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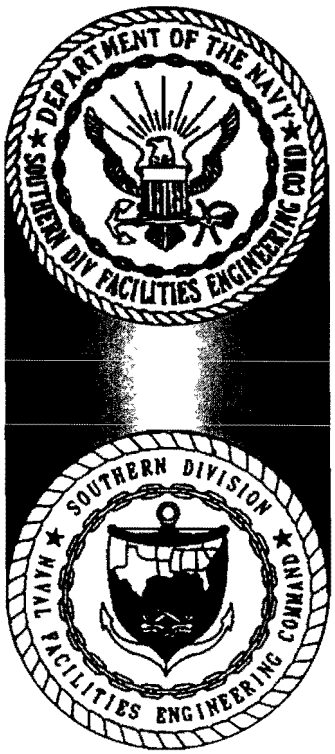
CORRECTIVE MEASURES STUDY WORK PLAN RATIONALE FOR NO FURTHER ACTION SOLID WASTE MANAGEMENT UNIT 38 (SWMU 38) ZONE A WITH TRANSMITTAL CNC CHARLESTON SC

2/15/2001

NAVFAC SOUTHERN

CORRECTIVE MEASURES STUDY WORK PLAN

Rationale for No Further Action
Solid Waste Management Unit 38, Zone A



Charleston Naval Complex
North Charleston, South Carolina

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

PREPARED BY
CH2M-Jones

February 2001

Revision 0
Contract N62467-99-C-0960

CORRECTIVE MEASURES STUDY WORK PLAN

Rationale for No Further Action
Solid Waste Management Unit 38, Zone A

Charleston Naval Complex
North Charleston, South Carolina

SUBMITTED TO
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DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
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2155 EAGLE DRIVE
NORTH CHARLESTON, S.C. 29419-9010

5090/11
Code 18713
15 Feb 01

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 CORRECTIVE MEASURES STUDY WORK PLAN FOR SOLID WASTE MANAGEMENT UNIT 38

Dear Mr. Litton,

The purpose of this letter is to submit the Corrective Measures Study Work Plan (Revision 0) for Solid Waste Management Unit (SMWU) 38 located at the Charleston Naval Complex. The work plan is submitted to fulfill the requirements of condition IV.E.2 of the RCRA Part B permit issued to the Navy by the South Carolina Department of Health and Environmental Control and the U.S. Environmental Protection Agency (EPA.)

This document and the proposed rationale for no further action were discussed by the Charleston Naval Complex BRAC Cleanup Team. CH2M Hill has distributed the document under separate cover letter. Appropriate certification is provided under that correspondence. We request that the Department and the EPA review this document and provide comments or approval whichever is appropriate.

If you should have any questions, please contact Matthew Humphrey or myself at (843) 743-9985 and (843) 820-5551 respectively.

Sincerely,

ROBERT A. HARRELL, JR., P.E.
Environmental Engineer
BRAC Division

Copy to:
SCDHEC (4)
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CH2MHILL

February 14, 2001

John Litton, P.E.
Director
Division of Hazardous and Infectious Wastes
South Carolina Department of Health and
Environmental Control
Bureau of Land and Waste Management
2600 Bull Street
Columbia, SC 29201

Dear Mr. Litton:

Enclosed please find four copies of the Corrective Measures Study (CMS) Work Plan – Source Area Delineation for SWMU 38, Zone A, at 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.

Please contact me if you have any questions or comments.

Sincerely,

Dean Williamson (KB)

Dean Williamson, P.E.

xc: Tony Hunt/Navy, w/att
Rob Harrell/Navy, w/att
Mihir Mehta/SCDHEC
Gary Foster/CH2M HILL w/att

CORRECTIVE MEASURES STUDY WORK PLAN

Rationale for No Further Action
Solid Waste Management Unit 38, Zone A

Charleston Naval Complex
North Charleston, South Carolina

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

PREPARED BY
CH2M-Jones

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February 2001
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Revision 0
Contract N62467-99-C-0960

Certification Page for the Corrective Measure Study Work Plan – Source Area Delineation for SWMU 38, Miscellaneous Storage, North of Building 1605, Zone A

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

Temporary Permit No. T2000342

Dean Williamson, P.E.

2/9/2001

Date

SOUTH CAROLINA
CH2M HILL, INC.
No. C00201
CERTIFICATE OF AUTHORIZATION

Contents, Continued

Acronyms and Abbreviations

AOC	area of concern
BCT	BRAC Clean-Up Team
BEQ	benzo(a)pyrene equivalent
BRAC	Base Realignment and Closure Act
CA	corrective action
CMS	Corrective Measures Study
CNC	Charleston Naval Complex
COC	chemical of concern
COPC	chemical of potential concern
CSAP	Comprehensive Sampling and Analysis Plan
DAF	dilution attenuation factor
DDD	dichlorodiphenyldi-chloroethane
DDE	dichlorodiphenyldichloro-ethene
DDT	dichlorodiphenyltrichloro-ethane
DET	Environmental Detachment Charleston
DPT	direct-push technology
DRO	diesel-range organic
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ft bgs	feet below ground surface
ILCR	incremental lifetime excess cancer risk
IM	interim measure
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
MCL	maximum contaminant limit
MCS	media cleanup standard
mg/kg	milligrams per kilogram

Acronyms and Abbreviations, Continued

NAVBASE	Naval Base
Navy	United States Navy
NFA	no further action
OWS	oil/water separator
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
PPE	personal protective equipment
PVC	polyvinyl chloride
RA	risk assessment
RAB	Restoration Advisory Board
RBC	risk-based concentration
RC	reference concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SSL	soil screening level
SUPSHIP	Supervisor of Shipbuilding, Conversion, and Repair
SWMU	solid waste management unit
TPH	total petroleum hydrocarbon
UST	underground storage tank
VOC	volatile organic compound

SECTION 1

Introduction

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.

CNC Corrective Action (CA) activities are being conducted under the Resource Conservation and Recovery Act (RCRA); the South Carolina Department of Health and Environmental Control (SCDHEC) is the lead agency for CA activities at the site. 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 document the basis for a Corrective Measures Study Work Plan (CMS WP) at Solid Waste Management Unit (SWMU) 38 in Zone A of the CNC.

1.1 Background and Summary for Corrective Measures Study Work Plan

As part of RCRA CA activities, a RCRA Facility Investigation (RFI) report was finalized for Zone A (EnSafe Inc. [EnSafe], 1998). Zone A is located in the northern-most portion of the CNC on the west side of the Cooper River. It is bounded by the base boundary to the north and west, the Cooper River to the east, and Noisette Creek to the south.

SWMU 38, Miscellaneous Storage, is located to the north of Building 1605, along the CNC northern boundary. Figure 1-1 shows the location of SWMU 38 within Zone A; an aerial view of SWMU 38 and the surrounding area is presented on Figure 1-2. Although little historical information is available, for approximately 50 years, the site was used as a storage yard associated with Buildings 1605 and 1604. More recently, the site was used for storage of empty drums.

The Zone A RFI for SWMU 38 concluded that surface soil chemicals of concern (COCs) at SWMU 38 included several metals, a polychlorinated biphenyl (PCB), and chlorinated pesticides; no COCs were identified. Groundwater COCs at SWMU 38 were identified as metals and chlorinated pesticides.

Completed in October 1998, an interim measure (IM) was conducted by the Environmental Detachment Charleston (DET) at SWMU 38 to remove pesticide-contaminated soil from the site. The IM targeted soil containing DDT and DDE concentrations above 6.5 milligrams per kilogram (mg/kg), and DDD concentrations greater than 9.2 mg/kg. EnSafe developed these values as target media cleanup standards (MCSs) for the DET. The excavation also resulted in the removal of a co-located total petroleum hydrocarbon (TPH)-contaminated soil.

The DET removed approximately 500 cubic yards of pesticide-contaminated soil. Confirmatory sampling found that one surface soil sample collected along the fence line between the CNC and the Hess Oil property had a residual DDT concentration of 50.9 mg/kg, which is above the MCS of 6.5 mg/kg. Additionally, two confirmatory samples collected along the bottom of the excavation had elevated concentrations of DDD and DDT. The excavation was terminated because the depth of the excavation was below the top of the water-bearing zone. The excavated pit was back-filled, leaving behind pesticide-contaminated subsurface soils with concentrations of DDD and DDT above their respective SSLs.

CH2M-Jones has conducted an additional evaluation of the data collected during the RFI and IM, as part of this CMS WP. This evaluation has resulted in the identification of DDD, DDE, and DDT as COCs for SWMU 38 surface soils. Based on the data collected as part of the DET's IM, DDD, DDE, and DDT are COCs for subsurface soil at SWMU 38. Pesticides were detected in a single monitor well that was subsequently removed; therefore, pesticides cannot be eliminated as potential COCs without verification of their absence from site groundwater.

1.2 Purpose of the CMS Work Plan

CH2M-Jones has determined that in order to develop a remedial plan for SWMU 38, additional sampling is necessary to ascertain the extent of the residual pesticide-contaminated soil at SWMU 38. In addition, groundwater samples will be collected to determine whether pesticides have impacted groundwater. Accordingly, CH2M-Jones has prepared this CMS WP to describe the proposed sampling and analysis plan for SWMU 38.

1.3 Document Organization

This CMS WP consists of the following seven sections, including this introductory section:

1.0 Introduction – Presents the purpose of the CMS WP and background information pertaining to the site.

2.0 Technical Basis and Rationale for Corrective Measures Study – Provides a brief overview of the site and previous investigations.

3.0 Corrective Measures Study Work Plan – Presents details associated with the proposed sampling and analysis plan.

4.0 References – Lists the references used in this document.

Appendix A contains excerpts from the Zone A RFI.

Appendix B contains the IM Completion Report, DET, October 29, 1998.

Appendix C contains a list of the 27 known oil/water separators (OWSs) at the CNC.

Tables and figures appear at the end of their respective sections.

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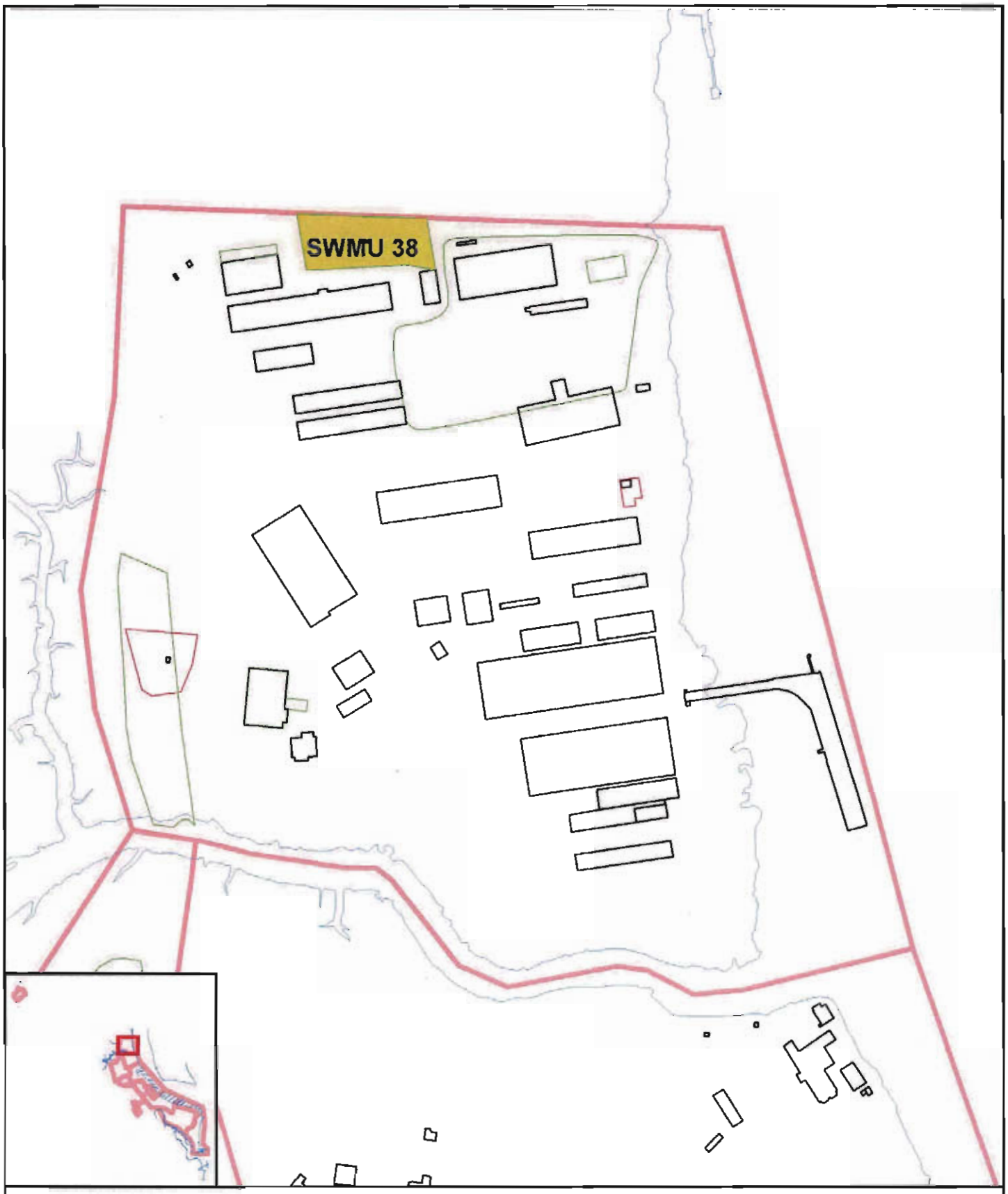

Figure 1-1
SWMU 38, Zone A
Charleston Naval Complex
North Charleston, South Carolina

Note: Original Figure is in color.

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

N

0 60 120 Feet

Figure 1-2
Aerial Photograph of SWMU 38
Zone A
Charleston Naval Complex

Note: Original Figure is in color.

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SECTION 2

Technical Basis and Rationale for Interim Measure

2.0 Technical Basis and Rationale for Corrective Measures Study Work Plan

2.1 Brief Overview of Site and Previous Investigations

The RCRA Facility Assessment (RFA) completed by EnSafe (1998) identified the following chemicals of potential concern (COPCs) resulting from operations: volatile organic compounds (VOCs), heavy metals, PCBs, petroleum hydrocarbons, and acids/bases. An RFI work plan was developed for SWMU 38, which included these COPCs as target analytes.

2.1.1 RFI Status and Conclusions

The status of the *Zone A RCRA Facility Investigation Report* is final (EnSafe, 1998). Results of the RFI for SWMU 38 are discussed in Section 10.3 of the Zone A RFI Report. Selected excerpts from the Zone A RFI are provided in Appendix A of this report to facilitate its review. The excerpts are referred to in specific sections of this report, where appropriate.

Where the data support a conclusion that deviates from the conclusions in the RFI, the more recent conclusions are also presented in this section.

Brief Summary of Soil Results from the Zone A RFI

Surface Soil

During the RFI, results of surface soil analyses were compared to applicable screening criteria (U.S. Environmental Protection Agency [EPA] Region III residential risk-based concentrations [RBCs] or background values) for selection of COPCs.

Analytes that exceeded the screening criteria were considered COPCs and were further evaluated in the Risk Assessment (RA) (Section 10.3.6, Zone A RFI) to determine which of the parameters were to be considered COCs at SWMU 38. Pages 10.3.63 through 10.3.66, which include Table 10.3.22 from the RFI, are included in Appendix A-1. This analysis resulted in the identification of the following COCs for SWMU 38 surface soil:

- Aluminum
- Arsenic
- Beryllium
- Aroclor 1260
- DDD

- DDE
- DDT

Although TPH-diesel range organics (DROs) were not identified as COCs in the RFI report, they were detected above the screening level (100 mg/kg) at one location within SWMU 38 (A038SB001) at an estimated concentration of 2,400 J µg/kg (The use of TPH as a screening criterion was established during the September 1996 NAVBASE Project Team meeting). The TPH-contaminated soil in this area was removed along with the pesticide-contaminated soil during the IM conducted by the DET; therefore, TPHs are no longer present at SWMU38 at concentrations above the cleanup level.

Table 2-1 presents a summary of the surface soil data for COCs identified in the RFI for samples collected in the vicinity of SWMU 38; Figure 2-1 illustrates the sample locations. Each analyte is discussed in the text that follows. The RA summary and final COC selection is further discussed in Section 2.2.

Aluminum

Aluminum was detected in seven surface soil samples collected at SWMU 38 (see Table 2-1), including one SWMU 2 sample (AS02SB003) collected within SWMU 38. Of these, two sample locations (A038SB004, 16,600 mg/kg; A038SB005, 13,200 mg/kg) were reported marginally above the Zone A reference value of 12,800 mg/kg, but below the leachability to groundwater-based soil screening level (SSL) of 555,074 mg/kg. Aluminum is a relatively non-toxic chemical, as reflected in its residential RBC of 78,000 mg/kg. No samples collected at SWMU 38 reported concentrations above the RBC. Therefore, aluminum is not identified as a COC requiring further evaluation.

Arsenic

Arsenic was detected in seven surface soil samples collected at SWMU 38 (see Table 2-1), including one SWMU 2 sample (AS02SB003) collected within SWMU 38. Of these, five sample locations (A038SB001, 19.8 mg/kg; A038SB002, 21.5 mg/kg; A038SB003, 15.0 mg/kg; A038SB004, 14.3 mg/kg; A038SB006, 15.6 mg/kg) were reported above the Zone A reference value of 9.4 mg/kg. Figure 10.3.5 from the RFI (included in Appendix A-2) illustrates the locations of exceedances of arsenic at SWMU 38. The range of concentrations in the background surface soil samples from Zone A were between 1.4 and 30.1 mg/kg, with a mean concentration of 13.8 (12.4 following the IM), indicating that these samples were all within the background range for Zone A. Therefore, arsenic should not be considered a surface soil COC at SWMU 38.

Beryllium

Beryllium was detected at a single location (A038SB003, 0.5 J mg/kg) above its RBC of 0.15 mg/kg (as reported in Table 5.2 of the Zone A RFI [EnSafe, 1998]). The reported concentration is an estimated concentration, as indicated by the "J" qualifier. The Zone A reference concentration was not determined for beryllium, as more than 90 percent of the samples were reported as "non-detect" (below the detection limit of 0.22-0.31 mg/kg); however, reference concentrations of 1.34 mg/kg and 0.98 mg/kg were determined for Zones B and C, respectively. While these reference concentrations are not applicable to Zone A, it can be inferred that the background level of beryllium within the northern portion of the CNC is generally greater than the detection limit (0.22 – 0.31 mg/kg).

The RBC provided in the RFI was based on the October 1997 EPA Region III *Risk-Based Concentration Table.* Since the completion of the Zone A RFI, the RBC for beryllium has been increased significantly. The April 2000 EPA Region III Risk-Based Concentration Table lists a RBC of 160 mg/kg for beryllium; the Region IX PRG tables list beryllium at 150 mg/kg. No samples collected at SWMU 38 reported beryllium concentrations above the more recent RBC. Therefore, based on the latest RBC, beryllium should be not considered a COC at SWMU 38.

PCBs (Aroclor-1260)

Table 2-1 presents analytical results for Aroclor-1260 in surface soil samples collected at SWMU 38. Aroclor-1260 was detected in six surface soil samples collected in SWMU 38. Of these, four samples (A038SB006, 500 µg/kg; A038SB007, 410 µg/kg; A038SB011, 720 µg/kg; A038SB012, 1,300 µg/kg;) were reported above the RBC of 320 µg/kg for Aroclor-1260, and one sample (A038SB012) marginally exceeded the *Requirements for PCB Spill Cleanup*, 40 CFR 761.125 (c)(4)(v), of 1,000 µg/kg (1 ppm, or 1 mg/kg). Figure 10.3.5 from the RFI (included in Appendix A-2) illustrates the locations of exceedances of Aroclor-1260 at SWMU 38. The presence of PCBs in surface soil is discussed further in Section 2.2.

Pesticides (DDD, DDE, and DDT)

Analysis for pesticides in surface soil determined that three pesticides, DDD, DDE, and DDT, were above their respective RBCs (DDD: 2,700 µg/kg; DDE and DDT: 1,900 µg/kg) in the sample collected at A038SB001. In addition, DDD and DDT exceeded their RBCs in sample A038SB00301. A second sampling event was conducted to determine the extent of pesticide contamination. None of the twelve second-event surface soil samples detected pesticides above their respective RBCs. Figure 10.3.5 from the RFI (included in

Appendix A-2) illustrates the locations of exceedances of pesticides at SWMU 38. The presence of pesticides in surface soil is discussed further in Section 2.2.

Subsurface Soil

Subsurface soil samples were collected as part of the RFI at each of the soil boring locations, except where saturated soils were encountered within the sample interval. Figure 2-1 illustrates the locations of the soil samples evaluated as part of this CMS WP.

Results of subsurface soil analyses in the RFI were compared to applicable screening criteria (EPA SSLs or background values). Analytes detected in subsurface soils either were not detected above their respective SSLs in subsurface soil or were not reliably identified in shallow groundwater, indicating that existing soil concentrations are protective of surficial groundwater. Appendix A-3 provides pages 10.3.28 - 10.3.31, including Table 10.3.8, of Section 10.3.5.1 of the Zone A RFI.

Concentrations of DDD, DDE, and DDT exceeded their SSLs in one surface soil sample (A038SB001); DDD and DDT were detected in one shallow groundwater monitor well (A038GW001) at SWMU 38 (DDD, 4 of 4 sampling events; DDT, 3 of 4 sampling events). However, no subsurface samples reported pesticide concentrations above their respective SSLs in the RFI. The RFI concluded that the isolated detection of these constituents in groundwater, their apparent absence from subsurface soil, and their fate and transport properties indicated that they were not present at concentrations sufficient to consider them COCs in subsurface soil.

Based on these data, the RFI RA did not identify any COCs for subsurface soil at SWMU 38.

Groundwater

Results of the groundwater analyses were compared in the RFI to applicable screening criteria (EPA Region III residential RBCs or background values).

Analytes that exceeded the screening criteria were further evaluated in the RA (Section 10.3.6, Zone A RFI) to determine which of these parameters were considered COCs at SWMU 38. Appendix A-4 provides Tables 10.3.6 and 10.3.7 and pages 10.3.63 - 10.3.66 from the RFI. This analysis resulted in the identification of the following COCs for SWMU 38 groundwater:

- Arsenic
- Thallium

- DDD
- DDT

Table 2-2 presents a summary of the groundwater COC data for samples collected at SWMU 38 and Figure 2-2 illustrates the sample locations at the site. Each of the analytes is discussed below.

Arsenic

Arsenic was detected in nine groundwater samples collected at SWMU 38 (see Table 2-2). Of these, three samples, two from the same well, were reported above the Zone A reference concentration for shallow groundwater of 7.4 micrograms per liter (µg/L), compared to the October 1996 sample's maximum detected concentration of 14.9 µg/L. The range of background concentrations for Zone A shallow groundwater was between 2.6 and 68.1 µg/L. Arsenic concentrations in groundwater at SWMU 38 are within the range of background concentrations at Zone A. Based on these considerations, arsenic should not be considered a COC at SWMU 38.

Thallium

Thallium was detected in a single groundwater sample (A038GW002, 4.0 J µg/L) collected at SWMU 38 (see Table 2-2) in December 1995. This concentration is above the MCL (2 µg/L), but it is an estimated concentration, as indicated by the "J" qualifier. Thallium was not detected in the three subsequent samples collected from the same well between April and October 1996. As such, thallium should not be considered a COC in groundwater at SWMU 38.

Pesticides (DDD and DDT)

Analysis for pesticides in SWMU 38 groundwater determined that DDD and DDT were above their respective RBCs in one or more samples collected at monitor well A038GW001 (see Table 2-2). Between December 1995 and October 1996, DDD exceeded its RBC in all four samples collected at A038GW001; DDT exceeded its RBC at the same location in the first three samples collected between December 1995 and June 1996. Neither DDD nor 4,4'DDT were reported at concentrations above their respective RBCs in any other wells at SWMU 38, including monitor well A038GW003. Monitor well A038GW003 is located hydraulically downgradient of monitor well A038GW001 (A038GW001 was removed during the IM, consequently no data were collected after 1996), indicating that migration of pesticides is not occurring. EnSafe determined the groundwater flow direction to be toward the southeast,

based on the results of groundwater level measurements. Figure 2.8 from the RFI, which presents a groundwater contour map, is included in Appendix A-5.

