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DRAFT ZONE E RESOURCE CONSERVATION AND RECOVERY FACILITY INVESTIGATION REPORT VOLUME III OF XV SECTIONS 10.0 TO 10.9 CNC CHARLESTON SC

11/1/1997

ENSAFE

DRAFT ZONE E
RCRA FACILITY INVESTIGATION REPORT
NAVBASE CHARLESTON

VOLUME III OF XV
SECTIONS 10.0 to 10.9

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Prepared for:

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10.2 SWMU 21, Old Paint Storage Area; and SWMU 54, Former Abrasive Blasting Area

SWMUs 21 and 54 are at the northern end of Zone E directly adjacent to the Cooper River. SWMU 21 is surrounded by SWMU 54. SWMU 21 consists of a 20-foot by 180-foot concrete pad originally constructed in 1942 and formerly used to store containerized paint wastes generated by ship repair and overhaul operations. SWMU 54 is the area south of Building 223 formerly used for the abrasive blasting of ship components and hull sections. Additionally, ship components and anchor chains were painted in this area. Spent blast grit still remains on the ground. The dates of operation for these facilities are not available.

SWMU 21 has been the subject of two previous investigative efforts. The first sampling event was a limited-scale effort with the goal of obtaining RCRA closure. During this sampling event, spent blast media and paint chips were analyzed for Extraction Procedure (EP) Toxicity Characteristic. The second sampling event occurred in the fall of 1993 as a prelude to the RFI field activities now being conducted.

Samples collected at SWMU 21 also included portions of the area now identified as SWMU 54. The media sampled included soil, groundwater, and sediment. Samples were analyzed for VOCs, SVOCs, and the Target Analyte List (TAL) of inorganics using SW-846 methods at DQO Level III with duplicates collected at a frequency of 10% and analyzed at DQO Level IV. The sampling adhered to methods outlined in the USEPA Region IV ESDSOP/QAM. Table 10.2.1.1 summarizes these investigations and the compound groups for which constituents were detected. As outlined in the sampling strategy presented in the *Final Comprehensive RFI Work Plan*, these constituents were compared to the USEPA Region III RBCs to identify the COPCs for the HHRA.

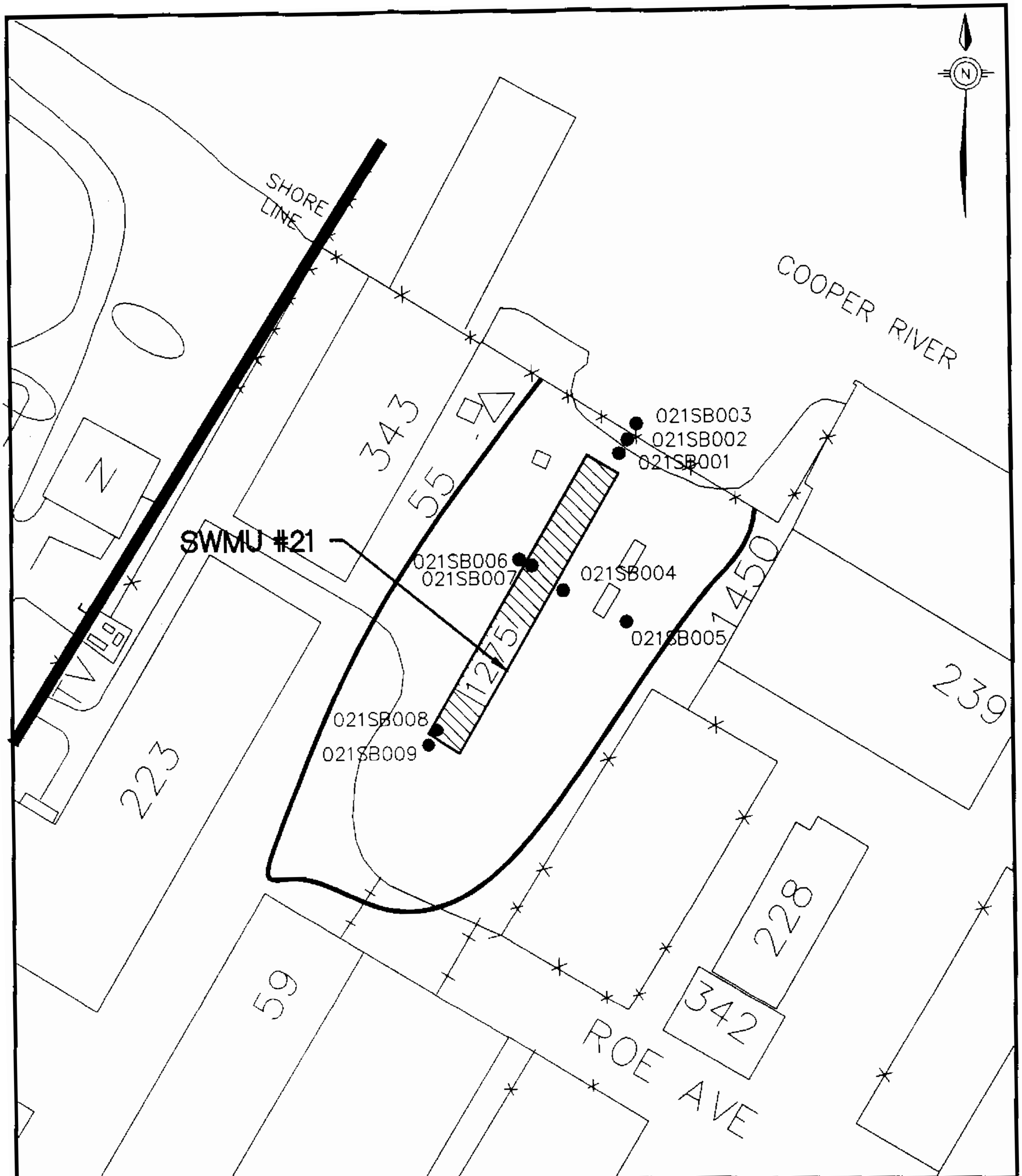
The COPCs identified by the current data set included benzo(a)pyrene, benzo(b)fluoranthene (both SVOCs), and lead. Sample locations where constituents were detected at concentrations above their respective RBCs included soil borings S21-B01 through S21-B06, and S21-B09. One COPC detected at an offshore sediment sampling location in the Cooper River (S21-S01) will be addressed in the Zone J RFI. VOCs were detected in monitoring well CNSY-21-02 at concentrations below the RBC values. Table 10.2.1.1 lists the previous investigations and the contaminants identified during those investigations. Figure 10.2.1 illustrates previous sampling locations for SWMU 21 and the locations of samples collected during the current round of sampling. It should be noted that monitoring well locations CNSY-21-01 through CNSY-21-03 correspond to soil boring locations S21-B01 through S21-B03 on the figure.

Table 10.2.1.1
SWMUs 21 and 54
Previous Investigations

Number	Previous Investigations	Contaminants Identified
SWMU 21	Field Investigation for Interim Status Unit RCRA Closure, 1988; Preliminary RFI Field Activities, 1993.[a]	VOCs, SVOCs, and inorganics
SWMU 54	None specifically for SWMU 54. The sampling described above, however, included sampling at SWMU 54.	VOCs, SVOCs, and inorganics

Note:
a = See Tables in Appendix C of the *Final Zone E RFI Work Plan* (E/A&H, June 1995) for analytical results.

Materials of concern at SWMUs 21 and 54, identified in the *Final Zone E RFI Work Plan*, include paint wastes, solvents, and abrasive blast media. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure. The subsurface utility distribution system (including storm and sanitary sewers) in this area has acted as a conduit for moving any product or waste released within Zone E, and thus could expose personnel working on any of these subsurface systems, as well as providing a contaminant route to the Cooper River, which borders Zone E along its northeastern side. The Cooper River could receive contaminated sediment, surface water runoff, and groundwater discharges, thus exposing ecological receptors.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
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CHARLESTON, S.C.

FIGURE 10.2.1
SWMU #21 SOIL BORING LOCATIONS
SWMU #21, SWMU #54
ABRASIVE BLAST AREA

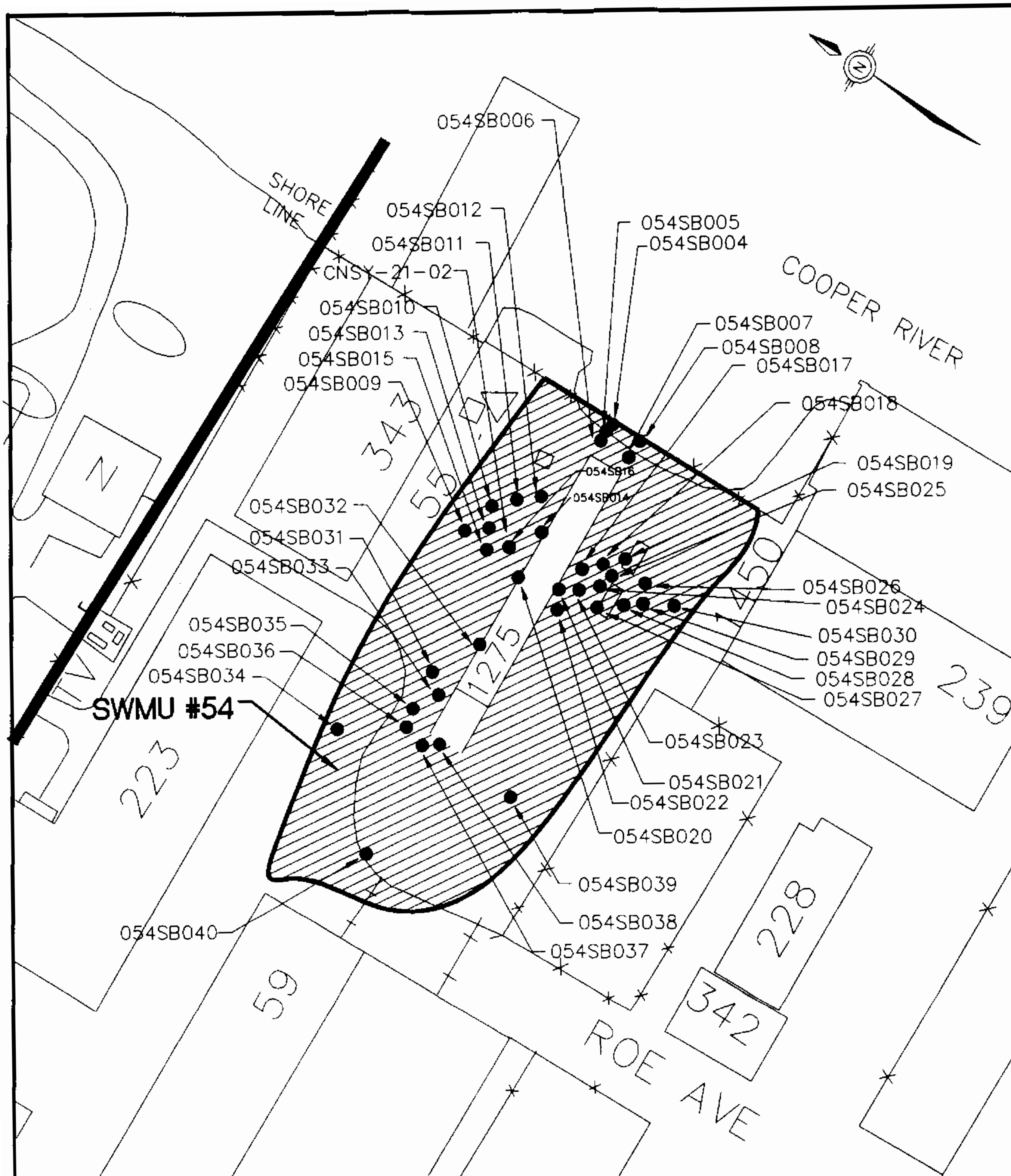
DWG DATE: 11/06/97 | DWG NAME: 10-02-01

To fulfill the RFI objectives, soil, sediment, groundwater and soil profile samples were collected in accordance with the *Final Zone E RFI Work Plan*, and Section 3 of this report to determine whether any contamination resulted from onsite activities.

10.2.1 Soil Sampling and Analysis

Soil was sampled in one round at SWMUs 21 and 54 from the locations shown in Figure 10.2.2. The *Final Zone E RFI Work Plan*, proposed collecting 37 soil samples from the upper interval and 37 samples from the lower interval. Soil samples were also collected at both intervals from the locations of the three shallow monitoring wells proposed at this site. All proposed upper-interval samples were collected and 35 of the proposed 40 lower-interval samples were collected.

At SWMU 54, five lower-interval samples were not collected due to subsurface obstructions in the form of large rocks at a depth of greater than two feet bgs. All samples were submitted for analysis at DQO Level III for SVOCs, metals, and organotins. In addition, one upper-interval sample and six lower-interval samples were submitted for VOC analysis due to high organic vapor analyzer (OVA) readings and/or strong petroleum odor in the sample indicating possible free product. Nine upper-interval samples selected as duplicates were analyzed at DQO Level IV for Appendix IX analytical parameters, which includes the suite of analyses proposed for the site as well as a more comprehensive list of VOCs, where applicable, and SVOCs, as well as herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. Table 10.2.1.2 summarizes soil sampling at SWMUs 21 and 54.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

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FIGURE 10.2.2
SWMU #54 SOIL BORING LOCATIONS
SWMU #21, SWMU #54
ABRASIVE BLAST AREA

DWG DATE: 11/06/97 | DWG NAME: 10-02-02

Table 10.2.1.2
SWMUs 21 and 54
Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	40	40	Metals, SVOCs, organotins	Metals, SVOCs, organotins	One sample was submitted for VOC analysis due to high OVA readings and/or a petroleum odor.
Lower	40	35	Metals, SVOCs, organotins	Metals, SVOCs, organotins	Five samples were not collected due to subsurface obstructions. Also, six samples were submitted for VOC analysis due to high OVA readings and/or petroleum odor.

10.2.2 Nature of Contamination in Soil

Organic compound analytical results for SWMU 54 soil samples are summarized in Table 10.2.2.1. Inorganic analytical results for SWMU 54 soil samples are summarized in Table 10.2.2.2. These tables also include the organic and inorganic analytical results from nine upper-interval and eight lower-interval SWMU 21 soil samples collected in 1993; these samples were analyzed only for VOCs, SVOCs, and metals. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.2.2.1
SWMUs 21 and 54
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs ($\mu g/kg$)						
Acetone	Upper	1/10	35.0	35.0	20,000,000	0
	Lower	8/14	30.0 - 170	75.0	NA	NA
2-Butanone (MEK)	Lower	1/14	6.00	6.00	100,000,000	0

Table 10.2.2.1
SWMUs 21 and 54
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs (μg/kg)						
Chlorobenzene	Upper	7/10	4.00 - 30.0	13.1	4,100,000	0
	Lower	2/14	11.0 - 18.0	14.5	NA	NA
Methylene chloride	Upper	1/10	6.10	6.10	760,000	0
Toluene	Upper	2/10	3.60 - 7.20	5.40	41,000,000	0
1,1,1-Trichloroethane	Upper	1/10	4.00	4.00	7,200,000	0
SVOCs (μg/kg)						
Acenaphthene	Lower	4/43	64.0 - 83,000	21,500	NA	NA
Anthracene	Upper	9/49	21.0 - 120	71.8	61,000,000	0
	Lower	7/43	20.0 - 250,000	36,000	NA	NA
Benzo(g,h,i)perylene	Upper	18/49	45 - 1,600	244.5	82,000,000	0
	Lower	11/43	52.0 - 160,000	14,800	NA	NA
Benzoic acid	Upper	1/40	1,100	1,100	100,000,000	0
bis(2-Ethylhexyl)phthalate	Upper	21/49	55.0 - 7,600	1,160	410,000	0
	Lower	14/43	76.0 - 380	189	NA	NA
Butylbenzylphthalate	Upper	11/49	46.0 - 280	114.4	41,000,000	0
	Lower	2/43	89.0 - 400	245	NA	NA
Carbazole	Upper	3/24	45.0 - 90.0	63	290,000	0
	Lower	1/11	87.0	87.0	NA	NA
Dibenzofuran	Upper	1/49	140	140	820,000	0
	Lower	2/43	1,300 - 72,000	36,700	NA	NA
Di-n-butylphthalate	Upper	18/49	66.0 - 480	190	20,000,000	0
	Lower	5/43	51.0 - 1,900	494	NA	NA
Diethylphthalate	Upper	2/49	100 - 120	110	100,000,000	0
	Lower	1/43	140	140	NA	NA
Di-n-octyl phthalate	Upper	1/49	10,000	10,000	4,100,000	0

Table 10.2.2.1
SWMUs 21 and 54
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (μg/kg)						
Fluoranthene	Upper	32/49	120 - 2,400	459	8,200,000	0
	Lower	21/43	43.0 - 700,000	34,000	NA	NA
Fluorene	Upper	1/49	200	200	8,200,000	0
	Lower	3/43	110 - 11,000	4670	NA	NA
2-Methylnaphthalene	Lower	1/43	12,000	12,000	NA	NA
4-Methylphenol (p-Cresol)	Upper	1/49	62.0	62.0	1,000,000	0
Naphthalene	Upper	2/49	58.0 - 95.0	76.5	8,200,000	0
	Lower	1/43	10,000	10,000	NA	NA
Phenanthrene	Upper	24/49	40.0 - 530	240	8,200,000	0
	Lower	14/43	53.0 - 700,000	50,800	NA	NA
Pyrene	Upper	37/49	62.0 - 3,900	504	6,100,000	0
	Lower	23/43	40.0 - 590,000	26,300	NA	NA
SVOCs (B(a)P Equivalents) (μg/kg)						
B(a)P Equiv.	Upper	31/49	0.0540 - 4,220	369.6	780	2
	Lower	17/43	0.130 - 476,000	28,393	NA	NA
Benzo(a)anthracene	Upper	27/49	95.0 - 1,900	297.9	7,800	0
	Lower	13/43	78.0 - 460,000	35,812	NA	NA
Benzo(b)fluoranthene	Upper	29/49	100 - 4,200	393.8	7,800	0
	Lower	15/43	76.0 - 290,000	19,733	NA	NA
Benzo(k)fluoranthene	Upper	20/49	75.0 - 2,400	302.4	78,000	0
	Lower	12/43	100 - 220,000	18,628	NA	NA
Benzo(a)pyrene	Upper	25/49	84.0 - 2,600	307.8	780	1
	Lower	15/43	55.0 - 290,000	19,662	NA	NA
Chrysene	Upper	29/49	54.0 - 4,000	369.4	780,000	0
	Lower	16/43	66.0 - 360,000	22,861	NA	NA

Table 10.2.2.1
SWMUs 21 and 54
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (B(a)P Equivalents) (μg/kg)						
Dibenz(a,h)anthracene	Upper	6/49	36.0 - 790	215	780	1
	Lower	4/43	140 - 93,000	23,418	NA	NA
Indeno(1,2,3-cd)pyrene	Upper	18/49	48.0 - 1,900	252.7	7,800	0
	Lower	11/43	44.0 - 150,000	13,934	NA	NA
Dioxins (ng/kg)						
Dioxin Equiv.	Upper	9/9	0.0106 - 3.18	0.947	1,000	0
1234678-HpCDD	Upper	7/9	3.98 - 85.1	27.5	NA	NA
1234678-HpCDF	Upper	9/9	0.521 - 58.8	15.3	NA	NA
123678-HxCDD	Upper	2/9	0.925 - 3.26	2.09	NA	NA
123789-HxCDD	Upper	1/9	1.84	1.84	NA	NA
123478-HxCDF	Upper	3/9	1.52 - 3.75	2.47	NA	NA
123678-HxCDF	Upper	4/9	1.51 - 5.17	3.13	NA	NA
234678-HxCDF	Upper	3/9	1.71 - 2.96	2.46	NA	NA
OCDD	Upper	9/9	4.17 - 491	127	NA	NA
OCDF	Upper	9/9	0.883 - 65.7	20.0	NA	NA
23478-PeCDF	Upper	1/9	0.750	0.750	NA	NA
2378-TCDF	Upper	2/9	0.808 - 1.14	0.974	NA	NA

Notes:
μg/kg = Micrograms per kilogram
ng/kg = Nanograms per kilogram
RBC = Risk-based concentration
NA = No industrial RBC established

Table 10.2.2.2
SWMUs 21 and 54
Inorganic Detections for Soil (mg/kg)

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Aluminum (Al)	Upper	49/49	1,140 - 9,170	3,380	100,000	26,600	0
	Lower	43/43	289 - 9,110	3,230	NA	41,100	NA
Antimony (Sb)	Upper	49/49	0.800 - 50.0	9	82	1.77	0
	Lower	23/43	0.460 - 138	11.7	NA	1.60	NA
Arsenic (As)	Upper	48/49	0.900 - 26	5.6	3.8	23.9	1
	Lower	40/43	0.660 - 44.8	7.07	NA	19.9	NA
Barium (Ba)	Upper	49/49	8.40 - 460	67	14,000	130	0
	Lower	43/43	5.50 - 2,760	146	NA	94.1	NA
Beryllium (Be)	Upper	40/49	0.130 - 4.00	1.07	1.3	1.70	9
	Lower	27/43	0.120 - 1.60	0.439	NA	2.71	NA
Cadmium (Cd)	Upper	44/49	0.160 - 8.40	1.70	100	1.50	0
	Lower	30/43	0.110 - 20.8	2.54	NA	0.960	NA
Calcium (Ca)	Upper	49/49	1,220 - 240,000	32,860	NA	NA	NA
	Lower	43/43	307 - 214,000	27,100	NA	NA	NA
Chromium (Cr)	Upper	49/49	6.00 - 226	54.6	1,000	94.6	0
	Lower	43/43	1.50 - 78.6	18.9	NA	75.2	NA
Cobalt (Co)	Upper	49/49	0.470 - 67.2	10.6	12,000	19.0	0
	Lower	34/43	0.400 - 14.0	3.18	NA	14.9	NA
Copper (Cu)	Upper	49/49	4.80 - 2,660	448	8,200	66.0	0
	Lower	43/43	1.10 - 7,930	522	NA	152	NA
Iron (Fe)	Upper	49/49	1620 - 46,200	15,514	61,000	NA	0
	Lower	43/43	660 - 139,000	12,500	NA	NA	NA
Lead (Pb)	Upper	49/49	9.00 - 9,520	890	1,300	265	5
	Lower	43/43	2.60 - 32,200	1,370	NA	173	NA
Magnesium (Mg)	Upper	49/49	103 - 24,000	2,267	NA	NA	NA
	Lower	43/43	42.1 - 6,120	1,330	NA	NA	NA

Table 10.2.2.2
SWMUs 21 and 54
Inorganic Detections for Soil (mg/kg)

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Manganese (Mn)	Upper	49/49	9.30 - 490	158	4,700	302	0
	Lower	43/43	3.90 - 1,090	99.6	NA	881	NA
Mercury (Hg)	Upper	49/49	0.0130 - 20	1.1	61	2.60	0
	Lower	39/43	0.0290 - 64.5	2.23	NA	1.59	NA
Nickel (Ni)	Upper	49/49	2.30 - 492	50.4	4,100	77.1	0
	Lower	39/43	0.700 - 333	23.8	NA	57.0	NA
Potassium (K)	Upper	46/49	140 - 1,480	561	NA	NA	NA
	Lower	28/43	103 - 1,530	588	NA	NA	NA
Selenium (Se)	Upper	12/49	0.530 - 2.20	1.06	1,000	1.70	0
	Lower	11/43	0.710 - 1.80	1.32	NA	2.40	NA
Silver (Ag)	Upper	23/49	0.240 - 6.10	1.11	1,000	NA	0
	Lower	8/43	0.260 - 2.20	1.06	NA	NA	NA
Sodium (Na)	Upper	39/49	17.2 - 1,970	378	NA	NA	NA
	Lower	23/43	69.0 - 2,810	750	NA	NA	NA
Thallium (Tl)	Upper	9/49	0.570 - 4.20	1.5	16	NA	0
	Lower	4/43	0.760 - 6.30	2.59	NA	NA	NA
Tin (Sn)	Upper	35/40	7.40 - 236	46.6	100,000	59.4	0
	Lower	20/35	3.30 - 900	134	NA	9.23	NA
Vanadium (V)	Upper	49/49	1.80 - 27.3	10.8	1,400	94.3	0
	Lower	42/43	1.20 - 97.8	11.7	NA	155	NA
Zinc (Zn)	Upper	49/49	14.3 - 3,500	1,030	61,000	827	0
	Lower	43/43	2.80 - 10,800	858	NA	886	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Risk-based concentration
RC = Reference concentration
NA = No industrial RBC or RC established

Volatile Organic Compounds in Soil

Six VOCs were detected in soil samples at SWMUs 21 and 54. Twelve detections occurred in the upper interval and 11 in the lower interval. No VOC was detected above its respective industrial RBC.

Semivolatile Organic Compounds in Soil

Twenty-five SVOCs were detected in soil samples collected at SWMUs 51 and 54. Three hundred and thirty-six detections occurred in the upper interval and 196 occurred in the lower interval. Two SVOCs — benzo(a)pyrene and dibenz(a,h)anthracene — exceeded their respective industrial RBC in the upper interval. Additionally, seven SVOCs — benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene — exceeded their respective SSLs in the lower interval.

Benzo(a)pyrene was detected in 25 upper-interval samples with a range of 84.0 to 2,600 μg/kg and a mean of 308 μg/kg. One upper-interval sample (054SB017, 2,600 μg/kg) exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg.

Dibenz(a,h)anthracene was detected in six upper-interval samples with a range of 36.0 to 790 μg/kg and a mean of 215 μg/kg. One upper-interval sample (054SB017, 790 μg/kg) exceeded the dibenz(a,h)anthracene industrial RBC of 780 μg/kg.

Benzo(a)anthracene was detected 13 of 43 lower-interval samples with a range of 78 to 460,000 μg/kg and a mean of 35,812 μg/kg. Three lower-interval samples (054SB022, 1,400 μg/kg; 054SB027, 890 μg/kg; and 054SB031, 460,000 μg/kg) exceeded the benzo(a)anthracene SSL of 700 μg/kg.

Benzo(a)pyrene was detected 15 of 43 lower-interval samples with a range of 55 to 290,000 μg/kg and a mean of 19,662 μg/kg. One lower-interval sample (054SB031, 290,000 μg/kg) exceeded the benzo(a)pyrene SSL of 4,000 μg/kg.

Benzo(b)fluoranthene was detected 15 of 43 lower-interval samples with a range of 76 to 290,000 μg/kg and a mean of 19,733 μg/kg. One lower-interval sample (054SB031, 290,000 μg/kg) exceeded the benzo(b)fluoranthene SSL of 4,000 μg/kg.

Benzo(k)fluoranthene was detected 12 of 43 lower-interval samples with a range of 100 to 220,000 μg/kg and a mean of 18,628 μg/kg. One lower-interval sample (054SB031, 220,000 μg/kg) exceeded the benzo(k)fluoranthene SSL of 4,000 μg/kg.

Chrysene was detected 16 of 43 lower-interval samples with a range of 66 to 360,000 μg/kg and a mean of 22,861 μg/kg. Two lower-interval samples (054SB022, 1,500 μg/kg and 054SB031, 360,000 μg/kg) exceeded the chrysene SSL of 1,000 μg/kg.

Dibenz(a,h)anthracene was detected four of 43 lower-interval samples with a range of 140 to 93,000 μg/kg and a mean of 23,418 μg/kg. One lower-interval sample (054SB031, 93,000 μg/kg) exceeded the dibenz(a,h)anthracene SSL of 11,000 μg/kg.

Indeno(1,2,3-cd)pyrene was detected 11 of 43 lower-interval samples with a range of 44 to 150,000 μg/kg and a mean of 13,934 μg/kg. One lower-interval sample (054SB031, 150,000 μg/kg) exceeded the indeno(1,2,3-cd)pyrene SSL of 11,000 μg/kg.

In accordance with recent cPAH guidance, BEQs were calculated for cPAHs at SWMUs 21 and 54. The upper-interval BEQ was calculated for 31 samples with a range of 0.0540 to

4,220 μg/kg and a mean of 370 μg/kg. Two upper-interval samples (054SB017, 4,220 μg/kg and 054SB031, 1,076 μg/kg) exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg.

Pesticides and PCBs in Soil

No pesticides or PCBs were detected in soil samples collected at SWMUs 21 and 54.

Other Organic Compounds in Soil

No organotins were detected in soil samples collected at SWMUs 21 and 54.

Eleven dioxins were detected in the nine upper-interval duplicate soil samples collected at SWMUs 21 and 54, with 50 detections. No industrial RBCs exist for these parameters.

In accordance with recent dioxin guidance, TEQs were calculated for upper-interval samples. The TEQ was calculated for nine samples with a range of 0.0106 to 3.18 ng/kg and a mean of 0.947 ng/kg. All TEQs were below the 2,3,7,8-TCDD industrial RBC of 1,000 ng/kg.

Inorganic Elements in Soil

Twenty-four metals were detected in soil samples collected at SWMUs 21 and 54. One thousand and thirty-one detections occurred in the upper interval and 798 in the lower interval. Three metals — arsenic, beryllium, and lead — exceeded both their respective industrial RBC and background RC in the upper interval. Additionally, three metals — arsenic, barium, and cadmium — exceeded both their respective SSLs and background reference concentrations (RCs) in the lower interval.

Arsenic was detected in 48 of 49 upper-interval samples with a range of 0.900 to 26 mg/kg and a mean of 5.6 mg/kg. One upper-interval sample (S21-B03, 26 mg/kg) exceeded both the arsenic industrial RBC of 3.8 mg/kg and the background RC of 23.9 mg/kg.

Beryllium was detected in 40 of 49 upper-interval samples with a range of 0.130 to 4.00 mg/kg, and a mean of 1.10 mg/kg. Nine upper-interval samples exceeded both the beryllium industrial RBC of 1.30 mg/kg and the background RC of 1.70 mg/kg:

S21-B02 (2.8 mg/kg)	054SB008 (1.9 mg/kg)	054SB016 (1.8 mg/kg)
054SB001 (1.8 mg/kg)	054SB012 (3.9 mg/kg)	054SB031 (4 mg/kg)
054SB003 (1.8 mg/kg)	054SB014 (2.4 mg/kg)	054SB037 (1.8 mg/kg)

Lead was detected in 49 of 49 upper-interval samples with a range of 9.00 to 9,520 mg/kg, and a mean of 890 mg/kg. Five upper-interval samples exceeded both the lead industrial RBC of 1,300 mg/kg and the background RC of 265 mg/kg:

S21-SB03 (2,900 mg/kg)
054SB029 (9,270 mg/kg)
054SB031 (1,440 mg/kg)
054SB038 (2,570 mg/kg)
054SB039 (9,520 mg/kg)

Arsenic was detected in 40 of 43 lower-interval samples with a range of 0.660 to 44.8 mg/kg and a mean of 7.07 mg/kg. Three lower-interval samples (054SB031, 34.5 mg/kg; 054SB032, 36.2 mg/kg; and 054SB035, 44.8 mg/kg) exceeded both the arsenic SSL of 15 mg/kg and the background RC of 19.9 mg/kg.

Barium was detected in 43 of 43 lower-interval samples with a range of 5.50 to 2,760 mg/kg and a mean of 146 mg/kg. Five lower-interval samples (054SB003, 1,410 mg/kg; 054SB031, 465 mg/kg; 054SB032, 184 mg/kg; 054SB033, 119 mg/kg; and 054SB035, 2,760 mg/kg) exceeded both the barium SSL of 32 mg/kg and the background RC of 94.1 mg/kg.

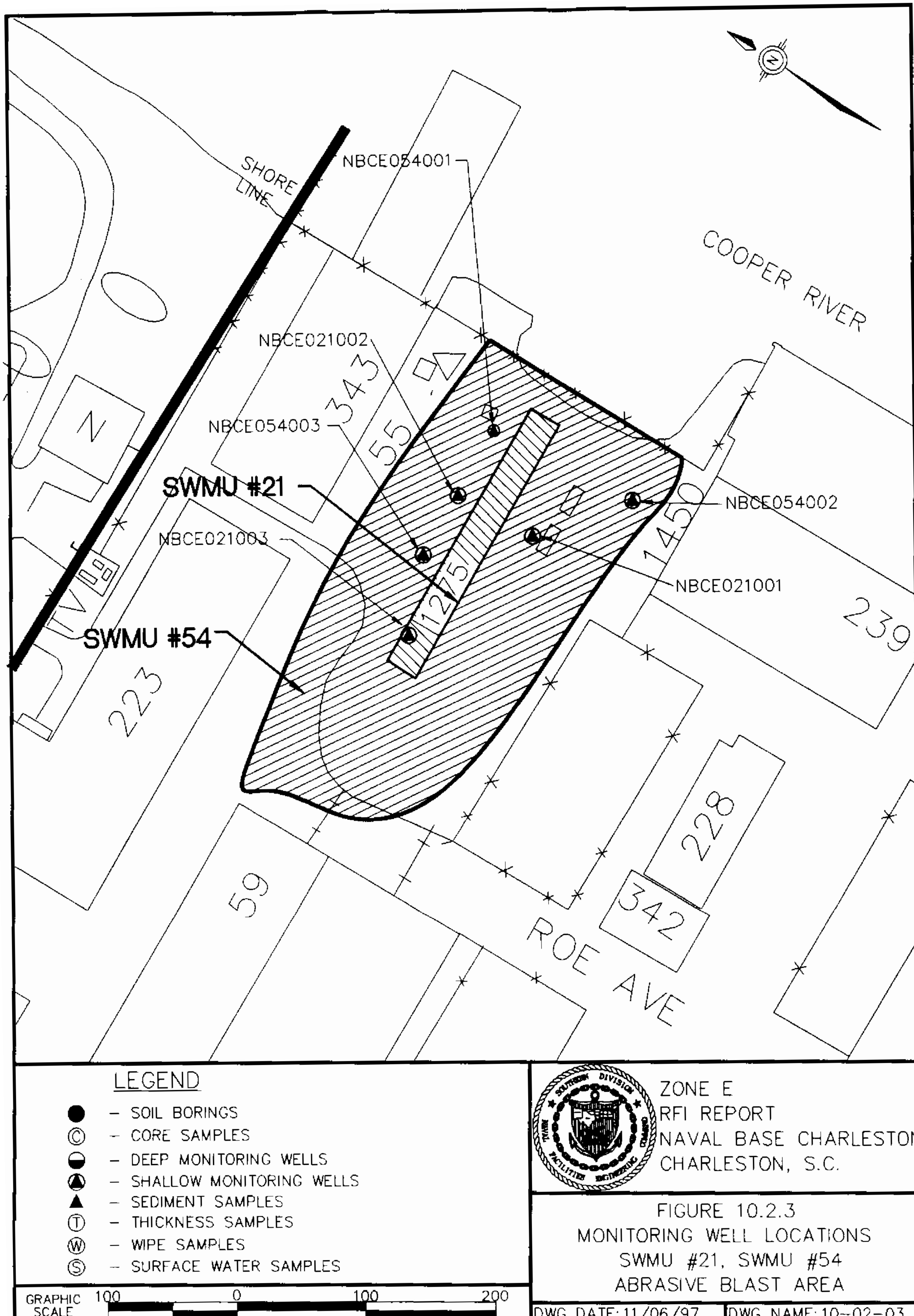
Cadmium was detected in 30 of 43 lower-interval samples with a range of 0.110 to 20.8 mg/kg and a mean of 2.54 mg/kg. Three lower-interval samples (054SB003, 12.2 mg/kg; 054SB031, 20.8 mg/kg; and 054SB035, 17.1 mg/kg) exceeded both the cadmium SSL of 6.0 mg/kg and the background RC of 0.960 mg/kg.

10.2.3 Groundwater Sampling and Analysis

Three shallow monitoring wells were installed and sampled to assess groundwater quality at SWMUs 21 and 54 as shown in Figure 10.2.3. Three existing wells, installed during the previous SWMU 21 investigation, were also sampled. The wells were installed as follows and the existing wells are also listed:

- Shallow Wells installed at SWMU 54 — NBCE054001, NBCE054002, and NBCE054003
- Shallow Wells existing at SWMU 21 — NBCE021001, NBCE021002, and NBCE021003

Groundwater samples were submitted for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, chlorides, sulfates, TDS, and organotins at DQO Level III. One duplicate sample was submitted for Appendix IX analyses at DQO Level IV, which includes the parameters listed above plus a more comprehensive list of VOCs and SVOCs as well as herbicides, hexavalent chromium, organophosphorous pesticides, and dioxins. Table 10.2.3.1 summarizes groundwater sampling and analysis at SWMUs 21 and 54.



ZONE E
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FIGURE 10.2.3
MONITORING WELL LOCATIONS
SWMU #21, SWMU #54
ABRASIVE BLAST AREA

DWG DATE: 11/06/97 | DWG NAME: 10-02-03

Table 10.2.3.1
SWMUs 21 and 54
Groundwater Sampling Summary

Depth	Wells Proposed	Wells Installed	Analyses Proposed	Analyses Collected	Deviations
Shallow	3	3	Standard Suite[a], chlorides, sulfates, and TDS	Standard Suite[a], chlorides, sulfates, and TDS	Three existing wells were also sampled

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs

The shallow monitoring wells were installed at 12.5 to 13.5 feet bgs in the surficial aquifer. All wells were installed in accordance with Section 3.3 of this report.

10.2.4 Nature of Contamination in Groundwater

Organic compound analytical results for groundwater are summarized in Table 10.2.4.1. Inorganic analytical results for groundwater are summarized in Table 10.2.4.2. Appendix H contains the complete data report for all samples collected in Zone E.

Volatile Organic Compounds in Groundwater

Shallow Groundwater

Two VOCs — 2-butanone and carbon disulfide — were detected in one of six shallow well groundwater samples collected at SWMUs 21 and 54. Neither VOC exceeded its respective tap-water RBC. No MCL has been established for either compound.

Table 10.2.4.1
SWMUs 21 and 54
Organic Compounds Detected in First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	MCL	Number of Samples Exceeding RBC
VOCs						
2-Butanone (MEK)	1/6	11.0	11	190	NA	0
Carbon disulfide	1/6	2.00	2.00	100	NA	0

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
NA = No MCL established for this compound

Table 10.2.4.2
SWMUs 21 and 54
Inorganic Detections for First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Antimony (Sb)	2/6	10.2 - 22.0	16.1	1.50	NA	6.00	2
Arsenic (As)	2/6	6.00 - 19.5	12.8	0.0450	18.7	50.0	1
Calcium (Ca)	6/6	47,500 - 378,000	139,000	NA	NA	NA	NA
Chromium (Cr)	3/6	1.20 - 1.60	1.40	18.0	12.3	100	0
Iron (Fe)	5/6	3,690 - 28,000	14,900	1,100	NA	NA	5
Lead (Pb)	3/6	5.50 - 22.3	11.9	NA	4.80	15.0*	1
Magnesium (Mg)	6/6	18,800 - 127,000	52,100	NA	NA	NA	NA
Manganese (Mn)	6/6	110 - 713	481	84.0	2,560	NA	0
Nickel (Ni)	3/6	1.40 - 2.80	2.23	73.0	15.2	100	0
Potassium (K)	6/6	11,600 - 68,100	32,800	NA	NA	NA	NA
Sodium (Na)	4/6	251,000 - 763,000	508,000	NA	NA	NA	NA
Thallium (Tl)	1/6	5.00	5.00	0.290	NA	2.00	1

Table 10.2.4.2
SWMUs 21 and 54
Inorganic Detections for First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Vanadium (V)	1/6	2.20	2.20	26.0	11.4	NA	0
Zinc (Zn)	1/6	42.8	42.8	1,100	27.3	NA	0

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
RC = Reference concentration
NA = No RBC, MCL, or RC established
* = TTAL

Inorganic Elements in Groundwater

Shallow Groundwater

Fourteen metals were detected in shallow groundwater samples at SWMUs 21 and 54. Five metals — antimony, arsenic, iron, lead, and thallium — exceeded both their respective residential tap-water RBCs and background RCs (where established).

Antimony was detected in two of six samples with a range of 10.2 to 22.0 μg/L, and a mean of 16.1 μg/L. Two samples from wells NBCE021002 (10.2 μg/L) and NBCE054002 (22 μg/L) exceeded the antimony tap-water RBC of 1.5 μg/L and MCL of 6 μg/L. No background RC has been established for antimony.

Arsenic was detected in two of six samples with a range of 6.00 to 19.5 μg/L and a mean of 12.8 μg/L. One sample from well NBCE021002 (19.5 μg/L) exceeded both the arsenic tap-water RBC of 0.0450 μg/L and background RC of 18.7 μg/L. The sample did not exceed the arsenic MCL (50 μg/L).

Iron was detected in five of six samples with a range of 3,690 to 28,000 μg/kg, and a mean of 14,900 μg/kg. Samples from the following five wells exceeded the iron tap-water RBC of 1,100 μg/L:

NBCE021001 (3,690 μg/L)	NBCE054002 (24,500 μg/L)
NBCE021002 (28,000 μg/L)	NBCE054003 (13,000 μg/L)
NBCE021003 (5,370 μg/L)	

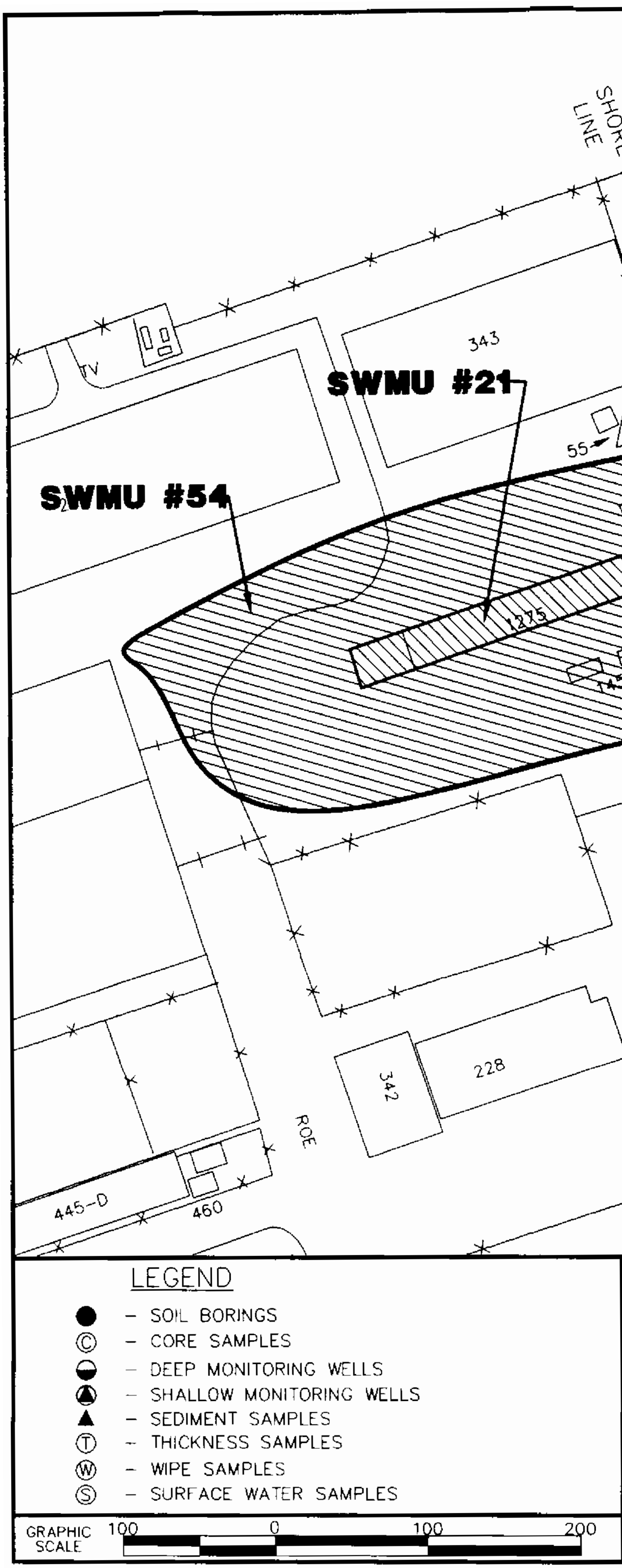
No MCL or shallow groundwater RC has been established for iron.

Lead was detected in three of six shallow groundwater samples with a range of 5.50 to 22.3 μg/L and a mean of 11.9 μg/L. One sample from well NBCE054002 (22.3 μg/L) exceeded both the lead TTAL of 15.0 μg/L and shallow groundwater RC of 4.8 μg/L. No tap-water RBC or MCL has been established for lead.

Thallium was detected in one of six shallow groundwater samples at 5.00 μg/L. The sample from well NBCE054002 (5.0 μg/L) exceeded the thallium tap-water RBC of 0.290 μg/Land its MCL of 2 μg/L. No shallow groundwater RC has been established for thallium.

10.2.5 Sediment Sampling and Analysis

The *Final Zone E RFI Work Plan* proposed collecting four sediment samples at SWMUs 21 and 54 from the locations shown in Figure 10.2.4. Four sediment samples were collected from the nearshore area of the Cooper River and submitted for analysis at DQO Level III for SVOCs, metals, and organotins. One sample was selected as a duplicate and submitted for Appendix IX analysis at DQO Level IV for the suite of parameters proposed for the site plus a more comprehensive list of SVOCs, in addition to herbicides, organophosphorus pesticides,



ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.2.4
SEDIMENT SAMPLE LOCATIONS
SWMU #21
SWMU #54
ABRASIVE BLAST AREA

DWG DATE: 09/02/97 | DWG NAME: 10-02-4

dioxins, and hexavalent chromium. Table 10.2.5.1 summarizes sediment sampling and analysis at SWMUs 21 and 54.

Table 10.2.5.1
SWMUs 21 and 54
Sediment Sampling Summary

Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviation
4	4	SVOCs, metals, and organotins	SVOCs, metals, and organotins	None

10.2.6 Nature of Contamination in Sediment

Table 10.2.6.1 summarizes the organic analytical results for sediment. Table 10.2.6.2 summarizes the inorganic analytical results for sediment. Appendix H contains the complete analytical report for all samples collected in Zone E. Sediment analytical results were evaluated in Section 8, Ecological Risk Assessment, of this report and will be further assessed in the Zone J RFI.

Table 10.2.6.1
SWMUs 21 and 54
Organic Compounds Detected in Sediment

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Sediment Quality Criteria	Number of Samples Exceeding SSV
SVOCs (μg/kg)					
Acenaphthene	1/4	640	640	330	1
Anthracene	1/4	1,400	1,400	330	1
Benzo(g,h,i)perylene	3/4	120 - 1,200	497	NA	NA
Dibenzofuran	1/4	590	590	NA	NA
Fluoranthene	3/4	255 - 6,700	2,490	330	2

Table 10.2.6.1
SWMUs 21 and 54
Organic Compounds Detected in Sediment

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Sediment Quality Criteria	Number of Samples Exceeding SSV
SVOCs ($\mu g/kg$)					
Fluorene	1/4	760	760	330	1
2-Methylnaphthalene	1/4	220	220	330	0
Naphthalene	1/4	590	590	330	1
Phenanthrene	2/4	260 - 6,900	3,580	330	1
Pyrene	4/4	130 - 5,600	1,710	330	3
SVOCs (B(a)P Equivalents) ($\mu g/kg$)					
B(a)P Equiv.	3/4	261 - 3,330	1330	NA	NA
Benzo(a)anthracene	3/4	210 - 2,600	1,010	330	1
Benzo(b)fluoranthene	2/4	170 - 230	200	NA	NA
Benzo(k)fluoranthene	3/4	210 - 3,600	1,350	NA	NA
Benzo(a)pyrene	3/4	210 - 2,200	883	330	1
Chrysene	3/4	160 - 2,900	1,110	330	1
Dibenz(a,h)anthracene	2/4	90.0 - 720	405	330	1
Indeno(1,2,3-cd)pyrene	3/4	110 - 1,100	450	NA	NA
Dioxins (ng/kg)					
Dioxin Equiv.	1/1	1.77	1.77	NA	NA
1234678-HpCDD	1/1	37.8	37.8	NA	NA
1234678-HpCDF	1/1	3.23	3.23	NA	NA
123678-HxCDD	1/1	1.69	1.69	NA	NA
123789-HxCDD	1/1	2.54	2.54	NA	NA
123678-HxCDF	1/1	1.16	1.16	NA	NA
123789-HxCDF	1/1	0.939	0.939	NA	NA
OCDD	1/1	724	724	NA	NA

Table 10.2.6.1
SWMUs 21 and 54
Organic Compounds Detected in Sediment

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Sediment Quality Criteria	Number of Samples Exceeding SSV
Dioxins (ng/kg)					
OCDF	1/1	6.23	6.23	NA	NA

Notes:
μg/kg = Micrograms per kilogram
ng/kg = Nanograms per kilogram
SSV = Sediment screening value
NA = No SSV established

Table 10.2.6.2
SWMUs 21 and 54
Inorganic Detections in Sediment (mg/kg)

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Sediment Quality Criteria	Number of Samples Exceeding SSV
Aluminum (Al)	4/4	2,140 - 15,300	5,520	NA	NA
Antimony (Sb)	4/4	1.10 - 23.2	7.33	12.0	1
Arsenic (As)	4/4	3.70 - 21.8	8.83	7.24	1
Barium (Ba)	4/4	19.5 - 56.8	37.0	NA	NA
Beryllium (Be)	4/4	0.260 - 2.50	1.25	NA	NA
Cadmium (Cd)	4/4	0.270 - 0.450	0.350	1.000	0
Calcium (Ca)	4/4	8,800 - 23,800	13,400	NA	NA
Chromium (Cr)	4/4	28.4 - 40.4	34.6	52.3	0
Cobalt (Co)	4/4	2.90 - 18.3	10.9	NA	NA
Copper (Cu)	4/4	38.1 - 427	225	18.7	4
Iron (Fe)	4/4	7,170 - 28,500	16,000	NA	NA
Lead (Pb)	4/4	69.4 - 482	206	30.2	4
Magnesium (Mg)	4/4	1,320 - 7,000	3,290	NA	NA
Manganese (Mn)	4/4	47.1 - 299	155	NA	NA

Table 10.2.6.2
SWMUs 21 and 54
Inorganic Detections in Sediment (mg/kg)

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Sediment Quality Criteria	Number of Samples Exceeding SSV
Mercury (Hg)	4/4	0.0600 - 0.67	0.319	0.130	2
Nickel (Ni)	4/4	15.9 - 42.4	28.1	15.9	4
Potassium (K)	1/4	4,040	4,040	NA	NA
Selenium (Se)	3/4	0.800 - 2.1	1.15	NA	NA
Silver (Ag)	2/4	0.710 - 0.750	0.730	2.00	0
Sodium (Na)	4/4	925 - 8,480	2,940	NA	NA
Tin (Sn)	2/4	43.6 - 55.7	49.7	NA	NA
Vanadium (V)	4/4	5.40 - 58.3	18.2	NA	NA
Zinc (Zn)	4/4	121 - 1,390	725	124	3

Notes:
mg/kg = Milligrams per kilogram
SSV = Sediment screening value
NA = No SSV established

Semivolatile Organic Compounds in Sediment

Seventeen SVOCs were detected in sediment samples collected from SWMUs 21 and 54 with 37 detections occurring in the upper interval (no lower-interval samples were collected). Eleven SVOCs — acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and pyrene — exceeded their respective SSVs.

Acenaphthene was detected in one of four upper-interval samples at 640 μg/kg. The sample, 054M0001, exceeded the acenaphthene SSV of 330 μg/kg.

Anthracene was detected in one of four upper-interval samples at 1,400 μg/kg. The sample, 054M0001, exceeded the anthracene SSV of 330 μg/kg.

Benzo(a)anthracene was detected in three of four upper-interval samples with a range of 210 to 2,600 μg/kg and a mean of 1,010 μg/kg. One sample (054M0001, 2,600 μg/kg) exceeded the benzo(a)anthracene SSV of 330 μg/kg.

Benzo(a)pyrene was detected in three of four upper-interval samples with a range of 210 to 2,200 μg/kg and a mean of 883 μg/kg. One sample (054M0001, 2,200 μg/kg) exceeded the benzo(a)pyrene SSV of 330 μg/kg.

Chrysene was detected in three of four upper-interval samples with a range of 160 to 2,900 μg/kg and a mean of 1,110 μg/kg. One sample (054M0001, 2,900 μg/kg) exceeded the chrysene SSV of 330 μg/kg.

Dibenz(a,h)anthracene was detected in two of four upper-interval samples with a range of 90 to 720 μg/kg and a mean of 405 μg/kg. One sample (054M0001, 720 μg/kg) exceeded the dibenz(a,h)anthracene SSV of 330 μg/kg.

Fluoranthene was detected in three of four upper-interval samples with a range of 255 to 6,700 μg/kg and a mean of 2,490 μg/kg. Two samples (054M0001, 6,700 μg/kg; and 054M0003, 500 μg/kg) exceeded the fluoranthene SSV of 330 μg/kg.

Fluorene was detected in one of four upper-interval samples at 760 μg/kg. The sample, 054M0001, exceeded the fluorene SSV of 330 μg/kg.

Naphthalene was detected in one of four upper-interval samples at 590 μg/kg. The sample, 054M0001, exceeded the naphthalene SSV of 330 μg/kg.

Phenanthrene was detected in two of four upper-interval samples with a range of 260 to 6,900 μg/kg and a mean of 3,580 μg/kg. One sample (054M0001, 6,900 μg/kg) exceeded the phenanthrene SSV of 330 μg/kg.

Pyrene was detected in four of four upper-interval samples with a range of 130 to 5,600 μg/kg and a mean of 1,710 μg/kg. Three samples (054M0001, 5,600 μg/kg; 054M0002, 590 μg/kg; and 054M0003, 480 μg/kg) exceeded the pyrene SSV of 330 μg/kg.

Pesticides and PCBs in Sediment

No pesticides were detected in samples submitted for analysis from SWMUs 21 and 54. No samples were submitted for PCB analysis.

Other Organic Compounds in Sediment

No organotins were detected in samples submitted for laboratory analysis from SWMUs 21 and 54.

Eight dioxins were detected in samples submitted for laboratory analysis from SWMUs 21 and 54. No SSVs apply to these dioxins. In accordance with recent dioxin guidance, TEQs (dioxin equivalent) were calculated. The TEQ was calculated for one sample at 1.77 ng/kg; no SSV applies to the TEQ.

Inorganic Elements in Sediment

Twenty-three metals were detected in sediment samples collected at SWMUs 21 and 54 with 84 detections occurring. Seven metals — antimony, arsenic, copper, lead, mercury, nickel, and zinc — exceeded their respective SSVs.

Antimony was detected in four of four samples with a range of 1.10 to 23.2 mg/kg and a mean of 7.33 mg/kg. One sample, 054M0004 (23.2 mg/kg), exceeded the antimony SSV of 12.0 mg/kg.

Arsenic was detected in four of four samples with a range of 3.70 to 21.8 mg/kg and a mean of 8.83 mg/kg. One sample, 054M0002 (21.5 mg/kg), exceeded the arsenic SSV of 7.24 mg/kg.

Copper was detected in four of four samples with a range of 38.1 to 427 mg/kg and a mean of 225 mg/kg. Four samples exceeded the copper SSV of 18.7 mg/kg: 054M0001, 83.1 mg/kg; 054M0002, 38.1 mg/kg; 054M0003, 427 mg/kg; and 054M0004, 355 mg/kg.

Lead was detected in four of four samples with a range of 69.4 to 482 mg/kg and a mean of 206 mg/kg. All four samples exceeded the lead SSV of 30.2 mg/kg: 054M0001, 87 mg/kg; 054M0002, 69.4 mg/kg; 054M0003, 196 mg/kg; and 054M0004, 482 mg/kg.

Mercury was detected in four of four samples with a range of 0.0600 to 0.67 μg/kg and a mean of 0.319 μg/kg. Two samples exceeded the mercury SSV of 0.130 mg/kg: 054M0001, 0.52 mg/kg; and 054M0002, 0.67 mg/kg.

Nickel was detected in four of four samples with a range of 15.9 to 42.4 mg/kg and a mean of 28.1 μg/kg. All four samples exceeded the nickel SSV of 15.9 mg/kg: 054M0001 (19.7 mg/kg), 054M0002 (15.9 mg/kg), 054M0003 (42.4 mg/kg), and 054M0004 (35.7 mg/kg).

Zinc was detected in four of four samples with a range of 121 to 1,390 mg/kg and a mean of 725 mg/kg. Three samples exceeded the zinc SSV of 124 mg/kg: 054M0001 (211 mg/kg), 054M0003 (1,180 mg/kg) and 054M0004 (1,390 mg/kg).

10.2.7 Fate and Transport Assessment for SWMUs 21 and 54

Combined SWMU 21 is at the northern end of Zone E directly adjacent to the Cooper River and comprises SWMUs 21 and 54. SWMU 21 consists of a 20-foot by 180-foot concrete pad formerly used to store containerized paint wastes generated by ship repair and overhaul operations. SWMU 54 is the area south of Building 223 formerly used for the abrasive blasting of ship components and hull sections. Except for the concrete pad, the site is largely unpaved. Environmental media sampled as part of the combined SWMU 21 RFI include surface soil, subsurface soil, sediment, and shallow groundwater. Potential constituent migration pathways investigated for combined SWMU 21 include soil to groundwater, groundwater to surface water, surface soil to sediment, and emission of volatiles from surface soil to air.

10.2.7.1 Soil-to-Groundwater Cross-Media Transport: Tier One

Table 10.2.7.1 compares maximum detected organic constituent concentrations in surface soil and subsurface soil samples to groundwater protection SSLs considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based SSLs, or (b) background RCs. To provide a conservative screen, generic SSLs are used; leachate entering the aquifer is assumed to be diluted by a ratio of 10:1 with no attenuation of constituents in soil (DAF = 10).

Eight organic constituents — benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluroanthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and phenanthrene — were detected above groundwater protection SSLs in combined SWMU 21 soil. Maximum concentrations of 17 SVOCs, including the eight exceeding their generic SSLs, were reported from a single subsurface soil sample, 054SB031. Benzo(a)anthracene and benzo(b)fluoranthene were the only organic constituents detected above their generic SSLs in more than one soil sample. Benzo(a)anthracene was also reported above its generic SSL in subsurface soil samples 054SB024 and 054SB027 and in surface soil sample 054SB017, while benzo(b)fluoranthene was also detected above its generic SSL in surface soil sample 054SB017. None of these organic constituents was detected in first-quarter groundwater samples.

Fourteen inorganic constituents — antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, thallium, tin, and zinc — were detected in soil samples above their respective groundwater protection SSLs or background reference values. Metals contamination in soil is probably related to past abrasive blast activities at SWMU 54. Antimony, copper, lead, and tin were most widespread in soil samples reporting concentrations above their SSLs. Antimony was detected in 27 of 49 surface soil samples and 13 of 45 subsurface soil samples at concentrations exceeding its generic SSL. Copper was detected in 35 of 49 surface soil samples and nine of 45 subsurface soil samples at concentrations exceeding its background RC. Lead was detected in 27 of 49 surface soil samples and nine of 45 subsurface soil samples at concentrations exceeding its AL of 1,300 mg/kg for soil. Tin was detected in 12 of 49 surface soil samples and four of 45 subsurface soil samples at concentrations above its background RC. Of the inorganic constituents exceeding SSLs, antimony, arsenic, barium, chromium, lead, manganese, nickel, thallium, and zinc were also detected in first-quarter groundwater samples. Four of these metals — antimony, arsenic, lead, and thallium — were the only inorganic constituents detected in first-quarter groundwater samples above their background RCs or tap-water RBCs.

10.2.7.2 Groundwater-to-Surface Water Cross-Media Transport: Tier One

Table 10.2.7.1 also compares maximum detected organic constituent concentrations in shallow groundwater samples to RBCs for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background RCs for groundwater, as well as to the saltwater surface water chronic values. To provide a conservative first-tier screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

Antimony, arsenic, lead, and thallium were detected in combined SWMU 21 shallow groundwater above their tap-water RBCs. Each was reported in only one of six first-quarter groundwater samples collected. Antimony exceeded its tap-water RBC and lead exceeded its TTAL and its saltwater surface water chronic screening level in the duplicate groundwater sample collected from monitoring well NBCE054002. The original groundwater sample collected from monitoring well NBCE054002 reported concentrations of antimony and lead below their respective screening levels. Similarly, thallium exceeded its tap-water RBC in the original groundwater sample collected from monitoring well NBCE054002 and was not detected in the duplicate sample. Arsenic was detected above its background RC in the groundwater sample collected from monitoring well NBCE021002. A valid set of quarterly groundwater data subsequent to first-quarter sampling is not available for combined SWMU 21 due to an interim measures activity which compromised site monitoring wells. As a result, first-quarter results cannot be confirmed.

10.2.7.3 Soil and Groundwater-to-Surface Water Transport: Tier Two

Table 10.2.7.2 provides a second screening tier for all constituents detected in soil or groundwater at concentrations exceeding any of the first-tier screening levels. Constituent concentrations in groundwater are compared to combined ecological/human health RBCs that have been adjusted upward for site-specific dilution by surface water in the Cooper River, while soil constituent concentrations are compared to calculated SSLs based on the adjusted RBCs rather than the original target leachate concentrations. For the second-tier screen, no dilution of leachate by groundwater or attenuation of constituents in soil is assumed (DAF = 1). The second screening tier identifies any constituents in soil or groundwater that pose a threat to surface water quality, after allowing for dilution of groundwater by surface water when the groundwater discharges into the river. The site-specific surface-water dilution factor calculated for combined SWMU 21 is 17,600:1 (see Table 6.2.1).

Except for arsenic and copper, none of the first-tier constituent concentrations exceeded the adjusted screening levels of the second tier, indicating that most of the site constituents in soil and groundwater pose no threat to human health or the environment in the Cooper River. Copper was reported at concentrations above the second-tier screening level in two surface soil samples (054SB016 and 054SB019) and in three subsurface soil samples (054SB003, 054SB031, and 054SB035). Arsenic was detected above its adjusted SSL in three surface soil samples (054SB031, 054SB032, and 054SB035). The adjusted SSLs are obtained assuming a DAF of 1, while the calculated site-specific DAF for combined SWMU 21 is 37, taking into account dilution only. In addition, the adjusted SSLs assume uniformly distributed constituent concentrations in soil equal to the maximum detected concentrations, while arsenic and copper SSL exceedances in soil are limited to three and five samples, respectively. Consequently, levels protective of Cooper River water are actually much greater than indicated in the table, and are well above the detected soil concentrations at the site.

10.2.7.4 Surface Soil-to-Sediment Cross-Media Transport

Four sediment samples were collected from the bottom of the Cooper River within 20 feet of the shoreline of combined SWMU 21. Tables 10.2.6.1 and 10.2.6.2 summarize the constituent concentrations detected in sediment samples. Nearly all of the constituents detected in sediment samples were also detected in surface soil samples at the site, including many PAH compounds and inorganics. This relationship implies either that surface soil is a potential source of these constituents in sediment, or that both surface soil and sediment were contaminated by the same site source. Fate and transport for constituents detected in Cooper River sediments will be examined in the Zone J RFI report.

10.2.7.5 Soil-to-Air Cross-Media Transport

Table 10.2.7.3 lists the VOCs detected in surface soil samples collected from combined SWMU 21 along with corresponding soil-to-air volatilization screening levels. Much of the site's surface soil is exposed at combined SWMU 21, however, none of the VOCs was reported at a maximum concentration exceeding its corresponding soil-to-air volatilization screening level. As a result, the soil-to-air migration pathway is not expected to be significant at combined SWMU 21.

10.2.7.6 Fate and Transport Summary

In the first-tier screen, nine metals — antimony, arsenic, barium, chromium, lead, manganese, nickel, thallium, and zinc — that were detected above their generic SSLs or background RCs in soil were also present in groundwater samples. Antimony, arsenic, lead, and thallium were the only metals whose maximum groundwater concentrations also exceeded their respective tap-water RBCs. While subsurface soil concentrations of several PAH compounds — benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and phenanthrene — were reported at maximum concentrations that were above generic SSLs, these concentrations were isolated to one subsurface soil sample (054SB031). Additionally, concentrations of benzo(a)anthracene reported for two other subsurface soil samples (054SB022 and 054SB023), and concentrations of benzo(a)anthracene and benzo(b)fluoranthene reported for one surface soil sample (054SB017) exceeded corresponding generic SSLs. None of these PAH constituents was detected in groundwater samples. Valid subsequent quarterly groundwater sampling results were not available to confirm first-quarter sample results, due to an interim measures activity conducted for this site that breached the integrity of the monitoring wells.

Concentrations of arsenic reported for three subsurface soil samples and copper reported for two surface and three subsurface soil samples exceeded the adjusted screening values of the second-tier comparisons, suggesting soil concentrations of arsenic and copper as threats to surface water in the Cooper River via the soil to surface water (via groundwater) migration pathway. However, comparison of site hydrogeologic conditions with the extremely conservative assumptions of the second-tier screening process demonstrates that site concentrations of soil and groundwater should be sufficiently protective of Cooper River water via the evaluated migration pathways.

