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CNC CHARLESTON
5090.3a

CORRECTIVE MEASURES STUDY WORK PLAN ZONE A CNC CHARLESTON SC

6/5/1998

ENSAFE INC.

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

ZONE A
CORRECTIVE MEASURES STUDY
WORK PLAN

Revision: 0

CTO-029
Contract No: N62467-89-D-0318

Prepared for:

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

Prepared by:

EnSafe Inc.
5724 Summer Trees Drive
Memphis, Tennessee 38134
(901) 372-7962

The Contractor, EnSafe Inc., 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: June 5, 1998
Signature: Lawson Anderson
Name: Lawson Anderson
Title: Task Order Manager

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY
NAVAL BASE CHARLESTON
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List of Acronyms

AOC	Area of Concern
BTEX	Benzene, toluene, ethylbenzene, and xylene
CAP	Corrective Action Program
CDI	Chronic Daily Intake
CMI	Corrective Measures Implementation
CMS	Corrective Measure Study
COCs	Contaminants of Concern
CRP	Community Relations Plan
DCE	Dichloroethene
DET	Environmental Detachment Charleston
dL	Deciliters
DMP	Data Management Plan
DNAPL	Dense Non-aqueous Phase Liquid
DRMO	Defense Reutilization Marketing Office
E/A&H	EnSafe/Allen & Hoshall
HASP	Health and Safety Plan
HQ	Hazard Quotient
ILCR	Incremental Lifetime Excess Cancer Risk
ISM	Interim Stabilization Measure
LNAPL	Light Non-aqueous Phase Liquid
MNA	Monitored Natural Attenuation
MCLs	Maximum Contaminant Levels
NFA	No Further Action
Pb	Lead
PCE	Tetrachoroethene
POL	Petroleum, Oil, and Lubricant
ppm	Parts per Million
PST	Petroleum Storage Tank
QA/QC	Quality Assurance/Quality Control
QAP	Quality Assurance Plan

RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SAP	Sampling and Analysis Plan
SCDHEC	South Carolina Department of Health and Environmental Control
SPLP	Synthetic Precipitant Leaching Procedure
SSL	Soil Screening Level
SWMU	Solid Waste Management Unit
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TTAL	Treatment Technique Action Level
UCL	Upper Confidence Limit
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOCs	Volatile Organic Compounds

1.0 DESCRIPTION OF THE RCRA CAP PROCESS

The Resource Conservation and Recovery Act (RCRA) Corrective Action Program (CAP) consists of a series of actions typically required at permitted facilities at which a release has occurred from a solid waste management unit (SWMU) or area of concern (AOC). Consent orders issued by an authorizing agency can also require that a facility establish and begin a RCRA CAP.

The environmental investigation and remediation at the former Charleston Naval Base and Shipyard are required by the Hazardous and Solid Waste Amendments section of the facility's RCRA Part B permit. This work plan describes the corrective measures study portion of the RCRA CAP for Zone A at the former military base.

1.1 Components of the RCRA CAP

A RCRA CAP may consist of the following five actions, as well as other actions not listed:

- Action 1 — RCRA Facility Assessment (RFA)
- Action 2 — RCRA Facility Investigation (RFI)
- Action 3 — Interim Stabilization Measures (ISM)
- Action 4 — Corrective Measures Study (CMS)
- Action 5 — Corrective Measures Implementation (CMI)

The RFA is the initial assessment and investigation of releases at the subject facility. This step is noninvasive (i.e., no environmental media are sampled) and it primarily reviews the facility's history of releases. Should there be sufficient evidence of a release, the facility usually proceeds to the next stage of the program, an RFI, which is used to evaluate the nature and extent of the release and provide additional information to support a CMS, if warranted.

The CMS identifies and evaluates potential remedial alternatives for selected sites at the facility and is usually followed by implementation of the one selected. This subsequent step (remedial alternative implementation) is referred to as the CMI.

ISMs are intended to control or abate immediate and extreme threats to human health and/or the environment from the release(s), and/or prevent or reduce the further spread of contamination while long-term remedies are being developed. By definition, this stabilization effort is not required for all sites. However, if emergency stabilization efforts are required, they generally occur during the first stage of corrective action, though they may also be conducted at any time during the process. The level of present threat and/or likelihood of potential threat to either human health or the environment from releases at the subject facility determines the time and scope of the ISM, if required.

1.2 Sequencing of the RCRA CAP

It is not necessary for the RCRA CAP to occur in the sequence indicated by the steps listed. Nor are all the steps required to satisfy the RCRA CAP. Every facility and associated site release is unique. Therefore, the remedial action evaluation and cleanup process needs to be tailored to each facility, and should be directly related to the complexity of facility operations and the severity of associated release(s).

In summary, the level of detail, and thus ensuing effort, of a corrective action program at a RCRA-regulated facility should be proportional to the actual risk to human health and/or the environment posed by facility-related contaminants.

2.0 DESCRIPTION OF THE CMS PROCESS

The CMS essentially starts with the selection of candidate sites for remedial alternative evaluation. As part of a risk management decision, the project team selects sites for inclusion in the CMS process. The decision is primarily based on applicable site conditions and the information obtained during the RFI process, such as risk level and the main risk drivers.

2.1 Objective

The CMS' overall objective is to identify, screen, evaluate, and rank potential remedial alternatives for sites that have been elevated into the CMS stage from the RFI.

This objective will be met by screening and evaluating potential alternatives against four threshold criteria and five balancing criteria. If more than one viable alternative is identified for the subject site, a matrix of ranked alternatives will be presented in the CMS report.

2.2 Inclusion Criteria

Sites with the following characteristics were included in the CMS process. However, as stated previously, final CMS site selection is a result of risk management decisions made by the project team.

- Inclusion Criteria 1 — Sites at which surface soil posed an incremental lifetime excess cancer risk (ILCR) exceeding 1E-6, based on a maximum unrestricted reuse scenario (i.e., residential reuse).

- Inclusion Criteria 2 — Sites at which groundwater contaminants exceeded applicable maximum contaminant levels (MCLs) or other promulgated standards, as defined by the project team, and/or groundwater with residential risk exceeding 1E-6.

- Inclusion Criteria 3 — Sites recommended for further consideration by the project team.

2.3 Threshold Criteria

Potential remedial technologies or alternatives have been listed for each site based on information from the current RFI, other field or support documents, professional experience, and project team input. Each potential remedial technology or alternative will then be screened against four threshold criteria to determine its viability. Threshold criteria are considered primary criteria that must be met by the screened alternative for it to be further considered as a viable candidate.

- Threshold Criteria 1 — Protection of human health and the environment
- Threshold Criteria 2 — Attainment of cleanup standards
- Threshold Criteria 3 — Source control
- Threshold Criteria 4 — Compliance with applicable waste management standards

Technologies or alternatives that pass this initial screening will be retained for further evaluation and comparison. In addition, ranking the alternatives may be required if more than one remedial option passes the initial screening. Formal, or secondary, screening typically requires engineering calculation, parameter estimation, or treatability/pilot study to determine technology effectiveness.

2.4 Balancing Criteria

If more than one remedial option is identified for the site, they are further evaluated against five balancing criteria. These secondary criteria can act as a tie-breaker for remedial alternatives that have met all four of the threshold criteria described above.

- Balancing Criteria 1 — Long-term reliability and effectiveness
- Balancing Criteria 2 — Reduction in waste toxicity, mobility, or volume
- Balancing Criteria 3 — Short-term effectiveness
- Balancing Criteria 4 — Implementability
- Balancing Criteria 5 — Cost

The remedial alternative eventually selected for the site is usually the one that presents favorable overall balancing characteristics. However, it is important that the evaluation process consider site-specific constraints and remain flexible. It is possible that technology limitations, or other yet-to-be-determined limitations, could drive remedy selection rather than media-specific cleanup goals being the driving factor. Property reuse consideration is an example of a potential limiting factor.

2.5 Ranking of Alternatives

Alternatives will then be compared and ranked, based on their ability to satisfy the nine criteria. The proposed alternative for the site's final remedy typically will consist of the alternative, or group of alternatives, that present the most cost-effective and technically feasible approach, that can protect human health and the environment while obtaining ~~realistic cleanup goals in a timely fashion, considering property reuse~~ **BSHWM cleanup goals in a timely fashion considering both residential and industrial re-use scenarios."**

2.6 Public Participation

Public involvement and input regarding remedial alternative selection will be solicited during the CMS. However, public participation can also be solicited at any time throughout the RCRA CAP. It is important to openly communicate with all stakeholders at the former Charleston Naval Base and Shipyard. The practice of early, and frequent, public involvement usually leads to informed and sincere public support of the project, rather than public opposition through misunderstanding.

The CMS process is further described in *Volume I of the Comprehensive Corrective Measures Study Project Management Plan, EnSafe/Allen & Hoshall, June 1997.*

2.7 Final Remedy Selection

The United States Navy and the South Carolina Department of Health and Environmental Control (SCDHEC) will jointly lead the effort to select the final remedy for each site. The United States Environmental Protection Agency (USEPA) will assist the joint leaders during the selection process. Selection of the final remedy will consist of developing a statement of basis and an

associated public involvement plan. Public feedback and input will be considered during final remedy selection.

3.0 DESCRIPTION OF THE CMS WORK PLAN

This draft work plan describes the proposed CMS components for Zone A at the former Charleston Naval Base and Shipyard. Zone A is one of 12 investigative zones (A through L) that make up the former base. The designation of 12 separate investigative zones was necessary to effectively manage and expedite environmental investigation of a large and multi-functional military facility.

The Draft Zone A CMS Work Plan consists of the following sections:

- Section 1 — Description of the RCRA CAP Process
- Section 2 — Description of the CMS Process
- Section 3 — Description of the CMS Work Plan
- Section 4 — CMS Site Selection
- Section 5 — Site-Specific Overview
- Section 6 — CMS Schedule and Report Outline
- Section 7 — References
- Section 8 — Signatory Requirement

3.1 Reference to the Comprehensive CMS Work Plan

A comprehensive CMS operational plan was written and finalized in June 1997 by EnSafe/Allen & Hoshall (E/A&H): *Final Comprehensive Corrective Measures Study Project Management and Work Plans (Volumes I and II).* These two volumes, which make up the comprehensive CMS work plan, detail the proposed approach to the overall CMS effort and its objective for the Charleston Naval Base complex.

It is not the intent of this zone-specific CMS work plan to develop or restate the information previously presented in the comprehensive CMS work plan. Rather, it outlines brief approaches

to the CMS efforts for all applicable Zone A sites. Applicable sites are defined as those designated by the Charleston Naval Base Project Team as warranting a CMS under the RCRA Corrective Action Program. Section 4, *CMS Site Selection,* describes how sites are selected for the CMS. By using the comprehensive and zone-specific work plans together, a more efficient and cost-effective CMS will be realized.

The comprehensive CMS work plan should be referenced for the following general plans:

- Sampling and analysis plan (SAP)
- Quality assurance plan (QAP)
- Health and safety plan (HASP)
- Data management plan (DMP)
- Community relations plan (CRP)

These general plans have been developed and approved for use during the RCRA Facility Investigation of the former naval base and shipyard. The comprehensive CMS work plan also presents the *overall* technical approach to the CMS effort, as well as project management details (i.e., typical project work elements, overall project schedule, and project management responsibilities). Zone-specific information is provided in the zone-specific CMS work plans such as this one.

3.2 Objective of Zone- or Site-Specific CMS Work Plans

The primary goal of this zone-specific work plan is to present the CMS process and overall objectives proposed for Zone A only. Included in Section 5, *Site-Specific Overview,* are data needs (additional site-specific field investigations, additional sampling and analysis, treatability, pilot studies, etc.) required to complete the CMS effort for each applicable Zone A site. This data will supplement the site-specific information previously obtained during the Zone A RCRA Facility Investigation. ~~Section 5 also presents remedial objectives consistent with property reuse plans as currently identified by the Charleston Naval Complex Redevelopment Authority~~.

Section 5 also presents remedial objectives consistent with SCDHEC BSHWM cleanup goals considering both residential and industrial re-use.

4.0 CMS SITE SELECTION

This section describes how Zone A sites were selected for the CMS process. The project team included a site in the CMS process based primarily on whether residential risk exceeded 1E-06. The inclusion process did not directly consider contaminant extent, frequency, type, or property reuse plans.

4.1 Use of Risk Management

Risk management decisions made by project team consensus were based primarily on RFI risk assessment results. This allowed the project team to categorize each Zone A site into one of three categories:

- Category I — No further action (NFA) sites
- Category II — CMS sites
- Category III — Petroleum storage tank (PST) sites

4.2 Category I — NFA Sites

Based on RFI results, the project team designated some sites (Table 4.1) for no further action under the RCRA Subtitle C program. Therefore, these sites will not be addressed in the CMS. However, some NFA sites may require further action under the Navy's PST program or other applicable regulatory programs such as RCRA Subtitle I. The Navy PST program sites are classified as Category III sites which will be listed later in this section.

Table 4.1
Zone A Sites Designated for NFA

~~SWMU 1~~	~~DRMO Storage~~
SWMU 43	Publications and Printing Plant, Building 1628
AOC 506	Flammable Storage Shelter, Building 1629

Note:
DRMO — Defense Reutilization Marketing Office

4.3 Category II — CMS Sites

Sites designated for the CMS (Table 4.2) warrant a corrective measures study as directed by the project team. Figure 5.A, *Zone A CMS Sites,* shows the location of each CMS-designated site in Zone A.

Table 4.2
Sites Designated for CMS

~~SWMU 2~~	~~Lead Contamination Area~~
Combined SWMU 2 (SWMU 2 and SWMU 1)	**Lead Contamination Area and DRMO Storage Area**
SWMU 38	Miscellaneous Storage, North of Building 1605
SWMU 39	Former POL Drum Storage Area, Building 1604
SWMU 42 and AOC 505	Former Asphalt Plant Tanks/ Boiler Plant and Former Creosote Cross-Tie/ Railroad Ballast Storage Area

Note:
POL — petroleum, oil, and lubricants

4.4 Category III — PST and RCRA Subtitle I Sites

PST-designated sites were identified by the project team as requiring additional studies or field work under the Navy's PST program or, if applicable, under the RCRA Subtitle I program for underground storage tanks. **PST sites will be addressed or managed by the South Carolina Underground Storage Tank Program.** ~~These sites do not require further action under Subtitle C (hazardous waste provision) of the RCRA CAP. Therefore, they have been eliminated from further RCRA Subtitle C corrective action requirements and will not be addressed in the CMS~~.

No Zone A sites have been designated as PST sites. However, the Hess, Inc. Tank Farm north of and adjacent to Zone A is currently undergoing investigation and corrective action to address a benzene, toluene, ethylbenzene, and xylene (BTEX) and free-product-contaminated groundwater plume emanating from their property. The irregularly shaped product plume (approximately

120 feet by 50 feet) reaches as far south as NBCA-039-011 in the northwest corner of Zone A (H_20 Environmental, Inc., January, 1997).

4.5 Pending Risk Management Tool

At this time, a "risk management decision tool" is being developed by the project team for the RCRA CAP at the Charleston Naval Base. The purpose of this tool is to assist the project team in determining which RFI sites should undergo a CMS, thus focusing resources on those sites posing unacceptable risks to human health or the environment. It is expected that this tool should be available to the project team by the latter part of 1998.

The risk management process will evaluate the RFI, supplemental sampling data, and ISM results to evaluate current status. Current and projected land use scenarios, contaminant distributions and frequency of detection and various other criteria will be evaluated to determine if site risks are acceptable. The project team will then develop a list of sites within each zone which require CMS.

5.0 SITE-SPECIFIC OVERVIEW

This section presents applicable background information for each CMS-designated site. The site-specific information includes:

- Site description
- Current use
- Future use
- Interim Stabilization Measures (ISM) Status
- Fate and transport summary
- Human health risk assessment summary and discussion of primary contaminants of concern (COCs)
- Ecological risk assessment summary
- Remedial objectives ~~consistent with property reuse plans~~
- Potential remedial alternatives
- CMS data needs

Additional information, such as zone-wide ambient water quality, has also been included where necessary. The *Final RCRA Facility Assessment* (E/A&H, June 6, 1995) and the *Final Zone A*

RCRA Facility Investigation Report (EnSafe, June 1998) should be referenced for additional site-specific information (field investigation methodology, physical setting, nature of contamination, fate and transport, baseline human health risk assessment, and ecological risk assessment).

Zone A RFI Summary

Zone A is on the northwestern edge of the naval base (Figure 5.A) and is bounded by Zone B to the south; the Cooper River to the east; and the base property boundary to the west and north. Zone A consists primarily of light industrial and commercial properties, including the Defense Reutilization Marketing Office (DRMO), and a portion of the former naval base golf course. Zone A properties identified in the *Final Environmental Impact Statement for Disposal and Reuse of the Charleston Naval Base* (Ecology and Environment Inc., June 1995) are to be designated for warehouse/storage space, cargo terminal, or maritime industrial use.

The objectives of the RFI were to characterize the nature and extent of contaminants associated with releases from SWMUs and AOCs, evaluate migration pathways, and identify both actual and potential receptors. Ten sites were identified in Zone A through the RFA process, eight of which advanced to the RFI. Of those eight, five advanced to the CMS.

Zone A Groundwater Physical Setting and Ambient Water Quality

Physical Setting

Groundwater occurs under water table or poorly confined conditions overlying a confining unit named the Ashley Formation (Figure 5.B). The Ashley Formation has a high clay and silt content and acts as a confining unit between the lower members of the Cooper Group/Eocene-age Santee Limestone and the overlying water-bearing Quaternary-age sediments (Park, 1985).

Figure 5.A Zone A CMS Sites

SWMU #39
POL
DRUM
STORAGE

SWMU #38
MISCELLANEOUS
STORAGE

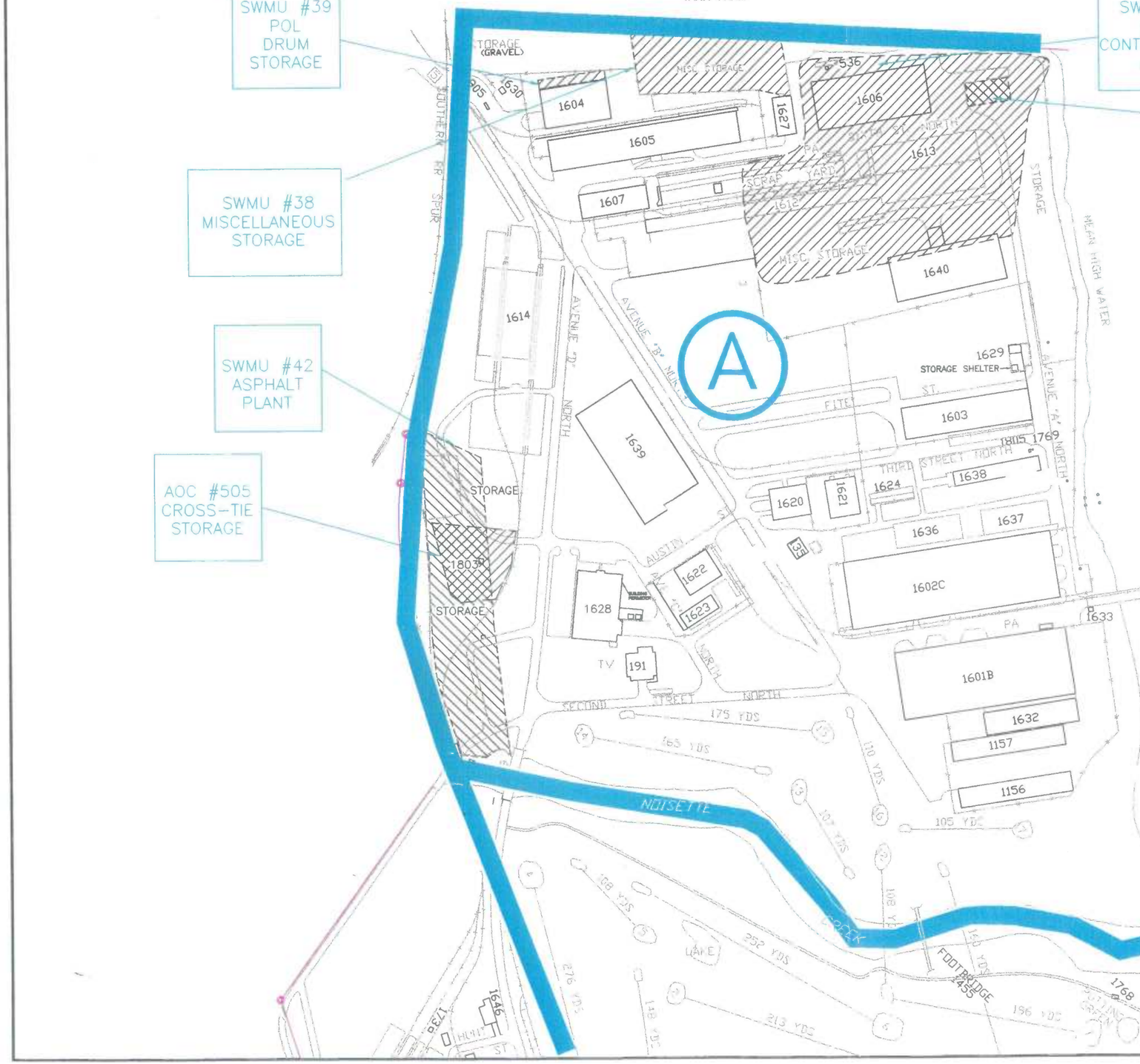
SWMU #42
ASPHALT
PLANT

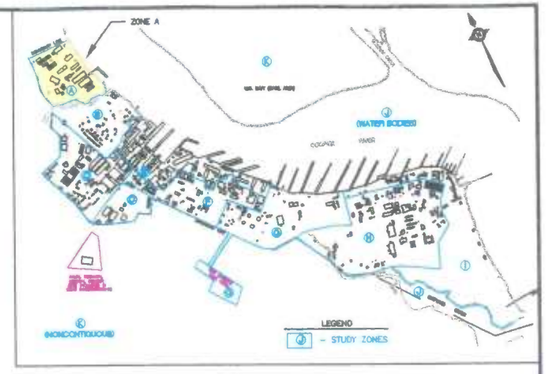
AOC #505
CROSS-TIE
STORAGE

SWMU #2
LEAD
CONTAMINATION
AREA

SWMU #1
DRMO
STORAGE

HESS OIL COMPANY
TANK FARM





COOPER
RIVER

N

LEGEND

A – RCRA INVESTIGATION ZONES

– RECOMMENDED FOR CMS (PER NAVAL BASE CHARLESTON PROJECT TEAM CONCENSUS)

300 0 300
SCALE FEET

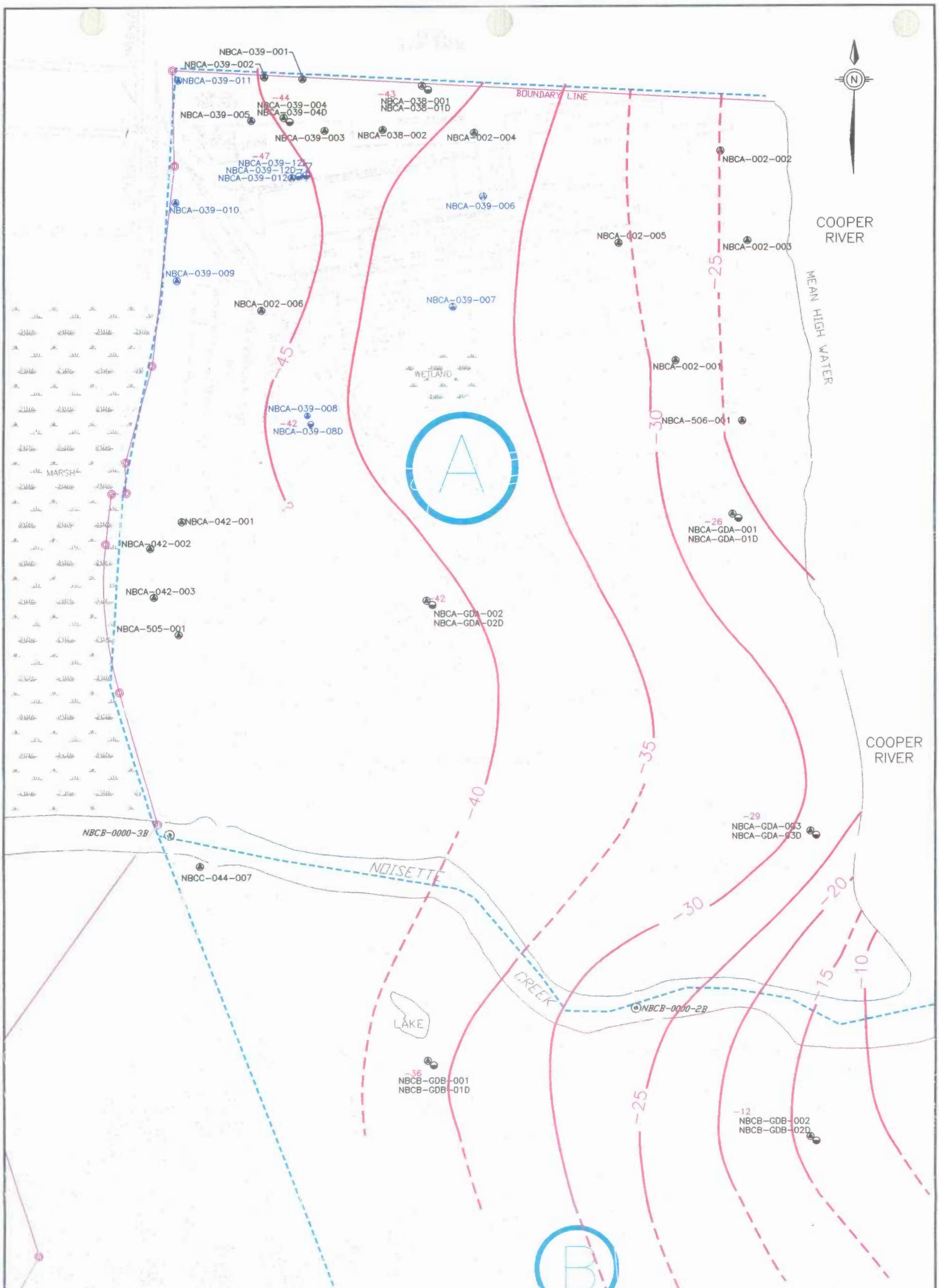
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.A
ZONE A CMS SITES

DWG DATE:05/26/98 | DWG NAME:2903M001

00087I012

Figure 5.B Top of Ashley Formation



LEGEND

- ● – SHALLOW MONITORING WELL
- ◒ – DEEP MONITORING WELL
- ◈ – INTERMEDIATE MONITORING WELL
- ⊙ – SURFACE WATER ELEVATION POINT

CONTOUR INTERVAL = 5 FT. MSL
CONTOURS DASHED WHERE INFERRED

NOTE
WELLS LABELED IN BLUE WERE INSTALLED IN JULY 1996.

250 0 250
SCALE FEET

ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.B
TOP OF ASHLEY FORMATION
ELEVATION (MSL)

DWG DATE: 02/25/98 | DWG NAME: 2901S010

00087T022

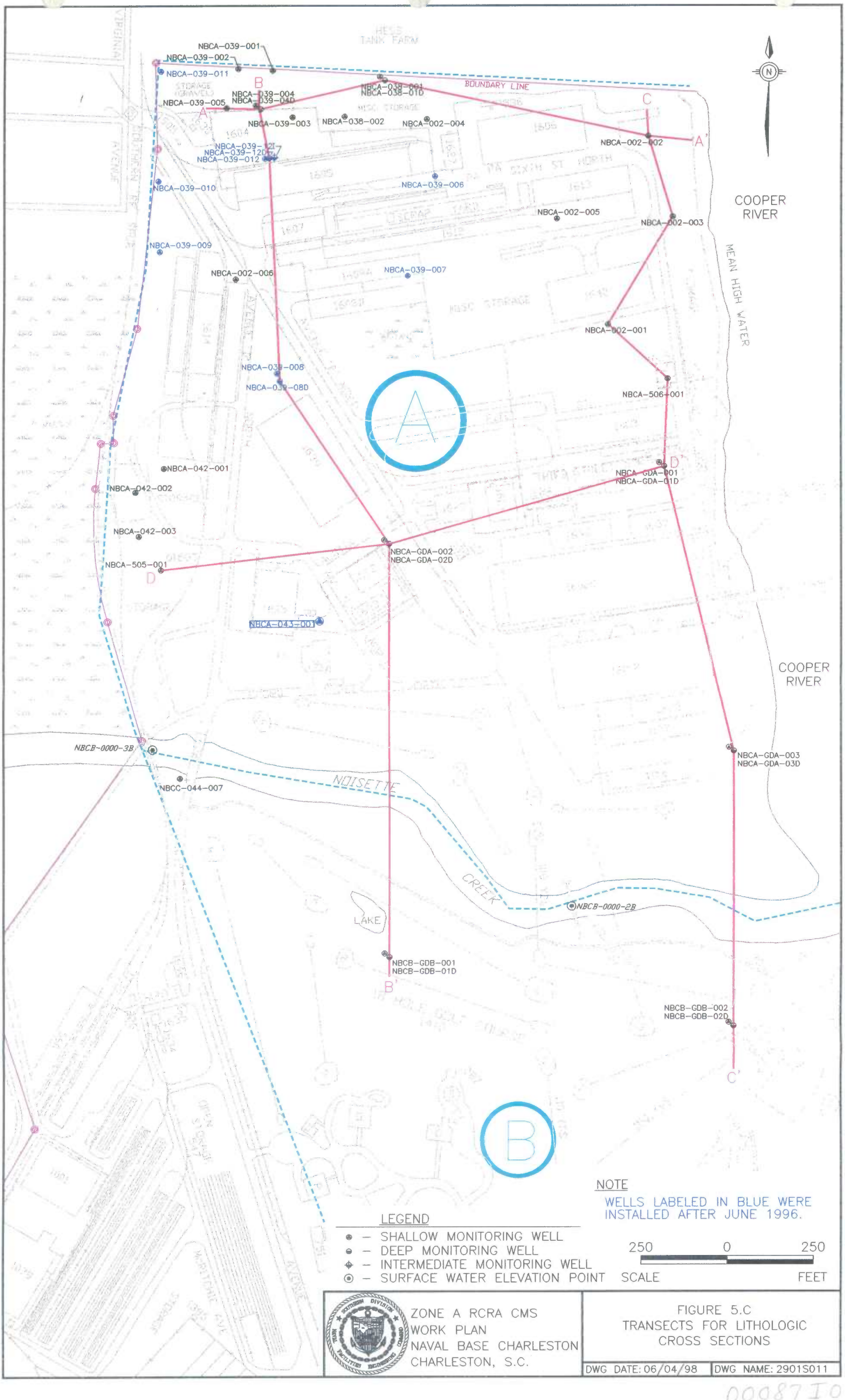
Above the Ashley formation, marsh clay deposits in the northern portion of Zone A at wells NBCA-039-04D and NBCA-039-12D separate three distinct sand units, leading to the localized development of a three-tier groundwater flow zone (Figures 5.C through 5.G). Shallow, intermediate, and deep wells at several SWMU 39 locations were installed to monitor these separate tiers above the Ashley. However, the marsh clay deposits pinch out to the south and were not encountered in deep well borings NBCA-039-08D, NBCA-GDA-02D, and NBCA-GDA-01D. The three sand units evident in the northern portion of the zone appear to commingle and coalesce in the central to southern portions of the zone. A more detailed discussion of and investigation into the complex geology and hydrogeology of Zone A is presented in Sections 2.2 and 10.4.11 of the Zone A RFI Report (EnSafe, 1998).

Due to extensive man-made surface features such as sewer lines, paved surfaces, gravel fill, and concrete foundations, water table elevations (Figures 5.H through 5.N) display many anomalous highs and lows. Water table elevations are also influenced by tides and seasonal variations in precipitation and evapotranspiration rates, barometric pressure changes, and recharge rates.

Tides caused shallow-tier groundwater levels to fluctuate up to 1.5 feet in the northeastern portion of Zone A closest to the Cooper River. Tidal fluctuations produced less than 0.3-foot variations for the remainder of the shallow-tier wells installed in Zone A. Tidal variation did not alter deep- or intermediate-tier groundwater flow direction.

Potentiometric elevations in some deep monitoring wells were above the top of the aquifer, a characteristic typical of a confined aquifer system. However, this was not true for all Zone A deep-tier wells. It is likely that aquitards, where present, are either leaky or of such limited lateral extent that the hydraulic conditions do not appear to vary greatly from unconfined conditions.

Figure 5.C Transects for Lithologic Cross Sections



NOTE

WELLS LABELED IN BLUE WERE INSTALLED AFTER JUNE 1996.

LEGEND

- ● – SHALLOW MONITORING WELL
- ◒ – DEEP MONITORING WELL
- ◆ – INTERMEDIATE MONITORING WELL
- ◉ – SURFACE WATER ELEVATION POINT

250 0 250

SCALE FEET

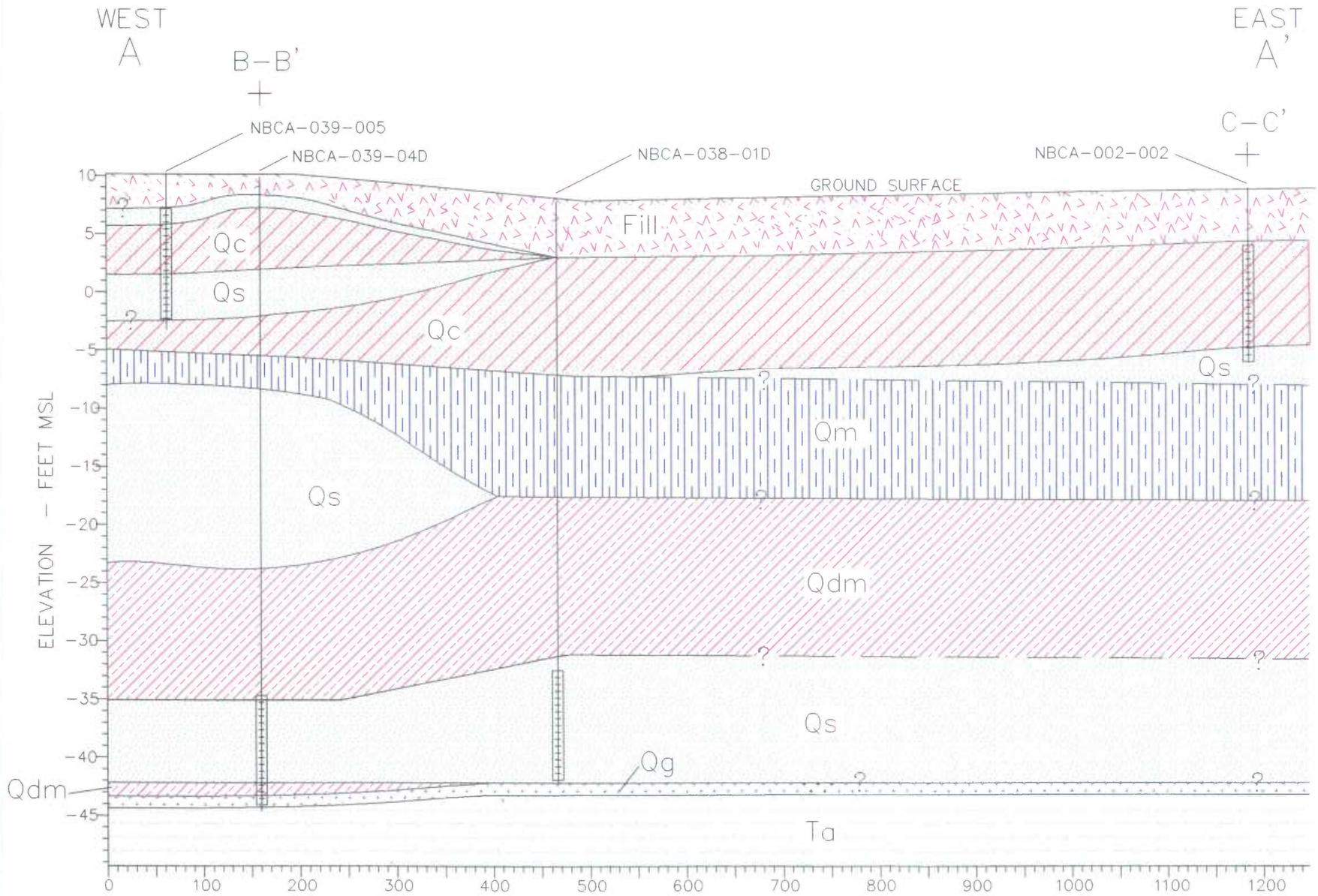
ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.C
TRANSECTS FOR LITHOLOGIC CROSS SECTIONS

DWG DATE: 06/04/98 | DWG NAME: 2901S011

00087I032

Figure 5.D Lithologic Cross Section A-A'



Fill	Undifferentiated mixture of medium to high plasticity clays, fine sand, silt, gravel and ROC. Varies greatly with location.
Qp	QUATERNARY PEAT--brown, silty, trace very fine sand, grasses and fibrous woody pieces, soft.
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
Qm	QUATERNARY MARSH CLAY--dark gray to black, silty, high organic content, with brown grasses and occasional peat; very soft, low plasticity, sticky; occasionally interbedded with very fine to fine sand laminae and pods. AQUITARD
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.
Qdm	QUATERNARY DEWATERED MARSH CLAY--dark green to dark gray, silty, high plasticity, firm to stiff clay; occasionally very fine sand present in very thin laminae and pods. AQUITARD.
Qg	QUATERNARY GRAVEL--gray to dark gray; typically grain-supported subrounded phosphate pebbles up to 2 cm in size and fine to coarse shell hash; silty and clayey fine to coarse sand matrix. AQUIFER.
Tmh	TERTIARY MARKS HEAD FORMATION--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.
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.

LEGEND

– WELL SCREEN INTERVAL NOT INCLUDING FILTERPACK

– CROSS SECTION INTERSECTION

? – GEOLOGIC CONTACT INFERRED

ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.D
LITHOLOGIC CROSS SECTION
A – A'

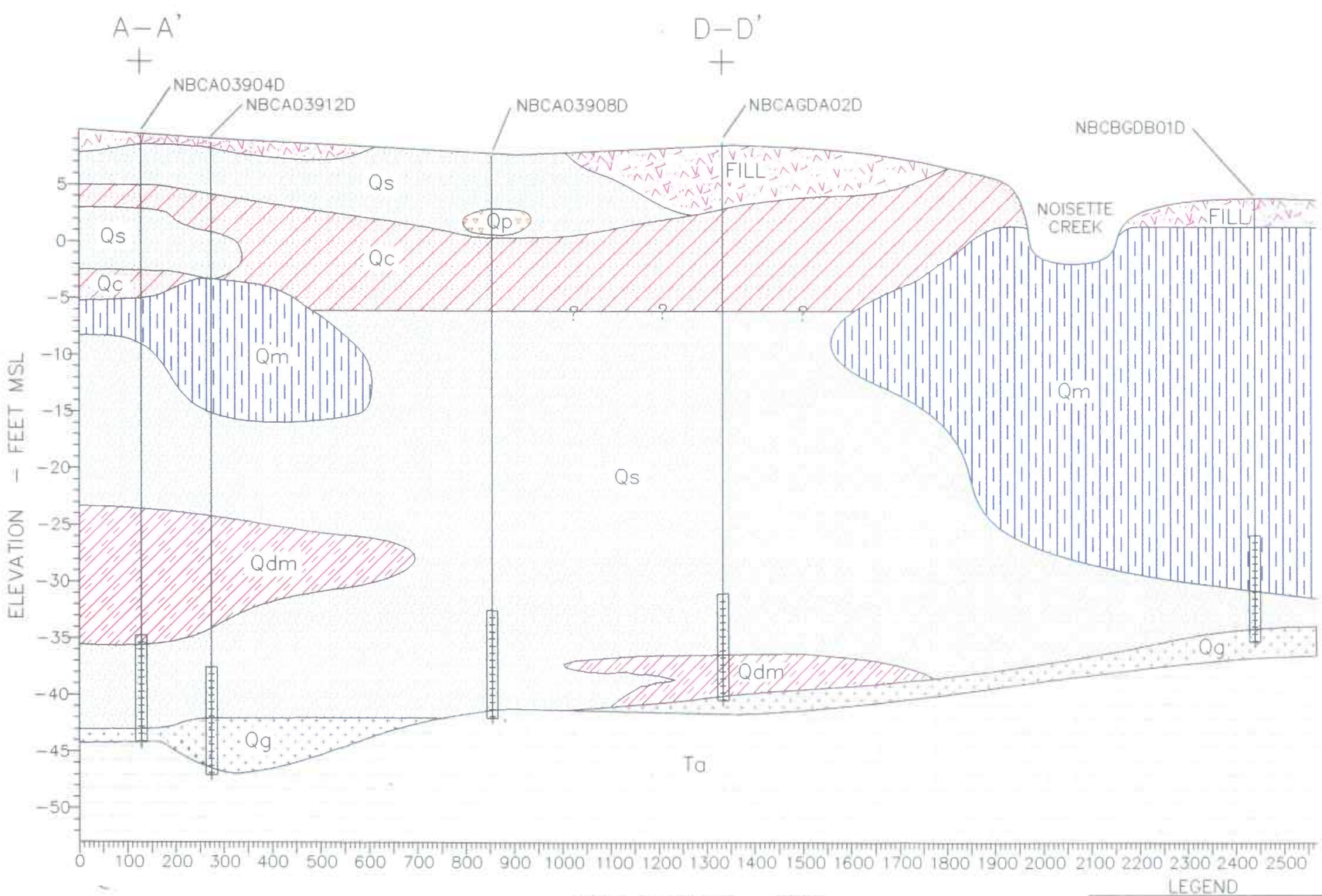
DWG DATE: 06/04/98 | DWG NAME: 2901S012

00087 I042

Figure 5.E Lithologic Cross Section B-B'

NORTH
B

SOUTH
B'



FILL	Undifferentiated mixture of medium to high plasticity clays, fine sand, silt, gravel and ROC. Varies greatly with location.
Qp	QUATERNARY PEAT--brown, silty, trace very fine sand, grasses and fibrous woody pieces, soft.
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
Qm	QUATERNARY MARSH CLAY--dark gray to black, silty, high organic content, with brown grasses and occasional peat; very soft, low plasticity, sticky; occasionally interbedded with very fine to fine sand laminae and pods. AQUITARD
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.
Qdm	QUATERNARY DEWATERED MARSH CLAY--dark green to dark gray, silty, high plasticity, firm to stiff clay; occasionally very fine sand present in very thin laminae and pods. AQUITARD.
Qg	QUATERNARY GRAVEL--gray to dark gray; typically grain–supported subrounded phosphate pebbles up to 2 cm in size and fine to coarse shell hash; silty and clayey fine to coarse sand matrix. AQUIFER.
Tmh	TERTIARY MARKS HEAD FORMATION--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.
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.

LEGEND

– WELL SCREEN INTERVAL NOT INCLUDING FILTERPACK

+ – CROSS SECTION INTERSECTION

? – GEOLOGIC CONTACT INFERRED

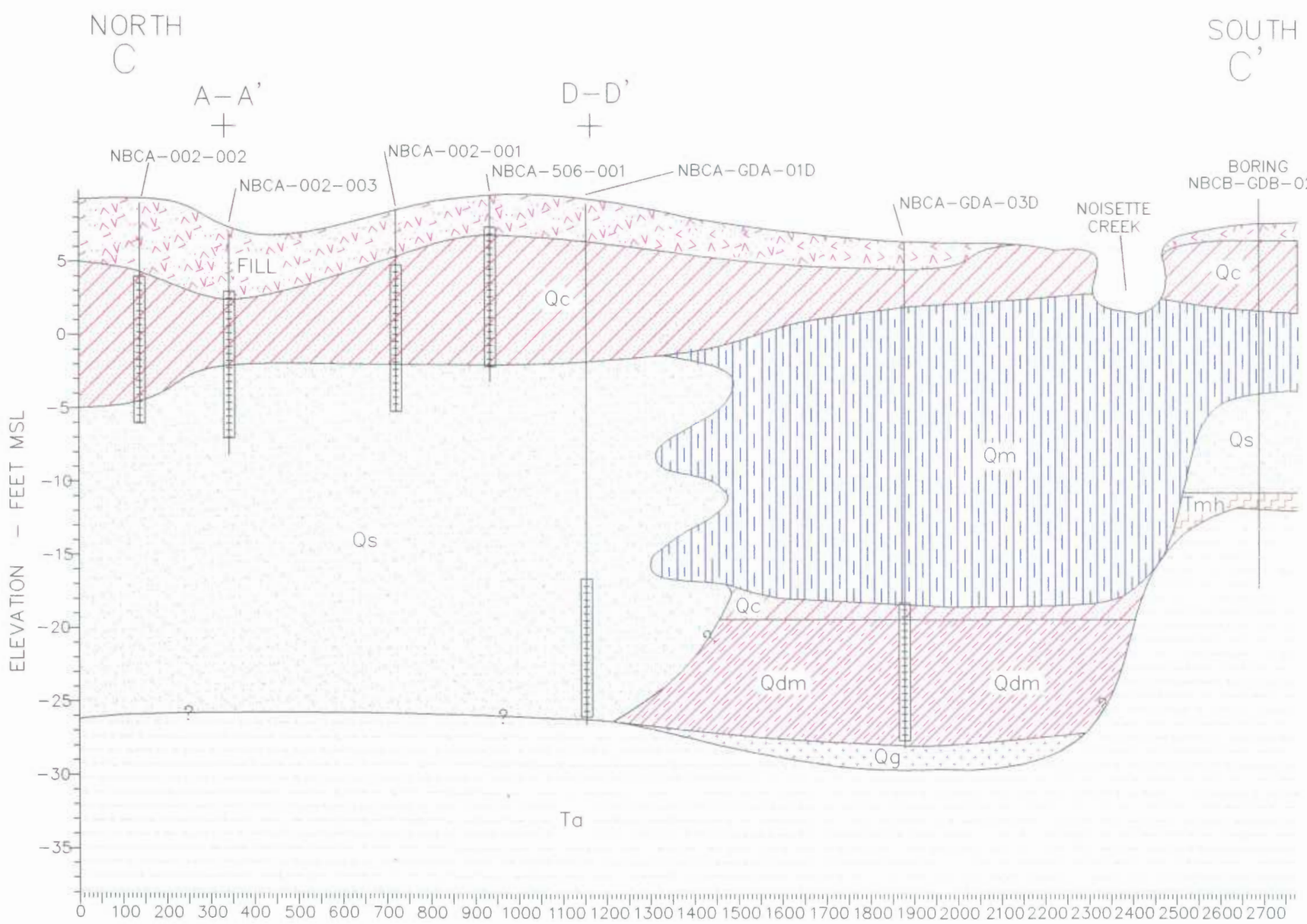
ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.E
LITHOLOGIC CROSS SECTION
B – B'

DWG DATE: 06/04/98 | DWG NAME: 2901S013

00871052

Figure 5.F Lithologic Cross Section C-C'



Fill	Undifferentiated mixture of medium to high plasticity clays, fine sand, silt, gravel and ROC. Varies greatly with location.
Qp	QUATERNARY PEAT––brown, silty, trace very fine sand, grasses and fibrous woody pieces, soft.
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
Qm	QUATERNARY MARSH CLAY––dark gray to black, silty, high organic content, with brown grasses and occasional peat; very soft, low plasticity, sticky; occasionally interbedded with very fine to fine sand laminae and pods. AQUITARD
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.
Qdm	QUATERNARY DEWATERED MARSH CLAY––dark green to dark gray, silty, high plasticity, firm to stiff clay; occasionally very fine sand present in very thin laminae and pods. AQUITARD.
Qg	QUATERNARY GRAVEL––gray to dark gray; typically grain–supported subrounded phosphate pebbles up to 2 cm in size and fine to coarse shell hash; silty and clayey fine to coarse sand matrix. AQUIFER.
Tmh	TERTIARY MARKS HEAD FORMATION––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.
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.

