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FINAL ZONE I WORK PLAN PAGE CHANGES REVISION 1 CNC CHARLESTON SC
4/10/1996
ENSAFE/ ALLEN AND HOSHALL

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

FINAL ZONE I WORK PLAN
PAGE CHANGES, REVISION NO: 01

Prepared for:

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON, SOUTH CAROLINA

SOUTHDIV CONTRACT NUMBER:
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April 10, 1996

FILING INSTRUCTIONS

The following is a list of pages in the *Final Zone I Work Plan*, dated February 24, 1995, that have been revised. The obsolete pages presently in your binders are listed in the column headed "Remove". New and replacement pages are listed in the column headed "Replace". Please file this instruction cover sheet preceding the Table of Contents of the *Final Zone I Work Plan*.

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

List of Changes/Revisions	**Remove Pages**	**Replace Pages**
Table of Contents and Acronym List - updated.	i-vi	i-viii
Section 1.0 - Revised Figure 1-1.	1-2	1-2
Section 2.0 - Added Section 2.12	—	2-81 - 2-86
Section 4.0 - Updated Section 4. Text changes are highlighted.	4-1 - 4-90	4-1 - 4-92
Section 4.0 - Added Section 4-15.	—	4-49 - 4-52

Record of Changes to the Final Zone I RFI Work Plan Naval Base Charleston		
Page(s)	**Change/Revision**	**Reason for Change**
i-vi	Table of Contents: Entire TOC.	Table of Contents had to be revised to incorporate the addition of Sections 2.12 and 4.15.
vii-viii	Replace the Acronym List.	The acronym NOAA was added.
1-3	Figure 1-1.	Included location of SWMU 177 on the SWMU/AOC Site Location Map.
2-81 to 2-86	Addition of site specific, Sampling and Analysis Plan for SWMU 177	Incorporate an additional site requiring a CSI into the investigation. Includes Figure 2-12 which indicates the proposed soil sample locations.
4-1 to 4-92	Resubmit entire Section 4.0.	Reflect corrections to page and section references due to SWMU 177 section addition.
4-49 to 4-52	Addition of site specific, Sampling and Health and Safety Plan for SWMU 177, Section 4.15.	Incorporate an additional site requiring a CSI into the investigation.
4-52	Corrected the header for Table 4-23.	Changed header to indicate SWMU 177.

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ACRONYM LIST

ACGIH	American Conference for Governmental Industrial Hygienists
AL	Action Level
AOC	Areas of Concern
bgs	Below Ground Surface
CAMP	Corrective Action Management Plan
CEC	Cation Exchange Capacity
CFR	Code of Federal Register
CHASP	Comprehensive Health and Safety Plan
CLEAN	Comprehensive Long Term Environmental Action Navy
CMS	Corrective Measures Study
COPC	Constituent of Potential Concern
CRZ	Contaminant Reduction Zone
CSI	Confirmatory Sampling Investigation
CWP	Comprehensive Work Plan
DANC	Decontaminating Agent Non-Corrosive
DMDA	Dredged Materials Disposal Area
DNAPL	Dense Non-Aqueous Phase Liquid
DOD	Department of Defense
DQO	Data Quality Objective
E/A&H	EnSafe/Allen & Hoshall
EM	Electro Magnetic
EPA	Environmental Protection Agency
EZ	Exclusion Zone
HAZWOPER	Hazardous Waste Workers and Emergency Responders
LEL	Lower Explosive Limit
MSDS	Material Safety Data Sheet
MWR	Morale, Welfare, and Recreation Department
NAVBASE	Naval Base Charleston
NE	North East
NFI	No Further Investigation
NIOSH	National Institute of Occupational Safety and Health Administration
NOAA	National Oceanographic and Atmospheric Administration
OSHA	Occupational Safety and Health Act
PCB	Polychlorinated Biphenyl
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Officer
PPE	Person Protective Equipment
PRG	Preliminary Remedial Goal
PWC	Public Works Center

ACRONYM LIST CONTINUED

QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
REL	Recommended Exposure Limit
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SAA	Satellite Accumulation Area
SCBA	Self-Contained Breathing Apparatus
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division
STEL	Short-Term Exposure Limit
SWMU	Solid Waste Management Unit
SZ	Support Zone
TIC	Tentatively Identified Compounds
TLV	Threshold Limit Value
TOC	Total Organic Carbon
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
ZIHASP	Zone I Health and Safety Plan

ACRONYM LIST

ACGIH	American Conference for Governmental Industrial Hygienists
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ACRONYM LIST CONTINUED

QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
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TLV	Threshold Limit Value
TOC	Total Organic Carbon
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
ZIHASP	Zone I Health and Safety Plan

1.0 INTRODUCTION

As part of the U.S. Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, the following Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan has been prepared by EnSafe/Allen and Hoshall (E/A&H) for Zone I at Naval Base Charleston (NAVBASE). This work plan addresses sampling and analysis requirements specific to sites within Zone I and is intended to be used in conjunction with the *Final Comprehensive RFI Work Plan* (August 330, 1994) prepared for NAVBASE. The Solid Waste Management Units (SWMU) and Areas of Concern (AOC) to be investigated within Zone I are presented in Appendix A and in Figure 1-1, which illustrates the location of each.

1.1 Environmental Setting

Physiography

Zone I, in the southernmost portion of Naval Base Charleston, is bounded by the Cooper River to the north and east; Shipyard Creek to the south; and Hobson Avenue, Osprey Street, and C.B. Lane to the west. Figure 1-2 identifies the Zone I boundary in relation to NAVBASE boundaries and the remaining investigative zones.

Geologic and Hydrogeologic Information

The local and regional geologic/hydrogeologic characteristics are described in Volume II, Sections 1.2 through 1.5 of the *Final Comprehensive RFI Work Plan*. Of particular relevance for Zone I is the anthropogenic origin of soil throughout this area. NAVBASE, like most of the Charleston peninsula bordering the Ashley, Cooper and Wando rivers, was low-lying marsh when the base was established in the early 1900s. Portions of the northern end and almost the entire southern end of the base were filled with a wide variety of known and unknown materials to make the property suitable for development. The majority of the filling activity took place during the 1930s and 1940s. Figure 1-3 indicates extent of modern fill activities.

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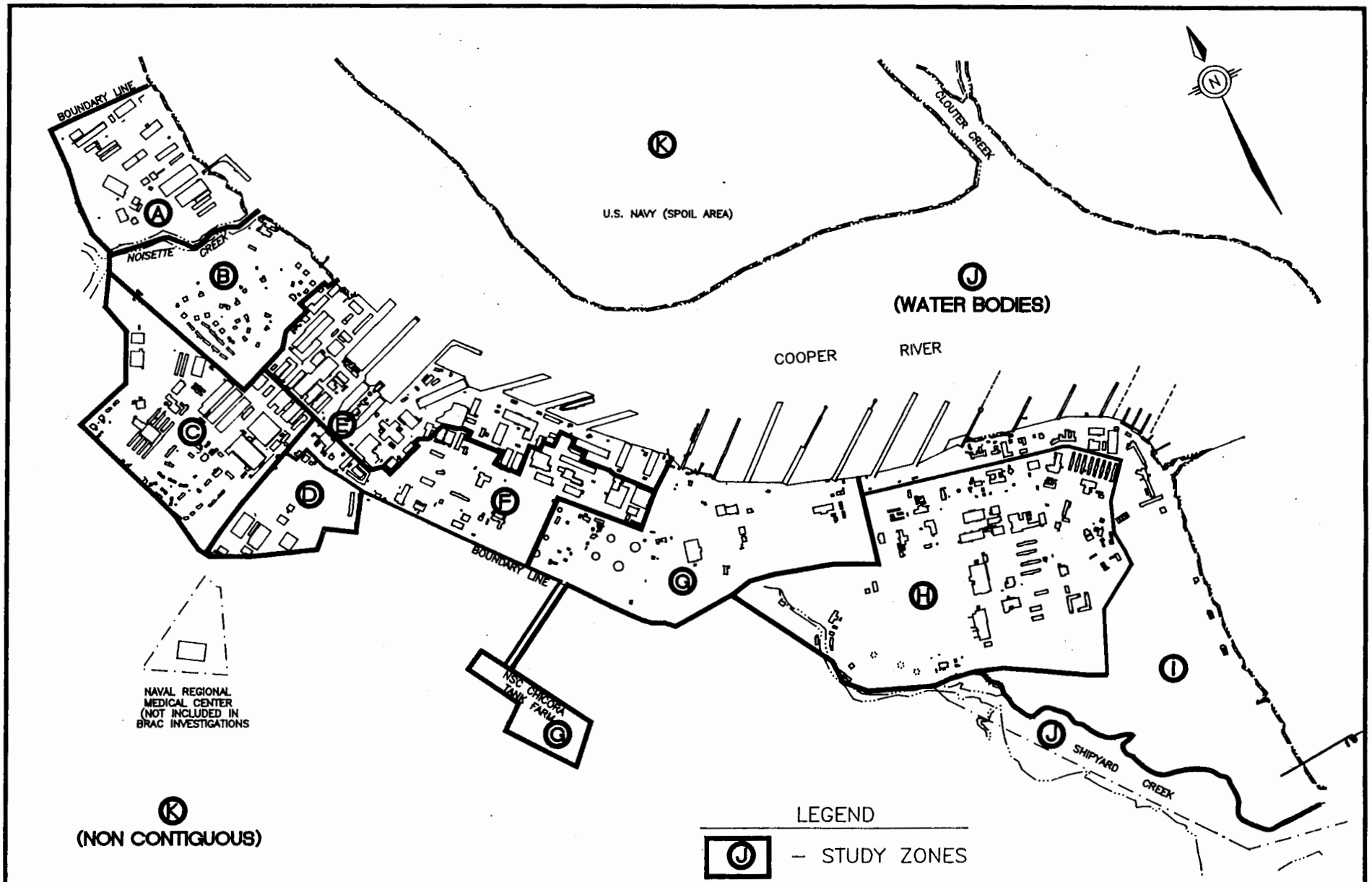
BOUNDARY LINE
NOISETTE CREEK
U.S. NAVY (SPOIL AREA)
CLOUTER CREEK
(WATER BODIES)
COOPER RIVER
BOUNDARY LINE
NAVAL REGIONAL MEDICAL CENTER (NOT INCLUDED IN BRAC INVESTIGATIONS
NSC CHICORA TANK FARM
SHIPYARD CREEK
(NON CONTIGUOUS)
LEGEND
– STUDY ZONES
2000 0 2000
SCALE FEET
SOURCES: SOUTHDIV, n.d. ESE, 1981.
DRAFT RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 1–2
ZONE BOUNDARIES
DWG DATE: 08/01/94
DWG NAME: 029ZONE

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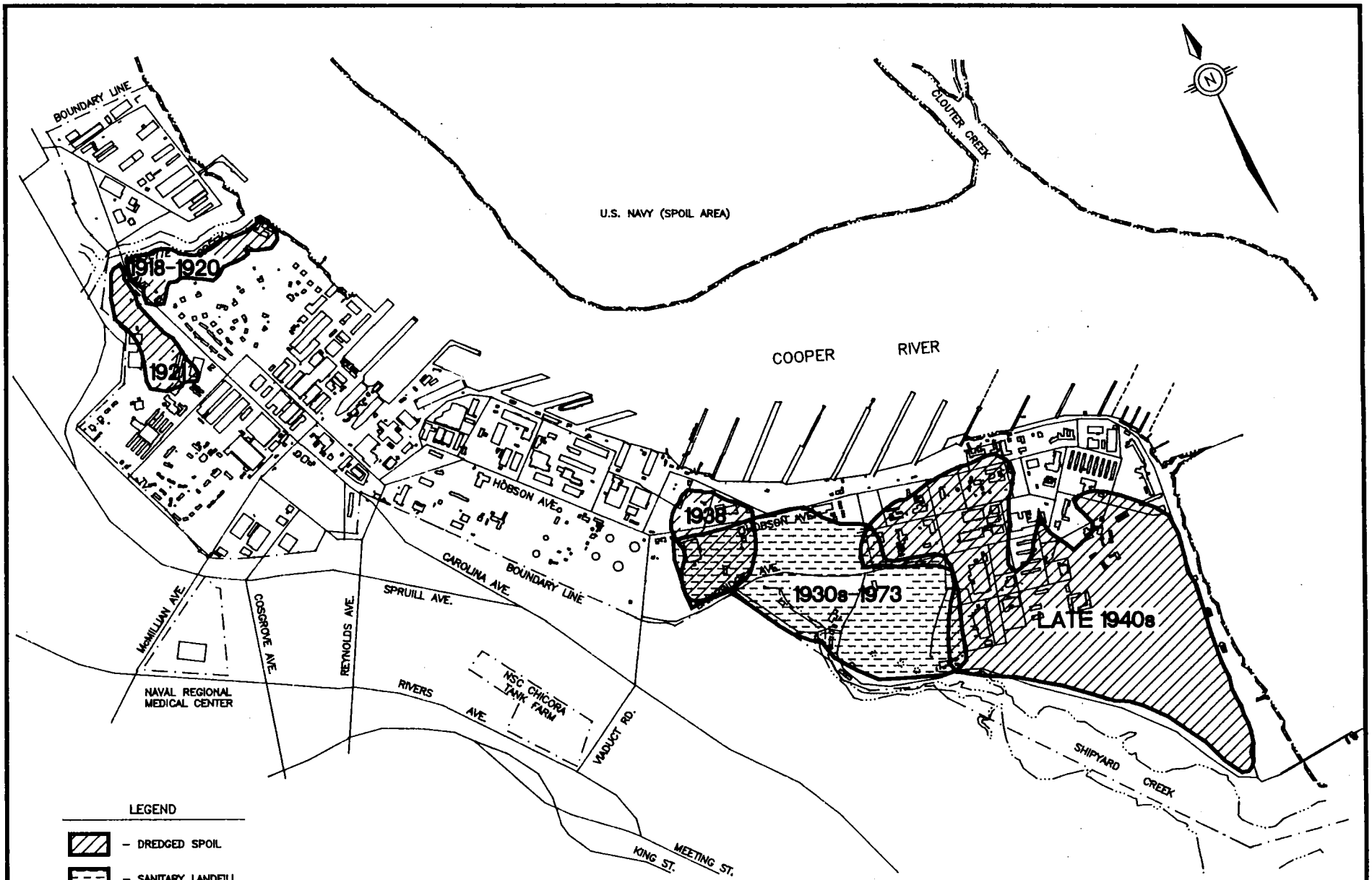

DRAFT RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 1-3
AREAS FILLED AND
APPROXIMATE DATES
OF FILLING OPERATIONS

DWG DATE: 09/29/94 | DWG NAME: 29FILCH1

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Climatology

The climatological setting of NAVBASE is described in Volume II, Section 1.6 of the *Final Comprehensive RFI Work Plan.*

1.2 Investigative Strategy

The proposed investigative approach for each of the sites was developed in accordance with the overall investigative strategy presented in Section 2, Volume I, *Final Comprehensive RFI Work Plan*, emphasizing a Fast-Track clean up program.

Central to this idea is a phased approach to data collection that will ultimately identify constituents of potential concern (COPCs) (if present), define nature and extent of any contamination, and provide data collection for a corrective measures study (CMS). To meet these objectives, sampling methods and locations discussed in this work plan are designed to be as complete as possible.

If the proposed sampling efforts do not achieve this goal, collection will continue until sufficient data are obtained. In order to determine the need for additional sampling not specified in this work plan, data collected under this plan will be evaluated regarding potential human health impacts expressed as preliminary remedial goals (PRGs), ecological risk, and technical requirements for a CMS. For some chemicals, additional information regarding background concentrations will be required, necessitating onsite and offsite data collection. Background, migration pathways, human and ecological receptors, and PRGs are discussed in Section 1.0, Volume III of the *Final Comprehensive RFI Work Plan.* Sampling will continue until the extent of any contamination is determined, which is defined herein as the horizontal and vertical area in which concentrations of COPCs in the investigated media are above either PRGs or background concentrations, whichever is appropriate. Background concentrations for inorganics will be determined using the 2X rule. Using this rule, background will be regarded as concentrations less than or equal to the mean concentration of the designated background

sampling locations multiplied by two. Background determination is discussed further in the following sections.

The zone-specific work plans outline the data collection process for each SWMU and AOC in the particular zones. The *Final Comprehensive RFI Work Plan* discusses how these data will be used to fulfill the investigation goals. An RFI Report and Baseline Risk Assessment (BRA) will be generated when each zone investigation concludes, and a final RFI Report and final BRA will address NAVBASE as a single entity once all zone investigations are completed.

The proposed schedule for conducting the Zone I investigation is included in the *Corrective Action Management Plan* (August 30, 1994) prepared for the NAVBASE RFI. Activity scheduling during the Zone I investigation will be closely coordinated with United States Environmental Protection Agency (USEPA) Region IV and South Carolina Department of Health and Environmental Control (SCDHEC).

1.3 Other Relevant Investigations

Because the Zone I investigation is part of a larger investigative strategy, some pathways included for investigation in Volume III of the *Final Comprehensive RFI Work Plan* that may be relevant to Zone I also will be considered in other zone investigations. Sediment and surface water sampling of Shipyard Creek and the associated wetlands are proposed in this plan to identify point sources. The Zone J investigation will address measures of potential impacts to these water bodies. The Zone L investigation will address the sewer systems. Groundwater flow and hydrology are dependent upon basewide conditions. Information gathered in this investigation will contribute to groundwater characterization, but will not fully characterize all groundwater processes. Because of the suspected heterogeneity of the dredged materials, it is premature to designate any onsite areas within Zone I as representing background. Dredged materials will be characterized as part of the Zone I investigation to establish a baseline data set representing dredged materials across all dredge disposal areas at NAVBASE. An offsite

representative dredged materials area will be investigated as part of the Final Comprehensive RFI Work Plan to determine background concentrations for some chemicals relevant to the Zone I Work Plan. Finally, results from other investigations may influence the scope of work proposed therein. Evaluating the results of the investigations discussed above will be necessary in order to fully understand the significance of the results of the proposed Zone I investigation results.

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2.0 SWMU and AOC-SPECIFIC INVESTIGATORY APPROACH

The SWMUs and AOCs in Zone I requiring either a Confirmatory Sampling Investigation (CSI) or RFI activities, as determined in the RCRA Facilities Assessment (RFA), November 1994, are presented in the following sections. Table A.1 (Appendix A) is a reference indicating the location of each site within Zone I, proximity to existing structures, as well as each site's investigative approach as proposed by the RFA. Table A.2 lists in numerical order the buildings within Zone I and their associated SWMUs and AOCs. The sites identified may not represent all hazardous waste activity that has occurred in Zone I, and the systematic sampling plan outlined in Section 3 was designed in part to help identify any sites not found in the RFA process. The Zone I investigation will be based upon the strategy outlined in the *Final Comprehensive RFI Project Management Plan* (August 30, 1994).

Radiological Potential

The Charleston Naval Shipyard (CNSY) Radiological Control Office has determined there are a number of sites within Zone I that have a low potential for radioactivity. CNSY will perform detailed radiological surveys at these locations and document that radioactive materials have been removed. This process may be independently verified by the USEPA and the State. These surveys are described in separate work plans and reports.

Contractor sampling at any point within Zone I shall not proceed until applicable Navy radiological verification surveys have been completed at the sampling location. As sampling is scheduled, and prior to sampling at any point in Zone I, contact the CNSY General Survey Project Superintendent to determine if the verification surveys have been completed. Once the completion of surveys has been verified, no gamma screening will be required for samples taken in the verified areas. CNSY will support E/A&H sampling schedules by adjusting survey schedules with reasonable advanced notification.

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2.1 AOC 671, Metering House, Former Building 3905G, and Surrounding Aviation Gasoline Compound

AOC 671, a CSI site, includes the former Metering House, Building 3905G, and the associated Aviation Gasoline compound east of Hobson Avenue, just south of Pier Q (Facility 329). The site is bounded to the northeast by the Cooper River. The facilities are in and adjacent to a parking lot for ship's personnel. The outlines of two underground 25,000-gallon concrete tanks can be seen in the asphalt parking lot. A description of this AOC is provided in Table 2.1.

2.1.1 Previous Investigations

AOC 671 has not been investigated previously.

Table 2.1
AOC 671
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 671 Metering House, Former Bldg. 3905G, and Surrounding Aviation Gasoline Compound	Aviation Gasoline compound operating from the 1940s until the 1960s. Two 25,000-gallon concrete tanks and the possible foundation of the truck load stand still exist. There is no evidence of the metering house, or any other ancillary structures at this time.[a]	Volatile Organic Compounds (VOCs), petroleum hydrocarbons and heavy metals	**Soil** Sediment Soil Gas Surface Water **Groundwater** Underground Utility conduits

Notes:

[a] Described in the *RCRA Facility Assessment, June 13, 1994 (revised November 1994).*
Pathways scheduled for confirmatory sampling are bold.

2.1.2 Treatment Alternatives

As outlined in the overall sampling strategy presented in the *Final Comprehensive RFI Work Plan*, treatment alternatives are being identified for each of the sites likely to require some type of remedial action. Data will be collected to support evaluation of these alternatives. Tables B-1, B-2, and B-3 (Appendix B) list the treatment alternatives for groundwater, surface water runoff, soil, sediment, and soil gas at AOC 671. Alternatives presented here are for

preliminary evaluation only. If contaminants are present at concentrations requiring remediation, a CMS will be undertaken to identify the most feasible treatment alternatives.

2.1.3 Data Gaps

No environmental media data have been collected at AOC 671 to characterize the site or to support a detailed evaluation of treatment alternatives, if necessary. As a result, the following data gaps have been identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Soil data to confirm/deny that a release(s) has occurred, and;
- Groundwater data to confirm/deny that a release(s) has occurred.

2.1.4 Potential Receptors

Potential receptors that may be exposed to site contaminants include current land users, such as NAVBASE personnel, and any future users this area may support following closure. Data will be generated during the investigation to determine the level of risk to the spectrum of current and potential future receptors, including any highly sensitive individuals within the population, who may be exposed through invasive or non-invasive activities. Sampling will characterize the potential pathways highlighted in Table 2.1. Characterizing the surface water and sediment pathways will be addressed in the Zone J RFI.

Land at AOC 671 is currently used as a parking lot for personnel assigned to ships at the adjacent piers. Potential receptors are workers involved with any invasive type of activity, such as utility maintenance, bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet below ground surface (bgs), site workers could also be subject to accidental ingestion or dermal exposure to contaminated groundwater. In addition, site workers may be exposed to soil gases resulting from tidal influences on groundwater at and around the site.

The area's extensive utility system may act as a conduit for moving any product released at this facility, and thus could expose anyone working on these underground systems in the general vicinity, as well as providing a contaminant migration route to the Cooper River. The Cooper River could receive contaminated surface water runoff and groundwater discharges, resulting in exposure to biological receptors other than humans.

2.1.5 Objective

The objective of the proposed field investigation is to confirm the presence/absence of contamination in environmental media. If present, the investigation will delineate the horizontal and vertical extent of any soil and/or groundwater contamination. While sediment, soil gas, surface water, and underground utility conduits are potential contaminant pathways, initial sampling of these matrices is not required to determine if contaminants are present. If soil and/or groundwater contamination is identified, then the site will be designated for a complete RFI to delineate the nature and extent of contamination. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.1.6 Screening Alternatives

No sampling has been conducted to determine constituents of potential concern (COPCs); therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A photoionization detector (PID) will be used to qualitatively screen for volatile organic compounds (VOCs) in all soil samples from every soil boring and monitoring well location. Results will be recorded in the field notes and on boring logs.

2.1.7 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Table 2.2 summarizes the types of samples to be collected and the analytical parameters. Six soil borings spaced evenly around the perimeter of the underground storage tanks (USTs) and two borings around the remaining pumphouse foundation are proposed to detect the presence of any contamination. The four corner borings around the USTs will be converted into shallow monitoring wells to determine if the USTs have any impact on surrounding groundwater. Data obtained from a nearby proposed Zone I well pair will also be incorporated into this AOC's assessment. Proposed sampling locations are illustrated on Figure 2-1. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan* (August 30, 1994).

Table 2.2
AOC 671 and Associated Structures
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	8	VOAs and SVOCs w/ Tentatively Identified Compounds (TICs), Metals, Cyanide, Pesticides, and Polychlorinated Biphenyls (PCBs).
Soil (3-5' bgs)	8	
Groundwater (Shallow well)	5[a]	Chlorides, Total dissolved solids (TDS), and sulfates
(Deep well)	1[a]	

Engineering Parameters:

Slug tests will be performed on 25% of the shallow/deep well pairs. While installing the deep wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, total organic carbons (TOC), and cation exchange capacity (CEC). Analysis for any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution is developed.

Notes:

[a] One shallow and one deep grid-based monitoring well designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis will be performed per SW-846 except where other methods are specified. Data Quality Objective (DQO) Level III analyses as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include Quality Assurance/Quality Control (QA/QC) samples.

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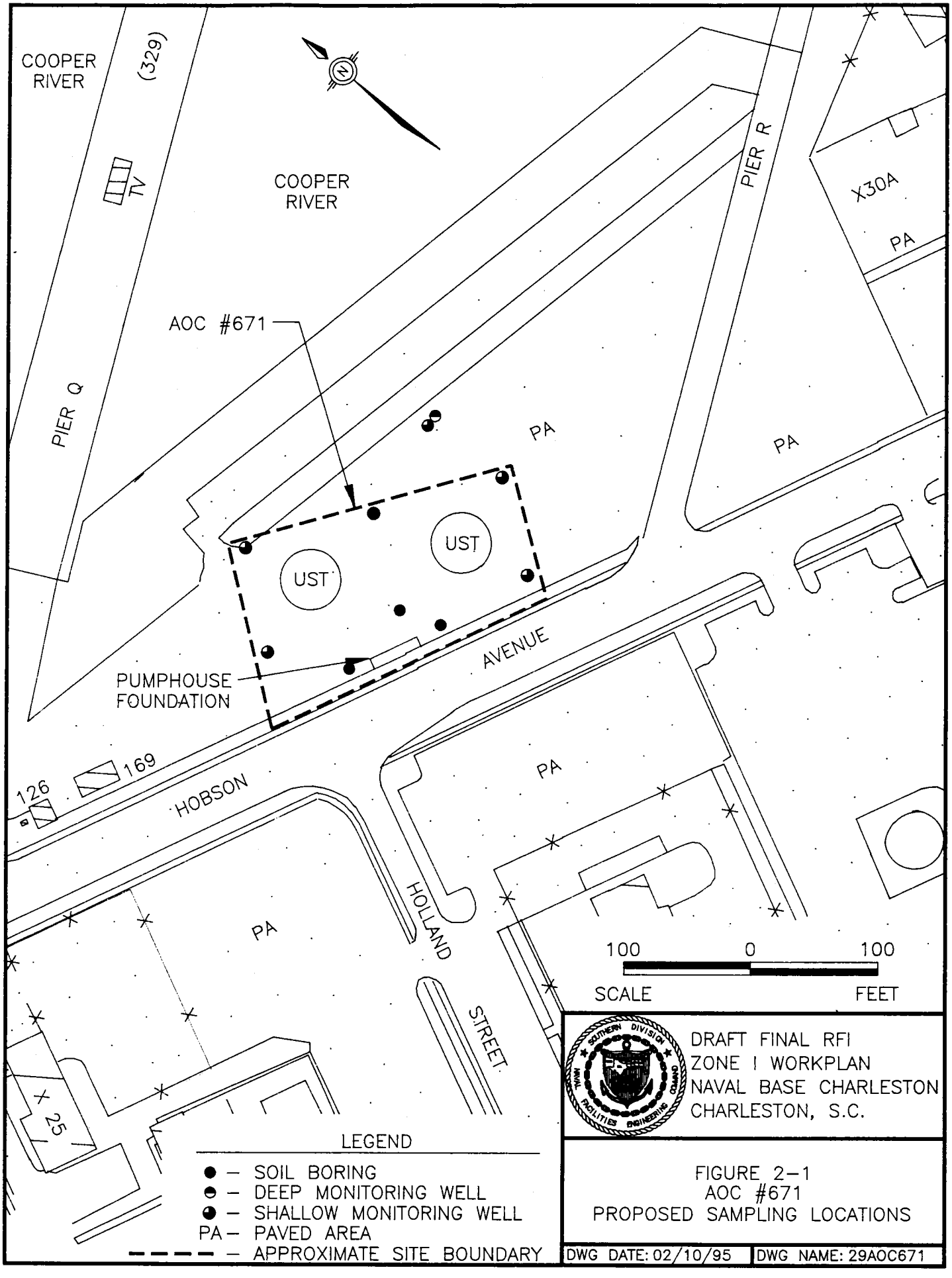
COOPER RIVER
(329)
TV
COOPER RIVER
PIER R
X30A
PA
AOC #671
PIER Q
PA
PA
UST
UST
PUMPHOUSE FOUNDATION
AVENUE
169
126
HOBSON
PA
HOLLAND
PA
STREET
25
100 0 100
SCALE FEET
LEGEND
● – SOIL BORING
◓ – DEEP MONITORING WELL
◕ – SHALLOW MONITORING WELL
PA – PAVED AREA
– – – – – APPROXIMATE SITE BOUNDARY
DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-1
AOC #671
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/10/95
DWG NAME: 29AOC671

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2.2 AOC 672, Building 126 Substation (includes AOC 673, Building 169 Paint and Oil Storage)

AOC 672 is an electrical substation (Building 126), built in 1947 and modified in 1950. It houses transformers and switch gear. Present equipment is non-PCB, but previous equipment (transformers and switches) may have contained PCB dielectric fluid or PCB-contaminated dielectric fluid. Building 126 is northeast of Hobson Avenue, immediately south of the approach to Pier Q. It is adjacent to Building 169, which has been designated AOC 673. Building 169 was built in 1949 and has stored paints, oils, and solvents. It also was the former site of two 25,000-gallon USTs. This AOC has been designated for a CSI. Table 2.3 describes AOCs 672 and 673.

Table 2.3
AOC 672 and AOC 673
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 672 Bldg. 126 Substation	Substation containing transformer and switch gear to support electrical grid. Facility dates from WWII era with a modification in 1950. Transformer reported to have had a moderate leak in 1981. Tests completed in 1987 showed transformer was PCB-contaminated (73 ppm). Present equipment all non-PCB.[a]	Dielectric fluids	**Soil** Soil Gas Sediment Surface Water **Groundwater** Underground utility conduits
AOC 673 Bldg. 169 Paint & Oil Storage	Building used to store paint, oils, solvents, and other support materials. Former location of 2 25,000-gallon underground storage tanks.[a]	Paints, oils, and solvents. VOCs and petroleum hydrocarbons	**Soil** Soil Gas Sediment Surface Water **Groundwater** Underground utility conduits

Notes:

[a] Described in *RCRA Facility Assessment, June 13, 1994 (revised November 1994)*
Pathways scheduled for confirmatory sampling are bold.

2.2.1 Previous Investigations

AOCs 672 and 673 have not been investigated previously.

2.2.2 Treatment Alternatives

As outlined in the overall sampling strategy in the *Final Comprehensive RFI Work Plan* (August 30, 1994), treatment alternatives are being identified for each of the sites likely requiring some type of remedial action. Data collection efforts will support evaluating these alternatives. Tables B-1 and B-2 (Appendix B) list the treatment alternatives for groundwater, soil, sediment, and surface water runoff for AOCs 672 and 673. Alternatives presented here are for preliminary evaluation only. If contaminants are present at concentrations requiring remediation, a CMS will be undertaken to identify feasible treatment alternatives.

2.2.3 Data Gaps

Currently no environmental media data have been collected at AOCs 672 and 673 to characterize the sites or to support a detailed evaluation of treatment alternatives, if necessary. As a result, the following data gaps have been identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Soil data to confirm/deny that a release(s) has occurred, and;
- Groundwater data to confirm/deny that a release(s) has occurred.

2.2.4 Potential Receptors

Potential receptors that may be exposed to site contaminants include current land users, such as NAVBASE personnel, and any future users this area may support following closure. Data will be generated during the investigation to determine the level of risk to the spectrum of current and potential future receptors, including any highly sensitive individuals within the population, who may be exposed through invasive or non-invasive activities. Sampling will characterize the potential pathways highlighted in Table 2.3. Characterizing the surface water and sediment pathways will be addressed in the Zone J RFI.

Land near AOCs 672 and 673 is used for vehicle parking and vehicular and pedestrian traffic (both the parking lot, and Hobson Avenue and sidewalk). Potential receptors are site workers involved with invasive activity, such as utility maintenance, bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet bgs, site workers could also be subject to accidental ingestion or dermal exposure to contaminated groundwater.

The area's extensive utility system could act as a conduit for moving any product released at this facility, and thus could expose anyone working on these underground systems, as well as providing a contaminant route to the Cooper River. The Cooper River could receive contaminated surface water runoff and groundwater discharges, resulting in exposure to biological receptors other than humans.

2.2.5 Objective

The objective of the proposed field investigation is to confirm the presence/absence of contamination in environmental media. If present, the investigation will delineate the horizontal and vertical extent of any soil and/or groundwater contamination. While sediment, soil gas, surface water, and underground utility conduits are potential contaminant pathways, initial sampling of these matrices is not required to determine the presence of contaminants. If soil contamination is identified, then the site will be designated for a complete RFI to delineate the nature and extent of contamination. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.2.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A PID will be used to qualitatively screen for volatile compounds in all soil samples from every soil boring and monitoring well location. Results will be recorded in the field notes and on boring logs.

2.2.7 Sampling and Analysis Plan

Ten shallow soil borings are proposed for AOCs 672 and 673, four encircling the transformer pad and doorway of Building 126 and six around the doorways of Building 169 to detect contaminant migration through these potential point sources and pathways. The locations in Figure 2-2 are expected to closely represent the actual sample locations in number and placement. The six borings around Building 169 are on pavement and must be mechanically advanced. If possible, these borings will be advanced to 5 feet bgs. Data obtained from a nearby proposed Zone I well pair will also be incorporated into the AOCs' assessment due to its proximity to the sites and its potentially hydraulically downgradient location. Table 2.4 summarizes the sampling plan for AOCs 672 and 673.

