the least tern is recognized as a threatened and endangered (T&E) species by the South Carolina Wildlife and Marine Resources Department and the U.S. Fish and Wildlife Service.

Unusual Geologic Resources and Conditions

Describe any geologic condition that may affect the facility.

An earthquake that struck the Charleston area in 1886 affected a 50-kilometer area and was felt as far as 1,000 kilometers from the epicenter. Although the Charleston area is not considered an earthquake-prone area based on the frequency of historic earthquakes, studies by the Earthquake Branch of the U. S. Geological Survey indicate that the region is undergoing intra-plate motion. The Atlantic oceanic plate, which is currently sliding westward beneath the earth's crust, that includes the Charleston region, is generating movement that is being recorded as micro-seismic events. Release of lithostatic pressure from intra-plate motions has, on occasion, manifested itself at the surface as an earthquake.

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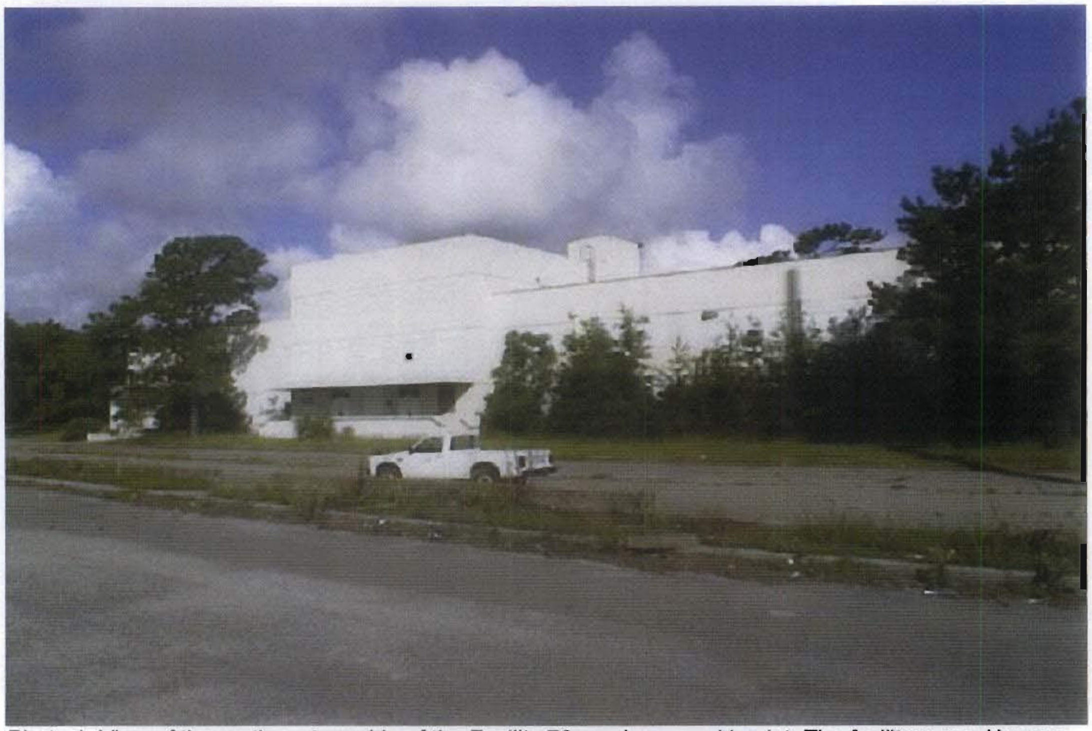
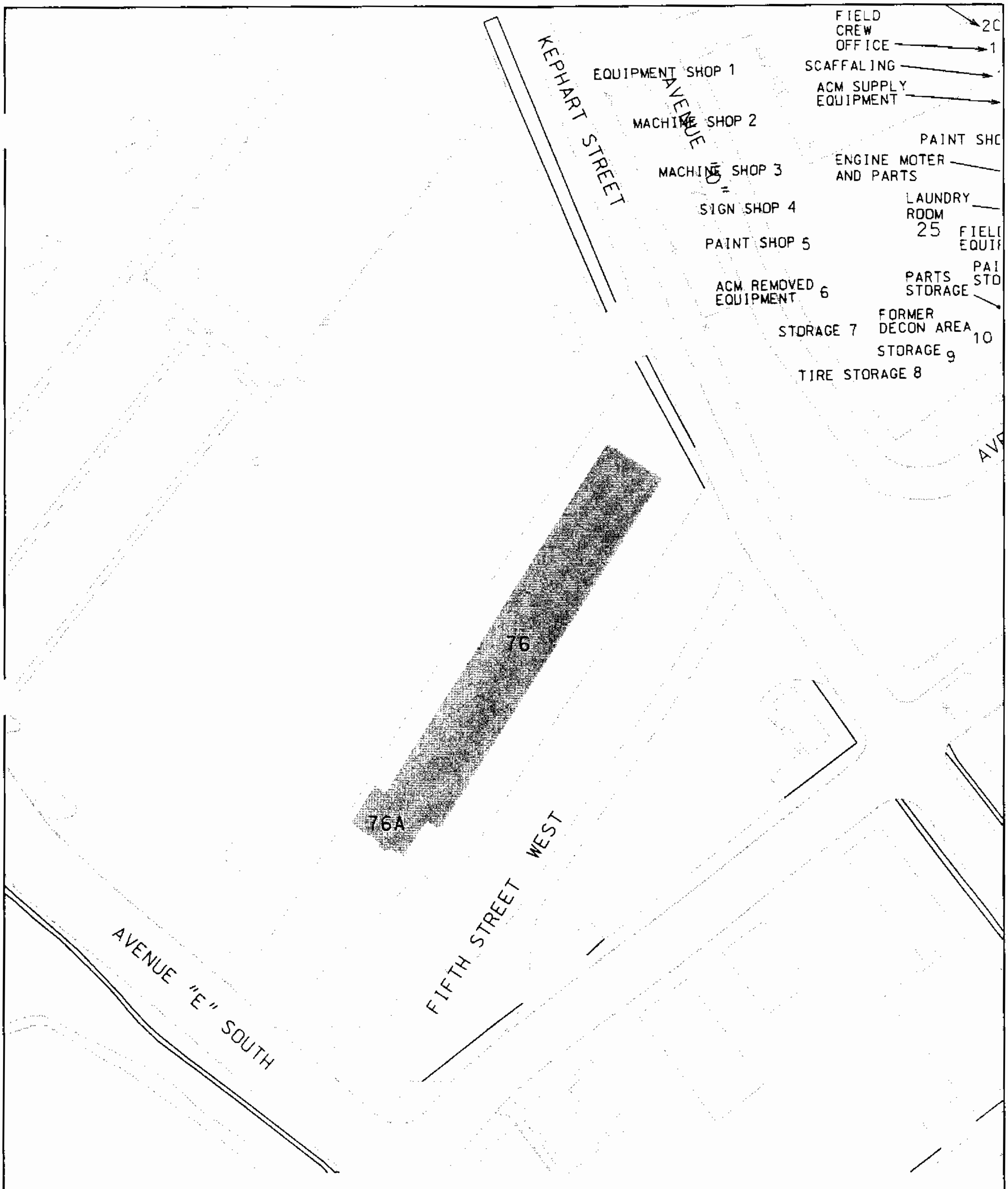


Photo 1. View of the northwestern side of the Facility 76 employee parking lot. The facility was a Human Resources, and Safety and Environmental administration office located at 1450 5th Street.

Photo 2. View of the southwestern side of Facility 76-A, the southern annex to Facility 76. The facility was used as a conference center.



LEGEND

- UST ACTIVE
- UST REMOVED
- UST INACTIVE
- AST ACTIVE
- AST REMOVED
- AST INACTIVE
- OWS ACTIVE
- OWS REMOVED
- OWS INACTIVE
- SRU ACTIVE
- SRU REMOVED
- BLDG. DEMOLISHED
- BUILDING
- SUMP
- STAINED SOIL
- LANDFILL
- GREASE TRAP
- WASH RACK
- STORAGE AREA
- SEPTIC TANK
- SEPTIC TANK INACTIVE
- BASE BOUNDARY

FIGURE 1
Building 76/76A
Environmental Baseline Survey
for Transfer Phase IV Parcels
Charleston Naval Complex
North Charleston, South Carolina

Note which documents you review in all sections of this form.

Base: *Charleston Naval Shipyard*
Building Number: *76*
Site Location: *D-40*

CONCLUSION/EXECUTIVE SUMMARY

(ATTACH PLANS AND PHOTOGRAPHS)

CLASSIFICATION (BASED ON THE INFORMATION/DATA/DOCUMENTATION AVAILABLE AT THE TIME OF THE SURVEY)	CLASSIFICATION NUMBER	MAP COLOR
AREAS WHERE NO STORAGE, RELEASE OR DISPOSAL OF HAZARDOUS SUBSTANCES OR PETROLEUM PRODUCTS HAS OCCURRED (INCLUDING NO MIGRATION OF THESE SUBSTANCES FROM ADJACENT AREAS).	1	WHITE
AREAS WHERE ONLY STORAGE OF HAZARDOUS SUBSTANCES OR PETROLEUM PRODUCTS HAS OCCURRED (BUT NO RELEASE, DISPOSAL, OR MIGRATION FROM ADJACENT AREAS HAS OCCURRED).	2	BLUE
AREAS WHERE STORAGE, RELEASE, DISPOSAL AND/OR MIGRATION OF HAZARDOUS SUBSTANCES OR PETROLEUM PRODUCTS HAS OCCURRED, BUT AT CONCENTRATIONS THAT DO NOT REQUIRE A REMOVAL OR A REMEDIAL ACTION.	3	LIGHT GREEN
AREAS WHERE STORAGE, RELEASE, DISPOSAL AND/OR MIGRATION OF HAZARDOUS SUBSTANCES OR PETROLEUM PRODUCTS HAS OCCURRED, AND ALL REMEDIAL ACTIONS NECESSARY TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT HAVE BEEN TAKEN.	4	DARK GREEN
AREAS WHERE STORAGE, RELEASE, DISPOSAL AND/OR MIGRATION OF HAZARDOUS SUBSTANCES OR PETROLEUM PRODUCTS HAS OCCURRED, REMOVAL AND/OR REMEDIAL ACTIONS ARE UNDER WAY, BUT ALL REQUIRED REMEDIAL ACTIONS HAVE NOT YET BEEN TAKEN.	5	YELLOW
AREAS WHERE STORAGE, RELEASE, DISPOSAL AND/OR MIGRATION OF HAZARDOUS SUBSTANCES OR PETROLEUM PRODUCTS HAS OCCURRED, BUT REQUIRED RESPONSE ACTIONS HAVE NOT YET BEEN IMPLEMENTED.	6	RED
AREAS THAT HAVE NOT BEEN EVALUATED OR REQUIRE ADDITIONAL EVALUATION.	7	GREY

EXECUTIVE SUMMARY:

FACILITY 76 IS A THREE STORY STRUCTURE BUILT OUT OF CEMENT AND WOOD AROUND 1942. THE INTERIOR OF THE BUILDING HAS BEEN REMODELED TO MAKE ALL FLOORS FUNCTIONAL OFFICE SPACE. THE PAINT IN THIS FACILITY IS IN FAIR TO BAD CONDITION AND IS PEELING IN SOME PLACES. A WATER COOLER THAT CONTAINED .0252 PPM OF LEAD IS STILL PRESENT ON THE FIRST FLOOR OF THE FACILITY. POSSIBLE WASTE STREAMS OF AMMONIUM HYDROXIDE WERE PRESENT FROM THE FACILITY WHEN A 250 GALLON ABOVEGROUND STEEL TANK EXISTED AT THIS SITE. THE TANK WAS REMOVED APPROXIMATELY FOUR YEARS AGO. THIS FACILITY IS LOCATED APPROXIMATELY 100 FEET FROM BUILDING 25, WHICH HAS BEEN ASSIGNED PSWMUS 119 AND 105. THERE IS STILL AN ASBESTOS PROBLEM UNDERNEATH THE STRUCTURE, INDICATED BY A LIMITED ACCESS SIGN, DUE TO THE PRESENCE OF FRIABLE ASBESTOS. FOR THESE REASONS, BUILDING 76 RECEIVES A BRAC CLASSIFICATION OF 6/RED.

LIST A DESCRIPTION OF DOCUMENTS REVIEWED.

1993. *REMEDIAL INVESTIGATION/FEASIBILITY STUDY COMPLIANCE OVERSIGHT - CHARLESTON NAVAL SHIPYARD, CHARLESTON, SOUTH CAROLINA - SOURCES OF HAZARDOUS WASTE RELEASE TABLES.* (DOCUMENT CONTROL NO. C04163-NAVSHIP-LC-005), DYNAMAC CORPORATION, ENVIRONMENTAL SERVICES.

1993. (JANUARY) *MAP OF CHARLESTON NAVAL SHIPYARD, NAVAL STATION AND CONTIGUOUS ACTIVITIES.* DRAWING NO. H606-281, CHARLESTON NAVAL SHIPYARD, CHARLESTON, SC.

1983. *INITIAL ASSESSMENT STUDY OF NAVAL BASE CHARLESTON, CHARLESTON, SOUTH CAROLINA.* ENVIRONMENTAL SCIENCE AND ENGINEERING, INC. (ESE). CONTRACT NUMBER N62474-81-C-9583.

1939. *BLACK AND WHITE AERIAL PHOTOGRAPH OF CHARLESTON NAVAL STATION, CHARLESTON, SC.* CHARLESTON COUNTY SOIL AND WATER CONSERVATION DISTRICT.

1941. *BLACK AND WHITE AERIAL PHOTOGRAPH OF CHARLESTON NAVAL STATION, CHARLESTON, SC.* CHARLESTON COUNTY SOIL AND WATER CONSERVATION DISTRICT.

1949. *BLACK AND WHITE AERIAL PHOTOGRAPH OF CHARLESTON NAVAL STATION, CHARLESTON, SC.* UNIVERSITY OF SOUTH CAROLINA.

1954. *BLACK AND WHITE AERIAL PHOTOGRAPH OF CHARLESTON NAVAL STATION, CHARLESTON, SC.* CHARLESTON COUNTY SOIL AND WATER CONSERVATION DISTRICT.

CONTINUED ON SUPPLEMENTAL INFORMATION, PAGE 17.

SECTION 2.0

Methodology

2.1 Approach and Rationale

This Environmental Baseline Survey (EBST) follows a process in which all reasonably available information is analyzed and conclusions are drawn about the environmental condition of the facilities. The information presented in this EBST was obtained through record searches, visual inspections, and interviews.

The facilities in this survey were previously evaluated in EBSTs performed before 1996 as part of Base closure requirements. Data gaps in the EBSTs were identified for additional research during data collection and the VSI/PSI phase of this EBST. Tables and lists of information with applicable sources were identified for updates and knowledgeable personnel were contacted for more in-depth interviews as necessary.

2.1.1 General Activities

The record search included reviewing historical aerial photographs, Civil Engineering Base planning maps, CSO environmental management records, real estate records, and previous EBST documents. These records included environmental restoration and compliance reports, audits, surveys, facility maps and drawings, and inspection reports. The VSI/PSIs included a walk-through of all accessible portions of each facility, as well as open areas around the facility. Any limitations on specific facilities are detailed in the Appendix.

Whenever possible, interviews with current and former employees were conducted in person or by telephone, primarily during the period of data collection, and during the performance of the VSI/PSI (August 2002).

Information gathered during data collection was organized according to requirements of CERCLA 120(h)(1) through (h)(4) [(Property Categorization Factors, (Section 3.1 of this report), if applicable), or the data reflected information that would be disclosed to the public during property transfers (Section 3.2, Facility Disclosure Factors and Section 3.3, Natural Resource Disclosure Factors)].

This EBST also evaluated the environmental condition of adjacent properties within one-quarter mile of each facility surveyed in the Economic Development Conveyance (EDC) Phase IV area. The evaluations focused on adjacent properties and particularly those that were located hydraulically upgradient. Contaminant releases to the shallow groundwater in upgradient properties were considered to have the potential for migration resulting in impacts to the shallow groundwater of downgradient properties. The Basewide groundwater gradient map, contaminant distribution maps, and ongoing remedial site assessments were part of the property evaluations.

The VSI/PSI information gathered from the 1996 EBST was also used to further assess and define environmental concerns and to identify data gaps on adjacent properties.

The information gathered during the 1996 EBST for adjacent properties, including off-base properties, was used and corroborated by windshield surveys when environmental conditions required updating. Additional searches of the files and aerial photo evaluations were implemented on an as needed basis.

The facilities evaluated in this EBST are located in remedial investigation zones A, D,E, F, G, H, I, and K. The zones were established to manage site investigations and remedial activities throughout the CNC and the Naval Annex. Twelve remediation zones were established and are designated Zones A through L (**Figure 1-2**).

2.1.2 Adjacent Properties

For the purpose of this EBST, adjacent properties are identified as those areas within a quarter-mile radius of the facilities in the EDC Phase IV area. Information developed from the 1996 EBST on adjacent properties is incorporated by reference. Additional information developed for facilities or facilities from this EBST was also incorporated by reference.

2.2 Property Categorization Criteria

The Base property is categorized in seven groups. These categories range from Property Category 1 (uncontaminated property) to Property Category 6 (property that requires remedial activities) and Category 7 (property that requires additional evaluation to determine whether the property can be reclassified to a lower Category, i.e., Category 1 to 6). Due to the requirement for further activities required under Category 6, the category is considered more conservative than Category 7, which could change to a 1 or 2 based on further information. Based on an evaluation of available data, the real property (i.e., individual facilities) within EDC Phase III area classified using one of the following seven categories:

Category 1: Areas where no release or disposal of hazardous substances or petroleum products[a] has occurred (including no migration of these substances from adjacent areas).

Category 2: Areas where storage, release, or disposal of petroleum products has occurred[b].

Category 3: Areas where release, disposal, and/or migration of hazardous substances has occurred, but at concentrations that do not require a removal or remedial response.

Category 4: Areas where release, disposal, and/or migration of hazardous substances has occurred, and all removal or remedial actions to protect human health and the environment have been taken.

[a] For the purpose of this EBST, "petroleum products" is inclusive of oil, its derivatives (such as fuels), and related wastes.

[b] This category may require investigations and/or remediation under separate laws and regulation (excluding CERCLA).

Category 5: Areas where release, disposal, and/or migration of hazardous substances has occurred, and removal or remedial actions are underway, but all required remedial actions have not yet been taken.

Category 6: Areas where release, disposal, and/or migration of hazardous substances has occurred, but required actions have not yet been implemented.

Category 7: Areas that are not evaluated or require additional evaluation.

Property in Categories 1 through 4 is suitable for transfer by deed under CERCLA §120(h), requirements. Property in Categories 5 and 6 is unsuitable for transfer by deed under CERCLA § 120(h), unless it can be shown that all necessary remedial actions have been taken and the property is awaiting reclassification into one of the first four categories The covenant that states that all necessary remedial actions have been taken can be deferred through use of early transfer authority under CERCLA Section 334, with the signature of the Governor and with concurrence of the Secretary of the Navy. Land use restrictions and access clauses would be added to the property deed to provide appropriate protection of human health and the environment in the interim until remedial actions are complete.

Included in the EDC Phase IV parcel are facilities that require use of early transfer authority and where land use controls will be implemented. Facilities within areas where land use controls will be implemented will be Categorized as 2 (If only petroleum release had occurred), 5, 6, or 7 in this EBST.

Property in Category 7 is unsuitable for transfer by deed, unless all necessary investigations are completed and the property is awaiting reclassification into one of the first four categories. Category 7 may be made suitable for transfer if further investigation reveals no contamination and the property can be reclassified into one of the first four categories.

Buildings that are Property Category 3 to 6 where release, disposal, and/or migration of hazardous substances has occurred may also be affected by the migration of contaminated groundwater from adjacent properties. The property categorization will be affected by the existence of the contaminated groundwater that underlies the properties.

Properties in Categories 1 through 7 may be suitable for lease. Methodology used in determining uncontaminated property follows the guidance presented in CERCLA Section 120(h)(4).

2.3 Property Categorization

Property categorization is a two-step process. The first step in CERCLA 120(h)(4) requirements is to identify "uncontaminated property." The second step in CERCLA 120(h)(1) through (h)(3) requirements is to identify property where hazardous substances are stored, released, or disposed and/or in-migrated.

A facility being considered for transfer is assigned a property category number. The property category number that is assigned is based on Property Categorization Factors in accordance with CERCLA § 120(h)(4) and CERCLA § 120(h)(1) through (h)(3) requirements. The property category number that is assigned to a facility represents the most conservative property categorization. The Property Categorization Factors that are assigned are based on the environmental conditions and investigation/restoration status of surface, subsurface, and groundwater. This study evaluated the potential for impacts to the environmental condition of the facilities from the following factors:

- Storage tanks and related systems
- Industrial wastewater treatment systems
- Sanitary and storm water systems
- Air emission sources
- Oil/water separators (OWS)
- Septic tanks
- Silver recovery units (SRU)
- Washracks and grease racks
- Installation Restoration Program Sites (IRP)
- Solid waste management units (SWMU)
- Areas of Concern (AOC)
- Areas where a PCB or mercury release to the environment occurred
- Groundwater contamination

In addition, facility disclosure factors were evaluated in this study for impacts to the environmental condition of the property. Facility disclosure factors are not regulated under CERCLA, but may cause environmental concerns. In such occurrences where there was an impact to the environment, the contaminated sites may require investigation under the CNC RCRA permit as part of an AOC or SWMU. The following disclosure factors are included in the evaluation:

- Asbestos
- Lead-based paint (LBP)
- Polychlorinated biphenyls (PCB), where no release to the environment occurred
- Radon
- OSHA concerns (drinking water and indoor air quality)
- Pesticides
- Ordnance
- Medical/biohazardous wastes
- Radiological substances
- Deicing agents
- Mercury, where no documented release to the environment occurred

The environmental condition factors and disclosure factors for the facilities are discussed in Section 3.0, while the final property categorizations are summarized in Section 4.0.

2.4 Limitations and Assumptions

General limitations on collecting data at CNC and the Naval Annex include personnel changes, facility closures, and reorganizations (many knowledgeable personnel are no longer available due to transfers, staff changes, or resignations associated with Base closure). Other limitations include incomplete or lost files due to information not being centrally filed, and missing historical information (paper trail) for particular facilities.

Readily available records and information available through the VSI/PSI and interviews limit each individual categorization and disclosure factor.

General data gaps identified for the CNC and the Naval Annex are discussed in Section 4.0, while data gaps for specific facilities appear in the Appendix. Limitations and assumptions made for the EBST are summarized below.

2.4.1 Groundwater Contamination

Groundwater contamination is being assessed during petroleum storage tank removals, and during investigations of SWMUs and AOCs. Site investigation may result in the installation of monitoring wells to characterize possible groundwater contamination, monitor the natural attenuation of groundwater contaminant plumes, or evaluate the effectiveness of ongoing interim remedial actions to determine the quality of the groundwater. Groundwater samples in recent site assessments were analyzed for volatile organic compounds (VOCs) and metals, with semivolatile organic compounds (SVOCs) analyzed when necessary, based on past uses of the property.

In some cases, the boundary between groundwater containing hazardous substances exceeding maximum contaminant levels (MCLs) and groundwater containing hazardous substances below MCLs intersect beneath a facility. When this occurs, the most conservative categorization factor is assigned to that facility, regardless of how much the footprint of the facility extends beyond the area of contamination.

2.4.2 Hazardous Materials and Petroleum, Oil, and Lubricants (POLs)

The records at the CSO were reviewed to identify quantities and types of hazardous materials and POL materials (other than in tanks, which are discussed in Section 2.4.6). The CNC and the Naval Annex, through an Environmental Management Information System (EMIS), has tracked records pertaining to hazardous materials used at industrial workplaces since about 1987.

Hazardous Material. A Basewide EBS was conducted in 1995, which investigated historical storage of materials in all facilities on the CNC and the Naval Annex. This document is incorporated by reference into the current EBST, whose main purpose is to provide an update of the existing conditions as they have changed since the initial EBS. According to CSO personnel, EMIS is designed to represent the purchases of each building. However, since many of the buildings were vacated during the VSI/PSIs, a comparison of databases with materials in the shop areas was not performed. This EBST relied on the description of previous EBSTs and SS-EBSTs for past uses and storage. To confirm the materials at each facility, the types and quantities of material stored at the facility were generally cross-checked during the VSI/PSI, but not inventoried. For those facilities that were already vacated, the field investigators evaluated known hazardous material storage areas to determine the environmental condition, and to determine if an environmental impact to the facility occurred. For those facilities that were vacated, the historical increase or decrease of materials stored was not determined. For POLs, the UST and AST databases were used during the VSI/PSI to confirm the presence of the storage tanks.

POL Products. The classification for petroleum products that is used at the CNC and the Naval Annex is based on the U. S. Environmental Protection Agency (EPA) interpretation of CERCLA section 101(14) to exclude crude oil and their indigenous fractions from the definition of hazardous substances. Under this interpretation, petroleum includes hazardous substances (such as benzene, toluene, ethylbenzene, and xylene [BTEX] and some of the SVOCs) that are normally contained within crude oil or crude oil fractions during the refining process. This includes indigenous hazardous substances, the levels of which may be increased as a normal part of the refining process. However, hazardous substances that are added to petroleum or that increase in concentration as a result of contamination of the petroleum during use (such as through incomplete combustion) are not considered part of the petroleum and are, therefore, regulated under CERCLA.

Heating fuel oil contains no additives from the refining process that would be considered a hazardous substance, even though certain constituents within the virgin crude oil may be elevated through the refining process. As such, heating fuel oil is considered strictly a petroleum product, and qualifies for the petroleum exclusion under CERCLA section 101(14). Heating oil stored in USTs are, therefore, classified Property Category 2, even though a release of product during use or during UST removal sometimes occurs. This interpretation applies even if the storage tanks are still present in the ground, or even if the tanks are only suspected to be present.

2.4.3 Hazardous and State-Regulated, Non-Hazardous Wastes

Prior to Base Closure the hazardous waste compliance programs at CNC and the Annex were conducted under COMNAVBASE Charleston Instruction 5090.3A, the Federal and State requirements found in 40 CFR 260 through 270, 40 CFR 117, Department of Transportation regulations, and South Carolina Regulation R.61-79.260. Since Base Closure SOUTHDIV has assumed ownership of the Base and did not adopt the COMNAVBASE instructions. The CSO operates the Base in compliance with State and Federal Regulations for dealing with abandoned wastes. Releases from hazardous waste sites are addressed under the Navy's IRP. Management of investigation derived waste is in accordance with the approved Comprehensive Sampling and Analysis Plan.

During Base operations, there were 59 hazardous waste satellite accumulation points and 10 less-than-90-day storage areas located at CNC. Satellite Accumulation Areas (SAAs) at CNC consisted of 55-gallon drums used to store various associated hazardous wastes. These drums were removed from the SAAs prior to being filled to capacity, and were transported to a permitted storage facility.

The CNC EMIS database was used to assess hazardous and POL waste generation, accumulation, and storage at facilities. Waste at CNC and the Annex were managed in accordance with an approved Hazardous Waste Management Plan (HWMP). In addition, a Spill Prevention, Control, and Countermeasure (SPCC) Plan has been developed for all locations where hazardous and POL materials and wastes are stored. The CNC SPCC Plan meets the requirements for Spill Prevention and Response (SPR) Plan (40 CFR Part 264).

During the VSI/PSI, drums and other containers of hazardous and POL wastes were inventoried when encountered. New wastes identified during the VSI/PSI were added to the inventory and changes in container sizes were noted. No wastes were deleted from the inventory so that the inventory would reflect past and current waste generation information.

Information on spills and releases at the facilities, including hazardous materials and POL storage areas, hazardous and POL waste accumulation areas, and other areas, was obtained from the CNC and Annex database of spills. Available records were reviewed and incorporated from the list provided. Additionally, during the VSI/PSI, field investigators noted any indications of releases to the environment and anecdotal information regarding spills based on interviews. For property categorization, individual reports of spills, where release to the environment was observed, were categorized as a separate event. If evidence of a release to the environment were noted at a non-POL storage tank, the release would affect the categorization of that unit and would not be categorized alone. Releases to the environment were based on visual evidence of stains and spills noted on adjacent soils, extending to floor drains or cracks in the floor, or evidence of stressed vegetation in the area surrounding the stain or spill.

2.4.4 Installation Restoration Program Sites (IRPs)

At CNC and the Naval Annex, a RCRA Facility Assessment (RFA) was prepared, which divided the Base into zones and identified SWMUs and AOCs within each zone. The RFA evaluated each SWMU and AOC and determined which sites required further investigation. Based on the RFA, a RCRA Facility Investigation (RFI) work plan was prepared for each zone containing SWMUs and AOCs requiring further investigation. For purposes of corrective action, the Navy treated both SWMUs and AOCs equally as contaminated sites. On completion of the RFI for each zone, an RFI report was prepared for that zone. The RFI report identified SWMUs and AOCs containing wastes requiring remediation. Eventually, Corrective Measures Studies (CMSs) were prepared to determine the best means of remediating each site. Interim Measures (IM) were performed to remediate each site, as appropriate.

2.4.5 RCRA Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs)

SWMU and AOC listings and locations were based on the 1996 EBS. The CSO and the current remediation contractor provided the status of the SWMUs and AOCs. Information on SWMUs and AOCs was obtained from the previous EBST and subsequent RFA, RFI, and CSM reports. SWMUs and AOCs that were in adjacent properties were further evaluated to determine their potential impact to each of the facilities. During the VSI/PSI, only active SWMUs and AOCs were verified, since former units were either closed or designated NFA sites with regulatory concurrence from the South Carolina Department Health and Environmental Control (SCDHEC) or the Environmental Protection Agency (EPA).

Railroads, sewer lines, drains, and ditches are also addressed when they are adjacent to or within the boundaries of SWMUs and AOCs. Source areas and migration pathways to the surface water bodies are evaluated as part of an ongoing zone-wide investigation.

2.4.6 Storage Tanks and Related Systems

The SCDHEC is authorized to administer the petroleum UST (referenced as petroleum storage tank [PST] in this EBST) program in lieu of the federal program, with EPA maintaining oversight authority for this program. Therefore, PST closure and investigation activities throughout CNC and the Annex are conducted under SCDHEC Regulation 61-92 (Underground Storage Tank Control Regulations). The UST closures are ongoing with about 50 UST sites already closed.

South Carolina does not have regulations that govern ASTs. However, if an AST release to the environment contains petroleum products, this release becomes subject to the South Carolina Pollution Control Act, and must be assessed and remediated accordingly. Further, if an AST contains a substance other than a petroleum product, such as other chemical products or wastes, these tanks may be regulated under other programs. These programs may include, but are not limited to, the South Carolina Hazardous Waste Management Regulations (R.61-79) or South Carolina Regulation 61-9 for National Pollution Discharge Elimination System (NPDES) permits. Additionally, federal SPCC regulations (40 CFR 110 and 40 CFR 112) apply to ASTs.

The 1996 EBS provided information on storage tanks for this EBST. This information was updated based on the VSI/PSIs, records regarding closure from the SOUTHDIV Command, a review of historical maps and plans, and interviews.

Conflicting information that resulted from several interrelated record-keeping systems was occasionally identified. Where possible, VSI/PSIs identified the accurate information (e.g., confirmed the existence or status of tanks). However, where tanks were not visible (such as USTs), the presence of vent pipes, fill pipes, or fuel oil boilers on the property were used to determine their possible location.

2.4.7 Industrial Wastewater Treatment and Related Systems

Information on the Industrial Wastewater Collection System (IWCS) lines and sanitary and storm sewer systems are discussed for the facilities. Although not a categorization factor, these systems are discussed as part of the facility description. Information on sanitary and storm sewer systems was provided by engineering drawings (where available), and Basewide utility drawings.

2.4.7.1 Silver Recovery Units (SRU)

The CSO personnel supplied information on former SRUs in the EBST area. The descriptions and uses of the SRUs were verified during the VSI/PSIs, and determinations made regarding whether the SRU was a closed system or connected to a floor drain.

2.4.7.2 Oil/Water Separators (OWSs)

Information on the OWSs in the area investigated in this EBST was obtained from the previous 1996 EBS. During the VSI/PSI, these sites were visually examined and evaluated.

Where possible, the current and past operational status, locations, and operational practices were determined. The Navy recently performed additional surveys and identified 9 existing OWS with designations AOC 711 through AOC 720. The AOCs were evaluated to determine impacts to the EDC Phase IV properties.

2.4.7.3 Washracks and Grease Racks

Washracks and grease racks are associated with equipment and vehicle wash down and maintenance areas. Locations and status of possible washracks and grease racks were confirmed during the VSI/PSIs. Some areas used as washracks and grease racks, but not previously listed as such, were added to the list. Historical information was obtained from the map files and verified from archived real estate records.

Information on the discharge locations was obtained by reviewing building plan maps, conducting interviews, and records of the sanitary and stormwater sewer system. A physical evaluation was not conducted.

2.4.7.4 Septic Tanks

Based on interviews and document reviews, including historical site plans and facilities drawings, septic systems were located throughout the Base. Their history of use was determined through interviews and from historical site maps to determine whether chemical releases were possible to the adjacent properties or the groundwater. The septic systems were located at remote locations beyond the reach of the Basewide sanitary sewage collection systems, and contained limited utilities.

2.4.7.5 Grease Traps

Grease traps were identified during the VSI/PSI and through interviews and review of Base utility maps. No formal list of grease traps was available, but was assumed in facilities with kitchens and in the commissary.

2.4.7.6 Dredge Spoil Fill Material

Dredge spoil fill material was placed in the lowland areas in the southeastern section of CNC and along Noisette Creek in the north. The fill along Noisette Creek was placed in stages from 1919 to 1921. A second fill area is located southwest of Piers L and Z in an area between Pierside Street and Bainbridge Avenue. This fill was placed in the area in 1938. The fill material in the southeastern section of CNC was placed in the area during the 1940s.

The dredge spoils are materials deposited as a landmass under regulation of the Clean Water Act (CWA), and permitted by the U.S. Army Corps of Engineers. The dredge fill areas were investigated as part of a Basewide background study at CNC and not as an investigative regulatory site. Results of the study found no evidence of elevated constituents above those in non-fill areas.

2.4.8 Facility Disclosure Factors

Facility disclosure factors are conditions that may affect the use of a property. If maintained and managed properly, however, facility disclosure factors do not pose a specific risk or hazard to human health or safety. These disclosure factors do not require notification under CERCLA 120(h)(1) and, therefore, do not affect the property categorization process.

Their presence and any required protective actions will be identified and disclosed in FOST/FOSL or FOSET documentation.

2.4.8.1 Asbestos-Containing Materials (ACMs)

Information on ACMs is derived from the 1996 EBS and the CSO database, and from ongoing ACM abatements performed during 1999 through 2002. The asbestos surveys performed to compile the information followed Navy guidance and only included areas in buildings that were accessible for sampling.

As a follow up to previous asbestos surveys, the Navy has performed additional field verifications throughout the CNC and Annex prior to Base closure. Suspect ACMs were identified at the facilities and were based on construction dates, not on samples collected or results from testing. If a facility was constructed before 1989, there is potential for ACMs. If the facility was constructed after 1989, the presence of ACMs is unlikely due to construction regulation. The VSI/PSI verified the occurrence of suspect ACMs and noted the physical condition of the ACMs where applicable. Suspect ACMs that appeared damaged were noted for possible further evaluation, sampling, and testing for friable asbestos.

In several instances, the report listed materials included in the survey that were not sampled. These suspected ACMs were not sampled for one of three reasons:

- The material was inaccessible
- Sampling would damage the integrity of the material
- Sampling of similar material during previous surveys provided the information needed to determine whether asbestos was or was not present

2.4.8.2 Lead-Based Paint (LBP)

The presence of LBP at the facilities was based on construction dates. If the facility was constructed before 1981, there is the potential for LBP. If the facility was constructed after 1981, the presence of LBP is unlikely.

Current LBP abatement is being performed mainly on residential buildings consistent with the Residential Lead-Based Paint Hazard Reduction Act of 1992 (Title X of the Public Law 102-550) and current DoD policy. There is no federal law that governs the inspection or abatement of LBP hazards for nonresidential structures; therefore, no formal surveys or abatement actions were required. During the VSI/PSI, however, the condition of the painted surfaces were observed and noted at all facilities in the EDC Phase IV area.

2.4.8.3 Polychlorinated Biphenyls (PCBs)

Information on PCBs is based on three sources: (1) South Carolina Electric & Gas (SCE&G) records; (2) the Navy PCB databases, surveys, and records for transformers, other electrical equipment (e.g., capacitors, switchgear), and hydraulic equipment; and (3) observations made during the VSI/PSI to determine whether transformers had a sticker indicating PCB compliance.

Based on interviews with SCE&G, the electrical distribution system and all its components have been transferred to the utility, except in the shipyard area where negotiations are underway to transfer the electrical system to Detyens Shipyards, Inc., the current tenant. Since Base closure, SCE&G has carried out a Basewide program to sample the dielectric fluid in all transformers to determine the PCB content.

Reports on hydraulic equipment tests were reported in the 1996 EBS. A record of the types of machinery in the former shops was not available during this property evaluation. Visual observations of the shops verified whether the equipment was still present in the shops (left behind by the Navy to be included with the facility) and, if so, whether it had a tag indicating it had been sampled.

Field verification of information was limited to the presence or absence of transformers, hydraulic units, fluorescent lighting, and capacitors, where visible. During the VSI/PSI, field investigators noted any evidence of releases from transformers and hydraulic units. Where there was no evidence of a release, the presence of the equipment was disclosed and no further investigation of the PCB content was made.

During the VSI/PSI, visual evidence of stickers placed on transformers to indicate their PCB content was used to confirm SCE&G data. A green sticker indicated the transformer was sampled by SCE&G and was in PCB compliance (<50 ppm). A blue sticker indicated the transformer was tested by the manufacturer and was in PCB compliance. Pole-mounted transformers were labeled indicating PCB compliance.

2.4.8.4 Radon

Several radon surveys were performed Basewide and in buildings that may have stored radiac equipment in the Naval Complex during the 1990s. The results of these surveys were examined during the VSI/PSI process. Sources such as the EPA nationwide study were consulted to determine background radon values for the South Carolina and the Charleston County area, where specific data was not available. Facilities not fully enclosed or with adequate ventilation based on structural or operational information that would preclude accumulation of radon gas within the facility were noted on the survey forms in Appendix A.

2.4.8.5 Occupational, Safety, and Health Association (OSHA) Concerns (Drinking Water Quality and Indoor Air Quality)

Information on drinking water quality is based on analysis of water supply to the facilities. Reports regarding drinking water analyses and remediation efforts were noted.

Records did not indicate there were indoor air quality problems for facilities in the EDC Phase IV area. Since many of the buildings are in lay up status and have been vacated since Base closure, mitigating air quality issues are the responsibility of the tenant.

2.4.8.6 Pesticides

The CNCRDA and current-building tenants were consulted regarding pesticide use. Throughout the EDC Phase IV area, however, many of the buildings were vacated.

2.4.8.7 Ordnance and Explosive

The CNC included specific ordnance storage and handling areas. One building (Facility 1888) in the EDC Phase IV area is being used as an indoor pistol range. There are no other designated ordnance or explosive storage facilities in the areas surveyed in this study.

2.4.8.8 Medical and Biohazardous Waste

Those facilities that were formerly medical clinics may have generated medical/biohazardous wastes. However, since the former clinics were renovated to administrative offices, or have been vacated since Base closure, the wastes were documented as past usage.

2.4.8.9 Radiological Substances

Information on radiological substances, use, and storage was based on the 1996 EBS and VSI/PSIs. Since many of the buildings and facilities were vacated, the VSI/PSIs were used to locate each permitted or otherwise listed source. Reference was also made to the Navy closure reports for the facilities.

2.4.8.10 Deicing Agents

No records are available regarding storage and use of deicing agents. Information gathered during interviews indicated that the use of deicing agents at CNC and the Annex were not required because of the climate.

2.4.8.11 Mercury

The mercury inventory was based on information from the 1996 EBS. During VSI/PSIs, personnel checked for storage of material, performed random checks for the presence of mercury thermostats, and checked for locations of mercury thermometers and manometers/level gauges.

Information is generally limited to anecdotal information from interviews, spill reports, and observations of visible gauges and instruments during the VSI/PSIs.

2.4.9 Natural and Cultural Resources Disclosure Factors

2.4.9.1 Cultural Resources

Information was limited to information provided from the previous 1996 EBS and the list of sites eligible for nomination to the National Register of Historic Places (NRHP). This information was transferred to the VSI/PSI forms and to the Building Summaries in the Appendix.

2.4.9.2 Biological Resources

Information was limited to a plant survey performed by Richard D. Porcher of The Citadel in 1993, and a species of concern survey conducted by the South Carolina Wildlife and Marine Resources Department.

2.4.9.3 Geological Conditions

Published sources, such as the recent topographic survey of CNC and Annex and regional geologic reports, were used to locate floodplain boundaries and regional geological conditions.

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07/03 FINAL

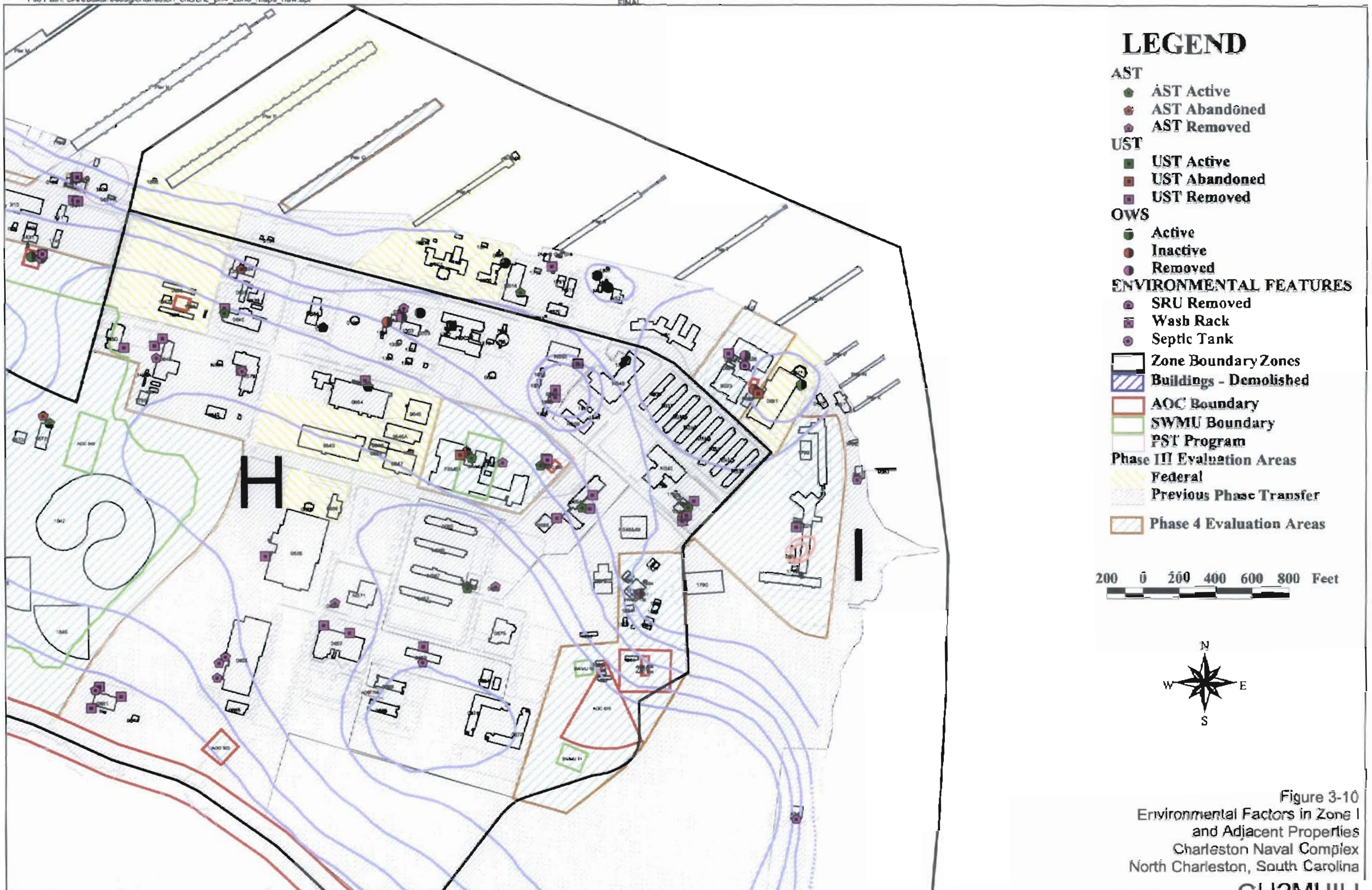


Figure 3-10
Environmental Factors in Zone I
and Adjacent Properties
Charleston Naval Complex
North Charleston, South Carolina

CH2MHILL

3.0 FIELD INVESTIGATION

The following section lists the objectives of the field investigation and describes the technical sampling methodologies, procedures, and protocols implemented during data collection within Zone D. Fieldwork was conducted in accordance with the *Final Comprehensive Sampling and Analysis Plan* (CSAP),(E/A&H, July 1996) and the USEPA Region IV Environmental Services Division, *Standard Operating Procedures and Quality Assurance Manual* (ESDSOPQAM), (USEPA, May 1996). The only deviation from the work plan was the collection of two additional groundwater samples using Direct Push Technology (DPT). All other fieldwork was conducted in accordance with the CSAP and approved work plan.