Table 10.2.7.1
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMUs 21 and 54
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds												
Acetone	35	170	ND	NA	8000	3700	NA	UG/KG	UG/L	NO	NO	NO
2-Butanone (MEK)	ND	6	11	NA	4000	1900	NA	UG/KG	UG/L	NO	NO	NO
Carbon Disulfide	ND	ND	2	NA	16000	1000	NA	UG/KG	UG/L	NO	NO	NO
Chlorobenzene	30	18	ND	NA	350	39	105	UG/KG	UG/L	NO	NO	NO
Methylene chloride	6.1	ND	ND	NA	10	4.1	2560	UG/KG	UG/L	NO	NO	NO
Toluene	7.2	ND	ND	NA	6000	750	37	UG/KG	UG/L	NO	NO	NO
1,1,1-Trichloroethane	4	ND	ND	NA	1000	790	312	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Acenaphthene	ND	83000	ND	NA	285000	2200	9.7	UG/KG	UG/L	NO	NO	NO
Anthracene	120	250000	ND	NA	5900000	11000	NA	UG/KG	UG/L	NO	NO	NO
Benzoic acid	1100	ND	ND	NA	200000	150000	NA	UG/KG	UG/L	NO	NO	NO
Benzo(g,h,i)perylene	1600	160000	ND	NA	2.33E+08	1500	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	1900	460000	ND	NA	800	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(a)pyrene	2600	290000	ND	NA	4000	0.0092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(b)fluoranthene	4200	290000	ND	NA	2500	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(k)fluoranthene	2400	220000	ND	NA	24500	0.92	NA	UG/KG	UG/L	YES	NO	NO
Chrysene	4000	360000	ND	NA	80000	9.2	NA	UG/KG	UG/L	YES	NO	NO
Dibenzo(a,h)anthracene	790	93000	ND	NA	800	0.0092	NA	UG/KG	UG/L	YES	NO	NO
Indeno(1,2,3-cd)pyrene	1900	150000	ND	NA	7000	0.092	NA	UG/KG	UG/L	YES	NO	NO
Butylbenzylphthalate	280	400	ND	NA	930000	7300	29.4	UG/KG	UG/L	NO	NO	NO
Carbazole	90	87	ND	NA	300	3.4	NA	UG/KG	UG/L	NO	NO	NO
Dibenzofuran	140	72000	ND	NA	NA	150	NA	UG/KG	UG/L	NO	NO	NO
Di-n-butylphthalate	480	1900	ND	NA	2300000	3700	3.4	UG/KG	UG/L	NO	NO	NO
Diethylphthalate	120	140	ND	NA	235000	29000	75.9	UG/KG	UG/L	NO	NO	NO
Di-n-octylphthalate	10000	ND	ND	NA	10000000	730	NA	UG/KG	UG/L	NO	NO	NO
bis(2-Ethylhexyl)phthalate (BEHP)	7600	380	ND	NA	1800000	4.8	NA	UG/KG	UG/L	NO	NO	NO
Fluoranthene	2400	700000	ND	NA	2150000	1500	1.6	UG/KG	UG/L	NO	NO	NO
Fluorene	200	11000	ND	NA	280000	1500	NA	UG/KG	UG/L	NO	NO	NO
2-Methylnaphthalene	ND	12000	ND	NA	63000	1500	NA	UG/KG	UG/L	NO	NO	NO
4-Methylphenol (p-cresol)	62	ND	ND	NA	690	180	NA	UG/KG	UG/L	NO	NO	NO
Naphthalene	95	10000	ND	NA	42000	1500	23.5	UG/KG	UG/L	NO	NO	NO
Phenanthrene	530	700000	ND	NA	690000	1500	NA	UG/KG	UG/L	YES	NO	NO
Pyrene	3900	590000	ND	NA	2100000	1100	NA	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	3.18	ND	ND	NA	950	0.43	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	9170	9110	710	NA	41100	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	50	138	22	NA	2.5	15	NA	MG/KG	UG/L	YES	YES	NO
Arsenic	26	44.8	19.5	NA	23.9	18.7	36	MG/KG	UG/L	YES	YES	NO
Barium	460	2760	220	NA	820	2600	NA	MG/KG	UG/L	YES	NO	NO
Beryllium	4	1.6	ND	NA	32	1.2	NA	MG/KG	UG/L	NO	NO	NO
Cadmium	8.4	20.8	ND	NA	4	18	9.3	MG/KG	UG/L	YES	NO	NO
Chromium (total)	226	78.6	1.6	NA	94.6	37000	103	MG/KG	UG/L	YES	NO	NO
Cobalt	67.2	14	ND	NA	19	2200	NA	MG/KG	UG/L	YES	NO	NO
Copper	2660	7930	ND	NA	152	1500	2.9	MG/KG	UG/L	YES	NO	NO
Lead	9520	32200	22.3	NA	400	15	8.5	MG/KG	UG/L	YES	YES	YES
Manganese	490	1090	713	NA	881	2560	NA	MG/KG	UG/L	YES	NO	NO
Mercury	20	64.5	ND	NA	2.6	11	0.2	MG/KG	UG/L	YES	NO	NO
Nickel	492	333	2.8	NA	77.1	730	42.2	MG/KG	UG/L	YES	NO	NO
Selenium	2.2	1.8	ND	NA	2.5	180	71	MG/KG	UG/L	NO	NO	NO
Silver	6.1	2.2	ND	NA	17	180	0.23	MG/KG	UG/L	NO	NO	NO
Thallium	4.2	6.3	5	NA	2.8	2.9	21.3	MG/KG	UG/L	YES	YES	NO
Tin	236	900	ND	NA	59.4	22000	NA	MG/KG	UG/L	YES	NO	NO

Table 10.2.7.1
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMUs 21 and 54
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Vanadium	27.3	97.8	2.2	NA	3000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	3500	10800	42.8	NA	6000	11000	86	MG/KG	UG/L	YES	NO	NO

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 10, adapted from 1996 EPA Soil Screening Guidance or calculated using values from Table 6.2
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, June 3, 1996
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November, 1995; Table 2
In each case, the value shown is the greater of the relevant screening value or the corresponding background reference value

Units: See notes for Table 10.1.5.1

Table 10.2.7.2
Chemicals Detected in Surface Soil, Subsurface Soil, or Shallow Groundwater at Concentrations Exceeding any Initial Screening Concentration
Comparison to Combined Ecological/Human Health RBCs Adjusted for Surface Water Dilution, and to SSLs Based on Adjusted Ecological/Human Health RBCs: Tier Two
NAVBASE-Charleston, Zone E: SWMUs 21 and 54
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Initial Screening Concentrations * Soil to GW SSL	Initial Screening Concentrations * Tap Water RBC	Initial Screening Concentrations * Salt Wtr. Surf. Wtr. Chronic	Adjusted Screening Concentrations # Combined Eco/HH Surf. Wtr. RBC	Adjusted Screening Concentrations # Adjusted Eco/HH GW RBC	Adjusted Screening Concentrations # Target Leachate Conc. (DAF=1)	Adjusted Screening Concentrations # SSL Multi-plier	Adjusted Screening Concentrations # Adjusted SSL (DAF=1)	Units Soil Units	Units Water Units	Screening Results Leaching Potential	Screening Results Surface Water Migration Concern
Semivolatile Organic Compounds																
Benzo(a)pyrene equivalents																
Benzo(a)anthracene	1900	460000	ND	NA	800	0.092	NA	0.092	1.62E+03	0.1	1.62E+04	1.30E+06	UG/KG	UG/L	NO	NO
Benzo(a)pyrene	2600	290000	ND	NA	4000	0.0092	NA	0.0092	1.62E+02	0.2	8.10E+02	3.24E+05	UG/KG	UG/L	NO	NO
Benzo(b)fluoranthene	4200	290000	ND	NA	2500	0.092	NA	0.092	1.62E+03	0.1	1.62E+04	4.05E+06	UG/KG	UG/L	NO	NO
Benzo(k)fluoranthene	2400	220000	ND	NA	24500	0.92	NA	0.92	1.62E+04	1	1.62E+04	1.04E+07	UG/KG	UG/L	NO	NO
Chrysene	4000	360000	ND	NA	80000	9.2	NA	9.2	1.62E+05	10	1.62E+04	1.04E+07	UG/KG	UG/L	NO	NO
Dibenzo(a,h)anthracene	790	93000	ND	NA	800	0.0092	NA	0.0092	1.62E+02	0.01	1.62E+04	1.30E+06	UG/KG	UG/L	NO	NO
Indeno(1,2,3-cd)pyrene	1900	150000	ND	NA	7000	0.092	NA	0.092	1.62E+03	0.1	1.62E+04	1.04E+07	UG/KG	UG/L	NO	NO
Phenanthrene	530	700000	1.3	NA	690000	1500	NA	1500	2.64E+07	1500	1.76E+04	1.04E+07	UG/KG	UG/L	NO	NO
Inorganic Compounds																
Antimony	50	138	22	NA	2.5	15	NA	15	2.64E+05	6	4.40E+04	1.10E+04	MG/KG	UG/L	NO	NO
Arsenic	26	44.8	19.5	NA	14.6	0.045	36	0.045	7.92E+02	50	1.58E+01	2.31E+01	MG/KG	UG/L	YES	NO
Barium	460	2760	220	NA	820	2600	NA	2600	4.58E+07	2000	2.29E+04	1.00E+06	MG/KG	UG/L	NO	NO
Cadmium	8.4	20.8	ND	NA	4	18	9.3	9.3	1.64E+05	5	3.27E+04	1.31E+04	MG/KG	UG/L	NO	NO
Chromium (total)	226	78.6	1.6	NA	19	180	50	50	8.80E+05	100	8.80E+03	1.67E+04	MG/KG	UG/L	NO	NO
Cobalt	67.2	14	ND	NA	1040	2200	NA	2200	3.87E+07	2200	1.76E+04	1.00E+06	MG/KG	UG/L	NO	NO
Copper	2660	7930	ND	NA	458	1500	2.9	2.9	5.10E+04	1300	3.93E+01	1.80E+03	MG/KG	UG/L	YES	NO
Lead	9520	32200	22.3	NA	400	15	8.5	8.5	1.50E+05	15	9.97E+03	3.99E+05	MG/KG	UG/L	NO	NO
Manganese	490	1090	713	NA	548	840	NA	840	1.48E+07	840	1.76E+04	9.64E+05	MG/KG	UG/L	NO	NO
Mercury	20	64.5	ND	NA	1.04	11	0.2	0.2	3.52E+03	2	1.76E+03	1.83E+02	MG/KG	UG/L	NO	NO
Nickel	492	333	2.8	NA	65	730	42.2	42.2	7.43E+05	100	7.43E+03	4.83E+04	MG/KG	UG/L	NO	NO
Thallium	4.2	6.3	5	NA	0.36	2.9	21.3	2.9	5.10E+04	2	2.55E+04	9.19E+02	MG/KG	UG/L	NO	NO
Tin	236	900	ND	NA	55000	22000	NA	22000	3.87E+08	22000	1.76E+04	1.00E+06	MG/KG	UG/L	NO	NO
Zinc	3500	10800	42.8	NA	6000	11000	86	86	1.51E+06	10000	1.51E+02	9.08E+04	MG/KG	UG/L	NO	NO

* Initial Screening Concentrations: See notes for Table 10.1.5.2
In this table, the screening values shown are not adjusted for background reference values.

\# Adjusted Screening Concentrations: See notes for Table 10.1.5.2
Adjusted Eco/HH Groundwater RBC - Combined Eco/HH Surface Water RBCs multiplied by site-specific surface water dilution factor of 17,600: GW concentrations protective of surface water

Units: See notes for Table 10.1.5.2

Table 10.2.7.3
Soil-to-Air Volatilization Screening Analysis
NAVBASE-Charleston, Zone E: SWMUs 21 and 54
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Acetone	35	62000000	UG/KG	NO
Chlorobenzene	30	94000	UG/KG	NO
Methylene chloride	6.1	7000	UG/KG	NO
Toluene	7.2	520000	UG/KG	NO
1,1,1-Trichloroethane	4	980000	UG/KG	NO

* - Soil screening levels for transfers from soil to air were obtained from
USEPA Region III Risk-Based Concentration Table, June 1996.

10.2.8 Fixed-Point Risk Evaluation for SWMUs 21 and 54

10.2.8.1 Site Background and Investigative Approach

SWMU 21 was formerly a paint storage area and SWMU 54 was formerly an abrasive blast area. The following refers to these sites as combined SWMU 21. Both are in a highly industrialized portion of Zone E. As a result, the risk assessment for this site is presented as a FRE following the framework presented in Section 7.3. The investigation for these SWMUs was combined due to their proximity. As a result, the risk evaluation will combine the environmental data from both SWMUs. Previous investigations were conducted at SWMU 21 in 1988 and 1993. The 1988 investigation generated data used to direct the 1993 investigation.

The 1993 sampling effort at SWMU 21 produced nine surface soil samples with BEQs and lead above their RBCs. Forty soil samples were collected from the upper interval as part of the 1995 RFI sampling effort. Forty-nine surface soil samples locations are considered this FRE. Three monitoring wells were installed as part of the original 1993 SWMU 21 investigation and three additional monitoring wells were installed as part of the 1995 RFI. All six monitoring wells were installed into the shallow aquifer. Groundwater data generated from the first-quarter RFI sampling event are used to represent point risk/hazard for the combined SWMU 21 FRE. Sections 10.2.1 and 10.2.3 summarize the sampling effort for combined SWMU 21 soil and groundwater.

Based on historical data and initial RFI sample results, an interim measures removal activity was conducted which resulted in the excavation of soil from this area. This removal action compromised the integrity of monitoring wells at these sites, invalidating subsequent quarterly sample data. Additionally, FRE conclusions regarding the surface soil at this site are based on data collected before the interim measures action. As a result, details of the interim measures action should be considered when interpreting FRE conclusions related to soil pathways.

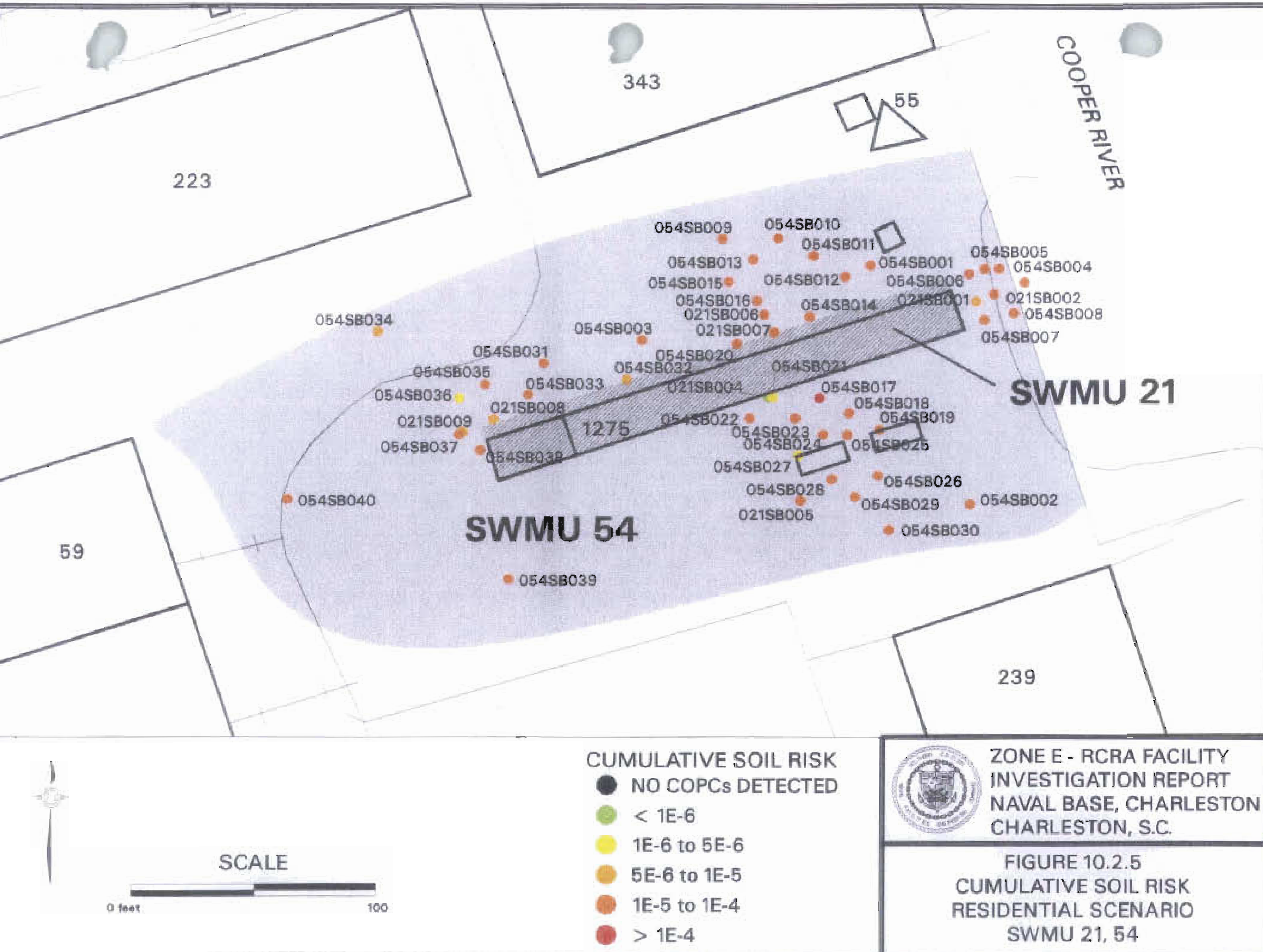
10.2.8.2 Fixed-Point Risk Evaluation for Soil

Residential Scenario

Table 10.2.8.1 provides CPSS summaries for combined SWMU 21 soil and identifies COPCs based on comparison to residential and industrial RBCs and background RCs. Based on residential RBCs, 14 COPCs (antimony, arsenic, BEQs, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, thallium, vanadium, and zinc) were identified for combined SWMU 21 soil. Chromium, which predominantly exists in either the trivalent or hexavalent state, was identified as a COPC based on a conservative comparison of the maximum concentration (regardless of valence) to the RBC for its hexavalent species (39 mg/kg). Hexavalent chromium was not detected, which indicates that the trivalent state predominates for combined SWMU 21 surface soil. The RBC for trivalent chromium is 7,800 mg/kg. Since it is evident that combined SWMU 21 chromium in soil predominantly exists in the trivalent state, chromium was eliminated as a COPC. Aluminum was detected in combined SWMU 21 soil above its RBCs but was eliminated from consideration in the residential FRE 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 based on background concentration.

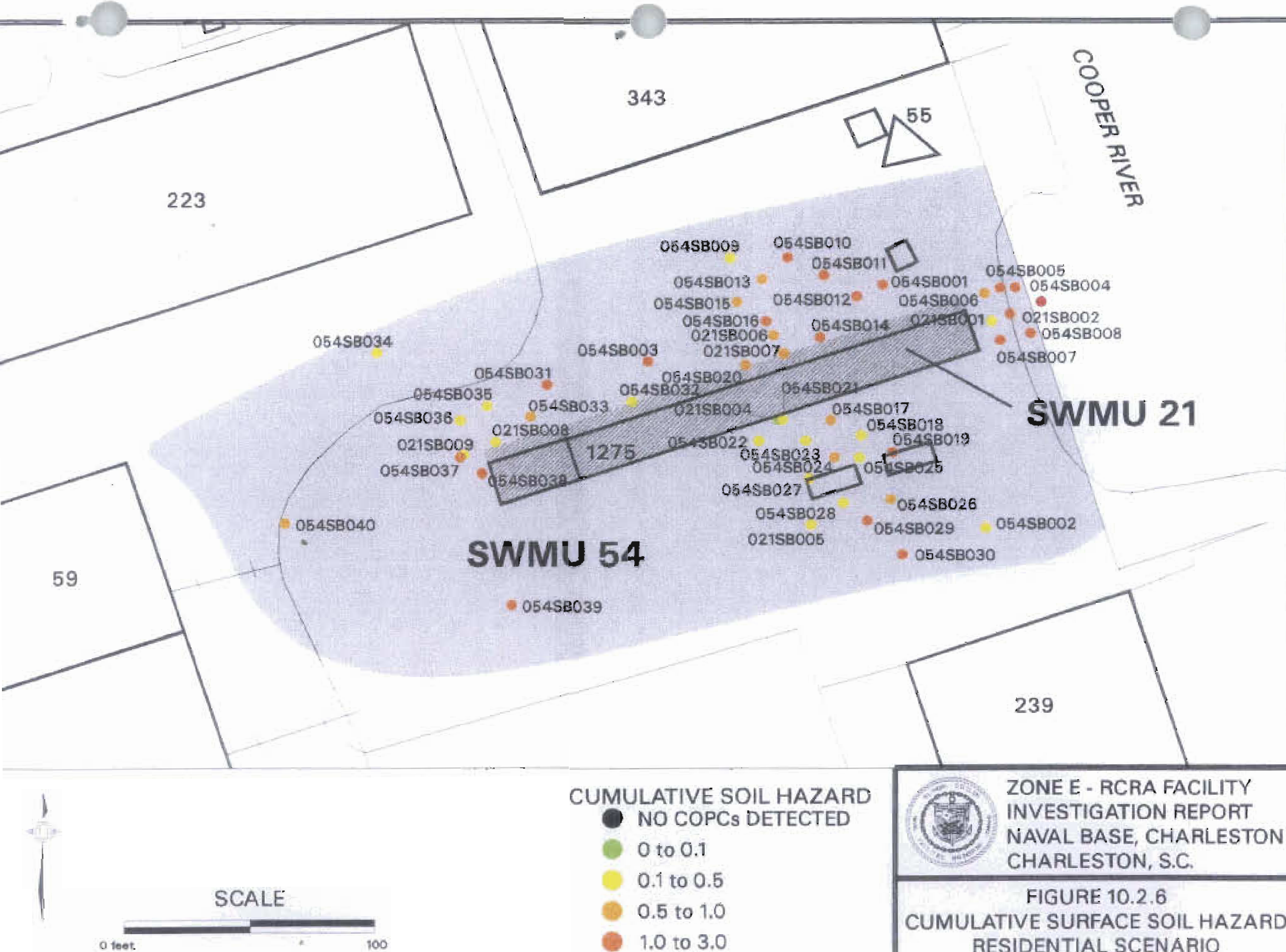
Table 10.2.8.2 summarizes the residential COPCs detected at each combined SWMU 21 sample location with contribution to risk and hazard. As shown, arsenic, BEQs, and beryllium are the only contributors to risk for combined SWMU 21, exceeding 1E-06 at 48 of 49 locations. Figure 10.2.5 is a spatial presentation of residential risk estimates for combined SWMU 21 surface soil. Risk estimates range from 2E-07 to 1E-04 with an arithmetic mean risk of 2E-05.

Figure 10.2.6 is a spatial presentation of HI estimates for combined SWMU 21 surface soil. As shown, HI projections exceeded the threshold of unity at 20 of 49 sample locations. HI estimates range from 0.04 to 3 with an arithmetic mean HI of 0.9.



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

FIGURE 10.2.5
CUMULATIVE SOIL RISK
RESIDENTIAL SCENARIO
SWMU 21, 54



CUMULATIVE SOIL HAZARD
- NO COPCs DETECTED
- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

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

FIGURE 10.2.6
CUMULATIVE SURFACE SOIL HAZARD
RESIDENTIAL SCENARIO
SWMU 21, 54

Antimony, arsenic, copper, mercury, thallium, and zinc were the primary contributors to HI projections.

Industrial Scenario

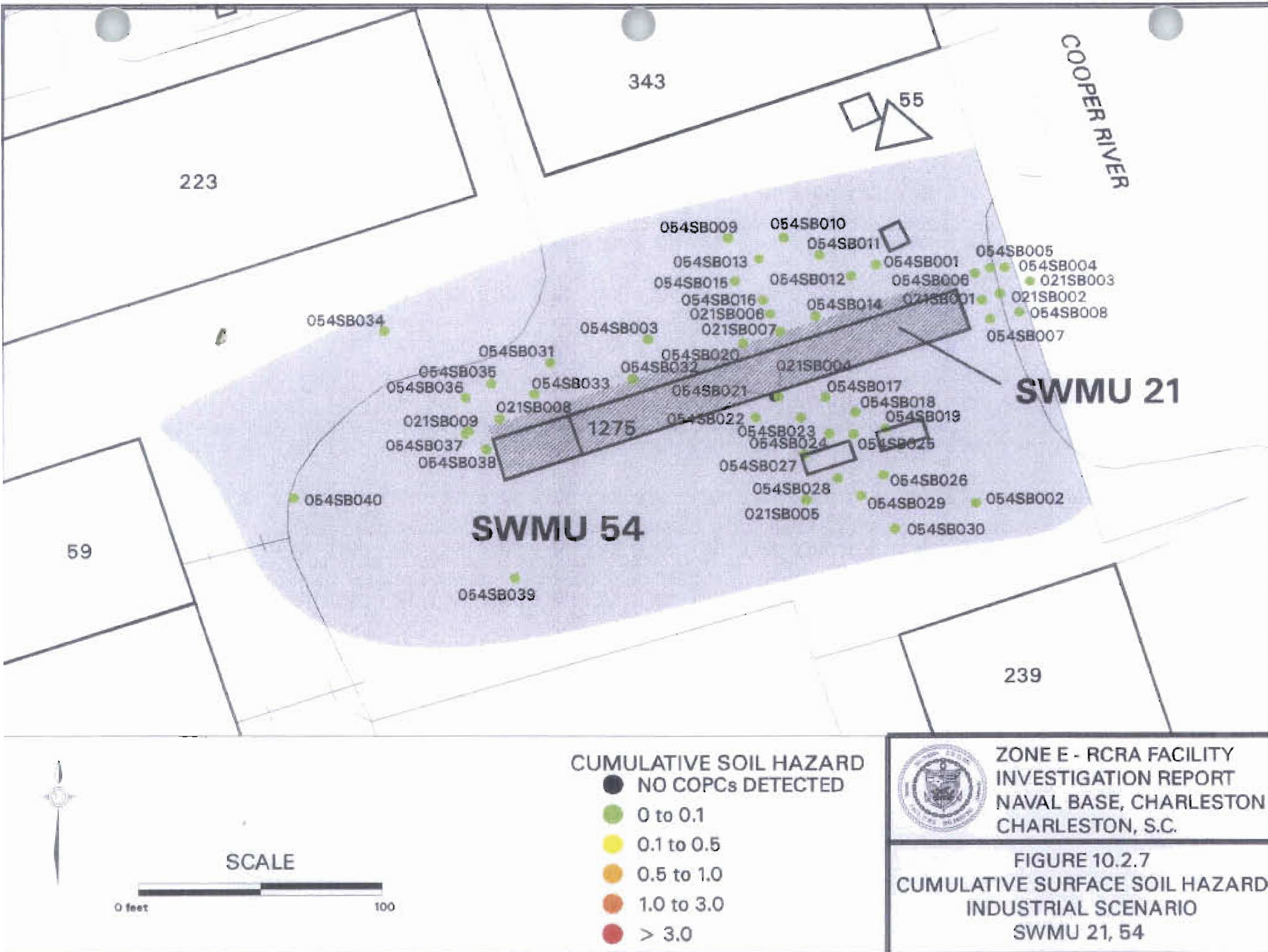
Based on industrial RBCs, arsenic, BEQs, beryllium, and lead were identified as COPCs for combined SWMU 21 surface soil. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration.

Table 10.2.8.3 summarizes the industrial COPCs detected at each combined SWMU 21 sample location with contribution to risk and hazard. As shown, arsenic, BEQs, and beryllium are the only contributors to risk for combined SWMU 21, exceeding 1E-06 at 44 of 49 locations based on the industrial scenario. Figure 10.2.7 is a spatial presentation of industrial scenario risk estimates for combined SWMU 21 surface soil. Risk estimates range from 3E-08 to 2E-05 with an arithmetic mean risk of 4E-06.

HI projections did not exceed the threshold of unity at any sample locations based on the industrial scenario. HI estimates range from 0.002 to 0.06.

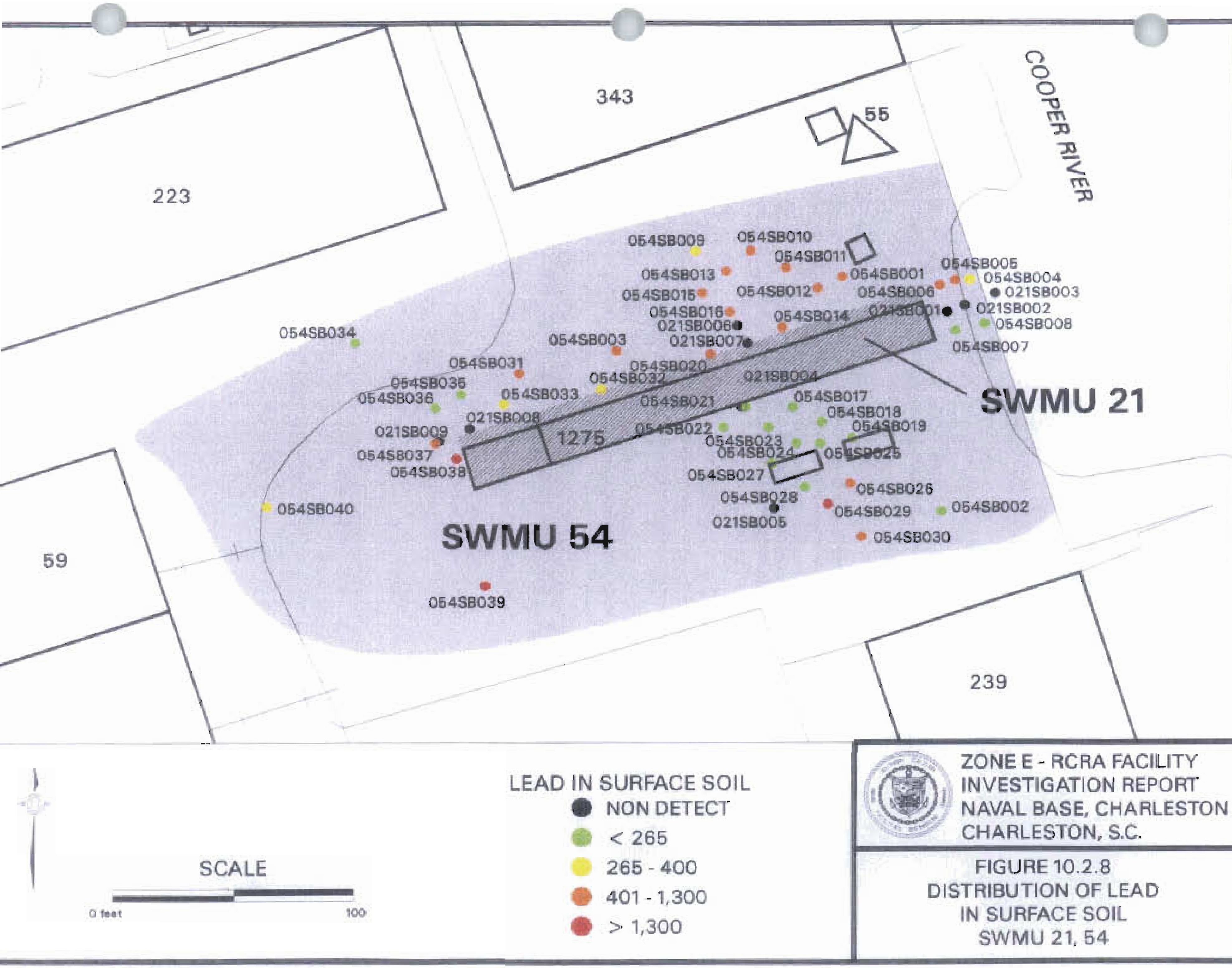
Lead

Lead was detected in all 49 surface soil samples collected at combined SWMU 21. Soil concentrations ranged from 9 to 9,520 mg/kg and exceeded the residential cleanup level of 400 mg/kg in 26 of 49 samples. The mean detected lead concentration for combined SWMU 21 is 890 mg/kg, which exceeds the action level of 400 mg/kg considered protective of children under a residential scenario, but does not exceed the industrial cleanup level of 1,300 mg/kg, considered protective of adults under an industrial scenario. Figure 10.2.8 is a spatial presentation of lead soil concentrations, using the surface soil background concentration of 265 mg/kg, the residential soil lead cleanup level of 400 mg/kg, and the industrial soil lead cleanup concentration of



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

FIGURE 10.2.7
CUMULATIVE SURFACE SOIL HAZARD
INDUSTRIAL SCENARIO
SWMU 21, 54



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

FIGURE 10.2.8
DISTRIBUTION OF LEAD
IN SURFACE SOIL
SWMU 21, 54

1,300 mg/kg as benchmark levels to illustrate the lead soil concentrations for combined SWMU 21.

10.2.8.3 Fixed-Point Risk Evaluation for Groundwater

Residential Scenario

Table 10.2.8.4 provides CPSS summaries for combined SWMU 21 groundwater and identifies COPCs. Antimony, arsenic, lead, and thallium were identified as groundwater COPCs based on comparison of first-quarter groundwater concentrations to tap-water RBCs and background RCs. Manganese was detected in combined SWMU 21 groundwater above its RBC but was eliminated from consideration in the FRE 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 based on background concentration.

Table 10.2.8.5 summarizes the COPCs identified in combined SWMU 21 monitoring wells sampled during the first quarter and their contribution to risk and/or hazard. Risk projections above 1E-06 were associated with arsenic concentrations in the groundwater samples collected from monitoring wells NBCE021002 and NBCE054W003. Monitoring wells NBCE021001, NBCE021003, NBCE054001, and NBCE054002 had no carcinogenic COPCs detected in first-quarter groundwater samples. The arithmetic mean risk for combined SWMU 21 groundwater is 9E-05, assuming a deminimus risk of 1E-07 for monitoring wells which produced samples with no carcinogenic COPCs. Figure 10.2.9 illustrates the groundwater data as a function of point-specific risk projections.

Four monitoring wells (NBCE021002, NBCE054001, NBCE054002, and NBCE054003) produced results corresponding with HIs above unity. Antimony, arsenic, and thallium were the primary contributors to HI projections. HIs ranged from 6 (NBCE021002) to 1 (NBCE054003). The arithmetic mean HI for combined SWMU 21 is 2, assuming a deminimus HI of 0.01 for monitoring wells which produced samples with no COPCs contributing to HI projections. Figure 10.2.10 illustrates the groundwater data as a function of point-specific HI projections.

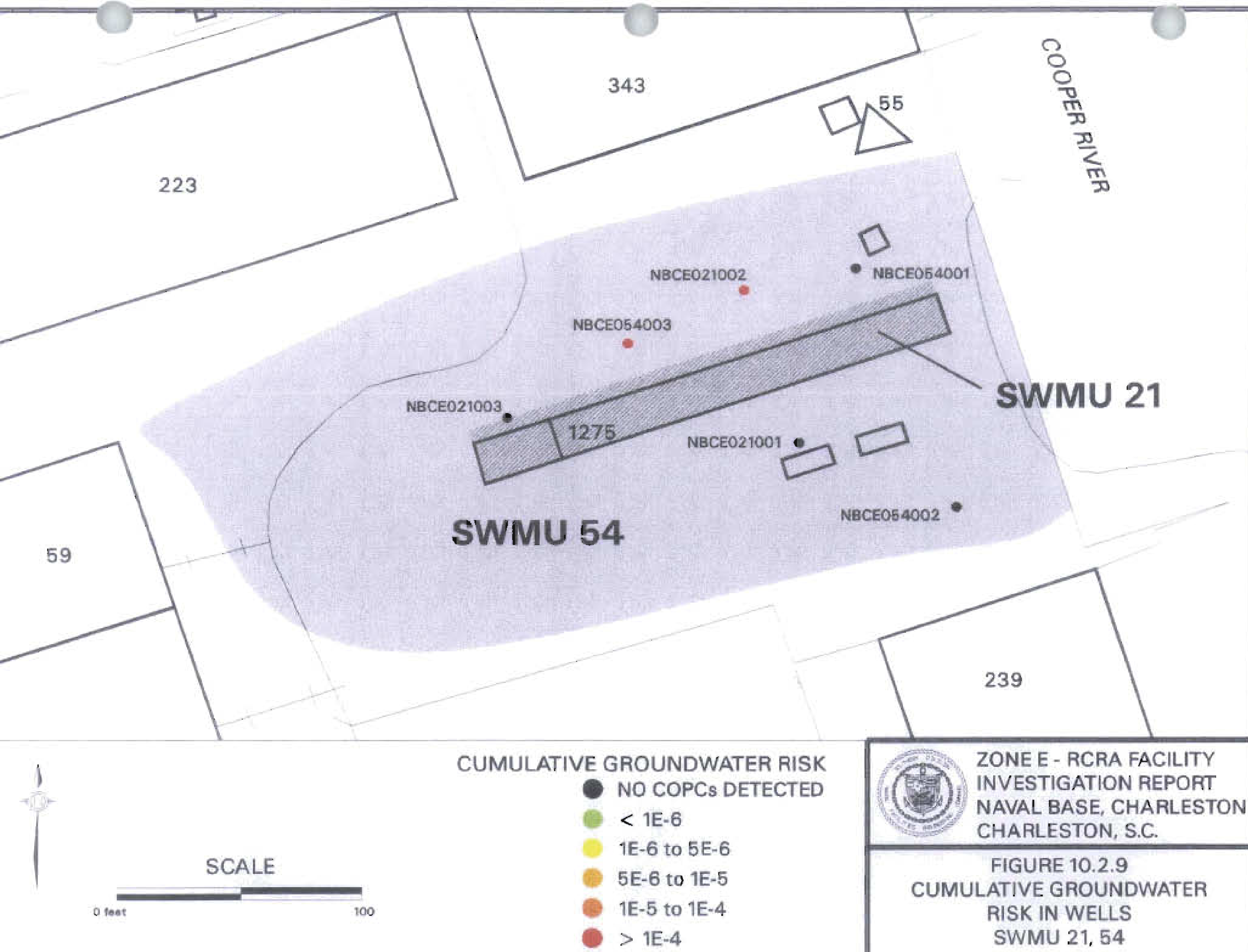


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FIGURE 10.2.9
CUMULATIVE GROUNDWATER RISK IN WELLS
SWMU 21, 54

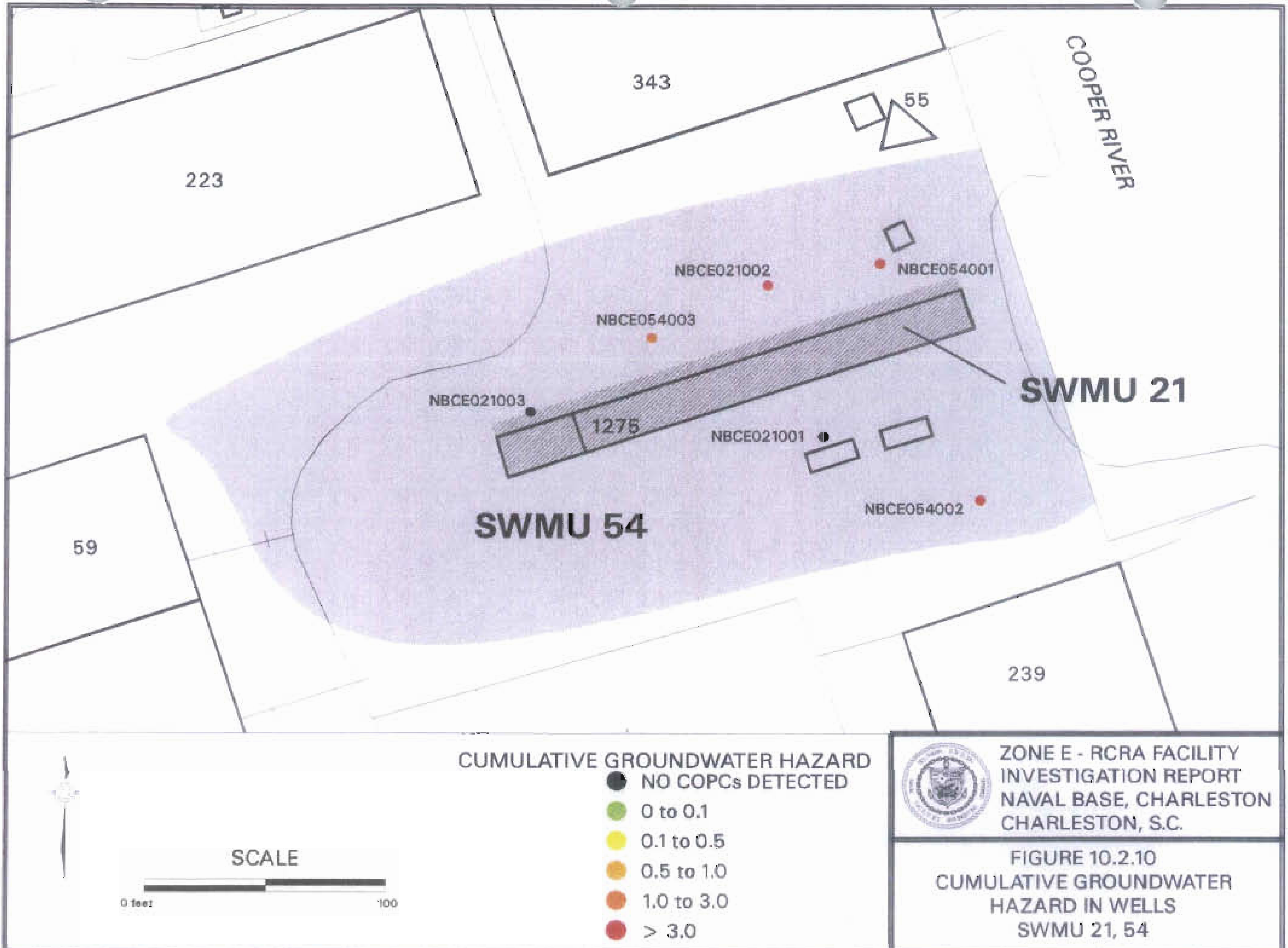

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FIGURE 10.2.10
CUMULATIVE GROUNDWATER HAZARD IN WELLS
SWMU 21, 54

Lead

Lead was detected in three of six shallow monitoring wells at concentrations ranging from 5.5 to 22.3 μg/L. The groundwater sample collected from monitoring well NBCE054002 had a concentration of 22.3 μg/L which is above the TTAL of 15 μg/L. The average detected lead groundwater concentration for combined SWMU 21 is 11.9 μg/L. Although first-quarter groundwater sample results could only identify marginally elevated lead concentrations, combined SWMU 21 monitoring wells are no longer usable following interim measures removal actions. As a result, first-quarter groundwater results cannot be confirmed.

10.2.8.4 Uncertainty

SWMU 21 uncertainty issues specific to the FRE and essential to the risk management process are discussed in the following paragraphs.

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure.

Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued industrial use of Zone E, specifically as a marine cargo terminal and drydocking facility. If this area were to be redeveloped, the buildings and other structures would be demolished, and the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Interim measures activities removed an unknown quantity of soil from the combined SWMU 21 area. Consequently, chronic exposure to surface soil conditions, as represented by the samples results used in this FRE, would be unlikely under any future use scenario. These factors indicate that exposure pathways assessed in this FRE would generally overestimate the risk and hazard posed to current/future site workers and future site residents.

Groundwater is not currently used as a potable water source at combined SWMU 21, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.

COPC Selection

Chromium was identified as a COPC in soil based on a conservative comparison to the RBC for the hexavalent species. Nine surface soil samples analyzed for hexavalent chromium had no detectable concentrations. Chromium was therefore eliminated as a soil COPC based on comparison to the RBC for trivalent chromium. The maximum concentration of chromium (226 mg/kg) was detected in surface soil sample 054SB005. Hexavalent chromium analysis was conducted on surface soil samples 054CB007 and 054CB008 which are in the same general location as 054SB005. These findings indicate that uncertainty associated with the elimination of chromium as a COPC is minimal.

Quantification of Risk/Hazard

Soil

A conservative screening process was used to identify COPCs for combined SWMU 21. The potential for eliminating CPSSs with the potential for cumulative HI greater than 1 was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment based on comparison to RBCs, none was reported at a concentration close to its RBC (e.g., within 10% of its RBC).

Aluminum was present in combined SWMU 21 soil at concentrations above its RBC benchmarks and was eliminated from consideration in the FRE based on comparison to its background concentration. As a result, aluminum's contribution to hazard has not been considered in this FRE.

Arsenic and beryllium contributed to both risk and hazard projections for residential and industrial soil pathways. Arsenic exceeded its background RC in only one of 49 surface soil samples (021SB003). Beryllium exceeded its background RC in only 10 of 49 surface soil samples. These findings indicate that while arsenic and beryllium contribute to elevated risk and hazard projections, their maximum concentrations were only marginally above background RCs and their average concentrations were below background RCs.

Groundwater

The same conservative screening process used for soil was also applied to groundwater. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, none was reported at concentrations close to its RBC (e.g., within 10% of its RBC).

Manganese was present in combined SWMU 21 groundwater at concentrations above its RBC benchmarks and was eliminated from consideration in the FRE based on comparison to its background concentration. As a result, manganese's contribution to hazard has not been considered in this FRE.

Arsenic was the only contributor to risk estimates based on the groundwater pathways. Concentrations of arsenic in groundwater exceeded its background RC in only one first-quarter groundwater sample (NBCE021002). Arsenic was not detected in any groundwater sample at a concentration above its MCL (0.05 mg/L). Subsequent quarterly data are not available to confirm first-quarter sample results.

10.2.8.5 FRE Summary

The risk and hazard posed by contaminants at combined SWMU 21 were assessed for the future site worker and the future site resident as sample point-specific estimates. In surface soil, the incidental ingestion and dermal contact pathways are reflected. The groundwater FRE was based on first-quarter data and considers the ingestion pathway only since no VOCs were identified as COPCs for this site. Risk and HI estimates are presented on Tables 10.2.8.2, 10.2.8.3, and 10.2.8.5 such that a risk (E-06) or HI that exceeds 1 for any COPC at any given sample location indicates that the concentration of that COPC exceeds its RGO. Section 7, Tables 7.3.1, 7.3.2, and 7.3.3 provide residential, industrial, and residential groundwater RGOs, respectively, for all of the COPCs identified for Zone E.

Soil — Residential Scenario

Arsenic, BEQs, and beryllium were detected in combined SWMU 21 surface soil at concentrations above their residential RGOs. It should be noted that arsenic and beryllium were detected at maximum concentrations only marginally above their background RCs.

Soil — Site Worker Scenario

Arsenic, BEQs, and beryllium were detected in combined SWMU 21 surface soil at concentrations above their industrial RGOs. It should be noted that arsenic and beryllium were detected at maximum concentrations only marginally above their background RCs.

Groundwater — Residential Scenario

Antimony, arsenic, and thallium were detected in combined SWMU 21 groundwater at concentrations above their RGOs. Arsenic was not, however, detected above its MCL. Subsequent quarterly sample data are not available to confirm first-quarter sample results.

Table 10.2.8.1
Summary of Chemicals Present in Site Samples
SWMU 21 and SWMU 54 - Surface Soil
NAVBASE - Charleston, Zone E
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Screening Concentration Industrial RBC	Reference	Units	Number Exceeding Res. RBC	Number Exceeding Ind. RBC	Number Exceeding Ref.
Inorganics													
Aluminum (Al)		49	49	1140 - 9170	3379.8	NA - NA	7800	100000	26600	mg/kg	1		
Antimony (Sb)	*	40	49	0.8 - 50	9.0	0.46 - 6.3	3.1	82	1.77	mg/kg	25		29
Arsenic	* *	48	49	0.9 - 26	5.6	1.1 - 1.1	0.43	3.8	23.9	mg/kg	48	26	1
Barium (Ba)		49	49	8.4 - 460	67.0	NA - NA	550	14000	130	mg/kg			4
Beryllium (Be)	* *	40	49	0.13 - 4	1.1	0.11 - 0.63	0.15	1.3	1.7	mg/kg	39	14	9
Cadmium (Cd)	*	44	49	0.16 - 8.4	1.7	0.11 - 0.56	3.9	100	1.5	mg/kg	6		23
Calcium (Ca)	N	49	49	1220 - 240000	32859.8	NA - NA	NA	NA	NA	mg/kg			
Chromium (Cr)	*	49	49	6 - 226	54.6	NA - NA	39	1000	94.6	mg/kg	27		8
Chromium (Cr+6)		0	9	NA - NA	NA	0.053 - 0.065	39	1000	94.6	mg/kg	27		8
Cobalt (Co)		49	49	0.47 - 67.2	10.6	NA - NA	470	12000	19	mg/kg			8
Copper (Cu)	*	49	49	4.8 - 2660	448.4	NA - NA	310	8200	66	mg/kg	25		39
Iron (Fe)	N	49	49	1620 - 46200	15513.9	NA - NA	NA	NA	NA	mg/kg			
Lead (Pb)	* *	49	49	9 - 9520	890.0	NA - NA	400	1300	265	mg/kg	26	3	31
Magnesium (Mg)	N	49	49	103 - 24000	2266.9	NA - NA	NA	NA	NA	mg/kg			
Manganese (Mn)	*	49	49	9.3 - 490	157.6	NA - NA	180	4700	302	mg/kg	20		3
Mercury (Hg)	*	49	49	0.013 - 20	1.1	NA - NA	2.3	61	2.6	mg/kg	4		3
Nickel (Ni)	*	49	49	2.3 - 492	50.4	NA - NA	160	4100	77.1	mg/kg	2		8
Potassium (K)	N	46	49	140 - 1480	560.7	167 - 409	NA	NA	NA	mg/kg			
Selenium (Se)		12	49	0.53 - 2.2	1.1	0.52 - 6.3	39	1000	1.7	mg/kg			2
Silver (Ag)		23	49	0.24 - 6.1	1.1	0.21 - 1.3	39	1000	NA	mg/kg			
Sodium (Na)	N	39	49	17.2 - 1970	378.3	39 - 700	NA	NA	NA	mg/kg			
Thallium (Tl)	*	9	49	0.57 - 4.2	1.5	0.52 - 6.3	0.63	16	2.8	mg/kg	7		1
Tin (Sn)		35	40	7.4 - 236	46.6	3.2 - 14.3	4700	100000	59.4	mg/kg			12
Vanadium (V)	*	49	49	1.8 - 100	10.8	NA - NA	55	1400	94.3	mg/kg	1		1
Zinc (Zn)	*	49	49	14.3 - 3500	1029.8	NA - NA	2300	61000	827	mg/kg	5		21
Carcinogenic PAHs													
Benzo(a)pyrene Equivale	* *	31	49	0.054 - 4218	369.6	808.85 - 2011	88	780	NA	ug/kg	25	2	
Benzo(a)anthracene	*	27	49	95 - 1900	297.9	350 - 870	880	7800	NA	ug/kg	1		
Benzo(a)pyrene	* *	25	49	84 - 2600	307.8	350 - 870	88	780	NA	ug/kg	24	1	
Benzo(b)fluoranthene	*	29	49	100 - 4200	393.8	350 - 870	880	7800	NA	ug/kg	1		
Benzo(k)fluoranthene		20	49	75 - 2400	302.4	340 - 870	8800	78000	NA	ug/kg			
Chrysene		29	49	54 - 4000	369.4	350 - 870	88000	780000	NA	ug/kg			
Dibenz(a,h)anthracene	* *	6	49	36 - 790	215.3	340 - 870	88	780	NA	ug/kg	4	1	
Indeno(1,2,3-cd)pyrene	*	18	49	48 - 1900	252.7	340 - 870	880	7800	NA	ug/kg	1		

Table 10.2.8.1
Summary of Chemicals Present in Site Samples
SWMU 21 and SWMU 54 - Surface Soil
NAVBASE - Charleston, Zone E
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration: Residential RBC	Screening Concentration: Industrial RBC	Screening Concentration: Reference	Units	Number Exceeding: Res. RBC	Number Exceeding: Ind. RBC	Number Exceeding: Ref.
Semivolatile Organics												
4-Methylphenol	1	49	62 - 62	62.0	340 - 870	39000	1000000	NA	ug/kg			
Anthracene	9	49	21 - 120	71.8	340 - 870	2300000	61000000	NA	ug/kg			
Benzo(g,h,i)perylene	18	49	45 - 1600	244.5	350 - 870	310000	8200000	NA	ug/kg			
Benzoic acid	1	40	1100 - 1100	1100.0	1700 - 4300	31000000	100000000	NA	ug/kg			
bis(2-Ethylhexyl)phthalat	21	49	55 - 8700	1160.0	350 - 2500	46000	41000	NA	ug/kg			
Butylbenzylphthalate	11	49	46 - 280	114.4	350 - 870	1600000	41000000	NA	ug/kg			
Carbazole	3	24	45 - 90	63.0	340 - 850	32000	29000	NA	ug/kg			
Dibenzofuran	1	49	140 - 140	140.0	340 - 870	31000	820000	NA	ug/kg			
Diethylphthalate	2	49	100 - 120	110.0	340 - 870	6300000	100000000	NA	ug/kg			
Di-n-butylphthalate	18	49	66 - 480	189.9	350 - 870	780000	20000000	NA	ug/kg			
Di-n-octyl phthalate	1	49	10000 - 10000	10000.0	340 - 870	160000	4100000	NA	ug/kg			
Fluoranthene	32	49	120 - 2400	458.8	350 - 870	310000	8200000	NA	ug/kg			
Fluorene	1	49	200 - 200	200.0	340 - 870	310000	8200000	NA	ug/kg			
Naphthalene	2	49	58 - 95	76.5	340 - 870	310000	8200000	NA	ug/kg			
Phenanthrene	24	49	40 - 530	239.7	350 - 870	310000	8200000	NA	ug/kg			
Pyrene	37	49	62 - 3900	503.5	350 - 870	230000	6100000	NA	ug/kg			
TCDD Equivalents												
Dioxin Equiv.	9	9	0.0106 - 3.1778	0.9	NA - NA	1000	NA	ng/kg				
Volatile Organics												
Acetone	1	10	35 - 35	35.0	53 - 63	20000000	NA	ug/kg				
Chlorobenzene	7	10	4 - 30	13.1	5.6 - 6.3	4100000	NA	ug/kg				
Methylene chloride	1	10	6.1 - 6.1	6.1	5.3 - 6.3	760000	NA	ug/kg				
Toluene	2	10	3.6 - 7.2	5.4	5.3 - 6.3	41000000	NA	ug/kg				
1,1,1-Trichloroethane	1	10	4 - 4	4.0	5.3 - 6.3	7200000	NA	ug/kg				

Notes:
* - Indentifed as a COPC based on screening process presented in Section 7.2.2
N - Essential nutrient
SQL - Sample quantitation limit
NA - Not Applicable
RBC - Risk-based Concentration
Reference - Background reference concentration for surface soil
mg/kg - milligram per kilogram
ug/kg - microgram per kilogram
ng/kg - nanogram per kilogram