Table 2.4
AOCs 672 and 673
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	10	VOAs and SVOCs w/ TICs, Metals, Cyanide, Pesticides, and PCBs.
Soil (3-5' bgs)	10	Chlorides, TDS, and sulfates.
Groundwater		
(Shallow well)	1[a]	
(Deep well)	1[a]	

Engineering Parameters:

Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, TOC, and cation exchange capacity (CEC). Analysis of any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution is developed.

Notes:

[a] One shallow and one deep grid-based monitoring well designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed, as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.

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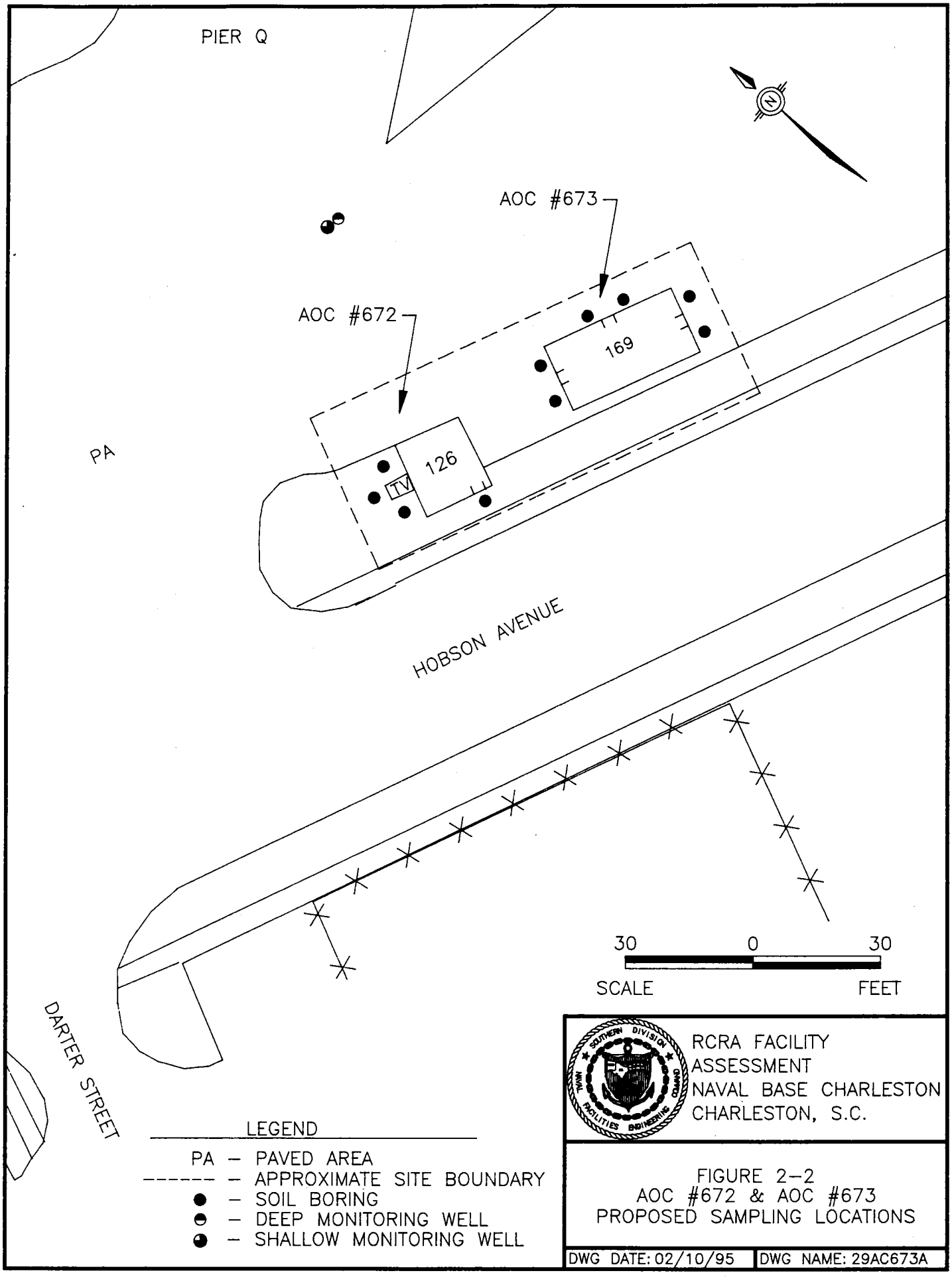
PIER Q
AOC #673
AOC #672
169
126
TV
PA
HOBSON AVENUE
DARTER STREET
30
0
30
SCALE
FEET
LEGEND
PA – PAVED AREA
------ – APPROXIMATE SITE BOUNDARY
● – SOIL BORING
◒ – DEEP MONITORING WELL
◕ – SHALLOW MONITORING WELL
RCRA FACILITY
ASSESSMENT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2–2
AOC #672 & AOC #673
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/10/95
DWG NAME: 29AC673A

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2.3 AOC 675, Fuel Oil Storage Tank NS-4; AOC 676, Former Incinerator; and AOC 677, Grounds of Building NS-2

The area designated as AOCs 675, 676, and 677 includes the following structures: Building NS-2, Tank NS-4, Building NS-3, abandoned USTs near NS-3, an oil/water separator, a storm water drain, and a sewage lift station. AOCs 675 and 676 have been designated for CSIs and AOC 677 for an RFI. These AOCs are described in Table 2.5.

Table 2.5
AOCs 675, 676, and 677
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 675 Fuel Oil Storage Tank NS-4	A 25,000-gallon UST supporting the boiler in Building NS-2. Held residual oil (No. 5) from time of installation in 1952 until conversion to diesel fuel in 1991. Additional USTs are near NS-3, adjacent to the west.[a]	Residual fuel, diesel fuel, aviation gasoline, and fuels from past operation.	**Soil** Soil Gas Surface Water **Sediment** **Groundwater** Underground utility conduits
AOC 676 Former Incinerator	An incinerator operated before the construction of NS-2 in area. There is no information regarding the type of structure that existed, the type of incinerator, or the materials incinerated at this facility.[a]	Ash — potentially high in metals, petroleum products	**Soil** Surface Water Sediment **Groundwater**
AOC 677 Grounds of Bldg. NS-2	The grounds around Building NS-2 have been the site of a number of petroleum spills associated with the operation of the boilers in NS-2. Spill reports indicate a number of releases since 1977. This also is near the location of seaplane refueling operations conducted during the 1940s.[b]	Residual fuel, diesel fuel, aviation gasoline, and lead	**Soil** Soil Gas Surface Water Sediment **Groundwater** Underground utility conduits

Notes:

[a] Described in *RCRA Facility Assessment, June 13, 1994 (revised November 1994)*
[b] Described in *RCRA Facility Assessment, May 31, 1994 (revised November 1994)*
Bold indicates pathways scheduled for confirmatory sampling.

2.3.1 Previous Investigations

AOCs 675, 676, or 677 have not been investigated previously.

2.3.2 Treatment Alternatives

As outlined in the overall sampling strategy presented in the *Final Comprehensive RFI Work Plan* (August 30, 1994), treatment alternatives are being identified for the sites likely requiring remedial action. Data collection efforts will support evaluating these alternatives. Tables B-1, B-3, and B-4 (Appendix B) list the treatment alternatives for groundwater, soil, sediment, and soil gas at AOCs 675, 676, and 677. Alternatives presented here are for preliminary evaluation only. If contaminants are present at concentrations requiring remediation, a CMS will be undertaken to identify the feasible treatment alternatives.

2.3.3 Data Gaps

No environmental media data have been collected at AOCs 675, 676, or 677 to characterize the site or to support a detailed evaluation of treatment alternatives, if necessary. As a result, the following data gaps have been identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Soil data to confirm/deny that a release(s) has occurred at AOCs 675 and 676;

- Groundwater data to confirm/deny that a release(s) has occurred at AOCs 675 and 676; and,

- Insufficient soil and groundwater data exist at AOC 677 to define the nature and extent of contamination from historical petroleum releases that have occurred.

2.3.4 Potential Receptors

Potential receptors of exposure to contaminants include current land users, such as NAVBASE personnel, and any future users this area may support following closure. Data will be generated during the investigation to determine the level of risk to the entire spectrum of current and potential users, including any highly sensitive individuals, who may be exposed through invasive

or non-invasive activities. Sampling will characterize the potential pathways highlighted in Table 2.5. Characterizing the surface water and sediment pathways will be addressed in the Zone J RFI. Infrastructure such as the storm sewer system will be addressed in the Zone L RFI.

Land near AOCs 675, 676, and 677 supports boiler operations in Building NS-2 and provides administrative storage in Building NS-3 and space for vehicle parking. Potential receptors are workers involved with any invasive activity, such as utility maintenance, bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet bgs, site workers could also be subject to accidental ingestion or dermal exposure to contaminated groundwater.

The area's extensive utility system could act as a conduit for moving any product released at this facility, and could therefore expose those working on any of these underground systems, as well as providing a way for the contamination to reach the Cooper River. The Cooper River could receive contaminated surface water runoff and groundwater discharges, resulting in exposure to biological receptors other than humans.

2.3.5 Objective

The objective of the proposed field investigation is to confirm the presence/absence of contamination at AOCs 675 and 676. If present, the investigation will delineate the horizontal and vertical extent of any soil and/or groundwater contamination. While soil gas, surface water, and underground utility conduits are potential contaminant pathways, initial sampling of these matrices is not required to determine the presence of contaminants. If soil and/or groundwater contamination is identified, the sites will be designated for a complete RFI to delineate its nature and extent. Data collection efforts will support technical evaluation of identified treatment alternatives.

The objective of the RFI at AOC 677 is to define the horizontal and vertical extent of soil and/or groundwater contamination from petroleum releases. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.3.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A PID will be used to qualitatively screen for volatile compounds in all soil samples from each soil boring and monitoring well location. Results will be recorded in the field notes and on boring logs.

2.3.7 Sampling and Analysis Plan

Thirteen soil borings and five biased shallow monitoring wells (soil samples will also be collected from each monitoring well location are proposed for these three AOCs. In addition, one sediment sample is proposed in the vicinity of the former oil/water separator. The boring/well locations were established using a grid pattern to characterize contaminant migration away from potential source areas. Potential source areas at AOCs 675, 676, and 677 are the former UST locations, stained soil around the former fuel loading/unloading facilities, and the oil water separator. The rationale for the five biased monitoring well locations is as follows: one well upgradient of Building NS3 and AOC 675; one well upgradient of NS2 and the former UST locations; and three wells downgradient of the AOCs. The locations in Figure 2-3 are expected to closely represent the actual sample locations in number and placement. Table 2.6 summarizes the sampling plan for AOCs 675, 676, and 677. All usable data obtained from the proposed nearby Zone I well pair will be incorporated into the AOC assessment due to its proximity to the AOCs.

Table 2.6
AOCs 675, 676, and 677
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	13	VOAs and SVOCs w/ TICs, Metals, Cyanide, Pesticides, and PCBs.
Soil (3-5' bgs)	13	
Sediment	1	Sediment samples will be analyzed for TOC and grain size.
Groundwater (Shallow well)	6[a]	Chlorides, TDS, and sulfates (groundwater only)
(Deep well)	1[a]	

Engineering Parameters:

Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis of any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution is developed.

Notes:

[a] One shallow and one deep grid-based monitoring well designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.

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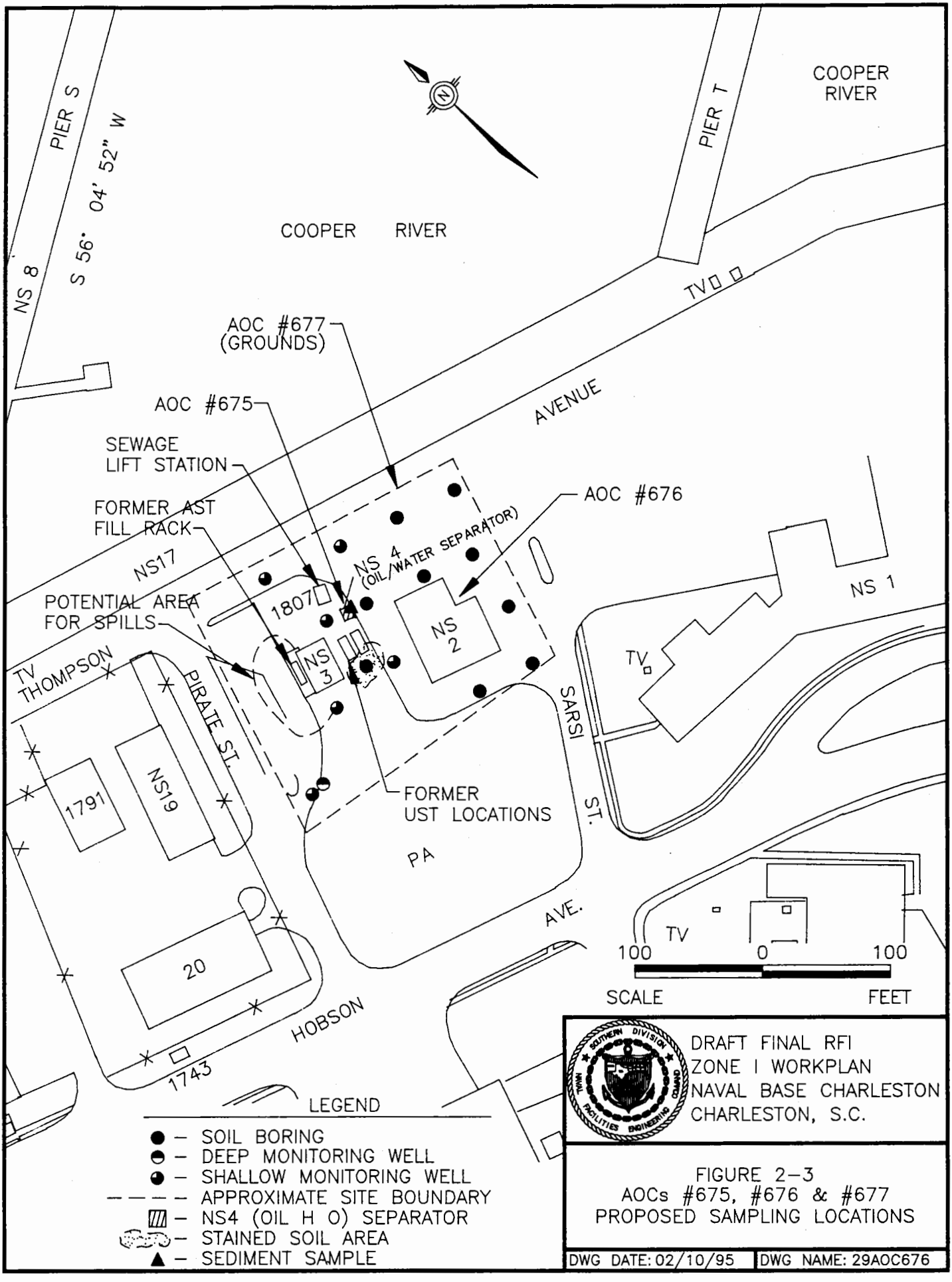
COOPER RIVER
PIER S
S 56° 04' 52" W
NS 8
COOPER RIVER
PIER T
TV
AOC #677
(GROUNDS)
AOC #675
AVENUE
SEWAGE
LIFT STATION
FORMER AST
FILL RACK
AOC #676
NS17
NS 4
(OIL/WATER SEPARATOR)
1807
POTENTIAL AREA
FOR SPILLS
NS 1
NS
2
TV
THOMPSON
NS
3
PIRATE ST.
SARSI
ST.
1791
NS19
FORMER
UST LOCATIONS
PA
AVE.
TV
100
0
100
SCALE
FEET
20
HOBSON
1743
LEGEND
– SOIL BORING
– DEEP MONITORING WELL
– SHALLOW MONITORING WELL
– APPROXIMATE SITE BOUNDARY
– NS4 (OIL H O) SEPARATOR
– STAINED SOIL AREA
– SEDIMENT SAMPLE
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-3
AOCs #675, #676 & #677
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/10/95
DWG NAME: 29AOC676

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2.4 AOC 678, Firefighter School, Former Building 2-V, and AOC 679, Former Wash Rack

AOC 678 is the former site of Building 2-V, the Firefighter School, which was behind Building NS-1 in the northeastern portion of the southern peninsula. The firefighting school was reportedly constructed in 1947 and demolished circa 1955. No other details regarding the design features or operating practices were available but controlled fires may have been ignited and extinguished onsite for firefighter training. Petroleum contaminants may therefore be present. This AOC has been designated for a CSI.

Nearby is AOC 679, the former location of a wash rack. Details regarding the design features, years of operation, and operating practices of this rack are also unknown but likely involved petroleum-based materials. The *RCRA Facility Assessment* (November 1994) lists paint as a characteristic waste. Upon further review of current information, paint contaminants were associated with lead-based paint suspected in adjacent Building NS-1, not the former wash rack. Like AOC 678, the wash rack has been designated for a CSI and both will be investigated concurrently. Table 2.7 describes these AOCs.

2.4.1 Previous Investigations

AOCs 678 or 679 have not been investigated previously.

2.4.2 Treatment Alternatives

As outlined in the overall sampling strategy in the *Final Comprehensive RFI Work Plan*, treatment alternatives are being identified for each site likely to require remedial action. Data collection efforts will support evaluating these alternatives. Tables B-1, B-3, and B-7 (Appendix B) list the treatment alternatives for groundwater, soil gas, soil, and surface water runoff at AOCs 678 and 679. Alternatives presented here are for preliminary evaluation only. If contaminants are present at concentrations requiring remediation, a CMS will be undertaken to identify feasible treatment alternatives.

2.4.3 Data Gaps

No environmental media data have been collected at AOCs 678 and 679 to characterize the sites or to support a detailed evaluation of treatment alternatives, if necessary. As a result, the following data gaps have been identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Soil data to confirm/deny that a release(s) has occurred; and,
- Groundwater data to confirm/deny that a release(s) has occurred.

Table 2.7
AOCs 678 and 679
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 678 Firefighter School, Former Bldg. V-2	Former firefighter school and potential site of controlled burning of ignitable materials.*	Petroleum (volatiles, light hydrocarbons)	**Soil** Soil Gas **Groundwater** Surface Water Underground utility conduits
AOC 679 Former Wash Rack	Former location of wash rack.*	Petroleum (oil & grease, heavy hydrocarbons)	**Soil** Soil Gas **Groundwater** Surface Water Underground utility conduits

Notes:

* Described in the *RCRA Facility Assessment, June 13, 1994 (revised November 1994)*
Pathways scheduled for confirmatory sampling are bold.

2.4.4 Potential Receptors

Potential receptors of exposure to contaminants include current land users, such as NAVBASE personnel, and any future users this area may support. Data will be generated during the RFI to determine the level of risk to the entire spectrum of current and potential users, including any highly sensitive individuals, who might be exposed through invasive or non-invasive activities.

Confirmatory sampling will characterize the potential pathways highlighted in Table 2.7. Characterizing the surface water and sediment pathways will be addressed in the Zone J RFI.

The only land use associated with both AOCs 678 and 679 is as an asphalt-paved parking area. Potential receptors would likely be workers involved with any invasive activity bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet bgs, site workers could also be subject to accidental ingestion or dermal exposure to contaminated groundwater. In addition, site workers may be exposed to soil gases resulting from tidal influences on groundwater at and around the site.

The Cooper River could receive contaminated surface water runoff and groundwater discharges, resulting in exposure to biological receptors other than humans. Several storm sewers are along an east-west drainage way in the center of the parking area and discharge directly into the Cooper River. The storm sewers will be addressed in the Zone L work plan.

2.4.5 Objective

The objective of the proposed field investigation is to confirm the presence/absence of contamination in environmental media. If present, the investigation will delineate the horizontal and vertical extent of any soil and/or groundwater contamination. While soil gas, surface water, and underground utility conduits are potential contaminant pathways, initial sampling of these matrices is not required to determine the presence of contaminants. Delineating the nature and extent of contamination should identify any onsite point sources for potential contaminants to enter Cooper River, such as the storm drains, as well as determining contaminant impact from potential offsite sources. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.4.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A PID will be used to qualitatively screen for volatile compounds in all soil samples from every soil boring and monitoring well location. Results will be recorded in the field notes and on boring logs.

2.4.7 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Twenty-five soil borings will be installed across the area of concern using a grid-based sampling scheme. Due to the lack of information regarding the exact locations of AOCs 678 and 679, a grid-based scheme was selected. A grid spacing of 40 feet provides sufficient coverage to define the nature and extent of releases, if any, from the approximated area.

Four of these borings will be converted into monitoring wells (three shallow, one deep), including one deep/shallow well pair which will be used in conjunction with 17 other well pairs along the perimeter of Zone I to monitor offsite contaminant migration patterns. Monitoring wells were located as follows: one well upgradient and three wells downgradient of the suspected groundwater flow direction. Each proposed sampling location is illustrated on Figure 2-4. Table 2.8 summarizes the types of samples to be collected and the analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan* (August 30, 1994).

Table 2.8
AOCs 678 and 679
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1')	25	VOAs and SVOCs w/ TICs, Metals (including organotins), Cyanide, Pesticides, and PCBs.
Soil (3-5')	25	
Groundwater (Shallow wells)	3[a]	Chlorides, TDS, and sulfates (groundwater only).
(Deep wells)	1[a]	

Engineering Parameters:

Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis of any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution is developed.

Notes:

[a] One shallow and one deep grid-based monitoring well designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.

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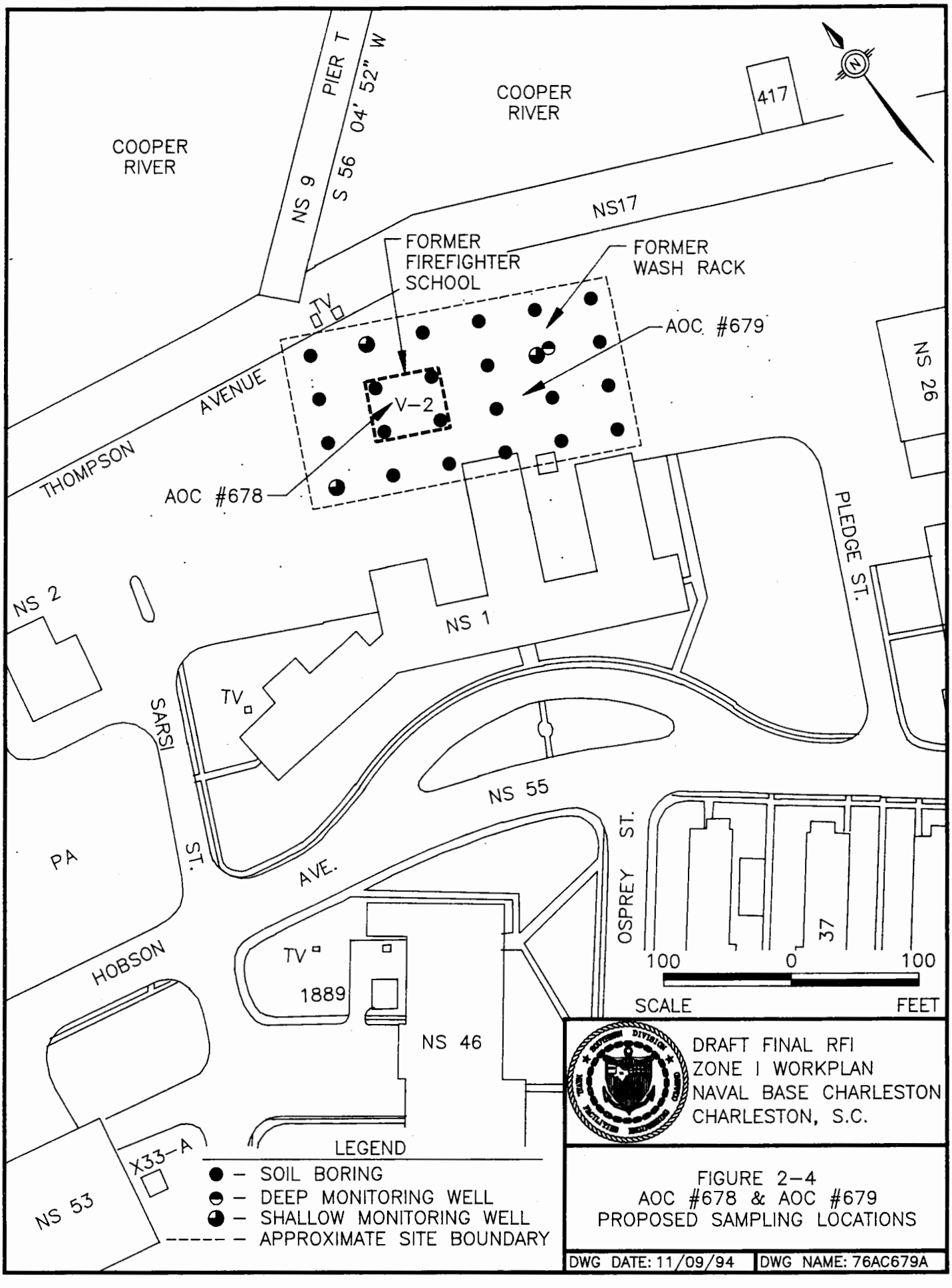
COOPER RIVER
COOPER RIVER
PIER T
S 56 04' 52" W
NS 9
417
NS17
FORMER FIREFIGHTER SCHOOL
FORMER WASH RACK
AOC #679
V-2
AOC #678
TV
THOMPSON AVENUE
NS 26
PLEDGE ST.
NS 2
NS 1
TV
SARSI ST.
NS 55
PA
AVE.
OSPREY ST.
37
100
0
100
SCALE
FEET
HOBSON
TV
1889
NS 46
X33-A
NS 53
LEGEND
● – SOIL BORING
◒ – DEEP MONITORING WELL
◕ – SHALLOW MONITORING WELL
----- – APPROXIMATE SITE BOUNDARY
DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-4
AOC #678 & AOC #679
PROPOSED SAMPLING LOCATIONS
DWG DATE: 11/09/94
DWG NAME: 76AC679A

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2.5 AOC 680, NS-26 Grinding Room/Brake Repair Area

AOC 680 is the former grinding room in Building NS-26, reportedly used for repairing brake components containing asbestos. Building plans from 1969 show the grinding room on the southern side of Building NS-26, not the northeast side as described in the *RCRA Facility Assessment* (November 1994). Recent interviews with NS-26 personnel also indicate that brakes have not been repaired at NS-26 since 1970. The area once occupied by the grinding room was remodeled in 1985 and is now the southern entrance with a short hallway. Since details regarding both past activities and period of operation are uncertain, AOC 680 has been designated for a CSI to determine if asbestos dust is present. This AOC is described in Table 2.9.

Table 2.9
AOC 680
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 680 Grinding Room Brake Repair Area	Former Grinding Room/Brake Repair Area in NS-26.[a]	Asbestos dust	**Air**

Notes:

[a] Described in the *RCRA Facility Assessment, June 13 1994 (revised November 1994)*
Pathways scheduled for confirmatory sampling are bold.

2.5.1 Previous Investigations

AOC 680 has not been previously investigated.

2.5.2 Treatment Alternatives

As outlined in the overall sampling strategy presented in the *Comprehensive RFI Work Plan*, treatment alternatives are being identified for the sites likely to require remedial action. Data collection efforts will support the evaluating these alternatives. If asbestos-containing accumulated dust is identified, then a South Carolina-certified asbestos abatement group would be required to effectively abate structural building components.

2.5.3 Data Gaps

No environmental media data have been collected at AOC 680 to characterize the site or to support a detailed evaluation of treatment alternatives, if necessary. As a result, the following data gap has been identified to ensure that data collection efforts are sufficient to fill this gap and to meet the stated investigation objectives:

- Asbestos data to confirm/deny that a release(s) has occurred.

2.5.4 Potential Receptors

Potential receptors of exposure to contaminants include current land users, such as NAVBASE personnel, and any future users this area may support. Data will be generated during the RFI to determine the level of risk to the entire spectrum of current and potential users, including any highly sensitive individuals, who might be exposed through invasive or non-invasive activities. Confirmatory sampling will characterize the potential air pathway identified in Table 2.9.

The only activity currently associated with AOC 680 is the regular passage of workers through the door and short hallway. Potential receptors would likely be workers involved with any aggressive activity that could disturb surfaces covered with asbestos dust, releasing the hazardous fibers into the air.

2.5.5 Objective

The objective of the proposed field investigation is to confirm the presence of asbestos contamination at AOC 680. If asbestos contamination is identified, then the site will be recommended for treatment and additional samples will be collected inside and outside to define its extent.

2.5.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is

inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

2.5.7 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. The scope of sampling at AOC 680 will focus on the collecting accumulated dust from horizontal surfaces unlikely to have undergone significant dusting or maintenance. Sampling areas are not predetermined, although ideal areas are typically structural building components such as beams and supports, window sills, and the upper surfaces of suspended ceilings. Where sufficient material is accumulated, three samples will be collected from each homogeneous sampling area (e.g., upper surfaces of structural beams). If asbestos contamination is identified, then the site will be recommended for treatment and additional samples will be collected inside and outside to define the extent of contamination.

Dust samples will be collected using a "micro-vacuuming" technique in which an industrial hygiene-type air pump draws air through a mixed-cellulose-ester filter cassette equipped with tubing at the cassette intake. The tubing will allow any accumulated dust from horizontal surfaces to be vacuumed.

The dust samples will be analyzed using the USEPA-endorsed polarized light microscopy with dispersion staining technique. If abating contaminated dust is required, any abatement project should be followed by clearance air monitoring using National Institute for Occupational Safety and Health (NIOSH) Method 7400 (phase-contrast light microscopy) or the transmission electron microscopy techniques set forth by the Code of Federal Regulations, 40 CFR 763, Subpart E. The site sampling location is illustrated on Figure 2-5. Table 2.10 summarizes the types of samples to be collected and the analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan* (August 30, 1994).

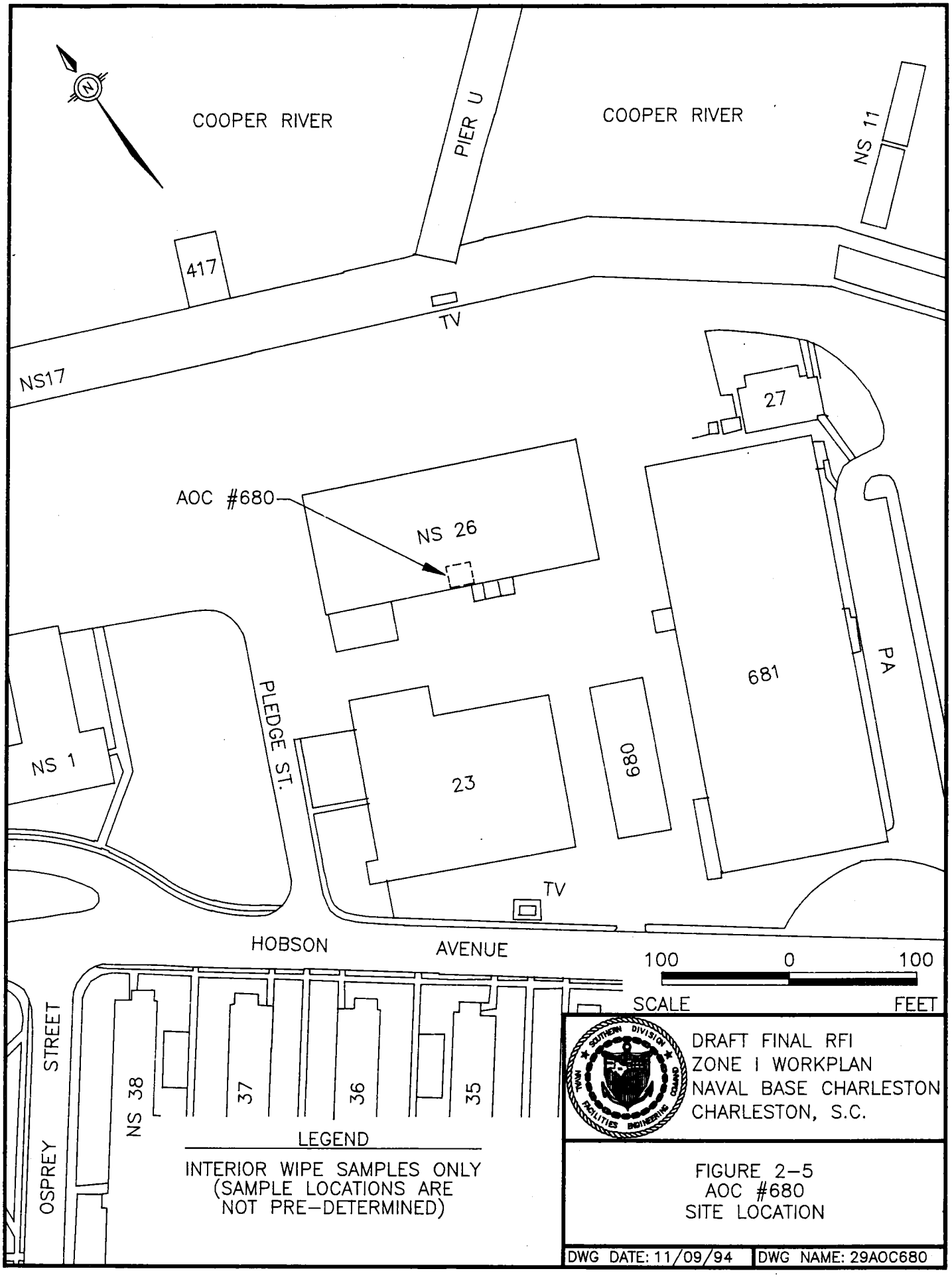
Table 2.10
AOC 680
Sampling Plan

Matrix	Quantity	Analysis
Dust	9 - 12	Asbestos (PLM-Dispersion Staining)

Notes:

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

Dust samples will be analyzed using NIOSH Method 7400 (phase-contrast light microscopy) or the techniques listed in 40 CFR 763 (transmission electron microscopy).


