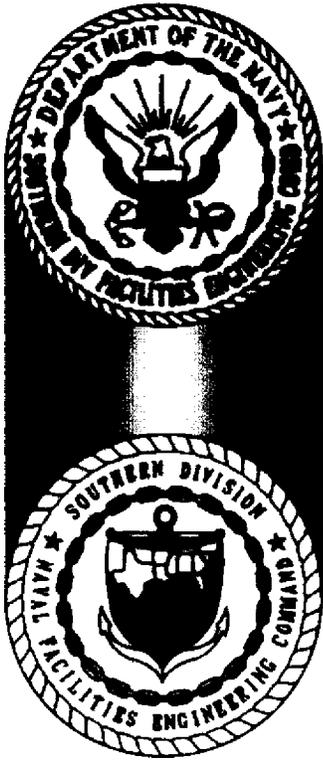


N61165.AR.003530
CNC CHARLESTON
5090.3a

RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT
ADDENDUM AREA OF CONCERN 566 (AOC 566) ZONE E CNC CHARLESTON SC
6/4/2002
CH2M HILL

RFI REPORT ADDENDUM

Area of Concern 566, Zone E



***Charleston Naval Complex
North Charleston, South Carolina***

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

CH2M Jones

May 2002

Contract N62467-99-C-0960

CH2M HILL
115 Perimeter Center Place N.E.
Suite 700
Atlanta, GA 30346-1278
Tel 770.604.9095
Fax 770.604.9183



CH2MHILL

June 4, 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 (Revision 0) – AOC 566, Zone E

Dear Mr. Scaturo:

Enclosed are four copies of the RFI Report Addendum (Revision 0) for AOC 566 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, should 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
Tim Frederick/Gannett-Fleming, Inc.

RFI REPORT ADDENDUM

Area of Concern 566, Zone E



***Charleston Naval Complex
North Charleston, South Carolina***

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

PREPARED BY
CH2M-Jones

May 2002

*Revision 0
Contract N62467-99-C-0960
158814.ZE.PR.08*

Certification Page for RFI Report Addendum (Revision 0) – AOC 566, Zone E

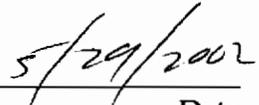
I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428



Dean Williamson, P.E.



Date

Contents

Section	Page
Acronyms and Abbreviations.....	vi
1.0 Introduction	1-1
1.1 Purpose of the RFI Report Addendum.....	1-2
1.2 Report Organization	1-2
Figure 1-1 Location of AOC 566 in Zone E	1-4
Figure 1-2 Site Map.....	1-5
2.0 Summary of RFI Conclusions for AOC 566.....	2-1
2.1 Soil Sampling and Analysis.....	2-1
2.1.1 Surface Soil.....	2-1
2.1.2 Subsurface Soil	2-2
2.2 Groundwater	2-2
2.2.1 Shallow Groundwater	2-3
2.2.2 Deep Groundwater	2-3
2.3 RFI Human Health Risk Assessment	2-4
2.3.1 Soils	2-4
2.3.2 Groundwater	2-4
2.4 RFI Conclusions and Recommendations.....	2-4
Figure 2-1 RFI Sample Locations	2-5
Figure 2-2 RFI Surface Soil Exceedances	2-6
Figure 2-3 Groundwater Exceedances	2-7
3.0 Summary of Interim Measures and UST/AST Removals at AOC 566	3-1
3.1 UST/AST Removals	3-1
3.2 Interim Measures	3-1
4.0 Summary of Additional Investigations.....	4-1
5.0 COPC/COC Refinement.....	5-1
5.1 Soils	5-1
5.1.1 Antimony	5-1
5.1.2 BEQs.....	5-2
5.1.3 Methylene Chloride.....	5-3
5.2 Groundwater	5-3
5.2.1 Beryllium.....	5-3
5.2.2 Arsenic.....	5-4

1 Contents, Continued

2	5.3	COC Summary	5-4
3	Table 5-1	Detected Concentrations of Antimony, BEQs, and Methylene Chloride in	
4		Surface and Subsurface Soils	5-5
5	Table 5-2	Detected PAH Concentrations in Subsurface Soils	5-7
6	Table 5-3	Detected Arsenic, Iron, Manganese, and Thallium Concentrations	
7		in Shallow and Deep Groundwater	5-9
8	Figure 5-1	Soil Exceedances	5-11
9	6.0	Summary of Information Related to Site Closeout Issues	6-1
10	6.1	RFI Status	6-1
11	6.2	Presence of Inorganics in Groundwater	6-1
12	6.3	Potential Linkage to SWMU 37, Investigated Sanitary Sewers	
13		at the CNC	6-2
14	6.4	Potential Linkage to AOC 699, Investigated Storm Sewers at the CNC	6-2
15	6.5	Potential Linkage to AOC 504, Investigated Railroad Lines at the CNC	6-2
16	6.6	Potential Migration Pathways to Surface Water Bodies at the CNC	6-2
17	6.7	Potential Contamination in Oil/Water Separators	6-3
18	6.8	Land Use Control	6-3
19	7.0	Recommendations	7-1
20	8.0	References	8-1
21			
22		Appendices	
23	A	Excerpts from the <i>Zone E RFI Report, Revision 0</i>	
24	B	Responses to SCDHEC Comments on <i>Zone E RFI Report, Revision 0</i> for AOC 566	
25	C	Figure C-1 showing site location and historic railroad lines on Public Works Map of the	
26		Charleston Navy Shipyard (December 1939)	

1 Acronyms and Abbreviations

2	AOC	area of concern
3	AST	aboveground storage tank
4	BCT	BRAC Cleanup Team
5	BRAC	Base Realignment and Closure Act
6	BRC	background reference concentration
7	CA	corrective action
8	CMS	corrective measures study
9	CNC	Charleston Naval Complex
10	COC	chemical of concern
11	COPC	chemical of potential concern
12	CSI	confirmatory sampling investigation
13	DAF	dilution attenuation factor
14	EnSafe	EnSafe Inc.
15	EPA	U.S. Environmental Protection Agency
16	FRE	fixed-point risk evaluation
17	HHRA	human health risk assessment
18	HI	hazard index
19	IM	interim measure
20	LUC	land use control
21	$\mu\text{g/L}$	micrograms per liter
22	MCL	maximum contaminant level
23	NAVBASE	Naval Base
24	NFA	no further action

1 **Acronyms and Abbreviations, Continued**

2	NFI	no further investigation
3	OWS	oil/water separator
4	PAH	polycyclic aromatic hydrocarbon
5	PCB	polychlorinated biphenyl
6	PCE	tetrachloroethene
7	RBC	risk-based concentration
8	RCRA	Resource Conservation and Recovery Act
9	RFI	RCRA Facility Investigation
10	SAA	satellite accumulation area
11	SCDHEC	South Carolina Department of Health and Environmental Control
12	SSL	soil screening level
13	SVOC	semivolatile organic compound
14	SWMU	solid waste management unit
15	TDS	total dissolved solids
16	UST	underground storage tank
17	VOC	volatile organic compound

Section 1.0

1 1.0 Introduction

2 In 1993, Naval Base (NAVBASE) Charleston was added to the list of bases scheduled for closure
3 as part of the Defense Base Realignment and Closure Act (BRAC), which regulates closure and
4 transition of property to the community. The Charleston Naval Complex (CNC) was formed as
5 a result of the dis-establishment of the Charleston Naval Shipyard and NAVBASE on April 1,
6 1996.

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

11 In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation and
12 remediation services at the CNC. This submittal has been prepared by CH2M-Jones to complete
13 the RCRA Facility Investigation (RFI) for Area of Concern (AOC) 566 in Zone E of CNC. The
14 location of this site in Zone E is shown in Figure 1-1. Figure 1-2 shows an aerial photograph of
15 the site.

16 AOC 566, a former paint storage area in Building 194, has been most recently used by the Navy
17 to store supplies, such as tools, hoses, and equipment. Building 194 was constructed in 1964
18 and has also been used to store unused blasting grit and paints. At one time, paints were
19 mixed just outside the building on a tarp-covered wooden pallet. Waste paints were stored in
20 the satellite accumulation area (SAA) on the east side of the building. Paint-mixing operations
21 were not observed at the site during the RFI which was conducted in 1995-1997. The site and
22 surrounding vicinity are paved. Currently the building is occupied by Charleston Marine
23 Manufacturing Corporation and is used to store equipment and paint used during the dry
24 docking of ships at Dry Docks No. 2 and No. 5.

25 Materials of concern identified in the *Final Zone E RFI Work Plan, Revision 1* (EnSafe Inc.
26 [EnSafe]/Allen & Hoshall, 1995) include metals (lead), paints, solvents, and blasting media.

27 This area of Zone E is zoned M2 (industrial). The CNC RCRA Permit identified AOC 566 as
28 requiring a Confirmatory Sampling Investigation (CSI).

29 The RFI was initially conducted by the Navy/EnSafe team. RFI activities are described in the
30 *Zone E RFI Report, Revision 0* (EnSafe, 1997). Regulatory review was conducted on this

1 document and a draft response to the comments from SCDHEC were prepared by the
2 Navy/EnSafe team.

3 **1.1 Purpose of the RFI Report Addendum**

4 The purpose of this RFI Report Addendum is to document the results of previous RFI
5 investigations conducted by EnSafe at AOC 566. This RFI Report Addendum also discusses
6 various close-out issues and the findings of previous investigations, existing site conditions,
7 and surrounding area land use.

8 **1.2 Report Organization**

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

11 **1.0 Introduction** – Presents the purpose of the report and background information relating to
12 the RFI Report Addendum.

13 **2.0 Summary of RFI Conclusions for AOC 566** – Summarizes the conclusions from the RFI
14 investigations and risk evaluations for AOC 566 as presented in the RFI report.

15 **3.0 Interim Measures and UST/AST Removals** – Provides information regarding any interim
16 measures (IMs) or tank removal activities performed at the site.

17 **4.0 Summary of Additional Investigations** – Summarizes information, if any, collected after
18 completion of the RFI report.

19 **5.0 COPC/COC Refinement** – Provides further evaluation of chemicals of potential concern
20 (COPCs) based on RFI and additional data to assess them as chemicals of concern (COCs).

21 **6.0 Summary of Information Related to Site Closeout Issues** – Discusses the various site
22 closeout issues that the BRAC Cleanup Team (BCT) agreed to evaluate prior to site closeout.

23 **7.0 Recommendations** – Provides recommendations for proceeding with site closure.