LEGEND

– WELL SCREEN INTERVAL NOT INCLUDING FILTERPACK

– CROSS SECTION INTERSECTION

? – GEOLOGIC CONTACT INFERRED

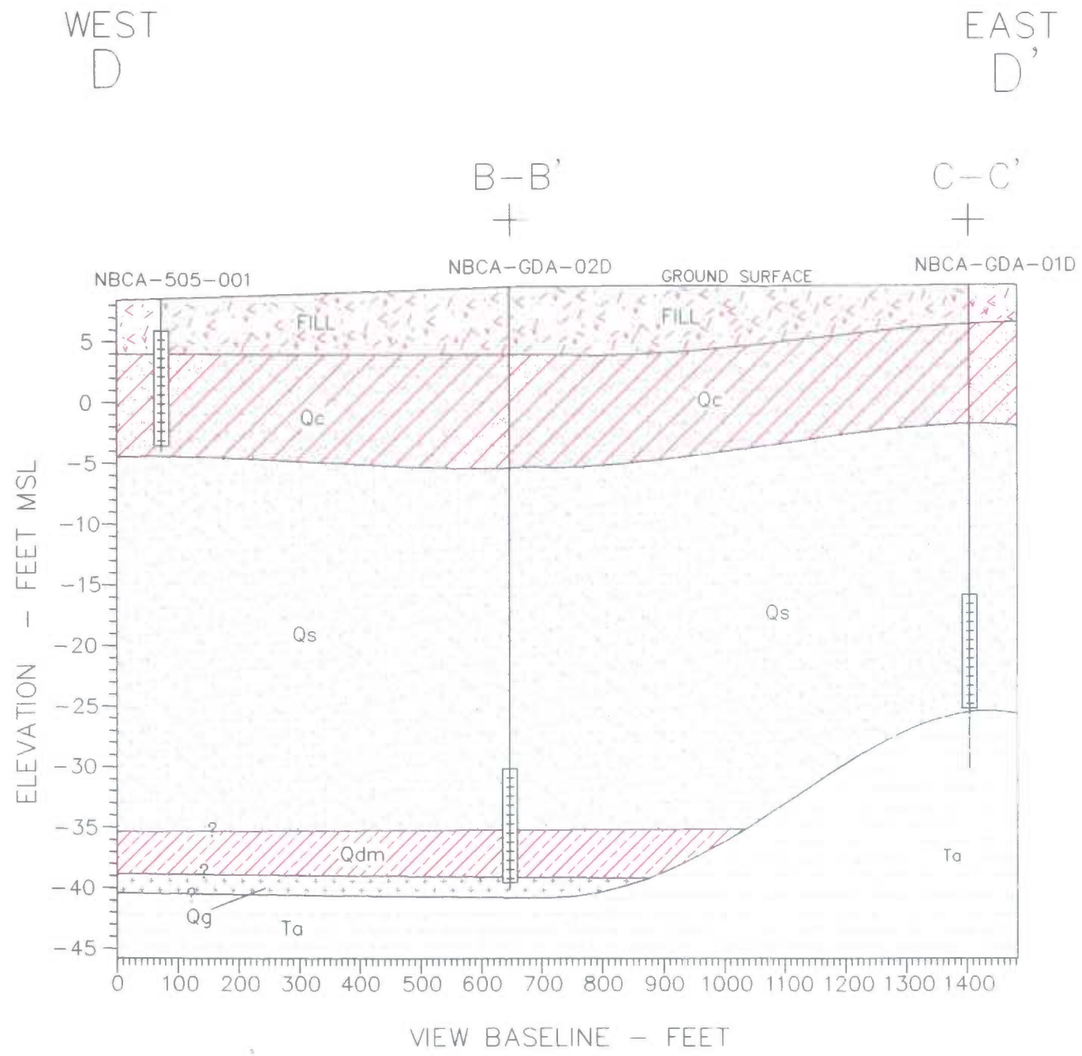
ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.F
LITHOLOGIC CROSS SECTION
C – C'

DWG DATE: 06/04/98 | DWG NAME: 2901S014

00087T063

Figure 5.G Lithologic Cross Section D-D'



FILL	Undifferentiated mixture of medium to high plasticity clays, fine sand, silt, gravel and ROC. Varies greatly with location.
Qp	QUATERNARY PEAT--brown, silty, trace very fine sand, grasses and fibrous woody pieces, soft.
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
Qm	QUATERNARY MARSH CLAY--dark gray to black, silty, high organic content, with brown grasses and occasional peat; very soft, low plasticity, sticky; occasionally interbedded with very fine to fine sand laminae and pods. AQUITARD
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.
Qdm	QUATERNARY DEWATERED MARSH CLAY--dark green to dark gray, silty, high plasticity, firm to stiff clay; occasionally very fine sand present in very thin laminae and pods. AQUITARD.
Qg	QUATERNARY GRAVEL--gray to dark gray; typically grain–supported subrounded phosphate pebbles up to 2 cm in size and fine to coarse shell hash; silty and clayey fine to coarse sand matrix. AQUIFER.
Tmh	TERTIARY MARKS HEAD FORMATION--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.
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.

LEGEND

– WELL SCREEN INTERVAL NOT INCLUDING FILTERPACK

– CROSS SECTION INTERSECTION

? – GEOLOGIC CONTACT INFERRED

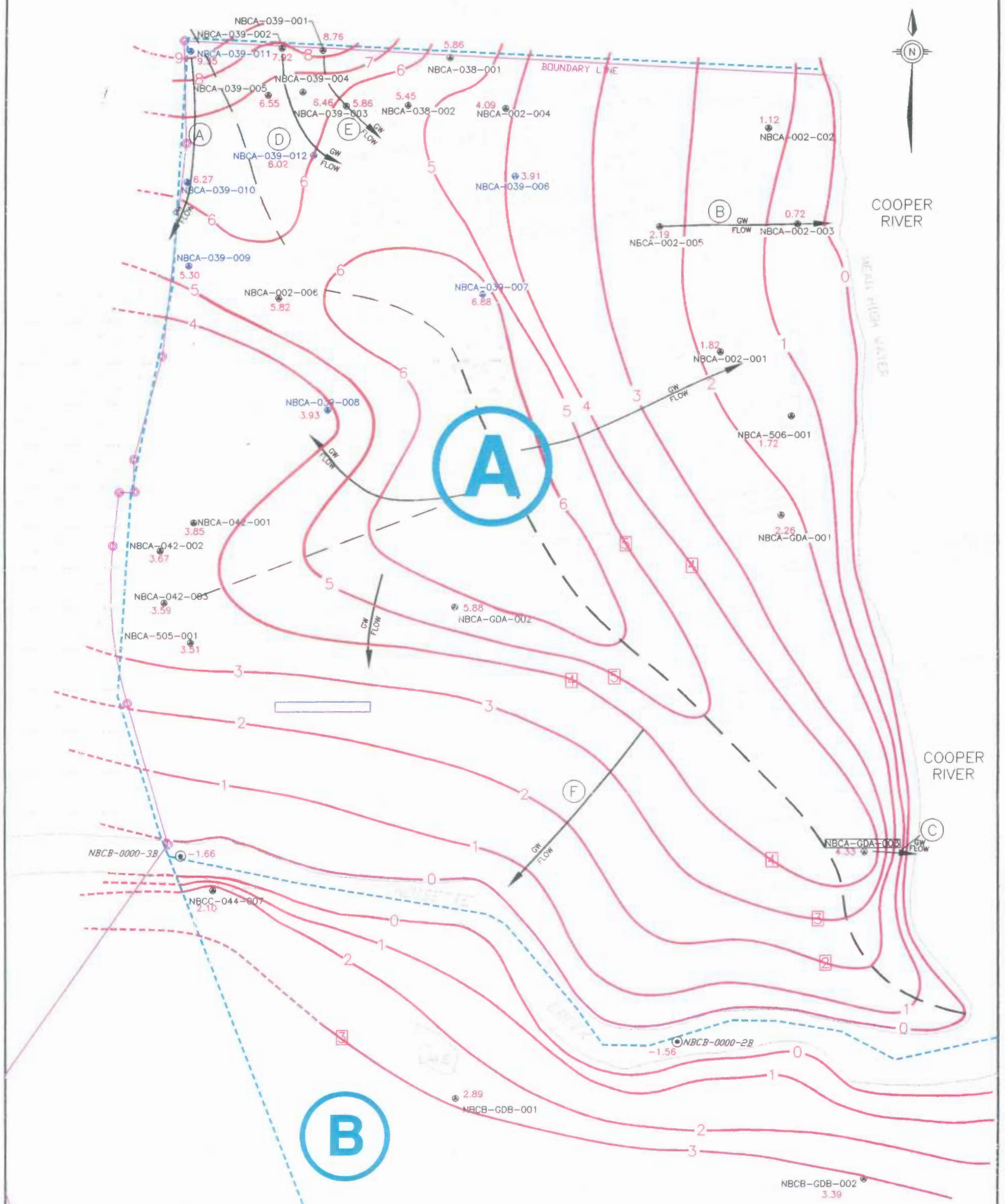
ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.G
LITHOLOGIC CROSS SECTION
D – D'

DWG DATE: 06/04/98 | DWG NAME: 2901S015

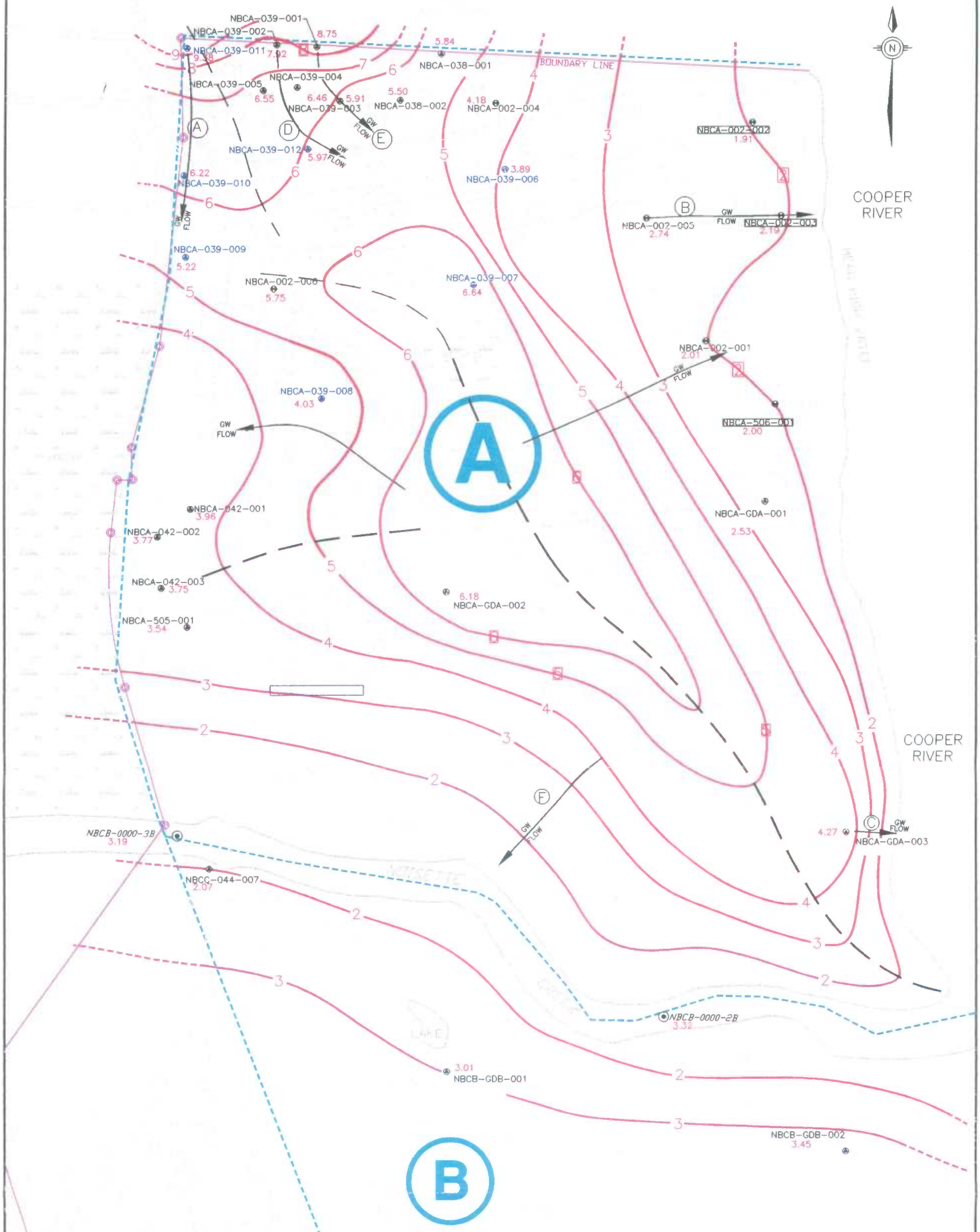
00087I07Z

Figure 5.H Groundwater Elevations in Shallow Wells at Low Tide — 8/7/96


NBCA-039-001
NBCA-039-002
NBCA-039-011
9.15
7.92
8.76
5.86
NBCA-038-001
BOUNDARY LINE
NBCA-039-004
NBCA-039-005
6.55
6.46
5.86
NBCA-039-003
5.45
NBCA-038-002
4.09
NBCA-002-004
1.12
NBCA-002-002
A
D
E
GW FLOW
NBCA-039-012
6.02
6.27
NBCA-039-010
3.91
NBCA-039-006
B
0.72
NBCA-002-003
2.19
NBCA-002-005
COOPER RIVER
NBCA-039-009
5.30
NBCA-002-006
5.82
NBCA-039-007
6.88
1.82
NBCA-002-001
NBCA-039-008
3.93
NBCA-506-001
1.72
A
NBCA-042-001
3.85
NBCA-042-002
3.67
NBCA-042-003
3.59
NBCA-505-001
3.51
5.88
NBCA-GDA-002
2.26
NBCA-GDA-001
F
C
NBCA-GDA-003
4.33
NBCB-0000-3B
-1.66
NBCC-044-007
2.10
NBCB-0000-2B
-1.56
B
2.89
NBCB-GDB-001
NBCB-GDB-002
3.39
NOTE
WELLS LABELED IN BLUE WERE INSTALLED IN JULY 1996.
LEGEND
– SHALLOW MONITORING WELL
– SURFACE WATER ELEVATION POINT
– GROUNDWATER DIVIDES
– REPRESENTATIVE GROUNDWATER FLOWPATHS (LABELED FLOWPATHS USED FOR GRADIENT CALCULATIONS)
CONTOUR INT. = 1 FOOT
250 0 250
SCALE FEET
ZONE A RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 5.H
GROUNDWATER ELEVATIONS IN SHALLOW WELLS AT LOW TIDE ON 8-7-96
DWG DATE: 06/04/98
DWG NAME: 2901S016

00087I082

Figure 5.I Groundwater Elevations in Shallow Wells at High Tide — 8/7/96



LEGEND

- – SHALLOW MONITORING WELL
- – SURFACE WATER ELEVATION POINT
- – GROUNDWATER DIVIDES
- GW FLOW – REPRESENTATIVE GROUNDWATER FLOWPATHS (LABELED FLOWPATHS USED FOR GRADIENT CALCULATIONS)

NOTE

WELLS LABELED IN BLUE WERE INSTALLED IN JULY 1996.

CONTOUR INT. = 1 FOOT

250 0 250

SCALE FEET

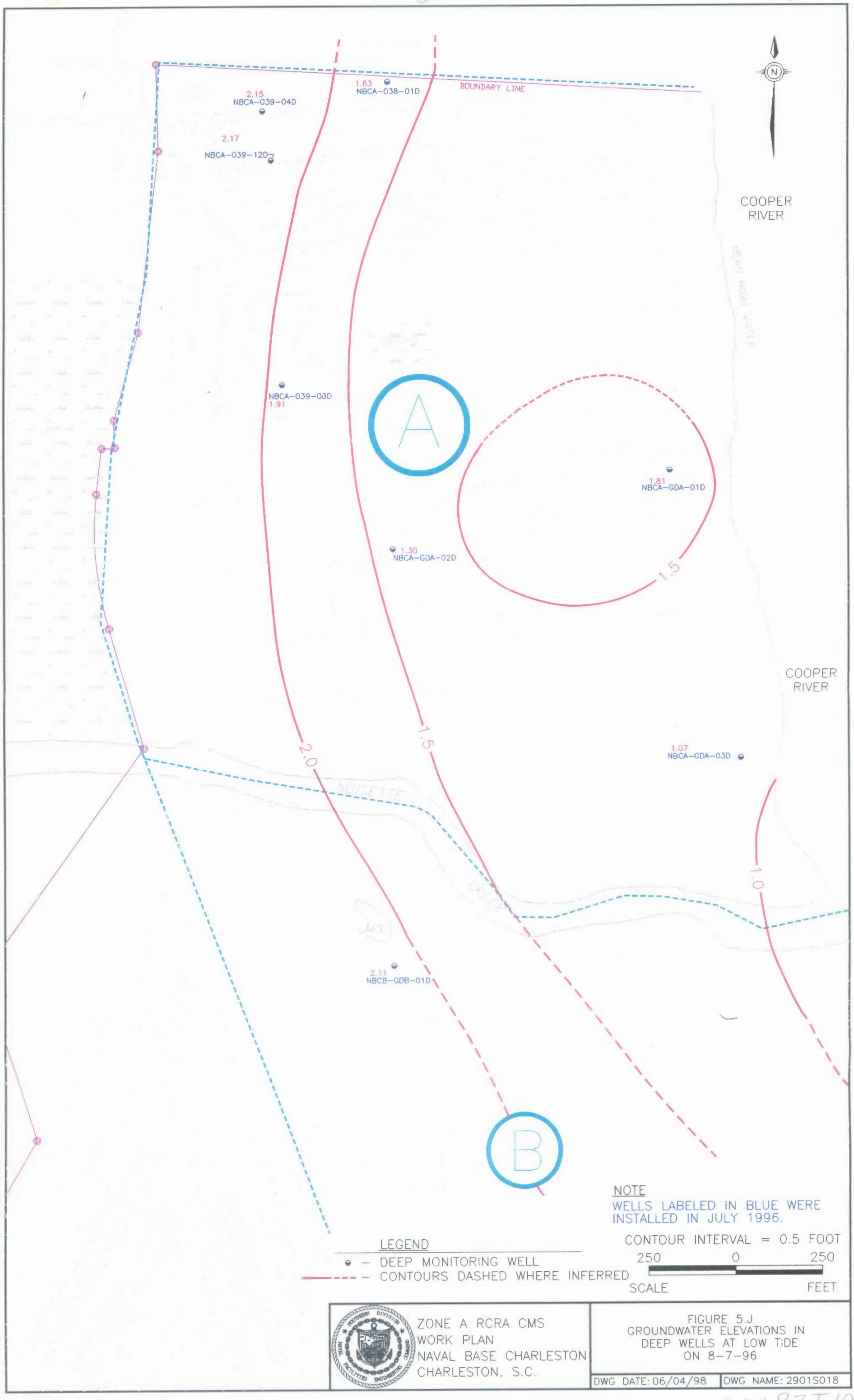
ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.1
GROUNDWATER ELEVATIONS IN SHALLOW WELLS AT HIGH TIDE ON 8-7-96

DWG DATE: 06/04/98 | DWG NAME: 2901S017

00087I09Z

Figure 5.J Groundwater Elevations in Deep Wells at Low Tide — 8/7/96



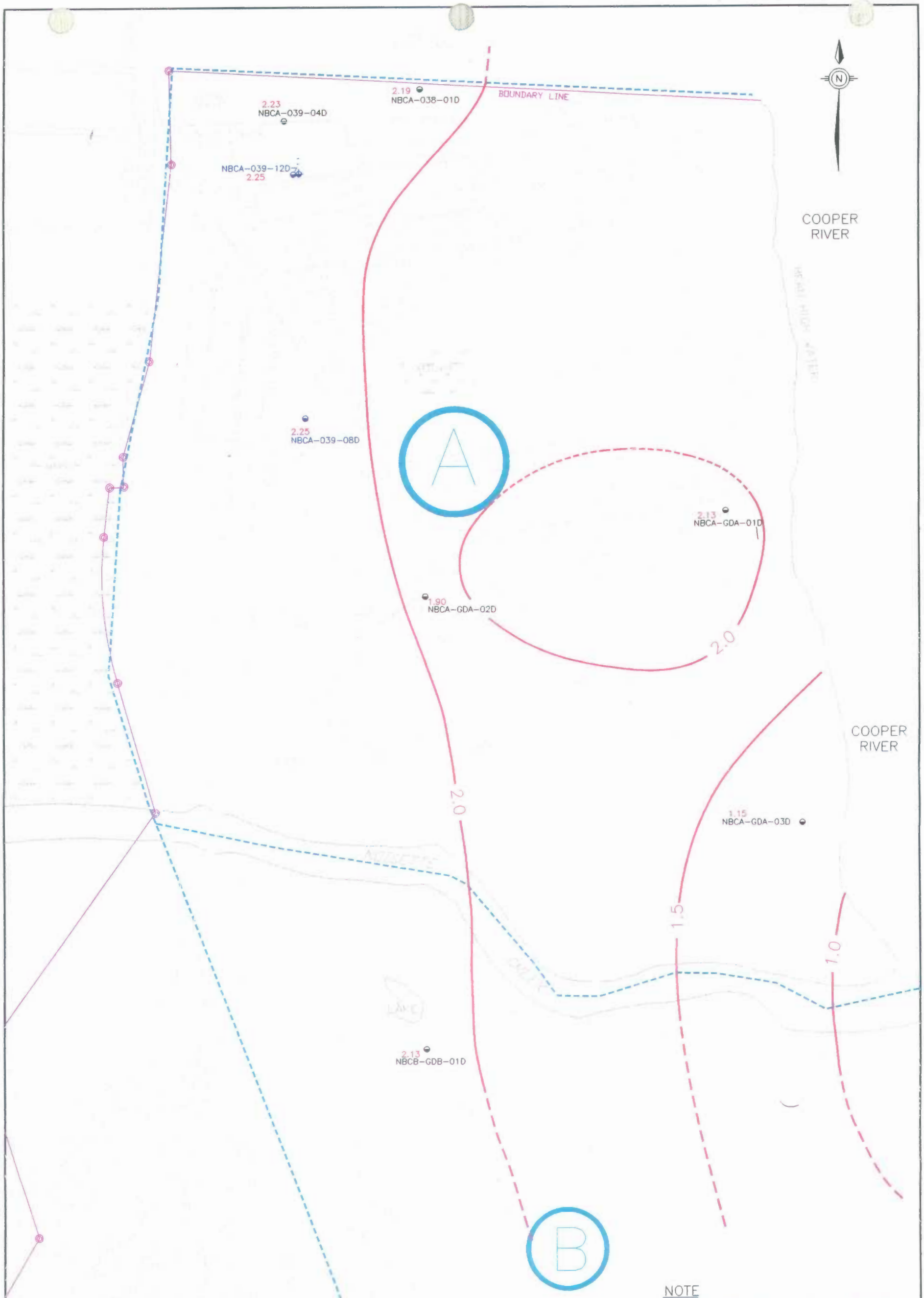
ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.J
GROUNDWATER ELEVATIONS IN
DEEP WELLS AT LOW TIDE
ON 8-7-96

DWG DATE: 06/04/98 | DWG NAME: 2901S018

00087I10Z

Figure 5.K Groundwater Elevations in Deep Wells at High Tide — 8/7/96



ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.K
GROUNDWATER ELEVATIONS IN
DEEP WELLS
AT HIGH TIDE ON 8-7-96

DWG DATE: 06/04/98 | DWG NAME: 2901S019

00087 I 112

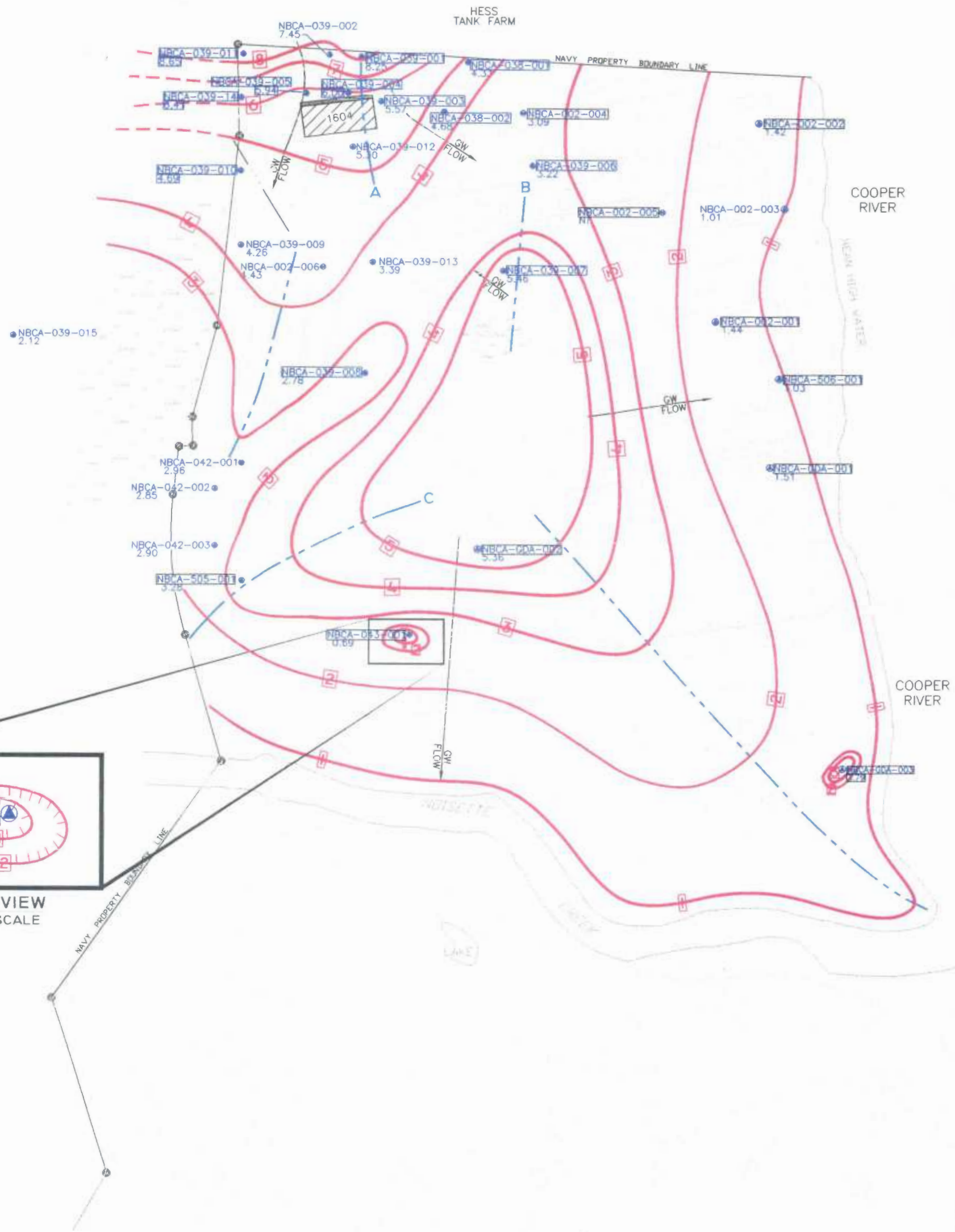
Figure 5.L Groundwater Elevations in Shallow Tier Wells — 1/22/97

LEGEND:

- APPROXIMATE GROUNDWATER FLOW
- SHALLOW WELL LOCATION
- GROUNDWATER CONTOUR (DASHED WHERE INFERRED)
- HACHURED CONTOURS INDICATE A DEPRESSION
- GROUNDWATER DIVIDE

NOTES:

1. CONTOUR INTERVAL EQUAL TO 1 FT.
2. REFER TO TEXT FOR EXPLANATION OF LETTERS ASSOCIATED WITH SELECT GROUNDWATER DIVIDE LINES.



DETAIL VIEW
NOT TO SCALE

300 0 300
SCALE FEET

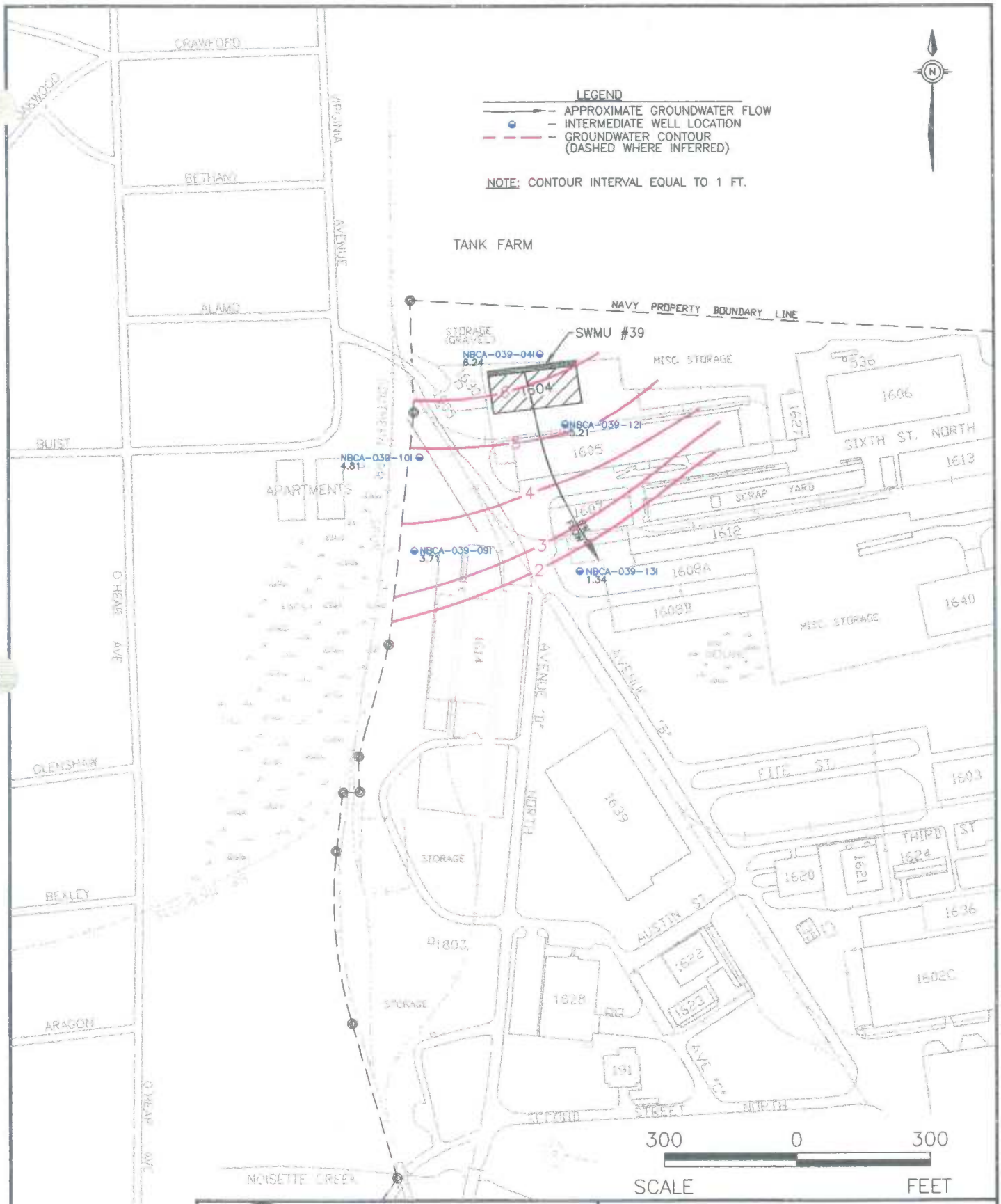
ZONE A
RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.L
GROUNDWATER ELEVATION CONTOURS
SWMU 39 SHALLOW WELLS
JANUARY 22, 1997

DWG DATE: 06/04/98 | DWG NAME: 2901S020

00087 I122

Figure 5.M Groundwater Elevations in Intermediate Tier Wells — 1/22/97

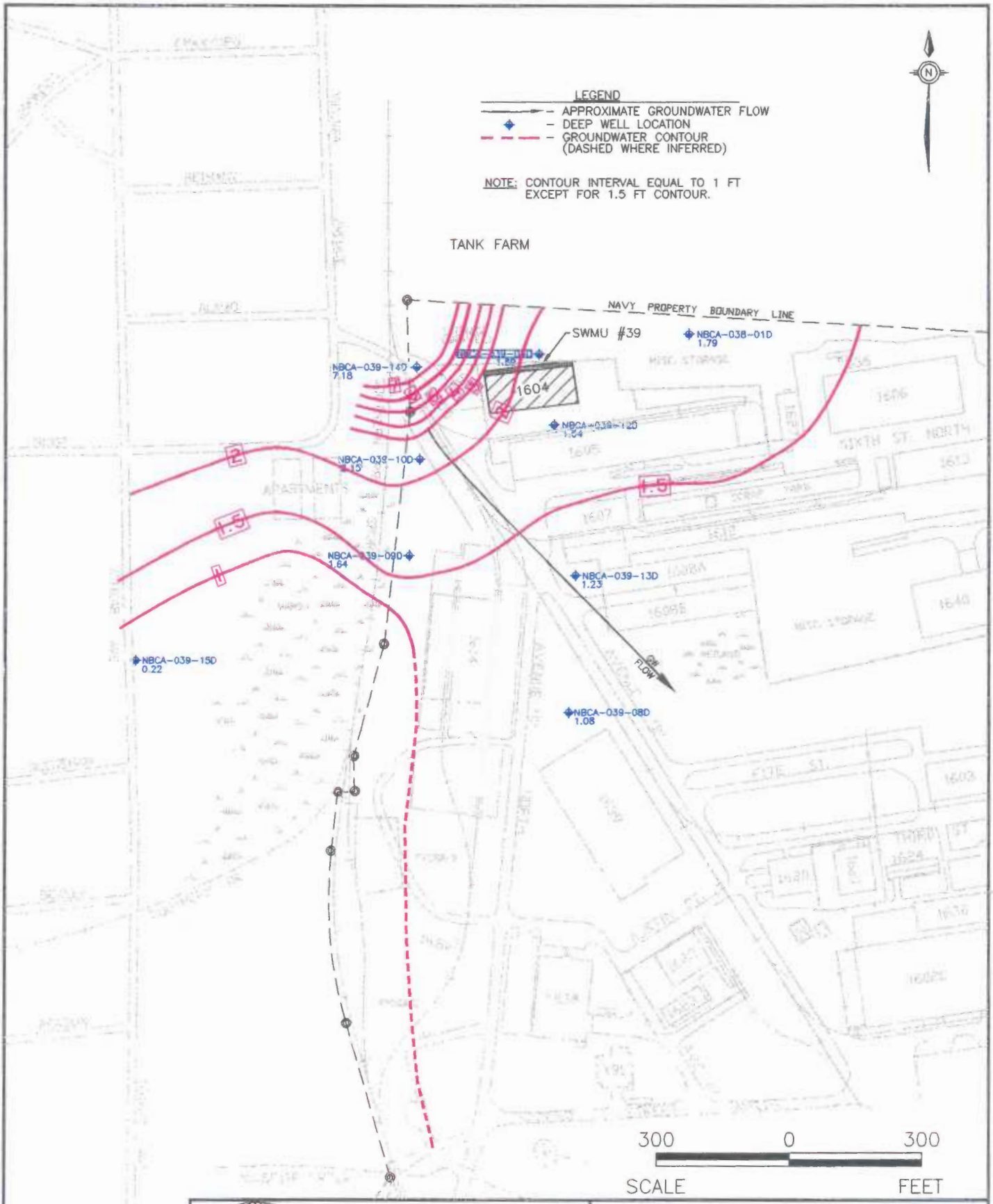


ZONE A
RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.M
GROUNDWATER ELEVATION CONTOURS
SWMU 39 INTERMEDIATE WELLS
JANUARY 22, 1997

DWG DATE: 06/04/98 | DWG NAME: 2901S021

Figure 5.N Groundwater Elevations in Deep Tier Wells — 1/22/97



ZONE A
RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.N
GROUNDWATER ELEVATION CONTOURS
SWMU 39 DEEP WELLS
JANUARY 22, 1997

DWG DATE: 06/04/98 | DWG NAME: 2901S022

The geometric means of horizontal hydraulic conductivity (Figure 5.O) based on slug-tested shallow wells vary from 6.5E-02 to 9.3 feet/day. The corresponding variation in the slug-tested deep wells was 0.77 to 24 feet/day. Seven Shelby tube samples, collected from the Ashley during the Zone E RFI, exhibited vertical permeabilities ranging from 1.6E-06 to 3.0E-04 centimeters per second (cm/sec) (4.6E-03 to 0.84 feet/day) with a geometric mean of 1.7E-05 cm/sec (0.05 feet/day) (E/A&H, November 1997).

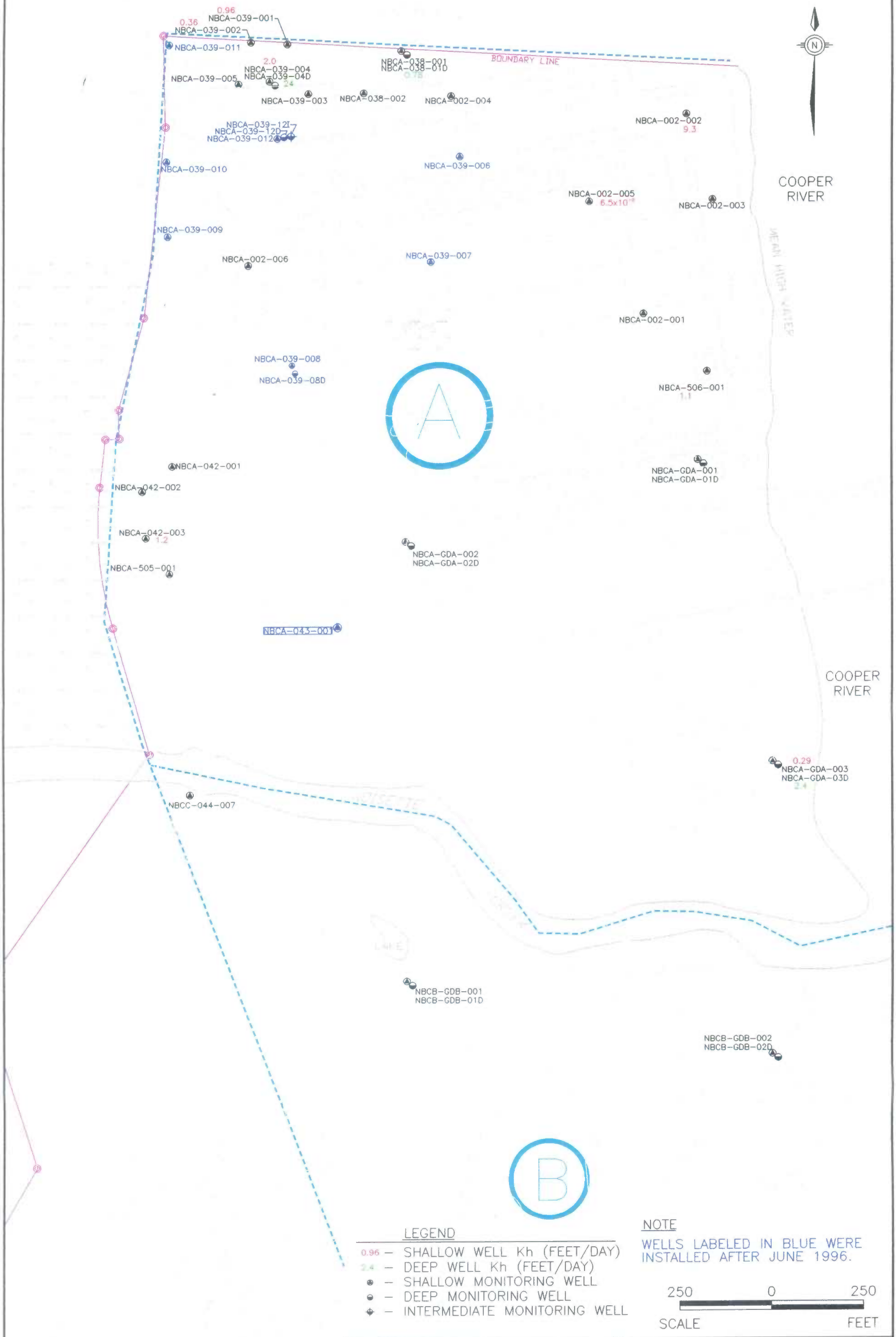
Horizontal gradients and calculated groundwater velocities are shown on Figure 5.P. All well pairs in Zone A have positive vertical gradients (Figure 5.Q), indicating downward groundwater flow potential during both low and high tides.

Ambient Water Quality

Both the shallow aquifer above the Ashley and the deep aquifer below function as potable water aquifers in the Charleston region. However, the shallow aquifer is poorly developed within the former naval base area and is not used.

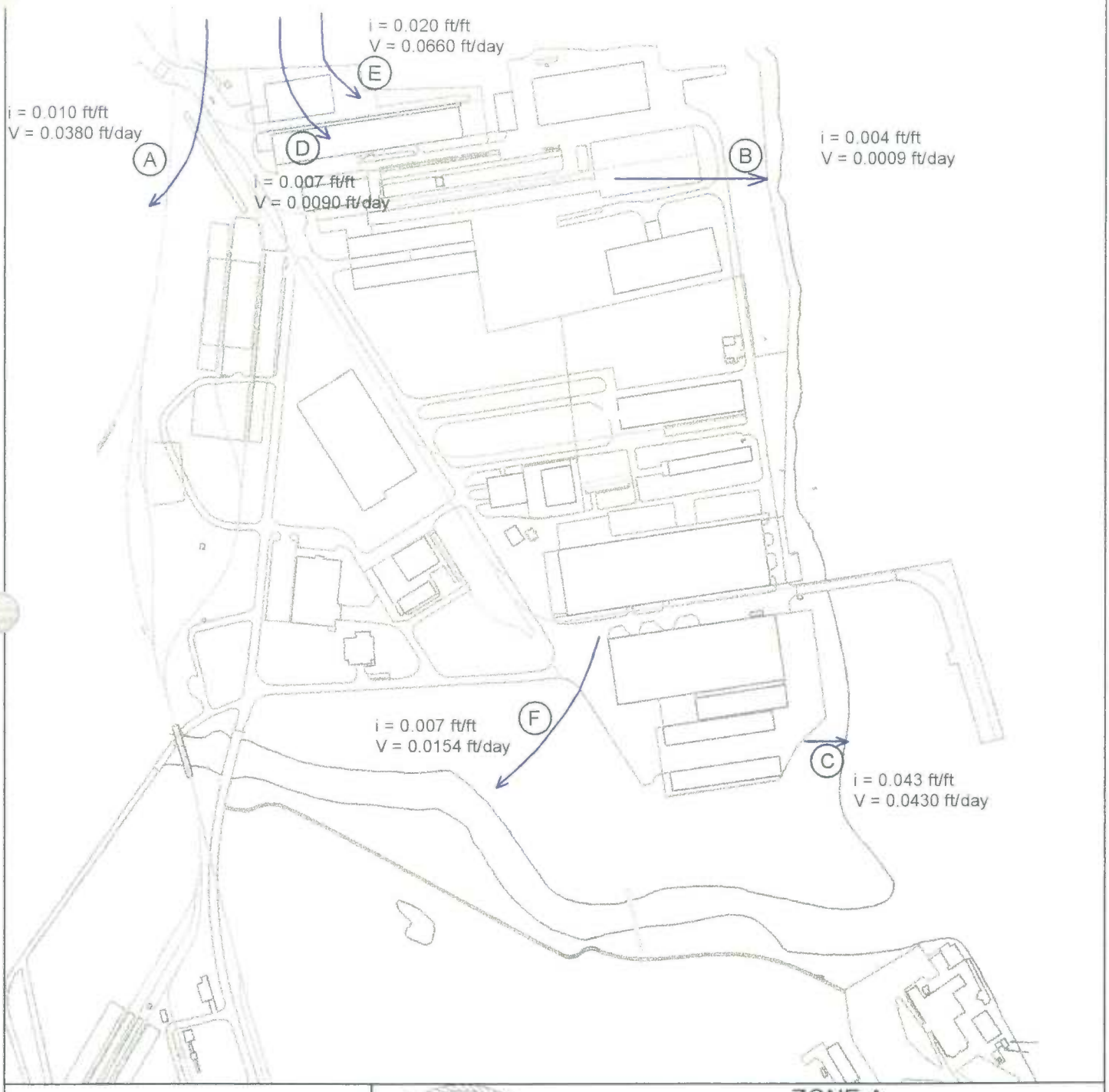
Zone A analytical data for various parameters reflective of groundwater quality were obtained during the RFI from five deep tier monitoring wells (Figure 5.R) and during the Monitored Natural Attenuation (MNA) initial sampling round from 26 shallow, intermediate, and deep tier wells. Table 5.A summarizes the ambient water quality.