3.1 Investigation Objectives

The sampling strategy for Zone D, as detailed in the *Final Zones D, F and G RFI Work Plan* (E/A&H, June 1996), was designed to collect sufficient environmental media data to accomplish the following:

- Characterize Zone D subsurface conditions.
- Characterize the naturally occurring background soil and groundwater quality.
- Define potential contaminant pathways and receptors (on and offsite, where applicable).
- Define the nature and extent of any Zone D contamination.
- Assess human health and ecological risk.
- Assess the need for corrective measures.

3.2 Sampling Procedures, Protocols, and Analyses

3.2.1 Sample Identification

All samples collected during this investigation were identified using the 10-character scheme in accordance with Section 11.4 of the CSAP. This scheme identifies the samples by site, sample matrix, location, and sample depth. The first three characters identify the site where the sample was collected. The fourth character identifies the matrix or quality control (QC) code for the sample. The fifth through eighth characters identify the sample location. The ninth and tenth characters identify the soil sample depth or sample interval.

3.2.2 Soil Sampling

Section 4 of the CSAP describes soil sampling procedures and activities used in the RFI. The following subsections summarize these procedures.

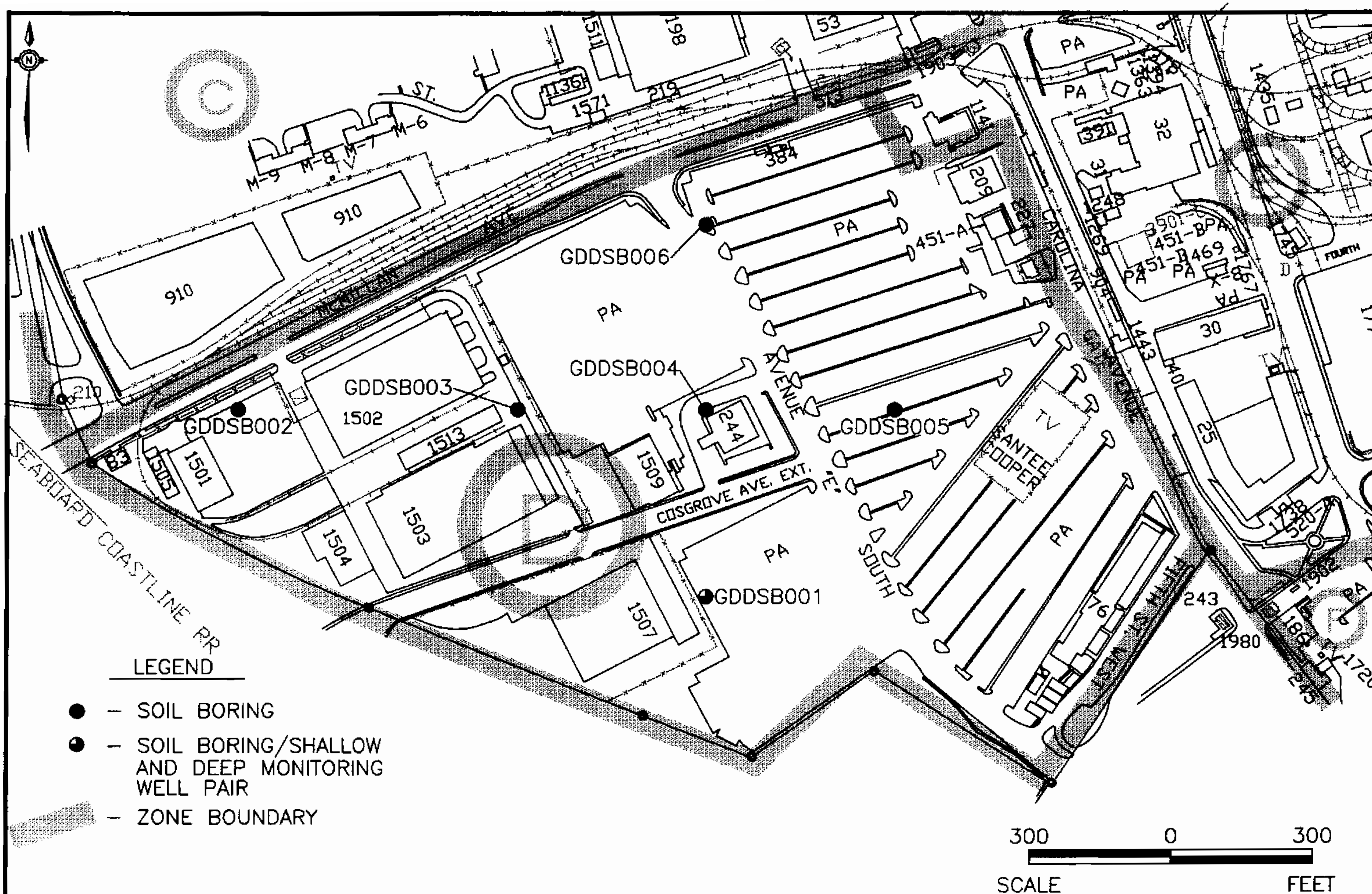
3.2.2.1 Soil Sample Locations

Soil samples were collected from locations proposed in the *Final Zones D, F and G RFI Work Plan* (E/A&H, June 1996); the locations were based on the investigation strategy outlined in Section 1.2 of that document. The sampling pattern is justified in Sections 2 and 3 of the work plan. No known hazardous waste activity has occurred in Zone D. The Zone D sample locations are all grid-based, designed to characterize background soil quality and identify any areas not recognized during the RFA process that may require further investigation. The Zone D soil samples were collected from the locations presented in the approved work plan and shown on Figure 3-1.

3.2.2.2 Soil Sample Collection

Composite soil samples were generally collected for laboratory analysis from 0 to 1 foot bgs and from 3 to 5 feet bgs. The 0- to 1- foot bgs interval is referred to in this report as the first or upper-interval sample. At soil sample locations overlain by pavement, the upper interval was collected from the base of the pavement to 1 foot below the base of the pavement. The 3- to 5-foot bgs interval is referred to as the second or lower-interval sample. No other intervals were sampled due to the relatively shallow depth to groundwater in Zone D, typically from 4 to 6 feet bgs. No saturated soil samples were retained for laboratory chemical analysis.

Stainless-steel hand augers were used to collect soil samples, as detailed in Section 4.5 of the CSAP. At sodded locations, the sod (generally less than 2 inches thick) overlying the soil



ZONE D
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 3–1
GRID–BASED SOIL SAMPLE LOCATIONS
ZONE D

DWG DATE: 02/13/97 | DWG NAME: 29CHZD61

sample at the upper interval was removed before augering to 1 foot bgs. A coring machine was used to gain access to soil covered by concrete and/or asphalt.

3.2.2.3 Soil Sample Preparation, Packaging, and Shipment

Soil samples were packed in accordance with procedures set forth in Section 4.4 of the CSAP. Collected samples were labeled, packaged, and shipped in accordance with procedures specified in Section 11 of the CSAP.

3.2.2.4 Soil Sample Analysis

Soil samples were analyzed per USEPA SW-846 methods at Data Quality Objective (DQO) Level III unless otherwise noted, as follows:

•	Volatile organic compounds (VOCs)	USEPA Method 8260
•	Semivolatile organic compounds (SVOCs)	USEPA Method 8270
•	Pesticides/Polychlorinated Biphenyls (PCBs)	USEPA Method 8080
•	Cyanide	USEPA Method 9010
•	Metals/Mercury	USEPA Method 6010/7470

Approximately 10% of the soil samples collected at Zone D were duplicated and submitted for Appendix IX analytical parameters at DQO Level IV. These additional samples were collected to fulfill quality assurance/quality control (QA/QC) standards while cost-effectively analyzing additional parameters.

In addition to the analyses listed above, Appendix IX parameters analyzed included:

•	Hexavalent chromium	USEPA Method 7196
•	Dioxins/Dibenzofurans	USEPA Method 8290
•	Herbicides	USEPA Method 8150

- Organophosphorous pesticides — USEPA Method 8140

3.2.3 Monitoring Well Installation and Development

Section 5 of the CSAP describes the methods used during monitoring well installation and development. All monitoring wells were installed in accordance with South Carolina Well Standards and Regulations after permits were acquired from the South Carolina Department of Health and Environmental Control (SCDHEC). The shallow and deep monitoring wells were constructed of an appropriate length of 2-inch inside diameter polyvinyl chloride (PVC) riser pipe attached to a 10-foot section of 0.010-inch slotted PVC well screen. The following subsections briefly describe the site-specific methods applied in Zone D. Appendix A includes the lithologic boring logs and monitoring well construction diagrams for Zone D.

3.2.3.1 Shallow Monitoring Well Installation

The shallow monitoring wells were installed so that groundwater samples could be collected from the shallow aquifer's upper portion. These monitoring wells were installed using the hollow-stem auger drilling method, in accordance with procedures set forth in Section 5.4 of the CSAP. The total depth of the Zone D shallow well depended primarily on depth to groundwater. Every effort was made to bracket the water table surface at the shallow monitoring well location. Because groundwater is encountered at approximately 4 to 6 feet bgs across Zone D at NAVBASE, the depth of the shallow monitoring well was approximately 12 feet bgs.

3.2.3.2 Deep Monitoring Well Installation

Review of regional geology identified the Ashley Formation of the Cooper Group as the shallowest formation most capable of retarding or preventing downward flow of water and/or contaminants. This formation is widely noted in the Charleston area for its low permeability and its effectiveness as a confining layer over the underlying Santee Limestone. The deep monitoring well was installed to a total depth of 26.5 feet bgs to allow groundwater sampling at the shallow aquifer's base in contact with the underlying Ashley Formation.

Per Section 5.5 of the CSAP, rotosonic drilling methods were used to install the deep monitoring wells.

3.2.3.3 Monitoring Well Protector Construction

A flush-mount, manhole type well protector was installed for the deep well and an above-grade protective casing type was installed for the shallow well. Flush-mount well protectors were installed in vehicle traffic areas such as parking lots. Above-grade steel protective casings were installed at all other areas. Well protectors were installed in accordance with Section 5.4 of the CSAP.

3.2.3.4 Monitoring Well Development

Monitoring well development consisted of initially stressing the filter pack by surging and pumping. This action continued until turbidity was reduced and stabilized as much as practical and specific conductance, pH, and temperature stabilized. Wells were developed according to Section 5.6 of the CSAP.

Surging Procedures:

1. Decontaminated PVC rods were attached to a surge block.
2. The surge block was lowered into the monitoring well screen section.
3. The surge block was then raised and lowered, forcing groundwater to be surged in and out of the monitoring well screen.
4. Surging was conducted for approximately 10 to 15 minutes per well.
5. The surge block was removed from the well for decontamination.

Shallow Well Pumping Procedures:

1. Decontaminated Teflon tubing was lowered into the well.
2. The tubing was attached to a centrifugal pump at the surface and pumping was begun.

3. If the productivity of the monitoring well was low, it would either be alternately pumped, then left idle to recover; or using a peristaltic pump, the pumping rate was reduced to approximate the recovery rate of the well.

4. Monitoring wells were developed until the water column was as free of turbidity as possible given the subsurface conditions and until the pH, temperature, and specific conductance were stabilized to satisfy the following criteria.

Temperature:	within ± 1.0°C
pH:	within ± 0.5 standard unit
Conductivity:	within ± 10 %
Turbidity:	generally between 10 and 30 nephelometric turbidity units (NTUs) or relatively stable (± 15 NTU)

3.2.4 Groundwater Sampling

Groundwater was sampled in accordance with Section 6 of the CSAP. The following subsections briefly summarize the site-specific methods applied in Zone D.

3.2.4.1 Groundwater Sampling Locations

Groundwater samples were collected from well locations based on the approved locations identified in the *Final Zones D, F and G RFI Work Plan* (E/A&H, June 1996).

3.2.4.2 Groundwater Sample Collection

Groundwater sample collection followed the procedures set forth in Section 6 of the CSAP. Additionally, groundwater samples were collected using a peristaltic pump, a transfer bottle, and a Teflon transfer cap. First, volatile organic analyses (VOA) samples were collected by inserting new Teflon tubing into the well, drawing a full tube of water with a peristaltic pump. The tubing was then removed from the pump, and immediately capped to prevent water from draining out of the tube. The tubing was removed from the well, and the water in the tubing was allowed to drain slowly into pre-preserved VOA vials until zero headspace was achieved in the sample container. Remaining samples were collected by re-inserting the tubing into the well and using a peristaltic pump to create a vacuum inside a new clean transfer container. Once the transfer bottle was filled, the remaining samples were collected by pouring directly from the transfer bottle into the sample container.

3.2.4.3 Groundwater Sample Preparation, Packaging, and Shipment

Guidelines in Section 11 of the CSAP were followed for the preparation, packaging, and shipment of groundwater samples collected during the Zone D RFI.

3.2.4.4 Groundwater Sample Analysis

Groundwater samples in Zone D were analyzed per USEPA SW-846 methods at DQO Level III, unless otherwise noted, as follows:

- VOCs — USEPA Method 8260
- SVOCs — USEPA Method 8270
- Pesticides/PCBs — USEPA Method 8080
- Cyanide — USEPA Method 9010
- Metals/Mercury — USEPA Method 6010/7470
- Total Dissolved Solids (TDS) — USEPA Method 160.1
- Chlorides — USEPA Method 325.1
- Sulfates — USEPA Method 375.1

3.2.5 DPT Groundwater Sampling

Groundwater samples were collected from two DPT sample locations (NBCDGDDGP00115 and NBCDGDDGP00125) near soil sample GDDSB006. These two samples were collected and analyzed to confirm that organic compounds detected in subsurface soils were not migrating to groundwater. The samples were collected as described in Section 6.1.3 of the CSAP using PVC well materials. Figure 2-1 presents these sample locations.

One of the DPT samples was collected to allow monitoring of the upper portion of the shallow aquifer. This sample was collected by advancing the DPT probe rod to 15 feet bgs, installing a one-inch diameter PVC riser pipe and a five foot slotted screen. The other DPT groundwater sample was collected from the base of the shallow aquifer. The methodology was the same as the shallow sample with the exception that the sample was collected from 25 feet bgs, at the contact with the Ashley Formation.

Samples were collected from these two locations as described in Section 6.3 of the CSAP. A decontaminated teflon[tm] bailer was used to collect the sample. Both samples were analyzed by an on-site mobile laboratory operated by Target Environmental Services, Inc. of Columbia, Maryland. The samples were analyzed per USEPA SW-846 methods at DQO Level II using USEPA Method 8260A.

Immediately following sample collection the PVC well materials were removed and the holes grouted to the surface.

3.2.6 Vertical and Horizontal Surveying

Soil boring and monitoring well locations and elevations were determined by Global Positioning System (GPS) surveying techniques. The horizontal and vertical control were established from existing monumentation on NAVBASE with horizontal datum of NAD 83 (North American Datum, 1983) and vertical datum of NGVD 29 (National Geodetic Vertical Datum, 1929). All traverse closures exceeded 1/20,000. No data corrections were required as part of the monitoring well survey.

3.2.7 Aquifer Characterization

A hydrogeologic assessment was conducted in accordance with Section 10.6 of the CSAP.

3.2.8 Decontamination Procedures

Decontamination procedures were performed in accordance with Section 15 of the CSAP and Appendix B, Section B.2.3 of the ESDSOPQAM for sampling equipment (USEPA, 1996) and in accordance with Appendix B, Section B.3.4 of the ESDSOPQAM for drilling equipment (USEPA, 1996).

3.3 Field Investigation Deviation

Samples of soil and groundwater were collected from the locations identified in the approved work plan. The addition of two DPT groundwater sample locations was the only deviation from the work plan. All other field work procedures were performed in accordance with the CSAP and ESDSOPQAM without deviation.

4.0 DATA VALIDATION

4.1 Introduction

DQOs are qualitative and quantitative statements specifying the quality of data required to support decisions during environmental response actions. The level of certainty regarding the precision of the data varies with their intended end use. According to USEPA guidance, *Data Quality Objectives for Remedial Response Activities, Development Process,* EPA/540/G-87/003 (USEPA, March 1987), the levels of analytical data are as follows:

- Level I — Field screening or analysis using portable instruments. Results are often not compound-specific and not quantitative, but they are available in real-time. Field screening or analysis is the least costly analytical option.

- Level II — Field analyses using more sophisticated portable analytical instruments. In some cases, the instruments may be set up in a mobile laboratory onsite. The quality of the data generated depends on the use of suitable calibration standards, reference materials, and sample preparation equipment, in addition to operator training. Results are available in real-time or in several hours.

- Level III — All analyses performed in an offsite analytical laboratory. Level III analyses may use Contract Laboratory Program (CLP) procedures, but do not usually use the validation or documentation procedures required of CLP Level IV analysis. The laboratory does not need to be a CLP laboratory.

- Level IV — All analyses are performed in an offsite analytical laboratory following rigorous QA/QC protocols and documentation meeting or exceeding CLP requirements.

- Level V — Analysis by nonstandard methods. All analyses are performed by an offsite analytical laboratory which does not need to be a CLP laboratory. Method development or method modification may be required for specific constituents or detection limits. CLP special analytical services (SAS) are Level V.

For the RFI at NAVBASE, analytical Level III data with 10% analyses for Appendix IX at Level IV were deemed appropriate for the intended data uses: site characterization, risk assessment, and corrective measure determinations/design. However, two DPT groundwater samples, collected to confirm no impact to groundwater were Level II.

In September 1993, USEPA replaced this guidance with an updated manual, *Data Quality Objectives Process for Superfund, Interim Final Guidance*, EPA/540/G-93/071 (USEPA, September 1993) which stated, "This guidance replaces the earlier guidance EPA 540/G-87/003, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.0-7B and the five analytical levels introduced in that document." As a result, the five analytical data levels were reduced to two — screening data and definitive data.

Definitive data (formerly Levels III and IV) are defined as analytical data generated using rigorous analytical methods, such as approved USEPA reference methods. These data are analyte-specific, with confirmation of analyte identity and concentration. These approved methods produce tangible raw data (e.g., chromatograms, spectra, digital values) in paper printouts or computer-generated electronic files. Analytical or total measurement error (precision) must be determined for data to be definitive (USEPA, September 1993). As a result, the data collected at NAVBASE are now defined as definitive data per the most recent USEPA guidance, but will still be referred to as Level III and Level IV throughout the report to avoid confusion.

4.2 Validation Summary

This section presents the QA/QC evaluation of the data produced from the analysis of environmental media samples collected in Zone D during the RFI. This evaluation will verify that the appropriate QA/QC elements were followed and/or completed (e.g., method requirements, documentation, etc.) to identify and/or characterize any problems with the data set, and ultimately to determine the usability of the analytical data for site characterization, risk assessment, and corrective measure determinations.

Examples of definitive data (formerly Level III and IV) QA/QC elements are as follows:

- Sample documentation (verified time of sample receipt, extraction and holding times)
- Chain of custody
- Initial and continuing calibration
- Determination and documentation of detection limits
- Analyte(s) identification
- Analyte(s) quantification
- QC blanks (trip, method, rinsate)
- Matrix spike recoveries
- Performance evaluation (PE) samples (when specified)
- Analytical method precision
- Total measurement error determination

RFI environmental samples were collected at Zone D from August to November 1996. All Level III and Level IV samples were analyzed by Southwest Laboratory of Oklahoma. The two Level II samples were analyzed by Target Environmental Services. In accordance with the approved CSAP, sample analyses followed the guidance in the *USEPA Test Methods for Evaluating Solid Waste*, SW-846 (USEPA, 1992) and Title 40 CFR Part 264. Table 4.1 summarizes the analytical methods and DQO laboratory deliverables.

Table 4.1
NAVBASE Analytical Program

Full Scan/Appendix IX Analytical Methods	Data Quality Level	Method Reference
Volatile Organic Compounds (VOCs)	II/III/IV	SW-846 8260
Semivolatile Organic Compounds (SVOCs)	III/IV	SW-846 8270
Pesticides/Polychlorinated biphenyls (PCBs)	III/IV	SW-846 8080
Chlorinated Herbicides	IV	SW-846 8150
Organophosphorous Pesticides (OP Pest)	IV	SW-846 8140
Cyanide	III/IV	USEPA 9012
TAL Metals	III/IV	SW-846 6010/7060/7421/7470/7740/7841
Hexavalent Chromium	IV	USEPA 218.4
Polychlorinated dibenzo-p-dioxins	IV	USEPA 8290

Notes:
Full Scan parameters include: VOCs, SVOCs, pesticides/PCBs, metals, and cyanide (Level III). Appendix IX parameters include: VOCs, SVOCs, pesticides/PCBs, herbicides, OP pesticides, metals, cyanide, hexavalent chromium, and dioxins (Level IV). TAL metals includes tin.

The methods listed in Table 4.1 are from:

- USEPA OSWER, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846), Third Edition, revised July 1992.

- USEPA Environmental Monitoring and Support Laboratory, *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, revised March 1983.

- *Title 40 Code of Federal Regulations Part 264, Appendix IX (52 Federal Register 25947)*, July 1987.

Third-party independent data validation of all Level III and Level IV analytical work performed under the CSAP was conducted by Heartland Environmental Services, Inc., St. Charles, Missouri, based on the QC criteria developed for CLP. The Level II data did not undergo third party validation. The third-party validator's function was to assess and summarize the quality and reliability of the data to determine their usability and to document any factors affecting data usability, such as compliance with methods, possible matrix interferences, and laboratory blank contamination.

4.2.1 Organic Evaluation Criteria

The USEPA methods in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, and *Methods for Chemical Analysis of Water and Wastes* define QC criteria that the laboratory must meet. However, the methods do not address data evaluation from a user's perspective. Data evaluation criteria for the user are available in *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review* (February 1994a) (Organic Functional Guidelines). For Zone D, these guidelines were used throughout the data evaluation process for this purpose.

Data evaluation included the following parameters:

- Holding times
- Gas Chromatography/Mass Spectroscopy (GC/MS) instrument performance checks
- Surrogate spike recoveries
- Instrument calibration
- Matrix spike and matrix spike duplicates (MS/MSD)
- Blank analysis
- Internal standard (IS) performance
- Compound quantitation

- Field duplicate precision
- Calculations

When the QC parameters did not fall within the specific method guidelines, the data evaluator annotated or *flagged* the corresponding compounds where deficiencies were found. The following validation flags were used to annotate data exhibiting laboratory and/or field deficiencies or problems:

U **Undetected** — The analyte was analyzed for but not detected or was also found in an associated blank, but at a concentration less than 10 times the blank concentration for common constituents (acetone, methylene chloride) or five times the blank concentration for other constituents (i.e.,benzene, toluene). The associated value shown is the quantitation or reporting limit.

J **Estimated Value** — One or more QC parameters were outside control limits.

UJ **Undetected and Estimated** — The analyte was analyzed for but not detected above the estimated quantitation limit. The quantitation limit is estimated because one or more QC parameters were outside control limits.

R/UR **Unusable Data** — One or more QC parameters grossly exceeded control limits.

These validation flags were applied to data where deficiencies were noted. Appendix D includes the complete analytical dataset for Zone D.

4.2.1.1 Holding Times

Acceptable technical holding times are specified in the CSAP. The sample holding time depends on the material and type of analysis. For water and soil samples, the holding time for VOC analysis is 14 days from the collection date. SVOC, pesticide/PCB, organophosphate (OP) pesticide, and chlorinated herbicide water samples must be extracted within seven days from the collection date and analyzed within 40 days after extraction. Soil samples must be extracted within 14 days of sample collection and analyzed within 40 days of collection. Dioxin water and soil samples require extraction within 30 days from date of collection and analysis within 45 days of collection. The holding time for TPH analysis is 28 days from the date of collection for both water and soil samples that are preserved and refrigerated.

4.2.1.2 GC/MS Instrument Performance Checks

Performance standards for VOC and SVOC analyses are analyzed to determine if the data produced by the instrument may be correctly interpreted according to the requirements of the method being used. Performance standards must be analyzed within 12 hours of sample analysis, and the results must be within the established criteria.

4.2.1.3 Surrogate Spike Recoveries

Surrogate compounds are added to samples and laboratory blanks before extraction and sample preparation to evaluate the effect of the sample matrix on extraction and measurement procedures. Surrogates are organic compounds chemically similar to analytes of interest but not normally found in environmental samples. Three surrogate compounds are added to samples for VOC analysis, eight are added to samples for SVOC analysis, two are added to pesticide/PCB and dioxin samples, and one is added to both OP pesticide and chlorinated herbicide samples. Percent recovery (%R) of the surrogates is calculated by comparing the amount of the compound recovered by the analysis to the amount added to the sample.

The surrogate compounds recommended by the SW-846 methods are listed in Table 4.2.

4.2.1.4 Instrument Calibration

Instruments are initially and continually calibrated with standard solutions to verify that they can produce acceptable quantitative data for the compounds.

Initial calibration (GC/MS): The instrument is initially calibrated at the beginning of the analytical run to check its performance and to establish a linear five-point calibration curve. The initial calibration is verified by calculating the relative response factor (RRF) and the percent relative standard deviation (%RSD) for each compound. An RRF less than 0.05 or a %RSD greater than 30% is outside the QC limits for the initial calibration.

Table 4.2
Surrogate Compound Summary

VOC Surrogates	SVOC Surrogates	Pesticide/PCB Surrogates	Herbicide Surrogate	OP Pesticide Surrogate
Toluene-d8 Bromofluorobenzene (BFB) 1,2-Dichloroethane (DCA)	Nitrobenzene-d5 (NBZ) 2-Fluorobiphenyl (FBP) Terphenyl-d14 (TPH) 2,4,6-Tribromophenol (TBP) Phenol-d5 (PHL) 2-Fluorophenol (2FP)	Tetrachloro-m-xylene (TCMX) Decachlorobiphenyl (DCB)	2,4-Dichloro-phenylacetic acid (DCAA)	Tributyl phosphate
Dioxin Surrogates				
$^{13}C_{6}$ - 1,2,3,4 -Tetrachlorodibenzo-p-dioxin (TCDD) $^{13}C_{12}$ - 1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)				

Continuing calibration (GC/MS): Standard solutions are run periodically to check the daily performance of the instrument and to establish the 12-hour RRF on which the sample quantitations are based. The continuing calibration is verified by calculating the RRF and the percent difference (%D) for each compound. An RRF less than 0.05 or a %D greater than 25% is outside the QC limits for the continuing calibration.

Initial calibration (GC): For single-component pesticides, five-point calibrations are analyzed, and calibration factors (CF) are established. The CF for single-component pesticides must be less than or equal to 20%.

The multicomponent pesticide toxaphene and all PCBs (or Aroclors) are analyzed separately. Retention times and CFs are determined for three to five primary peaks. Multi component compounds are reviewed to verify that these steps were taken.

A five-point initial calibration is analyzed for herbicides, OP pesticides, and TPH. Two calibration methods may be used: external or linear regression methods. For the external method, the initial calibration may be verified by calculating the RRF and the %RSD for each compound. An RRF less than 0.05 or a %RSD greater than 20% is outside the QC limits for the initial calibration. If linear regression is used, the correlation coefficient must meet or exceed 0.995 before samples can be analyzed.

Continuing calibration (GC): The calibration verification is to confirm the calibration and evaluate instrument performance for single-component pesticides. The calibration verification consists of an instrument blank, performance evaluation mixtures (PEMs), and the midpoint concentration of the two standard mixes. The continuing calibration is run on two GC columns (a primary and a secondary) for analyte confirmation. The %D between the calculated amount and the true amount must not exceed 15% on the primary column. Multi component compounds do not require continuing calibration.

For herbicides and OP pesticides, the continuing calibration is verified by calculating the RRF and the %D for each compound. An RRF less than 0.05 or a %D greater than 15% is outside the QC limits for the continuing calibration.

For NAVBASE Charleston, only positive results were flagged when the %RSDs and %D were outside control limits but less than 50%. If the %RSD or %D exceeded 50%, both the positive and nondetected results were flagged. Based on professional judgment, the results were flagged in this manner because the risk would be in reporting results with a high bias rather than a low bias.

4.2.1.5 Matrix Spike/Matrix Spike Duplicate

An MS, used to determine the accuracy of the analysis for a given matrix, consists of a known quantity of stock solution added to the sample before its preparation and analysis. Evaluating the MS data involves two calculations. First, the %R is calculated by comparing the amount of the compound recovered by the analysis to the amount added to the sample. In addition, the relative percent difference (RPD) between the MS and the MSD samples is calculated and assessed. No specific requirements have been established for qualifying MS/MSD data. However, guidelines to aid in applying professional judgment are discussed in the Organic Functional Guidelines (USEPA, 1994).

4.2.1.6 Laboratory Control Samples and Laboratory Duplicates

Other GC methods may require laboratory control samples (LCSs) and laboratory duplicates with each Sample Delivery Group (SDG). The LCS monitors the overall performance of each step during analysis, including sample preparation. All aqueous LCS %R results must fall within the control limits established by the laboratory. Laboratory duplicate samples are used to demonstrate acceptable method precision at the time of analysis. The RPD between the sample and the duplicate sample is calculated. Although no guidelines are established for organic laboratory duplicates, sample qualification is left up to professional judgment.

4.2.1.7 Blank Analysis

Laboratory method blanks are used to assess the presence and magnitude of potential contamination introduced during analysis. Additionally, field blanks may be collected to assess any contamination introduced while collecting samples. When chemicals are found both in samples and laboratory blanks analyzed within the same 12-hour period and/or field-derived blanks, the usability of the data depends on the reviewer's judgment and the blank's origin. According to the Organic Functional Guidelines (USEPA, 1994), a sample result should not be considered positive unless the concentration of the compound in the sample exceeds 10 times the amount in any blank for common laboratory contaminants (i.e., methylene chloride, acetone, 2-butanone, and phthalate esters), or five times the amount for other constituents. These amounts are referred to as action levels (ALs). Because blank samples may not be prepared using the same weight of sample, volume of sample, or dilution, these variables should also be considered when using these blank criteria.

The specific actions to be taken are as follows:

- If a chemical is found in the blank but not the sample, no action is taken.

- If the sample concentration is less than the quantitation limit and less than the AL, the quantitation limit is reported.

- If the sample concentration is between the quantitation limit and the AL, the concentration is reported as nondetect *U*.

- If the sample concentration is greater than the AL, the concentration may be used unqualified.

4.2.1.8 Field-Derived Blanks

For this project, four types of field-derived blanks were collected: the field blank, the rinsate blank, the equipment blank, and the trip blank. The field blank is a sample of the source water used onsite, primarily to decontaminate equipment. The rinsate blank is a sample of runoff water from one or more pieces of the decontaminated equipment used to collect samples. The equipment blank is a sample of each filter pack, grout, bentonite pellets, or powder used in well construction. The trip blank is a 40-milliliter (ml) VOA vial filled with certifiable water in the laboratory before the containers are shipped to the field. It is used to assess cross-contamination during VOC sample container handling, storage, and shipment.

The frequencies for collecting these QC samples were defined in Section 13 of the NAVBASE CSAP as follows:

- Field blank – one per sampling event (week) per source.
- Rinsate blank – one per week per media.
- Equipment blank — one sample of each well construction material per source.
- Trip blank – one per sample matrix in each sample shipping cooler containing VOA samples.

Each trip blank is associated only with the samples from the same shipment or cooler. The field blanks and the rinsate blanks apply to a larger number of samples because only one is collected per sampling event. Because field-derived blanks are used with method blanks to assess potential cross-contamination of field investigative samples, no action was taken if the same contaminants were detected in the method blanks and the associated field-derived blanks, but not in the investigative samples.

4.2.1.9 Internal Standard Performance

GC/MS internal standards are added to samples to check the stability of the instrument's sensitivity and response during each analytical VOC and SVOC run. IS area counts for samples and blanks must not vary more than a factor of two (-50% to +100%) from the associated calibration standard. If IS concentration results are outside this window, the sample would be flagged as estimated. The IS compounds recommended by the methods are listed below.

VOC IS Compounds	**SVOC IS Compounds**	**Dioxin**
Bromochloromethane (BCM)	1,4-Dichlorobenzene-d4 (DCB)	$^{13}C_{12}$- 2,3,7,8-TCDD
1,4-Difluorobenzene (DFB)	Naphthalene-d8 (NPT)	$^{13}C_{12}$- 2,3,7,8-TCDF
Chlorobenzene-d5 (CBZ)	Acenaphthene-d10 (ANT)	$^{13}C_{12}$- 1,2,3,7,8-PeCDD
	Phenanthrene-d10 (PHN)	$^{13}C_{12}$- 1,2,3,7,8-PeCDF
	Chrysene-d12 (CRY)	$^{13}C_{12}$- 1,2,3,6,7,8-HxCDD
	Perylene-d12 (PRY)	$^{13}C_{12}$-1,2,3,4,7,8-HxCDF
		$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDD
		$^{13}C_{12}$-1,2,3,4,6,7,8-HpCDF
		$^{13}C_{12}$-OCDD

Notes:

TCDD (Tetrachlorodibenzo-p-dioxin)
TCDF (Tetrachlorodibenzofuran)
PeCDD (Pentachlorodibenzo-p-dioxin)
PeCDF (Pentachlorodibenzofuran)
HpCDD (Heptachlorodibenzo-p-dioxin)
HpCDF (Heptachlorodibenzofuran)
HxCDD (Hexachlorodibenzo-p-dioxin)
HxCDF (Hexachlorodibenzofuran)
OCDD (Octachlorodibenzo-p-dioxin)

4.2.1.10 Diluted Samples

A special evaluation was performed for diluted samples to determine if method detection limits were sufficiently low to be compared with reference concentrations (e.g., maximum contaminant levels [MCLs], risk-based concentrations [RBCs], etc.). No diluted samples were reported from Zone D.

4.2.2 Inorganic Evaluation Criteria

The USEPA methods described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846)*, and 40 CFR Part 264, Appendix IX define QC criteria that the laboratory must meet, but the methods do not address data evaluation from a user's perspective. Evaluation criteria are available in *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, (February 1994b) (Inorganic Functional Guidelines). The guidelines were used throughout the data evaluation process to address data usability.

Data evaluation for samples collected at NAVBASE included:

- Holding times
- Instrument calibration
- MS results
- Laboratory duplicates
- Blank analysis
- Inductively Coupled Argon Plasma (ICAP) interference check samples
- ICAP serial dilutions
- LCS results
- Atomic Absorption (AA) duplicate injections and postdigestion spike recoveries
- Field duplicate precision

According to the Inorganic Functional Guidelines, when the QC parameters do not fall within the specific method guidelines, the data evaluator annotates or flags the corresponding compounds where deficiencies were found. The data from NAVBASE Charleston sites were evaluated using this approach. The following flags were used to annotate data exhibiting laboratory and/or field deficiencies or problems:

U **Undetected** — The analyte was analyzed for but not detected above the instrument detection limit (IDL) or was also found in an associated blank at a concentration less than five times the blank concentration.

J **Estimated Value** — One or more QC parameters were outside control limits.

UJ **Undetected and Estimated** — The analyte was analyzed for but not detected above the listed estimated IDL; the IDL is estimated because one or more QC parameters were outside control limits.

R/UR **Unusable Data** — One or more QC parameters grossly exceeded control limits.

4.2.2.1 Holding Times

Acceptable technical holding times are specified in the CSAP. For aqueous and soil samples, the holding time for metals analysis is six months, except for mercury, which is 28 days from the date of collection. For aqueous and soil samples, cyanide analysis has a sample holding time of 14 days from the date of collection.

4.2.2.2 Instrument Calibration

Instruments are initially and continually calibrated with standard solutions used to check that they are capable of producing acceptable qualitative and quantitative data for the analytes on the inorganics list.

An initial calibration is performed to check the performance of the instrument at the beginning of the analytical run and to establish a linear calibration curve. Calibration standard solutions are run periodically to check the performance of the instrument and confirm that the initial calibration curve is still valid. Calibrations are verified by calculating the %R and comparing the amount of the analyte recovered by analysis to the known amount of the standard. The %R for metals, except mercury and cyanide, should fall between 90% and 110%. The %R for mercury and cyanide should fall between 80% and 120% and 85% and 115%, respectively.

4.2.2.3 Blank Analysis

Laboratory method blanks are used to assess the presence and magnitude of potential contamination introduced during analysis. Whereas, field blanks may be collected to assess the potential contamination introduced during sample collection. When chemicals are found in samples and laboratory blanks, the data's usability depends on the reviewer's judgment and the blank's origin. According to the Inorganic Functional Guidelines, a sample result should not be considered positive unless the sample concentration exceeds five times the amount in any blank (the AL). Because blank samples may not be prepared using the same weight of sample, volume of sample, or dilution, these variables should also be considered when using these blank criteria. The specific actions to be taken are as follows:

- If a chemical is found in the blank but not the sample, no action is taken.
- If the sample concentration is between the IDL and less than five times the amount found in any blank, the concentration is reported as *U*.
- If the sample concentration is greater than five times the amount in any blank, the concentration may be used unqualified.

4.2.2.4 Inductively Coupled Argon Plasma Interference Check Samples

The ICAP interference check sample is used to confirm the laboratory instrument's inter-element and background correction factors. Interference samples should be analyzed at the beginning and end of each sample analysis or at least twice per eight-hour working shift. The %Rs for the interference check sample should fall between 80% and 120%.

4.2.2.5 Laboratory Control Samples

Laboratory Control Samples (LCSs) are used to monitor the overall performance of steps in the analysis, including the sample preparation. All aqueous LCS %R results must fall within the control limits of 80% to 120%, except for antimony and silver, for which control limits have not been established. Soil LCS standards are provided by the USEPA. Control limits are established for each soil LCS standard prepared.

4.2.2.6 Spike Sample Analysis

Samples are spiked with known quantities of analytes to evaluate the effect of the sample matrix on digestion and measurement procedures. The %R should be within 75% to 125%. However, when the sample concentration exceeds the spike concentration by a factor of four or more, spike recovery criteria do not apply.

4.2.2.7 Laboratory Duplicates

Laboratory duplicate samples are analyzed to evaluate data precision, a measure of reproducibility. The RPD between the sample and the duplicate sample is calculated. A control limit of 20% RPD should not be exceeded for analyte values greater than 100 times the IDL.

4.2.2.8 ICAP Serial Dilutions

ICAP serial dilutions assess whether matrix interference is present. One sample from each set of similar matrix type is diluted by a factor of five. For an analyte concentration that is at least a factor of 100 times above the IDL, the measured concentrations of the undiluted sample and the diluted sample should agree within 10%.

4.2.2.9 AA Duplicate Injections and Postdigestion Spike Recoveries

During AA analysis, duplicate injections and postdigestion spikes are used to assess precision and accuracy of the laboratory analysis. The %RSD of duplicate injections must agree within 20%. Percent recovery of the post-digestion spike sample should fall between 85% and 115%.

4.3 Zone D Data Validation Reports

A complete copy of the Zone D data validation reports are included as Appendix E for review. These reports are the outcome of the evaluations described above and are specific to the analytical data collected during the Zone D RFI. During data validation review of Zone D soil and groundwater analytical sample results, the following deficiencies and/or problems were noted in the volatile, semivolatile, pesticide/PCB, and metals methods. In the volatile analyses of the grid samples, 2-butanone was detected in the method blank, acetone was detected in the method, trip, and equipment blanks, and chloroform and methylene chloride were detected in the method, trip, equipment and distilled water blanks. Eight volatile parameters in sample GDDSB00601 have the flag of UJ due to the chlorobenzene-d5 internal standard exhibiting low areas.

In the semivolatile method for the soil grid samples, bis(2-Ethylhexyl) phthalate was detected in the equipment blank. Samples GDDSB00101 and GDDSB00102 had continuing calibration deficiencies for indeno(1,2,3-cd)pyrene and benzo(g,h,i)perylene and required the UJ flag. In the pesticide/PCB method, sample GDDSB00201 has a J flag for endrin due to compound quantitation differences greater than 40%. All of the parameters for sample GDDSB00302 have a UJ flag due to surrogate recoveries exhibiting low results. All of the parameters for samples GDDSB00101 and GDDSB00401 have a UJ due to holding time violations.

In the metals analyses, antimony and tin were detected in the method blank. Copper, sodium, and zinc were detected in the distilled water and equipment blanks and beryllium was detected in the method, distilled, and equipment blanks.

The groundwater samples exhibited method, field, distilled, and trip blank contamination for acetone in the volatile analyses. The metal analyses had detections of copper and thallium in the method and field blanks. Tin was detected in the method, distilled, field and equipment blanks, and zinc was detected in the method blank.

Review of analytical data showed no samples had elevated detection limits.

5.0 NATURE OF CHEMICALS DETECTED IN GRID-BASED SAMPLES

Systematic grid-based soil and groundwater sampling was performed to characterize background conditions across Zone D, as required by the *Final Zones D, F and G RFI Work Plan* (E/A&H, June 1996), and to identify potentially contaminated areas not previously recognized, for possible further investigation. Concentrations of chemicals detected were compared to corresponding risk-based concentrations in the USEPA Region III RBC Table (June 1996) and to generic soil screening levels (SSLs) for migration to groundwater (USEPA, 1996). Section 5.5 contains a discussion of the significance of detected compounds and compares their concentrations to background levels seen in other zones investigated at NAVBASE. Methods of evaluating analytical data and determining background reference concentrations for inorganics are described in Section 6.

