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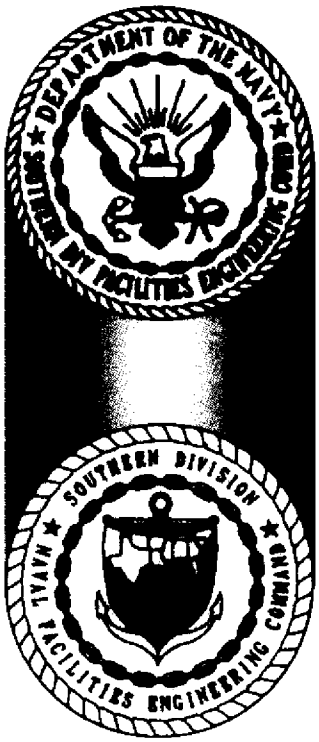
RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT ADDENDUM CORRECTIVE MEASURES STUDY WORK PLAN COMBINED SOLID WASTE MANAGEMENT UNIT 23 (SWMU 23) ZONE E CNC CHARLESTON SC

11/27/2002

CH2M HILL

RFI REPORT ADDENDUM

RFI Report Addendum and CMS Work Plan
Combined SWMU 23, Zone E



Charleston Naval Complex
North Charleston, South Carolina

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

CH2M-Jones

November 2002

Contract N62467-99-C-0960

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November 27, 2002

Mr. David Scaturo
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Re: RFI Report Addendum and CMS Work Plan (Revision 0) – Combined SWMU 23, Zone E

Dear Mr. Scaturo:

Enclosed please find four copies of the RFI Report Addendum and CMS Work Plan (Revision 0) for Combined SWMU 23 in Zone E of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

The principal author of this document is Sam Naik. Please contact him at 770/604-9182, extension 255, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Rob Harrell/Navy, w/att
Gary Foster/CH2M HILL, w/att

RFI REPORT ADDENDUM

RFI Report Addendum and CMS Work Plan
Combined SWMU 23, Zone E

Charleston Naval Complex
North Charleston, South Carolina

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

PREPARED BY
CH2M-Jones

November 2002

Revision 0
Contract N62467-99-C-0960
158814.ZE.PR.01

Contents

Certification Page for RFI Report Addendum and CMS Work Plan (Revision 0) – Combined SWMU 23, Zone E

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

South Carolina

P.E. No. 21428

Dean Williamson, P.E.

11/25/2002

Date

Contents, Continued

Appendices

Acronyms and Abbreviations

AOC	Area of concern
AST	Aboveground storage tank
BCT	BRAC Cleanup Team
BEQ	Benzo[a]pyrene equivalent
BRAC	Base Realignment and Closure Act
BRC	Background reference concentration
CA	Corrective action
CAP	Corrective action plan
CMS	Corrective measures study
CNC	Charleston Naval Complex
COC	Chemical of concern
COPC	Chemical of potential concern
CSI	Confirmatory Sampling Investigation
DAF	Dilution attenuation factor
DET	Environmental Detachment Charleston
EnSafe	EnSafe Inc.
EPA	U.S. Environmental Protection Agency
FRE	Fixed-point risk evaluation
HHRA	Human Health Risk Assessment
HI	Hazard index
ILCR	Incremental lifetime cancer risk
IM	Interim measure
LUC	Land use control
MCL	Maximum contaminant level
MCS	Media cleanup standard
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter

Acronyms and Abbreviations, Continued

mg/kg	Milligrams per kilogram
NAVBASE	Naval Base
NFA	No further action
NTU	Nephelometric turbidity unit
OWS	Oil/water separator
PCB	Polychlorinated biphenyl
RAO	Remedial action objective
RBC	Risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RGO	Remedial goal option
RI	Remedial investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SSL	Soil screening level
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TDS	Total dissolved solids
UST	Underground storage tank
VOC	Volatile organic compound
WWTS	Wastewater treatment system

Section 1.0

1.0 Introduction

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

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

In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation and remediation services at the CNC. This submittal has been prepared by CH2M-Jones to complete the RCRA Facility Investigation (RFI) for Solid Waste Management Units (SWMUs) 23 and 63, and Areas of Concern (AOC) 540 through 543 in Zone E of CNC. All of these SWMUs and AOCs together are hereafter referred to as Combined SWMU 23 in this report. The location of this site in Zone E is shown in Figure 1-1. Figure 1-2 shows an aerial photograph of the site.

1.1 Background

The Combined SWMU 23 area is located in and around Building 226. Prior to the construction of Building 226 in 1976, this area of Zone E originally included Buildings 1026, 73, and 1387, which were all demolished prior to the construction of Building 226. Building 1026 was used as a field electric shop and a storehouse. Building 73 was a battery charging area. No information is available regarding the historic operations at Building 1387.

SWMU 23

SWMU 23 is located outside Building 226 on the northeast corner, and is the location of the former wastewater treatment system (WWTS) associated with Building 226. The WWTS building is a concrete structure built around 1983 to replace an older system. The newer WWTS was installed to handle chrome effluent, acid/alkali effluent from metal plating, and cadmium effluent. The WWTS consisted of rinse water pumps, holding tanks, transfer

pumps, a clarifier, a neutralization tank, and a plate and frame filter press. The WWTS is no longer in use.

SWMU 63

SWMU 63 is in the area occupied by former Building 73, a battery charging station which operated from 1941 to approximately 1970. Currently the site is occupied by Building 226 and it is used as a valve repair shop in support of the shipyard and as a storage building.

AOC 540

AOC 540 consists of Building 226 and includes the former location of Building 73 (SWMU 63). Operations conducted at AOC 540 include a former pump and valve test area, a plating area, and a hydraulic repair area. A wet scrubber, plating dip tanks, a sludge pit, and a waste treatment facility were associated with this facility. Currently, the former pump and valve test areas and the hydraulic repair areas in Building 226 are being used as a valve repair shop and for storage in support of the shipyard. The plating tanks are not being used.

AOC 541

AOC 541 is the area of former Building 38, an oil storage house, which operated from 1909 until 1939, and was demolished in 1970. No other information was found during the RFI regarding its historical operating practices. The site is currently an asphalt parking lot between Buildings 6 and 226, west of Building 226.

AOC 542

AOC 542 is located in the area of former Building 22, which was a paint shop and oxyacetylene plant. Operations of the oxyacetylene plant began in 1922, and in 1943 the building was converted into a paint shop and served that purpose until it was demolished in 1976. During this period, paint stripping using chemicals and abrasives was conducted. Currently this site is an open paved area between Buildings 3, 6, and 226.

AOC 543

AOC 543 is the site of former Building 1026, which was constructed in 1922 and used as a storehouse until 1943. From 1943 to 1955, the site was a field electric shop. From 1955 until approximately 1970, this site was used again as a storehouse. This area is now under the footprint of Building 226.

A review of historical engineering drawings for the Combined SWMU 23 site shows that railroad lines were installed between 1929 and 1935 adjacent to and across Combined SWMU 23. A copy of the the site location from the Public Works Map of the Charleston

Navy Shipyard dated June 30, 1935, depicting the presence of railroad lines at the site is provided in Appendix A of this report.

The materials of concern, which were indicated in the *Final Zone E RFI Work Plan, Revision 1* (EnSafe Inc. [EnSafe]/Allen & Hoshall, 1995) for these sites are as follows:

- **SWMU 23:** Sulfuric acid, sodium metabisulfite, sodium hydroxide, potassium hydroxide, chromium, and cadmium.
- **SWMU 63:** Acids and metals.
- **AOC 540:** Acids, metals, hydraulic fluid, and petroleum hydrocarbons.
- **AOCs 541 and 543:** Petroleum hydrocarbons.
- **AOC 542:** Acids, metals, paints, solvents, acetylene gas, and abrasive grit.

This area of Zone E is zoned M-2 (marine industrial) for future land use.

The RCRA Permit designated SWMU 23 for a RFI and the rest of the sites within Combined SWMU 23 for a Confirmatory Sampling Investigation (CSI). To fulfill the RFI objectives for SWMU 23 and the CSI objectives for the remaining sites, soil and groundwater samples were collected in accordance with the *Final Zone E RFI Work Plan*. Although the site is zoned for industrial land use, a focused Corrective Measures Study (CMS) Work Plan is also provided in this submittal, in order to address potential remedies for chemicals of concern (COCs) detected in site surface soil.

The RFI was initially conducted by EnSafe, and the *Zone E RFI Report, Revision 0* (EnSafe, 1997) was prepared and submitted during 1997. Regulatory review was conducted on this document and a draft response to the comments from SCDHEC were prepared by the Navy/EnSafe team. These comments and responses are included in Appendix B of this document.

1.2 Purpose of the RFI Report Addendum

This submittal has been prepared by CH2M-Jones to complete the RFI for Combined SWMU 23 in Zone E of the CNC. This RFI Report Addendum includes a summary of previous RFI investigations and conclusions, and discusses the refinement of COCs, existing site conditions, and surrounding land use.

Prior to changing the status of any site in the CNC RCRA CA permit, the BRAC Cleanup Team (BCT) agreed that the following closeout issues should be considered:

- Status of the RFI
- Presence of metals (inorganics) in groundwater
- Potential linkage to SWMU 37, Investigated Sanitary Sewer at the CNC
- Potential linkage to AOC 699, Investigated Storm Sewer at the CNC
- Potential linkage to AOC 504, Investigated Railroad Lines at the CNC
- Potential linkage to surface water bodies (Zone J)
- Potential contamination associated with oil/water separators (OWSs)
- Relevance or need for land use controls (LUCs) at the site

Information regarding these issues is provided in this RFI Report Addendum to expedite evaluation of closure of the site.

1.3 Report Organization

This RFI Report Addendum consists of the following sections, including this introductory section:

1.0 Introduction – Presents the purpose of the report and background information relating to the RFI Report Addendum.

2.0 Summary of RFI Conclusions for Combined SWMU 23 – Summarizes the conclusions from the RFI investigations and risk evaluations for Combined SWMU 23, as presented in the *Zone E RFI Report, Revision 0* (EnSafe, 1997).

3.0 Interim Measures and UST/AST Removals at Combined SWMU 23– Provides information regarding any interim measures (IMs) or tank removal activities performed at the site.

4.0 Summary of Additional Investigations – Summarizes information, if any, collected after completion of the *Zone E RFI Report, Revision 0.*

5.0 COPC/COC Refinement – Provides further evaluation of chemicals of potential concern (COPCs) based on RFI and additional data to assess them as COCs.

6.0 Summary of Information Related to Site Closeout Issues – Discusses the various site closeout issues that the BCT agreed to evaluate prior to site closeout.

7.0 Recommendations – Provides recommendations for proceeding with the necessary corrective action process.

8.0 CMS Work Plan for Combined SWMU 23- Provides recommendations for proceeding with the CMS for this site.

9.0 References – Lists the references used in this document.

Appendix A contains Figure A-1, which shows the site location from the Public Works Map of the Charleston Navy Shipyard dated June 30, 1935, depicting the presence of railroad lines at the site.

Appendix B contains responses to SCDHEC comments for Combined SWMU 23 from the *Zone E RFI Report, Revision 0* (EnSafe, 1997).

Appendix C contains excerpts from the RFI report, including a summary of detections of chemicals and a groundwater flow map for the site vicinity.

Appendix D contains a copy of underground storage tank (UST) Removal Report for USTs 6A and 6B, prepared by the Environmental Detachment Charleston (DET, 1996).

Appendix E contains the site-specific soil screening level (SSL) calculations for methylene chloride at Combined SWMU 23, for the paved and unpaved scenarios.

All figures and tables appear at the end of their respective sections.

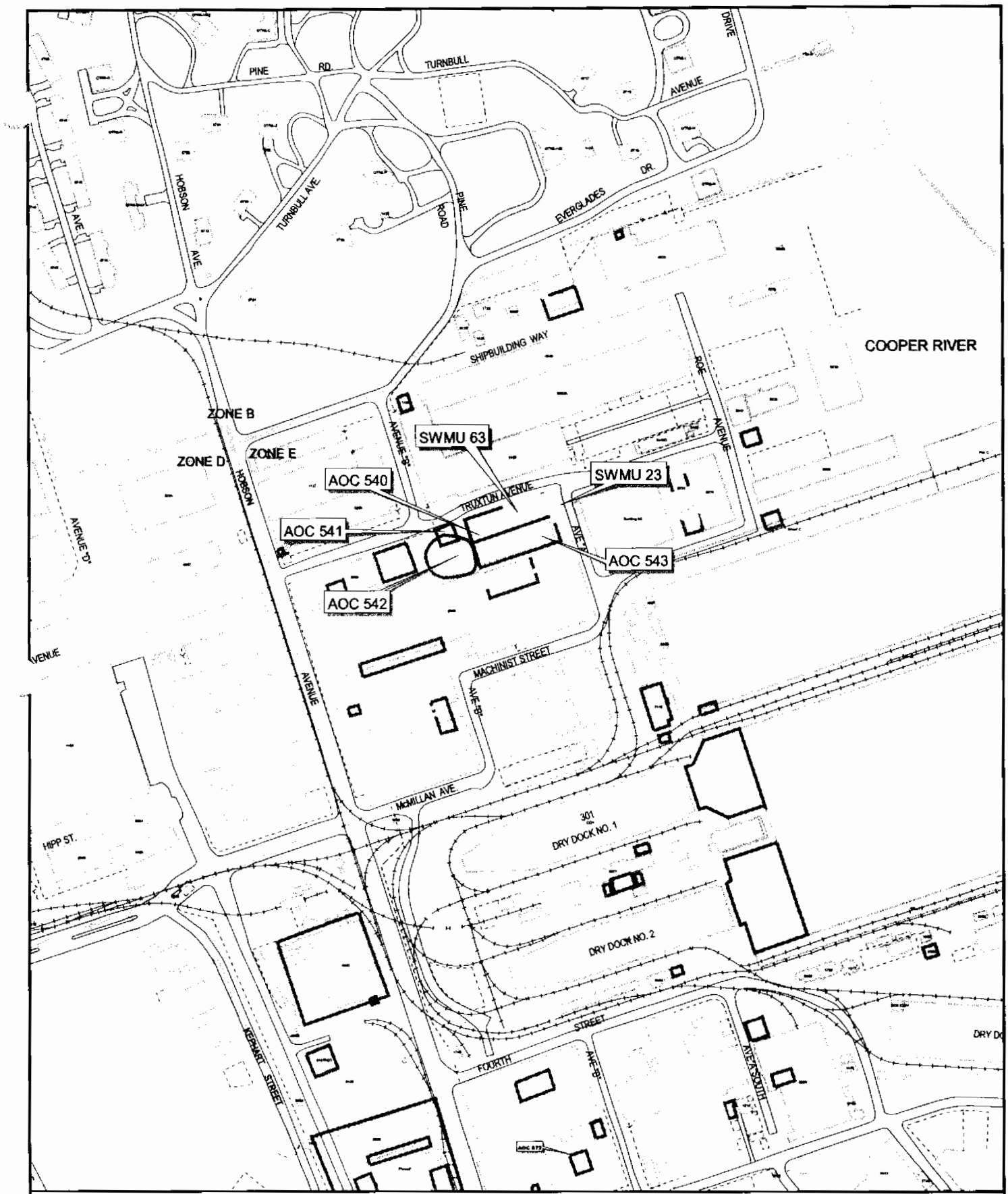

Figure 1-1
Location of Combined SWMU 23 in Zone E
Charleston Naval Complex

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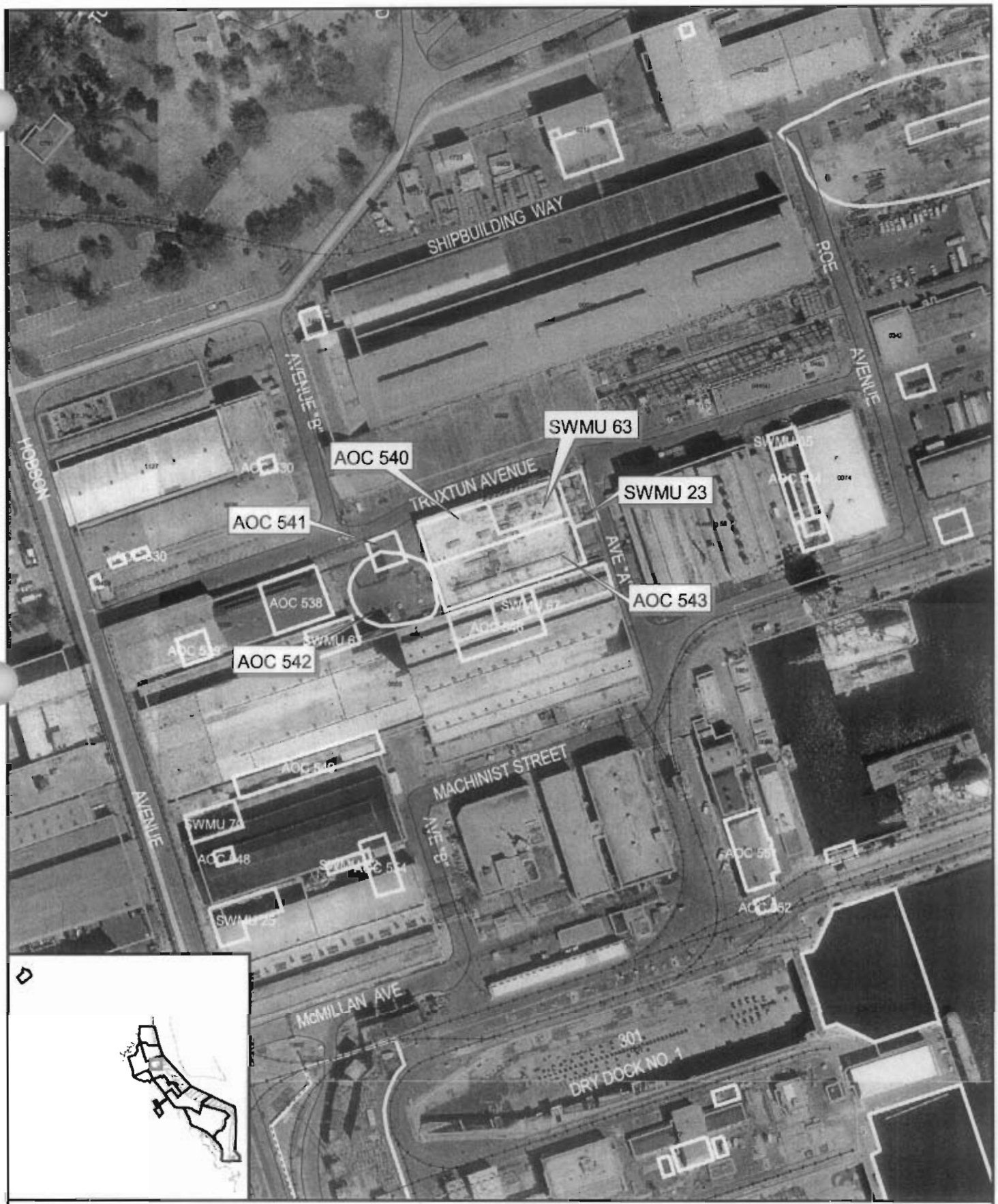