Figure 5.O Areal Distribution of Hydraulic Conductivity in Surficial Aquifer


0.96
NBCA-039-001
0.36
NBCA-039-002
NBCA-039-011
2.0
NBCA-039-004
NBCA-039-04D
NBCA-039-005
NBCA-039-003
NBCA-038-001
NBCA-038-01D
BOUNDARY LINE
NBCA-038-002
NBCA-002-004
NBCA-002-002
9.3
NBCA-039-12I
NBCA-039-12D
NBCA-039-012
NBCA-039-010
NBCA-039-006
NBCA-002-005
6.5x10⁻⁸
NBCA-002-003
COOPER
RIVER
NBCA-039-009
NBCA-002-006
NBCA-039-007
NBCA-002-001
NBCA-039-008
NBCA-039-08D
NBCA-506-001
1.1
A
NBCA-042-001
NBCA-GDA-001
NBCA-GDA-01D
NBCA-042-002
NBCA-042-003
1.2
NBCA-GDA-002
NBCA-GDA-02D
NBCA-505-001
NBCA-043-001
COOPER
RIVER
0.29
NBCA-GDA-003
NBCA-GDA-03D
2.4
NBCC-044-007
NBCB-GDB-001
NBCB-GDB-01D
NBCB-GDB-002
NBCB-GDB-02D
B
LEGEND
0.96 – SHALLOW WELL Kh (FEET/DAY)
2.4 – DEEP WELL Kh (FEET/DAY)
– SHALLOW MONITORING WELL
– DEEP MONITORING WELL
– INTERMEDIATE MONITORING WELL
NOTE
WELLS LABELED IN BLUE WERE INSTALLED AFTER JUNE 1996.
250 0 250
SCALE FEET
ZONE A RCRA CMS
WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 5.0
AREAL DISTRIBUTION OF
HYDRAULIC CONDUCTIVITY (Kh)
IN SURFICIAL AQUIFER
DWG DATE: 06/04/98
DWG NAME: 2901S023

00057132

Figure 5.P Horizontal Groundwater Gradients and Calculated Velocities



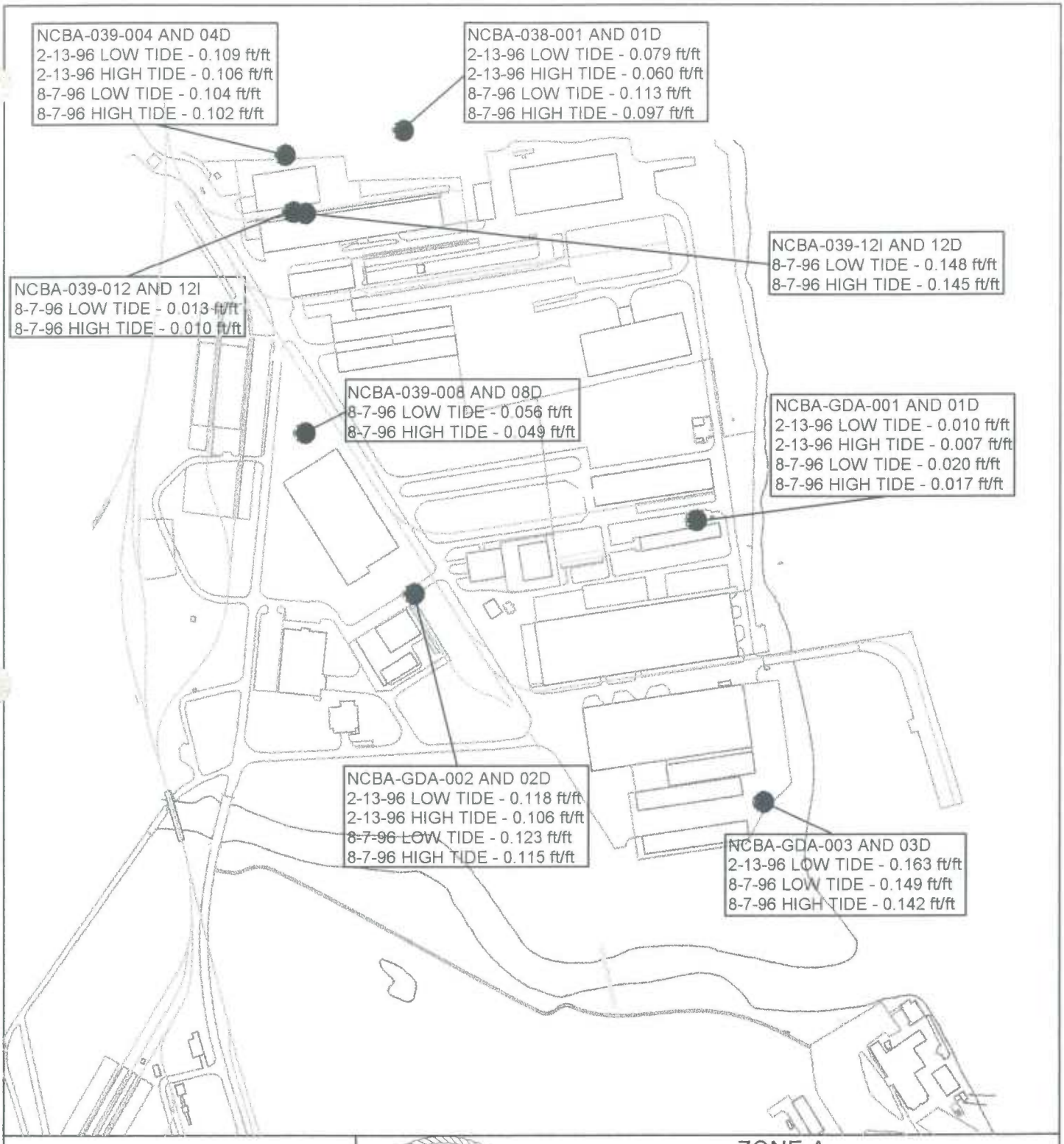
i = GRADIENT
V = ESTIMATED VELOCITY

N

100 0 100 200 300 Feet

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.P
HORIZONTAL GROUNDWATER GRADIENTS AND CALCULATED VELOCITIES

Figure 5.Q Vertical Groundwater Gradients



SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

ZONE A
RCRA CMS WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.Q
VERTICAL GROUNDWATER GRADIENTS

Figure 5.R Deep Groundwater TDS, Chloride, and Sulfate

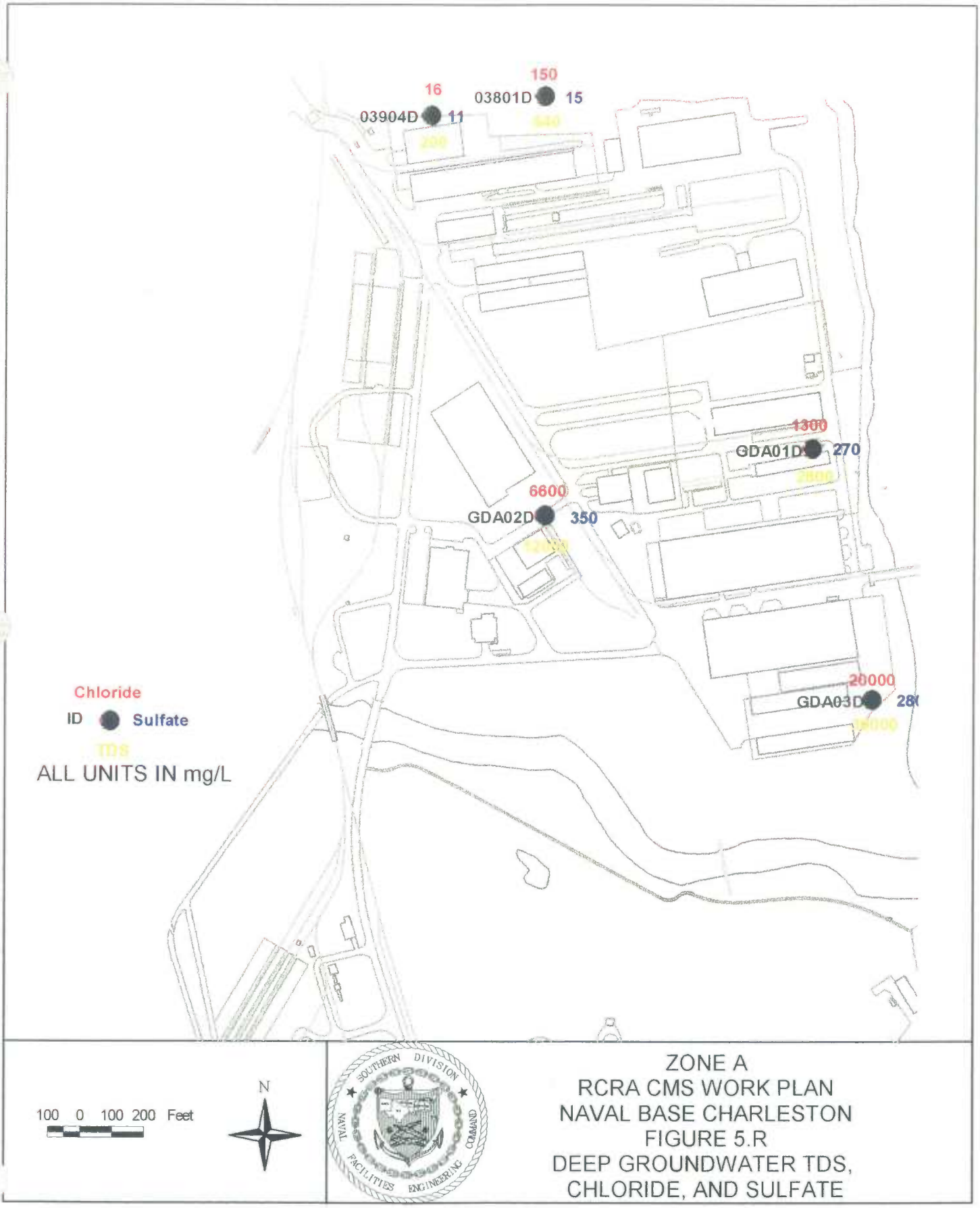

16
150
03904D
11
03801D
15
1300
GDA01D
270
6600
GDA02D
350
20000
GDA03D
Chloride
ID
Sulfate
TDS
ALL UNITS IN mg/L
100 0 100 200 Feet
N
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
FIGURE 5.R
DEEP GROUNDWATER TDS,
CHLORIDE, AND SULFATE

Table 5.A
Zone A — Ambient Water Quality (mg/L)

Water		RFI	MNA Event	SCDHEC Class GB Potable	USEPA
Total Dissolved Solids	Shallow	NA	NA	10,000	500
	Intermediate	NA	NA		
	Deep	200 - 39,000	NA		
Chloride	Shallow	NA	ND - 387	NL	250
	Intermediate	NA	5 - 11.8		
	Deep	16 - 20,000	ND - 16.4		
Sulfate	Shallow	NA	ND - 5620	NL	250
	Intermediate	NA	4.9 - 5510		
	Deep	11 - 350	3.2 - 5700		

Notes:
SCDHEC — South Carolina Department of Health and Environmental Control
USEPA SMCLs — Agency Secondary Maximum Contaminant Levels for drinking water per USEPA
NA — Shallow and intermediate wells were not sampled for water quality parameters during the RFI
NL — Not listed
mg/L — milligrams per liter
ND — nondetect

Comparative Water Quality Data

Because groundwater is used in many areas of the country as a drinking water source, typical drinking water pretreatment concentration ranges are available for comparison *(Wastewater Engineering, Treatment, Disposal, and Reuse,* Metcalf and Eddy, Inc., 3rd Edition, Tchobanoglous and Burton, McGraw-Hill, Inc., 1991; and *Water Quality, Characteristics, Modeling, and Modification,* Tchobanoglous and Schroeder, Addison Wesley,1987). **This information is relevant in that, due to naturally occurring conditions, groundwater at each Zone A site may require pretreatment prior to treatment for contaminants of concern or to use as a drinking water source. Because of a lack of shallow and intermediate zone water quality data, future groundwater sampling from Zone A wells should include analysis for TDS, chloride, and sulfate.**

The upper limit of freshwater total dissolved solids (TDS) is approximately 1,500 mg/L. Brackish waters have an upper limit of approximately 5,000 mg/L, while waters containing higher TDS concentrations are considered saline. Seawater typically ranges from 30,000 to 34,000 mg/L. Typical domestic U.S. wastewater contains TDS concentrations of approximately 500 mg/L.

The chloride concentrations in domestic U.S. drinking water supplies typically range from 5 to 100 mg/L, with the higher end of the range in coastal communities. Chloride concentrations in typical surface water supplies are approximately 50 mg/L; domestic U.S. wastewater will have chloride concentrations exceeding 100 mg/L versus a USEPA drinking water standard of 250 mg/L. The sulfate concentrations in domestic U.S. drinking water supplies typically range from 10 to 300 mg/L.

Zone A Groundwater Development Potential

Because ambient water quality parameters fall within or near acceptable ranges for potable water, shallow groundwater in Zone A could theoretically be collected and treated for use as drinking water. However, this area is currently served by or has ready access to city water utilities. The high cost, low benefit, and probable technical impracticality of developing a low-yield aquifer such as the one present in Zone A, coupled with the site's proximity to a large petroleum storage facility, would likely prohibit such development for anything other than supplemental private irrigation. **However, the CMS will evaluate remedial alternatives which would address this aquifer as a potential drinking water aquifer**

Zone A Contaminants of Concern (COCs)

Soil

Zone A contaminants of concern in soil were selected based primarily on their contribution to surface soil risk and hazard. Zone A COCs included arsenic, beryllium, Aroclor-1260, DDT and its daughter products, and lead. Because no particular COC was present on a zone-wide scale,

figures are provided in each site-specific section showing the distribution of that site's primary COC(s) for soil.

Groundwater

COCs in groundwater were selected based primarily on their presence in concentrations above MCLs, determined through multiple rounds of sampling. Figures 5.S and 5.T show the quarterly organic and inorganic groundwater sampling results for Zone A COCs.

Human Health Risk and Hazard

Human health risk and hazard presented in the RFI was calculated for each site in Zone A using data not adjusted for background concentrations of inorganics or BEQs. Per USEPA Subpart S Initiative, *Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities; Proposed Rule, 1996,* no ~~a~~ cleanup level will be proposed that restores the site to more protective risk levels than the risks produced by native materials.

Tables 5.B and 5.C summarize background study results for Zone A in terms of surface soil and shallow groundwater risk and hazard. Where applicable, these background values were subtracted from each compound's contribution to total site surface soil risk and hazard.

Uncertainty in Risk Assessment

As stated in the Zone A RFI and in accordance with USEPA protocol, the risk assessment methodology is a very conservative process which produces results extremely protective of human health. This fact should be considered when setting cleanup goals consistent with future site reuse.

NOTE:
PVTGW01 IS A PRIVATE OFF-SITE WELL LOCATED APPROXIMATELY 0.5 MILES NORTHWEST OF SWMU 39. TCE SOURCE IS UNRELATED TO NAVY ACTIVITIES.

PVTGW01

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	ROUND 5	RBC	UTL	MCL
VOAs								
TRICHLOROETHENE	47.00	35.00	66.00	ND	ND	11.80	NA	15.00

039002*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	NA	NA			
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

039120*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	ND	ND	ND			
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

039005*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
BENZENE	90.00	100.00	170.00	78.00	0.36	NU	5.00
VINYL CHLORIDE	11.00	ND	5.00	ND	0.02	NU	2.00
BIS(2-ETHYLHEXYL)PHTHALATE	ND	ND	5.10	ND	4.80	NU	5.00
SVOAs	ND	ND	NA	NA			
PESTICIDES	ND	NA	NA	NA			

039011*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
1,2-DICHLOROETHANE	4.00	NS	ND	ND	0.12	NU	5.00
1,1-DICHLOROETHENE	ND	NS	ND	ND	0.04	NU	7.00
ETHYLBENZENE	126.00	NS	180.00	140.00	1.30	NU	700.00
BENZENE	130.00	NS	140.00	150.00	0.36	NU	5.00
TOLUENE	24.00	NS	10.00	11.00	1.00	NU	1000.00
XYLENE	300.00	NS	260.00	280.00	3.20	200.00	NU	10000.00
SVOAs								
2,4-DIMETHYLPHENOL	15.00	NS	10.00	22.00	1.10	NU	NM
NAPHTHALENE	420.00	NS	300.00	160.00	1.10	NU	NM
BIS(2-ETHYLHEXYL)PHTHALATE	5.00	NS	ND	ND	4.80	NU	5.00
PENTACHLOROPHENOL	ND	NS	12.00	ND	0.55	NU	1.00
PESTICIDES	NA	NA	NA	NA			

039014*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
BENZENE	8.00	23.00	16.00	13.00	0.36	NU	5.00
METHYLENE CHLORIDE	6.00	ND	ND	ND	4.10	NU	5.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

039140*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	ND	ND	ND			
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	ND	NA	NA			

039010*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	ND	NA	NA			

039100*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
cis-1,2-DICHLOROETHENE	7.00	8.00	12.00	11.00	6.10	NU	70.00
VINYL CHLORIDE	ND	ND	ND	1.00	0.02	NU	2.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

039105*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
cis-1,2-DICHLOROETHENE	48.00	42.00	44.00	29.00	6.10	NU	70.00
VINYL CHLORIDE	10.00	7.00	8.00	6.00	0.02	NU	2.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

039095*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
1,1-DICHLOROETHENE	ND	ND	ND	ND	0.04	NU	7.00
cis-1,2-DICHLOROETHENE	38.00	28.00	44.00	38.00	6.10	NU	70.00
TRICHLOROETHENE	12.00	9.00	1.00	ND	1.60	NU	5.00
VINYL CHLORIDE	8.00	5.00	10.00	9.00	0.02	NU	2.00
SVOAs	ND	ND	NA	NA			
PESTICIDES	NA	NA	NA	NA			

039091*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

039151*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	ND	ND	ND			

039150*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	ND	ND	ND			

039090*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

002006*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	ROUND 5	RBC	UTL	MCL
VOAs	NA	NA	NA	NA	NA			
SVOAs	NA	NA	NA	NA	NA			
PESTICIDES	NA	NA	NA	NA	NA			

039013*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
1,1-DICHLOROETHENE	37.00	34.00	26.00	27.00	6.10	NU	70.00
TRICHLOROETHENE	6.00	7.00	4.00	3.00	1.60	NU	5.00
TETRACHLOROETHENE	20.00	30.00	19.00	9.00	1.10	RU	5.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

039131*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
1,1-DICHLOROETHENE	ND	7.00	3.00	7.00	0.04	NU	7.00
1,1,1-TRICHLOROETHANE	69.00	1,100.00	140.00	88.00	6.10	NU	200.00
BENZENE	44.00	61.00	43.00	42.00	1.80	NU	5.00
TETRACHLOROETHENE	110.00	85.00	110.00	100.00	1.10	NU	5.00
VINYL CHLORIDE	9.00	7.00	10.00	9.00	0.02	NU	2.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

039135*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
1,1-DICHLOROETHENE	ND	13.00	4.00	4.00	0.04	NU	7.00
cis-1,2-DICHLOROETHENE	170.00	180.00	180.00	160.00	6.10	NU	70.00
TRICHLOROETHENE	43.00	46.00	34.00	20.00	1.60	NU	5.00
TETRACHLOROETHENE	33.00	46.00	34.00	20.00	1.10	NU	5.00
VINYL CHLORIDE	2.00	ND	ND	ND	0.02	NU	2.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

042002*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

042001*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
CHLOROMETHANE	7.80	ND	ND	ND	1.10	NU	5.00
TRICHLOROETHENE	ND	1.40	1.50	ND	1.60	NU	5.00
TETRACHLOROETHENE	4.80	1.50	1.40	ND	1.10	NU	5.00
SVOAs	ND	ND	NA	NA			
PESTICIDES	ND	NA	NA	NA			

042003*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

039007*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
TRICHLOROETHENE	ND	2.30	1.60	ND	1.60	NU	5.00
TETRACHLOROETHENE	ND	5.80	1.70	ND	1.10	NU	5.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

039003*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
1,2-DICHLOROETHENE	14.80	1.50	6.80	3.00	6.10	NU	70.00
TRICHLOROETHENE	41.00	49.00	81.00	30.00	1.60	NU	5.00
TETRACHLOROETHENE	18.00	9.20	11.60	8.00	1.10	NU	5.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

039012*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
TRICHLOROETHENE	99.00	110.00	84.00	90.00	1.60	NU	5.00
1,1-DICHLOROETHENE	5.00	4.00	4.00	4.00	0.04	NU	7.00
cis-1,2-DICHLOROETHENE	130.00	170.00	180.00	160.00	6.10	NU	70.00
VINYL CHLORIDE	3.00	4.00	ND	2.00	0.02	NU	2.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

039041*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
BENZENE	ND	NS	ND	ND			
SVOAs	ND	NS	ND	ND			
PESTICIDES	NA	NS	NA	NA			

039045*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

039004*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
TRICHLOROETHENE	ND	2.30	1.60	ND	1.60	NU	5.00
TETRACHLOROETHENE	ND	5.80	1.70	ND	1.10	NU	5.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

039001*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
TRICHLOROETHENE	14.80	1.50	6.80	3.00	6.10	NU	70.00
1,1-DICHLOROETHENE	41.00	49.00	81.00	30.00	1.60	NU	5.00
TETRACHLOROETHENE	18.00	9.20	11.60	8.00	1.10	NU	5.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	NA	NA	NA			

039120*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
1,1-DICHLOROETHENE	5.00	4.00	5.00	5.00	0.04	NU	7.00
cis-1,2-DICHLOROETHENE	240.00	140.00	130.00	100.00	6.10	NU	70.00
BENZENE	NA	NA	1.00	1.00	0.36	NU	5.00
TRICHLOROETHENE	150.00	100.00	110.00	100.00	1.60	NU	5.00
VINYL CHLORIDE	ND	ND	ND	2.00	0.02	NU	2.00
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

038001*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
TRICHLOROETHENE	ND	NA	NA	NA			
SVOAs	ND	NA	NA	NA			
PESTICIDES							
4,4'-DDD	3.80	4.00	12.00	5.18	0.28	NU	NM
4,4'-DDT	11.50	12.00	10.25	ND	0.30	NU	NM

039001*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	NA	NA			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

039002*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	NA	NA			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	ND	ND	ND			

002004*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	ROUND 5	RBC	UTL	MCL
VOAs	NA	ND	NA	NA	NA			
SVOAs	NA	ND	NA	NA	NA			
PESTICIDES	NA	ND	NA	NA	NA			

002002*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	ROUND 5	RBC	UTL	MCL
VOAs	NA	ND	NA	NA	NA			
SVOAs	NA	ND	NA	NA	NA			
PESTICIDES	NA	NA	NA	NA	NA			

039006*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
CHLOROBENZENE	ND	NS	3.00	4.00	3.80	NU	NM
SVOAs	ND	NS	ND	ND			
PESTICIDES	NA	NS	NA	NA			

002003*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	ROUND 5	RBC	UTL	MCL
VOAs	NA	NA	NA	NA	NA			
SVOAs	NA	NA	NA	NA	NA			
PESTICIDES	NA	NA	NA	NA	NA			

002005*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	ROUND 5	RBC	UTL	MCL
VOAs	NA	NA	NA	NA	NS			
SVOAs	NA	NA	NA	NA	NA			
PESTICIDES	NA	NA	NA	NA	NA			

039007*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NS	ND	ND			
SVOAs	ND	NS	ND	ND			
PESTICIDES	NA	NS	NA	NA			

002001*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	ROUND 5	RBC	UTL	MCL
VOAs	NA	NA	NA	NA	NA			
SVOAs	NA	NA	NA	NA	NA			
PESTICIDES	NA	NA	NA	NA	NA			

GDA001*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	ND	ND			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

GDA002*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	ND	ND			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

GDA003*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	ND	ND			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

GDA004*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	ND	ND			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

GDA001*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	ND	ND			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

GDA002*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	ND	ND			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

GDA003*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	ND	ND			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

GDA004*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	NA	ND	ND			
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

043001*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs	ND	ND	ND	ND			
SVOAs	ND	ND	ND	ND			
PESTICIDES	ND	ND	ND	NA			

505001*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
1,1-DICHLOROETHENE	1.00	ND	ND	ND	0.04	NU	7.00
1,1,2,2-TETRACHLOROETHANE	1.50	ND	ND	ND	0.05	NU	NM
1,4-DICHLOROBENZENE	2.00	ND	ND	ND	0.44	NU	75.00
SVOAs	ND	NA	NA	NA			
PESTICIDES	ND	NA	NA	NA			

039008*

ORGANIC CHEMICALS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
VOAs							
SVOAs	ND	ND	ND	ND			
PESTICIDES	NA	NA	NA	NA			

LEGEND
UTL – UPPER THRESHOLD LIMIT
MCL – MAXIMUM CONCENTRATION LIMIT
NS – WELL NOT SAMPLED
ND – PARAMETER ANALYZED BUT NOT DETECTED ABOVE RBC, UTL, OR MCL
NM – MCL NOT AVAILABLE
NA – PARAMETER NOT ANALYZED
NU – UTL NOT AVAILABLE
● – SHALLOW MONITORING WELL
◆ – INTERMEDIATE MONITORING WELL
⊕ – DEEP MONITORING WELL
– – STUDY ZONE BOUNDARY

A – ROUND 1 – NOVEMBER 93
– ROUND 2 – SEPTEMBER 95
– ROUND 3 – APRIL 96
– ROUND 4 – JUNE 96
– ROUND 5 – OCTOBER 96

B – ROUND 1 – DECEMBER 95
– ROUND 2 – APRIL 96
– ROUND 3 – JUNE 96
– ROUND 4 – OCTOBER 96

C – ROUND 1 – OCTOBER 96
– ROUND 2 – MARCH 97
– ROUND 3 – JULY 97
– ROUND 4 – OCTOBER 97

D – ROUND 1 – FEBRUARY 97
– ROUND 2 – MARCH 97
– ROUND 3 – JULY 97
– ROUND 4 – OCTOBER 97

E – ROUND 1 – NOVEMBER 96
– ROUND 2 – MARCH 97
– ROUND 3 – JULY 97
– ROUND 4 – OCTOBER 97

NOTES
1. FOR PARAMETERS DETECTED IN BOTH PRIMARY AND DUPLICATE SAMPLES THE AVERAGE VALUE IS REPORTED.
2. FOR PARAMETERS THAT WERE DETECTED IN ONLY ONE OF THE PRIMARY OR DUPLICATE SAMPLES, THE DETECTION IS REPORTED.

250 0 250
SCALE FEET

REVISION		
Rev Number:000	Rev Date:00/00/00	Rev By: NAME
Rev Number:000	Rev Date:00/00/00	Rev By: NAME
Rev Number:000	Rev Date:00/00/00	Rev By: NAME
Rev Number:000	Rev Date:00/00/00	Rev By: NAME
Rev Number:000	Rev Date:00/00/00	Rev By: NAME

ZONE A
CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.5
ORGANIC CHEMICALS IN GROUNDWATER

Dr by: W. FAULK	Tr by: E. ROGERS	
Ck by: D. McCONNELL	App by: NAME	Sheet 1
Date: 08/28/98	DWG Name:2901N004	Of 1

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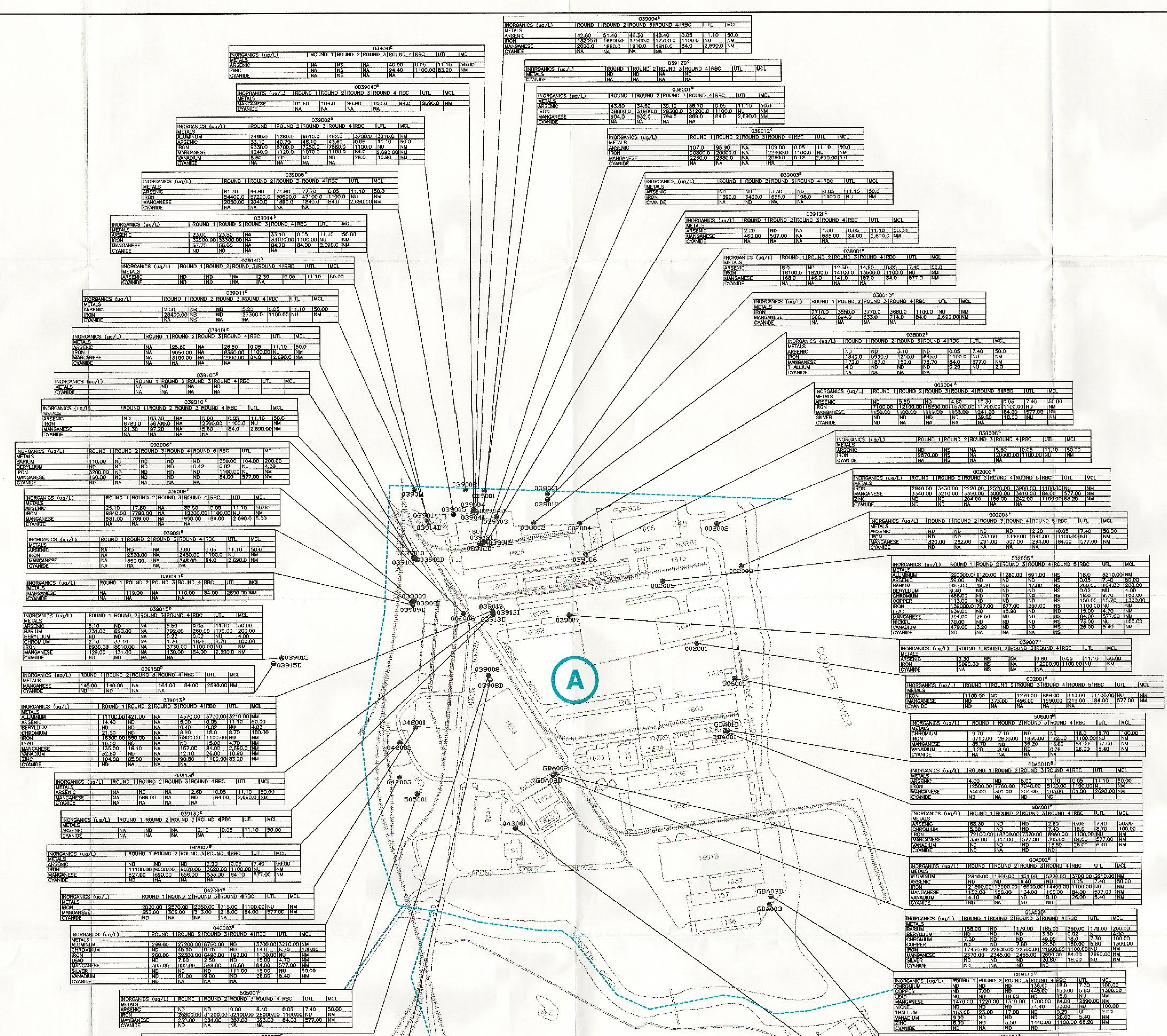


GDA03D[B]

INORGANICS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
CHROMIUM	ND	ND	ND	136.00	18.0	7.30	100.00
COPPER	ND	7.00	ND	445.00	150.00	5.80	1300.00
LEAD	ND	ND	18.60	ND	15.0	NU	NM
MANGANESE	1470.00	1220.00	1310.00	1700.00	84.00	2690.00	NM
NICKEL	ND	ND	ND	74.40	73.00	NU	100.00
THALLIUM	163.00	23.00	17.00	ND	0.29	U	2.00
VANADIUM	9.90	ND	ND	ND	26.00	5.40	NM
ZINC	6.90	ND	5.50	1440.00	1100.00	66.20	NM
CYANIDE	ND	NA	ND	ND			

GDA003[B]

INORGANICS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
METALS							
ARSENIC	ND	ND	7.40	4.90	0.05	7.40	50.00
IRON	8230.00	8880.00	9880.00	8390.00	1100.00	NU	NM
MANGANESE	79.80	96.00	94.60	94.00	84.00	577.00	NM
VANADIUM	ND	7.70	ND	1.30	26.00	5.40	NM
CYANIDE	ND	NA	ND	ND			

043001[D]

INORGANICS (ug/L)	ROUND 1	ROUND 2	ROUND 3	ROUND 4	RBC	UTL	MCL
METALS							
ARSENIC	18.30	21.20	NA	25.20	0.05	7.40	50.00
IRON	21600.00	18200.00	NA	18200.00	1100.00	NU	NM
CYANIDE	ND	ND	NA	NA			

LEGEND

UTL – UPPER THRESHOLD LIMIT
MCL – MAXIMUM CONCENTRATION LIMIT
NS – WELL NOT SAMPLED
ND – PARAMETER ANALYZED BUT NOT DETECTED ABOVE RBC, UTL, OR MCL
NM – MCL NOT AVAILABLE
NA – PARAMETER NOT ANALYZED
NU – UTL NOT AVAILABLE
● – SHALLOW MONITORING WELL
◆ – INTERMEDIATE MONITORING WELL
● – DEEP MONITORING WELL
---- – STUDY ZONE BOUNDARY

A – ROUND 1 – NOVEMBER 93
– ROUND 2 – SEPTEMBER 95
– ROUND 3 – APRIL 96
– ROUND 4 – JUNE 96
– ROUND 5 – OCTOBER 96

B – ROUND 1 – DECEMBER 95
– ROUND 2 – APRIL 96
– ROUND 3 – JUNE 96
– ROUND 4 – OCTOBER 96

C – ROUND 1 – OCTOBER 96
– ROUND 2 – MARCH 97
– ROUND 3 – JULY 97
– ROUND 4 – OCTOBER 97

D – ROUND 1 – FEBRUARY 97
– ROUND 2 – MARCH 97
– ROUND 3 – JULY 97
– ROUND 4 – OCTOBER 97

E – ROUND 1 – NOVEMBER 96
– ROUND 2 – MARCH 97
– ROUND 3 – JULY 97
– ROUND 4 – OCTOBER 97

NOTES
1. FOR PARAMETERS DETECTED IN BOTH PRIMARY AND DUPLICATE SAMPLES THE AVERAGE VALUE IS REPORTED.
2. FOR PARAMETERS THAT WERE DETECTED IN ONLY ONE OF THE PRIMARY OR DUPLICATE SAMPLES, THE DETECTION IS REPORTED.

250 0 250
SCALE FEET

REVISION		
Rev Number:000	Rev Date:00/00/00	Rev By: NAME
Rev Number:000	Rev Date:00/00/00	Rev By: NAME
Rev Number:000	Rev Date:00/00/00	Rev By: NAME
Rev Number:000	Rev Date:00/00/00	Rev By: NAME
Rev Number:000	Rev Date:00/00/00	Rev By: NAME

ZONE A
CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.T
INORGANICS IN GROUNDWATER

Dr by: W. FAULK	Tr by: E. ROGERS	
Ck by: D. McCONNELL	App by: NAME	Sheet 1
Date: 09/04/98	DWG Name:2901N005	Of 1

Table 5.B
Risk/Hazard Associated with Background COCs in Zone A Surface Soil

		Residential		Industrial	
Parameter	**Surface Soil Background Reference Conc. (mg/kg)**	**Background Hazard**	**Background Risk**	**Background Hazard**	**Background Risk**
B(a)P Equivalents (BEQ)	0.590	NA	9.7E-06	NA	1.4E-06
Aluminum	12,800	1.9E-01	NA	7.6E-03	NA
Arsenic	9.44	4.8E-01	2.5E-05	1.8E-02	1.6E-06
Chromium	50.4	7.7E-04	NA	3.0E-05	NA
Copper	165	4.0E-02	NA	1.5E-03	NA
Lead	*a*	NA	NA	NA	NA
Manganese	98.1	3.2E-02	NA	1.2E-03	NA
Mercury	0.3	2.8E-02	NA	1.1E-03	NA
Nickel	13.55	2.8E-02	NA	1.1E-03	NA
Vanadium	29.24	6.4E-02	NA	4.3E-03	NA
Cumulative Background Hazard		4.8E-01	—	1.8E-02	—
Cumulative Background Risk		—	2.1E-05	—	8.7E-06

Notes:

a: Lead does not have a reference background concentration. However, Lead is a COC in soil and is subject to cleanup standard of 400 mg/kg under residential re-use scenarios and 1,300 mg/kg under industrial re-use scenarios.

Table 5.C
Risk/Hazard Associated with Background Inorganic COCs in Zone A Shallow Groundwater

		Residential Reuse Scenario		Industrial Reuse Scenario	
Parameter	**Shallow GW Background Reference Value (μg/L)**	**Background Hazard**	**Background Risk**	**Background Hazard**	**Background Risk**
Aluminum	3,210	2.1E-01	NA	0.032	NA
Arsenic	7.4	1.6	1.7E-04	0.24	4.0E-05
Chromium	8.7	1.1E-01	NA	0.017	NA
Lead	*a*	NA	NA	NA	NA
Manganese	577	1.6	NA	0.24	NA
Vanadium	5.4	4.9E-02	NA	7.5E-03	NA
Cumulative Background Hazard		3.5	—	0.54	—
Cumulative Background Risk		—	1.7E-04	—	4.0E-05

Notes:

a: Lead does not have a reference background concentration. However, Lead is a COC in groundwater is subject to the USEPA TTAL cleanup standard of 15 *u*g/L.