Based on these data, DDD and DDT may be groundwater COCs at SWMU 38.

2.1.2 Interim Measure

After the completion of the RFI, the Southern Division Naval Facilities Engineering Command (SOUTHDIV) requested an IM be performed by the Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP), United States Navy (USN), Portsmouth VA Environmental Detachment Charleston (SPORTENVDETCHASN). The DET implemented an IM to remove pesticide-contaminated soil at SWMU 38. The results of the confirmatory sampling from the excavation are found in the *Completion Report Interim Measure for SWMU 38* (DET, 1998), which is provided in Appendix B.

The objective of the IM was to reduce soil concentrations of DDT, DDE, and DDD-contaminated soil by excavating soil near boring locations 038SB001 and 038SB003 until the sampling program indicated, with reasonable confidence, that the concentrations of the contaminants were below the residential limits specified by EPA Region III. The work plan (SUPSHIP, March 1997) requested two excavations: one to be located at soil boring A038SB001, measuring 6′ x 6′ x 4′ deep, and one to be located at soil boring A038SB003, measuring 6′ x 6′ x 2′ deep (see Figure 2-2 for boring locations). Following the initial excavation activities, confirmatory samples were to be collected to verify that pesticide-contaminated soil was removed. The work plan also requested expansion of the excavation should the presence of pesticide-contaminated soil occur following the initial excavations.

The IM Completion Report (SUPSHIP, October 1998) details the excavation and sampling activities at SWMU 38. The results of the confirmatory sampling indicated that pesticide-contaminated soil was present following the initial excavations. The excavation was eventually expanded so that the two excavations merged into a single excavation, measuring approximately 120 feet long (parallel to the base boundary/fence) by 25 feet wide (north to south) and 4 to 5 feet deep. Figure 2-4 illustrates the locations of soil borings 038SB001 and 038SB003 and the approximate area of the final excavation.

EnSafe conducted a residual risk evaluation following the initial excavations. The evaluation developed direct exposure-based target MCSs for pesticides in surface soil at SWMU 38. For DDT and DDE, the MCS was 6.5 mg/kg; for DDD, the MCS was 9.2 mg/kg. After completion of the excavation, confirmatory samples were collected along the east, west, and south side walls and from the bottom of the excavation. The north side wall and third

interval (6-7 feet below ground surface [ft bgs]) perimeter sampling was conducted following excavation backfill. Results of the confirmatory sampling indicated that pesticide levels were below the MCSs, except one upper interval (0-1 ft bgs) sample located along the fenced property line (038SB03701, 50.9 mg/kg). In addition, two of the three samples collected along the centerline of the excavation bottom reported DDD and DDT concentrations above their respective SSLs. The samples collected at the bottom of the excavation (4-5 ft bgs) are not a direct exposure concern under current conditions; however, they are a possible concern for leachability to groundwater.

Once groundwater was encountered, no further excavation was performed, and the excavation was back-filled. Six soil samples were collected at 6-7 ft bgs to determine if pesticide contamination was present below and beyond the perimeter of the excavation. Samples analysis indicated that none of the samples were above the MCSs. The data for these samples can be found in the IM Completion Report for SWMU 38 (DET, 1998).

Although the IM focused on removal of pesticide-contaminated soil, TPH-contaminated soil was also excavated during the effort. TPH, detected in a single upper interval sample (038SB00101) at a concentration of 2,400 mg/kg, was excavated along with the pesticide-contaminated soil.

2.2 Risk Assessment Review and Summary

2.2.1 Surface Soil

The RFI RA indicated that surface soil cancer risks (incremental lifetime excess cancer risk [ILCR]) were above acceptable limits ($>10^{-6}$ to $>10^{-4}$) at two sample locations (A038SB001 and A038SB003) primarily due to the presence of DDT, DDD, and DDE at the maximum detected concentration, or exposure point concentration (EPC). Arsenic and PCBs (Aroclor - 1260) also contributed to the high ILCR. The noncarcinogenic hazard index (HI) (HI > 1) was primarily from the DDT. Risks to workers were estimated at an ILCR of 2×10^{-4} due to DDT, DDD, and DDE; the HI is calculated at 2.0, resulting primarily from dermal contact with DDT-contaminated soil (HI = 1.28). Risks to future residential receptors were determined to be at an ILCR of 8×10^{-4}, from DDT, DDD, DDE, Aroclor-1260, and arsenic. The noncarcinogenic HI to a future resident child was calculated at 28, primarily due to ingestion and dermal contact with DDT-contaminated soil (ILCR = 6.2×10^{-4} and HI = 25.9). Over 90 percent of the HI and over 75 percent of the ILCR is due to the presence of DDT in surface soil.

The removal of site soil as part of the DET's IM has reduced the ILCR and HI to near-acceptable levels; however, the detection of DDT at a concentration of 50.9 mg/kg in one of the confirmation samples (03803701) collected at the site during the IM suggests that further investigation is needed prior to site closeout.

Although chemicals such as aluminum, arsenic, and beryllium were included as COCs in the RFI RA, aluminum and arsenic are within background levels, and the RBC for beryllium has been significantly increased since the completion of the Zone A RFI. Based on the above data, these chemicals were not selected as final COCs.

Subsurface Soil

The RFI RA concluded that COCs were not present at SWMU 38. Samples collected as part of the DET's IM indicated that subsurface soil concentrations of DDD and DDT are present above their respective SSLs. Additional sampling and analysis, as proposed in Section 3.0, will determine the extent of pesticide-contaminated subsurface soil at SWMU 38.

The risk (ILCR) estimated for exposure to groundwater was based on a single shallow well screened within the area of the highest pesticide contamination. Risks were estimated at 7×10^{-5} to a worker, and to a resident at 2×10^{-4} from arsenic, DDD, DDT and DDE. The HI was less than 1.0 for a worker, and 4 for a residential child, primarily due to arsenic and thallium in groundwater. The EPC for arsenic was at an average concentration of 8.9 µg/L compared to a background concentration of 7.4 µg/L. Arsenic was not detected in the other shallow monitor wells above its reference concentration. Thallium was reported above its MCL (2 µg/L) in sample A038GW00201 (12/95) at an estimated concentration of 4.0 J µg/L, but was not detected in any of the three subsequent sampling events at the same location, indicating that the exceedance was anomalous. Therefore, arsenic and thallium should not be selected as COCs in SWMU 38 groundwater.

Groundwater from shallow well (A038GW001), located within the area of the maximum detected concentration of DDT reported the pesticide at a concentration of 2.4 µg/L. This well has since been removed. Pesticides were not reported in the hydraulically downgradient monitor well (A038GW003) or in the deep monitor well (A038GW01D) at the site, indicating that migration of the pesticides is not occurring in spite of the fact that DDE and DDT were detected above their respective SSLs in two of the DET's confirmation samples collected at the bottom of the excavation. Because of the previous detection of DDD and DDT in site groundwater and the presence of DDT in subsurface soil in excess of its SSL, DDD, DDE, and DDT may be groundwater COCs. Additional sampling and analysis,

as proposed in Section 3.0, will determine whether these pesticides are still present in site groundwater.

2.2.2 Uncertainty Associated with COC Selection

Arsenic

Arsenic was detected at concentrations ranging between 7.8 mg/kg to 19.8 mg/kg, with an average concentration of 14.7 mg/kg. The range of detected concentrations is comparable to the background arsenic levels (1.4 mg/kg to 30.1 mg/kg in Zone A grid samples). The overall site levels may be even lower at the present time, as the soil excavation as part of the DET's IM included removal of the maximum detected arsenic concentration. Based on these data, arsenic is not considered a COC.

PCB

The maximum detected PCB concentration (EPC) of 1.3 mg/kg had a marginal contribution to overall site risks (ILCR $<10^{-6}$ for a worker, and at 5×10^{-6} for a resident). The mean PCB concentration in surface soil at SWMU 38 was 0.51 mg/kg, which is the EPA policy-based cleanup target level of 1 mg/kg for residential land use and is well below the industrial land use-based value of 25 mg/kg. Therefore, PCBs are not proposed as COCs for SWMU 38.

IM Implementation and Residual Risk Assessment:

Because the RFI concluded that DDT, DDE, and DDD exceeded unacceptable concentrations at the site, SOUTHDIV implemented removal actions in the vicinity of soil sample locations 038SB001 and 038SB003. When residual samples from these excavations indicated high pesticide concentrations, removal actions were expanded to encompass a larger area. A residual risk assessment was conducted only on samples from the first sampling event removal. The residual soil samples from the second sampling event of the IM were not evaluated for potential risks. The residual risk evaluation from the first sampling event indicated the need for further actions to reduce pesticide levels, assuming subsurface soils are a direct exposure concern. The second event of removal actions revealed DDT at one surface soil location (A03803701) exceeding the target MCSs for residential land use and above its leachability-based SSL. Two subsurface soil samples were also above SSL values below grade in the center of the excavated area, immediately above the shallow water table. Although these samples are not accessible for direct exposure, they may provide a leaching source to groundwater. Table 2-3 includes the target remedial goal options (RGOs) and MCSs developed for residential land use at a risk level of one in a million (10^{-6}) and the leachability-based SSLs.

One residual surface sample location was reported with a DDT concentration above direct exposure based RBCs for residential and industrial land use and its SSL. However, because of the extensive soil excavation previously completed, the extent of contaminated soil in this area is likely limited.

2.2.3 Final List of COCs

COCs for surface and subsurface soils are DDT, DDD, and DDE. Groundwater may also contain unacceptable levels of DDD and DDT. Further sampling and analysis is needed to confirm the presence or absence of these pesticides in site groundwater.

2.3 Summary

Pesticide-contaminated surface soil has been excavated to a depth of approximately 4-5 feet and removed from the SWMU 38 during the IM conducted by the DET. The excavation also included the only sample with TPH-DRO contamination above the cleanup level and the only location where beryllium was detected. Therefore, beryllium and TPH are no longer a concern in surface soil at SWMU 38.

Arsenic concentrations at the two excavated borings (A038SB001, 19.8 mg/kg and A038SB003, 15.0 mg/kg) were above the Zone A reference concentration of 9.4 mg/kg. The remaining arsenic levels are within the range of background concentrations for this area. Therefore, arsenic is not considered a COC, as discussed previously.

Aluminum concentrations are below the Region III RBC; therefore, aluminum is not considered a COC at SWMU 38.

Aroclor-1260 was detected below residential land use-based remedial action level of 1 mg/kg in all but one sample collected at SWMU 38. The single marginal exceedance of Aroclor-1260 was determined not to require remedial action, as no other samples detected Aroclor-1260 above the action level, and its mean concentration is well below the action level. There is not a sufficiently large exposure area to create a significant risk pathway for PCBs. Therefore, Aroclor-1260 is not considered a COC at SWMU 38.

The RFI did not identify any COCs in subsurface soil at SWMU 38. However, results from the samples collected as part of the IM indicated that the soil at the bottom of the excavation contained pesticides (DDD and DDT) above their SSLs.

DDT was detected in groundwater in a well located where the greatest DDT concentrations in soil were located. The well was removed during the IM. Previous detections of DDT in

groundwater at this location, in addition to the presence of pesticides in subsurface soil above their SSLs, warrants further consideration of DDD, DDE, and DDT as groundwater COCs at SWMU 38.

In summary, the COCs are DDT, DDD, and DDE in surface and subsurface soils and possibly in groundwater at SWMU 38. The extent of DDT, DDD, and DDE contamination in areas where exceedences were observed needs to be further defined.

TABLE 2-1
Surface Soil Analytical Results for Selected Compounds
CMS Work Plan, SWMU 38 in Zone A, Charleston Naval Complex

Sample Location	ID	Date	Constituent	Results (mg/kg)	Qualifier
A038SB001	038SB00101	10/03/1995	AL	5,880	=
			AS	**19.80**	=
			BE	0.22	U
			PCB1260	0.014	U
			DDD44	**450.00**	J
			DDE44	**37.00**	J
			DDT44	**1,000.00**	J
A038SB002	038SB00201	10/03/1995	AL	7,810	=
			AS	**21.50**	=
			BE	0.2100	U
			PCB1260	0.0140	U
			DDD44	0.0016	J
			DDE44	0.0082	=
			DDT44	0.0300	U
A038SB003	038SB00301	10/03/1995	AL	11,400	=
			AS	**15.00**	=
			BE	0.500	J
			PCB1260	0.016	U
			DDD44	**3.30**	=
			DDE44	0.45	=
			DDT44	**7.80**	J
A038SB004	038SB00401	10/03/1995	AL	16,600	=
			AS	**14.30**	=
			BE	0.3100	U
			PCB1260	0.0210	U
			DDD44	0.0053	U
			DDE44	0.0053	U
			DDT44	0.0200	U
A038SB005	038SB00501	10/03/1995	AL	13,200	=
			AS	7.80	=
			BE	0.23	U
			PCB1260	0.02	U
			DDD44	0.0040	U
			DDE44	0.0040	U
			DDT44	0.0040	U

TABLE 2-1
Surface Soil Analytical Results for Selected Compounds
CMS Work Plan, SWMU 38 in Zone A, Charleston Naval Complex

A038SB006	038SB00601	10/03/1995	AL	8,440	=
			AS	**15.60**	=
			BE	0.240	U
			PCB1260	0.500	=
			DDD44	0.059	=
			DDE44	0.170	=
			DDT44	0.370	J
A038SB007	038SB00701	03/26/1996	PCB1260	0.410	J
			DDD44	0.050	J
			DDE44	0.170	J
			DDT44	0.077	J
A038SB008	038SB00801	03/26/1996	PCB1260	0.0740	U
			DDD44	0.0027	U
			DDE44	0.0068	J
			DDT44	0.0210	J
A038SB009	038SB00901	03/26/1996	PCB1260	0.09	U
			DDD44	0.0034	U
			DDE44	0.0034	U
			DDT44	0.0034	U
A038SB010	038SB01001	03/26/1996	PCB1260	0.075	U
			DDD44	0.044	J
			DDE44	0.057	J
			DDT44	0.460	J
A038SB011	038SB01101	06/18/1996	PCB1260	0.72	=
			DDD44	0.21	=
			DDE44	0.53	=
			DDT44	1.40	=
A038SB012	038SB01201	06/18/1996	PCB1260	**1.30**	=
			DDD44	0.19	J
			DDE44	0.17	=
			DDT44	0.80	=
A038SB013	038SB01301	06/18/1996	PCB1260	0.018	=
			DDD44	0.0042	U
			DDE44	0.012	=
			DDT44	0.054	=

TABLE 2-1
Surface Soil Analytical Results for Selected Compounds
CMS Work Plan, SWMU 38 in Zone A, Charleston Naval Complex

A038SB014	038SB01401	06/18/1996	PCB1260	0.079	=
			DDD44	0.29	=
			DDE44	0.58	=
			DDT44	1.70	=
AS02SB003	S02SB00301	10/06/1993	AL	5,600.00	=
			AS	2.80	=
			BE	0.54	U

AL	Aluminum	
AS	Arsenic	
BE	Beryllium	
PCB1260		Aroclor-1260
DDD44	4,4'-DDD	dichlorodiphenyldichloroethane
DDE44	4,4'-DDE	dichlorodiphenylchloroethane
DDT44	4,4'-DDT	dichlorodiphenyltrichloroethane

Bold values indicate exceedance of RC, SSL, and/or RBC.
J indicates that the compound was detected and the concentration is an estimated value.
U indicates that the compound was not detected.
UJ indicates that the compound was not detected and the value provided is estimated.

TABLE 2-2
Groundwater Analytical Results for Selected Compounds
CMS Work Plan, SWMU 38 in Zone A, Charleston Naval Complex

Sample			Constituent				
Location	ID	Date	Arsenic (µg/L)	Thallium (µg/L)	DDD (µg/L)	DDE (µg/L)	DDT (µg/L)
MCL			10	2			
RBC			0.045	2.6	0.28	0.2	0.2
Background			11.1	2			
A002GW004	002GW00402	04/23/1996	7.0 U	3.0 UJ	NS	NS	NS
	002GW00403	06/19/1996	4.6 J	3.0 U	NS	NS	NS
	002GW00404	10/04/1996	**10.3** J	3.1 U	NS	NS	NS
	002GW004C1	10/15/1998	7.0 J	1.6 U	0.10 U	0.10 U	0.10 U
A038GW001	038GW00101	12/07/1995	6.0 J	4.0 UJ	**3.80** =	0.05 J	**1.50** J
	038GW00102	04/22/1996	10.4 U	3.0 U	**4.00** =	0.09 J	**2.60** =
	038GW00103	06/19/1996	**12.5** =	3.0 U	**2.90** =	0.11 U	**0.23** =
	038GW00104	10/09/1996	**14.9** =	3.1 U	**3.18** =	0.10 U	0.10 U
A038GW002	038GW00201	12/07/1995	4.0 U	**4.0** J	0.10 U	0.10 U	0.10 U
	038GW00202	04/22/1996	3.2 U	3.0 U	0.11 U	0.11 U	0.11 U
	038GW00203	06/19/1996	3.1 J	3.0 U	0.11 U	0.11 U	0.11 U
	038GW00204	10/08/1996	2.1 U	3.1 U	0.10 U	0.10 U	0.10 U
	038GWC0201	03/17/1999	NS	NS	0.08 U	0.08 U	0.08 U
A038GW003	038GW003C1	10/19/1998	2.6 J	1.6 U	0.10 U	0.10 U	0.10 U
	038G000310	07/21/2000	NS	NS	0.08 UJ	0.08 UJ	0.08 UJ
A038GW01D	038GW01D01	12/07/1995	4.0 U	4.0 UJ	0.10 U	0.10 U	0.10 U
	038GW01D02	04/23/1996	2.0 U	3.0 UJ	0.11 U	0.11 U	0.11 U
	038GW01D03	06/19/1996	2.0 U	3.0 U	0.11 U	0.11 U	0.11 U
	038GW01D04	10/08/1996	2.1 U	3.1 U	0.10 U	0.10 U	0.10 U
	038GWC1D01	03/17/1999	NS	NS	0.08 U	0.08 U	0.08 U

Bold values indicate exceedances of background values.
= indicates that the conpound was detected and the reported value is equal to the concentration.
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenylchloroethane
DDT dichlorodiphenyltrichloroethane
J indicates that the compound was detected and the concentration is an estimated value.
ND indicates that a background concentration was not determimed.
NS indicates that the sample was not analyzed for that constituent.
U indicates that the compound was not detected.
UJ Indicates that the compound was not detected and the value provided is estimated.

TABLE 2-3
Target Remedial Goal Options for COCs (Developed by EnSafe for Interim Measure)
CMS Work Plan, SWMU 38 in Zone A, Charleston Naval Complex

Constituent	Residential Land Use Based at 10^{-6} Target Risk Level	SSL (from RFI)	SSL (DAF_{20})[a]	Surface Soil Maximum Concentration[b, c]	Subsurface Soil Maximum Concentration[c]
DDT	6.5	16	32	50.9	388
DDE	6.5	27	54	5.88	0.546
DDD	9.2	8	16	8.04	123

[a] Values from EPA Region 9 PRG tables, December 2000 update.
[b] Maximum concentration after second sampling event of final IM.
[c] All maximum residual concentrations are in one sample, NBCA03803701 (surface soil).
All concentrations are in mg/kg (ppm) units.

Source: EnSafe Inc., 1998.

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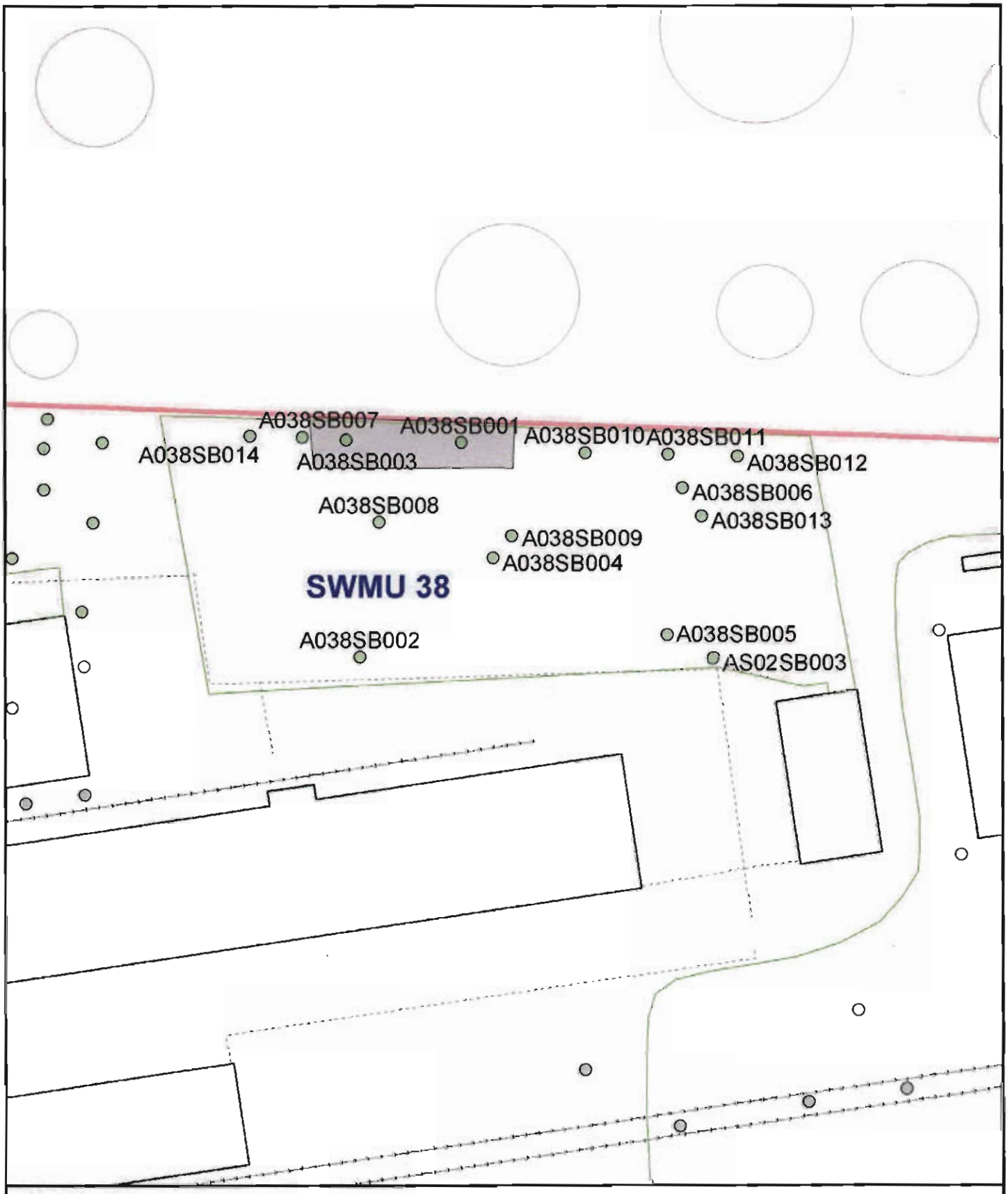

Figure 2-1
Sample Soil Locations
SWMU 38, Zone A
Charleston Naval Complex

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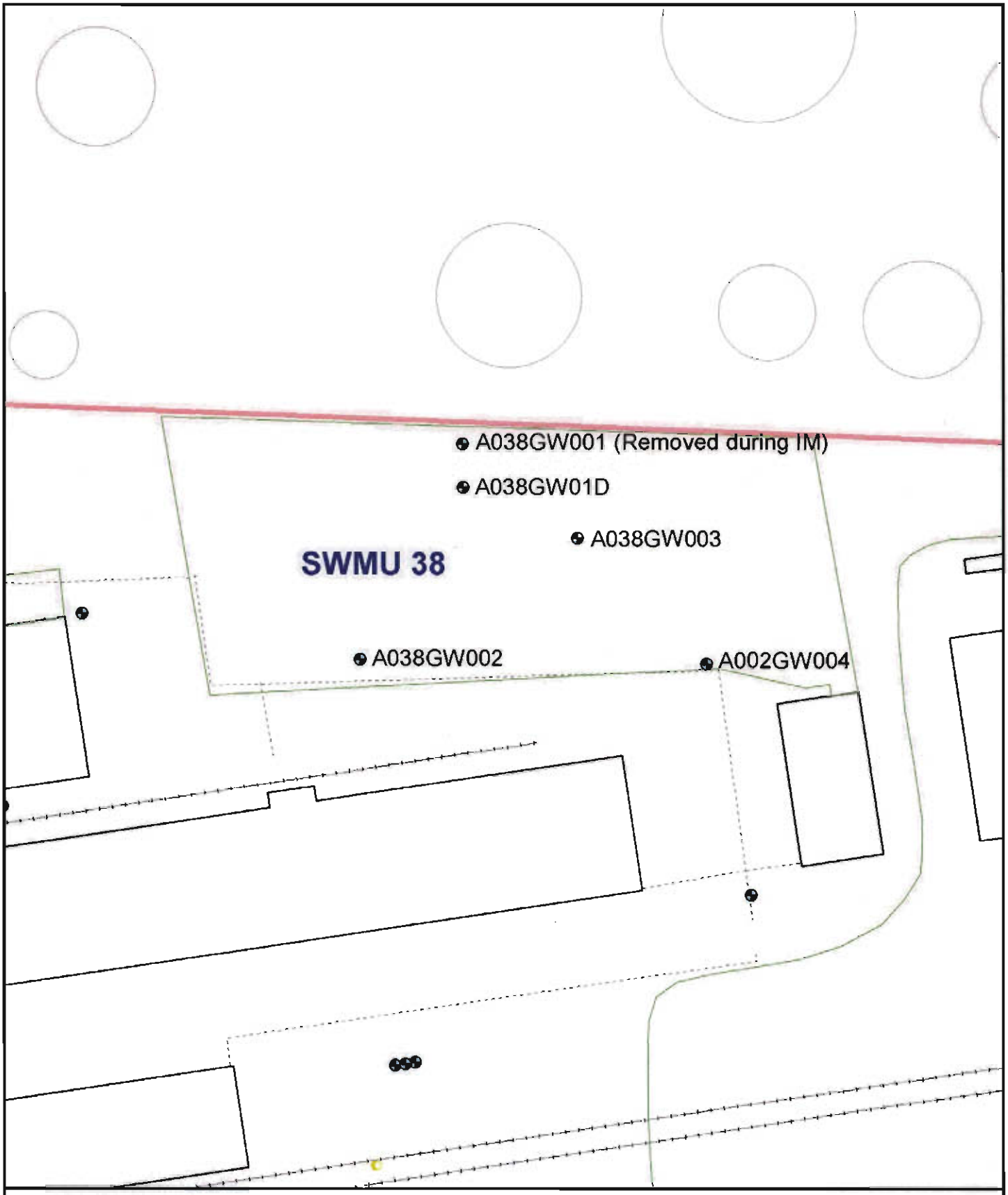

Note: Original Figure is in color.

