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FINAL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION ZONE C WORK PLAN PAGE CHANGES REVISION NUMBER 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 C WORK PLAN
PAGE CHANGES, REVISION NO: 01

Prepared for:

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

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April 10, 1996

Release of this document requires the prior notification of the Commanding Officer of the Naval Base Charleston, Charleston, South Carolina.

Record of Changes to the Final Zone C RFI Work Plan Naval Base Charleston		
Page(s)	**Change/Revision**	**Reason for Change**
i to vi	Table of Contents: Resubmit entire TOC.	Table of Contents had to be revised to incorporate the addition of Sections 2.7, 2.8, 4.9, and 4.10.
1-3	Modified Figure 1-1.	Include AOCs 522 and 700 on the Zone C SWMU/AOC Location Map.
2-3	Modified Figure 2-1.	Modified drawing to include proposed sampling locations for AOCs 522 and 700.
2-10, 2-19, 2-26, 2-32, 2-38 & 2-45	Under the matrix column of the table " was changed to ' .	Change made to indicate feet.
2-59	Modified last sentence of the first paragraph.	Change made for presentation purposes.
2-59 to 2-70	Addition for two site descriptions and investigative approaches: Sections 2.7 and 2.8.	Include two sites requiring either a CSI or RFI in the investigation.
2-61	Modified last sentence of first paragraph.	Clarified that sanitary and storm sewer utilities are to be investigated in Zone L.
2-61	Modified last sentence of this page.	Clarified that the number of samples and sample locations proposed are for AOC 522.
2-63	Modified Figure 2-13.	Changed drawing to include proposed sampling locations for AOC 522.
2-68	Modified the third line of the first paragraph.	Clarified that the number of samples and sample locations proposed are for AOC 700.
2-69	Modified Figure 2-14.	Changed drawing to include proposed sampling locations and topographical relief for AOC 700.
4-1 to 4-56	Resubmit entire Section 4.	Reflect corrections to page and section references due to AOCs 522 and 700 section additions.
4-19	Modified last sentence of the first paragraph.	Change made for presentation purposes.
4-19 to 4-24	Addition for two Site Specific Heath and Safety Plans: Sections 4.9 and 4.10.	Include two sites requiring either a CSI or RFI in the investigation.

f 9/3/96

FILING INSTRUCTIONS

The following is a list of pages in the *Final Zone C 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 Content of *Final Zone C Work Plan*.

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

List of Changes/Revisions	Remove Pages	Replace Pages
Table of Contents - updated.	i - vi	i - vi
Section 2.0 - Text change as are highlighted.	2-9 to 10, 2-19 to 20, 2-25 to 26, 2-31 to 32, 2-37 to 38, & 2-45 to 46	Same as Removed
Section 2.0 - Added Sections 2.7 and 2.8	—	2-59 - 2-70
Section 4.0 - Updated Section 4.0. Text changes are highlighted.	4-1 - 4-52	4-1 - 4-56
Section 4.0 - Added Sections 4.9 and 4.10	—	4-19 - 4-24

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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 for Zone C at Naval Base Charleston (NAVBASE). This work plan addresses sampling and analysis requirements specific to the sites within Zone C and is intended to be used in conjunction with the *Final Comprehensive RFI Work Plan* prepared for NAVBASE by EnSafe/Allen & Hoshall (E/A&H). The Solid Waste Management Units (SWMU) and Areas of Concern (AOC) to be investigated within Zone C are described in Appendix A and illustrated on Figure 1-1.

1.1 Environmental Settings

Physiography

Zone C is in the western portion of the base, bordered by McMillan Avenue to the south, Avenue D to the northeast, Hobson Avenue to the east, St. Johns Avenue to the west, and the NAVBASE boundary to the northwest. Figure 1-2 identifies the boundaries of Zone C 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*. Due to past and present activities, surface conditions within Zone C have been extensively disturbed throughout the years. However, most of Zone C is native soil comprising fine-grained silts, silty sands, and clays. A small portion of the northern section of Zone C is not native soil, as Figure 1-3 shows.

Climatology

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

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SWMU #44
COAL
STORAGE
AREA

SWMU #47
BURNING
DUMP

AOC #512
INCINERATOR
BLDG. (67)

AOC #516
BLDG. 233
WASH AREA

AOC #515
BLDG. 51
INCINERATOR

AOC #513
OLD
MORGUE

AOC #510
BLDG. NH-21
GEOTECHNICAL
LABORATORY

AOC #508
INCINERATOR
(19)

AOC #511
OIL
HOUSE

AOC #517
BLDG. M-192
FIRING RANGE

AOC #520
BLDG. M-1051
GARBAGE HOUSE

AOC #519
BLDG. 1081
BOILERHOUSE

AOC #518
COAL BINS

AOC #523
BLDG. M-1234
GAS STATION
STORAGE

AVENUE "D"

McRITCHIE AVE

PARSONS ST

AVENUE "H"

AVENUE "G"

AVENUE "F"

AVENUE "E"

AVENUE "C"

ST JOHNS AVENUE

SECOND STREET

MARINE AVE

COMMISSARY STREET

YORAN PLACE

SEABOARD COASTLINE RR

OPEN STORAGE

BOILER HOUSE

N

1972.3 ° 00' WEST

LEGEND

CSI – CSI

RFI – RFI

300 0 300 600 900

GRAPHIC SCALE

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

FIGURE 1-1
SWMU/AOC LOCATION MAP
CHARLESTON, SOUTH CAROLINA

Dr by: E/A&H		Tr by:	
Ck by: D.Niesse		App by:	Sheet 1
Date: 02/20/95	DWG Name: 29AOCSMU		Of 1

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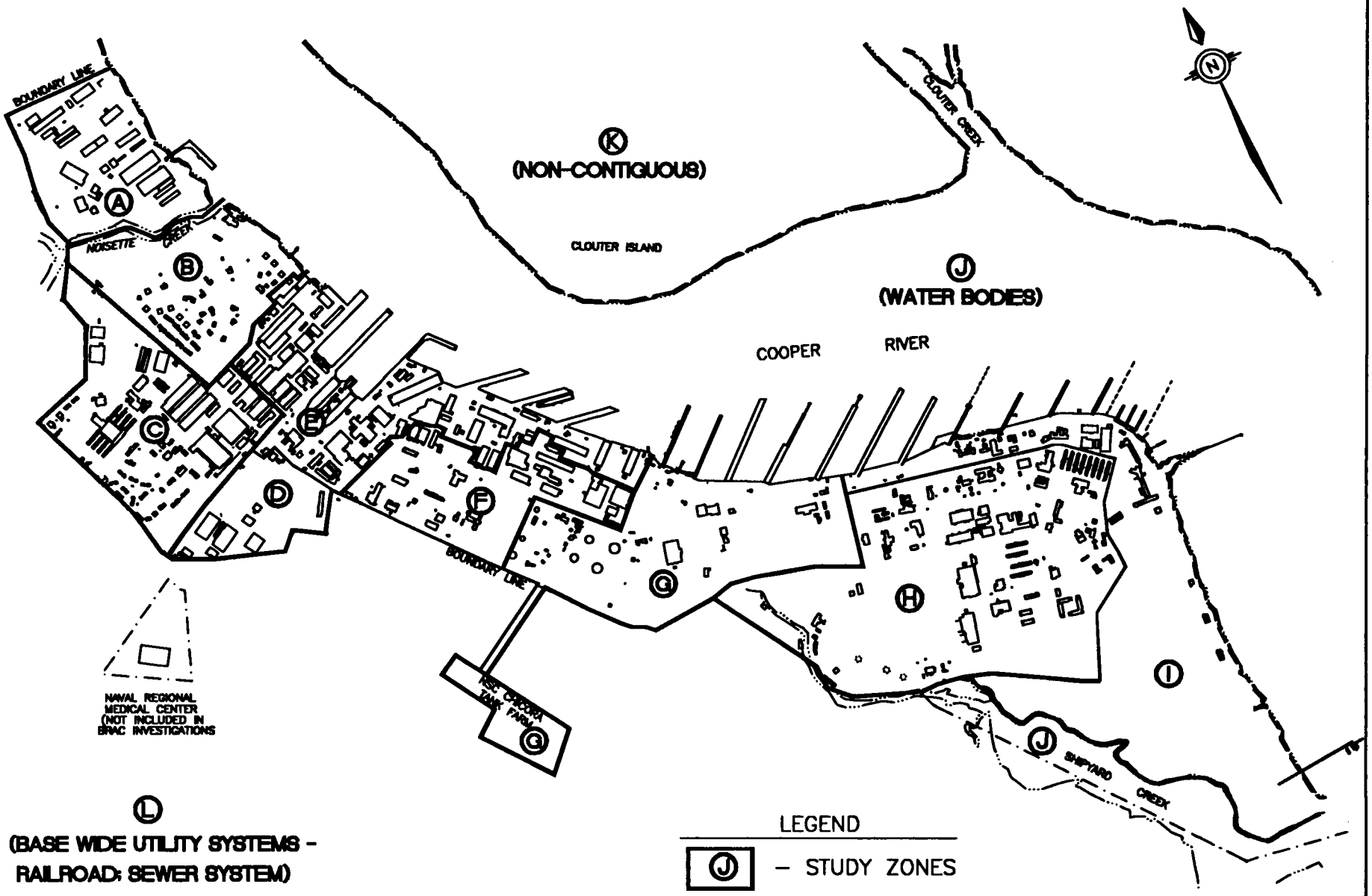

FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 1-2
ZONE BOUNDARIES

DWG DATE: 02/22/95 | DWG NAME: 029ZONE

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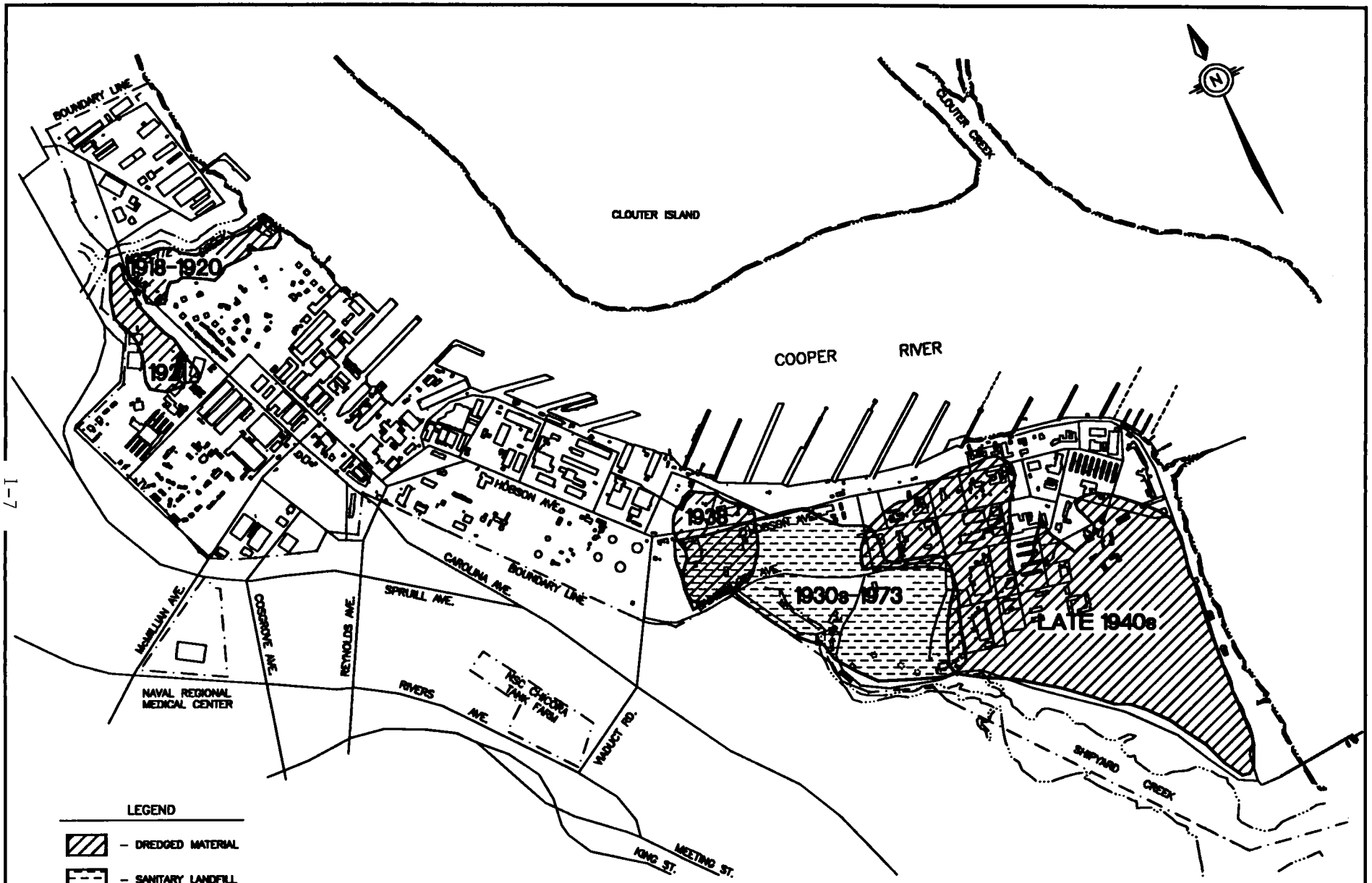

FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 1-3
NAVBASE FILL AREAS

DWG DATE: 02/22/95 | DWG NAME: 29FILCH1

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1.2 Investigative Strategy

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

Central to this idea is a phased approach to data collection that will ultimately identify contaminants of potential concern (COPCs) (if present), define nature and extent of contamination, and collect data supporting 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. To determine if additional sampling not specified in this work plan is needed, the 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 concentration will be required which will require onsite and offsite data collection. Background, migration pathways, human and ecological receptors, and PRGs are discussed in Section 1, Volume III of the *Final Comprehensive Work Plan*. Sampling will continue until extent is determined, which is defined for this investigation as the horizontal and vertical area in which the concentrations of COPCs in the investigated media are above either PRGs or background concentrations, whichever is appropriate.

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's goals. An RFI report and Baseline Risk Assessment (BRA) will be generated as each zone investigation concludes, and a Final RFI report and Final RFI BRA will address NAVBASE as a single entity once all zone investigations are completed.

The proposed schedule for conducting the Zone C investigation is included in the *Corrective Action Management Plan* (CAMP) prepared for the NAVBASE RFI. Scheduling activities during the Zone C investigation will be closely coordinated with U.S. Environmental Protection Agency (EPA) Region IV and South Carolina Department of Health and Environmental Control (SCDHEC).

1.3 Other Relevant Investigations

Because the Zone C investigation is part of a larger investigation strategy, some pathways included for investigation in Volume III, *Final Comprehensive RFI Work Plan* which may be relevant to this investigation will be considered in other investigations. Sediment and surface water sampling of Noisette Creek is proposed in this plan to identify point sources. Measures of potential impacts will be addressed within the Zone J investigation. The sewer systems will be addressed in the Zone L investigation. Groundwater flow and hydrology are dependent upon basewide conditions. Information gathered in this investigation will contribute to characterizing groundwater, but will not fully characterize all groundwater processes. Because most of Zone C is native soil, it may be feasible, once the analytical data have been reviewed, to designate some onsite areas as representive of background. An offsite investigation to determine background concentrations for some chemicals relevant to the Zone C Work Plan may be conducted as part of the *Final Comprehensive RFI Work Plan*. Finally, the results from other investigations may influence the scope of work proposed in this plan. The results of the investigations discussed above will be necessary in order to fully understand the significance of the results of the proposed investigation within Zone C.

2.0 SWMU- AND AOC-SPECIFIC INVESTIGATORY APPROACH

The SWMUs and AOCs in Zone C requiring either Confirmatory Sampling Investigation (CSI) or RFI activities, as determined in the *Draft Final RCRA Facility Assessments* (RFAs), Vol. I and II, November 1994, are presented in the following sections and shown on the Proposed Sampling Locations Map which follows as Figure 2-1. Tables A-1 and A-2 (found in Appendix A) are references indicating the location of each site within Zone C, the proximity to existing structures, and site investigative approach as proposed by the RFA. The sites identified may not represent all hazardous waste activity that has occurred in Zone C, therefore the systematic grid sampling plan outlined in Section 3 will help identify any sites that have not been identified in the RFA process. The investigation in Zone C will be based upon the strategy outlined in the *Final Comprehensive RFI Project Management Plan,* August 1994.

Radiological Potential

The Charleston Naval Shipyard (CNSY) Radiological Control Office has determined there are a number of sites within Zone C 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 EPA and SCDECH. These surveys are described in separate work plans and reports.

Contractor sampling at any point within Zone C 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 C, 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 EnSafe/Allen & Hoshall (E/A&H) sampling schedules by adjusting survey schedules with reasonable advanced notification.

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AOC #700

AOC #516

SWMU #44

SWMU #47

AOC #512

AOC #515

AOC #510

AOC #523

AOC #522

AOC #508

AOC #518

AOC #520

AOC #517

AOC #511

AOC #513

AOC #519

NOISETTE CREEK

DRAINAGE DITCH

SURFACE RUNOFF

COAL PILE APPROX. BOUNDARY

OPEN STORAGE

STORAGE

McCRITCHIE AVE

AVENUE "E"

AVENUE "D"

PARSONS

SECOND

YORAN PLACE

JOHNS AVENUE

SEABOARD COASTLINE RR

N 1972 3° 00' WEST

LEGEND

- ▲ – SURFACE WATER & SEDIMENT SAMPLE
- ● – SOIL BORING TO BE COMPLETED AS A GROUNDWATER MONITORING WELL
- ● – SOIL BORING

200 0 200 400 600
GRAPHIC SCALE

REVISION		
Rev Number: 001	Rev Date: 04/05/96	Added AOCs 522 AND 700. (JLM)
Rev Number: 000	Rev Date: 00/00/00	
Rev Number: 000	Rev Date: 00/00/00	
Rev Number: 000	Rev Date: 00/00/00	

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

FIGURE 2-1
PROPOSED SAMPLING LOCATIONS WITHIN ZONE C
CHARLESTON, SOUTH CAROLINA

Dr by:	Tr by:	
Ck by:	App by:	Sheet 1
Date: 04/05/96	DWG Name: 29SAMLOC	Of 1

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2.1 SWMU 44, Coal Storage Area

SWMU 44, an active coal pile designated for an RFI, is in the northern portion of Zone C with drainage ditches to the west and Noisette Creek and wetlands to the north. Table 2-1 describes SWMU 44.

Table 2-1
SWMU 44
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways
SWMU 44 COAL PILE	The coal storage yard began operations in the 1940s and is used for unloading coal railcars and for the intermediate storage of coal before use at the steam-generation plant (Building 32). The coal pile is currently 80' x 400'.*	Coal Coal Derivatives (Metals)	Air **Soil** **Sediment** **Groundwater** **Surface Water** **Soil Gas**

Notes:
* Described in the Draft Final RCRA Facility Assessment, Vol. I, November 1994
Pathways scheduled for sampling are bold.

2.1.1 Previous Investigations

Previous investigations conducted at SWMU 44 have focused on sampling surface water and surface water runoff. Previous sampling events detected the presence of metals and total suspended solids (TSS) in the surface water and surface water runoff. Table 2-2 lists the previous investigations and analytical results for SWMU 44. Based on review of the analytical data, analyses for inorganics and general water quality have been conducted at SWMU 44. Maps identifying previous sample locations have been found for the February 23 and 24, 1983, and October 22 to November 1, 1985, sampling events. A map identifying these previous sampling locations can be found in Appendix B, Location Maps from Previous Investigations.