5.1 Soil Sampling and Analysis

The *Final Zones D, F and G RFI Work Plan* proposed six upper interval (0 to 1 foot) soil samples and six lower interval (3 to 5 feet) samples in Zone D. All of the proposed soil samples were collected.

Samples collected from the locations shown in Figure 3-1 were analyzed for the standard suite of parameters: VOCs, SVOCs, metals, cyanide, pesticides, and PCBs. An additional volume from one upper interval soil sample (GDDCB00601) was submitted for duplicate analysis, consisting of the standard suite as well as herbicides, organophosphate pesticides, hexavalent chromium, and dioxins. Table 5.1 summarizes soil sampling and analysis of the grid-based locations.

5.2 Nature of Chemicals Detected in Soil

Organic compound analytical results for soil are summarized in Table 5.2. Inorganic analytical results for soil are summarized in Table 5.3. Chemicals detected in Zone D soil samples are summarized in Table 5.4. Consistent with previously submitted RFI reports at NAVBASE, results for sample GDDSB00601 and duplicate sample GDDCB00601 were combined as follows: when an analyte was detected in both samples, the mean of the detections is reported; when an analyte was detected in one but not the other, the detected value is reported. Appendix D contains a complete analytical data report for all samples collected in Zone D.

Table 5.1
Grid-Based Locations
Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	6	6	Standard Suite[a] One Duplicate[b]	Standard Suite[a] One Duplicate[b]	None
Lower	6	6	Standard Suite[a]	Standard Suite[a]	None

Note:
[a] Standard suite consists of VOCs, SVOCs, metals, cyanide, pesticides, and PCBs
[b] Duplicate analysis consists of standard suite plus herbicides, organophosphate pesticides, hexavalent chromium, and dioxins.

Table 5.2
Grid-Based Locations
Organic Compounds Detected in Soil

Compound	Sampling Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)
Volatile Organic Compounds (12 Samples collected: 6 upper interval and 6 lower interval; 1 sample duplicated)				
2-Butanone (MEK)	Upper	1/6	4.0	4.0
	Lower	0/6	NA	NA
Carbon disulfide	Upper	0/6	NA	NA
	Lower	1/6	2.0	2.0
Chlorobenzene	Upper	0/6	NA	NA
	Lower	1/6	1.0	1.0
1,1,2,2-Tetrachloroethane	Upper	0/6	NA	NA
	Lower	1/6	2.0	2.0

Table 5.2
Grid-Based Locations
Organic Compounds Detected in Soil

Compound	Sampling Interval	Frequency of Detection	Range of Detections (µg/kg)	Mean of Detections (µg/kg)
Semivolatile Organic Compounds (12 Samples collected: 6 upper interval and 6 lower interval; 1 sample duplicated)				
BEQs[a]	Upper	2/6	55.0 - 60.9	58.0
	Lower	0/6	NA	NA
Benzo(a)anthracene	Upper	2/6	34 - 44.5	39.3
	Lower	0/6	NA	NA
Benzo(a)pyrene	Upper	2/6	45 - 49	47
	Lower	0/6	NA	NA
Benzo(b)fluoranthene	Upper	2/6	58 - 66.5	62.3
	Lower	0/6	NA	NA
Benzo(g,h,i)perylene	Upper	1/6	41	41
	Lower	0/6	NA	NA
Benzo(k)fluoranthene	Upper	2/6	71 - 77	74
	Lower	0/6	NA	NA
Chrysene	Upper	2/6	57	57
	Lower	0/6	NA	NA
Fluoranthene	Upper	2/6	60 - 78	69
	Lower	0/6	NA	NA
Phenanthrene	Upper	1/6	71	71
	Lower	0/6	NA	NA
Pyrene	Upper	2/6	59 - 69	64
	Lower	0/6	NA	NA

Table 5.2
Grid-Based Locations
Organic Compounds Detected in Soil

Compound	Sampling Interval	Frequency of Detection	Range of Detections (μg/kg)	Mean of Detections (μg/kg)
Pesticides/PCBs (12 Samples collected: 6 upper interval and 6 lower interval; 1 sample duplicated)				
4,4'-DDE	Upper	1/6	4.8	4.8
	Lower	0/6	NA	NA
4,4'-DDT	Upper	1/6	3.1	3.1
	Lower	0/6	NA	NA
Endrin	Upper	1/6	4.3	4.3
	Lower	0/6	NA	NA
Herbicides (1 Upper interval sample collected)				
Dinoseb	Upper	1/1	15	15
	Lower	0/0	NA	NA
Dioxins (1 Upper interval sample collected)				
Dioxin (2,3,7,8-TCDD TEQs[a])	Upper	1/1	3.524E-03	3.524E-03
	Lower	0/0	NA	NA

Notes:

[a] Calculated from methods described in USEPA *Interim Supplemental Guidance to RAGS: Human Health Risk Assessment*, Bulletin 2, November 1995 (See Section 6)

NA Not applicable

Table 5.3
Grid-Based Locations
Inorganics Detected in Soil

Chemical	Sample Interval	Frequency of Detections	Range of Detections (mg/kg)	Mean of Detections (mg/kg)
Inorganics (12 samples collected: 6 upper interval and 6 lower interval; 1 sample duplicated)				
Aluminum	Upper	6/6	3,560 - 6,510	4,350
	Lower	6/6	2,850 - 12,800	5,130
Antimony	Upper	1/6	1.7	1.7
	Lower	0/6	NA	NA
Arsenic	Upper	6/6	0.84 - 7.0	2.8
	Lower	6/6	0.74 - 5.8	2.0
Barium	Upper	6/6	9.7 - 19.7	15.1
	Lower	6/6	7.7 - 28.9	14.9
Beryllium	Upper	1/6	0.13	0.13
	Lower	3/6	0.12 - 0.96	[illegible]
Cadmium	Upper	1/6	0.10	0.10
	Lower	2/6	0.30 - 0.76	0.53
Calcium	Upper	6/6	[illegible] - 14,300	3,350
	Lower	6/6	192 - 84,400	14,300
Chromium	Upper	6/6	4.5 - 10.1	6.2
	Lower	6/6	2.5 - 40.7	11.1
Cobalt	Upper	6/6	0.84 - 17.1	4.7
	Lower	5/6	0.30 - 5.9	1.7
Copper	Upper	1/6	116	116
	Lower	0/6	NA	NA
Iron	Upper	6/6	966 - 5,160	2,500
	Lower	6/6	916 - 11,100	[illegible]

Table 5.3
Grid-Based Locations
Inorganics Detected in Soil

Chemical	Sample Interval	Frequency of Detections	Range of Detections (mg/kg)	Mean of Detections (mg/kg)
Inorganics (12 samples collected: 6 upper interval and 6 lower interval; 1 sample duplicated)				
Lead	Upper	6/6	2.2 - 21.0	9.4
	Lower	6/6	1.4 - 9.2	3.9
Magnesium	Upper	6/6	157 - 811	338
	Lower	6/6	102 - 5,290	1,070
Manganese	Upper	6/6	5.0 - 27.3	14.3
	Lower	6/6	4.6 - 50.6	15.0
Mercury	Upper	1/6	0.06	0.06
	Lower	1/6	0.05	0.05
Nickel	Upper	6/6	1.2 - 4.5	2.3
	Lower	6/6	0.84 - 11.9	3.4
Potassium	Upper	0/6	NA	NA
	Lower	1/6	1,240	1,240
Selenium	Upper	4/6	0.40 - 1.1	0.60
	Lower	4/6	0.34 - 1.9	1.0
Silver	Upper	3/6	0.26 - 0.42	0.32
	Lower	1/6	0.50	0.50
Sodium	Upper	1/6	170	170
	Lower	1/6	179	179
Thallium	Upper	0/6	NA	NA
	Lower	1/6	0.68	0.68

Table 5.3
Grid-Based Locations
Inorganics Detected in Soil

Chemical	Sample Interval	Frequency of Detections	Range of Detections (mg/kg)	Mean of Detections (mg/kg)
Inorganics (12 samples collected: 6 upper interval and 6 lower interval; 1 sample duplicated)				
Vanadium	Upper	6/6	2.2 - 9.1	4.9
	Lower	6/6	1.9 - 28.6	7.6
Zinc	Upper	4/6	6.8 - 40.5	17.5
	Lower	5/6	10.0 - 40.4	17.7
Cyanide	Upper	2/6	0.12 - 0.15	0.14
	Lower	1/6	0.16	0.16

Table 5.4
Chemicals Detected In
Zone D Soil Samples

Name	Location	Surface Conc	Subsurface Conc	Residential RBC (THQ=0.1)	Soil to Groundwater SSL* (DAF=20)	Surface Background	Subsurface Background
Pesticides/PCBs (μg/kg)							
Endrin	B002	4.3	ND	2300.0	1000	NA	NA
4,4'-DDE	B006	4.8	ND	1900.0	54000[b]	NA	NA
4,4'-DDT	B006	9.1	ND	1900.0	32000[b]	NA	NA
Semivolatile Organic Compounds (μg/kg)							
B(a)P Equiv.	B004	55.0	NA	88.0	NL	NA	NA
	B006	60.9	NA				
Benzo(a)anthracene	B004	34.0	ND	880.0	2000[b]	NA	NA
	B006	44.5	ND				
Benzo(a)pyrene	B004	45.0	ND	88.0	8000	NA	NA
	B006	49.0	ND				

Table 5.4
Chemicals Detected In
Zone D Soil Samples

Name	Location	Surface Conc	Subsurface Conc	Residential RBC (THQ=0.1)	Soil to Groundwater SSL* (DAF=20)	Surface Background	Subsurface Background
Benzo(b)fluoranthene	B004	58.0	ND	880.0	5000[b]	NA	NA
	B006	66.5	ND				
Benzo(g,h,i)perylene	B006	41.0	ND	230000.0	NL	NA	NA
Benzo(k)fluoranthene	B004	71.0	ND	8800.0	49000[b]	NA	NA
	B006	77.0	ND				
Chrysene	B004	57.0	ND	88000.0	160000[b]	NA	NA
	B006	57.0	ND				
Fluoranthene	B004	78.0	ND	310000.0	4300000[b]	NA	NA
Phenanthrene	B006	71.0	ND	230000.0	NL	NA	NA
Pyrene	B004	59.0	ND	230000.0	4200000[b]	NA	NA
	B006	69.0	ND				
Herbicides (μg/kg)							
Dinoseb	B006	15.0	ND	7800.0	NL	NA	NA
Dioxins (μg/kg)							
Dioxin (2,3,7,8-TCDD TEQs)	B006	0.003524	ND	1	NL	NA	NA
Volatile Organic Compounds (μg/kg)							
Carbon disulfide	B005	ND	2.0	780000.0	2000	NA	NA
Chlorobenzene	B006	ND	1.0	160000.0	1000	NA	NA
1,1,2,2-Tetrachloroethane	B006	ND	2.0	3200.0	3.0[d]	NA	NA
2-Butanone (MEK)	B001	4.0	ND	4700000.0	NL	NA	NA
Inorganics (mg/kg)							
Aluminum (Al)	B001	3560.0	2850.0	7800.0	NL	8700.0	10300.0
	B002	3690.0	3160.0				
	B003	4020.0	4450.0				
	B004	4530.0	2920.0				
	B005	6510.0	12800.0				
	B006	3800.0	4600.0				

Table 5.4
Chemicals Detected In
Zone D Soil Samples

Name	Location	Surface Conc	Subsurface Conc	Residential RBC (THQ=0.1)	Soil to Groundwater SSL* (DAF=20)	Surface Background	Subsurface Background
Antimony (Sb)	B002	1.7	ND	3.1	5	0.92	ND
Arsenic (As)	B001	4.5	1.6	0.43	29[d]	5.65	4.08
	B002	1.2	1.2				
	B003	0.84	1.0				
	B004	0.9	0.740				
	B005	2.2	5.8				
	B006	7.0	1.9				
Barium (Ba)	B001	12.1	10.4	550.0	1600[d]	30.1	29.7
	B002	19.6	15.2				
	B003	11.1	7.7				
	B004	9.7	13.1				
	B005	18.2	28.9				
	B006	19.7	13.9				
Beryllium (Be)	B001	[illegible]	0.120	0.15	63[d]	[illegible]	[illegible]
	[illegible]	ND	0.330				
	B006	ND	0.960				
Cadmium (Cd)	B005	ND	0.3	3.9	8[d]	0.07	0.38
	B006	0.1	0.760				
Calcium (Ca)	B001	2810.0	4830.0	NA	NL	NA	NA
	B002	[illegible]	870.0				
	B003	[illegible]	142.0				
	B004	[illegible]	544.0				
	B005	[illegible]	82400.0				
	B006	14300.0	2300.0				
Chromium (Cr)	B001	5.9	5.3	39 VI 7800 III	38[d] (Total)	12.4	22.3
	B002	5.5	8.1				

Table 5.4
Chemicals Detected In
Zone D Soil Samples

Name	Location	Surface Conc	Subsurface Conc	Residential RBC (THQ=0.1)	Soil to Groundwater SSL* (DAF=20)	Surface Background	Subsurface Background
Chromium (Cr)	B003	4.9	5.4				
	B004	4.5	2.5				
	B005	6.3	40.7				
	B006	10.1	4.8				
Cobalt (Co)	B001	0.34	0.3	470.0	NL	9.46	2.89
	B002	1.6	0.740				
	B003	8.1	0.590				
	B004	0.42	ND				
	B005	17.1	5.9				
	B006	0.81	1.1				
Copper (Cu)	B002	116.0	ND	310.0	NL	40.6	ND
Cyanide (CN)	B001	0.12	0.160	160.0	40	0.18	0.16
	B006	0.15	ND		(Amenable)		
Iron (Fe)	B001	2180.0	1360.0	2300.0	NL	NA	NA
	B002	2060.0	1620.0				
	B003	966.0	916.0				
	B004	2230.0	1890.0				
	B005	2400.0	11100.0				
	B006	5160.0	1920.0				
Lead (Pb)	B001	3.1	2.2	400.0	400'	18.8	7.87
	B002	18.7	2.1				
	B003	2.2	1.6				
	B004	6.3	1.4				
	B005	5.1	9.2				
	B006	21.0	7.1				

Table 5.4
Chemicals Detected In
Zone D Soil Samples

Name	Location	Surface Conc	Subsurface Conc	Residential RBC (THQ=0.1)	Soil to Groundwater SSL* (DAF=20)	Surface Background	Subsurface Background
Magnesium (Mg)	B001	350.0	245.0	NA	NL	NA	NA
	B002	203.0	310.0				
	B003	179.0	215.0				
	B004	157.0	102.0				
	B005	330.0	5290.0				
	B006	811.0	240.0				
Manganese (Mn)	B001	10.7	5.2	180.0	NL	28.6	29.9
	B002	17.2	6.4				
	B003	5.0	4.6				
	B004	13.6	9.1				
	B005	11.9	50.6				
	B006	27.3	13.9				
Mercury (Hg)	B005	ND	0.05	2.3	NL	0.05	0.05
	B006	0.06	ND				
Nickel (Ni)	B001	1.2	0.95	160.0	130	[illegible]	[illegible]
	B002	[illegible]	[illegible]				
	B003	2.0	1.0				
	B004	[illegible]	0.84				
	B005	[illegible]	11.9				
	B006	4.5	3.3				
Potassium (K)	B005	ND	1240.0	NA	NL	NA	NA
Selenium (Se)	B002	ND	0.6	9.0	[illegible]	[illegible]	[illegible]
	B003	0.4	ND				
Selenium (Se)	B00[illegible]	0.49	0.34				
	B00[illegible]	0.4	1.9				
	B006	1.1	1.2				

Table 5.4
Chemicals Detected In
Zone D Soil Samples

Name	Location	Surface Conc	Subsurface Conc	Residential RBC (THQ=0.1)	Soil to Groundwater SSL* (DAF=20)	Surface Background	Subsurface Background
Silver (Ag)	B002	0.42	ND	39.0	34[a,d]	0.43	0.36
	B003	0.27	ND				
	B004	0.26	ND				
	B006	ND	0.5				
Sodium (Na)	B001	170.0	179.0	NA	NL	NA	NA
Thallium (Tl)	B006	ND	0.68	0.63	0.7[d]	ND	0.57
Vanadium (V)	B001	6.3	3.7	55.0	6000[a]	9.73	15.1
	B002	2.5	4.2				
	B003	2.2	1.9				
	B004	5.3	2.0				
	B005	3.8	28.6				
	B006	9.1	5.0				
Zinc (Zn)	B001	6.8	10.0	2300.0	12000[a,d]	25.1	30.1
	B002	13.6	12.8				
	B004	9.1	11.0				
	B005	ND	40.4				
	B006	40.5	14.4				

Notes:

NA = Not available
ND = Not detected
NL = Not listed
DAF = Dilution and attenuation factor.
a = Calculated values correspond to a noncancer hazard quotient of 1.
b = Calculated values correspond to a cancer risk level of 1 in 1000000.
c = Level is at or below contract laboratory program required quantitation limit for Regular Analytical Services (RAS).
d = SSL for pH of 6.8.
e = A screening level of 400 mg/kg has been set for lead based on Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (U.S.EPA, 1994).
* = Generic SSL values taken from the Soil Screening Guidance: Technical Background Document (USEPA, 1996) for the migration to groundwater pathway developed using a default DAF of 20 to account for natural processes that reduce contamination concentrations in the subsurface.

Volatile Organic Compounds in Soil

Chlorobenzene, 2-butanone (MEK), carbon disulfide, and 1,1,2,2-tetrachloroethane were each detected in only one grid-based soil sample. Chlorobenzene and 1,1,2,2-tetrachloroethane were detected in sample GDDSB00602; 2-butanone (MEK) was detected in sample GDDSB00101; and carbon disulfide was detected in sample GDDSB00502. None of the detected concentrations of VOCs exceeded its respective RBC or its generic soil screening level for migration to groundwater (assuming Dilution Attenuation Factor = 20).

Semivolatile Organic Compounds in Soil

Nine semivolatile organic compounds, including five of the seven carcinogenic PAHs, were detected in grid-based upper interval soil samples; none was found in lower interval soil samples. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, and pyrene were detected in both GDDSB00401 and GDDSB00601 (primary and duplicate results combined). None of the detected concentrations exceeded its respective RBC or generic soil screening level, nor did the maximum calculated total BEQs exceed the RBC or generic soil screening level of benzo(a)pyrene.

Pesticides and PCBs in Soil

Three pesticides were detected in grid-based upper interval soil samples. 4,4'-DDE and 4,4'-DDT were detected in sample GDDSB00601, while endrin was found in sample GDDSB00201. No pesticides were detected in lower interval soil samples, and no PCBs were found in any of the grid-based soil samples. None of the detected concentrations exceeded its respective RBC or generic soil screening level.

Herbicides in Soil

Dinoseb was detected in upper interval duplicate soil sample GDDCB00601 at a concentration of 15 μg/kg, far below its RBC of 7,800 μg/kg. Dinoseb does not have a listed generic soil screening level for migration to groundwater.

Other Organic Compounds in Soil

Eleven dioxin/furan compounds were detected in duplicate upper interval soil sample GDDCB00601. Calculated 2,3,7,8-TCDD equivalents (TEQs) for this sample were 3.524E-03 μg/kg, which is well below the cleanup level of 1.0 μg/kg currently recommended by USEPA (see Section 6.1).

Inorganics in Soil

Twenty-three metals and cyanide were detected in grid-based soil samples. Five of these (aluminum, arsenic, beryllium, iron, and thallium) were detected at least once at concentrations exceeding their RBCs, but none exceeded their generic soil screening levels for migration to groundwater. Three of the five (aluminum, beryllium, and thallium) exceeded their respective RBCs only in lower interval soil samples. Since RBCs apply only to upper interval samples, they are used here only for illustrative purposes, and not to indicate regulatory exceedances. Aluminum (RBC=7,800 mg/kg; no listed SSL) was detected at 12,800 mg/kg in lower interval sample GDDSB00502. Arsenic (RBC=0.43 mg/kg; SSL=29 mg/kg) detections exceeded its RBC in all upper interval and lower interval samples. Beryllium (RBC=0.15 mg/kg; SSL=63 mg/kg) was detected above its RBC in lower interval samples GDDSB00502 (0.83 mg/kg) and GDDSB00602 (0.96 mg/kg). Iron (RBC=2,300 mg/kg; no listed SSL) was detected at concentrations exceeding its RBC in upper interval samples GDDSB00501 (2,400 mg/kg) and GDDSB00601 (5,160 mg/kg), and in lower interval sample GDDSB00502 (11,100 mg/kg). Thallium (RBC=0.63 mg/kg; SSL=0.70 mg/kg) was detected above its RBC in lower interval sample GDDSB00602. In addition, chromium was reported at a concentration of 40.7 mg/kg in lower interval sample GDDSB00502. Although this value exceeds the RBC of 39 mg/kg for hexavalent chromium in upper interval soil, no hexavalent chromium was detected in the only Zone D soil sample (GDDCB00601) in which it was an analyte. The RBC for trivalent chromium is 7,800 mg/kg. The generic SSL for hexavalent chromium is 38 mg/kg, while the pathway for trivalent chromium is not of concern at any soil contaminant concentration.

5.3 Groundwater Sampling and Analysis

The *Final Zones D, F, and G RFI Work Plan* proposed one shallow and one deep grid-based monitoring well in Zone D. Both of these wells were installed (Figure 2-1). As proposed, groundwater samples were analyzed for VOCs, SVOCs, metals, cyanide, and pesticides/PCBs, as well as the water-quality parameters TDS, chloride, and sulfate. Table 5.5 summarizes the grid-based groundwater sampling.

5.4 Nature of Chemicals Detected in Groundwater

No organic compounds were detected in first-round samples from either the shallow or the deep grid well. Table 5.6 summarizes inorganic analytical results. Chemicals detected in Zone D shallow monitoring wells are summarized in Table 5.7. Chemicals detected in Zone D deep monitoring wells are summarized in Table 5.8.

Table 5.5
Grid-Based Locations
Groundwater Sampling Summary

Event	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Performed	Deviations
November 1996 (1st round)	1 shallow	1 shallow	Standard suite[a] plus TDS, chloride, and sulfate	As proposed	None
	1 deep	1 deep	Standard suite[a] plus TDS, chloride, and sulfate	As proposed	None

Note:
[a] Standard suite consists of VOCs, SVOCs, metals, cyanide, pesticides, and PCBs.

Table 5.6
Grid-Based Locations
Inorganics Detected in Groundwater

Chemical	Event	Interval	Detected? (Y/N)	Detected Concentration
Inorganics (μg/L)				
(1 Shallow sample collected; 1 deep sample collected)				
Aluminum	Nov. 96	Shallow	Y	707.00
	Nov. 96	Deep	N	–
Arsenic	Nov. 96	Shallow	Y	2.70
	Nov. 96	Deep	Y	4.20
Barium	Nov. 96	Shallow	Y	8.80
Barium	Nov. 96	Deep	Y	15.90
Beryllium	Nov. 96	Shallow	Y	0.40
	Nov. 96	Deep	N	
Calcium	Nov. 96	Shallow	Y	13400.00
	Nov. 96	Deep	Y	54900.00
Chromium	Nov. 96	Shallow	Y	1.90
	Nov. 96	Deep	N	
Iron	Nov. 96	Shallow	Y	2270.00
	Nov. 96	Deep	Y	547.00
Lead	Nov. 96	Shallow	Y	1.90
	Nov. 96	Deep	N	
Magnesium	Nov. 96	Shallow	Y	1680.00
	Nov. 96	Deep	Y	3290.00
Manganese	Nov. 96	Shallow	Y	15.50
	Nov. 96	Deep	Y	160.00
Nickel	Nov. 96	Shallow	Y	1.70
	Nov. 96	Deep	N	–

Table 5.6
Grid-Based Locations
Inorganics Detected in Groundwater

Chemical	Event	Interval	Detected? (Y/N)	Detected Concentration
Potassium	Nov. 96	Shallow	Y	2960.00
	Nov. 96	Deep	N	—
Sodium	Nov. 96	Shallow	Y	3000.00
	Nov. 96	Deep	Y	15300.00
Vanadium	Nov. 96	Shallow	Y	3.60
	Nov. 96	Deep	N	—
Water quality parameters (mg/L)				
(1 Shallow sample collected; 1 deep sample collected)				
TDS	Nov. 96	Shallow	Y	48.00
	Nov. 96	Deep	Y	204.00
Sulfate	Nov. 96	Shallow	Y	12.90
	Nov. 96	Deep	Y	13.50
Chloride	Nov. 96	Shallow	Y	2.70
	Nov. 96	Deep	Y	15.00

Note:
NA   Not applicable

Table 5.7
Chemicals Detected
In Shallow Monitoring Wells

Sampling Round 1

Name	Location	Round 1 Conc.	RBC (THQ=0.1) (µg/L)	Background Zone D	MCL (µg/L)
Inorganics (µg/L)					
Aluminum (Al)	W001	707.0	3700.0	1410.0	NA
Arsenic (As)	W001	2.7	0.045	5.4	50.0
Barium (Ba)	W001	8.8	260.0	17.6	2000.0
Beryllium (Be)	W001	0.4	0.016	0.8	4.0
Calcium (Ca)	W001	13400.0	NA	NA	NA
Chromium (Cr)	W001	1.9	3700 III 18 VI	3.8	100.0
Iron (Fe)	W001	2270.0	1100.0	NA	300*
Lead (Pb)	W001	1.9	15.0	3.8	15.0
Magnesium (Mg)	W001	1680.0	NA	NA	NA
Manganese (Mn)	W001	15.3	84.0	30.6	50*
Nickel (Ni)	W001	1.7	73.0	3.4	100.0
Potassium (K)	W001	2960.0	NA	NA	NA
Sodium (Na)	W001	3000.0	NA	NA	NA
Vanadium (V)	W001	3.6	26.0	7.2	NA
Water Quality Parameters (mg/L)					
Chloride	W001	2.7	NA	NA	NA
Sulfate	W001	12.9	NA	NA	NA
Total Dissolved Solids (TDS)	W001	48.0	NA	NA	NA

Notes:
* = Secondary Maximum Contaminant Level
NA = Not available

Table 5.8
Chemicals Detected
In Deep Monitoring Wells

Sampling Round 1

Name	Location	Round 1 Conc.	RBC (THQ=0.1) (μg/L)	Background Zone D	MCL (μg/L)
Inorganics (μg/L)					
Arsenic (As)	W01D	4.2	0.045	8.4	50.0
Barium (Ba)	W01D	15.9	260.0	31.8	2000.0
Calcium (Ca)	W01D	54900.0	NA	NA	NA
Iron (Fe)	W01D	547.0	1100.0	NA	300*
Magnesium (Mg)	W01D	3290.0	NA	NA	NA
Manganese (Mn)	W01D	160.0	84.0	320.0	50*
Sodium (Na)	W01D	15300.0	NA	NA	NA
Water Quality Parameter (mg/L)					
Chloride	W01D	15.0	NA	NA	NA
Sulfate	W01D	13.5	NA	NA	NA
Total Dissolved Solids (TDS)	W01D	204.0	NA	NA	NA

Notes:
* = Secondary Maximum Contaminant Level
NA = Not available

Volatile Organic Compounds in Groundwater

No VOCs were detected in grid-based groundwater samples.

Semivolatile Organic Compounds in Groundwater

No SVOCs were detected in grid-based groundwater samples.

Pesticides and PCBs in Groundwater

No pesticides or PCBs were detected in grid-based groundwater samples.

Inorganics in Groundwater

Fourteen metals were detected in grid-based groundwater samples. Cyanide was not detected. Concentrations of four metals (arsenic, beryllium, iron, and manganese) exceeded their respective tap water RBCs, but two of those (arsenic and beryllium) were below their respective MCLs. Arsenic (RBC=0.045 μg/L; MCL=50 μg/L) was detected at 2.7 μg/L in shallow sample GDDGW00101 and at 4.2 μg/L in deep sample GDDGW01D01. Beryllium (RBC=0.016 μg/L; MCL=4 μg/L) was detected at 0.4 μg/L in shallow sample GDDGW01D01. Iron (RBC=1,100 μg/L; SMCL=300 μg/L) was detected at 2,270 μg/L in shallow sample GDDGW00101. Manganese (RBC=84 μg/L; SMCL=50μg/L) was detected at 160 μg/L in deep sample GDDGW01D01.

5.5 Discussion of Detected Chemicals

One of the few organic compounds detected in Zone D grid-based soil samples was the herbicide dinoseb. The upper level sample in which dinoseb appeared (GDDCB00601) was collected from a small grassy island in a parking lot. Two other organic compounds (1,1,2,2-Tetrachloroethane and chlorobenzene) detected in sample GDDSB00602, the subsurface soil sample. Shallow and deep groundwater samples, collected to determine if these compounds have impacted groundwater, exhibited no detections of volatile organic compounds in either sample. Reported concentrations of arsenic from this location (7.4 mg/kg in primary sample GDDSB00601; 6.6 mg/kg in duplicate sample GDDCB00601) were the highest of any soil sample in Zone D. Elevated levels of arsenic in upper level soil on the former golf course in Zones A and B appear to be related to past application of herbicides. Since the dinoseb detection coincides with moderately high concentrations of arsenic, it is probable that both chemicals are present in upper level soil at this location as a result of herbicide application. The lower interval soil sample (GDDSB00602) from the same location reported a lower concentration of arsenic (1.9 mg/kg); dinoseb was an analyte only in the single duplicate sample collected from the upper interval.

Although detected concentrations exceed RBCs for five metals in soil samples (but only for arsenic and iron in surface soil) and four metals in groundwater, reported concentrations of metals in grid-based samples from Zone D are consistently low compared to comparable samples from other investigative zones previously studied. Maximum concentrations of those metals exceeding their RBCs in Zone D are lower than virtually every corresponding calculated background reference value (generally an upper tolerance limit) for Zones A, B, C, H, and I. In addition, every RBC exceedance except those for beryllium (in groundwater) and arsenic (in soil and groundwater) is due to an adjustment of the values taken from the RBC table: for the sake of conservatism, the original listed values have been multiplied by a target hazard quotient (THQ) of 0.1 to account for possible additive effects of multiple constituents. For samples with so few significant detections, this precaution may be unnecessary. None of the metal detections in soil samples exceeded its generic soil screening level for migration to groundwater.

Detected concentrations of beryllium and arsenic in soil and groundwater have consistently exceeded RBCs throughout NAVBASE. Arsenic concentrations for sediments in Charleston Harbor and throughout the southeastern United States are known to be high relative to the rest of the nation (Holland, et al., 1996), possibly as a result of phosphate deposits throughout the region (Windom, et al., 1989). For the large dataset (n=104) of upper interval grid-based soil samples in Zone H, concentrations of beryllium, arsenic, and numerous other trace metals can be shown to covary significantly with aluminum, indicating that natural aluminosilicate minerals — rather than contaminants — are the main metal-bearing phases (E/A&H, 1995). A similar relationship exists between arsenic and iron in surface soil in adjoining Zone C (E/A&H 1996). Iron, like trace metals, is associated with soil particle surfaces, and its concentration in soil is relatively uniform and unaffected by human activity. Although Zone D background datasets are too small to determine whether comparable relationships exist, mean background concentrations of beryllium and arsenic in upper and lower interval soil, and of arsenic in shallow groundwater, are somewhat lower in Zone D than in Zone H; beryllium was not detected in Zone H groundwater. Mean arsenic concentrations in Zone D upper and lower interval soil are also lower than comparable values in Zone C grid samples. Beryllium was not detected frequently enough in Zone C samples for a comparison of means to be valid, but detected concentrations in Zone D samples were comparable to those of Zone C. If correlations between various trace metals and aluminum in Zone H surface soil (and between arsenic and iron in Zone C surface soil) support a natural origin for the trace metals, and if concentrations of the same trace metals are somewhat lower in Zone D soil than in Zones H and C soils, then the same trace metals are very likely of natural origin in Zone D soil as well.

6.0 Analytical Data Evaluation and Background Reference Concentrations

This section describes the approach and technical methods employed to determine types (nature) of all chemicals present in grid-based samples in soil and groundwater at Zone D. Chemical types in grid-based samples were evaluated to determine the overall distribution of constituents detected on a macro (zone-wide) scale. In addition, these data will be used to assess basewide conditions and the relationship of background levels of constituents between zones across NAVBASE.

6.1 Organic Compound Analytical Results Evaluation

Organic compounds detected in Zone D soil and groundwater grid-based samples were compared to RBCs and SSLs and discussed in Section 5 of this report. The RBCs employed in Section 5 are taken from the USEPA Region III *Risk-Based Concentration Table* (June 1996). Information on each compound's frequency of detection and its average and range of detected concentrations was also compiled (see Sections 5.2 and 5.4).

Dioxin data reflect summations of the tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) equivalency quotient (TEQ) values computed using the procedure identified in *Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated dibenzo-p-dioxins and dibenzofurans* (CDDs and CDFs), the 1989 update (USEPA, 1989), and the USEPA *Interim Supplemental Guidance to RAGS: Region IV Bulletins, Human Health Risk Assessment*, Bulletin No. 2, November 1995. For screening purposes, dioxin data were compared to the dioxin TEQ of 1.0 microgram per kilogram (μg/kg) for a worker/industrial scenario, based on a slope factor approach currently endorsed by USEPA. This dioxin concentration corresponds to a risk level of 1E-04, which USEPA Region IV has sanctioned as a prudent risk management option for dioxin.

In accordance with recent carcinogenic polynuclear aromatic hydrocarbons (cPAH) guidance (USEPA, Region IV, November 1995), benzo(a)pyrene equivalents (BEQs) were computed, where

where appropriate, by multiplying the reported concentration of each of the seven cPAHs by its corresponding toxicity equivalency factor (TEF). The BEQ values were then summed for each sample, and the total was compared to the benzo(a)pyrene RBC value.

6.2 Inorganic Chemical Analytical Results Evaluation

Sample results for inorganics are often difficult to evaluate because inorganics are naturally occurring and ubiquitous in soil. Further compounding this difficulty is the fact that much of NAVBASE is dredge-fill material that has been artificially placed onsite. The following describes the procedures used to determine background for inorganics within Zone D.

Many chemicals, particularly carcinogenic metals such as arsenic and beryllium, are typically detected at much higher concentrations than their risk-based screening levels. Where hazardous waste sites have been identified, it is usually necessary to supplement site-specific sampling efforts with an attempt to determine the non-site-related concentrations of these compounds. The problem is how to determine these reference (or background) concentrations, and how much higher than background a parameter must be before it is of concern at a site. USEPA Region IV guidance (USEPA, Region IV, November 1995a) recommends using twice the mean of the background sample concentrations as an upper bound for each inorganic and considers any site-related sample higher than this bound to be contaminated. Although this method is not ideal for large background datasets such as the ones assembled at several other investigative zones at NAVBASE, it is more appropriate for small datasets where the number of samples collected does not permit analysis via most statistical tests. Due to the small size of the background datasets for soil and groundwater in Zone D, twice the mean concentration of each inorganic constituent served as its background reference level. Because there was only one shallow grid-based groundwater sample and one deep sample, twice the detected value was used as the background reference concentration for those groundwater constituents that were detected.

6.2.1 Grid-Based Background Dataset

The background dataset for Zone D soil collected from the upper (surface) interval consisted of 6 samples (GDDSB00101 to GDDSB00601), one of which was duplicated (GDDCB00601). The lower interval soil dataset also consisted of 6 samples (GDDSB00102 to GDDSB00602). The background datasets for shallow and deep groundwater were derived from one sample apiece, collected from wells NBCDGDD001 and NBCDGDD01D, respectively, in the first quarterly sampling round in November, 1996.

Due to the small size of the background datasets, descriptive statistics other than means were not compiled. To identify potential outliers, individual detections were compared to means and upper tolerance limits for corresponding grid-based samples in Zone H, and to RBCs. None was considered an outlier.

6.2.2 Nondetect Data

Following guidelines presented in various USEPA documents, one-half of the sample quantitation limit (SQL) was used to represent nondetect values for the purpose of calculating means. In practice, this meant using one-half of the *U* values reported by the analytical laboratory and confirmed by the validator. Analytical results qualified *R* or *UR* were considered unusable and were not included in the datasets. If all sample results were nondetect for a given constituent, no background reference value was estimated.

6.2.3 Background Reference Concentrations

Background reference concentrations were calculated for 18 inorganic chemicals in upper interval soil and 17 inorganics in lower interval soil, as shown in Table 6.1. Table 6.2 presents reference concentrations for nine inorganics in shallow groundwater and three in deep groundwater. In all of the background calculations, nondetect values were treated as discussed above in Section 6.2.2.

Table 6.1
Charleston Zone D Soil
Characteristics of Background Datasets

Chemical	Level 1 Soil Detections	Level 1 Soil Mean (mg/kg)	Level 1 Soil Background Reference Value (mg/kg)	Level 2 Soil Detections	Level 2 Soil Mean (mg/kg)	Level 2 Soil Background Reference Value (mg/kg)
Aluminum	6	4350	8700	6	5130	10300
Antimony	1	0.458	0.92	0	ND	ND
Arsenic	6	2.77	5.6	6	2.04	4.1
Barium	6	15.07	30.1	6	14.87	29.7
Beryllium	1	0.1055	0.21	3	0.373	0.75
Cadmium	1	0.034	0.07	2	0.19	0.38
Chromium	6	6.2	12.4	6	11.13	22.3
Cobalt	6	4.73	9.5	5	1.44	2.9
Copper	1	20.3	40.6	0	ND	ND
Lead	6	9.4	18.8	6	3.93	7.9
Manganese	6	14.3	28.6	6	14.97	29.9
Mercury	1	0.026	0.05	1	0.025	0.05
Nickel	6	2.34	4.7	6	3.38	6.8
Selenium	4	0.453	0.91	4	0.73	1.5
Silver	3	0.213	0.43	1	0.18	0.36
Thallium	0	ND	ND	1	0.283	0.57
Vanadium	6	4.87	9.7	6	7.57	15.1
Zinc	4	12.54	25.1	5	15.06	30.1
Cyanide	2	0.09	0.18	1	0.08	0.16

Notes:
mg/kg milligrams per kilogram
ND not detected in samples

Table 6.2
Charleston Zone D Groundwater
Characteristics of Background Datasets

Chemical	Shallow GW Detection? (Y/N)	Shallow GW Result (μg/L)	Shallow GW Background Reference Value (μg/L)	Deep GW Detection? (Y/N)	Deep GW Result (μg/L)	Deep GW Background Reference Value (μg/L)
Aluminum	Y	707	1410	N	ND	ND
Antimony	N	ND	ND	N	ND	ND
Arsenic	Y	2.7	5.4	Y	4.2	8.4
Barium	Y	8.8	17.6	Y	15.9	31.8
Beryllium	Y	0.4	0.8	N	ND	ND
Cadmium	N	ND	ND	N	ND	ND
Chromium	Y	1.9	3.8	N	ND	ND
Cobalt	N	ND	ND	N	ND	ND
Copper	N	ND	ND	N	ND	ND
Lead	Y	1.9	3.8	N	ND	ND
Manganese	Y	15.3	30.6	Y	160	320
Mercury	N	ND	ND	N	ND	ND
Nickel	Y	1.7	3.4	N	ND	ND
Selenium	N	ND	ND	N	ND	ND
Silver	N	ND	ND	N	ND	ND
Thallium	N	ND	ND	N	ND	ND
Vanadium	Y	3.6	7.2	N	ND	ND
Zinc	N	ND	ND	N	ND	ND
Cyanide	N	ND	ND	N	ND	ND

Notes:
μg/L micrograms per liter
ND not detected in samples

7.0 CONCLUSIONS

The purpose of the Zone D RFI was to ensure that no potential sites are present which were not identified previously during the RFA process. The results of the grid-based and other sampling did not reveal any such sites. However, elevated concentrations, below the respective RBCs, of the herbicide (dinoseb) and two pesticides (4,4'-DDE and 4,4'-DDT) were detected at soil sample location GDDSB006 in the upper interval. Arsenic was detected in this same location at a concentration which exceeded the RBC and Zone D background. Sample GDDSB006 was collected from a grassy island in a paved parking area. These detections are most likely the result of planned application and not accidental release. In addition, AOC 570 located in Zone E maybe impacting deep groundwater quality in the northeastern portion of Zone D. The project team has decided to address this potential problem in the Zone E RFI. Therefore this information is not presented in this RFI report. The analytical results were tabulated and background soil and groundwater concentrations were determined. Comparison of the Zone D background values to other previously investigated zones indicated the Zone D results to be representative of naturally occurring inorganics and ambient organic compounds.

