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PHASE II INTERIM MEASURE WORK PLAN LIGHT NON-AQUEOUS PHASE LIQUID (LNAPL)
AND LIGHT NON-AQUEOUS PHASE LIQUID (LNAPL) IMPACTED SOIL REMOVAL AREA OF
CONCERN 633 (AOC 633) ZONE G WITH TRANSMITTAL CNC CHARLESTON SC

5/13/2002
CH2M HILL

PHASE II INTERIM MEASURE WORK PLAN

LNAPL and LNAPL-Impacted Soil Removal AOC 633, Zone G



*Charleston Naval Complex
North Charleston, South Carolina*



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

PREPARED BY
CH2M-Jones

May 2002

*Revision No. 0
Contract N62467-99-C-0960
158814.ZG.PR.03*

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May 13, 2002

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

Re: Phase II Interim Measure Work Plan (Revision 0) – LNAPL and LNAPL-Impacted
Soil Removal - AOC 633, Zone G

Dear Mr. Scaturo:

Enclosed please find four copies of the Phase II Interim Measure Work Plan (Revision 0) for AOC 633 in Zone G 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

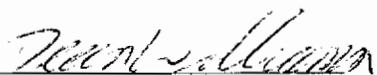
**Certification Page for the Phase II Interim Measure Work Plan,
Revision 0 – AOC 633, Zone G**

LNAPL and LNAPL-Impacted Soil Removal

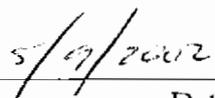
I, Dean Williamson, certify that this report has been prepared under my direct supervision. The data and information are, to the best of my knowledge, accurate and correct, and the report has been prepared in accordance with current standards of practice for engineering.

South Carolina

P.E. No. 21428



Dean Williamson, P.E.



Date

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1 Acronyms and Abbreviations

2	AOC	Area of concern
3	CA	Corrective action
4	CFR	<i>Code of Federal Regulations</i>
5	CNC	Charleston Naval Complex
6	COC	Chemical of concern
7	COPC	Chemical of potential concern
8	CSAP	Comprehensive Sampling and Analysis Plan
9	DAF	Dilution attenuation factor
10	DMP	Data Management Plan
11	EEG	Environmental Enterprise Group
12	EnSafe	EnSafe Inc.
13	ESDSOPQAM	U.S. Environmental Protection Agency <i>Operating Procedures and</i>
14		<i>Quality Assurance Manual</i>
15	EPA	U.S. Environmental Protection Agency
16	ft bls	Feet below land surface
17	IDW	Investigation-derived waste
18	IM	Interim measure
19	LNAPL	Light non-aqueous phase liquid
20	MCL	Maximum contaminant level
21	µg/L	Micrograms per liter
22	µg/kg	Micrograms per kilogram
23	mg/kg	Milligrams per kilogram
24	NFA	No further action
25	QAP	Quality Assurance Plan
26	PCB	Polychlorinated biphenyl
27	PCE	Tetrachloroethene
28	PPE	Personal protective equipment

1 **Acronyms and Abbreviations, Continued**

2	RBC	Risk-based concentration
3	RCRA	Resource Conservation and Recovery Act
4	RFI	RCRA Facility Investigation
5	SSL	Soil screening level
6	SVOC	Semivolatile organic compound
7	VOC	Volatile organic compound

1.0 Introduction

1.1 Purpose of the Phase II Interim Measure Work Plan

This Phase II Interim Measure (IM) Work Plan presents a technical approach to remove soil containing a weathered diesel fuel light non-aqueous phase liquid (LNAPL), which may contain polychlorinated biphenyls (PCBs) and other contaminants, from Area Of Concern (AOC) 633, which is located in Zone G of Charleston Naval Complex (CNC). The removal of the LNAPL-impacted soil will remove a source of contaminants from this site. This IM will be performed, documented, and reported in a manner consistent with the investigative and corrective action (CA) goals and requirements of the existing Resource Conservation and Recovery Act (RCRA) permit for the facility.

1.2 Site Background and Setting

AOC 633 is located near Building 451C, an electrical substation built in 1943. Building 451C is a block structure with a concrete roof and floor. Several high voltage switches, breakers, and transformers are located in the two-room block structure. The site contains several steel enclosures on concrete slabs and foundations from earlier buildings. In 1989, an electrical transformer at this substation was destroyed by Hurricane Hugo. Several historical PCB releases have been reported for this site, including a large leak of 10C oil in 1981. No remedial activities were known to have occurred at this site prior to commencement of the Zone G RCRA Facility Investigation (RFI) conducted by EnSafe, Inc. (EnSafe) in 1997. Recently, an IM was conducted at the site by CH2M-Jones to remove subsurface soil containing PCBs above the water-bearing zone.

1.3 Organization of the Phase II IM Work Plan

This Phase II IM Work Plan consists of the following sections, including this introductory section:

1.0 Introduction — Presents the purpose of the Phase II IM Work Plan and background information regarding the site.

2.0 Results of Previous Investigations – Presents the results of several soil investigations that were previously conducted at AOC 633.

- 1 **3.0 Review of Post-Interim Measure Site Data** – Presents the results of review and analysis
2 of the data collected following the IM at the site.
- 3 **4.0 Technical Approach for the Phase II Interim Measure**— Provides a brief description of
4 the technical approach for the Phase II IM that will be conducted at AOC 633, including a
5 description of activities to be carried out prior to the implementation of the IM, and analysis
6 of the data collected.
- 7 **5.0 Investigation-Derived Waste** — Describes the procedures that will be followed for the
8 proper management and disposal of the waste generated from this IM.
- 9 **6.0 References** — Lists the references used in this document.

Section 2.0

2.0 Results of Previous Investigations

Several soil investigations were conducted at AOC 633 that resulted in numerous soil samples being collected and analyzed. The locations of the samples collected at AOC 633 are presented on Figure 2-1.

EnSafe conducted an RFI in 1997 and 1998 to investigate the nature and extent of any environmental contamination at the site. The results of the RFI were reported in the *Zone G RFI Report, Revision 0* (EnSafe, 1998). The RFI report identified Aroclor-1260 as a chemical of potential concern (COPC), but did not identify any chemicals of concern (COCs). The site was recommended for No Further Action (NFA).