Table 2-2
SWMU 44
Previous Investigations

Previous Investigations	Analytical Results
Date: September 2, 1981 Type: Pooled leachate sample	pH (3.0) Phenol (0.004 parts per million [ppm])
Date: September 7, 1981 Type: Storm water runoff sample	pH (2.5) Chloride (4.5 ppm) Cd (0.005 ppm) Zn (0.202 ppm) Cu (0.05 ppm) Ni (0.12 ppm) phenol (0.11 ppm) Total Solids (TS) (1,482 ppm) TSS (158 ppm) Biological Oxygen Demand (BOD5) (1.5 ppm) Cr (0.04 ppm)(Total) Hg (0.0002 ppm) Pb (95.0 ppm) Ag (0.01 ppm) Cr VI (0.04 ppm) Chemical Oxygen Demand (COD) (265 ppm)
Date: February 23, 1983 Type: Storm water runoff sample Location: Depressions within the drainage area downgradient of the coal pile	pH (2.5) TSS (<50 ppm)
Date: February 24, 1983 Type: Soil sample Location: Intersection of drainage ditch and Noisette Creek	pH (8.0) Chloride (1.5 micrograms per gram [ug/gm]) Cd (<0.08 ppm) Cu (201 ppm) Ni (124 ppm) TOC (1.84 wt%) Hg (<0.1 ppm) Phenol (6.84 ug/gm) Extraction Procedures (EP) Toxicity Extract: arsenic (0.001 ppm) and selenium (<0.001 ppm) TS (63.6 wt%) Pb (55.2 ppm) Ag (0.04 ppm) Zn (95.3 ppm) Cr (8.75 ppm)(Total)
Date: March 1, 1983 Type: Coal pile liquid runoff sample	pH (2.26) Cd (0.08 ppm) Cu (4.3 ppm) Ni (14.4 ppm) TSS (25 ppm) Phenol (0.002 ppm) Hg (<0.002 ppm) COD (359 ppm) EP Toxicity Extract: arsenic (0.002 ppm) and selenium (<0.001 ppm) TSS (23,150 ppm) Cr (0.33 ppm) (Total) Pb (<0.1 ppm) Ag (<0.03 ppm) BOD (101 ppm) chloride (90 ppm) Zn (45.5 ppm)
Date: August 20 - November 1, 1985 Type: Coal pile liquid runoff samples (8)	pH (2.16 - 6.56) Cd (<0.01 - 0.03 ppm) Cu (<0.1 - 2.3 ppm) Ni (<0.05 - 2.01 ppm) TSS (4-4,180 ppm) Cr (<0.05-.22 ppm) Pb (<0.05 ppm) Zn (<0.1-5.2 ppm)

Table 2-2
SWMU 44
Previous Investigations

Previous Investigations	Analytical Results
Date: October 22 - November 1, 1985 Type: Surface water samples (5) Location: Drainage ditch west of coal pile	pH (2.61 - 6.56) Cd (<0.01) Cu (<0.1 - 0.3 ppm) Ni (<0.05 - 0.33 ppm) TSS (73 - 456 ppm) Cr (<.050-.05 ppm) (Total) Pb (<0.05 ppm) Zn (<0.1 -1.1 ppm)
Date: Unknown Type: Storm water runoff sample	Al (121 ppm) Cu (1.7 ppm) Mg (93 ppm) Ni (5.7 ppm) Zn (17 ppm) Cr (0.4 ppm)(Total) Fe (541 ppm) Mn (2.6 ppm) Sn (0.5 ppm)

2.1.2 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 remediation. Data collection efforts will support evaluation of these alternatives. Table C-1 (Appendix C) lists treatment alternatives for groundwater and surface water runoff; Table C-2 lists treatment alternatives for soil and sediment; and Table C-3 lists treatment alternatives for the presence of soil gas. Alternatives presented here are for preliminary evaluation only.

2.1.3 Data Gaps

Currently limited environmental media data have been collected to characterize the site or to support a detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient to meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The nature and extent of impact to environmental media (air, soil, soil gas, sediment, groundwater and surface water) has not been defined.

- The current data are insufficient to support a detailed evaluation of treatment alternatives.

2.1.4 Potential Receptors

Potential receptors that may be exposed to site contaminants include current land users, such as NAVBASE personnel, recreational waterway users, 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 bolded in Table 2-1. Characterizing the surface water and sediment pathways will be addressed in greater detail in the Zone J RFI.

Land at SWMU 44 is used as a coal and miscellaneous storage yard. Potential receptors are site workers and recreational waterway users involved in invasive and non-invasive activities, bringing them in direct contact with subsurface and surface water contaminants. Considering the shallow depth to groundwater, generally less than 4 feet below ground surface (bgs), potential receptors could also be subject to accidental ingestion or dermal exposure to contaminated groundwater.

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

2.1.5 Objectives

Based on the data gaps presented, the objective of the proposed field investigation is to collect the data necessary to confirm whether contaminants are present. If COPCs are detected, the horizontal and vertical extent, as well as the rate of any soil, soil-gas, groundwater, surface water or sediment contamination, will be delineated concurrently. Data collection efforts will also support the technical evaluation of identified remedial options.

2.1.6 Screening Alternatives

Only limited sampling has been conducted to determine COPCs, therefore, selecting a screening alternative would be premature. If the proposed collection of high-quality samples is inadequate to define the extent of contamination (if present), the feasibility of employing screening methods will be reevaluated. While collecting all soil boring samples and installing all monitoring wells, samples will be screened for volatile organic compounds (VOCs) using a photoionization detector (PID). All screening results will be recorded in field notebooks and boring logs.

2.1.7 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Table 2-3 summarizes the types of samples and analytical parameters. Several surface water runoff samples taken in previous investigations were used to select the following biased sampling locations.

Table 2-3
SWMU 44
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	8	Metals and Cyanide
Soil (3'-5' bgs)	8	
Groundwater (shallow wells)	8	Grain size and total organic carbon (sediment).
Sediment	14	
Surface Water	14	General water quality standards (surface water).

Engineering Parameters:

Slug tests will be performed on two of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, total organic carbon (TOC) and cation exchange capacity (CEC). Analysis for any of the remaining design parameters listed in Appendix C will be performed at selected locations when a better understanding of the contamination distribution (if contamination is present) is developed.

Notes:

Groundwater monitoring wells will be sampled quarterly for one year.

A leachability test will be conducted on a sample from the coal pile.

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

All analysis to be performed per SW-846 except where other methods are specified. Data Quality Objective (DQO) Level III analysis as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include Quality Assurance/Quality Control (QA/QC).

The soil boring and groundwater monitoring well locations are proposed for the inner and outer perimeters of the anticipated migration pathways. Four soil borings to be completed as groundwater monitoring wells will be located on each side, directly adjacent to the coal pile. These sampling locations will be used to confirm if COPCs derived directly from the coal pile are present. Four additional soil borings completed as groundwater monitoring wells will be oriented on the west and northwest side of the coal pile adjacent to the surface water runoff ditches, which are also the site boundaries. These borings and wells will confirm the presence of COPCs deposited and/or having the possibility of migrating offsite.

Surface water and sediment will generally be sampled on the west/northwest side of the site, which is topographically downgradient and receives surface runoff. Samples will be collected in the drainage ditches leading to Noisette Creek and from within Noisette Creek. Samples from Noisette Creek will be collected both upgradient and downgradient of this site. Sampling locations not in the drainage ditches or Noisette Creek are in small runoff accumulation areas which will be sampled when runoff has accumulated. This sampling scheme will help confirm the presence of COPCs deposited and/or having the possibility of migrating offsite.

Because soil gas has been identified as a migration pathway, a PID will be used to screen all borings and samples. Each proposed sampling location is illustrated on Figure 2-2. All sampling will adhere to the *NAVBASE Final Comprehensive RFI Work Plan*.

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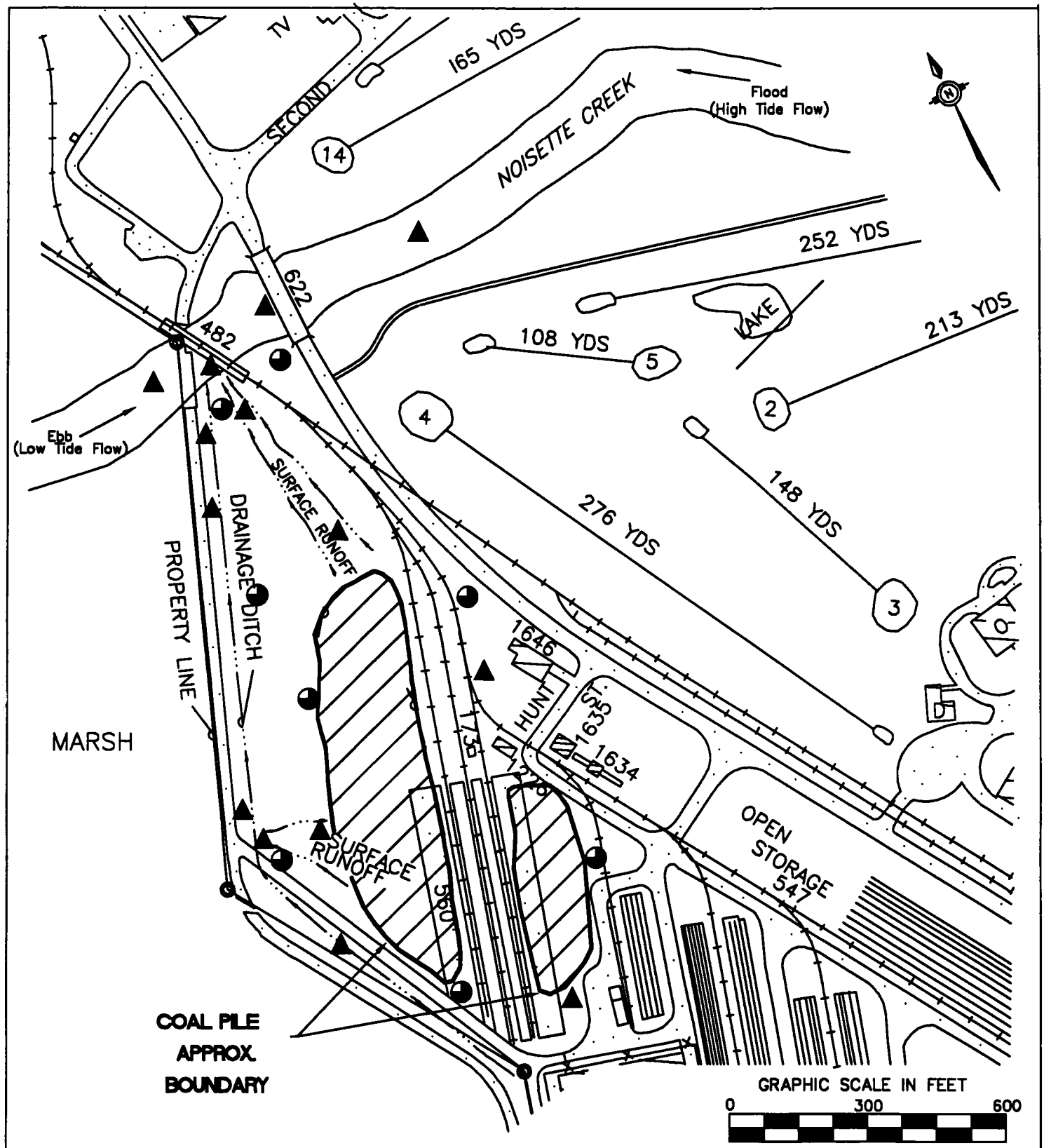

LEGEND

▲ – SURFACE WATER & SEDIMENT SAMPLE

◕ – SOIL BORING TO BE COMPLETED AS A GROUNDWATER MONITORING WELL

FINAL RFI
ZONE C WORK PLAN
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CHARLESTON, S.C.

FIGURE 2-2
SWMU 44
COAL PILE
PROPOSED SAMPLING LOCATION

DWG DATE: 2/22/95 | DWG NAME: swmu44

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2.2 AOC 516, Wash Area (Includes SWMU 47)

AOC 516, a former wash area in Building 233, is currently a lead-acid battery charging area. SWMU 47, a former burning dump, is to the southeast. Currently this area contains Buildings NSC-66, NSC-64, and NSC-67, where petroleum product spills have been reported in recent years. These sites have been designated for an RFI. Because of the proximity of SWMU 47 to AOC 516, these sites will be investigated as a single unit. Table 2-4 describes the sites.

Table 2-4
AOC 516 and SWMU 47
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways
AOC 516 WASH AREA/ BATTERY CHARGING	Building 233 was used for spray washing vehicles and equipment from 1972 until the 1980s. Currently it is used as a lead-acid battery charging facility.[a]	Lead Metals Solvents Battery Acids Petroleum Hydrocarbon (Volatile Organic Analysis [VOA], Semivolatile Organic Analysis [SVOA], Metals, and Total Petroleum Hydrocarbons [TPH])	**Soil** **Soil Gas** **Groundwater**
SWMU 47 BURNING DUMP	This site was a burning dump during the 1920s. Currently, it is an asphalt and grassy area on which Buildings NSC-64, NSC-66, and NSC-67 are located. Petroleum product spills have been reported at these buildings in recent years.[b]	Petroleum Hydrocarbons Products of Incomplete Combustion Medical Waste (VOA, SVOA, Metals, and TPH)	**Soil** **Soil Gas** **Groundwater**

Notes:
[a] Described in the Draft Final RCRA Facility Assessment, Vol. II, November 1994
[b] Described in the Draft Final RCRA Facility Assessment, Vol. I, November 1994
Pathways scheduled for sampling are bold.

2.2.1 Previous Investigations

This site has not been investigated previously.

2.2.2 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 remediation. Data collection efforts will support evaluating these alternatives. Tables C-4 (Appendix C) lists treatment alternatives for groundwater; Table C-5 lists treatment alternatives for soil; and Table C-6 lists treatment alternatives for the presence of soil gas. Alternatives presented here are for preliminary evaluation only.

2.2.3 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient to meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The nature and extent of impact to environmental media (soil, soil gas and groundwater) from reported releases has not been defined.

- No data exist to support a detailed evaluation of treatment alternatives.

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 bolded in Table 2-4.

Land around AOC 516 and SWMU 47 is used for vehicle parking and vehicular and pedestrian traffic. Potential receptors are site 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 utility system in this area could act as a conduit for moving any product released at this facility, and thus could expose those working on any of these underground systems, as well as providing a contaminant route. The underground utility system will be investigated in the Zone L work plan.

2.2.5 Objectives

The objective of the proposed field investigation is to fill the identified data gaps by establishing whether contaminants are present in the identified migration pathways. If COPCs are detected, the horizontal and vertical extent and rate of any soil and/or groundwater contamination will be delineated concurrently. Data collection efforts will also support the technical evaluation of identified remedial options.

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 high-quality samples is inadequate to define the extent of contamination (if present), the feasibility of employing screening methods will be reevaluated. While collecting all soil boring samples and installing all monitoring wells, samples will be screened for VOCs with a PID. All screening results will be recorded in field notebooks and boring logs.

2.2.7 Sampling and Analysis Plan

To fulfill the RFI objectives, site-specific sampling and analysis requirements have been proposed. Limited information has been found regarding the dimensions and location of the burning dump. Due to the shallow depth to groundwater and that the contents of the burning have been buried at unknown depths, it is believed the use of monitoring wells will generate more effective and usable results. Therefore, 15 wells will be placed in two circular patterns, one small and one large, to both locate and define the site boundaries and establish COPCs. The circular well patterns will enable the collection of both up and downgradient groundwater data regardless of the groundwater flow direction. Wells will need to be located in Buildings NCS 64, NCS 66, and NSC 67 because the small circular well pattern has been placed in a known portion of the former burning dump and because space between the building does not allow well placement. Before installing wells within the buildings the proper authorities will be notified, building foundation maps checked, and proper ventilation precautions taken.

One of the larger circular pattern wells will serve the dual purpose of identifying whether COPCs are present from both AOC 516 and SWMU 47. Two soil borings are proposed west of Building 233, where COPCs from the wash area are likely. Because soil gas has been identified as a migration pathway, a PID will be used to screen all borings and samples. Table 2-5 summarizes the types of samples and analytical parameters. Each proposed sampling location is illustrated on Figure 2-3. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

Table 2-5
AOC 516 (Including SWMU 47)
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1½ bgs)	17	VOA, SVOA w/ Tentatively Identified Compounds (TICs), Metals, Cyanide, Pesticides, TPH and Polychlorinated biphenyls (PCBs).
Soil (3½-5½ bgs)	17	
Groundwater (shallow wells)	15	

Engineering Parameters:

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

Notes:

Groundwater monitoring wells will be sampled quarterly for one year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation 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 analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.

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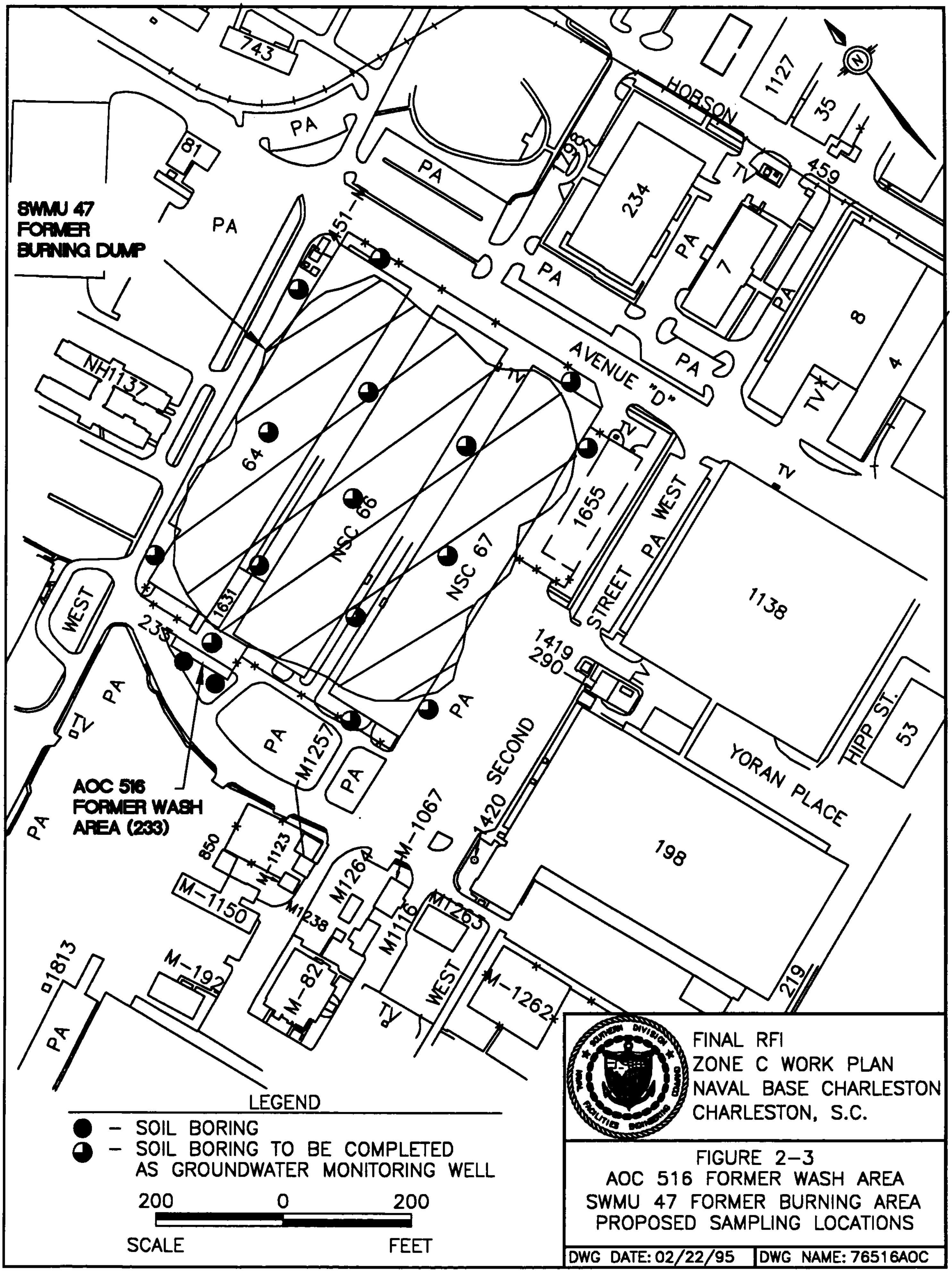
SWMU 47
FORMER
BURNING DUMP
AOC 516
FORMER WASH
AREA (233)
AVENUE "D"
HOBSON
SECOND
STREET
WEST
PA WEST
YORAN PLACE
HIPP ST.
PA
TV
743
81
198
234
7
8
4
1127
35
459
451
NH1137
64
NSC 66
NSC 67
1631
1655
1138
1419
290
233
M1257
M-1067
1420
198
850
M-1123
M-1150
M1238
M126
M1116
M1263
M-82
M-192
1813
M-1262
219
53
LEGEND
SOIL BORING
SOIL BORING TO BE COMPLETED AS GROUNDWATER MONITORING WELL
200
0
200
SCALE
FEET
FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-3
AOC 516 FORMER WASH AREA
SWMU 47 FORMER BURNING AREA
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/22/95
DWG NAME: 76516AOC

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2.3 AOC 508, Former Incinerator (Includes AOC 511, Former Oil Storehouse)

AOC 508 is the site of a former incinerator, between Avenue H and the west NAVBASE property boundary. Southwest of this site is AOC 511, a former oil storehouse. These sites have been designated as a CSI. These sites will be investigated as a single unit because of their proximity. Table 2-6 describes the sites.