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
021	B001	Antimony	ND	mg/kg	NA		NA	
021	B001	Arsenic	1.60	mg/kg	4.1792	63.07	0.0731	31.38
021	B001	B(a)P Equiv.	147.78	ug/kg	2.4473	36.93	NA	
021	B001	Beryllium	ND	mg/kg	NA		NA	
021	B001	Cadmium	ND	mg/kg	NA		NA	
021	B001	Copper	120.00	mg/kg	NA		0.0411	17.65
021	B001	Lead	150.00	mg/kg	NA		NA	
021	B001	Manganese	62.00	mg/kg	NA		0.0181	7.76
021	B001	Mercury	0.18	mg/kg	NA		0.0082	3.53
021	B001	Nickel	81.00	mg/kg	NA		0.0555	23.83
021	B001	Thallium	ND	mg/kg	NA		NA	
021	B001	Vanadium	5.10	mg/kg	NA		0.0100	4.29
021	B001	Zinc	590.00	mg/kg	NA		0.0270	11.57
		Total			6.6265		0.2331	
021	B002	Antimony	8.30	mg/kg	NA		0.2845	28.42
021	B002	Arsenic	3.20	mg/kg	8.3584	25.64	0.1463	14.61
021	B002	B(a)P Equiv.	197.44	ug/kg	3.2697	10.03	NA	
021	B002	Beryllium	2.80	mg/kg	20.9657	64.32	0.0077	0.77
021	B002	Cadmium	1.80	mg/kg	NA		0.0247	2.46
021	B002	Copper	800.00	mg/kg	NA		0.2742	27.39
021	B002	Lead	800.00	mg/kg	NA		NA	
021	B002	Manganese	240.00	mg/kg	NA		0.0700	6.99
021	B002	Mercury	0.35	mg/kg	NA		0.0160	1.60
021	B002	Nickel	85.00	mg/kg	NA		0.0583	5.82
021	B002	Thallium	ND	mg/kg	NA		NA	
021	B002	Vanadium	12.00	mg/kg	NA		0.0235	2.35
021	B002	Zinc	2100.00	mg/kg	NA		0.0960	9.59
		Total			32.5937		1.0012	
021	B003	Antimony	16.00	mg/kg	NA		0.5485	16.60
021	B003	Arsenic	26.00	mg/kg	67.9120	93.02	1.1884	35.96
021	B003	B(a)P Equiv.	307.49	ug/kg	5.0921	6.98	NA	
021	B003	Beryllium	ND	mg/kg	NA		NA	
021	B003	Cadmium	3.30	mg/kg	NA		0.0452	1.37
021	B003	Copper	720.00	mg/kg	NA		0.2468	7.47
021	B003	Lead	2900.00	mg/kg	NA		NA	
021	B003	Manganese	210.00	mg/kg	NA		0.0613	1.85
021	B003	Mercury	20.00	mg/kg	NA		0.9142	27.66
021	B003	Nickel	33.00	mg/kg	NA		0.0226	0.68
021	B003	Thallium	ND	mg/kg	NA		NA	
021	B003	Vanadium	100.00	mg/kg	NA		0.1959	5.93
021	B003	Zinc	1800.00	mg/kg	NA		0.0823	2.49
		Total			73.0042		3.3051	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
021	B004	Antimony	ND	mg/kg	NA		NA	
021	B004	Arsenic	ND	mg/kg	NA		NA	
021	B004	B(a)P Equiv.	10.84	ug/kg	0.1795	100.00	NA	
021	B004	Beryllium	ND	mg/kg	NA		NA	
021	B004	Cadmium	ND	mg/kg	NA		NA	
021	B004	Copper	32.00	mg/kg	NA		0.0110	24.80
021	B004	Lead	151.00	mg/kg	NA		NA	
021	B004	Manganese	30.00	mg/kg	NA		0.0088	19.78
021	B004	Mercury	0.06	mg/kg	NA		0.0027	6.10
021	B004	Nickel	6.30	mg/kg	NA		0.0043	9.76
021	B004	Thallium	ND	mg/kg	NA		NA	
021	B004	Vanadium	3.80	mg/kg	NA		0.0074	16.83
021	B004	Zinc	220.00	mg/kg	NA		0.0101	22.73
		Total			0.1795		0.0442	
021	B005	Antimony	ND	mg/kg	NA		NA	
021	B005	Arsenic	2.70	mg/kg	7.0524	49.54	0.1234	34.39
021	B005	B(a)P Equiv.	194.15	ug/kg	3.2152	22.58	NA	
021	B005	Beryllium	0.53	mg/kg	3.9685	27.88	0.0015	0.40
021	B005	Cadmium	1.80	mg/kg	NA		0.0247	6.87
021	B005	Copper	290.00	mg/kg	NA		0.0994	27.70
021	B005	Lead	467.00	mg/kg	NA		NA	
021	B005	Manganese	110.00	mg/kg	NA		0.0321	8.94
021	B005	Mercury	0.18	mg/kg	NA		0.0082	2.29
021	B005	Nickel	27.00	mg/kg	NA		0.0185	5.16
021	B005	Thallium	ND	mg/kg	NA		NA	
021	B005	Vanadium	10.00	mg/kg	NA		0.0196	5.46
021	B005	Zinc	690.00	mg/kg	NA		0.0315	8.79
		Total			14.2361		0.3589	
021	B006	Antimony	ND	mg/kg	NA		NA	
021	B006	Arsenic	5.30	mg/kg	13.8436	52.42	0.2423	41.16
021	B006	B(a)P Equiv.	216.20	ug/kg	3.5803	13.56	NA	
021	B006	Beryllium	1.20	mg/kg	8.9853	34.02	0.0033	0.56
021	B006	Cadmium	2.10	mg/kg	NA		0.0288	4.89
021	B006	Copper	440.00	mg/kg	NA		0.1508	25.63
021	B006	Lead	422.00	mg/kg	NA		NA	
021	B006	Manganese	180.00	mg/kg	NA		0.0525	8.92
021	B006	Mercury	0.23	mg/kg	NA		0.0105	1.79
021	B006	Nickel	56.30	mg/kg	NA		0.0386	6.56
021	B006	Thallium	ND	mg/kg	NA		NA	
021	B006	Vanadium	8.20	mg/kg	NA		0.0161	2.73
021	B006	Zinc	1000.00	mg/kg	NA		0.0457	7.77
		Total			26.4092		0.5885	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
021	B007	Antimony	ND	mg/kg	NA		NA	
021	B007	Arsenic	2.30	mg/kg	6.0076	58.89	0.1051	19.66
021	B007	B(a)P Equiv.	ND	ug/kg	NA		NA	
021	B007	Beryllium	0.56	mg/kg	4.1931	41.11	0.0015	0.29
021	B007	Cadmium	1.40	mg/kg	NA		0.0192	3.59
021	B007	Copper	350.00	mg/kg	NA		0.1200	22.44
021	B007	Lead	411.00	mg/kg	NA		NA	
021	B007	Manganese	200.00	mg/kg	NA		0.0583	10.91
021	B007	Mercury	0.15	mg/kg	NA		0.0069	1.28
021	B007	Nickel	220.00	mg/kg	NA		0.1508	28.20
021	B007	Thallium	ND	mg/kg	NA		NA	
021	B007	Vanadium	6.90	mg/kg	NA		0.0135	2.53
021	B007	Zinc	1300.00	mg/kg	NA		0.0594	11.11
		Total			10.2007		0.5348	
021	B008	Antimony	ND	mg/kg	NA		NA	
021	B008	Arsenic	2.40	mg/kg	6.2688	99.99	0.1097	37.82
021	B008	B(a)P Equiv.	0.05	ug/kg	0.0009	0.01	NA	
021	B008	Beryllium	ND	mg/kg	NA		NA	
021	B008	Cadmium	1.20	mg/kg	NA		0.0164	5.67
021	B008	Copper	60.00	mg/kg	NA		0.0206	7.09
021	B008	Lead	27.00	mg/kg	NA		NA	
021	B008	Manganese	300.00	mg/kg	NA		0.0875	30.17
021	B008	Mercury	0.01	mg/kg	NA		0.0006	0.20
021	B008	Nickel	61.00	mg/kg	NA		0.0418	14.42
021	B008	Thallium	ND	mg/kg	NA		NA	
021	B008	Vanadium	4.90	mg/kg	NA		0.0096	3.31
021	B008	Zinc	84.00	mg/kg	NA		0.0038	1.32
		Total			6.2697		0.2901	
021	B009	Antimony	ND	mg/kg	NA		NA	
021	B009	Arsenic	1.70	mg/kg	4.4404	67.83	0.0777	35.43
021	B009	B(a)P Equiv.	127.15	ug/kg	2.1056	32.17	NA	
021	B009	Beryllium	ND	mg/kg	NA		NA	
021	B009	Cadmium	0.70	mg/kg	NA		0.0096	4.37
021	B009	Copper	140.00	mg/kg	NA		0.0480	21.88
021	B009	Lead	43.00	mg/kg	NA		NA	
021	B009	Manganese	170.00	mg/kg	NA		0.0496	22.61
021	B009	Mercury	0.02	mg/kg	NA		0.0010	0.44
021	B009	Nickel	30.00	mg/kg	NA		0.0206	9.38
021	B009	Thallium	ND	mg/kg	NA		NA	
021	B009	Vanadium	4.40	mg/kg	NA		0.0086	3.93
021	B009	Zinc	94.00	mg/kg	NA		0.0043	1.96
		Total			6.5460		0.2193	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B001	Antimony (Sb)	11.80	MG/KG	NA		0.4045	35.96
054	B001	Arsenic (As)	5.60	MG/KG	14.6272	37.82	0.2560	22.76
054	B001	B(a)P Equiv.	638.57	UG/KG	10.5749	27.34	NA	
054	B001	Beryllium (Be)	1.80	MG/KG	13.4779	34.84	0.0049	0.44
054	B001	Cadmium (Cd)	1.80	MG/KG	NA		0.0247	2.19
054	B001	Copper (Cu)	534.00	MG/KG	NA		0.1831	16.27
054	B001	Lead (Pb)	689.00	MG/KG	NA		NA	
054	B001	Manganese (Mn)	229.00	MG/KG	NA		0.0668	5.94
054	B001	Mercury (Hg)	0.14	MG/KG	NA		0.0064	0.57
054	B001	Nickel (Ni)	63.20	MG/KG	NA		0.0433	3.85
054	B001	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B001	Vanadium (V)	8.80	MG/KG	NA		0.0172	1.53
054	B001	Zinc (Zn)	2580.00	MG/KG	NA		0.1179	10.48
		Total			38.6800		1.1248	
054	B002	Antimony (Sb)	2.80	MG/KG	NA		0.0960	19.86
054	B002	Arsenic (As)	3.30	MG/KG	8.6196	46.43	0.1508	31.21
054	B002	B(a)P Equiv.	170.92	UG/KG	2.8305	15.25	NA	
054	B002	Beryllium (Be)	0.95	MG/KG	7.1133	38.32	0.0026	0.54
054	B002	Cadmium (Cd)	0.69	MG/KG	NA		0.0095	1.96
054	B002	Copper (Cu)	281.00	MG/KG	NA		0.0963	19.93
054	B002	Lead (Pb)	220.00	MG/KG	NA		NA	
054	B002	Manganese (Mn)	138.00	MG/KG	NA		0.0403	8.33
054	B002	Mercury (Hg)	0.15	MG/KG	NA		0.0069	1.42
054	B002	Nickel (Ni)	43.30	MG/KG	NA		0.0297	6.14
054	B002	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B002	Vanadium (V)	7.00	MG/KG	NA		0.0137	2.84
054	B002	Zinc (Zn)	822.00	MG/KG	NA		0.0376	7.77
		Total			18.5634		0.4833	
054	B003	Antimony (Sb)	13.90	MG/KG	NA		0.4765	40.40
054	B003	Arsenic (As)	4.50	MG/KG	11.7540	46.58	0.2057	17.44
054	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B003	Beryllium (Be)	1.80	MG/KG	13.4779	53.42	0.0049	0.42
054	B003	Cadmium (Cd)	2.70	MG/KG	NA		0.0370	3.14
054	B003	Copper (Cu)	733.00	MG/KG	NA		0.2513	21.31
054	B003	Lead (Pb)	937.00	MG/KG	NA		NA	
054	B003	Manganese (Mn)	232.00	MG/KG	NA		0.0677	5.74
054	B003	Mercury (Hg)	0.16	MG/KG	NA		0.0073	0.62
054	B003	Nickel (Ni)	56.40	MG/KG	NA		0.0387	3.28
054	B003	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B003	Vanadium (V)	8.30	MG/KG	NA		0.0163	1.38
054	B003	Zinc (Zn)	1620.00	MG/KG	NA		0.0740	6.28
		Total			25.2319		1.1794	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B004	Antimony (Sb)	3.60	MG/KG	NA		0.1234	8.66
054	B004	Arsenic (As)	11.90	MG/KG	31.0828	83.39	0.5439	38.16
054	B004	B(a)P Equiv.	21.11	UG/KG	0.3496	0.94	NA	
054	B004	Beryllium (Be)	0.78	MG/KG	5.8404	15.67	0.0021	0.15
054	B004	Cadmium (Cd)	1.20	MG/KG	NA		0.0164	1.15
054	B004	Copper (Cu)	317.00	MG/KG	NA		0.1087	7.62
054	B004	Lead (Pb)	362.00	MG/KG	NA		NA	
054	B004	Manganese (Mn)	208.00	MG/KG	NA		0.0607	4.26
054	B004	Mercury (Hg)	0.17	MG/KG	NA		0.0078	0.55
054	B004	Nickel (Ni)	40.90	MG/KG	NA		0.0280	1.97
054	B004	Thallium (Tl)	2.60	MG/KG	NA		0.4457	31.26
054	B004	Vanadium (V)	27.30	MG/KG	NA		0.0535	3.75
054	B004	Zinc (Zn)	772.00	MG/KG	NA		0.0353	2.48
		Total			37.2728		1.4255	
054	B005	Antimony (Sb)	15.70	MG/KG	NA		0.5382	21.36
054	B005	Arsenic (As)	9.30	MG/KG	24.2916	55.48	0.4251	16.87
054	B005	B(a)P Equiv.	453.82	UG/KG	7.5154	17.16	NA	
054	B005	Beryllium (Be)	1.60	MG/KG	11.9804	27.36	0.0044	0.17
054	B005	Cadmium (Cd)	5.70	MG/KG	NA		0.0781	3.10
054	B005	Copper (Cu)	1330.00	MG/KG	NA		0.4559	18.09
054	B005	Lead (Pb)	1190.00	MG/KG	NA		NA	
054	B005	Manganese (Mn)	249.00	MG/KG	NA		0.0726	2.88
054	B005	Mercury (Hg)	0.23	MG/KG	NA		0.0105	0.42
054	B005	Nickel (Ni)	92.60	MG/KG	NA		0.0635	2.52
054	B005	Thallium (Tl)	4.20	MG/KG	NA		0.7199	28.57
054	B005	Vanadium (V)	18.10	MG/KG	NA		0.0355	1.41
054	B005	Zinc (Zn)	2540.00	MG/KG	NA		0.1161	4.61
		Total			43.7874		2.5198	
054	B006	Antimony (Sb)	4.90	MG/KG	NA		0.1680	17.11
054	B006	Arsenic (As)	8.20	MG/KG	21.4184	80.79	0.3748	38.17
054	B006	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B006	Beryllium (Be)	0.68	MG/KG	5.0917	19.21	0.0019	0.19
054	B006	Cadmium (Cd)	2.00	MG/KG	NA		0.0274	2.79
054	B006	Copper (Cu)	294.00	MG/KG	NA		0.1008	10.26
054	B006	Lead (Pb)	613.00	MG/KG	NA		NA	
054	B006	Manganese (Mn)	490.00	MG/KG	NA		0.1429	14.56
054	B006	Mercury (Hg)	0.14	MG/KG	NA		0.0064	0.65
054	B006	Nickel (Ni)	42.30	MG/KG	NA		0.0290	2.95
054	B006	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B006	Vanadium (V)	21.70	MG/KG	NA		0.0425	4.33
054	B006	Zinc (Zn)	1930.00	MG/KG	NA		0.0882	8.98
		Total			26.5101		0.9819	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B007	Antimony (Sb)	5.20	MG/KG	NA		0.1783	17.16
054	B007	Arsenic (As)	9.40	MG/KG	24.5528	62.11	0.4297	41.35
054	B007	B(a)P Equiv.	181.18	UG/KG	3.0004	7.59	NA	
054	B007	Beryllium (Be)	1.60	MG/KG	11.9804	30.30	0.0044	0.42
054	B007	Cadmium (Cd)	0.99	MG/KG	NA		0.0136	1.31
054	B007	Copper (Cu)	573.00	MG/KG	NA		0.1964	18.91
054	B007	Lead (Pb)	434.00	MG/KG	NA		NA	
054	B007	Manganese (Mn)	176.00	MG/KG	NA		0.0513	4.94
054	B007	Mercury (Hg)	0.16	MG/KG	NA		0.0073	0.70
054	B007	Nickel (Ni)	53.50	MG/KG	NA		0.0367	3.53
054	B007	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B007	Vanadium (V)	18.80	MG/KG	NA		0.0368	3.54
054	B007	Zinc (Zn)	1850.00	MG/KG	NA		0.0846	8.14
		Total			39.5336		1.0390	
054	B008	Antimony (Sb)	33.60	MG/KG	NA		1.1518	50.75
054	B008	Arsenic (As)	9.20	MG/KG	24.0304	53.52	0.4205	18.53
054	B008	B(a)P Equiv.	400.91	UG/KG	6.6392	14.79	NA	
054	B008	Beryllium (Be)	1.90	MG/KG	14.2267	31.69	0.0052	0.23
054	B008	Cadmium (Cd)	2.30	MG/KG	NA		0.0315	1.39
054	B008	Copper (Cu)	650.00	MG/KG	NA		0.2228	9.82
054	B008	Lead (Pb)	493.00	MG/KG	NA		NA	
054	B008	Manganese (Mn)	191.00	MG/KG	NA		0.0557	2.46
054	B008	Mercury (Hg)	0.48	MG/KG	NA		0.0219	0.97
054	B008	Nickel (Ni)	75.30	MG/KG	NA		0.0516	2.27
054	B008	Thallium (Tl)	1.00	MG/KG	NA		0.1714	7.55
054	B008	Vanadium (V)	19.70	MG/KG	NA		0.0386	1.70
054	B008	Zinc (Zn)	2150.00	MG/KG	NA		0.0983	4.33
		Total			44.8963		2.2694	
054	B009	Antimony (Sb)	0.97	MG/KG	NA		0.0333	8.68
054	B009	Arsenic (As)	2.20	MG/KG	5.7464	53.39	0.1006	26.26
054	B009	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B009	Beryllium (Be)	0.67	MG/KG	5.0168	46.61	0.0018	0.48
054	B009	Cadmium (Cd)	1.40	MG/KG	NA		0.0192	5.01
054	B009	Copper (Cu)	430.00	MG/KG	NA		0.1474	38.50
054	B009	Lead (Pb)	297.00	MG/KG	NA		NA	
054	B009	Manganese (Mn)	78.20	MG/KG	NA		0.0228	5.96
054	B009	Mercury (Hg)	0.08	MG/KG	NA		0.0037	0.95
054	B009	Nickel (Ni)	37.70	MG/KG	NA		0.0258	6.75
054	B009	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B009	Vanadium (V)	5.30	MG/KG	NA		0.0104	2.71
054	B009	Zinc (Zn)	393.00	MG/KG	NA		0.0180	4.69
		Total			10.7632		0.3829	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B010	Antimony (Sb)	5.10	MG/KG	NA		0.1748	11.33
054	B010	Arsenic (As)	11.00	MG/KG	28.7320	86.09	0.5028	32.57
054	B010	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B010	Beryllium (Be)	0.62	MG/KG	4.6424	13.91	0.0017	0.11
054	B010	Cadmium (Cd)	2.30	MG/KG	NA		0.0315	2.04
054	B010	Copper (Cu)	277.00	MG/KG	NA		0.0950	6.15
054	B010	Lead (Pb)	1020.00	MG/KG	NA		NA	
054	B010	Manganese (Mn)	155.00	MG/KG	NA		0.0452	2.93
054	B010	Mercury (Hg)	13.60	MG/KG	NA		0.6216	40.27
054	B010	Nickel (Ni)	23.10	MG/KG	NA		0.0158	1.03
054	B010	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B010	Vanadium (V)	5.90	MG/KG	NA		0.0116	0.75
054	B010	Zinc (Zn)	957.00	MG/KG	NA		0.0437	2.83
		Total			33.3744		1.5438	
054	B011	Antimony (Sb)	23.50	MG/KG	NA		0.8056	52.71
054	B011	Arsenic (As)	3.10	MG/KG	8.0972	30.08	0.1417	9.27
054	B011	B(a)P Equiv.	368.13	UG/KG	6.0963	22.64	NA	
054	B011	Beryllium (Be)	1.70	MG/KG	12.7292	47.28	0.0047	0.31
054	B011	Cadmium (Cd)	1.60	MG/KG	NA		0.0219	1.43
054	B011	Copper (Cu)	565.00	MG/KG	NA		0.1937	12.67
054	B011	Lead (Pb)	813.00	MG/KG	NA		NA	
054	B011	Manganese (Mn)	218.00	MG/KG	NA		0.0636	4.16
054	B011	Mercury (Hg)	3.00	MG/KG	NA		0.1371	8.97
054	B011	Nickel (Ni)	50.00	MG/KG	NA		0.0343	2.24
054	B011	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B011	Vanadium (V)	7.10	MG/KG	NA		0.0139	0.91
054	B011	Zinc (Zn)	2450.00	MG/KG	NA		0.1120	7.33
		Total			26.9227		1.5285	
054	B012	Antimony (Sb)	14.40	MG/KG	NA		0.4936	37.21
054	B012	Arsenic (As)	6.90	MG/KG	18.0228	38.16	0.3154	23.77
054	B012	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B012	Beryllium (Be)	3.90	MG/KG	29.2022	61.84	0.0107	0.81
054	B012	Cadmium (Cd)	1.50	MG/KG	NA		0.0205	1.55
054	B012	Copper (Cu)	488.00	MG/KG	NA		0.1673	12.61
054	B012	Lead (Pb)	998.00	MG/KG	NA		NA	
054	B012	Manganese (Mn)	233.00	MG/KG	NA		0.0680	5.12
054	B012	Mercury (Hg)	1.50	MG/KG	NA		0.0686	5.17
054	B012	Nickel (Ni)	40.10	MG/KG	NA		0.0275	2.07
054	B012	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B012	Vanadium (V)	11.30	MG/KG	NA		0.0221	1.67
054	B012	Zinc (Zn)	2910.00	MG/KG	NA		0.1330	10.03
		Total			47.2250		1.3267	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B013	Antimony (Sb)	4.60	MG/KG	NA		0.1577	26.59
054	B013	Arsenic (As)	2.30	MG/KG	6.0076	52.36	0.1051	17.72
054	B013	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B013	Beryllium (Be)	0.73	MG/KG	5.4660	47.64	0.0020	0.34
054	B013	Cadmium (Cd)	2.10	MG/KG	NA		0.0288	4.85
054	B013	Copper (Cu)	439.00	MG/KG	NA		0.1505	25.37
054	B013	Lead (Pb)	411.00	MG/KG	NA		NA	
054	B013	Manganese (Mn)	98.00	MG/KG	NA		0.0286	4.82
054	B013	Mercury (Hg)	1.20	MG/KG	NA		0.0548	9.25
054	B013	Nickel (Ni)	32.00	MG/KG	NA		0.0219	3.70
054	B013	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B013	Vanadium (V)	5.20	MG/KG	NA		0.0102	1.72
054	B013	Zinc (Zn)	733.00	MG/KG	NA		0.0335	5.65
		Total			11.4736		0.5931	
054	B014	Antimony (Sb)	11.60	MG/KG	NA		0.3977	34.95
054	B014	Arsenic (As)	5.10	MG/KG	13.3212	42.57	0.2331	20.49
054	B014	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B014	Beryllium (Be)	2.40	MG/KG	17.9706	57.43	0.0066	0.58
054	B014	Cadmium (Cd)	8.40	MG/KG	NA		0.1151	10.11
054	B014	Copper (Cu)	499.00	MG/KG	NA		0.1711	15.03
054	B014	Lead (Pb)	841.00	MG/KG	NA		NA	
054	B014	Manganese (Mn)	214.00	MG/KG	NA		0.0624	5.49
054	B014	Mercury (Hg)	0.29	MG/KG	NA		0.0133	1.16
054	B014	Nickel (Ni)	29.10	MG/KG	NA		0.0200	1.75
054	B014	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B014	Vanadium (V)	8.80	MG/KG	NA		0.0172	1.52
054	B014	Zinc (Zn)	2220.00	MG/KG	NA		0.1015	8.92
		Total			31.2918		1.1378	
054	B015	Antimony (Sb)	3.80	MG/KG	NA		0.1303	17.78
054	B015	Arsenic (As)	3.50	MG/KG	9.1420	47.69	0.1600	21.84
054	B015	B(a)P Equiv.	17.62	UG/KG	0.2918	1.52	NA	
054	B015	Beryllium (Be)	1.30	MG/KG	9.7341	50.78	0.0036	0.49
054	B015	Cadmium (Cd)	1.60	MG/KG	NA		0.0219	2.99
054	B015	Copper (Cu)	766.00	MG/KG	NA		0.2626	35.85
054	B015	Lead (Pb)	595.00	MG/KG	NA		NA	
054	B015	Manganese (Mn)	164.00	MG/KG	NA		0.0478	6.53
054	B015	Mercury (Hg)	0.20	MG/KG	NA		0.0091	1.25
054	B015	Nickel (Ni)	51.90	MG/KG	NA		0.0356	4.86
054	B015	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B015	Vanadium (V)	9.80	MG/KG	NA		0.0192	2.62
054	B015	Zinc (Zn)	928.00	MG/KG	NA		0.0424	5.79
		Total			19.1679		0.7325	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B016	Antimony (Sb)	13.80	MG/KG	NA		0.4731	24.47
054	B016	Arsenic (As)	3.50	MG/KG	9.1420	36.10	0.1600	8.28
054	B016	B(a)P Equiv.	163.48	UG/KG	2.7073	10.69	NA	
054	B016	Beryllium (Be)	1.80	MG/KG	13.4779	53.22	0.0049	0.26
054	B016	Cadmium (Cd)	1.80	MG/KG	NA		0.0247	1.28
054	B016	Copper (Cu)	2370.00	MG/KG	NA		0.8125	42.03
054	B016	Lead (Pb)	720.00	MG/KG	NA		NA	
054	B016	Manganese (Mn)	163.00	MG/KG	NA		0.0475	2.46
054	B016	Mercury (Hg)	0.08	MG/KG	NA		0.0037	0.19
054	B016	Nickel (Ni)	492.00	MG/KG	NA		0.3373	17.45
054	B016	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B016	Vanadium (V)	6.50	MG/KG	NA		0.0127	0.66
054	B016	Zinc (Zn)	1240.00	MG/KG	NA		0.0567	2.93
		Total			25.3272		1.9330	
054	B017	Antimony (Sb)	2.10	MG/KG	NA		0.0720	9.59
054	B017	Arsenic (As)	10.40	MG/KG	27.1648	26.26	0.4754	63.32
054	B017	B(a)P Equiv.	4218.00	UG/KG	69.8514	67.52	NA	
054	B017	Beryllium (Be)	0.86	MG/KG	6.4395	6.22	0.0024	0.31
054	B017	Cadmium (Cd)	0.70	MG/KG	NA		0.0096	1.28
054	B017	Copper (Cu)	188.00	MG/KG	NA		0.0644	8.59
054	B017	Lead (Pb)	248.00	MG/KG	NA		NA	
054	B017	Manganese (Mn)	139.00	MG/KG	NA		0.0405	5.40
054	B017	Mercury (Hg)	0.34	MG/KG	NA		0.0155	2.07
054	B017	Nickel (Ni)	27.00	MG/KG	NA		0.0185	2.47
054	B017	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B017	Vanadium (V)	11.10	MG/KG	NA		0.0217	2.90
054	B017	Zinc (Zn)	669.00	MG/KG	NA		0.0306	4.07
		Total			103.4557		0.7507	
054	B018	Antimony (Sb)	2.20	MG/KG	NA		0.0754	18.97
054	B018	Arsenic (As)	3.00	MG/KG	7.8360	47.67	0.1371	34.49
054	B018	B(a)P Equiv.	275.33	UG/KG	4.5596	27.74	NA	
054	B018	Beryllium (Be)	0.54	MG/KG	4.0434	24.60	0.0015	0.37
054	B018	Cadmium (Cd)	0.39	MG/KG	NA		0.0053	1.34
054	B018	Copper (Cu)	236.00	MG/KG	NA		0.0809	20.35
054	B018	Lead (Pb)	108.00	MG/KG	NA		NA	
054	B018	Manganese (Mn)	94.80	MG/KG	NA		0.0277	6.95
054	B018	Mercury (Hg)	0.09	MG/KG	NA		0.0041	1.03
054	B018	Nickel (Ni)	35.00	MG/KG	NA		0.0240	6.03
054	B018	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B018	Vanadium (V)	4.90	MG/KG	NA		0.0096	2.41
054	B018	Zinc (Zn)	700.00	MG/KG	NA		0.0320	8.05
		Total			16.4389		0.3976	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B019	Antimony (Sb)	1.00	MG/KG	NA		0.0343	2.66
054	B019	Arsenic (As)	5.40	MG/KG	14.1048	83.29	0.2468	19.13
054	B019	B(a)P Equiv.	26.21	UG/KG	0.4340	2.56	NA	
054	B019	Beryllium (Be)	0.32	MG/KG	2.3961	14.15	0.0009	0.07
054	B019	Cadmium (Cd)	0.81	MG/KG	NA		0.0111	0.86
054	B019	Copper (Cu)	2660.00	MG/KG	NA		0.9119	70.68
054	B019	Lead (Pb)	214.00	MG/KG	NA		NA	
054	B019	Manganese (Mn)	93.40	MG/KG	NA		0.0272	2.11
054	B019	Mercury (Hg)	0.20	MG/KG	NA		0.0091	0.71
054	B019	Nickel (Ni)	12.50	MG/KG	NA		0.0086	0.66
054	B019	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B019	Vanadium (V)	10.60	MG/KG	NA		0.0208	1.61
054	B019	Zinc (Zn)	425.00	MG/KG	NA		0.0194	1.51
		Total			16.9349		1.2901	
054	B020	Antimony (Sb)	3.90	MG/KG	NA		0.1337	18.65
054	B020	Arsenic (As)	4.60	MG/KG	12.0152	50.07	0.2103	29.32
054	B020	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B020	Beryllium (Be)	1.60	MG/KG	11.9804	49.93	0.0044	0.61
054	B020	Cadmium (Cd)	2.30	MG/KG	NA		0.0315	4.39
054	B020	Copper (Cu)	432.00	MG/KG	NA		0.1481	20.65
054	B020	Lead (Pb)	450.00	MG/KG	NA		NA	
054	B020	Manganese (Mn)	212.00	MG/KG	NA		0.0618	8.63
054	B020	Mercury (Hg)	0.17	MG/KG	NA		0.0078	1.08
054	B020	Nickel (Ni)	97.10	MG/KG	NA		0.0666	9.28
054	B020	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B020	Vanadium (V)	7.30	MG/KG	NA		0.0143	1.99
054	B020	Zinc (Zn)	844.00	MG/KG	NA		0.0386	5.38
		Total			23.9956		0.7170	
054	B021	Antimony (Sb)	1.70	MG/KG	NA		0.0583	33.47
054	B021	Arsenic (As)	0.90	MG/KG	2.3508	100.00	0.0411	23.63
054	B021	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B021	Beryllium (Be)	ND	MG/KG	NA		NA	
054	B021	Cadmium (Cd)	0.17	MG/KG	NA		0.0023	1.34
054	B021	Copper (Cu)	21.70	MG/KG	NA		0.0074	4.27
054	B021	Lead (Pb)	36.60	MG/KG	NA		NA	
054	B021	Manganese (Mn)	15.10	MG/KG	NA		0.0044	2.53
054	B021	Mercury (Hg)	1.10	MG/KG	NA		0.0503	28.88
054	B021	Nickel (Ni)	3.30	MG/KG	NA		0.0023	1.30
054	B021	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B021	Vanadium (V)	1.80	MG/KG	NA		0.0035	2.03
054	B021	Zinc (Zn)	97.80	MG/KG	NA		0.0045	2.57
		Total			2.3508		0.1741	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B022	Antimony (Sb)	1.00	MG/KG	NA		0.0343	15.22
054	B022	Arsenic (As)	2.70	MG/KG	7.0524	50.57	0.1234	54.80
054	B022	B(a)P Equiv.	294.24	UG/KG	4.8727	34.94	NA	
054	B022	Beryllium (Be)	0.27	MG/KG	2.0217	14.50	0.0007	0.33
054	B022	Cadmium (Cd)	0.35	MG/KG	NA		0.0048	2.13
054	B022	Copper (Cu)	39.90	MG/KG	NA		0.0137	6.07
054	B022	Lead (Pb)	87.60	MG/KG	NA		NA	
054	B022	Manganese (Mn)	80.60	MG/KG	NA		0.0235	10.44
054	B022	Mercury (Hg)	0.05	MG/KG	NA		0.0023	1.01
054	B022	Nickel (Ni)	6.10	MG/KG	NA		0.0042	1.86
054	B022	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B022	Vanadium (V)	4.50	MG/KG	NA		0.0088	3.91
054	B022	Zinc (Zn)	208.00	MG/KG	NA		0.0095	4.22
		Total			13.9468		0.2252	
054	B023	Antimony (Sb)	1.00	MG/KG	NA		0.0343	12.39
054	B023	Arsenic (As)	3.80	MG/KG	9.9256	87.46	0.1737	62.80
054	B023	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B023	Beryllium (Be)	0.19	MG/KG	1.4227	12.54	0.0005	0.19
054	B023	Cadmium (Cd)	0.16	MG/KG	NA		0.0022	0.79
054	B023	Copper (Cu)	44.20	MG/KG	NA		0.0152	5.48
054	B023	Lead (Pb)	48.60	MG/KG	NA		NA	
054	B023	Manganese (Mn)	74.80	MG/KG	NA		0.0218	7.89
054	B023	Mercury (Hg)	0.04	MG/KG	NA		0.0018	0.66
054	B023	Nickel (Ni)	5.70	MG/KG	NA		0.0039	1.41
054	B023	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B023	Vanadium (V)	7.90	MG/KG	NA		0.0155	5.60
054	B023	Zinc (Zn)	169.00	MG/KG	NA		0.0077	2.79
		Total			11.3483		0.2766	
054	B024	Antimony (Sb)	2.10	MG/KG	NA		0.0720	14.16
054	B024	Arsenic (As)	3.40	MG/KG	8.8808	58.58	0.1554	30.57
054	B024	B(a)P Equiv.	13.00	UG/KG	0.2153	1.42	NA	
054	B024	Beryllium (Be)	0.81	MG/KG	6.0651	40.00	0.0022	0.44
054	B024	Cadmium (Cd)	0.38	MG/KG	NA		0.0052	1.02
054	B024	Copper (Cu)	157.00	MG/KG	NA		0.0538	10.59
054	B024	Lead (Pb)	124.00	MG/KG	NA		NA	
054	B024	Manganese (Mn)	106.00	MG/KG	NA		0.0309	6.08
054	B024	Mercury (Hg)	0.21	MG/KG	NA		0.0096	1.89
054	B024	Nickel (Ni)	28.00	MG/KG	NA		0.0192	3.78
054	B024	Thallium (Tl)	0.68	MG/KG	NA		0.1166	22.93
054	B024	Vanadium (V)	2.60	MG/KG	NA		0.0051	1.00
054	B024	Zinc (Zn)	840.00	MG/KG	NA		0.0384	7.55
		Total			15.1612		0.5084	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B025	Antimony (Sb)	0.80	MG/KG	NA		0.0274	7.21
054	B025	Arsenic (As)	4.80	MG/KG	12.5376	85.67	0.2194	57.69
054	B025	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B025	Beryllium (Be)	0.28	MG/KG	2.0966	14.33	0.0008	0.20
054	B025	Cadmium (Cd)	0.48	MG/KG	NA		0.0066	1.73
054	B025	Copper (Cu)	117.00	MG/KG	NA		0.0401	10.55
054	B025	Lead (Pb)	147.00	MG/KG	NA		NA	
054	B025	Manganese (Mn)	72.20	MG/KG	NA		0.0211	5.54
054	B025	Mercury (Hg)	0.47	MG/KG	NA		0.0215	5.65
054	B025	Nickel (Ni)	14.30	MG/KG	NA		0.0098	2.58
054	B025	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B025	Vanadium (V)	9.00	MG/KG	NA		0.0176	4.64
054	B025	Zinc (Zn)	351.00	MG/KG	NA		0.0160	4.22
		Total			14.6342		0.3803	
054	B026	Antimony (Sb)	4.30	MG/KG	NA		0.1474	20.06
054	B026	Arsenic (As)	8.50	MG/KG	22.2020	91.94	0.3885	52.87
054	B026	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B026	Beryllium (Be)	0.26	MG/KG	1.9468	8.06	0.0007	0.10
054	B026	Cadmium (Cd)	0.73	MG/KG	NA		0.0100	1.36
054	B026	Copper (Cu)	352.00	MG/KG	NA		0.1207	16.42
054	B026	Lead (Pb)	545.00	MG/KG	NA		NA	
054	B026	Manganese (Mn)	76.10	MG/KG	NA		0.0222	3.02
054	B026	Mercury (Hg)	0.30	MG/KG	NA		0.0137	1.87
054	B026	Nickel (Ni)	7.20	MG/KG	NA		0.0049	0.67
054	B026	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B026	Vanadium (V)	6.60	MG/KG	NA		0.0129	1.76
054	B026	Zinc (Zn)	302.00	MG/KG	NA		0.0138	1.88
		Total			24.1488		0.7349	
054	B027	Antimony (Sb)	ND	MG/KG	NA		NA	
054	B027	Arsenic (As)	1.80	MG/KG	4.7016	100.00	0.0823	39.35
054	B027	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B027	Beryllium (Be)	ND	MG/KG	NA		NA	
054	B027	Cadmium (Cd)	ND	MG/KG	NA		NA	
054	B027	Copper (Cu)	6.90	MG/KG	NA		0.0024	1.13
054	B027	Lead (Pb)	9.00	MG/KG	NA		NA	
054	B027	Manganese (Mn)	9.30	MG/KG	NA		0.0027	1.30
054	B027	Mercury (Hg)	0.10	MG/KG	NA		0.0046	2.19
054	B027	Nickel (Ni)	2.30	MG/KG	NA		0.0016	0.75
054	B027	Thallium (Tl)	0.58	MG/KG	NA		0.0994	47.55
054	B027	Vanadium (V)	7.50	MG/KG	NA		0.0147	7.03
054	B027	Zinc (Zn)	32.50	MG/KG	NA		0.0015	0.71
		Total			4.7016		0.2091	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B028	Antimony (Sb)	0.91	MG/KG	NA		0.0312	11.39
054	B028	Arsenic (As)	2.60	MG/KG	6.7912	61.41	0.1188	43.37
054	B028	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B028	Beryllium (Be)	0.57	MG/KG	4.2680	38.59	0.0016	0.57
054	B028	Cadmium (Cd)	1.10	MG/KG	NA		0.0151	5.50
054	B028	Copper (Cu)	58.20	MG/KG	NA		0.0200	7.28
054	B028	Lead (Pb)	144.00	MG/KG	NA		NA	
054	B028	Manganese (Mn)	109.00	MG/KG	NA		0.0318	11.60
054	B028	Mercury (Hg)	0.25	MG/KG	NA		0.0114	4.17
054	B028	Nickel (Ni)	10.60	MG/KG	NA		0.0073	2.65
054	B028	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B028	Vanadium (V)	4.90	MG/KG	NA		0.0096	3.50
054	B028	Zinc (Zn)	597.00	MG/KG	NA		0.0273	9.96
		Total			11.0592		0.2740	
054	B029	Antimony (Sb)	50.00	MG/KG	NA		1.7140	75.32
054	B029	Arsenic (As)	5.70	MG/KG	14.8884	61.38	0.2605	11.45
054	B029	B(a)P Equiv.	199.42	UG/KG	3.3025	13.62	NA	
054	B029	Beryllium (Be)	0.81	MG/KG	6.0651	25.00	0.0022	0.10
054	B029	Cadmium (Cd)	1.10	MG/KG	NA		0.0151	0.66
054	B029	Copper (Cu)	238.00	MG/KG	NA		0.0816	3.59
054	B029	Lead (Pb)	9270.00	MG/KG	NA		NA	
054	B029	Manganese (Mn)	169.00	MG/KG	NA		0.0493	2.17
054	B029	Mercury (Hg)	0.03	MG/KG	NA		0.0014	0.06
054	B029	Nickel (Ni)	16.60	MG/KG	NA		0.0114	0.50
054	B029	Thallium (Tl)	0.57	MG/KG	NA		0.0977	4.29
054	B029	Vanadium (V)	6.00	MG/KG	NA		0.0118	0.52
054	B029	Zinc (Zn)	673.00	MG/KG	NA		0.0308	1.35
		Total			24.2559		2.2757	
054	B030	Antimony (Sb)	6.70	MG/KG	NA		0.2297	20.77
054	B030	Arsenic (As)	6.30	MG/KG	16.4556	74.32	0.2880	26.04
054	B030	B(a)P Equiv.	153.48	UG/KG	2.5417	11.48	NA	
054	B030	Beryllium (Be)	0.42	MG/KG	3.1448	14.20	0.0012	0.10
054	B030	Cadmium (Cd)	1.50	MG/KG	NA		0.0205	1.86
054	B030	Copper (Cu)	437.00	MG/KG	NA		0.1498	13.55
054	B030	Lead (Pb)	673.00	MG/KG	NA		NA	
054	B030	Manganese (Mn)	351.00	MG/KG	NA		0.1024	9.26
054	B030	Mercury (Hg)	0.20	MG/KG	NA		0.0091	0.83
054	B030	Nickel (Ni)	74.20	MG/KG	NA		0.0509	4.60
054	B030	Thallium (Tl)	1.20	MG/KG	NA		0.2057	18.60
054	B030	Vanadium (V)	8.70	MG/KG	NA		0.0170	1.54
054	B030	Zinc (Zn)	691.00	MG/KG	NA		0.0316	2.86
		Total			22.1421		1.1059	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B031	Antimony (Sb)	18.60	MG/KG	NA		0.6376	36.81
054	B031	Arsenic (As)	7.40	MG/KG	19.3288	28.80	0.3382	19.53
054	B031	B(a)P Equiv.	1076.45	UG/KG	17.8263	26.56	NA	
054	B031	Beryllium (Be)	4.00	MG/KG	29.9509	44.63	0.0110	0.63
054	B031	Cadmium (Cd)	2.20	MG/KG	NA		0.0301	1.74
054	B031	Copper (Cu)	655.00	MG/KG	NA		0.2245	12.96
054	B031	Lead (Pb)	1440.00	MG/KG	NA		NA	
054	B031	Manganese (Mn)	273.00	MG/KG	NA		0.0796	4.60
054	B031	Mercury (Hg)	0.04	MG/KG	NA		0.0018	0.11
054	B031	Nickel (Ni)	81.20	MG/KG	NA		0.0557	3.21
054	B031	Thallium (Tl)	1.00	MG/KG	NA		0.1714	9.90
054	B031	Vanadium (V)	11.20	MG/KG	NA		0.0219	1.27
054	B031	Zinc (Zn)	3500.00	MG/KG	NA		0.1600	9.24
		Total			67.1061		1.7320	
054	B032	Antimony (Sb)	1.40	MG/KG	NA		0.0480	21.97
054	B032	Arsenic (As)	1.60	MG/KG	4.1792	67.40	0.0731	33.48
054	B032	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B032	Beryllium (Be)	0.27	MG/KG	2.0217	32.60	0.0007	0.34
054	B032	Cadmium (Cd)	0.65	MG/KG	NA		0.0089	4.08
054	B032	Copper (Cu)	110.00	MG/KG	NA		0.0377	17.26
054	B032	Lead (Pb)	291.00	MG/KG	NA		NA	
054	B032	Manganese (Mn)	51.70	MG/KG	NA		0.0151	6.90
054	B032	Mercury (Hg)	0.03	MG/KG	NA		0.0014	0.63
054	B032	Nickel (Ni)	10.50	MG/KG	NA		0.0072	3.30
054	B032	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B032	Vanadium (V)	3.80	MG/KG	NA		0.0074	3.41
054	B032	Zinc (Zn)	413.00	MG/KG	NA		0.0189	8.64
		Total			6.2009		0.2185	
054	B033	Antimony (Sb)	4.20	MG/KG	NA		0.1440	18.68
054	B033	Arsenic (As)	5.50	MG/KG	14.3660	66.56	0.2514	32.61
054	B033	B(a)P Equiv.	272.99	UG/KG	4.5208	20.95	NA	
054	B033	Beryllium (Be)	0.36	MG/KG	2.6956	12.49	0.0010	0.13
054	B033	Cadmium (Cd)	1.50	MG/KG	NA		0.0205	2.67
054	B033	Copper (Cu)	416.00	MG/KG	NA		0.1426	18.50
054	B033	Lead (Pb)	338.00	MG/KG	NA		NA	
054	B033	Manganese (Mn)	185.00	MG/KG	NA		0.0540	7.00
054	B033	Mercury (Hg)	2.10	MG/KG	NA		0.0960	12.45
054	B033	Nickel (Ni)	27.70	MG/KG	NA		0.0190	2.46
054	B033	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B033	Vanadium (V)	10.30	MG/KG	NA		0.0202	2.62
054	B033	Zinc (Zn)	488.00	MG/KG	NA		0.0223	2.89
		Total			21.5824		0.7709	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B034	Antimony (Sb)	ND	MG/KG	NA		NA	
054	B034	Arsenic (As)	3.10	MG/KG	8.0972	89.27	0.1417	85.74
054	B034	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B034	Beryllium (Be)	0.13	MG/KG	0.9734	10.73	0.0004	0.22
054	B034	Cadmium (Cd)	ND	MG/KG	NA		NA	
054	B034	Copper (Cu)	4.80	MG/KG	NA		0.0016	1.00
054	B034	Lead (Pb)	17.70	MG/KG	NA		NA	
054	B034	Manganese (Mn)	15.20	MG/KG	NA		0.0044	2.68
054	B034	Mercury (Hg)	0.03	MG/KG	NA		0.0014	0.83
054	B034	Nickel (Ni)	6.60	MG/KG	NA		0.0045	2.74
054	B034	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B034	Vanadium (V)	5.40	MG/KG	NA		0.0106	6.40
054	B034	Zinc (Zn)	14.30	MG/KG	NA		0.0007	0.40
		Total			9.0706		0.1653	
054	B035	Antimony (Sb)	1.60	MG/KG	NA		0.0548	17.36
054	B035	Arsenic (As)	3.60	MG/KG	9.4032	53.84	0.1645	52.08
054	B035	B(a)P Equiv.	206.56	UG/KG	3.4207	19.58	NA	
054	B035	Beryllium (Be)	0.62	MG/KG	4.6424	26.58	0.0017	0.54
054	B035	Cadmium (Cd)	0.38	MG/KG	NA		0.0052	1.65
054	B035	Copper (Cu)	40.50	MG/KG	NA		0.0139	4.39
054	B035	Lead (Pb)	63.80	MG/KG	NA		NA	
054	B035	Manganese (Mn)	87.60	MG/KG	NA		0.0256	8.09
054	B035	Mercury (Hg)	0.20	MG/KG	NA		0.0091	2.89
054	B035	Nickel (Ni)	9.20	MG/KG	NA		0.0063	2.00
054	B035	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B035	Vanadium (V)	9.50	MG/KG	NA		0.0186	5.89
054	B035	Zinc (Zn)	353.00	MG/KG	NA		0.0161	5.11
		Total			17.4663		0.3159	
054	B036	Antimony (Sb)	0.99	MG/KG	NA		0.0339	28.56
054	B036	Arsenic (As)	1.10	MG/KG	2.8732	65.74	0.0503	42.31
054	B036	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B036	Beryllium (Be)	0.20	MG/KG	1.4975	34.26	0.0005	0.46
054	B036	Cadmium (Cd)	ND	MG/KG	NA		NA	
054	B036	Copper (Cu)	7.70	MG/KG	NA		0.0026	2.22
054	B036	Lead (Pb)	34.00	MG/KG	NA		NA	
054	B036	Manganese (Mn)	41.80	MG/KG	NA		0.0122	10.26
054	B036	Mercury (Hg)	0.15	MG/KG	NA		0.0069	5.77
054	B036	Nickel (Ni)	2.90	MG/KG	NA		0.0020	1.67
054	B036	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B036	Vanadium (V)	4.20	MG/KG	NA		0.0082	6.92
054	B036	Zinc (Zn)	47.60	MG/KG	NA		0.0022	1.83
		Total			4.3707		0.1188	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B037	Antimony (Sb)	18.80	MG/KG	NA		0.6445	43.68
054	B037	Arsenic (As)	7.10	MG/KG	18.5452	47.73	0.3245	21.99
054	B037	B(a)P Equiv.	412.67	UG/KG	6.8339	17.59	NA	
054	B037	Beryllium (Be)	1.80	MG/KG	13.4779	34.69	0.0049	0.33
054	B037	Cadmium (Cd)	3.10	MG/KG	NA		0.0425	2.88
054	B037	Copper (Cu)	506.00	MG/KG	NA		0.1735	11.76
054	B037	Lead (Pb)	957.00	MG/KG	NA		NA	
054	B037	Manganese (Mn)	212.00	MG/KG	NA		0.0618	4.19
054	B037	Mercury (Hg)	1.20	MG/KG	NA		0.0548	3.72
054	B037	Nickel (Ni)	85.30	MG/KG	NA		0.0585	3.96
054	B037	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B037	Vanadium (V)	9.00	MG/KG	NA		0.0176	1.19
054	B037	Zinc (Zn)	2030.00	MG/KG	NA		0.0928	6.29
		Total			38.8571		1.4755	
054	B038	Antimony (Sb)	10.90	MG/KG	NA		0.3737	16.48
054	B038	Arsenic (As)	16.20	MG/KG	42.3144	85.09	0.7405	32.65
054	B038	B(a)P Equiv.	447.61	UG/KG	7.4126	14.91	NA	
054	B038	Beryllium (Be)	ND	MG/KG	NA		NA	
054	B038	Cadmium (Cd)	4.10	MG/KG	NA		0.0562	2.48
054	B038	Copper (Cu)	1320.00	MG/KG	NA		0.4525	19.95
054	B038	Lead (Pb)	2570.00	MG/KG	NA		NA	
054	B038	Manganese (Mn)	317.00	MG/KG	NA		0.0925	4.08
054	B038	Mercury (Hg)	2.40	MG/KG	NA		0.1097	4.84
054	B038	Nickel (Ni)	40.50	MG/KG	NA		0.0278	1.22
054	B038	Thallium (Tl)	1.70	MG/KG	NA		0.2914	12.85
054	B038	Vanadium (V)	18.90	MG/KG	NA		0.0370	1.63
054	B038	Zinc (Zn)	1900.00	MG/KG	NA		0.0868	3.83
		Total			49.7270		2.2680	
054	B039	Antimony (Sb)	29.90	MG/KG	NA		1.0250	62.78
054	B039	Arsenic (As)	8.20	MG/KG	21.4184	92.23	0.3748	22.96
054	B039	B(a)P Equiv.	109.00	UG/KG	1.8051	7.77	NA	
054	B039	Beryllium (Be)	ND	MG/KG	NA		NA	
054	B039	Cadmium (Cd)	1.50	MG/KG	NA		0.0205	1.26
054	B039	Copper (Cu)	243.00	MG/KG	NA		0.0833	5.10
054	B039	Lead (Pb)	9520.00	MG/KG	NA		NA	
054	B039	Manganese (Mn)	127.00	MG/KG	NA		0.0370	2.27
054	B039	Mercury (Hg)	0.61	MG/KG	NA		0.0279	1.71
054	B039	Nickel (Ni)	23.40	MG/KG	NA		0.0160	0.98
054	B039	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B039	Vanadium (V)	10.10	MG/KG	NA		0.0198	1.21
054	B039	Zinc (Zn)	618.00	MG/KG	NA		0.0282	1.73
		Total			23.2235		1.6327	

Table 10.2.8.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B040	Antimony (Sb)	1.60	MG/KG	NA		0.0548	10.80
054	B040	Arsenic (As)	6.00	MG/KG	15.6720	77.66	0.2742	54.02
054	B040	B(a)P Equiv.	136.59	UG/KG	2.2620	11.21	NA	
054	B040	Beryllium (Be)	0.30	MG/KG	2.2463	11.13	0.0008	0.16
054	B040	Cadmium (Cd)	0.91	MG/KG	NA		0.0125	2.46
054	B040	Copper (Cu)	184.00	MG/KG	NA		0.0631	12.43
054	B040	Lead (Pb)	272.00	MG/KG	NA		NA	
054	B040	Manganese (Mn)	72.30	MG/KG	NA		0.0211	4.15
054	B040	Mercury (Hg)	0.61	MG/KG	NA		0.0279	5.49
054	B040	Nickel (Ni)	19.30	MG/KG	NA		0.0132	2.61
054	B040	Thallium (Tl)	ND	MG/KG	NA		NA	
054	B040	Vanadium (V)	8.20	MG/KG	NA		0.0161	3.16
054	B040	Zinc (Zn)	523.00	MG/KG	NA		0.0239	4.71
		Total			20.1803		0.5076	

Table 10.2.8.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
021	B001	Arsenic	1.60	MG/KG	0.5912	54.30	0.0037	100.00
021	B001	B(a)P Equiv.	147.78	UG/KG	0.4976	45.70	NA	
021	B001	Beryllium	ND	MG/KG	NA		NA	
021	B001	Lead	150.00	MG/KG	NA		NA	
		Total			1.0888		0.0037	
021	B002	Arsenic	3.20	MG/KG	1.1824	24.57	0.0074	95.01
021	B002	B(a)P Equiv.	197.44	UG/KG	0.6648	13.81	NA	
021	B002	Beryllium	2.80	MG/KG	2.9659	61.62	0.0004	4.99
021	B002	Lead	800.00	MG/KG	NA		NA	
		Total			4.8131		0.0077	
021	B003	Arsenic	26.00	MG/KG	9.6072	90.27	0.0598	100.00
021	B003	B(a)P Equiv.	307.49	UG/KG	1.0354	9.73	NA	
021	B003	Beryllium	ND	MG/KG	NA		NA	
021	B003	Lead	2900.00	MG/KG	NA		NA	
		Total			10.6425		0.0598	
021	B004	Arsenic	ND	MG/KG	NA		NA	
021	B004	B(a)P Equiv.	10.84	UG/KG	0.0365	100.00	NA	
021	B004	Beryllium	ND	MG/KG	NA		NA	
021	B004	Lead	151.00	MG/KG	NA		NA	
		Total			0.0365		NA	
021	B005	Arsenic	2.70	MG/KG	0.9977	45.09	0.0062	98.84
021	B005	B(a)P Equiv.	194.15	UG/KG	0.6537	29.54	NA	
021	B005	Beryllium	0.53	MG/KG	0.5614	25.37	0.0001	1.16
021	B005	Lead	467.00	MG/KG	NA		NA	
		Total			2.2128		0.0063	
021	B006	Arsenic	5.30	MG/KG	1.9584	49.49	0.0122	98.66
021	B006	B(a)P Equiv.	216.20	UG/KG	0.7280	18.39	NA	
021	B006	Beryllium	1.20	MG/KG	1.2711	32.12	0.0002	1.34
021	B006	Lead	422.00	MG/KG	NA		NA	
		Total			3.9575		0.0124	
021	B007	Arsenic	2.30	MG/KG	0.8499	58.89	0.0053	98.56
021	B007	B(a)P Equiv.	ND	UG/KG	NA		NA	
021	B007	Beryllium	0.56	MG/KG	0.5932	41.11	0.0001	1.44
021	B007	Lead	411.00	MG/KG	NA		NA	
		Total			1.4430		0.0054	

Table 10.2.8.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
021	B008	Arsenic	2.40	MG/KG	0.8868	99.98	0.0055	100.00
021	B008	B(a)P Equiv.	0.05	UG/KG	0.0002	0.02	NA	
021	B008	Beryllium	ND	MG/KG	NA		NA	
021	B008	Lead	27.00	MG/KG	NA		NA	
		Total			0.8870		0.0055	
021	B009	Arsenic	1.70	MG/KG	0.6282	59.47	0.0039	100.00
021	B009	B(a)P Equiv.	127.15	UG/KG	0.4281	40.53	NA	
021	B009	Beryllium	ND	MG/KG	NA		NA	
021	B009	Lead	43.00	MG/KG	NA		NA	
		Total			1.0563		0.0039	
054	B001	Arsenic (As)	5.60	MG/KG	2.0692	33.78	0.0129	98.11
054	B001	B(a)P Equiv.	638.57	UG/KG	2.1502	35.10	NA	
054	B001	Beryllium (Be)	1.80	MG/KG	1.9067	31.12	0.0002	1.89
054	B001	Lead (Pb)	689.00	MG/KG	NA		NA	
		Total			6.1260		0.0131	
054	B002	Arsenic (As)	3.30	MG/KG	1.2194	43.53	0.0076	98.30
054	B002	B(a)P Equiv.	170.92	UG/KG	0.5755	20.55	NA	
054	B002	Beryllium (Be)	0.95	MG/KG	1.0063	35.92	0.0001	1.70
054	B002	Lead (Pb)	220.00	MG/KG	NA		NA	
		Total			2.8012		0.0077	
054	B003	Arsenic (As)	4.50	MG/KG	1.6628	46.58	0.0103	97.66
054	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B003	Beryllium (Be)	1.80	MG/KG	1.9067	53.42	0.0002	2.34
054	B003	Lead (Pb)	937.00	MG/KG	NA		NA	
		Total			3.5694		0.0106	
054	B004	Arsenic (As)	11.90	MG/KG	4.3971	83.05	0.0274	99.61
054	B004	B(a)P Equiv.	21.11	UG/KG	0.0711	1.34	NA	
054	B004	Beryllium (Be)	0.78	MG/KG	0.8262	15.61	0.0001	0.39
054	B004	Lead (Pb)	362.00	MG/KG	NA		NA	
		Total			5.2944		0.0275	
054	B005	Arsenic (As)	9.30	MG/KG	3.4364	51.60	0.0214	98.98
054	B005	B(a)P Equiv.	453.82	UG/KG	1.5281	22.95	NA	
054	B005	Beryllium (Be)	1.60	MG/KG	1.6948	25.45	0.0002	1.02
054	B005	Lead (Pb)	1190.00	MG/KG	NA		NA	
		Total			6.6593		0.0216	
054	B006	Arsenic (As)	8.20	MG/KG	3.0300	80.79	0.0189	99.50
054	B006	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B006	Beryllium (Be)	0.68	MG/KG	0.7203	19.21	0.0001	0.50
054	B006	Lead (Pb)	613.00	MG/KG	NA		NA	
		Total			3.7502		0.0189	

Table 10.2.8.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B007	Arsenic (As)	9.40	MG/KG	3.4734	60.11	0.0216	98.99
054	B007	B(a)P Equiv.	181.18	UG/KG	0.6101	10.56	NA	
054	B007	Beryllium (Be)	1.60	MG/KG	1.6948	29.33	0.0002	1.01
054	B007	Lead (Pb)	434.00	MG/KG	NA		NA	
		Total			5.7782		0.0218	
054	B008	Arsenic (As)	9.20	MG/KG	3.3995	50.27	0.0212	98.78
054	B008	B(a)P Equiv.	400.91	UG/KG	1.3499	19.96	NA	
054	B008	Beryllium (Be)	1.90	MG/KG	2.0126	29.76	0.0003	1.22
054	B008	Lead (Pb)	493.00	MG/KG	NA		NA	
		Total			6.7620		0.0214	
054	B009	Arsenic (As)	2.20	MG/KG	0.8129	53.39	0.0051	98.21
054	B009	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B009	Beryllium (Be)	0.67	MG/KG	0.7097	46.61	0.0001	1.79
054	B009	Lead (Pb)	297.00	MG/KG	NA		NA	
		Total			1.5226		0.0052	
054	B010	Arsenic (As)	11.00	MG/KG	4.0646	86.09	0.0253	99.66
054	B010	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B010	Beryllium (Be)	0.62	MG/KG	0.6567	13.91	0.0001	0.34
054	B010	Lead (Pb)	1020.00	MG/KG	NA		NA	
		Total			4.7213		0.0254	
054	B011	Arsenic (As)	3.10	MG/KG	1.1455	27.37	0.0071	96.81
054	B011	B(a)P Equiv.	368.13	UG/KG	1.2395	29.61	NA	
054	B011	Beryllium (Be)	1.70	MG/KG	1.8007	43.02	0.0002	3.19
054	B011	Lead (Pb)	813.00	MG/KG	NA		NA	
		Total			4.1857		0.0074	
054	B012	Arsenic (As)	6.90	MG/KG	2.5496	38.16	0.0159	96.72
054	B012	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B012	Beryllium (Be)	3.90	MG/KG	4.1311	61.84	0.0005	3.28
054	B012	Lead (Pb)	998.00	MG/KG	NA		NA	
		Total			6.6807		0.0164	
054	B013	Arsenic (As)	2.30	MG/KG	0.8499	52.36	0.0053	98.13
054	B013	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B013	Beryllium (Be)	0.73	MG/KG	0.7733	47.64	0.0001	1.87
054	B013	Lead (Pb)	411.00	MG/KG	NA		NA	
		Total			1.6231		0.0054	
054	B014	Arsenic (As)	5.10	MG/KG	1.8845	42.57	0.0117	97.25
054	B014	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B014	Beryllium (Be)	2.40	MG/KG	2.5422	57.43	0.0003	2.75
054	B014	Lead (Pb)	841.00	MG/KG	NA		NA	
		Total			4.4267		0.0121	

Table 10.2.8.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B015	Arsenic (As)	3.50	MG/KG	1.2933	47.38	0.0080	97.82
054	B015	B(a)P Equiv.	17.62	UG/KG	0.0593	2.17	NA	
054	B015	Beryllium (Be)	1.30	MG/KG	1.3770	50.45	0.0002	2.18
054	B015	Lead (Pb)	595.00	MG/KG	NA		NA	
		Total			2.7296		0.0082	
054	B016	Arsenic (As)	3.50	MG/KG	1.2933	34.48	0.0080	97.01
054	B016	B(a)P Equiv.	163.48	UG/KG	0.5505	14.68	NA	
054	B016	Beryllium (Be)	1.80	MG/KG	1.9067	50.84	0.0002	2.99
054	B016	Lead (Pb)	720.00	MG/KG	NA		NA	
		Total			3.7504		0.0083	
054	B017	Arsenic (As)	10.40	MG/KG	3.8429	20.27	0.0239	99.51
054	B017	B(a)P Equiv.	4218.00	UG/KG	14.2026	74.92	NA	
054	B017	Beryllium (Be)	0.86	MG/KG	0.9110	4.81	0.0001	0.49
054	B017	Lead (Pb)	248.00	MG/KG	NA		NA	
		Total			18.9564		0.0240	
054	B018	Arsenic (As)	3.00	MG/KG	1.1085	42.51	0.0069	98.93
054	B018	B(a)P Equiv.	275.33	UG/KG	0.9271	35.55	NA	
054	B018	Beryllium (Be)	0.54	MG/KG	0.5720	21.94	0.0001	1.07
054	B018	Lead (Pb)	108.00	MG/KG	NA		NA	
		Total			2.6076		0.0070	
054	B019	Arsenic (As)	5.40	MG/KG	1.9953	82.37	0.0124	99.65
054	B019	B(a)P Equiv.	26.21	UG/KG	0.0883	3.64	NA	
054	B019	Beryllium (Be)	0.32	MG/KG	0.3390	13.99	0.0000	0.35
054	B019	Lead (Pb)	214.00	MG/KG	NA		NA	
		Total			2.4226		0.0125	
054	B020	Arsenic (As)	4.60	MG/KG	1.6997	50.07	0.0106	97.96
054	B020	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B020	Beryllium (Be)	1.60	MG/KG	1.6948	49.93	0.0002	2.04
054	B020	Lead (Pb)	450.00	MG/KG	NA		NA	
		Total			3.3945		0.0108	
054	B021	Arsenic (As)	0.90	MG/KG	0.3326	100.00	0.0021	100.00
054	B021	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B021	Beryllium (Be)	ND	MG/KG	NA		NA	
054	B021	Lead (Pb)	36.60	MG/KG	NA		NA	
		Total			0.3326		0.0021	
054	B022	Arsenic (As)	2.70	MG/KG	0.9977	43.86	0.0062	99.40
054	B022	B(a)P Equiv.	294.24	UG/KG	0.9907	43.56	NA	
054	B022	Beryllium (Be)	0.27	MG/KG	0.2860	12.57	0.0000	0.60
054	B022	Lead (Pb)	87.60	MG/KG	NA		NA	
		Total			2.2744		0.0062	

Table 10.2.8.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B023	Arsenic (As)	3.80	MG/KG	1.4041	87.46	0.0087	99.70
054	B023	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B023	Beryllium (Be)	0.19	MG/KG	0.2013	12.54	0.0000	0.30
054	B023	Lead (Pb)	48.60	MG/KG	NA		NA	
		Total			1.6054		0.0088	
054	B024	Arsenic (As)	3.40	MG/KG	1.2563	58.21	0.0078	98.59
054	B024	B(a)P Equiv.	13.00	UG/KG	0.0438	2.03	NA	
054	B024	Beryllium (Be)	0.81	MG/KG	0.8580	39.76	0.0001	1.41
054	B024	Lead (Pb)	124.00	MG/KG	NA		NA	
		Total			2.1581		0.0079	
054	B025	Arsenic (As)	4.80	MG/KG	1.7736	85.67	0.0110	99.65
054	B025	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B025	Beryllium (Be)	0.28	MG/KG	0.2966	14.33	0.0000	0.35
054	B025	Lead (Pb)	147.00	MG/KG	NA		NA	
		Total			2.0702		0.0111	
054	B026	Arsenic (As)	8.50	MG/KG	3.1408	91.94	0.0195	99.82
054	B026	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B026	Beryllium (Be)	0.26	MG/KG	0.2754	8.06	0.0000	0.18
054	B026	Lead (Pb)	545.00	MG/KG	NA		NA	
		Total			3.4162		0.0196	
054	B027	Arsenic (As)	1.80	MG/KG	0.6651	100.00	0.0041	100.00
054	B027	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B027	Beryllium (Be)	ND	MG/KG	NA		NA	
054	B027	Lead (Pb)	9.00	MG/KG	NA		NA	
		Total			0.6651		0.0041	
054	B028	Arsenic (As)	2.60	MG/KG	0.9607	61.41	0.0060	98.70
054	B028	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B028	Beryllium (Be)	0.57	MG/KG	0.6038	38.59	0.0001	1.30
054	B028	Lead (Pb)	144.00	MG/KG	NA		NA	
		Total			1.5645		0.0061	
054	B029	Arsenic (As)	5.70	MG/KG	2.1062	57.93	0.0131	99.15
054	B029	B(a)P Equiv.	199.42	UG/KG	0.6715	18.47	NA	
054	B029	Beryllium (Be)	0.81	MG/KG	0.8580	23.60	0.0001	0.85
054	B029	Lead (Pb)	9270.00	MG/KG	NA		NA	
		Total			3.6357		0.0132	
054	B030	Arsenic (As)	6.30	MG/KG	2.3279	70.77	0.0145	99.60
054	B030	B(a)P Equiv.	153.48	UG/KG	0.5168	15.71	NA	
054	B030	Beryllium (Be)	0.42	MG/KG	0.4449	13.52	0.0001	0.40
054	B030	Lead (Pb)	673.00	MG/KG	NA		NA	
		Total			3.2896		0.0145	

Table 10.2.8.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B031	Arsenic (As)	7.40	MG/KG	2.7344	25.81	0.0170	96.86
054	B031	B(a)P Equiv.	1076.45	UG/KG	3.6246	34.21	NA	
054	B031	Beryllium (Be)	4.00	MG/KG	4.2370	39.99	0.0006	3.14
054	B031	Lead (Pb)	1440.00	MG/KG	NA		NA	
		Total			10.5959		0.0176	
054	B032	Arsenic (As)	1.60	MG/KG	0.5912	67.40	0.0037	99.00
054	B032	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B032	Beryllium (Be)	0.27	MG/KG	0.2860	32.60	0.0000	1.00
054	B032	Lead (Pb)	291.00	MG/KG	NA		NA	
		Total			0.8772		0.0037	
054	B033	Arsenic (As)	5.50	MG/KG	2.0323	60.98	0.0126	99.61
054	B033	B(a)P Equiv.	272.99	UG/KG	0.9192	27.58	NA	
054	B033	Beryllium (Be)	0.36	MG/KG	0.3813	11.44	0.0000	0.39
054	B033	Lead (Pb)	338.00	MG/KG	NA		NA	
		Total			3.3328		0.0127	
054	B034	Arsenic (As)	3.10	MG/KG	1.1455	89.27	0.0071	99.75
054	B034	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B034	Beryllium (Be)	0.13	MG/KG	0.1377	10.73	0.0000	0.25
054	B034	Lead (Pb)	17.70	MG/KG	NA		NA	
		Total			1.2832		0.0071	
054	B035	Arsenic (As)	3.60	MG/KG	1.3302	49.59	0.0083	98.98
054	B035	B(a)P Equiv.	206.56	UG/KG	0.6955	25.93	NA	
054	B035	Beryllium (Be)	0.62	MG/KG	0.6567	24.48	0.0001	1.02
054	B035	Lead (Pb)	63.80	MG/KG	NA		NA	
		Total			2.6825		0.0084	
054	B036	Arsenic (As)	1.10	MG/KG	0.4065	65.74	0.0025	98.92
054	B036	B(a)P Equiv.	ND	UG/KG	NA		NA	
054	B036	Beryllium (Be)	0.20	MG/KG	0.2119	34.26	0.0000	1.08
054	B036	Lead (Pb)	34.00	MG/KG	NA		NA	
		Total			0.6183		0.0026	
054	B037	Arsenic (As)	7.10	MG/KG	2.6235	44.32	0.0163	98.50
054	B037	B(a)P Equiv.	412.67	UG/KG	1.3895	23.47	NA	
054	B037	Beryllium (Be)	1.80	MG/KG	1.9067	32.21	0.0002	1.50
054	B037	Lead (Pb)	957.00	MG/KG	NA		NA	
		Total			5.9197		0.0166	
054	B038	Arsenic (As)	16.20	MG/KG	5.9860	79.89	0.0372	100.00
054	B038	B(a)P Equiv	447.61	UG/KG	1.5072	20.11	NA	
054	B038	Beryllium (Be)	ND	MG/KG	NA		NA	
054	B038	Lead (Pb)	2570.00	MG/KG	NA		NA	
		Total			7.4932		0.0372	

Table 10.2.8.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
054	B039	Arsenic (As)	8.20	MG/KG	3.0300	89.20	0.0189	100.00
054	B039	B(a)P Equiv.	109.00	UG/KG	0.3670	10.80	NA	
054	B039	Beryllium (Be)	ND	MG/KG	NA		NA	
054	B039	Lead (Pb)	9520.00	MG/KG	NA		NA	
		Total			3.3970		0.0189	
054	B040	Arsenic (As)	6.00	MG/KG	2.2170	74.03	0.0138	99.70
054	B040	B(a)P Equiv.	136.59	UG/KG	0.4599	15.36	NA	
054	B040	Beryllium (Be)	0.30	MG/KG	0.3178	10.61	0.000041	0.30
054	B040	Lead (Pb)	272.00	MG/KG	NA		NA	
		Total			2.9947		0.0138	

Table 10.2.8.4
Summary of Chemical Present in Site Samples - First Quarter Groundwater
SWMU 21 and SWMU 54
NAVBASE - Charleston, Zone E
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Conc.	Range of SQL	Screening Concentration RBC	Screening Concentration Reference	Units	Number Exceeding RBC	Number Exceeding Ref.
Inorganics											
Antimony (Sb)	*	2	6	10.2 - 22	16.1	4 - 4	1.5	NA	ug/L	2	
Arsenic (As)	*	2	6	6 - 19.5	12.8	5 - 5	0.045	18.7	ug/L	2	1
Calcium (Ca)	N	6	6	47500 - 378000	138866.7	NA - NA	NA	NA	ug/L		
Chromium (Cr)		3	6	1.2 - 1.6	1.4	1 - 1	18	12.3	ug/L		
Iron (Fe)	N	5	6	3690 - 28000	14912.0	65.3 - 65.3	NA	NA	ug/L		
Lead (Pb)	*	3	6	5.5 - 22.3	11.9	3 - 3	15	4.8	ug/L	1	3
Magnesium (Mg)	N	6	6	18800 - 127000	52083.3	NA - NA	NA	NA	ug/L		
Manganese (Mn)		6	6	110 - 713	481.0	NA - NA	84	2560	ug/L	6	
Nickel (Ni)		3	6	1.4 - 2.8	2.2	1 - 1	73	15.2	ug/L		
Potassium (K)	N	6	6	11600 - 68100	32833.3	NA - NA	NA	NA	ug/L		
Sodium (Na)	N	4	6	251000 - 763000	508250.0	80600 - 139000	NA	NA	ug/L		
Thallium (Tl)	*	1	6	5 - 5	5.0	5 - 5	0.29	2	ug/L	1	1
Vanadium (V)		1	6	2.2 - 2.2	2.2	1 - 3	26	11.4	ug/L		
Zinc (Zn)		1	6	42.8 - 42.8	42.8	4 - 32.5	1100	27.3	ug/L		
Volatile Organics											
2-Butanone		1	6	11 - 11	11.0	10 - 10	190	NA	ug/L		
Carbon disulfide		1	6	2 - 2	2.0	5 - 5	100	NA	ug/L		

Notes:
* - Identified as a COPC through the screening process presented in Section 7.2.2
N - Essential Nutrient
SQL - Sample quantitation limit
NA - Not applicable
RBC - Residential RBC
Reference - Background reference concentration
ug/L - Micrograms per liter

Table 10.2.8.5
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMUs 21 and 54
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
021	G001	Antimony (Sb)	ND	UG/L	NA		NA	
021	G001	Arsenic (As)	ND	UG/L	NA		NA	
021	G001	Lead (Pb)	ND	UG/L	NA		NA	
021	G001	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			NA		NA	
021	G002	Antimony (Sb)	10.20	UG/L	NA		1.6301	28.18
021	G002	Arsenic (As)	19.50	UG/L	435.0294	100.00	4.1553	71.82
021	G002	Lead (Pb)	7.90	UG/L	NA		NA	
021	G002	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			435.0294		5.7854	
021	G003	Antimony (Sb)	ND	UG/L	NA		NA	
021	G003	Arsenic (As)	ND	UG/L	NA		NA	
021	G003	Lead (Pb)	ND	UG/L	NA		NA	
021	G003	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			NA		NA	
054	G001	Antimony (Sb)	ND	UG/L	NA		NA	
054	G001	Arsenic (As)	ND	UG/L	NA		NA	
054	G001	Lead (Pb)	ND	UG/L	NA		NA	
054	G001	Thallium (Tl)	5.00	UG/L	NA		3.8462	100.00
		Total			NA		3.8462	
054	G002	Antimony (Sb)	22.00	UG/L	NA		3.5160	100.00
054	G002	Arsenic (As)	ND	UG/L	NA		NA	
054	G002	Lead (Pb)	22.30	UG/L	NA		NA	
054	G002	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			NA		3.5160	
054	G003	Antimony (Sb)	ND	UG/L	NA		NA	
054	G003	Arsenic (As)	6.00	UG/L	133.8552	100.00	1.2785	100.00
054	G003	Lead (Pb)	5.50	UG/L	NA		NA	
054	G003	Thallium (Tl)	ND	UG/L	NA		NA	
		Total			133.8552		1.2785	

10.2.9 Corrective Measures Considerations

For SWMUs 21 and 54, the upper and lower soil intervals, shallow groundwater, and sediment were investigated. Based on the analytical results and the FRE, COCs requiring further evaluation through the CMS process were identified for the upper soil interval and the shallow groundwater. However, residential use of the site is not expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use as a marine cargo terminal and drydock. The ground surface around SWMUs 21 and 54 has been disturbed.

The Navy conducted an interim action on the surface soil using the results presented in this section. The excavation was limited to areas of visible blast material. Confirmation samples were not collected. As a result, chronic exposure to current soil conditions is highly unlikely. A FRE was substituted for a full risk assessment.

Using residential scenario, 14 COPCs were identified for combined SWMU 21 soil: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, thallium, vanadium, zinc, and BEQs. Arsenic, beryllium, and BEQs were the only contributors to residential risk, exceeding 1E-06 at 48 of 49 locations. The combined ingestion and dermal residential exposure risk ranged between 2E-7 to 1E-04 with an arithmetic mean risk of 2E-05. The HI ranged between 0.04 to 3 with an arithmetic mean HI of 0.9. These values are between USEPA's acceptable range of 1E-06 and 1E-04 and HI of 3 to 0.1.

Arsenic and beryllium maximum detected concentrations marginally exceed their background RCs. Antimony, arsenic, copper, mercury, thallium, and zinc were the primary contributors to HI projections.

Lead was present at 26 of the 49 locations above USEPA's residential acceptable level of 400 mg/kg. The mean detected lead concentration was 890 mg/kg. An interim action removed the first 3 to 5 feet of soil; therefore, additional soil samples should be collected to confirm that contaminated surface soil has been removed. The site should be backfilled with clean fill.

Antimony, arsenic, lead, and thallium are identified as COPCs in shallow groundwater. Shallow groundwater residential risk is associated with antimony in monitoring wells NBCE21002 and NBCE054W002 and arsenic in monitoring wells NBCE21002 and NBCE054W003. Residential risk ranged from 4E-06 to 1E-05 with the arithmetic mean of 9E-05. Antimony, arsenic, and thallium were the primary contributors to HI projections at monitoring wells NBCE021002, NBCE054001, NBCE054002, and NBCE054003. The HI ranged from 6 to 1 with an arithmetic mean HI of 2.

Based on data collected, surface soil has been impacted from the previous painting and blasting operations. This surface soil was removed. Samples should be collected and laboratory-analyzed for inorganic constituents and BEQs to define any remaining contamination requiring corrective measures. A groundwater plume is not indicated but may exist. Groundwater monitoring wells that have been compromised should be replaced. Based on the above facts, corrective measures from may be appropriate. Potential corrective measures for the impacted media and respective COPCs are in Table 10.2.9.1.

Table 10.2.9.1
Potential Corrective Measures for SWMUs 21 and 54

Medium	Compounds	Potential Corrective Measures
Soil	Antimony, arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, thallium, vanadium, zinc, and BEQs	a) No Action b) Removal - Excavation & Offsite Disposal c) Containment - Cap
Shallow Groundwater	Antimony, arsenic, lead, and thallium	a) No Action b) Intrinsic Remediation and Monitoring c) Ex-Situ, Chemical, and Physical Treatment

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10.3 SWMU 22, Old Plating Shop Wastewater Treatment System (WWTS); SWMU 25, Building 44, Old Plating Operation; and AOC 554, Paint Shop, Former Building 1003

SWMUs 22 and 25 and AOC 554 are northwest of the intersection of McMillan and Hobson Avenues in Zone E. SWMU 22, the Old Plating Shop Wastewater Treatment System, was originally constructed in 1972 and consisted primarily of a 5-foot by 5-foot by 8-foot concrete collection sump partitioned in half. One side accumulated acidic wastewater while the other side collected cyanide and alkaline wastewater. Treated effluent was discharged to the sanitary sewer. Other components included an elevated 1,000-gallon clarifier, four mixing tanks (two 70-gallon and two 250-gallon), chemical feed equipment, and associated piping. This unit became inactive around 1983 when the new metal plating waste treatment facility began operation.

SWMU 25, an electroplating operation in the southwestern portion of Building 44, was operational until 1983. The facility stored approximately 40 metal tanks containing solutions used in the plating process. The concrete floor shows signs of deterioration. The process tanks were removed in 1992.

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

10.3.1 Previous Investigations

SWMUs 22 and 25 have been the subject of previous assessments in conjunction with RCRA closure activities and preliminary RFI field work conducted in the fall of 1993. The media sampled included soil, groundwater, waste material, and equipment.

The initial assessment performed at SWMU 22 in 1988 consisted of sampling soil immediately below the concrete surface at 16 locations. The samples were analyzed for pH, cadmium, and chromium. In comparison to the USEPA Region III RBCs, none of the samples exceeded the RBCs of 39 and 390 ppm, respectively, for cadmium or chromium (the RBC for hexavalent chromium was used for the most conservative comparison). The pH values ranged from 8.3 to 12.7. Sample results and a sample location diagram from the closure report may be found in Appendix C and Appendix D of the *Final Zone E RFI Work Plan*.