Figure 1-2
Aerial Photograph of Combined SWMU 23
Zone E
Charleston Naval Complex

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Section 2.0

2.0 Summary of RFI Conclusions for Combined SWMU 23

This section summarizes the results and conclusions from the soil and groundwater investigations conducted at Combined SWMU 23 during 1995 through 1997, as reported in the *Zone E RFI Report, Revision 0* (EnSafe, 1997). Figure 2-1 shows the soil and groundwater sampling locations.

The RFI report presented the results of these investigations and conclusions concerning contamination and risk, as summarized in the following sections. A further evaluation of COCs at this combined site is provided in Section 5.0. The relevant excerpts from the *Zone E RFI Report, Revision 0,* including summary tables of soil and groundwater detections and a groundwater flow map for the site vicinity, are provided in Appendix C.

2.1 Soil Sampling and Analysis

Soil was sampled during two sampling events at Combined SWMU 23. During the first sampling event, 19 surface and 15 co-located subsurface samples were collected. These boring locations were identified as E023SB001 through E023SB003, E063SB001 through E063SB003, E540SB001, E541SB001, E542SB001 through E542SB007, and E543SB001 through E543SB004. Four proposed subsurface samples were not collected due to subsurface obstructions. These samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/polychlorinated biphenyls (PCBs), cyanides, metals, organotins and pH. There are no unpaved surface soils around the site.

During the second sampling event, one surface and one co-located subsurface soil sample were collected. This boring was identified as E023SB004. The samples were analyzed for SVOCs and metals.

2.1.1 Surface Soil Results

During the initial RFI, surface soil detections of organic compounds were screened against the U.S. Environmental Protection Agency (EPA) Region III industrial risk-based concentrations (RBCs). Surface soil detections of inorganic compounds were evaluated against the EPA Region III industrial RBCs and the Zone E background reference concentrations (BRCs). Detected concentrations of organic and inorganic analytes exceeding their respective screening criteria are as follows:

- **VOCs:** No VOCs exceeded the screening criteria.
- **SVOCs:** Benzo[a]pyrene equivalents (BEQs) in two surface soil samples exceeded their respective screening criteria. BEQs exceeded the industrial RBC of 780 micrograms per kilogram ($\mu g/kg$) for benzo[a]pyrene in the sample from E023SB004 at 1,100 $\mu g/kg$, and in the sample from E542SB005 at 1,690 $\mu g/kg$.
- **Pesticides/PCBs:** No pesticide detections exceeded the screening criteria. One PCB detection for aroclor-1254 exceeded its former industrial RBC of 740 $\mu g/kg$ in E542SB006 at 1,200 $\mu g/kg$. This value is below the current EPA Region III industrial RBC of 2.9 mg/kg.
- **Dioxins:** No dioxins were detected in surface soil samples.
- **Inorganics:** No inorganics exceeded the screening criteria.

2.1.2 Subsurface Soil Results

During the RFI, subsurface soil detections of organic compounds were compared with generic soil screening levels (SSLs) (using a dilution attenuation factor [DAF]=10). Subsurface soil detections of inorganic compounds were compared with generic SSLs (using a DAF=10) and the Zone E BRCs. Detected concentrations of organic and inorganic compounds from subsurface soil samples are as follows:

- **VOCs:** No VOCs exceeded the screening criteria.
- **SVOCs:** No SVOCs exceeded the screening criteria.
- **Pesticides/PCBs:** Two pesticides, alpha-BHC and dieldrin exceeded their respective SSLs in subsurface soil samples. Alpha-BHC exceeded its SSL of 0.4 $\mu g/kg$ in E542SB002 at 3.3 $\mu g/kg$. Dieldrin exceeded its SSL of 1 $\mu g/kg$ in E543SB004 at 4.5 $\mu g/kg$. No PCBs exceeded their screening criteria.
- **Dioxins:** Dioxins were detected in subsurface soil at TEQ concentrations ranging from 0.026 to 6.8 ng/kg. These detections were not compared to SSLs in the Revision 0 Zone E RFI report because no SSLs were available at the time the report was prepared. Currently , no generic SSLs are available for any dioxin congeners. EPA Region III's October 2000 RBC table provides an SSL for only the 2,3,7,8 TCDD congener of 4.3 ng/kg (based on a DAF=10). A single detection of this congener was reported in subsurface soil samples, at a concentration of 1.34 ng/kg, well below the EPA Region III SSL value.
- **Inorganics:** Six inorganics (antimony, cadmium, cobalt, copper, lead, and nickel) were reported as exceeding the SSL screening value or BRC. Each of these chemicals were further evaluated in the fate and transport assessment portion of the RFI report and concluded to not be COCs for soil.

2.2 Groundwater Sampling and Analysis

During the RFI for Combined SWMU 23, eight shallow groundwater monitoring wells identified as E023GW001, E063GW001, E063GW002, E542GW001 through E542GW004, and E543GW001 and one deep groundwater monitoring well identified as E023GW01D, were installed. Groundwater was sampled during four sampling events from 1996 to 1997. During the first two sampling events, groundwater samples were analyzed for VOCs, SVOCs, pesticides/PCBs, metals, cyanides, chlorides, sulfates, pH, and total dissolved solids (TDS). During the second sampling event, all of the above parameters except pesticides/PCBs were analyzed. During the third and fourth events, only inorganics, TDS, sulfates, chlorides and pH were analyzed. During the RFI, detections in groundwater samples were compared with the EPA Region III tap water RBCs, maximum contaminant levels (MCLs), and the Zone E BRCs for shallow and deep aquifers.

2.2.1 Shallow Groundwater Results

The detections in shallow groundwater samples were found as follows:

- **VOCs:** The only detection of VOCs above screening criteria was acetone at 800 micrograms per liter ($\mu g/L$) in well E543GW001. This detection exceeded the tap water RBC of 370 $\mu g/L$. No MCL has been established for acetone.
- **SVOCs:** No SVOCs exceeded screening criteria.
- **Inorganics:** The RFI report stated that among detected inorganic analytes, aluminum and iron exceeded their respective screening criteria.
  - Aluminum was detected in well E542GW001 at a concentration of 5,090 $\mu g/L$, above both its tap water RBC of 3,700 $\mu g/L$ and the Zone E shallow groundwater BRC of 2,810 $\mu g/L$. No MCL has been established for aluminum.
  - Iron was detected in seven wells above its tap water RBC of 1,100 $\mu g/L$. There is no primary MCL for iron. No shallow groundwater BRC has been established for iron in Zone E.
- **Pesticides/PCBs:** There were no pesticide or PCB detections above laboratory detection limits.

2.2.2 Deep Groundwater Results

The following detections were found in the deep groundwater samples at the site:

- **VOCs:** There were no VOC detections above laboratory detection limits.
- **SVOCs:** There were no SVOC detections above screening criteria.
- **Inorganics:** There were no inorganic detections above screening criteria.

- **Pesticides/PCBs:** There were no pesticide or PCB detections above laboratory detection limits.

2.3 RFI Human Health Risk Assessment (HHRA)

The *Zone E RFI Report, Revision 0* (EnSafe, 1997) used a fixed-point risk evaluation (FRE) approach at this site. The FRE considered site resident and site worker scenarios during the FRE. The detailed risk assessment for the combined SWMU 23 sites are presented in Sections 10.4.6 of the RFI report.

2.3.1 Soils

The RFI report concluded that the site did not present unacceptable risks for the industrial worker scenario. For the future unrestricted (i.e., residential) land use scenario, BEQs and lead were identified as COCs for surface soil. The RFI report did not identify any COCs in the subsurface soil at Combined SWMU 23.

2.3.2 Groundwater

No COCs were retained in shallow or deep groundwater at Combined SWMU 23.

2.4 RFI Conclusions and Recommendations

The *Zone E RFI Report, Revision 0* recommended that a CMS be conducted for surface soil COCs (BEQs and lead) at Combined SWMU 23.

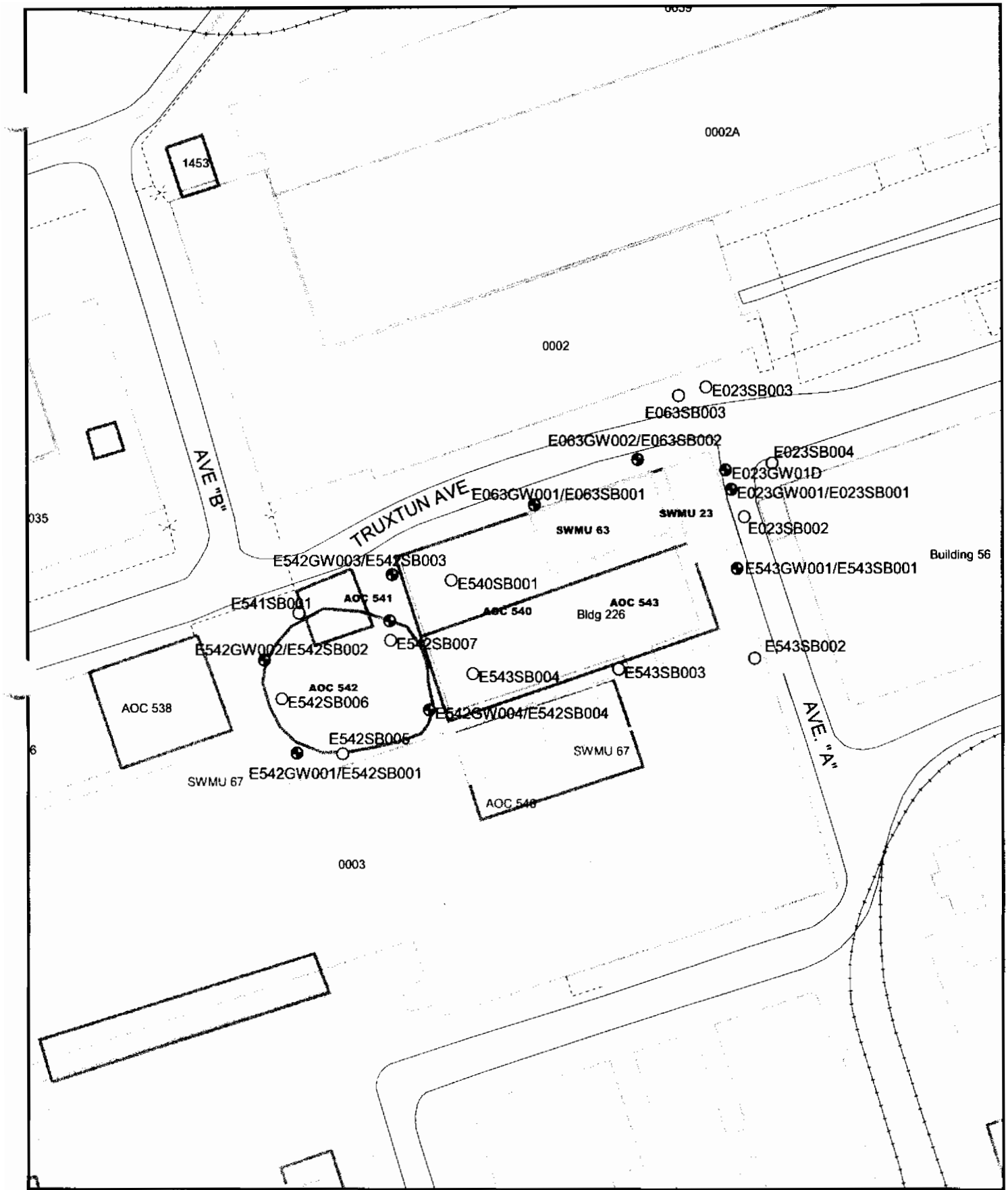

Figure 2-1
RFI Sampling Locations
Combined SWMU 23, Zone E
Charleston Naval Complex

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Section 3.0

3.0 Summary of Interim Measures and UST/AST Removals at Combined SWMU 23

3.1 UST/AST Removals

Two aboveground storage tanks (ASTs) identified as 226-1 and 226-2, which are associated with Building 226, were located at AOC 542. Both ASTs were put into service in 1976. AST 226-1 was located on the west end and mounted flush to Building 226. AST 226-1 had a 500-gallon capacity and was used for providing heating fuel oil for Building 226's boiler. AST 226-2 was located adjacent to the south side of the building. AST 226-2 had a 350-gallon capacity and was used to store hydraulic fluid for a testing facility located inside Building 226. Between October 1, 1997 and November 26, 1997, both ASTs were removed, drained, cut open at both ends, steamed cleaned, and recycled. No pitting, corrosion, or holes were found on either AST. No soil samples were taken during the time of the closure because the ASTs were located on concrete and asphalt pavement, and no exposed soils were located in the vicinity of the ASTs.

Two USTs, identified as 6A and 6B, were located under a concrete cap in the middle of the asphalt-paved parking lot area northeast of Building 6. Both the USTs were put into service in 1967. USTs 6A and 6B both had 2,500-gallon capacities and contained No. 2 fuel oil, which served Buildings 6 and 226. Between April 24, 1996 and May 15, 1996, both USTs were removed, drained, and cleaned. The two tanks were cut up and recycled as scrap, and the asphalt and the concrete removed during the excavation were disposed of as construction debris. Several holes of ⅛-inch or less diameter were found in the upper portion of USTs 6A and 6B. After the excavation, soil samples were taken from the bottom of the UST pit and along the associated piping. The UST closure report (DET, 1996) is included as Appendix D.

A corrective action plan (CAP) has been prepared by CH2M-Jones under the SCDHEC UST Program for this site, which is identified as *Zone E Site-26*. The CAP proposes soil excavation and a groundwater monitoring plan. The recommended corrective action in the CAP is to advance additional soil borings in order further delineate soil, remove identified soil, and continue to monitor the groundwater for a period of 18 months.

3.2 Interim Measures

An IM is being proposed for UST-related excavation as part of the UST program to remove petroleum-contaminated soils.

Section 4.0

4.0 Summary of Additional Investigations

No additional investigations have been conducted at Combined SWMU 23 under the RCRA program since the RFI field investigations conducted by the Navy/EnSafe team during the period of 1995-1997.

Section 5.0

5.0 COPC/COC Refinement

The *Zone E RFI Report, Revision 0* (EnSafe, 1997) identified BEQs and lead as COCs for Combined SWMU 23 for the future unrestricted (i.e., residential) land use scenario, and concluded that the site did not present unacceptable risks for the industrial land use scenario. The Navy/CH2M-Jones team is recommending Combined SWMU 23 for future industrial land use only, and is proposing land use controls (LUCs) at this site for that purpose.