Table 2-6
AOC 508 and AOC 511
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways
AOC 508 INCINERATOR	Former Incinerator 19 operated from 1922 until 1929. Its exact dimensions and operating practices are unknown. Currently the site is a grassy area west of Avenue H and north of AOC 511.*	Metals Petroleum Hydrocarbons Products of Incomplete Combustion (VOA, SVOA, Metals, and TPH)	**Soil** **Soil Gas** Groundwater
AOC 511 OIL STORAGE	Former Building 16 was used for oil storage from 1922 until approximately 1955. The design features and operating practices of this facility are unknown. Currently the site is a grassy area west of Avenue H and north of Building 762.*	Petroleum Hydrocarbons (VOA, SVOA, and TPH)	**Soil** **Soil Gas** Groundwater

Notes:
* Described in the Draft Final RCRA Facility Assessment, Vol. II, November 1994
Pathways scheduled for sampling are bold.

2.3.1 Previous Investigations

These sites have not been investigated previously.

2.3.2 Treatment Alternatives

Because there are no environmental media data, treatment alternatives for these sites cannot be evaluated.

2.3.3 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient to meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives, if necessary.

2.3.4 Potential Receptors

Potential receptors that may be exposed to site contaminants include current land users, such as NAVBASE personnel, recreational land users from adjacent residential areas 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 bolded in Table 2-6.

Land around AOC 508 and AOC 511 is used for pedestrian traffic and recreational activities. Potential receptors are site users or workers involved with invasive activity bringing them in direct contact with subsurface contaminants. Considering the shallow depth to groundwater, generally less than 4 feet bgs, receptors could also be subject to accidental ingestion or dermal exposure to contaminated groundwater.

The utility system in this area could act as a conduit for moving any product released at this facility, and thus could expose those working on any of these underground systems. The underground utility system will be investigated in the Zone L work plan.

2.3.5 Objectives

The goal of the CSI is to classify the site as requiring No Further Investigation (NFI) or an RFI by using DQO Level III or IV data to determine whether contaminants are present. If an RFI is required, the objective of field investigations shall be to fill the identified data gaps by delineating the horizontal and vertical extent of any soil and groundwater contamination as well as the rate of contaminant migration at the sites. Data collection efforts shall support the technical evaluation of identified remedial options.

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 high-quality samples is inadequate to define the extent of contamination (if present), the feasibility of employing screening methods will be reevaluated. While collecting all soil boring samples, soil samples will be screened for VOCs with a PID. All screening results will be recorded in field notebooks and boring logs.

2.3.7 Sampling and Analysis Plan

To fulfill the CSI objectives, the following site-specific sampling and analysis requirements have been proposed. Two soil borings will be placed inside the suspected boundaries of the former building locations and one on each of the sides, 25 feet away. This sampling scheme will confirm whether COPCs are present relating to the former buildings. The length of time since operation and the shallow depth to groundwater enables the use of soil borings only to determine whether COPCs are present. Because soil gas has been identified as a migration pathway, a PID will be used to screen all borings and soil samples. Table 2-7 summarizes the types of samples to be collected and analytical parameters to be used. Proposed sampling locations for AOCs 508 and 511 are illustrated in Figure 2-4. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

Table 2-7
AOC 508 (Including AOC 511)
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3'-5' bgs)	12 12	VOA, SVOA w/ TICs, Metals, Cyanide, Pesticides, TPH and PCBs

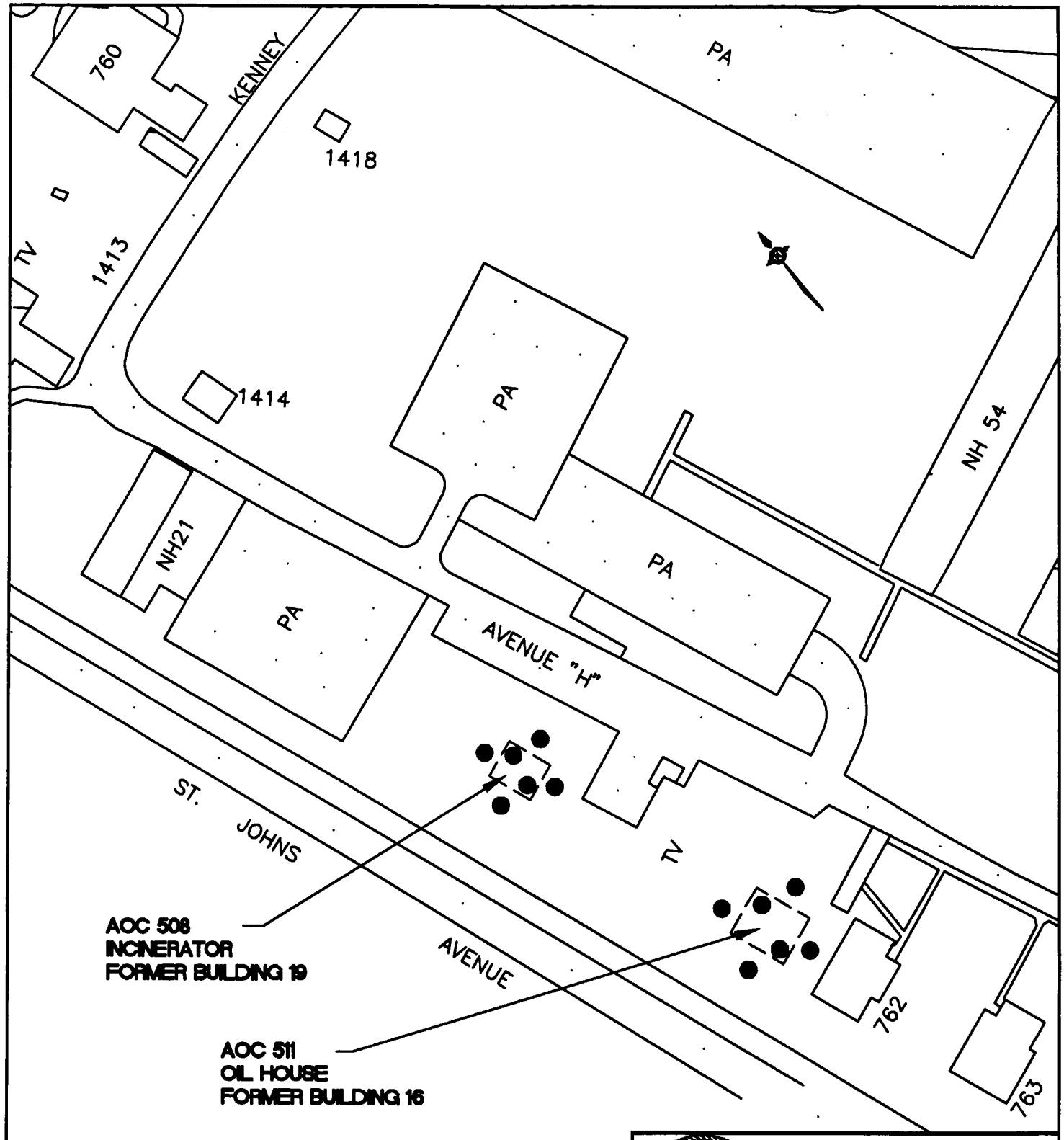
Engineering Parameters:

Selected soil samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation 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 analysis as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be present. The sample quantities presented do not include QA/QC samples.



FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2–4
AOC 508 FORMER INCINERATOR
AOC 511 FORMER OIL HOUSE
PROPOSED SAMPLING LOCATIONS

DWG DATE: 02/22/95 | DWG NAME: 76AOC511

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2.4 AOC 515, Former Incinerator and Paint Shop (Includes AOC 519, Former Boiler House)

AOC 515, a former incinerator and paint shop, and AOC 519, a former boiler house, are both south of Turnbull Avenue and east of NH-55. These sites are both designated for a CSI. Because of the close proximity of these sites they will be discussed as a unit. Table 2-8 describes these sites.

Table 2-8
AOC 515 and AOC 519
Site Information and Description

Number	Description	Material Released or Stored	Potential Pathways
AOC 515 INCINERATOR	An incinerator operated at this site in the 1920s and a paint shop replaced it in the 1930s. Currently, it is a gravel parking area east of AOC 519.*	Oils Paints Solvents Products of Incomplete Combustion Petroleum Hydrocarbons (VOA, SVOA, Metals, and TPH)	**Soil** **Soil Gas** Groundwater
AOC 519 BOILER HOUSE	A boiler house for the Navy Brig operated at this site from 1922 until 1929. Currently this site is a gravel parking area east of Building NH-55.*	Coal Coal Derivatives Petroleum Hydrocarbons (VOA, SVOA, Metals, and TPH)	**Soil** **Soil Gas** Groundwater

Notes:
* Described in the Draft Final RCRA Facility Assessment, Vol. II, November, 1994
Pathways scheduled for sampling are bold.

2.4.1 Previous Investigations

These sites have not been investigated previously.

2.4.2 Treatment Alternatives

Because there are no environmental media data, treatment alternatives for these sites cannot be evaluated.

2.4.3 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient to meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are no data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives, if necessary.

2.4.4 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 bolded in Table 2-8.

Land around AOC 515 and AOC 519 is used for vehicular parking and pedestrian traffic. 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.

2.4.5 Objectives

The goal of the CSI is to classify the site as NFI or RFI by using DQO Level III or IV data to determine whether contaminants are present. If an RFI is required, the objectives of field

investigations shall be to fill the identified data gaps by delineating the horizontal and vertical extent of any soil and/or groundwater contamination as well as the rate of contaminant migration at the sites. Data collection efforts will also support the technical evaluation of identified remedial options.

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 high-quality samples is inadequate to define the extent of contamination (if present), the feasibility of employing screening methods will be reevaluated. However, while collecting all soil boring samples, soil samples will be screened for VOCs with a PID. All screening results will be recorded in field notebooks and boring logs.

2.4.7 Sampling and Analysis Plan

To fulfill the CSI objectives, the following site-specific sampling and analysis requirements have been proposed. Two soil borings will be placed inside the suspected boundaries of the former buildings and one on each of the sides, 25 feet away. This sampling scheme will determine whether COPCs are present relating to the former buildings. The length of time since operation and shallow depth to groundwater enables the use of soil borings only to determine whether COPCs are present. Because soil gas is identified as a potential migration pathway, a PID will be used to screen all borings and soil samples. Table 2-9 summarizes the types of samples to be collected and analytical parameters to be used. Proposed sampling locations for AOCs 515 and 519 are illustrated in Figure 2-5. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan*.

Table 2-9
AOC 515 (Including AOC 519)
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3'-5' bgs)	12 12	VOA, SVOA w/ TICs, Metals, Cyanide, Pesticides, TPH, and PCBs

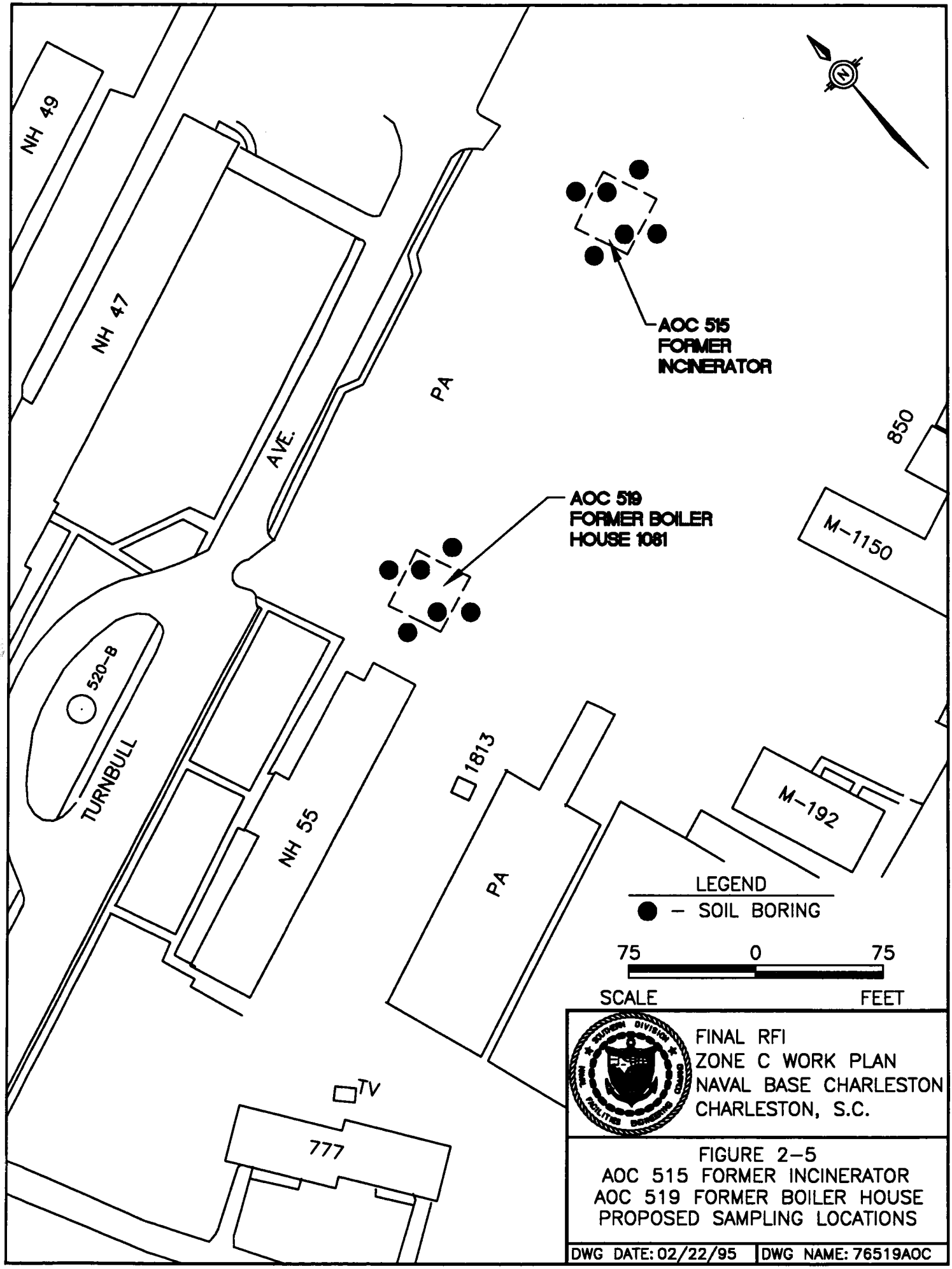
Engineering Parameters:

Selected soil samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation 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 analysis as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the locations where contaminants are most likely to be found. The sample quantities presented do not include QA/QC samples.


NH 49
NH 47
AVE.
PA
AOC 515
FORMER
INCINERATOR
850
AOC 519
FORMER BOILER
HOUSE 1081
M-1150
520-B
TURNBULL
NH 55
1813
PA
M-192
LEGEND
– SOIL BORING
75 0 75
SCALE FEET
TV
777
FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-5
AOC 515 FORMER INCINERATOR
AOC 519 FORMER BOILER HOUSE
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/22/95
DWG NAME: 76519AOC

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2.5 AOC 523, Former Gas Station

AOC 523 is the site of a former gas station located where Building 198 now stands. This site has been designated for a CSI. Table 2-10 describes the site.

Table 2-10
AOC 523
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways
AOC 523 GAS STATION	Former Gas Station (M-1234) operated from 1958 until 1962. Currently the site is covered by the southeastern portion of Building 198. It is unknown if Underground Storage Tanks (USTs) are present.*	Lead Petroleum Hydrocarbons (VOA, SVOA, Metals, and TPH)	**Soil** **Soil Gas** **Groundwater**

Notes:
* Described in the Draft Final RCRA Facility Assessment, Vol. II, November 1994
Pathways scheduled for sampling are bold.

2.5.1 Previous Investigations

This sits has not been investigated previously.

2.5.2 Treatment Alternatives

Because there are no environmental media data, treatment alternatives for this site cannot be evaluated.

2.5.3 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient and meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- No information exists on presence/absence, number of or location of UST.

- There are no data to establish whether COPCs are present for any of the potential migration pathways.

- No data exist to support a detailed evaluation of treatment alternatives, if necessary.

2.5.4 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 bolded in Table 2-10.

Land around AOC 523 is used for vehicle parking, pedestrian traffic, and vehicular traffic. 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.

2.5.5 Objectives

The goal of the CSI is to classify the site as NFI or RFI by using DQO Level III or IV data to determine if contaminants are present. If an RFI is required, the objectives of field investigations shall be to fill the identified data gaps by delineating the horizontal and vertical extent of any soil and/or groundwater contamination as well as the rate of contaminant migration

at the sites. The remaining objective will be to establish the presence/absence, number of, and location of USTs. Data collection efforts shall also support the technical evaluation of identified remedial treatment options.

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 high-quality samples is inadequate to define the extent of contamination (if present), the feasibility of employing screening methods will be reevaluated. While collecting all soil boring samples and installing all monitoring wells, samples will be screened for VOCs using a PID. All screening results will be recorded in field notebooks and boring logs.

2.5.7 Sampling and Analysis Plan

To fulfill the CSI objectives, the following site-specific sampling and analysis requirements have been proposed. Two soil borings, which will be completed as groundwater monitoring wells, will be located just outside the south and east perimeters of Building 198. The placement of the first well, south of the building, was chosen because it is the closest feasible location to the site and it is upgradient of the anticipated easterly flow of groundwater. The remaining well will be placed downgradient, east of Building 198, to define whether COPCs are present relating to AOC 523.