Figure 2-2
Groundwater Sample Locations
SWMU 38, Zone A
Charleston Naval Complex

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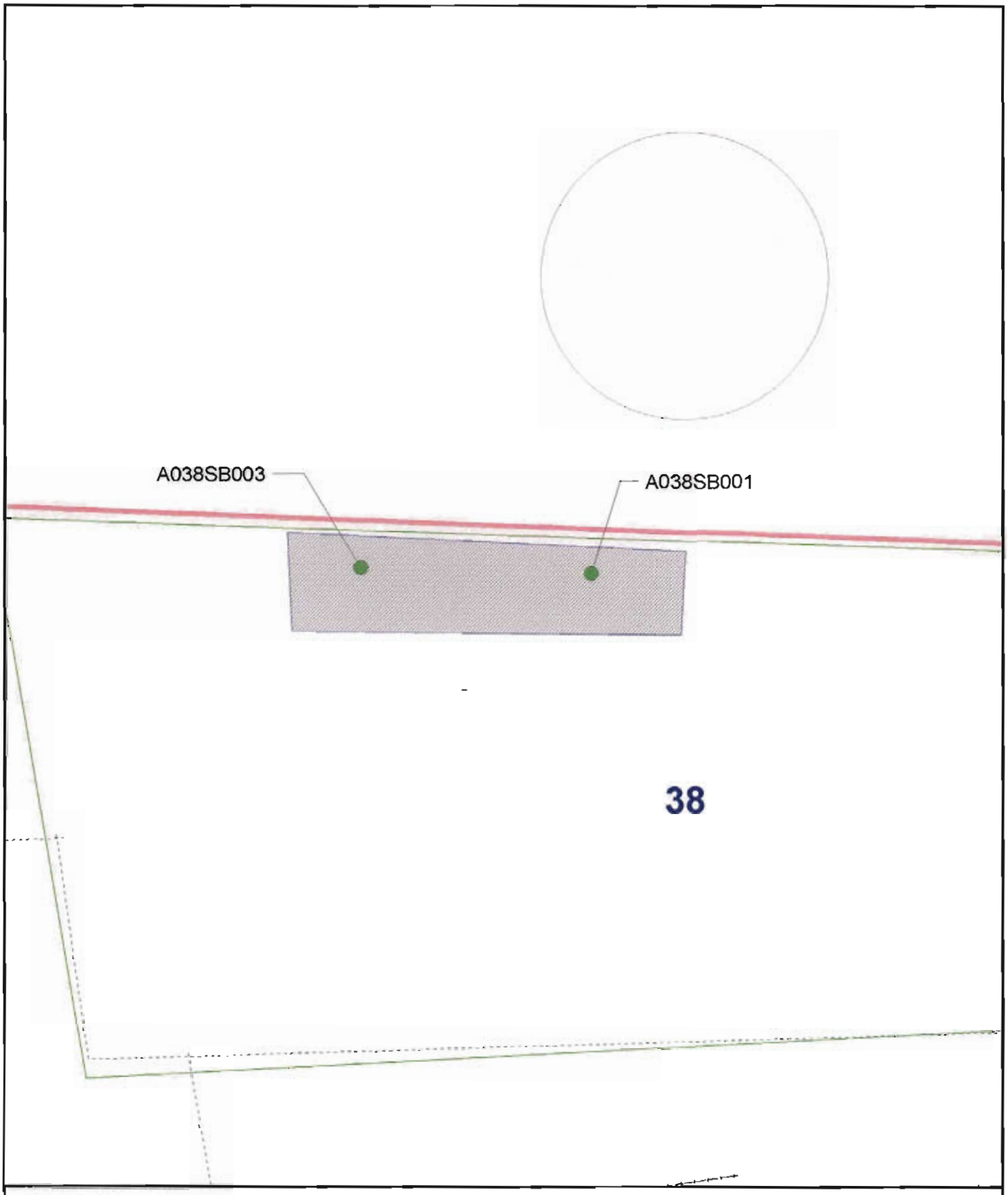

Note: Original Figure is in color.

Figure 2-3
Approximate Area of IM Excavation
SWMU 38, Zone A
Charleston Naval Complex

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SECTION 3

Interim Measure Work Plan

3.0 Source Area Delineation Sampling Approach

The objective of the source area delineation sampling is to determine the areal extent of the remaining pesticide-contaminated soil at SWMU 38. DDD and DDT have been detected in surface and subsurface soil above their respective MCSs and SSLs. DDD and DDT have also been detected in site groundwater in the area of the previous IM. Three samples collected from the bottom of the excavation and one surface sample collected from the north wall of the excavation were found to contain DDD and DDT above their respective SSLs of 8.0 mg/kg and 16.0 mg/kg, respectively. Additional soil and groundwater samples are proposed to delineate the areal extent of pesticide-contaminated media above the MCSs.

Following the delineation of pesticide-contaminated soils and groundwater sampling, a CMS will be prepared to develop a final remedial plan. The remainder of this section describes the components of the CMS.

3.1 Health and Safety

All work completed as part of this CMS will be performed in accordance with the CH2M-Jones Site-Specific Health and Safety Plan.

3.2 Sampling and Analysis Plan

All investigative work will be performed in accordance with the Comprehensive Sampling and Analysis Plan (CSAP) portion of the RFI Work Plan (EnSafe, 1996).

3.3 Contaminant Delineation

The surface soil sample (A03803701) previously collected from the north wall of the DET's excavation showed reported a DDT concentration of 50.9 mg/kg. The soil to the south of this sample location is non-native fill and is expected to be free of contamination. The surface and subsurface samples collected from the west (A038036) and east (A038038) of this location all reported pesticides below 1 mg/kg. The extent of the pesticide contamination at this location appears to be small, or anomalous. Therefore, CH2M-Jones proposes to resample this surface soil location. If the results of this sample are above the MCSs,

additional sample collections will be considered. Additional samples will be based on the location and number of results reported above the MCSs. Surface soil samples will be collected using a hand auger and will be analyzed for DDD, DDE, and DDT. The location of the proposed surface soil sample is illustrated in Figure 3-1.

Samples collected from the bottom of the IM excavation (A038S030 and A038S031), conducted by the DET, had reported concentrations of DDD and DDT that exceeded their respective SSLs (DDD 8.0 mg/kg and DDT 16.0 mg/kg). Sample A038S03001 had reported concentrations of DDD and DDT of 19.0 mg/kg and 41.6 mg/kg, respectively (see Figure 3-2 for sample locations). Sample A038S03101 showed reported concentrations of DDD and DDT of 123.0 mg/kg and 388.0 mg/kg, respectively. Sample location A038S03201, which is west of A038S03001 and A038S03101, showed reported pesticide concentrations below their SSLs. CH2M-Jones is proposing five sample locations around A038S03001 and A038S03101, as shown in Figure 3-2. Each sample location will consist of two samples; one sample will be collected one foot above the water table, and the other will be collected one foot below the water table (total of ten samples). If the result of any sample is above the SSLs, additional samples will be considered. The location of additional samples will be based on the location and number of results above the SSLs. Additional samples will be collected using a hand auger and will be analyzed for DDD, DDE, and DDT.

In addition to the proposed subsurface samples, one monitor well is proposed to determine the impact of pesticide-contaminated soil to the local groundwater, if any. The monitor well will be located in the same location as the well (A038GW001) that was removed as part of DET's IM, as shown in Figure 3-3. Monitor well A038GW003, which is located outside of the footprint of the excavation and hydraulically downgradient (east-southeast) of sample locations A038S03001 and A038S03101, will be used to monitor migration of contaminants. This monitor well was determined to be downgradient of the contaminated area based on EnSafe's evaluation of groundwater levels (Appendix A-5 presents Figure 2.8 from the RFI, which indicates groundwater flow direction).

Additional monitor wells may be necessary to delineate the groundwater plume, if present. The location of additional monitor wells will be determined based on the results reported from the initial well (A038GW01R) and A038GW003. The monitor wells will be constructed as permanent monitor wells. A two-inch polyvinyl chloride (PVC) well screen will be used. Groundwater samples could contain significant suspended solids that can produce elevated results.

To reduce suspended solids and to provide results that are more representative of the dissolved-phase pesticide concentrations in site groundwater, the monitor wells should be well developed and purged using low-flow techniques prior to collecting the samples. After the required 3 to 5 well volumes have been purged from the well, the groundwater will be allowed to stand undisturbed for 2 hours prior to collecting the sample to allow settling of suspended solids. The sample will be collected from the upper third of the water column. Sampling of monitor wells will conform to the Comprehensive Sampling and Analysis Plan (Section 6.3; EnSafe/Allen & Hoshall, July 1996), and to the *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual* (Section 7.2.2; EPA, May 1996). Groundwater samples are to be analyzed for pesticides. The potentiometric groundwater elevations from the RFI are superimposed on Figure 3-3.

The top of the casings of the temporary wells will be surveyed and depth to water measured in these wells, as well as wells A038GW002, A038GW003, A038GW004, A039GW003, and A038GW006. The data collected will be used to create a potentiometric map for SWMU 38.

3.4 Support Activities

3.4.1 Waste Management

Three waste streams will be generated as part of this CMS: soil cuttings, purge water, and decontamination wastes. No hazardous wastes are expected to be generated as a result of this CMS. Soil cuttings will be characterized in accordance with South Carolina Hazardous Waste Management Regulations (Section SCDHEC R.61-79.261) and disposed of in accordance with all applicable regulations and permits. Assuming soils will be characterized as non-hazardous, they will be sent to a subtitle D landfill. Decontamination wastes and purge water also will be disposed of in accordance with regulations.

Offsite transportation and disposal will be performed by properly permitted and licensed subcontractors. Materials designated for offsite disposal will be documented, tracked, and their disposition verified. This information will be reported in the CMS Completion Report.

3.4.2 Equipment Decontamination

Decontamination of personnel, sampling and removal equipment, and materials will be in accordance with the CH2M-Jones Site-Specific Project Health and Safety Plan.

3.5 Corrective Measures Study Completion Report

A final report will be submitted within 90 days after completion of all sampling and analysis activities. The report will summarize the analytical results and recommend a final remedial action for SWMU 38.

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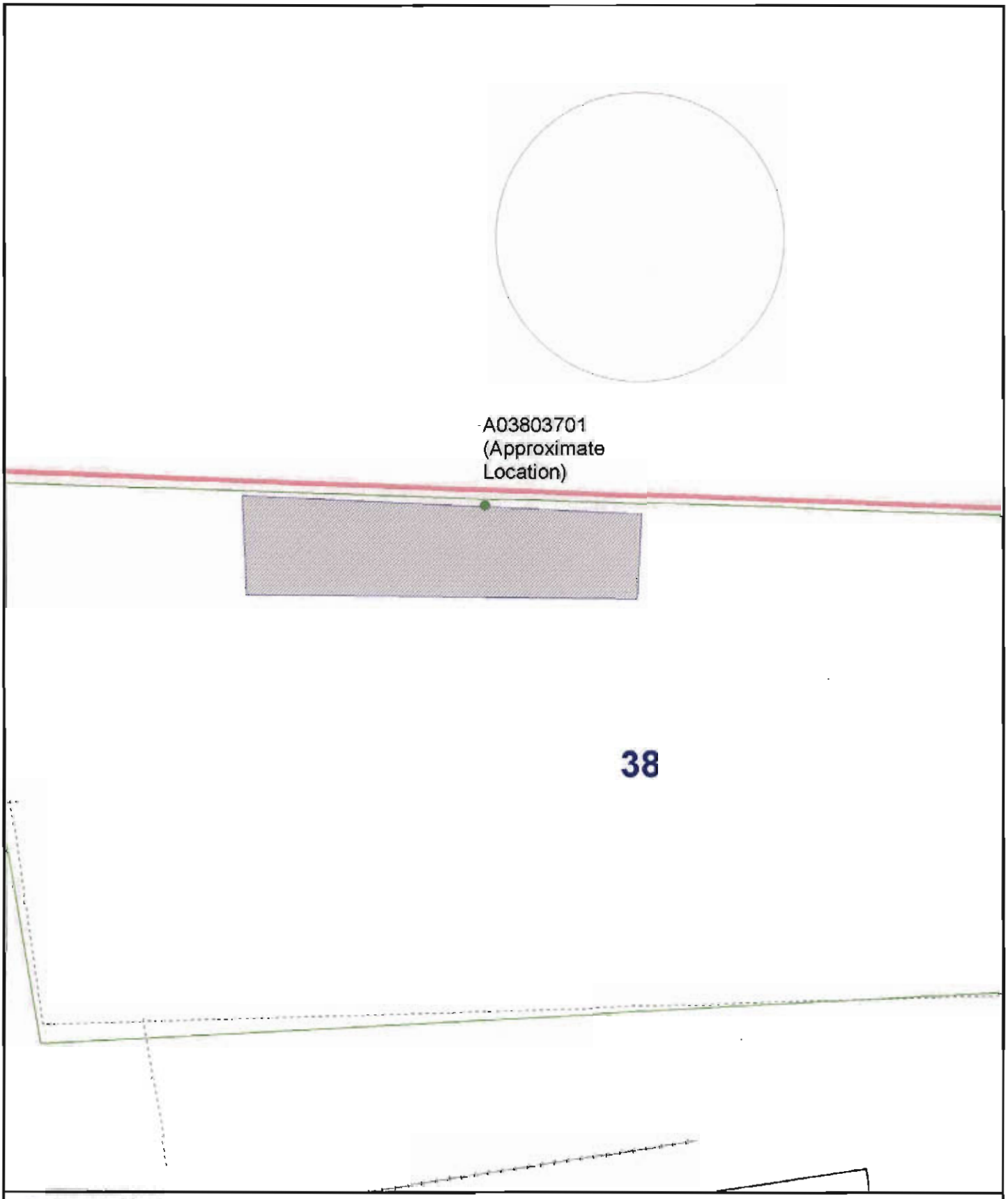

Figure 3-1
Proposed Surface Soil Sample Locations
SWMU 38, Zone A
Charleston Naval Complex

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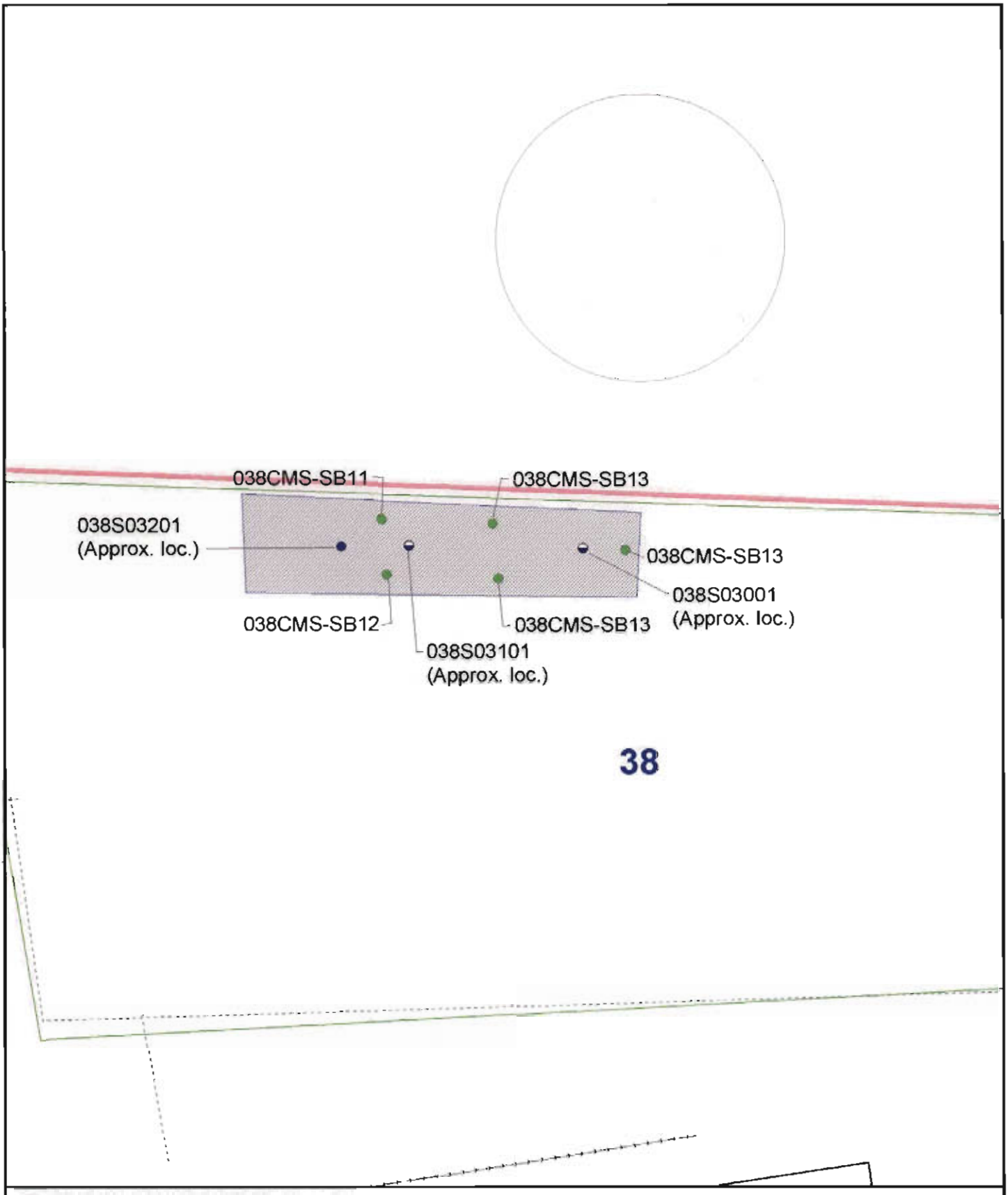

Figure 3-2
Proposed Subsurface Soil Sample Locations
SWMU 38, Zone A
Charleston Naval Complex

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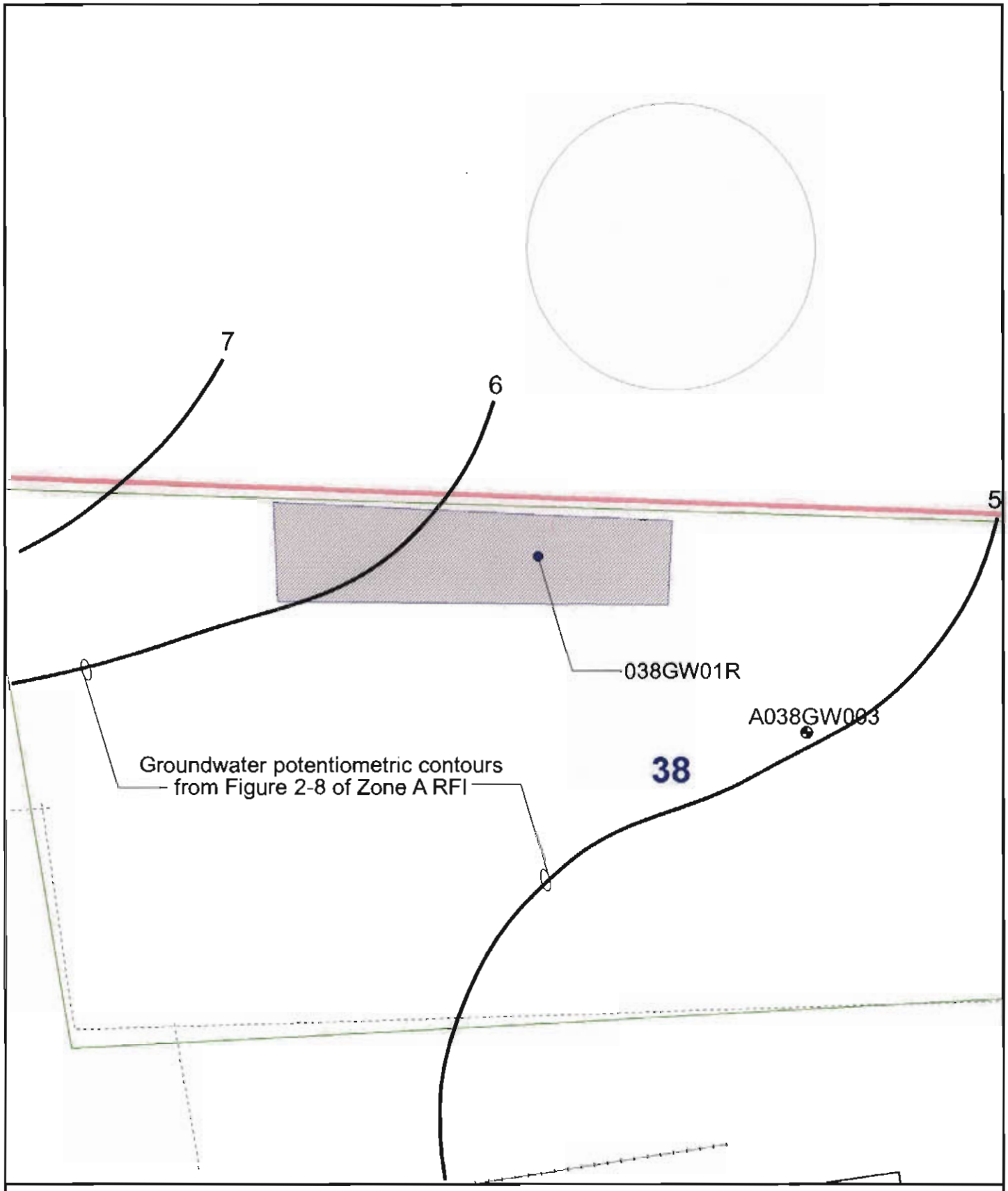

Figure 3-3
Proposed Well Location
SWMU 38, Zone A
Charleston Naval Complex

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SECTION 4

References

4.0 References

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APPENDIX A

Excerpts from Zone A RFI, Revision 0, EnSafe, Inc.