A second study in 1991 addressed only the sampling of waste material and equipment in Building 44. The sampling was completed as part of a study to address demolishing and removing the plating operation. Analysis of samples collected primarily from material left in the process tanks identified the following metals: silver (<1.0 to 145 ppm), cadmium (2.02 to 84,340 ppm), chromium (18 to 11,940 ppm), nickel (0.63 to 2.7 ppm), mercury (6.7 to 446,000 ppm), lead (<0.08 to 6,920 ppm), and cyanide (83 to 129,100 ppm).

Finally, in the fall of 1993, field work conducted as a preliminary phase of the RFI was conducted near SWMUs 22 and 25. The scope of the preliminary work consisted of installing three monitoring wells. Soil samples were collected from each of these borings as they were drilled. Samples were analyzed for VOCs, SVOCs, and TAL inorganics using SW-846 methodologies at DQO Level III with duplicates collected at a frequency of 10% and analyzed at DQO Level IV. The sampling adhered to methods outlined in the USEPA Region IV ESDSOP/QAM. At the locations sampled no inorganics were detected at concentrations exceeding their respective RBCs. Both trichloroethene (TCE) and perchloroethylene (PCE) were detected in monitoring well CNSY-25-03 at concentrations exceeding their respective RBCs. The analytical data are summarized in Appendix C of the *Final Zone E RFI Work Plan*.

Table 10.3.1.1 summarizes these investigations and the compound groups for which constituents were detected. Well construction logs for the three monitoring wells installed are included in Appendix D of the *Final Zone E RFI Work Plan*.

Table 10.3.1.1
SWMUs 22 and 25 and AOC 554
Previous Investigations

Number	Previous Investigations	Contaminants Identified
SWMU 22	EnSafe. Report of Field Activities, Closure of Interim Status HW Facilities, Naval Shipyard, Charleston, South Carolina 1988; Preliminary RFI Field Activities, 1993.[1]	VOCs, SVOCs, and inorganics
SWMU 25	Davis and Floyd, Inc. April 1991. Environmental Study of Building No. 44 Demolition of Electro-Plating Facility, Charleston Naval Shipyard, Charleston, South Carolina.	VOCs, SVOCs, and inorganics
AOC 554	None has been specifically conducted for AOC 554. The sampling described above also pertains to this site.	VOCs, SVOCs, and inorganics

Note:
1 = See Tables in Appendix C of the *Final Zone E RFI Work Plan* for analytical results.

Materials of concern at SWMU 22, identified in the *Final Zone E RFI Work Plan*, include chromic acid, cadmium, copper, chromium, lead, nickel, and silver. At SWMU 25, the materials of concern include silver, cadmium, nickel, mercury, lead, cyanide, and barium. The materials of concern at AOC 554 include heavy metals, waste paint, paint thinner, and solvents. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure.

To fulfill RFI objectives for SWMUs 22 and 25, and the CSI objectives for AOC 554, soil, sediment, groundwater, air, and structural surface wipe samples were collected in accordance with the *Final Zone E RFI Work Plan*, and Section 3 of this report to determine whether any contamination resulted from onsite activities.

An interim measures action was conducted at SWMU 25 during the spring of 1997. The Building 44 Annex was demolished and removed along with the foundation of the building. Confirmation soil samples were collected from the area underneath the foundation by the Environmental Detachment Charleston (Detachment). A summary of the interim measure actions conducted will be presented in the closure report being produced by the Detachment. A total of 28 confirmatory samples were collected from 14 locations (two intervals per location) and analyzed for inorganic parameters. The following is a summary of the preliminary SWMU 25 soil sample results as compared to available Zone E background RC values and residential RBCs. The analytical data for this interim measures is included in Appendix H.

Nine metals of concern were reported in confirmatory soil samples collected at SWMU 25. Two metals —barium and lead— exceeded both their residential RBC and background RC in the upper interval. Two upper-interval metals — chromium and cyanide — exceeded only their respective background RC. Barium also exceeded both its respective SSL and background RC in the lower interval. Two lower-interval metals — chromium and lead — exceeded only their respective background RC.

Barium was detected in all 14 upper-interval samples with a range of 16.7 to 1,160 mg/kg and a mean of 112.88 mg/kg. One upper-interval sample (025SB02001) exceeded both the residential RBC of 550 mg/kg and background RC of 130 mg/kg. Barium was also detected in all 14 lower-interval samples with a range of 6.04 mg/kg to 465 mg/kg and a mean of 51.91 mg/kg. One lower-interval sample (025SB020002) exceeded both the barium SSL of 32 mg/kg and background RC of 94.1 mg/kg.

Lead was detected in all 14 upper-interval samples with a range of 30.1 to 4,890 mg/kg, and a mean of 618.24 mg/kg. Four upper-interval samples (025SB01501, 025SB2001, 025SB02201, and 025SB02301) exceeded both the residential RBC of 400 mg/kg and background RC of 265 mg/kg. Lead was also detected in the 14 lower-interval samples with a range of 2.2 to

1,910 mg/kg and a mean of 173.66 mg/kg. Two lower-interval samples (025SB01402 and 025SB02002) exceeded the background RC of 173 mg/kg.

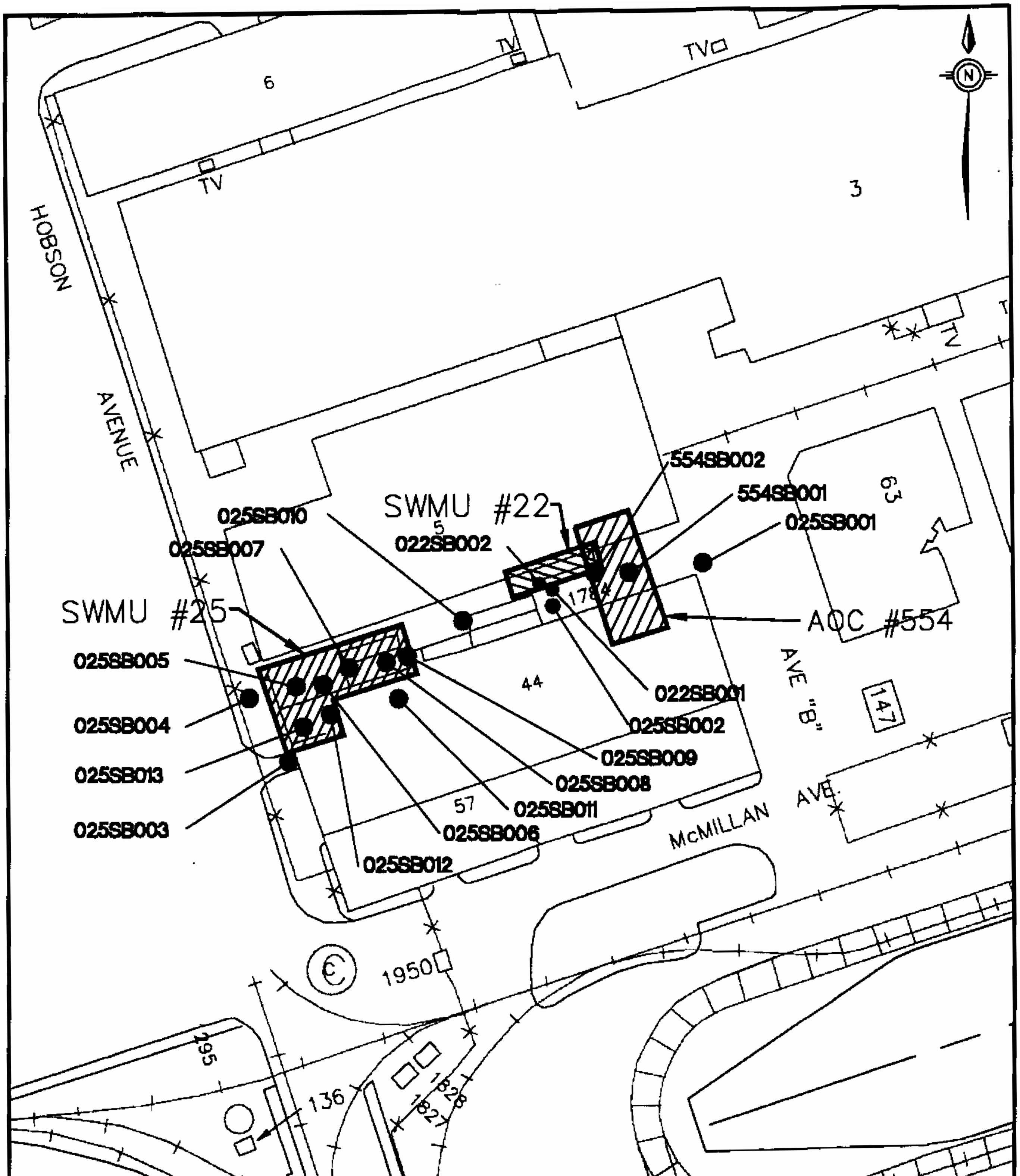
Chromium was detected in all 14 upper-interval samples with a range of 17.6 to 6,880 mg/kg, and a mean of 1,447.44 mg/kg. Nine upper-interval samples exceeded the background RC of 94.6 mg/kg but were below the residential RBC of 7,800 mg/kg. Chromium was also detected in the 14 lower-interval samples with a range of 6.52 to 18,600 mg/kg and a mean of 2,448.33 mg/kg. Ten lower-interval samples exceeded the background RC of 75.2 mg/kg.

Cyanide was detected in 10 upper-interval samples with a range of 0.104 to 10.5 mg/kg, and a mean of 2.54 mg/kg. Six upper-interval samples exceeded the background RC of 0.5 mg/kg but were below the residential RBC of 160 mg/kg. Cyanide was also detected in nine lower-interval samples with a range of 0.107 to 12.9 mg/kg and a mean of 1.83 mg/kg but a residential RBC or background RC has not been established for cyanide in subsurface soil.

10.3.2 Soil Sampling and Analysis

Soil was sampled in one round at SWMUs 22 and 25 and AOC 554 from the locations shown in Figure 10.3.1. The *Final Zone E RFI Work Plan* proposed collecting 13 soil samples from the upper interval and 13 samples from the lower interval. Soil samples were also collected at both intervals for the shallow monitoring well proposed at this site. All of the proposed upper-interval samples were collected. Thirteen of the proposed 14 lower-interval samples were collected.

At SWMU 25, one lower-interval sample was not collected due to an obstruction in the form of a pipe. All samples were submitted for analysis at DQO Level III for pH, organotins and the standard suite of parameters which includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide. Four samples (3 upper-interval and 1 lower-interval) selected as duplicates were analyzed at DQO Level IV for Appendix IX analytical parameters, which includes the suite of parameters proposed



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.3.1
SOIL BORING LOCATIONS
SWMU #22, OLD PLATING SHOP WWTS
SWMU #25, OLD PLATING OPERATION
AOC #554, PAINT SHOP

DWG DATE: 09/02/97 | DWG NAME: 10-3-1

for the site plus a more comprehensive list of VOCs, SVOCs, as well as herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. Table 10.3.2.1 summarizes soil sampling at SWMUs 22 and 25 and AOC 554.

Table 10.3.2.1
SWMUs 22 and 25 and AOC 554
Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	14	14	Standard Suite[a], pH, organotins	Standard Suite[a], pH, organotins	None
Lower	14	13	Standard Suite[a], pH, organotins	Standard Suite[a], pH, organotins	Subsurface obstruction prevented the collection of one sample

Note:
a = Standard Suite includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide

10.3.3 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.3.3.1. Inorganic analytical results for soil are summarized in Table 10.3.3.2. These tables also include the soil boring sample results from the three monitoring wells installed in 1993 during the RFI's preliminary phase. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.3.3.1
SWMUs 22 and 25 and AOC 554
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs (μg/kg)						
Acetone	Upper	2/17	12.0 - 88.0	50.0	20,000,000	0
	Lower	2/16	16.0 - 95.0	55.5	NA	NA

Table 10.3.3.1
SWMUs 22 and 25 and AOC 554
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs ($\mu g/kg$)						
Bromodichloromethane	Upper	1/17	3.00	3.00	720,000	0
2-Butanone (MEK)	Lower	1/16	3.00	3.00	NA	NA
Chloroform	Upper	1/17	9.00	9.00	940,000	0
Methylene chloride	Upper	7/17	2.00 - 43.0	15.7	760,000	0
	Lower	4/16	2.00 - 10.0	4.50	NA	NA
Tetrachloroethene	Upper	6/17	1.000 - 16.0	5.33	110,000	0
	Lower	5/16	1.000 - 45.0	10.6	NA	NA
Trichloroethene	Upper	10/17	2.00 - 140	33.6	520,000	0
	Lower	8/16	1.000 - 100	16.6	NA	NA
Xylene (Total)	Lower	2/16	1.000 - 2.00	1.50	NA	NA
SVOCs ($\mu g/kg$)						
Acenaphthene	Upper	1/17	82.0	82.0	12,000,000	0
Anthracene	Upper	4/17	42.0 - 82.0	60.3	61,000,000	0
Benzo(g,h,i)perylene	Upper	10/17	44.0 - 300	149	8,200,000	0
	Lower	3/16	56.0 - 200	119	NA	NA
bis(2-Ethylhexyl)phthalate	Upper	4/17	63.0 - 3,900	1140	410,000	0
	Lower	1/16	85.0	85.0	NA	NA
Carbazole	Upper	1/6	42.0	42.0	290,000	0
Dibenzofuran	Upper	2/17	50.0 - 56.0	53.0	820,000	0
Di-n-butylphthalate	Lower	1/16	55.0	55.0	NA	NA
1,2-Dichlorobenzene	Upper	1/17	46.0	46.0	18,000,000	0
Fluoranthene	Upper	14/17	33.0 - 610	241	8,200,000	0
	Lower	4/16	63.0 - 240	139	NA	NA

Table 10.3.3.1
SWMUs 22 and 25 and AOC 554
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (μg/kg)						
Fluorene	Upper	1/17	89.0	89.0	8,200,000	0
2-Methylnaphthalene	Upper	2/17	40.0 - 200	120	8,200,000	0
Naphthalene	Upper	1/17	160	160	8,200,000	0
Phenanthrene	Upper	11/17	38.0 - 470	134	8,200,000	0
	Lower	2/16	110 - 120	115	NA	NA
Pyrene	Upper	15/17	45.0 - 640	233	6,100,000	0
	Lower	4/16	57.0 - 230	127	NA	NA
SVOCs (B(a)P Equivalents) (μg/kg)						
B(a)P Equiv.	Upper	13/17	0.0420 - 656	225	780	0
	Lower	4/16	48.1 - 384	157	NA	NA
Benzo(a)anthracene	Upper	10/17	40.0 - 380	168	7,800	0
	Lower	4/16	39.0 - 200	92.0	NA	NA
Benzo(b)fluoranthene	Upper	12/17	40.0 - 560	190	7,800	0
	Lower	4/16	51.0 - 190	103	NA	NA
Benzo(k)fluoranthene	Upper	8/17	48.0 - 370	164	78,000	0
	Lower	2/16	93.0 - 220	157	NA	NA
Benzo(a)pyrene	Upper	10/17	51.0 - 380	187	780	0
	Lower	4/16	39.0 - 250	110	NA	NA
Chrysene	Upper	11/17	42.0 - 410	194	780,000	0
	Lower	4/16	50.0 - 200	112	NA	NA
Dibenz(a,h)anthracene	Upper	7/17	40.0 - 150	74.7	780	0
	Lower	1/16	78.0	78.0	NA	NA

Table 10.3.3.1
SWMUs 22 and 25 and AOC 554
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (B(a)P Equivalents) (μg/kg)						
Indeno(1,2,3-cd)pyrene	Upper	8/17	55.0 - 280	147	7,800	0
	Lower	3/16	47.0 - 150	91.7	NA	NA
Pesticides/PCBs (μg/kg)						
gamma-Chlordane	Upper	1/14	2.00	2.00	4,400	0
	Lower	1/13	3.00	3.00	NA	NA
4,4'-DDT	Upper	2/14	4.70 - 7.20	5.95	17,000	0
	Lower	1/13	7.70	7.70	NA	NA
Dieldrin	Lower	1/13	6.70	6.70	NA	NA
Endrin ketone	Upper	1/14	2.80	2.80	61,000	0
Dioxins (ng/kg)						
Dioxin Equiv.	Upper	3/3	0.00430 - 1.24	0.416	1,000	0
	Lower	1/1	0.248	0.248	NA	NA
1234678-HpCDD	Upper	1/3	63.6	63.6	NA	NA
1234678-HpCDF	Upper	1/3	4.76	4.76	NA	NA
	Lower	1/1	5.26	5.26	NA	NA
123478-HxCDF	Lower	1/1	1.81	1.81	NA	NA
OCDD	Upper	3/3	4.33 - 536	182	NA	NA
	Lower	1/1	8.23	8.23	NA	NA
OCDF	Upper	1/3	16.9	16.9	NA	NA
	Lower	1/1	6.30	6.30	NA	NA

Notes:
μg/kg = Micrograms per kilogram
ng/kg = Nanograms per kilogram
RBC = Risk-based concentration
NA = No industrial RBC established

Table 10.3.3.2
SWMUs 22 and 25 and AOC 554
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Aluminum (Al)	Upper	17/17	2,740 - 7,340	4,710	100,000	26,600	0
	Lower	16/16	1,200 - 9,010	5,160	NA	41,100	NA
Antimony (Sb)	Upper	4/17	0.800 - 5.10	2.13	82	1.77	0
	Lower	4/16	1.80 - 6.20	4.05	NA	1.60	NA
Arsenic (As)	Upper	15/17	1.10 - 6.20	3.35	3.8	23.9	0
	Lower	15/16	0.860 - 17.6	3.69	NA	19.9	NA
Barium (Ba)	Upper	17/17	10.0 - 93.5	32.6	14,000	130	0
	Lower	16/16	6.10 - 290	39.9	NA	94.1	NA
Beryllium (Be)	Upper	14/17	0.160 - 0.420	0.265	1.3	1.70	0
	Lower	12/16	0.150 - 0.720	0.323	NA	2.71	NA
Cadmium (Cd)	Upper	9/17	0.140 - 30.9	9.84	100	1.50	0
	Lower	8/16	0.160 - 103	16.5	NA	0.960	NA
Calcium (Ca)	Upper	17/17	598 - 140,000	13,800	NA	NA	NA
	Lower	16/16	226 - 235,000	15,600	NA	NA	NA
Chromium (Cr)	Upper	17/17	4.70 - 1,080	106	1,000	94.6	1
	Lower	16/16	2.10 - 1,430	172	NA	75.2	NA
Cobalt	Upper	14/17	0.450 - 23.0	5.80	12,000	19.0	0
	Lower	12/16	0.500 - 5.20	1.74	NA	14.9	NA
Copper (Cu)	Upper	17/17	4.50 - 539	62.0	8,200	66.0	0
	Lower	12/16	1.90 - 148	35.3	NA	152	NA
Cyanide (CN)	Upper	3/15	0.460 - 16.6	5.87	4,100	0.500	0
	Lower	2/14	1.000 - 13.8	7.40	NA	NA	NA
Iron (Fe)	Upper	17/17	1,800 - 13,400	4,850	61,000	NA	0
	Lower	16/16	1,570 - 55,400	9,190	NA	NA	NA

Table 10.3.3.2
SWMUs 22 and 25 and AOC 554
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Lead (Pb)	Upper	17/17	3.60 - 469	79.9	1,300	265	0
	Lower	16/16	2.10 - 486	43.6	NA	173	NA
Magnesium (Mg)	Upper	17/17	134 - 4,310	619	NA	NA	NA
	Lower	16/16	73.2 - 3,430	437	NA	NA	NA
Manganese (Mn)	Upper	17/17	11.0 - 215	63.1	4,700	302	0
	Lower	16/16	12.2 - 187	50.7	NA	881	NA
Mercury (Hg)	Upper	15/17	0.0480 - 2.20	0.313	61	2.60	0
	Lower	8/16	0.0150 - 0.320	0.110	NA	1.59	NA
Nickel (Ni)	Upper	14/17	1.30 - 85.1	20.7	4,100	77.1	0
	Lower	12/16	0.660 - 55.5	13.1	NA	57.0	NA
Potassium (K)	Upper	8/17	120 - 1,150	374	NA	NA	NA
	Lower	7/16	120 - 507	306	NA	NA	NA
Selenium (Se)	Upper	3/17	0.620 - 0.830	0.707	1,000	1.70	0
	Lower	2/16	0.650 - 0.670	0.660	NA	2.40	NA
Silver (Ag)	Upper	8/17	0.240 - 4.40	1.48	1,000	NA	0
	Lower	3/16	0.360 - 3.20	1.43	NA	NA	NA
Sodium (Na)	Upper	9/17	32.6 - 643	197	NA	NA	NA
	Lower	7/16	20.6 - 465	128	NA	NA	NA
Thallium (Tl)	Upper	1/17	0.560	0.560	16	NA	0
	Lower	1/16	4.30	4.30	NA	NA	NA
Tin (Sn)	Upper	2/14	14.9 - 98.3	56.6	100,000	59.4	0
	Lower	3/13	2.70 - 153	62.9	NA	9.23	NA
Vanadium (V)	Upper	17/17	3.70 - 18.4	8.34	1,400	94.3	0
	Lower	16/16	3.00 - 65.0	12.1	NA	155	NA

Table 10.3.3.2
SWMUs 22 and 25 and AOC 554
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Zinc (Zn)	Upper	17/17	8.60 - 1,040	132	61,000	827	0
	Lower	16/16	2.90 - 128	30.6	NA	886	NA
pH (SU)							
pH	Upper	14/14	7.35 - 9.92	8.49	NA	NA	NA
	Lower	13/13	4.68 - 8.59	7.34	NA	NA	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Risk-based concentration
RC = Reference concentration
NA = No industrial RBC or RC established
SU = Standard units

Volatile Organic Compounds in Soil

Eight VOCs were detected in soil samples collected at SWMUs 22 and 25 and AOC 554. Twenty-seven detections occurred in the upper interval and 22 in the lower interval. No VOC exceeded its respective industrial RBC in the upper interval. Two VOCs — tetrachloroethene and trichloroethene — exceeded their respective SSL in the lower interval.

Tetrachloroethene was detected in five of 16 lower-interval samples with a range 1.0 to 45 μg/kg and a mean of 10.6 μg/kg. Three lower-interval samples (022SB002, 45 μg/kg; 025SB009, 2 μg/kg; and 025SB011, 4 μg/kg) exceeded the tetrachloroethene SSL of 1.0 μg/kg.

Trichloroethene was detected in eight of 16 lower-interval samples with a range of 1.00 to 100 μg/kg and a mean of 16.6 μg/kg. One lower-interval sample (025SB011, 100 μg/kg) exceeded the trichloroethene SSL of 10 μg/kg.

Semivolatile Organic Compounds in Soil

Twenty-one SVOCs were detected in soil samples collected at SWMUs 22 and 25 and AOC 554. One hundred and thirty-three detections occurred in the upper interval and 37 in the lower interval. No SVOC exceeded its respective industrial RBC in the upper interval or its respective SSL in the lower interval.

In accordance with recent cPAH guidance, BEQs were calculated for cPAHs at SWMUs 22 and 25 and AOC 554. The upper-interval BEQ was calculated for 13 samples with a range of 0.0420 to 656 μg/kg and a mean of 225 μg/kg. The BEQ did not exceed the benzo(a)pyrene industrial RBC of 780 μg/kg.

Pesticides and PCBs in Soil

Four pesticides were detected in soil samples collected at SWMUs 22 and 25 and AOC 554. Four detections occurred in the upper interval and three in the lower interval. No pesticide exceeded its respective industrial RBC in the upper interval. One pesticide — dieldrin — exceeded its respective SSL in the lower interval.

Dieldrin was detected in one of 13 lower-interval samples. One lower-interval sample (022SB002, 6.70 μg/kg) exceeded the dieldrin SSL of 1.0 μg/kg.

No PCBs were detected in the soil samples collected at SWMUs 22 and 25 and AOC 554.

Other Organic Compounds in Soil

Five dioxins were detected in soil samples collected at SWMUs 22 and 25 and AOC 554. Six detections occurred in the upper interval and four in the lower interval. No industrial RBCs or SSLs exist for dioxins.

In accordance with recent dioxin guidance, TEQs (dioxin equivalent) were calculated for dioxins at SWMUs 22 and 25 and AOC 554. The upper-interval TEQ was calculated for three samples with a range of 0.00430 to 1.24 ng/kg and a mean of 0.416 ng/kg. None of the samples exceeded the industrial RBC of 1,000 ng/kg.

Inorganic Elements in Soil

Twenty-five metals were detected in soil samples collected at SWMUs 22 and 25 and AOC 554. Three hundred and six detections occurred in the upper interval and 268 in the lower interval. Only chromium exceeded both its industrial RBC and background RC in the upper interval. One metal — cadmium — exceeded both its respective SSL and background RC in the lower interval.

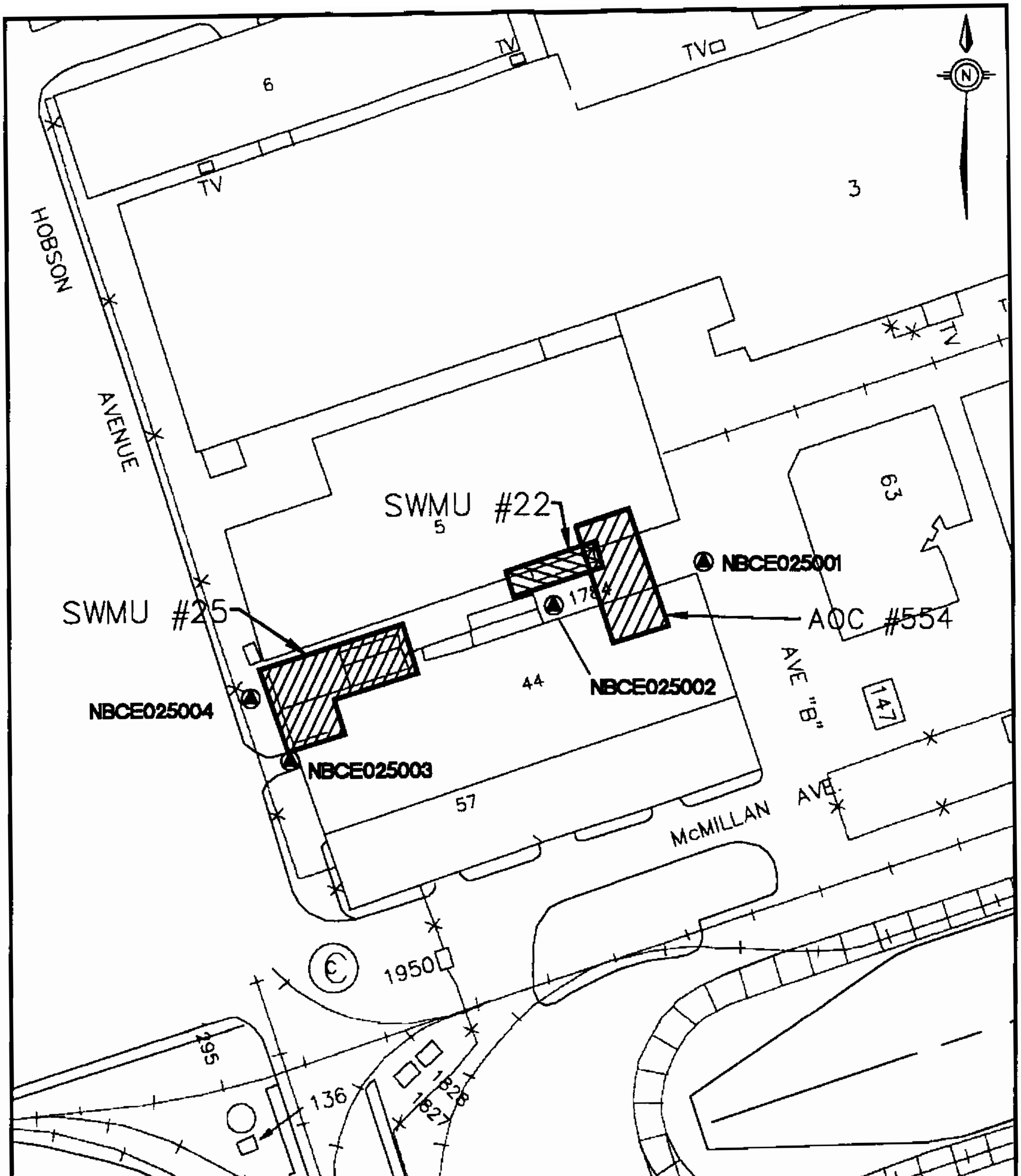
Chromium was detected in 17 of 17 upper-interval samples with a range of 4.70 to 1,080 mg/kg, and a mean of 106 mg/kg. One upper-interval sample (022SB009, 1,080 mg/kg) exceeded both the chromium industrial RBC of 1,000 mg/kg and background RC of 94.6 mg/kg.

Cadmium was detected in eight of 16 lower-interval samples with a range of 0.160 to 103 mg/kg and a mean of 16.5 mg/kg. Three lower-interval samples (025SB006, 103 mg/kg; 025SB008, 7.2 mg/kg; and 025SB012, 17.3 mg/kg) exceeded both the cadmium SSL of 6.0 mg/kg and background RC of 0.960 mg/kg.

10.3.4 Groundwater Sampling and Analysis

One shallow monitoring well was installed and sampled to assess groundwater quality at SWMUs 22 and 25 and AOC 554 as shown in Figure 10.3.2. Three existing wells located at the site were also sampled. The wells were installed as follows:

- Shallow Wells installed at SWMU 25 — NBCE0025004
- Shallow Wells existing at SWMU 25 — NBCE025001, NBCE025002, and NBCE025003



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.3.2
MONITORING WELL LOCATIONS
SWMU #22, OLD PLATING SHOP WWTS
SWMU #25, OLD PLATING OPERATION
AOC #554, PAINT SHOP

DWG DATE: 09/02/97	DWG NAME: 10-3-1

Groundwater samples were submitted for pH, VOCs, SVOCs, pesticides/PCBs, metals, cyanide, chlorides, sulfates, TDS, and organotins at DQO Level III. No samples were selected as duplicates at this site. Table 10.3.4.1 summarizes groundwater sampling and analysis at SWMUs 22 and 25 and AOC 554.

Table 10.3.4.1
SWMUs 22 and 25 and AOC 554
Groundwater Sampling Summary

Depth	Wells Proposed	Wells Installed	Analyses Proposed	Analyses Collected	Deviations
Shallow	1	1	Standard Suite[a], pH, chlorides, sulfates, and TDS	Standard Suite[a], pH, chlorides, sulfates, and TDS	Three existing wells were also sampled and analyzed for the same parameters

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs

The shallow monitoring well was installed at 13.5 feet bgs in the surficial aquifer in accordance with Section 3.3 of this report.

10.3.5 Nature of Contamination in Groundwater

Organic compound analytical results for groundwater are summarized in Table 10.3.5.1. Inorganic analytical results for groundwater are summarized in Table 10.3.5.2. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.3.5.1
SWMUs 22 and 25 and AOC 554
Organic Compounds Detected in First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	MCL	Number of Samples Exceeding RBC
VOCs						
1,2-Dichloroethene (total)	1/4	2.00	2.00	5.50	70.0	0
Tetrachloroethene	2/4	1.000 - 3.00	2.00	1.10	5.00	1
Trichloroethene	2/4	2.00 - 4.00	3.00	1.60	5.00	2
SVOCs						
Acenaphthene	1/4	1.000	1.000	220	NA	0
Naphthalene	1/4	6.00	6.00	150	NA	0
Pesticides/PCBs						
alpha-Chlordane	1/4	0.160	0.160	0.0520	2.00	1
gamma-Chlordane	1/4	0.120	0.120	0.0520	2.00	1

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
NA = No MCL established

Table 10.3.5.2
SWMUs 22 and 25 and AOC 554 Inorganic Detections
for First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Aluminum (Al)	3/4	327 - 1,020	590	3,700	2,810	NA	0
Antimony (Sb)	1/4	4.10	4.10	1.50	NA	6.00	1
Barium (Ba)	4/4	7.30 - 26.5	15.6	260	211	2,000	0
Cadmium (Cd)	35464	6.3 - 84.0	45.1	1.80	NA	5.00	2

Table 10.3.5.2
SWMUs 22 and 25 and AOC 554 Inorganic Detections
for First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Calcium (Ca)	4/4	1,580 - 33,600	21,400	NA	NA	NA	NA
Chromium (Cr)	4/4	12.6 - 843	290	18.0	12.3	100	3
Copper (Cu)	2/4	4.00 - 7.50	5.75	150	2.7	1,300	0
Iron (Fe)	3/4	67.2 - 1,080	490	1,100	NA	NA	0
Magnesium (Mg)	4/4	1,300 - 3,960	2,450	NA	NA	NA	NA
Manganese (Mn)	4/4	6.90 - 320	94.7	84.0	2,560	NA	0
Nickel (Ni)	3/4	5.70 - 513	180	73.0	15.2	100	1
Potassium (K)	4/4	1,810 - 12,700	7,450	NA	NA	NA	NA
Selenium (Se)	1/4	6.10	6.10	18.0	NA	50.0	0
Sodium (Na)	4/4	4,960 - 23,400	10,400	NA	NA	NA	NA
Vanadium (V)	3/4	1.70 - 2.30	2.03	26.0	11.4	NA	0
Zinc (Zn)	3/4	4.50 - 48.3	20.4	1,100	27.3	NA	0
pH (SU)							
pH	4/4	4.49 - 7.23	6.21	NA	NA	NA	NA

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
RC = Reference concentration
NA = No RBC or RC established
SU = Standard units

Volatile Organic Compounds in Groundwater

Shallow Groundwater

Three VOCs were detected in shallow groundwater samples collected at SWMU 25. Two VOCs — tetrachloroethene and trichloroethene — exceeded their respective tap-water RBC. No shallow groundwater samples were collected from SWMU 22 or AOC 554.

Tetrachloroethene was detected in two of four samples with a range of 1.000 to 3.000 μg/L and a mean of 2.00 μg/L. One sample from well NBCE025003 (3 μg/L) exceeded the tetrachloroethene tap-water RBC of 1.10 μg/L. The sample did not exceed the tetrachloroethene MCL of 5.0 μg/L.

Trichloroethene was detected in two of four samples with a range of 2.00 to 4.00 μg/L and a mean of 3.00 μg/L. Two samples from wells NBCE025003 (4 μg/L) and NBCE025004 (2 μg/L) exceeded the trichloroethene tap-water RBC of 1.60 μg/L. The samples did not exceed the trichloroethene MCL of 5.0 μg/L.

Semivolatile Organic Compounds in Groundwater

Shallow Groundwater

Two SVOCs were detected in shallow groundwater samples collected at SWMU 25. Neither of the SVOCs exceeded its respective tap-water RBC. No MCL has been established for either detected SVOC.

Pesticides and PCBs in Groundwater

Shallow Groundwater

Two pesticides were detected in shallow groundwater samples collected at SWMU 25. Both pesticides — alpha-chlordane and gamma-chlordane — exceeded their respective tap-water RBC.

Alpha-chlordane was detected in one of four samples at 0.160 μg/L. The sample from well NBCE025001 (0.160 μg/L) exceeded the alpha-chlordane tap-water RBC of 0.0520 μg/L. The sample did not exceed the alpha-chlordane MCL of 2.0 μg/L.

Gamma-chlordane was detected in one of four samples at 0.120 μg/L. The sample from well NBCE025001 (0.120 μg/L) exceeded the gamma-chlordane tap-water RBC of 0.0520 μg/L. The sample did not exceed the gamma-chlordane MCL of 2.0 μg/L.

Inorganic Elements in Groundwater

Shallow Groundwater

Sixteen metals were detected in shallow groundwater samples collected at SWMU 25. Four metals — antimony, cadmium, chromium, and nickel — exceeded both their respective tap-water RBC and background shallow groundwater RC (where available).

Antimony was detected in one of four samples at 4.10 μg/L. The sample from well NBCE025003 (4.10 μg/L) exceeded the antimony tap-water RBC of 1.50 μg/L; no shallow groundwater RC has been established for antimony. The sample did not exceed the antimony MCL of 6.0 μg/L.

Cadmium was detected in two of four samples with a range of 6.3 to 84.0 μg/L and a mean of 45.1 μg/L. Two samples from wells NBCE025002 (6.3 μg/L) and NBCE025003 (84 μg/L) exceeded the cadmium tap-water RBC of 1.80 μg/L; no shallow groundwater RC has been established for cadmium. Both samples also exceeded the cadmium MCL of 5.0 μg/L.

Chromium was detected in four of four samples with a range of 12.6 to 843 μg/L and a mean of 290 μg/L. Three samples from wells NBCE025002 (177 μg/L); NBCE025003, (843 μg/L); and NBCE025004, 127 μg/L) exceeded both the chromium tap-water RBC of 18.0 μg/L and the chromium shallow groundwater RC of 12.3 μg/L. All three samples also exceeded the chromium MCL of 100 μg/L.

Nickel was detected in three of four samples with a range of 5.70 to 513 μg/L and a mean of 180 μg/L. One sample from well NBCE025003 (513 μg/L) exceeded both the nickel tap-water

RBC of 73.0 μg/L and the nickel shallow groundwater RC of 15.2 μg/L. The sample also exceeded the nickel MCL of 100 μg/L.

pH in Groundwater

Shallow Groundwater

The shallow groundwater samples were analyzed for pH. pH ranged from 4.49 to 7.23 SU, with a mean of 6.21 SU. No tap-water RBC or RC has been established for pH.

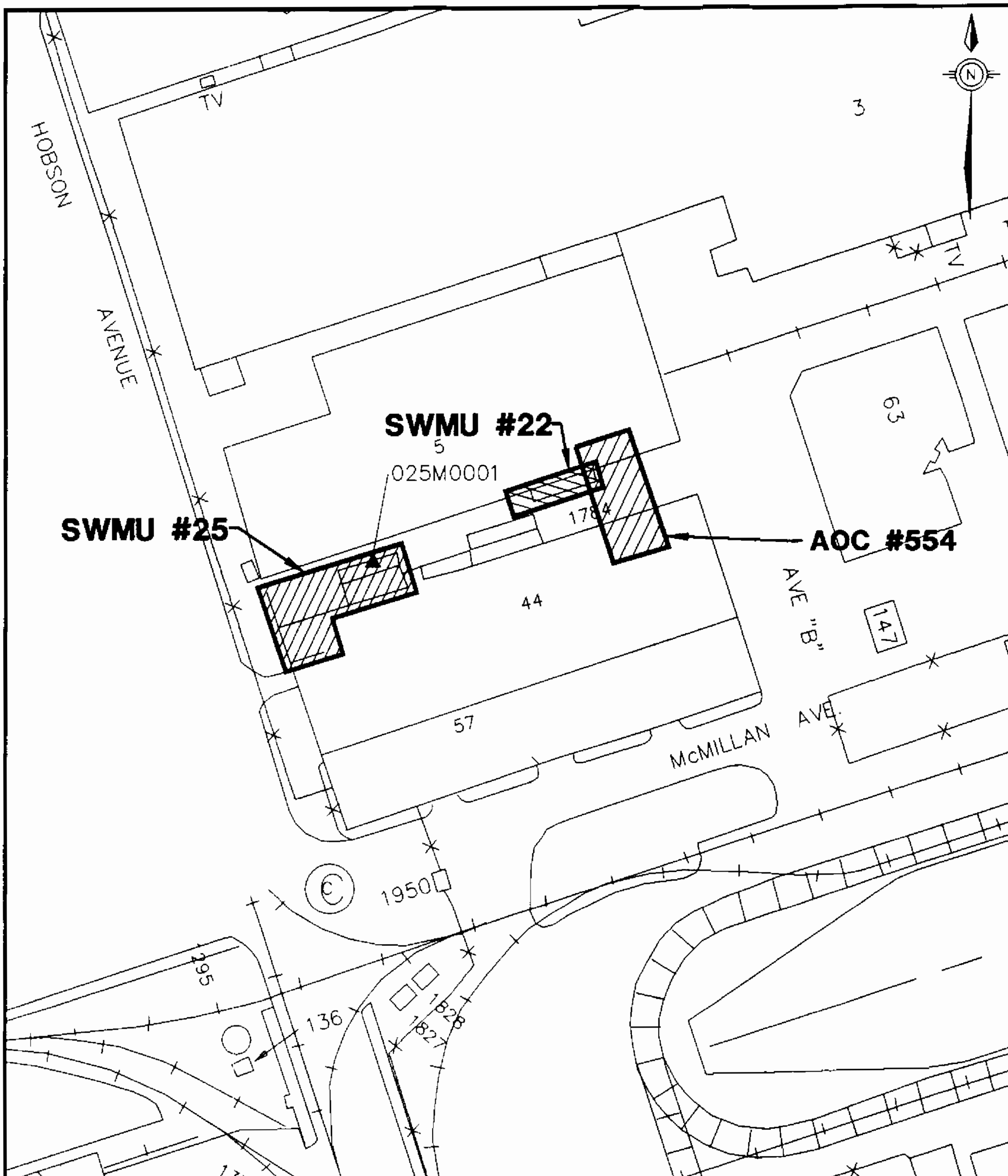
10.3.6 Sediment Sampling and Analysis

The *Final Zone E RFI Work Plan* proposed collecting one sediment sample at SWMUs 22 and 25 and AOC 554 from the location shown in Figure 10.3.3. One sediment sample was collected and submitted for analysis at DQO Level III for pH, organotins and the standard suite of parameters which includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide. No samples were selected as duplicates at this site. Table 10.3.6.1 summarizes sediment sampling and analysis at SWMUs 22 and 25 and AOC 554.

Table 10.3.6.1
SWMUs 22 and 25 and AOC 554
Sediment Sampling Summary

Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviation
1	1	Standard Suite[a], pH, and organotins	Standard Suite[a], pH, and organotins	None

Note:
a = Standard suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.3.3
SEDIMENT SAMPLE LOCATION
SWMU #22, OLD PLATING SHOP WWTS
SWMU #25, OLD PLATING OPERATION
AOC #554, PAINT SHOP

DWG DATE: 09/02/97 | DWG NAME: 10-03-3

10.3.7 Nature of Contamination in Sediment

Organic compound analytical results for sediment are summarized in Table 10.3.7.1. Inorganic analytical results for groundwater are summarized in Table 10.3.7.2. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.3.7.1
SWMUs 22 and 25 and AOC 554
Organic Compounds Detected in Sediment (μg/kg)

Compound	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial Soil RBC	Number of Samples Exceeding RBC
VOCs						
Methylene chloride	Upper	1/1	7.00	7.00	760,000	0
SVOCs						
Anthracene	Upper	1/1	1,400	1,400	61,000,000	0
Benzo(g,h,i)perylene	Upper	1/1	45,000	45,000	8,200,000	0
bis(2-Ethylhexyl)phthalate (BEHP)	Upper	1/1	3,200	3,200	410,000	0
Fluoranthene	Upper	1/1	2,000	2,000	8,200,000	0
Phenanthrene	Upper	1/1	2,300	2,300	8,200,000	0
Pyrene	Upper	1/1	6,600	6,600	6,100,000	0
SVOCs (B(a)P Equivalents)						
B(a)P Equiv.	Upper	1/1	23,200	23,200	780	1
Benzo(b)fluoranthene	Upper	1/1	7,900	7,900	7,800	1
Chrysene	Upper	1/1	12,000	12,000	780,000	0
Dibenz(a,h)anthracene	Upper	1/1	12,000	12,000	780	1
Indeno(1,2,3-cd)pyrene	Upper	1/1	24,000	24,000	7,800	1
Benzo(k)fluoranthene	Upper	1/1	5,100	5,100	78,000	0
Benzo(a)pyrene	Upper	1/1	7,900	7,900	780	0

Table 10.3.7.1
SWMUs 22 and 25 and AOC 554
Organic Compounds Detected in Sediment (μg/kg)

Compound	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial Soil RBC	Number of Samples Exceeding RBC
Pesticides						
alpha-Chlordane	Upper	1/1	26.0	26.0	4,400	0
gamma-Chlordane	Upper	1/1	15.0	15.0	4,400	0
4,4'-DDE	Upper	1/1	29.0	29.0	17,000	0
4,4'-DDT	Upper	1/1	110	110	17,000	0
Endosulfan sulfate	Upper	1/1	51.0	51.0	1,200,000	0
Endrin aldehyde	Upper	1/1	51.0	51.0	61,000	0
Endrin ketone	Upper	1/1	85.0	85.0	61,000	0

Notes:
μg/kg = Micrograms per kilogram
RBC = Industrial soil RBC
NA = No industrial soil RBC established
* = For the purposes of this investigation, sediment collected from storm and floor drain catch basins are treated as soil and compared to industrial RBCs instead of RAGS sediment screening values.

Table 10.3.7.2
SWMUs 22 and 25 and AOC 554
Inorganic Detections in Sediment

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial Soil RBC	Number of Samples Exceeding RBC
Inorganic Elements (mg/kg)						
Aluminum (Al)	Upper	1/1	5,210	5,210	100,000	0
Arsenic (As)	Upper	1/1	105	105	3.8	1
Barium (Ba)	Upper	1/1	183	183	14,000	0
Cadmium (Cd)	Upper	1/1	69.7	69.7	100	0
Chromium (Cr)	Upper	1/1	35,000	35,000	1,000	1
Cobalt (Co)	Upper	1/1	1.10	1.10	12,000	0

Table 10.3.7.2
SWMUs 22 and 25 and AOC 554
Inorganic Detections in Sediment

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial Soil RBC	Number of Samples Exceeding RBC
Inorganic Elements (mg/kg)						
Copper (Cu)	Upper	1/1	1,990	1,990	8,200	0
Cyanide (CN)	Upper	1/1	2.50	2.50	4,100	0
Iron (Fe)	Upper	1/1	24,600	24,600	61,000	0
Lead (Pb)	Upper	1/1	754	754	1,300	1
Manganese (Mn)	Upper	1/1	315	315	NA	NA
Mercury (Hg)	Upper	1/1	0.0900	0.0900	61	0
Nickel (Ni)	Upper	1/1	109	109	4,100	0
Silver (Ag)	Upper	1/1	36.3	36.3	1,000	0
Thallium (Tl)	Upper	1/1	3.30	3.30	16	0
Tin (Sn)	Upper	1/1	71.9	71.9	100,000	0
Vanadium (V)	Upper	1/1	72.9	72.9	1,400	0
Zinc (Zn)	Upper	1/1	4,430	4,430	61,000	0
pH (SU)						
pH	Upper	1/1	6.37	6.37	NA	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Industrial soil risk-based concentration
NA = No industrial soil RBC established
SU = Standard units
* = For the purposes of this investigation, sediment collected from storm and floor drain catch basins are treated as soil and compared to industrial RBCs instead of RAGS sediment screening values.

Volatile Organic Compounds in Sediment

One VOC — methylene chloride — was detected in the sediment sample collected at SWMUs 22 and 25 and AOC 554. The VOC did not exceeded its respective industrial soil RBC. Methylene chloride is considered a common laboratory artifact or contaminant by the National Functional Guidelines, February 1994.

Semivolatile Organic Compounds in Sediment

Twelve SVOCs were detected in the sediment sample collected at SWMUs 22 and 25 and AOC 554. Four SVOCs — benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and benzo(a)pyrene — exceeded their respective industrial soil RBC.

Benzo(b)fluoranthene was detected in sediment sample 025M0001 at 7,900 μg/kg, exceeding the benzo(b)fluoranthene industrial soil RBC of 7,800 μg/kg.

Dibenz(a,h)anthracene was detected in sediment sample 025M0001 at 12,000 μg/kg, exceeding the dibenz(a,h)anthracene industrial soil RBC of 780 μg/kg.

Indeno(1,2,3-cd)pyrene was detected in sediment sample 025M0001 at 24,000 μg/kg, exceeding the indeno(1,2,3-cd)pyrene industrial soil RBC of 7,800 μg/kg.

Benzo(a)pyrene was detected in sediment sample 025M0001 at 7,900 μg/kg, exceeding the benzo(a)pyrene industrial soil RBC of 780 μg/kg.

In accordance with recent cPAH guidance, BEQs were calculated for cPAHs at SWMUs 22 and 25 and AOC 554. The BEQ calculated for sediment sample 025M0001 was 23,200 μg/kg, exceeding the benzo(a)pyrene industrial soil RBC of 780 μg/kg.

Pesticides and PCBs in Sediment

Seven pesticides were detected in the sediment sample collected at SWMUs 22 and 25 and AOC 554. None of the pesticides were detected above their respective industrial soil RBC.

No PCBs were detected in the sediment sample collected at SWMUs 22 and 25 and AOC 554.

Other Organic Compounds in Sediment

No dioxins or organotins were detected in the sediment sample collected at SWMUs 22 and 25 and AOC 554.

Inorganic Elements in Sediment

Eighteen metals were detected in the sediment sample collected at SWMUs 22 and 25 and AOC 554. Two metals — arsenic and chromium — were detected above their respective industrial soil RBC.

Arsenic was detected in sediment sample 025M0001 at 105 mg/kg, exceeding the arsenic industrial soil RBC of 3.80 mg/kg.

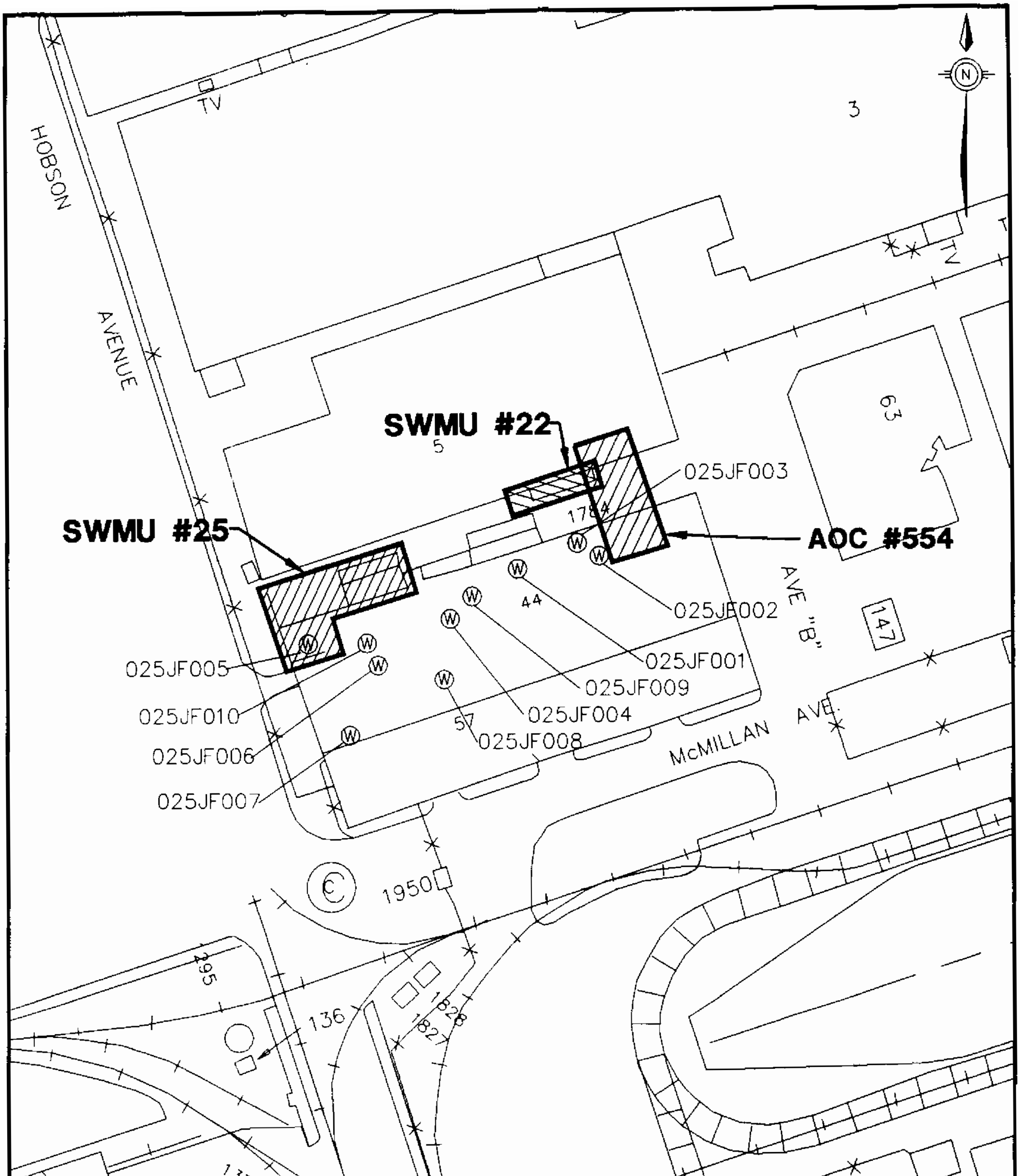
Chromium was detected in sediment sample 025M0001 at 35,000 mg/kg, exceeding the chromium industrial soil RBC of 52.3 mg/kg.

pH in Sediment

The sediment sample was analyzed for pH. The pH of the sediment sample was 6.37 SU; no industrial soil RBC has been established for pH.

10.3.8 Wipe Sampling and Analysis

The *Final Zone E RFI Work Plan* did not propose the collection of wipe samples at this SWMU, however, eleven wipe samples were collected to determine the presence of hazardous constituents in onsite dust. Sample locations were determined in the field and are shown on Figure 10.3.4. Table 10.3.8.1 summarizes the analytical results of air samples collected at SWMU 25. Sample locations biased in an attempt to identify worst case situations.



LEGEND

- ● – SOIL BORINGS
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GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.3.4
WIPE SAMPLE LOCATIONS
SWMU #22, OLD PLATING SHOP WWTS
SWMU #25, OLD PLATING OPERATION
AOC #554, PAINT SHOP

DWG DATE: 09/02/97 | DWG NAME: 10-03-4

Table 10.3.8.1
SWMU 25
Wipe Sampling Summary

Samples Proposed	Samples Collected	Analyses Proposed	Analyses Performed	Deviations
0	11	Metals, SW-846	Metals, SW-846	Collection of 11 wipe samples

10.3.9 Nature of Contamination in Dust

Table 10.3.9.1 summarizes the wipe sample analytical results for SWMU 25. Sample locations were determined in the field and were biased in an attempt to identify worst case situations.

Table 10.3.9.1
SWMU 25
Wipe Sampling Analytical Results

Element	Frequency of Detection	Range of Detections (mg\wipe)
Aluminum	11/ 11	5.7 - 1,860
Antimony	10/ 11	1.6 - 78
Arsenic	8/11	1.2 - 19.4
Barium	11/11	0.79 - 965
Cadmium	10/11	0.61 - 1,110
Calcium	11/11	254 - 11,200
Chromium	11/11	2.0 - 21,200
Cobalt	7/11	3.0 - 16.9
Copper	11/11	4.7 - 2,950
Iron	11/11	29.3 - 39,500
Lead	11/11	1.2 - 4,260
Magnesium	10/11	28.9 - 350
Manganese	11/11	0.5 - 770

Table 10.3.9.1
SWMU 25
Wipe Sampling Analytical Results

Element	Frequency of Detection	Range of Detections (mg\wipe)
Mercury	8/11	0.01 - 0.03
Nickel	11/11	0.9 - 3,860
Potassium	3/11	1,160 - 1,880
Selenium	7/11	1.40 - 3.0
Silver	9/11	12.6 - 119
Sodium	11/11	377 - 4,610
Thallium	2/11	3.1 - 3.6
Tin	9/11	19.0 - 218
Vanadium	10/11	0.37 - 13.6
Zinc	11/11	3.7 - 3,770

Inorganic Elements Detected on Surfaces

Twenty-three metals were detected in wipe samples collected at SWMU 25. Beryllium was not detected in collected samples. No residential or industrial RBCs exist for wipe samples. Refer to Table 10.3.9.1 for results.

10.3.10 Air Sampling and Analysis

A Jerome Mercury Vapor Analyzer was used to screen for ambient mercury vapor at SWMU 25. The instrument was placed in the survey mode during all qualitative sampling. The survey mode is useful for locating spills or to assess areas of potential high mercury vapor concentration. All surveying was performed at floor level to detect any contamination from spills.

10.3.11 Nature of Contamination in Air

No detectable quantities of mercury vapor were identified in ambient air during the survey.

10.3.12 Fate and Transport Assessment for SWMU 22, SWMU 25, and AOC 554

Combined SWMU 22 comprises the Old Plating Shop Wastewater Treatment System, an electroplating operation located in the southwestern portion of Building 44, and a former paint shop. The area of combined SWMU 22 includes buildings and asphalt and concrete pavement. Environmental media sampled as part of the combined SWMU 22 RFI include surface soil, subsurface soil, sediment, shallow groundwater, and wipe samples. Potential constituent migration pathways investigated for combined SWMU 22 include soil to groundwater, groundwater to surface water, surface soil to sediment, and emission of volatiles from surface soil to air.

10.3.12.1 Soil- to-Groundwater Cross-Media Transport: Tier One

Table 10.3.12.1 compares maximum detected organic constituent concentrations in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels, or (b) background reference concentrations. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 10:1, with no attenuation of constituents in soil (DAF=10).

Four organic compounds — methylene chloride, tetrachloroethene, trichloroethene, and dieldrin — were detected in combined SWMU 22 soil at concentrations greater than groundwater protection SSLs. Methylene chloride was detected above its generic SSL in two surface soil samples and one subsurface soil sample. Tetrachloroethene, detected in 11 samples, exceeded its SSL in only one subsurface soil sample (022SB002). Trichloroethene was detected in three surface soil samples (025SB006 at 97 μg/kg, 025SB009 at 42 μg/kg, and 025SB010 at 140 μg/kg) and one subsurface soil sample (025SB011 at 100 μg/L) at concentrations greater than its SSL. Overall trichloroethene was detected in 10 surface soil and eight subsurface soil samples. Dieldrin was detected at 6.7 μg/L in subsurface soil sample 022SB002 above its SSL of 2.0 μg/L.

Two of the four organic compounds exceeding SSLs — tetrachloroethene and trichloroethene — were also detected in groundwater at concentrations greater than their respective tap water RBCs, indicating a completed pathway from soil to groundwater. Dieldrin and methlyene chloride were not detected in first-quarter groundwater samples.

Nine inorganics — antimony, cadmium, chromium, cobalt, copper, lead, nickel, thallium, and tin — were detected in soil samples at concentrations above their respective groundwater protection SSLs or background reference values, and were carried over to the second-tier screen. Six of the nine (excepting cobalt, thallium, and tin) were also detected in groundwater, indicating a completed pathway from soil to groundwater. Of these six, only cadmium was detected in groundwater at a concentration above its RBC and/or background reference value.

Cadmium and chromium were detected in soil samples at concentrations more than an order of magnitude greater than either their respective SSLs or background reference values. Cadmium concentrations exceeded its generic SSL of 4 mg/kg in four surface soil and three subsurface soil samples. Maximum concentrations were 30.9 mg/kg in surface soil sample 025SB012 and 103 mg/kg in subsurface soil sample 025SB006. The remaining two subsurface soil exceedances were below 20 mg/kg. Chromium was detected above its background reference value of 94.6 mg/kg in two surface soil samples (344 mg/kg in 025SB008 and 1,080 mg/kg in 025SB009) and three subsurface soil samples (561 mg/kg in 025SB006, 1,430 mg/kg in 025SB008, and 508 mg/kg in 025SB009). Although the generic SSL (assuming DAF=10) for hexavalent chromium is 19 mg/kg, it was not applied to the chromium site results for two reasons: (1) hexachrome was not detected in duplicate surface soil sample 025SB004, the only sample at combined SWMU 22 with hexachrome analysis; and (2) for all of Zone E, hexachrome was detected in only four of 59 surface soil samples (maximum concentration of 0.586 mg/kg) and in zero of 27 subsurface soil samples in which it was analyzed. According to EPA guidance (*1996 Soil Screening Guidance: Technical Background Document*) trivalent chromium as a contaminant in soil is not considered a threat to groundwater at any concentration.

Of the seven other inorganics detected above their SSLs, cobalt, copper, and thallium exceeded their screening levels in one sample each, lead and nickel in two samples each, tin in three samples, and antimony in four samples. The highest concentrations of antimony, barium, chromium, cobalt, copper, lead, manganese, mercury, nickel, tin, and zinc were detected in surface soil sample 025SB009 at combined SWMU 22.

10.3.12.2 Groundwater-to-Surface Water Cross-Media Transport: Tier One

Table 10.3.12.1 also compares maximum detected organic constituent concentrations in shallow groundwater samples to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background reference concentrations for groundwater, as well as to the saltwater/surface water chronic values. To provide a conservative first-tier screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

Four organic compounds — alpha-Chlordane, gamma-Chlordane, trichloroethene, and tetrachloroethene — were detected in shallow groundwater at concentrations above tap water RBCs. Two of these compounds — alpha-Chlordane and gamma-Chlordane — were also detected above saltwater surface water chronic screening levels. Trichloroethene has no established surface water screening value. Alpha-Chlordane and gamma-Chlordane were detected in only one first-round sample each. Tetrachloroethene and trichloroethene were each detected in two samples with tetrachloroethene exceeding its tap water RBC in one sample.

Cadmium, in one sample, was the only inorganic detected at a concentration exceeding its tap water RBC in the first round. Four inorganic constituents — cadmium, chromium, copper and nickel — were detected in groundwater at concentrations above their saltwater/surface water chronic screening values. Chromium concentrations exceeded its surface water standard of 103 μg/L in three of four samples, with a maximum concentration of 843 μg/L in the sample from well NBCE025003. This well provided the majority of the inorganic constituent detections that exceeded groundwater screening levels. The same well contained the trichloroethene and tetrachloroethene detections that exceeded the screening levels. Alpha- and gamma-Chlordane were detected in well NBCE025001.

Combined SWMU 22 is located above the groundwater flow divide referred to as anomaly A, as discussed in Section 2.3.2. The majority of groundwater originating at the site, both shallow and deep, appears to flow toward the Cooper River. The remainder of the groundwater apparently flows to the depression referred to as anomaly E, near the boundary of Zones C, D, and E. Possible fates for groundwater flowing to anomaly E are presented in Section 2.3.2.1.

10.3.12.3 Soil and Groundwater-to-Surface Water Transport: Tier Two

Table 10.3.12.2 provides a second screening tier for all constituents detected in soil or groundwater at concentrations exceeding any of the first-tier screening levels. Constituent concentrations in groundwater are compared to combined ecological/human health RBCs that have been adjusted upward for site-specific dilution by surface water in the Cooper River, while soil constituent concentrations are compared to calculated SSLs that are based on the adjusted RBCs rather than the original target leachate concentrations. For the second-tier screen, no dilution of leachate by groundwater or attenuation of constituents in soil is assumed (DAF=1).

No organic or inorganic constituents in soil or groundwater samples at combined SWMU 22 were detected at concentrations exceeding their corresponding adjusted SSLs or ecological/human health RBCs, indicating that site constituents pose no threat to human health or the environment in the Cooper River through the associated migration pathway. Chromium and copper were detected in soil at concentrations that were relatively close (within one order of magnitude) to their adjusted SSLs. However, the adjusted SSLs were obtained assuming a DAF of 1, while the calculated site-specific DAF for combined SWMU 22 is 40, taking into account dilution only. Consequently, the margin between detected soil concentrations and levels protective of the Cooper River is actually much greater than indicted by the table.

10.3.12.4 Surface Soil-to-Sediment Cross-Media Transport

Tables 10.3.7.1 and 10.3.7.2 summarize the constituent concentrations detected in the only catch-basin sediment sample collected at combined SWMU 22. Pesticides, SVOCs, one VOC, and inorganic constituents were present in this sample (025M0001). Fate and transport for constituents originating in sediments from catch basins will be examined in the Zone L RFI report.

Constituents detected in the sediment sample were very similar to those seen in soil samples at combined SWMU 22, although generally higher in the sediment. Chromium concentrations were the most notable of the inorganics in both media. All of the pesticides detected in surface soil were detected in the sediment sample, and all of the SVOCs that were detected in sediment were also detected in surface soil. Although the similarity of compounds detected in soil and sediment indicates that a migration pathway has been completed, the physical separation of soil and sediment at the sites — soil beneath a continuous paved surface, sediment contained by a catch basin — makes it more likely that soil and sediment were impacted independently by constituents related to onsite activities.

10.3.12.5 Soil-to-Air Cross-Media Transport

Table 10.3.12.3 lists the VOCs detected in surface soil samples collected at combined SWMU 22 along with corresponding soil-to-air volatilization screening levels. Little or no surface soil is exposed at combined SWMU 22. In addition, none of the VOCs was reported at a maximum concentration exceeding its corresponding soil-to-air volatilization screening level. As a result, the soil-to-air migration pathway is not expected to be significant at combined SWMU 22.

10.3.12.6 Fate and Transport Summary

Four organic and nine inorganic constituents were detected at concentrations above their respective generic SSLs or background reference values. Two of the organics and six of the inorganics were also detected in groundwater samples, indicating completed migration pathways from soil to groundwater. Four organics and one inorganic exceeded their tap water RBCs in groundwater, while groundwater concentrations of two organics and four inorganics exceeded saltwater surface water chronic screening levels for ecological receptors.

Trichloroethene and tetrachloroethene are widely distributed at low concentrations in soil at combined SWMU 22 and have consequently impacted groundwater. Other organic compounds detected in soil do not appear to present potential for migration to groundwater. Cadmium has been the only detected inorganic constituent in soil to significantly impact groundwater quality, although one detection of chromium in groundwater was approximately eight times higher than its saltwater surface water screening level.

None of the constituents exceeding first-tier screening values for soil or groundwater also exceeded the adjusted screening values of the second-tier comparisons, indicating no threat to surface water in the Cooper River via the evaluated migration pathways.