The soil borings will occur directly on the area with suspected COPCs. Investigative measures to determine the presence/absence of USTs will be conducted by a location specialist under the direction of E/A&H personnel. Because soil gas is identified as a potential migration pathway, a PID will be used to screen all borings and soil samples. Table 2-11 summarizes the types of samples to be collected and analytical parameters to be used. Proposed sampling locations for AOC 523 are illustrated in Figure 2-6. All sampling will adhere to the NAVBASE *Final Comprehensive RFI Work Plan.*

Table 2-11
AOC 523 (Including SWMU 49)
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1½ bgs)	4	VOA & SVOA w/ TICs, Metals, Cyanide, Pesticides, TPH, and PCBs.
Soil (3½-5½ bgs)	4	
Groundwater	2	

Engineering Parameters:

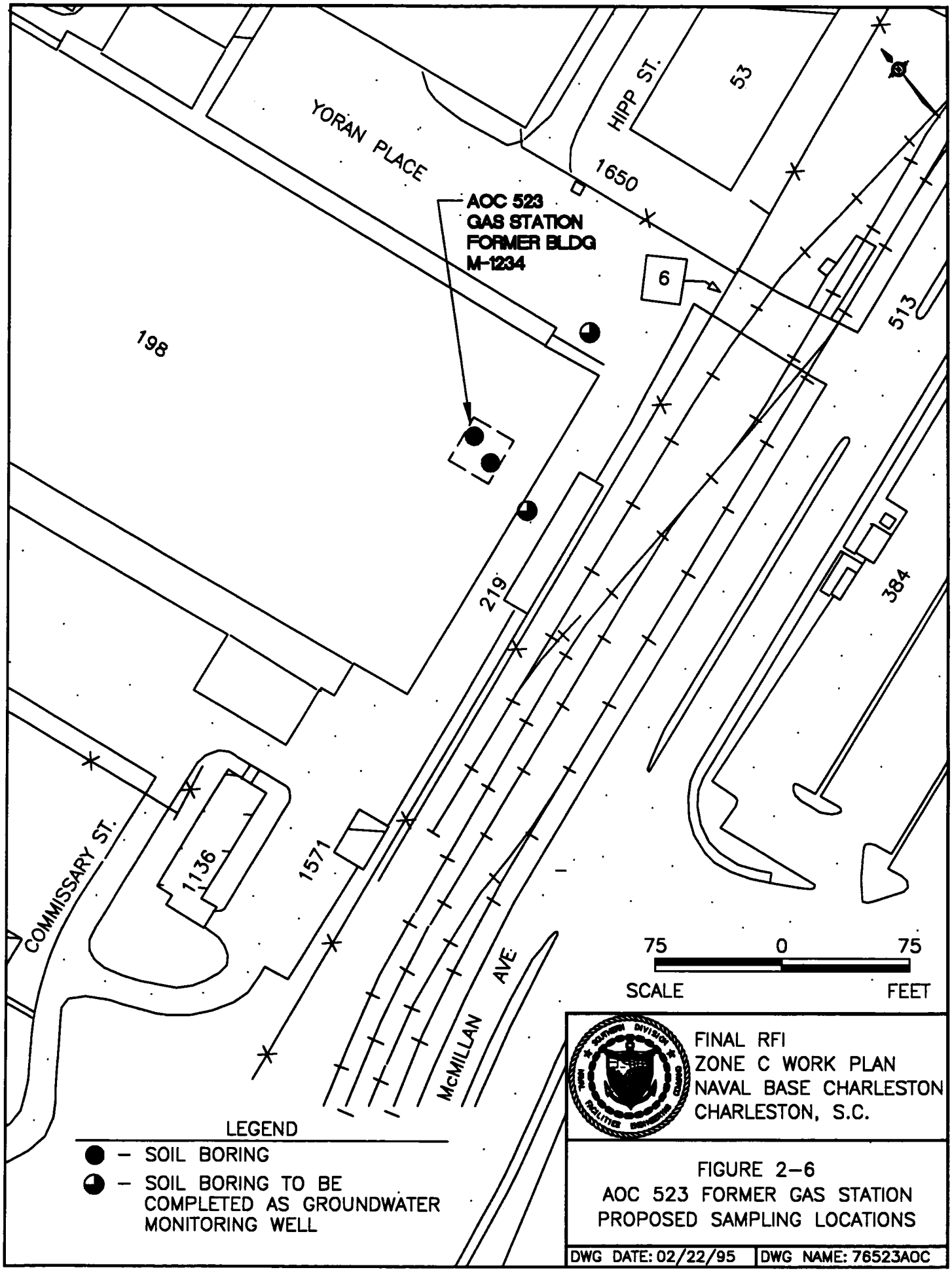
Slug tests will be performed on 25% of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC, and CEC.

Notes:

Groundwater monitoring wells will be sampled quarterly for a year.

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation 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 analysis as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at the location where contaminants are most likely to be found. The sample quantities presented do not include QA/QC samples.


YORAN PLACE
HIPP ST.
53
1650
AOC 523
GAS STATION
FORMER BLDG
M-1234
6
198
513
219
384
COMMISSARY ST.
1136
1571
McMILLAN AVE
75
0
75
SCALE
FEET
LEGEND
– SOIL BORING
– SOIL BORING TO BE COMPLETED AS GROUNDWATER MONITORING WELL
FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2–6
AOC 523 FORMER GAS STATION
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/22/95
DWG NAME: 76523AOC

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2.6 Other Sites Designated CSI (Includes AOCs 510, 512, 513, 517, 518, and 520)

This group of sites has a common investigative strategy and will be discussed as a unit. Table 2-12 describes the sites.

Table 2-12
Other Sites Designated CSI
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways
AOC 510 GEOTECHNICAL LABORATORY	Building NH-21 is a geotechnical laboratory and equipment storage area. This site has historically been used as a fireproof warehouse (1919-1947), a washroom (1947-1955), a paint shop (1955-1962), storage area (1962-1977), and a geotechnical laboratory (1977-present). A covered pit is on the west side of the building.*	Paints Acetone Solvents Laboratory Chemicals Methylene Chloride Methyl Ethyl Ketone (VOA, SVOA, and Metals)	Air **Soil** **Soil Gas** **Groundwater**
AOC 512 INCINERATOR	Former Incinerator 67 operated from 1943 until 1958. Currently, the site is a grassy area southwest of Building 1079.*	Metals Petroleum Hydrocarbons Products of Incomplete Combustion (VOA, SVOA, Metals, and TPH)	**Soil** **Soil Gas** Groundwater
AOC 513 MORGUE	A morgue operated at this site in the early 1920s. The waste disposal practices of this facility are unknown. Currently the site is a grassy area southwest of Building NH-55.*	Alcohol Creosote Formaldehyde (VOA and SVOA)	**Soil** **Soil Gas** Groundwater
AOC 517 FIRING RANGE	From 1959 until 1974, Building M192 was used as an indoor firing range. Currently it serves as a classroom and storage area.*	Lead Metals (Metals)	**Soil** **Soil Gas** Groundwater
AOC 518 COAL BINS	Coal was stored in bins at this site from 1926 until 1937. The design or construction of the coal bins is unknown. Currently this site is a gravel and asphalt parking lot and a portion of the area underlying Building M-1257.*	Coal Coal Derivatives (Metals)	**Soil** **Soil Gas** Groundwater

Table 2-12
Other Sites Designated CSI
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways
AOC 520 **GARBAGE HOUSE**	Former Building M-1051 was a garbage house for a Marine barracks in the 1920s through the 1940s. Currently the site is an asphalt parking lot north of Building M-17.*	Domestic Wastes (VOA, SVOA, Metals, TPH, pesticides and PCBs)	**Soil** **Soil Gas** Groundwater

Notes:

* Described in the Draft Final RCRA Facility Assessment, Vol. II, November 1994
Pathways scheduled for sampling are bold.

2.6.1 Previous Investigations

These sites have not been investigated previously.

2.6.2 Treatment Alternatives

Because there are no environmental media data, treatment alternatives for these sites cannot be evaluated.

2.6.3 Data Gaps

Currently no environmental media data have been collected to characterize these sites or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient to meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are currently no data to establish whether COPCs are present for any of the potential migration pathways; and,

- No data exist to support a detailed evaluation of treatment alternatives, if necessary.

2.6.4 Potential Receptors

Potential receptors that may be exposed to site contaminants include current land users, such as NAVBASE personnel, recreational land users from adjacent residential areas 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 bolded in Table 2-12.

Land around these sites range from grassy areas to paved parking areas. Potential receptors are site workers or other land users involved with invasive and non-invasive activities 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 utility system in this area could act as a conduit for moving any product released at this facility, and thus could expose those working on any of these underground systems. The underground utility system will be investigated in the Zone L work plan.

2.6.5 Objectives

The goal of the CSI is to classify the site as NFI or RFI by using DQO Level III or IV data to determine whether COPCs are present. If an RFI is required, the objective of field investigations shall be to fill the identified data gaps by delineating the horizontal and vertical extent of any soil and/or groundwater contamination as well as the rate of contaminant migration at the sites. Data collection efforts shall also support the technical evaluation of identified remedial options.

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 high-quality samples is inadequate to define the extent of contamination (if present), the feasibility of employing screening methods will be reevaluated. While collecting all soil boring samples and installing all monitoring wells, samples will be screened for VOCs using a PID. All screening results will be recorded in field notebooks and boring logs.

2.6.7 Sampling and Analysis Plan

To fulfill the CSI objectives, the following site-specific sampling and analysis requirements have been proposed. Table 2-13 summarizes the types of samples to be collected and analytical parameters to be used. Proposed sampling locations for AOCs 510, 512, 513, 517, 518, and 520 are illustrated in Figures 2-7, 2-8, 2-9, 2-10, 2-11, and 2-12, respectively.

Due to the general lack of information regarding these sites, proposed sample locations, as illustrated, represent the areas most likely to have been impacted if a release has occurred. The number of samples and sample locations for the above-listed AOCs are based on what is reasonably expected to provide adequate information to identify the presence of COPCs. All sampling will adhere to NAVBASE *Final Comprehensive RFI Work Plan.*

Table 2-13
Other Sites Designated CSI
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs)	28	VOA & SVOA w/ TICs, Metals, Cyanide, Pesticides and PCBs.
Soil (3'-5' bgs)	28	
Groundwater wells (shallow)	2	

Engineering Parameters:

Slug tests will be performed on one of the shallow wells. While installing the wells, Shelby tubes will be collected when lithology changes significantly. Samples will be tested for permeability, grain size, porosity, TOC and CEC.

Notes:

Groundwater monitoring wells will be sampled quarterly for one year.

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

Samples will be taken of the residue in the pit, if present, at AOC 510.

Floor and roof wipe samples will be taken at the former indoor range, AOC 517.

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

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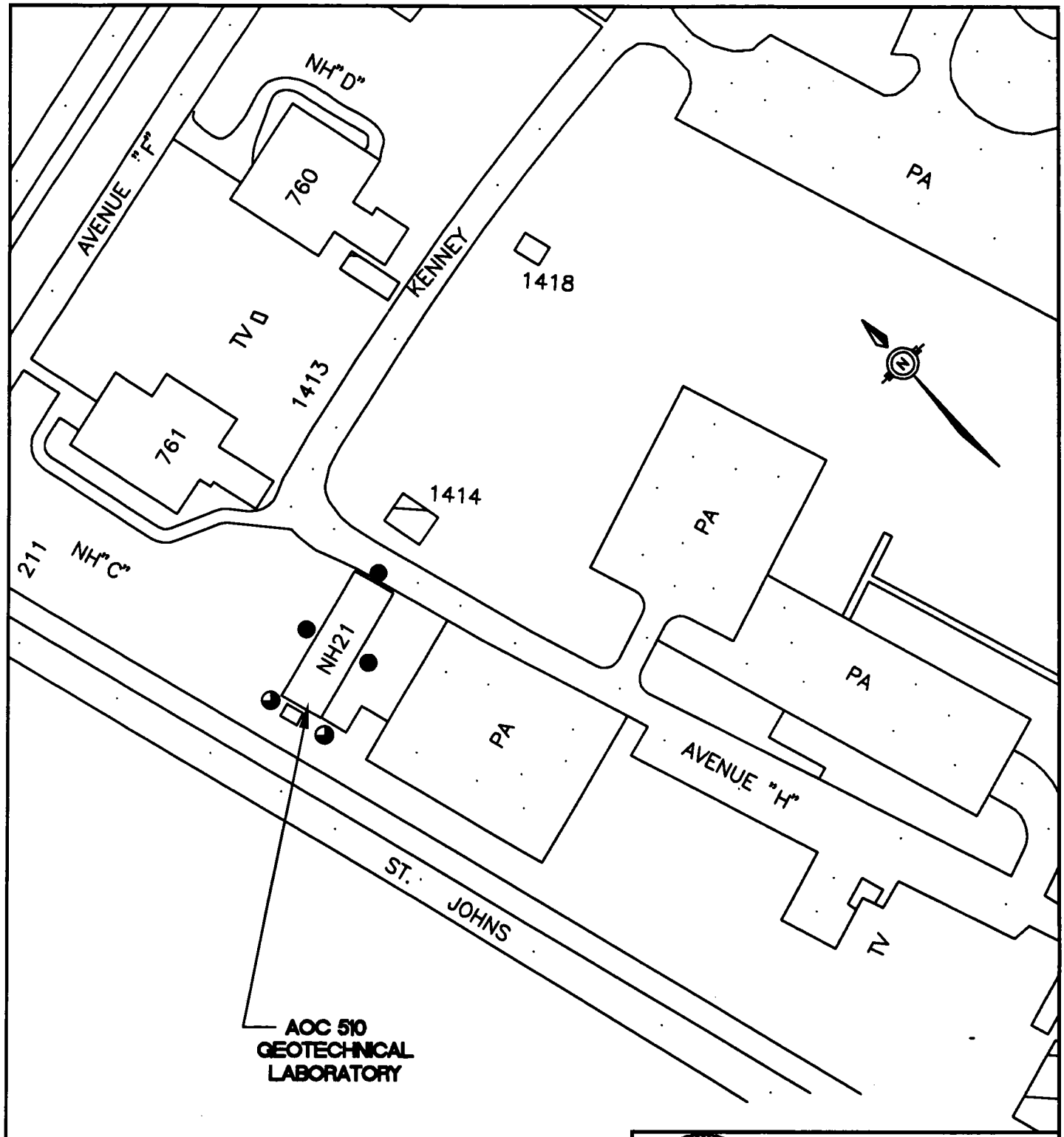

LEGEND

- ● – SOIL BORING
- ◕ – SOIL BORING TO BE COMPLETED AS A GROUNDWATER MONITORING WELL

75 0 75

SCALE FEET

FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2–7
AOC 510
GEOTECHNICAL LABORATORY
PROPOSED SAMPLING LOCATIONS

DWG DATE: 02/22/95 | DWG NAME: 76AOC510

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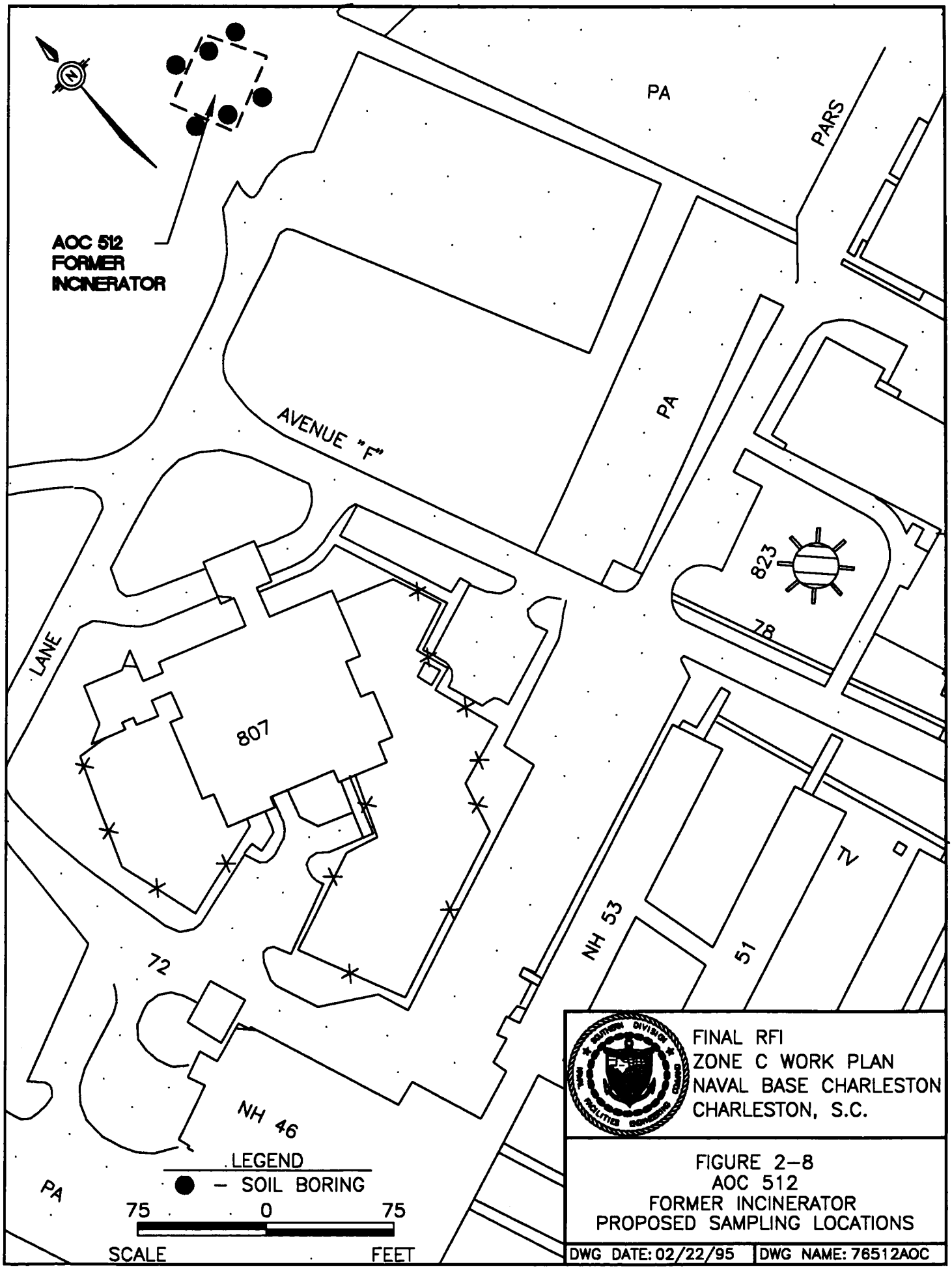
AOC 512
FORMER
INCINERATOR
PA
PARS
AVENUE "F"
PA
823
78
LANE
807
72
NH 53
51
72
NH 46
PA
LEGEND
– SOIL BORING
75
0
75
SCALE
FEET
FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2–8
AOC 512
FORMER INCINERATOR
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/22/95
DWG NAME: 76512AOC

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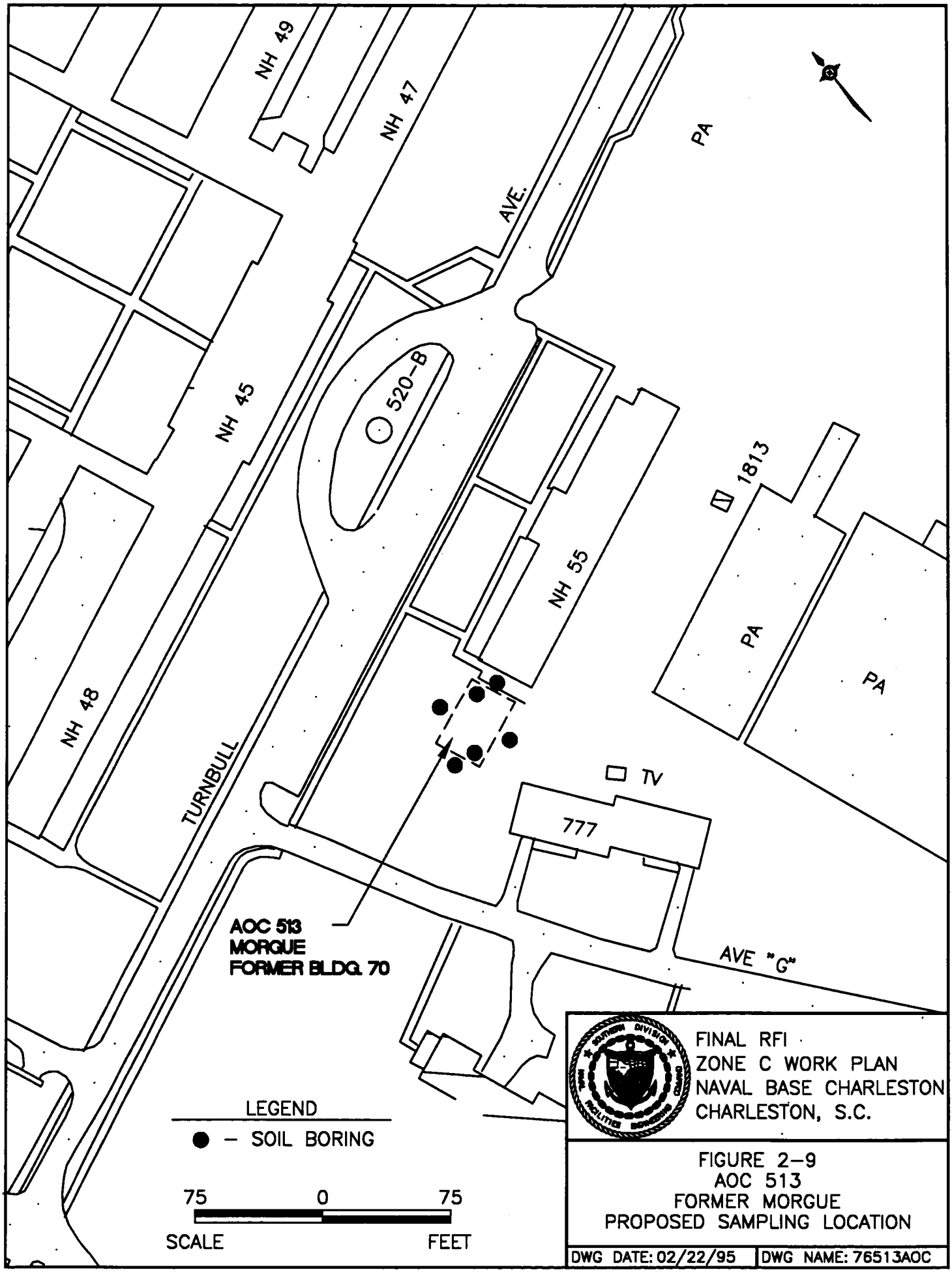
NH 49
NH 47
AVE.
PA
NH 45
520-B
1813
NH 55
PA
PA
NH 48
TURNBULL
TV
777
AOC 513
MORGUE
FORMER BLDG. 70
AVE "G"
LEGEND
● – SOIL BORING
75 0 75
SCALE FEET
FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-9
AOC 513
FORMER MORGUE
PROPOSED SAMPLING LOCATION
DWG DATE: 02/22/95
DWG NAME: 76513AOC