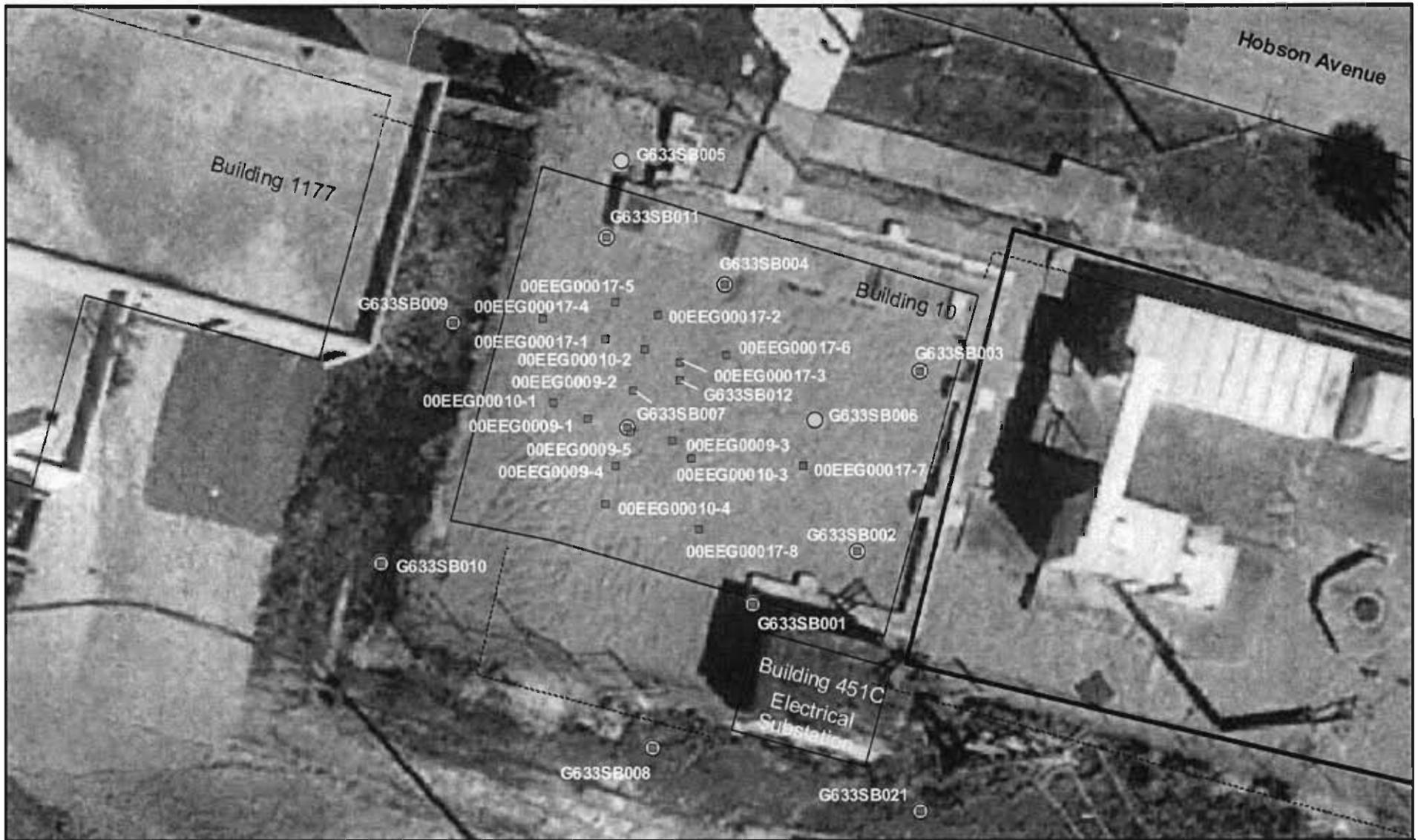
The *Zone G RFI Work Plan Addendum* (EnSafe, 2000) recommended one additional soil boring (G633SB021) to delineate the extent of Aroclor-1260 in surface and subsurface soil to the south of G633SB001. Aroclor-1260 was not detected in either sample.

Additional delineation samples were collected by the Environmental Enterprise Group (EEG) (formerly the Environmental Detachment Charleston [DET]) in cooperation with EnSafe, and analyzed for PCBs. These samples were collected to delineate the extent of Aroclor-1260 found at soil boring G633SB007. The analytical results of EEG's sampling were presented in the *Sampling Report, Site Delineation for PCBs at Area of Concern (AOC) 633, Charleston Naval Complex, Charleston, SC* (EEG, 2000a). The analytical results indicated that the extent of PCB-impacted soil was greater than expected.

A soil excavation IM was then planned and subsequently executed by CH2M-Jones. The IM involved collecting delineation/confirmation samples and the removal of PCB-contaminated subsurface (3 to 5 feet below land surface [ft bls]) soil in excess of the site-specific soil screening level (SSL) (15.4 milligrams per kilogram [mg/kg]). Surface soil analytical results indicated that PCB-impacted surface soil was not present above the cleanup standard (1 mg/kg) presented in Title 40 *Code of Federal Regulations* (CFR) Part 761.61 (40 CFR 761.61), *PCB Remediation Waste*. Therefore, surface soil was removed and stockpiled on site for use as fill material. The approximate areal boundary of the excavation is illustrated in Figure 2-2.

Near the completion of the IM, LNAPL was observed entering the excavation. LNAPL and groundwater samples were collected and submitted for analyses. The analytical results from these samples, which are discussed in detail in Section 3.2, indicated the presence of PCBs and other chemicals. The excavation was backfilled in accordance with the IM WP. The removal of the residual LNAPL and LNAPL-impacted soil is the objective of this Phase II IM WP.