Table 10.3.12.1
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMUs 22 and 25 and AOC 554
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds												
Acetone	88	95	ND	NA	8000	3700	NA	UG/KG	UG/L	NO	NO	NO
Bromodichloromethane	3	ND	ND	NA	300	0.17	NA	UG/KG	UG/L	NO	NO	NO
2-Butanone (MEK)	ND	3	ND	NA	4000	1900	NA	UG/KG	UG/L	NO	NO	NO
Chloroform	9	ND	ND	NA	300	0.15	815	UG/KG	UG/L	NO	NO	NO
1,2-Dichloroethene (total)	ND	ND	2	NA	200	55	NA	UG/KG	UG/L	NO	NO	NO
Methylene chloride	43	10	ND	NA	10	4.1	2560	UG/KG	UG/L	YES	NO	NO
Tetrachloroethene	16	45	3	NA	30	1.1	45	UG/KG	UG/L	YES	YES	NO
Trichloroethene	140	100	4	NA	30	1.6	NA	UG/KG	UG/L	YES	YES	NO
Xylene (total)	ND	2	ND	NA	71000	12000	NA	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Acenaphthene	82	ND	1	NA	285000	2200	9.7	UG/KG	UG/L	NO	NO	NO
Anthracene	82	ND	ND	NA	5900000	11000	NA	UG/KG	UG/L	NO	NO	NO
Benzo(g,h,i)perylene	300	200	ND	NA	2.33E+08	1500	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	380	200	ND	NA	800	0.092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene	380	250	ND	NA	4000	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(b)fluoranthene	560	190	ND	NA	2500	0.092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(k)fluoranthene	370	220	ND	NA	24500	0.92	NA	UG/KG	UG/L	NO	NO	NO
Chrysene	410	200	ND	NA	80000	9.2	NA	UG/KG	UG/L	NO	NO	NO
Dibenzo(a,h)anthracene	150	78	ND	NA	800	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Indeno(1,2,3-cd)pyrene	280	150	ND	NA	7000	0.092	NA	UG/KG	UG/L	NO	NO	NO
Carbazole	42	ND	ND	NA	300	3.4	NA	UG/KG	UG/L	NO	NO	NO
Dibenzofuran	56	ND	ND	NA	NA	150	NA	UG/KG	UG/L	NO	NO	NO
Di-n-butylphthalate	ND	55	ND	NA	2300000	3700	3.4	UG/KG	UG/L	NO	NO	NO
1,2-Dichlorobenzene	46	ND	ND	NA	8500	270	19.7	UG/KG	UG/L	NO	NO	NO
bis(2-Ethylhexyl)phthalate (BEHP)	3900	85	ND	NA	1800000	4.8	NA	UG/KG	UG/L	NO	NO	NO
Fluoranthene	610	240	ND	NA	2150000	1500	1.6	UG/KG	UG/L	NO	NO	NO
Fluorene	89	ND	ND	NA	280000	1500	NA	UG/KG	UG/L	NO	NO	NO
2-Methylnaphthalene	200	ND	ND	NA	63000	1500	NA	UG/KG	UG/L	NO	NO	NO
Naphthalene	160	ND	6	NA	42000	1500	23.5	UG/KG	UG/L	NO	NO	NO
Phenanthrene	470	120	ND	NA	690000	1500	NA	UG/KG	UG/L	NO	NO	NO
Pyrene	640	230	ND	NA	2100000	1100	NA	UG/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
alpha-Chlordane	ND	ND	0.16	NA	5000	0.052	0.004	UG/KG	UG/L	NO	YES	YES
gamma-Chlordane	2	3	0.12	NA	5000	0.052	0.004	UG/KG	UG/L	NO	YES	YES
4,4'-DDT	7.2	7.7	ND	NA	16000	0.2	0.001	UG/KG	UG/L	NO	NO	NO
Dieldrin	ND	6.7	ND	NA	2	0.0042	0.0019	UG/KG	UG/L	YES	NO	NO
Endrin ketone	2.8	ND	ND	NA	500	11	NA	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	1.24	0.248	NA	NA	950	0.43	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	7340	9010	1020	NA	41100	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	5.1	6.2	4.1	NA	2.5	15	NA	MG/KG	UG/L	YES	NO	NO
Arsenic	6.2	17.6	ND	NA	23.9	18.7	36	MG/KG	UG/L	NO	NO	NO
Barium	93.5	290	26.5	NA	820	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	0.42	0.72	ND	NA	32	1.2	NA	MG/KG	UG/L	NO	NO	NO
Cadmium	30.9	103	84	NA	4	18	9.3	MG/KG	UG/L	YES	YES	YES
Chromium (total)	1080	1430	843	NA	94.6	37000	103	MG/KG	UG/L	YES	NO	YES
Cobalt	23	5.2	ND	NA	19	2200	NA	MG/KG	UG/L	YES	NO	NO
Copper	539	148	7.5	NA	152	1500	2.9	MG/KG	UG/L	YES	NO	YES
Cyanide	16.6	13.8	ND	NA	20	730	37.3	MG/KG	UG/L	NO	NO	NO
Lead	469	486	ND	NA	400	15	8.5	MG/KG	UG/L	YES	NO	NO

Table 10.3.12.1
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMUs 22 and 25 and AOC 554
Charleston, South Carolina

	Max. Concentration		Max. Concentration		Screening Concentration *							
Parameter	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Manganese	215	187	320	NA	881	2560	NA	MG/KG	UG/L	NO	NO	NO
Mercury	2.2	0.32	ND	NA	2.6	11	0.2	MG/KG	UG/L	NO	NO	NO
Nickel	85.1	55.5	513	NA	77.1	730	42.2	MG/KG	UG/L	YES	NO	YES
Selenium	0.83	0.67	6.1	NA	2.5	180	71	MG/KG	UG/L	NO	NO	NO
Silver	4.4	3.2	ND	NA	17	180	0.23	MG/KG	UG/L	NO	NO	NO
Thallium	0.56	4.3	ND	NA	2.8	2.9	21.3	MG/KG	UG/L	YES	NO	NO
Tin	98.3	153	ND	NA	59.4	22000	NA	MG/KG	UG/L	YES	NO	NO
Vanadium	18.4	65	2.3	NA	3000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	1040	128	48.3	NA	6000	11000	86	MG/KG	UG/L	NO	NO	NO

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 10, adapted from 1996 EPA Soil Screening Guidance or calculated using values from Table 6.2
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, June 3, 1996
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November, 1995; Table 2
In each case, the value shown is the greater of the relevant screening value or the corresponding background reference value

Units: See notes for Table 10.1.5.1

Table 10.3.12.2
Chemicals Detected in Surface Soil, Subsurface Soil, or Shallow Groundwater at Concentrations Exceeding any Initial Screening Concentration
Comparison to Combined Ecological/Human Health RBCs Adjusted for Surface Water Dilution, and to SSLs Based on Adjusted Ecological/Human Health RBCs: Tier Two
NAVBASE-Charleston, Zone E: SWMUs 22 and 25 and AOC 554
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentrations * Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Adjusted Screening Concentrations # Combined Eco/HH Surf. Wtr. RBC	Adjusted Eco/HH GW RBC	Target Leachate Conc. (DAF=1)	SSL Multi-plier	Adjusted SSL (DAF=1)	Units Soil Units	Water Units	Screening Results Leaching Potential	Surface Water Migration Concern
Volatile Organic Compounds																
Methylene chloride	43	10	ND	NA	10	4.1	2560	4.1	1.39E+05	5	2.78E+04	2.78E+04	UG/KG	UG/L	NO	NO
Tetrachloroethene	16	45	3	NA	30	1.1	45	1.1	3.73E+04	5	7.46E+03	2.24E+04	UG/KG	UG/L	NO	NO
Trichloroethene	140	100	4	NA	30	1.6	NA	1.6	5.42E+04	5	1.08E+04	3.25E+04	UG/KG	UG/L	NO	NO
Pesticides/PCB Compounds																
alpha-Chlordane	ND	ND	0.16	NA	5000	0.052	0.004	0.004	1.36E+02	2	6.78E+01	3.39E+04	UG/KG	UG/L	NO	NO
gamma-Chlordane	2	3	0.12	NA	5000	0.052	0.004	0.004	1.36E+02	2	6.78E+01	3.39E+04	UG/KG	UG/L	NO	NO
Dieldrin	ND	6.7	ND	NA	2	0.0042	0.0019	0.0019	6.44E+01	0.005	1.29E+04	2.58E+03	UG/KG	UG/L	NO	NO
Inorganic Compounds																
Antimony	5.1	6.2	4.1	NA	2.5	15	NA	15	5.09E+05	6	8.48E+04	2.12E+04	MG/KG	UG/L	NO	NO
Cadmium	30.9	103	84	NA	4	18	9.3	9.3	3.15E+05	5	6.31E+04	2.52E+04	MG/KG	UG/L	NO	NO
Chromium (total)	1080	1430	843	NA	19	180	50	50	1.70E+06	100	1.70E+04	3.22E+04	MG/KG	UG/L	NO	NO
Cobalt	23	5.2	ND	NA	1040	2200	NA	2200	7.46E+07	2200	3.39E+04	1.00E+06	MG/KG	UG/L	NO	NO
Copper	539	148	7.5	NA	458	1500	2.9	2.9	9.83E+04	1300	7.56E+01	3.46E+03	MG/KG	UG/L	NO	NO
Lead	469	486	ND	NA	400	15	8.5	8.5	2.88E+05	15	1.92E+04	7.68E+05	MG/KG	UG/L	NO	NO
Nickel	85.1	55.5	513	NA	65	730	42.2	42.2	1.43E+06	100	1.43E+04	9.30E+04	MG/KG	UG/L	NO	NO
Thallium	0.56	4.3	ND	NA	0.36	2.9	21.3	2.9	9.83E+04	2	4.92E+04	1.77E+03	MG/KG	UG/L	NO	NO
Tin	98.3	153	ND	NA	55000	22000	NA	22000	7.46E+08	22000	3.39E+04	1.00E+06	MG/KG	UG/L	NO	NO

* Initial Screening Concentrations: See notes for Table 10.1.5.2
In this table, the screening values shown are not adjusted for background reference values.

\# Adjusted Screening Concentrations: See notes for Table 10.1.5.2
Adjusted Eco/HH Groundwater RBC - Combined Eco/HH Surface Water RBCs multiplied by site-specific surface water dilution factor of 33,900: GW concentrations protective of surface water

Table 10.3.12.3
Soil-to-Air Volatilization Screening Analysis
NAVBASE-Charleston, Zone E: SWMUs 22 and 25 and AOC 554
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Acetone	88	62000000	UG/KG	NO
Bromodichloromethane	3	1800000	UG/KG	NO
Chloroform	9	200	UG/KG	NO
Methylene chloride	43	7000	UG/KG	NO
Tetrachloroethene	16	11000	UG/KG	NO
Trichloroethene	140	3000	UG/KG	NO

* - Soil screening levels for transfers from soil to air were obtained from USEPA Region III Risk-Based Concentration Table, June 1996.

10.3.13 Fixed-Point Risk Evaluation for SWMUs 22 and 25 and AOC 554

10.3.13.1 Site Background and Investigative Approach

SWMU 22 is the old plating shop waste water treatment system (Building 5). SWMU 25 is the old plating operation (Building 44). AOC 554 was formerly the location of a paint shop operation (Building 1003). The following refers to these sites as combined SWMU 22. All are located in a highly industrialized portion of Zone E. As a result, the risk assessment for this site is presented as a FRE following the framework presented in Section 7.3. Due to their proximity, the investigational effort for these sites was combined. As a result, the risk evaluation will combine the environmental data from all three sites.

A total of seventeen surface soil samples were considered in the combined SWMU 22 FRE. During the 1993 investigation of SWMU 22 and SWMU 25, three surface soil samples were collected. Fourteen soil samples were collected from the upper interval as part of the 1995 RFI sampling effort: two from SWMU 22, 10 from SWMU 25, and two from AOC 554. Three monitoring wells were installed as part of the original 1993 investigation and one monitoring well was installed as part of the 1995 RFI. All four monitoring wells were installed into the shallow aquifer. Groundwater data generated from the first-quarter RFI sampling event are used to represent point risk/hazard for the combined SWMU 22 FRE. Sections 10.3.2 and 10.3.4 contain summaries of the sampling effort for combined SWMU 22 soil and groundwater.

10.3.13.2 Fixed-Point Risk Evaluation for Soil

Residential Scenario

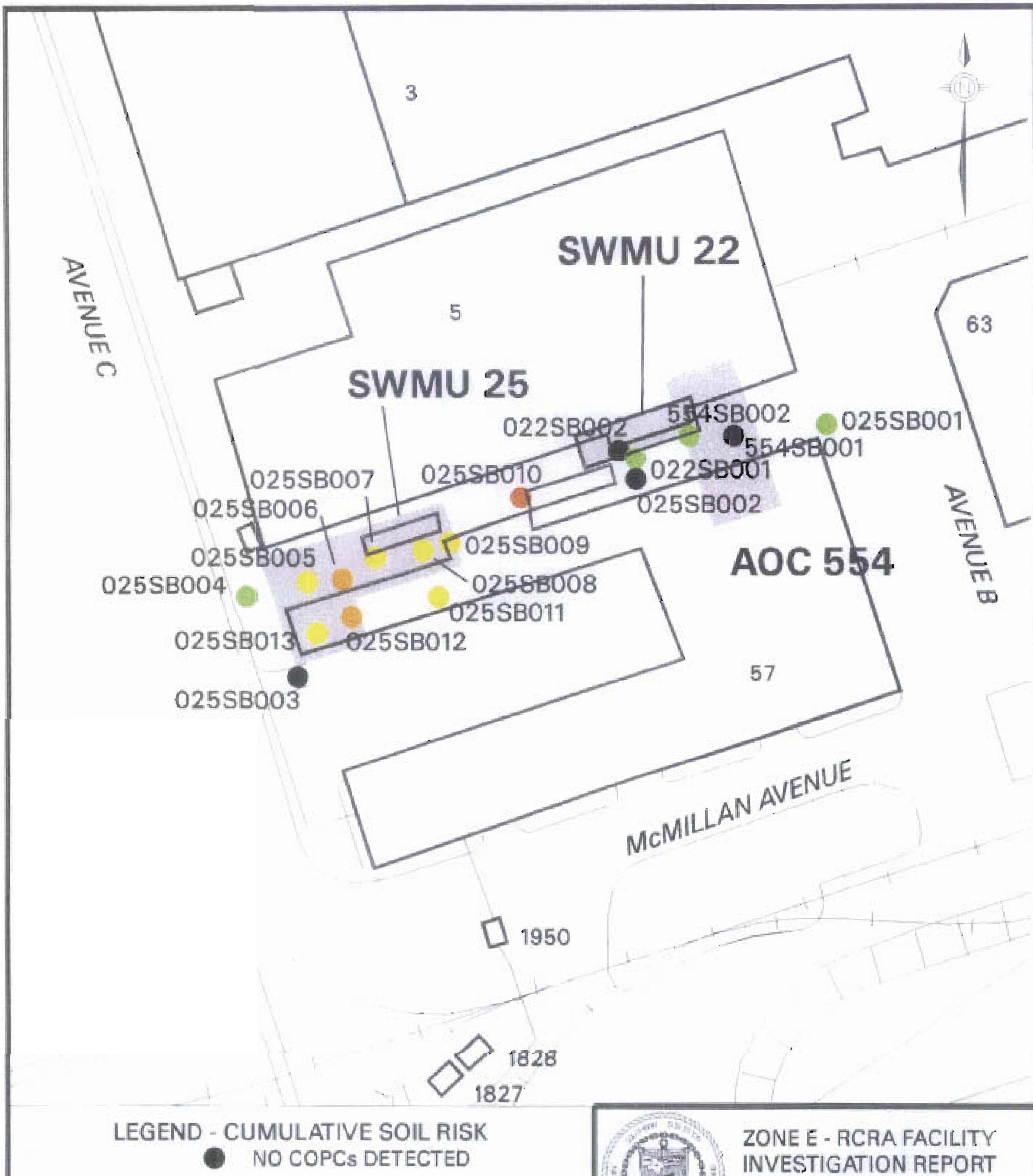
Table 10.3.13.1 provides CPSS summaries for combined SWMU 22 soil and identifies COPCs based on comparison to residential and industrial RBCs and background RCs. Based on residential RBCs, six COPCs (antimony, BEQs, cadmium, chromium, copper, and lead) were identified for combined SWMU 22 soil. Chromium, which predominantly exists in either the trivalent or hexavalent state, was identified as a COPC based on a conservative comparison of the maximum concentration (regardless of valence) to the RBC for its hexavalent species (39 mg/kg). Analyses for hexavalent chromium in soil indicate that the trivalent state predominates for combined SWMU 22 surface soil. The RBC for trivalent chromium is 7,800 mg/kg. Since it is evident that combined SWMU 22 chromium in soil predominantly exist in the less toxic trivalent state, chromium was eliminated as a COPC. Arsenic, beryllium, and manganese were detected in combined SWMU 22 soil at concentrations above their RBCs but were eliminated from consideration in the residential FRE based on comparison to their background concentrations. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration.

Table 10.3.13.2 summarizes the residential COPCs detected at each combined SWMU 22 sample location with contribution to risk and hazard. As shown, BEQs are the only contributors to risk for combined SWMU 22, exceeding 1E-06 at nine of 17 locations. No carcinogenic COPC were detected at sample locations 022SB002, 025SB002, 025SB003, and 554SB001. Figure 10.3.5 is a spatial presentation of residential risk estimates for combined SWMU 22 soil. For samples with concentrations of carcinogenic COPCs, risk estimates range from 7E-10 to 1E-05 with an arithmetic mean risk of 3E-06. The arithmetic mean was calculated assuming a deminimus risk level of 1E-07 for locations were no carcinogenic COPCs were detected.

HI projections did not exceed the threshold of unity at any sample locations. HI estimates range from 0.001 to 0.5.

Industrial Scenario

Based on industrial RBCs, chromium was identified as a COPC for combined SWMU 22 soil. As with the residential scenario, since it is evident that combined SWMU 22 chromium in soil predominantly exist in the less toxic trivalent state, chromium was eliminated as a COPC. Arsenic was detected in combined SWMU 22 soil at concentrations above its industrial RBC but was



LEGEND - CUMULATIVE SOIL RISK

- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 150

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

FIGURE 10.3.5
CUMULATIVE SOIL RISK
RESIDENTIAL SCENARIO
SWMU 22,25 AOC 554

eliminated from consideration in the industrial FRE 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 based on background concentration.

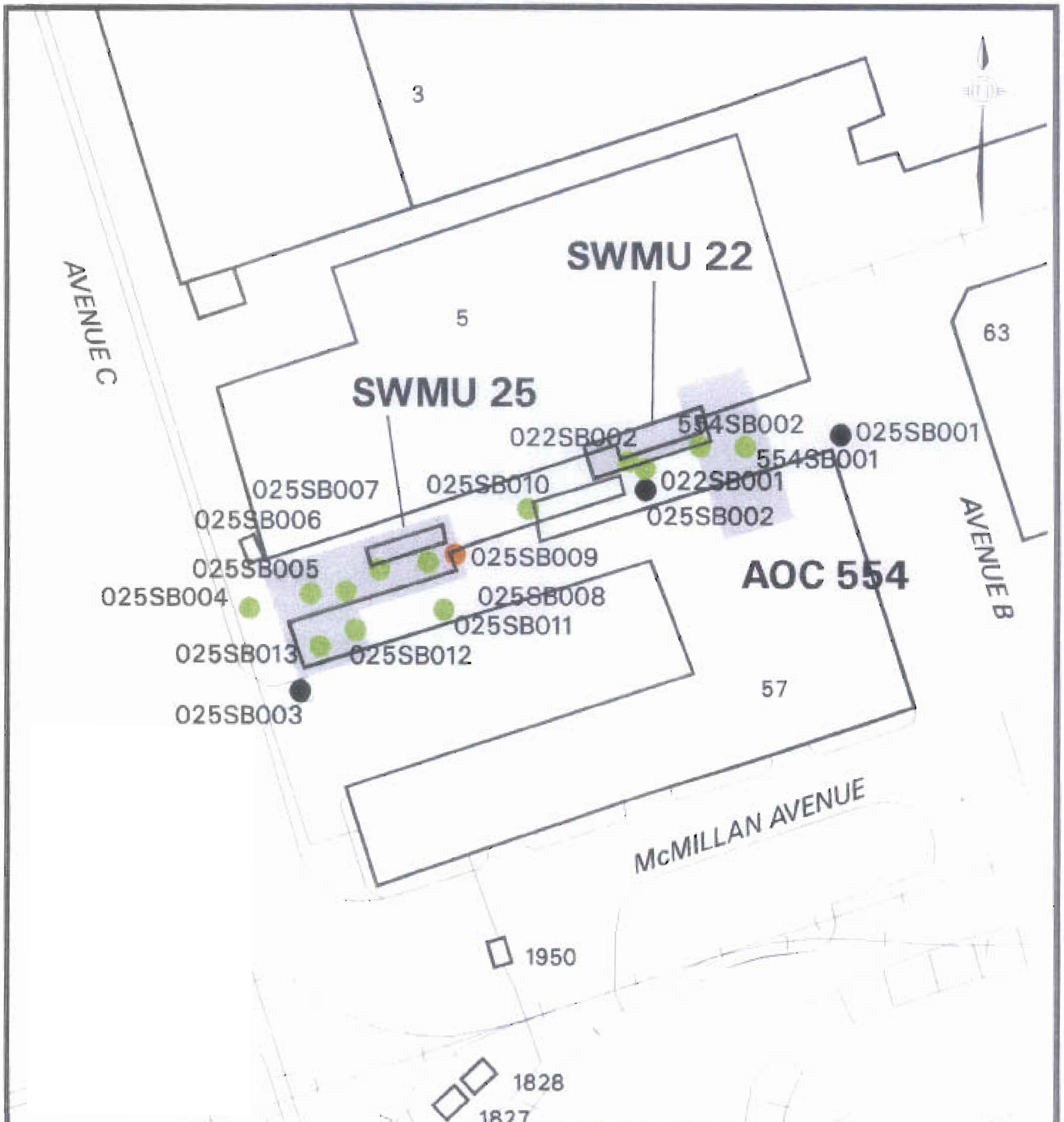
Lead

Lead was detected in all 17 surface soil samples collected at combined SWMU 22. Soil concentrations ranged from 3.6 to 469 mg/kg and exceeded the residential clean up level of 400 mg/kg in one of 14 samples (025SB009). The mean detected lead concentration for combined SWMU 22 is 79.9 mg/kg which is well below both the action level of 400 mg/kg, considered protective of children under a residential scenario, and the industrial cleanup level of 1,300 mg/kg, considered protective of adults under an industrial scenario. Figure 10.3.6 is a spatial presentation of lead soil concentrations, using the surface soil background concentration of 265 mg/kg, the residential soil lead cleanup level of 400 mg/kg, and the industrial soil lead cleanup concentration of 1,300 mg/kg as benchmark levels to illustrate the lead soil concentrations for combined SWMU 22.

10.3.13.3 Fixed-Point Risk Evaluation for Groundwater

Residential Scenario

Table 10.3.13.3 provides CPSS summaries for combined SWMU 22 groundwater and identifies COPCs. Antimony, cadmium, chlordane (alpha and gamma), chromium, nickel, tetrachloroethene, and trichloroethene were identified as groundwater COPCs based on comparison of first-quarter groundwater concentrations to tap-water RBCs. Manganese was detected in combined SWMU 22 groundwater at concentrations above its RBC but was eliminated from consideration in the FRE 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 based on background concentration.



LEAD IN SURFACE SOIL

- NON DETECT
- < 265
- 265 - 400
- 401 - 1,300
- > 1,300

0 feet 150

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

FIGURE 10.3.6
DISTRIBUTION OF LEAD
IN SURFACE SOIL
SWMU 22,25 AOC 554

Table 10.3.13.4 summarizes the COPCs identified in combined SWMU 22 monitoring wells sampled during the first quarter. Risk projections above 1E-06 were associated with concentrations of chlordane (alpha and gamma) in the groundwater sample collected from monitoring well NBCE025001 and concentrations of tetrachloroethene and trichloroethene in groundwater samples collected from monitoring well NBCE025W003. Trichloroethene was detected in the first-quarter groundwater sample collected from monitoring well NBCE025004 at a concentration equating with a risk of 5E-07. Monitoring well NBCE025002 had no carcinogenic COPCs detected in the first-quarter groundwater sample. For the groundwater samples with concentrations of carcinogenic COPCs, risk projections ranged from 5E-07 to 6E-06 with an arithmetic mean risk of 3E-06. The arithmetic mean was calculated assuming a deminimus risk level of 1E-07 for locations were no carcinogenic COPC were detected. Figure 10.3.7 illustrates the groundwater data as a function of point-specific risk projections.

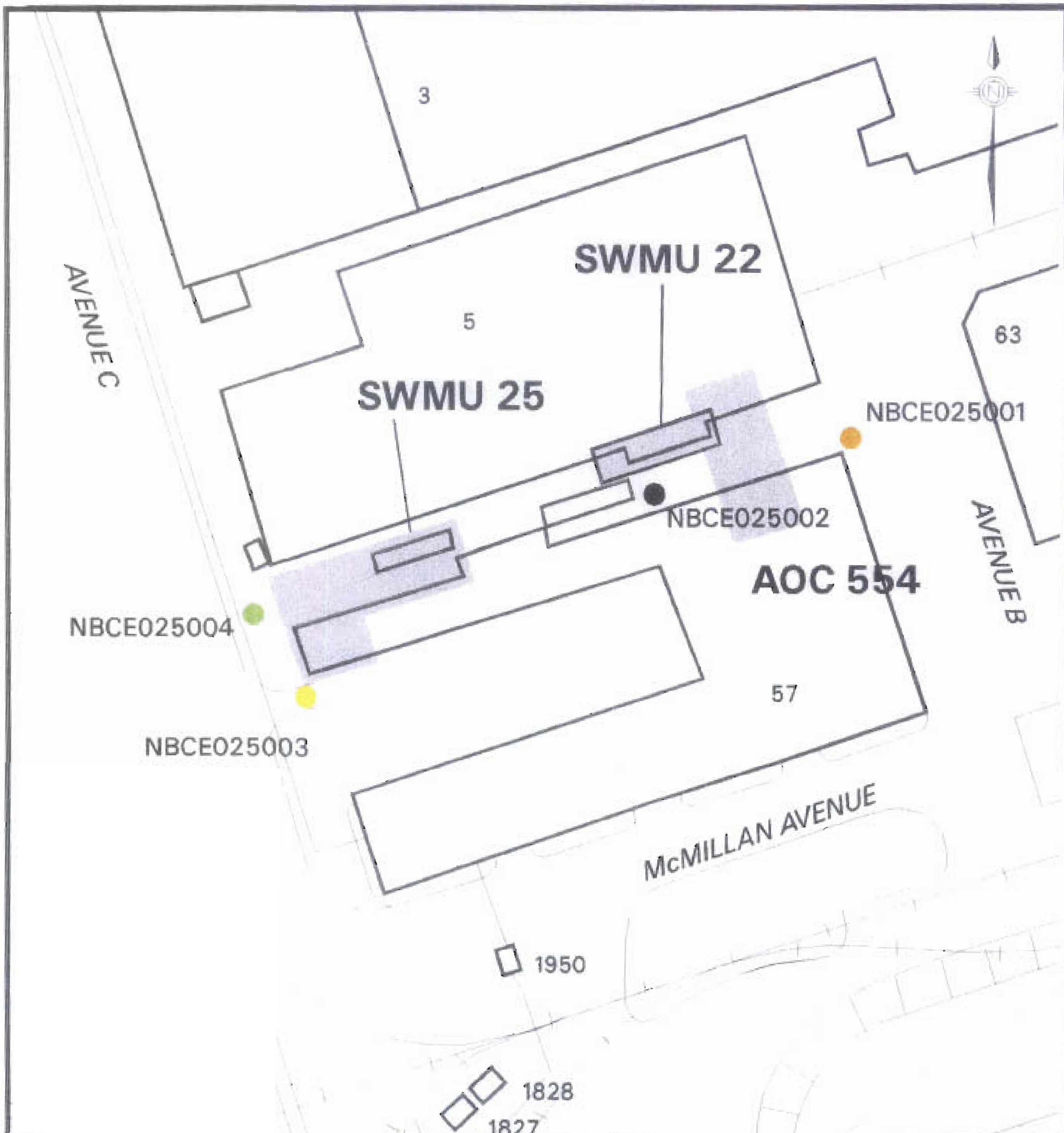
Three monitoring wells (NBCE025002, NBCE025003, and NBCE025004) produced results corresponding with HIs above unity. Cadmium, chromium (assumed to be hexavalent), and nickel were the primary contributor to HI projections. HIs ranged from 0.5 (NBCE025001) to 24 (NBCE025003). The arithmetic mean HI for combined SWMU 22 is 7. Figure 10.3.8 illustrates the groundwater data as a function of point-specific hazard projections.

10.3.13.4 Uncertainty

SWMU 22 uncertainty issues specific to the FRE and essential to the risk management process are presented in the following paragraphs.

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure.



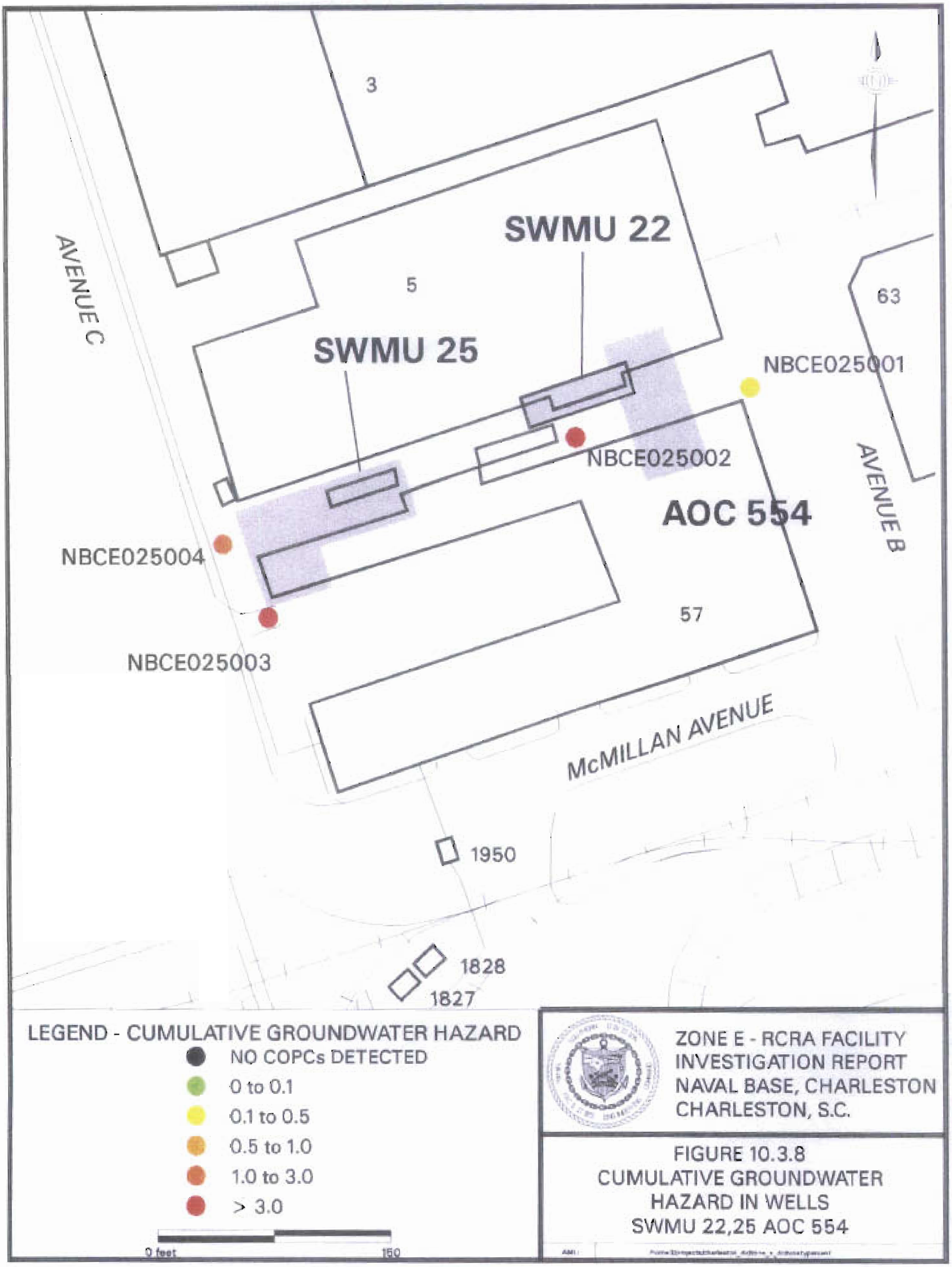
LEGEND - CUMULATIVE GROUNDWATER RISK

- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 150

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

FIGURE 10.3.7
CUMULATIVE GROUNDWATER RISK IN WELLS
SWMU 22,25 AOC 554



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

FIGURE 10.3.8
CUMULATIVE GROUNDWATER HAZARD IN WELLS
SWMU 22,25 AOC 554

Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use of Zone E, specifically as a marine cargo terminal and drydocking facility. The ground surface around SWMUs 22 and 25 and AOC 554 is currently covered with either asphalt or concrete. As a result, chronic exposure to current soil condition is highly unlikely and the associated direct contact exposure pathways evaluations overestimate risk and hazard. If this area were to be redeveloped, the buildings and other structures would be demolished, and the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, chronic exposure to current surface soil conditions would not be likely under any future use scenario. These factors indicate that exposure pathways assessed in this FRE would generally overestimate the risk and hazard posed to current/future site workers and future site residents.

Groundwater is not currently used as a potable water source at combined SWMU 22, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.

COPC Selection

Chromium was identified as a COPC in both soil and groundwater based on a conservative comparison to the RBC for the hexavalent species. Three surface soil samples were analyzed for hexavalent chromium and had no detectable concentrations. Chromium was therefore eliminated as a soil COPC based on comparison to the RBC for trivalent chromium. Conversely, no hexavalent chromium data was gathered for combined SWMU 22, and as a result, concentrations of chromium in groundwater were considered to exist in the more toxic hexavalent state.

Hexavalent chromium was not detected in groundwater in samples collected at other Zone E sites. This findings indicate that hazard estimates associated with chromium in combined SWMU 22 groundwater may be overestimates.

Chlordane (alpha and gamma) was identified as a COPC based on the groundwater sample collected from monitoring well NBCE025001. This monitoring well was established near the corner of Building 44. The concentrations of chlordane in groundwater may reflect monitoring well installation artifacts from historical pesticide application to the Building 44 foundation. Results from quarterly groundwater sampling should be considered prior to any risk management decision based on concentrations of chlordane in groundwater.

Quantification of Risk/Hazard

Soil

A conservative screening process was used to identify COPCs for combined SWMU 22. The potential for eliminating CPSSs with the potential for cumulative HI greater than one was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment based on comparison to RBCs, aluminum, barium, mercury, nickel, thallium, vanadium, and zinc were reported at a concentration close to the RBC (e.g. within 10% of their RBCs). Of these, only zinc and thallium were detected at a concentration above their background RC.

Arsenic, beryllium, and manganese were present in combined SWMU 22 soil at concentrations above RBC benchmarks and were eliminated from consideration in the FRE based on comparison to background concentration. As a result, their contribution to risk and hazard has not been considered in this FRE.

Groundwater

The same conservative screening process used for soil was also applied to groundwater. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, aluminum, selenium, and 1,2-dichloroethene (total) were reported at concentrations close to their RBCs (e.g. within 10% of their RBCs).

10.3.13.5 FRE Summary

The risk and hazard posed by contaminants at combined SWMU 22 were assessed for the future site worker and the future site resident as sample point-specific estimates. In surface soils, the incidental ingestion and dermal contact pathways are reflected. The groundwater FRE was based on first-quarter data and considers the ingestion and inhalation (VOCs only) pathways. Risk and HI estimates are presented on Tables 10.3.13.2 and 10.3.13.4 such that a risk (E-06) or HI that exceed one for any COPC at any given sample location is an indication that the concentration of that COPC exceeds its RGO. Section 7, Tables 7.3.1, 7.3.2, and 7.3.3 provide residential, industrial, and residential groundwater RGOs, respectively, for all of the COPCs identified for Zone E.

Soil — Residential Scenario

BEQs were detected in combined SWMU 22 surface soil at concentrations above their RGOs.

Soil — Site Worker Scenario

No COPCs were identified based on the comparison of maximum surface soil concentrations to industrial RBCs and background RCs.

Groundwater — Residential Scenario

Chlordane (alpha and gamma), cadmium, chromium (assumed to be hexavalent), nickel, tetrachloroethene, and trichloroethene were detected in combined SWMU 22 groundwater at concentrations above their RGOs.

Table 10.3.13.1
Chemicals Present in Site Sample
SWMUs 22, 25; AOC 554-Surface Soil
NAVBASE-Charleston
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration: Residential RBC	Industrial RBC	Reference	Units	Number Exceeding: Res. RBC	Ind. RBC	Ref.
Inorganics													
Aluminum (Al)		17	17	2740 - 7340	4710.59	NA - NA	7800	100000	26600	mg/kg			
Antimony (Sb)	*	4	17	0.8 - 5.1	2.13	0.43 - 5.7	3.1	82	1.77	mg/kg	1		1
Arsenic (As)		15	17	1.1 - 6.2	3.35	1.1 - 5.7	0.43	3.8	23.9	mg/kg	15	5	
Barium (Ba)		17	17	10 - 93.5	32.61	NA - NA	550	14000	130	mg/kg			
Beryllium (Be)		14	17	0.16 - 0.42	0.27	0.54 - 0.57	0.15	1.3	1.7	mg/kg	14		
Cadmium (Cd)	*	9	17	0.14 - 30.9	9.84	0.44 - 1.1	3.9	100	1.5	mg/kg	4		4
Calcium (Ca)	N	17	17	598 - 140000	13833.06	NA - NA	NA	NA	NA	mg/kg			
Chromium (Cr)	* *	17	17	4.7 - 1080	106.38	NA - NA	39	1000	94.6	mg/kg	6	1	2
Chromium (Hexavalent)	* *	0	3	ND - ND	ND	0.055 - 0.062	39	1000	NA	mg/kg			
Cobalt (Co)		14	17	0.45 - 23	5.80	1.1 - 1.1	470	12000	19	mg/kg			1
Copper (Cu)	*	17	17	4.5 - 539	62.02	NA - NA	310	8200	66	mg/kg	1		3
Cyanide (CN)		3	15	0.46 - 16.6	5.87	0.22 - 1.1	160	4100	NA	mg/kg			
Iron (Fe)	N	17	17	1800 - 13400	4847.65	NA - NA	NA	NA	NA	mg/kg			
Lead (Pb)	*	17	17	3.6 - 469	79.90	NA - NA	400	1300	265	mg/kg	1		1
Magnesium (Mg)	N	17	17	134 - 4310	618.53	NA - NA	NA	NA	NA	mg/kg			
Manganese (Mn)		17	17	11 - 215	63.06	NA - NA	180	4700	302	mg/kg	1		
Mercury (Hg)		15	17	0.048 - 2.2	0.31	0.02 - 0.03	2.3	61	2.6	mg/kg			
Nickel (Ni)		14	17	1.3 - 85.1	20.69	4.3 - 4.5	160	4100	77.1	mg/kg			2
Potassium (K)	N	8	17	120 - 1150	374.00	88.8 - 945	NA	NA	NA	mg/kg			
Selenium (Se)		3	17	0.62 - 0.83	0.71	0.54 - 5.4	39	1000	1.7	mg/kg			
Silver (Ag)		8	17	0.24 - 4.4	1.48	0.22 - 1.1	39	1000	NA	mg/kg			
Sodium (Na)	N	9	17	32.6 - 643	196.57	24.1 - 98.8	NA	NA	NA	mg/kg			
Thallium (Tl)		1	17	0.56 - 0.56	0.56	0.54 - 1.1	0.63	16	2.8	mg/kg			
Tin (Sn)		2	14	14.9 - 98.3	56.60	2.2 - 11.3	4700	100000	59.4	mg/kg			1
Vanadium (V)		17	17	3.7 - 18.4	8.34	NA - NA	55	1400	94.3	mg/kg			
Zinc (Zn)		17	17	8.6 - 1040	132.06	NA - NA	2300	61000	827	mg/kg			1

Table 10.3.13.1
Chemicals Present in Site Sample
SWMUs 22, 25; AOC 554-Surface Soil
NAVBASE-Charleston
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Screening Concentration Industrial RBC	Reference	Units	Number Exceeding Res. RBC	Number Exceeding Ind. RBC	Number Exceeding Ref.
Pesticides													
gamma-Chlordane		1	14	2 - 2	2.00	1.4 - 1.8	490	4400	NA	mg/kg			
4,4'-DDT		2	14	4.35 - 7.2	5.78	2.7 - 3.4	1900	17000	NA	mg/kg			
Endrin ketone		1	14	2.8 - 2.8	2.80	2.7 - 3.4	2300	61000	NA	mg/kg			
Carcinogenic PAHs													
Benzo(a)pyrene Equiv.	*	13	17	0.042 - 656.11	224.94	NA - NA	88	780	NA	ug/kg	8		
Benzo(a)anthracene		10	17	40 - 380	167.80	360 - 720	880	7800	NA	ug/kg			
Benzo(a)pyrene	*	10	17	51 - 380	187.20	360 - 720	88	780	NA	ug/kg	7		
Benzo(b)fluoranthene		12	17	40 - 560	190.42	360 - 440	880	7800	NA	ug/kg			
Benzo(k)fluoranthene		8	17	48 - 370	164.25	350 - 440	8800	78000	NA	ug/kg			
Chrysene		11	17	42 - 410	193.55	360 - 720	88000	780000	NA	ug/kg			
Dibenz(a,h)anthracene	*	7	17	40 - 150	74.71	360 - 720	88	780	NA	ug/kg	2		
Indeno(1,2,3-cd)pyrene		8	17	55 - 280	147.00	360 - 720	880	7800	NA	ug/kg			
Semivolatile Organics													
Acenaphthene		1	17	82 - 82	82.00	350 - 720	470000	12000000	NA	ug/kg			
Anthracene		4	17	42 - 82	60.25	350 - 720	2300000	61000000	NA	ug/kg			
Benzo(g,h,i)perylene		10	17	44 - 300	149.30	360 - 720	310000	8200000	NA	ug/kg			
Carbazole		1	3	42 - 42	42.00	410 - 720	32000	290000	NA	ug/kg			
Dibenzofuran		2	17	50 - 56	53.00	350 - 720	31000	820000	NA	ug/kg			
1,2-Dichlorobenzene		1	17	46 - 46	46.00	350 - 720	700000	18000000	NA	ug/kg			
bis(2-Ethylhexyl)phthalate		4	17	63 - 3200	965.75	350 - 720	46000	410000	NA	ug/kg			
Fluoranthene		14	17	33 - 610	240.79	360 - 720	310000	8200000	NA	ug/kg			
Fluorene		1	17	89 - 89	89.00	350 - 720	310000	8200000	NA	ug/kg			
2-Methylnaphthalene		2	17	40 - 200	120.00	350 - 720	310000	8200000	NA	ug/kg			
Naphthalene		1	17	160 - 160	160.00	350 - 720	310000	8200000	NA	ug/kg			
Phenanthrene		11	17	38 - 470	133.91	360 - 720	310000	8200000	NA	ug/kg			
Pyrene		15	17	45 - 640	232.27	360 - 360	230000	6100000	NA	ug/kg			

Table 10.3.13.1
Chemicals Present in Site Sample
SWMUs 22, 25; AOC 554-Surface Soil
NAVBASE-Charleston
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Industrial RBC	Reference	Units	Number Exceeding Res. RBC	Ind. RBC	Ref.
TCDD Equivalents												
Dioxin Equiv.	3	3	0.0043 - 1.2365	0.42	NA - NA	1000	1000	NA	ng/kg			
Volatile Organics												
Acetone	2	17	12 - 88	50.00	11 - 57	780000	20000000	NA	ug/kg			
Bromodichloromethane	1	17	3 - 3	3.00	5 - 7	10000	92000	NA	ug/kg			
Chloroform	1	17	9 - 9	9.00	5 - 7	100	940	NA	mg/kg			
Methylene chloride	7	17	2 - 43	15.71	5.4 - 16	85000	760000	NA	ug/kg			
Tetrachloroethene	6	17	1 - 16	5.25	5 - 6	12000	110000	NA	ug/kg			
Trichloroethene	10	17	2 - 140	33.60	5 - 6	58000	520000	NA	ug/kg			

Notes:
* - Identified as a residential COPC
** - Indentified as an industrial COPC
N - Essential Nutrient
mg/kg - milligrams per kilogram
ug/kg - micrograms per kilogram
ng/kg - nanograms per kilogram
SQL - Sample Quantitation Limit

Table 10.3.13.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 22, 25, and AOC 554
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
025	B001	Antimony	ND	MG/KG	NA		NA	
025	B001	B(a)P Equiv.	4.04	UG/KG	0.0669	100.00	NA	
025	B001	Cadmium (Cd)	ND	MG/KG	NA		NA	
025	B001	Copper	6.10	MG/KG	NA		0.0021	100.00
025	B001	Lead	7.90	MG/KG	NA		NA	
		Total			0.0669		0.0021	
025	B002	Antimony	ND	MG/KG	NA		NA	
025	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
025	B002	Cadmium	ND	MG/KG	NA		NA	
025	B002	Copper	4.80	MG/KG	NA		0.0016	100.00
025	B002	Lead	15.00	MG/KG	NA		NA	
		Total			NA		0.0016	
025	B003	Antimony	ND	MG/KG	NA		NA	
025	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
025	B003	Cadmium	ND	MG/KG	NA		NA	
025	B003	Copper	10.00	MG/KG	NA		0.0034	100.00
025	B003	Lead	16.00	MG/KG	NA		NA	
		Total			NA		0.0034	
022	B001	Antimony	ND	MG/KG	NA		NA	
022	B001	B(a)P Equiv.	0.04	UG/KG	0.0007	100.00	NA	
022	B001	Cadmium	ND	MG/KG	NA		NA	
022	B001	Copper	7.80	MG/KG	NA		0.0027	100.00
022	B001	Lead	15.60	MG/KG	NA		NA	
		Total			0.0007		0.0027	
022	B002	Antimony	ND	MG/KG	NA		NA	
022	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
022	B002	Cadmium	ND	MG/KG	NA		NA	
022	B002	Copper	11.50	MG/KG	NA		0.0034	100.00
022	B002	Lead	5.60	MG/KG	NA		NA	
		Total			NA		0.0034	
025	B004	Antimony (Sb)	ND	MG/KG	NA		NA	
025	B004	B(a)P Equiv.	9.29	UG/KG	0.1538	100.00	NA	
025	B004	Cadmium (Cd)	ND	MG/KG	NA		NA	
025	B004	Copper (Cu)	4.50	MG/KG	NA		0.0015	100.00
025	B004	Lead (Pb)	10.70	MG/KG	NA		NA	
		Total			0.1538		0.0015	

Table 10.3.13.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 22, 25, and AOC 554
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
025	B005	Antimony (Sb)	0.80	MG/KG	NA		0.0274	7.98
025	B005	B(a)P Equiv.	292.99	UG/KG	4.8520	100.00	NA	
025	B005	Cadmium (Cd)	21.90	MG/KG	NA		0.3000	87.32
025	B005	Copper (Cu)	47.10	MG/KG	NA		0.0161	4.70
025	B005	Lead (Pb)	156.00	MG/KG	NA		NA	
		Total			4.8520		0.3436	
025	B006	Antimony (Sb)	ND	MG/KG	NA		NA	
025	B006	B(a)P Equiv.	509.34	UG/KG	8.4348	100.00	NA	
025	B006	Cadmium (Cd)	20.90	MG/KG	NA		0.2863	90.30
025	B006	Copper (Cu)	89.70	MG/KG	NA		0.0307	9.70
025	B006	Lead (Pb)	42.50	MG/KG	NA		NA	
		Total			8.4348		0.3171	
025	B007	Antimony (Sb)	0.81	MG/KG	NA		0.0278	54.12
025	B007	B(a)P Equiv.	107.20	UG/KG	1.7753	100.00	NA	
025	B007	Cadmium (Cd)	0.81	MG/KG	NA		0.0111	21.63
025	B007	Copper (Cu)	36.30	MG/KG	NA		0.0124	24.25
025	B007	Lead (Pb)	56.40	MG/KG	NA		NA	
		Total			1.7753		0.0513	
025	B008	Antimony (Sb)	1.80	MG/KG	NA		0.0617	64.81
025	B008	B(a)P Equiv.	187.17	UG/KG	3.0996	100.00	NA	
025	B008	Cadmium (Cd)	1.20	MG/KG	NA		0.0164	17.26
025	B008	Copper (Cu)	49.80	MG/KG	NA		0.0171	17.93
025	B008	Lead (Pb)	139.00	MG/KG	NA		NA	
		Total			3.0996		0.0952	
025	B009	Antimony (Sb)	5.10	MG/KG	NA		0.1748	33.02
025	B009	B(a)P Equiv.	246.78	UG/KG	4.0868	100.00	NA	
025	B009	Cadmium (Cd)	12.40	MG/KG	NA		0.1699	32.08
025	B009	Copper (Cu)	539.00	MG/KG	NA		0.1848	34.90
025	B009	Lead (Pb)	469.00	MG/KG	NA		NA	
		Total			4.0868		0.5295	
025	B010	Antimony (Sb)	ND	MG/KG	NA		NA	
025	B010	B(a)P Equiv.	656.11	UG/KG	10.8654	100.00	NA	
025	B010	Cadmium (Cd)	0.18	MG/KG	NA		0.0025	18.08
025	B010	Copper (Cu)	32.60	MG/KG	NA		0.0112	81.92
025	B010	Lead (Pb)	216.00	MG/KG	NA		NA	
		Total			10.8654		0.0136	

Table 10.3.13.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 22, 25, and AOC 554
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
025	B011	Antimony (Sb)	ND	MG/KG	NA		NA	
025	B011	B(a)P Equiv.	82.05	UG/KG	1.3588	100.00	NA	
025	B011	Cadmium (Cd)	0.14	MG/KG	NA		0.0019	40.85
025	B011	Copper (Cu)	8.10	MG/KG	NA		0.0028	59.15
025	B011	Lead (Pb)	22.60	MG/KG	NA		NA	
		Total			1.3588		0.0047	
025	B012	Antimony (Sb)	ND	MG/KG	NA		NA	
025	B012	B(a)P Equiv.	510.36	UG/KG	8.4517	100.00	NA	
025	B012	Cadmium (Cd)	30.90	MG/KG	NA		0.4233	96.03
025	B012	Copper (Cu)	51.10	MG/KG	NA		0.0175	3.97
025	B012	Lead (Pb)	129.00	MG/KG	NA		NA	
		Total			8.4517		0.4408	
025	B013	Antimony (Sb)	ND	MG/KG	NA		NA	
025	B013	B(a)P Equiv.	258.50	UG/KG	4.2808	100.00	NA	
025	B013	Cadmium (Cd)	0.14	MG/KG	NA		0.0019	31.26
025	B013	Copper (Cu)	12.30	MG/KG	NA		0.0042	68.74
025	B013	Lead (Pb)	15.70	MG/KG	NA		NA	
		Total			4.2808		0.0061	
554	B001	Antimony (Sb)	ND	MG/KG	NA		NA	
554	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
554	B001	Cadmium (Cd)	ND	MG/KG	NA		NA	
554	B001	Copper (Cu)	133.00	MG/KG	NA		0.0456	100.00
554	B001	Lead (Pb)	3.60	MG/KG	NA		NA	
		Total			NA		0.0456	
554	B002	Antimony (Sb)	ND	MG/KG	NA		NA	
554	B002	B(a)P Equiv.	60.34	UG/KG	0.9992	100.00	NA	
554	B002	Cadmium (Cd)	ND	MG/KG	NA		NA	
554	B002	Copper (Cu)	10.60	MG/KG	NA		0.0036	100.00
554	B002	Lead (Pb)	37.70	MG/KG	NA		NA	
		Total			0.9992		0.0036	

Table 10.3.13.3
Chemical Present in Site Samples
SWMUs 22, 25; AOC 554 - Shallow Groundwater
NAVBASE-Charleston
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Screening Concentration Reference	Units	Number Exceeding Res.	Number Exceeding Ref.
Inorganics											
Aluminum (Al)		3	4	327 - 1020	589.67	49.5 - 49.5	3700	2810	ug/L		
Antimony (Sb)	*	1	4	4.1 - 4.1	4.10	4 - 4	1.5	NA	ug/L	1	
Barium (Ba)		4	4	7.3 - 26.5	15.60	NA - NA	260	211	ug/L		
Cadmium (Cd)	*	3	4	1.2 - 84	30.50	1 - 1	1.8	NA	ug/L	2	
Calcium (Ca)	N	4	4	1580 - 33600	21370.00	NA - NA	NA	NA	ug/L		
Chromium (Cr)	*	4	4	12.6 - 843	289.90	NA - NA	18	12.3	ug/L	4	4
Copper (Cu)		2	4	4 - 7.5	5.75	2 - 2	150	2.7	ug/L		2
Iron (Fe)	N	3	4	67.2 - 1080	490.07	20 - 20	NA	NA	ug/L		
Magnesium (Mg)	N	4	4	1300 - 3960	2450.00	NA - NA	NA	NA	ug/L		
Manganese (Mn)		4	4	6.9 - 320	94.73	NA - NA	84	2560	ug/L	1	
Nickel (Ni)	*	3	4	5.7 - 513	179.67	1 - 1	73	15.2	ug/L	1	2
Potassium (K)	N	4	4	1810 - 12700	7447.50	NA - NA	NA	NA	ug/L		
Selenium (Se)		1	4	6.1 - 6.1	6.10	5 - 5	18	NA	ug/L		
Sodium (Na)	N	4	4	4960 - 23400	10382.50	NA - NA	NA	NA	ug/L		
Vanadium (V)		3	4	1.7 - 2.3	2.03	1 - 1	26	11.4	ug/L		
Zinc (Zn)		3	4	4.5 - 48.3	20.40	4 - 4	1100	27.3	ug/L		1
Pesticides											
alpha-Chlordane	*	1	4	0.16 - 0.16	0.16	0.04 - 0.04	0.052	NA	ug/L	1	
gamma-Chlordane	*	1	4	0.12 - 0.12	0.12	0.04 - 0.04	0.052	NA	ug/L	1	
Semivolatile Organics											
Acenaphthene		1	4	1 - 1	1.00	10 - 10	220	NA	ug/L		
Naphthalene		1	4	6 - 6	6.00	10 - 10	150	NA	ug/L		

Table 10.3.13.3
Chemical Present in Site Samples
SWMUs 22, 25; AOC 554 - Shallow Groundwater
NAVBASE-Charleston
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Screening Concentration Reference	Units	Number Exceeding Res.	Number Exceeding Ref.
Volatile Organics											
1,2-Dichloroethene (total)		1	4	2 - 2	2.00	5 - 5	5.5	NA	ug/L		
Tetrachloroethene	*	2	4	1 - 3	2.00	5 - 5	1.1	NA	ug/L	1	
Trichloroethene	*	2	4	2 - 4	3.00	5 - 5	1.6	NA	ug/L	2	

Notes:
* - Identified as a COPC
N - Essential Nutrient
ug/L - micrograms per liter
SQL - Sample Quantitation Limit

Table 10.1.3.13.4
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMUs 22 and 25; AOC 554
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
025	G001	Antimony (Sb)	ND	UG/L	NA		NA	
025	G001	Cadmium (Cd)	ND	UG/L	NA		NA	
025	G001	Chromium (Cr)	12.60	UG/L	NA		0.1611	34.12
025	G001	Nickel (Ni)	ND	UG/L	NA		NA	
025	G001	Tetrachloroethene	1.00	UG/L	0.8036	13.01	0.0128	2.71
025	G001	Trichloroethene	ND	UG/L	NA		NA	
025	G001	alpha-Chlordane	0.16	UG/L	3.0697	49.71	0.1705	36.10
025	G001	gamma-Chlordane	0.12	UG/L	2.3023	37.28	0.1279	27.08
		Total			6.1756		0.4722	
025	G002	Antimony (Sb)	ND	UG/L	NA		NA	
025	G002	Cadmium (Cd)	6.30	UG/L	NA		0.8055	25.71
025	G002	Chromium (Cr)	177.00	UG/L	NA		2.2630	72.22
025	G002	Nickel (Ni)	20.30	UG/L	NA		0.0649	2.07
025	G002	Tetrachloroethene	ND	UG/L	NA		NA	
025	G002	Trichloroethene	ND	UG/L	NA		NA	
025	G002	alpha-Chlordane	ND	UG/L	NA		NA	
025	G002	gamma-Chlordane	ND	UG/L	NA		NA	
		Total			NA		3.1334	
025	G003	Antimony (Sb)	4.10	UG/L	NA		0.6553	2.74
025	G003	Cadmium (Cd)	84.00	UG/L	NA		10.7397	44.87
025	G003	Chromium (Cr)	843.00	UG/L	NA		10.7781	45.03
025	G003	Nickel (Ni)	513.00	UG/L	NA		1.6397	6.85
025	G003	Tetrachloroethene	3.00	UG/L	2.4107	70.45	0.0384	0.16
025	G003	Trichloroethene	4.00	UG/L	1.0114	29.55	0.0852	0.36
025	G003	alpha-Chlordane	ND	UG/L	NA		NA	
025	G003	gamma-Chlordane	ND	UG/L	NA		NA	
		Total			3.4221		23.9364	
025	G004	Antimony (Sb)	ND	UG/L	NA		NA	
025	G004	Cadmium (Cd)	1.20	UG/L	NA		0.1534	8.35
025	G004	Chromium (Cr)	127.00	UG/L	NA		1.6237	88.34
025	G004	Nickel (Ni)	5.70	UG/L	NA		0.0182	0.99
025	G004	Tetrachloroethene	ND	UG/L	NA		NA	
025	G004	Trichloroethene	2.00	UG/L	0.5057	100.00	0.0426	2.32
025	G004	alpha-Chlordane	ND	UG/L	NA		NA	
025	G004	gamma-Chlordane	ND	UG/L	NA		NA	
		Total			0.5057		1.8380	

10.3.14 Corrective Measures Considerations

For SWMUs 22 and 25 and AOC 554, the upper and lower soil intervals and the shallow groundwater were investigated. Based on the analytical results and the FRE, COCs requiring further evaluation through the CMS process were identified for the upper soil interval and shallow groundwater. However, residential use of the site is not expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use, marine cargo terminal and drydock. The ground surface around the SWMUs 22 and 25 and AOC 554 is capped with either asphalt or concrete. As a result, chronic exposure to current soil conditions is highly unlikely. A FRE substituted for a full risk assessment.

Six COPCs were identified for combined SWMU 22 soil: antimony, cadmium, chromium, copper, lead, and BEQs. Arsenic, beryllium, and manganese were detected in combined SWMU 22 soil at concentrations above their RBCs but were eliminated because they were below their background concentrations. The combined ingestion and dermal residential exposure risk range is between 7E-10 to 1E-05 with an arithmetic mean risk of 4E-06 and an HI between 0.001 to 0.5 with an arithmetic mean HI of 1, which is between USEPA's acceptable range of 1E-06 and 1E-04 and HI of 3 to 0.1. Lead is above USEPA's residential acceptable level of 400 mg/kg, 469 mg/kg,at sample location 025SB009. Since the site soil is covered with asphalt and concrete, the residential risk associated with the COPCs will not exceed 1E-06. No further action is recommended for the soil.

Antimony, cadmium, chromium, nickel, chlordane (alpha and gamma), tetrachloroethene, and trichloroethene were identified as COCs in shallow groundwater. Shallow groundwater-associated residential risk ranges from 5E-07 to 6E-06 and the HI ranges from 0.5 to 24. Chlordane is the primary COC in the risk equation and only at monitoring well NBCE025001. Chlordane was most likely applied as an insecticide and is not associated with a release or spill. Tetrachloroethene and trichloroethene were the primary COCs at monitoring well NBCE025003. Chromium had

HIs 10.7, 2.2, and 1.6 at monitoring wells NBCE025003, NBCE025002, and NBCE025004, respectively. However, chromium was identified as being in its less-toxic state, trivalent, thus the HI may be overestimated. If chromium is eliminated from the HI equation, then only the groundwater sample from monitoring well NBCE025003 would exceed an HI of 1.

Based on data collected, a groundwater plume is not indicated but may exist. No clear, definable source or release is associated with these units. Based on the above facts, corrective measures may be appropriate. Potential corrective measures for the impacted medium and respective COCs are in Table 10.3.14.1. Corrective measures for SWMUs 22 and 25 and AOC 544 are detailed in Section 9.

Table 10.3.14.1
Potential Corrective Measures for SWMUs 22 and 25 and AOC 554

Medium	Compounds	Potential Corrective Measures
Soil	Antimony, cadmium, chromium, copper, lead, and BEQs	a) No Action
Shallow Groundwater	Antimony, cadmium, chromium, nickel, chlordane (alpha and gamma), tetrachloroethene, and trichloroethene	a) No Action b) Intrinsic remediation and Monitoring c) Ex-Situ, chemical, and physical treatment

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10.4 SWMU 23, New Plating Waste Water Treatment System — Building 226; SWMU 63, Former Building 73 Battery Charging Station; AOC 540, Building 226 Plating Plant; AOC 541, Oil Storage Shop, Former Building 38; AOC 542, Old Oxy-Acetylene Plant and Paint Shop, Former Building 22; and AOC 543, Former Building 1026, Storage Facility

SWMU 23 is the new wastewater treatment system (WWTS) on the northeast corner of Building 226. The treatment building is a concrete structure built around 1983 to replace an existing system. The new WWTS handles chrome effluent, acid/alkali effluent from metal plating and cadmium effluent. The treatment system consists of rinse water pumps, holding tanks, transfer pumps, a clarifier, a neutralization tank, and a plate and frame filter press.

SWMU 63, a battery charging station which operated from 1941 to approximately 1970 was located in former Building 73. No records have been found providing specific information on its operating practices. More recently this site was used by NAVBASE as Building 226, a plating facility.

AOC 540 is a plating plant in Building 226 and was constructed in 1976. Recent operations consist of a pump and valve test area, a plating area, and a hydraulic repair area. A wet scrubber, 120 plating dip tanks, a sludge pit, and waste treatment facility are associated with this facility. An oil/water separator and 300-gallon fuel oil tank are also on the southwest side of Building 226.

AOC 541, an oil storage house, was in former Building 38, and operated from 1909 until 1939, but was demolished in 1970. No other information was discovered regarding its operating practices. The site is currently an asphalt parking lot between Building 6 and Building 226.

AOC 542, a paint shop and oxy-acetylene plant, was located at former Building 22. Operations of the oxyacetylene plant began here in 1922, and in 1943, the building was converted into a paint shop and served that purpose until it was demolished in 1976. During this period, chemical and abrasive paint stripping were also conducted here. Currently this site is an open paved area between Buildings 3, 6, and 226.

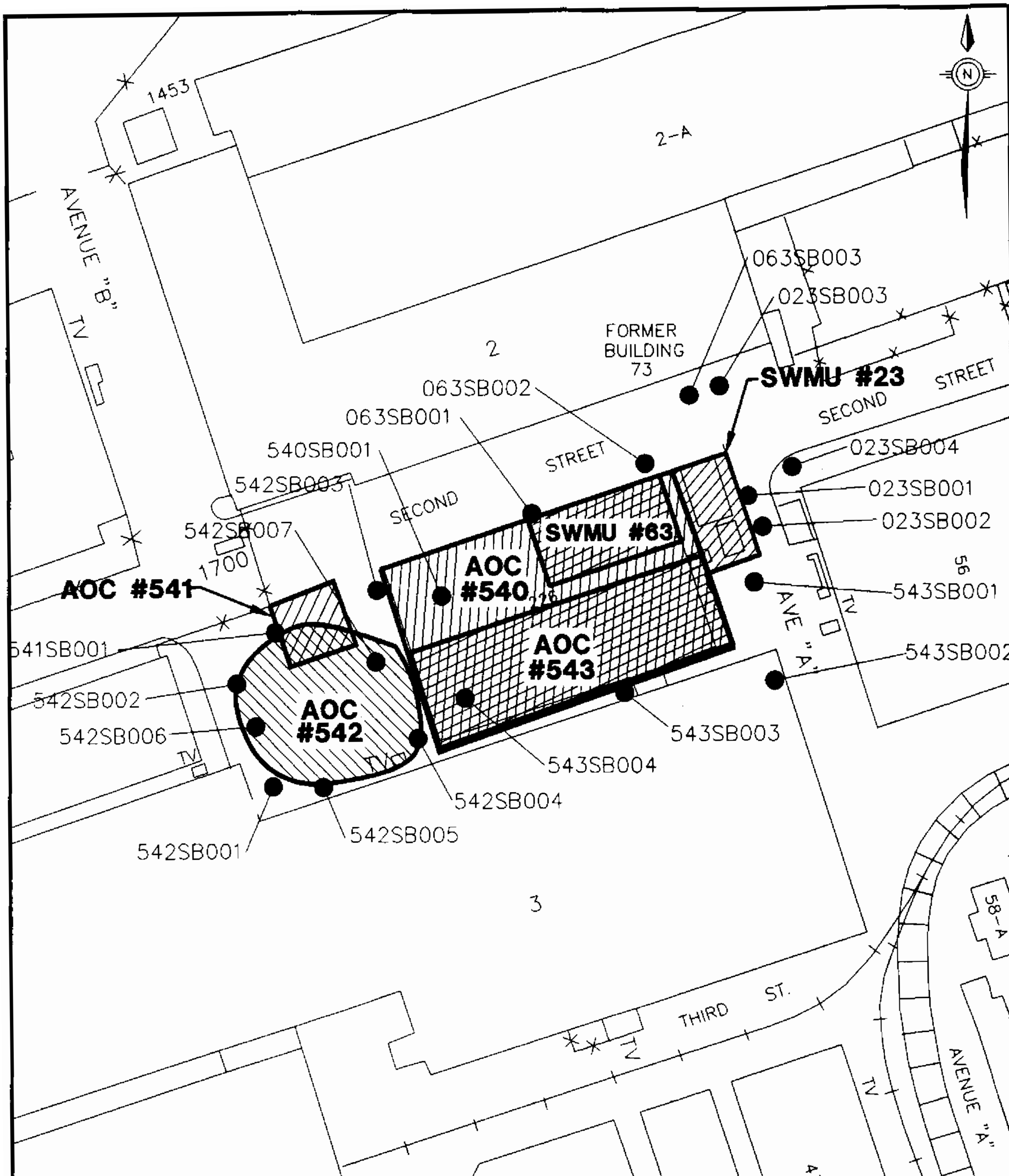
AOC 543 is the site of former Building 1026 which was constructed in 1922 and used as a storehouse until 1943. From 1943 to 1955, the site was a field electric shop. From 1955 until approximately 1970, this site was used as a storehouse again. Currently this site is occupied by Building 226.

Materials of concern, indicated in the *Final Zone E RFI Work Plan*, include: at SWMU 23, sulfuric acid, sodium metabisulfite, sodium hydroxide, potassium hydroxide, chromium, and cadmium; at SWMU 63, acids and metals; at 540, acids, metals, hydraulic fluid, and petroleum hydrocarbons; at AOCs 541 and 543, petroleum hydrocarbons; at AOC 542, acids, metals, paints, solvents, acetylene gas, abrasive grit. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure.

To fulfill the RFI objectives for SWMU 23 and CSI objectives for the remaining sites, soil and groundwater samples will be collected in accordance with the *Final Zone E RFI Work Plan*, and Section 3 of this report to determine whether any contamination resulted from onsite activities.