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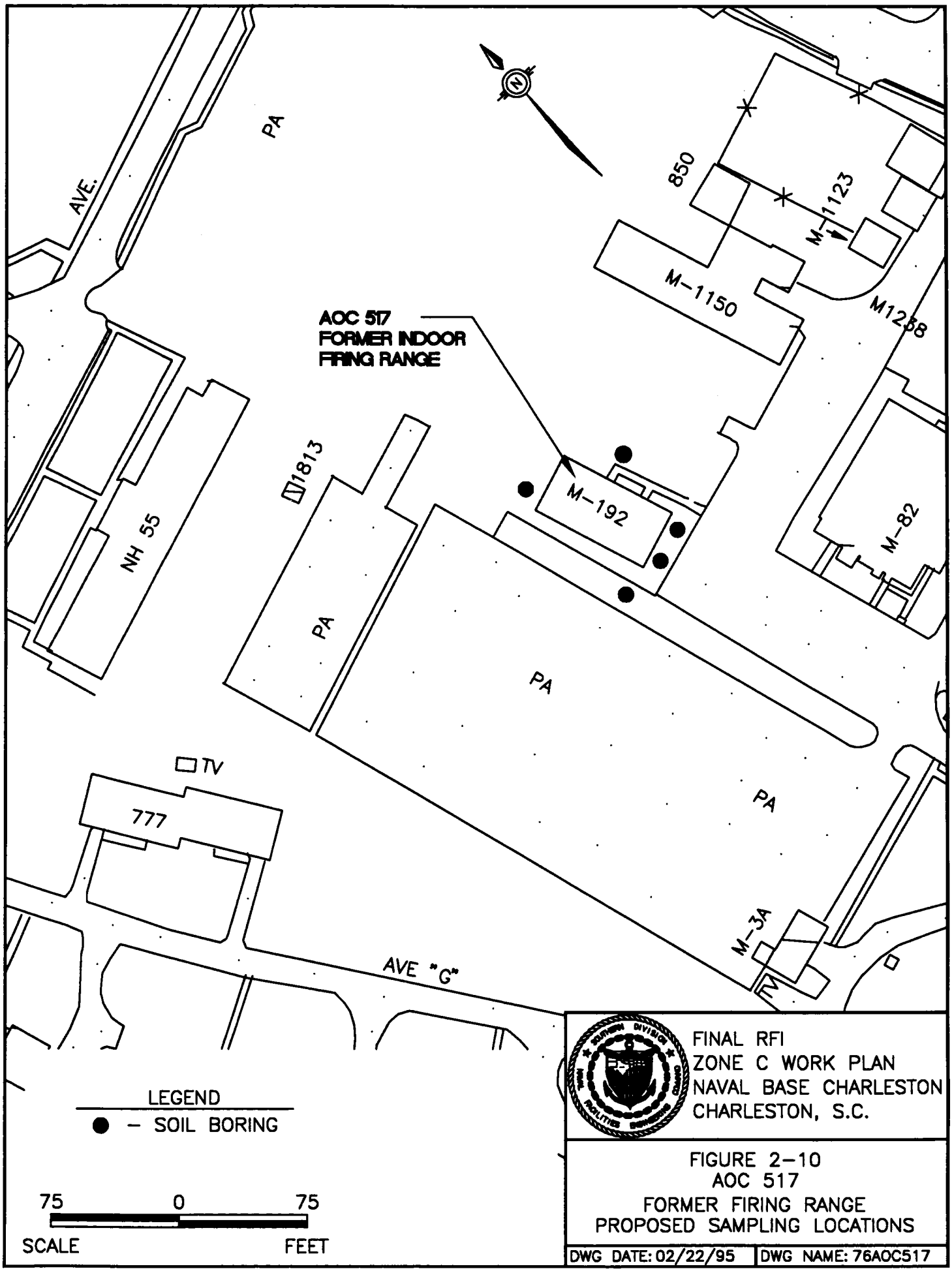
AVE.
PA
850
M-1123
M-1150
M1238
AOC 517
FORMER INDOOR
FIRING RANGE
1813
M-192
M-82
NH 55
PA
PA
PA
TV
777
M-3A
AVE "G"
LEGEND
● – SOIL BORING
75 0 75
SCALE FEET
FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-10
AOC 517
FORMER FIRING RANGE
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/22/95
DWG NAME: 76AOC517

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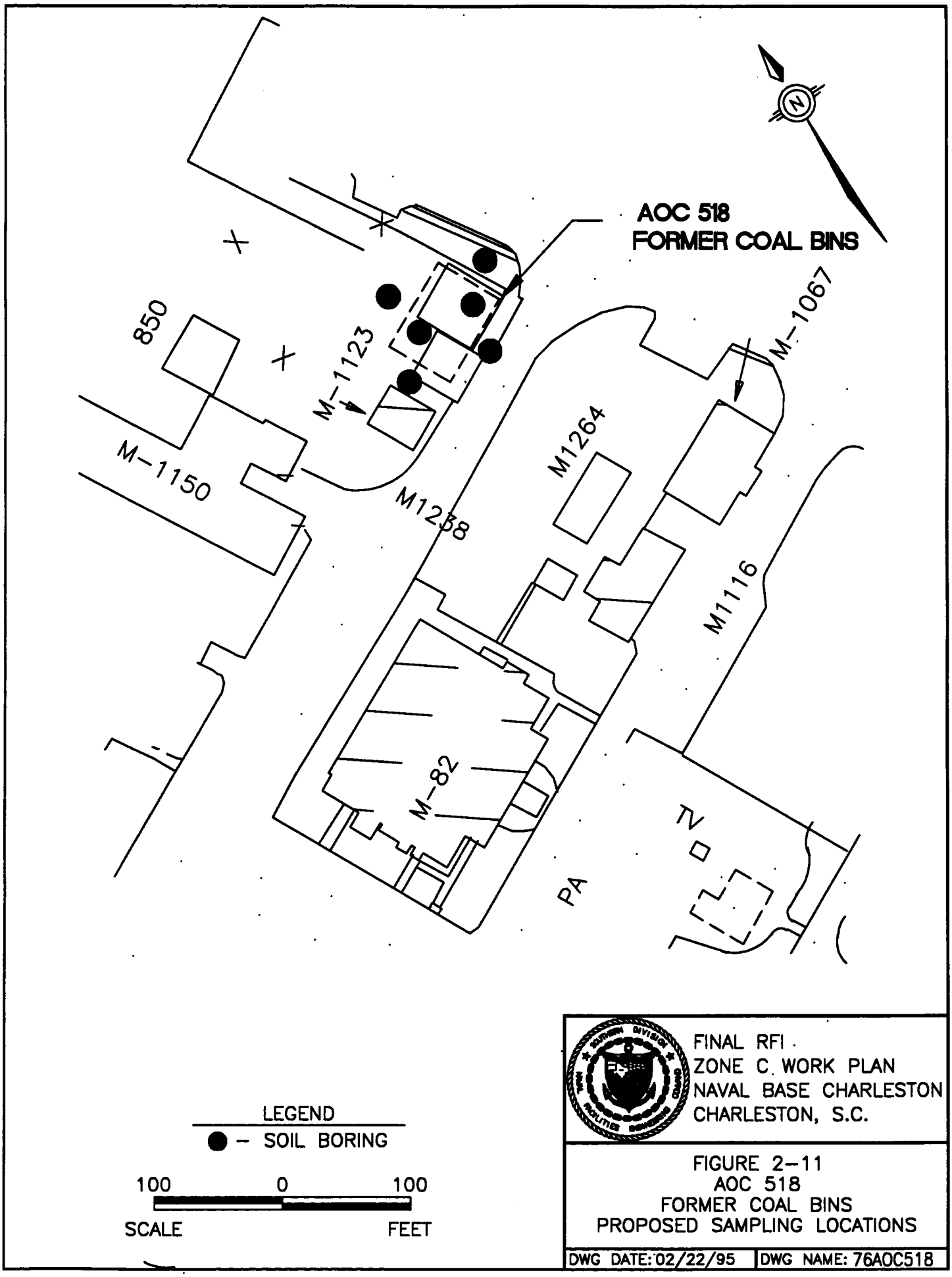
AOC 518
FORMER COAL BINS
850
M-1123
M-1067
M-1150
M1264
M1258
M1116
M-82
PA
N
LEGEND
● – SOIL BORING
100 0 100
SCALE FEET
FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-11
AOC 518
FORMER COAL BINS
PROPOSED SAMPLING LOCATIONS
DWG DATE: 02/22/95
DWG NAME: 76AOC518

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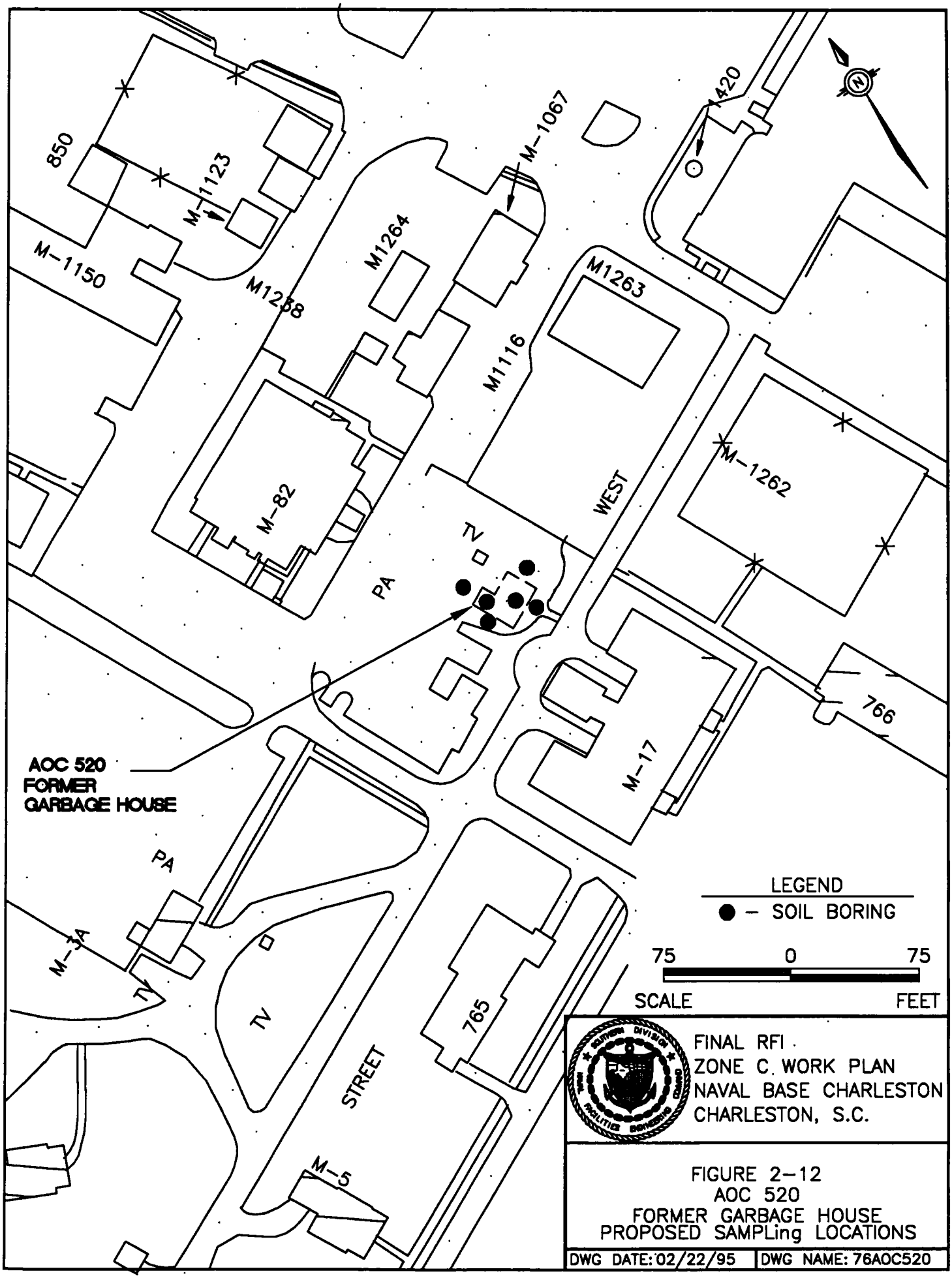

850
M-1123
M-1067
1420
M-1150
M1258
M1264
M1263
M1116
M-82
WEST
M-1262
PA
AOC 520
FORMER
GARBAGE HOUSE
M-17
766
M-1A
TV
765
STREET
M-5
LEGEND
● – SOIL BORING
75 0 75
SCALE FEET
FINAL RFI
ZONE C WORK PLAN
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 2-12
AOC 520
FORMER GARBAGE HOUSE
PROPOSED SAMPLing LOCATIONS
DWG DATE: 02/22/95
DWG NAME: 76AOC520

2.7 AOC 522, Former Grease and Wash Building

AOC 522 is the site of former Building 1252, a grease and wash building, located at the southeast corner of Building 198, near the loading docks. This site has been designated for a CSI. Table 2-14 describes the site.

Table 2-14
AOC 522
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways
AOC 522 **FORMER** **BUILDING 1252**	Former building 1252 was a small garage-type structure used for vehicle maintenance in the early 1950s. It was located adjacent to the present Building 198 shipping and receiving warehouse. No visible evidence of the building remains today, and the area is now mainly covered by asphalt.[a]	Lead Paint Solvent Anti-freeze Battery acid Degreasing solvents Petroleum hydrocarbons (VOA, SVOA, and Metals)	Air **Soil** Soil Gas Groundwater Surface Water

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

2.7.1 Previous Investigations

This site has not been investigated previously.

2.7.2 Treatment Alternatives

Because there are no environmental media data, treatment alternatives for this site cannot be evaluated.

2.7.3 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient to meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- There are currently no data to establish whether COPCs are present for any of the potential migration pathways; and,

- No data exist to support a detailed evaluation of treatment alternatives, if necessary.

2.7.4 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 bolded in Table 2-14.

Land around this site consists of paved parking areas. Potential receptors are site workers or other land users involved with invasive and non-invasive activities 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 underground utility systems in this area could act as a conduit for moving any product released at this facility, and thus could expose those working on any of these underground

systems. The sanitary and storm sewer systems, as well as the railroad system, will be investigated in the Zone L Work Plan.

2.7.5 Objectives

The goal of the CSI is to classify the site as NFI or RFI by using DQO Level III or IV data to determine whether COPCs are present. If an RFI is required, the objective of field investigations shall be to fill the identified data gaps by delineating the horizontal and vertical extent of any soil and/or groundwater contamination as well as the rate of contaminant migration at the sites. Data collection efforts shall also support the technical evaluation of identified remedial options.

2.7.6 Screening Alternatives

No sampling has been conducted to determine the existence of COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of high-quality samples is inadequate to define the extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated. While collecting all soil boring samples and installing all monitoring wells, samples will be screened for VOCs using a PID. All screening results will be recorded in field notebooks and boring logs.

2.7.7 Sampling and Analysis Plan

To fulfill the CSI objectives, the following site-specific sampling and analysis requirements have been proposed. Table 2-15 summarizes the types of samples to be collected and analytical parameters to be used. Proposed sampling locations for AOC 522 are illustrated in Figure 2-13.

Due to the general lack of information regarding this site, proposed sample locations, as illustrated, represent the areas most likely to have been impacted if a release has occurred. The number of samples and sample locations for AOC 522 are based on what is reasonably expected

to provide adequate information to identify the presence of COPCs. All sampling will adhere to NAVBASE *Final Comprehensive RFI Work Plan.*

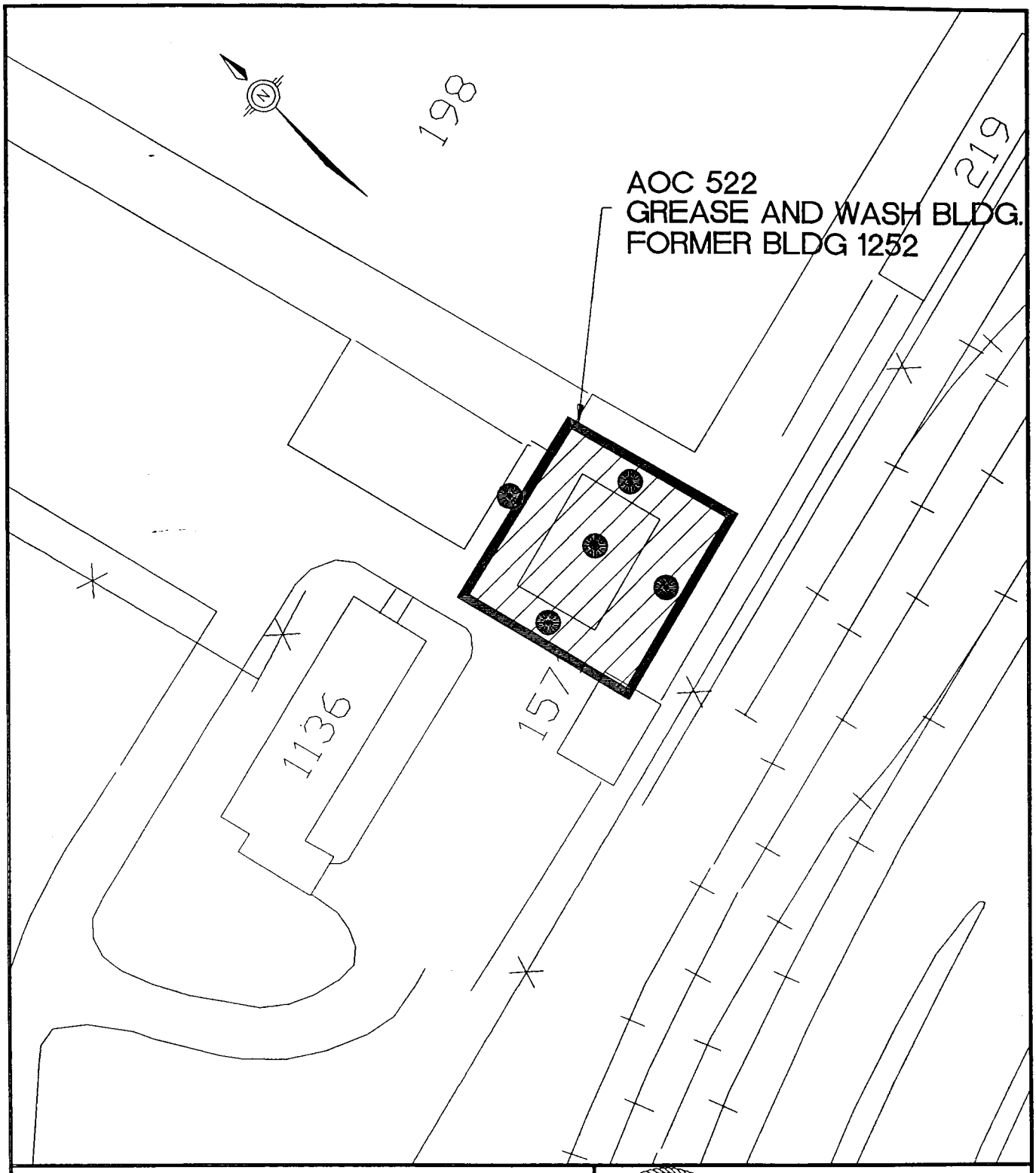
Table 2-15
AOC 522
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3'-5' bgs)	5 5	VOA & SVOA w/ TICs, Metals, Cyanide, Pesticides and PCBs.