No COCs were identified at this site for the industrial land use scenario in the *Zone E RFI Report, Revision 0*. However, one surface soil BEQ result (1.67 mg/kg at boring E542SB005) exceeded the CNC sitewide BEQ reference concentration of 1.304 mg/kg. In addition, as discussed further in Section 6.3, three surface soil samples (LE037SB009, LE037SB010, and LE037SB012) collected as part of the SWMU 37 investigation, had BEQ concentrations above this reference concentration at 1.48, 1.37, and 73.5 mg/kg, respectively. For this reason, BEQs are identified as COCs for the industrial land use scenario for Combined SWMU 23. Currently, the site is paved and all BEQ exceedances are beneath pavement, so there is no current exposure concern. However, a CMS is recommended to ensure that unacceptable exposures may occur in the future.

The CNC BCT has agreed that soil VOC data will be rescreened against generic SSLs, using a DAF=1. Four VOCs, acetone, methylene chloride, toluene and total xylenes, were detected in soil; these data are presented in Table 5-1. One of the detected VOCs, methylene chloride, was detected in surface and subsurface soil above the generic SSL (DAF=1). The methylene chloride exceedances are discussed below.

5.1 Soil COCs

5.1.1 Methylene Chloride

Methylene chloride detections in soil are summarized in Table 5-1. There were two detections of methylene chloride above the laboratory detection limits. One detection was in the surface soil sample from E543SB002 at an estimated value of 0.002 mg/kg, and the other detection was in the subsurface soil sample from E063SB002 at an estimated value of 0.018 mg/kg. The surface soil detection is below the residential RBC for methylene chloride of 85 mg/kg, indicating that methylene chloride does not pose a direct exposure concern.

Both detections of methylene chloride exceed the generic SSL (with a DAF=1) of 0.001 mg/kg. Site-specific SSLs (for both the paved and unpaved scenarios) were calculated for this site and are 0.199 mg/kg and 0.019 mg/kg for the paved and unpaved scenarios, respectively. Appendix E provides copies of the calculation tables for these SSLs. Both detections of methylene chloride are below the more conservative SSL for the unpaved scenario of 0.019 mg/kg, indicating that these soil concentrations are not a leaching concern.

Methylene chloride was detected in two of the field sample and in one laboratory quality control (QC) blank samples associated with the Combined SWMU 23 sample data group (SDG 23386) at concentrations ranging from 4 to 10 micrograms per kilogram ($\mu g/kg$), as shown in Appendix C. Methylene chloride is a recognized common laboratory contaminant and has been widely detected previously in many blanks associated with CNC samples. Based on EPA's "ten times rule," methylene chloride at concentrations up to 100 parts per billion (ppb) may be considered as possible laboratory contamination. Because of its presence at relatively low concentrations in the QC blanks and its reported presence in two soil samples well below 100 ppb, it is likely that methylene chloride detections are due to laboratory contaminant. Therefore, methylene chloride is not considered a COC.

5.2 COC Summary

BEQs in surface soil were identified as COCs at Combined SWMU 23 for the industrial land use scenario at this site. BEQs and lead in surface soils were identified as COCs for unrestricted (i.e., residential) land use for the site.

Based on this evaluation, the site is recommended for continued and future industrial land use. Such use is appropriate given the location of these facilities within the heavily industrialized portion of the CNC and consistent with previous BCT agreements regarding RCRA investigation and assessment processes.

A focused CMS is recommended for this site to evaluate LUCs or other potential remedies. Should a future property owner decide to use the property for unrestricted land use, the future owner may make a demonstration that the property is suitable for the proposed use or perform the necessary additional investigations and remediation, as necessary for that proposed use.

TABLE 5-1
Concentrations of Methylene Chloride, Acetone, Toluene, and Total Xylenes in Soil at Combined SWMU 23
RFI Report Addendum and CMS Work Plan, Combined SWMU 23, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC	SSL (DAF=1)
Methylene Chloride						85	0.001
Surface Soil	023SB001	023SB00101	08/30/95	0.005	U		
	023SB002	023SB00201	10/13/95	0.006	U		
	023SB003a	023SB00301a	08/29/95	0.005	U		
	063SB001a	063SB00101a	10/11/95	0.006	U		
	063SB002a	063SB00201a	08/30/95	0.005	U		
	063SB003a	063SB00301a	08/30/95	0.005	U		
	540SB001a	540SB00101a	08/29/95	0.005	U		
	541SB001a	541SB00101a	08/29/95	0.005	U		
	542SB001	542SB00101	08/30/95	0.018	U		
	542SB002	542SB00201	08/30/95	0.005	U		
	542SB003a	542SB00301a	08/29/95	0.005	U		
	542SB004a	542SB00401a	08/30/95	0.006	U		
	542SB005	542SB00501	08/30/95	0.019	U		
	542SB006	542SB00601	10/13/95	0.013	U		
	542SB007	542SB00701	10/13/95	0.028	U		
	543SB002b	543SB00201b	08/30/95	**0.002**	J		
	543SB003	543SB00301	08/30/95	0.032	U		
	543SB004	543SB00401	08/30/95	0.006	U		
Methylene Chloride						85	0.001
Subsurface Soil	023SB001	023SB00102	10/13/1995	0.005	U		
	023SB002	023SB00202	10/13/1995	0.005	U		
	063SB001b	063SB00102b	08/30/1995	0.006	U		
	063SB002a	063SB00202a	08/30/1995	**0.018**	J		
	063SB003a	063SB00302a	08/30/1995	0.006	U		
	540SB001a	540SB00102a	08/30/1995	0.005	U		
	542SB001	542SB00102	08/29/1995	0.017	U		
	542SB002	542SB00202	08/29/1995	0.026	U		
	542SB003a	542SB00302a	08/30/1995	0.006	U		

TABLE 5-1
Concentrations of Methylene Chloride, Acetone, Toluene, and Total Xylenes in Soil at Combined SWMU 23
RFI Report Addendum and CMS Work Plan, Combined SWMU 23, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC	SSL (DAF=1)
Methylene Chloride							
Subsurface Soil	542SB005	542SB00502	08/29/1995	0.015	U	85	0.001
	542SB006	542SB00602	08/29/1995	0.006	U		
	543SB001	543SB00102	10/11/1995	0.032	U		
	543SB002b	543SB00202b	10/13/1996	0.005	U		
	543SB003	543SB00302	10/11/1995	0.023	U		
	543SB004	543SB00402	08/30/1995	0.005	U		
Acetone							
Surface Soil	E023SB001	023SB00101	10/13/1995	0.011	U	780	0.8
	E023SB002	023SB00201	10/13/1995	0.200	U		
	E023SB003	023SB00301a	08/30/1995	0.011	U		
	E063SB001	063SB00101a	08/30/1995	0.011	U		
	E063SB002	063SB00201a	08/30/1995	0.011	U		
	E063SB003	063SB00301a	08/30/1995	0.011	U		
	E540SB001	540SB00101a	08/30/1995	0.011	U		
	E541SB001	541SB00101a	08/30/1995	0.011	U		
	E542SB001	542SB00101	08/29/1995	0.011	U		
	E542SB002	542SB00201	08/29/1995	0.011	U		
	E542SB003	542SB00301a	08/30/1995	0.011	U		
	E542SB004	542SB00401a	08/30/1995	0.011	U		
	E542SB005	542SB00501	08/29/1995	0.011	U		
	E542SB006	542SB00601	08/29/1995	0.011	U		
	E542SB007	542SB00701	08/30/1995	0.170	U		
	E543SB002	543SB00201b	10/13/1995	0.012	U		
	E543SB003	543SB00301	10/11/1995	0.018	U		
	E543SB004	543SB00401	08/30/1995	0.011	U		
Acetone							
Subsurface Soil	E023SB001	023SB00102	10/13/1995	0.011	U	NA	0.8
	E023SB002	023SB00202	10/13/1995	0.021	U		
	E063SB001	063SB00102b	08/30/1995	0.012	U		

TABLE 5-1
Concentrations of Methylene Chloride, Acetone, Toluene, and Total Xylenes in Soil at Combined SWMU 23
RFI Report Addendum and CMS Work Plan, Combined SWMU 23, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC	SSL (DAF=1)
Acetone							
Subsurface Soil	E063SB002	063SB00202a	08/30/1995	0.011	UJ	NA	0.8
	E063SB003	063SB00302a	08/30/1995	0.012	U		
	E540SB001	540SB00102a	08/30/1995	0.071	U		
	E542SB001	542SB00102	08/29/1995	0.011	U		
	E542SB002	542SB00202	08/29/1995	0.100	=		
	E542SB003	542SB00302a	08/30/1995	0.011	U		
	E542SB005	542SB00502	08/29/1995	0.012	U		
	E542SB006	542SB00602	08/29/1995	0.012	U		
	E543SB001	543SB00102	10/11/1995	0.031	U		
	E543SB002	543SB00202b	10/13/1996	0.011	U		
	E543SB003	543SB00302	10/11/1995	0.040	U		
	E543SB004	543SB00402	08/30/1995	0.027	U		
Toluene							
Surface Soil	E023SB001	023SB00101	10/13/1995	0.005	U	1,600	0.6
	E023SB002	023SB00201	10/13/1995	0.006	U		
	E023SB003	023SB00301a	08/30/1995	0.005	U		
	E063SB001	063SB00101a	08/30/1995	0.006	U		
	E063SB002	063SB00201a	08/30/1995	0.005	U		
	E063SB003	063SB00301a	08/30/1995	0.005	U		
	E540SB001	540SB00101a	08/30/1995	0.005	U		
	E541SB001	541SB00101a	08/30/1995	0.002	J		
	E542SB001	542SB00101	08/29/1995	0.006	U		
	E542SB002	542SB00201	08/29/1995	0.005	U		
	E542SB003	542SB00301a	08/30/1995	0.005	U		
	E542SB004	542SB00401a	08/30/1995	0.006	U		
	E542SB005	542SB00501	08/29/1995	0.002	J		
	E542SB006	542SB00601	08/29/1995	0.005	U		
	E542SB007	542SB00701	08/30/1995	0.028	U		
	E543SB002	543SB00201b	10/13/1995	0.006	U		
	E543SB003	543SB00301	10/11/1995	0.006	U		
Toluene							

TABLE 5-1
Concentrations of Methylene Chloride, Acetone, Toluene, and Total Xylenes in Soil at Combined SWMU 23
RFI Report Addendum and CMS Work Plan, Combined SWMU 23, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC	SSL (DAF=1)
Surface Soil	E543SB004	543SB00401	08/30/1995	0.006	U	1,600	0.6
Toluene							
Subsurface Soil	E023SB001	023SB00102	10/13/1995	0.005	U	NA	0.6
	E023SB002	023SB00202	10/13/1995	0.005	U		
	E063SB001	063SB00102b	08/30/1995	0.006	U		
	E063SB002	063SB00202a	08/30/1995	0.006	J		
	E063SB003	063SB00302a	08/30/1995	0.006	U		
	E540SB001	540SB00102a	08/30/1995	0.005	U		
	E542SB001	542SB00102	08/29/1995	0.006	U		
	E542SB002	542SB00202	08/29/1995	0.026	U		
	E542SB003	542SB00302a	08/30/1995	0.006	U		
	E542SB005	542SB00502	08/29/1995	0.006	U		
	E542SB006	542SB00602	08/29/1995	0.006	U		
	E543SB001	543SB00102	10/11/1995	0.005	U		
	E543SB002	543SB00202b	10/13/1996	0.005	U		
	E543SB003	543SB00302	10/11/1995	0.006	U		
	E543SB004	543SB00402	08/30/1995	0.005	U		
Xylenes (Total)							
Surface Soil	E023SB001	023SB00101	10/13/1995	0.005	U	16,000	9
	E023SB002	023SB00201	10/13/1995	0.002	J		
	E023SB003	023SB00301a	08/30/1995	0.005	U		
	E063SB001	063SB00101a	08/30/1995	0.006	U		
	E063SB002	063SB00201a	08/30/1995	0.005	U		
	E063SB003	063SB00301a	08/30/1995	0.005	U		
	E540SB001	540SB00101a	08/30/1995	0.005	U		
	E541SB001	541SB00101a	08/30/1995	0.002	J		
	E542SB001	542SB00101	08/29/1995	0.006	U		
	E542SB002	542SB00201	08/29/1995	0.005	U		
	E542SB003	542SB00301a	08/30/1995	0.005	U		
Xylenes (Total)						16,000	9
Surface Soil	E542SB004	542SB00401a	08/30/1995	0.006	U		

TABLE 5-1
Concentrations of Methylene Chloride, Acetone, Toluene, and Total Xylenes in Soil at Combined SWMU 23
RFI Report Addendum and CMS Work Plan, Combined SWMU 23, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	EPA Region III Residential RBC	SSL (DAF=1)
	E542SB005	542SB00501	08/29/1995	0.005	U		
	E542SB006	542SB00601	08/29/1995	0.005	U		
	E542SB007	542SB00701	08/30/1995	0.028	U		
	E543SB002	543SB00201b	10/13/1995	0.003	J		
	E543SB003	543SB00301	10/11/1995	0.006	U		
	E543SB004	543SB00401	08/30/1995	0.006	U		
Xylenes (Total)							
Subsurface Soil	E023SB001	023SB00102	10/13/1995	0.005	U	NA	9
	E023SB002	023SB00202	10/13/1995	0.005	U		
	E063SB001	063SB00102b	08/30/1995	0.006	U		
	E063SB002	063SB00202a	08/30/1995	0.006	UJ		
	E063SB003	063SB00302a	08/30/1995	0.006	U		
	E540SB001	540SB00102a	08/30/1995	0.005	U		
	E542SB001	542SB00102	08/29/1995	0.006	U		
	E542SB002	542SB00202	08/29/1995	0.026	U		
	E542SB003	542SB00302a	08/30/1995	0.006	U		
	E542SB005	542SB00502	08/29/1995	0.006	U		
	E542SB006	542SB00602	08/29/1995	0.006	U		
	E543SB001	543SB00102	10/11/1995	0.005	U		
	E543SB002	543SB00202b	10/13/1996	0.005	U		
	E543SB003	543SB00302	10/11/1995	0.006	U		
	E543SB004	543SB00402	08/30/1995	0.005	U		

All values are presented in units of milligrams per kilogram (mg/kg).

Concentrations in bold and outlined within the table represent exceedances of screening criteria.

J Indicates an estimated value. One or more quality control (QC) parameters were outside control limits or the value was detected below the laboratory's quanitification limit.

U Indicates that the analyte was analyzed for but not detected above the method detection limit.

Section 6.0

6.0 Summary of Information Related to Site Closeout Issues

6.1 RFI Status

The *Zone E RFI Report, Revision 0* (EnSafe, 1997) addressed SWMUs/AOCs within Zone E of the CNC, including Combined SWMU 23. With the submission of this RFI Report Addendum, the RFI is considered to be complete.

The RFI report for Combined SWMU 23 identified BEQs and lead as COCs for surface soils under the unrestricted (i.e., residential) land use scenario. Based on the discussion presented in Section 5.0, no COCs have been identified for soil or groundwater at Combined SWMU 23 for industrial land use.

The remaining subsections address the issues that the BCT agreed to evaluate prior to site closeout. Although a No Further Action (NFA) designation is not being requested, these issues are presented to facilitate decision-making at the site.

6.2 Presence of Inorganics in Groundwater

For the purpose of site closeout documentation, the inorganics in groundwater issue refers to the occasional or intermittent detection of several metals (primarily arsenic, thallium, and antimony) in groundwater at concentrations above the applicable MCL, preceded or followed by detections of these same metals below the MCL or below the practicable quantitation limit.

There were no detections of arsenic in shallow or deep wells above the MCLs at Combined SWMU 23. There were no detections of antimony above laboratory detection limits in shallow or deep wells in any of the groundwater samples at the site. There were intermittent thallium detections in shallow groundwater at the site, but only one detection in the sample from well E063GW002 at a concentration of 5.7 μg/L, exceeded the MCL of 2 μg/L. This detection is below the Zone E maximum background concentration of 5.8 μg/L in shallow groundwater. Table 6-1 shows thallium detections in groundwater at this site. Thallium detections in groundwater at the site do not point to a site-specific source, but represent background conditions. Therefore, further evaluation of this issue is not warranted.

6.3 Potential Linkage to SWMU 37, Investigated Sanitary Sewers at the CNC

Several investigation activities related to the RFI for SWMU 37 (Sanitary Sewer) were conducted in the vicinity of SWMU 23. As shown in Figure 6-1, well E037GW002 was installed on the west side of Building 226. Groundwater samples from this well do not indicate the presence of contamination.