10.4.1 Soil Sampling and Analysis

Soil was sampled in two rounds at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543 from the locations shown in Figure 10.4.1. The *Final Zone E RFI Work Plan* proposed collecting 11 soil samples from the upper interval and 11 samples from the lower interval. Soil samples were also collected at both intervals for the eight shallow monitoring well locations proposed at this site.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- ◒ – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.4.1
SOIL BORING LOCATIONS
SWMU #23, SWMU #63/AOC #540
AOC#541, OIL STORAGE SHOP, AOC#542
AOC #543, FORMER BLDG 1026

DWG DATE: 09/02/97 | DWG NAME: 10-04-1

First-round Sampling — During the first round of sampling, all 19 proposed upper-interval samples were collected and fifteen lower-interval samples were collected.

A lower-interval sample at both SWMU 23 and AOC 541, and two lower- interval samples at AOC 543 were not collected due to subsurface obstructions in the form of large rocks at a depth of greater than two feet bgs. In all, four lower-interval samples were not collected due to subsurface obstructions.

Seven soil samples (one from the upper interval and six from the lower interval) were selected as duplicates and analyzed at DQO Level IV for Appendix IX analytical parameters, which includes the suite of parameters proposed for the site, plus a more comprehensive list of VOCs and SVOCs, as well as herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. Table 10.4.1.1 summarizes first-round soil sampling at SWMU 23 and associated sites.

Table 10.4.1.1
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
First-Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	19	19	Standard Suite[a], organotins, pH	Standard Suite[a], organotins, pH	One sample was not submitted for VOC, pesticide/PCB, cyanide, or pH analysis. Two samples were not submitted for organotin analysis.
Lower	19	15	Standard Suite[a], organotins, pH	Standard Suite[a], organotins, pH	Four lower-interval samples were not collected due to subsurface obstructions. One sample was not submitted for VOC, pesticide/PCB, cyanide, or pH analysis. Two samples were not submitted for organotin analysis.

Note:
a = Standard Suite includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide

Second-round Sampling — Second-round sampling was performed at SWMU 23 after first round analytical results were compared to the USEPA Region III RBCs (April 1996). One upper-interval and one lower-interval sample were proposed during second-round sampling to determine the extent of constituents detected during the initial round of sampling. Samples from both intervals at 023SB004 were collected during second-round sampling. No duplicate samples were collected during second-round sampling. Second-round samples were analyzed for a reduced list of analytical parameters which included SVOCs and metals. Table 10.4.1.2 summarizes second-round soil sampling at SWMU 23 and associated sites.

Table 10.4.1.2
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Second Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	1	1	SVOCs, metals	SVOCs, metals	None
Lower	1	1	SVOCs, metals	SVOCs, metals	None

10.4.2 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.4.2.1. Inorganic analytical results for soil are summarized in Table 10.4.2.2. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.4.2.1
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs (μg/kg)						
Acetone	Lower	1/15	100	100	NA	NA
Methylene chloride	Upper	1/19	2.00	2.00	760,000	0
	Lower	1/15	18.0	18.0	NA	NA

Table 10.4.2.1
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs (μg/kg)						
Toluene	Upper	3/19	2.00	2.00	41,000,000	0
	Lower	2/15	1.000 - 6.00	3.50	NA	NA
Xylene (Total)	Upper	3/19	2.00 - 3.00	2.33	100,000,000	0
SVOCs (μg/kg)						
Acenaphthene	Upper	2/20	43.0 - 52.0	47.5	12,000,000	0
	Lower	4/16	41.0 - 470	171	NA	NA
Acenaphthylene	Upper	1/20	54.0	54.0	8,200,000	0
Anthracene	Upper	2/20	160 - 180	170	6,100,000	0
	Lower	3/16	120 - 240	197	NA	NA
Benzo(g,h,i)perylene	Upper	11/20	39.0 - 820	263	8,200,000	0
	Lower	8/16	49.0 - 660	271	NA	NA
Benzoic acid	Upper	1/20	65.0	65.0	100,000,000	0
	Lower	1/16	38.0	38.0	NA	NA
bis(2-Ethylhexyl)phthalate	Upper	3/20	52.0 - 120	87.7	410,000	0
	Lower	4/16	66.0 - 170	113	NA	NA
Carbazole	Lower	2/6	110 - 130	120	NA	NA
4-Chloro-3-methylphenol	Lower	1/16	43.0	43.0	NA	NA
2-Chlorophenol	Lower	1/16	38.0	38.0	NA	NA
Dibenzofuran	Lower	2/16	110 - 390	250	NA	NA
Di-n-butylphthalate	Upper	1/20	44.0	44.0	20,000,000	0
Fluoranthene	Upper	12/20	71.0 - 1,700	578	8,200,000	0
	Lower	9/16	140 - 1,900	620	NA	NA
Fluorene	Upper	2/20	38.0 - 39.0	38.5	8,200,000	0
	Lower	2/16	170 - 960	565	NA	NA

Table 10.4.2.1
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (µg/kg)						
2-Methylnaphthalene	Upper	2/20	91.0 - 140	116	8,200,000	0
	Lower	1/16	6,800	6,800	NA	NA
Naphthalene	Upper	1/20	65.0	65.0	8,200,000	0
Pentachlorophenol	Lower	1/16	45.0	45.0	NA	NA
Phenanthrene	Upper	10/20	47.0 - 710	317	8,200,000	0
	Lower	10/16	97.0 - 1,500	569	NA	NA
Pyrene	Upper	13/20	84.0 - 1,900	573	6,100,000	0
	Lower	12/16	100 - 2,200	608	NA	NA
1,2,4,5-Tetrachlorobenzene	Lower	1/6	41.0	41.0	NA	NA
SVOCs (B(a)P Equivalents) (µg/kg)						
B(a)P Equiv.	Upper	13/20	0.566 - 1,690	445	780	2
	Lower	9/16	89.9 - 1,280	468	NA	NA
Benzo(a)anthracene	Upper	9/20	180 - 970	413	7,800	0
	Lower	9/16	88.0 - 940	358	NA	NA
Benzo(b)fluoranthene	Upper	3/20	140 - 860	420	7,800	0
	Lower	4/16	130 - 680	343	NA	NA
Benzo(k)fluoranthene	Upper	13/20	52.0 - 1,100	394	78,000	0
	Lower	9/16	81.0 - 1,100	388	NA	NA
Benzo(a)pyrene	Upper	11/20	130 - 1,100	400	780	2
	Lower	9/16	80.0 - 850	338	NA	NA
Chrysene	Upper	13/20	46.0 - 1,000	349	780,000	0
	Lower	9/16	100 - 1,400	429	NA	NA
Dibenz(a,h)anthracene	Upper	3/20	77.0 - 410	196	780	0
	Lower	4/16	52.0 - 200	124	NA	NA

Table 10.4.2.1
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (B(a)P Equivalents) (μg/kg)						
Indeno(1,2,3-cd)pyrene	Upper	9/20	130 - 690	270	7,800	0
	Lower	8/16	52.0 - 530	222	NA	NA
Pesticides/PCBs (μg/kg)						
Aldrin	Upper	2/19	1.80 - 8.80	5.30	340	0
beta-BHC	Upper	1/19	4.00	4.00	3,200	0
alpha-BHC	Upper	1/19	5.40	5.40	910	0
	Lower	1/15	3.30	3.30	NA	NA
delta-BHC	Upper	2/19	3.40 - 11.0	7.20	910	0
	Lower	1/15	12.0	12.0	NA	NA
gamma-BHC (Lindane)	Upper	2/19	1.40 - 5.10	3.25	4,400	0
alpha-Chlordane	Upper	10/19	1.50 - 130	37.5	4,400	0
	Lower	5/15	3.80 - 38.0	20.6	NA	NA
gamma-Chlordane	Upper	9/19	3.20 - 240	65.5	4,400	0
	Lower	5/15	6.80 - 48.0	26.8	NA	NA
4,4'-DDD	Upper	3/19	4.30 - 17.0	9.00	24,000	0
	Lower	2/15	4.70 - 4.90	4.80	NA	NA
4,4'-DDE	Upper	7/19	6.70 - 96.0	26.5	17,000	0
	Lower	3/15	4.80 - 12.0	8.70	NA	NA
4,4'-DDT	Upper	6/19	4.40 - 66.0	18.6	17,000	0
	Lower	4/15	3.30 - 7.40	5.05	NA	NA
Dieldrin	Upper	3/19	5.20 - 9.90	7.90	360	0
	Lower	1/15	4.50	4.50	NA	NA
Endosulfan I	Upper	1/19	5.10	5.10	1,200,000	0
Endosulfan II	Upper	1/19	5.90	5.90	1,200,000	0

Table 10.4.2.1
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Pesticides/PCBs (μg/kg)						
Endosulfan sulfate	Upper	1/19	5.10	5.10	1,200,000	0
Endrin	Upper	2/19	5.30 - 11.0	8.15	61,000	0
Endrin aldehyde	Upper	2/19	3.90 - 15.0	9.45	61,000	0
	Lower	4/15	2.90 - 17.0	7.08	NA	NA
Endrin ketone	Upper	1/19	3.10	3.10	61,000	0
Heptachlor	Upper	9/19	1.40 - 130	24.0	1,300	0
	Lower	6/15	1.50 - 4.00	2.73	NA	NA
Heptachlor epoxide	Upper	4/19	2.50 - 19.0	8.50	630	0
	Lower	1/15	2.90	2.90	NA	NA
Methoxychlor	Upper	1/19	22.0	22.0	1,000,000	0
Aroclor-1254	Upper	2/19	190 - 1,200	695	740	1
Dioxins (ng/kg)						
Dioxin Equiv.	Lower	6/6	0.0259 - 6.84	2.19	NA	NA
1234678-HpCDD	Lower	6/6	0.638 - 244	68.3	NA	NA
1234678-HpCDF	Lower	4/6	2.12 - 35.4	16.9	NA	NA
1234789-HpCDF	Lower	2/6	0.492 - 2.27	1.38	NA	NA
123678-HxCDD	Lower	4/6	0.806 - 7.54	2.84	NA	NA
123789-HxCDD	Lower	3/6	0.361 - 1.90	1.07	NA	NA0
123478-HxCDF	Lower	4/6	0.570 - 8.96	3.28	NA	NA
123678-HxCDF	Lower	3/6	1.24 - 2.35	1.84	NA	NA
123789-HxCDF	Lower	1/6	1.25	1.25	NA	NA
234678-HxCDF	Lower	2/6	0.335 - 0.527	0.431	NA	NA
OCDD	Lower	6/6	11.6 - 1913.85	557	NA	NA
OCDF	Lower	5/6	3.52 - 271	78.9	NA	NA

Table 10.4.2.1
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Dioxins (ng/kg)						
12378-PeCDD	Lower	1/6	0.439	0.439	NA	NA
12378-PeCDF	Lower	1/6	0.910	0.910	NA	NA
23478-PeCDF	Lower	2/6	0.527 - 0.816	0.672	NA	NA
2378-TCDF	Lower	1/6	1.34	1.34	NA	NA

Notes:
μg/kg = Micrograms per kilogram
ng/kg = Nanograms per kilogram
RBC = Risk-based concentration
NA = No industrial RBC established

Table 10.4.2.2
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Aluminum (Al)	Upper	20/20	821 - 6,440	3,410	100,000	26,600	0
	Lower	16/16	956 - 7,330	3,640	NA	41,100	NA
Antimony (Sb)	Upper	7/20	1.60 - 29.5	10.7	82	1.77	0
	Lower	4/16	0.700 - 4.80	1.90	NA	1.60	NA
Arsenic (As)	Upper	19/20	0.660 - 7.90	3.51	3.8	23.9	0
	Lower	14/16	0.830 - 7.60	3.29	NA	19.9	NA
Barium (Ba)	Upper	19/20	0.960 - 54.8	23.6	14,000	130	0
	Lower	15/16	6.70 - 33.0	19.9	NA	94.1	NA
Beryllium (Be)	Upper	16/20	0.130 - 0.440	0.256	1.3	1.70	0
	Lower	14/16	0.110 - 0.350	0.243	NA	2.71	NA
Cadmium (Cd)	Upper	11/20	0.150 - 18.0	2.83	100	1.50	0
	Lower	6/16	0.160 - 5.80	1.21	NA	0.960	NA

Table 10.4.2.2
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Calcium (Ca)	Upper	19/20	1,660 - 145,000	25,400	NA	NA	NA
	Lower	15/16	761 - 35,200	6,860	NA	NA	NA
Chromium (Cr)	Upper	20/20	2.60 - 42.7	10.2	1,000	94.6	0
	Lower	15/16	1.70 - 15.3	5.54	NA	75.2	NA
Cobalt (Co)	Upper	19/20	0.470 - 50.7	5.76	12,000	19.0	0
	Lower	14/16	0.260 - 3.80	1.08	NA	14.9	NA
Copper (Cu)	Upper	20/20	0.250 - 1,760	168	8,200	66.0	0
	Lower	16/16	1.10 - 171	32.8	NA	152	NA
Cyanide (CN)	Upper	2/19	0.380 - 0.500	0.440	4,100	0.500	0
	Lower	1/15	0.490	0.490	NA	NA	NA
Iron (Fe)	Upper	19/20	1,160 - 10,800	4,730	61,000	NA	0
	Lower	15/16	1,110 - 15,300	5,190	NA	NA	NA
Lead (Pb)	Upper	20/20	1.10 - 434	72.5	1,300	265	0
	Lower	16/16	2.40 - 293	56.6	NA	173	NA
Magnesium (Mg)	Upper	19/20	26.4 - 1,870	484	NA	NA	NA
	Lower	15/16	78.5 - 516	250	NA	NA	NA
Manganese (Mn)	Upper	19/20	5.90 - 152	65.5	4,700	302	0
	Lower	15/16	18.7 - 176	51.2	NA	881	NA
Mercury (Hg)	Upper	11/20	0.0200 - 1.70	0.460	61	2.60	0
	Lower	8/16	0.0300 - 1.60	0.435	NA	1.59	NA
Nickel (Ni)	Upper	20/20	0.290 - 193	14.7	4,100	77.1	0
	Lower	14/16	0.620 - 15.9	3.60	NA	57.0	NA
Potassium (K)	Upper	3/20	176 - 720	445	NA	NA	NA
	Lower	4/16	189 - 454	299	NA	NA	NA
Selenium (Se)	Upper	1/20	0.580	0.580	1,000	1.70	0
Silver (Ag)	Upper	2/20	0.240 - 1.20	0.720	1,000	NA	0

Table 10.4.2.2
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Sodium (Na)	Upper	4/20	42.1 - 90.6	69.3	NA	NA	NA
	Lower	4/16	39.3 - 50.3	43.1	NA	NA	NA
Tin (Sn)	Upper	12/20	2.60 - 54.3	13.8	100,000	59.4	0
	Lower	9/16	2.30 - 13.1	5.00	NA	9.23	NA
Vanadium (V)	Upper	20/20	2.20 - 16.1	6.53	1,400	94.3	0
	Lower	16/16	1.60 - 13.1	5.77	NA	155	NA
Zinc (Zn)	Upper	20/20	0.690 - 4,080	386	61,000	827	0
	Lower	16/16	2.30 - 1,550	153	NA	886	NA
pH (SU)							
pH	Upper	19/19	7.27 - 8.74	8.05	NA	NA	NA
	Lower	15/15	6.40 - 8.37	7.88	NA	NA	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Risk-based concentration
RC = Reference concentration
NA = No industrial RBC or RC established
SU = Standard units

Volatile Organic Compounds in Soil

Four VOCs were detected in soil samples collected at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543. Seven detections occurred in the upper interval and four in the lower interval. No VOC exceeded its respective industrial RBC in the upper interval or respective SSL in the lower interval.

Semivolatile Organic Compounds in Soil

Twenty-seven SVOCs were detected in soil samples collected at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543. One hundred and twenty-two detections occurred in the upper interval and 115 in the lower interval. One SVOC — benzo(a)pyrene — exceeded its respective industrial RBC in the upper interval. However, no SVOC exceeded its respective SSL in the lower interval.

Benzo(a)pyrene was detected in 11 of 20 upper-interval soil samples with a range of 130 to 1,100 μg/kg and a mean of 400 μg/kg. Two upper-interval samples (023SB004, 800 μg/kg and 542SB005, 1,110 μg/kg) exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg.

In accordance with recent cPAH guidance, BEQs were calculated for cPAHs at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543. The upper-interval BEQ was calculated for 13 samples with a range of 0.566 to 1,690 μg/kg and a mean of 445 μg/kg. Two upper-interval samples (023SB004, 1,100 μg/kg and 542SB005, 1,690 μg/kg) exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg.

Pesticides and PCBs in Soil

Twenty pesticides were detected in soil samples collected at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543. Seventy detections occurred in the upper interval and 33 in the lower interval. No pesticide exceeded its respective industrial RBC in the upper interval. However, two pesticides — alpha-BHC and dieldrin — exceeded their respective SSL in the lower interval.

Alpha-BHC was detected in one of 15 lower-interval samples at 3.3 μg/kg. One lower-interval sample (542SB002, 3.3 μg/kg) exceeded the alpha-BHC SSL of 0.4 μg/kg.

Dieldrin was detected in one of 15 lower-interval samples at 4.5 μg/kg. One lower-interval sample (543SB004, 4.5 μg/kg) exceeded the dieldrin SSL of 1.0 μg/kg.

One PCB was detected in soil samples collected at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543. Two detections occurred in the upper interval and no detections in the lower interval. One PCB — Aroclor-1254 — exceeded its respective RBC in the upper interval. However, no PCB exceeded its respective SSL in the lower interval.

Aroclor-1254 was detected in two of 19 upper-interval samples with a range of 190 μg/kg to 1,200 μg/kg and a mean of 695 μg/kg. One upper-interval sample (542SB006, 1,200 μg/kg) exceeded the Aroclor-1254 industrial RBC of 740 μg/kg.

Other Organic Compounds in Soil

Fifteen dioxins were detected in soil samples collected at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543. No detections occurred in the upper interval and 45 occurred in the lower interval. No industrial RBCs or SSLs exist for dioxins.

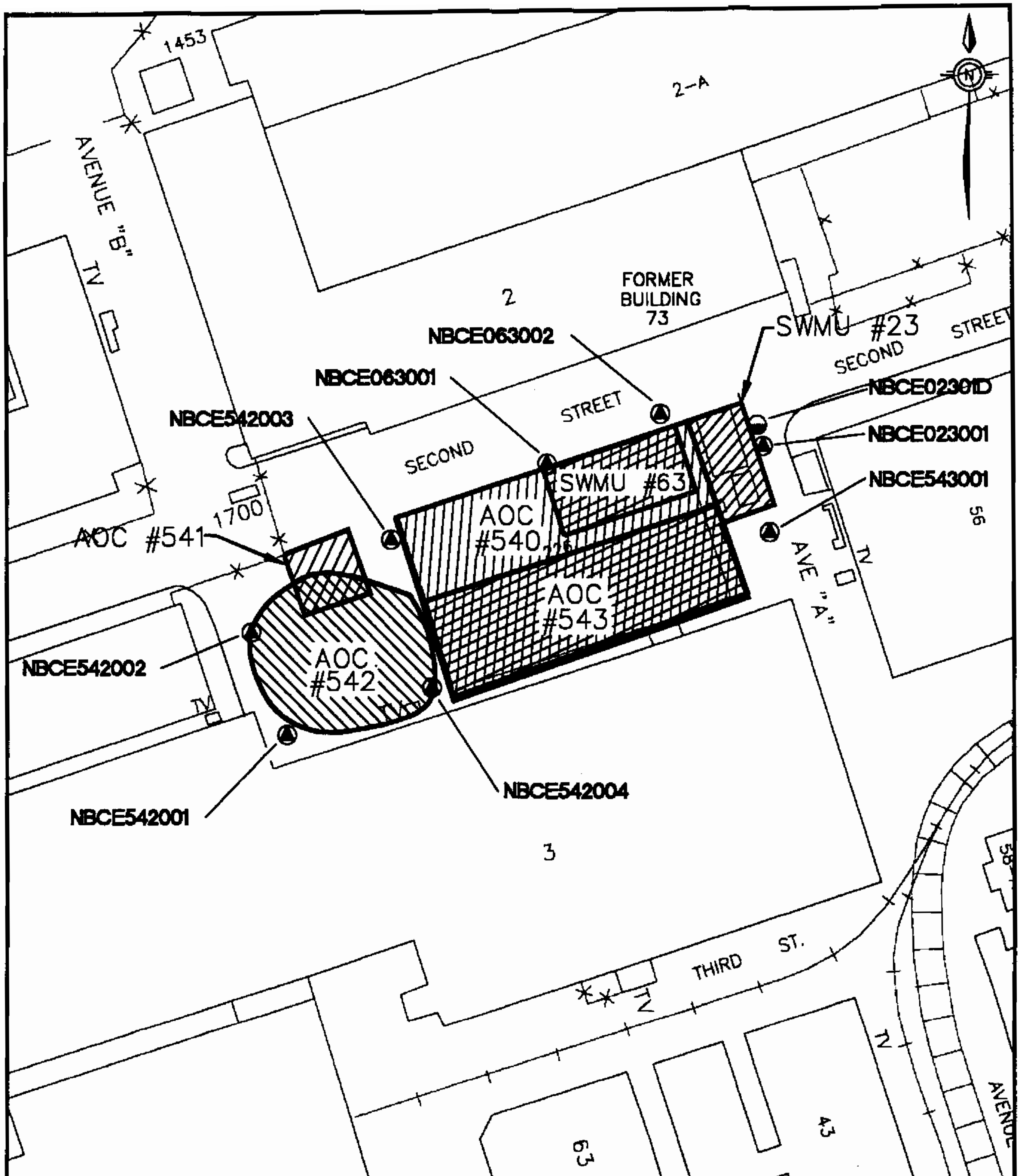
Inorganic Elements in Soil

Twenty-four metals were detected in soil samples collected at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543. Three hundred and forty-two detections occurred in the upper interval and 262 occurred in the lower interval. No metal exceeded both its industrial RBC and background RC in either the upper or lower interval.

10.4.3 Groundwater Sampling and Analysis

One deep monitoring well and eight shallow monitoring wells were installed and sampled to assess groundwater quality at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543 as shown in Figure 10.4.2. The wells were installed as follows:

- Shallow well installed at SWMU 23 — NBCE023001
- Deep well installed at SWMU 23 — NBCE02301D



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.4.2
MONITORING WELL LOCATIONS
SWMU #23, SWMU #63, AOC #540
AOC #541, AOC #542,
AND AOC #543

DWG DATE: 09/02/97 | DWG NAME: 10-4-2

- Shallow wells installed at SWMU 63 — NBCE063001 and NBCE063002
- Shallow wells installed at AOC 542 — NBCE542001, NBCE542002, NBCE542003, and NBCE542004
- Shallow well installed at AOC 543 — NBCE543001

Groundwater samples were submitted for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, pH, chlorides, sulfates, TDS, and organotins at DQO Level III. No duplicate samples were collected at this site. Table 10.4.3.1 summarizes groundwater sampling and analysis at SWMUs 23 and 63 and AOCs 540, 541, 542, and 543.

Table 10.4.3.1
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Groundwater Sampling Summary

Depth	Wells Proposed	Wells Installed	Analyses Proposed	Analyses Collected	Deviations
Shallow	8	8	Standard Suite[a], pH, chlorides, sulfates, and TDS	Standard Suite[a], pH, chlorides, sulfates, and TDS	None
Deep	1	1	Standard Suite[a], pH, chlorides, sulfates, and TDS	Standard Suite[a], pH, chlorides, sulfates, and TDS	None

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs

The shallow monitoring wells were installed at 12.5 to 13.5 feet bgs in the surficial aquifer. The deep well was installed at 37.1 feet bgs at the base of the surficial aquifer. All wells were installed in accordance with Section 3.3 of this report.

10.4.4 Nature of Contamination in Groundwater

Organic compound analytical results for shallow and deep groundwater are summarized in Tables 10.4.4.1 and 10.4.4.2, respectively. Inorganic analytical results for shallow and deep groundwater are summarized in Tables 10.4.4.3 and 10.4.4.4, respectively. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.4.4.1
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Organic Compounds Detected in First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	MCL	Number of Samples Exceeding RBC
VOCs						
Acetone	1/8	800	800	370	NA	1
Trichloroethene	1/8	1.000	1.000	1.60	5.00	0
SVOCs						
Acenaphthene	1/8	3.00	3.00	220	NA	0
bis(2-Ethylhexyl)phthalate	1/8	2.00	2.00	4.80	NA	0
Dibenzofuran	1/8	2.00	2.00	15.0	NA	0
Fluorene	1/8	6.00	6.00	150	NA	0
2-Methylnaphthalene	1/8	12.0	12.0	150	NA	0
Phenanthrene	2/8	2.00 - 5.00	3.50	150	NA	0

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
NA = No MCL established

Table 10.4.4.2
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Organic Compounds Detected in First-Quarter Groundwater
Deep Monitoring Well

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	MCL	Number of Samples Exceeding RBC
SVOCs (μg/L)						
Benzoic acid	1/1	2.00	2.00	15,000	NA	0
bis(2-Ethylhexyl)phthalate	1/1	2.00	2.00	4.80	NA	0

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
NA = No MCL established

Table 10.4.4.3
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Inorganic Detections for First-Quarter Groundwater
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (μg/L)							
Aluminum (Al)	7/8	639 - 5,090	2,590	3,700	2,810	NA	1
Arsenic (As)	2/8	7.40 - 17.4	12.4	0.0450	18.7	50.0	0
Barium (Ba)	3/8	14.5 - 27.1	22.3	260	211	2,000	0
Calcium (Ca)	8/8	10,700 - 146,000	73,300	NA	NA	NA	NA
Chromium (Cr)	5/8	5.10 - 6.10	5.66	18.0	12.3	100	0
Cobalt (Co)	1/8	2.10	2.10	220	2.5	NA	0
Copper (Cu)	4/8	3.20 - 12.8	6.45	150	2.7	1,300	0
Iron (Fe)	8/8	344 - 41,500	8,930	1,100	NA	NA	7
Lead (Pb)	6/8	3.30 - 10.3	5.38	NA	4.8	15.0*	0
Magnesium (Mg)	8/8	1,560 - 29,200	9,740	NA	NA	NA	NA
Manganese (Mn)	6/8	10.1 - 405	171	84.0	2,560	NA	0
Nickel (Ni)	1/8	2.20	2.20	73.0	15.2	100	0

Table 10.4.4.3
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Inorganic Detections for First-Quarter Groundwater
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (μg/L)							
Potassium (K)	3/8	2,510 - 13,800	7,120	NA	NA	NA	NA
Selenium (Se)	1/8	5.20	5.20	18.0	NA	50.0	0
Sodium (Na)	3/8	5,180 - 36,400	16,900	NA	NA	NA	NA
Vanadium (V)	5/8	3.70 - 9.50	6.84	26.0	11.4	NA	0
Zinc (Zn)	2/8	17.6 - 119	68.3	1,100	27.3	NA	0
pH (SU)							
pH	8/8	6.39 - 7.08	6.80	NA	NA	NA	NA

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
RC = Reference concentration
NA = No RBC, MCL, or RC established
SU = Standard units
* = TTAL

Table 10.4.4.4
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Inorganic Detections for First-Quarter Groundwater
Deep Monitoring Well

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (μg/L)							
Barium (Ba)	1/1	32.4	32.4	260	218	2,000	0
Calcium (Ca)	1/1	64,500	64,500	NA	NA	NA	NA
Iron (Fe)	1/1	25.6	25.6	1,100	NA	NA	0
Magnesium (Mg)	1/1	5,740	5,740	NA	NA	NA	NA
Manganese (Mn)	1/1	121	121	84.0	869	NA	0

Table 10.4.4.4
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Inorganic Detections for First-Quarter Groundwater
Deep Monitoring Well

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (μg/L)							
Potassium (K)	1/1	2,760	2,760	NA	NA	NA	NA
Sodium (Na)	1/1	85,200	85,200	NA	NA	NA	NA
pH (SU)							
pH	1/1	7.58 SU	7.58 SU	NA	NA	NA	NA

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
RC = Reference concentration
NA = No RBC, MCL, or RC established
SU = Standard units

Volatile Organic Compounds in Groundwater

Shallow Groundwater

Two VOCs were detected in shallow groundwater samples collected at SWMUs 23 and 63 and AOCs 542 and 543 (no shallow wells were installed at AOC 540 or 541). One VOC — acetone — exceeded its respective tap-water RBC.

Acetone was detected in one of eight samples in well NBCE543001 (800 μg/L), exceeding its tap-water RBC of 370 μg/L. No MCL has been established for acetone.

Semivolatile Organic Compounds in Groundwater

Shallow Groundwater

Six SVOCs were detected in shallow groundwater samples collected at SWMUs 23 and 63 and AOCs 542 and 543. No detected SVOC exceeded its respective tap-water RBC. No MCLs have been established for the detected SVOCs in shallow groundwater.

Deep Groundwater

Two SVOCs were detected in the deep groundwater sample collected at SWMU 23 (no deep wells were installed at SWMU 63 or AOCs 540, 541 and 543). Neither SVOC exceeded its respective tap-water RBC. No MCL has been established for either detected SVOC.

Inorganic Elements in Groundwater

Shallow Groundwater

Seventeen metals were detected in shallow groundwater samples collected at SWMUs 23 and 63 and AOCs 542 and 543. Two metals — aluminum and iron — exceeded both their respective tap-water RBC and background shallow groundwater RC.

Aluminum was detected in seven of eight samples with a range of 639 to 5,090 μg/L and a mean of 2,590 μg/L. One sample from well NBCE542001 (5,090 μg/L) exceeded both the aluminum tap-water RBC of 3,700 μg/L and shallow groundwater RC of 2,810 μg/L. No MCL has been established for aluminum.

Iron was detected in eight of eight samples with a range of 344 to 41,500 μg/L and a mean of 8,930 μg/L. Samples from the following seven wells exceeded the iron tap-water RBC of 1,100 μg/L:

NBCE023001 (1,630 μg/L)
NBCE063002 (4,040 μg/L)
NBCE542001 (3,620 μg/L)
NBCE542002 (41,500 μg/L)
NBCE542003 (3,110 μg/L)
NBCE542004 (14,900 μg/L)
NBCE543001 (2,320 μg/L)

No shallow groundwater RC or MCL has been established for iron.

Deep Groundwater

Seven metals were detected in the deep groundwater sample collected at SWMU 23. No detected metal exceeded both its respective tap-water RBC and background deep groundwater RC.

pH in Groundwater

The pH of the shallow groundwater samples ranged from 6.39 to 7.08 SU with a mean of 6.80 SU. The pH of the deep groundwater sample was 7.58 SU. No RBC, MCL, or RC has been established for pH in groundwater.

10.4.5 Fate and Transport Assessment for SWMUs 23 and 63 and AOCs 540, 541, 542, and 543

Combined SWMU 23 is comprised of a new wastewater treatment system for handling chrome, acid/alkali, and cadmium effluents, a former battery charging station, a plating plant, a former oil storage house, a paint shop and oxy-acetylene plant, and a former storehouse. AOCs 540 and 543 are covered by a concrete foundation from Building 226. Asphalt covers the remaining area associated with SWMUs 23 and 63 and AOCs 540 and 541. Environmental media sampled as part of the combined SWMU 23 RFI include surface soil, subsurface soil, and shallow and deep groundwater. Potential constituent migration pathways investigated for combined SWMU 23 include soil to groundwater, groundwater to surface water, and emission of volatiles from surface soil to air.

10.4.5.1 Soil-to-Groundwater Cross-Media Transport: Tier One

Table 10.4.5.1 compares maximum detected organic constituent concentrations in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels, or (b) background RCs. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 10:1, with no attenuation of constituents in soil (DAF=10).

Nine organic compounds — methylene chloride, benzo(a)anthracene, pentachlorophenol, Aroclor-1254, alpha-BHC, beta-BHC, delta-BHC, gamma-BHC (Lindane), and dieldrin — were detected in combined SWMU 23 soil at concentrations greater than or equal to groundwater protection SSLs and were carried over to the second-tier screening. None of the nine compounds were detected in groundwater samples, indicating that the current soil-groundwater equilibrium is sufficiently protective of the surficial aquifer. Aroclor-1254, beta-BHC, and gamma-BHC (Lindane) were detected in surface soil but not in subsurface soil samples. Higher concentrations of methylene chloride and delta-BHC were detected in subsurface soil samples than in surface soil samples. Pentachlorophenol was detected in a single subsurface soil sample (540SB001) but not in surface soil. Of the organic compounds detected above their SSLs, benzo(a)anthracene was most widely distributed, with detections in nine soil samples at each depth.

Six inorganics — antimony, cadmium, cobalt, copper, lead, and nickel — were detected in soil above their respective groundwater protection SSLs or background reference values, and were carried over to the second-tier screen. All inorganics except antimony and cadmium were also detected in groundwater, indicating a completed pathway from soil to groundwater; however, no inorganic was detected at a concentration above its respective RBC and/or background reference value. Copper was detected above background concentrations in four surface soil samples and one subsurface sample. The maximum concentration of 1760 mg/kg in surface soil sample 543SB003 was more than twice as high as that of any other site sample. Maximum concentrations of cobalt and nickel in surface and subsurface samples were also detected in sample location 543SB003. Antimony concentrations exceeded the screening level of 2.5 mg/kg in six surface soil samples and one subsurface sample.

10.4.5.2 Groundwater-to-Surface Water Cross-Media Transport: Tier One

Table 10.4.5.1 also compares maximum detected organic constituent concentrations in shallow and deep groundwater samples to RBCs for drinking water and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background RCs for groundwater, as well as to the saltwater surface water chronic values. To provide a conservative first-tier screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

No organic compounds were detected in groundwater samples at concentrations above tap water RBCs or saltwater surface water chronic screening values, and no inorganics were detected above tap water RBCs. Copper, lead, and zinc were detected above their respective saltwater surface water chronic screening values in first-round shallow groundwater samples from three separate well locations (NBCE542004, NBCE063002, and NBCE542001, respectively). Of the three inorganics, only copper was reported at a concentration (12.8 μg/L) more than twice as high as its corresponding screening value (2.9 μg/L).

10.4.5.3 Soil and Groundwater-to-Surface Water Cross-Media Transport: Tier Two

Table 10.4.5.2 provides a second screening tier for all constituents detected in soil or groundwater at concentrations exceeding any of the first-tier screening levels. Constituent concentrations in groundwater are compared to combined ecological/human health RBCs that have been adjusted upward for site-specific dilution by surface water in the Cooper River, while soil constituent concentrations are compared to calculated SSLs that are based on the adjusted RBCs rather than the original target leachate concentrations. For the second-tier screen, no dilution of leachate by groundwater or attenuation of constituents in soil is assumed (DAF=1). The second screening tier identifies any constituents in soil or groundwater that pose a threat to surface water quality, after allowing for dilution of groundwater by surface water when the groundwater discharges into the river. The site-specific surface-water dilution factor calculated for combined SWMU 23 is 47,400:1 (see Table 6.2.1).

None of the first-tier constituent concentrations exceeded the adjusted screening levels of the second tier, indicating that site constituents in soil and groundwater pose no threat to human health or the environment in the Cooper River through the associated migration pathway. The elevated concentrations of benzo(a)anthracene and Aroclor-1254 are not a concern because PAHs and PCBs are not particularly mobile in soil or groundwater. Maximum copper concentrations in soil samples were approximately 36% of copper's adjusted SSL of 4,840 mg/kg. However, the adjusted SSLs were obtained assuming a DAF of 1, while the calculated site-specific DAF for combined SWMU 23 is 25, taking into account dilution only. Consequently, the margin between detected soil concentrations and levels protective of the Cooper River is actually much greater than indicated in the table.

10.4.5.4 Soil-to-Air Cross-Media Transport

Table 10.1.5.3 lists the VOCs detected in surface soil samples collected at combined SWMU 23 along with corresponding soil-to-air volatilization screening levels. Little or no surface soil is exposed at combined SWMU 23. In addition, none of the VOCs was reported at a maximum concentration exceeding its corresponding soil-to-air volatilization screening level. As a result, the soil-to-air migration pathway is not expected to be significant at combined SWMU 23.

10.4.5.5 Fate and Transport Summary

In the first-tier screen, nine organic compounds detected at concentrations above groundwater protections SSLs in soil were not detected in groundwater. Most of these compounds were detected in only one or two soil samples. Four metals — cobalt, copper, lead, and nickel — were detected above their generic SSLs or background reference values in soil but were detected in groundwater samples below their RBCs. Of these four metals, only copper exceeded its background reference value in both surface and subsurface soil. The widespread presence in soil of copper and to a lesser extent, nickel, lead, and cobalt, is likely related to the uses of AOC 540 as a plating plant and SWMU 23 as a plating waste water treatment system. Copper, lead, and zinc also exceeded their respective saltwater surface water chronic screening values.

None of the constituents exceeding first-tier screening values also exceeded the adjusted screening values of the second-tier comparisons, indicating no threat to surface water in the Cooper River via the evaluated migration pathways.

Table 10.4.5.1
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, and Deep Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds												
Acetone	ND	100	800	ND	8000	3700	NA	UG/KG	UG/L	NO	NO	NO
Methylene chloride	2	18	ND	ND	10	4.1	2560	UG/KG	UG/L	YES	NO	NO
Trichloroethene	ND	ND	1	ND	30	1.6	NA	UG/KG	UG/L	NO	NO	NO
Toluene	2	6	ND	ND	6000	750	37	UG/KG	UG/L	NO	NO	NO
Xylene (total)	3	ND	ND	ND	71000	12000	NA	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Acenaphthene	52	470	3	ND	285000	2200	9.7	UG/KG	UG/L	NO	NO	NO
Acenaphthylene	54	ND	ND	ND	150000	1500	NA	UG/KG	UG/L	NO	NO	NO
Anthracene	180	240	ND	ND	5900000	11000	NA	UG/KG	UG/L	NO	NO	NO
Benzoic acid	65	38	ND	2	200000	150000	NA	UG/KG	UG/L	NO	NO	NO
Benzo(g,h,i)perylene	820	660	ND	ND	2.33E+08	1500	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	970	940	ND	ND	800	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(a)pyrene	1100	850	ND	ND	4000	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(b)fluoranthene	860	680	ND	ND	2500	0.092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(k)fluoranthene	1100	1100	ND	ND	24500	0.92	NA	UG/KG	UG/L	NO	NO	NO
Chrysene	1000	1400	ND	ND	80000	9.2	NA	UG/KG	UG/L	NO	NO	NO
Dibenzo(a,h)anthracene	410	200	ND	ND	800	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Indeno(1,2,3-cd)pyrene	690	530	ND	ND	7000	0.092	NA	UG/KG	UG/L	NO	NO	NO
Carbazole	ND	130	ND	ND	300	3.4	NA	UG/KG	UG/L	NO	NO	NO
4-Chloro-3-methylphenol	ND	43	ND	ND	3150	180	NA	UG/KG	UG/L	NO	NO	NO
2-Chlorophenol	ND	38	ND	ND	2000	180	NA	UG/KG	UG/L	NO	NO	NO
Dibenzofuran	ND	390	2	ND	NA	150	NA	UG/KG	UG/L	NO	NO	NO
Di-n-butylphthalate	44	ND	ND	ND	2300000	3700	3.4	UG/KG	UG/L	NO	NO	NO
bis(2-Ethylhexyl)phthalate (BEHP)	120	170	2	2	1800000	4.8	NA	UG/KG	UG/L	NO	NO	NO
Fluoranthene	1700	1900	ND	ND	2150000	1500	1.6	UG/KG	UG/L	NO	NO	NO
Fluorene	39	960	6	ND	280000	1500	NA	UG/KG	UG/L	NO	NO	NO
2-Methylnaphthalene	140	6800	12	ND	63000	1500	NA	UG/KG	UG/L	NO	NO	NO
Naphthalene	65	ND	ND	ND	42000	1500	23.5	UG/KG	UG/L	NO	NO	NO
Pentachlorophenol	ND	45	ND	ND	15	0.56	7.9	UG/KG	UG/L	YES	NO	NO
Phenanthrene	710	1500	5	ND	690000	1500	NA	UG/KG	UG/L	NO	NO	NO
Pyrene	1900	2200	ND	ND	2100000	1100	NA	UG/KG	UG/L	NO	NO	NO
1,2,4,5-Tetrachlorobenzene	ND	41	ND	ND	690	1.8	129	UG/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
Aldrin	8.8	ND	ND	ND	250	0.004	0.13	UG/KG	UG/L	NO	NO	NO
Aroclor-1254	1200	ND	ND	ND	1000	0.0087	0.03	UG/KG	UG/L	YES	NO	NO
alpha-BHC	5.4	3.3	ND	ND	0.25	0.011	1400	UG/KG	UG/L	YES	NO	NO
beta-BHC	4	ND	ND	ND	1.5	0.037	NA	UG/KG	UG/L	YES	NO	NO
delta-BHC	11	12	ND	ND	1.5	0.037	NA	UG/KG	UG/L	YES	NO	NO
gamma-BHC (Lindane)	5.1	ND	ND	ND	4.5	0.052	0.016	UG/KG	UG/L	YES	NO	NO
alpha-Chlordane	130	38	ND	ND	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
gamma-Chlordane	240	48	ND	ND	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
technical Chlordane	680	30	ND	ND	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
4,4'-DDD	17	4.9	ND	ND	8000	0.28	0.025	UG/KG	UG/L	NO	NO	NO
4,4'-DDE	96	12	ND	ND	27000	0.2	0.14	UG/KG	UG/L	NO	NO	NO
4,4'-DDT	66	7.4	ND	ND	16000	0.2	0.001	UG/KG	UG/L	NO	NO	NO
Dieldrin	9.9	4.5	ND	ND	2	0.0042	0.0019	UG/KG	UG/L	YES	NO	NO
Endosulfan I	5.1	ND	ND	ND	9000	220	0.0087	UG/KG	UG/L	NO	NO	NO
Endosulfan II	5.9	ND	ND	ND	9000	220	0.0087	UG/KG	UG/L	NO	NO	NO
Endosulfan sulfate	5.1	ND	ND	ND	9000	220	NA	UG/KG	UG/L	NO	NO	NO
Endrin	11	ND	ND	ND	500	11	0.0023	UG/KG	UG/L	NO	NO	NO
Endrin aldehyde	15	17	ND	ND	500	11	NA	UG/KG	UG/L	NO	NO	NO
Endrin ketone	3.1	ND	ND	ND	500	11	NA	UG/KG	UG/L	NO	NO	NO
Heptachlor	130	4	ND	ND	11500	0.0023	0.0036	UG/KG	UG/L	NO	NO	NO

Table 10.4.5.1
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, and Deep Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Heptachlor epoxide	19	2.9	ND	ND	350	0.0012	0.0036	UG/KG	UG/L	NO	NO	NO
Methoxychlor	22	ND	ND	ND	80000	180	0.03	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	ND	6.84	NA	NA	950	0.43	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	6440	7330	5090	ND	41100	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	29.5	4.8	ND	ND	2.5	15	NA	MG/KG	UG/L	YES	NO	NO
Arsenic	7.9	7.6	17.4	ND	23.9	18.7	36	MG/KG	UG/L	NO	NO	NO
Barium	54.8	33	27.1	32.4	820	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	0.44	0.35	ND	ND	32	1.2	NA	MG/KG	UG/L	NO	NO	NO
Cadmium	18	5.8	ND	ND	4	18	9.3	MG/KG	UG/L	YES	NO	NO
Chromium (total)	42.7	15.3	6.1	ND	94.6	37000	103	MG/KG	UG/L	NO	NO	NO
Cobalt	50.7	3.8	2.1	ND	19	2200	NA	MG/KG	UG/L	YES	NO	NO
Copper	1760	171	12.8	ND	152	1500	2.9	MG/KG	UG/L	YES	NO	YES
Cyanide	0.5	0.49	ND	ND	20	730	37.3	MG/KG	UG/L	NO	NO	NO
Lead	434	293	10.3	ND	400	15	8.5	MG/KG	UG/L	YES	NO	YES
Manganese	152	176	405	121	881	2560	NA	MG/KG	UG/L	NO	NO	NO
Mercury	1.7	1.6	ND	ND	2.6	11	0.2	MG/KG	UG/L	NO	NO	NO
Nickel	193	15.9	2.2	ND	77.1	730	42.2	MG/KG	UG/L	YES	NO	NO
Selenium	0.58	ND	5.2	ND	2.5	180	71	MG/KG	UG/L	NO	NO	NO
Silver	1.2	ND	ND	ND	17	180	0.23	MG/KG	UG/L	NO	NO	NO
Tin	54.3	13.1	ND	ND	59.4	22000	NA	MG/KG	UG/L	NO	NO	NO
Vanadium	16.1	13.1	9.5	ND	3000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	4080	1550	119	ND	6000	11000	86	MG/KG	UG/L	NO	NO	YES

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 10, adapted from 1996 EPA Soil Screening Guidance or calculated using values from Table 6.2
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, June 3, 1996
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November, 1995; Table 2
In each case, the value shown is the greater of the relevant screening value or the corresponding background reference value

Units: See notes for Table 10.1.5.1

Table 10.4.5.2

Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, or Deep Groundwater at Concentrations Exceeding any Initial Screening Concentration

Comparison to Combined Ecological/Human Health RBCs Adjusted for Surface Water Dilution, and to SSLs Based on Adjusted Ecological/Human Health RBCs: Tier Two

NAVBASE-Charleston, Zone E: SWMUs 23 and 63 and AOCs 540, 541, 542, and 543

Charleston, South Carolina

Parameter	Max. Concentration		Max. Concentration		Initial Screening Concentrations *			Adjusted Screening Concentrations #					Units		Screening Results	
	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Combined Eco/HH Surf. Wtr. RBC	Adjusted Eco/HH GW RBC	Target Leachate Conc. (DAF=1)	SSL Multi-plier	Adjusted SSL (DAF=1)	Soil Units	Water Units	Leaching Potential	Surface Water Migration Concern
Volatile Organic Compounds																
Methylene chloride	2	18	ND	ND	10	4.1	2560	4.1	1.94E+05	5	3.89E+04	3.89E+04	UG/KG	UG/L	NO	NO
Semivolatile Organic Compounds																
Benzo(a)pyrene equivalents																
Benzo(a)anthracene	970	940	ND	ND	800	0.092	NA	0.092	4.36E+03	0.1	4.36E+04	3.49E+06	UG/KG	UG/L	NO	NO
Pentachlorophenol	ND	45	ND	ND	15	0.56	7.9	0.56	2.65E+04	1	2.65E+04	3.98E+04	UG/KG	UG/L	NO	NO
Pesticides/PCB Compounds																
Aroclor-1254	1200	ND	ND	ND	1000	0.0087	0.03	0.0087	4.12E+02	0.5	8.25E+02	8.25E+04	UG/KG	UG/L	NO	NO
alpha-BHC	5.4	3.3	ND	ND	0.25	0.011	1400	0.011	5.21E+02	0.01	5.21E+04	1.30E+03	UG/KG	UG/L	NO	NO
beta-BHC	4	ND	ND	ND	1.5	0.037	NA	0.037	1.75E+03	0.05	3.51E+04	5.26E+03	UG/KG	UG/L	NO	NO
delta-BHC	11	12	ND	ND	1.5	0.037	NA	0.037	1.75E+03	0.05	3.51E+04	5.26E+03	UG/KG	UG/L	NO	NO
gamma-BHC (Lindane)	5.1	ND	ND	ND	4.5	0.052	0.016	0.016	7.58E+02	0.2	3.79E+03	1.71E+03	UG/KG	UG/L	NO	NO
Dieldrin	9.9	4.5	ND	ND	2	0.0042	0.0019	0.0019	9.01E+01	0.005	1.80E+04	3.60E+03	UG/KG	UG/L	NO	NO
Inorganic Compounds																
Antimony	29.5	4.8	ND	ND	2.5	15	NA	15	7.11E+05	6	1.19E+05	2.96E+04	MG/KG	UG/L	NO	NO
Cadmium	18	5.8	ND	ND	4	18	9.3	9.3	4.41E+05	5	8.82E+04	3.53E+04	MG/KG	UG/L	NO	NO
Cobalt	50.7	3.8	2.1	ND	1040	2200	NA	2200	1.04E+08	2200	4.74E+04	1.00E+06	MG/KG	UG/L	NO	NO
Copper	1760	171	12.8	ND	458	1500	2.9	2.9	1.37E+05	1300	1.06E+02	4.84E+03	MG/KG	UG/L	NO	NO
Lead	434	293	10.3	ND	400	15	8.5	8.5	4.03E+05	15	2.69E+04	1.00E+06	MG/KG	UG/L	NO	NO
Nickel	193	15.9	2.2	ND	65	730	42.2	42.2	2.00E+06	100	2.00E+04	1.30E+05	MG/KG	UG/L	NO	NO
Zinc	4080	1550	119	ND	6000	11000	86	86	4.08E+06	10000	4.08E+02	2.45E+05	MG/KG	UG/L	NO	NO

* Initial Screening Concentrations: See notes for Table 10.1.5.2
In this table, the screening values shown are not adjusted for background reference values.

\# Adjusted Screening Concentrations: See notes for Table 10.1.5.2
Adjusted Eco/HH Groundwater RBC - Combined Eco/HH Surface Water RBCs multiplied by site-specific surface water dilution factor of 47,400: GW concentrations protective of surface water

Units: See notes for Table 10.1.5.2

Table 10.4.5.3
Soil-to-Air Volatilization Screening Analysis
NAVBASE-Charleston, Zone E: SWMUs 23 and 63 and AOCs 540, 541, 542, and 543
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Methylene chloride	2	7000	UG/KG	NO
Toluene	2	520000	UG/KG	NO
Xylene (total)	3	320000	UG/KG	NO

* - Soil screening levels for transfers from soil to air were obtained from USEPA Region III Risk-Based Concentration Table, June 1996.

10.4.6 Fixed-Point Risk Evaluation for SWMUs 23 and 63, and AOCs 540, 541, 542, and 543

10.4.6.1 Site Background and Investigative Approach

SWMU 23 is the new plating shop waste water treatment system (Building 226). SWMU 63 is the former battery charging area and its former location is now covered by Building 226. AOC 540 is the plating plant (Building 226). AOC 541 is the former oil storage shop (Building 22) which is currently an asphalt parking lot situated between Buildings 6 and 226. AOC 542 is the former paint shop and oxy-acetylene plant (Building 22) and its former location is currently an asphalt parking lot between buildings 6 and 226. AOC 543 is a former storage facility (Building 1026) and its former location is currently covered by building 226. The following refers to these sites as combined SWMU 23. All are located in a highly industrialized portion of Zone E. As a result, the risk assessment for this site is presented as FRE following the framework presented in Section 7.3. Due to their proximity, the investigational effort for these sites was combined. As a result, the risk evaluation will combine the environmental data from all three sites.

A total of twenty surface soil samples collected as part of the 1995 RFI were considered in the combined SWMU 23 FRE. Eight shallow monitoring wells and one deep monitoring well were installed as part of the 1995 RFI. Groundwater data generated from the first-quarter sampling event are used to represent point risk/hazard for the combined SWMU 23 FRE. Sections 10.4.1 and 10.4.3 contain summarys of the sampling effort for combined SWMU 23 soil and groundwater.

10.4.6.2 Fixed-Point Risk Evaluation for Soil

Residential Scenario

Table 10.4.6.1 provides CPSS summaries for combined SWMU 23 soil and identifies COPCs based on comparison to residential and industrial RBCs and background RCs. Based on residential

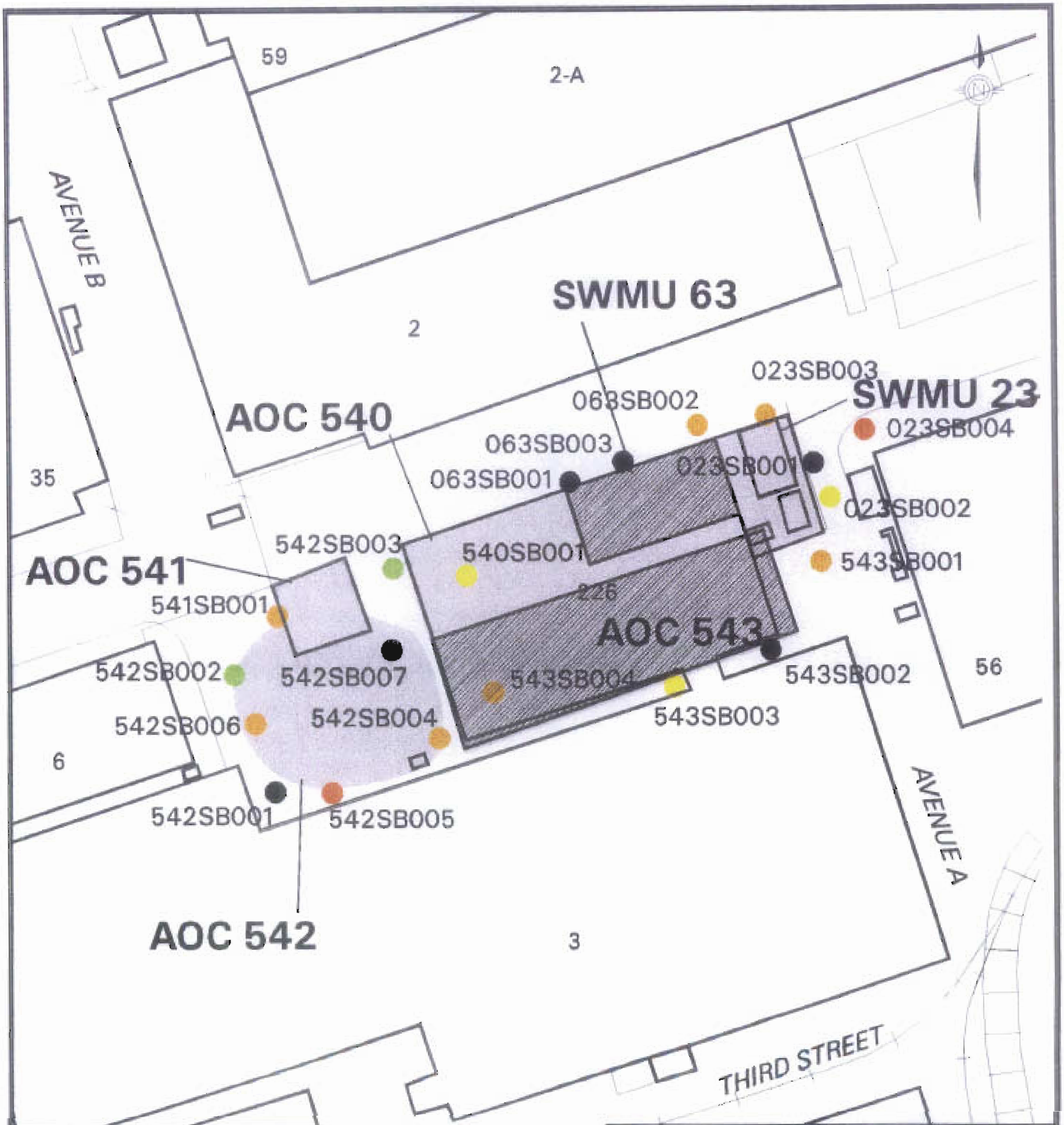
RBCs, eight COPCs (antimony, BEQs, cadmium, copper, lead, nickel, and zinc) were identified for combined SWMU 23 soil. Arsenic, beryllium, and chromium were detected in combined SWMU 23 soil at concentrations above their RBCs but were eliminated from consideration in the residential FRE based on comparison to their background concentrations. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration.

Table 10.4.6.2 summarizes the residential COPCs detected at each combined SWMU 23 sample location with contribution to risk and hazard. As shown, BEQs are the primary contributors to risk for combined SWMU 23, exceeding 1E-06 at 11 of 19 locations. Concentrations of Aroclor-1254 in sample 542SB006 equate with a risk of 5E-06. No carcinogenic COPC were detected at sample locations 023SB001, 063SB001, 063SB003, 542SB001, and 542SB007. Figure 10.4.3 is a spatial presentation of residential risk estimates for combined SWMU 23 soil. For samples with concentrations of carcinogenic COPCs, risk estimates range from 3E-08 to 3E-05 with an arithmetic mean risk of 6E-06. The arithmetic mean was calculated assuming a deminimus risk level of 1E-07 for locations where no carcinogenic COPC were detected.

HI projections exceeded the threshold of unity at only one sample locations (541SB001) due to the concentration of antimony detected in the associated sample. HI estimates range from 0.0003 to 1 with an arithmetic mean risk of 0.3.

Industrial Scenario

Based on industrial RBCs, Aroclor-1254 and BEQs were identified as COPCs for combined SWMU 23 soil. Arsenic was detected in combined SWMU 23 soil at concentrations above its industrial RBC but was eliminated from consideration in the industrial FRE 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 based on background concentration.



LEGEND - CUMULATIVE SOIL RISK

- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 160

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

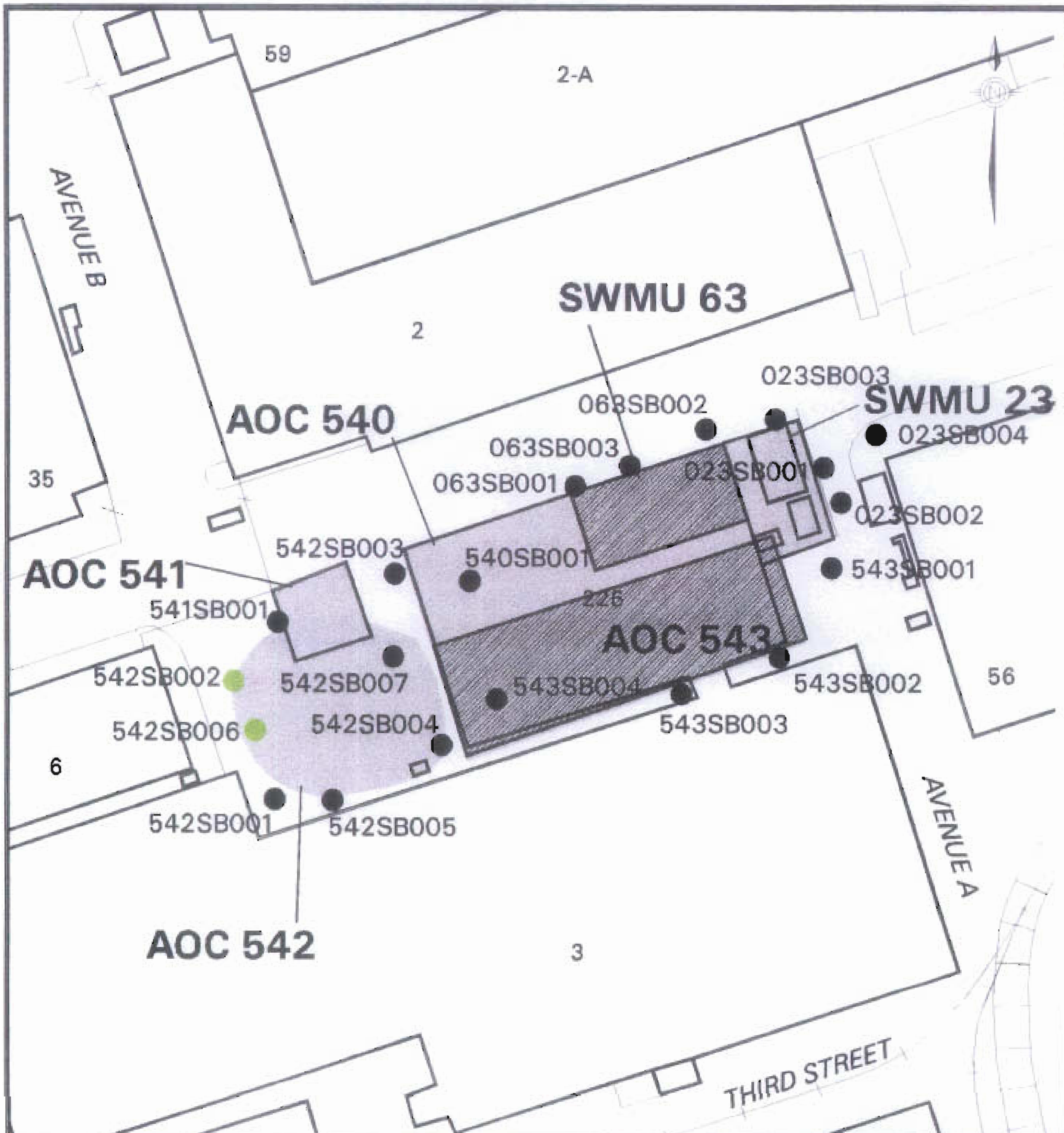
FIGURE 10.4.3
CUMULATIVE SOIL RISK
RESIDENTIAL SCENARIO
SWMU 23,63 AOC 540-543

Table 10.4.6.3 summarizes the industrial COPCs detected at each combined SWMU 23 sample location with contribution to risk and hazard. As shown, BEQs are the primary contributors to risk for combined SWMU 23, exceeding 1E-06 at eight of 19 locations based on the industrial scenario. The concentration of Aroclor-1254 in the sample from location 542SB006 equates with a risk of 1E-06. No carcinogenic COPCs were detected in five of the surface soil samples (same as residential scenario). Figure 10.4.4 is a spatial presentation of industrial scenario risk estimates for combined SWMU 23 surface soil. For the samples with concentrations of carcinogenic COPCs, risk estimates range from 6E-09 to 6E-06 with an arithmetic mean risk of 1E-06, assuming a deminimus risk of 1E-07 for sample locations where no carcinogenic COPCs were detected.

HI projections did not exceed the threshold of unity at any sample locations based on the industrial scenario. For sample with concentrations of COPCs contributing to HI estimates, the range was from 0.01 to 0.08.

Lead

Lead was detected in all 19 surface soil samples collected at combined SWMU 23. Soil concentrations ranged from 1.1 to 434 mg/kg and exceeded the residential clean up level of 400 mg/kg in one of 19 samples (023SB004). The mean detected lead concentration for combined SWMU 23 is 73.5 mg/kg which is well below both the action level of 400 mg/kg, considered protective of children under a residential scenario, and the industrial cleanup level of 1,300 mg/kg, considered protective of adults under an industrial scenario. Figure 10.4.5 is a spatial presentation of lead soil concentrations, using the surface soil background concentration of 265 mg/kg, the residential soil lead cleanup level of 400 mg/kg, and the industrial soil lead cleanup concentration of 1,300 mg/kg as benchmark levels to illustrate the lead soil concentrations for combined SWMU 23.

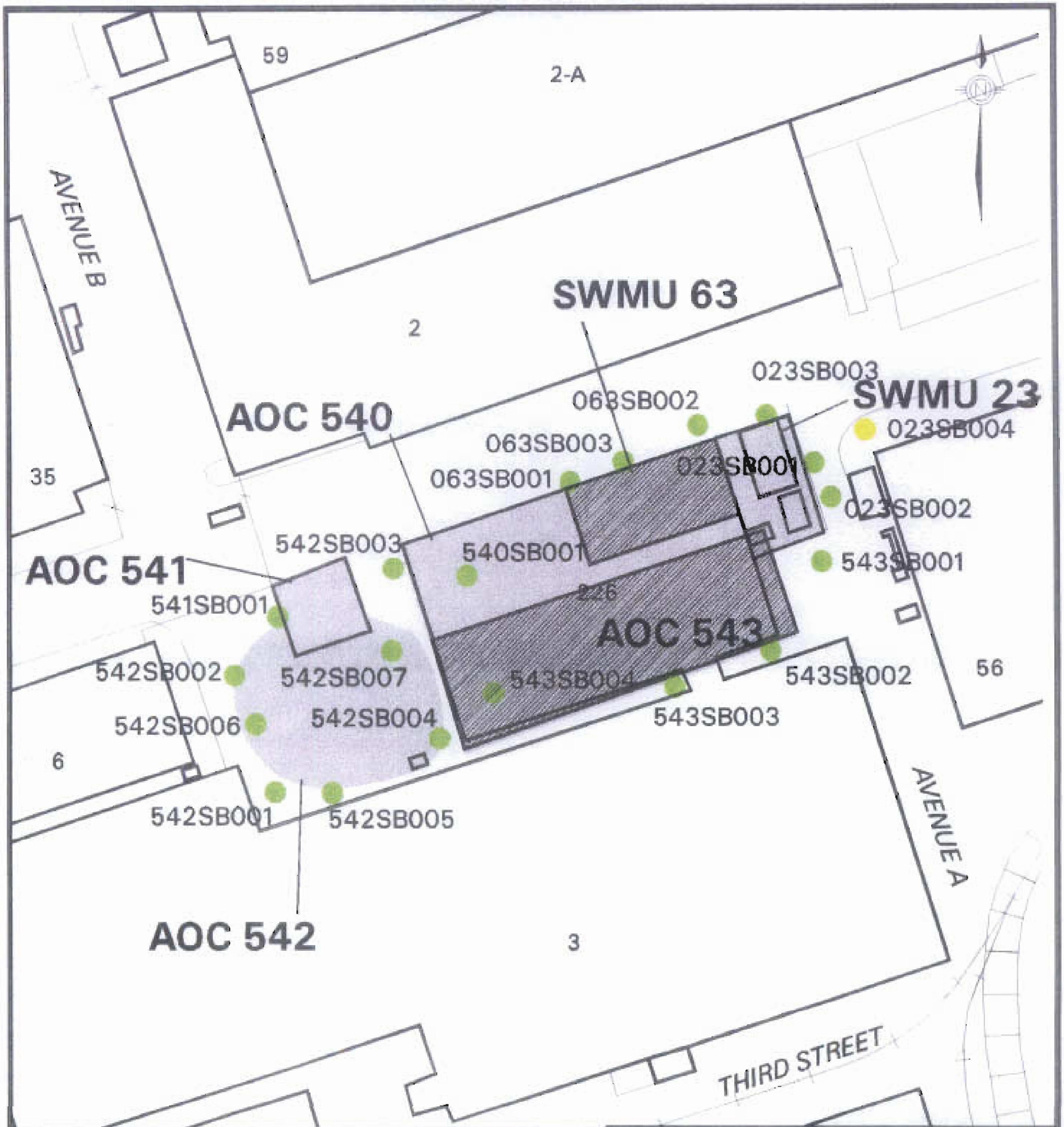


LEGEND - CUMULATIVE SOIL HAZARD

- NO COPCs DETECTED
- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

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

FIGURE 10.4.4
CUMULATIVE SOIL HAZARD
INDUSTRIAL SCENARIO
SWMU 23,63 AOC 540-543



LEAD IN SURFACE SOIL

- NON DETECT
- < 265
- 265 - 400
- 401 - 1,300
- > 1,300

0 feet 150

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

FIGURE 10.4.5
DISTRIBUTION OF LEAD
IN SURFACE SOIL
SWMU 23,63 AOC 540-543

10.4.6.3 Fixed-Point Risk Evaluation for Groundwater

Residential Scenario

Table 10.4.6.4 provides separate CPSS summaries for combined SWMU 23 shallow and deep groundwater and identifies COPCs. No COPCs were identified in deep groundwater and aluminum and acetone were identified as COPCs in shallow groundwater based on comparison of first-quarter groundwater concentrations to tap-water RBCs and background RCs. Arsenic (shallow only) and manganese (shallow and deep) were detected in combined SWMU 23 groundwater at concentrations above their respective RBCs but were eliminated from consideration in the FRE based on comparison to background concentrations. For shallow groundwater, Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration. Combined SWMU 23 deep groundwater data were not sufficient to perform Wilcoxon rank sum test analyses, and as a result, manganese was eliminated from the deep groundwater FRE based on direct comparison of its maximum concentration to its background RC.