COOPER RIVER
PIER U
COOPER RIVER
NS 11
417
TV
NS17
27
AOC #680
NS 26
NS 1
PLEDGE ST.
23
680
681
PA
TV
HOBSON AVENUE
100 0 100
SCALE FEET
OSPREY STREET
NS 38
37
36
35
LEGEND
INTERIOR WIPE SAMPLES ONLY
(SAMPLE LOCATIONS ARE
NOT PRE-DETERMINED)
DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-5
AOC #680
SITE LOCATION
DWG DATE: 11/09/94
DWG NAME: 29AOC680

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2.6 AOC 681, Building 681 Blast Booth

AOC 681 is the abrasive blast booth on the west side of Building 681 used for stripping miscellaneous ship and boiler components. The blasting agent (aluminum oxide) is recycled through a cyclone separator and the generated wastes, primarily paint dust, are directed into an outdoor hopper and then into 55-gallon drums for disposal. AOC 681 has been designated for an RFI to determine if the blast booth has impacted either the building's interior or the soil surrounding the exterior hopper. This AOC is described in Table 2.11.

Table 2.11
AOC 681
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 681 Blast Booth	Blast Booth in Building 681 used to strip miscellaneous components.[a]	Lead-based paint Aluminum oxide	**Soil** Groundwater **Air**

Notes:

[a] Described in the *RCRA Facility Assessment, May 31, 1994 (revised November 1994).*
Pathways scheduled for confirmatory sampling are bold.

2.6.1 Previous Investigations

AOC 681 has not been investigated previously.

2.6.2 Treatment Alternatives

As outlined in the overall sampling strategy presented in the *Final Comprehensive RFI Work Plan* (August 30, 1994), treatment alternatives are being identified for the sites likely to require remedial action. Data collection efforts will support the evaluating these alternatives. Tables B-1 and B-4 (Appendix B) list the treatment alternatives for groundwater, soil, and sediment at AOC 681. Alternatives presented here are for preliminary evaluation only. If contaminants are present at concentrations requiring remediation, a CMS will be undertaken to identify the probable treatment alternatives.

2.6.3 Data Gaps

No environmental media data have been collected at AOC 681 to characterize the site or to support a detailed evaluation of treatment alternatives, if necessary. As a result, the following data gaps have been identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Soil data to define the nature and extent of contamination from the blast booth operation; and,

- Wipe sample data to determine the nature and extent of historical air releases.

2.6.4 Potential Receptors

Potential receptors of exposure to contaminants include current land users, such as NAVBASE personnel, and any future users this area may support. Data will be generated during the RFI to determine the level of risk to the entire spectrum of current and potential users, including any highly sensitive individuals, who may be exposed through invasive or non-invasive activities. Confirmatory sampling will characterize the potential pathways highlighted in Table 2.11. Characterizing the groundwater pathway will be addressed through the zone-wide investigation.

The only operation currently associated with AOC 681 is an abrasive blast booth. Potential receptors would likely be the workers involved in the blasting and waste-collection process and those working near the booth's particulate emissions. Average particulate air emissions from the booth are 0.0004 pounds per hour or 0.00175 tons per year.

2.6.5 Objective

The objective of the proposed field investigation is to fill the identified data gaps by delineating the nature and extent of soil and blast residue contamination at AOC 681. While groundwater and air are potential contaminant pathways, initial sampling of these matrices is not required to determine if contaminants are present. Delineating the extent of contamination will identify the environmental impact of the blast booth. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.6.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

2.6.7 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Seven wipe samples are proposed for surfaces near the blast booth to detect blast residues. Three soil borings will be installed around the outdoor hopper to determine if the unit's operation has impacted the surrounding soil. Each proposed sampling location is illustrated on Figure 2-6. Table 2.12 summarizes the types of samples to be collected and the analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan* (August 30, 1994).

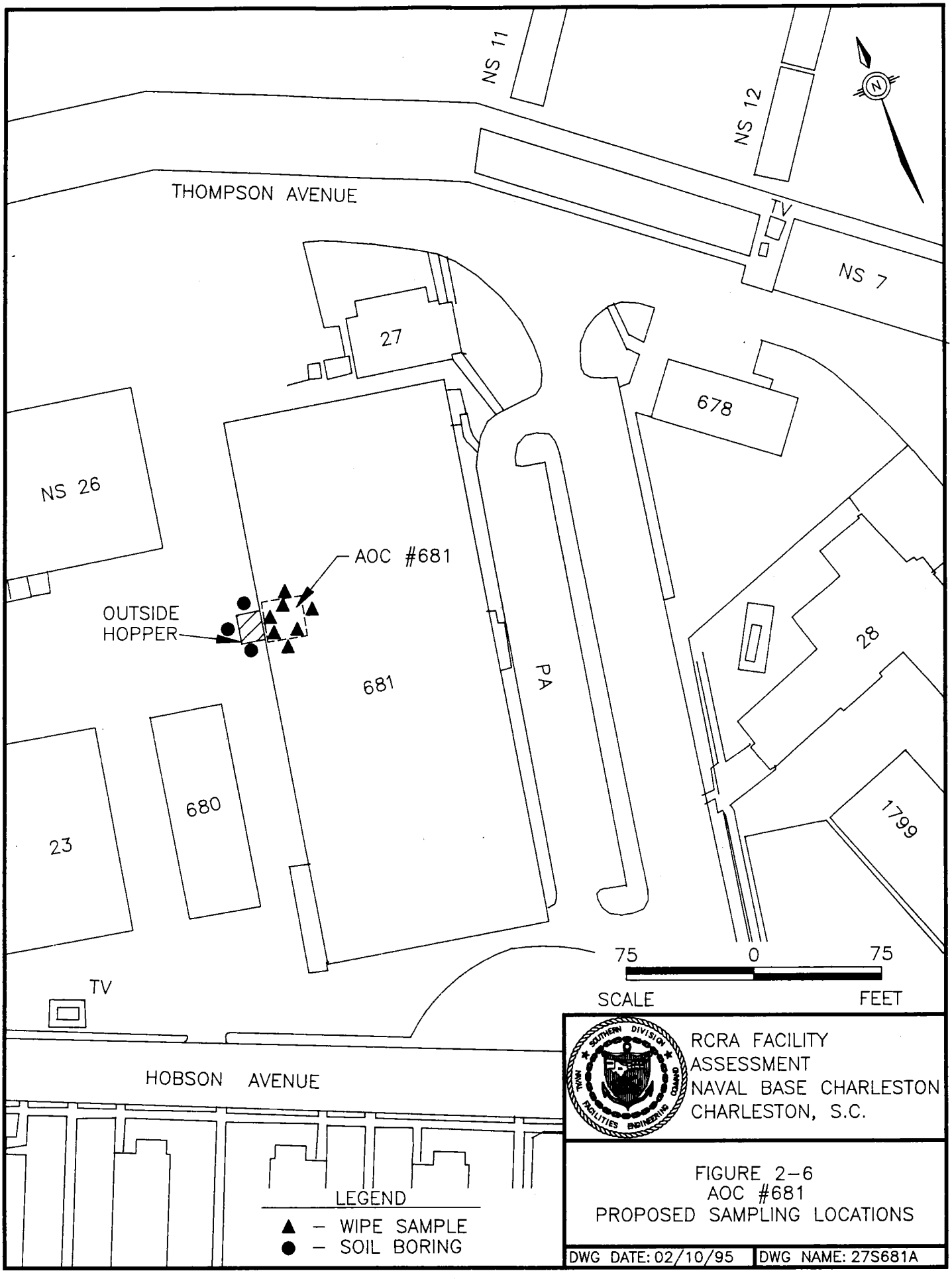
Table 2.12
AOC 681
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	3	VOAs and SVOCs w/ TICs, Metals (including organotins), Cyanide, Pesticides, and PCBs
Soil (3-5' bgs)	3	
Wipe	7	

Notes:

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.


NS 11
NS 12
THOMPSON AVENUE
TV
NS 7
27
678
NS 26
AOC #681
OUTSIDE
HOPPER
681
PA
28
1799
680
23
75
0
75
SCALE
FEET
TV
HOBSON AVENUE
LEGEND
▲ – WIPE SAMPLE
● – SOIL BORING
RCRA FACILITY
ASSESSMENT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-6
AOC #681
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/10/95
DWG NAME: 27S681A

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2.7 AOC 685, Former Smoke Drum

AOC 685, the former site of a smoke drum which reportedly operated from 1941 until 1953, was on the west side of Juneau Avenue, south of Partridge Avenue. Currently, this area is a grassy field with no visible evidence of the former smoke drum. The smoke drum's design features, dimensions, and operating practices are unknown, thus this AOC is designated as a CSI site. Table 2.13 describes AOC 685.

Table 2.13
AOC 685
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 685 Former Smoke Drum Site	Former Smoke Drum; use unknown.[a]	Products of incomplete combustion	Air (past) **Soil** Soil Gas Surface Water Sediment **Groundwater**

Notes:

[a] Described in the *RCRA Facility Assessment, June 13, 1994 (revised November 1994)*
Pathways scheduled for confirmatory sampling are bold.

2.7.1 Previous Investigations

AOC 685 has not been investigated previously.

2.7.2 Treatment Alternatives

As outlined in the overall sampling strategy in the *Final Comprehensive RFI Work Plan* (August 30, 1994), treatment alternatives are being identified for the sites likely to require remedial action. Data collection efforts will support the evaluating these alternatives. Tables B-1 and B-4 (Appendix B) list the treatment alternatives for groundwater, soil, and sediment at AOC 685. Alternatives presented here are for preliminary evaluation only. If contaminants are present in concentrations requiring remediation, a CMS will be undertaken to identify feasible treatment alternatives.

2.7.3 Data Gaps

No environmental media data have been collected at AOC 685 to characterize the site or to support a detailed evaluation of treatment alternatives, if necessary. As a result, the following data gaps have been identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Soil data to confirm/deny that a release(s) has occurred; and,
- Groundwater data to confirm/deny that a release(s) has occurred.

2.7.4 Potential Receptors

Potential receptors of exposure to contaminants include current land users, such as NAVBASE personnel, and any future users this area may support. Data will be generated during the RFI to determine the level of risk to the entire spectrum of current and potential users, including any highly sensitive individuals, who might be exposed through invasive or non-invasive activities. Confirmatory sampling will characterize the potential pathways highlighted in Table 2.13. Characterizing the surface water and sediment pathways will be addressed in the Zone J RFI.

No activities are associated with AOC 685. Potential receptors would likely be workers involved with any invasive activity, bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet bgs, site workers could also be subject to accidental ingestion or dermal exposure to contaminated groundwater. In addition, site workers may be exposed to soil gases resulting from tidal influences on groundwater at and around the site.

Because groundwater is suspected to flow east toward the Cooper River, it and adjacent wetlands are potentially subject to receiving contaminated surface water runoff and groundwater discharges. This may result in exposure to biological receptors other than humans.

2.7.5 Objective

The objective of the proposed field investigation is to confirm the presence/absence of contamination in environmental media. If present, the investigation will delineate the horizontal and vertical extent of any soil and/or groundwater contamination. Although air, soil gas, surface water, and sediment are potential contaminant pathways, initial sampling of these matrices is not required to determine if contaminants are present. If soil contamination is identified, then the site will be designated for a complete RFI to delineate the nature and extent of contamination. An RFI will also identify any onsite point sources for potential contaminants to enter Cooper River and bordering wetlands, as well as determining contaminant impact from potential offsite sources. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.7.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A PID will be used to qualitatively screen for volatile compounds in all soil samples from every soil boring and monitoring well location. Results will be recorded in the field notes and on boring logs.

2.7.7 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Due to the lack of knowledge of the exact location and operation of the site, nine grid-based soil sampling locations are proposed to characterize any contamination at AOC 685. Each proposed sampling location is illustrated on Figure 2-7. Table 2.14 summarizes the types of samples to be collected and the analytical parameters. All usable data obtained from the

proposed nearby Zone I well pair will also be incorporated into the AOC assessment. If contamination is detected, additional soil and groundwater samples may need to collected to define the nature and extent of contamination. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan* (August 30, 1994).

Table 2.14
AOC 685
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	9	VOAs and SVOCs w/ TICs, Metals (including organotins), Cyanide, Pesticides, and PCBs.
Soil (3-5' bgs)	9	
Groundwater (Shallow well)	1[a]	Chlorides, Total dissolved solids, and sulfates (groundwater only).
(Deep well)	1[a]	

Engineering Parameters:

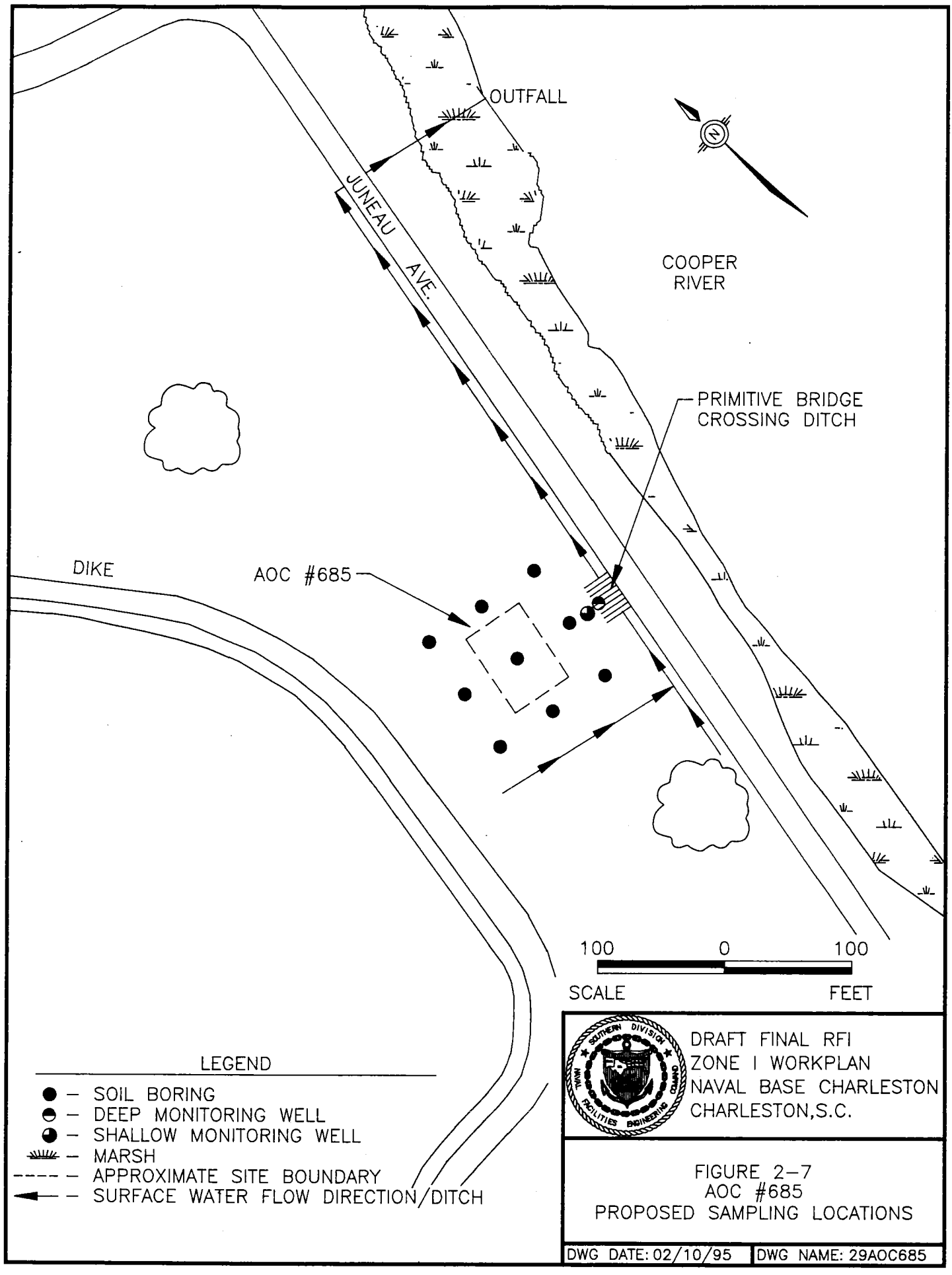
Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis of any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution is developed.

Notes:

[a] One shallow and one deep grid-based monitoring well designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.


OUTFALL
JUNEAU AVE.
COOPER RIVER
PRIMITIVE BRIDGE CROSSING DITCH
DIKE
AOC #685
100 0 100
SCALE FEET
LEGEND
● – SOIL BORING
◒ – DEEP MONITORING WELL
◕ – SHALLOW MONITORING WELL
– MARSH
---- – APPROXIMATE SITE BOUNDARY
– SURFACE WATER FLOW DIRECTION/DITCH
DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON,S.C.
FIGURE 2-7
AOC #685
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/10/95
DWG NAME: 29AOC685

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2.8 AOC 687, Building X-55 — Ammunition Storage Bunker (includes SWMU 16, Paint Storage Bunker)

AOC 687 is an earth-covered ammunition storage bunker constructed in 1942 between Juneau Avenue and the current southern dredged materials area. The facility continues to store explosives and small arms ammunition. The bunker reportedly was also once used for unauthorized paint storage. This AOC is designated for a CSI.

The earth-covered roof of X-55, designated as SWMU 16, was reportedly used for the unauthorized open storage of small quantities of paint, paint thinner, and other hazardous materials. Both X-55 sites will be investigated concurrently. Table 2.15 describes AOC 687 and SWMU 16.

Table 2.15
AOC 687 and SWMU 16
Site Descriptions

Number	Description	Materials of Concern	Potential Pathways
AOC 687 Ammunition Storage Bunker	Ammunition Storage Bunker X-55 used to store explosives and paint.[a]	Explosives Paint waste	**Soil** **Sediment** Surface Water **Groundwater**
SWMU 16 Paint Storage Bunker	Roof of Storage Bunker X-55 used for unauthorized open storage of small quantities of paint and other materials with a spill history.[b]	Paint wastes and paint thinner	**Soil** Soil Gas **Sediment** Surface Water **Groundwater**

Notes:

[a] Described in the *RCRA Facility Assessment, June 13, 1994 (revised November 1994)*
[b] Described in the *RCRA Facility Assessment, August 1987*
Pathways scheduled for sampling are bold.

2.8.1 Previous Investigations

AOC 687 and SWMU 16 have not been investigated previously. When X-55 was visually inspected in 1987, spilled paint was observed on the earth-covered roof and NAVBASE personnel were notified. The spilled paint and surrounding soil were reportedly excavated within

12 hours of notification. The waste was later confirmed by NAVBASE to be discarded cleanup materials originating from a ship.

2.8.2 Treatment Alternatives

As outlined in the overall sampling strategy presented in the *Final Comprehensive RFI Work Plan* (August 30, 1994), treatment alternatives are being identified for the sites likely to require some type of remedial action. Data collection efforts will support evaluating these alternatives. Tables B-3 and B-5 (Appendix B) list the treatment alternatives for soil gas and soil at SWMU 16. Alternatives presented here are for preliminary evaluation only. If contaminants are present in concentrations requiring remediation, a CMS will be undertaken to identify feasible treatment alternatives.

2.8.3 Data Gaps

No environmental media data have been collected at AOC 687 or SWMU 16 to characterize the sites or to support a detailed evaluation of treatment alternatives, if necessary. As a result, the following data gaps have been identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Soil, sediment, and groundwater data to confirm/deny that a release(s) has occurred at AOC 687; and,

- Soil, sediment, and groundwater data to define the nature and extent of contamination from releases at SWMU 16.

2.8.4 Potential Receptors

Potential receptors of exposure to contaminants include current land users, such as NAVBASE personnel, and any future users this area may support. Data will be generated during the RFI to determine the level of risk to the entire spectrum of current and potential users, including any

highly sensitive individuals, who might be exposed through invasive or non-invasive activities. Sampling will characterize the potential pathways highlighted in Table 2.15. Characterizing the surface water pathway will be addressed in the Zone J RFI.

Activities associated with AOC 687 and SWMU 16 are limited to storing small amounts of ammunition and explosives. Potential receptors would likely be workers involved with any invasive activity, bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet bgs, site workers could also be subject to accidental ingestion or dermal exposure to contaminated groundwater. In addition, site workers may be exposed to soil gases resulting from tidal influences on groundwater at and around the site.

The Cooper River and adjacent wetlands are potentially subject to receiving contaminated surface water runoff and groundwater discharges, resulting in exposure to biological (aquatic and terrestrial) receptors other than humans. Wetlands are not present due to the proximity of the AOC to the Cooper River.

2.8.5 Objective

The objective of the proposed field investigation at AOC 687 is to confirm the presence/absence of contamination in environmental media. If present, the investigation will delineate the horizontal and vertical extent of any soil and/or groundwater contamination. The objective of the field investigation at SWMU 16 is to fill the identified data gaps by defining the nature and extent of contamination from reported releases. While surface water is also a potential contaminant pathway, initial sampling of this matrix is not required to determine the presence of contaminants. Delineating the nature and extent of contamination should identify any onsite point sources for potential contaminants to enter Cooper River and bordering wetlands as well as determining contaminant impact from potential offsite sources. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.8.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A PID will be used to qualitatively screen for volatile compounds in all soil samples from every soil boring and monitoring well location. Results will be recorded in the field notes and on boring logs.

2.8.7 Sampling and Analysis Plan

To fulfill both the CSI and RFI objectives, site-specific sampling and analysis requirements have been proposed. For AOC 687, four shallow monitoring wells are proposed at each corner of the X-55 structure to determine if any contaminants have migrated into the groundwater. The suspected groundwater flow direction is east toward the Cooper River. Monitoring wells will encircle the site to determine if releases to groundwater have occurred. Two sediment samples will be collected from the east drainage ditch to determine if contamination from surface water runoff is present. The surface water drainage ditch is approximately 4 feet wide and 2 feet deep, with a vegetated bottom. Flow direction in the ditch from the site is north to an outfall to the Cooper River. This outfall will be addressed in the Zone J RFI.

For SWMU 16, seven soil samples will be collected from the earth-covered roof of the bunker and adjacent blast berm to detect any impact from the past open storage of hazardous materials. The depth of each soil boring on the bunker itself will advance to the outer surface of its roof. The single boring on the adjacent blast berm will advance to a maximum depth of 5 feet. Each proposed sampling location is illustrated on Figure 2-8. Table 2.16 summarizes the types of samples to be collected and the analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan* (August 30, 1994).

Table 2.16
AOC 687 and SWMU 16
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	11	VOAs and SVOCs w/ TICs, Metals (including organotins), Cyanide, Pesticides, and PCBs
Soil (3-5' bgs)	11	
Sediment	2	Sediment samples will be analyzed for TOC and grain size.
Groundwater (Shallow Well)	4	
	1*	Chlorides, TDS, and sulfates (groundwater only).

Notes:

* One shallow and one deep grid-based monitoring well designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.
The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.

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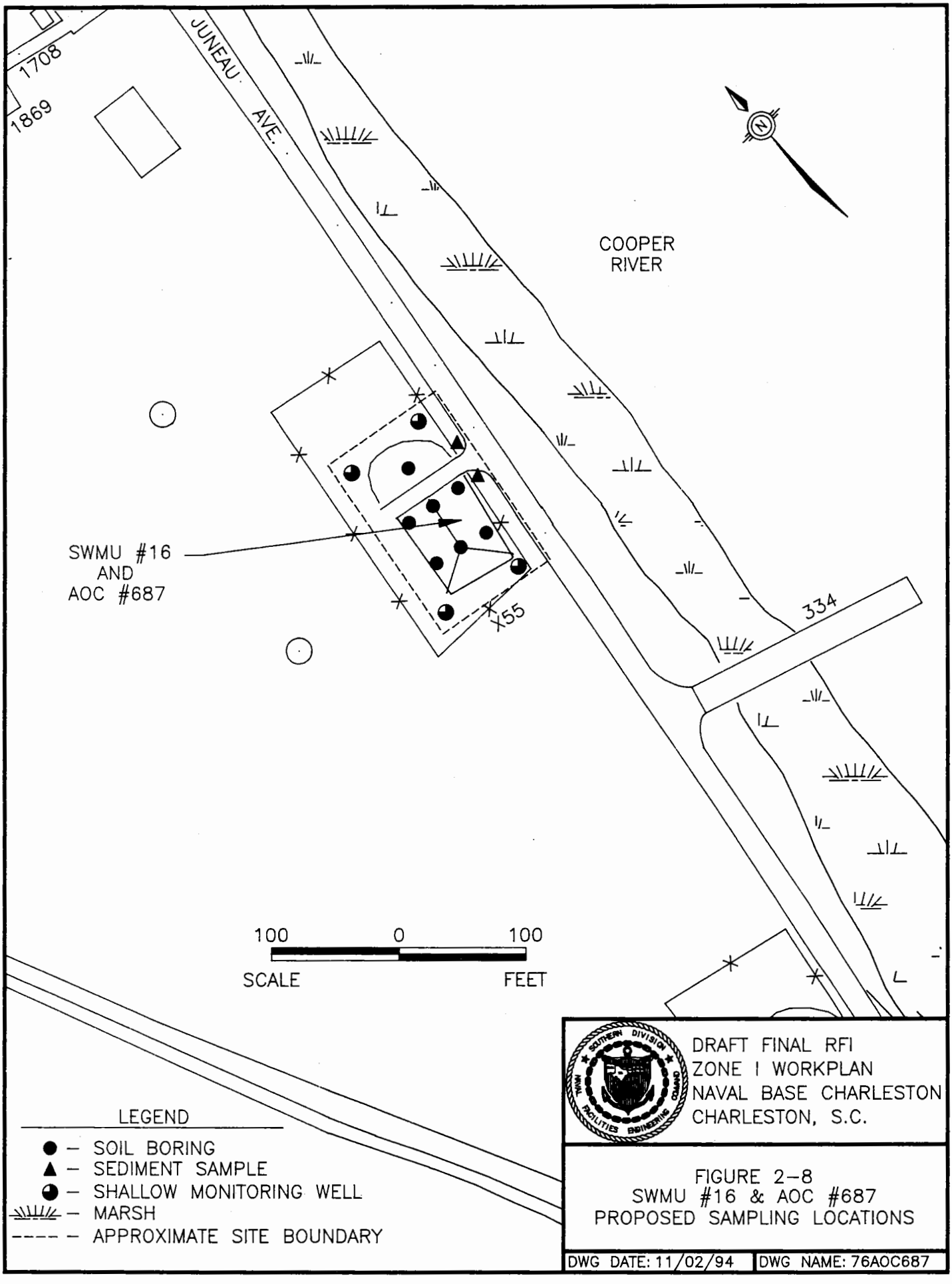
1708
1869
JUNEAU AVE.
COOPER RIVER
SWMU #16
AND
AOC #687
X55
334
100 0 100
SCALE FEET
LEGEND
● – SOIL BORING
▲ – SEDIMENT SAMPLE
◕ – SHALLOW MONITORING WELL
– MARSH
---- – APPROXIMATE SITE BOUNDARY
SOUTHERN DIVISION NAVAL FACILITIES ENGINEERING COMMAND
DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-8
SWMU #16 & AOC #687
PROPOSED SAMPLING LOCATIONS
DWG DATE: 11/02/94
DWG NAME: 76AOC687

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2.9 AOC 688, Building X-56 — Ammunition Storage Bunker

AOC 688 is an earth-covered ammunition storage bunker constructed in 1942 between Juneau Avenue and the current southern dredged materials area. The facility still stores explosives and ammunition. The bunker reportedly was once used for the unauthorized storage of 3,420 gallons of paint in 1987. This AOC, designated for a CSI, is described in Table 2.17.

2.9.1 Previous Investigations

AOC 688 has not been investigated previously. During the 1994 visual site inspection, spilled paint was observed near the door of X-56.

Table 2.17
AOC 688
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 688 Ammunition Storage Bunker	Ammunition Storage Bunker X-56 used to store explosives and paint.[a]	Explosives Paint waste	**Soil** **Sediment** Surface Water **Groundwater**

Notes:

[a] Described in the *RCRA Facility Assessment, June 13, 1994 (revised November 1994)*
Pathways scheduled for sampling are bold.

2.9.2 Treatment Alternatives

As outlined in the overall sampling strategy presented in the *Final Comprehensive RFI Work Plan*, treatment alternatives are being identified for the sites likely to require remedial action. Data collection efforts will support evaluating these alternatives. Tables B-1 and B-2 (Appendix B) list the treatment alternatives groundwater, surface water runoff, soil, and sediment at AOC 688. Alternatives presented here are for preliminary evaluation only. If contaminants are present in concentrations requiring remediation, a CMS will be undertaken to identify feasible treatment alternatives.

2.9.3 Data Gaps

No environmental media data have been collected at AOC 688 to characterize the site or to support a detailed evaluation of treatment alternatives, if necessary. As a result, the following data gaps have been identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Sediment data to confirm/deny that a release(s) has occurred; and,
- Groundwater data to confirm/deny that a release(s) has occurred.

2.9.4 Potential Receptors

Potential receptors of exposure to contaminants include current land users, such as NAVBASE personnel, and any future users this area may support. Data will be generated during the RFI to determine the level of risk to the entire spectrum of current and potential users, including any highly sensitive individuals, who might be exposed through invasive or non-invasive activities. Confirmatory sampling will characterize the potential pathways highlighted in Table 2.17. The surface water pathway will be addressed in the Zone J RFI.

Activities associated with AOC 688 are limited to storing small amounts of ammunition and explosives. Potential receptors would likely be workers involved with any invasive activity bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet bgs, site workers could also be subject to accidental ingestion or dermal exposure to contaminated groundwater. In addition, site workers may be exposed to soil gases resulting from tidal influences on groundwater at and around the site.

The Cooper River and adjacent wetlands are potentially subject to receiving contaminated surface water runoff and groundwater discharges, resulting in exposure to biological receptors other than humans.

2.9.5 Objective

The objective of the proposed field investigation is to confirm the presence/absence of contamination in environmental media. If present, the investigation will delineate the horizontal and vertical extent of any soil, sediment, and/or groundwater contamination. While soil and surface water are also potential contaminant pathways, initial sampling of these matrices is not required to determine the presence of contaminants. Delineating the nature and extent of contamination should identify any onsite point sources for potential contaminants to enter Cooper River and bordering wetlands as well as determining contaminant impact from potential offsite sources. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.9.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A PID will be used to qualitatively screen for volatile compounds in all soil samples from every soil boring and monitoring well location. Results will be recorded in the field notes and on boring logs.

2.9.7 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Based on visual inspection of the bunker and the thickness of the concrete walls, the only potential contaminant migration pathway could be surface water runoff and sediment if the interior of the bunker had been washed out. Thus, two sediment samples will be collected from the east drainage ditch to determine if contamination from surface water runoff is present. All usable data obtained from the proposed nearby Zone I well pair will be incorporated into the

AOC assessment. If groundwater contamination is detected, additional wells may be necessary to define the nature and extent of contamination. Each proposed sampling location is illustrated on Figure 2-9. Table 2.18 summarizes the types of samples to be collected and the analytical parameters. All sampling will adhere to the NAVBASE Charleston *Final Comprehensive RFI Work Plan*, unless otherwise stated.

Table 2.18
AOC 688
Sampling Plan

Matrix	Quantity	Analysis
Sediment	2	VOAs and SVOCs w/ TICs, Metals (including organotins), Cyanide, Pesticides, PCBs .
Groundwater		
(Shallow)	1[a]	Sediment samples will be analyzed for TOC and grain size.
(Deep)	1[a]	Chlorides, TDS, and sulfates (groundwater only).

Engineering Parameters:

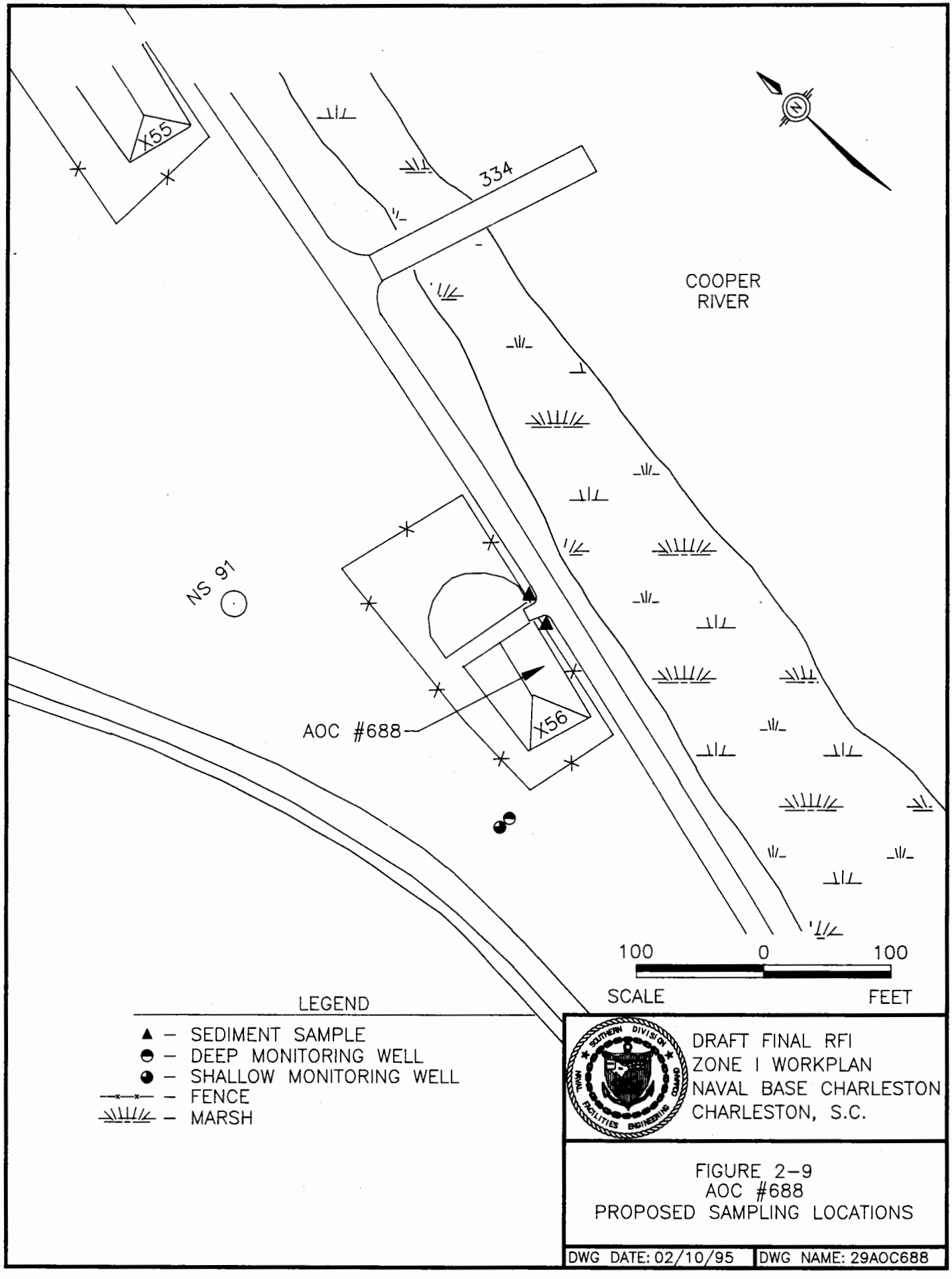
Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis of any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution is developed.