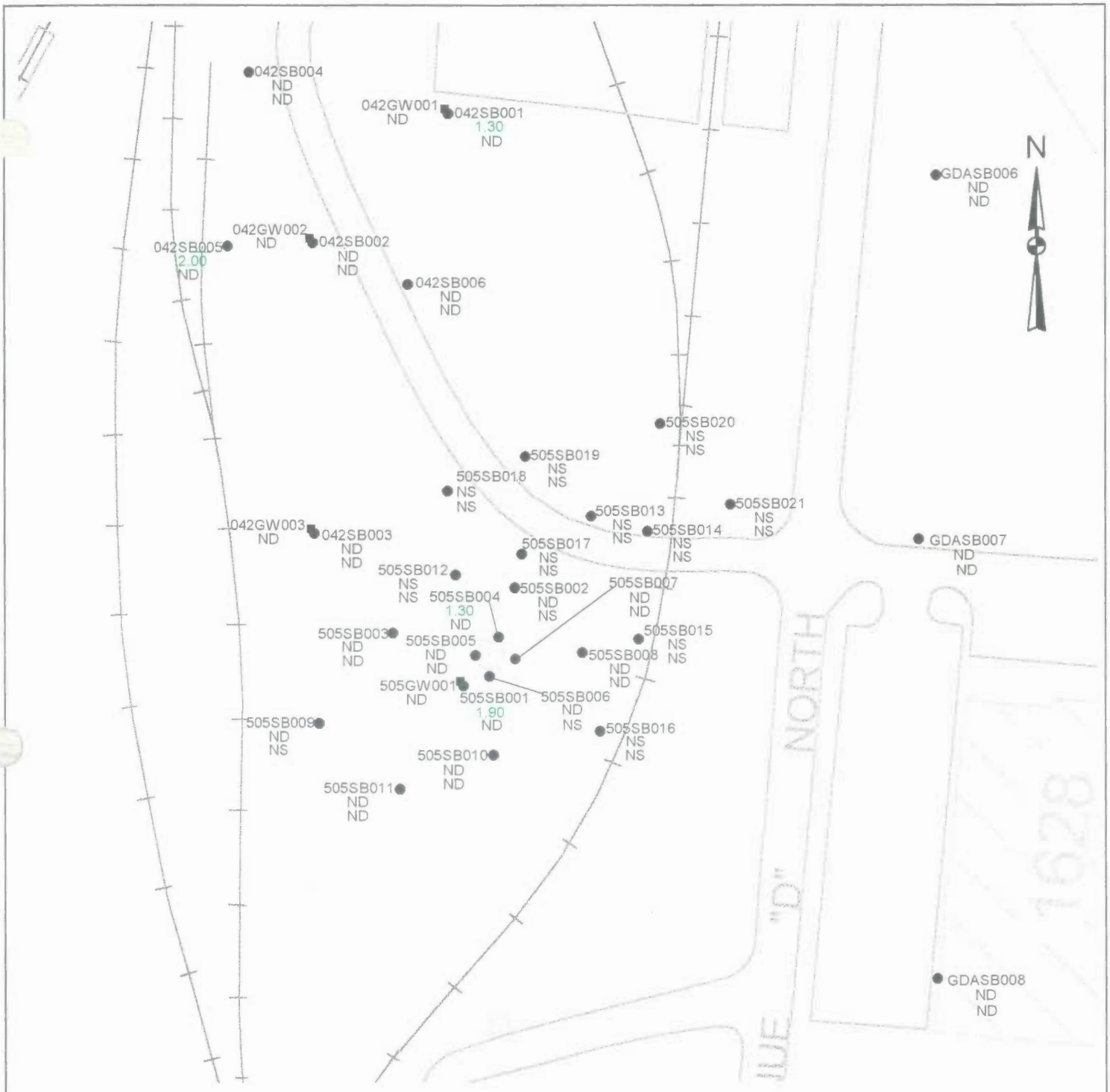
LEGEND

- ZONE A GW WELL LOCATION
- ZONE A SOIL BORING LOCATION

100 0 100 200 Feet

ZONE A - RCRA
CORRECTIVE MEASURES STUDY
NAVAL BASE CHARLESTON
CHARLESTON, SC

FIGURE 5.U
ZONE A - SOUTHWEST CORNER
SAMPLE LOCATIONS



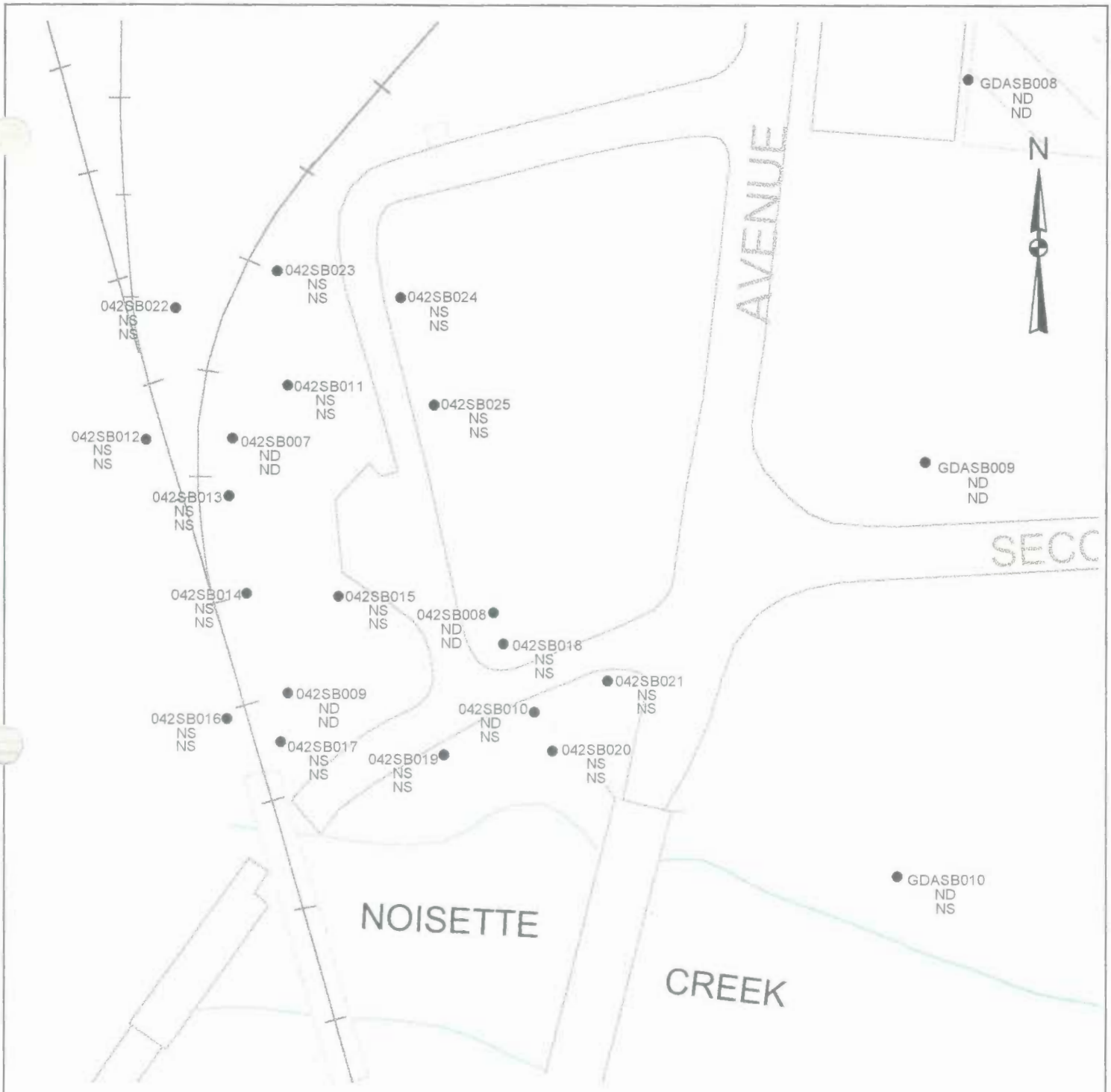
LEGEND

- ▪ ZONE A GW WELL LOCATION
- 12.3 MAX. QUARTERLY GW CONC. (ug/L)
- ● ZONE A SOIL BORING LOCATION
- 12.3 SURFACE SOIL CONC. (ug/kg)
- 12.3 SUBSURFACE SOIL CONC. (ug/kg)
- ND NOT DETECTED
- NS NO SAMPLE TAKEN

75 0 75 150 Feet

ZONE A - RCRA
CORRECTIVE MEASURES STUDY
NAVAL BASE CHARLESTON
CHARLESTON, SC

FIGURE 5.V
ZONE A - SOUTHWEST CORNER
TOLUENE
SOIL AND GROUNDWATER
CONCENTRATIONS



LEGEND

- ▪ ZONE A GW WELL LOCATION
- 12.3 MAX. QUARTERLY GW CONC. (ug/L)
- ● ZONE A SOIL BORING LOCATION
- 12.3 SURFACE SOIL CONC. (ug/kg)
- 12.3 SUBSURFACE SOIL CONC. (ug/kg)
- ND NOT DETECTED
- NS NO SAMPLE TAKEN

50 0 50 100 Feet

ZONE A - RCRA
CORRECTIVE MEASURES STUDY
NAVAL BASE CHARLESTON
CHARLESTON, SC

FIGURE 5.W
ZONE A - SOUTHWEST CORNER
TOLUENE
SOIL AND GROUNDWATER
CONCENTRATIONS

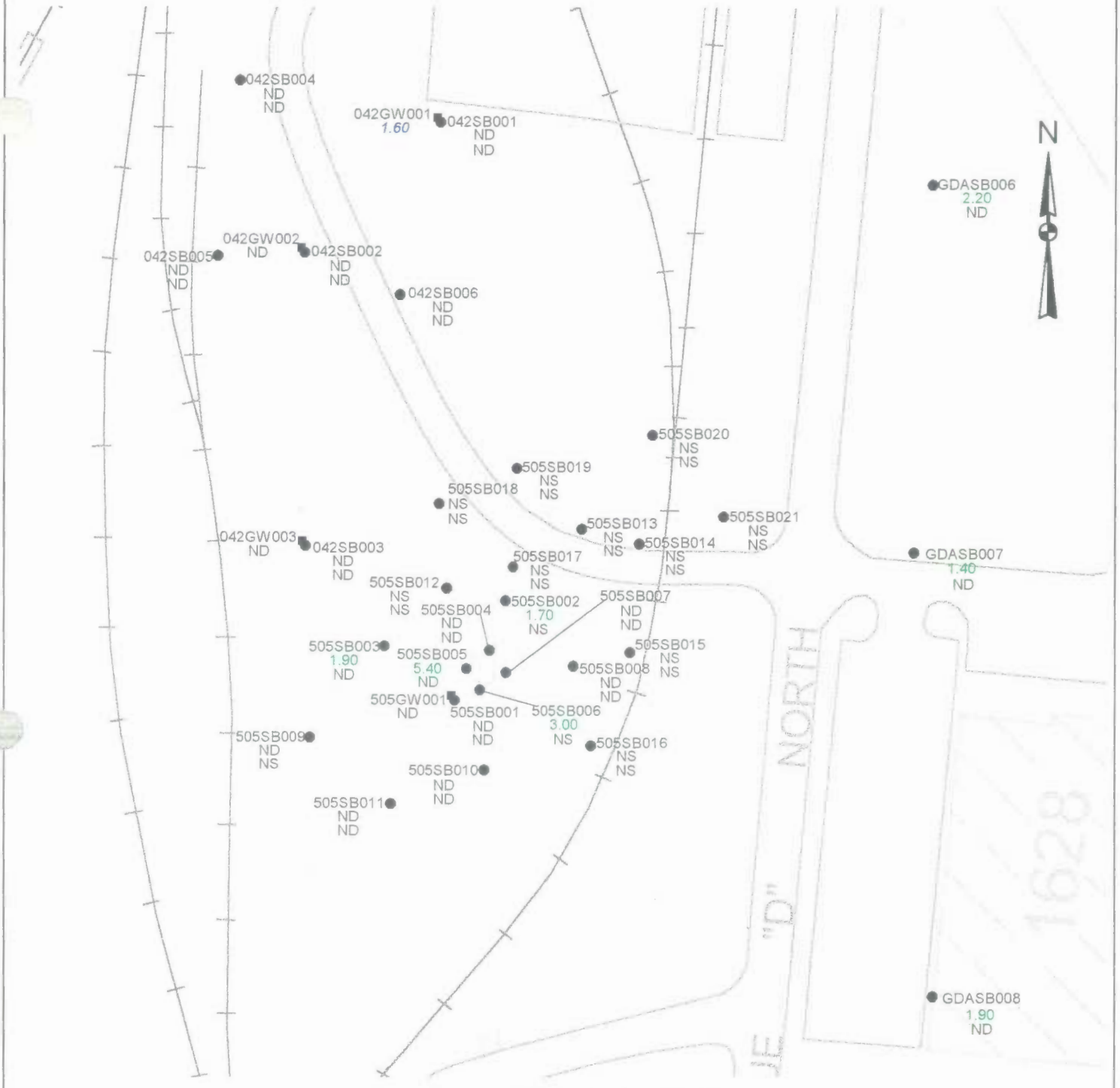
LEGEND

- ▪ ZONE A GW WELL LOCATION
- 12.3 MAX. QUARTERLY GW CONC. (ug/L)
- ● ZONE A SOIL BORING LOCATION
- 12.3 SURFACE SOIL CONC. (ug/kg)
- 12.3 SUBSURFACE SOIL CONC. (ug/kg)
- ND NOT DETECTED
- NS NO SAMPLE TAKEN

75 0 75 150 Feet

ZONE A - RCRA
CORRECTIVE MEASURES STUDY
NAVAL BASE CHARLESTON
CHARLESTON, SC

FIGURE 5.X
ZONE A - SOUTHWEST CORNER
TOLUENE
SOIL AND GROUNDWATER
CONCENTRATIONS



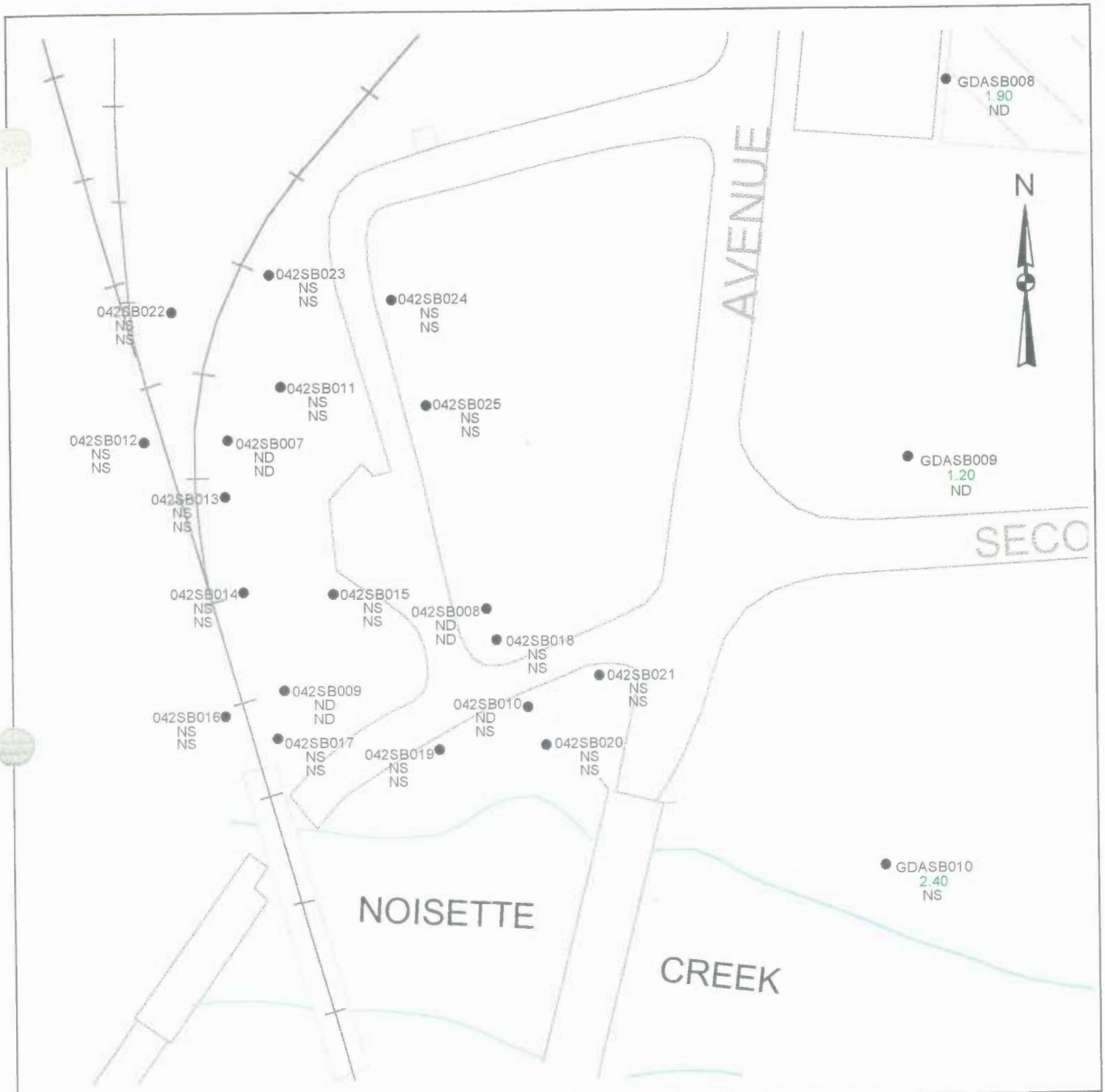
LEGEND

- ▪ ZONE A GW WELL LOCATION
- 12.3 MAX. QUARTERLY GW CONC. (ug/L)
- ● ZONE A SOIL BORING LOCATION
- 12.3 SURFACE SOIL CONC. (ug/kg)
- 12.3 SUBSURFACE SOIL CONC. (ug/kg)
- ND NOT DETECTED
- NS NO SAMPLE TAKEN

75 0 75 150 Feet

ZONE A - RCRA
CORRECTIVE MEASURES STUDY
NAVAL BASE CHARLESTON
CHARLESTON, SC

FIGURE 5.Y
ZONE A - SOUTHWEST CORNER
TRICHLOROETHENE
SOIL AND GROUNDWATER
CONCENTRATIONS



LEGEND

- ■ ZONE A GW WELL LOCATION
- 12.3 MAX. QUARTERLY GW CONC. (ug/L)
- ● ZONE A SOIL BORING LOCATION
- 12.3 SURFACE SOIL CONC. (ug/kg)
- 12.3 SUBSURFACE SOIL CONC. (ug/kg)
- ND NOT DETECTED
- NS NO SAMPLE TAKEN

50 0 50 100 Feet

ZONE A - RCRA
CORRECTIVE MEASURES STUDY
NAVAL BASE CHARLESTON
CHARLESTON, SC

FIGURE 5.Z
ZONE A - SOUTHWEST CORNER
TRICHLOROETHENE
SOIL AND GROUNDWATER
CONCENTRATIONS

LEGEND

- ■ ZONE A GW WELL LOCATION
- 12.3 MAX. QUARTERLY GW CONC. (ug/L)
- ● ZONE A SOIL BORING LOCATION
- 12.3 SURFACE SOIL CONC. (ug/kg)
- 12.3 SUBSURFACE SOIL CONC. (ug/kg)
- ND NOT DETECTED
- NS NO SAMPLE TAKEN

75 0 75 150 Feet

ZONE A - RCRA
CORRECTIVE MEASURES STUDY
NAVAL BASE CHARLESTON
CHARLESTON, SC

FIGURE 5.AA
ZONE A - SOUTHWEST CORNER
TRICHLOROETHENE
SOIL AND GROUNDWATER
CONCENTRATIONS

5.1 SWMU 2 — Lead Contamination Area

SWMU 2 (Figure 5.1.1) consists of former salvage bin No. 3 and the adjacent paved ground surface at the former DRMO facility. The area was used to store recovered lead from lead-acid submarine batteries from the mid-1960s until 1984. Electrodes and associated internal metallic components were removed from the battery jars in the battery electrode treatment area, SWMU 5 in Zone E. Recovered materials were then placed on a railcar and transferred to the DRMO area for storage and eventual sale to a salvage contractor.

Extensive surface soil sampling has been conducted at SWMU 2 from 1986 to present, and the site has been designated for the CMS primarily because of the lead found in surface soil. Aluminum, antimony, Aroclor-1260, arsenic, beryllium, BEQ, and thallium were also identified as COCs in surface soil.

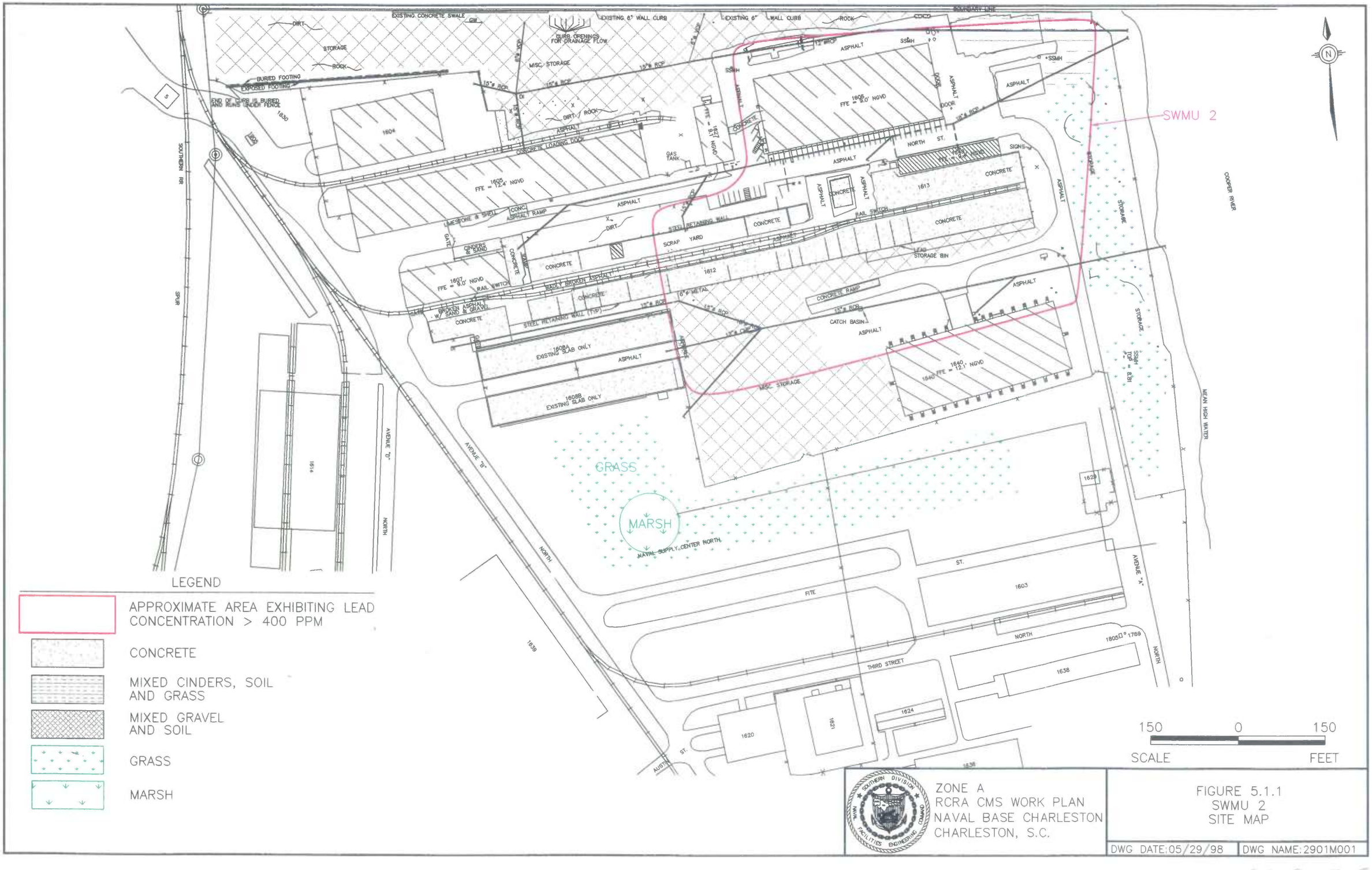
Potential receptors include current and future site users involved in excavation and other invasive activities. The Cooper River is also a potential receptor of contaminated surface water runoff and groundwater discharges.

Due to contaminant migration via surface water runoff, the investigation area for SWMU 2 has been expanded to cover a larger area encompassing SWMU 1. However, the RFI did not find any contamination which could be linked to SWMU 1 activities.

5.1.1 Current Use

The majority of SWMU 2 consists of open space that is not presently in use. Buildings 1606, 1627 and 1649, in the north-central and northeastern part of the site, are unoccupied. Carolina Marine Handling occupies Buildings 1604 and 1607 and the surrounding parking and open storage areas adjacent to the northwest portion of SWMU 2.

Figure 5.1.1 SWMU 2 — Site Map



LEGEND

- APPROXIMATE AREA EXHIBITING LEAD CONCENTRATION > 400 PPM
- CONCRETE
- MIXED CINDERS, SOIL AND GRASS
- MIXED GRAVEL AND SOIL
- GRASS
- MARSH

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.1.1
SWMU 2
SITE MAP

DWG DATE: 05/29/98 | DWG NAME: 2901M001

00087152

5.1.2 Future Use

According to the Charleston Naval Complex Redevelopment Authority, this area will likely be used for maritime/industrial purposes in the future.

5.1.3 ISM Status

The Navy Environmental Detachment Charleston (DET) has performed additional soil sampling to further delineate the area of lead-contaminated soil likely to require remedial action under either residential (400 parts per million [ppm] lead) or industrial (1,300 ppm lead) reuse scenarios. In addition to its use in this CMS WP, these data are being used by the DET to evaluate potential ISM hot-spot stabilization and/or treatment alternatives.

5.1.4 Contaminant Nature and Extent Summary

Soil Contamination Summary

1986 Sampling Event

According to the *Final Contamination and Exposure Assessment for the Lead Contamination within the DRMO* (Environmental Science and Engineering, October 1986), 71 samples were collected from the DRMO site in 1986. Because this sampling was conducted separate from the RFI process and lacked detailed quality assurance quality control (QA/QC) documentation, the lead concentrations from these samples could only be used as "screening" data. A comparison of the 1986 data to confirmatory sampling performed as part of a 1993 investigation, plus the 1995 RFI, showed that the 1986 data were no longer reflective of current site conditions.

1993 Sampling Event

Twenty-five soil borings and six shallow monitoring wells were installed. Additionally, 11 sediment samples were collected from the Cooper River and the nearby storm sewer system. This investigation was conducted by E/A&H and the data are of sufficient quality to be included in the CMS process.

1995 Sampling Event

Forty-four soil samples were collected from the upper interval onsite and 35 five lower-interval samples were collected.

1998 Sampling Event

At the request of the Navy, the DET performed additional sampling to further delineate lead in surface soil. Lead concentrations in surface soil from the 1993, 1995, and 1998 sampling events were combined and are shown on Figure 5.1.2.

Groundwater Contamination Summary

Arsenic, beryllium, lead, manganese, and silver exceeded tap water RBCs in shallow groundwater. During the 1993 sampling event, arsenic and barium exceeded their MCLs **and lead exceeded its USEPA TTAL (15 *u*g/L)** in well 002-005 (Figure 5.T). ~~This well was not sampled and analyzed for these parameters again.~~ **Results for subsequent rounds generally fell below MCLs, and the cause of the extremely high concentrations seen in 1993 is not known**.

~~However,~~ These groundwater COCs appeared inconsistently through five rounds of sampling and were not present site-wide. In four quarters of RFI sampling beginning in 1995, arsenic never exceeded its MCL, and exceeded its reference concentration in only one well during only one sampling quarter. Beryllium was never detected above its MCL. Lead has no MCL but was detected in only one well above the USEPA Treatment Technique Action Level (TTAL) and during only one sampling event. Manganese exceeded both the reference concentration and the RBC, but manganese is a common element in coastal environments and could be attributed to natural conditions. Silver exceeded its MCL but was detected in only one well (002-004) in only one quarter of sampling.

LEGEND

400 PPM
1,300 PPM

<400 PPM
400 TO 1,300 PPM
>1,300 PPM

Approximate area where lead is greater than 400 ppm : 39,750 square feet.

30 0 30 Feet

N

ZONE A
RCRA CMS WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.1.2
LEAD IN SHALLOW SOIL

00087I16X

Figure 5.1.2 Lead in Shallow Soil

5.1.5 Fate and Transport Summary

Soil-to-Groundwater

SWMU 2 groundwater and soil contaminants were evaluated using relevant fate and transport criteria to highlight potential migration pathways. Arsenic, lead, and manganese were detected in soil and groundwater above their RBCs and therefore may pose a long-term soil-to-groundwater risk. **Lead was detected in groundwater samples from well 002-005. Lead is the primary COC at this SWMU and will be addressed by corrective measures.** However, arsenic concentrations did not exceed their respective MCLs in any of the sampling rounds conducted during the RFI, and manganese occurs naturally at the site.

Antimony, mercury, selenium, and thallium were found in soil but not groundwater, and therefore pose no likely risk to groundwater. Aluminum, cadmium, barium, cobalt, copper, nickel, and zinc were found in soil but not groundwater above their tap water RBCs, and therefore pose no likely risk to groundwater.

Groundwater-to-Surface Water

Silver is considered the most mobile of the aforementioned constituents, and thus groundwater contaminant travel time was based on silver transport characteristics. Silver's estimated minimum travel time to the Cooper River was approximately 1,500 years. As a result, impacts to the Cooper River from SWMU 2 groundwater are not anticipated to be significant.

Surface Soil-to-Sediment

Most of SWMU 2 is covered by pavement or concrete, or is beneath building structures, and soil in these areas is not likely to contribute sediment to the Cooper River or the wetland southwest of the site. However, exposed surface soil in the eastern portion of SWMU 2, where topography drains storm water to the east, is a potential source of sediment transport to the Cooper River.

Other Transport Pathways

The possibility of SWMU 2 surface soil-to-air cross-media transport was evaluated during the RFI. This transport route was considered not to be a concern for this site.

5.1.6 Human Health Risk Assessment Summary

Surface Soil Risk Above Background

Table 5.A in Section 5.0 summarizes background study results for Zone A in terms of surface soil risk and hazard. Where applicable, background values were subtracted from each compound's contribution to total site surface soil risk and hazard.

Table 5.1.1 summarizes SWMU 2 risk and hazard in excess of Zone A background. The following subsections interpret these results in terms of future CMS activities.

Table 5.1.1
SWMU 2
Site Human Health Risk and Hazard above Background

		Surface Soil		Shallow GW	
		Hazard Quotient	**ILCR**	**Hazard Quotient**	**ILCR**
SWMU 2	Res.[1]	0.9	2.3E-05	2.95	0.0
	Ind.[1]	0.04	3.3E-06	0.48	0.0

Notes:
ILCR — Cumulative risk is presented as ILCR (incremental lifetime cancer risk).
1 — Residential risk and hazard are for a child; Industrial risk and hazard are for an adult site worker.

SWMU 2 Surface Soil

Of the 2.3E-05 residential risk above background, arsenic accounts for 1.8E-05 and beryllium for 2.3E-06. However, lead (Pb) is present over large areas of the site in excess of regulatory

standards (400 mg/kg for residential reuse; 1,300 mg/kg for industrial reuse) and is the primary COC at this site based on USEPA blood level modeling, described below.

The RFI modeled lead toxicity on the USEPA Lead Up-take/Biokinetics Model (Version 0.99d, Lead Model) and recommended corrective action for lead-contaminated soil based on a child receptor scenario. Using the mean surface soil lead concentration from the one-half acre area of highest observed concentration, the model predicted a geometric mean blood lead concentration of 85.7 μg/dL and a 100% probability of exceeding the USEPA neurotoxic chronic effects threshold of 10 μg/dL for children. The model was also run under a current industrial use scenario using maternal adults as receptors. Results again predicted blood lead levels (4.0 μg/L) in excess of protective levels (3.3 μg/dL).

Current base reuse plans for Zone A are industrial/maritime. Therefore, a very conservative exposure scenario for the lead up-take model was run, based on a child accompanying a parent to work for one day only and ingesting 0.1 grams of soil from the most lead-contaminated area in SWMU 2. Using the mean surface soil lead concentration from the one-half acre area of highest observed lead concentration, the model predicted a geometric mean blood lead concentration of 4.3 μg/dL and a 3.24% probability of exceeding the USEPA neurotoxic chronic effects threshold of 10 μg/dL for children. Under this scenario, surface soil concentrations at SWMU 2 would not require specific action under the hypothetical exposure scenario.

The USEPA Region IV calculated a general soil cleanup level for lead of 1,300 mg/kg based on industrial reuse and 400 mg/kg based on residential reuse. Both the 95% upper confidence limit (UCL) (1,370 mg/kg) and arithmetic mean (1,709 mg/kg) for lead in surface soil at SWMU 2 exceed the adult-based soil cleanup level.

SWMU 2 Groundwater

For lead, groundwater samples from only one well (NBCA002005) exceeded the USEPA TTAL of 15 μg/L during two of ~~three~~ **four** sampling events (639 μg/L in 1993; 18.9 μg/L in April 1996; nondetect in June 1996). This well has since been damaged and abandoned, but it was located near the area of highest lead soil concentrations. Lead was not detected above its Zone A background concentration (4.7 μg/L) in any of the five other SWMU 2 wells.

Arsenic and barium exceeded their MCLs during 1993 sampling. However, sampling results for these parameters fell below MCLs during subsequent rounds of sampling. Figures 5.T and 5.S summarize organic and inorganic groundwater detections for COCs at SWMU 2.

5.1.7 Ecological Risk Assessment Summary

The RFI did not find risk to ecological receptors from soil/sediment exposure found in subzone A-1 (all Zone A sites are included within this area) requiring further action. RFI exposure scenarios were based on detected concentrations and current status of the area. Ecological risk may be different if land use is modified.

5.1.8 Remedial Objectives

Surface Soil

Although arsenic and beryllium are present in concentrations capable of driving risk and hazard to potentially actionable levels, lead concentrations exceed regulatory standards over a much greater area. Because lead-contaminated areas include the areas of elevated arsenic and beryllium levels, CMS soil activities will focus on lead contamination in areas exceeding residential (400 mg/kg) or industrial (1,300 mg/kg) regulatory standards.

Groundwater

Lead in groundwater near well NBCA002005 appears to be isolated in that area and is likely linked to very high lead concentrations in the surrounding soil. Concentrations decreased dramatically following well redevelopment in 1996, and 1993 levels may have been caused by previously poor well development or sampling-method induced suspended solids in water samples. The suspected soil source of this past groundwater contamination will be addressed during corrective measures.

~~Although~~ **Because** the hazard index for this site exceeds a residential hazard-based threshold of one, shallow groundwater contamination ~~may not need to be addressed~~ **requires further assessment** at this site because:

- Manganese exceeded Zone A background concentrations in only one of five wells (NBCA-002002), yet it accounted for 2.8 of the 2.95 groundwater hazard index above background (silver makes up the balance of 0.15).

- Manganese is a naturally occurring element typically found in estuarine environments and has not been linked to past management practices at this facility.

- Groundwater at SWMU 2 is not a likely drinking water source due to brackish ambient water quality linked to the site's close proximity to the Cooper River.

~~Further assessment of groundwater near this well is required during the CMS.~~ The additional data will be combined with other rounds for the project team to make a risk management decision about whether to proceed with future corrective actions addressing groundwater at this site based on frequency of detection, spatial distribution, and other relevant factors.

5.1.9 Potential Remedial Alternatives

Proposed remedial alternative(s) for surface soil at this site include:

- Institutional controls
- Partial or full capping
- Excavation and offsite treatment and/or disposal
- In-situ or ex-situ solidification/stabilization
- Electrokinetics or landfarming
- Soil washing
- Physical separation and/ or acid leaching

~~Based on available data, groundwater does not require remediation, and thus no remedial alternatives are proposed.~~ **Groundwater requires further investigation prior to making a decision as to whether it requires remediation**. ~~However, potential alternatives may be analyzed pending a risk management decision by the project team~~ **This supplemental investigation will include additional groundwater well installation and sampling detailed in Section 5.1.10 of this work plan. If data collected during the CMS indicates the presence of a groundwater plume requiring remediation, alternatives to address this contamination will be evaluated and presented in the CMS report.**

5.1.10 CMS Data Needs

Based on the remedial objectives presented for SWMU 2, the following supplemental activities are proposed **(Figure 5.1.3):**

- Laboratory bench scale pilot testing to evaluate potential solidification/stabilization mix designs.

0 200 feet

LEGEND

- Existing Shallow Monitoring Well Location
- Former Shallow Monitoring Well Location
- Proposed Shallow Monitoring Well Location

Zone A CMS Work Plan
Naval Base Charleston
Charleston, SC

FIGURE 5.1.3 - SWMU 2
Proposed CMS Sample Locations

file:/home3/projects/charleston_dir/m_hancher/cms_fig513.ami

00087 F 172

- Four toxicity characteristic leaching procedure (TCLP) and synthetic precipitant leaching procedure (SPLP) samples for metals (including lead) in soil to evaluate disposal options and in-situ leachability. Samples should be collected within the areas of observed lead contamination.

- Sample groundwater wells NBCA-002-002 **and** NBCA-002-004~~, and NBCA-002-005~~ for SW-846 metals. ~~Well NBCA-002-005 has been damaged. If it cannot be sampled, a new well will be installed to replace it.~~

- Well 002-005 has been destroyed and abandoned. To replace it, a new well will be installed and sampled for SW-846 metals.

- An additional well will be installed east of former well 002-005 approximately half the distance to well 002-003 and sampled for SW-846 metals to further delineate potential groundwater contamination in this area.

- Review DET final ISM completion report.

- Laboratory bench scale pilot testing to evaluate potential for phytoremediation or landfarming of lead-contaminated soil.

5.2 SWMU 38

SWMU 38 (Figure 5.2.1) is the former storage yard associated with Buildings 1605 and 1604. DRMO used the area to store empty drums, and miscellaneous ship- and shore-based naval equipment and supplies were also stored at this site. The site is adjacent to the base's northern property line, just south of the Hess Oil Co. tank farm, immediately east of SWMU 39, and west of SWMU 2. The Hess Oil Co. petroleum storage and distribution facility has been operational for at least 20 years.

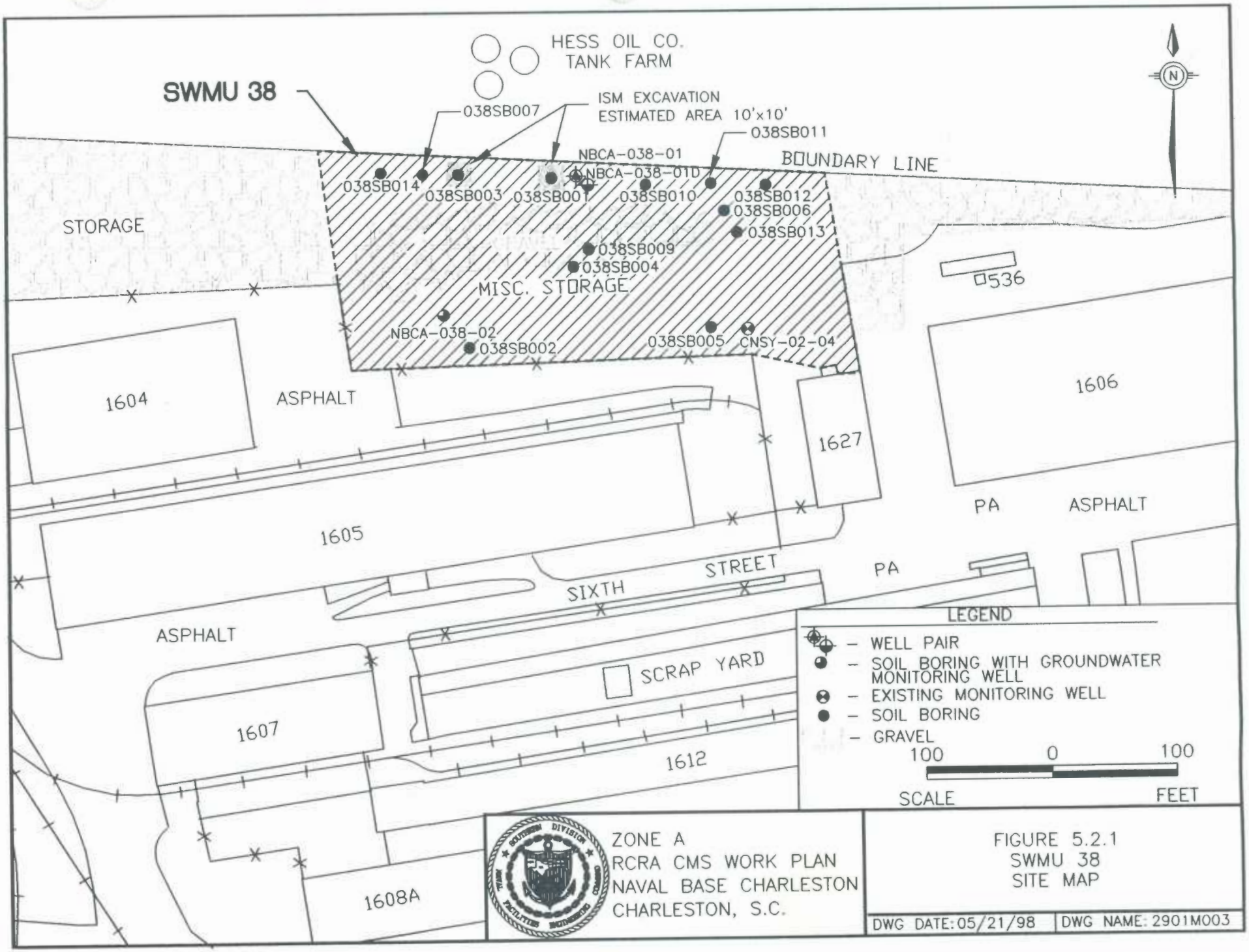
The gravel storage area originally belonged to the supply department and later became part of the DRMO which used it for empty drum storage. In addition, wooden pallets, boats, and automobiles were stored in the vicinity of SWMU 38 during the operational period of the base.

According to interviews with site personnel, routine pesticide application near SWMU 38 prior to 1970 included the use of open-topped drums filled with DDT-based pesticides. The drums were placed near the property boundary fence line and allowed to overflow during periods of rainfall, in an effort to apply the pesticides to areas likely to pond.

5.2.1 Current Use

SWMU 38 is currently used for storage of miscellaneous items by a recent reuse tenant, Carolina Marine Handling. Equipment jigs (metal-framed devices used to hold items during an assembly or general work process) and new plastic-wrapped pleasure boats were observed in the site vicinity during the fall of 1997. Carolina Marine Handling occupies Buildings 1605 and 1607 in Zone A as well as other buildings at the former naval base.

Figure 5.2.1 SWMU 38 — Site Map


HESS OIL CO.
TANK FARM
SWMU 38
038SB007
ISM EXCAVATION
ESTIMATED AREA 10'x10'
038SB011
NBCA-038-01
NBCA-038-01D
BOUNDARY LINE
038SB014
038SB003
038SB001
038SB010
038SB012
038SB006
038SB013
STORAGE
038SB009
038SB004
MISC. STORAGE
536
NBCA-038-02
038SB002
038SB005
CNSY-02-04
1604
ASPHALT
1606
1627
1605
PA
ASPHALT
SIXTH
STREET
PA
ASPHALT
SCRAP YARD
1607
1612
1608A
LEGEND
– WELL PAIR
– SOIL BORING WITH GROUNDWATER MONITORING WELL
– EXISTING MONITORING WELL
– SOIL BORING
– GRAVEL
100 0 100
SCALE FEET
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 5.2.1
SWMU 38
SITE MAP
DWG DATE: 05/21/98
DWG NAME: 2901M003

5.2.2 Future Use

According to the Charleston Naval Complex Redevelopment Authority, this area will likely be used for industrial/maritime purposes in the future.

5.2.3 ISM Status

The DET has excavated and disposed of two approximately 10-foot by 10- foot areas of pesticide and PCB-contaminated surface soil associated with soil borings 038SB001 and 038SB003. Confirmatory screening samples collected by the DET found pesticides above RBCs in an estimated area approximately 100 feet by 40 feet between the two sample points, and extending to the groundwater table (3 to 4 feet below the surface). The DET has submitted a proposal to the Navy for additional excavation to remove all soil exceeding their RBCs for pesticides at this site. **This removal action is scheduled to begin in September, 1998.**

5.2.4 Contaminant Nature and Extent Summary

Soil Contamination Summary

SWMU 38 surface soil were investigated during the RFI and subsequent ISM activities. Primary COCs included DDD, DDE, and DDT. PCBs, arsenic, beryllium, and aluminum were also present in several borings. Figure 5.2.2 shows the RFI and DET ISM sampling results for surface soil COCs.

Groundwater Contamination Summary

The RFI identified DDD, DDT, and arsenic as SWMU 38 COCs. Arsenic was never detected above its MCL (50 μg/L). However, Figure 5.T shows arsenic was detected in well 038001 at a maximum concentration of 14.9 μg/L and well 038002 (max. conc. 3.1 μg/L). Figure 5.S shows that well 038001 also contained DDD (max. conc. 4.0 μg/L) and DDT (max. conc. 2.6 μg/L).

5.2.5 Fate and Transport Summary

Soil-to-Groundwater

The potential for soil-to-groundwater migration appears to be high for DDD and DDT, since their concentrations were above groundwater protection soil screening levels (SSLs) in soil and tap water RBCs in groundwater. Moreover, these pesticides were detected in water samples from well NBCA-038-001.

Groundwater-to-Surface Water

Because pesticides are relatively immobile and were not observed in any wells downgradient of NBCA-038-001, groundwater-to-surface water transport is unlikely at this site. Moreover, the RFI estimated pesticide-plume travel time to the Cooper River to be over 700,000 years.

Surface Soil-to-Sediment

The RFI did not identify surface soil-to-sediment as a significant contaminant migration pathway at this site.

Surface Soil-to-Air

No volatile organic compound exceeded its soil-to-air volatilization screening level. As a result, the soil-to-air migration pathway is not expected to be significant at SWMU 38.

5.2.6 Human Health Risk Assessment Summary

Surface Soil Risk Above Background

Table 5.2.1 summarizes SWMU 38 risk and hazard in excess of Zone A background prior to ISM activities.

Figure 5.2.2 SWMU 38 — Distribution and Concentration of COPCs

HESS OIL CO.

TANK FARM

038SB003

038SB007

038SB014

038SB001

038SB010

038SB011

038SB012

038SB006

038SB013

038SB008

038SB009

038SB004

038SB005

038SB002

DET CONFIRMATORY SAMPLES

SAMPLE ID	DEPTH	SAMPLE RESULTS		
		DDD	DDE	DDT
1	4	23.1	0	1.3
2	1	1.5	0	5
3	1	298	0	154
4	1	30	0	136
5	1	550	0	1790
13	4	41.5	0	116
14	1	0.464	0.253	0.373
15	1	0.473	0.281	0.054
16	1	13.3	0	51.5
17	1	5.27	1.04	3.54

DET GC SAMPLES

SAMPLE ID	DEPTH	SAMPLE RESULTS		
		DDD	DDE	DDT
22	1	<.4	<.8	<.4
22	4	<.4	<.8	<.4
23	1	<.4	<.8	<.4
23	4	0.16	NR	NR
24	1	<.4	0.04	<.4
24	4	<.4	<.8	<.4
25	1	1.6	5	25
26	1	NR	0.02	NR
26	4	<.4	<.8	<.4
27	1	NR	NR	NR
28	1	<.4	<.2	<.4
28	4	4	20	9
29	1	<.4	<.8	<.4
29	4	0.08	NR	NR
30	1	0.16	0.12	<.4
30	4	0.02	<.8	<.4
31	1	NR	NR	NR
32	1	NR	0.8	17
33	1	NR	0.02	0.3

DET IMMUNOASSAY SAMPLES

SAMPLE ID	DEPTH	SAMPLE RESULTS
		DDT (TOTAL)
1	5	>20
6	1	20
6	4	>20
7	1	>20
7	4	>20
8	1	~2
8	4	>2, <20
9	1	>20
9	4	~2
10	1	>20
10	4	>2, <20
11	1	>.4, <20
11	4	>2, <20
12	1	>20
12	4	>20
13	4	<.4
18	2	>20
19	2	>20
20	1	>2, <20
21	1	>2, <20

RESULTS IN PPM,
NR = NOT REPORTED

ENSAFE SAMPLES

SAMPLE ID	ALUMINUM	ARSENIC	BERYLLIUM	4,4'-DDD	4,4'-DDE	4,4'-DDT	AROCLOR 160
038SB001	ND	19.6	ND	450	37	1,000	ND
038SB002	9,305	18	ND	ND	ND	ND	ND
038SB003	11,950	9.9	0.15	3.3	ND	7.8	ND
038SB004	16,600	14.3	ND	ND	ND	ND	ND
038SB005	13,200	7.8	ND	ND	ND	ND	ND
038SB006	8,520	13.4	ND	ND	ND	ND	0.5
038SB007	ND	ND	ND	ND	ND	ND	0.41
038SB008	ND	ND	ND	ND	ND	ND	ND
038SB009	ND	ND	ND	ND	ND	ND	ND
038SB010	ND	ND	ND	ND	ND	ND	ND
038SB011	ND	ND	ND	ND	ND	ND	0.72
038SB012	ND	ND	ND	ND	ND	ND	1.3
038SB013	ND	ND	ND	ND	ND	ND	ND
038SB014	ND	ND	ND	ND	ND	ND	ND

RESULTS IN PPM, ND = NOT DETECTED

LEGEND

● 038SB010 ENSAFE RFI SAMPLE
× 5 DETACHMENT SAMPLE

ESTIMATED EXTENT OF PESTICIDE CONTAMINATION

30 15 0 30

N

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.2.2
SWMU 38
DISTRIBUTION AND CONCENTRATION OF COPCs

DWG DATE:05/19/98 | DWG NAME:SWMU38

00087I18Z

Table 5.2.1
SWMU 38
Site Human Health Risk and Hazard above Background

		Surface Soil		Shallow GW	
		Hazard Quotient	**ILCR**	**Hazard Quotient**	**ILCR**
SWMU 38	Res.[1]	28	8.0E-04	2.1	4.9E-05
	Ind.[1]	2	2.0E-04	0.5	3.0E-05

Notes:
ILCR — Cumulative risk is presented as ILCR (incremental lifetime cancer risk).
1 — Residential risk and hazard are for a child; Industrial risk and hazard are for an adult site worker.

SWMU 38 Soil

The primary risk driver in SWMU 38 soil is DDT and its daughter products. DET ISM activities have removed a 10-foot by 10-foot area containing part of the pesticide contamination at this site. However, confirmation samples indicated that DDT remains above RBCs. Therefore, human health risk and hazard must be recalculated during the CMS following completion of proposed additional ISM activities and/or confirmatory sampling and analysis.

SWMU 38 Groundwater

Arsenic accounts for 3.0E-05 of the 4.9E-05 residential groundwater risk above background. However, arsenic was never detected above its MCL (50 μg/L). DDT, DDE, and DDD account for the remainder of residential risk above background (1.9E-05).

5.2.7 Ecological Risk Assessment Summary

The RFI did not find risk to ecological receptors from soil/sediment exposure in subzone A-1 (all Zone A sites are included within this area) requiring further action. RFI exposure scenarios were based on detected concentrations and current status of the area. Ecological risk may be different if land use is modified.

5.2.8 Remedial Objectives

Soil

The RFI identified pesticides, PCBs, arsenic, aluminum, beryllium, and TPH as soil COCs at SWMU 38. However, the primary risk drivers are pesticides. The CMS will examine potential alternatives which could reduce risk above background to a level below 1E-06 or 1E-05, hazard above background to a level below 1.0 or 0.1, or a separate cost-benefit risk-and hazard-reduction-based goal. Both residential and industrial reuse scenarios will be examined. **However, if ISM activities at SWMU 38 succeed in meeting SCDHEC approved RGOs, no further action will be needed to address soil contamination in this area.**

~~As previously stated, the DET has submitted an ISM proposal to the Navy for excavation of the suspected area of pesticide contamination. If this proposal is accepted, and ISM activities remove this soil, further corrective actions may not be necessary at this site.~~

Groundwater

The RFI identified pesticides and arsenic as COCs at this site. Since arsenic did not exceed its MCL, only pesticides found in groundwater samples from NBCA-038-001 need to be addressed. An additional round of pesticide data needs to be collected and combined with other rounds so the project team can make a risk management decision about whether to proceed with future corrective actions addressing groundwater at this site based on concentration and frequency of detection, spatial distribution, and other relevant factors.

