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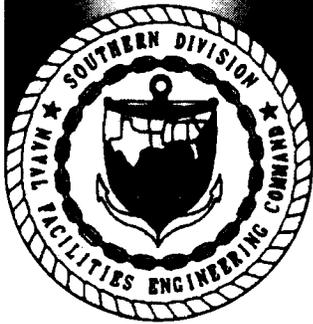
RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT
ADDENDUM AREA OF CONCERN 709 (AOC 709) ZONE F CNC CHARLESTON SC
8/16/2001
CH2M HILL

RFI REPORT ADDENDUM

Area of Concern 709(F), Zone F



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



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

CH2M-Jones

August 2001

Contract N62467-99-C-0960



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August 16, 2001

Mr. David Scaturo
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

Re: RFI Report Addendum (Revision 0) – AOC 709(F), Zone F

Dear Mr. Scaturo:

Enclosed please find four copies of the RFI Report Addendum (Revision 0) – AOC 709(F), Zone F of the Charleston Naval Complex (CNC). This report has been prepared pursuant to agreements by the CNC BRAC Cleanup Team for completing the RCRA Corrective Action process.

The principal author of this document is Jim Edens. Please contact him at 352/335-5877, extension 2491, if you have any questions or comments.

Sincerely,

CH2M HILL

Dean Williamson, P.E.

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

RFI REPORT ADDENDUM

Area of Concern 709(F), Zone F



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

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

PREPARED BY
CH2M-Jones

August 2001

*Revision 0
Contract N62467-99-C-0960
158814.ZF.PR.04*

Certification Page for RFI Report Addendum (Revision 0) – AOC 709 (F), Zone F

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.

8/14/2001
Date



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1 Acronyms and Abbreviations

2	AOC	area of concern
3	AST	aboveground storage tank
4	BCT	BRAC Cleanup Team
5	BRAC	Base Realignment and Closure Act
6	BRC	background reference concentration
7	CA	corrective action
8	CMS	corrective measures study
9	CNC	Charleston Naval Complex
10	COC	chemical of concern
11	COPC	chemical of potential concern
12	DAF	dilution attenuation factor
13	DQO	data quality objective
14	DRO	diesel range organics
15	EnSafe	Ensafe Inc.
16	EPA	U.S. Environmental Protection Agency
17	FDS	fuel distribution system
18	ft bls	feet below land surface
19	GRO	gasoline range organics
20	HBSA	Halls Brook Storage Area
21	HHRA	human health risk assessment
22	HI	hazard index
23	ILCR	incremental lifetime cancer risk
24	IM	interim measure
25	MCL	maximum contaminant level
26	µg/kg	microgram per kilogram
27	µg/L	microgram per liter
28	mg/kg	milligram per kilogram
29	NAVBASE	Naval Base
30	NFA	no further action

1	OP	organo-phosphorus
2	OWS	oil/water separator
3	PCB	polychlorinated biphenyl
4	ppb	part per billion
5	ppm	part per million
6	RBC	risk-based concentration
7	RCRA	Resource Conservation and Recovery Act
8	RFI	RCRA Facility Investigation
9	SCDHEC	South Carolina Department of Health and Environmental Control
10	SPLP	synthetic precipitation leaching procedure
11	SSL	soil screening level
12	SVOC	semivolatile organic compound
13	SWMU	solid waste management unit
14	TPH	total petroleum hydrocarbons
15	TSS	total suspended solids
16	UST	underground storage tank
17	VOC	volatile organic compound

1.0 Introduction

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

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

11 In April 2000, CH2M-Jones was awarded a contract to provide environmental investigation
12 and remediation services at the CNC. This submittal has been prepared by CH2M-Jones to
13 complete the RCRA Facility Investigation (RFI) for Area of Concern (AOC) 709(F) in Zone F
14 of the CNC. Figure 1-1 presents the location of AOC 709(F) within Zone F; Figure 1-2 is a
15 1997 aerial photograph of the site.

16 1.1 Background

17 AOC 709(F) was identified during the base-wide investigation of the Fuel Distribution
18 System (FDS) at the CNC. The investigation focused on identifying potential releases of
19 hydrocarbons from the system. AOC 709(F) was originally identified as Area 16 for the
20 purposes of the investigation. During the investigation, elevated concentrations of arsenic
21 and thallium were detected in the shallow groundwater above their respective screening
22 criteria (maximum contaminant levels [MCLs] and background concentrations). Arsenic
23 concentrations detected in monitoring well FFDSGW16B were of primary concern.

24 AOC 709(F) is located beneath a portion of Hobson Avenue. There are no known industrial
25 or waste disposal activities associated with the site. The source of arsenic in groundwater is
26 not known.

27 1.2 Purpose of the RFI Report Addendum

28 This RFI Report Addendum provides information about AOC 709(F) that documents the
29 conclusions from the *Zone F RFI Report, Revision 0* (EnSafe Inc. [EnSafe], 1997), provides the

1 results of some limited additional sampling performed after the RFI, and presents a
2 recommendation for No Further Action (NFA) under the RCRA CA program. Should
3 SCDHEC determine that further evaluation of this site is warranted, the additional
4 evaluation should be completed under the underground storage tank (UST) program.

5 **1.3 Report Organization**

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

8 **1.0 Introduction** — Presents the purpose of and background information relating to the RFI
9 Report Addendum.

10 **2.0 Summary of RFI Conclusions for AOC 709(F)** — Summarizes the conclusions from the
11 RFI investigations and risk evaluations for AOC 709(F).

12 **3.0 Interim Measures and UST/AST Removals**— Summarizes any interim measures (IMs)
13 or UST/aboveground storage tank (AST) removals conducted at the site.

14 **4.0 Summary of Additional Investigations** — Summarizes information collected after
15 completion of the *Zone F RFI Report, Revision 0*.

16 **5.0 COPC/COC Refinement** — Provides further evaluation of chemicals of potential
17 concern (COPCs) based on RFI and additional data to assess them as chemicals of concern
18 (COCs).

19 **6.0 Site Closeout Issues** — Summarizes the site closeout issues.

20 **7.0 Recommendations** — Provides recommendations for AOC709(F).

21 **8.0 References** — Lists the references used in this document.

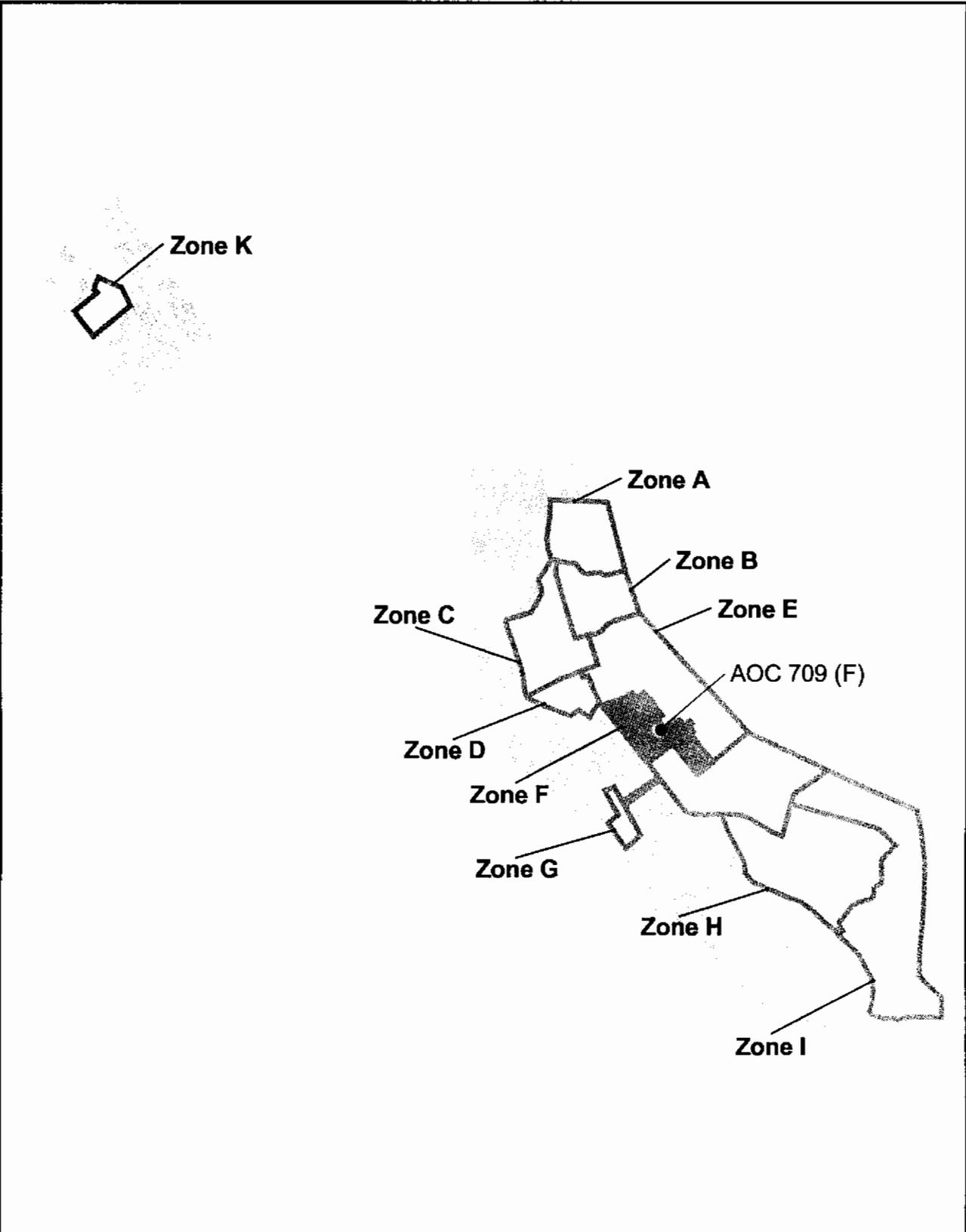
22 **Appendix A** contains excerpts from the *Zone F RFI Report, Revision 0*.

23 **Appendix B** contains analytical data from sampling subsequent to the RFI report.

24 **Appendix C** contains validation reports for the data from sampling subsequent to the RFI
25 report.

26 **Appendix D** contains responses to SCDHEC comments regarding the AOC 709(F) portions
27 of the *Zone F RFI Report, Revision 0*.

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



 Zone Boundary
 Zone F
 Surrounding Area

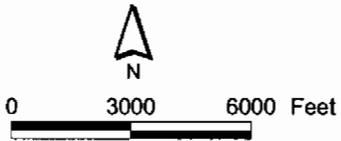
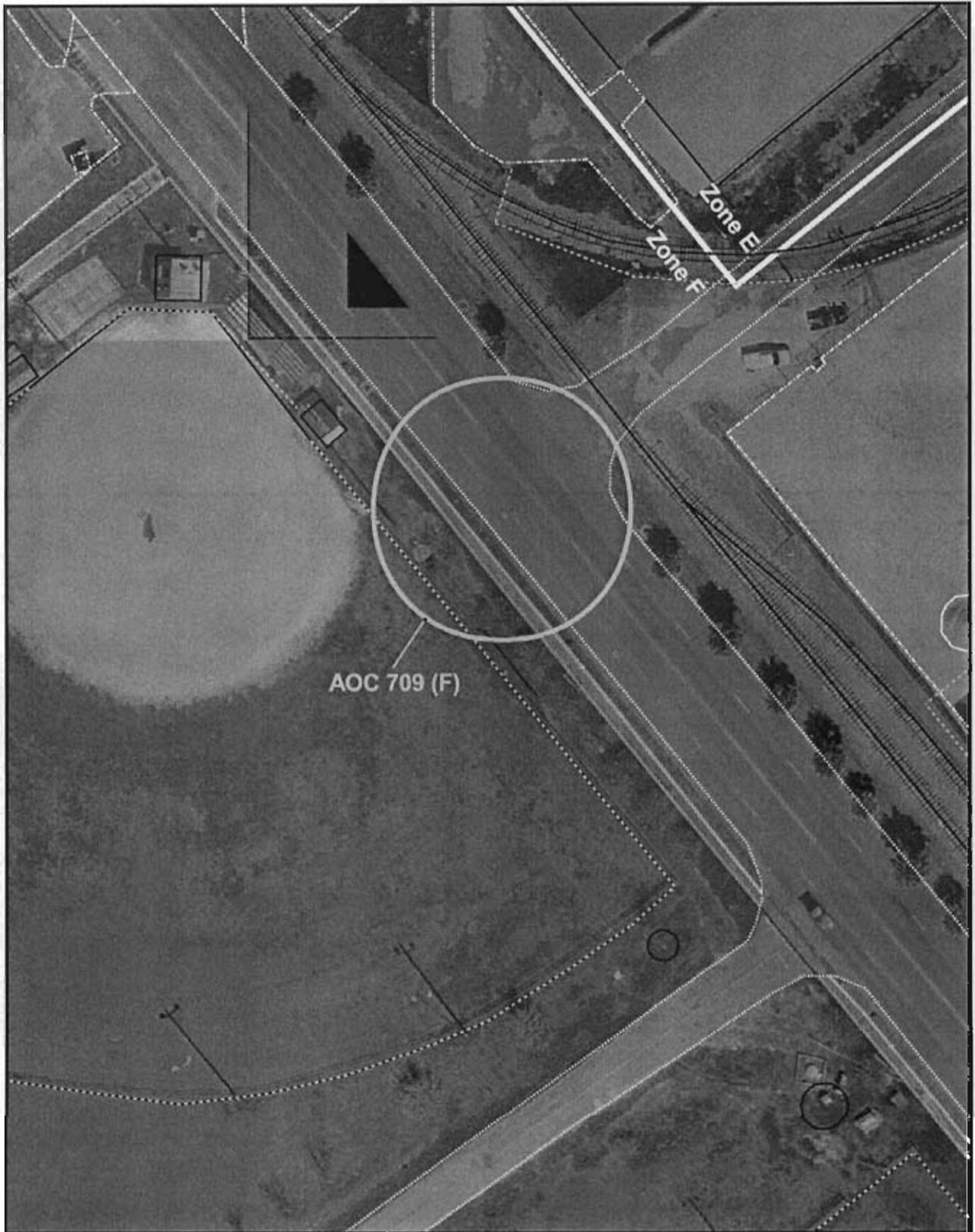


Figure 1-1
 AOC 709 (F)
 Zone F
 Charleston Naval Complex

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- Fence
- Railroads
- Roads
- Pavement
- Sidewalk
- Buildings

Zone Boundary

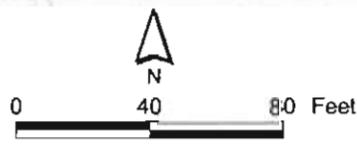


Figure 1-2
 Aerial Photograph of AOC 709 (F)
 Zone F
 Charleston Naval Complex

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Section 2.0

2.0 Summary of RFI Conclusions for AOC 709(F)

2.1 FDS Investigation

Area 16 of the FDS investigation included collection of two subsurface soil samples (FFDSSC09701 and FFDSSC09702) and the installation of three monitoring wells (FFDSGW16A, FFDSGW16B, and FFDSGW16C). Figure 2-1 presents the locations of the samples collected at Area 16. Analytical data from monitoring well FFDSGW16B identified the presence of elevated levels of arsenic in groundwater above its MCL (50 micrograms per liter [$\mu\text{g}/\text{L}$]). As a result, the NAVBASE Project Team decided to evaluate this area in the RFI process. During the RFI the area was designated as AOC 709(F). Discussion of the analytical results for the samples collected at Area 16 was deferred to the *Zone F RFI Report, Revision 0* (EnSafe, 1997).

2.2 RFI Investigation

2.2.1 Surface Soil

Since the fuel distribution pipeline is buried under the surface, no surface soil samples were collected as part of the FDS or initial RFI investigations. No potential COPCs in surface soil were identified in AOC 709(F) surface soil.

2.2.2 Subsurface Soil

As part of the Zone F RFI, subsurface soil investigations were conducted at AOC 709(F) (Area 16) to determine if the presence of the fuel line may have impacted site soil. The depths of the soil samples were intended to coincide with the burial depth of the pipeline. In October 1996, two samples were collected at soil boring location FFDSSC097 (see Figure 2-1). Sample FFDSSC09701 was collected at 7 to 9 feet below land surface (ft bls). Sample FFDSSC09702 was collected at 9 to 11 ft bls. Based on the information regarding water table elevations, these samples were likely collected from the saturated portion of the aquifer. Typically, soil samples are not collected from the saturated zone. However, because of the depth of the buried pipeline, soil samples collected in the saturated zone adjacent to the pipeline were considered to be most representative of soil adjacent to the pipeline. An odor of fuel oil was noted in soil samples during sample collection.

1 The samples were analyzed for total petroleum hydrocarbons (TPH), including diesel range
2 organics (DRO) and gasoline range organics (GRO). GRO was detected in sample
3 FDSSC09702 at a concentration of 0.087 milligrams per kilogram (mg/kg). No other
4 petroleum hydrocarbons were detected in samples FDSSC09701 and FDSSC09702.

5 In December 1996, another subsurface soil sample was collected to identify the individual
6 constituents responsible for the petroleum odor. This sample was collected at the same
7 location as boring FDSSC097 (8 to 10 ft bls), and was identified as FDSSC09701 (the same as
8 the previous 7 to 9 ft bls sample identification [ID]). Sample FDSSC09701 was analyzed for
9 metals, cyanide, pesticides/polychlorinated biphenyls (PCBs), semivolatile organic
10 compounds (SVOCs), and volatile organic compounds (VOCs) at data quality objective
11 (DQO) level III.

12 A duplicate sample (FDSCC09701) was also collected. This sample was analyzed for metals,
13 hexa-chrome, cyanide, dioxins, pesticides (including organo-phosphorus [OP]-
14 pesticides)/PCBs, herbicides, SVOCs, and VOCs at DQO level IV.

15 The *Zone F RFI Report, Revision 0* (EnSafe, 1997) presented the results of these soil samples
16 and conclusions concerning contamination and risk. Appendix A of this RFI Report
17 Addendum contains excerpts from the *Zone F RFI Report, Revision 0*. Conclusions from the
18 RFI are summarized below:

- 19 • The nature of contamination section (10.10.3.1) concluded that no organics or inorganics
20 were detected above their respective background reference concentrations (BRCs) or soil
21 screening levels (SSLs), dilution attenuation factor (DAF)=20. Therefore, no COPCs
22 were identified in subsurface soil at AOC 709(F). Page 10.10.15 summarizes the RFI
23 findings, and is included as Appendix A-1 to this report addendum.
- 24 • The fate and transport section (10.10.5) concluded that no constituents were detected in
25 site soil above applicable SSLs (DAF=20). Thus, the soil-to-groundwater pathway was
26 considered invalid. Section 10.10.5.3 of the RFI report is a summary of the fate and
27 transport section. It is included as Appendix A-2.

28 No COPCs were identified for subsurface soil at AOC 709(F).

29 **2.3 Groundwater**

30 As part of the RFI, three groundwater monitoring wells (FFDSGW16A, FFDSGW16B, and
31 FFDSGW16C) were sampled four times each as part of the RFI. The first through fourth

1 sampling events were conducted in January 1997, June 1997, April 1998, and October 1998,
2 respectively. The locations of the monitoring wells are presented in Figure 2-1.

3 The *Zone F RFI Report, Revision 0* presented the analytical results from these groundwater
4 samples and conclusions concerning contamination and risk. Appendix A to this RFI Report
5 Addendum contains excerpts from the RFI report. Conclusions from the RFI are
6 summarized below:

- 7 • The nature of contamination in groundwater section (10.10.4.1, included as Appendix
8 A-3) concluded that one organic compound (heptachlor) was detected above its risk-
9 based concentration (RBC) of 0.0023 µg/L (hazard index [HI]=0.1). Heptachlor was
10 detected in only the first sampling event at a concentration of 0.049 µg/L in monitoring
11 well FFDSGW16A. It was not detected above its MCL (0.4 µg/L). No other detections of
12 this parameter occurred in other wells or groundwater samples.
- 13 • Arsenic and thallium were the only inorganic compounds detected at concentrations
14 above both their respective RBCs and BRCs. Arsenic has been consistently detected
15 above its RBC (0.045 µg/L [HI=1]) and BRC (16.7 µg/L) in monitoring well
16 FFDSGW16B. It was also detected above its BRC in monitoring well FFDSGW16C
17 during the third and fourth sampling events. With the exception of the first sampling
18 event, all samples collected and analyzed for arsenic from monitoring well FFDSGW16B
19 were reported at concentrations above the MCL (50 µg/L) for arsenic. No samples from
20 FFDSGW16A or FFDSGW16C reported arsenic concentrations above the MCL. Thallium
21 was detected above its RBC (0.26 µg/L [HI=0.1]) and BRC (2.0 µg/L) in two of three
22 samples collected during the first sampling event. It was detected in samples collected
23 from monitoring wells FFDSGW16B (6.4 µg/L) and FFDSGW16C (4.6 µg/L). These
24 samples were also above the MCL (2 µg/L) for thallium. Thallium was not detected in
25 any of the three subsequent sampling events.
- 26 • Antimony concentrations also exceeded the RBC (1.5 µg/L [HI=0.1]), however no
27 background concentration was determined for antimony in Zone F. Antimony did not
28 exceed its MCL (6 µg/L) in any sample.
- 29 • The fate and transport section (10.10.5) reported that heptachlor, arsenic, and thallium
30 were detected in site groundwater above their respective RBCs. Section 10.10.5.3 of the
31 RFI report is a summary of the fate and transport section, and is included as Appendix
32 A-2.