Table 10.4.6.5 summarizes the COPCs identified in combined SWMU 23 shallow monitoring wells sampled during the first quarter and their contribution to HI projections. No carcinogenic COPCs were detected in any of the first-quarter groundwater samples. HIs ranged from 0.04 to 0.7.

10.4.6.4 Uncertainty

SWMU 23 uncertainty issues specific to the FRE and essential to the risk management process are presented in the following paragraphs.

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA

Region IV when assessing potential future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure.

Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use of Zone E, specifically as a marine cargo terminal and drydocking facility. The ground surface around SWMUs 23 and 63 and AOCs 540, 541, 542, and 543 is currently covered with either asphalt or concrete. As a result, chronic exposure to current soil condition is highly unlikely and the associated direct contact exposure pathways evaluations overestimate risk and hazard. If this area were to be redeveloped, the buildings and other structures would be demolished, and the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, chronic exposure to current surface soil conditions would not be likely under any future use scenario. These factors indicate that exposure pathways assessed in this FRE would generally overestimate the risk and hazard posed to current/future site workers and future site residents.

Groundwater is not currently used as a potable water source at combined SWMU 23, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.

Quantification of Risk/Hazard

Soil

A conservative screening process was used to identify COPCs for combined SWMU 23. The potential for eliminating CPSSs with the potential for cumulative HI greater than one was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment based on comparison to RBCs, heptachlor was reported at a concentration close to its RBC (e.g. within 10% of its RBC). Arsenic, beryllium, and chromium were present in combined SWMU 23 soil at concentrations above RBC benchmarks and were eliminated from consideration in the FRE based on comparison to background concentration. As a result, their contribution to soil pathway risk and hazard has not been considered in this FRE.

The point risk/hazard estimates used for FRE are based on the unlikely assumption that a potential future site resident will be chronically exposed to specific points. Exposure to surface soil conditions is more likely the result of uniform exposure to the soil conditions of the entire site (or exposure unit area) rather than specific points. With this in mind, it should be noted that antimony and Aroclor-1254 were each detected at concentrations above their RGOs in only one sample. As a result, overall site risk/hazard has been overestimated for these two constituents.

Groundwater

The same conservative screening process used for soil was also applied to groundwater. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, none was reported at concentrations close to their RBCs (e.g. within 10% of their RBCs). Arsenic and manganese were present in combined SWMU 23 groundwater at concentrations above RBC benchmarks and were eliminated from consideration in the FRE based on comparison to background concentration. As a result, their contribution to groundwater pathway risk and hazard has not been considered in this FRE.

10.4.6.5 FRE Summary

The risk and hazard posed by contaminants at combined SWMU 23 were assessed for the future site worker and the future site resident as sample point-specific estimates. In surface soils, the incidental ingestion and dermal contact pathways are reflected. The groundwater FRE was based on first-quarter data and considers the ingestion and inhalation (VOCs only) pathways. Risk and HI estimates are presented on Tables 10.4.6.2, 10.4.6.3, and 10.4.6.5 such that a risk (E-06) or HI that exceed one for any COPC at any given sample location is an indication that the concentration of that COPC exceeds its RGO. Section 7, Tables 7.3.1, 7.3.2, and 7.3.3 provide residential, industrial, and residential groundwater RGOs, respectively, for all of the COPCs identified for Zone E.

Soil — Residential Scenario

Antimony, Aroclor-1254, and BEQs were detected in combined SWMU 23 surface soil at concentrations above their RGOs. Antimony and Aroclor-1254 were each only detected at concentrations above their RGOs in one surface soil sample and therefore do not represent significant contributors to overall site risk and hazard.

Soil — Site Worker Scenario

Aroclor-1254 and BEQs were detected in combined SWMU 23 surface soil at concentrations above their RGOs. Aroclor-1254 was only detected at a concentration above its RGO in one surface soil sample and therefore does not represent a significant contributor to overall site risk and hazard.

Groundwater — Residential Scenario

No COPCs were detected in combined SWMU 23 groundwater at concentrations above their RGOs (based on a target HI of 1 and a target risk of 1E-06).

Table 10.4.6.1
Chemicals Present in Site Samples
SWMUs 23,63; AOC 540, 541, 542, 543 - Surface Soil
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Screening Concentration Industrial RBC	Screening Concentration Reference	Units	Number Exceeding Res. RBC	Number Exceeding Ind. RBC	Number Exceeding Ref.
Inorganics													
Aluminum (Al)		19	19	821 - 6440	3357.42	NA - NA	7800	100000	26600	MG/KG			
Antimony (Sb)	*	7	19	1.6 - 29.5	10.70	0.43 - 3.3	3.1	82	1.77	MG/KG	4		6
Arsenic (As)		18	19	0.66 - 7.9	3.55	0.56 - 0.56	0.43	3.8	23.9	MG/KG	18	8	
Barium (Ba)		18	19	0.96 - 54.8	23.61	23.6 - 23.6	550	14000	130	MG/KG			
Beryllium (Be)		15	19	0.13 - 0.44	0.25	0.11 - 0.15	0.15	1.3	1.7	MG/KG	14		
Cadmium (Cd)	*	10	19	0.15 - 18	3.07	0.11 - 0.12	3.9	100	1.5	MG/KG	4		3
Calcium (Ca)	N	18	19	1660 - 145000	23732.22	7420 - 7420	NA	NA	NA	MG/KG			
Chromium (Cr)		19	19	2.6 - 42.7	10.24	NA - NA	39	1000	94.6	MG/KG	1		
Cobalt (Co)		18	19	0.47 - 50.7	5.90	0.22 - 0.22	470	12000	19	MG/KG			2
Copper (Cu)	*	19	19	0.25 - 1760	168.59	NA - NA	310	8200	66	MG/KG	2		6
Cyanide (CN)		2	18	0.38 - 0.5	0.44	0.21 - 0.24	160	4100	0.5	MG/KG			1
Iron (Fe)	N	18	19	1160 - 10800	4793.89	7980 - 7980	NA	NA	NA	MG/KG			
Lead (Pb)	*	19	19	1.1 - 434	73.54	NA - NA	400	1300	265	MG/KG	1		1
Magnesium (Mg)	N	18	19	26.4 - 1870	469.97	645 - 645	NA	NA	NA	MG/KG			
Manganese (Mn)		18	19	5.9 - 152	61.83	55.6 - 55.6	180	4700	302	MG/KG			
Mercury (Hg)		10	19	0.02 - 1.7	0.49	0.02 - 1.1	2.3	61	2.6	MG/KG			
Nickel (Ni)	*	19	19	0.29 - 193	14.91	NA - NA	160	4100	77.1	MG/KG	1		1
Potassium (K)	N	3	19	176 - 720	444.67	168 - 724	NA	NA	NA	MG/KG			
Selenium (Se)		1	19	0.58 - 0.58	0.58	0.53 - 0.59	39	1000	1.7	MG/KG			
Silver (Ag)		2	19	0.24 - 1.2	0.72	0.21 - 0.55	39	1000	NA	MG/KG			
Sodium (Na)	N	3	19	47.7 - 90.6	71.67	11 - 170	NA	NA	NA	MG/KG			
Tin (Sn)		11	19	2.6 - 54.3	13.79	2.1 - 2.4	4700	6100	59.4	MG/KG			
Vanadium (V)		19	19	2.2 - 16.1	6.59	NA - NA	55	1400	94.3	MG/KG			
Zinc (Zn)	*	19	19	0.69 - 4080	400.68	NA - NA	2300	61000	827	MG/KG	1		3
Pesticides													
4,4'-DDD		3	18	4.3 - 17	9.00	2.6 - 2.9	2700	24000	NA	UG/KG			
4,4'-DDE		7	18	6.7 - 96	26.46	2.6 - 2.9	1900	17000	NA	UG/KG			
4,4'-DDT		6	18	4.4 - 66	18.58	2.6 - 2.8	1900	17000	NA	UG/KG			
Aldrin		2	18	1.8 - 8.8	5.30	1.4 - 1.5	38	340	NA	UG/KG			

Table 10.4.6.1
Chemicals Present in Site Samples
SWMUs 23,63; AOC 540, 541, 542, 543 - Surface Soil
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Screening Concentration Industrial RBC	Reference	Units	Number Exceeding Res. RBC	Number Exceeding Ind. RBC	Ref.
alpha-BHC		1	18	5.4 - 5.4	5.40	1.4 - 1.5	100	910	NA	UG/KG			
alpha-Chlordane		10	18	1.5 - 130	37.51	1.4 - 1.5	470	2200	NA	UG/KG			
Aroclor-1254	* *	2	18	190 - 1200	695.00	71 - 78	83	740	NA	UG/KG	2	1	
beta-BHC		1	18	4 - 4	4.00	1.4 - 1.5	350	3200	NA	UG/KG			
delta-BHC		2	18	3.4 - 11	7.20	1.4 - 1.5	100	910	NA	UG/KG			
Dieldrin		3	18	5.2 - 9.9	7.90	2.6 - 2.9	40	360	NA	UG/KG			
Endosulfan I		1	18	5.1 - 5.1	5.10	1.4 - 1.5	47000	1200000	NA	UG/KG			
Endosulfan II		1	18	5.9 - 5.9	5.90	2.6 - 2.9	47000	1200000	NA	UG/KG			
Endosulfan sulfate		1	18	5.1 - 5.1	5.10	2.6 - 2.9	47000	1200000	NA	UG/KG			
Endrin		2	18	5.3 - 11	8.15	2.6 - 2.9	2300	61000	NA	UG/KG			
Endrin aldehyde		2	18	3.9 - 15	9.45	2.6 - 3	2300	61000	NA	UG/KG			
Endrin ketone		1	18	3.1 - 3.1	3.10	2.6 - 2.9	2300	61000	NA	UG/KG			
gamma-BHC (Lindane)		2	18	1.4 - 5.1	3.25	1.4 - 1.5	490	4400	NA	UG/KG			
gamma-Chlordane		9	18	3.2 - 240	65.54	1.4 - 1.5	470	2200	NA	UG/KG			
Heptachlor		9	18	1.4 - 130	23.98	1.4 - 1.5	140	1300	NA	UG/KG			
Heptachlor epoxide		4	18	2.5 - 19	8.50	1.4 - 1.5	70	630	NA	UG/KG			
Methoxychlor		1	18	22 - 22	22.00	14 - 15	39000	1000000	NA	UG/KG			
Technical Chlordane		2	2	46 - 680	363.00	NA - NA	NA	NA	NA	UG/KG			
Carcinogenic PAHs													
B(a)P Equiv.	* *	13	19	0.566 - 1688	444.90	808.85 - 1733.25	88	780	NA	UG/KG	11	2	
Benzo(a)anthracene	*	9	19	180 - 970	413.33	350 - 750	880	7800	NA	UG/KG	1		
Benzo(a)pyrene	* *	11	19	130 - 1100	400.00	350 - 750	88	780	NA	UG/KG	11	2	
Benzo(b)fluoranthene		3	19	140 - 860	420.00	350 - 770	880	7800	NA	UG/KG			
Benzo(k)fluoranthene		13	19	52 - 1100	394.00	350 - 750	8800	78000	NA	UG/KG			
Chrysene		13	19	46 - 1000	348.92	350 - 750	88000	780000	NA	UG/KG			
Dibenz(a,h)anthracene	*	3	19	77 - 410	195.67	350 - 770	88	780	NA	UG/KG	2		
Indeno(1,2,3-cd)pyrene		9	19	130 - 690	270.00	350 - 770	880	7800	NA	UG/KG			
Semivolatile Organics													
2-Methylnaphthalene		2	20	91 - 140	115.50	350 - 810	310000	8200000	NA	UG/KG			

Table 10.4.6.1
Chemicals Present in Site Samples
SWMUs 23,63; AOC 540, 541, 542, 543 - Surface Soil
NAVBASE - Charleston
Charleston, SC

Parameter	Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Industrial RBC	Reference	Units	Number Exceeding Res. RBC	Ind. RBC	Ref.
Acenaphthene	2	20	43 - 52	47.50	350 - 810	470000	12000000	NA	UG/KG			
Acenaphthylene	1	20	54 - 54	54.00	350 - 810	310000	8200000	NA	UG/KG			
Anthracene	2	19	160 - 180	170.00	350 - 770	2300000	61000000	NA	UG/KG			
Benzo(g,h,i)perylene	11	19	39 - 820	263.36	350 - 750	310000	8200000	NA	UG/KG			
Benzoic acid	1	20	65 - 65	65.00	1700 - 4000	31000000	1E+08	NA	UG/KG			
bis(2-Ethylhexyl)phthalat	3	19	52 - 120	87.67	350 - 770	46000	410000	NA	UG/KG			
Di-n-butylphthalate	1	19	44 - 44	44.00	350 - 770	780000	20000000	NA	UG/KG			
Fluoranthene	12	19	71 - 1700	578.42	350 - 750	310000	8200000	NA	UG/KG			
Fluorene	2	20	38 - 39	38.50	350 - 810	310000	8200000	NA	UG/KG			
Naphthalene	1	20	65 - 65	65.00	350 - 810	310000	8200000	NA	UG/KG			
Phenanthrene	10	19	47 - 710	316.70	350 - 750	310000	8200000	NA	UG/KG			
Pyrene	13	19	84 - 1900	573.38	350 - 750	230000	6100000	NA	UG/KG			
Volatile Organics												
Methylene chloride	1	19	2 - 2	2.00	5 - 32	85000	760000	NA	UG/KG			
Toluene	3	19	2 - 2	2.00	5 - 28	1600000	41000000	NA	UG/KG			
Xylene (Total)	3	19	2 - 3	2.33	5 - 28	16000000	1E+08	NA	UG/KG			

Notes:
* - Identified as a residential COPC
** - Identified as an industrial COPC
N - Essential nutrient
MG/KG - milligrams per kilogram
UG/KG - micrograms per kilogram
SQL - Sample quantitation limit
RBC - Risk-based concentration
NA - Not applicable

Table 10.4.6.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 23 and 63/AOCs 540, 541, 542, and 543
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
023	B001	Antimony (Sb)	ND	MG/KG	NA		NA	
023	B001	Aroclor-1254	ND	UG/KG	NA		NA	
023	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
023	B001	Cadmium (Cd)	ND	MG/KG	NA		NA	
023	B001	Copper (Cu)	1.2	MG/KG	NA		0.00041	23.7
023	B001	Lead (Pb)	1.1	MG/KG	NA		NA	
023	B001	Nickel (Ni)	1.7	MG/KG	NA		0.0012	67.1
023	B001	Zinc (Zn)	3.5	MG/KG	NA		0.00016	9.2
		Total			NA		0.0017	
023	B002	Antimony (Sb)	ND	MG/KG	NA		NA	
023	B002	Aroclor-1254	ND	UG/KG	NA		NA	
023	B002	B(a)P Equiv.	181.93	UG/KG	3.01	100	NA	
023	B002	Cadmium (Cd)	0.24	MG/KG	NA		0.0033	21.2
023	B002	Copper (Cu)	3.6	MG/KG	NA		0.0012	8.0
023	B002	Lead (Pb)	6.4	MG/KG	NA		NA	
023	B002	Nickel (Ni)	14.8	MG/KG	NA		0.010	65.5
023	B002	Zinc (Zn)	18.1	MG/KG	NA		0.00083	5.3
		Total			3.01		0.015	
023	B003	Antimony (Sb)	1.6	MG/KG	NA		0.055	83.2
023	B003	Aroclor-1254	ND	UG/KG	NA		NA	
023	B003	B(a)P Equiv.	330.15	UG/KG	5.47	100	NA	
023	B003	Cadmium (Cd)	ND	MG/KG	NA		NA	
023	B003	Copper (Cu)	16.9	MG/KG	NA		0.0058	8.8
023	B003	Lead (Pb)	29.3	MG/KG	NA		NA	
023	B003	Nickel (Ni)	6.2	MG/KG	NA		0.0043	6.4
023	B003	Zinc (Zn)	23	MG/KG	NA		0.0011	1.6
		Total			5.47		0.066	
023	B004	Antimony (Sb)	7.4	MG/KG	NA		0.25	48.0
023	B004	Aroclor-1254	ND	UG/KG	NA		NA	
023	B004	B(a)P Equiv.	1,101	UG/KG	18.23	100	NA	
023	B004	Cadmium (Cd)	8.9	MG/KG	NA		0.12	23.1
023	B004	Copper (Cu)	245	MG/KG	NA		0.084	15.9
023	B004	Lead (Pb)	434	MG/KG	NA		NA	
023	B004	Nickel (Ni)	16.4	MG/KG	NA		0.011	2.1
023	B004	Zinc (Zn)	1,270	MG/KG	NA		0.058	11.0
		Total			18.23		0.53	

Table 10.4.6.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 23 and 63/AOCs 540, 541, 542, and 543
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
063	B001	Antimony (Sb)	ND	MG/KG	NA		NA	
063	B001	Aroclor-1254	ND	UG/KG	NA		NA	
063	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
063	B001	Cadmium (Cd)	ND	MG/KG	NA		NA	
063	B001	Copper (Cu)	0.25	MG/KG	NA		0.000086	27.1
063	B001	Lead (Pb)	2.7	MG/KG	NA		NA	
063	B001	Nickel (Ni)	0.29	MG/KG	NA		0.00020	62.9
063	B001	Zinc (Zn)	0.69	MG/KG	NA		0.000032	10.0
		Total			NA		0.00032	
063	B002	Antimony (Sb)	ND	MG/KG	NA		NA	
063	B002	Aroclor-1254	ND	UG/KG	NA		NA	
063	B002	B(a)P Equiv.	353.81	UG/KG	5.86	100	NA	
063	B002	Cadmium (Cd)	ND	MG/KG	NA		NA	
063	B002	Copper (Cu)	8.5	MG/KG	NA		0.0029	57.6
063	B002	Lead (Pb)	29.8	MG/KG	NA		NA	
063	B002	Nickel (Ni)	1.8	MG/KG	NA		0.0012	24.4
063	B002	Zinc (Zn)	20	MG/KG	NA		0.00091	18.1
		Total			5.86		0.0051	
063	B003	Antimony (Sb)	ND	MG/KG	NA		NA	
063	B003	Aroclor-1254	ND	UG/KG	NA		NA	
063	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
063	B003	Cadmium (Cd)	ND	MG/KG	NA		NA	
063	B003	Copper (Cu)	2.5	MG/KG	NA		0.00086	36.9
063	B003	Lead (Pb)	4.3	MG/KG	NA		NA	
063	B003	Nickel (Ni)	1.6	MG/KG	NA		0.0011	47.2
063	B003	Zinc (Zn)	8.1	MG/KG	NA		0.00037	15.9
		Total			NA		0.0023	
540	B001	Antimony (Sb)	2.6	MG/KG	NA		0.089	79.7
540	B001	Aroclor-1254	ND	UG/KG	NA		NA	
540	B001	B(a)P Equiv.	145.35	UG/KG	2.41	100	NA	
540	B001	Cadmium (Cd)	0.15	MG/KG	NA		0.0021	1.8
540	B001	Copper (Cu)	36.7	MG/KG	NA		0.013	11.2
540	B001	Lead (Pb)	97.3	MG/KG	NA		NA	
540	B001	Nickel (Ni)	3.2	MG/KG	NA		0.0022	2.0
540	B001	Zinc (Zn)	129	MG/KG	NA		0.0059	5.3
		Total			2.41		0.11	

Table 10.4.6.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 23 and 63/AOCs 540, 541, 542, and 543
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
541	B001	Antimony (Sb)	29.5	MG/KG	NA		1.01	79.0
541	B001	Aroclor-1254	ND	UG/KG	NA		NA	
541	B001	B(a)P Equiv.	429.6	UG/KG	7.11	100	NA	
541	B001	Cadmium (Cd)	0.25	MG/KG	NA		0.0034	0.3
541	B001	Copper (Cu)	747	MG/KG	NA		0.26	20.0
541	B001	Lead (Pb)	75.4	MG/KG	NA		NA	
541	B001	Nickel (Ni)	4.7	MG/KG	NA		0.0032	0.3
541	B001	Zinc (Zn)	141	MG/KG	NA		0.0064	0.5
		Total			7.11		1.28	
542	B001	Antimony (Sb)	ND	MG/KG	NA		NA	
542	B001	Aroclor-1254	ND	UG/KG	NA		NA	
542	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
542	B001	Cadmium (Cd)	ND	MG/KG	NA		NA	
542	B001	Copper (Cu)	1.1	MG/KG	NA		0.00038	23.2
542	B001	Lead (Pb)	2.1	MG/KG	NA		NA	
542	B001	Nickel (Ni)	1.5	MG/KG	NA		0.0010	63.3
542	B001	Zinc (Zn)	4.8	MG/KG	NA		0.00022	13.5
		Total			NA		0.0016	
542	B002	Antimony (Sb)	ND	MG/KG	NA		NA	
542	B002	Aroclor-1254	190	UG/KG	0.86	100	0.16	97.4
542	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
542	B002	Cadmium (Cd)	ND	MG/KG	NA		NA	
542	B002	Copper (Cu)	6.4	MG/KG	NA		0.0022	1.4
542	B002	Lead (Pb)	8.8	MG/KG	NA		NA	
542	B002	Nickel (Ni)	1.7	MG/KG	NA		0.0012	0.7
542	B002	Zinc (Zn)	19	MG/KG	NA		0.00087	0.5
		Total			0.86		0.16	
542	B003	Antimony (Sb)	ND	MG/KG	NA		NA	
542	B003	Aroclor-1254	ND	UG/KG	NA		NA	
542	B003	B(a)P Equiv.	1.72	UG/KG	0.03	100	NA	
542	B003	Cadmium (Cd)	0.2	MG/KG	NA		0.0027	9.3
542	B003	Copper (Cu)	57.7	MG/KG	NA		0.020	67.5
542	B003	Lead (Pb)	94.6	MG/KG	NA		NA	
542	B003	Nickel (Ni)	4.7	MG/KG	NA		0.0032	11.0
542	B003	Zinc (Zn)	78.3	MG/KG	NA		0.0036	12.2
		Total			0.03		0.029	

Table 10.4.6.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 23 and 63/AOCs 540, 541, 542, and 543
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
542	B004	Antimony (Sb)	3.8	MG/KG	NA		0.13	74.1
542	B004	Aroclor-1254	ND	UG/KG	NA		NA	
542	B004	B(a)P Equiv.	509.01	UG/KG	8.43	100	NA	
542	B004	Cadmium (Cd)	0.43	MG/KG	NA		0.0059	3.3
542	B004	Copper (Cu)	82.4	MG/KG	NA		0.028	16.1
542	B004	Lead (Pb)	84.2	MG/KG	NA		NA	
542	B004	Nickel (Ni)	3.5	MG/KG	NA		0.0024	1.4
542	B004	Zinc (Zn)	198	MG/KG	NA		0.0091	5.1
		Total			8.43		0.18	
542	B005	Antimony (Sb)	ND	MG/KG	NA		NA	
542	B005	Aroclor-1254	ND	UG/KG	NA		NA	
542	B005	B(a)P Equiv.	1,688	UG/KG	27.95	100	NA	
542	B005	Cadmium (Cd)	18	MG/KG	NA		0.25	52.9
542	B005	Copper (Cu)	82.8	MG/KG	NA		0.028	6.1
542	B005	Lead (Pb)	138	MG/KG	NA		NA	
542	B005	Nickel (Ni)	6.2	MG/KG	NA		0.0043	0.9
542	B005	Zinc (Zn)	4,080	MG/KG	NA		0.19	40.0
		Total			27.95		0.47	
542	B006	Antimony (Sb)	ND	MG/KG	NA		NA	
542	B006	Aroclor-1254	1,200	UG/KG	5.44	99.8	0.99	99.2
542	B006	B(a)P Equiv.	0.57	UG/KG	0.01	0.2	NA	
542	B006	Cadmium (Cd)	ND	MG/KG	NA		NA	
542	B006	Copper (Cu)	8.4	MG/KG	NA		0.0029	0.3
542	B006	Lead (Pb)	10.2	MG/KG	NA		NA	
542	B006	Nickel (Ni)	4.3	MG/KG	NA		0.0029	0.3
542	B006	Zinc (Zn)	36.4	MG/KG	NA		0.0017	0.2
		Total			5.45		1.0	
542	B007	Antimony (Sb)	27.4	MG/KG	NA		0.94	95.2
542	B007	Aroclor-1254	ND	UG/KG	NA		NA	
542	B007	B(a)P Equiv.	ND	UG/KG	NA		NA	
542	B007	Cadmium (Cd)	0.44	MG/KG	NA		0.0060	0.6
542	B007	Copper (Cu)	81.1	MG/KG	NA		0.028	2.8
542	B007	Lead (Pb)	126	MG/KG	NA		NA	
542	B007	Nickel (Ni)	4.1	MG/KG	NA		0.0028	0.3
542	B007	Zinc (Zn)	227	MG/KG	NA		0.010	1.1
		Total			NA		0.99	

Table 10.4.6.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 23 and 63/AOCs 540, 541, 542, and 543
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
543	B001	Antimony (Sb)	ND	MG/KG	NA		NA	
543	B001	Aroclor-1254	ND	UG/KG	NA		NA	
543	B001	B(a)P Equiv.	354	UG/KG	5.86	100	NA	
543	B001	Cadmium (Cd)	0.42	MG/KG	NA		0.0058	17.7
543	B001	Copper (Cu)	45	MG/KG	NA		0.015	47.4
543	B001	Lead (Pb)	41.6	MG/KG	NA		NA	
543	B001	Nickel (Ni)	11.8	MG/KG	NA		0.0081	24.8
543	B001	Zinc (Zn)	72.4	MG/KG	NA		0.0033	10.2
		Total			5.86		0.033	
543	B003	Antimony (Sb)	ND	MG/KG	NA		NA	
543	B003	Aroclor-1254	ND	UG/KG	NA		NA	
543	B003	B(a)P Equiv.	214.2	UG/KG	3.55	100	NA	
543	B003	Cadmium (Cd)	1.7	MG/KG	NA		0.023	2.9
543	B003	Copper (Cu)	1,760	MG/KG	NA		0.60	74.0
543	B003	Lead (Pb)	148	MG/KG	NA		NA	
543	B003	Nickel (Ni)	193	MG/KG	NA		0.13	16.2
543	B003	Zinc (Zn)	1,240	MG/KG	NA		0.057	6.9
		Total			3.55		0.82	
543	B004	Antimony (Sb)	2.6	MG/KG	NA		0.089	90.9
543	B004	Aroclor-1254	ND	UG/KG	NA		NA	
543	B004	B(a)P Equiv.	474.36	UG/KG	7.86	100	NA	
543	B004	Cadmium (Cd)	ND	MG/KG	NA		NA	
543	B004	Copper (Cu)	16.7	MG/KG	NA		0.0057	5.8
543	B004	Lead (Pb)	63.4	MG/KG	NA		NA	
543	B004	Nickel (Ni)	1.8	MG/KG	NA		0.0012	1.3
543	B004	Zinc (Zn)	43.7	MG/KG	NA		0.0020	2.0
		Total			7.86		0.098	

Table 10.4.6.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 23 and 63/AOCs 540, 541, 542, and 543
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
023	B001	Aroclor-1254	ND	UG/KG	NA		NA	
023	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
023	B002	Aroclor-1254	ND	UG/KG	NA		NA	
023	B002	B(a)P Equiv.	181.93	UG/KG	0.6126	100.00	NA	
		Total			0.6126		NA	
023	B003	Aroclor-1254	ND	UG/KG	NA		NA	
023	B003	B(a)P Equiv.	330.15	UG/KG	1.1117	100.00	NA	
		Total			1.1117		NA	
023	B004	Aroclor-1254	ND	UG/KG	NA		NA	
023	B004	B(a)P Equiv.	1101.06	UG/KG	3.7074	100.00	NA	
		Total			3.7074		NA	
063	B001	Aroclor-1254	ND	UG/KG	NA		NA	
063	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
063	B002	Aroclor-1254	ND	UG/KG	NA		NA	
063	B002	B(a)P Equiv.	353.81	UG/KG	1.1913	100.00	NA	
		Total			1.1913		NA	
063	B003	Aroclor-1254	ND	UG/KG	NA		NA	
063	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
540	B001	Aroclor-1254	ND	UG/KG	NA		NA	
540	B001	B(a)P Equiv.	145.35	UG/KG	0.4894	100.00	NA	
		Total			0.4894		NA	
541	B001	Aroclor-1254	ND	UG/KG	NA		NA	
541	B001	B(a)P Equiv.	429.60	UG/KG	1.4465	100.00	NA	
		Total			1.4465		NA	
542	B001	Aroclor-1254	ND	UG/KG	NA		NA	
542	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
542	B002	Aroclor-1254	190.00	UG/KG	0.1753	100.00	0.0123	100.00
542	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			0.1753		0.0123	

Table 10.4.6.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 23 and 63/AOCs 540, 541, 542, and 543
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
542	B003	Aroclor-1254	ND	UG/KG	NA		NA	
542	B003	B(a)P Equiv.	1.72	UG/KG	0.0058	100.00	NA	
		Total			0.0058		NA	
542	B004	Aroclor-1254	ND	UG/KG	NA		NA	
542	B004	B(a)P Equiv.	509.01	UG/KG	1.7139	100.00	NA	
		Total			1.7139		NA	
542	B005	Aroclor-1254	ND	UG/KG	NA		NA	
542	B005	B(a)P Equiv.	1688.00	UG/KG	5.6837	100.00	NA	
		Total			5.6837		NA	
542	B006	Aroclor-1254	1200.00	UG/KG	1.1070	99.83	0.0775	100.00
542	B006	B(a)P Equiv.	0.57	UG/KG	0.0019	0.17	NA	
		Total			1.1089		0.0775	
542	B007	Aroclor-1254	ND	UG/KG	NA		NA	
542	B007	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
543	B001	Aroclor-1254	ND	UG/KG	NA		NA	
543	B001	B(a)P Equiv.	354.00	UG/KG	1.1920	100.00	NA	
		Total			1.1920		NA	
543	B003	Aroclor-1254	ND	UG/KG	NA		NA	
543	B003	B(a)P Equiv.	214.20	UG/KG	0.7212	100.00	NA	
		Total			0.7212		NA	
543	B004	Aroclor-1254	ND	UG/KG	NA		NA	
543	B004	B(a)P Equiv.	474.36	UG/KG	1.5972	100.00	NA	
		Total			1.5972		NA	

Table 10.4.6.4
Chemicals Present in Site Samples
SWMUs 23,63; AOC 540, 541, 542, 543 - Groundwater
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Residential RBC	Screening Reference	Units	Number Exceeding Res.	Number Exceeding Ref.
Deep wells											
Inorganics											
Barium (Ba)		1	1	32.4 - 32.4	32.4	NA - NA	260	218	UG/L		
Calcium (Ca)	N	1	1	64500 - 64500	64500	NA - NA	NA	NA	UG/L		
Iron (Fe)	N	1	1	25.6 - 25.6	25.6	NA - NA	1100	NA	UG/L		
Magnesium (Mg)	N	1	1	5740 - 5740	5740	NA - NA	NA	NA	UG/L		
Manganese (Mn)		1	1	121 - 121	121	NA - NA	84	869	UG/L	1	
Potassium (K)	N	1	1	2760 - 2760	2760	NA - NA	NA	NA	UG/L		
Sodium (Na)	N	1	1	85200 - 85200	85200	NA - NA	NA	NA	UG/L		
Semivolatile Organics											
Benzoic acid		1	1	2 - 2	2	NA - NA	15000	NA	UG/L		
bis(2-Ethylhexyl)phthalate (BEHP)		1	1	2 - 2	2	NA - NA	4.8	NA	UG/L		
Shallow Wells											
Inorganics											
Aluminum (Al)	*	7	8	639 - 5090	2590	25 - 25	3700	2810	UG/L	1	2
Arsenic (As)		2	8	7.4 - 17.4	12.4	5 - 5	0.045	18.7	UG/L	2	
Barium (Ba)		3	8	14.5 - 27.1	22.3	20.3 - 94.8	260	211	UG/L		
Calcium (Ca)	N	8	8	10700 - 146000	73250	NA - NA	NA	NA	UG/L		
Chromium (Cr)		5	8	5.1 - 6.1	5.66	1 - 5	18	12.3	UG/L		
Cobalt (Co)		1	8	2.1 - 2.1	2.1	2 - 2	220	2.5	UG/L		
Copper (Cu)		4	8	3.2 - 12.8	6.45	2 - 2	150	2.7	UG/L		
Iron (Fe)	N	8	8	344 - 41500	8933	NA - NA	NA	NA	UG/L		
Lead (Pb)		6	8	3.3 - 10.3	5.38	3 - 3	15	4.8	UG/L		1

Table 10.4.6.4
Chemicals Present in Site Samples
SWMUs 23,63; AOC 540, 541, 542, 543 - Groundwater
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Residential RBC	Screening Reference	Units	Number Exceeding Res.	Number Exceeding Ref.
Magnesium (Mg)	N	8	8	1560 - 29200	9743	NA - NA	NA	NA	UG/L		
Manganese (Mn)		6	8	10.1 - 405	170.5	11.8 - 25	84	2560	UG/L	4	
Nickel (Ni)		1	8	2.2 - 2.2	2.2	1 - 2.7	73	15.2	UG/L		
Potassium (K)	N	3	8	2510 - 13800	7120	1500 - 7780	NA	NA	UG/L		
Selenium (Se)		1	8	5.2 - 5.2	5.2	5 - 5	18	NA	UG/L		
Sodium (Na)	N	3	8	5180 - 36400	16923	5450 - 54200	NA	NA	UG/L		
Vanadium (V)		5	8	3.7 - 9.5	6.84	1 - 5.1	26	11.4	UG/L		
Zinc (Zn)		2	8	17.6 - 119	68.3	4 - 42.6	1100	27.3	UG/L		1
Semivolatile Organics											
2-Methylnaphthalene		1	8	12 - 12	12	10 - 10	150	NA	UG/L		
Acenaphthene		1	8	3 - 3	3	10 - 10	220	NA	UG/L		
bis(2-Ethylhexyl)phthalate (BEHP)		1	8	2 - 2	2	10 - 10	4.8	NA	UG/L		
Dibenzofuran		1	8	2 - 2	2	10 - 10	15	NA	UG/L		
Fluorene		1	8	6 - 6	6	10 - 10	150	NA	UG/L		
Phenanthrene		2	8	2 - 5	3.5	10 - 10	150	NA	UG/L		
Volatile Organics											
Acetone	*	1	8	800 - 800	800	10 - 82	370	NA	UG/L	1	
Trichloroethene		1	8	1 - 1	1	5 - 5	1.6	NA	UG/L		

Notes:
* - Identified as a COPC
N - Essential nutrient
UG/L - micrograms per liter
SQL - Sample quantitation limit
NA - Not applicable

Table 10.4.6.5
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMUs 23 and 63/AOCs 540, 541, 542, and 543
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
023	G001	Acetone	ND	UG/L	NA		NA	
023	G001	Aluminum (Al)	1660.00	UG/L	NA		0.1061	75.85
023	G001	Chromium (Cr)	ND	UG/L	NA		NA	
023	G001	Thallium (Tl)	ND	UG/L	NA		NA	
023	G001	Vanadium (V)	3.70	UG/L	NA		0.0338	24.15
		Total			NA		0.1399	
063	G001	Acetone	ND	UG/L	NA		NA	
063	G001	Aluminum (Al)	ND	UG/L	NA		NA	
063	G001	Chromium (Cr)	ND	UG/L	NA		NA	
063	G001	Thallium (Tl)	ND	UG/L	NA		NA	
063	G001	Vanadium (V)	ND	UG/L	NA		NA	
		Total			NA		NA	
063	G002	Acetone	ND	UG/L	NA		NA	
063	G002	Aluminum (Al)	3470.00	UG/L	NA		0.2218	58.35
063	G002	Chromium (Cr)	6.10	UG/L	NA		0.0780	20.51
063	G002	Thallium (Tl)	ND	UG/L	NA		NA	
063	G002	Vanadium (V)	8.80	UG/L	NA		0.0804	21.14
		Total			NA		0.3802	
542	G001	Acetone	ND	UG/L	NA		NA	
542	G001	Aluminum (Al)	5090.00	UG/L	NA		0.3254	72.88
542	G001	Chromium (Cr)	5.40	UG/L	NA		0.0690	15.46
542	G001	Thallium (Tl)	ND	UG/L	NA		NA	
542	G001	Vanadium (V)	5.70	UG/L	NA		0.0521	11.66
		Total			NA		0.4465	
542	G002	Acetone	ND	UG/L	NA		NA	
542	G002	Aluminum (Al)	639.00	UG/L	NA		0.0408	100.00
542	G002	Chromium (Cr)	ND	UG/L	NA		NA	
542	G002	Thallium (Tl)	ND	UG/L	NA		NA	
542	G002	Vanadium (V)	ND	UG/L	NA		NA	
		Total			NA		0.0408	
542	G003	Acetone	ND	UG/L	NA		NA	
542	G003	Aluminum (Al)	2800.00	UG/L	NA		0.1790	53.06
542	G003	Chromium (Cr)	5.60	UG/L	NA		0.0716	21.22
542	G003	Thallium (Tl)	ND	UG/L	NA		NA	
542	G003	Vanadium (V)	9.50	UG/L	NA		0.0868	25.72
		Total			NA		0.3374	

Table 10.4.6.5
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMUs 23 and 63/AOCs 540, 541, 542, and 543
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
542	G004	Acetone	ND	UG/L	NA		NA	
542	G004	Aluminum (Al)	2570.00	UG/L	NA		0.1643	56.88
542	G004	Chromium (Cr)	5.10	UG/L	NA		0.0652	22.57
542	G004	Thallium (Tl)	ND	UG/L	NA		NA	
542	G004	Vanadium (V)	6.50	UG/L	NA		0.0594	20.55
		Total			NA		0.2889	
543	G001	Acetone	800.00	UG/L	NA		0.5114	71.94
543	G001	Aluminum (Al)	1900.00	UG/L	NA		0.1215	17.09
543	G001	Chromium (Cr)	6.10	UG/L	NA		0.0780	10.97
543	G001	Thallium (Tl)	ND	UG/L	NA		NA	
543	G001	Vanadium (V)	ND	UG/L	NA		NA	
		Total			NA		0.7109	

10.4.7 Corrective Measures Considerations

For SWMUs 23 and 63 and AOCs 540, 541, 542, and 543, the upper and lower soil intervals and the shallow and deep groundwater were investigated. All but one sample was collected beneath pavement, boring 023SB004. Based on the analytical results and the FRE, COCs requiring further evaluation through the CMS process were identified for the upper soil interval. However, residential use of the site is not expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use, marine cargo terminal, and drydock. Since the ground surface is capped with either asphalt or concrete, chronic exposure to current soil conditions is highly unlikely except at 023SB004. A FRE substituted for a full risk assessment.

Eight COPCs were identified for combined SWMU 23 soil: antimony, cadmium, copper, lead, nickel, zinc, Aroclor-1254, and BEQs. Arsenic, beryllium, and chromium were detected in combined SWMU 23 soil at concentrations above their RBCs but were eliminated because they were below their background concentrations. The combined ingestion and dermal residential exposure risk ranges between 3E-08 to 3E-05 with an arithmetic mean risk of 6E-06 and an HI between 0.0003 to 1 with an arithmetic mean HI of 0.3, which is between USEPA's acceptable range of 1E-06 and 1E-04 and HI of 3 to 0.1. BEQs are the primary contributors to risk, exceeding 1E-06 at 11 of 19 locations including 023SB004. Concentrations of Aroclor-1254 in sample 542SB006 equal a risk of 5E-06.

Lead is above USEPA's residential acceptable level of 400 mg/kg, 434 mg/kg at sample location 023SB004. Since the site soil is covered with asphalt and concrete, the residential risk associated with the COPCs will not exceed 1E-06. Further action is recommended only at soil sample 023SB004 for BaP and lead.

No COPCs were identified in the deep groundwater. Aluminum and acetone were identified as COPCs in shallow groundwater. Acetone may be present due to laboratory contamination of the sample or sampling equipment. Arsenic and manganese were also identified as COPCs in shallow groundwater but were eliminated based on the FRE and comparison to background. No carcinogenic COPCs were detected. HIs ranged from 0.04 to 0.7.

Based on the data collected, a groundwater plume is not indicated but may exist. No clear, definable source or release is associated with these units. Based on the above facts, corrective measures may be appropriate. Potential corrective measures for the impacted media and respective COCs are in Table 10.4.7.1.

Table 10.4.7.1
Potential Corrective Measures for SWMUs 23 and 63 and AOCs 540, 541, 542, and 543

Medium	Compounds	Potential Corrective Measures
Soil	Lead and BEQs	a) No Action b) Containment — Cap c) Removal — Excavation and Offsite Disposal
Shallow and Deep Groundwater	None	a) No Action

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10.0 SITE-SPECIFIC EVALUATIONS

This section evaluates for each site the nature and extent of contamination including identification of COPCs, fate and transport of the COPCs, human health and ecological excess risk, and corrective measures considerations. This section is divided into investigatory groups that were established in the *Final Zone E RFI Work Plan* (E/A&H, June 1995).

Soil sampling occurred in phases as presented in Section 2, Volume 1, *Final Comprehensive RFI Work Plan* (E/A&H, August 1994). The first round of sampling was performed per the Final Zone E RFI Work Plan. Organic compound analytical results were compared to the USEPA Region III Risk-Based Concentration Table, April 1996 (RBCs). Inorganic analytical results were compared to RBCs and reference concentrations, as outlined in Section 5 of this report, or to RBCs where no reference concentrations were available. Based on this preliminary review, some sites required further sampling and analysis (Phase II) to identify COPCs, to define the nature and extent of any contamination, and to provide additional data for the CMS. To comply with the Corrective Action Management Plan schedule, it was necessary to use unvalidated data for first-round screening. Site-specific concentration figures of COCs driving risk in surface soil for several sites requiring CMS are presented in Appendix K. Lower interval soil samples exceeding EPA Region III SSLs are also presented in a table in the same appendix.

Groundwater was sampled quarterly for a one year period. First-round groundwater data were used to produce the summary tables provided in the site-specific nature of contamination sections. Subsequent rounds of quarterly groundwater results were reviewed before making decisions regarding risk, corrective measures, conclusions and recommendations. Subsequent groundwater data are discussed to confirm the presence of constituents where appropriate. If the subsequent data do not impact the recommendation for the site, it is not discussed in the text. Analytical data are presented in Appendix H. Zone-wide color-coded concentration figures for COCs commonly detected in groundwater are presented in Appendix K. Groundwater samples exceeding MCLs are also presented in a table in the same appendix.

Data Evaluation

The following screening tools and data evaluation methods were used to determine COPCs at each site:

- Soil analytical results for upper-interval samples were compared to industrial soil ingestion screening values in the USEPA Region III RBC table. Analytical results for lower-interval soil samples were compared to soil screening levels (SSLs) for soil-to-groundwater transfer in the Region III RBC table. Lead was specifically compared to the OSWER soil screening value of 1,300 mg/kg for an industrial scenario and 400 mg/kg for a residential scenario, as described in Section 7.2.2. Analytical results for sediment samples collected from storm and floor drain catch basins were treated as soil and compared to industrial RBCs. Noncarcinogenic chemical screening values were adjusted to equal an HQ of 0.1.

- Groundwater analytical results were compared to tap water RBCs or to the USEPA *Drinking Water Regulations and Health Advisories* (May 1995). Noncarcinogenic chemical screening values were adjusted to equal an HQ of 0.1.

- Sediment and surface water results for samples collected from the Cooper River were compared to sediment screening values and saltwater surface water screening values in the USEPA Region IV, *Supplemental Guidance to Risk Assessment Guidance for Superfund* (November 1995), as discussed in Section 8.

- TEFs were used to convert cPAHs to BEQs, which were subsequently summed for each sample and compared to the benzo(a)pyrene (BaP) RBC. Similarly, TEFs were used to convert dioxins to TEQs, which were compared to the 2,3,7,8-TCDD screening value of 1,000 ng/kg for soil and 0.4 picograms per liter (pg/L) for groundwater. A soil screening value for TEQs was applied to chlorinated dibenzodioxins and dibenzofurans, based on a worker/industrial scenario and a target risk of 1E-04.

- Duplicate samples were incorporated with their respective primary samples. When either the duplicate or primary sample had a detection, the detected value was used. When both the duplicate and primary samples had detections, the higher of the two concentrations was used to compensate for matrix heterogeneity.

Deviations from *Final Zone E RFI Work Plan* (E/A&H, June 1995)

Deviations from the proposed sampling in the work plan were required in some cases and are specifically noted in the investigatory group subsections. Deviations included elimination of proposed samples from both upper and lower intervals and relocation of several monitoring wells due to a high water table, subsurface obstructions (i.e., large rocks, old pilings, fill material), or underground utilities.

Where appropriate in this document, SWMUs and AOCs are collectively referred to as *sites*. Due to their proximity and similarity in processes chemicals used, many of the sites in Zone E have been grouped for investigative purposes and share data from sample locations to define nature and extent of contamination along site boundaries. Site-specific deviations are detailed in Table 10.0.1.

Table 10.0.1
Zone E — Site-Specific Deviations

Site Name	Sample and Analytical Deviations
SWMUs 5 and 18 and AOC 605	Six first-round lower-interval, one second-round upper-interval, and two second-round lower-interval soil samples could not be collected due to saturation and/or subsurface obstructions (lower-interval samples) or surface obstructions (upper-interval sample). One second round soil boring was analyzed (upper- and lower-interval) for SVOCs and metals only. pH analysis was added to two soil samples (one upper and one lower). One free product sample was collected and analyzed for VOCs, SVOCs, and pesticides.
SWMUs 21 and 54	Five lower-interval soil samples could not be collected due to subsurface obstructions. One upper-interval and six lower-interval samples were submitted for VOC analysis due to elevated OVA readings and/or petroleum odor.
SWMUs 22 and 25 and AOC 554	One lower-interval soil sample could not be collected due to a subsurface obstruction.
SWMUs 23 and 63 and AOCs 540, 541, 542, and 543	Four lower-interval soil samples could not be collected during first-round sampling due to subsurface obstructions. One soil sample (upper and lower interval) was not submitted for VOC, pesticide/PCB, cyanide, or pH analysis; two samples were not submitted for organotin analysis.
SWMU 53 and AOC 526	One upper- and one lower-interval soil sample could not be collected during first-round sampling due to surface and/or subsurface obstructions.
SWMU 65 and AOCs 544 and 546	One upper- and three lower-interval soil samples could not be collected during first-round sampling due to surface and/or subsurface conditions. Two free-product samples (one soil, one groundwater) were collected and analyzed for VOCs, PCBs, TPH-GRO, TPH-DRO, metals, and cyanide. Two additional shallow monitoring wells were installed after first-round analytical results were evaluated. One sediment sample was collected in the location originally proposed for a soil boring. Four wipe samples were collected.
SWMU 67	One upper-interval duplicate soil sample was not analyzed at DQO Level IV for Appendix IX parameters. One additional wipe sample was collected.
SWMU 70 and AOCs 548 and 549	One first-round lower-interval sample could not be collected due to a subsurface obstruction; one second-round soil sample (upper and lower interval) could not be collected due to a surface obstruction.
SWMUs 83 and 84 and AOC 574	Five upper-interval and six lower-interval first-round soil samples were also submitted for TPH analysis due to elevated OVA readings and/or surface staining. One upper- and one lower-interval second-round soil sample could not be collected due to surface obstructions (upper interval) or saturation and subsurface obstruction (lower interval). A total of 15 air samples (rather than 17) were collected based on field determinations.
SWMUs 87 and 172 and AOC 564	Mercury vapor analysis was not performed at SWMU 87 since the site was paved.
SWMU 102	Three upper-interval second/third-round soil samples could not be collected due to surface obstructions and were screened only for mercury vapor. Seven lower-interval samples could not be collected due to subsurface obstructions. TPH analysis was added to three soil samples.

Table 10.0.1
Zone E — Site-Specific Deviations

Site Name	Sample and Analytical Deviations
SWMU 106 and AOC 603	One proposed deep well and one proposed shallow well were not installed due to the proximity of a supplemental well pair. pH analysis was added to two soil samples.
SWMUs 170 and 171	Five upper- and 13 lower-interval soil samples could not be collected due to surface/subsurface obstructions. Nine soil samples were analyzed for VOCs due to elevated OVA readings and/or petroleum odor in the samples; one soil sample was analyzed for VOC and TPH due to the possible presence of free product in the sample. Eight asphalt samples were not collected because asphalt did not cover the sampling locations.
AOC 528	Metals, cyanide, pesticide, and organotin analyses were added to one upper- and one lower-interval soil sample. Metals, chlorides, sulfates, and TDS analysis was added to the groundwater sample to further characterize groundwater at the site.
AOC 530	One sample location was shared with AOC 531 due to its proximity.
AOC 531	One sample location was shared with AOC 530. One upper- and one lower-interval second-round sample could not be collected due to surface/subsurface obstructions.
AOCs 538 and 539	One additional upper- and lower-interval soil sample was collected. One lower-interval soil sample could not be collected due to a subsurface obstruction. One soil boring and one shallow well were identified as AOC 542 locations, due to their proximity to AOC 542. One additional deep well was installed. Six additional wipe samples were collected.
AOC 550	Three upper- and three lower-interval soil samples could not be collected due to the thickness of fill material. One shallow well was not installed due to the proximity of a supplemental (grid-based) shallow well.
AOCs 551 and 552	One upper- and one lower-interval first-round soil sample and one lower-interval second-round sample could not be collected due to surface/subsurface obstructions. Due to obstructions, the deep well was relocated from the southeast to the southwest edge of the building.
AOC 556	One additional sediment sample was collected to further characterize the site. Organotin analysis was added to two sediment and four surface-water samples. Fifteen additional surface-water samples were collected due to depth of water and to further characterize the site.
AOCs 559, 560, and 561	One upper- and one lower-interval sample could not be collected due to proximity to an electrical substation; two additional lower-interval samples could not be collected due to subsurface obstructions.
AOC 562	One upper-interval and two lower-interval soil samples were submitted for VOC analysis due to high OVA readings.
AOC 567	One lower-interval soil sample could not be collected due to a subsurface obstruction.
AOCS 569, 570, and 578	One first-round soil sampling location (upper- and lower-intervals) at AOC 570 was abandoned due to its proximity to an existing soil boring location. One soil boring (upper- and lower-intervals) proposed for second-round sampling was abandoned due to inaccessibility. An additional shallow monitoring well was installed at AOC 570 to determine the extent of constituents detected during first-round groundwater sampling.

Table 10.0.1
Zone E — Site-Specific Deviations

Site Name	Sample and Analytical Deviations
AOC 573	One upper-interval duplicate soil sample was not analyzed for pesticides. Groundwater samples (one shallow and one deep) were not analyzed for pH.
AOC 580	One lower-interval sample could not be collected due to subsurface obstructions.
AOC 583	One upper- and two lower-interval second-round samples could not be collected due to surface/subsurface obstructions. One upper- and one lower-interval sample were inadvertently analyzed for pesticides and cyanide.
AOC 590	Five first-round soil samples (one upper- and four lower-interval) were submitted to be analyzed for TPH due to elevated OVA readings and petroleum odor. The second-round lower-interval soil sample could not be collected due to subsurface obstructions. One sediment sample was not collected because a storm drain did not exist at the originally proposed location.
AOC 592	One lower-interval sample could not be collected due to subsurface obstructions.
AOC 596	One first-round sample location (upper- and lower-interval) was abandoned due to the thickness of concrete at the sample location. Pesticide analysis was inadvertently added to the second-round soil sample (upper- and lower-interval).
AOCs 598 and 599	Two first-round lower-interval soil samples and one second-round lower-interval sample were not collected due to subsurface obstructions. Sediment samples were not submitted for pesticide/PCB or cyanide analyses.
AOC 602	One lower-interval soil sample was submitted for VOC analysis due to elevated OVA readings.
AOC 604	Two samples (one upper-interval and one lower-interval) were submitted for VOC analysis, and two samples (one upper-interval and one lower-interval) were submitted for TPH analysis due to elevated OVA readings and petroleum odor in the samples.
Supplemental Sampling	Five additional soil samples (both intervals) were collected from five additional supplemental shallow well locations added to further characterize Zone E groundwater; the five additional well locations were analyzed for SVOCs and metals. Two lower-interval samples could not be collected due to subsurface obstructions. One soil sample (both intervals) was submitted for TPH analysis due to elevated OVA readings.

Notes:
GRO = Gasoline Range Organics
DRO = Diesel Range Organics

10.1 SWMU 5, Battery Electrolyte Treatment Area, Pad 1278; SWMU 18, PCB Spill Area; and AOC 605, Waste Paint Storage Area

SWMU 5 is a former battery electrolyte treatment area adjacent to Pad 1278 and Drydock (DD) 4. Associated with battery salvaging, restoring, and recharging operations, this site was used to neutralize submarine battery acid from 1962 until 1985. It consisted of a battery disassembly platform, two neutralization USTs, and customized transporting railcars.

SWMU 18 is a PCB spill area at the Public Works Resource Recovery Facility Storage Area. On June 12, 1987, a contractor was loading PCB-containing items when a transformer broke and discharged Pyranol insulating fluid. The leaking transformer was placed in a drip pan, but the liquid overflowed and approximately 75 gallons of Pyranol fluid spilled onto the ground. Three soil excavations were conducted to remediate the site.

AOC 605 is a waste paint storage area adjacent to DD 4 on Pad 1278. The 40 foot x 250 foot concrete pad was constructed in 1943 as a welding area. Since 1987, the pad has been used to store materials such as paints, used oils, solvents, and chemicals. The pad is bordered to the south and west by unpaved areas.

SWMU 5 and AOC 605 have not been investigated previously. At SWMU 18, however, the 20 foot x 20 foot spill site was sampled on a 13-point grid system. Soil samples were collected following the three soil excavations. According to facility personnel, no additional excavation was required, based on analytical results, as reported in the *Final Report RCRA Facility Investigation (RFI) — Charleston Naval Base* (Kemron, 1991).

Materials of concern at SWMU 5, identified in the *Final Zone E RFI Work Plan*, include solvents and lead/acid batteries. Pyranol insulating fluid is the material of concern at SWMU 18. At AOC 605, the materials of concern include acids, paints, metals (lead), solvents, and petroleum hydrocarbons. Potential receptors who may be exposed to site contaminants include current and future building users and site workers.

To fulfill the RFI objectives, soil and groundwater were sampled in accordance with the *Final Zone E RFI Work Plan*, and Section 3 of this report to determine whether any contamination resulted from onsite activities.

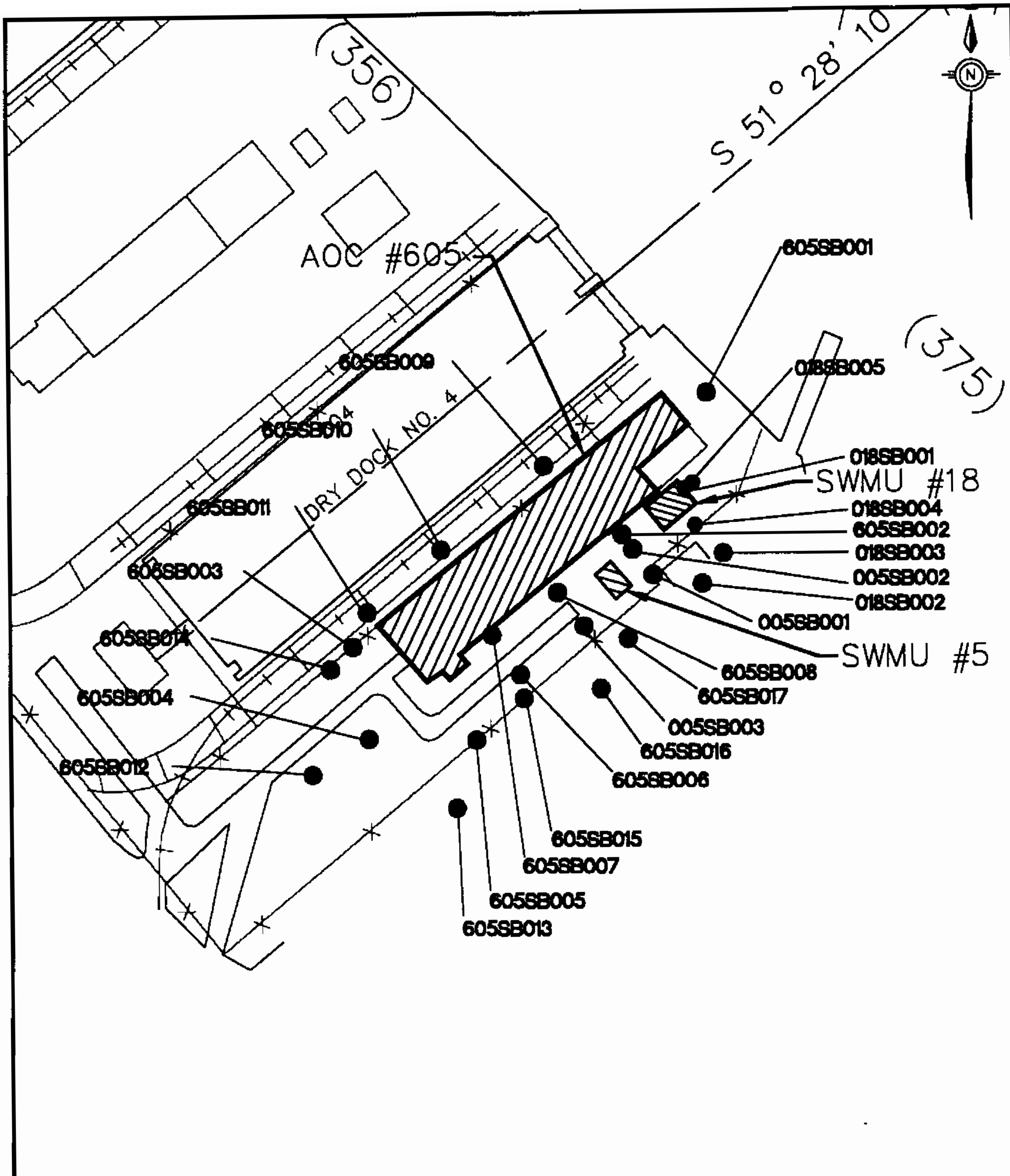
10.1.1 Soil Sampling and Analysis

Soil samples were collected in two rounds at SWMUs 5 and 18 and AOC 605 from the locations shown in Figure 10.1.1. The *Final Zone E RFI Work Plan* proposed collecting 14 soil samples from the upper and lower intervals. Soil samples were also collected at both intervals from the five shallow monitoring well locations proposed for this site.

First-round Sampling — During the first round of sampling, all 19 proposed upper-interval samples were collected and 13 of the proposed 19 lower-interval samples were collected from the soil borings and shallow well locations.

At SWMU 18, two lower-interval samples were not collected due to subsurface obstructions in the form of large rocks at a depth of greater than 2 feet bgs. At AOC 605, four lower-interval samples were not collected due to sample saturation or the presence of subsurface obstructions such as wood or rocks.

All first-round samples were submitted for DQO Level III analysis for organotins and the standard suite of parameters which includes VOCs, SVOCs with tentatively identified compounds (TICs), pesticides/PCBs, metals, and cyanide. Four soil samples, two upper- and two lower-interval, were selected as duplicates and analyzed at DQO Level IV for Appendix IX analytical parameters,



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.1.1
SOIL BORING LOCATIONS
SWMU 5, SWMU #18 & AOC #605
PAD 1278 AND
WASTE PAINT STORAGE AREA

DWG DATE: 09/02/97 | DWG NAME: 10-1-1

which includes the suite of parameters proposed for the site plus a more comprehensive list of VOCs and SVOCs as well as herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. Table 10.1.1.1 summarizes the first-round soil sampling at SWMUs 5 and 18 and AOC 605.

Table 10.1.1.1
SWMUs 5 and 18 and AOC 605
First-Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	19	19	Standard Suite[a], organotins	Standard Suite[a], organotins	pH analysis was added to one sample.
Lower	19	13	Standard Suite[a], organotins	Standard Suite[a], organotins	Saturation and subsurface obstructions prevented the collection of six samples. pH analysis was added to one sample.

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, and pesticides/PCBs

Second-round Sampling — Second-round sampling was performed at AOC 605 after first-round analytical results were compared to the USEPA Region III RBCs and SSLs. Six upper-interval and six lower-interval soil samples were proposed for second-round sampling to determine the extent of constituents detected during the initial round. Five of the six proposed upper-interval samples and four of six proposed lower-interval soil samples were collected.

The upper- and lower-interval samples proposed at 605SB016 could not be collected due to surface and subsurface obstructions (i.e., large rocks). The lower interval sample at 605SB013 could not be collected due to large rocks at a depth greater than 2 feet bgs.

All second-round samples were submitted for analysis at DQO Level III for organotins and the standard suite of parameters which includes VOCs, SVOCs with TICs, pesticides/PCBs, metals, and cyanide. Samples collected from 605SB017 were analyzed for SVOCs and metals only. Two upper-interval duplicate samples were analyzed at DQO Level IV for Appendix IX analytical parameters, which includes the suite of parameters proposed for the site plus a more comprehensive list of VOCs and SVOCs as well as herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. Table 10.1.1.2 summarizes second-round soil sampling at SWMUs 5 and 18 and AOC 605.

Table 10.1.1.2
SWMUs 5 and 18 and AOC 605
Second-Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviation
Upper	6	5	Standard Suite[a], organotins	Standard Suite[a], organotins	One upper-interval sample could not be collected because of surface obstructions; one sample was analyzed for SVOCs and metals only.
Lower	6	4	Standard Suite[a], organotins	Standard Suite[a], organotins	Subsurface obstructions prevented the collection of two samples; one sample was analyzed for SVOCs and metals only.

Note:
a = Standard suite includes VOCs, SVOCs, metals, cyanide, and pesticides/PCBs.

