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RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT ADDENDUM CORRECTIVE MEASURES STUDY WORK PLAN COMBINED SOLID WASTE MANAGEMENT UNIT 70 (SWMU 70) ZONE E CNC CHARLESTON SC

12/5/2002

CH2M HILL

RFI REPORT ADDENDUM

RFI Report Addendum and CMS Work Plan Combined SWMU 70, Zone E

Charleston Naval Complex
North Charleston, South Carolina

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

CH2M-Jones

December 2002

Revision No. 1
Contract N62467-99-C-0960

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December 5, 2002

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

Re: RFI Report Addendum and CMS Work Plan (Revision 1) – Combined SWMU 70, Zone E, Charleston Naval Complex

Dear Mr. Scaturo:

Enclosed please find two sets of replacement pages which serve as Revision 1 of the RFI Report Addendum and CMS Work Plan for Combined SWMU 70 in Zone E of the Charleston Naval Complex (CNC). The material enclosed includes the following:

- Revision 1 text and Appendix table to replace text and Appendix table in the Revision 0 RFI Report Addendum for Combined SWMU 70.
- New Appendix L divider page and material to be inserted in the back of the original Revision 0 RFI Report Addendum 3-ring binder.
- Revision 1 covers/spines and flysheets to replace those in the original Revision 0 RFI Report Addendum 3-ring binder.

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 Paul Favara. Please contact him at 352/335-5877, extension 2396, if you have any questions or comments.

Sincerely,

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Dean Williamson, P.E.

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September 26, 2002

Mr. David Scaturo
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2600 Bull Street
Columbia, SC 29201

Re: RFI Report Addendum and CMS Work Plan (Revision 0) – Combined SWMU 70, Zone E, Charleston Naval Complex

Dear Mr. Scaturo:

Enclosed please find two copies of the RFI Report Addendum and CMS Work Plan (Revision 0) for Combined SWMU 70 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 Paul Favara. Please contact him at 352/335-5877, extension 2396, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

cc: Tim Frederick/Gannett Fleming, Inc., w/att
Rob Harrell/Navy, w/att
Gary Foster/CH2M HILL, w/att

RFI REPORT ADDENDUM

RFI Report Addendum and CMS Work Plan Combined SWMU 70, Zone E

Charleston Naval Complex
North Charleston, South Carolina

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

PREPARED BY
CH2M-Jones

December 2002

Revision 1
Contract N62467-99-C-0960
158814.ZE.PR.03

Certification Page for RFI Report Addendum and CMS Work Plan (Revision 1) — Combined SWMU 70, 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

Permit No. 21428

Dean Williamson

Dean Williamson, P.E.

12/5/2002

Date

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I Results Report for ZVI Pilot Test Conducted at Combined SWMU 70 to Treat Hexavalent Chromium in Groundwater

J Analytical Results of Groundwater Sampling at Combined SWMU 70 (March 2002)

K Analytical Report for Groundwater Data Collected as Part of the ZVI Pilot Test

L CH2M-Jones' Responses to EPA Comments regarding the *RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Revision 0* (September 2002)

Acronyms and Abbreviations

AOC	Area of concern
BCT	BRAC Cleanup Team
BEQ	Benzo[a]pyrene equivalent
BRAC	Base Realignment and Closure Act
BRC	Background reference concentration
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
CA	Corrective Action
CMS	Corrective Measures Study
CNC	Charleston Naval Complex
COC	Chemical of concern
COPC	Chemical of potential concern
CVOC	Chlorinated volatile organic compound
DAF	Dilution attenuation factor
DCE	Dichloroethene
DET	Environmental Detachment Charleston
ELCR	Excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
EPC	Exposure point concentration
FRE	Fixed-point risk evaluation
ft bls	Feet below land surface
ft/ft	Feet per foot
HI	Hazard index
ILCR	Incremental lifetime cancer risk
IM	Interim measure
IR	Investigative report
IRIS	Integrated Risk Information System
kg	Kilograms
LUC	Land use control
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
MCL	Maximum contaminant level
MCS	Media cleanup standard

Acronyms and Abbreviations, Continued

MNA	Monitored natural attenuation
MSL	Mean sea level
NAVBASE	Naval Base
NFA	No further action
OWS	Oil/water separator
PAH	Polycyclic aromatic hydrocarbon
PCE	Tetrachloroethene
ppm	Parts per million
RAO	Remedial action objective
RBC	Risk-based concentration
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RGO	Remedial goal option
SCDHEC	South Carolina Department of Health and Environmental Control
SPLP	Synthetic precipitation leachate procedure
SQL	Sample quanititation limit
SSL	Soil screening level
SVOC	Semivolatile organic compound
SWMU	Solid waste management unit
TCE	Trichloroethene
TCLP	Toxicity characteristic leachate procedure
TEF	Toxicity equivalency factor
UCL_{95}	95-percent Upper Confidence Level
UST	Underground storage tank
VOC	Volatile organic compound
ZVI	Zero-valent iron

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) 22, 25, and 70, and Areas of Concern (AOCs) 548, 549, and 554. This group of sites is herein referred to as Combined SWMU 70. This report also contains a Corrective Measures Study (CMS) Work Plan for the Combined SWMU 70 site, which will evaluate corrective measure alternatives that are proposed for the soil and groundwater at the site.

Figure 1-1 presents the location of Zone E within the CNC. Figure 1-2 shows the location of the Combined SWMU 70 area within Zone E.

1.1 Background

SWMU 22, the Old Plating Shop Wastewater Treatment System, was originally constructed in 1972 and is located on the southeast side of Building 5. The system consisted primarily of a 5-foot (ft) by 5-ft by 8-ft concrete collection sump partitioned in half. One side accumulated acid wastewater, while the other side collected cyanide and alkaline wastewater. The treated effluent was discharged to the sanitary sewer. Other components included an elevated 1,000-gallon clarifier, four mixing tanks (two 70-gallon and two-250-gallon), chemical feed equipment, and associated piping. This unit became inactive around 1983 when the new metal plating waste treatment facility began operation.

SWMU 25, an electroplating operation located near the southwestern portion of Building 5, was operational until 1983. The facility stored approximately 40 metal tanks containing

solutions used in the plating process. The concrete floor showed signs of deterioration at this location. The process tanks were removed in 1992.

AOC 554 is the former Building 1003 location. Building 1003 was used as a paint shop from approximately 1909 to 1940. No additional information regarding the size, design features, or operating practices is known regarding this unit.

SWMU 70 consists of a former dip tank at the northwest corner of Building 5. The dip tank was used to treat wood with a fire retardant chemical. The tank was removed in 1981 when the shipyard began receiving pre-treated lumber. No information was found indicating when the operations started.

AOC 548, an electric hydraulic elevator, is located on the western side of Building 5. The elevator is in a shaft that is paved on the bottom with approximately 8 inches of concrete. Containment is provided by a container that captures hydraulic fluid leaks and returns the fluid to the main reservoir. However, this containment system has not been in place throughout the life of this unit.

AOC 549 is the site of a former scrap yard north of Building 5, which was in operation during the 1920s and 1930s. No information was found concerning its operating practices. This area is currently paved with concrete and asphalt.

1.2 Purpose of the RFI Report Addendum/CMS Work Plan

This RFI Report Addendum contains two RCRA submittals – the RFI Report Addendum and the CMS Work Plan for Combined SWMU 70. Sections 2.0 through 6.0 of this document address topics associated with the RFI Report Addendum. This portion of the submittal provides information about Combined SWMU 70 and documents the conclusions presented for the site in the *Zone E RFI Report, Revision 0* (EnSafe Inc. [EnSafe], 1997). Appendix A provides CH2M-Jones' responses to SCDHEC comments made regarding the *Zone E RFI Report, Revision 0.*

The RFI Report Addendum also provides the results of additional sampling performed after completion of the *Zone E RFI Report, Revision 0* in order to complete the nature and extent investigation for chemicals of potential concern (COPCs) that were identified in surface soil, subsurface soil, and groundwater. This document evaluates these additional data, and provides conclusions regarding further RCRA activities at Combined SWMU 70.

The CMS Work Plan, contained within Sections 7.0 through 9.0 of this submittal, evaluates and refines the findings for Combined SWMU 70, as presented in the *Zone E RFI Report,*

Revision 0 and subsequent investigations, particularly as they relate to the chemicals of concern (COCs) identified at Combined SWMU 70.

Prior to changing the status of any site to No Further Action (NFA) in the CNC RCRA CA permit, the BRAC Cleanup Team (BCT) agreed that the following issues should be considered:

- Status of the RFI
- Presence of metals (inorganics) in groundwater
- Potential linkage to SWMU 37, Investigated Sanitary Sewers at the CNC
- Potential linkage to AOC 699, Investigated Storm Sewers at the CNC
- Potential linkage of 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 submittal. At this time, Combined SWMU 70 is not being recommended for NFA. However, the above information is presented in this report as it will eventually be required for the site to be considered for NFA in the future.

1.3 Report Organization

This RFI Report Addendum/CMS Work Plan consists of the following sections, including this introductory section:

1.0 Introduction — Presents the purpose of the report and background information regarding the Combined SWMU 70 area.

2.0 Summary of RFI Conclusions for Combined SWMU 70 — Summarizes the conclusions from the RFI investigations for the area comprising Combined SWMU 70.

3.0 Summary of Interim Measures – Summarizes four different interim measures (IMs) completed at Combined SWMU 70.

4.0 Summary of Additional Investigations — Summarizes information collected at Combined SWMU 70 after completion of the *Zone E RFI Report, Revision 0.*

5.0 COPC/COC Refinement —Provides further evaluation of COPCs based on the RFI report 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 Remedial Action Objectives and Media Cleanup Standards – Defines the remedial action objectives (RAOs) and associated media cleanup standards (MCSs) for the COCs that are identified in Section 5.0. This section also presents nature and extent of COCs for the Combined SWMU 70 area.

8.0 Evaluation of Corrective Measure Alternatives – Addresses the CMS procedures that will be used to evaluate and compare relevant remedial approaches to achieving RAOs and MCS for the COCs.

9.0 Discussion of Potential Remedial Technologies – Presents potential remedial technologies that will be evaluated in the CMS for Combined SWMU 70.

10.0 References — Lists the references used in this document.

Appendix A contains responses to SCHDHEC comments on the *Zone E RFI Report, Revision 0*.

Appendix B contains IM Completion Reports (Appendices B-1 through B-4), which detail the completion of the four IMs executed in the Combined SWMU 70 site by the Environmental Detachment Charleston (DET).

Appendix C contains the summary tables for constituents that were detected in soil and groundwater at Combined SWMU 70 during the post-RFI sampling events.

Appendix D contains the analytical data for the post-RFI soil and groundwater collection events conducted at Combined SWMU 70.

Appendix E contains the data validation report for the post-RFI soil and groundwater collection events.

Appendix F contains summary tables of the COPC screening process for soil and groundwater at Combined SWMU 70, exposure factors for these media, exposure point concentrations (EPCs) for the COPCs, toxicity factors for the preliminary COPCs, as well as other risk summary information relevant to this site.

Appendix G contains summary tables that present risk characterization results for future potential receptors at the Combined SWMU 70 site.

Appendix H contains the site-specific soil screening level (SSL) and dilution attenuation factor (DAF) calculation for Combined SWMU 70.

Appendix I contains a copy of the results report for the pilot test that was conducted at Combined SWMU 70 to assess the effectiveness of the Ferox^{SM} process for treating hexavalent chromium in groundwater, implemented by CH2M-Jones in 2002.

Appendix J contains the analytical results from the groundwater sampling conducted at Combined SWMU 70 during March 2002.

Appendix K contains the full analytical report for all groundwater data collected as part of the ZVI pilot study.

Appendix L contains a copy of CH2M-Jones' Responses to EPA Comments regarding the *RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Revision 0* (September 2002).

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

NOTE: Original figure created in color

Roads - Lines
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 700 1400 Feet

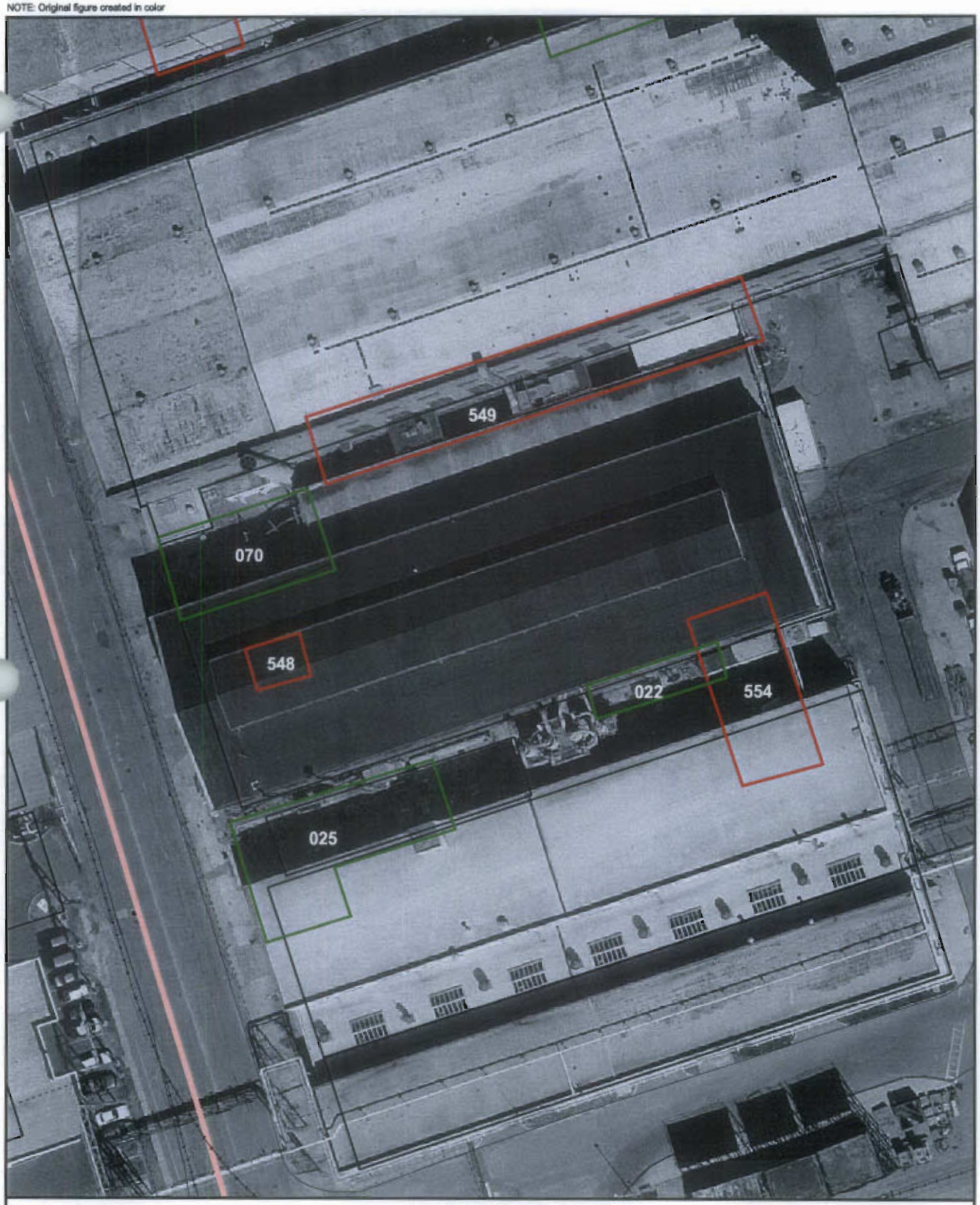
1 inch = 980.21 feet

Figure 1-1
Location of Combined SWMU 70
in Zone E
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 16 Sep 2002 15:07, User: PFAVARA, RFIRA-CMSWP: Figure 1-1 Location of Combined SWMU 70

NOTE: Aerial Photo Date is 1997
NOTE: Original figure created in color



AOC Boundary
SWMU Boundary

N

0 50 100 Feet

Figure 1-2
Individual SWMUs/AOCS
in Combined SWMU 70
Charleston Naval Complex

Section 2.0

2.0 Summary of RFI Conclusions for Combined SWMU 70

The results of the RFI for Combined SWMUs 22/25 and AOC 554 were discussed in Section 10.3 of the *Zone E RFI Report, Revision 0* (EnSafe, 1997). The RFI results for SWMU 70 and AOCs 548/549 are found in Section 10.8 of the RFI report. For the purpose of clarity, these sites will herein be referred to as Combined SWMU 70.

According to the *Zone E RFI Report, Revision 0*, antimony, cadmium, chromium (total), copper, lead, and benzo[a]pyrene equivalents (BEQs) were identified as COCs in the surface soil. No COCs were identified for subsurface soils following the Tier II COPC refinement step performed in the original RFI.

Aluminum, antimony, cadmium, chromium (total), nickel, benzene, chlorobenzene, chlordane (alpha and gamma), chloroform, tetrachloroethene (PCE), trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1,2-DCE) were identified as COCs for shallow groundwater at Combined SWMU 70. Antimony, chromium (total), thallium, chloroform, PCE, TCE, and cis-1,2-DCE were identified as COCs in the deep groundwater. These constituents are discussed in the following subsections.

2.1 Surface Soil Results

The results for soil samples were compared in the *Zone E RFI Report, Revision 0* to the applicable screening criteria (U.S. Environmental Protection Agency [EPA] Region III residential risk-based concentrations [RBCs], EPA Office of Solid Waste and Emergency Response [OSWER] generic soil screening levels [SSLs], or background values). Analytes that exceeded the screening criteria were further evaluated in the fixed-point risk evaluation (FRE) to determine which of these parameters was considered a COC at Combined SWMU 70. To assess the soil-to-groundwater leachability potential, maximum concentrations of detected chemicals were compared to the generic SSL or background values. Parameters that exceeded the soil-to-groundwater leachability criteria were further evaluated in a soil-to-surface water transport screening (Tier II evaluation). This evaluation used adjusted SSLs based on a site-specific DAF that is protective of surface water in the Cooper River. A chemical was considered a leachability COC only if its concentration exceeded the adjusted Tier II SSL.

The screening of surface soil resulted in the identification of the following surface soil COCs:

- Antimony
- Cadmium
- Chromium, total
- Copper
- Lead
- BEQs

2.1.1 Antimony

Antimony was detected in eight of 35 surface soil samples and five of 33 subsurface soil samples collected. One surface soil sample exceeded the soil background reference concentration (BRC) and EPA Region III Residential RBC. No surface soil samples exceeded the industrial RBC. Four soil samples exceeded the SSL for antimony. Antimony was identified as a COC due to its contribution to a Hazard Index (HI) greater than 1.0 for the FRE that was used for a residential receptor exposed to surface soils. Antimony was identified as a soil-to-groundwater leaching concern because it exceeded the generic SSL of 2.5 milligrams per kilogram (mg/kg). However, following the Tier II evaluation for cross-media transport from soil to surface water (i.e., the Cooper River), antimony was not considered a COC based on leachability concerns.

2.1.2 Cadmium

Cadmium was detected in 20 of 35 surface soil samples and 10 of 33 subsurface soil samples. Four samples exceeded the residential criteria in surface soils. Cadmium did not exceed the industrial RBC in surface soils. Cadmium exceeded the SSL in four surface soil and three subsurface soil samples. Cadmium was identified as a COC based on its contribution to a HI greater than 1.0 for the residential receptor FRE. Cadmium was identified as a soil-to-groundwater leaching concern because it exceeded the generic SSL of 4 mg/kg. However, following the Tier II evaluation for cross-media transport from soil to surface water (i.e., the Cooper River), cadmium was not considered a COC based on leachability concerns.

2.1.3 Chromium (Total)

Chromium (total) was detected in all 35 surface soil samples and all 33 subsurface soil samples collected. Chromium (total) exceeded the EPA Region III residential RBC (HI=0.1) in six samples and the industrial RBC once in surface soils. Chromium (total) exceeded the surface soil BRC twice and the subsurface soil BRC three times. The hexavalent chromium SSL was not applied to the chromium at this site. The original RFI screened for leachability

potential against the BRC of 94.6 mg/kg, but did not apply the hexavalent chromium SSL of 19 mg/kg. Because hexavalent chromium was not detected in the single duplicate surface soil sample and was infrequently detected (and only at low concentrations) in the hexavalent state (4 of 59 samples) in Zone E, it was assumed in the *Zone E RFI Report, Revision 0* that this SSL was not applicable.

Chromium (total) was identified as a COC based on its contribution to a HI greater than 1.0 for the residential receptor FRE. Chromium (total) was identified as a soil-to-groundwater leaching concern for exceeding the background reference value of 94.6 mg/kg. However, following the Tier II evaluation for cross-media transport from soil to surface water (i.e., the Cooper River), chromium (total) was not considered a COC based on leachability concerns.

2.1.4 Copper

Copper was detected in all 35 surface soil samples and 28 of 33 subsurface soil samples collected. The EPA Region III residential RBC (HI=0.1) was exceeded in five surface soil samples and the industrial RBC (HI=0.1) was exceeded in one sample. The BRC was exceeded in 10 samples. There is no generic SSL for copper and the BRC was taken as the screening criteria for migration to groundwater. Using the BRC as the criteria, six surface soil samples and one subsurface soil sample exceeded the BRC. Copper was identified as a COC based on its contribution to a HI exceeding unity for the residential receptor FRE. Copper was identified as a soil-to-groundwater leaching concern because it exceeded the BRC of 152 mg/kg. However, following the Tier II evaluation for cross-media transport from soil to surface water (i.e, the Cooper River), copper was not considered a COC based on leachability concerns.

2.1.5 Lead

Lead was detected in all 35 surface soil and all 33 subsurface soil samples collected. Three surface soil samples exceeded the EPA Region III residential screening level of 400 mg/kg for lead and exceeded the industrial screening level of 1,300 mg/kg once. The BRC was exceeded four times. Lead exceeded the leachability criteria in four samples. Lead was not quantitatively evaluated in the FRE but was considered a COC based on its maximum detected concentration of 1,620 mg/kg, which exceeds the 400 mg/kg RBC. Lead was identified as a soil-to-groundwater leaching concern for exceeding the screening level of 400 mg/kg. However, following the Tier II evaluation for cross-media transport from soil to surface water (i.e., the Cooper River), lead was not considered a COC based on leachability concerns.

2.1.6 BEQs

BEQs were detected in 27 of 39 surface soil and 11 of 37 subsurface soil samples collected. Nineteen surface soil samples exceeded the EPA Region III residential RBC for benzo[a]pyrene, and three exceeded the industrial RBC. No BRC was established for BEQs in the *Zone E RFI Report, Revision 0*. BEQs contributed to an overall Incremental Lifetime Cancer Risk (ILCR) exceeding 1E-6, and were identified as COCs. None of the carcinogenic polycyclic aromatic hydrocarbons (cPAHs) that are included in the BEQ calculations exceeded their respective soil-to-groundwater generic SSLs.

2.2 Subsurface Soil Results

The results of the subsurface soil sample analyses were compared in the *Zone E RFI Report, Revision 0* to the applicable screening criteria (EPA OSWER SSLs or BRCs) to assess the leachability potential of chemicals detected in soils. All chemicals were screened against an SSL with a DAF of 10. This was presented as the soil-to-groundwater Tier I screening process. Chemicals exceeding the Tier I criteria were carried over to a Tier II screening. Groundwater-to-surface water Tier II screening compared constituents to a site-specific SSL that was calculated on the basis of an adjusted tap water RBC. The RBC was adjusted by a site-specific factor to account for dilution by the Cooper River. Any chemical exceeding the Tier II screening value was considered a COC based on leachability.

In the Zone *E RFI Report, Revision 0*, no constituents were identified as COCs in subsurface soil following the Tier II screening process.

2.3 Shallow Groundwater Results

The results from the first quarter groundwater analyses were evaluated in the *Zone E RFI Report, Revision 0* and compared to EPA Region III tap water RBCs and appropriate BRC values. Analytes that exceeded the screening criteria were further evaluated in the FRE to determine which chemicals were considered COCs at this site. Based on the FRE results, the *Zone E RFI Report, Revision 0* identified the following shallow groundwater COCs for the Combined SWMU 70 area:

- Aluminum
- Antimony
- Cadmium
- Chromium (total)
- Nickel

- 1,2-DCE (total)
- Benzene
- Chlorobenzene
- PCE
- TCE
- alpha-Chlordane
- gamma-Chlordane

2.3.1 Aluminum

Aluminum was detected in six of nine shallow groundwater samples collected at this site. One sample exceeded the EPA Region III residential RBC of 3,700 micrograms per liter (μg/L), and two samples exceeded the BRC of 2,810 μg/L. Although the HI for aluminum did not exceed 1.0, aluminum was identified as a COC due to its contribution to an overall HI greater than 1.0 in the FRE for shallow groundwater.

2.3.2 Antimony

Antimony was detected in three of nine shallow groundwater samples collected at Combined SWMU 70. All three detected concentrations of antimony exceeded the EPA Region III residential RBC of 1.5 μg/L. Six non-detect sample quantitation limits (SQL) also exceeded the residential RBC. No BRC had been established for this chemical in shallow groundwater. Antimony was identified as a COC based on its HI exceeding 1.0 in the FRE.

2.3.3 Cadmium

Cadmium was detected in five of nine shallow groundwater samples. Three samples exceeded the EPA Region III residential RBC of 1.8 μg/L. No BRC had been established for cadmium. One sample contributed to a HI of 10.8 (E025GW003), while all others were below 1.0. Cadmium was identified as a COC based on a HI exceeding 1.0 in the FRE.

2.3.4 Chromium (Total)

Chromium was detected in seven of nine groundwater samples collected at Combined SWMU 70. Six samples exceeded the EPA Region III residential RBC and seven exceeded the BRC. Six samples were one to two orders of magnitude (127 to 7,350 μg/L) greater than the RBC (18 μg/L) and BRC (12 μg/L). Detected chromium was compared to its hexavalent-state RBC during the screening process and the FRE. The HI for chromium ranged between 0.2 and 94.0. Six samples exceeded an HI of 1.0 for chromium. Chromium was considered a COC and identified as the primary noncarcinogenic risk driver in the FRE.

2.3.5 Nickel

Nickel was detected in five of nine shallow groundwater samples analyzed at Combined SWMU 70. One sample exceeded the EPA Region III residential RBC of 73 μg/L, and two samples exceeded the BRC of 15.2 μg/L. The HI for nickel exceeded 1.0 in the residential groundwater FRE at one location (E025GW003) and was considered a COC for shallow groundwater.

2.3.6 1,2-DCE (Total)

Total 1,2-DCE was detected in five of nine shallow groundwater samples. Three wells exceeded the tap water RBC of 5.5 μg/L. Although total 1,2-DCE did not exceed a HI of 1.0 for residential shallow groundwater, it was identified as a COC based on its contribution to an overall HI greater than 1.0 in the FRE.

2.3.7 Benzene

Benzene was detected in one of nine shallow groundwater samples included in the original RFI. The single detection from monitoring well E549GW001 was an estimated ("J") value of 2 μg/L which exceeded the tap water RBC of 0.36 μg/L. Benzene was considered a COC based on its contribution to an ILCR of greater than 1.0E-6 in the FRE.

2.3.8 Chlorobenzene

Chlorobenzene was detected in one of nine shallow groundwater samples. A value of 29 μg/L was detected at E549GW001. This detected value exceeded the tap water RBC of 3.9 μg/L. Although chlorobenzene did not exceed a HI of 1.0 for shallow groundwater and was not associated with an overall HI exceeding 1.0, it was included as a COC in the residential FRE.

2.3.9 PCE

PCE was detected in two of nine samples. Both detections were estimated detections ("J") of 1 and 3 μg/L. One sample exceeded the tap water RBC of 1.1 μg/L. PCE was considered a COC based on its ILCR exceeding the 1E-6 risk level at a single location (E025GW003) in the FRE.

2.3.10 TCE

TCE was detected in five of nine shallow groundwater samples. TCE exceeded the tap water RBC of 1.6 μg/L in all five samples, which ranged from 2 to 15 μg/L. TCE was considered a COC for shallow groundwater based on its ILCR exceeding 1E-6 in the FRE.

2.3.11 Alpha-Chlordane

Alpha-Chlordane was detected in one of nine samples in shallow groundwater. The single detection of 0.16 μg/L exceeded the tap water RBC for chlordane of 0.052 μg/L, and was identified as a COC based on its ILCR exceeding the 1E-6 risk level at a single location (E025GW001) in the FRE.

2.3.12 Gamma-Chlordane

Gamma-Chlordane was detected in one of nine samples in shallow groundwater. The single detection of 0.12 μg/L exceeded the tap water RBC for chlordane of 0.052 μg/L, and was identified as a COC based on its ILCR exceeding the 1E-6 risk level at a single location (E025GW001) in the FRE.

2.4 Deep Groundwater Results

One deep well (E070GW01D) was installed at Combined SWMU 70. The groundwater sample results were compared to the EPA Region III tap water RBC and the BRC in the *Zone E RFI Report, Revision 0*. Analytes exceeding the screening criteria were included in the deep groundwater FRE. If a COC contributed to an overall ILCR of 1E-6 or a HI exceeding 1.0, it was considered a COC for deep groundwater. The following chemicals detected in deep groundwater were considered COCs in the *Zone E RFI Report, Revision 0*:

- Antimony
- Chromium (total)
- Thallium
- 1,2-DCE (total)
- Chloroform
- PCE
- TCE

2.4.1 Antimony

Antimony was detected at a concentration of 115 μg/L in deep well E070GW01D, which exceeded the tap water RBC of 1.5 μg/L. Antimony was considered a COC based on its HI of 18.4 in the FRE.

2.4.2 Chromium (Total)

Chromium was detected at 52,500 μg/L. Chromium was assumed to be in the hexavalent form and exceeded the tap water RBC of 18 μg/L for hexavalent chromium and the BRC of

15.5 μg/L. Chromium was the primary noncarcinogenic risk driver with a HI of 671.2 in the FRE.

2.4.3 Thallium

Thallium was detected in deep groundwater at a concentration of 9.5 μg/L, which exceeded the tap water RBC of 0.29 μg/L and the BRC of 2 μg/L. Thallium was considered a COC based on its ILCR exceeding 1E-6 in the FRE.

2.4.4 1,2-DCE (Total)

Total 1,2-DCE was detected at 10 μg/L, which exceeded the tap water RBC of 5.5 μg/L. Although it did not exceed a HI of 1.0 in deep groundwater, total 1,2-DCE was considered a COC based on its contribution to an overall HI exceeding 1.0 in deep groundwater.

2.4.5 Chloroform

Chloroform was detected at 7.0 μg/L, which exceeded the tap water RBC of 0.15 μg/L. As the ILCR for chloroform was 9.0E-6 in deep groundwater, it was considered a COC for residential pathways.

2.4.6 PCE

PCE was detected at 8 μg/L, which is above the tap water RBC of 1.1 μg/L. PCE contributed an ILCR of 6.4E-6, and was therefore considered a COC for deep groundwater in the FRE.

2.4.7 TCE

TCE was detected at 22 μg/L, which exceeded the tap water RBC of 1.6 μg/L. TCE contributed an ILCR of 5.6E-6 for deep groundwater in the FRE, and was therefore considered a COC.

2.5 Sediment Results

One sediment sample (E025M000101) was taken from a lined catch basin located at SWMU 25. The original RFI screened sediments against the industrial soil RBC. BEQs, arsenic, chromium, and lead were identified as exceeding their industrial RBCs.

Section 3.0

3.0 Summary of Interim Measures

Following completion of the *Zone E RFI Report, Revision 0* (EnSafe, 1997), it was decided by the Southern Division Naval Facilities Engineering Command (SOUTHDIV) that a series of IMs would be performed by the Supervisor of Shipbuilding, Conversion and Repair, Portsmouth VA, Environmental Detachment Charleston, or SPORTENVDETCHASN (herein referred to as the DET). The following four IMs were completed:

1. Demolition and removal of the Building 44 Annex (the former plating shop).
2. Removal of chromium-contaminated fluid from the electrical vault.
3. Removal of electrical cable, contaminated conduit, and the electrical vault.
4. Cleaning of the storm drain.

The purpose of the first three IMs was to remove the source of soil and groundwater contamination at SWMU 25. The objectives for these IMs were completed with the installation of an asphalt cap at SWMU 25, which resulted in minimizing the infiltration pathway that would facilitate further migration of contaminants from surface and subsurface soils into the groundwater. The objective of the fourth IM was to remove contaminated sediments from the storm sewers throughout the CNC.

3.1 Demolition and Removal of Building 44 Annex

The objective of the first IM was to demolish and remove the Building 44 Annex. The Building 44 Annex contained the former electroplating facility and its removal was considered consistent with the ultimate cleanup of SWMU 25 by allowing access to the soil beneath the building. In April 1997, the DET demolished and removed 396 tons of building materials from SWMU 25. During the demolition a high voltage utility manhole (electrical vault 7A) could not be removed as planned. It could not be determined if the seven electrical cables running through the electrical vault were energized and no attempt was made to remove the cables and vault. The IM Completion Report for this first IM is presented as Appendix B-1.

3.2 Delineation and Removal of Chromium-Contaminated Fluid from Electrical Vault

Subsequent to the first IM performed in April 1997, SOUTHDIV decided that an investigation would be performed by the DET to determine/delineate the extent of contamination in electrical vault 7A and the surrounding surface soil. In August 1997, the DET performed soil sampling at fourteen locations in SWMU 25. Upper and lower intervals were collected for a total of 28 samples. Samples were analyzed for metals, semivolatile organic compounds (SVOCs), and volatile organic compounds (VOCs). The Investigative Report (IR) for SWMU 25 stated that the source of contamination was electrical service vault 7A. The IR recommended that protective measures be taken to remove the source area for contamination at SWMU 25. The IM Completion Report for this second completed IM is presented as Appendix B-2.

In June 1998, 6,203 pounds of chromium-contaminated fluid was removed by the DET from the electrical vault. This fluid exceeded the 5 parts per million (ppm) level specified by 40 CFR 261.64 Table 1—*Maximum Concentration of Contaminants for the Toxicity Characteristic Leaching Potential*. Two soil core samples taken from within the vault also exceeded the 5 ppm Toxicity Characteristic Leachate Procedure (TCLP) level. Protective measures were implemented in July 1999 and documented in the Final Completion Report for the SWMU 25 Interim Measure. The results of this effort are presented in the IM Completion Report found in Appendix B-2.

3.3 Removal of Electrical Cable, Contaminated Conduit, and Electrical Vault

For the third IM performed at the site, which was completed by the DET in July 1999, the following actions were taken:

- Remove the electrical cables from the electrical service vault 7A.
- Remove the cable conduits leading to and from electrical service vault 7A.
- Remove electrical service vault 7A and associated soil and backfill.
- Cap the area with a layer of asphalt.

Approximately 50,360 pounds (25 tons) of debris and soil were removed and disposed of from SWMU 25. The IM Completion Report for the third IM completed at SWMU 25 is presented as Appendix B-3. This report also addresses the work that was described above in Section 3.2.

3.4 Cleaning of the Storm Drain

The fourth IM involved cleaning the storm sewers at CNC; this work was completed by the DET in early 1999. The execution of this IM consisted of cleaning catch basins piped to the storm drain system, isolated/abandoned catch basins, and OWSs, along with portions of nine different storm drain piping runs which lead to outfalls. A total of nine different storm drain piping runs were targeted for cleanout, based on the presence of accumulated bottom sludge/sediments that exceed residential or industrial RBC levels.

One of the storm sewer segments targeted for sediment removal was connected to SWMU 25, based on the elevated sediment results, as reported in Section 2.5. To remove contaminated sediment, a Jet-Rodder device was inserted into a downstream manhole and crawled forward to the next upstream manhole. Vacuuming was used to remove process water and sediment with contaminants; vacuuming was performed at the injection point of the Jet-Rodder device. The segments of sewer pipe run cleaned out at SWMU 25 and downstream of the contaminated sediment location is presented in Figure 7A of the IM Completion Report for this fourth IM (see Appendix B-4).

3.5 Groundwater Treatment Pilot Test Using ZVI Delivered via Injection

A pilot test to assess the effectiveness of the Ferox^{SM} process for treating hexavalent chromium in groundwater was also implemented by CH2M-Jones in 2002. This pilot test is further discussed in Section 9.1 (also, see Appendix I).

Section 4.0

4.0 Summary of Additional Investigations

This section summarizes site activities conducted subsequent to the *Zone E RFI Report, Revision 0* (EnSafe, 1997), and provides the interpretation of analytical data associated with these activities.

Following the demolition of the Building 44 Annex by the DET, SOUTHDIV decided that an investigation to determine the extent of contamination in electrical service vault 7A was needed. Fourteen surface and subsurface soil samples were collected at SWMU 25 and analyzed for metals. Results from this sampling effort were included in an IR submitted in September 1998 to SOUTHDIV by the DET (see Appendix B-2). Subsequent to the post-RFI sampling at SWMU 25, electrical vault 7A and the surrounding soils were removed. Approximately 25 tons of soil and material were removed from SWMU 25 in July 1999. As a result, some of the supplemental samples may have been removed and would no longer be representative of site conditions. The information available regarding the removal action is inadequate to clearly identify sample locations that were removed, as compared to those left in-place. Therefore, all soils were conservatively assumed to be remaining in-place, and detected concentrations in soil were screened against COPC screening criteria. Thus the screening results may represent higher number of exceedence than those actually present at the site after the third IM was completed.

Groundwater monitoring wells were also sampled subsequent to the *Zone E RFI Report, Revision 0*. The Navy/EnSafe team sampled select wells at Combined SWMU 70 up to four different times, after the RFI was finalized. Additionally, CH2M-Jones collected one round of post-RFI samples from select wells at Combined SWMU 70.

4.1 Surface Soil Results

The results of the post-RFI surface soil samples collected at SWMU 25 are presented in Appendix C-1. During the additional sampling event at SWMU 25, metals were targeted for analysis. The locations of all RFI and additional samples are presented in Figure 4-1. The additional samples were collected from the SWMU 25 area and are designated as E025SB015 through E025SB027. Samples that exceeded the COPC screening parameters (i.e., Zone E background range of concentrations, RBCs, or SSLs) are in bold text and outlined within the table. The screening criteria used to evaluate analytical results are those approved by the CNC BCT (see *Project Team Notebook and Instructions, Revision 1A*, CH2M-Jones, 2001b).

This screening of the surface soil samples that were taken subsequent to the *Zone E RFI Report, Revision 0* showed that the following constituents exceeded one or more of the applicable screening criteria:

- Antimony
- Cadmium
- Chromium (hexavalent)
- Chromium (total)
- Lead
- Nickel
- Silver

The analytical reports for these additional surface soil sampling results are presented in Appendix D-1. Data validation reports for these samples are presented in Appendix E.

4.2 Subsurface Soil Results

Appendix C-2 summarizes the detection results from post-RFI sample collection of subsurface soil at Combined SWMU 70. No subsurface soil COPCs were identified in the original RFI report. Samples collected at SWMU 25 subsequent to the RFI report were analyzed for metals. The locations of all RFI and post-RFI samples are presented in Figure 4-1. The post-RFI samples that exceeded applicable screening criteria (i.e., background range and SSL) are in bold text and outlined in the table.

This screening identified the following chemicals as COPCs for post-RFI subsurface soil:

- Antimony
- Cadmium
- Chromium (hexavalent)
- Chromium (total)
- Lead
- Nickel
- Thallium

The analytical reports for the post-RFI subsurface soil sampling results are presented in Appendix D-2. Data validation reports for these samples are presented in Appendix E.

4.3 Groundwater Results

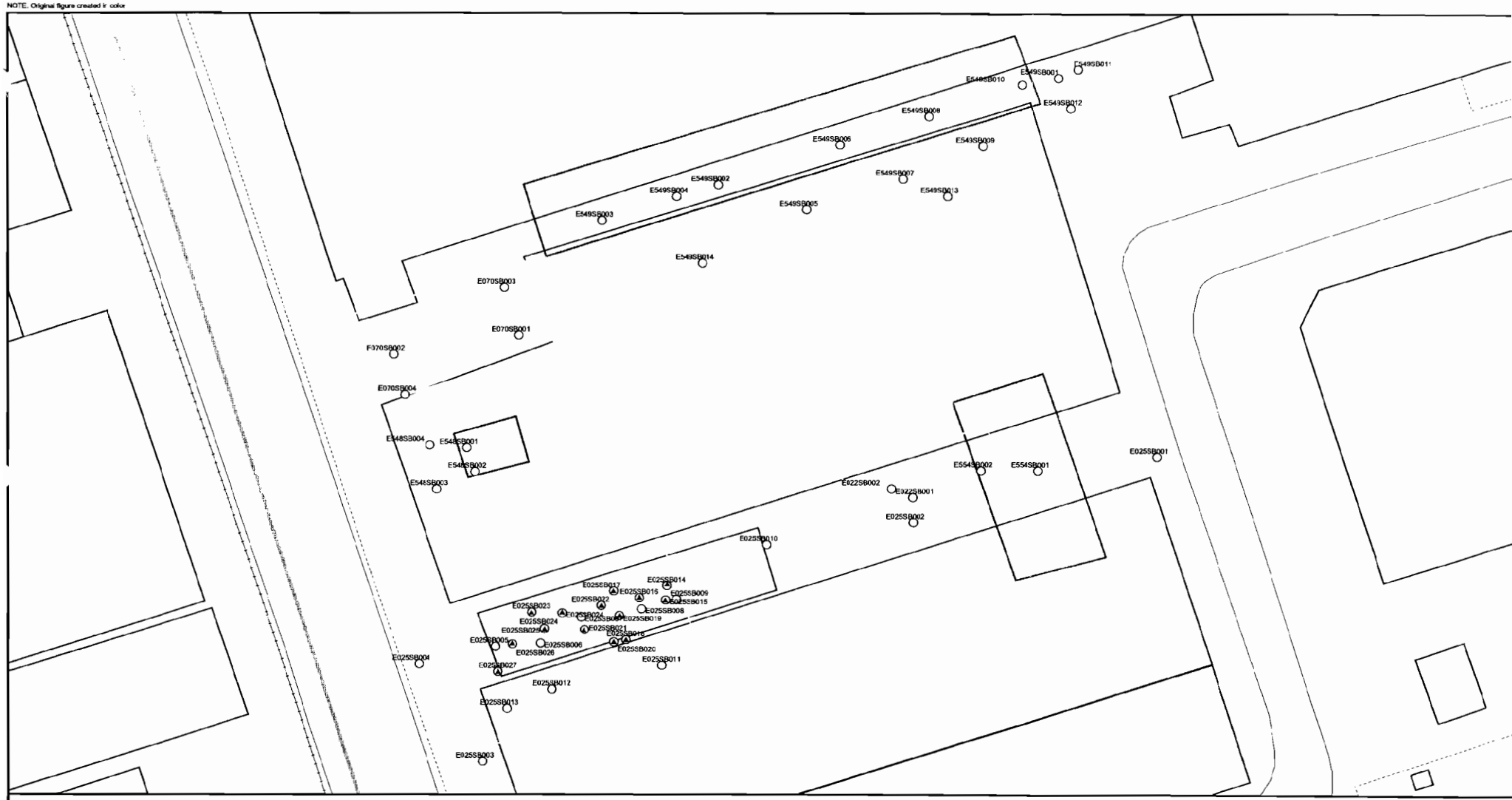
Groundwater samples were collected from nine shallow monitoring wells and one deep well associated with Combined SWMU 70 following the completion of the RFI report. The locations of these wells are presented in Figure 4-2. The first quarter sampling results were included in the original RFI report. Approximately three more quarterly sampling events were performed. Results from the subsequent sampling events were screened against applicable criteria (i.e., background range of concentrations, maximum contaminant levels (MCLs), or RBCs, if appropriate). The results of the screening are presented in Appendices C-3 and C-4, for shallow and deep groundwater, respectively.

The shallow and deep groundwater were screened against respective background levels (shallow and deep); The health-based RBCs are the same for both aquifer zones (see Appendices C-3 and C-4). The chemicals identified as exceeding criteria and background are provided as one combined list below. The following COPCs were identified in the post-RFI groundwater samples:

- Antimony
- Cadmium
- Chromium (hexavalent)
- Chromium (total)
- Nickel
- PCE
- TCE
- Vinyl chloride

The analytical reports for the post-RFI groundwater sampling results are presented in Appendix D-3. The data validation reports for these samples are presented in Appendix E.

NOTE. Original figure created in color



○ Surface and Subsurface Soil Sample Locations
AOC Boundary
SWMU Boundary
Buildings
Post RFI Surface and Subsurface Soil Sample Locations

N

0 20 40 Feet

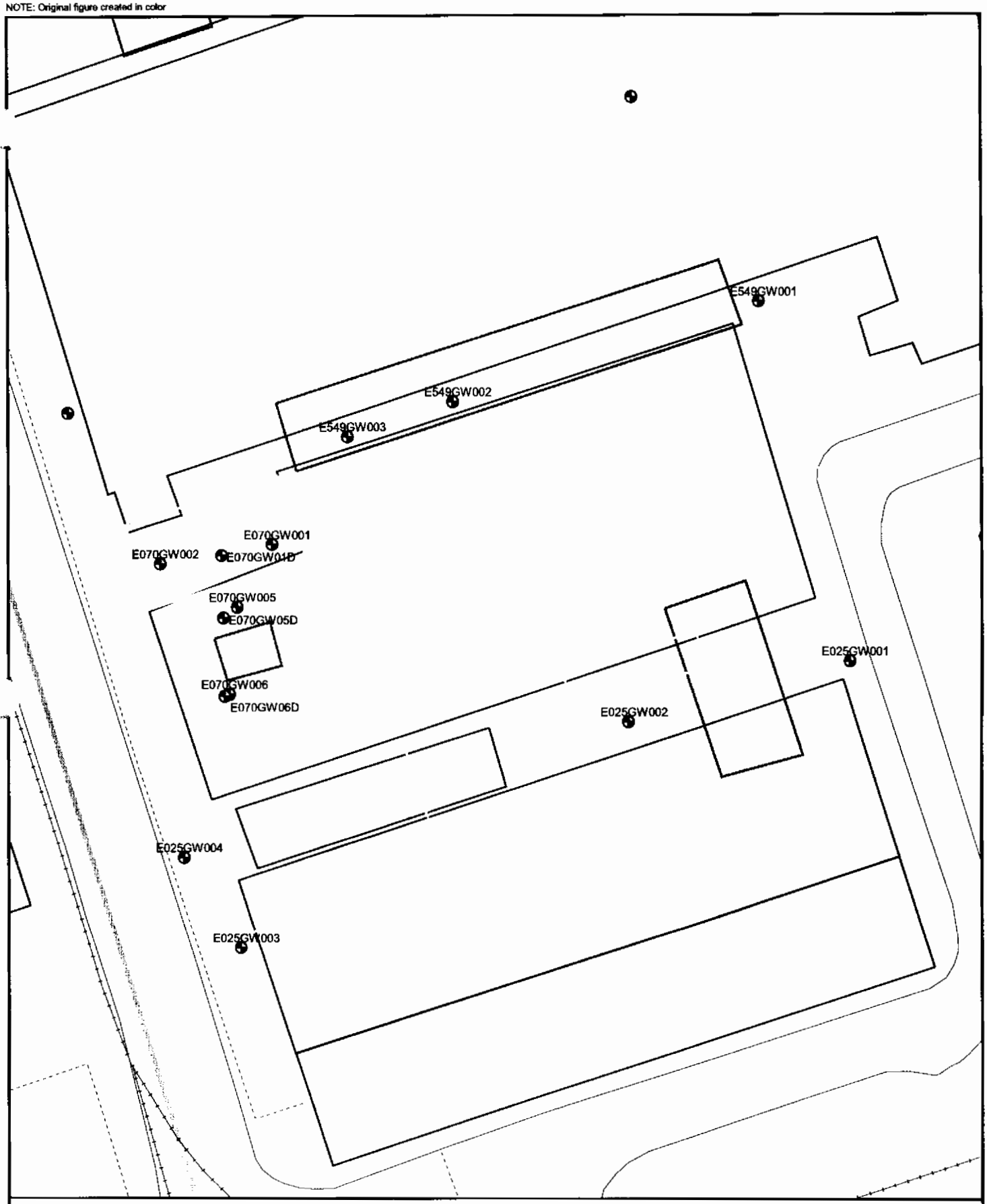
1 inch = 28.8501 feet

Figure 4-1
RFI and Post-RFI Soil Sample Locations
Combined SWMU 70
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr; Date: 23 Jul 2002 8:39; User: PFAVARA; RFIRA_CMSWP: Figure 4-1 RFI and Post-RFI Surface Soils Sampes

NOTE: Original figure created in color



Groundwater Well
AOC Boundary
SWMU Boundary
Buildings

N

0 50 100 Feet

1 inch = 61.5469 feet

Figure 4-2
Monitor Well Locations
Combined SWMU 70
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 23 Jul 2002 9:14, User: PFAVARA, RFIRA_CMSWP: Figure 4-2 Monitor Well Locations

Section 5.0

5.0 COPC/COC Refinement

In order to determine if detected chemicals in site media of Combined SWMU 70 present unacceptable risks to human (baseline conditions), a human health risk assessment was completed. The human health direct exposure based risk assessment was followed with assessment of leachability using a process whereby detected site constituents were screened for their potential impact to groundwater. The COPCs that were thusly identified were further refined, resulting in the final identification of COCs for Combined SWMU 70. These processes and their results are described in detail in the following subsections.

5.1 Human Health Risk Assessment

5.1.1 Selection of COPCs

All sample results (including RFI data) for surface soil (0 to 1 ft below land surface [ft bls]), subsurface soil (3 to 5 ft bls), and groundwater from Combined SWMU 70 were screened for COPCs to provide a health-based evaluation for all media at this site. The surface and subsurface soil samples were screened separately during the COPC identification step. Surface soil was evaluated for exposures to most of the receptors identified below in the exposure assessment section. The exposures to subsurface soils were evaluated only for utility worker scenario, as discussed below. The maximum detected concentrations in soils were screened against EPA Region III RBC values and Zone E background values. If a chemical exceeded the range of background concentrations and the RBC value (HI=0.1), it was selected as a COPC. The groundwater sample results were screened against zone background levels and MCLs. If no MCL was available, the EPA Region III tap water RBC (HI=0.1) value was used. The chemicals in groundwater exceeding the range of background concentrations and the appropriate health-based criteria (MCL or RBC) were selected as COPCs. The results of this COPC screening process are presented in Appendix F-1 (for surface soil), F-2 (for subsurface soil), and F-3 (for groundwater); the selected COPCs are presented in Table 5-1.

The polycyclic aromatic hydrocarbons (PAHs) were evaluated by calculating BEQs, and comparing against CNC based-wide background levels of 1,304 micrograms per kilogram (μg/kg) for surface soil, and 1,400 μg/kg for subsurface soil. Benzo[a]pyrene was detected in surface soil at a maximum concentration of 3.1 mg/kg, which exceeds the residential RBC of 0.087 mg/kg and BRC of 1.3 mg/kg. Following EPA Region IV Human Health Risk

Assessment Bulletins—*Supplemental Guidance to RAGS* (EPA, 2000), toxicity assessment for cPAHS follow the toxicity equivalent (TEF) methodology. Thus, risk-based screening for cPAHS is based on the BEQs calculated for each sample. The risk-based discussion for BEQs is presented in Section 5.1.4.

Selected soil and groundwater samples were analyzed for total chromium (chromium III and chromium VI) and hexavalent chromium. The RBC value for hexavalent chromium was used as a conservative surrogate value for total chromium. Both forms of chromium exceeded screening criteria in soils and groundwater. In order to provide a conservative risk analysis that would avoid "duplicating" exposure to chromium by including total and hexavalent results, only hexavalent chromium was included in the quantitative risk analysis. Hexavalent chromium is considered the more toxic valence state for this chemical and this was seen as a conservative choice for evaluating chromium risk at Combined SWMU 70.

Bis-2ethylhexyl-phthalate was detected infrequently (three of 20 samples) in groundwater at concentrations from 1 to 24 $\mu g/L$. Bis-2ethylhexyl-phthalate was not detected above screening criteria in soils. This chemical is a common laboratory contaminant and there is no site-related history to suspect a release at this site. As a result, this chemical is not considered a COPC for groundwater at Combined SWMU 70.

The chemicals that are considered essential nutrients, present at low concentrations (i.e., slightly elevated above background levels), and toxic only at extremely high doses were eliminated from the quantitative risk analysis. These constituents were calcium, magnesium, potassium, and sodium.

5.1.2 Exposure Assessment

There are currently no complete exposure pathways for receptors at Combined SWMU 70. The area is covered by asphalt and concrete, which minimizes or prevents contact with any contaminated soils. In addition, site groundwater is not used as a potable water source.

Potential exposure was evaluated for a hypothetical future industrial worker, hypothetical future utility worker, and hypothetical future residential adult and child.

Industrial workers and residents were assumed to have contact with surface soils and groundwater. Utility workers were assumed to have contact with soils (surface and subsurface) only and would not utilize site groundwater as a potable source.

Routes of exposure for soils include ingestion, dermal contact, and inhalation of soil particulates and vapors. Contact with groundwater was assumed to occur via ingestion, dermal contact, and inhalation of VOCs. Dermal contact with groundwater would be expected to occur during showering for residents and hand/face washing for industrial receptors. Exposure receptors and routes are identified in Table 5-2. As per EPA Region IV practice, inhalation exposure to VOCs in groundwater was considered to be equivalent to ingestion intake. Default exposure assumptions common to EPA Region IV practice for these scenarios were used and are provided in Appendices F-4 and F-5.

Exposure point concentrations (EPCs) were the 95-percent upper confidence limit [UCL_{95}] on the mean for all media (unless the UCL_{95} exceeded the maximum concentration, in which case the EPC would default to the maximum detected concentration). The appropriate UCL_{95} estimate, based on the sample population distribution, was taken as the EPC. For a utility worker, soil surface soil samples combined with subsurface soil samples of up to 5 ft bls were used for EPC estimation. Data summaries and EPC estimates for COPCs are provided in Appendix F-6.

5.1.3 Toxicity Assessment

Toxicity factors were obtained from the Integrated Risk Information System (IRIS) website or Health Effects Assessment Summary Tables (HEAST, 1997), as appropriate. The toxicity factors, weight-of-evidence classification, and oral-to-dermal adjustment factors are provided in Appendix F-7. As there are no available toxicity factors for total chromium, the toxicity factors for hexavalent chromium were taken as surrogate values. BEQs were calculated for cPAHs in accordance with EPA Region IV policy for this assessment. benzo[a]pyrene toxicity factors were used as surrogate toxicity factors for BEQs.

5.1.4 Risk Characterization

For the purposes of site management decision-making at contaminated sites, EPA uses an acceptable risk range of 10E-4 to 10E-6 (one chance in 10,000 to one chance in 1,000,000 of developing cancer for carcinogenic chemicals). Typically, results falling within or below this range are considered a reasonable basis for NFA at the site, depending on the degree of conservatism and uncertainty. Likewise, a total HI of 1.0 or less is considered evidence of minimal potential for noncarcinogenic health effects. The risks and hazards are summarized in Tables 5-3 and 5-4, and specific risk summaries are provided in Appendices G-1 through G-4.

Hypothetical Future Industrial Worker Exposure Scenario

The Excess Lifetime Cancer Risk (ELCR) for a hypothetical industrial worker is 2.2E-5, from soil and groundwater exposures at the Combined SWMU 70 site. This is within the

acceptable risk range of 1 to 100 in a million for carcinogenic effects. The total HI is 34.5, which exceeds the acceptable limit for noncarcinogenic effects. Carcinogenic risk drivers include BEQs in surface soil and PCE, TCE, and vinyl chloride in groundwater. Noncarcinogenic risk drivers in groundwater include hexavalent chromium and thallium. The HI for surface soils did not exceed unity. Risk drivers are those chemicals contributing to an ELCR greater than 1E-6 or a HI greater than 1.0. The detailed quantitative risk characterization is presented in Appendices G-1a, G-1b, G-1c, and G-1d.

Hypothetical Future Utility Worker Exposure Scenario

For a future hypothetical utility worker exposed to soils, the ELCR is 4.4E-7 and the HI is 2.5. Iron contributed to a HI greater than 1.0 from exposure to soils. See Appendices G-2a and G-2b for the detailed risk characterization results for this receptor.

Hypothetical Future Adult Residential Exposure Scenario

The total ELCR for a future hypothetical residential adult is 9.6E-5, which is approaching the upper-limit of the acceptable risk range, though it is below 10^{-4} level. The total HI for a residential adult is 96.3, which is above the acceptable HI of 1.0. Carcinogenic risk drivers include BEQs in surface soil and PCE, TCE, and vinyl chloride in groundwater. The noncarcinogenic risk drivers in groundwater include hexavalent chromium, antimony, and thallium. There are no risk drivers for surface soils, as the HI did not exceed 1.0. Appendices G-3a, G-3b, G-3c, and G-3d include detailed risk characterization results for this receptor.

Hypothetical Future Child Residential Exposure Scenario

The HI for a future hypothetical residential child is 227.4. Risk drivers include cadmium, hexavalent chromium, antimony, and thallium in groundwater. Hexavalent chromium contributed a HI greater than 1.0 for exposure to surface soils. Appendices G-4a and G-4b include detailed risk characterization results for this receptor.

5.1.5 Summary

Currently, there are no complete exposure pathways for soils or groundwater at the Combined SWMU 70 site. Groundwater is not currently used as a potable water source and the contact with soils is limited due to the presence of asphalt and concrete covering the entire exposure unit.

For hypothetical potential future receptors, the primary sources for adverse effects from exposure to media at Combined SWMU 70 would be associated with exposure to metals in groundwater. Chromium and thallium are the primary contributors to noncarcinogenic

health hazards, with a lesser contribution from antimony and cadmium. Carcinogenic risk associated with chemicals in groundwater is within the acceptable limits for all receptors.

In soils, there is some elevated noncarcinogenic health hazard associated with a child's exposure to chromium in surface soils. A utility worker exposed to the soil column had a slightly elevated noncarcinogenic health hazard due primarily to iron.

The human health direct exposure based risk assessment evaluated all RFI data. The constituents below were identified as COCs in the RFI report but are not final COCs, following the direct exposure-based risk assessment:

Surface Soil COCs	Subsurface Soil COCs	Groundwater COCs
Lead	None	Aluminum
		Chloroform
		Chlordane (alpha and gamma)
		Chlorobenzene
		1,2-DCE
		Benzene

The above were identified as COCs in the *Zone E RFI Report, Revision 0* due to a fixed-point based risk assessment; they are not COCs based on the direct exposure-based risk assessment.

5.2 Evaluation of Soil-to-Groundwater Pathway

5.2.1 Soil-to-Groundwater Screening for VOCs

The results for soil samples were compared in the *Zone E RFI Report, Revision 0* to the applicable screening criteria (EPA OSWER SSLs or background values) to assess the leachability potential of chemicals detected in soils by comparing against SSLs, with a DAF=10. Parameters exceeding the SSLs (soil-to-groundwater leachability criteria) were further evaluated in a soil-to-groundwater-to-surface water transport screening (Tier II evaluation). This evaluation used adjusted SSLs based on a site-specific DAF protective of surface water in the Cooper River. A chemical was considered a COC based on its potential for leachability only if its concentration exceeded the adjusted Tier II SSL.

In the original RFI, no constituents were identified as leachability-based COCs following the second tier screening process. As agreed to by the CNC BCT, VOCs that were detected in the original RFI data set were evaluated against the generic SSL based on a DAF=1. VOCs

exceeding the SSL at a DAF=1 are considered COPCs and will be further considered in the refinement process. VOCs detected in the original RFI soil samples were screened against the appropriate SSLs. The results are presented in Table 5-5.

Methylene chloride, PCE, and TCE were present in soils at concentrations exceeding the SSL based on a DAF=1. Methylene chloride, PCE, and TCE were considered to be COPCs for subsurface soil and are evaluated as part of the COPC/COC refinement process.

5.2.2 Surface Soil Results

Data that exceeded the default SSL screening values in Sections 4.0 and 5.2.1 represent samples that would exceed the SSL based on an unrestricted land-use scenario. Although the Combined SWMU 70 is entirely paved, and future plans for the area will require land-use controls with pavement at areas that exceed the unrestricted land-use SSLs, the unrestricted land-use leachability evaluation is addressed in this section for completeness.

All data that exceeded the default SSL screening values in Sections 4.0 and 5.2.1 were screened against a site-specific SSL using a DAF based on the presence of pavement over contaminated soils scenario. The DAF using the paved scenario is 17 and the SSL values calculated using DAF of 17 are included in Table 5-5 (the basis of the site-specific SSL is presented in Appendix H). Using a leachability-based screening value calculated using an assumption that contaminated soils are under impervious pavement is appropriate because the current and future anticipated land use for the Combined SWMU 70 site is likely to remain under current paved condition.

The results of this screening effort are represented in Table 5-6. The following constituents exceeded the SSL in one or more samples:

- Antimony
- Cadmium
- Chromium (total)
- Chromium (hexavalent)
- Lead
- Methylene Chloride
- Nickel
- TCE
- Silver (unrestricted land use only)
- PCE (unrestricted land use only)

The constituents that failed the screening in one or more samples are further discussed in the following sections. The discussion below focuses on exceedances of the paved-based scenario, as this is the most relevant future use for the Combined SWMU 70. Those samples that exceeded the unrestricted land use screening levels are noted in Table 5-6.

Antimony

The paved-based SSL is within the background range for Zone E grid samples. Therefore, the refined screening against the paved-based SSL did not change the results of the overall screening conducted. A total of five of 14 surface soil samples exceeded the background range of 0.50 to 7.4 mg/kg. All the exceedances were reported as occurring in SWMU 25. The average concentration of antimony in surface soil was 11.8 mg/kg; this value exceeds the upper-range background value of 7.4 mg/kg.

Cadmium

Ten surface soil samples exceeded the default SSL of 4.0 mg/kg. Using the site-specific SSL of 6.8 mg/kg, six samples exceeded the paved-based SSL. All the exceedances were reported as occurring at SWMU 25. The average concentration of cadmium in surface soil is 27.4 mg/kg; this value exceeds the paved SSL value of 6.8 mg/kg.

Benzo[a]pyrene

The maximum detected concentrations of benzo[a]pyrene did not exceed the site-specific SSL of 6.8 mg/kg. Benzo[a]pyrene is not considered a leachability COC for surface soils based on comparison with leachability criteria.

BEQs

No BEQs exceeded the paved-based SSL of 6.8 mg/kg. BEQs are not considered a COC based on leachability to groundwater.

Chromium (Hexavalent)

Six of 13 surface soil samples exceeded the default SSL of 19.0 mg/kg for hexavalent chromium. Using the site-specific SSL of 32.3 mg/kg, the same six samples exceeded the site-specific SSL. All the exceedances were associated with SWMU 25. The average concentration of hexavalent chromium in surface soil is 211 mg/kg; this value exceeds the site-specific SSL value of 32.3 mg/kg (DAF=17).

Chromium (Total)

Six of 13 surface soil samples exceeded the default SSL of 19.0 mg/kg for chromium. Using the site-specific SSL of 32.3 mg/kg, the same six samples exceeded the paved-based SSL. All

the exceedances were reported as having occurred at SWMU 25. The average concentration of chromium in surface soil is 2,448 mg/kg; this value exceeds the paved-based SSL value of 32.3 mg/kg. This indicates that detected samples all had hexavalent chromium as well, above SSLs.

Lead

Four of 14 surface soil samples exceeded the default SSL of 400 mg/kg for lead. No sites-specific SSL was calculated for lead. However, the subsurface soil was evaluated for lead to determine if the exceedances, as reported in Section 4.0, were in subsurface soil (indicating mobility). One surface soil sample exceeded the screening value for leachability. When the subsurface soil data were averaged for SWMU 25, the concentration in subsurface soil was calculated to be 173 mg/kg. This value is less than the screening value and indicates that the subsurface soil lead levels at SWMU 25 do not represent a threat to groundwater. Furthermore, none of the groundwater samples collected from Combined SWMU 70 were reported with detectable levels of lead (with the highest detection level of 5.2 μg/L). Based on this information, further consideration of lead as a COC based on leachability to groundwater is not warranted.

Methylene Chloride

Methylene chloride was detected in 11 of 31 surface soil samples. The only two exceedances of the site-specific SSL of 0.017 mg/kg were reported as having occurred in SWMU 25. The average concentration of methylene chloride at SWMU 25 is 0.014 mg/kg, which is less than the site-specific SSL. When considering SWMU 25 as a whole, the average concentration of methylene chloride is not above the site-specific SSL at SWMU 25, its presence is not expected to adversely affect water quality. Therefore, further consideration of methylene chloride as a COC based on soil leachability is not warranted.

Nickel

Two of 14 surface soil samples exceeded the default SSL of 65 mg/kg for nickel. Using the site-specific SSL of 111 mg/kg, the same two samples exceeded the paved-based SSL. Both exceedances were reported at SWMU 25. The average concentration of nickel in surface soil is 50 mg/kg, which is less than the site-specific and default SSL values. The average nickel concentration in site surface soils did not exceed the site-specific SSL at SWMU 25. Therefore, further consideration of nickel as a COC based on soil leachability is not warranted.

TCE

Eight of 13 surface soil samples exceeded the default SSL of 0.003 mg/kg for TCE. All the exceedances were located at SWMU 25. Using the site-specific SSL of 0.051 mg/kg, only one sample exceeded the site-specific SSL. The average concentration of TCE in surface soil is 0.023 mg/kg, which is less than the site-specific SSL value. When considering SWMU 25 as a whole, the exceedance at one sample location of the site-specific SSL at SWMU 25 is not expected to adversely affect water quality. Therefore, further consideration of TCE as a COC based on soil leachability is not warranted.

5.2.3 Subsurface Soil Results

All data that failed the default SSLs presented in Sections 4.0 and 5.2.1 were screened against a site-specific SSL using a DAF based on presence of impervious pavement on contaminated soils at the site. The site-specific DAF calculated using presence of pavement scenario is 17 and the SSLs calculated using DAF=17 are included in Table 5-5 (the calculation for this DAF is presented in Appendix H). The SSL value calculated for hexavalent chromium was used to compare with total chromium concentrations, as a literature based K_d value is not available for total chromium. The entire area surrounding Combined SWMU 70 is paved, and is anticipated to be maintained as such in the future.

The results of this screening effort are represented in Table 5-7. The following constituents exceeded the SSL in one or more subsurface soil samples

- Antimony
- Cadmium
- Chromium (hexavalent)
- Chromium (total)
- Nickel
- TCE

Methylene chloride, PCE, and thallium were the only constituents that exceeded the default SSL (unrestricted land use scenario), however, were below the site-specific SSL, thus were not identified as COCs. The constituents identified as COPCs due to exceedence of SSL in one or more samples are discussed in detail in the following subsections. The discussion below focuses on exceedances of the paved-based scenario, as this is the most relevant future use for the Combined SWMU 70. Those samples that exceeded the unrestricted land-use screening levels are noted in Table 5-7.

Antimony

A total of eight of 14 subsurface soil samples exceeded the site-specific SSL of 4.25 mg/kg. All the exceedances were reported in SWMU 25. The average concentration of antimony in SWMU 25 subsurface soil was 17.0 mg/kg; this value exceeds the site-specific SSL value of 4.25 mg/kg.

Cadmium

A total of four subsurface soil samples exceeded the default SSL of 4.0 mg/kg. Using the site-specific SSL of 6.8 mg/kg, the same four samples exceeded the site-specific SSL. All the exceedances were reported at SWMU 25. The average concentration of cadmium in subsurface soil is 12.4 mg/kg; this value exceeds the site-specific SSL of 6.8 mg/kg.

Chromium (Hexavalent)

Six of 14 subsurface soil samples exceeded the default SSL of 19.0 mg/kg for hexavalent chromium. Using the site-specific SSL of 32.3 mg/kg, the same six samples exceeded the site-specific SSL. All the exceedances were reported at SWMU 25. The average concentration of hexavalent chromium in subsurface soil is 183 mg/kg; this value exceeded the site-specific SSL value of 32.3 mg/kg.

Chromium (Total)

Ten of 14 subsurface soil samples exceeded the default SSL of 19.0 mg/kg for hexavalent chromium. Using the site-specific SSL of 32.3 mg/kg, the same 10 samples exceeded the site-specific SSL. All the exceedances were reported at SWMU 25. The average concentration of chromium in subsurface soil is 1,447 mg/kg; this value exceeds the paved-based SSL value of 32.3 mg/kg.

Nickel

Three of 14 subsurface soil samples exceeded the default SSL of 65 mg/kg for nickel. Using the site-specific SSL of 111 mg/kg, two of these three samples exceeded the paved-based SSL. Both exceedances were reported at SWMU 25. The average concentration of nickel in subsurface soil is 26 mg/kg, which is less than the site-specific and default SSL values. When considering SWMU 25 as a whole, the average nickel levels are below background and default SSL levels, thus the two exceedances of the site-specific SSL at SWMU 25 are not expected to adversely affect water quality. Therefore, further consideration of nickel as a COC based on soil leachability is not warranted.

TCE

Five of nine subsurface soil samples exceeded the default SSL of .003 mg/kg for TCE. All the exceedances were located at SWMU 25. Using the site-specific SSL of 0.051 mg/kg, only one sample exceeded the site-specific SSL. The average concentration of TCE in subsurface soil is 0.016 mg/kg and is less than the site-specific SSL value. Based on this infrequent exceedence, soils at the site may not be a continuing source of groundwater TCE level. Therefore, further consideration of TCE as a COC based on soil leachability is not warranted.

5.3 COC Summary

The following subsections present the COCs identified, according to media and receptor.

5.3.1 Surface Soil

BEQs, hexavalent chromium, chromium, cadmium, and antimony are final COCs for surface soil. Hexavalent chromium and BEQs were the only constituents which represented a direct exposure concern to human health (i.e., future child receptor). Although the HI for iron was estimated as 3.0 for the utility worker scenario, this HI could be considered to be within an acceptable HI level for a utility worker. Hexavalent chromium, chromium, cadmium, and antimony represent a potential threat to groundwater via leachability when considering the most-likely future use scenario for the site. PCE and silver would be considered groundwater leachability COCs, in addition to those referenced above, if the site is used for unrestricted land use.

Since all the soils are under pavement, there is no direct exposure at the present time. The chemicals are COCs for a future scenario, if the site is considered for altered land use. Also, the site is surrounded by asphalt pavement, and adjacent to roadway that is routinely used, thus detected PAHs could be from these non-site related sources, and plating operations are not likely responsible for BEQs.

5.3.2 Subsurface Soil

The subsurface soils do not represent a direct exposure concern to human health. Hexavalent chromium, chromium, cadmium, and antimony are COCs for subsurface soils because they exceed the SSL, and thus may pose a threat to groundwater. PCE, thallium, and methylene chloride would be considered groundwater leachability COCs, in addition to those referenced above, if the site is used for unrestricted land use.

5.3.3 Groundwater

Antimony, cadmium, chromium (hexavalent and total), PCE, TCE, and vinyl chloride were identified as COCs for groundwater following the COPC/COC refinement process, due to the presence of these chemicals at levels that are either risks to human health or exceedance of MCLs in groundwater.

5.3.4 COC Summary Table

The following matrix summarizes COCs by exposure pathway, contaminant, and media.

Receptor	BEQ	PCE	TCE	Vinyl Chloride	Hexavalent Chromium	Total Chromium	Cadmium	Antimony	
Industrial Worker	SS	G	G	G	G				
Utility Worker									
Residential Adult	SS	G	G	G	G			G	
Residential Child					SS G		G	G	
Surface Soil Leachability					SS	SS	SS	SS	PCE, Silver (residential only)
Subsurface Soil Leachability					SB	SB	SB	SB	PCE, Methylene Chloride, Thallium (residential only)
Chemical Exceeding MCL		G	G	G	G	G	G	G	

G Groundwater
SB Subsurface Soil
SS Surface Soil

TABLE 5-1
COPCs Selected for Human Health Risk Assessment
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Charleston Naval Complex

Surface Soil (0-1 ft bls)	Soil Column (0-5 ft bls)[a]	Groundwater
Antimony	Antimony	Antimony
Cadmium	Cadmium	Cadmium
Chromium (Hexavalent)	Chromium (Hexavalent)	Chromium (Hexavalent)
Chromium, Total	Chromium, Total	Chromium, Total
Copper	Copper	Nickel
Nickel	Nickel	Thallium
BEQs	Iron	Naphthalene
PCE[b]	Thallium	PCE
Silver[b]	BEQs	TCE
	Methylene Chloride[b]	Vinyl chloride
	PCE[b]	
	Thallium[b]	

[a] Represents screening of combined surface and subsurface soils down to a depth of 5 feet below land surface (ft bls).

[b] Exceeds unrestricted land use scenario only.

TABLE 5-2
Receptors, Media, and Pathways Evaluated in the Risk Analysis for Combined SWMU 70
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Charleston Naval Complex

Receptor	Media	Exposure Routes
Industrial Worker	Surface Soil	Ingestion, dermal, inhalation (particulates and vapors)
	Groundwater	Ingestion, dermal, inhalation (vapors)
Utility Worker	Soil Column (0-5 ft bls)	Ingestion, dermal, inhalation (particulates and vapors)
Residential Adult and Child	Surface Soil	Ingestion, dermal, inhalation (particulates and vapors)
	Groundwater	Ingestion, dermal, inhalation (vapors)

TABLE 5-3
Risk Summary for Receptors Evaluated at Combined SWMU 70
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Charleston Naval Complex

Receptor	Media	Total ELCR	Risk Driver	Total HI	Hazard Driver
Future Industrial Worker	Surface Soil	1.4E-6	BEQs	0.09	--
	Groundwater	2.0E-5	TCE, PCE, VC	34.4	CR6, TL*
	Total	**2.2E-5**		**34.5**	
Future Utility Worker	Soil Column	4.4E-7		2.5	FE
	Total	**4.4E-7**		**2.5**	
Future Residential Adult	Surface Soil	1.0E-5	BEQs	0.25	--
	Groundwater	8.6E-5	TCE, PCE, VC	96.2	CR6, SB, TL*
	Total	**9.6E-5**		**96.5**	
Future Residential Child	Surface Soil	NA		2.4	CR6
	Groundwater	NA		224.9	CR6, CD, SB, TL*
	Total	**NA**		**227.3**	

CR6—hexavalent chromium
CD—cadmium
SB—antimony
TL*—thallium – was sporadically detected in groundwater and is not a COC, see Sec. 6.1
FE—iron
BEQs— benzo[a]pyrene equivalents
TCE—trichloroethene
PCE—tetrachloroethene
VC—vinyl chloride
NA—not applicable
ELCR—excess lifetime cancer risk
HI—hazard index

TABLE 5-4
Risk Summary
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

	ELCR					HI				
Receptor	**Ingestion**	**Dermal**	**Inhalation**	**Total**	**Risk Driver**	**Ingestion**	**Dermal**	**Inhalation**	**Total**	**Hazard Driver**
Industrial Worker										
	Surface Soil					*Surface Soil*				
	8.0E-07	5.4E-07	7.0E-09	1.4E-06		0.080	0.0065	0.0018	[redacted]	
	Groundwater					*Groundwater*				
	1.5E-05	1.6E-08	4.7E-06	2.0E-05		34	0.031	0.0048	34	CR6, TL
	Total					*Total*				
	1.6E-05	**5.6E-07**	**4.7E-06**	**2.2E-05**		**34**	**0.038**	**0.0066**	**34**	**CR6, TL**
Utility Worker										
	Surface Soil					*Surface Soil*				
	3.6E-07	8.4E-08	2.8E-10	4.4E-07		2.4	0.070	0.0019	[redacted]	FE
	Total					*Total*				
	3.6E-07	**8.4E-08**	**2.8E-10**	**4.4E-07**		**2.4**	**0.070**	**0.0019**	**2.5**	**FE**
Residential Adult										
	Surface Soil					*Surface Soil*				
	7.2E-06	3.2E-06	1.8E-08	1.0E-05		0.23	0.026	0.0026	0.25	
	Groundwater					*Groundwater*				
	6.6E-05	2.4E-07	2.0E-05	8.6E-05		96	0.011	0.013	96	CR6, SB, TL
	Total					*Total*				
	7.3E-05	**3.5E-06**	**2.0E-05**	**9.6E-05**		**96**	**0.037**	**0.016**	**96**	**CR6, SB, TL**

TABLE 5-4
Risk Summary
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

	ELCR					HI				
Receptor	**Ingestion**	**Dermal**	**Inhalation**	**Total**	**Risk Driver**	**Ingestion**	**Dermal**	**Inhalation**	**Total**	**Hazard Driver**
Residential Child										
	Surface Soil					*Surface Soil*				
	--	--	--	NA		2.1	0.29	0.0090	[redacted]	CR6
	Groundwater					*Groundwater*				
	--	--	--	NA	--	224	0.50	0.031	225	CD, CR6, SB, TL
	Total					*Total*				
	--	**--**	**--**	**NA**		**226**	**0.79**	**0.040**	**227**	**CD, CR6, SB, TL**

Risk and Hazard Drivers are those chemicals contributing an ELCR above 1E-6 and and HQ greater than 1, respectively

BEQ -- Benzo(a)pyrene equivalents

CD -- Cadmium

CR6 -- Hexavalent chromium

PCE -- Tetrachloroethene

SB -- Antimony

TCE -- Trichloroethene

TL -- Thallium

VC -- Vinyl chloride

TABLE 5-5
VOC Detections in Surface and Subsurface Soil
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Charleston Naval Complex

Analyte	Sample Location	Sample ID	Concentration (mg/kg)	Qualifier	SSL (DAF = 1)
		Surface Soil			
Acetone	E025SB002	025SB00201	0.088	=	0.8
Bromodichloromethane	E554SB002	554SB00201	0.003	J	0.03
Chloroform	E554SB002	554SB00201	0.009	=	0.03
Methylene Chloride	E025SB010	025SB01001	**0.003**	J	0.001
	E025SB006	025SB00601	**0.043**	=	
	E025SB007	025SB00701	**0.039**	=	
	E025SB008	025SB00801	**0.002**	J	
	E025SB009	025SB00901	**0.005**	=	
	E025SB011	025SB01101	**0.005**	J	
	E548SB003	548SB00301	**0.01**	=	
	E548SB004	548SB00401	**0.01**	=	
	E549SB005	549SB00501	**0.014**	=	
	E549SB004	549SB00401	**0.01**	=	
	E548SB002	548SB00201	**0.011**	=	
PCE	E022SB002	022SB00201	**0.016**	=	0.003
	E025SB009	025SB00901	0.003	J	
	E025SB008	025SB00801	0.003	J	
	E025SB006	025SB00601	0.001	J	
	E022SB001	022SB00101	**0.004**	J	
	E025SB010	025SB01001	0.002	J	
Toluene	E549SB002	549SB00201	0.001	J	0.6
	E549SB003	549SB00301	0.003	J	
	E549SB007	549SB00701	0.002	J	
	E549SB001	549SB00101	0.001	J	
TCE	E025SB010	025SB01001	**0.042**	=	0.003
	E025SB012	025SB01201	**0.01**	=	
	E025SB011	025SB01101	**0.011**	=	

TABLE 5-5
VOC Detections in Surface and Subsurface Soil
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Charleston Naval Complex

Analyte	Sample Location	Sample ID	Concentration (mg/kg)	Qualifier	SSL (DAF = 1)
TCE	E025SB008	025SB00801	**0.01**	=	0.003
	E025SB007	025SB00701	**0.009**	=	
	E025SB005	025SB00501	**0.01**	J	
	E025SB013	025SB01301	**0.008**	=	
	E025SB006	025SB00601	**0.097**	=	
	E025SB009	025SB00901	**0.042**	=	
	E022SB002	022SB00201	0.002	J	
Xylenes, Total	E549SB001	549SB00101	0.001	J	9
	E549SB003	549SB00301	0.004	J	9
	E549SB007	549SB00701	0.003	J	9
	E549SB009	549SB00901	0.001	J	9
		Subsurface Soil			
Acetone	E025SB011	025SB01102	0.016	=	0.8
	E022SB002	022SB00202	0.095	=	
	E548SB004	548SB00402	0.014	=	
Carbon Disulfide	E549SB006	549SB00602	0.002	J	2
Methyl ethyl ketone	E022SB002	022SB00202	0.003	J	
Methylene Chloride	E025SB011	025SB01102	**0.01**	=	0.001
	E549SB004	549SB00402a	**0.014**	=	
	E025SB008	025SB00802	**0.002**	J	
	E548SB002	548SB00202	**0.012**	=	
	E548SB003	548SB00302	**0.009**	=	
	E548SB004	548SB00402	**0.011**	=	
	E025SB005	025SB00502	**0.004**	J	
	E025SB009	025SB00902	**0.002**	J	
PCE	E022SB002	022SB00202	**0.045**	=	0.003
	E025SB011	025SB01102	**0.004**	J	
	E025SB008	025SB00802	0.001	J	

TABLE 5-5
VOC Detections in Surface and Subsurface Soil
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Charleston Naval Complex

Analyte	Sample Location	Sample ID	Concentration (mg/kg)	Qualifier	SSL (DAF = 1)
PCE	E025SB009	025SB00902	0.002	J	0.003
Toluene	E549SB006	549SB00602	0.002	J	0.6
TCE	E025SB008	025SB00802	**0.005**	=	0.003
	E025SB005	025SB00502	**0.004**	J	
	E025SB010	025SB01002	**0.01**	=	
	E025SB011	025SB01102	**0.1**	=	
	E025SB006	025SB00602	0.003	J	
	E022SB002	022SB00202	0.001	J	
	E025SB013	025SB01302	0.001	J	
	E025SB009	025SB00902	**0.008**	=	
Vinyl acetate	E070SB002	070SB00202	0.005	J	8
Xylenes, Total	E549SB008	549SB00802	0.002	J	9
	E549SB010	549SB01002	0.002	J	9
	E549SB006	549SB00602	0.003	J	9
	E025SB005	025SB00502	0.001	J	9

Concentrations shown in bold text and outlined within the table represent exceedances of the screening criteria.
All values are presented in units of milligrams per kilogram (mg/kg).

= Indicates that the chemical is detected at the concentration shown.
DAF Dilution attenuation factor
SSL Soil screening level
J Indicates that the concentration shown is an estimated value.

TABLE 5-6
Surface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range of Concentrations Min	Max	SSL[a] (DAF=17)
Antimony	E025SB014	025SB01401	28-Aug-1997	**47**	=	0.50	7.4	4.25
	E025SB015	025SB01501	28-Aug-1997	**19**	=			
	E025SB016	025SB01601	28-Aug-1997	4.0	=			
	E025SB017	025SB01701	28-Aug-1997	**14**	=			
	E025SB018	025SB01801	28-Aug-1997	1.1	=			
	E025SB019	025SB01901	28-Aug-1997	**4.8**	=			
	E025SB020	025SB02001	28-Aug-1997	**23**	=			
	E025SB021	025SB02101	28-Aug-1997	2.1	=			
	E025SB022	025SB02201	28-Aug-1997	**40**	=			
	E025SB023	025SB02301	28-Aug-1997	1.7	=			
	E025SB024	025SB02401	28-Aug-1997	0.54	J			
	E025SB026	025SB02601	28-Aug-1997	0.33	J			
	E025SB027	025SB02701	28-Aug-1997	7.3	=			
Bromodichloromethane	E554SB002	554SB00201	07-Sep-1995	0.003	J	NA	NA	0.51
Cadmium	E025SB013	025SB01301	05-Feb-1996	0.14	J	0.06	1.5	6.8
	E025SB014	025SB01401	28-Aug-1997	0.57	=			
	E025SB015	025SB01501	28-Aug-1997	0.40	J			
	E025SB016	025SB01601	28-Aug-1997	6.4	=			
	E025SB017	025SB01701	28-Aug-1997	**6.9**	=			
	E025SB018	025SB01801	28-Aug-1997	4.1	=			
	E025SB019	025SB01901	28-Aug-1997	0.57	=			
	E025SB020	025SB02001	28-Aug-1997	**73**	=			
	E025SB021	025SB02101	28-Aug-1997	0.41	J			
	E025SB022	025SB02201	28-Aug-1997	6.8	=			
	E025SB023	025SB02301	28-Aug-1997	**243**	=			
	E025SB024	025SB02401	28-Aug-1997	1.7	=			
	E025SB025	025SB02501	28-Aug-1997	**8.0**	=			

TABLE 5-6
Surface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range of Concentrations Min	Max	SSL[a] (DAF=17)
Cadmium	E025SB026	025SB02601	28-Aug-1997	**15**	=	0.06	1.5	6.8
	E025SB027	025SB02701	28-Aug-1997	**17**	=			
Chloroform	E554SB002	554SB00201	07-Sep-1995	0.0090	=	NA	NA	0.51
Chromium (Hexavalent)	E025SB015	025SB01501	28-Aug-1997	**411**	=	NA	NA	32.3
	E025SB016	025SB01601	28-Aug-1997	**46**	=			
	E025SB017	025SB01701	28-Aug-1997	**463**	=			
	E025SB018	025SB01801	28-Aug-1997	0.88	=			
	E025SB019	025SB01901	28-Aug-1997	**201**	=			
	E025SB020	025SB02001	28-Aug-1997	**906**	=			
	E025SB021	025SB02101	28-Aug-1997	1.6	=			
	E025SB022	025SB02201	28-Aug-1997	**708**	=			
	E025SB023	025SB02301	28-Aug-1997	0.12	J			
	E025SB026	025SB02601	28-Aug-1997	0.043	J			
	E025SB027	025SB02701	28-Aug-1997	0.22	=			
Chromium, Total	E025SB001	025SB00101	07-Oct-1993	10	=	2.3	567	32.3
	E025SB002	025SB00201	07-Oct-1993	31	=			
	E025SB003	025SB00301	01-Nov-1993	6.9	J			
	E025SB013	025SB01301	05-Feb-1996	10.3	=			
	E025SB014	025SB01401	28-Aug-1997	**6,880**	=			
	E025SB015	025SB01501	28-Aug-1997	**1,620**	=			
	E025SB016	025SB01601	28-Aug-1997	452	=			
	E025SB017	025SB01701	28-Aug-1997	**2,010**	=			
	E025SB018	025SB01801	28-Aug-1997	93	=			
	E025SB019	025SB01901	28-Aug-1997	**693**	=			
	E025SB020	025SB02001	28-Aug-1997	**2,420**	=			
	E025SB021	025SB02101	28-Aug-1997	274	=			
	E025SB022	025SB02201	28-Aug-1997	**5,530**	=			

TABLE 5-6
Surface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range of Concentrations Min	Max	SSL[a] (DAF=17)
Chromium, Total	E025SB023	025SB02301	28-Aug-1997	137	=	2.3	567	32.3
	E025SB024	025SB02401	28-Aug-1997	38	=			
	E025SB025	025SB02501	28-Aug-1997	35	=			
	E025SB026	025SB02601	28-Aug-1997	18	=			
	E025SB027	025SB02701	28-Aug-1997	64	=			
Lead	E025SB001	025SB00101	07-Oct-1993	7.9	J	1.0	400	400
	E025SB002	025SB00201	07-Oct-1993	15	J			
	E025SB003	025SB00301	01-Nov-1993	16	=			
	E025SB013	025SB01301	05-Feb-1996	15.7	=			
	E025SB014	025SB01401	28-Aug-1997	252	=			
	E025SB015	025SB01501	28-Aug-1997	**550**	=			
	E025SB016	025SB01601	28-Aug-1997	95	=			
	E025SB017	025SB01701	28-Aug-1997	77	=			
	E025SB018	025SB01801	28-Aug-1997	83	=			
	E025SB019	025SB01901	28-Aug-1997	65	=			
	E025SB020	025SB02001	28-Aug-1997	**4,890**	=			
	E025SB021	025SB02101	28-Aug-1997	30	=			
	E025SB022	025SB02201	28-Aug-1997	**1,090**	=			
	E025SB023	025SB02301	28-Aug-1997	**917**	=			
	E025SB024	025SB02401	28-Aug-1997	113	=			
	E025SB025	025SB02501	28-Aug-1997	105	=			
	E025SB026	025SB02601	28-Aug-1997	125	=			
	E025SB027	025SB02701	28-Aug-1997	264	=			
Methylene Chloride	E025SB006	025SB00601	02-Feb-1996	**0.043**	=	NA	NA	0.02
	E025SB007	025SB00701	02-Feb-1996	**0.039**	=			
	E025SB008	025SB00801	02-Feb-1996	0.002	J			
	E025SB009	025SB00901	02-Feb-1996	0.005	=			

TABLE 5-6
Surface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range of Concentrations Min	Max	SSL[a] (DAF=17)
Methylene Chloride	E025SB010	025SB01001	05-Feb-1996	0.003	J	NA	NA	0.02
	E025SB011	025SB01101	28-Feb-1996	0.005	J			
	E548SB002	548SB00201	05-Sep-1995	0.011	=			
	E548SB003	548SB00301	05-Sep-1995	0.01	=			
	E548SB004	548SB00401	05-Sep-1995	0.01	=			
	E549SB004	549SB00401	05-Sep-1995	0.01	=			
	E549SB005	549SB00501	05-Sep-1995	0.014	=			
Nickel	E025SB013	025SB01301	05-Feb-1996	4	J	0.60	72	110.5
	E025SB014	025SB01401	28-Aug-1997	32	=			
	E025SB015	025SB01501	28-Aug-1997	2.8	=			
	E025SB016	025SB01601	28-Aug-1997	29	=			
	E025SB017	025SB01701	28-Aug-1997	24	=			
	E025SB018	025SB01801	28-Aug-1997	8.4	=			
	E025SB019	025SB01901	28-Aug-1997	5.5	=			
	E025SB020	025SB02001	28-Aug-1997	**260**	=			
	E025SB021	025SB02101	28-Aug-1997	3.3	=			
	E025SB022	025SB02201	28-Aug-1997	27	=			
	E025SB023	025SB02301	28-Aug-1997	**244**	=			
	E025SB024	025SB02401	28-Aug-1997	9.8	=			
	E025SB025	025SB02501	28-Aug-1997	5.0	=			
	E025SB026	025SB02601	28-Aug-1997	19	=			
	E025SB027	025SB02701	28-Aug-1997	34	=			
Silver	E025SB014	025SB01401	28-Aug-1997	0.39	J	0.75	0.91	28.9
	E025SB015	025SB01501	28-Aug-1997	2.1	=			
	E025SB016	025SB01601	28-Aug-1997	1.5	=			
	E025SB017	025SB01701	28-Aug-1997	0.47	J			
	E025SB018	025SB01801	28-Aug-1997	2.9	=			

TABLE 5-6
Surface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range of Concentrations Min	Max	SSL[a] (DAF=17)
Silver	E025SB019	025SB01901	28-Aug-1997	0.17	J	0.75	0.91	28.9
	E025SB020	025SB02001	28-Aug-1997	24	=			
	E025SB021	025SB02101	28-Aug-1997	0.34	J			
	E025SB022	025SB02201	28-Aug-1997	1.8	=			
	E025SB023	025SB02301	28-Aug-1997	4.4	=			
	E025SB024	025SB02401	28-Aug-1997	1.8	=			
	E025SB025	025SB02501	28-Aug-1997	3.5	=			
	E025SB026	025SB02601	28-Aug-1997	0.91	J			
	E025SB027	025SB02701	28-Aug-1997	11	=			
PCE	E022SB001	022SB00101	07-Sep-1995	0.004	J	NA	NA	0.05
	E022SB002	022SB00201	07-Sep-1995	0.016	=			
	E025SB006	025SB00601	02-Feb-1996	0.001	J			
	E025SB008	025SB00801	02-Feb-1996	0.003	J			
	E025SB009	025SB00901	02-Feb-1996	0.003	J			
	E025SB010	025SB01001	05-Feb-1996	0.002	J			
Toluene	E549SB001	549SB00101	01-Sep-1995	0.001	J	NA	NA	10.2
	E549SB002	549SB00201	31-Aug-1995	0.001	J			
	E549SB003	549SB00301	31-Aug-1995	0.003	J			
	E549SB007	549SB00701	01-Sep-1995	0.002	J			
TCE	E022SB002	022SB00201	07-Sep-1995	0.002	J	NA	NA	0.05
	E025SB005	025SB00501	05-Feb-1996	0.01	J			
	E025SB006	025SB00601	02-Feb-1996	**0.097**	=			
	E025SB007	025SB00701	02-Feb-1996	0.009	=			
	E025SB008	025SB00801	02-Feb-1996	0.01	=			
	E025SB009	025SB00901	02-Feb-1996	0.042	=			
	E025SB010	025SB01001	05-Feb-1996	0.042	=			
	E025SB011	025SB01101	28-Feb-1996	0.011	=			

TABLE 5-6
Surface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range of Concentrations		SSL[a] (DAF=17)
						Min	Max	
TCE	E025SB012	025SB01201	05-Feb-1996	0.007	=	NA	NA	0.05
	E025SB013	025SB01301	05-Feb-1996	0.008	=			
Xylenes, Total	E549SB001	549SB00101	01-Sep-1995	0.001	J	NA	NA	153
	E549SB003	549SB00301	31-Aug-1995	0.004	J			
	E549SB007	549SB00701	01-Sep-1995	0.003	J			
	E549SB009	549SB00901	01-Sep-1995	0.001	J			

All values are presented in units of micrograms per liter (μg/L).

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

[a] Soil screening levels (SSLs) are adjusted by a Dilution Attenutation Factor (DAF)=17 based on paved land use and site-specific data.

= Indicates that the chemical was detected at the concentration shown.

J Indicates the concentration shown is an estimated value.

NA Not applicable/not available

TABLE 5-7
Subsurface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL[a] (DAF=17)
Acetone	E022SB002	022SB00202	07-Sep-1995	0.095	=	NA	NA	13.6
	E025SB011	025SB01102	28-Feb-1996	0.016	=			
	E548SB004	548SB00402	05-Sep-1995	0.014	=			
Antimony	E025SB014	025SB01402	28-Aug-1997	**28**	=	0.52	1.6	4.25
	E025SB015	025SB01502	28-Aug-1997	**28**	=			
	E025SB016	025SB01602	28-Aug-1997	**26**	=			
	E025SB017	025SB01702	28-Aug-1997	**121**	=			
	E025SB018	025SB01802	28-Aug-1997	**5.2**	=			
	E025SB019	025SB01902	28-Aug-1997	2.0	=			
	E025SB020	025SB02002	28-Aug-1997	**12**	=			
	E025SB021	025SB02102	28-Aug-1997	2.0	=			
	E025SB022	025SB02202	28-Aug-1997	**7.0**	=			
	E025SB024	025SB02402	28-Aug-1997	0.26	J			
	E025SB025	025SB02502	28-Aug-1997	**4.6**	=			
	E025SB026	025SB02602	28-Aug-1997	0.21	J			
	E025SB027	025SB02702	28-Aug-1997	2.4	=			
Cadmium	E025SB014	025SB01402	28-Aug-1997	0.093	J	0.13	0.96	6.8
	E025SB016	025SB01602	28-Aug-1997	0.61	=			
	E025SB017	025SB01702	28-Aug-1997	1.9	=			
	E025SB018	025SB01802	28-Aug-1997	1.6	=			
	E025SB019	025SB01902	28-Aug-1997	0.056	J			
	E025SB020	025SB02002	28-Aug-1997	**22**	=			
	E025SB021	025SB02102	28-Aug-1997	1.6	=			
	E025SB022	025SB02202	28-Aug-1997	0.62	J			
	E025SB023	025SB02302	28-Aug-1997	**12**	=			
	E025SB024	025SB02402	28-Aug-1997	**74**	=			
	E025SB025	025SB02502	28-Aug-1997	**55**	=			
	E025SB026	025SB02602	28-Aug-1997	2.9	=			

TABLE 5-7
Subsurface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL[a] (DAF=17)
Cadmium	E025SB027	025SB02702	28-Aug-1997	2.5	=	0.13	0.96	6.8
Carbon Disulfide	E549SB006	549SB00602	31-Aug-1995	0.002	J	NA	NA	34.0
Chromium (Hexavalent)	E025SB014	025SB01402	28-Aug-1997	**270**	=	NA	NA	32.3
	E025SB015	025SB01502	28-Aug-1997	**1,260**	=			
	E025SB016	025SB01602	28-Aug-1997	**562**	=			
	E025SB017	025SB01702	28-Aug-1997	1.3	=			
	E025SB018	025SB01802	28-Aug-1997	5.6	=			
	E025SB019	025SB01902	28-Aug-1997	**111**	=			
	E025SB020	025SB02002	28-Aug-1997	**261**	=			
	E025SB021	025SB02102	28-Aug-1997	0.98	=			
	E025SB022	025SB02202	28-Aug-1997	**89**	=			
	E025SB024	025SB02402	28-Aug-1997	0.14	J			
	E025SB027	025SB02702	28-Aug-1997	0.11	J			
Chromium, Total	E025SB013	025SB01302	05-Feb-1996	12.5	=	1.6	75	32.3
	E025SB014	025SB01402	28-Aug-1997	**3,880**	=			
	E025SB015	025SB01502	28-Aug-1997	**4,050**	=			
	E025SB016	025SB01602	28-Aug-1997	**3,850**	=			
	E025SB017	025SB01702	28-Aug-1997	**18,600**	=			
	E025SB018	025SB01802	28-Aug-1997	**752**	=			
	E025SB019	025SB01902	28-Aug-1997	**296**	=			
	E025SB020	025SB02002	28-Aug-1997	**1,320**	=			
	E025SB021	025SB02102	28-Aug-1997	**253**	=			
	E025SB022	025SB02202	28-Aug-1997	**804**	=			
	E025SB023	025SB02302	28-Aug-1997	6.5	=			
	E025SB024	025SB02402	28-Aug-1997	**54**	=			
	E025SB025	025SB02502	28-Aug-1997	**372**	=			
	E025SB026	025SB02602	28-Aug-1997	13	=			

TABLE 5-7
Subsurface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL[a] (DAF=17)
Chromium, Total	E025SB027	025SB02702	28-Aug-1997	26	=	1.6	75	32.3
Lead	E025SB013	025SB01302	05-Feb-1996	3.1	=	1.8	322	400
	E025SB020	025SB02002	28-Aug-1997	**1,910**	=			
Methyl ethyl ketone (2-Butanone)	E022SB002	022SB00202	07-Sep-1995	0.003	J	--	--	
Methylene Chloride	E025SB005	025SB00502	05-Feb-96	0.004	J	--	--	0.017
	E025SB008	025SB00802	02-Feb-96	0.002	J			
	E025SB009	025SB00902	02-Feb-96	0.002	J			
	E025SB011	025SB01102	28-Feb-96	0.01	=			
	E548SB002	548SB00202	05-Sep-95	0.012	=			
	E548SB003	548SB00302	05-Sep-95	0.009	=			
	E548SB004	548SB00402	05-Sep-95	0.011	=			
	E549SB004	549SB00402a	05-Sep-95	0.014	=			
Nickel	E025SB014	025SB01402	28-Aug-97	3.0	=	0.85	20	110.5
	E025SB015	025SB01502	28-Aug-1997	2.3	=			
	E025SB016	025SB01602	28-Aug-1997	8.3	=			
	E025SB017	025SB01702	28-Aug-1997	6.4	=			
	E025SB018	025SB01802	28-Aug-1997	11	=			
	E025SB019	025SB01902	28-Aug-1997	2.2	=			
	E025SB020	025SB02002	28-Aug-1997	**121**	=			
	E025SB021	025SB02102	28-Aug-1997	8.3	=			
	E025SB022	025SB02202	28-Aug-1997	1.8	=			
	E025SB023	025SB02302	28-Aug-1997	7.4	=			
	E025SB024	025SB02402	28-Aug-1997	**114**	=			
	E025SB025	025SB02502	28-Aug-1997	67	=			
	E025SB026	025SB02602	28-Aug-1997	11	=			
	E025SB027	025SB02702	28-Aug-1997	3.8	=			
PCE	E022SB002	022SB00202	07-Sep-1995	0.045	=	NA	NA	0.051

TABLE 5-7
Subsurface Soil Screen, Soil-to-Groundwater Pathway
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL[a] (DAF=17)
PCE	E025SB008	025SB00802	02-Feb-1996	0.001	J	NA	NA	0.051
	E025SB009	025SB00902	02-Feb-1996	0.002	J			
	E025SB011	025SB01102	28-Feb-1996	0.004	J			
Thallium	E025SB017	025SB01702	28-Aug-1997	0.86	J	NA	NA	5.95
TCE	E022SB002	022SB00202	07-Sep-1995	0.001	J	NA	NA	0.051
	E025SB005	025SB00502	05-Feb-1996	0.004	J			
	E025SB006	025SB00602	02-Feb-1996	0.003	J			
	E025SB008	025SB00802	02-Feb-1996	0.005	=			
	E025SB009	025SB00902	02-Feb-1996	0.008	=			
	E025SB010	025SB01002	05-Feb-1996	0.01	=			
	E025SB011	025SB01102	28-Feb-1996	**0.1**	=			
	E025SB013	025SB01302	05-Feb-1996	0.001	J			
Vinyl acetate	E070SB002	070SB00202	31-Aug-1995	0.005	J	NA	NA	136
Xylenes, Total	E025SB005	025SB00502	05-Feb-1996	0.001	J	NA	NA	153
	E549SB006	549SB00602	31-Aug-1995	0.003	J			
	E549SB008	549SB00802	31-Aug-1995	0.002	J			
	E549SB010	549SB01002	01-Sep-1995	0.002	J			

All values are presented in units of micrograms per liter (µg/L).

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

[a] Soil screening levels (SSLs) are adjusted by a Dilution Attenutation Factor (DAF)=17 based on paved land use and site-specific data.

= Indicates that the chemical was detected at the concentration shown.

J Indicates the concentration shown is an estimated value.

NA Not applicable/not available

Section 6.0

6.0 Summary of Information Related to Site Closeout Issues

6.1 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 practical quantitation limit.

Several metals, mainly chromium, are COCs in groundwater at this site. While antimony was detected at concentrations suggestive of site-related contributions to groundwater, arsenic and thallium are not elevated above background levels at this site.

Arsenic was not a COC at Combined SWMU 70. The high levels of antimony in soil at SWMU 25, and the elevated concentrations of this constituent in groundwater at well E070GW01D warrant antimony being considered a COC. Thallium, however, was only intermittently detected, as presented in Table 6-1. The infrequent detections of thallium do not warrant this constituent being considered a COC in groundwater.

6.2 Potential Linkage to Sanitary Sewers (SWMU 37)

Combined SWMU 70 was used for multiple purposes. No data indicate that this site has impacted the sanitary sewer system. Further evaluation of this issue for Combined SWMU 70 is not warranted. The sediment samples in the sludge were removed as part of the IM at the site, as previously discussed in Sections 3.0 and 4.0.

6.3 Potential Linkage to Storm Sewers (AOC 699)

Potential linkage of a SWMU or AOC to the storm sewer refers to the possibility of a groundwater plume at the SWMU or AOC migrating into a storm water sewer from within which it would subsequently migrate to the water bodies around the CNC, or to the presence of a cross connection between the sanitary sewer and storm sewer, which could transport pollutants directly to surface waters.

There is no indication that contaminated groundwater migrated into the storm sewers. Further evaluation of this issue for Combined SWMU 70 is not warranted.

6.4 Potential Linkage to Railroad Lines (AOC 504)

One railroad line runs near Combined SWMU 70. It is located on the west side of Hobson avenue and is approximately 80 feet from the Combined SWMU 70 area, at its closest distance. There are no known linkages between Combined SWMU 70 and the railroad lines. Further evaluation of this issue is not warranted.

6.5 Potential Migration Pathways to Surface Water Bodies

Surface water was studied separately as part of the *Zone J RFI Report, Revision 0* (EnSafe, 2000). The *Zone J RFI Report, Revision 0* includes the investigated surface water bodies. The nearest investigated surface water body to Combined SWMU 70 is the Cooper River, which is approximately 1,300 feet to the east.

The storm water piping running from SWMU 25 to the Cooper River was cleaned out in 1998. As this action was completed after the source of contamination was removed, further evaluation of this migration pathway is not warranted.

The site investigations performed during the RFI evaluated the potential release of site soil and groundwater contamination to offsite surface water bodies. It was concluded that none of the site COPCs/COCs present a potential concern for their release to offsite surface water bodies, as discussed in Sections 2.0 and 5.0.

6.6 Potential Contamination in Oil/Water Separators (OWSs)

The potential contamination of OWSs issue refers to the possible presence of an OWS that has not yet been investigated at a SWMU or AOC as part of the RCRA or underground storage tank (UST) process.

Neither the RFA nor the RFI report refers to the presence or possible presence of an OWS at Combined SWMU 70. Additionally, there is no reference to an OWS at this facility in the base-wide OWS report prepared by the Navy for Y2000 (Hunt, 2000). Therefore, further evaluation of this issue at Combined SWMU 70 is not warranted.

6.7 Land Use Controls (LUCs)

Combined SWMU 70 lies within Zone E. Future use of this site will be for industrial purposes. As such, Combined SWMU 70, along with other SWMUs and AOCs, will be subject to LUCs that ensure the site is used in accordance with the intended re-use plan. The paved areas around this site are expected to remain paved in the future.

TABLE 6-1
Thallium Detections in Groundwater at Combined SWMU 70
RFI Report & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Date Collected	Station ID	Sample ID	Concentration (µg/L)	Qualifications
04/25/1996	E025GW001	025GW00101	5	U
07/25/1996	E025GW001	025GW00102	2.8	U
12/02/1996	E025GW001	025GW00103	2.7	U
02/14/1997	E025GW001	025GW00104	3.3	J
04/25/1996	E025GW002	025GW00201	5	U
07/26/1996	E025GW002	025GW00202	2.7	UJ
12/02/1996	E025GW002	025GW00203	2.9	U
02/14/1997	E025GW002	025GW00204	2.7	U
04/26/1996	E025GW003	025GW00301	5	U
07/26/1996	E025GW003	025GW00302	2.7	UJ
12/02/1996	E025GW003	025GW00303	6	U
02/13/1997	E025GW003	025GW00304	3.1	J
04/26/1996	E025GW004	025GW00401	5	U
07/26/1996	E025GW004	025GW00402	2.7	UJ
12/02/1996	E025GW004	025GW00403	2.7	U
02/13/1997	E025GW004	025GW00404	4.5	J
04/25/1996	E070GW001	070GW00101	5	U
07/29/1996	E070GW001	070GW00102	3.7	UJ
12/03/1996	E070GW001	070GW00103	3.2	J
02/18/1997	E070GW001	070GW00104	5	U
04/26/1996	E070GW002	070GW00201	5	U
07/29/1996	E070GW002	070GW00202	2.7	UJ
12/03/1996	E070GW002	070GW00203	2.7	UJ
02/18/1997	E070GW002	070GW00204	5	U
04/26/1996	E070GW01D	070GW01D01	9.5	J
07/29/1996	E070GW01D	070GW01D02	10	UJ
12/03/1996	E070GW01D	070GW01D03	10.6	J
02/18/1997	E070GW01D	070GW01D04	10.3	U
01/19/1999	E070GW01D	070GW01DF5	3.1	U
01/19/1999	E070GW01D	070GW01DU5	3.1	U

TABLE 6-1
Thallium Detections in Groundwater at Combined SWMU 70
RFI Report & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Date Collected	Station ID	Sample ID	Concentration (µg/L)	Qualifications
04/24/1996	E549GW001	549GW00101	5	U
08/01/1996	E549GW001	549GW00102	2.7	U
11/25/1996	E549GW001	549GW00103	2.7	U
02/13/1997	E549GW001	549GW00104	3.4	J
04/25/1996	E549GW002	549GW00201	5	U
08/01/1996	E549GW002	549GW00202	2.7	U
11/25/1996	E549GW002	549GW00203	5.1	U
02/13/1997	E549GW002	549GW00204	2.7	U
04/24/1996	E549GW003	549GW00301	5	U
07/29/1996	E549GW003	549GW00302	3	UJ
11/25/1996	E549GW003	549GW00303	2.7	U
02/14/1997	E549GW003	549GW00304	4.1	J
01/19/1999	E549GW003	549GW003U5	3.1	U
01/19/1999	E549GW003	549GW003F5	3.1	U

J Indicates that the chemical is detected at a concentration below the method detection limit; the concentration is estimated.