- 1 • The human health risk assessment (HHRA) section (10.10.6) identified antimony,
2 arsenic, heptachlor, and thallium as COCs on the basis of site groundwater being used
3 as a drinking water source. Arsenic and thallium were identified as COCs, assuming
4 consumption of shallow groundwater by industrial site workers. Table 10.10.16 of the
5 RFI report summarizes the results of the HHRA. It is included as Appendix A-4.
- 6 The RFI report recommended a Corrective Measures Study (CMS) for shallow groundwater
7 at AOC 709(F) for antimony, arsenic, heptachlor, and thallium. These constituents are
8 discussed further in Section 4.0 of this RFI Report Addendum.

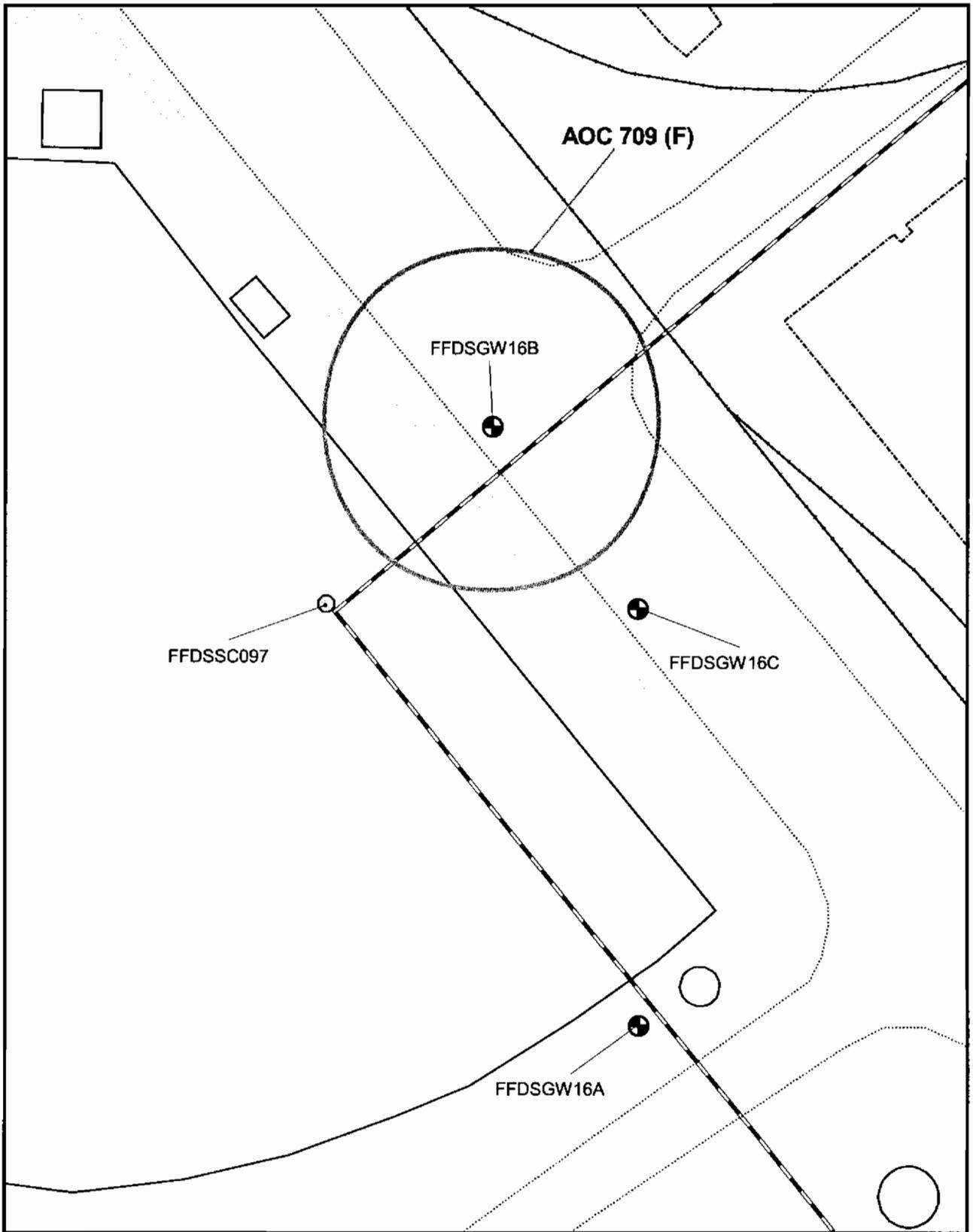


Figure 2-1
 Monitor Well Locations
 AOC 709 (F), Zone F
 Charleston Naval Complex

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Section 3.0

1 **3.0 Interim Measures and UST/AST Removals**

- 2 No IMs have been conducted at AOC 709(F). Additionally, no USTs or ASTs have been
3 removed or identified at AOC 709(F).

4.0 Summary of Additional Investigations

During the latter part of 1999, additional field activities were conducted by EnSafe subsequent to the original RFI. Additional soil samples (surface and subsurface) were collected to determine synthetic precipitation leaching procedure (SPLP) leach ratios for organic and inorganic constituents at AOC 709(F), although no COPCs were identified in site soil. From these results, site-specific SSL values could be calculated. No additional field activities were conducted for contamination delineation purposes as the RFI did not identify excessive contamination in site soil.

One additional groundwater sample (and a duplicate) was collected from FFDSGW16B subsequent to the RFI. The samples were analyzed for antimony, arsenic, beryllium, total chromium, lead, mercury, thallium, and total suspended solids (TSS). The groundwater samples were collected in January 1999.

The data from the additional investigations are summarized in this section. Analytical data and SPLP results are provided in Appendix B of this RFI Report Addendum. Data validation summary reports are provided in Appendix C.

4.1 Soil

Two surface (0 to 1 ft bls) soil samples (FDSSC097T1 and FDSSC097S1) and two additional subsurface (3 to 5 ft bls) soil samples (FDSSC097T2 and FDSSC097S2) were collected by EnSafe. The sample IDs that include a "T" were analyzed for metals, PCBs, pesticides, SVOCs, VOCs, and cyanide. The sample IDs that include an "S" were analyzed for SPLP characteristics for the constituents listed above. These four samples were collected at the same location as the previously collected RFI sample FFDSSC097. The sample location is shown in Figure 2-1.

Soil samples were compared to the appropriate screening criteria (RBCs or SSLs [DAF=1 for VOCs and DAF=10 for other constituents], and Zone F BRCs). Tables 4-1 and 4-2 present summary results of the analyses from these additional investigations for surface and subsurface soil, respectively. These tables show all detections and compare them to the appropriate screening criteria. Concentrations that exceeded the screening criteria are in bold text and outlined within the tables.

1 **4.1.1 Surface Soil**

2 No VOCs were detected in the surface soil sample (FDSSC097T1) collected after the RFI.
3 One SVOC (fluoranthene, 98 J micrograms per kilogram [$\mu\text{g}/\text{kg}$]) was detected in the
4 sample, but it was reported at a concentration below its RBC ($3.1 \text{ E}+5 \mu\text{g}/\text{kg}$, $\text{HI}=0.1$) and
5 SSL ($2,150 \mu\text{g}/\text{kg}$, $\text{DAF}=10$). One PCB (Aroclor-1260, $590 \mu\text{g}/\text{kg}$) was detected in the surface
6 soil sample. The reported concentration was above its RBC ($320 \mu\text{g}/\text{kg}$), but it did not
7 exceed the PCB action level for residential land use of $1 \text{ mg}/\text{kg}$ ($1,000 \mu\text{g}/\text{kg}$) (see
8 *Requirements for PCB Spill Cleanup*, 40 CFR 761.125 [c][4][v]). No inorganic constituents were
9 reported in surface soil sample FDSSC097T1 at concentrations that exceeded both their
10 respective RBCs and BRCs. No constituents detected in surface soil were reported at
11 concentrations above their respective SSLs.

12 **4.1.2 Subsurface Soil**

13 No VOCs were detected in the subsurface soil sample (FDSSC097T2) above their respective
14 SSLs. Benzene was detected at a concentration ($2.0 \text{ J } \mu\text{g}/\text{kg}$) equal to its SSL ($2.0 \mu\text{g}/\text{kg}$,
15 $\text{DAF}=1$).

16 Two SVOCs were detected at concentrations that exceeded their respective screening
17 criteria. Benzo(a)anthracene ($2,700 \text{ J } \mu\text{g}/\text{kg}$) was detected above its SSL of $1,000 \mu\text{g}/\text{kg}$
18 ($\text{DAF}=10$) in the subsurface soil (3 to 5 ft bls) sample (FDSSC097T2) collected at AOC 709(F).
19 The reported concentration is estimated and near the detection limit, as indicated by the "J"
20 qualifier. 2-methylnaphthalene ($21,000 \mu\text{g}/\text{kg}$) was also reported at a concentration that
21 exceeded its SSL of $11,000 \mu\text{g}/\text{kg}$ ($\text{DAF}=10$). A petroleum odor was observed and recorded
22 in the field notes during collection of the subsurface samples.

23 **4.2 Groundwater**

24 An additional set of groundwater samples was collected at AOC 709(F) following the RFI.
25 The additional sampling was conducted in January 1999 and included only one
26 (FDSGW16B) of the three monitoring wells. Two samples (FDSGW16BF3 and
27 FDSGW16BU3) were collected from monitoring well FDSGW16B. The samples were
28 analyzed for select metals (antimony, arsenic, beryllium, chromium, lead, mercury, and
29 thallium), and sample FDSGW16BF3 was also tested for TSS.

30 Groundwater analytical results were compared to the appropriate screening criteria (MCLs
31 and Zone F BRCs). U.S. Environmental Protection Agency (EPA) Region III RBCs were used
32 in place of the MCLs where no MCLs were available. Table 4-3 presents a summary of the
33 analytical results for groundwater samples collected at AOC 709(F) after completion of the

1 RFI. Values that exceeded the screening criteria are in bold text and outlined within the
2 table. Only arsenic exceeded its applicable screening criteria.

3 Arsenic was detected above its MCL (50 µg/L) in both samples (FDSGW16BF3 and
4 FDSGW16BU3) collected from monitoring well FDSGW16B. It was detected at
5 concentrations of 214 µg/L and 204 µg/L, respectively. None of the other inorganic analytes
6 were detected in these samples above their respective screening criteria.

7 **4.3 Summary**

8 Based on the comparison of the analytical data collected after the RFI to the appropriate
9 screening criteria, no COPCs are present in surface soil at AOC 709(F). Benzo(a)anthracene
10 and 2-methylnaphthalene were identified as COPCs in subsurface soil at AOC 709(F).

11 Data for groundwater samples collected after the RFI identified arsenic as the only
12 constituent that exceeded its screening criteria. These constituents are discussed further in
13 Section 5.0 of this RFI Report Addendum.

TABLE 4-1
 Analytes Detected in Surface Soil Sample FDSSC097T1
 RFI Report Addendum, AOC 709(F), Zone F, Charleston Naval Complex

Parameter	Concentration	Qualifier	EPA Region III RBC (HI=0.1)*	SSL (DAF=10)	Surface Soil BRC
SVOCs (µg/kg)					
Fluoranthene	98	J	310,000	2,150	NA
PCBs (µg/kg)					
PCB-1260 (Aroclor 1260) °	590	=	320	1,000	NA
Pesticides (µg/kg)					
p,p'-DDE	9.6	=	1,900	27	NA
Metals (mg/kg)					
Aluminum	9,580	=	39,000	555,000	18,500
Antimony	1.6	J	15.5	2.5	0.79
Arsenic °	6.5	=	0.43	14.5	19.9
Barium	20.3	=	550	800	61.5
Beryllium	0.17	J	16	31.5	1.05
Calcium	35,300	J		Essential Nutrient	
Chromium, Total	19.4	J	23	19	34.8
Cobalt	2.2	J	470	NA	15.1
Copper	18.6	J	310	5,500	48.2
Iron	9,510	J		Essential Nutrient	
Lead	65.5	J	400	400	180
Magnesium	3,720	J		Essential Nutrient	
Manganese	111	J	160	475	307
Mercury	0.11	=	2.3	1.0	0.62
Nickel	5.1	J	160	65	12.6
Potassium	745	J		Essential Nutrient	
Selenium	0.99	=	39	2.5	1.15
Sodium	217	J		Essential Nutrient	
Vanadium	20.9	=	55	3,000	48.9
Zinc	71.6	J	2,300	6,000	198

Concentrations in bolded and outlined text exceeded the BRC and RBC.

TABLE 4-1
 Analytes Detected in Surface Soil Sample FDSSC097T1
RFI Report Addendum, AOC 709(F), Zone F, Charleston Naval Complex

Parameter	Concentration	Qualifier	EPA Region III RBC (HI=0.1)*	SSL (DAF=10)	Surface Soil BRC
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SSLs are from the *EPA Soil Screening Guidance: Technical Background Document* (May 1996) unless indicated otherwise, and adjusted to a DAF of 10.

Aluminum SSL is the site-specific SSL presented in the *Zone F RFI Report, Revision 0* (EnSafe, 1997) adjusted to a DAF of 10.

Copper SSL is from the EPA Region III RBC Table (April 13, 2000) and adjusted to a DAF of 10.

Lead SSL is the screening level established by the *EPA Soil Screening Guidance: Technical Background Document*.

RBC for chromium is based on Cr+6.

RBC for lead is based on *EPA Soil Screening Guidance: Technical Background Document*.

RBC for mercury is based on mercuric chloride.

* HI for non-carcinogenic compounds was reduced by one order of magnitude for screening purposes

= Analyte was detected and the reported value is equal to the concentration

° RBC was calculated based on a carcinogenic endpoint

J Analyte was detected and the concentration is an estimated value

NA Not available/not applicable

TABLE 4-2
 Analytes Detected in Subsurface Soil Sample FDSSC097T2
 RFI Report Addendum, AOC 709(F), Zone F, Charleston Naval Complex

Parameter	Concentration	Qualifier	SSL (DAF=10 [1 for VOCs])	Subsurface Soil BRC
VOCs (µg/kg)				
Benzene	2.0	J	2.0	NA
Carbon Disulfide	6.0	=	2,000	NA
Ethylbenzene	8.0	=	700	NA
Xylenes, Total	47.0	=	14,500	NA
SVOCs (µg/kg)				
2-Methylnaphthalene	21,000	=	11,000	NA
Acenaphthene	4,600	=	285,000	NA
Anthracene	3,600	=	6,000,000	NA
Benzo(a)anthracene	2,700	J	1,000	NA
Benzo(a)pyrene	1,200	J	4,000	NA
Benzo(b)fluoranthene	1,500	J	2,500	NA
Benzo(g,h,i)perylene	740	J	232,803,000	NA
Benzo(k)fluoranthene	710	J	24,500	NA
Chrysene	2,900	J	80,000	NA
Dibenzofuran	2,100	=	3,850	NA
Fluoranthene	4,800	=	2,150,000	NA
Fluorene	5,200	=	280,000	NA
Indeno(1,2,3-c,d)pyrene	570	J	7,000	NA
Naphthalene	2,100	=	42,000	NA
Phenanthrene	17,000	=	690,500	NA
Pyrene	7,300	J	2,100,000	NA
Pesticides (µg/kg)				
Gamma-Chlordane	8.6	=	5,000	NA
p,p'-DDD	15	=	8,000	NA
p,p'-DDE	40	J	27,000	NA
Metals (mg/kg)				
Aluminum	15,600	=	555,000	17,100
Antimony	1.3	J	2.5	ND
Arsenic	10.8	=	14.5	18.2
Barium	54.5	=	800	51.8
Beryllium	0.63	=	31.5	1.2
Calcium	6,110	J	Essential Nutrient	
Chromium, Total	24.3	J	19	32.2
Cobalt	4.3	J	NA	6.85

TABLE 4-2
 Analytes Detected in Subsurface Soil Sample FDSSC097T2
RFI Report Addendum, AOC 709(F), Zone F, Charleston Naval Complex

Parameter	Concentration	Qualifier	SSL (DAF=10 [1 for VOCs])	Subsurface Soil BRC
Copper	51.3	J	5,500	30.4
Iron	15,100	J	Essential Nutrient	
Lead	165	J	400	51.7
Magnesium	2,100	J	Essential Nutrient	
Manganese	117	J	475	469
Mercury	0.34	=	1	0.23
Nickel	10.5	J	65	8.85
Potassium	1,280	J	Essential Nutrient	
Selenium	1.8	=	2.5	1.24
Sodium	964	=	Essential Nutrient	
Vanadium	45.9	=	3,000	49.4
Zinc	186	J	6,000	84.2

Concentrations in bolded and outlined text exceeded the SSL and BRC.

SSLs are from the *EPA Soil Screening Guidance: Technical Background Document* (May 1996) unless otherwise indicated, and adjusted to a DAF of 10.

Lead SSL is the screening level established by the *EPA Soil Screening Guidance: Technical Background Document*.

SSLs for aluminum, benzo(g,h,i)perylene, and phenanthrene are the site-specific SSLs presented in the *Zone F RFI Report, Revision 0* (EnSafe, 1997) adjusted to a DAF of 10.

SSL for total xylenes is the sum of the individual SSLs for m-xylene, o-xylene, and p-xylene.

SSLs for 2-methylnaphthalene, dibenzofuran, copper, and manganese are from the EPA Region III RBC Table (April 13,2000) and adjusted to a DAF of 10.

SSL for chlordane was used as a surrogate for gamma-chlordane.

- = Analyte was detected and the reported value is equal to the concentration
- J Analyte was detected and the concentration is an estimated value
- NA Not available/not applicable
- ND Not detected

TABLE 4-3
 Analytes Detected in Groundwater
 RFI Report Addendum, AOC 709(F), Zone F, Charleston Naval Complex

Parameter	Location	Sample ID	Concentration (µg/L)	Qualifier	MCL	BRC
Metals						
Antimony	FFDSGW16B	FDSGW16BF3	2.7	U	6	NC
Arsenic			214	=	50	16.7
Beryllium			0.1	U	4	0.66
Chromium, Total			0.7	U	100	2.05
Lead			1.5	U	15	NC
Mercury			0.1	U	2	NC
Thallium			3.1	U	2	5.58
General Chemistry						
Total Suspended Solids (TSS)	FFDSGW16B	FDSGW16BF3	92	=	NA	NA
Metals						
Antimony	FFDSGW16B	FDSGW16BU3	2.7	U	6	NC
Arsenic			204	=	50	16.7
Beryllium			0.1	U	4	0.66
Chromium, Total			0.7	U	100	2.05
Lead			1.5	U	15	NC
Mercury			0.1	U	2	NC
Thallium			3.1	U	2	5.58

Concentrations in bolded and outlined text exceeded the MCL and BRC.

- * MCL was not available, value provided is the EPA Region III RBC
- = Analyte was detected, the reported concentration is the actual analytical concentration
- J Analyte was detected, the reported concentration is an estimated concentration
- NA Analyte was not analyzed for, or the information is not applicable
- NC BRC was not calculated due to a large number of "non-detects"
- U Analyte was not detected, the reported concentration is the detection limit

1 **5.0 COPC/COC Refinement**

2 This section provides an evaluation of the data collected at AOC 709(F) for constituents that
3 exceeded applicable screening criteria, in order to determine whether these parameters
4 should be considered COCs.

5 **5.1 Soil**

6 **5.1.1 Surface Soil**

7 COCs were not identified in site soil during the RFI. Evaluation of the surface soil samples
8 collected subsequent to the RFI did not identify any constituents that required further
9 evaluation. Two organic analytes, fluoroanthene and Aroclor-1260, were detected in site
10 surface soil. However, these analytes do not require further evaluation based on the
11 rationale provided in Section 4.0 of this report addendum (i.e., the results are below the
12 applicable screening criteria). No inorganic constituents were detected at concentrations
13 that exceeded their respective screening criteria in surface soil. Based on these data, no
14 COCs are identified in surface soil; therefore, surface soil at AOC 709(F) does not warrant
15 further investigation.

16 **5.1.2 Subsurface Soil**

17 One VOC, benzene (2 J µg/kg), was detected at a concentration equal to its SSL (2.0 µg/kg,
18 DAF=1) in subsurface soil sample FDSSC097T2. A SPLP sample (FDSSC097S2) was also
19 collected at this location. The SPLP samples were collected to determine leach ratios for site-
20 specific SSL calculations. The analytical results for the SPLP samples are included in
21 Appendix B of this report addendum. Benzene was not detected in the SPLP sample,
22 indicating that the existing concentration of this constituent does not represent a risk to site
23 groundwater. Additionally, no VOCs were detected in any groundwater sample collected at
24 AOC 709(F) that was analyzed for VOCs, further indicating that existing concentrations of
25 VOCs are protective of site groundwater.