NOTE: Aerial Photo Date is 1997

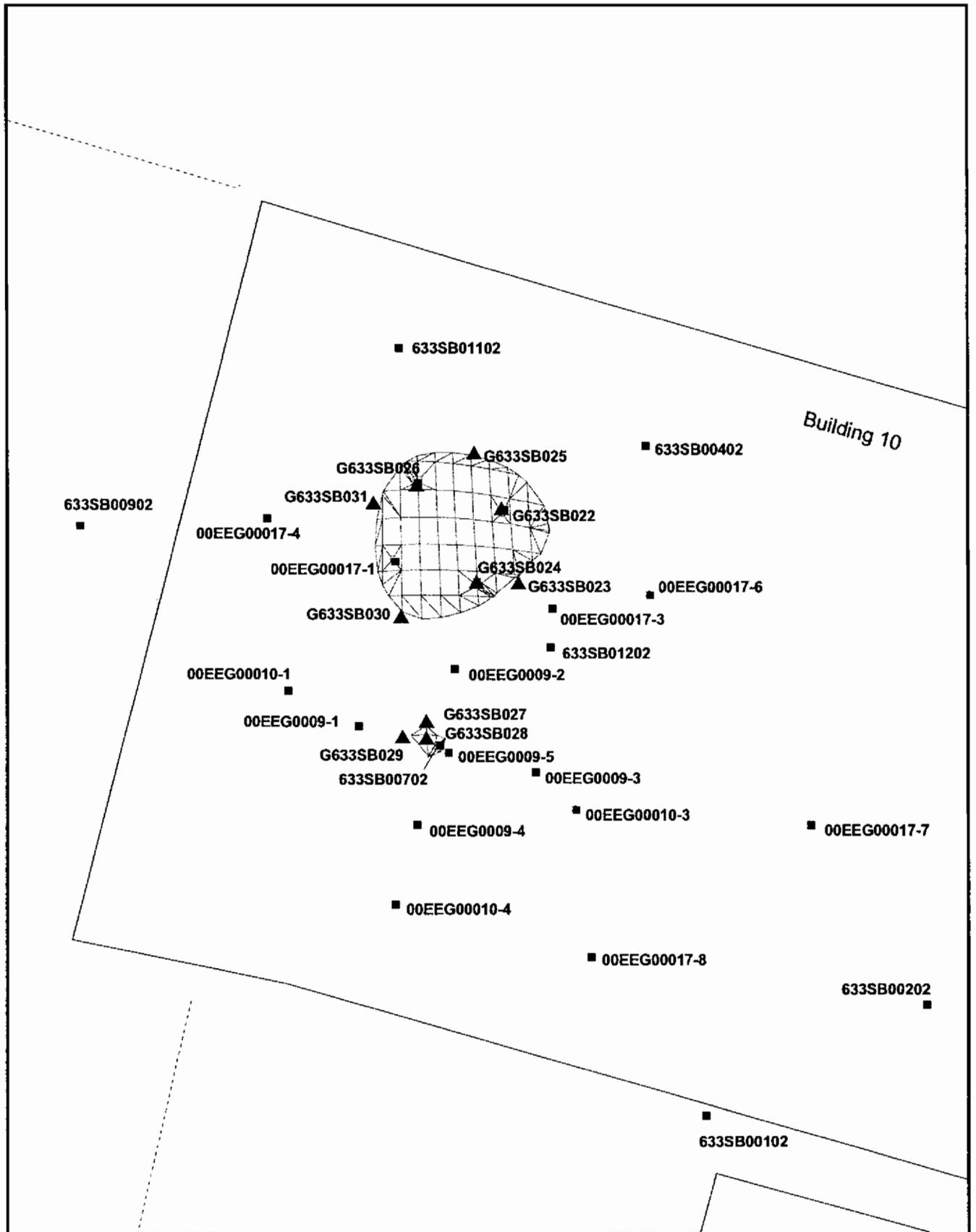


- Subsurface Soil Samples
- Surface Soil Samples
- ∩ Roads
- ∩ Fence
- ▭ Pavement
- ▭ Buildings
- ▭ AOC Boundary



Figure 2-1
RFI and DET Soil Sample Locations
AOC 633, Zone G
Charleston Naval Complex

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- ▲ Delineation Sample Locations
- Subsurface Soil Samples
- ▭ Excavation Area
- ▭ Fence
- ▭ Buildings



0 6 12 Feet

Figure 2-2
 Previous IM Boundary and
 Delineation Sample Locations
 AOC 633, Zone G
 Charleston Naval Complex

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3.0 Review of Post-Interim Measure Site Data

Twelve soil borings were advanced around the site of the previous IM excavation and along Hobson Avenue to assess the extent and source of the LNAPL. A soil sample was collected at the top of the water-bearing zone from each boring (except at boring G633SB037, due to an obstruction that was encountered). The samples were collected from approximately 3.5 to 5 ft bls. The samples were analyzed for PCBs, volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs). Figure 3-1 presents the sample locations, and Table 3-1 summarizes the detected compounds from the samples.

3.1 Subsurface Soil Analytical Results

3.1.1 PCBs

Aroclor-1254 was detected in one subsurface soil sample (633SB03603, 0.093 J mg/kg). Aroclor-1260 was detected in six samples (including 633SB03603) at concentrations ranging from 0.066 J to 2.4 mg/kg. No other PCBs were detected. A summary of these detections is provided in Table 3-1.

The single detection of Aroclor-1254 was below the SSL (0.55 mg/kg, dilution attenuation factor [DAF]=10) presented in the U.S. Environmental Protection Agency (EPA) Region III risk-based concentration (RBC) table (October 2000). The SSL from the Region III RBC table was used because a SSL was not available in Table A-1 of the EPA's *Soil Screening Guidance* (EPA, 1996b). The SSLs presented in the RBC table are based on protection of groundwater to the RBC values rather than maximum contaminant levels (MCLs), and therefore are highly conservative.

All detected concentrations of Aroclor-1260 were below its site-specific SSL of 15.4 mg/kg.

3.1.2 VOCs

Twelve VOCs were detected in the subsurface soil samples. Three compounds (1,3-dichlorobenzene, bromomethane, and tetrachloroethene [PCE]) were detected in one or more samples at concentrations that exceed their respective SSLs. SSLs for VOCs were based on a DAF of 1. A summary of these detections is provided in Table 3-1.

1,3-Dichlorobenzene was detected in one sample (633SB03503) at a concentration of 9.1 micrograms per kilogram ($\mu\text{g}/\text{kg}$), exceeding its SSL of 4.4 $\mu\text{g}/\text{kg}$ (DAF=1). Because an SSL

1 was not available in Table A-1 of the EPA *Soil Screening Guidance*, the SSL value from the
2 EPA Region III RBC table (October 2000) was used as a screening value.

3 Bromomethane was detected in two samples (633SB03303, 24 J µg/kg and 633SB03603, 31 J
4 µg/kg) at concentrations above its SSL of 2.1 µg/kg (DAF=1). Because an SSL was not
5 available in Table A-1 of the *Soil Screening Guidance*, the SSL value from the EPA Region III
6 RBC table (October 2000) was used as a screening value.

7 Tetrachloroethene (PCE) was detected in sample 633SB03503 at a concentration of 6.7
8 µg/kg, above its generic SSL (3 µg/kg, DAF=1) presented in Table A-1 of the *Soil Screening*
9 *Guidance*.

10 **3.1.3 SVOCs**

11 No SVOCs were detected above screening criterion in the subsurface soil samples collected
12 after the IM.

13 **3.2 Groundwater and LNAPL Analytical Results**

14 Samples of the LNAPL and groundwater observed entering the excavation were collected
15 and submitted for analyses. A small amount of product was observed to have been
16 inadvertently collected with the groundwater sample. The LNAPL and groundwater
17 samples were analyzed for PCBs, VOCs, and SVOCs. The LNAPL sample was also analyzed
18 for fuel identification. The analytical results identified the LNAPL as weathered diesel fuel.