A-1

Pages 10.3.63 – 66

Zone A RFI

Hypothetical Site Residents

For the groundwater ingestion pathway, the lifetime weighted average ILCR was computed to be 2E-4. Arsenic, 4,4'-DDD and 4,4'-DDT were the primary contributors to risk through the groundwater ingestion exposure route. Hazard indices for the adult and child resident are 2 and 4 for the ingestion pathway. Arsenic and thallium were primary contributors to the hazard index for this exposure route.

Hypothetical Site Workers

For the groundwater ingestion pathway, the ILCR was computed to be 7E-5. Arsenic, 4,4'-DDD and 4,4'-DDT were the primary contributors to risk through the groundwater ingestion pathway. The ingestion pathway hazard index was computed to be 0.6, with arsenic and thallium as the primary contributors.

Current Site Workers

Shallow groundwater is not currently used as a potable water source for SWMU 38, or other areas of Zone A. In the absence of a completed exposure pathway, no threat to human health is posed by reported shallow groundwater contamination.

COCs Identified

Chemicals of concern were identified based on cumulative (all pathway) risk and hazard projected for this site. USEPA has established a generally acceptable risk range of 1E-4 to 1E-6, and a hazard index threshold of 1.0 (unity). In this HHRA, a COC was considered to be any chemical contributing to a cumulative risk level of 1E-6 or greater and/or a cumulative hazard index above 1.0, if its individual ILCR exceeds 1E-6 or its hazard quotient exceeds 0.1. For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-4 (and individual ILCR of 1E-6) is recommended by USEPA Region IV as the trigger for establishing COCs. The COC selection method presented was used to provide a more comprehensive evaluation of chemicals

Table 10.3.22
Summary of Risk and Hazard-based COCs
SWMU 38
Naval Base Charleston, Zone A
Charleston, South Carolina

Medium	Exposure Pathway		Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident Iwa ILCR	Site Worker Hazard Quotient	Site Worker ILCR	Identification of COCs
Surface Soil	Incidental Ingestion	Aluminum	0.023	0.21	ND	0.0081	ND	1
		Aroclor-1260	ND	ND	4.1E-06	ND	4.5E-07	2
		Arsenic	0.090	0.84	4.6E-05	0.032	5.2E-06	1 2 4
		Beryllium	0.000137	0.00128	3.4E-06	0.0000489	3.8E-07	2
		4,4'-DDD	ND	ND	1.0E-04	ND	1.1E-05	2 4
		4,4'-DDE	ND	ND	1.6E-05	ND	1.8E-06	2 4
		4,4'-DDT	2.2	20	4.3E-04	0.78	4.8E-05	1 2 3 4
		Manganese	0.0074	0.069	ND	0.0026	ND	
	Dermal Contact	Aluminum	0.0047	0.015	ND	0.0033	ND	
		Aroclor-1260	ND	ND	1.8E-06	ND	7.5E-07	2
		Arsenic	0.019	0.061	5.2E-06	0.013	2.1E-06	2 4
		Beryllium	0.0000281	0.000093	3.8E-07	0.0000201	1.5E-07	
		4,4'-DDD	ND	ND	4.6E-05	ND	1.9E-05	2 4
		4,4'-DDE	ND	ND	7.1E-06	ND	2.9E-06	2 4
		4,4'-DDT	1.8	5.9	1.9E-04	1.28	7.8E-05	1 2 3 4
		Manganese	0.015	0.050	ND	0.01	ND	
Surface Soil Pathway Sum			4	28	8E-04	2	2E-04	
Shallow Groundwater	Ingestion	Arsenic	0.81	1.9	2.0E-04	0.29	6.4E-05	1 2 4
		4,4'-DDD	ND	ND	1.3E-05	ND	4.0E-06	2 4
		4,4'-DDE	ND	ND	2.2E-07	ND	7.0E-08	
		4,4'-DDT	0.060	0.14	5.6E-06	0.022	1.8E-06	1 2 4
		Thallium	0.72	1.7	ND	0.26	ND	1
Groundwater Pathway Sum			2	4	2E-04	1	7E-05	

Notes:
ND indicates not determined due to the lack of available risk information.
ILCR indicates incremental lifetime cancer risk
HI indicates hazard index
COC indicates chemical of concern
1- Chemical is a COC by virtue of projected child residence noncarcinogenic hazard.
2- Chemical is a COC by virtue of projected future resident lifetime ILCR.
3- Chemical is a COC by virtue of projected site worker noncarcinogenic hazard.
4- Chemical is a COC by virtue of projected site worker ILCR.

the only locations with 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT surface soil concentrations above the residential RBCs. Aroclor-1260 was detected in six of fourteen surface soil samples and was detected above the residential RBC in 4 of 14. The highest Aroclor- 1260 locations are 038SB006 (0.5 mg/kg), 038SB011 (0.72 mg/kg), and 038SB012 (1.3 mg/kg).

Groundwater

Hypothetical Site Residents (future land use)

Thallium was identified as a groundwater COC, based on its contribution to the cumulative hazard index. 4,4'-DDD was identified as a groundwater COC based on its contribution to the cumulative ILCR. Arsenic and 4,4'-DDT were identified as groundwater COCs based on their contribution to cumulative ILCR and hazard index.

Hypothetical Site Workers (current land use)

Arsenic, 4,4'-DDD and 4,4'-DDT were identified as groundwater COCs based on their contribution to ILCR.

Arsenic was detected in the sample collected from the monitoring well NBCA038001 in the first, third, and fourth quarters. Arsenic was also detected in the sample collected from monitoring well NBCA038002 in the third quarter. Arsenic was not detected in either well in the second quarter. Thallium was detected in the first quarter in one of two monitoring wells (NBCA038002) at a concentration of 4 μg/L. Thallium was not detected in shallow groundwater in any subsequent quarter sample. 4,4'-DDD was detected in one shallow monitoring well (NBCA038001) in each of the four quarters. 4,4'-DDT was detected in the same shallow monitoring well (NBCA038001) in each of the first three quarters. Due to their hydrophobic nature, however, 4,4'-DDD and 4,4'-DDT are not expected to migrate with groundwater.

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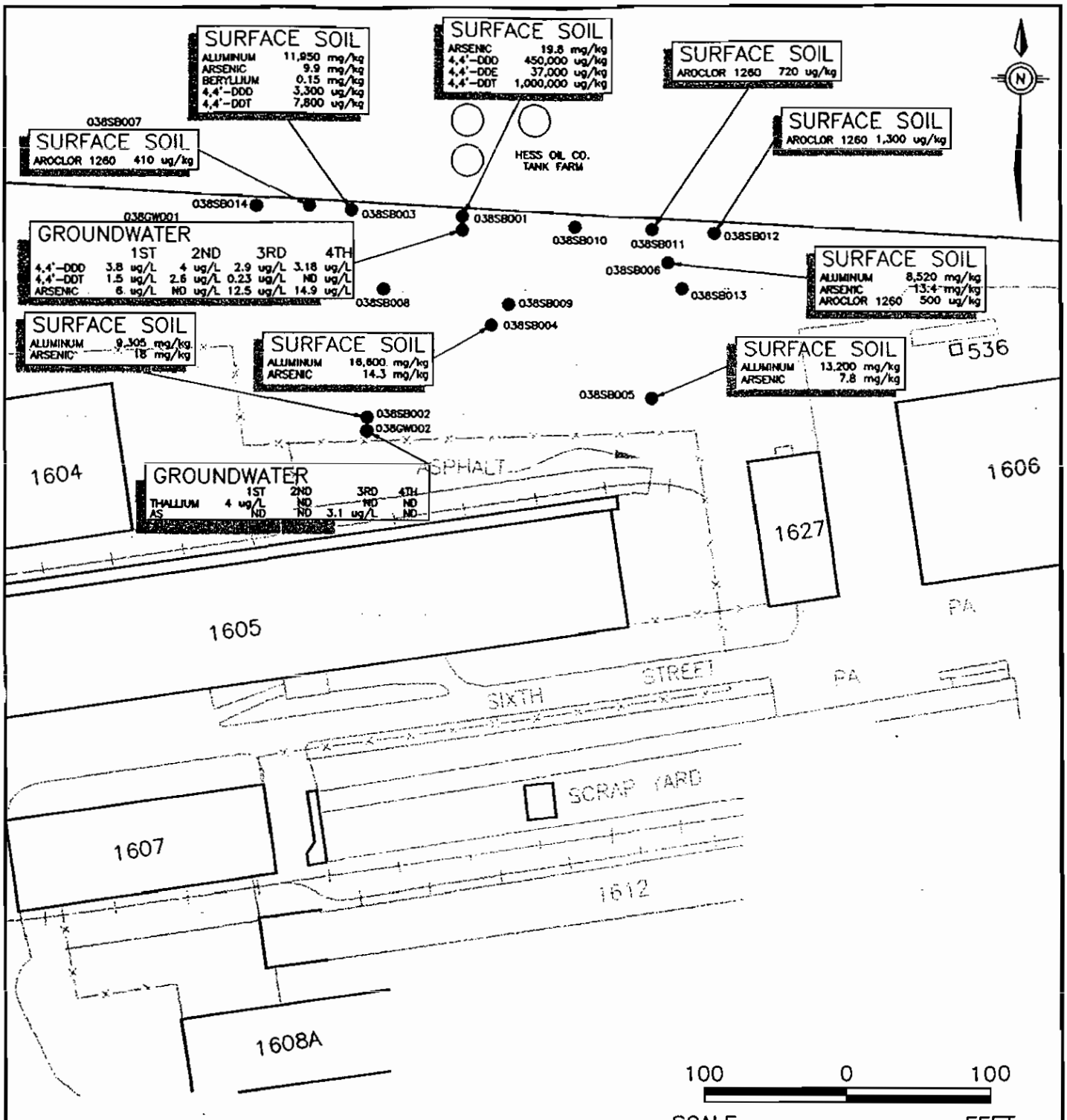
Figure 10.3.5

Zone A RFI



RESIDENTIAL SOIL RBC
ALUMINUM – 7,800 mg/kg
AROCLOR 1260 – 320 ug/kg
ARSENIC – 0.43 mg/kg
BERYLLIUM – 0.15 mg/kg
4,4'-DDD – 2,700 ug/kg
4,4'-DDE – 1,900 ug/kg
4,4'-DDT – 1,900 ug/kg

TAP WATER RBC
4,4'-DDD – 0.28 ug/L
4,4'-DDT – 0.2 ug/L
4,4'-DDE – 0.2 ug/L
THALLIUM – 2.9 ug/L

GROUNDWATER PROTECTION SSL
ARSENIC – 15 mg/kg
4,4'-DDD – 8,000 ug/kg
4,4'-DDE – 27,000 ug/kg
4,4'-DDT – 16,000 ug/kg

LEGEND

- ● – SOIL BORING
- ● – MONITORING WELL
- —— – ZONE A BOUNDARY

ZONE A
RCRA FACILITY
INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.3.5
SWMU 38
DISTRIBUTION AND CONCENTRATION
OF COPCs

DWG DATE: 04/13/98 | DWG NAME: 2901B001

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Zone A RFI

predominantly covered with dirt and gravel. Environmental media sampled as part of the SWMU 38 CSI include surface soil, subsurface soil, and shallow and deep groundwater. Potential contaminant migration pathways for SWMU 38 include soil constituents leaching to groundwater, groundwater constituent migration to surface water, constituent migration through surface soil erosion, and emission of VOCs from surface soil to ambient air.

10.3.5.1 SWMU 38 – Soil to Groundwater Cross-Media Transport

Tables 10.3.8 and 10.3.9 compare the maximum detected concentrations of organic and inorganic chemicals reported in soil to risk-based soil screening levels considered protective of groundwater. As shown on Table 10.3.8, five organics — Aroclor-1260, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dieldrin — were identified for further evaluation of soil to groundwater migration based on the screening process presented in Section 6. As shown on Table 10.3.9, four inorganics — antimony, arsenic, chromium, and selenium — were identified for further evaluation of soil to groundwater migration. Aroclor-1260, dieldrin, antimony, and selenium were not reported in SWMU 38 groundwater (including all four quarters of sampling).

None of the organic constituents was detected in subsurface soil at a concentration exceeding its soil to groundwater SSL. Concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT exceeded their soil to groundwater SSLs in only one surface soil sample (038SB001). The potential for soil to groundwater migration is highlighted for 4,4'-DDD and 4,4'-DDT since their detected concentrations were above both groundwater protection SSLs in soil and tap water RBCs in shallow groundwater. These pesticide compounds are isolated to one monitoring well (NBCA-038-001) and, based on their fate and transport properties, are not anticipated to migrate significantly. Aroclor-1260 (038SB012) and dieldrin (038SB007) were each reported in a single surface soil sample at concentrations exceeding their respective soil to groundwater SSLs.

Table 10.3.8
Organic Compounds Detected in Surface Soil, Subsurface Soil, Sediment, Shallow Groundwater, and Deep Groundwater
Comparison to Cross-media SSLs, Tap Water RBCs, and Saltwater Surface Water Chronic Screening Levels
NAVBASE-Charleston, Zone A: SWMU 38
Charleston, South Carolina

Parameter	Maximum Concentration				Screening Concentration *									
	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW	Soil to Air	Tap Water RBC	Saltwater Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Volatilization Potential	Groundwater Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds														
Acetone	61	200	ND	ND	8000	1E+08	3700	NA	UG/KG	UG/L	NO	NO	NO	NO
2-Butanone	9.6	32	ND	ND	3900 c	NDA	1900	NA	UG/KG	UG/L	NO	NO	NO	NO
Carbon disulfide	ND	5	ND	ND	16000	720000	1000	NA	UG/KG	UG/L	NO	NO	NO	NO
cis-1,2-Dichloroethene	ND	21	ND	ND	200	1200000	61	NA	UG/KG	UG/L	NO	NO	NO	NO
Toluene	4.2	ND	ND	ND	6000	650000	750	37	UG/KG	UG/L	NO	NO	NO	NO
Xylene	ND	1.5	ND	ND	70000 c	320000	12000	NA	UG/KG	UG/L	NO	NO	NO	NO
Semivolatile Organic Compounds														
Benzo(a)pyrene equivalents														
Chrysene	150	ND	ND	ND	80000	NA	9.2	NA	UG/KG	UG/L	NO	NO	NO	NO
Butylbenzylphthalate	2300	ND	ND	ND	8100000	930000	7300	29	UG/KG	UG/L	NO	NO	NO	NO
Di-n-octylphthalate	410	ND	ND	ND	5000000	10000000	730	NA	UG/KG	UG/L	NO	NO	NO	NO
bis(2-Ethylhexyl)phthalate (BEHP)	210	ND	ND	ND	1800000	31000000	4.8	NA	UG/KG	UG/L	NO	NO	NO	NO
Pesticides/PCB Compounds														
Aldrin	0.73	ND	ND	ND	250	3000	0.004	0.13	UG/KG	UG/L	NO	NO	NO	NO
Aroclor-1260	1300	ND	ND	ND	1000	1000	0.034	0.03	UG/KG	UG/L	YES	YES	NO	NO
gamma-BHC (Lindane)	0.51	ND	ND	ND	4.5	NA	0.052	0.016	UG/KG	UG/L	NO	NO	NO	NO
alpha-Chlordane	8.4	ND	ND	ND	5000	20000	0.19	0.004	UG/KG	UG/L	NO	NO	NO	NO
gamma-Chlordane	37	ND	ND	ND	5000	20000	0.19	0.004	UG/KG	UG/L	NO	NO	NO	NO
4,4'-DDD	450000	1800	4	ND	8000	NA	0.28	0.025	UG/KG	UG/L	YES	NO	YES	YES
4,4'-DDE	37000	140	0.092	ND	27000	NA	0.2	0.14	UG/KG	UG/L	YES	NO	NO	NO
4,4'-DDT	1000000	11000	2.6	ND	16000	1E+09	0.2	0.001	UG/KG	UG/L	YES	NO	YES	YES
Dieldrin	9.6	ND	ND	ND	2	1000	0.0042	0.0019	UG/KG	UG/L	YES	NO	NO	NO
Endosulfan II	6.3	ND	ND	ND	9000	NA	220	0.0087	UG/KG	UG/L	NO	NO	NO	NO
Endrin	14	ND	ND	ND	500	NA	11	0.0023	UG/KG	UG/L	NO	NO	NO	NO
Endrin aldehyde	6.6	ND	ND	ND	500	NA	11	NA	UG/KG	UG/L	NO	NO	NO	NO
Heptachlor	2.1	1.7	ND	ND	12000	100	0.0023	0.0036	UG/KG	UG/L	NO	NO	NO	NO
Dioxin Compounds														
Dioxin (TCDD TEQs)	28	NA	NA	NA	1600 c	NA	0.45	10	NG/KG	PG/L	NO	NO	NO	NO
Petroleum Hydrocarbons														
TPH - (Diesel range organics)	2400	ND	ND	ND	NA	NA	NA	NA	MG/KG	UG/L	NO	NO	NO	NO

Explanations of screening procedures appear in Section 6.2.
Frequency and range of detections, average detected concentrations, and number of screening concentration exceedances appear in Tables 10.2.3 and 10.2.6.

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 10, adapted from USEPA Soil Screening Guidance: Technical Background Document, May 1996 (first preference), or calculated using values from Table
Soil to Air - From USEPA Soil Screening Guidance: Technical Background Document, May 1996 (first preference), or USEPA Region III Risk-Based Concentration Table, June 1996
Tap Water RBC - From USEPA Region III Risk-Based Concentration Table, October 1997
Salt Water Surface Water Chronic - From USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November 1995, Table 2

c - Calculated soil to groundwater SSL value (See Table 6.2)
GW - Groundwater
NA - Not available
RBC - Risk-based concentration
SSL - Soil screening level
MG/KG - Milligrams per kilogram
NG/KG - Nanograms per kilogram
UG/KG - Micrograms per kilogram
PG/L - Picograms per liter
UG/L - Micrograms per liter

Table 10.3.9
Inorganic Chemicals Detected in Surface Soil, Subsurface Soil, Sediment, Shallow Groundwater,and Deep Groundwater
Comparison to Cross-media SSLs, Tap Water RBCs, Saltwater Surface Water Chronic Screening Levels, and Background Reference Values
NAVBASE-Charleston, Zone A: SWMU 38
Charleston, South Carolina

Parameter	Maximum Concentration				Screening Concentration *						Soil Units	Water Units	Leaching Potential	Fugitive Particulate Inhalation Concern	Ground-Water Migration Concern	Surface Water Migration Concern
	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW	Soil Background Reference	Soil to Air	Tap Water RBC	GW Background Reference	Saltwater Surf. Wtr. Chronic						
Inorganic Chemicals																
Aluminum	16600	21600	2400	68.6	560000 c	28240	NA	37000	3210	NA	MG/KG	UG/L	NO	NO	NO	NO
Antimony	ND	14.8	ND	ND	2.5	ND	NA	15	ND	NA	MG/KG	UG/L	YES	NO	NO	NO
Arsenic	19.8	11.9	14.9	ND	15	9.8	750	0.045	11.1	36	MG/KG	UG/L	YES	NO	YES	NO
Barium	45.5	31.5	40.9	22.3	820	53	690000	2600	179	NA	MG/KG	UG/L	NO	NO	NO	NO
Beryllium	0.5	0.44	ND	ND	32	ND	1300	0.016	ND	NA	MG/KG	UG/L	NO	NO	NO	NO
Cadmium	1.5	ND	ND	ND	4	ND	1800	18	ND	9.3	MG/KG	UG/L	NO	NO	NO	NO
Chromium (total)	37.7	63.4	5.6	ND	19	63.4	270	180	8.7	103	MG/KG	UG/L	YES	NO	NO	NO
Chromium (hexavalent)	0.074	ND	ND	ND	19	ND	270	180	ND	50	MG/KG	UG/L	NO	NO	NO	NO
Cobalt	4.1	2.6	7.1	ND	990 c	4.4	NA	2200	12.1	NA	MG/KG	UG/L	NO	NO	NO	NO
Copper	87.3	16	8.8	0.9	5600 c	165	NA	130000	15.7	2.9	MG/KG	UG/L	NO	NO	NO	YES
Lead	218.3	11.6	2	ND	400	140	400	15	4.7	8.5	MG/KG	UG/L	NO	NO	NO	NO
Manganese	254	223	241	714	550 c	98.1	NA	840	2690	NA	MG/KG	UG/L	NO	NO	NO	NO
Mercury	0.31	ND	ND	ND	1	0.3	10	11	ND	0.2	MG/KG	UG/L	NO	NO	NO	NO
Nickel	21.6	29	ND	ND	65	35	13000	730	21.1	42	MG/KG	UG/L	NO	NO	NO	NO
Selenium	2.2	4.5	ND	ND	2.5	1.74	NA	180	ND	71	MG/KG	UG/L	YES	NO	NO	NO
Silver	ND	ND	39.8	ND	17	ND	NA	180	ND	0.23	MG/KG	UG/L	NO	NO	NO	YES
Thallium	ND	ND	4	ND	0.35	ND	NA	2.9	2	21	MG/KG	UG/L	NO	NO	YES	NO
Vanadium	35.2	47.2	ND	ND	3000	77.3	NA	260	10.9	NA	MG/KG	UG/L	NO	NO	NO	NO
Zinc	220.5	84.3	67.4	3.8	6200	208	NA	11000	83.2	86	MG/KG	UG/L	NO	NO	NO	NO

Explanations of screening procedures appear in Section 6.2.
Frequency and range of detections, average detected concentrations, and number of screening concentration exceedances appear in Tables 10.2.4 and 10.2.7.

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 10, adapted from USEPA Soil Screening Guidance: Technical Background Document, May 1996 (first preference), or calculated using values from Table 6.2
Soil to Air - From USEPA Soil Screening Guidance: Technical Background Document, May 1996 (first preference), or USEPA Region III Risk-Based Concentration Table, June 1996
Tap Water RBC - From USEPA Region III Risk-Based Concentration Table, October 1997
Salt Water Surface Water Chronic - From USEPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November 1995, Table 2
Background reference values for soil are shown for comparison purposes only.
Maximum groundwater concentrations are screened against the greater of tap water RBCs or corresponding background reference values to determine groundwater migration concern.

c - Calculated soil to groundwater SSL value (See Table 6.2)
GW - Groundwater
NA - Not available/Not applicable
ND - Not detected
RBC - Risk-based concentration
SSL - Soil screening level
MG/KG - Milligrams per kilogram
UG/L - Micrograms per liter

Arsenic exceeded its SSL in surface soil only, antimony and selenium in subsurface soil only, and chromium in both surface and subsurface soil. Arsenic was reported at concentrations equal to or slightly exceeding its SSL in three surface soil samples (038SB001, 038SB002, and 038SB003). Antimony (038SB004) and selenium (038SB005) each were reported in only one subsurface soil sample at concentrations exceeding their SSLs. Antimony was not detected in any surface soil samples. Although chromium was reported in four surface soil samples and three subsurface soil samples at concentrations exceeding its SSL, it was not reported in any soil sample at a concentration exceeding its background reference value. For screening purposes, chromium was conservatively assumed to exist in its soluble hexavalent state. Hexachrome analyses at SWMU 38 and elsewhere in Zone A suggest that chromium in soil exists predominantly in less soluble valence states. These findings suggest that concentrations of inorganic soil constituents do not appreciably threaten SWMU 38 groundwater.

Total petroleum hydrocarbons (diesel range) were detected in surface soil above the UST action level but were not detected in either subsurface soil or shallow groundwater. These findings indicate that soil concentrations of TPH are protective of the shallow aquifer.

10.3.5.2 SWMU 38 — Groundwater to Surface Water Cross-Media Transport

For purposes of fate and transport analysis, sample results from monitoring well NBCA-002-004 were included in the groundwater dataset because the well borders SWMU 38; data from this well are also included with the analysis for SWMU 2. Analytical results from samples collected from well NBCA-002-004 during 1993 were not evaluated along with those from the 1995-1996 sampling rounds because of the time dependence of groundwater concentrations. Tables 10.3.8 and 10.3.9 compare maximum detected groundwater concentrations from four sampling rounds at three shallow wells and one deep well at SWMU 38 to tap water RBCs, saltwater surface water chronic AWQCs, and background reference values for inorganics.