5.2.9 Potential Remedial Alternatives

Soil **(if ISM activities fail to achieve SCDHEC approved RGOs)**

- Hot-spot removal outside of building and paved areas, with offsite treatment/disposal
- Capping
- In-situ stabilization

- In-situ or ex-situ bioenhanced degradation using passive or active bioventing, nutrient additions, or other applicable technology
- Soil Washing
- Phytoremediation and/or landfarming

Groundwater (pending a risk management decision by the project team whether to further address groundwater at this site)

- Monitored natural attenuation
- COC source removal (where applicable)
- Biochemical enhancement of in-situ natural attenuation
- In-situ stabilization or containment
- Phytoremediation (if reuse plans allow for cultivation along the property fenceline)

5.2.10 CMS Data Needs

~~Based on the remedial objectives identified for SWMU 38, the following is proposed (Figure 5.2.3):~~

- ~~To confirm DET sampling results and better delineate COC contamination at this site, 10 additional soil samples need to be collected and analyzed for SW-846 Pesticides/PCBs. If additional ISM removal activities occur during the CMS, additional confirmatory sampling may be necessary.~~
- ~~Laboratory bench scale pilot testing to evaluate potential solidification/ stabilization mix designs for soil.~~
- ~~Four TCLP and SPLP samples for pesticides/PCBs in soil to evaluate disposal options and in-situ leachability. Samples should be collected within the areas of observed pesticide/PCB contamination.~~

Due to ISM activities scheduled to begin in September, 1998 and which are designed to excavate and dispose of all soils above an SCDHEC approved RGO, there are no apparent additional soil data needs for the CMS. However, the following groundwater activities are needed:

- **Well 038-001 was destroyed and abandoned during previous ISM activities. Therefore, a replacement well will be installed and sampled for SW-846 pesticides and PCBs approximately 50 feet downgradient (southeast) during the CMS to assess potential groundwater contamination in this area.**

- An additional round of groundwater monitoring in ~~the three SWMU 38 area~~ wells **002-004, 038-01D, and 038-002** for pesticides and **the ongoing demonstration of** ~~baseline~~ monitored natural attenuation ~~parameters~~.

- If area reuse allows **and pesticide contamination warrants corrective measures at this site**, field-scale ~~phytoremediation~~ pilot testing may be performed. **However, the need for and scope of field-scale testing will be re-evaluated pending the results of the additional groundwater sampling described in this work plan.**

5.3 SWMU 39

SWMU 39 (Figure 5.3.1) is the former storage area for petroleum, oil, and lubricant (POL) drums north of Building 1604, near the northernmost boundary of the former base. The Hess Oil Co. tank farm is adjacent to the north property line and approximately 300 feet north of the former POL storage area. SWMU 39 is bounded to the east by SWMU 38 and to the west by a wetland approximately 500 feet downgradient.

5.3.1 Current Use

SWMU 39 is being used by Carolina Marine Handling, that also occupies SWMU 38. Therefore, the same equipment jigs and new plastic-wrapped pleasure boats that were observed at SWMU 38 during the fall of 1997 were also stored at SWMU 39.

5.3.2 Future Use

According to the Charleston Naval Complex Redevelopment Authority, this area will likely be used for maritime/industrial purposes in the future.

5.3.3 ISM Status

No interim measures have been performed or proposed at SWMU 39.

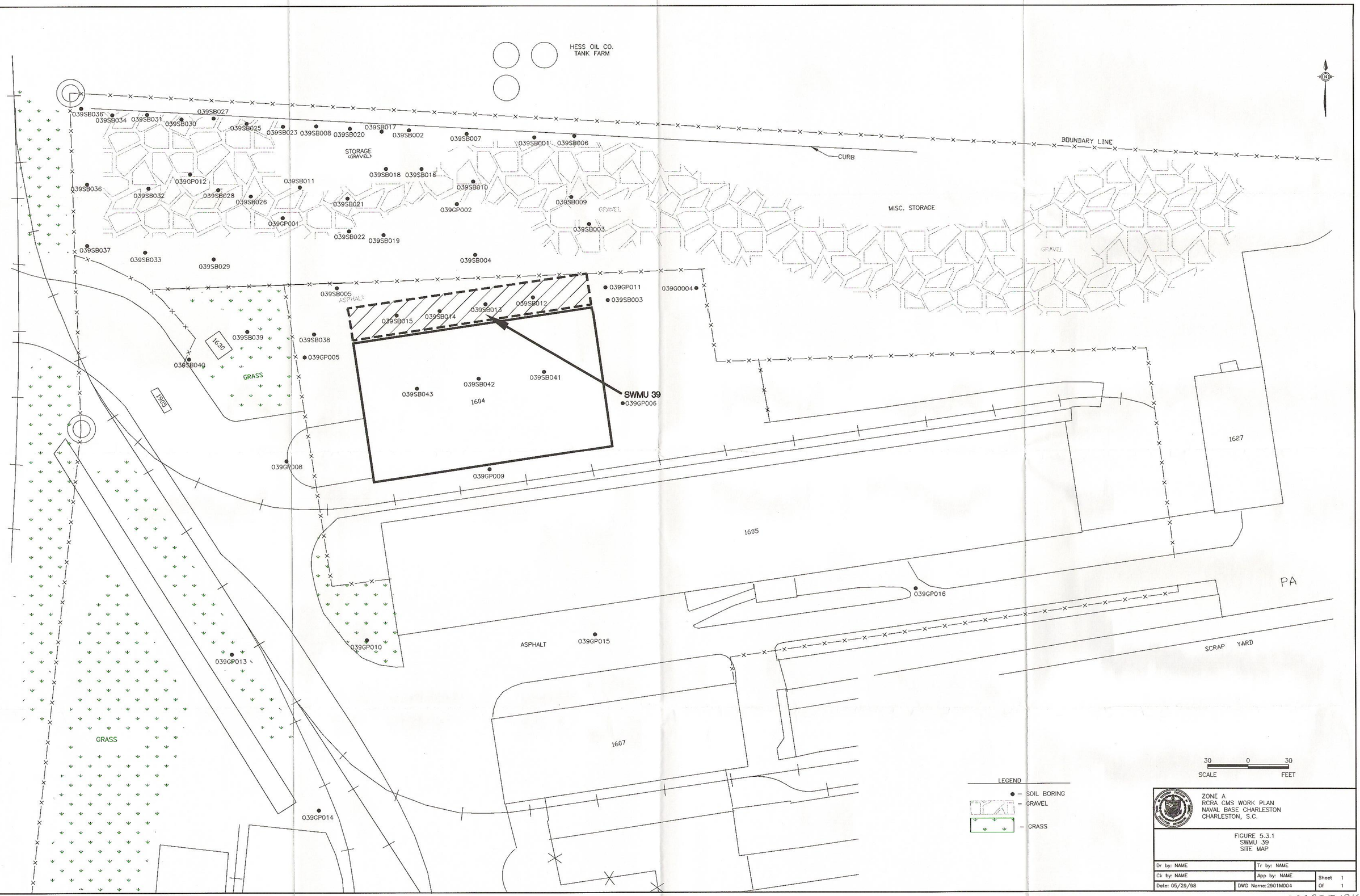
~~EnSafe, the DET, and the United States Geological Survey (USGS) collectively obtained natural attenuation baseline data for the impacted groundwater at SWMU 39. Results indicate the need for additional monitoring wells and additional rounds of sampling. However, the specific number and locations of additional wells have not been determined.~~

5.3.4 Contaminant Nature and Extent Summary

Soil Contamination Summary

~~The RFI identified aluminum, arsenic, beryllium, and BEQs as COCs at this site. The maximum arsenic (17.9 mg/kg) and beryllium (0.45 mg/kg) detections were in boring 038SB006.~~

Figure 5.3.1 SWMU 39 — Site Map


HESS OIL CO.
TANK FARM
BOUNDARY LINE
CURB
STORAGE
(GRAVEL)
MISC. STORAGE
GRAVEL
ASPHALT
GRASS
039SB001
039SB002
039SB003
039SB004
039SB005
039SB006
039SB007
039SB008
039SB009
039SB010
039SB011
039SB012
039SB013
039SB014
039SB015
039SB016
039SB017
039SB018
039SB019
039SB020
039SB021
039SB022
039SB023
039SB025
039SB026
039SB027
039SB028
039SB029
039SB030
039SB031
039SB032
039SB033
039SB034
039SB036
039SB037
039SB038
039SB039
039SB040
039SB041
039SB042
039SB043
039GP001
039GP002
039GP005
039GP006
039GP008
039GP009
039GP010
039GP011
039GP012
039GP013
039GP014
039GP015
039GP016
039G0004
SWMU 39
1604
1605
1607
1627
1630
1995
PA
SCRAP YARD
LEGEND
SOIL BORING
GRAVEL
GRASS
30 0 30
SCALE FEET
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 5.3.1
SWMU 39
SITE MAP
Dr by: NAME
Tr by: NAME
Ck by: NAME
App by: NAME
Sheet 1
Of 1
Date: 05/29/98
DWG Name: 2901M004

00087I19X

~~However, only four other soil samples exceeded the Zone A background concentration for arsenic (4.4 mg/kg), and beryllium was found in only one other sample (039SB010, 0.24 mg/kg). The maximum BEQ (5.78 mg/kg) detection was in boring 039SB005. BEQs were found in only three other borings: 039SB006 (0.92 mg/kg), 039SB011 (0.80 mg/kg), and 039SB024 (0.38 mg/kg). Data summaries for SWMU 39 soil COCs are included in Appendix A.~~

Benzene, ethylbenzene, and 1,2-dichloroethane exceeded their SSLs in lower-interval samples from borings 039SB008 and 039SB011. These borings were located in the northern part of SWMU 39 near the property boundary with Hess Oil. This indicates the source may have been caused by the rising and falling of the underlying BTEX contaminated aquifer.

Trichloroethene and1,3,5-trimethylbenzene exceeded their SSLs in upper interval samples from geoprobe borings 039GP008 and 039GP009. Neither of these compounds was detected above RBCs in lower interval samples. This indicates the source may have been at the surface near this area, and not the result of rising and falling water levels.

BEQs exceeded RBCs in only one upper-interval sample (039SB005). No BEQs exceeded their SSLs. PCBs exceeded RBCs in only two samples (039SB002 and 039SB017). No pesticides or PCBs exceeded their SSLs.

Arsenic, beryllium, cobalt, and mercury were also detected at significant concentrations. Arsenic and beryllium exceeded their RBCs in upper-interval samples from 039SB006. Cobalt exceeded its reference concentration, but not its SSL, in seven lower interval samples. Mercury exceeded its SSL in four lower interval samples.

Greater detail of soil sampling results can be found in Section 10.4.2, Soil Sampling and Analysis, of the August, 1998 RFI Report for Zone A.

Groundwater Contamination Summary

The RFI identified multiple metals, SVOCs, and VOCs as COCs at this site. However, the primary COCs are petroleum products and chlorinated solvents in shallow groundwater. Petroleum contamination was discovered in the form of a light non-aqueous phase liquid (LNAPL) in one site well.

The Hess Oil Co. tank farm is the most likely source of this petroleum contamination. The Hess plume originates north of the northern property boundary and extends south into SWMU 39. Free product has been found in NBCA-039-011. BTEX extends south to shallow-tier well NBCA-039-014S, and toluene was observed as far south as intermediate- and deep-tier wells NBCA-039-009I and -009D. For more information on the Hess petroleum plume, please see Section 10.4.4 of the EnSafe, Inc., 1998 Zone A RFI Report or H_20 Environmental, Inc., 1997 Site Assessment Report.

Dissolved-phase chlorinated solvents were observed during the RFI over a wide area in the northwestern portion of Zone A (Figures 5.3.2 through 5.3.14). However, no evidence of dense non-aqueous phase liquid (DNAPL) was found. Figure 5.3.15 shows the locations of monitoring wells for the 1998 MNA sampling event. Chlorinated solvents and water quality parameters from the 1998 MNA sampling event are shown on Figures 5.3.16 through 5.3.21, respectively.

Greater detail of groundwater sampling results can be found in Section 10.4.2, Soil Sampling and Analysis, of the August, 1998 RFI Report for Zone A.

Figure 5.3.2 SWMU 39 — PCE in Shallow Groundwater

LEGEND

Approximate extent of PCE based upon computer generated contours

- ND
- ND - MCL (5 ppb)
- > MCL (5 ppb)

0 feet 700

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.2
SWMU 39
PCE IN
SHALLOW GROUNDWATER

AML /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.3 SWMU 39 — TCE in Shallow Groundwater

LEGEND

Approximate extent of TCE based upon computer generated contours

- ND
- ND - MCL (5 ppb)
- > MCL (5 ppb)

0 feet 700

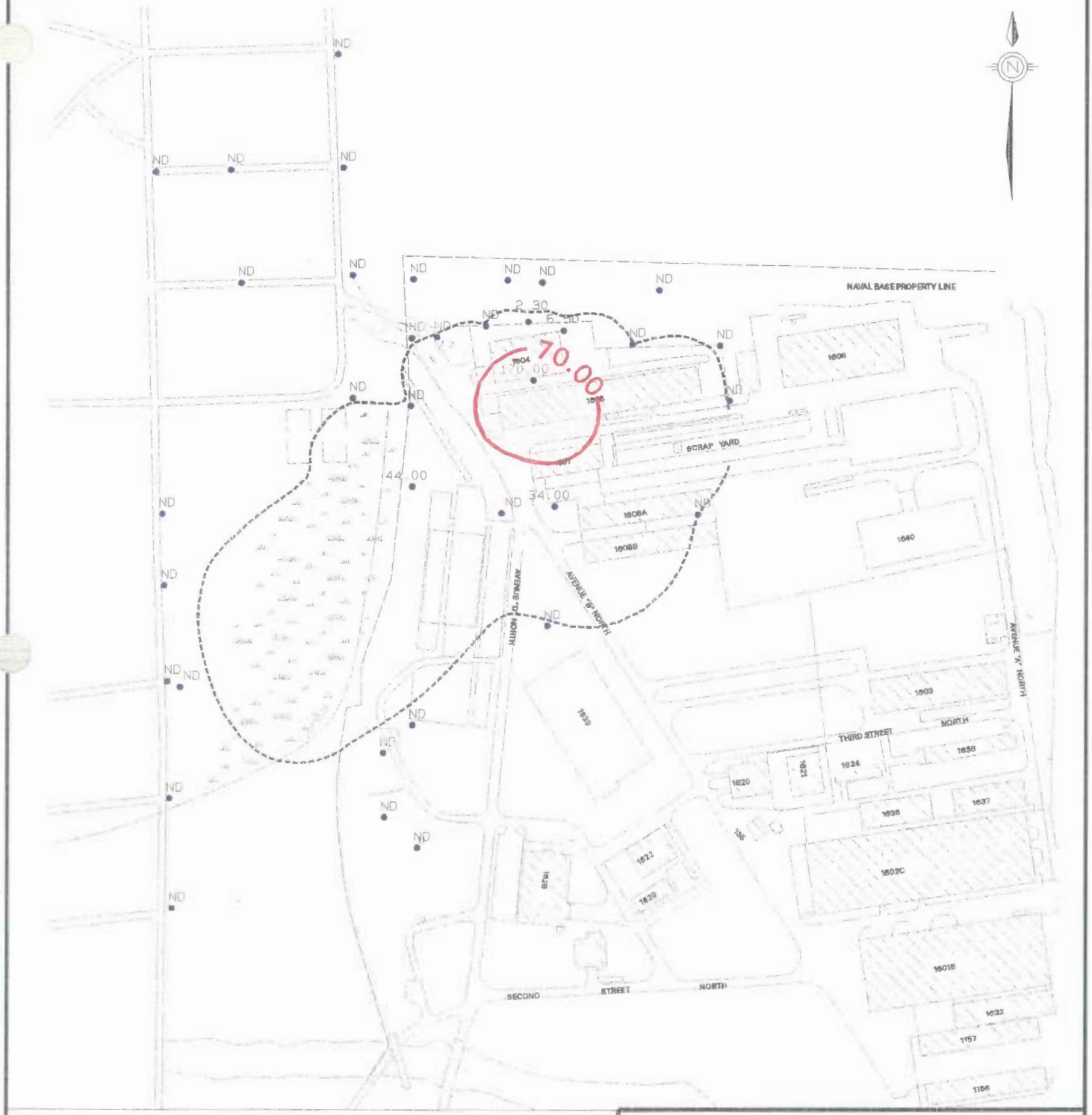
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.3
SWMU 39
TCE IN
SHALLOW GROUNDWATER

AML /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.4 SWMU 39 — CIS-1,2-DCE in Shallow Groundwater



LEGEND

Approximate extent of CIS-1,2-DCE based upon computer generated contours

- ND
- ND - MCL (70 ppb)
- > MCL (70 ppb)

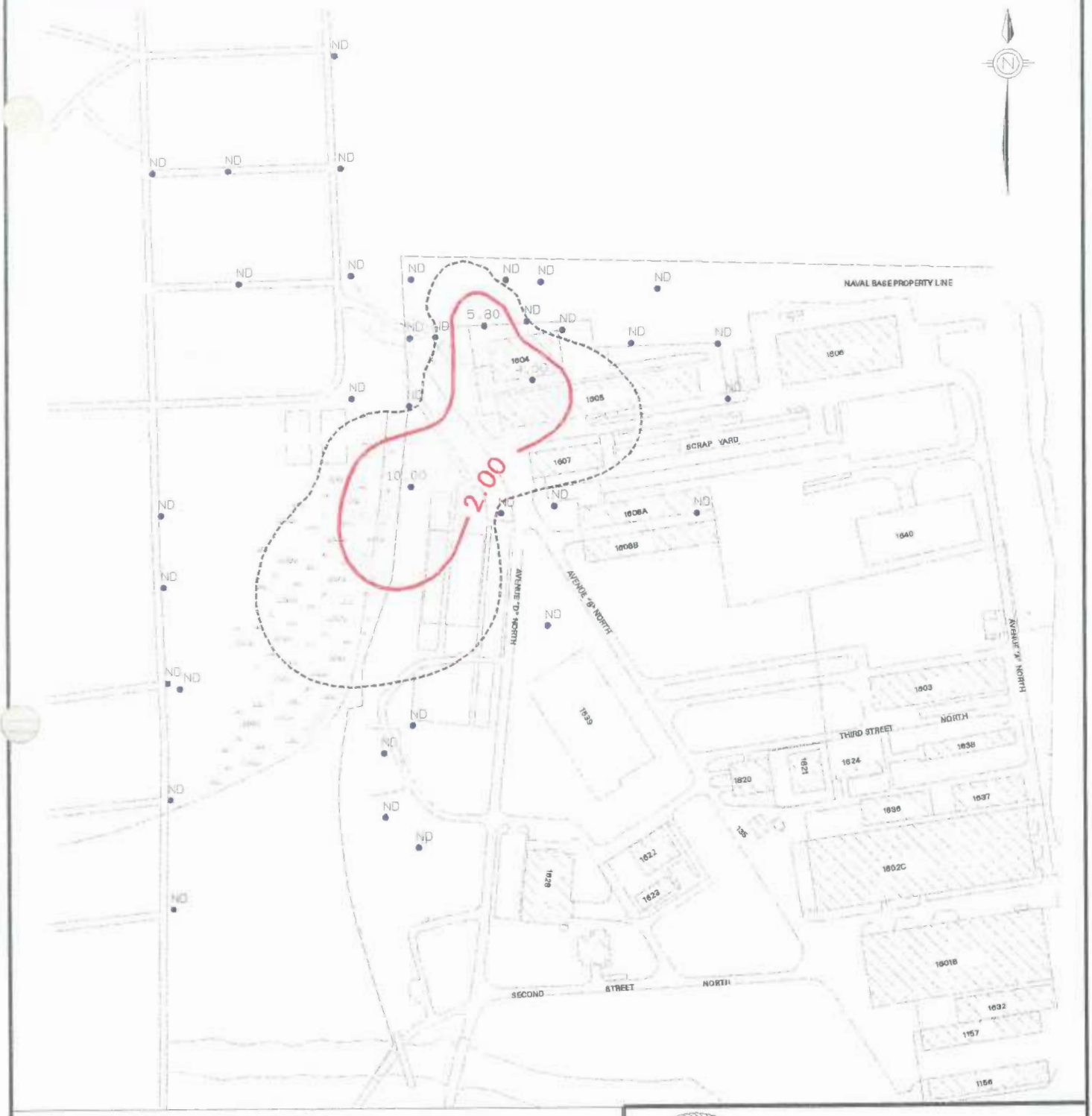
0 feet 700

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.4
SWMU 39
CIS-1,2-DCE IN
SHALLOW GROUNDWATER

AML /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.5 SWMU 39 — Vinyl Chloride in Shallow Groundwater



LEGEND

Approximate extent of VINYL CHLORIDE based upon computer generated contours

- ND
- ND - MCL (2 ppb)
- > MCL (2 ppb)

0 feet 700

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.5
SWMU 39
VINYL CHLORIDE IN
SHALLOW GROUNDWATER

AML /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.6 SWMU 39 — 1,1-DCE in Shallow Groundwater

LEGEND

Approximate extent of 1,1-DCE based upon computer generated contours

- ND
- ND - MCL (7 ppb)
- > MCL (7 ppb)

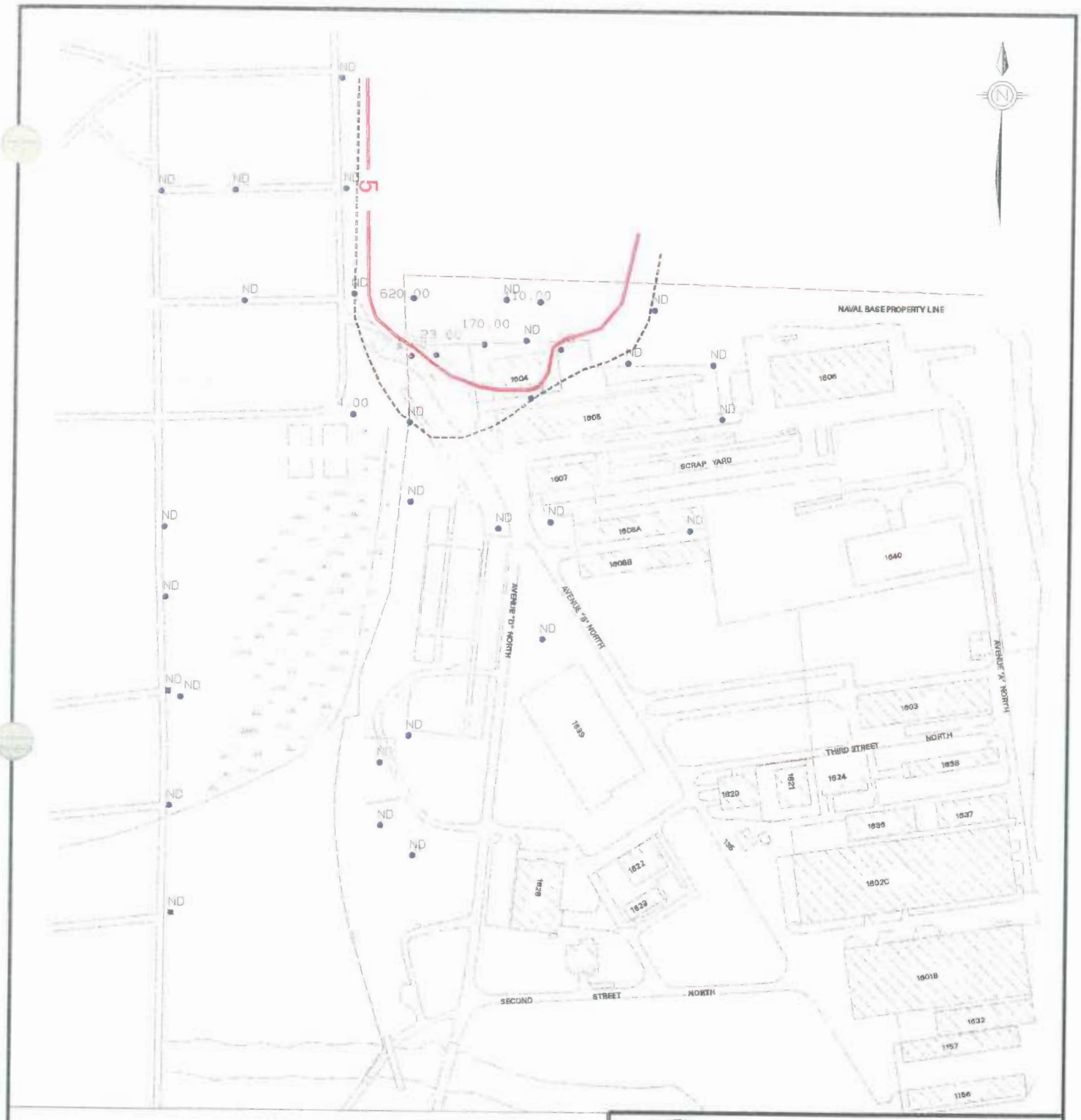
0 feet 700

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.6
SWMU 39
1,1-DCE IN
SHALLOW GROUNDWATER

AML /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.7 SWMU 39 — Benzene in Shallow Groundwater



LEGEND

Approximate extent of BENZENE based upon computer generated contours

- ND
- ND - MCL (5 ppb)
- > MCL (5 ppb)

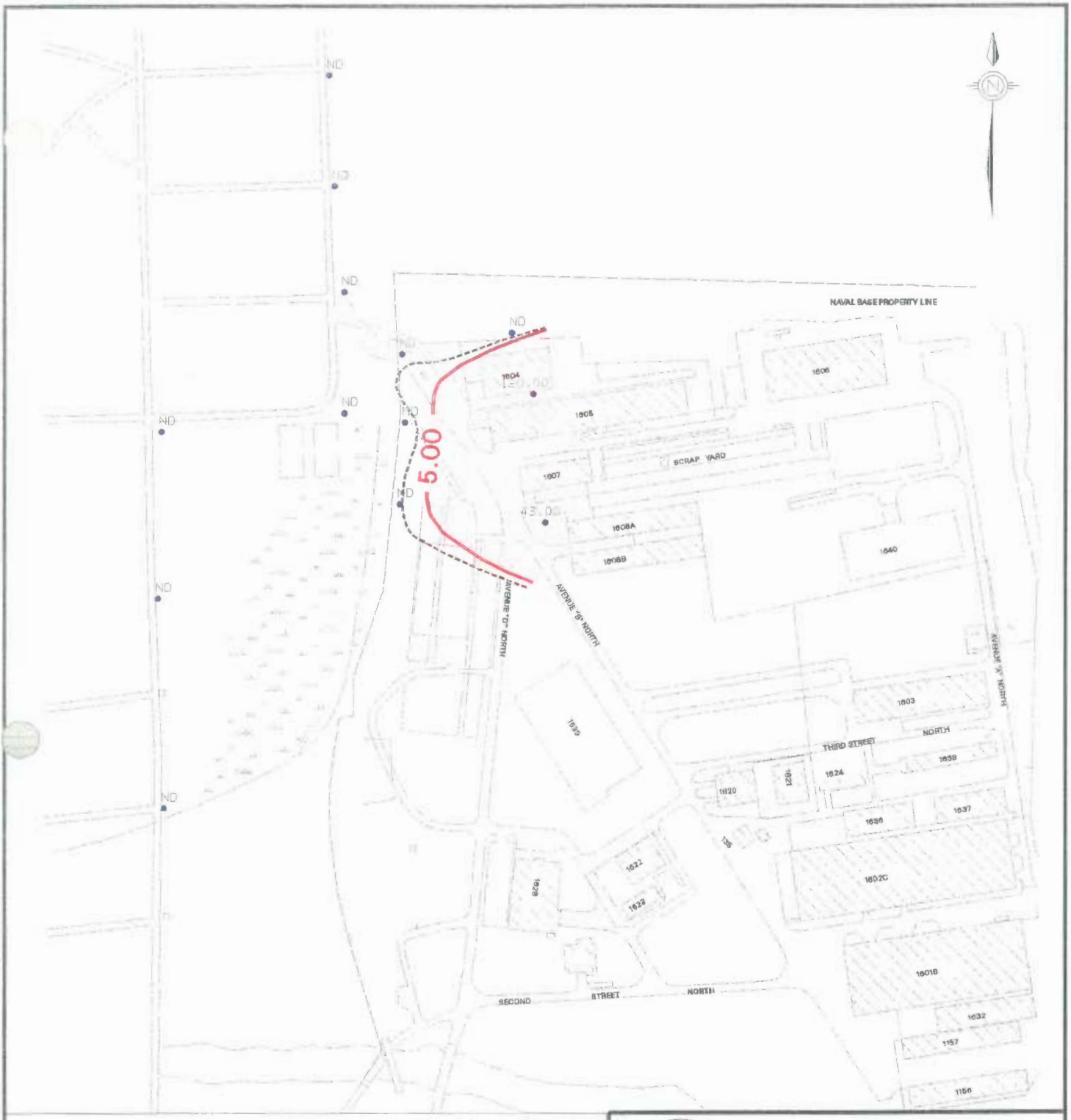
0 feet 700

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.7
SWMU 39
BENZENE IN
SHALLOW GROUNDWATER

AML: /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.8 SWMU 39 — TCE in Intermediate Groundwater



LEGEND

Approximate extent of TCE based upon computer generated contours

- ND
- ND - MCL (5 ppb)
- > MCL (5 ppb)

0 feet 700

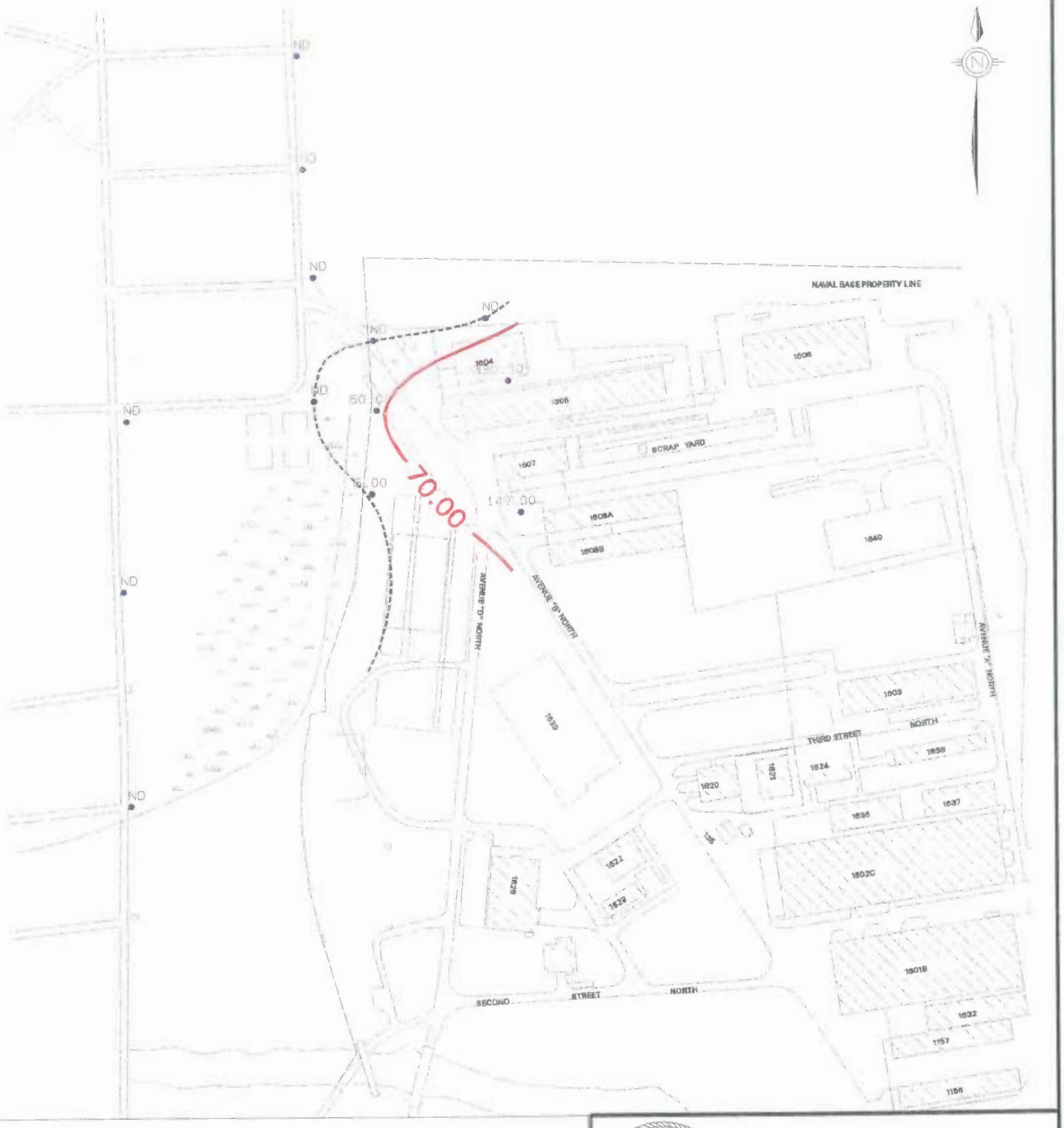
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.8
SWMU 39
TCE IN
INTERMEDIATE GROUNDWATER

AMEC /home2/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.9 SWMU 39 — CIS-1,2-DCE in Intermediate Groundwater



LEGEND

Approximate extent of CIS-1,2-DCE based upon computer generated contours

- ND
- ND - MCL (70 ppb)
- > MCL (70 ppb)

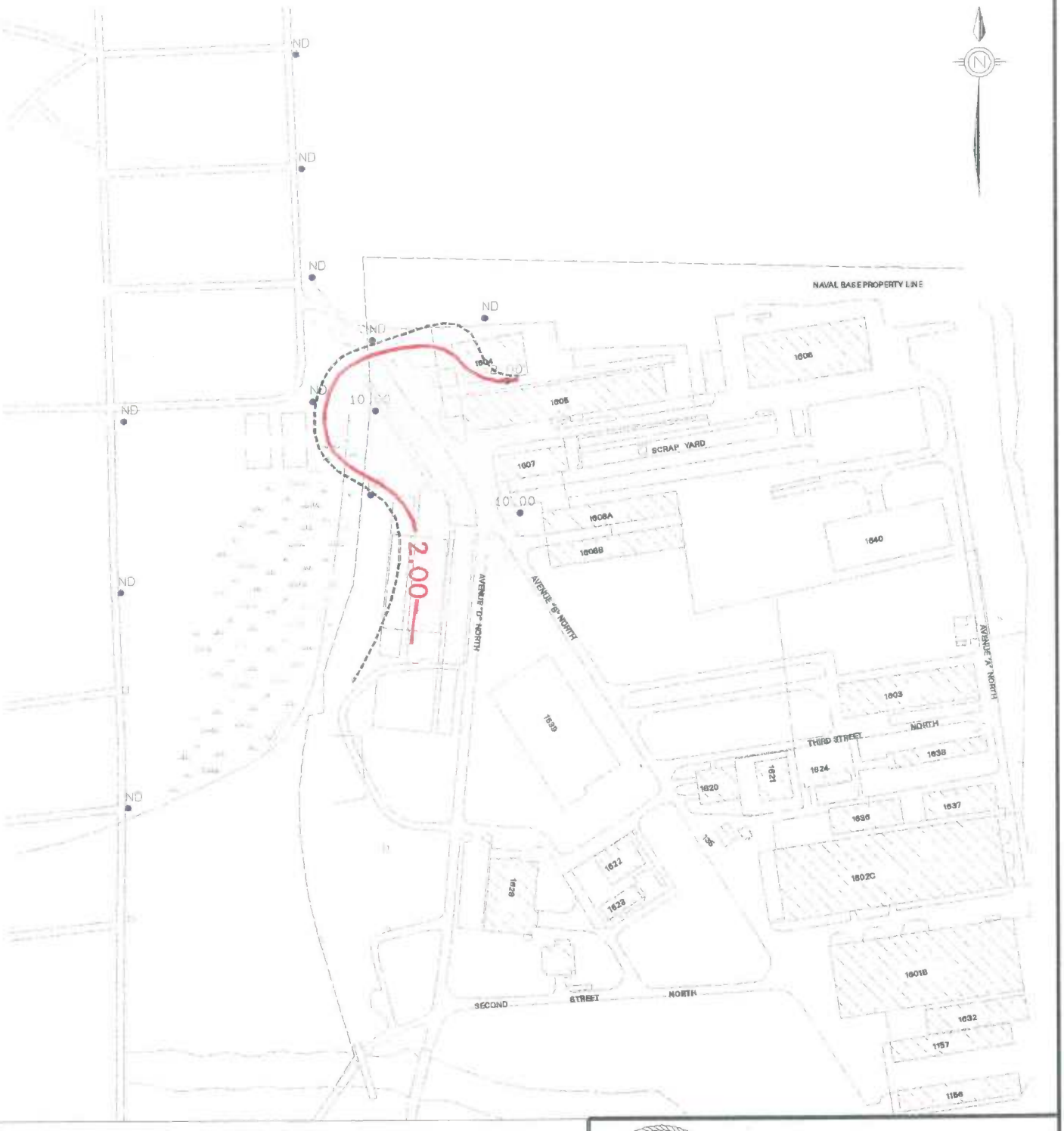
0 feet — 700

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.9
SWMU 39
CIS-1,2-DCE IN
INTERMEDIATE GROUNDWATER

AML: /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.10 SWMU 39 — Vinyl Chloride in Intermediate Groundwater



LEGEND

Approximate extent of VINYL CHLORIDE based upon computer generated contours

- ND
- ND - MCL (2 ppb)
- > MCL (2 ppb)

0 feet 700

SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.10
SWMU 39
VINYL CHLORIDE IN
INTERMEDIATE GROUNDWATER

AML /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.11 SWMU 39 — 1,1 DCE in Intermediate Groundwater

LEGEND

Approximate extent of 1,1-DCE based upon computer generated contours

- ND
- ND - MCL (7 ppb)
- > MCL (7 ppb)

0 feet 700

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.11
SWMU 39
1,1-DCE IN
INTERMEDIATE GROUNDWATER

AML /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.12 SWMU 39 — Benzene in Intermediate Groundwater

LEGEND

Approximate extent of BENZENE based upon computer generated contours

- ND
- ND - MCL (5 ppb)
- > MCL (5 ppb)

0 feet 700

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.12
SWMU 39
BENZENE IN
INTERMEDIATE GROUNDWATER

AML: /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.13 SWMU 39 – CIS-1,2-DCE in Deep Groundwater

LEGEND

Approximate extent of CIS-1,2-DCE based upon computer generated contours

- ND
- ND - MCL (70 ppb)
- > MCL (70 ppb)

0 feet 700

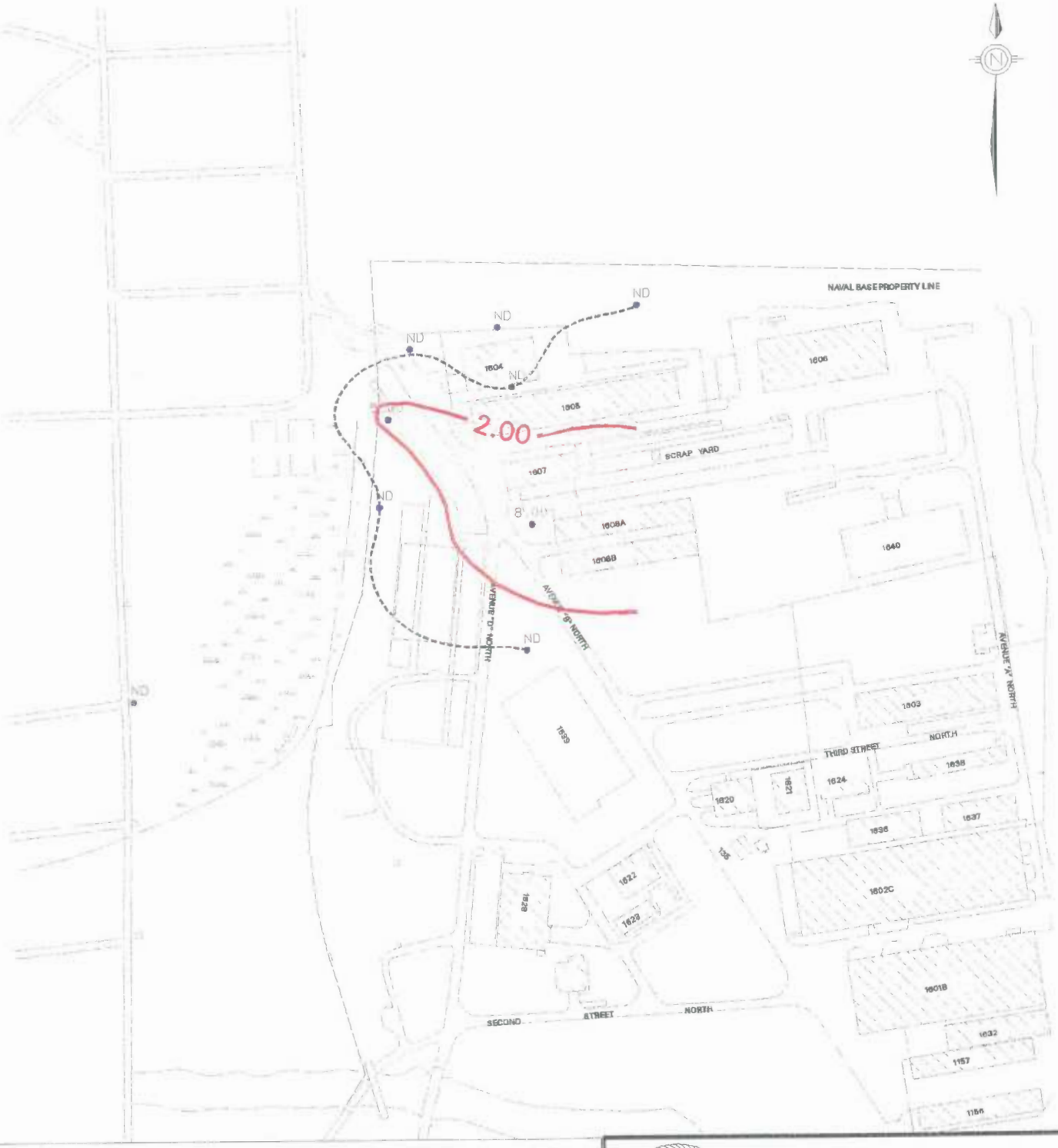
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.13
SWMU 39
CIS-1,2-DCE IN
DEEP GROUNDWATER

AML: /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.14 SWMU 39 — Vinyl Chloride in Deep Groundwater



LEGEND

Approximate extent of VINYL CHLORIDE based upon computer generated contours

- ND
- ND - MCL (2 ppb)
- > MCL (2 ppb)

0 feet 700

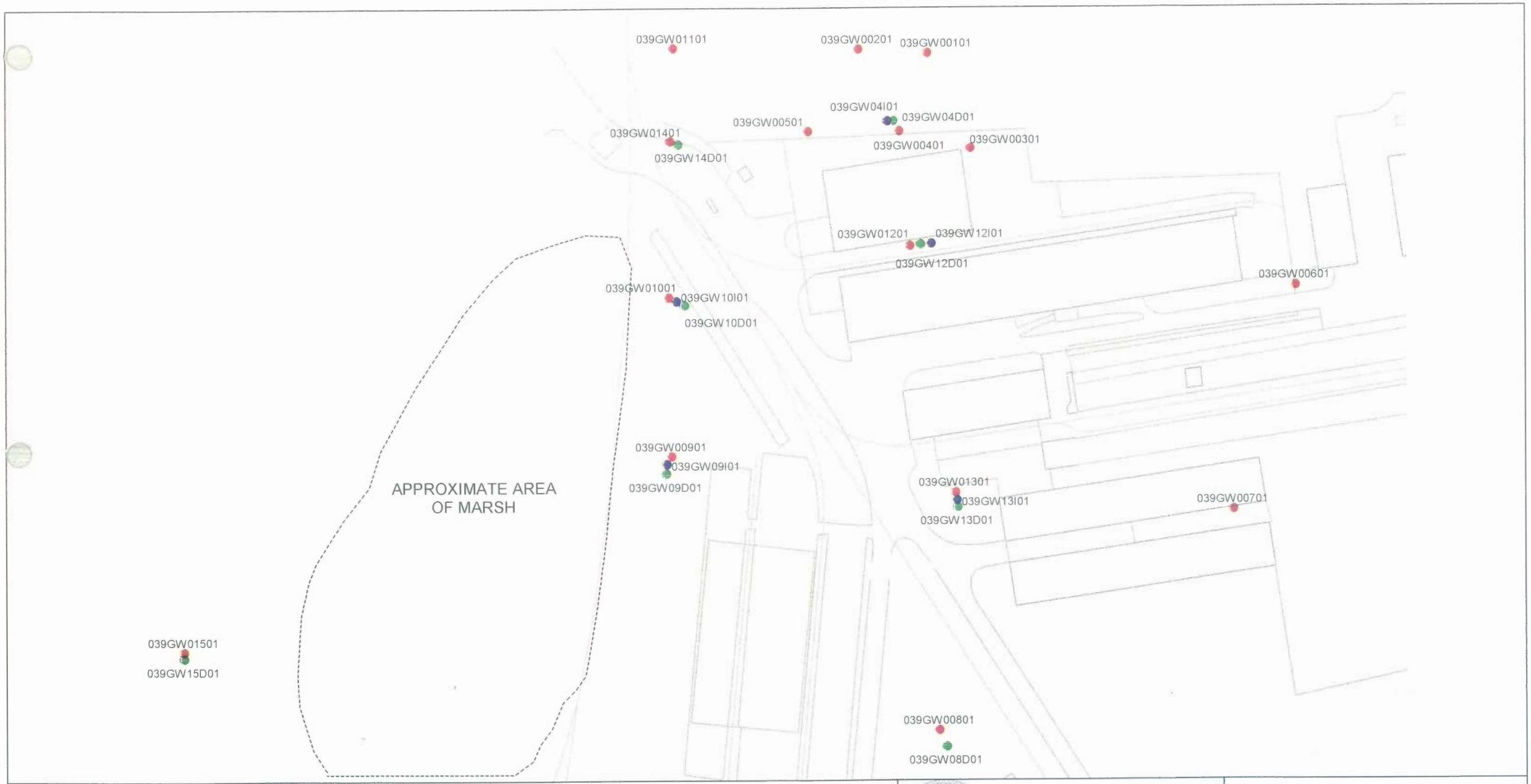
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.14
SWMU 39
VINYL CHLORIDE IN
DEEP GROUNDWATER