In addition, four Geoprobe groundwater samples (LE037GP061, LE037GP062, LE037GP063, and LE037GP064) were collected from along Truxtun Avenue on the northern edge of Combined SWMU 23. No VOCs were detected in these samples. These unfiltered groundwater samples had turbidity ranging from 39 to 102 nephelometric turbidity units (NTUs), and the metals results are not considered representative of actual groundwater quality.

Four soil borings (LE037SB009, LE037SB010, LE037SB011, and LE037SB012) were installed west of and adjacent to Building 226 as part of the SWMU 37 investigation. These four samples were collected at the former location of AST 219, used to store fuel oil and connected to former USTs 6A and 6B. BEQ concentrations in surface soil samples collected at these four borings were 1.48, 1.37. 0.59, and 73.5 mg/kg, respectively. Three of these values exceed the CNC BEQ sitewide reference concentration of 1.304 mg/kg. Although installed to assess impacts to the sanitary sewer, these elevated BEQs may be related to the long-time handling of fuel at the site, rather than being an indication of impacts to the sanitary sewer. BEQs were previously identified as COCs for residential land use. Based on the exceedances of the sitewide reference concentration in these samples, BEQs should also be considered COCs for industrial land use.

It was previously noted by SCDHEC in a review of the RFI Report Addendum for SWMU 67 that several results for mercury in these soil samples were elevated. Additional assessment of mercury in these soil borings is being conducted as part of the SWMU 67 RFI activities.

Based on a review of these soil and groundwater samples, there does not appear to have been any impact to the sanitary sewers from this site. Therefore, further evaluation of this issue is not warranted.

6.4 Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC

No direct connection from these sites to the storm sewers are known to exist. AOC 540, the new plating shop, was built in 1976. SWMU 23, the new plating shop wastewater treatment plant, was built in 1983. Both of these facilities were constructed after 1972, which is when industrial discharges to the combined stormwater/sanitary sewer ceased. Thus, neither of these units would be expected to have discharged to or impacted the storm sewer.

AOC 541, a former oil storage shop that operated until 1939, is not known to have had any operations that discharged wastes to the sanitary sewer. There could have been some releases of oils to the storm sewer during its operational period. However, because these operations ceased over 60 years ago and because oils are generally biodegradable in the environment, it is likely that any releases that might have occurred from this unit to the storm sewer attenuated long ago. In addition, the storm sewer outfall sampling being conducted by the Navy/EnSafe team will indicate whether any contaminants are discharging from the storm sewers.

AOC 542, former oxyacetylene plant and former paint shop, was demolished in 1976. The acetylene production effort may have produced wastewaters containing calcium hydroxide and would have had a high pH. Wastewater form the acetylene production process might have been released from this unit to the storm sewer. However, it would not be expected to have had a lasting environmental effect, since any high pH residuals would be neutralized over time and calcium is not toxic. During its operation as a paint shop, there could have been releases of paints or solvents. Thus, assessment of groundwater samples collected as part of the AOC 699 investigation (storm sewer) in the vicinity of AOC 542 were evaluated.

Four Geoprobe samples (LE699075, LE699076, LE699077, LE699078) were collected within or close to the former location of AOC 542 along the stormsewer that passes through this area, as shown in Figure 6-1. No VOCs were detected in these samples. These unfiltered groundwater samples had turbidity ranging from 176 to 558 NTUs, and the metals results are not considered representative of actual groundwater quality.

Based on these findings, no impacts to the storm sewer appear to have occurred and further evaluation of this issue is not warranted.

6.5 Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC

There are no known linkages to Combined SWMU 23 and the investigated railroad lines.

6.6 Potential Migration Pathways to Surface Water Bodies at the CNC

The nearest surface water body to Combined SWMU 23 is the Cooper River, which lies approximately 265 feet east of the site. The only potential migration pathway from the site to surface water is via overland flow via stormwater runoff. The entire site is covered with buildings and pavement, which eliminates contact of surface soil with stormwater. Similarly, runoff directed to the storm sewer system, which discharges to the Cooper River, does not contact the surface soil. Therefore, no further evaluation of a potential pathway for contaminant migration via stormwater runoff is warranted.

6.7 Potential Contamination in Oil/Water Separators (OWSs)

There is one OWS located at the Combined SWMU 23 site. The OWS is located on the western side of Building 226 and is fed by trench drains in the repair facility. Groundwater collected from the vicinity of the OWS does not indicate that the groundwater is impacted.

6.8 Land Use Controls (LUCs)

The Navy/CH2M-Jones team is proposing that this site be used only for industrial land use. LUCs restricting the land use to industrial use only will be implemented by the BCT. The LUC issue will be addressed in the CMS Work Plan and CMS Report for Combined SWMU 23.

TABLE 6-1
Concentrations of Thallium in Groundwater at Combined SWMU 23
RFI Report Addendum and CMS Work Plan, Combined SWMU 23, Zone E, Charleston Naval Complex

Analyte	Station ID	Sample ID	Date Collected	Concentration (µg/L)	Qualifier	EPA Region III Tap Water RBC	MCL	Zone E Background Conc.
Thallium	E063GW001	E063GW00201	04/18/1996	5	U	0.26	2	5.4
		E063GW00202	08/07/1996	2.7	U			
		E063GW00203	12/12/1996	5.3	J			
		E063GW00204	02/21/1997	5	U			
	E063GW002	E063GW00201	04/19/1996	5	U			
		E063GW00202	08/071996	2.7	U			
		E063GW00203	12/13/1996	5.7	J			
		E063GW00204	02/21/1997	5	U			
	E542GW001	E542GW00101	04/23/1996	5	U			
		E542GW00102	08/05/1996	2.7	U			
		E542GW00103	12/04/1996	3.3	J			
		E542GW00104	02/19/1997	5	U			
	E542GW003	E542GW00301	04/22/1996	5	U			
		E542GW00302	08/05/1996	4.2	J			
		E542GW00303	12/04/1996	2.7	UJ			
		E542GW00304	02/20/1997	5	U			
	E542GW004	E542GW00401	04/22/7996	5	U			
		E542GW00402	08/06/1996	2.7	U			
		E542GW00403	12/05/1996	3.3	J			
		E542GW00404	02/20/1997	5	U			

All values are presented in units of milligrams per kilogram (mg/kg).

J Indicates an estimated value. One or more quality control (QC) parameters were outside control limits or the value was detected below the laboratory's quanitification limit.

U Indicates that the analyte was analyzed for but not detected above the method detection limit.

UJ Indicates that the detection limit is estimated. The analyte was analyzed for but qualified as not detected; the result is estimated.

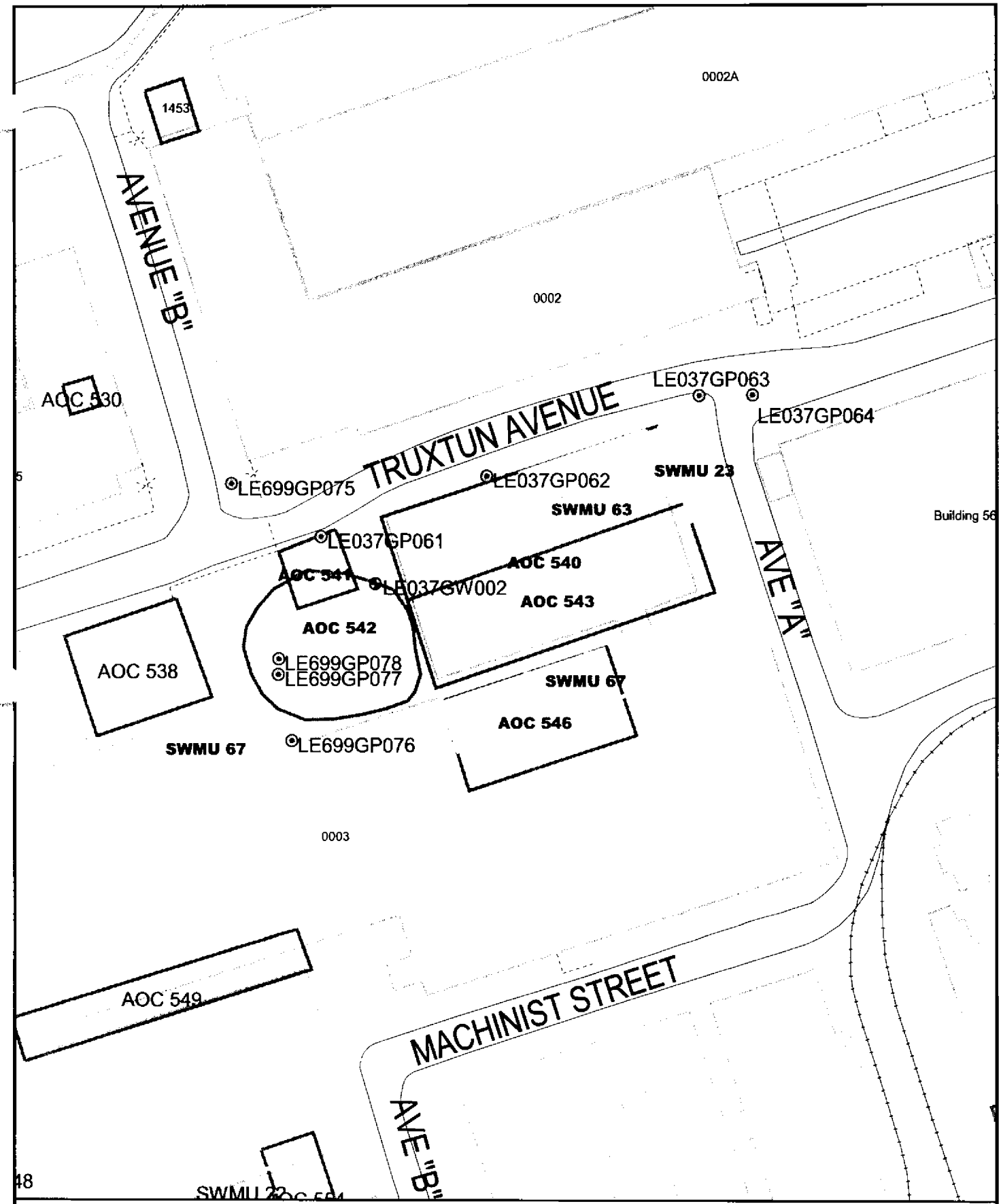


Figure 6-1
Zone L RFI Sampling Locations
Combined SWMU 23 Area
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\cnc\statbasis.apr, Date: 25 Nov 2002 7:43, User: SNAIK1

Section 7.0

7.0 Recommendations

The *Zone E RFI Report, Revision 0* (EnSafe, 1997) identified BEQs and lead in surface soils as COCs for unrestricted (i.e., residential) land use at Combined SWMU 23. BEQs in surface soil were identified as COCs for the industrial land use scenario.

A focused CMS is recommended for this site to evaluate potential remedies. Section 8.0 presents this focused CMS Work Plan. Should a future property owner decide to use the property for unrestricted land use, the future owner may make a demonstration that the property is suitable for the proposed use or perform the necessary additional investigations and remediation, as necessary, for that proposed use.

Section 8.0

8.0 CMS Work Plan for Combined SWMU 23

BEQs and lead were identified as COCs in surface soil for the unrestricted (i.e., residential) land use scenario at Combined SWMU 23. BEQs in surface soil were identified as COCs for the industrial land use scenario. Only one soil boring location, E023SB004, is located in an unpaved area and is the location of elevated lead detection at 434 mg/kg in the duplicate sample from this location. The BEQ concentration at this location is 1,116 µg/kg, which is below the CNC sitewide reference concentration of 1,304 µg/kg. All other areas of the site are paved. Therefore, the exposed surface soil at the site with BEQ- or lead-containing soils is minimal and there is currently no unacceptable exposure or risk from these COCs for current industrial use; however, it is feasible that in the future, should site conditions change, some exposure could occur. Therefore, a CMS should be conducted to evaluate potential corrective measures and identify an appropriate remedy for the site.

This section presents a focused CMS work plan. Media cleanup standards (MCSs) are identified for COCs, and potential remedies that should be evaluated are also presented.

8.1 Remedial Action Objectives

Remedial action objectives (RAOs) are medium-specific goals that the remedial actions are designed to accomplish in order to protect human health and the environment by preventing or reducing exposures under current and future land use conditions. The RAOs identified for the surface soil at Combined SWMU 23 are being chosen to prevent ingestion and direct/dermal contact with surface soil containing COCs at unacceptable levels. No remedial actions are required for subsurface soil or groundwater at Combined SWMU 23.

8.2 Remedial Goal Options and Media Cleanup Standards

Throughout the process of remediating a hazardous waste site, a risk manager uses a progression of increasingly acceptable site-specific media levels in considering remedial alternatives. Under the RCRA program, remedial goal options (RGOs) and MCSs are developed at the end of the risk assessment in the RFI/Remedial Investigation (RI) programs, before completion of the CMS.

RGOs can be based on a variety of criteria, such as specific incremental lifetime cancer risk (ILCR) levels (e.g., 1E-04, 1E-05, or 1E-06), HI levels (e.g., 0.1, 1.0, 3.0), or site background concentrations. For a particular RGO, specific MCSs can be determined as target

concentration values. Achieving these MCSs is accepted as demonstrating that RGOs and RAOs have been achieved. Achieving these goals should promote the protection of human health and the environment, while achieving compliance with applicable state and federal standards.

The exposure medium of concern for Combined SWMU 23 is surface soil impacted by BEQs and lead. Because Combined SWMU 23 is located within a highly developed area of the CNC and there are no surface water bodies in the immediate vicinity of the site, ecological exposures were not considered applicable for evaluation.

The general vicinity around Combined SWMU 23 within Zone E has elevated concentrations of BEQs, making it unfit for future unrestricted (i.e., residential) land use. For BEQs, the target MCS for surface soil should be the sitewide reference concentration of 1.304 mg/kg, which was developed by the BCT. For lead within Zone E, the MCS is the EPA target cleanup goal of 400 mg/kg for unrestricted land use. An MCS will be met if the site statistical estimates of concentrations are similar to the background statistical estimates. For point comparisons between site and background levels, site concentration ranges may be compared with the ranges of background concentrations. The EPA Region IV residential land use value for lead in soil of 400 mg/kg, or a sitewide average similar to that in Zone E, are potential practical MCSs for this area. Other potential RGOs, such as the 1E-06 ILCR, were considered but regarded as not applicable for BEQs because the site background concentrations of BEQs are significantly greater than this level.

Although the background levels of lead are below the target cleanup goal for unrestricted land use of 400 mg/kg, the background levels of BEQs preclude this area from suitability for future residential land use.

8.3 Potential Remedies to Evaluate

Because of the small size of this site and the relatively small quantity of impacted surface soil, the list of practicable remedial alternatives for this site is limited. Because this area of Zone E is currently heavily industrialized, and industrial use is expected to continue in all of Zone E, only LUCs are being considered as a presumptive remedy to be evaluated as part of the CMS.

8.4 Focused CMS Approach

The focused CMS will consist of the following tasks that will be performed in the order presented below:

1. The corrective measure alternative described above will be screened using several criteria and decision factors.
2. The CMS and preferred corrective measure alternative will be documented in the CMS report.

8.5 Approach to Evaluating Corrective Measure Alternatives

According to the RCRA permit issued by SCDHEC (SCDHEC, 1998), the alternatives will be evaluated with the following five standards:

1. Protecting human health and the environment.
2. Attaining media cleanup standards (RGOs).
3. Controlling the source of releases to minimize future releases that may pose a threat to human health and the environment.
4. Complying with applicable standards for the management of wastes generated by remedial activities.
5. Other factors include (a) long-term reliability and effectiveness; (b) reduction in toxicity, mobility, or volume of wastes; (c) short-term effectiveness; (d) implementability; and (e) cost.

Each of the five criteria is defined in more detail below:

1. **Protecting human health and the environment.** The alternatives will be evaluated on the basis of their ability to protect human health and the environment. The ability of an alternative to achieve this criterion may or may not be independent of its ability to achieve the other four standards. For example, an alternative may be protective of human health, but may not be able to attain the MCSs if the MCSs are not directly tied to protecting human health.

2. **Attaining media cleanup standards (RGOs).** The alternatives will be evaluated on the basis of their ability to achieve the RGOs defined in this CMS Work Plan. Another aspect of this criterion is the timeframe to achieve the RGOs. Estimates of the timeframe for the alternatives to achieve RGOs will be provided.

3. **Controlling the source of releases.** This criterion deals with the control of releases of contamination from the source (the area in which the contamination originated).

4. **Complying with applicable standards for management of wastes.** This criterion deals with the management of wastes derived from implementing the alternatives, for

example, treatment or disposal of excavated material. The soil removal alternative will be designed to comply with all applicable standards for management of remediation wastes. Consequently, this criterion will not be explicitly included in the detailed evaluation presented in the CMS but will be part of a work plan specific to the removal action should a removal action become the chosen alternative.