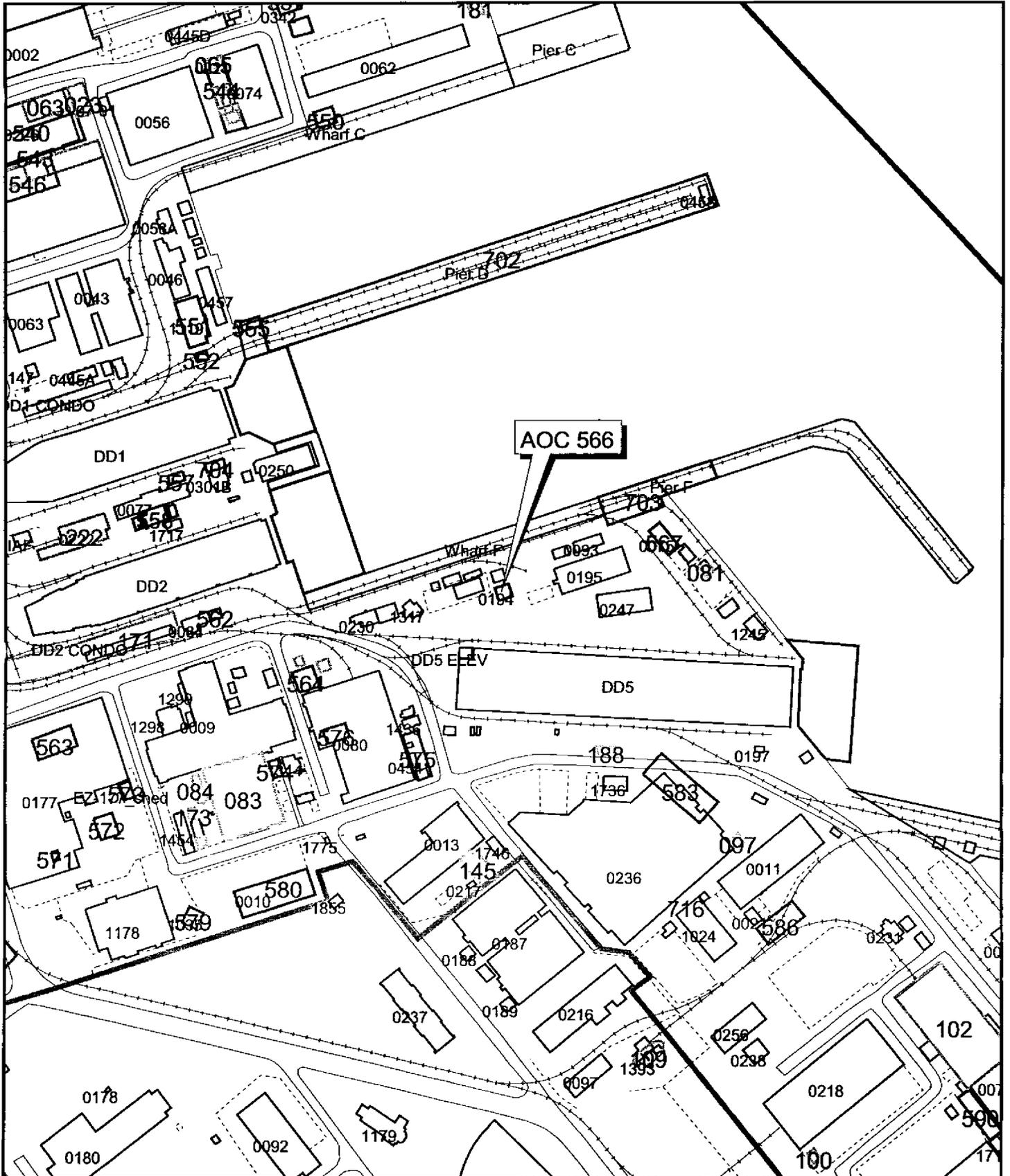
24 **8.0 References** – Lists the references used in this document.

25 **Appendix A** – Contains excerpts from the RFI report, including a summary of detections of
26 chemicals and a groundwater flow map for the site vicinity.

27 **Appendix B** – Contains responses to SCDHEC comments for AOC 566 from the RFI report.

- 1 **Appendix C – Figure C-1, which shows the site location from the Public Works Map of the**
- 2 **Charleston Navy Shipyard, dated December 1939, and depicts the presence of historic railroad**
- 3 **lines at the site.**

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



- Railroads
- Fence
- Roads
- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary

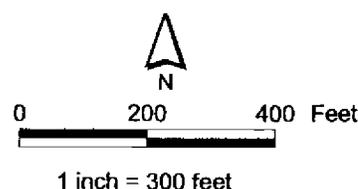
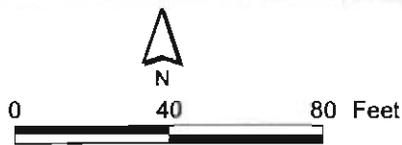


Figure 1-1
 Location of AOC 566 in Zone E
 Charleston Naval Complex



-  Railroads
-  Fence
-  Roads
-  AOC Boundary
-  Buildings



1 inch = 50 feet

Figure 1-2
Site Map
AOC 566, Zone E
Charleston Naval Complex

CH2MHILL

Section 2.0

1 **2.0 Summary of RFI Conclusions for AOC 566**

2 This section summarizes the results and conclusions from the soil and groundwater
3 investigations conducted at AOC 566 which were reported in the *Zone E RFI Report,*
4 *Revision 0* (EnSafe, 1997). Figure 2-1 shows soil and groundwater sampling locations.

5 As part of the Zone E RFI, soil and groundwater investigations were conducted at AOC 566
6 during 1995 to 1997. The RFI report presented the results of these investigations and
7 conclusions concerning contamination and risk, as summarized in the following sections. A
8 further evaluation of COCs at this combined site is provided in Section 5.0.

9 **2.1 Soil Sampling and Analysis**

10 Soil was sampled during two sampling events at AOC 566. During the first event, five
11 surface soil and five subsurface soil samples were collected and analyzed from locations
12 under concrete and asphalt pavement. Figure 2-1 shows RFI sample locations. First event
13 samples were identified as E566SB001 through E566SB005 and analyzed for volatile organic
14 compounds (VOCs), semivolatile organic compounds (SVOCs), and metals.

15 During the second sampling event at AOC 566, surface and subsurface soil samples were
16 collected at two additional locations to define the outer extent of chemicals exceeding
17 screening criteria detected during the first event. These locations, under asphalt and
18 concrete pavement, were identified as E566SB006 and E566SB007 and analyzed for VOCs,
19 SVOCs, pesticide/PCBs, metals, and cyanide. No samples were selected as duplicates at
20 AOC 566.

21 **2.1.1 Surface Soil**

22 During the RFI, surface soil detections of organic compounds were evaluated against the
23 EPA Region III industrial risk-based concentrations (RBCs) (with a hazard index [HI]=0.1
24 for noncarcinogens). Surface soil detections of inorganic compounds were evaluated against
25 the EPA Region III industrial RBCs (HI=0.1 for noncarcinogens) and the Zone E background
26 reference concentrations (BRCs).

27 Detected concentrations of organic and inorganic analytes exceeding their respective criteria
28 are as follows:

- 29 • **VOCs:** No VOC detections exceeded the screening criteria in surface soils.

- 1 • **SVOCs:** The RFI reported that among detected SVOC compounds, elevated BEQ
2 concentrations were detected at one location. The BEQ calculation was performed using
3 the method adopted by the BCT at the time of writing of the RFI report. The calculated
4 BEQ value at the single location (E566SB006) was 801 micrograms per kilogram ($\mu\text{g}/\text{kg}$).
5 There were no other exceedances of SVOC compounds in surface soils above screening
6 criteria.
- 7 • **Inorganics:** The RFI did not report any exceedances of inorganic chemicals above the
8 screening criteria in surface soils.

9 Figure 2-2 shows the exceedances of screening criteria in soil samples as reported in the RFI.
10 BEQs were the only surface soil COCs identified for AOC 566.

11 **2.1.2 Subsurface Soil**

12 During the RFI, subsurface soil detections of organic compounds were compared with
13 generic soil screening levels (SSLs) (using a dilution attenuation factor [DAF]=10) .
14 Subsurface soil detections of inorganic compounds were compared with generic SSLs (using
15 a DAF=10) and the Zone E BRCs.

16 Detected concentrations of organic and inorganic compounds from subsurface soil samples
17 are as follows:

- 18 • **VOCs:** No VOC detections exceeded the screening criteria in subsurface soils.
19 • **SVOCs:** The RFI did not identify SVOC detections above the screening criteria in
20 subsurface soils.
21 • **Inorganics:** No inorganic detections exceeded the screening criteria in subsurface soils.
22 • **Pesticides/PCBs:** There were no pesticide/PCB detections above laboratory detection
23 limits in subsurface soil samples from AOC 566.

24 No subsurface soil COCs were identified for AOC 566.

25 **2.2 Groundwater**

26 The RFI investigation for AOC 566 consisted of a one shallow monitoring well, E566GW001
27 (formerly NBCE566001), and one deep monitoring well, E566GW001D (formerly
28 NBCE56601D), installed at the northeastern side of Building 194 at the location shown in
29 Figure 2-1. Groundwater samples were analyzed for VOCs, SVOCs, metals, chlorides,
30 sulfates, and total dissolved solids (TDS). No duplicate samples were collected at this site.

31 During the RFI, each well was sampled four times between 1996 and 1997. Detections in
32 groundwater samples were compared with the EPA Region III tap water RBCs, MCLs and
33 the Zone E BRCs for shallow and deep aquifers.

1 2.2.1 Shallow Groundwater

2 Analyte concentrations in shallow groundwater samples were detected as follows at this
3 site:

4 **VOCs:** There were no VOC detections in shallow groundwater samples from AOC 566.

5 **SVOCs:** There were no SVOC detections in shallow groundwater samples from AOC 566.

6 **Inorganics:** The RFI report reported that beryllium and iron exceeded the screening criteria.

- 7 • Beryllium at a concentration of 1.0 µg/L, at E566GW001, exceeded both its tap water
8 RBC of 0.0160 µg/L, and shallow groundwater BRC of 0.43 µg/L. The detection did not
9 exceed the beryllium MCL of 4.0 µg/L.
- 10 • Iron at a concentration of 4,980 µg/L, at E566GW001, exceeded its tap water RBC of
11 1,100 µg/L (HI=0.1). No primary MCL exists for iron and no shallow groundwater BRC
12 was developed for iron in Zone E during the RFI.

13 Figure 2-3 shows detections that exceeded screening criteria for shallow and deep
14 groundwater samples.

15 2.2.2 Deep Groundwater

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

17 **VOCs:** There were no VOC detections in deep groundwater samples from AOC 566.

18 **SVOCs:** There were no SVOC detections in deep groundwater samples from AOC 566.

19 **Inorganics:** The RFI report reported detections of inorganic analytes, arsenic, iron, and
20 manganese above the screening criteria.

- 21 • Arsenic concentrations ranged from 62.7 µg/L to 74.6 µg/L, exceeding both its tap
22 water RBC of 0.0450 µg/L and deep groundwater BRC of 16.4 µg/L. The detections also
23 exceeded the arsenic MCL of 50 µg/L.
- 24 • Iron concentrations ranged from 12,300 µg/L to 12,900 µg/L, exceeding its tap water
25 RBC of 1,100 µg/L. No deep groundwater BRC or MCL was developed for iron during
26 the RFI.
- 27 • Manganese concentrations ranged from 1,270 µg/L to 1,410 µg/L exceeding both its tap
28 water RBC of 84.0 µg/L and deep groundwater BRC of 869 µg/L. No primary MCL is
29 available for manganese.