19 A summary of the detected compounds in the groundwater and LNAPL samples is
20 provided in Table 3-2. Table 3-2 also presents the screening criteria for groundwater.

21 **3.2.1 PCBs**

22 The PCB Aroclor-1260 was detected in both the LNAPL and groundwater sample. It was
23 detected at a concentration of 1,200 mg/kg in the LNAPL and 300 micrograms per liter
24 (µg/L) in the groundwater sample. No other PCBs were detected in either sample.

25 **3.2.2 VOCs**

26 Several VOCs including 1,2-dichlorobenzene (1,000 J µg/kg), 1,3-dichlorobenzene (4,000
27 µg/kg), and 1,4-dichlorobenzene (19,000 µg/kg) were detected in the LNAPL. These
28 chlorobenzenes have been previously associated with PCB fluids at the CNC. Acetone
29 (4,200 J µg/kg) was also reported to be present, although it would be unusual to find
30 acetone associated a PCB transformer oil. Its presence may be due to laboratory
31 contamination.

1 Acetone (28 µg/L), chloroethane (4.2 J µg/L), chlorobenzene (1.8 J µg/L), 1,2-
2 dichlorobenzene (0.69 J µg/L), 1,3-dichlorobenzene (2.9 J µg/L), and 1,4-dichlorobenzene
3 (14 µg/L) were reported in the groundwater sample.

4 **3.2.3 SVOCs**

5 Target SVOCs were not detected in either the LNAPL or the groundwater sample. The
6 SVOC detection limits in the LNAPL were greatly elevated due to the need to dilute the oil
7 matrix to allow for analysis.

8 **3.3 Summary**

9 Three VOCs, 1,3-dichlorobenzene, bromomethane, and tetrachloroethene, were detected in
10 subsurface soil samples above their respective SSLs (DAF=1). PCBs and SVOCs were not
11 detected at concentrations that exceed conservative screening criteria.

12 The PCB Aroclor-1260 and three VOCs (1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-
13 dichlorobenzene) were detected in the LNAPL and groundwater sample. Chloroethane and
14 chlorobenzene were also detected in the groundwater sample. Comparison of groundwater
15 data to groundwater screening criteria (MCLs or RBCs) results in Aroclor-1260 and
16 chloroethane exceeding the screening criteria. Permanent monitoring well(s) will be
17 installed and sampled at AOC 633 following the completion the IM to further assess
18 potential groundwater impacts.

19 Aroclor-1260 has been detected in the LNAPL and underlying groundwater at AOC 633. It
20 has not been detected in subsurface soil samples above its SSL around the perimeter of the
21 excavation.

22 It is likely that transformers were stored on the concrete slab. These transformers may have
23 leaked, contaminating subsurface soil with PCBs (and chlorobenzenes). In the presence of
24 the diesel fuel, PCBs were likely mobilized locally and are now located within the LNAPL-
25 saturated soil interval. Because the LNAPL is on top of the water table, the PCBs are likely
26 located within the relatively thin layer of soil between the seasonally high and seasonally
27 low water levels. Therefore, CH2M-Jones is recommending removal of this LNAPL-
28 impacted soil interval (smear zone) as a source removal activity.

TABLE 3-1
 Detected Compounds in Subsurface Soil Samples
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Parameter Class	Compound	Station ID	Sample ID	Date Collected	Concentration (µg/kg)	Qualifier	SSL ^a
VOCs	1,2,4--Trichlorobenzene	G633SB034	633SB03403	28-Feb-02	6.9	J	300
		G633SB035	633SB03503	28-Feb-02	9.1	=	4.4 ^b
	1,3-Dichlorobenzene	G633SB038	633SB03803	28-Feb-02	2.5	J	
		G633SB035	633SB03503	28-Feb-02	38	=	100
		G633SB036	633SB03603	28-Feb-02	3.9	J	
		G633SB038	633SB03803	28-Feb-02	9.8	=	
	Acetone	G633SB033	633SB03303	28-Feb-02	240	J	800
		G633SB036	633SB03603	28-Feb-02	400	J	
		G633SB038	633SB03803	28-Feb-02	95	J	
		G633SB039	633SB03903	28-Feb-02	130	J	
		G633SB040	633SB04003	28-Feb-02	140	J	
		G633SB042	633SB04203	28-Feb-02	210	J	
	Bromomethane	G633SB033	633SB03303	28-Feb-02	24	J	2.1 ^b
		G633SB036	633SB03603	28-Feb-02	31	J	
	Carbon Disulfide	G633SB034	633SB03403	28-Feb-02	3.9	J	2,000
		G633SB035	633SB03503	28-Feb-02	4	J	
G633SB036		633SB03603	28-Feb-02	49	=		
G633SB038		633SB03803	28-Feb-02	52	=		

TABLE 3-1
 Detected Compounds in Subsurface Soil Samples
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Parameter Class	Compound	Station ID	Sample ID	Date Collected	Concentration (µg/kg)	Qualifier	SSL ^a
VOCs	Carbon Disulfide	G633SB039	633SB03903	28-Feb-02	6.7	J	2,000
		G633SB040	633SB04003	28-Feb-02	21	=	
		G633SB041	633SB04103	28-Feb-02	2.4	J	
		G633SB042	633SB04203	28-Feb-02	6.4	J	
	Ethylbenzene	G633SB035	633SB03503	28-Feb-02	2	J	700
	m+p Xylene	G633SB035	633SB03503	28-Feb-02	10	=	10,000 (p-xylene)
	Methyl ethyl ketone (2-Butanone)	G633SB033	633SB03303	28-Feb-02	53	J	400 ^b
		G633SB036	633SB03603	28-Feb-02	56	J	
		G633SB038	633SB03803	28-Feb-02	11	J	
		G633SB039	633SB03903	28-Feb-02	23	J	
		G633SB040	633SB04003	28-Feb-02	25	J	
		G633SB041	633SB04103	28-Feb-02	6.9	J	
		G633SB042	633SB04203	28-Feb-02	37	J	
		o-Xylene	G633SB035	633SB03503	28-Feb-02	4.5	J
Tetrachloroethylene (PCE)	G633SB035	633SB03503	28-Feb-02	6.7	=	3	
Xylenes, Total	G633SB035	633SB03503	28-Feb-02	14	=	9,000 (o-xylene)	
SVOCs	Acenaphthene	G633SB038	633SB03803	28-Feb-02	6.2	J	285,000