26 Two SVOCs were detected above their respective SSLs in subsurface soil sample
27 FDSSC097T2. Benzo(a)anthracene (2,700 J µg/kg) was detected above its SSL (1,000 µg/kg,
28 DAF=10) in the subsurface soil sample (FDSSC097T2) collected at AOC 709(F). The detected
29 concentration of this constituent is estimated and near the detection limit, as indicated by
30 the "J" qualifier. The SPLP results for this sample (FDSSC097S2) did not indicate detectable

1 levels of benzo(a)anthracene in the leachate. Based on this information, the existing
2 concentration of benzo(a)anthracene does not represent a significant threat to surficial
3 groundwater at AOC 709(F). 2-methylnaphthalene was also detected in sample
4 FDSSC097T2 at 21,000 µg/kg. It was also detected in the leachate of the SPLP sample
5 (FDSSC097S2). 2-methylnaphthalene was detected at a concentration of 18 µg/L in the
6 leachate, which is below its RBC of 120 µg/L. Because these constituents were not detected
7 in the leachate of the SPLP sample above their respective RBCs, they are not considered to
8 be a threat to site groundwater. Additionally, no SVOCs were detected in any groundwater
9 samples at this site, further confirming that groundwater has not been impacted by the FDS.
10 Based on this information, subsurface soil does not warrant further evaluation.

11 **5.2 Groundwater**

12 The following groundwater COCs were identified in the *Zone F RFI Report, Revision 0*
13 (EnSafe, 1997):

- 14 • antimony
- 15 • arsenic
- 16 • thallium
- 17 • heptachlor

18 Evaluation of the data from samples collected after the RFI did not result in additional
19 COPCs being identified in groundwater. Each of these constituents is discussed below. Data
20 for these constituents and selected additional constituents are presented in Table 5-1.

21 **5.2.1 Antimony**

22 The RFI report identified antimony as a COC based on its contribution to the cumulative
23 residential HI. It was detected above its RBC (1.5 µg/L) in three out of 12 samples. A
24 background concentration for antimony was not determined due to a low frequency of
25 detection in background (grid-based) samples. Table 5-1 illustrates that antimony was not
26 detected in any of the 10 samples collected and analyzed for antimony in the four
27 subsequent sampling efforts, nor was it detected above its MCL (6 µg/L) in any sample
28 collected at AOC 709(F). Based on these data, antimony in groundwater does not warrant
29 further investigation.

30 **5.2.2 Thallium**

31 Thallium was identified as a COC in the RFI report based on its contribution to the
32 cumulative residential HI. Review of the RFI data by CH2M-Jones found that thallium was

1 detected above its RBC (0.26 µg/L) and MCL (2 µg/L) in two of three monitoring wells
2 (FDSGW16B, 6.4 J µg/L and FDSGW16C, 4.6 J µg/L) sampled in January 1997. It was not
3 detected in monitoring well FDSGW16A. The detected concentrations are estimated and
4 near the detection limit, as indicated by the "J" qualifier. Thallium was not detected in any
5 of the three subsequent sampling events in any monitoring well at AOC 709(F). Nor was
6 thallium detected in the sample, or duplicate, collected from FDSGW16B after completion of
7 the RFI. These data support the conclusion that thallium is not a COC; therefore, further
8 investigation of thallium in groundwater is not warranted.

9 **5.2.3 Heptachlor**

10 Heptachlor was identified as a COC in the RFI based on its contribution to the cumulative
11 residential incremental lifetime cancer risk (ILCR). It was detected in one of two samples
12 collected during the first groundwater sampling event conducted as part of the RFI. It was
13 detected at a concentration of 0.049 µg/L, which is above its RBC of 0.0023 µg/L, but below
14 its MCL of 0.4 µg/L. It was not detected in any of the three samples collected during the
15 second sampling event conducted at AOC 709(F). Based on these data, the single detection
16 of heptachlor below its MCL in groundwater does not warrant further investigation.

17 **5.2.4 Arsenic**

18 Arsenic was identified as a COC in the RFI based on its contribution to both the cumulative
19 residential ICLR and HI. It presented multiple exceedances of the screening criteria (EPA
20 Region III RBCs and background concentrations). Arsenic was detected in all 12 samples
21 that were collected as part of the RFI. Four samples collected from monitoring well
22 FFDSGW16B reported arsenic concentrations above the MCL (50 µg/L).

23 The RFI report suggested that the elevated concentrations may be a result of the application
24 of arsenic-containing pesticides in the nearby grassy area, although no direct evidence of
25 any such application of pesticides was provided in the report. It is also possible that the
26 detected concentrations of arsenic are the result of natural processes or other factors (i.e., the
27 presence of suspended solids in the samples).

28 **Brief Overview of Arsenic Behavior in Groundwater/Soil Systems**

29 This section provides a brief overview of the behavior of arsenic in groundwater/soil
30 systems, as well as factors that influence its solubility and mobility in groundwater. This
31 information will support the possibility that the elevated arsenic concentrations detected at
32 well FFDSGW16B are of natural geochemical origin.

1 The behavior of arsenic in ecological, soil/groundwater, and sediment systems has been the
2 subject of extensive research. A complete discussion of this topic is beyond the scope of this
3 report; however, the reader may wish to consult various references that present a thorough
4 discourse on this topic. One reference that summarizes much of the research that has been
5 performed is *Arsenic in the Environment, Part I: Cycling and Characterization* (Nriagu et al.,
6 1994). This publication covers a wide variety of topics related to the behavior of arsenic in
7 the environment, including sources of arsenic and its historical uses, natural arsenic levels
8 in soils throughout the world, arsenic adsorption in soils, oxidation-reduction reactions,
9 mobility and biotransformation in sediments, and many other topics. Some of the key issues
10 regarding the behavior of arsenic in soil/groundwater systems presented by Nriagu et al.
11 (1994) that are relevant to the discussions about arsenic in groundwater at the CNC site are
12 summarized below.

13 **Arsenic Oxidation States and Oxyanion Formation.** Arsenic is commonly found in the
14 environment in the pentavalent (+5) valence state as arsenic acid, but may also occur in the
15 trivalent state (+3). In the +5 valence state, it forms the oxyanion arsenate (AsO_4^{3-}), as well
16 as associated acid forms (HAsO_4^{2-} , $\text{H}_2\text{AsO}_4^{-}$, H_3AsO_4), depending on the specific pH of the
17 system. In the more reduced +3 valence, it forms the oxyanion arsenite (AsO_3^{3-}), as well as
18 various forms of arsenious acid. In non-reducing soil and aqueous environments, arsenic is
19 most commonly present in the arsenate form.

20 **Factors That Affect Arsenic Mobility and Dissolved Phase Concentrations.** Soluble arsenic
21 concentrations are usually controlled by redox conditions, pH, biological activity, and
22 adsorption reactions, but not by solubility equilibria. In both soil and water systems, arsenic
23 species are both chemically and microbiologically subject to oxidation and reduction. These
24 processes greatly influence the levels of dissolved phase arsenic and its mobility in
25 groundwater.

26 Under reducing conditions, arsenate may be reduced to arsenite by geochemical or
27 biological activity. The reduction of arsenate to arsenite, with a corresponding increase in
28 dissolved levels of arsenic and an increase in the mobility of arsenic in soil/groundwater
29 systems, has been well documented in various research efforts. Arsenite is not only more
30 mobile in groundwater systems, it also possesses greater toxicity than arsenate.

31 **Impact of Microbiological Activity on Dissolved Arsenic Concentrations.** Microbial populations
32 can exert substantial influence over dissolved arsenic concentrations. The contribution of
33 dissolved arsenic by anaerobic bacteria was reported in the article *Microbial Mobilization of*
34 *Arsenic from Sediments of the Aberjona Watershed* (Ahmann et al., 1997). Several bacteria are

1 known to reduce arsenate (As[V]) to arsenite (As[III]). Among the microbial populations
2 that reduce arsenic are sulfate-reducing and iron-reducing bacteria, both of which are
3 ubiquitous in anoxic environments.

4 Microcosm studies were conducted to determine the biotic contribution to dissolved arsenic
5 mobilization in the Halls Brook Storage Area (HBSA), a reservoir near the headwaters of the
6 Aberjona Watershed (Ahmann et al., 1997). The sediments of the HBSA have a high arsenic
7 content (6000 ± 5000 parts per million [ppm]) from past industrial activities. Dissolved
8 phase arsenic, primarily As(III), was reported to be as high as 3.3 micro-moles (μM) ($266 \pm$
9 65 parts per billion [ppb]). Microbial processes were found to have made a substantial
10 contribution to the dissolution and mobilization of arsenic. While the study focused on
11 sediments, the sediments were anaerobic; the same processes may impact dissolved arsenic
12 concentrations in groundwater systems.

13 **Impact of Soil Type on Arsenic Mobility and Dissolved Phase Concentration.** The amount of
14 water-soluble arsenic in soil has been found to be inversely proportional to the iron and
15 aluminum content of the soil. The water soluble fraction of arsenic has also been found to be
16 greatest in soil with the lowest clay content, and the lowest in soils with a high clay content.
17 Arsenic is strongly sorbed by amorphous iron oxides and is released from those oxides
18 under anaerobic conditions. Hydrrous manganese and iron and aluminum oxides are
19 considered to be the principal solid-phase components controlling the adsorption of arsenic
20 in soils. Generally, As(V), the arsenate form, is better adsorbed than As(III), arsenite.

21 **Discussion of Arsenic in Groundwater at AOC 709(F).** No source areas of arsenic are known to
22 be present or suspected to be present at AOC 709(F), based on the investigations and past
23 history of the site (an FDS pipeline beneath a road). The results of TPH analysis during the
24 original FDS investigation suggest the presence of hydrocarbons in the vicinity of the FDS
25 pipeline. However, groundwater analyses conducted for a monitoring well adjacent to the
26 pipeline indicated that there are no dissolved phase hydrocarbons or fuel compounds
27 present above MCLs or other groundwater criteria.

28 The elevated arsenic concentrations in groundwater at this site may be present due to the
29 geochemical conditions. Dissolved iron concentrations, which are indicative of the relative
30 activity of iron-reducing bacteria, range from 5,180 to 53,200 $\mu\text{g/L}$ in well FFDSGW16B (see
31 Table 5-1). These elevated iron concentrations suggest that biologically-mediated iron
32 reduction is occurring. The hydrocarbons in the saturated zone at the site, as indicated by
33 the TPH analysis, are likely providing an organic carbon source for iron-reducing bacteria.
34 Fuel hydrocarbons are known to contain a variety of organic compounds, including long-

1 chain DRO compounds. These long-chain carbon chains are good substrates for a variety of
2 microbes. With an abundance of the substrate, microbial populations would be expected to
3 grow substantially. Under these conditions, microbes responsible for the reduction of iron
4 and arsenic would also be expected to be in abundance. A larger, active microbe population
5 could explain the elevated iron and arsenic concentrations in groundwater at AOC 709(F).
6 As a result of the dissolution of iron via iron-reducing bacteria, arsenic that is naturally
7 present and is adsorbed to the iron may be coming into solution with the iron.

8 Based on the above considerations, it does not appear that the elevated concentrations of
9 arsenic that are present in groundwater are related to RCRA activities or are from releases
10 at the site. The likelihood that the arsenic that is present in the groundwater is of natural
11 origin is great. CH2M-Jones recommends this site for NFA under the RCRA CA program. If
12 additional work at this site is required, it should be performed under the UST program.

TABLE 5-1
 Analytical Results for Select Compounds in Groundwater
 RFI Report Addendum, AOC 709(F), Zone F, Charleston Naval Complex

Location	Collection Date	BRC	Antimony (µg/L)		Arsenic (µg/L)		Heptachlor (µg/L)		Iron (µg/L)		Thallium (µg/L)		Total Suspended Solids (µg/L)	
			Concentration/Qualifier	Qualifier	Concentration/Qualifier	Qualifier								
		MCL	ND		16.7		NA		NA		2		NA	
			6		50		0.4		300 ^a		2		NA	
FFDSGW16A	1/29/97		3.90	J	9.9	J	0.049	=	3,390	J	2.70	U	NA	
	6/18/97		1.60	U	12.1	=	0.040	U	3,690	=	5.00	U	NA	
	4/22/98		5.00	U	9.8	J	NA		13,000	=	5.50	U	NA	
	10/28/98		2.70	U	6.7	J	NA		5,130	=	3.10	U	NA	
FFDSGW16B	1/29/97		4.20	J	28.5	=	NA		5,180	J	6.40	J	NA	
	6/16/97		3.30	U	94.6	=	0.040	U	23,300	=	5.00	U	NA	
	4/20/98		5.00	U	254.0	=	NA		53,200	=	5.50	U	NA	
	10/28/98		2.70	U	236.0	=	NA		22,400	=	3.90	U	NA	
	1/7/99		2.70	U	214.0	=	NA		NA	J	3.10	U	NA	
	1/7/99		2.70	U	204.0	=	NA		NA		3.10	U	92,000	=
	Duplicate													
FFDSGW16C	1/29/97		3.10	J	9.4	J	0.040	U	6,590	J	4.60	J	NA	
	6/16/97		2.40	U	6.2	J	0.040	U	8,980	=	5.70	U	NA	
	4/20/98		5.00	U	29.6	=	NA		34,000	=	5.50	U	NA	
	10/28/98		2.70	U	42.3	=	NA		9,800	=	4.20	U	NA	

Concentrations in bolded and outlined text exceeded MCL and zone BRC.

- ^a The EPA Secondary Drinking Water Regulation used as MCL for iron
- = Analyte was detected, the reported concentration is the actual analytical concentration
- J Analyte was detected, the reported concentration is an estimated concentration
- NA Analyte was not analyzed for or the information is not applicable/available
- U Analyte was not detected, the reported concentration is the detection limit

1 **6.0 Site Closeout Issues**

2 AOC 709(F), located in part under Hobson Avenue, is an area investigated as part of the
3 FDS investigation conducted at the CNC. The site is currently being investigated for the
4 presence of arsenic in groundwater. Antimony and thallium were not detected in the last
5 four sampling events conducted at the site.

6 AOC 709(F) has not been connected to either the sanitary nor the storm sewer collection
7 systems. Therefore, linkages to the storm sewer and the sanitary sewer do not warrant
8 further investigation at AOC 709(F).

9 Railroad lines are located near AOC 709(F), but because AOC 709(F) is entirely
10 underground, no linkage between the railroad line and AOC 709(F) is believed to exist.

11 No linkage is believed to exist between AOC 709(F) and surface water bodies. Because AOC
12 709(F) is underground, it could not impact surface soil. Therefore, stormwater runoff from
13 AOC 709(F) would not impact any surface water bodies. Soil has been determined not to
14 have impacted groundwater at AOC 709(F); therefore, further investigation of any linkage
15 of AOC 709(F) to surface water bodies is not warranted.

16 No oil/water separators (OWSs) are known to have been located at AOC 709(F). Because
17 this site is an underground pipeline, there is no reason to believe that an OWS that was not
18 previously identified is present.

1 **7.0 Recommendations**

2 AOC 709(F) was part of the base-wide investigation of the FDS at the CNC, and was
3 identified as Area 16 for the purposes of that investigation. In the course of the
4 investigation, elevated concentrations of arsenic in groundwater were discovered. No site
5 activities are known to have occurred at this site that would have released arsenic into the
6 environment.

7 Microbial reduction of naturally-occurring arsenic or iron in soil is believed to be the most
8 likely cause of the elevated arsenic concentrations in groundwater at AOC 709(F). This
9 process is believed to be stimulated by the presence of hydrocarbons in the subsurface as a
10 substrate for microbial growth. The local geochemistry (reduction potential) could also be
11 contributing to the observed arsenic concentration.

12 Because the elevated arsenic concentrations in groundwater are not considered to be the
13 result of waste disposal or mismanagement, the site is recommended for NFA under the
14 RCRA CA program. If SCDHEC believes that further evaluation of this site is warranted, it
15 should be transferred back into the UST program for such purpose.

1 **8.0 References**

- 2 Ahmann et al. *Microbial Mobilization of Arsenic from Sediments of the Aberjona Watershed.*
3 Environmental Science and Technology. 1997.
- 4 EnSafe Inc. *Zone F RFI Report, NAVBASE Charleston.* Revision 0. December 31, 1997.
- 5 Nriagu et al. *Arsenic in the Environment – Part 1; Cycling and Characterization.* 1994.
- 6 U.S. Environmental Protection Agency. *RCRA Corrective Action Plan, OSWER Directive*
7 9902.3-2A. May 1994.
- 8 U.S. Environmental Protection Agency. *EPA Soil Screening Guidance.* Technical Document.
9 May 1996.
- 10 40 CFR 761.125(c)(4)(v). *Requirements for PCB Spill Cleanup.* Revised July 1, 2000.

summarizes all analytes detected in subsurface soil at the site. Appendix D contains a complete analytical data report for all Zone F samples collected.

Volatile Organic Compounds in Subsurface Soil

Three VOCs were detected in the subsurface soil samples. Carbon disulfide, ethylbenzene, and xylene were detected in subsurface soil at concentrations far below their respective SSLs.

Semivolatile Organic Compounds in Subsurface Soil

Nineteen SVOCs were detected in the subsurface soil samples at AOC 709. None of these compounds were detected above their respective SSLs.

Pesticides and PCBs in Subsurface Soil

No pesticides or PCBs were detected in subsurface soil samples at AOC 709.

Other Organic Compounds in Subsurface Soil

Dioxin (2,3,7,8-TCDD TEQ) was detected in the duplicate sample at a concentration far below its SSL.

Inorganic Elements in Subsurface Soil

Nineteen metals were detected in the subsurface soil samples collected at AOC 709. All detections were below the respective SSLs. No inorganic element concentrations exceeded its Zone F background concentration. No background was established for calcium, iron, magnesium, potassium and sodium because they are considered to be essential nutrients.

10.10.4 Groundwater Sampling and Analysis

The approved final work plan proposed shallow monitoring wells to be installed as needed in areas where soil has been impacted. Based on the analytical results of soil samples collected at

groundwater concentrations over short time periods is common. Thallium was present in two wells during the first quarter, but has been non-detect since, effectively invalidating the pathway for this parameter.

One organic - heptachlor - and four inorganics - arsenic, copper, cyanide, and mercury - were detected in groundwater at concentrations that exceeded their respective surface water screening values. The trend and potential source for arsenic was previously discussed. Copper detections have been sporadic over four quarters of sampling, and concentrations have been only slightly greater than the screening value. The levels of both copper and cyanide suggest that the pathway with respect to them will not be significant, given the distance to nearest surface water, the Cooper River and the physical attenuation mechanisms of dispersion and dilution. Mercury was present in all three wells at similar concentrations during the fourth quarter, but was non-detect prior to that. The source for mercury is unknown, and its sudden appearance in site groundwater is problematic in terms of defining and understanding trends. The nearest surface water is approximately 1,200 feet to the northeast, and the direction of groundwater flow on a local scale is to the east. Therefore, unless the flow path changes azimuth outboard of the site, it is unlikely that site groundwater will discharge to the nearest surface water discharge point. Additionally, with the exception of arsenic, it is unlikely that any of the parameters would discharge at hazardous levels given the physical attenuation mechanisms associated with groundwater flow.

10.10.5.3 Fate and Transport Summary

No constituents were present in subsurface soil at concentrations exceeding their SSLs, thus the soil-to-groundwater pathway is considered invalid.

Only one organic parameter - heptachlor - was detected in groundwater at a concentration exceeding its RBC. This parameter was detected in only the first quarter samples, and has been

non-detect since, effectively invalidating the groundwater ingestion and migration to surface water pathways. 1
2

Two inorganics – arsenic and thallium – were present in groundwater at levels that exceeded their RBCs. Arsenic exhibits an overall increase in concentration over four quarters of sampling, particularly in wells FDS16B and FDS16C. The source for arsenic may be linked to the use of arsenate-based pesticides and/or herbicides, which can infiltrate into groundwater quickly and exhibit rapid concentration changes. The data suggest that most of the groundwater mass underlying the site should be considered in risk management with respect to this parameter. Thallium was present in two wells during the first quarter, and has been non-detect since, effectively invalidating the groundwater ingestion and migration to surface water pathways with respect to this parameter. 3
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One organic and four inorganics were present in groundwater above their respective surface water screening values. The heptachlor and arsenic distributions were discussed above. 12
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Copper detections have been sporadic over four quarters of sampling; cyanide was present in all wells during the first quarter of sampling. Both of these parameters are at concentrations only slightly above their screening values, and given the physical attenuation mechanisms of dispersion and dilution, are not expected to be significant with respect to this pathway. Mercury was present in all wells during the fourth quarter, but was previously non-detect. The source and reason for the sudden appearance of mercury is unknown, and additional sampling data is needed to fully evaluate it's occurrence. 14
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The nearest surface water is approximately 1,200 feet to the northeast, while local groundwater flow is to the east. It is therefore unlikely that site groundwater will discharge at the nearest discharge point, and it is also unlikely that parameters would be at hazardous levels at the nearest 21
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discharge point. One exception is arsenic, which should be considered during the risk management evaluation of this site.