1 **2.3 RFI Human Health Risk Assessment**

2 The RFI report used a fixed-point risk evaluation (FRE) approach at this site. The FRE
3 considered site resident and site worker scenarios during the FRE. The detailed risk
4 assessment for the AOC 566 site is presented in Sections 10.32.6.2 and 10.32.6.3 of the RFI
5 report.

6 **2.3.1 Soils**

7 For the unrestricted future land use scenario, BEQs were retained as a COC for surface soils.
8 For the commercial/industrial reuse scenario, BEQs were retained as a COC for surface
9 soils. The RFI report did not identify COCs in subsurface soils at AOC 566.

10 **2.3.2 Groundwater**

11 The human health risk assessment (HHRA) retained beryllium as a COC in shallow
12 groundwater, and arsenic and manganese as COCs for deep groundwater.

13 **2.4 RFI Conclusions and Recommendations**

14 The RFI report recommended that a CMS be conducted for the surface soil COC (BEQs) at
15 AOC 566.

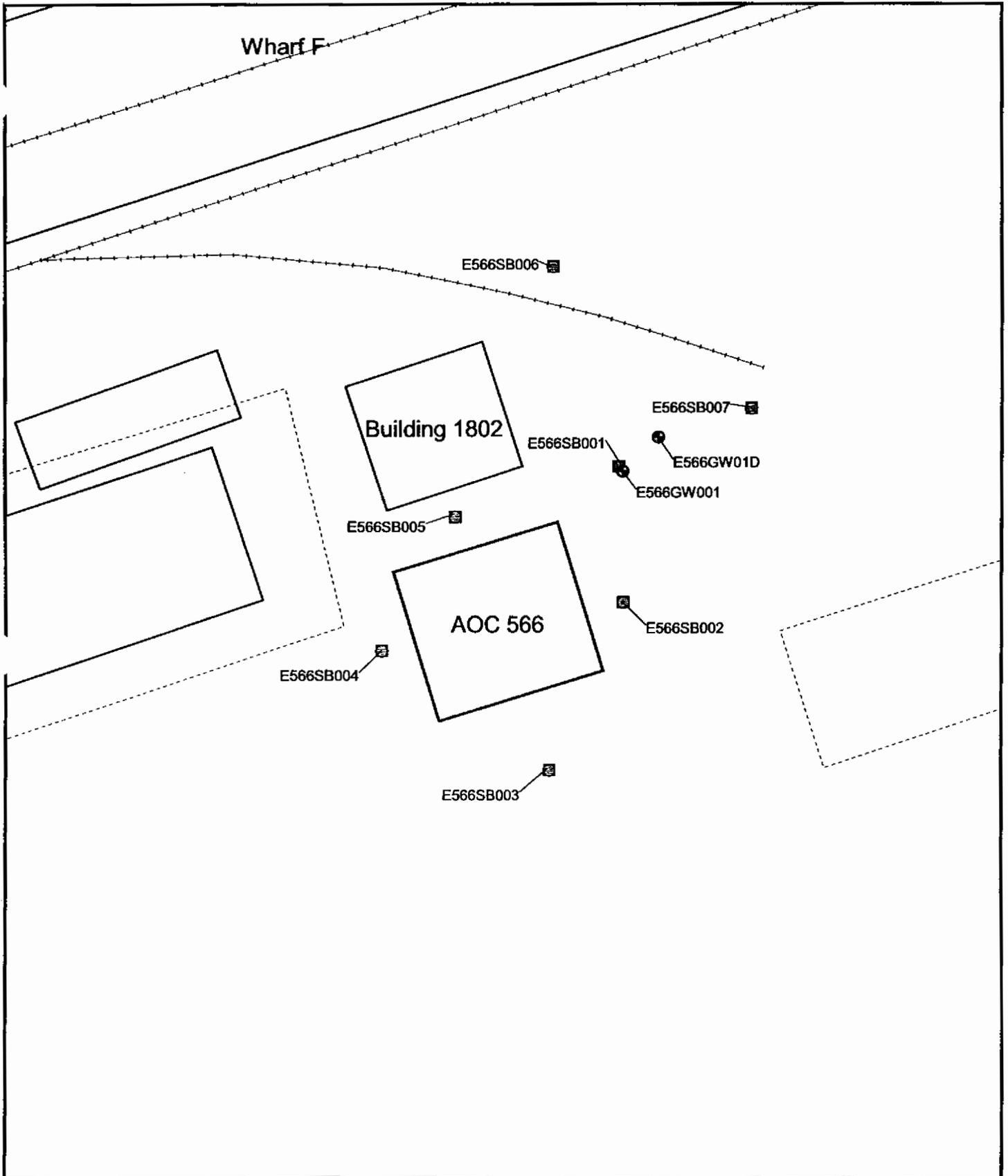
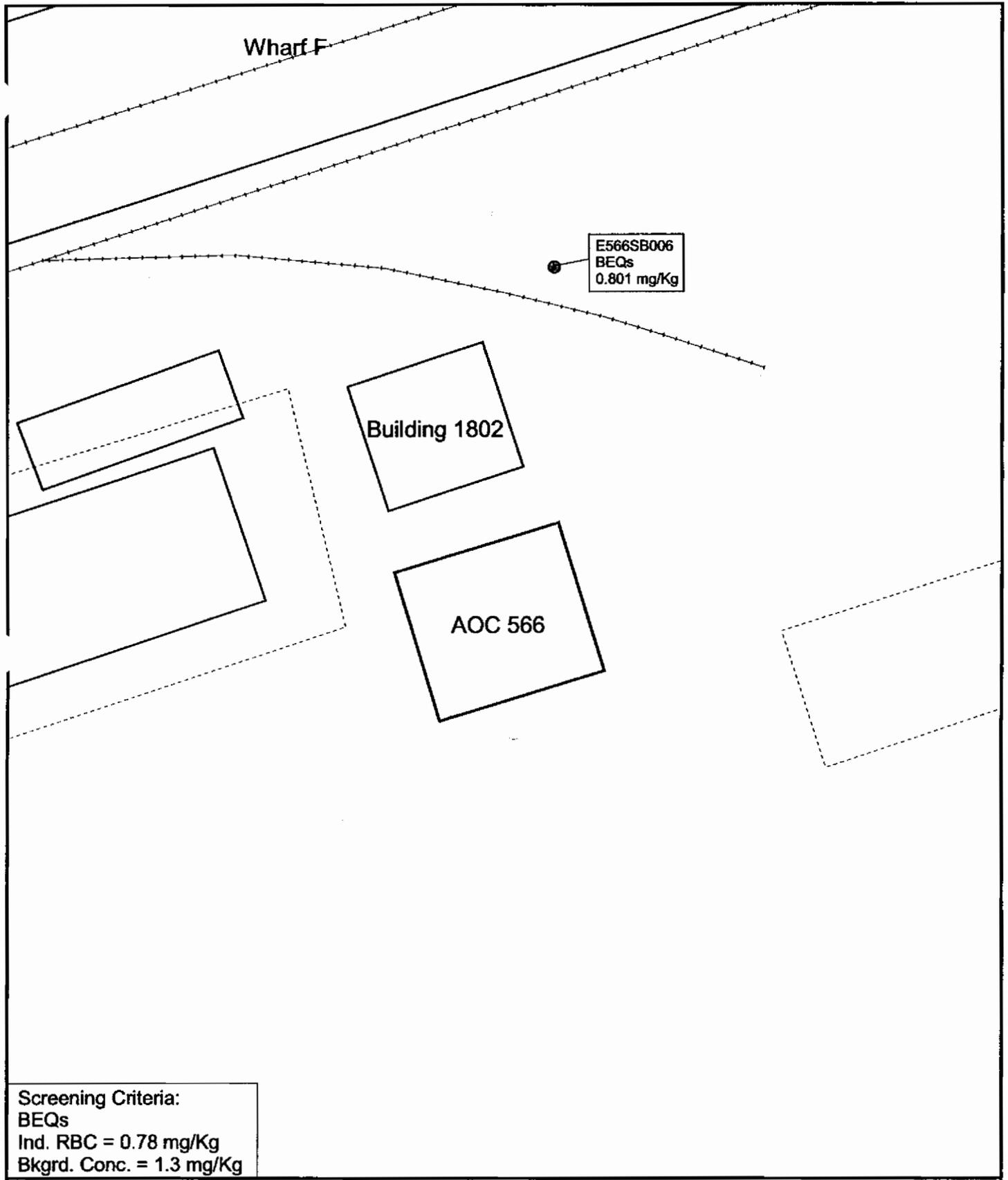


Figure 2-1
RFI Sample Locations
AOC 566, Zone E
Charleston Naval Complex

CH2MHILL



- Surface Soil Sample Locations
- ∧ Railroads
- ∧ Fence
- ∧ Roads - Lines
- AOC Boundary
- Buildings