TABLE 3-1
 Detected Compounds in Subsurface Soil Samples
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Parameter Class	Compound	Station ID	Sample ID	Date Collected	Concentration (µg/kg)	Qualifier	SSL ^a
		G633SB039	633SB03903	28-Feb-02	6.4	J	
		G633SB042	633SB04203	28-Feb-02	4.5	J	
	Acenaphthylene	G633SB036	633SB03603	28-Feb-02	14	J	285,000 (Acenaphthene)
		G633SB038	633SB03803	28-Feb-02	2.5	J	
		G633SB039	633SB03903	28-Feb-02	4.8	J	
		G633SB042	633SB04203	28-Feb-02	7.1	J	
	Anthracene	G633SB035	633SB03503	28-Feb-02	20	J	6,000,000
		G633SB038	633SB03803	28-Feb-02	14	=	
		G633SB039	633SB03903	28-Feb-02	18	=	
		G633SB042	633SB04203	28-Feb-02	6.8	J	
	Benzo(a)Anthracene	G633SB033	633SB03303	28-Feb-02	35	=	1,000
		G633SB035	633SB03503	28-Feb-02	9	J	
		G633SB036	633SB03603	28-Feb-02	60	J	
		G633SB038	633SB03803	28-Feb-02	66	=	
		G633SB039	633SB03903	28-Feb-02	130	=	
		G633SB040	633SB04003	28-Feb-02	31	J	
		G633SB041	633SB04103	28-Feb-02	18	J	
		G633SB042	633SB04203	28-Feb-02	35	=	

TABLE 3-1
 Detected Compounds in Subsurface Soil Samples
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Parameter Class	Compound	Station ID	Sample ID	Date Collected	Concentration (µg/kg)	Qualifier	SSL ^a
SVOCs	Benzo(a)Pyrene	G633SB032	633SB03203	28-Feb-02	1.9	J	4,000
		G633SB033	633SB03303	28-Feb-02	34	=	
		G633SB036	633SB03603	28-Feb-02	71	J	
		G633SB038	633SB03803	28-Feb-02	75	=	
		G633SB039	633SB03903	28-Feb-02	150	=	
		G633SB040	633SB04003	28-Feb-02	35	J	
		G633SB041	633SB04103	28-Feb-02	16	J	
		G633SB042	633SB04203	28-Feb-02	44	=	
	Benzo(b)Fluoranthene	G633SB032	633SB03203	28-Feb-02	2.1	J	2,500
		G633SB033	633SB03303	28-Feb-02	34	=	
		G633SB035	633SB03503	28-Feb-02	13	J	
		G633SB036	633SB03603	28-Feb-02	55	J	
		G633SB038	633SB03803	28-Feb-02	110	=	
		G633SB039	633SB03903	28-Feb-02	160	=	
		G633SB040	633SB04003	28-Feb-02	45	J	
		G633SB041	633SB04103	28-Feb-02	18	J	
	G633SB042	633SB04203	28-Feb-02	57	=		
	Benzo(g,h,i)Perylene	G633SB033	633SB03303	28-Feb-02	17	J	1,000 (Dibenz(a,h)anthracene)

TABLE 3-1
 Detected Compounds in Subsurface Soil Samples
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Parameter Class	Compound	Station ID	Sample ID	Date Collected	Concentration (µg/kg)	Qualifier	SSL ^a
SVOCs	Benzo(g,h,i)Perylene	G633SB036	633SB03603	28-Feb-02	36	J	1,000 (Dibenz(a,h)anthracene)
		G633SB038	633SB03803	28-Feb-02	33	=	
		G633SB039	633SB03903	28-Feb-02	57	=	
		G633SB040	633SB04003	28-Feb-02	20	J	
		G633SB042	633SB04203	28-Feb-02	18	=	
	Benzo(k)Fluoranthene	G633SB033	633SB03303	28-Feb-02	47	=	24,500
		G633SB035	633SB03503	28-Feb-02	17	J	
		G633SB036	633SB03603	28-Feb-02	77	=	
		G633SB038	633SB03803	28-Feb-02	110	=	
		G633SB039	633SB03903	28-Feb-02	180	=	
		G633SB040	633SB04003	28-Feb-02	33	J	
		G633SB041	633SB04103	28-Feb-02	13	J	
		G633SB042	633SB04203	28-Feb-02	55	=	
	Chrysene	G633SB033	633SB03303	28-Feb-02	43	=	80,000
		G633SB035	633SB03503	28-Feb-02	20	J	
		G633SB036	633SB03603	28-Feb-02	69	J	
		G633SB038	633SB03803	28-Feb-02	100	=	
		G633SB039	633SB03903	28-Feb-02	150	=	
		G633SB041	633SB04103	28-Feb-02	21	J	

TABLE 3-1
 Detected Compounds in Subsurface Soil Samples
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Parameter Class	Compound	Station ID	Sample ID	Date Collected	Concentration (µg/kg)	Qualifier	SSL ^a
	Chrysene	G633SB042	633SB04203	28-Feb-02	46	=	80,000
	Dibenz(a,h)anthracene	G633SB033	633SB03303	28-Feb-02	8.8	J	1,000
		G633SB036	633SB03603	28-Feb-02	18	J	
		G633SB038	633SB03803	28-Feb-02	18	=	
		G633SB039	633SB03903	28-Feb-02	32	=	
		G633SB042	633SB04203	28-Feb-02	11	J	
	Fluoranthene	G633SB032	633SB03203	28-Feb-02	3.1	J	2,150,000
		G633SB033	633SB03303	28-Feb-02	80	=	
		G633SB035	633SB03503	28-Feb-02	44	=	
		G633SB036	633SB03603	28-Feb-02	73	=	
		G633SB038	633SB03803	28-Feb-02	160	=	
		G633SB039	633SB03903	28-Feb-02	180	=	
		G633SB040	633SB04003	28-Feb-02	45	J	
		G633SB041	633SB04103	28-Feb-02	35	J	
		G633SB042	633SB04203	28-Feb-02	54	=	
	Fluorene	G633SB038	633SB03803	28-Feb-02	6.6	J	280,000
		G633SB039	633SB03903	28-Feb-02	5.6	J	
		G633SB042	633SB04203	28-Feb-02	2.6	J	