10.10.6 Human Health Risk Assessment

10.10.6.1 Site Background and Investigative Approach

The purpose of the investigation at AOC 709, (former FDS Area 17) was the assessment of soil and groundwater potentially affected by the FDS pipelines. This area of potential impact is on the south side of Hobson Avenue, across the road from and west of Building 1172. The Cooper River lies approximately 1,200 feet to the east.

10.10.6.2 COPC Identification

Groundwater

Based on the screening comparisons described in Section 7 of this RFI and presented in Table 10.10.10, the focus of this HHRA is on the following COPCs in shallow groundwater: antimony, arsenic, heptachlor, and thallium. Manganese was detected at a maximum concentration exceeding its RBC, however, this constituent was eliminated from consideration in the risk assessment based on comparison to its background concentration. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out on the basis of background concentration.

10.10.6.3 Exposure Assessment

Exposure Setting

AOC 709 is located in an industrialized setting, approximately 1,200 feet southwest of the water front along the Cooper River. The site is mostly surrounded by buildings, roads, railroad right-of-ways, and paved parking areas to the north and east and grass-covered open fields to the west and south. In general, direct contact with soil, and migration of potential contaminants to groundwater or air is currently limited by these surface coverings. All potable water is provided through the

AOC 709, three shallow wells were installed and sampled. Figure 10.10-1 presents the locations of these wells. The purpose of these wells was to: (1) assess groundwater quality and (2) identify contaminants which may be migrating from the site.

Groundwater samples were initially analyzed for VOCs, SVOCs, metals and cyanide and pesticides/PCBs at DQO III. During the second sampling round, cyanide was not an analytical parameter. Because no pesticides or PCBs were detected in the two previous sampling events, this analysis was not performed during the third sampling round. During the fourth sampling round, metals were the only analytes of interest. Table 10.10.5 summarizes the groundwater samples and analyses at AOC 709. Appendix D contains a complete analytical data report for all Zone F samples collected.

10.10.4.1 Nature of Contamination in Groundwater

Organic analytical results for groundwater are summarized in Table 10.10.6. Inorganic analytical results for groundwater are summarized in Table 10.10.7. Table 10.10.8 presents a summary of all analytes detected at AOC 709.

Volatile Organic Compounds in Groundwater

No VOCs were detected in shallow groundwater during the three sampling events which analyzed for these compounds.

Semivolatile Organic Compounds in Groundwater

No SVOCs were detected in shallow groundwater during the three sampling events which analyzed for these compounds.

Pesticides and PCBs in Groundwater

Heptachlor was the only pesticide detected in shallow groundwater at AOC 709. It was detected in only the initial sampling event. The detected concentration 0.049 $\mu\text{g/L}$, exceeded the tap water RBC of 0.0023 $\mu\text{g/L}$ but was below the MCL of 0.4 $\mu\text{g/L}$. Heptachlor was not detected in the next sampling event. No PCBs were detected in any of the events they were an analytical parameter.

Inorganic Elements in Groundwater

Twenty-one metals plus cyanide were detected in shallow groundwater samples at AOC 709. Arsenic and thallium were the only metals detected at concentrations which exceeded both the respective RBCs and Zone F background concentrations of the shallow surficial aquifer.

Antimony was detected at concentrations exceeding the RBC of 1.5 $\mu\text{g/L}$ in all three samples collected during the initial sampling event. The MCL of 6 $\mu\text{g/L}$ was not exceeded. No background concentration was determined for antimony in Zone F.

Arsenic was detected in all samples collected during the four sampling events. Concentrations of arsenic have generally increased over time. During the initial sampling event only one sample collected from FDS16B, exceeded the RBC and background. This detection was below the MCL of 50 $\mu\text{g/L}$. The second round exhibited an increase in arsenic in wells FDS16A and FDS16B. The detection in FDS16B exceeded the RBC, background and the MCL. The third sampling event exhibited a significant increase in arsenic at FDS16B and FDS16C. This distribution was similar in the fourth sampling round. A similar pattern of arsenic detections were observed in the adjacent Zone E shallow grid well GDE008. These arsenic concentrations ranged from 17.3 $\mu\text{g/L}$ to a maximum of 160 $\mu\text{g/L}$. All detections exceeded both the tap water RBC and Zone F background concentration. The Zone E grid well samples were collected earlier than the AOC 709 samples. The fourth quarter Zone E sample date corresponds with the initial sampling of the AOC 709

wells. Appendix H of the draft Final Zone E RFI contains the analytical results for this well. 1

Figure 10.10-4 illustrates the distribution of arsenic in shallow groundwater at AOC 709. 2

Iron exceeded its RBC in all samples collected, no background was determined for the essential 3
nutrient iron. 4

Manganese was detected in all samples collected at AOC 709. All detections exceeded the RBC 5
of 73 $\mu\text{g/L}$ and the MCL of 50 $\mu\text{g/L}$. However, no detections exceeded the Zone F background 6
of 2010 $\mu\text{g/L}$. 7

Thallium was detected in samples collected from FDS16B and FDS16C at concentrations 8
exceeding the RBC, background and MCL during the initial sampling event. The subsequent 9
events exhibited no thallium detections. 10

10.10.5 Fate and Transport Assessment for AOC 709 11

Environmental media sampled as part of the AOC 709 investigation include subsurface soil and 12
shallow groundwater. Potential constituent migration pathways investigated include soil-to- 13
groundwater and groundwater migration to human receptors and to surface water. 14

10.10.5.1 Soil-to-Groundwater Cross-Media Transport 15

Table 10.10.9 compares maximum detected constituent concentrations in subsurface soil samples 16
to risk-based soil screening levels considered protective of groundwater. For inorganics maximum 17
concentrations in soil are compared to the greater of (a) risk-based soil screening levels or (b) 18
background concentrations. To provide a conservative screen, generic SSLs were used; leachate 19
entering the aquifer is assumed to be diluted by a ratio of 20:1, with no attenuation of constituents 20
in soil ($\text{DAF}=20$). 21

Table 10.10.16
 Summary of Risk and Hazard-based COCs
 AOC 709
 Charleston Naval Complex, Zone F
 Charleston, South Carolina

Medium	Exposure Pathway		Future	Future	Future	Site Worker		Identification of COCs
			Resident Adult Hazard Quotient	Resident Child Hazard Quotient	Resident Iwa ILCR	Hazard Quotient	ILCR	
Groundwater Ingestion Pathways		Antimony (Sb)	0.21	0.50	ND	0.076	ND	1
		Arsenic (As)	23.2	54.1	5.7E-03	8.3	1.3E-03	1 2 3 4
		Heptachlor	0.0027	0.0063	3.3E-06	0.00096	7.7E-07	2
		Thallium (Tl)	1.45	3.37	ND	0.52	ND	1 3
Groundwater Pathway Sum			25	58	6E-03	9	1E-03	
Sum of All Pathways			25	58	6E-03	9	1E-03	

Notes:

ND Indicates not determined due to the lack of available risk information.

NA Not applicable

ILCR Indicates incremental excess lifetime cancer risk

HI Indicates hazard index

1- Chemical is a COC by virtue of projected child residence non-carcinogenic 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 non-carcinogenic hazard.

4- Chemical is a COC by virtue of projected site worker ILCR

Analytical Data Summary

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VOCs	StationID SampleID DateCollected DateAnalyzed SDGNumber	FFDSSC097 FDSSC097S1 (0-1ft) 10/14/1999 10/20/1999 EN021	FFDSSC097 FDSSC097S2 (3-5ft) 10/14/1999 10/20/1999 EN021	FFDSSC097 FDSSC097T1 (0-1ft) 10/14/1999 10/18/1999 EN021
Parameter	Units			
1,1,1-TRICHLOROETHANE	UG/KG			3 U
1,1,2,2-TETRACHLOROETHANE	UG/KG			3 U
1,1,2-TRICHLOROETHANE	UG/KG			3 U
1,1-DICHLOROETHANE	UG/KG			3 U
1,1-DICHLOROETHENE	UG/KG			3 U
1,2-DICHLOROETHANE	UG/KG			3 U
1,2-Dichloroethene (total)	UG/KG			3 U
1,2-DICHLOROPROPANE	UG/KG			3 U
2-Chloroethyl vinyl ether	UG/KG			11 U
2-HEXANONE	UG/KG			6 U
ACETONE	UG/KG			6 U
BENZENE	UG/KG			3 U
BROMODICHLOROMETHANE	UG/KG			3 U
BROMOFORM	UG/KG			3 U
BROMOMETHANE	UG/KG			3 U
CARBON DISULFIDE	UG/KG			3 U
CARBON TETRACHLORIDE	UG/KG			3 U
CHLOROBENZENE	UG/KG			3 U
CHLOROETHANE	UG/KG			3 U
CHLOROFORM	UG/KG			3 U
CHLOROMETHANE	UG/KG			3 U
cis-1,3-DICHLOROPROPENE	UG/KG			3 U
DIBROMOCHLOROMETHANE	UG/KG			3 U
ETHYLBENZENE	UG/KG			3 U
METHYL ETHYL KETONE (2-BUTANONE)	UG/KG			6 U
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG			6 U
METHYLENE CHLORIDE	UG/KG			6 U
STYRENE	UG/KG			3 U
TETRACHLOROETHYLENE(PCE)	UG/KG			3 U
TOLUENE	UG/KG			3 U
trans-1,3-DICHLOROPROPENE	UG/KG			3 U
TRICHLOROETHYLENE (TCE)	UG/KG			3 U
Vinyl acetate	UG/KG			3 U
VINYL CHLORIDE	UG/KG			3 U
XYLENES, TOTAL	UG/KG			3 U

Analytical Data Summary

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VOCs

Parameter	Units	StationID	FFDSSC097	
		SampleID	FDSSC097T2 (3-5ft)	FDSSC097T2RE (3-5ft)
		DateCollected	10/14/1999	10/14/1999
		DateAnalyzed	10/18/1999	10/20/1999
		SDGNumber	EN021	EN021
1,1,1-TRICHLOROETHANE	UG/KG	4	R	6 U
1,1,2,2-TETRACHLOROETHANE	UG/KG	4	R	6 U
1,1,2-TRICHLOROETHANE	UG/KG	4	R	6 U
1,1-DICHLOROETHANE	UG/KG	4	R	6 U
1,1-DICHLOROETHENE	UG/KG	4	R	6 U
1,2-DICHLOROETHANE	UG/KG	4	R	6 U
1,2-Dichloroethene (total)	UG/KG	4	R	6 U
1,2-DICHLOROPROPANE	UG/KG	4	R	6 U
2-Chloroethyl vinyl ether	UG/KG	14	R	18 U
2-HEXANONE	UG/KG	7	R	9 U
ACETONE	UG/KG	71	R	120 U
BENZENE	UG/KG	4	R	2 J
BROMODICHLOROMETHANE	UG/KG	4	R	6 U
BROMOFORM	UG/KG	4	R	6 U
BROMOMETHANE	UG/KG	4	R	6 U
CARBON DISULFIDE	UG/KG	4	R	6 =
CARBON TETRACHLORIDE	UG/KG	4	R	6 U
CHLOROBENZENE	UG/KG	4	R	6 U
CHLOROETHANE	UG/KG	4	R	6 U
CHLOROFORM	UG/KG	4	R	6 U
CHLOROMETHANE	UG/KG	4	R	6 U
cis-1,3-DICHLOROPROPENE	UG/KG	4	R	6 U
DIBROMOCHLOROMETHANE	UG/KG	4	R	6 U
ETHYLBENZENE	UG/KG	23	R	8 =
METHYL ETHYL KETONE (2-BUTANONE)	UG/KG	8	R	9 U
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE)	UG/KG	7	R	9 U
METHYLENE CHLORIDE	UG/KG	16	R	18 U
STYRENE	UG/KG	4	R	6 U
TETRACHLOROETHYLENE(PCE)	UG/KG	4	R	6 U
TOLUENE	UG/KG	4	R	6 U
trans-1,3-DICHLOROPROPENE	UG/KG	4	R	6 U
TRICHLOROETHYLENE (TCE)	UG/KG	4	R	6 U
Vinyl acetate	UG/KG	4	R	6 U
VINYL CHLORIDE	UG/KG	4	R	6 U
XYLENES, TOTAL	UG/KG	62	R	47 =

Analytical Data Summary

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VOCs

Parameter	StationID	FFDSSC097		FFDSSC097		FFDSSC097	
	SampleID	FDSSC097S1 (0-1ft)		FDSSC097S2 (3-5ft)		FDSSC097T1 (0-1ft)	
	DateCollected	10/14/1999		10/14/1999		10/14/1999	
	DateAnalyzed	10/20/1999		10/20/1999		10/18/1999	
	SDGNumber	EN021		EN021		EN021	
	Units						
1,1,1-TRICHLOROETHANE, SPLP	UG/L	60	U	60	U		
1,1,2,2-TETRACHLOROETHANE, SPLP	UG/L	60	U	60	U		
1,1,2-TRICHLOROETHANE, SPLP	UG/L	60	U	60	U		
1,1-DICHLOROETHANE, SPLP	UG/L	60	U	60	U		
1,1-DICHLOROETHENE, SPLP	UG/L	60	U	60	U		
1,2-DICHLOROETHANE, SPLP	UG/L	60	U	60	U		
1,2-Dichloroethene (total), SPLP	UG/L	60	U	60	U		
1,2-DICHLOROPROPANE, SPLP	UG/L	60	U	60	U		
2-Chloroethyl vinyl ether, SPLP	UG/L	200	U	200	U		
2-HEXANONE, SPLP	UG/L	100	U	100	U		
ACETONE, SPLP	UG/L	100	R	100	R		
BENZENE, SPLP	UG/L	60	U	60	U		
BROMODICHLOROMETHANE, SPLP	UG/L	60	U	60	U		
BROMOFORM, SPLP	UG/L	60	U	60	U		
BROMOMETHANE, SPLP	UG/L	60	U	60	U		
CARBON DISULFIDE, SPLP	UG/L	60	U	60	U		
CARBON TETRACHLORIDE, SPLP	UG/L	60	U	60	U		
CHLOROBENZENE, SPLP	UG/L	60	U	60	U		
CHLOROETHANE, SPLP	UG/L	60	U	60	U		
CHLOROFORM, SPLP	UG/L	60	U	60	U		
CHLOROMETHANE, SPLP	UG/L	60	U	60	U		
cis-1,3-DICHLOROPROPENE, SPLP	UG/L	60	U	60	U		
DIBROMOCHLOROMETHANE, SPLP	UG/L	60	U	60	U		
ETHYLBENZENE, SPLP	UG/L	60	U	60	U		
METHYL ETHYL KETONE (2-BUTANONE), SPLP	UG/L	100	U	100	U		
METHYL ISOBUTYL KETONE (4-METHYL-2-PENTANONE), S	UG/L	100	U	100	U		
METHYLENE CHLORIDE, SPLP	UG/L	60	U	60	U		
STYRENE, SPLP	UG/L	60	U	60	U		
TETRACHLOROETHYLENE(PCE), SPLP	UG/L	60	U	60	U		
TOLUENE, SPLP	UG/L	60	U	60	U		
trans-1,3-DICHLOROPROPENE, SPLP	UG/L	60	U	60	U		
TRICHLOROETHYLENE (TCE), SPLP	UG/L	60	U	60	U		
Vinyl acetate, SPLP	UG/L	60	U	60	U		
VINYL CHLORIDE, SPLP	UG/L	60	U	60	U		
XYLENES, TOTAL, SPLP	UG/L	60	U	60	U		

Analytical Data Summary

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SVOCs

Parameter	StationID	FFDSSC097	FFDSSC097	FFDSSC097
	SampleID	FDSSC097S1 (0-1ft)	FDSSC097S2 (3-5ft)	FDSSC097T1 (0-1ft)
	DateCollected	10/14/1999	10/14/1999	10/14/1999
	DateAnalyzed	10/26/1999	10/27/1999	10/27/1999
	SDGNumber	EN021	EN021	EN021
Parameter	Units			
1,2,4-TRICHLORO BENZENE	UG/KG			390 U
1,2-DICHLORO BENZENE	UG/KG			390 U
1,3-DICHLORO BENZENE	UG/KG			390 U
1,4-DICHLORO BENZENE	UG/KG			390 U
2,2'-OXYBIS(1-CHLORO)PROPANE	UG/KG			390 U
2,4,5-TRICHLOROPHENOL	UG/KG			390 U
2,4,6-TRICHLOROPHENOL	UG/KG			390 U
2,4-DICHLOROPHENOL	UG/KG			390 U
2,4-DIMETHYLPHENOL	UG/KG			390 U
2,4-DINITROPHENOL	UG/KG			780 U
2,4-DINITROTOLUENE	UG/KG			390 U
2,6-DINITROTOLUENE	UG/KG			390 U
2-CHLORONAPHTHALENE	UG/KG			390 U
2-CHLOROPHENOL	UG/KG			390 U
2-METHYLNAPHTHALENE	UG/KG			390 U
2-METHYLPHENOL (o-CRESOL)	UG/KG			390 U
2-NITROANILINE	UG/KG			390 U
2-NITROPHENOL	UG/KG			390 U
3,3'-DICHLORO BENZIDINE	UG/KG			780 U
3-NITROANILINE	UG/KG			390 U
4,6-DINITRO-2-METHYLPHENOL	UG/KG			780 U
4-BROMOPHENYL PHENYL ETHER	UG/KG			390 U
4-CHLORO-3-METHYLPHENOL	UG/KG			390 U
4-CHLOROANILINE	UG/KG			390 U
4-CHLOROPHENYL PHENYL ETHER	UG/KG			390 U
4-METHYLPHENOL (p-CRESOL)	UG/KG			390 U
4-NITROANILINE	UG/KG			390 U
4-NITROPHENOL	UG/KG			780 U
ACENAPHTHENE	UG/KG			390 U
ACENAPHTHYLENE	UG/KG			390 U
ANTHRACENE	UG/KG			390 U
BENZO(a)ANTHRACENE	UG/KG			390 U

Analytical Data Summary

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SVOCs

Parameter	StationID	FFDSSC097		FFDSSC097	
	SampleID	FDSSC097T2 (3-5ft)		FDSSC097T2DL (3-5ft)	
	DateCollected	10/14/1999		10/14/1999	
	DateAnalyzed	10/28/1999		10/28/1999	
	SDGNumber	EN021		EN021	
	Units				
1,2,4-TRICHLOROBENZENE	UG/KG	2000	U	5000	R
1,2-DICHLOROBENZENE	UG/KG	2000	U	5000	R
1,3-DICHLOROBENZENE	UG/KG	2000	U	5000	R
1,4-DICHLOROBENZENE	UG/KG	2000	U	5000	R
2,2'-OXYBIS(1-CHLORO)PROPANE	UG/KG	2000	U	5000	R
2,4,5-TRICHLOROPHENOL	UG/KG	2000	U	5000	R
2,4,6-TRICHLOROPHENOL	UG/KG	2000	U	5000	R
2,4-DICHLOROPHENOL	UG/KG	2000	U	5000	R
2,4-DIMETHYLPHENOL	UG/KG	2000	U	5000	R
2,4-DINITROPHENOL	UG/KG	4000	U	10000	R
2,4-DINITROTOLUENE	UG/KG	2000	U	5000	R
2,6-DINITROTOLUENE	UG/KG	2000	U	5000	R
2-CHLORONAPHTHALENE	UG/KG	2000	U	5000	R
2-CHLOROPHENOL	UG/KG	2000	U	5000	R
2-METHYLNAPHTHALENE	UG/KG	21000	=	22000	R
2-METHYLPHENOL (o-CRESOL)	UG/KG	2000	U	5000	R
2-NITROANILINE	UG/KG	2000	U	5000	R
2-NITROPHENOL	UG/KG	2000	U	5000	R
3,3'-DICHLOROBENZIDINE	UG/KG	4000	UJ	10000	R
3-NITROANILINE	UG/KG	2000	U	5000	R
4,6-DINITRO-2-METHYLPHENOL	UG/KG	4000	U	10000	R
4-BROMOPHENYL PHENYL ETHER	UG/KG	2000	U	5000	R
4-CHLORO-3-METHYLPHENOL	UG/KG	2000	U	5000	R
4-CHLOROANILINE	UG/KG	2000	U	5000	R
4-CHLOROPHENYL PHENYL ETHER	UG/KG	2000	U	5000	R
4-METHYLPHENOL (p-CRESOL)	UG/KG	2000	U	5000	R
4-NITROANILINE	UG/KG	2000	U	5000	R
4-NITROPHENOL	UG/KG	4000	U	10000	R
ACENAPHTHENE	UG/KG	4600	=	4800	R
ACENAPHTHYLENE	UG/KG	2000	U	5000	R
ANTHRACENE	UG/KG	3600	=	3000	R
BENZO(a)ANTHRACENE	UG/KG	2700	J	2400	R