5. **Other factors.** Five other factors are to be considered if an alternative is found to meet the four criteria described above. These other factors are as follows:

   a. Long-term reliability and effectiveness

   The two alternatives will be evaluated on the basis of their reliability, and the potential impact should the chosen alternative fail. In other words, a qualitative assessment will be made as to the chance of the alternative's failure and the consequences of that failure.

   b. Reduction in the toxicity, mobility, or volume of wastes

   Alternatives with technologies that reduce the toxicity, mobility, or volume of the contamination will be generally favored over those that do not. Consequently, a qualitative assessment of this factor will be performed for each alternative.

   c. Short-term effectiveness

   Alternatives will be evaluated on the basis of the risk they create during the implementation of the remedy. Factors that may be considered include fire, explosion, and exposure of workers to hazardous substances.

   d. Implementability

   The alternatives will be evaluated for their implementability by considering any difficulties associated with conducting the alternatives (such as the construction disturbances they may create), operation of the alternatives, and the availability of equipment and resources to implement the technologies comprising the alternatives.

   e. Cost

   A net present value of each alternative will be developed. These cost estimates will be used for the relative evaluation of the alternatives, not to bid or budget the work. The estimates will be based on information available at the time of the CMS and on a conceptual design of the alternative. They will be "order-of-magnitude" estimates with a generally expected accuracy of -50 percent to +50 percent for the scope of action described for each alternative. The estimates will be categorized into capital costs and operations and maintenance costs for each alternative.

In addition to the criteria described above, the alternative will be evaluated for its ability to achieve all contractual obligations of CH2M-Jones and the Navy.

8.6 Focused CMS Report

A focused CMS Report will be prepared to present the identification, development, and evaluation of the potential corrective measure for Combined SWMU 23. A proposed outline of the report, as shown in Table 8-1, provides an example of the report format and content.

TABLE 8-1
Outline of Focused CMS Report for Combined SWMU 23
RFI Report Addendum and CMS Work Plan, Combined SWMU 23, Zone E, Charleston Naval Complex

Section No.	Section Title
1.0	**Introduction**
1.1	Corrective Measures Study Purpose and Scope
1.2	Report Organization
1.3	Background Information
1.3.1	Facility Description
1.3.2	Site History and Background
1.3.2.1	Nature and Extent of Contamination
1.3.2.2	Summary of Risk Assessment
2.0	**Remedial Goal Objectives**
3.0	**Detailed Analysis of Focused Alternative**
3.1	Approach
3.2	Evaluation Criteria
3.3	Description of Alternative
3.3.1	Alternative 1: Land Use Controls
3.4	Detailed Analysis of Alternative
3.4.1	Analysis of Alternative 1
3.5	Comparative Analysis of Alternatives
4.0	**Recommended Remedial Alternative**
5.0	**References**
Appendix A	**Corrective Measure Alternative Cost Estimate**[b]
List of Tables	
List of Figures	

[a] Additional alternatives will be analyzed as found necessary.

[b] Additional appendices will be added, if necessary.

Section 9.0

9.0 References

EnSafe Inc. *Zone E RFI Report, Revision 0, NAVBASE Charleston*. 1997.

EnSafe Inc./Allen & Hoshall. *Final RCRA Facility Assessment, NAVBASE Charleston*. July 1995.

EnSafe Inc./Allen & Hoshall. *Final Zone E RFI Work Plan, Revision 1, NAVBASE Charleston*. June 1995.

South Carolina Department of Health and Environmental Control, Final RCRA Part B Permit No. - SC0 170 022 560.

Appendix A

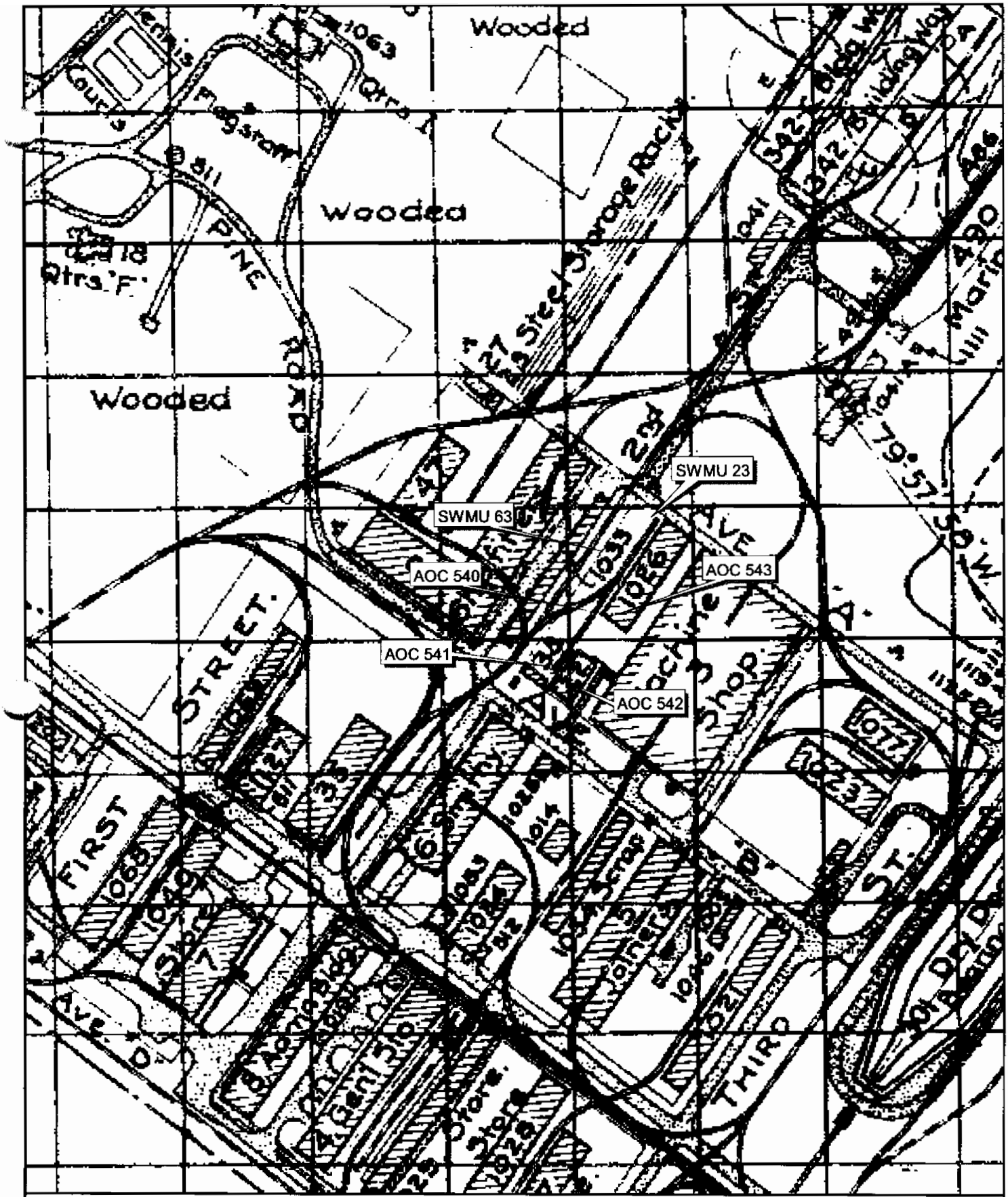


Figure A-1
Historic Rairoad Line Locations
June 30, 1935
SWMU 23/63, AOC 540 through 543, Zone E
Charleston Naval Complex

File Path: C:\18gis\CNC\cnc-egls.apr, Date: 18 Jul 2002 14:47, User: MKARAFA

Appendix B

Response To Comments from Eric F. Cathcart — SCDHEC
Draft Zone E RCRA Facility Investigation Report
Charleston Naval Complex

SWMU 23/63, AOC 540/541/542/543

Comment 7

Figure 10.4.2 should be followed by a groundwater contour map representing each quarter of groundwater level data.

Navy/EnSafe Response:
Quarterly water level measurements have been collected and will be reviewed. Site-specific sample location figures will be revised to include average groundwater flow directions in the Final Zone E RFI Report, based on the average flow direction over four quarters. Zone-wide contour maps will also be provided for each of the quarterly groundwater monitoring events.

CH2M-Jones Response:
Groundwater level measurements were conducted by CH2M-Jones in the Zone E wells during March 2002. Figure A-1, included in Appendix A of the RFIRA/CMSWP for this site includes the groundwater elevation contours for this site from the March 2002 measurements. These groundwater elevation contours are representative of the general groundwater levels in Zone E.

Comment 8

Page 10.4-26. Please indicate the "evaluated migration pathways".

Navy/EnSafe Response:
Please see page 10.4-22, lines 16 and 17.

CH2M-Jones Response:
No additional response.

SWMU 23/63, AOC 540/541/542/543

Comment 1

Page 10.4-1. The report accounts for operations at AOC 541 from 1909 to 1939 and demolition in 1970; however, no information exists for the operation between 1939 and 1970. The Navy should investigate the history of the building.

Navy/EnSafe Response:
The history of the building will be further investigated and included in the Final Zone E RFI Report.

CH2M-Jones Response:
As discussed in the RFIRA, AOC 541is the location of former Building 38, an oil storage house that was constructed in 1939 and demolished in 1970. No additional information was found on the history of operations of this building during the period 1939 to 1970 during the preparation of the RFIRA for Combined SWMU 23.

The historic engineering drawings for this period consistently describe the facility as an Oil House for Shops. It is believed that this was a location where lube and hydraulic-type oils were stored in drums or small containers for use in the various machine and repair shops in the marine fabrication area. There is no information that indicates that industrial operations other than oil storage occurred at this location.

Appendix C

Table 10.4.A
Chemicals Present in Site Samples
SWMUs 23,63; AOC 540, 541, 542, 543 - Surface Soil
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Residential RBC	Screening Concentration Industrial RBC	Screening Concentration Reference	Units	Number Exceeding Res.	Number Exceeding Ind.	Number Exceeding Ref.
Inorganics															
Aluminum (Al)		19	19	821	6440	3357.42	NA	NA	7800	100000	26600	MG/KG			
Antimony (Sb)	*	7	19	1.6	29.5	10.70	0.43	3.3	3.1	82	1.77	MG/KG	4		6
Arsenic (As)		18	19	0.66	7.9	3.55	0.56	0.56	0.43	3.8	23.9	MG/KG	18	8	
Barium (Ba)		18	19	0.96	54.8	23.61	23.6	23.6	550	14000	130	MG/KG			
Beryllium (Be)		15	19	0.13	0.44	0.25	0.11	0.15	0.15	1.3	1.7	MG/KG	14		
Cadmium (Cd)	*	10	19	0.15	18	3.07	0.11	0.12	3.9	100	1.5	MG/KG	4		3
Calcium (Ca)	N	18	19	1660	145000	23732.22	7420	7420	NA	NA	NA	MG/KG			
Chromium (Cr)		19	19	2.6	42.7	10.24	NA	NA	39	1000	94.6	MG/KG	1		
Cobalt (Co)		18	19	0.47	50.7	5.90	0.22	0.22	470	12000	19	MG/KG			2
Copper (Cu)	*	19	19	0.25	1760	168.59	NA	NA	310	8200	66	MG/KG	2		6
Cyanide (CN)		2	18	0.38	0.5	0.44	0.21	0.24	160	4100	0.5	MG/KG			1
Iron (Fe)	N	18	19	1160	10800	4793.89	7980	7980	NA	NA	NA	MG/KG			
Lead (Pb)	*	19	19	1.1	434	73.54	NA	NA	400	1300	265	MG/KG	1		1
Magnesium (Mg)	N	18	19	26.4	1870	469.97	645	645	NA	NA	NA	MG/KG			
Manganese (Mn)		18	19	5.9	152	61.83	55.6	55.6	180	4700	302	MG/KG			
Mercury (Hg)		10	19	0.02	1.7	0.49	0.02	1.1	2.3	61	2.6	MG/KG			
Nickel (Ni)	*	19	19	0.29	193	14.91	NA	NA	160	4100	77.1	MG/KG	1		1
Potassium (K)	N	3	19	176	720	444.67	168	724	NA	NA	NA	MG/KG			
Selenium (Se)		1	19	0.58	0.58	0.58	0.53	0.59	39	1000	1.7	MG/KG			
Silver (Ag)		2	19	0.24	1.2	0.72	0.21	0.55	39	1000	NA	MG/KG			
Sodium (Na)	N	3	19	47.7	90.6	71.67	11	170	NA	NA	NA	MG/KG			
Tin (Sn)		11	19	2.6	54.3	13.79	2.1	2.4	4700	6100	59.4	MG/KG			
Vanadium (V)		19	19	2.2	16.1	6.59	NA	NA	55	1400	94.3	MG/KG			
Zinc (Zn)	*	19	19	0.69	4080	400.68	NA	NA	2300	61000	827	MG/KG	1		3
Pesticides															
4,4'-DDD		3	18	4.3	17	9.00	2.6	2.9	2700	24000	NA	UG/KG			
4,4'-DDE		7	18	6.7	96	26.46	2.6	2.9	1900	17000	NA	UG/KG			
4,4'-DDT		6	18	4.4	66	18.58	2.6	2.8	1900	17000	NA	UG/KG			
Aldrin		2	18	1.8	8.8	5.30	1.4	1.5	38	340	NA	UG/KG			
alpha-BHC		1	18	5.4	5.4	5.40	1.4	1.5	100	910	NA	UG/KG			
alpha-Chlordane		10	18	1.5	130	37.51	1.4	1.5	470	2200	NA	UG/KG			
Aroclor-1254	**	2	18	190	1200	695.00	71	78	83	740	NA	UG/KG	2	1	
beta-BHC		1	18	4	4	4.00	1.4	1.5	350	3200	NA	UG/KG			
delta-BHC		2	18	3.4	11	7.20	1.4	1.5	100	910	NA	UG/KG			
Dieldrin		3	18	5.2	9.9	7.90	2.6	2.9	40	360	NA	UG/KG			
Endosulfan I		1	18	5.1	5.1	5.10	1.4	1.5	47000	1200000	NA	UG/KG			
Endosulfan II		1	18	5.9	5.9	5.90	2.6	2.9	47000	1200000	NA	UG/KG			
Endosulfan sulfate		1	18	5.1	5.1	5.10	2.6	2.9	47000	1200000	NA	UG/KG			
Endrin		2	18	5.3	11	8.15	2.6	2.9	2300	61000	NA	UG/KG			
Endrin aldehyde		2	18	3.9	15	9.45	2.6	3	2300	61000	NA	UG/KG			
Endrin ketone		1	18	3.1	3.1	3.10	2.6	2.9	2300	61000	NA	UG/KG			
gamma-BHC (Lindane)		2	18	1.4	5.1	3.25	1.4	1.5	490	4400	NA	UG/KG			
gamma-Chlordane		9	18	3.2	240	65.54	1.4	1.5	470	2200	NA	UG/KG			
Heptachlor		9	18	1.4	130	23.98	1.4	1.5	140	1300	NA	UG/KG			
Heptachlor epoxide		4	18	2.5	19	8.50	1.4	1.5	70	630	NA	UG/KG			
Methoxychlor		1	18	22	22	22.00	14	15	39000	1000000	NA	UG/KG			
Technical Chlordane		2	2	46	680	363.00	NA	NA	NA	NA	NA	UG/KG			
Carcinogenic PAHs															
B(a)P Equiv.	**	13	19	0.566	1688	444.90	808.85	1733.25	88	780	NA	UG/KG	11	2	
Benzo(a)anthracene	*	9	19	180	970	413.33	350	750	880	7800	NA	UG/KG	1		
Benzo(a)pyrene	**	11	19	130	1100	400.00	350	750	88	780	NA	UG/KG	11	2	
Benzo(b)fluoranthene		3	19	140	860	420.00	350	770	880	7800	NA	UG/KG			
Benzo(k)fluoranthene		13	19	52	1100	394.00	350	750	8800	78000	NA	UG/KG			
Chrysene		13	19	48	1000	348.92	350	750	88000	780000	NA	UG/KG			
Dibenz(a,h)anthracene	*	3	19	77	410	195.67	350	770	88	780	NA	UG/KG	2		
Indeno(1,2,3-cd)pyrene		9	19	130	690	270.00	350	770	880	7800	NA	UG/KG			
Semivolatile Organics															
2-Methylnaphthalene		2	20	91	140	115.50	350	810	310000	8200000	NA	UG/KG			
Acenaphthene		2	20	43	52	47.50	350	810	470000	12000000	NA	UG/KG			
Acenaphthylene		1	20	54	54	54.00	350	810	310000	8200000	NA	UG/KG			
Anthracene		2	19	160	180	170.00	350	770	2300000	61000000	NA	UG/KG			
Benzo(g,h,i)perylene		11	19	39	820	263.36	350	750	310000	8200000	NA	UG/KG			
Benzoic acid		1	20	65	65	65.00	1700	4000	31000000	100000000	NA	UG/KG			
bis(2-Ethylhexyl)phthalate (BEHP)		3	19	52	120	87.67	350	770	46000	410000	NA	UG/KG			
Di-n-butylphthalate		1	19	44	44	44.00	350	770	780000	20000000	NA	UG/KG			
Fluoranthene		12	19	71	1700	578.42	350	750	310000	8200000	NA	UG/KG			
Fluorene		2	20	38	39	38.50	350	810	310000	8200000	NA	UG/KG			
Naphthalene		1	20	65	65	65.00	350	810	310000	8200000	NA	UG/KG			
Phenanthrene		10	19	47	710	316.70	350	750	310000	8200000	NA	UG/KG			
Pyrene		13	19	84	1900	573.38	350	750	230000	8100000	NA	UG/KG			
Volatile Organics															
Methylene chloride		1	19	2	2	2.00	5	32	85000	760000	NA	UG/KG			
Toluene		3	19	2	2	2.00	5	28	1600000	41000000	NA	UG/KG			
Xylene (Total)		3	19	2	3	2.33	5	28	16000000	100000000	NA	UG/KG			