8.0 SIGNATORY REQUIREMENT

Condition I.E. of the Hazardous and Solid Waste Amendments (HSWA) portion of RCRA Part B Permit (EPA SCO 170 022 560) states: *All applications, reports, or information submitted to the Regional Administrator shall be signed and certified in accordance with 40 CFR §270.11.* The certification reads as follows:

I certify under penalty of law that this document and all attachments were prepared under by direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Caretaker Site Officer

2/28/97
Date

9.0 REFERENCES

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APPENDIX A

BORING LOGS

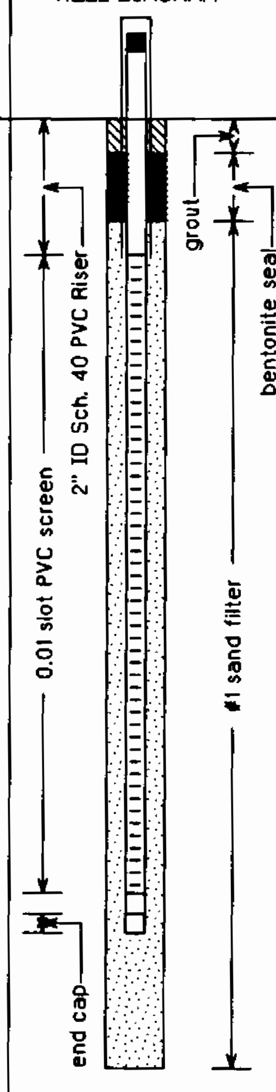
EnSafe/Allen & Hoshall

Monitoring Well NBCDGDD001

Project: *ZONE D - Naval Base Charleston*	Coordinates: *2315605.07 E, 374951.44 N*
Location: *Charleston, SC*	Surface Elevation: *11.7 feet msl*
Started at *08:30 on 08-27-96*	TOC Elevation: *14.42 feet msl*
Completed at *09:45 on 08-27-96*	Depth to Groundwater: *6.90 feet TOC* Measured: *12/18/96*
Drilling Method: *4.25" ID (7.5" OD) HSA with split spoon sampler*	Groundwater Elevation: *7.52 feet msl*
Drilling Company: *Alliance Environmental (SC # 889)*	Total Well Depth: *12.0 feet bgs*
Geologist: *D. Doyle*	Well Screen: *2.0 to 11.4 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: Grass	
							SM	Sand: gray-brown; very fine to fine; some silt; trace mica; loose; saturated.	8.7
5			SS-1	100	0				6.7
							SM	Sand: red-brown; very fine to fine; some silt; loose; saturated. Note: Shoe was lost in hole and color change occurred at approx. 5'.	2.2
10			SS-2	50	0				1.7
							CL	Clay: dark gray; silty; some fine sand; soft; very moist to wet.	-1.3
15			SS-3	100	0				-3.3
20									

WELL DIAGRAM



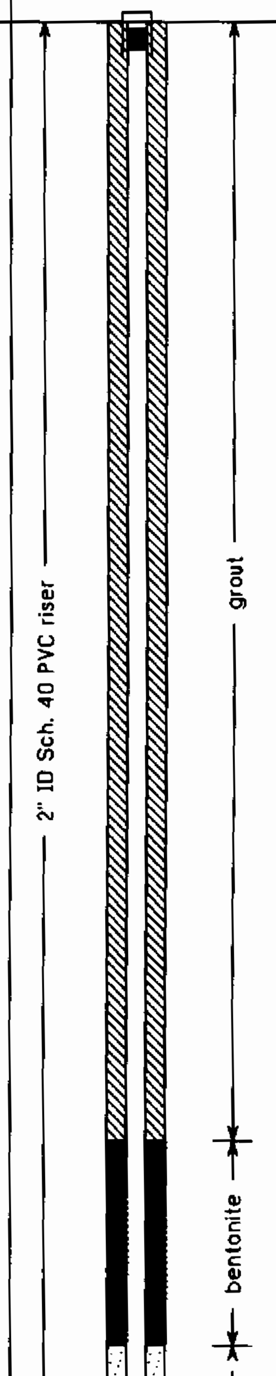
EnSafe/Allen & Hoshall

Monitoring Well NBCDGDD01D

Project: ZONE D – Naval Base Charleston	Coordinates: 2315616.7 E, 374957.8 N
Location: Charleston, SC	Surface Elevation: 11.7 feet msl
Started at 0815 on 9-10-96	TOC Elevation: 11.45 feet msl
Completed at 1100 on 9-10-96	Depth to Groundwater: 3.75 feet TOC Measured: 12-18-96
Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit)	Groundwater Elevation: 7.70 feet msl
Drilling Company: Boart-Longyear (SC# 1232)	Total Well Depth: 26.5 feet bgs
Geologist: P. Bayley	Well Screen: 21.7 to 25.7 feet bgs

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							GM	Surface conditions: Asphalt Gravel: lt grey, white ROC; damp.	10.8
							SP	Sand: yellow brown; very fine to fine, trace to some silt; damp, soft.	9.7
5			1	40	0.0		SP/SM	Sand: lt grey brown w/thin orange FeOx indistinct laminae; very fine to fine, some silt to silty, some clay decreasing to trace; wet. @8.5 to 9.8 ft.: w/occasional intercalated clay: grey; plastic.	6.7
10			2	96	0.0		SP/SM	Sand: orange brown; very fine to medium, some silt to silty; wet, soft. @11.3 to 14.7 ft.: color grades to lt brown then brown; slight decrease in grain size to trace medium, and decreasing silt with depth. @ 12.9, 13.0, 13.4, and 14.0 ft.: Clay: grey; silty; very thin.	1.9 1.7
15			3	84	0.0		SM/SC	Sand: lt grey; very fine to fine, clayey, silty; wet, very soft, sticky; w/occasional shell fragments, and occasional clay clasts. @16.5 ft.: color changes to buff; w/disseminated granular PO_4, and occasional very thin shell fragments. @18.2 ft.: color changes to lt brown: trace PO_4, and trace shell fragments.	-3 -3.3
20									

WELL DIAGRAM



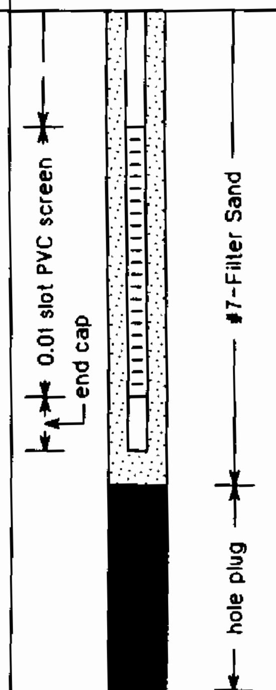
EnSafe/Allen & Hoshall

Monitoring Well NBCDGDD01D

Project: *ZONE D – Naval Base Charleston*	Coordinates: *2316616.7 E, 374957.8 N*
Location: *Charleston, SC*	Surface Elevation: *11.7 feet msl*
Started at *0815 on 9-10-96*	TOC Elevation: *11.45 feet msl*
Completed at *1100 on 9-10-96*	Depth to Groundwater: *3.75 feet TOC* Measured: *12-18-96*
Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)*	Groundwater Elevation: *7.70 feet msl*
Drilling Company: *Boart-Longyear (SC# 1232)*	Total Well Depth: *26.5 feet bgs*
Geologist: *P. Bayley*	Well Screen: *21.7 to 25.7 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							SM SC	Sand: olive green grey, w/black very fine PO_4 sand; very fine to fine, some clay to clayey, some silt to silty; w/disseminated shell fragments. @23.0 to 24.7 ft.: w/Silt: olive brown; clayey: and trace Clay: blue green: as matrix supported clasts.	-13
25			4	97	0.0				-13.3
							ML CL	Silt: olive brown; clayey, some sand to sandy-very fine, trace fine; wet, firm, plastic; w/trace to some PO_4 sand...Ashley Fm. @25.0, 26.9-28.5 ft.: Sand pods: grey green; very fine to fine, silty, clayey; w/fine grain shell fragments. @29.7 ft.: increase in sand to sandy.	
30			5	100	0.0			@30.0-32.5 ft.: Shelby Tube Recovery: top of tube as above with shell fragments. bottom of tube as above without shell fragments.	
			6	100	0.0				-20.8
35									
40									

WELL DIAGRAM



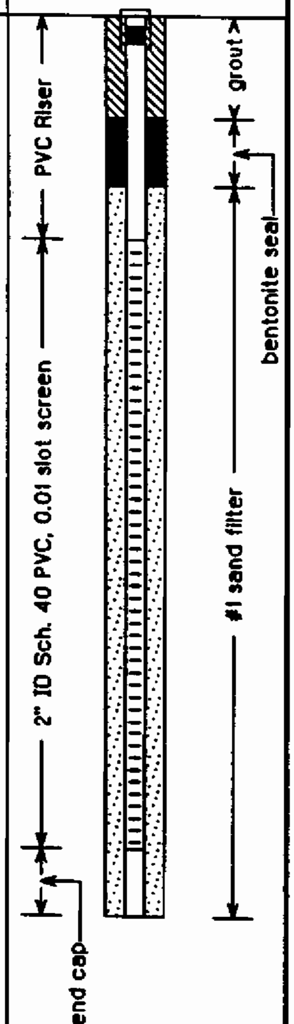
EnSafe/Allen & Hoshall

Monitoring Well NBCEGDE029

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2316214.3 E, 375987.4 N*
Location: *Charleston, SC*	Surface Elevation: *7.5 feet msl*
Started at *1230 on 9-3-96*	TOC Elevation: *7.32 feet msl*
Completed at *1400 on 9-3-96*	Depth to Groundwater: *4.24 feet TOC* Measured: *10/16/96*
Drilling Method: *4.25" ID (7.5" OD) HSA with split spoon*	Groundwater Elevation: *3.08 feet msl*
Drilling Company: *Atlantic Drilling (S.C.# 1210)*	Total Well Depth: *13.3 feet bgs*
Geologist: *J. Albert*	Well Screen: *3.3 to 12.3 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: Asphalt	
								FID reading 0.0 ppm in cuttings from 2.0 to 4.0 ft.	
5							SP	Sand: brown; fine, w/some black laminae; fine; moist to saturated. @5.5 ft.: saturated.	3
			1	98	0				1.1
10							SP	Sand: light grey to grey brown; fine; moist to very moist.	1
			2	100	0				3
							SP	Sand: grey brown to yellow grey; fine, slightly silty; saturated.	5
15			3	75	2.3				6.5
20									

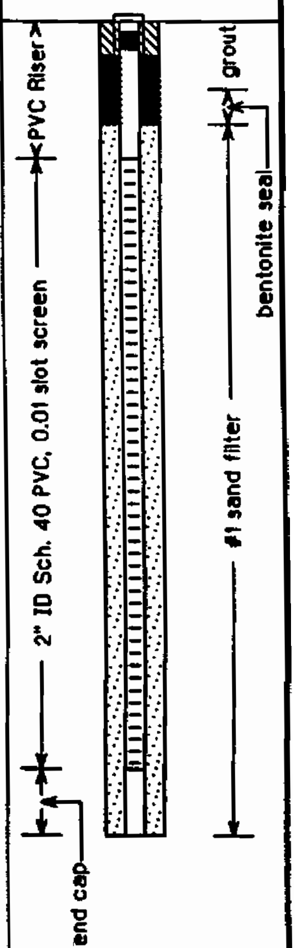
WELL DIAGRAM



EnSafe/Allen & Hoshall	Monitoring Well NBCEGDE030
Project: ZONE E - Naval Base Charleston	Coordinates: 2316491.1 E, 375997.1 N
Location: Charleston, SC	Surface Elevation: 12.3 feet msl
Started at 0800 on 9-4-96	TOC Elevation: 12.10 feet msl
Completed at 0940 on 9-4-96	Depth to Groundwater: 4.43 feet TOC Measured: 10/16/96
Drilling Method: 4.25" ID (7.5" OD) HSA with split spoon	Groundwater Elevation: 7.67 feet msl
Drilling Company: Atlantic Drilling (S.C.# 1210)	Total Well Depth: 12.0 feet bgs
Geologist: J. Albert	Well Screen: 2.0 to 11.0 feet bgs

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: Asphalt	
								FID reading 0.0 ppm in cuttings from 2.0 to 4.0 ft.	
5			1	75	0		SP	Sand: light brown, grades to light olive grey; fine; loose, saturated.	8.3 / 6.8
10			2	70	0		SP	Sand: beige grading to tan; fine, trace silt; loose, saturated.	4.3 / 2.9
			3	100	0		SP	Sand: tan to reddish tan; fine, trace silt; loose, saturated.	.3 / -1.7
15									
20									

WELL DIAGRAM



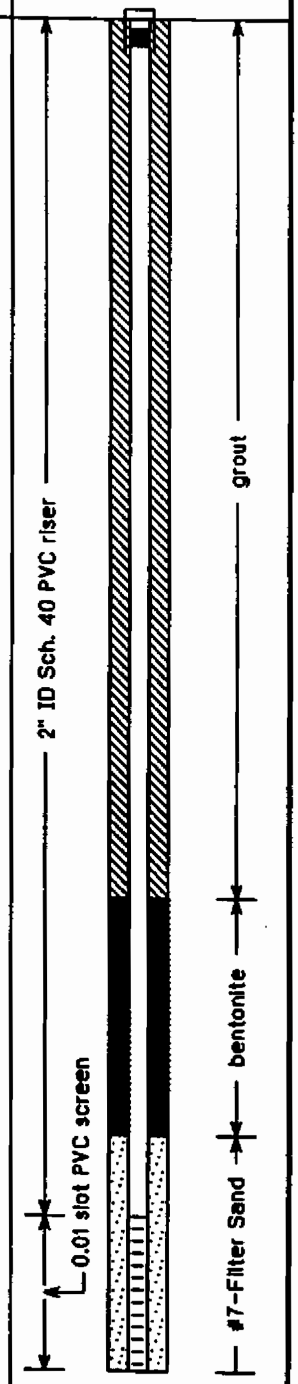
EnSafe/Allen & Hoshall

Monitoring Well NBCEGDE29D

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2316209.75 E, 375997.14 N*
Location: *Charleston, SC*	Surface Elevation: *7.5 feet msl*
Started at *1430 on 9-11-96*	TOC Elevation: *7.36 feet msl*
Completed at *1700 on 9-11-96*	Depth to Groundwater: *4.20 feet TOC* Measured: *10/16/96*
Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)*	Groundwater Elevation: *3.16 feet msl*
Drilling Company: *Boart-Longyear (SC# 1232)*	Total Well Depth: *22.5 feet bgs*
Geologist: *P. Bayley*	Well Screen: *17.7 to 21.7 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
						GW GP	Surface conditions: asphalt. Gravel: black; some silt and sand in matrix.	6.7
						FILL	Fill: mostly orange to brown sand, very fine to fine, some silt; loose, damp.	4.5
5			1	60	0.0	WOOD	Wood: black with red-brown; no chemical odor.	2.5 / 2.1
						SM	Sand: light brown; very fine to fine, silty; some rootlets, loose, wet.	.6
						SP SW	Sand: light gray; fine to medium, trace silt, trace small shell fragments; loose, wet.	-2.4
10						SM	Sand: light brown with trace faint brown and black laminae; very fine to fine, silty; loose, wet; @ 11.8' color is orange with light brown thin laminae and decreased silt content.	-4.3
						SP SM		-5
15			2	70	0.0	ML CL	Clay: brown; silty; firm, plastic, effervescent with HCl, wet; occasional pods of very fine to fine, rose colored sand to 15.7ft.	-7.5
						ML	Silt: gray-green; sandy-very fine, w/some phosphatic sand and some thin, white shell fragments; effervesces in HCl.	-9
						ML SM		-9.7
						ML SC	Silt: olive-gray green; sandy-very fine, w/some phosphatic sand; firm, slight plasticity, wet; effervesces in HCl.	-10.8
20							Silt: olive-gray-green; clayey, sandy-very fine, w/some phosphatic sand; firm, plastic, wet;	

WELL DIAGRAM



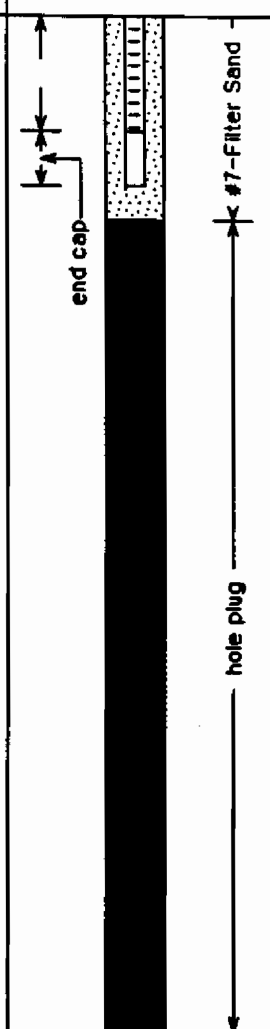
EnSafe/Allen & Hoshall

Monitoring Well NBCEGDE29D

Project: *ZONE E – Naval Base Charleston*	Coordinates: *2316209.75 E, 375997.14 N*
Location: *Charleston, SC*	Surface Elevation: *7.5 feet msl*
Started at *1430 on 9-11-96*	TOC Elevation: *7.36 feet msl*
Completed at *1700 on 9-11-96*	Depth to Groundwater: *4.20 feet TOC* Measured: *10/16/96*
Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)*	Groundwater Elevation: *3.16 feet msl*
Drilling Company: *Boart-Longyear (SC# 1232)*	Total Well Depth: *22.5 feet bgs*
Geologist: *P. Bayley*	Well Screen: *17.7 to 21.7 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							ML/SC	effervesces in HCl. @18.3-18.9 ft.: pods of Silt: gray and black "pepper" w/shell fragments.	
25			3	100	0.0				-17.5
30							ML/CL	Silt: olive-green; clayey, trace sand-very fine; wet, stiff, plastic; effervesces in HCl.	
35			4	100	0.0				-27.5
40									

WELL DIAGRAM



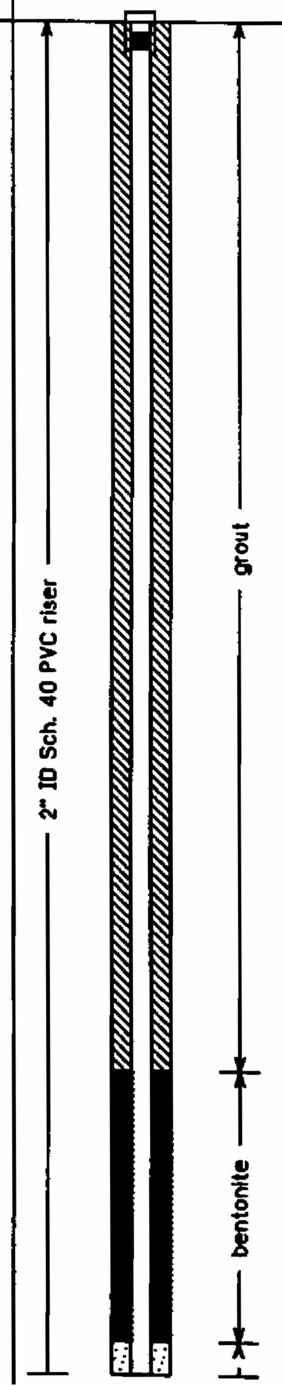
EnSafe/Allen & Hoshall

Monitoring Well NBCEGDE30D

Project: ZONE E – Naval Base Charleston	Coordinates: 2316498.94 E, 375208.44 N
Location: Charleston, SC	Surface Elevation: 12.3 feet msl
Started at 1435 on 9-10-96	TOC Elevation: 12.34 feet msl
Completed at 1700 on 9-10-96	Depth to Groundwater: 4.69 feet TOC Measured: 10/16/96
Drilling Method: Rotasonic (6.5" OD casing, 3.8" ID coring bit)	Groundwater Elevation: 7.65 feet msl
Drilling Company: Boart-Longyear (SC# 1232)	Total Well Depth: 26.5 feet bgs
Geologist: P. Bayley	Well Screen: 21.7 to 25.7 feet bgs

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							FILL	Surface conditions: asphalt.	11.5
							SP	Sand: brown with faint orange-brown horizontal laminae; very fine to fine, trace to some silt; loose, moist.	8.6
5			1	74	0.0				7.3
							SM/SP	Sand: gray-green with occasional orange FeOx laminae and mottle; very fine to fine, silty, trace clay; loose, wet. from 7.5-9.8' alternating bands of orange FeOx laminae with pale gray green laminae.	2.5
10							SP	Sand: orange to brown, trace gray-green; very fine to fine, trace to some silt, slight increase in grainsize with depth; loose, wet.	1.5
							SP/SW	Sand: orange to orange-brown; very fine to fine/medium; loose, wet; very thin clay laminae in last 0.2'.	-.9
15			2	80	0.0				-2.7
							SP/SW	Sand: orange-brown; very fine to fine with trace medium, trace silt; loose, wet.	-4
							CH/OH	Clay: dark gray to black; very thinly laminated, some silt; stiff, plastic, wet. pods of light gray to brown silt with shell fragments from 19-20'.	
20									

WELL DIAGRAM



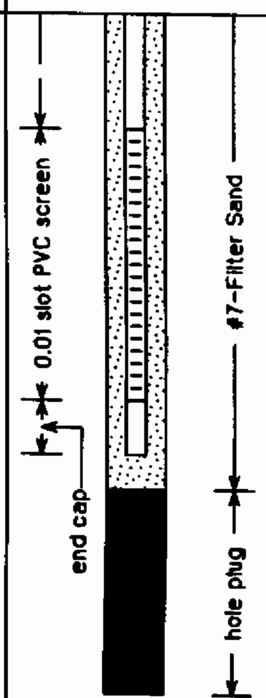
EnSafe/Allen & Hoshall

Monitoring Well NBCEGDE30D

Project: *ZONE E - Naval Base Charleston*	Coordinates: *2316498.94 E, 375208.44 N*
Location: *Charleston, SC*	Surface Elevation: *12.3 feet msl*
Started at *1435 on 9-10-96*	TOC Elevation: *12.34 feet msl*
Completed at *1700 on 9-10-96*	Depth to Groundwater: *4.69 feet TOC* Measured: *10/16/96*
Drilling Method: *Rotasonic (6.5" OD casing, 3.8" ID coring bit)*	Groundwater Elevation: *7.65 feet msl*
Drilling Company: *Boart-Longyear (SC# 1232)*	Total Well Depth: *26.5 feet bgs*
Geologist: *P. Bayley*	Well Screen: *21.7 to 25.7 feet bgs*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	% RECOVERY	PID (ppm)	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
							CH OH		8.1
							SM ML	Sand: light gray; very fine to fine, trace medium, with some shell fragments and phosphatic sand, very silty; soft, wet, sticky.	9.6
							SM SC	Sand: light brown; very fine to fine, very silty, some clay; soft, wet; few large shell fragments. @23.7-24.2 ft.: some 1-3 cm laminae of brown, sandy, clayey silt.	11.8
25			3	91	0.0				12.7
							ML CL	Silt: olive drab; very thin faint brown to black very fine phosphatic sand laminae; clayey, some sand to sandy-very fine to fine, with some PO_4 nodules; soft to firm, low plasticity, wet--Ashley Fm.; @25.0-26.5 ft.: occasional sand pods containing small shell fragments and some PO_4 sand decreasing in frequency and size w/depth.	17.3
30			4	92	0.0				17.7
							ML CL	Shelby Tube from 30-32.5': top and bottom of tube consists of Ashley Fm as above.	
			5	100	0.0				20.2
35									
40									

WELL DIAGRAM



APPENDIX B

SOIL CONSULTANTS, INC.

SCI Laboratory No. 97-166

Materials Testing Report

SOIL CONSULTANTS, INC.

Tabulated Data Sheet

ect And State

Naval Base Charleston, South Carolina
Zone 'D' Investigation
Ensafe/Allen & Hoshall P.O. #88

Date: 1-29-97

I. Results of Falling Head Permeability Test

Sample: NBCD/GDD-01
Depth : 8' - 10' (tan fine sand with slight inorganic clay lens content)

Porosity %	41.8
Moisture Content %	25.4%
Wet Unit Weight	124 lb/cu.ft.
Specific Gravity	2.66
Permeability (cm/sec)	9.0×10^{-5}

II. Results of Moisture Contents and Wet Unit Weights for Shelby Tube Samples

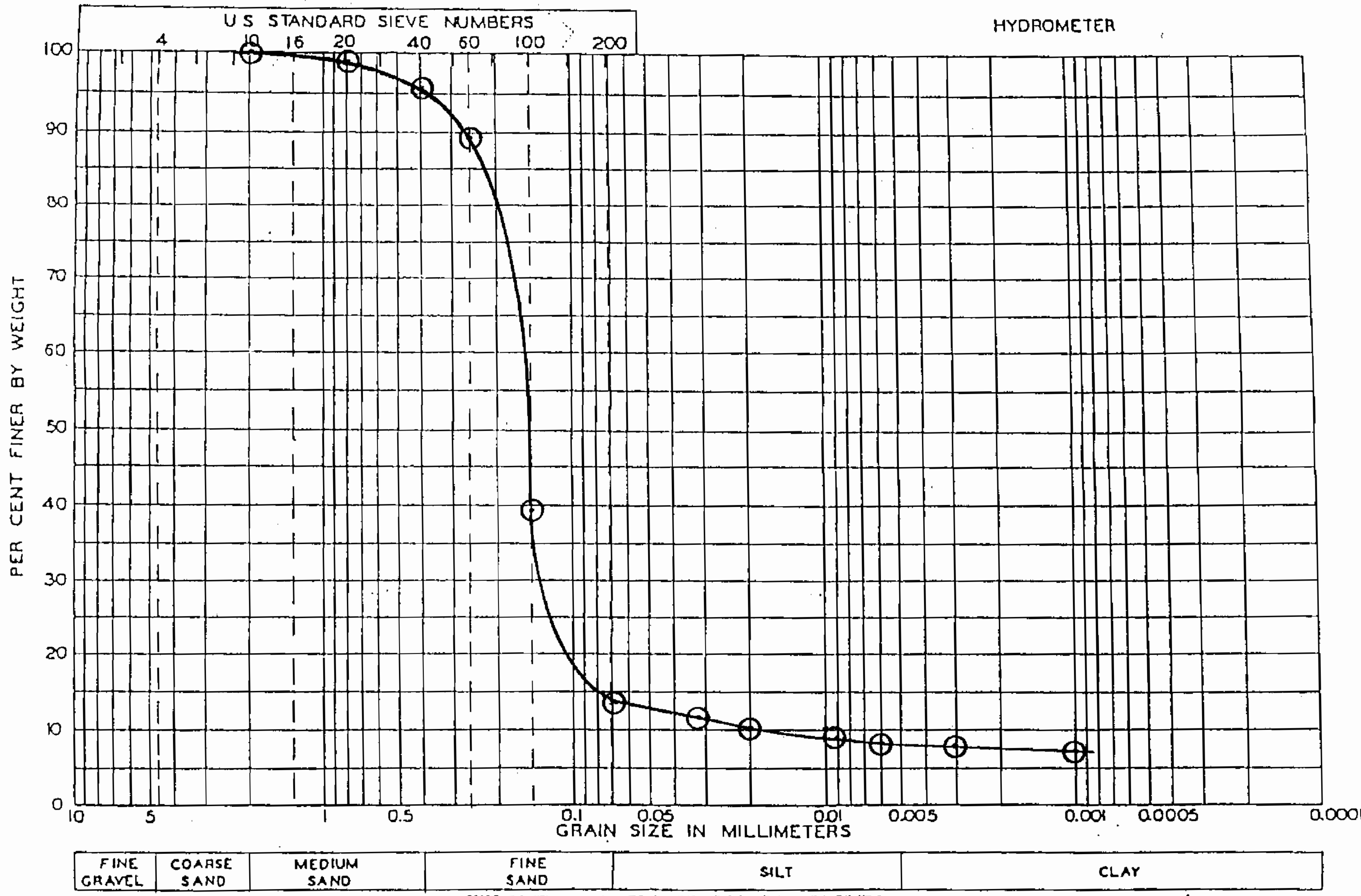
Sample Number	Depth (feet)	Moisture Content (%)	Wet Unit Weight (lb/cu.ft.)
Zone D			
NBCD/GDD-01	8'-10'	25	129

III. Results of Porosity, Moisture Content, Unit Weight, and Specific Gravity Tests

Sample: NBCD/GDD-01
Depth : 2' - 4' (tan fine sand)

Porosity %	44.7
Moisture Content %	13.7
Wet Unit Weight	106 lb/cu.ft.
Specific Gravity	2.65

SCI NUMBER: 97-166



UNIFIED SOIL CLASSIFICATION SYSTEM

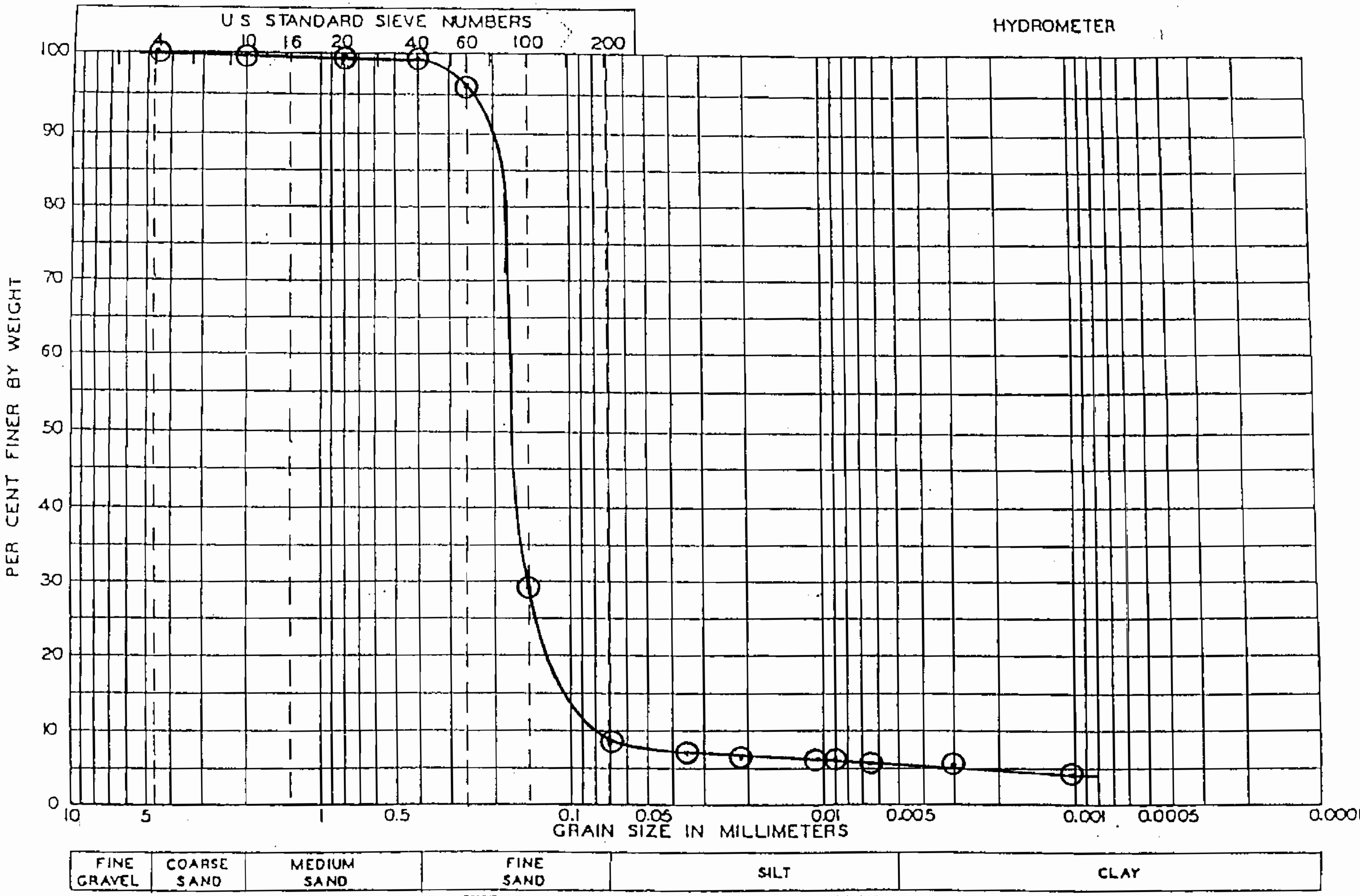
PROJECT NAVAL BASE CHARLESTON, S.C.
ZONE D INVESTIGATION, E/A&H P.O.#88

BORING NUMBER NBCD/GDD-01 SAMPLE NUMBER

DEPTH 8' - 10' ELEVATION REMARKS VISUALLY IDENTIFIED AS TAN FINE SAND WITH SLIGHT INORGANIC CLAY LENS CONTENT.

ASTM D422

GRAIN SIZE DISTRIBUTION DIAGRAM



UNIFIED SOIL CLASSIFICATION SYSTEM

NBCD/GDD-01

PROJECT NAVAL BASE CHARLESTON, S.C. BORING NUMBER ____ SAMPLE NUMBER ____

ZONE D INVESTIGATION, E/A&H P.O. #88

DEPTH 2' - 4' ELEVATION ____ REMARKS VISUALLY IDENTIFIED AS TAN FINE SAND.

ASTM D422

GRAIN SIZE DISTRIBUTION DIAGRAM

Materials Testing Report	SOIL CONSULTANTS, INC.	**HYDRAULIC CONDUCTIVITY TEST ASTM - D 5084**
Project And Location:	Naval Base Charleston, RCRA Facility Investigation, Charleston, SC Zones D, F, and G	
SCI Project:	96-1660	Date: 10-14-96

SAMPLE IDENTIFICATION	Zone D GDD-01D 30 - 32.5'			

INITIAL CONDITIONS

Sample Length, cm	5.08			
Sample Diameter, cm	5.08			
Moisture Content, %	45.8			
Unit Wet Weight, pcf	108.1			
Unit Dry Weight, pcf	74.1			
Specific Gravity	2.72			
Porosity (computed)	0.563114			
Saturation, %	96.6			

FINAL CONDITIONS

Sample Length, cm	5.08			
Sample Diameter, cm	5.08			
Moisture Content, %	47.9			
Unit Wet Weight, pcf	108.2			
Unit Dry Weight, pcf	73.1			
Saturation, %	98.7			

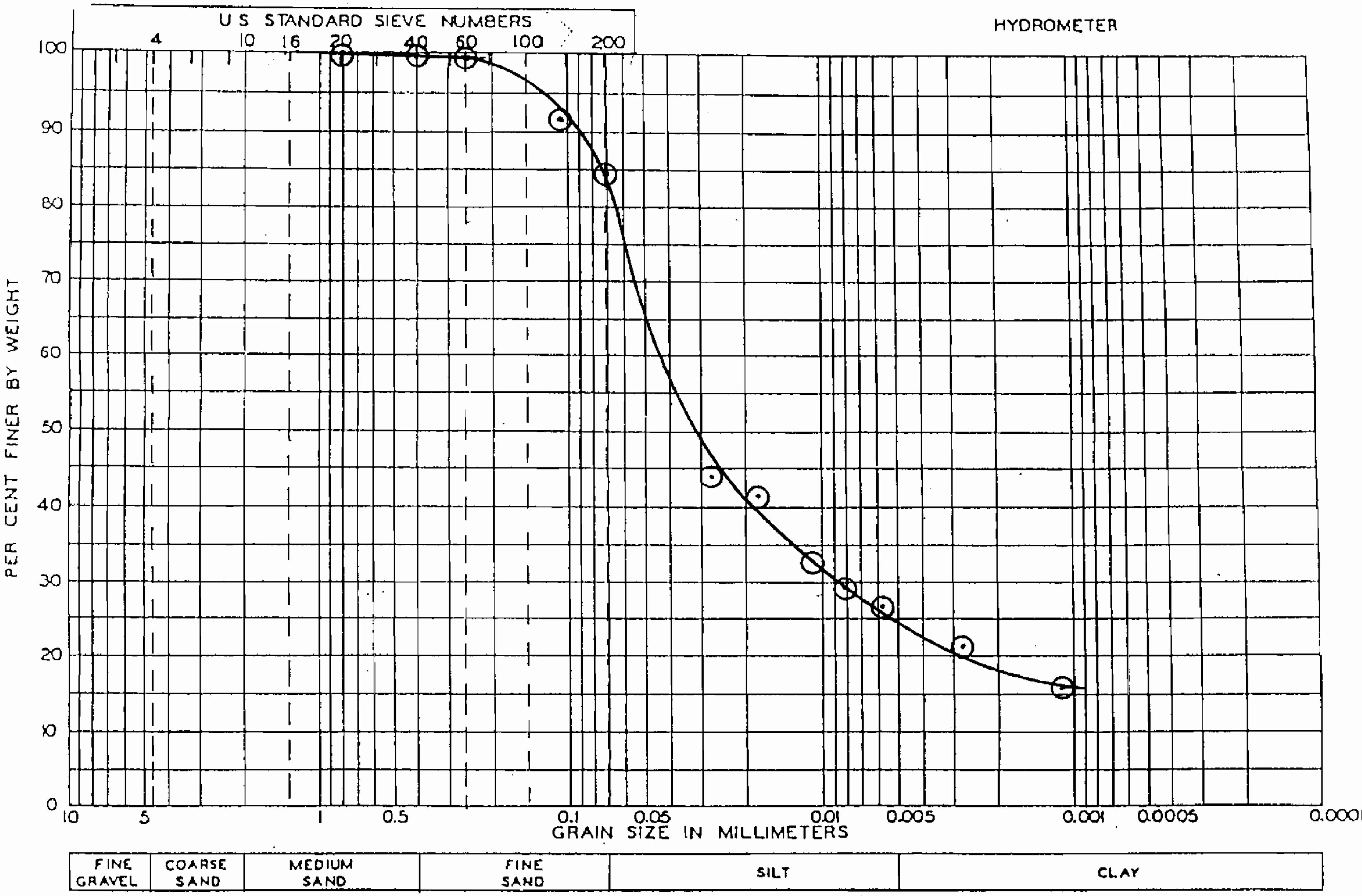
TEST CONDITIONS

Permeant	Potable Water			
Cell Pressure, psi	30			
Back Pressure, psi	27-25			
B-value	0.950			
Average Gradient	27.6			
Hydraulic Conductivity, cm/sec @ 20 deg. C	1.185×10^{-6}			

SOIL CONSULTANTS, INC.

[signature]

SCI NUMBER: 96-1660



UNIFIED SOIL CLASSIFICATION SYSTEM

PROJECT NAVAL BASE CHARLESTON, RCRA FACILITY INVESTIGATION, CHARLESTON, S.C. BORING NUMBER ________ SAMPLE NUMBER GDD-01D

ZONE D (SUBCONTRACT 0376/96)

DEPTH 30'-32.5' ELEVATION ________ REMARKS Visually identified as brownish green calcareous claye silt with slight sand content.**(MH)

ASTM D422

GRAIN SIZE DISTRIBUTION DIAGRAM

**Locally called Marl;

APPENDIX C

AQUIFER CHARACTERISTIC DATA

ZONE D
SLUG TEST HYDRAULIC CONDUCTIVITIES

Shallow: NBCD\GDD001

Falling head test = 5.0 ft/day
Rising head test = 6.0 ft/day
Geometric mean = 5.5 ft/day

Deep: NBCD\GDD01D

Falling head test = 0.76 ft/day
Rising head test = 0.78 ft/day
Geometric mean = 0.77 ft/day

The Waterloo Hydrogeologic Institute's AQUIFERTEST 2.0 software, which includes the Bouwer and Rice (1976) method, was used in analyzing the Zone D slug test data. The Bouwer and Rice method (updated in Bouwer [1989]) has the following assumptions:

- a homogeneous, isotropic aquifer of uniform thickness.
- horizontal water table/potentiometric surface prior to test.
- instantaneous change in head.
- negligible well losses.
- well storage is not negligible and accounted for.
- fully or partially penetrating wells.
- steady state flow.

Since the method can be used for unconfined, semiconfined, to leaky conditions, it was deemed appropriate for the deep and shallow well. Both were analyzed as if they were fully penetrating the aquifer; not unusual for deep wells at the base since they lie on top of the regional confining unit (Ashley Fm). However, an overlying confining unit is not always present or readily apparent, as in the case of GDD01D. Since slug tests impart an instantaneous but relatively low overall stress to the system, which is often not "felt" by the aquifer beyond a 5 ft radius usually (due to effects of storage and low permeability aquifer materials), the aquifer thickness (D) is generally taken as that length adjacent to the filter pack for deep wells. This also reflects the fact that the horizontal contribution to recovery is thought to far outweigh that contributed vertically. In the shallow wells (and GDD001), which primarily straddle the water table, D is set equal to the saturated interval (b). Thus, the requirements of "full" penetration have been met since vertical flow is assumed to be negligible compared to horizontal flow. Additionally, the intake length (L) is set equal to b and D since water may only enter the well through the same saturated interval.

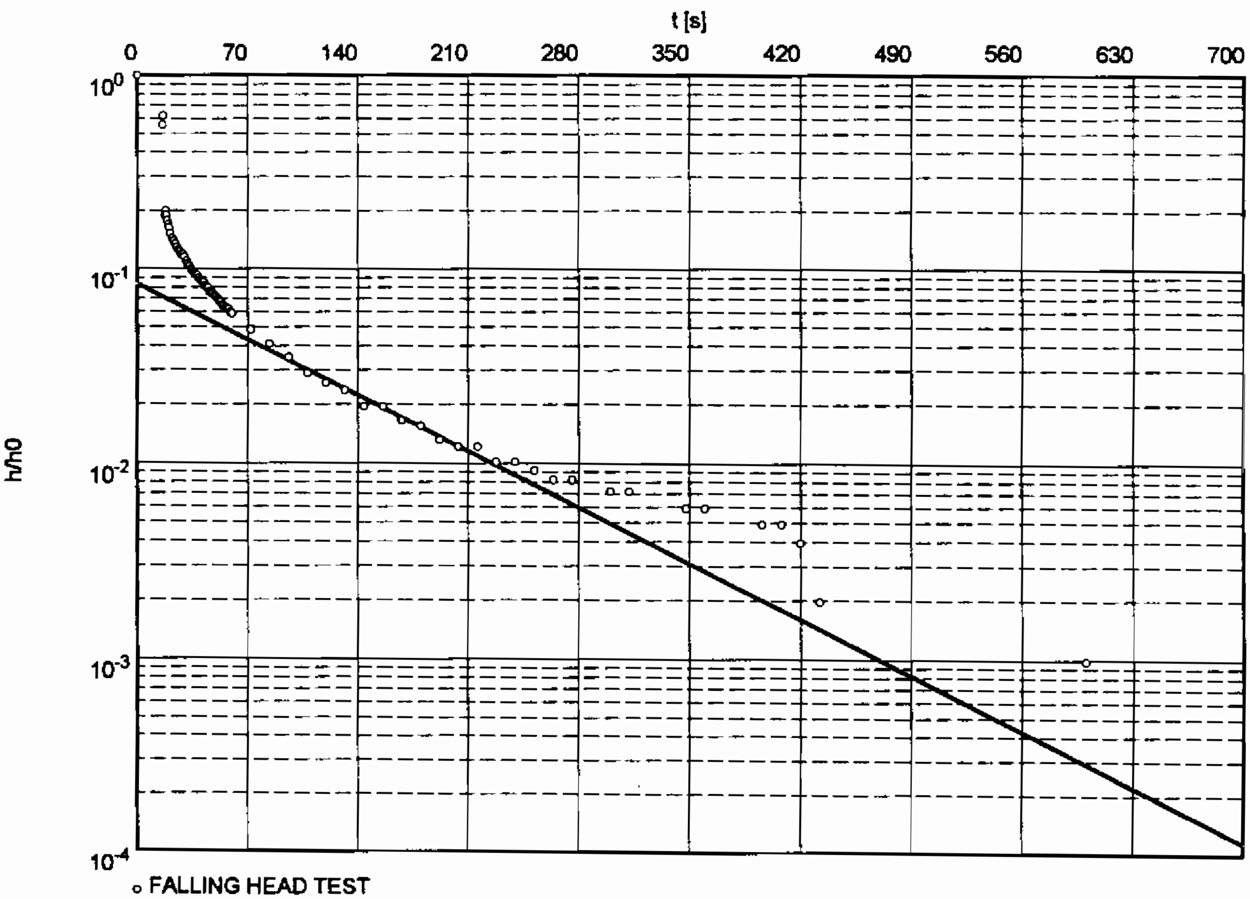
Since the shallow well screens the water table, it is important to account for filter pack drainage effects (not required in deep well since filter pack is fully saturated). This is done by determining an effective radius (r_{eff}) of influence for the test, which equals

$$r_{eff} = [r^2(1-n) + nR^2]^{0.5}.$$

where n is the estimated porosity of the filter pack, r is the well casing radius, and R is the borehole radius. A line of best fit was matched to the h(t) vs. t data that was thought to best represent the "true" aquifer response. Given all the above qualifiers, it has been typical to only present the hydraulic conductivity data from these tests to 2 significant figures.