AML /home3/projects/charleston_dir/zone_a_dir/contour_dir/

Figure 5.3.15 SWMU 39 — Monitoring Well Locations



LEGEND

- SHALLOW MONITORING WELL WITH ID
- INTERMEDIATE MONITORING WELL WITH ID
- DEEP MONITORING WELL WITH ID

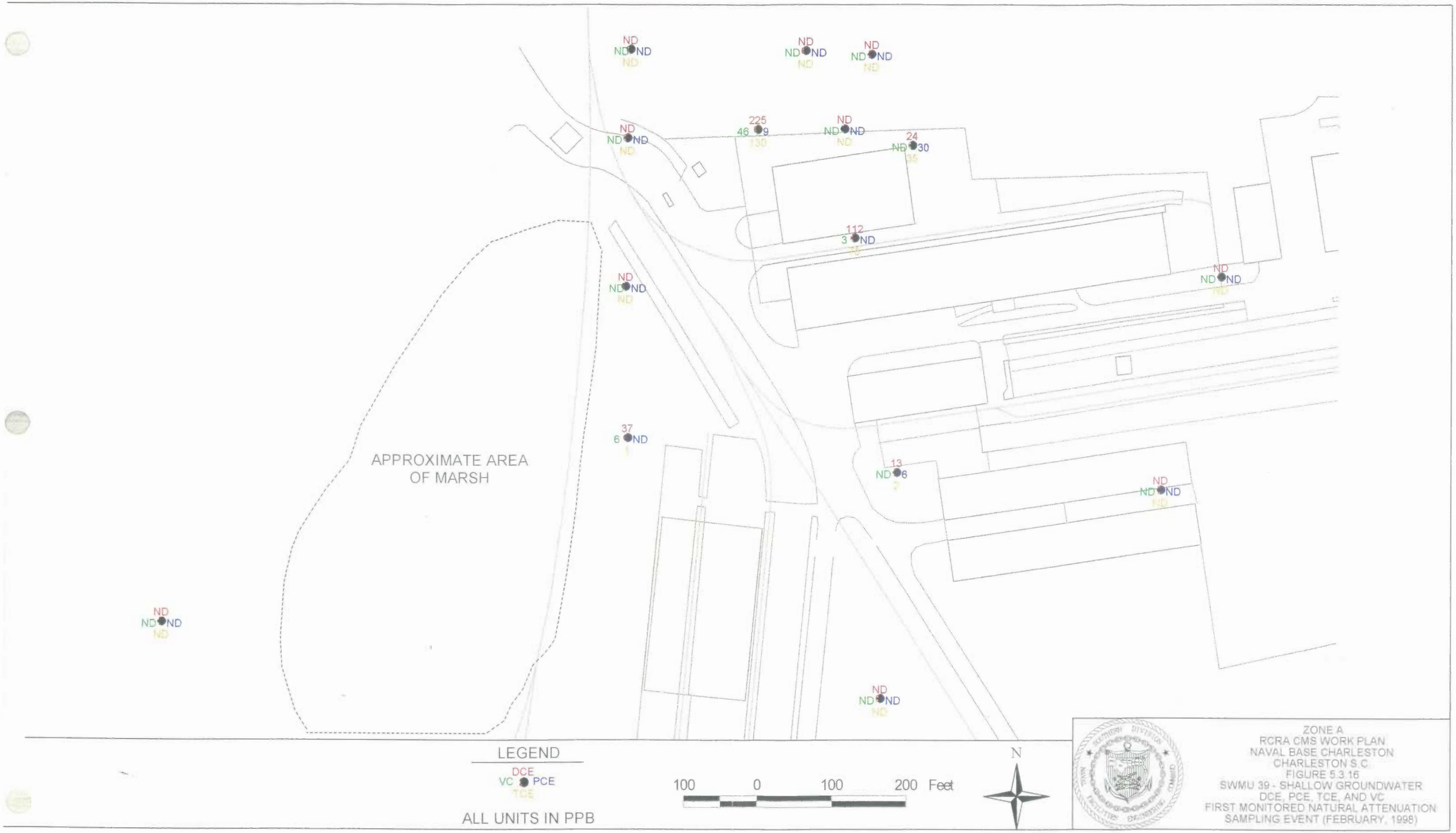
100 0 100 200 Feet

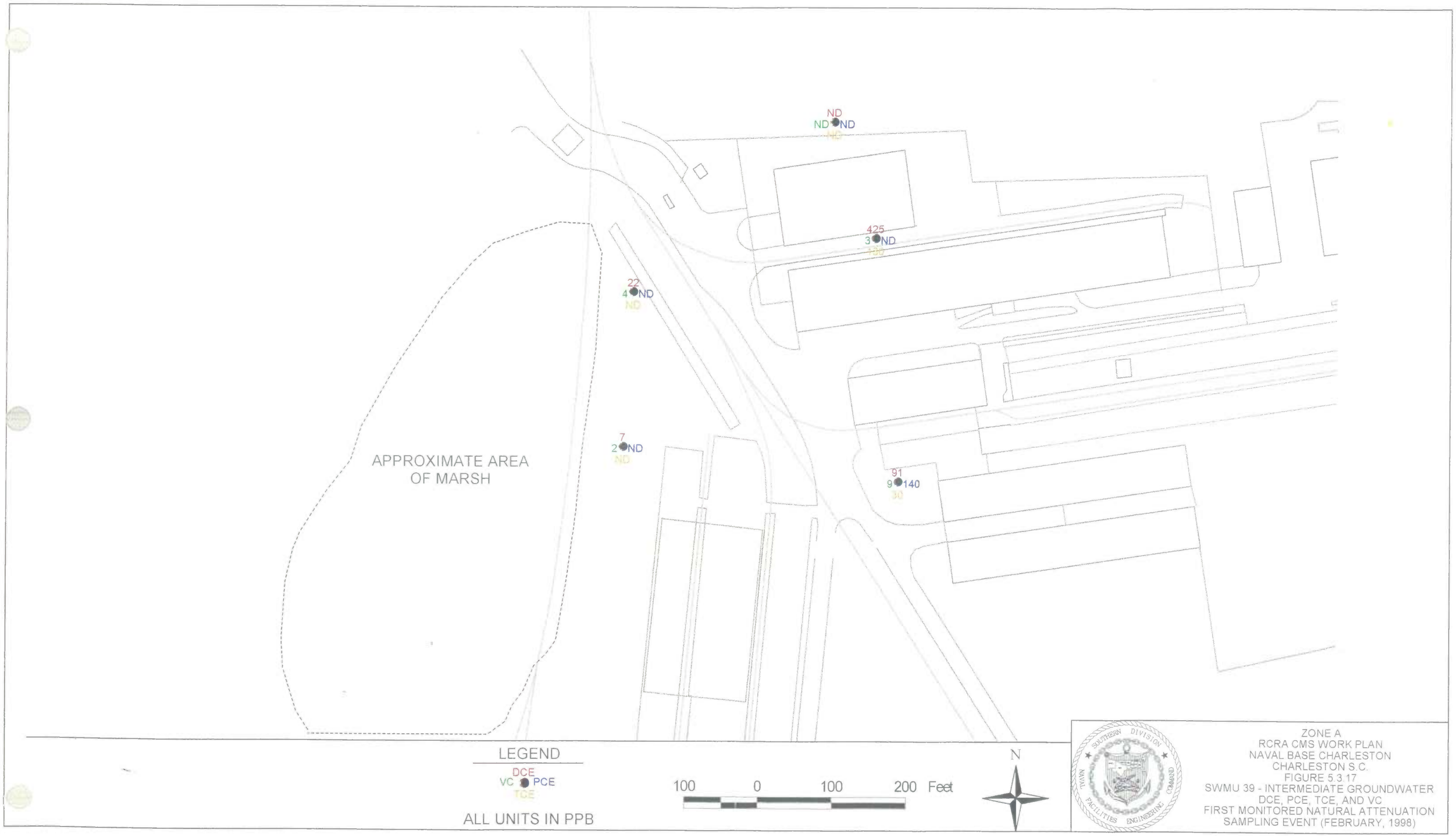
N

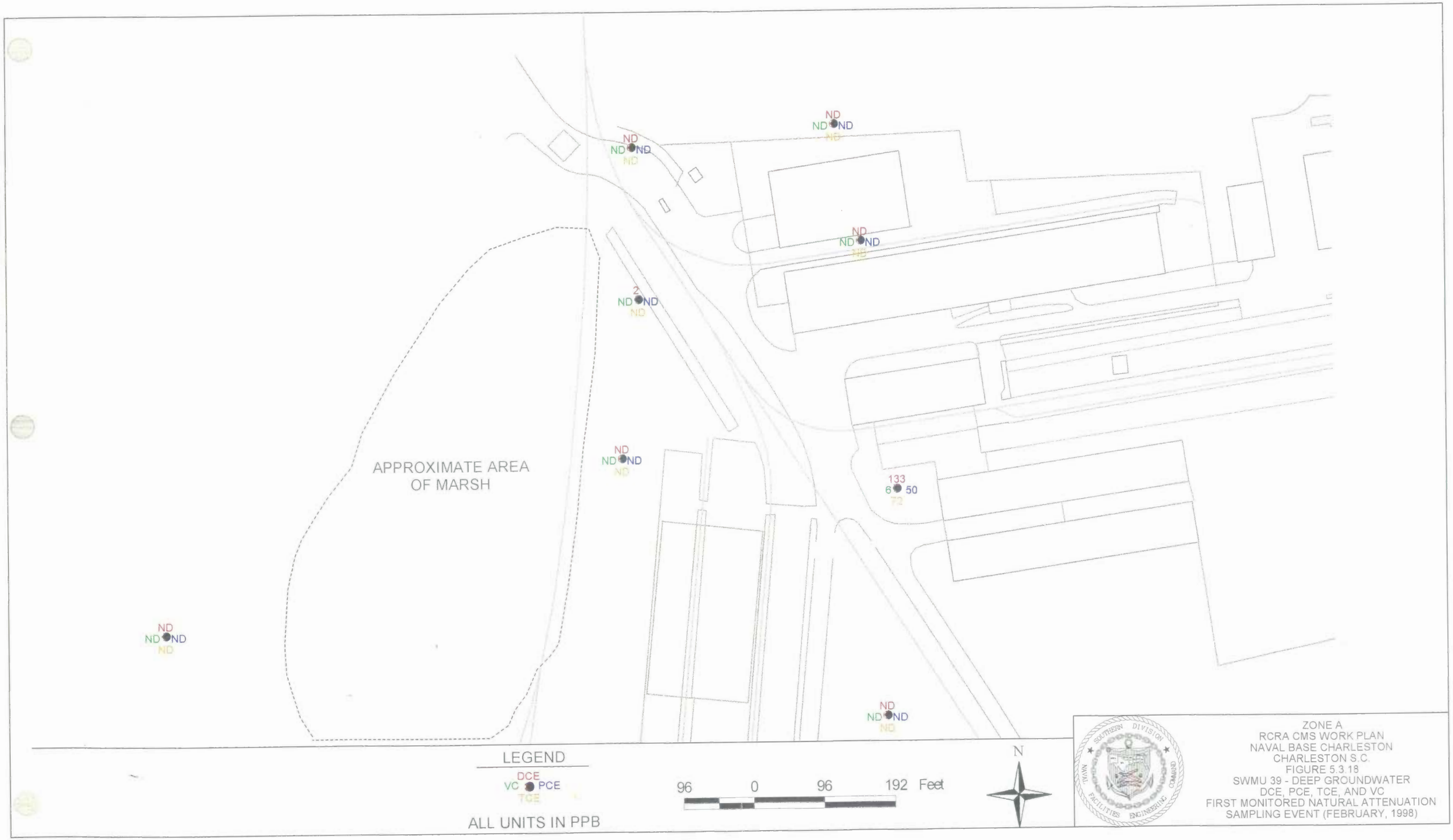
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.15
SWMU 39
MONITORING WELL LOCATIONS
FIRST MONITORED NATURAL ATTENUATION
SAMPLING EVENT (FEBRUARY, 1998)

00087IB202

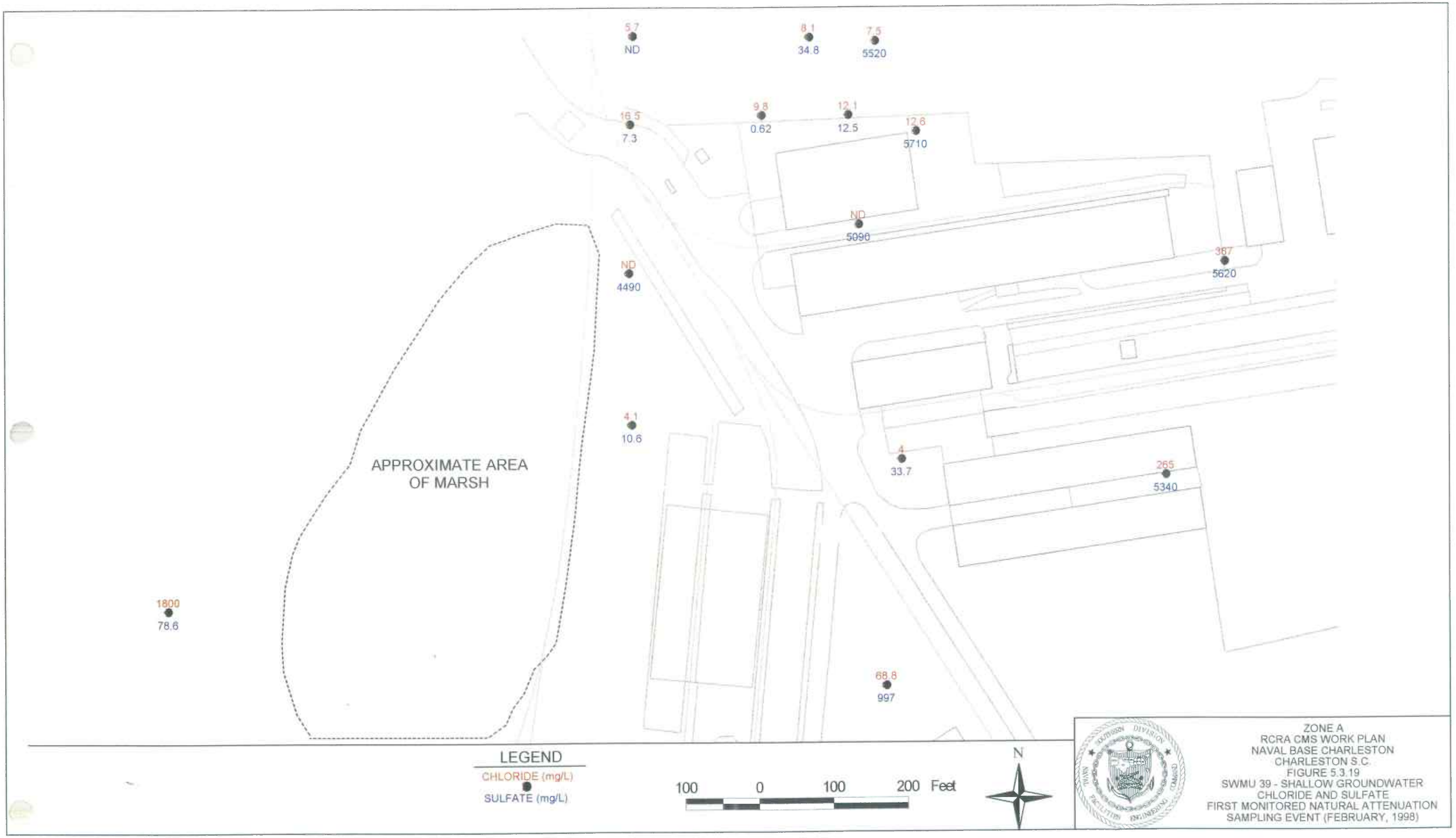

APPROXIMATE AREA
OF MARSH
LEGEND
DCE
VC PCE
TCE
ALL UNITS IN PPB
100 0 100 200 Feet
N
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.3.16
SWMU 39 - SHALLOW GROUNDWATER
DCE, PCE, TCE, AND VC
FIRST MONITORED NATURAL ATTENUATION
SAMPLING EVENT (FEBRUARY, 1998)


ND
ND ND
425
3 ND
22
4 ND
ND
7
2 ND
ND
91
9 140
30
APPROXIMATE AREA
OF MARSH
LEGEND
DCE
VC PCE
TCE
ALL UNITS IN PPB
100 0 100 200 Feet
N
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.3.17
SWMU 39 - INTERMEDIATE GROUNDWATER
DCE, PCE, TCE, AND VC
FIRST MONITORED NATURAL ATTENUATION
SAMPLING EVENT (FEBRUARY, 1998)



ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.3.18
SWMU 39 - DEEP GROUNDWATER
DCE, PCE, TCE, AND VC
FIRST MONITORED NATURAL ATTENUATION
SAMPLING EVENT (FEBRUARY, 1998)

Figure 5.3.19 SWMU 39 — Shallow Groundwater Chloride and Sulfate


5.7
ND
8.1
34.8
7.5
5520
16.5
7.3
9.8
0.62
12.1
12.5
12.6
5710
ND
5090
ND
4490
367
5620
4.1
10.6
4
33.7
265
5340
APPROXIMATE AREA
OF MARSH
1800
78.6
68.8
997
LEGEND
CHLORIDE (mg/L)
SULFATE (mg/L)
100 0 100 200 Feet
N
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.3.19
SWMU 39 - SHALLOW GROUNDWATER
CHLORIDE AND SULFATE
FIRST MONITORED NATURAL ATTENUATION
SAMPLING EVENT (FEBRUARY, 1998)

00087E212

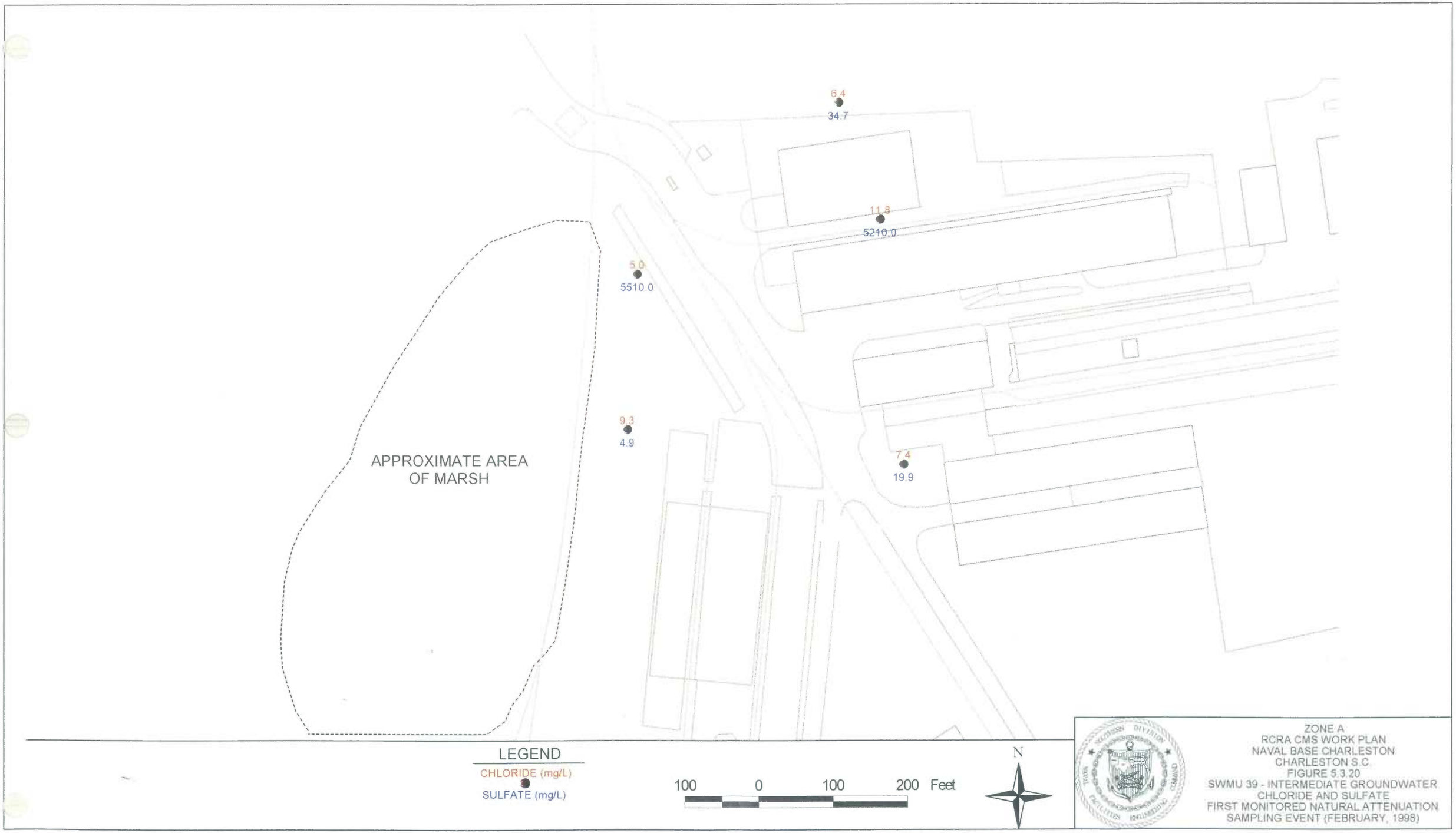
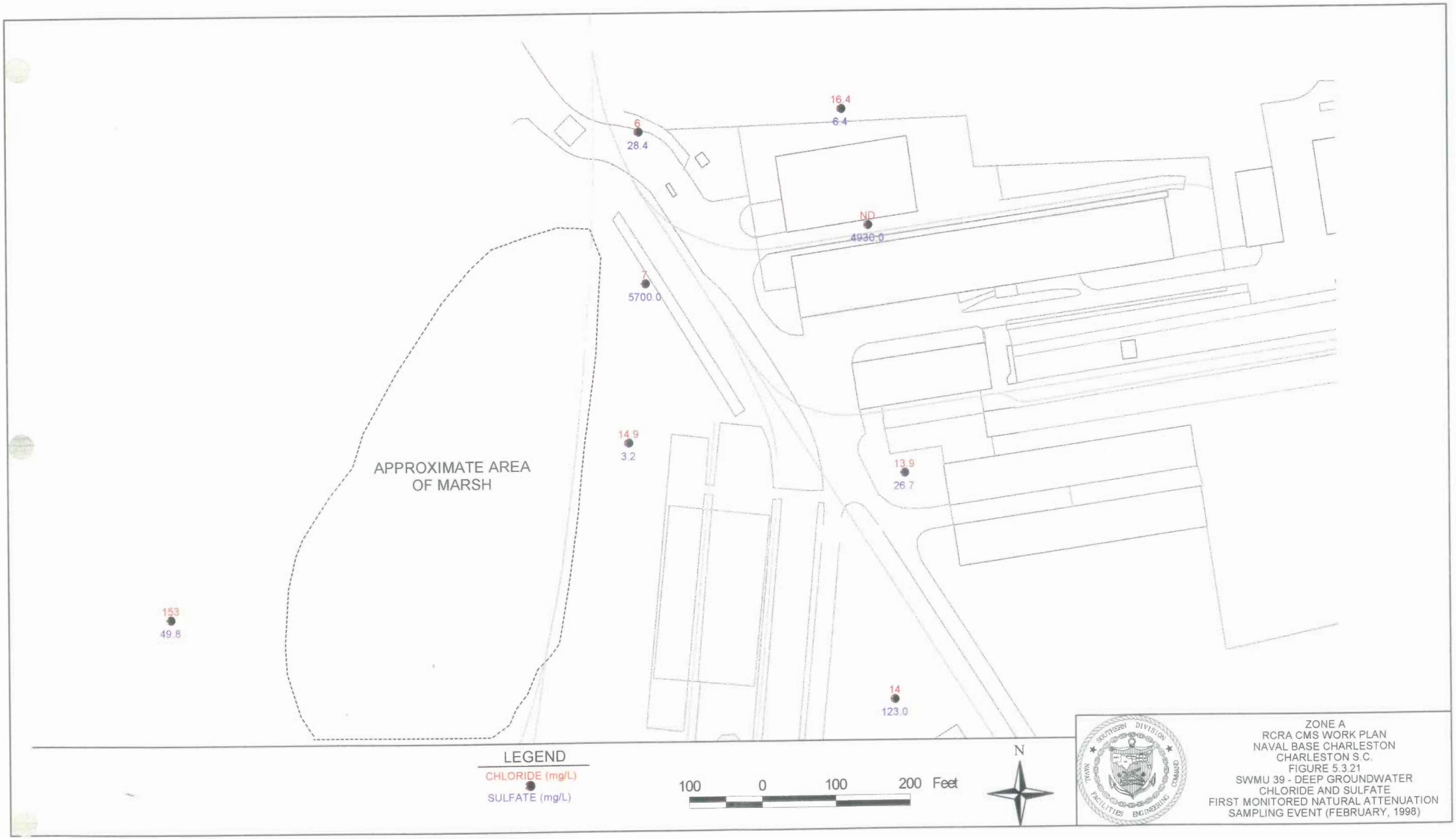

6.4
34.7
11.8
5210.0
5.0
5510.0
9.3
4.9
7.4
19.9
APPROXIMATE AREA
OF MARSH
LEGEND
CHLORIDE (mg/L)
SULFATE (mg/L)
100 0 100 200 Feet
N
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.3.20
SWMU 39 - INTERMEDIATE GROUNDWATER
CHLORIDE AND SULFATE
FIRST MONITORED NATURAL ATTENUATION
SAMPLING EVENT (FEBRUARY, 1998)

Figure 5.3.21 SWMU 39 — Deep Groundwater Chloride and Sulfate



ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S C.
FIGURE 5.3.21
SWMU 39 - DEEP GROUNDWATER
CHLORIDE AND SULFATE
FIRST MONITORED NATURAL ATTENUATION
SAMPLING EVENT (FEBRUARY, 1998)

5.3.5 Fate and Transport Summary

Soil-to-Groundwater

~~The RFI found that soil contamination was not likely to migrate to the underlying aquifer in most areas, based on observed soil and groundwater concentrations. However, elevated concentrations of chlorinated solvents in separate, limited areas around soil borings 039SB011 and 039SB014 indicate the potential for soil-to-groundwater contaminant migration.~~

VOC contaminated soils south and west of Building 1604 may be a continuing source of groundwater contamination seen in SWMU 39 wells. VOCs present in lower interval samples in this area also indicate that the VOCs are capable of migrating to deeper soils.

Of the inorganic compounds examined in the RFI, only mercury concentrations in soil exceed their SSLs and could possibly contribute to future groundwater contamination. However, mercury has not been detected in any SWMU 39 groundwater samples.

Groundwater-to-Surface Water

The direction of groundwater flow (Section 5.0, Figures 5.H through 5.Q) would take the chlorinated solvent plume into or beneath the wetland west of SWMU 39. The extreme reducing conditions and anaerobic microbial activity present in wetland sediments is conducive to the breakdown of chlorinated solvents, and is likely helping to prevent of further offsite migration of the plume. Moreover, chlorinated solvents have been shown to be more susceptible to degradation in the presence of petroleum hydrocarbons, which are present at SWMU 39 due to the onsite migration of the Hess Oil Co. plume.

Surface Soil-to-Sediment

The RFI did not identify surface soil-to-sediment as a significant contaminant migration pathway at this site.

Soil-to-Air Pathway

Aroclor-1260 and benzene were detected at concentrations exceeding their corresponding soil-to-air volatilization screening levels. Aroclor-1260 was reported in a single surface soil sample (039SB00201) at a concentration of 1,100 μg/kg which exceeds its soil-to-air SSL of 1,000 μg/kg. Benzene was reported in a single subsurface soil sample (039SB00802) at a concentration of 990 μg/kg which exceeds its soil-to-air SSL of 800 μg/kg. According to the RFI, these isolated screening value exceedances do not indicate a substantial threat via the soil-to-air pathway.

5.3.6 Human Health Risk Assessment Summary

Table 5.3.1 summarizes SWMU 39 total groundwater risk and hazard and soil risk and hazard in excess of Zone A background.

Table 5.3.1
Combined SWMU 39
Site Human Health Risk and Hazard above Background

		Surface Soil		Shallow GW	
		Hazard Quotient	**ILCR**	**Hazard Quotient**	**ILCR**
SWMU 39	Res.[1]	9.3E-04	1.3E-05	27	1.2E-03
	Ind.[1]	3.5E-05	2.6E-06	4	3E-04

Notes:
ILCR — Cumulative risk is presented as ILCR (incremental lifetime cancer risk).
1 — Residential risk and hazard are for a child; Industrial risk and hazard are for an adult site worker.

SWMU 39 Soil

Of the 1.3E-05 residential site risk, BEQs account for 1.1E-05, beryllium for 0.13E-05, and Aroclor-1260 for 0.05E-5. Residential site risk could be reduced by 50% (to 6.5E-06 residential and 1.2E-06 industrial) if soil surrounding 039SB005 were removed. Industrial site risk would drop below 1.0E-06 if soil surrounding points 039SB005, -006, and -002 were removed. Point

risk for each surface soil sample is shown on Figures 5.3.22 and 5.3.23. Surface soil hazard is below 0.1 (residential) and will not be directly addressed by corrective measures. Site and point risk and hazard summaries for this site are provided in Appendix A.

SWMU 39 Groundwater

SWMU 39 groundwater risk and hazard exceed MCL, risk, and hazard thresholds under residential and industrial scenarios. Primary risk and hazard drivers include inorganics and volatile organic compounds (VOCs).

5.3.7 Ecological Risk Assessment Summary

The RFI did not find risk to ecological receptors from soil/sediment exposure found in subzone A-1 (all Zone A sites are included within this area) requiring further action. RFI exposure scenarios were based on detected concentrations and current status of the area. Ecological risk may be different if land use is modified.

5.3.8 Remedial Objectives

Soil

BEQs and beryllium in surface soil could potentially require remediation based on current site risk levels. The CMS will examine potential alternatives which could reduce risk above background to a level below 1E-06 or 1E-05, hazard above background to a level below 1.0 or 0.1, or a separate cost-benefit risk-and hazard-reduction-based goal. Both residential and industrial reuse scenarios will be examined.

Figure 5.3.22 SWMU 39 — Surface Soil Point Risk Above Background — Residential

039SB025
039SB023
039SB008
039SB020
039SB017
039SB002
039SB007
039SB001
039SB006
039SB018
039SB016
039SB010
039SB011
039SB009
039SB024
039SB022
039SB004
039SB005
039SB012
039SB003
039SB013
039SB014
039SB015
039SB038

30 0 30 60 Feet

LEGEND

1E-6	0
1E-5	< 1E-6
1E-4	1E-6 TO 1E-5
	1E-5 TO 1E-4
	>1E-4

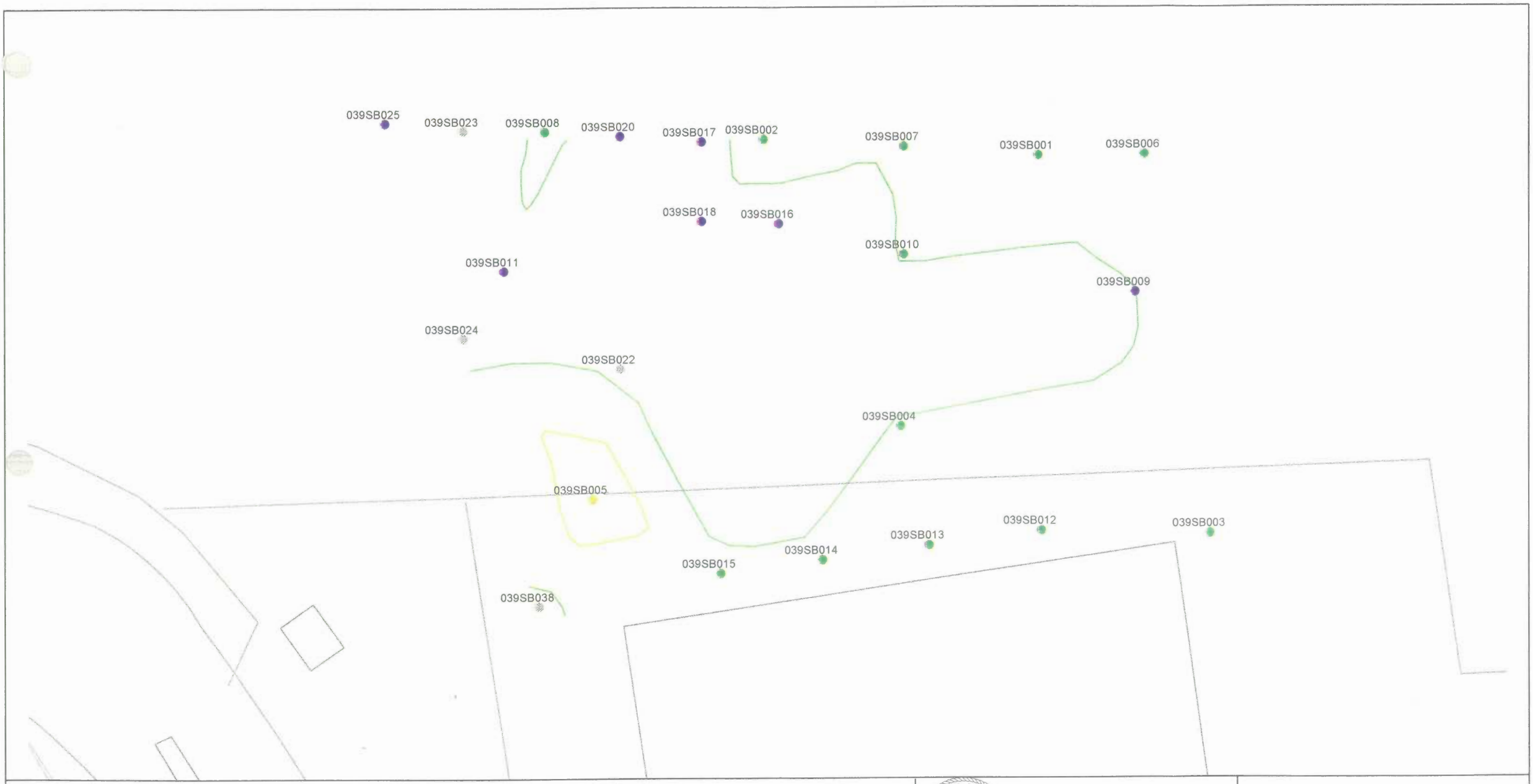
N

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.22
SWMU 39
SURFACE SOIL POINT RISK ABOVE
BACKGROUND-RESIDENTIAL

00087I242

Figure 5.3.23 SWMU 39 — Surface Soil Point Risk Above Background — Industrial



ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.23
SWMU 39
SURFACE SOIL POINT RISK ABOVE
BACKGROUND-INDUSTRIAL

Groundwater

~~Dissolved phased chlorinated solvents and BTEX compounds are present at this site in excess of MCLs. Therefore, groundwater remediation goals include:~~

- ~~Ensure contaminant mass reduction and progress towards MCLs.~~
- ~~Ensure the COC plume does not pose an unacceptable risk or hazard to potential offsite receptors via monitoring of perimeter wells.~~
- ~~Ensure no further degradation of the wetlands above Noisette Creek~~.

Remedial objectives for SWMU 39 groundwater include:

- **Treat and/or monitor site groundwater to ensure compliance with South Carolina Bureau of Solid and Hazardous Waste Management (BSHWM) Assessment and Remediation criteria**
- **Control and/or monitor potential offsite migration of the groundwater plume in order to prevent significant risk to potential downgradient receptors**
- **Restriction of groundwater use**

5.3.9 Potential Remedial Alternatives

Soil

- Hot-spot removal outside of building and paved areas, with offsite treatment/disposal

- Capping
- In-situ stabilization
- In-situ or ex-situ bioenhanced degradation using passive or active bioventing, nutrient additions, or other applicable technology
- Soil washing
- Phytoremediation and/or landfarming

Groundwater

The following unique site characteristics ~~make long-term, ex-situ groundwater treatment unnecessary or potentially detrimental to current site conditions~~ **will be important in the evaluation of remedial alternatives at this site:**

- The Hess Oil Co. BTEX plume is currently being addressed by other entities, and the initiation of any groundwater removal operations at SWMU 39 may result in accelerated migration of the Hess BTEX plume onto Navy property. **Moreover, any corrective measures implemented offsite by other entities to address the Hess plume will need to be considered while evaluating corrective measures for SWMU 39.**
- Site hydrogeology and baseline natural attenuation monitoring indicate that site conditions ~~are~~ **may be** conducive to natural attenuation of chlorinated VOCs and immobilization of inorganic compounds. **Evaluation of natural attenuation will continue during the CMS.**

- COCs have not been observed offsite at concentrations above their RBCs, and there is no immediate threat to any potential offsite receptors.

~~Therefore, potential remedial alternatives for SWMU 39 groundwater include~~:

- ~~Monitored natural attenuation (MNA)~~
- ~~COC source removal (where applicable)~~
- ~~Biochemical enhancement of in-situ natural attenuation~~
- ~~Short-term, low-volume groundwater extraction for COC mass removal (standard or vacuum-enhanced recovery)~~
- ~~In-situ air sparging and/or oxidation using oxygen release compounds~~
- ~~Steam injection~~
- ~~Containment (hydraulic, physical, or flow-through treatment wall barrier)~~
- ~~Phytoremediation~~

~~Note that any corrective measures implemented offsite by other entities to address the Hess plume will need to be considered while evaluating corrective measures for SWMU 39.~~

(The remainder of the text in Section 5.3.9 is new, but it has not been underlined for ease of reading.)

An initial desktop evaluation of all potential technologies will be performed during the CMS to determine which technologies are most likely to succeed in meeting remedial goals. Based on the desktop evaluation, some technologies will be advanced to laboratory bench- and field-scale testing phases to further evaluate their ability to meet remedial goals. Potential remedial technologies for SWMU 39 groundwater include:

- **In-Situ Physical Air Sparging** - Air is injected into the aquifer to strip COCs in-situ. The resulting soil vapor is vacuum extracted.

- **In-situ Chemical Oxidation and Enhanced Aerobic Biological Degradation** -ORCs or other oxidizing agents will be delivered to the aquifer via a passive release wells or pressurized injection.
- **Anaerobic-aerobic Treatment Zone Sequencing** - Nutrients, substrates, and/or exogenous bacteria are introduced in-situ to the aquifer to drive reductive biological dechlorination of the COCs. Downgradient of the reduction zone, air or other oxidizing agent is forced into the aquifer to strip or oxidize COCs in-situ. Resulting soil vapor is vacuum extracted.

- **Six-phase Soil and Aquifer Heating (SPSH) with Soil Vapor Extraction (SVE)** - Resistance heating of contaminated media effectively increases the vapor pressure of the VOCs and creates an in-situ source of steam to strip contaminants from unsaturated and saturated soil. Voltage is applied to electrodes placed in the contaminated media in-situ. Electric current conducts through the soil, heating both soil and groundwater resistively. SPSH uses multi-phase electricity to create a more uniform heating pattern throughout the treated soil volume. Resulting soil vapor is vacuum extracted.

- **Vacuum-enhanced Dual-phase Groundwater-Soil Vapor Extraction**- Vacuum pumps are used to de-water selected zones of unusually high COC concentration. This technology

may be needed to reduce contaminants to non-toxic concentrations and allow for long-term natural biological degradation to occur.

- **Vacuum-enhanced Dual-phase Groundwater-Soil Vapor Extraction with Steam Injection Enhancement**- Low-pressure steam is injected around the perimeter of the plume or source area and vacuum pumps are used to de-water selected zones of unusually high COC concentration. This technology may be needed to improve COC removal efficiency

- **Phytoremediation (In-situ)**- Vegetation is planted to uptake and/or enhance biodgradation of groundwater contaminants

- **Long-term Monitored Natural Attenuation-** COCs are allowed to remain in-place to allow naturally occurring processes such as biological degradation and physical dilution to reduce COC concentrations to acceptable levels. This technology is often used in conjunction with or subsequent to implementation of other remedial technologies.

- **Permeable Barrier (Reactive Wall)**- A wall containing iron-filings or some other reactive media is placed in-situ to treat groundwater as it moves through the wall.

- **Impermeable Barrier (Slurry Wall)**- An impermeable wall is placed in-situ to prevent the migration of groundwater. If this wall is designed to cut-off groundwater flow in one direction (e.g. at the site boundary), a groundwater extraction and ex-situ treatment system will also be required. If the wall is emplaced in a closed circle with a surface cap around the contaminant plume, no such extraction system would be needed for hydraulic control.

- **Passive Groundwater Extraction and Ex-situ treatment** - (Pump and Treat) Groundwater wells or infiltration trenching is used to collect contaminated groundwater

for treatment by air-stripping, carbon polishing, or other process prior to discharge to the local POTW.

Note that some of the above technologies may be combined to form an integrated alternative based on the results of this CMS.

5.3.10 CMS Data Needs

Based on the remedial objectives identified for SWMU 39, the following is proposed (Figure 5.3.24):

HESS OIL CO.
TANK FARM

BOUNDARY LINE

CURB

STORAGE
(GRAVEL)

MISC. STORAGE

GRAVEL

039SB036 039SB034 039SB031 039SB030 039SB027 039SB025 039SB023 039SB008 039SB020 039SB017 039SB002 039SB007 039SB001 039SB006

039GP012 039SB011 039SB018 039SB016 039SB010 039SB009

039SB036 039SB032 039SB028 039SB026 039SB021 039GP002 039SB003

039GP001 039SB022 039SB019

039SB037 039SB033 039SB029 039SB004

039SB005 ASPHALT 039GP011 039G0004 039SB003

039SB015 039SB014 039SB013 039SB012

1630 039SB039 039SB038

039SB040 039GP005

GRASS

039SB042 039SB041

039SB043

1604

SWMU 39
039GP006

1627

039GP008 039GP009

1605

1905

039GP016

PA

039GP010 ASPHALT 039GP015

SCRAP YARD

039GP013

1607

GRASS

039GP014

30 0 30
SCALE FEET

LEGEND
- ● – SOIL BORING
- – GRAVEL
- – GRASS

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 5.3.1
SWMU 39
SITE MAP

Dr by: NAME		Tr by: NAME	
Ck by: NAME		App by: NAME	Sheet 1
Date: 05/29/98	DWG Name:2901M004		Of 1

00087I19X

Soil

- **One bulk sample from an area of VOC contamination south of Building 1604 for** laboratory bench scale pilot testing to evaluate potential soil solidification/stabilization mix designs.

- ~~Four TCLP and SPLP samples for SVOCs and metals (including beryllium) in soil to evaluate disposal options and in-situ leachability~~. **Fourteen geoprobe borings with samples from upper- and lower-intervals for SW-846 VOCs, SVOCs and metals. Two upper- and two lower-interval samples should be also be analyzed for TCLP and SPLP VOCs, SVOCs and metals to evaluate disposal options and in-situ leachability. TCLP and SPLP** samples should be collected within the areas of greatest observed **VOC, mercury**, BEQ and beryllium contamination.

Groundwater

- Sampling of all existing and proposed additional monitoring wells for **SW-846 metals**, VOCs **MTBE, sulfate, chloride, TDS and other** monitored natural attenuation parameters. ~~Proposed well locations will be selected pending review of baseline SWMU 39 MNA data and subsequent discussions with the project team.~~

- ~~Short-term specific-capacity pump testing of wells where such testing will not interfere with monitored natural attenuation testing and data interpretation.~~

- If area reuse allows, field-scale phytoremediation pilot testing may be performed.

Wetland Sediment and Offsite Migration

- Three sediment cores need to be collected from the wetland area/**ditch** west of SWMU 39. Cores should **be located in the lowest point of local elevation and** extend at least 6-inches

into the soil horizon below the sediment. Pore water samples should be collected from each core for SW-846 VOCs and chlorides. The sediment should be analyzed for total organic carbon, SW-846 metals, VOCs, SVOCs, pesticides, and PCBs.

- **Sediment sampling will also include installation of Robelsky samplers near each sediment core.**

- Redox potential measurements should be collected from three areas near each sediment core prior to core sample collection.

- Preliminary modeling based on specific capacity testing results and other available hydrogeologic data to assess groundwater flow and COC fate and transport into the wetland area west of SWMU 39.