Notes:

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation 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 analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at locations where contaminants are most likely to be found. The sample quantities presented do not include QA/QC samples.



LEGEND

- ● – ZONE C SOIL BORINGS
- ◒ – ZONE C DEEP MONITORING WELLS
- ◬ – ZONE C SHALLOW MONITORING WELLS

GRAPHIC SCALE 50 0 50 100

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

FIGURE 2-13
AOC 522
FORMER GREASE & WASH BUILDING
PROPOSED SAMPLING LOCATIONS

DWG DATE: 4/04/96 | DWG NAME: 29AOC522

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2.8 AOC 700, Golf Course Maintenance Building

AOC 700 is the site of a golf course maintenance building, Building 1646, located west of Avenue "D" and north of Hunt Street. This site has been designated for an RFI. Table 2-16 describes the sites.

Table 2-16
AOC 700
Site Information and Description

Number	Description	Materials Generated or Stored	Potential Pathways
AOC 700 GOLF COURSE MAINTENANCE BUILDING	This structure was built in 1975. It has been used for lawnmower storage and repair and pesticide storage and mixing. The building is no longer being used and all chemicals and equipment have been removed.[a]	Acids Solvents Herbicides Pesticides Petroleum Hydrocarbons (VOA, SVOA, Pesticides, Herbicides and Metals)	Air **Soil** Soil Gas Groundwater Surface Water

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

2.8.1 Previous Investigations

This site has not been investigated previously. However, several areas of dark soil were observed on the west and northwest sides of the building. Stressed and dead vegetation was also observed on the west, north and northwest sides of the building.

2.8.2 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 remediation. Data collection efforts will support evaluating these alternatives. Table C-4 (Appendix C) lists treatment alternatives for groundwater; Table C-5 lists treatment alternatives for soil; Table C-6

lists treatment alternatives for the presence of soil gas. Alternatives presented here are for preliminary evaluation only.

2.8.3 Data Gaps

Currently no environmental media data have been collected to characterize this site or to support detailed evaluation of treatment alternatives, if necessary. To ensure data collection efforts are sufficient to meet the stated investigative objectives, the following data gaps have been identified and will be resolved:

- The nature and extent of impact to environmental media (soil, soil-gas and groundwater) from the suspected releases has not been defined.

- No data exist to support a detailed evaluation of treatment alternatives, if necessary.

2.8.4 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 bolded in Table 2-16.

Land around this site ranges from grassy to asphalt areas. Potential receptors are site workers or other land users involved with invasive and non-invasive activities 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.

Runoff patterns, drainage ditches and runoff accumulation areas provide a possible contaminant route to Noisette Creek, approximately 600 feet away. These avenues may result in the exposure to biological receptors other than humans.

The utility system in this area could act as a conduit for moving any product released at this facility, and thus could expose those working on any of these underground systems. The underground utility system will be investigated in the Zone L work plan.

2.8.5 Objectives

The objective of field investigations is to fill the identified data gaps by establishing whether contaminants are present in the identified migration pathways. If COPCs are detected, the horizontal and vertical extent and rate of any soil contamination will be delineated concurrently. Data collection efforts shall also support the technical evaluation of identified remedial options.

2.8.6 Screening Alternatives

No sampling has been conducted to determine the existence of COPCs; therefore, selecting a screening alternative would be premature. If the proposed collection of high-quality samples is inadequate to define the extent of contamination (if present), the feasibility of employing screening methods will be re-evaluated. While collecting all soil boring samples and installing all monitoring wells, samples will be screened for VOCs using a PID. All screening results will be recorded in field notebooks and boring logs.

2.8.7 Sampling and Analysis Plan

To fulfill the objectives, the following site-specific sampling and analysis requirements have been proposed. Table 2-17 summarizes the types of samples to be collected and analytical parameters to be used. Proposed sampling locations for AOCs 700 are illustrated in Figure 2-14.

Due to the general lack of information regarding this site, proposed sample locations, as illustrated, represent the areas most likely to have been impacted if a release has occurred. The number of samples and sample locations for AOC 700 are based on what is reasonably expected to provide adequate information to identify the presence of COPCs. All sampling will adhere to NAVBASE *Final Comprehensive RFI Work Plan.*

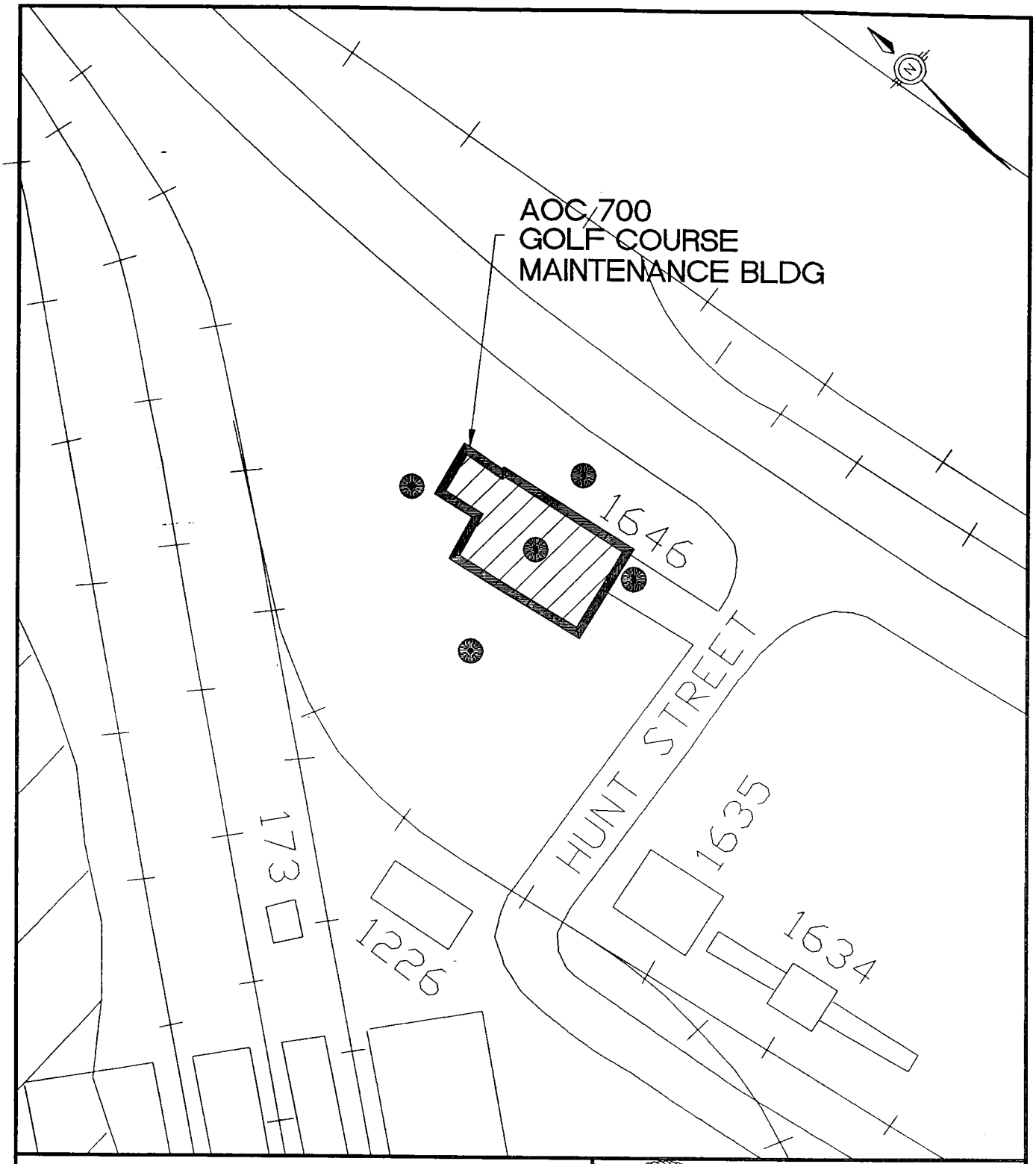
Table 2-17
AOC 700
Sampling Plan

Matrix	Quantity	Analysis
Soil (0-1' bgs) Soil (3'-5' bgs)	5 5	VOA & SVOA w/ TICs, Metals, Cyanide, Pesticides, Herbicides and PCBs.

Notes:

The quantities presented are estimated numbers of samples believed to be needed to fulfill the objectives of the investigation. Expansion of the investigation 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 analysis, as specified in the sampling plan will be used, with a minimum of 10% duplicates analyzed for all Appendix IX constituents at DQO Level IV. Duplicates will be collected at locations where contaminants are most likely to be found. The sample quantities presented do not include QA/QC samples.



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

FIGURE 2-14
AOC 700
GOLF COURSE MAINTENANCE BLDG.
PROPOSED SAMPLING LOCATIONS

DWG DATE: 4/04/96 | DWG NAME: 29AOC700

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

FIGURE 3-1
SYSTEMATIC GRID BASED SAMPLING LOCATIONS
CHARLESTON, SOUTH CAROLINA

Dr by: E/A&H	Tr by:		
Ck by: D.NIESSE	App by:	Sheet 1	
Date: 02/20/95	DWG Name: 29GRID	Of 1	

00070 G03X

4.0 HEALTH AND SAFETY PLAN

EnSafe/Allen and Hoshall is conducting an environmental monitoring program at various specified locations (sites) within NAVBASE. The purpose of the monitoring program is to assess the nature and extent of contamination at these sites and to determine if additional action is required to maintain compliance with environmental regulations.

The base closure team has divided the NAVBASE sites into SWMUs and AOCs which have been grouped into zones for investigative purposes. These SWMUs and AOCs have been grouped into zones for investigative purposes. This Zone-Specific Health and Safety Plan (ZCHASP) has been developed for SWMUs and AOCs located in Zone C.

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

This Work Plan and ZCHASP use both the term COPC "chemical of potential concern" and contaminate of concern. Not all COPCs are necessarily of interest from a human health perspective. COPCs refers to compounds of analytical interest. The analytical interest may be because of public health, regulatory, ecological or other concerns. The term contaminant of concern is used to identify (potential) 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 Code of Federal Regulations (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 Resource Conservation and Recovery Act (RCRA): training 1910.120(e), medical surveillance 1910.120(f), and personal protective equipment (PPE) 1910.120(g).

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

This ZCHASP 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 these tasks may proceed.

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4.2 Zone Characterization

Sites included in this ZCHASP consist of SWMUs and AOCs as identified in the RFI plan for NAVBASE as prepared by E/A&H (Appendix A). Figure 2-1 on page 2-3 shows the location of each SWMU and AOC and the associated sampling locations.

Physical hazards that are inherent in environmental investigations, or present throughout the zone are discussed in Section 4.11. Subsections 4.3 through 4.10 contain site specific health safety information for each site in Zone C. 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 COPCs. COPCs 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 COPC. Rather, one or two of the most toxic or most prevalent contaminants within a class of chemicals are listed. It is in this light that cadmium and chromium have been listed in the health and safety plan as COPCs. 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 COPC 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
• Non-chlorinated solvents	benzene, toluene, xylene, ethylbenzene, 2-butanone and hexane
• Metals/Heavy metals	lead, cadmium, chromium (especially hexavalent chrome), 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 — DDT, DDE, chlordane, dieldrin and endrin

Material Safety Data Sheets (MSDSs) for COPCs are provided in a field MSDS book.

4.2.1 Work Zones

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

- Exclusion Zone (EZ)
- Contaminant Reduction Zone (CRZ)
- Support Zone (SZ)

These work zones will be established and utilized during field work covered under this ZCHASP.

4.2.2 Work Area Access

Authorized personnel will be allowed access to work areas as long as they follow the requirements of this ZCHASP 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 certificate before being allowed to enter a work area.

Subcontractors, DOD oversight personnel, and other site visitors shall demonstrate compliance with HAZWOPER training requirements before entering a work area.

4.3 SWMU 44, Coal Storage Area

SWMU 44 is an active coal pile, in the northern portion of Zone C with drainage ditches to the west and Noisette Creek and wetlands to the north. Table 4-1 describes SWMU 44.

Table 4-1
SWMU 44
Site Information and Description

Number	Description	Materials Generated or Stored
SWMU 44 Coal Pile	The coal storage yard began operations in the 1940s and is used for unloading coal railcars and for the intermediate storage of coal before use at the steam-generation plant (Building 32). The coal pile is currently 80' x 400'.[1]	Coal Coal Derivatives

Note:
[1] Described in the Draft Final RCRA Facility Assessment, (Volume I, November 1994).

Previous investigations conducted at SWMU 44 have focused on sampling surface water and surface water runoff. Previous sampling events detected the presence of metals and TSS in the surface water and surface water runoff. Table 2-2 lists the previous investigations and analytical results for SWMU 44. A map identifying previous sampling locations can be found in Appendix B, Location Maps from Previous Investigations.

Site Activities

Initial site activities include soil borings, soil sampling, sediment 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 stored coal itself is not hazardous, but rainwater percolating through the coal produces runoff water which has been very acidic (pH average as low as 2.5) causing metals to precipitate

and elevate TSS above background. If additional chemicals of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the ZCHASP.

The initial level of PPE for invasive field activities performed at SWMU 44 is modified Level D. The Action Level (AL) for this site is a continuous photoionization detector (PID) reading of 5 parts per million (ppm) or greater in the breathing zone. If this occurs, the required PPE level shall be upgraded to Level C.

4.4 AOC 516, Wash Area (Includes SWMU 47)

AOC 516, a former wash area in Building 233, is currently used as a lead-acid battery charging area. SWMU 47, a former burning dump, is to the southeast. Currently this area contains Buildings NSC-66, NSC-64 and NSC-67, where petroleum product spills have been reported in recent years. These sites have been designated for an RFI. Because of the proximity of SWMU 47 to AOC 516, these sites will be investigated as a single unit. These sites have not been investigated previously. Table 4-2 describes the sites.

Table 4-2
AOC 516 and Associated Site Information and Description

Number	Description	Materials Generated or Stored
AOC 516 Wash Area/ Battery Charging	Building 233 was used for spray washing vehicles and equipment from 1972 until the 1980s. Currently it is used as a lead-acid battery charging facility.[1]	Lead Metals Solvents Battery Acids Petroleum Products
SWMU 47 Burning Dump	This site was a burning dump during the 1920s. Currently, it is an asphalt and grassy area on which Buildings NSC-64, NSC-66 and NSC-67 are located. Petroleum product spills have been reported at these buildings in recent years.[2]	Petroleum Products Products of incomplete combustion Medical waste

Notes:
[1] Described in the Draft Final RCRA Facility Assessment, (Volume II, November 1994).
[2] Described in the Draft Final RCRA Facility Assessment, (Volume I, 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. Field work for this site is described in Section 2.2 of this Work Plan.

Chemical Hazards and PPE Requirements

The contaminants of concern at this site are petroleum products, heavy metals, solvents, and battery acids. Table 4-3 lists exposure guidelines for these compounds.

If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into this ZCHASP.

Table 4-3
Exposure Guidelines for Expected Site Chemical Hazards — AOC 516

Contaminant of Concern	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Ionization Potential (eV)[e]	Flammable Range (% by Volume)
Benzene	4.68 ppm	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	9.25	1.3 to 7.1
Cadmium	NA	0.6 mg/m³ Ceiling	0.05 mg/m³	Potential Occupational Carcinogen	NA	NA
Chromium	NA	1 mg/m³	0.5 mg/m³	NA	NA	NA
Ethylbenzene	140 ppm	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	8.8	1.0 to 6.7
Kerosene	1 ppm	NA	NA	100 mg/m³	6.8	0.7 to 5.0
Lead	NA	0.05 mg/m³	0.05 mg/m³	0.1 mg/m³	NA	NA
Sulfuric Acid	NA	1 mg/m³	1 mg/m³	1 mg/m³	NA	NA
Toluene	40 ppm	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 STEL	8.8	1.3 to 7.1
Xylene	1 ppm [e]	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	8.6	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 of Occupational Safety and Health Administration (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
[e] = Odor Thresholds for Chemicals, *Chemical Hazards in the Workplace,* by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fichman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

The initial PPE level for invasive field activities performed at AOCs 516 and SWMU 47 is modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If this occurs, the required PPE level shall be upgraded to Level C.

4.5 AOC 508, Former Incinerator (Includes AOC 511, Former Oil Storage House)

AOC 508 is the site of a former incinerator, between Avenue H and the west NAVBASE property boundary. Southwest of this site is AOC 511, a former oil storehouse. These sites have been designated as a CSI. These sites will be investigated as a single unit because of their proximity. Table 4-3A describes the sites.

Table 4-3A
AOC 508 and AOC 511
Information and Description

Number	Description	Materials Generated or Stored
AOC 508 INCINERATOR	Former Incinerator 19 operated from 1922 until 1929. Its exact dimensions and operating practices are unknown. Currently the site is a grassy area west of Avenue H and north of AOC 511.[a]	Metals Petroleum Hydrocarbons Products of Incomplete Combustion (VOA, SVOA, Metals, and TPH)
AOC 511 OIL STORAGE	Former Building 16 was used for oil storage from 1922 until approximately 1955. The design features and operating practices of this facility are unknown. Currently the site is a grassy area west of Avenue H and north of Building 762.[a]	Petroleum Hydrocarbons (VOA, SVOA, and TPH)

Notes:
[a] Described in the Draft Final RCRA Facility Assessment, Vol. II, 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 2.3 of this Work Plan.

Chemical Hazards and PPE Requirements

The COCPs at this site are petroleum products, heavy metals, and polynuclear aromatic hydrocarbons. Table 4-4 lists exposure guidelines for representative contaminants of concern. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into this ZCHASP.

The initial PPE level for invasive field activities performed at AOCs 508 and 511 is modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If this occurs, the required PPE level shall be upgraded to Level C.

Table 4-4
Exposure Guidelines for Expected Site Chemical Hazards — AOC 508

Contaminant of Concern	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Ionization Potential (eV)[e]	Flammable Range (% by Volume)
Benzene	4.68 ppm	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	9.25	1.3 to 7.1
Benzo(a) pyrene	NA	0.2 mg/m^3	Suspected Human Carcinogen	NA	NA	NA
Cadmium	NA	0.6 mg/m^3 Ceiling	0.05 mg/m^3	Potential Occupational Carcinogen	NA	NA
Chromium	NA	1 mg/m^3	0.5 mg/m^3	NA	NA	NA
Ethylbenzene	140 ppm	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	8.8	1.0 to 6.7
Kerosene	1 ppm	NA	NA	100 mg/m^3	6.8	0.7 to 5.0
Lead	NA	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3	NA	NA
Mercury	NA	0.05 mg/m^3 Skin	0.05 mg/m^3 Skin	0.05 mg/m^3	NA	NA
Toluene	40 ppm	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 STEL	8.8	1.3 to 7.1
Xylene	1 ppm [a]	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	8.6	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 of Occupational Safety and Health Administration (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*

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

NA = Substance information not available, or substance unlisted.

4.6 AOC 515, Former Incinerator and Paint Shop (Includes AOC 519, Former Boiler House)

AOC 515, a former incinerator and paint shop, and AOC 519, a former boiler house, are both south of Turnbull Avenue and east of NH-55. These sites are both designated for a CSI. Because of the close proximity of these sites they will be discussed as a unit. Table 4-5 describes these sites.

Table 4-5
AOC 515 and Associated Site Information and Description

Number	Description	Material Released or Stored
AOC 515 Incinerator	An incinerator operated at this site in the 1920s and a paint shop replaced it in the 1930s. Currently, it is a gravel parking area east of AOC 519.[1]	Oils Paints Solvents Products of Incomplete Combustion Petroleum Products
AOC 519 Boiler House	A boiler house for the Navy Brig operated at this site from 1922 until 1929. Currently this site is a gravel parking area east of Building NH-55.[1]	Coal Petroleum Products

Note:
[1] Described in the Draft Final RCRA Facility Assessment, (Volume II, 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

The COPCs at this site include oils, metal-based paints, solvents, petroleum hydrocarbons, and polynuclear aromatic hydrocarbons. This site has not been investigated previously. Table 4-6 lists exposure guidelines for contaminants of concern. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into the ZCHASP.