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 1 Project: ZONE D--NAVBASE CHARLESTON Evaluated by: T. Kafka / Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD001	



Hydraulic conductivity [ft/s]: 5.83×10^{-5}

Hydraulic conductivity [ft/day]: 5.04

L = 9 ft
b = 9 ft
D = 9 ft [full penetration]
Reff = 0.195 ft

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 2 Project: ZONE D--NAVBASE CHARLESTON Evaluated by: T. Kafka · Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD001	FALLING HEAD TEST

Static water level: 0.00 ft below datum

	Pumping test duration [s]	Water level [ft]	Drawdown [ft]	
1	0	-3.06	-3.06	
2	16	-1.69	-1.69	
3	17	-1.89	-1.89	
4	17	-0.57	-0.57	
5	18	-0.61	-0.61	
6	18	-0.57	-0.57	
7	19	-0.54	-0.54	
8	20	-0.52	-0.52	
9	20	-0.50	-0.50	
10	21	-0.46	-0.46	
11	22	-0.44	-0.44	
12	23	-0.42	-0.42	
13	24	-0.41	-0.41	
14	25	-0.39	-0.39	
15	26	-0.38	-0.38	
16	27	-0.37	-0.37	
17	28	-0.36	-0.36	
18	29	-0.36	-0.36	
19	30	-0.35	-0.35	
20	31	-0.33	-0.33	
21	32	-0.32	-0.32	
22	33	-0.31	-0.31	
23	34	-0.30	-0.30	
24	35	-0.30	-0.30	
25	36	-0.29	-0.29	
26	37	-0.29	-0.29	
27	38	-0.28	-0.28	
28	39	-0.27	-0.27	
29	40	-0.27	-0.27	
30	41	-0.26	-0.26	
31	42	-0.26	-0.26	
32	43	-0.25	-0.25	
33	44	-0.24	-0.24	
34	45	-0.24	-0.24	
35	46	-0.23	-0.23	
36	47	-0.23	-0.23	
37	48	-0.23	-0.23	
38	49	-0.22	-0.22	
39	50	-0.22	-0.22	
40	51	-0.21	-0.21	
41	52	-0.21	-0.21	
42	53	-0.20	-0.20	
43	54	-0.20	-0.20	
44	55	-0.19	-0.19	
45	56	-0.19	-0.19	
46	57	-0.19	-0.19	
47	58	-0.19	-0.19	

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 3 Project: ZONE D–NAVBASE CHARLESTON Evaluated by: T. Kafka Date: 27 JAN 97

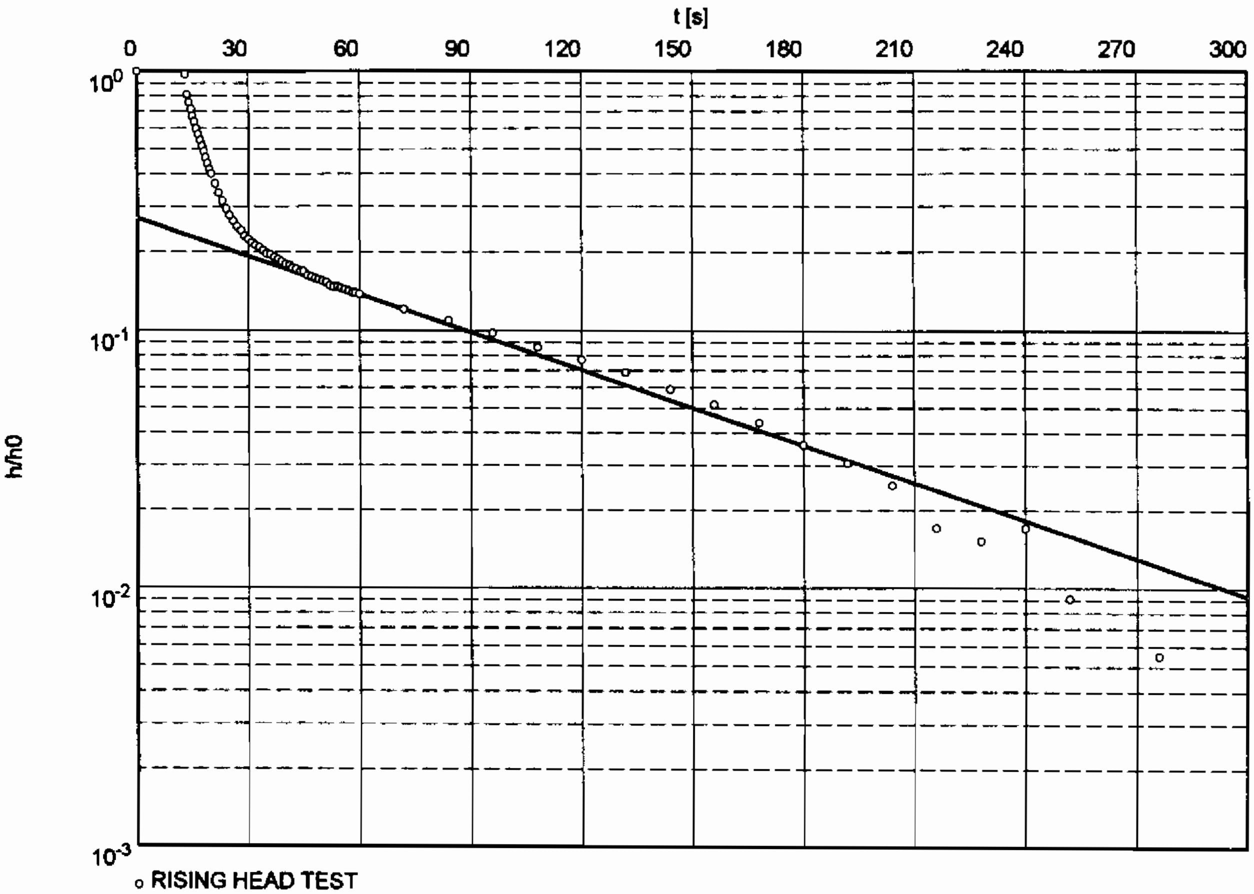
Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD001	FALLING HEAD TEST

Static water level: 0.00 ft below datum

	Pumping test duration [s]	Water level [ft]	Drawdown [ft]	
51	84	-0.13	-0.13	
52	96	-0.11	-0.11	
53	108	-0.09	-0.09	
54	120	-0.08	-0.08	
55	132	-0.07	-0.07	
56	144	-0.06	-0.06	
57	156	-0.06	-0.06	
58	168	-0.05	-0.05	
59	180	-0.05	-0.05	
60	192	-0.04	-0.04	
61	204	-0.04	-0.04	
62	216	-0.04	-0.04	
63	228	-0.03	-0.03	
64	240	-0.03	-0.03	
65	252	-0.03	-0.03	
66	264	-0.03	-0.03	
67	276	-0.03	-0.03	
68	300	-0.02	-0.02	
69	312	-0.02	-0.02	
70	348	-0.02	-0.02	
71	360	-0.02	-0.02	
72	396	-0.02	-0.02	
73	408	-0.02	-0.02	
74	420	-0.01	-0.01	
75	432	-0.01	-0.01	
76	600	-0.00	-0.00	

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 1 Project: ZONE D--NAVBASE CHARLESTON Evaluated by: T. Kafka — Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD001	



Hydraulic conductivity [ft/s]: 6.95×10^{-5}

Hydraulic conductivity [ft/day]: 6.00

L = 9 ft
b = 9 ft
D = 9 ft (full penetration)
Reff = 0.195 ft

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 2 Project: ZONE D--NAVBASE CHARLESTON Evaluated by: T. Kafka — Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD001	RISING HEAD TEST

Static water level: 0.00 ft below datum

	Pumping test duration [s]	Water level [ft]	Drawdown [ft]	
1	0	1.65	1.65	
2	13	1.60	1.60	
3	14	1.33	1.33	
4	14	1.24	1.24	
5	14	1.17	1.17	
6	15	1.10	1.10	
7	15	1.04	1.04	
8	16	0.98	0.98	
9	17	0.93	0.93	
10	17	0.88	0.88	
11	17	0.84	0.84	
12	18	0.80	0.80	
13	18	0.76	0.76	
14	19	0.72	0.72	
15	20	0.69	0.69	
16	20	0.66	0.66	
17	21	0.60	0.60	
18	22	0.55	0.55	
19	23	0.52	0.52	
20	24	0.48	0.48	
21	25	0.45	0.45	
22	26	0.43	0.43	
23	27	0.41	0.41	
24	28	0.40	0.40	
25	29	0.38	0.38	
26	30	0.37	0.37	
27	31	0.36	0.36	
28	32	0.35	0.35	
29	33	0.34	0.34	
30	34	0.33	0.33	
31	35	0.32	0.32	
32	36	0.32	0.32	
33	37	0.31	0.31	
34	38	0.31	0.31	
35	39	0.30	0.30	
36	40	0.30	0.30	
37	41	0.29	0.29	
38	42	0.29	0.29	
39	43	0.28	0.28	
40	44	0.28	0.28	
41	45	0.28	0.28	
42	46	0.27	0.27	
43	47	0.26	0.26	
44	48	0.26	0.26	
45	49	0.26	0.26	
46	50	0.26	0.26	
47	51	0.25	0.25	

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 3 Project: ZONE D--NAVBASE CHARLESTON Evaluated by: T. Kafka — Date: 27 JAN 97

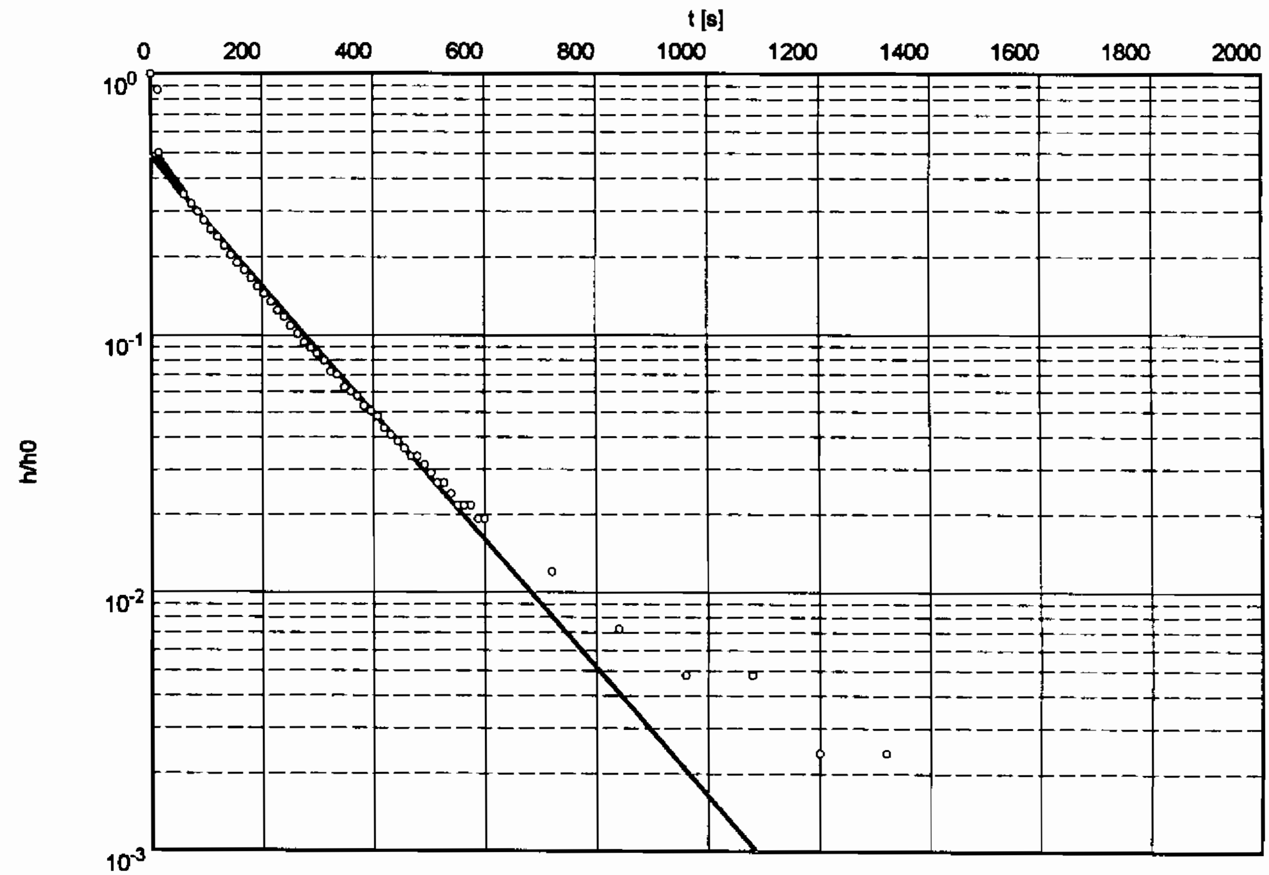
Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD001	RISING HEAD TEST

Static water level: 0.00 ft below datum

	Pumping test duration [s]	Water level [ft]	Drawdown [ft]	
51	55	0.24	0.24	
52	56	0.24	0.24	
53	57	0.23	0.23	
54	58	0.23	0.23	
55	59	0.23	0.23	
56	60	0.23	0.23	
57	72	0.20	0.20	
58	84	0.18	0.18	
59	96	0.16	0.16	
60	108	0.14	0.14	
61	120	0.13	0.13	
62	132	0.11	0.11	
63	144	0.10	0.10	
64	156	0.09	0.09	
65	168	0.07	0.07	
66	180	0.06	0.06	
67	192	0.05	0.05	
68	204	0.04	0.04	
69	216	0.03	0.03	
70	228	0.03	0.03	
71	240	0.03	0.03	
72	252	0.02	0.02	
73	276	0.01	0.01	
74	312	0.00	0.00	

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 1 Project: ZONE D–NAVBASE CHARLESTON Evaluated by: T. Kafka · Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD01D	



o FALLING HEAD TEST

Hydraulic conductivity [ft/s]: 8.78×10^{-6}

Hydraulic conductivity [ft/day]: 0.76

L = 5.5 ft
b = 5.5 ft
D = 5.5 ft (full penetration)
rc = 0.083 ft

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 2 Project: ZONE D–NAVBASE CHARLESTON Evaluated by: T. Kafka / Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD01D	FALLING HEAD TEST

Static water level: 0.00 ft below datum

	Pumping test duration [s]	Water level [ft]	Drawdown [ft]	
1	0	-4.16	-4.16	
2	13	-3.62	-3.62	
3	14	-2.07	-2.07	
4	14	-1.96	-1.96	
5	16	-1.96	-1.96	
6	16	-1.94	-1.94	
7	17	-1.92	-1.92	
8	17	-1.92	-1.92	
9	18	-1.92	-1.92	
10	19	-1.90	-1.90	
11	19	-1.90	-1.90	
12	20	-1.88	-1.88	
13	21	-1.87	-1.87	
14	22	-1.86	-1.86	
15	23	-1.84	-1.84	
16	24	-1.83	-1.83	
17	25	-1.81	-1.81	
18	26	-1.80	-1.80	
19	27	-1.79	-1.79	
20	28	-1.78	-1.78	
21	29	-1.77	-1.77	
22	30	-1.76	-1.76	
23	31	-1.75	-1.75	
24	32	-1.73	-1.73	
25	33	-1.72	-1.72	
26	34	-1.70	-1.70	
27	35	-1.69	-1.69	
28	36	-1.68	-1.68	
29	37	-1.67	-1.67	
30	38	-1.67	-1.67	
31	39	-1.65	-1.65	
32	40	-1.64	-1.64	
33	41	-1.63	-1.63	
34	42	-1.62	-1.62	
35	43	-1.61	-1.61	
36	44	-1.60	-1.60	
37	45	-1.59	-1.59	
38	46	-1.58	-1.58	
39	47	-1.56	-1.56	
40	48	-1.56	-1.56	
41	49	-1.55	-1.55	
42	50	-1.54	-1.54	
43	51	-1.53	-1.53	
44	52	-1.52	-1.52	
45	53	-1.50	-1.50	
46	54	-1.49	-1.49	
47	55	-1.49	-1.49	
48	56	-1.48	-1.48	
49	57	-1.47	-1.47	

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 3 Project: ZONE D–NAVBASE CHARLESTON Evaluated by: T. Kafka / Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD01D	FALLING HEAD TEST

Static water level: 0.00 ft below datum

	Pumping test duration [s]	Water level [ft]	Drawdown [ft]	
51	59	-1.45	-1.45	
52	60	-1.44	-1.44	
53	72	-1.33	-1.33	
54	84	-1.24	-1.24	
55	96	-1.15	-1.15	
56	108	-1.06	-1.06	
57	120	-0.99	-0.99	
58	132	-0.92	-0.92	
59	144	-0.85	-0.85	
60	156	-0.79	-0.79	
61	168	-0.74	-0.74	
62	180	-0.69	-0.69	
63	192	-0.64	-0.64	
64	204	-0.60	-0.60	
65	216	-0.56	-0.56	
66	228	-0.52	-0.52	
67	240	-0.49	-0.49	
68	252	-0.45	-0.45	
69	264	-0.42	-0.42	
70	276	-0.39	-0.39	
71	288	-0.37	-0.37	
72	300	-0.35	-0.35	
73	312	-0.33	-0.33	
74	324	-0.30	-0.30	
75	336	-0.29	-0.29	
76	348	-0.26	-0.26	
77	360	-0.25	-0.25	
78	372	-0.24	-0.24	
79	384	-0.22	-0.22	
80	396	-0.21	-0.21	
81	408	-0.20	-0.20	
82	420	-0.18	-0.18	
83	432	-0.17	-0.17	
84	444	-0.16	-0.16	
85	456	-0.15	-0.15	
86	468	-0.14	-0.14	
87	480	-0.14	-0.14	
88	492	-0.13	-0.13	
89	504	-0.12	-0.12	
90	516	-0.11	-0.11	
91	528	-0.11	-0.11	
92	540	-0.10	-0.10	
93	552	-0.09	-0.09	
94	564	-0.09	-0.09	
95	576	-0.09	-0.09	
96	588	-0.08	-0.08	
97	600	-0.08	-0.08	
98	720	-0.05	-0.05	
99	840	-0.03	-0.03	

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 4 Project: ZONE D--NAVBASE CHARLESTON Evaluated by: T. Kafka Date: 27 JAN 97

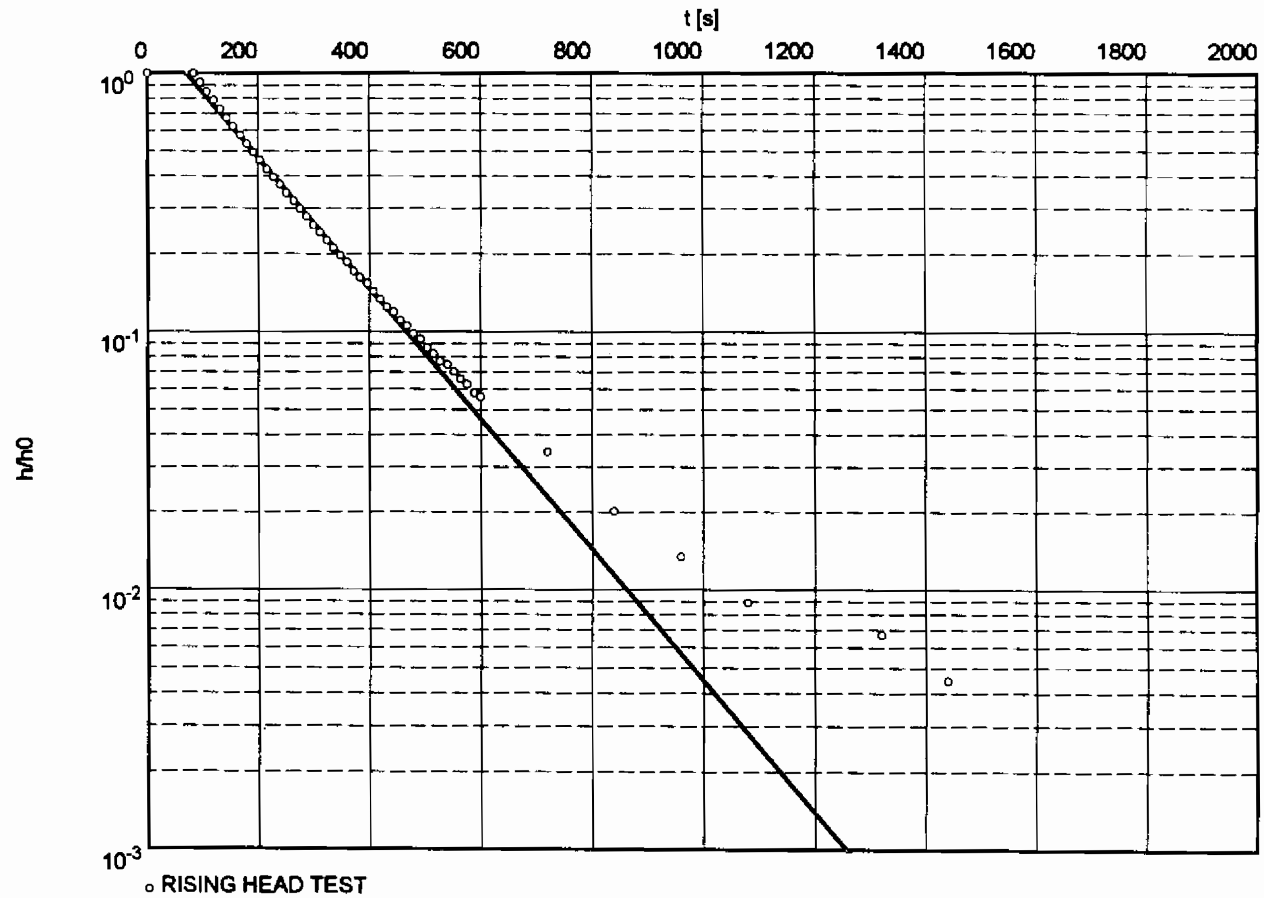
Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD01D	FALLING HEAD TEST

Static water level: 0.00 ft below datum

	Pumping test duration [s]	Water level [ft]	Drawdown [ft]	
101	1080	-0.02	-0.02	
102	1200	-0.01	-0.01	
103	1320	-0.01	-0.01	

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 1 Project: ZONE D–NAVBASE CHARLESTON Evaluated by: T. Kafka / Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD01D	



Hydraulic conductivity [ft/s]: 8.99×10^{-6}

Hydraulic conductivity [ft/day]: 0.78

L = 5.5 ft
b = 5.5 ft
D = 5.5 ft (full penetration)
rc = 0.083 ft

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 2 Project: ZONE D--NAVBASE CHARLESTON Evaluated by: T. Kafka / Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD01D	RISING HEAD TEST

Static water level: 0.00 ft below datum

	Pumping test duration [s]	Water level [ft]	Drawdown [ft]	
1	0	1.34	1.34	
2	23	2.09	2.09	
3	24	2.13	2.13	
4	25	2.09	2.09	
5	26	2.07	2.07	
6	27	2.05	2.05	
7	28	2.03	2.03	
8	29	2.01	2.01	
9	30	1.99	1.99	
10	31	1.97	1.97	
11	32	1.95	1.95	
12	33	1.94	1.94	
13	34	1.92	1.92	
14	35	1.91	1.91	
15	36	1.89	1.89	
16	37	1.88	1.88	
17	38	1.86	1.86	
18	39	1.85	1.85	
19	40	1.84	1.84	
20	41	1.82	1.82	
21	42	1.81	1.81	
22	43	1.80	1.80	
23	44	1.78	1.78	
24	45	1.77	1.77	
25	46	1.76	1.76	
26	47	1.74	1.74	
27	48	1.73	1.73	
28	49	1.72	1.72	
29	50	1.70	1.70	
30	51	1.70	1.70	
31	52	1.68	1.68	
32	53	1.67	1.67	
33	54	1.66	1.66	
34	55	1.65	1.65	
35	56	1.63	1.63	
36	57	1.62	1.62	
37	58	1.61	1.61	
38	59	1.60	1.60	
39	60	1.59	1.59	
40	72	1.46	1.46	
41	84	1.34	1.34	
42	96	1.24	1.24	
43	108	1.14	1.14	
44	120	1.06	1.06	
45	132	0.97	0.97	
46	144	0.90	0.90	
47	156	0.84	0.84	
48	168	0.77	0.77	
49	180	0.71	0.71	

EnSafe/Allen & Hoshall 935 Houston Northcutt Blvd. Ste 113 Mt. Pleasant, SC. 29464 (803) 884-0029	slug/bail test analysis BOUWER-RICE's method	Appendix, Page 3 Project: ZONE D–NAVBASE CHARLESTON Evaluated by: T. Kafka — Date: 27 JAN 97

Slug Test No. 1	Test conducted on: 16 JAN 97
NBCD\GDD01D	RISING HEAD TEST

Static water level: 0.00 ft below datum

	Pumping test duration [s]	Water level [ft]	Drawdown [ft]	
51	204	0.62	0.62	
52	216	0.57	0.57	
53	228	0.53	0.53	
54	240	0.50	0.50	
55	252	0.46	0.46	
56	264	0.43	0.43	
57	276	0.40	0.40	
58	288	0.37	0.37	
59	300	0.35	0.35	
60	312	0.32	0.32	
61	324	0.30	0.30	
62	336	0.28	0.28	
63	348	0.26	0.26	
64	360	0.25	0.25	
65	372	0.23	0.23	
66	384	0.22	0.22	
67	396	0.20	0.20	
68	408	0.19	0.19	
69	420	0.18	0.18	
70	432	0.17	0.17	
71	444	0.16	0.16	
72	456	0.15	0.15	
73	468	0.14	0.14	
74	480	0.13	0.13	
75	492	0.13	0.13	
76	504	0.12	0.12	
77	516	0.11	0.11	
78	528	0.10	0.10	
79	540	0.10	0.10	
80	552	0.09	0.09	
81	564	0.09	0.09	
82	576	0.08	0.08	
83	588	0.08	0.08	
84	600	0.08	0.08	
85	720	0.05	0.05	
86	840	0.03	0.03	
87	960	0.02	0.02	
88	1080	0.01	0.01	
89	1320	0.01	0.01	
90	1440	0.01	0.01	

APPENDIX D

ANALYTICAL DATA

TALCP3
'22/97

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

Page: 1
Time: 13:23

(9 HERB	SAMPLE ID -------->	GDD-C-B006-01						
	ORIGINAL ID ----->	GDDCB00601						
	LAB SAMPLE ID --->	27229.01						
	ID FROM REPORT -->	GDDCB00601						
	SAMPLE DATE ----->	10/07/96						
	DATE EXTRACTED -->	10/10/96						
	DATE ANALYZED --->	10/19/96						
	MATRIX ---------->	Soil						
	UNITS ----------->	UG/KG	A					
CAS #	Parameter	27228	VAL					
94-75-7	2,4-D	67.	U					
93-72-1	2,4,5-TP (Silvex)	15.	U					
93-76-5	2,4,5-T	17.	U					
88-85-7	Dinoseb	15.	J					

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

(9 PEST

SAMPLE ID ------->	GDD-C-B006-01	
ORIGINAL ID ----->	GDDCB00601	
LAB SAMPLE ID --->	27229.01	
ID FROM REPORT -->	GDDCB00601	
SAMPLE DATE ----->	10/07/96	
DATE EXTRACTED -->	10/09/96	
DATE ANALYZED --->	10/24/96	
MATRIX ---------->	Soil	
UNITS ----------->	UG/KG	A

CAS #	Parameter	27228	VAL
319-84-6	alpha-BHC	1.4	U
319-85-7	beta-BHC	1.4	U
319-86-8	delta-BHC	1.4	U
58-89-9	gamma-BHC (Lindane)	1.4	U
76-44-8	Heptachlor	1.4	U
309-00-2	Aldrin	1.4	U
024-57-3	Heptachlor epoxide	1.4	U
959-98-8	Endosulfan I	1.4	U
60-57-1	Dieldrin	2.7	U
72-55-9	4,4'-DDE	4.2	
72-20-8	Endrin	2.7	U
213-65-9	Endosulfan II	2.7	U
72-54-8	4,4'-DDD	2.7	U
031-07-8	Endosulfan sulfate	2.7	U
50-29-3	4,4'-DDT	3.1	
72-43-5	Methoxychlor	14.	U
494-70-5	Endrin ketone	2.7	U
421-93-4	Endrin aldehyde	2.7	U
103-71-9	alpha-Chlordane	1.4	U
103-74-2	gamma-Chlordane	1.4	U
001-35-2	Toxaphene	90.	U
674-11-2	Aroclor-1016	36.	U
104-28-2	Aroclor-1221	36.	U
141-16-5	Aroclor-1232	36.	U
469-21-9	Aroclor-1242	36.	U
672-29-6	Aroclor-1248	36.	U
097-69-1	Aroclor-1254	73.	U
096-82-5	Aroclor-1260	73.	U

*** Validation Complete ***

X9 SVOA

	SAMPLE ID ------->	GDD-C-B006-01						
	ORIGINAL ID ----->	GDDCB00601						
	LAB SAMPLE ID --->	27229.01						
	ID FROM REPORT -->	GDDCB00601						
	SAMPLE DATE ----->	10/07/96						
	DATE EXTRACTED -->	10/09/96						
	DATE ANALYZED --->	10/23/96						
	MATRIX ---------->	Soil						
	UNITS ----------->	UG/KG	A					
CAS #	Parameter	27228	VAL					
108-95-2	Phenol	360.	U					
111-44-4	bis(2-Chloroethyl)ether	360.	U					
95-57-8	2-Chlorophenol	360.	U					
541-73-1	1,3-Dichlorobenzene	360.	U					
106-46-7	1,4-Dichlorobenzene	360.	U					
100-51-6	Benzyl alcohol	360.	U					
95-50-1	1,2-Dichlorobenzene	360.	U					
95-48-7	2-Methylphenol (o-Cresol)	360.	U					
108-60-1	2,2'-oxybis(1-Chloropropane)	360.	U					
106-44-5	4-Methylphenol (p-Cresol)	360.	U					
621-64-7	N-Nitroso-di-n-propylamine	360.	U					
67-72-1	Hexachloroethane	360.	U					
98-95-3	Nitrobenzene	360.	U					
78-59-1	Isophorone	360.	U					
88-75-5	2-Nitrophenol	360.	U					
105-67-9	2,4-Dimethylphenol	360.	U					
111-91-1	bis(2-Chloroethoxy)methane	360.	U					
120-83-2	2,4-Dichlorophenol	360.	U					
120-82-1	1,2,4-Trichlorobenzene	360.	U					
91-20-3	Naphthalene	360.	U					
106-47-8	4-Chloroaniline	360.	U					
87-68-3	Hexachlorobutadiene	360.	U					
59-50-7	4-Chloro-3-methylphenol	360.	U					
91-57-6	2-Methylnaphthalene	360.	U					
77-47-4	Hexachlorocyclopentadiene	360.	U					
88-06-2	2,4,6-Trichlorophenol	360.	U					
95-95-4	2,4,5-Trichlorophenol	1700.	U					
91-58-7	2-Chloronaphthalene	360.	U					
88-74-4	2-Nitroaniline	1700.	U					
131-11-3	Dimethyl phthalate	360.	U					
208-96-8	Acenaphthylene	360.	U					
606-20-2	2,6-Dinitrotoluene	360.	U					
99-09-2	3-Nitroaniline	1700.	U					
83-32-9	Acenaphthene	360.	U					
51-28-5	2,4-Dinitrophenol	1700.	U					
100-02-7	4-Nitrophenol	1700.	U					

*** Validation Complete ***

TALCP3
/22/97

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

Page: 4
Time: 13:23

K9 SVOA

SAMPLE ID ------->	GDD-C-B006-01
ORIGINAL ID ----->	GDDCB00601
LAB SAMPLE ID --->	27229.01
ID FROM REPORT -->	GDDCB00601
SAMPLE DATE ----->	10/07/96
DATE EXTRACTED -->	10/09/96
DATE ANALYZED --->	10/23/96
MATRIX ---------->	Soil
UNITS ----------->	UG/KG A

CAS #	Parameter	27228	VAL
132-64-9	Dibenzofuran	360.	U
121-14-2	2,4-Dinitrotoluene	360.	U
84-66-2	Diethylphthalate	360.	U
7005-72-3	4-Chlorophenylphenylether	360.	U
86-73-7	Fluorene	360.	U
100-01-6	4-Nitroaniline	1700.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	1700.	U
86-30-6	N-Nitrosodiphenylamine	360.	U
101-55-3	4-Bromophenyl-phenylether	360.	U
118-74-1	Hexachlorobenzene	360.	U
87-86-5	Pentachlorophenol	1700.	U
85-01-8	Phenanthrene	71.	J
120-12-7	Anthracene	360.	U
86-74-8	Carbazole	360.	UR
84-74-2	Di-n-butylphthalate	360.	U
206-44-0	Fluoranthene	60.	J
129-00-0	Pyrene	78.	J
85-68-7	Butylbenzylphthalate	360.	U
91-94-1	3,3'-Dichlorobenzidine	720.	U
56-55-3	Benzo(a)anthracene	51.	J
218-01-9	Chrysene	60.	J
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	360.	U
117-84-0	Di-n-octyl phthalate	360.	U
205-99-2	Benzo(b)fluoranthene	76.	J
207-08-9	Benzo(k)fluoranthene	360.	U
50-32-8	Benzo(a)pyrene	49.	J
193-39-5	Indeno(1,2,3-cd)pyrene	360.	U
53-70-3	Dibenz(a,h)anthracene	360.	U
191-24-2	Benzo(g,h,i)perylene	41.	J
110-86-1	Pyridine	360.	U
62-75-9	N-Nitrosodimethylamine	360.	U
66-27-3	Methyl methanesulfonate	1700.	U
62-53-3	Aniline	360.	U
10595-95-6	N-Nitrosomethylethylamine	360.	UJ
924-16-3	N-Nitroso-di-n-butylamine	360.	UJ
55-18-5	N-Nitrosodiethylamine	360.	UJ

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

X9 SVOA

	SAMPLE ID ------->	GDD-C-B006-01	
	ORIGINAL ID ----->	GDDCB00601	
	LAB SAMPLE ID --->	27229.01	
	ID FROM REPORT -->	GDDCB00601	
	SAMPLE DATE ----->	10/07/96	
	DATE EXTRACTED -->	10/09/96	
	DATE ANALYZED --->	10/23/96	
	MATRIX ---------->	Soil	
	UNITS ----------->	UG/KG	A
CAS #	Parameter	27228	VAL
62-50-0	Ethyl methanesulfonate	360.	U
109-06-8	2-Picoline	360.	U
98-86-2	Acetophenone	360.	UJ
930-55-2	N-Nitrosopyrrolidine	360.	UJ
108-39-4	3-Methylphenol (m-Cresol)	360.	UJ
59-89-2	N-Nitrosomorpholine	360.	U
95-53-4	o-Toluidine	360.	UJ
119-93-7	3,3-Dimethylbenzidine	360.	UJ
96-12-8	1,2-Dibromo-3-Chloropropane	360.	UR
100-75-4	N-Nitrosopiperidine	360.	UJ
126-68-1	O,O,O-Triethylphosphorothioate	360.	UJ
122-09-8	a,a-Dimethylphenethylamine	360.	U
87-65-0	2,6-Dichlorophenol	360.	U
1888-71-7	Hexachloropropene	360.	U
106-50-3	p-Phenylenediamine	1700.	U
95-94-3	1,2,4,5-Tetrachlorobenzene	360.	U
94-59-7	Safrole	360.	UJ
120-58-1	Isosafrole	360.	UJ
130-15-4	1,4-Naphthoquinone	360.	UR
99-65-0	1,3-Dinitrobenzene	360.	UR
58-90-2	2,3,4,6-Tetrachlorophenol	360.	U
608-93-5	Pentachlorobenzene	360.	U
134-32-7	1-Naphthylamine	360.	U
56-57-5	4-Nitroquinoline 1-oxide	1700.	U
91-59-8	2-Naphthylamine	360.	UJ
297-97-2	Thionazin	720.	UJ
99-55-8	5-Nitro-o-toluidine	360.	UJ
122-39-4	Diphenylamine	360.	UJ
689-24-5	Sulfotep	720.	U
99-35-4	1,3,5-Trinitrobenzene	360.	U
298-02-2	Phorate	360.	UJ
62-44-2	Phenacetin	360.	UR
303-16-4	Diallate	360.	UR
60-51-5	Dimethoate	360.	UJ
92-67-1	4-Aminobiphenyl	360.	UJ
950-58-5	Pronamide	360.	UJ

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

X9 SVOA

SAMPLE ID ------->	GDD-C-B006-01	
ORIGINAL ID ----->	GDDCB00601	
LAB SAMPLE ID --->	27229.01	
ID FROM REPORT -->	GDDCB00601	
SAMPLE DATE ----->	10/07/96	
DATE EXTRACTED -->	10/09/96	
DATE ANALYZED --->	10/23/96	
MATRIX ---------->	Soil	
UNITS ----------->	UG/KG	A

CAS #	Parameter	27228	VAL
82-68-8	Pentachloronitrobenzene	1700.	UJ
298-04-4	Disulfoton	360.	UJ
88-85-7	Dinoseb	360.	U
298-00-0	Methyl parathion	720.	UJ
56-38-2	Parathion	720.	UJ
91-80-5	Methapyrilene	720.	U
465-73-6	Isodrin	720.	UJ
140-57-8	Aramite	1700.	U
60-11-7	p-(Dimethylamino)azobenzene	360.	U
510-15-6	Chlorobenzilate	360.	U
143-50-0	Kepone	1700.	UR
52-85-7	Famphur	360.	UJ
53-96-3	Acetamidofluorene	360.	UJ
57-97-6	7,12-Dimethylbenz(a)anthracene	1700.	UJ
70-30-4	Hexachlorophene	7200.	UR
56-49-5	3-Methyl cholanthrene	360.	UR

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

X9 VOA

	SAMPLE ID ------->	GDD-C-B006-01					
	ORIGINAL ID ----->	GDDCB00601					
	LAB SAMPLE ID --->	27229.01					
	ID FROM REPORT -->	GDDCB00601					
	SAMPLE DATE ----->	10/07/96					
	DATE ANALYZED --->	10/13/96					
	MATRIX ---------->	Soil					
	UNITS ----------->	UG/KG A					
CAS #	Parameter	27228 VAL					
74-87-3	Chloromethane	11. U					
74-83-9	Bromomethane	11. U					
75-01-4	Vinyl chloride	11. U					
75-00-3	Chloroethane	11. U					
75-09-2	Methylene chloride	10. U					
67-64-1	Acetone	11. U					
75-15-0	Carbon disulfide	5. U					
75-35-4	1,1-Dichloroethene	5. U					
75-34-3	1,1-Dichloroethane	5. U					
540-59-0	1,2-Dichloroethene (total)	5. U					
67-66-3	Chloroform	5. U					
107-06-2	1,2-Dichloroethane	5. U					
78-93-3	2-Butanone (MEK)	11. U					
71-55-6	1,1,1-Trichloroethane	5. U					
56-23-5	Carbon tetrachloride	5. U					
108-05-4	Vinyl acetate	11. U					
75-27-4	Bromodichloromethane	5. U					
78-87-5	1,2-Dichloropropane	5. U					
0061-01-5	cis-1,3-Dichloropropene	5. U					
79-01-6	Trichloroethene	5. U					
124-48-1	Dibromochloromethane	5. U					
79-00-5	1,1,2-Trichloroethane	5. U					
71-43-2	Benzene	5. U					
0061-02-6	trans-1,3-Dichloropropene	5. U					
75-25-2	Bromoform	5. U					
108-10-1	4-Methyl-2-Pentanone (MIBK)	11. U					
591-78-6	2-Hexanone	11. U					
127-18-4	Tetrachloroethene	5. U					
108-88-3	Toluene	5. U					
79-34-5	1,1,2,2-Tetrachloroethane	5. U					
108-90-7	Chlorobenzene	5. U					
100-41-4	Ethylbenzene	5. U					
100-42-5	Styrene	5. U					
330-20-7	Xylene (Total)	5. U					
110-75-8	2-Chloroethyl vinyl ether	11. U					
107-02-8	Acrolein	54. UR					
74-88-4	Methyl iodide	5. U					

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

X9 VOA

	SAMPLE ID ------->	GDD-C-B006-01						
	ORIGINAL ID ----->	GDDCB00601						
	LAB SAMPLE ID --->	27229.01						
	ID FROM REPORT -->	GDDCB00601						
	SAMPLE DATE ----->	10/07/96						
	DATE ANALYZED --->	10/13/96						
	MATRIX ---------->	Soil						
	UNITS ----------->	UG/KG	A					
CAS #	Parameter	27228	VAL					
107-05-1	3-Chloropropene	5.	U					
126-99-8	Chloroprene	5.	U					
110-57-6	trans-1,4-Dichloro-2-butene	5.	U					
76-01-7	Pentachloroethane	5.	U					
75-05-8	Acetonitrile	220.	UR					
107-13-1	Acrylonitrile	54.	U					
107-12-0	Propionitrile	110.	U					
126-98-7	Methacrylonitrile	110.	U					
78-83-1	Isobutyl alcohol	220.	UR					
123-91-1	1,4-Dioxane	540.	UR					
80-62-6	Methyl methacrylate	5.	U					
97-63-2	Ethyl methacrylate	5.	U					
106-93-4	1, 2-Dibromoethane	5.	U					
630-20-6	1,1,1,2-Tetrachloroethane	5.	U					
96-18-4	1,2,3-Trichloropropane	5.	U					
75-71-8	Dichlorodifluoromethane	5.	U					
75-69-4	Trichlorofluoromethane	5.	U					
74-95-3	Methylene bromide	11.	U					
96-12-8	1,2-Dibromo-3-Chloropropane	11.	U					

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

ANIDE													
	SAMPLE ID ------->	GDD-S-B001-01		GDD-S-B001-02		GDD-S-B002-01		GDD-S-B002-02		GDD-S-B003-01		GDD-S-B003-02	
	ORIGINAL ID ----->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	LAB SAMPLE ID --->	26738.01		26738.02		27259.01		27259.02		27279.01		27279.02	
	ID FROM REPORT -->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	SAMPLE DATE ----->	08/26/96		08/26/96		10/09/96		10/09/96		10/10/96		10/10/96	
	DATE EXTRACTED -->	09/04/96		09/04/96		10/13/96		10/13/96		10/17/96		10/17/96	
	DATE ANALYZED --->	09/05/96		09/05/96		10/14/96		10/14/96		10/19/96		10/19/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	MG/KG	A	MG/KG	A	MG/KG	A	MG/KG	A	MG/KG	A	MG/KG	A
CAS #	Parameter	26738	VAL	26738	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
57-12-5	Cyanide (CN)	0.12	J	0.16	J	0.19	U	0.18	U	0.12	U	0.11	U

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

YANIDE													
	SAMPLE ID ------->	GDD-S-B004-01		GDD-S-B004-02		GDD-S-B005-01		GDD-S-B005-02		GDD-S-B006-01		GDD-C-B006-01	
	ORIGINAL ID ----->	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDCB00601	
	LAB SAMPLE ID --->	27228.03		27228.06		27228.08		27228.09		27228.01		27229.01	
	ID FROM REPORT -->	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDCB00601	
	SAMPLE DATE ----->	10/07/96		10/07/96		10/07/96		10/07/96		10/07/96		10/07/96	
	DATE EXTRACTED -->	10/10/96		10/10/96		10/10/96		10/10/96		10/10/96		10/10/96	
	DATE ANALYZED --->	10/14/96		10/14/96		10/14/96		10/14/96		10/14/96		10/14/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	MG/KG	A	MG/KG	A	MG/KG	A	MG/KG	A	MG/KG	A	MG/KG	A
CAS #	Parameter	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
57-12-5	Cyanide (CN)	0.1	U	0.11	U	0.12	U	0.13	U	0.13	U	0.15	J

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

'ANIDE

	SAMPLE ID ------->	GDD-S-B006-02						
	ORIGINAL ID ----->	GDDSB00602						
	LAB SAMPLE ID --->	27228.02						
	ID FROM REPORT -->	GDDSB00602						
	SAMPLE DATE ----->	10/07/96						
	DATE EXTRACTED -->	10/10/96						
	DATE ANALYZED --->	10/14/96						
	MATRIX ---------->	Soil						
	UNITS ----------->	MG/KG	A					
CAS #	Parameter	27228	VAL					
57-12-5	Cyanide (CN)	0.11	U					

*** Validation Complete ***

TALCP3
/22/97

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

XACHROME		
	SAMPLE ID ------->	GDD-C-B006-01
	ORIGINAL ID ----->	GDDCB00601
	LAB SAMPLE ID --->	27229.01
	ID FROM REPORT -->	GDDCB00601
	SAMPLE DATE ----->	10/07/96
	DATE EXTRACTED -->	10/21/96
	DATE ANALYZED --->	10/21/96
	MATRIX ---------->	Soil
	UNITS ----------->	MG/KG A