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Tables 10.3.6 - 7

Zone A RFI

The shallow monitoring wells were installed at 13 feet bgs in the upper sand aquifer, and the deep well was installed at 50 feet bgs in the lower aquifer. All wells were installed as described in Section 3.3 of this report.

10.3.4 Nature and Extent of Contamination in Groundwater

Table 10.3.6 summarizes organic groundwater analytical results and Table 10.3.7 summarizes groundwater inorganic analytical results for SWMU 38. Appendix D is a complete analytical data report for all samples collected in Zone A, including those collected at SWMU 38.

Table 10.3.6
SWMU 38
Organic Compounds Detected in Groundwater

Compound	Sampling Event	Sampling Interval	Frequency of Detection	Range of Detections (µg/L)	Mean of Detections (µg/L)	RBC (µg/L)	Number of Samples Exceeding RBC
Pesticides (3 shallow groundwater samples and 1 deep sample collected during each event[a])							
4,4'-DDD	Dec. 95	Shallow	1/3	3.8	NA	0.28	1
	Apr. 96	Shallow	1/2	4.0	NA	0.28	1
	June 96	Shallow	1/2	2.9	NA	0.28	1
	Oct. 96	Shallow	1/2	3.2	NA	0.28	1
	Dec. 95	Deep	0/1	NA	NA	0.28	0
	Apr. 96	Deep	0/1	NA	NA	0.28	0
	June 96	Deep	0/1	NA	NA	0.28	0
	Oct. 96	Deep	0/1	NA	NA	0.28	0
4,4'-DDE	Dec. 95	Shallow	1/3	0.045	NA	0.20	0
	Apr. 96	Shallow	1/2	0.092	NA	0.20	0
	June 96	Shallow	0/2	NA	NA	0.20	0
	Oct. 96	Shallow	0/2	NA	NA	0.20	0
	Dec. 95	Deep	0/1	NA	NA	0.20	0
	Apr. 96	Deep	0/1	NA	NA	0.20	0
	June 96	Deep	0/1	NA	NA	0.20	0
	Oct. 96	Deep	0/1	NA	NA	0.20	0

Table 10.3.6
SWMU 38
Organic Compounds Detected in Groundwater

Compound	Sampling Event	Sampling Interval	Frequency of Detection	Range of Detections (µg/L)	Mean of Detections (µg/L)	RBC (µg/L)	Number of Samples Exceeding RBC
4,4'-DDT	Dec. 95	Shallow	1/3	1.5	NA	0.20	1
	Apr. 96	Shallow	1/2	2.6	NA	0.20	1
	June 96	Shallow	1/2	0.23	NA	0.20	1
	Oct. 96	Shallow	0/2	NA	NA	0.20	0
	Dec. 95	Deep	0/1	NA	NA	0.20	0
	Apr. 96	Deep	0/1	NA	NA	0.20	0
	June 96	Deep	0/1	NA	NA	0.20	0
	Oct. 96	Deep	0/1	NA	NA	0.20	0

Note:
a = NBCA-002-004 not sampled in second- and third-quarters.
NA = Not applicable

Table 10.3.7
SWMU 38
Inorganic Analysis Results for Groundwater

Compound	Sampling Event	Sampling Interval	Freq. of Detection	Range of Detections (µg/L)	Mean of Detections (µg/L)	Reference Conc. (µg/L)	RBC (µg/L)	Number of Samples Exceeding both RC and RBC
Inorganics (3 Shallow groundwater samples and 1 deep sample collected during each event)								
Aluminum	Dec. 95	Shallow	3/3	162 - 1,410	643	3,210	37,000	0
	Apr. 96	Shallow	2/3	1,260 - 2,400	1,830	3,210	37,000	0
	June 96	Shallow	0/3	NA	NA	3,210	37,000	0
	Oct. 96	Shallow	0/3	NA	NA	3,210	37,000	0
	Dec. 95	Deep	1/1	57	NA	245	37,000	0
	Apr. 96	Deep	0/1	NA	NA	245	37,000	0
	June 96	Deep	1/1	68.6	NA	245	37,000	0
	Oct. 96	Deep	0/1	NA	NA	245	37,000	0

Table 10.3.7
SWMU 38
Inorganic Analysis Results for Groundwater

Compound	Sampling Event	Sampling Interval	Freq. of Detection	Range of Detections (µg/L)	Mean of Detections (µg/L)	Reference Conc. (µg/L)	RBC (µg/L)	Number of Samples Exceeding both RC and RBC
Inorganics (3 Shallow groundwater samples and 1 deep sample collected during each event)								
Arsenic	Dec. 95	Shallow	2/3	5.8 - 6.0	5.9	7.4	0.045	0
	Apr. 96	Shallow	0/3	NA	NA	7.4	0.045	0
	June 96	Shallow	3/3	3.1 - 12.5	6.7	7.4	0.045	1
	Oct. 96	Shallow	2/3	10.3 - 14.9	12.6	7.4	0.045	2
	Dec. 95	Deep	0/1	NA	NA	11.1	0.045	0
	Apr. 96	Deep	0/1	NA	NA	11.1	0.045	0
	June 96	Deep	0/1	NA	NA	11.1	0.045	0
	Oct. 96	Deep	0/1	NA	NA	11.1	0.045	0
Barium	Dec. 95	Shallow	3/3	21.0 - 40.9	31.3	104	2,600	0
	Apr. 96	Shallow	0/3	NA	NA	104	2,600	0
	June 96	Shallow	3/3	17.5 - 34.4	26.1	104	2,600	0
	Oct. 96	Shallow	3/3	17.5 - 28.5	24.3	104	2,600	0
	Dec. 95	Deep	1/1	22.3	NA	179	2,600	0
	Apr. 96	Deep	0/1	NA	NA	179	2,600	0
	June 96	Deep	1/1	17.5	NA	179	2,600	0
	Oct. 96	Deep	1/1	15.9	NA	179	2,600	0
Calcium	Dec. 95	Shallow	3/3	7,540 - 112,000	60,350	NA	NA	NA
	Apr. 96	Shallow	2/3	54,100 - 99,100	76,600	NA	NA	NA
	June 96	Shallow	3/3	7,500 - 98,000	52,800	NA	NA	NA
	Oct. 96	Shallow	3/3	6,260 - 95,600	52,500	NA	NA	NA
	Dec. 95	Deep	1/1	101,000	NA	NA	NA	NA
	Apr. 96	Deep	1/1	102,000	NA	NA	NA	NA
	June 96	Deep	1/1	97,500	NA	NA	NA	NA
	Oct. 96	Deep	1/1	99,300	NA	NA	NA	NA

Table 10.3.7
SWMU 38
Inorganic Analysis Results for Groundwater

Compound	Sampling Event	Sampling Interval	Freq. of Detection	Range of Detections (µg/L)	Mean of Detections (µg/L)	Reference Conc. (µg/L)	RBC (µg/L)	Number of Samples Exceeding both RC and RBC
Inorganics (3 Shallow groundwater samples and 1 deep sample collected during each event)								
Chromium	Dec. 95	Shallow	2/3	4.2 - 5.6	4.9	8.7	180	0
	Apr. 96	Shallow	0/3	NA	NA	8.7	180	0
	June 96	Shallow	0/3	NA	NA	8.7	180	0
	Oct. 96	Shallow	0/3	NA	NA	8.7	180	0
	Dec. 95	Deep	0/1	NA	NA	7.3	180	0
	Apr. 96	Deep	0/1	NA	NA	7.3	180	0
	June 96	Deep	0/1	NA	NA	7.3	180	0
	Oct. 96	Deep	0/1	NA	NA	7.3	180	0
Cobalt	Dec. 95	Shallow	0/3	NA	NA	**	2,200	0
	Apr. 96	Shallow	0/3	NA	NA	**	2,200	0
	June 96	Shallow	1/3	7.1	NA	**	2,200	0
	Oct. 96	Shallow	0/3	NA	NA	**	2,200	0
	Dec. 95	Deep	0/1	NA	NA	12.1	2,200	0
	Apr. 96	Deep	0/1	NA	NA	12.1	2,200	0
	June 96	Deep	0/1	NA	NA	12.1	2,200	0
	Oct. 96	Deep	0/1	NA	NA	12.1	2,200	0
Copper	Dec. 95	Shallow	2/3	8.5 - 8.8	8.7	15.7	1,500	0
	Apr. 96	Shallow	0/3	NA	NA	15.7	1,500	0
	June 96	Shallow	0/3	NA	NA	15.7	1,500	0
	Oct. 96	Shallow	3/3	1.7 - 7.9	4.5	15.7	1,500	0
	Dec. 95	Deep	0/1	NA	NA	5.8	1,500	0
	Apr. 96	Deep	0/1	NA	NA	5.8	1,500	0
	June 96	Deep	0/1	NA	NA	5.8	1,500	0
	Oct. 96	Deep	1/1	0.9	NA	5.8	1,500	0

Table 10.3.7
SWMU 38
Inorganic Analysis Results for Groundwater

Compound	Sampling Event	Sampling Interval	Freq. of Detection	Range of Detections (µg/L)	Mean of Detections (µg/L)	Reference Conc. (µg/L)	RBC (µg/L)	Number of Samples Exceeding both RC and RBC
Inorganics (3 Shallow groundwater samples and 1 deep sample collected during each event)								
Iron	Dec. 95	Shallow	3/3	1,840 - 16,100	10,000	NA	NA	NA
	Apr. 95	Shallow	3/3	5,990 - 16,200	12,600	NA	NA	NA
	June 96	Shallow	3/3	4,210 - 15,700	11,300	NA	NA	NA
	Oct. 96	Shallow	3/3	645 - 13,600	8,650	NA	NA	NA
	Dec. 95	Deep	1/1	2,710	NA	NA	NA	NA
	Apr. 96	Deep	1/1	3,550	NA	NA	NA	NA
	June 96	Deep	1/1	3,770	NA	NA	NA	NA
	Oct. 96	Deep	1/1	3,660	NA	NA	NA	NA
Lead	Dec. 95	Shallow	0/3	NA	NA	4.7	15*	0
	Apr. 96	Shallow	1/3	2.0	NA	4.7	15*	0
	June 96	Shallow	0/3	NA	NA	4.7	15*	0
	Oct. 96	Shallow	0/3	NA	NA	4.7	15*	0
	Dec. 95	Deep	0/1	NA	NA	**	15*	0
	Apr. 96	Deep	0/1	NA	NA	**	15*	0
	June 96	Deep	0/1	NA	NA	**	15*	0
	Oct. 96	Deep	0/1	NA	NA	**	15*	0
Magnesium	Dec. 95	Shallow	3/3	5,130 - 14,400	9,190	NA	NA	NA
	Apr. 96	Shallow	3/3	6,090 - 17,100	10,100	NA	NA	NA
	June 96	Shallow	3/3	5,550 - 17,200	9,930	NA	NA	NA
	Oct. 96	Shallow	3/3	3,960 - 13,200	8,510	NA	NA	NA
	Dec. 95	Deep	1/1	11,700	NA	NA	NA	NA
	Apr. 96	Deep	1/1	11,100	NA	NA	NA	NA
	June 96	Deep	1/1	11,000	NA	NA	NA	NA
	Oct. 96	Deep	1/1	11,400	NA	NA	NA	NA

Table 10.3.7
SWMU 38
Inorganic Analysis Results for Groundwater

Compound	Sampling Event	Sampling Interval	Freq. of Detection	Range of Detections (µg/L)	Mean of Detections (µg/L)	Reference Conc. (µg/L)	RBC (µg/L)	Number of Samples Exceeding both RC and RBC
Inorganics (3 Shallow groundwater samples and 1 deep sample collected during each event)								
Manganese	Dec. 95	Shallow	3/3	108 - 172	149	577	840	0
	Apr. 96	Shallow	3/3	119 - 187	151	577	840	0
	June 96	Shallow	3/3	141 - 168	154	577	840	0
	Oct. 96	Shallow	3/3	78.7 - 241	159	577	840	0
	Dec. 95	Deep	1/1	666	NA	2,690	840	0
	Apr. 96	Deep	1/1	694	NA	2,690	840	0
	June 96	Deep	1/1	633	NA	2,690	840	0
	Oct. 96	Deep	1/1	714	NA	2,690	840	0
Potassium	Dec. 95	Shallow	3/3	1,340 - 21,800	8,210	NA	NA	NA
	Apr. 96	Shallow	1/3	19,800	NA	NA	NA	NA
	June 96	Shallow	3/3	2,820 - 24,700	10,200	NA	NA	NA
	Oct. 96	Shallow	3/3	2,010 - 38,800	14,300	NA	NA	NA
	Dec. 95	Deep	1/1	3,560	NA	NA	NA	NA
	Apr. 96	Deep	1/1	2,670	NA	NA	NA	NA
	June 96	Deep	1/1	5,080	NA	NA	NA	NA
	Oct. 96	Deep	1/1	6,540	NA	NA	NA	NA
Silver	Dec. 95	Shallow	0/3	NA	NA	**	180	0
	Apr. 96	Shallow	0/3	NA	NA	**	180	0
	June 96	Shallow	0/3	NA	NA	**	180	0
	Oct. 96	Shallow	1/3	39.8	NA	**	180	0
	Dec. 95	Deep	0/1	NA	NA	**	180	0
	Apr. 96	Deep	0/1	NA	NA	**	180	0
	June 96	Deep	0/1	NA	NA	**	180	0
	Oct. 96	Deep	0/1	NA	NA	**	180	0

Table 10.3.7
SWMU 38
Inorganic Analysis Results for Groundwater

Compound	Sampling Event	Sampling Interval	Freq. of Detection	Range of Detections (µg/L)	Mean of Detections (µg/L)	Reference Conc. (µg/L)	RBC (µg/L)	Number of Samples Exceeding both RC and RBC
Inorganics (3 Shallow groundwater samples and 1 deep sample collected during each event)								
Sodium	Dec. 95	Shallow	3/3	43,400 - 268,000	122,000	NA	NA	NA
	Apr. 96	Shallow	1/3	287,000	NA	NA	NA	NA
	June 96	Shallow	3/3	39,000 - 290,000	126,000	NA	NA	NA
	Oct. 96	Shallow	3/3	34,300 - 228,000	103,000	NA	NA	NA
	Dec. 95	Deep	1/1	131,000	NA	NA	NA	NA
	Apr. 96	Deep	0/1	NA	NA	NA	NA	NA
	June 96	Deep	1/1	124,000	NA	NA	NA	NA
	Oct. 96	Deep	1/1	108,000	NA	NA	NA	NA
Thallium	Dec. 95	Shallow	1/3	4.0	NA	**	2.9	1
	Apr. 96	Shallow	0/3	NA	NA	**	2.9	0
	June 96	Shallow	0/3	NA	NA	**	2.9	0
	Oct. 96	Shallow	0/3	NA	NA	**	2.9	0
	Dec. 95	Deep	0/1	NA	NA	2	2.9	0
	Apr. 96	Deep	0/1	NA	NA	2	2.9	0
	June 96	Deep	0/1	NA	NA	2	2.9	0
	Oct. 96	Deep	0/1	NA	NA	2	2.9	0
Zinc	Dec. 95	Shallow	2/3	64.3 - 67.4	65.9	83.2	11,000	0
	Apr. 96	Shallow	0/3	NA	NA	83.2	11,000	0
	June 96	Shallow	0/3	NA	NA	83.2	11,000	0
	Oct. 96	Shallow	0/3	NA	NA	83.2	11,000	0
	Dec. 95	Deep	1/1	3.8	NA	66.2	11,000	0
	Apr. 96	Deep	0/1	NA	NA	66.2	11,000	0
	June 96	Deep	0/1	NA	NA	66.2	11,000	0
	Oct. 96	Deep	0/1	NA	NA	66.2	11,000	0

Table 10.3.7
SWMU 38
Inorganic Analysis Results for Groundwater

Compound	Sampling Event	Sampling Interval	Freq. of Detection	Range of Detections (µg/L)	Mean of Detections (µg/L)	Reference Conc. (µg/L)	RBC (µg/L)	Number of Samples Exceeding both RC and RBC
Inorganics (3 Shallow groundwater samples and 1 deep sample collected during each event)								
Chloride	June 96	Shallow	2/2	36,000 - 62,000	49,000	NA	NA	NA
	Oct. 96	Shallow	3/3	33,000 - 177,000	90,000	NA	NA	NA
	Dec. 95	Deep	1/1	150,000	NA	NA	NA	NA
	June 96	Deep	1/1	160,000	NA	NA	NA	NA
	Oct. 96	Deep	1/1	165,000	NA	NA	NA	NA
Sulfate	June 96	Shallow	1/2	26,000	NA	NA	NA	NA
	Oct. 96	Shallow	1/3	19,800	NA	NA	NA	NA
	Dec. 95	Deep	1/1	15,000	NA	NA	NA	NA
	June 96	Deep	1/1	8,200	NA	NA	NA	NA
	Oct. 96	Deep	0/1	NA	NA	NA	NA	NA
TDS	June 96	Shallow	2/2	360,000 - 540,000	450,000	NA	NA	NA
	Oct. 96	Shallow	3/3	244,000 - 706,000	451,000	NA	NA	NA
	Dec. 95	Deep	1/1	640,000	NA	NA	NA	NA
	June 96	Deep	1/1	200,000	NA	NA	NA	NA
	Oct. 96	Deep	1/1	624,000	NA	NA	NA	NA

Notes:
a = Lead does not have an RBC. Therefore, the USEPA Treatment Technique Action Level (TTAL) of 15 µg/L has been substituted for the RBC.
** = Number of nondetects prevented determination of UTL.

Volatile Organic Compounds in Groundwater

No VOCs were detected in groundwater samples collected at SWMU 38.

Semivolatile Organic Compounds in Groundwater

No SVOCs were detected in groundwater samples collected at SWMU 38.

Hypothetical Site Residents

For the groundwater ingestion pathway, the lifetime weighted average ILCR was computed to be 2E-4. Arsenic, 4,4'-DDD and 4,4'-DDT were the primary contributors to risk through the groundwater ingestion exposure route. Hazard indices for the adult and child resident are 2 and 4 for the ingestion pathway. Arsenic and thallium were primary contributors to the hazard index for this exposure route.

Hypothetical Site Workers

For the groundwater ingestion pathway, the ILCR was computed to be 7E-5. Arsenic, 4,4'-DDD and 4,4'-DDT were the primary contributors to risk through the groundwater ingestion pathway. The ingestion pathway hazard index was computed to be 0.6, with arsenic and thallium as the primary contributors.

Current Site Workers

Shallow groundwater is not currently used as a potable water source for SWMU 38, or other areas of Zone A. In the absence of a completed exposure pathway, no threat to human health is posed by reported shallow groundwater contamination.

COCs Identified

Chemicals of concern were identified based on cumulative (all pathway) risk and hazard projected for this site. USEPA has established a generally acceptable risk range of 1E-4 to 1E-6, and a hazard index threshold of 1.0 (unity). In this HHRA, a COC was considered to be any chemical contributing to a cumulative risk level of 1E-6 or greater and/or a cumulative hazard index above 1.0, if its individual ILCR exceeds 1E-6 or its hazard quotient exceeds 0.1. For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-4 (and individual ILCR of 1E-6) is recommended by USEPA Region IV as the trigger for establishing COCs. The COC selection method presented was used to provide a more comprehensive evaluation of chemicals

contributing to carcinogenic risk or noncarcinogenic hazard during the remedial goal options development process. Table 10.3.22 provides a summary of COCs identified in each medium based on contribution to cumulative ILCR or hazard index.

Surface Soils

Hypothetical Site Residents (future land use)

Aluminum was identified as a COC based on its contribution to cumulative hazard index. Aroclor-1260, beryllium, 4,4'-DDD and 4,4'-DDE were identified as COCs based on their contribution to cumulative ILCR. Arsenic and 4,4'-DDT were identified as COCs based on their contribution to cumulative ILCR and hazard index.

Hypothetical Site Workers (current land use)

Arsenic, 4,4'-DDD, and 4,4'-DDE were identified as COCs based on their contribution to cumulative ILCR. 4,4'-DDT was identified as COC based on its contribution to cumulative ILCR and hazard index.

Aluminum and arsenic were detected in soil throughout SWMU 38. Aluminum was detected in all six surface soil samples and exceeded the Zone A background concentration in two of six samples. Arsenic was detected in all six surface soil samples and exceeded the Zone A background concentration in five of six samples. 4,4'-DDD was detected in 9 of 14 surface soil samples, while 4,4'-DDE and 4,4'-DDT were detected in eleven of fourteen surface soil samples. The maximum concentrations of all three pesticides were located in the surface soil sample 038SB001 (450, 37, and 1,000 mg/kg, respectively). The next highest concentrations of these pesticides were all located in surface soil sample 038SB003 (3.3, 0.45, and 7.8 mg/kg respectively). These samples were collected from the northern boundary of SWMU 38, along the property line adjoining the Hess Oil tank farm. The two surface soil locations listed above were

Table 10.3.22
Summary of Risk and Hazard-based COCs
SWMU 38
Naval Base Charleston, Zone A
Charleston, South Carolina

Medium	Exposure Pathway		Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident Iwa ILCR	Site Worker Hazard Quotient	Site Worker ILCR	Identification of COCs
Surface Soil	Incidental Ingestion	Aluminum	0.023	0.21	ND	0.0081	ND	1
		Aroclor-1260	ND	ND	4.1E-06	ND	4.5E-07	2
		Arsenic	0.090	0.84	4.6E-05	0.032	5.2E-06	1 2 4
		Beryllium	0.000137	0.00128	3.4E-06	0.0000489	3.8E-07	2
		4,4'-DDD	ND	ND	1.0E-04	ND	1.1E-05	2 4
		4,4'-DDE	ND	ND	1.6E-05	ND	1.8E-06	2 4
		4,4'-DDT	2.2	20	4.3E-04	0.78	4.8E-05	1 2 3 4
		Manganese	0.0074	0.069	ND	0.0026	ND	
	Dermal Contact	Aluminum	0.0047	0.015	ND	0.0033	ND	
		Aroclor-1260	ND	ND	1.8E-06	ND	7.5E-07	2
		Arsenic	0.019	0.061	5.2E-06	0.013	2.1E-06	2 4
		Beryllium	0.0000281	0.000093	3.8E-07	0.0000201	1.5E-07	
		4,4'-DDD	ND	ND	4.6E-05	ND	1.9E-05	2 4
		4,4'-DDE	ND	ND	7.1E-06	ND	2.9E-06	2 4
		4,4'-DDT	1.8	5.9	1.9E-04	1.28	7.8E-05	1 2 3 4
		Manganese	0.015	0.050	ND	0.01	ND	
Surface Soil Pathway Sum			4	28	8E-04	2	2E-04	
Shallow Groundwater	Ingestion	Arsenic	0.81	1.9	2.0E-04	0.29	6.4E-05	1 2 4
		4,4'-DDD	ND	ND	1.3E-05	ND	4.0E-06	2 4
		4,4'-DDE	ND	ND	2.2E-07	ND	7.0E-08	
		4,4'-DDT	0.060	0.14	5.6E-06	0.022	1.8E-06	1 2 4
		Thallium	0.72	1.7	ND	0.26	ND	1
Groundwater Pathway Sum			2	4	2E-04	1	7E-05	

Notes:
ND indicates not determined due to the lack of available risk information.
ILCR indicates incremental lifetime cancer risk
HI indicates hazard index
COC indicates chemical of concern
1- Chemical is a COC by virtue of projected child residence noncarcinogenic hazard.
2- Chemical is a COC by virtue of projected future resident lifetime ILCR.
3- Chemical is a COC by virtue of projected site worker noncarcinogenic hazard.
4- Chemical is a COC by virtue of projected site worker ILCR.

the only locations with 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT surface soil concentrations above the residential RBCs. Aroclor-1260 was detected in six of fourteen surface soil samples and was detected above the residential RBC in 4 of 14. The highest Aroclor- 1260 locations are 038SB006 (0.5 mg/kg), 038SB011 (0.72 mg/kg), and 038SB012 (1.3 mg/kg).