Notes:

[a] One shallow and one deep grid-based monitoring well designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.


X55
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COOPER
RIVER
NS 91
AOC #688
X56
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SCALE
FEET
LEGEND
▲ – SEDIMENT SAMPLE
◓ – DEEP MONITORING WELL
◕ – SHALLOW MONITORING WELL
–x–x– – FENCE
MARSH
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2–9
AOC #688
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/10/95
DWG NAME: 29AOC688

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2.10 AOC 689 Southern Tip of Base (Marina Parking Area) and AOC 690 Dredged Materials Area Roads

AOC 689 is the marina parking area at the southern tip of the base and the surrounding marshlands. This site is bound to the east by the Cooper River, to the west by the dredged materials area roads, and to the south by Shipyard Creek. The marina parking area has been identified as an area of concern based on information that the former parking area was used for unauthorized disposal of unknown materials during filling activities. As a result, this site has been designated for a CSI.

AOC 690 is the network of roadways at the southern tip of the base, including West Road, Lunsford Loop, and a portion of Juneau Avenue. The roadside areas along these dirt roads, totaling about 4,500 feet, are reported locations of historic, unauthorized chemical dumping by ship personnel and have therefore been designated for a CSI. Table 2.19 describes AOCs 689 and 690.

2.10.1 Previous Investigations

The southern tip of the peninsula, approximately 500 feet south of the dredged materials area was sampled, in May 1992 by McCord & Steffen, a local environmental company, and the U.S. Army Corps of Engineers. Six soil/sediment samples were collected and analyzed to determine the disposal suitability of the land removal/dredge materials proposed to be placed at the base's southern disposal area. This removal was necessary to install a turning basin at the mouth of Shipyard Creek.

Two of the six samples (sediment samples) were analyzed for dioxins and both samples had trace concentrations (1.3 to 2.7 parts per trillion). As of this writing, neither the turning basin installation nor the soil removal has taken place and no known dioxin-contaminated soil/sediments associated with the turning-basin project have been deposited in the dredged materials area. A copy of the sampling results and a brief summary are included in Appendix C.

Table 2.19
AOCs 689 and 690
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 689 Southern Tip of the Base (Marina Parking Area)	The marina parking area was reportedly used for unauthorized disposal of unknown materials during filling activities.[a]	Unknown materials	**Soil** **Sediment** Surface Water **Groundwater** Air
AOC 690 Dredged Materials Area Roads	Dredged Materials Area Roads are reported sites for unauthorized disposal of chemicals and other hazardous wastes by ship personnel.[a]	Petroleum products; Unknown materials	**Soil** **Sediment** Surface Water **Groundwater** Air

Notes:

[a] Described in the *RCRA Facility Assessment, June 13, 1994 (revised November 1994)*
The pathways scheduled for confirmatory sampling are bold.

Usable data derived from these and other associated investigations will be incorporated into the assessment of AOC 689. The marina parking area has not been previously investigated.

AOC 690 has not been previously investigated.

2.10.2 Treatment Alternatives

As outlined in the overall sampling strategy in the *Final Comprehensive RFI Work Plan*, treatment alternatives are being identified for the sites likely to require remedial action. Data collection efforts will support evaluating these alternatives. Tables B-2, B-3, and B-6 (Appendix B) list the treatment alternatives for surface water runoff, soil, sediment, soil gas, groundwater, and leachate for AOCs 689 and 690. Alternatives presented here are for preliminary evaluation only. If contaminants are present in concentrations requiring remediation, a CMS will be undertaken to identify feasible treatment alternatives.

2.10.3 Data Gaps

Available information is insufficient to characterize the site or support a detailed evaluation of treatment alternatives, where necessary. Therefore, remaining data gaps are identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Soil, groundwater, surface water, sediment, and leachate data to confirm/deny that a release has occurred at AOC 690;

- Groundwater, surface water, and leachate data to confirm/deny that a release has occurred at AOC 689;

- The impacts (potential point sources) of AOC 689 and 690 to Shipyard Creek, Cooper River, and nearby wetlands have not been fully defined; and,

- Insufficient soil and sediment data exist at AOC 689 to determine the nature and extent of impacts to environmental media.

2.10.4 Potential Receptors

Potential receptors of exposure to contaminants include current land users, such as NAVBASE personnel, and any future users this area may support. Data will be generated during the RFI to determine the level of risk to the entire spectrum of current and potential users, including any highly sensitive individuals, who might be exposed through invasive or non-invasive activities. This will include characterizing all potential pathways of exposure at this site, including soil, sediment, surface water, and groundwater.

Land use at AOC 689 and 690 is limited to the marina facility, the dredged materials area roads, and the construction lay-down yard. Potential receptors would likely be workers involved with

any invasive activities bringing them in direct contact with subsurface contaminants, or marina personnel and/or users that may come in contact with surface waters and/or point source discharges. Considering the presence of standing water and shallow depth to groundwater, generally less than 4 feet bgs, site workers could also be subject to accidental ingestion or dermal exposure to contaminated surface and groundwater. Shipyard Creek, Cooper River, and adjacent wetlands are potentially subject to receiving dredge water runback permitted under Section 404(b) of the Clean Water Act, resulting in potential exposure to biological receptors other than humans.

2.10.5 Objective

The objective of the proposed field investigation is to confirm the presence/absence of contamination at AOCs 689 and 690. If present, the investigation will delineate the horizontal and vertical extent of any soil, surface water, sediment, leachate, and groundwater contamination. Delineating the nature and extent of contamination should identify any onsite point sources for potential contaminants to enter Shipyard Creek, Cooper River, and bordering wetlands as well as determining contaminant impact from potential offsite sources. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.10.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A PID will be used to qualitatively screen for volatile compounds in all soil samples from every soil boring and monitoring well location. Results will be recorded in the field notes and on boring logs.

2.10.7 Sampling and Analysis Plan

To fulfill the CSI objectives, site-specific sampling and analysis requirements have been proposed. Due to the large areas and the uncertainty of disposal practices along the roadways, 20 soil borings and eight sediment samples are proposed for AOCs 689 and 690. Each proposed sampling location is illustrated on Figure 2-10. Table 2.20 summarizes the types of samples to be collected and the analytical parameters. Five proposed Zone I grid-based well pairs are also near AOC 690 and the data obtained from these points will be incorporated into AOC 689 and 690's assessment. All sampling will adhere to the NAVBASE Charleston *Final Comprehensive RFI Work Plan* (August 30, 1994).

Table 2.20
AOCs 689 and 690
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	20	VOAs and SVOCs w/ TICs, Metals (including organotins), dibenzofurans, and dioxins, Cyanide, Pesticides, and PCBs.
Soil (3-5' bgs)	20	
Sediment	8	Sediment samples will be analyzed for TOC and grain size.
Groundwater (Shallow)	5[a]	Chlorides, TDS, and sulfates (groundwater only).
(Deep)	5[a]	

Engineering Parameters:

Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis of any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution is developed.

Notes:

[a] Five shallow and five deep grid-based monitoring wells designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.

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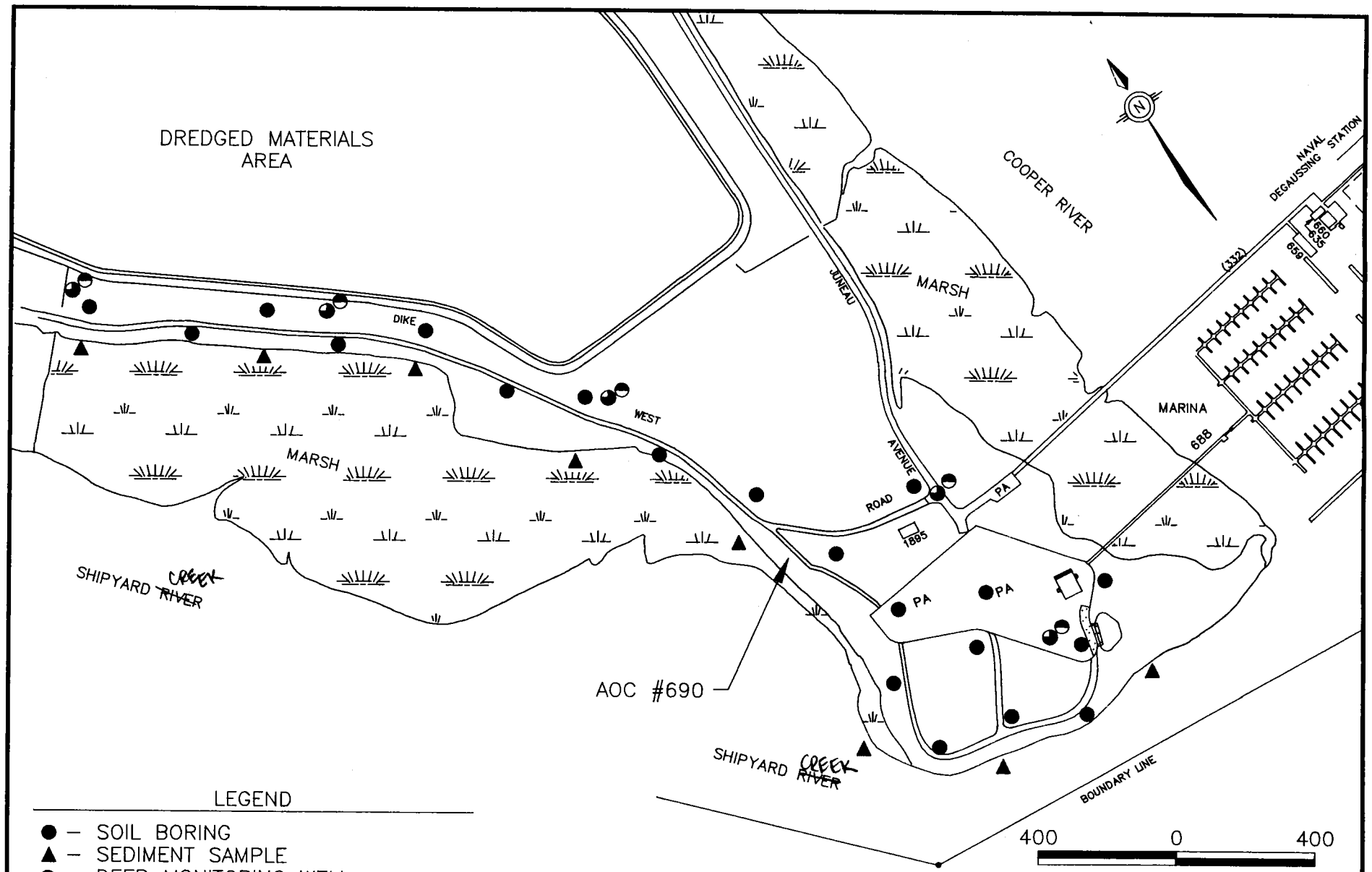

DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2–10
AOCs #689 & #690
DREDGED MATERIALS AREA ROAD &
SOUTHERN TIP OF BASE

DWG DATE: 02/10/95 | DWG NAME: 29AOC690

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2.11 SWMU 12, Old Firefighter Training Area

SWMU 12 is the former firefighter training area in the southwestern portion of the southern peninsula. This unit was a 30-foot to 50-foot diameter pit used for training between 1966 and 1971. A gravel road and clearing in this area, currently used as a construction lay-down yard, is believed to be near the training area's former location. SWMU 12 has been designated for an RFI and is described in Table 2.21.

Table 2.21
SWMU 12
Site Description

Number	Description	Materials of Concern	Potential Pathways
SWMU 12 Old Firefighter Training Area	Old firefighter training area consisting of a shallow pit into which flammable liquids were pumped, ignited, and then extinguished.[a]	Petroleum hydrocarbons Coal Ash SVOCs and Metals	**Soil** Soil Gas Sediment **Groundwater** Surface Water

Notes:

[a] Described in the *RCRA Facility Assessment, August 1987*
Pathways scheduled for sampling are bold.

2.11.1 Previous Investigations

Previous investigations of SWMU 12 include a 1992 Confirmation Study after the training pit was cited by the U.S. Coast Guard in 1971 for releasing oil into Shipyard Creek following a heavy rainfall. The study involved installing three soil borings, one in the pit and two along West Road bordering Shipyard Creek. No visual evidence of oil was found in any of the borings and no results of chemical analyses on the samples were reported. During the 1994 RFA visual site inspection, a 4-foot diameter oil spill was observed in the construction lay-down yard, but it is uncertain whether this oil-stained soil is associated with the former training pit or the recent storage of leaking equipment.

2.11.2 Treatment Alternatives

As outlined in the overall sampling strategy presented in the *Final Comprehensive RFI Work Plan*, treatment alternatives are being identified for the sites likely to require remedial action. Data collection efforts will support evaluating these alternatives. Tables B-1, B-3, and B-4 (Appendix B) list the treatment alternatives for groundwater, soil gas, soil, and sediments for SWMU 12. Alternatives presented here are for preliminary evaluation only. If contaminants are present at concentrations requiring remediation, a CMS will be undertaken to identify feasible treatment alternatives.

2.11.3 Data Gaps

Available information is insufficient to characterize the site or support a detailed evaluation of treatment alternatives, where necessary. The data gaps are as follows:

- Soil and groundwater data to define the nature and extent of contamination from reported releases at SWMU 12; and,

- The impact of SWMU 12 on Shipyard Creek and nearby wetlands has not been fully defined.

2.11.4 Potential Receptors

Potential receptors of exposure to contaminants include current land users, such as NAVBASE personnel, and any future users this area may support. Data will be generated during the RFI to determine the level of risk to the entire spectrum of current and potential users, including any highly sensitive individuals, who might be exposed through invasive or non-invasive activities. This will include characterizing all potential pathways of exposure at this site, including soil, sediment, surface water, and groundwater.

The only known activity associated with SWMU 12 is a construction laydown yard. Potential receptors would likely be workers involved with any invasive activity bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet bgs, site workers could also be subject to accidental ingestion or dermal exposure to contaminated groundwater. In addition, site workers may be exposed to soil gases from tidal influences on groundwater at and around the site. Shipyard Creek and adjacent wetlands are potentially subject to receiving contaminated surface water runoff and groundwater discharges, resulting in exposure to biological receptors other than humans.

2.11.5 Objective

The objective of the proposed field investigation is to fill the identified data gaps by delineating the horizontal and vertical extent and migration rate of any soil and/or groundwater contamination at SWMU 12. While sediment and surface water are potential contaminant pathways, these matrices will be sampled under the Zone J RFI. Delineating the nature and extent of contamination should identify any onsite point sources for potential contaminants to enter Cooper River and bordering wetlands, as well as determining contaminant impact from potential offsite sources. Data collection efforts will support technical evaluation of identified treatment alternatives.

2.11.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the areal extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A PID will be used to qualitatively screen for volatile compounds in all soil samples from each soil boring and monitoring well location. Results will be recorded in the field notes and on boring logs.

2.11.7 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Thirteen grid-based soil borings, four of which will be converted into shallow monitoring wells, are proposed for characterizing of SWMU 12. Data from the well pair proposed in the Zone I grid-based well sampling program and the soil boring and sediment sample proposed in the CSI for AOC 690, each immediately west of SWMU 12, will be incorporated into SWMU 12's assessment. Each proposed sampling location is illustrated on Figure 2-11. Table 2.22 summarizes the types of samples to be collected at SWMU 12 and the analytical parameters. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan* (August 30, 1994).

Table 2.22
SWMU 12
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1')	13	VOAs and SVOCs w/ TICs, Metals (including organotins), Cyanide, Pesticides, and PCBs.
Soil (3-5')	13	
Groundwater (Shallow)	4[a]	Chlorides, TDS, and sulfates (groundwater only).
(Deep)	1[a]	

Engineering Parameters:

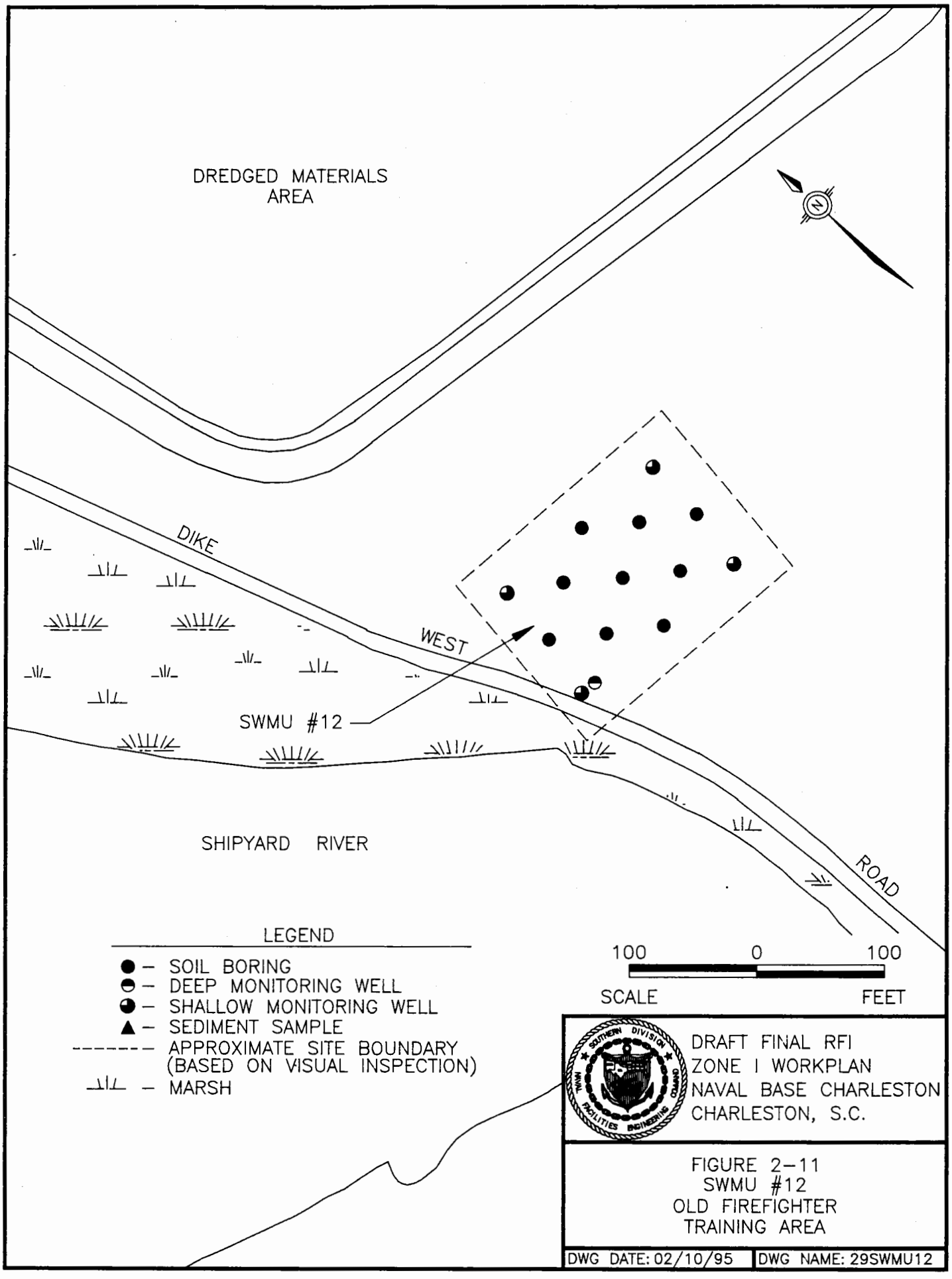
Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis of any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution is developed.

Notes:

[a] One shallow and one deep grid-based monitoring wells designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.


DREDGED MATERIALS
AREA
DIKE
WEST
SWMU #12
SHIPYARD RIVER
ROAD
LEGEND
● – SOIL BORING
◓ – DEEP MONITORING WELL
◕ – SHALLOW MONITORING WELL
▲ – SEDIMENT SAMPLE
------- APPROXIMATE SITE BOUNDARY
(BASED ON VISUAL INSPECTION)
– MARSH
100 0 100
SCALE FEET
DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-11
SWMU #12
OLD FIREFIGHTER
TRAINING AREA
DWG DATE: 02/10/95
DWG NAME: 29SWMU12

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2.12 SWMU #177, RTC-4 Oil Spill

SWMU #177 consists of two adjacent buildings both of which have been designated as Building RTC-4. The original RTC-4 was a 24 foot x 60 foot metal structure used to house heavy equipment including backhoes and trackhoes. Recently, however, the designation RTC-4 has been given to a newer facility built adjacent to the former RTC-4. The new RTC-4 is used to store lawn mowers and other lawn maintenance equipment. This unit was designated as a SWMU because of oil spillage associated with operations at these two buildings. These buildings are included in a lease agreement reached between the Navy and the National Oceanographic and Atmospheric Administration (NOAA) in the spring 1995. SWMU 177 has been designated for a CSI and is described in Table 2.23.

Table 2.23
SWMU 177
Site Description

Number	Description	Materials of Concern	Potential Pathways
SWMU 177 RTC-4 Oil Spill	Petroleum spill on the order of several gallons observed within the original Building RTC-4. Spill most likely waste motor oil based on usage of Building RTC-4 as shelter for heavy equipment. Stains in parking area suspected to be hydraulic fluid leaks from facility fork lift.[a]	VOCs Petroleum Hydrocarbons Lubricating oil Anti-freeze Motor oil	**Soil** Soil Gas Sediment Surface Water Groundwater Air

Notes:
[a] Described in the *Final RCRA Facility Assessment*, June 6, 1995.
Pathways scheduled for confirmatory sampling are in bold.

2.12.1 Previous Investigations

SWMU 177 has not been investigated previously.

2.12.2 Treatment Alternatives

As outlined in the overall sampling strategy in the *Final Comprehensive RFI Work Plan* (August 30, 1994), treatment alternatives are being identified for each of the sites likely requiring some type of remedial action. Data collection efforts will support evaluating these alternatives. Tables B-1 through B-7 (Appendix B) list the treatment alternatives for groundwater, soil, sediment, and surface water runoff for SWMU 177. Alternatives presented here are for preliminary evaluation only. If contaminants are present at concentrations requiring remediation, a CMS will be undertaken to identify feasible treatment alternatives.

2.12.3 Data Gaps

Currently no environmental media data have been collected at SWMU 177 to characterize the site or to support a detailed evaluation of treatment alternatives. As a result, the following data gaps have been identified to ensure that data collection efforts are sufficient to fill these gaps and to meet the stated investigation objectives:

- Soil data to define the nature and extent of contamination from releases which have occurred at SWMU 177.

2.12.4 Potential Receptors

Potential receptors that may be exposed to site contaminants include current land users, such as NAVBASE personnel, and any future users this area may support following closure. Due to the nature of the wastes stored at this unit and its proximity to the Cooper River, the potential exists for exposure to ecological receptors in the Cooper River. Data will be generated during the investigation to determine the level of risk to the spectrum of current and potential future receptors, including any highly sensitive individuals within the population, who may be exposed through invasive or non-invasive activities. Sampling will characterize the potential pathways highlighted in Table 2.23.

Land near SWMU 177 is used for vehicle parking and vehicular and pedestrian traffic. Potential receptors are site workers involved in invasive activity bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet bgs, site workers could also be subject to accidental ingestion or dermal exposure to contaminated groundwater.

Risk posed to terrestial ecological receptors will be evaluated as part of this site investigation. The nature and extent determinations also indicate migration of site contaminants which creates a potential for exposure to ecological receptors in the Cooper River. Sufficient data will be collected to perform a preliminary risk characterization. A complete risk characterization with respect to aquatic receptors will be assessed in the Zone J RFI.

2.12.5 Objective

The objective of the proposed field investigation is to confirm the presence/absence of contamination in environmental media. If present, the investigation will delineate the horizontal and vertical extent of any soil contamination. While sediment, soil gas, surface water, groundwater, and underground utility conduits are potential contaminant pathways, initial sampling of these matrices is not required to determine the presence of contaminants. If soil contamination is identified, then the site will be designated for a complete RFI to delineate the nature and extent of contamination. Data collection will support technical evaluation of identified treatment alternatives.

2.12.6 Screening Alternatives

No sampling has been conducted to determine COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of the high-quality samples is inadequate to define the real extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated.

A PID will be used to qualitatively screen for volatile compounds in all soil samples from every soil boring location. Results will be recorded in the field notebooks and boring logs.

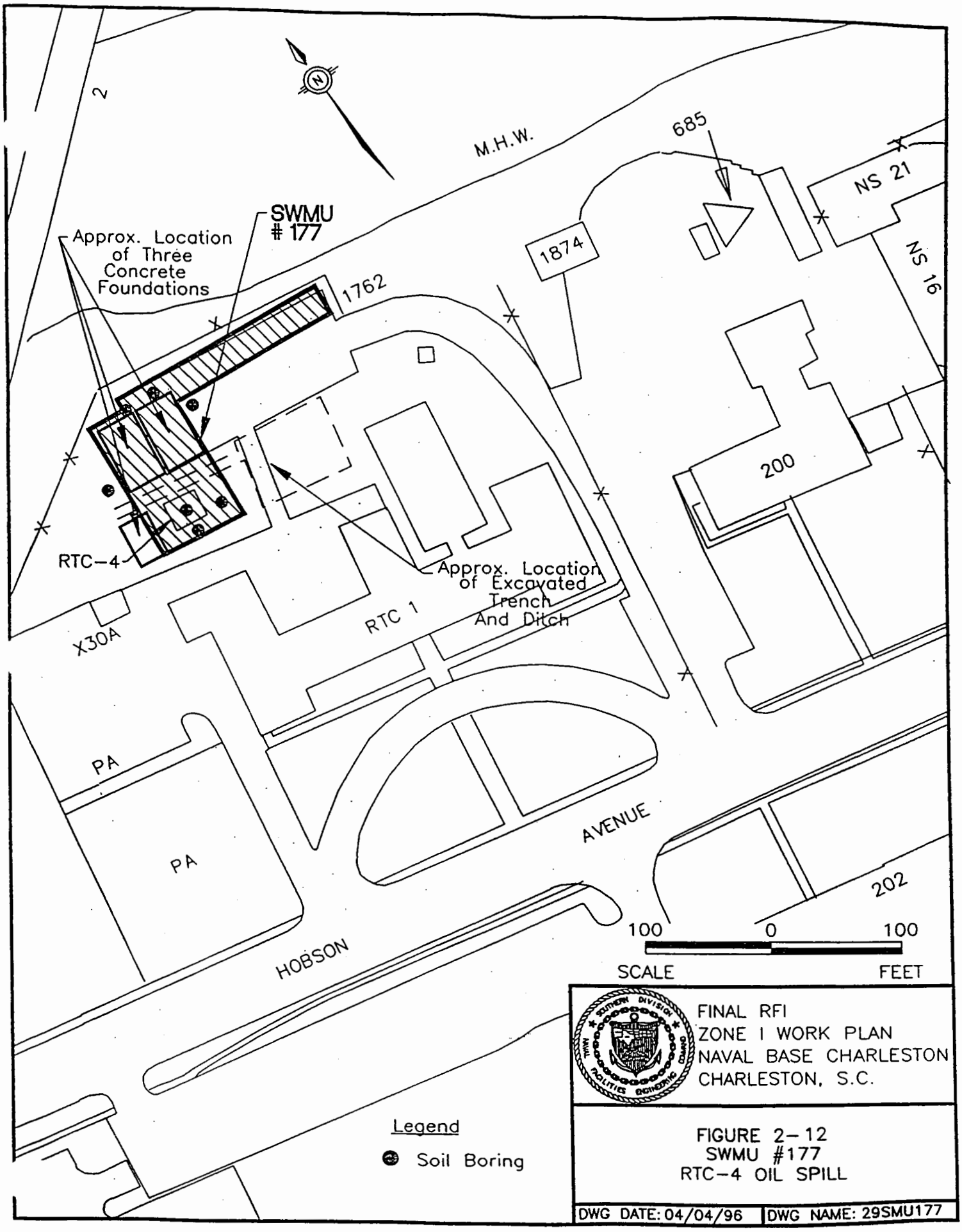
2.12.7 Sampling and Analysis Plan

Seven shallow soil borings are proposed for SWMU 177. Six locations will encircle Building RTC-4 with three of the six situated between the building and the Cooper River to investigate the potential for contaminant migration from the point source of Building RTC-4 to the river. One location will be advanced mechanically through the asphalt and/or concrete floor of Building RTC-4 where the major spill at SWMU 177 is known to have occurred. The locations in Figure 2-12 are expected to closely represent the actual sample locations in number and placement. All the borings will be advanced to a depth of 5 feet bgs wherever possible. Table 2.24 summarizes the sampling plan for SWMU 177. Any deviations that occur in the field will be documented and reported in the RFI report.

Table 2.24
SWMU 177
Sampling Plan

Matrix	Quantity	Analysis
Soil (0'-1') bgs	7	VOCs, SVOCs, TPH, PCBs, dioxin (fill dirt present), Metals
Soil (3'-5') bgs	7	

Notes:
All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed, as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.


M.H.W.
SWMU
177
Approx. Location
of Three
Concrete
Foundations
1762
1874
685
NS 21
NS 16
200
RTC-4
Approx. Location
of Excavated
Trench
And Ditch
RTC 1
X30A
PA
PA
AVENUE
202
HOBSON
100
0
100
SCALE
FEET
Legend
Soil Boring
FINAL RFI
ZONE I WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-12
SWMU #177
RTC-4 OIL SPILL
DWG DATE: 04/04/96
DWG NAME: 29SMU177

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3.0 SYSTEMATIC (GRID-BASED) SAMPLING PLAN

As noted in the RFA, much of NAVBASE, particularly the southern end that includes Zone I, is built upon a series of dredged material deposits, whose composition has been impacted by industrial activities to an unknown extent. It is anticipated that this heterogeneous structure will have a significant impact upon risk-management decisions, and therefore a more intensive approach for characterizing background conditions will be required than is typical of RFI investigations.

To accomplish this objective, a systematic distribution of biased monitoring well pairs has been proposed across Zone I, complementing the zone-wide sampling points designated in Zone I and neighboring Zone H. Eighteen shallow and 18 deep monitoring wells will be installed on 600-foot centers near the shorelines of Zone I and will assess potential discharges to the Cooper River and Shipyard Creek. The algorithm proposed in the *Final Comprehensive RFI Work Plan* (August 30, 1994) will not be implemented for Zone I due to the even distribution of sites throughout the zone. Figure 3-1 presents the zone-wide sampling locations, including the grid-based monitoring well pairs. Table 3.1 presents the number of soil and groundwater samples associated with the well pairs. Usable data from those well pairs near identified Zone I AOCs/SWMUs will be incorporated into the appropriate site assessments.

In addition, the proposed investigation of the Dredged Materials Disposal Area (DMDA), which covers the largest portion of the zone, will use a grid-based sampling scheme. The combination of perimeter well pairs and grid-based samples associated with the DMDA will adequately characterize background conditions from dredged material deposits within Zone I. The DMDA data will also provide a baseline data set for calculating risk at other NAVBASE areas filled by dredge materials.

Table 3.1
Well Pair Sampling Plan

Matrix	Quantity	Analysis
Soil (surface)	18	VOAs and SVOCs w/TICs, Metals, Cyanide, Pesticides, and PCBs.
Soil (depth)	18	
Groundwater (Shallow)	18	Chlorides, TDS, and sulfates (groundwater only).
(Deep)	18	

Engineering Parameters:

Engineering parameters will be dictated by the field data collected.

Slug tests will be performed on 25 percent of the shallow/deep well pairs. While installing the deep wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis for any of the remaining design parameters in Appendix E will be performed at selected locations when a better understanding of the contaminant distribution is developed.

Notes:

The quantity of groundwater samples only represent one quarter of sampling.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.

This area is approximately 67.95 acres at the southern end of NAVBASE, confined by a dike, that has received materials from dredging operations in both the Cooper River and Shipyard Creek since the 1940s. Several dike relocation projects sponsored by the U.S. Army Corps of Engineers have been completed during the history of the area and are on file in the Charleston Division office. Two spillways in the southern portion of the diked area allow deposited sediments to de-water. The southernmost spillway ultimately discharges to the Cooper River and the western spillway discharges directly to Shipyard Creek. The DMDA is bound to the southwest by West Road and Shipyard Creek and to the east by Juneau Avenue and the Cooper River.