Other Information

- Obtain all relevant information pertaining to assessment and remediation of the Hess Oil site adjacent to the northern boundary of Zone A.

Field Scale Pilot Studies

The desktop study portion of the CMS has not been completed, however preliminary review indicates the following field scale pilot studies may be required at this site. Pilot studies are listed in order of likelihood to be performed, beginning with the most likely pilot study to be performed. Treatability Study Work Plans will be generated prior to implementing any field-scale pilot study.

Long-term monitored natural attenuation is currently undergoing field evaluation at this site and is therefore not described in this list.

(1) **Physical Air Sparging with SVE**- A single 2-inch sparging well connected to a blower for air supply is installed near the center of the VOC plume. About six 2-inch observation wells and two 2-inch background wells is installed to monitor the changes in groundwater concentrations. Groundwater is monitored for concentration changes in VOCs, dissolved oxygen, dissolved iron and other general water quality parameters.

A single SVE well is installed to collect vapor generated by the sparging well. At least three vapor probes are installed in the vadose zone to evaluate air flow from the sparged zone to the surface and to obtain air samples for VOCs, carbon dioxide, and oxygen. The testing is conducted at three separate flow rate/pressure levels. The first step is the lowest flow rate while the third step will be the maximum flow rate the equipment is capable of producing. Vapor samples are be taken from the effluent of the SVE system in the beginning, midpoint, and end of each combination step test. Pilot test results are used to calculate the air permeabilities, radius of influence, and VOC removal rates used in full-scale design and implementation.

(2) **Passive Bioventing**- About four open-air wells are installed to stimulate and monitor aerobic degradation of COCs. Groundwater is monitored for parameters similar to those checked during long-term monitored natural attenuation.

(3) **Anaerobic-aerobic field pilot bioremediation study** The pilot study consists of two zones of treatment in a selected location of the saturated subsurface. The upgradient zone is anaerobic and consists of a series of horizontal or vertical injection wells through which a reducing catalyst (dissolved or gaseous carbon source, nutrients, etc.) is introduced to

enhance biological reduction of the chlorinated hydrocarbons. The downgradient aerobic zone could be either a physical sparging zone (see Field-scale Study 1), a chemically oxygenated zone (see Field Scale Study 2), or both (in which case two separate anaerobic zones may be needed for this study). About six nested pairs of shallow and deep monitoring wells would be needed in the study area.

(4) **In-Situ Chemical Oxidation and Aerobic Biological Degradation-** ORCs or other oxidizing agents are delivered to the aquifer via a single passive release well or pressurized injection. In either case, about six groundwater monitoring wells are needed. However, no soil vapor extraction is needed during this test. Groundwater is monitored for VOCS, dissolved oxygen, redox potential, microbial plate counts, nutrients, dissolved iron, oxidizing agent-specific compounds, and any other compounds which may lead to long term fouling.

(5) **Vacuum-enhanced Dual-phase Groundwater-Soil Vapor Extraction** "Vacuum-enhanced" pumping tests would use negative-pressurized pumps to draw both water and soil vapor out of the ground at a more rapid rate than "passive" testing in order to evaluate the potential for significant short-term contaminant mass reduction. Such mass reduction is sometimes needed prior to implementation of a biological degradation technology.

(6) **Vacuum-enhanced Dual-phase Groundwater-Soil Vapor Extraction with Steam Injection-** Low-pressure steam is injected at the perimeter of the study area to assess changes in COC removal efficiencies. Piping and controls would be needed to access nearby low pressure steam lines. Three steam injection wells and several subsurface temperature probes would likely be installed.

(7) **In-situ Six-phase Soil and Aquifer Heating with SVE**- Contaminated media is heated in-situ through electric resistance heating. An SVE study would be conducted concurrently to assess VOC removal as they volatilize. This study includes collecting soil temperature data, moisture removal rates, pressure within the soil, off-gas contaminant concentrations, and periodic soil and groundwater sampling to estimate changes in contaminant concentration.

(8) **"Passive" aquifer pumping tests** - These tests may be performed alone or in combination with other pilot studies. "Passive" pumping tests typically consist of a single, non-vacuum pumping well positioned in a contaminated area of the plume. The pumping well is used to draw down the water surface in order to evaluate aquifer transmissivities and potential remediation system pumping rates.

5.4 SWMU 42 and AOC 505

SWMU 42 and AOC 505 (Figure 5.4.1) are overlapping sites in Zone A's southwest portion, and are bounded by a wetland to the west, Noisette Creek to the south, and the railroad storage yard surrounding former Building 1614 to the north. The east side of the site roughly follows a railroad spur and divides an open area to the Noisette Creek bridge on Avenue D. The site is mostly grassed with some gravel areas and patches of concrete slab, asphalt rubble and rock-type debris.

SWMU 42 consists of a former asphalt plant and its associated tanks. The plant operated from 1947 until 1962, and has since been demolished. Because the facility was taken out of service in the early 1960s, little information is available regarding dimensions, design features, operating practices, or waste disposal methods. The site currently contains a concrete rack once used to support asphalt-related aboveground storage tanks.

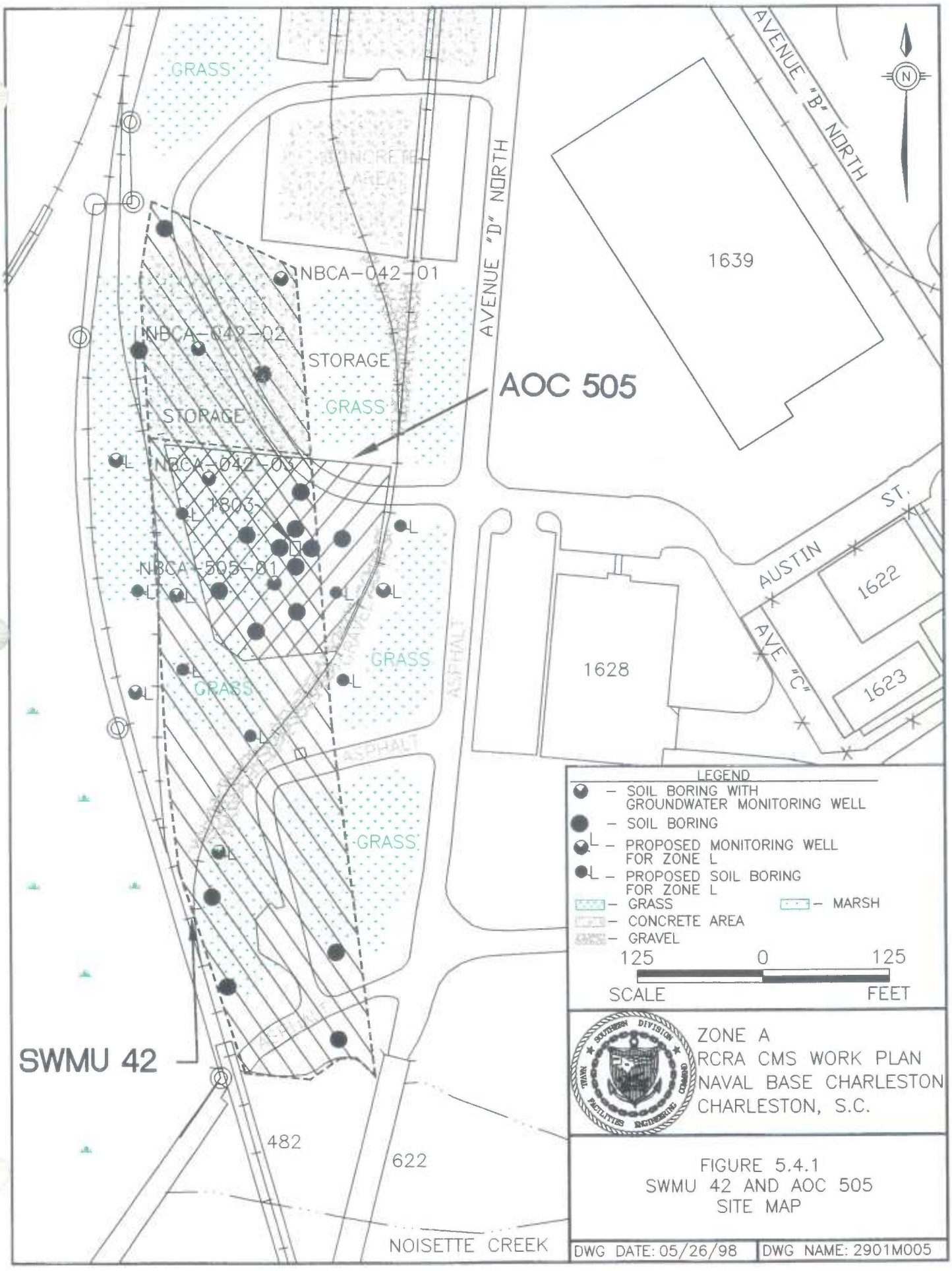
AOC 505 consists of Building 1803, the former golf course maintenance shop, and a nearby area which was used to store creosote cross-ties and railroad ballast during the 1960s and 1970s. Pesticides used at the golf course were handled in Building 1803. Operations were discontinued at this area in the 1970s, and little information is available regarding the overall operating or waste management practices of the entities previously located at AOC 505.

SWMU 42 and AOC 505 also include site features being addressed by the Zone L investigation. These include parts of the base sewer system and railroad tracks. However, no samples addressing these site features in the SWMU 42 and AOC 505 area have been collected during previous investigations.

5.4.1 Current Use

SWMU 42 and AOC 505 are not currently in use.

Figure 5.4.1 SWMU 42/AOC 505 – Site Map


GRASS
AVENUE "B" NORTH
AVENUE "D" NORTH
1639
NBCA-042-01
NBCA-042-02
STORAGE
AOC 505
STORAGE
GRASS
NBCA-042-03
1603
NBCA-505-01
AUSTIN ST.
1622
AVE "C"
1623
1628
GRASS
ASPHALT
GRASS
GRASS
SWMU 42
482
622
NOISETTE CREEK
LEGEND
– SOIL BORING WITH GROUNDWATER MONITORING WELL
– SOIL BORING
– PROPOSED MONITORING WELL FOR ZONE L
– PROPOSED SOIL BORING FOR ZONE L
– GRASS
– MARSH
– CONCRETE AREA
– GRAVEL
125 0 125
SCALE FEET
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 5.4.1
SWMU 42 AND AOC 505
SITE MAP
DWG DATE: 05/26/98
DWG NAME: 2901M005

5.4.2 Future Use

According to the Charleston Naval Complex Redevelopment Authority, it is intended that this area in Zone A be developed for recreational purposes such as a park.

5.4.3 ISM Status

The Navy DET has completed soil removal activities at this site. Removal was performed on an estimated 5.4 cubic yards of lead-impacted soil. A soil volume measuring 6 feet by 6 feet by 2 feet (depth) was removed from a lead-impacted area associated with soil borings 505SB00601 (491 ppm) and 042SB00901 (1,180 ppm). These two soil borings were completed in the upper interval (0 to 1 foot). Lower interval (3 to 5 feet) sampling for lead was conducted in the SWMU 42 area, but none of these samples exceeded 400 ppm.

The excavated soil was removed from the site, characterized and then disposed of at an offsite landfill. Five confirmation samples were obtained from each excavation pit. The samples were analyzed and did not contain lead exceeding 400 ppm. The pits were backfilled with clean soil.

5.4.4 Contaminant Nature and Extent Summary

Soil Contamination Summary

The RFI identified arsenic, beryllium, and BEQs as the primary COCs at this site. COC distribution did not display any consistent pattern for arsenic or beryllium, however the greatest concentration of BEQs appeared either near the former golf maintenance shed or near roadways and railroad tracks. Appendix A provides COC data summaries for surface sample points collected during the RFI.

Groundwater Contamination Summary

Chlorinated solvents were detected in only one well (NBCA-042-001), and only tetrachloroethene (PCE) exceeded its MCL in one of four rounds of sampling (Round 1, 5.9 μg/L). Chlorinated

solvents were not detected in the most recent round of sampling. Manganese, silver, and aluminum were also detected in area wells. Organic and inorganic groundwater sampling results are summarized on Figures 5.S and 5.T.

5.4.5 Fate and Transport Summary

Soil-to-Groundwater

PAHs, PCBs and pesticides were detected in soil, but not in groundwater. These compounds occurred infrequently above their SSLs and typically bind to soil. Therefore, the RFI did not indicate a significant soil-to-groundwater migration concern for inorganic or organic contaminants.

Groundwater-to-Surface Water

The RFI estimated a travel time of between 65 and 140 years for the most mobile observed groundwater COCs to reach surface water near the western site boundary. Thus, impacts from SWMU 42 and AOC 505 groundwater to the wetland area along the western boundary are not anticipated to be significant.

Surface Soil-to-Sediment

The RFI did not identify surface soil-to-sediment as a significant contaminant migration pathway at this site.

Surface Soil-to-Air

No VOC soil-to-air volatilization screening level was exceeded in even the maximum surface soil concentrations. As a result, the soil-to-air migration pathway is not expected to be significant at SWMU 42 and AOC 505.

5.4.6 Human Health Risk Assessment Summary

Table 5.4.1 summarizes SWMU 42 and AOC 505 total groundwater risk and hazard and soil risk and hazard in excess of Zone A background.

Table 5.4.1
Combined SWMU 42 and AOC 505
Site Human Health Risk and Hazard above Background

		Surface Soil		Shallow GW	
		Hazard Quotient	**ILCR**	**Hazard Quotient**	**ILCR**
SWMU 42 and AOC 505	Res.[1]	0.69	4.6E-05	1.8	2.6E-05
	Ind.[1]	0.026	7.2E-06	0.3	8.3E-06

Notes:
ILCR — Cumulative risk is presented as ILCR (incremental lifetime cancer risk).
1 — Residential risk and hazard are for a child; Industrial risk and hazard are for an adult site worker.

SWMU 42 and AOC 505 Soil

Of the 4.6E-05 residential site risk above background, arsenic accounts for 3.5E-05, BEQs for 9.6.E-06, and beryllium for 1.4E-06. Point risk for each surface soil sample is shown on Figures 5.4.2 and 5.4.3. Site and point risk and hazard summaries are provided in Appendix A.

SWMU 42 and AOC 505 Groundwater

Site risk above background is attributable primarily to chlorinated solvents (tetrachloroethene [PCE], trichloroethene [TCE], dichloroethene [DCE]). Chlorinated solvents were detected in only one well (NBCA-042-001), and only PCE exceeded its MCL in one of four rounds of sampling (Round 1, 5.9 μg/L). Chlorinated solvents were not detected in the most recent round of sampling.

Figure 5.4.2 SWMU 42/AOC — Surface Soil Point Risk Above Background — Residential

042SB004
042SB001
042SB005
042SB002
042SB006
505SB020
505SB019
505SB018
505SB021
505SB013
505SB014
042SB003
505SB017
505SB012
505SB002
505SB003
505SB004
505SB015
505SB005
505SB007
505SB008
505SB006
505SB001
505SB009
505SB016
505SB010
505SB011
042SB023
042SB024
042SB022
042SB011
042SB025
042SB012
042SB007
042SB013
042SB014
042SB015
042SB008
042SB018
042SB021
042SB009
042SB010
042SB016
042SB017
042SB019
042SB020

60 0 60 120 Feet

LEGEND

1E-6	< 1E-6
1E-5	1E-6 TO 1E-5
1E-4	1E-5 TO 1E-4
	>1E-4

N

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.4.2
SWMU 42/AOC 505
SURFACE SOIL POINT RISK
ABOVE BACKGROUND-RESIDENTIAL

Figure 5.4.3 SWMU 42/AOC — Surface Soil Point Risk Above Background — Industrial

042SB004
042SB001
042SB005
042SB002
042SB006
505SB020
505SB019
505SB018
505SB021
505SB013
505SB014
042SB003
505SB017
505SB012
505SB002
505SB003
505SB004
505SB015
505SB005
505SB007
505SB008
505SB006
505SB001
505SB009
505SB016
505SB010
505SB011
042SB023
042SB024
042SB022
042SB011
042SB025
042SB012
042SB007
042SB013
042SB014
042SB015
042SB008
042SB018
042SB021
042SB009
042SB010
042SB016
042SB017
042SB019
042SB020

60 0 60 120 Feet

LEGEND

1E-6	< 1E-6
1E-5	1E-6 TO 1E-5
1E-4	1E-5 TO 1E-4
	>1E-4

N

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.4.3
SWMU 42/AOC 505
SURFACE SOIL POINT RISK
ABOVE BACKGROUND-INDUSTRIAL

00087 I 282

Groundwater hazard above background is attributable primarily to manganese (0.7 residential), silver (0.5 residential), and aluminum (0.5 residential).

5.4.7 Ecological Risk Assessment Summary

The RFI did not find risk to ecological receptors from soil/sediment exposure in subzone A-1 (all Zone A sites are included within this area) requiring further action. RFI exposure scenarios were based on detected concentrations and current status of the area. Ecological risk may be different if land use is modified.

5.4.8 Remedial Objectives

Soil

BEQs and arsenic in surface soil could potentially require remediation based on current site risk levels. The CMS will examine potential alternatives which could reduce risk above background to a level below 1E-06 or 1E-05, hazard above background to a level below 0.1, or a separate cost-benefit risk-and hazard-reduction-based goal. Both residential and industrial reuse scenarios will be examined.

Groundwater

Even though VOCs were not detected in groundwater during the most recent round of sampling, an additional sampling round would be useful in verifying that VOCs are not a groundwater COC at this site. The additional data will be combined with other rounds for the project team to make a risk management decision about whether to proceed with future corrective actions addressing groundwater at this site based on concentration and frequency of detection, spatial distribution, and other relevant factors.

The hazard quotient above background for groundwater is within the range of potentially acceptable hazard (1 to 3), and the inorganic compounds driving hazard (manganese, silver, and

aluminum) may be naturally occurring. The maximum observed detection was used to calculate the hazard quotient (HQ) for manganese, silver was detected only once in 16 samples, and the UCL used to calculate the HQ for aluminum was three times the arithmetic mean for aluminum. Expanding the data set with an additional sampling round could cause the HQ to drop below one because: similar to the proposed additional VOC data, the additional round of metals data will be combined with other rounds for the project team to make a risk management decision about whether to proceed with future corrective actions addressing groundwater at this site based on concentration and frequency of detection, spatial distribution, and other relevant factors.

5.4.9 Potential Remedial Alternatives

Soil

For treatment of arsenic and BEQs:

- Hot-spot removal outside of Building 1803 and paved areas, with offsite treatment/disposal
- Capping
- In-situ stabilization
- In-situ or ex-situ bioenhanced degradation using passive or active bioventing, nutrient additions, or other applicable technology
- Soil washing
- Phytoremediation and/or landfarming

Groundwater

Because groundwater does not require remediation based on available data, no remedial alternatives are proposed. However, potential alternatives may be analyzed pending a risk management decision to be made by the project team.

5.4.10 CMS Data Needs

Results from the following proposed field activities (Figure 5.4.4) are needed to complete the CMS:

- Collection of 18 additional surface soil samples for arsenic, **beryllium**, and SW-846 SVOC analysis to refine estimates of the extent of arsenic and beryllium, and to assess whether roadway paving and railroad cross-ties are a primary source of surface soil BEQ contamination. This information will be needed to make volume and area estimates to evaluate remedial alternatives.

- **Bulk sample collection for** laboratory bench scale pilot testing to evaluate potential solidification/stabilization mix designs.

- Four TCLP and SPLP samples for metals (including arsenic) and SVOCs in soil to evaluate disposal options and in-situ leachability. Samples should be collected within the areas of greatest observed arsenic and BEQ contamination.

- Sampling of all existing SWMU 42 and AOC 505 monitoring wells for SW-846 VOCs and metals.

042SB004
042SB001
042SB005
042SB002
042SB006
505SB020
505SB019
505SB018
505SB021
505SB013
042SB003
505SB014
505SB017
505SB012
505SB002
505SB003
505SB004
505SB015
505SB005
505SB008
505SB007
505SB006
505SB001
504SB002
505SB009
505SB016
505SB010
505SB011
504SB005
504SB007
504SB006
504SB008
042SB023
042SB024
042SB022
042SB011
042SB025
042SB012
042SB007
037A01
042SB013
042SB014
042SB015
042SB008
042SB018
042SB021
042SB009
042SB010
042SB016
042SB017
042SB019
042SB020

60 0 60 120 Feet

LEGEND

- RFI SOIL SAMPLE LOCATION
- RFI SOIL SAMPLE LOCATION WITH MONITORING WELL
- PROPOSED CMS SOIL SAMPLE LOCATION

N

ZONE A
RCRA CMS WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON S.C.
FIGURE 5.4.4
SWMU 42/AOC 505
PROPOSED CMS SAMPLING LOCATIONS

00087I29Z

- Incorporation~~, and expedition if needed,~~ of applicable Zone L ~~proposed~~ **and nearby grid** soil and groundwater sampling results into the SWMU 42 and AOC 505 data set. ~~All Zone L sample parameters in this area should match those outlined for SWMU 42 and AOC 505 COCs.~~

- If area reuse allows and corrective actions are required by the project team for groundwater, field-scale ~~phytoremediation~~ pilot testing may be performed near areas of observed groundwater contamination.

6.0 CMS SCHEDULE AND REPORT OUTLINE

CMS Schedule

Figure 6.1 outlines the anticipated schedule for the CMS process for Zone A. The total time to complete the entire Zone A CMS is strictly site-specific. This schedule is based on current remedial goals as defined by the project team and the anticipated use of demonstrated remedial technologies. Innovative technologies could require more preparation and evaluation time (i.e., treatability studies) than demonstrated technologies. However, the possible benefit, such as reduced costs, more effective remediation, less site disruption, and public acceptance/perception obtained from implementing an innovative technology can justify lengthening of this proposed schedule.

CMS Report

The CMS report will present the corrective measures goals, describe site conditions and results of CMS field activities, and identify, screen, assemble, rank, and recommend remedial alternatives for each Zone A CMS site. The CMS report will include:

- Section 1 Introduction and Report Organization
- Section 2 Purpose of the CMS
- Section 3 Proposed Cleanup Objectives
- Section 4 Site-specific Descriptions and Results of Additional Studies (CMS sampling, treatability/pilot studies, aquifer testing, groundwater modeling, etc.)
- Section 5 Identification and Screening of Zone A Remedial Components

- Section 6 Site-specific Evaluation and Ranking of Assembled Remedial Alternative(s)
- Section 7 Community Relations Plan
- Section 8 Signatory Requirement
- Appendix A Risk and Hazard Reduction Calculations and Results

Additional appendices (treatability study reports, ISM completion reports, etc.) will be included if needed.

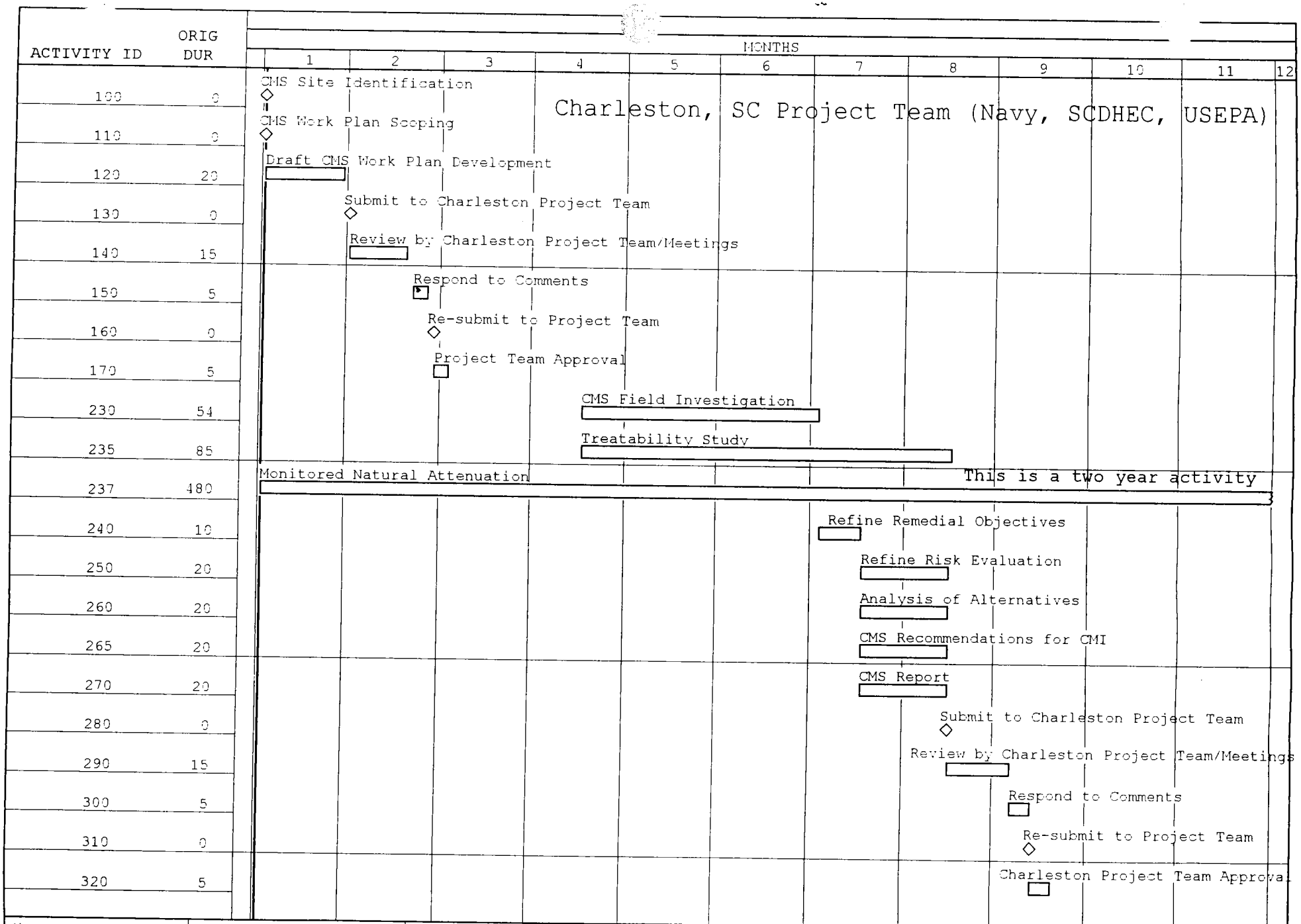


Figure 6.1

Naval Base Charleston, Zone A, CMS

Zone A-CMS Project Schedule

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8.0 SIGNATORY REQUIREMENT

Condition I.E. of the Hazardous and Solid Waste Amendments (HSWA) portion of the 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 Section 40 CFR 270.11. The certification reads as follows:

I certify under penalty of law that this document and all attachments were prepared under my 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, 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.

Henry N. Sheppard II

Date 6/10/98

Henry N. Sheppard II, P.E.
Caretaker Site Office, Charleston

Appendix A

Risk Reduction Summary Tables

SWMU 39
Site Data Summary

	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor-1260	Arsenic	BEQ	Beryllium
Number of Samples (n):	20.00	20.00	20.00	20.00	15.00	19.00	15.00
Standard Deviation of Ln Transformed Data:	0.90	1.11	0.96	1.31	0.60	0.57	0.39
Sample Mean of Ln Transformed Data:	-5.86	-5.76	-5.61	-4.07	1.40	-0.20	-2.03
H-Stat Interpolation							
n(low)	15.00	15.00	15.00	15.00	15.00	15.00	15.00
n(high)	21.00	21.00	21.00	21.00	21.00	21.00	21.00
S(low)	0.80	1.00	0.90	1.25	0.60	0.50	0.30
S(high)	0.90	1.25	1.00	1.50	0.70	0.60	0.40
H(NL,SL)	2.44	2.74	2.59	3.16	2.18	2.07	1.88
H(NL,SH)	2.59	3.16	2.74	3.61	2.31	2.18	1.97
H(NH,SL)	2.31	2.56	2.43	2.92	2.09	1.99	1.83
H(NH,SH)	2.43	2.92	2.56	3.31	2.19	2.09	1.91
NL Interp	2.59	2.93	2.69	3.27	2.19	2.15	1.96
NH Interp	2.43	2.72	2.52	3.02	2.09	2.06	1.90
H-stat:	2.46	2.76	2.54	3.06	2.19	2.09	1.96
95% UCL:	0.01	0.01	0.01	0.10	6.89	1.27	0.17
Maximum_Value:	0.02	0.05	0.02	1.10	17.90	5.78	0.45
Exposure Point Concentation (mg/kg):	0.01	0.01	0.01	0.10	6.89	1.27	0.17
Background Conc. (mg/kg)	0.00	0.00	0.00	0.00	9.44	0.59	0.00
BORING_ID							
039SB001	0.002 *	0.002 *	0.002 *	0.007 *	2.3	0.89 *	0.115 *
039SB002	0.009 *	0.009 *	0.009 *	1.100	1.9	0.87 *	0.115 *
039SB003	0.005	0.035	0.021 *	0.008 *	4.6	0.89 *	0.115 *
039SB004	0.002 *	0.053	0.018	0.007 *	5	0.86 *	0.11 *
039SB005	0.002 *	0.002 *	0.002 *	0.008 *	7.3	5.78	0.12 *
039SB006	0.022	0.009	0.002 *	0.008 *	17.9	0.92	0.45
039SB007	0.002 *	0.002 *	0.002 *	0.098	3.9	0.84 *	0.11 *
039SB008	0.002 *	0.002 *	0.002 *	0.026	4	0.94 *	0.12 *
039SB009	0.010	0.002 *	0.008	0.007 *	3.6	0.83 *	0.11 *
039SB010	0.007	0.005	0.002 *	0.007 *	6.5	0.82 *	0.24
039SB011	0.016	0.010	0.011	0.007 *	5	0.80	0.105 *
039SB012	0.002 *	0.002 *	0.002 *	0.007 *	3.8	0.87 *	0.115 *
039SB013	0.002 *	0.002 *	0.002 *	0.007 *	3.7	0.86 *	0.115 *
039SB014	0.002 *	0.002 *	0.003 *	0.007 *	2.7	0.87 *	0.115 *
039SB015	0.002 *	0.002 *	0.009 *	0.007 *	3.9	0.87 *	0.115 *
039SB016	0.001 *	0.001 *	0.017	0.036 *	-	-	-
039SB017	0.002 *	0.002 *	0.002 *	0.040 *	-	-	-
039SB018	0.001 *	0.001 *	0.001 *	0.037 *	-	-	-
039SB020	0.001 *	0.001 *	0.001 *	0.038 *	-	-	-
039SB025	0.001 *	0.001 *	0.004	0.038 *	-	-	-
039SB022	-	-	-	-	-	0.40 *	-
039SB023	-	-	-	-	-	0.44 *	-
039SB024	-	-	-	-	-	0.38	-
039SB038	-	-	-	-	-	0.42 *	-

Note: Blank entries indicate parameter was not analyzed for in that sample

** - indicates samples were non-detect for specified parameter; values represent ½ the sample quantification limit*

SWMU 39
Site Risk and Hazard Summary

Surface Soil Ingestion

	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor-1260	Arsenic	BEQ	Beryllium	Site Totals
Residential Scenario								
Hazard Quotient (HQ):	NA	NA	2.6E-04	NA	2.9E-01	NA	4.4E-04	2.9E-01
Background HQ:	NA	NA	0.0E+00	NA	4.0E-01	NA	0.0E+00	4.0E-01
HQ Above Background (Child):	**0.0E+00**	**0.0E+00**	**2.6E-04**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**4.4E-04**	7.1E-04
Incremental Excess Lifetime Cancer Risk (ILCR):	2.7E-09	6.3E-09	5.4E-09	3.2E-07	1.6E-05	1.5E-05	1.2E-06	3.2E-05
Background ILCR:	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E-05	6.7E-06	0.0E+00	2.9E-05
ILCR Above Background:	**2.7E-09**	**6.3E-09**	**5.4E-09**	**3.2E-07**	**0.0E+00**	**7.8E-06**	**1.2E-06**	9.3E-06
Industrial Scenario (Adult Site Worker)								
Hazard Quotient (HQ):	NA	NA	1.0E-05	NA	1.1E-02	NA	1.7E-05	1.1E-02
Background HQ:	NA	NA	0.0E+00	NA	1.5E-02	NA	0.0E+00	1.5E-02
HQ Above Background:	**0.0E+00**	**0.0E+00**	**1.0E-05**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**1.7E-05**	2.7E-05
Incremental Excess Lifetime Cancer Risk (ILCR):	3.0E-10	7.0E-10	6.1E-10	3.5E-08	1.8E-06	1.6E-06	1.3E-07	3.6E-06
Background ILCR:	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E-06	7.5E-07	0.0E+00	3.2E-06
ILCR Above Background:	**3.0E-10**	**7.0E-10**	**6.1E-10**	**3.5E-08**	**0.0E+00**	**8.7E-07**	**1.3E-07**	1.0E-06

Surface Soil Dermal Contact

	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor-1260	Arsenic	BEQ	Beryllium	Site Totals
Residential Scenario								
Hazard Quotient (HQ):	NA	NA	1.3E-04	NA	5.9E-02	NA	8.9E-05	5.9E-02
Background HQ:	NA	NA	0.0E+00	NA	8.0E-02	NA	0.0E+00	8.0E-02
HQ Above Background (Child):	**0.0E+00**	**0.0E+00**	**1.3E-04**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**8.9E-05**	2.2E-04
Incremental Excess Lifetime Cancer Risk (ILCR):	1.2E-09	2.8E-09	2.4E-09	1.4E-07	1.8E-06	6.5E-06	1.3E-07	8.6E-06
Background ILCR:	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E-06	3.0E-06	0.0E+00	5.5E-06
ILCR Above Background:	**1.2E-09**	**2.8E-09**	**2.4E-09**	**1.4E-07**	**0.0E+00**	**3.5E-06**	**1.3E-07**	3.8E-06
Industrial Scenario (Adult Site Worker)								
Hazard Quotient (HQ):	NA	NA	5.0E-06	NA	2.2E-03	NA	3.4E-06	2.3E-03
Background HQ:	NA	NA	0.0E+00	NA	3.1E-03	NA	0.0E+00	3.1E-03
HQ Above Background:	**0.0E+00**	**0.0E+00**	**5.0E-06**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**3.4E-06**	8.4E-06
Incremental Excess Lifetime Cancer Risk (ILCR):	4.9E-10	1.2E-09	1.0E-09	5.8E-08	7.4E-07	2.7E-06	5.4E-08	3.5E-06
Background ILCR:	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-06	1.2E-06	0.0E+00	2.2E-06
ILCR Above Background:	**4.9E-10**	**1.2E-09**	**1.0E-09**	**5.8E-08**	**0.0E+00**	**1.4E-06**	**5.4E-08**	1.5E-06

Total Surface Soil Risk and Hazard

	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor-1260	Arsenic	BEQ	Beryllium	Site Totals
Residential Scenario								
HQ Above Background (Child):	**0.0E+00**	**0.0E+00**	**3.9E-04**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**5.3E-04**	**9.3E-04**
ILCR Above Background:	**3.9E-09**	**9.1E-09**	**7.9E-09**	**4.6E-07**	**0.0E+00**	**1.1E-05**	**1.3E-06**	**1.3E-05**
Industrial Scenario (Adult Site Worker)								
HQ Above Background:	**0.0E+00**	**0.0E+00**	**1.5E-05**	**0.0E+00**	**0.0E+00**	**0.0E+00**	**2.0E-05**	**3.5E-05**
ILCR Above Background:	**7.9E-10**	**1.9E-09**	**1.6E-09**	**9.3E-08**	**0.0E+00**	**2.3E-06**	**1.8E-07**	**2.6E-06**

SWMU 39

Point Risk Above Background

Residential

	4,4'-DDD		4,4'-DDE		4,4'-DDT		Aroclor-1260		Arsenic	BEQ		Beryllium		Point Risk Above Background
Background Risk:	0.0E+00		0.0E+00		0.0E+00		0.0E+00		2.5E-05	9.8E-06		0.0E+00		
039SB001	9.8E-10	*	1.4E-09	*	1.4E-09	*	3.2E-08	*	0.0E+00	5.0E-06	*	8.6E-07	*	5.9E-06
039SB002	4.9E-09	*	6.9E-09	*	6.9E-09	*	5.0E-06		0.0E+00	4.6E-06	*	8.6E-07	*	1.0E-05
039SB003	2.7E-09		2.7E-08		1.6E-08	*	3.6E-08	*	0.0E+00	5.0E-06	*	8.6E-07	*	5.9E-06
039SB004	9.8E-10	*	4.1E-08		1.4E-08		3.2E-08	*	0.0E+00	4.4E-06	*	8.2E-07	*	5.3E-06
039SB005	1.1E-09	*	1.5E-09	*	1.5E-09	*	3.6E-08	*	0.0E+00	8.6E-05		9.0E-07	*	8.7E-05
039SB006	1.2E-08		7.2E-09		1.5E-09	*	3.6E-08	*	2.2E-05	5.5E-06		3.4E-06		3.1E-05
039SB007	9.8E-10	*	1.4E-09	*	1.4E-09	*	4.4E-07		0.0E+00	4.2E-06	*	8.2E-07	*	5.5E-06
039SB008	1.1E-09	*	1.5E-09	*	1.5E-09	*	1.2E-07		0.0E+00	5.7E-06	*	9.0E-07	*	6.7E-06
039SB009	5.2E-09		1.4E-09	*	6.5E-09		3.2E-08	*	0.0E+00	4.0E-06	*	8.2E-07	*	4.9E-06
039SB010	3.8E-09		3.8E-09		1.4E-09	*	3.2E-08	*	0.0E+00	3.8E-06	*	1.8E-06		5.7E-06
039SB011	8.7E-09		7.6E-09		8.5E-09		3.2E-08	*	0.0E+00	3.5E-06		7.9E-07	*	4.3E-06
039SB012	9.8E-10	*	1.4E-09	*	1.4E-09	*	3.2E-08	*	0.0E+00	4.6E-06	*	8.6E-07	*	5.5E-06
039SB013	9.8E-10	*	1.4E-09	*	1.4E-09	*	3.2E-08	*	0.0E+00	4.4E-06	*	8.6E-07	*	5.3E-06
039SB014	9.8E-10	*	1.4E-09	*	2.0E-09	*	3.2E-08	*	0.0E+00	4.6E-06	*	8.6E-07	*	5.5E-06
039SB015	9.8E-10	*	1.4E-09	*	6.6E-09	*	3.2E-08	*	0.0E+00	4.6E-06	*	8.6E-07	*	5.5E-06
039SB016	7.1E-10	*	1.0E-09	*	1.3E-08		1.6E-07	*	0.0E+00	0.0E+00		0.0E+00		1.8E-07
039SB017	8.2E-10	*	1.2E-09	*	1.2E-09	*	1.8E-07	*	0.0E+00	0.0E+00		0.0E+00		1.8E-07
039SB018	7.6E-10	*	1.1E-09	*	1.1E-09	*	1.7E-07	*	0.0E+00	0.0E+00		0.0E+00		1.7E-07
039SB020	7.6E-10	*	1.1E-09	*	1.1E-09	*	1.7E-07	*	0.0E+00	0.0E+00		0.0E+00		1.8E-07
039SB025	7.6E-10	*	1.1E-09	*	2.8E-09		1.7E-07	*	0.0E+00	0.0E+00		0.0E+00		1.8E-07
039SB022	0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	*	0.0E+00		0.0E+00
039SB023	0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	*	0.0E+00		0.0E+00
039SB024	0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00		0.0E+00		0.0E+00
039SB038	0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	*	0.0E+00		0.0E+00

Industrial

	4,4'-DDD		4,4'-DDE		4,4'-DDT		Aroclor-1260		Arsenic	BEQ		Beryllium		Point Risk Above Background
Background Risk:	0.0E+00		0.0E+00		0.0E+00		0.0E+00		3.5E-06	2.0E-06		0.0E+00		
039SB001	2.0E-10	*	2.8E-10	*	2.8E-10	*	6.5E-09	*	0.0E+00	1.0E-06	*	1.2E-07	*	1.1E-06
039SB002	1.0E-09	*	1.4E-09	*	1.4E-09	*	1.0E-06		0.0E+00	9.3E-07	*	1.2E-07	*	2.1E-06
039SB003	5.5E-10		5.5E-09		3.2E-09	*	7.4E-09	*	0.0E+00	1.0E-06	*	1.2E-07	*	1.1E-06
039SB004	2.0E-10	*	8.3E-09		2.8E-09		6.5E-09	*	0.0E+00	8.9E-07	*	1.2E-07	*	1.0E-06
039SB005	2.2E-10	*	3.1E-10	*	3.1E-10	*	7.4E-09	*	0.0E+00	1.7E-05		1.3E-07	*	1.8E-05
039SB006	2.4E-09		1.5E-09		3.1E-10	*	7.4E-09	*	3.1E-06	1.1E-06		4.8E-07		4.7E-06
039SB007	2.0E-10	*	2.8E-10	*	2.8E-10	*	9.0E-08		0.0E+00	8.5E-07	*	1.2E-07	*	1.1E-06
039SB008	2.2E-10	*	3.1E-10	*	3.1E-10	*	2.4E-08		0.0E+00	1.2E-06	*	1.3E-07	*	1.3E-06
039SB009	1.1E-09		2.8E-10	*	1.3E-09		6.5E-09	*	0.0E+00	8.1E-07	*	1.2E-07	*	9.4E-07
039SB010	7.6E-10		7.7E-10		2.8E-10	*	6.5E-09	*	0.0E+00	7.8E-07	*	2.5E-07		1.0E-06
039SB011	1.8E-09		1.6E-09		1.7E-09		6.5E-09	*	0.0E+00	7.1E-07		1.1E-07	*	8.3E-07
039SB012	2.0E-10	*	2.8E-10	*	2.8E-10	*	6.5E-09	*	0.0E+00	9.3E-07	*	1.2E-07	*	1.1E-06
039SB013	2.0E-10	*	2.8E-10	*	2.8E-10	*	6.5E-09	*	0.0E+00	8.9E-07	*	1.2E-07	*	1.0E-06
039SB014	2.0E-10	*	2.8E-10	*	4.2E-10	*	6.5E-09	*	0.0E+00	9.3E-07	*	1.2E-07	*	1.1E-06
039SB015	2.0E-10	*	2.8E-10	*	1.3E-09	*	6.5E-09	*	0.0E+00	9.3E-07	*	1.2E-07	*	1.1E-06
039SB016	1.4E-10	*	2.0E-10	*	2.7E-09		3.3E-08	*	0.0E+00	0.0E+00		0.0E+00		3.6E-08
039SB017	1.7E-10	*	2.4E-10	*	2.4E-10	*	3.7E-08	*	0.0E+00	0.0E+00		0.0E+00		3.8E-08
039SB018	1.5E-10	*	2.2E-10	*	2.2E-10	*	3.4E-08	*	0.0E+00	0.0E+00		0.0E+00		3.5E-08
039SB020	1.5E-10	*	2.2E-10	*	2.2E-10	*	3.5E-08	*	0.0E+00	0.0E+00		0.0E+00		3.6E-08
039SB025	1.5E-10	*	2.2E-10	*	5.6E-10		3.5E-08	*	0.0E+00	0.0E+00		0.0E+00		3.6E-08
039SB022	0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	*	0.0E+00		0.0E+00
039SB023	0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	*	0.0E+00		0.0E+00
039SB024	0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00		0.0E+00		0.0E+00
039SB038	0.0E+00		0.0E+00		0.0E+00		0.0E+00		0.0E+00	0.0E+00	*	0.0E+00		0.0E+00

SWMU 39

Point Risk Reduction Summary

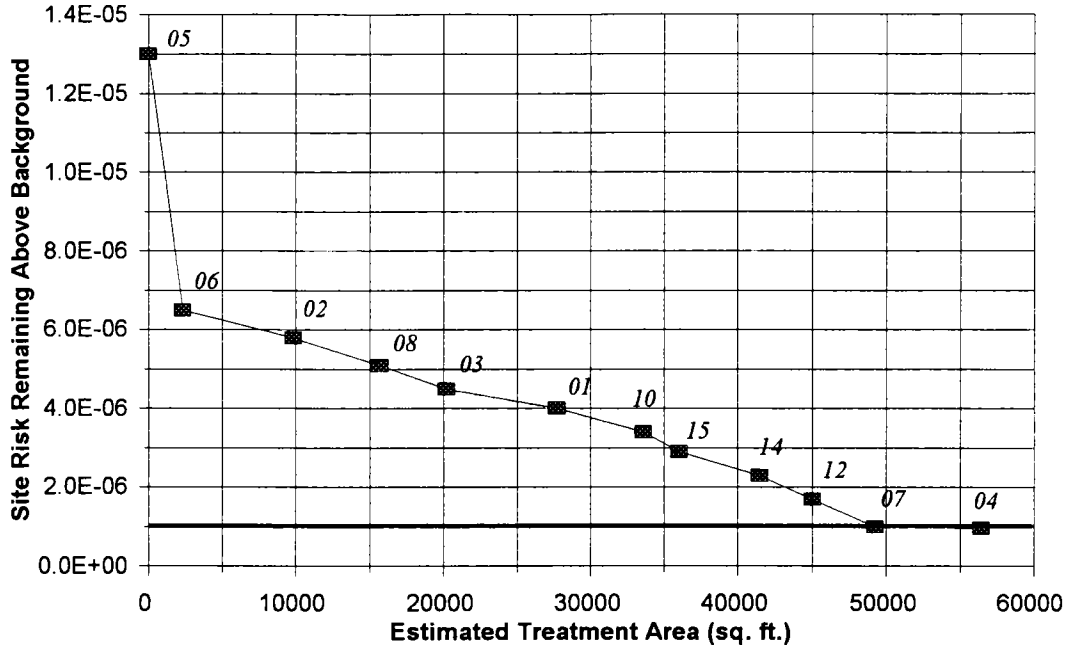
Residential

Boring I.D.	Estimated Area*	Cumulative Area	Point Risk Above Background	Risk/Area Ratio	Site Risk Remaining Above Background Prior to Sample Point Removal
039SB005	2363	0	8.7E-05	4.0E-08	1.3E-05
039SB006	7500	2363	3.1E-05	5.9E-09	6.5E-06
039SB002	5883	9863	1.0E-05	1.8E-09	5.8E-06
039SB008	4461	15746	6.7E-06	1.5E-09	5.1E-06
039SB003	7500	20207	5.9E-06	8.7E-10	4.5E-06
039SB001	5880	27707	5.9E-06	1.0E-09	4E-06
039SB010	2457	33587	5.7E-06	4.6E-09	3.4E-06
039SB015	5454	36044	5.5E-06	1.0E-09	2.9E-06
039SB014	3545	41498	5.5E-06	1.5E-09	2.3E-06
039SB012	4202	45042	5.5E-06	1.3E-09	1.7E-06
039SB007	7203	49244	5.5E-06	7.6E-10	1E-06
039SB004	3035	56447	5.3E-06	2.3E-09	9.7E-07
039SB013	2929	59482	5.3E-06	1.8E-09	
039SB009	5671	62411	4.9E-06	8.6E-10	
039SB011	1358	68082	4.3E-06	4.4E-09	
039SB017	2391	69440	1.8E-07	7.7E-11	
039SB025	3767	71831	1.8E-07	4.7E-11	
039SB016	1438	75598	1.8E-07	1.2E-10	
039SB020	4184	77036	1.8E-07	4.2E-11	
039SB018	1021	81219	1.7E-07	1.7E-10	
039SB024	1934	82240	0.0E+00	0.0E+00	
039SB038	7500	84174	0.0E+00	0.0E+00	
039SB022	1245	91674	0.0E+00	0.0E+00	
039SB023	3442	92919	0.0E+00	0.0E+00	