Groundwater

Hypothetical Site Residents (future land use)

Thallium was identified as a groundwater COC, based on its contribution to the cumulative hazard index. 4,4'-DDD was identified as a groundwater COC based on its contribution to the cumulative ILCR. Arsenic and 4,4'-DDT were identified as groundwater COCs based on their contribution to cumulative ILCR and hazard index.

Hypothetical Site Workers (current land use)

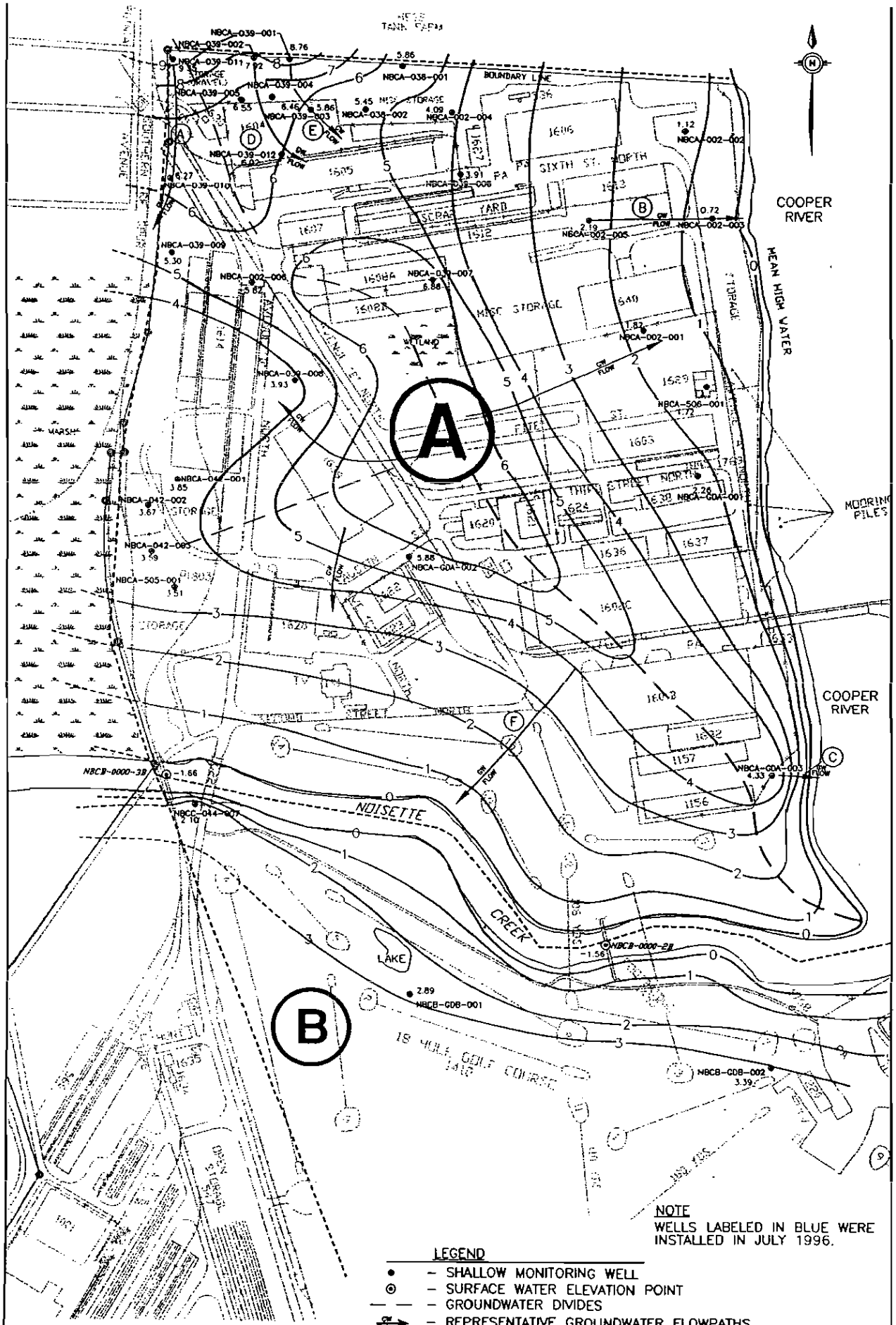
Arsenic, 4,4'-DDD and 4,4'-DDT were identified as groundwater COCs based on their contribution to ILCR.

Arsenic was detected in the sample collected from the monitoring well NBCA038001 in the first, third, and fourth quarters. Arsenic was also detected in the sample collected from monitoring well NBCA038002 in the third quarter. Arsenic was not detected in either well in the second quarter. Thallium was detected in the first quarter in one of two monitoring wells (NBCA038002) at a concentration of 4 μg/L. Thallium was not detected in shallow groundwater in any subsequent quarter sample. 4,4'-DDD was detected in one shallow monitoring well (NBCA038001) in each of the four quarters. 4,4'-DDT was detected in the same shallow monitoring well (NBCA038001) in each of the first three quarters. Due to their hydrophobic nature, however, 4,4'-DDD and 4,4'-DDT are not expected to migrate with groundwater.

A-5

Figure 2.8

Zone A RFI



ZONE A RCRA FACILITY INVESTIGATION REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 2.8
GROUNDWATER ELEVATIONS IN SHALLOW WELLS AT LOW TIDE ON 8-7-96

APPENDIX B

IM Completion Report, DET, October 29, 1998

COMPLETION REPORT

INTERIM MEASURE FOR
SWMU 38
NAVAL BASE CHARLESTON
CHARLESTON, SC

Prepared for:

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
CHARLESTON SC

Prepared by:

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USN, (SUPSHIP) Portsmouth Va.,
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1899 North Hobson Ave.
North Charleston, SC 29405-2106

October 29, 1998

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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
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 SWMU 38 SWMU 38 is a site where a former storage yard was associated with Buildings 1605 and 1604 for approximately 50 years. The site is a graded "Run of Crusher" (ROC) area used for the temporary storage of non perishable industrial equipment such as high voltage cable, transformers, electrical controllers/motors, refrigerators, construction and heavy machining equipment. The site is north of Building 1605, near the northern boundary of NAVBASE. The

Hess Oil. Inc.. tank farm is adjacent to this boundary. The boundary of SWMU 38 was reduced to encompass only the specific area formerly used for storage of empty drums. The remaining area depicted in the RFA was exclusively used for the storage of wooden pallets, boats, and automobiles. (See Figure #1, Appendix A).

Past investigations documented in the Zone A RCRA Facility Investigation Report for NAVBASE Charleston have identified the pesticides 4,4'-DDT, 4,4'-DDE and 4,4'-DDD as contaminants of concern at this site.

1.4 SWMU 38 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 (SPORTENVDETCHASN). The objective of this IM was to excavate and dispose of pesticide contaminated soil. The excavation was to continue until a sampling program indicated with reasonable confidence that the concentrations of contaminants at the site were less than residential limits specified by the United States Environmental Protection Agency Region III Risk Based Concentrations (RBC's), dated 23 September 1996 for pesticides. This IM is consistent with the ultimate cleanup of SWMU 38 and is not intended to circumvent the public participation process inherent within environmental cleanup under RCRA authority.

1.4.1 SWMU 38 INTERIM MEASURE EXECUTION SUMMARY The execution of this IM consisted of two excavations at the site. The initial work plan (Rev 0) required the excavation of pesticide contaminated soil from two 6' by 6' and 4' in depth areas. One was located at soil boring 038-S-B001, the other at soil boring 038-S-B003. (See Figure #1, Appendix A). The cleanup goal for the pesticides was 1.9 mg/kg for DDT, DDE, and 2.7 mg/kg for DDD, which are the residential RBC's. The initial work plan also required the abandonment of well NBCA-38-01. See Appendix B for the well abandonment letter. The initial excavation began in April of 1997. Soil removed from the site was characterized as hazardous "U" listed waste, and disposed of in a

certified Subtitle C landfill. Confirmation samples collected after completion of the initial excavation indicated results above the residential RBC's. (See Figure #2 and sample results, Appendix A).

To further delineate the area, immunoassay and field gas chromatograph sampling was conducted in July and November of 1997. Results from this sampling indicated an area approximately 120' x 25' and a depth of 3 to 4 feet was contaminated with pesticides. (See Figure #3, Appendix A).

In February of 1998, the Navy reassessed the waste characterization of soils at SWMU 38 and SCDHEC agreed with the Navy that the soil at SWMU 38 was contaminated from the application of the pesticides and was therefore not a listed waste. SCDHEC agreed that since the soil was not contaminated with a listed waste, it could not be considered hazardous waste, and should be managed as "Contaminated Media." (See Appendix B).

A risk evaluation for SWMU 38 was conducted by Ensafe, Inc. following the initial excavation. (See Appendix C). This evaluation developed Remedial Goal Options (RGO) values of 9.2 mg/kg for DDD and 6.5 mg/kg for DDT and DDE as the clean up goals. Based on the newly established clean-up goals (RGO values), the work plan was amended as (Rev 1) in April 1998 to incorporate the new RGO's.

The final excavation began in August of 1998 and encompassed an area approximately 120' x 25' and a depth of 4 to 5 feet. Upon completion of the excavation confirmatory samples were taken along the east, west and south side walls and bottom of the excavation. (See Figure #4 and sample results, Appendix A). The north side walls and 3rd interval perimeter sampling was conducted following excavation back fill. (See Figure #5 and sample results, Appendix A).

Perimeter confirmatory sampling of the excavation side walls was conducted at the 1st and 2nd intervals. Results showed that pesticide levels were less than the RGO's with the exception of one 1st interval sample located along the fenced property line of Hess Oil Inc. reading 50.9 ppm DDT.

Three confirmatory samples were collected from the bottom centerline of the excavation. Results showed pesticide contamination in all three samples ranging from 19 ppm to 388 ppm. Because groundwater was encountered, no further excavation was performed and the site was back filled, compacted and graded. SCDHEC requested additional perimeter sampling be performed in the 3rd interval (6' - 7') to determine if pesticide contamination existed below and beyond the perimeter of

the excavation. The DET collected six samples from around the perimeter of the excavation. The results of these samples were all less than the RGO's with the highest detection reading 2.25 ppm. (See Figure #5 and sample results, Appendix A). Sample analysis data sheets are found in Appendix D.

1.4.2 SWMU 38 INTERIM MEASURE CONCLUSION

This Interim Measure effectively removed contaminated soil from land surface to approximately 4' below land surface (BLS). Groundwater was encountered at approximately 4' BLS. According to investigative samples conducted after remediation, 3rd interval samples collected at the perimeter of the excavation indicated the presence of pesticides, although below the clean levels defined for SWMU 38. Samples collected along the Naval Complex property line indicated one result greater than RGO levels and confirmation samples collected approximately 4' BLS also exceeded RGO levels. Based on these results, further investigation may be warranted.

2. INTERIM MEASURE EXECUTION

2.1 ACTIONS REQUIRED BY INTERIM MEASURE WORK PLAN Required actions are listed below:

2.1.1 Actions required by Interim Measure Work Plan Rev (0)

- Abandonment of groundwater monitoring well NBCA-38-01 to prevent possible cross contamination of the groundwater by the surrounding soil.

- Removal and disposal of approximately 5.4 cubic yards of DDD, DDE, and DDT contaminated soil at soil boring 038-S-B001.

- Removal and disposal of approximately 2.7 cubic yards of DDD and DDT contaminated soil at soil boring 038-S-B003.

2.1.2 Actions required by Interim Measure Work Plan Rev (1)

- Removal and disposal of DDD, DDE, and DDT contaminated soil from an area approximately 120' x 25' to a depth of 4 to 5 feet extending between and beyond soil borings 038-S-B001 and 038-S-B003 based on new clean guidelines established as RGO's.

2.2 OBSERVATIONS NOTED

2.2.1 Soil Conditions The land surface to approximately 6" below ground surface was made up of gravel (ROC). From 6" below ground surface to the bottom of the excavations, the soil was a sandy fill, gray in color with orange-brown mottling, with some silt and clay.

2.2.2 Groundwater Groundwater was encountered at approximately 4 feet.

2.3 PLAN MODIFICATIONS AND JUSTIFICATION The IM Work Plan (Rev 0) specified removal of soil to a depth of 4' in two 6' x 6' square areas at RFI sample locations 038-S-B001 and 038-S-B003. The sample analysis from the two areas revealed that the excavation site required further expansion to include an area approximately 120' x 25', extending between and beyond the two RFI sample locations. (See Figure #3, Appendix A).

Waste disposal characterization was changed from hazardous, for the initial excavation, to non-hazardous for the final excavation. Additionally a change was made from the residential RBC cleanup goals specified by USEPA to Remedial Goal Option (RGO) values. This change was based on a risk evaluation conducted by Ensafe, Inc. (See Appendix C) The RGO values established for SWMU 38 was 6.5 mg/kg for DDT, DDE and 9.2 mg/kg for DDD.

3. INTERIM MEASURE OUTCOME

3.1 SITE CONDITIONS FOLLOWING COMPLETION OF WORK. Following completion of all site work on 29 October 1998, the DET had removed 519 cubic yards of pesticide contaminated soil. The site was back-filled, compacted, covered with ROC and graded to existing conditions. Site photographs are included in Appendix E.

4. SAMPLING

4.1 SAMPLING EVOLUTIONS AND RESULTS

4.1.1 Field Sampling Field sampling consisted of immunoassay and field gas chromatography testing to determine the extent of contamination. This data was used to estimate growth in the scope of work.

4.1.2 Confirmation Sampling Upon completion of field work, grab samples were taken along the perimeter and bottom of the excavations to determine the effectiveness of the soil removal. Additional investigative sampling was conducted after clean fill and grading had been completed at the site for the Corrective Measures Study. See Appendix D for sampling documentation.

5. WASTE GENERATION

5.1 HAZARDOUS/POTENTIALLY HAZARDOUS WASTE

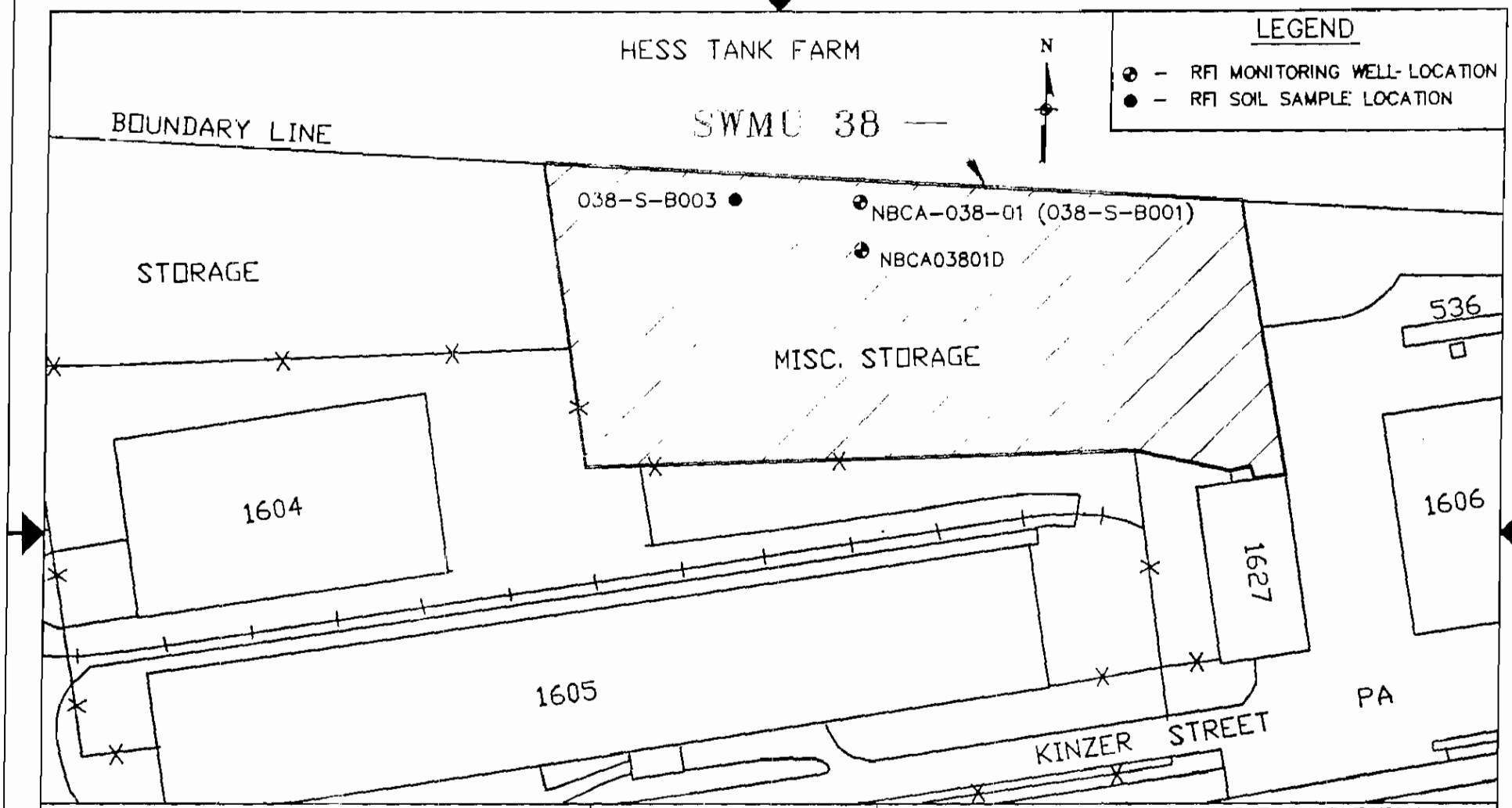
A total of 16 cubic yards of pesticide contaminated soil was disposed of to a permitted Treatment, Storage and Disposal Facility.

5.2 NON-HAZARDOUS WASTE

A total of 503 cubic yards of non-hazardous pesticide contaminated soil was disposed of to a Subtitle D landfill permitted to accept special waste.

Waste Manifests are in Appendix F.

519



ENVIRONMENTAL DETACHMENT CHARLESTON
1899 NORTH HOBSON AVENUE – BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405-2106

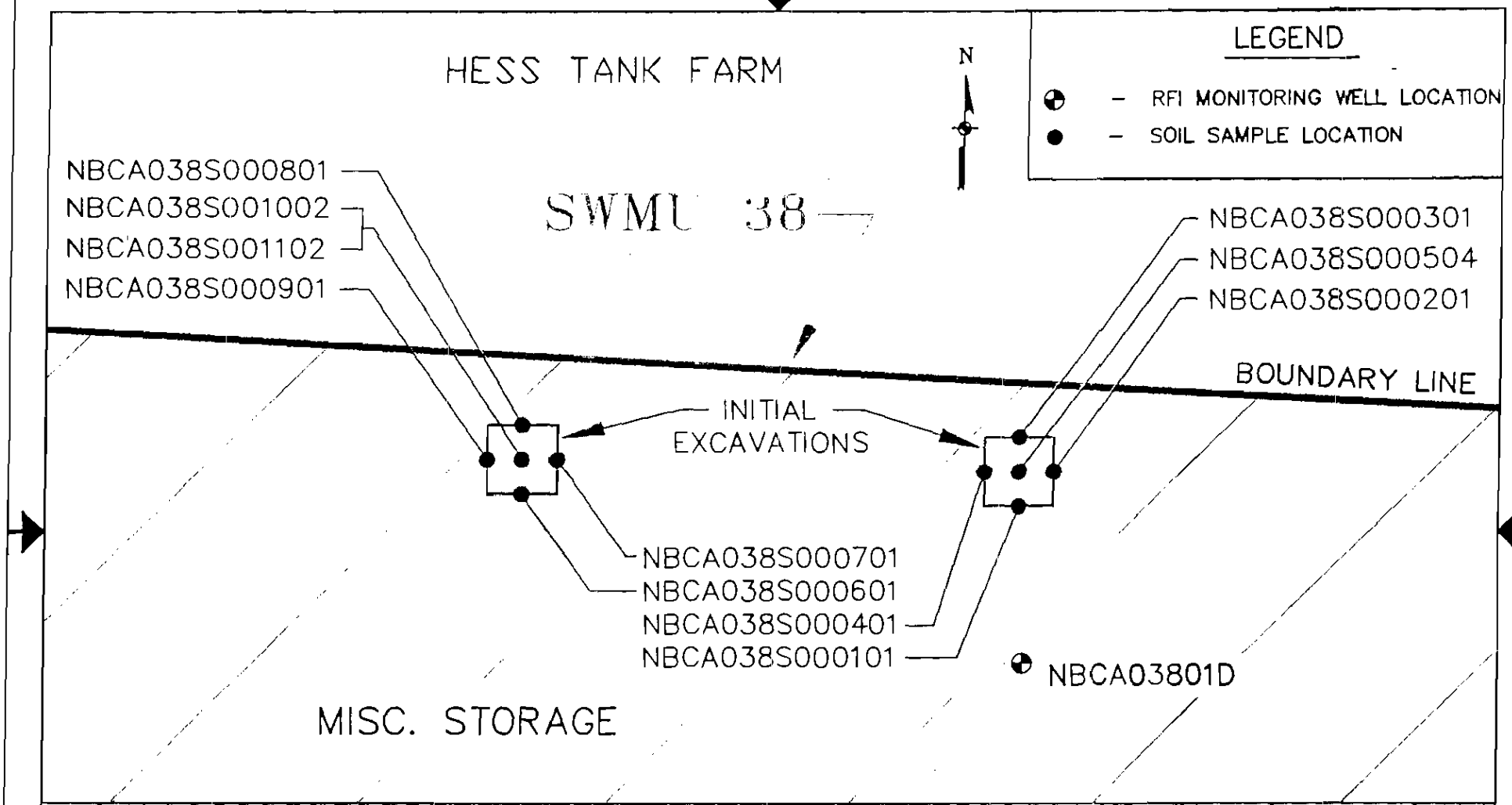
FIGURE 1

SWMU 38 COMPLETION REPORT SITE MAP WITH
RFI SOIL SAMPLE AND MONITORING WELL LOCATIONS

SIZE	DATE:	PREPARED BY:	REV
A	10-29-98	J.I. BROWNLEE	–

SCALE: –

SHEET: A-1



10 0 20 40

GRAPHIC SCALE (FEET)

ENVIRONMENTAL DETACHMENT CHARLESTON
1899 NORTH HOBSON AVENUE – BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405-2106

FIGURE 2

SWMU 38 COMPLETION REPORT SITE MAP WITH INITIAL EXCAVATION BOUNDARY AND SOIL SAMPLE LOCATIONS

SIZE	DATE:	PREPARED BY:	REV
A	10-30-98	J.I. BROWNLEE	–

SCALE: –

SHEET: A-2

CONFIRMATION SOIL SAMPLE RESULTS FROM INITIAL EXCAVATION

SAMPLE # (SPORT)	SAMPLE # (NBCA)	CONSTITUENT	RESULTS (MG/KG)	REGION III INDUSTRIAL RBC (MG/KG)	REGION III RESIDENTIAL RBC (MG/KG)
474-1	038S000101	DDD	**30.0**	24	2.7
474-1	038S000101	DDE	ND	17	1.9
474-1	038S000101	DDT	**136.0**	17	1.9
474-2	038S000201	DDD	**298.0**	24	2.7
474-2	038S000201	DDE	ND	17	1.9
474-2	038S000201	DDT	**154.0**	17	1.9
474-3	038S000301	DDD	1.5	24	2.7
474-3	038S000301	DDE	ND	17	1.9
474-3	038S000301	DDT	**5.03**	17	1.9
474-4	038S000401	DDD	**550.0**	24	2.7
474-4	038S000401	DDE	ND	17	1.9
474-4	038S000401	DDT	**1790.0**	17	1.9
474-5	038S000504	DDD	**23.1**	24	2.7
474-5	038S000504	DDE	ND	17	1.9
474-5	038S000504	DDT	1.36	17	1.9
474-6	038S000601	DDD	**13.3**	24	2.7
474-6	038S000601	DDE	ND	17	1.9
474-6	038S000601	DDT	**51.5**	17	1.9
474-7	038S000701	DDD	0.473	24	2.7
474-7	038S000701	DDE	0.281	17	1.9
474-7	038S000701	DDT	0.0548	17	1.9
474-8	038S000801	DDD	0.464	24	2.7
474-8	038S000801	DDE	0.253	17	1.9
474-8	038S000801	DDT	0.373	17	1.9
474-9	038S000901	DDD	**5.27**	24	2.7
474-9	038S000901	DDE	1.04	17	1.9
474-9	038S000901	DDT	**3.54**	17	1.9
474-10	038S001002	DDD	**41.5**	24	2.7
474-10	038S001002	DDE	ND	17	1.9
474-10	038S001002	DDT	**116.0**	17	1.9
474-11 (DUP OF 474-10)	038C001102	DDD	**20.3**	24	2.7
474-11 (DUP OF 474-10)	038C001102	DDE	**1.9**	17	1.9
474-11 (DUP OF 474-10)	038C001102	DDT	**26.2**	17	1.9