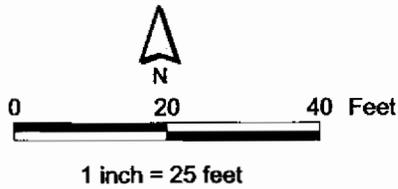


Figure 2-2
RFI Surface Soil Exceedances
AOC 566, Zone E
Charleston Naval Complex

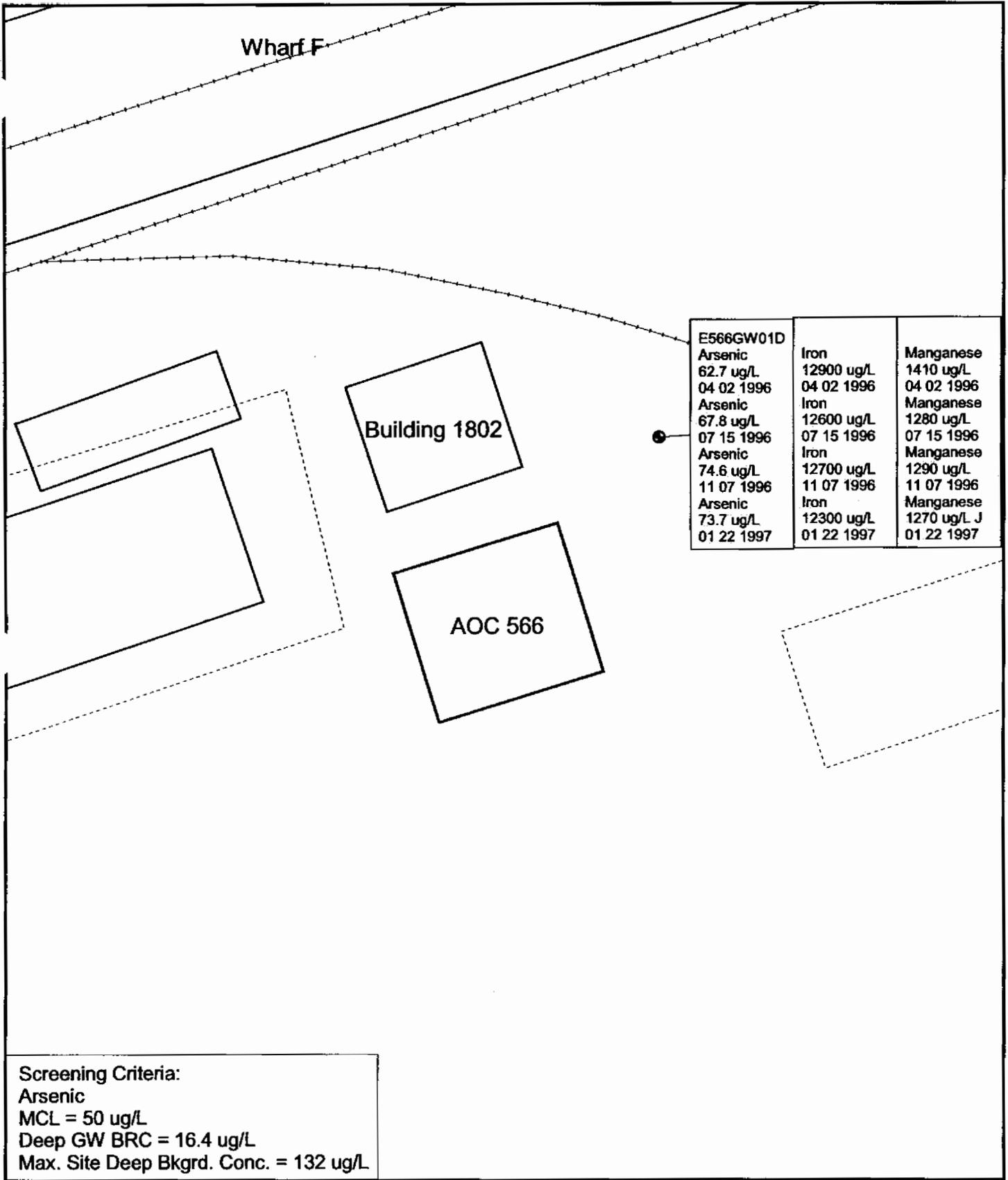
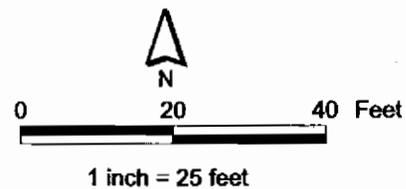


Figure 2-3
Groundwater Exceedances
AOC 566, Zone E
Charleston Naval Complex

Screening Criteria:
Arsenic
MCL = 50 ug/L
Deep GW BRC = 16.4 ug/L
Max. Site Deep Bkgrd. Conc. = 132 ug/L

- Groundwater Sampling Location
- ∨ Railroads
- ∧ Fence
- ∨ Roads - Lines
- AOC Boundary
- Buildings



Section 3.0

1 **3.0 Summary of Interim Measures and UST/AST**
2 **Removals at AOC 566**

3 **3.1 UST/AST Removals**

4 There is no indication of a UST or AST being present at this site.

5 **3.2 Interim Measures**

6 There were no IMs conducted at the site.

1 **4.0 Summary of Additional Investigations**

- 2 No additional investigations have been conducted at AOC 566 since the RFI field
3 investigations conducted by EnSafe during the period of 1995-1997.

1 **5.0 COPC/COC Refinement**

2 The *Zone E RFI Report, Revision 0* (EnSafe, 1997) identified BEQs at a maximum
3 concentration of 0.801 mg/kg as a surface soil COC for the future industrial and residential
4 land use scenario, beryllium as a shallow groundwater COC, and arsenic and manganese as
5 deep groundwater COCs for AOC 566.

6 In addition to the original screening criteria, current screening criteria for Zone E include
7 comparing surface soil concentrations to residential RBCs and generic SSLs, comparing soil
8 and groundwater inorganic concentrations to the Zone E background concentration ranges,
9 and comparing soil BEQ concentrations to the sitewide BEQ reference concentrations.
10 Surface and subsurface soil VOC concentrations are compared to SSLs with a DAF of 1, and
11 SVOC and inorganic concentrations are compared to SSLs with a DAF of 10.

12 Based on an evaluation of the data collected during the RFI and a comparison to COPC
13 screening criteria currently used by the BCT, antimony and BEQs in subsurface soil and
14 arsenic, iron, and manganese in deep groundwater exceed the current screening criteria.
15 BEQs in surface soil and beryllium in shallow groundwater are not retained as COPCs. The
16 nature of occurrence and the relevance of these chemicals at these sites are further discussed
17 below.

18 **5.1 Soils**

19 **5.1.1 Antimony**

20 The surface soil antimony at AOC 566 was below background levels, therefore, antimony
21 was not identified as COPC for surface soil.

22 Detections of antimony in the subsurface soil samples above screening criteria were 12.2
23 mg/kg at E566SB007 and 9.3 mg/kg at E566SB006. These detections exceed both the SSL
24 (with a DAF=10) of 3.0 mg/kg and the maximum Zone E subsurface soil background
25 antimony concentration of 1.6 mg/kg. Detections at the other five subsurface soil samples
26 either did not exceed screening criteria or were below laboratory detection limits. The
27 average subsurface antimony concentration for the site is 3.0 mg/kg as shown in Table 5-1.
28 This average concentration does not exceed the SSL of 3.0 mg/kg. Though isolated sample
29 locations had antimony detections above background and leachability criteria, site
30 groundwater did not have detectable levels of antimony, indicating leaching is not

1 occurring. The two samples where antimony was detected were away from AOC 566,
2 closest to the railroad tracks. This area of CNC likely consists of fill material, which could
3 be the reason for the observed higher antimony concentrations in subsurface soil and the
4 lack of elevated antimony concentrations in surface soil. There is no indication from
5 information on past site uses that antimony was used during operations at AOC 566 or that
6 the presence of antimony in the soil is related to releases from AOC 566. Based on these
7 observations, antimony is not considered a COC for soil at AOC 566.

8 **5.1.2 BEQs**

9 The RFI reported that among detected SVOC compounds, elevated BEQ concentrations
10 were detected at one surface soil sample location. The calculated BEQ value at the single
11 location (E566SB006) was 801 $\mu\text{g}/\text{kg}$, which was above the direct exposure-based RBC value
12 of 780 $\mu\text{g}/\text{kg}$ (for an industrial worker exposure). However, this detection is below the
13 CNC BEQ sitewide reference concentration of 1,304 $\mu\text{g}/\text{kg}$ for surface soils. Therefore, BEQs
14 are not considered COCs for surface soil at this site.

15 BEQs were detected in one subsurface soil sample at E566SB001 at a concentration of 11,424
16 $\mu\text{g}/\text{kg}$, which exceeds the CNC BEQ sitewide reference concentration of 1,400 $\mu\text{g}/\text{kg}$ for
17 subsurface soils as shown in Table 5-1. This detection also exceeded the maximum
18 background BEQ concentrations along the railroad line of 5,133 $\mu\text{g}/\text{kg}$ (CH2M-Jones, 2001).
19 Table 5-2 shows AOC 566 subsurface soil polycyclic aromatic hydrocarbon (PAH)
20 concentrations. As stated above, this area of CNC is built upon fill material and is paved
21 with asphalt material. The groundwater samples from the shallow well from the same
22 location did not have any PAH detections. Thus, leachability is not a concern. The
23 subsurface soil BEQs might be related to extensive soil disturbance and/or asphalt
24 materials mixed with the fill material or could be from a piece of surface asphalt cover
25 material being pushed down to the subsurface depths during sampling.

26 Figure C-1 in Appendix C shows the presence of historic railroad lines at the site from the
27 Public Works Map of the CNC, dated June 30, 1928. The lines were located in the vicinity of
28 the higher detections of BEQs found during the RFI. The majority of these railroad line
29 locations appear to have been paved over in subsequent Public Works Maps from the late
30 1930s and later, and they currently remain paved over with concrete and asphalt.

31 None of the surface soil BEQ detections were above screening criteria, and only one
32 detection of BEQs was above screening criteria in subsurface soils. The isolated area with
33 elevated BEQ concentrations is under asphalt pavement, and the sitewide BEQ
34 concentrations are not elevated, and thus do not represent widespread distribution.

1 Additionally, there is no possibility of direct contact with subsurface soils or a concern for
2 contaminant contact with stormwater runoff from subsurface soils at the present time. The
3 detected BEQs are likely associated with the non-point source in the general background of
4 the area, which includes asphalt material used to pave the roads or the previous and
5 existing railroad lines at the site, and is not likely associated with site operations at AOC
6 566. Additionally, BEQs were not detected in the groundwater, indicating that the BEQs in
7 soils do not pose a threat to groundwater via leaching.

8 For these reasons, BEQs are not considered COCs for surface or subsurface soil at this site.

9 **5.1.3 Methylene Chloride**

10 Detections of methylene chloride above screening criteria were 0.010 mg/kg in surface soil
11 at E566SB006 and 0.003 mg/kg in subsurface soil at E566SB001 as shown in Table 5-1. Both
12 of these detections exceeded the SSL of 0.001 mg with a DAF of 1. However, methylene
13 chloride is considered a common laboratory artifact or contaminant by the *EPA Contract*
14 *Laboratory Program National Functional Guidelines for Organic Data Review* (February 1994). It
15 is unlikely to be associated with site operations at AOC 566.

16 Furthermore, methylene chloride was detected in only one of six surface soil samples and
17 one of seven subsurface soil samples. These detections do not represent widespread
18 distribution of methylene chloride. Although methylene chloride was detected in the
19 surface soil sample at E566SB006, it was not detected in the subsurface soil sample at this
20 location, indicating that there has been no leaching. At E566SB001, it was also not detected
21 in the groundwater sample collected directly below the subsurface soil sample location,
22 indicating that methylene chloride in soil does not pose a threat to groundwater via
23 leaching.

24 For these reasons, methylene chloride is not considered a COC for surface or subsurface soil
25 at this site.

26 **5.2 Groundwater**

27 **5.2.1 Beryllium**

28 The RFI report considered beryllium as a COC based on the detections of beryllium above
29 the tap water RBC of 0.0160 µg/L and the Zone E BRC of 0.43 µg/L in shallow groundwater
30 at AOC 566. This exceedance was determined using the screening criteria adopted by the
31 BCT at the time of writing of the RFI report. Beryllium detections in shallow groundwater
32 ranged from 1.0 to 2.1 µg/L and are all below the MCL of 4.0 µg/L and the current tap

1 water RBC of 7.3 µg/L (HI=0.1). Thus current detections are below all health-based criteria
2 (RBC and MCL). Therefore, beryllium is not considered a COC for shallow groundwater at
3 this site.