U Indicates that the chemical was not detected above the method detection limit.

UJ Indicates that the chemical was not detected above the method detection limit; the concentration is estimated.

Section 7.0

7.0 Remedial Action Objectives and Proposed Media Cleanup Standards

This section discusses the RAOs of the CMS that is proposed for Combined SWMU 70, and presents the proposed MCSs for VOCs and metals in groundwater and metals in soils. Once the RAOs and MCSs are established, the candidate remedial technologies and alternatives can be developed to meet these objectives.

7.1 Remedial Goal Options and Proposed 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. Remedial goal options (RGOs) and media cleanup standards (MCSs) under RCRA are developed at the end of the risk assessment in the RFI/RI/State programs.

RGOs can be based on a variety of criteria, such as specific ILCRs (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 results in the protection of human health and the environment, while achieving compliance with applicable state and federal standards.

Preliminary MCSs were selected from EPA Region III RBC tables (EPA, 2000), established drinking water MCLs, and EPA SSL guidance for COCs. The media of concern to be addressed in the IM/CMS for Combined SWMU 70 are surface and subsurface soils and groundwater. Because Combined SMWU 70 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 a concern from contamination detected at this site.

As previously indicated, MCSs can be based on target carcinogenic risks levels ranging between of 10E-06, 10E-05, and 10E-04; target HIs ranging between 0.1, 1, and 3; or background concentrations. These target MCSs are estimated for industrial or residential (unrestricted) land use. It is also important to specify the assumed land use and exposure conditions in the RGOs.

7.1.1 RGOs and MCSs for Soil

The matrix in Section 5.3 presents a summary of the COCs identified by medium and exposure pathway. Hexavalent chromium was the only COC identified for soil, based on the exposure pathway to residential children (for human health protection); no direct exposure-based human health COCs were identified for subsurface soils.

Table 7-1 presents RGOs and MCSs for the associated target risk levels for hexavalent chromium. Although unrestricted (i.e., residential) land use is not planned for this site, for purposes of comparison Table 7-1 presents RGOs for this type of land use. During the CMS, the feasibility of achieving an MCS of 230 mg/kg for hexavalent chromium in surface soil will be evaluated.

The statistical averages (e.g., UCL_{95}) of the residual surface soil concentrations following implementation of the corrective measures are expected to be within the proposed target cleanup levels (i.e., MCS), protective of the residential receptors. For EPCs in the residual risk estimations, these are the UCL_{95} concentrations of the mean. The Combined SWMU 70 site is approximately one-half acre in size and will be used as the target exposure unit.

Cadmium, chromium, hexavalent chromium, and antimony were COCs based on potential threats to groundwater via leachability from surface and subsurface soil. All soils identified with COCs exceeding SSLs that could potentially impact groundwater are located in SWMU 25. A site-specific SSL-based MCS will be developed for these COCs upon additional sampling for leachable fractions, using the Synthetic Precipitation Leaching Procedure (SPLP).

The RGO for surface soil is to remove contaminated soils, or cap them, to the extent that the groundwater would not be impacted by soils that remain in place. The cadmium, chromium, hexavalent chromium, and antimony MCSs for this RGO will be determined after the current distribution of these contaminants is better defined, and the SPLP data are interpreted.

Figures 7-1 and 7-3 present the extent of antimony and cadmium sample results exceeding the surface and subsurface soil screening criteria, respectively. Figures 7-2 and 7-4 present the extent of chromium and hexavalent chromium results exceeding surface and subsurface soil screening criteria, respectively.

7.1.2 MCSs for Groundwater

Antimony, hexavalent chromium, cadmium, PCE, TCE, and vinyl chloride were identified as COCs in groundwater at Combined SWMU 70. MCLs are the primary MCSs for

groundwater RGOs. In the absence of a MCL, EPA Region III tap water RBCs and CNC background levels were selected as MCSs, with a target cancer risk ranges between 10-6 to 10-4, and HI ranges between 0.1 to 3.0, for residential (potable) use. MCLs are applied to public water supply wells, which are typically completed in deeper aquifers. Table 7-2 provides a preliminary list of the groundwater MCS values.

Figure 7-5 shows the distribution of chromium, hexavalent chromium, antimony, and cadmium in groundwater at Combined SWMU 70. Figure 7-6 shows the distribution of PCE, TCE, and vinyl chloride in groundwater at Combined SWMU 70. In April 2001, vertical profile samples of groundwater were collected and analyzed for hexavalent chromium and cadmium. Figures 7-7, 7-8, and 7-9 show the distribution of hexavalent chromium and cadmium in groundwater, as reported by the vertical profile results. The three figures represent three different elevation zones in the groundwater (shallow, intermediate, and deep). The information demonstrated in figures 7-5 through 7-8 is complemented by the discussion of site hydrogeology, presented below in Section 7.2. The areas of groundwater with contaminant concentrations greater than the MCS will be addressed in the CMS.

7.2 Site Hydrogeology

The hydrogeology for Zone E was discussed in detail in the *Zone E RFI Report, Revision 0* (EnSafe, 1997). That discussion is summarized in this section.

The hydrogeology in Zone E is very complex due to several factors:

- There is variable geologic lithology horizontally and vertically;
- The Cooper River, which lies to its east and serves as a groundwater discharge zone, is tidally influenced;
- A quay wall of sheet pilings and concrete which lies along the waterfront serves as a partial hydraulic barrier; and
- The shallow subsurface has been heavily disturbed by many anthropogenic activities related to industrial work such as utilities, non-native fill material, support pilings, railroad lines, and crane rails.

7.2.1 Lithology

In the Combined SWMU 70 area, there are two stratigraphic units: the Wando Formation and the Ashley Formation. Overlying the Wando Formation, are fill materials placed by anthropogenic activities. Geologic maps and cross-sections through Zone E are presented in the *Zone E RFI Report, Revision 0.*

Ashley Formation

The Ashley Formation serves as a regional confining unit for the shallow aquifer and consists of a clayey, dense, calcareous silt. The top of the Ashley Formation under Zone E is gently rolling and typically slopes very slightly eastward toward the Cooper River. In the Combined SWMU 70 area, the top of the formation increases with depth to the north. The average elevation of the top of the Ashley Formation in Zone E is –24 ft mean sea level (msl). Figure 7-10 shows the top of the Ashley elevation contours for the Combined SWMU 70 vicinity. Figure 7-11 depicts the same data in a 3-D perspective.

Wando Formation

The Wando Formation, which overlies the Ashley Formation, is composed of repeating sequences of back barrier clayey sand and clay deposits, barrier island sand deposits, and near shore shelf-sand deposits corresponding to three depositional periods. The thickness of the formation decreases to the south. In the Combined SMWU 70 area, the sands of the Wando Formation decrease in areal extent with depth. The clay deposits are typically thin and discontinuous, allowing for interconnection of sands at various depths. The clays within the formation serve as semi-confining layers between the shallow and deep groundwater zones.

On the western edge of the Combined SWMU 70 area, the Wando Formation extends to a depth of approximately 24 ft bls and consists of three layers: an upper sand unit, an interbedded sand and clay unit, and a lower sand unit. The upper sand unit is younger and is composed of fine-to-medium-grained, silty sand, with occasional shell fragments. The lower sand unit is an older, fine-to-medium-grained sand with some occasional shells.

On the eastern edge of the Combined SMWU 70 area, approaching the Cooper River, the Wando Formation extends to a depth of approximately 26 ft bls and consists of two layers: a clay unit and a sand unit. The top unit is a firm to stiff clay, which is often silty or sandy. The sand unit, which underlies the clay, corresponds to the younger, upper sand unit described previously. There is no interbedded sand and clay unit or older sand unit present, which indicates these layers pinch out somewhere in the middle of the Combined SWMU 70 area, possibly around AOC 554.

Fill Materials

Due to the extensive surface soil disturbance at NAVBASE during its operational history, approximately the upper five feet of the subsurface at Zone E is typically a mixture or artificial fill and native sediments. In the Combined SMWU 70 area, the Wando Formation is overlain by a Fill Sand, which is typically very fine to fine-grained, and by Run of Crusher,

which consists of a gravel in a clayey silt and sand matrix, typically used for subgrade in construction.

7.2.2 Hydrology

The Cooper River lies to the east of Zone E and serves as a groundwater discharge area. Its tidal influences are reflected to varying degrees, within up to 300 feet from the waterfront; Combined SMWU 70 is approximately 1,300 feet from the Cooper River. However, where storm water or sewer lines have been installed, its influence may reach further inland. A tidal study preformed at Zone E determined that, in general, groundwater levels increase between high and low tides.

The surficial aquifer extends from the water table to the top of the confining unit, or the Ashley Formation. The saturated thickness of the aquifer in the Combined SWMU 70 area is approximately 27 feet. Groundwater levels were measured at Zone E during the RFI and in May 2002. Figures 7-12 and 7-13 present groundwater contours for the shallow and deep zones of the surficial aquifer, respectively (May 2002). These groundwater levels are approximately one foot lower than those presented in the RFI report, possibly due to drought conditions currently present in the southeast.

In the shallow groundwater zone, a groundwater divide exists in the Combined SWMU 70 area. This divide occurs approximately at the contact of the Wando sand (Qs) and the Wando clay (Qc), as presented in Figure 2-3a in the RFI report. Groundwater to the east of the divide flows primarily to the east, towards a groundwater depression, just west of the Cooper River. Groundwater to the west of the divide primarily flows to the west and may flow eventually southwest toward the groundwater depression at SWMU 559.

Similar to the shallow zone, a groundwater divide also exists in the deep groundwater zone in the Combined SMWU 70 area. This divide may correspond to where the interbedded clay and sand unit of the Wando formation pinch out at Zone E. Groundwater to the east of the divide flows primarily to the east-southeast towards the Cooper River and groundwater to the west of the divide flows primarily to the west-southwest and may eventually flow toward the depression at SWMU 559.

Several anomalies (mounds or depressions) were identified in the groundwater potentiometric surface for the shallow and deep groundwater zones. These anomalies are most likely caused by anthropogenic activities and are consistent with historical water levels. Shallow subsurface utilities, such as storm sewers and sanitary sewers, are located at or beneath the water table elevation and are most likely the cause of groundwater depressions. As the water table elevation fluctuates, groundwater will periodically come in

direct contact with the system, possibly allowing groundwater to leak into the storm and sanitary sewer systems. Groundwater entering storm sewers most likely flows to outfalls on the Cooper River. Groundwater entering sanitary sewers would be transported off the NAVBASE property to a water treatment facility. Fill materials placed above less permeable natural material or in trenches may account for mounds, or perched conditions in the groundwater potentiometric surface. Groundwater in the deep zone is also influenced by the quay walls and dry docks, which serve as a groundwater barrier in some locations. However, there appears to be no anomalies in groundwater flow indicators located directly in the Combined SWMU 70 vicinity.

Based on the May 2002 data, the hydraulic gradient for flow in the shallow zone on both sides of the divide is approximately 0.001 feet per foot (ft/ft). In the deep zone the gradient is approximately 0.002 ft/ft. The small hydraulic gradients indicate that the groundwater velocity in the vicinity of Combined SMWU 70 may be extremely low. Such a conclusion would be consistent with the observation that groundwater contamination has not migrated a significant distance from the SWMU 70 source areas. The vertical gradient measured at well cluster E070GW001 and E070GW01D (0.0097 ft/ft) in May 2002, indicates that there is a slight upward vertical flow at Combined SWMU 70. Upward vertical flow at the CNC generally gets stronger when closer to the Cooper River, except in very localized areas that are influenced by man-made recharge or discharge such as leaking water lines or stormwater lines. Various geologic tests, including slug tests (October 1996), a pumping test at Combined SWMU 70 (April/May 1997), and specific capacity tests (November 1996), were performed at Zone E to estimate hydraulic conductivity at the site. The work was completed by the Navy/EnSafe team and was reported in the Draft Zone E RFI Report (EnSafe, 1997). The average effective hydraulic conductivity was reported at 120 ft/day for the fill sand, at 0.84 ft/day for the Wando clay, at 11 ft/day for the upper sand of the Wando formation, and at 3.8 ft/day for the lower sand of the Wando formation.

7.3 Contamination Assessment Summary

The information presented in this section discusses the extent of COCs in soil and groundwater. Additional delineation of soil is required in the SWMU 25 area to define post-IM contaminant distribution (see Section 8.0). The groundwater appears to be moving at very slow velocity, due to the flat gradients at the site. This fact, in conjunction with the knowledge that deeper groundwater movement is impeded by the rising Ashley formation, indicates the Combined SWMU 70 site does not pose a significant groundwater contamination migration risk in the future. Additionally, existing contamination at the site is likely to be reduced in the future, due to the focused CMS being implemented at the site.

TABLE 7-1
Surface Soil MCSs/RGOs for Combined SWMU 70
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Chemical	Range of Detected Concentrations	EPC	Residential RGO/MCS based on Noncarcinogenic Health Hazards			Industrial RGO/MCS based on Noncarcinogenic Health Hazards			Proposed MCS
		HI=	0.1	1.0	3.0	0.1	1.0	3.0	
Chromium VI	0.04 – 960	344	23	230	690	610	6,100	18,300	230

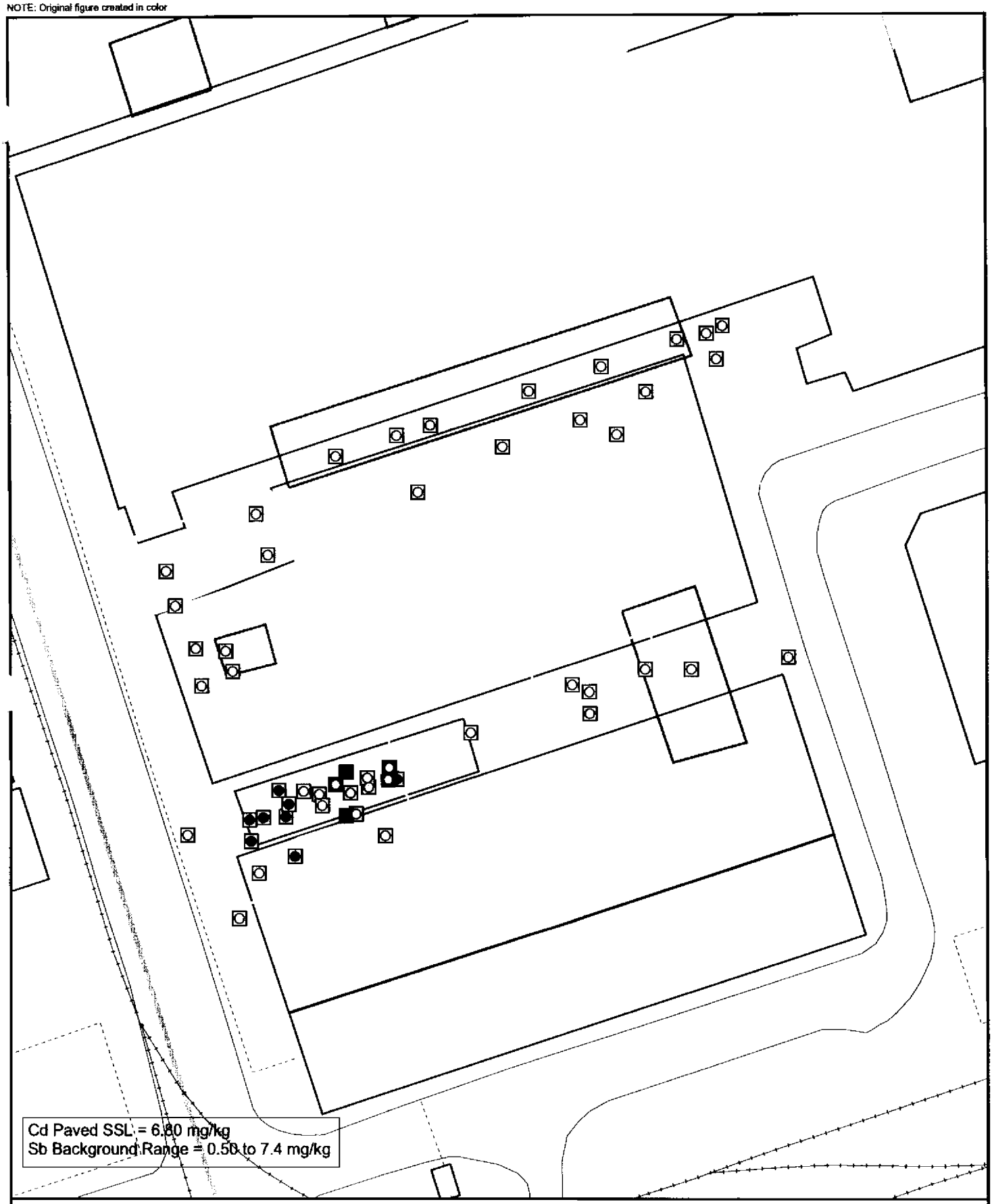
All units in are in milligrams per kilogram (mg/kg).
EPC – Exposure Point Concentration for risk estimates
RGO – Remedial Goal Option
MCS -- Media Cleanup Standard

TABLE 7-2
Groundwater MCSs/RGOs for Combined SWMU 70
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Chemical	Range of Detected Concentrations (µg/L)	EPC	Background Range of Concentrations (µg/L)	MCL	RGO for Noncarcinogenic Health Hazards				Proposed MCS	Explanation
					HI =	0.1	1.0	3.0		
Antimony	2.8 - 209	25	2.0 - 5.0	6.0		1.5	15	45	6.0	MCL is proposed goal
Cadmium	0.4 - 88	17	1.4	5.0		3.7	37	111	5.0	MCL is proposed goal
Chromium VI	147 - 31,000	9,732	NA	NA		11	111	333	100	Noncarcinogen via ingestion, same as MCL
Chromium, total	1.6 - 52,500	8,524	0.8 - 31	100		5500	55000	165000	100	
					ELCR	10-6	10-5	10-4		
PCE	1.0 - 26	5.6	NA	5		1.1	11	110	5.0	MCL is proposed goal
TCE	0.26 - 70	13	NA	5		1.6	16	160	5.0	MCL is proposed goal
Vinyl Chloride	0.7 - 5.0	4.0	NA	2		0.041	0.41	4.1	2.0	MCL is proposed goal

All units are in micrograms per liter (ug/L).
EPC – Exposure Point Concentration (calculated as UCL_{95})
RGO – Remedial Goal Option
MCS – Media Cleanup Standard
MCL – Maximum Contaminant Level

NOTE: Original figure created in color



○ < CD Paved SSL
● > CD Paved SSL
□ < SB Background
■ > SB Background
AOC Boundary
SWMU Boundary
Buildings

N

0 50 100 Feet

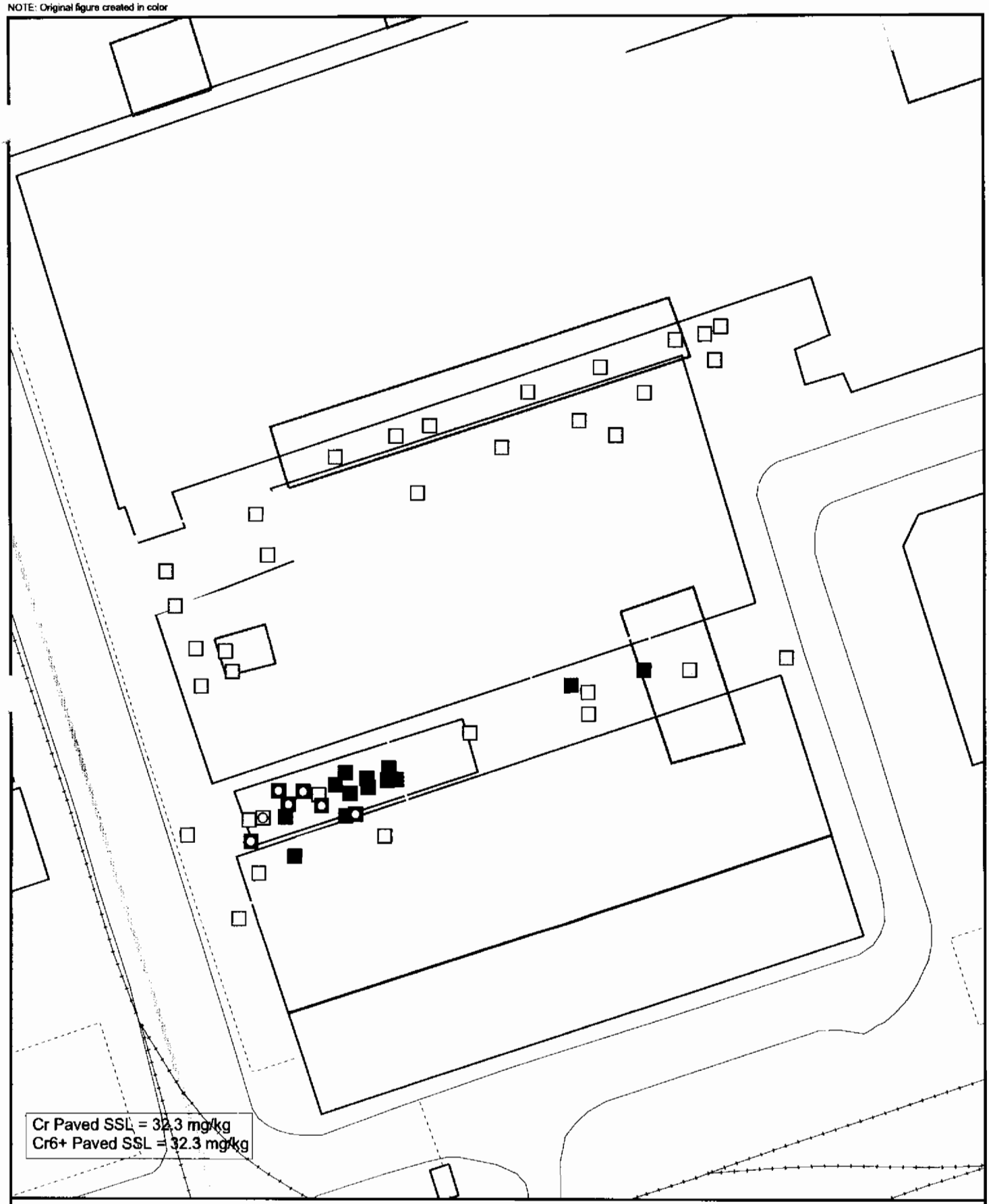
1 inch = 68.3854 feet

Figure 7-1
Locations of Sb and Cd Exceeding Screening Criteia
Surface Soil Combined SWMU 70
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 23 Jul 2002 10:26, User: PFAVARA, RFIRA_CMSWP: Figure 7-1 Locations of Sb and Cd Exceeding Screening Criteia

NOTE: Original figure created in color



< Paved SSL CR6+
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>Paved SSL CR
AOC Boundary
SWMU Boundary
Buildings

N

0 50 100 Feet

1 inch = 68.3854 feet

Figure 7-2
CR and CR6 Exceeding Criteria
Surface Soil Combined SWMU 70
Charleston Naval Complex

CH2MHILL

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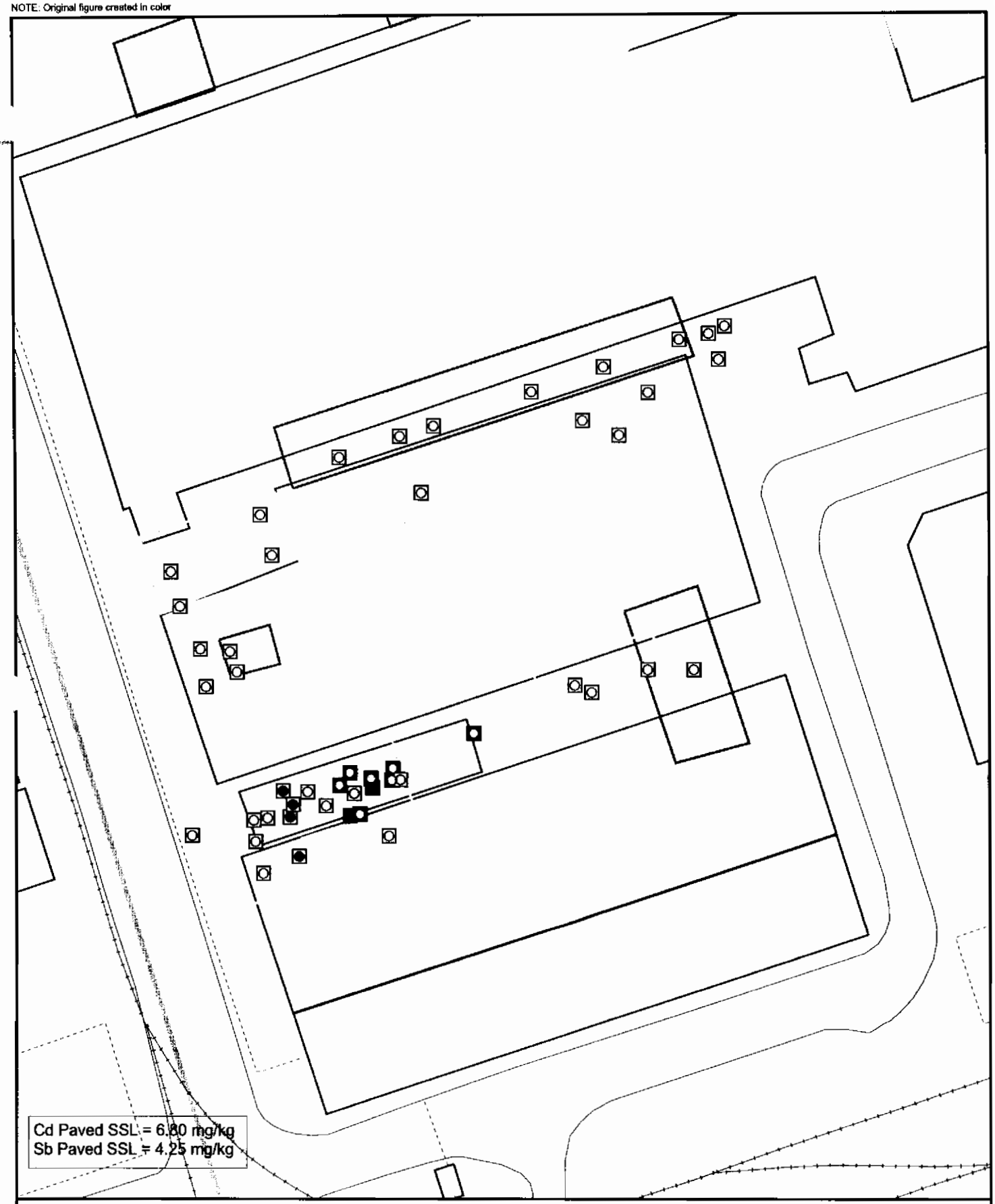
NOTE: Original figure created in color



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● > CD Paved SSL
□ < SB Paved SSL
■ > SB Paved SSL
AOC Boundary
SWMU Boundary
Buildings

N

0 50 100 Feet

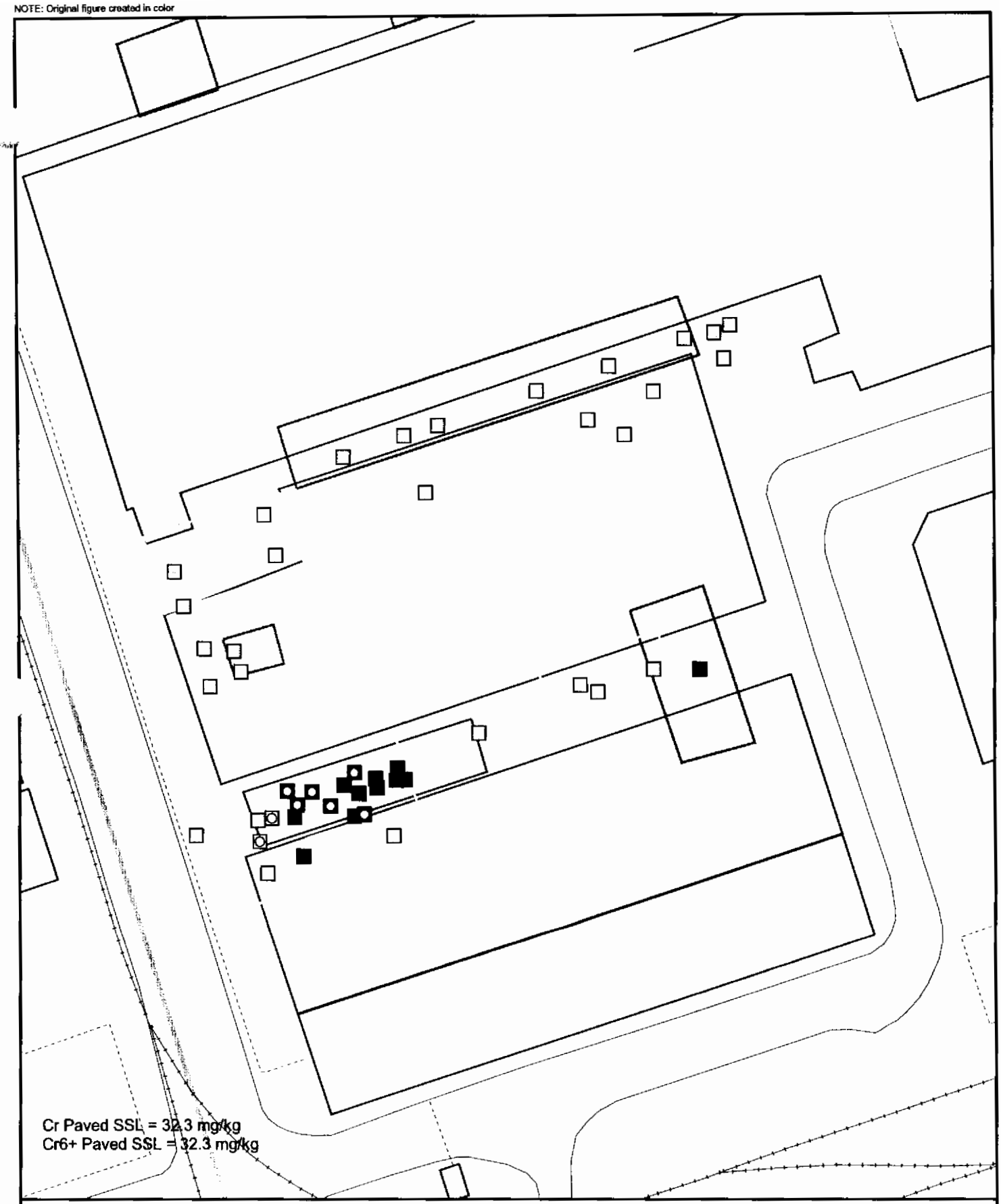
1 inch = 68.3854 feet

Figure 7-3
Sb and Cd Exceeding Screening Criteira
Subsurface Soil Combined SWMU 70
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 23 Jul 2002 17:07, User: PFAVARA, RFIRA_CMSWP: Figure 7-3 Sb and Cd Exceeding Screening Criteira

NOTE: Original figure created in color



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● > Cr6+ Paved SSL
□ < CR Paved SSL
■ > Cr Paved SSL
AOC Boundary
SWMU Boundary
Buildings

N

0 50 100 Feet

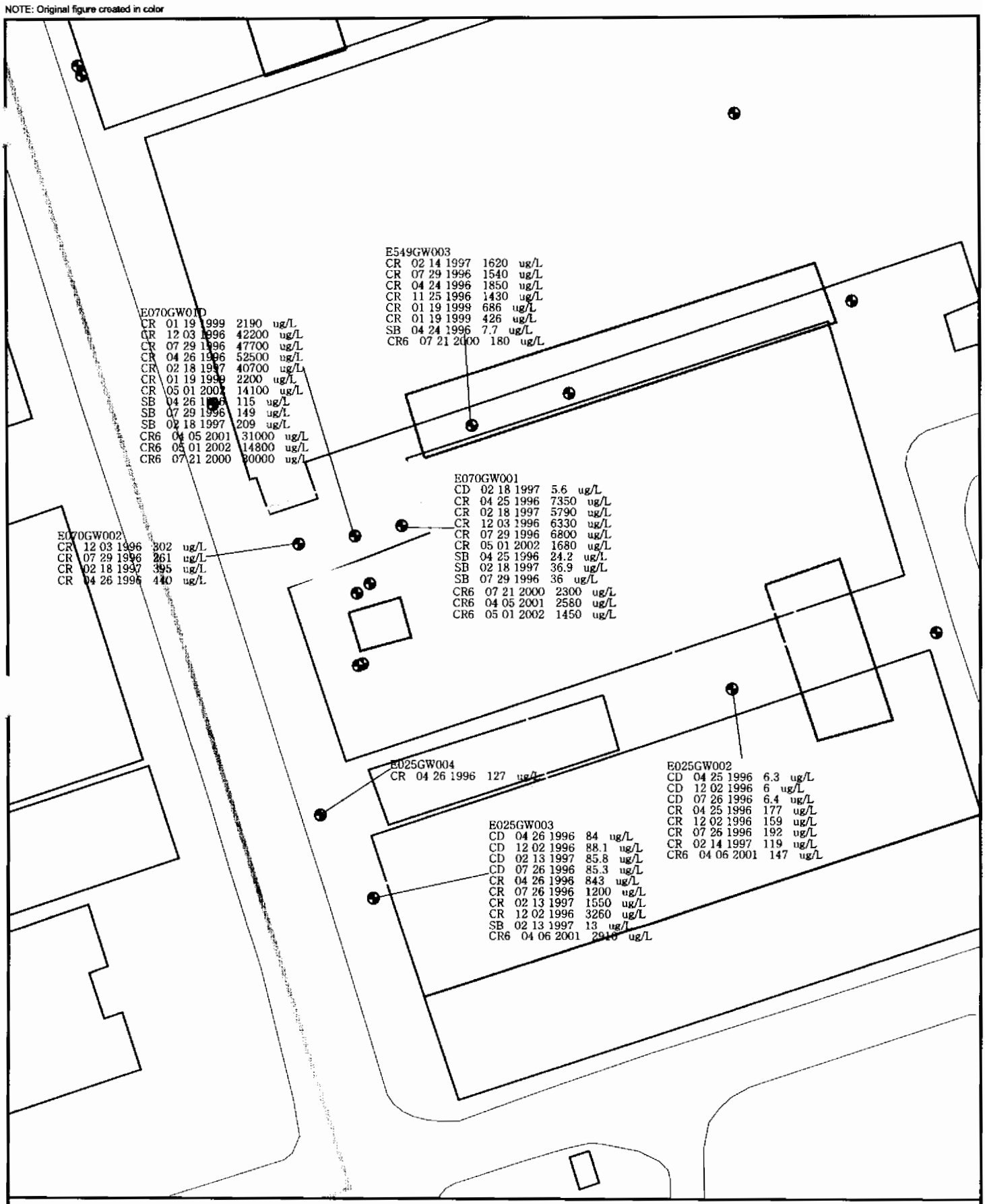
1 inch = 68.3854 feet

Figure 7-4
CR and CR6 Exceeding Criteria
Subsurface Soil Combined SWMU 70
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 23 Jul 2002 17:10, User: PFAVARA, RFIRA_CMSWP: Figure 7-4 CR and CR6 Exceeding Criteria

NOTE: Original figure created in color



Groundwater Well
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 50 100 Feet

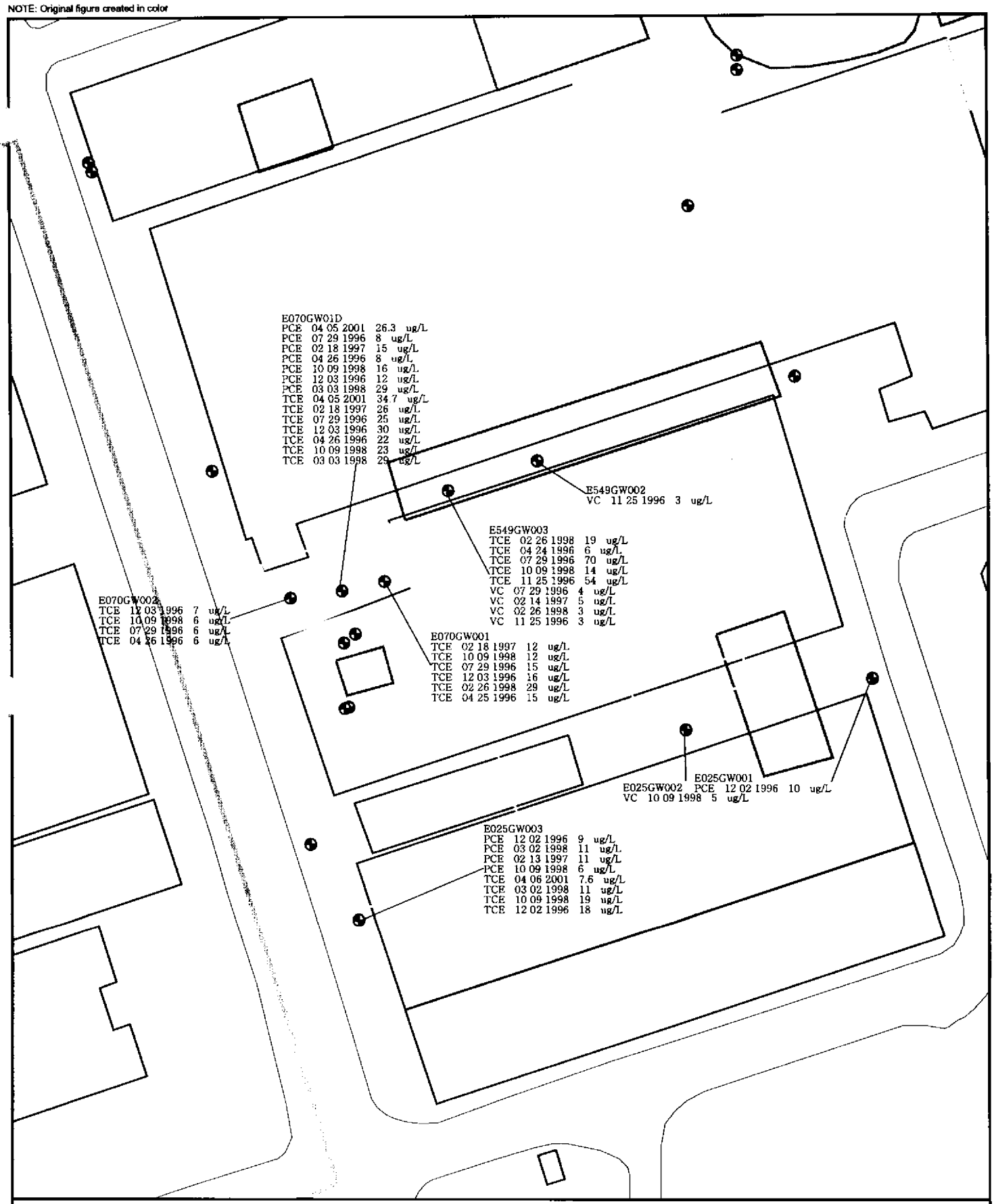
1 inch = 73.3432 feet

Figure 7-5
Sb, Cr, Cr6, and Cd MCL Exceedances
Groundwater Combined SWMU 70
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 25 Jul 2002 15:42, User: PFAVARA, RFIRA_CMSWP: Figure 7-5 Sb, Cr, Cr6, and Cd MCL Exceedances

NOTE: Original figure created in color



Groundwater Well
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 60 120 Feet

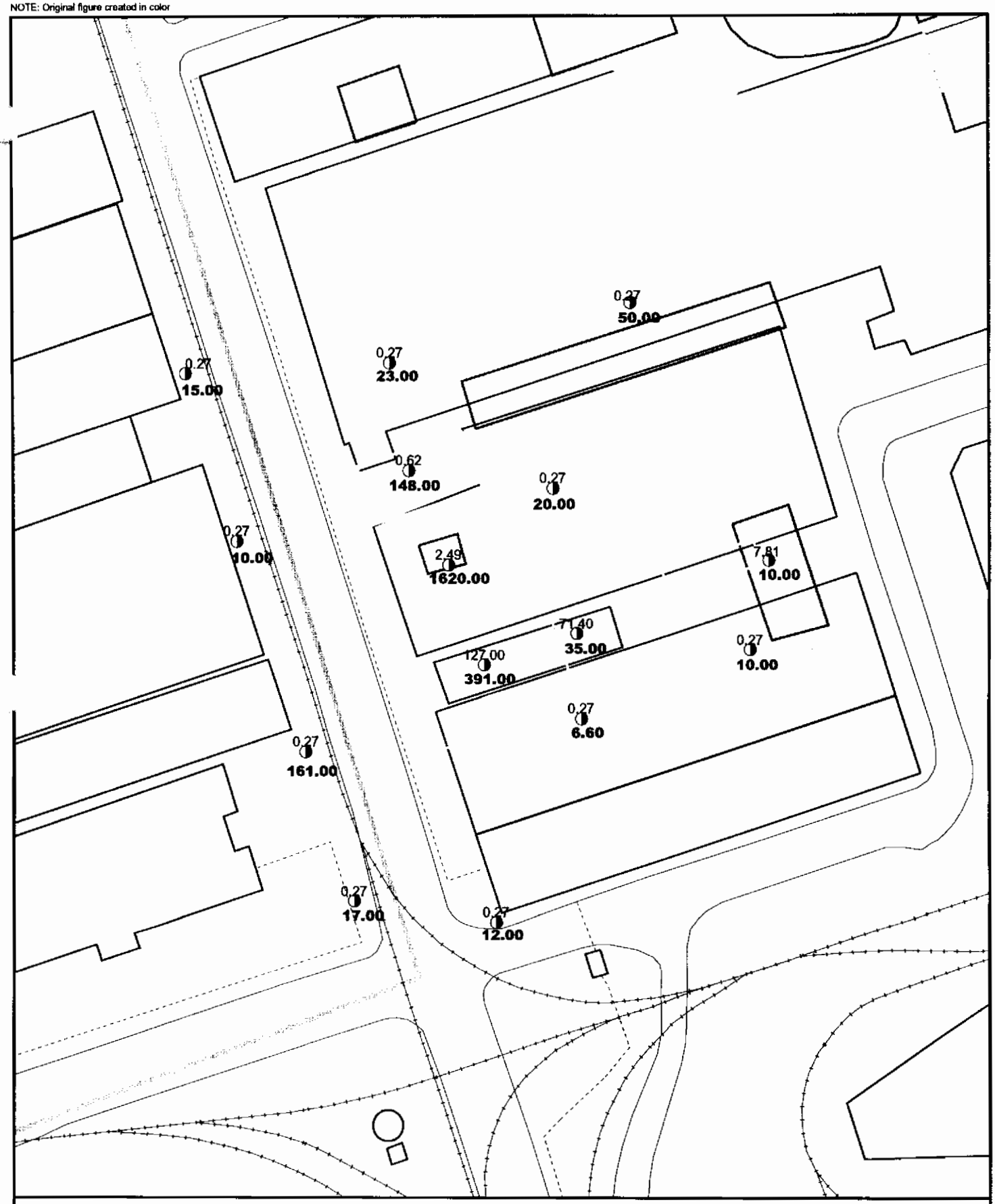
1 inch = 73.3432 feet

Figure 7-6
PCE, TCE, and VC Exceeding MCLS
Groundwater at Combined SWMU 70
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 25 Jul 2002 15:20, User: PFAVARA, RFIRA_CMSWP: Figure 7-6 PCE, TCE, and VC Exceeding MCLS

NOTE: Original figure created in color



CD and CR6 (ppb) 0 - + 2 FT MSL (see note)
AOC Boundary
SWMU Boundary
Buildings

N

0 70 140 Feet

1 inch = 88.901 feet

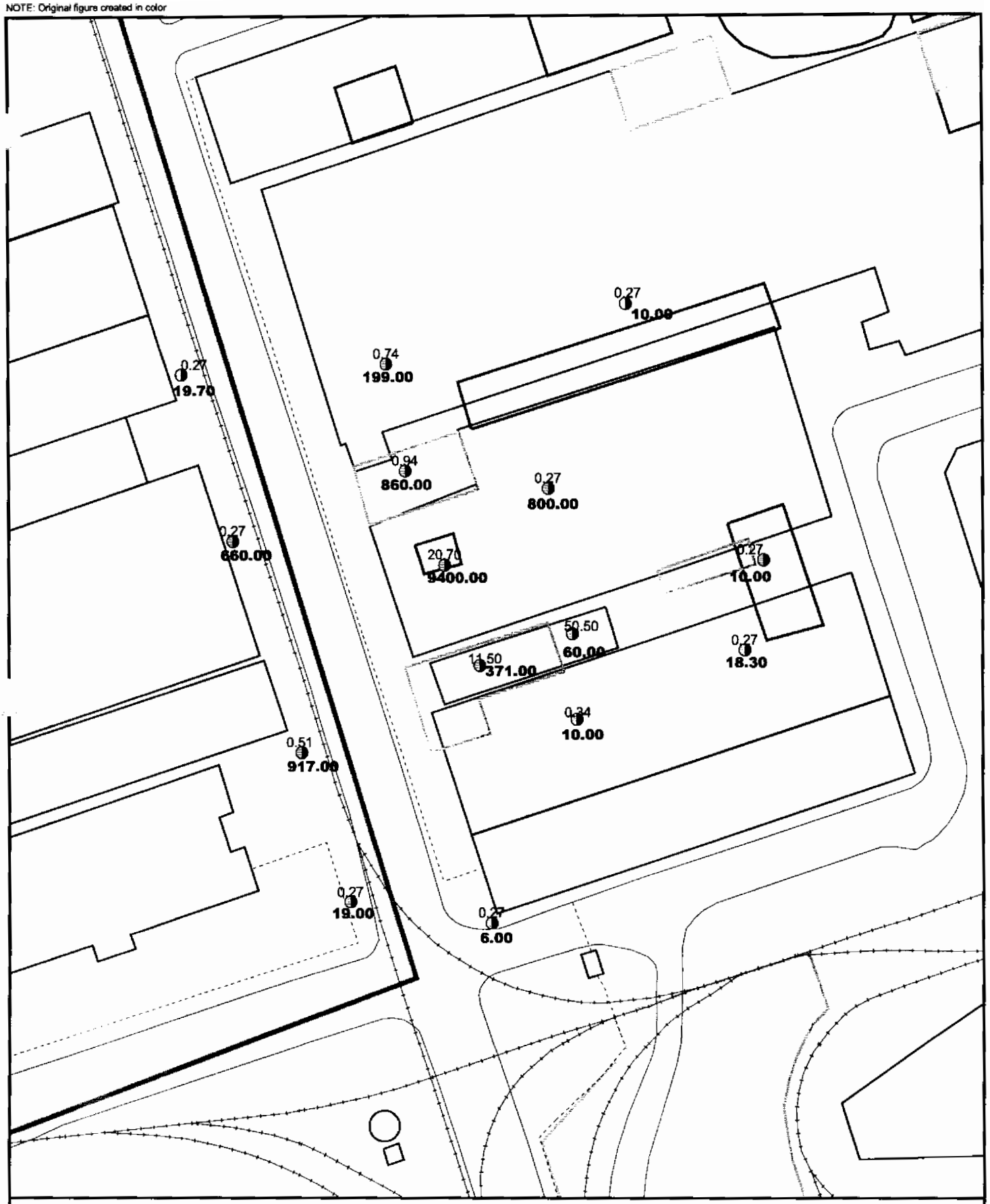
Note: Bold = Cr6, Non-Bold = Cd
Detection limit for Cd = 0.27 ppb

Figure 7-7
Cd and Cr6 in Groundwater
0 - +2 Ft MSL
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 23 Jul 2002 17:20, User: PFAVARA, RFIRA_CSMWP: Figure 7-5 Cd and Cr6 in Groundwater

NOTE: Original figure created in color



CD and CR6 (ppb) 0 to -15 Ft MSL (see note)
AOC Boundary
SWMU Boundary
Buildings

Note: Bold = Cr6; Non-Bold = Cd
Detection limit for Cd = 0.27 ppb

N

0 70 140 Feet

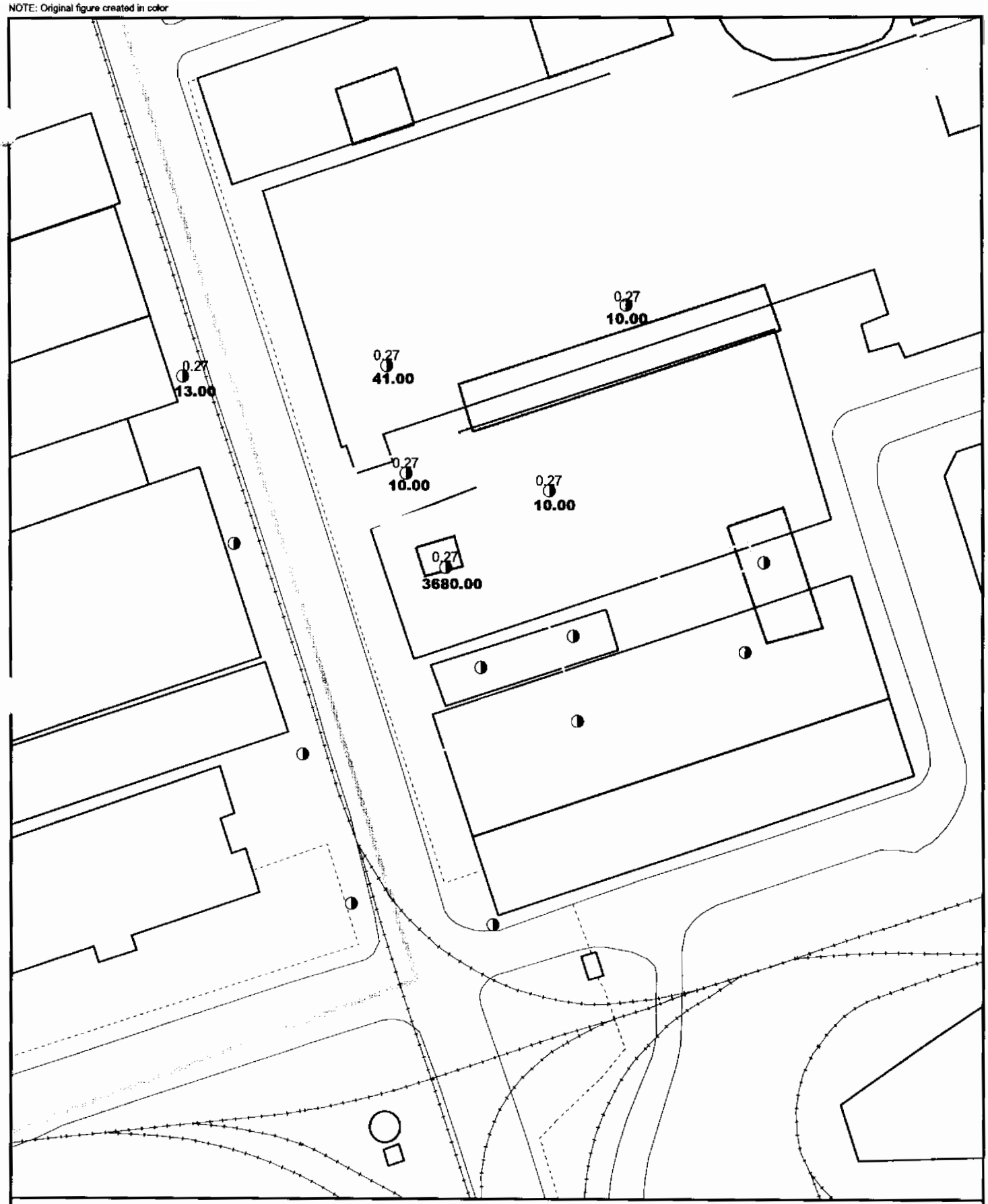
1 inch = 88.901 feet

Figure 7-8
Cd and Cr6 in Groundwater
0 to - 15 Ft MSL
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 23 Jul 2002 17:39, User: PFAVARA, RFIRA_CMSWP: Figure 7-6 Cd and Cr6 in Groundwater

NOTE: Original figure created in color



CD and CR6 (ppb) -16 to -24 Ft MSL (see note)
AOC Boundary
SWMU Boundary
Buildings

Note: Bold = Cr6, Non-Bold = Cd
Detection limit for Cd = 0.27 ppb

N

0 70 140 Feet

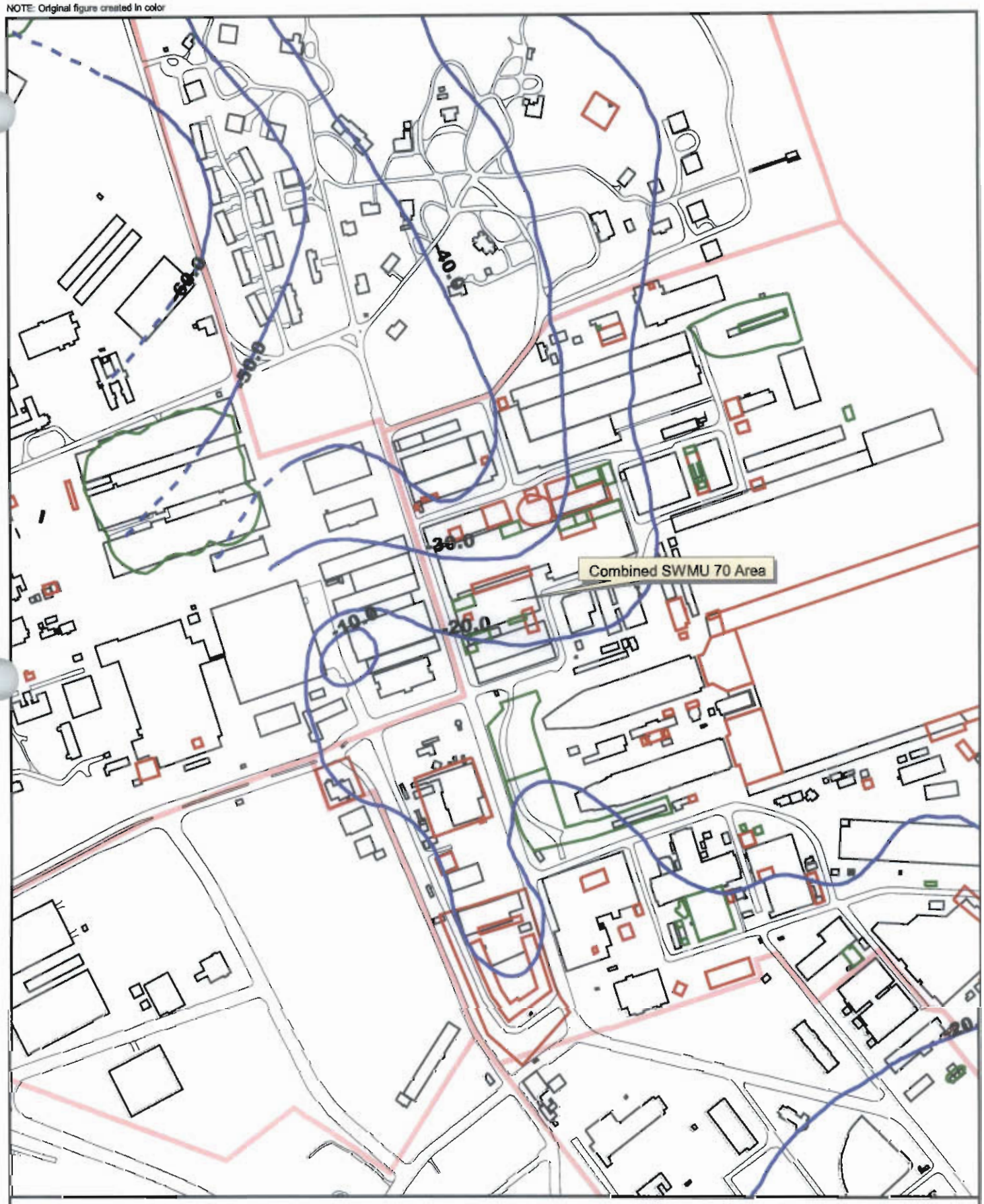
1 inch = 88.901 feet

Figure 7-9
Cd and Cr6 in Groundwater
-16 to -24 Ft MSL
Charleston Naval Complex

CH2MHILL

File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 23 Jul 2002 17:35, User: PFAVARA, RFIRA_CMSWP: Figure 7-7 Cd and Cr6 in Groundwater

NOTE: Original figure created in color



inferred
known
Roads - Lines
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 400 800 Feet

1 inch = 478.698 feet

Figure 7-10
Top of Ashley Formation
In Vicinity of Combined SWMU 70
Charleston Naval Complex

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File Path: c:\18gis\projects\zone_e\combined swmu 70\gis\rfira_cmswp.apr, Date: 16 Sep 2002 17:16, User: PFAVARA, RFIRA, CMSWP: Figure 7-10 Top of Ashley Formation

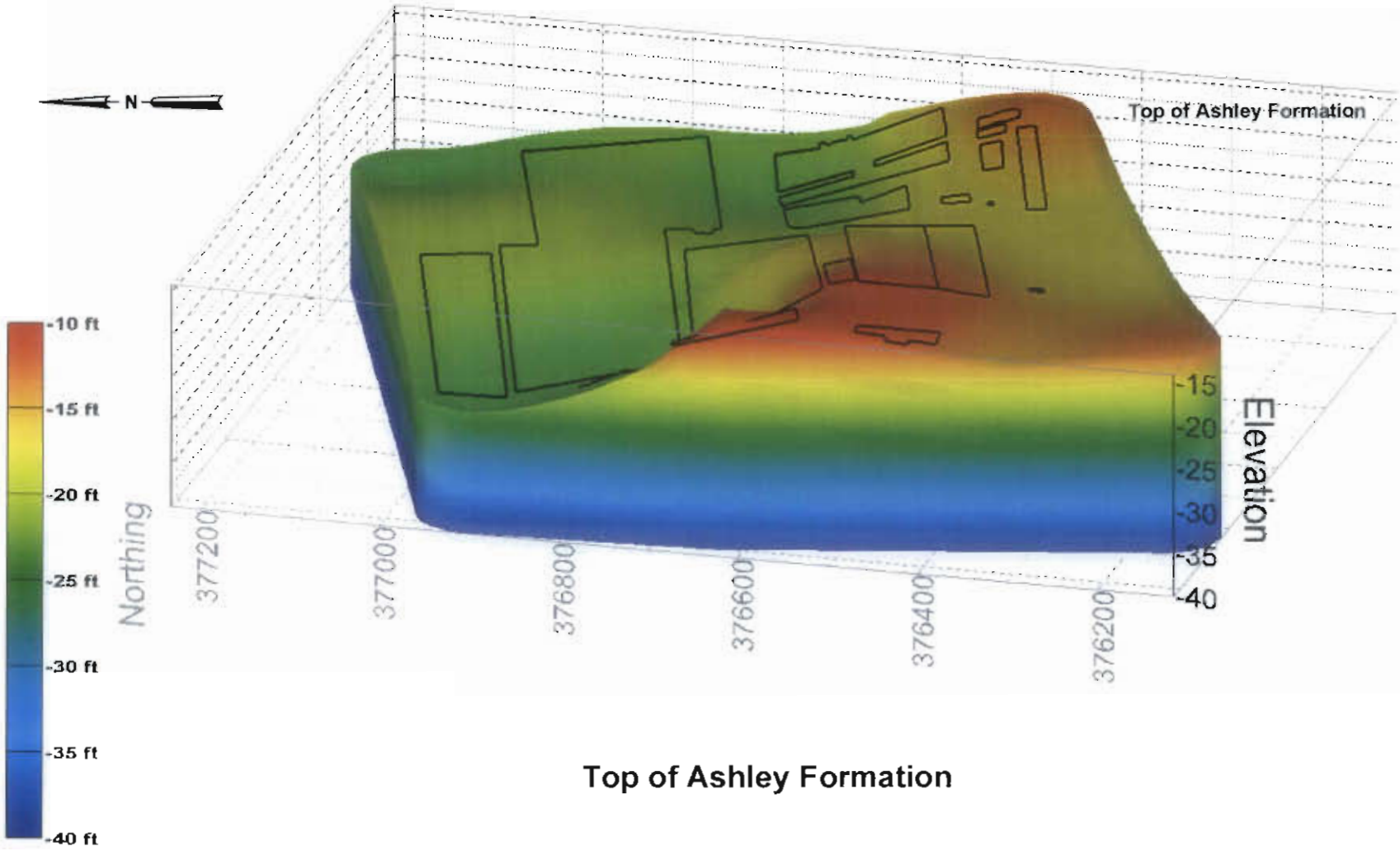

Figure 7-11

Top of Ashley Formation, Elevation
Combined SWMU 70, Zone E
Charleston Naval Complex

E092002019GNV

CH2MHILL

NOTE: Original figure created in color

Shallow Zone Groundwater Elevations (May 2002)
Roads - Lines
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 400 800 Feet

1 inch = 478.698 feet

Figure 7-12
Shallow Groundwater Elevation
Combined SWMU 70 Vicinity
Charleston Naval Complex

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File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 16 Sep 2002 17:23, User: PFAVARA, RFIRA_CMSWP: Figure 7-12 Shallow Groundwater Elevation

NOTE: Original figure created in color

Deep Zone Groundwater Elevations (May 2002)
Roads - Lines
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 400 800 Feet

1 inch = 478.698 feet

Figure 7-13
Deep Groundwater Elevations
Combined SWMU 70
Charleston Naval Complex

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Section 8.0

8.0 Evaluation of Corrective Measure Alternatives

A focused CMS will evaluate alternatives proposed to achieve the RAOs and MCSs for COCs in soil and groundwater at Combined SWMU 70. Several remedial technologies will be evaluated for applicability. Passive as well as active technologies will be evaluated for soil and groundwater.

Potential technologies that may be evaluated in the CMS for soil included:

- Capping with LUCs
- Excavation and removal
- In situ treatment with LUCs
- NFA

The most recent data for SWMU 25 were collected in August 1997, prior to completion of the third IM at the site, which involved the removal of 25 tons of contaminated soil and other contaminated material. No confirmatory samples were collected following this IM. Additional soil samples will be collected at SWMU 25 and analyzed for COCs. The proposed locations of surface and subsurface soils samples are presented in Figure 8-1 (11 surface and subsurface soil samples). Additionally, SPLP data will be collected to evaluate site-specific leachability characteristics of the soil. A total of 11 samples will be analyzed for SPLP; the specific samples to be analyzed for SPLP will be defined after the initial 10 sample results are evaluated. Target analytes will consist of COCs in soils.

Potential technologies that may be evaluated in the CMS for groundwater include:

- Groundwater extraction and chemical/physical treatment
- LUCs
- In situ plume remediation using zero-valent iron (ZVI)
- Permeable reactive barriers
- Monitored Natural Attenuation (MNA)
- Enhanced MNA

8.1 Focused CMS Approach

Four additional monitoring wells have been installed in the Combined SWMU 70 area to better delineate the extent of contamination as well as monitor the ongoing pilot study that is evaluating ZVI for groundwater treatment.

Data from the new monitoring wells will be acquired through a groundwater sampling effort prior to beginning the remedial alternatives screening process. The sampling will refine understanding of dissolved metals distribution in Combined SWMU 70 groundwater.

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

1. Review existing and new site data and technical literature to identify and screen the various corrective measure alternatives for applicability. In addition to those listed above, other corrective measure alternatives may also be evaluated in the CMS.
2. The preferred corrective measure alternative will then be selected.
3. The CMS methods and the preferred corrective measure alternative will be documented in the CMS report.

8.2 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 criteria:

1. Protect human health and the environment.
2. Attain MCSs, which will generally be the RGOs.
3. Control the source of releases to minimize future releases that may pose a threat to human health and the environment.
4. Comply 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:

8.2.1 Protect 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 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.

8.2.2 Attain Media Cleanup Standards

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 time frame to achieve the RGOs. Estimates of the time frame for the alternatives to achieve RGOs will be provided.

8.2.3 Control the Source of Releases

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

8.2.4 Comply 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 well cuttings, contaminated groundwater, or excavated material from a source area.

8.2.5 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 various alternatives will be evaluated on the basis of their reliability, and the potential impact should the alternative fail. In other words, a qualitative assessment will be made as to the chance of the alternative's failing 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. Implementatiblity

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 +100 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.

8.3 CMS Report

The CMS report will be prepared to present the identification, development, and evaluation of potential corrective measures for Combined SWMU 70. A proposed outline of the report, as shown in Table 8-1, provides an example of the report format and content organization.

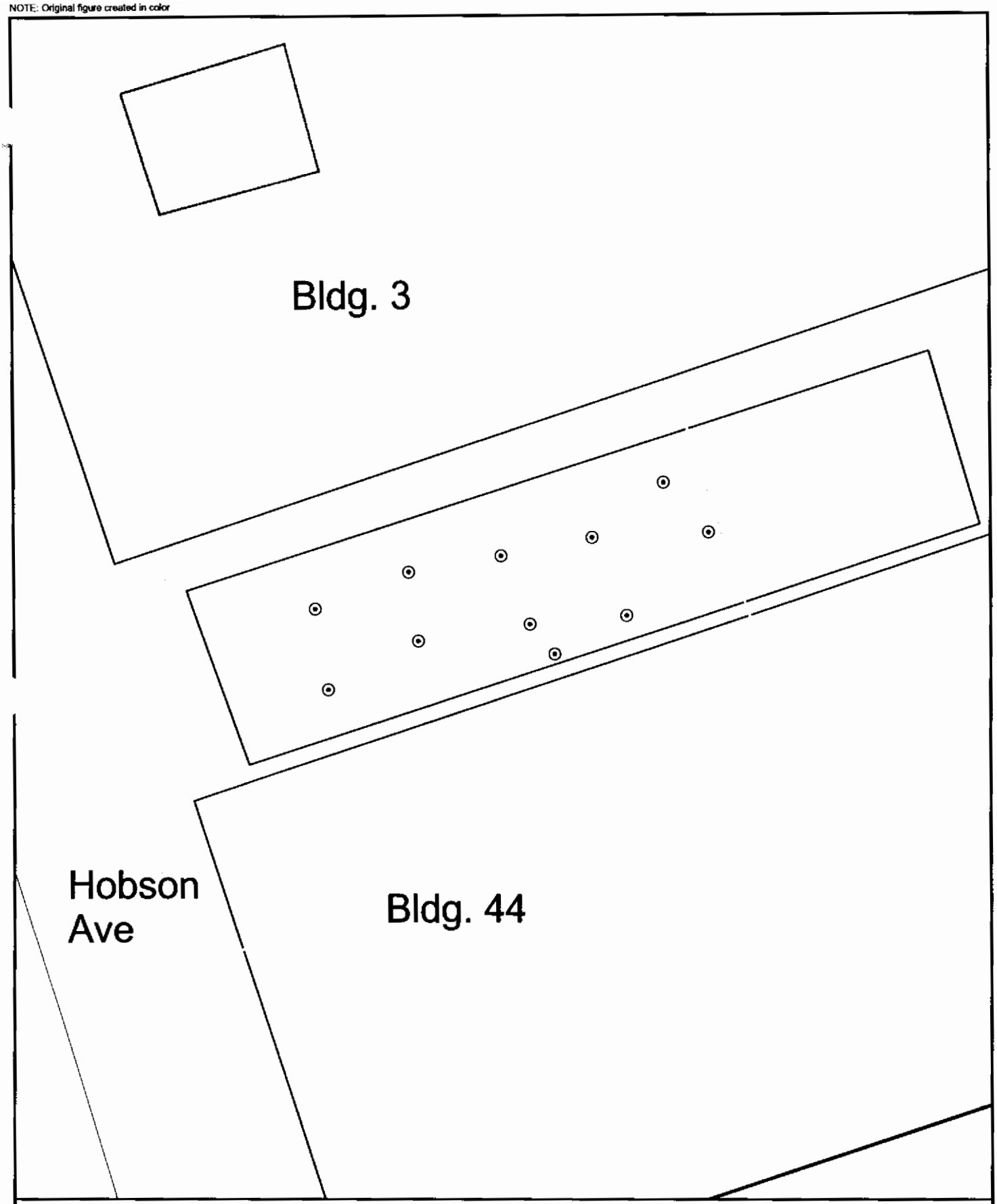
TABLE 8-1
Outline of Focused CMS Report for Combined SWMU 70, Zone E
CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

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 Alternatives**
3.1	Approach
3.2	Evaluation Criteria
3.3	Description of Alternatives
3.3.1	Soil Alternatives
3.3.2	Groundwater Alternatives
3.4	Detailed Analysis of Alternatives
3.4.1	Soil Alternatives
3.4.2	Groundwater Alternatives
3.5	Comparative Analysis of Alternatives
3.5.1	**Comparative Analysis of Soil Alternatives**
3.5.2	**Comparative Analysis of Groundwater Alternatives**
4.0	**Recommended Remedial Alternative**
4.1	**Recommended Soil Alternative**
4.2	**Recommended Groundwater Alternative**
5.0	**References**
Appendix A	**Corrective Measure Alternative Cost Estimates**[b]
List of Tables	
List of Figures	

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

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

NOTE: Original figure created in color



Proposed Sample Locations
AOC Boundary
SWMU Boundary
Buildings

N

0 20 40 Feet

1 inch = 21.0598 feet

Figure 8-1
Proposed Surface and Subsurface Soil Sample Locations, SWMU 25
Charleston Naval Complex

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File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 24 Jul 2002 12:18, User: PFAVARA, RFIRA_CMSWP: Figure 8-1 Proposed Surface and Subsurface Soil

9.0 Discussion of Potential Remedial Alternatives

During the CMS, the refined site hydrogeologic model and new soil data collected from SWMU 25 will be used to evaluate several groundwater and soil remediation technology alternatives. The feasibility of using ZVI to chemically reduce hexavalent chromium in groundwater is currently being evaluated; the data that have been collected to date are presented below in Section 9.1. The identification of other potentially applicable corrective measure technologies is discussed in Section 9.2. These technologies will be thoroughly evaluated and screened in the Phase II CMS.

9.1 Preliminary Conclusions from the Pilot Test Using ZVI Delivered via Injection

Ferox^{sm} injections were conducted within 15 boreholes between January 8 and 28, 2002. A Work Plan for this effort was previously prepared and approved by EPA. The details associated with the injection of ZVI into the subsurface at Combined SWMU 70 are presented in Appendix I.

Each injection event consisted of a 5 to 15-second injection duration and targeted a discrete 2-ft linear interval within the borehole. The intervals were sealed using pneumatic packers that were inflated above the target zone. Starting at the deepest interval, injections were performed working upwards in the borehole. As the injection equipment was raised, the sandy formation collapsed under the equipment, forming a boundary layer below the injection nozzle and negating the need for a lower straddled packer.

The locations of the injection borings are presented in Figure 9-1. A total of 16,725 kg of ZVI was injected into the subsurface. The amount of ZVI delivered to discrete boring intervals is presented in Figure 9-2. Table 9-1 details the amount of iron injection at each boring and depth.

Following treatment, groundwater monitoring wells were sampled. Also, groundwater vertical profile samples were collected from eight different locations. Groundwater samples were collected from three different depths in the vertical profile locations. The results of the post-treatment groundwater samples (vertical profile samples and monitoring wells) are

presented in Figures 9-3, 9-4, and 9-5 (each figure represents a different elevation). A discussion of pre- and post-sample data from each well is provided below. The pretreatment sample results are represented by groundwater chemistry reported in April 2001. Two post-treatment sampling events have been completed. The samples collected in May 2002 were intended to be represented by one sampling event, however, the samples were inadvertently not analyzed for chromium or hexavalent chromium, so an additional sampling event was required to collect this data. However, the data collected in May 2002 will be referred to collectively as the second sampling event. Data for the monitoring wells for the March 2002 event are presented in Appendix J. The data for the Hach tests are not included, as the method detection limits were not adequate for the purposes of this study.

The Phase II CMS Work Plan specified that post-treatment groundwater samples would be analyzed for the parameters that are listed in Table 2-2 of that document (CH2M-Jones, 2002). An evaluation of pre- and post-treatment data is presented in the following sections (note this discussion is limited to groundwater monitoring wells as these were the only means by which to evaluate pre- and post-treatment data). A full analytical report for all groundwater data collected as part of the pilot study is presented in Appendix K.

Redox reaction with ARS' Ferox^{SM} ZVI powder involves Fe^0 oxidation with dissolved oxygen and subsequent chromate ion reduction with Fe (II) cations.

In a reducing environment, the iron will react following equation (1);

$$Fe^0 + 2H^+ = Fe^{2+} + H_2 \qquad (1)$$

When oxygen is present, the iron will react following equation (2);

$$Fe^0 + 1.5O_2 + 6H^+ = Fe(OH)_3 + 1.5H_2 \qquad (2)$$

With the presence of chromate, the net reaction will be;

$$Fe^0 + CrO_4^{2-} + 4H_2O = Fe(OH)_3 + Cr(OH)_3 + 2OH^- \qquad (3)$$

9.1.1 Monitoring Well E070GW001

Total pretreatment chromium and hexavalent chromium results for this well were 2,580 and 2,070 $\mu g/L$, respectively. Three post-treatment groundwater samples were collected from this well (February and May 2002). The total chromium results for post-treatment samples are similar. The hexavalent chromium results showed an initial decrease to 770 $\mu g/L$ in February, however, this value was reported as 1,450 $\mu g/L$ in the May sampling episode. The

pH, hydrogen and Eh results indicate that geochemistry at this location was not significantly affected by the injection of ZVI.

9.1.2 Monitoring Well E070GW002

Total pretreatment chromium and hexavalent chromium results for this well were below the MCL for chromium. The hydrogen and Eh results indicate that the geochemistry at this location was not significantly affected by the injection of ZVI. However, pH results have decreased slightly. As presented in Equation 3, a pH increase would be expected when ZVI is actively being oxidized in groundwater.

9.1.3 Monitoring Well E070GW01D

Total pretreatment chromium and hexavalent chromium results for this well were 31,000 and 30,600 μg/L, respectively. Three post-treatment groundwater samples were collected from this well (February and May 2002). The total chromium results for post-treatment samples are similar. The hexavalent chromium results showed an initial decrease to 1,350 μg/L in February, however, this value was reported as 14,800 μg/L in the May sampling event.

The pH values are higher after treatment, as expected by Equation 3. Hydrogen results have significantly increased, when comparing pre-and post-treatment concentrations. Eh results also show a decrease overtime.

9.1.4 Monitoring Well Summary

The increase of hydrogen concentrations in groundwater is probably the most reliable indicator that the ZVI is active in an area near a monitoring point. A pH increase (see reaction 3) is expected with the emplacement of ZVI, increase in pH levels may. The Eh values (a calculated value based on oxygen reduction potential [ORP]) are not expected to be sufficiently reliable to definitively evaluate if ZVI oxidation is occurring near the monitoring point, but may provide evidence of a more reducing environment.

9.1.5 DPT Sample Results

Eight vertical profile groundwater sample borings were installed in March 2002 to collect discrete groundwater samples from different depths. Up to three samples were collected per boring. The locations of the borings, with respect to injection locations, are presented in Figure 9-1. Appendix J presents the total and hexavalent chromium results for each sample collected.

9.1.6 Comparison of Pre- and Post-Treatment Groundwater Samples

As previously stated, the monitoring wells discussed above were the only stations from which pre-and post-treatment data could be evaluated. The post-treatment boring data could not be compared to pre-treatment results since the same borehole was not used for sample collection. In order to evaluate the post-treatment data with respect to pre-treatment data, a section of the pre- and post-treatment groundwater plumes were constructed (note, since the dimensions of pre-and post-treatment sample grids were different, it was not possible to construct pre-and post-treatment 3-D plumes).

To construct the section of the same axis for both pre-and post-treatment data, the pre-and post-treatment groundwater data were loaded into a Environmental Visualization Software (EVS). The data was then krigged. Following this, a section from the same axis in both krigged data sets was extracted for visualization purposes. The results of this evaluation (i.e., pre- and post-treatment data) are presented in Figures 9-6 and 9-7. This figure indicates that post-treatment hexavalent chromium results have decreased, as compared to pre-treatment results.

It is expected that hexavalent chromium concentrations will continue to reduce over time, as more contaminated groundwater flows through the reactive treatment zone. To better evaluate the changing groundwater chemistry overtime, four new monitoring wells (two shallow and two deep) have been installed in the Combined SWMU 70 area; the location of these wells was presented in Figure 4-2 (E070GW005, E070GW006, E070GW05D, E070GW06D). These wells will be sampled during the first six to twelve months for the following parameters on a quarterly basis:

- pH
- Temperature
- Turbidity
- Dissolved oxygen (DO)
- ORP
- Conductivity
- Total chromium
- Total dissolved chromium
- Total hexavalent chromium
- Total dissolved hexavalent chromium
- Hydrogen
- Methane

Additional data from the pilot study will be available when the CMS is produced and will be evaluated in detail against the CMS evaluation criteria.

9.2 Identification of Corrective Measure Technologies

Corrective measure technologies that have the potential to reduce, eliminate, or control the unacceptable risk to human health and the environment to acceptable levels will be identified and screened.

A key element of the remedial approach to be developed for Combined SWMU 70 corrective measures will be the overall strategy for achieving the various RAOs.

The following preliminary list of technologies, presented below, was developed based upon the known site COCs and the RGOs desired for the site:

9.2.1 Groundwater

- Groundwater extraction and chemical/physical treatment
- LUCs
- In situ plume remediation using in situ reactive zones
- Permeable reactive barriers
- MNA, or enhanced MNA (alteration of groundwater geochemistry, with the addition of specific chemicals, to immobilize contaminants in groundwater)

Groundwater Extraction/Treatment for Hydraulic Containment

This technology involves strategically placed groundwater extraction wells which are pumped to control groundwater gradients, creating a hydraulic barrier which prevents migration of contaminated groundwater off site. The extracted groundwater is treated to remove contaminants and can be re-injected at strategic locations to further enhance hydraulic containment in the aquifer, or can be discharged. This approach is often determined during a CMS or its implementation to be excessively expensive and may be dropped during its development if more cost-effective methods for achieving plume control are identified.

LUCs

LUCs may be needed during the period before the MCSs are achieved. Such restrictions are likely to relate to control of zoning and groundwater use restrictions.

In situ VOC Source Area or Plume Treatment by ZVI Injection

This technology involves injecting powdered granular iron into the aquifer to promote in situ dechlorination of chlorinated VOCs (CVOCs). The process depends on the corrosion of the injected elemental iron particles to form ferrous iron and hydrogen, both of which are reducing agents for CVOCs in the saturated and vadose aquifer zones.

Permeable Reactive Barriers

This technology also involves ZVI, but includes construction of a permeable reactive wall of granular or powdered iron below the water table to intercept and treat the dissolved phase VOC plume as the groundwater passes through it, but before it moves off site.

MNA

This technology involves monitoring groundwater to evaluate naturally occurring aquifer processes such as biodegradation, dispersion, adsorption, and dilution of contaminants, which may be adequate to prevent migration of contamination away from Combined SWMU 70. MNA could be one component of an overall plume control strategy for portions of the plume.

Enhanced MNA

This technology is similar to that which is described above for MNA, with the addition of chemicals that would alter groundwater geochemistry to favor immobilization of dissolved COCs in groundwater.

9.2.2 Soil

- Capping with LUCs
- Excavation and removal
- In situ treatment with LUCs
- NFA

Capping with LUCs

This technology involves installation of an impermeable barrier over contaminated soils. The barrier would prevent further infiltration into contaminated soils and result in significant decreased in leachability of contaminants from soils. The cap would also prevent human receptors from coming into contact with contaminated soils. The suitability of the existing asphalt cap which was installed after the IM completed in 1998 will be evaluated.

Excavation and Removal

This technology involves removal of contaminated soils. Soil would be removed to a level where the remaining soils no longer poses a threat to groundwater or risks to human health.

In Situ Treatment with LUCs

This technology involves adding chemicals to the site to stabilize the leachability of metals.

NFA

As stated in Section 8.0, additional soil samples and SPLP data will be collected to redefined the extent of soil contamination following the IM completed in 1998. These data interpretations may result in a finding for NFA in soil.

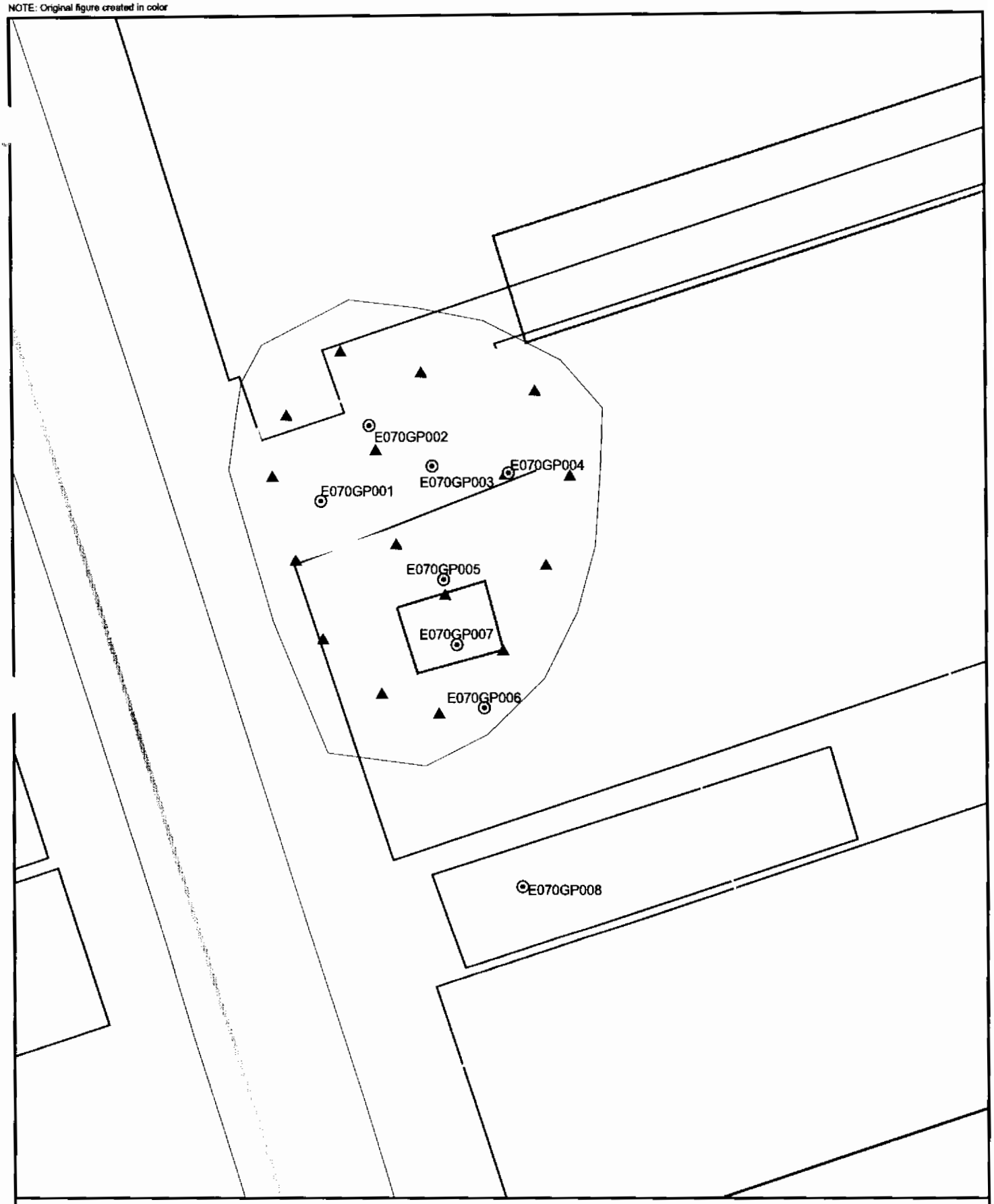
TABLE 9-1
Iron Distribution During Field Injections at Combined SWMU 70
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Injection Location	Date of Injection	Depth (ft bls)	Approximate Weight of Iron Injected (kg)
PF-1	1/10/02	15-27	900
PF-2	1/14/02	17-27	975
PF-3	1/8/02 1/9/02	11-27	1,150
PF-4	1/15/02	14.5-30.5	1,525
PF-5	1/12/02	13-27	1,300
PF-6	1/22/02	13-25	1,150
PF-7	1/11/02	13-27	1,225
PF-8	1/20/02 1/26/02	13.5-28	1,150
PF-9	1/18/02 1/19/02	11.5-29.5	1,650
PF-10	1/25/01	13-29	1,025
PF-11	1/19/02 1/25/02	12-30	1,150
PF-12	1/28/02	23-27	250
PF-13	1/17/02 1/18/02	19-29	950
PF-14	1/24/02	16-30	875
PF-15	1/23/02	13-31	1,450
		Total Iron Injected	**16,725 kg**

ft bls Feet below land surface

kg Kilograms

NOTE: Original figure created in color



Groundwater Probe
Pilot Study Treatment Zone
ZVI Injection Locations
Roads - Lines
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 30 60 Feet

1 inch = 39.199 feet

Figure 9-1
Injection Locations and Post-Treatment
Vertical Profile Sample Locations
Charleston Naval Complex

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File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 18 Sep 2002 14:02, User: PFAVARA, RFIRA_CMSWP: Charleston Naval Complex - Figure 9-1 Injection Locations and Post-Treatment

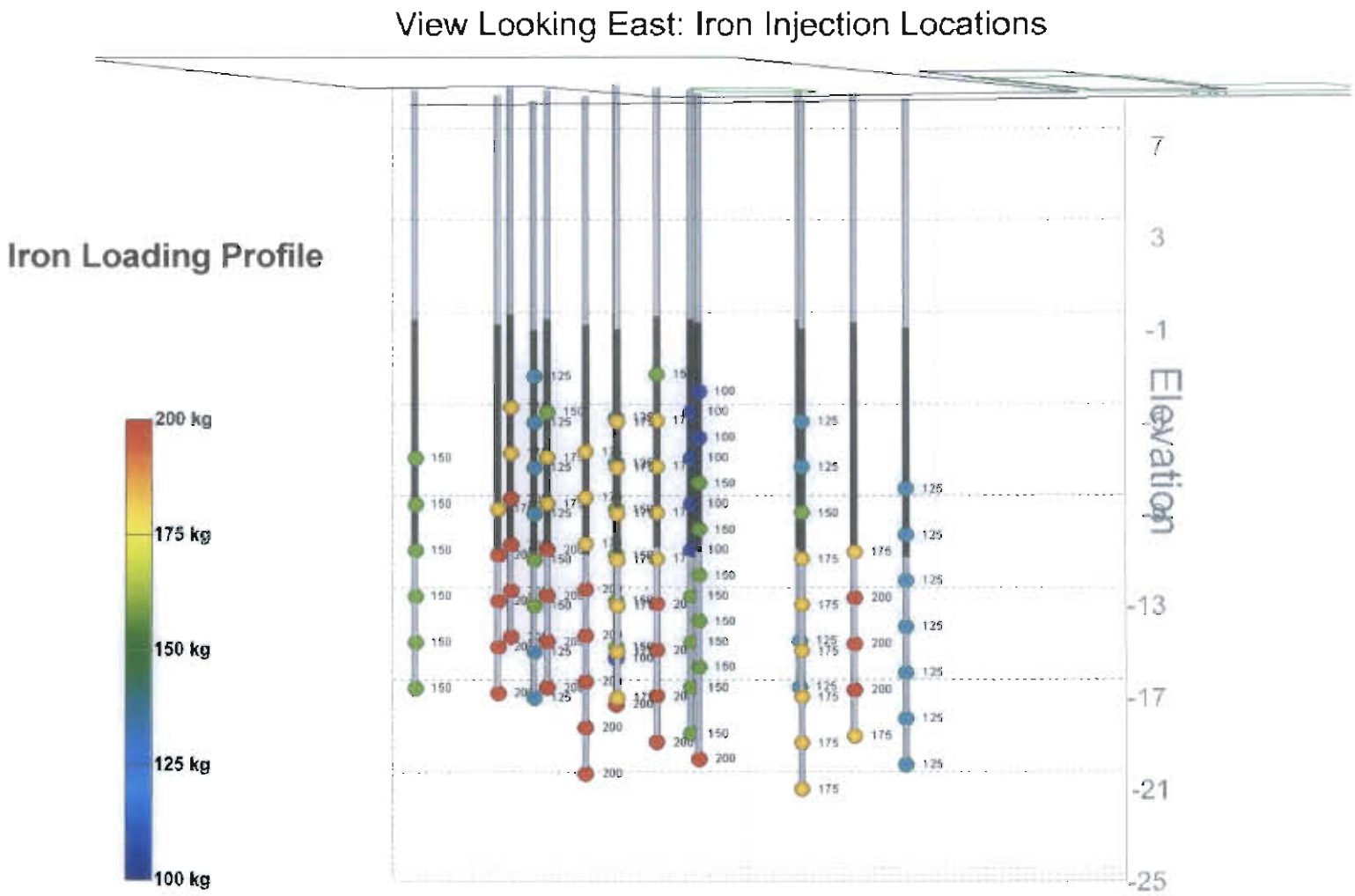

Figure 9-2

Iron Loading Profile
Combined SWMU 70, Zone E
Charleston Naval Complex

E092002019GNV

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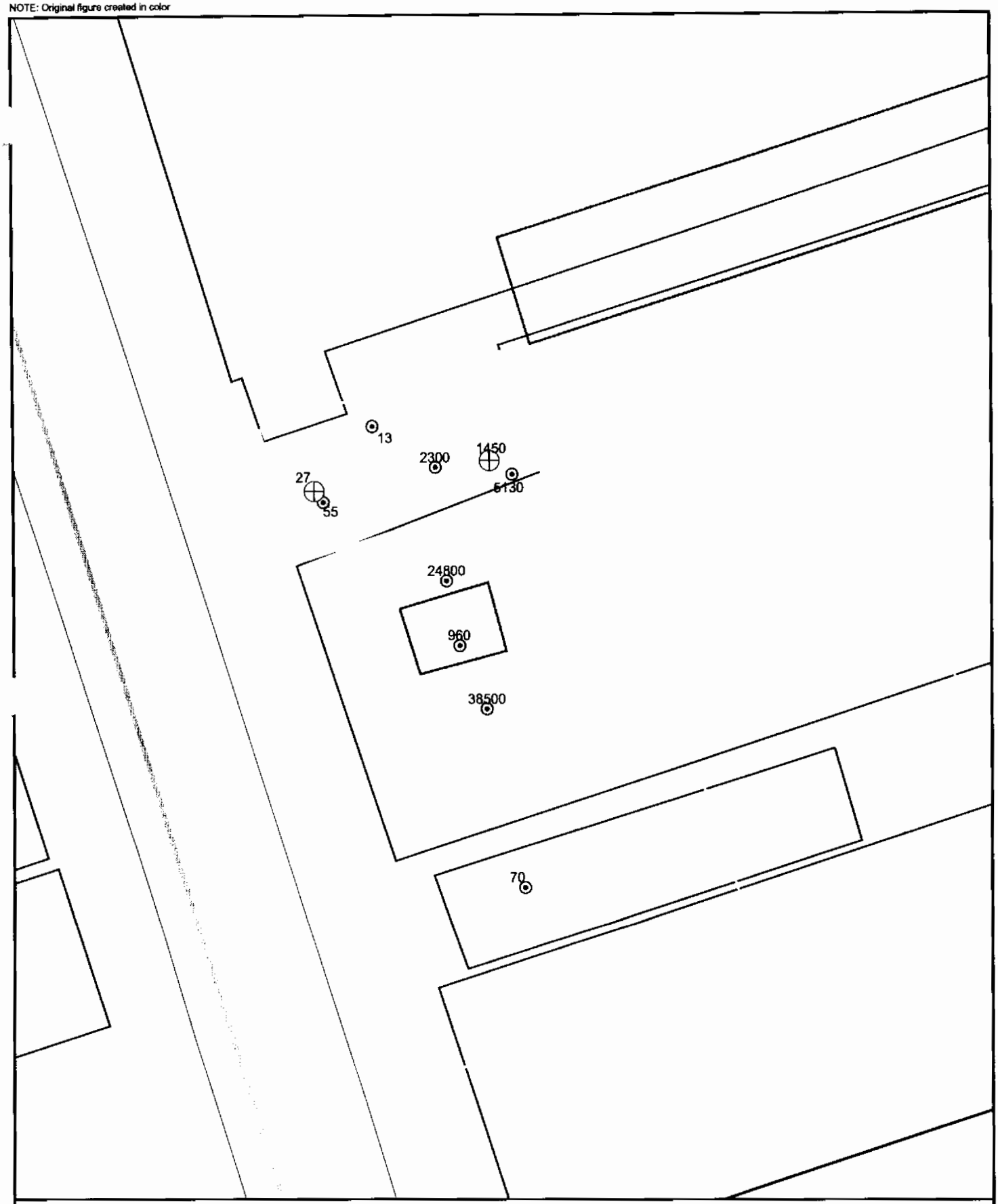
NOTE: Original figure created in color



Groundwater Probe
Monitor Well Location
Roads - Lines
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 30 60 Feet

1 inch = 39.199 feet

Figure 9-3
Post-Injection Cr6+ Results (ppb)
0 - 10 feet bgs
Charleston Naval Complex

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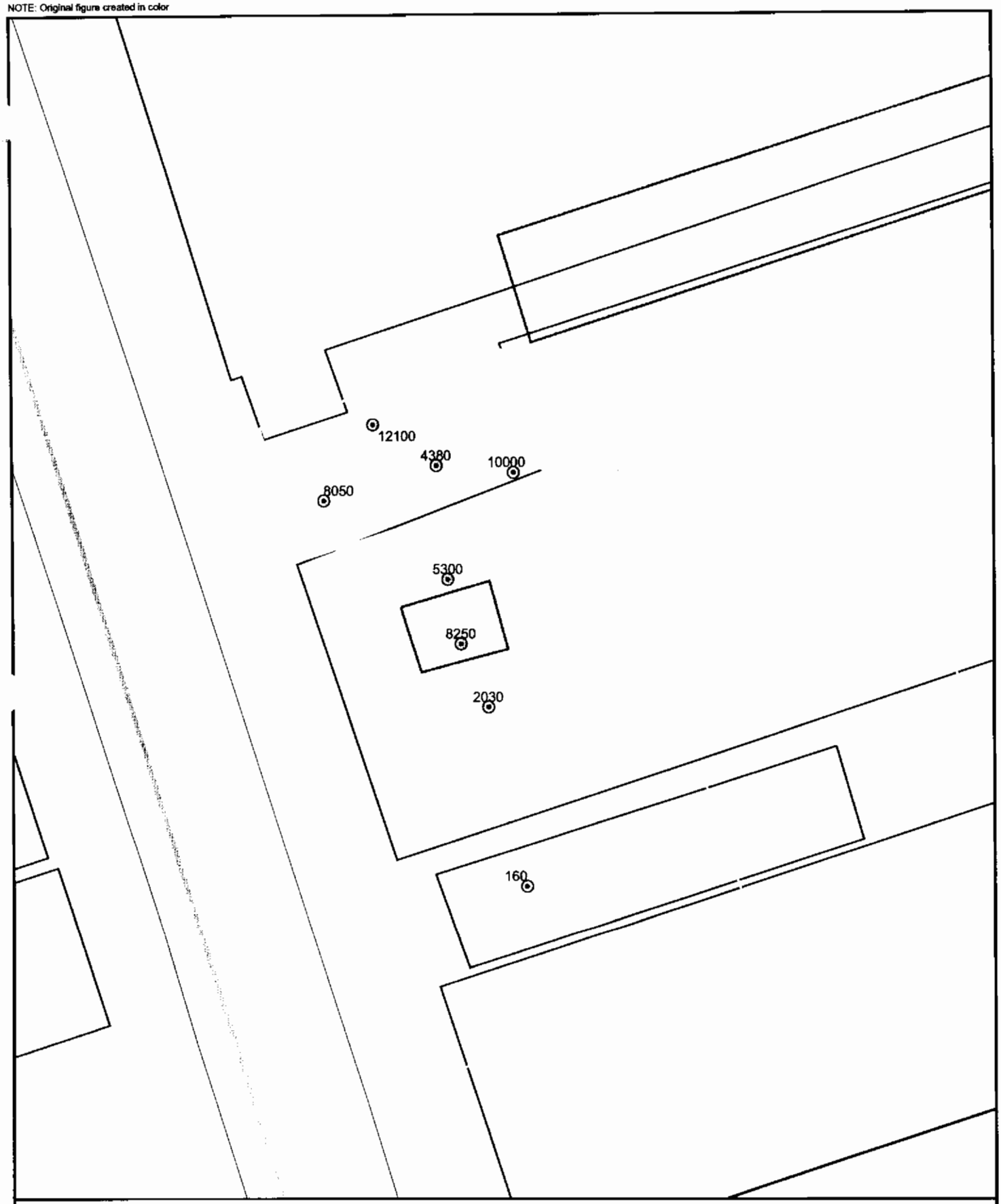
File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 18 Sep 2002 13:32, User: PFAVARA, RFIRA_CMSWP: Figure 9-3 Post-Injection Cr6+ Results (ppb)

NOTE: Original figure created in color



Groundwater Probe
Roads - Lines
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary

N

0 30 60 Feet

1 inch = 39.199 feet

Figure 9-4
Post-Injection Cr6+ Results (ppb)
10 - 20 feet bgs
Charleston Naval Complex

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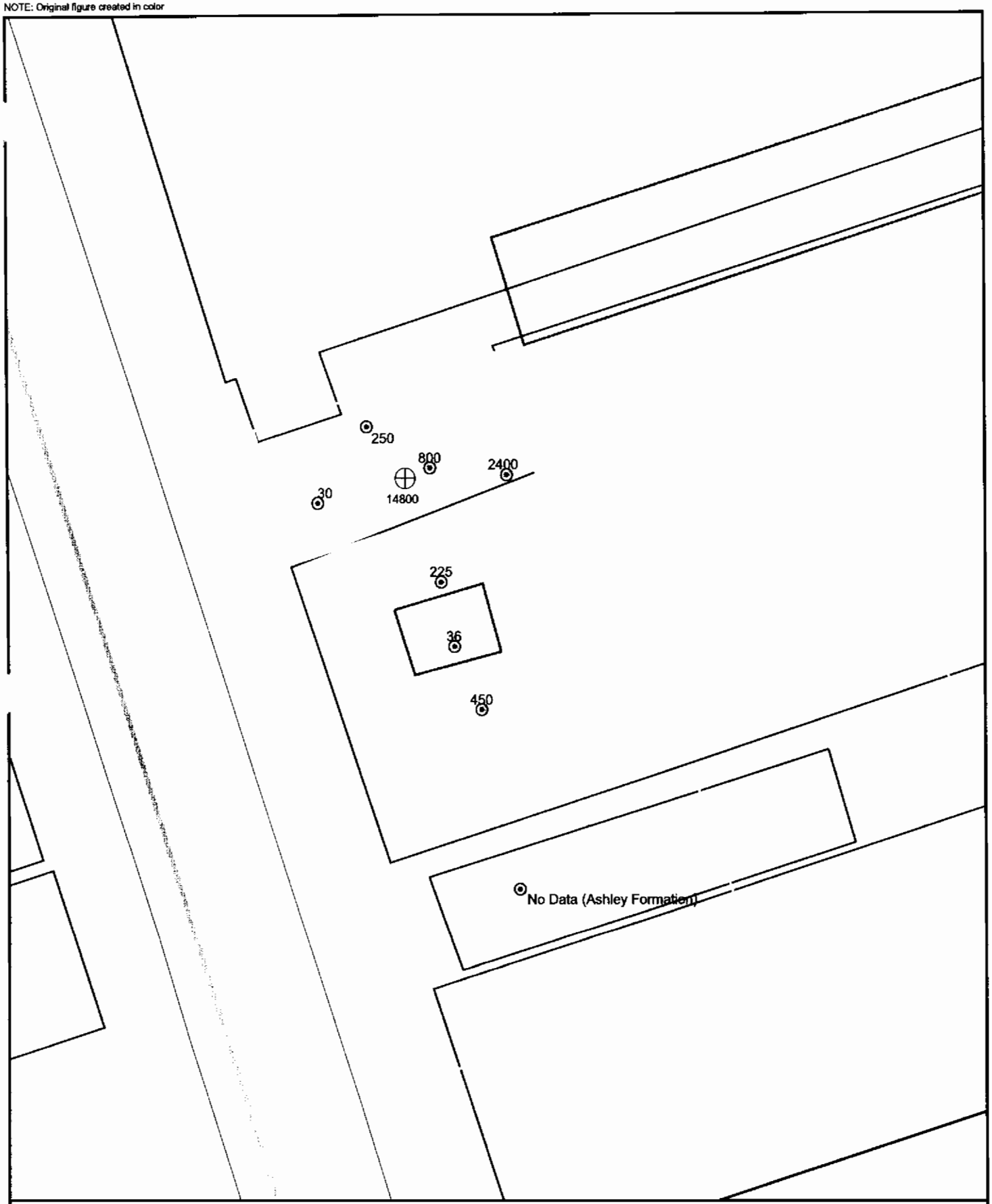
File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 18 Sep 2002 13:37, User: PFAVARA, RFIRA_CMSWP: Figure 9-4 Post-Injection Cr6+ Results (ppb)

NOTE: Original figure created in color



Groundwater Probe
Roads - Lines
AOC Boundary
SWMU Boundary
Buildings
Zone Boundary
Monitor Well Location

N

0 30 60 Feet

1 inch = 39.199 feet

Figure 9-5
Post-Injection Cr6+ Results
20 - 31 feet bgs
Charleston Naval Complex

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File Path: c:\18gis\projects\zone_e\combined swmu 70\aprs\rfira_cmswp.apr, Date: 18 Sep 2002 15:43, User: PFAVARA, RFIRA_CMSWP: Figure 9-5 Post-Injection Cr6+ Results

Cr^{6+} Pre-Treatment Profile View - Cross Section down Spine

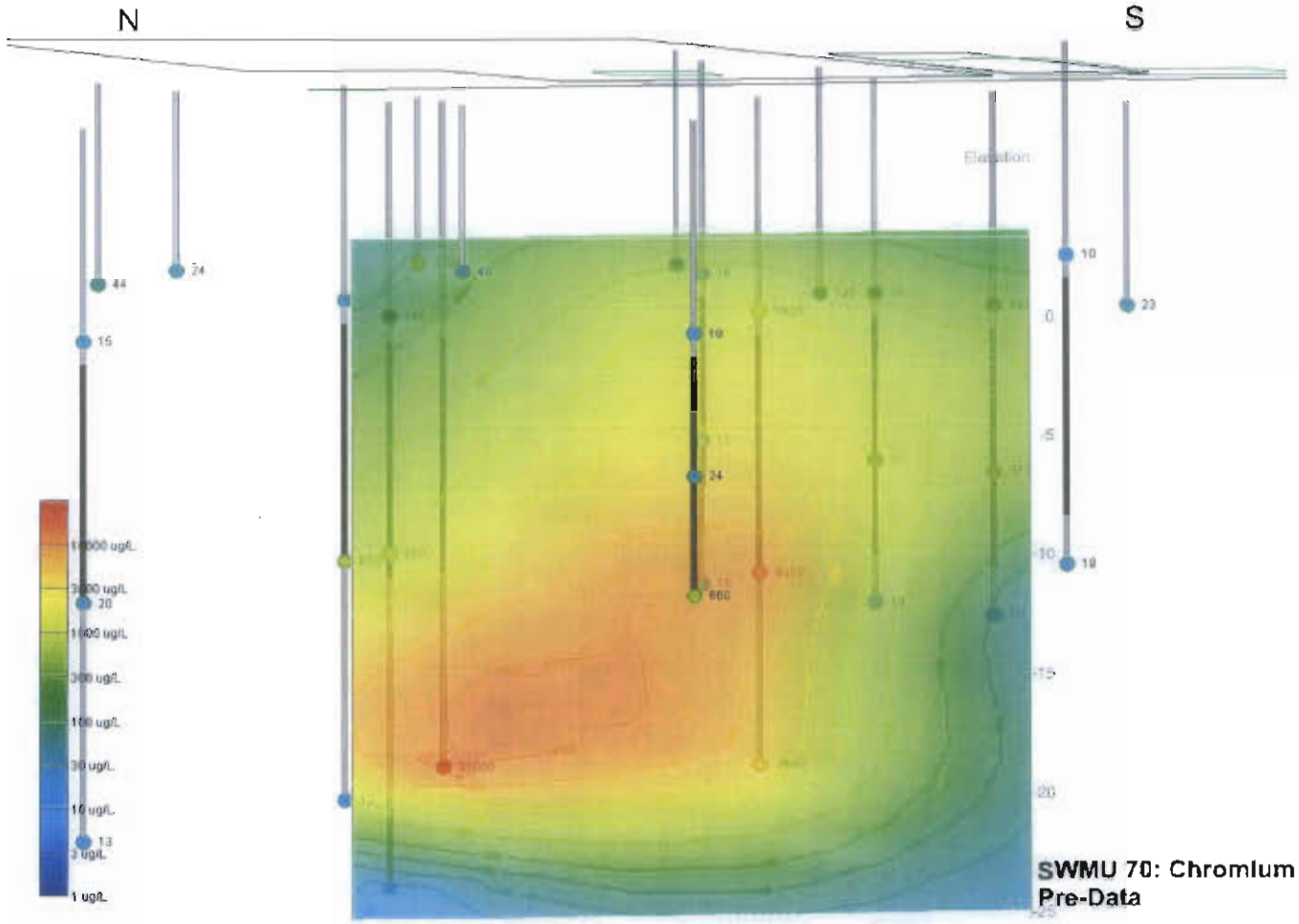

Figure 9-6

Hexavalent Chromium Pre-Treatment-Centerline of Treatment Zone
Combined SWMU 70, Zone E
Charleston Naval Complex

E092002019GNV

CH2MHILL

Cr^{6+} Post-Treatment Profile View - Cross Section down Spine

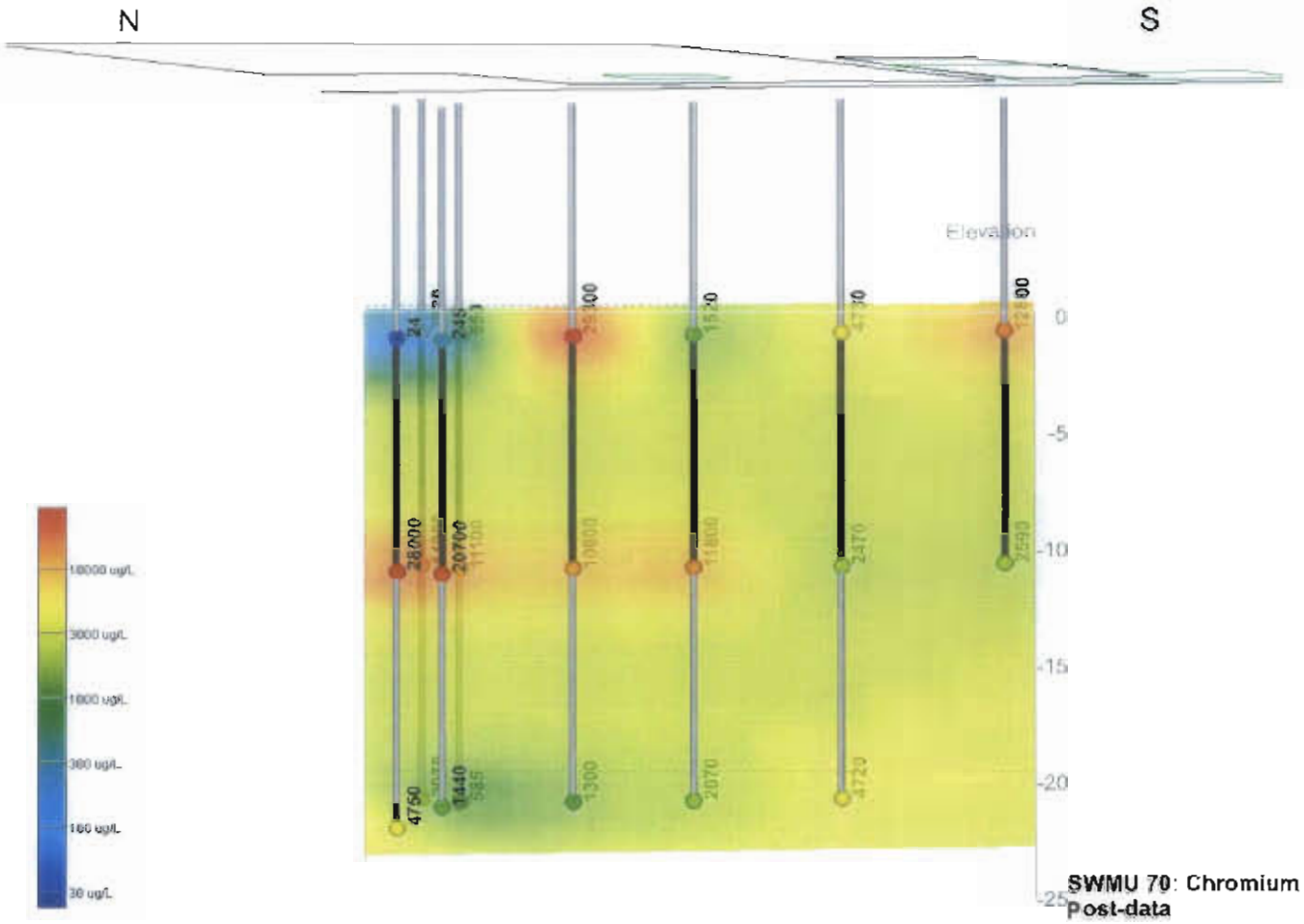

Figure 9-7

Hexavalent Chromium Post-Treatment-Centerline of Treatment Zone
Combined SWMU 70, Zone E
Charleston Naval Complex

E092002019GNV

CH2MHILL

Section 10.0

10.0 References

CH2M-Jones. *Technical Information for Development of Background BEQ Values*. Revision 0. 2001.