* - Identified as a residential COPC
** - Identified as an industrial COPC
N - Essential nutrient
MG/KG - milligrams per kilogram
UG/KG - micrograms per kilogram
SQL - Sample quantitation limit
RBC - Risk-based concentration
NA - Not applicable

Table 10.4.D
Chemicals Present in Site Samples
SWMUs 23,63; AOC 540, 541, 542, 543 - Groundwater
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection		Average Detected Concentration	Range of SQL		Screening Concentration Residential RBC	Screening Concentration Reference	Units	Number Exceeding Res.	Number Exceeding Ref.
Deep wells													
Inorganics													
Barium (Ba)		1	1	32.4	32.4	32.4	NA	NA	260	218	UG/L		
Calcium (Ca)	N	1	1	64500	64500	64500	NA	NA	NA	NA	UG/L		
Iron (Fe)	N	1	1	25.6	25.6	25.6	NA	NA	1100	NA	UG/L		
Magnesium (Mg)	N	1	1	5740	5740	5740	NA	NA	NA	NA	UG/L		
Manganese (Mn)		1	1	121	121	121	NA	NA	84	869	UG/L	1	
Potassium (K)	N	1	1	2760	2760	2760	NA	NA	NA	NA	UG/L		
Sodium (Na)	N	1	1	85200	85200	85200	NA	NA	NA	NA	UG/L		
Semivolatile Organics													
Benzoic acid		1	1	2	2	2	NA	NA	15000	NA	UG/L		
bis(2-Ethylhexyl)phthalate (BEHP)		1	1	2	2	2	NA	NA	4.8	NA	UG/L		
Shallow Wells													
Inorganics													
Aluminum (Al)	*	7	8	639	5090	2590	25	25	3700	2810	UG/L	1	2
Arsenic (As)		2	8	7.4	17.4	12.4	5	5	0.045	18.7	UG/L	2	
Barium (Ba)		3	8	14.5	27.1	22.3	20.3	94.8	260	211	UG/L		
Calcium (Ca)	N	8	8	10700	146000	73250	NA	NA	NA	NA	UG/L		
Chromium (Cr)		5	8	5.1	6.1	5.66	1	5	18	12.3	UG/L		
Cobalt (Co)		1	8	2.1	2.1	2.1	2	2	220	2.5	UG/L		
Copper (Cu)		4	8	3.2	12.8	6.45	2	2	150	2.7	UG/L		
Iron (Fe)	N	8	8	344	41500	8933	NA	NA	NA	NA	UG/L		
Lead (Pb)		6	8	3.3	10.3	5.38	3	3	15	4.8	UG/L		1
Magnesium (Mg)	N	8	8	1560	29200	9743	NA	NA	NA	NA	UG/L		
Manganese (Mn)		6	8	10.1	405	170.5	11.8	25	84	2560	UG/L	4	
Nickel (Ni)		1	8	2.2	2.2	2.2	1	2.7	73	15.2	UG/L		
Potassium (K)	N	3	8	2510	13800	7120	1500	7780	NA	NA	UG/L		
Selenium (Se)		1	8	5.2	5.2	5.2	5	5	18	NA	UG/L		
Sodium (Na)	N	3	8	5180	36400	16923	5450	54200	NA	NA	UG/L		
Vanadium (V)		5	8	3.7	9.5	6.84	1	5.1	26	11.4	UG/L		
Zinc (Zn)		2	8	17.6	119	68.3	4	42.6	1100	27.3	UG/L		1
Semivolatile Organics													
2-Methylnaphthalene		1	8	12	12	12	10	10	150	NA	UG/L		
Acenaphthene		1	8	3	3	3	10	10	220	NA	UG/L		
bis(2-Ethylhexyl)phthalate (BEHP)		1	8	2	2	2	10	10	4.8	NA	UG/L		
Dibenzofuran		1	8	2	2	2	10	10	15	NA	UG/L		
Fluorene		1	8	6	6	6	10	10	150	NA	UG/L		
Phenanthrene		2	8	2	5	3.5	10	10	150	NA	UG/L		
Volatile Organics													
Acetone	*	1	8	800	800	800	10	82	370	NA	UG/L	1	
Trichloroethene		1	8	1	1	1	5	5	1.6	NA	UG/L		

* - Identified as a COPC
N - Essential nutrient
UG/L - micrograms per liter
SQL - Sample quantitation limit
NA - Not applicable

APPENDIX C
Results of VOC Analyses
on QA/QC Samples for SDG 23386
RFI Report Addendum, SWMUs 23 and 63, AOCs 540, 541, 542 and 543, Zone E
Charleston Naval Complex

	StationID	FIELDQC		FIELDQC		FIELDQC	
	SampleID	023DB00301		023DB00901		023EB00301	
	DateCollected	8/30/1995		8/30/1995		8/30/1995	
	DateExtracted			9/1/1995			
	DateAnalyzed	9/6/1995		9/7/1995		9/6/1995	
	SDGNumber	23386		23386		23386	
Parameter	Units						
1,1,1,2-Tetrachloroethane	ug/Kg						
1,1,1,2-Tetrachloroethane	ug/L	5	U			5	U
1,2,3-Trichloropropane	ug/Kg						
1,2,3-Trichloropropane	ug/L	5	U			5	U
1,2-Dibromo-3-chloropropane	ug/Kg						
1,2-Dibromo-3-chloropropane	ug/L	10	U	10	U	10	U
1,4-Dioxane	ug/Kg						
1,4-Dioxane	ug/L	500	U			500	U
3-Chloropropene	ug/Kg						
3-Chloropropene	ug/L	5	U			5	U
Acetonitrile	ug/Kg						
Acetonitrile	ug/L	200	U			200	U
Acrolein	ug/Kg						
Acrolein	ug/L	50	U			50	U
Acrylonitrile	ug/Kg						
Acrylonitrile	ug/L	50	U			50	U
Chloroprene	ug/Kg						
Chloroprene	ug/L	5	U			5	U
Dichlorodifluoromethane	ug/Kg						
Dichlorodifluoromethane	ug/L	5	U			5	U
Ethylene Dibromide (1,2-Dibromoethane)	ug/Kg						
Ethylene Dibromide (1,2-Dibromoethane)	ug/L	5	U			5	U
Isobutyl alcohol	ug/Kg						
Isobutyl alcohol	ug/L	200	U			200	U
Methacrylonitrile	ug/Kg						
Methacrylonitrile	ug/L	100	U			100	U
Methyl iodide	ug/Kg						
Methyl iodide	ug/L	5	U			5	U
Methylene bromide	ug/Kg						
Methylene bromide	ug/L	10	U			10	U
Propionitrile	ug/Kg						
Propionitrile	ug/L	100	U			100	U
trans-1,4-Dichloro-2-butene	ug/Kg						
trans-1,4-Dichloro-2-butene	ug/L	5	U			5	U
Trichlorofluoromethane	ug/Kg						
Trichlorofluoromethane	ug/L	5	U			5	U
1,2,4-Trichlorobenzene	ug/Kg						
1,2,4-Trichlorobenzene	ug/L			10	U		
Chloromethane	ug/Kg						
Chloromethane	ug/L	10	U			10	U
Vinyl chloride	ug/Kg						
Vinyl chloride	ug/L	10	U			10	U
Bromomethane	ug/Kg						
Bromomethane	ug/L	10	U			10	U
Chloroethane	ug/Kg						
Chloroethane	ug/L	10	U			10	U
1,1-Dichloroethene	ug/Kg						

APPENDIX C
Results of VOC Analyses
on QA/QC Samples for SDG 23386
RFI Report Addendum, SWMUs 23 and 63, AOCs 540, 541, 542 and 543, Zone E
Charleston Naval Complex

	StationID	FIELDQC		FIELDQC		FIELDQC	
	SampleID	023DB00301		023DB00301		023EB00301	
	DateCollected	8/30/1995		8/30/1995		8/30/1995	
	DateExtracted			9/1/1995			
	DateAnalyzed	9/6/1995		9/7/1995		9/6/1995	
	SDGNumber	23386		23386		23386	
Parameter	Units						
1,1-Dichloroethene	ug/L	5	U			5	U
Acetone	ug/Kg						
Acetone	ug/L	27				10	U
Carbon Disulfide	ug/Kg						
Carbon Disulfide	ug/L	5	U			5	U
Methylene Chloride	ug/Kg						
Methylene Chloride	ug/L	10				10	
1,1-Dichloroethane	ug/Kg						
1,1-Dichloroethane	ug/L	5	U			5	U
Vinyl acetate	ug/Kg						
Vinyl acetate	ug/L	10	U			10	U
Methyl ethyl ketone (2-Butanone)	ug/Kg						
Methyl ethyl ketone (2-Butanone)	ug/L	10	U			10	U
1,2-Dichloroethene (total)	ug/Kg						
1,2-Dichloroethene (total)	ug/L	5	U			5	U
Chloroform	ug/Kg						
Chloroform	ug/L	3	J			1	J
1,1,1-Trichloroethane	ug/Kg						
1,1,1-Trichloroethane	ug/L	5	U			5	U
Carbon Tetrachloride	ug/Kg						
Carbon Tetrachloride	ug/L	5	U			5	U
1,2-Dichloroethane	ug/Kg						
1,2-Dichloroethane	ug/L	5	U			5	U
Benzene	ug/Kg						
Benzene	ug/L	5	U			5	U
Trichloroethylene (TCE)	ug/Kg						
Trichloroethylene (TCE)	ug/L	5	U			5	U
1,2-Dichloropropane	ug/Kg						
1,2-Dichloropropane	ug/L	5	U			5	U
Bromodichloromethane	ug/Kg						
Bromodichloromethane	ug/L	5	U			5	U
2-Chloroethyl vinyl ether	ug/Kg						
2-Chloroethyl vinyl ether	ug/L	10	U			10	U
cis-1,3-Dichloropropene	ug/Kg						
cis-1,3-Dichloropropene	ug/L	5	U			5	U
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/Kg						
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/L	10	U			10	U
Toluene	ug/Kg						
Toluene	ug/L	5	U			5	U
trans-1,3-Dichloropropene	ug/Kg						
trans-1,3-Dichloropropene	ug/L	5	U			5	U
1,1,2-Trichloroethane	ug/Kg						
1,1,2-Trichloroethane	ug/L	5	U			5	U
2-Hexanone	ug/Kg						
2-Hexanone	ug/L	10	U			10	U
Tetrachloroethylene (PCE)	ug/Kg						
Tetrachloroethylene (PCE)	ug/L	5	U			5	U
Dibromochloromethane	ug/Kg						
Dibromochloromethane	ug/L	5	U			5	U
Chlorobenzene	ug/Kg						
Chlorobenzene	ug/L	5	U			5	U
Ethylbenzene	ug/Kg						
Ethylbenzene	ug/L	5	U			5	U
Xylenes, Total	ug/Kg						
Xylenes, Total	ug/L	5	U			5	U
Styrene	ug/Kg						
Styrene	ug/L	5	U			5	U
Bromoform	ug/Kg						
Bromoform	ug/L	5	U			5	U
1,1,2,2-Tetrachloroethane	ug/Kg						
1,1,2,2-Tetrachloroethane	ug/L	5	U			5	U

APPENDIX C
Results of VOC Analyses
on QA/QC Samples for SDG 23386
RFI Report Addendum, SWMUs 23 and 63, AOCs 540, 541, 542
Charleston Naval Complex

	St	FIELDQC		LABQC		LABQC		LABQC	
	Sa	023EB00301		BLK0338604		BLK0338604		BLK0338604	
	DateCo	8/30/1995							
	DateExt	9/1/1995						9/1/1995	
	DateAn	9/7/1995		9/7/1995		9/8/1995		9/7/1995	
	SDGN	23386		23386		23386		23386	
Parameter	**Units**								
1,1,1,2-Tetrachloroethane	ug/Kg					5	U		
1,1,1,2-Tetrachloroethane	ug/L								
1,2,3-Trichloropropane	ug/Kg					5	U		
1,2,3-Trichloropropane	ug/L								
1,2-Dibromo-3-chloropropane	ug/Kg					10	U	330	U
1,2-Dibromo-3-chloropropane	ug/L	10	U						
1,4-Dioxane	ug/Kg					500	U		
1,4-Dioxane	ug/L								
3-Chloropropene	ug/Kg					5	U		
3-Chloropropene	ug/L								
Acetonitrile	ug/Kg					200	U		
Acetonitrile	ug/L								
Acrolein	ug/Kg					50	U		
Acrolein	ug/L								
Acrylonitrile	ug/Kg					50	U		
Acrylonitrile	ug/L								
Chloroprene	ug/Kg					5	U		
Chloroprene	ug/L								
Dichlorodifluoromethane	ug/Kg					5	U		
Dichlorodifluoromethane	ug/L								
Ethylene Dibromide (1,2-Dibromoethane)	ug/Kg					5	U		
Ethylene Dibromide (1,2-Dibromoethane)	ug/L								
Isobutyl alcohol	ug/Kg					200	U		
Isobutyl alcohol	ug/L								
Methacrylonitrile	ug/Kg					100	U		
Methacrylonitrile	ug/L								
Methyl iodide	ug/Kg					5	U		
Methyl iodide	ug/L								
Methylene bromide	ug/Kg					10	U		
Methylene bromide	ug/L								
Propionitrile	ug/Kg					100	U		
Propionitrile	ug/L								
trans-1,4-Dichloro-2-butene	ug/Kg					5	U		
trans-1,4-Dichloro-2-butene	ug/L								
Trichlorofluoromethane	ug/Kg					5	U		
Trichlorofluoromethane	ug/L								
1,2,4-Trichlorobenzene	ug/Kg							2000	
1,2,4-Trichlorobenzene	ug/L	10	U						
Chloromethane	ug/Kg			10	U	58			
Chloromethane	ug/L								
Vinyl chloride	ug/Kg			10	U	55			
Vinyl chloride	ug/L								
Bromomethane	ug/Kg			10	U	52			
Bromomethane	ug/L								
Chloroethane	ug/Kg			10	U	48			
Chloroethane	ug/L								
1,1-Dichloroethene	ug/Kg			5	U	50			

APPENDIX C
Results of VOC Analyses
on QA/QC Samples for SDG 23386
RFI Report Addendum, SWMUs 23 and 63, AOCs 540, 541, 542
Charleston Naval Complex