4 **5.2.2 Arsenic**

5 The RFI report considered arsenic as a COC based on the detections of arsenic above the
6 MCL in deep groundwater at AOC 566. The detections of arsenic in the deep well RFI
7 samples ranged from 62.7 µg/L to 74.6 µg/L, all of which are above the MCL of 50 µg/L for
8 arsenic. Arsenic concentrations in shallow groundwater wells were below laboratory
9 detection limits, which suggests that arsenic detections in deep groundwater are likely from
10 background occurrence rather than site-related activities. Similar elevated arsenic
11 concentrations in deep groundwater are observed elsewhere across the CNC. The
12 groundwater background arsenic levels at CNC are included in *Technical Memorandum: A*
13 *Summary of Inorganic Chemical Concentrations in Background Soil and Groundwater at the CNC*
14 (CH2M-Jones, 2001). The range for background arsenic concentrations in deep
15 groundwater at Zone E is from 1.6 µg/L to 132 µg/L. Table 5-3 shows detections of arsenic
16 in groundwater at the site.

17 It should also be noted that the iron and manganese concentrations in this well are elevated
18 (see Table 5-3). Iron concentrations range from 12,300 µg/L to 12,900 µg/L and manganese
19 concentrations range from 1,270 µg/L to 1,410 µg/L. These data suggest that iron-reducing
20 conditions are present at the site and influencing the arsenic concentrations. Arsenic
21 concentrations in groundwater at the CNC have previously been shown to be correlated
22 with iron concentrations at the CNC, as described in the document *Technical Memorandum,*
23 *An Overview of Arsenic Geochemistry, Terminal Electron Accepting Processes in GW Systems, and*
24 *Implications for the CNC Hydrogeologic Environment*, (CH2M Jones, 2001). These data suggest
25 that the elevated arsenic is due to natural geochemical processes at this site. For these
26 reasons, arsenic is not considered a COC for groundwater at AOC 666.

27 **5.3 COC Summary**

28 No COCs that require further action are identified as AOC 566.

TABLE 5-1
 Detected Concentrations of Antimony, BEQs, and Methylene Chloride in Surface and Subsurface Soils
 RFI Report Addendum, AOC 566, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Collected	Region III Residential RBC	SSL (DAF=10)	Zone E Background Range of Conc.
Antimony						3.1	3.0	0.5 - 7.4
	Surface Soil							
	E566SB007	566SB00701	6.4	J	05/30/1996			
	E566SB006	566SB00601	4.3	J	05/30/1996			
	E566SB004	566SB00401	0.45	U	09/09/1995			
	E566SB005	566SB00501	0.45	U	09/09/1995			
	E566SB003	566SB00301	0.44	U	09/09/1995			
	E566SB002	566SB00201	0.44	U	09/09/1995			
	E566SB001	566SB00101	0.43	U	09/09/1995			
	Subsurface Soil							
	E566SB007	566SB00702	12.2	=	05/30/1996	3.1	3.0	0.52 - 1.6
	E566SB006	566SB00602	9.3	=	05/30/1996			
	E566SB001	566SB00102	0.66	J	09/09/1995			
	E566SB002	566SB00202	0.63	J	09/09/1995			
	E566SB003	566SB00302	0.55	J	09/09/1995			
	E566SB004	566SB00402	0.48	U	09/09/1995			
	E566SB005	566SB00502	0.48	U	09/09/1995			
	AVE. SUBSURFACE ANTIMONY CONC.		3					
BEQs	Surface Soil							
	E566SB001	566SB00101	0.416	U	09/09/1995	0.088	NA	1.304
	E566SB002	566SB00201	0.428	U	09/09/1995			
	E566SB003	566SB00301	0.416	U	09/09/1995			
	E566SB004	566SB00401	0.439	U	09/09/1995			
	E566SB005	566SB00501	0.278	=	09/09/1995			
	E566SB006	566SB00601	0.801	=	05/30/1996			
	E566SB007	566SB00701	0.018	U	09/09/1995			
	Subsurface Soil							
	E566SB001	566SB00102	11.42	=	09/09/1995	0.088	NA	1.4
	E566SB002	566SB00202	0.485	U	09/09/1995			
	E566SB003	566SB00302	0.474	U	09/09/1995			
	E566SB004	566SB00402	0.462	U	09/09/1995			
	E566SB005	566SB00502	0.497	U	09/09/1995			
	E566SB006	566SB00602	0.02	U	09/09/1995			
	E566SB007	566SB00702	0.451	U	05/30/1996			
	AVE. SUBSURFACE BEQ CONC.		1.80					
Methylene Chloride	Surface Soil							
	E566SB001	566SB00101	0.005	U	09/09/1995	85	DAF=1 0.001	NA
	E566SB002	566SB00201	0.006	U	09/09/1995			
	E566SB004	566SB00401	0.006	U	09/09/1995			
	E566SB005	566SB00501	0.006	U	09/09/1995			

TABLE 5-1

Detected Concentrations of Antimony, BEQs, and Methylene Chloride in Surface and Subsurface Soils
RFI Report Addendum, AOC 566, Zone E, Charleston Naval Complex

Parameter	Station ID	Sample ID	Result (mg/kg)	Qualifier	Date Collected	Region III Residential RBC	SSL (DAF=10)	Zone E Background Range of Conc.
	E566SB006	566SB00601	0.010	J	05/30/1996			
	E566SB007	566SB00701	0.018	U	05/30/1996			
	Subsurface Soil					85	DAF =1 0.001	NA
	E566SB001	566SB00102	0.003	J	09/09/1995			
	E566SB002	566SB00202	0.006	U	09/09/1995			
	E566SB003	566SB00302	0.031	U	09/09/1995			
	E566SB004	566SB00402	0.006	U	09/09/1995			
	E566SB005	566SB00502	0.006	U	09/09/1995			
	E566SB006	566SB00602	0.017	U	05/30/1996			
	E566SB007	566SB00702	0.018	U	05/30/1996			
	AVE. SUBSURFACE METHYLENE CHLORIDE CONC.		0.006					

Average concentrations were calculated by using the full value of the detected concentrations and half the detection limit for sample results with U or UJ qualifiers.

TABLE 5-2
 Detected PAH Concentrations in Subsurface Soils
 RFI Report Addendum, AOC 566, Zone E, Charleston Naval Complex

Station ID	Sample ID	Concentration (mg/kg)	Qualifier	Date Collected	SSL (mg/kg) DAF= 10
Benzo(a)Anthracene					1
E566SB001	566SB00102	9.20	=	09/09/1995	
E566SB005	566SB00502	0.43	U	09/09/1995	
E566SB002	566SB00202	0.42	U	09/09/1995	
E566SB003	566SB00302	0.41	U	09/09/1995	
E566SB004	566SB00402	0.40	U	09/09/1995	
E566SB007	566SB00702	0.39	U	05/30/1996	
E566SB006	566SB00602	0.39	UJ	05/30/1996	
Benzo(a)Pyrene					4
E566SB001	566SB00102	8.20	=	09/09/1995	
E566SB005	566SB00502	0.43	U	09/09/1995	
E566SB002	566SB00202	0.42	U	09/09/1995	
E566SB003	566SB00302	0.41	U	09/09/1995	
E566SB004	566SB00402	0.40	U	09/09/1995	
E566SB007	566SB00702	0.39	U	05/30/1996	
Benzo(k)Fluoranthene					24.5
E566SB001	566SB00102	9.00	=	09/09/1995	
E566SB005	566SB00502	0.43	U	09/09/1995	
E566SB002	566SB00202	0.42	U	09/09/1995	
E566SB003	566SB00302	0.41	U	09/09/1995	
E566SB004	566SB00402	0.40	U	09/09/1995	
E566SB007	566SB00702	0.39	U	05/30/1996	
Chrysene					80
E566SB001	566SB00102	8.80	=	09/09/1995	
E566SB005	566SB00502	0.43	U	09/09/1995	
E566SB002	566SB00202	0.42	U	09/09/1995	
E566SB003	566SB00302	0.41	U	09/09/1995	
E566SB004	566SB00402	0.40	U	09/09/1995	
E566SB007	566SB00702	0.39	U	05/30/1996	
E566SB006	566SB00602	0.39	UJ	05/30/1996	
Dibenz(a,h)Anthracene					1
E566SB001	566SB00102	1.70	J	09/09/1995	
E566SB005	566SB00502	0.43	U	09/09/1995	
E566SB002	566SB00202	0.42	U	09/09/1995	
E566SB003	566SB00302	0.41	U	09/09/1995	
E566SB004	566SB00402	0.40	U	09/09/1995	
E566SB007	566SB00702	0.39	U	05/30/1996	
Indeno(1,2,3-c,d)Pyrene					7
E566SB001	566SB00102	4.10	=	09/09/1995	
E566SB005	566SB00502	0.43	U	09/09/1995	
E566SB002	566SB00202	0.42	U	09/09/1995	

TABLE 5-2
 Detected PAH Concentrations in Subsurface Soils
RFI Report Addendum, AOC 566, Zone E, Charleston Naval Complex

Station ID	Sample ID	Concentration (mg/kg)	Qualifier	Date Collected	SSL (mg/kg) DAF= 10
E566SB003	566SB00302	0.41	U	09/09/1995	
E566SB004	566SB00402	0.40	U	09/09/1995	
E566SB007	566SB00702	0.39	U	05/30/1996	
Benzo(b)Fluoranthene					2.5
E566SB001	566SB00102	1.90	U	09/09/1995	
E566SB005	566SB00502	0.43	U	09/09/1995	
E566SB002	566SB00202	0.42	U	09/09/1995	
E566SB003	566SB00302	0.41	U	09/09/1995	
E566SB004	566SB00402	0.40	U	09/09/1995	
E566SB007	566SB00702	0.39	U	05/30/1996	

- 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 quantification limit.
- U Indicates that the concentration was not detected.
- UJ Indicates that the concentration was not detected and is estimated.