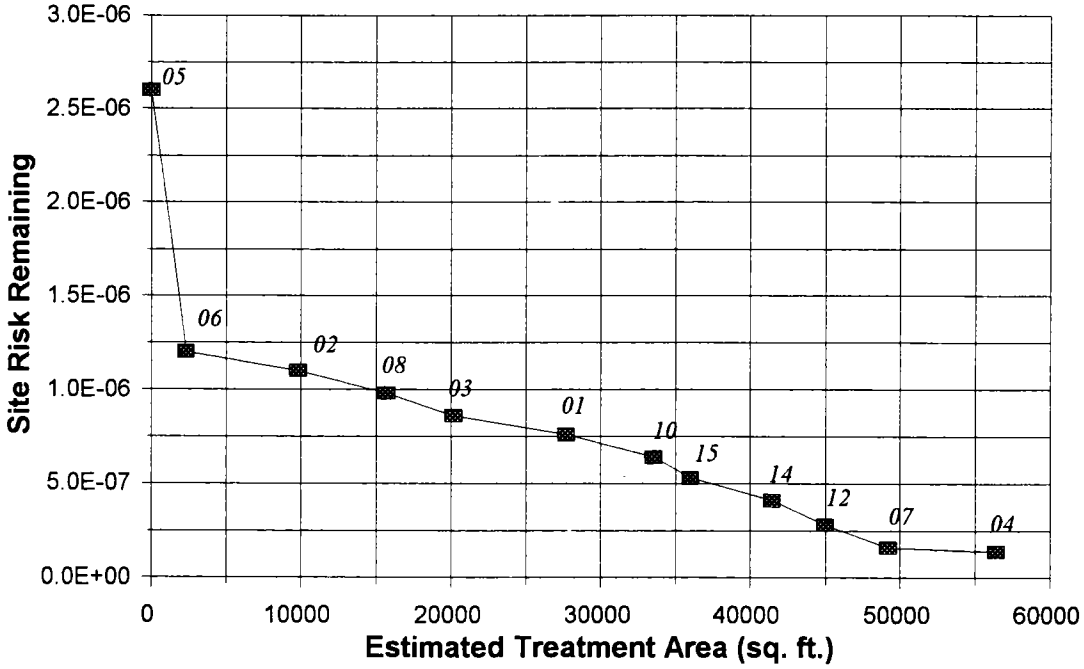
Industrial

Boring I.D.	Estimated Area*	Cumulative Area	Point Risk Above Background	Risk/Area Ratio	Site Risk Remaining Above Background Prior to Sample Point Removal
039SB005	2363	0	1.8E-05	7.5E-09	2.6E-06
039SB006	7500	2363	4.7E-06	6.3E-10	1.2E-06
039SB002	5883	9863	2.1E-06	3.5E-10	1.1E-06
039SB008	4461	15746	1.3E-06	3.0E-10	9.8E-07
039SB003	7500	20207	1.1E-06	1.5E-10	8.6E-07
039SB001	5880	27707	1.1E-06	1.9E-10	7.6E-07
039SB010	2457	33587	1.0E-06	4.2E-10	6.4E-07
039SB015	5454	36044	1.1E-06	1.9E-10	5.3E-07
039SB014	3545	41498	1.1E-06	3.0E-10	4.1E-07
039SB012	4202	45042	1.1E-06	2.5E-10	2.8E-07
039SB007	7203	49244	1.1E-06	1.5E-10	1.6E-07
039SB004	3035	56447	1.0E-06	3.4E-10	1.4E-07
039SB013	2929	59482	1.0E-06	3.5E-10	
039SB009	5671	62411	9.4E-07	1.7E-10	
039SB011	1358	68082	8.3E-07	6.1E-10	
039SB017	2391	69440	3.8E-08	1.6E-11	
039SB025	3767	71831	3.6E-08	9.6E-12	
039SB016	1438	75598	3.6E-08	2.5E-11	
039SB020	4184	77036	3.6E-08	8.5E-12	
039SB018	1021	81219	3.5E-08	3.4E-11	
039SB024	1934	82240	0.0E+00	0.0E+00	
039SB038	7500	84174	0.0E+00	0.0E+00	
039SB022	1245	91674	0.0E+00	0.0E+00	
039SB023	3442	92919	0.0E+00	0.0E+00	

SWMU 39 Point Removal
Residential Risk Reduction Graph



SWMU 39 Point Removal
Industrial Risk Reduction Graph



SWMU 42/ AOC 505
Site Data Summary

	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor-1260	Arsenic	BEQ	Beryllium
Number of Samples (n):	27.00	27.00	27.00	27.00	32.00	46.00	32.00
Standard Deviation of Ln Transformed Data:	1.80	1.84	1.89	1.66	1.18	0.57	0.38
Sample Mean of Ln Transformed Data:	-5.28	-4.40	-4.67	-3.70	1.88	-0.17	-1.90
H-Stat Interpolation							
n(low)	21.00	21.00	21.00	21.00	31.00	31.00	31.00
n(high)	31.00	31.00	31.00	31.00	51.00	51.00	51.00
S(low)	1.75	1.75	1.75	1.50	1.00	0.50	0.30
S(high)	2.00	2.00	2.00	1.75	1.25	0.60	0.40
H(NL,SL)	3.72	3.72	3.72	3.31	2.42	1.93	1.79
H(NL,SH)	4.14	4.14	4.14	3.72	2.74	2.01	1.86
H(NH,SL)	3.44	3.44	3.44	3.08	2.31	1.88	1.76
H(NH,SH)	3.81	3.81	3.81	3.44	2.58	1.95	1.81
NL Interp	3.81	3.88	3.96	3.58	2.64	1.99	1.85
NH Interp	3.52	3.58	3.65	3.31	2.50	1.93	1.80
H-stat:	3.63	3.70	3.78	3.42	2.64	1.94	1.84
95% UCL:	0.09	0.26	0.23	0.30	22.71	1.17	0.18
Maximum_Value:	0.70	2.50	2.30	0.01	38.60	7.39	0.38
Exposure Point Concentation (mg/kg):	0.09	0.26	0.23	0.01	22.71	1.17	0.18
Background Conc. (mg/kg):	0.00	0.00	0.00	0.00	9.44	0.59	0.00
BORING_ID							
042SB001	2.0E-03 *	2.0E-03 *	2.4E-03 *	8.0E-03 *	1.5E+00	8.7E-01 *	1.2E-01
042SB002	1.8E-03 *	1.8E-03 *	1.8E-03 *	7.0E-03 *	2.3E+00	8.2E-01 *	2.7E-01
042SB003	1.8E-03 *	1.8E-03 *	1.8E-03 *	7.0E-03 *	2.0E+00	8.4E-01 *	3.7E-01
042SB004	1.8E-03 *	1.8E-03 *	9.7E-03	7.0E-03 *	1.8E+00	8.6E-01 *	1.1E-01
042SB005	1.8E-03 *	1.8E-03 *	1.8E-03 *	7.0E-03 *	2.1E+00	8.7E-01 *	1.1E-01
042SB006	2.0E-03 *	2.0E-03 *	7.2E-03	8.0E-03 *	4.7E-01 *	8.9E-01 *	1.1E-01
042SB007	2.3E-03 *	6.9E-02	4.7E-02	9.0E-03 *	5.5E+00	1.2E+00	1.4E-01
042SB008	2.0E-03 *	2.0E-03 *	1.9E-02	8.0E-03 *	1.1E+00	8.7E-01 *	1.2E-01
042SB009	2.0E-03 *	7.2E-02	6.2E-02	8.0E-03 *	6.1E+00	7.8E-01	1.2E-01
042SB010	7.0E-01	2.5E+00	2.3E+00	1.1E-02 *	1.2E+01	1.9E+00	3.8E-01
042SB011					3.2E+00	5.4E-01	1.9E-01
042SB012					4.8E+00	8.7E-01	2.8E-01
042SB013					9.5E+00	6.3E-01	1.9E-01
042SB014					3.0E+01	1.2E+00	2.7E-01
042SB015					4.9E+00	8.6E-01 *	1.8E-01
042SB016					2.8E+01	1.1E+00	1.7E-01
042SB017					3.9E+01	1.9E+00	2.3E-01
042SB018					2.6E+00	8.8E-01 *	1.3E-01
042SB019					6.3E+00	3.7E-01	1.7E-01
042SB020					3.2E+01	8.3E-0 *	9.0E-02
042SB021					2.5E+01	5.4E-01	1.3E-01
042SB022						1.4E+00	
042SB023						7.4E-01	
042SB024						7.4E+00	
042SB025						8.4E-01 *	
505SB001	2.3E-03 *	2.3E-03 *	2.3E-03 *	9.0E-03 *	2.9E+00	1.1E+00 *	1.4E-01 *
505SB002	2.0E-03 *	3.9E-02	2.0E-03 *	2.7E-01	6.2E+01	7.0E-01	1.2E-01 *
505SB003	2.0E-03 *	3.4E-02	1.7E-01	8.0E-03 *	3.3E+00	8.9E-01 *	1.2E-01 *
505SB004	2.0E-03 *	2.0E-02	2.0E-03 *	8.0E-03 *	6.6E+00	1.0E+00	1.2E-01 *
505SB005	2.0E-03 *	2.0E-03 *	2.0E-03 *	8.3E-02	8.6E+00	8.8E-01	1.2E-01 *
505SB006	2.2E-03 *	1.2E-02	3.7E-02	2.1E-01	7.0E+00	8.6E-01	1.3E-01 *
505SB007	2.2E-03 *	4.5E-02	2.2E-03 *	7.8E-01	1.8E+01	1.4E+00	1.4E-01 *
505SB008	2.5E-03 *	5.4E-02	2.5E-03 *	1.8E+00	1.3E+01	2.3E+00	1.5E-01 *
505SB009	1.8E-03 *	1.8E-03 *	8.1E-03	7.0E-03 *	3.6E+00	8.8E-01 *	1.2E-01 *
505SB010	2.0E-03 *	2.0E-03 *	4.3E-02	8.0E-03 *	3.3E+01	8.8E-01	1.1E-01 *
505SB011	1.8E-03 *	7.6E-02	6.5E-02	7.0E-03 *	1.0E+01	8.3E-01 *	1.1E-01 *
505SB012	1.8E-02	2.0E-02	2.1E-02	3.9E-02 *		2.7E-01	
505SB013	7.0E-02	1.5E-02	1.4E-03 *	3.8E-02 *		8.7E-01 *	
505SB014	6.9E-01	7.9E-02	2.1E-02	4.1E-01 *		2.9E-01	
505SB015	3.0E-02	1.2E-02	1.4E-03 *	3.8E-02 *		2.6E-01	
505SB016	9.0E-03	1.4E-02	1.5E-03 *	3.9E-02 *		2.9E-01	
505SB017	6.8E-02	6.4E-02	8.4E-02	3.8E-02 *		3.7E-01	
505SB018						8.1E-01	
505SB019						8.4E-01 *	
505SB020						9.2E-01 *	
505SB021						8.2E-01	

Note: Blank entries indicate parameter was not analyzed for in that sample
** indicates the sample was non-detect for that parameter*

SWMU 42/ AOC 505
Site Risk and Hazard Summary

Surface Soil Ingestion

	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor-1260	Arsenic	BEQ	Beryllium	Site Totals
Residential Scenario								
Hazard Quotient (HQ):	NA	NA	5.9E-03	NA	9.7E-01	NA	4.7E-04	9.7E-01
Background HQ:	NA	NA	0.0E+00	NA	4.0E-01	NA	0.0E+00	4.0E-01
HQ Above Background (Child):	**0.0E+00**	**0.0E+00**	**5.9E-03**	**0.0E+00**	**5.7E-01**	**0.0E+00**	**4.7E-04**	5.7E-01
Incremental Excess Lifetime Cancer Risk (ILCR):	3.5E-08	1.4E-07	1.2E-07	3.3E-08	5.3E-05	1.3E-05	1.2E-06	6.8E-05
Background ILCR:	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.2E-05	6.7E-06	0.0E+00	2.9E-05
ILCR Above Background:	**3.5E-08**	**1.4E-07**	**1.2E-07**	**3.3E-08**	**3.1E-05**	**6.7E-06**	**1.2E-06**	3.9E-05
Industrial Scenario (Adult Site Worker)								
Hazard Quotient (HQ):	NA	NA	2.2E-04	NA	3.7E-02	NA	1.8E-05	3.7E-02
Background HQ:	NA	NA	0.0E+00	NA	1.5E-02	NA	0.0E+00	1.5E-02
HQ Above Background:	**0.0E+00**	**0.0E+00**	**2.2E-04**	**0.0E+00**	**2.2E-02**	**0.0E+00**	**1.8E-05**	2.2E-02
Incremental Excess Lifetime Cancer Risk (ILCR):	3.9E-09	1.5E-08	1.4E-08	3.7E-09	6.0E-06	1.5E-06	1.4E-07	7.6E-06
Background ILCR:	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E-06	7.5E-07	0.0E+00	3.2E-06
ILCR Above Background:	**3.9E-09**	**1.5E-08**	**1.4E-08**	**3.7E-09**	**3.5E-06**	**7.4E-07**	**1.4E-07**	4.4E-06

Surface Soil Dermal Contact

	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor-1260	Arsenic	BEQ	Beryllium	Site Totals
Residential Scenario								
Hazard Quotient (HQ):	NA	NA	2.9E-03	NA	1.9E-01	NA	9.4E-05	2.0E-01
Background HQ:	NA	NA	0.0E+00	NA	8.0E-02	NA	0.0E+00	8.0E-02
HQ Above Background (Child):	**0.0E+00**	**0.0E+00**	**2.9E-03**	**0.0E+00**	**1.1E-01**	**0.0E+00**	**9.4E-05**	1.2E-01
Incremental Excess Lifetime Cancer Risk (ILCR):	1.6E-08	6.1E-08	5.5E-08	1.5E-08	6.0E-06	6.0E-06	1.4E-07	1.2E-05
Background ILCR:	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.5E-06	3.0E-06	0.0E+00	5.5E-06
ILCR Above Background:	**1.6E-08**	**6.1E-08**	**5.5E-08**	**1.5E-08**	**3.5E-06**	**3.0E-06**	**1.4E-07**	6.8E-06
Industrial Scenario (Adult Site Worker)								
Hazard Quotient (HQ):	NA	NA	1.1E-04	NA	7.4E-03	NA	3.6E-06	7.5E-03
Background HQ:	NA	NA	0.0E+00	NA	3.1E-03	NA	0.0E+00	3.1E-03
HQ Above Background:	**0.0E+00**	**0.0E+00**	**1.1E-04**	**0.0E+00**	**4.3E-03**	**0.0E+00**	**3.6E-06**	4.4E-03
Incremental Excess Lifetime Cancer Risk (ILCR):	6.4E-09	2.5E-08	2.2E-08	6.0E-09	2.4E-06	2.5E-06	5.6E-08	5.0E-06
Background ILCR:	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.0E-06	1.2E-06	0.0E+00	2.2E-06
ILCR Above Background:	**6.4E-09**	**2.5E-08**	**2.2E-08**	**6.0E-09**	**1.4E-06**	**1.2E-06**	**5.6E-08**	2.8E-06

Total Surface Soil Risk and Hazard

	4,4'-DDD	4,4'-DDE	4,4'-DDT	Aroclor-1260	Arsenic	BEQ	Beryllium	Site Totals
Residential Scenario								
HQ Above Background (Child):	**0.0E+00**	**0.0E+00**	**8.8E-03**	**0.0E+00**	**6.8E-01**	**0.0E+00**	**5.6E-04**	**6.9E-01**
ILCR Above Background:	**5.1E-08**	**2.0E-07**	**1.8E-07**	**4.8E-08**	**3.5E-05**	**9.6E-06**	**1.4E-06**	**4.6E-05**
Industrial Scenario (Adult Site Worker)								
HQ Above Background:	**0.0E+00**	**0.0E+00**	**3.4E-04**	**0.0E+00**	**2.6E-02**	**0.0E+00**	**2.2E-05**	**2.6E-02**
ILCR Above Background:	**1.0E-08**	**4.0E-08**	**3.6E-08**	**9.7E-09**	**4.9E-06**	**2.0E-06**	**1.9E-07**	**7.2E-06**

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Point Risk Above Background

Residential

	4,4'-DDD		4,4'-DDE		4,4'-DDT		Aroclor-1260		Arsenic		BEQ		Beryllium		Point Risk Above Background
Background Risk:	0.0E+00		0.0E+00		0.0E+00		0.0E+00		2.5E-05		9.8E-06		0.0E+00		
042SB001	1.1E-09	*	1.5E-09	*	1.9E-09	*	3.6E-08	*	0.0E+00		4.6E-06	*	8.6E-07		5.5E-06
042SB002	9.8E-10	*	1.4E-09	*	1.4E-09	*	3.2E-08	*	0.0E+00		3.8E-06	*	2.0E-06		5.9E-06
042SB003	9.8E-10	*	1.4E-09	*	1.4E-09	*	3.2E-08	*	0.0E+00		4.2E-06	*	2.8E-06		7.0E-06
042SB004	9.8E-10	*	1.4E-09	*	7.5E-09		3.2E-08	*	0.0E+00		4.4E-06	*	8.2E-07		5.3E-06
042SB005	9.8E-10	*	1.4E-09	*	1.4E-09	*	3.2E-08	*	0.0E+00		4.6E-06	*	8.2E-07		5.4E-06
042SB006	1.1E-09	*	1.5E-09	*	5.6E-09		3.6E-08	*	0.0E+00	*	5.0E-06	*	8.2E-07		5.8E-06
042SB007	1.3E-09	*	5.3E-08		3.6E-08		4.1E-08	*	0.0E+00		1.1E-05		1.0E-06		1.2E-05
042SB008	1.1E-09	*	1.5E-09	*	1.5E-08		3.6E-08	*	0.0E+00		4.6E-06	*	8.6E-07		5.5E-06
042SB009	1.1E-09	*	5.6E-08		4.8E-08		3.6E-08	*	0.0E+00		3.2E-06		8.6E-07		4.2E-06
042SB010	3.8E-07		1.9E-06		1.8E-06		4.8E-08	*	7.5E-06		2.2E-05		2.8E-06		3.6E-05
042SB011	NS		NS		NS		NS		0.0E+00		0.0E+00		1.4E-06		1.4E-06
042SB012	NS		NS		NS		NS		0.0E+00		4.6E-06		2.1E-06		6.7E-06
042SB013	NS		NS		NS		NS		1.6E-07		6.1E-07		1.4E-06		2.2E-06
042SB014	NS		NS		NS		NS		5.4E-05		1.1E-05		2.0E-06		6.7E-05
042SB015	NS		NS		NS		NS		0.0E+00		4.4E-06	*	1.3E-06		5.7E-06
042SB016	NS		NS		NS		NS		4.9E-05		7.9E-06		1.3E-06		5.8E-05
042SB017	NS		NS		NS		NS		7.6E-05		2.1E-05		1.7E-06		9.9E-05
042SB018	NS		NS		NS		NS		0.0E+00		4.8E-06	*	9.7E-07		5.7E-06
042SB019	NS		NS		NS		NS		0.0E+00		0.0E+00		1.3E-06		1.3E-06
042SB020	NS		NS		NS		NS		5.8E-05		4.0E-06	*	6.7E-07		6.3E-05
042SB021	NS		NS		NS		NS		4.2E-05		0.0E+00		9.7E-07		4.3E-05
042SB022	NS		NS		NS		NS		NS		1.3E-05		NS		1.3E-05
042SB023	NS		NS		NS		NS		NS		2.5E-06		NS		2.5E-06
042SB024	NS		NS		NS		NS		NS		1.1E-04		NS		1.1E-04
042SB025	NS		NS		NS		NS		NS		4.2E-06	*	NS		4.2E-06
505SB001	1.3E-09	*	1.8E-09	*	1.8E-09	*	4.1E-08	*	0.0E+00		7.8E-06	*	1.0E-06	*	8.9E-06
505SB002	1.1E-09	*	3.0E-08		1.5E-09	*	1.2E-06		1.4E-04		1.8E-06		8.6E-07	*	1.4E-04
505SB003	1.1E-09	*	2.6E-08		1.3E-07		3.6E-08	*	0.0E+00		5.0E-06	*	8.6E-07	*	6.0E-06
505SB004	1.1E-09	*	1.5E-08		1.5E-09	*	3.6E-08	*	0.0E+00		6.7E-06		8.6E-07	*	7.6E-06
505SB005	1.1E-09	*	1.5E-09	*	1.5E-09	*	3.8E-07		0.0E+00		4.9E-06		9.0E-07	*	6.1E-06
505SB006	1.2E-09	*	9.3E-09		2.9E-08		9.5E-07		0.0E+00		4.5E-06		9.4E-07	*	6.5E-06
505SB007	1.2E-09	*	3.5E-08		1.7E-09	*	3.5E-06		2.3E-05		1.3E-05		1.0E-06	*	4.0E-05
505SB008	1.4E-09	*	4.2E-08		1.9E-09	*	8.2E-06		9.0E-06		2.9E-05		1.1E-06	*	4.7E-05
505SB009	9.8E-10	*	1.4E-09	*	6.2E-09		3.2E-08	*	0.0E+00		4.8E-06	*	8.6E-07	*	5.7E-06
505SB010	1.1E-09	*	1.5E-09	*	3.3E-08		3.6E-08	*	6.2E-05		4.8E-06		8.2E-07	*	6.7E-05
505SB011	9.8E-10	*	5.9E-08		5.0E-08		3.2E-08	*	2.2E-06		4.0E-06	*	7.9E-07	*	7.2E-06
505SB012	9.8E-09		1.5E-08		1.6E-08		1.8E-07	*	NS		0.0E+00		NS		2.2E-07
505SB013	3.8E-08		1.2E-08		1.1E-09	*	1.7E-07	*	NS		4.6E-06	*	NS		4.8E-06
505SB014	3.8E-07		6.1E-08		1.6E-08		1.8E-06	*	NS		0.0E+00		NS		2.3E-06
505SB015	1.6E-08		9.3E-09		1.1E-09	*	1.7E-07	*	NS		0.0E+00		NS		2.0E-07
505SB016	4.9E-09		1.1E-08		1.1E-09	*	1.8E-07	*	NS		0.0E+00		NS		1.9E-07
505SB017	3.7E-08		4.9E-08		6.5E-08		1.7E-07	*	NS		0.0E+00		NS		3.2E-07
505SB018	NS		NS		NS		NS		NS		3.6E-06		NS		3.6E-06
505SB019	NS		NS		NS		NS		NS		4.2E-06	*	NS		4.2E-06
505SB020	NS		NS		NS		NS		NS		5.5E-06	*	NS		5.5E-06
505SB021	NS		NS		NS		NS		NS		3.8E-06		NS		3.8E-06

Industrial

	4,4'-DDD		4,4'-DDE		4,4'-DDT		Aroclor-1260		Arsenic		BEQ		Beryllium		Point Risk Above Background
Background Risk:	0.0E+00		0.0E+00		0.0E+00		0.0E+00		3.5E-06		2.0E-06		0.0E+00		
042SB001	2.2E-10	*	3.1E-10	*	3.8E-10	*	7.4E-09	*	0.0E+00		9.3E-07	*	1.2E-07		1.1E-06
042SB002	2.0E-10	*	2.8E-10	*	2.8E-10	*	6.5E-09	*	0.0E+00		7.8E-07	*	2.9E-07		1.1E-06
042SB003	2.0E-10	*	2.8E-10	*	2.8E-10	*	6.5E-09	*	0.0E+00		8.5E-07	*	3.9E-07		1.3E-06
042SB004	2.0E-10	*	2.8E-10	*	1.5E-09		6.5E-09	*	0.0E+00		8.9E-07	*	1.2E-07		1.0E-06
042SB005	2.0E-10	*	2.8E-10	*	2.8E-10	*	6.5E-09	*	0.0E+00		9.3E-07	*	1.2E-07		1.1E-06
042SB006	2.2E-10	*	3.1E-10	*	1.1E-09		7.4E-09	*	0.0E+00	*	1.0E-06	*	1.2E-07		1.1E-06
042SB007	2.5E-10	*	1.1E-08		7.4E-09		8.3E-09	*	0.0E+00		2.2E-06		1.5E-07		2.3E-06
042SB008	2.2E-10	*	3.1E-10	*	3.0E-09		7.4E-09	*	0.0E+00		9.3E-07	*	1.2E-07		1.1E-06
042SB009	2.2E-10	*	1.1E-08		9.7E-09		7.4E-09	*	0.0E+00		6.5E-07		1.2E-07		8.0E-07
042SB010	7.7E-08		3.9E-07		3.6E-07		9.7E-09	*	1.1E-06		4.4E-06		4.0E-07		6.7E-06
042SB011	NS		NS		NS		NS		0.0E+00		0.0E+00		2.0E-07		2.0E-07
042SB012	NS		NS		NS		NS		0.0E+00		9.3E-07		3.0E-07		1.2E-06
042SB013	NS		NS		NS		NS		2.2E-08		1.2E-07		2.0E-07		3.5E-07
042SB014	NS		NS		NS		NS		7.7E-06		2.1E-06		2.9E-07		1.0E-05
042SB015	NS		NS		NS		NS		0.0E+00		8.9E-07	*	1.9E-07		1.1E-06
042SB016	NS		NS		NS		NS		6.9E-06		1.6E-06		1.8E-07		8.7E-06
042SB017	NS		NS		NS		NS		1.1E-05		4.4E-06		2.4E-07		1.5E-05
042SB018	NS		NS		NS		NS		0.0E+00		9.7E-07	*	1.4E-07		1.1E-06
042SB019	NS		NS		NS		NS		0.0E+00		0.0E+00		1.8E-07		1.8E-07
042SB020	NS		NS		NS		NS		8.2E-06		8.1E-07	*	9.5E-08		9.1E-06
042SB021	NS		NS		NS		NS		5.9E-06		0.0E+00		1.4E-07		6.0E-06
042SB022	NS		NS		NS		NS		NS		2.6E-06		NS		2.6E-06
042SB023	NS		NS		NS		NS		NS		5.0E-07		NS		5.0E-07
042SB024	NS		NS		NS		NS		NS		2.3E-05		NS		2.3E-05
042SB025	NS		NS		NS		NS		NS		8.5E-07	*	NS		8.5E-07
505SB001	2.5E-10	*	3.6E-10	*	3.6E-10	*	8.3E-09	*	0.0E+00		1.6E-06	*	1.4E-07	*	1.7E-06
505SB002	2.2E-10	*	6.1E-09		3.1E-10	*	2.5E-07		1.9E-05		3.7E-07		1.2E-07	*	2.0E-05
505SB003	2.2E-10	*	5.3E-09		2.7E-08		7.4E-09	*	0.0E+00		1.0E-06	*	1.2E-07	*	1.2E-06
505SB004	2.2E-10	*	3.1E-09		3.1E-10	*	7.4E-09	*	0.0E+00		1.4E-06		1.2E-07	*	1.5E-06
505SB005	2.2E-10	*	3.1E-10	*	3.1E-10	*	7.7E-08		0.0E+00		9.9E-07		1.3E-07	*	1.2E-06
505SB006	2.4E-10	*	1.9E-09		5.8E-09		1.9E-07		0.0E+00		9.2E-07		1.3E-07	*	1.3E-06
505SB007	2.4E-10	*	7.1E-09		3.4E-10	*	7.2E-07		3.2E-06		2.6E-06		1.4E-07	*	6.7E-06
505SB008	2.8E-10	*	8.5E-09		3.9E-10	*	1.7E-06		1.3E-06		5.9E-06		1.5E-07	*	9.0E-06
505SB009	2.0E-10	*	2.8E-10	*	1.3E-09		6.5E-09	*	0.0E+00		9.7E-07	*	1.2E-07	*	1.1E-06
505SB010	2.2E-10	*	3.1E-10	*	6.7E-09		7.4E-09	*	8.7E-06		9.7E-07		1.2E-07	*	9.8E-06
505SB011	2.0E-10	*	1.2E-08		1.0E-08		6.5E-09	*	3.2E-07		8.1E-07	*	1.1E-07	*	1.3E-06
505SB012	2.0E-09		3.1E-09		3.3E-09		3.6E-08	*	NS		0.0E+00		NS		4.4E-08
505SB013	7.7E-09		2.4E-09		2.2E-10	*	3.5E-08	*	NS		9.3E-07	*	NS		9.8E-07
505SB014	7.6E-08		1.2E-08		3.3E-09		3.7E-07	*	NS		0.0E+00		NS		4.7E-07
505SB015	3.3E-09		1.9E-09		2.2E-10	*	3.5E-08	*	NS		0.0E+00		NS		4.0E-08
505SB016	1.0E-09		2.2E-09		2.3E-10	*	3.6E-08	*	NS		0.0E+00		NS		3.9E-08
505SB017	7.5E-09		1.0E-08		1.3E-08		3.5E-08	*	NS		0.0E+00		NS		6.5E-08
505SB018	NS		NS		NS		NS		NS		7.4E-07		NS		7.4E-07
505SB019	NS		NS		NS		NS		NS		8.5E-07	*	NS		8.5E-07
505SB020	NS		NS		NS		NS		NS		1.1E-06	*	NS		1.1E-06
505SB021	NS		NS		NS		NS		NS		7.8E-07		NS		7.8E-07

SWMU 42/ AOC 505

Point Risk Reduction Summary

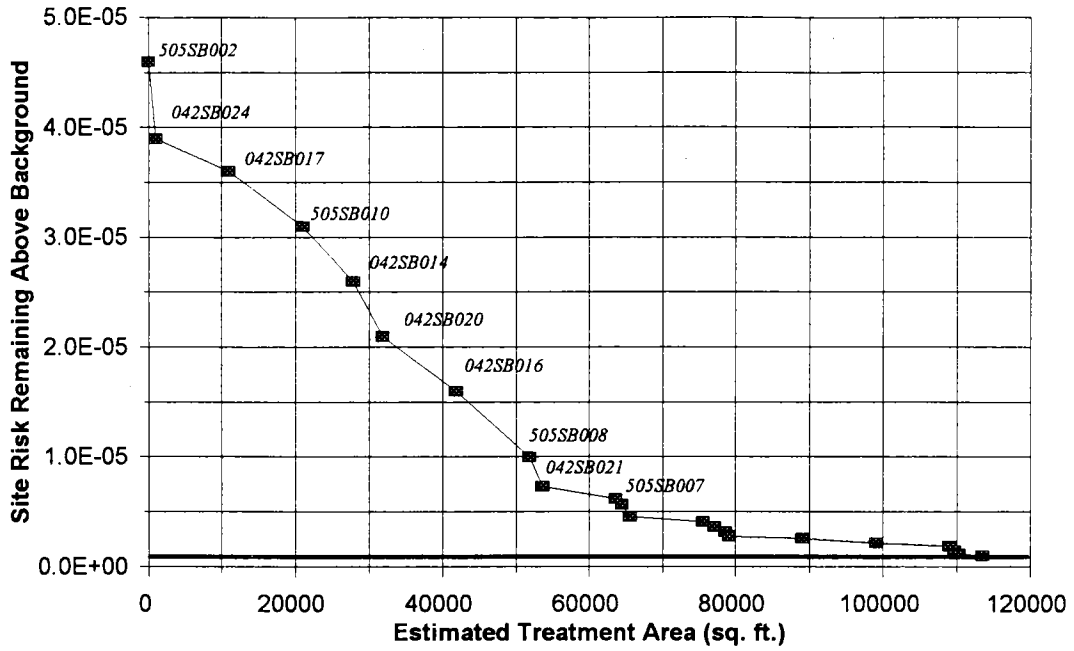
Residential

Boring I.D.	Estimated Area	Cumulative Area	Point Risk Above Background	Risk/Area Ratio	Site Risk Remaining Above Background Prior to Sample Point Removal
505SB002	1055	0	1.4E-04	1.3E-07	4.6E-05
042SB024	10000	1055	1.1E-04	1.1E-08	3.9E-05
042SB017	10000	11055	9.9E-05	9.9E-09	3.6E-05
505SB010	6848	21055	6.7E-05	9.9E-09	3.1E-05
042SB014	3948	27903	6.7E-05	1.7E-08	2.6E-05
042SB020	10000	31851	6.3E-05	6.3E-09	2.1E-05
042SB016	10000	41851	5.8E-05	5.8E-09	1.6E-05
505SB008	1755	51851	4.7E-05	2.7E-08	1E-05
042SB021	10000	53607	4.3E-05	4.3E-09	7.3E-06
505SB007	913	63607	4.0E-05	4.4E-08	6.2E-06
042SB010	1075	64520	3.6E-05	3.4E-08	5.7E-06
042SB022	10000	65595	1.3E-05	1.3E-09	4.6E-06
042SB007	1524	75595	1.2E-05	7.7E-09	4.1E-06
505SB001	1459	77118	8.9E-06	6.1E-09	3.6E-06
505SB004	576	78577	7.6E-06	1.3E-08	3.2E-06
505SB011	10000	79153	7.2E-06	7.2E-10	2.8E-06
042SB003	10000	89153	7.0E-06	7.0E-10	2.6E-06
042SB012	10000	99153	6.7E-06	6.7E-10	2.2E-06
505SB006	555	109153	6.5E-06	1.2E-08	1.9E-06
505SB005	636	109708	6.1E-06	9.7E-09	1.5E-06
505SB003	3251	110344	6.0E-06	1.9E-09	1.2E-06
042SB002	5764	113595	5.9E-06	1.0E-09	9.9E-07
042SB006	10452	119359	5.8E-06	5.6E-10	
042SB018	1517	129811	5.7E-06	3.8E-09	
042SB015	3964	131328	5.7E-06	1.4E-09	
505SB009	10000	135292	5.7E-06	5.7E-10	
505SB020	10000	145292	5.5E-06	5.5E-10	
042SB008	5314	155292	5.5E-06	1.0E-09	
042SB001	10000	160606	5.5E-06	5.5E-10	
042SB005	10000	170606	5.4E-06	5.4E-10	
042SB004	10000	180606	5.3E-06	5.3E-10	
505SB013	2155	190606	4.8E-06	2.2E-09	
042SB009	1795	192761	4.2E-06	2.4E-09	
042SB025	10000	194556	4.2E-06	4.2E-10	
505SB019	5241	204556	4.2E-06	8.0E-10	
505SB021	8606	209797	3.8E-06	4.4E-10	
505SB018	4613	218403	3.6E-06	7.8E-10	
042SB023	9148	223016	2.5E-06	2.7E-10	
505SB014	2457	232165	2.3E-06	9.3E-10	
042SB013	2523	234622	2.2E-06	8.7E-10	
042SB011	2869	237145	1.4E-06	5.0E-10	
042SB019	10000	240014	1.3E-06	1.3E-10	
505SB017	1491	250014	3.2E-07	2.2E-10	
505SB012	1910	251505	2.2E-07	1.1E-10	
505SB015	7447	253415	2.0E-07	2.6E-11	
505SB016	10000	260862	1.9E-07	1.9E-11	

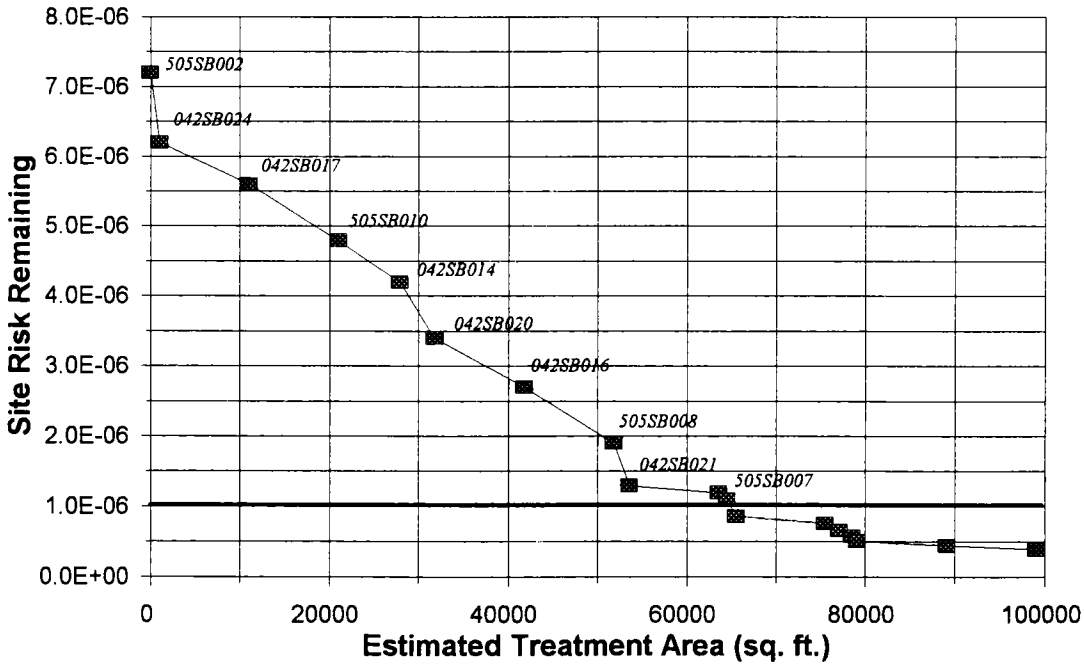
Industrial

Boring I.D.	Estimated Area	Cumulative Area	Point Risk Above Background	Risk/Area Ratio	Site Risk Remaining Above Background Prior to Sample Point Removal
505SB002	1055	0	2.0E-05	1.9E-08	7.2E-06
042SB024	10000	1055	2.3E-05	2.3E-09	6.2E-06
042SB017	10000	11055	1.5E-05	1.5E-09	5.6E-06
505SB010	6848	21055	9.8E-06	1.4E-09	4.8E-06
042SB014	3948	27903	1.0E-05	2.6E-09	4.2E-06
042SB020	10000	31851	9.1E-06	9.1E-10	3.4E-06
042SB016	10000	41851	8.7E-06	8.7E-10	2.7E-06
505SB008	1755	51851	9.0E-06	5.1E-09	1.9E-06
042SB021	10000	53607	6.0E-06	6.0E-10	1.3E-06
505SB007	913	63607	6.7E-06	7.4E-09	1.2E-06
042SB010	1075	64520	6.7E-06	6.2E-09	1.1E-06
042SB022	10000	65595	2.6E-06	2.6E-10	8.6E-07
042SB007	1524	75595	2.3E-06	1.5E-09	7.6E-07
505SB001	1459	77118	1.7E-06	1.2E-09	6.6E-07
505SB004	576	78577	1.5E-06	2.6E-09	5.8E-07
505SB011	10000	79153	1.3E-06	1.3E-10	5.1E-07
042SB003	10000	89153	1.3E-06	1.3E-10	4.5E-07
042SB012	10000	99153	1.2E-06	1.2E-10	3.9E-07
505SB006	555	109153	1.3E-06	2.3E-09	3.2E-07
505SB005	636	109708	1.2E-06	1.9E-09	2.6E-07
505SB003	3251	110344	1.2E-06	3.6E-10	1.9E-07
042SB002	5764	113595	1.1E-06	1.9E-10	1.4E-07
042SB006	10452	119359	1.1E-06	1.1E-10	
042SB018	1517	129811	1.1E-06	7.3E-10	
042SB015	3964	131328	1.1E-06	2.7E-10	
505SB009	10000	135292	1.1E-06	1.1E-10	
505SB020	10000	145292	1.1E-06	1.1E-10	
042SB008	5314	155292	1.1E-06	2.0E-10	
042SB001	10000	160606	1.1E-06	1.1E-10	
042SB005	10000	170606	1.1E-06	1.1E-10	
042SB004	10000	180606	1.0E-06	1.0E-10	
505SB013	2155	190606	9.8E-07	4.5E-10	
042SB009	1795	192761	8.0E-07	4.5E-10	
042SB025	10000	194556	8.5E-07	8.5E-11	
505SB019	5241	204556	8.5E-07	1.6E-10	
505SB021	8606	209797	7.8E-07	9.0E-11	
505SB018	4613	218403	7.4E-07	1.6E-10	
042SB023	9148	223016	5.0E-07	5.5E-11	
505SB014	2457	232165	4.7E-07	1.9E-10	
042SB013	2523	234622	3.5E-07	1.4E-10	
042SB011	2869	237145	2.0E-07	7.0E-11	
042SB019	10000	240014	1.8E-07	1.8E-11	
505SB017	1491	250014	6.5E-08	4.4E-11	
505SB012	1910	251505	4.4E-08	2.3E-11	
505SB015	7447	253415	4.0E-08	5.4E-12	
505SB016	10000	260862	3.9E-08	3.9E-12	

SWMU 42 and AOC 505 Point Removal
Residential Risk Reduction Graph



SWMU 42 and AOC 505 Point Removal
Industrial Risk Reduction Graph



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
9 September, 1998

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

Subj: SUBMITTAL OF ZONE A DRAFT CORRECTIVE MEASURES STUDY WORKPLAN RESPONSE TO COMMENTS

Dear Mr. Litton,

The purpose of this letter is to submit the response to comments on Zone A Draft Corrective Measures Study Workplan for Naval Base Charleston. The Workplan is submitted to fulfill the requirements of condition IV.E.2 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and U.S. Environmental Protection Agency.

The responses and changes to the document have been discussed with Department and EPA personnel. We request that the Department and the EPA review these changes and responses and provide approval. If you should have any questions, please contact Bill Drawdy or myself at (843) 743-9985 and (843) 820-5525 respectively.

Sincerely,

M. A. Hunt

M.A.HUNT, P.E.
Environmental Engineer
Installation Restoration III

Copy to:
SCDHEC (Paul Bergstrand, Johnny Tapia), USEPA (Dann Spariosu), CSO Naval Base Charleston (Billy Drawdy), SPORTENVDETCHASN (Bobby Dearhart)

f 9/17/98
BW

FILING INSTRUCTIONS

The following is a list of pages in the *Draft Zone A Corrective Measures Study Work Plan dated June 5, 1998*, 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 Content of *Draft Corrective Measures Study Work Plan for Zone A*.

If you have any questions, please call 843-884-0029.

List of Changes/Revisions	**Remove Pages**	**Replace Pages**
Table of Contents - updated.	i - iv	i - iv
Section 2.0	2-3 and 2-4	2-3 and 2-4
Section 3.0	3-2 to 3-3	3-2 to 3-3
Section 4.0	4-1 to 4-3	4-1 to 4-3
Section 5.0 ***(Please keep the color drawings except for:)***	Entire text pages Drawing 5.2.3, 5.3.16, 5.3.17, 5.3.18, 5.3.24 5.4.4, 5.S, 5.T 5.U	Entire text pages Drawing 5.1.3 5.3.16, 5.3.17. 5.3.18, 5.3.24 5.4.4, 5.S, 5.T 5.U, 5.V, 5.W 5.X, 5.Y, 5.Z, 5.AA
Section 7.0	Entire	Entire

DEPARTMENT OF THE NAVY
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9 June, 1998

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

Subj: SUBMITTAL OF ZONE A DRAFT CORRECTIVE MEASURES STUDY WORKPLAN

Dear Mr. Litton,

The purpose of this letter is to submit the Zone A Draft Corrective Measures Study Workplan for Naval Base Charleston. The Workplan is submitted to fulfill the requirements of condition IV.E.2 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and U.S. Environmental Protection Agency.

We request that the Department and the EPA review this document and provide comments or approval whichever is appropriate. If you should have any questions, please contact Bill Drawdy or Matthew A. Hunt at (843) 743-9985 and (843) 820-5525 respectively.

Sincerely,

H.N. Shepard II, P.E.
Caretaker Site Officer
By direction

Copy to:
SCDHEC (Paul Bergstrand, Johnny Tapia), USEPA (Dann Spariosu),
SOUTHNAVFACENGCOM (Matthew Hunt), CSO Naval Base Charleston (Billy Drawdy, Daryle Fontenot), SPORTENVDETCHASN (Bobby Dearhart)