Table 4-6
Exposure Guidelines for Expected Site Chemical Hazards — AOC 515

Contaminant of Concern	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Ionization Potential (eV)	Flammable Range (% by Volume)
Benzene	4.68 ppm	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	9.25	1.3 to 7.1
Benzo(a) pyrene	NA	0.2 mg/m^3	Suspected Human Carcinogen	NA	NA	NA
Ethylbenzene	140 ppm	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	8.8	1.0 to 6.7
Lead	NA	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3	NA	NA
Toluene	40 ppm	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	8.8	1.3 to 7.1
Trichloroethylene	0.5 to 176	50 ppm 200 ppm STEL	50 ppm 200 ppm STEL	25 ppm	9.45	11 to 41
Xylene	1 ppm [e]	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	8.6	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 of Occupational Safety and Health Administration (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
[e] = Odor Thresholds for Chemicals, *Chemical Hazards in the Workplace,* by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fichman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

The initial PPE level for invasive field activities performed at AOCs 515 and 519 is modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If this occurs, the required PPE level shall be upgraded to Level C.

4.7 AOC 523, Former Gas Station (Includes SWMU 49, Lead-Acid Battery Charging Area)

AOC 523 is the site of a former gas station located where Building 198 now stands. This site has been designated as a CSI. These sites will be investigated as a unit because of their proximity. Table 4-7 describes the sites.

Table 4-7
AOC 523
Site Information and Description

Number	Description	Materials Generated or Stored
AOC 523 Gas Station	Former Gas Station (M-1234) operated from 1958 until 1962. Currently the site is covered by the southeastern portion of Building 198. It is unknown if USTs are present.[1]	Lead Petroleum Products

Note:
[1] Described in the Draft Final RCRA Facility Assessment (Volume I, 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 2.5 of this Work Plan.

Chemical Hazards and PPE Requirements

The COPCs at these sites include acids, solvents, heavy metals, and petroleum products. Table 4-8 lists exposure guidelines for contaminants of concern. This site has not been investigated previously. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into this ZCHASP.

The initial PPE level for invasive field activities performed at AOC 523 is modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If this occurs, the required PPE level shall be upgraded to Level C.

Table 4-8
Exposure Guidelines for Expected Site Chemical Hazards — AOC 523

Contaminant of Concern	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Ionization Potential (eV) [e]	Flammable Range (% by Volume)
Benzene	4.68 ppm	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	9.25	1.3 to 7.1
Cadmium	NA	0.6 mg/m³ Ceiling	0.05 mg/m³	Potential Human Carcinogen	NA	NA
Chromium	NA	1 mg/m³	0.5 mg/m³	NA	NA	NA
Ethylbenzene	140 ppm	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	8.8	1.0 to 6.7
Lead	NA	0.05 mg/m³	0.05 mg/m³	0.1 mg/m³	NA	NA
Toluene	40 ppm	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	8.8	1.3 to 7.1
Xylene	1 ppm [a]	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	8.6	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 of Occupational Safety and Health Administration (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
[e] = Odor Thresholds for Chemicals, *Chemical Hazards in the Workplace,* by Nick H. Proctor, Ph.D., James P. Hughes, M.D., F.A.C.P., and Michael L. Fichman, M.D., M.P.H.
NA = Substance information not available, or substance unlisted.

4.8 All other CSI Sites (Includes AOC 510, Geotechnical Laboratory; AOC 512, Former Incinerator; AOC 513, Former Morgue; AOC 517, Indoor Firing Range; AOC 518, Former Coal Bins; AOC 520, Former Garbage House)

Site Activities

Site activities will include soil borings, soil sampling, wide sampling, residue sampling and installing a monitoring well. Subsequent activities will include well development, purging, and sampling as required. Field work for this site is described in Section 2.6 of this Work Plan.

Chemical Hazards and PPE Requirements

The risk assessment performed by E/A&H indicated that numerous chemicals were stored and used at these locations. The major constituents of concern are solvents, heavy metals, petroleum products, coal, and formaldehyde. Table 4-9 lists exposure guidelines for COPCs. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into this ZCHASP.

The initial PPE level for invasive field activities performed at these AOCs will be modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If this occurs, the required PPE level shall be upgraded to Level C.

Table 4-9
Exposure Guidelines for Expected Site Chemical Hazards — Other Sites Designated CSI

Contaminant of Concern	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Ionization Potential (eV) [d]	Flammable Range (% by Volume)
Acetone	100	750 ppm 1,000 ppm STEL	750 ppm 1,000 ppm STEL	250 ppm	9.69	2.6 to 12.8
Benzene	4.68 ppm	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	9.25	1.3 to 7.1
Benzo(a) pyrene	NA	0.2 mg/m^3	Suspected Human Carcinogen	NA	NA	NA

Table 4-9
Exposure Guidelines for Expected Site Chemical Hazards — Other Sites Designated CSI

Contaminant of Concern	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Ionization Potential (eV) [e]	Flammable Range (% by Volume)
Ethylbenzene	140 ppm	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	NA	8.8	1.0 to 6.7
Formaldeyde		0.75 ppm 2 ppm STEL	Suspected Human Carcinogen	0.016 ppm 0.1 ppm STEL	10.88	
Lead	NA	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3	NA	NA
Methyl Ethyl Ketone		200 ppm 300 ppm STEL	200 ppm 300 ppm STEL	200 ppm 300 ppm STEL	9.54	
Methylene Chloride	214	500 ppm 1,000 ppm Ceiling	50 ppm Suspected Human Carcinogen	Potential Occupational Carcinogen	11.32	12 to 19
Toluene	40 ppm	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	8.8	1.3 to 7.1
Trichloroethylene	0.5 to 176	50 ppm 200 ppm STEL	50 ppm 200 ppm STEL	25 ppm	9.45	11 to 41
Xylene	1 ppm [e]	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	8.6	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 of Occupational Safety and Health Administration (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*

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

NA = Substance information not available, or substance unlisted.

4.9 AOC 522, Former Grease and Wash Building

AOC 522 is the site of former Building 1252, a grease and wash building, located at the southeast corner of Building 198, near the loading docks. This site has been designated for a CSI. Table 4-10 describes the site.

Table 4-10
AOC 522
Site Information and Description

Number	Description	Materials Generated or Stored
AOC 522 FORMER BUILDING 1252	Former building 1252 was a small garage-type structure used for vehicle maintenance in the early 1950s. It was located adjacent to the present Building 198 shipping and receiving warehouse. No visible evidence of the building remains today, and the area is now mainly covered by asphalt.[1]	Lead Paint Solvents Ethylene Glycol Sulfuric Acid Degreasing Solvents Petroleum Hydrocarbons

Notes:
[1] Described in the *Final RCRA Facility Assessment*, Vol. II, June 1995

Site Activities

Site activities will include coring, soil borings, and soil sampling. Field work for this site is described in Section 2.7 of this Work Plan.

Chemical Hazards and PPE Requirements

The COPCs at these sites include ethylene glycol, lead, paints, solvents, sulfuric acid, and petroleum hydrocarbons. Table 4-11 lists exposure guidelines for contaminants of concern. This site has not been investigated previously. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into this ZCHASP.

The initial PPE level for invasive field activities performed at this AOC will be modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If this occurs, the required PPE level shall be upgraded to Level C.

Table 4-11
Exposure Guidelines For Expected Site Chemical Hazards - AOC 522

Chemical Name	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Autoignition Temp.(°F)	Flammable range (% by volume)
Acetone	100	750 ppm 1000 ppm STEL	750 ppm 1000 ppm STEL	250 ppm	869	2.6 to 12.8%
Benzene	4.68 ppm	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	1097	1.3 to 7.1%
Ethylbenzene	140 ppm	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	N.A.	860	1.0 to 6.7%
Ethylene Glycol	N.A.	50 ppm Ceiling	50 ppm Ceiling	N.A.	751.8	3.2 to 15.3%
Kerosene	1	N.A.	N.A.	100 mg/m^3	444	0.7 to 5%
Lead	N.A.	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3	N.A.	N.A.
Methylene Chloride	214	500 ppm 1000 ppm Ceiling	50 ppm Suspected Human Carcinogen	Potential Occupational Carcinogen	1184	12 to 19%
Methyl Ethyl Ketone	10	200 ppm 300 ppm STEL	200 ppm 300 ppm STEL	200 ppm 300 ppm STEL	960	1.8 TO 11.5%
Sulfuric Acid	N.A.	1 mg/m^3	1 mg/m^3 3 mg/m^3 STEL	1 mg/m^3	N.A.	N.A.
Tetraethyl Lead	N.A.	0.075 mg/m^3 Skin	0.1 mg/m^3 Skin	<0.1 mg/m^3	229.8	1.8 to ?%
Trichloroethylene	0.5 to 176	50 ppm 200 ppm STEL	50 ppm 200 ppm STEL	25 ppm	770	11 to 41%

Table 4-11
Exposure Guidelines For Expected Site Chemical Hazards - AOC 522

Chemical Name	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Autoignition Temp.(°F)	Flammable range (% by volume)
Toluene	40 ppm	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	996.5	1.3 to 7.1%
Xylene	N.A.	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	N.A.	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 of Occupational Safety and Health Administration (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*

NA = Substance information not available, or substance unlisted.

4.10 AOC 700, Golf Course Maintenance Building

AOC 700 is the site of a golf course maintenance building, Building 1646, located west of Avenue "D" and north of Hunt Street. This site has been designated for an RFI. Table 4-12 describes the sites.

Table 4-12
AOC 700
Site Information and Description

Number	Description	Materials Generated or Stored
AOC 700 **GOLF COURSE MAINTENANCE BUILDING**	This structure was built in 1975. It has been used for lawnmower storage and repair and pesticide storage and mixing. The building is no longer being used and all chemicals and equipment have been removed.[1]	Sulfuric Acids Solvents Herbicides Pesticides Petroleum Hydrocarbons

Notes:
[1] Described in the *Final RCRA Facility Assessment*, Vol. V, June 1995.

Site Activities

Site activities will include coring, soil borings, and soil sampling. Field work for this site is described in Section 2.8 of this Work Plan.

Chemical Hazards and PPE Requirements

The COPCs at these sites include sulfuric acids solvents, pesticides, herbicides, and petroleum hydrocarbons. Table 4-13 lists exposure guidelines for contaminants of concern. This site has not been investigated previously. If additional contaminants of concern are discovered during the investigation, MSDSs will be immediately obtained, reviewed, and incorporated into this ZCHASP.

Table 4-13
Exposure Guidelines For Expected Site Chemical Hazards - AOC 700

Chemical Name	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Autoignition Temp.(°F)	Flammable range (% by volume)
Acetone	100	750 ppm 1000 ppm STEL	750 ppm 1000 ppm STEL	250 ppm	869	2.6 to 12.8%
Benzene	4.68 ppm	1 ppm 5 ppm STEL	0.1 ppm Confirmed Human Carcinogen	0.1 ppm 1 ppm STEL Potential Occupational Carcinogen	1097	1.3 to 7.1%
Chlordane	N.A.	0.5 mg/m^3 Skin	0.5 mg/m^3 Skin	Potential Occupation Carcinogen	N.A.	N.A.
DDT	N.A.	1 mg/m^3 Skin	1 mg/m^3	0.5 mg/m^3	N.A.	N.A.
DDE	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Dieldrin	0.041	0.25 mg/m^3 Skin	0.25 mg/m^3 Skin	Potential Occupational Carcinogen	N.A.	N.A.
Endrin	N.A.	0.1 mg/m^3 Skin	0.1 mg/m^3 Skin	N.A.	N.A.	N.A.
Ethylbenzene	140 ppm	100 ppm 125 ppm STEL	100 ppm 125 ppm STEL	N.A.	860	1.0 to 6.7%
Ethylene Glycol	N.A.	50 ppm Ceiling	50 ppm Ceiling	N.A.	751.8	3.2 to 15.3%
Kerosene	1	N.A.	N.A.	100 mg/m^3	444	0.7 to 5%
Lead	N.A.	0.05 mg/m^3	0.05 mg/m^3	0.1 mg/m^3	N.A.	N.A.
Malathion	N.A.	10 mg/m^3	10 mg/m^3 Skin	15 mg/m^3	N.A.	N.A.
Methylene Chloride	214	500 ppm 1000 ppm Ceiling	50 ppm Suspected Human Carcinogen	Potential Occupational Carcinogen	1184	12 to 19%
Methyl Ethyl Ketone	10	200 ppm 300 ppm STEL	200 ppm 300 ppm STEL	200 ppm 300 ppm STEL	960	1.8 TO 11.5%
Parathion	N.A.	0.1 mg/m^3 Skin	0.1 mg/m^3 Skin	0.05 mg/m^3	N.A.	N.A.

Table 4-13
Exposure Guidelines For Expected Site Chemical Hazards - AOC 700

Chemical Name	Odor[a] Threshold	OSHA PEL[b]	ACGIH TLV[c]	NIOSH REL[d]	Autoignition Temp.(°F)	Flammable range (% by volume)
Sulfuric Acid	N.A.	1 mg/m³	1 mg/m³ 3 mg/m³ STEL	1 mg/m³	N.A.	N.A.
Tetraethyl Lead	N.A.	0.075 mg/m³ Skin	0.1 mg/m³ Skin	<0.1 mg/m³	229.8	1.8 to ?%
Trichloroethylene	0.5 to 176	50 ppm 200 ppm STEL	50 ppm 200 ppm STEL	25 ppm	770	11 to 41%
Toluene	40 ppm	100 ppm 150 ppm STEL	50 ppm	100 ppm 150 ppm STEL	996.5	1.3 to 7.1%
Xylene	N.A.	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	100 ppm 150 ppm STEL	N.A.	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 of Occupational Safety and Health Administration (NIOSH) to support OSHA. *NIOSH Pocket Guide to Chemical Hazards, June 1990.*
NA = Substance information not available, or substance unlisted.

The initial PPE level for invasive field activities performed at this AOC will be modified Level D. The AL for this site is a continuous PID reading of 5 ppm or greater in the breathing zone. If this occurs, the required PPE level shall be upgraded to Level C.

4.11 Zone 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 include heat related illnesses, severe weather, aboveground utilities, working with and around drill rigs and heavy equipment, uneven terrain, slippery surfaces, lifting, and the presence of poisonous flora and fauna such as poison ivy, and snakes.

4.11.1 Radiological Site Screening

Radioactive materials/hazards are potentially present within Zone C 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 C shall be contacted by E/A&H employees and contractors to determine if the CNSY verification surveys have been completed in Zone C. 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 C, including but not limited to walkover investigations, drilling, well development, soil sampling, water sampling, and trenching.

4.11.2 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.

4.11.3 Procedures and Equipment for Extreme Hot or Cold Weather Conditions

The Site Supervisor and the Site Health and Safety Officer (SHSO) shall be aware of the potential for heat stress and other environmental illnesses. When necessary, work regimens shall be implemented that minimize the potential for employee illness. At these times field staff need to be reminded to regularly look at their co-workers for signs or symptoms of hot or cold induced illness. For a discussion of the more common heat and cold related illnesses and their associated symptoms (see CHASP Section 6.5.1).

Monitoring of heat stress conditions (area and/or 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).

Note: Rather than measuring oral temperatures which can be influenced by external factors such as breathing through one's mouth, temperature measurements using infrared measurements of the tympanic membrane will be used as oral temperature equivalents.

4.11.4 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.

4.11.5 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.

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4.12 Employee Protection

Employee protection for this project is addressed in several ways including the use of: work limitations (Section 4.12.1), specified personal protective equipment (Section 4.12.2), air monitoring (Section 4.12.3), establishment of action levels (Section 4.12.3), decontamination procedures (Section 4.13), standard safe work practices (Section 4.14), and general rules of conduct (Section 4.15).

4.12.1 Work Limitations

All site activities will be conducted during daylight hours 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 at the site.

4.12.2 Selection of Personal Protective Equipment

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 ZCHASP must be made or reviewed by the Project Health and Safety Officer (PHSO).**

Initial Level of Personal Protective Equipment

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).

4.12.3 Air Monitoring

Air monitoring using a PID and/or other appropriate sampling equipment will be conducted prior to beginning field activities at a new EZ and during ground-disturbing activities. The PID will be field calibrated to measure volatile organic compounds (VOCs) relative to a 100 ppm isobutylene standard. If VOCs are detected down-hole, colorimetric detector tubes and/or other sampling media may be used to determine the identity and approximate the concentration 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 action level 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 couple of 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. This action level was selected after reviewing available site-specific information and previous sampling data for each site in Zone C. If additional information becomes available, the AL for this zone or specific sites may be revised. 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.

If breathing zone levels 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 4-14 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 levels 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.

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 levels 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 levels 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

Table 4-14
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).	• Positive-pressure full-face piece self-contained breathing apparatus or positive pressure supplied air respirator with escape self-contained breathing apparatus (SCBA).
	• 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.	• Fully-encapsulating chemical protective suit.
	• Potential situations include those where immersion may occur, vapors may be generated or splashing may occur through site activities.	• Chemical-resistant inner and outer gloves.
	• Where atmospheres are oxygen deficient.	• Steel toe and steel shank chemical resistant boots.
	• When the type(s) and or potential concentration of toxic substances are not known.	• 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.
Level B	• When respiratory protection is warranted and cartridge respirators are not appropriate. Examples of these conditions are:	• Chemical resistant clothes, coveralls.
	• When work area may contain less than 19.5 percent oxygen,	• Positive-pressure full-face, SCBA or supplied airline system (SAR) with escape bottle.
	• When expected contaminants do not have appropriate warning properties e.g. vinyl chloride, or	• Hard hat.
	• When cartridges are not available to protect against all COPCs.	• Chemical resistant outer and inner gloves.
	• Hazards associated with limited dermal exposure are not significant.	• Steel toe and steel shank boots.
		• Chemical resistant outer boots.
Level C	• When respiratory protection is warranted and cartridge respirators are appropriate.	• Chemical resistant coveralls.
	• When PID readings exceed the Action Level.	• Full-face, air purifying respirator equipped with cartridges suitable for the hazard.

Table 4-14
Level of Protection and Criteria

Level of Protection	Criteria for Use	Equipment
Level C	• When air monitoring indicates airborne concentration of a chemical is 50 percent or more of the PEL or TLV	• Hard hat.
	• And the work area contains at least 19.5 percent oxygen.	• Chemical resistant outer and inner gloves.
Modified Level D	• When chemical contamination is known or expected to be present, yet inhalation risk is	• Chemical resistant coveralls.
	• Low and respiratory protection is not required.	• Chemical resistant outer gloves; inner gloves or glove liners, optional.
	• Site contaminants may be absorbed through the skin.	• Steel toe and steel shank boots.
	• The "default level" of PPE required when the ZCHASP does not specify another level of PPE.	• Hard hat.
	• And the work area has at least 19.5 percent oxygen.	• Safety glasses with side shields or safety goggles.
		• Optional: chemical resistant outer boots.
Level D	• When minimal or no chemical contamination is expected.	• Inner gloves or chemical-resistant gloves needed to handle soil or water samples.
	• When ZCHASP specifies Level D protection is adequate.	• Steel toe and steel shank boots.
	• And the work area has at least 19.5 percent oxygen.	• Hard hat.
		• Safety glasses with side shields or safety goggles.
		• Optional: coveralls and disposable outer boots.
		• Work clothes.

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 or was not 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.

4.13 Personnel and Equipment Decontamination

As needed, a CRZ will be established adjacent 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 4-15 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 4-15
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.