CAS #	Parameter	27228	VAL
8540-29-9	Chromium (Hexavalent)	0.272	U

*** Validation Complete ***

346-DIOX	SAMPLE ID ------->	GDD-C-B006-01	
	ORIGINAL ID ----->	GDDCB00601	
	LAB SAMPLE ID --->	27229.01	
	ID FROM REPORT -->	GDDCB00601	
	SAMPLE DATE ----->	10/07/96	
	DATE EXTRACTED -->	10/10/96	
	DATE ANALYZED --->	10/15/96	
	MATRIX ---------->	Soil	
	UNITS ----------->	NG/KG	A
CAS #	Parameter	27228	VAL
1746-01-6	2378-TCDD	0.075	U
0321-76-4	12378-PeCDD	0.388	
9227-28-6	123478-HxCDD	1.26	
7653-85-7	123678-HxCDD	3.02	
9408-74-3	123789-HxCDD	2.56	
5822-46-9	1234678-HpCDD	90.3	
5268-87-9	OCDD	635.	
1207-31-9	2378-TCDF	0.117	U
7117-41-6	12378-PeCDF	0.071	U
7117-31-4	23478-PeCDF	0.295	
0648-26-9	123478-HxCDF	2.65	J
7117-44-9	123678-HxCDF	1.14	
2918-21-9	123789-HxCDF	0.205	U
0851-34-5	234678-HxCDF	1.84	U
7562-39-4	1234678-HpCDF	33.3	
5673-89-7	1234789-HpCDF	2.41	U
9001-02-0	OCDF	64.7	
1903-57-5	Total Tetra-Dioxins	2.22	
5088-22-9	Total Penta-Dioxins	3.75	
4465-46-8	Total Hexa-Dioxins	47.8	
7871-00-4	Total Hepta-Dioxins	232.	
1722-27-5	Total Tetra-Furans	3.6	
0602-15-4	Total Penta-Furans	11.2	
5684-94-1	Total Hexa-Furans	28.9	
8998-75-3	Total Hepta-Furans	33.3	

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

846-META													
	SAMPLE ID ------->	GDD-S-B001-01		GDD-S-B001-02		GDD-S-B002-01		GDD-S-B002-02		GDD-S-B003-01		GDD-S-B003-02	
	ORIGINAL ID ----->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	LAB SAMPLE ID --->	26738.01		26738.02		27259.01		27259.02		27279.01		27279.02	
	ID FROM REPORT -->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	SAMPLE DATE ----->	08/26/96		08/26/96		10/09/96		10/09/96		10/10/96		10/10/96	
	DATE EXTRACTED -->	09/06/96		09/06/96		10/14/96		10/14/96		10/14/96		10/14/96	
	DATE ANALYZED --->	09/12/96		09/12/96		10/23/96		10/23/96		10/16/96		10/16/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	MG/KG	A	MG/KG	A	MG/KG	A	MG/KG	A	MG/KG	A	MG/KG	A
CAS #	Parameter	26738	VAL	26738	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
7429-90-5	Aluminum (Al)	3560.		2850.		3690.		3160.		4020.		4450.	
7440-36-0	Antimony (Sb)	0.33	U	0.46	U	1.7	J	0.51	UJ	0.37	UJ	0.32	UJ
7440-38-2	Arsenic (As)	4.5		1.6		1.2		1.2	J	0.84	J	1.	J
7440-39-3	Barium (Ba)	12.1		10.4		19.6	J	15.2	J	11.1	J	7.7	J
7440-41-7	Beryllium (Be)	0.13	J	0.12	J	0.18	U	0.31	U	0.18	U	0.2	U
7440-43-9	Cadmium (Cd)	0.04	U	0.05	U	0.04	U	0.05	U	0.05	U	0.04	U
7440-70-2	Calcium (Ca)	2810.		483.		1770.		870.		344.		142.	
7440-47-3	Chromium (Cr)	5.9		5.3		5.5	J	8.1	J	4.9	J	5.4	J
7440-48-4	Cobalt (Co)	0.34	J	0.3	J	1.6	J	0.74	J	8.1		0.59	J
7440-50-8	Copper (Cu)	1.3	U	2.	U	116.		1.4	U	0.98	U	0.94	U
7439-89-6	Iron (Fe)	2180.		1360.		2060.		1620.		966.		916.	
7439-92-1	Lead (Pb)	3.1		2.2		18.7		2.1		2.2		1.6	
7439-95-4	Magnesium (Mg)	350.		245.		203.		310.		179.		215.	
7439-96-5	Manganese (Mn)	10.7		5.2		17.2	J	6.4	J	5.	J	4.6	J
7439-97-6	Mercury (Hg)	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
7440-02-0	Nickel (Ni)	1.2	J	0.95	J	1.4	J	2.3	J	2.	J	1.	J
7440-09-7	Potassium (K)	218.	U	249.	U	215.	U	252.	U	250.	U	215.	U
7782-49-2	Selenium (Se)	0.33	U	0.37	U	0.32	U	0.6	J	0.4	J	0.32	U
7440-22-4	Silver (Ag)	0.21	U	0.24	U	0.42	J	0.24	U	0.27	J	0.2	U
7440-23-5	Sodium (Na)	170.	J	179.	J	127.	U	145.	U	131.	U	122.	U
7440-28-0	Thallium (Tl)	0.37	U	0.42	U	0.37	U	0.43	U	0.42	U	0.37	U
7440-31-5	Tin (Sn)	0.69	U	1.1	U	6.6	U	1.2	U	1.1	U	1.2	U
7440-62-2	Vanadium (V)	6.3		3.7		2.5		4.2		2.2		1.9	
7440-66-6	Zinc (Zn)	6.8		10.		13.6		12.8		3.8	U	3.5	U

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

346-META						
SAMPLE ID ------->	GDD-S-B004-01	GDD-S-B004-02	GDD-S-B005-01	GDD-S-B005-02	GDD-S-B006-01	GDD-C-B006-01
ORIGINAL ID ----->	GDDSB00401	GDDSB00402	GDDSB00501	GDDSB00502	GDDSB00601	GDDCB00601
LAB SAMPLE ID --->	27228.03	27228.06	27228.08	27228.09	27228.01	27229.01
ID FROM REPORT -->	GDDSB00401	GDDSB00402	GDDSB00501	GDDSB00502	GDDSB00601	GDDCB00601
SAMPLE DATE ----->	10/07/96	10/07/96	10/07/96	10/07/96	10/07/96	10/07/96
DATE EXTRACTED -->	10/14/96	10/14/96	10/14/96	10/14/96	10/14/96	10/14/96
DATE ANALYZED --->	10/23/96	10/23/96	10/23/96	10/23/96	10/23/96	10/23/96
MATRIX ---------->	Soil	Soil	Soil	Soil	Soil	Soil
UNITS ----------->	MG/KG A	MG/KG A	MG/KG A	MG/KG A	MG/KG A	MG/KG A

CAS #	Parameter	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
7429-90-5	Aluminum (Al)	4530.		2920.		6510.		12800.		3560.		4040.	
7440-36-0	Antimony (Sb)	0.7	UJ	0.32	UJ	0.36	UJ	0.4	UJ	0.33	UJ	0.33	U
7440-38-2	Arsenic (As)	0.9	J	0.74	J	2.2		5.8		7.4		6.6	
7440-39-3	Barium (Ba)	9.7	J	13.1	J	18.2	J	28.9	J	20.2	J	19.1	
7440-41-7	Beryllium (Be)	0.12	U	0.14	U	0.21	U	0.83		0.31	U	0.32	U
7440-43-9	Cadmium (Cd)	0.04	U	0.04	U	0.05	U	0.3	J	0.11	J	0.08	J
7440-70-2	Calcium (Ca)	2570.		544.		1380.		82400.		15500.		13000.	
7440-47-3	Chromium (Cr)	4.5	J	2.5	J	6.3	J	40.7	J	9.7	J	10.5	
7440-48-4	Cobalt (Co)	0.42	J	0.06	U	17.1		5.9		0.67	J	0.95	J
7440-50-8	Copper (Cu)	0.97	U	0.6	U	1.5	U	6.2	U	6.7	U	8.9	U
7439-89-6	Iron (Fe)	2230.		1890.		2400.		11100.		3600.	J	6720.	J
7439-92-1	Lead (Pb)	6.3		1.4		5.1		9.2		21.1		20.9	
7439-95-4	Magnesium (Mg)	157.		102.		330.		5290.		850.		771.	
7439-96-5	Manganese (Mn)	13.6	J	9.1	J	11.9	J	50.6	J	23.3	J	31.2	
7439-97-6	Mercury (Hg)	0.03	U	0.04	U	0.04	U	0.05		0.06		0.06	
7440-02-0	Nickel (Ni)	1.4	J	0.84	J	3.6	J	11.9		4.7		4.2	
7440-09-7	Potassium (K)	205.	U	212.	U	242.	U	1240.		218.	U	217.	U
7782-49-2	Selenium (Se)	0.49	J	0.34	J	0.4	J	1.9		1.		1.2	
7440-22-4	Silver (Ag)	0.26	J	0.2	U	0.23	U	0.25	U	0.21	U	0.21	U
7440-23-5	Sodium (Na)	113.	U	146.	U	258.	U	1740.	U	237.	U	192.	U
7440-28-0	Thallium (Tl)	0.35	U	0.36	U	0.41	U	0.45	U	0.37	U	0.37	U
7440-31-5	Tin (Sn)	0.69	U	0.53	U	1.2	U	1.4	U	1.1	U	1.6	U
7440-62-2	Vanadium (V)	5.3		2.		3.8		28.6		9.1		9.1	
7440-66-6	Zinc (Zn)	9.1		11.		6.8	U	40.4		40.8		40.1	

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

46-META							
	SAMPLE ID ------->	GDD-S-B006-02					
	ORIGINAL ID ----->	GDDSB00602					
	LAB SAMPLE ID --->	27228.02					
	ID FROM REPORT -->	GDDSB00602					
	SAMPLE DATE ----->	10/07/96					
	DATE EXTRACTED -->	10/14/96					
	DATE ANALYZED --->	10/23/96					
	MATRIX ---------->	Soil					
	UNITS ----------->	MG/KG	A				

CAS #	Parameter	27228	VAL				
429-90-5	Aluminum (Al)	4600.					
440-36-0	Antimony (Sb)	0.6	UJ				
440-38-2	Arsenic (As)	1.9					
440-39-3	Barium (Ba)	13.9	J				
440-41-7	Beryllium (Be)	0.96					
440-43-9	Cadmium (Cd)	0.76					
440-70-2	Calcium (Ca)	2300.					
440-47-3	Chromium (Cr)	4.8	J				
440-48-4	Cobalt (Co)	1.1	J				
440-50-8	Copper (Cu)	2.6	U				
439-89-6	Iron (Fe)	1920.					
439-92-1	Lead (Pb)	7.1					
439-95-4	Magnesium (Mg)	240.					
439-96-5	Manganese (Mn)	13.9	J				
439-97-6	Mercury (Hg)	0.04	U				
440-02-0	Nickel (Ni)	3.3	J				
440-09-7	Potassium (K)	214.	U				
782-49-2	Selenium (Se)	1.2					
440-22-4	Silver (Ag)	0.5	J				
440-23-5	Sodium (Na)	180.	U				
440-28-0	Thallium (Tl)	0.68	J				
440-31-5	Tin (Sn)	1.7	U				
440-62-2	Vanadium (V)	5.					
440-66-6	Zinc (Zn)	14.4					

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

46-OP P							
	SAMPLE ID ------->	GDD-C-B006-01					
	ORIGINAL ID ----->	GDDCB00601					
	LAB SAMPLE ID --->	27229.01					
	ID FROM REPORT -->	GDDCB00601					
	SAMPLE DATE ----->	10/07/96					
	DATE EXTRACTED -->	10/09/96					
	DATE ANALYZED --->	10/22/96					
	MATRIX ---------->	Soil					
	UNITS ----------->	UG/KG A					
CAS #	Parameter	27228 VAL					
298-02-2	Phorate	73. U					
298-04-4	Disulfoton	130. U					
298-00-0	Methyl parathion	18. U					

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

46-PEST													
	SAMPLE ID -------->	GDD-S-B001-01 RE		GDD-S-B001-02		GDD-S-B002-01		GDD-S-B002-02		GDD-S-B003-01		GDD-S-B003-02	
	ORIGINAL ID ------>	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	LAB SAMPLE ID --->	26738.01		26738.02		27259.01		27259.02		27279.01		27279.02	
	ID FROM REPORT -->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	SAMPLE DATE ------>	08/26/96		08/26/96		10/09/96		10/09/96		10/10/96		10/10/96	
	DATE EXTRACTED -->	09/17/96		08/28/96		10/12/96		10/12/96		10/12/96		10/12/96	
	DATE ANALYZED --->	09/25/96		09/14/96		10/25/96		10/25/96		10/24/96		10/24/96	
	MATRIX ----------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ------------>	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A
CAS #	Parameter	26738	VAL	26738	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
319-84-6	alpha-BHC	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
319-85-7	beta-BHC	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
319-86-8	delta-BHC	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
58-89-9	gamma-BHC (Lindane)	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
76-44-8	Heptachlor	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
309-00-2	Aldrin	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
024-57-3	Heptachlor epoxide	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
959-98-8	Endosulfan I	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
60-57-1	Dieldrin	2.7	UJ	3.1	U	2.7	U	3.1	U	2.9	U	2.7	UJ
72-55-9	4,4'-DDE	2.7	UJ	3.1	U	2.7	U	3.1	U	2.9	U	2.7	UJ
72-20-8	Endrin	2.7	UJ	3.1	U	4.3	J	3.1	U	2.9	U	2.7	UJ
213-65-9	Endosulfan II	2.7	UJ	3.1	U	2.7	U	3.1	U	2.9	U	2.7	UJ
72-54-8	4,4'-DDD	2.7	UJ	3.1	U	2.7	U	3.1	U	2.9	U	2.7	UJ
031-07-8	Endosulfan sulfate	2.7	UJ	3.1	U	2.7	U	3.1	U	2.9	U	2.7	UJ
50-29-3	4,4'-DDT	2.7	UJ	3.1	U	2.7	U	3.1	U	2.9	U	2.7	UJ
72-43-5	Methoxychlor	14.	UJ	16.	U	14.	U	16.	U	15.	U	14.	UJ
494-70-5	Endrin ketone	2.7	UJ	3.1	U	2.7	U	3.1	U	2.9	U	2.7	UJ
421-93-4	Endrin aldehyde	2.7	UJ	3.1	U	2.7	U	3.1	U	2.9	U	2.7	UJ
103-71-9	alpha-Chlordane	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
103-74-2	gamma-Chlordane	1.4	UJ	1.6	U	1.4	U	1.6	U	1.5	U	1.4	UJ
001-35-2	Toxaphene	90.	UJ	100.	U	89.	U	100.	U	95.	U	89.	UJ
674-11-2	Aroclor-1016	36.	UJ	41.	U	35.	U	41.	U	38.	U	35.	UJ
104-28-2	Aroclor-1221	36.	UJ	41.	U	35.	U	41.	U	38.	U	35.	UJ
141-16-5	Aroclor-1232	36.	UJ	41.	U	35.	U	41.	U	38.	U	35.	UJ
469-21-9	Aroclor-1242	36.	UJ	41.	U	35.	U	41.	U	38.	U	35.	UJ
672-29-6	Aroclor-1248	36.	UJ	41.	U	35.	U	41.	U	38.	U	35.	UJ
097-69-1	Aroclor-1254	73.	UJ	84.	U	72.	U	84.	U	77.	U	72.	UJ
096-82-5	Aroclor-1260	73.	UJ	84.	U	72.	U	84.	U	77.	U	72.	UJ

*** Validation Complete ***

TALCP3 /22/97

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

346-PEST		GDD-S-B004-01 RE		GDD-S-B004-02		GDD-S-B005-01		GDD-S-B005-02		GDD-S-B006-01		GDD-S-B006-02	
	SAMPLE ID ------->	GDD-S-B004-01 RE		GDD-S-B004-02		GDD-S-B005-01		GDD-S-B005-02		GDD-S-B006-01		GDD-S-B006-02	
	ORIGINAL ID ----->	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDSB00602	
	LAB SAMPLE ID --->	27228.03		27228.06		27228.08		27228.09		27228.01		27228.02	
	ID FROM REPORT -->	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDSB00602	
	SAMPLE DATE ----->	10/07/96		10/07/96		10/07/96		10/07/96		10/07/96		10/07/96	
	DATE EXTRACTED -->	10/29/96		10/09/96		10/09/96		10/09/96		10/09/96		10/09/96	
	DATE ANALYZED --->	11/01/96		10/23/96		10/23/96		10/24/96		10/23/96		10/23/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A
CAS #	Parameter	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
319-84-6	alpha-BHC	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
319-85-7	beta-BHC	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
319-86-8	delta-BHC	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
58-89-9	gamma-BHC (Lindane)	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
76-44-8	Heptachlor	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
309-00-2	Aldrin	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
1024-57-3	Heptachlor epoxide	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
959-98-8	Endosulfan I	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
60-57-1	Dieldrin	2.6	UJ	2.6	U	3.	U	3.3	U	2.7	U	2.6	U
72-55-9	4,4'-DDE	2.6	UJ	2.6	U	3.	U	3.3	U	5.4		2.6	U
72-20-8	Endrin	2.6	UJ	2.6	U	3.	U	3.3	U	2.7	U	2.6	U
213-65-9	Endosulfan II	2.6	UJ	2.6	U	3.	U	3.3	U	2.7	U	2.6	U
72-54-8	4,4'-DDD	2.6	UJ	2.6	U	3.	U	3.3	U	2.7	U	2.6	U
031-07-8	Endosulfan sulfate	2.6	UJ	2.6	U	3.	U	3.3	U	2.7	U	2.6	U
50-29-3	4,4'-DDT	2.6	UJ	2.6	U	3.	U	3.3	U	3.		2.6	U
72-43-5	Methoxychlor	13.	UJ	14.	U	16.	U	17.	U	14.	U	14.	U
494-70-5	Endrin ketone	2.6	UJ	2.6	U	3.	U	3.3	U	2.7	U	2.6	U
421-93-4	Endrin aldehyde	2.6	UJ	2.6	U	3.	U	3.3	U	2.7	U	2.6	U
103-71-9	alpha-Chlordane	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
103-74-2	gamma-Chlordane	1.3	UJ	1.4	U	1.6	U	1.7	U	1.4	U	1.4	U
001-35-2	Toxaphene	85.	UJ	88.	U	100.	U	110.	U	90.	U	88.	U
674-11-2	Aroclor-1016	34.	UJ	35.	U	40.	U	43.	U	36.	U	35.	U
104-28-2	Aroclor-1221	34.	UJ	35.	U	40.	U	43.	U	36.	U	35.	U
141-16-5	Aroclor-1232	34.	UJ	35.	U	40.	U	43.	U	36.	U	35.	U
469-21-9	Aroclor-1242	34.	UJ	35.	U	40.	U	43.	U	36.	U	35.	U
672-29-6	Aroclor-1248	34.	UJ	35.	U	40.	U	43.	U	36.	U	35.	U
097-69-1	Aroclor-1254	68.	UJ	71.	U	81.	U	88.	U	73.	U	71.	U
096-82-5	Aroclor-1260	68.	UJ	71.	U	81.	U	88.	U	73.	U	71.	U

*** Validation Complete ***

ALCP3
22/97

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

46-SVOA												
	SAMPLE ID ------->	GDD-S-B001-01		GDD-S-B001-02		GDD-S-B002-01		GDD-S-B002-02		GDD-S-B003-01		GDD-S-B003-02	
	ORIGINAL ID ----->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	LAB SAMPLE ID --->	26738.01		26738.02		27259.01		27259.02		27279.01		27279.02	
	ID FROM REPORT -->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	SAMPLE DATE ----->	08/26/96		08/26/96		10/09/96		10/09/96		10/10/96		10/10/96	
	DATE EXTRACTED -->	08/28/96		08/28/96		10/12/96		10/12/96		10/12/96		10/12/96	
	DATE ANALYZED --->	09/06/96		09/06/96		10/24/96		10/24/96		10/28/96		10/28/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A
CAS #	Parameter	26738	VAL	26738	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
108-95-2	Phenol	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
111-44-4	bis(2-Chloroethyl)ether	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
95-57-8	2-Chlorophenol	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
541-73-1	1,3-Dichlorobenzene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
106-46-7	1,4-Dichlorobenzene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
100-51-6	Benzyl alcohol	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
95-50-1	1,2-Dichlorobenzene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
95-48-7	2-Methylphenol (o-Cresol)	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
106-44-5	4-Methylphenol (p-Cresol)	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
621-64-7	N-Nitroso-di-n-propylamine	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
67-72-1	Hexachloroethane	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
98-95-3	Nitrobenzene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
78-59-1	Isophorone	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
88-75-5	2-Nitrophenol	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
105-67-9	2,4-Dimethylphenol	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
65-85-0	Benzoic acid	1700.	U	2000.	U	1700.	U	2000.	U	1800.	U	1700.	U
111-91-1	bis(2-Chloroethoxy)methane	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
120-83-2	2,4-Dichlorophenol	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
120-82-1	1,2,4-Trichlorobenzene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
91-20-3	Naphthalene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
106-47-8	4-Chloroaniline	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
87-68-3	Hexachlorobutadiene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
59-50-7	4-Chloro-3-methylphenol	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
91-57-6	2-Methylnaphthalene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
77-47-4	Hexachlorocyclopentadiene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
88-06-2	2,4,6-Trichlorophenol	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
95-95-4	2,4,5-Trichlorophenol	1700.	U	2000.	U	1700.	U	2000.	U	1800.	U	1700.	U
91-58-7	2-Chloronaphthalene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
88-74-4	2-Nitroaniline	1700.	U	2000.	U	1700.	U	2000.	U	1800.	U	1700.	U
31-11-3	Dimethyl phthalate	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
08-96-8	Acenaphthylene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
06-20-2	2,6-Dinitrotoluene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
99-09-2	3-Nitroaniline	1700.	U	2000.	U	1700.	U	2000.	U	1800.	U	1700.	U
83-32-9	Acenaphthene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
51-28-5	2,4-Dinitrophenol	1700.	U	2000.	U	1700.	U	2000.	U	1800.	U	1700.	U

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

846-SVOA													
	SAMPLE ID ------->	GDD-S-B001-01		GDD-S-B001-02		GDD-S-B002-01		GDD-S-B002-02		GDD-S-B003-01		GDD-S-B003-02	
	ORIGINAL ID ----->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	LAB SAMPLE ID --->	26738.01		26738.02		27259.01		27259.02		27279.01		27279.02	
	ID FROM REPORT -->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	SAMPLE DATE ----->	08/26/96		08/26/96		10/09/96		10/09/96		10/10/96		10/10/96	
	DATE EXTRACTED -->	08/28/96		08/28/96		10/12/96		10/12/96		10/12/96		10/12/96	
	DATE ANALYZED --->	09/06/96		09/06/96		10/24/96		10/24/96		10/28/96		10/28/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A
CAS #	Parameter	26738	VAL	26738	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
100-02-7	4-Nitrophenol	1700.	U	2000.	U	1700.	U	2000.	U	1800.	U	1700.	U
132-64-9	Dibenzofuran	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
121-14-2	2,4-Dinitrotoluene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
84-66-2	Diethylphthalate	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
7005-72-3	4-Chlorophenylphenylether	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
86-73-7	Fluorene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
100-01-6	4-Nitroaniline	1700.	U	2000.	U	1700.	U	2000.	U	1800.	U	1700.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	1700.	U	2000.	U	1700.	U	2000.	U	1800.	U	1700.	U
86-30-6	N-Nitrosodiphenylamine	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
101-55-3	4-Bromophenyl-phenylether	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
118-74-1	Hexachlorobenzene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
87-86-5	Pentachlorophenol	1700.	U	2000.	U	1700.	U	2000.	U	1800.	U	1700.	U
85-01-8	Phenanthrene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
120-12-7	Anthracene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
84-74-2	Di-n-butylphthalate	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
206-44-0	Fluoranthene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
129-00-0	Pyrene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
85-68-7	Butylbenzylphthalate	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
91-94-1	3,3'-Dichlorobenzidine	720.	U	820.	U	710.	U	820.	U	760.	U	710.	U
56-55-3	Benzo(a)anthracene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
218-01-9	Chrysene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
117-84-0	Di-n-octyl phthalate	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
205-99-2	Benzo(b)fluoranthene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
207-08-9	Benzo(k)fluoranthene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
50-32-8	Benzo(a)pyrene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
193-39-5	Indeno(1,2,3-cd)pyrene	360.	UJ	410.	UJ	350.	U	410.	U	380.	U	350.	U
53-70-3	Dibenz(a,h)anthracene	360.	U	410.	U	350.	U	410.	U	380.	U	350.	U
191-24-2	Benzo(g,h,i)perylene	360.	UJ	410.	UJ	350.	U	410.	U	380.	U	350.	U

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

846-SVOA

	SAMPLE ID -------->	GDD-S-B004-01		GDD-S-B004-02		GDD-S-B005-01		GDD-S-B005-02		GDD-S-B006-01		GDD-S-B006-02	
	ORIGINAL ID ------>	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDSB00602	
	LAB SAMPLE ID --->	27228.03		27228.06		27228.08		27228.09		27228.01		27228.02	
	ID FROM REPORT -->	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDSB00602	
	SAMPLE DATE ----->	10/07/96		10/07/96		10/07/96		10/07/96		10/07/96		10/07/96	
	DATE EXTRACTED -->	10/09/96		10/09/96		10/09/96		10/09/96		10/09/96		10/09/96	
	DATE ANALYZED --->	10/29/96		10/30/96		10/30/96		10/30/96		11/01/96		10/29/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A
CAS #	Parameter	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
108-95-2	Phenol	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
111-44-4	bis(2-Chloroethyl)ether	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
95-57-8	2-Chlorophenol	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
541-73-1	1,3-Dichlorobenzene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
106-46-7	1,4-Dichlorobenzene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
100-51-6	Benzyl alcohol	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
95-50-1	1,2-Dichlorobenzene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
95-48-7	2-Methylphenol (o-Cresol)	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
106-44-5	4-Methylphenol (p-Cresol)	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
621-64-7	N-Nitroso-di-n-propylamine	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
67-72-1	Hexachloroethane	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
98-95-3	Nitrobenzene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
78-59-1	Isophorone	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
88-75-5	2-Nitrophenol	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
105-67-9	2,4-Dimethylphenol	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
65-85-0	Benzoic acid	1600.	U	1700.	U	1900.	U	2100.	U	1700.	U	1700.	U
111-91-1	bis(2-Chloroethoxy)methane	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
120-83-2	2,4-Dichlorophenol	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
120-82-1	1,2,4-Trichlorobenzene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
91-20-3	Naphthalene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
106-47-8	4-Chloroaniline	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
87-68-3	Hexachlorobutadiene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
59-50-7	4-Chloro-3-methylphenol	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
91-57-6	2-Methylnaphthalene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
77-47-4	Hexachlorocyclopentadiene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
88-06-2	2,4,6-Trichlorophenol	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
95-95-4	2,4,5-Trichlorophenol	1600.	U	1700.	U	1900.	U	2100.	U	1700.	U	1700.	U
91-58-7	2-Chloronaphthalene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
88-74-4	2-Nitroaniline	1600.	U	1700.	U	1900.	U	2100.	U	1700.	U	1700.	U
131-11-3	Dimethyl phthalate	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
208-96-8	Acenaphthylene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
606-20-2	2,6-Dinitrotoluene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
99-09-2	3-Nitroaniline	1600.	U	1700.	U	1900.	U	2100.	U	1700.	U	1700.	U
83-32-9	Acenaphthene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
51-28-5	2,4-Dinitrophenol	1600.	U	1700.	U	1900.	U	2100.	U	1700.	U	1700.	U

*** Validation Complete ***

TALCP3
/22/97

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

846-SVOA													
	SAMPLE ID ------->	GDD-S-B004-01		GDD-S-B004-02		GDD-S-B005-01		GDD-S-B005-02		GDD-S-B006-01		GDD-S-B006-02	
	ORIGINAL ID ----->	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDSB00602	
	LAB SAMPLE ID --->	27228.03		27228.06		27228.08		27228.09		27228.01		27228.02	
	ID FROM REPORT -->	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDSB00602	
	SAMPLE DATE ----->	10/07/96		10/07/96		10/07/96		10/07/96		10/07/96		10/07/96	
	DATE EXTRACTED -->	10/09/96		10/09/96		10/09/96		10/09/96		10/09/96		10/09/96	
	DATE ANALYZED --->	10/29/96		10/30/96		10/30/96		10/30/96		11/01/96		10/29/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A
CAS #	Parameter	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
100-02-7	4-Nitrophenol	1600.	U	1700.	U	1900.	U	2100.	U	1700.	U	1700.	U
132-64-9	Dibenzofuran	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
121-14-2	2,4-Dinitrotoluene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
84-66-2	Diethylphthalate	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
7005-72-3	4-Chlorophenylphenylether	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
86-73-7	Fluorene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
100-01-6	4-Nitroaniline	1600.	U	1700.	U	1900.	U	2100.	U	1700.	U	1700.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	1600.	U	1700.	U	1900.	U	2100.	U	1700.	U	1700.	U
86-30-6	N-Nitrosodiphenylamine	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
101-55-3	4-Bromophenyl-phenylether	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
118-74-1	Hexachlorobenzene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
87-86-5	Pentachlorophenol	1600.	U	1700.	U	1900.	U	2100.	U	1700.	U	1700.	U
85-01-8	Phenanthrene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
120-12-7	Anthracene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
84-74-2	Di-n-butylphthalate	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
206-44-0	Fluoranthene	78.	J	350.	U	400.	U	430.	U	360.	U	350.	U
129-00-0	Pyrene	59.	J	350.	U	400.	U	430.	U	60.	J	350.	U
85-68-7	Butylbenzylphthalate	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
91-94-1	3,3'-Dichlorobenzidine	670.	U	700.	U	800.	U	870.	U	720.	U	710.	U
56-55-3	Benzo(a)anthracene	34.	J	350.	U	400.	U	430.	U	38.	J	350.	U
218-01-9	Chrysene	57.	J	350.	U	400.	U	430.	U	54.	J	350.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
117-84-0	Di-n-octyl phthalate	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
205-99-2	Benzo(b)fluoranthene	58.	J	350.	U	400.	U	430.	U	57.	J	350.	U
207-08-9	Benzo(k)fluoranthene	71.	J	350.	U	400.	U	430.	U	77.	J	350.	U
50-32-8	Benzo(a)pyrene	45.	J	350.	U	400.	U	430.	U	360.	U	350.	U
193-39-5	Indeno(1,2,3-cd)pyrene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
53-70-3	Dibenz(a,h)anthracene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U
191-24-2	Benzo(g,h,i)perylene	340.	U	350.	U	400.	U	430.	U	360.	U	350.	U

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

846-VOA													
	SAMPLE ID ------->	GDD-S-B001-01		GDD-S-B001-02		GDD-S-B002-01		GDD-S-B002-02		GDD-S-B003-01		GDD-S-B003-02	
	ORIGINAL ID ----->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	LAB SAMPLE ID --->	26738.01		26738.02		27259.01		27259.02		27279.01		27279.02	
	ID FROM REPORT -->	GDDSB00101		GDDSB00102		GDDSB00201		GDDSB00202		GDDSB00301		GDDSB00302	
	SAMPLE DATE ----->	08/26/96		08/26/96		10/09/96		10/09/96		10/10/96		10/10/96	
	DATE ANALYZED --->	08/30/96		08/30/96		10/15/96		10/15/96		10/15/96		10/15/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A
CAS #	Parameter	26738	VAL	26738	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
74-87-3	Chloromethane	11.	U	12.	U	11.	U	12.	U	12.	U	11.	U
74-83-9	Bromomethane	11.	U	12.	U	11.	U	12.	U	12.	U	11.	U
75-01-4	Vinyl chloride	11.	U	12.	U	11.	U	12.	U	12.	U	11.	U
75-00-3	Chloroethane	11.	U	12.	U	11.	U	12.	U	12.	U	11.	U
75-09-2	Methylene chloride	5.	U	6.	U	10.	U	7.	U	22.	U	20.	U
67-64-1	Acetone	26.	U	12.	U	11.	U	17.	U	20.	UJ	20.	UJ
75-15-0	Carbon disulfide	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
75-35-4	1,1-Dichloroethene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
75-34-3	1,1-Dichloroethane	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
540-59-0	1,2-Dichloroethene (total)	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
67-66-3	Chloroform	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
107-06-2	1,2-Dichloroethane	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
78-93-3	2-Butanone (MEK)	4.	J	12.	U	11.	U	12.	U	12.	U	11.	U
71-55-6	1,1,1-Trichloroethane	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
56-23-5	Carbon tetrachloride	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
108-05-4	Vinyl acetate	11.	U	12.	U	11.	U	12.	U	12.	U	11.	U
75-27-4	Bromodichloromethane	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
79-34-5	1,1,2,2-Tetrachloroethane	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
78-87-5	1,2-Dichloropropane	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
0061-02-6	trans-1,3-Dichloropropene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
79-01-6	Trichloroethene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
124-48-1	Dibromochloromethane	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
79-00-5	1,1,2-Trichloroethane	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
71-43-2	Benzene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
0061-01-5	cis-1,3-Dichloropropene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
110-75-8	2-Chloroethyl vinyl ether	11.	UR	12.	UR	11.	U	12.	U	12.	U	11.	U
75-25-2	Bromoform	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
591-78-6	2-Hexanone	11.	U	12.	U	11.	U	12.	U	12.	U	11.	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	11.	U	12.	U	11.	U	12.	U	12.	U	11.	U
127-18-4	Tetrachloroethene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
108-88-3	Toluene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
108-90-7	Chlorobenzene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
100-41-4	Ethylbenzene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
100-42-5	Styrene	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U
1330-20-7	Xylene (Total)	5.	U	6.	U	5.	U	6.	U	6.	U	5.	U

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
SOIL SAMPLES

846-VOA	SAMPLE ID ------->	GDD-S-B004-01		GDD-S-B004-02		GDD-S-B005-01		GDD-S-B005-02		GDD-S-B006-01		GDD-S-B006-02	
	ORIGINAL ID ----->	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDSB00602	
	LAB SAMPLE ID --->	27228.03		27228.06		27228.08		27228.09		27228.01		27228.02	
	ID FROM REPORT -->	GDDSB00401		GDDSB00402		GDDSB00501		GDDSB00502		GDDSB00601		GDDSB00602	
	SAMPLE DATE ----->	10/07/96		10/07/96		10/07/96		10/07/96		10/07/96		10/07/96	
	DATE ANALYZED --->	10/15/96		10/14/96		10/14/96		10/15/96		10/13/96		10/14/96	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ----------->	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A	UG/KG	A
CAS #	Parameter	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL	27228	VAL
74-87-3	Chloromethane	10.	U	11.	U	12.	U	13.	U	11.	U	11.	U
74-83-9	Bromomethane	10.	U	11.	U	12.	U	13.	U	11.	U	11.	U
75-01-4	Vinyl chloride	10.	U	11.	U	12.	U	13.	U	11.	U	11.	U
75-00-3	Chloroethane	10.	U	11.	U	12.	U	13.	U	11.	U	11.	U
75-09-2	Methylene chloride	5.	U	5.	U	15.	U	7.	U	10.	U	5.	U
67-64-1	Acetone	10.	U	11.	U	59.	U	54.	U	11.	U	14.	U
75-15-0	Carbon disulfide	5.	U	5.	U	6.	U	2.	J	5.	U	5.	U
75-35-4	1,1-Dichloroethene	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
75-34-3	1,1-Dichloroethane	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
540-59-0	1,2-Dichloroethene (total)	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
67-66-3	Chloroform	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
107-06-2	1,2-Dichloroethane	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
78-93-3	2-Butanone (MEK)	10.	U	11.	U	10.	U	6.	U	11.	U	11.	U
71-55-6	1,1,1-Trichloroethane	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
56-23-5	Carbon tetrachloride	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
108-05-4	Vinyl acetate	10.	U	11.	U	12.	U	13.	U	11.	U	11.	U
75-27-4	Bromodichloromethane	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
79-34-5	1,1,2,2-Tetrachloroethane	5.	U	5.	U	6.	U	6.	U	5.	U	2.	J
78-87-5	1,2-Dichloropropane	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
0061-02-6	trans-1,3-Dichloropropene	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
79-01-6	Trichloroethene	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
124-48-1	Dibromochloromethane	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
79-00-5	1,1,2-Trichloroethane	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
71-43-2	Benzene	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
0061-01-5	cis-1,3-Dichloropropene	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
110-75-8	2-Chloroethyl vinyl ether	10.	U	11.	U	12.	U	13.	U	11.	U	11.	U
75-25-2	Bromoform	5.	U	5.	U	6.	U	6.	U	5.	U	5.	U
591-78-6	2-Hexanone	10.	U	11.	U	12.	U	13.	U	11.	UJ	11.	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	10.	U	11.	U	12.	U	13.	U	11.	UJ	11.	U
127-18-4	Tetrachloroethene	5.	U	5.	U	6.	U	6.	U	5.	UJ	5.	U
108-88-3	Toluene	5.	U	5.	U	6.	U	6.	U	5.	UJ	5.	U
108-90-7	Chlorobenzene	5.	U	5.	U	6.	U	6.	U	5.	UJ	1.	J
100-41-4	Ethylbenzene	5.	U	5.	U	6.	U	6.	U	5.	UJ	5.	U
100-42-5	Styrene	5.	U	5.	U	6.	U	6.	U	5.	UJ	5.	U
330-20-7	Xylene (Total)	5.	U	5.	U	6.	U	6.	U	5.	UJ	5.	U

*** Validation Complete ***

TALCP3
/22/97

NAVAL BASE CHARLESTON
ZONE D RFI
GROUNDWATER SAMPLES

LORIDE	SAMPLE ID ------->	GDD-G-W001-01	GDD-G-W01D-01				
	ORIGINAL ID ----->	GDDGW00101	GDDGW01D01				
	LAB SAMPLE ID --->	27553.01	27553.02				
	ID FROM REPORT -->	GDDGW00101	GDDGW01D01				
	SAMPLE DATE ----->	11/07/96	11/07/96				
	DATE ANALYZED --->	11/20/96	11/20/96				
	MATRIX ---------->	Water	Water				
	UNITS ----------->	MG/L A	MG/L A				
CAS #	Parameter	27553 VAL	27553 VAL				
6887-00-6	Chloride	2.7	15.				