CH2M-Jones. *Adult Lead Methodology (ALM) Derived Target Lead Concentrations for Industrial Use*. Technical Memorandum. 2001.

CH2M-Jones. *Project Team Notebook and Instructions*. Charleston Naval Complex. Revision 1A. 2001.

CH2M-Jones. *Phase II CMS Work Plan, Combined SWMU 70, Zone E*. Revision 1. 2002.

EnSafe Inc. *Draft Zone E RCRA Facility Investigation Report*. Charleston Naval Complex. Revision 0. 1997.

EnSafe Inc. *Zone J RCRA Facility Investigation Report*. Charleston Naval Complex. Revision 0. 1998.

USEPA. Integrated Risk Information System (IRIS) http://www.epa.gov/iris/. 2001.

USEPA. Health Effects Assessment Summary Tables (HEAST). EPA-540-R-97-036. 1997.

Appendix A

Response To Comments from Charles B. Watson — SCDHEC
for Draft Zone E RCRA Facility Investigation Report
Charleston Naval Complex

General Comment
The Zone E RFI submittal uses industrial RBC's as part of the determination of contamination. And in some cases, an inappropriate industrial RBC was referenced. Sampling results need to be compared to residential RBC values. Therefore, it is requested that all sampling results be re-evaluated based upon residential RBC's from the latest EPA Region III RBC Table. In addition, it is requested that comparison be made in the same units as the table. Based upon review of the RFI as submitted, only AOC's 571 and 592 are recommended for NFA classification.

Response to General Comment
The screening of analytical results for Zone E had been previously discussed in Project Team meetings. It was agreed upon by the Project Team, including SCDHEC representatives, that Zone E data be screened using industrial RBCs. This approach was again submitted in the pre-submittal review for the Draft Zone E RFI Report and the Project Team again had a chance to comment and were fine with the approach. Residential and industrial RBCs were used in the risk assessment to select COPCs for the site worker and residential scenarios. Both residential and industrial RBC comparisons are presented in the CPSS tables in the site-specific risk assessments of the Draft Zone E RFI Report. In the final Zone E RFI Report the reader will be referred to the appropriate sections for comparisons to residential RBCs.

Site-Specific Comments and Responses

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.

Response 1
The history of the building will be further investigated and included in the Final Zone E RFI Report.

SWMU 65, AOC 544/546
Comment 2
Page 10.6-33 (Table 10.6.6.2). Lead exceeded industrial soil RBC (1,300 mg/kg) with 3,130 mg/kg. More sampling is required for this area.

Response 2
The sample referred to is a sediment sample collected from a catch basin (storm drain) at AOC 546. The catch basin was cleaned during interim measures conducted by the Environmental Detachment Charleston. Details of the cleaning can be found in the Closure Report for AOC 699 Storm Drain Cleaning prepared on March 8, 1999.

Comment 3
Page 10.6-4, states that since free product was discovered in 065SB006, an additional soil boring (065SB00603) was installed. The location of this boring has not been included on location maps. In soil boring 065SB0063, the soil was described as "fine sand with oily stains in laminations". Analyses were performed but data was not presented. The RFI states that two VOC's, TPH-GRO, and fifteen metals were detected. The data should be presented and a determination made as to the full extent of the impact.

Response 3
The text states "During drilling, free product was noted in soil boring 065SB006, prompting the collection of an additional soil sample (065SB00603)." An additional soil boring was not installed. The last 2 digits of the sample identification refer to the interval at which the sample was collected. The location of soil boring 065SB006 is shown on Figure 10.6.1, the same location from which sample 065SB00603 was collected. Refer to Section 3 of this report for the sample identification system. None of the detected concentrations exceeded their respective SSLs. Analytical results are included in Appendix H of this report. The source of the free product has been identified as a UST, which has been removed and is now part of the UST program. The responsibility of delineating the extent of contamination has fallen under the jurisdiction of the UST program. SCDHEC may want to discuss this site with Mr. Paul Bristol of the Departments UST program.

SWMU 70, AOC548/549
Comment 4
The extent of contamination of the soil around 549SB010 should be fully characterized for lead.

Response 4
The extent of lead contamination has been determined on the east, west, and south sides of 549SB010 with borings 549SB001, 549SB008, 549SB009, and 549SB012. Due to the thickness of the concrete floor and the equipment in place in Building 3 along the northern perimeter of AOC 549, soil samples were not collected in this area. The closest accessible area to the site is approximately 120 feet to the north inside Building 3, which would not have been a representative sample for the site.

SWMU 81
Comment 5
The previous building located at this site had a wooden floor which could have allowed spills to reach soil underneath the building. What determined that the soils underneath the pad and around the pad did not need to be sampled?

Response 5
The less-than-90-day accumulation area was not a building, but a sheltered area with a wooden platform for storing drums and containers. The wooden platform sat on the concrete foundation of the area adjacent to the seawall, thus any spillage would have been onto the concrete, therefore areas of stained concrete were sampled rather than soil. The Final Zone E RFI Report will be clarified to include this information.

SWMU 97
Comment 6
Arsenic, beryllium, and chromium were above residential RBC for surface soil and should be evaluated.

Response 6
Arsenic, beryllium, and chromium were addressed in the site-specific risk assessment which identified the fact that each of these elements were well below their respective background reference concentrations.

SWMU 100
Comment 7
Arsenic and beryllium were above residential RBC for surface soil and should be evaluated.

Response 7
Arsenic and beryllium were addressed in the site-specific risk assessment which identified the fact that each of these elements were well below their respective background reference concentrations.

SWMU 102

Comment 8
The Navy should investigate the level of cleanup conducted in 1969 for the mercury spill. The information should assist with the determination of contamination and exact location of the spill.

Response 8
Intense scrutiny by the Project Team resulted in an expanded investigation of this site. All available records were researched and interviews of former employees were conducted in order to determine where the spill occurred. The area of investigation was expanded several times to cover the entire building area after the initial investigation revealed no source. All results were documented and reviewed by the Project Team for several consecutive months and it was agreed upon by the Team that all investigative efforts had been exhausted. The Final Zone E RFI Report will be revised to reflect the level of effort put forth to investigate this site.

Comment 9
The report indicates that the mercury release was discovered inside the central portion of the building; however, samples 102SB0101 and 102SB011, and 102SB012 (located along southwest edge of building) were sampled for mercury vapor. The navy should sample in locations closer to the approximate release area. Also, the Navy must sample for mercury in the lower soil interval.

Response 9
Mercury vapor samples (see Section 10.14.5) were collected at each of the soil sample locations shown on Figure 10.14.1. Lower-interval soil samples were collected at 39 of the 46 proposed locations. These results are presented in Section 10.14.2.

SWMU 170/171
Comment 10
Aroclor-1260 was detected above the residential RBC in boring 171SB0012 and 171SB0013. The vertical and horizontal extent of contamination should be determined.

Response 10
The area around boring 171SB013 has been delineated vertically and horizontally. Additional upper and lower-interval samples will be collected along the western edge of 171SB012 to complete delineation of Aroclor-1260 at this location.

AOC 525
Comment 11
Arsenic and beryllium were detected above the residential RBC in surface soil. The vertical and horizontal extent of contamination should be determined.

Response 11
Arsenic and beryllium were addressed in the site-specific risk assessment which identified the fact that each of these elements were well below their respective background reference concentrations.

AOC 528
Comment 12
Benzo(a)pyrene equivalents, arsenic, and beryllium were detected above the residential RBC in surface soil and should be evaluated. Sediment samples from 528M0001 exhibited levels of BEQs, pesticides and metals above the residential RBC and should be evaluated.

Response 12
Benzo(a)pyrene equivalents were detected in one sample at a concentration above its residential RBC but well below its industrial RBC. Arsenic and beryllium were detected at concentrations above their respective RBCs but were well below their respective background reference concentrations. The sediment sample from the catch basin did exhibit elevated concentrations of metals, pesticides, and BEQs, however, this catch basin was cleaned during interim measures conducted by the Environmental Detachment Charleston. Details of the cleaning can be found in the Closure Report for AOC 699 Storm Drain Cleaning prepared on March 8, 1999.

AOC 530
Comment 13
The Department recommends adding Lead to the list of Contaminants of Concern in the soils. The report indicates elevated levels in the southwest area. Also, soil borings should be installed closer to the northeast area of AOC 530 if possible.

Response 13
Lead was detected in all 11 surface soil samples, however, the mean detected concentration for AOC 530 was 336 mg/kg, below its residential clean up level, and no sample exceeded the industrial cleanup level of 1,300 mg/kg. Samples were collected from the closest accessible locations adjacent to AOC 530.

AOC 531
Comment 14
Site history reveals the existence of electric transformers and Aroclor-1260 was detected in the first round of soil sampling. The Department therefore recommends the addition of Aroclor-1260 as a Contaminant of Concern.

Response 14
Aroclor-1260 was detected in 2 surface soil samples but each of these were well below their respective industrial RBCs. These samples were collected in locations where the old PCB-containing transformer were located and where the highest concentrations would be detected.

Comment 15
The first round of soil samples were analyzed for VOCs, SVOCs, PCBs, metals, and pH; but the second round was analyzed for only SVOCs, metals, and pH. The Department recommends that CMS samples include VOCs and PCBs.

Response 15
Additional sampling will be conducted for VOCs and PCBs.

AOC 538/539
Comment 16
Line 12 on page 10.23-2 states "AOC 538 will not include soil samples from 538002 and 538003. The Department does not agree with this exclusion. Please provide information in the revision and also include their locations on the site map.

Response 16
Please refer to Section 10.4.1, Figure 10.4.1, page 10.4-3 in Volume III of this report. Sample locations 542SB002 and 542SB006 for AOC 542 are the same locations which were proposed for sample locations 538SB002 and 538SB003 for AOC 538. Therefore, due to the proximity of these 2 sites, these locations were designated with the AOC 542 identification. Analytical results from these 2 locations were taken into consideration during the interpretation of nature and extent of contamination at AOC 538. The Final RFI Report will be revised to clarify this statement.

AOC 555
Comment 17
The area of former Building 2 has not been sampled. The Department recommends collection of a minimum of one soil sample per AOC Level III for metals and PCBs.

Response 17
The location of former Building 2 is on the edge of Pier D, an area built on pilings and over water. The only media samples which could be collected were sediment and surface water, therefore sediment samples were collected. A surface water sample would not have been representative due to the time elapsed since the facility was in service.

AOC 558
Comment 18
An explanation is needed as to why concrete core samples were not collected in the middle of the building.

Response 18
Concrete samples were collected from the concrete pads associated with [illegible] witchge[illegible] outside the building to investigate possible releases of dielectric fl[illegible] Wipe sampl[illegible] collected from the several areas within the transformer vault and i[illegible]uded any st[illegible]d ar[illegible] inside the building to detect any possible migration pathway of re[illegible]sed dielect[illegible] fluid.

Comment 19
The Navy should collect soil samples around building 77 for DQO Leve[illegible] [illegible]andard suite of parameters which includes VOCs, SVOCs, pesticides/PCBs, metal[illegible]nd o[illegible]

Response 19
An attempt will be made to collect soil samples from aroun[illegible] [illegible]77 for the st[illegible] [illegible]uite of parameters.

AOC 567
Comment 20
Arsenic, antimony, beryllium, and chromiu[illegible]re detect[illegible] in soil abo[illegible] their residential RBC values. The vertical and horizontal extent [illegible]ntaminati[illegible] needs to be [illegible]termined.

Response 20
Arsenic, bery[illegible]m, and chrom[illegible] [illegible] addresse[illegible] [illegible]specific risk assessment which identified [illegible]hat each [illegible]ments were [illegible]elow their respective background reference [illegible]ns. Anti[illegible]ove its residential RBC and background reference concentratio[illegible]it was we[illegible]ndustrial RBC.

AOC 569/570/5[illegible]
Comment 2[illegible]
The site [illegible]p shows a former [illegible] in the center of AOC 570 but the report did not mention its for[illegible] existence or usage.

Re[illegible]nse 21
I[illegible]mation regarding Bui[illegible]ng 1199 will be researched and included in the Final Zone E RFI [illegible]t.

AOC 580
Comment 22
In the conclusions of the report, lead was noted to be at its highest concentrations along the northern and eastern walls of Building 10. These areas should be investigated thoroughly as part of the RFI.

Response 22
Lead was detected in all 9 surface soil samples, however, the mean concentration for lead was 314 mg/kg, below its residential clean up level of 400 mg/kg, and no sample exceeded industrial cleanup level of 1,300 mg/kg. Additional samples will be collected along the northern and eastern edges of Building 10 to assure that the site has been delineated.

AOC 583
Comment 23
N-Nitroso-di-n-propylamine and pentachlorophenol were detected at concentrations above their respective SSLs and should be confirmed by resampling as part of the RFI.

Response 23
Additional sampling will be conducted in the area of [illegible] to confirm the presence of these 2 compounds and assure that the site has been delineated.

AOC 590
Comment 24
Section 10.43.7 reports "two storm sewer inlets" exists in the AOC. Only one sewer inlet was sampled for the investigation. Please verify the existence or absence of the other inlet. Also, has the Navy performed an interim measure for the sediment [illegible]?

Response 24
Only one [illegible] was present [illegible] site during the investigation. It appeared that the other drain inlet [illegible] covered over, [illegible] sample could not be collected. The existing catch basin was cleaned [illegible] interim measure conducted by the Environmental Detachment Charleston. Details [illegible] cleaning can be found in the Closure Report for AOC 699 Storm Drain Cleaning [illegible] March 8, 199[illegible]

Comment 25
On page 10.43-20, the word acetone has been improperly used in the first paragraph for acetone.

Response 25
The correction will appear in the Final Zone E RFI Report.

AOC 598/599
Comment 26
Soil samples identified exceedances for lead in several areas of AOC 598 and AO[illegible]9. Page 10.47-36 states that "soil samples collected for the AOC 597 RFI defin[illegible] the extent [illegible] soil to the north of sample location 598SB005, it is unclear whether the ex[illegible]s been a[illegible] defined to the west of sample location 598SB005". The Departmen[illegible] commends ad[illegible] boreholes in the western area. Also, additional boreholes should be loc[illegible] near the cen[illegible] of A[illegible] 598.

Response 26
Additional samples will be collected in the area west of 598SB005 [illegible]at the site has been delineated.

AOC 602
Comment 27
Soil boring 602SB004 exhibited detections of Aroclor 1254 [illegible] above reside[illegible] RBC values. The surface soil around 602SB004 should the[illegible]re be in[illegible] PCB.

Response 27
Additional samples will be collected in the ar[illegible] around 6[illegible]SB004 to [illegible]ure that the site has been delineated.

draft

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

General Comments

Comment 1

Soil and groundwater sample blanks for several areas of investig[illegible]n contained [illegible]tecta[illegible] contaminants. These detections were noted in the volatile, semivolat[illegible] and metal[illegible]ethods. In accordance with the Environmental Protection Agency, *Standard Ope[illegible] Proce[illegible]res* for sample collection, trace contaminants in field, trip, equipment, and distilled [illegible]s may indicate a problem with either decontamination procedures and/or cross contam[illegible]amples during collection or transport. The RFI report should fully explain the existenc[illegible]taminants in blanks. Please revise the text to include this/these explanation(s).

Response 1

The Navy agrees with SCDHEC's statement that trace co[illegible] field, trip, [illegible]ent, and distilled water blanks may indicate a problem wi[illegible]mination p[illegible]dures and/or cross contamination of samples during colle[illegible] or tra[illegible]y effo[illegible] has been made to reduce cross contamination at CNC in o[illegible]er to elimi[illegible]ate [illegible]s. As part of the RFI process at CNC all Level III and IV [illegible]a collecte[illegible]vent th[illegible]ependent data validation. According to EPA guidelines, bla[illegible] contamin[illegible]on is allo[illegible] to be above certain levels, described in detail in Section 4 of th[illegible]e E RFI [illegible]port. If co[illegible]stent detections occur that would indicate a chronic problem, [illegible]bles the [illegible]vy to corre[illegible]he problem. Sporadic detections which are not indicative [illegible] chronic [illegible]lems en[illegible]e the Navy to use this information in an appropriate va[illegible]lati[illegible]. Section 4 [illegible] in the Final RFI Report to include all c[illegible]minants foun[illegible] blanks to [illegible]tempting to fully explain the existence [illegible]ontamin[illegible] blank wou[illegible]ve speculation which would serve little pur[illegible]

Comment 2

The RFI report [illegible]oundwate[illegible]aps specific to the SWMU and/or AOC. The groundwater[illegible]aps should [illegible]sent each quarter of groundwater levels collected.

Resp[illegible]e 2

Qua[illegible]rly water level measu[illegible]ts have been collected and will be reviewed. Site-specific sa[illegible]e location figures will [illegible] revised to include average groundwater flow directions in the F[illegible] Zone E RFI Report, [illegible]sed on the average flow direction over four quarters. Zone-wide [illegible]r maps will also b[illegible]rovided for each of the quarterly groundwater monitoring events.

draft

Comment 3
The report should also integrate the grid well locations and data into the standard SWMU or AOC well networks. The Navy should avoid overlooking the data from adjoining grid wells while investigating a site.

Response 3
Data from adjoining grid wells will be reviewed and included in the zone wide context and in the site-specific figures.

Site-Specific Comments

SWMU 5,18, AOC 605
Comment 4
Page 10.1-39 (line 10) Data from the first quarter sampling event were used to [illegible] groundwater exposure pathways. It would be useful to use data from other quarterly sampling [illegible] navy should explain the exclusive use of first quarter data.

Response 4
The point is well founded, however, considering the time project schedule was on a "fast track" and due to the vast amount of data going into the report, [illegible] quarter of validated groundwater data was used to assess the exposure pathway [illegible] Nevertheless, all four quarters of validated groundwater data were reviewed and taken into consideration prior to the submittal of the report. If any significant changes occurred in subsequent quarterly sampling events, these changes were considered and are reflected in the risk assessment summaries, the recommendations, and conclusions. Groundwater summary tables providing results from all quarterly sampling events are provided in Appendix H, part 1 of the draft report. All results, including the qualifiers and [illegible]tions for validated data will be provided [illegible] H, part [illegible] Zone E [illegible]port.

SWMU 21/54
Comment 5
Page 10.2-50 The [illegible] "combined SWMU 21 monitoring wells are no longer usable following interim measures [illegible]tions." Have replacement wells been installed to date? If so, the Navy should update the site [illegible] new well locations. If replacement wells have not been installed, the Navy should inform [illegible]partment of plans for monitoring the site.

Response 5
Prior to the interim action, metals detections in groundwater were sporadic and generally less than MCLs. These wells were not replaced after the detachment conducted the soil removal,

because the source of contamination was eliminated. 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. There are no plans to re-install monitoring [illegible] this site.

SWMU 22/25, AOC 554
Comment 6
Figure 10.3.2 should be followed by a groundwater contour map [illegible] each quarter of groundwater level data.

Response 6
Please see response to comment 2.

SWMU 23/63, AOC 540/541/542/543
Comment 7
Figure 10.4.2 should be followed by a groundwater contour map [illegible] quarter of groundwater level data.

Response 7
Please see response to comment 2.

Comment 8
Page 10.4-[illegible] indicate[illegible] migratio[illegible]ays".

Response 8
Please see page [illegible]s 16 and [illegible]

SWMU 65, [illegible]C 544/54[illegible]
Comme[illegible]
Free p[illegible]uct was reported in [illegible]. The Navy needs to locate the source of the free product. The [illegible]ity map seems to ident[illegible] a [illegible]ely pathway for free product to travel very near the soil boring. P[illegible]0.6.1, states that "until [illegible]74, spent pickling bath solution was discharged via the storm drain in[illegible]e Cooper River." Mo[illegible] assessment should be performed around storm drain system.
[illegible]nse 9

The source of the free product has been identified as a UST, which has been removed and is now part of the UST program. The responsibility of delineating the extent of contamination has fallen under the jurisdiction of the UST program. SCDHEC may want to discuss this site with Mr. Paul Bristol of the Departments UST program.

Comment 10

Deep well (NBCE06504D) reported a TCE value of 8.00 ug/L (MCL=[illegible]L) and vinyl [illegible] value of 6.00 ug/L (MCL=2.0 ug/L). DCE was also detected, but belo[illegible]e MCL. Th[illegible]rizo[illegible] and vertical extent of organics in the lower aquifer should be determi[illegible]

Response 10
Organics were also detected in elevated concentrations in shallow g[illegible]r. Prior to the installation of additional shallow wells, the UST program will be cons[illegible]mine if they have already installed additional shallow wells in response to t[illegible] pre[illegible]ent #9. Additional deep monitoring wells will be installed in the area ar[illegible]nd SWM[illegible]rther delineation of these contaminants.

Comment 11
Shallow wells have exceedances for MCL of metals[illegible]dditional [illegible]ep [illegible] installed to adequately delineate the vertical extent of contam[illegible]ation in th[illegible] deep aq[illegible]ddition to the installation of additional deep wells, both shallo[illegible]ells and ex[illegible]ng deep w[illegible] should be resampled to monitor the concentrations of metals.

Response 11
Discussions are ongoing pertaini[illegible] to [illegible]e widespre[illegible] inorganics in groundwater and how to i[illegible]pret the signi[illegible] that data[illegible] memo was submitted to the Project T[illegible]view sev[illegible]ago and i[illegible]iefly discussed at a meeting with SCDHE[illegible] that m[illegible]EC indicated their review of the memo was not complete an[illegible] discussi[illegible] deferred until that review was complete. Deep and shallow gr[illegible]at this s[illegible] recommended for CMS and long-term monitoring.

SWMU [illegible], AOC 548/549
Comm[illegible]t 12
Chr[illegible]um was detected in ext[illegible]high amounts in NBCE07001D at 52,500 ug/L, exceeding the M[illegible] of 100 ug/L. The Nav[illegible] should present the percentage of the Chromium detected in the h[illegible]alent form?
[illegible]nse 12

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 comp[illegible] In that memo it was noted that an additional sample was collected at this well NBC[illegible] using a low flow method and the level of chromium dropped an[illegible] of ma[illegible] NBCE07001D will be resampled and analyzed for hexavalent chro[illegible]n and results provided in the Final Zone E RFI Report.

Comment 13

Page 10.8-19 (line 11) states "No MCL has been established for chloro[illegible] The Department has informed the Navy in previous reviews that an MCL of 100 ug/L [illegible] established for Monochlorobenzene. The report should be revised to reflect the prop[illegible] info[illegible]

Response 13

The Final Zone E RFI Report will be revised to reflect th[illegible]on.

Comment 14

The report indicates that shallow wells NBCE0700[illegible] and NBC[illegible]49003 h[illegible]es of 1.82 and 2.27 respectively. Since the materials of conce[illegible]sts acids t[illegible] Departmen[illegible] concerned about this pH. The Navy has failed to define the horiz[illegible]nd verti[illegible] extent of th[illegible]cidic conditions in the shallow aquifer. The Navy should resam[illegible]e wells a[illegible] consider th[illegible]nstallation of additional wells if the exceedances continue.

Response 14

As a result [illegible]mment, [illegible] researche[illegible] discrepancy and has determined the follow[illegible] from sha[illegible]BCE070002 and NBCE549003 indicated a very low pH and resu[illegible] well NB[illegible]t the same site and analyzed during the same quarterly sampl[illegible]dicated a[illegible]H. Based on field measurements recorded in a legal binding [illegible] pH resu[illegible]ted from these same wells, during the same quarterly sampl[illegible]he subse[illegible]nt rounds of sampling, indicated very different results. The[illegible]d notes in[illegible]pH measurement of all shallow and deep wells at this site ranged f[illegible]n 5 to slightly gr[illegible] during each quarterly sampling event. Based on field notes, [illegible]d the fact that th[illegible]uch a wide contrast in pH results provided by the labo[illegible]ory, it appears the lab[illegible]ate[illegible]y errantly analyzed for pH out of sample containers which ha[illegible] reviously been prese[illegible]d for metals with nitric acid and for cyanide with sodium h[illegible]xide, rather than fr[illegible] unpreserved samples. Wells at this site will continue to be

draft

monitored in the future, including for pH, which will be measured in the field to confirm this determination.

Comment 15
The report indicates that deep well NBCE07001 had a pH value of 13.10. The Navy ha define the horizontal and vertical extent of the basic conditions in the deep a The Na resample the well and consider the installation of additional wells if the edances cont

Response 15
The well referenced is actually NBCE07001D, which will continue monit d and the pH measured. Please see response to comment 14.

Comment 16
Page 10.8-27 The second paragraph refers to a groundwater flow vide call A, as discussed in Section 2.3.2. Mr. Paul Bergstrand has informed me that the suspect is anomaly, the storm drain line, has been repaired. The poten o the overal the groundwater in this area may be significant. The Navy s the ground r flow direction using a minimum of four quarters of new wa evel dat hould included in the revised RFI report.

Response 16
This comment suggest that the Navy del omittal the report one year while four quarters of water level measurements a ected. T is not prac al. Groundwater levels have been measured for four continuou arters an l be eval d. One additional round of measurements will be collect a evaluated e previous data and new groundwater tour maps wi nitted in t E RFI Report.

Comment 17
Page 10.8-47 "S at a local m plume exists in the area of SWMU 25 and SWMU 70." The N provide a ter map and an isoconcentration map to assist in the horizontal ination ntamination migration.

Respons 7
A piez etric map and isoco n map will be provided in the Final Zone E RFI Report. Co coded concentration ps rovided in Appendix K will also assist in determining the ex of chromium contam ation.

S U 83/84, AOC 574

Comment 18

The upper interval soil boring 083SB010 (1,400 mg/kg) exceeded the lead industrial RBC of 1,300 mg/kg and the lead background RC of 265 mg/kg. The RFI states that a soil cleanup/screening level for lead of 1,300 mg/kg was calculated for the Zone H RFI using the Adult Lead Mode[illegible]. The RFI states that only one surface soil sample exceeded this limit; however, the mean sur[illegible] soil concentration for combined SWMU 83 is 231 mg/kg and falls below the U[illegible]EPA both[illegible] adult cleanup/screening levels. The Navy has calculated the mean lead [illegible] and has concluded no further action. The Department recommends that the Navy [illegible]ll additional s[illegible] points of the area surrounding 083SB010. The horizontal and v[illegible]cal extent o[illegible]he [illegible] contamination should be determined. In summary, the Department d[illegible] not accept [illegible]t localized elevations of lead should be diluted with analytical values from surrou[illegible] sampl[illegible]oints that may be below detection limits.

Response 18

As shown on Figure 10.10.11, the horizontal extent has been defin[illegible]o th[illegible]3SB001, to the west by 084SB001, and to the south by 083SB009. An additional s[illegible]ill be installed to delineate the northern edge.

Comment 19

Data reveals that Arsenic may be a key COC at this a[illegible] for both th[illegible]so[illegible]water. The Department agrees with the Navy's recommend[illegible]on for C[illegible]. The [illegible]t would also recommend the formation of an isoconcentratio[illegible]p and inte[illegible]tion of pot[illegible]al sensitive receptors that may mobilize contaminants.

Response 19

Arsenic was identified as a COC i[illegible] bo[illegible] soil and d[illegible] groundwater, which have been recomm[illegible]ed for CMS a[illegible] The site [illegible] further evaluation during the CMS, at w[illegible] the prop[illegible]e for reme[illegible] will be selected. Isoconcentration maps wil[illegible]ded in th[illegible]E RFI Report. The Navy does not understand the comment "i[illegible]f potenti[illegible] receptors that may mobilize contaminants", therefore a resp[illegible] be subm[illegible]

Comment 2[illegible]

Groundw[illegible]r data reports tha[illegible]as detected at levels above the MCL (.002mg/l) for four wells [illegible]ing the second, third [illegible]h quarters of groundwater sampling. The horizontal and verti[illegible] extent of thallium con[illegible]ntr[illegible]ons in the area must be determined.

Response 20

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 meeting SCDHEC indicated their review of the memo was not complete and that discussion should be deferred until that review was complete.

Comment 21

Page 10.6-42 States that "PAHs are not of concern because most chlorinated group are not particularly mobile in soil or groundwater." The Department does not agree with this comment and recommends delineating the horizontal and vertical extent of PAHs in the

Response 21

In accordance with carcinogenic polynuclear aromatic hydrocarbon (cPAH) guidelines, BEQs were calculated for cPAHs at this site. At issue seems to be whether or not it would be feasible to continue sampling when constituents are so wide-spread and have already been collected from all across the zone. Due to the high number of potential source close to one another and the shallow depth of groundwater contribution of [illegible] may or may not be attributable to any one site or source. The majority of second round sampling was conducted on the basis of arsenic and BEQs detected in the initial round of sampling and for the purpose of determining whether or not these constituents were wide-spread across Zone E. Results of second round sampling indicate that BEQs wide-spread across Zone E, as well as NAVBASE Charleston in general, and the feasibility of additional sampling is questionable.

Comment 22

Figure 10.[illegible] is listed as [illegible] detected, yet free product has been reported for this well. The figure should be revised.

Response 22

The figure will be revised to include the SVOCs detected in the free product sample collected at NBCE065[illegible]. The figure will be included in the Final Zone E RFI Report after the risk has been re-calculated.

draft

SWMU 87/172, AOC 564
Comment 23
Page 10.11-16, The first paragraph states "No MCL has been established for chlorobenzene". The Department has informed the Navy in previous reviews that an MCL of 100 ug/L ha been established for Monochlorobenzene. The report should be revised to reflect the proper info on.

Response 23
The Final Zone E RFI Report will be revised to reflect this informa .

SWMU 97
Comment 24
Antimony and arsenic were above residential RBC for shallow groundwa ture and extent should be evaluated. The RFI is therefore incomplete.

Response 24
Antimony, although considered a COPC, was reported only in the origina r sample and was not reported at a concentration above a limit during nd, third, or fourth quarters of sampling. Arsenic was dete tions greate han its corresponding background reference concentratio ny in th arterl sampling events. However, the last two sampling events yi ed concen ati e reference concentration and/or detection limit. A compari n of the m imum oncentrations of antimony and arsenic at nearby wells in tes that timony w not detected in any groundwater samples, and arsenic did n eed its erence con ntration. All arsenic detections were less than the maximum rted con tration of 5 mg/L at SWMU 97. Neither antimony nor arsenic exceede eir respe MCLs, t efore it appears that the risk and hazard posed by antim y arsenic h estimated. Discussions are ongoing pert ng to the wid presence in groundwater and how to interpret t cance of technical as submitted to the Project Team to review hs ago a fly discussed at a meeting with SCDHEC in June. At that mee C indica iew of the memo was not complete and that further discussi e deferre eview was complete.

SWMU 100
Commen 25
Arseni as above residentia shallow groundwater. The nature and extent should be eval ed. The RFI is therefo nplete.

Response 25

Arsenic was detected at concentrations exceeding its corresponding background reference concentration in the first two quarterly sampling events only. It did not exceed its reference concentration in the last two quarterly sampling events and did not exceed its MCL [illegible] any sampling event. Therefore it appears that the risk and hazard posed by arsenic ha[illegible]en overestimated. Discussions are ongoing pertaining to the widespread p[illegible]ence of i[illegible] in groundwater and how to interpret the significance of that data. [illegible]nical m[illegible] submitted to the Project Team to review several months ago and it [illegible]briefly discus[illegible] meeting with SCDHEC in June. At that meeting SCDHEC indicate[illegible]eir review o[illegible]e me[illegible] was not complete and that further discussion should be defer[illegible] until tha[illegible]eview was complete.

SWMU 102

Comment 26

Page 10.14-13. Line 11 states "Gasoline (TPH-GRO) was detected." [illegible]dditional [illegible]ld be collected in the effected well for petroleum constituents.

Response 26

TPH, as a single component, was not considered [illegible]OPC f[illegible]ns: 1) the TPH analysis was used as a screening tool for subseque[illegible]specific a[illegible]ys[illegible]se TPH did not have an RBC value specifically assigned to i[illegible]But becau[illegible] TPH is [illegible] of numerous organic compounds, commonly called sur[illegible]e compo[illegible]ds, the to[illegible]ity of TPH can be evaluated when reviewing VOC and SVO[illegible]. The S[illegible]HEC Risk-[illegible]sed Corrective Action For Petroleum Releases document (June [illegible]) has ide[illegible]ed certain [illegible]OCs and SVOCs (Table 8; RBSLs for Ingestion or Dermal Co[illegible]ct with Su[illegible]ial Soil) f[illegible]nd in TPH which pose a toxicity risk. Specifically to Secti[illegible] 1[illegible].2, four o[illegible]mpounds were identified as exceeding th[illegible]espective RBC[illegible]fter evalu[illegible]lts, calculating the BEQs, and going thro[illegible]oxicity a[illegible]EQs were [illegible]ed as both a Human Health Risk COPC a[illegible]t SWMU[illegible]ficial soil. BEQs were identified as needing further evaluation as [illegible]CMS pro[illegible]refer to the memorandum attached to the Zone C CMS Work [illegible] "Use of [illegible]C Analytical Results for RFI Evaluation at CNC." The Navy [illegible] specific [illegible]nts of TPH and their subsequent evaluation of them have b[illegible]dressed i[illegible]e RFI report, therefore, no additional samples will be coll[illegible]d for TPH.

Co[illegible]ent 27

So[illegible]ta for Arsenic on page [illegible].14-14 should be summarized in an isoconcentration map.

draft

Response 27
There appears to be a sufficient number of sample points at this particular site, therefore, isoconcentration maps for arsenic will be presented in the Final Zone E RFI Report.

Comment 28
The reason for the particular well locations is not clear. The current locatio[illegible] not be i[illegible] the area of mercury release. The Department recommends installation o[illegible]ditional wells[illegible]

Response 28
The Navy will collect additional soil samples at several locations w[illegible] exceed[illegible] generic SSLs. These samples will be analyzed for the constituents which exce[illegible] respective SSLs according to the Synthetic Precipitation Leaching Procedure (SPL[illegible] TOC content. Results will be reviewed and the need for additional monitoring we[illegible]termined.

Comment 29
Page 10.14-20 states "the current soil-groundwater equilibrium [illegible] of the surf[illegible]er." The location of the well is not specific to the location[illegible]nt. The D[illegible]rtment recommends placing a well in the area of the maximu[illegible]ported c[illegible]

Response 29
Please see response to Comment 28.

Comment 30
Page 10.14-23. The Navy has instal[illegible]d a[illegible]adequate [illegible] to support the statement, "the current distrib[illegible]n of mercury c[illegible]on in soil a[illegible] protective of groundwater at the site".

Response 30
Please see respo[illegible]ment 28.

Comment 3[illegible]
Page 10.[illegible]56. Were the sa[illegible]r 102CB004 and 102SB041 the same?

Res[illegible]se 31
Ye[illegible]urface soil samples we[illegible] collected from the 0- to 1-foot interval at each location.
S[illegible]U 106, AOC 603
[illegible]ent 32

draft

The investigation of Dry Dock #3 would benefit greatly through the collection of a sediment sample from the drain. The Navy should collect a sediment sample if possible.

Response 32
A representative sediment sample will be collected from the drain of Dry Dock #3, if p[illegible]le.

Comment 33
Section 10.15.3 states that existing grid wells NBCEGDE03D and NBC[illegible]DE03 will be [illegible]d ra[illegible] than installing additional wells; however, no data from the wells exists i[illegible]e report. P[illegible]se provide.

Response 33
Soil and groundwater analytical results which exhibited concentra[illegible]ding reference concentrations, RBCs, and MCLs in these grid wells, are presente[illegible] and extent writeups in Section 10.50. Soil and groundwater results for all [illegible]d we[illegible]found in Appendix H, part 1 of the draft report. The Final Zone E RFI Report wi[illegible]ed to include the results for grid wells NBCEGDE003 and 03D in S[illegible]n 10.15.

Comment 34
Aerial photographs reveal the existence of relict tid[illegible]creeks in t[illegible] are[illegible]#3 trending from the Cooper River to the southwest. The Dep[illegible]ment there[illegible]e recom[illegible] installation of one well pair along the southwest border of [illegible] Dock #3[illegible] High soil [illegible]ontaminant values at 603SB003 supports a well in this area.

Response 34
Grid well pair NBCEGDE001/0[illegible]D [illegible]e located [illegible]of Dry Dock #3, but are approximate[illegible]0 feet from th[illegible]st edge. T[illegible] collect additional soil samples at several [illegible] which e[illegible]eric SSLs. [illegible] samples will be analyzed for the constitue[illegible]ceeded th[illegible]ve SSLs according to the Synthetic Precipitation Leaching Pr[illegible]LP), and [illegible]tent. Results will be reviewed and additional monitoring wel[illegible]talled in t[illegible]ecessary.

Comment 35
Section 10.1[illegible].1 Four o[illegible]ounds were detected in 106SB003. The report states that "none of [illegible] four compounds [illegible] in groundwater samples, indicating that the current soil-groun[illegible]ter equilibrium is s[illegible] protective of the surficial aquifer." The Department disa[illegible]s. Soil boring 106SB0[illegible] is [illegible]cated more than 200 feet from well NBCE10601 and will not su[illegible]t this statement. The D[illegible]artment therefore recommends the installation of an additional well di[illegible]y next to soil boring 1[illegible]SB003.

Response 35

The Navy will collect additional soil samples at several locations which exceeded generic SSLs. These samples will be analyzed for the constituents which exceeded their respective SSLs according to the Synthetic Precipitation Leaching Procedure (SPLP), and for TOC content. Results will be reviewed and additional monitoring wells will be installed in this [illegible] if necessary.

Comment 36

Figure 10.15.6 did not include grid wells NBCEGDE03 and NBCEGD[illegible]3D. Please r[illegible]se.

Response 36

Figure 10.15.6 will be revised to include both grid well pairs [illegible]DE003/03D and NBCEGDE001/01D. These will be included in the Final Zone E R[illegible]

AOC 525

Comment 37

Manganese was detected above the residential RBC in shallow [illegible]r. The natu[illegible]ent should be evaluated. The RFI is therefore incomplete.

Response 37

While it's true that manganese was detected at [illegible] concentra[illegible]n (905 [illegible]eeding its tap water RBC, this detection was well below [illegible]s backg[illegible]nd refer[illegible]e concentration of 2,560 µg/L.

AOC 530

Comment 38

The RFI re[illegible]tifies Tha[illegible]ected in th[illegible]ter samples collected from all four monitorin[illegible]centratio[illegible] MCL". The Department understands that Thallium exceedances [illegible]ssed in a b[illegible]dy.

Response 38

A significant p[illegible]roughou[illegible]one E have shown Thallium concentrations exceeding i[illegible]CL of 2 µ[illegible] Tap Water RBC of 2.9 µg/L. Discussions are ongoing pertainin[illegible]o the widespre[illegible]f inorganics in groundwater and how to interpret the signif[illegible]ce of that data. A[illegible] memo was submitted to the Project Team to review seve[illegible] months ago and it wa[illegible]y discussed at a meeting with SCDHEC in June. At that me[illegible]g SCDHEC indicate[illegible]heir review of the memo was not complete and that further d[illegible]ssion should be defer[illegible] until that review was complete.

draft

Comment 39
The report states on page 10.21-3 that sample data from 531SB001 will be incorporated in the AOC 530 investigation "due to their close proximity" with AOC 531. Figures should be revised to show the location of 531SB001.

Response 39
Figures in Section 10.21 will be revised to include soil boring 531SB001 in the Final Zone E RFI Report.

AOC 531
Comment 40
The report states on page 10.22-3 that sample data from 530SB006 will be incorporated in the AOC 531 investigation "due to their close proximity" with AOC 530. Figures should be revised to show the location of 530SB006.

Response 40
Figures in Section 10.22 will be revised to include soil boring 530SB006 in the Final Zone E RFI Report.

Comment 41
The report notes that "a 1986 UST Registration Document reports the presence of a 20,000-gallon fuel oil tank". Has the UST and associated piping been removed? The location of the UST should be indicated on the figure.

Response 41
The Navy will be unable to verify if the UST has been removed prior to and during the implementation of field work. The presence of the UST will be researched and verified and the location will be provided in the Final Zone E RFI Report.

Comment 42
The second and third paragraphs on page 10.22-25 make reference to AOC 530 instead of AOC 531. Please make the necessary revisions.

Response 42
The revisions will be made and provided in the Final Zone E RFI Report.

draft

AOC 538/539
Comment 43
The first paragraph on page 10.23-1 makes note of a "quench oil tank". Please describe the tank and its' function (ie., size, capacity, leak detection system). The sampling parameters should be evaluated to determine if they can detect a release from the tank.

Response 43
The dimensions of the tank are not known but it was used a dip tank for cooling hot steel and it did not have a leak detection system. Sample locations were placed in areas surrounding the tank. The analytical parameters for samples at this site included VOCs and SVOCs, which would have detected a wide range of materials stored, including petroleum-based oils.

Comment 44
Line 19 on page 10.23-10 states "One shallow well proposed for AOC 538 was identified as an AOC 542 monitoring well (NBCE542002)" and was therefore not included in this section. The Department does not agree with this exclusion. Please include the information from well NBCE542002 in the revisions and also include the location on the site map.

Response 44
Analytical results from this well were taken into consideration when evaluating the nature and extent of constituents at AOC 538. The analytical results from well NBCE542002, along with its location will be provided in this section of the Final Zone E RFI Report.

Comment 45
During a site visit on May 13, 1999, Department personnel noted the existence of a monitoring well in the area east of AOC 538. The Department recognizes the benefits to data collected in this area and the absence of such in this RFI section. Please include the data from this well and locate the well on Figure 10.23.2.

Response 45
This is the same monitoring well (NBCE542002) referred to in Comment 44. Please see the response to Comment 44.

AOC 550
Comment 46
Section 10.24.3 notes that one well was omitted from installation "due to the close proximity of the grid-based deep and shallow well pair". The Department agrees with these revisions; however, the report does not include data from the grid-based shallow well (NBCEGDE022).

Response 46
Analytical results from this shallow well were taken into consideration when evaluating the nature and extent of constituents at AOC 550. The analytical results from well NBCEGDE022, along with its location, will be provided in this section of the Final Zone E RFI Report.

AOC 551
Comment 47
Grid wells around AOC 551 have revealed elevated levels for tetrachloroethene, chlorobenzene, dichloroethylene, and trichloroethene in past sampling events. This data should be included in the RFI report. Also, the local groundwater flow regime has not been fully represented. The Department recommends collection of a minimum of four consecutive quarters of groundwater data and the production of associated flow maps. The Navy has not successfully delineated the nature and extent of the contamination at the area.

Response 47
Grid well NBCEGDE17D indicated detectable concentrations of several of the constituents mentioned, however, these constituents did not exceed their respective MCLs in groundwater samples collected at AOC 551. The Navy has delineated the nature of contamination in this area, however, in order to define the extent of contamination, the installation of several additional monitoring wells to the north and west of AOC 551 and grid well NBCEGDE17D may be required. These particular constituents have been identified at elevated concentrations at several sites and in grid wells throughout the northern portion of Zone E. Analytical results from this area will be evaluated and additional well locations determined. Please refer to responses to comments 2 and 16, regarding groundwater flow maps. Also, please refer to Appendix H, part 1 for summarized results of each quarterly sampling event.

AOC 555
Comment 48
Sediment samples from the Cooper River revealed eight metals above their sediment screening values. Additional samples should be collected to confirm the presence or absence of these metals.

Response 48
The intent was to sample point sources to determine the presence of contaminants. These results will be addressed in the Zone J RFI for evaluation of the overall significance.

AOC 559/560/561
Comment 49
The amount of contaminant detections in this area are overwhelming and should be summarized in map form with isoconcentration maps.

Response 49
Isoconcentration maps will be included in the Final Zone E RFI Report.

Comment 50
Data presented in the report indicates the need for additional wells to fully characterize the nature and extent of contamination. One area in particular is between building 391 and 32.

Response 50
Grid well pair NBCEGDE014/14D is located in the area between Buildings 391 and 32. Analytical results from this well pair will be included in this section of the Final Zone E RFI Report.

Comment 51
Page 10.29-24, the third paragraph states "No MCL has been established for chlorobenzene". The Department has informed the Navy in previous reviews that an MCL of 100 ug/L has been established for Monochlorobenzene. The report should be revised to reflect the proper information.

Response 51
The Final Zone E RFI Report will be revised to reflect this information.

Comment 52
The last sentence in the second paragraph on page 10.29-30 lists the organics that are commonly found in dielectric fluid. The paragraph should be revised to include N-nitroso-methylethylamine. This compound may be used in condensers to increase dielectric constant.

Response 52
The sentence refers only to these organics detected in shallow groundwater which are also commonly found in dielectric fluid. It is not a list of all organics commonly found in dielectric fluid, only those detected in shallow groundwater at the site. N-Nitroso-methylethylamine was detected in soil at the site, but not in shallow groundwater.

Comment 53
Section 10.29.8.2 COPC Identification should be revised to include the following compounds as COPCs: Benzo(a)anthracene, Benzo(b)fluoranthene, Benzo(a)pyrene, Dibenz(a,h)anthracene, and Indeno(1,2,3-cd)pyrene.

Response 53
Because these are polynuclear aromatic hydrocarbons (PAHs), they are included in the COPC list as benzo(a)pyrene equivalents (BEQs), a sum of PAHs detected in the samples.

AOC 563
Comment 54
Trichloroethene in shallow groundwater at AOC 563 has not been fully delineated both horizontally or vertically. Additional groundwater samples should be proposed.

Response 54
The Navy recognizes the TCE problem in shallow groundwater at this site. However, analytical results for shallow monitoring wells to the west at AOCs 569 and 570 do not indicate significant concentrations of TCE. Also, results from shallow wells to the south at AOCs 572 and 573 and from wells to the east at SWMUs 83, 84 and AOC 574 do not indicate elevated concentrations of TCE. Elevated concentrations of TCE have been detected in deep groundwater to the west at AOC 570 (NBCE57003D), consistently exceeding its MCL, but as previously mentioned, this particular constituent has been identified at elevated concentrations at several sites and in deep grid wells throughout the northern portion of Zone E. Analytical results from this area will be evaluated and the Navy will discuss additional well locations with the Project Team.

Comment 55
The first sentence in the third paragraph on page 10.31-18 should be revised. 1,2-Dichloroethene (total) was also detected in shallow groundwater at a concentration exceeding its corresponding tap water RBC.

Response 55
This sentence will be revised to include 1,2-Dichloroethene in the Final Zone E RFI Report.

AOC 566
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.

Response 56

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 several months ago and it was briefly discussed at a meeting with SCDHEC in June. At meeting SCDHEC indicated their review of the memo was not complete and that 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.

AOC 569/570/578

Comment 57

The data presented in this section should be presented in an isoconcentration map whenever possible. At this time, the Department is unable to determine if the extent of contamination has been fully characterized.

Response 57

Isoconcentration maps will be provided in the Final Zone E RFI Report.

Comment 58

The Department recommends the installation of additional groundwater points from areas around the existing well network in an effort to determine the vertical and horizontal extent.

Response 58

Grid-based [illegible] NBCE[illegible] are located [illegible] west of the site and indicated no significant [illegible] metals contamination. Additional monitoring wells will be placed to the northwest, southwest [illegible] help determine the extent of contaminants.

Comment 59

On page 10.34-2[illegible] states that "the elevated aluminum concentration in the sample from well NBCE5[illegible]02 indicates [illegible]ded clay particles affected the analytical results". The Navy may opt to collect future samples [illegible]ered versus non-filtered in an attempt to validate this statement.

Response 59

As part of the ongoing evaluation of inorganics in groundwater, the Navy will continue to [illegible] samples using the "low flow" method, which appears to have eliminated the need for

filtered samples. Samples are also being analyzed for TSS. If turbidity appears to persist, samples will be filtered.

AOC 573

Comment 60

Information contained in the Zone E RFI Presubmittal review for AOC 573 states that the site has been recommended for interim measures for the removal of sediment from the catch basins based on results of the sediment samples. If the sediment removal has been performed, confirmatory samples should be collected and reported to evaluate post-interim measure conditions and understanding residual contamination, if any, left in place.

Response 60

The catch basin was cleaned during interim measures conducted by the Environmental Detachment Charleston. Cleaning removed all sediment from the catch basin, therefore, there is nothing left to sample for confirmation. Details of the cleaning can be found in the Closure Report for AOC 699 Storm Drain Cleaning prepared on March 8, 1999. These results will be summarized in the Final Zone E RFI Report.

AOC 576

Comment 61

Organic compounds detected in first quarter groundwater samples from the deep well include 1,2-Dichloroethene (total). This compound may be a degradation product of trichloroethylene or tetrachloroethane. This RFI has not defined the horizontal or vertical extent of this contaminant. It has also failed to reveal the source.

Response 61

1,2-Dichloroethene was detected in monitoring well NBCE57602D. However, concentrations were below its RBC and MCL and the detection was not confirmed by nearby grid well NBCEGDE13D. Based on review of data from surrounding deep monitoring wells, the Navy feels it has delineated the extent of DCE contamination in this area. TCE and PCE have been identified in elevated concentrations in deep groundwater at several sites and grid wells throughout the northern portion of Zone E, therefore, DCE could very well be from the degradation of TCE and/or PCE. Due to the high number of potential point sources close to one another, contribution of contaminants may not be site-attributable. Analytical results from this area will be evaluated and the Navy will discuss additional well locations with the Project Team.

Comment 62

Organic compounds detected in first quarter groundwater samples from the shallow wells include pentachlorophenol above the MCL. Pentachlorophenol is a compound that is commonly used in the manufacturing of insecticides, algicides, herbicides, fungicides, and bactericides; wood preservatives. Soil data does not include pentachlorophenol or bromodichloromethane. The Department recommends the collection of additional soil samples to include these parame

Response 62
Soil samples collected from soil borings installed at the locations of s ow monitori were analyzed for SVOCs, and thus would have indicated entachlorop ol a bromodichloromethane had they been detected. There were no d ctions of e er of these compounds in soil.

AOC 580
Comment 63
Figure 10.40.6 which illustrates the distribution of lead in surface soil could b in an isoconcentration map to better understand the distribution of the contaminant. A he Department is unable to determine if the extent of contamina fully chara

Response 63
An isoconcentration map will be provided for lead tribution A mal Zone E RFI Report.

AOC 583
Comment 64
The following SVOCs exceeded their ustrial RB soil interval in addition to Benzo(a)pyre nd chrysene:

B(t		780
Benzo		780
Dibenzo(ne	1,	780

The second paragra 0.41-10 s evised to include the above.

Response 6
Lower-i val soil sample mpared to RBCs, but instead were compared to soil screen levels (SSLs) for gr r protection. Based on the comparisons to SSLs, BEQs, ben)anthracene, and chr ne xceeded their respective SSLs, as stated in the text on page 10 10.

Comment 65
The report should provide the exact locations of all USTs on the site and update the site map.

Response 65
An attempt will be made to identify the exact locations of the USTs and figures will be [illegible]ed for AOC 583 to include these locations in the Final Zone E RFI Report.

AOC 590
Comment 66
Five soil samples were submitted to be analyzed for TPH due to [illegible]ted OV[illegible] readings and petroleum odor in samples. The Navy reported levels of TPH-gasoline [illegible]ne upper-interval soil sample. Additional sampling should be conducted to identify the s[illegible] gasoline.

Response 66
TPH, as a single component, was not considered a COPC for two reasons: 1) [illegible]lysis was used as a screening tool for subsequent specific analysis; and 2) because TP[illegible]e an RBC value specifically assigned to it. But because TPH [illegible]d of numer[illegible]nic compounds, commonly called surrogate compounds, [illegible]H can be [illegible]uated when reviewing VOC and SVOC data. The SCD[illegible]C Risk-[illegible]ective [illegible]tion For Petroleum Releases document (June 1995) has ide[illegible]ified certa[illegible]s (Table 8; RBSLs for Ingestion or Dermal Contact with [illegible]rficial S[illegible]) found [illegible] which pose a toxicity risk. Specifically to Section 10.14.2, f[illegible] of the S[illegible]C compo[illegible]s were identified as exceeding their respective RBC values. Af[illegible]aluating [illegible] results, ca[illegible]lating the BEQs, and going through the toxicity assessment, [illegible]s were id[illegible]ified as bo[illegible]a Human Health Risk COPC and as a COC at AOC 590 for [illegible]icial soil. [illegible]Qs were i[illegible]tified as needing further evaluation as part of the CMS pr[illegible]ess [illegible]lease refer[illegible]ndum attached to the Zone C CMS Wor[illegible]an entitled "U[illegible]H and TIC[illegible] Results for RFI Evaluation at CNC." Th[illegible]eels that [illegible]omponent[illegible] and their subsequent evaluation of them i[illegible]quately [illegible] the RFI report, therefore, no additional samples will be collec[illegible]

Comment 67
The occurrence of le[illegible] soil arou[illegible]006 should be delineated further in attempt to characterize the [illegible] lead co[illegible]nation.

Respons[illegible]7
Additi[illegible]al soil samples will [illegible]d to the north, south, and west of soil boring 590SB006 to d[illegible]eate the extent of lead. Th[illegible]area to the east has been defined by soil boring 590SB002

[illegible]596

Comment 68
Table 10.45.6.2 shows arsenic and BEQ equivalent compounds contributing to risk and hazard for AOC 596 surface soil, with the highest concentrations of BEQ equivalents reported in surface soil samples 596SB006 and 596SB013. This area of AOC 596 is absent of both grid wells and site wells. The Department recommends the installation of an additional well to clarify the presence or absence of contaminants if the groundwater. Soil samples should also be collected during well installation. The Department therefore considers the RFI incomplete for AOC 596.

Response 68
Monitoring wells NBCE596001/01D were installed less than 100 feet from these soil borings. However, piezometric maps indicate that groundwater flows more northward, rather than directly toward the well pair. The concentrations of arsenic and BEQs do appear to be significant in soil at these locations, therefore, an additional deep and shallow well pair will be installed in the location of soil boring 596SB013.

Comment 69
The report indicates that only one round of groundwater data was collected for this site. The Department recommends that the Navy collect additional rounds of groundwater samples.

Response 69
Four rounds of groundwater sampling were conducted and will be presented in the Final Zone E RFI Report. Please see the response to Comment 4.

Appendix H (part 1)
Groundwater-Summary Table

Comment 70
The data is missing for AOC 559, AOC 560 and AOC 561. Please include the data in the revised report.
Response 70
Groundwater summary tables for AOCs 559, 560, and 561 will be included in the Final Zone E RFI Report.

Comment 71
The summary table should be revised to include an MCL of 100 ug/l for chlorobenzene. Sample 172GW001 from SWMU 172 reported a value above the MCL.

Response 71

Summary tables will be revised to include an MCL of 100 μg/L for chlorobenzene in the Final Zone E RFI Report.

Comment 72
VOCs were not sampled for rounds 2, 3 or 4 in AOC 530 (530GW001). Please explain.

Response 72
Results for VOCs was obviously omitted in the groundwater summary tables in Appendix. These samples were analyzed for VOCs during the 2nd, 3rd, and 4th rounds of sampling and this data will be included in the Final Zone E RFI Report.

Comment 73
Semi-volatiles were not sampled for rounds 2, 3 or 4 in AOC 538 (538GW001, 538GW01D). Please explain.

Response 73
Groundwater samples were analyzed for SVOCs in the [illegible] but were [illegible] in the 3rd and 4th rounds of sampling. Additional samples will be collected and analyzed for SVOCs and these results will be included in the Final Zone E RFI Report.

Comment 74
The MCL for bis(2-Ethylhexl)phthlate (BEHP) should be corrected as 6 μg/l, not NA.

Response 74
The MCL for bis(2-ethylhexyl)phthalate (BEHP) [illegible] in the EPA Drinking Water Regulations [illegible] Health Advisories listed as bis(2-ethylhexyl)phthalate with an MCL of 6 μg/L. This will be included in the Final Zone E RFI Report.

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Responses To Comments from Susan K. Byrd — SCDHEC
for Draft Zone E RCRA Facility Investigation Report
Charleston Naval Complex

General Comments

Comment 1

Section 6.2.1, Page 6-18, Line 6: The text states that the greater of the b[illegible]ground refer[illegible] va[illegible] for surface soil and subsurface soil was used as the screening alternat[illegible]s to SSLs f[illegible] inorganics. Using the highest background reference value does not seem to be [illegible]servati[illegible] approach for background comparison. An explanation should be given to support [illegible]t that the higher background value is always relevant. Also, the approach of comparing [illegible]s to subsurface soils is not supported due to the influence to "naturally occurring" sur[illegible] the Naval activities such as land covering with dredge materials. To resolve co[illegible]ring [illegible]ranges", compare surface soil background levels solely to surface soil samples an[illegible] soil background levels to subsurface samples.

Response 1

The text will be modified to clarify that only SSLs wi[illegible]e used f[illegible] fate an[illegible]transport screening. Because the water infiltrating through [illegible] pore spa[illegible] in [illegible] is exposed to background concentrations of soil constituen[illegible]at each le[illegible], the on[illegible] background concentration for fate and transport comp[illegible]sons is t[illegible] greater [illegible] the surface soil or subsurface soil values. The surficial so[illegible]s that 5[illegible]et bgs) th[illegible]ghout Zone E is an extremely heterogeneous composite of n[illegible] soil and [illegible]dge spoil a[illegible] other fill materials. It would not be feasible to accurately [illegible]ntify, ch[illegible]erize a[illegible] determine background concentrations for each soil type [illegible]tered.

Comment [illegible]

Section 10.0, [illegible] Lines 18-[illegible] states that first round groundwater data were used to produce the su[illegible]s. Subseq[illegible] of quarterly groundwater results were reviewed before making decis[illegible]g risk, co[illegible]easures, and conclusions and recommendations. Subsequent gr[illegible] discuss[illegible]o confirm the presence of constituents where appropriate. [illegible]he subsequ[illegible]ot impact the recommendation for the site, it is not discussed in the te[illegible] These statement[illegible]at unclear in how the additional data was utilized, and clarifi[illegible]on is needed. It woul[illegible]l to have information regarding groundwater concentration fluc[illegible]ions in the subsequent [illegible]mp[illegible]g rounds whether the data impacts the recommendations for the[illegible] or not. Increased conc[illegible]trations in the subsequent sampling could potentially effect the risk a[illegible] various sites. This inf[illegible]mation is important before making risk management decisions.

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Response 2

Please see Appendix H, part 1 of the Draft Zone E RFI Report, which provides summary tables for all quarterly groundwater sampling events. Analytical summary tables which provide all detections above MCLs for all groundwater quarterly sampling events are also provided in Appendix K. All rounds of groundwater data will be included in Appendix H, part [illegible] the Final Zone E RFI Report.

Comment 3

Each unit evaluation in Section 10 has a table that shows the number of samples exceeding RBCs. The table only shows a comparison to industrial RBCs. Since the Risk Assessments compare to residential RBCs, they should be included in the tables. Also SSL's should be included in the table for comparison to the lower-interval soils.

Response 3

The Project Team which includes the EPA, SCDHEC and the Navy, agreed [illegible] industrial RBCs would be used for risk and hazard screening in the Zone E RFI. [illegible] both industrial and residential RBCs were used in the risk assessment to select COPCs [illegible] site worker and residential scenarios. The fate and transport [illegible] include comparisons to SSLs. The comparisons to residential RBCs are included in [illegible] tables of the site-specific risk assessments, and the SSL comparisons are included in [illegible] fate and transport summary tables in each section. The Final Zone E RFI [illegible] refer to the appropriate sections for comparisons to residential RBCs and SSLs.

Comment 4

SCDHEC acknowledges EPA's target risk range of 1E-[illegible] However, as stated in the text, the department [illegible] selected to use [illegible] conservative [illegible] of 1E-06 in both residential and industrial [illegible] When risk [illegible] 1E-06, the [illegible] may require corrective action. Decisions [illegible] corrective [illegible] made on a site by site basis.

Response 4

Both residential and [illegible] risk assessment scenarios are presented in the Draft Zone E RFI Report. The [illegible] and a target risk of 1E-06 were used to determine if a site should be considered in [illegible]

Comment 5

Section 10.0, Page 10.1-2, Line 6: The text states that results for upper-interval samples were compared to industrial soil ingestion screening values in the USEPA Region III RBC table. The [illegible] should be compared to the more conservative residential soil ingestion screening values. A

discussion of this comparison should be included in the Corrective Measures Considerations section of each unit or combined unit summary in Section 10.

Response 5
Please see the response to General Comments #3 and #4.

Comment 6
Section 7.2.3, Page 7-25, Line 22: The text states that because Zone E is [illegible] of the Base [illegible]sure [illegible] Realignment Act, future site use cannot be assumed with any certainty [illegible]his statem[illegible] contradicts many of the statements throughout Section 10 that emphasize that the [illegible]use pl[illegible]s are industrial and residential use is not expected.

Response 6
The text will be modified to read "because Zone E is part of BRA[illegible]utu[illegible]nnot be assumed with absolute certainty; however, the Project Team has made a r[illegible]ment decision that future use of all Zone E sites will be industrial."

Comment 7
Section 7.2.6, Page 7-25, Lines 21-25: The text state[illegible]at parame[illegible]s i[illegible] values were not included in the CDI calculation data. EP[illegible] Risk Ass[illegible]ment [illegible]or Superfund recommends alternative measures when toxicity [illegible]lues are n[illegible] available. [illegible] alternative measure should be implemented in order to prevent [illegible]g values [illegible]m the calcu[illegible]tions.

Response 7
The comment references the text [illegible]n p[illegible]e 7-25, lin[illegible]ver, this comment seems to be referring t[illegible]e text on page [illegible]s 21-25. A[illegible]n Section 7 of the Zone A RFI Report, th[illegible] assessm[illegible] following r[illegible]es to compile a list of quantitative toxicity d[illegible]icals ide[illegible]ne E media: IRIS, HEAST, and ATSDR. After exhausting t[illegible] the risk [illegible] concluded that there was not enough data to complete a quai[illegible] assessme[illegible]hemicals. The Navy will gladly review any additional sources [illegible]ive toxic[illegible] which EPA or SCDHEC have access.

Comme[illegible]
Sever[illegible]WMUs and AOCs [illegible] contaminant levels above industrial RBCs but below back[illegible]und Rcs. In RAGS S[illegible]5.7, Page 5-18, it states that if background risk might be of co[illegible]n, it should be calculat[illegible] separate from site-related risk. Samples above RBCs but below b[illegible]round may be contrib[illegible]g risk at the Navy Base; therefore, a background risk assessment [illegible] be conducted.

Response 8

In this comment, SCDHEC seems to be indicating that a background risk assessment would be useful for making risk management decisions at the CNC. It would be in the Project Team's best interest to outline the goals and details prior to conducting a background risk assessment.

Comment 9

A DAF value of 10 was applied to generic SSLs throughout Zone E. A [illegible]gue description was given for the justification of the DAF value used; however, a more thorough explanation as to why the DAF value of 10 was selected, including site specific parameter, should [illegible]ed in this section. A table showing the comparative site specific values should be included [illegible]

Response 9

The comment does not reference a specific section of the report. Pages 6-14 and [illegible]ction 6.2.1 present a general discussion of the use of a DAF of 10, as well as a reference [illegible]n 6.3 for a comparison of site-specific conditions to fate and [illegible] screening assumptions. Item 4 of Section 6.3 is a detailed discussion of Zone E [illegible] presents calculated DAFs for 20 sites, with values ranging from 14 to 23. Consider [illegible] "DAF" account only for dilution and ignore attenuation effects. The choice of a [illegible] Zone E is considered extremely conservative.

Comment 10

Section 10.23 - 11.3, Page 10.23-39, Line [illegible]6: Numerous [illegible]cations throughout the text indicate that site constitutents pose no threat to human health or the [illegible] Cooper River). The term "no threat" should be eliminated from [illegible]tions within [illegible]ampling at the site can give an indication [illegible]tential risk [illegible] with the site. [illegible]ver, the actual threat to human and health and [illegible]ent is assessed [illegible]mated. If contamination is not detected in a round of sampling, it [illegible] stated that [illegible]s no threat. A threat could potentially be present at locations that [illegible] been sampled [illegible]. The term "no threat" should be modified or deleted from the text.

Response 10

The term "no threat" will be [illegible] from the text in the Final Zone E RFI Report.

Specific Comments

Comment 1

Section 7.2.1, Page 7-4, lines 15 and 16: The text states that the lesser of the two values (½ U or ½ J) was used as the best estimate of the concentration that was potentially below the e[illegible]ted quantitation limit. Thereafter of the two values would be a more conservativ[illegible] value and [illegible] used.

Response 1

Because of the large difference between SQLs ("U" flagged valu[illegible] and report[illegible] estimated ("J" flagged) values, using one-half the reported SQL value as an [illegible]mate fo[illegible] nondetected constituent would yield an unrealistically high result. In reality, sa[illegible]entrations much lower than the SQLs are detected and reported as J-flagged valu[illegible]ne-half of the lowest J-flagged value as an estimate for a nondetect provides a mor[illegible]alue.

Comment 2

Section 7.3, Page 7-49, Lines 4-12: The text states that thre[illegible]ngs require [illegible]line HHRAs. A detailed explanation should be given as to wh[illegible]s require fu[illegible]aseline HHRAs while all others were evaluated using the FRE[illegible]thod.

Response 2

These three sites required full HHRAs du[illegible] the exp[illegible]ure poten[illegible] as determined by evaluation of surface (land) coverage. Eac[illegible]ese sites [illegible]ntained lar[illegible] areas which were not covered by either asphalt or concrete. F[illegible]s 7.2.1 th[illegible]gh 7.2.11 [illegible]vide detailed photos of the specific land cover for each AOC [illegible] WMU, an[illegible] lack of [illegible]osure potential based on coverage.

Comment [illegible]

Section 8.3, P[illegible]s 13-15: T[illegible] that based on numerous factors such as tidal flow, the parameter co[illegible] detected a[illegible]n will be used to assess near shore ecological conditions along the [illegible] E coast. [illegible]ment is confusing, and it is unclear as to why only one locatio[illegible] the enti[illegible]one E coast. A more thorough explanation of this statement sh[illegible]d be given.

Respo[illegible]e 3

The [illegible]al Zone E RFI Repor[illegible]e revised to state that due to the constant and dynamic flux of [illegible]benthos along the Zon[illegible]E coastline, both the maximum and mean concentration of each p[illegible]eter detected in the [illegible]shore samples will be used as the concentration representative

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of Zone E nearshore sediments. While this isn't necessarily the conservative approach for such a preliminary assessment, it results in an overestimation of risk.

Comment 4
Figure 8.3, Page 8-8: The note at the bottom of the page indicates what all symbols represent except for the shaded circles. An explanation of the meaning of the circle symbol should be provided.

Response 4
The figure's legend will be revised to include the representation of all symbols.

Comment 5
Section 10.1.7, Page 10.1-100, Lines 8 and 9: The text refers to an interim action removal at SWMUs 5, 18, and AOC 605 that has eliminated the associated risk. No information was provided to support this assumption. More detail should be given regarding post removal contaminant levels or confirmation sampling. Based on remaining levels of contaminants, it may be necessary to conduct a post removal risk assessment.

Response 5
The risk assessment for this site was based on data collected prior to an IM conducted by the Detachment. Section 10.1.7, page 10.1-100, lines 8 and 9 will be changed to read "The Navy conducted an interim action which resulted in the excavation and offsite disposal of the upper and lower soil interval." The IM Report will be reviewed and a determination will be made as to whether a separate risk assessment will be conducted for this site using post IM sample results.

Comment 6
Section 10.2.9, Page 10.2-84, Line 17: The text states "corrective measures from may be appropriate." It appears that a word or words are missing from the text; therefore the statement should be revised.

Response 6
An editorial change will be made and the word "from" will be eliminated from the text.

Comment 7
Section 10.3.11, Page 10.3-33, Lines 22-24 and Section 10.3.11, Page 10.3-43, Lines 1-4: The text states that the generic SSL for hexavalent chromium was not applied to chromium. The reason was that hexachrome was not detected in the only sample at combined SWMU 22 with hexachrome

analysis and hexachrome as detected in only four of 59 surface soil samples from Zone E. According to the text, only one sample was analyzed for hexachrome at combined SWMU 22; therefore, it is not conservative to assume that hexachrome is not present at other locations within combined SWMU 22. Additional analysis of hexachrome should be collected at combined SWMU 22 before this assumption can be made.

Response 7
Combined SWMU 22 samples will be screened assuming the presen[illegible] hexachrom[illegible]

Comment 8
Section 10.6.11, Page 10.6-74, Lines 17-20: The text refers to dieldrin, [illegible] BEQ contributing to the risk estimates above 1E-06; however, the text also states no furt[illegible] recommended for soil, since the risk estimate is above 1E-06, a more thorough explan[illegible] be given to defend the recommendation of no further action. Potential alternative [illegible]s should be included in Table 10.6.11.1.

Response 8
Under the industrial scenario only two points margi[illegible] 1E-06 tri[illegible]r that SCDHEC recommends for triggering CMS. Unde[illegible] resid[illegible]io only [illegible]ix out of twelve points marginally exceeded the 1E-06 t[illegible]ger. Usin[illegible] bo[illegible]al and the residential scenarios, point risks fell within the [illegible]PA's acce[illegible]able ris[illegible] Furthermore, based on the fact that all points are curre[illegible] covered [illegible] an asph[illegible] or a concrete cap, exposure potential at this site is minim[illegible] Therefo[illegible] the Navy [illegible]els that NFA is the appropriate designation for soil at this [illegible] This w[illegible]be reflecte[illegible]n the text of the Final Zone E RFI Report

Comment [illegible]
Section 10[illegible]8-60, Lin[illegible] Section 10.14.9, Page 10.14-50, Lines 8-10: The text states that risk [illegible] soil inter[illegible]hed due to the site being capped with concrete and asphalt, and direc[illegible] unlikely. [illegible]uld be revised to state current risk and current direct exposure are [illegible] Previous t[illegible] that future use of the base is known; therefore, it is not feasible [illegible]sk will b[illegible]inished due to the site being capped.

Respons[illegible]
The te[illegible] will be revised to st[illegible]rrent risk and current direct exposure are diminished due [illegible]he asphalt and concr[illegible] l[illegible]d cover.

C[illegible]ment 10

Table 10.9.7.1, Page 10.9-12: Sediment samples at SWMU 81 detected contamination of arsenic and copper above their respective SSVs. Therefore, potential corrective measures or interim measures should be listed in the table.

Response 10
NFA will be removed from Section 11. Data will be considered as pa[illegible] of the Z[illegible] Report.

Comment 11
Section 10.11.11, Page 10.11-53, Lines 10-15: The soil pathway exp[illegible] risk ra[illegible]s from 1E-05 to 2E-04. This range is above DHEC's more conservative risk value[illegible] Other corrective measures besides no further action should be listed for soil due to the ele[illegible]tial risk. Table 10.11.11.1 should also be modified.

Response 11
The final Zone E RFI Report will recommend SWMU 87, SWM[illegible]72, and AO[illegible]S. Section 10.11.11 of the Draft Zone E RFI Report erra[illegible]ended NF[illegible]ver, surface soil was recommended for CMS in Section 11[illegible] E RFI Re[illegible]. The text in Section 10.11.11 and Table 10.11.11.1 will b[illegible]rected [illegible]eport.

Comment 12
Section 10.15.7, Page 10.15-44, Lines 10-13 [illegible]site is re[illegible]mended fo[illegible]o further action for soil since the site is covered with asphalt. The [illegible]xposure [illegible]dential risk [illegible]ge is above SCDHEC's recommended value of 1E-06; therefo[illegible]ternative [illegible]ctive or i[illegible]rim measures should be included in the text.

Response [illegible]
The Fina[illegible]FI Repo[illegible]mmend SWMU 106 and AOC 603 for CMS. Section 10.15[illegible]ft Zone E[illegible]errantly recommended NFA; however, surface soil was recomm[illegible]CMS in S[illegible]the Draft Zone E RFI Report. The text in Section 10.15.17 w[illegible]ted in the [illegible]ort.

Commen[illegible]3
Sectio[illegible]0.21.7, Page 10.21-4[illegible] The text states "the upper and soil intervals". The term "lo[illegible] should be added befo[illegible]'s[illegible].

R[illegible]nse 13
T[illegible]xt will be correcte[illegible]o read "upper and lower soil intervals".

Comment 14

Section 10.24.5.2, Page 10.24-14, Lines 19 and 20: The text states that relatively high arsenic concentrations were detected in groundwater samples at SWMU 65, but were determined [illegible] be a threat to surface water in the Cooper River. Justification should be given as to [illegible] contamination is not impacting the Cooper River.

Response 14

The text will be revised to read "relatively high arsenic concentrations were also detected in groundwater samples at nearby SWMU 65, but were determined [illegible] to significantly impact surface water in the Cooper River." Please refer to Section 10.6.9.[illegible] 10.9.2; maximum groundwater concentration does not exceed the Adjusted Eco/Hu[illegible] Water RBC for arsenic.

Comment 15

Section 10.26.4, Page 10.26-6 and Section 10.27.6, Page 10.27[illegible] states that [illegible] risk assessment was not conducted since only sediment samples [illegible] A statement [illegible] should be included regarding the potential for human contact with [illegible] sediment [illegible] ation.

Response 15

Text will be added stating "Potential for human contact with contaminated sediment from the Cooper River is highly unlikely."

Comment 16

Section 10.37[illegible] Page 10.37-2[illegible]-5: The text [illegible] is unlikely that constituents in surface soil [illegible] urce of c[illegible] in the catch[illegible] sediment since the ground surface is paved. If [illegible] as recently [illegible] soil contamination could have historically influenced the catch basin [illegible] run-off. [illegible] should be added to clarify when the pavement was applied in relation [illegible] the rele[illegible] soil occurred.

Response 16

Text will be [illegible]ded statin[illegible] occurred in 1989 and the site was paved prior to 1989."

Comment 17

Se[illegible] 10.43.6, Page 10.,43-[illegible], Line 3: The term "arsenic" should be replace with "acetone".

R[illegible]nse 17

The text will revised to read "The detected concentration did not exceed the acetone industrial soil RBC."

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Responses To Comments from Dynamac/Gannett Fleming
for Draft Zone E RCRA Facility Investigation Report
Charleston Naval Complex

General Comments

Comment 1

The Zone E RFI Report does not include significant portions of the information relevant to the investigation of Zone E and to the preparation of the HHRA and ERA. The missing information includes data on the characteristics affecting the fate and transport for various groups of chemicals. Instead, the Zone E RFI Report states that this information is available in the Zone A RFI Report. Given the size and complexity of the respective RFI reports, referring the reader from the Zone E RFI Report to the Zone A RFI Report to obtain information needed for interpretation of the Zone E RFI is unnecessarily cumbersome. The Zone E RFI Report should include all information relevant to the Zone E HHRA and ERA.

Response 1

Reduced versions of Sections 7 and 8 in the Draft Zone E Report is consistent with the desire of the Project Team and was done in order to cut down the amount of repetitive information provided in the series of reports for each zone.

Comment 2

The HHRA does not include an assessment of the exposure pathways for contact with subsurface soil. At many of the SWMUs or AOCs, contaminants have been identified in subsurface soil that exceed screening criteria. The exposure scenarios should be expanded, where applicable, to consider the potential for construction workers, utility workers, and other to come into contact with contaminants in subsurface soil.

Response 2

The HHRA concluded that direct exposure to subsurface soil was an unlikely pathway. Future construction events are not expected to penetrate the 3 to 5 foot soil interval, mainly due to the shallow water table. Instances where construction or maintenance activities would penetrate the 3 to 5 foot interval are likely to be very short in duration. Subsurface soil was considered in the fate and transport section that evaluated indirect exposure pathways through soil to groundwater migration (SSLs) with discharge to the Cooper River.

Comment 3

The ERA for Zone E was limited to a preliminary assessment of offshore sediment and surface water adjacent to Zone E. Impacts of surface water contaminants on ecological receptors and on the fate and transport of contaminated catch-basin sediments were not evaluated in the Zone E RFI, but will be addressed in the Zone J and Zone L RFI Reports. A thorough evaluation of the ecological risk associated with Zone E cannot be done until all Zone E data are assimilated with data from the Zone J and Zone L RFI Reports.

Response 3
The intent was only to determine the presence of contaminants in Zones E and L. Data from the Zone E RFI and Zone L RFI will be assimilated in the Final Zone J RFI.

Comment 4
For many of the sites, compounds identified as COCs in the Corrective Measures Considerations section for each site (Section 10) do not match the list of compounds selected as COCs in the Potential Corrective Measures Table for a particular site. For example, for the combined site, SWMUs 5 and 18 and AOC 605 (page 10.1-100), zinc was identified as a COC in the upper soil interval. However, zinc is not listed in the Potential Corrective Measures Table for that site (Table 10.1.7.1, page 10.1-101). Also, antimony was identified in the text (page 10.1-101) as a COC in shallow groundwater, but was not included in the Potential Corrective Measures Table. The conclusions in the text and tables for each site must be in agreement.

Response 4
These inconsistencies will be addressed, and revisions will be included in the Final Zone E RFI Report.

Comment 5
The process that was used to identify the chemicals that are driving the risk in each affected medium at each site were not adequately described in Section 10. Chemicals identified as COCs for each site in Chapter 10 do not match the risk drivers identified for each site in Section 11. At some point in the selection process, chemicals referred to as "COCs" were called "risk-driving chemicals" in the Section 10 site discussions. It appears that several steps were omitted from this RFI report in the discussion of the chemical selection process. An explanation should be provided in this RFI report as to how the information provided in the Corrective Measures Consideration section for each site in Section 10 was used to derive the conclusions presented for each site in Section 11. All steps of the chemical selection process, including why certain chemicals qualified as risk-drivers and others did not, must be clearly explained in the Zone E RFI Report.

Response 5

Site-specific Corrective Measures Considerations (Section 10) were based on chemicals driving risk and hazard in an industrial reuse scenario, where as recommendations and conclusions in Section 11 were based on a residential reuse scenario. This may help explain the difference in the specific chemicals listed in each section. Nonetheless, the process of selecting COCs will be reviewed and clarified (industrial vs. residential; 1E-06 vs 1E-04; surface cover; etc.) in the Final Zone E RFI Report. Section 11 will be revised to be based on an industrial s

Comment 6

The uncertainty section of the HHRA for each site focuses on highly protective exposure assumptions that tend to overestimate exposure. Little or no discussion of sources of uncertainty that could result in an underestimation of risk was provided. For example, the toxicity values and information concerning the effects of chemical interactions could result in underestimation of risk. The uncertainty section of the HHRA for each site should be expanded to include discussion of toxicity- and risk-characterization uncertainties, as well as general sources of uncertainty and their potential effects on the magnitude of estimated risks.

Response 6

In the Final Zone E RFI Report, the risk assessment sections will include discussions of the potential for underestimating risk. A site-specific discussion will be added regarding the lack of toxicity values. Section 7 provides a general discussion of uncertainty associated with the lack of toxicity values.

Comment 7

In the Conclusions and Preliminary Recommendations section (Section 11), a Summary of Risk and Hazard-based COCs Table should be added to each site-specific section. The table should include a list of all evaluated chemicals, and indications as to which chemicals were retained as COCs whereas other were eliminated from consideration as

Response 7

Tables for Points of Risk and Hazard are provided in the site-specific risk assessments of Section 11 provided chemicals were evaluated and their overall contribution to risk at the site. The site-specific risk summaries (at the end of each site-specific risk section) provide an explanation as to why certain chemicals were retained as COCs, while others were eliminated.

draft

Comment 8

Dust was not included as a potential exposure pathway for inorganics in the HHRA. Inhalation of chemicals entrained in fugitive dust can be a potential exposure pathway in the transport of inorganics such as arsenic and beryllium. The uncertainty section of the HHRA should include a discussion of fugitive dust as a potential exposure pathway for inorganics.

Response 8

The soil-to-air pathway was concluded to be insignificant in the fate and transport s due to the fact that nearly all of Zone E is either paved or covered by a building.

Comment 9

The acronyms, "HQ" and "HI" are used interchangeably and often inco ughout the text and tables. "HQ" (Hazard Quotient) refers to hazards from exposure to a s cal and "HI" (Hazard Index) refers to the sum of the HQ values. The terms should be used roughout the document.

Response 9

The Navy does understand the difference between the t made every ort to use them in their proper context. It is possible th e two ere inadvertently switched on occasion. The Final Zone E RFI Rep t will be r se to account for the appropriate use of these acronyms.

Comment 10

Soil screening levels (SSLs) were not in ed in the t s and wer t consistently cited in the text when compared to the concent tio f a particu C i er-interval soil samples. In contrast, the in trial risk-based ion (RBC) for each COPC in the tables and text, so tha tuent co uld easily b ared to the respective industrial RBC value. It w ful if the l SSL values were included in the text and tables for ease of comp onstituent ns.

Response 10

SSL comparis in the sit ecific Fate and Transport Summary text and correspond tables. T ly referred to in the nature and extent text if detected concentr ons in lower-int s exceeded their respective SSLs. Nature and extent tables l be amended to in s in the Final Zone E RFI Report.

draft

Comment 11
The statement that no chemicals exceeded a particular screening value (i.e. AWRCL, RBC, RC), used throughout the document, is misleading. The statement implies that no chemicals were potential risks. It does not account for those chemicals that lack screening values but may pose potential risks. The text should be revised to specify those chemicals with a particular group (VOCs, SVOCs, inorganics) that have screening values, and those that do not. In addition, the uncertainty section of the HHRA should include a brief discussion of the potential underestimation of risk from COPCs that were eliminated from further consideration because they lack screening values. The uncertainties associated with eliminating a chemical as a COC from a specific site because it lacks screening values should be discussed for each site.

Response 11
In the Final Zone E RFI Report, the risk assessment uncertainty sections will include discussions of the potential for underestimating risk. A site-specific discussion will be added regarding the lack of toxicity values. Section 7 provides a general discussion of the uncertainty associated with the lack of toxicity values.

Comment 12
The Zone E RFI Report makes repeated references to Appendix IX analytical parameters. Appendix IX was not located in any of the volumes for Zone E. All appendices for Zone E have alphabetical designations. The text should be corrected.

Response 12
The term "Appendix IX" refers to a specific expanded list of analytical parameters found in Appendix IX of 40 CFR, part 264. In accordance with the Comprehensive Sampling and Analysis Plan (CSAP), samples were analyzed for the Appendix IX list of parameters at a frequency of 10 percent of the total number of samples.

Specific Comments

Comment 1
<u>All Tables:</u> Many of the tables did not have page numbers, so that comparing information presented in the tables and text was often time-consuming, particularly when a table was comprised of numerous pages. It would be helpful if the tables were assigned page numbers to expedite comparison of information presented in the text and tables.

Response 1
Tables will be assigned page numbers in the Final Zone E RFI Report.

Comment 2
All Tables: Throughout the document, the abbreviations, "NA" and "ND" are not always defined in the tables. All abbreviations should be defined in footnotes to the tables.

Response 2
Tables will be revised to include all abbreviations

Comment 3
Section 6.2.,2, Page 6-19, Line 12: The text states that "other than ant[illegible] 556, s[illegible]ace water was not sampled as part of the Zone E RFI... potential impacts on surfa[illegible]ere evaluated by comparing groundwater constituent concentrations to surface water sc[illegible]dards." Since surface waters may be impacted through routes other than groun[illegible]lishing that groundwater is not impacting surface water does not imply that there a[illegible]o ris[illegible] with the surface water. The text should be revised to state that potential impacts on [illegible]er by groundwater were evaluated by comparing groundwater constituent concentrations t[illegible]er screening standards, but that since no surface water samples [illegible]zed, potenti[illegible]om surface water are uncertain.

Response 3
The text will be revised to reflect this informati[illegible] in the Fi[illegible] Zone [illegible]ort.

Comment 4
Section 7.2.2, Page 7-9, Line 8 The tex[illegible]tes that ir[illegible]as elimin[illegible]d from consideration as a contaminant of potential concern (C[illegible]OP[illegible]based upon [illegible]tion as an essential nutrient. Region IV g[illegible]nce does not i[illegible]n as a nut[illegible]y be eliminated based upon an essential n[illegible]signation[illegible]iron should [illegible]uated as a COPC in the HHRA. In addition, a[illegible]f the resu[illegible] included in the uncertainty section of the Zone E RFI Report, given [illegible]ial uncerta[illegible]g the iron toxicity screening values.

Response 4
Accordingly, ir[illegible]inated fr[illegible] consideration in the HHRA due to its status as an essential [illegible]trient and [illegible]uded in the Final Zone E RFI Report.

Co[illegible]ent 5
Se[illegible]n 8.0, Page 8-1, Line 1[illegible] The discussion of the zone rationale is confusing and incomplete. T[illegible]hysical relationship b[illegible]een the Ecological Study Areas (ESA) and the Areas of Ecological [illegible]n (AEC) and Zone [illegible]s not clear from the text or Figures 8-1 and 8-2. Specifically, there is

no explanation as to how the AECs fit within the ESA; the AEC are briefly mentioned, but never defined or located on maps. The locations of the AEC in relation to Zone E and the ESA are not shown in either figure. The confusion is compounded by the statement that basewide, zone configurations were based on SWMU or AOC locations and therefore, do not necessarily parallel ESA boundaries (line 18). Figures 8-1 and 8-2 should be modified to clearly delin the boundaries of Zone E, the ESAs, and the AECs.

Response 5

Discussion concerning the interrelationship among the boundaries o SAs, AECs, a Zon itself will be revised. Independent of AOCs/SWMUs, the entire C C was divi into eigh large study areas based on land use to make the ecological assess of the 00 acre base more manageable. Ecological surveys at some of the less industri ntified smaller, specific areas of ecological concern (AECs), such as isolated wetlan urbed wooded areas that required further assessment. As noted in Section 8.1, no designated within Zone E.

Comment 6

Section 8.0, Page 8-1, Line 16: The text states that the s d for the Z E RFI Report is also described in the Zone J RFI Work Plan xcept fo ussion the zone rationale, the survey method is not described in the e E RFI R por scussion of the survey method should be included in the Zone RFI Repo

Response 6

A reference to the USEPA's ERA Proce cument w be added a he survey method used for the Zone E ERA. The reference to e J RFI W Plan for ails on the methods used for the Zone E habitat and bi ta veys was ed ause at the onset of the comprehensi RFI at the C one J RF LL zone-specific ERAs and therefore the com l for cond the all zone-specific surveys. The scope for ERAs ha delegated to the zone-specific investigations.

Comment 7

Section 8.1, Pag text state t although Zone E has 23 identified outfalls along its shoreline n a potent nt pathway to the Cooper River, sediment and surface water were coll ed only from out d with AOCs 555 and 556 and SWMUs 54 and 81. The ration for this decision was one J RFI Report was specifically designed to assess the NA ASE water bodies inclu ng e Cooper River. No rationale was provided as to why AOCs 55 d 556 and SWMUs 54 d 91 were selected for the preliminary assessment. An explanation o these sites were selec to assess potential risk from sediment and water collected from Zone lls should be adde this section.

Response 7

All outfalls to the Cooper River were designated for assessment in either the Zone J or Zone L RFI. During the Zone E investigation of AOCs 555 and 556, and SWMUs 54 and 81, the USEPA requested that the Navy include these specific outfalls in the Zone E RFI. The point will be clarified in the text.

Comment 8

Figure 8.3, Page 8-8: Direct ingestion of soil and ingestion of soil via food ingestion are identified (by shading the appropriate box) as selected exposure pathways for terrestrial wildlife in the contaminant pathway model (Figure 8-3). Similarly, direct contact with soil is identified as selected exposure pathways for terrestrial plants and terrestrial invertebrates. However, these exposure pathways and terrestrial species as ecological receptors were not considered in the Zone E ERA. It was stated that for the Zone E assessment, only exposure routes directly to sediment and surface water pathways would be evaluated to determine the need for subsequent investigation during the Zone J RFI (page 8-7, line 3). Furthermore, only aquatic species were addressed in the Zone E ERA. Terrestrial species were not considered as ecological receptors in the Zone E ERA. Therefore, the text and figure should be modified to clearly identify those exposure pathways and ecological receptors that will be addressed in the Zone E ERA.

Response 8

Figure 8.3 will be revised to identify those pathways addressed in the Zone E ERA. Terrestrial exposure pathways to plants and invertebrates will be excluded, since no quality habitat exists for these species in Zone E.

Comment 9

Figure 8.3, Page 8-8: The definition of Aquatic Receptors used in the Contaminant Pathway Model include invertebrates, plants, amphibians, and fish. The text does not identify the specific groups of aquatic receptors. It is uncertain if all of the listed groups were included in the model for Zone E. The groups of aquatic receptors for Zone E must be identified, and the model should be revised accordingly.

Response 9

The model for this screening ERA will be revised and will not specify particular guilds of aquatic receptors (plants, invertebrates, etc.), but rather indicate that, if present in the Cooper River, a variety of aquatic receptors may be exposed to Zone E constituents.

draft

Comment 10

Figure 8.3, Page 8-8: The Contaminant Pathway Model defines Aquatic Receptors as invertebrates plants, algae, amphibians, and fish. The exposure pathways for these organisms are not all identical. For example, plants would be exposed to water and sediment, whereas fish could also consume contaminated invertebrates, smaller fish, plants, and algae. The exposure model should be revised to reflect these different exposure pathways.

Response 10

Please see the response to Comment 9.

Comment 11

Section 8.4, Page 8-13: The impacts of groundwater contaminants on ecological receptors were not addressed. Shallow groundwater could reach the surface and become available to ecological receptors. Aquatic receptors in Zone nearshore environments could be exposed to contaminated groundwater via direct exposure. Aquatic plans could also be exposed via [illegible]. The risks associated with groundwater must be included in the ERA exposure assessment. A detailed justification as to why groundwater was not considered an exposure pathway must be provided.

Response 11

Potential impacts of contaminated groundwater to aquatic [illegible] will not be addressed in the Zone E RFI, but rather in the Zone J RFI, which is designed to assess impacts from comprehensive groundwater-to-surface water interaction from all [illegible] Zones A, B, C, D, E, G, H, and I) rather than one zone at a time.

Comment 12

Section 8.4, Page 8-13, Line 1: This section is incorrectly titled "Contaminant Fate and Transport". The section primarily addresses the toxicity of inorganics [illegible]. A discussion of the fate and transport of contaminants must address movement of contaminants through various media (i.e., soil, sediment, groundwater) and pathways. The information provided in this section deals primarily with the toxicity of inorganics rather than a direct discussion of the fate and transport of chemicals. The toxicity information presented in this section should be addressed under a new heading that [illegible] with the [illegible] inorganics and organics. Section 6.0 of the risk assessment, entitled "[illegible] Transport", [illegible] some discussion of the chemical and physical properties of chemicals in relation to Zone E. It was stated that the Zone A RFI Report details characteristics that affect [illegible] and transport of specific groups of chemical (page 6-4). The detailed discussion in the Zone A report should be included in the Zone E ERA, as well as the Zone J ERA, since Zone E exposure pathways and aquatic receptors will be assessed in the Zone J ERA. Issues such as water solubility, the likelihood of complexing with soil, and the effects of pH and anaerobic conditions on each ECPC should be addressed, and should include discussion of site specific data when available.

Response 12
Section 8.4 will be more appropriately titled "Stressor Characteristics", and additional chemical-specific fate and transport items, such as water solubility and pH effects will be appended to Section 6.0 as applicable.

Comment 13
Section 8.4, Page 8-13, Line 20: The statement that cadmium has been [illegible]icated as the [illegible] severe delecterious effects on fish and wildlife is followed by the statem[illegible] that birds an[illegible]amm[illegible] are comparatively resistant to the biocidal properties of cadmium. The s[illegible]nd stateme[illegible]mplies tha[illegible] birds and mammals are not wildlife, which is incorrect. It is correct tha[illegible] compa[illegible]on basis, birds and mammals are less susceptible than freshwater organisms. The text [illegible]evised for clarify.

Response 13
The text will be revised to reflect aquatic organisms' greater sens[illegible]ity [illegible] relative to its effect on birds and mammals.

Comment 14
Section 8.5, Page 8-16, Line 12: The text states that [illegible] assessm[illegible] was s[illegible]cted that evaluates the aquatic community health with a meas[illegible]ment end[illegible]nt [illegible]onic effects to aquatic community species. This statement is [illegible] general. [illegible]e asses[illegible]point, "aquatic community health", must be defined in specific [illegible]rms. The [illegible]easuremen[illegible]ndpoint that predicts "chronic effects" for each selected ecologic[illegible]ptor mu[illegible]e defined i[illegible]pecific terms "such as productivity or specific diversity). Also, "[illegible]nic effect[illegible]must be defi[illegible]d.

Response 14
The text will [illegible]evised to clari[illegible]aluation a[illegible]t of exposure pathways. This screening-[illegible] assessm[illegible]not design[illegible]ecific endpoint species, but rather compare [illegible]trations [illegible]iate screening-level benchmarks (USEPA's SSV, NOAA's ER[illegible] Ridge Na[illegible]ratory's SCVs), to determine if the site could pose unacceptab[illegible]

Comment 1[illegible]
Section 8[illegible], Page 8-17, Line [illegible]on is entitled "Risk Characterization", but is actually a prelim[illegible]ry risk assessment. [illegible]acterization integrates the results of exposure and effects anal[illegible]s to evaluate the likel[illegible]of adverse ecological effects associated with exposure to a str[illegible]r. The ecological sign[illegible]cance of the adverse effects is discussed, including the types and m[illegible]tudes of the effects, [illegible]r spatial and temporal patterns, and the likelihood of recovery. [illegible]cals determined to [illegible] ECPCs are identified, and problems associated with each ECPC,

including the extent of the problems and possible interactions of ECPCs (i.e. additivity or synergism), are discussed. This section should be renamed "Preliminary Risk Assessment" and should include an introductory statement that an in-depth risk characterization of Zone E ERA will be provided in the Zone J RFI Report.

Response 15
This section will be renamed to better reflect its content. A statemen also be reference the Zone J RFI Report for an in-depth risk characteri on of offsho including the areas adjacent to Zone E.

Comment 16
Section 8.7, Page 8-17, Line 7: The reference to "published" surface wa effects levels is confusing in that all effects levels reported in Table 8.3 are published va t should be modified to be more specific.

Response 16
The text will be revised and will state that the few param plicable su ter effect levels were exceeded by the maximum concentra one E surf water samples.

Comment 17
Section 8.7, Page 8-17, Line 13: The text sta t "the HQ for the rema ng parameters were all below 1", based on the mean constituent co rations in face water. is statement is incorrect. Based on the mean HQ values presente Table 8.3 e 8-11), exceeded 1 for 4-chloro-3methylphenol (3.33) and tributylti (1,). The tex ected.

Response 1
These om e correct al Zone E RFI Report.

Comment 18
Section 8.7, Pag e text sta at overall...only a moderate risk to surface water quality exits his conclu rect. Mean HQ values for BEHP (146.67) and tributyltin (1,058) i cate extreme risk st be revised to state that risk to surface water quality is extrem or BEHP and tributy oderate for all other analytes.

Re nse 18
T ext will be revised to lect the higher risk from the organics BEHP and tributyltin.

Comment 19

Section 8.7, Page 8-17, Line 17: The text states that for sediment, "HQ values greater than 1 but less than 3 for copper, arsenic, chromium, nickel, lead, zinc, and pyrene were determined." The statement is incorrect. Using the mean constituent concentrations, the HQ value exceed[illegible] for copper (10.35), lead (3.04), and pyrene (9.14), and was less than 1 for chromi[illegible] (0.83). [illegible] analytes with HQs between 1 and 3 that were not included in the discuss[illegible]re the [illegible] mercury, 4,4'-DDE, methoxychlor, acenaphthene, acenaphthylene, diben[illegible]anthracene, [illegible] and naphthalene. The text must be corrected to include only those analy[illegible] with HQ valu[illegible] betw[illegible] 1 and 3. Also, the statement should qualify that the mean (not the max[illegible]m) HQ val[illegible] were used to determine which analytes had HQ values between 1 and 3.

Response 19

The text will be revised to reflect the HQs presented in the Table 8.2

Comment 20

Section 8.7, Page 8-17, Line 21: The text states that "overall ri[illegible] receptors fr[illegible]ent concentrations appears low." This statement is incorrect. [illegible] (page 8-9), [illegible]an HQ values exceeded 10 for copper (10.35), Aroclor-1260 [illegible].76), fl[illegible] 4.03), [illegible]d carbon disulfide (16.55), indicating moderate risk. The m[illegible]n HQ exc[illegible]de[illegible]e (132.84), indicating extreme risk. The text must be revised to [illegible]clude a dis[illegible]ssion o[illegible]uatic receptors from analytes in sediment with Hqs exceeding 1[illegible] moderate [illegible]k) and 100 [illegible]xtreme risk).

Response 20

The text will be revised to reflect the H[illegible] presente[illegible]he Table[illegible].

Comment [illegible]

Section 8.[illegible] Lines 3 a[illegible]xt states that moderate risks from ECPCs in surface water and po[illegible]vel risk fr[illegible] ECPCs are predicted for aquatic wildlife. This statement is inco[illegible]rface wate[illegible] value for tributyltin (1,058) indicates extreme risk. For sediment, [illegible]lues exce[illegible]r BEHP (37.78), copper (10.35), Aroclor-1260 (20.76), fluoranth[illegible]rbon dis[illegible]e (16.55), indicating moderate risk, and exceeded 100 for acet[illegible] (132.84), i[illegible]treme risk. The text must be revised to include a discussion of analyt[illegible]n surface water a[illegible]hat pose moderate (HI>10) to extreme (HI>100) risks to aquati[illegible]ceptors.

Re[illegible]nse 21

T[illegible]ext will be revised to [illegible]lect the HQs presented in the Table 8.2

SWMUs 23 and 63: AOCs 540, 541, 542, and 543
Comment 1
Section 10.4.4, Page 10.4-21, Line 8: The text states that aluminum and iron in shallow groundwater exceeded both their respective tap-water RBC and background shallow groundwater RC. This statement is incorrect. A background shallow groundwater RC was not available for iron. It should state that a background shallow groundwater RC was not available for iron.

Response 1
As part of the Final Zone E RFI, iron background reference concentrations will be developed and used to screen iron data.

AOC 550
Comment 1
Section 10.24.4, Page 10.24-14, Line 18: The text states that the relatively high arsenic concentrations in groundwater samples at nearby SWMU 65 were not a threat to surface water in the Cooper River. The relationship between AOC 550 and SWMU 65 is not explained, or a "relatively high" concentrations defined. The significance of the arsenic data for SWMU 65 to surface water at AOC 550 must be explained. It must be explained why relatively high arsenic concentrations in SWMU 65 groundwater samples are not considered a threat to surface water in the Cooper River. Lastly, "relatively high" concentrations should be defined in quantitative terms.

Response 1
The text will be revised to read "relatively high arsenic concentrations were also detected in groundwater samples at nearby SWMU 65, but were determined not to significantly impact surface water in the Cooper River. Please refer to Section 10.6.9, Table 10.6.9.2; maximum groundwater concentration does not exceed the Tap/HH Groundwater RBC for arsenic."

AOC 555
It was stated that a risk assessment conducted for this site. Conclusions and recommendations for sediment and surface water sampled from the Cooper River will be presented in the Zone J RFI.

Response
Corre

draft

AOC 556
It was stated that a formal risk assessment was not conducted for this site. Conclusions and recommendations for sediment and surface water sampled from the Cooper River will be presented in the Zone J RFI Report.

Response
Correct.

AOCs 559, 560, and 561
Comment 1
Figure 10.29.7, Page 10.29-70: A figure representing the Point Risk Estimates for Groundwater-Future Residential Scenario was not provided. The figure must be added to the page.

Response 1
This figure will be added in the Final Zone E RFI Report.

Specific Comments Requiring Only Editorial Changes To Correct The Document

Comment 1
Figure 8.2, Page 8-3: The figure should be modified so that the numerical designations for the SWMUs and AOCs are legible. Also, it would be helpful if the legends were color-coded for ease of locating where a sediment or sediment and water sample was collected and the outfall locations within Zone E.

Response 1
A new Figure 8.2 will be generated so that SWMU and AOC designations are legible and sample and outfall locations are easier to recognize.

Comment 2
Figure 8.2, Page 8-8: The Contaminant Pathway Model uses solid circles and triangles to designate various receptors. A definition of the solid circle is not provided. A figure note should be added to explain what the solid circle represents. Also, the difference between the solid circle and solid triangle symbols should be included as a note to the figure.

Response 2
The legend to Figure 8.2 will be revised to include all symbols and their representations.

Comment 3
Table 8.3, Page 8-11: The Effect Level for 4-nitrophenol is reported as rather than the value of 82.8 reported as the chronic screening value listed in USEPA/SCDHEC Ambient Water Criteria (Region IV Bulletin). To conform with other screening values cited in the Region IV Bulletin, the exact effect level, rather than a rounded number, should be reported in the table.

Response 3
The Effect Levels in Table 8.3 will be revised so they are consistent with the Region IV Bulletin.

Comment 4
Table8.3, Page 8-11: The Effect Level for bis(2-Ethylhexyl)phthalate (BEHP) is reported as 0.30 rather than <0.30 reported as the chronic screening listed in the USEPA/SCDHEC Ambient Water Criteria (Region IV Bulletin). The effect level should be corrected to conform with the other screening values cited in the Region IV Bulletin.

Response 4
The Effect Levels in Table 8.3 will be revised so they are consistent with the Region IV Bulletin.

Comment 5
Table 8.3, Page 8-12: The first note located at the bottom of the table states that chronic saltwater effect levels were used. This statement is incorrect. Chronic freshwater effect levels were used. The text should be corrected.

Response 5
The notes will be revised to cite the use of chronic freshwater effect levels.

Comment 6
Section 8.7, Page 8-17, Line 7: The text states that "the only five analytes with published surface water quality effects levels exceed those levels" is incorrect. In fact, six analytes exceeded those levels, based on Table 8.3 (page 8-11): aluminum, barium, iron, lead, thallium, and BEHP. The text should be corrected.

Response 6
The text will be revised to reflect the correct number of exceedances presented in Table 8.3.

Comment 7
FRE Summaries, Section 10: The FRE Summaries in Section 10 stated that Tables 7.3.1, 7.3.2, and 7.3.3 presented in Section 7 provide residential, industrial, and residential groundwater RGOs, respectively. This statement should be revised to state that Tables 7.3.1, 7.3.2, and 7.3.3 provide residential soil, industrial soil, and residential groundwater RGOs, respectively.

Response 7
This will be clarified and the revision will be made in the Final Zone E RFI Report.

SWMUs 5 and 18: AOC 605
Comment 1
Table 10.1.6.13, Page 10.1-87: "HI" is defined in a footnote to the table but is not used in the table. The last row in the table designated "Surface Soil Pathway Sum" should be renamed "Soil Surface Pathway Sum HI/ILCR".

Response 1
Noted.

SWMUs 21 and 54
Comment 1
Table 10.2.8.1, Page 10.2-55: The definition of the double asterisk ("identified as an industrial COPC") should be added as a note to the table.

Response 1
A footnote will be added to the table.

Comment 2
Section 11.2,, Page 11-8, Line 2: The text states that SWMU 21 consists of a 20 by 80-foot concrete pad. The site consists of a 20 by 180-foot concrete pad, according to Section 10.2 (page 10.2-1). The text in Section 11.2 should be corrected.

Response 2
The text will be revised to reflect this correction.

SWMUs 23 and 63; AOCs 540, 541, 542, and 543
Comment
Section 10.4.2, Page 10.4-13, Line 13: The text states that 20 pesticides were detected in soil samples. The correct number is 21 pesticides. The text should be corrected.

Response
The text will be revised to reflect this correction.

SWMUs 83 and 84: AOC 574
Comment
Section 10.10.10.7, Page 10.10-64, Line 18: The text states that concentrations of manganese equate with a hazard quotient of nine. The concentrations of manganese equate with a hazard index of nine. The text should be corrected.

Response
The text will be revised to reflect this correction.

SWMU 102
Comment
Section 10.14.4, Page 10.14-17, Line 8: The text states that no metal in shallow groundwater samples exceeded its respective tap-water RBC. This statement is incorrect. Arsenic (5.10 μg/L) exceeded its tap-water RBC (0.0450 μg/L), according to Table 10.14.4.2 (page 10.14-17). The text should be corrected.