ND = NOT DETECTED

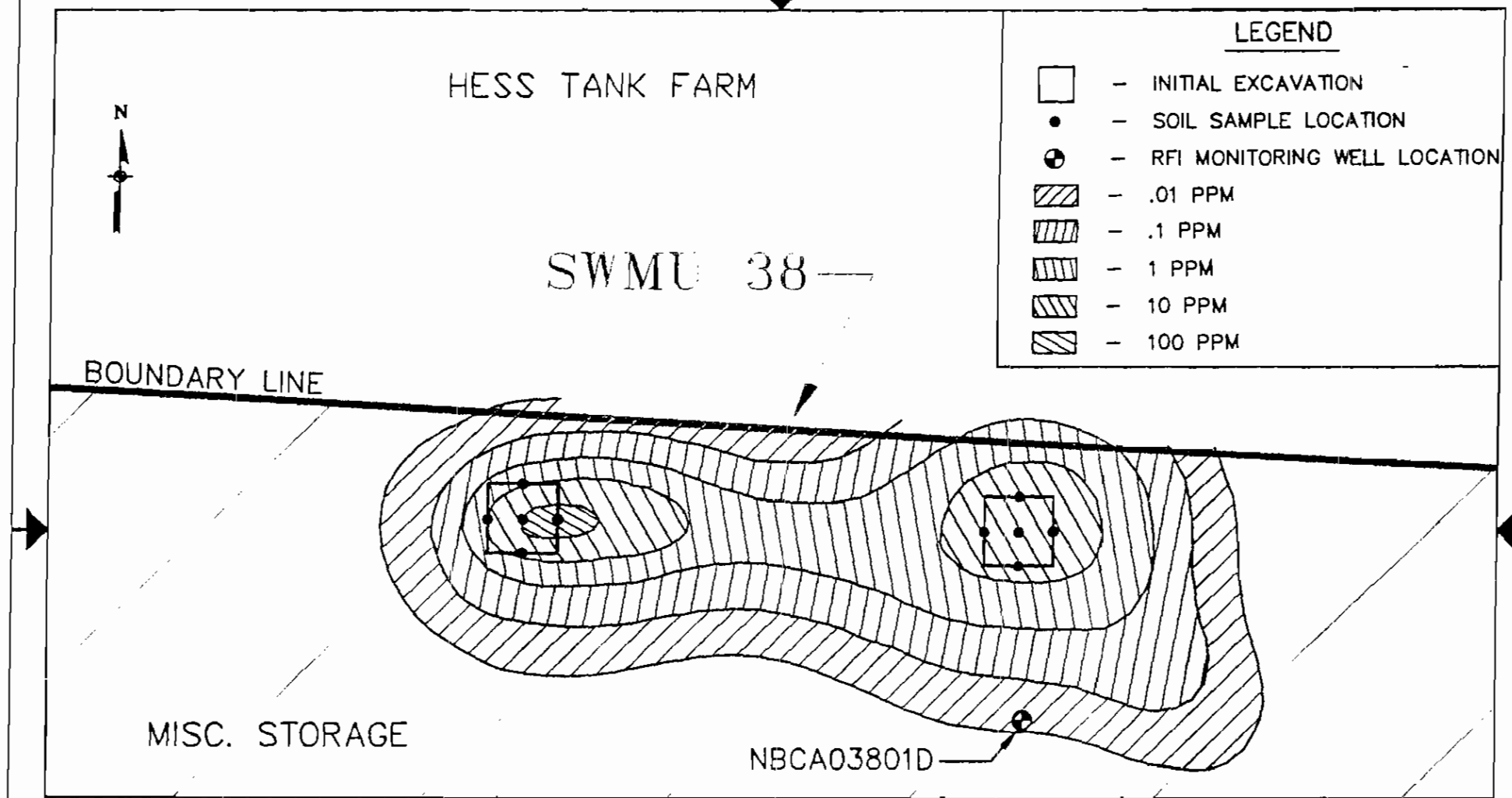
BOLD = VALUES EQUAL TO OR EXCEEDING THE RESIDENTIAL RBC

CONFIRMATION SOIL SAMPLE RESULTS FROM BOTTOM OF EXCAVATION

SAMPLE # (SPORT)	SAMPLE # (NBCA)	CONSTITUENT	RESULTS (MG/KG)	REMEDIAL GOAL OPTION RGO (MG/KG)
783-1	038S03001	DDD	**19.0**	9.2
783-1	038S03001	DDE	ND	6.5
783-1	038S03001	DDT	**41.6**	6.5
783-2	038S03101	DDD	**123.0**	9.2
783-2	038S03101	DDE	ND	6.5
783-2	038S03101	DDT	**388.0**	6.5
783-3	038S03201	DDD	0.992	9.2
783-3	038S03201	DDE	ND	6.5
783-3	038S03201	DDT	4.63	6.5

ND = NOT DETECTED

BOLD = VALUES EXCEEDING THE REMEDIAL GOAL OPTION



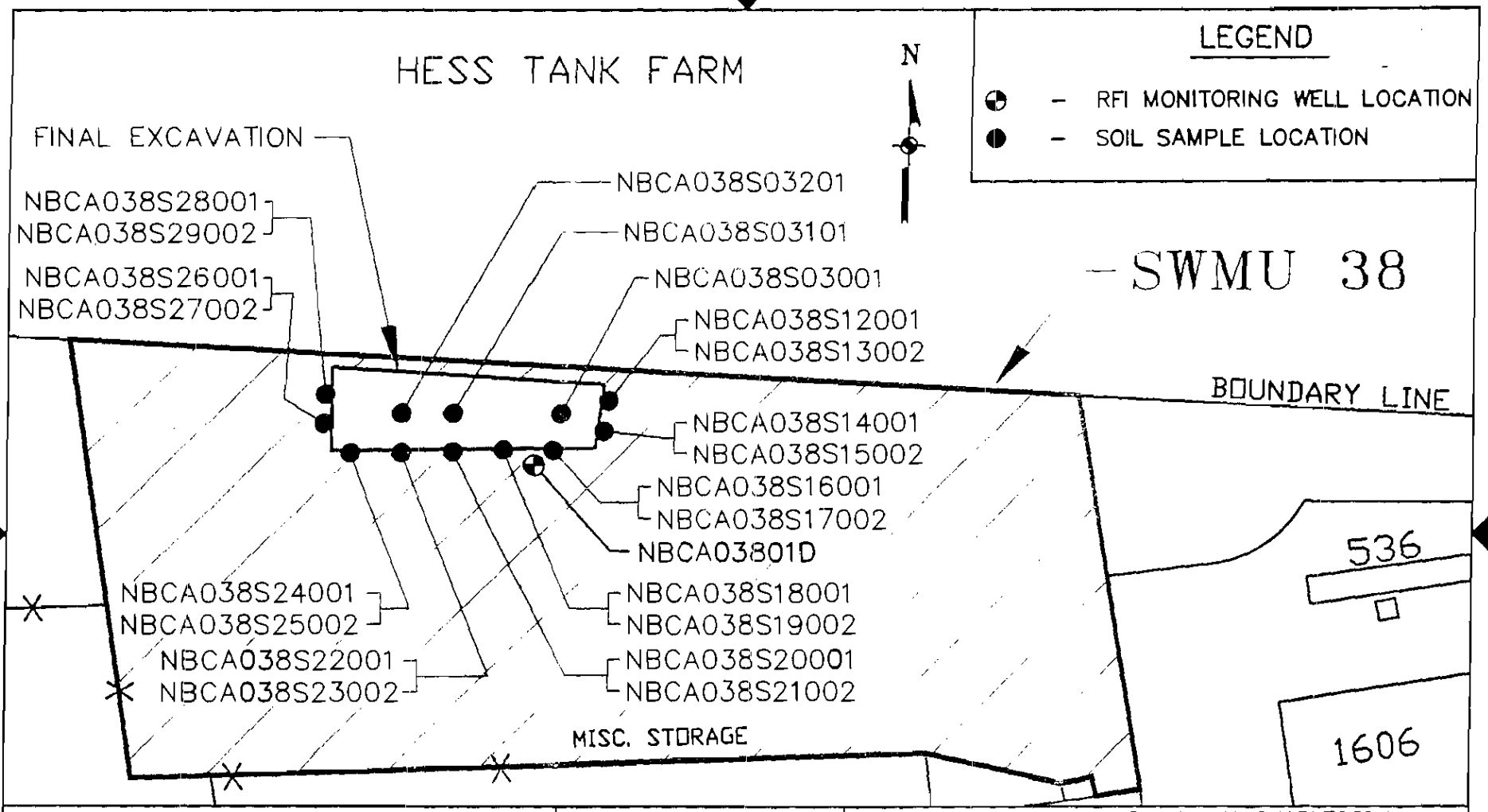
ENVIRONMENTAL DETACHMENT CHARLESTON
1899 NORTH HOBSON AVENUE – BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405-2106

FIGURE 3
SWMU 38 COMPLETION REPORT CONTOUR MAP

SIZE	DATE:	PREPARED BY:	REV
A	11-03-98	J.I. BROWNLEE	–

SCALE: –

SHEET: A-3



ENVIRONMENTAL DETACHMENT CHARLESTON
1899 NORTH HOBSON AVENUE – BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405-2106

FIGURE 4

SWUM 38 COMPLETION REPORT SITE MAP WITH FINAL EXCAVATION BOUNDARY AND SOIL SAMPLE LOCATIONS

SIZE	DATE:	PREPARED BY:	REV
A	10-30-98	J.I. BROWNLEE	–

SCALE: –

SHEET: A-4

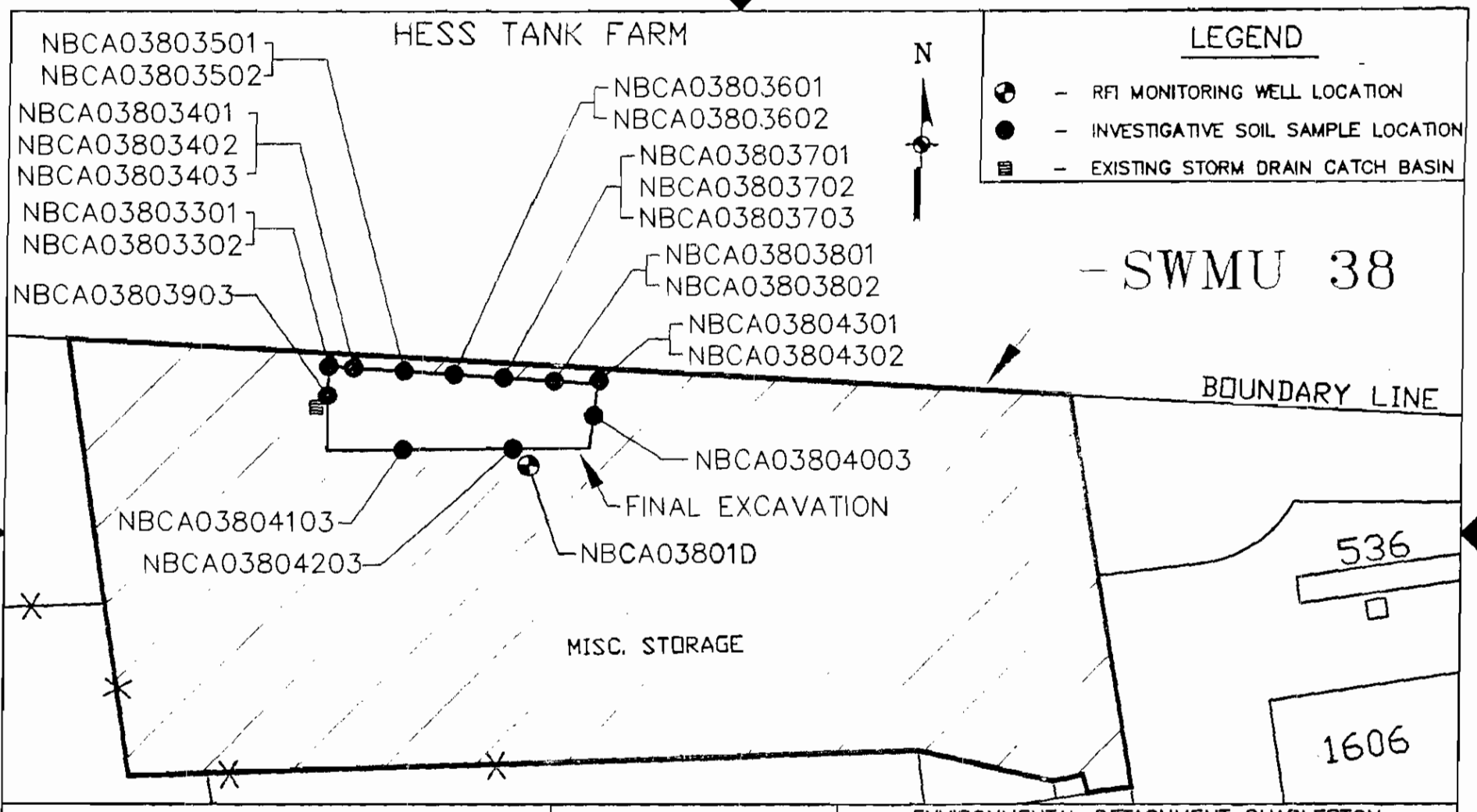
CONFIRMATION SOIL SAMPLE RESULTS FROM FINAL EXCAVATION

SAMPLE # (SPORT)	SAMPLE # (NBCA)	CONSTITUENT	RESULTS (MG/KG)	REMEDIAL GOAL OPTION RGO (MG/KG)
886-1	038S12001	DDD	0.00169	9.2
886-1	038S12001	DDE	0.0127	6.5
886-1	038S12001	DDT	ND	6.5
886-2	038S013002	DDD	ND	9.2
886-2	038S013002	DDE	ND	6.5
886-2	038S013002	DDT	ND	6.5
886-3	038S014001	DDD	0.0847	9.2
886-3	038S014001	DDE	ND	6.5
886-3	038S014001	DDT	0.619	6.5
886-4	038S015002	DDD	0.0434	9.2
886-4	038S015002	DDE	ND	6.5
886-4	038S015002	DDT	0.319	6.5
886-5	038S016001	DDD	ND	9.2
886-5	038S016001	DDE	0.0331	6.5
886-5	038S016001	DDT	0.0513	6.5
886-6	038S017002	DDD	ND	9.2
886-6	038S017002	DDE	ND	6.5
886-6	038S017002	DDT	ND	6.5
886-7	038S018001	DDD	ND	9.2
886-7	038S018001	DDE	ND	6.5
886-7	038S018001	DDT	ND	6.5
886-8	038S019002	DDD	ND	9.2
886-8	038S019002	DDE	ND	6.5
886-8	038S019002	DDT	ND	6.5
886-9	038S020001	DDD	ND	9.2
886-9	038S020001	DDE	ND	6.5
886-9	038S020001	DDT	ND	6.5
886-10	038S021002	DDD	ND	9.2
886-10	038S021002	DDE	ND	6.5
886-10	038S021002	DDT	ND	6.5
886-11	038S022001	DDD	0.134	9.2
886-11	038S022001	DDE	ND	6.5
886-11	038S022001	DDT	ND	6.5

CONFIRMATION SOIL SAMPLE RESULTS FROM FINAL EXCAVATION (CON'T)

886-12	038S023002	DDD	ND	9.2
886-12	038S023002	DDE	ND	6.5
886-12	038S023002	DDT	ND	6.5
886-13	038S024001	DDD	ND	9.2
886-13	038S024001	DDE	ND	6.5
886-13	038S024001	DDT	ND	6.5
886-14	038S025002	DDD	ND	9.2
886-14	038S025002	DDE	ND	6.5
886-14	038S025002	DDT	ND	6.5
886-15	038S026001	DDD	ND	9.2
886-15	038S026001	DDE	ND	6.5
886-15	038S026001	DDT	ND	6.5
886-16	038S027002	DDD	ND	9.2
886-16	038S027002	DDE	ND	6.5
886-16	038S027002	DDT	ND	6.5
886-17	038S028001	DDD	7.630	9.2
886-17	038S028001	DDE	0.305	6.5
886-17	038S028001	DDT	0.170	6.5
886-18	038S029002	DDD	0.0616	9.2
886-18	038S029002	DDE	ND	6.5
886-18	038S029002	DDT	ND	6.5

ND = NOT DETECTED



ENVIRONMENTAL DETACHMENT CHARLESTON
1899 NORTH HOBSON AVENUE – BUILDING 30
NORTH CHARLESTON, SOUTH CAROLINA 29405-2106

FIGURE 5

SWMU 38 COMPLETION REPORT SITE MAP
WITH INVESTIGATIVE SOIL SAMPLE LOCATIONS

SIZE	DATE:	PREPARED BY:	REV
A	11-02-98	J.I. BROWNLEE	–

SCALE: –

SHEET: A-5

INVESTIGATIVE SAMPLES

SAMPLE # (SPORT)	SAMPLE # (NBCA)	CONSTITUENT	RESULTS (MG/KG)	REMEDIAL GOAL OPTION RGO (MG/KG)
0015-01	03803301	DDD	0.0999	9.2
0015-01	03803301	DDE	0.546	6.5
0015-01	03803301	DDT	0.376	6.5
0015-02	03803302	DDD	0.024	9.2
0015-02	03803302	DDE	0.0306	6.5
0015-02	03803302	DDT	0.160	6.5
0015-03	03803401	DDD	0.013	9.2
0015-03	03803401	DDE	0.0639	6.5
0015-03	03803401	DDT	0.046	6.5
0015-04	03803402	DDD	ND	9.2
0015-04	03803402	DDE	ND	6.5
0015-04	03803402	DDT	ND	6.5
0015-05	03803501	DDD	0.0666	9.2
0015-05	03803501	DDE	0.123	6.5
0015-05	03803501	DDT	0.338	6.5
0015-06	03803502	DDD	0.783	9.2
0015-06	03803502	DDE	ND	6.5
0015-06	03803502	DDT	0.599	6.5
0015-07	03803601	DDD	0.193	9.2
0015-07	03803601	DDE	0.523	6.5
0015-07	03803601	DDT	0.713	6.5
0015-08	03803602	DDD	0.00598	9.2
0015-08	03803602	DDE	0.00783	6.5
0015-08	03803602	DDT	0.0291	6.5
0015-09	03803701	DDD	8.040	9.2
0015-09	03803701	DDE	5.880	6.5
0015-09	03803701	DDT	50.900	6.5
0015-10	03803702	DDD	0.0146	9.2
0015-10	03803702	DDE	0.011	6.5
0015-10	03803702	DDT	0.103	6.5
0015-11	03803801	DDD	0.0479	9.2
0015-11	03803801	DDE	0.115	6.5
0015-11	03803801	DDT	0.250	6.5

INVESTIGATIVE SAMPLES CON'T

SAMPLE # (SPORT)	SAMPLE # (NBCA)	CONSTITUENT	RESULTS (MG/KG)	REMEDIAL GOAL OPTION RGO (MG/KG)
0015-12	03803802	DDD	0.649	9.2
0015-12	03803802	DDE	ND	6.5
0015-12	03803802	DDT	0.122	6.5
0015-13	03803903	DDD	0.0573	9.2
0015-13	03803903	DDE	0.0133	6.5
0015-13	03803903	DDT	0.114	6.5
0015-14	03804003	DDD	0.000829	9.2
0015-14	03804003	DDE	0.00113	6.5
0015-14	03804003	DDT	0.0110	6.5
0015-15	03804103	DDD	2.250	9.2
0015-15	03804103	DDE	ND	6.5
0015-15	03804103	DDT	0.639	6.5
0015-16	03804203	DDD	0.00216	9.2
0015-16	03804203	DDE	0.00456	6.5
0015-16	03804203	DDT	0.00633	6.5
0015-17	03804301	DDD	0.000679	9.2
0015-17	03804301	DDE	0.00423	6.5
0015-17	03804301	DDT	0.00290	6.5
0015-18	03804302	DDD	0.0739	9.2
0015-18	03804302	DDE	0.0999	6.5
0015-18	03804302	DDT	0.0348	6.5
0015-19	03803403	DDD	0.165	9.2
0015-19	03803403	DDE	0.0386	6.5
0015-19	03803403	DDT	0.153	6.5
0015-20	03803703	DDD	0.018	9.2
0015-20	03803703	DDE	0.00879	6.5
0015-20	03803703	DDT	0.0453	6.5

ND = NOT DETECTED

BOLD = VALUES EXCEEDING THE REMEDIAL GOAL OPTION

LETTERS OF RECORD

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: 968
NOV 17 1998

Mr. John Litton, 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 SWMU 38 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 Engineering Command at (843)820-5578.

Sincerely,

for E.R. Dearhart
Director

Encl:
(1) Completion Report for SWMU 38

Copy to:
SCDHEC (Mr. Tapia, Mr. Bergstrand)
USEPA (Mr. Spariosu)
CSO Naval Base Charleston (Mr. Shepard)
NAVFAC (Mr. Batten)
EA&H (Ms. Maddux)

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: 534
APR 29 1997

Mr. Paul Berstrand
South Carolina Department of Health & Environmental Control
Bureau of Solid and Hazardous Waste Management
2600 Bull Street
Columbia, SC 29201

Subj: ABANDONMENT OF MONITORING WELL NBCA-38-01

Ref: (a) Approved Interim/Stabilization Measure (IM) Work Plan for Waste Management Unit (SWMU) 38, Naval Base Charleston, Charleston, SC

(b) South Carolina Well Standards and Regulations R. 61-71

Dear Mr. Bergstand,

Abandonment of monitoring well NBCA-38-01 was identified in paragraph 4.1 of reference (a). Abandonment of this well was determined to be necessary to facilitate excavation at the well location as part of the IM process. This well is located adjacent to the Hess Tank Farm boundary line at the Charleston Naval Complex. Fourth quarter sampling of this well is complete.

Please be informed that on April 22, 1997 this well was abandoned in place by Environmental Detachment Charleston (DET) personnel. This was accomplished by filling the 2 inch PVC well casing with cement grout in accordance with the requirements of reference (b) and under the supervision of Mr. Chuck Stutz of Southern Division Naval Facilities Engineering Command, Caretaker Site Office. Mr. Stutz is a well driller licensed by the state of South Carolina.

Questions and/or comments regarding abandonment of this well should be addressed to William W. Smalls at (803) 743-6777 extension 125.

E. R. Dearhart

Distribution:
EPA (J. Basset)
SCDHEC (J. Tapia)
SDIV (Code 1876)

DEPARTMENT OF THE NAVY
SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
P.O. BOX 190010
2155 EAGLE DRIVE
NORTH CHARLESTON, S.C. 29419-9010

5090
Ser CSO/77
24 July 1998

Mr. Wray Mattice
Chambers Landfill
Hazardous Waste Permitting Section
P. O. Box 145
Dorchester, SC 29437

Dear Mr. Mattice:

SUBJECT: WASTE DISPOSAL CHARACTERIZATION AT SWMU 38

This letter provides information concerning the pesticide contaminated soils identified for removal located at SWMU 38, Charleston Naval Complex, Charleston. SWMU 38 is a graded gravel area that was used as a temporary storage area for nonperishable industrial equipment from 1940 through 1995.

An entomologist familiar with pesticide control practices at the former Charleston Naval Shipyard explained in the enclosed e-mail that the levels of DDT, DDD and DDE at SWMU 38 are consistent with application levels used on the Naval Base from 1950 through the early 1970's and did not originate from a spill of the pure commercial product. There is no documentation supporting any spills of DDT at this site from previous investigations. Therefore, the Navy has characterized this waste as nonhazardous.

S. C. Department of Health and Environmental Control (SC DHEC) reviewed the Navy's characterization methodology and confirmed that the soils at SWMU 38 are not contaminated with a listed (RCRA U-Listed or P-Listed) waste as stated in the enclosed e-mail. Therefore, the soils are not considered hazardous waste.