To characterize the dredged materials area, seven sediment samples and five surface water samples will be collected within the active diked area using a grid-based sampling scheme. Five grid-based soil borings will also be advanced outside the diked area. Two additional sediment samples will be collected in the southern drainage ditch, which conveys runback from the dredged materials area to the Cooper River. Table 3.2 summarizes the types of samples to be collected and the analytical parameters. Each proposed sampling location is illustrated on Figure 3-2. All sampling will adhere to the NAVBASE Charleston *Final Comprehensive RFI Work Plan* except for circumstance stated below.

Site conditions within the diked area may be non-conducive to standard sampling protocol as outlined in the *Final Comprehensive RFI Work Plan* (August 30, 1994). Access to several predetermined sampling locations will require techniques designed for moving personnel and equipment within a marsh habitat with scrub-shrub vegetation and extremely soft, fine-grained calcareous sediments. Modifying gear, primarily to its portability and effectiveness in such conditions, may be required.

Upon reaching the sampling location, sediment may be cored and sampled using a hand auger with interchangeable heads and extension rods, providing a wide range of coring capabilities. If standard hand-augering techniques are inadequate for collecting sediment samples within the diked area, the following sampler configuration may be used: 3-foot section of schedule-40 polyvinyl chloride (PVC) pipe with a metal trap valve at the bottom (coated with 1.5 to 2.0 millimeters of abrasive-resistant Teflon) and threaded pipe at the top connected to 5-foot extensions to reach lower depths.

Table 3.2
Dredged Materials Disposal Area
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	5	VOAs and SVOCs w/ TICs, Metals (including organotins), Cyanide, Pesticides, and PCBs
Soil (3-5' bgs)	5	
Sediment	9	Sediment samples will also be analyzed for TOC and grain size.
Surface Water	5	Chlorides, TDS, and sulfates (groundwater only).
Groundwater (Shallow)	8[a]	
(Deep)	8[a]	

Engineering Parameters:

Slug tests will be performed on 25% of the wells. While installing the wells, Shelby tubes will be collected at distinct changes in lithology. Samples will be tested for permeability, grain size, porosity, TOC, and CEC. Analysis of any of the remaining design parameters listed in Appendix B will be performed at selected locations when a better understanding of the contaminant distribution is developed.

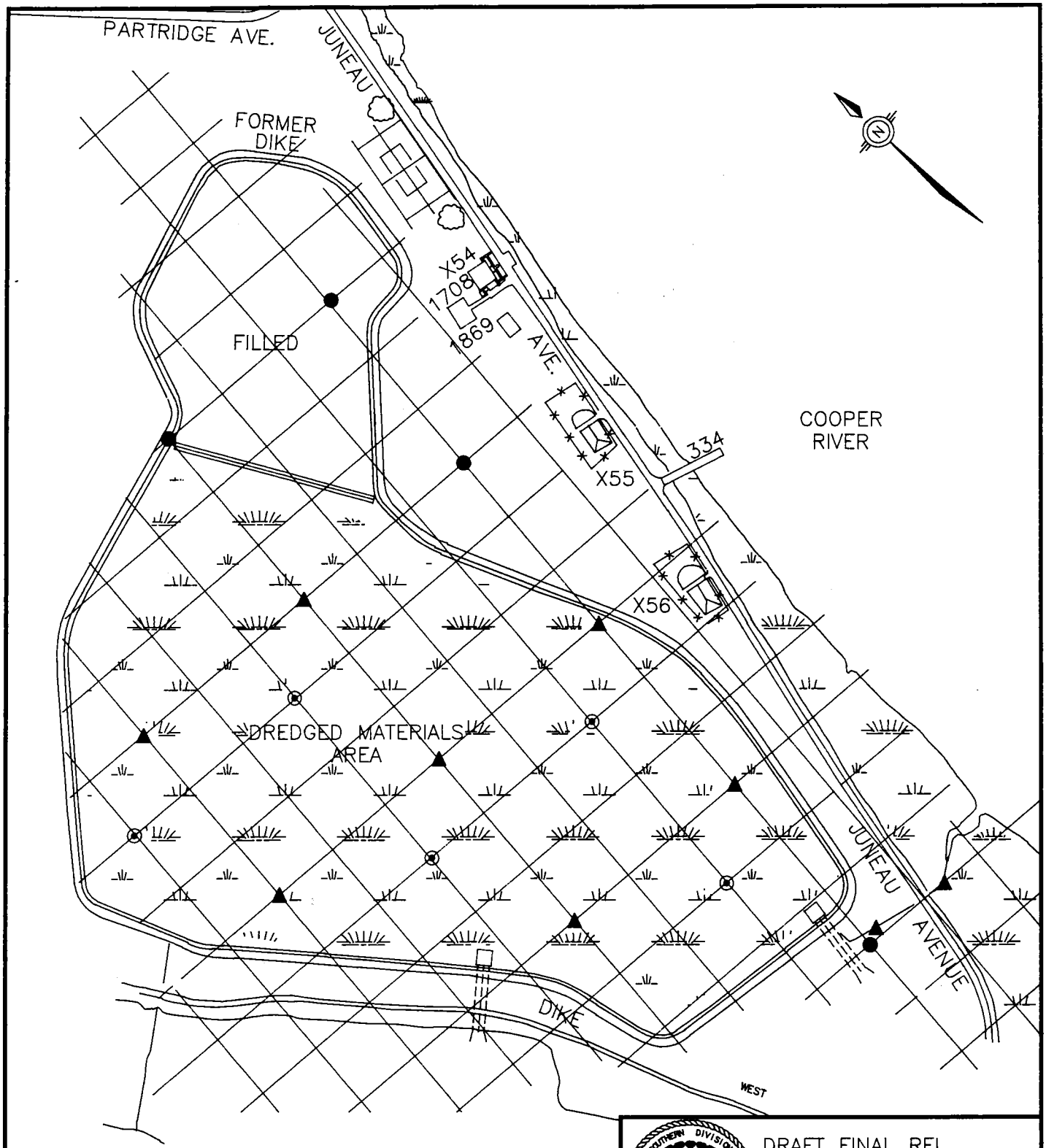
Notes:

[a] Eight shallow and eight deep grid-based monitoring wells designated for use in characterizing the zone perimeter groundwater will be incorporated into this sampling plan due to their proximity to the site. Groundwater monitoring wells will be sampled quarterly for four quarters.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion may be necessary to meet the stated objectives.

All analysis to be performed per SW-846 except where other methods are specified. DQO Level III analyses will be performed as specified in sampling plan, with a minimum of 10 percent duplicates analyzed for all Appendix IX constituents at DQO Level IV. The sample quantities presented do not include QA/QC samples.

After coring with a hand auger to the predetermined depth, the sampler is placed in the hole. The desired dredge material profile is forced into the sample tube by driving the sampler into the material. The entire assemblage is then withdrawn from the hole and capped at both ends with threaded PVC caps. Contacts between the tube threads and the caps are sealed with melted paraffin to prevent leakage. The labeled tube is then inserted into a 4 millimeter polyethylene sheath, further ensuring the sample's integrity for shipping, and sealed with duct tape at both ends.



DRAFT FINAL RFI
ZONE I WORKPLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 3–2
DREDGED MATERIALS AREA

DWG DATE: 02/10/95 | DWG NAME: 29AOC689

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4.0 HEALTH AND SAFETY PLAN

EnSafe/Allen and Hoshall (E/A&H) is conducting an environmental monitoring program at various specified locations (sites) within NAVBASE to assess the nature and extent of contamination at these sites and to determine if additional action is required to maintain compliance with the HSWA permit and environmental regulations. The Navy project contract number with E/A&H is *N62467-89-D-0318.*

The base closure team has divided the NAVBASE sites into SWMUs and AOCs which have been grouped into zones for investigative purposes. This Zone I Specific Health and Safety Plan (ZIHASP) has been developed for SWMUs and AOCs there.

This ZIHASP was written to complement the E/A&H NAVBASE *Final Comprehensive Health and Safety Plan (CHASP)* by providing site-specific details absent in the CHASP. Site-specific details presented in this ZIHASP include: potential site contaminants, proposed site activities, action levels, and initial level of personal protective equipment (PPE). Copies of both this plan and the CHASP should be onsite during all field operations.

This ZIHASP uses the term *contaminants of concern* and *constituents of concern.* Not all constituents of concern are contaminants of concern. Constituents of concern are compounds of analytical interest. The analytical interest may be because of public health, regulatory, ecological, or other concerns. Contaminant of concern identifies site contaminants that may be present in sufficient concentrations to cause concern about potential occupational exposures to onsite personnel.

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4.1 Applicability

The provisions of this plan are mandatory for E/A&H personnel. E/A&H personnel shall read this plan and sign the plan acceptance form (Appendix D) before starting site activities. In addition, personnel will operate in accordance with the most current requirements of 29 CFR 1910.120, Standards for Hazardous Waste Workers and Emergency Responders (HAZWOPER). These regulations include the following provisions for employees involved in cleanup operations covered by RCRA: training 1910.120(e), medical surveillance 1910.120(f), and PPE 1910.120(g).

All non-E/A&H personnel present in E/A&H work areas shall either adopt and abide by this ZIHASP and the corresponding CHASP or shall have their own safety plan which, at minimum, meets the requirements of the E/A&H CHASP and ZIHASP.

This ZIHASP applies to standard field procedures and tasks such as drilling; installing and developing monitoring wells; surveying; and collecting soil, groundwater, surface water, and sediment samples. Non-routine procedures and tasks involving non-routine risks are not covered by this plan, examples of procedures that are not covered in this plan are:

- Trenching
- Confined space entry
- Locating and/or recovering unexploded ordnance
- Sampling, handling, or removing unidentified drums

Should it be necessary to conduct these or other *high risk* tasks, specific Health and Safety procedures must be developed, approved, and implemented before proceeding.

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4.2 Zone Characterization

Sites included in this ZIHASP consist of SWMUs and AOCs as identified in the RFI plan for NAVBASE as prepared by E/A&H. These subsections will include Site Descriptions, Chemical Hazards, and Operational/Physical Hazards for each site. Each site within Zone I is discussed in the following subsections of this document.

Physical hazards that are inherent in environmental investigations, or present throughout the zone are discussed in Section 4.16. Subsections 4.3 through 4.15 contain site specific health safety information for each site in Zone I. Included in these subsections is a discussion of Site Descriptions, planned Site Activities, Chemical Hazards, and PPE requirements. Also any Operational/Physical Hazards that are specific to a site will be discussed in that site's subsection.

Under the heading "Chemical Hazard", chemical hazards are discussed in terms of potential chemicals of concern (PCOCs). PCOCs are selected to represent the range of acute and chronic health (toxicological) hazards that are, or foreseeably may be present at the site. That is, not every chemical known or suspected of being present is listed as a PCOC. Rather, one or two of the most toxic or most prevalent contaminants within a class of chemicals is listed. It is in this light that cadmium and chromium have been listed in the health and safety plan as PCOCs. To illustrate this principle, listed below are classes of chemicals or chemical categories in one column, and examples of chemicals that may be listed as a PCOC in the second column.

Class of Chemical/Product	**Potential Contaminant of Concern**
— Chlorinated solvents/ Degreasers	perchloroethylene, chloroform, methylene chloride, trichloroethylene, and 1,1,1-trichloroethane

Class of Chemical/Product	Potential Contaminant of Concern
— Non-chlorinated solvents	benzene, toluene, xylene, ethylbenzene, 2-butanone (MEK) and hexane
— Metals/Heavy metals	lead, cadmium, chromium (especially hexavalent chromium compounds), mercury, silver, and copper
— Fuels - gasoline, fuel, oils, diesel, lubricants,	benzene, toluene, tetraethyl lead, kerosene, xylene, hexane
— Paints	see - Solvents and Metals above, plus tributyl tin
— Pesticides - chlorinated organophosphate	DDT, DDE, chlordane, dieldrin and endrin

4.2.1 Work Zones

Section 2.1 of the CHASP, describes the function and interrelationship of the three work zones which, in combination, compose the work area. The three work zones are:

- Exclusion Zone (EZ)
- Contaminant Reduction Zone (CRZ), and
- Support Zone (SZ).

These work zones will be established and used during field work covered under this ZIHASP.

4.2.2 Work Area Access

Authorized personnel will be allowed access to work areas as long as they follow the requirements of this ZIHASP and the CHASP. See also Work Area Access, Section 2.2 of the CHASP.

Authorized Personnel — In order for E/A&H personnel to be authorized to enter an E/A&H controlled work area, they must have a current HAZWOPER training certificate on file onsite. Individuals whose certification is not on file, or those who have a more recent certificate (have attended a refresher course), will provide the onsite Supervisor with a copy of their certificates before being allowed to enter a work area.

Subcontractors, Department Of Defense (DoD) oversight personnel, and other site visitors shall demonstrate compliance with HAZWOPER training requirements before entering a work area.

4.2.3 Zone Investigation

Figure 1-1 (Section 1.0) contains a map of Zone I showing each SWMU and AOC. In addition, included in the sampling and analysis section of the Work Plan is a map of each site. The EZ, CRZ, and SZ for each site will be established in the field. The location of these zones is dependent on the work task, layout of the site, meteorological conditions and logistical factors.

Sites covered by this ZIHASP consist of SWMUs and AOCs (Appendix A). Sections 4.3 through 4.15 of this ZIHASP describe sites, chemical hazards, and operations/physical hazards for each SWMU or AOC.

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4.3 AOC 671, Metering House, Former Building 3905G and Surrounding Aviation Gasoline Compound

AOC 671 includes the former Metering House, Building 3905G, and the associated Aviation Gasoline compound east of Hobson Avenue, just south of Pier Q (Facility 329). The site is bounded to the northeast by the Cooper River. The facilities are in and adjacent to a parking lot for ship's personnel. The outlines of the two underground 25,000-gallon concrete tanks can be seen in the asphalt parking lot. This site has been designated for a CSI. Table 4.1 describes the AOC.

Table 4.1
AOC 671
Site Description

Number	Description	Materials Generated or Stored	Potential Pathways
AOC 671	Aviation Gasoline compound operating from the 1940s until the 1960s. Two 25,000 gallon concrete tanks, and the possible foundation of the truck load stand still exist. There is no evidence of the metering house, or any other ancillary structures at this time.[a]	Aviation gasoline	Soil Sediment Soil Gas Surface Water Groundwater Underground utility conduits

Notes:
[a] Described in the *RCRA Facility Assessment, November 1994.*

Site Activities

Initial site activities include soil borings, soil sampling, and installing monitoring wells. Subsequent activities include well development, purging, and sampling. Field work for this site is described in Section 2.1 of this Work Plan.

Chemical Hazards and PPE Requirements

The major constituents of concern are volatile organic compounds contained in gasoline, aviation gasoline (AVGAS), and lead. Table 4.2 lists exposure guidelines for expected site contaminants of concern. Material Safety Data Sheets (MSDS) will only be placed in field copies of the

ZIHASP. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the MSDS files onsite.

The initial level of PPE for invasive field activities performed at AOC 671 is modified Level D. The Action Level (AL) for this site is a continuous photoionization detector (PID) reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater that 2-3 minutes), the required PPE level shall be upgraded to Level C.

Table 4.2
Exposure Guidelines For Expected Site Chemical Hazards — AOC 671

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[a]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Benzene	4.68 ppm	9.24	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	1.3 to 7.1%
Ethylbenzene	140 ppm	8.76	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	1.0 to 6.7%
Kerosene	1 ppm	6.8	NA	NA	100 mg/m^3	0.7 to 5.0%
Lead	NA	NA	0.05 mg/m^3	0.15 mg/m^3	0.15 mg/m^3	NA
Toluene	40 ppm	8.82	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	1.3 to 7.1%

Table 4.2
Exposure Guidelines For Expected Site Chemical Hazards — AOC 671

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Xylene	1 ppm [e]	8.56	100 150 STEL	100 150 STEL	100 150 STEL	1.0 to 7.0%

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) are legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short-Term Exposure Limits (TLVs and STELs) recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH) and published annually. For this ZIHASP site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. NIOSH Pocket Guide to Chemical Hazards, June 1990.
[e] = Odor Threshold for Chemicals, *Chemical Hazards of the Workplace*, by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

See Section 4.16.

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4.4 AOC 672, Building 126 Substation (includes AOC 673, Building 169 Paint and Oil Storage

AOC 672 is an electrical substation (Building 126), built in 1947 and modified in 1950. It houses transformers and switch gear. Present equipment is non-PCB, but previous equipment (transformers and switches) would have contained PCB dielectric fluid or PCB-contaminated dielectric fluid. Building 126 is northeast of Hobson Avenue just south of the approach to Pier Q. It is adjacent to Building 169, which has been designated AOC 673. Building 169 was built in 1949 and has been used to store paints, oils, solvents and other materials associated with painting. This AOC has been designated for a CSI. Table 4.3 describes AOCs 672 and 673.

Table 4.3
AOC 672 and AOC 673
Site Description

Number	Description	Materials Generated or Stored	Potential Pathways
AOC 672	Substation containing transformer and switch gear to support electrical grid. Facility dates from WWII era with a modification in 1950. Transformer reported to have had a moderate leak in 1981. Tests completed in 1987 showed transformer was PCB contaminated (73 ppm). Present equipment all non-PCB.[a]	Dielectric fluids	Soil Sediment Surface Water Groundwater Underground utility conduits
AOC 673	Building used to store paint, oils, solvents and other materials supporting painting activities.[a]	Paints, oils, solvents and other associated materials.	Soil Sediment Surface Water Groundwater Underground utility conduits

Notes:
[a] Described in *RCRA Facility Assessment, November 1994*

Site Activities

Initial site activities will include soil borings, soil sampling, and installing monitoring wells. Subsequent activities include well development, purging, and sampling. Section 2.2 of this Work Plan describes the field work for this site.

Chemical Hazards and PPE Requirements

The contaminants of concern at this site are PCBs, paints, solvents, petroleum products, metals and volatile organic compounds (VOCs). Table 4.4 lists exposure guidelines for the contaminants of concern. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the MSDS file onsite.

The initial PPE level for invasive field activities performed at AOC 672 and 673 is modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required PPE level shall be upgraded to Level C.

Table 4.4
Exposure Guidelines For Expected Site Chemical Hazards — AOC 672 and AOC 673

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Benzene	4.68 ppm	9.24	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 STEL Potential Occupational Carcinogen	1.3 to 7.1%
Cadmium	NA	NA	0.6 mg/m^3	0.05 mg/m^3	Potential Human Carcinogen	NA
Chromium	NA	NA	1 mg/m^3	0.5 mg/m^3	NA	NA
Chromium VI	NA	NA	0.1 mg/m^3	0.05 mg/m^3 Suspected Human Carcinogen	1 μg/m^3 Potential Human Carcinogen	NA
Copper	NA	NA	0.1 mg/m^3 - Fume 1 mg/m^3 - Dust	0.2 mg/m^3 - Fume 1 mg/m^3 - Dust	NA	NA
Ethylbenzene	140 ppm	8.76	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	1.0 to 6.7%
Kerosene	1 ppm	6.8	NA	NA	100 mg/m^3	0.7 to 5.0%
Lead	NA	NA	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3	NA
Mercury	NA	NA	0.05 mg/m^3 Skin	0.025 mg/m^3 Skin	0.05 mg/m^3 Skin	NA

Table 4.4
Exposure Guidelines For Expected Site Chemical Hazards — AOC 672 and AOC 673

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Polychlorinated Biphenyls (PCB)	NA	NA	1 mg/m^3	0.5 - 1 mg/m^3	0.001 mg/m^3	NA
Silver	NA	NA	0.01 mg/m^3	0.1 mg/m^3	NA	NA
Toluene	40 ppm	8.82	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	1.3 to 7.1%
Xylene	1 ppm [e]	8.56	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	1.0 to 7.0%

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) are recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
[e] = Odor Threshold for Chemicals, *Chemical Hazards of the Workplace*, by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

See Section 4.16.

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4.5 AOC 675, Fuel Oil Storage Tank NS-4; AOC 676, Former Incinerator; and AOC 677, Grounds of Building NS-2

The area designated AOC 675, 676, and 677 includes the following structures: Building NS-2, Tank NS-4, Building NS-3, abandoned USTs near NS-3, an oil/water separator, a storm water drain, and a sewage lift station. These AOCs are described in Table 4.5.

Table 4.5
AOC 675, AOC 676, and AOC 677
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 675	A 25,000-gallon residual oil UST supporting the boiler in Building NS-2 used from 1952 until conversion to diesel fuel in 1991. There are additional USTs are near NS-3 to the west.[a]	Residual fuel Diesel fuel Aviation gasoline	Soil Soil Gas Surface Water Groundwater Underground utility conduits
AOC 676	An incinerator which operated in the area prior to the construction of NS-2. There is no information regarding the type of structure which existed, the type of incinerator, or the materials incinerated at this facility.[a]	Ash (metals) Petroleum products	Soil Surface Water Groundwater
AOC 677	The grounds around Building NS-2 have been the site of a number of petroleum spills associated with the operation of the boilers in NS-2. Spill reports indicate a number of releases since 1977. This is also near the location of seaplane refueling operations conducted during the 1940s.[a]	Residual fuel Diesel fuel Aviation gasoline Lead	Soil Surface Water Groundwater Underground utility conduits

Notes:
[a] Described in *RCRA Facility Assessment, November 1994.*

Site Activities

Site activities will include soil borings, soil sampling, and installing monitoring wells. Subsequent activities will include well development, purging, and sampling as required.

Chemical Hazards and PPE Requirements

The exact nature of the contaminants of concern in AOC 675, 676, and 677 are likely to be associated with residual petroleum hydrocarbons from the storage of fuels at the site and ash contaminated with heavy metals.

Table 4.6 lists the primary chemicals of concern as well as regulatory and recommended exposure guidelines for this site. The primary chemicals of concern were determined based on an informal evaluation of potential site contaminants, looking at such factors as: site history and the toxicity of known and suspected contaminants.

The initial PPE level for invasive field activities at AOCs 675, 676, and 677 in modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required PPE level shall be upgraded to Level C.

Table 4.6
Exposure Guidelines For Expected Site Chemical Hazards — AOC 675, AOC 676, and AOC 677

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Benzene	4.68 ppm	9.24	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 STEL Potential Occupational Carcinogen	1.3 to 7.1%
Cadmium	NA	NA	0.6 mg/m^3	0.05 mg/m^3	Potential Human Carcinogen	NA
Chromium	NA	NA	1 mg/m^3	0.5 mg/m^3	NA	NA
Chromium VI	NA	NA	0.1 mg/m^3 Ceiling	0.05 mg/m^3 Suspected Human Carcinogen	1 $\mu g/m^3$ Suspected Human Carcinogen	NA
Copper	NA	NA	0.1 mg/m^3 - Fume 1 mg/m^3 - Dust	0.2 mg/m^3 - Fume 1 mg/m^3 - Dust	NA	NA
Ethylbenzene	140 ppm	8.76	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	1.0 to 6.7%
Kerosene	1 ppm	6.8	NA	NA	100 mg/m^3	0.7 to 5.0%
Lead	NA	NA	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3	NA

Table 4.6
Exposure Guidelines For Expected Site Chemical Hazards — AOC 675, AOC 676, and AOC 677

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Mercury	NA	NA	0.05 mg/m3 Skin	0.025 mg/m3 Skin	0.05 mg/m3 Skin	NA
Polychlorinated Biphenyls (PCB)	NA	NA	1 mg/m^3	0.5 - 1 mg/m^3	0.001 mg/m^3	NA
Silver	NA	NA	0.01 mg/m^3	0.1 mg/m^3	NA	NA
Toluene	40 ppm	8.82	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	1.3 to 7.1%
Xylene	1 ppm [e]	8.56	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	1.0 to 7.0%

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) are recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
[e] = Odor Threshold for Chemicals, *Chemical Hazards of the Workplace*, by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

See Section 4.16.

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4.6 AOC 678, Firefighter School, Former Building 2-V and AOC 679, Former Wash Rack

AOC 678 is the former site of Building 2-V, the Firefighter School, which was behind Building NS-1 in the northeastern portion of the southern peninsula. The firefighting school was reportedly constructed in 1947 and demolished circa 1955. No other details regarding the design features or operating practices were available but controlled fires may have been ignited and extinguished onsite for firefighter training. Petroleum contaminants may therefore be present.

Nearby is AOC 679, the former location of a wash rack. Details regarding the design features, years of operation, and operating practices of this rack are also unknown but likely involved petroleum-based materials. The *RCRA Facility Assessment, November 1994,* lists paint as a characteristic waste. Upon further review of current information, paint contaminants were associated with lead-based paint suspected in adjacent Building NS-1, not the former wash rack. Like AOC 678, the wash rack has been designated for a CSI and both sites will be investigated concurrently. Table 4.7 describes these AOCs.

Table 4.7
AOC 678 and AOC 679
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 678	Former firefighter school and potential site of controlled burning of ignitable materials.[a]	Petroleum	Soil Groundwater Surface Water Underground utility conduits
AOC 679	Former location of wash rack.[a]	Petroleum	Soil Groundwater Surface Water Underground utility conduits

Notes:
[a] Described in the *RCRA Facility Assessment, November 1994.*

Site Activities

Site activities will include soil borings, soil sampling, and installing monitoring wells. Subsequent activities will include well development, purging, and sampling as required. Field work for this site is described in Section 2.4 of this Work Plan.

Chemical Hazards and PPE Requirements

Table 4.8 lists exposure guidelines for expected site chemicals. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the MSDS file onsite.

The initial PPE level for invasive field activities performed at AOC 678 and 679 is modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required PPE level shall be upgraded to Level C.

Table 4.8
Exposure Guidelines For Expected Site Chemical Hazards — AOC 678 and AOC 679

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Benzene	4.68 ppm	9.24	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	1.3 to 7.1%
Ethylbenzene	140 ppm	8.76	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	1.0 to 6.7%
Kerosene	1 ppm	6.8	NA	NA	100 mg/m^3	0.7 to 5.0%
Lead	NA	NA	0.05 mg/m^3	0.15 mg/m^3	0.15 mg/m^3	NA
Toluene	40 ppm	8.82	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	1.3 to 7.1%

Table 4.8
Exposure Guidelines For Expected Site Chemical Hazards — AOC 678 and AOC 679

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Xylene	1 ppm *	8.56	100 150 STEL	100 150 STEL	100 150 STEL	1.0 to 7.0%

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) are legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) are recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
* = Odor Threshold for Chemicals, *Chemical Hazards of the Workplace*, by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

See Section 4.16.

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4.7 AOC 680, NS-26 Grinding Room/Brake Repair Area

AOC 680 is the former grinding room in Building NS-26, reportedly used for repairing brake components containing asbestos. Building plans from 1969 show the grinding room on the southern side of Building NS-26, not the northeast side as described in the *RCRA Facility Assessment, November 1994*. Recent interviews with NS-26 personnel also indicate that brakes have not been repaired at NS-26 since 1970. The area once occupied by the grinding room was remodeled in 1985 and is now the southern entrance with a short hallway. Since details regarding both past activities and period of operation are uncertain, AOC 680 has been designated for a CSI to determine if asbestos dust is present.

Site Activities

The CSI for this AOC will consist of sampling accumulated dust from building structural component surfaces.

Chemical Hazards and PPE Requirements

The chemical hazard of concern for this site is asbestos-containing dust on building components. Sampling activities require modified Level D PPE. The OSHA PEL for asbestos is 0.2 fibers/cubic centimeter (f/cc) with a prescribed action level of 0.1 f/cc.

In the worst circumstances rather than starting work in Level C, E/A&H would collect aggressive air samples to determine if airborne asbestos is present in the facility. For E/A&H to work in PPE less than Level C, air samples must confirm that airborne asbestos concentrations do not exceed 0.05 f\cc.

Site-specific Operational and Physical Hazards

Access to the building's structural components may require using ladders and working at potentially hazardous heights.

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4.8 AOC 681, Building 681 Blast Booth

AOC 681 is the abrasive blast booth on the west side of Building 681 used for stripping miscellaneous ship and boiler components. The blasting agent (aluminum oxide) is recycled through a cyclone separator and the wastes generated, primarily paint dust, are directed into an outdoor hopper and then into 55-gallon drums for disposal. AOC 681 has been designated for an RFI to determine if the blast booth has impacted either the building's interior or the soil surrounding the exterior hopper. Table 4.9 describes this AOC.

Table 4.9
AOC 681
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 681	Blast Booth in Building 681 used to strip miscellaneous components.[a]	Lead-based paint Aluminum oxide	Soil Groundwater Air

Notes:
[a] Described in the *RCRA Facility Assessment, November 1994.*

Site Activities

Seven wipe samples are proposed for surfaces near the blast booth. Three soil borings will be installed around the outdoor hopper.

Chemical Hazards and PPE Requirements

The major constituents of concern are lead-based paint, aluminum oxide, cadmium and chromium. Table 4.10 lists exposure guidelines for expected site chemicals. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the MSDS file onsite. The initial PPE level for invasive field activities performed at AOC 681 is modified Level D.

Table 4.10
Exposure Guidelines For Expected Site Chemical Hazards — AOC 681

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Aluminum Oxide	NA	NA	10.0 mg/m^3	10.0 mg/m^3	10.0 mg/m^3	NA
Cadmium	NA	NA	0.6 mg/m^3	0.05 mg/m^3	Potential Occupational Carcinogen	NA
Chromium	NA	NA	1 mg/m^3	0.5 mg/m^3	NA	NA
Chromium VI	NA	NA	0.1 mg/m^3 Ceiling	0.05 mg/m^3 Suspected Human Carcinogen	1 μg/m^3 Suspected Human Carcinogen	NA
Copper	NA	NA	0.1 mg/m^3 - Fume 1 mg/m^3 - Dust	0.2 mg/m^3 - Fume 1 mg/m^3 - Dust	NA	NA
Lead	NA	NA	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3	NA
Mercury	NA	NA	0.05 mg/m^3 Skin	0.025 mg/m^3 Skin	0.05 mg/m^3 Skin	NA
Silver	NA	NA	0.01 mg/m^3	0.1 mg/m^3	NA	NA

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) are recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

See Section 4.16.

4.9 AOC 685, Former Smoke Drum

AOC 685, the former site of a smoke drum which reportedly operated from 1941 until 1953, was on the west side of Juneau Avenue, south of Partridge Avenue. Currently, this area is a grassy field with no visible evidence of the former smoke drum. The smoke drum's design features, dimensions, and operating practices are unknown; thus this AOC is designated as a CSI site. Table 4.11 describes this AOC.

Table 4.11
AOC 685
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 685	Former Smoke Drum; usage unknown.[a]	Unknown	Air (past) Soil Sediment Groundwater

Notes:
[a] Described in the *RCRA Facility Assessment, November 1994.*

Site Activities

Site activities will include soil borings, soil sampling, and installing monitoring wells. Subsequent activities will include well development, purging, and sampling as required. Field work for this site is described in Section 2.7 of this Work Plan.

PPE Requirements

The initial PPE level for invasive field activities performed at AOC 685 is modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required PPE level shall be upgraded to Level C.

Site-specific Operational and Physical Hazards

See Section 4.16.

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4.10 AOC 687, Building X-55 — Ammunition Storage Bunker (Includes SWMU 16, Paint Storage Bunker)

AOC 687 is an earth-covered ammunition storage bunker constructed in 1942 between Juneau Avenue and the current southern spoils area. The facility continues to store high explosives and small arms ammunition. Prior to starting any invasive activities the bunkers will be checked again to make sure that ammunition is not present when field work is being conducted. The bunker reportedly was also once used for unauthorized paint storage. This AOC is designated for a CSI.

The earth-covered roof of X-55 was reportedly used for the unauthorized open storage of small quantities of paint, paint thinner, and other hazardous materials and has been designated as SWMU 16. The investigations for both X-55 sites will be performed concurrently. A description of the AOC and SWMU is provided in Table 4.12.

Table 4.12
AOC 687 and SWMU 16
Site Descriptions

Number	Description	Materials of Concern	Potential Pathways
AOC 687	Ammunition Storage Bunker X-55 used to store explosives and paint.[a]	Explosives Paint waste	Soil Sediment Surface Water Groundwater
SWMU 16	Roof of Storage Bunker X-55 used for unauthorized open storage of small quantities of paint and other materials with a spill history.[b]	Paint wastes	Soil Sediment Surface Water Groundwater

Notes:
[a] Described in the *RCRA Facility Assessment, November 1994.*
[b] Described in the *RCRA Facility Assessment, August, 1987.*

Site Activities

Site activities will include sediment sampling, soil borings, soil sampling, and installing monitoring wells. Subsequent activities will include well development, purging, and sampling as required. Field work for this site is described in Section 2.8 of this Work Plan.

Chemical Hazards and PPE Requirements

Table 4.13 lists exposure guidelines for expected site chemicals. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the MSDS file onsite.

The initial PPE level for invasive field activities performed at AOC 687 and SWMU 16 is modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required PPE level shall be upgraded to Level C.