Response
The text will be revised to reflect this correction.

AOC 550
Comment 1
Section 10.24.2, Page 10.24-9, Line 13: The text refers to the industrial RBC of TEQs (dioxin equivalents) as 1,000 ng/kg. This statement is incorrect. The industrial RBC of TEQs is 43 ng/kg, according to Table 10.24.2.1 (page 10.24-6). The text should be corrected.

Response 1
The text will be revised to reflect this correction.

Comment 2
Section 10.24.4, Page 10.24-13, Line 3: The text states that only one metal (iron) in shallow groundwater exceeded its tap-water RBC. This statement is incorrect. Arsenic and manganese also exceeded their respective RBC, according to Table 10.,24.4.1 (page 10.24-12). The text should be corrected.

Response 2
The text will be revised to reflect this correction.

AOC 556
Comment
Section 10.27.2, Page 10.27-10, Line 5: The text states that ten SVOCs were detected above their respective SSV. This statement is incorrect. An additional chemical, anthracene, was also detected at concentrations that exceeded its SSV, according to Table 10.27.2.1 (page 10.27-7). The text should be corrected.

Response
The text will be revised to reflect this correction.

AOCs 559, 560, and 561
Comment
Section 10.29.4, Page 10.29-25, Line 13: The text states that only one metal (iron) in shallow groundwater exceeded its tap-water RBC. This statement is incorrect. Arsenic and manganese also exceeded their respective tap-water RBC, according to Table 10.29.4.4 (page 10.29-23). The text should be corrected.

Response
The text will be revised to reflect this correction.

AOC 562
Comment
Section 10.30.2, Page 10.30-4, Line 2: The text states that acetone and carbon disulfide were detected in two lower-interval samples. This statement is incorrect. Both VOCs were detected in one of two lower-interval samples, according to Table 10.30.2.1 (page 10.30-3). The text should be corrected.

Response
The text will be revised to reflect this correction.

AOCs 569, 570, and 578
Comment
Section 10.34.4, Page 10.34-22, Line 8: The text states that only one metal (thallium) in deep groundwater exceeded its tap-water RBC. This statement is incorrect. Arsenic and manganese also

exceeded their respective tap-water RBCs, according to Table 10.34.4.4 (page 10.34-18). The text should be corrected.

Response
The text will be revised to reflect this correction.

AOC 572
Comment
Section 10.36.4, Page 10.36-13, Line 3: The text states that only [illegible] metal (iro[illegible]n shallow groundwater exceeded its tap-water RBC. This statement is incorrect. [illegible]nic and [illegible]anganese also exceeded their respective tap-water RBC, according to Table 10.36.4.[illegible]6-12). The text should be corrected.

Response
The text will be revised to reflect this correction.

AOC 573
Comment 1
Section 10.37.4, Page 10.37-14, Line 3: The text [illegible]tes that o[illegible] in shallow groundwater exceeded its tap-water RBC. This st[illegible]ment is in[illegible]rect. I[illegible] also exceeded its tap-water RBC, according to Table 10.37.4.1 [illegible]age 10.37[illegible]). The tex[illegible]ould be corrected.

Response 1
The text will be revised to reflect this [illegible]ection.

Comment [illegible]
Section 1[illegible]0.37-18, [illegible] text states that lead was detected above its industrial RBC in sedi[illegible]tatement i[illegible] Lead was detected at a maximum of 405 mg/kg, which was below [illegible]l soil RB[illegible]/kg, according to Table 10.,37.6.2 (page 10.37-17). The text shoul[illegible]d.

Response 2
The text [illegible]ll be revised to r[illegible]rrection.

draft

AOC 580
Comment
Section 10.40.4, Page 10.40-15, Line 7: The text states that only one metal (iron) in shallow groundwater exceeded its tap-water RBC. This statement is incorrect. Arsenic and manganese also exceeded their respective tap-water RBC, according to Table 10.40.4.2 (page 10.40-13). The text should be corrected.

Response
The text will be revised to reflect this correction.

AOC 596
Comment 1
Section 10.45.4, Page 10.45-16, Line 6: The text states that one metal (iron) in shallow groundwater samples exceeded its tap-water RBC. This statement is incorrect. Arsenic and manganese also exceeded its tap-water RBC, according to Table 10.45.4.2 (page 10.45-14). The text should be corrected.

Response 1
The text will be revised to reflect this correction.

Comment 2
Section 10.45.4, Page 10.45-16, Line 11: The text states that two metals (arsenic and iron) in deep groundwater samples exceeded their respective tap-water RBC. This statement is incorrect. Manganese also exceeded its tap-water RBC, according to Table 10.45.4.3 (page 10.45-15). This text should be corrected.

Response 2
The text will be revised to reflect this correction.

Supplemental Sampling Questions
Comment 1
Table 10.50.4.3, Page 10.50-15: The Reference Concentration (μg/L) for manganese is reported as "2560". For consistency with the tables, the concentration should be reported as "2,560".

Response 1
The concentration in the table will be revised to reflect this correction.

Comment 2

Section 10.50.4, Page 10.50-25, Line 4: The text states that antimony exceeded its tap-water RBC and shallow groundwater background RC. A shallow groundwater background RC is not available for antimony, based on Table.50.4.3 (page 10.50-18). The text should be corrected.

Response 2
The text will be revised to reflect this correction.

Comment 3
Section 10.50.4, Page 10.50-26, Line 8: The text states that chromium concentrations in two shallow groundwater samples exceeded the chromium tap-water TTAL of 18.0 μg/L. However, in Table 10.50.4.3 (page 10.50-18), an asterisks is not marked for the chromium tap-water RBC to designate that the value is for TTAL. An asterisks should be added to the chromium tap-water RBC value in the table so that the text and table are in agreement.

Response 3
The text will be revised to read "tap-water RBC" rather than Tap-water TTAL.

Comment 4
Section 10.50.4, Page 10.50-26, Line 15: The text states that one shallow groundwater sample exceeded the manganese RC of 2,560 μg/L. This statement is incorrect. The concentration of manganese in the sample was equal to the RC value (2,560 μg/L). The text and table should be in agreement.

Response 4
The text and table will be revised to reflect this correction.

Comment 5
Section 10.50.4, Page 10.50-26, Line 18: The text states that one shallow groundwater sample exceeded the vanadium RBC of 26.0 μg/L. This statement is incorrect. The concentration of vanadium in the sample was equal to the RBC value (26.0 μg/L). The text should be corrected.

Response 5
The text will be revised to reflect this correction.

Comment 6
Section 10.50.4, Page 10.50-27, Line 3: The text states that antimony exceeded its deep groundwater background RC. This statement is incorrect. A RC value is not available for antimony, based on Table 10.50.4.4 (page 10.50-20). The text should be corrected.

Response 6
The text will be revised to reflect this correction.

Comment 7
Section 10.50.4, Page 10.50-27, Line 15: The text states that the concentration of barium in one sample exceeded its deep groundwater background RC of 322 μg/L. This statement is incorrect. The concentration of barium in the sample was equal to the RC value (322 μg/L). The text should be corrected.

Response 7
The text will be revised to reflect this correction.

Comment 8
Section 10.50.4, Page 10.50-27, Line 3 and Page 10.50-28, Line 2: The text states that cadmium exceeded its tap-water RBC and deep groundwater background RC. This statement is incorrect. The concentration of cadmium in one sample was equal to the cadmium tap-water RBC of 1.8 μg/L. In addition, a deep groundwater background RC is not available for cadmium, based on Table 10.50.4.4 (page 10.50-20). The text should be corrected.

Response 8
The text will be revised to reflect this correction.

Comment 9
Section 10.50.4, Page 10.50-27, Line 3 and Page 10.50-28, Line 2: The text states that thallium exceeded its tap-water background RC. A tap-water background RC is not available for thallium, based on Table 10.50.4.4 (page 10.50-20). The text should be corrected.

Response 9
The text will be revised to reflect this correction.

Appendix B

DEPARTMENT OF THE NAVY
SUPERVISOR OF SHIPBUILDING, CONVERSION AND REPAIR, USN
PORTSMOUTH, VIRGINIA, DETACHMENT ENVIRONMENTAL CHARLESTON
1899 NORTH HOBSON AVENUE, BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405-2106

IN REPLY REFER TO:
Ser: 1063
OCT 30 1997

From: Director, Supervisor of Shipbuilding, Conversion and Repair, USN, Portsmouth, VA, Environmental Detachment Charleston (SPORTENVDETCHASN)
To: Commanding Officer, Southern Division Naval Facilities Engineering Command (Code 18 - Hayes Patterson)

Subj: COMPLETION REPORT FOR PROCESS CLOSURE OF BUILDING 44 ANNEX (SWMU 25), PROJECT NUMBER C96018

Encl: (1) Completion Report Process Closure/Demolition for SWMU 25 (Building 44 Annex) Naval Base Charleston, Charleston, SC

1. Subject report was delivered to Southern Division, Naval Facilities Engineering Command on June 30, 1997 for review and comment. There were no comments generated or received by SPORTENVDETCHASN, therefore the report is issued as complete.

2. Questions regarding this report may be directed to Danny Hughes at 743-6777 ext. 122, or Kevin Tunstall at ext. 227.

for M.K. Tunstall
E.R. DEARHART

Copy to:
Ensafe, Inc. (Todd Havercost)

COMPLETION REPORT

PROCESS CLOSURE / DEMOLITION FOR
SWMU 25 (BUILDING 44 ANNEX)
NAVAL BASE CHARLESTON
CHARLESTON, SC

Prepared for:

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON SC

Prepared by:

Supervisor of Shipbuilding, Conversion and Repair,
USN, (SUPSHIP) Portsmouth Va.,
Environmental Detachment Charleston, S.C.
1899 North Hobson Ave.
North Charleston, SC 29405-2106

June 30, 1997

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ACRONYM LIST

AOC	Area of Concern
BEQ	Benzo(a)pyrene Equivalents
CNCRA	Charleston Naval Complex Redevelopment Authority
CMS	Corrective Measure Study
COPC	Constituents of Potential Concern
DERP	Defense Environmental Restoration Program
DON	Department of the Navy
DQO	Data Quality Objective
EOX	Extractable Organic Halides
EPA	U.S. Environmental Protection Agency
IM	Interim Measure
IR	Installation Restoration
RBC	Risk Based Concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SARA	Superfund Amendments and Restoration Act
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SPORTENVDETCHASN	Supervisor of Shipbuilding, Conversion and Repair, Portsmouth VA, Environmental Detachment Charleston
SWMU	Solid Waste Management Unit

1. INTRODUCTION

1.1 INSTALLATION RESTORATION PROGRAM. The purpose of the Department of the Navy (DON) Installation Restoration (IR) Program is to identify, assess, characterize, and cleanup or control contamination from past hazardous waste disposal operations and hazardous material spills at Navy and Marine Corps activities. The Defense Environmental Restoration Program (DERP) is codified in the Superfund Amendments and Reauthorization Act (SARA) Section 211 (10 USC 2701). The IR Program is a component of the DERP.

1.1.1 Naval Base Charleston IR Program. At Naval Base Charleston, a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) was prepared which divided the Naval Base into zones and identified Solid Waste Management Units (SWMU) and Areas of Concern (AOC) within each zone. The RFA evaluated each SWMU and AOC and determined which sites required further investigation. Based on the RFA, a RCRA Facility Investigation (RFI) work plan has been or is being prepared for each zone containing SWMUs and AOCs requiring further investigation. On completion of the RFI for each zone, a RFI report will be prepared for that zone. The RFI reports will identify SWMUs and AOCs containing hazardous wastes requiring remediation. Eventually, Corrective Measures Studies (CMS) will be prepared to determine the best means of remediating the site.

1.2 SOLID WASTE MANAGEMENT UNIT 25. SWMU 25 is the site of a former electroplating facility associated with Building 44 which is located in Zone E. The electroplating facility occupied two rooms in the northwest portion of Building 44 which connected to an annex. The electroplating facility is bordered on the north by Building 5, on the south by Building 44, on the east by Avenue B, and on the west by Hobson Avenue. The facility contained approximately 40 metal tanks that contained the solutions used in the plating process. These tanks and associated equipment were removed in 1995 during the closure operations of Charleston Naval Shipyard.

1.3 BUILDING 44 DEMOLITION. During the interval between the RFI and the completion of the CMS, it was decided by Southern Division Naval Facilities Engineering Command (SOUTHDIV) that an IM would be performed by Supervisor of Shipbuilding, Conversion and Repair, Portsmouth VA, Environmental Detachment Charleston (SPORTENVDETCHASN). To facilitate the sampling effort for the RFI, a process closure action to demolish and remove the building was deemed necessary prior to implementation of any interim measure action. The objective of this process closure action was to demolish the annex, since it was considered unsafe, and to allow access to the soil underneath the building. This action was consistent with the ultimate cleanup of SWMU 25 and was not intended to circumvent the public participation process inherent within environmental cleanup under RCRA authority.

2. INTERIM MEASURE EXECUTION

2.1 ACTIONS REQUIRED BY INTERIM MEASURE WORK PLAN. Clean the rooms located in Building 44. Remove the asbestos roof coating and the asbestos pipe from the annex. Demolish and remove the annex, floor slab and in ground electrical utility manhole. See Appendix A for site location.

2.2 PROBLEMS ENCOUNTERED.

2.2.1 HIGH VOLATGE UTILITY MANHOLE. The electrical utility manhole, shown in Appendix B (Figure B-1), could not be removed as planned. After the removal of the annex floor and pump down of the water which filled the manhole, it was discovered that seven electrical cables traversed through the manhole, three of which were high voltage (13,200 volts). South Carolina Electric and Gas Co. was requested to determine if the cables in the manhole were energized. Drawings do not show origin or destination of the cables passing through this manhole. None of the SCE&G employees were Hazardous Worker Operations (HAZWOPER) qualified to enter the site to inspect the manhole, nor was their contractor who performs gas free testing of enclosed spaces. Since no one was able to determine the status of the electrical lines no attempt was made to cut the cables in order to remove the manhole. Also, it was discovered that concrete conduits encased the cables leading to and from the manhole. These conduits were not part of the original plan, but should be considered for removal along with the manhole during any follow up action.

2.2.2 ADDITONAL VOLUME OF HAZARDOUS WASTE. After the removal of the asbestos roofing material, it was revealed that areas of the roof contained chromium contamination. Samples taken proved the roof contained chromium above 5 parts per million (ppm) Toxic Characteristic Leaching Process (TCLP). Furthermore, the concrete columns inside the annex could not be cleaned by pressure washing as detailed in the plan. Sample analysis of a column after pressure washing also indicated levels of chromium above 5 ppm TCLP.

Additional debris was encountered in the cleaning room of the annex due to two concrete floors, one on the top of the other. This double floor was not indicated on any drawings but was removed along with the top flooring with a minor amount of additional effort.

The concrete roof, beams, purlins, interior columns and double concrete floor added significantly to the amount of hazardous waste removed during the demolition.

2.3 PLAN MODIFICATIONS AND JUSTIFICATION. Modified the work plan to leave electrical utility manhole.

3. INTERIM MEASURE OUTCOME

3.1 SITE CONDITIONS FOLLOWING COMPLETION OF WORK. On 11 April 1997, after completion of work, SPORTENVDETCHASN had removed 396 tons of building material from SWMU 25. The door ways from Building 44 into the annex were filled with concrete block and the annex area covered with plastic sheeting to prevent water infiltration and runoff. An electrical vault that was adjacent to the annex in the alley has been identified as being contaminated with chromium. Several areas of concrete outside the annex have the visual appearance of being contaminated.

3.2 AREAS REQUIRING FURTHER ACTION. The electrical utility manhole and associated concrete conduit need to be removed if any evacuation at the site is deemed required by the RFI.

4. SAMPLING

4.1 SAMPLING EVOLUTIONS AND RESULTS. Initial sampling was conducted to determine the areas of contamination for accessing waste volume. Additional samples were taken to verify cleaning evolutions and to test areas previously indiscernible as contaminated. Initial sampling included walls, floors, drains, trenches and concrete columns. Additional sampling included the concrete roof, beams and purlins. Sample results are included in Appendix B.

5. WASTE GENERATION

5.1 HAZARDOUS/POTENTIALLY HAZARDOUS WASTE. The hazardous waste identified below in paragraph 5.1.1 was packaged at the work site for disposal. A less than 90 day storage area was created to accumulate the waste at the site as the building was being demolished. The less than 90 day storage area met the requirements of the South Carolina Department of Health and Environmental Control (SCDHEC) regulations R.61-79.265. See Appendix C for shipping manifest.

5.1.1 Hazardous Waste. Between 26 February 1997 and 1 April 1997 twenty three shipments, for a total of 330.09 tons, of contaminated building material was packed in 20 cubic yard roll offs and transported to Laidlaw Environmental Services of South Carolina, Inc. for disposal. The disposal site was located in Pinewood, SC at a Title "C" landfill and the disposal made under license number N9702076.

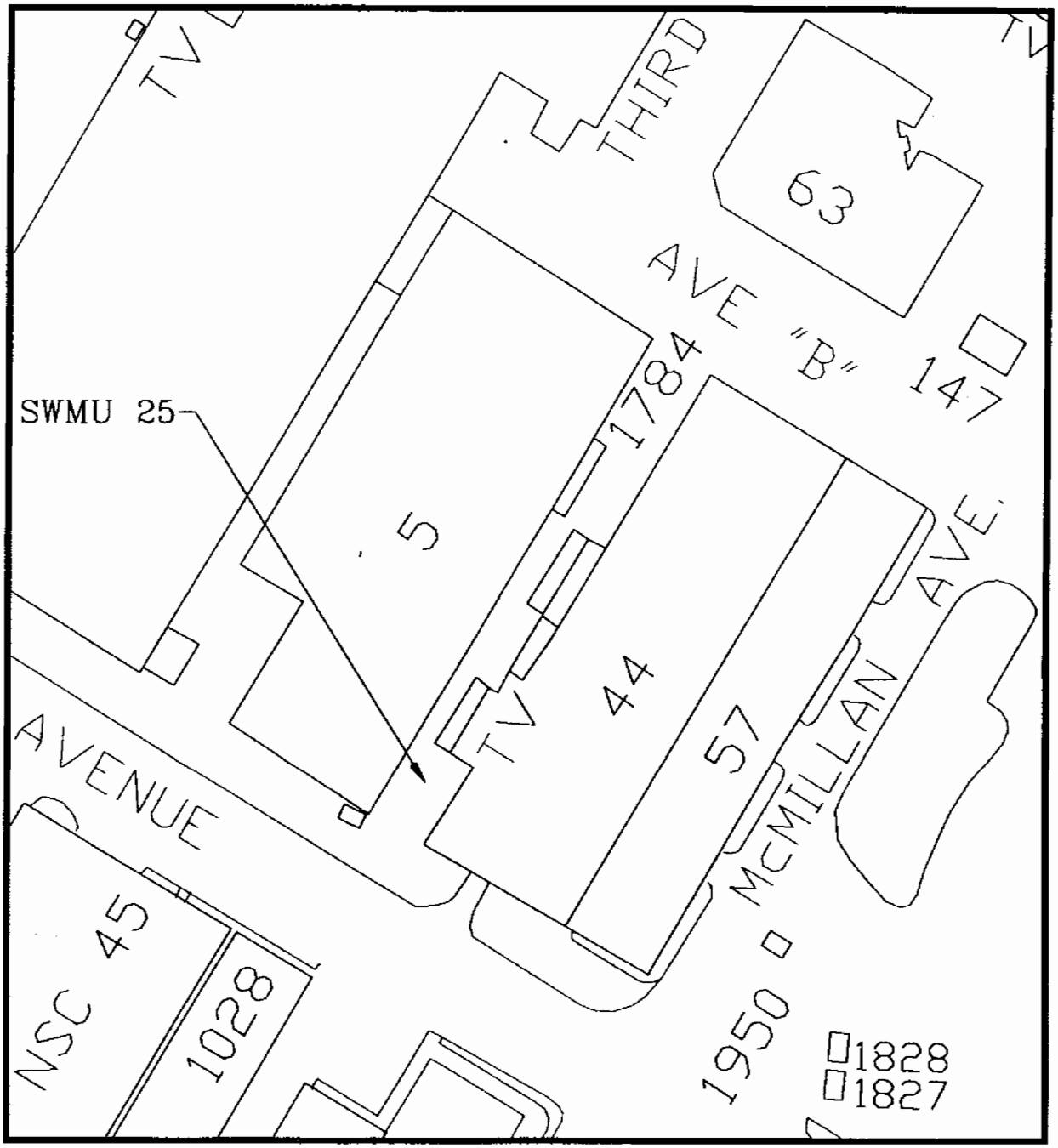
5.1.2 Asbestos Waste. One shipment of asbestos containing material (5.96 Tons) was transported by Fennel Container Company, Inc. to Chambers Oakridge Landfill located in Dorchester County, South Carolina under license number SC N9612040 on 21 February 1997.

5.2 NON-HAZARDOUS WASTE. A total of 60 tons of non-hazardous construction material was removed from the site and transported to Charleston County Landfill on Bees Ferry Road.

APPENDIX A

SITE MAP

FIGURE A-1
SWMU 25 SITE MAP



APPENDIX B

SAMPLE DATA

FIGURE B-1
SAMPLE LOCATIONS

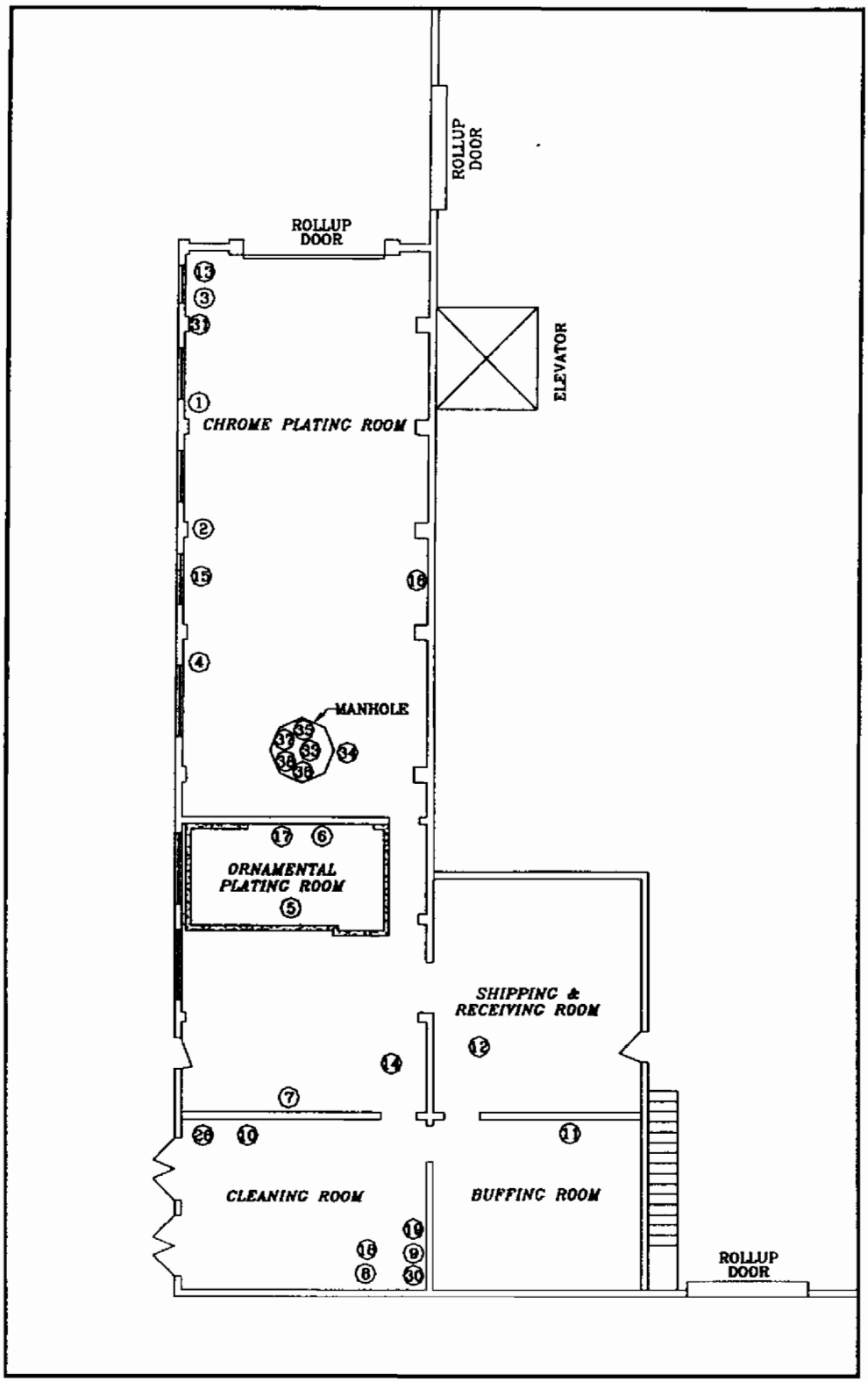


FIGURE B-1 Con't
SAMPLE LOCATIONS

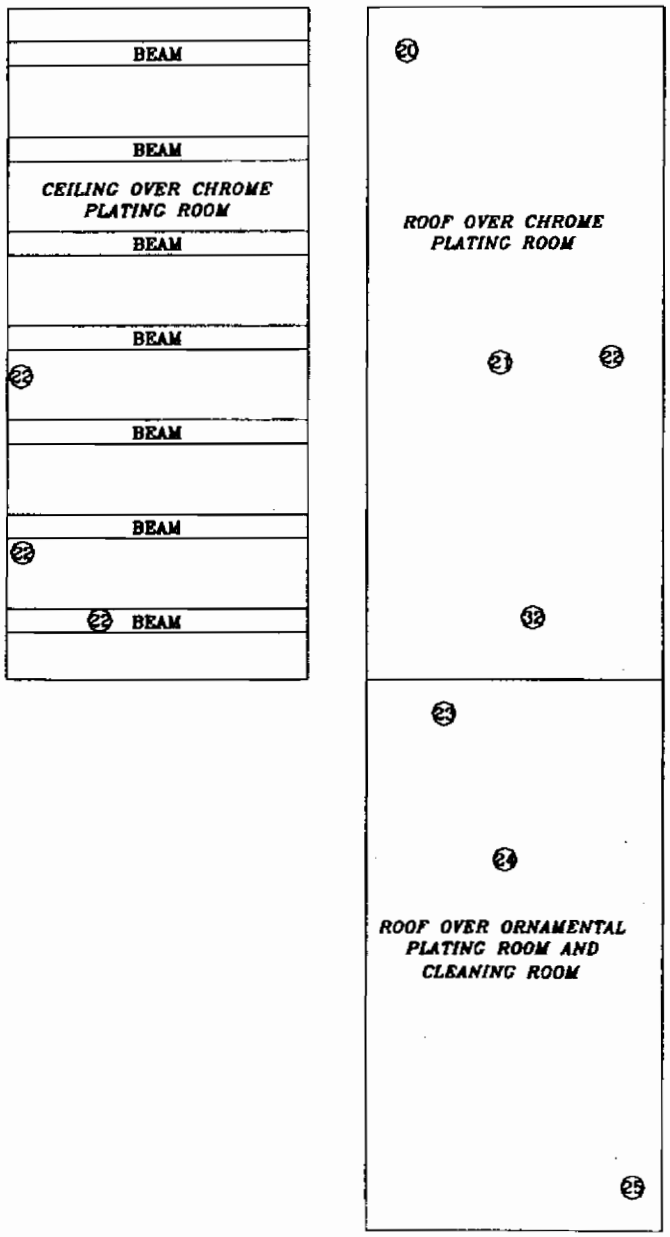


TABLE B-1

BUILDING 44 ANNEX DEMOLITION SAMPLE IDENTIFICATION

LOCATION	SAMPLE ID #	TYPE OF ANALYSIS	TYPE OF SAMPLE	DESCRIPTION OF SAMPLE LOCATION
1	SPORT0120-1	TCLP	CONCRETE	North wall 2' up, 12' from East wall
2	SPORT0120-2	TCLP	CONCRETE	North wall 8' high, 18' from East wall
3	SPORT0120-3	TCLP/RCRA METALS/ HEXAVALENT CHROMIUM	CONCRETE	Floor
4	SPORT0120-4	TCLP	CONCRETE	Bottom block 16' from West wall
5	SPORT0120-5	TCLP	DRAIN RESIDUE	
6	SPORT0120-6	TCLP	CONCRETE	Bottom block 14' from North wall
7	SPORT0120-7	TCLP	CONCRETE	Middle block 5' high, 10' from North wall
8	SPORT0120-8	TCLP	CONCRETE	Bottom block 18' from North wall
9	SPORT0120-9	TCLP	CONCRETE	Floor
10	SPORT0120-10	TCLP	CONCRETE	Middle block 5' high, 6' from North wall
11	SPORT0120-11	TCLP/RCRA METALS	TRENCH RESIDUE	Trench in buffing room
12	SPORT0120-12	TCLP/RCRA METALS	TRENCH RESIDUE	Trench in shipping and receiving room
13	SPORT0120-13	TCLP/RCRA METALS/ HEXAVALENT CHROMIUM	CONCRETE	Duplicate of #3
14	SPORT0120-14	TCLP/RCRA METALS	DRAIN RESIDUE	Residue from drain
15	SPORT0122-1	TCLP	CONCRETE	8' high, 25' from East wall
16	SPORT0122-2	TCLP	CONCRETE	2' high, 23' from East wall
17	SPORT0122-3	TCLP	CONCRETE	8' high, 14' from North wall
18	SPORT0122-4	TCLP	CONCRETE	8' high, 18' from North wall
19	SPORT0122-5	TCLP	CONCRETE	3' high, 3' from South wall
20	SPORT0131-1	ASBESTOS	TAR	Roof coating north east corner upper roof
21	SPORT0131-2	ASBESTOS	TAR	Roof coating center of upper roof
22	SPORT0131-3	ASBESTOS	TAR	Roof coating south end center upper roof
23	SPORT0131-4	ASBESTOS	TAR	Roof coating north east side lower roof
24	SPORT0131-5	ASBESTOS	TAR	Roof coating east side center lower roof
25	SPORT0131-6	ASBESTOS	TAR	Roof coating south west corner lower roof
26	SPORT0199-1	PCB	CONCRETE	Cleaning room
27	SPORT0328-1	TCLP	CONCRETE	Column after cleaning
28	SPORT0328-2	TCLP	CONCRETE	Upper roof
29	SPORT0356-1	TCLP	CONCRETE	Roof beam

TABLE B-1 Con't

BUILDING 44 ANNEX DEMOLITION SAMPLE IDENTIFICATION

LOCATION	SAMPLE ID #	TYPE OF ANALYSIS	TYPE OF SAMPLE	DESCRIPTION OF SAMPLE LOCATION
30	SPORT0356-2	TCLP	CONCRETE	Roof beam
31	SPORT0356-3	TCLP	CONCRETE	Roof beam
32	SPORT0357-1	RCRA METALS	SOIL	Under grade block
33	SPORT0390-1	TCLP/RCRA METALS/ CYANIDE	SOIL	Inside vault
34	SPORT0390-2	TCLP/RCRA METALS/ CYANIDE	SOIL	Outside vault
35	SPORT0390-3	TCLP/RCRA METALS/ CYANIDE	SOIL	Floor residue inside vault
36	SPORT0390-4	RCRA METALS	SWIPE	Swipe of conduit pipe
37	SPORT0392-1	TCLP	WATER	Rinsate from vault pump down
38	SPORT0405-1	pH/NPDES METALS/ HEXAVALENT CHROMIUM, CYANIDE, OIL & GREASE	WATER	Water from vault pump down

DEPARTMENT OF THE NAVY
SUPERVISOR OF SHIPBUILDING, CONVERSION AND REPAIR, USN
PORTSMOUTH, VIRGINIA, ENVIRONMENTAL DETACHMENT CHARLESTON
1899 NORTH HOBSON AVENUE, BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405-2106

IN REPLY REFER TO:

Ser: 823

SEP 24 1998

Mr. G. Randall Thompson, Director
Division of Hazardous and Infectious Waste Management
Bureau of Solid and Hazardous Waste Management
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia SC 29201

Dear Mr. Thompson:

The enclosed investigation report for Solid Waste Management Unit (SWMU) 25 is submitted to fulfill the requirement of Permit Condition IV.D.6 for Permit Number SCO 170 022 560. If the Department of Health and Environment Control should have any questions, please contact Reece Batten of Southern Division Naval Facilities Engineering Command (NAVFAC) at (843)820-5578.

Sincerely,

for

E.R. Dearhart
Director

Encl:
(1) SWMU 25 Investigation Report

Copy to:
SCDHEC (Mr. Tapia, Mr. Bergstrand)
USEPA (Mr. Spariosu)
CSO Naval Base Charleston (LCDR Rose)
NAVFAC (Mr. Batten)
EA&H (Ms. Maddux)

INVESTIGATION REPORT

For SWMU 25
Charleston Naval Complex, Charleston, SC

ENVIRONMENTAL DETACHMENT CHARLESTON
SOUTH CAROLINA

Engineering Branch Head: [redacted] Date: 23-98

Prepared By: Michael P. Whalen Date: 9-16-98

REPORT GENERATED BY:

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1899 NORTH HOBSON AVENUE
NORTH CHARLESTON, SC 29405

SWMU 25
INVESTIGATION REPORT

NAVAL BASE CHARLESTON
CHARLESTON, SC

Prepared for:

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON SC

Prepared by:

Supervisor of Shipbuilding, Conversion and Repair,
USN, (SUPSHIP) Portsmouth Va.,
Environmental Detachment Charleston, S.C.
1899 North Hobson Ave.
North Charleston, SC 29405-2106

Sept 14, 1998

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ACRONYMS, ABBREVIATIONS, AND SYMBOL

AOC	Area of Concern
CFR	Code of Federal Regulations
CMS	Corrective Measures Study
DERP	Defense Environmental Restoration Program
DET	Environmental Detachment Charleston
DHEC	Department of Health and Environmental Control
EPA	Environmental Protection Agency
ppm	Parts Per Million
SARA	Superfund Amendments and Reauthorization Act
SOUTHDIV	Southern Division Facilities Naval Engineering Command
RBC	Risk Based Concentrations
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SWMU	Solid Waste Management Unit

1. INTRODUCTION

1.1 SOLID WASTE MANAGEMENT UNIT 25. SWMU 25 is the site of a former electroplating facility associated with Building 44 which is located in Zone E. The electroplating facility occupied two rooms in the northwest portion of Building 44 which connected to an annex. The electroplating facility was bordered on the north by Building 5, on the south by Building 44, on the east by Avenue B, and on the west by Hobson Avenue. The facility contained approximately 40 metal tanks that contained the solutions used in the plating process. These tanks and associated equipment were removed in 1995 during the closure operations of Charleston Naval Shipyard.

In 1997, the Environmental Detachment Charleston (DET) was tasked with the demolition of the Building 44 electroplating facility. The facility was considered unsafe and removal would result in access to the soil beneath the building. However, electrical vault 7A could not be removed as planned. After removal of the fluid that filled the vault, it was discovered that seven electrical cables traversed through the vault. South Carolina Electric and Gas Company could not determine if the cables were energized. Since the status of these cables were unknown, no attempt was made to cut the cables in order to remove the vault. Also, it was discovered that concrete conduits encased the cables. These conduits were not shown on the original plan.

1.2 SWMU 25 INVESTIGATION. During the interval between the RFI and the completion of the CMS, it was decided by Southern Division Naval Facilities Engineering Command that an investigation would be performed by Supervisor of Shipbuilding, Conversion and Repair, United States Navy, Portsmouth Va. Environmental Detachment Charleston (DET). The objective of this investigation was to determine/delineate the extent of contamination in electrical service vault 7A located in SWMU 25 and provide SOUTHDIV with resulting data and possible corrective measures.

2. INVESTIGATION EXECUTION

2.1 ACTIONS REQUIRED BY INVESTIGATION WORK PLAN.

- Sample and remove fluid from within the electrical service vault.
- Monitor infiltration of fluid into the vault and re-sample.
- Delineate surface soil contamination exceeding Risk Based Criteria (RBC) in the vicinity of the electrical service vault.

2.2 OBSERVATIONS NOTED.

2.2.1 Fluid Within the Electrical Service Vault.

6,203 pounds of Chromium contaminated fluid was removed from the electrical vault. This fluid exceeded the regulatory level of 5 ppm as specified by 40 Code of Federal Regulations (CFR) 261.64 Table 1 – Maximum Concentration of Contaminants For The Toxicity Characteristic. Laboratory reports for the contaminated fluid are provided in Appendix A.

Two core samples were taken from the inside surfaces of the electrical service vault. These core samples exceeded the regulatory level of 5 ppm as specified by 40 CFR 261.64 Table 1 – Maximum concentration of Contaminants For The Toxicity Characteristic. Laboratory reports for the core sampling are provided in Appendix B.

2.2.2 Infiltration of Fluid Into the Electrical Service Vault.

From the time period of 1 June, 1998 through 25 August, 1998, no additional fluid entered the electrical service vault. However, evidence exists that previously removed fluid entered the service vault via electrical cable conduits that route to electrical service vaults 7 and 7B. Yellow deposits consistent with Chromium contamination can be found

in service vaults 7, 7A, and 7B. The fluid in vault 7A does not appear to be influenced by changes in groundwater levels.

2.2.3 Delineation of Surface Soil Contamination.

In August 1997, the DET performed soil sampling at fourteen locations in SWMU 25 that were informally provided to the Project Team for evaluation. This Investigation Report formally submits the results of this soil sampling. These samples were taken at the first and second intervals for a total of 28 samples. Six second interval samples exceeded the EPA's Risk Based Concentration (RBC) Tables limit of 19 ppm for Hexavalent Chromium.

The Project Team established a level of 1,300 ppm as an industrial use clean-up for lead. One sample exceeded this level of 1,300 ppm for lead at both the first and second intervals. The sample locations are provided in Figure 1. A matrix summarizing sample results are provide in Table 1. Laboratory reports for the soil sampling are provided in Appendix C.

2.3 PLAN MODIFICATIONS AND JUSTIFICATIONS.

The Detachment's internal Work Plan indicated that five core samples should be taken on the inside surfaces of the electrical vault. However, the Caretaker Site Office could not verify that the electrical cables transversing the vault were de-energized. Therefore, DET personnel were not allowed to enter the vault to obtain these samples. Due to this situation, only two core samples were obtained. However, these two core samples provided the necessary information to properly delineate the inside surfaces of the vault. The internal Work Plan indicated for the DET to re-sample infiltration fluid. However, no additional fluid infiltrated the service vault. Therefore, this re-sampling was not accomplished.

3. INVESTIGATION OUTCOME

3.1 SITE CONDITIONS FOLLOWING COMPLETION OF WORK.

Following completion of work on 25 August, 1998, the DET had removed 6,203 pounds of contaminated fluid from the electrical vault. 28 soil samples, two core samples inside the vault, and one composite sample of the former transformer building were taken.

Electrical service vault 7A currently contains numerous high-voltage electrical cables. The DET has investigated the source and use of these cables to the maximum extent possible. The CSO was requested to coordinate the identification and de-energization of these electrical cables as required by 29 CFR 1910.333 – Electrical - Safety-Related Work Practices. The identification and de-energization of these cables has yet to be accomplished. Prior to any work being performed near or on these cables, the status of these cables must be identified.

Ensafe Inc. performed a SWMU Manhole/Confined Space Study of electrical service vault 7A. The results of this study are provided in Appendix F.

4. SAMPLING

4.1 SAMPLING EVOLUTIONS AND RESULTS.

4.1.1 Investigative Sampling. Laboratory results for the investigative sampling can be found in the Appendices of this report. Field sampling consisted of:

- Soil and electrical service vault sampling consisted of grab samples to determine the areas of contamination.
- Transformer building sampling consisted of a composite sample to determine the areas of contamination.

5. WASTE GENERATION

5.1 HAZARDOUS/POTENTIALLY HAZARDOUS WASTE. The hazardous waste identified below in paragraph 5.5.1 was packaged at Building 1824 for disposal. This less than 90 day storage area met the requirements of the South Carolina Department of Health and Environmental Control (SCDHEC) regulations R.61-79.265. All contaminated waste was disposed of to a permitted Treatment, Storage, and Disposal Facility. Waste manifests are provided in Appendix E.

5.1.1 Hazardous Waste. On 6/1/98, 6,203 pounds of chromium contaminated fluid was removed from the electrical vault. This waste was properly packaged and transported to Chem-Met Services for disposal.

5.2 NON-HAZARDOUS WASTE. No non-hazardous waste was generated during the accomplishment of this investigation.

6. CONCLUSIONS

6.1 ELECTRICAL SERVICE VAULT 7A. The statement of work requested that the Detachment determine alternatives of protective measures to eliminate the infiltration of contamination into the electrical service vault. However, the source of contamination at SWMU 25 is electrical service vault 7A and associated cable conduits. Recommended protective measures are:

- Remove the electrical cables from electrical service vault 7A.
- Remove the cable conduits leading to and from electrical service vault 7A.
- Remove electrical service vault 7A and backfill.

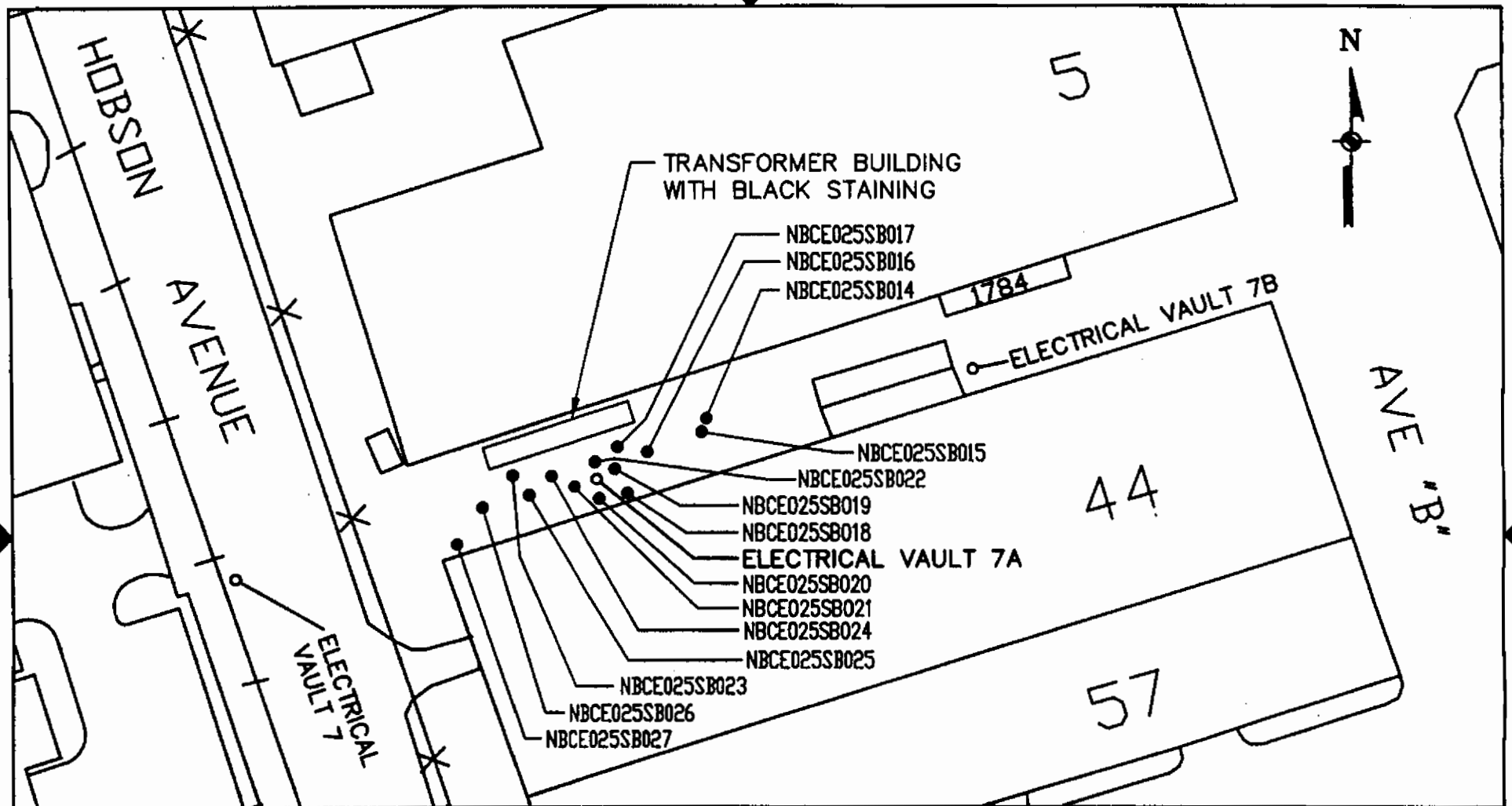
6.2 TRANSFORMER BUILDING. A black stain was noticed on the south side of the transformer building located between SWMU 25 and Building 5. The former plating shop's exhaust fans were adjacent to this transformer building. At the request of SOUTHDIV, a core sample was taken of this stained area. This sample significantly exceeded the regulatory level of 5 ppm as specified by 40 CFR 261.64 Table 1 – Maximum Concentration of Contaminants For The Toxicity Characteristic. Laboratory reports for the black staining are provided in Appendix D. Photographs of the black staining are provided in Appendix G.

The presence of this black stain was first noticed during the demolition of the former plating shop in March, 1997. At this time, the Detachment sprayed the transformer building stained area with water and collected a rinsate sample. This sample was below the regulatory level of 5 ppm as specified by 40 CFR 261.64 Table 1 – Maximum Concentration of Contaminants For The Toxicity Characteristic. Laboratory reports for this rinsate are provided in Appendix D.

The transformer building is providing support for in-use electrical cable conduit. The laboratory report from the rinsate sample indicates that the rinsate from the transformer building is not characterized as hazardous waste. However, if the transformer building

use is no longer needed or if the building is demolished, the building/debris possessing the black stain should be characterized as hazardous waste.

FIGURES



LEGEND

- SOIL SAMPLE

0 40 80 120

GRAPHIC SCALE (FEET)

ENVIRONMENTAL DETACHMENT CHARLESTON
1899 NORTH HOBSON AVENUE – BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405–2106

FIGURE 1
SWMU 25 COMPLETION REPORT SITE MAP WITH SAMPLE LOCATIONS

SIZE	DATE:	PREPARED BY:	REV
A	9–2–98	M. WHEELER	–
SCALE: –		SHEET: F1	

TABLES

SWMU 25 SOIL SAMPLING

SAMPLE #	ARSENIC RBC 3.8c	BARIUM RBC 140,000	BERYLLIUM RBC 1.3	CADMIUM RBC 1,000	CHROMIUM TOTAL RBC 1,000,000	HEXAVALENT CHROMIUM RBC 10,000 SSL 19	LEAD DIRECTIVE 1300	MERCURY RBC 1,300	CYANIDE TOTAL
025SB01401	1.89	64.8	0.152	0.566	6,880	842	252	0.641	0.177
025SB01402	1.34	44.3	0.0831	0.0927	3,880	[illegible]	279	0.587	0.132
025SB01501	0.899	16.7	0.0454	0.397	1,620	411	550	0.0894	U
025SB01502	1.61	32.4	0.124	U	4,050	[illegible]	14.2	0.0377	U
025SB01601	2.83	34.2	0.23	63.6	452	45.5	94.9	0.225	10.5
025SB01602	0.535	18.4	0.206	0.614	3,850	[illegible]	9.52	0.111	0.149
025SB01701	1.59	26.8	0.184	6.86	2,010	463	76.6	0.281	U
025SB01702	0.438	22.1	0.206	1.86	18,600	1.29	31.1	0.342	0.222
025SB01801	2.12	34.9	0.211	4.1	93	0.878	82.8	0.192	U
025SB01802	1.04	23.4	0.253	1.61	752	5.56	17.8	0.499	U
025SB01901	2.19	25.9	0.208	0.572	693	201	65	0.228	0.104
025SB01902	1.64	18.8	0.125	0.056	296	[illegible]	11.1	0.0387	U
025SB02001	0.645	1,160	0.0241	73	2,420	906	[illegible]	0.0348	U
025SB02002	0.672	465	0.0225	22	1,320	[illegible]	[illegible]	0.0312	U
025SB02101	1.32	21.1	0.174	0.414	274	1.64	30.1	0.0883	0.166
025SB02102	1.49	25.2	0.182	1.59	253	0.981	53.5	0.175	0.932
025SB02201	3.1	53.2	0.206	6.7	5,530	708	1,090	0.892	0.802
025SB02202	0.484	13.5	0.0494	0.0624	804	[illegible]	46.2	0.0182	0.107
025SB02301	1.59	36.9	0.186	243	137	0.12	917	0.139	8.38
025SB02302	0.531	9.6	0.0644	12.4	6.52	U	6.88	0.083	0.868
025SB02401	2.93	35.1	0.208	1.72	38.4	U	113	0.142	0.797
025SB02402	1.07	22.9	0.272	73.7	54.3	0.144	6.25	0.0486	0.817
025SB02501	1.87	25.5	0.102	7.98	34.8	U	105	0.231	3.1
025SB02502	1.02	13	0.112	54.5	372	U	2.2	0.0542	12.9
025SB02601	2.22	25.7	0.223	15.4	17.6	U	125	0.727	0.415
025SB02602	0.67	12.1	0.0879	2.85	13.1	U	11.7	0.087	0.339
025SB02701	1.4	19.5	0.0252	16.6	64.3	0.222	264	0.06	0.956
025SB02702	0.446	6.04	0.00314	2.51	25.7	0.108	31.8	U	U

SHADED BLOCKS REFLECT RESULTS GREATER THAN
RBC/ OR PROJECT TEAM DIRECTIVE FOR LEAD

TA E 1

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 190010
2155 EAGLE DRIVE
NORTH CHARLESTON, S.C. 29419-9010

5090/11
Code 18B1
22 November, 1999

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

Subj: SUBMITTAL OF FINAL COMPLETION REPORT FOR SWMU 25 INTERIM MEASURE

Dear Mr. Litton,

The purpose of this letter is to submit the Final Completion Report for SWMU 25 Interim Measure at Naval Base Charleston. The Completion Report is submitted to fulfill the requirements of condition II.F.3(b) of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and U.S. Environmental Protection Agency.

We request that the Department and the EPA review the report and file for future reference. If you should have any questions, please contact Amy Daniel or myself at (803) 743-9985 and (803) 820-5525 respectively.

Sincerely,

M. A. Hunt

M.A.HUNT, P.E.
BRAC Environmental Coordinator
BRAC Division

Encl: Final SWMU 25 Interim Measure Completion Report

Copy to:
SCDHEC (3)
USEPA (Dann Spariosu)
SOUTHNAVFACENGCOM (Matthew Hunt)
CSO Naval Base Charleston (Amy Daniel)

SCRA®

1899 North Hobson Avenue
North Charleston, SC 29405-2106
TEL (843) 202-8000
FAX (843) 202-8001
http://www.eeg-scra.org

November 17, 1999
Ser: 074

Delphinus Engineering (Al Stoll)
93 Monte Sano Drive
Hanahan, SC 29406

Re: Completion Report for Charleston Naval Complex (CNC) Solid Waste Management Unit (SWMU) 25.

South Carolina Research Authority (SCRA), Environmental Enterprise Group was contracted to generate a Completion Report for SWMU 25 per purchase requisition No. CHNPO9922. The enclosed report documents the actions performed at SWMU 25.

Questions or information concerning this report should be addressed to Alan Moyer at (843) 202-8064 or Jed Heames at 202-8060.

Respectfully,

E.R Dearhart
SCRA, Vice-President
Environmental Enterprise Group

COMPLETION REPORT
Interim Measure for
SWMU 25
Naval Base Charleston
Charleston, SC

Engineering Branch Head: _____ Date: 11-19-99

Prepared By: _____ Date: 11/17/99

Site work for this Interim Measure was completed by SUPSHIP, Environmental Detachment Charleston. This report is being submitted by South Carolina Research Authority (SCRA) Environmental Enterprise Group (EEG) established as a result of the US Navy's privatization of SUPSHIP Environmental Detachment Charleston on 13 September 1999.

DOCUMENT GENERATED BY:
SOUTH CAROLINA RESEARCH AUTHORITY
Environmental Enterprise Group
1899 NORTH HOBSON AVENUE
NORTH CHARLESTON, SC 29405

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ACRONYMS, ABBREVIATIONS and SYMBOLS

AOC	Area of Concern
CMS	Corrective Measures Study
DERP	Defense Environmental Restoration Program
DET	Environmental Detachment Charleston
DON	Department of The Navy
IM	Interim Measure
IR	Installation Restoration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
PPM	Parts Per Million
SARA	Superfund Amendments and Reauthorization Act
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SUPSHIP	Supervisor of Shipbuilding, Conversion, and Repair
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
USN	United States Navy
VOC	Volatile Organic Compounds

1. INTRODUCTION

1.1 INSTALLATION RESTORATION PROGRAM The purpose of the Department of The Navy (DON) Installation Restoration (IR) Program is to identify, assess, characterize, and clean up or control contamination from past hazardous waste disposal operations and hazardous material spills at Navy and Marine Corps activities. The Defense Environmental Restoration Program (DERP) is codified in the Superfund Amendments and Reauthorization Act (SARA) Section 211 (10 USC 2701). The IR Program is a component of DERP.

1.1.1 Naval Base Charleston IR Program At Naval Base Charleston, a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) was prepared which divided the Naval Base into zones and identified Solid Waste Management Units (SWMU) and Areas of Concern (AOC) within each zone. The RFA evaluated each SWMU and AOC and determined which sites required further investigation. Based on the RFA, a RCRA Facility Investigation (RFI) Work Plan has been or is being prepared for each zone containing SWMU and AOC requiring further investigation. On completion of the RFI for each zone, a RFI report will be prepared for that zone. The RFI reports will identify SWMU and AOC containing wastes requiring remediation. Eventually, Corrective Measures Studies (CMS) will be prepared to determine the best means of remediating each site.

1.2 INTERIM MEASURES Interim Measures (IM) performed as part of the IR Program are intended to eliminate sources of environmental contamination or limit the spread of environmental contaminants prior to the completion of the RFI CMS.

1.3 SWMU 25 Solid Waste Management Unit 25 is the site of a former electroplating facility associated with Building 44 which is located in Zone E of the former Charleston Naval Complex. The electroplating facility occupied two rooms in the northwest portion of Building 44 which connected to an annex. The electroplating facility was bordered on the north by Building 5, on the south by Building 44, on the east by Avenue B, and on

the west by Hobson Avenue. The location of SWMU 25 is provided as Figure A-1 of Appendix A.

In 1997, the Environmental Detachment Charleston (DET) was tasked with the demolition of the Building 44 electroplating facility. This removal action is documented in the Completion Report titled "Process Closure/Demolition for SWMU 25 (Building 44 Annex)," dated June 30, 1997. During Building 44 demolition it was determined electrical vault 7A could not be removed as planned. After removal of the fluid that filled the vault, it was discovered that seven high voltage electrical cables traversed through the vault. Since the status of the cables could not be verified by South Carolina Electric & Gas or shipyard electrical drawings, no attempt was made to cut the cables and vault 7A removal was deferred.

In 1998, the DET was tasked with performing an investigation to determine/delineate the extent of contamination at SWMU 25. This investigation, documented in SWMU 25 Investigation Report dated September 14, 1998, revealed vault 7A was a source of chromium contamination. The fluids and inside surfaces of the vault were stained yellow with chromium (see pictures in Appendix E).

1.4 SWMU 25 INTERIM MEASURE During the interval between the RFI and the completion of the CMS, it was decided by Southern Division Naval Facilities Engineering Command (SOUTHDIV) that an IM would be performed by Supervisor of Shipbuilding, Conversion, and Repair (SUPSHIP), United States Navy (USN), Portsmouth Va. Environmental Detachment Charleston. The scope of this IM was limited to excavation and disposal of electrical vault 7A and associated electrical cable conduit. This IM may not necessarily be the final remedial action taken at this site. This IM is consistent with the ultimate cleanup of SWMU 25 and is not intended to circumvent the public participation process inherent within environmental cleanup under RCRA authority. The letter of record for the approval of SWMU 25 IM work plan is provided as Appendix B.

2. INTERIM MEASURE EXECUTION

2.1 ACTIONS REQUIRED BY INTERIM MEASURE WORK PLAN The following actions were required by the interim measure work plan:

- Remove any fluid from within the electrical vault
- Remove electrical service vault 7A and associated cable conduit
- Obtain an information sample of the soil beneath the vault
- Dispose of the electrical cables
- Remove any encountered groundwater
- Backfill the excavation

2.2 SWMU 25 INTERIM MEASURE EXECUTION SUMMARY The execution of this IM consisted of removing vault 7A and associated cables. The excavation began in July 1999. Debris removed from this site was characterized as hazardous and disposed in a certified Subtitle C landfill.

2.3 SWMU 25 INTERIM MEASURE CONCLUSION This IM effectively removed the chromium contaminated concrete electrical vault 7A and approximately 109 feet of associated concrete cable conduit. Figure A-2 identifies the extent of conduit removal.

2.4 OBSERVATIONS NOTED The bottom of electrical vault 7A had an approximate 12 inch thick layer of deposits from the past plating operations of the plating shop. This layer is believed to be the source of chromium contamination that existed in electrical vault 7A. No groundwater was encountered during vault 7A removal.

2.5 PLAN MODIFICATIONS AND JUSTIFICATION After the completion of actions required by this interim measure, SOUTHDIV issued a statement of work to include installing an asphalt cap over the soil where Building 44 once stood.

3. SAMPLING

3.1 SAMPLING EVOLUTIONS AND RESULTS One discrete soil sample was collected in the center of the excavation following vault 7A removal for informational purposes. Laboratory analytical results are provided as Appendix C of this report. These analyses consisted of RCRA Metals, TCLP metals, and Appendix IX volatile organic compounds (VOC). The sample results show only lead exceeded the soil to groundwater Soil Screening Levels (SSL's) listed in Table 6.2, Volume II of the November 1997 Draft Zone E RFI Report. Sample results and SSL's are listed below.

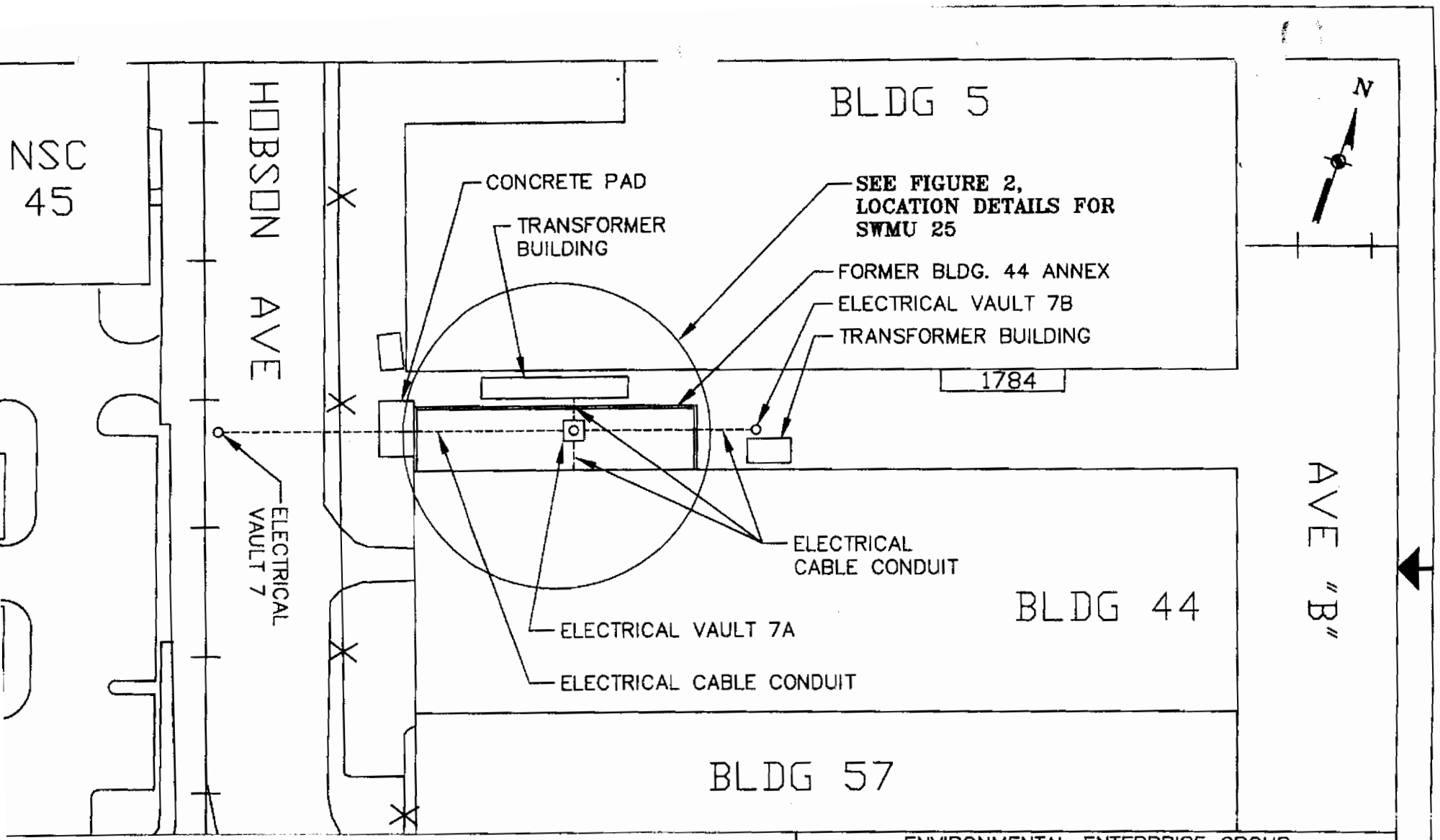
Metal Analysis	Result (ppm)	Draft Zone E RFI SSL (ppm)
Mercury	0.0477	1.04
Silver	1.38	15.3
Arsenic	2.07	14.6
Barium	25.7	824
Cadmium	3.5	3.76
Chromium	849	1,800,000
Lead	108	* 39.6
Selenium	0.313	2.60

*** Table 6.2 recognizes lead SSL as Background, Table 5.2 of the Draft RFI lists the mean concentration for lead in Zone E as 39.6 ppm**

4.0 WASTE GENERATION

4.1 HAZARDOUS WASTE A total of 50,360 pounds of chromium contaminated debris was disposed of to a permitted Subtitle C landfill. This debris was disposed of at Safety-Kleen Inc. Pinewood facility located in Pinewood, South Carolina. Waste manifests are provided as Appendix D.

4.2 NON-HAZARDOUS WASTE No non-hazardous waste was generated during the accomplishment of this interim measure.



40 0 40 80

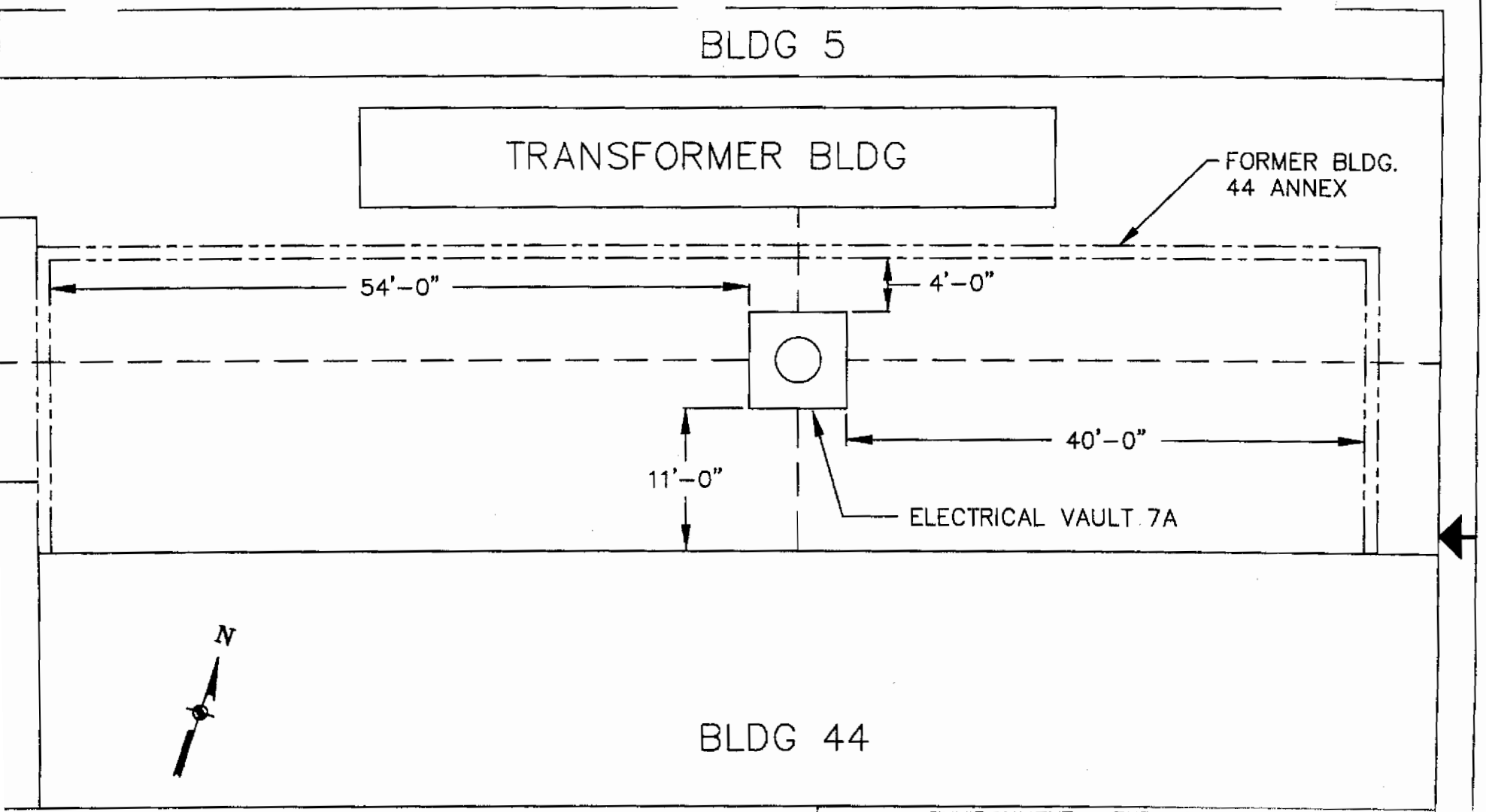
GRAPHIC SCALE (FEET)

SCRA EEG Environmental Enterprise Group

ENVIRONMENTAL ENTERPRISE GROUP
1899 NORTH HOBSON AVENUE – BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405–2106

FIGURE 1
SITE LAYOUT DRAWING OF SWMU 25

SIZE	DATE:	PREPARED BY:	REV
A	21 OCT 1999	J.I. BROWNLEE	–
SCALE: –		SHEET: A–1	



LEGEND

REMOVED ELECTRICAL CABLE CONDUIT

SCRA EEG Environmental Enterprise Group

ENVIRONMENTAL ENTERPRISE GROUP
1899 NORTH HOBSON AVENUE – BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405-2106

FIGURE 2
LOCATION DETAILS FOR SWMU 25

SIZE	DATE:	PREPARED BY:	REV
A	21 OCT 1999	J.I. BROWNLEE	–
SCALE: NONE		SHEET: A-2	

D H E C

PR E PROTECT PROSPER

2600 Street
Columbia, SC 29201-1708

COMMISSIONER:
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Secretary

Mark B. Kent

Lyndi C. Mosteller

Brian K. Smith

Sidney L. Grandy

July 7, 1999

Henry Shepard II, P.E.
Caretaker Site Office
NAVFACENGCOM, Southern Division
P. O. Box 190010
North Charleston, SC 29419-9010

Re: Interim Measures Work Plan for SWMU 25, Dated April 9, 1999, Located in Zone E Charleston Naval Complex SCO 170 022 560, Revision 1.0, Received June 29, 1999.

Dear Mr. Shepard:

The South Carolina Department of Health and Environmental Control (Department) has reviewed the above referenced Revision 1.0 Interim Measures Work Plan (6/29/99) according to applicable State and Federal Regulations, and the Charleston Naval Complex Hazardous Waste Permit, effective September 17, 1999. Based on this review the referenced Interim Measure Work Plan is approved.

Should you have any questions, please contact me at (803) 896-4185 or Mihir Mehta at (803) 896-4088 or Paul Bergstrand at (803) 896-4016.

Sincerely,

David M. Scaturo

David M. Scaturo, P.E., P.G., Manager
Corrective Action Engineering Section
Bureau of Land & Waste Management

cc: Paul Bergstrand, Hydrogeology
Rick Richter, Trident EQC
David Dodds, SOUTHDIV
Dann Spariosu, EPA Region IV

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 04, 1999

Sample ID	: 99SPORT0237-1
Lab ID	: 9907929-01
Matrix	: Soil
Date Collected	: 07/27/99
Date Received	: 07/27/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Metals Analysis											
rcury	J	0.0470	0.00221	0.100	mg/kg	1.0	RMJ	08/02/99	1207	154827	1
..ver		1380	65.5	455	ug/kg	2.0	MBL	08/03/99	1702	154580	2
Arsenic		2070	414	455	ug/kg	2.0					
Barium		25700	49.1	455	ug/kg	2.0					
Cadmium		3500	34.6	455	ug/kg	2.0					
Chromium		849000	69.2	455	ug/kg	2.0					
Lead		108000	143	455	ug/kg	2.0					
Selenium	J	313	246	455	ug/kg	2.0					

The following prep procedures were performed:

Mercury	ARD	07/30/99	1930	154827	3
TRACE	AJM	08/02/99	1000	154580	3

M = Method	Method-Description
M 1	EPA 7471A
M 2	EPA 6010B
M 3	EPA 3005

Notes:
The qualifiers in this report are defined as follows:
ND indicates that the analyte was not detected at a concentration greater than the detection limit.
licates presence of analyte at a concentration less than the reporting limit (RL) and greater than the detection limit (DL).
dicates that the analyte was not detected at a concentration greater than the detection limit.
* indicates that a quality control analyte recovery is outside of specified acceptance criteria.

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client:	Supervisor of Ship Building & Conversion SUPSHIP-Portsmouth Detachment-Env. 1899 North Hobson Ave. North Charleston, South Carolina 29405-2106
Contact:	Mr. Bill Hiers
Project Description:	SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 04, 1999

Sample ID : 99SPORT0237-1

M = Method	Method-Description

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

ewed By

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 04, 1999

Sample ID	: 99SPORT0237-1
Lab ID	: 9907929-02
Matrix	: TCLP
Date Collected	: 07/27/99
Date Received	: 07/27/99
Priority	: Routine
Collector	: Client

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Metals Analysis											
rcury	U	ND	0.000350	0.0200	mg/l	1.0	RMJ	08/02/99	1704	154861	1
ver	J	25.3	7.30	50.0	ug/l	10.	JLS	07/31/99	1925	154870	2
Arsenic	U	ND	45.1	50.0	ug/l	10.					
Barium		235	5.10	50.0	ug/l	10.					
Cadmium	J	37.0	4.40	50.0	ug/l	10.					
Chromium		260	5.60	50.0	ug/l	10.					
Lead	J	37.8	15.9	50.0	ug/l	10.					
Selenium	U	ND	27.1	50.0	ug/l	10.					

The following prep procedures were performed:

Mercury	ARD	07/30/99	1845	154861	3
TCLP Prep for Metals	JJ	07/29/99	1550	154562	3

M = Method	Method-Description
M 1	EPA 7470
M 2	EPA 6010A
M 3	EPA 3005

Notes:
The qualifiers in this report are defined as follows:
ND indicates that the analyte was not detected at a concentration greater than the detection limit.
'dicates presence of analyte at a concentration less than the reporting limit (RL) and greater than the detection limit (DL).
licates that the analyte was not detected at a concentration greater than the detection limit.
dicates that a quality control analyte recovery is outside of specified acceptance criteria.

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client:	Supervisor of Ship Building & Conversion SUPSHIP-Portsmouth Detachment-Env. 1899 North Hobson Ave. North Charleston, South Carolina 29405-2106
Contact:	Mr. Bill Hiers
Project Description:	SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 04, 1999 Page 2 of 2

Sample ID : 99SPORT0237-1

M = Method	Method-Description

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

ewed By

PWC00197

CHAIN OF CUSTODY RECORD

9907929%

Page 1 of 1

General Engineering ' ies, Inc.
2040 Savage Road
Charleston, South Ca. 29407
P.O. Box 30712
Charleston, South Carolina 29417
(803) 556-8171

Client Name/Facility Name: SPORTENVDETCHASN

Collected by/Company: SPORTENVDETCHASN

SAMPLE ANALYSIS REQUIRED (x) - use remarks area to specify specific compounds or methods

Use F or P in the boxes to indicate whether sample was filtered and/or preserved

41669

	SAMPLE ID	DATE	TIME	WELL	SOIL	COMP	GRAB	# OF CONTAINERS	pH, conductivity	TOC/DOC	TOX	Chloride, Fluoride, Sulfide	Nitrite/Nitrate	VOC - Specify Method required	RCRA METALS - specify	Pesticide	Herbicide	Total Phenol	Acid Extractables	B/N Extractables	PCB's	Cyanide	Coliform - specify type	TCLP METALS		Remarks
32	99SPORT0237-1	7/27/99	0900		X		X	2							X									X		NBCE0255003702
33	99SPORT0237-2	7/27/99	0910		X		X	2							X									X		NORFOLK BLDG. 195

Remark: Sample preserved to <4°C

Relinquished by:	Date:	Time:	Received by:	Relinquished by:	Date:	Time:	Received by:
Michael P. [illegible]	7/27/99	1020	[illegible]	[illegible]	[illegible]	1520	[illegible]

Relinquished by:	Date:	Time:	Received by lab by:	Date:	Time:	Remarks:
[illegible]	7/27/99	1554	[illegible]	7/27/99	1554	

White = sample collector Yellow = file Pink = with report

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 17, 1999

Sample ID : 99SPORT0254-01
Lab ID : 9908412-01
Matrix : Soil
Date Collected : 08/12/99
Date Received : 08/12/99
Priority : Rush
Collector : Client

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Volatile Organics											
pendix IX Volatiles - 55 items											
,1,2-Tetrachloroethane	U	ND	0.200	1.00	ug/kg	1.0	JEB	08/13/99	1422	155813	1
1,1-Trichloroethane	U	ND	0.100	1.00	ug/kg	1.0					
,1,2,2-Tetrachloroethane	U	ND	0.600	1.00	ug/kg	1.0					
1,1,2-Trichloroethane	U	ND	0.300	1.00	ug/kg	1.0					
1,1-Dichloroethane	U	ND	0.100	1.00	ug/kg	1.0					
1,1-Dichloroethylene	U	ND	0.300	1.00	ug/kg	1.0					
1,2,3-Trichloropropane	U	ND	0.400	1.00	ug/kg	1.0					
1,2-Dibromo-3-chloropropane	U	ND	0.400	1.00	ug/kg	1.0					
1,2-Dibromoethane	U	ND	0.200	1.00	ug/kg	1.0					
1,2-Dichlorobenzene	U	ND	0.500	1.00	ug/kg	1.0					
1,2-Dichloroethane	U	ND	0.200	1.00	ug/kg	1.0					
1,2-Dichloropropane	U	ND	0.200	1.00	ug/kg	1.0					
1,2-cis-Dichloroethylene	U	ND	0.100	1.00	ug/kg	1.0					
1,2-trans-Dichloroethylene	U	ND	0.100	1.00	ug/kg	1.0					
2-Butanone	U	ND	3.20	5.00	ug/kg	1.0					
2-Hexanone	U	ND	2.80	5.00	ug/kg	1.0					
4-Methyl-2-pentanone	U	ND	3.10	5.00	ug/kg	1.0					
Acetone	U	ND	10.3	10.3	ug/kg	1.0					
Acetonitrile	U	ND	1.00	25.0	ug/kg	1.0					
Acrolein	U	ND	4.60	10.0	ug/kg	1.0					
Acrylonitrile	U	ND	3.90	10.0	ug/kg	1.0					
Allyl Chloride	U	ND	0.400	5.00	ug/kg	1.0					
Benzene	U	ND	0.500	1.00	ug/kg	1.0					
Bromoform	U	ND	0.300	1.00	ug/kg	1.0					
bon Disulfide	U	ND	0.300	5.00	ug/kg	1.0					
bon Tetrachloride	U	ND	0.500	1.00	ug/kg	1.0					
Chlorobenzene	U	ND	0.300	1.00	ug/kg	1.0					

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9908412-01

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 17, 1999

Sample ID : 99SPORT0254-01

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Chlorodibromomethane	U	ND	0.200	1.00	ug/kg	1.0					
Chloroethane	U	ND	0.300	1.00	ug/kg	1.0	JEB	08/13/99	1422	155813	1
Chloroform	U	ND	0.100	1.00	ug/kg	1.0					
Chloroprene	U	ND	10.0	20.0	ug/kg	1.0					
Dibromomethane	U	ND	0.200	1.00	ug/kg	1.0					
Dichlorobromomethane	U	ND	0.100	1.00	ug/kg	1.0					
Dichlorodifluoromethane	U	ND	1.20	1.20	ug/kg	1.0					
Ethylbenzene	U	ND	0.300	1.00	ug/kg	1.0					
obutyl Alcohol	U	ND	6.30	10.0	ug/kg	1.0					
Methacrylonitrile	U	ND	0.900	5.00	ug/kg	1.0					
Methyl Bromide	U	ND	0.300	1.00	ug/kg	1.0					
Methyl Chloride	U	ND	0.200	1.00	ug/kg	1.0					
Methyl Iodide	U	ND	0.600	5.00	ug/kg	1.0					
Methyl Methacrylate	U	ND	0.400	5.00	ug/kg	1.0					
Methylene Chloride	U	ND	1.40	1.40	ug/kg	1.0					
Propionitrile	U	ND	3.40	10.0	ug/kg	1.0					
Styrene	U	ND	0.300	1.00	ug/kg	1.0					
Tetrachloroethylene	U	ND	0.400	1.00	ug/kg	1.0					
Toluene	U	ND	0.900	1.00	ug/kg	1.0					
Trichloroethylene		5.82	0.300	1.00	ug/kg	1.0					
Trichlorofluoromethane	U	ND	0.300	1.00	ug/kg	1.0					
Vinyl Acetate	U	ND	2.10	5.00	ug/kg	1.0					
Vinyl chloride	U	ND	0.400	1.00	ug/kg	1.0					
Xylenes (TOTAL)	U	ND	0.700	2.00	ug/kg	1.0					
bis(2-Chloromethylethyl)ether	U	ND	5.09	10.0	ug/kg	1.0					
cis-1,3-Dichloropropylene	U	ND	0.200	1.00	ug/kg	1.0					
trans-1,3-Dichloropropylene	U	ND	0.300	1.00	ug/kg	1.0					
trans-1,4-Dichloro-2-butene	U	ND	0.500	5.00	ug/kg	1.0					

The following prep procedures were performed:

Volatiles 8260 High Level JEB 08/11/99 0800 155813 2

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GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 17, 1999

Sample ID : 99SPORT0254-01

Surrogate Recovery	Test	Percent%	Acceptable Limits
Bromofluorobenzene	APP 9 VOA-8260B	77.0	(73.0 - 129.)
Dibromofluoromethane	APP 9 VOA-8260B	93.4	(66.0 - 117.)
Toluene-d8	APP 9 VOA-8260B	87.2	(73.0 - 122.)

M = Method	Method-Description
1	EPA 8260B
2	EPA 5035

Notes:
The qualifiers in this report are defined as follows:
ND indicates that the analyte was not detected at a concentration greater than the detection limit.
J indicates presence of analyte at a concentration less than the reporting limit (RL) and greater than the detection limit (DL).
U indicates that the analyte was not detected at a concentration greater than the detection limit.
* indicates that a quality control analyte recovery is outside of specified acceptance criteria.

This data report has been prepared and reviewed
in accordance with General Engineering Laboratories
standard operating procedures. Please direct
any questions to your Project Manager. Elise Hanson at 843-556-8171.

Reviewed By

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(843) 556-8171 • Fax (843) 766-1178

9908412-01

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 17, 1999

Sample ID	: 99SPORT0254-02
Lab ID	: 9908412-02
Matrix	: GroundH2O
Date Collected	: 08/12/99
Date Received	: 08/12/99
Priority	: Rush
Collector	: Client

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Volatile Organics											
ɔendix IX Volatiles - 55 items											
,1,2-Tetrachloroethane	U	ND	0.300	1.00	ug/l	1.0	JEB	08/13/99	1320	155956	1
1,1,1-Trichloroethane	U	ND	0.200	1.00	ug/l	1.0					
1,1,2,2-Tetrachloroethane	U	ND	0.500	1.00	ug/l	1.0					
1,1,2-Trichloroethane	U	ND	0.400	1.00	ug/l	1.0					
1,1-Dichloroethane	U	ND	0.400	1.00	ug/l	1.0					
1,1-Dichloroethylene	U	ND	0.700	1.00	ug/l	1.0					
1,2,3-Trichloropropane	U	ND	0.500	1.00	ug/l	1.0					
1,2-Dibromo-3-chloropropane	U	ND	0.600	1.00	ug/l	1.0					
1,2-Dibromoethane	U	ND	0.400	1.00	ug/l	1.0					
1,2-Dichlorobenzene	U	ND	0.400	1.00	ug/l	1.0					
1,2-Dichloroethane	U	ND	0.200	1.00	ug/l	1.0					
1,2-Dichloropropane	U	ND	0.200	1.00	ug/l	1.0					
1,2-cis-Dichloroethylene	U	ND	0.700	1.00	ug/l	1.0					
1,2-trans-Dichloroethylene	U	ND	0.700	1.00	ug/l	1.0					
2-Butanone	U	ND	5.90	10.0	ug/l	1.0					
2-Hexanone	U	ND	3.20	5.00	ug/l	1.0					
4-Methyl-2-pentanone	U	ND	1.60	5.00	ug/l	1.0					
Acetone	U	ND	3.70	5.00	ug/l	1.0					
Acetonitrile	U	ND	15.6	25.0	ug/l	1.0					
Acrolein	U	ND	8.90	10.0	ug/l	1.0					
Acrylonitrile	U	ND	8.20	10.0	ug/l	1.0					
Allyl Chloride	U	ND	2.10	5.00	ug/l	1.0					
Benzene	U	ND	0.300	1.00	ug/l	1.0					
Bromoform	U	ND	0.400	1.00	ug/l	1.0					
·bon Disulfide	U	ND	1.80	5.00	ug/l	1.0					
ɔon Tetrachloride	U	ND	0.200	1.00	ug/l	1.0					
ɔnlorobenzene	U	ND	0.300	1.00	ug/l	1.0					

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client: Supervisor of Ship Building & Conversion
SUPSHIP-Portsmouth Detachment-Env.
1899 North Hobson Ave.
North Charleston, South Carolina 29405-2106
Contact: Mr. Bill Hiers
Project Description: SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 17, 1999

Sample ID : 99SPORT0254-02

Parameter	Qualifier	Result	DL	RL	Units	DF	Analyst	Date	Time	Batch	M
Chlorodibromomethane	U	ND	0.300	1.00	ug/l	1.0					
Chloroethane	U	ND	0.300	1.00	ug/l	1.0	JEB	08/13/99	1320	155956	1
Chloroform	U	ND	0.700	1.00	ug/l	1.0					
Chloroprene	U	ND	0.100	20.0	ug/l	1.0					
Dibromomethane	U	ND	0.200	1.00	ug/l	1.0					
Dichlorobromomethane	U	ND	0.400	1.00	ug/l	1.0					
Dichlorodifluoromethane	U	ND	1.20	5.00	ug/l	1.0					
ylbenzene	U	ND	0.300	1.00	ug/l	1.0					
butyl Alcohol	U	ND	36.0	50.0	ug/l	1.0					
ethacrylonitrile	U	ND	3.80	5.00	ug/l	1.0					
Methyl Bromide	U	ND	0.300	1.00	ug/l	1.0					
Methyl Chloride	U	ND	0.200	1.00	ug/l	1.0					
Methyl Iodide	U	ND	5.20	10.0	ug/l	1.0					
Methyl Methacrylate	U	ND	3.90	5.00	ug/l	1.0					
Methylene Chloride	J	1.73	1.20	5.00	ug/l	1.0					
Propionitrile	U	ND	2.60	10.0	ug/l	1.0					
Styrene	U	ND	0.200	1.00	ug/l	1.0					
Tetrachloroethylene	U	ND	0.700	1.00	ug/l	1.0					
Toluene	U	ND	0.500	1.00	ug/l	1.0					
Trichloroethylene	U	ND	0.600	1.00	ug/l	1.0					
Trichlorofluoromethane	U	ND	1.70	5.00	ug/l	1.0					
Vinyl Acetate	U	ND	1.80	5.00	ug/l	1.0					
Vinyl chloride	U	ND	0.400	1.00	ug/l	1.0					
Xylenes (TOTAL)	U	ND	1.10	2.00	ug/l	1.0					
bis(2-Chloromethylethyl)ether	U	ND	3.70	10.0	ug/l	1.0					
cis-1,3-Dichloropropylene	U	ND	0.300	1.00	ug/l	1.0					
trans-1,3-Dichloropropylene	U	ND	0.300	1.00	ug/l	1.0					
trans-1,4-Dichloro-2-butene	U	ND	2.80	5.00	ug/l	1.0					

Surrogate Recovery	Test	Percent%	Acceptable Limits
romofluorobenzene	APP 9 VOA-8260B	83.9	(73.0 - 129.)
omofluoromethane	APP 9 VOA-8260B	102.	(66.0 - 117.)
uene-d8	APP 9 VOA-8260B	87.1	(73.0 - 122.)

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9908412-02

GENERAL ENGINEERING LABORATORIES

Meeting today's needs with a vision for tomorrow.

Client:	Supervisor of Ship Building & Conversion SUPSHIP-Portsmouth Detachment-Env. 1899 North Hobson Ave. North Charleston, South Carolina 29405-2106
Contact:	Mr. Bill Hiers
Project Description:	SUPSHIP-Portsmouth Detachment

cc: NPWC00197 Report Date: August 17, 1999

Sample ID : 99SPORT0254-02

Surrogate Recovery	Test	Percent %	Acceptable Limits

M = Method	Method-Description
M 1	EPA 8260B

Notes:

qualifiers in this report are defined as follows:

U indicates that the analyte was not detected at a concentration greater than the detection limit.

J indicates presence of analyte at a concentration less than the reporting limit (RL) and greater than the detection limit (DL).

U indicates that the analyte was not detected at a concentration greater than the detection limit.

* indicates that a quality control analyte recovery is outside of specified acceptance criteria.

This data report has been prepared and reviewed in accordance with General Engineering Laboratories standard operating procedures. Please direct any questions to your Project Manager, Elise Hanson at 843-556-8171.

Reviewed By

P O Box 30712 • Charleston, SC 29417 • 2040 Savage Road • 29407

(843) 556-8171 • Fax (843) 766-1178

9908412-02

PWC00197 — 3 DAY TURNAROUND —

CHAIN OF CUSTODY RECORD

9908412%

Page 1 of 1

General Engineering Laboratories, Inc.
2040 Savage Road
Charleston, South C 29407
P.O. Box 30712
Charleston, South Carolina 29417
(803) 556-8171

Client Name/Facility Name: SPORTENV DETCHASN

Collected by/Company: SPORTENV DETCHASN

SAMPLE ANALYSIS REQUIRED (x) - use remarks area to specify specific compounds or methods

Use F or P in the boxes to indicate whether sample was filtered and/or preserved

PRESERVED @ 4°C

41964

	SAMPLE ID	DATE	TIME	WELL	SOIL	COMP	GRAB	# OF CONTAINERS	pH, conductivity	TOC/DOC	TOX	Chloride, Fluoride, Sulfide	Nitrite/Nitrate	VOC - Specify Method required	METALS - specify	Pesticide	Herbicide	Total Phenol	Acid Extractables	B/N Extractables	PCB's	Cyanide	Coliform - specify type			Remarks	
1 99	SPORT0254-01	8/12/99	0900		X		X	3						X												NBC60253003802	.1
2 99	SPORT0254-02	8/12/99	0900		~~X~~ WK		X	3						X												NBC60253T0038	.2

Relinquished by:	Date:	Time:	Received by:	Relinquished by:	Date:	Time:	Received by:
Mike [illegible]	8/12/99	0950	W.R. Hiers Jr.	W.R. Hiers Jr.	8/12/99	1318	—
Relinquished by:	Date:	Time:	Received by lab by:	Date:	Time:	Remarks:	
—	—	—	Franco	8/12/99	1318		

White = sample collector Yellow = file Pink = with report

South Carolina Department of Health and Environmental Control

65240 9201HH02 38

Bureau of Solid & Hazardous Waste Mgt.
2600 Bull Street, Columbia, SC 29201
Phone: (803) 896-4000
Emergency & Holidays: (803) 253-6488

PLEASE PRINT or TYPE (Form designed for use on elite [12-pitch] typewriter) Form Approved OMB No. 2050-0039 Expires 9-

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's U.S. EPA ID No.: SC017002256 0 — Manifest Document No.: 13563
2. Page 1 of 1

Information in the shaded areas is not required by Federal law, but is by State law.

3. Generator's Name and Mailing Address
SOUTHDIVNAVFACENGCOM, Caretaker Site Office, PO Box 190010, N. Charleston, SC 29419-9010

4. Generator's Phone (843) 743-~~6777~~ 9985

5. Transporter 1 Company Name: Safety-Kleen (TG), Inc.
6. U.S. EPA ID Number: SCD987574647

7. Transporter 2 Company Name:
8. U.S. EPA ID Number:

9. Designated Facility Name and Site Address
Safety-Kleen (Pinewood), Inc.
Rt 1 Box 255
Pinewood, South Carolina 29125
10. U.S. EPA ID Number: SCD070375985

A. State Manifest Document Number
B. State Generator's ID
C. State Transporter's ID
D. Transporter's Phone: 803-452-5050
E. State Transporter's ID
F. Transporter's Phone
G. State Facility's ID
H. Facility's Phone: (803) 452-5003

11. U.S. DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste Number
a. RQ, Hazardous Waste Solid, N.O.S., 9, NA3077, PG III (chromium)	001	CM	16	Y	D007
b.					
c.					

a. PW-01343-4115
b.
c.
d.

15. Special Handling Instructions and Additional Information
WO# 237961
24 hour emergency contact: Mike Wheeler
(843) 743-6777

Public reporting burden for this collection of information is estimated to average: 37 minutes for generators, 15 minutes for transporters, and 10 minutes for treatment, storage and disposal facilities. This includes time for reviewing instructions, gathering data, and completing and reviewing the form. Send comments regarding the burden estimate, including suggestions for reducing the burden, to Chief, Information Policy Branch, PM-223, U.S. Environmental Protection Agency, 401 M St., S.W., Washington, D.C. 20460, and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, D.C. 20503.

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations and the laws of the State of South Carolina.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name: RICHARD G. NIELSON — Signature: [signature] — Month Day Year: 08 09 99

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: LENNON Glover — Signature: Lennon Glover — Month Day Year: 08 09 99

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name: — Signature: — Month Day Year:

Discrepancy Indication Space
a. 21820 lbs. c. lbs.
b. lbs. d. lbs.

20. Facility Owner or Operator; Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.
Printed/Typed Name: Jim Tilstire — Signature: [signature] — Month Day Year: 08 09 99

GENERATOR

TRANSPORTER

FACILITY

9201HH01

South Carolina Department of Health and Environmental Control

71640 49

Bureau of Solid & Hazardous Waste Mgt.
2600 Bull Street, Columbia, SC 29201
Phone: (803) 896-4000
Emergency & Holidays: (803) 253-6488

PLEASE PRINT or TYPE (Form designed for use on elite [12-pitch] typewriter) Form Approved OMB No. 2050-0039 Expires 9-30-99

UNIFORM HAZARDOUS WASTE MANIFEST

1. Generator's U.S. EPA ID No. S C 0 1 7 0 0 2 2 5 6 0 — Manifest Document No. 3 4 4 0
2. Page 1 of 1

Information in the shaded areas is not required by Federal law, but is by State law.

3. Generator's Name and Mailing Address
SOUTHDIVNAVFACENGCOM, Caretaker Site Office, PO Box 190010, N. Charleston, SC 29419-9010

4. Generator's Phone (843) 743-6777

5. Transporter 1 Company Name: Safety-Kleen (TG), Inc.
6. U.S. EPA ID Number: S C D 9 8 7 5 7 4 6 4 7

7. Transporter 2 Company Name
8. U.S. EPA ID Number

9. Designated Facility Name and Site Address
Safety-Kleen (Pinewood), Inc.
Rt 1 Box 255
Pinewood, South Carolina 29125
10. U.S. EPA ID Number: S C D 0 7 0 3 7 5 9 8 5

11. U.S. DOT Description (including Proper Shipping Name, Hazard Class, and ID Number)	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	
a. RQ, Hazardous Waste Solid, N.O.S., 9, NA3077, PG III (chromium)	0 0 1	C M	1 8	Y	D 0 0 7
b.					
c.					

a. P W - 0 1 8 4 3 - 4 1 1 5
b. - -
c. - -
d. - -

15. Special Handling Instructions and Additional Information
WO# 237200
24 hour emergency contact: Mike Wheeler
(843) 743-6777

Public reporting burden for this collection of information is estimated to average: 37 minutes for generators, 15 minutes for transporters, and 10 minutes for treatment storage and disposal facilities. This includes time for reviewing instructions, gathering data, and completing and reviewing the form. Send comments regarding the burden estimate, including suggestions for reducing this burden, to Chief, Information Policy Branch, PM-223, U.S. Environmental Protection Agency, 401 M St. S.W., Washington, D.C. 20460, and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, D.C. 20503.

16. GENERATOR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations and the laws of the State of South Carolina.

If I am a large quantity generator, I certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method of treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name: Lillie D. Frierson — Signature: Lillie D. Frierson — Month Day Year: 07 30 99

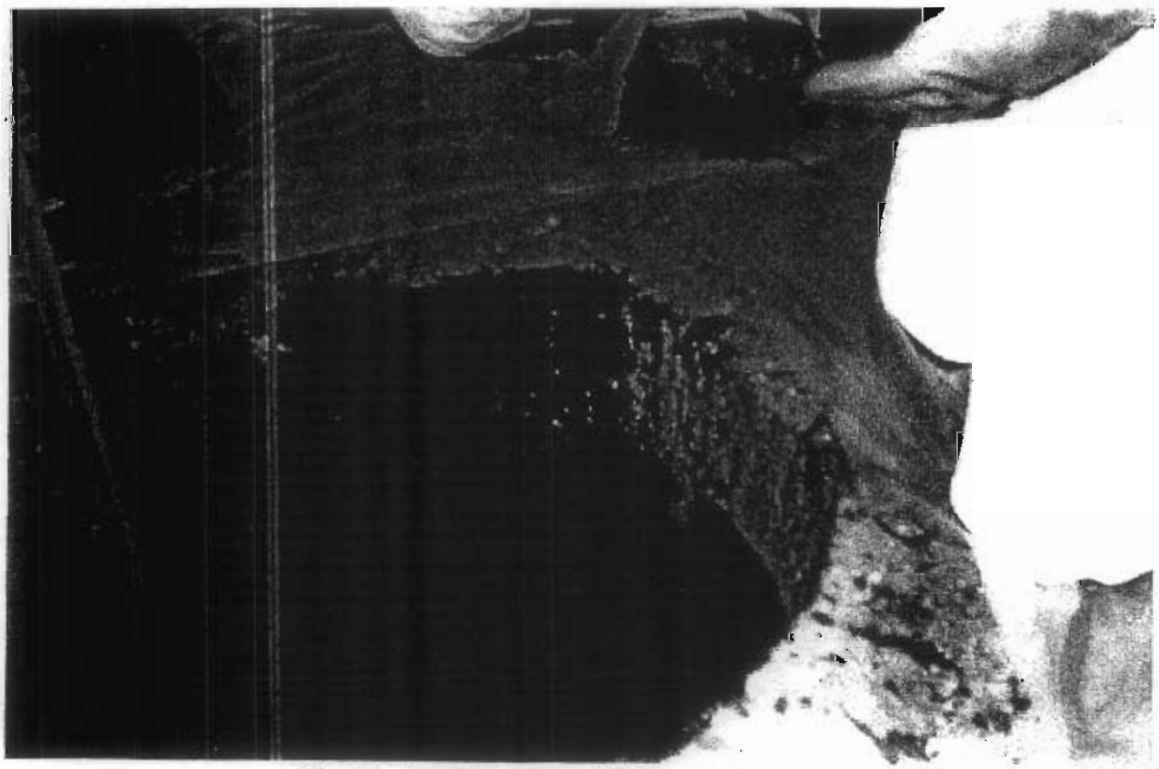
17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: LeNNON Glover — Signature: Lennon Glover — Month Day Year: 07 30 99

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name — Signature — Month Day Year

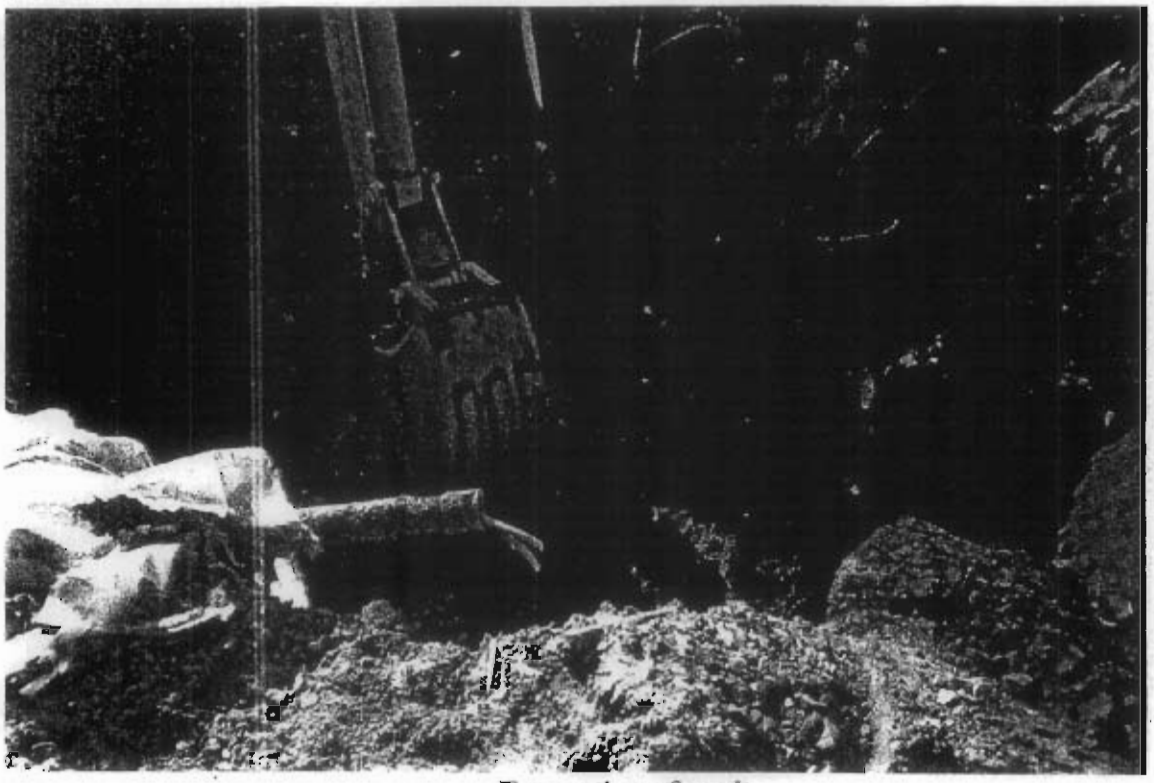
Discrepancy Indication Space
a. 28540 lbs. c. lbs.
b. lbs. d. lbs.

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.
Printed/Typed Name — Signature

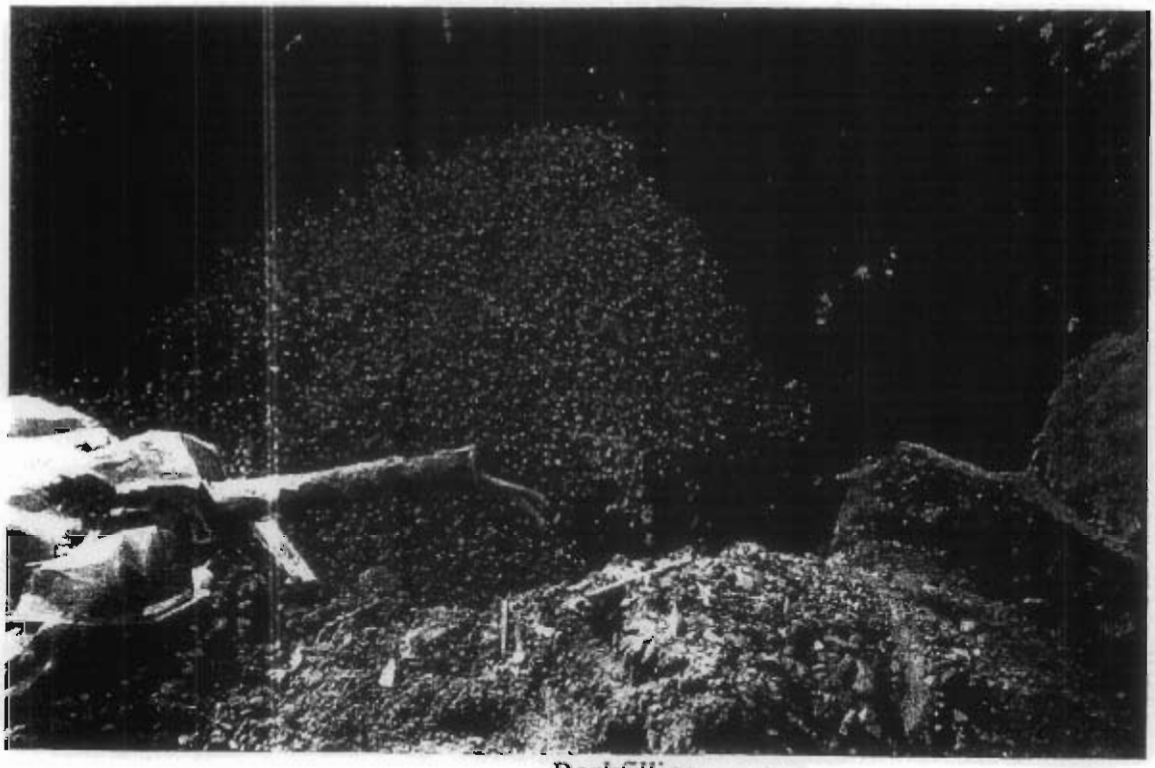
Sampling fluid from electrical vault 7A during 1998 investigation



Electrical cables traversing through electrical vault



Excavation of vault



Backfilling

After excavation and backfill

Final restoration (asphalt)

Ser: 191
March 8, 1999

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

Dear Mr. Litton:

The enclosed completion report for AOC 699 Storm Drain Cleaning is submitted to fulfill the requirement of permit condition IV.D.6. for Permit Number SCO 170 022 560. If the Department of Health and Environmental Control should have any questions, please contact Reece Batten of Southern Division Naval Facilities Command at (843)820-5578.

Sincerely

for E.R. Dearhart
Director

Encl:
(1) Completion Report for AOC 699 Storm Drain Cleaning

Copy to:
SCDHEC (Mr. Tapia, Mr. Bergstrand)
USEPA (Mr. Spariosu)
CSO Naval Base Charleston (Mr. Shepard)
NAVFAC (Mr. Batten)
Ensafe Inc. (Ms. Maddux)

COMPETION REPORT

INTERIM MEASURE
FOR AOC 699 STORM DRAIN CLEANING
Naval Base Charleston
Charleston, South Carolina

ENVIRONMENTAL DETACHMENT CHARLESTON
SOUTH CAROLINA

Engineering Branch Head: _____ Date: 3-5-99

Interim Measures Team Leader: _____ Date: 3-5-99

Prepared By: _____ Date: 3-5-99

REPORT GENERATED BY:

ENVIRONMENTAL DETACHMENT CHARLESTON

1899 NORTH HOBSON AVENUE
NORTH CHARLESTON, SC 29405

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ACRONYMS, ABBREVIATIONS and SYMBOL

ACM	Asbestos Containing Material
AOC	Area of Concern
BLS	Below Land Surface
CMS	Corrective Measures Study
DERP	Defense Environmental Restoration Program
DET	Environmental Detachment Charleston
DON	Department of the Navy
FO	Fuel Oil
IM	Interim Measure
IR	Installation Restoration
PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
ROC	Run of Crusher
SARA	Superfund Amendments and Reauthorization Act
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SUPSHIP	Supervisor of Shipbuilding, Conversion and Repair, USN
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
USN	United States Navy

1. INTRODUCTION

1.1 INSTALLATION RESTORATION PROGRAM The purpose of the Department of the Navy (DON) Installation Restoration (IR) Program is to identify, assess, characterize and clean up or control contamination from past hazardous waste disposal operations and hazardous material spills at Navy and Marine Corps activities. The Defense Environmental Restoration Program (DERP) is codified in the Superfund Amendments and Reauthorization Act (SARA) Section 211 (10 USC 2701). The IR Program is a component of DERP.

1.1.1 Naval Base Charleston IR Program At Naval Base Charleston, a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) was prepared which divided the Naval Base into zones and identified Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) within each zone. The RFA evaluated each SWMU and AOC and determined which sites required further investigation. Based on the RFA, a RCRA Facility Investigation (RFI) work plan has been or is being prepared for each zone containing SWMUs and AOCs requiring further investigation. On completion of the RFI for each Zone, a RFI report will be prepared for that zone. The RFI reports will identify SWMUs and AOCs containing wastes requiring remediation. Eventually, Corrective Measures Studies (CMSs) will be prepared to determine the best means of remediating each site.

1.2 INTERIM MEASURES Interim Measures (IM) performed as part of the IR Program are intended to eliminate sources of environmental contamination or limit the spread of environmental contaminants prior to the completion of the RFI CMSs.

1.3 AOC 699 STORM DRAIN CLEANING The storm drain system, located in Zone L of the RFI, has been identified as Area of Concern (AOC) 699. This system collects rainfall from throughout the former shipyard and naval station from an area of approximately 1,325 acres. Water collected by the storm drain system is ultimately discharged to the Cooper River through approximately 55 discharge outfalls. Piping materials include vitrified clay, ductile iron, PVC, corrugated metal, and reinforced concrete. Pipe sizes range from 4 inches in diameter to 72 inches

in diameter. It is estimated that during a typical ½ inch rainfall, 8.3 million gallons of water is collected and discharged through the storm drain system.