TABLE 3-1
 Detected Compounds in Subsurface Soil Samples
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Parameter Class	Compound	Station ID	Sample ID	Date Collected	Concentration (µg/kg)	Qualifier	SSL ^a
SVOCs	Indeno(1,2,3-c,d)pyrene	G633SB033	633SB03303	28-Feb-02	17	J	7,000
		G633SB036	633SB03603	28-Feb-02	31	J	
		G633SB038	633SB03803	28-Feb-02	24	=	
		G633SB039	633SB03903	28-Feb-02	38	=	
		G633SB040	633SB04003	28-Feb-02	20	J	
		G633SB042	633SB04203	28-Feb-02	13	=	
	Naphthalene	G633SB038	633SB03803	28-Feb-02	2.1	J	42,000
		G633SB039	633SB03903	28-Feb-02	2.7	J	
		G633SB042	633SB04203	28-Feb-02	2.2	J	
	Phenanthrene	G633SB035	633SB03503	28-Feb-02	78	=	6,000,000 (Anthracene)
		G633SB036	633SB03603	28-Feb-02	22	J	
		G633SB038	633SB03803	28-Feb-02	84	=	
		G633SB039	633SB03903	28-Feb-02	57	=	
		G633SB040	633SB04003	28-Feb-02	12	J	
		G633SB041	633SB04103	28-Feb-02	8.3	J	
		G633SB042	633SB04203	28-Feb-02	16	=	
	Pyrene	G633SB032	633SB03203	28-Feb-02	2.5	J	2,100,000
		G633SB033	633SB03303	28-Feb-02	79	=	
		G633SB035	633SB03503	28-Feb-02	34	=	

TABLE 3-1
 Detected Compounds in Subsurface Soil Samples
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Parameter Class	Compound	Station ID	Sample ID	Date Collected	Concentration (µg/kg)	Qualifier	SSL ^a	
SVOCs	Pyrene	G633SB036	633SB03603	28-Feb-02	93	=	2,100,000	
		G633SB038	633SB03803	28-Feb-02	140	=		
		G633SB039	633SB03903	28-Feb-02	190	=		
		G633SB040	633SB04003	28-Feb-02	58	J		
		G633SB041	633SB04103	28-Feb-02	38	J		
		G633SB042	633SB04203	28-Feb-02	49	=		
PCBs	PCB-1254 (Aroclor-1254)	G633SB036	633SB03603	28-Feb-02	93	J	550 ^b	
		PCB-1260 (Aroclor-1260)	G633SB033	633SB03303	28-Feb-02	420	J	15,400 ^c
			G633SB034	633SB03403	28-Feb-02	960	J	
			G633SB035	633SB03503	28-Feb-02	2,400	J	
			G633SB036	633SB03603	28-Feb-02	1,100	=	
			G633SB039	633SB03903	28-Feb-02	66	J	
			G633SB043	633SB04303	28-Feb-02	350	J	

Concentrations in bold text and outlined within the table indicate an exceedance of the appropriate screening criteria.
 SSL values with a compound name in parenthesis indicates that the named compound SSL was used as a surrogate.

^a SSLs are based on a DAF of 1 for VOCs and 10 for all other compounds.

^b SSL was not available in Table A-1 of the Soil Screening Guidance (EPA, 1996b). SSL from U.S. EPA Region III RBC Table (October, 2000).

^c This value is the calculated SSL from the Phase I IM Work Plan for AOC 633, Zone G.

µg/kg - micrograms per kilogram

= indicates that the compound was detected. the reported concentration is the measured concentration.

J indicates that the compound was detected. The reported concentration is the estimated concentration.

TABLE 3-2
 Detected Compounds in Groundwater and LNAPL Samples
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Sampled Media	Parameter Class	Compound	Station ID	Sample ID	Date Collected	Concentration	Qualifier	Units	MCL	RBC ^a
LNAPL	VOA	1,2-Dichlorobenzene	G633WA001	633WA001M1	04-Feb-02	1,000	J	µg/kg	NA	NA
		1,3-Dichlorobenzene	G633WA001	633WA001M1	04-Feb-02	4,000	=		NA	NA
		1,4-Dichlorobenzene	G633WA001	633WA001M1	04-Feb-02	19,000	=		NA	NA
	TPH	Acetone	G633WA001	633WA001M1	04-Feb-02	4,200	J		NA	NA
		Diesel	G633WA001	633WA001M1	04-Feb-02	720,000	=	mg/kg	NA	NA
		PCB	PCB-1260 (Aroclor-1260)	G633WA001	633WA001M1	04-Feb-02	1,200	=		NA
Groundwater	VOA	1,2-Dichlorobenzene	G633GA001	633GA001M1	21-Jan-02	0.69	J	µg/L	600	NA
		1,3-Dichlorobenzene	G633GA001	633GA001M1	21-Jan-02	2.9	J		NA	5.5
		1,4-Dichlorobenzene	G633GA001	633GA001M1	21-Jan-02	14	=		75	NA
		Acetone	G633GA001	633GA001M1	21-Jan-02	28	J		NA	610
		Chlorobenzene	G633GA001	633GA001M1	21-Jan-02	1.8	J		100	NA
		Chloroethane	G633GA001	633GA001M1	21-Jan-02	4.2	J		NA	3.6
	PCB	PCB-1260 (Aroclor-1260)	G633GA001	633GA001M1	21-Jan-02	300	=		0.5	NA

Concentrations in bold text and outlined within the table indicate an exceedance of the appropriate screening criteria.

^a RBCs were used as screening criteria only in the absence of a MCL.

µg/kg - micrograms per kilogram

µg/L - micrograms per liter

mg/kg - milligrams per kilogram

= indicates that the compound was detected. the reported concentration is the measured concentration.

J indicates that the compound was detected. The reported concentration is the estimated concentration.

NA indicates that information is not available or not applicable.

Section 4.0

4.0 Technical Approach for the Phase II IM

4.1 Excavation Approach

Prior to commencement of soil removal activities, the water within the concrete electrical conduit will be gauged for the presence of LNAPL, and a sample will be collected and submitted for PCB and VOC analysis.

The proposed removal action will be accomplished through excavation of the LNAPL-impacted soil and its associated "smear zone," and the offsite disposal of the excavated material. Initially, the overburden in the area of the previous IM will be excavated to a depth of 3 to 4 ft bls and stockpiled for later use as backfill (since this material has previously been determined to meet COPC screening criteria).

During the previous IM, the field team observed that the LNAPL appeared to be moving into the open excavation in the approximate vicinity of borings G633SB033 and G633SB043. The excavation will proceed initially in these areas, beginning at approximately 4 ft bls. The actual interval to be excavated will be determined based on field observations. Obviously stained or LNAPL-impacted soil will be removed. The excavation will be expanded in the direction in which LNAPL or LNAPL-impacted soil is observed until the limits of the LNAPL-impacted soil have effectively been determined and removed.

Dewatering of the excavation may be performed if necessary to allow more effective soil removal or backfilling. Any water removed from the excavation will be stored in a tank for subsequent treatment and/or disposal.