Analytical Data Summary

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SVOCs

	StationID	FFDSSC097	FFDSSC097	FFDSSC097
	SampleID	FDSSC097S1 (0-1ft)	FDSSC097S2 (3-5ft)	FDSSC097T1 (0-1ft)
	DateCollected	10/14/1999	10/14/1999	10/14/1999
	DateAnalyzed	10/26/1999	10/27/1999	10/27/1999
	SDGNumber	EN021	EN021	EN021
Parameter	Units			
BENZO(a)PYRENE	UG/KG			390 U
BENZO(b)FLUORANTHENE	UG/KG			390 U
BENZO(g,h,i)PERYLENE	UG/KG			390 U
BENZO(k)FLUORANTHENE	UG/KG			390 U
Benzoic acid	UG/KG			1900 U
Benzyl alcohol	UG/KG			390 U
BENZYL BUTYL PHTHALATE	UG/KG			390 U
bis(2-CHLOROETHOXY) METHANE	UG/KG			390 U
bis(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG			390 U
bis(2-ETHYLHEXYL) PHTHALATE	UG/KG			390 U
CHRYSENE	UG/KG			390 U
DIBENZ(a,h)ANTHRACENE	UG/KG			390 U
DIBENZOFURAN	UG/KG			390 U
DIETHYL PHTHALATE	UG/KG			390 U
DIMETHYL PHTHALATE	UG/KG			390 U
DI-n-BUTYL PHTHALATE	UG/KG			390 U
DI-n-OCTYLPHTHALATE	UG/KG			390 U
FLUORANTHENE	UG/KG			98 J
FLUORENE	UG/KG			390 U
HEXACHLOROENZENE	UG/KG			390 U
HEXACHLOROBUTADIENE	UG/KG			390 U
HEXACHLOROCYCLOPENTADIENE	UG/KG			390 U
HEXACHLOROETHANE	UG/KG			390 U
INDENO(1,2,3-c,d)PYRENE	UG/KG			390 U
ISOPHORONE	UG/KG			390 U
NAPHTHALENE	UG/KG			390 U
NITROBENZENE	UG/KG			390 U
N-NITROSODI-n-PROPYLAMINE	UG/KG			390 U
N-NITROSODIPHENYLAMINE	UG/KG			390 U
PENTACHLOROPHENOL	UG/KG			780 U
PHENANTHRENE	UG/KG			390 U
PHENOL	UG/KG			390 U
PYRENE	UG/KG			390 U

Analytical Data Summary

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SVOCs

Parameter	StationID	FFDSSC097		FFDSSC097	
	SampleID	FDSSC097T2 (3-5ft)		FDSSC097T2DL (3-5ft)	
DateCollected		10/14/1999		10/14/1999	
DateAnalyzed		10/28/1999		10/28/1999	
SDGNumber		EN021		EN021	
Units					
BENZO(a)PYRENE	UG/KG	1200	J	1400	R
BENZO(b)FLUORANTHENE	UG/KG	1500	J	1100	R
BENZO(g,h,i)PERYLENE	UG/KG	740	J	5000	R
BENZO(k)FLUORANTHENE	UG/KG	710	J	1000	R
Benzoic acid	UG/KG	10000	U	25000	R
Benzyl alcohol	UG/KG	2000	U	5000	R
BENZYL BUTYL PHTHALATE	UG/KG	2000	UJ	5000	R
bis(2-CHLOROETHOXY) METHANE	UG/KG	2000	U	5000	R
bis(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER)	UG/KG	2000	U	5000	R
bis(2-ETHYLHEXYL) PHTHALATE	UG/KG	2000	UJ	5000	R
CHRYSENE	UG/KG	2900	J	3700	R
DIBENZ(a,h)ANTHRACENE	UG/KG	2000	UJ	5000	R
DIBENZOFURAN	UG/KG	2100	=	2800	R
DIETHYL PHTHALATE	UG/KG	2000	U	5000	R
DIMETHYL PHTHALATE	UG/KG	2000	U	5000	R
DI-n-BUTYL PHTHALATE	UG/KG	2000	U	5000	R
DI-n-OCTYLPHTHALATE	UG/KG	2000	UJ	5000	R
FLUORANTHENE	UG/KG	4800	=	5700	R
FLUORENE	UG/KG	5200	=	6100	R
HEXACHLORO BENZENE	UG/KG	2000	U	5000	R
HEXACHLORO BUTADIENE	UG/KG	2000	U	5000	R
HEXACHLORO CYCLOPENTADIENE	UG/KG	2000	U	5000	R
HEXACHLOROETHANE	UG/KG	2000	U	5000	R
INDENO(1,2,3-c,d)PYRENE	UG/KG	570	J	5000	R
ISOPHORONE	UG/KG	2000	U	5000	R
NAPHTHALENE	UG/KG	2100	=	1900	R
NITROBENZENE	UG/KG	2000	U	5000	R
N-NITROSODI-n-PROPYLAMINE	UG/KG	2000	U	5000	R
N-NITROSODIPHENYLAMINE	UG/KG	2000	U	5000	R
PENTACHLOROPHENOL	UG/KG	4000	U	10000	R
PHENANTHRENE	UG/KG	17000	=	16000	R
PHENOL	UG/KG	2000	U	5000	R
PYRENE	UG/KG	7300	J	8500	R

Analytical Data Summary

07/06/2001 8:14 AM

SVOCs	StationID SampleID	FFDSSC097 FDSSC097S1 (0-1ft)	FFDSSC097 FDSSC097S2 (3-5ft)	FFDSSC097 FDSSC097T1 (0-1ft)
	DateCollected	10/14/1999	10/14/1999	10/14/1999
	DateAnalyzed	10/26/1999	10/27/1999	10/27/1999
	SDGNumber	EN021	EN021	EN021
Parameter	Units			
1,2,4-TRICHLOROBENZENE, SPLP	UG/L	5 U	5 U	
1,2-DICHLOROBENZENE, SPLP	UG/L	5 U	5 U	
1,3-DICHLOROBENZENE, SPLP	UG/L	5 U	5 U	
1,4-DICHLOROBENZENE, SPLP	UG/L	5 U	5 U	
2,2'-OXYBIS(1-CHLORO)PROPANE, SPLP	UG/L	5 U	5 U	
2,4,5-TRICHLOROPHENOL, SPLP	UG/L	5 U	5 U	
2,4,6-TRICHLOROPHENOL, SPLP	UG/L	5 U	5 U	
2,4-DICHLOROPHENOL, SPLP	UG/L	5 U	5 U	
2,4-DIMETHYLPHENOL, SPLP	UG/L	5 U	5 U	
2,4-DINITROPHENOL, SPLP	UG/L	10 U	11 U	
2,4-DINITROTOLUENE, SPLP	UG/L	5 U	5 U	
2,6-DINITROTOLUENE, SPLP	UG/L	5 U	5 U	
2-CHLORONAPHTHALENE, SPLP	UG/L	5 U	5 U	
2-CHLOROPHENOL, SPLP	UG/L	5 U	5 U	
2-METHYLNAPHTHALENE, SPLP	UG/L	5 U	18 =	
2-METHYLPHENOL (o-CRESOL), SPLP	UG/L	5 U	5 U	
2-NITROANILINE, SPLP	UG/L	5 U	5 U	
2-NITROPHENOL, SPLP	UG/L	5 U	5 U	
3,3'-DICHLOROBENZIDINE, SPLP	UG/L	10 U	11 U	
3-NITROANILINE, SPLP	UG/L	5 U	5 U	
4,6-DINITRO-2-METHYLPHENOL, SPLP	UG/L	10 U	11 U	
4-BROMOPHENYL PHENYL ETHER, SPLP	UG/L	5 U	5 U	
4-CHLORO-3-METHYLPHENOL, SPLP	UG/L	5 U	5 U	
4-CHLOROANILINE, SPLP	UG/L	5 U	5 U	
4-CHLOROPHENYL PHENYL ETHER, SPLP	UG/L	5 U	5 U	
4-METHYLPHENOL (p-CRESOL), SPLP	UG/L	5 U	5 U	
4-NITROANILINE, SPLP	UG/L	5 U	5 U	
4-NITROPHENOL, SPLP	UG/L	10 U	11 U	
ACENAPHTHENE, SPLP	UG/L	5 U	5 =	
ACENAPHTHYLENE, SPLP	UG/L	5 U	5 U	
ANTHRACENE, SPLP	UG/L	5 U	5 U	
BENZO(a)ANTHRACENE, SPLP	UG/L	5 U	5 U	
BENZO(a)PYRENE, SPLP	UG/L	5 U	5 U	

Analytical Data Summary

07/06/2001 8:14 AM

SVOCs

Parameter	StationID	FFDSSC097	FFDSSC097
	SampleID	FDSSC097T2 (3-5ft)	FDSSC097T2DL (3-5ft)
	DateCollected	10/14/1999	10/14/1999
	DateAnalyzed	10/28/1999	10/28/1999
	SDGNumber	EN021	EN021
	Units		
1,2,4-TRICHLOROBENZENE, SPLP	UG/L		
1,2-DICHLOROBENZENE, SPLP	UG/L		
1,3-DICHLOROBENZENE, SPLP	UG/L		
1,4-DICHLOROBENZENE, SPLP	UG/L		
2,2'-OXYBIS(1-CHLORO)PROPANE, SPLP	UG/L		
2,4,5-TRICHLOROPHENOL, SPLP	UG/L		
2,4,6-TRICHLOROPHENOL, SPLP	UG/L		
2,4-DICHLOROPHENOL, SPLP	UG/L		
2,4-DIMETHYLPHENOL, SPLP	UG/L		
2,4-DINITROPHENOL, SPLP	UG/L		
2,4-DINITROTOLUENE, SPLP	UG/L		
2,6-DINITROTOLUENE, SPLP	UG/L		
2-CHLORONAPHTHALENE, SPLP	UG/L		
2-CHLOROPHENOL, SPLP	UG/L		
2-METHYLNAPHTHALENE, SPLP	UG/L		
2-METHYLPHENOL (o-CRESOL), SPLP	UG/L		
2-NITROANILINE, SPLP	UG/L		
2-NITROPHENOL, SPLP	UG/L		
3,3'-DICHLOROBENZIDINE, SPLP	UG/L		
3-NITROANILINE, SPLP	UG/L		
4,6-DINITRO-2-METHYLPHENOL, SPLP	UG/L		
4-BROMOPHENYL PHENYL ETHER, SPLP	UG/L		
4-CHLORO-3-METHYLPHENOL, SPLP	UG/L		
4-CHLOROANILINE, SPLP	UG/L		
4-CHLOROPHENYL PHENYL ETHER, SPLP	UG/L		
4-METHYLPHENOL (p-CRESOL), SPLP	UG/L		
4-NITROANILINE, SPLP	UG/L		
4-NITROPHENOL, SPLP	UG/L		
ACENAPHTHENE, SPLP	UG/L		
ACENAPHTHYLENE, SPLP	UG/L		
ANTHRACENE, SPLP	UG/L		
BENZO(a)ANTHRACENE, SPLP	UG/L		
BENZO(a)PYRENE, SPLP	UG/L		

Analytical Data Summary

07/06/2001 8:14 AM

SVOCs

Parameter	StationID	FFDSSC097		FFDSSC097		FFDSSC097	
	SampleID	FDSSC097S1 (0-1ft)		FDSSC097S2 (3-5ft)		FDSSC097T1 (0-1ft)	
DateCollected		10/14/1999		10/14/1999		10/14/1999	
DateAnalyzed		10/26/1999		10/27/1999		10/27/1999	
SDGNumber		EN021		EN021		EN021	
Units							
BENZO(b)FLUORANTHENE, SPLP	UG/L	5	U	5	U		
BENZO(g,h,i)PERYLENE, SPLP	UG/L	5	U	5	U		
BENZO(k)FLUORANTHENE, SPLP	UG/L	5	U	5	U		
Benzoic acid, SPLP	UG/L	25	U	27	U		
Benzyl alcohol, SPLP	UG/L	5	U	5	U		
BENZYL BUTYL PHTHALATE, SPLP	UG/L	5	U	5	U		
bis(2-CHLOROETHOXY) METHANE, SPLP	UG/L	5	U	5	U		
bis(2-CHLOROETHYL) ETHER (2-CHLOROETHYL ETHER), :	UG/L	5	U	5	U		
bis(2-ETHYLHEXYL) PHTHALATE, SPLP	UG/L	5	U	12	=		
CHRYSENE, SPLP	UG/L	5	U	5	U		
DIBENZ(a,h)ANTHRACENE, SPLP	UG/L	5	U	5	U		
DIBENZOFURAN, SPLP	UG/L	5	U	2	J		
DIETHYL PHTHALATE, SPLP	UG/L	5	U	5	U		
DIMETHYL PHTHALATE, SPLP	UG/L	5	U	5	U		
DI-n-BUTYL PHTHALATE, SPLP	UG/L	5	U	5	U		
DI-n-OCTYLPHTHALATE, SPLP	UG/L	5	U	5	U		
FLUORANTHENE, SPLP	UG/L	5	U	5	U		
FLUORENE, SPLP	UG/L	5	U	4	J		
HEXACHLOROBENZENE, SPLP	UG/L	5	U	5	U		
HEXACHLOROBUTADIENE, SPLP	UG/L	5	U	5	U		
HEXACHLOROCYCLOPENTADIENE, SPLP	UG/L	5	U	5	U		
HEXACHLOROETHANE, SPLP	UG/L	5	U	5	U		
INDENO(1,2,3-c,d)PYRENE, SPLP	UG/L	5	U	5	U		
ISOPHORONE, SPLP	UG/L	5	U	5	U		
NAPHTHALENE, SPLP	UG/L	5	U	5	J		
NITROBENZENE, SPLP	UG/L	5	U	5	U		
N-NITROSODI-n-PROPYLAMINE, SPLP	UG/L	5	U	5	U		
N-NITROSODIPHENYLAMINE, SPLP	UG/L	5	U	5	U		
PENTACHLOROPHENOL, SPLP	UG/L	10	U	11	U		
PHENANTHRENE, SPLP	UG/L	5	U	4	J		
PHENOL, SPLP	UG/L	5	U	5	U		
PYRENE, SPLP	UG/L	5	U	5	U		

Analytical Data Summary

07/06/2001 8:15 AM

Pesticides

	StationID	FFDSSC097	FFDSSC097	FFDSSC097
	SampleID	FDSSC097S1 (0-1ft)	FDSSC097S2 (3-5ft)	FDSSC097T1 (0-1ft)
	DateCollected	10/14/1999	10/14/1999	10/14/1999
	DateAnalyzed	10/28/1999	10/28/1999	10/28/1999
	SDGNumber	EN021	EN021	EN021
Parameter	Units			
ALDRIN	UG/KG			2 U
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG			2 U
ALPHA-CHLORDANE	UG/KG			2 U
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG			2 U
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG			2 U
DIELDRIN	UG/KG			3.8 U
ENDOSULFAN I	UG/KG			2 U
ENDOSULFAN II	UG/KG			3.8 U
ENDOSULFAN SULFATE	UG/KG			3.8 U
ENDRIN	UG/KG			3.8 U
ENDRIN ALDEHYDE	UG/KG			3.8 U
ENDRIN KETONE	UG/KG			3.8 U
GAMMA BHC (LINDANE)	UG/KG			2 U
GAMMA-CHLORDANE	UG/KG			2 U
HEPTACHLOR	UG/KG			2 U
HEPTACHLOR EPOXIDE	UG/KG			2 U
METHOXYCHLOR	UG/KG			20 U
p,p'-DDD	UG/KG			3.8 U
p,p'-DDE	UG/KG			9.6 =
p,p'-DDT	UG/KG			3.8 U
TOXAPHENE	UG/KG			200 U

Analytical Data Summary

07/06/2001 8:15 AM

Pesticides

Parameter	Units	FFDSSC097		FFDSSC097	
		SampleID	DateCollected	SampleID	DateCollected
		FDSSC097T1DL (0-1ft)	10/14/1999	FDSSC097T2 (3-5ft)	10/14/1999
			10/22/1999		10/23/1999
		SDGNumber	EN021	SDGNumber	EN021
ALDRIN	UG/KG	7.9	R	2.5	U
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE)	UG/KG	7.9	R	2.5	U
ALPHA-CHLORDANE	UG/KG	7.9	R	2.5	U
BETA BHC (BETA HEXACHLOROCYCLOHEXANE)	UG/KG	7.9	R	2.5	U
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE)	UG/KG	7.9	R	2.5	U
DIELDRIN	UG/KG	15	R	4.9	U
ENDOSULFAN I	UG/KG	7.9	R	2.5	U
ENDOSULFAN II	UG/KG	15	R	4.9	U
ENDOSULFAN SULFATE	UG/KG	15	R	4.9	U
ENDRIN	UG/KG	15	R	4.9	U
ENDRIN ALDEHYDE	UG/KG	15	R	4.9	U
ENDRIN KETONE	UG/KG	15	R	4.9	U
GAMMA BHC (LINDANE)	UG/KG	7.9	R	2.5	U
GAMMA-CHLORDANE	UG/KG	7.9	R	8.6	=
HEPTACHLOR	UG/KG	7.9	R	2.5	U
HEPTACHLOR EPOXIDE	UG/KG	7.9	R	2.5	U
METHOXYCHLOR	UG/KG	79	R	25	U
p,p'-DDD	UG/KG	15	R	15	=
p,p'-DDE	UG/KG	15	R	40	J
p,p'-DDT	UG/KG	15	R	4.9	U
TOXAPHENE	UG/KG	790	R	250	U

Analytical Data Summary

07/06/2001 8:15 AM

Pesticides

Parameter	StationID	FFDSSC097		FFDSSC097		FFDSSC097	
	SampleID	FDSSC097S1 (0-1ft)		FDSSC097S2 (3-5ft)		FDSSC097T1 (0-1ft)	
	DateCollected	10/14/1999		10/14/1999		10/14/1999	
	DateAnalyzed	10/28/1999		10/28/1999		10/28/1999	
	SDGNumber	EN021		EN021		EN021	
Parameter	Units						
ALDRIN, SPLP	UG/L	0.05	U	0.05	U		
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE), SPLP	UG/L	0.05	U	0.05	U		
ALPHA-CHLORDANE, SPLP	UG/L	0.05	U	0.05	U		
BETA BHC (BETA HEXACHLOROCYCLOHEXANE), SPLP	UG/L	0.05	U	0.05	U		
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE), SPLP	UG/L	0.05	U	0.05	U		
DIELDRIN, SPLP	UG/L	0.1	U	0.1	U		
ENDOSULFAN I, SPLP	UG/L	0.05	U	0.05	U		
ENDOSULFAN II, SPLP	UG/L	0.1	U	0.1	U		
ENDOSULFAN SULFATE, SPLP	UG/L	0.1	U	0.1	U		
ENDRIN ALDEHYDE, SPLP	UG/L	0.1	U	0.1	U		
ENDRIN KETONE, SPLP	UG/L	0.1	U	0.1	U		
ENDRIN, SPLP	UG/L	0.1	U	0.1	U		
GAMMA BHC (LINDANE), SPLP	UG/L	0.05	U	0.05	U		
GAMMA-CHLORDANE, SPLP	UG/L	0.05	U	0.05	U		
HEPTACHLOR EPOXIDE, SPLP	UG/L	0.05	U	0.05	U		
HEPTACHLOR, SPLP	UG/L	0.05	U	0.05	U		
METHOXYCHLOR, SPLP	UG/L	0.5	U	0.5	U		
p,p'-DDD, SPLP	UG/L	0.1	U	0.1	U		
p,p'-DDE, SPLP	UG/L	0.1	U	0.1	U		
p,p'-DDT, SPLP	UG/L	0.1	U	0.1	U		
TOXAPHENE, SPLP	UG/L	5	U	5	U		

Analytical Data Summary

07/06/2001 8:15 AM

Pesticides

	StationID	FFDSSC097	FFDSSC097
	SampleID	FDSSC097T1DL (0-1ft)	FDSSC097T2 (3-5ft)
	DateCollected	10/14/1999	10/14/1999
	DateAnalyzed	10/22/1999	10/23/1999
	SDGNumber	EN021	EN021
Parameter	Units		
ALDRIN, SPLP	UG/L		
ALPHA BHC (ALPHA HEXACHLOROCYCLOHEXANE), SPLP	UG/L		
ALPHA-CHLORDANE, SPLP	UG/L		
BETA BHC (BETA HEXACHLOROCYCLOHEXANE), SPLP	UG/L		
DELTA BHC (DELTA HEXACHLOROCYCLOHEXANE), SPLP	UG/L		
DIELDRIN, SPLP	UG/L		
ENDOSULFAN I, SPLP	UG/L		
ENDOSULFAN II, SPLP	UG/L		
ENDOSULFAN SULFATE, SPLP	UG/L		
ENDRIN ALDEHYDE, SPLP	UG/L		
ENDRIN KETONE, SPLP	UG/L		
ENDRIN, SPLP	UG/L		
GAMMA BHC (LINDANE), SPLP	UG/L		
GAMMA-CHLORDANE, SPLP	UG/L		
HEPTACHLOR EPOXIDE, SPLP	UG/L		
HEPTACHLOR, SPLP	UG/L		
METHOXYCHLOR, SPLP	UG/L		
p,p'-DDD, SPLP	UG/L		
p,p'-DDE, SPLP	UG/L		
p,p'-DDT, SPLP	UG/L		
TOXAPHENE, SPLP	UG/L		