The storm drain system is a gravity drain system. Surface water runoff is collected by shallow catch basins and flows through interconnecting piping into manholes where larger outfall pipes carry the water to the Cooper River. A significant portion of the area from which the surface water runoff is collected was utilized for a variety of heavy industrial activities over a period of many years which has been the primary source for the Constituents of Potential Concern (COPC's). The COPC's presents include acids, solvents, surfactants, heavy metals, caustic solutions, petroleum hydrocarbons, polychlorinated biphenyls (PCBs) and volatiles. The primary migration pathways associated with the storm drain system are soil, soil gas, and ground water. Ensafe/Allen & Hoshall performed previous sampling of Solid Waste Manuagement Units (SWMU's) and AOC's throughout the base and the sample data was used to delineate portions of the storm drain system to be cleaned. 19 storm drain locations with sampling results exceeding United States Environmental Protection Agency (USEPA) Region III Risk Based Concentrations (RBC) residential and/or industrial levels were identified for cleaning. (See Table 4 of Appendix A for sample data.)

2. INTERIM MEASURE EXECUTION

2.1 AOC 699 STORM DRAIN CLEANING INTERM MEASURE During the interval between the RFI and the completion of the CMS, it was decided by Southern Division Naval Facilities Engineering Command (SOUTHDIV) that an IM would be performed by Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP), United States Navy (USN), Portsmouth Va. Environmental Detachment Charleston (SPORTENVDETCHASN). The objective of this IM was to control and/or eliminate the release of hazardous waste and/or hazardous constituents from the storm drain system prior to the implementation of final corrective measures. This was accomplished by removing all sediments from all portions of the system down stream of locations identified by Ensafe/Allen & Hoshall which contain elevated levels of COPC's. (See Table 4 and Figures 1 through 11A of Appendix A for sample data and locations.) This IM is consistent with the ultimate cleanup of AOC 699 and is not intended to circumvent the public participation process inherent within environmental cleanup under RCRA authority.

2.2 ACTIONS REQUIRED BY INTERIM MEASURE WORK PLAN The intent of the IM work plan was to collect from the storm drain system, and properly dispose of, an estimated 325 cubic yards of soils/sediments which contain elevated levels of COPCs. This project required hydro-blast cleaning of catch basins, manholes and associated interconnecting piping and collection of all soils/sediments and process water to the maximum extent practical. Use of a Vactor Jet- Rodder truck was intended for this operation which has the capability to vacuum extract water and soil/sediment as it was generated. All process water used for system cleaning was collected, stored in tanks, sampled and characterized prior to disposal. All soil/sediment collected during cleaning were stored in roll-off type containers, sampled and characterized prior to disposal. A total of 42 catch basins and 75 manholes were identified for cleaning and the table below identifies the total length of each size of pipe cleaned.

NOMINAL SIZE OF PIPE CLEANED (INCHES)																	
1-1/4	3	6	8	10	12	14	15	18	21	24	28	30	48	18x11	22x13	42x60	42x81
CORRESPONDING ESTIMATED TOTAL LENGTH (FEET)																	
65	20	449	870	295	390	100	1,065	1,450	250	905	870	3,855	1,565	110	90	486	144

2.3 AOC 699 STORM DRAIN CLEANING INTERIM MEASURE EXECUTION SUMMARY The execution of this IM consisted of cleaning catch basins piped to the storm drain system, isolated/abandoned catch basins, and an oil water separator along with portions of nine different storm drain piping runs which lead to outfalls. Each outfall is numbered starting at the most northern section of the shipyard on the Cooper River and increasing southward. (See Figures #1 through #11A, Appendix A for locations of designated pipe runs, catch basins, oil water separator and, manholes for cleaning). Inserting the Jet-Rodder device into a down stream manhole and allowing it to crawl forward to the next upstream manhole was the preferred methodology in cleaning. Vacuuming to remove process water and sediment with contaminants was done at the injection point of the Jet-Rodder device. A few exceptions to this methodology existed. When cleaning the last pipe run to the outfall, the Jet-Rodder device had to be sent downstream and likewise when there was a bend in the pipeline outside of a manhole. The contractor, CSI Environmental of Indianapolis, Indiana, chose to clean all catch basins of different storm drain lines first removing sediment in the areas of the greatest contamination. Once the truck was full, its tank was drained, dumped and washed out into a 25 cubic yard dewatering roll-off box. The water in the box would later be pumped to a 6,500 gallon portable storage tank leaving the sediment behind. Each tank when full was sampled for RCRA 8 metals and pH. If samples were within acceptable limits and approval obtained from North Charleston Sewer Department, the tank was emptied to the nearest sanitary sewer manhole. An Inductively Coupled Plasma (ICP) scan, RCRA 8 metals Toxicity Characteristic Leaching Procedure (TCLP), Polynuclear Aromatic Hydrocarbons (PAH), and Pesticides testing were performed when a dewatering roll-off box was full. Sediment removed from the site was characterized as non hazardous waste, and disposed of in a certified Subtitle D landfill.

2.3.1 Observations Noted Pipe run to outfall #23 adjacent to Building 2 had visible petroleum residue product at the bottom of the pipe. A strong petroleum odor persisted during cleaning. After cleaning, a sheen was noted on the water in the storm drainpipe. A cross-connect is believed to exist in the area, which is leaking petroleum product to the storm drain system. Samples of process water had high lead and chromium levels and were characterized as hazardous waste. The Caretaker Site Office on the base as well as the tennants of Building 2 were notified of the problem. (See Figure #7 and #7A, Appendix A for the piping configuration and location.) Based on these observations, further investigation may be warranted.

2.3.2 Plan Modifications and Results During vactor jet cleaning of pipe run to outfall #36, the last 100' was plugged with an oil absorbent snake. Attempts to remove it were unsuccessful and the last portion of the pipe to the outfall could not be cleaned. (See Figure #5 and #5A, Appendix A for the piping configuration and location.) Pipe diameter at the stoppage was estimated to be 6 inches instead of the 10 inches shown on base drawings. 65' of 1-1/4" diameter pipe between two catch basins shown in Figure 9A of Appendix A could not be cleaned. Due to the extremely small diameter , the Vactor Jet- Rodder truck's hose and jet nozzle would not fit. Minimum diameter necessary is 3". Upon inspection of the 65' of 1-1/4" pipe, an insignificant amount of sediment was present. The purpose of the pipe was for pump discharge to a catch basin, and the pumping action would have kept sediment to a minimum.

3. INTERIM MEASURE OUTCOME

3.1 SITE CONDITIONS FOLLOWING COMPLETION OF WORK.

Following completion of all site work on 12 January 1999, a total of 29 cubic yards of storm drain sediment contaminated with COPC's from the heavy industrial areas of the shipyard was removed and disposed of at a Subtitle D landfill . An oil water separator, 2 abandoned catch basins, 42 catch basins tied to the storm drain, 75 manholes and over 12,900 linear feet of pipe were cleaned. The storm drain system was returned to its normal use. All site equipment and tanks have been removed. The CSO has installed oil absorbent booms at several manhole sites on pipe run to outfall #23 to contain product discovered at the site. Site photographs are included in Appendix B.

3.2 SAMPLING EVOLUTIONS AND RESULTS

3.2.1 Process Water Sampling 6,500 gallon portable tanks were sampled when full with a COLIWASA tube. Grab samples were tested for pH and RCRA 8 metals. A RCRA 8 TCLP was performed for each metal with levels above 40 CFR section 261.24 Table 1, Maximum Concentrations of Contaminants for the Toxicity Characteristic.

3.2.2 Sediment Sampling Two composite samples were taken in each full 25 cubic yard roll-off. The first-roll off used, roll-off #1 was sampled and re-sampled after the contractor decided to continuing filling the roll-off. Roll-off #2 had only 4 cubic yards of sediment, and only one composite sample was taken. Tests performed on composite samples were ICP Scan for metals, RCRA 8 TCLP, Pesticides and Polynuclear Aromatic Hydrocarbons. See Appendix C for sampling documentation.

3.3 WASTE GENERATED

3.3.1 Hazardous/Potentially Hazardous Waste

A total of 17,710 gallons of process water was disposed of as hazardous waste to a permitted Treatment, Storage and Disposal Facility. (See Table 1 of Appendix A for Process Water Sample Results and Appendix C for sampling documentation.)

3.3.2 Non-Hazardous Waste

A total of 33.10 tons of non-hazardous storm drain system sediment was disposed of to a Subtitle D landfill. A total of 56,000 gallons of non-hazardous process water was disposed of to the sanitary sewer system with North Charleston Sewer Department approval. A total of 13,000 gallons of non-hazardous process water exceeded North Charleston Sewer Department discharge requirements and was disposed of to a wastewater filtering facility. (See Table 1 of Appendix A for Process Water Sample Results, see Table 2 and Table 3 of Appendix A for storm drain sediment sample results and Appendix C for sampling documentation.)

APPENDIX A

FIGURES AND SAMPLE RESULT

Figure 1

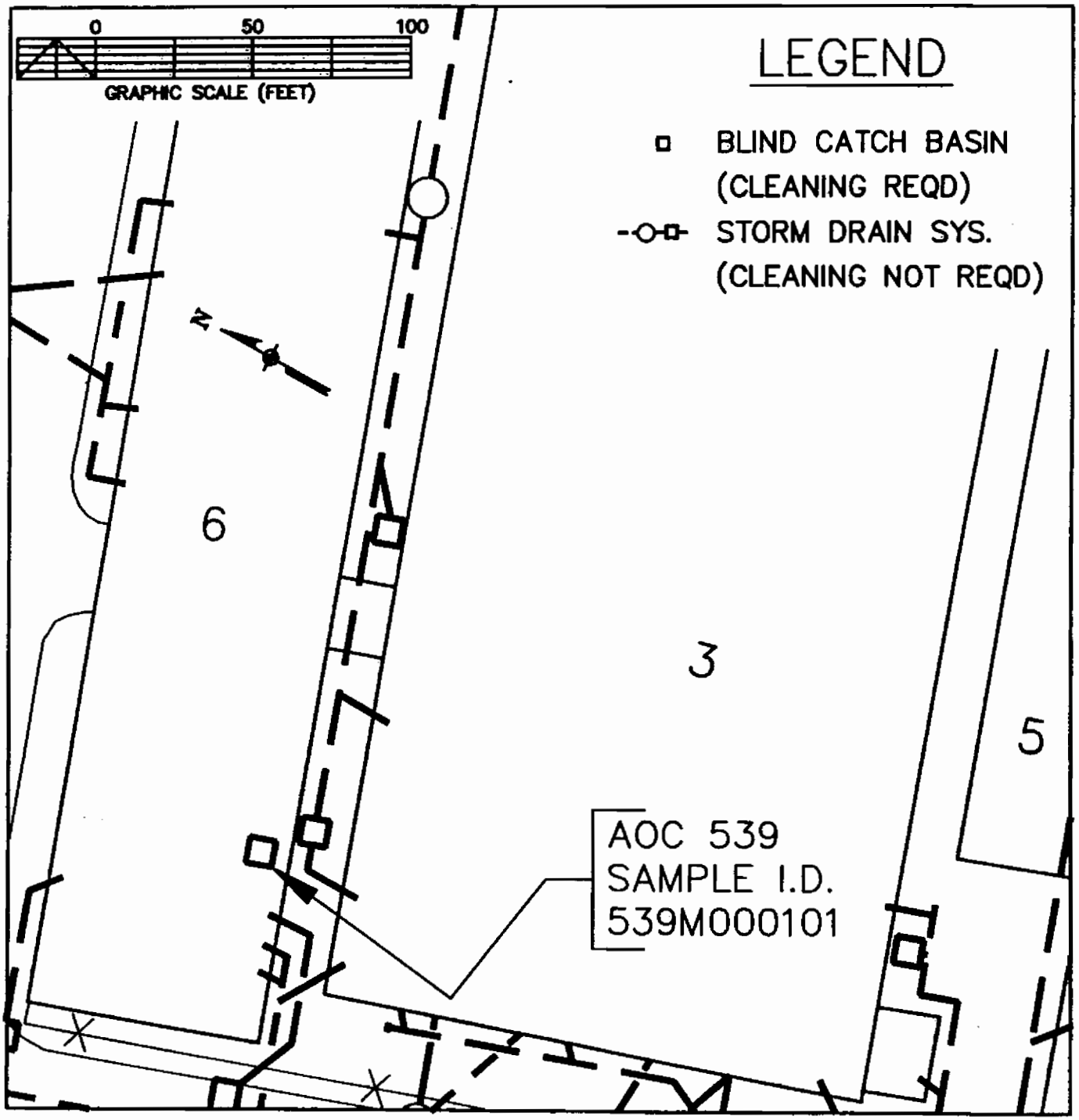

0
50
100
GRAPHIC SCALE (FEET)
LEGEND
BLIND CATCH BASIN
(CLEANING REQD)
STORM DRAIN SYS.
(CLEANING NOT REQD)
N
6
3
5
AOC 539
SAMPLE I.D.
539M000101

Figure 2

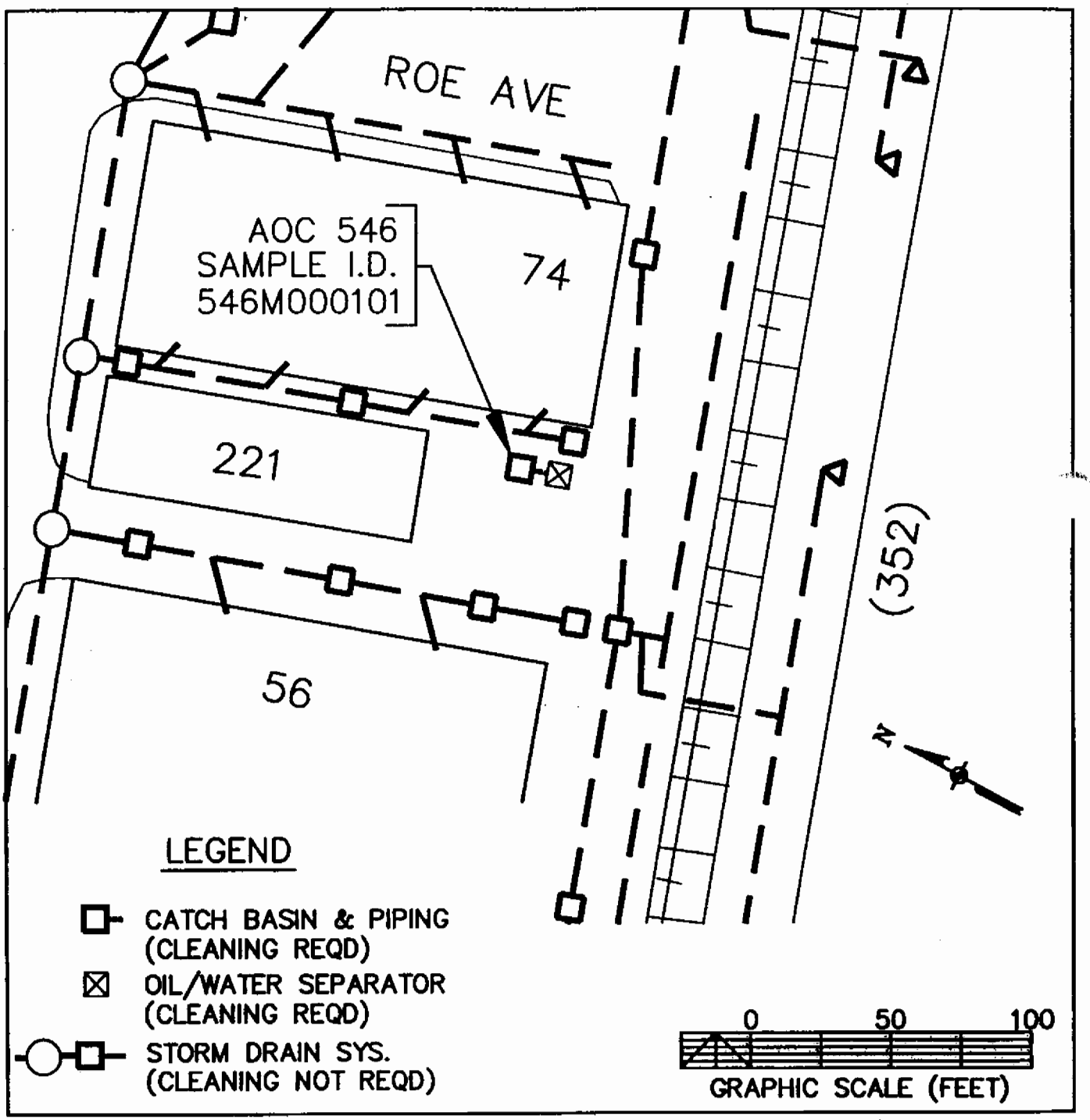
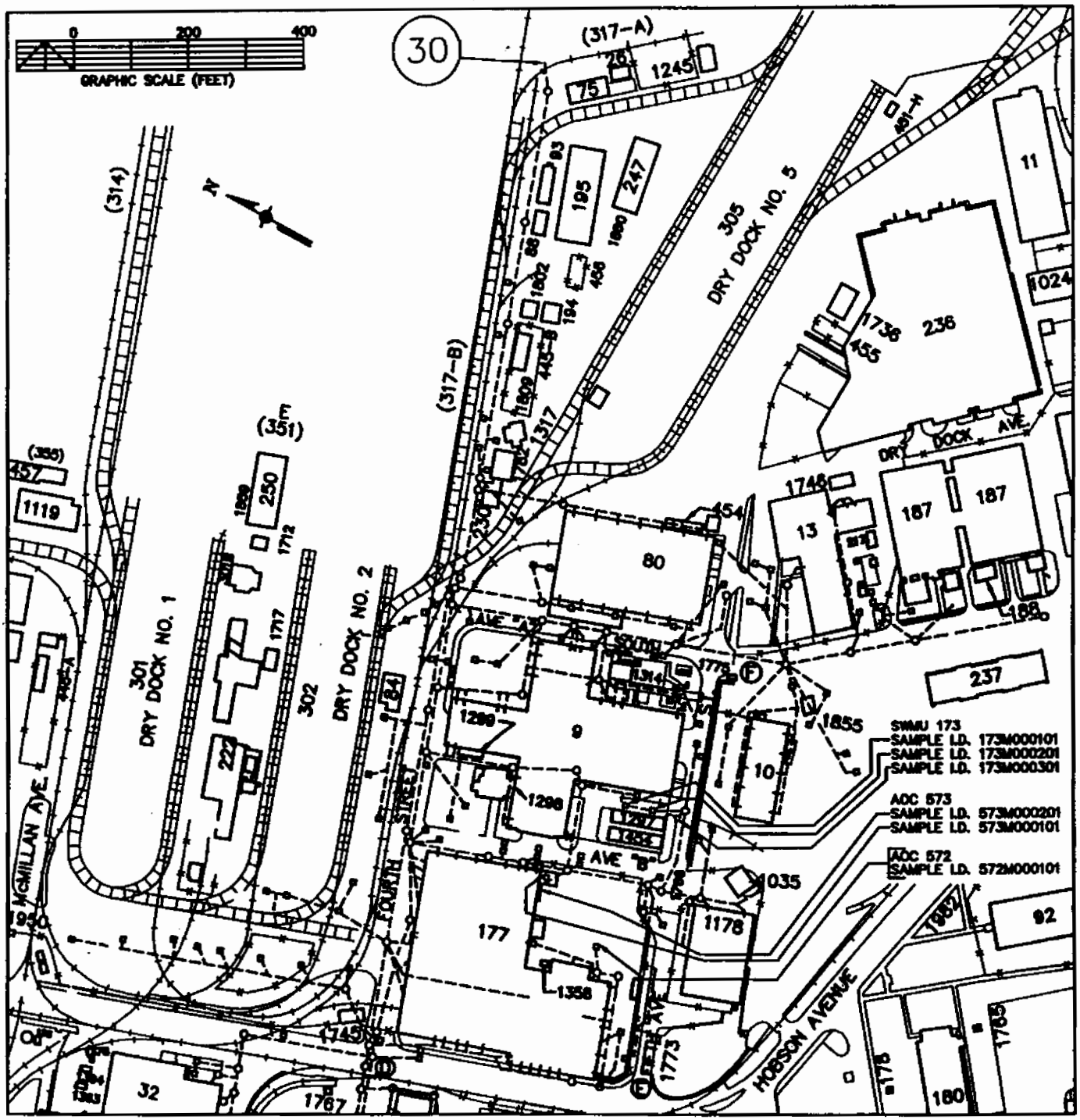

ROE AVE
AOC 546
SAMPLE I.D.
546M000101
74
221
56
(352)
N
LEGEND
CATCH BASIN & PIPING
(CLEANING REQD)
OIL/WATER SEPARATOR
(CLEANING REQD)
STORM DRAIN SYS.
(CLEANING NOT REQD)
0
50
100
GRAPHIC SCALE (FEET)

Figure 3



0
200
400
GRAPHIC SCALE (FEET)
30
(317-A)
(314)
(317-B)
(351)
305
DRY DOCK NO. 5
301
DRY DOCK NO. 1
302
DRY DOCK NO. 2
DRY DOCK AVE.
FOURTH STREET
McMILLAN AVE.
HOBSON AVENUE
AVE "A"
AVE "B"
SWMU 173
SAMPLE I.D. 173M000101
SAMPLE I.D. 173M000201
SAMPLE I.D. 173M000301
AOC 573
SAMPLE I.D. 573M000201
SAMPLE I.D. 573M000101
AOC 572
SAMPLE I.D. 572M000101

Figure 3A

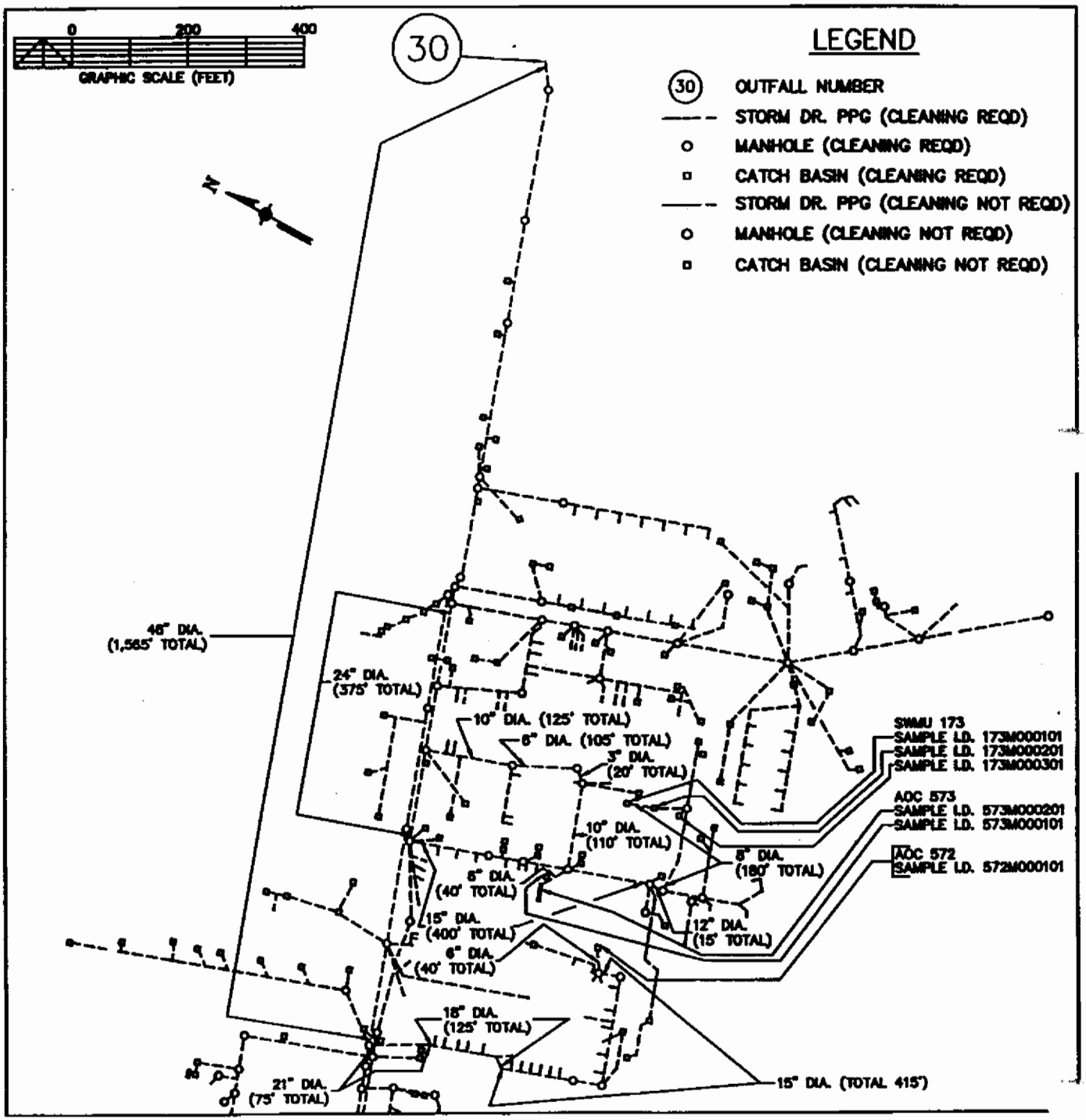
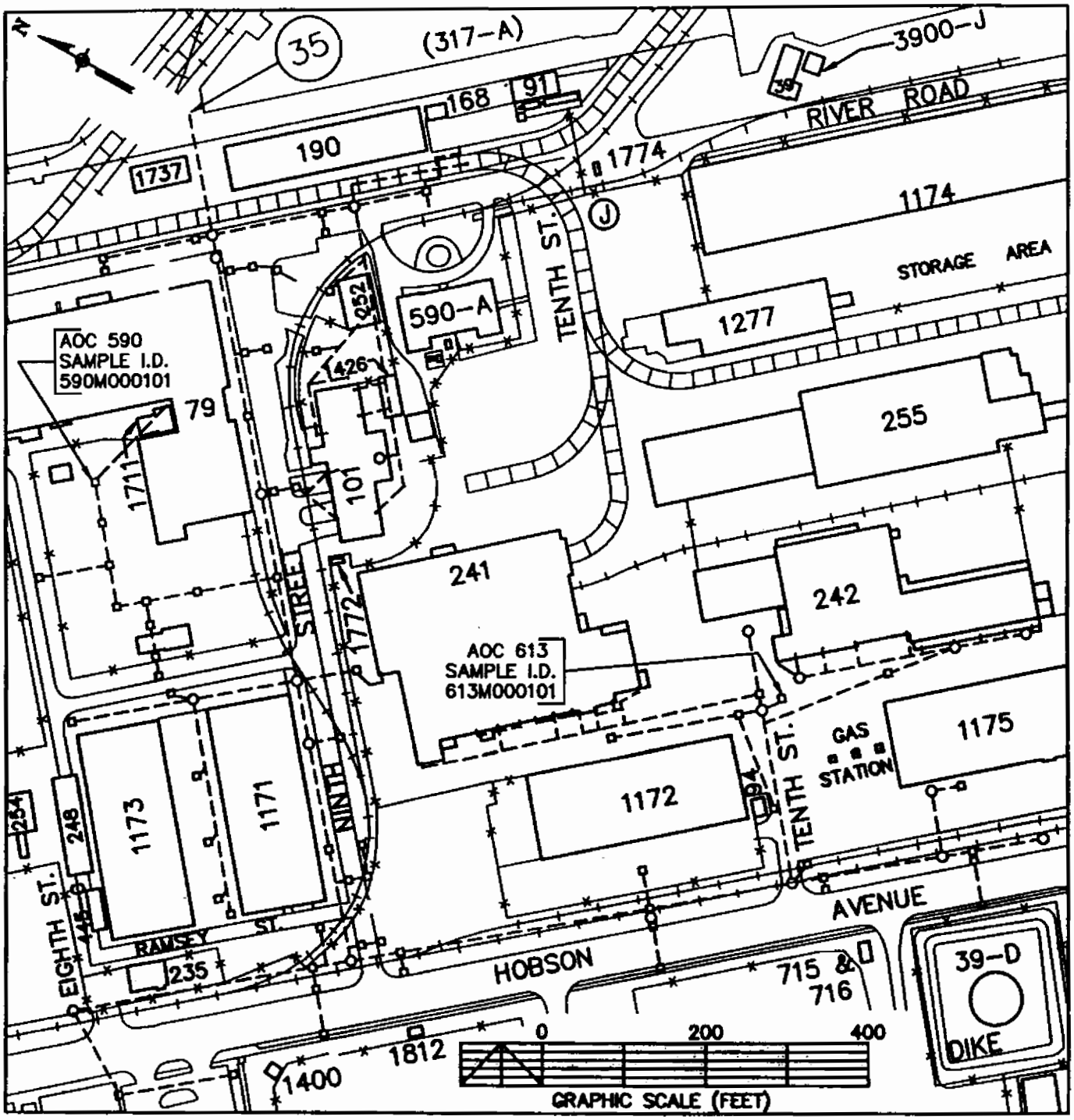

0
200
400
GRAPHIC SCALE (FEET)
30
LEGEND
30 OUTFALL NUMBER
STORM DR. PPG (CLEANING REQD)
MANHOLE (CLEANING REQD)
CATCH BASIN (CLEANING REQD)
STORM DR. PPG (CLEANING NOT REQD)
MANHOLE (CLEANING NOT REQD)
CATCH BASIN (CLEANING NOT REQD)
N
46" DIA. (1,565' TOTAL)
24" DIA. (375' TOTAL)
10" DIA. (125' TOTAL)
6" DIA. (105' TOTAL)
3" DIA. (20' TOTAL)
10" DIA. (110' TOTAL)
8" DIA. (180' TOTAL)
6" DIA. (40' TOTAL)
15" DIA. (400' TOTAL)
6" DIA. (40' TOTAL)
12" DIA. (15' TOTAL)
18" DIA. (125' TOTAL)
21" DIA. (75' TOTAL)
15" DIA. (TOTAL 415')
SWMU 173
SAMPLE I.D. 173M000101
SAMPLE I.D. 173M000201
SAMPLE I.D. 173M000301
AOC 573
SAMPLE I.D. 573M000201
SAMPLE I.D. 573M000101
AOC 572
SAMPLE I.D. 572M000101

Figure 4



35
(317-A)
3900-J
39
168
91
RIVER ROAD
190
1737
1774
1174
J
TENTH ST.
STORAGE AREA
252
590-A
1277
AOC 590
SAMPLE I.D.
590M000101
426
79
255
1711
101
241
242
STREET
1772
AOC 613
SAMPLE I.D.
613M000101
GAS
STATION
1175
1173
1171
NINTH
1172
94
TENTH ST.
254
248
EIGHTH ST.
445
RAMSEY ST.
235
AVENUE
HOBSON
715 &
716
39-D
DIKE
1812
1400
0
200
400
GRAPHIC SCALE (FEET)

Figure 4A

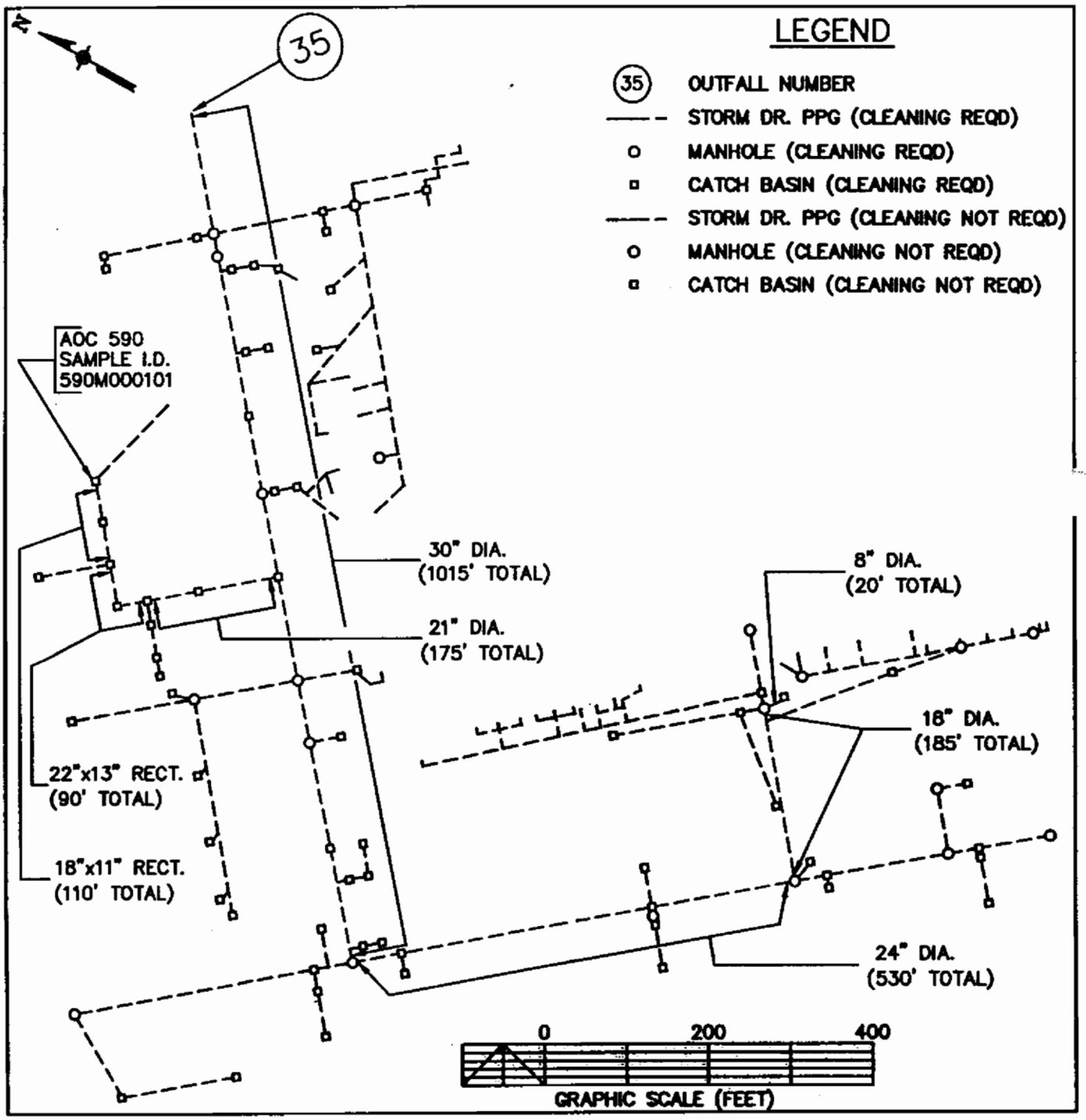

LEGEND
35 OUTFALL NUMBER
STORM DR. PPG (CLEANING REQD)
MANHOLE (CLEANING REQD)
CATCH BASIN (CLEANING REQD)
STORM DR. PPG (CLEANING NOT REQD)
MANHOLE (CLEANING NOT REQD)
CATCH BASIN (CLEANING NOT REQD)
35
AOC 590
SAMPLE I.D.
590M000101
30" DIA.
(1015' TOTAL)
21" DIA.
(175' TOTAL)
8" DIA.
(20' TOTAL)
18" DIA.
(185' TOTAL)
22"x13" RECT.
(90' TOTAL)
18"x11" RECT.
(110' TOTAL)
24" DIA.
(530' TOTAL)
0
200
400
GRAPHIC SCALE (FEET)

Figure 5

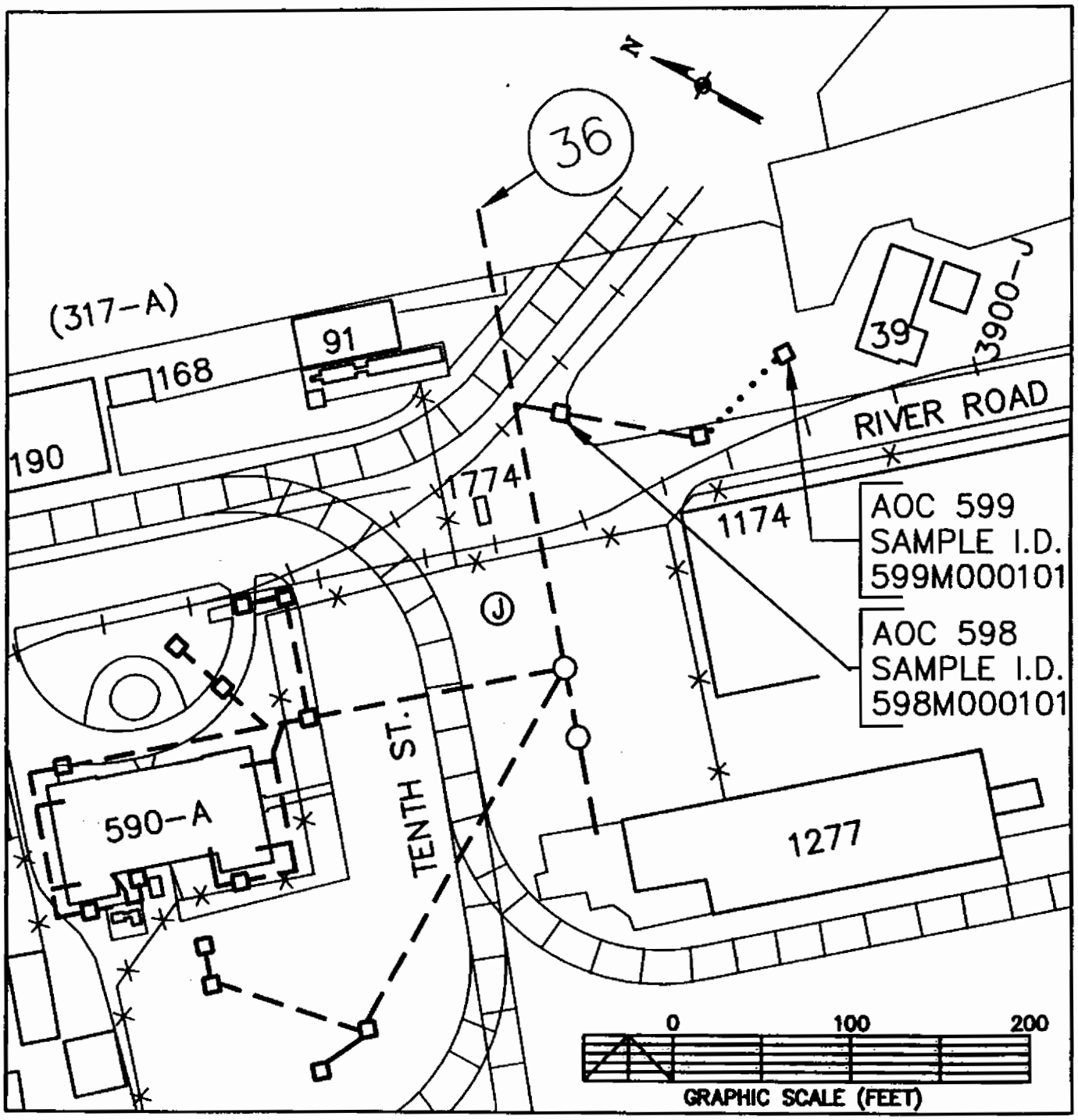

N
36
(317-A)
91
168
190
39
3900-J
RIVER ROAD
1774
1174
AOC 599
SAMPLE I.D.
599M000101
AOC 598
SAMPLE I.D.
598M000101
J
TENTH ST.
590-A
1277
0
100
200
GRAPHIC SCALE (FEET)

Figure 5A

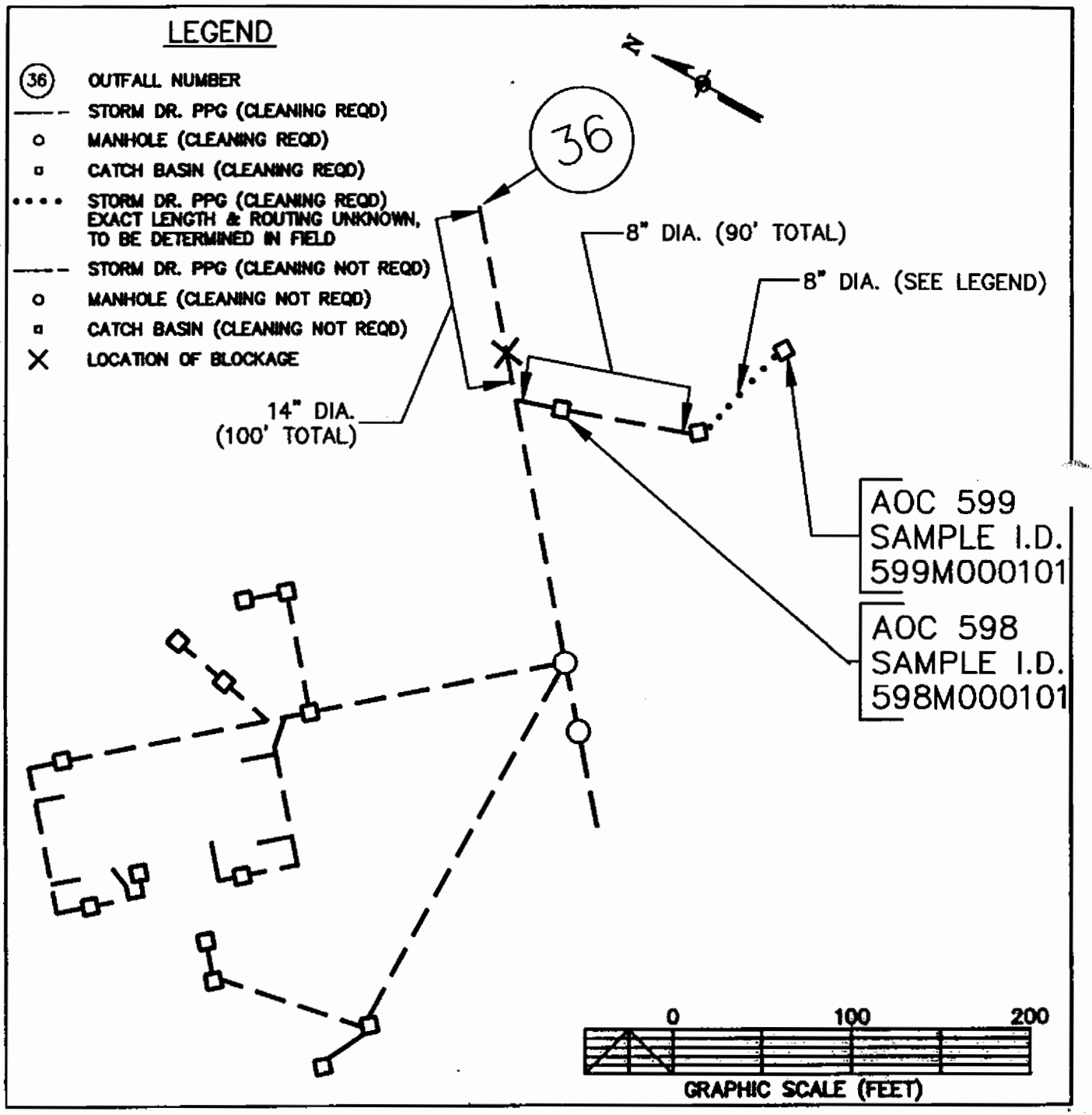

LEGEND
36 OUTFALL NUMBER
STORM DR. PPG (CLEANING REQD)
MANHOLE (CLEANING REQD)
CATCH BASIN (CLEANING REQD)
STORM DR. PPG (CLEANING REQD) EXACT LENGTH & ROUTING UNKNOWN, TO BE DETERMINED IN FIELD
STORM DR. PPG (CLEANING NOT REQD)
MANHOLE (CLEANING NOT REQD)
CATCH BASIN (CLEANING NOT REQD)
LOCATION OF BLOCKAGE
N
36
8" DIA. (90' TOTAL)
8" DIA. (SEE LEGEND)
14" DIA. (100' TOTAL)
AOC 599 SAMPLE I.D. 599M000101
AOC 598 SAMPLE I.D. 598M000101
0
100
200
GRAPHIC SCALE (FEET)

Figure 6

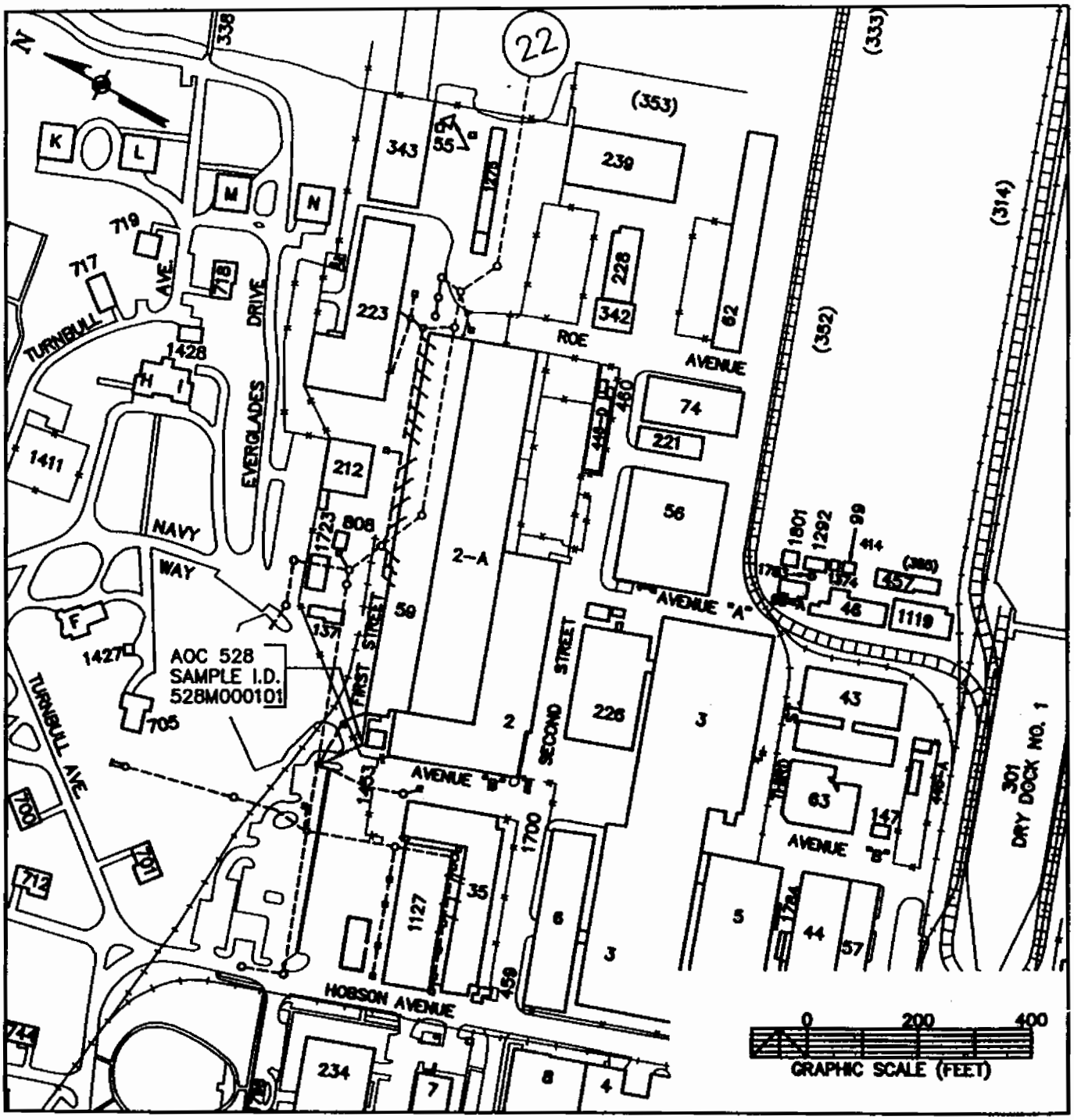

N
22
AOC 528
SAMPLE I.D.
528M000101
TURNBULL AVE.
TURNBULL AVE
NAVY WAY
EVERGLADES DRIVE
ROE AVENUE
AVENUE "A"
AVENUE "B"
FIRST STREET
SECOND STREET
HOBSON AVENUE
DRY DOCK NO. 1
GRAPHIC SCALE (FEET)
0
200
400

Figure 6A

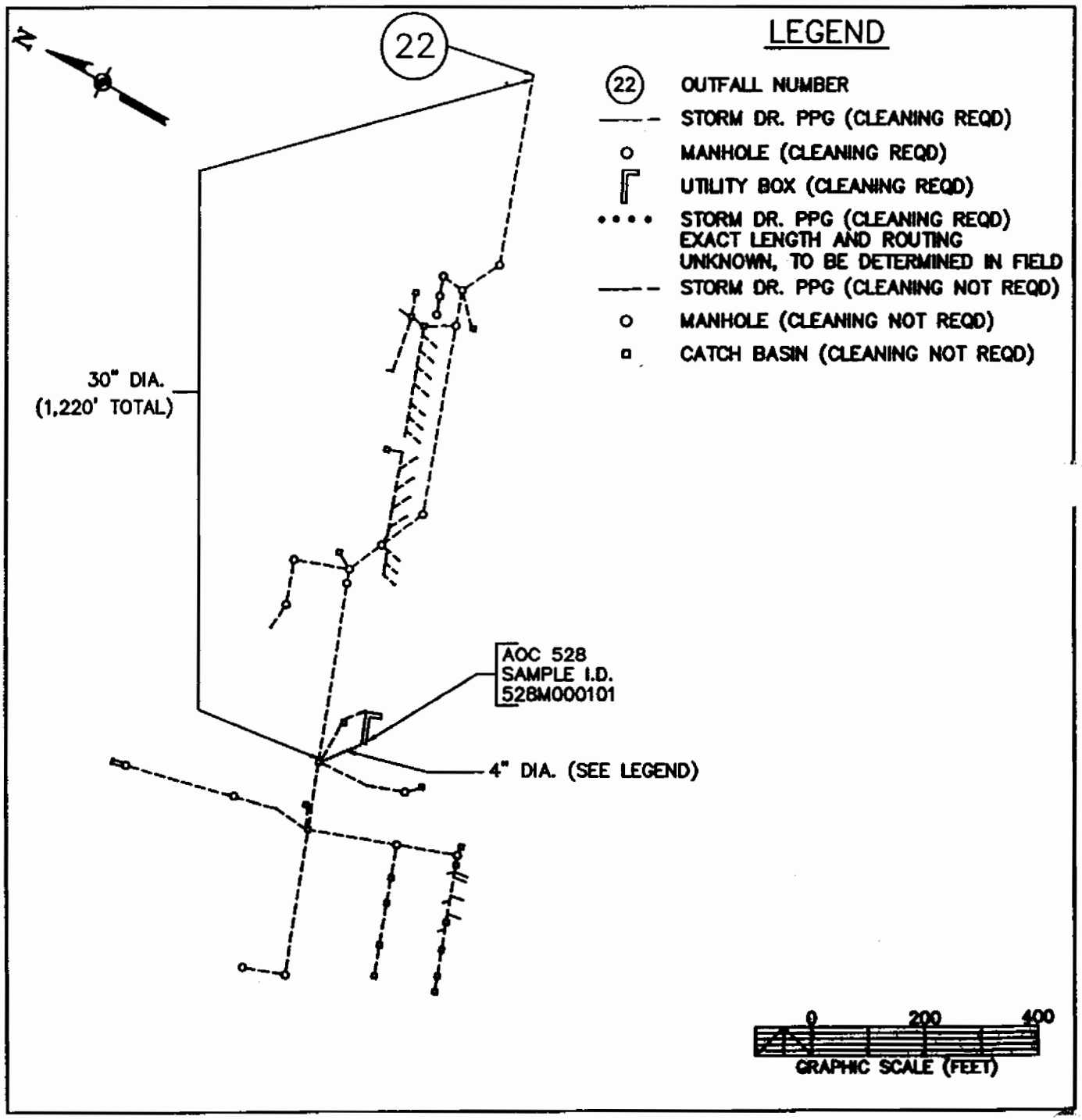
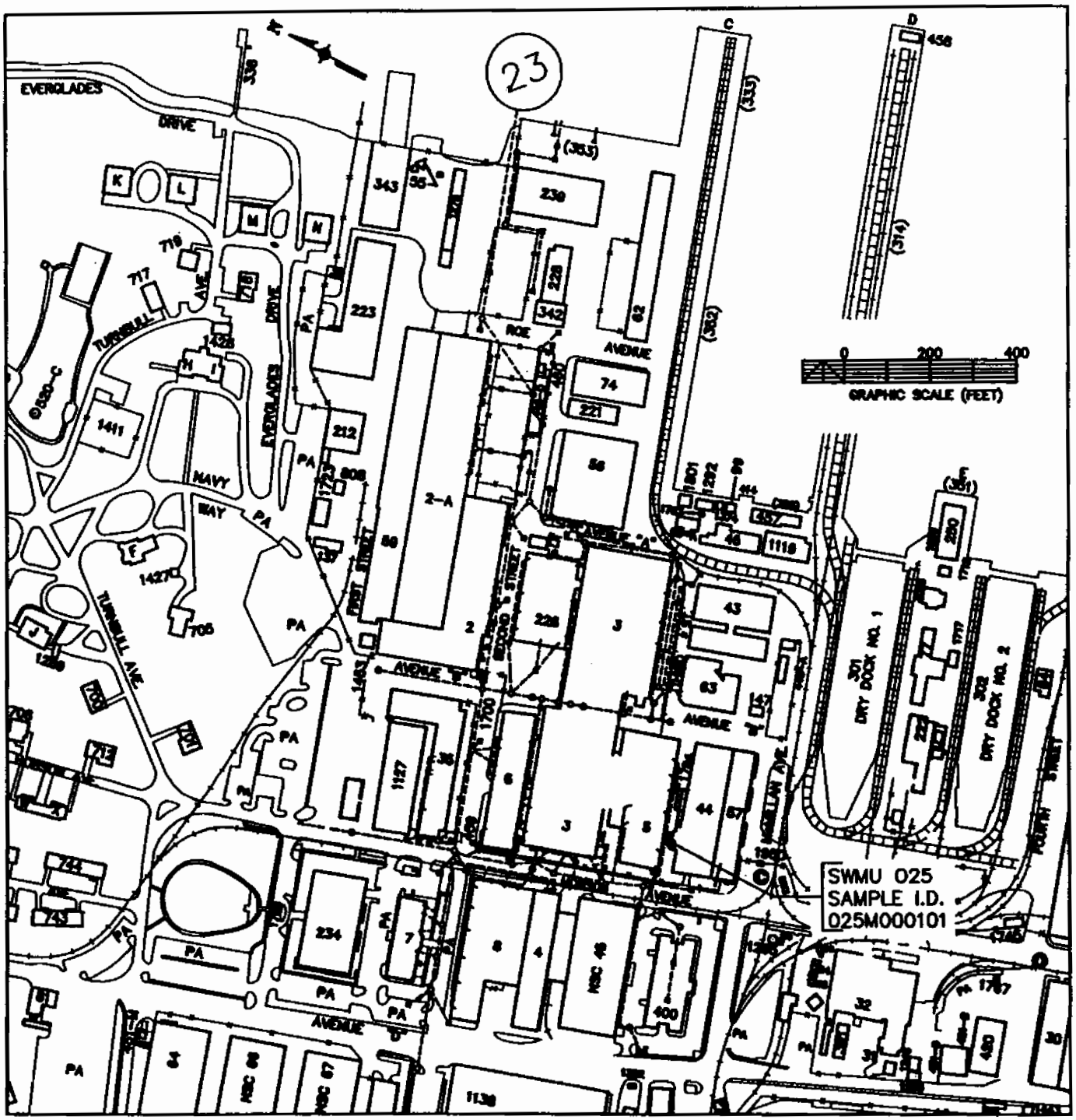

N
22
LEGEND
22 OUTFALL NUMBER
STORM DR. PPG (CLEANING REQD)
MANHOLE (CLEANING REQD)
UTILITY BOX (CLEANING REQD)
STORM DR. PPG (CLEANING REQD) EXACT LENGTH AND ROUTING UNKNOWN, TO BE DETERMINED IN FIELD
STORM DR. PPG (CLEANING NOT REQD)
MANHOLE (CLEANING NOT REQD)
CATCH BASIN (CLEANING NOT REQD)
30" DIA. (1,220' TOTAL)
AOC 528 SAMPLE I.D. 528M000101
4" DIA. (SEE LEGEND)
0
200
400
GRAPHIC SCALE (FEET)

Figure 7



23
EVERGLADES
DRIVE
TURNBULL AVE
NAVY
WAY
PA
ROE
AVENUE
FIRST STREET
SECOND STREET
AVENUE "A"
AVENUE "B"
AVENUE "D"
MCMILLAN AVE
FOURTH STREET
DRY DOCK NO. 1
DRY DOCK NO. 2
0
200
400
GRAPHIC SCALE (FEET)
SWMU 025
SAMPLE I.D.
025M000101

Figure 7A

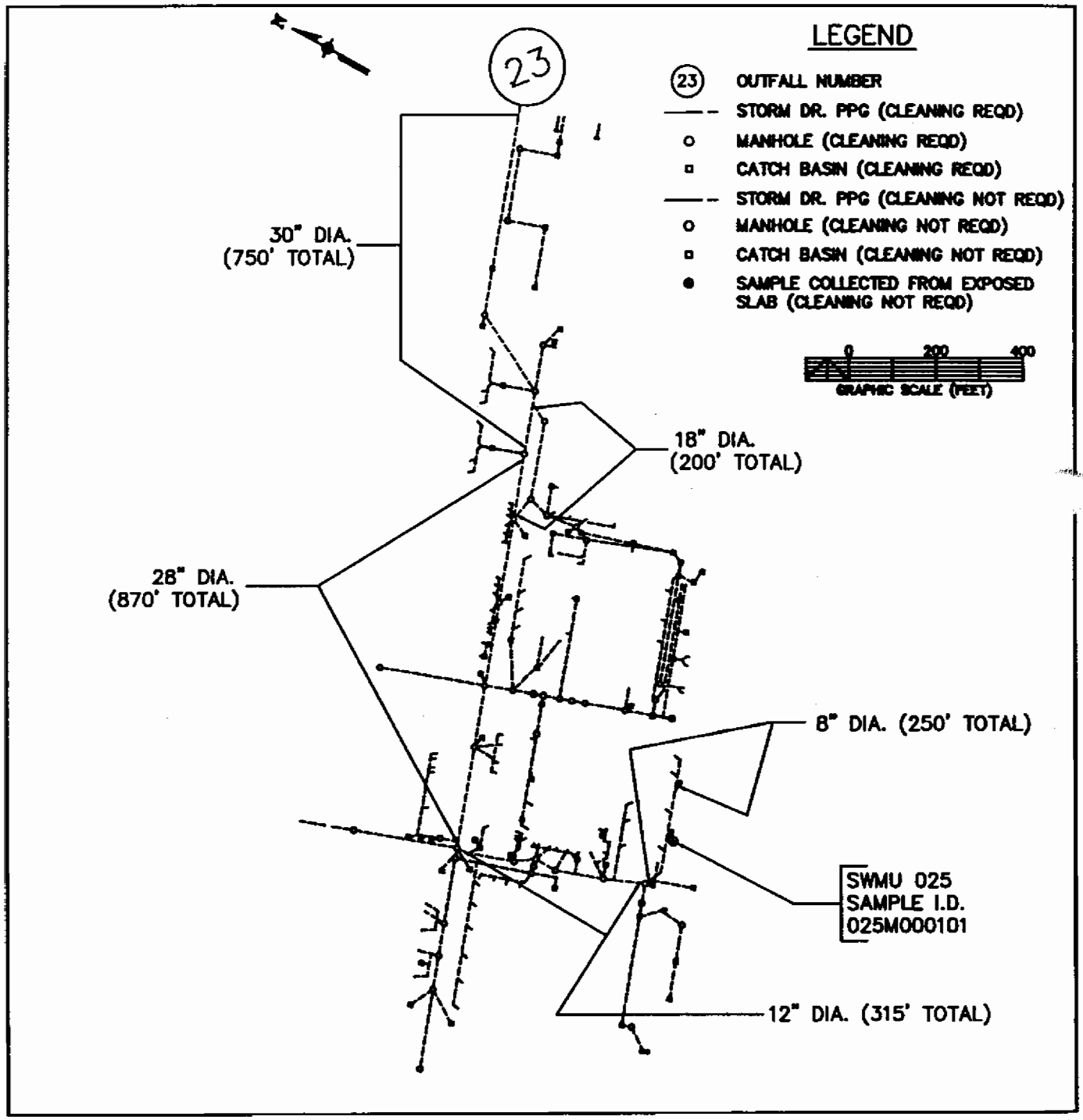

LEGEND
23 OUTFALL NUMBER
STORM DR. PPG (CLEANING REQD)
MANHOLE (CLEANING REQD)
CATCH BASIN (CLEANING REQD)
STORM DR. PPG (CLEANING NOT REQD)
MANHOLE (CLEANING NOT REQD)
CATCH BASIN (CLEANING NOT REQD)
SAMPLE COLLECTED FROM EXPOSED SLAB (CLEANING NOT REQD)
0 200 400
GRAPHIC SCALE (FEET)
23
30" DIA. (750' TOTAL)
18" DIA. (200' TOTAL)
28" DIA. (870' TOTAL)
8" DIA. (250' TOTAL)
SWMU 025 SAMPLE I.D. 025M000101
12" DIA. (315' TOTAL)

Figure 8

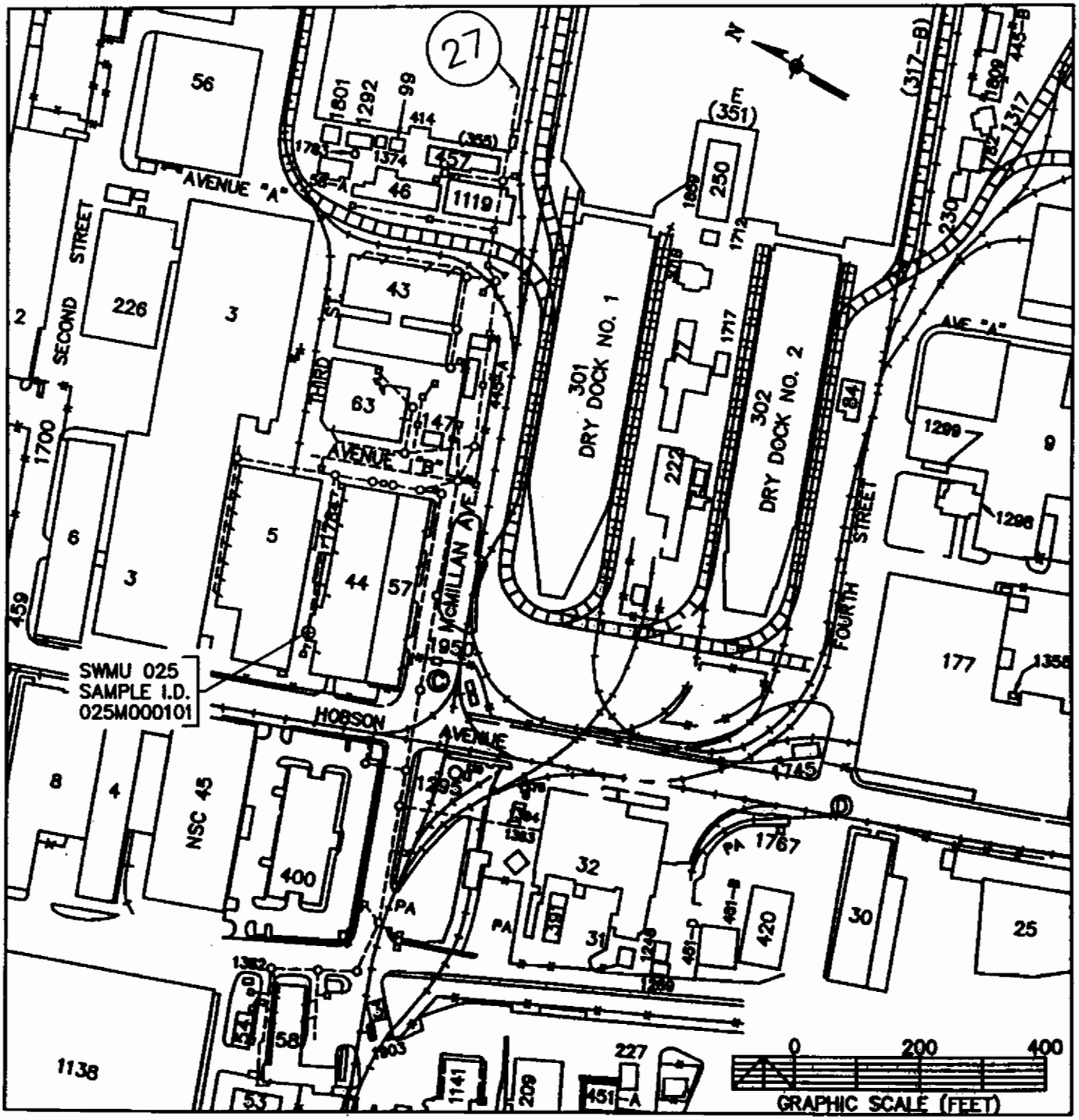

27
N
AVENUE "A"
SECOND STREET
THIRD
AVENUE "B"
MCMILLAN AVE
HOBSON AVENUE
FOURTH STREET
AVE "A"
301 DRY DOCK NO. 1
302 DRY DOCK NO. 2
NSC 45
SWMU 025
SAMPLE I.D.
025M000101
GRAPHIC SCALE (FEET)
0
200
400

Figure 8A

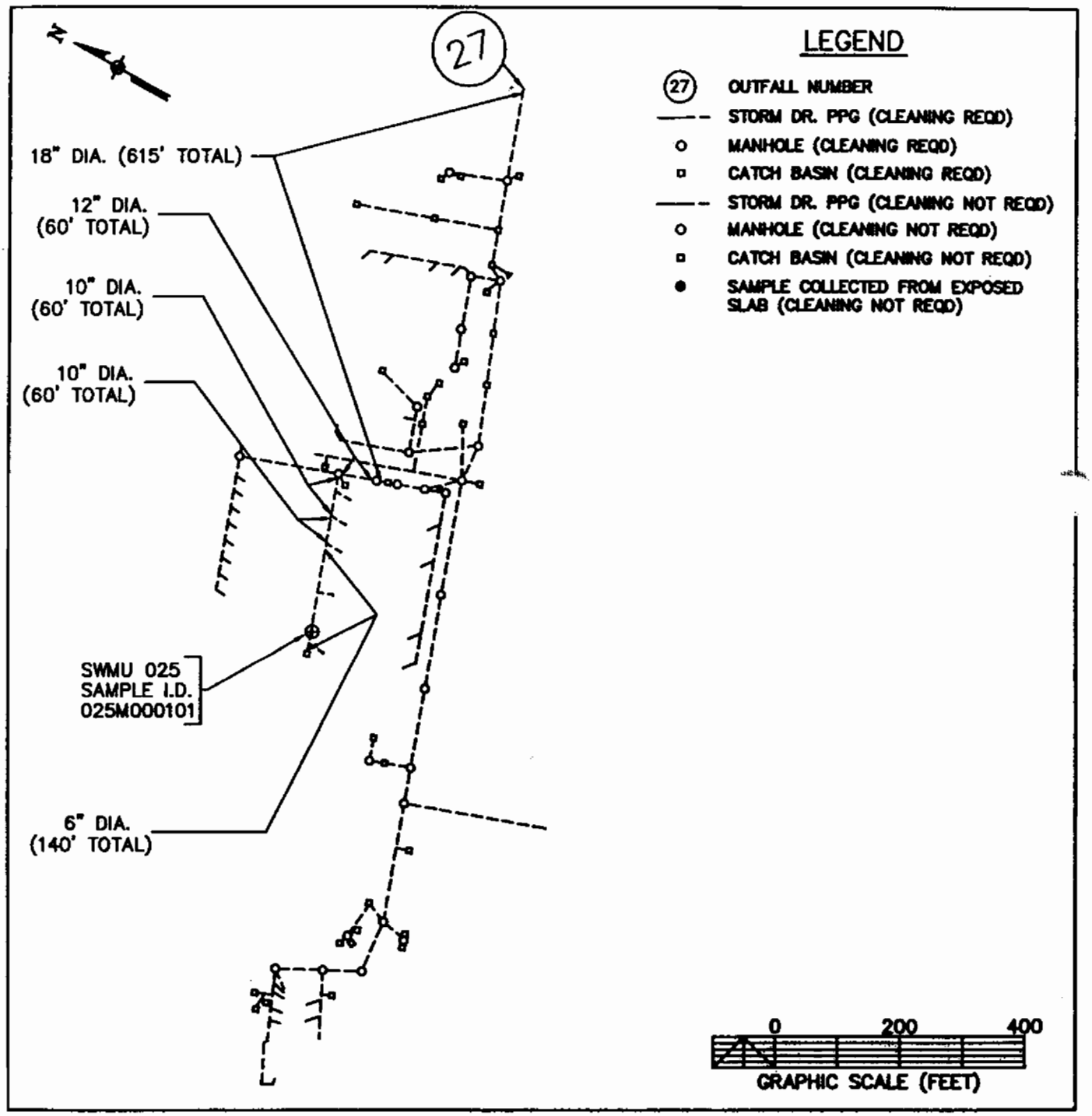

N
27
18" DIA. (615' TOTAL)
12" DIA.
(60' TOTAL)
10" DIA.
(60' TOTAL)
10" DIA.
(60' TOTAL)
SWMU 025
SAMPLE I.D.
025M000101
6" DIA.
(140' TOTAL)
LEGEND
27 OUTFALL NUMBER
STORM DR. PPG (CLEANING REQD)
MANHOLE (CLEANING REQD)
CATCH BASIN (CLEANING REQD)
STORM DR. PPG (CLEANING NOT REQD)
MANHOLE (CLEANING NOT REQD)
CATCH BASIN (CLEANING NOT REQD)
SAMPLE COLLECTED FROM EXPOSED SLAB (CLEANING NOT REQD)
0
200
400
GRAPHIC SCALE (FEET)

Figure 9

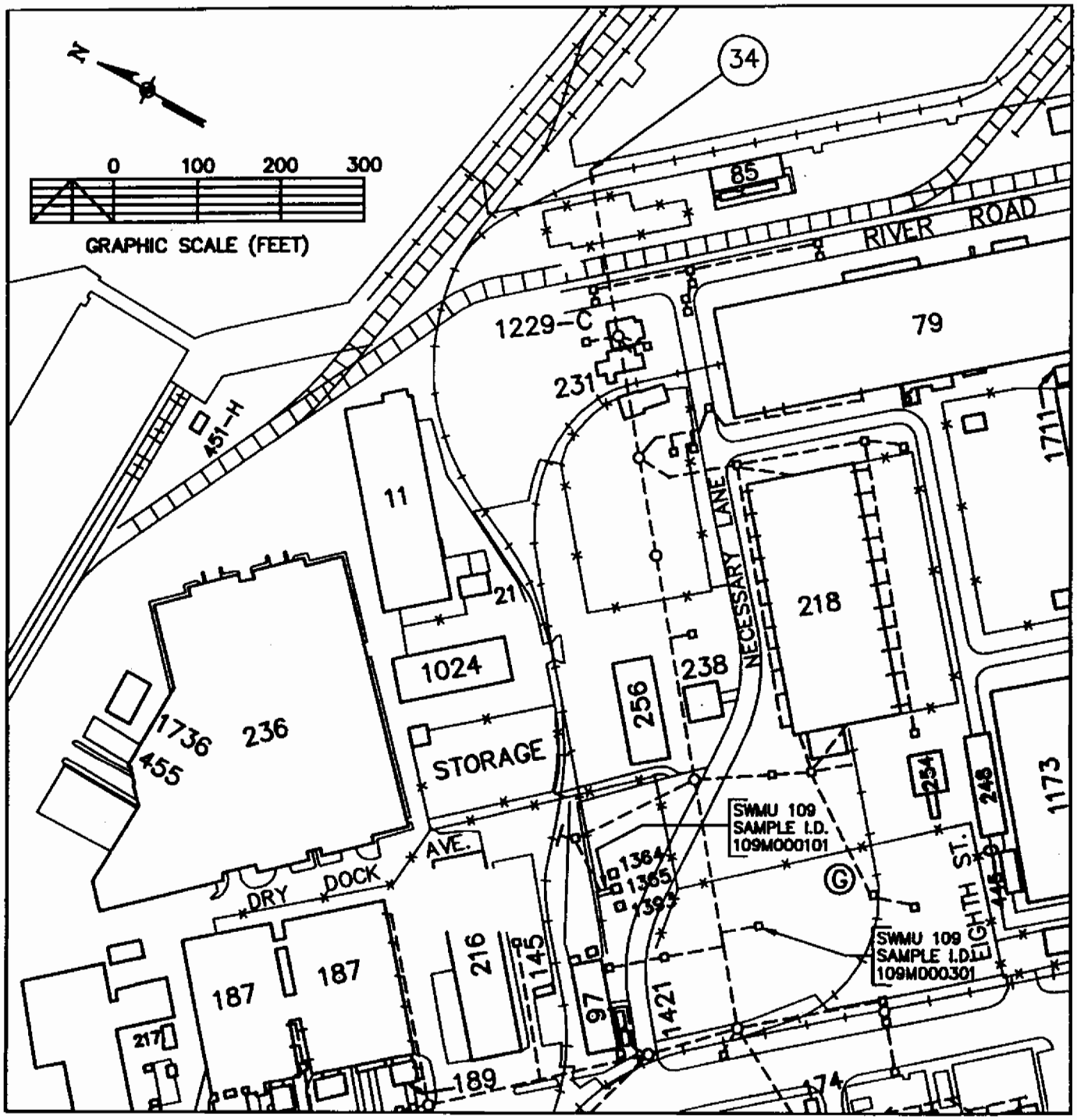

N
0
100
200
300
GRAPHIC SCALE (FEET)
34
85
RIVER ROAD
79
1229-C
231
451-H
11
21
1024
STORAGE
236
1736
455
DRY DOCK
AVE.
NECESSARY LANE
218
238
256
1711
1173
254
248
SWMU 109
SAMPLE I.D.
109M000101
1364
1365
1393
SWMU 109
SAMPLE I.D.
109M000301
EIGHTH ST.
187
187
217
216
145
97
1421
189
174

Figure 9A

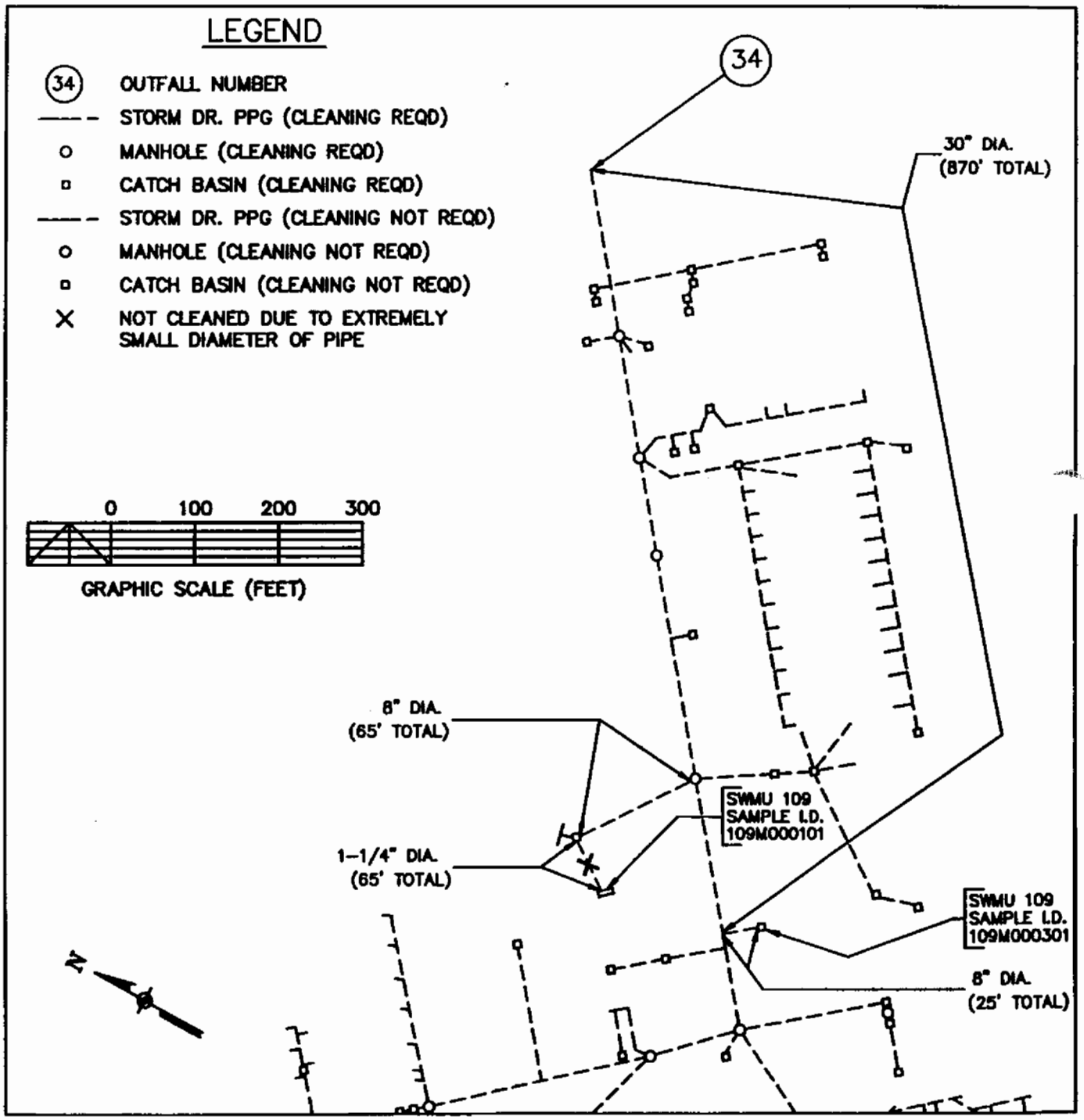

LEGEND
34 OUTFALL NUMBER
STORM DR. PPG (CLEANING REQD)
MANHOLE (CLEANING REQD)
CATCH BASIN (CLEANING REQD)
STORM DR. PPG (CLEANING NOT REQD)
MANHOLE (CLEANING NOT REQD)
CATCH BASIN (CLEANING NOT REQD)
NOT CLEANED DUE TO EXTREMELY SMALL DIAMETER OF PIPE
0 100 200 300
GRAPHIC SCALE (FEET)
34
30" DIA. (870' TOTAL)
8" DIA. (65' TOTAL)
1-1/4" DIA. (65' TOTAL)
SWMU 109 SAMPLE I.D. 109M000101
SWMU 109 SAMPLE I.D. 109M000301
8" DIA. (25' TOTAL)
N

Figure 10

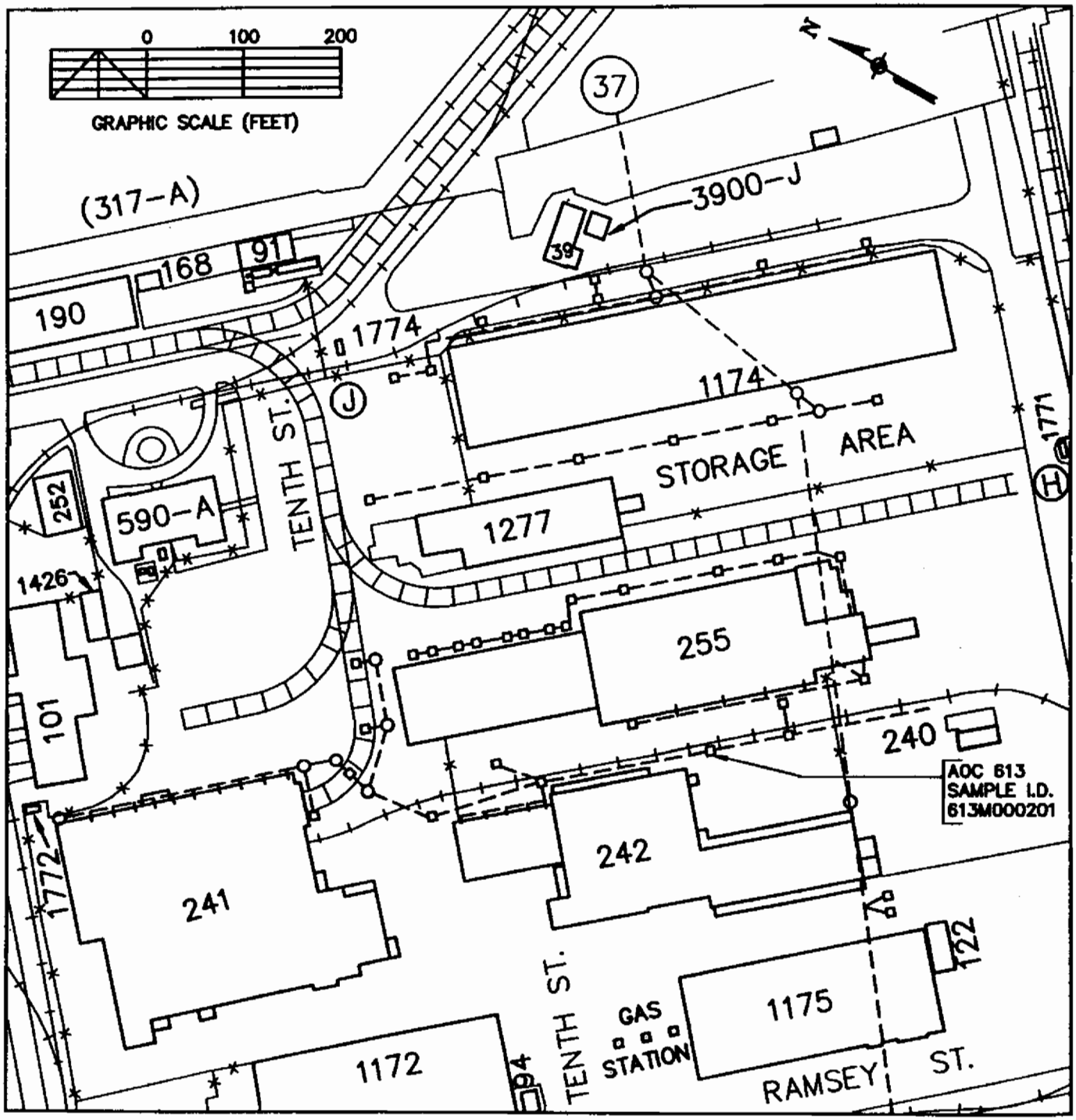

0
100
200
GRAPHIC SCALE (FEET)
N
37
3900-J
39
(317-A)
168
91
190
1774
J
1174
STORAGE
AREA
1771
H
TENTH ST.
252
590-A
1277
1426
255
101
240
AOC 613
SAMPLE I.D.
613M000201
242
1772
241
122
1175
GAS
STATION
1172
94
TENTH ST.
RAMSEY
ST.

Figure 10A

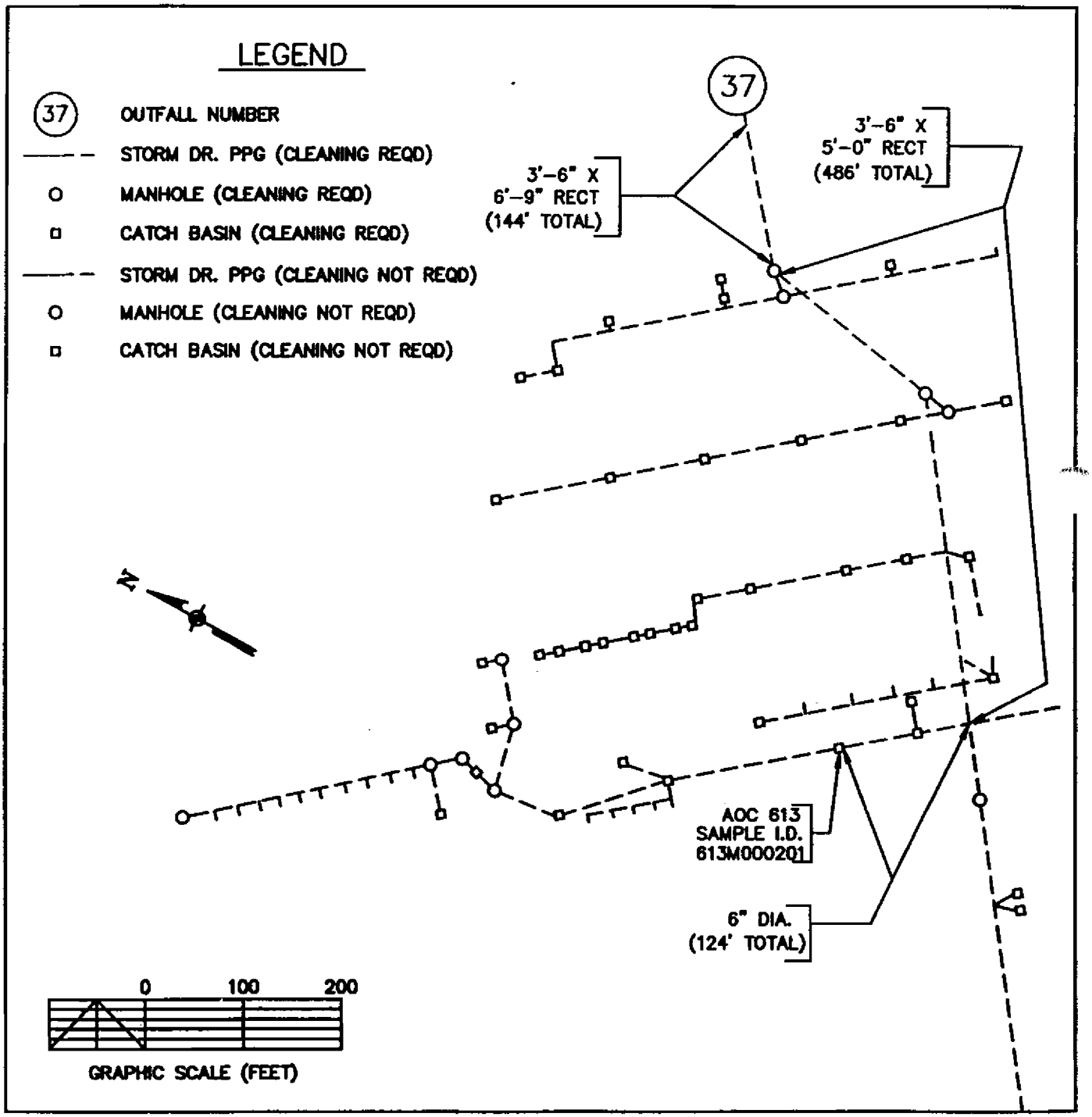

LEGEND
37 OUTFALL NUMBER
STORM DR. PPG (CLEANING REQD)
MANHOLE (CLEANING REQD)
CATCH BASIN (CLEANING REQD)
STORM DR. PPG (CLEANING NOT REQD)
MANHOLE (CLEANING NOT REQD)
CATCH BASIN (CLEANING NOT REQD)
37
3'-6" X 6'-9" RECT (144' TOTAL)
3'-6" X 5'-0" RECT (486' TOTAL)
N
AOC 613 SAMPLE I.D. 613M000201
6" DIA. (124' TOTAL)
0
100
200
GRAPHIC SCALE (FEET)

Figure 11

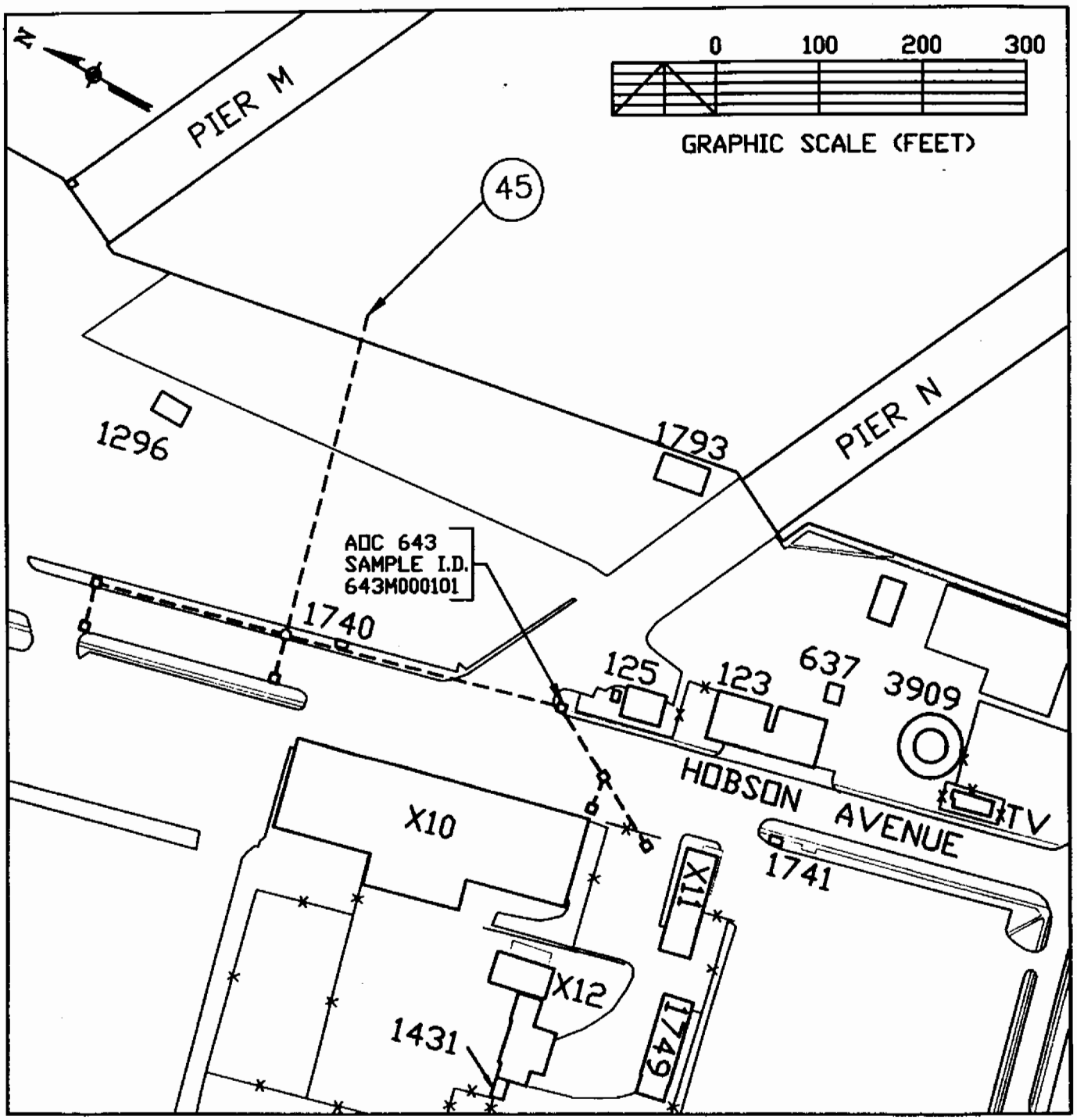

N
0
100
200
300
GRAPHIC SCALE (FEET)
PIER M
45
1296
1793
PIER N
AOC 643
SAMPLE I.D.
643M000101
1740
125
123
637
3909
HOBSON AVENUE
TV
X10
1741
X11
X12
1749
1431

Figure 11A

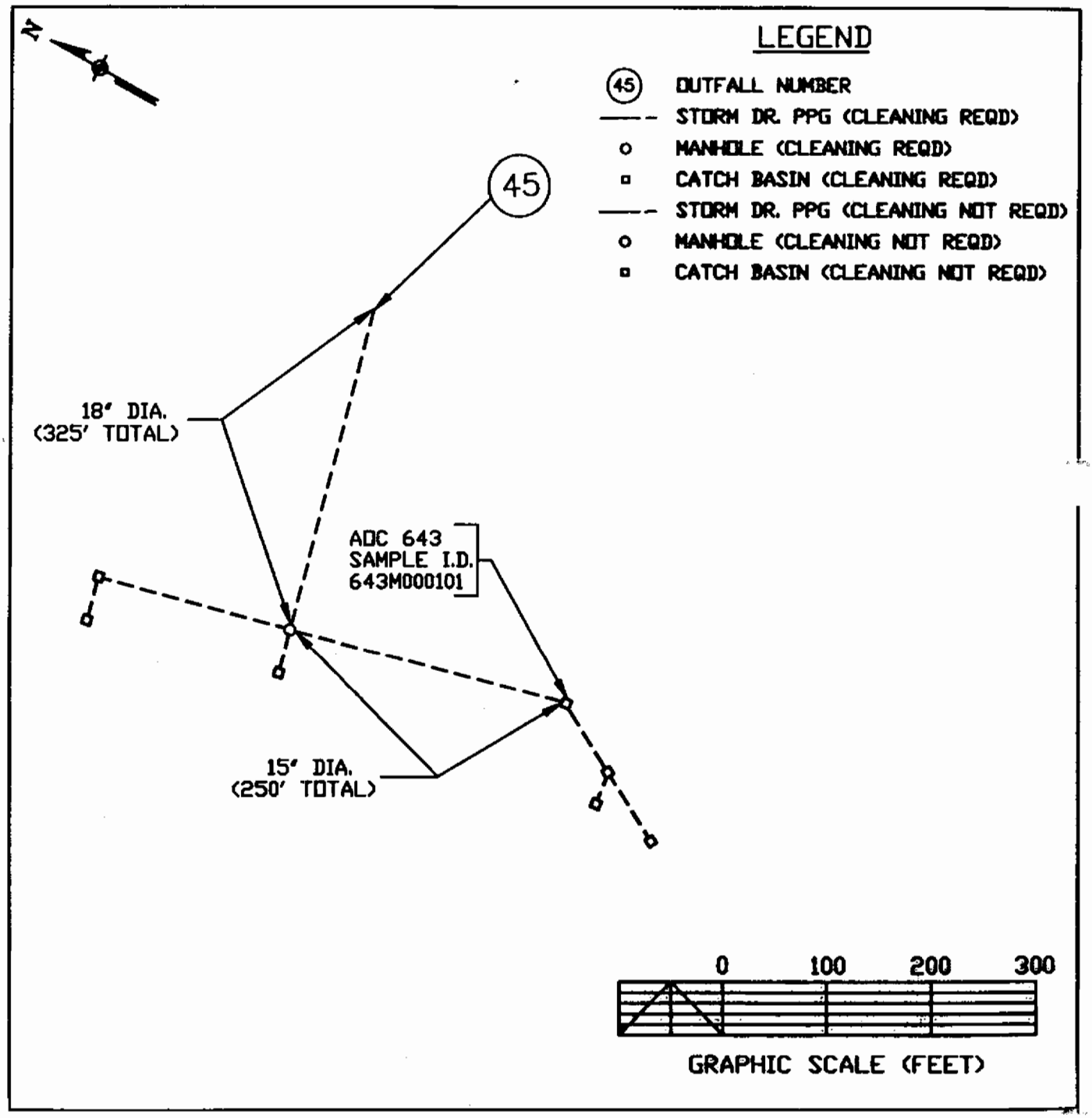

N
LEGEND
45 OUTFALL NUMBER
STORM DR. PPG (CLEANING REQD)
MANHOLE (CLEANING REQD)
CATCH BASIN (CLEANING REQD)
STORM DR. PPG (CLEANING NOT REQD)
MANHOLE (CLEANING NOT REQD)
CATCH BASIN (CLEANING NOT REQD)
45
18" DIA.
(325' TOTAL)
ADC 643
SAMPLE I.D.
643M000101
15" DIA.
(250' TOTAL)
0
100
200
300
GRAPHIC SCALE (FEET)

TABLE 1

PROCESS WATER SAMPLE RESULTS FROM STORM DRAIN CLEANING

VOLUME # & TANK #	SAMPLE # (99SPORT)	CONSTITUENT	TOTALS RCRA 8 METALS (PPM)	SAMPLE # (99SPORT)	TCLP RCRA 8 METALS (PPM)
VOL #1/ TK #1	0006-01	Mercury	0.0447	0018-01	0.000418
VOL #1/ TK #1	0006-01	Silver	0.194	0018-01	ND
VOL #1/ TK #1	0006-01	Arsenic	0.172	0018-01	ND
VOL #1/ TK #1	0006-01	Barium	2.160	0018-01	0.0476
VOL #1/ TK #1	0006-01	Cadmium	0.177	0018-01	ND
VOL #1/ TK #1	0006-01	Chromium	18.200	0018-01	ND
VOL #1/ TK #1	0006-01	Lead	42.700	0018-01	ND
VOL #1/ TK #1	0006-01	Selenium	0.0232	0018-01	ND
VOL #2/ TK #2	0033-01	Mercury	—	0033-01	ND
VOL #2/ TK #2	0033-01	Silver	ND	0033-01	ND
VOL #2/ TK #2	0033-01	Arsenic	ND	0033-01	ND
VOL #2/ TK #2	0033-01	Barium	0.097	0033-01	0.0957
VOL #2/ TK #2	0033-01	Cadmium	ND	0033-01	ND
VOL #2/ TK #2	0033-01	Chromium	ND	0033-01	0.00598
VOL #2/ TK #2	0033-01	Lead	0.00803	0033-01	ND
VOL #2/ TK #1	0033-01	Selenium	ND	0033-01	ND
VOL #3/ TK #1	0028-01	Mercury	—	0028-01	0.000610
VOL #3/ TK #1	0028-01	Silver	0.0185	0028-01	ND
VOL #3/ TK #1	0028-01	Arsenic	0.0242	0028-01	ND
VOL #3/ TK #1	0028-01	Barium	0.334	0028-01	0.076
VOL #3/ TK #1	0028-01	Cadmium	0.020	0028-01	0.00526
VOL #3/ TK #1	0028-01	Chromium	1.330	0028-01	0.0233
VOL #3/ TK #1	0028-01	Lead	3.170	0028-01	0.261
VOL #3/ TK #1	0028-01	Selenium	ND	0028-01	ND
VOL #4/ TK #2	0031-01	Mercury	—	0031-01	0.00100
VOL #4/ TK #2	0031-01	Silver	ND	0031-01	ND
VOL #4/ TK #2	0031-01	Arsenic	ND	0031-01	ND
VOL #4/ TK #2	0031-01	Barium	0.125	0031-01	0.116
VOL #4/ TK #2	0031-01	Cadmium	ND	0031-01	0.00453
VOL #4/ TK #2	0031-01	Chromium	0.00644	0031-01	0.0115
VOL #4/ TK #2	0031-01	Lead	0.053	0031-01	ND
VOL #4/ TK #2	0031-01	Selenium	ND	0031-01	ND

ND = NOT DETECTED

TABLE 1 CONTINUED

PROCESS WATER SAMPLE RESULTS FROM STORM DRAIN CLEANING

VOLUME # & TANK #	SAMPLE # (99SPORT)	CONSTITUENT	TOTALS RCRA 8 METALS (PPM)	SAMPLE # (99SPORT)	TCLP RCRA 8 METALS (PPM)
VOL #5/ TK #4	0044-01	Mercury	ND	---	---
VOL #5/ TK #4	0044-01	Silver	ND	---	---
VOL #5/ TK #4	0044-01	Arsenic	ND	---	---
VOL #5/ TK #4	0044-01	Barium	0.393	---	---
VOL #5/ TK #4	0044-01	Cadmium	0.00303	---	---
VOL #5/ TK #4	0044-01	Chromium	0.0691	---	---
VOL #5/ TK #4	0044-01	Lead	0.047.4	---	---
VOL #5/ TK #4	0044-01	Selenium	ND	---	---
VOL #6/ TK #2	0046-01	Mercury	0.0887	---	---
VOL #6/ TK #2	0046-01	Silver	0.144	---	---
VOL #6/ TK #2	0046-01	Arsenic	0.771	---	---
VOL #6/ TK #2	0046-01	Barium	2.960	---	---
VOL #6/ TK #2	0046-01	Cadmium	0.206	---	---
VOL #6/ TK #2	0046-01	Chromium	6.910	0056-01	0.296
VOL #6/ TK #2	0046-01	Lead	20.600	0056-01	2.470
VOL #6/ TK #2	0046-01	Selenium	0.0427	---	---
VOL #7/ TK #4	0063-01	Mercury	0.000949	---	---
VOL #7/ TK #4	0063-01	Silver	ND	---	---
VOL #7/ TK #4	0063-01	Arsenic	0.012	---	---
VOL #7/ TK #4	0063-01	Barium	0.101	---	---
VOL #7/ TK #4	0063-01	Cadmium	0.00245	---	---
VOL #7/ TK #4	0063-01	Chromium	0.128	---	---
VOL #7/ TK #4	0063-01	Lead	0.140	---	---
VOL #7/ TK #4	0063-01	Selenium	0.00347	---	---
VOL #8/ TK #3	0063-02	Mercury	0.000378	---	---
VOL #8/ TK #3	0063-02	Silver	ND	---	---
VOL #8/ TK #3	0063-02	Arsenic	0.00723	---	---
VOL #8/ TK #3	0063-02	Barium	0.0494	---	---
VOL #8/ TK #3	0063-02	Cadmium	0.000972	---	---
VOL #8/ TK #3	0063-02	Chromium	0.0216	---	---
VOL #8/ TK #3	0063-02	Lead	0.0495	---	---
VOL #8/ TK #3	0063-02	Selenium	ND	---	---

ND = NOT DETECTED

TABLE 1 CONTINUED

PROCESS WATER SAMPLE RESULTS FROM STORM DRAIN CLEANING

VOLUME # & TANK #	SAMPLE # (99SPORT)	CONSTITUENT	TOTALS RCRA 8 METALS (PPM)	SAMPLE # (99SPORT)	TCLP RCRA 8 METALS (PPM)
VOL #9/ TK #2	0063-03	Mercury	0.0915	---	---
VOL #9/ TK #2	0063-03	Silver	0.294	---	---
VOL #9/ TK #2	0063-03	Arsenic	0.423	---	---
VOL #9/ TK #2	0063-03	Barium	1.720	---	---
VOL #9/ TK #2	0063-03	Cadmium	0.192	---	---
VOL #9/ TK #2	0063-03	Chromium	11.900	0068-01	**7.330**
VOL #9/ TK #2	0063-03	Lead	12.800	0068-01	**13.300**
VOL #9/ TK #2	0063-03	Selenium	0.0375	---	---
VOL #10/ TK #1	0067-01	Mercury	0.139	---	---
VOL #10/ TK #1	0067-01	Silver	3.190	---	---
VOL #10/ TK #1	0067-01	Arsenic	1.740	---	---
VOL #10/ TK #1	0067-01	Barium	5.660	---	---
VOL #10/ TK #1	0067-01	Cadmium	4.710	0074-01	0.504
VOL #10/ TK #1	0067-01	Chromium	161.000	0074-01	2.970
VOL #10/ TK #1	0067-01	Lead	163.000	0074-01	**9.850**
VOL #10/ TK #1	0067-01	Selenium	0.181	---	---
VOL #11/ TK #5	0067-02	Mercury	0.143	---	---
VOL #11/ TK #5	0067-02	Silver	0.149	---	---
VOL #11/ TK #5	0067-02	Arsenic	0.0752	---	---
VOL #11/ TK #5	0067-02	Barium	0.575	---	---
VOL #11/ TK #5	0067-02	Cadmium	0.120	---	---
VOL #11/ TK #5	0067-02	Chromium	3.440	---	---
VOL #11/ TK #5	0067-02	Lead	5.530	0074-02	**5.430**
VOL #11/ TK #5	0067-02	Selenium	0.00662	---	---
VOL #12/ TK #3	0073-01	Mercury	0.00139	---	---
VOL #12/ TK #3	0073-01	Silver	ND	---	---
VOL #12/ TK #3	0073-01	Arsenic	0.0102	---	---
VOL #12/ TK #3	0073-01	Barium	0.0353	---	---
VOL #12/ TK #3	0073-01	Cadmium	0.000806	---	---
VOL #12/ TK #3	0073-01	Chromium	0.0210	---	---
VOL #12/ TK #3	0073-01	Lead	0.0512	---	---
VOL #12/ TK #3	0073-01	Selenium	ND	---	---

ND = NOT DETECTED

BOLD = VALUES EQUAL TO OR EXCEEDING THE RCRA LIMIT

TABLE 1 CONTINUED

PROCESS WATER SAMPLE RESULTS FROM STORM DRAIN CLEANING

VOLUME # & TANK #	SAMPLE # (99SPORT)	CONSTITUENT	TOTALS RCRA 8 METALS (PPM)	SAMPLE # (99SPORT)	TCLP RCRA 8 METALS (PPM)
VOL #13/ TK #4	0073-02	Mercury	0.000444	---	---
VOL #13/ TK #4	0073-02	Silver	ND	---	---
VOL #13/ TK #4	0073-02	Arsenic	0.006	---	---
VOL #13/ TK #4	0073-02	Barium	0.031	---	---
VOL #13/ TK #4	0073-02	Cadmium	0.001	---	---
VOL #13/ TK #4	0073-02	Chromium	0.0197	---	---
VOL #13/ TK #4	0073-02	Lead	0.064	---	---
VOL #13/ TK #4	0073-02	Selenium	ND	---	---
VOL #14/ TK #3	0079-02	Mercury	0.0174	---	---
VOL #14/ TK #3	0079-02	Silver	0.0190	---	---
VOL #14/ TK #3	0079-02	Arsenic	ND	---	---
VOL #14/ TK #3	0079-02	Barium	0.175	---	---
VOL #14/ TK #3	0079-02	Cadmium	0.0169	---	---
VOL #14/ TK #3	0079-02	Chromium	0.690	---	---
VOL #14/ TK #3	0079-02	Lead	1.100	---	---
VOL #14/ TK #3	0079-02	Selenium	ND	---	---

ND = NOT DETECTED

TABLE 2 STORM DRAIN SEDIMENT SAMPLE RESULTS					
COPC	COPC CONCENTRATION BY SAMPLE ID# (99SPORT) AND ROLL OFF # (PPM)				
	0029-01 Roll off #1	0029-02 Roll off #1	0064-01 Roll off #1	0064-02 Roll off #1	0079-01 Roll off #2
Arsenic	4.510	4.110	3.600	3.170	5.290
Barium	105.000	32.000	48.100	28.300	15.900
Beryllium	0.250	0.233	0.177	0.380	0.239
Cadmium	3.860	2.190	2.600	2.130	0.933
Chromium	68.000	49.600	124.000	121.000	28.800
Copper	348.000	118.000	251.000	478.000	508.000
Iron	18,000.000	16,600.000	8,170.000	7,030.000	11,100.000
Lead	244.000	217.000	258.000	410.000	170.000
Manganese	186.000	184.000	64.300	52.100	154.000
Thallium	ND	ND	ND	ND	0.522
Nickel	36.000	48.000	45.600	146.000	167.000
Dieldrin	ND	ND	ND	ND	ND
Benzo(a) Anthracene	ND	ND	9.810	2.240	3.470
Chrysene	2.090	ND	10.500	2.330	3.370
Benzo(b) Fluoranthene	3.290	0.940	13.100	3.000	ND
Benzo(k) Fluoranthene	ND	ND	ND	ND	3.350
Benzo(a) Pyrene	1.620	ND	7.350	1.770	2.970
Indeno (1, 2, 3-Cd) pyrene	1.270	ND	5.090	1.140	1.270
Dibenz (a, h) Anthracene	ND	ND	1.150	ND	ND

ND = NOT DETECTED

TABLE 3 SEDIMENT RCRA METALS TCLIP RESULTS					
COPC	COPC CONCENTRATION BY SAMPLE ID# (99SPORT) AND ROLL OFF # (PPM)				
	0029-01 Roll off #1	0029-02 Roll off #1	0064-01 Roll off #1	0064-02 Roll off #1	0079-01 Roll off #2
Mercury	0.000730	0.000450	ND	ND	ND
Silver	0.0110	ND	0.0383	0.0309	ND
Arsenic	ND	ND	ND	ND	ND
Barium	0.279	0.227	0.346	0.301	0.312
Cadmium	0.00874	0.00514	0.0462	0.0243	0.0365
Chromium	ND	ND	0.0304	0.0349	ND
Lead	0.0494	0.0774	1.120	3.040	0.944
Selenium	ND	ND	ND	ND	ND

ND = NOT DETECTED

TABLE 4 STORM DRAIN CATCH BASIN SEDIMENT SAMPLE RESULTS WHICH EXCEED RBC TABLE RESIDENTIAL LEVELS

COPC	RBC LEVEL (PPM		COPC CONCENTRATION BY SAMPLE ID# AND CORRESPONDING SWMU/AOC (PPM)									
	INDUS	RESID.	173M000101 SWMU 173	173M000201 SWMU 173	173M000301 SWMU 173	539M000101 AOC 539	546M000101 AOC 546	572M000101 AOC 572	573M000101 AOC 573	573M000201 AOC 573	590M000101 AOC 590	598M000101 AOC 598
Arsenic	3.8	0.43	15.9	[illegible]	7.5	6.9	9.9	7.4	4.9	9.6	3	6.2
Barium	140,000	5,500							9,700			
Beryllium	1.3	0.15		0.22	0.54		0.52	0.52		0.45	0.38	0.18
Cadmium	1,000	39							60.2			
Chromium	10,000	390							7,320			
Copper	82,000	3,100	5,420			134,000	8,560					5,880
Iron	610,000	23,000	69,700			25,100	89,800	28,100		28,800		
Lead	1,300	400	270	811	721		140			405		
Manganese	47,000	1,800	435			3,150	400					
Nickel	41,000	1,600				6,480						
Dieldrin	0.36	0.04				0.37						
Benzo (a) anthracene	7.8	0.88				2.2	15	1			120	
Chrysene	780	88									110	
Benzo (b) fluoranthene	7.8	0.88				1.6		0.89			110	
Benzo (k) fluoranthene	78	8.8					19				57	
Benzo (a) pyrene	0.78	0.088	0.24	0.50		13	11	0.77	0.22		92	0.35
Indeno (1,2,3-cd) pyrene	7.8	0.88				0.98	6.1				85	
Dibenz (a, h) anthracene	0.78	0.088				0.49	3.7	0.29			23	

Shaded blocks represent COPC concentrations which are in excess of RBC table industrial levels.