The excavated saturated soil will be stockpiled in suitable containers or within a lined containment area for temporary storage prior to offsite disposal. LNAPL that accumulates within the open excavation will be removed using sorbent pads, booms, and/or vacuum trucks. The soil pile will be covered when not in use. Any liquids draining from the stockpiled soil will be collected and stored in a tank or drum, pending analysis and appropriate disposal.

The contaminated soil will be transported to an appropriately permitted offsite disposal facility for appropriate disposal. The transported waste will be covered with a tarp to minimize airborne transfer of soil particulates.

1 If contaminated soil adjacent to the concrete structure has been removed, the concrete
2 structure will be evaluated for possible contamination. If the concrete is determined to be
3 significantly contaminated, it may be decontaminated or demolished and disposed of off
4 site.

5 **4.2 Confirmatory Sample Collection and Backfilling**

6 Once all visible LNAPL-impacted soil has been removed and no more LNAPL is found to
7 be migrating into the excavation, confirmatory samples will be collected from the perimeter
8 of the excavation (in the unsaturated zone) to verify that residual concentrations of COPCs
9 are below the their site-specific SSLs (see following section for derivation of site-specific
10 SSLs). If confirmation samples contain COPCs that exceed their respective SSLs, additional
11 soil will be considered for removal. The expanded boundary of the excavation will be re-
12 sampled after each removal activity to verify that subsurface soil meets the site-specific
13 SSLs.

14 Once sufficient data have been collected to confirm that the limits of excavation are
15 adequate, the excavation will be backfilled with clean backfill plus the previously
16 stockpiled overburden. If necessary, additional clean fill will be brought in for use as fill.

17 **4.3 Calculation of Site-Specific SSLs**

18 During the preparation of the previous IM WP, CH2M-Jones calculated a site-specific SSL
19 for Aroclor-1260 (CH2M-Jones, 2001). The SSL calculation resulted in a site-specific SSL of
20 15.4 mg/kg for Aroclor-1260, based on an infiltration rate of 0.1 ft/yr (1.2 in/yr). Since the
21 development of that IM WP, CH2M-Jones has revised (increased) the assumed infiltration
22 rate used in the SSL calculation for unpaved scenarios. The current infiltration rate value
23 (0.45 ft/yr) is based on the regional precipitation, evapotranspiration, and a runoff
24 coefficient based on site ground cover (unpaved). The derivation of the infiltration rate was
25 presented in the Technical Memorandum, *Infiltration Variable Used in SSL Calculation*
26 (CH2M-Jones, 2002). Prior to development of this technical memorandum, the infiltration
27 rate (1.2 in/yr) was based on the USGS report (USGS, 1999).

28 As a result of changing the infiltration variable in the SSL calculation, CH2M-Jones has re-
29 calculated the SSL for Aroclor-1260. The revised SSL calculation is presented in Table 4-1
30 and is consistent with the EPA's *Soil Screening Guidance: User's Guide* (EPA, 1996a) and the
31 *Soil Screening Guidance: Technical Background Document* (EPA, 1996b). The revised SSL for
32 Aroclor-1260 was calculated to be 9.9 mg/kg.

1 Aroclor-1260, bromomethane, 1,3-dichlorobenzene, and tetrachloroethene (PCE) were
2 detected in soil samples at concentrations above their respective screening criteria. Acetone,
3 chloroethane, chlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, and 1,4-
4 dichlorobenzene were detected in the liquid samples (LNAPL and groundwater). SSLs were
5 calculated for each of these constituents to be used as target media cleanup standards
6 (MCSs) in unsaturated subsurface soil for the proposed IM. Table 4-1 presents the
7 calculations and results. Table 4-2 presents a summary of the proposed MCSs.

8 **4.4 Soil Sample Analysis**

9 Any confirmatory samples collected will be delivered or sent via overnight carrier to an
10 offsite laboratory, where they will be analyzed for PCBs and VOCs using EPA Methods
11 SW846-8082 and SW846-8260. The soil analysis will follow the procedures provided in the
12 approved Comprehensive Sampling and Analysis Plan (CSAP) portion of the *Final*
13 *Comprehensive RFI Work Plan* (EnSafe/Allen & Hoshall, 1994). The CSAP outlines all
14 monitoring procedures to be performed during the investigation to characterize the
15 environmental setting, source, and releases of hazardous constituents. In addition, the
16 CSAP includes the Quality Assurance Plan (QAP) and Data Management Plan (DMP) to
17 verify that all information and data are valid and properly documented. Sample analysis
18 will be conducted in accordance with the guidance in the EPA's *Test Methods for Evaluating*
19 *Solid Waste, SW-846, 3rd Ed.*, Office of Solid Waste and Emergency Response (SW846) and in
20 the EPA Environmental Services Division *Laboratory Operations and Quality Control Manual*
21 (ESDLOQCM) (1996c).

22 The results of the IM will be summarized in an IM Completion Report. The IM Completion
23 Report will document the field activities and provide the analytical results from any
24 confirmation samples collected at the site.

Table 4-1
 Leachate Transport Analysis Model (Revised SSL Calculations for Aroclor-1260)
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Parameter	Acetone	Bromoethane	Chloroethane	Chlorobenzene	1,2-Dichlorobenzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	Tetrachloroethene	Aroclor-1260
Chemical Specific Input Parameters									
Cw = Target groundwater concentration MCL (mg/L)	6.10E-01	0.0085	0.0036	0.1	0.6	0.0055	0.075	0.005	0.0005
H = Henry's Law Constant, dimensionless	7.67E-04	2.56E-01	4.55E-01	1.55E-01	6.15E-02	1.16E-01	1.11E-01	7.26E-01	1.89E-01
ks = Soil-water sorption coefficient (cm ³ water / g soil = Koc x foc where koc = organic carbon-water sorption coefficient, (cm ³ (ml) water) / (g soluble organic carbon) foc = Fraction of organic content, dimensionless	1.04E-02	1.31E+00	2.50E-01	1.65E+00	2.61E+01	4.14E+01	4.65E+01	2.27E+00	8.84E+03
	0.0104	1	126	24	159	2512	3981	4467	218.5
Site Specific Input Parameters									
Sw = Width of Source Parallel to Groundwater Flow Direction (impacted soil zone)	3.7 m	12 ff							
da = Aquifer Thickness	4.9 m	16 ff							
d = Groundwater Mixing Zone thickness	1.39 m	4.6 ft							
i = Groundwater Gradient		1.0E-03 (unitless)							
Ks = Saturated Hydraulic Conductivity	445.0 m/yr	1460.0 ft/yr							
θw = Volumetric Water Content of Soil Pore Space	0.3 cm ³ _{vapor} /cm ³ _{soil}	0.3 in ³ _{vapor} /in ³ _{soil}							
θv = Volumetric Vapor Content of Soil Pore Space	0.11 cm ³ _{vapor} /cm ³ _{soil}	0.11 in ³ _{vapor} /in ³ _{soil}							
ρs = Soil Bulk Density	1.5 g/cm ³	93.64 lb _m /ft ³							
qi = Water Infiltration Rate	0.1372 m/yr	0.4500 ft/yr							
Partition Term, Cw/Csoil, (L/kg)	$\frac{C_{cont}}{C_w} = \left(\frac{\theta + K_d \rho_s + H \theta}{\rho_s} \right) \left(\frac{K_d i + q_s}{q_s} \right)$								
Dilution Term, dimensionless	2.24E+00	2.24E+00	2.24E+00	2.24E+00	2.24E+00	2.24E+00	2.24E+00	2.24E+00	2.23E+00
Csoil/Cw = Partition term * Dilution term (mg/kg / mg/L) = L/kg	4.71E-01	3.42E+00	1.08E+00	4.17E+00	5.89E+01	9.31E+01	1.04E+02	5.65E+00	1.977E+04
Calculated Site Specific Target Level for Soil									
Csoil calculated source soil concentration (SSL, mg/kg) Cw*(partition term)*(dilution term)	0.29	0.029	0.0039	0.42	35.3	0.51	7.8	0.028	9.9