Table 4.13
Exposure Guidelines For Expected Site Chemical Hazards — AOC 687 and SWMU 16

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Benzene	4.68 ppm	9.24	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 STEL Potential Occupational Carcinogen	1.3 to 7.1%
Cadmium	NA	NA	0.6 mg/m^3	0.05 mg/m^3	Potential Human Carcinogen	NA
Chromium	NA	NA	1 mg/m^3	0.5 mg/m^3	NA	NA
Chromium VI	NA	NA	0.1 mg/m^3 Ceiling	0.05 mg/m^3 Suspected Human Carcinogen	1 μg/m^3 Suspected Human Carcinogen	NA

Table 4.13
Exposure Guidelines For Expected Site Chemical Hazards — AOC 687 and SWMU 16

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Copper	NA	NA	0.1 mg/m^3 - Fume 1 mg/m^3 - Dust	0.2 mg/m^3 - Fume 1 mg/m^3 - Dust	NA	NA
Ethylbenzene	140 ppm	8.76	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	1.0 to 6.7%
Kerosene	1 ppm	Not Listed	NA	NA	100 mg/m^3	0.7 to 5.0%
Mercury	NA	NA	0.05 mg/m^3 Skin	0.025 mg/m^3 Skin	0.05 mg/m^3	NA
Polychlorinated Biphenyls (PCB)	NA	NA	1 mg/m^3	0.5 - 1 mg/m^3	0.001 mg/m^3	NA
Silver	NA	NA	0.01 mg/m^3	0.1 mg/m^3	NA	NA
Toluene	40 ppm	8.82	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	1.3 to 7.1%
Xylene	1 ppm [e]	8.56	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	1.0 to 7.0%

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) are recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines
[e] = Odor Threshold for Chemicals, *Chemical Hazards of the Workplace*, by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H.

Site-specific Operational and Physical Hazards

See Section 4.16.

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4.11 AOC 688, Building X-56 — Ammunition Storage Bunker

AOC 688 is an earth-covered ammunition storage bunker constructed in 1942 between Juneau Avenue and the current southern spoils area. The facility still stores high explosives and ammunition. The bunker reportedly was once used for the unauthorized storage of 3,420 gallons of paint in 1987. This AOC, designated for a CSI, is described in Table 4.14.

Table 4.14
AOC 688
Site Descriptions

Number	Description	Materials of Concern	Potential Pathways
AOC 688	Ammunition Storage Bunker X-56 used to store explosives and paint.[a]	Explosives Paint waste	Soil Sediment Surface Water

Notes:
[a] Described in the *RCRA Facility Assessment, June 13, 1994*

Site Activities

Site activities will include soil borings, soil sampling, and installing monitoring wells. Subsequent activities will include well development, purging, and sampling as required. Field work for this site is described in Section 2.9 of this Work Plan.

Chemical Hazards and PPE Requirements

The contaminants of concern for this AOC include petroleum hydrocarbons, solvents, and paints. Table 4.15 list exposure guidelines for expected site chemicals. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the MSDS file onsite.

The initial PPE level for invasive field activities performed at AOC 688 is modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required PPE level shall be upgraded to Level C.

Table 4.15
Exposure Guidelines For Expected Site Chemical Hazards — AOC 688

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Benzene	4.68 ppm	9.24	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 STEL Potential Occupational Carcinogen	1.3 to 7.1%
Cadmium	NA	NA	0.6 mg/m^3	0.05 mg/m^3	Potential Human Carcinogen	NA
Chromium	NA	NA	1 mg/m^3	0.5 mg/m^3	NA	NA
Chromium VI	NA	NA	0.1 mg/m^3 Ceiling	0.05 mg/m^3 Suspected Human Carcinogen	1 μg/m^3 Suspected Human Carcinogen	NA
Copper	NA	NA	0.1 mg/m^3 Fume 1 mg/m^3 Dust	0.2 mg/m^3 Fume 1 mg/m^3 Dust	NA	NA
Ethylbenzene	140 ppm	8.76	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	1.0 to 6.7%
Kerosene	1 ppm	Not Listed	NA	NA	100 mg/m^3	0.7 to 5.0%
Mercury	NA	NA	0.05 mg/m^3 Skin	0.025 mg/m^3 Skin	0.05 mg/m^3	NA
Polychlorinated Biphenyls (PCB)	NA	NA	1 mg/m^3	0.5 - 1 mg/m^3	0.001 mg/m^3	NA
Silver	NA	NA	0.01 mg/m^3	0.1 mg/m^3	NA	NA
Toluene	40 ppm	8.82	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	1.3 to 7.1%

Table 4.15
Exposure Guidelines For Expected Site Chemical Hazards — AOC 688

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Xylene	1 ppm [e]	8.56	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	1.0 to 7.0%

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) are legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) are recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 -1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
[e] = Odor Threshold for Chemicals, *Chemical Hazards of the Workplace*, by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

See Section 4.16.

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4.12 AOC 689, Dredged Materials Disposal Area at Southern Tip of Base

AOC 689 is a 67.95-acre dredged materials disposal area at the southern end of NAVBASE. The confined area has received materials from dredging operations in both the Cooper River and Shipyard Creek since the 1940s and has undergone several dike relocation projects sponsored by the U.S. Army Corps of Engineers. Two spillways in the southern portion of the diked area deposited sediments to de-water. The southernmost spillway ultimately discharges to the Cooper River and the western spillway discharges directly to Shipyard Creek. AOC 689 is bounded to the southwest by West Road and Shipyard Creek, and to the east by Juneau Avenue and the Cooper River. This AOC has been designated for an RFI. AOC 689 is described in Table 4.16.

Table 4.16
AOC 689
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 689	Confined Land Dredge Disposal Area used since the 1940s. The spoil area received dredged material from both the Cooper River and Shipyard Creek.[a]	Petroleum Dioxins Tricyclic Aromatic Tributyltin	Soil Sediment Soil Gas Surface Water Groundwater

Notes:
[a] Described in the *RCRA Facility Assessment, November 1994.*

Site Activities

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Eight proposed sediment samples within the dike will be collected on a grid-based sampling scheme. Two additional sediment samples will be collected in the drainage ditch which conveys effluent from the spoils area to the Cooper River. Four grid-based soil samples will be collected outside the dike. Five surface water samples from standing water in the diked area are also proposed.

Site conditions within the diked area may be non-conducive to standard sampling protocol as outlined in the NAVBASE Charleston *Final Comprehensive RFI Work Plan*. Access to several of the pre-determined sampling locations will require techniques designed for moving personnel and equipment within a marsh habitat with scrub-shrub vegetation and extremely soft, fine-grained, calcareous sediments. Modifying gear, primarily to its portability and effectiveness in such conditions, may be required. Site activities will include soil borings and soil sampling.

Chemical Hazards and PPE Requirements

Table 4.17 lists exposure guidelines for expected site chemicals. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the MSDS file onsite.

Due to the potential presence of low concentration dioxins and tributyl tins in the dredge spoils, the initial PPE level for invasive field activities at AOC 689 is modified Level D, augmented with *Saranex*-treated protective coveralls and full-length nitrile gloves. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required PPE level shall be upgraded to Level C.

Table 4.17
Exposure Guidelines For Expected Site Chemical Hazards — AOC 689

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Benzene	4.68 ppm	9.24	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	1.3 to 7.1%

Table 4.17
Exposure Guidelines For Expected Site Chemical Hazards — AOC 689

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Dioxin 2,3,7,8-TCDD	NA	NA	NA	NA	NA	NA
Dioxin 2,3,7,8-TCDF	NA	NA	NA	NA	NA	NA
Ethylbenzene	140 ppm	8.76	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	1.0 to 6.7%
Tributyl tin	NA	NA	0.1 mg/m^3	0.1 mg/m^3	0.1 mg/m^3	NA
Toluene	40 ppm	8.82	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	1.3 to 7.1%
Xylene	1 ppm [e]	8.56	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	1.0 to 7.0%

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) are legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) are recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
[e] = Odor Threshold for Chemicals, *Chemical Hazards of the Workplace*, by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

Site conditions within the diked area require techniques designed for moving personnel and equipment within a marsh habitat with scrub-shrub vegetation and extremely soft, fine-grained calcareous sediments. Due to the extremely soft sediments, access to sample collection points will be gained using a shallow draft swamp boat and pole. All personnel will be secured via

lifeline to the boat and the boat secured via cable to a vehicle on the spoil area road. All personnel will wear U.S. Coast Guard approved personal floatation devices (PFD). This is a prime habitat for poisonous reptiles and insects.

4.13 SWMU 12, Old Firefighter Training Area

SWMU 12 is the former location of the firefighter training area in the southwestern portion of the southern peninsula. This unit was a 30-foot to 50-foot diameter pit used for training between 1966 and 1971. A gravel road and clearing in this area, currently used as a construction *lay-down* yard, is believed to be near the former location of the training area. SWMU 12 has been designated for an RFI. Table 4.18 describes this SWMU.

Table 4.18
SWMU 12
Site Description

Number	Description	Materials of Concern	Potential Pathways
SWMU 12	Old firefighter training area consisting of a shallow pit into which ignitable liquids were pumped and set on fire and then extinguished. [a]	Petroleum	Soil Sediment Groundwater Surface Water

Notes:
[a] Described in the *RCRA Facility Assessment, August 1987*

Site Activities

Site activities will include soil borings and soil sampling. Field work for this site is described in Section 2.11 of this Work Plan.

Chemical Hazards and PPE Requirements

The major constituent of concern at SWMU 12 is petroleum hydrocarbon. Table 4.19 lists exposure guidelines for expected site chemicals. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the MSDS file onsite.

The initial PPE level for invasive field activities performed at SWMU 12 is modified Level D PPE. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required PPE level shall be upgraded to Level C.

Table 4.19
Exposure Guidelines For Expected Site Chemical Hazards — SWMU 12

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[a]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Benzene	4.68 ppm	9.24	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	1.3 to 7.1%
Ethylbenzene	140 ppm	8.76	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	1.0 to 6.7%
Kerosene	1 ppm	6.8	NA	NA	100 mg/m^3	0.7 to 5.0%
Toluene	40 ppm	8.82	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	1.3 to 7.1%
Xylene	1 ppm [e]	8.56	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	1.0 to 7.0%

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) are legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
[e] = Odor Threshold for Chemicals, *Chemical Hazards of the Workplace*, by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

See Section 4.16.

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4.14 AOC 690, Dredged Materials Area Roads

AOC 690 is the network of roadways on the southern tip of the naval base, including West Road, Lunsford Loop, and a portion of Juneau Avenue. The roadside areas along these dirt roads, totaling about 4,500 feet, are reported locations of historic, unauthorized chemical dumping by ship personnel; and have therefore been designated for a CSI. A description of this AOC is provided in Table 4.20.

Table 4.20
AOC 690
Site Description

Number	Description	Materials of Concern	Potential Pathways
AOC 690	Spoils Area Roads are reported sites for unauthorized disposal of chemicals and other hazardous wastes by ship personnel.[a]	Unknown	Soil Sediment Surface Water Groundwater Air

Notes:
[a] Described in the *RCRA Facility Assessment, November 1994.*

Site Activities

Site activities will include soil borings, soil sampling, and installing monitoring wells. Subsequent activities will include well development, purging, and sampling as required. Field work for this site is described in Section 2.10 of this Work Plan.

Chemical Hazards and PPE Requirements

Table 4.21 lists exposure guidelines for expected site chemicals. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the MSDS file onsite.

Due to the unknown type or quantities of pesticides potentially present in the soil, all field work that will disturb soil or require contact with groundwater should be performed in Level C PPE

until analytical data can be evaluated for possible consideration of a downgrade to Level D PPE. The AL for this site is a continuous PID reading of 10 ppm or greater. If this occurs, work activities shall be discontinued until arrangements can be made to resume work in Level B.

Table 4.21
Exposure Guidelines For Expected Site Chemical Hazards — AOC 690

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)[d]	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Arsenic	NA	NA	0.01 mg/m^3	0.2 mg/m^3	0.002 mg/m^3 potential occupational carcinogen	NA
Chlordane	NA	NA	0.5 mg/m^3	0.5 mg/m^3 2.0 mg/m^3 STEL	potential occupational carcinogen	NA
DDT	NA	NA	1 mg/m^3	1 mg/m^3	0.5 mg/m^3	NA
Dieldrin	0.041 ppm	NA	0.25 mg/m^3	0.25 mg/m^3	potential occupational carcinogen	NA
Malathion	NA	NA	10 mg/m^3	10 mg/m^3	15 mg/m^3	NA
Toxaphene	NA	NA	0.5 mg/m^3 1.0 mg/m^3 STEL	0.5 mg/m^3 1.0 mg/m^3 STEL	potential occupational carcinogen	NA

Notes:
[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.
[b] = Permissible Exposure Limits (PELs) are legal standards enforced by OSHA and found in 29 CFR 1910.1000.
[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.
[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

See Section 4.16.

4.15 SWMU #177, RTC-4 Oil Spill

SWMU #177 consists of two adjacent buildings both of which have been designated as Building RTC-4. The original RTC-4 was a 24' x 60' metal structure used to house heavy equipment including backhoes and trackhoes. Recently, however, the designation RTC-4 has been given to a newer facility built adjacent to the former RTC-4. The new RTC-4 is used to store lawn mowers and other lawn maintenance equipment. This unit was designated as a SWMU because of oil spillage associated with operations at these two buildings. SWMU 177 is described in Table 4.22.

Table 4.22
SWMU 177
Site Description

Number	Description	Materials of Concern	Potential Pathways
SWMU 177 RTC-4 Oil Spill	Petroleum spill on the order of several gallons observed within the original Building RTC-4. Spill most likely waste motor oil based on usage of Building RTC-4 as shelter for heavy equipment. Stains in parking area suspected to be hydraulic fluid leaks from facility fork lift.[a]	**VOCs** Petroleum Hydrocarbons Lubricating oil Anti-freeze Motor oil	**Soil** Soil Gas Sediment Surface Water Groundwater Air

Notes:
[a] Described in the *Final RCRA Facility Assessment*, June 6, 1995.
Pathways scheduled for confirmatory sampling are in bold.

Site Activities

Site activities will include soil borings and soil sampling. Field work for this site is described in Section 2.12 of this Work Plan.

Chemical Hazards and PPE Requirements

The major constituents of concern at SWMU 177 are related to used motor oil, in particular, petroleum hydrocarbons and heavy metals may be present at this site. Table 4.23 lists exposure guidelines for expected site chemicals.

The initial PPE level for invasive field activities performed at SWMU 177 is modified Level D PPE. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If 5 ppm above background is measured continuously for a substantial time (greater than 2-3 minutes), the required PPE level shall be upgraded to Level C.

Table 4.23
Exposure Guidelines For Expected Site
Chemical Hazards — SWMU 177

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)
Benzene	4.68 ppm	9.24	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 STEL Potential Occupational Carcinogen	1.3 to 7.1%
Cadmium	NA	NA	0.6 mg/m^3	0.05 mg/m^3	Potential Human Carcinogen	NA
Chromium	NA	NA	1 mg/m^3	0.5 mg/m^3	NA	NA
Ethylbenzene	140 ppm	8.76	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	1.0 to 6.7%
Kerosene	1 ppm	6.8	NA	NA	100 mg/m^3	0.7 to 5.0%
Lead	NA	NA	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3	NA
Toluene	40 ppm	8.82	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	1.3 to 7.1%
Xylene	1 ppm [e]	8.56	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	1.0 to 7.0%

Table 4.23
Exposure Guidelines For Expected Site Chemical Hazards — SWMU 177

Chemical Name	Odor[a] Threshold	Ionization Potential (eV)	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Flammable range (% by volume)

Notes:

[a] = Odor Thresholds for Chemicals with Established Occupational Health Standards, American Industrial Hygiene Association, 1989.

[b] = Permissible Exposure Limits (PELs) legal standards enforced by OSHA and found in 29 CFR 1910.1000.

[c] = Threshold Limit Values, and Short Term Exposure Limits (TLVs and STELs) are recommended exposure guidelines developed by the American Conference for Governmental Industrial Hygienists (ACGIH), and published annually. For this site, *1993 - 1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices* was used.

[d] = Recommended Exposure Limits (RELs) are non-enforceable exposure guidelines developed by the National Institute for Occupational Safety and Health (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*

[e] = Odor Threshold for Chemicals, *Chemical Hazards of the Workplace*, by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fischman, M.D., M.P.H.

NA = Substance information not available, or substance unlisted.

Site-specific Operational and Physical Hazards

See Section 4.16.

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4.16 General Operational and Physical Hazards

Field personnel should be aware of and act in a manner to minimize the dangers associated with physical hazards typically encountered during environmental investigations. These hazards may include movement over slippery and/or uneven terrain. Personnel may be required to carry equipment over this type of terrain. These types of surfaces present a significant slip, trip and fall hazard. When conducting any field operations personnel will walk.

Heat stress and other environmental illnesses are a major concern when performing site activities during summer months. When deemed necessary the Site Supervisor and the Site Health and Safety Officer shall implement work regiments that will minimize the potential for employee illness.

4.16.1 Radiological Site Screening

Radioactive materials/hazards are potentially present within Zone I as a result of past operational activities at the Charleston Naval Shipyard (CNSY).

As part of the CNSY and the Charleston Naval Base closure process, the Navy is required to conduct radiological surveys to verify that all Naval material has been removed.

Prior to EnSafe/Allen & Hoshall and contractors performing any of the below actions, the CNSY General Survey Project Superintendent of Zone I shall be contacted by E/A&H employees and contractors to determine if the CNSY verification surveys have been completed in Zone I. Once completion of the surveys has been verified, work may be performed in the verified areas with no radiological precautions required. This applies to all E/A&H employees and their contractors while conducting field work in Zone I, including but not limited to walkover investigations, drilling, well development, soil sampling, water sampling, and trenching.

4.16.2 Underground Utilities

A major safety concern in environmental investigations is drilling into underground utilities, particularly electrical and natural gas lines. Prior to drilling or conducting an intrusive activity with the potential to penetrate a utility line, at a minimum, the following steps must be taken at each location, for each well or penetration:

- Conduct a surficial resistivity and magnetic survey to locate underground utilities.
- Offset drilling location from located utility allowing a minimum of 5 feet.
- Core asphalt and concrete then post hole dig to 5 feet below ground surface (bgs).
- During the act of drilling, post hole digging, and hand augering in areas where underground utilities may be present the individual(s) actually doing the invasive work shall wear boots and gloves that provide electrical insulation.

4.16.3 Severe Weather Conditions

Field work shall not be conducted when lightning can be seen from the work area. When lightning is observed, cease work, perform emergency personal and equipment decontamination (see Section 4.18) as needed, then seek shelter.

During extreme weather conditions the Site Supervisor shall use his/her best judgement and has the authority to stop field work or dismiss workers for the day. Examples of conditions that may warrant work stoppage include: high winds, hail, flooding, and ice storms. In the event of severe weather (e.g., lightning) or an emergency requiring immediate evacuation, contaminated equipment will be bagged or wrapped and taped in 6 mil polyethylene sheeting and tagged as "contaminated" for later decontamination.

4.16.4 Working Around Drill Rigs and Heavy Equipment

Heavy equipment and drill rig operations will be performed in accordance with the procedures outlined in the CHASP.

4.17 Employee Protection

Employee protection for this project is addressed in several ways including the use of: work limitations, specified PPE, air monitoring, decontamination procedures, standard safe work practices, general rules of conduct, procedures for extreme weather conditions and medical surveillance.

4.17.1 Work Limitations

All site activities will be conducted during daylight only. All personnel scheduled for these activities will have completed initial health and safety training and actual field training as specified in 29 CFR 1910.120(e). All supervisors must complete an additional eight hours of HAZWOPER Site Supervisor training. All personnel must complete an eight-hour refresher training course annually to continue working onsite.

4.17.2 Selecting Proper PPE

It is important that specified PPE protects against known and suspected site hazards. Selection of protective equipment is based on the types, concentrations, and routes of personal exposure that may be encountered. In situations where the types of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the PPE required, and a greater emphasis is placed on past experiences and sound safety practices.

PPE requirements are subject to change as site information is updated or changes. **A decision to deviate from specified levels of PPE as contained in this ZIHASP must be made or reviewed by the Project Health and Safety Officer (PHSO).**

Initial Level of PPE

Based on the best available information, the appropriate level of PPE for initial site entry is modified Level D. Modified Level D shall be the initial PPE for work activities that disturb the soil or could result in personnel coming into contact with contaminated soil, sediment, groundwater, or surface water. This level of protection was selected because the concentrations of contaminants detected in the previous studies were low and free product was not detected. Modified Level D protection consists of a hard hat, chemical-resistant coveralls and gloves (vinyl or nitrile), eye protection, and steel-toed and shank boots.

Examples of activities to be initiated in Modified Level D include: soil boring, well installation and construction, soil sampling, and well development. Collecting groundwater samples and determining water levels are two field activities than can be conducted in Level D, provided that field personnel supplement their Level D attire with nitrile gloves (outer gloves, not the 4-mil nitrile inner glove liners). **The history and nature of potential contaminants at specific site locations may indicate a higher or lower level of initial PPE. In these cases the PPE requirements are defined in the subsection *Chemical Hazards and PPE Requirements*.**

4.17.3 Air Monitoring

Air monitoring using a PID and/or other appropriate sampling equipment will be conducted before beginning field activities at a new EZ and during ground-disturbing activities. The PID will be field calibrated to measure VOCs relative to a 100 ppm isobutylene standard. If VOCs are detected downhole, colorimetric detector tubes and/or other sampling media may be used to identify and approximate the concentrations of these compounds.

The PHSO reserves the right to require personal exposure monitoring or other types of air sample collection and analysis. These samples may be required for a variety of reasons such as: to identify a chemical odor, PID readings exceed or approach the action level, or to determine if personal exposures are below OSHA PELs.

A combustible gas indicator (CGI) will be used during all soil borings and well installations. The CGI will be field calibrated to measure flammable gases relative to a methane standard. Downhole CGI readings will be collected periodically during soil-disturbing operations. Field activities will immediately cease if downhole readings exceed 20 percent of the lower explosive limit (LEL). If CGI readings do not subside, the area will be immediately evacuated and the situation re-evaluated to determine how to proceed. An investigation of the area will be made; operations may not proceed until downhole readings are below 20 percent LEL.

Action Level and Ceiling Concentration

Each site at NAVBASE has a designated AL and ceiling concentration. For this project the AL is defined as the PID reading in the breathing zone above which respiratory protection must be upgraded; chemical-protective clothing may also be upgraded. The AL is determined on a site-by-site basis. To exceed the AL, PID readings should be sustainable. Readings should remain above the AL for at least one or two minutes at a time. Readings that are elevated for only a few seconds every 15 or 20 minutes do not exceed the AL and do not require workers to upgrade their level of PPE.

The general AL for this zone, as determined on a properly calibrated PID, is 5 PID units above background. PPE shall be upgraded to Level C (assuming that cartridge respirators are appropriate, otherwise Level B) if airborne VOC concentrations in the breathing zone exceed the AL, or if the concentration of any contaminant exceeds 50 percent of the OSHA PEL. This baseline AL and PPE requirement may be superseded by more stringent site-specific levels, as identified in each Site Chemical Hazard and PPE requirements section.

If breathing zone concentrations exceed the AL, or site conditions indicate that additional health and safety precautions are needed, field activities in the area shall stop. Field staff shall notify the Site Supervisor of the situation and he/she shall contact the Project Manager and/or the PHSO. The PHSO will be responsible for reassessing the hazards and prescribing revised health

and safety requirements as necessary, including upgraded PPE requirements, revised work schedules, and revised decontamination procedures. See Table 4.24 for specific criteria for each protection level.

If PID readings exceed 10 units, the SHSO shall contact the PHSO and discuss the need to identify and quantify airborne contaminants. Work shall not proceed until breathing zone concentrations return to background levels and it is reasonably anticipated that breathing zone readings will stay approximately at background levels, or the chemical constituent(s) are identified and appropriate PPE is donned.

Table 4.24
Level of Protection and Criteria

Level of Protection	Criteria for Use	Equipment
Level A	• When atmospheres are "immediately dangerous to life and health" (IDLH in the NIOSH/OSHA Pocket Guide to Chemical Hazards or other guides.) • When known atmospheres or potential situations exist that could affect the skin or eyes or be absorbed into the body through these surfaces. Consult standard references to obtain concentrations hazardous to skin, eyes or mucous membranes. • Potential situations include those where immersion may occur, vapors may be generated or splashing may occur through site activities. • Where atmospheres are oxygen deficient. • When the type(s) and or potential concentration of toxic substances are not known.	• Positive-pressure full-face piece self-contained breathing apparatus or positive-pressure supplied air respirator with escape SCBA. • Fully-encapsulating chemical protective suit. • Chemical-resistant inner and outer gloves. • Steel toe and steel shank chemical resistant boots. • Hard hat under suit. • Two-way radios worn inside suit. • Optional: coveralls, long cotton underwear, disposable protective suit, gloves and boots, over fully encapsulating suit.

Table 4.24
Level of Protection and Criteria

Level of Protection	Criteria for Use	Equipment
Level B	• When respiratory protection is warranted and cartridge respirators are not appropriate. Examples of these conditions are: — when work area may contain less than 19.5 percent oxygen, — when expected contaminants do not have appropriate warning properties e.g. vinyl chloride, or — when cartridges are not available to protect against all contaminants of concern. • Hazards associated with limited dermal exposure are not significant.	• Chemical resistant clothes, coveralls. • Positive-pressure full-face, self-contained breathing apparatus (SCBA) or supplied airline system (SAR) with escape bottle. • Hard hat. • Chemical resistant outer and inner gloves. • Steel toe and steel shank boots. • Chemical resistant outer boots.
Level C	• When respiratory protection is warranted and cartridge respirators are appropriate. • When PID readings exceed the Action Level. • When air monitoring indicates airborne concentration of a chemical is 50 percent or more of the PEL or TLV • And the work area contains at least 19.5 percent oxygen.	• Chemical resistant coveralls. • Full-face, air purifying respirator equipped with cartridges suitable for the hazard. • Hard hat. • Chemical resistant outer and inner gloves. • Steel toe and steel shank boots. • Disposable outer boots.
Modified Level D	• When chemical contamination is known or expected to be present, yet inhalation risk is low and respiratory protection is not required. • Site contaminants may be absorbed through the skin. • The "default level" of PPE required when the ZIHASP does not specify another level of PPE. • And the work area has at least 19.5 percent oxygen.	• Chemical resistant coveralls. • Chemical resistant outer gloves; inner gloves or glove liners, optional. • Steel toe and steel shank boots. • Hard hat. • Safety glasses with side shields or safety goggles. • Optional: chemical resistant outer boots.
Level D	• When minimal or no chemical contamination is expected. • When ZIHASP specifies Level D protection is adequate. • And the work area has at least 19.5 percent oxygen.	• Inner gloves or chemical-resistant gloves needed to handle soil or water samples. • Steel toe and steel shank boots. • Hard hat. • Safety glasses with side shields or safety goggles. • Optional: coveralls and disposable outer boots. • Work clothes.

The ceiling concentration is defined as the maximum allowable PID reading in the breathing zone regardless of PPE. A ceiling concentration of 50 PID units has been established. Should VOC concentrations exceed 50 ppm in the breathing zone, field workers should secure their equipment and back off the site. Work shall not resume until the Site Supervisor understands

why VOC concentrations became elevated, knows the major constituents of the VOCs being generated, and the VOCs in the breathing zone are less than 5 ppm or workers have upgraded to Level C or B. The proper PPE upgrade shall be determined by the PHSO based on site-specific chemical information (i.e., is there enough information to determine that air purifying respirators will provide sufficient protection).

Field monitoring values will be recorded in a field logbook and copies must be posted for field personnel review.

Equipment Maintenance

Before being used on a daily basis, PIDs, CGIs, and other monitoring equipment shall be calibrated or their proper function verified. Throughout the day this equipment shall be periodically checked to ensure it is working properly. A final calibration shall be conducted at the end of the work day, at which time each instrument will be checked to ensure that it is free from surface contamination. Air monitoring equipment shall detect the calibration standard within a range of plus or minus 10 percent; otherwise the instrument shall be considered to be malfunctioning. Field staff shall note in their field notebooks that they conducted these calibrations and checks and note whether the equipment was functioning properly.

When equipment is not functioning properly it should be brought to the attention of the Site Supervisor or SHSO, who will arrange for repairs and/or replacement of that equipment as needed.

4.18 Personnel and Equipment Decontamination

As needed, a CRZ will be next to EZs established for invasive activities and will include stations for decontaminating personnel, PPE, and hand tools. Typically, a portion of the CRZ will be covered with sheets of 6-mil polyethylene (generally, an area 20 feet by 20 feet is sufficient) with specific stations to accommodate the removal and disposal of the protective clothing, boot covers, gloves, and respiratory protection.

Heavy equipment and field equipment that cannot adequately be decontaminated in the CRZ may be decontaminated on a more centrally located decontamination pad. Table 4.25 lists equipment that may be convenient to have onsite to decontaminate heavy equipment and vehicles; this table also explains how this equipment may be utilized.

Table 4.25
Equipment Recommended for Decontaminating Heavy Equipment and Vehicles

- Storage tanks or drums to be used for storing collected wash and rinse solutions, alternatively, equipment for the treatment of collected wash and rinse solutions may be substituted.
- Pumps and filters as needed for the collection of wash and rinsate solutions.
- Pressurized steam sprayers for steam cleaning equipment.
- Long-handled brushes for general cleaning of exterior surfaces. Also shovels and other equipment may be used to dislodge caked on contaminated mud that may be present on the undercarriage or in the tires.
- Wash solutions, selected for their ability to remove (dissolve, etc.) contaminants
- Rinse solutions, selected for their ability to remove contaminants and wash solutions.
- Pressurized sprayers for washing and rinsing, particularly hard to reach areas.
- Clean buckets that can contain cleaning and rinsing solutions.
- Brooms and brushes that can be used to clean the interior operator areas of vehicles and equipment.

Figure 4-1 shows one method of laying out an acceptable decontamination area for Level B PPE. There are numerous ways to lay out decontamination areas. Decontamination areas for Level C and Modified D PPE should be based on this concept of decontamination, but can be scaled back in accordance with the decontamination needs of the specific site and level of PPE. As a general rule, persons working in the CRZ and assisting in the decontamination of workers leaving the EZ, shall be outfitted in PPE that is one protection level below what the exiting workers are

using. For example, if workers leave the EZ in Level C, personnel in the CRZ should be in Modified D.

Often equipment may be adequately decontaminated using a soapy wash solution and following specified rinsing procedures. Normally equipment decontamination will be completed in Level D with gloves or Modified D PPE. Respirators not only need to be decontaminated and cleaned between uses, but also need to be sanitized. Alcohol swabs are generally sufficient.

Field work shall not be conducted when lightning can be seen from the work area. When lightning is observed, cease work, perform emergency personal and equipment decontamination if need be, then seek shelter.

In the event of inclement weather (e.g., lightning) or an emergency requiring immediate evacuation, contaminated equipment will be bagged or wrapped and taped in 6 mil polyethylene sheeting and tagged as "contaminated" for later decontamination.

4.18.1 Full Decontamination Procedures

Workers shall use the following cleaning and decontamination procedures when exiting the EZ. These procedures should be followed when workers are leaving the area for lunch, at the end of their shifts, or when work is completed for an EZ. Procedures for rest breaks and changing SCBA tanks and cartridges are described in Section 4.18.2. Not all steps apply to every situation; follow applicable procedures. Decontamination procedures shall start at the EZ/CRZ interface and continue away from the EZ toward the SZ.

Full Decontamination Level B

1. ***Equipment drop***. Deposit equipment used onto plastic drop cloths or into a plastic-lined tub. All gross contamination should be removed here; equipment may be fine-cleaned and decontaminated here or elsewhere. Equipment that is still contaminated must be wrapped and taped before being moved.

2. ***Outer boot and glove wash***. Wash/remove gross contamination from outer boots, outer gloves, SCBA and/or airline equipment.

3. ***Tape removal***. Remove tape from ankles and wrists and dispose of in plastic lined drum.

4. ***Outer boot removal***. Remove outer boots, disposable outer boots may be disposed of in the same waste container used in Step 3. Non-disposable boots need a thorough cleaning before they can be removed from the site. (If non-disposable boots are used, it is preferable to have them dedicated to the project.)

5. ***Outer glove removal***. Remove and dispose outer gloves. Gloves may be disposed of in the same waste container as used in Step 3.

6. ***SCBA and SAR removal***. For Level B*.

   SCBA — With buddy or other site worker, remove backpack, remove face-piece and shut off air flow.

   Airline — With buddy or other site worker, remove harness and escape bottle, remove face-piece, shut off air flow.

   * If coveralls are significantly contaminated, leave the respirator face-piece on, disconnect the air hose just downstream of the regulator, turn off the flow of air, remove

the backpack or equipment harness, and leave the face-piece in place. Remove the face-piece in Step 9.

7. ***Coverall removal.*** Rinse coveralls if needed. Remove coveralls and dispose of them. The same drum may be used as in Step 3. Non-disposable coveralls shall be double-bagged with the outer bag clearly labeled "contaminated".

8. ***Respirator removal.*** Remove respirator (or face-piece of Level B equipment, if it is still being worn). Dispose of spent cartridges. Clean, disinfect, dry, and properly store respirator or face-piece.

9. ***Inner glove removal.*** Remove and discard inner gloves.

10. ***Exit area.*** Exit the CRZ via the SZ.