TABLE 4 CONTINUED STORM DRAIN CATCH BASIN SEDIMENT SAMPLE RESULTS WHICH EXCEED RBC TABLE RESIDENTIAL LEVELS

COPC	RBC LEVEL (PPM)		COPC CONCENTRATION BY SAMPLE ID# AND CORRESPONDING SWMU/AOC (PPM)										
	INDUS	RESID.	599M000101 AOC 599	025M000101 SWMU 025	025M000101RE SWMU 025	528M000101 AOC 528	613M000101 AOC 613	613M000201 AOC 613	643M000101 AOC 643	109M000101 SWMU 109	109M000201 SWMU 109	109M000301 SWMU 109	
Arsenic	3.8	0.43	61	210			3.0	117		0.64		9.0	
Beryllium	1.3	0.15								0.20		1.5	
Cadmium	1,000	39		69.7									
Chromium	10,000	390		35,000									
Copper	82,000	3,100	17,900									3,930	
Iron	610,000	23,000		24,600								255,000	
Lead	1,300	400		754								1,150	
Thallium	160	6.3										8.4	
Benzo (a) anthracene	7.8	0.88		2.4					1.3				
Benzo (b) fluoranthene	7.8	0.88		18	79				1.2				
Benzo (a) pyrene	0.78	0.088	0.11	15	79	0.26	0.10	0.39	1.3				
Indeno (1,2,3-cd) pyrene	7.8	0.88		8	74								
Dibenz (a, h) anthracene	0.78	0.088		10	10	.094			0.39				

Shaded blocks represent COPC concentrations which are in excess of RBC table industrial levels

Appendix C

APPENDIX C-1
Detected Compounds in Surface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Aluminum	E025SB014	025SB01401	8/28/97	4,640	=	261	20,500	7,821	NA
	E025SB015	025SB01501	8/28/97	1,450	=				
	E025SB016	025SB01601	8/28/97	5,840	=				
	E025SB017	025SB01701	8/28/97	5,040	=				
	E025SB018	025SB01801	8/28/97	5,510	=				
	E025SB019	025SB01901	8/28/97	5,980	=				
	E025SB020	025SB02001	8/28/97	730	=				
	E025SB021	025SB02101	8/28/97	4,390	=				
	E025SB022	025SB02201	8/28/97	6,220	=				
	E025SB023	025SB02301	8/28/97	5,120	=				
	E025SB024	025SB02401	8/28/97	5,480	=				
	E025SB025	025SB02501	8/28/97	2,160	=				
	E025SB026	025SB02601	8/28/97	5,390	=				
	E025SB027	025SB02701	8/28/97	1,010	=				
Antimony	E025SB014	025SB01401	8/28/97	**47.2**	=	0.5	7.4	3.1	2.5
	E025SB015	025SB01501	8/28/97	**19**	=				
	E025SB016	025SB01601	8/28/97	4.0	=				
	E025SB017	025SB01701	8/28/97	**14**	=				

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Antimony	E025SB018	025SB01801	8/28/97	1.1	=	0.5	7.4	3.1	2.5
	E025SB019	025SB01901	8/28/97	4.8	=				
	E025SB020	025SB02001	8/28/97	**23**	=				
	E025SB021	025SB02101	8/28/97	2.1	=				
	E025SB022	025SB02201	8/28/97	**40**	=				
	E025SB023	025SB02301	8/28/97	1.7	=				
	E025SB024	025SB02401	8/28/97	0.54	J				
	E025SB026	025SB02601	8/28/97	0.33	J				
	E025SB027	025SB02701	8/28/97	7.3	=				
Arsenic	E025SB014	025SB01401	8/28/97	1.89	=	0.95	68	0.43	14.5
	E025SB015	025SB01501	8/28/97	0.90	J				
	E025SB016	025SB01601	8/28/97	2.8	=				
	E025SB017	025SB01701	8/28/97	1.6	=				
	E025SB018	025SB01801	8/28/97	2.1	=				
	E025SB019	025SB01901	8/28/97	2.2	=				
	E025SB020	025SB02001	8/28/97	0.65	J				
	E025SB021	025SB02101	8/28/97	1.3	=				
	E025SB022	025SB02201	8/28/97	3.1	=				

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Arsenic	E025SB023	025SB02301	8/28/97	1.6	=	0.95	68	0.43	14.5
	E025SB024	025SB02401	8/28/97	2.9	=				
	E025SB025	025SB02501	8/28/97	1.9	=				
	E025SB026	025SB02601	8/28/97	2.2	=				
	E025SB027	025SB02701	8/28/97	1.4	=				
Barium	E025SB014	025SB01401	8/28/97	64.8	=	1.8	1,980	548	800
	E025SB015	025SB01501	8/28/97	17	=				
	E025SB016	025SB01601	8/28/97	34	=				
	E025SB017	025SB01701	8/28/97	27	=				
	E025SB018	025SB01801	8/28/97	35	=				
	E025SB019	025SB01901	8/28/97	26	=				
	E025SB020	025SB02001	8/28/97	1,160	=				
	E025SB021	025SB02101	8/28/97	21	=				
	E025SB022	025SB02201	8/28/97	53	=				
	E025SB023	025SB02301	8/28/97	37	=				
	E025SB024	025SB02401	8/28/97	35	=				
	E025SB025	025SB02501	8/28/97	26	=				
	E025SB026	025SB02601	8/28/97	26	=				

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RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Barium	E025SB027	025SB02701	8/28/97	19	=	1.8	1,980	548	800
Beryllium	E025SB014	025SB01401	8/28/97	0.152	J	0.13	1.6	16	31.5
	E025SB015	025SB01501	8/28/97	0.045	J				
	E025SB016	025SB01601	8/28/97	0.23	J				
	E025SB017	025SB01701	8/28/97	0.18	J				
	E025SB018	025SB01801	8/28/97	0.21	J				
	E025SB019	025SB01901	8/28/97	0.21	J				
	E025SB020	025SB02001	8/28/97	0.024	J				
	E025SB021	025SB02101	8/28/97	0.17	J				
	E025SB022	025SB02201	8/28/97	0.21	J				
	E025SB023	025SB02301	8/28/97	0.19	J				
	E025SB024	025SB02401	8/28/97	0.21	J				
	E025SB025	025SB02501	8/28/97	0.10	J				
	E025SB026	025SB02601	8/28/97	0.022	J				
	E025SB027	025SB02701	8/28/97	0.025	J				
Cadmium	E025SB014	025SB01401	8/28/97	0.566	=	0.06	1.5	7.8	4
	E025SB015	025SB01501	8/28/97	0.40	J				
	E025SB016	025SB01601	8/28/97	**6.4**	=				

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RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Cadmium	E025SB017	025SB01701	8/28/97	**6.9**	=	0.06	1.5	7.8	4
	E025SB018	025SB01801	8/28/97	**4.1**	=				
	E025SB019	025SB01901	8/28/97	0.57	=				
	E025SB020	025SB02001	8/28/97	**73**	=				
	E025SB021	025SB02101	8/28/97	0.41	J				
	E025SB022	025SB02201	8/28/97	**6.8**	=				
	E025SB023	025SB02301	8/28/97	**243**	=				
	E025SB024	025SB02401	8/28/97	1.7	=				
	E025SB025	025SB02501	8/28/97	**8.0**	=				
	E025SB026	025SB02601	8/28/97	**15**	=				
	E025SB027	025SB02701	8/28/97	**17**	=				
Chromium (Hexavalent)	E025SB015	025SB01501	8/28/97	**411**	=	NA	NA	23	19
	E025SB016	025SB01601	8/28/97	**46**	=				
	E025SB017	025SB01701	8/28/97	**463**	=				
	E025SB018	025SB01801	8/28/97	0.88	=				
	E025SB019	025SB01901	8/28/97	**201**	=				

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Chromium (Hexavalent)	E025SB020	025SB02001	8/28/97	**906**	=	NA	NA	23	19
	E025SB021	025SB02101	8/28/97	1.6	=				
	E025SB022	025SB02201	8/28/97	**708**	=				
	E025SB023	025SB02301	8/28/97	0.12	J				
	E025SB026	025SB02601	8/28/97	0.043	J				
	E025SB027	025SB02701	8/28/97	0.22	=				
Chromium, Total	E025SB014	025SB01401	8/28/97	**6,880**	=	2.3	567	23	19
	E025SB015	025SB01501	8/28/97	**1,620**	=				
	E025SB016	025SB01601	8/28/97	452	=				
	E025SB017	025SB01701	8/28/97	**2,010**	=				
	E025SB018	025SB01801	8/28/97	93	=				
	E025SB019	025SB01901	8/28/97	**693**	=				
	E025SB020	025SB02001	8/28/97	**2,420**	=				
	E025SB021	025SB02101	8/28/97	274	=				
	E025SB022	025SB02201	8/28/97	**5,530**	=				
	E025SB023	025SB02301	8/28/97	137	=				

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Chromium, Total	E025SB024	025SB02401	8/28/97	38	=	2.3	567	23	19
	E025SB025	025SB02501	8/28/97	35	=				
	E025SB026	025SB02601	8/28/97	18	=				
	E025SB027	025SB02701	8/28/97	64	=				
Cobalt	E025SB014	025SB01401	8/28/97	1.83	=	0.35	111	469	NA
	E025SB015	025SB01501	8/28/97	0.53	J				
	E025SB016	025SB01601	8/28/97	0.98	=				
	E025SB017	025SB01701	8/28/97	1.5	=				
	E025SB018	025SB01801	8/28/97	0.68	J				
	E025SB019	025SB01901	8/28/97	0.89	J				
	E025SB020	025SB02001	8/28/97	1.6	=				
	E025SB021	025SB02101	8/28/97	0.47	J				
	E025SB022	025SB02201	8/28/97	2.2	=				
	E025SB023	025SB02301	8/28/97	1.0	=				
	E025SB024	025SB02401	8/28/97	0.90	J				
	E025SB025	025SB02501	8/28/97	0.26	J				
	E025SB026	025SB02601	8/28/97	0.58	J				
	E025SB027	025SB02701	8/28/97	0.25	J				

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Concentration Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Copper	E025SB014	025SB01401	8/28/97	85	=	0.47	866	313	
	E025SB015	025SB01501	8/28/97	22	=				
	E025SB016	025SB01601	8/28/97	76	=				
	E025SB017	025SB01701	8/28/97	89	=				
	E025SB018	025SB01801	8/28/97	41	=				
	E025SB019	025SB01901	8/28/97	21	=				
	E025SB020	025SB02001	8/28/97	150	=				
	E025SB021	025SB02101	8/28/97	22	=				
	E025SB022	025SB02201	8/28/97	210	=				
	E025SB023	025SB02301	8/28/97	494	=				
	E025SB024	025SB02401	8/28/97	59	=				
	E025SB025	025SB02501	8/28/97	56	=				
	E025SB026	025SB02601	8/28/97	69	=				
	E025SB027	025SB02701	8/28/97	172	=				
Cyanide	E025SB014	025SB01401	8/28/97	0.177	J	NA	NA	156[c]	20
	E025SB016	025SB01601	8/28/97	11	=				
	E025SB019	025SB01901	8/28/97	0.10	J				
	E025SB021	025SB02101	8/28/97	0.17	J				

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Concentration Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (Hi=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Cyanide	E025SB022	025SB02201	8/28/97	0.80	=	NA	NA	156[c]	20
	E025SB023	025SB02301	8/28/97	8.4	=				
	E025SB024	025SB02401	8/28/97	0.80	=				
	E025SB025	025SB02501	8/28/97	3.1	=				
	E025SB026	025SB02601	8/28/97	0.42	J				
	E025SB027	025SB02701	8/28/97	0.96	=				
Iron	E025SB014	025SB01401	8/28/97	5,260	=	1,050	30,600	2,346	NA[d]
	E025SB015	025SB01501	8/28/97	1,870	=				
	E025SB016	025SB01601	8/28/97	5,800	=				
	E025SB017	025SB01701	8/28/97	4,800	=				
	E025SB018	025SB01801	8/28/97	3,870	=				
	E025SB019	025SB01901	8/28/97	5,040	=				
	E025SB020	025SB02001	8/28/97	4,970	=				
	E025SB021	025SB02101	8/28/97	2,740	=				
	E025SB022	025SB02201	8/28/97	8,170	=				
	E025SB023	025SB02301	8/28/97	5,540	=				
	E025SB024	025SB02401	8/28/97	5,520	=				
	E025SB025	025SB02501	8/28/97	2,320	=				

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Iron	E025SB026	025SB02601	8/28/97	4,000	=	1,050	30,600	2,346	NA[d]
	E025SB027	025SB02701	8/28/97	2,510	=				
Lead	E025SB014	025SB01401	8/28/97	252	=	1	400	400	400
	E025SB015	025SB01501	8/28/97	**550**	=				
	E025SB016	025SB01601	8/28/97	95	=				
	E025SB017	025SB01701	8/28/97	77	=				
	E025SB018	025SB01801	8/28/97	83	=				
	E025SB019	025SB01901	8/28/97	65	=				
	E025SB020	025SB02001	8/28/97	**4,890**	=				
	E025SB021	025SB02101	8/28/97	30	=				
	E025SB022	025SB02201	8/28/97	**1,090**	=				
	E025SB023	025SB02301	8/28/97	**917**	=				
	E025SB024	025SB02401	8/28/97	113	=				
	E025SB025	025SB02501	8/28/97	105	=				
	E025SB026	025SB02601	8/28/97	125	=				
	E025SB027	025SB02701	8/28/97	264	=				
Manganese	E025SB014	025SB01401	8/28/97	39	=	0.93	508	156	NA[d]

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Manganese	E025SB015	025SB01501	8/28/97	7.2	=	0.93	508	156	NA[d]
	E025SB016	025SB01601	8/28/97	43	=				
	E025SB017	025SB01701	8/28/97	60	=				
	E025SB018	025SB01801	8/28/97	42	=				
	E025SB019	025SB01901	8/28/97	49	=				
	E025SB020	025SB02001	8/28/97	48	=				
	E025SB021	025SB02101	8/28/97	36	=				
	E025SB022	025SB02201	8/28/97	71	=				
	E025SB023	025SB02301	8/28/97	483	=				
	E025SB024	025SB02401	8/28/97	234	=				
	E025SB025	025SB02501	8/28/97	27	=				
	E025SB026	025SB02601	8/28/97	63	=				
	E025SB027	025SB02701	8/28/97	14	=				
Mercury	E025SB014	025SB01401	8/28/97	0.641	=	0.03	2.7	2.3	1
	E025SB015	025SB01501	8/28/97	0.089	=				
	E025SB016	025SB01601	8/28/97	0.23	=				
	E025SB017	025SB01701	8/28/97	0.28	=				
	E025SB018	025SB01801	8/28/97	0.19	=				

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Mercury	E025SB019	025SB01901	8/28/97	0.23	=	0.03	2.7	2.3	1
	E025SB020	025SB02001	8/28/97	0.035	=				
	E025SB021	025SB02101	8/28/97	0.088	=				
	E025SB022	025SB02201	8/28/97	0.89	=				
	E025SB023	025SB02301	8/28/97	0.14	=				
	E025SB024	025SB02401	8/28/97	0.14	=				
	E025SB025	025SB02501	8/28/97	0.23	=				
	E025SB026	025SB02601	8/28/97	0.73	=				
	E025SB027	025SB02701	8/28/97	0.060	=				
Nickel	E025SB014	025SB01401	8/28/97	32.3	=	0.6	72	156	65
	E025SB015	025SB01501	8/28/97	2.8	=				
	E025SB016	025SB01601	8/28/97	29	=				
	E025SB017	025SB01701	8/28/97	24	=				
	E025SB018	025SB01801	8/28/97	8.4	=				
	E025SB019	025SB01901	8/28/97	5.5	=				
	E025SB020	025SB02001	8/28/97	**260**	=				
	E025SB021	025SB02101	8/28/97	3.3	=				
	E025SB022	025SB02201	8/28/97	27	=				

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Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Nickel	E025SB023	025SB02301	8/28/97	**244**	=	0.6	72	156	65
	E025SB024	025SB02401	8/28/97	9.8	=				
	E025SB025	025SB02501	8/28/97	5.0	=				
	E025SB026	025SB02601	8/28/97	19	=				
	E025SB027	025SB02701	8/28/97	34	=				
Selenium	E025SB018	025SB01801	8/28/97	0.29	J	0.57	4.0	39	2.5
	E025SB020	025SB02001	8/28/97	0.42	J				
	E025SB023	025SB02301	8/28/97	0.44	J				
	E025SB024	025SB02401	8/28/97	0.27	J				
	E025SB026	025SB02601	8/28/97	0.35	J				
Silver	E025SB014	025SB01401	8/28/97	0.393	J	0.75	0.91	39	17
	E025SB015	025SB01501	8/28/97	2.1	=				
	E025SB016	025SB01601	8/28/97	1.5	=				
	E025SB017	025SB01701	8/28/97	0.47	J				
	E025SB018	025SB01801	8/28/97	2.9	=				
	E025SB019	025SB01901	8/28/97	0.17	J				
	E025SB020	025SB02001	8/28/97	**24**	=				

APPENDIX C-1
Detected Compounds in Surface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Silver	E025SB021	025SB02101	8/28/97	0.34	J	0.75	0.91	39	17
	E025SB022	025SB02201	8/28/97	1.8	=				
	E025SB023	025SB02301	8/28/97	4.4	=				
	E025SB024	025SB02401	8/28/97	1.8	=				
	E025SB025	025SB02501	8/28/97	3.5	=				
	E025SB026	025SB02601	8/28/97	0.91	J				
	E025SB027	025SB02701	8/28/97	11	=				
Thallium	E025SB014	025SB01401	8/28/97	0.452	J	0.61	2.8	0.55	0.35
	E025SB023	025SB02301	8/28/97	1.1	=				
	E025SB024	025SB02401	8/28/97	0.76	J				
Tin	E025SB014	025SB01401	8/28/97	12.1	=	0.77	45	4,693	NA
	E025SB015	025SB01501	8/28/97	195	=				
	E025SB016	025SB01601	8/28/97	9.4	=				
	E025SB017	025SB01701	8/28/97	8.8	=				
	E025SB018	025SB01801	8/28/97	4.5	=				
	E025SB019	025SB01901	8/28/97	4.2	=				
	E025SB020	025SB02001	8/28/97	1,160	=				
	E025SB021	025SB02101	8/28/97	2.7	=				

APPENDIX C-1
Detected Compounds in Surface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Concentration Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Tin	E025SB022	025SB02201	8/28/97	57	=	0.77	45	4,693	NA
	E025SB023	025SB02301	8/28/97	28	=				
	E025SB024	025SB02401	8/28/97	4.1	=				
	E025SB025	025SB02501	8/28/97	1.9	J				
	E025SB026	025SB02601	8/28/97	7.9	=				
	E025SB027	025SB02701	8/28/97	221	=				
Vanadium	E025SB014	025SB01401	8/28/97	7.93	=	1.1	60	55	3,000
	E025SB015	025SB01501	8/28/97	3.8	=				
	E025SB016	025SB01601	8/28/97	8.8	=				
	E025SB017	025SB01701	8/28/97	6.7	=				
	E025SB018	025SB01801	8/28/97	6.5	=				
	E025SB019	025SB01901	8/28/97	9.0	=				
	E025SB020	025SB02001	8/28/97	3.9	=				
	E025SB021	025SB02101	8/28/97	4.4	=				
	E025SB022	025SB02201	8/28/97	10	=				
	E025SB023	025SB02301	8/28/97	5.2	=				
	E025SB024	025SB02401	8/28/97	7.4	=				
	E025SB025	025SB02501	8/28/97	3.6	=				

APPENDIX C-1
Detected Compounds in Surface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Concentration Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]
Vanadium	E025SB026	025SB02601	8/28/97	5.5	=	1.1	60	55	3,000
	E025SB027	025SB02701	8/28/97	2.0	=				
Zinc	E025SB014	025SB01401	8/28/97	93.6	=	1.9	855	2,346	6,000
	E025SB015	025SB01501	8/28/97	17	=				
	E025SB016	025SB01601	8/28/97	286	=				
	E025SB017	025SB01701	8/28/97	535	=				
	E025SB018	025SB01801	8/28/97	119	=				
	E025SB019	025SB01901	8/28/97	94	=				
	E025SB020	025SB02001	8/28/97	102	=				
	E025SB021	025SB02101	8/28/97	177	=				
	E025SB022	025SB02201	8/28/97	410	=				
	E025SB023	025SB02301	8/28/97	547	=				
	E025SB024	025SB02401	8/28/97	113	=				
	E025SB025	025SB02501	8/28/97	100	=				
	E025SB026	025SB02601	8/28/97	144	=				
	E025SB027	025SB02701	8/28/97	99	=				

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

Values that exceed screening criterion(a) are in bold and outlined within the table.

[a] Hazard Index (HI) reduced by one order of magnitude for non-carcinogenic compounds.

APPENDIX C-1
Detected Compounds in Surface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Background Range Min	Background Range Max	EPA Region II RBC (HI=0.1)[a]	SSL (DAF=10) (VOCs DAF=1)[b]

[b] Soil Screening Level (SSL) adjusted to a Dilution Attenuation Factor (DAF) of 10 (DAF=1 for VOCs).

[c] Free cyanide (CAS 57125) used as surrogate screening value.

[d] Nutritionally essential element.

= indicates that the compound was detected, the reported value is equal to the sample concentration.

J indicates that the compound was detected, the reported concentration is estimated.

NA Not available/not applicable

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Aluminum	E025SB014	025SB01402	8/28/97	2,460	=	1,220	29,900	NA
	E025SB015	025SB01502	8/28/97	4,520	=			
	E025SB016	025SB01602	8/28/97	4,910	=			
	E025SB017	025SB01702	8/28/97	5,670	=			
	E025SB018	025SB01802	8/28/97	5,330	=			
	E025SB019	025SB01902	8/28/97	5,570	=			
	E025SB020	025SB02002	8/28/97	7,360	=			
	E025SB021	025SB02102	8/28/97	4,730	=			
	E025SB022	025SB02202	8/28/97	2,360	=			
	E025SB023	025SB02302	8/28/97	1,720	=			
	E025SB024	025SB02402	8/28/97	5,410	=			
	E025SB025	025SB02502	8/28/97	3,870	=			
	E025SB026	025SB02602	8/28/97	2,410	=			
	E025SB027	025SB02702	8/28/97	207	=			
Antimony	E025SB014	025SB01402	8/28/97	**27.8**	=	0.52	1.6	2.5
	E025SB015	025SB01502	8/28/97	**28**	=			
	E025SB016	025SB01602	8/28/97	**26**	=			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Antimony	E025SB017	025SB01702	8/28/97	**121**	=	0.52	1.6	2.5
	E025SB018	025SB01802	8/28/97	**5.2**	=			
	E025SB019	025SB01902	8/28/97	2.0	=			
	E025SB020	025SB02002	8/28/97	**12**	=			
	E025SB021	025SB02102	8/28/97	2.0	=			
	E025SB022	025SB02202	8/28/97	**7.0**	=			
	E025SB024	025SB02402	8/28/97	0.26	J			
	E025SB025	025SB02502	8/28/97	**4.6**	=			
	E025SB026	025SB02602	8/28/97	0.21	J			
	E025SB027	025SB02702	8/28/97	2.4	=			
Arsenic	E025SB014	025SB01402	8/28/97	1.34	=	0.83	26	15
	E025SB015	025SB01502	8/28/97	1.6	=			
	E025SB016	025SB01602	8/28/97	0.54	J			
	E025SB017	025SB01702	8/28/97	0.44	J			
	E025SB018	025SB01802	8/28/97	1.0	=			
	E025SB019	025SB01902	8/28/97	1.6	=			
	E025SB020	025SB02002	8/28/97	0.67	J			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Arsenic	E025SB021	025SB02102	8/28/97	1.5	=	0.83	26	15
	E025SB022	025SB02202	8/28/97	0.48	J			
	E025SB023	025SB02302	8/28/97	0.53	J			
	E025SB024	025SB02402	8/28/97	1.1	=			
	E025SB025	025SB02502	8/28/97	1.0	=			
	E025SB026	025SB02602	8/28/97	0.67	J			
	E025SB027	025SB02702	8/28/97	0.45	J			
Barium	E025SB014	025SB01402	8/28/97	44.3	=	6.1	91	800
	E025SB015	025SB01502	8/28/97	32	=			
	E025SB016	025SB01602	8/28/97	18	=			
	E025SB017	025SB01702	8/28/97	22	=			
	E025SB018	025SB01802	8/28/97	23	=			
	E025SB019	025SB01902	8/28/97	19	=			
	E025SB020	025SB02002	8/28/97	465	=			
	E025SB021	025SB02102	8/28/97	25	=			
	E025SB022	025SB02202	8/28/97	14	=			
	E025SB023	025SB02302	8/28/97	9.6	=			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Barium	E025SB024	025SB02402	8/28/97	23	=	6.1	91	800
	E025SB025	025SB02502	8/28/97	13	=			
	E025SB026	025SB02602	8/28/97	12	=			
	E025SB027	025SB02702	8/28/97	6.0	=			
Beryllium	E025SB014	025SB01402	8/28/97	0.08	J	0.15	1.6	32
	E025SB015	025SB01502	8/28/97	0.12	J			
	E025SB016	025SB01602	8/28/97	0.21	J			
	E025SB017	025SB01702	8/28/97	0.21	J			
	E025SB018	025SB01802	8/28/97	0.25	J			
	E025SB019	025SB01902	8/28/97	0.13	J			
	E025SB020	025SB02002	8/28/97	0.022	J			
	E025SB021	025SB02102	8/28/97	0.18	J			
	E025SB022	025SB02202	8/28/97	0.049	J			
	E025SB023	025SB02302	8/28/97	0.064	J			
	E025SB024	025SB02402	8/28/97	0.27	J			
	E025SB025	025SB02502	8/28/97	0.11	J			
	E025SB026	025SB02602	8/28/97	0.088	J			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Cadmium	E025SB014	025SB01402	8/28/97	0.09	J	0.13	0.96	4.0
	E025SB016	025SB01602	8/28/97	0.61	=			
	E025SB017	025SB01702	8/28/97	1.9	=			
	E025SB018	025SB01802	8/28/97	1.6	=			
	E025SB019	025SB01902	8/28/97	0.056	J			
	E025SB020	025SB02002	8/28/97	**22**	=			
	E025SB021	025SB02102	8/28/97	1.6	=			
	E025SB022	025SB02202	8/28/97	0.62	J			
	E025SB023	025SB02302	8/28/97	**12**	=			
	E025SB024	025SB02402	8/28/97	**74**	=			
	E025SB025	025SB02502	8/28/97	**55**	=			
	E025SB026	025SB02602	8/28/97	2.9	=			
	E025SB027	025SB02702	8/28/97	2.5	=			
Chromium (Hexavalent)	E025SB014	025SB01402	8/28/97	**270**	=	NA	NA	19
	E025SB015	025SB01502	8/28/97	**1,260**	=			
	E025SB016	025SB01602	8/28/97	**562**	=			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Chromium (Hexavalent)	E025SB017	025SB01702	8/28/97	1.3	=	NA	NA	19
	E025SB018	025SB01802	8/28/97	5.6	=			
	E025SB019	025SB01902	8/28/97	**111**	=			
	E025SB020	025SB02002	8/28/97	**261**	=			
	E025SB021	025SB02102	8/28/97	0.98	=			
	E025SB022	025SB02202	8/28/97	**89**	=			
	E025SB024	025SB02402	8/28/97	0.14	J			
	E025SB027	025SB02702	8/28/97	0.11	J			
Chromium, Total	E025SB014	025SB01402	8/28/97	**3,880**	=	1.6	75	19
	E025SB015	025SB01502	8/28/97	**4,050**	=			
	E025SB016	025SB01602	8/28/97	**3,850**	=			
	E025SB017	025SB01702	8/28/97	**18,600**	=			
	E025SB018	025SB01802	8/28/97	**752**	=			
	E025SB019	025SB01902	8/28/97	**296**	=			
	E025SB020	025SB02002	8/28/97	**1,320**	=			
	E025SB021	025SB02102	8/28/97	**253**	=			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Chromium, Total	E025SB022	025SB02202	8/28/97	**804**	=	1.6	75	19
	E025SB023	025SB02302	8/28/97	6.5	=			
	E025SB024	025SB02402	8/28/97	54	=			
	E025SB025	025SB02502	8/28/97	**372**	=			
	E025SB026	025SB02602	8/28/97	13	=			
	E025SB027	025SB02702	8/28/97	26	=			
Cobalt	E025SB014	025SB01402	8/28/97	1.2	=	0.41	15	NA
	E025SB015	025SB01502	8/28/97	1.1	=			
	E025SB016	025SB01602	8/28/97	0.99	=			
	E025SB017	025SB01702	8/28/97	3.3	=			
	E025SB018	025SB01802	8/28/97	0.82	J			
	E025SB019	025SB01902	8/28/97	0.46	J			
	E025SB020	025SB02002	8/28/97	0.82	J			
	E025SB021	025SB02102	8/28/97	0.62	J			
	E025SB022	025SB02202	8/28/97	0.32	J			
	E025SB023	025SB02302	8/28/97	0.35	J			
	E025SB024	025SB02402	8/28/97	0.39	J			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Cobalt	E025SB025	025SB02502	8/28/97	0.54	J	0.41	15	NA
	E025SB026	025SB02602	8/28/97	0.25	J			
Copper	E025SB014	025SB01402	8/28/97	44.6	=	1.3	192	NA
	E025SB015	025SB01502	8/28/97	14	=			
	E025SB016	025SB01602	8/28/97	48	=			
	E025SB017	025SB01702	8/28/97	136	=			
	E025SB018	025SB01802	8/28/97	65	=			
	E025SB019	025SB01902	8/28/97	5.2	=			
	E025SB020	025SB02002	8/28/97	83	=			
	E025SB021	025SB02102	8/28/97	50	=			
	E025SB022	025SB02202	8/28/97	11	=			
	E025SB023	025SB02302	8/28/97	27	=			
	E025SB024	025SB02402	8/28/97	4.3	=			
	E025SB025	025SB02502	8/28/97	97	=			
	E025SB026	025SB02602	8/28/97	20	=			
	E025SB027	025SB02702	8/28/97	10	=			
Cyanide	E025SB014	025SB01402	8/28/97	0.13	J	NA	NA	20

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Cyanide	E025SB016	025SB01602	8/28/97	0.15	J	NA	NA	20
	E025SB017	025SB01702	8/28/97	0.22	J			
	E025SB021	025SB02102	8/28/97	0.93	=			
	E025SB022	025SB02202	8/28/97	0.11	J			
	E025SB023	025SB02302	8/28/97	0.87	=			
	E025SB024	025SB02402	8/28/97	0.82	=			
	E025SB025	025SB02502	8/28/97	13	=			
	E025SB026	025SB02602	8/28/97	0.34	J			
Iron	E025SB014	025SB01402	8/28/97	6,190	=	924	35,800	NA
	E025SB015	025SB01502	8/28/97	5,180	=			
	E025SB016	025SB01602	8/28/97	2,550	=			
	E025SB017	025SB01702	8/28/97	3,690	=			
	E025SB018	025SB01802	8/28/97	2,830	=			
	E025SB019	025SB01902	8/28/97	5,360	=			
	E025SB020	025SB02002	8/28/97	3,000	=			
	E025SB021	025SB02102	8/28/97	3,360	=			
	E025SB022	025SB02202	8/28/97	2,520	=			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Iron	E025SB023	025SB02302	8/28/97	1,610	=	924	35,800	NA
	E025SB024	025SB02402	8/28/97	2,550	=			
	E025SB025	025SB02502	8/28/97	2,540	=			
	E025SB026	025SB02602	8/28/97	1,760	=			
	E025SB027	025SB02702	8/28/97	348	=			
Lead	E025SB014	025SB01402	8/28/97	279	=	1.8	322	400
	E025SB015	025SB01502	8/28/97	14	=			
	E025SB016	025SB01602	8/28/97	9.5	=			
	E025SB017	025SB01702	8/28/97	31	=			
	E025SB018	025SB01802	8/28/97	18	=			
	E025SB019	025SB01902	8/28/97	11	=			
	E025SB020	025SB02002	8/28/97	**1,910**	=			
	E025SB021	025SB02102	8/28/97	54	=			
	E025SB022	025SB02202	8/28/97	46	=			
	E025SB023	025SB02302	8/28/97	6.9	=			
	E025SB024	025SB02402	8/28/97	6.3	=			
	E025SB025	025SB02502	8/28/97	2.2	=			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Lead	E025SB026	025SB02602	8/28/97	12	=	1.8	322	400
	E025SB027	025SB02702	8/28/97	32	=			
Manganese	E025SB014	025SB01402	8/28/97	41	=	4.9	625	NA
	E025SB015	025SB01502	8/28/97	35	=			
	E025SB016	025SB01602	8/28/97	54	=			
	E025SB017	025SB01702	8/28/97	60	=			
	E025SB018	025SB01802	8/28/97	54	=			
	E025SB019	025SB01902	8/28/97	17	=			
	E025SB020	025SB02002	8/28/97	21	=			
	E025SB021	025SB02102	8/28/97	43	=			
	E025SB022	025SB02202	8/28/97	9.5	=			
	E025SB023	025SB02302	8/28/97	33	=			
	E025SB024	025SB02402	8/28/97	80	=			
	E025SB025	025SB02502	8/28/97	93	=			
	E025SB026	025SB02602	8/28/97	20	=			
	E025SB027	025SB02702	8/28/97	1.6	=			
Mercury	E025SB015	025SB01502	8/28/97	0.038	=	0.040	0.90	1.0

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Mercury	E025SB016	025SB01602	8/28/97	0.11	=	0.040	0.90	1.0
	E025SB017	025SB01702	8/28/97	0.34	=			
	E025SB018	025SB01802	8/28/97	0.50	=			
	E025SB019	025SB01902	8/28/97	0.039	=			
	E025SB020	025SB02002	8/28/97	0.031	=			
	E025SB021	025SB02102	8/28/97	0.18	=			
	E025SB022	025SB02202	8/28/97	0.018	J			
	E025SB023	025SB02302	8/28/97	0.083	=			
	E025SB024	025SB02402	8/28/97	0.076	=			
	E025SB025	025SB02502	8/28/97	0.054	=			
	E025SB026	025SB02602	8/28/97	0.087	=			
Nickel	E025SB014	025SB01402	8/28/97	3.0	=	0.85	20	65
	E025SB015	025SB01502	8/28/97	2.3	=			
	E025SB016	025SB01602	8/28/97	8.3	=			
	E025SB017	025SB01702	8/28/97	6.4	=			
	E025SB018	025SB01802	8/28/97	11	=			
	E025SB019	025SB01902	8/28/97	2.2	=			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Nickel	E025SB020	025SB02002	8/28/97	**121**	=	0.85	20	65
	E025SB021	025SB02102	8/28/97	8.3	=			
	E025SB022	025SB02202	8/28/97	1.8	=			
	E025SB023	025SB02302	8/28/97	7.4	=			
	E025SB024	025SB02402	8/28/97	**114**	=			
	E025SB025	025SB02502	8/28/97	**67**	=			
	E025SB026	025SB02602	8/28/97	11	=			
	E025SB027	025SB02702	8/28/97	3.8	=			
Silver	E025SB014	025SB01402	8/28/97	0.5	J	NA	NA	17
	E025SB015	025SB01502	8/28/97	2.9	=			
	E025SB016	025SB01602	8/28/97	0.092	J			
	E025SB017	025SB01702	8/28/97	0.43	J			
	E025SB018	025SB01802	8/28/97	0.60	J			
	E025SB019	025SB01902	8/28/97	0.29	J			
	E025SB020	025SB02002	8/28/97	12	=			
	E025SB021	025SB02102	8/28/97	3.1	=			
	E025SB022	025SB02202	8/28/97	0.60	J			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Silver	E025SB023	025SB02302	8/28/97	5.0	=	NA	NA	17
	E025SB024	025SB02402	8/28/97	0.76	J			
	E025SB025	025SB02502	8/28/97	2.2	=			
	E025SB026	025SB02602	8/28/97	1.4	=			
	E025SB027	025SB02702	8/28/97	2.9	=			
Thallium	E025SB017	025SB01702	8/28/97	**0.86**	J	NA	NA	0.35
Tin	E025SB014	025SB01402	8/28/97	20	=	2.8	24	NA
	E025SB015	025SB01502	8/28/97	6.1	=			
	E025SB016	025SB01602	8/28/97	0.82	J			
	E025SB017	025SB01702	8/28/97	4.1	=			
	E025SB018	025SB01802	8/28/97	1.2	J			
	E025SB019	025SB01902	8/28/97	1.1	J			
	E025SB020	025SB02002	8/28/97	414	=			
	E025SB021	025SB02102	8/28/97	5.3	=			
	E025SB022	025SB02202	8/28/97	18	=			
	E025SB023	025SB02302	8/28/97	1.2	J			
	E025SB024	025SB02402	8/28/97	0.90	J			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Tin	E025SB025	025SB02502	8/28/97	1.1	J	2.8	24	NA
	E025SB026	025SB02602	8/28/97	2.0	J			
	E025SB027	025SB02702	8/28/97	15	=			
Vanadium	E025SB014	025SB01402	8/28/97	12	=	1.6	71	3,000
	E025SB015	025SB01502	8/28/97	13	=			
	E025SB016	025SB01602	8/28/97	4.1	=			
	E025SB017	025SB01702	8/28/97	6.7	=			
	E025SB018	025SB01802	8/28/97	4.5	=			
	E025SB019	025SB01902	8/28/97	12	=			
	E025SB020	025SB02002	8/28/97	3.0	=			
	E025SB021	025SB02102	8/28/97	5.0	=			
	E025SB022	025SB02202	8/28/97	4.6	=			
	E025SB023	025SB02302	8/28/97	2.1	=			
	E025SB024	025SB02402	8/28/97	3.7	=			
	E025SB025	025SB02502	8/28/97	4.4	=			
	E025SB026	025SB02602	8/28/97	2.7	=			
	E025SB027	025SB02702	8/28/97	0.59	J			

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]
Zinc	E025SB014	025SB01402	8/28/97	36.5	=	5.8	438	6,000
	E025SB015	025SB01502	8/28/97	8.4	=			
	E025SB016	025SB01602	8/28/97	38	=			
	E025SB017	025SB01702	8/28/97	113	=			
	E025SB018	025SB01802	8/28/97	20	=			
	E025SB019	025SB01902	8/28/97	25	=			
	E025SB020	025SB02002	8/28/97	45	=			
	E025SB021	025SB02102	8/28/97	169	=			
	E025SB022	025SB02202	8/28/97	14	=			
	E025SB023	025SB02302	8/28/97	40	=			
	E025SB024	025SB02402	8/28/97	109	=			
	E025SB025	025SB02502	8/28/97	57	=			
	E025SB026	025SB02602	8/28/97	27	=			
	E025SB027	025SB02702	8/28/97	7.9	=			

All values are presented in units of milligrams per kilogram (mg/kg).
Values that exceed screening criterion(a) are in bold and outlined within the table.
[a] Soil Screening Level (SSL) adjusted to a Dilution Attenuation Factor (DAF) of 10 (DAF=1 for VOCs).
= indicates that the compound was detected, the reported value is equal to the sample concentration.
J indicates that the compound was detected, the reported concentration is estimated.

APPENDIX C-2
Detected Compounds in Subsurface Soil Samples, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Location	Sample ID	Date Collected	Concentration (mg/kg)	Qualifier	Zone E Background Range Min	Zone E Background Range Max	SSL (DAF=10) (VOCs DAF=1)[a]

NA Not available/not applicable

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
1,2-DCE (total)	E025GW003	025GW00301a	03/02/98	4.0	SJ	NA	NA	70	5.5
	E025GW003	025GW00302	07/26/96	1.0	J				
	E025GW003	025GW00303	12/02/96	5.0	J				
	E025GW003	025GW00304	02/13/97	4.0	J				
	E070GW001	070GW00101a	02/26/98	10	S=				
	E070GW001	070GW00102	07/29/96	10	=				
	E070GW001	070GW00103	12/03/96	8.0	=				
	E070GW001	070GW00104	02/18/97	11	=				
	E070GW002	070GW00202	07/29/96	4.0	J				
	E070GW002	070GW00203	12/03/96	7.0	=				
	E070GW002	070GW00204	02/18/97	4.0	J				
	E549GW002	549GW00201a	03/03/98	10	S=				
	E549GW002	549GW00202	08/01/96	17	=				
	E549GW002	549GW00203	11/25/96	19	=				
	E549GW002	549GW00204	02/13/97	18	=				
	E549GW003	549GW00301a	02/26/98	21	S=				
	E549GW003	549GW00302	07/29/96	49	=				
	E549GW003	549GW00303	11/25/96	51	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
1,2-DCE (total)	E549GW003	549GW00304	02/14/97	57	=	NA	NA	70	5.5
Alpha-Chlordane	E025GW001	025GW00102	07/25/96	0.17	=	NA	NA	2.0	0.19
	E025GW001	025GW00103	12/02/96	0.15	=				
	E025GW001	025GW00104	02/14/97	0.14	J				
Aluminum	E025GW001	025GW00102	07/25/96	377	=	19	16,100	NA	3,650
	E025GW001	025GW00103	12/02/96	506	=				
	E025GW001	025GW00104	02/14/97	636	=				
	E025GW002	025GW00204	02/14/97	121	J				
	E025GW003	025GW00302	07/26/96	284	=				
	E025GW003	025GW00303	12/02/96	121	J				
	E025GW003	025GW00304	02/13/97	571	=				
	E025GW004	025GW00402	07/26/96	517	=				
	E025GW004	025GW00403	12/02/96	299	=				
	E025GW004	025GW00404	02/13/97	397	=				
	E070GW001	070GW00102	07/29/96	3,320	=				
	E070GW001	070GW00103	12/03/96	267	=				
	E070GW001	070GW00104	02/18/97	173	J				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration µg/L	Concentration Qualifier	Zone E Background Range Min	Zone E Background Range Max	MCL	EPA Region III RBC (HI=0.1)[a]
Aluminum	E070GW002	070GW00202	07/29/96	2,480	=	19	16,100	NA	3,650
	E070GW002	070GW00203	12/03/96	418	=				
	E070GW002	070GW00204	02/18/97	316	=				
	E549GW001	549GW00102	08/01/96	127	=				
	E549GW001	549GW00103	11/25/96	55	J				
	E549GW001	549GW00104	02/13/97	44	J				
	E549GW002	549GW00202	08/01/96	341	=				
	E549GW002	549GW00203	11/25/96	147	J				
	E549GW002	549GW00204	02/13/97	388	=				
	E549GW003	549GW00302	07/29/96	971	=				
	E549GW003	549GW00303	11/25/96	457	=				
	E549GW003	549GW00304	02/14/97	398	=				
Antimony	E025GW003	025GW00304	02/13/97	**13**	J	2.0	5.0	6.0	1.5
	E070GW001	070GW00102	07/29/96	**36**	J				
	E070GW001	070GW00104	02/18/97	**37**	J				
Arsenic	E025GW003	025GW00302	07/26/96	3.0	J	3.0	316	50	0.045
	E025GW003	025GW00304	02/13/97	3.0	J				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
Arsenic	E025GW004	025GW00404	02/13/97	2.8	J	3.0	316	50	0.045
	E070GW001	070GW00102	07/29/96	4.3	J				
	E070GW002	070GW00202	07/29/96	3.1	J				
	E549GW001	549GW00102	08/01/96	17	=				
	E549GW001	549GW00103	11/25/96	11	=				
	E549GW001	549GW00104	02/13/97	13	=				
	E549GW002	549GW00202	08/01/96	5.3	J				
	E549GW002	549GW00203	11/25/96	4.7	J				
	E549GW002	549GW00204	02/13/97	5.4	J				
Barium	E025GW001	025GW00102	07/25/96	22	=	6.0	398	2,000	256
	E025GW001	025GW00103	12/02/96	21	J				
	E025GW001	025GW00104	02/14/97	20	J				
	E025GW002	025GW00202	07/26/96	18	J				
	E025GW002	025GW00203	12/02/96	19	J				
	E025GW002	025GW00204	02/14/97	17	J				
	E025GW003	025GW00302	07/26/96	7.4	J				
	E025GW003	025GW00303	12/02/96	7.7	J				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
Barium	E025GW003	025GW00304	02/13/97	7.6	J	6.0	398	2,000	256
	E025GW004	025GW00402	07/26/96	7.3	J				
	E025GW004	025GW00403	12/02/96	7.5	J				
	E025GW004	025GW00404	02/13/97	6.5	J				
	E070GW001	070GW00102	07/29/96	27	=				
	E070GW001	070GW00103	12/03/96	15	J				
	E070GW001	070GW00104	02/18/97	15	J				
	E070GW002	070GW00202	07/29/96	14	=				
	E070GW002	070GW00203	12/03/96	9.8	J				
	E070GW002	070GW00204	02/18/97	8.1	J				
	E549GW001	549GW00102	08/01/96	10	=				
	E549GW001	549GW00103	11/25/96	9.7	J				
	E549GW001	549GW00104	02/13/97	9.1	J				
	E549GW002	549GW00202	08/01/96	14	=				
	E549GW002	549GW00203	11/25/96	13	J				
	E549GW002	549GW00204	02/13/97	14	J				
	E549GW003	549GW00302	07/29/96	34	=				
	E549GW003	549GW00303	11/25/96	28	J				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration µg/L	Concentration Qualifier	Zone E Background Range Min	Zone E Background Range Max	MCL	EPA Region III RBC (HI=0.1)[a]
Barium	E549GW003	549GW00304	02/14/97	30	J	6.0	398	2,000	256
Benzene	E549GW001	549GW00102	08/01/96	3.0	J	NA	NA	5.0	0.32
Benzoic Acid	E025GW004	025GW00402	07/26/96	1.0	J	NA	NA	NA	14,600
Beryllium	E070GW001	070GW00102	07/29/96	0.33	J	0.30	0.90	4.0	7.3
	E070GW002	070GW00202	07/29/96	0.32	J				
	E070GW002	070GW00203	12/03/96	0.32	J				
	E549GW003	549GW00302	07/29/96	0.32	J				
bis(2-Ethylhexyl) Phthalate	E070GW002	070GW00202	07/29/96	2.0	J	NA	NA	6.0	4.8
Bromodichloromethane	E025GW001	025GW00102a	10/09/98	1.0	SJ	NA	NA	80[b]	0.17
	E549GW002	549GW00202a	10/09/98	10	S=				
Cadmium	E025GW002	025GW00202	07/26/96	**6.4**	=	1.4	1.4	5.0	3.7
	E025GW002	025GW00203	12/02/96	**6.0**	=				
	E025GW002	025GW00204	02/14/97	4.5	J				
	E025GW003	025GW00302	07/26/96	**85**	=				
	E025GW003	025GW00303	12/02/96	**88**	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
Cadmium	E025GW003	025GW00304	02/13/97	**86**	=	1.4	1.4	5.0	3.7
	E025GW004	025GW00402	07/26/96	0.77	J				
	E025GW004	025GW00403	12/02/96	0.73	J				
	E025GW004	025GW00404	02/13/97	1.0	J				
	E070GW001	070GW00102	07/29/96	4.0	J				
	E070GW001	070GW00103	12/03/96	2.8	J				
	E070GW001	070GW00104	02/18/97	**5.6**	=				
	E070GW002	070GW00202	07/29/96	0.76	J				
	E070GW002	070GW00203	12/03/96	0.63	J				
	E070GW002	070GW00204	02/18/97	0.43	J				
Carbon Disulfide	E070GW001	070GW00102	07/29/96	1.0	J	NA	NA	NA	104
Chlorobenzene	E549GW001	549GW00102	08/01/96	34	=	NA	NA	100	11
	E549GW001	549GW00103	11/25/96	16	=				
	E549GW001	549GW00104	02/13/97	14	=				
Chloroform	E025GW001	025GW00101a	03/02/98	11	S=	NA	NA	80[b]	0.15
	E025GW001	025GW00102a	10/09/98	12	S=				
	E025GW002	025GW00201a	03/02/98	2.0	SJ				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration µg/L	Concentration Qualifier	Zone E Background Range Min	Zone E Background Range Max	MCL	EPA Region III RBC (HI=0.1)[a]
Chloroform	E549GW002	549GW00202a	10/09/98	36	S=	NA	NA	80[b]	0.15
Chromium (Hexavalent)	E025GW002	025GW002L1	04/06/01	**147**	=	NA	NA	100	11
	E025GW003	025GW003L1	04/06/01	**2,910**	J				
	E070GW001	025G700110	07/21/00	**2,300**	J				
	E070GW001	070GW001L1	04/05/01	**2,580**	J				
	E549GW003	025G549310	07/21/00	**180**	J				
Chromium, Total	E025GW001	025GW00102	07/25/96	16	=	0.80	31	100	11
	E025GW001	025GW00103	12/02/96	12	=				
	E025GW001	025GW00104	02/14/97	9.1	J				
	E025GW002	025GW00202	07/26/96	**192**	=				
	E025GW002	025GW00203	12/02/96	**159**	=				
	E025GW002	025GW00204	02/14/97	**119**	=				
	E025GW003	025GW00302	07/26/96	**1,200**	=				
	E025GW003	025GW00303	12/02/96	**3,260**	=				
	E025GW003	025GW00304	02/13/97	**1,550**	=				
	E025GW004	025GW00402	07/26/96	73	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration µg/L	Concentration Qualifier	Zone E Background Range Min	Zone E Background Range Max	MCL	EPA Region III RBC (HI=0.1)[a]
Chromium, Total	E025GW004	025GW00403	12/02/96	55	=	0.80	31	100	11
	E025GW004	025GW00404	02/13/97	43	=				
	E070GW001	070GW00102	07/29/96	**6,800**	=				
	E070GW001	070GW00103	12/03/96	**6,330**	=				
	E070GW001	070GW00104	02/18/97	**5,790**	=				
	E070GW002	070GW00202	07/29/96	**261**	=				
	E070GW002	070GW00203	12/03/96	**302**	=				
	E070GW002	070GW00204	02/18/97	**395**	=				
	E549GW002	549GW00204	02/13/97	1.6	J				
	E549GW003	549GW00302	07/29/96	**1,540**	=				
	E549GW003	549GW00303	11/25/96	**1,430**	=				
	E549GW003	549GW00304	02/14/97	**1,620**	=				
	E549GW003	549GW003F5	01/19/99	**426**	=				
	E549GW003	549GW003U5	01/19/99	**686**	=				
cis-1,2-DCE	E025GW002	025GW00202a	10/09/98	12	S=	NA	NA	70	6.1
	E025GW003	025GW00302a	10/09/98	2.0	SJ				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (Hi=0.1)[a]
				µg/L	Qualifier	Min	Max		
cis-1,2-DCE	E025GW003	025GW003L1	04/06/01	2.9	=	NA	NA	70	6.1
	E070GW001	070GW00102a	10/09/98	17	S=				
	E070GW001	070GW001L1	04/05/01	0.60	J				
	E070GW002	070GW00202a	10/09/98	1.0	SJ				
	E549GW002	549GW002L1	04/06/01	1.1	=				
	E549GW003	549GW00302a	10/09/98	13	S=				
	E549GW003	549GW003L1	04/06/01	0.98	J				
Cobalt	E025GW001	025GW00103	12/02/96	0.91	J	0.90	44	NA	219
	E025GW002	025GW00204	02/14/97	1.1	J				
	E025GW003	025GW00303	12/02/96	2.7	J				
	E025GW003	025GW00304	02/13/97	2.9	J				
	E070GW001	070GW00102	07/29/96	1.0	J				
	E070GW001	070GW00103	12/03/96	1.0	J				
	E070GW001	070GW00104	02/18/97	1.4	J				
	E070GW002	070GW00202	07/29/96	1.4	J				
	E070GW002	070GW00203	12/03/96	1.6	J				
	E070GW002	070GW00204	02/18/97	1.2	J				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
Cobalt	E549GW002	549GW00203	11/25/96	1.1	J	0.90	44	NA	219
	E549GW003	549GW00302	07/29/96	1.0	J				
Copper	E025GW003	025GW00303	12/02/96	11	J	0.90	8.0	1,300	146
	E025GW003	025GW00304	02/13/97	12	J				
Cyanide	E070GW001	070GW00102	07/29/96	4.0	J	NA	NA	200	73
	E070GW002	070GW00202	07/29/96	2.3	J				
Dibromochloromethane	E549GW002	549GW00202a	10/09/98	3.0	SJ	NA	NA	80[b]	0.13
Gamma-Chlordane	E025GW001	025GW00102	07/25/96	0.15	=	NA	NA	2.0	0.19
	E025GW001	025GW00103	12/02/96	0.12	=				
	E025GW001	025GW00104	02/14/97	0.11	=				
Iron	E025GW001	025GW00103	12/02/96	276	=	144	76,600	NA	1,095
	E025GW001	025GW00104	02/14/97	435	=				
	E025GW002	025GW00204	02/14/97	65	J				
	E025GW003	025GW00302	07/26/96	289	J				
	E025GW003	025GW00303	12/02/96	148	=				
	E025GW003	025GW00304	02/13/97	518	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
Iron	E025GW004	025GW00402	07/26/96	626	J	144	76,600	NA	1,095
	E025GW004	025GW00403	12/02/96	266	=				
	E025GW004	025GW00404	02/13/97	315	=				
	E070GW001	070GW00102	07/29/96	2,660	=				
	E070GW001	070GW00103	12/03/96	279	=				
	E070GW001	070GW00104	02/18/97	191	=				
	E070GW002	070GW00202	07/29/96	1,440	=				
	E070GW002	070GW00203	12/03/96	286	=				
	E070GW002	070GW00204	02/18/97	277	=				
	E549GW001	549GW00102	08/01/96	4,550	=				
	E549GW001	549GW00103	11/25/96	1,410	=				
	E549GW001	549GW00104	02/13/97	3,040	=				
	E549GW002	549GW00202	08/01/96	8,430	=				
	E549GW002	549GW00203	11/25/96	4,740	=				
	E549GW002	549GW00204	02/13/97	5,290	=				
	E549GW003	549GW00302	07/29/96	677	=				
	E549GW003	549GW00303	11/25/96	314	=				
	E549GW003	549GW00304	02/14/97	264	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
Manganese	E025GW001	025GW00102	07/25/96	4.6	J	2	2,650	NA	73
	E025GW001	025GW00103	12/02/96	4.6	J				
	E025GW001	025GW00104	02/14/97	4.5	=				
	E025GW002	025GW00202	07/26/96	18	J				
	E025GW002	025GW00203	12/02/96	16	=				
	E025GW002	025GW00204	02/14/97	14	J				
	E025GW003	025GW00302	07/26/96	281	J				
	E025GW003	025GW00303	12/02/96	349	=				
	E025GW003	025GW00304	02/13/97	350	=				
	E025GW004	025GW00402	07/26/96	5.0	J				
	E025GW004	025GW00403	12/02/96	3.6	J				
	E025GW004	025GW00404	02/13/97	3.1	J				
	E070GW001	070GW00102	07/29/96	46	=				
	E070GW001	070GW00103	12/03/96	23	=				
	E070GW001	070GW00104	02/18/97	36	=				
	E070GW002	070GW00202	07/29/96	18	=				
	E070GW002	070GW00203	12/03/96	21	=				
	E070GW002	070GW00204	02/18/97	17	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
Manganese	E549GW001	549GW00102	08/01/96	67	=	2	2,650	NA	73
	E549GW001	549GW00103	11/25/96	39	J				
	E549GW001	549GW00104	02/13/97	54	=				
	E549GW002	549GW00202	08/01/96	58	=				
	E549GW002	549GW00203	11/25/96	50	J				
	E549GW002	549GW00204	02/13/97	47	=				
	E549GW003	549GW00302	07/29/96	48	=				
	E549GW003	549GW00303	11/25/96	25	J				
	E549GW003	549GW00304	02/14/97	41	=				
Nickel	E025GW001	025GW00102	07/25/96	1.2	J	0.90	17	NA	73
	E025GW001	025GW00104	02/14/97	0.95	J				
	E025GW002	025GW00202	07/26/96	17	J				
	E025GW002	025GW00203	12/02/96	18	J				
	E025GW002	025GW00204	02/14/97	16	J				
	E025GW003	025GW00302	07/26/96	**464**	=				
	E025GW003	025GW00303	12/02/96	**590**	=				
	E025GW003	025GW00304	02/13/97	**553**	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration µg/L	Concentration Qualifier	Zone E Background Range Min	Zone E Background Range Max	MCL	EPA Region III RBC (HI=0.1)[a]
Nickel	E025GW004	025GW00404	02/13/97	2.7	J	0.90	17	NA	73
	E070GW001	070GW00102	07/29/96	9.5	J				
	E549GW002	549GW00204	02/13/97	0.83	J				
Selenium	E025GW004	025GW00402	07/26/96	3.2	J	3.0	5.0	50	18
	E549GW003	549GW00304	02/14/97	2.9	J				
Silver	E025GW002	025GW00204	02/14/97	1.6	J	2.0	4.0	NA	18
	E070GW001	070GW00104	02/18/97	1.8	J				
PCE	E025GW001	025GW00102	07/25/96	4.0	J	NA	NA	5.0	1.1
	E025GW001	025GW00103	12/02/96	**10**	=				
	E025GW001	025GW00104	02/14/97	4.0	J				
	E025GW002	025GW00204	02/14/97	1.0	J				
	E025GW003	025GW00301a	03/02/98	**11**	S=				
	E025GW003	025GW00302	07/26/96	4.0	J				
	E025GW003	025GW00302a	10/09/98	**6.0**	S=				
	E025GW003	025GW00303	12/02/96	**9.0**	=				
	E025GW003	025GW00304	02/13/97	**11**	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
PCE	E025GW003	025GW003L1	04/06/01	4.3	=	NA	NA	5.0	1.1
Thallium	E025GW001	025GW00104	02/14/97	3.3	J	3.0	6.0	2.0	0.26
	E025GW003	025GW00304	02/13/97	3.1	J				
	E025GW004	025GW00404	02/13/97	4.5	J				
	E070GW001	070GW00103	12/03/96	3.2	J				
	E549GW001	549GW00104	02/13/97	3.4	J				
	E549GW003	549GW00304	02/14/97	4.1	J				
trans-1,2-DCE	E070GW001	070GW00102a	10/09/98	9.0	S=	NA	NA	100	12
	E549GW003	549GW00302a	10/09/98	2.0	SJ				
TCE	E025GW001	025GW00103	12/02/96	2.0	J	NA	NA	5.0	1.6
	E025GW002	025GW00202a	10/09/98	2.0	SJ				
	E025GW003	025GW00301a	03/02/98	**11**	S=				
	E025GW003	025GW00302	07/26/96	5.0	=				
	E025GW003	025GW00302a	10/09/98	**19**	S=				
	E025GW003	025GW00303	12/02/96	**18**	=				
	E025GW003	025GW003L1	04/06/01	**7.6**	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration µg/L	Concentration Qualifier	Zone E Background Range Min	Zone E Background Range Max	MCL	EPA Region III RBC (HI=0.1)[a]
TCE	E025GW004	025GW00401a	02/27/98	2.0	SJ	NA	NA	5.0	1.6
	E025GW004	025GW00402	07/26/96	2.0	J				
	E025GW004	025GW00402a	10/09/98	2.0	SJ				
	E025GW004	025GW00403	12/02/96	1.0	J				
	E070GW001	070GW00101a	02/26/98	**29**	S=				
	E070GW001	070GW00102	07/29/96	**15**	=				
	E070GW001	070GW00102a	10/09/98	**12**	S=				
	E070GW001	070GW00103	12/03/96	**16**	=				
	E070GW001	070GW00104	02/18/97	**12**	=				
	E070GW001	070GW001L1	04/05/01	0.26	J				
	E070GW002	070GW00201a	03/03/98	3.0	SJ				
	E070GW002	070GW00202	07/29/96	**6.0**	=				
	E070GW002	070GW00202a	10/09/98	**6.0**	S=				
	E070GW002	070GW00203	12/03/96	**7.0**	=				
	E070GW002	070GW00204	02/18/97	5.0	J				
	E549GW003	549GW00301a	02/26/98	**19**	S=				
	E549GW003	549GW00302	07/29/96	**70**	=				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
TCE	E549GW003	549GW00302a	10/09/98	**14**	S=	NA	NA	5.0	1.6
	E549GW003	549GW00303	11/25/96	**54**	=				
Vanadium	E025GW001	025GW00103	12/02/96	0.74	J	0.60	26	NA	26
	E025GW001	025GW00104	02/14/97	1.4	J				
	E025GW002	025GW00202	07/26/96	1.4	J				
	E025GW002	025GW00203	12/02/96	1.5	J				
	E025GW002	025GW00204	02/14/97	2.5	J				
	E025GW003	025GW00302	07/26/96	1.6	J				
	E025GW003	025GW00303	12/02/96	1.5	J				
	E025GW003	025GW00304	02/13/97	2.8	J				
	E025GW004	025GW00402	07/26/96	2.2	J				
	E025GW004	025GW00403	12/02/96	1.3	J				
	E025GW004	025GW00404	02/13/97	1.3	J				
	E070GW001	070GW00102	07/29/96	7.1	J				
	E070GW001	070GW00103	12/03/96	1.1	J				
	E070GW002	070GW00202	07/29/96	6.9	J				
	E070GW002	070GW00203	12/03/96	3.8	J				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
Vanadium	E549GW001	549GW00103	11/25/96	0.85	J	0.60	26	NA	26
	E549GW002	549GW00203	11/25/96	1.0	J				
	E549GW002	549GW00204	02/13/97	1.6	J				
	E549GW003	549GW00303	11/25/96	2.0	J				
	E549GW003	549GW00304	02/14/97	2.1	J				
Vinyl Chloride	E025GW002	025GW00202a	10/09/98	**5.0**	SJ	NA	NA	2.0	0.04
	E025GW003	025GW003L1	04/06/01	1.4	=				
	E549GW002	549GW00201a	03/03/98	2.0	SJ				
	E549GW002	549GW00202	08/01/96	1.0	J				
	E549GW002	549GW00203	11/25/96	**3.0**	J				
	E549GW002	549GW00204	02/13/97	2.0	J				
	E549GW003	549GW00301a	02/26/98	**3.0**	SJ				
	E549GW003	549GW00302	07/29/96	**4.0**	J				
	E549GW003	549GW00302a	10/09/98	1.0	SJ				
	E549GW003	549GW00303	11/25/96	**3.0**	J				
	E549GW003	549GW00304	02/14/97	**5.0**	J				

APPENDIX C-3
Detected Compounds in Shallow Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC (HI=0.1)[a]
				µg/L	Qualifier	Min	Max		
Zinc	E025GW001	025GW00104	02/14/97	9.2	J	5.0	141	NA	1,095
	E025GW002	025GW00204	02/14/97	23	=				
	E025GW003	025GW00302	07/26/96	48	=				
	E025GW003	025GW00303	12/02/96	59	=				
	E025GW003	025GW00304	02/13/97	61	=				
	E025GW004	025GW00404	02/13/97	14	J				
	E070GW001	070GW00102	07/29/96	41	=				
	E070GW001	070GW00103	12/03/96	9.7	J				
	E070GW002	070GW00203	12/03/96	34	=				
	E549GW001	549GW00104	02/13/97	7.7	J				
	E549GW002	549GW00204	02/13/97	5.9	J				
	E549GW003	549GW00304	02/14/97	11	J				

All values are presented in units of micrograms per liter (µg/L).

Values that exceed screening criteria are in bold and outlined within the table.

[a] Hazard Index (HI) reduced by one order of magnitude for non-carcinogenic compounds.

[b] MCL is based on total trihalomethanes (TTHM)

= or S= indicates that the compound was detected, the reported value is equal to the sample concentration.

J or SJ indicates that the compound was detected, the reported concentration is estimated.

NA Not available/not applicable

APPENDIX C-4
Detected Compounds in Deep Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration		Zone E Background Range		MCL	EPA Region III RBC
				µg/L	Qualifier	Min	Max		
1,2-DCE (total)	E070GW01D	070GW01D01a	03/03/98	14	S=	NA	NA	70	5.48
	E070GW01D	070GW01D02	07/29/96	15	=				
	E070GW01D	070GW01D03	12/03/96	21	=				
	E070GW01D	070GW01D04	02/18/97	19	=				
1,2-Dichloropropane	E070GW01D	070GW01D02	07/29/96	1	J	NA	NA	5	0.16
	E070GW01D	070GW01D02a	10/09/98	2	SJ				
	E070GW01D	070GW01D03	12/03/96	2	J				
Antimony	E070GW01D	070GW01D02	07/29/96	**149**	=	3	7	6	1.46
	E070GW01D	070GW01D04	02/18/97	**209**	=				
	E070GW01D	070GW01DU5	01/19/99	2.8	J				
Arsenic	E070GW01D	070GW01D02	07/29/96	12.8	=	3	132	50	0.045
	E070GW01D	070GW01D03	12/03/96	5	J				
	E070GW01D	070GW01D04	02/18/97	6.4	J				
Barium	E070GW01D	070GW01D02	07/29/96	14.2	=	12	322	2,000	256
	E070GW01D	070GW01D03	12/03/96	12.6	J				
	E070GW01D	070GW01D04	02/18/97	11.7	J				
bis(2-Ethylhexyl) Phthalate	E070GW01D	070GW01D02	07/29/96	**24**	=	NA	NA	6	4.78

APPENDIX C-4
Detected Compounds in Deep Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration µg/L	Qualifier	Zone E Background Range Min	Zone E Background Range Max	MCL	EPA Region III RBC
Cadmium	E070GW01D	070GW01D02	07/29/96	1.1	J	0.6	0.6	5	3.7
	E070GW01D	070GW01D03	12/03/96	0.73	J				
	E070GW01D	070GW01D04	02/18/97	1	J				
Chloroform	E070GW01D	070GW01D01a	03/03/98	4	SJ	NA	NA	80	0.15
	E070GW01D	070GW01D02	07/29/96	6	=				
Chromium (Hexavalent)	E070GW01D	025G701D10	07/21/00	**30,000**	J	NA	NA	100	11
	E070GW01D	070GW01DL1	04/05/01	**31,000**	J				
Chromium, Total	E070GW01D	070GW01D02	07/29/96	**47,700**	=	0.8	27	100	11
	E070GW01D	070GW01D03	12/03/96	**42,200**	=				
	E070GW01D	070GW01D04	02/18/97	**40,700**	=				
	E070GW01D	070GW01DF5	01/19/99	**2,200**	=				
	E070GW01D	070GW01DU5	01/19/99	**2,190**	=				
cis-1,2-DCE	E070GW01D	070GW01D02a	10/09/98	16	S=	NA	NA	70	6.08
	E070GW01D	070GW01DL1	04/05/01	14.8	=				
Cobalt	E070GW01D	070GW01D02	07/29/96	8.4	J	1.1	14		219
	E070GW01D	070GW01D03	12/03/96	12.5	J				
	E070GW01D	070GW01D04	02/18/97	10.3	J				

APPENDIX C-4
Detected Compounds in Deep Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration µg/L	Concentration Qualifier	Zone E Background Range Min	Zone E Background Range Max	MCL	EPA Region III RBC
Cyanide	E070GW01D	070GW01D02	07/29/96	3.8	J	NA	NA	200	73
Iron	E070GW01D	070GW01D02	07/29/96	780	=	19	26,000	NA	1,095
	E070GW01D	070GW01D03	12/03/96	493	=				
	E070GW01D	070GW01D04	02/18/97	138	=				
Manganese	E070GW01D	070GW01D02	07/29/96	208	=	1.3	1,660	NA	73
	E070GW01D	070GW01D03	12/03/96	192	=				
	E070GW01D	070GW01D04	02/18/97	187	=				
Nickel	E070GW01D	070GW01D02	07/29/96	43.7	=	0.8	46	NA	73
	E070GW01D	070GW01D03	12/03/96	43.2	=				
	E070GW01D	070GW01D04	02/18/97	42.3	=				
Silver	E070GW01D	070GW01D04	02/18/97	6.7	J	2	3	NA	18.3
PCE	E070GW01D	070GW01D01a	03/03/98	**29**	S=	NA	NA	5	1.07
	E070GW01D	070GW01D02	07/29/96	**8**	=				
	E070GW01D	070GW01D02a	10/09/98	**16**	S=				
	E070GW01D	070GW01D03	12/03/96	**12**	=				
	E070GW01D	070GW01D04	02/18/97	**15**	=				
	E070GW01D	070GW01DL1	04/05/01	**26.3**	=				

APPENDIX C-4
Detected Compounds in Deep Groundwater, Post-RFI
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Sample Location	Sample ID	Date Collected	Concentration µg/L	Concentration Qualifier	Zone E Background Range Min	Zone E Background Range Max	MCL	EPA Region III RBC
Thallium	E070GW01D	070GW01D03	12/03/96	**10.6**	J	3	7	2	0.26
trans-1,2-DCE	E070GW01D	070GW01DL1	04/05/01	1.6	=	NA	NA	100	12.2
TCE	E070GW01D	070GW01D01a	03/03/98	**29**	S=	NA	NA	5	1.55
	E070GW01D	070GW01D02	07/29/96	**25**	=				
	E070GW01D	070GW01D02a	10/09/98	**23**	S=				
	E070GW01D	070GW01D03	12/03/96	**30**	=				
	E070GW01D	070GW01D04	02/18/97	**26**	=				
	E070GW01D	070GW01DL1	04/05/01	**34.7**	=				
Vanadium	E070GW01D	070GW01D02	07/29/96	2.9	J	0.5	8	NA	25.6
	E070GW01D	070GW01D03	12/03/96	1.5	J				
Vinyl Chloride	E070GW01D	070GW01D01a	03/03/98	2	SJ	NA	NA	2	0.04
	E070GW01D	070GW01DL1	04/05/01	0.7	J				
Zinc	E070GW01D	070GW01D03	12/03/96	14.6	J	4	21	NA	1,095

All values are presented in units of micrograms per liter (µg/L).
Values that exceed screening criteria are in bold and outlined within the table.
= or S= indicates that the compound was detected, the reported value is equal to the sample concentration.
J or SJ indicates that the compound was detected, the reported concentration is estimated.
NA Not available/not applicable

Appendix D

	StationID	E025SB014		E025SB015		E025SB016		E025SB017	
	SampleID	025SB01401 (0-1ft)		025SB01501 (0-1ft)		025SB01601 (0-1ft)		025SB01701 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	DateAnalyzed	09/04/1997		09/04/1997		09/04/1997		09/04/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	Units								
Cyanide	mg/Kg	0.177	J	0.0746	U	10.5	=	0.0713	U

	StationID	E025SB018		E025SB019		E025SB020		E025SB021	
	SampleID	025SB01801 (0-1ft)		025SB01901 (0-1ft)		025SB02001 (0-1ft)		025SB02101 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	DateAnalyzed	09/04/1997		09/04/1997		09/04/1997		09/04/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	Units								
Cyanide	mg/Kg	0.0741	U	0.104	J	0.0701	U	0.166	J

	StationID	E025SB022		E025SB023		E025SB024		E025SB025	
	SampleID	025SB02201 (0-1ft)		025SB02301 (0-1ft)		025SB02401 (0-1ft)		025SB02501 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	DateAnalyzed	09/04/1997		09/04/1997		09/04/1997		09/04/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Cyanide	mg/Kg	0.802	=	8.38	=	0.797	=	3.1	=

	StationID	E025SB026		E025SB027	
	SampleID	025SB02601 (0-1ft)		025SB02701 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997	
	DateExtracted	09/03/1997		09/03/1997	
	DateAnalyzed	09/04/1997		09/04/1997	
	SDGNumber	00001		00001	
Parameter	**Units**				
Cyanide	mg/Kg	0.415	J	0.956	=

	StationID	E025SB015		E025SB016		E025SB017		E025SB018	
	SampleID	025SB01501 (0-1ft)		025SB01601 (0-1ft)		025SB01701 (0-1ft)		025SB01801 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateAnalyzed	08/29/1997		08/29/1997		08/29/1997		08/29/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Chromium (Hexavalent)	mg/Kg	411	=	45.5	=	463	=	0.878	=

	StationID	E025SB019		E025SB020		E025SB021		E025SB022	
	SampleID	025SB01901 (0-1ft)		025SB02001 (0-1ft)		025SB02101 (0-1ft)		025SB02201 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateAnalyzed	08/29/1997		08/29/1997		08/29/1997		08/29/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	Units								
Chromium (Hexavalent)	mg/Kg	201	=	906	=	1.64	=	708	=

	StationID	E025SB023		E025SB024		E025SB025		E025SB026	
	SampleID	025SB02301 (0-1ft)		025SB02401 (0-1ft)		025SB02501 (0-1ft)		025SB02601 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateAnalyzed	08/29/1997		08/29/1997		08/29/1997		08/29/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Chromium (Hexavalent)	mg/Kg	0.12	J	0.046	U	0.043	U	0.043	J

	StationID	E025SB027	
	SampleID	025SB02701 (0-1ft)	
	DateCollected	08/28/1997	
	DateExtracted	08/28/1997	
	DateAnalyzed	08/29/1997	
	SDGNumber	00001	
Parameter	**Units**		
Chromium (Hexavalent)	mg/Kg	0.222	=

	StationID	E025SB014		E025SB015		E025SB016		E025SB017	
	SampleID	025SB01401 (0-1ft)		025SB01501 (0-1ft)		025SB01601 (0-1ft)		025SB01701 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/02/1997		09/02/1997		09/02/1997		09/02/1997	
	DateAnalyzed	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Tin (Sn)	mg/Kg	12.1	=	195	=	9.35	=	8.8	=
Aluminum	mg/Kg	4640	=	1450	=	5840	=	5040	=
Antimony	mg/Kg	47.2	=	18.9	=	3.96	=	13.8	=
Arsenic	mg/Kg	1.89	=	0.899	J	2.83	=	1.59	=
Barium	mg/Kg	64.8	=	16.7	=	34.2	=	26.8	=
Beryllium	mg/Kg	0.152	J	0.0454	J	0.23	J	0.184	J
Cadmium	mg/Kg	0.566	=	0.397	J	6.36	=	6.86	=
Calcium	mg/Kg	1720	=	346	=	2140	=	1960	=
Chromium, Total	mg/Kg	6880	=	1620	=	452	=	2010	=
Cobalt	mg/Kg	1.83	=	0.532	J	0.976	=	1.53	=
Copper	mg/Kg	85	=	22.1	=	76.1	=	89.2	=
Iron	mg/Kg	5260	=	1870	=	5800	=	4800	=
Lead	mg/Kg	252	=	550	=	94.9	=	76.6	=
Magnesium	mg/Kg	273	=	107	=	335	=	345	=
Manganese	mg/Kg	39	=	7.22	=	42.5	=	60.3	=
Nickel	mg/Kg	32.3	=	2.78	=	28.9	=	24.3	=
Potassium	mg/Kg	263	=	123	=	254	=	171	=
Selenium	mg/Kg	0.228	U	0.213	U	0.221	U	0.219	U
Silver	mg/Kg	0.393	J	2.1	=	1.45	=	0.468	J
Sodium	mg/Kg	15.9	=	34.2	=	33.8	=	16.2	=
Thallium	mg/Kg	0.452	J	0.227	U	0.236	U	0.234	U
Vanadium	mg/Kg	7.93	=	3.76	=	8.77	=	6.71	=
Zinc	mg/Kg	93.6	=	17.4	=	286	=	535	=
Mercury	mg/Kg	0.641	=	0.0894	=	0.225	=	0.281	=

	StationID	E025SB018		E025SB019		E025SB020		E025SB021	
	SampleID	025SB01801 (0-1ft)		025SB01901 (0-1ft)		025SB02001 (0-1ft)		025SB02101 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/02/1997		09/02/1997		09/02/1997		09/02/1997	
	DateAnalyzed	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Tin (Sn)	mg/Kg	4.52	=	4.24	=	1160	=	2.7	=
Aluminum	mg/Kg	5510	=	5980	=	730	=	4390	=
Antimony	mg/Kg	1.08	=	4.84	=	23.3	=	2.12	=
Arsenic	mg/Kg	2.12	=	2.19	=	0.645	J	1.32	=
Barium	mg/Kg	34.9	=	25.9	=	1160	=	21.1	=
Beryllium	mg/Kg	0.211	J	0.208	J	0.024	J	0.174	J
Cadmium	mg/Kg	4.1	=	0.572	=	73	=	0.414	J
Calcium	mg/Kg	2280	=	4050	=	499	=	1790	=
Chromium, Total	mg/Kg	93	=	693	=	2420	=	274	=
Cobalt	mg/Kg	0.676	J	0.887	J	1.58	=	0.466	J
Copper	mg/Kg	41.4	=	20.8	=	150	=	21.9	=
Iron	mg/Kg	3870	=	5040	=	4970	=	2740	=
Lead	mg/Kg	82.8	=	65	=	4890	=	30.1	=
Magnesium	mg/Kg	324	=	357	=	70	=	210	=
Manganese	mg/Kg	42.4	=	49	=	48.4	=	35.7	=
Nickel	mg/Kg	8.44	=	5.46	=	260	=	3.32	=
Potassium	mg/Kg	248	=	289	=	63.2	=	163	=
Selenium	mg/Kg	0.286	J	0.217	U	0.421	J	0.223	U
Silver	mg/Kg	2.86	=	0.168	J	24.2	=	0.344	J
Sodium	mg/Kg	27.9	=	58.7	=	35	=	16.8	=
Thallium	mg/Kg	0.236	U	0.232	U	0.236	U	0.238	U
Vanadium	mg/Kg	6.49	=	8.97	=	3.88	=	4.36	=
Zinc	mg/Kg	119	=	93.7	=	102	=	177	=
Mercury	mg/Kg	0.192	=	0.228	=	0.0348	=	0.088	=

	StationID	E025SB022		E025SB023		E025SB024		E025SB025	
	SampleID	025SB02201 (0-1ft)		025SB02301 (0-1ft)		025SB02401 (0-1ft)		025SB02501 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/02/1997		09/02/1997		09/02/1997		09/02/1997	
	DateAnalyzed	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Tin (Sn)	mg/Kg	56.7	=	28.4	=	4.06	=	1.94	J
Aluminum	mg/Kg	6220	=	5120	=	5480	=	2160	=
Antimony	mg/Kg	39.8	=	1.73	=	0.541	J	0.181	U
Arsenic	mg/Kg	3.1	=	1.59	=	2.93	=	1.87	=
Barium	mg/Kg	53.2	=	36.9	=	35.1	=	25.5	=
Beryllium	mg/Kg	0.206	J	0.186	J	0.208	J	0.102	J
Cadmium	mg/Kg	6.77	=	243	=	1.72	=	7.98	=
Calcium	mg/Kg	3030	=	2830	=	2450	=	806	=
Chromium, Total	mg/Kg	5530	=	137	=	38.44	=	34.8	=
Cobalt	mg/Kg	2.17	=	1.01	=	0.899	J	0.262	J
Copper	mg/Kg	210	=	494	=	58.6	=	55.9	=
Iron	mg/Kg	8170	=	5540	=	5520	=	2320	=
Lead	mg/Kg	1090	=	917	=	113	=	105	=
Magnesium	mg/Kg	369	=	363	=	451	=	124	=
Manganese	mg/Kg	70.8	=	483	=	234	=	27.2	=
Nickel	mg/Kg	26.7	=	244	=	9.83	=	4.99	=
Potassium	mg/Kg	259	=	284	=	424	=	153	=
Selenium	mg/Kg	0.217	U	0.443	J	0.272	J	0.223	U
Silver	mg/Kg	1.84	=	4.42	=	1.82	=	3.49	=
Sodium	mg/Kg	29.3	=	78.4	=	89.8	=	11.1	=
Thallium	mg/Kg	0.232	U	1.14	=	0.764	J	0.238	U
Vanadium	mg/Kg	10.1	=	5.16	=	7.4	=	3.55	=
Zinc	mg/Kg	410	=	547	=	113	=	99.7	=
Mercury	mg/Kg	0.892	=	0.139	=	0.142	=	0.231	=

	StationID	E025SB026		E025SB027	
	SampleID	025SB02601 (0-1ft)		025SB02701 (0-1ft)	
	DateCollected	08/28/1997		08/28/1997	
	DateExtracted	09/02/1997		09/02/1997	
	DateAnalyzed	09/03/1997		09/03/1997	
	SDGNumber	00001		00001	
Parameter	**Units**				
Tin (Sn)	mg/Kg	7.88	=	221	=
Aluminum	mg/Kg	5390	=	1010	=
Antimony	mg/Kg	0.333	J	7.28	=
Arsenic	mg/Kg	2.22	=	1.4	=
Barium	mg/Kg	25.7	=	19.2	=
Beryllium	mg/Kg	0.022	J	0.025	J
Cadmium	mg/Kg	15.4	=	16.6	=
Calcium	mg/Kg	2830	=	2260	=
Chromium, Total	mg/Kg	17.6	=	64.3	=
Cobalt	mg/Kg	0.578	J	0.251	J
Copper	mg/Kg	68.5	=	172	=
Iron	mg/Kg	4000	=	2510	=
Lead	mg/Kg	125	=	264	=
Magnesium	mg/Kg	273	=	109	=
Manganese	mg/Kg	63.4	=	14.2	=
Nickel	mg/Kg	19.2	=	33.5	=
Potassium	mg/Kg	292	=	86.2	=
Selenium	mg/Kg	0.349	J	0.221	U
Silver	mg/Kg	0.907	J	10.8	=
Sodium	mg/Kg	26.7	=	8.49	J
Thallium	mg/Kg	0.233	U	0.236	U
Vanadium	mg/Kg	5.54	=	1.98	=
Zinc	mg/Kg	144	=	99.3	=
Mercury	mg/Kg	0.727	=	0.06	=

	StationID	E025SB014		E025SB015		E025SB016		E025SB017	
	SampleID	025SB01402 (3-5ft)		025SB01502 (3-5ft)		025SB01602 (3-5ft)		025SB01702 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	DateAnalyzed	09/04/1997		09/04/1997		09/04/1997		09/04/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Cyanide	mg/Kg	0.132	J	0.0707	U	0.149	J	0.222	J

	StationID	E025SB018		E025SB019		E025SB020		E025SB021	
	SampleID	025SB01802 (3-5ft)		025SB01902 (3-5ft)		025SB02002 (3-5ft)		025SB02102 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	DateAnalyzed	09/04/1997		09/04/1997		09/04/1997		09/04/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	Units								
Cyanide	mg/Kg	0.0749	U	0.0693	U	0.071	U	0.932	=

	StationID	E025SB022		E025SB023		E025SB024		E025SB025	
	SampleID	025SB02202 (3-5ft)		025SB02302 (3-5ft)		025SB02402 (3-5ft)		025SB02502 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	DateAnalyzed	09/04/1997		09/04/1997		09/04/1997		09/04/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	Units								
Cyanide	mg/Kg	0.107	J	0.868	=	0.817	=	12.9	=

	StationID	E025SB026		E025SB027	
	SampleID	025SB02602 (3-5ft)		025SB02702 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997	
	DateExtracted	09/03/1997		09/03/1997	
	DateAnalyzed	09/04/1997		09/04/1997	
	SDGNumber	00001		00001	
Parameter	Units				
Cyanide	mg/Kg	0.339	J	0.074	U

	StationID	E025SB014		E025SB015		E025SB016		E025SB017	
	SampleID	025SB01402 (3-5ft)		025SB01502 (3-5ft)		025SB01602 (3-5ft)		025SB01702 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/09/1997		08/28/1997		08/28/1997		08/28/1997	
	DateAnalyzed	09/09/1997		08/29/1997		08/29/1997		08/29/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	Units								
Chromium (Hexavalent)	mg/Kg	270	=	1260	=	562	=	1.29	=

	StationID	E025SB018		E025SB019		E025SB020		E025SB021	
	SampleID	025SB01802 (3-5ft)		025SB01902 (3-5ft)		025SB02002 (3-5ft)		025SB02102 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateAnalyzed	08/29/1997		08/29/1997		08/29/1997		08/29/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	Units								
Chromium (Hexavalent)	mg/Kg	5.56	=	111	=	261	=	0.981	=

	StationID	E025SB022		E025SB023		E025SB024		E025SB025	
	SampleID	025SB02202 (3-5ft)		025SB02302 (3-5ft)		025SB02402 (3-5ft)		025SB02502 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateAnalyzed	08/29/1997		08/29/1997		08/29/1997		08/29/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Chromium (Hexavalent)	mg/Kg	88.8	=	0.046	U	0.144	J	0.046	U

	StationID	E025SB026		E025SB027	
	SampleID	025SB02602 (3-5ft)		025SB02702 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997	
	DateExtracted	08/28/1997		08/28/1997	
	DateAnalyzed	08/29/1997		08/29/1997	
	SDGNumber	00001		00001	
Parameter	**Units**				
Chromium (Hexavalent)	mg/Kg	0.045	U	0.108	J

	StationID	E025SB014		E025SB015		E025SB016		E025SB017	
	SampleID	025SB01402 (3-5ft)		025SB01502 (3-5ft)		025SB01602 (3-5ft)		025SB01702 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/03/1997		09/02/1997		09/02/1997		09/02/1997	
	DateAnalyzed	09/04/1997		09/03/1997		09/03/1997		09/03/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Tin (Sn)	mg/Kg	20	=	6.11	=	0.822	J	4.12	=
Aluminum	mg/Kg	2460	=	4520	=	4910	=	5670	=
Antimony	mg/Kg	27.8	=	27.5	=	26.1	=	121	=
Arsenic	mg/Kg	1.34	=	1.61	=	0.535	J	0.438	J
Barium	mg/Kg	44.3	=	32.4	=	18.4	=	22.1	=
Beryllium	mg/Kg	0.0831	J	0.124	J	0.206	J	0.206	J
Cadmium	mg/Kg	0.0927	J	0.0203	U	0.614	=	1.86	=
Calcium	mg/Kg	574	=	125	=	83	=	375	=
Chromium, Total	mg/Kg	3880	=	4050	=	3850	=	18600	=
Cobalt	mg/Kg	1.16	=	1.12	=	0.994	=	3.3	=
Copper	mg/Kg	44.6	=	14	=	48	=	136	=
Iron	mg/Kg	6190	=	5180	=	2550	=	3690	=
Lead	mg/Kg	279	=	14.2	=	9.52	=	31.1	=
Magnesium	mg/Kg	241	=	261	=	177	=	258	=
Manganese	mg/Kg	40.9	=	34.6	=	54	=	60.2	=
Nickel	mg/Kg	2.96	=	2.27	=	8.34	=	6.35	=
Potassium	mg/Kg	316	=	318	=	84.8	=	124	=
Selenium	mg/Kg	0.215	U	0.221	U	0.221	U	0.226	U
Silver	mg/Kg	0.523	J	2.91	=	0.0917	J	0.432	J
Sodium	mg/Kg	15.3	=	30.6	=	5.5	J	7.49	J
Thallium	mg/Kg	0.23	U	0.236	U	0.236	U	0.863	J
Vanadium	mg/Kg	12	=	13.2	=	4.09	=	6.69	=
Zinc	mg/Kg	36.5	=	8.38	=	38.4	=	113	=
Mercury	mg/Kg			0.0377	=	0.111	=	0.342	=

	StationID	E025SB018		E025SB019		E025SB020		E025SB021	
	SampleID	025SB01802 (3-5ft)		025SB01902 (3-5ft)		025SB02002 (3-5ft)		025SB02102 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/02/1997		09/02/1997		09/02/1997		09/02/1997	
	DateAnalyzed	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Tin (Sn)	mg/Kg	1.22	J	1.09	J	414	=	5.32	=
Aluminum	mg/Kg	5330	=	5570	=	7360	=	4730	=
Antimony	mg/Kg	5.15	=	2.02	=	11.6	=	1.98	=
Arsenic	mg/Kg	1.04	=	1.64	=	0.672	J	1.49	=
Barium	mg/Kg	23.4	=	18.8	=	465	=	25.2	=
Beryllium	mg/Kg	0.253	J	0.125	J	0.022	J	0.182	J
Cadmium	mg/Kg	1.61	=	0.056	J	21.6	=	1.59	=
Calcium	mg/Kg	251	=	1010	=	315	=	2500	=
Chromium, Total	mg/Kg	752	=	296	=	1320	=	253	=
Cobalt	mg/Kg	0.823	J	0.46	J	0.822	J	0.622	J
Copper	mg/Kg	64.8	=	5.2	=	82.7	=	49.8	=
Iron	mg/Kg	2830	=	5360	=	3000	=	3360	=
Lead	mg/Kg	17.8	=	11.1	=	1910	=	53.5	=
Magnesium	mg/Kg	239	=	328	=	56.4	=	2570	=
Manganese	mg/Kg	54.1	=	16.5	=	21.3	=	42.58	=
Nickel	mg/Kg	11.4	=	2.24	=	121	=	8.3	=
Potassium	mg/Kg	165	=	351	=	61.1	=	170	=
Selenium	mg/Kg	0.223	U	0.217	U	0.215	U	0.221	U
Silver	mg/Kg	0.604	J	0.286	J	11.8	=	3.13	=
Sodium	mg/Kg	17.1	=	37.2	=	21.8	=	20.6	=
Thallium	mg/Kg	0.238	U	0.232	U	0.23	U	0.236	U
Vanadium	mg/Kg	4.47	=	11.7	=	2.95	=	4.98	=
Zinc	mg/Kg	20.3	=	24.8	=	44.6	=	169	=
Mercury	mg/Kg	0.499	=	0.0387	=	0.031	=	0.175	=

	StationID	E025SB022		E025SB023		E025SB024		E025SB025	
	SampleID	025SB02202 (3-5ft)		025SB02302 (3-5ft)		025SB02402 (3-5ft)		025SB02502 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997		08/28/1997		08/28/1997	
	DateExtracted	09/02/1997		09/02/1997		09/02/1997		09/02/1997	
	DateAnalyzed	09/03/1997		09/03/1997		09/03/1997		09/03/1997	
	SDGNumber	00001		00001		00001		00001	
Parameter	**Units**								
Tin (Sn)	mg/Kg	18.4	=	1.22	J	0.903	J	1.05	J
Aluminum	mg/Kg	2360	=	1720	=	5410	=	3870	=
Antimony	mg/Kg	6.95	=	0.177	U	0.257	J	4.59	=
Arsenic	mg/Kg	0.484	J	0.531	J	1.07	=	1.02	=
Barium	mg/Kg	13.5	=	9.6	=	22.9	=	13	=
Beryllium	mg/Kg	0.049	J	0.064	J	0.272	J	0.112	J
Cadmium	mg/Kg	0.624	J	12.4	=	73.7	=	54.5	=
Calcium	mg/Kg	303	=	321	=	576	=	333	=
Chromium, Total	mg/Kg	804	=	6.52	=	54.3	=	372	=
Cobalt	mg/Kg	0.315	J	0.346	J	0.392	J	0.535	J
Copper	mg/Kg	11.3	=	26.9	=	4.26	=	96.8	=
Iron	mg/Kg	2520	=	1610	=	2550	=	2540	=
Lead	mg/Kg	46.2	=	6.88	=	6.25	=	2.2	=
Magnesium	mg/Kg	160	=	122	=	201	=	233	=
Manganese	mg/Kg	9.54	=	32.9	=	80.3	=	93	=
Nickel	mg/Kg	1.78	=	7.4	=	114	=	67	=
Potassium	mg/Kg	121	=	87.4	=	125	=	143	=
Selenium	mg/Kg	0.215	U	0.218	U	0.208	U	0.215	U
Silver	mg/Kg	0.601	J	5.02	=	0.76	J	2.23	=
Sodium	mg/Kg	6.32	J	17.5	=	44.8	=	16.9	=
Thallium	mg/Kg	0.23	U	0.232	U	0.222	U	0.23	U
Vanadium	mg/Kg	4.56	=	2.14	=	3.71	=	4.4	=
Zinc	mg/Kg	13.8	=	40	=	109	=	56.6	=
Mercury	mg/Kg	0.018	J	0.083	=	0.076	=	0.054	=

	StationID	E025SB026		E025SB027	
	SampleID	025SB02602 (3-5ft)		025SB02702 (3-5ft)	
	DateCollected	08/28/1997		08/28/1997	
	DateExtracted	09/02/1997		09/02/1997	
	DateAnalyzed	09/03/1997		09/03/1997	
	SDGNumber	00001		00001	
Parameter	**Units**				
Tin (Sn)	mg/Kg	1.96	J	14.9	=
Aluminum	mg/Kg	2410	=	207	=
Antimony	mg/Kg	0.214	J	2.44	=
Arsenic	mg/Kg	0.67	J	0.446	J
Barium	mg/Kg	12.1	=	6.04	=
Beryllium	mg/Kg	0.088	J	0.013	U
Cadmium	mg/Kg	2.85	=	2.51	=
Calcium	mg/Kg	355	=	165	=
Chromium, Total	mg/Kg	13.1	=	25.7	=
Cobalt	mg/Kg	0.245	J	0.056	U
Copper	mg/Kg	19.9	=	10.3	=
Iron	mg/Kg	1760	=	348	=
Lead	mg/Kg	11.7	=	31.8	=
Magnesium	mg/Kg	135	=	16.8	=
Manganese	mg/Kg	19.7	=	1.6	=
Nickel	mg/Kg	10.5	=	3.81	=
Potassium	mg/Kg	194	=	33	=
Selenium	mg/Kg	0.224	U	0.22	U
Silver	mg/Kg	1.35	=	2.88	=
Sodium	mg/Kg	2.32	U	2.29	U
Thallium	mg/Kg	0.239	U	0.236	U
Vanadium	mg/Kg	2.73	=	0.588	J
Zinc	mg/Kg	27.3	=	7.87	=
Mercury	mg/Kg	0.087	=	0.016	U

	StationID	E025GW001		E025GW002		E025GW003		E025GW003	
	SampleID	025GW001L1		025GW002L1		025GW003L1		025HW003L1	
	DateCollected	04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00	
	DateAnalyzed	04/12/2001		04/12/2001		04/12/2001		04/12/2001	
	SDGNumber	40369		40369		40369		40369	
Parameter	**Units**								
Cadmium, Dissolved	ug/L	0.272	U	4.58	J	72.7	=	74	=
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L	23.4	=	128	=	2380	=	2420	=
Manganese, Dissolved	ug/L	6.41	J	6.21	J	274	=	277	=
Iron, Dissolved	ug/L	3.27	U	3.27	U	3.27	U	3.27	U

	StationID	E025GW004		E070GW001		E070GW002		E070GW01D	
	SampleID	025GW004L1		070GW001L1		070GW002L1		070GW01DL1	
	DateCollected	04/06/2001 0:00		04/05/2001 0:00		04/05/2001 0:00		04/05/2001 0:00	
	DateAnalyzed	04/12/2001		04/12/2001		04/12/2001		04/12/2001	
	SDGNumber	40369		40369		40369		40369	
Parameter	**Units**								
Cadmium, Dissolved	ug/L	0.757	U	0.639	U	1.01	U	2.28	J
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L	3.97	U	2070	=	19.8	=	30600	=
Manganese, Dissolved	ug/L	0.338	U	1.18	J	48.3	=	192	=
Iron, Dissolved	ug/L	3.27	U	5.66	U	3.27	U	3.27	U

	StationID	E070VP001		E070VP001		E070VP001		E070VP002	
	SampleID	070VP00109		070VP00120		070VP00130		070HP00209	
	DateCollected	04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00		03/05/2001 0:00	
	DateAnalyzed	04/12/2001		04/12/2001		04/12/2001		04/12/2001	
	SDGNumber	40367		40367		40367		40284	
Parameter	**Units**								
Cadmium, Dissolved	ug/L	0.272	U	0.272	U	0.272	U	0.272	U
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L	0.582	U	0.582	U	0.582	U	0.582	UJ
Manganese, Dissolved	ug/L	44.1	=	14.9	U	252	=	11.5	J
Iron, Dissolved	ug/L	6.02	U	10.6	U	3.27	U	3.27	U

	StationID	E070VP002		E070VP002		E070VP002		E070VP003	
	SampleID	070VP00209		070VP00215		070VP00220		070VP00309	
	DateCollected	03/05/2001 0:00		03/05/2001 0:00		03/05/2001 0:00		04/06/2001 0:00	
	DateAnalyzed	04/12/2001		04/12/2001		04/12/2001		04/12/2001	
	SDGNumber	40284		40284		40284		40367	
Parameter	**Units**								
Cadmium, Dissolved	ug/L	0.272	U	0.272	U	0.272	U	0.272	U
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L	0.582	UJ	19.5	J	287	J	73.2	=
Manganese, Dissolved	ug/L	9.16	J	17.8	=	60.2	=	4.62	U
Iron, Dissolved	ug/L	4.33	U	9.27	U	3.27	U	3.27	U

	StationID	E070VP003		E070VP003		E070VP004		E070VP004	
	SampleID	070VP00315		070VP00320		070VP00409		070VP00415	
	DateCollected	04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00	
	DateAnalyzed	04/12/2001		04/12/2001		04/12/2001		04/12/2001	
	SDGNumber	40367		40367		40367		40367	
Parameter	**Units**								
Cadmium, Dissolved	ug/L	0.506	U	0.272	U	0.272	U	0.272	U
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L	852	=	0.582	U	0.922	U	0.582	U
Manganese, Dissolved	ug/L	33.6	=	115	=	0.68	U	248	=
Iron, Dissolved	ug/L	3.27	U	3.27	U	11.2	U	3.27	U

	StationID	E070VP004		E070VP005		E070VP005		E070VP005	
	SampleID	070VP00420		070VP00509		070VP00515		070VP00520	
	DateCollected	04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00		04/09/2001 0:00	
	DateAnalyzed	04/12/2001		04/12/2001		04/12/2001		04/10/2001	
	SDGNumber	40367		40367		40367		40464	
Parameter	**Units**								
Cadmium, Dissolved	ug/L	0.272	U	0.272	U	0.272	U		
Chromium (Hexavalent), Dissolved	ug/L							0.00001	UJ
Chromium, Dissolved	ug/L	0.582	U	0.582	U	0.582	U		
Manganese, Dissolved	ug/L	172	=	39.3	=	665	=		
Iron, Dissolved	ug/L	3.27	U	9.38	U	125	=		

	StationID	E070VP005		E070VP008		E070VP008		E070VP008	
	SampleID	070VP00520		070VP00809		070VP00820		070VP00828	
	DateCollected	04/09/2001 0:00		03/05/2001 0:00		03/05/2001 0:00		03/05/2001 0:00	
	DateAnalyzed	04/13/2001		04/12/2001		04/12/2001		04/12/2001	
	SDGNumber	40464		40284		40284		40284	
Parameter	**Units**								
Cadmium, Dissolved	ug/L	0.272	U	2.49	J	20.7	=	0.272	U
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L	0.582	U	1690	J	9010	J	3220	J
Manganese, Dissolved	ug/L	414	=						
Iron, Dissolved	ug/L	3.27	U						

	StationID	E070VP011		E070VP011		E070VP011		E070VP012	
	SampleID	070VP01109		070VP01119		070VP01133		070VP01209	
	DateCollected	04/12/2001 0:00		04/12/2001 0:00		04/12/2001 0:00		03/05/2001 0:00	
	DateAnalyzed	04/18/2001		04/18/2001		04/18/2001		04/12/2001	
	SDGNumber	40694		40694		40694		40284	
Parameter	**Units**								
Cadmium, Dissolved	ug/L	0.272	U	0.272	U	0.272	U	0.272	U
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L	0.582	U	0.582	U	0.582	U	0.582	UJ
Manganese, Dissolved	ug/L	116	=	34.5	=	70.4	=	145	=
Iron, Dissolved	ug/L	3.27	U	1310	J	3.27	U	3.27	U

	StationID	E070VP012		E070VP012		E549GW00	E549G	E549GW003	
	SampleID	070VP01220		070VP01230		549GW001	549GW	549GW003L1	
	DateCollected	03/05/2001 0:00		03/05/2001 0:00		04/05/2001 0:00		04/06/2001 0:00	
	DateAnalyzed	04/12/2001		04/12/2001		04/12/2001		04/12/2001	
	SDGNumber	40284		40284		40369	40	40369	
Parameter	**Units**								
Cadmium, Dissolved	ug/L	0.272	U	0.272	U	0.413	U	0.433	U
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L	765	J	0.582	UJ	0.582	U	30.2	=
Manganese, Dissolved	ug/L	141	=	149	=	1.14	J	0.338	U
Iron, Dissolved	ug/L	3.27	U	3.27	U	7.2	U	3.27	U

	StationID	E025GW001		E025GW002		E025GW003		E025GW003		E025GW003	
	SampleID	025GW001L1		025GW002L1		025GW003L1		025GW003L1		025HW003L1	
	DateCollected	04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00	
	DateAnalyzed	04/07/2001		04/07/2001		04/07/2001		04/27/2001		04/07/2001	
	SDGNumber	40369		40369		40369		40369		40369	
Parameter	**Units**										
Chromium (Hexavalent)	ug/L	0.000033	UJ	0.000147	=			0.00291	J		
Nitrate-Nitrite-N	ug/L					0.00005	U			0.00005	U
Sulfate (as SO4)	ug/L					0.0396	=			0.0395	=

	StationID	E025GW003		E025GW004		E070GW001		E070GW001		E070GW002	
	SampleID	025HW003L1		025GW004L1		070GW001L1		070GW001L1		070GW002L1	
	DateCollected	04/06/2001 0:00		04/06/2001 0:00		04/05/2001 0:00		04/05/2001 0:00		04/05/2001 0:00	
	DateAnalyzed	04/27/2001		04/07/2001		04/07/2001		04/27/2001		04/07/2001	
	SDGNumber	40369		40369		40369		40369		40369	
Parameter	**Units**										
Chromium (Hexavalent)	ug/L	0.00272	J	0.000023	U			0.00258	J	0.00004	UJ
Nitrate-Nitrite-N	ug/L					0.00808	=				
Sulfate (as SO4)	ug/L					0.0137	=				

	StationID	E070GW01D		E070GW01D		E070VP001		E070VP001		E070VP001	
	SampleID	070GW01DL1		070GW01DL1		070VP00109		070VP00120		070VP00130	
	DateCollected	04/05/2001 0:00		04/05/2001 0:00		04/06/2001 0:00		04/06/2001 0:00		04/06/2001 0:00	
	DateAnalyzed	04/07/2001		04/27/2001		04/06/2001		04/06/2001		04/06/2001	
	SDGNumber	40369		40369		40367		40367		40367	
Parameter	**Units**										
Chromium (Hexavalent)	ug/L			0.031	J	0.000015	=	0.0000197	=	0.000013	=
Nitrate-Nitrite-N	ug/L	0.00005	U								
Sulfate (as SO4)	ug/L	0.181	=								

	StationID	E070VP001		E070VP002		E070VP002		E070VP002		E070VP002	
	SampleID	070VP001L1		070HP00209		070VP00209		070VP00215		070VP00220	
	DateCollected	04/06/2001 0:00		03/05/2001 0:00		03/05/2001 0:00		03/05/2001 0:00		03/05/2001 0:00	
	DateAnalyzed	04/06/2001		04/06/2001		04/06/2001		04/06/2001		04/06/2001	
	SDGNumber	40367		40284		40284		40284		40284	
Parameter	**Units**										
Chromium (Hexavalent)	ug/L	0.00001	U	0.00001	UJ	0.00001	UJ	0.000024	J	0.00066	J
Nitrate-Nitrite-N	ug/L										
Sulfate (as SO4)	ug/L										

	StationID	E070VP003	E070VP003	E070VP003	E070VP004	E070VP004
	SampleID	070VP00309	070VP00315	070VP00320	070VP00409	070VP00415
	DateCollected	04/06/2001 0:00	04/06/2001 0:00	04/06/2001 0:00	04/06/2001 0:00	04/06/2001 0:00
	DateAnalyzed	04/06/2001	04/27/2001	04/06/2001	04/06/2001	04/06/2001
	SDGNumber	40367	40367	40367	40367	40367
Parameter	**Units**					
Chromium (Hexavalent)	ug/L	0.000161 =	0.000917 J	0.000021 =	0.000017 =	0.000019 =
Nitrate-Nitrite-N	ug/L					
Sulfate (as SO4)	ug/L					

	StationID	E070VP004	E070VP005	E070VP005	E070VP006	E070VP006
	SampleID	070VP00420	070VP00509	070VP00515	0704VP00609	070VP00617
	DateCollected	04/06/2001 0:00	04/06/2001 0:00	04/06/2001 0:00	04/09/2001 0:00	04/09/2001 0:00
	DateAnalyzed	04/06/2001	04/06/2001	04/06/2001	04/10/2001	04/10/2001
	SDGNumber	40367	40367	40367	40464	40464
Parameter	**Units**					
Chromium (Hexavalent)	ug/L	0.000013 =	0.000012 =	0.000006 J	0.0000066 J	0.00001 UJ
Nitrate-Nitrite-N	ug/L					
Sulfate (as SO4)	ug/L					

	StationID	E070VP006		E070VP006		E070VP007		E070VP007		E070VP007	
	SampleID	07OHP0617		07VP00625		07OVP00709		07OVP00716		07OVP00722	
	DateCollected	04/09/2001 0:00		04/09/2001 0:00		04/10/2001 0:00		04/10/2001 0:00		04/10/2001 0:00	
	DateAnalyzed	04/10/2001		04/10/2001		04/27/2001		04/27/2001		04/27/2001	
	SDGNumber	40464		40464		40516		40516		40516	
Parameter	**Units**										
Chromium (Hexavalent)	ug/L	0.00001	UJ	0.00001	UJ	0.000391	J	0.000371	J	0.00001	UJ
Nitrate-Nitrite-N	ug/L										
Sulfate (as SO4)	ug/L										

	StationID	E070VP008		E070VP008		E070VP008		E070VP009		E070VP009	
	SampleID	070VP00809		070VP00820		070VP00828		07OVP00909		07OVP00919	
	DateCollected	03/05/2001 0:00		03/05/2001 0:00		03/05/2001 0:00		04/10/2001 0:00		04/10/2001 0:00	
	DateAnalyzed	04/06/2001		04/06/2001		04/06/2001		04/10/2001		04/10/2001	
	SDGNumber	40284		40284		40284		40516		40516	
Parameter	**Units**										
Chromium (Hexavalent)	ug/L	0.00162	J	0.0094	J	0.00368	J	0.000148	U	0.00086	=
Nitrate-Nitrite-N	ug/L										
Sulfate (as SO4)	ug/L										

	StationID	E070VP009		E070VP010		E070VP010		E070VP010	
	SampleID	07OVP00933		07OVP01009		07OVP01019		07OVP01033	
	DateCollected	04/10/2001 0:00		04/10/2001 0:00		04/10/2001 0:00		04/10/2001 0:00	
	DateAnalyzed	04/27/2001		04/10/2001		04/10/2001		04/10/2001	
	SDGNumber	40516		40516		40516		40516	
Parameter	**Units**								
Chromium (Hexavalent)	ug/L	0.00001	UJ	0.000023	U	0.000199	U	0.000041	U
Nitrate-Nitrite-N	ug/L								
Sulfate (as SO4)	ug/L								

	StationID	E070VP011		E070VP011		E070VP011		E070VP012	
	SampleID	070VP01109		070VP01119		070VP01133		070VP01209	
	DateCollected	04/12/2001 0:00		04/12/2001 0:00		04/12/2001 0:00		03/05/2001 0:00	
	DateAnalyzed	04/13/2001		04/13/2001		04/13/2001		04/06/2001	
	SDGNumber	40694		40694		40694		40284	
Parameter	**Units**								
Chromium (Hexavalent)	ug/L	0.00005	U	0.00001	U	0.00001	U	0.00002	J
Nitrate-Nitrite-N	ug/L								
Sulfate (as SO4)	ug/L								

	StationID	E070VP012		E070VP012		E070VP013		E070VP013	
	SampleID	070VP01220		070VP01230		07OVP01309		07OVP01316	
	DateCollected	03/05/2001 0:00		03/05/2001 0:00		04/10/2001 0:00		04/10/2001 0:00	
	DateAnalyzed	04/06/2001		04/06/2001		04/10/2001		04/10/2001	
	SDGNumber	40284		40284		40516		40516	
Parameter	**Units**								
Chromium (Hexavalent)	ug/L	0.0008	J	0.00001	UJ	0.000035	U	0.00006	U
Nitrate-Nitrite-N	ug/L								
Sulfate (as SO4)	ug/L								

	StationID	E070VP013		E070VP014		E070VP014		E070VP015	
	SampleID	07OVP01322		070VP01409		070VP01422		070VP01509	
	DateCollected	04/10/2001 0:00		04/09/2001 0:00		04/09/2001 0:00		04/09/2001 0:00	
	DateAnalyzed	04/27/2001		04/10/2001		04/10/2001		04/10/2001	
	SDGNumber	40516		40464		40464		40464	
Parameter	**Units**								
Chromium (Hexavalent)	ug/L	0.00001	UJ	0.00001	UJ	0.0000183	=	0.00001	U
Nitrate-Nitrite-N	ug/L								
Sulfate (as SO4)	ug/L								

	StationID	E070VP015		E070VP015		E549GW001		E549GW002		E549GW002	
	SampleID	070VP01516		070VP01522		549GW001L1		549GW002L1		549GW002L1	
	DateCollected	04/09/2001 0:00		04/09/2001 0:00		04/05/2001 0:00		04/06/2001 0:00		04/06/2001 0:00	
	DateAnalyzed	04/10/2001		04/10/2001		04/07/2001		04/07/2001		04/07/2001	
	SDGNumber	40464		40464		40369		40369		40369	
Parameter	**Units**										
Chromium (Hexavalent)	ug/L	0.00001	U	0.00001	U	0.000024	UJ			0.000044	UJ
Nitrate-Nitrite-N	ug/L							0.000979	=		
Sulfate (as SO4)	ug/L							0.0317	=		

	StationID	E549GW003		E549GW003	
	SampleID	549GW003L1		549GW003L1	
	DateCollected	04/06/2001 0:00		04/06/2001 0:00	
	DateAnalyzed	04/07/2001		04/07/2001	
	SDGNumber	40369		40369	
Parameter	**Units**				
Chromium (Hexavalent)	ug/L			0.000047	UJ
Nitrate-Nitrite-N	ug/L	0.00475	=		
Sulfate (as SO4)	ug/L	0.039	=		

	StationID	E070VP006		E070VP006		E070VP006		E070VP006		E070VP007	
	SampleID	0704VP00609		070VP00617		07OHP0617		07VP00625		07OVP00709	
	DateCollected	04/09/2001 0:00		04/09/2001 0:00		04/09/2001 0:00		04/09/2001 0:00		04/10/2001 0:00	
	DateAnalyzed	04/13/2001		04/13/2001		04/13/2001		04/13/2001		04/13/2001	
	SDGNumber	40464		40464		40464		40464		40516	
Parameter	**Units**										
Cadmium	ug/L	0.272	U	0.34	J	0.412	J	0.272	U	127	=
Chromium, Total	ug/L	4.77	J	0.582	U	0.582	U	0.582	U	434	=
Iron	ug/L	30	U	3.27	U	4.94	U	3.27	U	33.6	J
Manganese	ug/L	26.8	=	1650	=	1450	=	292	=	139	=

	StationID	E070VP007		E070VP007		E070VP009		E070VP009		E070VP009	
	SampleID	07OVP00716		07OVP00722		07OVP00909		07OVP00919		07OVP00933	
	DateCollected	04/10/2001 0:00		04/10/2001 0:00		04/10/2001 0:00		04/10/2001 0:00		04/10/2001 0:00	
	DateAnalyzed	04/13/2001		04/13/2001		04/13/2001		04/13/2001		04/13/2001	
	SDGNumber	40516		40516		40516		40516		40516	
Parameter	**Units**										
Cadmium	ug/L	11.5	=	0.547	J	0.621	J	0.937	J	0.272	U
Chromium, Total	ug/L	361	=	0.711	U	0.582	U	43200	=	5.63	U
Iron	ug/L	13.2	U	3.27	U	3.27	U	3.27	U	3.27	U
Manganese	ug/L	95	=	159	=	9.87	J	150	=	264	=

	StationID	E070VP010		E070VP010		E070VP010		E070VP013		E070VP013	
	SampleID	07OVP01009		07OVP01019		07OVP01033		07OVP01309		07OVP01316	
	DateCollected	04/10/2001 0:00		04/10/2001 0:00		04/10/2001 0:00		04/10/2001 0:00		04/10/2001 0:00	
	DateAnalyzed	04/13/2001		04/13/2001		04/13/2001		04/13/2001		04/13/2001	
	SDGNumber	40516		40516		40516		40516		40516	
Parameter	**Units**										
Cadmium	ug/L	0.272	U	0.737	J	0.272	U	71.4	=	50.5	=
Chromium, Total	ug/L	1.23	U	44600	=	6.49	U	602	=	71.2	=
Iron	ug/L	11.7	U	3.27	U	3.27	U	323	=	379	=
Manganese	ug/L	5.66	J	147	=	262	=	32.2	=	103	=

	StationID	E070VP013		E070VP014		E070VP014		E070VP015		E070VP015	
	SampleID	07OVP01322		070VP01409		070VP01422		070VP01509		070VP01516	
	DateCollected	04/10/2001 0:00		04/09/2001 0:00		04/09/2001 0:00		04/09/2001 0:00		04/09/2001 0:00	
	DateAnalyzed	04/13/2001		04/13/2001		04/13/2001		04/13/2001		04/13/2001	
	SDGNumber	40516		40464		40464		40464		40464	
Parameter	**Units**										
Cadmium	ug/L	0.272	U	0.272	U	0.272	U	7.81	=	0.272	U
Chromium, Total	ug/L	0.582	U	0.582	U	0.582	U	0.993	U	19.7	=
Iron	ug/L	213	=	5.02	U	3.27	U	3.78	U	150	=
Manganese	ug/L	104	=	10.7	J	73.6	=	17.8	=	59.7	=

	StationID	E070VP015	
	SampleID	070VP01522	
	DateCollected	04/09/2001 0:00	
	DateAnalyzed	04/13/2001	
	SDGNumber	40464	
Parameter	**Units**		
Cadmium	ug/L	0.272	U
Chromium, Total	ug/L	0.582	U
Iron	ug/L	476	=
Manganese	ug/L	500	=

	StationID	E025GW003		E025GW003		E070GW001		E070GW01D		E549GW002	
	SampleID	025GW003L1		025HW003L1		070GW001L1		070GW01DL1		549GW002L1	
	DateCollected	04/06/2001 0:00		04/06/2001 0:00		04/05/2001 0:00		04/05/2001 0:00		04/06/2001 0:00	
	DateAnalyzed	04/12/2001		04/12/2001		04/12/2001		04/12/2001		04/12/2001	
	SDGNumber	40369		40369		40369		40369		40369	
Parameter	**Units**										
Vinyl chloride	ug/L	1.4	=	1.7	=	1	U	0.7	J	1	U
1,1-Dichloroethene	ug/L	1	U	1	U	1	U	1	U	1	U
trans-1,2-Dichloroethene	ug/L	1	U	0.35	J	1	U	1.6	=	1	U
1,1-Dichloroethane	ug/L	1	U	1	U	1	U	1	U	1	U
cis-1,2-Dichloroethylene	ug/L	2.9	=	4	=	0.6	J	14.8	=	1.1	=
1,1,1-Trichloroethane	ug/L	1	U	1	U	1	U	1	U	1	U
Trichloroethylene (TCE)	ug/L	7.6	=	11.9	=	0.26	J	34.7	=	1	U
Tetrachloroethylene (PCE)	ug/L	4.3	=	5.7	=	1	U	26.3	=	1	U

	StationID	E549GW003	
	SampleID	549GW003L1	
	DateCollected	04/06/2001 0:00	
	DateAnalyzed	04/12/2001	
	SDGNumber	40369	
Parameter	Units		
Vinyl chloride	ug/L	1	U
1,1-Dichloroethene	ug/L	1	U
trans-1,2-Dichloroethene	ug/L	1	U
1,1-Dichloroethane	ug/L	1	U
cis-1,2-Dichloroethylene	ug/L	0.98	J
1,1,1-Trichloroethane	ug/L	1	U
Trichloroethylene (TCE)	ug/L	1	U
Tetrachloroethylene (PCE)	ug/L	1	U

Appendix E

Data Validation Summary - Charleston Naval Complex - Zone E, SWMU 70

TO: Jim Edens/CH2M HILL/GNA

FROM: Amy Juchem/CH2M HILL/GNA
Herb Kelly/CH2M HILL/GNA

DATE: August 12, 2002

The purpose of this memorandum is to present the results of the data validation process for the samples collected SWMU 70 in Zone E. The samples were collected between the dates of March 5 and April 12, 2001.