1

TABLE 5-3
 Detected Arsenic, Iron, Manganese, and Thallium Concentrations in Shallow and Deep Groundwater
 RFI Report Addendum, AOC 566, Zone E, Charleston Naval Complex

Station ID	Sample ID	Result µg/L	Qualifier	Date Collected	EPA Region III Tap Water RBC	MCL
ARSENIC					0.045	50.00
E566GW001	566GW00102	6.30	U	11/07/1996		
E566GW001	566GW00101	5.00	U	01/22/1997		
E566GW001	566GW00103	2.50	U	07/15/1996		
E566GW001	566GW00104	2.50	U	04/02/1996		
E566GW01D	E566GW01D03	74.60	=	11/07/1996		
E566GW01D	E566GW01D04	73.70	=	01/22/1997		
E566GW01D	E566GW01D02	67.80	=	07/15/1996		
E530GW01D	E530GW01D01	62.70	=	04/02/1996		
IRON					1,100	300*
E566GW001	566GW00104	8,600	=	01/22/1997		
E566GW001	566GW00103	5,070	=	11/07/1996		
E566GW001	566GW00101	4,980	=	04/02/1996		
E566GW001	566GW00102	4,460	=	07/15/1996		
E566GW01D	E566GW01D01	12,900	=	04/02/1996		
E566GW01D	E566GW01D03	12,700	=	11/07/1996		
E566GW01D	E566GW01D02	12,600	=	07/15/1996		
E530GW01D	E530GW01D04	12,300	=	01/22/1997		
MANGANESE					73	50*
E566GW001	566GW00104	269	J	01/22/1997		
E566GW001	566GW00103	158	=	11/07/1996		
E566GW001	566GW00101	157	=	04/02/1996		
E566GW001	566GW00102	117	=	07/15/1996		
E566GW01D	E566GW01D01	1,410	=	04/02/1996		
E566GW01D	E566GW01D03	1,290	=	11/07/1996		
E566GW01D	E566GW01D02	1,280	=	07/15/1996		
E530GW01D	E530GW01D04	1,270	J	01/22/1997		
THALLIUM					0.26	2
E566GW001	566GW00104	5.8	J	01/22/1997		
E566GW001	566GW00101	5.0	U	04/02/1996		

TABLE 5-3
 Detected Arsenic, Iron, Manganese, and Thallium Concentrations in Shallow and Deep Groundwater
RFI Report Addendum, AOC 566, Zone E, Charleston Naval Complex

Station ID	Sample ID	Result µg/L	Qualifier	Date Collected	EPA Region III Tap Water RBC	MCL
E566GW001	566GW00102	2.7	UJ	07/15/1996		
E566GW001	566GW00103	2.7	UJ	11/07/1996		
E566GW01D	566GW01D04	5.3	J	01/22/1997		
E566GW01D	566GW01D01	5.0	U	04/02/1996		
E566GW01D	566GW01D02	2.7	UJ	07/15/1996		
E566GW01D	566GW01D03	2.7	UJ	11/07/1996		

* No Primary MCL - only secondary MCL shown.

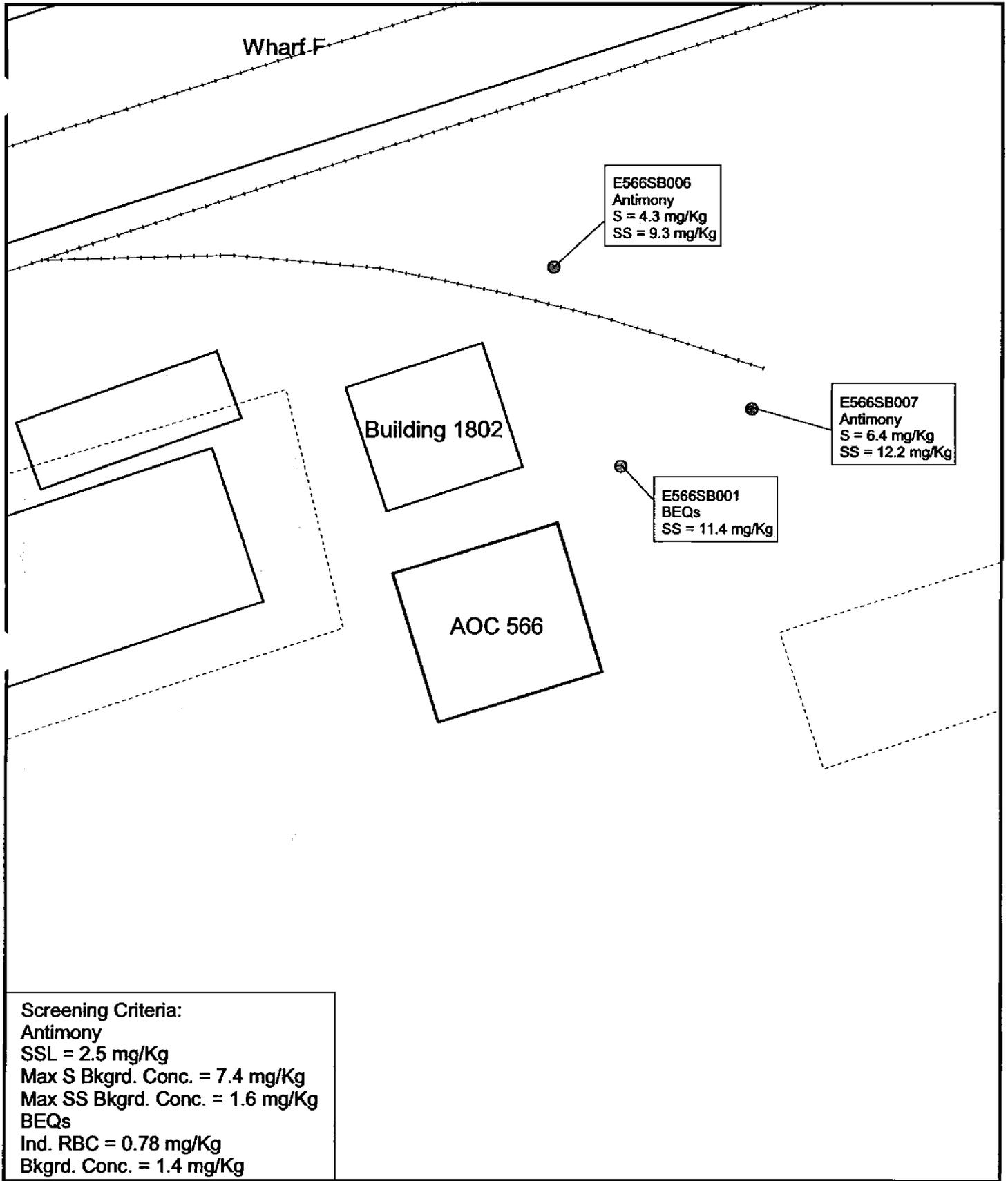
µg/L Micrograms per liter

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 quantification limit.

MCL Maximum Contaminant Level

U Indicates that the concentration was not detected.

UJ Indicates that the concentration was not detected and is estimated.



- Soil Sample Locations
- ∧ Railroads
- ∧ Fence
- ∧ Roads - Lines
- AOC Boundary
- Buildings

S = Surface Soil
 SS = Subsurface Soil

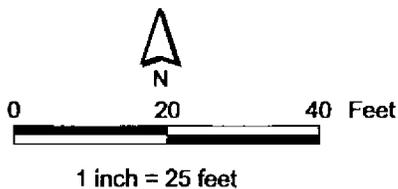


Figure 5-1
 Soil Exceedances
 AOC 566, Zone E
 Charleston Naval Complex

Section 6.0

1 **6.0 Summary of Information Related to Site** 2 **Closeout Issues**

3 **6.1 RFI Status**

4 The *Zone E RFI Report, Revision 0* (EnSafe, 1997) addressed SWMUs/AOCs within Zone E of
5 the CNC, including AOC 566.

6 In accordance with the RFI completion process, if a determination of No Further
7 Investigation (NFI) is made upon completion of the RFI, then a site may proceed to either
8 NFA status or to a CMS. The RFI for AOC 566 identified BEQs as a COC for surface soils,
9 beryllium as a COC for shallow groundwater, and arsenic and manganese as COCs for deep
10 groundwater. However, after evaluation of the RFI data against current screening criteria
11 and the COPC/COC refinement discussed in Section 5.0 above, no COCs were identified
12 for this site.

13 The remaining subsections address the issues that the BCT agreed to evaluate prior to site
14 closeout.

15 **6.2 Presence of Inorganics in Groundwater**

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

21 There were no detections of antimony in shallow or deep wells above the laboratory
22 detection limits. Arsenic was not detected above laboratory detection limits in shallow
23 wells. Arsenic detections in deep groundwater wells exceeded the MCL during four RFI
24 sampling events. However, the high concentrations of arsenic in the deep wells associated
25 with AOC 566 are attributed to natural geochemical processes as discussed in Section 5.3.2.

1 Intermittent detections of thallium at the site in shallow and deep groundwater do not point
2 to a site-specific source, but can be attributed to natural occurrence. One shallow
3 groundwater thallium detection at 5.8 µg/L was slightly above Zone E shallow
4 groundwater BRC for thallium of 5.4 µg/L. The deep groundwater thallium detections did
5 not exceed the Zone E deep groundwater BRC. Thallium was not detected in shallow and
6 deep groundwater during the first three sampling events. Table 5-3 shows thallium
7 concentrations from the RFI groundwater sampling at AOC 566. These single detections of
8 thallium do not indicate a site-related thallium release. Therefore, further evaluation of this
9 issue is not warranted.

10 **6.3 Potential Linkage to SWMU 37, Investigated Sanitary** 11 **Sewers at the CNC**

12 There are no data suggesting that there was an impact to the sanitary sewers from this site.
13 The only utility serving the site is electricity. Therefore, further evaluation of this issue is
14 not warranted.

15 **6.4 Potential Linkage to AOC 699, Investigated Storm Sewers at** 16 **the CNC**

17 No direct connection from this site to the storm sewers are known to exist. No COCs
18 requiring further evaluation are present at the site. Based on these findings, further
19 evaluation of this issue is not warranted.

20 **6.5 Potential Linkage to AOC 504, Investigated Railroad Lines** 21 **at the CNC**

22 The nearest existing railroad line to AOC 566 is approximately 40 feet northeast of the site.
23 There is no known linkage between AOC 566 and the investigated railroad lines of AOC
24 504, so further evaluation of this issue is not warranted. However, it likely that the former
25 railroads at the site resulted in elevated detections of some chemicals (PAHs) at this site.

26 **6.6 Potential Migration Pathways to Surface Water Bodies at** 27 **the CNC**

28 The nearest surface water body to AOC 566 is the Cooper River, which lies approximately
29 130 feet north of the site. The only potential migration pathway from the site to surface
30 water is via overland flow via stormwater runoff. The entire site is covered with buildings

1 and pavement, which eliminates contact of surface soil with stormwater. Similarly, runoff
2 directed to the storm sewer system, which discharges to the Cooper River, does not contact
3 the surface soil. No further evaluation of a potential pathway for contaminant migration via
4 stormwater runoff is warranted.

5 **6.7 Potential Contamination in Oil/Water Separators**

6 There are no oil/water separators (OWSs) associated with AOC 566. In addition, there is no
7 reference to an OWS at the site in the *Oil Water Separator Data* report, Department of the
8 Navy, September 2000. Therefore, further evaluation of this issue is not warranted.

9 **6.8 Land Use Control**

10 The CNC BCT has agreed that all of Zone E will have at least some land use controls (LUCs)
11 and restrictions. At a minimum, these LUCs are likely to include restrictions against
12 residential land use. Because there are no COCs at AOC 566, no LUCs are necessary. The
13 site is recommended for NFA.

Section 7.0

1 **7.0 Recommendations**

2 AOC 566, a former paint storage area in Building 194, has been most recently been used by
3 the Navy to store supplies such as tools, hoses, and equipment. Building 194 was
4 constructed in 1964 and has also been used to store unused blasting grit and paints. At one
5 time, paints were mixed just outside the building on a tarp-covered wooden pallet. Waste
6 paints were stored in the SAA on the east side of the building. Paint-mixing operations
7 were not observed at the site during the RFI which was conducted in 1995-1997. The site
8 and surrounding vicinity are paved. Currently the building is occupied by Charleston
9 Marine Manufacturing Corporation and is used to store equipment and paint used during
10 the dry docking of ships at Dry Docks No. 2 and No. 5. None of the site activities related
11 chemicals (e.g., lead, chromium, solvents) were detected in site media. The other detected
12 chemicals were discussed in Section 5.0, were concluded to be from non-point sources or
13 naturally occurring, and not from AOC 566 operations.