	St	FIELDQC	LABQC		LABQC		LABQC	
	Sa	023EB00301	BLK0338604		BLK0338604		BLK0338604	
	DateCo	8/30/1995						
	DateExt	9/1/1995					9/1/1995	
	DateAn	9/7/1995	9/7/1995		9/8/1995		9/7/1995	
	SDGN	23386	23386		23386		23386	
Parameter	**Units**							
1,1-Dichloroethene	ug/L							
Acetone	ug/Kg		10	U	54			
Acetone	ug/L							
Carbon Disulfide	ug/Kg		5	U	50			
Carbon Disulfide	ug/L							
Methylene Chloride	ug/Kg		4	J	52			
Methylene Chloride	ug/L							
1,1-Dichloroethane	ug/Kg		5	U	50			
1,1-Dichloroethane	ug/L							
Vinyl acetate	ug/Kg		10	U	58			
Vinyl acetate	ug/L							
Methyl ethyl ketone (2-Butanone)	ug/Kg		10	U	65			
Methyl ethyl ketone (2-Butanone)	ug/L							
1,2-Dichloroethene (total)	ug/Kg		5	U	120			
1,2-Dichloroethene (total)	ug/L							
Chloroform	ug/Kg		5	U	50			
Chloroform	ug/L							
1,1,1-Trichloroethane	ug/Kg		5	U	49			
1,1,1-Trichloroethane	ug/L							
Carbon Tetrachloride	ug/Kg		5	U	50			
Carbon Tetrachloride	ug/L							
1,2-Dichloroethane	ug/Kg		5	U	53			
1,2-Dichloroethane	ug/L							
Benzene	ug/Kg		5	U	52			
Benzene	ug/L							
Trichloroethylene (TCE)	ug/Kg		5	U	49			
Trichloroethylene (TCE)	ug/L							
1,2-Dichloropropane	ug/Kg		5	U	52			
1,2-Dichloropropane	ug/L							
Bromodichloromethane	ug/Kg		5	U	52			
Bromodichloromethane	ug/L							
2-Chloroethyl vinyl ether	ug/Kg		10	U	55			
2-Chloroethyl vinyl ether	ug/L							
cis-1,3-Dichloropropene	ug/Kg		5	U	54			
cis-1,3-Dichloropropene	ug/L							
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/Kg		10	U	58			
Methyl isobutyl ketone (4-Methyl-2-pentanone)	ug/L							
Toluene	ug/Kg		5	U	48			
Toluene	ug/L							
trans-1,3-Dichloropropene	ug/Kg		5	U	55			
trans-1,3-Dichloropropene	ug/L							
1,1,2-Trichloroethane	ug/Kg		5	U	55			
1,1,2-Trichloroethane	ug/L							
2-Hexanone	ug/Kg		10	U	61			
2-Hexanone	ug/L							
Tetrachloroethylene (PCE)	ug/Kg		5	U	44			
Tetrachloroethylene (PCE)	ug/L							
Dibromochloromethane	ug/Kg		5	U	54			
Dibromochloromethane	ug/L							
Chlorobenzene	ug/Kg		5	U	49			
Chlorobenzene	ug/L							
Ethylbenzene	ug/Kg		5	U	40			
Ethylbenzene	ug/L							
Xylenes, Total	ug/Kg		5	U	140			
Xylenes, Total	ug/L							
Styrene	ug/Kg		5	U	50			
Styrene	ug/L							
Bromoform	ug/Kg		5	U	58			
Bromoform	ug/L							
1,1,2,2-Tetrachloroethane	ug/Kg		5	U	60			
1,1,2,2-Tetrachloroethane	ug/L							

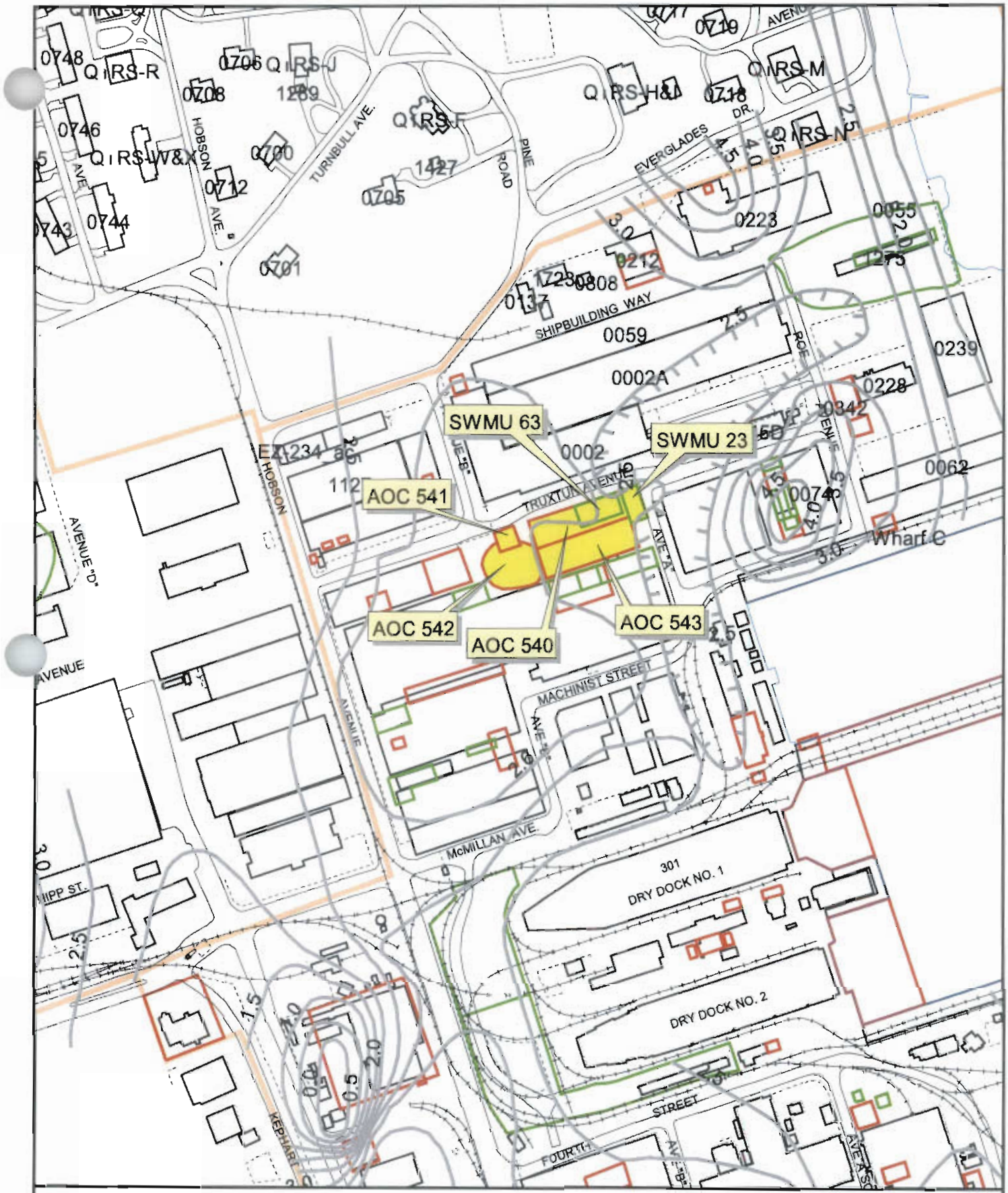


Figure C-1
Shallow Groundwater Contour Map
Combined SWMU 23, Zone E
Charleston Naval Complex

Appendix D

South Carolina Department of Health and Environmental Control (S.C.D.H.E.C.)
Underground Storage Tank (UST) Assessment Report

Date Received State Use Only

Submit Completed Form to:
UST Regulatory Section
SCDHEC
2600 Bull Street
Columbia, South Carolina 29201
Telephone (803) 734-5331

I OWNERSHIP OF UST(S)

Agency/Owner: Southern Division, Naval Facilities Engineering Command, Caretaker Site Office

Mailing Address: P O. Box 190010

City: N. Charleston State: SC Zip Code: 29419-9010

Area Code: 803 Telephone Number: 743-9985 Contact Person: LCDR Paul Rose

II SITE IDENTIFICATION AND LOCATION

Site I.D. #: 12094 Registered, not regulated

Facility Name: Charleston Naval Base Complex, CNSY Bldg 6

Street Address: South Hobson Avenue

City: North Charleston, 29405-2413 County: Charleston

III CLOSURE INFORMATION

Closure Started: 24 April 1996 Closure Completed: 15 May 1996

Number of USTs Closed: 2

N/A
Consultant

SPORTENVDETCHASN
UST Removal Contractor

IV. CERTIFICATION (Read and Sign after completing entire submittal)

I certify that I have personally examined and am familiar with the information submitted in this and all attached documents; and that based on my inquiry of those individuals responsible for obtaining the information, I believe that the submitted information is true, accurate and complete.

John T Amey
Name (Type or Print)

Signature

V. UST INFORMATION

		Tank 1 6A	Tank 2 6B	Tank 3	Tank 4	Tank 5	Tank 6
A.	Product	Fuel oil	Fuel oil				
B.	Capacity	2500 gal	2500 gal				
C.	Age	1967	1967				
D.	Construction Material	Steel	Steel				
E.	Month/Year of Last Use	Unknown	Unknown				
F.	Depth (ft.) To Base of Tank	7'	7'				
G.	Spill Prevention Equipment Y/N	N	N				
H.	Overfill Prevention Equipment Y/N	N	N				
I.	Method of Closure Removed/Filled	R	R				
J.	Visible Corrosion or Pitting Y/N	N	N				
K.	Visible Holes Y/N	Y	Y				

L. Method of disposal for any USTs removed from the ground (attach disposal manifests).

UST 6A & 6B were removed from the ground, drained, and cleaned. They were then cut-up and recycled as scrap (see Attachment III). Asphalt and concrete removed during the excavation were disposed of as construction debris.

M. Method of disposal for any liquid petroleum, sludges, or waste waters removed from the USTs (attach disposal manifests).

Residual waste oil was pumped into 55 gallon drums and disposed of by Chem-Met Services, Inc; 1855 Allen Road; Wyandotte, MI 48192. (See Attachment III, manifest number 13105, paragraph 11b.)

N If any corrosion, pitting, or holes were observed, describe the location and extent for each UST.

Several holes of 1/8" or less diameter were found in the upper portion of tanks 6A and 6B. The holes were not discernable until the tanks were cut open for cleaning and light was observed penetrating them from inside.

VI. PIPING INFORMATION

	Tank 1 6A	Tank 2 6B	Tank 3	Tank 4	Tank 5	Tank 6
A. Construction Material.....	Steel	Steel				
B. Distance from UST to Dispenser...(See note)....	N/A	N/A				
C. Number of Dispensers.....(See note).....	N/A	N/A				
D. Type of System P/S.....	S	S				
E. Was Piping Removed from the Ground? Y/N....	Y	Y				
F. Visible Corrosion or Pitting Y/N.....	Y	Y				
G. Visible Holes Y/N.....	N	N				
H. Age.....	1967	1967				

Note. UST 6A & 6B supplied fuel oil to the forge shop and Facility 226.

I. If any corrosion, pitting, or holes were observed, describe the location and extent for each line.

Although no holes were found in the pipe runs, they were heavily corroded throughout. Also, portions of pipe run excavation possessed a strong petrolium odor. See Map 3.

VII. BRIEF SITE DESCRIPTION AND HISTORY

Building 6, the Charleston Naval Shipyard's forge shop, was built in 1906 and expanded in 1967. Building 6 is situated inside what was the Controlled Industrial Area of the shipyard. USTs 6A and 6B were 2500 gallon, number two fuel oil tanks which served Building 6 and Facility 226. The tanks were located under a concrete cap in the middle of the asphalt paved parking lot/lay-down area northeast of Building 6.

Tanks 6A and 6B were connected by a 6" spool piece at their bottoms. One set of piping (supply, return, and vent) was routed from the north side of the tanks to Building 6. The piping ran through a pipe vault where it cross-connected with supply and return piping connected to AST 00219 on the west end of Building 226. There was another run of pipe from the south end of the tanks to AST 00219. The reason for the double cross connects is not known. The asphalt covering the pipe runs was patched along its entirety.

VIII. SITE CONDITIONS

		Yes	No	Unk
A.	Were any petroleum-stained or contaminated soils found in the UST excavation, soil borings, trenches, or monitoring wells? If yes, indicate depth and location on the site map.	X		
B.	Were any petroleum odors detected in the excavation, soil borings, trenches, or monitoring wells? If yes, indicate location on site map and describe the odor (strong, mild, etc)	X		
C.	Was water present in the UST excavation, soil borings, or trenches? If yes, how far below land surface (indicate location and depth)? Less than one inch deep in center of 7' deep excavation.	X		
D	Did contaminated soils remain stockpiled on site after closure? If yes, indicate the stockpile location on the site map. Name of DHEC representative authorizing soil removal: See Note 1.	X		
E.	Was a petroleum sheen or free product detected on any excavation or boring waters? If yes, indicate location and thickness.		X	

Note 1: The contaminated soil is located at Bldg 6. Per conversation with DHEC, Mr. Tim Mettlen, and SouthDiv, Mr. Gabriel Magwood, the entire naval complex is considered the site.

IX. SAMPLE INFORMATION

S.C.D.H.E.C. Lab Certification Number 10120

Sample #	Location	Sample Type (Soil/Water)	Depth*	Date/Time of Collection	Collected By	OVA#
UST 6-1.	Southwest corner of tank pit.	Soil	7'	24 April 96 1400	R. Atkins	Not taken
UST 6-2	South end, 6B center of tank pit.	Soil	7'	7 May 96 1000	R. Atkins	Not taken
UST 6-2D.	South end, 6B center of tank pit.	Soil	7'	7 May 96 1000	R. Atkins	Not taken
UST 6-3.	Between the tanks in bottom of pit.	Soil	7'	7 May 96 1015	R. Atkins	Not taken
UST 6-4.	North end, 6A center of tank pit.	Soil	7'	7 May 96 1015	R. Atkins	Not taken
UST 6-6.	East end of trough	Soil	3'	15 May 96 1300	R. Atkins	Not taken
UST 6-7.	1st turn from east end of trough	Soil	3'	15 May 96 1300	R. Atkins	Not taken
UST 6-8.	Mechanical joint in trough	Soil	3'	15 May 96 1300	R. Atkins	Not taken
UST 6-9.	Mechanical joint in trough	Soil	3'	15 May 96 1300	R. Atkins	Not taken
UST 6-10.	Mechanical joint turn into tank	Soil	3'	15 May 96 1300	R. Atkins	Not taken
UST 6-11.	20ft. Mid-ways in trough	Soil	3'	15 May 96 1300	R. Atkins	Not taken
UST 6-12.	Mechanical joint	Soil	3'	15 May 96 1300	R. Atkins	Not taken
UST 6-13.	Mechanical joint	Soil	3'	15 May 96 1300	R. Atkins	Not taken
UST 6-14.	Mechanical joint	Soil	3'	15 May 96 1300	R. Atkins	Not taken

* = Depth Below the Surrounding Land Surface

X. SAMPLING METHODOLOGY

Provide a detailed description of the methods used to collect and store (preserve) the samples.

After the removal of USTs 6A and 6B and their associated piping, soil samples were taken. The samples were extracted from the bottom of the UST and the pipe-run excavations from native soils in the locations indicated on Site Maps 2 and 3. Sampling was performed in accordance with SC DHEC R.61-92 Part 280 and SC DHEC UST Assessment Guidelines.

The samples are identified as follows:

	Detachment Charleston		General Engineering Labs
Soil Sample	UST 6-1	=	SPORT - 0015-2
Soil Sample	UST 6-2	=	SPORT - 0026-1
Soil Sample	UST 6-2D	=	SPORT - 0026-2
Soil Sample	UST 6-3	=	SPORT - 0026-3
Soil Sample	UST 6-4	=	SPORT - 0026-4
Soil Sample	UST 6-6	=	SPORT - 0038-1
Soil Sample	UST 6-7	=	SPORT - 0038-2
Soil Sample	UST 6-8	=	SPORT - 0038-3
Soil Sample	UST 6-9	=	SPORT - 0038-4
Soil Sample	UST 6-10	=	SPORT - 0038-5
Soil Sample	UST 6-11	=	SPORT - 0038-6
Soil Sample	UST 6-12	=	SPORT - 0038-7
Soil Sample	UST 6-13	=	SPORT - 0038-8
Soil Sample	UST 6-14	=	SPORT - 0038-9

Sample jars were prepared by the testing laboratory. The grab method was utilized to fill the sample containers leaving as little head space as possible and immediately capped.

The samples were marked, logged, and immediately placed in sample coolers packed with ice to maintain an approximate temperature of 4° C. Tools were thoroughly cleaned and decontaminated with organic-free soap and water after each sample.

The samples remained in the custody of SPORTENVDETCHASN until they were transferred to General Engineering Laboratories for analysis as documented in the attached Chain-of-Custody Record.

XI. RECEPTORS

		Yes	No
A.	Are there any lakes, ponds, streams, or wetlands located within 1000 feet of the UST system? [*Cooper River, 620'] If yes, indicate type of receptor, distance, and direction on site map.	X*	
B.	Are there any public, private, or irrigation water supply wells within 1000 feet of the UST system? If yes, indicate type of well, distance, and direction on site map.		X
C.	Are there any underground structures (e.g., basements) located within 100 feet of the UST system? If yes, indicate the type of structure, distance, and direction on site map.		X
D.	Are there any underground utilities (e.g., telephone, electricity, gas, water, sewer, storm drain) located within 100 feet of the UST system that could potentially come in contact with the contamination? [*Sewer & storm drain] If yes, indicate the type of utility, distance, and direction on the site map.	X*	
E.	Has contaminated soil been identified at a depth of less than 3 feet below land surface in an area that is not capped by asphalt or concrete? If yes, indicate the area of contaminated soil on the site map.		X

Attachment I

SITE MAP

You must supply a scaled site map. It should include all buildings, road names, utilities, tank and pump island locations, sample locations, extent of excavation, and any other pertinent information.