The specific samples and analytical fractions reviewed are summarized below in Table 1.

The Quality Control areas that were review and the resulting findings are documented within each subsection that follows. This data was validated for compliance with the analytical method requirements. This process also included a review of the data to assess the accuracy, precision, and completeness based upon procedures described in the guidance documents such as the Environmental Protection Agency (EPA) *National Functional Guidelines for Inorganic Data Review (EPA 1994) and National Functional Guidelines for Organic Data Review (EPA 1999)*. Quality assurance/quality control (QA/QC) summary forms and data reports were reviewed.

Samples were submitted to General Engineering Laboratories, Inc., in Charleston, South Carolina, for the following analyses: Metals following SW-846 6010/7000 Series methodology and Hexavalent Chromium following method SW-846 7196.

Sample results that were not within the acceptance limits were appended with a qualifying flag, which consisted of a single- or double-letter code that indicated a possible problem with the data. The qualifying flags originated during the data review and validation processes. These also include the secondary, or the two-digit "sub-qualifier" flags. The secondary qualifiers provide the reasoning behind the assignment of a qualifier flag to the data. The secondary qualifiers are presented and defined below.

Attachment 1 lists the changes in data qualifiers, due to the validation process.

The following primary flags were used to qualify the data:

[=] Detected. The analyte was analyzed for and detected at the concentration shown.

[J] Estimated. The analyte was present but the reported value may not be accurate or precise.

[U] Undetected. The analyte was analyzed for but not detected above the method detection limit.

[UJ] Detection limit estimated. The analyte was analyzed for but qualified as not detected; the result is estimated.

[R] Rejected. The data is not useable.

Secondary Data Validation Qualifiers

Code	Definition
2S	Second Source
BL	Blank
BD	Blank Spike/Blank Spike Duplicate or (LCS/LCSD) Precision
BS	Blank Spike/LCS
CC	Continuing Calibration Verification
DL	Dilution
FD	Field Duplicate
HT	Holding Time
IB	In-Between (metals - B's → J's)
IC	Initial Calibration
IS	Internal Standard
LD	Lab Duplicate
LR	Concentration exceeded Linear Range
MD	MS/MSD or LCS/LCSD Precision
MS	Matrix Spike/Matrix Spike Duplicate
OT	Other (see DV worksheet)
PD	Pesticide Degradation
PS	Post Spike
RE	Re-extraction/Re-analysis
SD	Serial Dilution
SS	Spiked Surrogate
TN	Tune

Table 1 - Chemical Analytical Methods – Field and Quality Control Samples

40284	E070VP002	070VP00209	40284001	03/05/01	WG	N	X	X
40284	E070VP002	070HP00209	40284002	03/05/01	WG	FD	X	X
40284	E070VP002	070VP00215	40284003	03/05/01	WG	N	X	X
40284	E070VP002	070VP00220	40284004	03/05/01	WG	N	X	X
40284	E070VP012	070VP01209	40284005	03/05/01	WG	N	X	X
40284	E070VP012	070VP01220	40284006	03/05/01	WG	N	X	X
40284	E070VP012	070VP01230	40284007	03/05/01	WG	N	X	X
40284	E070VP008	070VP00809	40284008	03/05/01	WG	N	X	X
40284	E070VP008	070VP00820	40284009	03/05/01	WG	N	X	X
40284	E070VP008	070VP00828	40284010	03/05/01	WG	N	X	X
40284	E070VP012	070VP01220LR	1000180914	04/05/01	WG	LR		X
40284	E070VP012	070VP01220MS	1000180915	04/05/01	WG	MS		X
40284	E070VP008	070VP00809LR	1000180916	04/05/01	WG	LR		X
40284	E070VP008	070VP00809MS	1000180917	03/05/01	WG	MS		X
40284	E070VP012	070VP01220SD	1000180963	04/05/01	WG	SD		X
40284	E070VP008	070VP00809SD	1000180964	03/05/01	WG	SD		X
40284	E070VP008	070VP00809MS	1000181460	03/05/01	WG	MS	X	
40284	E070VP008	070VP00809SD	1000181461	03/05/01	WG	SD	X	
40284	LABQC	MB40284	1000180912		WQ	LB		X
40284	LABQC	LCS40284	1000180913		WQ	BS		X
40284	LABQC	BLANK40284	1000181459		WQ	LB	X	
40284	LABQC	LCS40284	1000181462		WQ	BS	X	
40367	E070VP001	070VP00109	40367001	04/06/01	WG	N	X	X
40367	E070VP001	070VP00120	40367002	04/06/01	WG	N	X	X
40367	E070VP001	070VP00130	40367003	04/06/01	WG	N	X	X
40367	E070VP003	070VP00309	40367004	04/06/01	WG	N	X	X
40367	E070VP003	070VP00315	40367005	04/06/01	WG	N	X	X
40367	E070VP003	070VP00320	40367006	04/06/01	WG	N	X	X
40367	E070VP004	070VP00409	40367007	04/06/01	WG	N	X	X

40367	E070VP004	070VP00415	40367008	04/06/01	WG	N	X	X
40367	E070VP004	070VP00420	40367009	04/06/01	WG	N	X	X
40367	E070VP005	070VP00509	40367010	04/06/01	WG	N	X	X
40367	E070VP005	070VP00515	40367011	04/06/01	WG	N	X	X
40367	E070VP001	070VP001L1	40367012	04/06/01	WG	EB	X	X
40367	E070VP001	070VP00109LR	1000180711	04/06/01	WG	LR		X
40367	E070VP001	070VP00109MS	1000180712	04/06/01	WG	MS		X
40367	E070VP005	070VP00515LR	1000180713	04/06/01	WG	LR		X
40367	E070VP001	070VP00109MS	1000181483	04/06/01	WG	MS	X	
40367	E070VP001	070VP00109SD	1000181484	04/06/01	WG	SD	X	
40367	LABQC	MB140367	1000180696		WQ	LB		X
40367	LABQC	MB40367	1000180696		WQ	LB		X
40367	LABQC	LCS140367	1000180697		WQ	BS		X
40367	LABQC	LCS40367BS	1000180697		WQ	BS		X
40367	LABQC	BLANK40367	1000181482		WQ	LB	X	
40367	LABQC	LCS240367	1000181485		WQ	BS	X	
40367	LABQC	LCS40367	1000181485		WQ	BS	X	
40367	LABQC	LCS40367BS	1000181485		WQ	BS	X	
40367	LABQC	MB240367	1000187805		WQ	LB		X
40367	LABQC	MB403672	1000187805		WQ	LB		X
40367	LABQC	LCS40367	1000187806		WQ	BS		X
40367	LABQC	LCS40367BS2	1000187806		WQ	BS		X
40464	E070VP005	070VP00520	40464001	04/09/01	WG	N	X	X
40464	E070VP006	070VP00609	40464002	04/09/01	WG	N	X	X
40464	E070VP006	070VP00617	40464003	04/09/01	WG	N	X	X
40464	E070VP006	070VP00625	40464004	04/09/01	WG	N	X	X
40464	E070VP014	070VP01409	40464005	04/09/01	WG	N	X	X
40464	E070VP014	070VP01422	40464006	04/09/01	WG	N	X	X
40464	E070VP015	070VP01509	40464007	04/09/01	WG	N	X	X
40464	E070VP015	070VP01516	40464008	04/09/01	WG	N	X	X
40464	E070VP015	070VP01522	40464009	04/09/01	WG	N	X	X

40464	E070VP006	070HP0617	40464010	04/09/01	WG	FD	X	X
40464	FIELDQC	070EP002	40464011	04/09/01	WQ	EB	X	X
40464	E070VP005	070VP00520LR	1000181797	04/09/01	WG	LR		X
40464	E070VP005	070VP00520MS	1000181798	04/09/01	WG	MS		X
40464	E070VP005	070VP00520SD	1000181815	04/09/01	WG	SD		X
40464	LABQC	MB40464	1000181766		WQ	LB		X
40464	LABQC	LCS40464	1000181767		WQ	BS		X
40464	LABQC	BLANK40464	1000182030		WQ	LB	X	
40464	LABQC	LCS40464	1000182032		WQ	BS	X	
40516	E070VP013	070VP01309	40516001	04/10/01	WG	N	X	X
40516	E070VP013	070VP01316	40516002	04/10/01	WG	N	X	X
40516	E070VP013	070VP01322	40516003	04/10/01	WG	N	X	X
40516	E070VP007	070VP00709	40516004	04/10/01	WG	N	X	X
40516	E070VP007	070VP00716	40516005	04/10/01	WG	N	X	X
40516	E070VP007	070VP00722	40516006	04/10/01	WG	N	X	X
40516	E070VP009	070VP00909	40516007	04/10/01	WG	N	X	X
40516	E070VP009	070VP00919	40516008	04/10/01	WG	N	X	X
40516	E070VP009	070VP00933	40516009	04/10/01	WG	N	X	X
40516	E070VP010	070VP01009	40516010	04/10/01	WG	N	X	X
40516	E070VP010	070VP01019	40516011	04/10/01	WG	N	X	X
40516	E070VP010	070VP01033	40516012	04/10/01	WG	N	X	X
40516	FIELDQC	070EP003	40516013	04/10/01	WQ	EB	X	X
40516	E070VP013	070VP01309MS	1000181947	04/10/01	WG	MS		X
40516	E070VP010	070VP01019LR	1000181948	04/10/01	WG	LR		X
40516	E070VP013	070VP01309LR	1000181980	04/10/01	WG	LR		X
40516	E070VP013	070VP01309MS	1000182040	04/10/01	WG	MS	X	
40516	E070VP013	070VP01309SD	1000182041	04/10/01	WG	SD	X	
40516	LABQC	BLANK40516	1000182038		WQ	LB	X	
40516	LABQC	LCS40516	1000187806		WQ	BS		X
40694	E070VP011	070VP01109	40694001	04/12/01	WG	N	X	X
40694	E070VP011	070VP01119	40694002	04/12/01	WG	N	X	X

40694	E070VP011	070VP01133	40694003	04/12/01	WG	N	X	X
40694	FIELDQC	070EP011L2	40694004	04/12/01	WQ	EB	X	X
40694	E070VP011	070VP01109LR	1000183309	04/12/01	WG	LR		X
40694	E070VP011	070VP01109MS	1000183310	04/12/01	WG	MS		X
40694	E070VP011	070VP01109SD	1000183311	04/12/01	WG	SD		X
40694	LABQC	MB40694	1000183183		WQ	LB		X
40694	LABQC	LCS40694	1000183184		WQ	BS		X
40694	LABQC	BLANK40694	1000184228		WQ	LB	X	
40694	LABQC	LCS40694	1000184231		WQ	BS	X	

MATRIX CODE

WG – Ground Water Samples
WQ - Water QC Samples

SAMPLE TYPE CODE

BS - Blank Spike
EB - Equipment Blank
FD - Field Duplicate
N - Native Sample
MS – Matrix Spike
SD – Matrix Spike Duplicate
LR – Lab Replicate
LB - Laboratory Blank

Inorganic Parameters

Quality Control Review

The following list represents the QA/QC measures that are typically reviewed during the data quality evaluation procedure for inorganic parameters.

- **Holding Times** – The holding times are evaluated to verify that samples were extracted and analyzed within holding times.
- **Blank samples** – Sample preparation, initial calibration blanks/continuing calibration blanks, and equipment blanks were provided for this project. Blank samples enable the reviewer to determine if an analyte may be attributed to sampling or laboratory procedures, rather than environmental contamination from site activities.
- **Lab Control Sample (LCS)** – This sample is a "controlled matrix", in which target parameters have been added prior to digestion/analysis. The recoveries serve as a monitor of the overall performance of each step during the analysis, including sample preparation.
- **Field Duplicate Samples** – These samples are collected to determine precision between a native and its duplicate. This information can only be determined when target compounds are detected.
- **Pre/Post Digestion Spike (MS/MSD)** – Spike recovery is used to evaluate potential matrix interferences, as well as accuracy. Precision information is also determined by calculating the reproducibility between the recoveries of each spiked parameter.
- **ICP Interference Check Sample** – This sample verifies the lab's interelement and background correction factors.
- **Initial Calibration Verification** – This parameter ensures that the instrument is capable of producing acceptable quantitative data for the target analyte list to be measured.
- **Continuing Calibration Verification** – This one-point, mid-range parameter establishes that the initial calibration is still valid by checking the performance of the instrument on a continual basis.
- **ICP Serial Dilution** – The serial dilution of samples quantitated by ICP determines whether or not significant physical or chemical interferences exist due to the sample matrix.

Metals Analyses

The QA/QC parameters for the Metals analyses for all of the samples were within acceptable control limits, except as noted below.

Blanks

The Metals target parameters detected in blank samples are listed in Table 2.

TABLE 2
Blank Contamination: Metals
Charleston Naval Complex, Zone E, SWMU 70, Charleston, SC

40284	CCB5		CCB	Chromium	0.629	ug/L	< 3.15 ug/L
40284	1000181459	1000181459	MB	Chromium	1.23	ug/L	< 6.15 ug/L
				Iron	29.1	ug/L	< 145.5 ug/L
				Manganese	0.927	ug/L	< 4.64 ug/L
40367	CCB1		CCB	Cadmium	0.272	ug/L	< 1.36 ug/L
40367	CCB9		CCB	Chromium	0.735	ug/L	< 3.675 ug/L
40367	CCB3		CCB	Iron	4.37	ug/L	< 21.9 ug/L
40367	40367012	070VP001L1	EB	Manganese	3.720	ug/L	< 18.6 ug/L
40464	CCB5		CCB	Chromium	0.629	ug/L	< 3.15 ug/L
40464	CCB9		CCB	Iron	5.60	ug/L	< 28.0 ug/L
40464	1000182030	1000182030	MB	Iron	16.5	ug/L	< 82.5 ug/L
40516	CCB14		CCB	Chromium	0.773	ug/L	< 3.865 ug/L
40516	CCB9		CCB	Iron	5.60	ug/L	< 28.0 ug/L
40516	40516013	070EP003	EB	Chromium	2.390	ug/L	< 11.95 ug/L
40694	CCB3		CCB	Iron	3.79	ug/L	< 18.95 ug/L
40694	1000184228	1000184228	MB	Iron	7.93	ug/L	< 39.7 ug/L
				Manganese	0.567	ug/L	< 2.84 ug/L

If a target parameter was reported in a field sample, and the concentration was below the level determined to be due to blank contamination (5 times the concentration in the associated QC blank samples), it was flagged as "U", not detected. Initial and continuing calibration blanks were also evaluated for possible contamination.

The results qualified due to blank contamination are listed in Attachment 1.

Recoveries – Matrix Spike/Matrix Spike Duplicate (MS/MSD) and Laboratory Control Sample (LCS)

All Matrix Spike (MS), Matrix Spike Duplicate (MSD) and Laboratory Control Sample (LCS) recoveries were within acceptable quality control limits, except as noted in Table 3 below.

TABLE 3
MS/MSD Recoveries Out of QC Limits: Metals
Charleston Naval Complex, Zone E, SWMU 70, Charleston, SC

40284	070VP00809 MS/MSD	Chromium	66* / 66*	80-120	40284 – All	Detects-J, non-detects-UJ
40694	40762001 MS/MSD	Iron	120 / 122*	80-120	40694 - All	Detects-J
* - out of control limits						

General Chemistry Analyses

The QA/QC parameters for the General Chemistry analyses for all of the samples were within acceptable control limits, except as noted below.

Holding Times

Hexavalent chromium has a 24 hour holding time from time of collection to time of analysis. Samples in SDG's 40284, 40367, and 40464 were received by the lab past the 24 hour holding time. They were analyzed within a few hours of receiving the samples. Due to laboratory error, several samples in SDG 40516 had to be reanalyzed 16 days past holding time. Detect compounds were qualified "J", and non-detected compounds qualified "UJ". The following samples were affected:

- SDG 40284: All samples
- SDG 40367: 40367005
- SDG 40464: 40464001, 40464002, 40464003, 40464004, 40464005, and 40464010
- SDG 40516: 40516003, 40516004, 40516005, 40516006, and 40516009

Blanks

Hexavalent chromium was detected in the equipment blank, 070EP003, in SDG 40516 at 0.055 mg/L. Sample results less than 5 times the concentration in the associated equipment blank sample were flagged as "U", not detected

Rejected Data

No data were rejected for this sampling event

Conclusion

A review of the analytical data submitted regarding the investigation of Zone E, SWMU 70, at the Charleston Naval Complex, Charleston, South Carolina by CH2M HILL has been completed. An overall evaluation of the data indicates that the sample handling, shipment, and analytical procedures have been adequately completed, and that the analytical results should be considered usable as qualified.

One equipment blank sample was not correctly logged into the laboratory information management system. The sample ID on the Chain of Custody was 070EP001L1, but logged in as 070VP001L1. Therefore, Sample ID 070VP001L1 was used for the equipment blank.

The analytical data had minor QC concerns as indicated above, however, it did not affect data usability for those specific results. The validation review demonstrated that the analytical systems were generally in control and the data results can be used in the decision making process.

Attachment 1 - Changed Qualifiers and Results
Zone E, SW[illegible]70 - Data Validation

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
40284	40284008	070VP00809	WG	FLTMET	SW6010	CADMIUM, Dissolved	2.49	B	2.49	J	ug/L	IB
40284	40284001	070VP00209	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	0.582	U	0.582	UJ	ug/L	MS
40284	40284002	070HP00209	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	0.582	U	0.582	UJ	ug/L	MS
40284	40284003	070VP00215	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	19.5	=	19.5	J	ug/L	MS
40284	40284004	070VP00220	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	287	=	287	J	ug/L	MS
40284	40284005	070VP01209	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	0.582	U	0.582	UJ	ug/L	MS
40284	40284006	070VP01220	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	765	=	765	J	ug/L	MS
40284	40284007	070VP01230	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	0.582	U	0.582	UJ	ug/L	MS
40284	40284008	070VP00809	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	1690	=	1690	J	ug/L	MS
40284	40284009	070VP00820	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	9010	=	9010	J	ug/L	MS
40284	40284010	070VP00828	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	3220	=	3220	J	ug/L	MS
40284	40284001	070VP00209	WG	FLTMET	SW6010	IRON, Dissolved	4.33	B	4.33	U	ug/L	BL
40284	40284003	070VP00215	WG	FLTMET	SW6010	IRON, Dissolved	9.27	B	9.27	U	ug/L	BL
40284	40284001	070VP00209	WG	FLTMET	SW6010	MANGANESE, Dissolved	9.16	B	9.16	J	ug/L	IB
40284	40284002	070HP00209	WG	FLTMET	SW6010	MANGANESE, Dissolved	11.5	B	11.5	J	ug/L	IB
40284	40284001	070VP00209	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
40284	40284002	070HP00209	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
40284	40284003	070VP00215	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.024	=	0.024	J	mg/L	HT
40284	40284004	070VP00220	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.66	=	0.66	J	mg/L	HT
40284	40284005	070VP01209	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.02	=	0.02	J	mg/L	HT
40284	40284006	070VP01220	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.8	=	0.8	J	mg/L	HT
40284	40284007	070VP01230	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
40284	40284008	070VP00809	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	1.62	=	1.62	J	mg/L	HT
40284	40284009	070VP00820	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	9.4	=	9.4	J	mg/L	HT
40284	40284010	070VP00828	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	3.68	=	3.68	J	mg/L	HT
40367	40367005	070VP00315	WG	FLTMET	SW6010	CADMIUM, Dissolved	0.506	B	0.506	U	ug/L	BL
40367	40367007	070VP00409	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	0.922	B	0.922	U	ug/L	BL
40367	40367001	070VP00109	WG	FLTMET	SW6010	IRON, Dissolved	6.02	B	6.02	U	ug/L	BL
40367	40367002	070VP00120	WG	FLTMET	SW6010	IRON, Dissolved	10.6	B	10.6	U	ug/L	BL

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0367	40367007	070VP00409	WG	FLTMET	SW6010	IRON, Dissolved	11.2	B	11.2	U	ug/L	BL
0367	40367010	070VP00509	WG	FLTMET	SW6010	IRON, Dissolved	9.38	B	9.38	U	ug/L	BL
0367	40367002	070VP00120	WG	FLTMET	SW6010	MANGANESE, Dissolved	14.9	B	14.9	U	ug/L	BL
0367	40367004	070VP00309	WG	FLTMET	SW6010	MANGANESE, Dissolved	4.62	B	4.62	U	ug/L	BL
0367	40367007	070VP00409	WG	FLTMET	SW6010	MANGANESE, Dissolved	0.68	B	0.68	U	ug/L	BL
0367	40367005	070VP00315	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.917	=	0.917	J	mg/L	HT
0464	40464003	070VP00617	WG	FLTMET	SW6010	CADMIUM, Dissolved	0.34	B	0.34	J	ug/L	IB
0464	40464010	070HP0617	WG	FLTMET	SW6010	CADMIUM, Dissolved	0.412	B	0.412	J	ug/L	IB
0464	40464002	070VP00609	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	4.77	B	4.77	J	ug/L	IB
0464	40464007	070VP01509	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	0.993	B	0.993	U	ug/L	BL
0464	40464002	070VP00609	WG	FLTMET	SW6010	IRON, Dissolved	30	B	30	U	ug/L	BL
0464	40464005	070VP01409	WG	FLTMET	SW6010	IRON, Dissolved	5.02	B	5.02	U	ug/L	BL
0464	40464007	070VP01509	WG	FLTMET	SW6010	IRON, Dissolved	3.78	B	3.78	U	ug/L	BL
0464	40464010	070HP0617	WG	FLTMET	SW6010	IRON, Dissolved	4.94	B	4.94	U	ug/L	BL
0464	40464005	070VP01409	WG	FLTMET	SW6010	MANGANESE, Dissolved	10.7	B	10.7	J	ug/L	IB
0464	40464001	070VP00520	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
0464	40464002	070VP00609	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.0066	J	0.0066	J	mg/L	HT
0464	40464003	070VP00617	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
0464	40464004	070VP00625	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
0464	40464005	070VP01409	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
0464	40464010	070HP0617	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
0516	40516006	070VP00722	WG	FLTMET	SW6010	CADMIUM, Dissolved	0.547	B	0.547	J	ug/L	IB
0516	40516007	070VP00909	WG	FLTMET	SW6010	CADMIUM, Dissolved	0.621	B	0.621	J	ug/L	IB
0516	40516008	070VP00919	WG	FLTMET	SW6010	CADMIUM, Dissolved	0.937	B	0.937	J	ug/L	IB
0516	40516011	070VP01019	WG	FLTMET	SW6010	CADMIUM, Dissolved	0.737	B	0.737	J	ug/L	IB
0516	40516006	070VP00722	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	0.711	B	0.711	U	ug/L	BL
0516	40516009	070VP00933	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	5.63	B	5.63	U	ug/L	BL
0516	40516010	070VP01009	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	1.23	B	1.23	U	ug/L	BL
0516	40516012	070VP01033	WG	FLTMET	SW6010	CHROMIUM, TOTAL, Dissolved	6.49	B	6.49	U	ug/L	BL

40516	40516004	070VP00709	WG	FLTMET	SW6010	IRON, Dissolved	33.6	B	33.6	J	ug/L	IB
40516	40516005	070VP00716	WG	FLTMET	SW6010	IRON, Dissolved	13.2	B	13.2	U	ug/L	BL
40516	40516010	070VP01009	WG	FLTMET	SW6010	IRON, Dissolved	11.7	B	11.7	U	ug/L	BL
40516	40516007	070VP00909	WG	FLTMET	SW6010	MANGANESE, Dissolved	9.87	B	9.87	J	ug/L	IB
40516	40516010	070VP01009	WG	FLTMET	SW6010	MANGANESE, Dissolved	5.66	B	5.66	J	ug/L	IB
40516	40516001	070VP01309	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.035	=	0.035	U	mg/L	BL
40516	40516002	070VP01316	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.06	=	0.06	U	mg/L	BL
40516	40516003	070VP01322	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
40516	40516004	070VP00709	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.391	=	0.391	J	mg/L	HT
40516	40516005	070VP00716	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.371	=	0.371	J	mg/L	HT
40516	40516006	070VP00722	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
40516	40516007	070VP00909	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.148	=	0.148	U	mg/L	BL
40516	40516009	070VP00933	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.01	U	0.01	UJ	mg/L	HT
40516	40516010	070VP01009	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.023	=	0.023	U	mg/L	BL
40516	40516011	070VP01019	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.199	=	0.199	U	mg/L	BL
40516	40516012	070VP01033	WG	GENCHEM	SW7196A	Chromium (Hexavalent), Dissolved	0.041	=	0.041	U	mg/L	BL
40694	40694002	070VP01119	WG	FLTMET	SW6010	IRON, Dissolved	1310	=	1310	J	ug/L	MS

General Engineering Laboratories, Inc.
2040 Savage Road
Charleston, South Carolina 29407
P.O. Box 30712
Charleston, South Carolina 29417
(843) 556-8171

CHAIN OF CUSTODY RECORD

Page 1 of 1

404649

Client Name/Facility Name: Charleston Naval Complex/SMWU 25/70

Collected by/Company: CHZM. Jones

SAMPLE ANALYSIS REQUIRED (x) - use remarks area to specify specific compounds or methods

Use F or P in the boxes to indicate whether sample was filtered and/or preserved

SAMPLE ID	DATE	TIME	WELL	SOIL	COMP	GRAB	# OF CONTAINERS	pH, conductivity	TOC/DOC	TOX	Chloride, Fluoride, Sulfide	Nitrite/Nitrate	VOC - Specify Method required	METALS - specify	Pesticide	Herbicide	Total Phenol	Acid Extractables	B/N Extractables	PCB's	Cyanide	Coliform - specify type	DISS. Cd, Cr, Fe, Mn	DISS Cr6 (SW7196)	Remarks
1- 070VP00520	4/9/01	1230	✓				2																		SHORT HOLD
2- 070VP00609	4/9/01	1320	✓				2																		
3- 070VP00617	4/9/01	1345	✓				2																		
4- 070VP00625	4/9/01	1420	✓				2																		
5- 070VP01409	4/9/01	1500	✓				2																		
8- ~~070VP01416~~	~~4/9/01~~	~~1515~~	✓				~~2~~																		
06- 070VP01422	4/9/01	1545	✓				2																		
7- 070VP01509	4/9/01	1610	✓				2																		
8- 070VP01516	4/9/01	1630	✓				2																		
9- 070VP01522	4/9/01	1700	✓				2																		
0- 070HP0617	4/9/01	—	✓				2																		
1- 070EP002	4/9/01	1705					2																		

Relinquished by:	Date:	Time:	Received by:	Relinquished by:	Date:	Time:	Received by:
[signature]	4/10/01	0830					

Relinquished by:	Date:	Time:	Received by lab by:	Date:	Time:	Remarks:
			[signature]	4/10	0845	Send Report to Tom Geisel 115 Perimeter Rd. Atlanta 30346

200104143

Chain of Custody/ Laboratory Analysis Form

Lab Batch/SDG ID: _____

Laboratory:	GEL, Charleston, SC
Project Name:	Charleston Navy Complex
Site Name:	Zone E, SMWU 70
Project Number:	
TAT:	
Project Manager:	Tom Beisel/ATL
Level:	3
Address:	ATL: 115 Perimeter Center Place NE, Suite 700, Atlanta, GA 30346-1278
	GNV: 3011 SW Williston Rd., Gainesville, FL 32608-3928
Send Report To:	Tom Beisel/ATL, Herb Kelly/GNV
EDD:	CNC

Sample ID	Station ID	Depth Begin	Depth End	Date & Time Collected	Matrix	# of containers	Diss. Cd, Cr, ~~Mn, Fe~~ (SW6010) 1 - 0.5L HDPE	Diss. Cr6 (SW7196) 1 - 0.5L HDPE									Comments
~~070VP0[illegible]12~~	~~E070VP0[illegible]1209~~				WG		X	X									
~~070VP0[illegible]20~~	~~E070VP0[illegible]12~~				WG		X	X									
~~070VP0[illegible]30~~	~~E070VP001~~				WG		X	X									
070VP00209	E070VP002	8	9	3-5-01/0915	WG	2	X	X									40284001
070HP00209	E070VP002	8	9	3-5-01/0915	WG	2	X	X									002
070VP002 15	E070VP002	14	15	3-5-01/0950	WG	2	X	X									003
070VP002 20	E070VP002	19	20	3-5-01/1115	WG	2	X	X									004
070VP0[illegible]1209	E070VP0[illegible]12	8	9	3-5-01/1310	WG	2	X	X									005
070VP0[illegible]1220	E070VP0[illegible]12	19	20	3-5-01/1405	WG	2	X	X									006
070VP0[illegible]1230	E070VP0[illegible]12	29	30	3-5-01/1440	WG	2	X	X									007
~~070VP004~~	~~E070VP004~~				WG		X	X									
~~070VP004~~	~~E070VP004~~				WG		X	X									
~~070VP004~~	~~E070VP004~~				WG		X	X									
~~070VP005~~	~~E070VP005~~				WG		X	X									
~~070VP005~~	~~E070VP005~~				WG		X	X									
~~070HP005~~	~~E070VP005~~				WG		X	X									
~~070VP005~~	~~E070VP005~~				WG		X	X									
~~070VP006~~	~~E070VP006~~				WG		X	X									
~~070VP006~~	~~E070VP006~~				WG		X	X									
~~070VP006~~	~~E070VP006~~				WG		X	X									

Sampled By [signature] Date/Time 3-5-01/as above Relinquished By [signature] Date/Time 3-6-01/0800

Additional Samplers:

Received By Lab: Patricia Dauer Date/Time 4/6/01 8:10 Date/Time

Received By: Date/Time

Remarks: Dissolved Cadmium, Chromium, & Hexavalent Chromium to be filtered by laboratory. Please regard "VP" as "GP" on C-O-C.
MANGANESE + IRON Please ADD DISS. Fe + Mn to analysis.

Cooler Temp:

Custody Seals: Yes No

20010406432

Chain of Custody/ Laboratory Analysis Form

Lab Batch/SDG ID: _____

Laboratory: GEL, Charleston, SC

Project Name: Charleston Navy Complex

Site Name: Zone E, SMWU 70

Project Number:

TAT:

Project Manager: Casey Hudson/ORL

Level: 3

Address: ATL:

GNV: 3011 SW Williston Rd., Gainesville, FL 32608-3928

Send Report To: Tom Beisel/ATL, Herb Kelly/GNV

EDD: CNC

Sample ID	Station ID	Depth Begin	Depth End	Date & Time Collected	Matrix	# of containers	Dissolved Cd, Cr (500mL, HDPE)	Dissolved Cr6 (500mL, HDPE)									Comments
~~070VP007~~	~~E070VP007~~				WG		X	X									
~~070VP007~~	~~E070VP007~~				WG		X	X									
~~070VP007~~	~~E070VP007~~				WG		X	X									
070VP008 09	E070VP008	8	9	3.5.01 / 1510	WG	2	X	X									40284 008
070VP008MS	E070VP008	8	9	3.5.01 / 1510	WG	2	X	X									MS
070VP008SD	E070VP008	8	9	3.5.01 / 1510	WG	2	X	X									MSD
070VP008 20	E070VP008	19	20	3.5.01 / 1600	WG	2	X	X									009
070VP008 28	E070VP008	27	29	3.5.01 / 1626	WG	2	X	X									010
~~070VP009~~	~~E070VP009~~				WG		X	X									
~~070VP009~~	~~E070VP009~~				WG		X	X									
~~070VP009~~	~~E070VP009~~				WG		X	X									
070VP010	~~E070VP010~~				WG		X	X									
~~070VP010~~	~~E070VP010~~				WG		X	X									
~~070VP010~~	~~E070VP010~~				WG		X	X									
~~070VP010~~	~~E070VP010~~				WG		X	X									
~~070VP011~~	~~E070VP011~~				WG		X	X									
~~070VP011~~	~~E070VP011~~				WG		X	X									
~~070VP011~~	~~E070VP011~~				WG		X	X									

Sampled By _____ Date/Time _____ Date/Time _____

Additional Samplers:

Received By Lab: Patricia Dauer Date/Time 4/6/01 08:10 Date/Time _____

Received By: _____ Date/Time _____

Remarks: **Dissolved Cadmium, Chromium, & Hexavalent Chromium to be filtered by laboratory.**

Cooler Temp: _____

Custody Seals: Yes

cl)of Custody/ Laboratory Analysis Form

Lab Batch/SDG ID: ( )

Laboratory:	GEL, Charleston, SC
Project Name:	Charleston Navy Complex
Site Name:	Zone E, SMWU 70
Project Number:	
TAT:	
Project Manager:	Tom Beisel/ATL
Level:	3
Address:	ATL: 115 Perimeter Center Place NE, Suite 700, Atlanta, GA 30346-1278
	GNV: 3011 SW Williston Rd., Gainesville, FL 32608-3928
Send Report To:	Tom Beisel/ATL, Herb Kelly/GNV
EDD:	CNC

Sample ID	Station ID	Depth Begin	Depth End	Date & Time Collected	Matrix	# of containers	Diss. Cd, Cr, Fe, Mn (SW6010) 1 - 0.5L HDPE	Diss. Cr6 (SW7196) 1 - 0.5L HDPE									Comments
070VP001 09	E070VP001	8	9	4/6/01 / 1400	WG		X	X									40367001
070VP001 20	E070VP001	19	20	4/6/01 / 1430	WG		X	X									002
070VP001 30	E070VP001	29	30	4/6/01 / 1500	WG		X	X									003
070VP002	E070VP002				WG		X	X									
070HP002	E070VP002				WG		X	X									
070VP002	E070VP002				WG		X	X									
070VP002	E070VP002				WG		X	X									
070VP003 09	E070VP003	8	9	4/6/01 / 0915	WG		X	X									004
070VP003 15	E070VP003	14	15	4/6/01 / 0930	WG		X	X									005
070VP003 20	E070VP003	19	20	4/6/01 / 1000	WG		X	X									006
070VP004 09	E070VP004	8	9	4/6/01 / 1055	WG		X	X									007
070VP004 15	E070VP004	14	15	4/6/01 / 1200	WG		X	X									008
070VP004 20	E070VP004	19	20	4/6/01 / 1230	WG		X	X									009
070VP005	E070VP005				WG		X	X									
070VP005	E070VP005				WG		X	X									
~~070HP005~~	~~E070VP005~~				WG		X	X									
070VP005	E070VP005				WG		X	X									
070VP006	E070VP006				WG		X	X									
070VP006	E070VP006				WG		X	X									
070VP006	E070VP006				WG		X	X									

Sampled By: Darryl Gates Date/Time: 4/6/01 [signature] Date/Time: 4/6/01 / 1720

Additional Samplers:

Received By Lab: [signature] Date/Time: 04/06/01 1720 Date/Time:

Received By: Date/Time:

Chain of Custody/ Laboratory Analysis Form (Please extract within 24 hours Short HOLD!)

Lab Batch/SDG ID: _____

Remarks: Dissolved Cadmium, Chromium, & Hexavalent Chromium to be filtered by laboratory.

Cooler Temp: _____

Custody Seals: Yes No

Laboratory: GEL, Charleston, SC

Project Name: Charleston Navy Complex

Site Name: Zone E, SMWU 70

Project Number:

TAT:

Project Manager: Casey Hudson/ORL

Level: 3

Address: ATL:

GNV: 3011 SW Williston Rd., Gainesville, FL 32608-3928

Send Report To: Tom Beisel/ATL, Herb Kelly/GNV

EDD: CNC

Sample ID	Station ID	Depth Begin	Depth End	Date & Time Collected	Matrix	# of containers	Dissolved Cd, Cr, Fe, Mn (500mL, HDPE)	Dissolved Cr6 (500mL, HDPE)								Comments
070VP007 09	E070VP007	8	9	4/6/01 / 1545	WG		X	X								B0367010
070VP007 15	E070VP007	14	15	4/6/01 / 1615	WG		X	X								011
070VP007	E070VP007				WG		X	X								
070VP008	E070VP008				WG		X	X								
070VP008MS	E070VP008				WG		X	X								MS
070VP008SD	E070VP008				WG		X	X								MSD
070VP008	E070VP008				WG		X	X								
070VP008	E070VP008				WG		X	X								
070VP009	E070VP009				WG		X	X								
070VP009	E070VP009				WG		X	X								
070VP009	E070VP009				WG		X	X								
070VP010	E070VP010				WG		X	X								
070VP010	E070VP010				WG		X	X								
070VP010	E070VP010				WG		X	X								
070HP010	E070VP010				WG		X	X								
070VP011	E070VP011				WG		X	X								
070VP011	E070VP011				WG		X	X								
070VP011	E070VP011				WG		X	X								
070EP001L1	E070EP001L1	—	—	4/6/01/1700	WQ		X	X								EQ Blank 012

Sampled By: Recie

Additional Sig: [signature] Date/Time: 04/06/01 1 RO

[signature] Date/Time: 4/6/01 / 1720

General Engineering Laboratories, Inc.
2040 Savage Road
Charleston, South Carolina 29407
P.O. Box 30712
Charleston, South Carolina 29417
(843) 556-8171

CHAIN OF CUSTODY RECORD

Page_____ of _____

40516

Client Name/Facility Name: Charleston Naval Complex SMWD 25/70

Collected by/Company: CH2M-Jones

SAMPLE ANALYSIS REQUIRED (x) - use remarks area to specify specific compounds or methods

Use F or P in the boxes to indicate whether sample was filtered and/or preserved

	SAMPLE ID	DATE	TIME	WELL	SOIL	COMP	GRAB	# OF CONTAINERS	pH, conductivity	TOC/DOC	TOX	Chloride, Fluoride, Sulfide	Nitrite/Nitrate	VOC - Specify Method required	METALS - specify	Pesticide	Herbicide	Total Phenol	Acid Extractables	B/N Extractables	PCB's	Cyanide	Coliform - specify type	DISS. Cd, Cr, Fe, Mn	DISS. Cr6 (SW-7196)	Remarks
01	070VP01309	4/10/01	0915	✓				2																		SHORT HOLD (UNPRESERVED)
02	070VP01316		0935	✓				2																		
03	070VP01322		1000	✓				2																		
04	070VP00709		1045	✓				2																		
05	070VP00716		1010	✓				2																		
06	070VP00722		1030	✓				2																		
07	070VP00909		1320	✓				2																		
08	070VP00919		1345	✓				2																		
09	070VP00933		1415	✓				2																		
10	070VP01009		1500	✓				2																		
11	070VP01019		1525	✓				2																		
12	070HP01033 070VP01033		1600	✓				4																		
13	070EP003		1610					2																		

Relinquished by:	Date:	Time:	Received by:	Relinquished by:	Date:	Time:	Received by:
[signature]	4/10/01	1720					

Relinquished by:	Date:	Time:	Received by lab by:	Date:	Time:	Remarks:
			[signature]	4/10	1730	Please send report to Tom Beisel, 115 Perimeter Road, Suite 700, Atl., Ga

200104 14864

Chain of Custody/ Laboratory Analysis Form

Lab Batch/SDG ID: _____

Laboratory: GEL, Charleston, SC	
Project Name: Charleston Navy Complex	**Site Name:** Zone E, SMWU 70
Project Number:	**TAT:** 14 DAY
Project Manager: Tom Beisel/ATL	**Level:** 3
Address: ATL: 115 Perimeter Center Place NE, Suite 700, Atlanta, GA 30346-1278	
GNV: 3011 SW Williston Rd., Gainesville, FL 32608-3928	
Send Report To: Tom Beisel/ATL, Herb Kelly/GNV	**EDD:** CNC

Sample ID	Station ID	Depth Begin	Depth End	Date & Time Collected	Matrix	# of containers	Diss. Cd, Cr, Mn, Fe (SW6010) 1 - 0.5L HDPE	Diss. Cr6 (SW7196) 1 - 0.5L HDPE								Comments
070VP01109	E070VP011	8	9	4/12/01 / 1430	WG	2	X	X								40694 001
070VP01119	E070VP011	18	19	4/12/01 / 1445	WG	2	X	X								002
070VP01133	E070VP011	32	33	4/1201 / 1500	WG	2	X	X								003
070EP011L2	E070EP011	–	–	4/12/01 / 1515	WQ	2	X	X								004

Sampled By: Darryl Gates Date/Time: 4/12/01 / as above [signature] Date/Time: 4/12/01 / 1650

Additional Samplers:

Received By Lab: Patricia Dover Date/Time: 4/12/01 16:15 Date/Time:

Received By: Date/Time:

(14C)

Appendix F

Appendix F-1
COPC Screening for Combined SWMU 70 Surface Soils
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

CAS	Chemical	N	Detects	Maximum Detect	Minimum Detect	Mean Detect	Best Estimate of the Mean	Background	Residential RBC (HI = 0.1)	Industrial RBC (HI = 0.1)	Residential COPC	Industrial COPC
7429905	Aluminum	53	53	10,700	730	4,493	4,493	261 - 20,500	7,821	204,400		
7440360	Antimony	53	21	47	0.33	6.6	3.8	0.50 - 7.4	3.1	82	X	
7440382	Arsenic	53	51	13	0.65	3.2	3.1	0.95 - 68	0.43	3.8		
7440393	Barium	53	53	1,160	8.1	51	51	1.8 - 1,980	548	14,308		
7440417	Beryllium	53	42	0.42	0.022	0.20	0.18	0.13 - 1.6	16	409		
7440439	Cadmium	53	35	243	0.10	14	9	0.060 - 1.5	7.8	200	X	X
7440702	Calcium	53	51	140,000	274	6,602	6,461	187 - 182000				
18540299	Chromium (Hexavalent)	13	11	906	0.043	249	211		23	613	X	X
7440473	Chromium, Total	53	53	6,880	2.9	420	420	2.3 - 567	23	613	X	X
7440484	Cobalt	53	50	196	0.10	11	10	0.35 - 111	469	12,264		
7440508	Copper	53	53	18,200	0.76	474	474	0.47 - 866	313	8,176	X	X
57125	Cyanide	46	13	17	0.10	3.3	1.0		156	4,088		
7439896	Iron	53	51	13,400	1,710	4,826	4,770	1,050 - 30,600	2,346	61,320		
7439921	Lead	53	53	4,690	3.6	255	255	1.0 - 400	400	1300		
7439954	Magnesium	53	51	4,310	70	400	391	31 - 14,800				
7439965	Manganese	53	51	483	7.2	60	59	0.93 - 508	156	4,100		
7439976	Mercury	53	39	2.2	0.035	0.31	0.24	0.030 - 2.7	2.3	61		
7440020	Nickel	53	50	260	0.93	27	26	0.60 - 72	156	4,088	X	
7440097	Potassium	53	35	1,150	63	318	274	46 - 2,620				
7782492	Selenium	53	11	0.83	0.27	0.49	0.34	0.57 - 4.0	39	1,022		
7440224	Silver	53	23	24	0.17	3.1	1.5	0.75 - 0.91	39	1,022		
7440235	Sodium	53	36	643	8.5	91	74	12 - 28,200				
7440280	Thallium	53	4	1.1	0.45	0.73	0.29	0.61 - 2.8	0.55	14		
7440315	Tin (Sn)	50	27	1,800	1.9	144	78	0.77 - 45	4,693	122,640		
7440622	Vanadium	53	53	16	2.0	7.4	7.4	1.1 - 60	55	1,431		
7440666	Zinc	53	53	1,040	3.7	149	149	1.9 - 855	2,346	61,320		
11096825	PCB-1260 (Arochlor 1260)	30	1	0.066	0.066	0.066	0.036		0.32	2.9		
5103719	Alpha-chlordane	32	1	0.0054	0.0054	0.0054	6.72E-04		1.8	16		
319868	Delta BHC (Delta Hexachlorocyclohexane)	32	3	0.0048	0.0019	0.0030	9.38E-04					
33213659	Endosulfan II	32	2	0.0039	0.0039	0.0039	0.0015		47	1,200		
72208	Endrin	32	2	0.018	0.0043	0.011	0.0020		2.3	61		
7421934	Endrin Aldehyde	32	8	0.0055	0.0026	0.0036	0.0020		2.3	61		
53494705	Endrin Ketone	32	1	0.0028	0.0028	0.0028	0.0014		2.3	61		
5103742	Gamma-chlordane	32	5	0.0049	0.0016	0.0032	0.0011		1.8	16		
1024573	Heptachlor Epoxide	32	1	0.0017	0.0017	0.0017	7.59E-04		0.070	0.63		
72559	p,p'-DDE	32	4	0.049	0.0027	0.017	0.0033		1.9	17		
50293	p,p'-DDT	32	5	0.040	0.0034	0.014	0.0034		1.9	17		
95501	1,2-Dichlorobenzene	39	1	0.046	0.046	0.046	0.19		704	18,396		
91576	2-Methylnaphthalene	39	2	0.20	0.040	0.12	0.19		156	4,088		
83329	Acenaphthene	39	1	0.082	0.082	0.082	0.19		469	12,264		
120127	Anthracene	39	8	0.078	0.042	0.062	0.16		2,346	61,320		
56553	Benzo(a)Anthracene	39	23	0.56	0.040	0.16	0.19		0.87	7.8		
50328	Benzo(a)Pyrene	39	22	3.1	0.041	0.32	0.27		0.087	0.78	X	X
205992	Benzo(b)Fluoranthene	39	22	4.9	0.040	0.41	0.31		0.87	7.8	X	
191242	Benzo(g,h,i)Perylene	39	20	2.9	0.040	0.28	0.24		235	6,132		
207089	Benzo(k)Fluoranthene	39	20	2.8	0.048	0.30	0.25		8.7	78		
--	BEQ	39	26	4.7	0.19	0.56	0.45	1.3 - 1.3	0.087	0.78	X	X
117817	bis(2-Ethylhexyl) Phthalate	39	6	3.2	0.063	0.67	0.26		46	409		
218019	Chrysene	39	23	2.2	0.058	0.28	0.25		87	784		
117840	Di-n-octylphthalate	39	1	0.057	0.057	0.057	0.19		156	4,088		
53703	Dibenz(a,h)anthracene	39	11	0.79	0.039	0.14	0.18		0.087	0.78	X	X
132649	Dibenzofuran	39	3	0.053	0.044	0.049	0.18		31	818		
206440	Flouranthene	39	29	0.72	0.036	0.26	0.26		313	8,176		
86737	Fluorene	39	1	0.089	0.089	0.089	0.19		313	8,176		
193395	Indeno(1,2,3-c,d)pyrene	39	16	2.0	0.042	0.23	0.21		0.87	7.8	X	
91203	Naphthalene	39	1	0.16	0.16	0.16	0.19		156	4,088		
85018	Phenanthrene	39	23	0.40	0.038	0.16	0.17		235	6,132		
129000	Pyrene	39	29	4.6	0.043	0.41	0.35		235	6,132		
75274	Bromodichloromethane	35	1	0.0030	0.0030	0.0030	0.0027		10	92		
67663	Chloroform	35	1	0.0090	0.0090	0.0090	0.0029		105	936		
75092	Methylene Chloride	35	11	0.043	0.0020	0.014	0.010		85	763		
127184	Tetrachloroethylene (PCE)	35	6	0.016	0.0010	0.0048	0.0031		12	110		
108883	Toluene	35	4	0.0030	0.0010	0.0018	0.0026		1,564	40,880		
79016	Trichloroethylene (TCE)	35	10	0.097	0.0020	0.024	0.0067		58	520		
1330207	Xylenes, Total	35	4	0.0040	0.0010	0.0023	0.0027		15,643	408,800		

Units in mg/kg (ppm)

Appendix F-2
COPC Screening for Combined SWMU 70 Subsurface Soils
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

CAS	Chemical	N	Detects	Maximum Detect	Minimum Detect	Mean Detect	Best Estimate of the Mean	Background		Residential RBC (HI = 0.1)	Industrial RBC (HI = 0.1)	Residential COPC	Industrial COPC
7429905	Aluminum	48	48	9,780	207	4,650	4,550	1220	29,900	7,821	204,400		
7440360	Antimony	48	18	121	0.21	14.1	5.8	0.52	1.5	3.1	82	X	X
7440382	Arsenic	48	48	18	0.44	2.4	2.4	0.83	26	0.43	3.8		
7440393	Barium	48	47	0,465	6.0	31	31	6.1	0,091	548	14,308		
7440417	Beryllium	48	36	0.72	0.022	0.24	0.19	0.15	1.6	16	409		
7440439	Cadmium	48	23	103	0.056	13	6.4	0.130	1.0	7.8	200	X	
7440702	Calcium	46	46	235,000	83	5,809	5,595						
18540299	Chromium (Hexavalent)	14	11	1,260	0.1	233	163			23	613	X	X
7440473	Chromium, Total	48	48	18,600	2.100	773	773	1.5	75	23	613	X	X
7440484	Cobalt	48	43	6	0.25	1.3	1.2	0.41	15	469	12,264		
7440506	Copper	48	43	0,260	0.32	43	38	1.30	192	313	8,176		
57125	Cyanide	43	11	14	0.11	2.8	0.80			156	4,086		
7439896	Iron	48	46	55,400	348	5,007	4,913	0,924	35,800	2,346	61,320	X	
7439921	Lead	48	46	1,910	1.9	78	78	1.8	322	400			
7439954	Magnesium	48	46	3,430	17	335	326	77	9,140				
7439965	Manganese	48	46	187	1.8	38	37	4.90	625	156	4,100		
7439976	Mercury	47	18	0.9	0.018	0.18	0.09	0.040	0.9	2.3	61		
7440020	Nickel	48	47	121	0.56	13	13	0.85	20	156	4,088		
7440097	Potassium	48	24	0,591	33	274	199	106	3,440				
7782492	Selenium	48	4	0.65	0.40	0.53	0.25	0.59	2.4	39	1,022		
7440224	Silver	48	17	12	0.092	2.2	0.9	0.00	0.00	39	1,022		
7440235	Sodium	48	36	465	8.5	57	51	21	1,430				
7440280	Thallium	48	2	4.3	0.86	2.6	0.33	0.00	0.0	0.55	14	X	
7440315	Tin (Sn)	48	21	0,414	0.82	33	15	2.80	24	4,693	122,640		
7440622	Vanadium	48	48	65	0.59	7.5	7.5	1.6	71	55	1,431		
7440666	Zinc	48	48	0,173	1.6	41	41	5.8	438	2,346	61,320		
319868	Delta BHC	30	1	0.004	0.004	0.004	0.001						
60571	Dieldrin	30	1	0.0067	0.0067	0.0067	1.59E-03			0.0	0		
7421934	Endrin Aldehyde	30	4	0.0042	0.0027	0.0035	1.71E-03			2.346428571	61.32		
5103742	Gamma-chlordane	30	1	0.0030	0.0030	0.0030	0.0006			1.800	16.00		
72435	Methoxychlor	30	1	0.0360	0.0360	0.0360	0.0084			39	1,022		
72559	p,p'-DDE	30	3	0.014	0.0069	0.010	0.0023			1.9	17		
50293	p,p'-DDT	30	1	0.0077	0.0077	0.0077	0.0016			1.9	17		
91576	2-Methylnaphthalene	34	1	0.1100	0.1100	0.1100	0.1910			156.4	4088		
120127	Anthracene	34	3	0.0760	0.0390	0.0520	1.81E-01			2346.4	61320		
56553	Benzo(a)Anthracene	34	9	0.3800	0.0390	0.1090	1.72E-01			0.875	7.84		
50328	Benzo(a)Pyrene	34	9	0.480	0.039	0.115	0.1730			0	0,001	X	
205992	Benzo(b)Fluoranthene	34	9	0.480	0.0510	0.128	0.1760			0.9	6		
191242	Benzo(g,h,i)Perylene	34	7	0.210	0.0510	0.092	0.1729			234.6	6132		
207089	Benzo(k)Fluoranthene	34	7	0.310	0.052	0.120	0.18			9	0,078		
65850	Benzoic acid	34	2	0.06	0.045	0.05	0.89			31286	817,600		
--	BEQ	34	10	0.654	0.253	0.339	0.26	1.4	1.4	0	0,001		
117817	bis(2-Ethylhexyl) Phthalate	34	3	0.072	0.054	0.064	0.18			0,046	0,409		
218019	Chrysene	34	10	0.38	0.040	0.11	0.17			87.50	784.0		
84742	Di-n-butyl Phthalate	34	1	0.0	0.046	0.05	0.19			782.143	20440.00		
53703	Dibenz(a,h)anthracene	34	1	0.1	0.062	0.06	0.19			0.09	0.8		
84662	Diethyl Phthalate	34	1	0.1	0.110	0.11	0.19			6257	163,520		
206440	Flouranthene	33	11	0.5	0.049	0.16	0.18			312.9	8176		
193395	Indeno(1,2,3-c,d)pyrene	34	6	0.230	0.046	0.089	0.18			0,001	0,008		
91203	Naphthalene	34	1	0.1	0.09	0.09	0.19			156.429	4088.00		
85018	Phenanthrene	34	5	0.4	0.044	0.17	0.19			235	6132		
129000	Pyrene	34	12	0.8	0.055	0.14	0.18			235	6132		
67641	Acetone	30	3	0.095	0.014	0.042	0.01			782	20,440		
75150	Carbon Disulfide	30	1	0.002	0.002	0.002	0.00			782	20,440		
78933	Methyl ethyl ketone (2-Butanone)	30	1	0.00	0.003	0.00	0.01			4692.857	122640.00		
75092	Methylene Chloride	30	8	0.014	0.002	0.008	0.01			85	763		
127184	Tetrachloroethylene (PCE)	30	4	0.05	0.00	0.01	0.00			0,012	0,110		
108883	Toluene	30	1	0.00	0.002	0.00	0.00			1584	40,880		
79016	Trichloroethylene (TCE)	30	8	0.100	0.001	0.017	0.01			58	0,520		
108054	Vinyl acetate	30	1	0.0	0.005	0.01	0.01			7821.43	204400.0		
1330207	Xylenes, Total	30	4	0.00	0.001	0.00	0.00			15643	408,800		

Appendix F-3
COPC Screening for Combined SWMU 70 Groundwater
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

CAS	Chemical	N	Detects	Maximum Detect	Minimum Detect	Mean Detect	Best Estimate of the Mean	Background	MCL	Tap Water RBC (HI = 0.1)	COPC
7429905	Aluminum	40	31	6,490	44	833	652	19 - 16,100		3,650	
7440360	Antimony	44	10	209	2.8	60	15	2.0 - 5.0	6.0	1.5	X
7440382	Arsenic	44	17	17	2.8	7.3	3.8	3.0 - 316	50	0.045	
7440393	Barium	40	40	34	6.5	16	16	6.0 - 398	2,000	256	
7440417	Beryllium	44	4	0.33	0.32	0.32	0.25	0.30 - 0.90	4.0	7.3	
7440439	Cadmium	40	23	88	0.43	17	9.9	1.4 - 1.4	5.0	3.7	X
7440702	Calcium	40	40	81,300	1,070	25,875	25,875				
7440473	Chromium, Total	44	37	52,500	1.6	6,231	5,240	0.80 - 31	100	11	X
18540299	Chromium (Hexavalent)	14	7	31,000	147	9,874	4,945			11	X
7440484	Cobalt	40	16	13	0.91	3.2	1.7	0.90 - 44		219	
7440508	Copper	40	6	12	2.1	6.7	1.8	0.90 - 8.0	1,300	146	
57125	Cyanide	13	4	4.4	2.3	3.6	2.5		200	73	
7439896	Iron	40	36	8,430	65	1,549	1,397	144 - 76,600		1,095	
7439954	Magnesium	40	40	14,300	586	4,128	4,128	790 - 1.16E+06			
7439965	Manganese	40	40	350	3.1	77	77	2.0 - 2,650		73	
7440020	Nickel	40	20	590	0.83	120	61	0.90 - 17		73	X
7440097	Potassium	40	40	13,000	1,750	6,124	6,124	1,320 - 289,000			
7782492	Selenium	40	3	6.1	2.9	4.1	1.9	3.0 - 5.0	50	18	
7440224	Silver	40	3	6.7	1.6	3.4	1.0	2.0 - 4.0		18	
7440235	Sodium	40	40	922,000	4,590	44,010	44,010				
7440280	Thallium	44	8	11	3.1	5.2	2.6	3.0 - 6.0	2.0	0.26	X
7440622	Vanadium	40	29	12	0.74	2.8	2.2	0.60 - 26		26	
7440666	Zinc	40	20	61	4.5	25	16	5.0 - 141		1,095	
5103719	Alpha-chlordane	22	4	0.17	0.14	0.16	0.045		2.0	0.19	
5103742	Gamma-chlordane	22	4	0.15	0.11	0.13	0.039		2.0	0.19	
83329	Acenaphthene	20	1	1.0	1.0	1.0	4.8			37	
65850	Benzoic acid	20	3	4.0	1.0	2.0	20			14,600	
117817	bis(2-Ethylhexyl) Phthalate	20	3	24	1.0	9.0	5.6		6.0	4.8	X
84742	Di-n-butyl Phthalate	20	1	2.0	2.0	2.0	4.9			365	
91203	Naphthalene	20	4	6.0	1.0	3.0	4.6			0.65	X
540590	1,2-Dichloroethene (total)	50	23	57	1.0	16	9.0		70	5.5	
78875	1,2-Dichloropropane	60	2	2.0	1.0	1.5	2.4		5.0	0.16	
71432	Benzene	60	2	3.0	2.0	2.5	2.5		5.0	0.32	
75150	Carbon Disulfide	60	1	1.0	1.0	1.0	2.5			104	
108907	Chlorobenzene	60	4	34	14	23	3.9		100	11	
67663	Chloroform	60	2	7.0	6.0	6.5	3.1		80	0.15	
156592	cis-1,2-Dichloroethylene	15	5	15	0.60	4.1	4.1		70	6.1	
127184	Tetrachloroethylene (PCE)	65	15	26	1.0	8.0	4.0		5.0	1.1	X
156605	trans-1,2-Dichloroethene	15	1	1.6	1.6	1.6	1.9		100	12	
79016	Trichloroethylene (TCE)	65	25	70	0.26	16	8.7		5.0	1.6	X
75014	Vinyl chloride	65	8	5.0	0.70	2.5	3.6		2.0	0.040	X
1330207	Xylenes, Total	60	1	2.0	2.0	2.0	2.5		10,000	1,217	

Units in ug/L

Appendix F-4
Exposure Factors for Surface Soil
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Industrial Worker	Utility Worker	Residential Adult	Residential Child
Exposure Frequency (day/year)	250	250	350	350
Exposure Duration (years)	25	1	30	6
Averaging Time –Carcinogenic (days)	25550	25550	25550	--
Averaging Time – Noncarcinogenic (days)	9125	365	10950	2190
Body Weight (kg)	70	70	70	15
Ingestion:				
Ingestion Rate (mg/day)	50	480	100	200
Age-adjusted Ingestion Rate [(mg-day)/(kg-year)]*	NA	NA	114	NA
Fraction Ingested	1	1	1	1
Dermal:				
Surface Area (cm^2)	2679	2679	5049	2351
Age-adjusted Skin Surface Area [(cm^2-yr)/kg]*	NA	NA	2671	NA
Soil-to-Skin Adherence Factor (mg/cm^2)	0.03	0.1	0.03	0.15
Inhalation:				
Particulate Emission Factor (m^3/kg)	1.32E+09	1.32E+09	1.32E+09	1.32E+09
Inhalation Rate (m^3/day)	20	20	20	15
Age-adjusted Inhalation Rate [(m^3-yr)/(kg-day)]*	NA	NA	13	NA

* For carcinogenic scenarios only

Appendix F-5
Exposure Factors for Groundwater
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Parameter	Industrial Worker	Residential Adult	Residential Child
Exposure Frequency (day/year)	250	350	350
Exposure Duration (years)	25	30	6
Averaging Time –Carcinogenic (days)	25550	25550	--
Averaging Time – Noncarcinogenic (days)	9125	10950	2190
Body Weight (kg)	70	70	15
Ingestion:			
Ingestion Rate (L/day)	1	2	1
Age-adjusted Ingestion Rate [(mg-day)/(kg-year)]*	NA	1.1	NA
Dermal:			
Surface Area (cm^2)	2679	20000	6557
Age-adjusted Skin Surface Area [(cm^2-yr)/kg]*	NA	9480	NA
Inhalation:			
Inhalation Rate (m^3/day)	**	**	**
Age-adjusted Inhalation Rate [(m^3-yr)/(kg-day)]*	NA	**	NA

* For carcinogenic scenarios only
** Inhalation exposure to volatiles in groundwater are equal to ingestion exposures

Appendix F-6
Exposure point concentrations for COPCs at Combined SWMU 70
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Chemical	Units	N	Detects	FOD	Min Detect	Max Detect	Mean Detect	Best Estimate of the Mean[1]	95% UCL of Mean	EPC	Basis
Surface Soil											
Antimony	mg/kg	53	21	40%	47.20	0	8.6	3.8	5.8	5.8	UCL95
BEQ	mg/kg	39	26	67%	4.67	0.2	0.56	0.45	0.63	0.63	UCL95
Cadmium	mg/kg	53	35	66%	243.00	0	14	9	17	17	UCL95
Chromium (Hexavalent)	mg/kg	13	11	85%	906.000	0	249	211	344	344	UCL95
Chromium, Total	mg/kg	53	53	100%	6880.0	0,003	420	420	710	710	UCL95
Copper	mg/kg	53	53	100%	18200.00	0,001	474	474	605	605	UCL95
Nickel	mg/kg	53	50	94%	260.00	1	27	26	38	38	UCL95
Combined Surface and Subsurface Soil											
Antimony	mg/kg	101	39	39%	121	0.21	11	5	6.9	9.0	UCL95
BEQ	mg/kg	73	36	49%	4.7	0.19	0.5	0.36	0.46	0.73	UCL95
Cadmium	mg/kg	101	58	57%	243	0,056	14	8	12	17	UCL95
Chromium (Hexavalent)	mg/kg	27	22	81%	1,260	0.043	0,241	196	297	348	UCL95
Chromium, Total	mg/kg	101	101	100%	18,600	2.1	0,588	588	0,936	1,272	UCL95
Copper	mg/kg	101	96	95%	18,200	0.32	0,281	267	302	496	UCL95
Iron	mg/kg	101	97	96%	55,400	348	4,912	4,838	5,807	6,685	UCL95
Nickel	mg/kg	101	97	96%	260	0.66	20	20	26	31	UCL95
Thallium	mg/kg	101	6	6%	4.3	0.45	1.3	0.3	0.38	0.44	UCL95
Vanadium	mg/kg	101	101	100%	65	0.59	7	7.4	8.6	9.6	UCL95
Groundwater											
Antimony	ug/L	44	10	23%	2.8	209	60	15	25	25	UCL95
Cadmium	ug/L	40	23	57%	0.43	88	17	9.9	17	17	UCL95
Chromium (Hexavalent)	ug/L	14	7	50%	147	31,000	9,874	4,945	9,732	9,732	UCL95
Chromium (Total)	ug/L	44	37	84%	1.6	52,500	6,231	5,240	8,524	8,524	UCL95
PCE	ug/L	65	20	31%	1.0	29	9.4	4.5	5.6	5.6	UCL95
TCE	ug/L	65	38	58%	0.26	70	15	10.0	13	13	UCL95
Thallium	ug/L	44	8	18%	3.1	11	5.2	2.6	3.1	3.1	UCL95
Vinyl Chloride	ug/L	65	13	20%	0.70	5.0	2.5	3.7	4.0	4.0	UCL95

[1] Best estimate of the mean includes non-detects at 1/2 the detection limit
N -- Number of samples
UCL -- Upper confidence limit
EPC -- Exposure point concentration
FOD -- Frequency of detection

Appendix F-6

Exposure point concentrations for COPCs at Combined SWMU 70

RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Chemical	Units	N	Detects	FOD	Maximum Detect	Minimum Detect	Mean Detect	Best Estimate of the Mean[1]	95% UCL of Mean	EPC	Basis
Surface Soil											
Antimony	mg/kg	53	21	40%	47	0.33	8.6	3.8	5.8	5.8	UCL95
BEQ	mg/kg	39	26	67%	4.7	0.19	0.56	0.45	0.63	0.63	UCL95
Cadmium	mg/kg	53	35	66%	243	0.10	14	9	17	17	UCL95
Chromium (Hexavalent)	mg/kg	13	11	85%	906	0.043	249	211	344	344	UCL95
Chromium, Total	mg/kg	53	53	100%	6,880	2.9	420	420	710	710	UCL95
Copper	mg/kg	53	53	100%	18,200	0.76	474	474	605	605	UCL95
Nickel	mg/kg	53	50	94%	260	0.93	27	26	38	38	UCL95
Combined Surface and Subsurface Soil											
Antimony	mg/kg	101	39	39%	121	0.21	11	5	6.9	9.0	UCL95
BEQ	mg/kg	73	36	49%	4.7	0.19	0.5	0.36	0.46	0.73	UCL95
Cadmium	mg/kg	101	58	57%	243	0.056	14	8	12	17	UCL95
Chromium (Hexavalent)	mg/kg	27	22	81%	1,260	0.043	0,241	196	297	348	UCL95
Chromium, Total	mg/kg	101	101	100%	18,600	2.1	0,588	588	0,936	1,272	UCL95
Copper	mg/kg	101	96	95%	18,200	0.32	0,281	267	302	496	UCL95
Iron	mg/kg	101	97	96%	55,400	348	4,912	4,838	5,807	6,685	UCL95
Nickel	mg/kg	101	97	96%	260	0.66	20	20	26	31	UCL95
Thallium	mg/kg	101	6	6%	4.3	0.45	1.3	0.3	0.38	0.44	UCL95
Vanadium	mg/kg	101	101	100%	65	0.59	7	7.4	8.6	9.6	UCL95
Groundwater											
Antimony	ug/L	44	10	23%	209	2.8	60	15	25	25	UCL95
Cadmium	ug/L	40	23	57%	88	0.43	17	9.9	17	17	UCL95
Chromium (Hexavalent)	ug/L	14	7	50%	31,000	147	9,874	4,945	9,732	9,732	UCL95
Chromium (Total)	ug/L	44	37	84%	52,500	1.6	6,231	5,240	8,524	8,524	UCL95
PCE	ug/L	65	20	31%	29	1.0	9.4	4.5	5.6	5.6	UCL95
TCE	ug/L	65	38	58%	70	0.26	15	10.0	13	13	UCL95
Thallium	ug/L	44	8	18%	11	3.1	5.2	2.6	3.1	3.1	UCL95
Vinyl Chloride	ug/L	65	13	20%	5.0	0.70	2.5	3.7	4.0	4.0	UCL95

[1] Best estimate of the mean includes non-detects at 1/2 the detection limit

N -- Number of samples

UCL -- Upper confidence limit

EPC -- Exposure point concentration

FOD -- Frequency of detection

Appendix F-7
Toxicity Factors for Preliminary COPCs
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

Chemical	GI Absorption Factor (ABS_{GI})	Dermal Absorption Factor (DAF)	Permeability Constant	Weight-of-Evidence Class	Oral Slope Factor (kg-day/mg)	Inhalation Slope Factor (kg-day/mg)	Chronic Oral Reference Dose (mg/kg-day)	Chronic Inhalation Reference Dose (mg/kg-day)	Source
Antimony	2%	0.1%	0.001	--	--	--	4.00E-04	--	IRIS
BEQ[1,2]	31%	13%	1.2	B2	7.30E+00	--	--	--	IRIS
Cadmium (Water)	1%	1%	0.001	B1		1.90E+00	5.00E-04	5.70E-05	IRIS/NCEA
Cadmium (Food)	1%	1%	0.001	B1		1.90E+00	1.00E-03	5.70E-05	IRIS/NCEA
Chromium[3]	2%	0.1%	0.001	D/A[4]	--	2.90E-01	3.00E-03	2.86E-05	IRIS
Copper	30%	0.1%	0.001	D			3.70E-02		HEAST
Nickel	27%	0.1%	0.001				2.00E-02		IRIS
Iron	15%	0.1%	0.001	--	--	--	0.3	--	Reg IX PRG
PCE	100%	1.0%	0.37		5.20E-02	1.00E-02	1.00E-02	1.40E-01	IRIS/NCEA
TCE	15%	1.0%	0.016		4.00E-01	4.00E-01	3.00E-04	1.00E-02	NCEA
Thallium[5]	15%	0.1%	0.001	D	--	--	8.00E-05	--	IRIS
Vanadium	1%	0.1%	0.001	--	--	--	0.007	--	HEAST
Vinyl Chloride	100%	1.0%	0.0073	A	7.20E-01	1.50E-02	3.00E-03	2.80E-02	IRIS

Weight-of-Evidence Class definitions:
- A = known carcinogen
- B2 = suspected carcinogen
- D = not classifiable

Source definition
- IRIS = EPA Integrated Risk Information System
- HEAST = Health Effects Assessment Summary Tables
- NCEA = National Center for Environmental Assessment

[1] Toxicity assessment for carcinogenic Polycyclic Aromatic Hydrocarbons (cPAHs) based on Toxicity Equivalent Factor (TEM) methodology which is used to calculate BEQs. BEQs are used in estimating chronic daily intake of cPAHs.
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Dibenz(a,h)anthracene
- Indeno(1,2,3-c,d)pyrene

[2] As benzo(a)pyrene
[3] As chromium VI
[4] Group A by inhalation, Group D by ingestion
[5] As thallium carbonate

Appendix F-8
Risk Summary
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

	ELCR					HI				
Receptor	Ingestion	Dermal	Inhalation	Total	Risk Driver	Ingestion	Dermal	Inhalation	Total	Hazard Driver
Industrial Worker										
	Surface Soil					*Surface Soil*				
	8.0E-07	5.4E-07	7.0E-09	1.4E-06		0.080	0.0065	0.0018	0.089	
	Groundwater					*Groundwater*				
	1.5E-05	1.6E-08	4.7E-06	2.0E-05		34	0.031	0.0048	34	CR6, TL
	Total					*Total*				
	1.6E-05	**5.6E-07**	**4.7E-06**	**2.2E-05**		**34**	**0.038**	**0.0066**	**34**	CR6, TL
Utility Worker										
	Surface Soil					*Surface Soil*				
	3.6E-07	8.4E-08	2.8E-10	4.4E-07		2.4	0.070	0.0019	2.5	FE
	Total					*Total*				
	3.6E-07	**8.4E-08**	**2.8E-10**	**4.4E-07**		**2.4**	**0.070**	**0.0019**	**2.5**	**FE**
Residential Adult										
	Surface Soil					*Surface Soil*				
	7.2E-06	3.2E-06	1.8E-08	1.0E-05		0.23	0.026	0.0026	0.25	
	Groundwater					*Groundwater*				
	6.6E-05	2.4E-07	2.0E-05	8.6E-05		96	0.011	0.013	96	CR6, SB, TL
	Total					*Total*				
	7.3E-05	**3.5E-06**	**2.0E-05**	**9.6E-05**		**96**	**0.037**	**0.016**	**96**	**CR6, SB, TL**
Residential Child										
	Surface Soil					*Surface Soil*				
	--	--	--	NA		2.1	0.29	0.0090	2.4	CR6
	Groundwater					*Groundwater*				
	--	--	--	NA	--	224	0.50	0.031	225	CD, CR6, SB, TL
	Total					*Total*				
	--	**--**	**--**	**NA**		**226**	**0.79**	**0.040**	**227**	**CD, CR6, SB, TL**

Risk and Hazard Drivers are those chemicals contributing an ELCR above 1E-6 and and HQ greater than 1, respectively

BEQ -- Benzo(a)pyrene equivalents
CD -- Cadmium
CR6 -- Hexavalent chromium
PCE -- Tetrachloroethene
SB -- Antimony
TCE -- Trichloroethene
TL -- Thallium
VC -- Vinyl chloride

Appendix G

Appendix G-1a

Surface Soil - Hypothetical Future Industrial Worker Carcinogenic Scenario

RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

										Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**SFo**	**SFd**	**SFI**	**VFInd**	**EPC**	**ABSgI**	**DABS**	**CDI**	**ELCR**	**CDI**	**ELCR**	**CDI**	**ELCR**
	Antimony						5.80E+00	2%	0.001	1.01E-06		1.63E-09		3.07E-10	
	BEQ	B2	7.30E+00	2.35E+01			6.30E-01	31%	0.13	1.10E-07	8.0E-07	2.30E-08	5.4E-07	3.34E-11	
	Cadmium	B1			1.90E+00		1.71E+01	1%	0.001	2.99E-06		4.80E-09		9.05E-10	1.7E-09
	Chromium (Hexavalent)	D/A4			2.90E-01		3.44E+02	2%	0.001	6.01E-05		9.66E-08		1.82E-08	5.3E-09
	Copper	D					6.05E+02	30%	0.001	1.06E-04		1.70E-07		3.20E-08	
	Nickel						3.79E+01	2.70E-01	0.001	6.62E-06		1.06E-08		2.01E-09	
	Total Risk										**8E-07**		**5E-07**		**7E-09**
												Total Risk =		**1E-06**	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; EPC = Exposure Point Concentration; ELCR = Excess Lifetime Cancer Exposure

Appendix G-1b
Surface Soil - Hypothetical Future Industrial Worker Non-carcinogenic Scenario
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

										Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDI**	**VFind**	**EPC**	**ABSgI**	**DABS**	**CDI**	**HQ**	**CDI**	**HQ**	**CDI**	**HQ**
	Antimony		4.00E-04	8.00E-06			5.80E+00	2%	0.001	2.84E-06	0.0071	4.56E-09	5.70E-04	8.60E-10	
	BEQ	B2					6.30E-01	31%	0.13	3.08E-07		6.44E-08		9.34E-11	
	Cadmium	B1	1.00E-03	1.00E-05	5.70E-05		1.71E+01	1%	0.001	8.37E-06	0.0084	1.34E-08	0.001	2.54E-09	4.45E-05
	Chromium (Hexavalent)	D/A4	3.00E-03	6.00E-05	2.86E-05		3.44E+02	2%	0.001	1.68E-04	0.056	2.71E-07	0.0045	5.10E-08	0.0018
	Copper	D	3.70E-02	1.11E-02			6.05E+02	30%	0.001	2.96E-04	0.008	4.76E-07	4.29E-05	8.97E-08	
	Nickel		2.00E-02	5.40E-03			3.79E+01	27%	0.001	1.85E-05	9.27E-04	2.98E-08	5.52E-06	5.62E-09	
	Hazard Index										**0.080**		**0.006**		**0.0018**
													Total HI=	**0.09**	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; EPC = Exposure Point Concentration; HQ = Hazard Quotient; HI = Hazard Index

Appendix G-1c

Groundwater (Potable Use) - Hypothetical Future Industrial Worker Carcinogenic Scenario

RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

									Ingestion		Dermal[b]		Inhalation[c]
Units	**Chemical**	**WOE**	**SFo**	**SFd**	**SFI**	**RME**	**DE**	**PC**	**CDI**	**ELCR**	**CDI**	**ELCR**	**ELCR**
MG/L	Antimony					2.45E-02	2.00E-02	1.00E-03	8.56E-05		1.61E-09		
MG/L	Cadmium	B1			1.90E+00	1.66E-02	1.00E-02	1.00E-03	5.81E-05		1.09E-09		
MG/L	Chromium (Hexavalent)	D/A4			2.90E-01	9.73E+00	2.00E-02	1.00E-03	3.40E-02		6.38E-07		
MG/L	PCE		5.20E-02	5.20E-02	1.00E-02	5.56E-03	1.00E+00	3.70E-01	1.94E-05	1.0E-06	1.35E-07	7.0E-09	1.9E-07
MG/L	TCE		4.00E-01	2.67E+00	4.00E-01	3.07E-03	1.50E-01	1.60E-02	1.07E-05	4.3E-06	3.22E-09	8.6E-09	4.3E-06
MG/L	Thallium	D				1.27E-02	1.50E-01	1.00E-03	4.44E-05				
MG/L	Vinyl Chloride	A	7.20E-01	7.20E-01	1.50E-02	4.03E-03	1.00E+00	7.30E-03	1.41E-05	1.0E-05			2.1E-07
	Total Risk									**1.5E-05**		**1.6E-08**	**4.7E-08**
											Total Risk =	**2E-05**	

Notes:
a - One-hit equation for high carcinogenic risk levels (1E-02) used Risk = $1 - e^{(-CDI*SF)}$ (USEPA, 1989).
b - Dermal exposure, showering, is not assumed
c - Inhalation intake (CDI) = Ingestion intake for VOCs

Appendix G-1d
Groundwater (Potable Use) - Hypothetical Future Industrial Woker Non-carcinogenic Scenario
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

									Ingestion		Dermal[a]		Inhalation[b]
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**RME**	**DE**	**PC**	**CDI**	**HQ**	**CDI**	**HQ**	**HQ**
MG/L	Antimony		4.00E-04	8.00E-06		2.45E-02	2.00E-02	1.00E-03	2.40E-04	0.60	4.50E-09	5.62E-04	
MG/L	Cadmium	B1	5.00E-04	5.00E-06	5.70E-05	1.66E-02	1.00E-02	1.00E-03	1.63E-04	0.33	3.05E-09	6.10E-04	
MG/L	Chromium (Hexavalent)	D/A4	3.00E-03	6.00E-05	2.86E-05	9.73E+00	2.00E-02	1.00E-03	9.52E-02	32	1.79E-06	0.030	
MG/L	PCE		1.00E-02	1.00E-02	1.40E-01	5.56E-03	1.00E+00	3.70E-01	5.44E-05	0.0054	3.77E-07	3.77E-05	3.88E-04
MG/L	TCE		3.00E-04	4.50E-05	1.00E-02	3.07E-03	1.50E-01	1.60E-02	3.01E-05	0.10	9.02E-09	2.00E-04	0.0030
MG/L	Thallium	D	8.00E-05	1.20E-05		1.27E-02	1.50E-01	1.00E-03	1.24E-04	1.6			
MG/L	Vinyl Chloride	A	3.00E-03	3.00E-03	2.80E-02	4.03E-03	1.00E+00	7.30E-03	3.95E-05	0.013			0.0014
	Hazard Index									**34**		**0.031**	**0.0048**
										Total Hazard Index =		**34**	

Notes: a - Dermal exposure, showering, is not assumed
b - Inhalation intake (CDI) = Ingestion intake for VOCs

Appendix G-2a

Soil Column (0-5 ft bls) - Hypothetical Future Utility/Construction Worker Carcinogenic Scenario

RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

										Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**SFo**	**SFd**	**SFI**	**VFInd**	**EPC**	**ABSgI**	**DABS**	**CDI**	**ELCR**	**CDI**	**ELCR**	**CDI**	**ELCR**
mg/kg	Antimony						8.99E+00	2%	0.001	6.03E-07		3.37E-10		1.90E-11	
mg/kg	BEQ	B2	7.30E+00	2.35E+01			7.34E-01	31%	0.13	4.93E-08	3.6E-07	3.57E-09	8.4E-08	1.56E-12	
mg/kg	Cadmium	B1			1.90E+00		1.69E+01	1%	0.01	1.14E-06		6.34E-09		3.59E-11	6.8E-11
mg/kg	Chromium (Hexavalent)	D/A4			2.90E-01		3.48E+02	2%	0.001	2.34E-05		1.30E-08		7.37E-10	2.1E-10
mg/kg	Copper	D					4.96E+02	30%	0.001	3.33E-05		1.86E-08		1.05E-09	
mg/kg	Iron						6.69E+03	15%	0.001	4.49E-04		2.50E-07		1.42E-08	
mg/kg	Nickel	--					3.10E+01	27%	0.001	2.08E-06		1.16E-09		6.57E-11	
mg/kg	Thallium	D					4.39E-01	15%	0.001	2.94E-08		1.64E-11		9.29E-13	
mg/kg	Vanadium	--					9.56E+00	1%	0.001	6.42E-07		3.58E-10		2.03E-11	
	Total Risk										**4E-07**		**8E-08**		**3E-10**
												Total Risk =		**4E-07**	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; EPC = Exposure Point Concentration; ELCR = Excess Lifetime Cancer Exposure

Appendix G-2b

Soil Column (0-5 ft bls) - Hypothetical Future Utility/Construction Worker Non-carcinogenic Scenario

RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

										Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**VFind**	**EPC**	**ABSgi**	**DABS**	**CDI**	**HQ**	**CDI**	**HQ**	**CDI**	**HQ**
mg/kg	Antimony		4.00E-04	8.00E-06			8.99E+00	2%	0.001	4.28E-05	0.11	2.39E-08	0.0030	1.35E-09	
mg/kg	BEQ	B2					7.34E-01	31%	0.13	3.50E-06		2.54E-07		1.10E-10	
mg/kg	Cadmium	B1	1.00E-03	1.00E-05	5.70E-05		1.69E+01	1%	0.01	8.07E-05	0.081	4.50E-07	0.045	2.55E-09	4.47E-05
mg/kg	Chromium (Hexavalent)	D/A4	3.00E-03	6.00E-05	2.86E-05		3.48E+02	2%	0.001	1.66E-03	0.55	9.25E-07	0.015	5.23E-08	0.0018
mg/kg	Copper	D	3.70E-02	1.11E-02			4.96E+02	30%	0.001	2.36E-03	0.06	1.32E-06	1.19E-04	7.46E-08	
mg/kg	Iron		2.00E-02	3.00E-03			6.69E+03	15%	0.001	3.18E-02	1.6	1.78E-05	0.0059	1.00E-06	
mg/kg	Nickel	--	3.00E-01	8.10E-02			3.10E+01	27%	0.001	1.48E-04	4.92E-04	8.24E-08	1.02E-06	4.66E-09	
mg/kg	Thallium	D	8.00E-05	1.20E-05			4.39E-01	1.50E-01	0.001	2.09E-08	0.026	1.17E-09	9.72E-05	6.59E-11	
mg/kg	Vanadium	--	7.00E-03	7.00E-05			9.56E+00	1.00E-02	0.001	4.55E-05	0.0065	2.54E-08	3.63E-04	1.44E-09	
	Hazard Index										**2.4**		**0.070**		**0.0019**
													Total HI=	**2.5**	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; EPC = Exposure Point Concentration; HQ = Hazard Quotient; HI = Hazard Index

Appendix G-3a
Surface Soil - Future Residential Adult Carcinogenic Scenario
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

										Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**SFo**	**SFd**	**SFI**	**RME**	**DE**	**ABS**	**VFres**	**CDI**	**ELCR**	**CDI**	**ELCR**	**CDI**	**ELCR**
	Antimony					5.80E+00	2%	0.001		9.08E-06		9.74E-09		7.82E-10	
	BEQ	B2	7.30E+00	2.35E+01		6.30E-01	31%	0.13		9.86E-07	7.2E-06	1.38E-07	3.2E-06	8.50E-11	
	Cadmium	B1			1.90E+00	1.71E+01	1%	0.001		2.68E-05		2.87E-08		2.31E-09	4.4E-09
	Chromium (Hexavalent)	D/A4			2.90E-01	3.44E+02	2.00%	0.001		5.39E-04		5.78E-07		4.64E-08	1.3E-08
	Copper	D				6.05E+02	30%	0.001		9.47E-04		4.35E-07		3.50E-08	
	Nickel					3.79E+01	27%	0.001		5.93E-05		2.73E-08		2.19E-09	
	Total Risk										7.2E-06		3.2E-06		1.8E-08
													Total Risk =	**1E-05**	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration; ELCR = Excess Lifetime Cancer Exposure

Appendix G-3b
Surface Soil - Future Residential Adult Non-carcinogenic Scenario
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

										Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**RME**	**DE**	**ABS**	**VFres**	**CDI**	**HQ**	**CDI**	**HQ**	**CDI**	**HQ**
	Antimony		4.00E-04	8.00E-06		5.80E+00	2%	0.001		7.95E-06	0.020	1.81E-08	0.0023	1.20E-09	
	BEQ	B2				6.30E-01	31%	0.13		8.63E-07		2.56E-07		1.31E-10	
	Cadmium	B1	1.00E-03	1.00E-05	5.70E-05	1.71E+01	1%	0.001		2.34E-05	0.023	5.35E-08	0.005	3.55E-09	6.23E-05
	Chromium (Hexavalent)	D/A4	3.00E-03	6.00E-05	2.86E-05	3.44E+02	2.00%	0.001		4.71E-04	0.16	1.08E-06	0.018	7.14E-08	0.0025
	Copper	D	3.70E-02	1.11E-02		6.05E+02	30%	0.001		8.29E-04	0.022	4.42E-06	3.98E-04	1.26E-07	
	Nickel		2.00E-02	5.40E-03		3.79E+01	27%	0.001		5.19E-05	0.0026	2.77E-07	5.12E-05	7.87E-09	
	Hazard Index										0.23		0.026		0.0026
													Total HI =	**0.25**	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration; HQ = Hazard Quotient; HI = Hazard Index

Appendix G-3c

Groundwater (Potable Use) - Hypothetical Future Residential Adult Carcinogenic Scenario

RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

									Ingestion		Dermal[a]		Inhalation[b]	
Units	**Chemical**	**WOE**	**SFo**	**SFd**	**SFI**	**RME**	**DE**	**PC**	**CDI**	**ELCR**	**CDI**	**ELCR**	**CDI**	**ELCR**
MG/L	Antimony	--	--	--	--	2.45E-02	2.00E-02	1.00E-03	3.64E-04	--	2.2E-08			
MG/L	Cadmium	B1	--	--	1.90E+00	1.66E-02	1.00E-02	1.00E-03	2.47E-04	--	1.5E-08			
MG/L	Chromium (Hexavalent)	D/A4	--	--	2.90E-01	9.73E+00	2.00E-02	1.00E-03	1.45E-01	--	8.8E-06			
MG/L	PCE	--	5.20E-02	5.20E-02	1.00E-02	5.56E-03	1.00E+00	3.70E-01	8.26E-05	4.3E-06	1.9E-06	9.7E-08	8.3E-05	8.3E-07
MG/L	TCE	--	4.00E-01	2.67E+00	4.00E-01	3.07E-03	1.50E-01	1.60E-02	4.57E-05	1.8E-05	4.5E-08	1.2E-07	4.6E-05	1.8E-05
MG/L	Thallium	D	--	--	--	1.27E-02	1.50E-01	1.00E-03	1.89E-04	--	1.2E-08			
MG/L	Vinyl Chloride	A	7.20E-01	7.20E-01	1.50E-02	4.03E-03	1.00E+00	7.30E-03	6.00E-05	4.3E-05	2.7E-08	1.9E-08	4.3E-05	6.5E-07
	Total Risk									**6.6E-05**		**2.4E-07**		**2.0E-05**
										Total Risk =		**8.6E-05**		

Notes:

a - Inorganics only

b - Inhalation intake (CDI) = Ingestion intake for VOCs

Appendix G-3d

Groundwater (Potable Use) - Hypothetical Future Residential Adult Non-carcinogenic Scenario

RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

									Ingestion		Dermal[a]		Inhalation[b]	
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**RME**	**DE**	**PC**	**CDI**	**HQ**	**CDI**	**HQ**	**CDI**	**HI**
MG/L	Antimony	--	4.00E-04	8.00E-06	--	2.45E-02	2.00E-02	1.00E-03	6.71E-04	1.7	1.57E-09	1.96E-04		
MG/L	Cadmium	B1	5.00E-04	5.00E-06	5.70E-05	1.66E-02	1.00E-02	1.00E-03	4.56E-04	0.91	1.06E-09	2.13E-04		
MG/L	Chromium (Hexavalent)	D/A4	3.00E-03	6.00E-05	2.86E-05	9.73E+00	2.00E-02	1.00E-03	2.67E-01	89	6.22E-07	0.010		
MG/L	PCE	--	1.00E-02	1.00E-02	1.40E-01	5.56E-03	1.00E+00	3.70E-01	1.52E-04	0.015	1.31E-07	1.31E-05	1.52E-04	0.0011
MG/L	TCE	--	3.00E-04	4.50E-05	1.00E-02	3.07E-03	1.50E-01	1.60E-02	8.42E-05	0.28	3.14E-09	6.98E-05	8.42E-05	0.0084
MG/L	Thallium	D	8.00E-05	1.20E-05	--	1.27E-02	1.50E-01	1.00E-03	3.48E-04	4.3	8.11E-10	6.76E-05		
MG/L	Vinyl Chloride	A	3.00E-03	3.00E-03	2.80E-02	4.03E-03	1.00E+00	7.30E-03	1.11E-04	0.037	1.88E-09	6.27E-07	1.11E-04	0.0039
	Hazard Index									**96**		**0.011**		0.013
										Total Hazard Index =		**96**		

Notes: a - Inorganics only

b - Inhalation intake (CDI) = Ingestion intake for VOCs

Appendix G-4a
Surface Soil - Future Residential Child Non-carcinogenic Scenario
RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

										Ingestion		Dermal		Inhalation	
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**RME**	**DE**	**ABS**	**VF CHILD**	**CDI**	**HQ**	**CDI**	**HQ**	**CDI**	**HQ**
	Antimony		4.00E-04	8.00E-06		5.80E+00	2%	0.001		7.42E-05	0.19	2.05E-07	0.026	4.21E-09	
	BEQ	B2				6.30E-01	31%	0.13		8.05E-06		2.90E-06		4.58E-10	
	Cadmium	B1	1.00E-03	1.00E-05	5.70E-05	1.71E+01	1%	0.001		2.19E-04	0.22	6.05E-07	0.06	1.24E-08	2.18E-04
	Chromium (Hexavalent)	D/A4	3.00E-03	6.00E-05	2.86E-05	3.44E+02	2%	0.001		4.40E-03	1.5	1.22E-05	0.20	2.50E-07	0.0087
	Copper	D	3.70E-02	1.11E-02		6.05E+02	30%	0.001		7.74E-03	0.21	2.14E-05	0.0019	4.39E-07	
	Nickel		2.00E-02	5.40E-03		3.79E+01	27%	0.001		4.85E-04	0.024	1.34E-06	2.48E-04	2.75E-08	
	Hazard Index										2.1		0.29		0.0090
													Total HI =	**2.4**	

Notes: WOE = Weight of Evidence; CDI = Chronic Daily Intake; RME = Reasonable Maximum Exposure Concentration; HQ = Hazard Quotient; HI = Hazard Index

Appendix G-4b

Groundwater (Potable Use) - Hypothetical Future Residential Child Non-carcinogenic Scenario

RFI Report Addendum & CMS Work Plan, Combined SWMU 70, Zone E, Charleston Naval Complex

									Ingestion		Dermal[a]		Inhalation[b]
Units	**Chemical**	**WOE**	**RfDo**	**RfDd**	**RfDi**	**RME**	**DE**	**PC**	**CDI**	**HQ**	**CDI**	**HQ**	**HQ**
MG/L	Antimony	--	4.00E-04	8.00E-06	--	2.45E-02	2.00E-02	1.00E-03	1.57E-03	3.9	7.19E-08	0.0090	
MG/L	Cadmium	B1	5.00E-04	5.00E-06	5.70E-05	1.66E-02	1.00E-02	1.00E-03	1.06E-03	2.1	4.88E-08	0.0098	
MG/L	Chromium (Hexavalent)	D/A4	3.00E-03	6.00E-05	2.86E-05	9.73E+00	2.00E-02	1.00E-03	6.22E-01	207	2.86E-05	0.48	
MG/L	PCE	--	1.00E-02	1.00E-02	1.40E-01	5.56E-03	1.00E+00	3.70E-01	3.55E-04	0.036	6.03E-06	6.03E-04	0.0025
MG/L	TCE	--	3.00E-04	4.50E-05	1.00E-02	3.07E-03	1.50E-01	1.60E-02	1.96E-04	0.65	1.44E-07	0.0032	0.020
MG/L	Thallium	D	8.00E-05	1.20E-05	--	1.27E-02	1.50E-01	1.00E-03	8.11E-04	10	3.72E-08	0.0031	
MG/L	Vinyl Chloride	A	3.00E-03	3.00E-03	2.80E-02	4.03E-03	1.00E+00	7.30E-03	2.58E-04	0.086	8.64E-08	2.88E-05	0.0092
	Hazard Index									**224**		**0.50**	**0.031**
										Total Hazard Index =		**225**	

Notes: a - Dermal exposure, showering, is not assumed
b - Inhalation intake (CDI) = Ingestion intake for VOCs

Appendix H

Appendix H Dilution Attenuation Factor (DAF) Calculation
SWMU 70, Zone E
Charleston Naval Complex, North Charleston, SC

Site SWMU 70	Hydraulic Conductivity K (m/yr)	Hydraulic Gradient I (m/m)	Aquifer Thickness da (m)	Source Length Sw (m)	Infiltration Rate I' (m/yr)	Mixing Zone d (m)	DAF
Unpaved	611.9	0.0021	8.19912	25.9	0.14	5.1	2.8
Paved	611.9	0.0021	8.19912	25.9	0.0086	2.9	17.8

C:/my briefcase/CNC/Zone E/swmu70/DAF calc.xls

K — the value for the hydraulic conductivity is based on interpolation of CH2M Hill's map of hydraulic conductivities (k.apr, 5.5 ft/day ~ 611.9 m/yr).

I — The hydraulic gradient is based on the distance (190 ft) between 3.8- and 3.4-foot shallow groundwater contours from Figure 2-6A (Zone E RFI, 1997).

da — The aquifier thickness is based on Figure 2-5B from the Zone E RFI, 26.9 ft.

Sw — The source length is the diagonally measured distance across SWMU 70 from eastern to western most corners (direction of groundwater flow) (85 ft ~ 25.9 m).

I' — Internal CH2MHILL Technical Memorandum, *Infiltration Variable Used in SSL Calculation*, 0.45 ft/yr for unpaved areas and 0.0283 ft/yr for paved areas, October 5, 20011.

d — is the smaller of the aquifier thickness (da) or the result of the mixing zone equation:

$$d = (0.0112\ Sw^2)^{0.5} + da\{1 - \exp[(-Sw\ I')/(K\ I\ da)]\}$$

Appendix I

REPORT OF RESULTS

Ferox[sm] Powder Injections

SOLID WASTE MANAGEMENT UNIT (SWMU) 70
CHARLESTON NAVAL COMPLEX
CHARLESTON, SOUTH CAROLINA

Submitted to:

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Figure 4. Trivalent Chromium concentrations in reactor vials over time.

Figure 5. Hexavalent Chromium concentrations in reactor vials over time.

Figure 6. Groundwater from SWMU-70 in reactor vials containing a) iron powder and soil after 30 days b) no iron powder

Figure 7. Chromium concentrations in sediments during treatability testing

Figure 8. pH values in reactor vials during treatability testing

Figure 9. ORP measurements in reactor vials during treatability testing

Figure 10. Dissolved oxygen in reactor vials during treatability testing.

Figure 11. Turbidity measurements made during the treatability tests in all reactor vials.

Figure 12. Injection hole locations at SWMU-70

Figure 13. Soil grain analysis for samples collected at SWMU-70, Charleston Naval Complex

Figure 14. Pressure-history curve collected from PF-1 (23 to 25 feet bgs).

Appendix

Appendix A	Laboratory Analysis Reports
Appendix B	Soil Core Log Sheets
Appendix C	Pressure-History Curves for all Injection Events
Appendix D	Iron Injection Distribution
Appendix E	Chain of Custody Forms

Acronyms

bgs	Below Ground Surface
CB	Chlorobenzene
CNC	Charleston Naval Complex
COPC	Constituents of Potential Concern
CVOC	Chlorinated Volatile Organic Compound
DCE	Dichloroethene
DO	Dissolved Oxygen
EPA	Environmental Protection Agency
HI	Hazard Index
HW	Heavy Wall
MCL	Maximum Contaminant Level
MW	Monitoring Well
ND	Not Detected
NJAL	New Jersey Analytical Laboratories
NJDEP	New Jersey Department of Environmental Protection
NS	No Sample
OD	Outside Diameter
ORP	Oxygen Reducing Potential
PCE	Tetrachloroethylene
PF	Pneumatic Fracturing
PPB	Parts per billion
PPM	Parts per million
pH	$= -\log [H^+]$
psig	Pounds Per Square Inch Gauge
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
RFP	Request For Proposal
SC	Soil Core
SCFM	Standard Cubic Feet per Minute
TCE	Trichloroethene
TTZ	Target Treatment Zone
VC	Vinyl Chloride
VOC	Volatile Organic Compound
ZVI	Zero Valent Iron

1.0 INTRODUCTION

This report addresses the Ferox^{sm} powder injection activities conducted by ARS Technologies Inc. (ARS) at the SWMU-70 site, Charleston Naval Complex in North Charleston, South Carolina from January 8, 2002 to January 28, 2002.