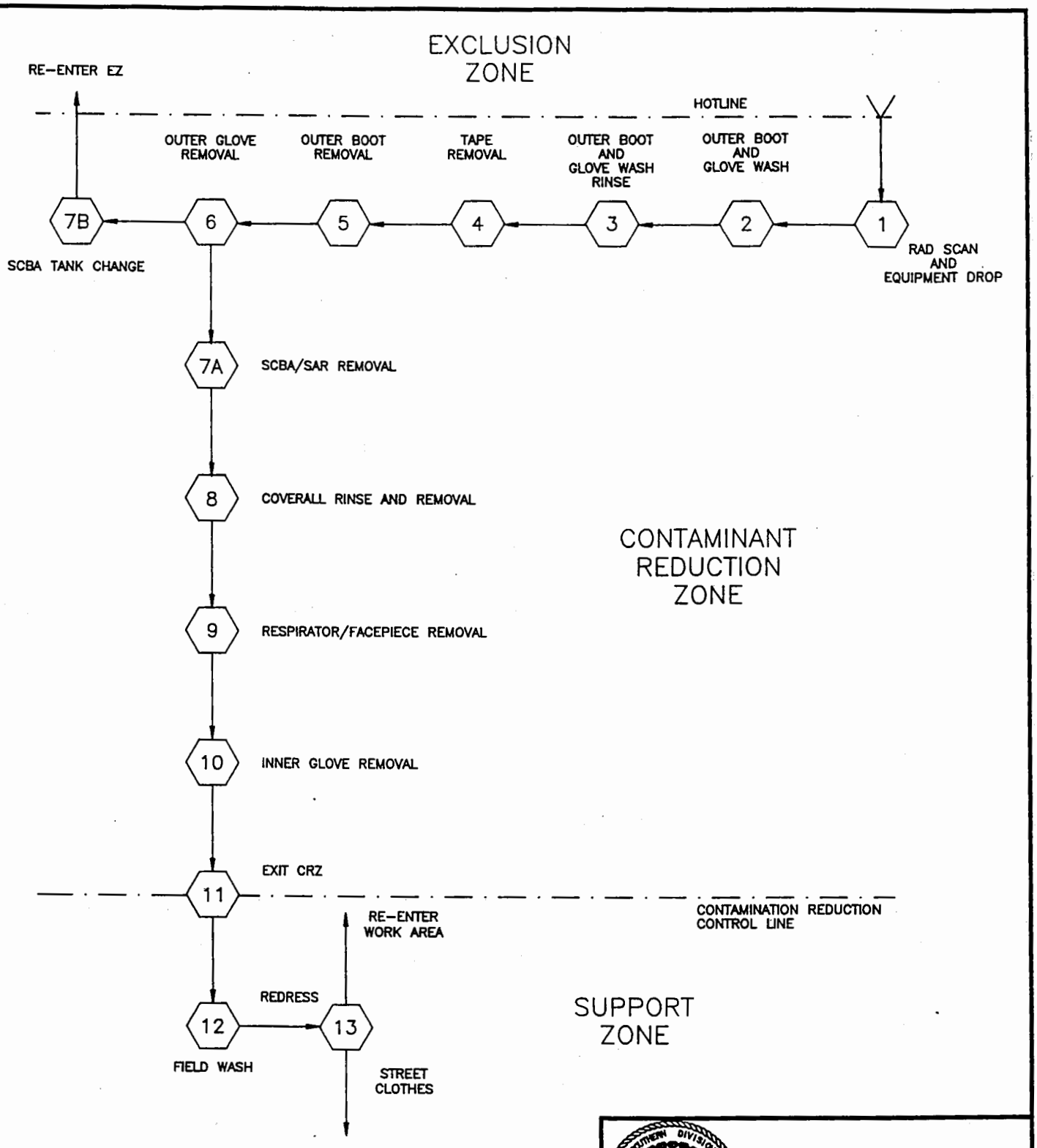
11. ***Field Wash.*** Wash and rinse hands and face.

12. ***Redress.*** Redress into appropriate PPE for re-entry or change into street clothes.

Notes:

- All wastes (soil and water) generated during personal decontamination will be collected in 55-gallon drums. The drums will be labeled by E/A&H personnel; final disposal will be by the Navy.

- Hard hats and eye protection should be washed at the end of each workday with a soap and water solution.



ZONE I HASP
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 4-1
FULL DECONTAMINATION LAYOUT
LEVEL B PROTECTION

DWG DATE: 10/19/94 | DWG NAME: 29FDLLP

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Full Decontamination Level C

1. ***Equipment drop.*** Deposit equipment used onto plastic drop cloths or into a plastic-lined tub. All gross contamination should be removed here; equipment may be fine-cleaned and decontaminated here or elsewhere. Equipment that is still contaminated must be wrapped and taped before being moved.

2. ***Outer boot and glove wash.*** Wash/remove gross contamination from outer boots, outer gloves.

3. ***Tape removal.*** Remove tape from ankles and wrists and dispose of in plastic lined drum.

4. ***Outer boot removal.*** Remove outer boots, disposable outer boots may be disposed of in the same waste container used in Step 3. Non-disposable boots need a thorough cleaning before they can be removed from the site. (If non-disposable boots are used it is preferable to have them dedicated to the project.)

5. ***Outer glove removal.*** Remove and dispose outer gloves. Gloves may be disposed of in the same waste container as used in Step 3.

6. ***Coverall removal.*** Rinse coveralls, if needed. Remove coveralls and dispose of them. The same drum may be used as in Step 3. Non-disposable coveralls shall be double-bagged with the outer bag clearly labeled *contaminated.*

7. ***Respirator removal.*** Remove respirator and dispose of spent cartridges. Clean, disinfect, dry, and properly store respirator.

8. ***Inner glove removal.*** Remove and discard inner gloves.

9. ***Exit area***. Exit the CRZ via the SZ.

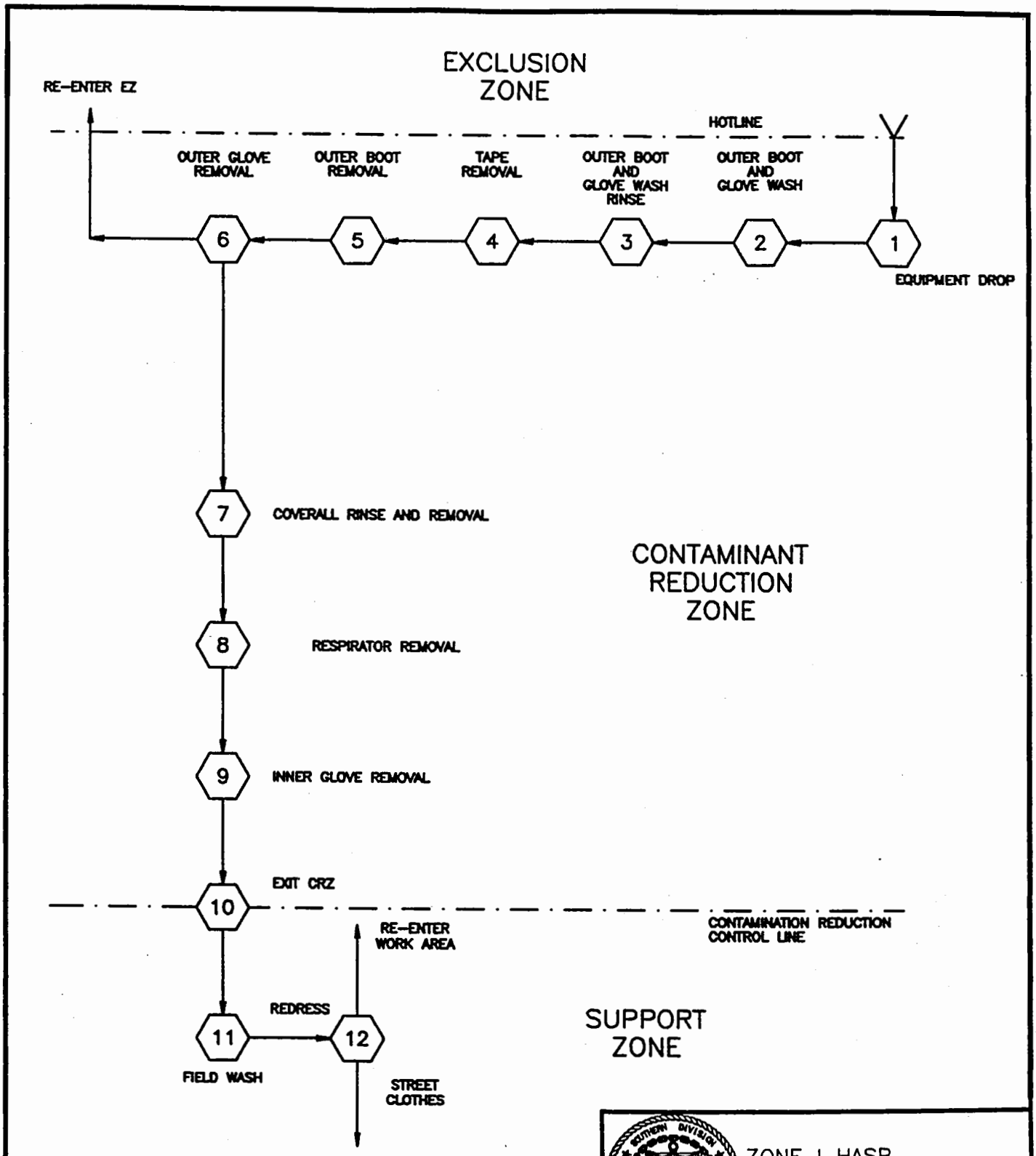
10. ***Field Wash***. Wash and rinse hands and face.

11. ***Redress***. Redress into appropriate PPE for re-entry or change into street clothes.

Notes:

- All wastes (soil and water) generated during personal decontamination will be collected in 55-gallon drums. The drums will be labeled by E/A&H personnel; final disposal will be by the Navy.

- Hard hats and eye protection should be washed at the end of each workday with a soap and water solution.



ZONE I HASP
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 4-2
FULL DECONTAMINATION LAYOUT
LEVEL C PROTECTION

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4.18.2 Partial Decontamination Procedures

To change a respirator cartridge or SCBA tank:

1. ***Outer boot and glove wash.*** Wash outer boots and gloves. Wash/remove gross contamination from SCBA and/or airline equipment.

2. ***Tape removal.*** Remove tape from ankles and wrists and discard of it in a plastic-lined drum.

3. ***Face-piece removal.*** Disconnect face-piece and air hose just downstream of regulator. The face-piece may remain in place, or may be removed and cleaned. Remove the spent tank from the backpack and replace it with a full tank. Connect air hose and turn on air.

4. ***Respirator removal.*** Remove respirator, remove used cartridges, clean and disinfect respirator, install new cartridges, and don respirator.

5. ***Respirator check.*** Check to make sure that respirator still seals properly to your face.

6. ***Don clean PPE.*** Put on clean outer gloves, tape wrists (as applicable), and re-enter EZ.

When taking a rest break:

1. ***Outer boot and glove wash.*** Wash outer boots and gloves. Wash/remove gross contamination from SCBA and/or airline equipment.

2. ***Tape removal.*** Remove tape from ankles and wrists and dispose of it in a plastic lined drum.

3. ***Respirator removal.*** Remove SCBA unit, airline harness, or respirator and place in a clean area, plastic sheeting may be needed.

4. ***Coverall removal.*** Remove outer wear if it is ripped or significantly contaminated. In hot weather, at least unzip and pull down upper half of coveralls.

5. ***Inner glove removal.*** Remove and dispose of inner gloves.

6. ***Wash.*** Wash and rinse hands and face at the field wash station.

7. ***Rest break.*** Take rest break: Remember to drink plenty of water, Gatorade or other similar beverage.

8. ***Don inner gloves.*** Put on inner gloves.

9. ***Don PPE.*** Don coveralls, outer boots, and outer gloves. Tape wrists and ankles (as needed), and re-enter the EZ.

Decontamination procedures, based on Level D protection:

- Brush heavily soiled boots and rinse outer gloves and boots with soap and water.
- Remove gloves and deposit them in a trash container.
- Dispose gloves and other disposable PPE in a trash container.
- Wash hands and face, and preferably shower as soon as practical.

4.18.3 Closure of the Decontamination Station

All disposable clothing and plastic sheeting used during site activities at sites with Level D through Level C will be double-bagged and disposed of in a refuse container. Decontamination and rinse solutions and disposable PPE from Level B site will be placed in a labeled 55-gallon drum (separate solids and liquids) for later analysis and disposal. All washtubs, pails, buckets, etc. will be washed and rinsed at the end of each workday.

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4.19 Procedures Hot or Cold Weather Conditions

For signs and symptoms of heat and cold related illnesses see CHASP Section 6.5.1. Monitoring of heat stress conditions (area and personal) will be employed during hot weather conditions and/or when elevated levels of PPE are utilized. When the oral temperature of field staff reaches or exceeds 100°F they shall rest until their temperature drops below 99°F. The oral temperature of field staff should not exceed 100.4°F as specified by the ACGIH (TLVs and BIs for 1994-5, Cincinnati, OH, ACGIH 1994, pp 84-90). Oral temperature equivalents shall be obtained by the infrared measurement of the tympanic membrane.

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4.20 Standard Safe Work Practices

- Eating, drinking, chewing gum or tobacco, smoking, or any activity that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated, unless authorized by the SHSO.

- Hands and face must be thoroughly washed upon leaving the work area.

- No contact lenses will be worn in work areas while invasive activities are conducted.

- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as practical after leaving the CRZ.

- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate, or discolored surfaces, or lean, sit, or place equipment on drums, containers, or soil suspected of being contaminated.

- Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on cleanup or response operations where the potential for absorption, inhalation, or ingestion of toxic substances exists unless specifically approved by a qualified physician. Consumption of alcoholic beverages is prohibited.

- Adequate side and overhead clearance must be maintained to ensure that the drill rig boom does not touch or pass close to any overhead power lines or other overhead obstacles or obstructions.

- NAVBASE Public Works and local utility representatives shall be contacted and requested to identify all underground utility lines. Utility lines should be marked using characteristic spray paint or labeled stakes. A buffer zone, 3 yards to either side of a utility line, should be maintained during all subsurface investigations.

- Due to the flammable properties of the potential chemical hazards, all spark or ignition sources should be bonded and/or grounded or mitigated before soil boring advancement or other site activities begin.

4.21 General Rules of Conduct:

- Liquor, firearms, narcotics, tape recorders, and other contraband items are not permitted on the premises.

- Any violation of local, state, or federal laws, or conduct outside the generally accepted moral standards of the community is prohibited.

- Violation of the Espionage Act, willfully hindering or limiting production, or sabotage is not permitted.

- Willfully damaging or destroying property, or removing government records is forbidden.

- Misappropriation or unauthorized altering of any government records is forbidden.

- Securing government tools in a personal or contractors' tool box is forbidden.

- Gambling in any form, selling tickets or articles, taking orders, soliciting subscriptions, taking up collections, etc., is forbidden.

- Doing personal work in government shop or office, using government property or material for unauthorized purposes, or using government telephones for unnecessary or unauthorized local or long-distance telephone calls is forbidden.

- Compliance with posted signs and notices is required.

- Boisterousness and noisy or offensive work habits, abusive language, or any verbal, written, symbolic, or other communicative expression which tends to disrupt the work or morale of others is forbidden.

- Fighting or threatening bodily harm to another is forbidden.

- Defacing any government property is forbidden.

- Wearing shorts of any type and/or offensive logos, pictures, or phrases on clothing is forbidden. Shirts, shoes, pants or slacks, or coverall-type garments will be worn at all times on government property.

- All persons operating motor vehicles will obey all NAVBASE traffic regulations.

4.22 Medical Monitoring Program

See CHASP Section 7.0.

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4.23 Authorized Personnel

Personnel anticipated to be onsite at various times during site activities include:

• Engineers-in-Charge	Matthew A. Hunt (SOUTHDIV) Brian Stockmaster
• Site Contact	Joe Camp (Caretaker Site Office)
• Principal-In-Charge	James Speakman (E/A&H)
• Task Order Manager	Todd Haverkost (E/A&H)
• Project Manager	Ginny Gray (E/A&H)
• Project Health & Safety Officer	John Borowski (E/A&H)
• Site Supervisor	Sam Weatherford (E/A&H)
• Site Health & Safety Officer	Tim McCord (E/A&H)

Responsibilities of Key Field Staff

Key field staff for this project, in terms of health and safety are:

- Site Supervisor,
- Site Health and Safety Officer, and
- (All) Field Staff.

The primary health and safety responsibilities associated with each of these positions are delineated in the CHASP, Sections 8.1, 8.2 and 8.3, respectively.

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4.24 Emergency Information

All hazardous waste site activities present a risk to onsite personnel. During routine operations, risk is minimized by establishing good work practices, staying alert, and using proper PPE. Unpredictable events such as physical injury, chemical exposure, or fire may occur and must be anticipated.

Examples of an emergency include:

- A fire, explosion, or similar event at or near the site whether related to this project or not.

- A member of the field crew sustains a significant injury, or experiences symptoms of a chemical exposure.

- The discovery of a condition which suggests that site conditions are imminently more dangerous or hazardous than anticipated.

4.24.1 Site Resources

A cellular telephone will be available in the SZ for routine and emergency communication/ coordination with NAVBASE, SOUTHDIV, and the E/A&H field office. First aid and eye wash equipment will be available at the work area and in each field vehicle.

In the event that a situation occurs such that it is necessary to evacuate the work site because of an emergency, all E/A&H personnel shall seek a safe place of refuge (Safe Haven). The primary place of Safe Haven shall be the E/A&H Trailer located in Zone H. Employees shall remain at their selected Safe Haven until they receive further instructions from either the Site Supervisor or PHSO, or the Safe Haven is no longer safe. It is imperative that persons remain

at the Safe Haven so that E/A&H can account for all personnel that were onsite at the time of the incident.

EnSafe's Charleston office will be used as the Command Center. Cellular phones will be used to contact the office and appraise them of the situation; to locate E/A&H personnel needed for assistance; and to coordinate other appropriate actions.

Emergency Actions

In the event of an emergency E/A&H personnel are not to take/effect emergency response actions unless they have received specific training in emergency response actions and their training is current. For example, several E/A&H employees presently hold EMT (Emergency Medical Training) certification by the American Red Cross.

In that E/A&H personnel do not operate heavy equipment as part of their employment, and E/A&H does not have heavy equipment of its own onsite, E/A&H personnel shall not operate heavy equipment in an emergency response situation. There are no functions or services provided by E/A&H that are critical to the operation of NAVBASE Charleston during an emergency.

All emergency response operations and actions that may be necessary at NAVBASE Charleston shall be directed by the Navy and shall utilize Naval personnel and **properly trained civilians**. However, if the Navy requests assistance and that assistance can be provided without personal risk, personnel should cooperate as much as possible. If possible let others (E/A&H) know you are safe first, than assist.

Additional procedures that should be followed include:

- If a member of the field team experiences effects or symptoms of exposure while on the scene, the field crew will immediately halt work and act according to the instructions provided by the Site Supervisor or, in his absence, the SHSO.

- For applicable site activities, including all Level B activities, use wind indicators to continuously indicate downwind, preferred escape routes, from upwind routes.

- Investigate condition(s) suggesting that site conditions may be more hazardous than anticipated. The condition observed and the decisions made shall be recorded in the safety logbook, or in the field logbook if there is not a safety logbook being maintained. If there are doubts about how to proceed, suspend work and leave the work area until the PHSO has evaluated the situation and provided the appropriate instructions to the field team.

- If an accident occurs, the Site Supervisor is to complete an Accident Report Form (Appendix D) for submittal to the managing Principal-in-Charge of the project.

- If a member of the field crew suffers a personal injury, the SHSO will call **NAVBASE Fire Department 743-5333, or 743-5444** if an ambulance is needed. Next, alert appropriate emergency response agencies as the situation dictates. Complete an Accident Report Form for any such incident.

- If a member of the field crew suffers chemical exposure, flush the affected areas immediately with copious amounts of clean water, and if the situation dictates, the SHSO should alert appropriate emergency response agencies, or personally ensure that the exposed individual is transported to the nearest medical treatment facility for prompt

treatment. (See Appendix E for directions to the emergency medical facility.) An Accident Report Form will be completed for any such incident.

Directions to the nearest emergency medical facility capable of providing general emergency medical assistance and treating chemical burns are provided in Appendix E of this ZIHASP.

Emergency Contacts

If any situation or unplanned occurrence requires outside emergency, immediately call the appropriate contact from the following list:

Contact	Agency or Organization	Telephone
Joe Camp	Caretaker Site Office, Site Contact	(803) 743-9985
Matthew A. Hunt Brian Stockmaster	SOUTHDIV Engineers-in-Charge	(803) 820-5525 (803) 820-7481
Law Enforcement	NAVBASE Security	(803) 743-5555
Fire Department	NAVBASE Fire Department	(803) 743-5333
Ambulance Service	NAVBASE Ambulance	(803) 743-5444
Hospital	Charleston Naval Hospital* Roper Hospital North *	(803) 743-7000 (803) 744-2110
Southern Poison Control Center	———	(800) 922-1117
Todd Haverkost	EnSafe/Allen & Hoshall Task Order Manager	(803) 884-0029
John Borowski	EnSafe/Allen & Hoshall PHSO	(901) 372-7962
Ginny Gray	EnSafe/Allen & Hoshall Project Manager	(513) 248-8449

* Use Charleston Naval hospital for (potentially) life-threatening situations. For medical needs that are less urgent, the Naval Hospital will not provide service to civilians. Roper Hospital North is the next closest appropriate medical facility.

As soon as practical, the following shall be fully apprised of the situation: Joe Camp, Caretaker; Matthew Hunt and Brian Stockmaster, SOUTHDIV Engineer-in-Charge; Ginny Gray, E/A&H Project Manager; and John Borowski, E/A&H PHSO. Other persons, as appropriate, may also need to be contacted.

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4.25 Forms

The following forms will be used in implementing this Health and Safety Plan:

- Plan Acceptance Form
- Plan Feedback Form
- Exposure History Form
- Accident Report Form

A ZIHASP Plan Acceptance Form will be filled out by all employees working on the site before site activities begin. The Plan Feedback Form will be filled out by the SHSO and any other on-site employee who wishes to fill one out. The Exposure History Form will be completed by both the Field Project Manager and the individual(s) for whom the form is intended. Examples of each form are provided in Appendix D of this plan.

All completed forms must be returned to the Task Order Manager at EnSafe/Allen & Hoshall, Memphis, Tennessee.

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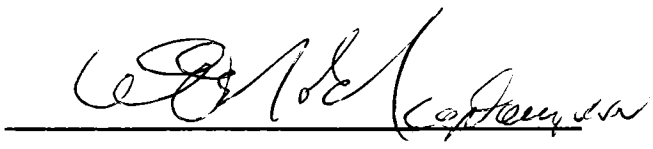
5.0 SIGNATORY REQUIREMENT

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

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



2/27/95

Commander,
Charleston Naval Shipyard

Date

6.0 REFERENCE LIST

Environmental and Safety Designs, Inc. March 26, 1993. *Preliminary RFI Field Activity Report (Soil Gas, Geophysics).*

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APPENDIX A
ZONE I SUMMARY

Table A.1 Zone I SWMU/AOC Summary				
SWMU Number	**SWMU Name**	**Investigative Approach**	**Work Plan Reference**	**Location**
12	Old Firefighter Training Area	RFI	Section 2.11	Southern Tip of Base
16	Paint Storage Bunker	RFI	Section 2.8	On Top of Bunker X-55
AOC Number	**AOC Name**	**Investigative Approach**	**Work Plan Reference**	**Location**
671	Former Building 3905G/Metering House	CSI	Section 2.1	North of Hobson Ave. and Near Pier Q
672	Building 126 Substation	CSI	Section 2.2	Building 126
673	Building 169 Paint and Oil Storehouse	CSI	Section 2.2	Building 169
675	Fuel Oil Storage (NS-4)	CSI	Section 2.3	Along Thompson Avenue
676	Former Incinerator	CSI (Investigate w/AOC 677)	Section 2.3	Area of Building NS-2
677	Building NS-2 Grounds	RFI	Section 2.3	Building NS-2
678	Former Building 2-V, Firefighting School	CSI	Section 2.4	Building NS-1 Area
679	Former Wash Rack	CSI	Section 2.4	Building NS-1 Area
680	Building NS-26 Brake Repair Area	CSI	Section 2.5	Building NS-26
681	Building 681 Blast Booth	RFI	Section 2.6	Building 681
685	Former Smoke Drum	CSI	Section 2.7	West of Juneau Avenue
687	Building X-55 Ammunition Storage	CSI	Section 2.8	Building X-55
688	Building X-56 Ammunition Storage	CSI	Section 2.9	Building X-56
689	Southern Tip of Base	RFI	Section 2.10	Southern Tip of Base
690	Dredge Materials Area Road	CSI	Section 2.12	South End of Base

Table A.2 Listing of Buildings with Associated SWMUs/AOCs (see Table A.1 for descriptions)	
Building Number	**Associated SWMU/AOC**
2-V (former)	AOC 678
126	AOC 672
169	AOC 673
681	AOC 681
3905-G (former)	AOC 671
NS-2	AOC 677
NS-4 (storage tank)	AOC 675
NS-26	AOC 680
X-55	AOC 687, SWMU 16
X-56	AOC 688

APPENDIX B
TREATMENT ALTERNATIVES

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls for contaminated groundwater	Groundwater Collection	Vertical Extraction Wells	Vertical wells are used to extract contaminated groundwater.	Use of aquifer Depth to water table Direction of flow Rate of flow Hydraulic conductivity (vertical and horizontal) Effective porosity Aquifer type Hydraulic gradient Identification of recharge and discharge areas Identification of aquifer boundaries Aquitard characteristics (Pilot - slug test)
To evaluate the feasibility and implementability of treatments for contaminated groundwater	Chemical Treatment	Ion Exchange	Ion exchange is the process of exchanging selected dissolved ionic contaminants with a set of substitute ions. Ion exchangers are primarily used for recovery of dilute solutions of metals or to soften water by removing calcium and manganese.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Bicarbonate Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Copper Iron Magnesium Manganese Nickel Oil and grease pH Potassium Sodium Sulfate Total Organic Carbon (TOC) Total Suspended Solids Zinc

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater	Chemical Treatment	Oxidation	Oxidation is a chemical reaction in which one or more electrons are transferred from the chemical being oxidized to an oxidizing agent. Chemical oxidation include destruction of cyanide; transformation of organics to biodegradable forms, or detoxification of organics and inorganics.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Bicarbonate Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Copper Iron Magnesium Manganese Nickel Oil and grease pH Potassium Sodium Sulfate Total Organic Carbon (TOC) Total Suspended Solids Zinc (Pilot - reagent consumption, optimal pH, and reaction time)

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater	Chemical Treatment	Metal Precipitation	Precipitation is a chemical unit process in which soluble metallic ions are removed from solution by conversion to an insoluble form. Precipitation is commonly used to treat heavy metals, phosphorus, and hardness.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Bicarbonate Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Copper Iron Magnesium Manganese Nickel Oil and grease pH Potassium Sodium Sulfate Total Organic Carbon (TOC) Total Suspended Solids Zinc (Pilot - chemical dosage, contact time, mixing rate, optimal pH, and sludge handling)
		pH Adjustment	Neutralizing agents are added to adjust pH.	Indicator Parameters Bicarbonate Calcium Chloride Iron Magnesium Manganese pH Potassium Sodium Sulfate Total Suspended Solids (Pilot - titration curve)

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater	Biological Treatment	Aerobic	Aerobic is the use of oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Metals, dissolved Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Total solids Specific conductance Sulfate Sulfide Suspended solids Temperature Volatile suspended solids

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater	Biological Treatment	Anaerobic	Anaerobic is the use of non-oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Metals, dissolved Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Total solids Specific conductance Sulfate Sulfide Suspended solids Volatile suspended solids

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater	Physical Treatment	Adsorption (Granular Activated Carbon)	Adsorption is a physical separation process in which organic and inorganic materials are removed by sorption or the attraction and accumulation of one substance on the surface of another.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids
		Air Stripping	Stripping refers to the removal of relatively volatile components from wastewater by passage of air, steam, or other gas through the contaminated liquid. Stripping is effective in removing ammonia, chlorinated solvents, monoaromatics, and other VOCs.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Chemical oxygen demand Hardness Iron Manganese Metals, dissolved Oil and grease pH

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater	Physical Treatment	Sedimentation	Sedimentation is a physical process that removes suspended solids from a liquid matrix by gravitational settling.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater	Physical Treatment	Filtration	Filtration is a physical process used to remove suspended solids from wastewater and is generally proceeded by chemical precipitation and neutralization.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatment for contaminated groundwater	Disposal	POTW	A chemical, physical, or biological wastewater treatment plant designed and constructed to treat municipal domestic wastewater.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatment for contaminated groundwater	Disposal	RCRA TSDF	The process of chemical, physically, or biologically treating the wastewater in an offsite permitted commercial hazardous waste facility.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids
		Land Application	The process of applying wastewater directly on the land to infiltration into the soil.	Depth to water table Total phosphorous Chloride Ammonia Nitrate Alkalinity pH Sodium Total dissolved solids soil type hydraulic conductivity application rate

Table B-1
Treatment Alternatives for Groundwater
AOC 671, 672, 673, 675, 676, 677, 678, 679, 681, 685, 688, 690, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatment for contaminated groundwater	Disposal	Injection	The process of hydraulicly placing wastewater into the aquifer using either vertical or horizontal wells.	Depth to water table Total phosphorous Chloride Ammonia Nitrate Alkalinity pH Sodium Total dissolved solids Total organic carbon soil type hydraulic conductivity application rate (2.5 gallons/ft^2/day or 5/square root of slowest percolation rate.

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfills Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA & SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

Table B-2
Treatment Alternatives for Surface Water Runoff/Soil/Sediment
AOCs 671, 672, 673, 688, 689, and 690

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls to prevent contact or runoff	Cap	Native Soil Single Barrier Double Barrier	This is the process of placing a physical horizontal barrier across the site.	Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Porosity Depth
	Excavation	Dig up	This is the process of physically removing the hot spot, soil, or waste from the site.	Organic/Inorganic Water Chemistry[d] Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Porosity Depth
	Surface Water Controls	Erosion and runon/runoff controls	System of vegetation and site grading for preventing soil erosion and stormwater runon/runoff.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Niitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Phosphorus Suspended solids
To evaluate the feasibility and implementability of treatments for contaminated soil	Thermal Treatment	Thermal Destruction	Thermal destruction is the process of oxidizing organic and inorganics using high temperature.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size BTU content TCLP
		Thermal Desorption	Thermal desorption is the process of using low temperature to volatilize organics and inorganics from a solid matrix.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size TCLP

Table B-2
Treatment Alternatives for Surface Water Runoff/Soil/Sediment
AOCs 671, 672, 673, 688, 689, and 690

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil	Biological Treatment	Aerobic	Aerobic is the use of oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Dissolved oxygen Methane Chemical Oxygen Demand
		Anaerobic	Anaerobic is the use of non-oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Methane Chemical Oxygen Demand
	Physical Treatment	Solidification/ fixation	Solidification is a physical process in which organic and inorganic materials are bound to the surface of another.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Suspended Solids Bulk Density Grain Size Analysis Atterberg Limits Cone Index Unconfined Compressive Strength Temperature pH

Table B-2
Treatment Alternatives for Surface Water Runoff/Soil/Sediment
AOCs 671, 672, 673, 688, 689, and 690

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil	Physical Treatment	Solvent Extraction	Solvent extraction is a physical separation process in which organic and inorganic materials are removed from the surface of a solid matrix to a liquid matrix.	Organic/Inorganic Water Chemistry[d] Total Organic Carbon Total Recoverable Hydrocarbons Moisture Content Soil Texture Permeability Bulk Density Grain Size Analysis Clay Content Temperature pH Chemical Oxygen Demand Cation Exchange Capacity Depth to groundwater TCLP
	Disposal	Consolidation	This is the process of consolidating the waste, soil, and other debris in a properly designed and constructed landfill.	Organic/Inorganic Water Chemistry[d] Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Depth to Groundwater TCLP
		RCRA TSDF	The process of chemical, physically, or biologically treating the contaminant, soil, and other debris in an offsite permitted commercial hazardous waste facility.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Dissolved oxygen TCLP

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfills Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA & SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

Table B-3
Treatment Alternatives for Soil Gas
AOC 671, 675, 676, 677, 689, SWMU 12, and SWMU 16

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls for subsurface gas	Cap	Native Soil Single Barrier Double Barrier	This is the process of placing a physical horizontal barrier across the site.	Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Porosity Depth
	Vent	Vertical Horizontal	Vertical or horizontal wells are used to vent gases.	Moisture Content Air Permeability Atterberg Limits Grain Size Analysis Porosity Depth
To evaluate the feasibility and implementability of treatments for contaminated soil gas	Thermal Treatment	Thermal Destruction	Thermal destruction is the process of oxidizing organic and inorganics using high temperature.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size BTU content TCLP
		Thermal Desorption	Thermal desorption is the process of using low temperature to volatilize organics and inorganics from a solid matrix.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size BTU content TCLP
	Physical Treatment	Carbon Absorption	Adsorption is a physical separation process in which organic and inorganic materials are removed by sorption or the attraction and accumulation of one substance on the surface of another.	Organic/Inorganic Water Chemistry (VOA & SVOA w/TICs, Pesticides, and PCBs) Moisture Content Temperature Total Organic Carbon

Table B-3
Treatment Alternatives for Soil Gas
AOC 671, 675, 676, 677, 689, SWMU 12, and SWMU 16

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil gas	Physical Treatment	Vacuum Extraction	Vacuum extraction refers to the removal of relatively volatile components from soil or waste by passage of air, steam, or other gas through the contaminated matrix. Stripping is effective in removing chlorinated solvents, monoaromatics, and other VOCs.	Organic/Inorganic Water Chemistry[d] Moisture Content Air Permeability Temperature pH Depth to groundwater
To evaluate the feasibility and implementability of treatments for contaminated soil gas	Disposal	RCRA TSDF	The process of chemical, physically, or biologically treating the contaminant in an offsite permitted commercial hazardous waste facility.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Dissolved oxygen TCLP

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfills Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA & SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

Table B-4
Treatment Alternatives for Soil/Sediment
AOCs 675, 676, 677, 681, 685, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls to prevent contact	Cap	Native Soil Single Barrier Double Barrier	This is the process of placing a physical horizontal barrier across the site.'	Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Porosity Depth
	Excavation	Dig up	This is the process of physically removing the hot spot, soil, or waste from the site.	Organic/Inorganic Water Chemistry[d] Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Porosity Depth
To evaluate the feasibility and implementability of treatments for contaminated soil/sediment	Thermal Treatment	Thermal Destruction	Thermal destruction is the process of oxidizing organic and inorganics using high temperature.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size BTU content TCLP
		Thermal Desorption	Thermal desorption is the process of using low temperature to volatilize organics and inorganics from a solid matrix.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size TCLP
	Biological Treatment	Aerobic	Aerobic is the use of oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Dissolved oxygen Methane Chemical Oxygen Demand