Analytical Data Summary

07/06/2001 8:13 AM

	StationID	FFDSSC097	FFDSSC097
	SampleID	FDSSC097T1 (0-1ft)	FDSSC097T2 (3-5ft)
	DateCollected	10/14/1999	10/14/1999
	DateAnalyzed	11/02/1999	11/02/1999
	SDGNumber	EN021	EN021
Parameter	Units		
TOTAL ORGANIC CARBON	%, DR	1.9 =	2.2 =

Analytical Data Summary

07/06/2001 8:16 AM

Metals

	StationID	GFDSGW16B		GFDSGW16B	
	SampleID	FDSGW16BF3		FDSGW16BU3	
	DateCollected	01/07/1999		01/07/1999	
	DateAnalyzed	01/11/1999		01/11/1999	
	SDGNumber	37018		37018	
Parameter	Units				
ANTIMONY	UG/L	2.7	U	2.7	U
ARSENIC	UG/L	214	=	204	=
BERYLLIUM	UG/L	0.1	U	0.1	U
CHROMIUM, TOTAL	UG/L	0.7	U	0.7	U
LEAD	UG/L	1.5	U	1.5	U
MERCURY	UG/L	0.1	U	0.1	U
THALLIUM	UG/L	3.1	U	3.1	U

Analytical Data Summary

07/06/2001 8:16 AM

General Chemistry

StationID GFDSGW16B
SampleID FDSGW16B03b
DateCollected 01/07/1999
DateAnalyzed 01/18/1999
SDGNumber 37018

Parameter

Parameter	Units	
Total Suspended Solids (TSS)	MG/L	92 =



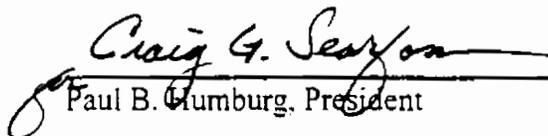
HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#: EN018
Date: November 29, 1999
Client Name: Ensafe
Project/Site Name: Charleston Zone F
Date Sampled: October 12, 1999
Number of Samples: 10 Aqueous Sample(s) with 0 MS/MSD(s)
Laboratory: Laucks Testing laboratories
Validation Guidance: National Functional Guidelines for Organic and Inorganic Data,
February, 1994
QA/QC Level: EPA DQO Level III
Method(s) Utilized: SW846 Third Edition
Analytical Fractions: Volatiles, Semivolatiles, Metals

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user is urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:


Paul B. Gumburg, President

11-30-99
Date

SDG# EN018

Samples and Fractions Reviewed

Sample Identifications

Analytical Fractions

ENSAFE ID	MATRIX	VOA	SVOA	MET			
607GW009A5	WATER			X			
609GW00102	WATER	X		X			
609GW00202	WATER	X		X			
613GW00105	WATER	X					
613GW00603	WATER	X	X	X			
613HW00603	WATER	X	X	X			
613DW00603	WATER	X	X	X			
FDSGW17A05	WATER	X	X	X			
FDSGW17B06	WATER	X	X	X			
GELGW01406	WATER	X	X	X			
Total Billable Samples (Water/Soil)		9	0	6	0	9	0

VOA= Volatiles
 SVOA= Semivolatiles
 MET= Metals

DATA ASSESSMENT NARRATIVES

DATA ASSESSMENT NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8260B for GC/MS Volatiles; the National Functional Guidelines for Organic Data Validation, 2/94, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # EN018

A validation was performed on the Volatile Data from SDG EN018. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- Calibration
- * • Blanks
- * • Internal Standard Performance
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- * • Compound Quantitation

* - All criteria were met for this parameter.

Calibrations

The initial calibration analyzed 10/18/99 on Instrument Flipper exhibited one (1) compound with an average RRF less than 0.05. For the following samples and non-compliant compound, the reported positive results are qualified as estimated, J, and the non-detect results are rejected, UR.

All Samples acetone (0.045)

**DATA ASSESSMENT NARRATIVE
VOLATILE ORGANICS**

PAGE 2

Calibrations (continued)

The continuing calibration F1029004.D exhibited one (1) compound with a RF less than 0.05. For the following samples and non-compliant compound, the reported positive results are qualified as estimated, J, and the non-detect results are rejected, UR.

609GW00202 acetone (0.037)

System Performance and Overall Assessment

The data, as reported, required qualifications/rejections.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

L = Result is estimated and biased low.

K = Result is estimated and biased high.

R = Result is rejected and unusable

D = Result value is based on dilution analysis

BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

<u>SAMPLE ID</u>	<u>COMPOUND ID</u>	<u>DL</u>	<u>QL</u>
All Samples	acetone (0.045)	+/-	J/UR
609GW00202	acetone (0.037)	+/-	J/UR

- * DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE

SEMIVOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8270C for GC/MS Semivolatiles; the National Functional Guidelines for Organic Data Validation, 2/94, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # EN018

A validation was performed on the Semivolatile Data from SDG EN018. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- * • Calibration
- * • Blanks
- Internal Standard Performance
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- Compound Quantitation

* - All criteria were met for this parameter.

Internal Standards

The following samples exhibited non-compliant EICP area recoveries below the QC limits for the noted internal standards. All reported positive and non-detect results are qualified as estimated, J/UJ.

613GW00603 perylene-d12
613HW00603

**DATA ASSESSMENT NARRATIVE
SEMIVOLATILE ORGANICS**

PAGE 2

Compound Quantitation

For the following sample the reported results are not used in favor of the results reported from the RE analysis. The RE analysis exhibited improved internal standard area recoveries and surrogate recoveries.

GELGW01406

System Performance and Overall Assessment

The data, as reported, required qualifications/rejections.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

L = Result is estimated and biased low.

K = Result is estimated and biased high.

R = Result is rejected and unusable

D = Result value is based on dilution analysis

BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

<u>SAMPLE ID</u>	<u>COMPOUND ID</u>	<u>DL</u>	<u>QL</u>
613GW00603 613HW00603	<i>All associated with</i> perylene-d12	+/-	J/UJ
GELGW01406	All Compounds	+/-	Do Not use

- * DL denotes the Form I qualifier supplied by the laboratory
QL denotes the qualifier used by the data validation firm
+ in the DL column denotes a positive result
- in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE METALS

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 methods: the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDGs # EN018

A validation was performed on the Metals for Data from SDG EN018. The data was evaluated based on the following parameters.

- * ● Data Completeness
- * ● Holding Times
- * ● Calibrations
- Blanks
- * ● Interferences
- * ● Matrix Spike Recovery
- * ● Matrix Duplicates
- * ● Field Duplicates
- * ● Laboratory Control Samples
- Serial Dilutions

* - All criteria were met for this parameter.

Preparation and Field Blanks

The preparation and calibration blanks exhibited contamination for the following elements.

<u>Elements</u>	<u>Conc.</u>	<u>Samples affected</u>
Calcium	97.4 ug/l	no impact
Iron	56.4 ug/l	no impact
Magnesium	71.6 ug/l	no impact
Zinc	4.9 ug/l	all water samples below 24.5 ug/l

The USEPA requires that all sample values below five times the preparation or calibration blank contamination be qualified as non-detect, "U".

The preparation blanks exhibited negative bias for the following elements.

<u>Elements</u>	<u>Conc.</u>	<u>Samples affected</u>
Aluminum	-75.9 ug/l	all water samples below 759 ug/l
Chromium	-1.2 ug/l	all water samples below 12.0 ug/l
Nickel	-11.2 ug/l	all water samples below 12.0 ug/l

This reviewer qualifies all samples results below 10 times the absolute value of the negative blank value.

Serial Dilution recovery results

The serial dilution results for waters for Barium, Potassium and Sodium were greater than 10%. All positive results are qualified as estimated, "J".

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B". Value is below the CRDL but greater than the IDL.

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
all water samples below 4.9 ug/l	Zn.	+	U
all water samples below 759 ug/l	Al.	+/U	J/UJ
all water samples below 12.0 ug/l	Cr.		
all water samples below 12.0 ug/l	Ni.		
all water samples	Ba, K and Na.	+	J
all "B" results	all analytes	B	J

CHAIN OF CUST RECORD

PROJECT/JOB NO: 2406-001-CB-47U-UK
 CDC NO: _____
 PD NO: 1940
 REL NO: 36-37
 LAB NAME: Lauck's Testing Lab

To: **charlie** 9910324
 ENP18

CLIENT: **CNC**
 LOCATION: **Zone F**
 SAMPLERS: (SIGNATURE) **PB Hardy**

PROJECT MANAGER: **Charlie Vernoy**
 TELE/FAX NO: (843) 884-0029
 (843) 856-0107

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		ANALYSIS REQUIRED						REMARKS	
					TEMP.	CHEMICAL	NO. OF CONTAINERS	VOA	SUGA	Pest/PCB	Metals	Cyanide		
NBCF/6130W0060X	10/13/99	1045	H ₂ O	40 ml vial 12 12 Amber Mly	44	*	6	X	X	X	X	X	X	GW DI Blank
NBCF/6130B01501	↑	1045	↑	40 ml VOA 12 Amber Ply	↑	↑	9	X	X	X	X	X	X	GW DI Blank
NBCF/6137B00601	↑	1130	↑	40 ml VOA	↑	↑	3	X						Trip Blank
NBCF/6076N00945	↑	1556	↑	12 poly	↑	↑	1				X			Moved to
NBCF/6096W00102	↑	1615	↑	40 ml vial 12 Amber	↑	↑	4	X			X			10/13/99 CDC Report with S&S
NBCF/6096W00202	↑	1645	↑	40 ml VOA 12 Amber	↑	↑	4	X			X			
NBCF/6136W00105	↑	1555	↑	40 ml VOA	↑	↑	1	X						
NBCF/6136W00603	↑	1110	↑	40 ml VOA 12 Amber	↑	↑	6	X	X		X			
NBCF/613HW00603	↑	1110	↑	" "	↑	↑	6	X	X		X			
NBCF/6136W01406	↑	1153	↑	" "	↑	↑	6	X	X		X			
NBCF/F056W17A05	↑	1200	↑	" "	↑	↑	6	X	X		X			
NBCF/F056W17B06	↓	1140	↓	" "	↓	↓	6	X	X		X			

RELINQUISHER: **PB Hardy** DATE: 10/13/99
 RECEIVED: **Charles Christensen** DATE: 10/13/99
 PRINTED: **PB Hardy** TIME: 1800
 COMPANY: **EnSafe** COMPANY: **LAUCKS**

METHOD OF SHIPMENT: **FEDEX**
 SHIPMENT NO: **809609460076**
 SEND RESULTS TO: **EnSafe**
 COMMENTS: *** H₂O - VOA**
H₂O - Metals
Metals - Cyanide
DOO Level III plus TICs

935 Houston Northcut Boulevard
Mt. Pleasant, South Carolina 29464

Phone (843) 884-0029
Fax (843) 856-0107

To: Jenna - Laucks

From: Julie - Charleston

Date: 10/14/99

Fax to Number: _____

Number of Pages: 5

Remarks

Here are the amended COC for Zone F 10/12/99 and 10/13/99.

GW Zone F COC 10/12/99

- ① Proj/Job# should be 2906-001-08-440-00 for 10/12/99 COC
- ② PO/REL# should be PO1840REL37 for 10/12/99 COC (GW)
- ③ 613DB01501 and 613TB00601 should be moved to 10/13/99 COC
They are associated with the Soil Boring not Groundwater
- ④ 613DW00601 should be changed to 613DW00603

SOIL Zone F COCs 10/13/99

- ⑤ Proj/Job# should be 2906-001-08-420-00 for 10/13/99 COCs (Soil)
- ⑥ TOC should be added to Samples 613SP022T₁ and 613SP022T₂
- ⑦ 61301902 should be 613SB01902
- ⑧ 61302001 should be 613SB02001
- ⑨ 613DB01501 and 613TB00601 should be added to 10/13/99 COC

Please call me if you have any questions or problems. ^{or email}

Thanks. Julie ☺

(Just a reminder - if you need to drop any part of the sample ID you don't need the "NBCF/" part of it.)

CHAIN OF CUSTODY RECORD

800-588-7962
MEMPHIS, TENNESSEE
CHARLESTON, SC; CINCINNATI, OH; DALLAS, TX; JACKSON, TN; KNOXVILLE, TN;
LANCASTER, PA; NASHVILLE, TN; NORFOLK, VA; PADUCAH, KY; PENSACOLA, FL;
RALEIGH, NC; COLOGNE, GERMANY

PROJECT/JOB NO: _____
COC NO: _____
PO NO: 1840
REL NO: 36
LAB NAME: Lavick's Testing Lab

CLIENT: CNC PROJECT MANAGER: Charlie Vernoy
LOCATION: _____ TELE/FAX NO: (843) 884-0029
SAMPLERS: (SIGNATURE) PB Hardy (843) 856-0107

NO. OF CONTAINERS	ANALYSIS REQUIRED					REMARKS
	VOA	SVOA	Pest/PCB	Metals	Cyanide	
6	X	X	X	X		GW DI Blank
4	X	X	X	X		SOI DI Blank
3	X					Trip Blank
1			X			
4	X		X			
4	X		X			
3	X		X			
6	X	X	X			
6	X	X	X			
6	X	X	X			
6	X	X	X			

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION	
					TEMP.	CHEMICAL
NBCF613DW00601	10/12/99	1045	H ₂ O	40 ml VOA / 12 Amber Poly	4°C	*
NBCF613DB01501	↑	1045	↑	40 ml VOA / 12 Amber Poly	↑	↑
NBCF/613TB00601	↑	1130	↑	40 ml VOA	↑	↑
NBCF/6076N00945	↑	1556	↑	12 poly	↑	↑
NBCF/6096W00102	↑	1615	↑	40 ml VOA / 12 Poly	↑	↑
NBCF/6096W00202	↑	1645	↑	40 ml VOA / 12 Poly	↑	↑
NBCF/613GW00105	↑	1555	↑	40 ml VOA	↑	↑
NBCF/613GW00603	↑	1110	↑	40 ml VOA / 12 Poly	↑	↑
NBCF/613HW00603	↑	1110	↑	" "	↑	↑
NBCF/613HW01406	↑	1153	↑	" "	↑	↑
NBCF/FD56W17A05	↑	1200	↑	" "	↑	↑
NBCF/FD56W17B06	↓	1140	↓	" "	↓	↓

RELINQUISHER: <u>PB Hardy</u>	DATE: <u>10/13/99</u>	RECEIVER: <u>Chl Christ</u>	DATE: <u>10/13/99</u>	RELINQUISHER: _____	DATE: _____
PRINTED: <u>PB Hardy</u>	TIME: <u>1800</u>	PRINTED: _____	TIME: <u>0840</u>	PRINTED: _____	TIME: _____
COMPANY: <u>Ensafe</u>	COMPANY: <u>LAVERICK'S</u>	Charles Christensen	COMPANY: _____	COMPANY: _____	COMPANY: _____

METHOD OF SHIPMENT: FEDEX
SHIPMENT NO: 309609460076
SEND RESULTS TO: Ensafe

COMMENTS: * HCF - VOA
H₂O - Metals
NAOH - Cyanide
DOO Level III plus TICs



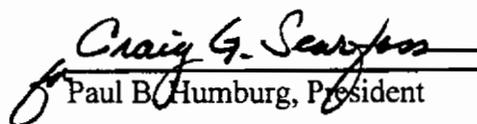
HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#: EN021
Date: November 22, 1999
Client Name: Ensafe
Project/Site Name: Charleston Zone F
Date Sampled: October 14, 1999
Number of Samples: 30 Non-Aqueous Sample(s) with 0 MS/MSD(s)
1 Aqueous Sample(s) with 0 MS/MSD(s)
Laboratory: Laucks Testing Laboratories
Validation Guidance: National Functional Guidelines for Organic and Inorganic Data,
February, 1994
QA/QC Level: DQO Level III
Method(s) Utilized: SW846 Third Edition
Analytical Fractions: Volatiles, SPLP Volatiles, Semivolatiles, SPLP Semivolatiles,
Pesticides/PCBs, SPLP Pesticides/PCBs, Metals, SPLP Metals,
Cyanide, SPLP Cyanide and Total Organic Carbon

Analytical data in this report were screened to determine usability of results and also to determine contractual compliance relative to these requirements and deliverables. This screening assumes analytical results are correct as reported and merely provides an interpretation of the reported quality control results. A minimum of 10% of all laboratory calculations have been verified as part of this validation. All instrument output, i.e. spectra, chromatograms, etc., for each sample have been carefully reviewed. The end-user is urged to review the Specific Findings and associated Data Qualifications presented in this report. Annotated Form 1s or spreadsheets for all samples reviewed are included after the Data Assessment Narratives. Form 1s for MS/MSD samples or spreadsheets are not annotated.

The release of this Data Validation Report is authorized by the following signature:


Paul B. Humburg, President

11-30-99
Date

SDG# EN021

Samples and Fractions Reviewed

Sample Identifications

Analytical Fractions

ENSAFE ID	MATRIX	VOA	SPLP-V	SVOA	SPLP-SV	P/P	SPLP-P/P	MET	SPLP-MET	CN	SPLP-CN	TOC
607SB010T1	SOIL	X		X		X		X		X		X
607SB010T2	SOIL	X		X		X		X		X		X
611SB001T1	SOIL	X		X		X		X		X		X
611SB001T2	SOIL	X		X		X		X		X		X
611SB002T1	SOIL	X		X		X		X		X		X
611SB002T2	SOIL	X		X		X		X		X		X
613SB00201	SOIL			X				X				
613SB00202	SOIL			X				X				
613SB00301	SOIL			X				X				
613CB00301	SOIL			X				X				
613SB00302	SOIL			X				X				
613CB00302	SOIL			X				X				
613SB01201	SOIL			X				X				
613CB01201	SOIL			X				X				
613SB01202	SOIL			X				X				
613CB01202	SOIL			X				X				
613SB01301	SOIL			X				X				
613CB01301	SOIL			X				X				
613SB01302	SOIL			X				X				
613CB01302	SOIL			X				X				
FDSSC097T1	SOIL	X		X		X		X		X		X
FDSSC097T2	SOIL	X		X		X		X		X		X
607SB010S1	SOIL		X		X		X		X		X	
607SB010S2	SOIL		X		X		X		X		X	
611SB001S1	SOIL		X		X		X		X		X	
611SB001S2	SOIL		X		X		X		X		X	
611SB002S1	SOIL		X		X		X		X		X	
611SB002S2	SOIL		X		X		X		X		X	
613TB01301	WATER		X									
FDSSC097S1	SOIL		X		X		X		X		X	
FDSSC097S2	SOIL		X		X		X		X		X	
Total Billable Samples (Water/Soil)		0 8	1 8	0 22	0 8	0 8	0 8	0 22	0 8	0 8	0 8	0 8

VOA= Volatiles
 SPLP-V= SPLP Volatiles
 SVOA= Semivolatiles
 SPLP-SV= SPLP Semivolatiles
 P/P= Pesticides/PCBs
 MET= Metals
 SPLP-MET= SPLP Metals
 CN= Cyanide
 SPLP-CN= SPLP Cyanide
 TOC= Total Organic Carbon

DATA ASSESSMENT NARRATIVES

DATA ASSESSMENT NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8260B for GC/MS Volatiles; the National Functional Guidelines for Organic Data Validation, 2/94, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # EN021

A validation was performed on the Volatile Data from SDG EN021. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- Calibration
- Blanks
- Internal Standard Performance
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- Compound Quantitation

* - All criteria were met for this parameter.

**DATA ASSESSMENT NARRATIVE
VOLATILE ORGANICS**

PAGE 2

Calibrations

The initial calibration analyzed 10/18/99 on Instrument Flipper exhibited one (1) compound with a RRF less than 0.05. For the following samples and non-compliant compound, the reported positive results are qualified as estimated, J, and the non-detect results are rejected, UR.

All SPLP Samples acetone (0.045)

The continuing calibration F1020010.D exhibited one (1) compound with a RRF less than 0.05. For the following samples and non-compliant compound, the reported positive results are qualified as estimated, J, and the non-detect results are rejected, UR.

All SPLP Samples acetone (0.045)

Blanks

The method blanks associated with the soil samples in this SDG exhibited contamination for which qualifications were required. The end user should note that the action levels indicated for the blank analysis may not involve the same weights, volumes, dilution factors, or percent moisture as associated samples. These factors must be taken into considerations when applying the 5X and 10X criteria to field samples.

<u>Associated blank</u>	<u>Compound</u>	<u>Concentration</u>	<u>Action Level</u>
VBLKO1	methylene chloride	5 ug/Kg	50 ug/Kg
VBLKO2	methylene chloride	9 ug/Kg	90 ug/Kg
	acetone	9 ug/Kg	90 ug/Kg

<u>Samples</u>	<u>Compound</u>	<u>Qualifications</u>
611SB001T1	methylene chloride	U
611SB002T1		
611SB002T1		
611SB002T2		
FDSSC097T1		

**DATA ASSESSMENT NARRATIVE
VOLATILE ORGANICS**

PAGE 4

Blanks (continued)

<u>Samples</u>	<u>Compound</u>	<u>Qualifications</u>
611SB001T2RE 607SB010T1 607SB010T2 FDSSC097T2RE	methylene chloride	U
611SB001T2RE 607SB010T1 607SB010T2 FDSSC097T2RE	acetone	U

Internal Standards

The following samples exhibited non-compliant EICP area recoveries below the QC limits for the noted internal standards. All reported positive and non-detect results are qualified as estimated, J/UJ.