2.0 PROJECT BACKGROUND

The SWMU-70 site is located at the Charleston Navel Complex in North Charleston, SC, and includes an area containing the northwest corner of building 5 and the southwest corner of building 3 (**Figure 1**). Historical operations at the site included the use of a chemical dip tank that was used to treat wood with fire retardant chemicals. This tank was removed in 1981, when operations at the site began receiving pre-treated lumber. The overall goal for this project is to reduce concentrations of hexavalent chromium in ground water to levels below 100 micrograms per liter (µg/L), or to the maximum extent possible. The area shown in **Figure 1** and designated as the Target Treatment Zone (TTZ) was the boundary for the treatment operations and encompasses an area of approximately 120-feet by 150-feet.

SWMU-70 contains numerous buildings with both active and inactive utilities prevalent throughout the site. The majority of the site is asphalt paved.

2.1 Regional Site Geology and Hydrogeology

The geology at the SWMU-70 site consists of predominantly fine sands and sandy silts interbedded with sand to depths of 24 feet bgs. Thin plastic clay stringers have also been identified at depths greater than 15 feet bgs. An aquitard boundary is present at approximately 24 to 31 feet bgs consisting of dense dark olive silty clay.

Soil and groundwater sampling indicates that antimony, chromium, chloroform, 1,2-DCE, PCE, and TCE are present in deep groundwater at concentrations that equal a risk above $1x10^{-6}$ and /or a Hazard Index (HI) above 1. Chromium was reported as the source of the HI. Aluminum, antimony, cadmium, chromium, benzene, chlorobenzene (CB), 1,2-DCE (total), and TCE were identified in the shallow groundwater as constituents of potential concern (COPS). Chromium was reported to be the most significant component of the HI at monitoring wells E070GW001, E070GW002, and E549GW003. Concentrations in E070GW01D were reported as high as 52,500 ug/L in previous site investigations.

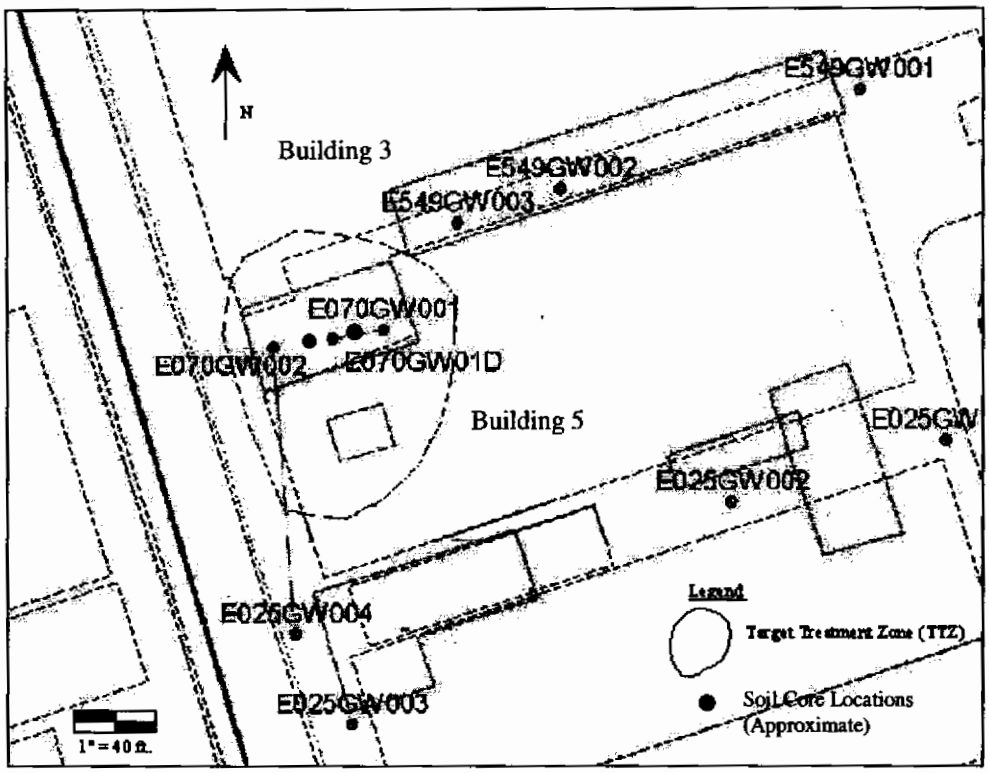
2.2 Groundwater and Soil Sampling

Groundwater samples were collected within the target zone on September 27, 2001 for use in baseline analysis and for preparation of reactor vials used in a bench scale treatability study. Groundwater samples were collected from well E070GW01D, where historically high elevations

of Cr(VI) have been documented. The groundwater sampling was conducted in accordance to low-flow protocol in order to provide accurate field parameters such as dissolved oxygen (DO), oxidation-reduction potential (ORP), and pH.

Two soil cores were also collected from the TTZ in locations on either side of well E070GW01D using a direct push drill rig (**Figure 1**). These cores were collected in butyrate sleeves, capped, sealed, and sent to ARS where they were logged and sampled immediately upon arrival.

Figure 1. Location of TTZ at SWMU-70, Charleston Naval Complex, SC.



3.0 TECHNOLOGY BACKGROUND

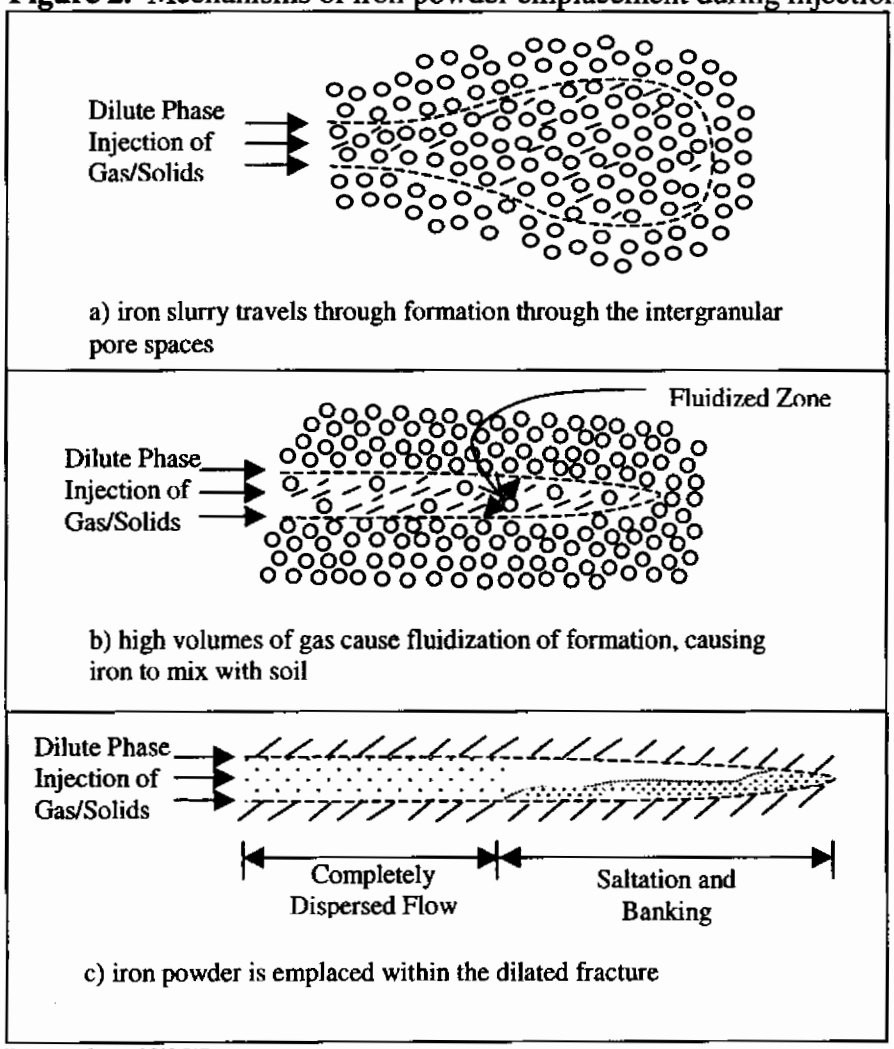
3.1 Ferox[sm] Treatment Technology

ARS' Ferox[sm] technology is a patented in-situ subsurface remediation process for the treatment of soluble metals. The Ferox[sm] technology involves the subsurface injection and dispersion of specific quantities of highly reactive zero-valent iron powder into saturated or unsaturated contamination zones.

Physical characteristics of a soil will typically govern the emplacement mechanism of the zero-valent iron powder. These mechanisms can be characterized into three categories; dispersion, fluidization, or fracture filling (**Figure 2**). In porous materials such as gravel, the injection of

iron powder will result in the dispersion around soil or rock particles, and will travel as far as the energy of the gas carrying the particle maintains enough energy to keep it from settling. In loose sand deposits, the injection of high volumes of gas and slurry will result in local fluidization of the formation causing iron particles to get "mixed" within the soil matrix. In more cohesive soils such as clays and silts, the high volume/pressure injections will result in pneumatic fracturing of the formation. The emplacement of iron will be governed by the flow of gas in the fractures and the iron particles will settle as the kinetic energy decreases. In field applications of the injection process, iron powder emplacement within a geologic formation will typically exhibit more than one of these mechanisms.

Figure 2. Mechanisms of iron powder emplacement during injection.



From U.S. Patent 6,012,517

3.2 Zero-Valent Iron Reduction of Cr+6

When naturally occuring in groundwater, chromium occurs in two states, Cr(III) and Cr(VI). The ionic state of chromium is strongly dependent on the pH and E_h of the groundwater. The Cr(III)

ionic state exists as $Cr(OH)^{2+}$ in the pH range of 4 to 6.5 and exists as an insoluble hydroxide $Cr(OH)_3$ when the pH is approximately 6.5 to 10.5.

Cr(VI) species are more likely present in alkali and aerobic environments. In groundwater Cr(VI) exists as oxyanions $HCrO_4^-$ (dichromate) at pH less than 6 and CrO_4^{2-} (chromate) at pH greater than 6. Because Cr(VI) species are charged negatively, their sorption onto most soil particles (having the same negative charge) is poor and decreases at higher pH values. These chromate oxyanions are of greatest environmental concern due to their toxic and carcinogenic properties and their greatly increased subsurface mobility when compared to a relatively less toxic and immobile Cr(III) species.

Redox reaction with ARS' Ferox^{SM} ZVI powder involves Fe^0 oxidation with dissolved oxygen and subsequent chromate ion reduction with Fe (II) cations.

In a reducing environment, the iron will react following equation (1);

$$Fe^0 + 2H^+ = Fe^{2+} + H_2 \qquad (1)$$

When oxygen is present, the iron will react following equation (2);

$$Fe^0 + 1.5O_2 + 6H^+ = Fe(OH)_3 + 1.5H_2 \qquad (2)$$

With the presence of chromate, the net reaction will be;

$$Fe^0 + CrO_4^{2-} + 4H_2O = Fe(OH)_3 + Cr(OH)_3 + 2OH^- \qquad (3)$$

Standard electrode potentials at 25^0C are –440 mV for the reaction $Fe^0 + 2e^- = Fe^{2+}$ and -0.771 mV for the reaction $Fe^{2+} + e^- = Fe^{3+}$. The ZVI iron provides a source of ferrous iron without having to introduce a ferrous salt, such as ferrous sulfate or ferrous chloride. Sulfate or chloride can tend to bring metals into solution. The reaction of ferrous iron alone has sufficient electrochemical reduction potential to reduce Cr(IV) to the insoluble Cr(III), however the ZVI provides the additional 440 mV for reduction of Cr(VI), without introducing other anions into the subsurface system.

Reactions (1) and (2) increase pH of the system and generate insoluble Cr(III) hydroxide or solid solution $(Cr_x Fe_{1-x})(OH)_3$ as a result of the chromate reduction. In most cases, the hydroxide that is created is buffered by the soil in the system.

Once reduced, Cr(III) is significantly more stable than Cr(VI) as it forms complexes with ferrous iron and has the tendency to precipitate out of solution. The reversal of the chromium oxidative state from trivalent to hexavalent is highly unlikely and can only occur under extreme oxidizing conditions not expected to be encountered under natural conditions at SWMU-70. That is, there are no known naturally occurring environmental conditions that will oxidize Cr(III) to Cr(VI).

4.0 BASELINE ANALYSIS

Two groundwater samples were collected in 40ml sample vials and sent to New Jersey Analytical Laboratories (NJAL) for analysis of Cr(VI) and Cr(total), respectively. In addition, one soil sample was collected and sent for Cr(VI) and Cr(total) analysis using Standard Methods 3500 or EPA method 7190 (Chromium – Atomic Adsorption, Direct Aspiration). These values provided baseline data that was used in the design of required iron dosages in the treatability study.

In addition, CVOCs were analyzed due to the competing nature of the reactions with iron powder, specifically the degradation of TCE. Historical records indicate that TCE, as well as its associated daughter products have been identified in groundwater from SWMU-70. The presence of significant concentrations of CVOCs would require increased dosages of iron powder.

To determine the concentrations of chlorinated VOCs in groundwater samples, EPA methods 5030B (Purge-and-Trap for Aqueous Samples) and 8021B (Aromatic and Haloginated Volatiles by GC Using Photoionization and/or Electrolyte Conductivity Detectors) were used. These methods are referenced in the most recently published edition of EPA publication SW-846, "Test Methods for Evaluating Solid Waste".

5.0 TREATABILITY STUDY SET-UP

The purpose of the treatability study was to generate site specific data to determine the target dosage of Ferox^{SM} powder needed for field injections.

The treatability of Cr(VI) reduction with Fe^0 powder was carried out following the specifications presented in the workplan, submitted to CH2M-Jones on September 21, 2001. The treatability test was conducted in sealed 250ml plastic micro-batch reactors that were sealed without headspace with defined quantities (approximately 50g to 100g) of contaminated soil, F-200 iron powder, and a minimum of 100ml of site groundwater. The soil used to create these reactors was taken from the soil cores collected within the TTZ, and was selected to be most representative of the site conditions.

Iron to Cr(VI) mass ratios of 1000:1 and 4000:1, respectively, were used in the treatability test based on successful results using these ratios in past studies of Cr(VI) reduction using zero-valent iron.

Once all micro-batch reactors were prepared, they were placed in a rotator and mixed at a speed of 10rpm. The purpose of mixing during laboratory bench-scale testing is to determine the ideal reaction kinetics with site-specific groundwater and soil. Although this setting would be difficult, if at all possible, to achieve in a field application, it provides the minimum required

dosage of iron needed for treatment. The amount of iron needed in field applications is then calculated by using this base amount, while taking into account subsurface heterogeneities including soil and contaminant concentrations, as well as a conservative factor of safety. Concentrations of Cr(VI) and Cr(total) in the micro-batch reactors containing iron powder and the control vials were measured at days 0, 5, 10, and 30.

A separate micro-batch reactor was used as a control for each iron powder to contaminant ratio for each measurement at the designated days (i.e. the micro-batch reactors were sacrificed during each analysis).

All samples were prepared and analyzed at NJAL following EPA protocol. Split Hexavalent chromium analysis for days 0 and 30 were conducted at a certified laboratory for verification. The outline for this testing was presented in the work plan, submitted to CH2M-Jones on September 21, 2001.
For each reactor vial, analysis included total hexavalent chromium and total chromium in aqueous phase, total chromium in soils, and total hexavalent chromium in soils. Cr(III) was determined as the difference in the two values. All aqueous samples collected in the field for hexavalent chromium were filtered using a .45μm filter.

5.1 Determination of Cr(III) and Cr(VI) in Reactor Vials

The chromium concentrations were determined in all sediment-water slurry samples. To determine the concentrations of Cr(VI) during the baseline and treatability testing, US EPA Methods 7190 and/or Standard Methods 3500 were used. For days 0 and 30, split hexavalent chromium analysis was performed as a verification of results. The split hexavalent chromium analysis is a more expensive colorimetric method resulting in values that are slightly more accurate. Prior to analysis, samples were kept at 4°C. Due to the difficult and expensive nature of analyzing for Cr(III) in the laboratory, it was calculated as the difference between total and hexavalent chromium.

5.2 Other Chemical Parameters

In addition to Cr and CVOC analysis, geochemical parameters such as pH, ORP, and DO were measured.

5.2.1 pH Measurements

The pH of samples was determined in accordance with EPA method 9045C using a standard glass electrode. As a result of treatment with iron powder, an increase in pH was expected and was therefore measured throughout the treatability study.

5.2.2 ORP Measurements

The oxidation-reduction potential (ORP) is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. During the treatability study, the ORP was monitored using an Ag/AgCl reference electrode. ARS is not aware of any EPA methods for ORP measurements, therefore the manufacturer's (e.g. Orion Research, In. or equivalent) instruction on the use of the electrode and meter was followed.

5.2.3 Dissolved Oxygen

As the reduction of Cr(VI) progresses, the amount of Dissolved Oxygen (DO) in the system will decrease. Changes in DO, therefore, can provide supplemental evidence that reduction reactions are taking place. DO in baseline analysis could also indicate that proper field conditions are present for the reduction of Cr(VI).

5.2.4 Turbidity

Turbidity was measured in all reactor vials during the treatability study to determine if there was a correlation between reducing trends and turbidity. It was also suspected that higher turbidity levels could result in elevated levels of chromium due to bonding between chromium molecules and particles within the groundwater.

6.0 TREATABILITY RESULTS

6.1 Introduction

Groundwater samples from all prepared reactor vials were analyzed for total and hexavalent chromium at 0, 5, 10 and 30 days from the start of the test, respectively. For each designated day, groundwater from a control vial and two reactor vials with different iron to contaminant mass ratios (1000:1 and 4000:1) were analyzed. The amount of trivalent chromium was determined as the difference between the total and hexavalent chromium. Sediment from the reactor vials was analyzed for total and hexavalent chromium at days 0 and 30. In addition, geochemical parameters including pH, oxidation-reduction potential (ORP), and dissolved oxygen (DO) were analyzed throughout the testing. These parameters were analyzed to determine the response of the system to the reduction of hexavalent chromium by zero-valent iron. The following sections discuss these results.

6.2 Groundwater

Table 1 and Figures 3, 4, and 5, present all chromium analysis conducted in groundwater samples collected from the reactor vials from days 0, 5, 10, and 30. Results indicate total reduction of hexavalent chromium in groundwater after 30 days in reactor vials containing iron to contaminant ratios of both 1000:1 and 4000:1. A significant drop in the control is observed after five days (from 34.6mg/l to 17.3mg/l) but remains constant for the remainder of the study. This initial drop is attributed to natural reduction of the hexavalent chromium in the reactor vials, possibly by biological processes.

Total chromium in groundwater also decreases to near zero values after 30 days **(Figure 3)**. This drop in total chromium is attributed to the reduction of hexavalent chromium (naturally soluble) to trivalent chromium (naturally insoluble). As the reduction of hexavalent chromium progresses, there is a corresponding drop in total chromium in groundwater. Conversely, as hexavalent chromium reduces to trivalent state and precipitates from solution, an increase in trivalent chromium over time is seen in the sediments (**section 9.2.3**). The decrease in total chromium in the control vials is likely attributed to natural biological processes.

The concentration of trivalent chromium in groundwater, calculated as the difference between total and hexavalent chromium, is observed to decrease with time in all reactor vials **(Figure 4)**. Since trivalent chromium is naturally insoluble, the higher levels at early times may be a result of trivalent chromium that is suspended in solution and subsequently analyzed. The decrease in trivalent chromium over time is greater in vials with higher iron concentrations and may be a result of the Cr^{+3} forming complexes with the iron powder.

Table 1. Chromium analysis results from treatability testing.

	Chromium Concentrations in Reactor Vials (mg/L)											
	Control				**1000:1**				**4000:1**			
Days	**0**	**5**	**10**	**30**	**0**	**5**	**10**	**30**	**0**	**5**	**10**	**30**
Total Chromium	77	36	41	20.7	77	12.1	7.9	0	77	7.6	10.4	0.3
Hexavalent Chromium	34.6	17.3	17.3	19.2	34.6	0	2.9	0	34.6	1.1	6.4	0
Trivalent Chromium*	42.4	18.7	23.7	1.5	42.4	12.1	5	0.3	42.4	6.5	4	0.3

***calculated as the difference between Total and Hexavalent chromium**

Figure 3. Total Chromium concentrations in reactor vials over time.

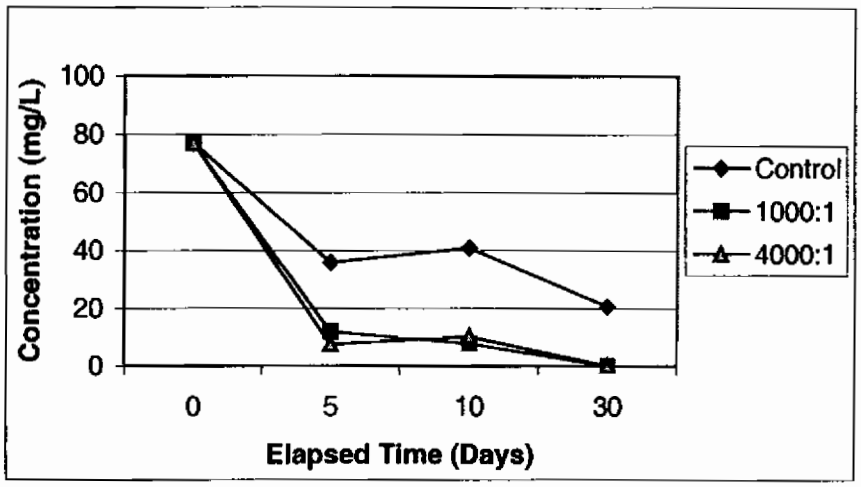


Figure 4. Trivalent Chromium concentrations in reactor vials over time.

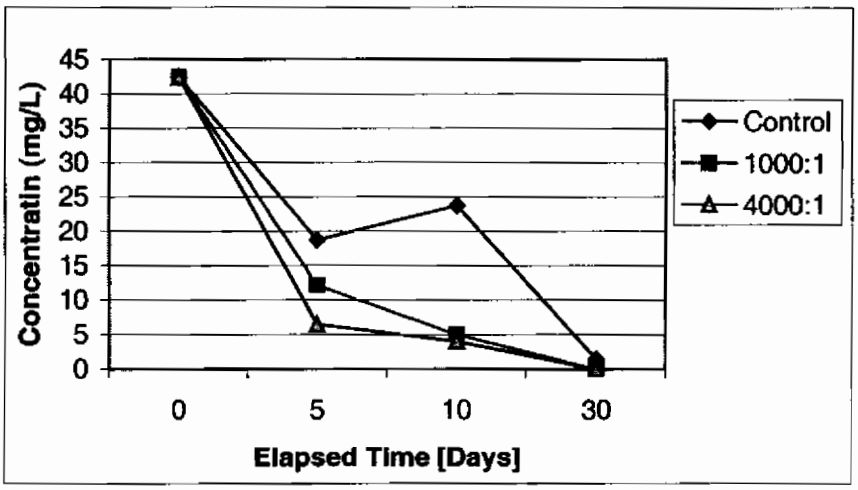
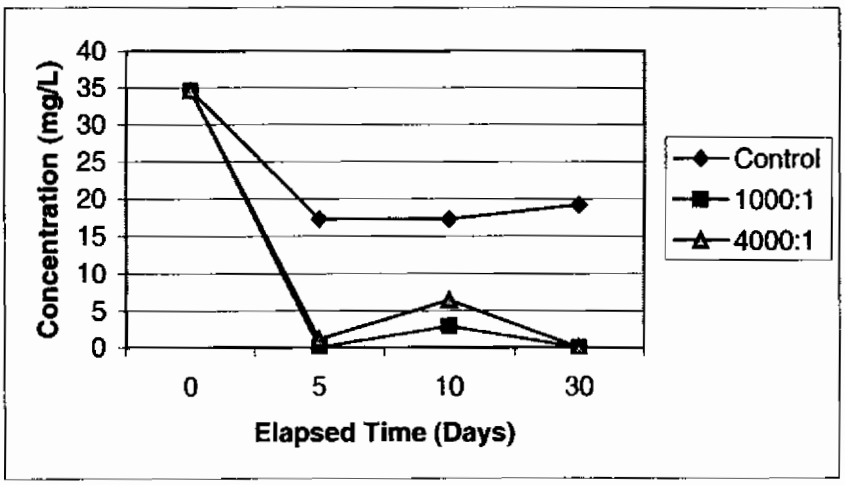
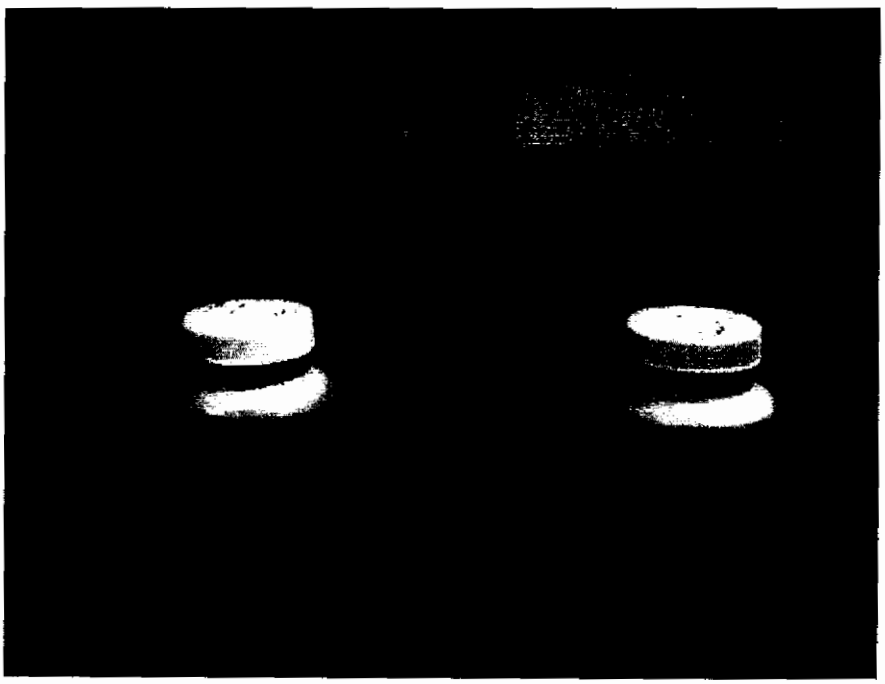


Figure 5. Hexavalent Chromium concentrations in reactor vials over time.



The treatment effectiveness of the iron powder with groundwater containing hexavalent chromium can be seen visually between the Day 0 and Day 30 reactor vials (**Figure 6**). Groundwater collected from the treatment area during baseline sampling has a deep yellow color (Figure 7b). After 30 days, the water is clear of the yellow color, which is likely a direct result of the hexavalent chromium precipitating from solution due to reductions caused by the ZVI powder.
7

Figure 6. Groundwater from SWMU-70 in reactor vials containing a) iron powder and soil after 30 days b) no iron powder



Results from days 0 and 30 for reactor vials containing iron to contaminant ratios of 1000:1 and 4000:1 were analyzed using a split-hexavalent chromium technique for verification purposes. This technique offers a slightly more accurate representation but is much more expensive to conduct. These results are presented in **Table 2** and indicate that the results obtained using the chlorimetric technique correlated well with those obtained using the split-hexavalent chromium technique.

Table 2. Comparison of sample analysis using colorimetric and split-hex techniques

Parameters	Day 0		Day 30			
	Control		1000:1 Fe to Contaminant ratio		4000:1 Fe to Contaminant ratio	
	Colorimetric	Split-Hex	Colorimetric	Split-Hex	Colorimetric	Split-Hex
Total Chromium	77	65	ND	ND	ND	0.3
Hexavalent Chromium	34.6	35.3	ND	ND	ND	ND
Trivalent Chromium	42.4	29.7	ND	ND	ND	0.3

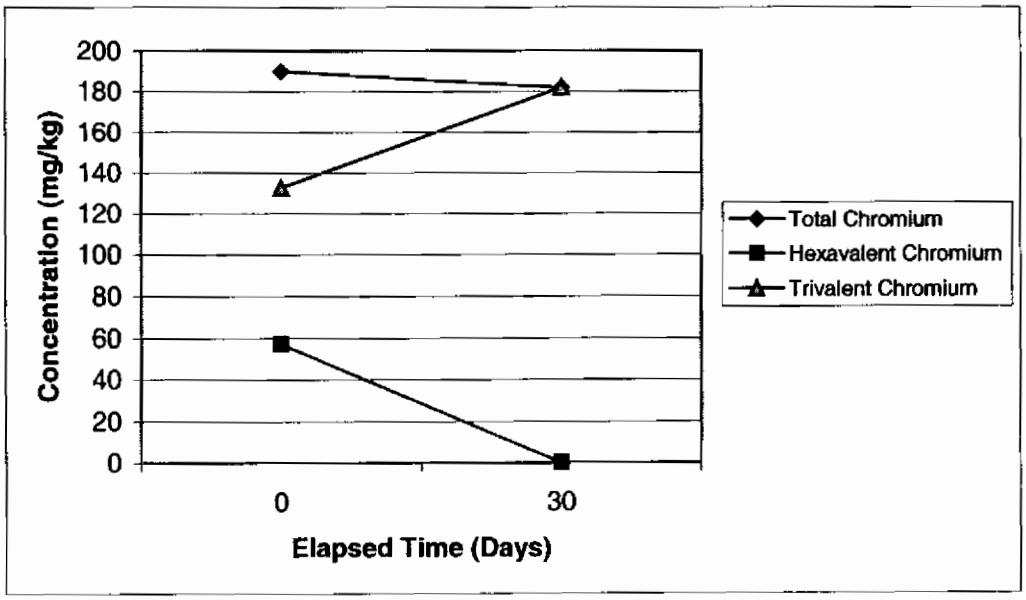
6.3 Sediment

Chromium analysis was performed on sediments from the reactor vials on days 0 and 30. Due to errors in the chain of custody forms sent to the laboratory, no analysis was performed on days 5 and 10. **Table 3** and **Figure 7** present the results from these analyses and indicates total reduction of hexavalent chromium after 30 days, while total chromium remains relatively stable. The increase in trivalent chromium is a result of hexavalent chromium reducing to trivalent state.

Table 3. Chromium results in sediments during treatability testing.

Parameters	Concentration (mg/kg)	
	Day 0	Day 30
Total Chromium	190	182
Hexavalent Chromium	57.3	0
Trivalent Chromium	132.7	182

Figure 7. Chromium concentrations in sediments during treatability testing



6.4 Geochemical Parameters

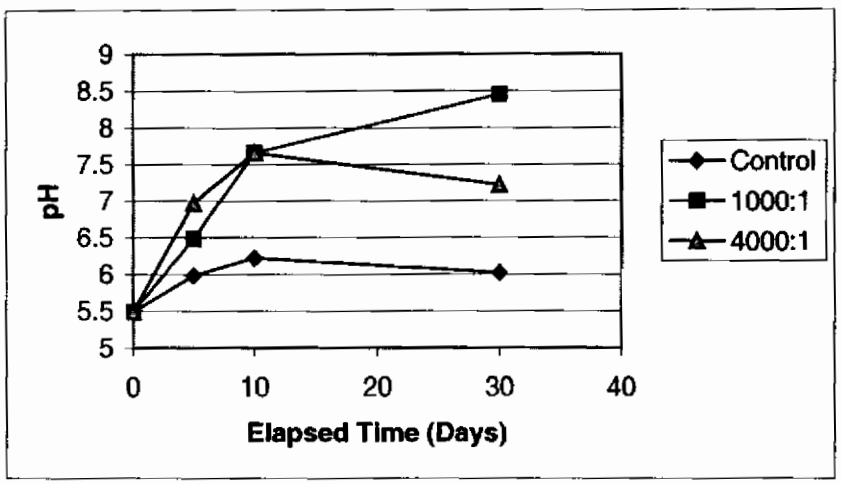
Geochemical parameters including pH, ORP, DO, and turbidity were measured from all reactor vials throughout the treatability study. These parameters assist in determining the redox conditions that take place during the reduction of hexavalent chromium and can be used as guidelines when monitoring the treatment system in the field.

6.4.1 pH

pH values in reactor vials containing both 1000:1 and 4000:1 mass ratios of iron to contaminant show an increasing trend in the first 10 days (**Figure 8**). This trend is indicative of the reductive process by zero valent iron and is caused by the increased production of hydroxyl ions [OH^-]. After 30 days, pH levels in the reactor vial containing an iron to contaminant ratio of 4000:1 is shown to decrease and is likely due to hydroxyl ions precipitating with iron, forming ferric hydroxides. pH values in the reactor vial containing an iron to contaminant ratio of 1000:1 continues to increase at day 30.

The control vial indicates a low initial pH but maintains a steady value from 6 to 6.3 from days 5 through 30.

Figure 8. pH values in reactor vials during treatability testing

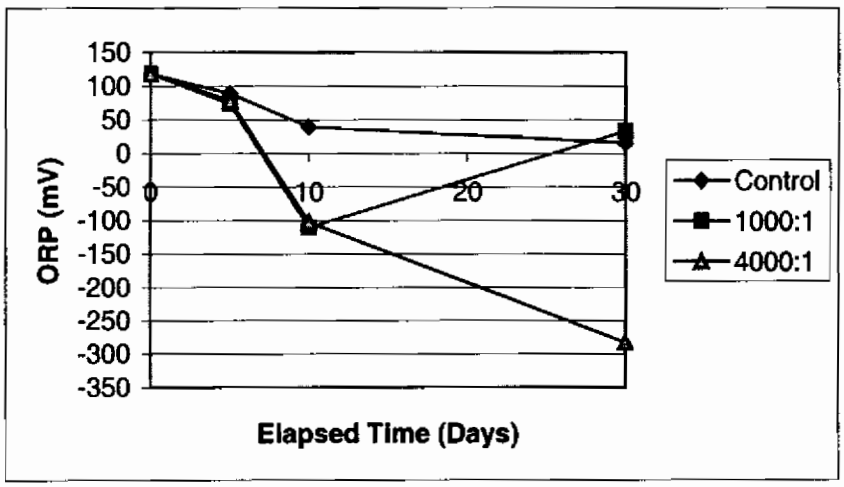


6.4.2 ORP

ORP measurements from reactor vials show a significant decrease over the initial 10 days (**Figure 9**). This indicates that the system is becoming more reductive over time due to the presence of the zero-valent iron powder. After 10 days, the ORP values in the reactor vial containing an iron to contaminant mass of 1000:1, increase to positive values indicating that the system is returning to an oxidative state. In the vial containing an iron to mass ratio of 4000:1, the reductive trend continues to 30 days, becoming more reductive over time. The fate of the iron after the reactions are complete, will depend on the ambient conditions. If

conditions remain reducing, then ferris iron will remain in solution. Under oxidizing conditions, the iron will precipitate as ferric iron.

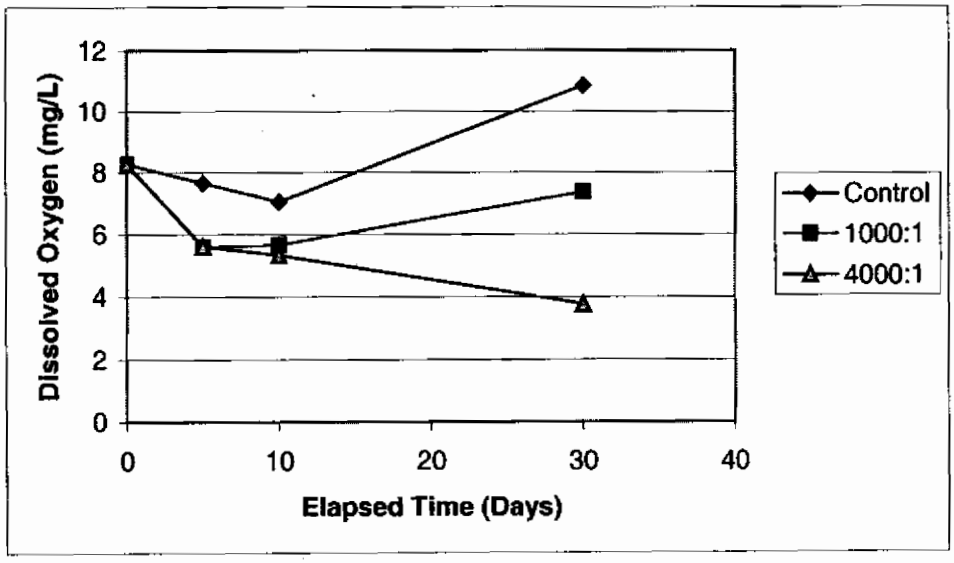
Figure 9. ORP measurements in reactor vials during treatability testing



6.4.3 Dissolved Oxygen

Dissolved oxygen measurements made during the treatability test are shown in **Figure 10**. During the first ten days, the dissolved iron concentrations are observed to decrease, which is indicative of the oxidation of the zero-valent iron. This decreasing trend continues in the reactor vial containing an iron to contaminant ratio of 4000:1, however, dissolved oxygen concentrations increase in the control and the 1000:1 reactor vial at day 30. It is unclear what mechanism is causing this increase in DO, but may be a result of hydroxide ions exchanging with oxygen present in the soil, or potentially a leak in the system. Based on ORP values in the previous section, these dissolved oxygen concentrations seem unrealistically high and are likely a result of a leak in the system.

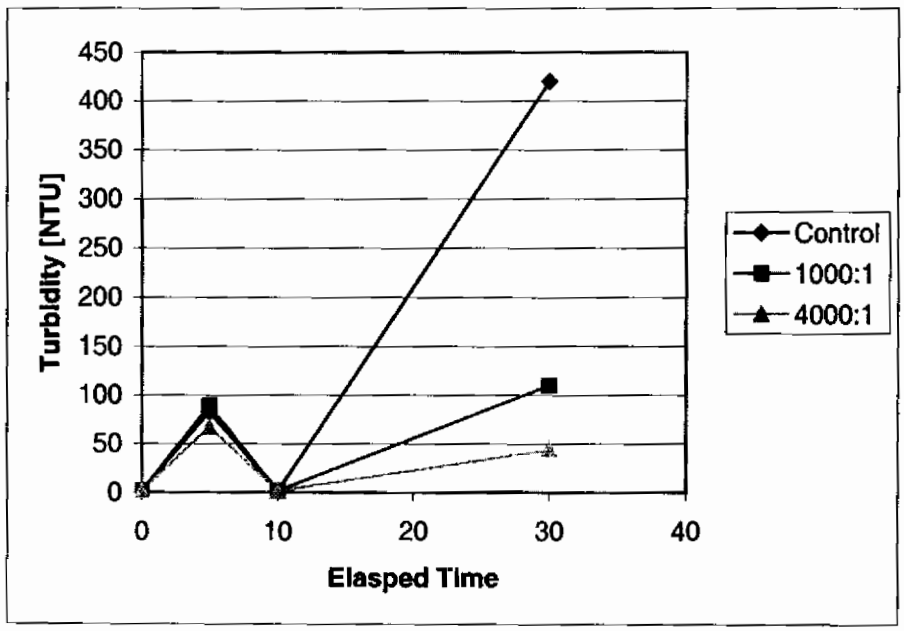
Figure 10. Dissolved oxygen in reactor vials during treatability testing.



6.4.4 Turbidity

Turbidity was measured in all reactor vials during the treatability study to determine if there was a correlation between reducing trends and turbidity. Turbidity measurements are presented in nephelometric units and represent the amount of particles that are present in the groundwater samples. **Figure 11** shows the results from the treatability study and indicates that a substantial increase in turbidity had occurred during the final sampling round in the control vial. Increases were also evident in the reactor vials containing iron to contaminant mass ratios of 1000:1 and 4000:1. It is unclear what may have caused this increase but may be due to accidental disturbance of the samples prior to measurements. No trend between the turbidity values and the reduction of Cr^{+6} is evident.

Figure 11. Turbidity measurements made during the treatability tests in all reactor vials.



6.5 Conclusions

Treatability lab testing of hexavalent chromium reduction with zero-valent iron powder indicates that both a 1000:1 and 4000:1 iron to contaminant mass ratio was sufficient to reduce hexavalent chromium to non-detectable levels in both groundwater and soil after 30 days. However, geochemical parameters indicate that after 30 days, the reactor vials containing a 4000:1 iron to contaminant mass ratio maintained a reducing environment while oxidizing trends were reported in the vial containing an iron to contaminant ratio of 1000:1.

Based on these results, an iron dosage of greater than 1000:1 was determined to be adequate to reduce the concentrations of hexavalent chromium at SWMU-70. A design dosage of 2500:1 was selected, which would provide a conservative factor of safety and ensure that target treatment levels would be reached.

7.0 INTERNAL QUALITY CONTROL

Reliable sampling and analytical measurements of environmental samples requires continual monitoring and evaluation of the measurement processes involved (i.e. quality assurance). To insure valid data generation, a scientifically sound and strictly adhered to quality control program must be incorporated in sample collection and the analytical laboratory program. Such a QC program employs a prescribed sequence of routine procedures to control and measure the quality of data generated. Inherent to this program is the use of scientifically sound sample collection, approved analytical methods and calibration protocols.

7.1 QC for Sample Preparation

All field groundwater samples were performed in accordance with the NJDEP low flow sampling protocol. All samples were promptly collected, sealed, properly labeled and shipped overnight to NJAL for analysis. Groundwater for the treatability study was stored in a cool room at 4°C until reactor vials were prepared. Temperature blanks were placed inside sample-storage coolers to ensure adequate maintenance of temperature during transportation. Proper documentation including the chain of custody and equipment calibration record were followed.

Similarly, all soil samples were shipped promptly to ARS on completion of sampling, with proper documentation including chain of custody (Appendix E).

7.2 QC for Laboratory Analysis

QA/QC measures for EPA methods and 8021B, 7190, and Standard Methods 3500 were followed as outlined in the workplan.

7.2.1 Method/Reagent Blanks

All parameters analyzed in the laboratory require the analysis of a method or reagent blank, with each batch of samples analyzed, or every 20 samples, whichever is more frequent. A method blank consists of an aliquot of reagent water carried through all preparation and analysis steps, and is designed to document that the analytical equipment and reagents are free of contamination and/or interferences.

7.2.2 Duplicate Injection Analysis

Duplicate injections were used to evaluate the precision of chromium analysis. The data from duplicate injections of the first and each subsequent eighth sample in a batch will generate RPD (12.5% frequency). The acceptance criteria are a deviation of duplicate concentrations of not more than 15% from the average value.

7.2.3 QC Check Standard

At least three calibration standards containing defined quantities of contaminant of concern were prepared from purchased certified reagents or their mixtures dissolved in methanol and sealed in glass ampoules. The prepared standards were stored in a refrigerator. An aliquot of these standards was analyzed daily as a means of verifying accuracy of the calibration curve. Deviation of standard concentrations should not exceed 15% from the average value. Otherwise, all standards will be analyzed and recalibrated.

7.2.4 Dosage of Samples for Analysis

All analytical data for soil and groundwater analysis should be within the calibration curve data. Since the concentration levels of the targeted VOCs in soil and groundwater may not be within the calibration curve, corrections in volumes of samples injected into the GC column (i.e. sample dilution) will be undertaken in order to receive results within the calibration curve.

For Chromium analysis, enough known samples should be sampled to determine estimates for the method detection limit and linear calibration range.

7.2.5 Corrective Action

The need for corrective action can potentially come from several sources: equipment malfunction, QA/QC checks outside the acceptance criteria, and noncompliance with sampling/analysis/QA requirements. In all instances, the individual directly performing the measurement task will be responsible for identifying any existing or potential problems with the protocols, equipment or method. If the individual identifying the problem can correct it independently, such corrective action must take place before any further analysis occurs.

The corrective actions to be taken must be determined on a case by case basis, taking into account the nature of the problem and the extent of the error. If at any time during analysis a process is out of control, corrective actions shall be taken and documented with regard to:

- What actions were taken to bring the process back into control.
- What actions were taken to prevent recurrences of the out of control situation.
- What was done with data obtained while the process was out of control.

7.3 QC for Treatability Studies of Chromium Reduction

The treatability studies of the chromium reduction with iron powder were carried out in a manner that will result in accurate representative results. In order to ensure accurate and representative results, all of the materials and equipment utilized during the treatability study met NJDEP criteria established in the NJDEP "Field Sampling Procedures Manual", May 1992.

The micro-batch reactors utilized for the treatability study consisted of high-density polyethylene wide-mouth jars, which were sealed with plastic screw caps. The micro-batch reactors were filled with soil/ groundwater slurry without headspace. The soil samples were sacrificed after their collection for analysis. This sacrificial approach ensures that all of the target contaminants are removed, thus eliminating the complexities of adsorption of the contaminants to soil or the surface of the micro-batch reactor.

Analysis of the control samples containing soil/groundwater slurry without added iron powder served to determine the percent of Chromium lost due to unexpected reduction from other processes.

The QA/QC measures for chromium analysis are similar to those mentioned in the previous section (blank check, double injection, evaluation of calibration results, correction of sample's volumes for analysis and correction actions).

8.0 PROJECT OBJECTIVE

This demonstration project will be used to evaluate the effectiveness of zero-valent iron (ZVI) in reducing hexavalent chromium in groundwater at SWMU-70. The goal is to reduce the concentrations to the MCL of 100ug/L in the Target Treatment Zone (TTZ).

8.1 Project Organization and Scope

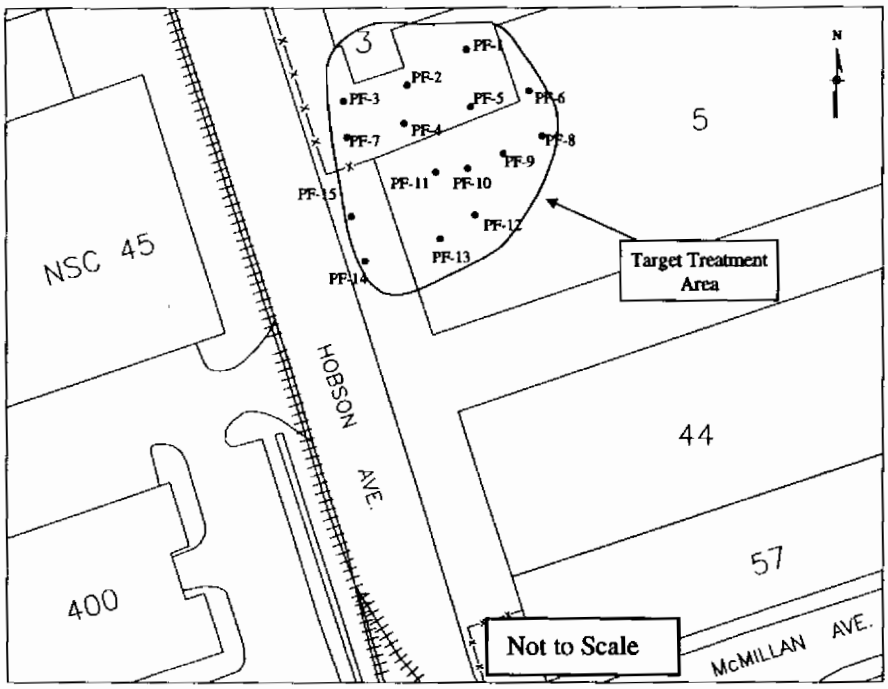
ARS performed this field work under subcontract (number N62467-99-C-0960) to CH2M-Jones, LLC. The project began with a treatability study of soils and groundwater from the site to determine the feasibility of the Ferox[sm] process in the site-specific environment, as well as kinetic rates and target dosages of iron powder needed to meet treatment objectives. These findings are discussed in detail in a subsequent section and were used in designing the field implementation. Upon completion of the treatability study, ARS then mobilized to SWMU-70 and proceeded to inject the designed dosage of ZVI in fifteen boreholes targeting 11 to 31 feet bgs.

8.2 Well Installation and Site Layout

Heavy wall (HW) casing with a 4-inch inside diameter was installed using a Geoprobe 66DT drill rig prior to targeting each injection location. This approach provided a significant advantage over installing all casings at once by minimizing the amount of potential vent hole locations. Each injection location was grout sealed immediately upon completion.

Fifteen injection locations were installed to encompass the TTZ. These locations were determined during a site visit to SWMU-70 on December 14, 2001 by ARS and CH2M-Jones personnel. These locations were placed not only in areas to ensure adequate distribution of iron in the subsurface, but also in areas which could be accessed by the Geoprobe drill rig and the Ferox[SM] injection equipment. These locations are shown in **Figure 12.**

Figure 12. Injection hole locations at SWMU-70



Due to an undulating boundary between the sandy deposit and the Ashley formation, depth of casing advancement varied throughout the site. In some locations, iron injections occurred as deep as 31 ft bgs, while in other areas borehole advance stopped at 27 ft. Casing advancement was terminated in each location when further progress of the casing became limited or stopped.

9.0 FEROX[SM] INJECTION OPERATIONS

9.1 Injection Procedures

Ferox[sm] injections were conducted within 15 boreholes between January 8 and 28, 2002. At shallow depths, typically above 15 ft below ground surface, the formation was loose enough that hydraulic pumping of the iron slurry was sufficient to penetrate the formation. In these instances, the mechanism for iron emplacement is most likely due to dispersion and fluidization. In deep applications, where pneumatic fracturing has occurred, the iron emplacement mechanism would follow conventional fracture flow characteristics as discussed in **section 3.1**. Fluidization is believed to have been the predominant emplacement process occurring at gas injection depths shallower than 28 ft bgs. This is discussed further in the results section of this report (**section 9.0**).

Each injection event consisted of a 5 to 15-second injection duration and encumbered a discrete 2-foot linear interval within the borehole. The intervals were sealed using pneumatic packers that were inflated above the target zone. Starting at the deepest interval, injections were performed working upwards in the borehole. As the injection equipment was raised, the sandy formation collapsed under the equipment, forming a boundary layer below the injection nozzle and negating the need for a lower straddled packer.

During each injection, data parameters including pneumatic pressure influence at surrounding monitoring points, ground surface heave measurements and visual field observations were made and recorded. Additionally, the pressure in the injection interval was logged electronically using a pressure transducer and datalogger system for later analysis and evaluation.

9.1.1 Initiation and Maintenance Pressures

During injections within the initial two boreholes, pressure readings were recorded by a pressure transducer located in-line with the high-pressure gas supply conduit leading to the down-hole injection nozzle. This transducer allowed the pressure within the supply line to be recorded 8 times per second during the fracturing injections. Critical data obtained from the pressure transducer includes a pressure-history graph of how the formation responds to injections. In finer sediment zones such as clays and silts, examination of the pressure-history curve illustrates a clear initiation pressure and maintenance pressure, which is direct evidence of fracture propagation. The fracture initiation pressure represents the pressure at which the formation yields (or fractures). The fracture maintenance pressure represents the pressure required to overcome overburden stress and dilate induced fractures. The graphical representation of this data plotted over time provides insight to the *in situ* stresses of the formation, and serves as confirmation that fracturing has occurred.

9.1.2 Pressure Influence at Adjacent Wells

During all injections, pressure gauges were installed at existing wells and boreholes within the target area. By monitoring the pressure influence in this manner, information about the flow direction of gas or the propagation of fractures, and the understanding of pressure influence within the formation can be attained. This data can be used to quantify the degree and orientation of the subsurface gas flow and in turn the emplacement of the Ferox^{SM} material.

At monitoring well locations, pressure gauges were secured to the center rods of packer assemblies, which were inflated within the riser pipe. The pressure gauges were equipped with a drag arm indicator that measured the maximum gas or hydraulic pressure influence at each location during the injections.

9.1.3 Ground Surface Heave Monitoring

Ground surface heave measurements were taken during each injection using surveying transits in conjunction with heave rods. The heave rods were placed within six feet of the injection well in use. During each gas injection, the rods were monitored with the survey transit to determine the maximum amount of upward motion (surface heave), and the post injection resting position, or permanent displacement, of the ground surface (residual heave). The presence of a stiff overlying cap at the site in the form of asphalt (outside the building) or concrete (inside the building), significantly effects surface heave measurements. These stiff layers can, in some cases, prevent surface or residual heave. In contrast, exaggerated movement can result when these surfaces do heave. Due to the stiff nature of these surfaces, movement at one point will invariably result in movement all around that point at distances that may not be representative of actual fracture propagation or pore space dilation. Therefore, these data parameters serve only as secondary data to quantify if fracture propagation did occur.

9.1.4 Structural Movement Monitoring

Prior to implementation of any field work, structural computer modeling of building 5 was conducted to insure that the Ferox^{SM} injection operations would have no detrimental impact to the structure. These results were presented to CH2M-Jones in a report entitled "Gas Injection Structural Analysis," submitted on November 9, 2001. Based on the modeling results, movement criteria of 0.5-inches for the structural supports was assessed as being a safe limit. During all injection events, the closest supporting column was monitored for movement using a graduated tape and a surveying transit. In addition, crack gauges were installed on all existing cracks on the outside of the building prior to beginning field work, and monitored throughout the injection activities.

10.0 RESULTS

10.1 Baseline Sampling

On September 27, 2001, groundwater samples were collected from well EO70GW01D within the TTZ using low flow sampling protocols as outlined by the Environmental Protection Agency (EPA). These samples were sent to NJAL for analysis of chromium compounds to verify background levels. CVOC analysis was also performed to confirm that high levels of chlorinated compounds were not present.

Table 4 presents all baseline data. Results confirm minimal amounts of CVOCs and relatively high levels of hexavalent chromium (41mg/L), consistent with levels reported in the RFP. All laboratory reports are presented in **Appendix A**.

Table 4. Baseline analysis of groundwater taken from well EO70GW01D in the Target Treatment Zone at SWMU-70

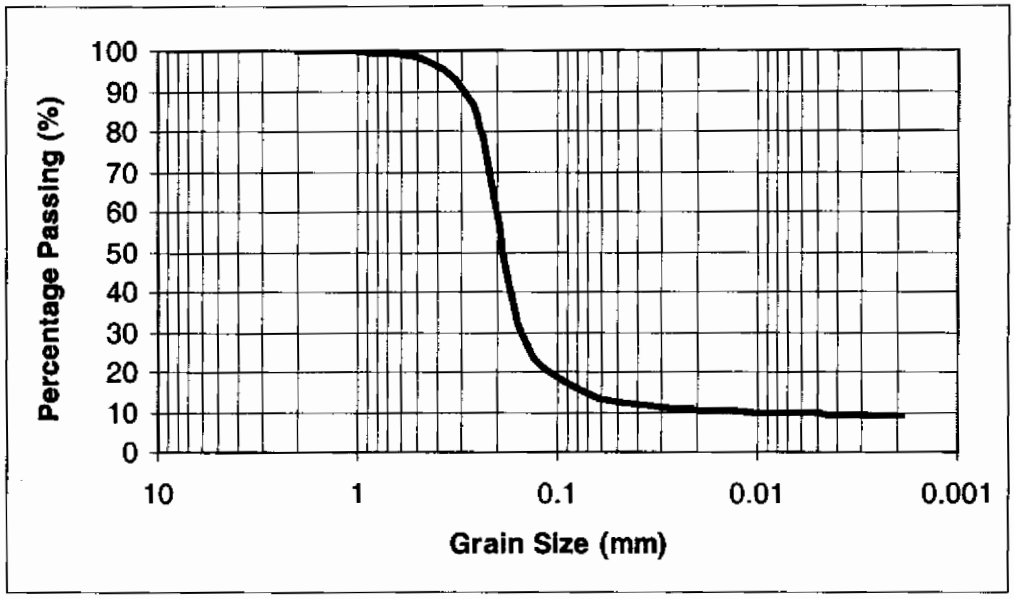
	COMPOUND				
WELL	**CR^{+6}**	**CR(TOTAL)**	**TCE**	**DCE**	**VC**
EO70GW01D	41 PPM	50 PPM	26 PPB	16 PPB	50 PPB

10.1.1 Core Logging and Soil Grain Analysis

During baseline sampling, conducted on September 27, 2001, two soil cores were collected using a direct push sampling technique (SC-1 and SC-2). These cores were sent back to ARS' offices where they were logged and sampled for representative soil that was used in the treatability testing. All soil core logs are presented in **Appendix B**. The soil strata consists of very fine sand and silt with few clay lenses. With depth, the soil changed from a light brown to grey color. At approximately 23 to 25 feet bgs, calcareous (shell) content became evident, common to beach sand deposits. Clay became more predominant with depth.

Approximately one kilogram of representative soil was collected from two soil cores and sent to Johnson Soils Engineering Company in Ridgefield, NJ, for sieve and hydrometer testing. Results indicate that the soils are representative of fine sand with traces of silt and clay. This is presented graphically in **Figure 13.**

Figure 13. Soil grain analysis for samples collected at SWMU-70, Charleston Naval Complex



10.3 Ferox[SM] Injection

10.3.1 Data and Results

All injection data collected during the field events are presented in **Appendix B**. Data collected during each injection includes the injection interval, injection duration, injection set pressure, and gas flow pressure. Each of the parameters monitored during serves to quantify the effectiveness of the method by which the gas flows into the subsurface and it's orientation.

10.3.2 Analysis of Pressure Transducer Data

For each injection, the pressures in the injection interval are recorded by a pressure transducer located in-line within the conduit leading to the injection nozzle. These pressures are recorded by a data logging system located on the injection module and accessed using a lap top computer. By comparing the magnitude and shape of the pressure-history curve to previously collected curves in similar geology, assessment of fracture propagation is made. This information allows one to determine if fracturing resulted and two critical measurements; the fracture initiation pressure and the fracture maintenance pressure. The recorded fracture maintenance pressure is an average over the propagation time.

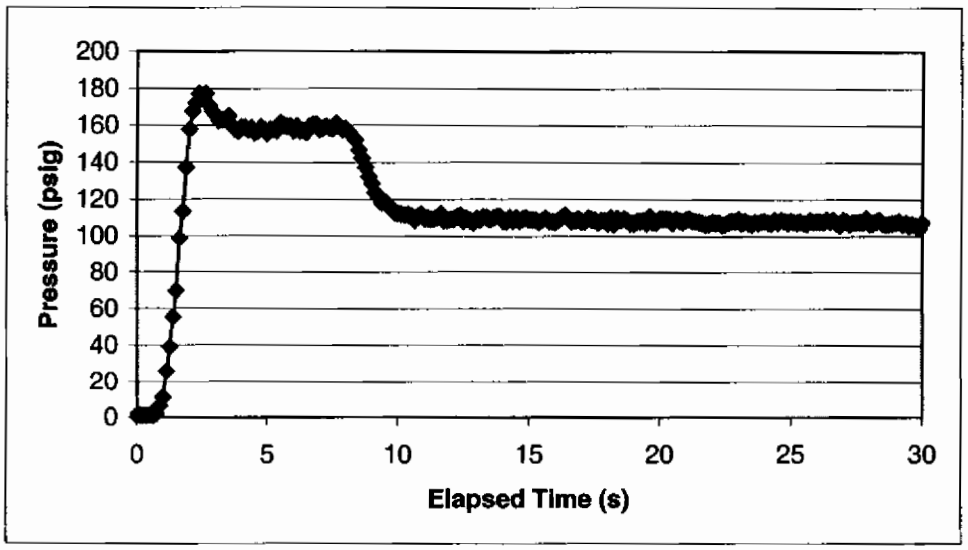
The loose nature of the soil present at SWMU-70 produced initiation pressures generally less than 150psi. On some occasions, sand flowing into the fracture nozzle required a higher initiation pressure, which was typically less than 200psi. However, these pressures are not

representative of the initiation pressure, but rather the pressure required to displace the sand from inside the injector nozzle.

All pressure-history curves collected during the first two injection well locations are presented in **Appendix C. Figure 14** shows the pressure-history curve collected during injection at location PF-1 with the fracture interval from approximately 23-25 feet below ground surface. A distinct pressure peak is visible during early times of this injection, representing the breaking pressure as the formation fractures, and is a typical shape for curves observed during successful fracturing attempts.

The pressure plateau that follows the fracture initiation peak represents the pressure required to maintain dilation within these fractures or matrix (approximately 110 psig). The fracture initiation pressure for the curve presented in **Figure 14** is approximately 180 psig. Based on this characteristic response, it can be concluded that during his injection, the gas and Ferox[SM] powder was emplaced through fracture propagation. In shallower applications where no pressure peak is visible (**Appendix C**), the emplacement of iron is likely from fluidization of the formation.

Figure 14. Pressure-history curve collected from PF-1 (23 to 25 feet bgs).



Unfortunately, an electrical short in the datalogging equipment occurred during injections at the third borehole resulting in no electronic data collection in subsequent boreholes. However, this lack of data in subsequent injections does not hinder the assessment of injection performance. Regulator initiation pressures, which are manually set prior to the start of injections, remained relatively constant for similar depths of all subsequent injection locations suggesting that the formation is relatively consistent throughout the site. Slightly higher pressures were required inside the building to initiate flow, which is attributed to the additional weight of the structure.

In addition, monitoring of pressure response at surrounding wells and surface heave served as supplemental data and indicated that gas distribution was occurring in the subsurface. It will inevitably be the post-injection ground water sampling that will determine how effective the zero-valent iron injections have been in reducing the hexavalent chromium at the site.

10.3.3 Analysis of Pressure Influence

The monitoring of pressure response at various locations around an injection location provides supplemental evidence that fracture propagation was the primary mechanism for Ferox[SM] powder emplaced. This data also assists in determining which directions they may have propagated. In addition, the degree of pressure response can often help determine whether a monitoring point has been directly influenced (i.e. fractures propagate outward and intersect wells or boreholes), or indirectly influenced (i.e. existing pathways such as naturally occurring fractures or root holes are dilated). Minimal pressure response in monitoring wells located close to the injection point, may indicate fluidization is occurring where large dispersion of gas occurs.

Pressure gauges with maximum pressure indicators were installed at all existing wells within the area of field activities. These wells included EO70GW002, EO70GW01D, and EO70GW001. Gauges were attached to the center rods of pneumatic packers, which were in turn inflated within the wells. These gauges were secured using threaded pipe fittings.

All pressure influence data is presented in **Table 5**. These pressure readings were recorded subsequent to each Ferox[SM] injection. At nearly all injection locations, pressure influence was recorded at EO70GW01D, which is screened from 23.1 to 32.6 ft bgs. These pressure readings were also observed to increase as injection depths increased. This variation in pressure magnitude may be a result of several factors including increased regulator set pressures required to initiate flow within the subsurface at greater depths, and increased gas dispersion which likely occurs as injections become shallower.

The additional overburden stresses that occur at deeper depths assist in keeping the gas/fracture propagation in a horizontal plane away from the injection location. At shallow depths, gas is more likely to propagate outward and upward more rapidly with distance from the injection location due to lower overburden pressures. This is evident during injections at PF1, PF4 and PF6 where gas influence began to register in monitoring well E070GW001, which is screened shallower than the injection depth. During injection at PF4 from 24.5 to 26.5 feet bgs, gas influence was observed in both monitoring wells E070GW001 and E070GW01D, screened at 2.5 to 11.5 ft and 23.1 to 32.6 ft bgs respectively, suggesting that significant gas dispersion is occurring during this injection.

In some instances, gas propagation was recorded greater than 60 feet (i.e. 10 psi reading in well EO70GW01D during injections at PF-14, 26 to 28 ft bgs). However, it is not interpreted that iron powder has traveled that distance. Since iron is very dense, it is expected that it would settle into the formation within approximately 30 feet of the injection location.

During some injections at locations PF-1, PF-4, and PF-13, pressure response was recorded in monitoring well EO70GW001, which is screened from 2.5 to 11.5 ft bgs (see **Table 5**). These pressure responses occurred during injections that took place at depths below this screened interval, but shallower that 26 ft bgs, indicating that gas propagated upwards into the screened portion of EO70GW001. In contrast, the lack of pressure response in E070GW001 during injections in surrounding points at depths deeper than 26 ft is good indication that gas propagation remained relatively horizontal during these instances.

Though pressure influence measurements provide an indication of gas propagation and orientation, the lack of a pressure reading on the gauges does not always mean that pressure influence was not present at a particular location. A disturbance in the subsurface of any type inherently propagates a pressure pulse, however, the measurement of a pressure perturbation is limited by the device used to measure it. Any pressure measurements below approximately 0.2 psig would not have been recorded by the pressure gauges used during the injection procedure. For determining fracture propagation however, pressures below this level are not considered relevant.

Table 5. Measured pressure response at existing monitoring wells during Ferox[SM] Injections at SWMU-70.

Well	Depth (ft bgs)	Influence and Location	Well	Depth (ft bgs)	Influence and Location
PF-1	25-27	20 psi @ MW1	**PF-7**	25-27	20 psi @MW1
	23-25	5 psi @ MW1		23-25	20 psi @MW1
	19-21	22 psi @ MW2	**PF-8**	26-28	22 psi @MW1
PF-2	25-27	25 psi @ MW1		24-26	20 psi @MW1
	23-25	20 psi @MW1	**PF-9**	27.5-29.5	25 psi @MW1
	21-23	15 psi @MW1		25.5-27.5	22 psi @MW1
PF-3	23-25	18 psi @MW1		23.5-25.5	15 psi @MW1
PF-4	28.5-30.5	25 psi @MW1		21.5-23.5	10 psi @MW1
	26.5-28.5	23 psi @MW1	**PF-11**	24-26	40 psi @ MW1
	24.5-26.5	15 psi @MW2		22-24	25 psi @MW1
		20psi @MW1			
	22.5-24.5	15 psi @MW1	**PF-12**	25-27	8 psi @ MW1
	20.5-22.5	10 psi @MW1	**PF-13**	25-27	10 psi @ MW2
PF-5	25-27	28 psi @MW1	**PF-14**	26-28	10 psi @ MW1
	23-25	20 psi @MW1	**PF-15**	29-31	10 psi @MW1
PF-6	23-25	15 psi @MW1		27-29	10 psi @MW1
	15-17	5 psi @MW2			

MW1 = E070GW01D; MW2 = E070GW001

10.3.4 Discussion of Surface Heave Data

Surface heave monitoring serves to provide supplemental evidence to support whether fracture propagation or gas fluidization flow during the gas based injections had occurred. During the injection, a heave rod placed within six feet of the injection location was monitored for surface movement. In most cases, heave ranging from 0.125 to 0.75 inches was recorded, confirming fracture propagation or soil void space dilation. Soil void space dilation would occur during fluidization, while fracture dilation would occur during a fracturing event. Surface heave measurements cannot distinguish these two mechanisms. Within the building, heave was consistently less than 0.5 inches.

The presence of an asphalt surface significantly affects the heave of a formation by providing a stiff overburden boundary. This in turn results in little to no residual heave measurements. Residual heave is the difference in surface displacement from before and after fracturing, and is a result of an increase in void space within the formation due to fracturing and/or dilation of existing pathways within the soil. Due to the presence of the ashphalt surface and the slab flooring within the building, no residual heave was recorded.

10.3.5 Structural Movement Monitoring

During all injections, a structural support column located closest to the injection point was monitored for movement using a graduated tape and a survey transit. The movement criteria, as calculated using computer modeling and presented to CH2M-Jones in a report entitled "Gas Injection Structural Analysis," dated November 9, 2001, was determined to be 0.5 inches. This maximum movement was not compromised during the entire field demonstration.

In addition to structural movement, crack gauges were installed at random locations prior to the beginning of any field work on the outside of the building along pre-existing cracks. These gauges were monitored throughout the field application for crack propagation or dilation. No movement was observed.

10.4 Ferox[sm] Injections

A total of approximately 16,725 kg of ZVI powder was injected at SWMU-70, CNC utilizing 15 boreholes within the TTZ. Target intervals varied with depth due to the undulating contact of the Ashley formation and the overlying sandy unit. In general, boreholes were advanced to a maximum of 31 ft bgs and a minimum of 27 ft bgs. Iron was injected within discrete two-foot zones utilizing an upper packer, and the natural seal of the formation below. As shallower depths were addresses, soil collapsed below the injection nozzle, forming a lower boundary.

The proposed work plan outlined fracturing and iron injections to occur between depths of 10 to 9 feet below ground surface. However, in several instances outside the building, severe daylighting of iron slurry occurred when targeting depths below 13 feet, caused by the loss of a seal around the annulus of the drive casing. To minimize any risks of spilling slurry within the building, which may have potentially damaged the tenant's equipment or bulk lumber that was present in the work area, all injections within the building were terminated at 12 to 13 feet bgs. At location PF-13, which was located adjacent to the tenant's storage room and filled with expensive furniture, injections were terminated at 19 ft bgs. At the 23 to 25 foot interval within this borehole, iron slurry began to daylight next to the roadway in an area that was recently dug and backfilled. The cohesion and compaction in this backfilled area is less than the compaction of the native soil, and therefore represents a weakened area where preferential flow occurs.

Table 6 summarizes the iron dosages injected at each location. **Appendix D** provides a more comprehensive breakdown of iron distribution with depth for each location.

Table 6. Iron distribution during field injections at SWMU-70.

Injection Location	Date of Injection	Depth (feet bgs)	Approximate Weight of Iron Injected (kg)
PF-1	1/10/02	15-27	900
PF-2	1/14/02	17-27	975
PF-3	1/8/02 1/9/02	11-27	1150
PF-4	1/15/02	14.5-30.5	1525
PF-5	1/12/02	13-27	1300
PF-6	1/22/02	13-25	1150
PF-7	1/11/02	13-27	1225
PF-8	1/20/02 1/26/02	13.5-28	1150
PF-9	1/18/02 1/19/02	11.5-29.5	1650
PF-10	1/25/01	13-29	1025
PF-11	1/19/02 1/25/02	12-30	1150
PF-12	1/28/02	23-27	250
PF-13	1/17/02 1/18/02	19-29	950
PF-14	1/24/02	16-30	875
PF-15	1/23/02	13-31	1450
Total Iron Injected			**16,725 kg**

11.0 SUMMARY

From January 8 to January 28, 2002, fifteen (15) locations at SWMU-70, Charleston Naval Complex were targeted with ZVI powder injections. A total of 16,725 kg of ZVI was emplaced targeting intervals from 31 to 11 feet below ground surface. 7 of these locations were located within a building structure. Structural movement and crack gauge monitoring, as well as visual observations showed that no impact occurred to the building as a result of the injection process.

Injection pressures typically less that 150 psi were required to initiate flow into the formation. Once initiated, injection pressures from 90 to 150 psi were required to inject the iron slurry, requiring approximately less than 15 minutes for 150 kg of iron to be emplaced. At depths shallower than 15 feet bgs the iron slurry could be hydraulically injected at pressures of less than 100 psi.

Variations in the magnitude of pressure influence at monitoring wells EO70GW001 and EO70GW01D during iron slurry injections indicate that gas propagation (and therefore slurry propagation) occurred relatively horizontal in applications below 26 ft. At shallower depths, pressure response in multiple monitoring wells, screened at different depths, suggests that significant dispersion may be occurring. Gas pressure influence was recorded from distances as

much as 60 feet, indicating that the layout of injection point locations was sufficient to cover the target treatment zone.

12.0 RECOMMENDATIONS

ARS recommends that sampling of monitoring wells occur on a monthly basis to determine whether adequate reduction is occurring within the target treatment area. ARS also recommends that soil cores be collected within the treatment area, specifically near monitoring well EO70GW01D where historically high levels of hexavalent chromium have been recorded. This may provide visual evidence of adequate iron dispersion within the subsurface at SWMU-70.

Appendix A

Laboratory Analysis Reports

Appendix B

Soil Core Log Sheets

Appendix C

Pressure-History Curves for all Injection Events

Appendix D

Iron Injection Distribution

Appendix E

Chain of Custody Forms

Appendix J

	StationID	E070GP001		E070GP001		E070GP001		E070GP001	
	SampleID	070GP00110		070GP00110		070GP00120		070GP00120	
	DateCollected	03/11/2002		03/11/2002		03/11/2002		03/11/2002	
	DateExtracted			03/15/2002				03/15/2002	
	DateAnalyzed	03/11/2002		03/16/2002		03/11/2002		03/16/2002	
	SDGNumber	57282		57282		57282		57282	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	0.013	=			10.2	=		
Chromium, Dissolved	ug/L			1.04	J			20200	=

	StationID	E070GP001		E070GP001		E070GP002		E070GP002	
	SampleID	070GP00130		070GP00130		070GP00210		070GP00210	
	DateCollected	03/11/2002		03/11/2002		03/13/2002		03/13/2002	
	DateExtracted			03/15/2002				03/23/2002	
	DateAnalyzed	03/11/2002		03/16/2002		03/13/2002		03/24/2002	
	SDGNumber	57282		57282		57443		57443	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	0.013	=			0.005	U		
Chromium, Dissolved	ug/L			4.02	J			0.57	U

	StationID	E070GP002		E070GP002		E070GP002		E070GP002	
	SampleID	070GP00220		070GP00220		070GP00231		070GP00231	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted			03/23/2002				03/23/2002	
	DateAnalyzed	03/13/2002		03/24/2002		03/13/2002		03/24/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	16.6	J			0.005	U		
Chromium, Dissolved	ug/L			21200	=			0.57	U

	StationID	E070GP003		E070GP003		E070GP003		E070GP003	
	SampleID	070GP00310		070GP00310		070GP00320		070GP00320	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted			03/15/2002				03/15/2002	
	DateAnalyzed	03/12/2002		03/16/2002		03/12/2002		03/16/2002	
	SDGNumber	57361		57361		57361		57361	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	0.078	=			3.35	=		
Chromium, Dissolved	ug/L			0.57	U			2930	=

	StationID	E070GP003		E070GP003		E070GP004		E070GP004	
	SampleID	070GP00330		070GP00330		070GP00410		070GP00410	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted			03/15/2002				03/15/2002	
	DateAnalyzed	03/12/2002		03/16/2002		03/12/2002		03/16/2002	
	SDGNumber	57361		57361		57361		57361	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	0.01	U			1.95	=		
Chromium, Dissolved	ug/L			0.846	U			3130	=

	StationID	E070GP004		E070GP004		E070GP004		E070GP004	
	SampleID	070GP00420		070GP00420		070GP00430		070GP00430	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted			03/15/2002				03/15/2002	
	DateAnalyzed	03/12/2002		03/16/2002		03/12/2002		03/16/2002	
	SDGNumber	57361		57361		57361		57361	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	6.6	=			0.008	J		
Chromium, Dissolved	ug/L			10900	=			2.59	U

	StationID	E070GP005		E070GP005		E070GP005		E070GP005	
	SampleID	070GP00510		070GP00510		070GP00520		070GP00520	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted			03/23/2002				03/23/2002	
	DateAnalyzed	03/13/2002		03/24/2002		03/13/2002		03/24/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	0.292	=			4.75	=		
Chromium, Dissolved	ug/L			624	=			7890	=

	StationID	E070GP005		E070GP005		E070GP006		E070GP006	
	SampleID	070GP00530		070GP00530		070GP00610		070GP00610	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted			03/23/2002				03/23/2002	
	DateAnalyzed	03/13/2002		03/24/2002		03/13/2002		03/24/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	0.01	U			2.28	=		
Chromium, Dissolved	ug/L			2.02	U			2810	=

	StationID	E070GP006		E070GP006		E070GP006		E070GP006	
	SampleID	070GP00620		070GP00620		070GP00630		070GP00630	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted			03/23/2002				03/23/2002	
	DateAnalyzed	03/13/2002		03/24/2002		03/13/2002		03/24/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	0.655	=			0.006	U		
Chromium, Dissolved	ug/L			2.89	U			0.57	U

	StationID	E070GP007		E070GP007		E070GP007		E070GP007	
	SampleID	070GP00710		070GP00710		070GP00720		070GP00720	
	DateCollected	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	DateExtracted			03/26/2002				03/26/2002	
	DateAnalyzed	03/14/2002		03/27/2002		03/14/2002		03/26/2002	
	SDGNumber	57539		57539		57539		57539	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	0.795	=			6.85	=		
Chromium, Dissolved	ug/L			231	=			10100	=

	StationID	E070GP007		E070GP007		E070GP008		E070GP008	
	SampleID	070GP00730		070GP00730		070GP00810		070GP00810	
	DateCollected	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	DateExtracted			03/26/2002				03/26/2002	
	DateAnalyzed	03/14/2002		03/27/2002		03/14/2002		03/27/2002	
	SDGNumber	57539		57539		57539		57539	
Parameter	**Units**								
Chromium (Hexavalent), Dissolved	mg/L	0.032	=			0.111	=		
Chromium, Dissolved	ug/L			2.34	U			4.24	U

	StationID	E070GP008		E070GP008	
	SampleID	070GP00820		070GP00820	
	DateCollected	03/14/2002		03/14/2002	
	DateExtracted			03/26/2002	
	DateAnalyzed	03/14/2002		03/27/2002	
	SDGNumber	57539		57539	
Parameter	**Units**				
Chromium (Hexavalent), Dissolved	mg/L	0.02	=		
Chromium, Dissolved	ug/L			1.84	U

	StationID	E070GP001		E070GP001		E070GP001		E070GP002	
	SampleID	070GP00110		070GP00120		070GP00130		070GP00210	
	DateCollected	03/11/2002		03/11/2002		03/11/2002		03/13/2002	
	DateExtracted	03/14/2002		03/14/2002		03/14/2002		03/23/2002	
	DateAnalyzed	03/14/2002		03/14/2002		03/14/2002		03/24/2002	
	SDGNumber	57282T		57282T		57282T		57443-T	
Parameter	Units								
Chromium, Total	ug/L	245	J	20700	J	1440	J	23.8	=

	StationID	E070GP002		E070GP002		E070GP003		E070GP003	
	SampleID	070GP00220		070GP00231		070GP00310		070GP00320	
	DateCollected	03/13/2002		03/13/2002		03/12/2002		03/12/2002	
	DateExtracted	03/23/2002		03/23/2002		03/14/2002		03/14/2002	
	DateAnalyzed	03/24/2002		03/24/2002		03/14/2002		03/14/2002	
	SDGNumber	57443-T		57443-T		57361T		57361T	
Parameter	Units								
Chromium, Total	ug/L	28000	=	4750	=	550	J	11100	J

	StationID	E070GP003		E070GP004		E070GP004		E070GP004	
	SampleID	070GP00330		070GP00410		070GP00420		070GP00430	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	DateAnalyzed	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	SDGNumber	57361T		57361T		57361T		57361T	
Parameter	**Units**								
Chromium, Total	ug/L	585	J	3830	J	14900	J	2970	J

	StationID	E070GP005		E070GP005		E070GP005		E070GP006	
	SampleID	070GP00510		070GP00520		070GP00530		070GP00610	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted	03/23/2002		03/23/2002		03/23/2002		03/23/2002	
	DateAnalyzed	03/24/2002		03/24/2002		03/24/2002		03/24/2002	
	SDGNumber	57443-T		57443-T		57443-T		57443-T	
Parameter	Units								
Chromium, Total	ug/L	29300	=	10600	=	1300	=	4730	=

	StationID	E070GP006		E070GP006		E070GP007		E070GP007	
	SampleID	070GP00620		070GP00630		070GP00710		070GP00720	
	DateCollected	03/13/2002		03/13/2002		03/14/2002		03/14/2002	
	DateExtracted	03/23/2002		03/23/2002		03/26/2002		03/26/2002	
	DateAnalyzed	03/24/2002		03/24/2002		03/27/2002		03/27/2002	
	SDGNumber	57443-T		57443-T		57539T		57539T	
Parameter	**Units**								
Chromium, Total	ug/L	2470	=	4720	=	1520	=	11800	=

	StationID	E070GP007		E070GP008		E070GP008	
	SampleID	070GP00730		070GP00810		070GP00820	
	DateCollected	03/14/2002		03/14/2002		03/14/2002	
	DateExtracted	03/26/2002		03/26/2002		03/26/2002	
	DateAnalyzed	03/27/2002		03/27/2002		03/27/2002	
	SDGNumber	57539T		57539T		57539T	
Parameter	**Units**						
Chromium, Total	ug/L	2070	=	12800	=	2590	=

	StationID	E070GP001		E070GP001		E070GP001		E070GP002	
	SampleID	070GP00110		070GP00120		070GP00130		070GP00210	
	DateCollected	03/11/2002		03/11/2002		03/11/2002		03/13/2002	
	DateExtracted								
	DateAnalyzed	03/11/2002		03/11/2002		03/11/2002		03/13/2002	
	SDGNumber	57282T		57282T		57282T		57443	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	0.055	=	8.05	=	0.03	J	0.013	U

	StationID	E070GP002		E070GP002		E070GP003		E070GP003	
	SampleID	070GP00220		070GP00231		070GP00310		070GP00320	
	DateCollected	03/13/2002		03/13/2002		03/12/2002		03/12/2002	
	DateExtracted								
	DateAnalyzed	03/13/2002		03/13/2002		03/12/2002		03/12/2002	
	SDGNumber	57443		57443		57361		57361	
Parameter	Units								
Chromium (Hexavalent)	mg/L	12.1	J	0.25	U	2.3	=	4.38	=

	StationID	E070GP003		E070GP004		E070GP004		E070GP004	
	SampleID	070GP00330		070GP00410		070GP00420		070GP00430	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted								
	DateAnalyzed	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	SDGNumber	57361		57361		57361		57361	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	0.8	=	5.13	=	10	=	2.4	=

	StationID	E070GP005		E070GP005		E070GP005		E070GP006	
	SampleID	070GP00510		070GP00520		070GP00530		070GP00610	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted								
	DateAnalyzed	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	Units								
Chromium (Hexavalent)	mg/L	24.8	=	5.3	=	0.225	J	38.5	=

	StationID	E070GP006		E070GP006		E070GP007		E070GP007	
	SampleID	070GP00620		070GP00630		070GP00710		070GP00720	
	DateCollected	03/13/2002		03/13/2002		03/14/2002		03/14/2002	
	DateExtracted								
	DateAnalyzed	03/13/2002		03/13/2002		03/14/2002		03/14/2002	
	SDGNumber	57443		57443		57539		57539	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	2.03	=	0.45	J	0.96	=	8.25	=

	StationID	E070GP007		E070GP008		E070GP008	
	SampleID	070GP00730		070GP00810		070GP00820	
	DateCollected	03/14/2002		03/14/2002		03/14/2002	
	DateExtracted						
	DateAnalyzed	03/14/2002		03/14/2002		03/14/2002	
	SDGNumber	57539		57539		57539	
Parameter	**Units**						
Chromium (Hexavalent)	mg/L	0.036	=	0.07	=	0.16	=

Appendix K

	StationID	E070GW001		E070GW001		E070GW001		E070GW002	
	SampleID	070GW001M2		070GW001M4		070HW001M4		070GW002M2	
	DateCollected	05/01/2002		07/10/2002		07/10/2002		05/01/2002	
	DateExtracted								
	DateAnalyzed	05/06/2002		07/19/2002		07/19/2002		05/06/2002	
	SDGNumber	P0205084		P0207280		P0207280		P0205084	
Parameter	**Units**								
Hydrogen	nM	0.52	=	3.9	=	1.8	=	0.36	=
Methane	ug/L	0.03	=	2.1	=	2.6	=	8.6	=

	StationID	E070GW002		E070GW002		E070GW01D		E070GW01D	
	SampleID	070GW002M4		070HW002M2		070GW01DM2		070GW01DM4	
	DateCollected	07/10/2002		05/01/2002		05/01/2002		07/10/2002	
	DateExtracted								
	DateAnalyzed	07/19/2002		05/06/2002		05/06/2002		07/19/2002	
	SDGNumber	P0207280		P0205084		P0205084		P0207280	
Parameter	**Units**								
Hydrogen	nM	35	=	0.42	=	29000	=	43000	=
Methane	ug/L	9.8	=	7.8	=	32	=	52	=

	StationID	E070GW05D		E070GW06D	
	SampleID	070GW05DM4		070GW06DM4	
	DateCollected	07/15/2002		07/11/2002	
	DateExtracted				
	DateAnalyzed	07/19/2002		07/19/2002	
	SDGNumber	P0207280		P0207280	
Parameter	**Units**				
Hydrogen	nM	39000	=	64000	=
Methane	ug/L	59	=	840	=

	StationID	E070GP001		E070GP001		E070GP001		E070GP001	
	SampleID	070GP00110		070GP00110		070GP00120		070GP00120	
	DateCollected	03/11/2002		03/11/2002		03/11/2002		03/11/2002	
	DateExtracted			03/15/2002				03/15/2002	
	DateAnalyzed	03/11/2002		03/16/2002		03/11/2002		03/16/2002	
	SDGNumber	57282		57282		57282		57282	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.013	=			10.2	=		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			1.04	J			20200	=
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP001		E070GP001		E070GP002		E070GP002	
	SampleID	070GP00130		070GP00130		070GP00210		070GP00210	
	DateCollected	03/11/2002		03/11/2002		03/13/2002		03/13/2002	
	DateExtracted			03/15/2002				03/23/2002	
	DateAnalyzed	03/11/2002		03/16/2002		03/13/2002		03/24/2002	
	SDGNumber	57282		57282		57443		57443	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.013	=			0.005	U		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			4.02	J			0.57	U
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP002		E070GP002		E070GP002		E070GP002	
	SampleID	070GP00220		070GP00220		070GP00231		070GP00231	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted			03/23/2002				03/23/2002	
	DateAnalyzed	03/13/2002		03/24/2002		03/13/2002		03/24/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	16.6	J			0.005	U		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			21200	=			0.57	U
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP003		E070GP003		E070GP003		E070GP003	
	SampleID	070GP00310		070GP00310		070GP00320		070GP00320	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted			03/15/2002				03/15/2002	
	DateAnalyzed	03/12/2002		03/16/2002		03/12/2002		03/16/2002	
	SDGNumber	57361		57361		57361		57361	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.078	=			3.35	=		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			0.57	U			2930	=
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP003		E070GP003		E070GP004		E070GP004	
	SampleID	070GP00330		070GP00330		070GP00410		070GP00410	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted			03/15/2002				03/15/2002	
	DateAnalyzed	03/12/2002		03/16/2002		03/12/2002		03/16/2002	
	SDGNumber	57361		57361		57361		57361	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.01	U			1.95	=		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			0.846	U			3130	=
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP004		E070GP004		E070GP004		E070GP004	
	SampleID	070GP00420		070GP00420		070GP00430		070GP00430	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted			03/15/2002				03/15/2002	
	DateAnalyzed	03/12/2002		03/16/2002		03/12/2002		03/16/2002	
	SDGNumber	57361		57361		57361		57361	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	6.6	=			0.008	J		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			10900	=			2.59	U
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP005		E070GP005		E070GP005		E070GP005	
	SampleID	070GP00510		070GP00510		070GP00520		070GP00520	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted			03/23/2002				03/23/2002	
	DateAnalyzed	03/13/2002		03/24/2002		03/13/2002		03/24/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.292	=			4.75	=		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			624	=			7890	=
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP005		E070GP005		E070GP006		E070GP006	
	SampleID	070GP00530		070GP00530		070GP00610		070GP00610	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted			03/23/2002				03/23/2002	
	DateAnalyzed	03/13/2002		03/24/2002		03/13/2002		03/24/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.01	U			2.28	=		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			2.02	U			2810	=
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP006		E070GP006		E070GP006		E070GP006	
	SampleID	070GP00620		070GP00620		070GP00630		070GP00630	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted			03/23/2002				03/23/2002	
	DateAnalyzed	03/13/2002		03/24/2002		03/13/2002		03/24/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.655	=			0.006	U		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			2.89	U			0.57	U
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP007		E070GP007		E070GP007		E070GP007	
	SampleID	070GP00710		070GP00710		070GP00720		070GP00720	
	DateCollected	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	DateExtracted			03/26/2002				03/26/2002	
	DateAnalyzed	03/14/2002		03/27/2002		03/14/2002		03/26/2002	
	SDGNumber	57539		57539		57539		57539	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.795	=			6.85	=		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			231	=			10100	=
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP007		E070GP007		E070GP008		E070GP008	
	SampleID	070GP00730		070GP00730		070GP00810		070GP00810	
	DateCollected	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	DateExtracted			03/26/2002				03/26/2002	
	DateAnalyzed	03/14/2002		03/27/2002		03/14/2002		03/27/2002	
	SDGNumber	57539		57539		57539		57539	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.032	=			0.111	=		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			2.34	U			4.24	U
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GP008		E070GP008		E070GP008		E070GP008	
	SampleID	070GP00820		070GP00820		070HP00820		070HP00820	
	DateCollected	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	DateExtracted			03/26/2002				03/26/2002	
	DateAnalyzed	03/14/2002		03/27/2002		03/14/2002		03/27/2002	
	SDGNumber	57539		57539		57539		57539	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.02	=			0.024	=		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			1.84	U			2.65	U
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GW001		E070GW001		E070GW001		E070GW001	
	SampleID	070GW001M1		070GW001M1		070GW001M2		070GW001M2	
	DateCollected	02/12/2002		02/12/2002		05/01/2002		05/01/2002	
	DateExtracted			02/15/2002				05/08/2002	
	DateAnalyzed	02/12/2002		02/16/2002		05/02/2002		05/08/2002	
	SDGNumber	56023		56023		59792		59792	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.77	=			1.42	J		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			1650	=			1650	=
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GW001		E070GW001		E070GW001		E070GW001	
	SampleID	070GW001M4		070GW001M4		070HW001M4		070HW001M4	
	DateCollected	07/10/2002		07/10/2002		07/10/2002		07/10/2002	
	DateExtracted			07/18/2002				07/18/2002	
	DateAnalyzed	07/11/2002		07/23/2002		07/11/2002		07/23/2002	
	SDGNumber	63417		63417		63417		63417	
Parameter	**Units**								
Antimony, Dissolved	ug/L			4.79	U			4.79	U
Chromium (Hexavalent), Dissolved	mg/L								
Chromium (Hexavalent), Dissolved	ug/L	1540	J			1510	J		
Chromium, Dissolved	ug/L			2010	=			2020	=
Iron, Dissolved	ug/L			2.53	U			2.12	U
Thallium, Dissolved	ug/L			4.99	U			4.99	U

	StationID	E070GW002		E070GW002		E070GW002		E070GW002	
	SampleID	070GW002M1		070GW002M1		070GW002M2		070GW002M2	
	DateCollected	02/12/2002		02/12/2002		05/01/2002		05/01/2002	
	DateExtracted			02/15/2002				05/08/2002	
	DateAnalyzed	02/12/2002		02/16/2002		05/02/2002		05/08/2002	
	SDGNumber	56023		56023		59792		59792	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.025	U			0.028	UJ		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			26.7	=			22.3	=
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GW002		E070GW002		E070GW002		E070GW002	
	SampleID	070GW002M4		070GW002M4		070HW002M1		070HW002M1	
	DateCollected	07/10/2002		07/10/2002		02/12/2002		02/12/2002	
	DateExtracted			07/18/2002				02/15/2002	
	DateAnalyzed	07/11/2002		07/22/2002		02/12/2002		02/16/2002	
	SDGNumber	63417		63417		56023		56023	
Parameter	**Units**								
Antimony, Dissolved	ug/L			4.79	U				
Chromium (Hexavalent), Dissolved	mg/L					0.041	U		
Chromium (Hexavalent), Dissolved	ug/L	10	=						
Chromium, Dissolved	ug/L			12.2	=			26.2	=
Iron, Dissolved	ug/L			4.84	U				
Thallium, Dissolved	ug/L			4.99	U				

	StationID	E070GW002		E070GW002		E070GW01D		E070GW01D	
	SampleID	070HW002M2		070HW002M2		070GW01DM1		070GW01DM1	
	DateCollected	05/01/2002		05/01/2002		02/12/2002		02/12/2002	
	DateExtracted			05/08/2002				02/15/2002	
	DateAnalyzed	05/02/2002		05/08/2002		02/12/2002		02/16/2002	
	SDGNumber	59792		59792		56023		56023	
Parameter	**Units**								
Antimony, Dissolved	ug/L								
Chromium (Hexavalent), Dissolved	mg/L	0.029	UJ			1.35	=		
Chromium (Hexavalent), Dissolved	ug/L								
Chromium, Dissolved	ug/L			20.6	=			12200	=
Iron, Dissolved	ug/L								
Thallium, Dissolved	ug/L								

	StationID	E070GW01D		E070GW01D		E070GW01D		E070GW01D	
	SampleID	070GW01DM2		070GW01DM2		070GW01DM4		070GW01DM4	
	DateCollected	05/01/2002		05/01/2002		07/10/2002		07/10/2002	
	DateExtracted			05/08/2002				07/18/2002	
	DateAnalyzed	05/02/2002		05/08/2002		07/11/2002		07/23/2002	
	SDGNumber	59792		59792		63417		63417	
Parameter	**Units**								
Antimony, Dissolved	ug/L							4.79	U
Chromium (Hexavalent), Dissolved	mg/L	14	J						
Chromium (Hexavalent), Dissolved	ug/L					5850	J		
Chromium, Dissolved	ug/L			13400	=			12200	=
Iron, Dissolved	ug/L							2.11	U
Thallium, Dissolved	ug/L							4.99	U

	StationID	E070GW05D		E070GW05D		E070GW06D		E070GW06D	
	SampleID	070GW05DM4		070GW05DM4		070GW06DM4		070GW06DM4	
	DateCollected	07/15/2002		07/15/2002		07/11/2002		07/11/2002	
	DateExtracted			07/18/2002				07/18/2002	
	DateAnalyzed	07/16/2002		07/23/2002		07/11/2002		07/23/2002	
	SDGNumber	63607		63607		63417		63417	
Parameter	**Units**								
Antimony, Dissolved	ug/L			4.79	U			4.79	U
Chromium (Hexavalent), Dissolved	mg/L								
Chromium (Hexavalent), Dissolved	ug/L	2680	J			10	U		
Chromium, Dissolved	ug/L			2750	J			0.532	U
Iron, Dissolved	ug/L			2.11	U			4.82	U
Thallium, Dissolved	ug/L			4.99	U			4.99	U

	StationID	E070GP001		E070GP001		E070GP001		E070GP002	
	SampleID	070GP00110		070GP00120		070GP00130		070GP00210	
	DateCollected	03/11/2002		03/11/2002		03/11/2002		03/13/2002	
	DateExtracted	03/14/2002		03/14/2002		03/14/2002		03/23/2002	
	DateAnalyzed	03/14/2002		03/14/2002		03/14/2002		03/24/2002	
	SDGNumber	57282T		57282T		57282T		57443-T	
Parameter	**Units**								
Antimony	ug/L								
Chromium, Total	ug/L	245	J	20700	J	1440	J	23.8	=
Iron	ug/L								
Thallium	ug/L								

	StationID	E070GP002		E070GP002		E070GP003		E070GP003	
	SampleID	070GP00220		070GP00231		070GP00310		070GP00320	
	DateCollected	03/13/2002		03/13/2002		03/12/2002		03/12/2002	
	DateExtracted	03/23/2002		03/23/2002		03/14/2002		03/14/2002	
	DateAnalyzed	03/24/2002		03/24/2002		03/14/2002		03/14/2002	
	SDGNumber	57443-T		57443-T		57361T		57361T	
Parameter	**Units**								
Antimony	ug/L								
Chromium, Total	ug/L	28000	=	4750	=	550	J	11100	J
Iron	ug/L								
Thallium	ug/L								

	StationID	E070GP003		E070GP004		E070GP004		E070GP004	
	SampleID	070GP00330		070GP00410		070GP00420		070GP00430	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	DateAnalyzed	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	SDGNumber	57361T		57361T		57361T		57361T	
Parameter	**Units**								
Antimony	ug/L								
Chromium, Total	ug/L	585	J	3830	J	14900	J	2970	J
Iron	ug/L								
Thallium	ug/L								

	StationID	E070GP005		E070GP005		E070GP005		E070GP006	
	SampleID	070GP00510		070GP00520		070GP00530		070GP00610	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted	03/23/2002		03/23/2002		03/23/2002		03/23/2002	
	DateAnalyzed	03/24/2002		03/24/2002		03/24/2002		03/24/2002	
	SDGNumber	57443-T		57443-T		57443-T		57443-T	
Parameter	**Units**								
Antimony	ug/L								
Chromium, Total	ug/L	29300	=	10600	=	1300	=	4730	=
Iron	ug/L								
Thallium	ug/L								

	StationID	E070GP006		E070GP006		E070GP007		E070GP007	
	SampleID	070GP00620		070GP00630		070GP00710		070GP00720	
	DateCollected	03/13/2002		03/13/2002		03/14/2002		03/14/2002	
	DateExtracted	03/23/2002		03/23/2002		03/26/2002		03/26/2002	
	DateAnalyzed	03/24/2002		03/24/2002		03/27/2002		03/27/2002	
	SDGNumber	57443-T		57443-T		57539T		57539T	
Parameter	**Units**								
Antimony	ug/L								
Chromium, Total	ug/L	2470	=	4720	=	1520	=	11800	=
Iron	ug/L								
Thallium	ug/L								

	StationID	E070GP007		E070GP008		E070GP008		E070GP008	
	SampleID	070GP00730		070GP00810		070GP00820		070HP00820	
	DateCollected	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	DateExtracted	03/26/2002		03/26/2002		03/26/2002		03/26/2002	
	DateAnalyzed	03/27/2002		03/27/2002		03/27/2002		03/27/2002	
	SDGNumber	57539T		57539T		57539T		57539T	
Parameter	**Units**								
Antimony	ug/L								
Chromium, Total	ug/L	2070	=	12800	=	2590	=	2360	=
Iron	ug/L								
Thallium	ug/L								

	StationID	E070GW001		E070GW001		E070GW001		E070GW002	
	SampleID	070GW001M2		070GW001M4		070HW001M4		070GW002M2	
	DateCollected	05/01/2002		07/10/2002		07/10/2002		05/01/2002	
	DateExtracted	05/08/2002		07/18/2002		07/18/2002		05/08/2002	
	DateAnalyzed	05/08/2002		07/22/2002		07/22/2002		05/08/2002	
	SDGNumber	59792		63416		63416		59792	
Parameter	**Units**								
Antimony	ug/L			4.79	U	4.79	U		
Chromium, Total	ug/L	1680	=	2000	=	1980	=	21.6	=
Iron	ug/L	106	U	90.4	J	158	=	58.3	U
Thallium	ug/L			4.99	U	4.99	U		

	StationID	E070GW002		E070GW002		E070GW01D		E070GW01D	
	SampleID	070GW002M4		070HW002M2		070GW01DM2		070GW01DM4	
	DateCollected	07/10/2002		05/01/2002		05/01/2002		07/10/2002	
	DateExtracted	07/18/2002		05/08/2002		05/08/2002		07/18/2002	
	DateAnalyzed	07/22/2002		05/08/2002		05/08/2002		07/22/2002	
	SDGNumber	63416		59792		59792		63416	
Parameter	**Units**								
Antimony	ug/L	4.79	U					4.79	U
Chromium, Total	ug/L	16.4	=	19.3	=	14100	=	12500	=
Iron	ug/L	328	=	98.1	U	1690	=	96.4	J
Thallium	ug/L	4.99	U					4.99	U

	StationID	E070GW05D		E070GW06D	
	SampleID	070GW05DM4		070GW06DM4	
	DateCollected	07/15/2002		07/11/2002	
	DateExtracted	07/18/2002		07/18/2002	
	DateAnalyzed	07/23/2002		07/22/2002	
	SDGNumber	63606		63416	
Parameter	**Units**				
Antimony	ug/L	4.79	U	4.79	U
Chromium, Total	ug/L	1950	J	504	=
Iron	ug/L	3760	=	14200	=
Thallium	ug/L	4.99	U	4.99	U

	StationID	E070GP001		E070GP001		E070GP001		E070GP002	
	SampleID	070GP00110		070GP00120		070GP00130		070GP00210	
	DateCollected	03/11/2002		03/11/2002		03/11/2002		03/13/2002	
	DateExtracted								
	DateAnalyzed	03/11/2002		03/11/2002		03/11/2002		03/13/2002	
	SDGNumber	57282T		57282T		57282T		57443	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	0.055	=	8.05	=	0.03	J	0.013	U
Chromium (Hexavalent)	ug/L								
Nitrate as Nitrous Oxide	mg/L								
Sulfate (as SO4)	mg/L								

	StationID	E070GP002		E070GP002		E070GP003		E070GP003	
	SampleID	070GP00220		070GP00231		070GP00310		070GP00320	
	DateCollected	03/13/2002		03/13/2002		03/12/2002		03/12/2002	
	DateExtracted								
	DateAnalyzed	03/13/2002		03/13/2002		03/12/2002		03/12/2002	
	SDGNumber	57443		57443		57361		57361	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	12.1	J	0.25	U	2.3	=	4.38	=
Chromium (Hexavalent)	ug/L								
Nitrate as Nitrous Oxide	mg/L								
Sulfate (as SO4)	mg/L								

	StationID	E070GP003		E070GP004		E070GP004		E070GP004	
	SampleID	070GP00330		070GP00410		070GP00420		070GP00430	
	DateCollected	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	DateExtracted								
	DateAnalyzed	03/12/2002		03/12/2002		03/12/2002		03/12/2002	
	SDGNumber	57361		57361		57361		57361	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	0.8	=	5.13	=	10	=	2.4	=
Chromium (Hexavalent)	ug/L								
Nitrate as Nitrous Oxide	mg/L								
Sulfate (as SO4)	mg/L								

	StationID	E070GP005		E070GP005		E070GP005		E070GP006	
	SampleID	070GP00510		070GP00520		070GP00530		070GP00610	
	DateCollected	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	DateExtracted								
	DateAnalyzed	03/13/2002		03/13/2002		03/13/2002		03/13/2002	
	SDGNumber	57443		57443		57443		57443	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	24.8	=	5.3	=	0.225	J	38.5	=
Chromium (Hexavalent)	ug/L								
Nitrate as Nitrous Oxide	mg/L								
Sulfate (as SO4)	mg/L								

	StationID	E070GP006		E070GP006		E070GP007		E070GP007	
	SampleID	070GP00620		070GP00630		070GP00710		070GP00720	
	DateCollected	03/13/2002		03/13/2002		03/14/2002		03/14/2002	
	DateExtracted								
	DateAnalyzed	03/13/2002		03/13/2002		03/14/2002		03/14/2002	
	SDGNumber	57443		57443		57539		57539	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	2.03	=	0.45	J	0.96	=	8.25	=
Chromium (Hexavalent)	ug/L								
Nitrate as Nitrous Oxide	mg/L								
Sulfate (as SO4)	mg/L								

	StationID	E070GP007		E070GP008		E070GP008		E070GP008	
	SampleID	070GP00730		070GP00810		070GP00820		070HP00820	
	DateCollected	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	DateExtracted								
	DateAnalyzed	03/14/2002		03/14/2002		03/14/2002		03/14/2002	
	SDGNumber	57539		57539		57539		57539	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	0.036	=	0.07	=	0.16	=	0.2	=
Chromium (Hexavalent)	ug/L								
Nitrate as Nitrous Oxide	mg/L								
Sulfate (as SO4)	mg/L								

	StationID	E070GW001		E070GW001		E070GW001		E070GW001	
	SampleID	070GW001M2		070GW001M2		070GW001M4		070HW001M4	
	DateCollected	05/01/2002		05/01/2002		07/10/2002		07/10/2002	
	DateExtracted								
	DateAnalyzed	05/02/2002		05/03/2002		07/11/2002		07/11/2002	
	SDGNumber	59792		59792		63416		63416	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	1.45	J						
Chromium (Hexavalent)	ug/L					1420	J	1790	J
Nitrate as Nitrous Oxide	mg/L			5.28	=				
Sulfate (as SO4)	mg/L			13.8	=				

	StationID	E070GW002		E070GW002		E070GW002		E070GW002	
	SampleID	070GW002M2		070GW002M2		070GW002M4		070HW002M2	
	DateCollected	05/01/2002		05/01/2002		07/10/2002		05/01/2002	
	DateExtracted								
	DateAnalyzed	05/02/2002		05/03/2002		07/11/2002		05/02/2002	
	SDGNumber	59792		59792		63416		59792	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L	0.027	UJ					0.025	UJ
Chromium (Hexavalent)	ug/L					22	=		
Nitrate as Nitrous Oxide	mg/L			2.04	=				
Sulfate (as SO4)	mg/L			30.6	=				

	StationID	E070GW002		E070GW01D		E070GW01D		E070GW01D	
	SampleID	070HW002M2		070GW01DM2		070GW01DM2		070GW01DM4	
	DateCollected	05/01/2002		05/01/2002		05/01/2002		07/10/2002	
	DateExtracted								
	DateAnalyzed	05/03/2002		05/02/2002		05/03/2002		07/11/2002	
	SDGNumber	59792		59792		59792		63416	
Parameter	**Units**								
Chromium (Hexavalent)	mg/L			14.8	J				
Chromium (Hexavalent)	ug/L							9200	J
Nitrate as Nitrous Oxide	mg/L	1.94	=			0.1	U		
Sulfate (as SO4)	mg/L	29.8	=			204	=		

	StationID	E070GW05D		E070GW06D	
	SampleID	070GW05DM4		070GW06DM4	
	DateCollected	07/15/2002		07/11/2002	
	DateExtracted				
	DateAnalyzed	07/16/2002		07/11/2002	
	SDGNumber	63606		63416	
Parameter	**Units**				
Chromium (Hexavalent)	mg/L				
Chromium (Hexavalent)	ug/L	1350	J	16	=
Nitrate as Nitrous Oxide	mg/L				
Sulfate (as SO4)	mg/L				

Appendix L

EPA Specific Comments

1. Page 5-1, Section 5.1.5, Line 8.
A table has been inserted in the text indicating that lead is a surface soil COC. However, lead was not presented as a COC for any of the receptors discussed in Section 5.1.2. Additionally, lead calculations were not included in Appendix F. A discussion of lead should be included in the text, where appropriate.

CH2M-Jones Response:
Lead is not a COC. The referenced table simply highlights those constituents that were previously considered COCs in the Draft Zone E RFI Report, and are now not considered COCs based on direct exposure-based calculations. Lead was initially considered a COC in the Draft RFI report, based on results from a fixed-point based risk assessment. Section 5.0 of the CMS Work Plan presents the results of a direct exposure-based risk assessment, and these results indicate lead is not a COC.

2. Page 5-3, Section 5.1.2. Line 9.
The text states the exposure point concentrations (EPCs) were the 95-percent upper confidence limit (UCL95) on the mean for all media. EPA Region 4 guidance states if the calculated UCL exceeds the maximum detected value should be used as the concentration term. Text should be added to this section clarifying the use of the UCL versus the maximum concentration as the EPC (It is acknowledged that the UCL was less than the maximum for the chemicals).

CH2M-Jones Response:
The text will be revised to reflect the above comment in the Revision 1 RFI Report Addendum/CMS Work Plan for this site.

3. Table F-6.
There appears to be confusion with concentrations of certain chemicals on this table. For surface soil and combined surface and subsurface soil, the minimum concentrations are listed as being greater than the maximum concentration. The appropriate minimum and maximum concentrations should be included in the table.

CH2M-Jones Response:
The referenced table will be corrected and included in the Revision 1 document.