For additional information, please contact William A. Drawdy at 743-9985, extension 29.

Sincerely,

H. N. Shepard II

H. N. SHEPARD II
Caretaker Site Officer
By direction

Enclosures: (1) E-Mail from Tony Hunt (SOUTHNAVFACENGCOM) of 7 Jan 98
(2) E-Mail from Johnny Tapia (SC DHEC) of 18 Feb 98

Author: <manuntlefdsouth.navfac.navy.mil> at p-ssports-smtp
Date: 1/7/98 1:54 PM
Priority: Normal
TO: Tunstall_Jerome_N_K at Banyan_Vines
Subject: DDT levels in soils
---------- Message Contents ----------

I spoke with Bill Bennett who is an entomologist in our applied biology division, public works department concerning the DDT levels. The following is a summary of our conversation.

DDT and similar compounds (DDE, DDD which are more impurities than degradation or daughter products) were applied extensively at the Naval Base beginning in the 1950's through the early 1970's. This pesticide was used for termite, mosquito, turf pests, and fly control primarily. The compound is hydrophobic and was applied by mixing in concentrations of 5 - 10% by volume of diesel fuel, kerosine or JP-5. This form of the pesticide was purchased premixed by the government. Other forms which were used included wettable powders and emulsifiable forms which could be mixed with water for application.

The pesticide was applied in several ways. Mosquito and fly control was accomplished by use of the petroleum based form and generating a fog by pouring the liquid over a hot manifold which created a dense, DDT concentrated smoke. In low lying areas where mosquito breeding was a particular problem, 55 gallon drums were cut in half and filled with the petroleum/DDT mixture and allowed to overflow during rain events which dispersed the material across the surface of ponded areas.

Soil contamination could easily be in the order of magnitude of 1000 ppm from the petroleum/DDT mixture. The Public Works area could easily have been where some of these 55 gallon drums were placed.

Mr. Bennett also offered information on Chlordane which was used into the 1980's at the Naval Base. Application rates could easily result in soil contamination in the 500 to 1000 ppm range. This contaminant would also expect to be widespread since it was used for lawns and other turfs to control pests in these areas. This chemical is as persistant as DDT, contains a number of different isomers and would not be expected to migrate from where it was applied.

One thing to look at where we have high DDT hits then is PAHs and Diesel Range Organics which may give us a clue to what occurred. Bill was not sure of the emulsion composition which could give us some idea of what to look for there, however it may irrelevant if the concentrations are in a range that is equal to or less than the 1000 ppm order of magnitude (application range). I believe this gives us sufficient justification to characterize soil in this range as industrial waste only.

Tony

Gunter, Tammy
From: Heames, Jed
Sent: Monday, May 18, 1998 10:30 AM
To: tgunter@edc.net
Subject: FW: Waste Disposal Characterization at SWMU 38

Jed heames

——Original Message——

From: M A (Tony) Hunt [SMTP:mahunt@efdsouth.navfac.navy.mil]
Sent: Monday, May 18, 1998 9:46 AM
To: jheames@edc.net
Subject: fwd: Waste Disposal Characterization at SWMU 38

The info you requested....

Original Text

From: "Johnny Tapia" <TapiaJM@columb34.dhec.state.sc.us>, on 2/18/98 3:45 PM:

To: SMTP@Incog@NAVFAC EFDSOUTH[<THaverkost@Ensafe.com>], SMTP@Incog@NAVFAC EFDSOUTH[<SPARIOSU.DANN@epamail.epa.gov>], SMTP@Incog@NAVFAC EFDSOUTH[<Dearhart_Earl_R@mlink.repair.navy.mil>], SMTP@Incog@NAVFAC EFDSOUTH[<Tunstall_Jerome_N_K@mlink.repair.navy.mil>], Daryle L Fontenot@Code 18@NAVFAC EFDSOUTH, M A (Tony) Hunt@Code 18@NAVFAC EFDSOUTH
Cc: SMTP@Incog@NAVFAC EFDSOUTH[<8ERGSTPM@gw.state.sc.us>]

** High Priority **

Gentlemen,

After last week's meeting I took on myself to confirm that the soils at SWMU 38 contaminated with pesticides (DDT, DDE) were characterized appropriately for disposal. The question revolved around DDT being listed as U061 waste and the regulatory interpretation of application to the land.

After consideration of all factors, it is clear that the DDT mixture purchased by the Navy was used for its intended purpose, as a product. The soil, although contaminated now is not because a documented spill, leak, etc. of a listed waste (U061) managed at the unit (SWMU 38). Therefore, since the soil is not contaminated with a listed waste, it cannot be considered hazardous waste. This

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pesticide contaminated soil should be managed as "Contaminated Media" and apply the Best Management Practices available.

Guidance on managing contaminated media can be found on Guidance Number TSC-92-02 from EPA Region IV. dated December 28. 1992.

If you have any questions, please call.

Johnny Tapia
SCDHEC

Enclosure (2)

APPENDIX C

RISK EVALUATION

Preliminary Risk Evaluation for SWMU 38 Following Initial Excavation

Site Background and Investigative Approach

SWMU 38, formerly a storage yard associated with Buildings 1604 and 1605, is located on the northern boundary of Zone A. Materials formerly stored in SWMU 38 included wooden pallets, boats, automobiles, and empty drums. Fourteen surface soil samples were collected as part of the 1995 CSI activities at SWMU 38 during three sampling rounds.

Interim measures were conducted at SWMU 38 involving the removal of soil due to elevated concentrations of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT detected in the RFI. Soil was excavated to a depth of 4' in two 10' X 10' square areas at RFI sample locations 038SB001 and 038SB003. The following assessment is based on data that was gathered after interim measures activities. Eight confirmatory surface soil samples were collected in proximity with the excavated areas. An additional twelve gas chromatograph samples were collected from the surficial interval in the same vicinity. Surface soil samples from the 20 sample locations were used to quantitatively assess soil exposure pathways. Nine immunoassay samples were also collected at the surficial interval in the immediate exposure area, but were not used in the quantitative assessment. Table 1 presents an initial screening against residential RBCs for 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT.

Exposure Assessment

Exposure Setting

SWMU 38 is located along the northern boundary of NAVBASE and is currently covered with soil and gravel. The site is within a moderately developed area of NAVBASE, and most surrounding parcels are occupied by warehouse buildings and/or parking lots. Current base reuse plans indicate that the SWMU 38 area is slated to be developed as a marine terminal and warehouse storage area. It is likely that the surrounding area will either maintain its current features or be subject to construction/renovation activities.

Potentially Exposed Populations

The most probable exposed populations are current and future site workers. Additional potentially exposed populations are hypothetical future site residents. Future site resident and worker

exposure scenarios were addressed in this risk assessment. Current exposure to workers is discussed qualitatively in relation to the future workers and future residents. The hypothetical future site worker scenario assumes continuous exposure to surface soil conditions. Current site workers' exposure would be less than that assumed for the hypothetical future site worker scenario because of their limited soil contact. Chronic exposure to subsurface soil conditions (i.e. greater than 3 feet in depth) due to construction events is unlikely due to the shallow water table in the area. Therefore, future worker assessment is considered to be protective of both current site use and future construction events. The future site resident scenario was developed on the premise that existing buildings and surface coverings would be removed and replaced with dwellings.

Exposure Pathways

Exposure pathways for the site workers are dermal contact and incidental ingestion of surface soils. The exposure pathways for future residential land use are the same as those for the future site worker. In addition, the hypothetical future site worker scenario assumed continuous exposure to surface soil conditions. Uniform exposure was assumed for all sample locations.

Exposure Point Concentrations

Twenty SWMU 38 surface soil samples, representing approximately 0.1 acres or 2/10 of a typical one-half acre exposure unit area, were analyzed for pesticides. Table 2 presents the EPCs for the COPCs identified in surface soil, by using the 95% UCL. The 95% UCL for 4,4'-DDT exceeded its maximum concentration. As a result, the maximum concentration was used as the EPC for 4,4'-DDT. The EPCs presented in Table 2 represent an upper-bound concentration for each COPC in the 0.1 acre area.

CDIs for ingestion and dermal contact with soils are shown in Tables 3 and 4, respectively. An FI/FC approach is used for estimating the risk and hazard from the soil exposure pathways since it is unreasonable to assume that a potential receptor will be chronically exposed at the upper-bound soil concentration, in the 0.1 acre area. The exposure unit area was considered to be approximately one-half acre which is typical of a residential lot. Since the upper-bound concentration was calculated for an area the size of 2/10 of a half acre, the EPCs for 4,4'-DDD,

4,4'-DDE, and 4,4'-DDE were adjusted by an FI/FC term of 0.2 to account for the fact that a hypothetical site resident or future site worker would not be chronically exposed to this isolated area of maximum concentration. FI/FC terms are based on the spatial distribution assuming that exposure is uniform in the exposure unit area.

Toxicity Assessment

Toxicity assessment terms and methods are discussed in Section 7 of the SWMU 38 RFI report. This information was used in the quantification of risk and hazard associated with soil and groundwater contaminants. Brief toxicological profiles for each COPC are provided in the following paragraphs:

4,4'-DDD, a by-product of the pesticide DDT, is a compound typical of halobenzene derivatives. It is soluble in fat, but not in water, and its target organ is the brain. This analog of DDT is the least toxic of the three primary DDT analog (i.e., the least likely to cause cancer). Other DDD effects could include cell death in the liver, fatty change of heart muscles, and kidney damage. If an individual loses body fat, DDD concentrations are not stored at sufficient concentrations to induce toxic effects (Dreisbach, et al., 1987). This compound is listed as a B2 carcinogen, and USEPA set the oral SF for DDD to 0.24 $(mg/kg\text{-}day)^{-1}$.

4,4'-DDE is a compound typical of halobenzene derivatives and is a by-product of the pesticide DDT. It is soluble in fat, but not in water, and its primary target organs are the liver and brain. DDE is the form of DDT which accumulates in organisms and is thought to be responsible for egg shell thinning and other ecological effects. DDE bioconcentrates in aquatic organisms and can significantly alter the ecology of some areas, especially where DDE-containing aquatic species are a critical species in the food chain (Dreisbach, et al., 1987) (Harte, et al., 1991). This compound is listed as a B2 carcinogen, and USEPA set the oral SF for DDE to 0.34 $(mg/kg\text{-}day)^{-1}$.

4,4'-DDT is a pesticide which is soluble in fat, but not in water. The primary target organ of DDT is the brain. Other DDT effects could include cell death in the liver, fatty change of heart muscles, and kidney damage. In a study mentioned in Dreisbach, et al., workers historically

exposed to DDT had up to 648 ppm DDT in their body fat, but no adverse health effects were observed. If an individual loses body fat, DDT concentrations are not stored at sufficient concentrations to induce toxic effects (Dreisbach, et al., 1987). As listed in IRIS, the critical noncarcinogenic effect of DDT is liver lesions. USEPA determined the oral RfD to be 0.0005 mg/kg-day, with an uncertainty factor of 100 and a modifying factor of 1.0. Confidence in the RfD is medium. DDT is a class B2 carcinogen based on tumors observed in seven studies in various mouse strains and three studies in rats. DDT is structurally similar to other probable carcinogens, such as DDD and DDE, common degradation products of DDT. USEPA determined the oral SF to be 0.34 $(mg/kg\text{-}day)^{-1}$.

Risk Characterization

Exposure to surface soil onsite was evaluated under both residential and industrial (site worker) scenarios. For these scenarios, the incidental ingestion and dermal contact exposure pathways were evaluated. For noncarcinogenic contaminants evaluated for future site residents, hazard was computed separately to address child and adult exposure. Tables 5 and 6 present the computed carcinogenic risks and/or HQs associated with the incidental ingestion of and dermal contact with site surface soils, respectively.

Hypothetical Site Residents

The ingestion ILCR (based on the adult and child lifetime weighted average) for SWMU 38 surface soils is 2E-04. The dermal pathway ILCR is 1E-04. 4,4'-DDD and 4,4'-DDT were the primary contributors for each pathway, and 4,4'-DDE was a secondary contributor. The computed hazard index for the adult and child resident were 1 and 9, respectively, for the soil ingestion pathway. The computed hazard index for the adult and child dermal contact pathways were 0.8 and 3, respectively. 4,4'-DDT was the sole contributor for both the ingestion and dermal pathways.

Hypothetical Site Workers

Site worker ILCRs are 3E-05 and 4E-05 for the ingestion and dermal contact pathways, respectively. 4,4'-DDD and 4,4'-DDT were the primary contributors for both pathways. Hazard

indices for the ingestion and dermal pathways are 0.4 and 0.6 for the ingestion and dermal pathways respectively for the future site-worker scenario. 4,4'-DDT is the sole hazard contributor for both pathways.

COCs Identified

Chemicals of concern were identified based on cumulative (all pathway) risk and hazard projected for this site. USEPA has established a generally acceptable risk range of 1E-04 to 1E-06, and a hazard index threshold of 1.0 (unity). As recommended by SCDHEC, a COC was considered to be any chemical contributing to a cumulative risk level of 1E-06 or greater and/or a cumulative hazard index above 1.0, if its individual ILCR exceeds 1E-06 or its hazard quotient exceeds 0.1. For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-04 (and individual ILCR of 1E-06) is recommended by USEPA Region IV as the trigger for establishing COCs. The COC selection method presented was used to provide a more comprehensive evaluation of chemicals contributing to carcinogenic risk or noncarcinogenic hazard during the remedial goal options development process. Table 7 provides a summary of COCs identified in soil based on contribution to cumulative ILCR or hazard index.

Hypothetical Site Residents

4,4'-DDD and 4,4'-DDT were identified as COCs based on their contribution to cumulative ILCR. 4,4'-DDT was also identified as a COC based on its contribution to cumulative hazard index.

Hypothetical Site Workers

4,4'-DDD, and 4,4-DDT were identified as COCs based on their contribution to cumulative ILCR.

4,4'-DDD and 4,4'-DDT were each detected in eleven of twenty surface soil samples, with the highest concentrations found at location 5 (550 and 1,790 mg/kg respectively). This sample was collected from the western edge of the excavated soil associated with sample location 038SB001. 4,4'-DDD and 4,4'-DDT surface soil concentrations were, however, detected at concentrations above their corresponding residential RBCs at 4 of 20 and 8 of 20 sample locations, respectively.

Risk Uncertainty

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV and SCDHEC when assessing potential future and current exposure. The exposure assumptions made in the site-worker scenario are highly protective and would tend to overestimate exposure. Although current and future exposure to impacted areas is possible, the frequency and duration of direct contact are quite low in comparison to those assumed under either residential or industrial scenarios.

Residential use of the site is not expected, based on current site uses and the nature of surrounding buildings. Current base reuse plans call for Zone A to become a marine terminal. If this area were to be used as a residential site, the buildings would be demolished, and its concrete footing removed. The surface soil conditions would likely change dramatically to accommodate a residential setting. The soils could be covered with landscaping soil, houses, and driveways. Consequently, exposure to current surface soil conditions would not be likely under a true future scenario. These factors indicate that exposure pathways assessed in this BHRA would generally overestimate the risk and hazard posed to future site residents.

Determination of Exposure Point Concentrations

The 95% UCL for 4,4'-DDT exceeded the maximum detected concentration. As a result, the maximum detected surface soil concentration was used as the EPC for 4,4'-DDT. Since it is unlikely for an individual to be chronically exposed to an isolated area of maximum or upper-bound concentration ('hot spot'), a FI/FC term was applied to the EPC to reflect the spatial distribution in SWMU 38 surface soil, relative to a one-half acre exposure unit area.

Frequency of Detection and Spatial Distribution Soil

4,4'-DDD and 4,4'-DDT were each detected in 4 of 20 and 8 of 20 surface soil samples, respectively at concentrations in excess of their residential RBCs. These detections are isolated to the northern portion of the site.

Quantification of Risk/Hazard

As indicated by the discussions above, the uncertainty and variability inherent in the risk assessment process is great. In addition, many site-specific factors have affected the uncertainty of this assessment that would positively bias the risk and hazard estimates. Exposure pathway-specific sources of uncertainty are discussed below.

Of the CPSSs screened and eliminated from formal assessment, none was reported at a concentration close to its RBC (i.e., within approximately 10% of the RBC). The use of maximum concentrations for screening comparisons minimizes the likelihood of potentially significant cumulative risk and hazard based on the eliminated CPSS.

Although the future land use of SWMU 38 is unknown, both the worker and residential exposure scenarios were assessed in this HHRA. Current base reuse plans call for the development a marine terminal for Zone A. As previously discussed, it is likely that residential scenarios would lead to overestimates of risk and/or hazard.

Risk Summary

The risk and hazard posed by contaminants at SWMU 38 were assessed for the hypothetical site-worker and the hypothetical future site resident under reasonable maximum exposure assumptions. For surface soils, the incidental ingestion and dermal contact pathways were assessed in this HHRA. Table 8 provides summaries for each pathway/receptor group evaluated for SWMU 38.

Remedial Goal Options

Surface soil RGOs for carcinogens presented in Table 9 were based on the lifetime weighted average site resident and adult site-worker, respectively. Hazard-based RGOs were calculated based on either the hypothetical child resident or the adult site-worker, as noted in each of the corresponding tables. The background reference concentration for arsenic in soil would equate with a risk of approximately 2E-05 under a residential scenario and 3E-06 under the worker scenario, as shown on Table 10. Therefore, a reasonable remediation goal would fall between a target risk of 1E-06 and 1E-05. Hence, the reasonable residential RGO ranges from 9.2 mg/kg to 92 mg/kg for 4,4'-DDD and from 6.5 to 65 mg/kg for 4,4'-DDT. Because it is likely that the

area will maintain its industrial usage the worker based RGOs ranging from 45 mg/kg to 452 mg/kg for 4,4'-DDD and from 32 mg/kg to 319 mg/kg for 4,4'-DDT would be most appropriate for this site.

Table 9
Remedial Goal Options Surface Soil
SWMU 38
Naval Base Charleston, Zone A
Charleston, South Carolina

Residential-Based Remedial Goal Options

Chemical	Slope Factor (mg/kg-day)-1	Reference Dose (mg/kg-day)	HI/FC Factor	EPC mg/kg	Hazard-Based Remedial Goal Options 3 mg/kg	1 mg/kg	0.1 mg/kg	Risk-Based Remedial Goal Options 1E-06 mg/kg	1E-05 mg/kg	1E-04 mg/kg	Background Concentration mg/kg
4,4'-DDD	0.24	NA	0.2	469.57	ND	ND	ND	9.2	92	918	NA
4,4'-DDE	0.34	NA	0.2	1.82	ND	ND	ND	6.5	65	648	NA
4,4'-DDT	0.34	0.0005	0.2	1790	455	152	15	6.5	65	648	NA

Worker-Based Remedial Goal Options

Chemical	Slope Factor (mg/kg-day)-1	Reference Dose (mg/kg-day)	HI/FC Factor	EPC mg/kg	Hazard-Based Remedial Goal Options 3 mg/kg	1 mg/kg	0.1 mg/kg	Risk-Based Remedial Goal Options 1E-06 mg/kg	1E-05 mg/kg	1E-04 mg/kg	Background Concentration mg/kg
4,4'-DDD	0.24	NA	0.2	469.57	ND	ND	ND	45	452	4516	NA
4,4'-DDE	0.34	NA	0.2	1.82	ND	ND	ND	32	319	3188	NA
4,4'-DDT	0.34	0.0005	0.2	1790	5807	1936	194	32	319	3188	NA

NOTES:

EPC Exposure point concentration
NA Not applicable
ND Not determined
- Remedial goal options were based on the lifetime weighted average for carcinogens and the child resident or site worker for noncarcinogens

Table 10
Risk/Hazard Associated with Background Inorganics
NAVBASE - Charleston , Zone A
Charleston, South Carolina

		Residential				Industrial			
Parameter	Reference Conc. (mg/kg)	RGO @ HI = 1	RGO @ 1E-6	Background Hazard	Background Risk	RGO @ HI = 1	RGO @ 1E-6	Background Hazard	Background Risk
Aluminum	12800	72927	NA	1.8E-01	NA	NA	NA	NA	NA
Arsenic	9.44	21.9	0.38	4.3E-01	2.5E-05	435	2.71	2E-02	3.5E-06
Barium	53	5105	NA	1.0E-02	NA	101500	NA	5E-04	NA
Chromium	50.4	72927	NA	6.9E-04	NA	NA	NA	NA	NA
Cobalt	4.4	4376	NA	1.0E-03	NA	87000	NA	5E-05	NA
Copper	165	255245	NA	6.5E-04	NA	53782	NA	3E-03	NA
Manganese	98.1	3650	NA	2.7E-02	NA	67800	NA	1E-03	NA
Mercury	0.3	22	NA	1.4E-02	NA	435	NA	7E-04	NA
Nickel	13.55	1459	NA	9.3E-03	NA	28993	NA	5E-04	NA
Selenium	1.2	365	NA	3.3E-03	NA	7248	NA	2E-04	NA
Vanadium	29.24	510	NA	5.7E-02	NA	10148	NA	3E-03	NA
Zinc	207.6	21878	NA	9.5E-03	NA	434894	NA	5E-04	NA
Cumulative Background Hazard				0.74				0.031	
Cumulative Background Risk					2.5E-05				3.5E-06

Notes:
RGO - Remedial goal option
mg/kg - milligrams per kilogram
NA - Not applicable or not available

APPENDIX C

Oil/Water Separator List

	DESCRIPTION	PROGRAM DATA			SAMPLES REPRESENTIVE OF O/W SEPARATOR RELEASE	CHEMICAL OF CONCERN BASED ON SITE OPERATIONS					ANALYSIS PERFORMED									SAMPLING REQUIRED				
	Facility/IR site / (if applicable)	IR	Petroleum	No IR site		Solvents	Petroleum Products	Metals	Pesticides	PCB's	VOC's	SVOC's	Metals	Pesticides	PCB's	[illegible]	[illegible]	[illegible]	TPH	VOC's	SVOC's	Metals	Pesticides	PCB's
1	Facility NS 2/AOC 675	x	x		Y		x	x			x	x	x	x	x	x	x	x	x					
2	Facility NS 3/AOC 675	x	x		Y		x	x	x	x	x	x	x	x	x	x	x	x	x					
3	Facility NS 26/AOC 680	x	x		Y	x	x	x			x	x	x	x	x	x	x	x	x					
4	Facility 32/AOC 559,560		x		N		x	x																
5	Facility NS 44(AOC 675, 676)	x	x		Y		x	x			x	x	x	x	x	x	x	x	x					
6	Facility FBM 61(SWMU 17)	x	x		Y	x	x	x			x	x	x	x	x	x	x	x	x					
7	Facility 80 (AOC 564)	x	x		Y	x	x	x	x	x	x	x	x											
8	Facility 98 AND 148/AOC 626		x		Y		x	x								x	x	x	x					
9	Facility 123		x	x	Y		x	x			x	x	x	x	x	x	x	x	x					
10	Facility NS 200		x	x	N	x	x	x	x	x														
11	Facility 221/SWMU 65, AOC 544)	x	x		N	x	x	x	x	x														
12	Facility 226/SWMU23, AOC 540)	x	x		N	x	x	x																
13	Facility 240 (tank)		x	x	Y	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
14	Facility 241		x	x	INCOMPLETE	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
15	Facility 242 (tank)		x	x	Y	x	x	x																
16	Facility 246	A search of the drawing files and a walk around the building revealed no oil-water separator on site.																						
17	Facility 680/(AOC 613)				N	x	x	x																
18	Facility 681 (tank) wrong →	x	x	x	Y	x	x	x			x	x	x	x	x	x	x	x	x					
19	Facility 1024			x	N	x	x	x																
20	Facility 1303/SWMU 13	x			N	x	x	x	x	x														
21	Facility 1308/SWMU 13	x			Y	x	x	x	x	x	x	x	x	x	x									
22	Facility 1653/AOC 626	x			N		x	x																
23	Facility 1656/SWMU 37	x			Y	x	x	x			x	x	x	x	x									
24	Facility 2505/SWMU 161	x			Y		x	x			x	x	x	x	x									
25	Facility 3913/AOC 627	x			Y		x				x	x	x	x	x									
26	Facility 3926/AOC 626	x			Y		x				x	x	x	x	x									

27 Facility 236 - pipe shop / AOC 583 ?