Site Maps 1, 2, and 3
Photographs

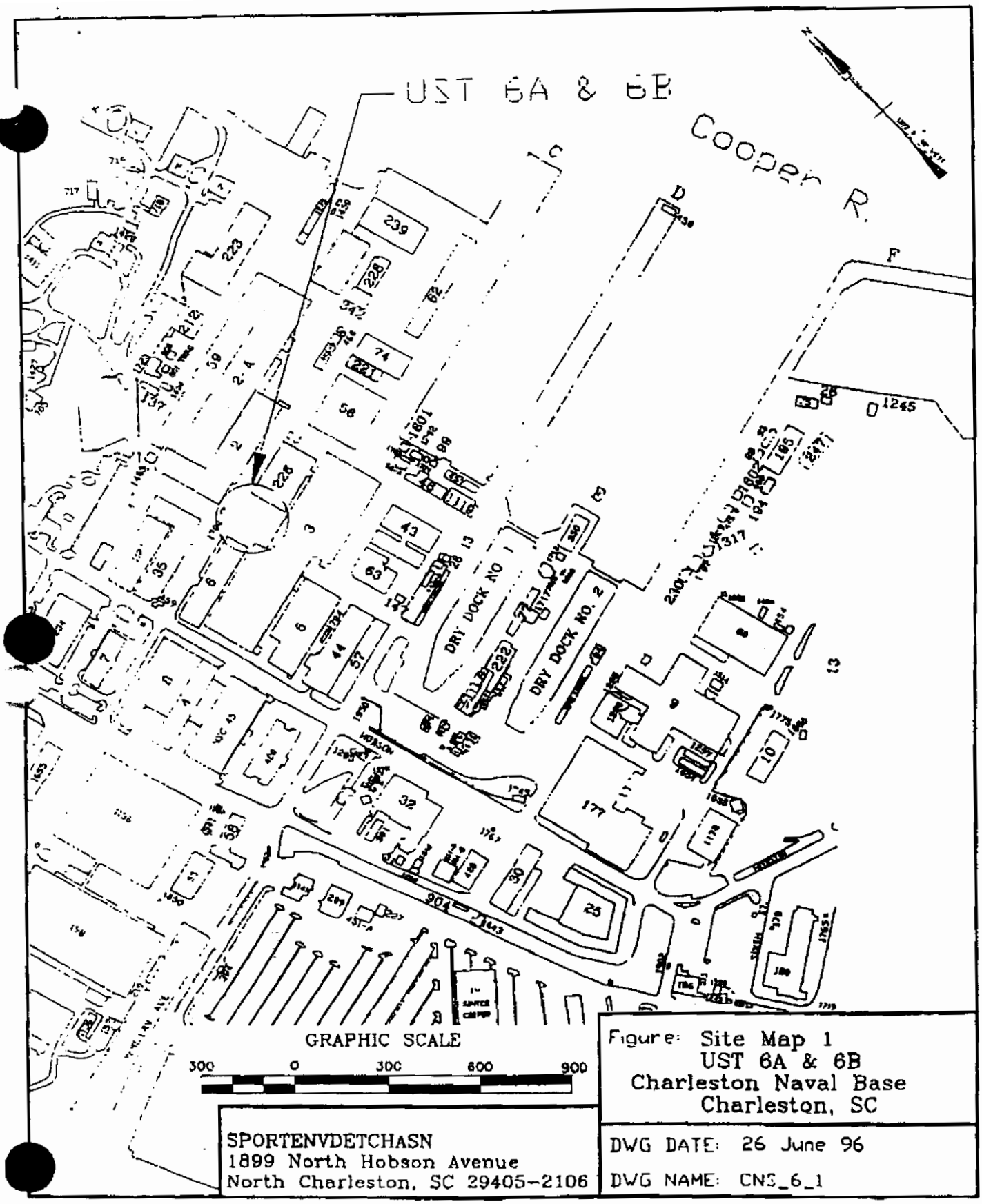
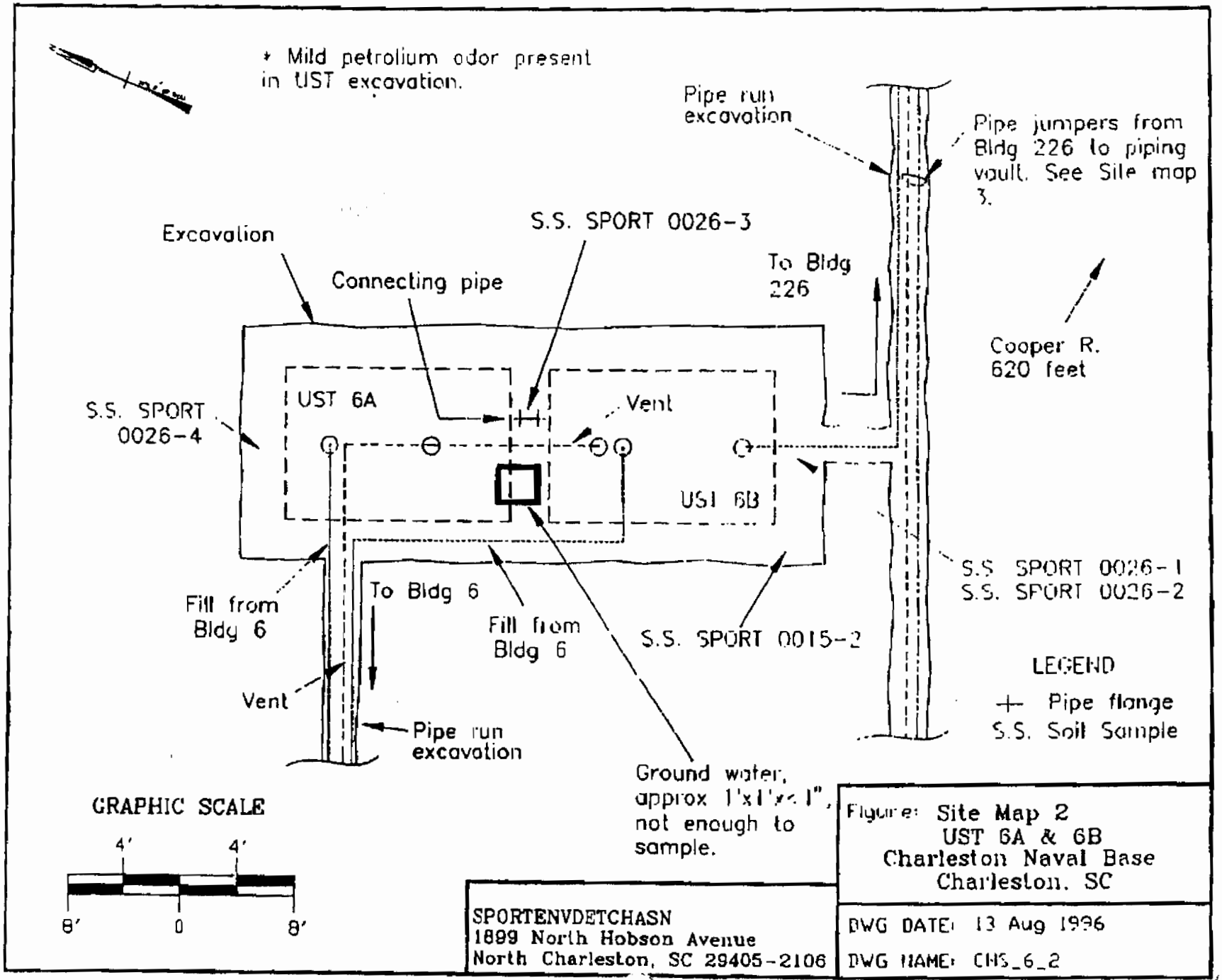


Figure: Site Map 1
UST 6A & 6B
Charleston Naval Base
Charleston, SC

SPORTENVDETCHASN
1899 North Hobson Avenue
North Charleston, SC 29405-2106

DWG DATE: 26 June 96

DWG NAME: CNS_6_1


* Mild petrolium odor present in UST excavation.
Pipe run excavation
Pipe jumpers from Bldg 226 to piping vault. See Site map 3.
Excavation
Connecting pipe
S.S. SPORT 0026-3
To Bldg 226
Cooper R. 620 feet
S.S. SPORT 0026-4
UST 6A
Vent
UST 6B
S.S SPORT 0026-1
S.S. SPORT 0026-2
Fill from Bldg 6
To Bldg 6
Fill from Bldg 6
S.S. SPORT 0015-2
Vent
Pipe run excavation
LEGEND
Pipe flange
S.S. Soil Sample
Ground water, approx 1'x1'x1", not enough to sample.
GRAPHIC SCALE
4'
4'
8'
0
8'
Figure: Site Map 2
UST 6A & 6B
Charleston Naval Base
Charleston, SC
SPORTENVDETCHASN
1899 North Hobson Avenue
North Charleston, SC 29405-2106
DWG DATE: 13 Aug 1996
DWG NAME: CHS_6_2

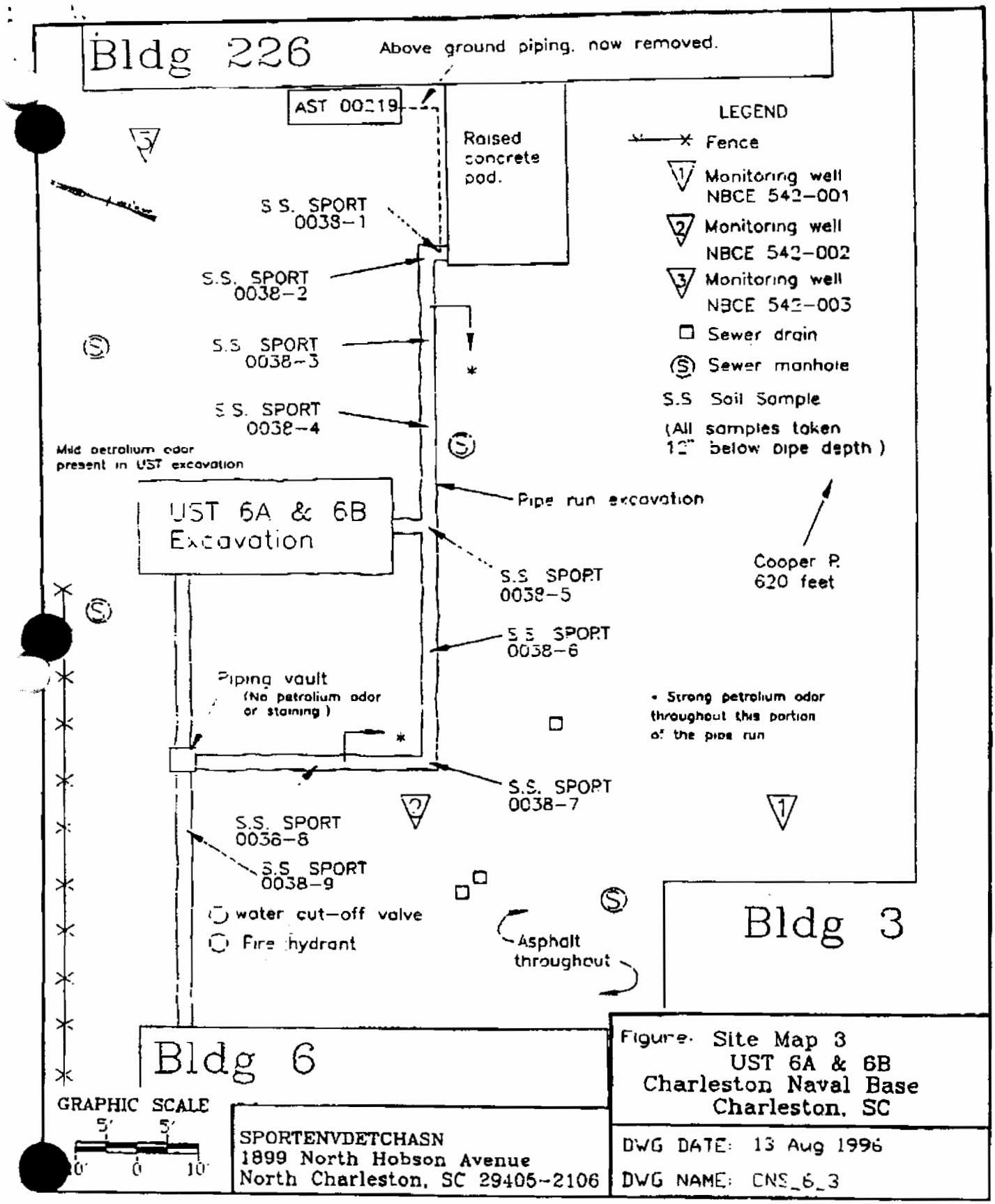


Figure. Site Map 3
UST 6A & 6B
Charleston Naval Base
Charleston, SC

SPORTENVDETCHASN
1899 North Hobson Avenue
North Charleston, SC 29405-2106

DWG DATE: 13 Aug 1996

DWG NAME: CNS_6_3

Appendix E

Leachate Transport Analysis Model
Charleston Naval Complex
Zone E - Combined SWMU 23

						Parameter	Methylene chloride
Chemical Specific Input Parameters							
Cw	=	Target groundwater concentration MCL (mg/L)					5.00E-03
H	=	Henry's Law Constant, dimensionless					8.98E-02
ks	=	Soil-water sorption coefficient (cm3 water / g soil = L/kg) = Koc x foc where					4.33E-01
		koc = organic carbon-water sorption coefficient, (cm3 (ml) water) / (g soluble organic carbon)					1.17E+01
		foc = Fraction of organic content, dimensionless			0.037		
Site Specific Input Parameters							
Sw	=	Width of Source Parallel to Groundwater Flow Direction	(impacted soil zone)	3.0 m	10 ft		
da	=	Aquifer Thickness		6.9 m	22.5 ft		
d	=	Groundwater Mixing Zone thickness	(paved)	0.33 m	1.1 ft		
			(unpaved)	0.41 m	1.3 ft		
i	=	Groundwater Gradient		7.3E-03 (unitless)			
Ks	=	Saturated Hydraulic Conductivity		667.5 m/yr	2190.0 ft/yr		
θw	=	Volumetric Water Content of Soil Pore Space		0.3 cm^3_{vapor}/cm^3_{soil}	0.3 in^3_{vapor}/in^3_{soil}		
θv	=	Volumetric Vapor Content of Soil Pore Space		0.15 cm^3_{vapor}/cm^3_{soil}	0.15 in^3_{vapor}/in^3_{soil}		
ρs	=	Soil Bulk Density		1.5 g/cm^3	93.64 lb_m/ft^3		
qi	=	Water Infiltration Rate	(paved)	0.0086 m/yr	0.0283 ft/yr		
			(unpaved)	0.1372 m/yr	0.4500 ft/yr		
		Partition Term, Cw/Csoil, (L/kg)		$\frac{C_{soil}}{C_w} = \left(\frac{\theta_w + K_s\rho_s + H\theta_v}{\rho_s}\right)\left(\frac{K_s i d + q_i S_w}{q_i S_w}\right)$			6.42E-01
		Dilution Term, dimensionless	(paved)				6.20E+01
			(unpaved)				5.77E+00
		Csoil/Cw =Partition term * Dilution term (mg/kg / mg/L) = L/kg	(paved)				3.98E+01
			(unpaved)				3.70E+00
		Calculated Site Specific Target Level for Soil					
		C_{soil} calculated source soil concentration (SSL, mg/kg) Cw*(partion term)*(dilution term)				(paved)	0.199
						(unpaved)	0.019

Cwt is the MCL from EPA National Drinking Water Standards (March 2001)or US EPA Region III RBCs (October, 2000).
H from Table 36 of the Soil Screening Guidance; Technical Background Document (EPA, 1996).
ks = koc x foc.
koc from Table 39 of the Soil Screening Guidance; Technical Background Document (EPA, 1996).
foc calculated as the mean foc from TOC measurements from Zone E.
Sw Conservatively estimated as the distance along groundwater flow path at each of 2 separate soil borings E063SB002 and E543SB002.
d is calculated as $M = (0.0112\ L^2)^{0.5} + da\{1 - e^{[-L\ qi/Ks\ da]}\}$ or da, whichever is less.
da is based on top of Ashley (-20 ft, GIS) and nearest isocontour line for groundwater level (2.5 ft msl, GIS).
i Calculated from groundwater elevations in Zone E measured during May 2000; wells E063GW001 and E063GW002, CH2MHill, 2002).
Ks Based on CH2MHill's hydraulic conductivity theme in the GIS (6 ft/d).
θw is the default value presented in the Soil Screening Guidance: User's Guide (EPA, 1996)
θv is calculated as total porosity (0.45, assumed) - θw (0.3) = 0.15.
ρs is the default value presented in the Soil Screening Guidance: User's Guide (EPA, 1996)
qi is a derived value (unpaved, 5.4 in/yr or paved, 0.34 in/yr) based on annual precipitation, evapo-transportation, and runoff coefficient values for the Charleston area.