607SB010T1 FDSSC097T2RE	1,4-dichlorobenzene-d4
----------------------------	------------------------

Compound Quantitation

For the following samples, the reported results are not used in favor of the results reported from the original or RE analysis of the samples. The samples used exhibited improved or similar internal standard areas.

607SB010T1RE
611SB001T2
FDSSC097T2

System Performance and Overall Assessment

The data, as reported, required qualifications/rejections.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

L = Result is estimated and biased low.

K = Result is estimated and biased high.

R = Result is rejected and unusable

D = Result value is based on dilution analysis

BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

<u>SAMPLE ID</u>	<u>COMPOUND ID</u>	<u>DL</u>	<u>QL</u>
All SPLP Samples	acetone (0.045)	+/-	J/UR
All SPLP Samples	acetone (0.045)	+/-	J/UR
611SB001T1 611SB002T1 611SB002T1 611SB002T2 FDSSC097T1 611SB001T2RE 607SB010T1 607SB010T2 FDSSC097T2RE	methylene chloride	+B	U
611SB001T2RE 607SB010T1 607SB010T2 FDSSC097T2RE	acetone	+B	U
607SB010T1 FDSSC097T2RE	<i>All associated with</i> 1,4-dichlorobenzene-d4	+/-	J/UJ
607SB010T1RE 611SB001T2 FDSSC097T2	All compounds	+/-	Do Not Use

- * DL denotes the Form I qualifier supplied by the laboratory
 QL denotes the qualifier used by the data validation firm
 + in the DL column denotes a positive result
 - in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE

SEMIVOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8270C for GC/MS Semivolatiles; the National Functional Guidelines for Organic Data Validation, 2/94, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # EN021

A validation was performed on the Semivolatile Data from SDG EN021. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC/MS Tuning
- Calibration
- * • Blanks
- Internal Standard Performance
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- Field Duplicates
- * • Compound Identification
- Compound Quantitation

* - All criteria were met for this parameter.

Calibrations

The continuing calibration D1027002.D exhibited one (1) compound with a %D greater than 20% but less than 50% for. For the following samples and non-compliant compound, the reported positive results are qualified as estimated, J.

607SB010T1	indeno(1,2,3-cd)pyrene (21.1%)
FDSSC097T2	dibenz(a,h)anthracene (24.5%)
	benzo(g,h,i)perylene (25.8%)

**DATA ASSESSMENT NARRATIVE
SEMIVOLATILE ORGANICS**

PAGE 2

Internal Standards

The following samples exhibited non-compliant EICP area recoveries below the QC limits for the noted internal standards. All reported positive and non-detect results are qualified as estimated, J/UJ.

613SB00301	perylene-d12
613CB00302	
613CB00301	chrysene-d12
FDSSC097T2	perylene-d12

Field Duplicates

The field duplicate analysis of the following samples exhibited non-compliant RPDs for the noted compounds. The reported positive results are qualified as estimated, J.

613SB01301	phenanthrene
613CB01301	fluoranthene
	pyrene
	benzo(a)anthracene
	chrysene
	benzo(b)fluoranthene
	benzo(a)pyrene

Compound Quantitation

For the following samples, the reported results are not used in favor of the results reported from the original analyses of the samples. The dilution analyses were not necessary because there were no compounds reported in the lessor dilutions that were above the calibration range.

613CB00301DL
613SB00301DL
613CB00302DL
FDSSC097T2DL

System Performance and Overall Assessment

The data, as reported, required qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

L = Result is estimated and biased low.

K = Result is estimated and biased high.

R = Result is rejected and unusable

D = Result value is based on dilution analysis

BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

<u>SAMPLE ID</u>	<u>COMPOUND ID</u>	<u>DL</u>	<u>QL</u>
607SB010T1 FDSSC097T2	indeno(1,2,3-cd)pyrene (21.1%) dibenz(a,h)anthracene (24.5%) benzo(g,h,i)perylene (25.8%)	+	J
613SB00301 613CB00302	<i>All associated with</i> perylene-d12	+/-	J/UJ
613CB00301 FDSSC097T2	<i>All associated with</i> chrysene-d12 perylene-d12	+/-	J/UJ
613SB01301 613CB01301	phenanthrene fluoranthene pyrene benzo(a)anthracene chrysene benzo(b)fluoranthene benzo(a)pyrene	+	J
613CB00301DL 613SB00301DL 613CB00302DL FDSSC097T2	All Compounds	+/-	Do Not Use

- * DL denotes the Form I qualifier supplied by the laboratory
 QL denotes the qualifier used by the data validation firm
 + in the DL column denotes a positive result
 - in the DL column denotes a non detect result

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLORS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8081A/8082; the National Functional Guidelines for Organic Data Validation, February 1994; and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # EN021

A validation was performed on the Pesticide/Aroclor Data from SDG EN021. The data was evaluated based on the following parameters:

- * • Data Completeness
- * • Holding Times
- * • GC Performance
- Calibration
- * • Blanks
- * • Surrogate Recoveries
- * • Matrix Spike/Matrix Spike Duplicates
- * • Field Duplicates
- * • Compound Identification
- Compound Quantitation

* - All criteria were met for this parameter.

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLOR ANALYSIS

PAGE - 2

Continuing Calibrations

The continuing calibration analyzed on 10/22/99 at 17:28 exhibited one (1) compound with a %D greater than 15% and less than 50% and required qualifications. For the following sample and non-compliant compound, the positive results are qualified as estimated, J.

607SB010T1 4,4'-DDE (-17.8%)

The continuing calibration analyzed on 10/23/99 at 03:15 exhibited one (1) compound with a %D greater than 15% and less than 50% and required qualifications. For the following sample and non-compliant compound, the positive results are qualified as estimated, J.

FDSSC097T2 4,4'-DDE (-16.9%)

Compound Quantitation

Several samples exhibited column quantitation %Ds greater than 40%. The following guidelines were used to qualify the data:

1. No qualifications are required for positive sample results which exhibited column quantitation differences < 40%. The "P" flag is removed from the result.
2. The positive sample result which exhibited a column quantitation difference > 40%, but ≤ 100% is qualified as estimated, J.
3. The positive single component pesticide sample result which exhibited a column quantitation difference > 100% and is < 10X the respective compound CRQL, is qualified as non-detect, U. (All multi-component results are exempt from this rule.)
4. The positive single component pesticide sample result which exhibited a column quantitation difference > 100% and > 10X the respective compound CRQL, is qualified as presumptively present at an estimated concentration, NJ. (All multi-component results are exempt from this rule.)
5. The positive multi-component pesticide sample result which exhibited a column quantitation difference > 100% and < 10% the respective multi-component CRQL is qualified as presumptively present at an estimated concentration, NJ.

DATA ASSESSMENT NARRATIVE

PESTICIDE/AROCLOR ANALYSIS

PAGE - 3

Compound Quantitation, Continued

The following samples and compounds have been qualified for high column quantitation %Ds.

<u>Sample ID</u>	<u>Compound</u>	<u>%D</u>	<u>Lab Qual.</u>	<u>HESI Qual.</u>	<u>Ref. #</u>
FDSSC097T2	Gamma-Chlordane	29.8%	P		1
	4,4'-DDE	33%	P		1
607SB010T1	Gamma-Chlordane	28.8%	P		1

One (1) sample was diluted to accurately quantitate target compounds. For the following sample, the results for the E-flagged compounds are replaced with the corresponding results from the dilution analysis. All other results from the dilution analysis are not used.

FDSSC097T1

System Performance and Overall Assessment

The data required qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

NJ = Result is considered presumptively present at an estimated concentration

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 5X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.

No Action = The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

<u>SAMPLE ID</u>	<u>COMPOUND ID</u>	<u>DL</u>	<u>QL</u>
607SB010T1	4,4'-DDE	+	J
FDSSC097T2	4,4'-DDE	+	J
ALL	All P < 40%	+	
ALL	All P > 40% But ≤ 100%	+	J
ALL	single component pests All P > 100% And < 10X CRQL	+	U
ALL	single component pests All P > 100% And > 10X CRQL	+	NJ
ALL	multi-component pests All P > 100% And < 10X CRQL	+	NJ
FDSSC097T1	All E-Flagged	+E	D
FDSSC097T1DL	All except corresponding D-Flagged results	+/-	not used

- * DL denotes the Form I qualifier supplied by the laboratory
 QL denotes the qualifier used by the data validation firm
 + in the DL column denotes a positive result
 - in the DL column denotes a non-detect result

DATA ASSESSMENT NARRATIVE METALS (SOILS AND SPLP) AND TOC

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 methods: the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDGs # EN021

A validation was performed on the Metals for soils and SPLP and TOC Data from SDG EN021. The data was evaluated based on the following parameters.

- * ● Data Completeness
- * ● Holding Times
- * ● Calibrations
- Blanks
- * ● Interferences
- Matrix Spike Recovery
- Matrix Duplicates
- * ● Field Duplicates
- * ● Laboratory Control Samples
- Serial Dilutions

* - All criteria were met for this parameter.

Preparation and Field Blanks

The preparation and calibration blanks exhibited contamination for the following elements.

<u>Elements</u>	<u>Conc.</u>	<u>Samples affected</u>
Calcium	75.4 mg/kg	no impact
Tin	2.16 mg/kg	all soil samples below 10.8 mg/kg
Zinc	0.40 mg/kg	no impact
Antimony	3.0 ug/l	all SPLP samples below 15.0 ug/l
Iron	80.1 ug/l	all SPLP samples below 400 ug/l
Manganese	0.50 ug/l	all SPLP samples below 2.5 ug/l
Zinc	2.2 ug/l	no impact

Tin 3.1 ug/l all SPLP samples below 15.5 ug/l

The USEPA requires that all sample values below five times the preparation or calibration blank contamination be qualified as non-detect, "U".

Matrix Spike Recovery results

The matrix spike recoveries for soils for Zinc (4%), Chromium (16%) and Copper (10%) were below 30%. All positive results are qualified as estimated, "J" and all non-detect results are rejected, "UR".

The matrix spike recoveries for soils for Antimony (53%), Manganese (54%) and Nickel (70%) were below the lower control limits (>30% but <75%). All positive and non-detect results are qualified as estimated, "J" or "UJ".

Matrix Duplicate results

The matrix duplicate RPD results for soils for Calcium (129%), Chromium (62%), Cobalt (81%), Copper (101%), Iron (52%), Lead (70%), Zinc (76%) and Nickel (90%) were greater than 35% and for SPLP samples for Zinc was greater than the CRDL. All positive results are qualified as estimated, "J".

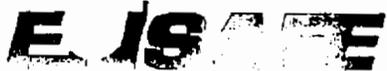
Serial Dilution recovery results

The serial dilution results for soils for Calcium, Iron, Magnesium and Iron and for splp samples for Potassium were greater than 10%. All positive results are qualified as estimated, "J".

All sample results left with a "B" qualifier after all other qualifications, will be qualified with a "J" qualifier in place of the "B". Value is below the CRDL but greater than the IDL.

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
all soil samples below 10.8 mg/kg	Sn.	+	U
all SPLP samples below 15.0 ug/l	Sb.		
all SPLP samples below 400 ug/l	Fe.		
all SPLP samples below 2.5 ug/l	Mn.		
all SPLP samples below 15.5 ug/l	Sn.		
all soil samples	Zn, Cr and Cu.	+ U	J UR
all soil samples	Sb, Mn and Ni.	+/U	J/UJ
all soil samples	Ca, Cr, Co, Cu, Fe, Pb, Ni and Zn.	+	J
all SPLP samples	Zn.		
all soil samples	Ca, Fe, Mg and K.	+	J
all SPLP samples	K.		
all "B" results	all analytes	B	J



091041-1 EN0221
EN021
CHAIN OF CUSTODY RECORD

PAGE 6 OF 6
PROJECT/JOB NO: 290600, 842000
COC NO:
PO NO: 1840
REL NO: 36
LAB NAME: LAUCK'S

CLIENT: U.S.N. PROJECT MANAGER: C. V. CROFT
LOCATION: Zone F Charleston, SC TELE/FAX NO. (843) 884-0029 ph
SAMPLERS: (SIGNATURE) PA Hardy (843) 956-0107 fax

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED										REMARKS	
					TEMP.	CHEMICAL		VOA	SVOA	PEST	PCB	METALS	CYANIDE	TOC	SPL VOA & SPL SVA	SPL PEST & SPL PCB	SPL METALS & SPL CYANIDE		
NBCF/611SB001T1	10/14/99	0830	SOIL	8oz. GLASS/ENL	4°C	NONE	5	X	X	X	X	X	X						
NBCF/611SB001S1		0830		8oz. GLASS			3								X	X	X		
NBCF/611SB001T2		0845		8oz. GLASS/ENC			5	X	X	X	X	X	X						
NBCF/611SB001S2		0845		8oz. GLASS			3								X	X	X		
NBCF/611SB002T1		0900		8oz. GLASS/ENL			5	X	X	X	X	X	X						
NBCF/611SB002S1		0900		8oz. GLASS			3								X	X	X		
NBCF/611SB002T2		0918		8oz. GLASS/ENC			5	X	X	X	X	X	X						
NBCF/611SB002S2		0918		8oz. GLASS			3								X	X	X		
NBCF/FDSSC097T1		1100		8oz / ENC			5	X	X	X	X	X	X						
NBCF/FDSSC097S1		1100		8oz			3								X	X	X		
NBCF/FDSSC097T2		1115		8oz / ENC			5	X	X	X	X	X	X						
NBCF/FDSSC097S2		1115		8oz			3								X	X	X		
NBCF/607SB010T1		1147		8oz / ENC			5	X	X	X	X	X	X						
NBCF/607SB010S1		1147		8oz			3								X	X	X		
NBCF/607SB010T2		1200		8oz / ENC			5	X	X	X	X	X	X						
NBCF/607SB010S2		1200		8oz			3								X	X	X		

RELINQUISHER: PA Hardy DATE: 10/14/99 TIME: 1830
 RECIPIENT: PAM R. JOHNSON DATE: 10/16/99 TIME: 0830
 COMPANY: ENSAFE COMPANY: LAUCK'S

METHOD OF SHIPMENT: FEDEX
 SHIPMENT NO: 814 7959 222 79
 SEND RESULTS TO: ENSAFE
 COMMENTS:



9910414 ~~EN022~~ 14
EN021
CHAIN OF CUSTODY RECORD

PAGE 5 OF 6 88 14
PROJECT/JOB NO: 2906 00108420 00
COC NO: _____
PD NO: 1840
REL NO: 36
LAB NAME: Lauck's

CLIENT: CNE PROJECT MANAGER: C. Verney
LOCATION: Zone F TELE/FAX NO: (843) 884-0029 ^{ph}
SAMPLERS: (SIGNATURE) PB Hardy (843) 856-0107 ^{FAX}

ANALYSIS REQUIRED

NO. OF CONTAINERS
SUA
Metals
VOA

REMARKS

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED			REMARKS
					TEMP.	CHEMICAL		SUA	Metals	VOA	
NBCF613SB01201	10/19/99	0905	Soil	8oz Jar	4°C	—	2	X	X		
NBCF613CB01201	"	"	"	"	"	—	2	X	X		
NBCF613SB01202	"	0920	"	"	"	—	2	X	X		
NBCF613CB01202	"	"	"	"	"	—	2	X	X		
NBCF613SB01301	"	"	"	"	"	—	2	X	X		
NBCF613CB01301	"	"	"	"	"	—	2	X	X		
NBCF613SB01302	"	0950	"	"	"	—	2	X	X		
NBCF613CB01302	"	"	"	"	"	—	2	X	X		
NBCF613SB00301	"	1100	"	"	"	—	2	X	X		
NBCF613CB00301	"	"	"	"	"	—	2	X	X		
NBCF613SB00302	"	1115	"	"	"	—	2	X	X		
NBCF613CB00302	"	"	"	"	"	—	2	X	X		
NBCF613SB00201	"	1130	"	"	"	—	2	X	X		
NBCF613SB00202	"	1140	"	"	"	—	2	X	X		
NBCF613TB01301	"	1700	Hand	40 ml VOA	"	—	2			X	trip blank

RELINQUISHER: PB Hardy DATE: 11/14/99 RECEPTOR: [Signature] DATE: 10/15/99
PRINTED: PB Hardy TIME: 1830 PRINTED: PAM R. JOHNSON TIME: 0630
COMPANY: EnSafe COMPANY: Lauck's COMPANY: _____

METHOD OF SHIPMENT: FEDEX COMMENTS: _____
SHIPMENT NO: 314795922279
SEND RESULT: EnSafe



091041 EN001/1
EN021

PAGE 6 OF 6
PROJECT/JOB NO: 2906001 0842000
COC NO:
PO NO: 194.0
REL NO: 36
LAB NAME: LAUCK'S

800-888-7818
MEMPHIS, TENNESSEE
CHARLESTON, SC; CINCINNATI, OH; DALLAS, TX; JACKSON, MS; KNOXVILLE, TN;
LANCASTER, PA; NASHVILLE, TN; PORTLAND, ME; RICHMOND, VA; RIVERSIDE, CA;
WILSON, NC; COLORADO, CO

CHAIN OF CUSTODY RECORD

CLIENT: U.S. NAVY PROJECT MANAGER: C. V. CROY
LOCATION: Zone F Charleston, SC TELE/FAX NO.: (843) 884-0029 ph
SAMPLERS: (SIGNATURE) PB Hardy (843) 956-0107 fax

NO. OF CONTAINERS	ANALYSIS REQUIRED										REMARKS
	VOA	SVOA	PEST	PCB	METALS	CYANIDE	TOC	SPP VOA	SPP PEST	SPP PCB	

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	VOA	SVOA	PEST	PCB	METALS	CYANIDE	TOC	SPP VOA	SPP PEST	SPP PCB	REMARKS
					TEMP.	CHEMICAL												
NBCF/611SB001T1	10/14/99	0830	SOIL	8oz. GLASS/ENL	4°C	NONE	5	X	X	X	X	X	X					
NBCF/611SB001S1		0830		8oz. GLASS			3							X	X	X		
NBCF/611SB001T2		0845		8oz. GLASS/ENC			5	X	X	X	X	X	X					
NBCF/611SB001S2		0845		8oz. GLASS			3							X	X	X		
NBCF/611SB002T1		0900		8oz. GLASS/ENL			5	X	X	X	X	X	X					
NBCF/611SB002S1		0900		8oz. GLASS			3							X	X	X		
NBCF/611SB002T2		0918		8oz. GLASS/ENC			5	X	X	X	X	X	X					
NBCF/611SB002S2		0918		8oz. GLASS			3							X	X	X		
NBCF/FDSSC097T1		1100		8oz / ENC			5	X	X	X	X	X	X					
NBCF/FDSSC097S1		1100		8oz			3							X	X	X		
NBCF/FDSSC097T2		1115		8oz / ENC			5	X	X	X	X	X	X					
NBCF/FDSSC097S2		1115		8oz			3							X	X	X		
NBCF/607SB010T1		1147		8oz / ENC			5	X	X	X	X	X	X					
NBCF/607SB010S1		1147		8oz			3							X	X	X		
NBCF/607SB010T2		1200		8oz / ENC			5	X	X	X	X	X	X					
NBCF/607SB010S2		1200		8oz			3							X	X	X		

RELINQUISHER: <u>PB Hardy</u>	DATE: <u>10/14/99</u>	RECEIVER: <u>PAM R. JOHNSON</u>	DATE: <u>10/16/99</u>	RELINQUISHER: _____	DATE: _____	RECEIVER: _____	DATE: _____
PRINTED: <u>PB Hardy</u>	TIME: <u>1830</u>	PRINTED: _____	TIME: <u>0830</u>	PRINTED: _____	TIME: _____	PRINTED: _____	TIME: _____
COMPANY: <u>Ensaf</u>	COMPANY: _____	COMPANY: <u>LAUCK'S</u>	COMPANY: _____	COMPANY: _____	COMPANY: _____	COMPANY: _____	COMPANY: _____

METHOD OF SHIPMENT: FedEx
SHIPMENT NO. 914 7959 222 79
SEND RESULT: Ensaf

COMMENTS: _____



800-622-7182
 MEMPHIS, TENNESSEE
 CHARLESTON, SC; CINCINNATI, OH; DALLAS, TX; JACKSON, TN; KNOXVILLE, TN;
 LANCASTER, PA; NASHVILLE, TN; NORFOLK, VA; PADUCAH, KY; PENSACOLA, FL;
 RALEIGH, NC; ROCHESTER, NY; WASHINGTON, DC