*** Validation Complete ***

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NAVAL BASE CHARLESTON
ZONE D RFI
GROUNDWATER SAMPLES

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ANIDE							
	SAMPLE ID ------->	GDD-G-W001-01	GDD-G-W01D-01				
	ORIGINAL ID ----->	GDDGW00101	GDDGW01D01				
	LAB SAMPLE ID --->	27553.01	27553.02				
	ID FROM REPORT -->	GDDGW00101	GDDGW01D01				
	SAMPLE DATE ----->	11/07/96	11/07/96				
	DATE EXTRACTED -->	11/19/96	11/19/96				
	DATE ANALYZED --->	11/19/96	11/19/96				
	MATRIX ---------->	Water	Water				
	UNITS ----------->	UG/L A	UG/L A				
CAS #	Parameter	27553 VAL	27553 VAL				
57-12-5	Cyanide (CN)	2. U	2. U				

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
GROUNDWATER SAMPLES

LFATE

	SAMPLE ID ------->	GDD-G-W001-01	GDD-G-W01D-01				
	ORIGINAL ID ----->	GDDGW00101	GDDGW01D01				
	LAB SAMPLE ID --->	27553.01	27553.02				
	ID FROM REPORT -->	GDDGW00101	GDDGW01D01				
	SAMPLE DATE ----->	11/07/96	11/07/96				
	DATE ANALYZED --->	11/20/96	11/20/96				
	MATRIX ---------->	Water	Water				
	UNITS ----------->	MG/L A	MG/L A				
CAS #	Parameter	27553 VAL	27553 VAL				
4808-79-8	Sulfate	12.9	13.5				

*** Validation Complete ***

TALCP3
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NAVAL BASE CHARLESTON
ZONE D RFI
GROUNDWATER SAMPLES

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846-META

	SAMPLE ID ------->	GDD-G-W001-01		GDD-G-W01D-01	
	ORIGINAL ID ----->	GDDGW00101		GDDGW01D01	
	LAB SAMPLE ID --->	27553.01		27553.02	
	ID FROM REPORT -->	GDDGW00101		GDDGW01D01	
	SAMPLE DATE ----->	11/07/96		11/07/96	
	DATE EXTRACTED -->	11/18/96		11/18/96	
	DATE ANALYZED --->	11/20/96		11/20/96	
	MATRIX ---------->	Water		Water	
	UNITS ----------->	UG/L	A	UG/L	A
CAS #	Parameter	27553	VAL	27553	VAL
7429-90-5	Aluminum (Al)	707.		18.	U
7440-36-0	Antimony (Sb)	2.1	U	2.1	U
7440-38-2	Arsenic (As)	2.7	J	4.2	J
7440-39-3	Barium (Ba)	8.8		15.9	
7440-41-7	Beryllium (Be)	0.4	J	0.3	U
7440-43-9	Cadmium (Cd)	0.5	U	0.5	U
7440-70-2	Calcium (Ca)	13400.		54900.	
7440-47-3	Chromium (Cr)	1.9	J	0.8	U
7440-48-4	Cobalt (Co)	0.9	U	0.9	U
7440-50-8	Copper (Cu)	3.9	U	0.6	U
7439-89-6	Iron (Fe)	2270.		547.	
7439-92-1	Lead (Pb)	1.9	J	1.7	U
7439-95-4	Magnesium (Mg)	1680.		3290.	
7439-96-5	Manganese (Mn)	15.3		160.	
7439-97-6	Mercury (Hg)	0.1	U	0.1	U
7440-02-0	Nickel (Ni)	1.7	J	0.8	U
7440-09-7	Potassium (K)	2960.	J	1600.	U
7782-49-2	Selenium (Se)	2.8	U	2.8	U
7440-22-4	Silver (Ag)	1.2	U	1.2	U
7440-23-5	Sodium (Na)	3000.		15300.	
7440-28-0	Thallium (Tl)	3.3	U	5.	U
7440-31-5	Tin (Sn)	15.	U	13.	U
7440-62-2	Vanadium (V)	3.6	J	0.5	U
7440-66-6	Zinc (Zn)	12.1	U	5.3	U

*** Validation Complete ***

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NAVAL BASE CHARLESTON
ZONE D RFI
GROUNDWATER SAMPLES

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846-PEST			
	SAMPLE ID ------->	GDD-G-W001-01	GDD-G-W01D-01
	ORIGINAL ID ----->	GDDGW00101	GDDGW01D01
	LAB SAMPLE ID --->	27553.01	27553.02
	ID FROM REPORT -->	GDDGW00101	GDDGW01D01
	SAMPLE DATE ----->	11/07/96	11/07/96
	DATE EXTRACTED -->	11/09/96	11/09/96
	DATE ANALYZED --->	11/15/96	11/15/96
	MATRIX ---------->	Water	Water
	UNITS ----------->	UG/L A	UG/L A

CAS #	Parameter	27553	VAL	27553	VAL
319-84-6	alpha-BHC	0.04	U	0.04	U
319-85-7	beta-BHC	0.04	U	0.04	U
319-86-8	delta-BHC	0.04	U	0.04	U
58-89-9	gamma-BHC (Lindane)	0.04	U	0.04	U
76-44-8	Heptachlor	0.04	U	0.04	U
309-00-2	Aldrin	0.04	U	0.04	U
1024-57-3	Heptachlor epoxide	0.04	U	0.04	U
959-98-8	Endosulfan I	0.04	U	0.04	U
60-57-1	Dieldrin	0.08	U	0.08	U
72-55-9	4,4'-DDE	0.08	U	0.08	U
72-20-8	Endrin	0.08	U	0.08	U
3213-65-9	Endosulfan II	0.08	U	0.08	U
72-54-8	4,4'-DDD	0.08	U	0.08	U
1031-07-8	Endosulfan sulfate	0.08	U	0.08	U
50-29-3	4,4'-DDT	0.08	U	0.08	U
72-43-5	Methoxychlor	0.38	U	0.38	U
3494-70-5	Endrin ketone	0.08	U	0.08	U
7421-93-4	Endrin aldehyde	0.08	U	0.08	U
5103-71-9	alpha-Chlordane	0.04	U	0.04	U
5103-74-2	gamma-Chlordane	0.04	U	0.04	U
8001-35-2	Toxaphene	2.5	U	2.5	U
2674-11-2	Aroclor-1016	1.	U	1.	U
104-28-2	Aroclor-1221	1.	U	1.	U
141-16-5	Aroclor-1232	1.	U	1.	U
3469-21-9	Aroclor-1242	1.	U	1.	U
2672-29-6	Aroclor-1248	1.	U	1.	U
097-69-1	Aroclor-1254	2.	U	2.	U
096-82-5	Aroclor-1260	2.	U	2.	U

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
GROUNDWATER SAMPLES

846-SVOA												
	SAMPLE ID ------->	GDD-G-W001-01		GDD-G-W01D-01								
	ORIGINAL ID ----->	GDDGW00101		GDDGW01D01								
	LAB SAMPLE ID --->	27553.01		27553.02								
	ID FROM REPORT -->	GDDGW00101		GDDGW01D01								
	SAMPLE DATE ----->	11/07/96		11/07/96								
	DATE EXTRACTED -->	11/11/96		11/11/96								
	DATE ANALYZED --->	11/22/96		11/22/96								
	MATRIX ---------->	Water		Water								
	UNITS ----------->	UG/L	A	UG/L	A							
CAS #	Parameter	27553	VAL	27553	VAL							
108-95-2	Phenol	10.	U	10.	U							
111-44-4	bis(2-Chloroethyl)ether	10.	U	10.	U							
95-57-8	2-Chlorophenol	10.	U	10.	U							
541-73-1	1,3-Dichlorobenzene	10.	U	10.	U							
106-46-7	1,4-Dichlorobenzene	10.	U	10.	U							
100-51-6	Benzyl alcohol	10.	U	10.	U							
95-50-1	1,2-Dichlorobenzene	10.	U	10.	U							
95-48-7	2-Methylphenol (o-Cresol)	10.	U	10.	U							
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U	10.	U							
106-44-5	4-Methylphenol (p-Cresol)	10.	U	10.	U							
621-64-7	N-Nitroso-di-n-propylamine	10.	U	10.	U							
67-72-1	Hexachloroethane	10.	U	10.	U							
98-95-3	Nitrobenzene	10.	U	10.	U							
78-59-1	Isophorone	10.	U	10.	U							
88-75-5	2-Nitrophenol	10.	U	10.	U							
105-67-9	2,4-Dimethylphenol	10.	U	10.	U							
65-85-0	Benzoic acid	50.	U	50.	U							
111-91-1	bis(2-Chloroethoxy)methane	10.	U	10.	U							
120-83-2	2,4-Dichlorophenol	10.	U	10.	U							
120-82-1	1,2,4-Trichlorobenzene	10.	U	10.	U							
91-20-3	Naphthalene	10.	U	10.	U							
106-47-8	4-Chloroaniline	10.	U	10.	U							
87-68-3	Hexachlorobutadiene	10.	U	10.	U							
59-50-7	4-Chloro-3-methylphenol	10.	U	10.	U							
91-57-6	2-Methylnaphthalene	10.	U	10.	U							
77-47-4	Hexachlorocyclopentadiene	10.	U	10.	U							
88-06-2	2,4,6-Trichlorophenol	10.	U	10.	U							
95-95-4	2,4,5-Trichlorophenol	50.	U	50.	U							
91-58-7	2-Chloronaphthalene	10.	U	10.	U							
88-74-4	2-Nitroaniline	50.	U	50.	U							
131-11-3	Dimethyl phthalate	10.	U	10.	U							
208-96-8	Acenaphthylene	10.	U	10.	U							
606-20-2	2,6-Dinitrotoluene	10.	U	10.	U							
99-09-2	3-Nitroaniline	50.	U	50.	U							
83-32-9	Acenaphthene	10.	U	10.	U							
51-28-5	2,4-Dinitrophenol	50.	U	50.	U							

*** Validation Complete ***

846-SVOA								
	SAMPLE ID ------->	GDD-G-W001-01		GDD-G-W01D-01				
	ORIGINAL ID ----->	GDDGW00101		GDDGW01D01				
	LAB SAMPLE ID --->	27553.01		27553.02				
	ID FROM REPORT -->	GDDGW00101		GDDGW01D01				
	SAMPLE DATE ----->	11/07/96		11/07/96				
	DATE EXTRACTED -->	11/11/96		11/11/96				
	DATE ANALYZED --->	11/22/96		11/22/96				
	MATRIX ----------->	Water		Water				
	UNITS ------------>	UG/L	A	UG/L	A			
CAS #	Parameter	27553	VAL	27553	VAL			
100-02-7	4-Nitrophenol	50.	U	50.	U			
132-64-9	Dibenzofuran	10.	U	10.	U			
121-14-2	2,4-Dinitrotoluene	10.	U	10.	U			
84-66-2	Diethylphthalate	10.	U	10.	U			
7005-72-3	4-Chlorophenylphenylether	10.	U	10.	U			
86-73-7	Fluorene	10.	U	10.	U			
100-01-6	4-Nitroaniline	50.	U	50.	U			
534-52-1	2-Methyl-4,6-Dinitrophenol	50.	U	50.	U			
86-30-6	N-Nitrosodiphenylamine	10.	U	10.	U			
101-55-3	4-Bromophenyl-phenylether	10.	U	10.	U			
118-74-1	Hexachlorobenzene	10.	U	10.	U			
87-86-5	Pentachlorophenol	50.	U	50.	U			
85-01-8	Phenanthrene	10.	U	10.	U			
120-12-7	Anthracene	10.	U	10.	U			
84-74-2	Di-n-butylphthalate	10.	U	10.	U			
206-44-0	Fluoranthene	10.	U	10.	U			
129-00-0	Pyrene	10.	U	10.	U			
85-68-7	Butylbenzylphthalate	10.	U	10.	U			
91-94-1	3,3'-Dichlorobenzidine	20.	U	20.	U			
56-55-3	Benzo(a)anthracene	10.	U	10.	U			
218-01-9	Chrysene	10.	U	10.	U			
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U	10.	U			
117-84-0	Di-n-octyl phthalate	10.	U	10.	U			
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U			
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U			
50-32-8	Benzo(a)pyrene	10.	U	10.	U			
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U	10.	U			
53-70-3	Dibenz(a,h)anthracene	10.	U	10.	U			
191-24-2	Benzo(g,h,i)perylene	10.	U	10.	U			

*** Validation Complete ***

846-VOA								
	SAMPLE ID ------->	GDD-G-W001-01	GDD-G-W01D-01					
	ORIGINAL ID ----->	GDDGW00101	GDDGW01D01					
	LAB SAMPLE ID --->	27553.01	27553.02					
	ID FROM REPORT -->	GDDGW00101	GDDGW01D01					
	SAMPLE DATE ----->	11/07/96	11/07/96					
	DATE ANALYZED --->	11/12/96	11/12/96					
	MATRIX ----------->	Water	Water					
	UNITS ------------>	UG/L A	UG/L A					

CAS #	Parameter	27553	VAL	27553	VAL				
74-87-3	Chloromethane	10.	U	10.	U				
74-83-9	Bromomethane	10.	U	10.	U				
75-01-4	Vinyl chloride	10.	U	10.	U				
75-00-3	Chloroethane	10.	U	10.	U				
75-09-2	Methylene chloride	5.	U	5.	U				
67-64-1	Acetone	10.	U	10.	U				
75-15-0	Carbon disulfide	5.	U	5.	U				
75-35-4	1,1-Dichloroethene	5.	U	5.	U				
75-34-3	1,1-Dichloroethane	5.	U	5.	U				
540-59-0	1,2-Dichloroethene (total)	5.	U	5.	U				
67-66-3	Chloroform	5.	U	5.	U				
107-06-2	1,2-Dichloroethane	5.	U	5.	U				
78-93-3	2-Butanone (MEK)	10.	U	10.	U				
71-55-6	1,1,1-Trichloroethane	5.	U	5.	U				
56-23-5	Carbon tetrachloride	5.	U	5.	U				
75-27-4	Bromodichloromethane	5.	U	5.	U				
78-87-5	1,2-Dichloropropane	5.	U	5.	U				
)061-01-5	cis-1,3-Dichloropropene	5.	U	5.	U				
79-01-6	Trichloroethene	5.	U	5.	U				
124-48-1	Dibromochloromethane	5.	U	5.	U				
79-00-5	1,1,2-Trichloroethane	5.	U	5.	U				
71-43-2	Benzene	5.	U	5.	U				
)061-02-6	trans-1,3-Dichloropropene	5.	U	5.	U				
75-25-2	Bromoform	5.	U	5.	U				
108-10-1	4-Methyl-2-Pentanone (MIBK)	10.	U	10.	U				
591-78-6	2-Hexanone	10.	U	10.	U				
127-18-4	Tetrachloroethene	5.	U	5.	U				
79-34-5	1,1,2,2-Tetrachloroethane	5.	U	5.	U				
108-88-3	Toluene	5.	U	5.	U				
108-90-7	Chlorobenzene	5.	U	5.	U				
100-41-4	Ethylbenzene	5.	U	5.	U				
100-42-5	Styrene	5.	U	5.	U				
330-20-7	Xylene (Total)	5.	U	5.	U				
108-05-4	Vinyl acetate	10.	U	10.	U				
110-75-8	2-Chloroethyl vinyl ether	10.	UR	10.	UR				

*** Validation Complete ***

NAVAL BASE CHARLESTON
ZONE D RFI
GROUNDWATER SAMPLES

S	SAMPLE ID ------->	GDD-G-W001-01	GDD-G-W01D-01				
	ORIGINAL ID ----->	GDDGW00101	GDDGW01D01				
	LAB SAMPLE ID --->	27553.01	27553.02				
	ID FROM REPORT -->	GDDGW00101	GDDGW01D01				
	SAMPLE DATE ----->	11/07/96	11/07/96				
	DATE ANALYZED --->	11/13/96	11/13/96				
	MATRIX ---------->	Water	Water				
	UNITS ----------->	MG/L A	MG/L A				
CAS #	Parameter	27553 VAL	27553 VAL				
9900-07-2	Total Dissolved Solids (TDS)	48.	204.				

*** Validation Complete ***

Samples Collected:	6/25/97
Samples Received:	6/25/97
Samples Analyzed:	6/25/97
Samples Reported:	6/26/97
Project Identification:	Charleston, SC
Target Job Code:	EAH001
Purchase Order:	TO 2912-08410

Collected by:	Target Environmental Services
Received by:	Jack Vorsteg
Analyzed by:	Jack Vorsteg
Reported by:	Jack Vorsteg
Report Revision:	Preliminary Data
Method Deviations:	None
Sampling Method:	Direct Push

Client:	Ensafe/Allen & Hoshall
Client Address:	Shelby Oaks Plaza 5909 Shelby Oaks Dr., Suite 201 Memphis, TN 38134
Client Contact:	Jack Mayfield
Client Phone:	803-884-0029
Client Fax:	803-856-0107

USEPA Method 8260A Water Sample Analysis Results in ug/L

Compound	Detection Limit (ug/L)	GDDGP001-15 (ug/L)	GDDGP001-25 (ug/L)
Chloromethane	5	ND	ND
Vinyl Chloride	5	ND	ND
Bromomethane	5	ND	ND
Chloroethane	5	ND	ND
Acetone	5	ND	ND
1,1-Dichloroethene	5	ND	ND
Methylene Chloride	5	ND	ND
Carbon Disulfide	5	ND	ND
trans-1,2-Dichloroethene	5	ND	ND
Vinyl Acetate	5	ND	ND
1,1-Dichloroethane	5	ND	ND
2-Butanone (MEK)	5	ND	ND
cis-1,2-Dichloroethene	5	ND	ND
Chloroform	5	ND	ND
1,1,1-Trichloroethane	5	ND	ND
Carbon Tetrachloride	5	ND	ND
1,2-Dichloroethane	5	ND	ND
Benzene	5	ND	ND
Trichloroethene (TCE)	5	ND	ND
1,2-Dichloropropane	5	ND	ND
Bromodichloromethane	5	ND	ND
2-Chloroethyl Vinyl Ether	5	ND	ND
Methyl Isobutyl Ketone (MIBK)	5	ND	ND
cis-1,3-Dichloropropene	5	ND	ND
Toluene	5	ND	ND
trans-1,3-Dichloropropene	5	ND	ND
2-Hexanone	5	ND	ND
1,1,2-Trichloroethane	5	ND	ND
Tetrachloroethene (PCE)	5	ND	ND
Dibromochloromethane	5	ND	ND
Chlorobenzene	5	ND	ND
Ethylbenzene	5	ND	ND
Xylenes(Total)	10	ND	ND
Styrene	5	ND	ND
Bromoform	5	ND	ND
1,1,2,2-Tetrachloroethane	5	ND	ND
Surrogate Recoveries		**% Rec.**	**% Rec.**
Dibromofluoromethane		106	102
1,2-Dichloroethane-d_4		113	99.9
Toluene-d_8		97.4	98.1
Bromofluorobenzene		99.7	101
Dilution	1		

Analyst Signature: Jvm

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NAVY CLEAN

ENSAFE/ALLEN&HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CTO–TASK: 2904-08440
COC #:
BPA/SO: 0343/96

CLIENT: Naval Base Charleston
PROJECT MANAGER: Charlie Vernoy
ADDRESS: Zone D
TELEPHONE NO. 803/884-0029
PROJECT NAME/NUMBER: 2904-03440
FAX. NO.
SAMPLERS: (SIGNATURE) [signature]

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOA	SVOA	Metals	CN	Pest/PCB	TDS/CL/SO4	Hex chrome	Dioxin	OP Pest/Herb	REMARKS
NBCD/GDDGW[illegible]	11-7-96	~~09[illegible]~~ 1130	H_2O	40 ml 1L Amber 1L poly	4°C	VOA-HCL poly-HNO3	9	X	X	X	X	X	X				
NBCD/GDDGW01D[illegible]	11-7-96	1150	H_2O	40 ml 1L Amber 1L poly	4°C	poly-HNO3	9	X	X	X	X	X	X				
NBCD/GDDEW01D01	11-7-96	0915	H_2O	40 ml 1L Amber 1L poly	4°C	VOA-HCL poly-HNO3	16	X	X	X	X	X	X	X	X	X	DQ04
NBCD/GDDFW01D01	11-7-96	1100	H_2O	40 ml 1L Amber 1L poly	4°C	poly-HNO3	16	X	X	X	X	X	X	X	X	X	DQ04
NBCD/GDDDW01D04	11-7-96	0900	H_2O	40 ml 1L Amber 1L poly	4°C	↓	16	X	X	X	X	X	X	X	X	X	DQ04
NBCD/GDDTW01D01	11-7-96	—	H_2O	2 40 ml	4°C		2	X									

RLH

RELINQUISHED BY:	DATE / TIME	RECEIVED BY:	DATE / TIME	RELINQUISHED BY:	DATE / TIME	RECEIVED BY:	DATE / TIME
SIGNATURE: [signature]	DATE: 11/7/96	SIGNATURE:	DATE:	SIGNATURE:	DATE:	SIGNATURE:	DATE:
PRINTED: Robert Lange		PRINTED:		PRINTED:		PRINTED:	
COMPANY: EnSafe	TIME: 1700	COMPANY:	TIME:	COMPANY:	TIME:	COMPANY:	TIME:
REASON: Ship to Lab		REASON:		REASON:		REASON:	

METHOD OF SHIPMENT: FEDEX
SHIPMENT NO. 0904035532
SPECIAL INSTRUCTION:

COMMENTS: DQ03 + TICs unless otherwise noted in remarks

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☒ DISPOSED OF
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS
- ☐ RETURNED TO CUSTOMER

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE):

NAVY CLEAN
ENSAFE/ALLEN&HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CTO-TASK:
COC #:
BPA/SO: 0343/96

CLIENT: NAVAL BASE CHAS
ADDRESS: Zone D
PROJECT NAME/NUMBER: 2904-06420
SAMPLERS: (SIGNATURE)

PROJECT MANAGER: Charlie Vernoy
TELEPHONE NO.: 884-0029 (803)
FAX NO.:

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOA	SVOA Pest PCB	Metals CN				REMARKS
NBCD/GDDSB00301	10-10-96	1248	Soil	2-2oz 2-4oz	4°C	None	4	X	X	X				
NBCD/GDDSB00302	10-10-96	1253	Soil	2-2oz 2-4oz	↓	↓	4	X	X	X				
NBCD/GDD7B00301	10-10-96	—	Soil	1-2oz			1	X						

RELINQUISHED BY:	DATE	RECEIVED BY:	DATE	RELINQUISHED BY:	DATE	RECEIVED BY:	DATE
SIGNATURE	10-10-96	SIGNATURE		SIGNATURE		SIGNATURE	
PRINTED John J. Kordonis	TIME	PRINTED	TIME	PRINTED	TIME	PRINTED	TIME
COMPANY CE&RD	1330	COMPANY		COMPANY		COMPANY	
REASON Analysis		REASON		REASON		REASON	

METHOD OF SHIPMENT: Fed Ex
SHIPMENT NO.: 0904037621
SPECIAL INSTRUCTION: NONE

COMMENTS: ALL SAMPLES ARE D003 and TICs unless otherwise noted

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☒ DISPOSED OF
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS
- ☐ RETURNED TO CUSTOMER

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

CLNCOCR1

NAVY CLEAN

ENSAFE/ALLEN&HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

CTO-TASK:
COC #:
BPA/SO: 0343/96

CLIENT: NAVAL BASE CHAS
ADDRESS: Zone D
PROJECT NAME/NUMBER: 2904-08420
SAMPLERS: (SIGNATURE) [signature]

PROJECT MANAGER: Charlie Vernoy
TELEPHONE NO. (803) 884-0029
FAX. NO.

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOA	SVOA Pest PCB	METALS CN				REMARKS
NBCD/GDDS800201	10-9-96	1310	Soil	2-2oz 2-4oz	4°C	NONE	4	X	X	X				
NBCD/GDDS800202	10-9-96	1315	Soil	2-2oz 2-4oz	4°C	NONE	4	X	X	X				
NBCD/GDDTB00201	10-9-96	—	Soil	1-2oz	4°C	NONE	1	X						

RELINQUISHED BY:	DATE	RECEIVED BY:	DATE	RELINQUISHED BY:	DATE	RECEIVED BY:	DATE
SIGNATURE [signature]	10-9-96	SIGNATURE		SIGNATURE		SIGNATURE	
PRINTED John J. Kordon's		PRINTED		PRINTED		PRINTED	
COMPANY EERD	TIME 1410	COMPANY	TIME	COMPANY	TIME	COMPANY	TIME
REASON Analysis		REASON		REASON		REASON	

METHOD OF SHIPMENT: Fed EX
SHIPMENT NO. 0616239131
SPECIAL INSTRUCTION: NONE

COMMENTS: ALL SAMPLES ARE DOO3 & TIC's unless otherwise noted

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☒ DISPOSED OF
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS
- ☐ RETURNED TO CUSTOMER

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

PAGE 2 OF 2

NAVY CLEAN
ENSAFE/ALLEN&HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

CTO-TASK:
COC #:
BPA/SO: 0343/96

CLIENT: NAVAL BASE CHAS
PROJECT MANAGER: Charlie Vernoy
ADDRESS: ZONE-D
TELEPHONE NO.: 803-884-0029
PROJECT NAME/NUMBER: 2904-08470
FAX NO.:
SAMPLERS: (SIGNATURE)

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	ANALYSIS REQUIRED: VOA						REMARKS
WACD/GDDTB00501	10-7-96	NA	H_2O	2-40 ml vial	4°C	HCL	2	X						

RELINQUISHED BY:	DATE	RECEIVED BY:	DATE	RELINQUISHED BY:	DATE	RECEIVED BY:	DATE
SIGNATURE	10/7/96	SIGNATURE		SIGNATURE		SIGNATURE	
PRINTED John S. Kucdoris	TIME 1530	PRINTED	TIME	PRINTED	TIME	PRINTED	TIME
COMPANY CEERD		COMPANY		COMPANY		COMPANY	
REASON ANALYSIS		REASON		REASON		REASON	

METHOD OF SHIPMENT: FED EX
SHIPMENT NO.: 0616239116
SPECIAL INSTRUCTION: NONE

COMMENTS: All samples are D003 and TIC's unless otherwise noted. D004 are to be analyzed for Appendix 9 para.

AFTER ANALYSIS, SAMPLES ARE TO BE:
- [x] DISPOSED OF
- [ ] STORED (90 DAYS MAX)
- [ ] STORED OVER 90 DAYS
- [ ] RETURNED TO CUSTOMER

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

CLNCOCR1

NAVY CLEAN

ENSAFE/ALLEN&HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

CTO–TASK:
COC #:
BPA/SO: 0393/96

CLIENT: NAVAL BASE CHAS
PROJECT MANAGER: Charlie Vernoy
ADDRESS: ZONE-D
TELEPHONE NO. 803-884-0029
PROJECT NAME/NUMBER: 2904-08420
FAX. NO. —
SAMPLERS: (SIGNATURE) [signature] [signature]

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOA	SVOA PEST	METALS CN	DIOXIN	HEXACHROME	HERB PEST		REMARKS
NBCD/GDDSB00601	10-7-96	0850	SOIL	2-2oz - 2-4oz	4°C	NONE	4	X	X	X					
NBCD/GDDCB00601	10-7-96	0850	SOIL	2-2oz 4-4oz 1-8oz	4°C	NONE	7	X	X	X	X	X	X		DQ04
NBCD/GDDSB00602	10-7-96	0900	SOIL	2-2oz 2-4oz	4°C	NONE	4	X	X	X					
NBCD/GDDSB00701	10-7-96	0940	SOIL	6-2oz, 6-4oz	4°C	NONE	12	X	X	X					MS • MSD
NBCD/GDDSB00702	10-7-96	0945	SOIL	2-2oz 2-4oz	4°C	NONE	4	X	X	X					
NBCD/GDDTB00601	10-7-96	NA	SOIL	1. 2oz	4°C	NONE	1	X							
NBCD/GDDEB00501	10-7-96	1255	H_2O	40ml vial, 1L Amber 1L Poly 500ml Poly	4°C	*	13	X	X	X	X	X	X		DQ04
NBCD/GDDDE00501	10-7-96	1305	H_2O	40ml vial, 1L Amber 1L Poly 500ml Poly	4°C	*	13	X	X	X	X	X	X		DQ04
NBCD/GDDSB00501	10-7-96	1030	SOIL	2-2oz, 2-4oz	4°C	NONE	4	X	X	X					
NBCD/GDDSB00502	10-7-96	1037	SOIL	2-2oz, 2-4oz	4°C	NONE	4	X	X	X					

RELINQUISHED BY:	DATE / TIME	RECEIVED BY:	DATE / TIME	RELINQUISHED BY:	DATE / TIME	RECEIVED BY:	DATE / TIME
SIGNATURE [signature]	DATE 10/7/96	SIGNATURE	DATE	SIGNATURE	DATE	SIGNATURE	DATE
PRINTED John J. Kolbook		PRINTED		PRINTED		PRINTED	
COMPANY CEERD	TIME 1330	COMPANY	TIME	COMPANY	TIME	COMPANY	TIME
REASON ANALYSIS		REASON		REASON		REASON	

METHOD OF SHIPMENT: FED EX
SHIPMENT NO. 0616239116
SPECIAL INSTRUCTION: NONE

COMMENTS: All SAMPLES ARE DQ03 AND TICS UNLESS OTHERWISE NOTED DQ04 ARE TO BE ANALYZED FOR APPENDIX 9 PARA.

AFTER ANALYSIS, SAMPLES ARE TO BE:
- [x] DISPOSED OF
- [ ] STORED (90 DAYS MAX)
- [ ] STORED OVER 90 DAYS
- [ ] RETURNED TO CUSTOMER

* H_2O PRESERVATION
METALS - HNO_3
CYANIDE - NaOH

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE):

CLNCOCR1

NAVY CLEAN
ENSAFE/ALLEN&HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

CTO-TASK:
COC #:
BPA/SO: 0343/96

CLIENT: Naval Base Charleston
ADDRESS: Zone D
PROJECT NAME/NUMBER: 2904.08420
SAMPLERS: (SIGNATURE) [signature]

PROJECT MANAGER: Charlie Vernoy
TELEPHONE NO. 803-884-0029
FAX. NO.

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOA	SVOA Pest/PCB	Metals, CN, Cr6	Herbs, OP Pest	Dioxin			REMARKS
NBCD\GDD7000101	9/12/96	0820	H_2O	[illegible] VOA, 1L Poly, 500 mL Poly	4°C	VOA: HCL, [illegible]	13	X	X	X	X	X			DQ04
NBCD\GDDE000101	9/12/96	0800	H_2O	↓	4°C	↓	13	X	X	X	X	X			DQ04
NBCD\GDD5000101	9/12/96	0945	Bottom Sed. ~~H_2O~~	2, 4 oz Glass	4°C	None	7	X	X	X	X	X			DQ04
NBCD\GDD6000101	9/12/96	0930	Sand ~~H_2O~~	2, 4 oz Glass	4°C	None	7	X	X	X	X	X			DQ04
~~[illegible]~~	~~9/12/96~~	TBT	~~H_2O~~	~~40 mL VOA, 1L Amber, 1L Poly, 500 mL Poly~~	~~4°C~~	~~VOA: HCL [illegible]~~	~~13~~	~~X~~	~~X~~	~~X~~	~~X~~	~~X~~			~~DQ04~~
NBCD\GDDT000101	9/12/96	—	H_2O	40 mL VOA	4°C	HCL	2	X							

RELINQUISHED BY:	DATE	RECEIVED BY:	DATE	RELINQUISHED BY:	DATE	RECEIVED BY:	DATE
SIGNATURE [signature]	9/12/96	SIGNATURE		SIGNATURE		SIGNATURE	
PRINTED Todd B. Temple		PRINTED		PRINTED		PRINTED	
COMPANY ENSAFE	TIME 1700	COMPANY	TIME	COMPANY	TIME	COMPANY	TIME
REASON Ship to Lab		REASON		REASON		REASON	

METHOD OF SHIPMENT: Fed Ex
SHIPMENT NO. 0904036921
SPECIAL INSTRUCTION:

COMMENTS: All samples are DQ03 + TICs unless otherwise stated in the Remarks as DQ04. All DQ04 samples are to be analyzed for APIII Parameters

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☒ DISPOSED OF
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS
- ☐ RETURNED TO CUSTOMER

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

CLNCOCR1

PAGE 1 OF 1

NAVY CLEAN
ENSAFE/ALLEN&HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

CTO-TASK:
COC #:
BPA/SO: 0342/96

CLIENT NAV BASE CHAS
ADDRESS ZONE D
PROJECT NAME/NUMBER 2904-09420
SAMPLERS: (SIGNATURE) T E Fryar

PROJECT MANAGER CHARLIE VERNOY
TELEPHONE NO. (803) 884-0029
FAX. NO.

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOA	SVOA PEST PCB	METALS, CN					REMARKS
NBCDGDDSB00101	8-26-96	1251	SOIL	2-2oz, 2 4oz	4°C	NONE	4	X	X	X					
NBCDGDDSB00102	↓	1340	SOIL	↓	4°C	NONE	4	X	X	X					
NBCDGDDTB00101	↓		H2O	2-40ml VIALS	4°C	HCL	2	X							

TEF

RELINQUISHED BY:	DATE	RECEIVED BY:	DATE	RELINQUISHED BY:	DATE	RECEIVED BY:	DATE
SIGNATURE T E Fryar	8-26-96	SIGNATURE		SIGNATURE		SIGNATURE	
PRINTED T E FRYAR	TIME	PRINTED	TIME	PRINTED	TIME	PRINTED	TIME
COMPANY CLEAN	1535	COMPANY		COMPANY		COMPANY	
REASON ANALYSIS		REASON		REASON		REASON	

METHOD OF SHIPMENT: FED EX
SHIPMENT NO. 0904037094
SPECIAL INSTRUCTION: NONE

COMMENTS: ALL SAMPLES ARE DQO 3 and TIC's UNLESS OTHERWISE NOTED.

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☒ DISPOSED OF
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS
- ☐ RETURNED TO CUSTOMER

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

CLNCOCR1

Amended CAV 6/30/97

PAGE 3 OF 3

NAVY CLEAN
ENSAFE/ALLEN&HOSHALL
(901) 383-9115

CHAIN OF CUSTODY RECORD

CTO-TASK: 2912-08410
COC #:
BPA/SO:

CLIENT: NAVAL BASE CHARLESTON
ADDRESS: ZONE L
PROJECT NAME/NUMBER: 2912-08410
SAMPLERS: (SIGNATURE) Randy Brand

PROJECT MANAGER: CHARLIE VERNOY
TELEPHONE NO.: 803-855-0029
FAX. NO.: 803-856-0107

ANALYSIS REQUIRED

	FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOA'S						REMARKS
X	GDDGP001-~~DX~~-25 CAV	6/25/97	1100	H_2O	40 mL	4	HCL		2						DQO LEVEL 2
X	GDDGP001-~~DX~~-15 CAV	6/25/97	1105	H_2O	40 mL	4	HCL		2						"

Wendell C Randall
6-25-97

RELINQUISHED BY:	DATE	RECEIVED BY:	DATE	RELINQUISHED BY:	DATE	RECEIVED BY:	DATE
SIGNATURE: Randy Brand	6/25/97	SIGNATURE: John B	6/25/97	SIGNATURE:		SIGNATURE:	
PRINTED: RANDY BRAND	TIME	PRINTED: JASON BUMSTEAD	TIME	PRINTED:	TIME	PRINTED:	TIME
COMPANY: TARGET		COMPANY: TARGET		COMPANY:		COMPANY:	
REASON: LAB	4:00	REASON: LAB	4:00	REASON:		REASON:	

METHOD OF SHIPMENT: HAND DELIVERED
SHIPMENT NO.:
SPECIAL INSTRUCTION: TO TARGET Mobile LAB

COMMENTS:

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☐ DISPOSED OF
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS
- ☐ RETURNED TO CUSTOMER

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE):

CLNCOCR1

APPENDIX E

DATA VALIDATION

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#:	26738B
Date:	October 23, 1996
Client Name:	Ensafe/ Allen & Hoshall
Project/Site Name:	Charleston - Zone D
Date Sampled:	August 12-26, 1996
Number of Samples:	2 Aqueous Sample(s) with 0 MS/MSD(s) 2 Non-aqueous Sample(s) with 0 MS/MSD(s)
Laboratory:	Southwest Laboratory of Oklahoma
Validation Guidance:	National Functional Guidelines for Organic and Inorganic Data, June 1991 and February, 1994, respectively
QA/QC Level:	EPA DQO Level III
Method(s) Utilized:	SW846 Third Edition
Analytical Fractions:	Volatiles, Semivolatiles, Pesticide/PCB's, Metals, Cyanide

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user in urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

Craig G. Fer [signature]
Paul B. Humburg, President

10/31/96
Date

4127 Plaza 94 South · St. Charles, MO 63304
(314) 936-1332 · Fax (314) 936-1335

SDG# 26738B

Samples and Fractions Reviewed

Sample Identifications

Analytical Fractions

ENSAFE ID	MATRIX	VOA		SVOA		P/P		TAL		CN	
GDDSB00101	SOIL		X		X		X		X		X
GDDSB00102	SOIL		X		X		X		X		X
GDDT000101	WATER	X									
GDDTB00101	WATER	X									
Total Billable Samples (Water/Soil)		2	2	0	2	0	2	0	2	0	2

VOA= SW846 Volatiles
SVOA= SW846 Semivolatiles
P/P= SW846 Pesticide/PCB's
TAL= SW846 Metals
CN= SW846 Cyanide

DATA ASSESSMENT NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8240; the National Functional Guidelines for Organic Data Validation, June 1991, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 26738B

A validation was performed on the Volatile Data from SDG 26738B. The data was evaluated based on the following parameters:

* • Data Completeness
* • Holding Times
* • GC/MS Tuning
   • Calibration
   • Blanks
* • Surrogate Recoveries
* • Matrix Spike/Matrix Spike Duplicates
* • Field Duplicates
* • Internal Standard Performance
* • Compound Identification
* • Compound Quantitation

* - All criteria were met for this parameter.

Continuing Calibrations

The continuing calibrations that were analyzed by the laboratory for these samples were not acceptable for all compound %Ds. The average RRF requirements were not met for all continuing calibration compounds.

Continuing Calibrations, continued

Specific Findings

The continuing calibration standard I20871.D contained a compound with an average RRF less than 0.05. For the samples and non-compliant compound listed below, positive results are qualified as estimated, J, and non-detect results are rejected, UR.

GDDSB00101	2-chloroethyl_vinyl_ether (0.032)
GDDSB00102	

Field QC Blanks

One (1) of the trip blanks and the rinseate blank associated with these soil samples exhibited contamination. The samples required qualification. The end-user should note that the action levels indicated for the blank analysis may not involve the same weights, volumes, dilution factors, or percent moisture as associated samples. These factors must be taken into consideration when applying the 5X or 10X criteria to field samples.

	GDDT000101	GDDE000101
acetone	--------	9 μg/L
chloroform	2 μg/L	11 μg/L

Blank	Samples	Compound	Action Level	Qualification
GDDE000101	GDDSB00101	acetone	90 μg/Kg	U
	GDDSB00102			CRQL
	GDDSB00101	chloroform	55 μg/Kg	CRQL

System Performance and Overall Assessment

Overall performance was acceptable. The data reviewer estimates that less than 10% of the data required qualifications/rejections.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDDSB00101 GDDSB00102	2-chloroethyl_vinyl_ether	+/-	J/R
GDDSB00101	acetone	+	U
GDDSB00102	acetone	+	CRQL
GDDSB00101	chloroform	+	CRQL

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT AND NARRATIVE

SEMIVOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA SW846, Method 8270 with CLP deliverables; National Functional Guidelines for Organic Data Review, and DQO Level III. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 26738

A validation was performed on the Semivolatile Data from SDG 26738. The data was evaluated based on the following parameters.

*	•	Data Completeness
*	•	Holding Times
*	•	GC/MS Tuning
	•	Calibrations
*	•	Internal Standard Performance
	•	Blanks
*	•	Surrogate Recoveries
*	•	Matrix Spike/Matrix Spike Duplicate
*	•	Field Duplicates
*	•	Compound Identification /Quantitation

* - All criteria were met for this parameter

Continuing calibrations

The continuing calibrations that were analyzed with this data package exhibited %Ds that were not within %D continuing calibration criteria. All RRFs were within calibration criteria.

DATA ASSESSMENT AND NARRATIVE
SEMIVOLATILE ANALYSIS

Continuing calibrations (continued)

Specific Finding:

The continuing calibration, JJS369, contained compounds with %Ds greater than 50%, but less than 90%. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and all non detects as estimated (UJ).

GDDSB00101	indeno(1,2,3-cd)pyrene (-54.0)
GDDSB00102	benzo(g,h,i)perylene (-62.0)

Equipment Blanks

Associated blank	Compound	Conc.	Action level
GDDE000101	bis(2-ethylhexyl) phthalate	1J ug/L	10 ug/L

Samples	Compound	Qualification
GDDSB00102	bis(2-ethylhexyl) phthalate	CRQL

System Performance and Overall Assessment

The overall system performance was acceptable. The laboratory did not encounter any large problems. The data reviewer estimates that less than 5% of the data is qualified.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

R = Result is rejected and unusable

D = Result value is based on the dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	ANALYTE ID	DL	QL
GDDSB00101	indeno(1,2,3-cd)pyrene (-54.0)	+/-	J/UJ
GDDSB00102	benzo(g,h,i)perylene (-62.0)		
GDDSB00102	bis(2-ethylhexyl) phthalate	+	CRQL

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLORS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8080A; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 26738B

A validation was performed on the Pesticide/Aroclor Data from SDG 26738B. The data was evaluated based on the following parameters:

- * Data Completeness
- Holding Times
- * GC Performance
- * Calibration
- * Blanks
- * Surrogate Recoveries
- * Matrix Spike/Matrix Spike Duplicates
- * Field Duplicates
- * Compound Identification
- Compound Quantitation

* - All criteria were met for this parameter.

Contractual Non-Compliance

The method requires that all target compounds, including the multi-component compounds, be analyzed with a five (5) point calibration curve. The laboratory did not analyze a five (5) point curve for the aroclors and toxaphene in each sequence included in this SDG. No positive results were reported for the compounds analyzed with a single point calibration, therefore the data did not require qualification.

Holding Times

The extraction holding time was exceeded for one (1) re-extracted sample.

Specific Finding

The extraction holding time was exceeded for one (1) sample by eight (8) days. For the following sample the positive results are qualified as estimated, J, and the non-detect results are qualified as estimated, UJ.

GDDSB00101RE

Compound Identification/Quantitation

One (1) sample was re-extracted due to non-compliant surrogate recoveries in the original analysis.

Specific Findings

The following samples rejected, UR, in favor of the results reported from the re-extracted analysis for the noted reason.

Sample	Compounds	Reason
GDDSB00101	ALL	0% surrogate recoveries

System Performance and Overall Assessment

Overall performance was acceptable. The data reviewer estimates less than 10% of the data required qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

NJ = Result is considered presumptively present at an estimated concentration

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDDSB00101RE	ALL	+/-	J/UJ
GDDSB00101	ALL	+/-	UR

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE
METALS AND CYANIDE

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 26738A

A validation was performed on the Metals and Cyanide Data from SDG 26738A. The data was evaluated based on the following parameters.

- * Data Completeness
- * Holding Times
- * Calibrations
- Blanks
- * Interferences
- * Matrix Spike Recovery
- * Matrix Duplicates
- * Field Duplicates
- * Laboratory Control Samples
- * Serial Dilutions
- * Post Digestion Spiking

* - All criteria were met for this parameter.

Preparation and Field Blanks

Specific Finding

The preparation blank exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Aluminum	3.41 mg/kg	no impact
Antimony	0.32 mg/kg	all soil samples below 1.6 mg/kg
Chromium	0.12 mg/kg	no impact
Iron	2.5 mg/kg	no impact
Tin	1.68 mg/kg	all soil samples below 8.4 mg/kg

The equipment and Rinsate blanks exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Antimony	5.8 ug/l	no impact
Calcium	140 ug/l	no impact
Copper	2.5 ug/l	all soil samples below 2.5 mg/kg
Iron	72.2 ug/l	no impact
Manganese	1.5 ug/l	no impact
Selenium	4.0 ug/l	no impact
Zinc	5.4 ug/l	no impact

The USEPA requires that all sample values below five times the preparation, field, DI or calibration blank contamination be qualified as non-detect, "U".

Specific Finding

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B" per Ensafe's request.

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
all soil samples below 8.4 mg/kg	Sn.	+	U
all soil samples below 1.6 mg/kg	Sb.		
all soil samples below 2.5 mg/kg	Cu.		
All "B" results	all analytes	B	J

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#:	26738A
Date:	October 23, 1996
Client Name:	Ensafe/ Allen & Hoshall
Project/Site Name:	Charleston - Zone D
Date Sampled:	August 12-13, 1996
Number of Samples:	2 Aqueous Sample(s) with 0 MS/MSD(s) 2 Non-aqueous Sample(s) with 0 MS/MSD(s)
Laboratory:	Southwest Laboratory of Oklahoma
Validation Guidance:	National Functional Guidelines for Organic and Inorganic Data, June 1991 and February, 1994, respectively
QA/QC Level:	EPA DQO Level IV
Method(s) Utilized:	SW846 Third Edition
Analytical Fractions:	Volatiles, Semivolatiles, Pesticide/PCB's, Organophosphorus Pesticides, Herbicides, Dioxin/Furans, Hexavalent Chromium, Metals, Cyanide

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user in urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

Craig G. Simpson
Paul B. Humburg, President

10/31/96
Date

4127 Plaza 94 South · St. Charles, MO 63304
(314) 936-1332 · Fax (314) 936-1335

SDG# 26738A

Samples and Fractions Reviewed

Sample Identifications — Analytical Fractions

ENSAFE ID	MATRIX	VOA		SVOA		P/P		OPP		HERB		D/F		HCR		TAL		CN	
GDD5000101	SOIL		X		X		X		X		X		X		X		X		X
GDD6000101	SOIL		X		X		X		X		X		X		X		X		X
GDDE000101	WATER	X		X		X		X		X		X		X		X		X	
GDD7000101	WATER	X		X		X		X		X		X		X		X		X	
Total Billable Samples (Water/Soil)		2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2

VOA= SW846 Volatiles
SV= SW846 Semivolatiles
P/P= SW846 Pesticide/PCBs
OPP= SW846 Organophosphorus Pesticides
HERB= SW846 Herbicides
D/F= SW846 Dioxin/Furans
HCR= SW846 Hexavalent Chromium
TAL= SW846 Metals
CN= SW846 Cyanide

DATA ASSESSMENT NARRATIVES

DATA ASSESSMENT NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8240 for Appendix IX target list; the National Functional Guidelines for Organic Data Validation, June 1991, and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 26738A

A validation was performed on the Volatile Data from SDG 26738A. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- * • Calibration
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Internal Standard Performance
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

System Performance and Overall Assessment

Overall performance was acceptable. The data did not require qualifications because the SDG consisted of four (4) field QC blanks only.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT AND NARRATIVE

SEMIVOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA SW846, Method 8270 with CLP deliverables; National Functional Guidelines for Organic Data Review, and DQO Level IV. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 26738A

A validation was performed on the Semivolatile Data from SDG 26738A. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- * • Calibrations
- * • Internal Standard Performance
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicate
- * • Field Duplicates
- • Compound Identification /Quantitation

* - All criteria were met for this parameter

Compound Identification/Quantitation

Specific Finding:

The laboratory did not include the following compounds in their calibration curve or continuing calibration, compounds carbazole, 3-methyl-cholanthrene and 1,2-dibromo-3-chloropropane. No qualifications are required because, only QC field samples were analyzed.

DATA ASSESSMENT AND NARRATIVE
SEMIVOLATILE ANALYSIS

System Performance and Overall Assessment

The overall system performance was acceptable. The laboratory did not encounter any large problems. The data as presented did not require qualifications because, only field QC samples were included in this SDG.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

R = Result is rejected and unusable

D= Result value is based on the dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	ANALYTE ID	DL	QL

No qualifications are required.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLORS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8080A; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 26738A

A validation was performed on the Pesticide/Aroclor Data from SDG 26738A. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC Performance
- * • Calibration
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

Contractual Non-Compliance

The method requires that all target compounds, including the multi-component compounds, be analyzed with a five (5) point calibration curve. The laboratory analyzed a single point curve for the aroclors and toxaphene. No positive results were reported for the compounds analyzed with a single point calibration, therefore the data did not require qualification.