14 The *Zone E RFI Report, Revision 0* (EnSafe, 1997) identified BEQs in surface soils, beryllium
15 in shallow groundwater, and arsenic and manganese in deep groundwater as COCs for the
16 AOC 566 site. However, further evaluation of COPCs and COCs as presented in Section 5.0
17 of this RFI Report Addendum did not identify COCs in soil or groundwater at this site, and
18 this report concludes that no corrective action is necessary at this site. Therefore, AOC 566
19 is recommended for NFA.

20 Because this site is located in Zone E, it is expected to have LUCs established via deed
21 restrictions prior to property transfer. LUCs are expected to include, at a minimum,
22 restriction of the property to non-residential use.

23 Provided that the information presented in this report is adequate to address RFI
24 completion and site closeout issues, it is expected that the BCT will concur that NFA is
25 appropriate for AOC 566. After BCT concurrence for NFA, a Statement of Basis will be
26 prepared and made available for public comment to allow for public participation in the
27 final remedy selection, in accordance with SCDHEC policy.

Section 8.0

1 **8.0 References**

- 2 EnSafe Inc. *Zone E RFI Report, Revision 0, NAVBASE Charleston.* 1997.
- 3 EnSafe Inc./Allen & Hoshall. *Final RCRA Facility Assessment, NAVBASE Charleston.* July
4 1995.
- 5 EnSafe Inc./Allen & Hoshall. *Final Zone E RFI Work Plan, Revision 1, NAVBASE Charleston.*
6 June 1995.
- 7 CH2M-Jones. *Technical Memorandum: A Summary of Inorganic Chemical Concentrations in*
8 *Background Soil and Groundwater at the CNC.* 2001.
- 9 CH2M-Jones. *Technical Memorandum: Results from Additional Background Sampling of the CNC*
10 *Railroad Lines and Naval Annex (Zone K). CNC.* August 2001.
- 11 South Carolina Department of Health and Environmental Control, Final RCRA Part B
12 Permit No. Permit No. SC0 170 022 560.
- 13 USEPA. *Contract Laboratory Program National Functional Guidelines for Organic Data Review.*
14 OSWER, EPA/540/R-94/012-013, February 1994.

Appendix A

Chemicals Detected in Zone E Soil Samples
AOC 566

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
<i>Volatile Organic Compounds (ug/kg)</i>						
Acetone	566SB001	44.00	72.00	780000	NA	NA
	566SB002	50.00	94.00			
	566SB003	120.00	770.00			
	566SB004	ND	9.00			
	566SB005	74.00	24.00			
Methylene chloride	566SB001	NS	3.00	85000	NA	NA
	566SB006	10.00	ND			
<i>Semi-volatile Compounds (ug/kg)</i>						
2,4,6-Trichlorophenol	566SB007	ND	39.00	58000	NA	NA
2-Methylnaphthalene	566SB001	ND	1200.00	NA	NA	NA
Acenaphthene	566SB001	ND	1700.00	470	NA	NA
Anthracene	566SB001	ND	7400.00	23000000	NA	NA
	566SB005	59.00	ND			
	566SB006	59.00	ND			
Benzo(a)anthracene	566SB001	ND	9200.00	880	NA	NA
	566SB005	88.00	ND			
	566SB006	380.00	ND			
Benzo(a)pyrene	566SB001	ND	8200.00	88	NA	NA
	566SB005	74.00	ND			
	566SB006	550.00	ND			
Benzo(b)fluoranthene	566SB005	52.00	ND	880	NA	NA
	566SB006	600.00	ND			
Benzo(g,h,i)perylene	566SB001	ND	4900.00	310000	NA	NA
	566SB005	45.00	ND			
	566SB006	370.00	ND			
Benzo(k)fluoranthene	566SB001	ND	9000.00	8800	NA	NA
	566SB005	59.00	ND			
	566SB006	580.00	ND			
Chrysene	566SB001	ND	8800.00	88000	NA	NA
	566SB005	73.00	ND			
	566SB006	500.00	ND			
Di-n-butylphthalate	566SB007	ND	56.00	780000	NA	NA
Di-n-octyl phthalate	566SB007	ND	44.00	160000	NA	NA
Dibenz(a,h)anthracene	566SB001	ND	1700.00	88000	NA	NA
	566SB006	120.00	ND			
Dibenzofuran	566SB001	ND	2800.00	31000	NA	NA
Diethylphthalate	566SB007	ND	52.00	630000	NA	NA
Fluoranthene	566SB001	ND	23000.00	310000	NA	NA
	566SB005	180.00	ND			
	566SB006	470.00	ND			
Fluorene	566SB001	ND	2400.00	310000	NA	NA
Indeno(1,2,3-cd)pyrene	566SB001	ND	4100.00	880	NA	NA
	566SB005	44.00	ND			
	566SB006	290.00	ND			
Naphthalene	566SB001	ND	3300.00	310000	NA	NA
	566SB006	92.00	ND			
Phenanthrene	566SB001	ND	22000.00	310000	NA	NA
	566SB005	200.00	ND			
	566SB006	210.00	ND			

**Chemicals Detected in Zone E Soil Samples
AOC 566**

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
Pyrene	566SB001	ND	20000.00	230000	NA	NA
	566SB005	180.00	ND			
	566SB006	930.00	ND			
bis(2-Ethylhexyl)phthalate (BEHP)	566SB002	ND	510.00	4600	NA	NA
	566SB004	ND	440.00			
	566SB006	120.00	ND			
	566SB007	72.00	84.00			
<i>Inorganic Compounds (mg/kg)</i>						
Cyanide (CN)	566SB007	0.26	ND	73	0.5	NA
Aluminum (Al)	566SB001	9150.00	8690.00	7800	26000	41100
	566SB002	7270.00	5900.00			
	566SB003	12500.00	14300.00			
	566SB004	12700.00	13900.00			
	566SB005	11800.00	7420.00			
	566SB006	4840.00	13000.00			
	566SB007	14400.00	15300.00			
Antimony (Sb)	566SB001	ND	0.66	3	1.77	1.6
	566SB002	ND	0.63			
	566SB003	ND	0.55			
	566SB006	4.30	9.30			
	566SB007	6.40	12.20			
Arsenic (As)	566SB001	3.50	10.50	0	23.9	19.9
	566SB002	2.30	7.90			
	566SB003	3.50	7.30			
	566SB004	3.40	5.40			
	566SB005	3.20	3.30			
	566SB006	9.20	4.30			
	566SB007	2.60	4.90			
Barium (Ba)	566SB001	15.80	26.90	550	130	94.1
	566SB002	16.10	10.80			
	566SB003	18.80	22.10			
	566SB004	17.70	25.00			
	566SB005	17.60	9.90			
	566SB006	34.90	20.20			
	566SB007	23.10	23.00			
Beryllium (Be)	566SB001	0.27	0.38	0	1.7	2.71
	566SB002	0.22	0.15			
	566SB003	0.35	0.26			
	566SB004	0.39	0.25			
	566SB005	0.33	ND			
	566SB006	0.24	0.33			
	566SB007	0.56	0.35			
Calcium (Ca)	566SB001	3920.00	3870.00	NA	NA	NA
	566SB002	9010.00	1710.00			
	566SB003	4550.00	3310.00			
	566SB004	3580.00	592.00			
	566SB005	5170.00	566.00			
	566SB006	5010.00	1370.00			
	566SB007	30800.00	1130.00			
Chromium (Cr)	566SB001	11.10	14.30	39	94.6	75.2

**Chemicals Detected in Zone E Soil Samples
AOC 566**

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *
	566SB002	8.50	22.30			
	566SB003	14.40	24.90			
	566SB004	13.50	22.10			
	566SB005	14.20	13.30			
	566SB006	8.00	15.40			
	566SB007	13.50	20.30			
Cobalt (Co)	566SB001	3.00	2.30	470	19	14.9
	566SB002	2.10	0.52			
	566SB003	3.50	2.90			
	566SB004	2.90	1.50			
	566SB005	2.90	0.75			
	566SB006	62.30	1.80			
	566SB007	15.00	2.00			
Copper (Cu)	566SB001	5.00	14.90	310	66	152
	566SB002	6.10	0.52			
	566SB003	8.80	2.00			
	566SB004	5.90	1.70			
	566SB005	5.60	0.70			
	566SB006	12.10	ND			
Iron (Fe)	566SB001	9240.00	9270.00	2300	NA	NA
	566SB002	5920.00	21800.00			
	566SB003	11800.00	17900.00			
	566SB004	10800.00	13600.00			
	566SB005	12400.00	9250.00			
	566SB006	5670.00	12300.00			
	566SB007	9040.00	15500.00			
Lead (Pb)	566SB001	5.20	72.30	400	265	173
	566SB002	5.20	7.20			
	566SB003	6.90	11.50			
	566SB004	6.50	12.80			
	566SB005	6.00	7.10			
	566SB006	59.10	8.80			
	566SB007	5.70	11.90			
Magnesium (Mg)	566SB001	1580.00	1170.00	NA	NA	NA
	566SB002	851.00	584.00			
	566SB003	1920.00	1250.00			
	566SB004	1600.00	837.00			
	566SB005	1780.00	662.00			
	566SB006	477.00	735.00			
	566SB007	1650.00	1040.00			
Manganese (Mn)	566SB001	187.00	72.20	180	302	881
	566SB002	134.00	15.00			
	566SB003	234.00	50.00			
	566SB004	209.00	15.90			
	566SB005	216.00	13.90			
	566SB006	45.40	22.00			
	566SB007	195.00	31.10			
Mercury (Hg)	566SB001	ND	0.07	2	2.6	1.59
	566SB002	0.03	0.03			
	566SB003	ND	0.07			
	566SB004	ND	0.04			

**Chemicals Detected in Zone E Soil Samples
AOC 566**

Name	ID	Surface Conc.	Subsurface Conc.	RBC (THQ=.1)	Surface UTL	Subsurface UTL *	
	566SB006	0.06	ND				
Nickel (Ni)	566SB006	15.30	3.90	160	77.1	57	
	566SB007	8.70	4.00				
Potassium (K)	566SB001	874.00	951.00	NA	NA	NA	
	566SB002	856.00	691.00				
	566SB003	961.00	1020.00				
	566SB004	1070.00	855.00				
	566SB005	1100.00	ND				
	566SB006	206.00	311.00				
	566SB007	308.00	460.00				
		566SB003	ND	0.64	39	1.7	2.4
Selenium (Se)	566SB004	ND	0.76				
	566SB006	0.56	0.62				
	566SB007	ND	0.61				
		566SB006	0.59	ND	39	NA	NA
Silver (Ag)	566SB001	140.00	135.00	NA	NA	NA	
Sodium (Na)	566SB002	167.00	151.00				
	566SB003	136.00	200.00				
	566SB004	165.00	62.40				
	566SB005	147.00	156.00				
	566SB006	83.70	119.00				
	566SB007	ND	151.00				
		566SB007	215.00	ND			
		566SB001	ND	3.80	4700	59.4	9.23
Tin (Sn)	566SB003	2.40	ND				
	566SB004	2.60	ND				
	566SB005	2.40	ND				
		566SB001	14.90	18.30	55	94.3	155
		566SB002	11.90	31.10			
Vanadium (V)	566SB003	19.50	44.50				
	566SB004	18.90	28.20				
	566SB005	20.70	18.00				
	566SB006	13.20	24.20				
	566SB007	19.60	31.90				
		566SB001	33.60	116.00	2300	827	886
		566SB002	25.50	6.60			
Zinc (Zn)	566SB003	39.70	18.20				
	566SB004	38.80	18.10				
	566SB005	37.30	9.00				
	566SB006	49.70	18.10				
	566SB007	31.90	14.30				

Notes:

ND: Not Detected

NS: No Sample Taken/Sample Not Analyzed

NA: Not applicable

For compounds detected in both the primary and duplicate sample, the concentration for both detections are averaged and listed as one detection.