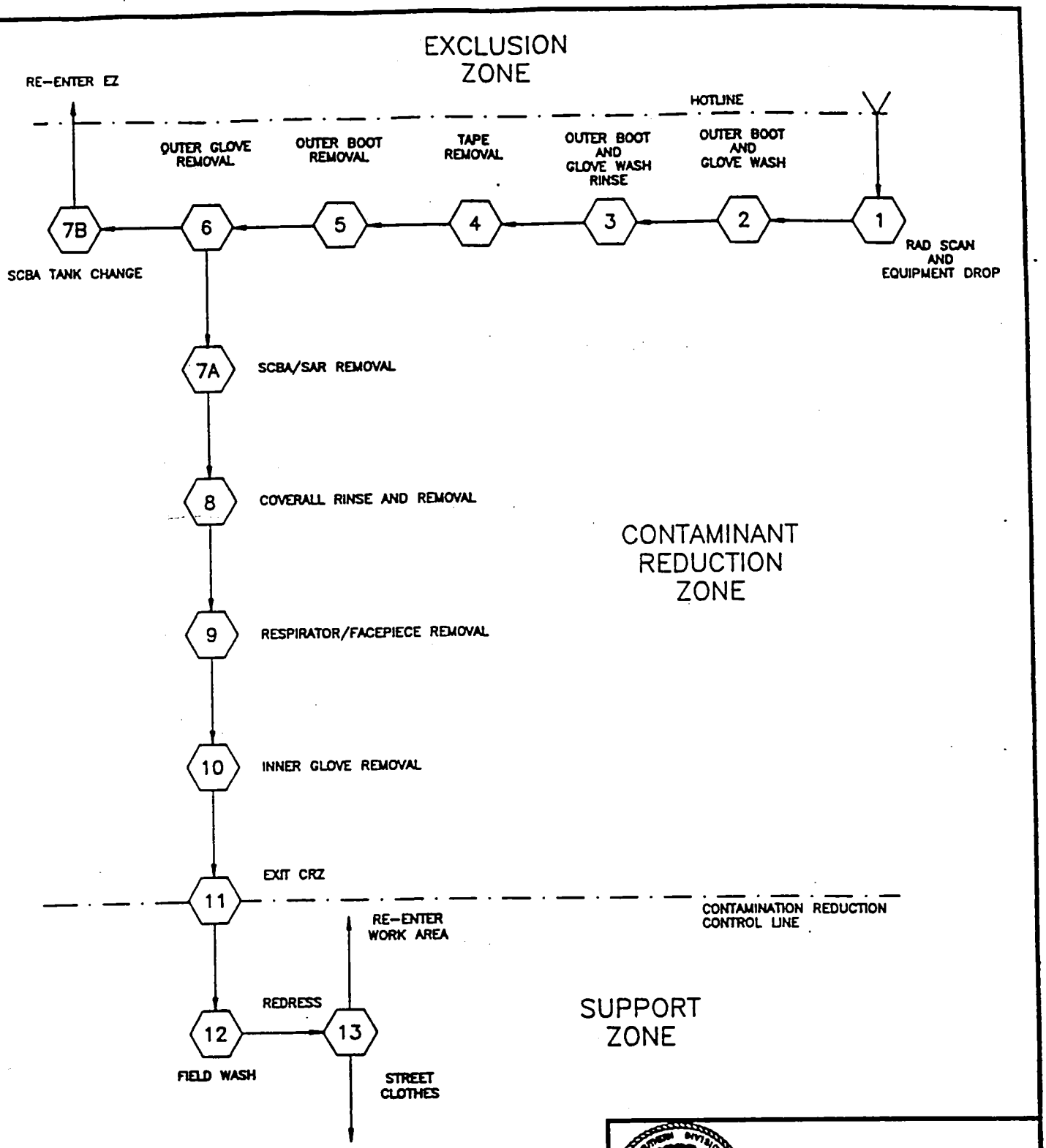
Figure 4-1 shows one method of laying out an acceptable decontamination area for Level B PPE. There are numerous ways to lay out decontamination areas. Decontamination areas for Level C and Modified D PPE should be based on this concept of decontamination, but can be scaled back in accordance with the 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.

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.

4.13.1 Full Decontamination Procedures

Workers shall utilize 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 shift or when work is completed for an EZ. Procedures for rest breaks and changing SCBA tanks and cartridges are described in Section 4.13.2. 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 towards the SZ.



ZONE C 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

1. ***Equipment drop.*** Deposit equipment used onto plastic drop cloths or into a plastic lined tub. All gross contamination should be removed here; fine cleaning and decontamination of equipment may be completed here or elsewhere. Equipment that is still contaminated must be wrapped and taped prior to 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 of 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 dispose 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 work day with a soap and water solution.

4.13.2 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 dispose 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.

4.13.3 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.

4.14 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 on 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.

4.15 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 which is 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 contractor's 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.

4.16 Medical Monitoring Program

See CHASP Section 7.0.

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4.17 Authorized Personnel

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

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

4.17.1 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 CHASP, Sections 8.1, 8.2 and 8.3 respectively.

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4.18 Emergency Information

All hazardous waste site activities present a potential 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.

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 Officer 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/Project Manager	(803) 884-0029
Ginny Gray	EnSafe/Allen & Hoshall, Task Order Manager	(513) 248-8449
David Isenberg	EnSafe/Allen & Hoshall, PHSO	(615) 399-8800

* 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.

Should an emergency occur or should a potential emergency arise, the following persons shall be fully appraised of the situation a soon as practical: Joe Camp, Caretaker; Matthew Hunt and Brian Stockmaster, SOUTHDIV Engineer-in-Charge; Todd Haverkost, E/A&H Manager Charleston Operations; Ginny Gray, Project Manager; and David Isenberg, E/A&H PHSO. As appropriate, other persons may also need to be contacted.

4.18.1 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.

4.18.2 Emergency Procedures

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.

In the event of an emergency, the following emergency procedures should be followed:

- If it is necessary to evacuate the area, immediately proceed to a rally point and remain there until instructed otherwise.
- Utilize planned escape routes.

- 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 ZCHASP.

4.19 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 ZCHASP 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 HSWA portion of RCRA Part B Permit (EPA SCO 170 022 560) states that, *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 submitted 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

Ebasco Services, Inc. August 1987. *Interim RCRA Facility Assessment of USN Charleston Naval Shipyard.*

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

EnSafe/Allen & Hoshall. August 1994. *Final Comprehensive RFI Work Plan.*

EnSafe/Allen & Hoshall. May 31, 1994 (revised November 1994). *Draft RCRA Facility Assessment for Naval Base Charleston, Volume I.*

EnSafe/Allen & Hoshall. June 13, 1994 (revised November 1994). *Draft RCRA Facility Assessment for Naval Base Charleston, Volume II.*

EnSafe/Allen & Hoshall. October, 1994. *Final Zone H Work Plan.*

EnSafe/Allen & Hoshall. April 1994. *Charleston Naval Base Site Files.*

Environmental Science and Engineering, Inc. May 1983. *Initial Assessment Study for the Charleston Naval Base.*

Park, Drennan A., *The Groundwater Resource of Charleston*, Berkeley and Dorchester Counties, S.C. Water Resources Commission. Report # 139, 1985.

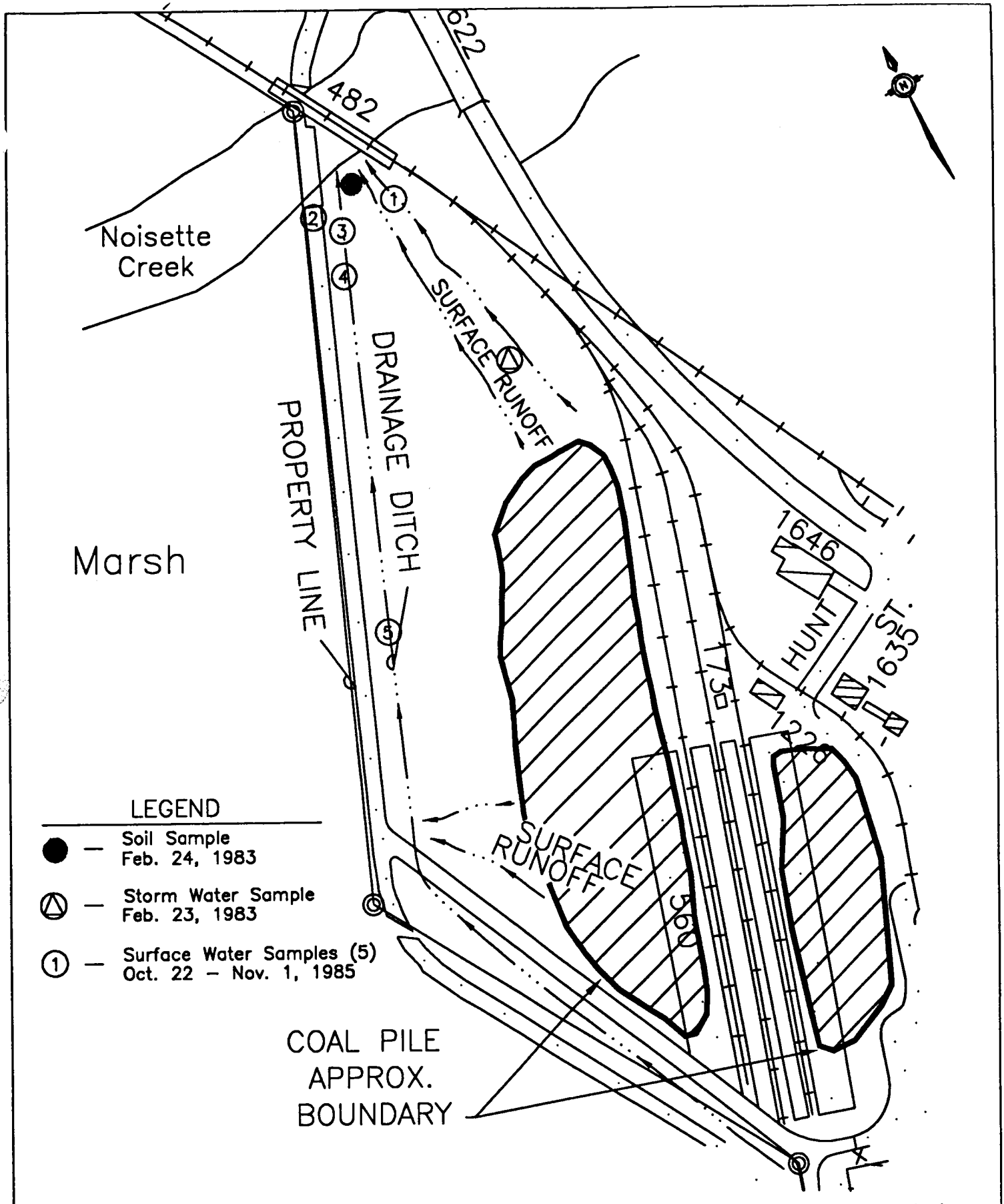
United States Environmental Protection Agency, Permit, EPA I.D. No. SCD 170 022 260.

APPENDIX A
ZONE C SUMMARY

Table A.1 Zone C SWMU Summary				
SWMU Number	**SWMU Name**	**Investigative Approach**	**NAVABASE Location**	**Work Plan Reference**
44	Coal Storage	RFI	South Side of Noisette Creek	Section 2.1
47	Burning Dump	RFI	Building NSC 64, 66, and 67 Area	Section 2.2

Table A.2 Zone C AOC Summary				
AOC Number	**AOC Name**	**Investigative Approach**	**NAVBASE Location**	**Work Plan Reference**
508	Incinerator (19)	CSI	West of Avenue H	Section 2.3
510	Geotechnical Laboratory (NH-21)	CSI	Avenue H	Section 2.6
511	Oil House (Building 16)	CSI	Building 762 Area	Section 2.3
512	Incinerator Building (67)	CSI	SW of Storage Area and Building 1079	Section 2.6
513	Parking Lot/Old Morgue	CSI	Building NH-55 Area	Section 2.6
515	Building 51 Incinerator, Paint Shop	CSI	West of Building 233	Section 2.4
516	Building 233 Wash Area	RFI	Building 233	Section 2.2
517	Former Firing Range M-192	CSI	Building M-192	Section 2.6
518	Coal Bins	CSI	Building M-1257 Area	Section 2.6
519	Former Boiler House (1081)	CSI	South of Turnbull Avenue	Section 2.4
520	Garbage House (M-1051)	CSI	North of 2nd Street	Section 2.6
523	Gas Station Storage (M-1252)	CSI	SE Corner of Building 198	Section 2.5

APPENDIX B
LOCATION MAPS FROM PREVIOUS INVESTIGATIONS



SWMU 44

COAL STORAGE PILE

PREVIOUSLY IDENTIFIED SAMPLING LOCATIONS

APPENDIX C
TREATMENT ALTERNATIVES

Table C-1
Treatment Alternatives For Groundwater/Surface Water Runoff
SWMU 44

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)
	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)

Table C-1
Treatment Alternatives For Groundwater/Surface Water Runoff
SWMU 44

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	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
		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 C-1
Treatment Alternatives For Groundwater/Surface Water Runoff
SWMU 44

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,e]	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 C-1
Treatment Alternatives For Groundwater/Surface Water Runoff
SWMU 44

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
		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 C-1
Treatment Alternatives For Groundwater/Surface Water Runoff
SWMU 44

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 C-1
Treatment Alternatives For Groundwater/Surface Water Runoff
SWMU 44

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
		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 C-1
Treatment Alternatives For Groundwater/Surface Water Runoff
SWMU 44

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,e]	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
		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

Table C-1
Treatment Alternatives For Groundwater/Surface Water Runoff
SWMU 44

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	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
		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 C-2
Treatment Alternatives Sediment/Soil
SWMU 44

Data Quality Objective Elements	Remedial Technology	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 Nitrogen, 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 C-2
Treatment Alternatives Sediment/Soil
SWMU 44

Data Quality Objective Elements	Remedial Technology	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 C-2
Treatment Alternatives Sediment/Soil
SWMU 44

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 C-3
Treatment Alternatives For the Presence of Soil Gas
SWMU 44

Data Quality Objective Elements	Remedial Technology	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 C-3
Treatment Alternatives For the Presence of Soil Gas
SWMU 44

Data Quality Objective Elements	Remedial Technology	Process Option[b,c]	Description	Data Quality Needs
		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 C-4
Treatment Alternatives For Groundwater
AOC 516 and Associated Site

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 C-4
Treatment Alternatives For Groundwater
AOC 516 and Associated Site

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 C-4
Treatment Alternatives For Groundwater
AOC 516 and Associated Site

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 C-4
Treatment Alternatives For Groundwater
AOC 516 and Associated Site

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 C-4
Treatment Alternatives For Groundwater
AOC 516 and Associated Site

Data Quality Objective Elements	Remedial Technology[a]	Process Option[b,c]	Description	Data Quality Needs
		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 C-4
Treatment Alternatives For Groundwater
AOC 516 and Associated Site

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 C-4
Treatment Alternatives For Groundwater
AOC 516 and Associated Site

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
		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 C-4
Treatment Alternatives For Groundwater
AOC 516 and Associated Site

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	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
		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

Table C-4
Treatment Alternatives For Groundwater
AOC 516 and Associated Site

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	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
		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 C-5
Treatment Alternatives for Soil
AOC 516 and Associated Site

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 C-5
Treatment Alternatives for Soil
AOC 516 and Associated Site

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 C-5
Treatment Alternatives for Soil
AOC 516 and Associated Site

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 C-6
Treatment Alternatives For the Presence of Soil Gas
AOC 516 and Associated Site

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 and 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 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 C-6
Treatment Alternatives For the Presence of Soil Gas
AOC 516 and Associated Site

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 and soil	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
	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

APPENDIX D

HEALTH AND SAFETY PLAN ACCEPTANCE AND ACCIDENT REPORT FORMS

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 Number: 2903-08420

Contract Number: N62467-89-D-0318

Project: Zone C - 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

EMPLOYEE EXPOSURE HISTORY FORM

Employee: _____

Job Name: _____

Date(s) From/To: _____

Hours Onsite: _____

Contaminants (Suspected/Reported):

_____

_____

_____

_____

_____

_____

_____

(See Attached Laboratory Analysis)

PLAN FEEDBACK FORM

Problems with plan requirements:

Unexpected situations encountered:

Recommendations for revisions:

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 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 threating medical emergencies. For other medical services please use Baker Hospital.

Nearest Hospital

Charleston Naval Hospital
McMillan Avenue
Charleston, South Carolina

Emergency Room Telephone: (803) 743-7011
General Information Number: (803) 753-7000

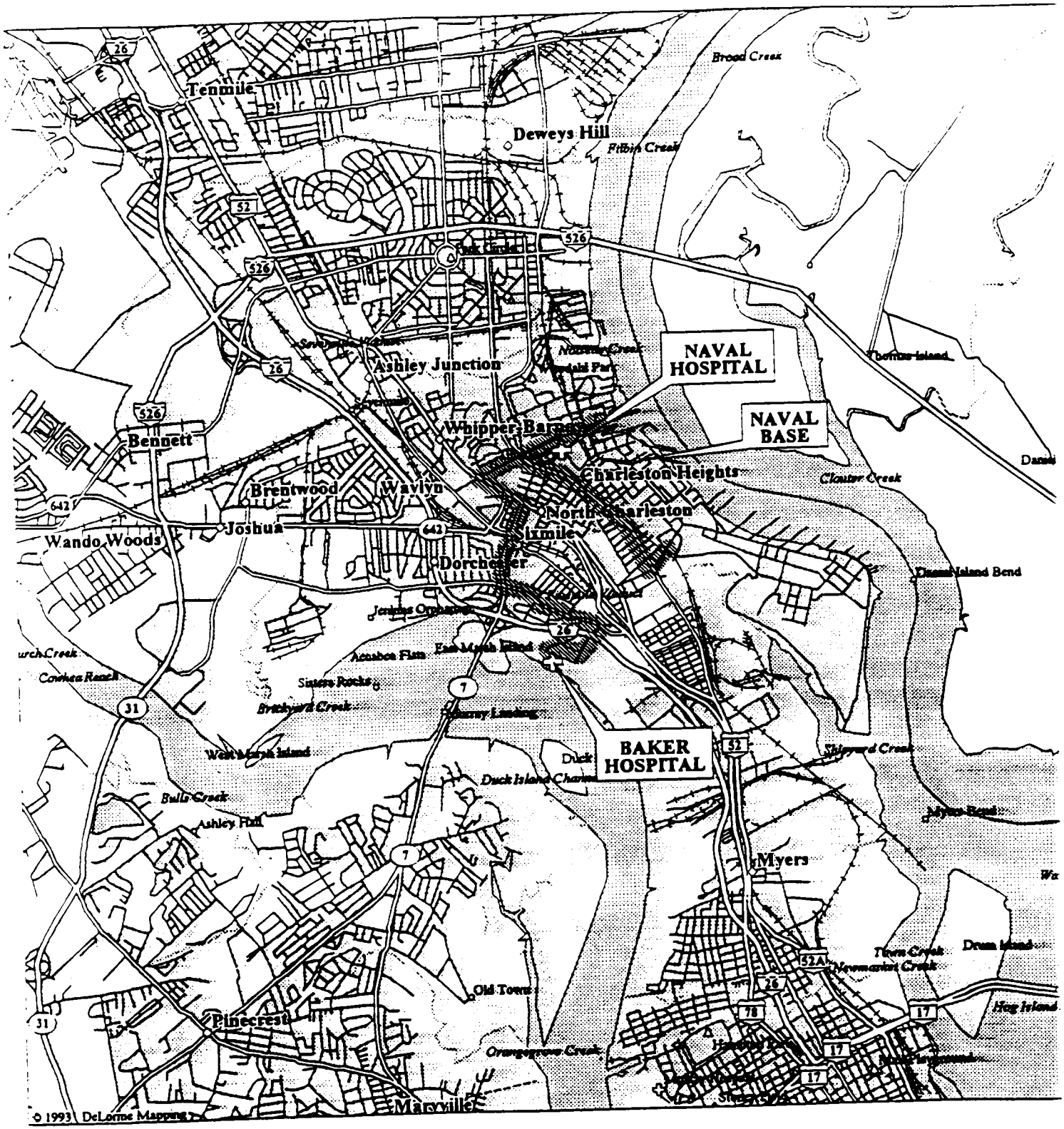
Directions to Charleston Naval Hospital From the Main Gate of the Charleston Naval Shipyard.

1) Refer to following figure.

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

3) Proceed west, toward Rivers Road.

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.



LEGEND

- Population Center
- State Route
- Geo Feature
- Town, Small City
- Hospital
- Park
- Interstate, Turnpike
- US Highway
- County Boundary
- Street, Road
- Hwy Ramps
- Street, Road
- Major Street/Road
- State Route
- Interstate Highway
- US Highway
- Railroad
- River
- Airfield
- Land Mass
- Open Water

Mag 13.00
Fri Jun 24 18:37:09 1994

Scale 1:62,500 (at center)

1 Miles

2 KM