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLOR ANALYSIS

System Performance and Overall Assessment

Overall performance was acceptable. The data reviewer estimates less than 10% of the data required qualifications. Several calibration summary pages submitted by the laboratory were not legible due to poor quality photocopies. Corresponding pages from the raw data were included in the worksheets.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

NJ = Result is considered presumptively present at an estimated concentration

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE

ORGANOPHOSPHORUS PESTICIDES

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8140; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 26738A

A validation was performed on the Organophosphorus Pesticide Data from SDG 26738A. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC Performance
- * • Calibration
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

System Performance and Overall Assessment

Overall performance was acceptable. The data did not require qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE

CHLORINATED HERBICIDES

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8150; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 26738A

A validation was performed on the Herbicide Data from SDG 26738A. The data was evaluated based on the following parameters:

* • Data Completeness
* • Holding Times
* • GC Performance
* • Calibration
* • Blanks
* • Surrogate Recoveries
* • Matrix Spike/Matrix Spike Duplicates
* • Field Duplicates
* • Compound Identification
* • Compound Quantitation

* - All criteria were met for this parameter.

System Performance and Overall Assessment

Overall performance was acceptable. The data did not require qualifications. The analytical sequences were not present in the data package.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS ARE REQUIRED.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT AND NARRATIVE

Dioxin/Furans

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard recoveries. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA SW846, Method 8290; National Functional Guidelines for Organic Data Review, and DQO Level IV. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 26738

A validation was performed on the Dioxin/Furans Data from SDG 26738. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • Mass Resolution Checks
- * • Column Performance
- * • Calibrations
- * • Internal Standard Performance
- • Blanks
- * • Matrix Spike/Matrix Spike Duplicate
- * • Field Duplicates
- * • Congener Identification /Quantitation

* - All criteria were met for this parameter

Method Blanks

Two (2) of the three (3) method blanks exhibited contamination for octa-dioxin.

Sample ID	Congener ID	Blank Conc. pg/L	Sample Conc. pg/L	Qualification
GDDE000101	OCDD	5.26	18.2	NA
GDD7000101	OCDD	5.26	9.36	NA
GDD5000101	OCDD	2.57	2.32	U

System Performance and Overall Assessment

The overall system performance was acceptable. The laboratory did not encounter any large problems.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D= Result value is based on the dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL =	The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.
U =	The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.
No Action =	The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	ANALYTE ID	DL	QL
GDDE000101 GDD7000101	OCDD	+B	NA
GDD5000101	OCDD	+B	U

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE
METALS, HEXAVALENT CHROMIUM AND CYANIDE

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 26738B

A validation was performed on the Metals, Hexavalent Chromium and Cyanide Data from SDG 26738B. The data was evaluated based on the following parameters for field duplicate samples.

- * ● Data Completeness
- * ● Holding Times
- * ● Calibrations
- ● Blanks
- * ● Interferences
- * ● Matrix Spike Recovery
- * ● Matrix Duplicates
- * ● Field Duplicates
- * ● Laboratory Control Samples
- * ● Serial Dilutions
- * ● Post Digestion Spiking

* - All criteria were met for this parameter.

Preparation and Field Blanks

Specific Finding

The preparation blank exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Tin	1.72 mg/kg	no impact

The equipment and field blanks exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Antimony	5.8 ug/l	no impact
Calcium	140 ug/l	no impact
Copper	2.5 ug/l	no impact
Iron	72.2 ug/l	no impact
Manganese	1.5 ug/l	no impact
Selenium	4.0 ug/l	no impact
Zinc	5.4 ug/l	no impact

* all samples are field QC samples

The USEPA requires that all sample values below five times the preparation, field, DI or calibration blank contamination be qualified as non-detect, "U".

The preparation blank exhibited negative bias for the following elements.

Elements	Conc.	Samples affected
Aluminum	-2.30 mg/kg	no impact
Cobalt	-0.12 mg/kg	no impact
Silver	-0.44 mg/kg	no impact
Vanadium	-0.13 mg/kg	no impact

* all samples are field QC samples

The USEPA requires that the reviewer review and qualify data bias on negative bias. This reviewer qualifies all non-detect and positive results below ten times the absolute value as estimated, "J" or "UJ".

Specific Finding

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B" per Ensafe's request.

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
All "B" results	all analytes	B	J

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#:	27553B
Date:	December 17, 1996
Client Name:	Ensafe/ Allen & Hoshall
Project/Site Name:	Charleston - Zone D
Date Sampled:	November 7, 1996
Number of Samples:	3 Aqueous Sample(s) with 0 MS/MSD(s)
Laboratory:	Southwest Laboratory of Oklahoma
Validation Guidance:	National Functional Guidelines for Organic and Inorganic Data, June 1991 and February, 1994, respectively
QA/QC Level:	EPA DQO Level III
Method(s) Utilized:	SW846 Third Edition
Analytical Fractions:	Volatiles, Semivolatiles, Pesticide/PCB's, Total Dissolved Solids, Chloride, Sulfate, Metals, Cyanide

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user in urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

for Kimberly S. Stopp — 30 December 1996
Paul B. Humburg, President — Date

4127 Plaza 94 South · St. Charles, MO 63304
(314) 936-1332 · Fax (314) 936-1335

SDG# 27553B

Samples and Fractions Reviewed

Sample Identifications | Analytical Fractions

ENSAFE ID	MATRIX	VOA		SVOA		P/P		TDS		CHL		SUL		TAL		CN	
GDDTW01D01	WATER	X															
GDDGW01D01	WATER	X		X		X		X		X		X		X		X	
GDDGW00101	WATER	X		X		X		X		X		X		X		X	
Total Billable Samples	(Water/Soil)	3	0	2	0	2	0	2	0	2	0	2	0	2	0	2	0

VOA= SW846 Volatiles
SVOA= SW846 Semivolatiles
P/P= SW846 Pesticide/PCB's
TDS= Total Dissolved Solids
CHL= Chloride
SUL= Sulfate
TAL= SW846 Metals
CN= SW846 Cyanide

DATA ASSESSMENT NARRATIVES

DATA ASSESSMENT NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8240; the National Functional Guidelines for Organic Data Validation, June 1991, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27553B

A validation was performed on the Volatile Data from SDG 27553B. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- • Calibration
- • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Internal Standard Performance
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

Continuing Calibrations

Specific Findings

The continuing calibration standard K16493.D contained one (1) compound with a RRF less than 0.05. For the samples and non-compliant compound listed below, positive results are qualified as estimated, J, and non-detect results are rejected, UR.

GDDGW00101	2-chloroethyl_vinyl_ether (0.020)
GDDGW01D01	

DATA ASSESSMENT NARRATIVE
VOLATILE ANALYSIS

Method Blanks

The method blanks exhibited contamination. The samples required qualification. The end-user should note that the action levels indicated for the blank analysis may not involve the same weights, volumes, dilution factors, or percent moisture as associated samples. These factors must be taken into consideration when applying the 5X or 10X criteria to field samples.

	VBLK1
acetone	8 μg/L

Specific Finding

Blank	Samples	Compound	Action Level	Qualification
VBLK1	GDDGW00101 GDDGW01D01	acetone	80 μg/L	CRQL

System Performance and Overall Assessment

The data reviewer estimates that less than 5% of the data required qualifications/rejections.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDDGW00101 GDDGW01D01	2-chloroethyl_vinyl_ether	+/-	J/UR
GDDGW00101 GDDGW01D01	acetone	+B	CRQL

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non detect result

DATA ASSESSMENT AND NARRATIVE

SEMIVOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA SW846, Method 8270 with CLP deliverables; National Functional Guidelines for Organic Data Review, and DQO Level III. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 27533B

A validation was performed on the Semivolatile Data from SDG 27533B. The data was evaluated based on the following parameters.

* • Data Completeness
* • Holding Times
* • GC/MS Tuning
* • Calibrations
* • Internal Standard Performance
* • Blanks
* • Surrogate Recoveries
* • Matrix Spike/Matrix Spike Duplicate
* • Field Duplicates
* • Compound Identification /Quantitation

* - All criteria were met for this parameter

System Performance and Overall Assessment

The laboratory did not encounter any large problems. The data as presented did not require qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

R = Result is rejected and unusable

D = Result value is based on the dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL =	The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.
U =	The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.
No Action =	The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	ANALYTE ID	DL	QL

No qualifications are required.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLORS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8080A; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27553B

A validation was performed on the Pesticide/Aroclor Data from SDG 27553B. The data was evaluated based on the following parameters:

* • Data Completeness
* • Holding Times
* • GC Performance
* • Calibration
* • Blanks
* • Surrogate Recoveries
* • Matrix Spike/Matrix Spike Duplicates
* • Field Duplicates
* • Compound Identification
* • Compound Quantitation

* - All criteria were met for this parameter.

Contractual Non-Compliance

The method requires that all target compounds, including the multi-component compounds, be analyzed with a five (5) point calibration curve. The laboratory analyzed a single point curve for the aroclors and toxaphene. No positive results were reported for the compounds analyzed with a single point calibration, therefore the data did not require qualification.

System Performance and Overall Assessment

The data did not require qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

NJ = Result is considered presumptively present at an estimated concentration

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE
METALS, WET CHEMISTRY AND CYANIDE

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27553A

A validation was performed on the Metals, wet chemistry and Cyanide Data from SDG 27553A. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • Calibrations
- • Blanks
- * • Interferences
- * • Matrix Spike Recovery
- * • Matrix Duplicates
- * • Field Duplicates
- * • Laboratory Control Samples
- * • Serial Dilutions
- * • Post Digestion Spiking

* - All criteria were met for this parameter.

Preparation and Field Blanks

Specific Finding

The preparation blank exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Calcium	28.8 ug/l	no impact
Copper	0.94 ug/l	all water samples below 4.7 ug/l
Selenium	3.78 ug/l	no impact
Silver	1.65 ug/l	no impact
Thallium	2.76 ug/l	all water samples below 13.8 ug/l

Tin	12.4 ug/l	all water samples below 62.0 ug/l
Zinc	5.84 ug/l	all water samples below 29.2 ug/l

The equipment and Rinsate blanks exhibited contamination for the several elements. No impact on the data.

The USEPA requires that all sample values below five times the preparation, field, DI or calibration blank contamination be qualified as non-detect, "U".

Specific Finding

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B" per Ensafe's request.

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
all water samples below 4.7 ug/l	Cu.	+	U
all water samples below 13.8 ug/l	Tl.		
all water samples below 62.0 ug/l	Sn.		
all water samples below 29.2 ug/l	Zn.		
All "B" results	all analytes	B	J

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#:	27553A
Date:	December 17, 1996
Client Name:	Ensafe/ Allen & Hoshall
Project/Site Name:	Charleston - Zone D
Date Sampled:	November 7, 1996
Number of Samples:	3 Aqueous Sample(s) with 0 MS/MSD(s)
Laboratory:	Southwest Laboratory of Oklahoma
Validation Guidance:	National Functional Guidelines for Organic and Inorganic Data, June 1991 and February, 1994, respectively
QA/QC Level:	EPA DQO Level IV
Method(s) Utilized:	SW846 Third Edition
Analytical Fractions:	Volatiles, Semivolatiles, Pesticide/PCB's, Herbicides, Organophosphorus Pesticides, Dioxin/Furans, Total Dissolved Solids, Chloride, Sulfate, Hexavalent Chromium, Metals, Cyanide

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user in urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

for Kimberly S. Shopp
Paul B. Humburg, President

20 December 1996
Date

4127 Plaza 94 South · St. Charles, MO 63304
(314) 936-1332 · Fax (314) 936-1335

SDG# 27553A

Samples and Fractions Reviewed

Sample Identifications

Analytical Fractions

ENSAFE ID	MATRIX	VOA		SVOA		P/P		OPP		HERB		D/F		TDS		CHL		SUL		HCR		TAL		CN	
GDDEW01D01	WATER	X		X		X		X		X		X		X		X		X		X		X		X	
GDDFW01D01	WATER	X		X		X		X		X		X		X		X		X		X		X		X	
GDDDW01D01	WATER	X		X		X		X		X		X		X		X		X		X		X		X	
Total Billable Samples	(Water/Soil	3	0	3	0	3	0	3	0	3	0	3	0	3	0	3	0	3	0	3	0	3	0	3	0

VOA= SW846 Volatiles
SVOA= SW846 Semivolatiles
P/P= SW846 Pesticide/PCB's
OPP= SW846 Organophosphorus Pesticides
HERB= SW846 Herbicides
D/F= SW846 Dioxin/Furans
TDS= Total Dissolved Solids
CHL= Chloride
SUL= Sulfate
HCR= SW846 Hexavalent Chromium
TAL= SW846 Metals
CN= SW846 Cyanide

DATA ASSESSMENT NARRATIVES

DATA ASSESSMENT NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8240 for the Appendix IX list, the National Functional Guidelines for Organic Data Validation, June 1991, and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27553A

A validation was performed on the Volatile Data from SDG 27553A. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- * • Calibration
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Internal Standard Performance
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

System Performance and Overall Assessment

The data did not require qualifications. Only field QC blanks were included in this SDG.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT AND NARRATIVE

SEMIVOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA SW846, Method 8270 with CLP deliverables; National Functional Guidelines for Organic Data Review, and DQO Level IV. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 27533A

A validation was performed on the Semivolatile Data from SDG 27533A. The data was evaluated based on the following parameters.

- * Data Completeness
- * Holding Times
- * GC/MS Tuning
- * Calibrations
- * Internal Standard Performance
- * Blanks
- * Surrogate Recoveries
- * Matrix Spike/Matrix Spike Duplicate
- * Field Duplicates
- Compound Identification /Quantitation

* - All criteria were met for this parameter

Compound Identification/Quantitation

Specific Finding:

The laboratory did not include the following compounds in there calibration curve or continuing calibration, compounds carbazole, 3-methyl-cholanthrene and 1,2-dibromo-3-chloropropane. No qualifications are required because, only QC field samples were analyzed.

DATA ASSESSMENT AND NARRATIVE
SEMIVOLATILE ANALYSIS

PAGE - 2

System Performance and Overall Assessment

The laboratory did not encounter any large problems. The data as presented did not require qualifications because, only field QC samples were included in this SDG.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

R = Result is rejected and unusable

D= Result value is based on the dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	ANALYTE ID	DL	QL

No qualifications are required.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLORS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8080A; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27553A

A validation was performed on the Pesticide/Aroclor Data from SDG 27553A. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC Performance
- * • Calibration
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

Contractual Non-Compliance

The method requires that all target compounds, including the multi-component compounds, be analyzed with a five (5) point calibration curve. The laboratory analyzed a single point curve for the aroclors and toxaphene. No positive results were reported for the compounds analyzed with a single point calibration, therefore the data did not require qualification.

System Performance and Overall Assessment

The data did not require qualifications. Only QC blanks were included in this data package.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

NJ = Result is considered presumptively present at an estimated concentration

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE

ORGANOPHOSPHORUS PESTICIDES

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8140; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27553A

A validation was performed on the Organophosphorus Pesticide Data from SDG 27553A. The data was evaluated based on the following parameters:

* • Data Completeness
* • Holding Times
* • GC Performance
* • Calibration
* • Blanks
* • Surrogate Recoveries
* • Matrix Spike/Matrix Spike Duplicates
* • Field Duplicates
* • Compound Identification
* • Compound Quantitation

* - All criteria were met for this parameter.

System Performance and Overall Assessment

The data did not require qualifications. Only QC blanks were included in this data package.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE

CHLORINATED HERBICIDES

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8150; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27553A

A validation was performed on the Herbicide Data from SDG 27553A. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC Performance
- * • Calibration
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

System Performance and Overall Assessment

The data did not require qualifications. Only QC blanks were included in this data package.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE
METALS, HEXAVALENT CHROMIUM, WET CHEMISTRY AND CYANIDE

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27553B

A validation was performed on the Metals, Hexavalent Chromium, wet chemistry and Cyanide Data from SDG 27553B. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • Calibrations
- * • Blanks
- * • Interferences
- * • Matrix Spike Recovery
- * • Matrix Duplicates
- * • Field Duplicates
- * • Laboratory Control Samples
- * • Serial Dilutions
- * • Post Digestion Spiking

* - All criteria were met for this parameter.

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL

Data stands as reported without qualification.

DATA ASSESSMENT AND NARRATIVE

Dioxin/Furans

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard recoveries. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA SW846, Method 8290; National Functional Guidelines for Organic Data Review, and DQO Level IV. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 27553

A validation was performed on the Dioxin/Furans Data from SDG 27553. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • Mass Resolution Checks
- * • Column Performance
- * • Calibrations
- * • Internal Standard Performance
- * • Blanks
- * • Matrix Spike/Matrix Spike Duplicate
- * • Field Duplicates
- * • Congener Identification /Quantitation

* - All criteria were met for this parameter

System Performance and Overall Assessment

The laboratory did not encounter any large problems.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D= Result value is based on the dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL =	The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.
U =	The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.
No Action =	The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	CONGENER ID	DL	QL

No qualifications are required - field QC only.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non detect result

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#:	27228A
Date:	November 25, 1996
Client Name:	Ensafe/ Allen & Hoshall
Project/Site Name:	Charleston - Zone D
Date Sampled:	October 7, 1996
Number of Samples:	2 Aqueous Sample(s) with 0 MS/MSD(s) 1 Non-aqueous Sample(s) with 0 MS/MSD(s)
Laboratory:	Southwest Laboratory of Oklahoma
Validation Guidance:	National Functional Guidelines for Organic and Inorganic Data, June 1991 and February, 1994, respectively
QA/QC Level:	EPA DQO Level IV
Method(s) Utilized:	SW846 Third Edition
Analytical Fractions:	Volatiles, Semivolatiles, Pesticide/PCB's, Organophosphorus Pesticides, Herbicides, Dioxin/Furans, Hexavalent Chromium, Metals, Cyanide

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user in urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

Paul B. Humburg, President — 12/5/96
Date

4127 Plaza 94 South · St. Charles, MO 63304

SDG# 27228A

Samples and Fractions Reviewed

Sample Identifications — Analytical Fractions

ENSAFE ID	MATRIX	VOA		SVOA		P/P		OPP		HERB		D/F		HCR		TAL		CN	
GDDEB00501	WATER	X		X		X		X		X		X		X		X		X	
GDDDB00501	WATER	X		X		X		X		X		X		X		X		X	
GDDCB00601	SOIL		X		X		X		X		X		X		X		X		X
Total Billable Samples (Water/Soil)		2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1

VOA= SW846 Volatiles
SVOA= SW846 Semivolatiles
P/P= SW846 Pesticide/PCB's
OPP= SW846 Organophosphorus Pesticides
HERB= SW846 Herbicides
D/F= SW846 Dioxin/Furans
HCR= SW846 Hexavalent Chromium
TAL= SW846 Metals
CN= SW846 Cyanide

DATA ASSESSMENT NARRATIVES

DATA ASSESSMENT AND NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA 8240, Appendix IX; the National Functional Guidelines for Organic Data Review, June 1991, and DQO Level IV. All comments made within this report should be considered when examining the analytical results.

SDG # 27228A

A validation was performed on the Volatile Data from SDG 27228A. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- • Calibrations
- * • Internal Standard Performance
- • Blanks
- * • Surrogate Recoveries
- * • Laboratory Control Samples
- * • Field Duplicates
- * • Compound Identification /Quantitation

* - All criteria were met for this parameter

Continuing calibrations

The continuing calibrations that were analyzed with this data package exhibited %Ds and average RRFs that were not within continuing calibration criteria. Qualifications are required.

DATA ASSESSMENT AND NARRATIVE

VOLATILE ANALYSIS

Continuing calibrations (continued)

Specific Finding:

The continuing calibration, K16187.D, contained compounds with RRFs less than 0.050. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as rejected (UR).

GDDCB00601	acrolein (0.028)
	Acetonitrile (0.022)
	Isobutyl alcohol (0.005)
	1,4-dioxane (0.002, 33.3%D)

Blank

The end user should note that the action levels indicated for the blank analysis may not involve the same weights, volumes, dilution factors, or percent moisture as associated samples. These factors must be taken into considerations when applying the 5X and 10X criteria to field samples.

Method Blank

Associated blank	Compound	Concentration	Action Level
VBLK2	methylene chloride	2J ug/kg	20 ug/kg
	Acetone	4J	40
	Chloroform	1J	10

Samples	Compound	Qualification
GDDCB00601	methylene chloride	U
GDDCB00601	acetone	CRQL
GDDCB00601	chloroform	CRQL

System Performance and Overall Assessment

The overall system performance was acceptable. The laboratory did not encounter any large problems. The data reviewer estimates that less than 5% of the data is qualified.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDDCB00601	acrolein Acetonitrile Isobutyl alcohol 1,4-dioxane	+/-	J/UR
GDDCB00601	methylene chloride	+	U
GDDCB00601	acetone	+	CRQL
GDDCB00601	chloroform	+	CRQL

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non detect result

DATA ASSESSMENT AND NARRATIVE

SEMIVOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA 8270, Appendix IX; National Functional Guidelines for Organic Data Review, and DQO Level IV. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 27228A

A validation was performed on the Semivolatile Data from SDG # 27228A. The data was evaluated based on the following parameters.

*	•	Data Completeness
*	•	Holding Times
*	•	GC/MS Tuning
	•	Calibrations
*	•	Internal Standard Performance
*	•	Blanks
*	•	Surrogate Recoveries
*	•	Laboratory Control Sample
*	•	Field Duplicates
	•	Compound Identification /Quantitation

* - All criteria were met for this parameter

Continuing calibrations

The continuing calibrations that were analyzed with this data package exhibited %Ds that were not within %D and RRF continuing calibration criteria. Qualifications are required.

DATA ASSESSMENT AND NARRATIVE

SEMIVOLATILE ANALYSIS

Continuing calibrations (continued)

Specific Finding:

The continuing calibration, A6437, contained compounds with %Ds greater than 50% and less than 90%. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and all non detects as estimated (UJ).

GDDCB00601	n-nitrosomethylethylamine (57.6)
	n-nitrosodiethylamine (53.2)
	acetophenone (50.7)
	n-nitrosomorphiline (50.4)
	o-toluidine (53.3)
	1-nitroso-piperidine (65.0)
	o,o,o-triethyl phosphorothioate (53.9)
	n-nitrosodi-n-butylamine (67.1)
	safrole (66.5)
	isosafrole (68.6)
	2-naphthylamine (57.5)
	thionazine (83.9)
	2-methyl-5-nitroaniline (75.8)
	phorate (72.0)
	dimethoate (89.8)
	4-aminobiphenyl (78.4)
	pronamide (72.6)
	pentachloronitrobenzene (65.3)
	disulfoton (68.2)
	methyl parathion (89.8)
	parathion (72.7)
	isodrin (67.6)
	3,3'-dimethylbenzidine (71.1)
	famphur (58.1)
	2-acetylaminofluorene (86.5)
	3-methylphenol (54.5)
	diphenylamine (64.7)
	7,12-dimethylbenz(a)anthrace (89.0)

DATA ASSESSMENT AND NARRATIVE

SEMIVOLATILE ANALYSIS

PAGE - 3

Continuing calibrations (continued)

Specific Finding:

The continuing calibration, A6437, contained compounds with %Ds greater than 90%. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and all non detects as rejected (UR).

GDDCB00601	1,4-naphthoquinone (112.9)
	1,3-dinitrobenzene (95.4)
	phenacetin (94.5)
	diallate (103.4)
	kepone (105.2)

The continuing calibration, A6437, contained compounds RRFs less than 0.050. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and all non detects as rejected (UR).

GDDCB00601	hexachloropene (0.011)

Compound Identification /Quantitation

Specific Finding:

The laboratory did not include the following compounds in the calibration curve or continuing calibration, compounds carbazole, 3-methyl-cholanthrene, and 1,2-dibromo-3-chloropropane. For all samples, qualify all positive results estimated (J) and reject all non detects (UR).

System Performance and Overall Assessment

The overall system performance was acceptable. The laboratory did not encounter any large problems. The data reviewer estimates that less than 10% of the data is qualified.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDDCB00601	n-nitrosomethylethylamine n-nitrosodiethylamine acetophenone n-nitrosomorphiline o-toluidine 1-nitroso-piperidine o,o,o-triethyl phosphorothioate n-nitrosodi-n-butylamine safrole isosafrole 2-naphthylamine thionazine 2-methyl-5-nitroaniline phorate dimethoate 4-aminobiphenyl pronamide pentachloronitrobenzene disulfoton methyl parathion parathion isodrin 3,3'-dimethylbenzidine famphur 2-acetylaminofluorene 3-methylphenol diphenylamine 7,12-dimethylbenz(a)anthrace	+/-	J/UJ
GDDCB00601	1,4-naphthoquinone 1,3-dinitrobenzene phenacetin diallate kepone	+/-	J/UR

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDDCB00601	hexachloropene	+/-	J/UR
All samples	carbazole 3-methyl-cholanthrene 1,2-dibromo-3-chloropropane	+/-	J/UR

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLORS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8080A; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27228A

A validation was performed on the Pesticide/Aroclor Data from SDG 27228A. The data was evaluated based on the following parameters:

* • Data Completeness
* • Holding Times
* • GC Performance
* • Calibration
* • Blanks
* • Surrogate Recoveries
* • Matrix Spike/Matrix Spike Duplicates
* • Field Duplicates
* • Compound Identification
* • Compound Quantitation

* - All criteria were met for this parameter.

Contractual Non-Compliance

The method requires that all target compounds, including the multi-component compounds, be analyzed with a five (5) point calibration curve. The laboratory analyzed a single point curve for the aroclors and toxaphene. No positive results were reported for the compounds analyzed with a single point calibration, therefore the data did not require qualification.

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLOR ANALYSIS

System Performance and Overall Assessment

Overall performance was acceptable. The data did not require qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

NJ = Result is considered presumptively present at an estimated concentration

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE

ORGANOPHOSPHORUS PESTICIDES

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8140; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27228A

A validation was performed on the Organophosphorus Pesticide Data from SDG 27228A. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC Performance
- * • Calibration
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

System Performance and Overall Assessment

Overall performance was acceptable. The data did not require qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE

CHLORINATED HERBICIDES

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8150; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27228A

A validation was performed on the Herbicide Data from SDG 27228A. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC Performance
- * • Calibration
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

System Performance and Overall Assessment

Overall performance was acceptable. The data did not require qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS ARE REQUIRED.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE
METALS, HEXAVALENT CHROMIUM AND CYANIDE

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level IV requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27228B

A validation was performed on the Metals, Hexavalent Chromium and Cyanide Data from SDG 27228B. The data was evaluated based on the following parameters for field QC samples.

* • Data Completeness
* • Holding Times
* • Calibrations
• Blanks
* • Interferences
* • Matrix Spike Recovery
* • Matrix Duplicates
• Field Duplicates
* • Laboratory Control Samples
* • Serial Dilutions
* • Post Digestion Spiking

* - All criteria were met for this parameter.

Preparation and Field Blanks

Specific Finding

The preparation blank exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Antimony	0.33 mg/kg	no impact
Beryllium	0.05 mg/kg	no impact
Chromium	0.11 mg/kg	no impact
Cobalt	0.10 mg/kg	no impact

Tin	1.17 mg/kg	all soil samples below 5.85 mg/kg
Vanadium	0.10 mg/kg	no impact

The equipment and Rinsate blanks exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Barium	0.3 ug/l	no impact
Beryllium	0.45 ug/l	all soil samples below 0.45 mg/kg
Calcium	75.2 ug/l	no impact
Copper	46.7 ug/l	all soil samples below 46.7 mg/kg
Sodium	8300 ug/l	all soil samples below 8300 mg/kg
Zinc	8.6 ug/l	no impact

The USEPA requires that all sample values below five times the preparation, field, DI or calibration blank contamination be qualified as non-detect, "U".

Field and Duplicate Analysis

Specific Finding

The RPD for field duplicate samples (GDDSB00601 and GDDCB00601) for Iron (60%) was greater than 50%. All positive results are qualified as estimated, "J".

Specific Finding

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B" per Ensafe's request.

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
All soil samples below 7.35 mg/kg	Sn.	+	U
All soil samples below 0.45 mg/kg	Be.		
All soil samples below 46.7 mg/kg	Cu.		
All soil samples below 8300 mg/kg	Na.		
GDDSB00601 and GDDCB00601.	Fe.	+	J
All "B" results	all analytes	B	J

DATA ASSESSMENT AND NARRATIVE

Dioxin/Furans

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard recoveries. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA SW846, Method 8290; National Functional Guidelines for Organic Data Review, and DQO Level IV. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 27228

A validation was performed on the Dioxin/Furans Data from SDG 27228. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • Mass Resolution Checks
- * • Column Performance
- * • Calibrations
- * • Internal Standard Performance
- • Blanks
- * • Matrix Spike/Matrix Spike Duplicate
- * • Field Duplicates
- * • Congener Identification /Quantitation

* - All criteria were met for this parameter

Blanks

The method blank rinseate blank exhibited contamination that resulted in qualifications.

Method 8290 Dioxin/Furans

Method Blanks - continued

Sample ID	Congener ID	Blank Conc. ng/Kg	Sample Conc. ng/Kg	Quals
GDD-C-B006-01	1,2,3,4,6,7,8-HpCDD	0.724	90.3	NA
	OCDD	4.627	635	NA
	1,2,3,4,6,7,8-HpCDF	1.067	33.3	NA
	OCDF	1.192	64.7	NA

Equipment Rinseate Blanks

Sample ID	Congener ID	Blank Conc. pg/L	Sample Conc. ng/Kg	Quals
GDD-C-B006-01	2,3,4,6,7,8-HxCDF	2.14	1.84	U

System Performance and Overall Assessment

The overall system performance was acceptable. The laboratory did not encounter any large problems.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D= Result value is based on the dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	CONGENER ID	DL	QL
GDD-C-B006-01	1,2,3,4,6,7,8-HpCDD	+B	NA
	OCDD	+B	NA
	1,2,3,4,6,7,8-HpCDF	+B	NA
	OCDF	+B	NA
GDD-C-B006-01	2,3,4,6,7,8-HxCDF	+	U

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#:	27228B
Date:	November 25, 1996
Client Name:	Ensafe/ Allen & Hoshall
Project/Site Name:	Charleston - Zone D
Date Sampled:	October 7-10, 1996
Number of Samples:	1 Aqueous Sample(s) with 0 MS/MSD(s) 13 Non-aqueous Sample(s) with 0 MS/MSD(s)
Laboratory:	Southwest Laboratory of Oklahoma
Validation Guidance:	National Functional Guidelines for Organic and Inorganic Data, June 1991 and February, 1994, respectively
QA/QC Level:	EPA DQO Level III
Method(s) Utilized:	SW846 Third Edition
Analytical Fractions:	Volatiles, Semivolatiles, Pesticide/PCB's. Metals, Cyanide

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user in urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:

for Kimberly S. Klopp
Paul B. Humburg, President

5 December 1996
Date

4127 Plaza 94 South · St. Charles, MO 63304
(314) 936-1332 · Fax (314) 936-1335

SDG# 27228B

Samples and Fractions Reviewed

Sample Identifications | Analytical Fractions

ENSAFE ID	MATRIX	VOA		SVOA		P/P		TAL		CN	
GDDSB00601	SOIL		X		X		X		X		X
GDDSB00602	SOIL		X		X		X		X		X
GDDSB00401	SOIL		X		X		X		X		X
GDDSB00402	SOIL		X		X		X		X		X
GDDTB00601	SOIL		X								
GDDSB00501	SOIL		X		X		X		X		X
GDDSB00502	SOIL		X		X		X		X		X
GDDTB00501	WATER	X									
GDDSB00201	SOIL		X		X		X		X		X
GDDSB00202	SOIL		X		X		X		X		X
GDDTB00201	SOIL		X								
GDDSB00301	SOIL		X		X		X		X		X
GDDSB00302	SOIL		X		X		X		X		X
GDDTB00301	SOIL		X								
Total Billable Samples (Water/Soil)		1	13	0	10	0	10	0	10	0	10

VOA= SW846 Volatiles
SVOA= SW846 Semivolatiles
P/P= SW846 Pesticide/PCB's
TAL= SW846 Metals
CN= SW846 Cyanide

DATA ASSESSMENT NARRATIVES

DATA ASSESSMENT AND NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA 8240; the National Functional Guidelines for Organic Data Review, June 1991, and DQO Level III. All comments made within this report should be considered when examining the analytical results.

SDG # 27228B

A validation was performed on the Volatile Data from SDG 27228B. The data was evaluated based on the following parameters.

- * Data Completeness
- * Holding Times
- * GC/MS Tuning
- Calibrations
- Internal Standard Performance
- Blanks
- Surrogate Recoveries
- * Laboratory Control Samples
- * Field Duplicates
- Compound Identification /Quantitation

* - All criteria were met for this parameter

Continuing calibrations

The continuing calibrations that were analyzed with this data package exhibited %Ds that were not within continuing calibration criteria. All average RRFs were within the calibration criteria. Qualifications are required.

Continuing calibrations (continued)

Specific Finding:

The continuing calibration, K16260.D, contained compounds with %Ds greater than 50% and less than 90%. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as estimated (UJ).

GDDSB00301	acetone (81.7%)
GDDSB00302	

Internal Standards

All internal standard EICP areas did not meet the internal standard EICP area QA/QC criteria. Qualifications are required.

Specific Finding:

The Samples listed below, exhibited low internal standard areas. Qualify all associated positive results as estimated (J) and all non detects as estimated(UJ).

GDDSB00601	chlorobenzene-d_5
GDDSB00601RE	

Blank

The end user should note that the action levels indicated for the blank analysis may not involve the same weights, volumes, dilution factors, or percent moisture as associated samples. These factors must be taken into considerations when applying the 5X and 10X criteria to field samples.

DATA ASSESSMENT AND NARRATIVE

VOLATILE ANALYSIS

Method Blank

Associated blank	Compound	Concentration	Action Level
VBLK2	methylene chloride	2J ug/kg	20 ug/kg
	Acetone	4J	40
	Chloroform	1J	10
VBLK3	methylene chloride	4J ug/kg	40 ug/kg
	Chloroform	2J	20
VBLK4	acetone	6J ug/kg	60 ug/kg
	Chloroform	1J	10
VBLK5	methylene chloride	2J ug/kg	20 ug/kg
	Acetone	2J	
	Chloroform	2J	

Samples	Compound	Qualification
GDDSB00601	methylene chloride	U
GDDSB00501		
GDDSB00301		
GDDSB00302		
GDDSB00602	methylene chloride	CRQL
GDDSB00402		
GDDSB00601	acetone	CRQL
GDDSB00401		
GDDSB00201		
GDDSB00502	acetone	U
GDDSB00202		
GDDSB00301		
GDDSB00302		

DATA ASSESSMENT AND NARRATIVE

VOLATILE ANALYSIS

Method Blank (continued)

Samples	Compound	Qualification
GDDSB00601	chloroform	CRQL
GDDSB00602		
GDDSB00501		
GDDSB00402		
GDDSB00401		
GDDSB00502		
GDDSB00201		
GDDSB00202		
GDDSB00301		
GDDSB00302		

Trip Blank

Associated blank	Compound	Concentration	Action Level
GDDTB00601	methylene chloride	3J ug/kg	30 ug/kg
	Acetone	5J	50

Samples	Compound	Qualification
GDDSB00201	methylene chloride	U
GDDSB00202		
GDDSB00502		
GDDSB00401	methylene chloride	CRQL
GDDSB00402	acetone	U
GDDSB00501		
GDDSB00602		

Surrogates

All of the surrogate recoveries for these samples were not within QA/QC limits. Qualifications are required.

Specific Finding:

Sample listed below exhibited high recoveries for toluene-d_8. Qualify all positive results as estimated (J).

GDDSB00601RE (121%)

Compound Identification /Quantitation

Specific Finding:

Reject sample GDDSB00601RE, in favor of the initial analysis, due to non compliant surrogates and internal standards.

System Performance and Overall Assessment

The overall system performance was acceptable. The laboratory did not encounter any large problems. The data reviewer estimates that less than 10% of the data is qualified.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDDSB00301 GDDSB00302	acetone	+/-	J/UJ
	All associated compounds	+/-	J/UJ
GDDSB00601 GDDSB00601RE	chlorobenzene-d_5		
GDDSB00601 GDDSB00501 GDDSB00301 GDDSB00302	methylene chloride	+	U
GDDSB00602 GDDSB00402	methylene chloride	+	CRQL
GDDSB00601 GDDSB00401 GDDSB00201	acetone	+	CRQL
GDDSB00502 GDDSB00202 GDDSB00301 GDDSB00302	acetone	+	U
GDDSB00601 GDDSB00602 GDDSB00501 GDDSB00402 GDDSB00401 GDDSB00502 GDDSB00201 GDDSB00202 GDDSB00301 GDDSB00302	chloroform	+	CRQL

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDDSB00201 GDDSB00202 GDDSB00502	methylene chloride	+	U
GDDSB00401	methylene chloride	+	CRQL
GDDSB00402 GDDSB00501 GDDSB00602	acetone	+	U
GDDSB00601RE	all compounds	+	J
GDDSB00601RE	all results	+/-	UR

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non detect result

DATA ASSESSMENT AND NARRATIVE

SEMIVOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA 8270; National Functional Guidelines for Organic Data Review, and DQO Level III. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 27228B

A validation was performed on the Semivolatile Data from SDG # 27228B. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- * • Calibrations
- * • Internal Standard Performance
- * • Blanks
- * • Surrogate Recoveries
- * • Laboratory Control Sample
- * • Field Duplicates
- * • Compound Identification /Quantitation

* - All criteria were met for this parameter

System Performance and Overall Assessment

The overall system performance was acceptable. The laboratory did not encounter any large problems. The data reviewer estimates that none of the data requires qualification.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

No qualifications are required.

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLORS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8080A; the National Functional Guidelines for Organic Data Validation, June 1991; and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27228B

A validation was performed on the Pesticide/Aroclor Data from SDG 27228B. The data was evaluated based on the following parameters:

* • Data Completeness
  • Holding Times
* • GC Performance
* • Calibration
* • Blanks
  • Surrogate Recoveries
* • Matrix Spike/Matrix Spike Duplicates
* • Field Duplicates
* • Compound Identification
  • Compound Quantitation

* - All criteria were met for this parameter.

Contractual Non-Compliance

The method requires that all target compounds, including the multi-component compounds, be analyzed with a five (5) point calibration curve. The laboratory did not analyze a five (5) point curve for all aroclors and toxaphene in each sequence included in this SDG. No positive results were reported for the compounds analyzed with a single point calibration, therefore the data did not require qualification.

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLOR ANALYSIS

Holding Times

The extraction holding time for one (1) re-extracted sample was exceeded.

Specific Finding

The extraction holding time for one (1) re-extracted sample was exceeded by eight (8) days. For the following sample, the positive results are qualified as estimated, J, and the non-detect results are qualified as estimated, UJ.

GDDSB00401RE

Surrogate Recoveries

One (1) field sample exhibited a non-compliant DCB recovery.

Specific Finding

The sample listed below exhibited a low DCB recovery. The positive results are qualified as estimated, J, and the non-detect results are qualified as estimated, UJ.

Sample ID	Surrogate	% Recovery
GDDSB00302	DCB-1	34%

Compound Identification/Quantitation

Several samples exhibited column quantitation %Ds greater than 40%. Qualifications were required per the EnSafe guidelines. Results were qualified as presumptively present at an estimated concentration (NJ) if they exhibited %Ds greater than 70% and one (1) or more of the following: were outside the calibration range, the result of a dilution, or above 10X the CRQL (professional opinion). As noted in the narrative, one (1) sample was re-extracted due to contamination from the GPC.

Compound Identification/Quantitation

Specific Findings

The positive results reported in all samples which exhibited column quantitation differences greater than 40% but less than 70% are qualified as presumptively present at an estimated concentration, NJ.

The following sample is rejected, UR, in favor of the results reported from the re-extracted analysis for the noted reason.

Sample	Compounds	Reason
GDDSB00401	All compounds	Contamination from the GPC

System Performance and Overall Assessment

Overall performance was acceptable. The data reviewer estimates less than 10% of the data required qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

NJ = Result is considered presumptively present at an estimated concentration

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 10X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDDSB00401RE	ALL	+/-	J/UJ
GDDSB00302	ALL	+/-	J/UJ
ALL	All P >40% But ≤ 70%	+	NJ
GDDSB00401	ALL	+/-	UR

* DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
\+ in the DL column denotes a positive result
\- in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE
METALS AND CYANIDE

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 27228A

A validation was performed on the Metals and Cyanide Data from SDG 27228A. The data was evaluated based on the following parameters.

- * • Data Completeness
- * • Holding Times
- * • Calibrations
- • Blanks
- * • Interferences
- • Matrix Spike Recovery
- * • Matrix Duplicates
- • Field Duplicates
- * • Laboratory Control Samples
- • Serial Dilutions
- * • Post Digestion Spiking

* - All criteria were met for this parameter.

Preparation and Field Blanks

Specific Finding

The preparation blank exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Antimony	0.33 mg/kg	all soil samples below 1.65 mg/kg
Beryllium	0.05 mg/kg	all soil samples below 0.25 mg/kg
Chromium	0.11 mg/kg	no impact
Cobalt	0.10 mg/kg	no impact
Tin	1.47 mg/kg	all soil samples below 7.35 mg/kg

Vanadium	0.10 mg/kg	no impact
Cyanide	0.11 mg/kg	all soil samples below 0.55 mg/kg

The equipment and Rinsate blanks exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Barium	0.3 ug/l	no impact
Beryllium	0.45 ug/l	all soil samples below 0.45 mg/kg
Calcium	75.2 ug/l	no impact
Copper	46.7 ug/l	all soil samples below 46.7 mg/kg
Sodium	8300 ug/l	all soil samples below 8300 mg/kg
Zinc	8.6 ug/l	all soil samples below 8.6 mg/kg

The USEPA requires that all sample values below five times the preparation, field, DI or calibration blank contamination be qualified as non-detect, "U".

Matrix Spike recovery

Specific Finding

The Matrix Spike recovery for soils for Antimony (69%) was below the lower control limits (>30% but <75%). All positive and non-detect results are qualified as estimated, "J" or "UJ".

Field and Duplicate Analysis

Specific Finding

The RPD for field duplicate samples (GDDSB00601 and GDDCB00601) for Iron (60%) was greater than 50%. All positive results are qualified as estimated, "J".

Serial Dilutions

Specific Findings

The Serial dilutions for soils for Barium, Chromium and Manganese were outside the control limits (>10%). All positive results are qualified as estimated, "J".

Specific Finding

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B" per Ensafe's request.

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
All soil samples below 1.65 mg/kg	Sb.	+	U
All soil samples below 0.25 mg/kg	Be.		
All soil samples below 7.35 mg/kg	Sn.		
All soil samples below 0.55 mg/kg	Cn.		
All soil samples below 0.45 mg/kg	Be.		
All soil samples below 46.7 mg/kg	Cu.		
All soil samples below 8300 mg/kg	Na.		
All soil samples below 8.6 mg/kg	Zn.		
All soil samples	Sb.	+/U	J/UJ
GDDSB00601 and GDDCB00601.	Fe.	+	J
All soil samples	Ba, Cr and Mn.	+	J
All "B" results	all analytes	B	J

ANNOTATED FORM Is