For compounds that were detected in only one of the primary or duplicate sample, the value of the detection was used.

* Surface soil samples will be used for human health risk assessment for the Zone E report.

**Chemicals Detected in Zone E Groundwater Samples
AOC 566**

Name	Location	Round 1 Conc.	Round 2 Conc.	Round 3 Conc.	Round 4 Conc.	RBC (THQ=.1)	UTL	MCL
<i>Other Compounds (mg/l)</i>								
Chloride	566GW001	182.00	159.00	212.00	347.00	NA	NA	NA
	566GW01D	1290.00 2398.00	1350.00	1150.00	NS			
Sulfate	566GW001	3506.00	201.00	146.00	151.00	NA	NA	NA
	566GW01D	4814.00 5722.00	140.00	133.00	NS			
Total Dissolved Solids	566GW001	6830.00	588.00	656.00	860.00	NA	NA	NA
	566GW01D	7938.00	430.00	2700.00	NS			
<i>Inorganic Compounds (ug/l)</i>								
Aluminum (Al)	566GW001	11262.00	1300.00	1770.00	3820.00	73.00	7.90	200.00
Arsenic (As)	566GW01D	12370.00	67.80	74.60	ND	0.05	18.70	50.00
Barium (Ba)	566GW001	13478.00	41.50	48.70	73.60	260.00	211.00	2000.00
	566GW01D	14586.00	77.30	77.10	ND			
Beryllium (Be)	566GW001	15694.00	1.20	2.10	ND	0.02	0.43	4.00
	566GW01D	16802.00	0.42	ND	ND			
Calcium (Ca)	566GW001	17910.00	17300.00	23700.00	41700.00	NA	NA	NA
	566GW01D	19018.00	272000.00	272000.00	ND			
Cobalt (Co)	566GW001	20126.00	8.80	9.50	18.80	220.00	2.50	NA
	566GW01D	21234.00	26.70	26.40	ND			
Iron (Fe)	566GW001	22342.00	4460.00	5070.00	8600.00	1100.00	NA	NA
	566GW01D	23450.00	12600.00	12700.00	ND			
Magnesium (Mg)	566GW001	24558.00	8290.00	19100.00	10800.00	NA	NA	NA
	566GW01D	25666.00	46700.00	47900.00	ND			
Manganese (Mn)	566GW001	26774.00	117.00	158.00	269.00	84.00	2560.00	NA
	566GW01D	27882.00	1280.00	1290.00	ND			
Nickel (Ni)	566GW001	28990.00	4.60	4.70	8.10	73.00	15.20	100.00
	566GW01D	30098.00	30.50	30.60	ND			
Potassium (K)	566GW01D	31206.00	5400.00	5470.00	ND	NA	NA	NA
Sodium (Na)	566GW001	32314.00	138000.00	167000.00	218000.00	NA	NA	NA
	566GW01D	33422.00	514000.00	518000.00	ND			
Thallium (Tl)	566GW001	34530.00	ND	ND	5.80	0.29	5.40	2.00
Vanadium (V)	566GW001	35638.00	1.10	ND	1.80	26.00	11.40	NA
Zinc (Zn)	566GW001	36746.00	64.80	65.10	104.00	1100.00	27.30	NA
	566GW01D	37854.00	ND	11.40	ND			

Notes:

ND: Not Detected

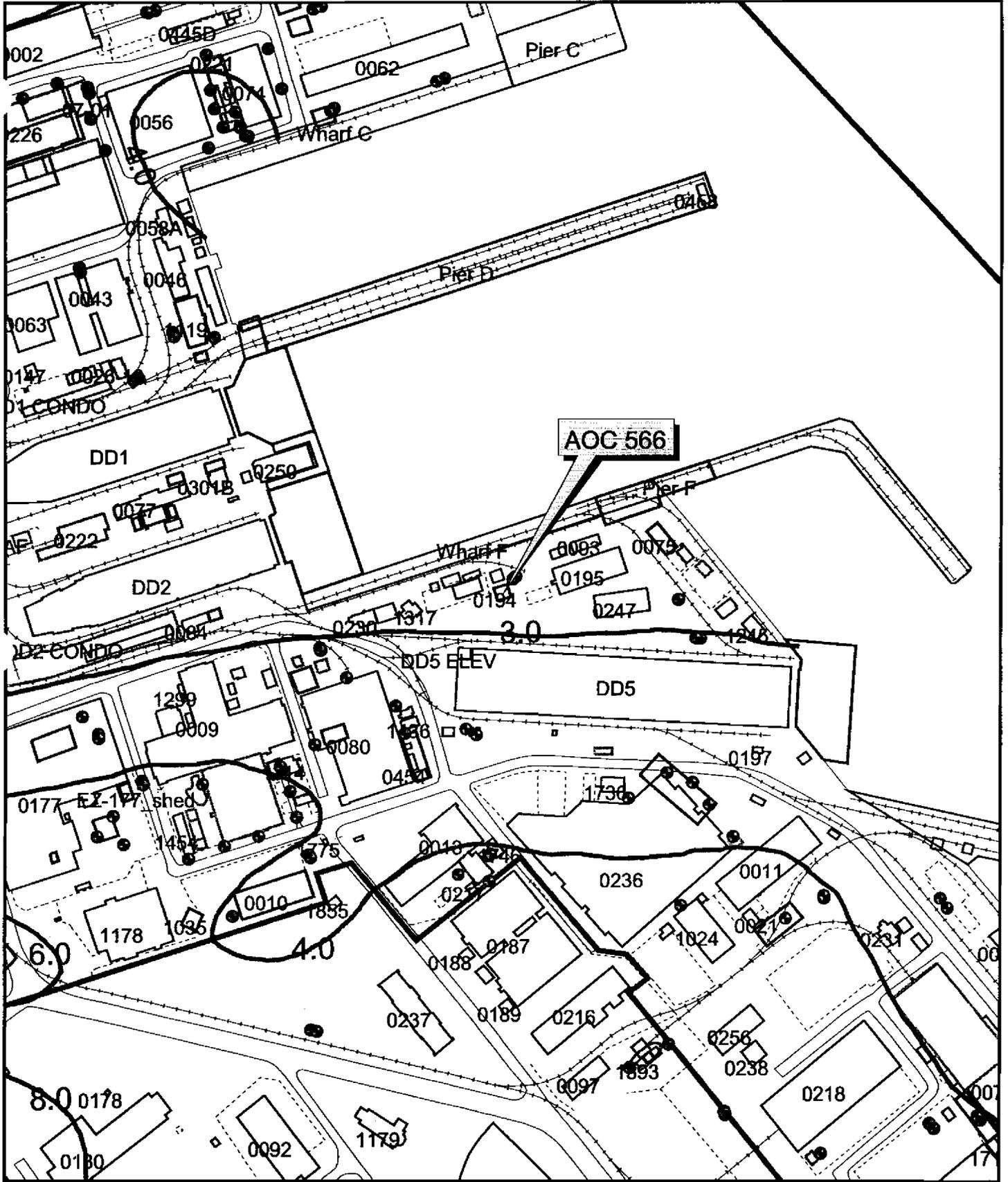
NS: No Sample Taken/Sample Not Analyzed

NA: Not Applicable

For compounds detected in both the primary and duplicate sample, the concentration for both detections are averaged and listed as one detection.

For compounds that were detected in only one of the primary or duplicate sample, the value of the detection was used.

NOTE: Original figure created in color



- Groundwater Well
- ▲ Groundwater Elevation (ft. above msl)
- ≡ Railroads
- ⋈ Fence
- ⋈ Roads

- AOC Boundary
- SWMU Boundary
- Buildings
- Zone Boundary

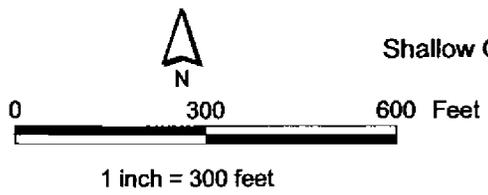


Figure A-1
 Shallow Groundwater Contour Map, 2001
 AOC 566, Zone E
 Charleston Naval Complex

CH2MHILL

Appendix B

Response To SCDHEC Comments on AOC 566 of the
Zone E RCRA Facility Investigation Report, Revision 0 (EnSafe, 1997)
Charleston Naval Complex
North Charleston, SC

ERIC F. CATHCART COMMENTS

GENERAL COMMENTS

SCDHEC Comment 56:

Thallium was detected in the fourth quarter groundwater sample collected from well NBCE566001 at a concentration of 5.8 ug/L, which is above its MCL of 2 ug/L. The Department therefore recommends adding thallium to the list of contaminants of concern for the shallow well.

Navy/EnSafe Response:

A significant number of wells throughout Zone E have shown Thallium concentrations exceeding its MCL of 2 µg/L and its Tap Water RBC of 2.9 µg/L. Discussions are ongoing pertaining to the widespread presence of inorganics in groundwater and how to interpret the significance of that data. A technical memo was submitted to the Project Team to review several months ago and it was briefly discussed at a meeting with SCDHEC in June. At that meeting SCDHEC indicated their review of the memo was not complete and that further discussion should be deferred until that review was complete. Analytical results from this area will be evaluated and the Navy will discuss additional well locations with the Project Team.

CH2M-Jones Response:

Intermittent detections of thallium in groundwater above the MCL are prevalent basewide at the CNC. As discussed in Section 6.2 of the RFI Report Addendum, Revision 0, these intermittent detections of thallium in shallow and deep groundwater at the site do not point to a site-specific source, but can be attributed to natural occurrence. Thallium was not detected in shallow and deep groundwater samples at this site during the first three sampling events. The single detection of thallium does not indicate a site-related thallium release. Therefore, thallium is not considered a COC at this site, and further evaluation of thallium is not warranted.