Table B-4
Treatment Alternatives for Soil/Sediment
AOCs 675, 676, 677, 681, 685, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil/sediment	Biological Treatment	Anaerobic	Anaerobic is the use of non-oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Methane Chemical Oxygen Demand
	Physical Treatment	Solidification/ fixation	Solidification is a physical process in which organic and inorganic materials are bound to the surface of another.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Suspended Solids Bulk Density Grain Size Analysis Atterberg Limits Cone Index Unconfined Compressive Strength Temperature pH
		Solvent Extraction	Solvent extraction is a physical separation process in which organic and inorganic materials are removed from the surface of a solid matrix to a liquid matrix.	Organic/Inorganic Water Chemistry[d] Total Organic Carbon Total Recoverable Hydrocarbons Moisture Content Soil Texture Permeability Bulk Density Grain Size Analysis Clay Content Temperature pH Chemical Oxygen Demand Cation Exchange Capacity Depth to groundwater TCLP

Table B-4
Treatment Alternatives for Soil/Sediment
AOCs 675, 676, 677, 681, 685, and SWMU 12

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil	Disposal	Consolidation	This is the process of consolidating the waste, soil, and other debris in a properly designed and constructed landfill.	Organic/Inorganic Water Chemistry[d] Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Depth to Groundwater TCLP
		RCRA TSDF	The process of chemical, physically, or biologically treating the contaminant, soil, and other debris in an offsite permitted commercial hazardous waste facility.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Dissolved oxygen TCLP

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfills Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA & SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

Table B-5
Treatment Alternatives for Surface Water Runoff/Soil
AOC 678 and AOC 679

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls to prevent contact	Cap	Native Soil Single Barrier Double Barrier	This is the process of placing a physical horizontal barrier across the site.	Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Porosity Depth
	Excavation	Dig up	This is the process of physically removing the hot spot, soil, or waste from the site.	Organic/Inorganic Water Chemistry[d] Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Porosity Depth
	Surface Water Controls	Erosion and runon/runoff controls	System of vegetation and site grading for preventing soil erosion and stormwater runon/runoff.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Niitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Phosphorus Suspended solids
To evaluate the feasibility and implementability of treatments for contaminated soil	Thermal Treatment	Thermal Destruction	Thermal destruction is the process of oxidizing organic and inorganics using high temperature.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size BTU content TCLP
		Thermal Desorption	Thermal desorption is the process of using low temperature to volatilize organics and inorganics from a solid matrix.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size TCLP

Table B-5
Treatment Alternatives for Surface Water Runoff/Soil
AOC 678 and AOC 679

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
	Biological Treatment	Aerobic	Aerobic is the use of oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Dissolved oxygen Methane Chemical Oxygen Demand
To evaluate the feasibility and implementability of treatments for contaminated soil	Biological Treatment	Anaerobic	Anaerobic is the use of non-oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Methane Chemical Oxygen Demand
	Physical Treatment	Solidification/ fixation	Solidification is a physical process in which organic and inorganic materials are bound to the surface of another.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Suspended Solids Bulk Density Grain Size Analysis Atterberg Limits Cone Index Unconfined Compressive Strength Temperature pH

Table B-5
Treatment Alternatives for Surface Water Runoff/Soil
AOC 678 and AOC 679

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
		Solvent Extraction	Solvent extraction is a physical separation process in which organic and inorganic materials are removed from the surface of a solid matrix to a liquid matrix.	Organic/Inorganic Water Chemistry[d] Total Organic Carbon Total Recoverable Hydrocarbons Moisture Content Soil Texture Permeability Bulk Density Grain Size Analysis Clay Content Temperature pH Chemical Oxygen Demand Cation Exchange Capacity Depth to groundwater TCLP
To evaluate the feasibility and implementability of treatments for contaminated soil	Disposal	Consolidation	This is the process of consolidating the waste, soil, and other debris in a properly designed and constructed landfill.	Organic/Inorganic Water Chemistry[d] Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Depth to Groundwater TCLP
		RCRA TSDF	The process of chemical, physically, or biologically treating the contaminant, soil, and other debris in an offsite permitted commercial hazardous waste facility.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Dissolved oxygen TCLP

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfills Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA & SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

Table B-6
Treatment Alternatives for Soil
SWMU 16

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls to prevent contact	Cap	Native Soil Single Barrier Double Barrier	This is the process of placing a physical horizontal barrier across the site.	Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Porosity Depth
	Excavation	Dig up	This is the process of physically removing the hot spot, soil, or waste from the site.	Organic/Inorganic Water Chemistry[d] Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Porosity Depth
To evaluate the feasibility and implementability of treatments for contaminated soil	Thermal Treatment	Thermal Destruction	Thermal destruction is the process of oxidizing organic and inorganics using high temperature.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size BTU content TCLP
		Thermal Desorption	Thermal desorption is the process of using low temperature to volatilize organics and inorganics from a solid matrix.	Organic/Inorganic Water Chemistry[d] Moisture Content Particle size TCLP
	Biological Treatment	Aerobic	Aerobic is the use of oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Dissolved oxygen Methane Chemical Oxygen Demand

Table B-6
Treatment Alternatives for Soil
SWMU 16

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil	Biological Treatment	Anaerobic	Anaerobic is the use of non-oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Methane Chemical Oxygen Demand
	Physical Treatment	Solidification/ fixation	Solidification is a physical process in which organic and inorganic materials are bound to the surface of another.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Suspended Solids Bulk Density Grain Size Analysis Atterberg Limits Cone Index Unconfined Compressive Strength Temperature pH
		Solvent Extraction	Solvent extraction is a physical separation process in which organic and inorganic materials are removed from the surface of a solid matrix to a liquid matrix.	Organic/Inorganic Water Chemistry[d] Total Organic Carbon Total Recoverable Hydrocarbons Moisture Content Soil Texture Permeability Bulk Density Grain Size Analysis Clay Content Temperature pH Chemical Oxygen Demand Cation Exchange Capacity Depth to groundwater TCLP

Table B-6
Treatment Alternatives for Soil
SWMU 16

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated soil	Disposal	Consolidation	This is the process of consolidating the waste, soil, and other debris in a properly designed and constructed landfill.	Organic/Inorganic Water Chemistry[d] Moisture Content Permeability In Situ Density Atterberg Limits Grain Size Analysis Depth to Groundwater TCLP
		RCRA TSDF	The process of chemical, physically, or biologically treating the contaminant, soil, and other debris in an offsite permitted commercial hazardous waste facility.	Organic/Inorganic Water Chemistry[d] Moisture Content Soil Texture Temperature pH Soil Microorganisms Total Nitrogen Total Phosphorus Depth to groundwater Dissolved oxygen TCLP

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfills Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA & SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls for contaminated groundwater and leachate	Vertical Barrier	Slurry Wall	Trench around site or hot spot and fill with bentonite slurry.	Organic/Inorganic Water Chemistry[d] Soil type Soil moisture Particle size distribution Porosity Hydraulic conductivity (saturated and unsaturated) Relative permeability Clay content Soil sorptive capacity Cation exchange capacity Organic carbon content Soil pH Depth to groundwater Groundwater velocity and direction Depth to aquitard (Pilot - Compatibility testing with slurry wall material)
	Groundwater Collection	Vertical Extraction Wells	Vertical wells are used to extract contaminated groundwater.	Use of aquifer Depth to water table Direction of flow Rate of flow Hydraulic conductivity (vertical and horizontal) Effective porosity Aquifer type Hydraulic gradient Identification of recharge and discharge areas Identification of aquifer boundaries Aquitard characteristics (Pilot - slug test)

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of controls for contaminated groundwater and leachate	Leachate Collection	Subsurface Drains	System of perforated pipe laid in trenches onsite to collect contaminated groundwater.	Use of aquifer Depth to water table Direction of flow Rate of flow Hydraulic conductivity (vertical and horizontal) Effective porosity Aquifer type Hydraulic gradient Identification of recharge and discharge areas Identification of aquifer boundaries Aquitard characteristics (Pilot - slug test)
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Chemical Treatment	Ion Exchange	Ion exchange is the process of exchanging selected dissolved ionic contaminants with a set of substitute ions. Ion exchangers are primarily used for recovery of dilute solutions of metals or to soften water by removing calcium and manganese.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Bicarbonate Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Copper Iron Magnesium Manganese Nickel Oil and grease pH Potassium Sodium Sulfate Total Organic Carbon (TOC) Total Suspended Solids Zinc

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Chemical Treatment	Oxidation	Oxidation is a chemical reaction in which one or more electrons are transferred from the chemical being oxidized to an oxidizing agent. Chemical oxidation include destruction of cyanide; transformation of organics to biodegradable forms, or detoxification of organics and inorganics.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Bicarbonate Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Copper Iron Magnesium Manganese Nickel Oil and grease pH Potassium Sodium Sulfate Total Organic Carbon (TOC) Total Suspended Solids Zinc (Pilot - reagent consumption, optimal pH, and reaction time)

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Chemical Treatment	Metal Precipitation	Precipitation is a chemical unit process in which soluble metallic ions are removed from solution by conversion to an insoluble form. Precipitation is commonly used to treat heavy metals, phosphorus, and hardness.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Bicarbonate Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Copper Iron Magnesium Manganese Nickel Oil and grease pH Potassium Sodium Sulfate Total Organic Carbon (TOC) Total Suspended Solids Zinc (Pilot - chemical dosage, contact time, mixing rate, optimal pH, and sludge handling)
		pH Adjustment	Neutralizing agents are added to adjust pH.	Indicator Parameters Bicarbonate Calcium Chloride Iron Magnesium Manganese pH Potassium Sodium Sulfate Total Suspended Solids (Pilot - titration curve)

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Biological Treatment	Aerobic	Aerobic is the use of oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Metals, dissolved Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Total solids Specific conductance Sulfate Sulfide Suspended solids Temperature Volatile suspended solids

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Biological Treatment	Anaerobic	Anaerobic is the use of non-oxygen utilizing micro-organisms to biodegrade contaminants.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Metals, dissolved Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Total solids Specific conductance Sulfate Sulfide Suspended solids Volatile suspended solids

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Physical Treatment	Adsorption (Granular Activated Carbon)	Adsorption is a physical separation process in which organic and inorganic materials are removed by sorption or the attraction and accumulation of one substance on the surface of another.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids
		Air Stripping	Stripping refers to the removal of relatively volatile components from wastewater by passage of air, steam, or other gas through the contaminated liquid. Stripping is effective in removing ammonia, chlorinated solvents, monoaromatics, and other VOCs.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Chemical oxygen demand Hardness Iron Manganese Metals, dissolved Oil and grease pH

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Physical Treatment	Sedimentation	Sedimentation is a physical process that removes suspended solids from a liquid matrix by gravitational settling.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Physical Treatment	Filtration	Filtration is a physical process used to remove suspended solids from wastewater and is generally proceeded by chemical precipitation and neutralization.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Disposal	POTW	A chemical, physical, or biological wastewater treatment plant designed and constructed to treat municipal domestic wastewater.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Disposal	RCRA TSDF	The process of chemical, physically, or biologically treating the wastewater in an offsite permitted commercial hazardous waste facility.	Organic/Inorganic Water Chemistry[d] Indicator Parameters Acidity-alkalinity Biochemical oxygen demand Calcium Chemical oxygen demand Chloride Dissolved oxygen Hardness Iron Metals, dissolved Manganese Nitrogen, ammonia Nitrogen, Kjeldahl Nitrogen, Nitrate-nitrite Oil and grease Organic carbon pH Phosphorus Sulfate Sulfide Suspended solids
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Disposal	Land Application	The process of applying wastewater directly on the land to infiltration into the soil.	Depth to water table Total phosphorous Chloride Ammonia Nitrate Alkalinity pH Sodium Total dissolved solids soil type hydraulic conductivity application rate

Table B-7
Treatment Alternatives for Groundwater/Leachate
AOC 689

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
To evaluate the feasibility and implementability of treatments for contaminated groundwater and leachate	Disposal	Injection	The process of hydraulicly placing wastewater into the aquifer using either vertical or horizontal wells.	Depth to water table Total phosphorous Chloride Ammonia Nitrate Alkalinity pH Sodium Total dissolved solids Total organic carbon soil type hydraulic conductivity application rate (2.5 gallons/ft^2/day or 5/square root of slowest percolation rate.

[a] USEPA *Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfills Sites*, EPA/540/P-91/001, Office of Solid Waste and Emergency Response Directive 9355.3-11, February 1991

[b] 40 Code of Federal Regulations (CFR) 268 Land Disposal Restriction

[c] USEPA *CERCLA Site Discharges to POTWs Treatability Manual*, EPA/540/2-90/007, Office of Solid Waste and Emergency Response, August 1990.

[d] VOA & SVOA w/TICs, Metals, Cyanide, Pesticides, and PCBs

APPENDIX C
PREVIOUS INVESTIGATION
SOUTHERN TIP OF THE BASE

CESAC-EN-PR : 3 August 1992

MEMORANDUM FOR RECORD

SUBJECT: Soil/Sediment Testing Results for the Shipyard River New Work Project, Charleston Harbor.

1. Soil and sediment samples were collected at 6 locations at the southern end of the U.S. Naval Base adjacent to Shipyard River. A copy of the results including a brief summary is attached.

2. None of the results appear unusual with the exception of the organotins and dioxin analyses. Information provided by Mr. David Moore of the Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, advises that of the organotins, the tributyltins are of most concern for toxicity with 0 - 3 ug/kg as background levels. Chemical analysis document that stations 1 - 4 exceed these levels with station 1 having the highest level at 49 ug/kg.

3. Results of the polynuclear aromatic hydrocarbons (PAH) and phthalate esters at station 1 are indefinite based on the higher detection limits which resulted from the presence of unidentified hydrocarbons.

4. Dioxin analysis was performed on samples collected from location 1 (hard, compact soil on high ground) and location 6 (fine grained mud from the intertidal zone). Various congeners were detected at both locations including 2,3,7,8-TCDD and 2,3,7,8-TCDF.

5. Based on the presence of tributyltins, the results of the dioxin analysis and the present position of the U.S. Environmental Protection Agency on disposal of dioxin contaminated soils/sediments, it does not appear that this material will be suitable for ocean disposal without additional testing to determine toxicity and bioaccumulation potential. Additionally, if the material is excavated/dredged and disposed of in an upland disposal area, the effluent from the disposal area should be monitored in order to verify that contaminants are not being transported into the receiving waters.

Robin Coller-Socha
Physical Scientist

SOIL COLLECTION AND TESTING FOR THE SHIPYARD RIVER NEW WORK PROJECT (CHARLESTON HARBOR), CHARLESTON, SOUTH CAROLINA, MAY 1992

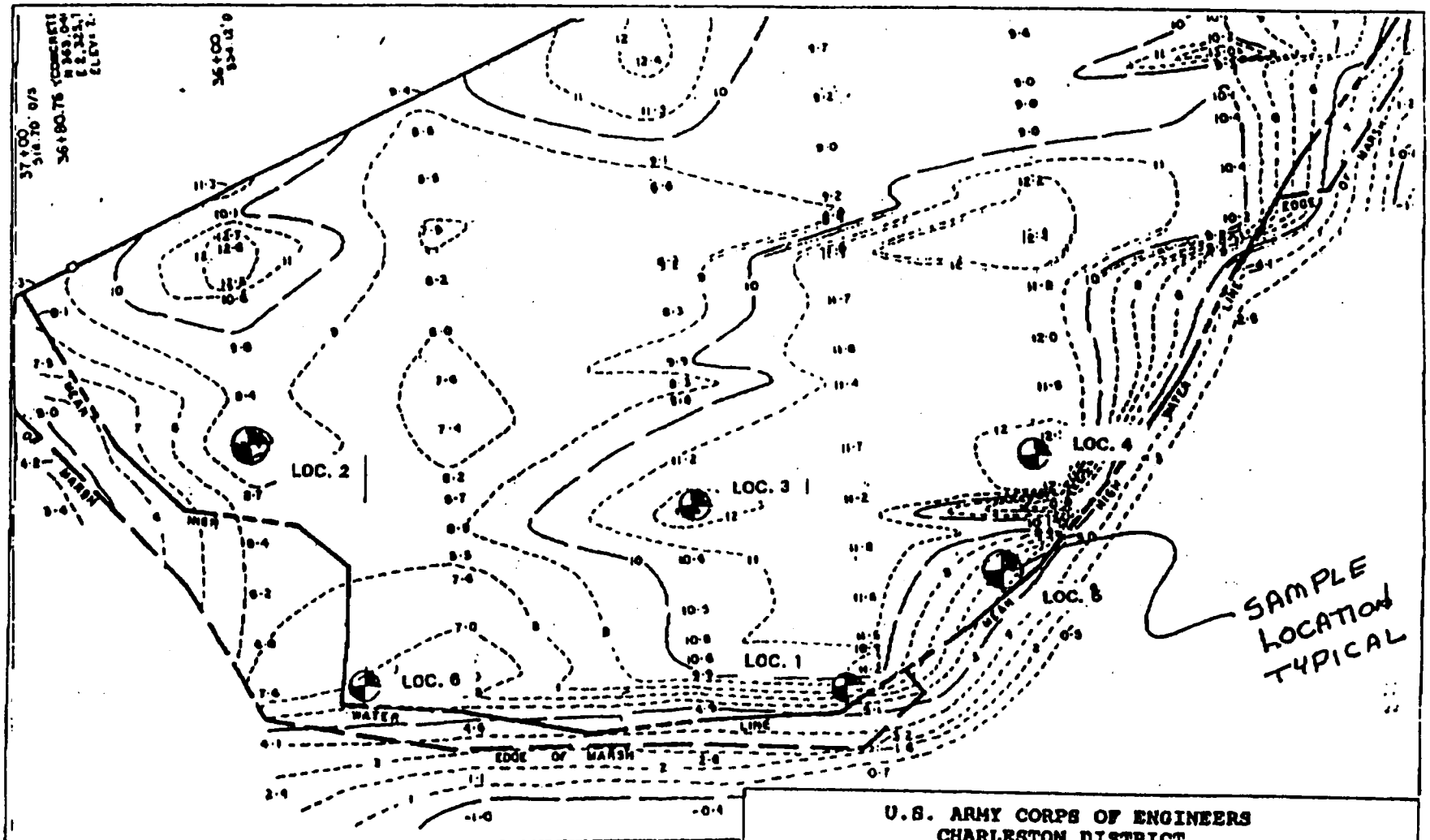
U. S. ARMY CORPS OF ENGINEERS,
CHARLESTON DISTRICT
CONTRACT NO. DACW60-92-M-0163

McCORD & STEFFEN

CHARLESTON, SOUTH CAROLINA

1.0 INTRODUCTION

As part of the assessment of upland soil contamination relative to dredge material for the Shipyard River New Work Dredging Project, near Charleston, South Carolina, the Charleston District Office of the U.S. Army Corps of Engineers contracted McCord & Steffen to collect and analyze soil samples during May, 1992. Samples of soils were collected from six sites at the Charleston Naval Station near the Shipyard River and analyzed for selected inorganic and organic pollutants to provide documentation, as requested by the Department of the Navy, that the material is suitable for disposal in Naval Station (NAVSTA), Charleston's south end spoil area. This report presents the specific methods used and the results obtained during the study.



U.S. ARMY CORPS OF ENGINEERS
CHARLESTON DISTRICT
SHIPYARD RIVER SITE, CHARLESTON HARBOR
MAY 1992

FIGURE 1-1

McCORD & STEFFEN CHARLESTON, SOUTH CAROLINA

2.0 METHODS AND MATERIALS

2.1 SAMPLING LOCATIONS

Six locations at the Shipyard River New Work site were sampled to characterize the soil quality in the vicinity of project (Figure 1-1). Sampling was conducted on May 15, 1992. Location 1 was located on high ground and consisted of very hard, compact soil. Location 2 was sampled in a relatively low area of soft, wet marsh. Location 3 was sampled in wetland woods. Soils at Location 3 were richly organic and wet. Location 4 was sampled in woods and contained relatively dry soils. Location 5 was near the shoreline of Shipyard River and contained wet, sandy soils. Sampling at Location 6 was conducted during low tide in the intertidal zone. Soils at Location 6 consisted of fine grained mud.

2.2 SOIL QUALITY

Soil samples were collected at each location for analyses of selected inorganic and organic pollutants. Each sample consisted of four aliquots (one for metals, one for volatile organics, one for dioxin, and one reserved as a back-up) taken from a composite consisting of three separate replicates per location. Samples for dioxin analyses were collected from Locations 1 and 6, only. Individual replicates were collected from one, two, and three foot depths at each location. The composite samples were collected at each location by creating a hole using at standard, manual, post-hole digger. The walls of the hole were lightly scraped with a stainless steel trowel to eliminate contamination from the post-hole digger. Each of the three replicates of a composite was collected by removing approximately 1L of soil. Each replicate (the individual depths) was placed in a stainless steel container and the composite was mixed thoroughly before the aliquots were removed. Between locations, the trowel and the mixing container were washed and rinsed, in order, with hydrochloric acid, acetone, and de-ionized water. Each aliquot (sample) was placed in a glass container designed to meet the quality control requirements for priority pollutant and dioxin testing, placed on ice, and shipped to the laboratory for analysis. Laboratory analyses for dioxins were performed by Triangle Laboratories, Inc., Durham,

North Carolina. Organotins analyses were performed by Dr. James Byrd, Department of Environmental and Chemical Engineering, Armstrong College, Savannah, Georgia. Analyses of all other metals and organic parameters were performed by Rogers & Callcott Engineers, Inc., Greenville, South Carolina. All collection, handling, and analytical procedures conformed to those presented by USEPA (1982 and 1990) and Stephenson and Smith (1988).

3.0 RESULTS

The results of soil analyses are presented in Tables 3-1 through 3-3. Results of heavy metals analyses indicated relatively consistent levels for each metal. None appeared to be unusually high. Organotin values varied among locations with Location 1 containing the highest values. Mono-, di-, and tributyltin levels at Location 1 were 81, 15, and 49 micrograms per kilogram, respectively.

No pesticides or PCB,s were detected from the six locations. Results of Polynuclear Aromatic Hydrocarbons (PAHs) indicated that Benzo(a)Anthracene, Benzo(a,e)Pyrene, Benzo(g,h,i,)Perylene, Benzo(b)/(k)Fluoranthene, Chrysene, Fluoranthene, Indo(1,2,3-c,d)Pyrene, and Pyrene were present at Locations 3 and 4. None of these PAHs was reported from the other locations. No phenols or substituted phenols were reported from the study area. Phthalate esters were found in soils from Locations 1, 3, and 5. The detection limits for PAHs and phthalate esters from Location 1 were increased due to the presence of unidentified hydrocarbons. The original sample from Location 1 was visually inspected but did not appear to contain any obvious contamination. The samples were re-extracted but the hydrocarbon continued to come over during the extraction procedure.

Polychlorinated dibenzodioxins and dibenzofurans (dioxins) were detected in soils from both Locations 1 and 6. 2,3,7,8-TCDD was found at Locations 1 and 6 at levels of 1.3 ppt and 1.9 ppt, respectively. 2,3,7,8-TCDF was found at Locations 1 and 6 at levels of 1.8 ppt and 2.7 ppt, respectively. A complete listing of all dioxin conagers is presented in Table 3-3.

TABLE 3-1

RESULTS OF HEAVEY METALS ANALYZED IN SOILS COLLECTED FROM THE SHIPYARD RIVER SITE, CHARLESTON, SOUTH CAROLINA, MAY 15, 1992. EXCEPT FOR THE ORGANOTINS, ALL RESULTS ARE EXPRESSED AS MILLIGRAMS PER KILOGRAM (mg/kg) DRY WEIGHT. ORGANOTINS ARE EXPRESSED AS MICROGRAMS PER KILOGRAM.

	Location					
Parameter	1	2	3	4	5	6
Antimony	1.4	1.6	2.1	2.0	2.0	1.2
Arsenic	14	19	12	13	5.6	9.8
Cadmium	3.1	3.7	4.4	2.9	0.99	1.7
Chromium	37	45	44	42	34	36
Copper	23	29	27	20	7.8	10
Lead	28	32	30	17	5.8	6.3
Mercury	0.21	0.26	0.22	0.24	0.09	0.07
Nickel	14	16	17	16	11	14
Selenium	<0.20	0.25	0.97	<0.20	0.71	<0.20
Silver	1.0	0.64	0.74	1.2	2.3	1.9
Thallium	21	16	18	20	27	26
Zinc	93	110	100	72	28	40
Monobutyltin[a]	81	57	45	44	30	26
Dibutyltin[a]	15	9.5	7.7	4.4	4.4	4.6
Tributyltin[a]	49	11	7.7	5.2	2.6	3.6

[a] Results expressed as micrograms per kilogram.

TABLE 3-2

RESULTS OF ORGANICS (PESTICIDES, POLYNUCLEAR AROMATIC HYDROCARBONS, PHENOLS, PHENOLS, AND PHTHALATE ESTERS) ANALYZED FROM SOILSCOLLECTED FROM THE SHIPYARD RIVER SITE, CHARLESTON, SOUTH CAROLINA, MAY 15, 1992. ALL RESULTS ARE EXPRESSED AS MICROGRAMS PER KILOGRAM (µg/kg) DRY WEIGHT.

	Location					
Parameter	1[a]	2	3	4	5	6
Aldrin	<10	<10	<10	<10	<10	<10
Chlordane	<10	<10	<10	<10	<10	<10
Dieldrin	<10	<10	<10	<10	<10	<10
4,4-DDD	<10	<10	<10	<10	<10	<10
4,4-DDE	<10	<10	<10	<10	<10	<10
4,4-DDT	<10	<10	<10	<10	<10	<10
Endosulfan I	<20	<20	<20	<20	<20	<20
Endosulfan II	<20	<20	<20	<20	<20	<20
Endosulfan Sulfate	<20	<20	<20	<20	<20	<20
Endrin	<10	<10	<10	<10	<10	<10
Endrin Aldehyde	<10	<10	<10	<10	<10	<10
Heptachlor	<20	<20	<20	<20	<20	<20
Heptachlor Epoxide	<20	<20	<20	<20	<20	<20
Toxaphene	<10	<10	<10	<10	<10	<10
PCB's	<10	<10	<10	<10	<10	<10
Acenaphthene	<600	<30	<30	<30	<30	<30
Acenaphthylene	<600	<30	<30	<30	<30	<30
Anthracene	<600	<30	<30	<30	<30	<30
Benzo(a)Anthracene	<600	<30	77	40	<30	<30
Benzo(a,e)Pyrene	<600	<30	68	51	<30	<30
Benzo(g,h,i)Perylene	<600	<30	49	<30	<30	<30
Benzo(b)/(k)Fluoranthene	<600	<30	160	110	<30	<30
Chrysene	<600	<30	87	47	<30	<30
Dibenzo(a,h)Anthracene	<600	<30	<30	<30	<30	<30

TABLE 3-2 (CONTINUED)

Parameter	Location 1	2	3	4	5	6
Fluoranthene	<600	<30	66	47	<30	<30
Fluorene	<600	<30	<30	<30	<30	<30
Indo(1,2,3-c,d)Pyrene	<600	<30	52	30	<30	<30
Methylnapthalene	<600	<30	<30	<30	<30	<30
Naphthalene	<600	<30	<30	<30	<30	<30
Phenanthrene	<600	<30	<30	<30	<30	<30
Pyrene	<600	<30	140	50	<30	<30
Phenol	<1200	<100	<100	<100	<100	<100
2,4-Dimethylphenol	<1200	<100	<100	<100	<100	<100
2,4,6-thrichlorophenol	<1200	<100	<100	<100	<100	<100
Para-chloro-meta-cresol	<1200	<100	<100	<100	<100	<100
2-chlorophenol	<1200	<100	<100	<100	<100	<100
2,4-dichlorophenol	<1200	<100	<100	<100	<100	<100
2-nitrophenol	<1200	<100	<100	<100	<100	<100
4-nitrophenol	<1200	<100	<30	<100	<30	<30
2,4-dinitrophenol	<1200	<100	<30	<100	<30	<30
4,6-dinitro-o-cresol	<1200	<100	<30	<100	<30	<30
Pentachlorophenol	<1200	<100	<30	<100	<30	<30
Dimethyl Phthalate	<600	<30	<30	<30	<30	<30
Diethyl Phthalate	<600	<30	<30	<30	<30	<30
Di-n-Butyl phthalate	<600	<30	<30	<30	<30	<30
Butyl Benzyl Phthalate	<600	<30	<30	<30	<30	<30
Bis (2-Ethyl Hexyl) Phthalate	9700	<30	170	<30	110	<30
Di-b-Octylphthalatae	<600	<30	35	<30	<30	<30

[a] Results from Location 1 subject to hydrocarbon interference.

TABLE 3-3

RESULTS OF POLYCHLORINATED DIBENZODIOXINS AND DIBENZOFURANS ANALYZED IN SOILS COLLECTED FROM THE SHIPYARD RIVER SITE, CHARLESTON, SOUTH CAROLINA, MAY 15, 1992. RESULTS ARE EXPRESSED AS CONCENTRATION IN PARTS PER TRILLION (ppt) DRY WEIGHT.

Parameter	Location	
	1	6
2,3,7,8-TCDD	1.3	1.9
1,2,3,7,8-PeCDD	2.0	1.4
1,2,3,4,7,8-HxCDD	2.8	2.4
1,2,3,6,7,8-HxCDD	3.4	EMPC
1,2,3,7,8,9-HxCDD	10.4	9.4
1,2,3,4,6,7,8-HpCDD	148 (B)	127 (B)
OCDD	2390 (B)	2110 (B)
2,3,7,8-TCDF	1.8	2.7
1,2,3,7,8-PeCDF	1.0	ND
2,3,4,7,8-PeCDF	EMPC	ND
1,2,3,4,7,8-HxCDF	EMPC	ND
1,2,3,6,7,8-HxCDF	ND	ND
2,3,4,6,7,8-HxCDF	ND	0.68
1,2,3,7,8,9-HxCDF	ND	ND
1,2,3,4,6,7,8-HpCDF	10.4	1.5
1,2,3,4,7,8,9-HpCDF	ND	ND
OCDF	16.9	4.0
Total TCDD	26.7	43.6
Total PeCDD	56.5	50.8
Total HxCDD	312	259
Total HpCDD	572	512
Total TCDF	5.2	6.1
Total PeCDF	7.1	1.4
Total HxCDF	7.3	0.63
Total HpCDF	18.0	2.0

TABLE 3-3 (CONTINUED)

B	This indicates that the analyte is found in the associated laboratory method blank sample as well as in the field sample. This is to warn the reader to the possible/probable blank contamination. The possible/probable contamination levels fall within the acceptable QA/QC limits for reporting, however.

4.0 REFERENCES CITED

U. S. Environmental Protection Agency. 1983. Methods for chemical analyses for water and wastes. U. S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, Ohio.

U. S. Environmental Protection Agency. 1990. Test methods for evaluating solid waste (3rd ed), SW-846. U. S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D. C.

Stephenson, M.D. and D.R. Smith. 1988. Determination of tributyltin in tissues and sediments by graphite furnace atomic absorption spectrometry. Anal. Chem. 60(7) 696-702.

APPENDIX D
HEALTH AND SAFETY PLAN FORMS

PLAN FEEDBACK FORM

Problems with plan requirements:

Unexpected situations encountered:

Recommendations for revisions:

PLAN ACCEPTANCE FORM

PROJECT HEALTH AND SAFETY PLAN

INSTRUCTIONS: This form is to be completed by each person working on the project site and returned to: EnSafe/Allen & Hoshall, Memphis, Tennessee.

Job No: 0029 - 00104

Contract No: N62467-89-D-0318

Project: Zone I - Naval Base Charleston

I have read and understand the contents of the above plan and agree to perform my work in accordance with it.

_____

Signed

_____

Print Name

_____

Company

_____

Date

ACCIDENT REPORT FORM

SUPERVISOR'S REPORT OF ACCIDENT	DO NOT USE FOR MOTOR VEHICLE OR AIRCRAFT ACCIDENTS
TO	FROM TELEPHONE (Include area code)
NAME OF INJURED OR ILL WORKER AND COMPANY	
WORKER'S SOCIAL SECURITY NUMBER	

DATE OF ACCIDENT	TIME OF ACCIDENT	EXACT LOCATION OF ACCIDENT

NARRATIVE DESCRIPTION OF ACCIDENT

NATURE OF ILLNESS OR INJURY AND PART OF BODY INVOLVED	LOST TIME YES ☐ NO ☐

PROBABLE DISABILITY (Check one)

FATAL ☐	LOST WORK DAY WITH ____DAYS AWAY FROM WORK	LOST WORK DAY WITH ____DAYS OF RESTRICTED ACTIVITY	NO LOST WORK DAY ☐ FIRST-AID ONLY ☐

CORRECTIVE ACTION RECOMMENDED (By whom and by when)

NAME OF SUPERVISOR	TITLE
SIGNATURE	DATE

APPENDIX E
DIRECTIONS TO EMERGENCY MEDICAL FACILITIES

DIRECTIONS TO THE CHARLESTON NAVAL HOSPITAL

The nearest hospital to the site is the Charleston Naval Hospital. This hospital should be used for all life threatening medical emergencies. For other medical services please use Baker Hospital.

Nearest Hospital

Charleston Naval Hospital
McMillan Avenue
Charleston, South Carolina

Emergency Room Telephone Number:	(803) 743-7011
General Information Number:	(803 743-7000

Directions to Charleston Naval Hospital From Main Gate of the Charleston Naval Shipyard:

1) Refer to following map to the Charleston Naval Hospital.

2) Exit Naval Base via the Main Gate (McMillan Gate).

3) Proceed west, toward Rivers Avenue.

4) At the intersection of McMillan and Rivers, the hospital is on the left.
   - Hospital entrance is just before the intersection.
   - Hospital is approximately 1/2-mile from the Main Gate.