09104-1 ~~ENV021~~
 ENV021
 CHAIN OF CUSTODY RECORD

PAGE 6 OF 6 0690 is
 PROJECT/JOB NO: 290600, 0842000
 COC NO: _____
 PO NO: 194.0
 REL NO: 36
 LAB NAME: LAUCK'S

CLIENT: U.S. Navy PROJECT MANAGER: C. V. Cray
 LOCATION: Zone F Charleston, SC TELE/FAX NO: (843) 884-0029 ph
 SAMPLERS: (SIGNATURE) PA Hardy (843) 956-0107 fax

ANALYSIS REQUIRED

NO. OF CONTAINERS	VOA	SVOA	PEST	PCB	METALS	CYANIDE	TOC	SPP VOA	SPP SVOA	SPP PEST	SPP PCB	SPP METALS	SPP CYANIDE	REMARKS
-------------------	-----	------	------	-----	--------	---------	-----	---------	----------	----------	---------	------------	-------------	---------

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	VOA	SVOA	PEST	PCB	METALS	CYANIDE	TOC	SPP VOA	SPP SVOA	SPP PEST	SPP PCB	SPP METALS	SPP CYANIDE	REMARKS	
					TEMP.	CHEMICAL																
NBCF/611SB001T1	10/14/99	0830	SOIL	8oz. GLASS/ENL	4°C	NONE	5	X	X	X	X	X	X									
NBCF/611SB001S1		0830		8oz. GLASS			3	X						X	X	X						
NBCF/611SB001T2		0845		8oz. GLASS/ENC			5	X	X	X	X	X	X									
NBCF/611SB001S2		0845		8oz. GLASS			3							X	X	X						
NBCF/611SB002T1		0900		8oz. GLASS/ENL			5	X	X	X	X	X	X									
NBCF/611SB002S1		0900		8oz. GLASS			3							X	X	X						
NBCF/611SB002T2		0918		8oz. GLASS/ENC			5	X	X	X	X	X	X									
NBCF/611SB002S2		0918		8oz. GLASS			3							X	X	X						
NBCF/FDSSC097T1		1100		8oz / ENC			5	X	X	X	X	X	X									
NBCF/FDSSC097S1		1100		8oz			3							X	X	X						
NBCF/FDSSC097T2		1115		8oz / ENC			5	X	X	X	X	X	X									
NBCF/FDSSC097S2		1115		8oz			3							X	X	X						
NBCF/6075B010T1		1147		8oz / ENC			5	X	X	X	X	X	X									
NBCF/6075B010S1		1147		8oz			3							X	X	X						
NBCF/6075B010T2		1200		8oz / ENC			5	X	X	X	X	X	X									
NBCF/6075B010S2		1200		8oz			3							X	X	X						

RELINQUISHER: <u>PA Hardy</u>	DATE: <u>10/14/99</u>	RECEIVER: <u>[Signature]</u>	DATE: <u>10/16/99</u>	RELINQUISHER: _____	DATE: _____
PRINTED: <u>PA Hardy</u>	TIME: <u>1830</u>	PRINTED: <u>PAM R. JOHNSON</u>	TIME: <u>0830</u>	PRINTED: _____	TIME: _____
COMPANY: <u>ENSAFE</u>		COMPANY: <u>LAUCK'S</u>		COMPANY: _____	

METHOD OF SHIPMENT: FEDEX
 SHIPMENT NO. 814 7959 222 79
 SEND RESULT: ENSAFE

COMMENTS: _____



800-888-
MEMPHIS, TN
CHARLESTON, SC
LAWRENCEVILLE, GA
DENVER, CO
KNOXVILLE, TN
PENSACOLA, FL

09104 1 EN0021
EN0021
CHAIN OF CUSTODY RECORD

PAGE 6 OF 6
PROJECT/JOB NO: 2906001 084 2000
COC NO:
PO NO: 194.0
REL NO: 36
LAB NAME: LAUCK'S

CLIENT: U.S. Navy
PROJECT MANAGER: C. V. Cray
LOCATION: Zone F Charleston, SC
TELE/FAX NO.: (843) 884-0029 ph
SAMPLERS: (SIGNATURE) PB Hardy (843) 956-0107 fax

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		ANALYSIS REQUIRED											REMARKS									
					TEMP.	CHEMICAL	NO. OF CONTAINERS	VOA	SVOA	PEST	PCB	METALS	CYANIDE	TOC	SPP VOA	SPP SVOA	SPP PEST		SPP PCB	SPP METALS	SPP CYANIDE						
NBCF/611SB001T1	10/14/99	0830	SDIL	8oz. GLASS/ENC	4°C	NONE	5	X	X	X	X	X	X	X													
NBCF/611SB001S1		0830		8oz. GLASS			3	X										X	X	X							
NBCF/611SB001T2		0845		8oz. GLASS/ENC			5	X	X	X	X	X	X	X													
NBCF/611SB001S2		0845		8oz. GLASS			3											X	X	X							
NBCF/611SB002T1		0900		8oz. GLASS/ENC			5	X	X	X	X	X	X	X													
NBCF/611SB002S1		0900		8oz. GLASS			3											X	X	X							
NBCF/611SB002T2		0918		8oz. GLASS/ENC			5	X	X	X	X	X	X	X													
NBCF/611SB002S2		0918		8oz. GLASS			3											X	X	X							
NBCF/FDSSC097T1		1100		8oz / ENC			5	X	X	X	X	X	X	X													
NBCF/FDSSC097S1		1100		8oz			3											X	X	X							
NBCF/FDSSC097T2		1115		8oz / ENC			5	X	X	X	X	X	X	X													
NBCF/FDSSC097S2		1115		8oz			3											X	X	X							
NBCF/607SB010T1		1147		8oz / ENC			5	X	X	X	X	X	X	X													
NBCF/607SB010S1		1147		8oz			3											X	X	X							
NBCF/607SB010T2		1200		8oz / ENC			5	X	X	X	X	X	X	X													
NBCF/607SB010S2		1200		8oz			3											X	X	X							

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COMMENTS:

Comments and Responses on the Zone F RFI Report Addendum August 6, 1999

SCDHEC (Mihir Mehta) Comments on The Zone F (AOC 709) RCRA Facility Investigation (RFI) Report Addendum, Charleston Naval Complex, SCO 170 022 560, dated 31 March 1998

Comment 1: Section 10.10.2: Field Investigation Approach; page 10.10.5.
It appears that the investigation for this RFI addendum focused on the soils and groundwater and did not include the "source" (i.e., the fuel distribution pipeline). Is the fuel distribution pipeline still operating, if not was it pressure flushed upon ceasing the operation, or was the inside of the pipeline investigated to see whether there is any fuel source left in place? Please revise this section or propose additional investigation strategy to address this concern.

Navy/EnSafe Response: The introduction to the RFI for AOC 709 will be revised to include a detailed description of what is known about the fuel distribution pipeline. The RFI focused on soil and groundwater since there was no documented evidence a release had ever occurred along this section of the line. The soil samples that were collected did indicate a petroleum release had occurred but the concentrations present were not significant. If the lines have not been cleaned or repaired the potential exists for additional petroleum to be released. At the time these responses were prepared, Navy personal were looking for information regarding the disposition of the line. Additional sampling has not been proposed at the current time since the Navy feels adequate information is available to characterize the nature and extent of the release provided the petroleum "source" in the pipeline has been removed or the leak repaired. If actions have not been taken to remove the source or repair the line then additional sampling may be required to determine if the release is ongoing.

CH2M-Jones Response: CH2M HILL Jones believes that adequate data has been obtained and evaluated to make a determination regarding whether further activities should be conducted at this site under the RCRA Corrective Action program. CH2M-Jones does not believe that the data indicate that this site qualifies as a SWMU or an AOC since it is strictly a petroleum site that was transferred to the RCRA CA program only because of detections of elevated arsenic in groundwater. Because the data suggest that the elevated arsenic is most likely due to geochemical site conditions and not from disposal or other releases or arsenic from waste handling activities, CH2M-Jones recommends this site be transferred back to the UST program if additional evaluation of this site is required.

Comment 2: **Section 10.10.3: Soil Sampling and Analysis; page 10.10.5.**
This section describes the one CPT soil sample collected as a part of "soil investigation: for the AOC 709 (Fuel Distribution Pipeline System). According to the Figure 10.10.1 the length of AOC 709 is approximately 720 feet. The Department believes that one soil sample is not adequate to fully delineate the nature and extent of contamination. The Figure should show the details about the joints in the pipeline, manholes, and other key features that are of interest for soil sample locations (e.g., sample depth with respect to pipeline). Please propose adequate sampling strategy for all media for this AOC and/or provide adequate justification and rationale for not collecting additional samples.

Navy/EnSafe Response: During the initial screening level investigation of the fuel distribution system 150 soil samples were collected at intervals of approximately 200 feet along the lines. The addendum only discussed the results from the one location that exceeded the screening criteria agreed upon in the work plan. A total of 4 samples were collected from 3 locations within the area of concern. The report will be revised to include this data. It should be noted as well that the soil samples were collected from below the water table so the groundwater samples which were subsequently collected from the FDS - 16 wells (A, B, and C) provide more reliable information with respect to the extent of contamination in this area. Additional samples were collected in the vicinity of soil sample location FDSSC0907 as part of the Zone F grid sampling, the Zone L investigation, and the Zone E investigation. The revised addendum will incorporate relevant data from those investigations as part of the characterization of this area of concern. The primary concern at this site is arsenic in groundwater at one location. As part of the basewide "inorganics in groundwater study", this area was evaluated and an Arcview figure summarizing the results was included as Figure 4 in that memo that was submitted to the project team. Additional groundwater sampling has not been proposed pending the outcome of project team discussions related to interpreting the significance of the random detections of inorganics above MCLs.

No records are available which detail the location of the welded pipeline joints. Because it was a pressure system, no manholes provide access to the line. Line 19 on page 10.10.5 states that "the sample depth interval was selected to correspond to the burial depth of the pipeline".

CH2M-Jones Response: CH2M-Jones believes that soil and groundwater has been adequately investigated at AOC 709(F). The screening level FDS investigation was designed to identify areas along the pipeline that required further

investigation. Subsurface soil at AOC 709(F) was then further evaluated, however, no COPCs were identified in subsurface soil that required further investigation or remediation at the site. Because the pipeline is buried, surface soil does not warrant further investigation. CH2M-Jones agrees with the Navy that as a result of the pipeline being buried within the shallow aquifer, groundwater data is a better indicator of whether or not the pipeline has impacted environmental media at the site. Because no VOCs or SVOCs were detected in site groundwater above their screening criteria, the pipeline does not appear to have had a direct impact on groundwater at AOC 709(F).

Comment 3: Section 10.10.3.1: Nature of Contamination in Subsurface Soil; page 10.10.5.

It appears that the nature of contamination at this AOC is delineated based on SSLs and not background concentrations. The Department does not agree with this approach. The nature and extent of contamination in any media should be delineated based on background concentrations. The SSLs or RBCs are numbers to understand or put into perspective the severity of the problem or risk associated with the site. Please revise all pertinent sections of the referenced document to address this concern.

Navy/EnSafe Response: This comment conflicts with the basic sampling strategy outlined in the Comprehensive RFI Work Plan for the Charleston Naval Complex which has been approved and in use since 1994. In addition this comment seems to conflict with the Department's Assessment and Remediation Criteria which allows the use of RBCs and SSLs for screening when a potential source is present such as the pipeline. Recent comments by SCDHEC representatives J. Tapia (Zone F Comment #4) and S. Byrd (Zone G Comment #2) support use of SSLs for fate and transport screening. Inorganic background concentrations are then used for comparative purposes only. Responses to these two comments were accepted by SCDHEC during a meeting held July 7, 1999 in Columbia, SC. This comment requires further discussion by the project team as it appears to represent a proposed change in the way the investigation is conducted.

CH2M-Jones Response: *CH2M-Jones agrees with the Navy that the screening approach (RBCs and SSLs) are appropriate for the site. Based on the above discussion, CH2M-Jones believes that revision of the report is not necessary.*

Comment 4: Table 10.10.2; page 10.10.8
The table shows the organic compound analytical results for subsurface soils that are calculated based on generic SSLs using a

DAF of 20. The fact that groundwater is very shallow in this area and CNC have enough site-specific information to develop site specific SSLs, the Department expects CNC to develop site specific SSLs using "simple site-specific SSL" approach as described in the EPA SSL Guidance. Please revise the document to address this concern.

Navy/EnSafe Response: This comment is similar to comments received for other Zone RFI reports and was discussed in the July 7 meeting. The approach proposed by the comment contradicts the current process which was approved by SCDHEC Project Team members. It was the Navy's understanding, from the recent meeting, that SCDHEC would investigate this issue internally. Because of the conflicting viewpoints of current and previous SCDHEC Project Team members, this issue should be placed on the agenda for the August Project Team meeting.

CH2M-Jones Response: *In Section 4 of this AOC 709(F) RFI Report Addendum, the soil data were rescreened against SSLs as agreed upon by the BCT, using a SSL based on a DAF = 1 for VOCs and a DAF = 10 for other parameters. No COCs were identified using this approach.*

Comment 5: Section 10.10.4.1: Inorganic Element in Groundwater; page 10.10.26. This section discusses that the arsenic concentration in shallow groundwater is consistently greater than zone specific background and MCL, but fails to identify and characterize the source of arsenic contamination. Please provide additional information for the arsenic source or propose additional characterization to address this concern.

Navy/EnSafe Response: Comments regarding the presence of various inorganics in groundwater at concentrations above MCLs have been made recently by the Department on multiple documents. Arsenic is one of the inorganic analytes which are being investigated basewide because of the nature of its occurrence. A memo regarding the presence arsenic and other inorganics as a result of turbidity/suspended solids was submitted for review and was briefly discussed at the July meeting. The Navy and EnSafe left that meeting under the impression the Department was going to discuss this matter internally and provide an opinion by the end of July. This comment can't be resolved with respect to AOC 709 until further project team discussions are held and an agreement is reached with respect to how to interpret the significance of the inorganics data.

CH2M-Jones Response: CH2M-Jones believes that the existing levels of arsenic in groundwater at AOC 709(F) are the result of natural processes. Therefore, CH2M-Jones does not believe that additional characterization of arsenic is warranted at AOC 709(F). This issue is addressed in Section 5 of this AOC 709(F) RFI Report Addendum.

Comment 6: **Figure 10.10-4; Arsenic in Shallow groundwater**
The well location FDS16B indicates arsenic detection of 236 ug/L whereas the text on page 10.10.26 states that the maximum arsenic detection is 160 ug/L. Please explain this discrepancy between the figure and text.

From the figure there are only three wells based on which the isoconcentration line is drawn to show arsenic concentrations greater than 16.7 ug/L. The arsenic detections in these three wells are 109, 236, and 42.3 ug/L. The full extent of arsenic contamination is not defined and is hard to understand how the marked area on the map defines the arsenic contamination above background when none of these wells have arsenic concentrations below background.

Also, no cross-sections have been provided to illustrate the vertical extent of arsenic contamination. Please revise all pertinent section of the referenced document to address these concerns.

Navy/EnSafe Response: There is no discrepancy. The maximum arsenic concentration, 160 ug/L, described on Lines 21 and 22 on page 10.10.26 refers to the maximum arsenic concentration detected in the adjacent Zone E shallow grid well GDE008.

The figures will be revised to include wells from multiple sites in the area to demonstrate that an arsenic "plume" does not exist. If new wells are installed, this data will also be presented on the figures. A cross section can be provided but the Navy feels it will be of limited value considering the arsenic detections above MCLs in this area are confined to the surficial portion of the shallow aquifer as well as being randomly distributed.

CH2M-Jones Response: The comment regarding the perceived discrepancy is noted. CH2M-Jones does not believe that further report revisions are necessary to address this issue.

Comment 7: **10.10.5.2: Groundwater Migration and Surface Water Cross-Media Transport; page 10.10.29.**

This paragraph states that "the risk-based pathway for shallow groundwater is currently an invalid pathway simply because there is no human consumption of the groundwater, e.g., there is no end-use receptor." All groundwater in the State of South Carolina is considered as potable water regardless of the land use. Also, the Department evaluates the risk posed by groundwater for future land use. Based on the stated facts, the Department does not agree with statement and recommends CNC to delete any and all language related to this issue or rewrite consistent with Department's expectations.

Navy/EnSafe Response: The text will be revised to reflect SCDHEC's position that "All groundwater in the State of South Carolina is considered as potable water regardless of the land use."

CH2M-Jones Response: CH2M-Jones understands and hereby notes the department's position on all groundwater being considered as potentially potable. Further revision of the document does not appear to be necessary.

Comment 8: 10.10.5.2: Groundwater Migration and Surface Water Cross-Media Transport; page 10.10.31.

The last paragraph discusses the mercury detection in groundwater and state that the trend and source is not defined. There is no information provided as to what are the concentration levels and there are no figures delineating the nature and extent of mercury contamination. Adequate information to understand the nature and extent of mercury contamination is not provided, therefore revise the document to address this concern.

Navy/EnSafe Response: The analytical data are contained in Table 10.10.8 on page 10.10.24. This comment requires action by the team similar to number 5 above since an acceptable means of evaluating data such as this has not been agreed upon. The Navy and EnSafe believe that multiple rounds of data indicate that mercury contamination does not exist and the document should be revised in a manner to support that belief.

CH2M-Jones Response: The detections of mercury (0.2 to 0.29 ug/L) at concentrations below its MCL (2 ug/L) during the fourth sampling effort conducted as part or the Zone F RFI appears to be anomalous. Because the concentrations did not exceed the screening criteria (MCL) and because previous sampling did not detect mercury, further investigation of mercury is not warranted.

Comment 9: 10.10.5.2: Groundwater Migration and Surface Water Cross-Media Transport; page 10.10.29.

This section concludes that the current groundwater contamination will not impact the surface water bodies but fails to provide any analysis or modeling used to reach this conclusion. Please revise this document, as necessary, to understand and substantiate the stated conclusions.

Navy/EnSafe Response: The text will be revised to justify this position.

CH2M-Jones Response: The groundwater flow direction at AOC 709(F) is generally toward the Cooper River. Analytical results for arsenic from shallow monitor wells between the site and the Cooper River generally report arsenic concentrations below the MCL, indicating that arsenic migration in groundwater is not significant.

Comment 10: Section 10.10.6: Human Health Risk Assessment; page 10.10.33.
This section does not evaluate the risk associated with the soils and the source (fuel distribution pipeline). As stated in previous comments the nature and extent of soil contamination is not defined and therefore, it is pre-mature not to consider the human health risk assessment for soils and source. Please revise as necessary.

Navy/EnSafe Response: Because the potential source is below the water table, surface soil contamination as a result of this site does not exist. If anything, it may be appropriate to include a worker scenario that addresses short term exposure which may occur as a result of construction/maintenance/utility work in the area.

CH2M-Jones Response: A complete exposure pathway for receptors does not exist for soil at AOC 709(F). Further evaluation of risk issues, if necessary, should be conducted as required under the UST program.

Comment 11: Section 10.10.6.5: COCs Identified; page 10.10.45.
The fourth sentence states that, "For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-4 is recommended by EPA Region IV as the trigger for establishing COCs." This is not a correct interpretation of EPA's approach to the COCs selection process. Media based COCs are selected based on carcinogenic risk equal to or greater than 1E-6 and non-carcinogenic hazard equal to or greater than HI of 1. EPA has defined an acceptable risk range of 1E-4 - 1E-6 for risk managers to make risk management decisions (i.e., whether active action or passive action or institutional controls or no remedial action may

be appropriate) for various land uses. Risk assessment is a tool to understand the sensitivity and magnitude of the problem therefore, please delete or revise the text to address this concern.

Navy/EnSafe Response: It is the Navy's understanding that the decision matrix used by EPA to select COCs is a cumulative (all pathway) site risk that exceeds 1E-04 and an individual chemical risk that exceeds 1E-06. Furthermore, the RFI used SCDHEC's more conservative approach of using a cumulative (all pathway) site risk exceeding 1E-06 and an individual chemical risk exceeding 1E-06 to select COCs for Zone F. It is the Navy's position that the text reference in Comment 11 needs no revision.

CH2M-Jones Response: *CH2M-Jones believes that the COPC screening criteria presented in the Zone F RFI are conservative and the referenced text does not require revision. Should further evaluation of risk from this site be required, it should be conducted as appropriate under the UST program.*

Comment 12: AOC 709

The section was received after the original review had been completed for the Draft RFI Report. A complete review has been performed and the Department offers the following comment:

The Department recommends additional sampling for all metals and heptachlor.

Navy/EnSafe Response: The Navy plans to sample these wells the week of June 28, 1999 for the requested parameters at DQO Level III.

CH2M-Jones Response: *Heptachlor was detected in one (of three) first round samples at a concentration of 0.049 µg/L. It was not detected in any second round sample (three collected). The single detection did not exceed the MCL of 0.4 µg/L for heptachlor. Groundwater analysis for metals did not indicate exceedances of MCLs except for arsenic and thallium as previously discussed in this RFI report addendum. Further evaluation of groundwater under the RCRA Corrective Action program does not appear warranted. Any additional investigations should be considered, if necessary, under the UST program.*