Cwt is based on the Drinking Water Standards and Health Advisories (EPA, 2000) where available. Where MCLs were not available (acetone, bromomethane, chloroethane, and 1,3-dichlorobenzene) the RBC from the EPA Region III RBC Table (October, 2000) was used.

H is from the Hazardous Substances Data Bank (HSDB, search 5/1,2002) or Table 3-2 of the Toxicological Profile for Polychlorinated Biphenyls (U.S. Department of Health & Human Services, 1995) [Aroclor-1260] adjusted to the dimensionless form (x 41).

ks = koc x foc.

koc is from the Hazardous Substances Data Bank (HSDB, search 5/1,2002) [bromomethane] or from the Superfund Chemical Data Matrix (Aroclor-1260)

foc is from site data, sample 633SB009P1 analytical results (10,400 mg/kg = 1.04% TOC).

Sw is the measured length of the source area exceeding the SSL along the groundwater flow direction.

d is calculated as $d = (0.0112 L^2)^{0.5} + da(1 - e^{-(L^2 / q K_s d)})$ or da, whichever is less.

da is the difference between the top of the Ashley formation (~ -20 ft msf) and the depth to water (~ -4 ft msf).

i is calculated (1/1000) from groundwater contours presented in Figure 1-4 Groundwater Monitoring Report (CH2M-Jones, 2001)

Ks is from Figure 21 of the USGS Report Hydrology and Simulation of Ground-Water Flow in the Surficial Aquifer System in the Area of Charleston Naval Base, North Charleston, South Carolina, 1995-97 (USGS, 1999).

θw is the default value presented in the Soil Screening Guidance: User's Guide (EPA, 1996)

θv is calculated as total porosity (0.41) - θw (0.3) = 0.11

ρs is the default value presented in the Soil Screening Guidance: User's Guide (EPA, 1996)

qi is from the USGS Report Hydrology and Simulation of Ground-Water Flow in the Surficial Aquifer System in the Area of Charleston

TABLE 4-2
 Summary of Calculated Site-Specific SSLs
 Phase II Interim Measure Work Plan, AOC 633, Zone G, Charleston Naval Complex

Compound	SSL (µg/kg)	Basis
Acetone	290	RBC
Bromomethane	29	RBC
Chloroethane	3.9	RBC
Chlorobenzene	420	MCL
1,2-Dichlorobenzene	3.5E+4	MCL
1,3-Dichlorobenzene	510	RBC
1,4-Dichlorobenzene	7.8E+3	MCL
Tetrachloroethene (PCE)	28	MCL
Aroclor-1260	9.9E+3	MCL

Notes: The "Basis" column indicates whether the SSL was calculated to meet an MCL or tap water RBC concentration in groundwater.

1 **5.0 Investigation-Derived Waste**

2 Five waste streams will be generated as part of this IM: excavated soils, removed
3 groundwater/LNAPL, adsorbent material, decontamination wastes, and personal
4 protective equipment (PPE). Excavated soil and liquid wastes will be characterized in
5 accordance with South Carolina Hazardous Waste Management Regulations (Section
6 SCDHEC R.61-79.261) and disposed of in accordance with all applicable regulations and
7 permits. Assuming the soils will be characterized as non-hazardous, they will be sent to a
8 subtitle D landfill. Liquid wastes will be characterized and disposed of in accordance with
9 applicable regulations. Decontamination wastes and PPE also will be disposed of in
10 accordance with regulations.

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

1 6.0 References

- 2 40 CFR 761.61. Title 40 Code of Federal Regulations Part 761.61, *PCB Remediation Waste*. July
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- 4 CH2M-Jones. *Interim Measure Work Plan, Subsurface Soil Removal, AOC 633, Zone G*. Revision
5 0. September 2001.
- 6 CH2M-Jones. *Infiltration Variable Used in SSL Calculation*. Technical Memorandum. April 12,
7 2002.
- 8 EnSafe Inc. *Zone G RFI Report, NAVBASE Charleston*. Revision 0. February 28, 1998.
- 9 EnSafe Inc. *Zone G RFI Report Workplan Addendum, NAVBASE Charleston*. January 17, 2000.
- 10 EnSafe Inc./ Allen & Hoshall. *Final Comprehensive RFI Work Plan*. 1994.
- 11 Environmental Enterprise Group (EEG). *Sampling Report, Site Delineation for PCBs at Area of
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14 633, Charleston Naval Complex, Charleston, SC*. September 15, 2000b.
- 15 U.S. Environmental Protection Agency (EPA). *Soil Screening Guidance: User's Guide*. Office of
16 Solid Waste and Emergency Response (OSWER). April, 1996a.
- 17 U.S. Environmental Protection Agency (EPA). *Soil Screening Guidance: Technical Background
18 Document*. Office of Solid Waste and Emergency Response (OSWER). May 1996b.
- 19 U.S. Environmental Protection Agency (EPA). *Operating Procedures and Quality Assurance
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- 21 USGS. *Hydrogeology and Simulation of Ground-Water Flow in the Surficial Aquifer System in the
22 Area of Charleston Naval Base, North Charleston, South Carolina, 1995-1997*. 1999.