10.1.2 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.1.2.1. Inorganic analytical results for soil are summarized in Table 10.1.2.2. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.1.2.1
SWMUs 5 and 18 and AOC 605
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs (μg/kg)						
Acetone	Upper	5/23	40.0 - 180	93.0	20,000,000	0
	Lower	6/16	17.0 - 170	72.2	NA	NA
2-Butanone (MEK)	Upper	1/23	30.0	30.0	100,000,000	0
Dichlorodifluoromethane	Upper	1/4	7.00	7.00	41,000,000	0
	Lower	1/2	6.00	6.00	NA	NA
SVOCs (μg/kg)						
Acenaphthene	Upper	5/24	47.0 - 470	227	12,000,000	0
	Lower	3/17	49.0 - 280	166	NA	NA
Acenaphthylene	Upper	2/24	99.0 - 150	125	8,200,000	0
	Lower	1/17	70.0	70.0	NA	NA
Anthracene	Upper	7/24	97.0 - 1,100	335	61,000,000	0
	Lower	7/17	96.0 - 560	224	NA	NA
Benzo(g,h,i)perylene	Upper	18/24	57.0 - 2,400	440	8,200,000	0
	Lower	8/17	72.0 - 800	206	NA	NA
Benzoic acid	Lower	2/17	49.0 - 53.0	51.0	NA	NA
bis(2-Ethylhexyl)phthalate	Upper	21/24	69.0 - 2,400	520	410,000	0
	Lower	12/17	82.0 - 4,500	689	NA	NA
Butylbenzylphthalate	Lower	1/17	79.0	79.0	NA	NA
Carbazole	Upper	2/9	88.0 - 110	99.0	290,000	0
4-Chloroaniline	Upper	1/24	190	190	820,000	0
	Lower	1/17	160	160	NA	NA
Dibenzofuran	Upper	4/24	79.0 - 150	112	820,000	0
	Lower	1/17	110	110	NA	NA
Di-n-butylphthalate	Upper	2/24	39.0 - 160	99.5	20,000,000	0
	Lower	1/17	180	180	NA	NA
Diethylphthalate	Upper	1/24	220	220	100,000,000	0

Table 10.1.2.1
SWMUs 5 and 18 and AOC 605
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs ($\mu g/kg$)						
2,4-Dinitrotoluene	Lower	1/17	290	290	NA	NA
Di-n-octyl phthalate	Upper	1/24	220	220	4,100,000	0
Fluoranthene	Upper	22/24	77.0 - 8,500	964	8,200,000	0
	Lower	11/17	90.0 - 1,200	622	NA	NA
Fluorene	Upper	4/24	66.0 - 340	187	8,200,000	0
	Lower	4/17	110 - 170	148	NA	NA
2-Methylnaphthalene	Upper	3/24	47.0 - 70.0	55.7	8,200,000	0
	Lower	1/17	330	330	NA	NA
4-Methylphenol (p-Cresol)	Upper	1/24	75.0	75.0	1,000,000	0
Naphthalene	Upper	5/24	59.0 - 450	194	8,200,000	0
	Lower	2/17	110	110	NA	NA
Pentachlorophenol	Lower	1/17	90.0	90.0	NA	NA
Phenanthrene	Upper	16/24	73.0 - 4,400	545	8,200,000	0
	Lower	8/17	57.0 - 640	301	NA	NA
Pyrene	Upper	22/24	78.0 - 9,800	1,010	6,100,000	0
	Lower	12/17	110 - 3,600	762	NA	NA
SVOCs (B(a)P Equivalents) ($\mu g/kg$)						
B(a)P Equivalent	Upper	22/24	0.860 - 6,200	788	780	7
	Lower	12/17	9.30 - 1,230	240	NA	NA
Benzo(a)anthracene	Upper	19/24	80.0 - 5,700	628	7,800	0
	Lower	10/17	65.0 - 840	241	NA	NA
Benzo(b)fluoranthene	Upper	15/24	100 - 4,400	852	7,800	0
	Lower	10/17	77.0 - 630	207	NA	NA
Benzo(k)fluoranthene	Upper	22/24	86.0 - 3,400	574	78,000	0
	Lower	9/17	59.0 - 550	211	NA	NA

Table 10.1.2.1
SWMUs 5 and 18 and AOC 605
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (B(a)P Equivalents) (μg/kg)						
Benzo(a)pyrene	Upper	19/24	100 - 4,000	583	780	5
	Lower	9/17	85.0 - 790	229	NA	NA
Chrysene	Upper	20/24	82.0 - 6,900	788	780,000	0
	Lower	11/17	80.0 - 1,400	309	NA	NA
Dibenz(a,h)anthracene	Upper	10/24	76.0 - 860	285	780	1
	Lower	1/17	240	240	NA	NA
Indeno(1,2,3-cd)pyrene	Upper	18/24	49.0 - 2,900	445	7,800	0
	Lower	7/17	57.0 - 500	163	NA	NA
Pesticides/PCBs (μg/kg)						
Aldrin	Upper	1/23	1.78	1.78	340	0
	Lower	1/16	2.70	2.70	NA	NA
alpha-BHC	Lower	1/16	11.0	11.0	NA	NA
alpha-Chlordane	Upper	3/23	3.50 - 5.70	4.33	4,400	0
gamma-Chlordane	Upper	2/23	5.70 - 11.2	8.45	4,400	0
	Lower	1/16	3.12	3.12	NA	NA
4,4'-DDD	Upper	6/23	4.59 - 19.0	8.50	24,000	0
	Lower	4/16	3.02 - 6.00	4.83	NA	NA
4,4'-DDE	Upper	11/23	3.04 - 15.0	6.23	17,000	0
	Lower	2/16	4.27 - 8.80	6.54	NA	NA
4,4'-DDT	Upper	16/23	4.56 - 43.0	18.2	17,000	0
	Lower	3/16	4.60 - 26.0	12.2	NA	NA
Dieldrin	Upper	3/23	3.04 - 6.96	5.00	360	0
Endosulfan II	Upper	2/23	4.63 - 6.00	5.32	1,200,000	0
	Lower	1/16	3.90	3.90	NA	NA
Endrin	Lower	1/16	6.81	6.81	NA	NA
Endrin aldehyde	Upper	5/23	3.60 - 18.2	12.1	61,000	0

Table 10.1.2.1
SWMUs 5 and 18 and AOC 605
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Pesticides/PCBs (μg/kg)						
Endrin ketone	Upper	4/23	3.84 - 7.02	5.51	61,000	0
	Lower	1/16	5.48	5.48	NA	NA
Heptachlor epoxide	Upper	1/23	2.34	2.34	630	0
	Lower	1/16	1.70	1.70	NA	NA
Aroclor-1260	Upper	3/23	230 - 350	277	740	0
	Lower	2/16	73.0 - 290	182	NA	NA
Dioxins (ng/kg)						
Dioxin Equivalent	Upper	4/4	0.328 - 3.01	1.20	1,000	0
	Lower	2/2	0.00750 - 0.299	0.153	NA	NA
1234678-HpCDD	Upper	3/4	32.7 - 61.0	42.8	NA	NA
	Lower	1/2	4.85	4.85	NA	NA
1234678-HpCDF	Upper	4/4	7.91 - 19.9	13.6	NA	NA
	Lower	1/2	2.89	2.89	NA	NA
1234789-HpCDF	Upper	1/4	0.970	0.970	NA	NA
	Lower	1/2	0.274	0.274	NA	NA
123678-HxCDD	Upper	1/4	3.08	3.08	NA	NA
123789-HxCDD	Upper	1/4	2.11	2.11	NA	NA
123478-HxCDF	Upper	3/4	1.14 - 1.61	1.30	NA	NA
	Lower	1/2	0.615	0.615	NA	NA
123678-HxCDF	Upper	1/4	2.25	2.25	NA	NA
	Lower	1/2	0.461	0.461	NA	NA
234678-HxCDF	Upper	2/4	0.434 - 1.34	0.888	NA	NA
	Lower	1/2	0.518	0.518	NA	NA
OCDD	Upper	4/4	9.10 - 376	192	NA	NA
	Lower	2/2	7.49 - 55.9	31.7	NA	NA

Table 10.1.2.1
SWMUs 5 and 18 and AOC 605
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Dioxins (ng/kg)						
OCDF	Upper	4/4	13.1 - 29.6	20.9	NA	NA
	Lower	1/2	3.25	3.25	NA	NA
23478-PeCDF	Upper	1/4	0.908	0.908	NA	NA
2378-TCDF	Upper	1/4	3.38	3.38	NA	NA

Notes:
μg/kg = Micrograms per kilogram
ng/kg = Nanograms per kilogram
RBC = Risk-based concentration
NA = No industrial RBC established

Table 10.1.2.2
SWMUs 5 and 18 and AOC 605
Inorganic Detections for Soil (mg/kg)

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Aluminum (Al)	Upper	24/24	85.1 - 15,000	3,150	100,000	26,600	0
	Lower	17/17	285 - 18,800	6,280	NA	41,100	NA
Antimony (Sb)	Upper	23/24	1.10 - 26.0	7.51	82.0	1.77	0
	Lower	17/17	0.570 - 15.6	4.09	NA	1.60	NA
Arsenic (As)	Upper	24/24	1.10 - 31.4	6.92	3.80	23.9	1
	Lower	17/17	4.20 - 20.6	8.69	NA	19.9	NA
Barium (Ba)	Upper	24/24	10.9 - 117	41.8	14,000	130	0
	Lower	17/17	9.70 - 115	36.9	NA	94.1	NA
Beryllium (Be)	Upper	21/24	0.200 - 3.70	0.977	1.30	1.70	4
	Lower	14/17	0.290 - 0.910	0.573	NA	2.71	NA
Cadmium (Cd)	Upper	17/24	0.150 - 1.40	0.534	100	1.50	0
	Lower	10/17	0.250 - 1.80	0.663	NA	0.960	NA

Table 10.1.2.2
SWMUs 5 and 18 and AOC 605
Inorganic Detections for Soil (mg/kg)

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Calcium (Ca)	Upper	24/24	246 - 124,000	25,600	NA	NA	NA
	Lower	17/17	266 - 222,000	26,700	NA	NA	NA
Chromium (Cr)	Upper	24/24	1.40 - 75.6	34.6	1,000	94.6	0
	Lower	17/17	5.80 - 67.7	27.7	NA	75.2	NA
Chromium (Hexavalent)	Upper	1/4	0.586	0.586	1,000	NA	0
Cobalt (Co)	Upper	22/24	0.400 - 36.1	10.1	12,000	19.0	0
	Lower	16/17	0.430 - 29.1	4.80	NA	14.9	NA
Copper (Cu)	Upper	24/24	3.80 - 1900	229	8,200	66.0	0
	Lower	17/17	1.90 - 540	86.1	NA	152	NA
Cyanide (CN)	Upper	4/23	0.270 - 0.350	0.308	4,100	0.500	0
	Lower	1/16	0.490	0.490	NA	NA	NA
Iron (Fe)	Upper	24/24	482 - 20,000	9,140	61,000	NA	0
	Lower	17/17	828 - 25,900	11,900	NA	NA	NA
Lead (Pb)	Upper	24/24	8.70 - 10,500	958	1,300	265	3
	Lower	17/17	10.7 - 1,260	203	NA	173	NA
Magnesium (Mg)	Upper	23/24	38.3 - 2,240	761	NA	NA	NA
	Lower	17/17	21.2 - 5,440	1,280	NA	NA	NA
Manganese (Mn)	Upper	24/24	1.10 - 227	95.2	4,700	302	0
	Lower	17/17	3.30 - 327	99.9	NA	881	NA
Mercury (Hg)	Upper	21/24	0.0300 - 1.80	0.373	61.0	2.60	0
	Lower	14/17	0.0500 - 1.10	0.294	NA	1.59	NA
Nickel (Ni)	Upper	24/24	0.770 - 270	47.4	4100	77.1	0
	Lower	17/17	0.790 - 127	19.6	NA	57.0	NA

Table 10.1.2.2
SWMUs 5 and 18 and AOC 605
Inorganic Detections for Soil (mg/kg)

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Potassium (K)	Upper	23/24	232 - 1,770	537	NA	NA	NA
	Lower	16/17	230 - 2,540	957	NA	NA	NA
Selenium (Se)	Upper	5/24	0.630 - 0.850	0.742	1,000	1.70	0
	Lower	7/17	0.430 - 2.20	0.914	NA	2.40	NA
Silver (Ag)	Upper	7/24	0.220 - 1.10	0.483	1,000	NA	0
	Lower	1/17	1.30	1.30	NA	NA	NA
Sodium (Na)	Upper	20/24	82.7 - 738	264	NA	NA	NA
	Lower	14/17	65.1 - 882	416	NA	NA	NA
Tin (Sn)	Upper	21/24	4.80 - 225	39.5	100,000	59.4	0
	Lower	12/17	2.70 - 61.6	13.6	NA	9.23	NA
Vanadium (V)	Upper	24/24	1.20 - 40.0	11.6	1,400	94.3	0
	Lower	17/17	6.60 - 48.6	19.7	NA	155	NA
Zinc (Zn)	Upper	24/24	5.30 - 3,180	746	61,000	827	0
	Lower	17/17	8.30 - 1,110	310	NA	886	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Risk-based concentration
RC = Reference concentration
NA = No industrial RBC or RC established

Volatile Organic Compounds in Soil

Three VOCs were detected in soil samples collected at SWMUs 5 and 18 and AOC 605. Seven detections occurred in both the upper and lower intervals. No VOCs were detected above their respective industrial RBC in the upper interval or respective SSL in the lower-interval.

Semivolatile Organic Compounds in Soil

Twenty-nine SVOCs were detected in soil samples collected at SWMUs 5 and 18 and AOC 605. Two hundred and sixty detections occurred in the upper interval and 146 occurred in the lower interval. Two SVOCs — dibenz(a,h)anthracene and benzo(a)pyrene — exceeded their respective industrial RBC in the upper interval. Three SVOCs — benzo(a)anthracene, chrysene, and 2,4-dinitrotoluene — exceeded their respective SSL in the lower interval.

Dibenz(a,h)anthracene was detected in 10 of 24 upper-interval samples ranging from 76.0 to 860 μg/kg and a mean of 285 μg/kg. One upper-interval sample (605SB004, 860 μg/kg) exceeded the dibenz(a,h)anthracene RBC of 780 μg/kg.

Benzo(a)pyrene was detected in 19 of 24 upper-interval samples with a range of 100 to 4,000 μg/kg and a mean of 583 μg/kg. The following five upper-interval samples exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg:

018SB004 (1,000 μg/kg)	605SB008 (810 μg/kg)	605SB014 (850 μg/kg)
605SB004 (4,000 μg/kg)	605SB013 (810 μg/kg)	

Benzo(a)anthracene was detected in 10 of 17 lower-interval samples with a range of 65 to 840 μg/kg and a mean of 241 μg/kg. One lower-interval sample (605SB015, 840 μg/kg) exceeded the benzo(a)anthracene SSL of 700 μg/kg.

Chrysene was detected in 11 of 17 lower-interval samples with a range of 80 to 1,400 μg/kg and a mean of 309 μg/kg. One lower-interval sample (605SB015, 1,400 μg/kg) exceeded the chrysene SSL of 1,000 μg/kg.

2,4-Dinitrotoluene was detected in one of 17 lower-interval samples at 290 μg/kg. One lower-interval sample (605SB010, 290 μg/kg) exceeded the 2,4-dinitrotoluene SSL of 200 μg/kg.

In accordance with recent cPAH guidance, BEQs were calculated for cPAHs at SWMUs 5 and 18 and AOC 605. The upper-interval BEQ was calculated for 22 samples with a range of 0.860 μg/kg to 6,200 μg/kg and a mean of 788 μg/kg. The following seven samples exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg:

018SB001 (863 μg/kg)	605SB004 (6,200 μg/kg)	605SB013 (1,370 μg/kg)
018SB004 (1,650 μg/kg)	605SB008 (1,227 μg/kg)	605SB014 (1,459 μg/kg)
605SB003 (1,107 μg/kg)		

Pesticides and PCBs in Soil

Thirteen pesticides were detected in soil samples collected at SWMUs 5 and 18 and AOC 605. Fifty-four detections occurred in the upper interval and 16 in the lower interval. No pesticides were detected above their respective industrial RBC in the upper interval. One pesticide — alpha-BHC — exceeded its respective SSL in the lower interval.

Alpha-BHC was detected in one of 16 lower-interval samples at 11 μg/kg. One sample (018SB003, 11 μg/kg) exceeded the alpha-BHC SSL of 0.4 μg/kg.

One PCB — Aroclor-1260 — was detected in soil samples collected at SWMUs 5 and 18 and AOC 605, with three detections occurring in the upper interval and two in the lower interval. The PCB did not exceed its respective industrial RBC in the upper interval. No SSL has been established for Aroclor-1260.

Other Organic Compounds in Soil

Twelve dioxins were detected in soil samples collected at SWMUs 5 and 18 and AOC 605. Twenty-six detections occurred in the upper interval and nine in the lower interval. No industrial RBCs or SSLs exist for these parameters.

In accordance with recent dioxin guidance, TEQs (dioxin equivalent) were calculated for the upper-interval samples. The TEQ was calculated for four samples with a range of 0.328 to 3.01 nanograms per kilogram (ng/kg) and a mean of 1.20 ng/kg. No samples exceeded the industrial RBC of 1,000 ng/kg.

Inorganic Elements in Soil

Twenty-five metals were detected in soil samples collected at SWMUs 5 and 18 and AOC 605. Four hundred and ninety-six detections occurred in the upper interval and 343 in the lower interval. Three metals — arsenic, beryllium, and lead — exceeded both their respective industrial RBC and background RC in the upper interval. Two metals — arsenic and barium — exceeded both their respective SSL and background RC in the lower interval.

Arsenic was detected in 24 of 24 upper-interval samples with a range of 1.10 to 31.4 mg/kg and a mean of 6.92 mg/kg. One upper-interval sample (605SB014, 6.92 mg/kg) exceeded both the arsenic industrial RBC of 3.80 mg/kg arsenic background RC of 23.9 mg/kg. Arsenic was also detected in 17 of 17 lower-interval samples with a range of 4.20 to 20.6 mg/kg and a mean of 8.69 mg/kg. One lower-interval sample (605SB014, 20.6 mg/kg) exceeded both the arsenic SSL of 15 mg/kg and background RC of 19.9 mg/kg.

Beryllium was detected in 21 of 24 upper-interval samples with a range of 0.200 to 3.70 mg/kg and a mean of 0.977 mg/kg. Four upper-interval samples (605SB005, 2.2 mg/kg; 605SB007, 3.7 mg/kg; 605SB012, 2.8 mg/kg; and 605SB015, 2.2 mg/kg) exceeded both the beryllium industrial RBC of 1.30 mg/kg and background RC of 1.70 mg/kg.

Lead was detected in 24 of 24 upper-interval samples with a range of 8.70 to 10,500 mg/kg and a mean of 958 mg/kg. The following 3 upper-interval samples exceeded both the lead industrial RBC of 1,300 mg/kg and background RC of 265 mg/kg: 005SB002 (10,500 mg/kg), 605SB002 (1,600 mg/kg), and 018SB004 (1,960 mg/kg).

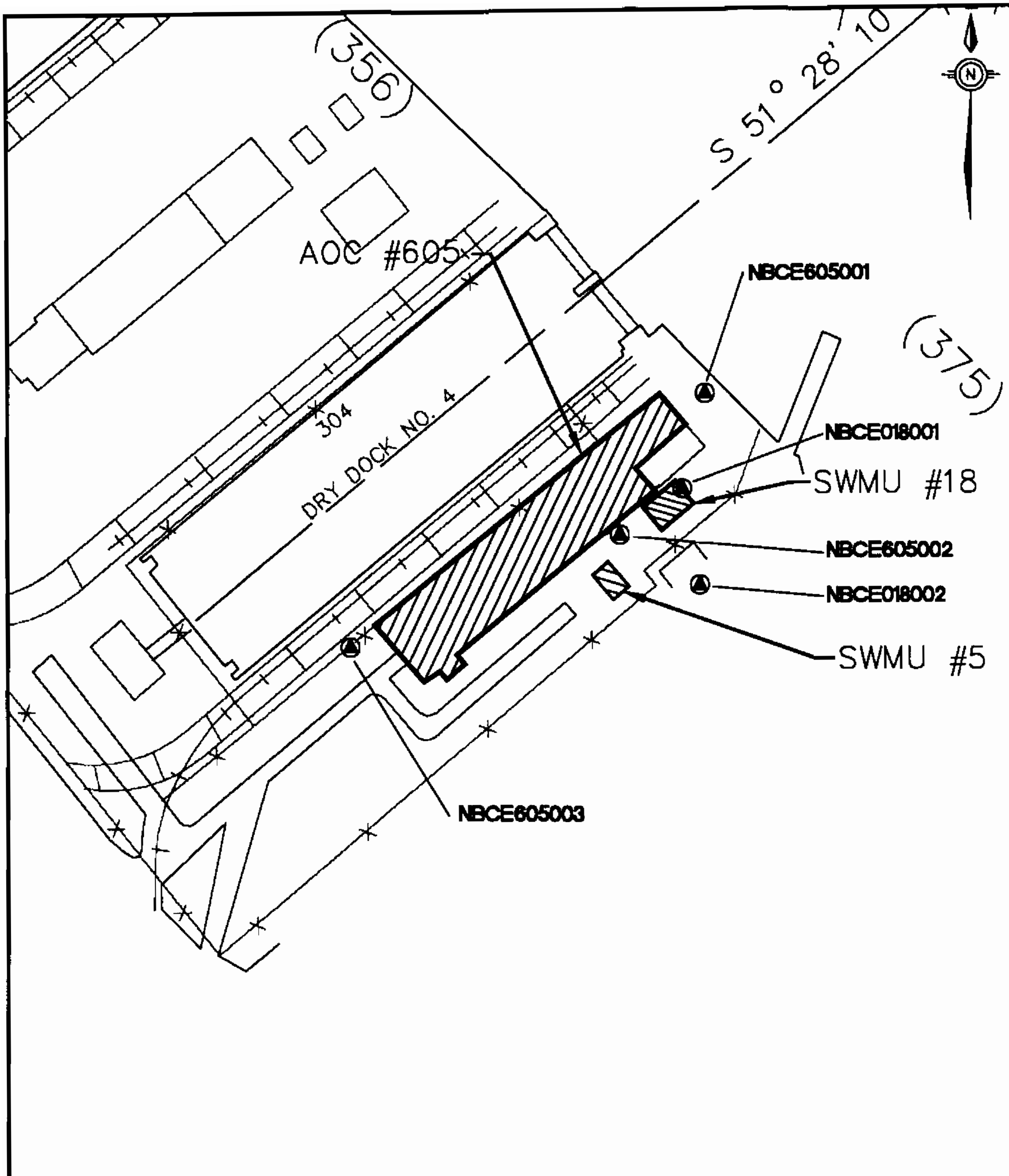
Barium was detected in 17 of 17 lower-interval samples with a range of 9.70 to 115 mg/kg and a mean of 36.9 mg/kg. One lower-interval sample (605SB015, 115 mg/kg) exceeded both the barium SSL of 32 mg/kg and background RC of 94.1 mg/kg.

10.1.3 Groundwater Sampling and Analysis

Five shallow monitoring wells were installed and sampled to assess groundwater quality at SWMUs 5 and 18 and AOC 605 as shown in Figure 10.1.2. The wells were installed as follows:

- Shallow Wells — NBCE605001, NBCE605002, NBCE605003, NBCE018001, and NBCE018002

Groundwater samples were submitted for analysis at DQO Level III for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, chlorides, sulfates, TDS, and organotins. One duplicate sample was collected and submitted for Appendix IX analyses at DQO Level IV, which includes the parameters listed above plus a more comprehensive list of VOCs and SVOCs as well as herbicides, hexavalent chromium, organophosphorous pesticides, and dioxins. One free product sample was collected and analyzed for VOCs, SVOCs, and pesticides. Table 10.1.3.1 summarizes groundwater sampling and analysis at SWMU 5 and 18 and AOC 605.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.1.2
MONITORING WELL LOCATIONS
SWMU 5, SWMU #18 & AOC #605
PAD 1278 AND
WASTE PAINT STORAGE AREA

DWG DATE: 09/02/97 | DWG NAME: 10-1-2

Table 10.1.3.1
SWMUs 5 and 18 and AOC 605
Groundwater Sampling Summary

Depth	Wells Proposed	Wells Installed	Analyses Proposed	Analyses Collected	Deviations
Shallow	5	5	Standard Suite[a], chlorides, sulfates, TDS, and organotins	Standard Suite[a], chlorides, sulfates, TDS, and organotins	One free-product sample collected and analyzed for VOCs, SVOCs, and pesticides

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs

The shallow monitoring wells were installed at 12.5 to 15 feet bgs in the surficial aquifer. All wells were installed in accordance with Section 3.3 of this report.

10.1.4 Nature of Contamination in Groundwater

Organic compound analytical results for groundwater are summarized in Table 10.1.4.1. Inorganic analytical results for groundwater are summarized in Table 10.1.4.2. Appendix H contains the data report for all samples collected in Zone E.

Table 10.1.4.1
SWMUs 5 and 18 and AOC 605
Organic Compounds Detected in First-Quarter Groundwater
Shallow Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	MCL	Number of Samples Exceeding RBC
SVOCs (μg/L)						
Acenaphthene	3/5	2.00 - 15.0	7	220	NA	0
Anthracene	1/5	1.000	1.000	1,100	NA	0
Butylbenzylphthalate	1/5	2.00	2.00	730	NA	0
Dibenzofuran	1/5	5.00	5.00	15.0	NA	0

Table 10.1.4.1
SWMUs 5 and 18 and AOC 605
Organic Compounds Detected in First-Quarter Groundwater
Shallow Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	MCL	Number of Samples Exceeding RBC
SVOCs (μg/L)						
Fluoranthene	1/5	2.00	2.00	150	NA	0
Fluorene	1/5	7.00	7.00	150	NA	0
2-Methylnaphthalene	1/5	4.00	4.00	150	NA	0
Naphthalene	1/5	9.00	9.00	150	NA	0
Phenanthrene	1/5	11.0	11.0	150	NA	0
Pyrene	1/5	1.000	1.000	110	NA	0
Dioxins (pg/L)						
Dioxin Equivalent	1/1	62.6	62.6	0.43	NA	1
234678-HxCDF	1/1	626	626	NA	NA	NA
Organotin (μg/L)						
Tributyltin	1/5	14.0	14.0	NA	NA	NA

Notes:
μg/L = Micrograms per liter
pg/L = Picograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
NA = No RBC or MCL established

Table 10.1.4.2
SWMUs 5 and 18 and AOC 605
Inorganic Detections for First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Aluminum (Al)	3/5	142 - 1,220	566	3,700	2,810	NA	0
Antimony (Sb)	3/5	5.80 - 6.60	6.23	1.50	NA	6.00	3
Arsenic (As)	2/5	6.80 - 45.9	26.4	0.0450	18.7	50.0	1
Barium (Ba)	1/5	291	291	260	211	2,000	1

Table 10.1.4.2
SWMUs 5 and 18 and AOC 605
Inorganic Detections for First-Quarter Groundwater (µg/L)
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Calcium (Ca)	4/5	53,400 - 117,000	91500	NA	NA	NA	NA
Chromium (Cr)	3/5	1.10 - 3.80	2.03	18.0	12.3	100	0
Cobalt (Co)	1/5	3.00	3.00	220	2.5	NA	0
Iron (Fe)	5/5	354 - 24,200	12,000	1,100	NA	NA	4
Lead (Pb)	2/5	4.60 - 426	215	NA	4.8	15.0*	1
Magnesium (Mg)	1/5	28,100	28,100	NA	NA	NA	NA
Manganese (Mn)	5/5	13.4 - 365	207	84.0	2,560	NA	0
Nickel (Ni)	3/5	1.10 - 15.4	6.80	73.0	15.2	100	0
Potassium (K)	2/5	13,200 - 14,300	13,800	NA	NA	NA	NA
Sodium (Na)	2/5	1,040,00 - 115,000	110,000	NA	NA	NA	NA
Vanadium (V)	3/5	1.000 - 1.70	1.33	26.0	11.4	NA	0
Zinc (Zn)	3/5	41.2 - 109	76.7	1,100	27.3	NA	0

Notes:
µg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
RC = Reference concentration
NA = No RBC, MCL, or RC established
* = TTAL

Semivolatile Organic Compounds in Groundwater

Shallow Groundwater

Ten SVOCs were detected in shallow groundwater samples collected at SWMU 18 and AOC 605 (no shallow groundwater wells were installed at SWMU 5). No SVOCs were detected above their respective tap-water RBCs. No MCLs have been established for the detected SVOCs in groundwater.

Other Organic Compounds in Groundwater

Shallow Groundwater

One dioxin — 234678-HxCDF — was detected in the one duplicate shallow groundwater sample collected from well NBCE605003 at AOC 605. No tap-water RBC or MCL exists for this parameter.

In accordance with recent dioxin guidance, the TEQ (dioxin equivalent) was calculated for the groundwater sample at 62.6 pg/L, exceeding the 2,3,7,8-TCDD tap-water RBC of 0.4 pg/L. No MCL has been established for the dioxin equivalent.

One organotin — tributylin — was detected in one of five shallow groundwater samples collected at SWMU 18 and AOC 605. No tap-water RBC or MCL has been established for this parameter.

Inorganic Elements in Groundwater

Shallow Groundwater

Sixteen metals were detected in shallow groundwater samples collected at SWMU 18 and AOC 605. Five metals — antimony, arsenic, barium, iron, and lead — exceeded both their respective tap-water RBC and shallow groundwater background RC.

Antimony was detected in three of five samples with a range of 5.80 to 6.60 μg/L and a mean of 6.23 μg/L. Three samples from wells NBCE018001 (5.8 μg/L), NBCE605002 (6.6 μg/L), and NBCE605003 (6.2 μg/L) exceeded the antimony tap-water RBC of 1.50 μg/L. No shallow groundwater RC has been established for antimony. Two samples from wells NBCE605002 (6.6 μg/L) and NBCE605003 (6.2 μg/L) exceeded the antimony MCL of 6.00 μg/L.

Arsenic was detected in two of five samples with a range of 6.80 to 45.9 μg/L and a mean of 26.4 μg/L. One sample from well NBCE605003 (45.9 μg/L) exceeded both the arsenic tap-water

RBC of 0.0450 μg/L and shallow groundwater RC of 18.7 μg/L. The sample did not exceed the arsenic MCL of 50.0 μg/L.

Barium was detected in one of five samples at 291 μg/L. The sample from well NBCE018002 (291 μg/L) exceeded both the barium tap-water RBC of 260 μg/L and the barium shallow groundwater RC of 211 μg/L. The sample did not exceed the barium MCL of 2,000 μg/L.

Iron was detected in five of five samples with a range of 354 to 24,200 μg/L and a mean of 12,000 μg/L. Four samples from wells NBCE018002 (15,700 μg/L), NBCE605001 (10,400 μg/L), NBCE605002 (24,200 μg/L), and NBCE605003 (9,580 μg/L) exceeded the iron tap-water RBC of 1,100 μg/L. No shallow groundwater RC or MCL has been established for iron.

Lead was detected in two of five samples with a range of 4.60 to 426 μg/L and a mean of 215 μg/L. One sample from well NBCE605002 (426 μg/L) exceeded both the treatment technique action level (TTAL) of 15.0 μg/L for lead in groundwater (substituted for the tap-water RBC and MCL) and the lead shallow groundwater RC of 4.8 μg/L.

10.1.5 Fate and Transport Assessment for SWMUs 5 and 18 and AOC 605

Combined SWMU 5 comprises a former battery electrolyte treatment area, a PCB spill area, and a waste paint storage area south of DD 4 and adjacent to the quay wall. Much of the ground is covered by a thick concrete pad (Pad 1278), with the rest of the area largely unpaved. Environmental media sampled as part of the combined SWMU 5 RFI include surface soil, subsurface soil, and shallow groundwater. Potential constituent migration pathways investigated for combined SWMU 5 include soil to groundwater, groundwater to surface water, and emission of volatiles from surface soil to air. Samples discussed in this section were collected prior to interim measures involving removal of soil from the site. Interpretations and conclusions presented here apply to the site as it existed before the interim measures were conducted.

10.1.5.1 Soil-to-Groundwater Cross-Media Transport: Tier One

Table 10.1.5.1 compares maximum detected organic constituent concentrations in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels, or (b) background reference concentrations. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 10:1, with no attenuation of constituents in soil (dilution attenuation factor [DAF]=10).

Eight organic constituents — benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, 2,4-dinitrotoluene, pentachlorophenol, alpha-BHC, and dieldrin — were detected in combined SWMU 5 soil at concentrations equal to or greater than groundwater protection SSLs, and were carried over to the second-tier screen. None of the eight compounds was detected in groundwater samples, indicating that the current soil-groundwater equilibrium is sufficiently protective of the surficial aquifer. Maximum concentrations of the four PAH compounds shown above were all reported from a single sample (605SB00401), and maximum surface soil concentrations were all higher than concentrations in subsurface soil, indicating that high concentrations of PAHs have not spread widely or deeply in soil. Pentachlorophenol, 2,4-dinitrotoluene, and alpha-BHC were all detected in single subsurface soil samples but not in surface soil. Dieldrin was reported from three surface soil samples but not from subsurface soil.

Seven inorganic constituents — antimony, arsenic, cobalt, copper, lead, nickel, and tin — were detected in soil above their respective groundwater protection SSLs or background reference values, and were carried over to the second-tier screen. All except copper and tin were also detected in groundwater, indicating a completed pathway from soil to groundwater; arsenic and lead were detected in groundwater at concentrations above their respective RBCs and/or background reference values. All seven of the metals were reported at higher maximum concentrations in surface soil samples than in subsurface samples. Copper was detected above background concentrations in nine surface soil samples and two subsurface samples. The maximum concentration of 1,900 mg/kg in sample 605SB01501 was more than twice as high as that of any other site sample. Lead concentrations exceeded the screening level of 400 mg/kg in 12 surface soil samples and two subsurface samples, as detailed in Section 10.1.2. Lead contamination in soil is probably related to past battery disassembly activities at SWMU 5.

10.1.5.2 Groundwater-to-Surface Water Cross-Media Transport: Tier One

Table 10.1.5.1 also compares maximum detected organic constituent concentrations in shallow groundwater samples to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background reference concentrations for groundwater, as well as to the saltwater surface water chronic values. To provide a conservative first-tier screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

Two organic constituents — dioxin TEQs and tributyltin — were detected in shallow groundwater samples at concentrations above tap water RBCs. The same two organic compounds plus two others — acenaphthene and fluoranthene — were detected above saltwater surface water chronic screening concentrations, and were carried over to the second-tier screen. The dioxin congener 234678-HxCDF was reported from the single duplicate sample at AOC 605 at 626 pg/L (qualified EMPC by the validator), equivalent to 62.6 pg/L of 2378-TCDD. Preliminary analysis of second-round samples at AOC 605 shows no detections of 234678-HxCDF in samples from three shallow monitoring wells, although very minor amounts of several other dioxin congeners (total TEQs < 0.1 pg/L) were reported. The tributyltin detection came from one of five groundwater samples. The acenaphthene and fluoranthene exceedances were marginally above the surface water standards.

Arsenic was detected in first-round shallow groundwater samples from well NBCE605003 at concentrations higher than its background reference value of 18.7 μg/L, while lead was detected in one sample (605GW00201) at 426 μg/L, far above its TTAL of 15 μg/L. Arsenic, lead, and zinc concentrations exceeded their respective saltwater surface water chronic screening values, although the zinc exceedance was marginal (109 μg/L versus the screening level of 86 μg/L), and occurred in a single sample (018GW00101). Preliminary analysis of later sampling rounds confirms the elevated concentrations of all three metals in groundwater.

10.1.5.3 Soil and Groundwater-to-Surface Water Cross-Media Transport: Tier Two

Table 10.1.5.2 provides a second screening tier for all detected constituents exceeding any of the first-tier screening concentrations. Constituent concentrations in groundwater are compared to combined ecological/human health RBCs that have been adjusted upward for site-specific dilution by surface water in the Cooper River, while soil constituent concentrations are compared to calculated SSLs that are based on the adjusted RBCs rather than the original target leachate concentrations. For the second-tier screen, no dilution of leachate by groundwater or attenuation of constituents in soil is assumed (DAF=1). The second screening tier identifies any constituents in soil or groundwater that pose a potential threat to surface water quality, after allowing for dilution of groundwater by surface water when the groundwater discharges into the river. The site-specific surface-water dilution factor calculated for combined SWMU 5 is 74,000:1 (see Table 6.2.1)

None of the first-tier constituent concentrations exceeded the adjusted screening levels of the second tier, indicating that site constituents in soil and groundwater pose no threat to human health or the environment in the Cooper River through the associated migration pathway. The elevated concentrations of several PAHs in surface soil samples are not of concern because PAHs are not particularly mobile in soil or groundwater. The high concentrations of lead and zinc in both soil and groundwater fall below their respective screening levels. Maximum arsenic and copper concentrations in soil samples were within one order of magnitude of their adjusted SSLs of 97.2 mg/kg and 7,560 mg/kg, respectively. However, the adjusted SSLs were obtained assuming a DAF of 1, while the calculated DAF for combined SWMU 5 is 18.65, taking into account dilution only. Consequently, the margin between detected soil concentrations and levels protective of Cooper River water is actually much greater than the table indicates.

10.1.5.4 Soil-to-Air Cross-Media Transport

Table 10.1.5.3 lists the VOCs detected in surface soil samples collected at combined SWMU 5 along with corresponding soil-to-air volatilization screening levels. Exposed soil constitutes less than half of the surface area at the site. In addition, none of the VOCs was reported at a maximum concentration exceeding its corresponding soil-to-air volatilization screening level. As a result, the soil-to-air migration pathway is not expected to be significant at combined SWMU 5.

10.1.5.5 Fate and Transport Summary

In the first-tier screen, five metals detected above their generic SSLs in soil were also detected in groundwater samples. The widespread presence in soil of at least two of these metals — lead and zinc — is likely a result of previous use of the site for battery disassembly. These two metals as well as others may also be present due to prior waste paint storage at AOC 605. Although widespread in soil, arsenic, lead, and zinc were detected at elevated concentrations in groundwater in only one sample each. Organic compounds detected at elevated concentrations in soil were not detected in groundwater. Those organic compounds detected at relatively elevated concentrations in groundwater were also detected only in single samples. None of the constituents exceeding first-tier screening values also exceeded the adjusted screening values of the second-tier comparisons, indicating that there is no threat to surface water in the Cooper River via the evaluated migration pathways.

Table 10.1.5.1
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMUs 5 and 18 and AOC 605
Charleston, South Carolina

	Max. Concentration		Max. Concentration		Screening Concentration *						Ground-Water	Surface Water
Parameter	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Migration Concern	Migration Concern
Volatile Organic Compounds												
Acetone	180	170	ND	NA	8000	3700	NA	UG/KG	UG/L	NO	NO	NO
2-Butanone (MEK)	30	ND	ND	NA	4000	1900	NA	UG/KG	UG/L	NO	NO	NO
Dichlorodifluoromethane	7	6	ND	NA	7500	390	NA	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Acenaphthene	470	280	15	NA	285000	2200	9.7	UG/KG	UG/L	NO	NO	YES
Acenaphthylene	150	70	ND	NA	150000	1500	NA	UG/KG	UG/L	NO	NO	NO
Anthracene	1100	560	1	NA	5900000	11000	NA	UG/KG	UG/L	NO	NO	NO
Benzoic acid	ND	53	ND	NA	200000	150000	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	5700	840	ND	NA	800	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(a)pyrene	4000	790	ND	NA	4000	0.0092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(b)fluoranthene	4400	630	ND	NA	2500	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(k)fluoranthene	3400	550	ND	NA	24500	0.92	NA	UG/KG	UG/L	NO	NO	NO
Chrysene	6900	1400	ND	NA	80000	9.2	NA	UG/KG	UG/L	NO	NO	NO
Dibenzo(a,h)anthracene	860	240	ND	NA	800	0.0092	NA	UG/KG	UG/L	YES	NO	NO
Indeno(1,2,3-cd)pyrene	2900	500	ND	NA	7000	0.092	NA	UG/KG	UG/L	NO	NO	NO
Butylbenzylphthalate	ND	79	2	NA	930000	7300	29.4	UG/KG	UG/L	NO	NO	NO
Carbazole	110	ND	ND	NA	300	3.4	NA	UG/KG	UG/L	NO	NO	NO
4-Chloroaniline	190	160	ND	NA	350	150	NA	UG/KG	UG/L	NO	NO	NO
Dibenzofuran	150	110	5	NA	NA	150	NA	UG/KG	UG/L	NO	NO	NO
Di-n-butylphthalate	160	180	ND	NA	2300000	3700	3.4	UG/KG	UG/L	NO	NO	NO
Diethylphthalate	220	ND	ND	NA	235000	29000	75.9	UG/KG	UG/L	NO	NO	NO
2,4-Dinitrotoluene	ND	290	ND	NA	0.4	73	NA	UG/KG	UG/L	YES	NO	NO
Di-n-octylphthalate	220	ND	ND	NA	10000000	730	NA	UG/KG	UG/L	NO	NO	NO
bis(2-Ethylhexyl)phthalate (BEHP)	2400	4500	ND	NA	1800000	4.8	NA	UG/KG	UG/L	NO	NO	NO
Fluoranthene	8500	1200	2	NA	2150000	1500	1.6	UG/KG	UG/L	NO	NO	YES
Fluorene	340	170	7	NA	280000	1500	NA	UG/KG	UG/L	NO	NO	NO
2-Methylnaphthalene	70	330	4	NA	63000	1500	NA	UG/KG	UG/L	NO	NO	NO
4-Methylphenol (p-cresol)	75	ND	ND	NA	690	180	NA	UG/KG	UG/L	NO	NO	NO
Naphthalene	450	110	9	NA	42000	1500	23.5	UG/KG	UG/L	NO	NO	NO
Pentachlorophenol	ND	90	ND	NA	15	0.56	7.9	UG/KG	UG/L	YES	NO	NO
Phenanthrene	4400	640	11	NA	690000	1500	NA	UG/KG	UG/L	NO	NO	NO
Pyrene	9800	3600	1	NA	2100000	1100	NA	UG/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
Aldrin	1.78	2.7	ND	NA	250	0.004	0.13	UG/KG	UG/L	NO	NO	NO
Aroclor-1260	350	290	ND	NA	1000	0.0087	0.03	UG/KG	UG/L	NO	NO	NO
alpha-BHC	ND	11	ND	NA	0.25	0.011	1400	UG/KG	UG/L	YES	NO	NO
alpha-Chlordane	5.7	ND	ND	NA	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
gamma-Chlordane	11.2	3.12	ND	NA	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
technical Chlordane	328	26	ND	NA	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
4,4'-DDD	19	6	ND	NA	8000	0.28	0.025	UG/KG	UG/L	NO	NO	NO
4,4'-DDE	15	8.8	ND	NA	27000	0.2	0.14	UG/KG	UG/L	NO	NO	NO
4,4'-DDT	43	26	ND	NA	16000	0.2	0.001	UG/KG	UG/L	NO	NO	NO
Dieldrin	6.96	ND	ND	NA	2	0.0042	0.0019	UG/KG	UG/L	YES	NO	NO
Endosulfan II	6	3.9	ND	NA	9000	220	0.0087	UG/KG	UG/L	NO	NO	NO
Endrin	ND	6.81	ND	NA	500	11	0.0023	UG/KG	UG/L	NO	NO	NO
Endrin aldehyde	18.2	ND	ND	NA	500	11	NA	UG/KG	UG/L	NO	NO	NO
Endrin ketone	7.02	5.48	ND	NA	500	11	NA	UG/KG	UG/L	NO	NO	NO
Heptachlor epoxide	2.34	1.7	ND	NA	350	0.0012	0.0036	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	3.01	0.299	62.6	NA	950	0.43	10	NG/KG	PG/L	NO	YES	YES
Organotin Compounds												
Tributyltin	ND	ND	14	NA	NA	1.1	0.01	UG/KG	UG/L	NO	YES	YES

Table 10.1.5.1
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMUs 5 and 18 and AOC 605
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Inorganic Compounds												
Aluminum	15000	18800	1220	NA	41100	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	26	15.6	6.6	NA	2.5	15	NA	MG/KG	UG/L	YES	NO	NO
Arsenic	31.4	20.6	45.9	NA	23.9	18.7	36	MG/KG	UG/L	YES	YES	YES
Barium	117	115	291	NA	820	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	3.7	0.91	ND	NA	32	1.2	NA	MG/KG	UG/L	NO	NO	NO
Cadmium	1.4	1.8	ND	NA	4	18	9.3	MG/KG	UG/L	NO	NO	NO
Chromium (total)	75.6	67.7	3.8	NA	94.6	37000	103	MG/KG	UG/L	NO	NO	NO
Chromium (hexavalent)	0.586	NA	ND	NA	19	180	50	MG/KG	UG/L	NO	NO	NO
Cobalt	36.1	29.1	3	NA	19	2200	NA	MG/KG	UG/L	YES	NO	NO
Copper	1900	540	ND	NA	152	1500	2.9	MG/KG	UG/L	YES	NO	NO
Cyanide	0.35	0.49	ND	NA	20	730	37.3	MG/KG	UG/L	NO	NO	NO
Lead	10500	1260	426	NA	400	15	8.5	MG/KG	UG/L	YES	YES	YES
Manganese	227	327	365	NA	881	2560	NA	MG/KG	UG/L	NO	NO	NO
Mercury	1.8	1.1	ND	NA	2.6	11	0.2	MG/KG	UG/L	NO	NO	NO
Nickel	270	127	15.4	NA	77.1	730	42.2	MG/KG	UG/L	YES	NO	NO
Selenium	0.85	2.2	ND	NA	2.5	180	71	MG/KG	UG/L	NO	NO	NO
Silver	1.1	1.3	ND	NA	17	180	0.23	MG/KG	UG/L	NO	NO	NO
Tin	225	61.6	ND	NA	59.4	22000	NA	MG/KG	UG/L	YES	NO	NO
Vanadium	40	48.6	1.7	NA	3000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	3180	1110	109	NA	6000	11000	86	MG/KG	UG/L	NO	NO	YES

* Screening Concentrations:

Soil to GW - Generic SSLs based on DAF = 10, adapted from 1996 EPA Soil Screening Guidance or calculated using values from Table 6.2

Tap Water RBC - From EPA Region III Risk-Based Concentration Table, June 3, 1996

Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November, 1995; Table 2

In each case, the value shown is the greater of the relevant screening value or the corresponding background reference value

NA - Not available/Not applicable
ND - Not detected
SSL - Soil screening level
RBC - Risk based concentration
MG/KG - Milligrams per kilogram
NG/KG - Nanograms per kilogram
PG/L - Picograms per liter
UG/KG - Micrograms per kilogram
UG/L - Micrograms per liter

Table 10.1.5.2
Chemicals Detected in Surface Soil, Subsurface Soil, or Shallow Groundwater at Concentrations Exceeding any Initial Screening Concentration
Comparison to Combined Ecological/Human Health RBCs Adjusted for Surface Water Dilution, and to SSLs Based on Adjusted Ecological/Human Health RBCs: Tier Two
NAVBASE-Charleston, Zone E: SWMUs 5 and 18 and AOC 605
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Initial Screening Concentrations * Soil to GW SSL	Initial Screening Concentrations * Tap Water RBC	Initial Screening Concentrations * Salt Wtr. Surf. Wtr. Chronic	Adjusted Screening Concentrations # Combined Eco/HH Surf. Wtr. RBC	Adjusted Screening Concentrations # Adjusted Eco/HH GW RBC	Adjusted Screening Concentrations # Target Leachate Conc. (DAF=1)	Adjusted Screening Concentrations # SSL Multi-plier	Adjusted Screening Concentrations # Adjusted SSL (DAF=1)	Units Soil Units	Units Water Units	Screening Results Leaching Potential	Screening Results Surface Water Migration Concern
Semivolatile Organic Compounds																
Acenaphthene	470	280	15	NA	285000	2200	9.7	9.7	7.18E+05	2000	3.59E+02	1.02E+07	UG/KG	UG/L	NO	NO
Benzo(a)pyrene equivalents																
Benzo(a)anthracene	5700	840	ND	NA	800	0.092	NA	0.092	6.81E+03	0.1	6.81E+04	5.45E+06	UG/KG	UG/L	NO	NO
Benzo(a)pyrene	4000	790	ND	NA	4000	0.0092	NA	0.0092	6.81E+02	0.2	3.40E+03	1.36E+06	UG/KG	UG/L	NO	NO
Benzo(b)fluoranthene	4400	630	ND	NA	2500	0.092	NA	0.092	6.81E+03	0.1	6.81E+04	1.04E+07	UG/KG	UG/L	NO	NO
Dibenzo(a,h)anthracene	860	240	ND	NA	800	0.0092	NA	0.0092	6.81E+02	0.01	6.81E+04	5.45E+06	UG/KG	UG/L	NO	NO
2,4-Dinitrotoluene	ND	290	ND	NA	0.4	73	NA	73	5.40E+06	73	7.40E+04	2.96E+03	UG/KG	UG/L	NO	NO
Fluoranthene	8500	1200	2	NA	2150000	1500	1.6	1.6	1.18E+05	1000	1.18E+02	1.04E+07	UG/KG	UG/L	NO	NO
Pentachlorophenol	ND	90	ND	NA	15	0.56	7.9	0.56	4.14E+04	1	4.14E+04	6.22E+04	UG/KG	UG/L	NO	NO
Pesticides/PCB Compounds																
alpha-BHC	ND	11	ND	NA	0.25	0.011	1400	0.011	8.14E+02	0.01	8.14E+04	2.04E+03	UG/KG	UG/L	NO	NO
Dieldrin	6.96	ND	ND	NA	2	0.0042	0.0019	0.0019	1.41E+02	0.005	2.81E+04	5.62E+03	UG/KG	UG/L	NO	NO
Dioxin Compounds																
Dioxin (TCDD TEQ)	3.01	0.299	62.6	NA	950	0.43	10	0.43	3.18E+04	30	1.06E+03	1.01E+05	NG/KG	PG/L	NO	NO
Organotin Compounds																
Tributyltin	ND	ND	14	NA	NA	1.1	0.01	0.01	7.40E+02	NA	NA	NA	UG/KG	UG/L	NO	NO
Inorganic Compounds																
Antimony	26	15.6	6.6	NA	2.5	15	NA	15	1.11E+06	6	1.85E+05	4.63E+04	MG/KG	UG/L	NO	NO
Arsenic	31.4	20.6	45.9	NA	14.6	0.045	36	0.045	3.33E+03	50	6.66E+01	9.72E+01	MG/KG	UG/L	NO	NO
Cobalt	36.1	29.1	3	NA	1040	2200	NA	2200	1.63E+08	2200	7.40E+04	1.00E+06	MG/KG	UG/L	NO	NO
Copper	1900	540	ND	NA	458	1500	2.9	2.9	2.15E+05	1300	1.65E+02	7.56E+03	MG/KG	UG/L	NO	NO
Lead	10500	1260	426	NA	400	15	8.5	8.5	6.29E+05	15	4.19E+04	1.00E+06	MG/KG	UG/L	NO	NO
Nickel	270	127	15.4	NA	65	730	42.2	42.2	3.12E+06	100	3.12E+04	2.03E+05	MG/KG	UG/L	NO	NO
Tin	225	61.6	ND	NA	55000	22000	NA	22000	1.00E+09	22000	4.55E+04	1.00E+06	MG/KG	UG/L	NO	NO
Zinc	3180	1110	109	NA	6000	11000	86	86	6.36E+06	10000	6.36E+02	3.82E+05	MG/KG	UG/L	NO	NO

* Initial Screening Concentrations:
Soil to GW - Generic SSLs based on DAF=10, adapted from 1996 EPA Soil Screening Guidance or calculated using values from Table 6.2
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, June 3, 1996
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November, 1995; Table 2
In this table, the screening values shown are not adjusted for background reference values

Adjusted Screening Concentrations:

Combined Eco/HH Surface Water RBC - Where EPA Saltwater Surface Water Screening Values exist, the lesser of surface water values and tap water RBCs; otherwise, tap water RBCs

Adjusted Eco/HH Groundwater RBC - Combined Eco/HH Surface Water RBCs multiplied by site-specific surface water dilution factor of 74000: GW concentrations protective of surface water

Target Leachate Concentration (DAF=1) - Acceptable leachate concentrations used by EPA to calculate original SSLs (protective of GW as drinking water); from 1996 Soil Screening Guidance, Attachment D

SSL Multiplier - Adjusted Eco/HH GW RBCs divided by Target Leachate Concentrations

Adjusted SSL (DAF=1) - Generic SSLs based on DAF=1, multiplied by SSL Multipliers: soil concentrations protective of surface water

Upper limit for adjusted SSLs for organics is geometric mean TOC concentration of Zone E soils; upper limit for inorganics is unity

HH - Human health
NA - Not available/Not applicable
ND - Not detected
SSL - Soil screening level
RBC - Risk based concentration
MG/KG - Milligrams per kilogram
NG/KG - Nanograms per kilogram
PG/L - Picograms per liter
UG/KG - Micrograms per kilogram
UG/L - Micrograms per liter

Table 10.1.5.3
Soil-to-Air Volatilization Screening Analysis
NAVBASE-Charleston, Zone E: SWMUs 5 and 18 and AOC 605
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Acetone	180	62000000	UG/KG	NO
2-Butanone (MEK)	30	10000	UG/KG	NO
Dichlorodifluoromethane	7	37000	UG/KG	NO

* - Soil screening levels for transfers from soil to air were obtained from USEPA Region III Risk-Based Concentration Table, June 1996. The value for 2-Butanone (MEK) was estimated.

10.1.6 Human Health Risk Assessment for Combined SWMUs 5 and 18, and AOC 605

10.1.6.1 Site Background and Investigative Approach

SWMU 5 is a former battery treatment area used to neutralize submarine battery electrolyte. SWMU 18 is a 400-square-foot area contaminated by a PCB spill that occurred at the Public Works Resource Recovery Facility Storage Area in June 1987. AOC 605 is a waste paint storage area situated on Pad 1278. The following refers to sites as combined SWMU 5. Due to their proximity, the data for these sites have been combined for the HHRA.

During the RFI, a total of 24 soil samples were collected from the upper interval to identify potential impacts resulting from the site activities. Five monitoring wells were installed in the shallow aquifer. Data from the first quarter sampling event were used to quantitatively assess groundwater exposure pathways. Sections 10.1.1 and 10.1.3 summarize the sampling effort for combined SWMU 5.

An interim measures action was conducted on combined SWMU 5 soil. Risk assessment conclusions regarding surface soil at this site are based on data collected prior to the interim measures action. As a result, details of the interim measures action should be considered when interpreting risk assessment conclusions that relate to soil pathways.

10.1.6.2 COPC Identification

Soil

Based on the screening comparisons described in Section 7 of this RFI and presented in Table 10.1.6.1, this HHRA will focus on the following COPCs: antimony, arsenic, Aroclor-1260, BEQs, beryllium, copper, lead, nickel, and zinc. Wilcoxon rank sum test analyses resulted in the inclusion of chromium, which had been eliminated on the basis of background concentration. Chromium, which predominantly exists in either the trivalent or hexavalent state, was identified as a COPC based on a conservative comparison of the maximum concentration (regardless of valence) to the RBC for its hexavalent species (39 mg/kg). Surface soil analyses for hexavalent chromium indicate the chromium predominantly exists in the trivalent state. The RBC for trivalent chromium is 7,800 mg/kg. Since it is evident that combined SWMU 5 chromium in soil predominantly exists in the less-toxic trivalent state, chromium was eliminated as a COPC.

Groundwater

As shown in Table 10.1.6.2, the COPCs identified in shallow groundwater for this site were antimony, dioxin equivalents, and lead. Wilcoxon rank sum test analyses did not result in the inclusion of any inorganic parameters that had been eliminated on the basis of background concentration. The maximum concentration of manganese exceeded its RBC but was eliminated from the formal HHRA based on direct comparison to its background concentration and the statistical comparison of site data to grid-based data through the Wilcoxon rank sum test. A discussion of the risk and hazard associated with background concentrations of these constituents is included in the uncertainty section.

10.1.6.3 Exposure Assessment

Exposure Setting

Combined SWMU 5 is located in the southeastern end of the CIA, where access is controlled with a fence and a series of guarded check points. Land use in the CIA and combined SWMU 5 is consistent with an industrial setting. At least half of the site is covered with asphalt, concrete, or building's which would prevent direct contact with soil and would inhibit migration of potential contaminants to groundwater or air. All potable water is provided through the city's water supply. Groundwater is not currently nor anticipated to be used in the future as potable or process water.

Potentially Exposed Populations

Potentially exposed populations are current and future site workers and adolescent trespassers. Additional potentially exposed populations are hypothetical future site residents. Future site resident and worker exposure scenarios were addressed quantitatively in this risk assessment. Current exposure to workers and adolescent trespassers is discussed qualitatively in relation to the future workers and future residents. The hypothetical future site worker scenario assumed continuous exposure to surface soil conditions. Current site workers' exposure would be less than that assumed for the hypothetical future site worker scenario because of their limited soil contact. Therefore, future worker assessment is considered to be protective of current site users. The degree to which access to Zone E is restricted would effectively prevent exposure to adolescent trespassers. The future site resident scenario assumed that existing buildings would be removed and replaced with dwellings.

Exposure Pathways

Exposure pathways for the hypothetical future site residents are dermal contact and incidental ingestion of surface soil. The exposure pathways for current and future site workers are the same as those for the future site worker with respect to soil. Uniform exposure was assumed for all sample locations. To provide for remedial decisions relative to groundwater, the associated pathways (ingestion and inhalation of volatiles) are addressed as FREs and are presented as risk maps based on residential exposure. Table 10.1.6.3 justifies exposure pathways assessed in this HHRA.

Exposure Point Concentrations

As discussed in Section 7 of this RFI, UCLs were calculated for datasets consisting of at least ten samples. UCLs calculated for surface soil are presented in Table 10.1.6.4. These UCLs were applied as EPCs for combined SWMU 5 surface soil pathways. Since the 95% UCL for zinc exceeded the maximum concentration, the maximum concentration was used as the EPC. The maximum concentration of dioxin equivalents was applied as the EPC since there are less than 10 data points. Point risk and hazard estimates have been calculated for each of the five monitoring wells at this site. Therefore, no EPCs have been calculated for groundwater.

Quantification of Exposure

Soil

CDIs for ingestion and dermal contact with soil are shown in Tables 10.1.6.5 and 10.1.6.6, respectively.

10.1.6.4 Toxicity Assessment

Toxicity assessment terms and methods are discussed in Section 7 of this report. Table 10.1.6.7 presents toxicological information specific to each COPC identified at combined SWMU 5. This information was used to quantify risk/hazard associated with soil and groundwater contaminants. Brief toxicological profiles for each COPC are provided in the following paragraphs.

Antimony is absorbed slowly through the gastrointestinal tract, which is the target of this element. Antimony has been experimentally shown to reduce in lifespan, decrease blood glucose, and alter cholesterol levels when tested on a population of mice. Due to frequent industrial use, the primary exposure route for antimony to the general population is food. Antimony is also a common air pollutant from industrial emissions. USEPA has posted an RfDo of 0.0004 mg/kg-day based on a lowest observed adverse effects level (LOAEL) of 0.35 mg/kg-day and an uncertainty factor of 1,000. (Klaassen et al., 1986).

Arsenic exposure via the ingestion route causes darkening and hardening of the skin in chronically exposed humans. Inhalation exposure to arsenic causes neurological deficits, anemia, and cardiovascular effects (Klaassen et al., 1986). USEPA set 0.3 μg/kg/day as the RfD for arsenic based on a no observed adverse effects level (NOAEL) of 0.8 μg/kg-day in a human exposure study. Arsenics' effects on the nervous and cardiovascular systems are primarily associated with acute exposure to higher concentrations. Exposure to arsenic-containing materials has been shown to cause cancer in humans. Inhalation of these materials can lead to increased lung cancer risk, and ingestion of these materials is associated with increased skin cancer rates. Arsenic has been classified as a group A carcinogen by USEPA, which set the 1.5 $(mg/kg/day)^{-1}$ SF. As listed in IRIS, the classification is based on sufficient evidence from human data. An increased lung cancer mortality was observed in multiple human populations exposed primarily through inhalation. Also, increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer were observed in populations consuming drinking water high in inorganic arsenic. Human milk contains about 3 μg/L arsenic. As listed in IRIS, the critical effect of this chemical is hyperpigmentation, keratosis, and possible vascular complications. The uncertainty factor was determined to be 3 and the modifying factor was determined to be 1.

Beryllium exposure via the inhalation route can cause inflammation of the lungs, a condition known as Acute Beryllium Disease, as a result of short-term exposure to high concentrations. Removal from exposure results in a reversal of the symptoms. Chronic exposure to much lower concentrations of beryllium or beryllium oxide by inhalation has been reported to cause chronic beryllium disease, with symptoms including shortness of breath, scarring of the lungs, and berylliosis, which is noncancerous growths in the lungs of humans. Both forms of beryllium disease can be fatal, depending on the severity of the exposure. Additionally, a skin allergy may develop when soluble beryllium compounds come into contact with the skin of sensitized individuals (Gradient, 1991). An oral RfD of 0.005 mg/kg-day has been set for beryllium based on a chronic oral bioassay (rats were the study species) which determined no adverse effects occur at 0.54 mg/kg-day. Beryllium has been classified by USEPA as a group B2 carcinogen based on animal studies. It has been shown to induce lung cancer via inhalation in rats and monkeys, and to induce osteosarcomas in rabbits via intravenous or intramedullary injection. Human epidemiology studies of beryllium are considered to be inadequate. An inhalation SF of 8.4 $(mg/kg\text{-}day)^{-1}$ and an oral SF of 4.3 $(mg/kg\text{-}day)^{-1}$ have been set by USEPA. As listed in IRIS, this chemical has no cited adverse effect. The uncertainty factor was 100 and the modifying factor was 1.

Copper is a nutritionally essential element, necessary for many of the body's enzymes. Copper has replaced lead water pipes in residences due to its lower toxicity to man. Short-term exposure to copper can result in anemia (the lack of iron), the breakdown of red blood cells, and liver and kidney lesions. The target organs for copper are the liver, kidney, and red blood cell. Vitamin C reduces copper uptake from the gut, and other substances can also influence copper uptake. Copper fumes can cause metal fume fever. The RfD set by the USEPA is 0.04 mg/kg-day, which is 2.8 mg/day for the average adult (70 kg). In typical vitamin supplements, 2 mg/day is the approximate dose (Gradient, 1991) (Klaassen et al., 1986).

Lead has been classified as a group B2 carcinogen by USEPA based on animal data. No RfD or SF has been set by USEPA. However, an action level for soil protective of child residents (400 mg/kg) has been proposed by USEPA Region IV. USEPA's OSWER has recommended a 1,300 mg/kg cleanup standard for industrial properties. USEPA's Office of Water has established a TTAL of 15 μg/L. As listed in IRIS (search date 10/17/95), classification is based on sufficient animal evidence. Ten rat bioassays and one mouse assay have shown statistically significant increases in renal tumors with dietary and subcutaneous exposure to several soluble lead salts. Animal assays provide reproducible results in several laboratories, in multiple rat strains with some evidence of multiple tumor sites. Short-term studies show that lead affects gene expression. Human evidence is inadequate. No RfD or SF have been established because of the confounding nature of lead toxicity. Lead can accumulate in bone marrow, and effects have been observed in the central nervous system (CNS), blood, and mental development of children. RfDs are based on the assumption that a threshold must be exceeded to result in toxic effects (other than carcinogenicity). Once lead accumulates in the body, other influences cause the actual levels in the blood to fluctuate — sometimes the lead is attached to binding sites; sometimes lead is free-flowing. If an exposed individual has previously been exposed to lead, this individual could lose weight and set fat-bound lead free. This fluctuation and lack of previous lead exposure data are two reasons lead effects are difficult to predict (Klaassen et al., 1986).

Nickel is also an essential nutrient; a 5 μg dose is typical of supplemental vitamins. USEPA set the RfDo to 0.02 mg/kg-day. Chronic exposure of rats to nickel caused decreased body and organ weights. For a chronically exposed individual, nickel salts would affect the gastrointestinal system, and would also target the liver and kidney. This element has been shown to be a sensitizer, an element that can produce allergic reactions. Sensitization of skin to nickel dust has been shown to occur in industry (Dreisbach et al., 1987).

Zinc is an essential, ubiquitous element present in food, water, and soil. The average American daily intake is approximately 12 to 15 mg, and the recommended daily allowance (RDA) is 15 mg. Excessive exposure to zinc is relatively uncommon and requires exposure to high concentrations. This element does not accumulate under chronic exposure conditions, and body content is self-regulated by zinc liver levels and absorption mechanisms. Inhalation of zinc dust can cause metal fume fever, and the primary effect of zinc ingestion (at toxic concentrations) is gastrointestinal disturbance and irritation. Other effects on the blood, liver, and kidney are possible at higher concentrations. Twelve grams of elemental zinc per day were not shown to elicit effects other than gastrointestinal disturbances over a 48 hour period. Experimental animals have been given 100 times the dietary requirements without discernible effects. USEPA determined that the RfDo is 0.3 mg/kg-day (Klaassen et al., 1986).

PCB Aroclors are a group of chlorinated hydrocarbons (such as *Aroclors-1248, -1254, and -1260*) that accumulate in fat tissue. Occupational exposure (both inhalation and dermal) to PCBs causes eye and lung irritation, loss of appetite, liver enlargement, increased serum liver enzyme levels, rashes, chloracne, and decreased birth weight of infants in heavily exposed worker/mothers. Of the effects listed above, the liver is the primary target organ (Klaassen et al., 1986; Dreisbach et al., 1987). USEPA classified PCB Aroclors as group B2 carcinogens, primarily based on animal data. As listed in IRIS, classification is based on hepatocellular carcinomas in three strains of rats and two strains of mice and inadequate yet suggestive evidence of excess risk of liver cancer in humans by ingestion and inhalation or dermal contact. Oral ingestion of PCBs causes liver and stomach tumors in rat studies. USEPA uses a tiered approach to determine an SF that depends on the exposure route. For exposures that occur through soil, sediment, or through the food chain, an oral SF of 2.0 $(mg/kg/day)^{-1}$ is used. For exposures that occur through ingestion of water-soluble congeners or evaporated congeners an oral SF of 0.4 $(mg/kg/day)^{-1}$ is used. The RfD was set to 0.00002 mg/kg/day for Aroclor-1254.

Benzo(a)pyrene *equivalents* include the following list of polynuclear aromatic hydrocarbons (PAHs):

Benzo(a)anthracene	TEF	0.1
Benzo(b)fluoranthene	TEF	0.1
Dibenz(a,h)anthracene	TEF	1.0
Benzo(k)fluoranthene	TEF	0.01
Benzo(a)pyrene	TEF	1.0
Indeno(1,2,3-cd)pyrene	TEF	0.1
Chrysene	TEF	0.001

Some PAHs are toxic to the liver, kidney, and blood. However, the toxic effects of the PAHs above have not been well established. There are no RfDs for the PAHs above due to a lack of data. All PAHs listed above are classified by USEPA as B2 carcinogens, and their carcinogenicity is addressed relative to that of benzo(a)pyrene, having an oral of SF 7.3 $(mg/kg/day)^{-1}$. TEFs, also set by USEPA, are multipliers that are applied to the detected concentrations, which are subsequently used to calculate excess cancer risk. These multipliers are discussed further in the exposure and toxicity assessment sections. Most carcinogenic PAHs have been classified as such due to animal studies using large doses of purified PAHs. There is some doubt as to the validity of these listings, and the SFs listed in USEPA's RBC table are provisional. However, these PAHs are carcinogens when the exposure involves a mixture of other carcinogenic substances (e.g., coal tar, soot, cigarette smoke, etc.). As listed in IRIS, the BaP B2 classification is based on a lack of human data specifically linking BaP to a carcinogenic effect. However, multiple animal studies in many species demonstrate BaP to be carcinogenic by numerous routes.

BaP has produced positive results in numerous genotoxicity assays. At the June 1992 CRAVE Work Group meeting, a revised risk estimate for BaP was verified. This section provides information on three aspects of the carcinogenic risk assessment for the agent in question: the USEPA classification and quantitative estimates of exposure. The USEPA classification reflects a weight-of-evidence judgment of the likelihood that the agent is a human carcinogen. The quantitative risk estimates are presented in application of a low-dose extrapolation procedure and presented as the risk per (mg/kg)/day. The unit risk is the quantitative estimate in terms of either risk per μg/L drinking water or risk per micrograms per cubic meter ($\mu g/m^3$) of air breathed. The third form in which risk is presented is drinking water or air concentration providing cancer risks of 1 in 10,000 or 1 in 1 million. The Carcinogenicity Background Document provides details on the carcinogenicity values found in IRIS. Users are referred to the Oral Reference Dose and Reference Concentration sections for information on long-term toxic effects other than carcinogenicity.

As listed in IRIS, the dibenz(a,h)anthracene and benzo(b)fluoranthene B2 classification is based on no human data but sufficient data from animal bioassays. Benzo(b)fluoranthene produced tumors in mice after lung implantation, intraperitoneal or subcutaneous injection, and skin painting. As listed in IRIS, the benzo(a)anthracene B2 classification is based on no human data but sufficient data from animal bioassays. Benzo(a)anthracene produced tumors in mice exposed by gavage; intraperitoneal, subcutaneous, or intramuscular injection; and topical application. Benzo(a)anthracene produced mutations in bacteria and in mammalian cells, and transformed mammalian cells in culture. As listed in IRIS, the benzo(k)fluoranthene B2 classification is based on no human data but sufficient data from animal bioassays. Benzo(k)fluoranthene produced tumors after lung implantation in mice and when administered with a promoting agent in skin-painting studies. Equivocal results have been found in a lung adenoma assay in mice. Benzo(k)fluoranthene is mutagenic in bacteria. (Klaassen et al., 1986).

Chlorinated *Dibenzodioxins*/Dibenzofurans are a general grouping of many congeners or chemicals within the same chemical family. This family of chemicals is considered a by-product the combustion process, especially if certain precursor compounds (e.g., PCBs, chlorinated benzenes). Chlorinated dibenzodioxins/dibenzofurans are potent carcinogens that target the liver. Because of their persistence in the environment, dioxin compounds, have accumulated in soil and sediment, and have moved up the food chain. It has been determined that only certain congeners are capable of producing the most severe toxic effects associated with exposure to dioxin. The toxicity of this subset of chlorinated dibenzodioxins/dibenzofurans is measured relative to the 2,3,7,8-tetrachlorodibenzodioxin congener (2,3,7,8-TCDD). In order to simplify the estimation of risk due to exposure to dioxin, the concentration of each toxic congener is adjusted by multiplying by its TEF. The following is a list of 2,3,7,8-TCDD congeners and TEFs:

2,3,7,8-TCDD	1.0
2,3,7,8-PeCDD	0.5
2,3,7,8-HxCDD	0.1
2,3,7,8-HpCDD	0.01
OCDD	0.001
2,3,7,8-TCDF	0.1
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
2,3,7,8-HxCDF	0.1
2,3,7,8-HpCDF	0.01
OCDF	0.001

The numbers 2,3,7,8 correspond to the positioning of chorine atoms on the molecular structure while the T, Pe, Hx, Hp, and O stand for the total number (4, 5, 6, 7, and 8, respectively) of chlorine atoms in the molecular structure. The result of this procedure provides one concentration representative of all toxic dioxin congeners for each sample, which is compared to toxicity criteria for 2,3,7,8-tetrachlorodibenzodioxin. HEAST lists an oral SF of 156,000 $(mg/kg\text{-}day)^{-1}$ and an inhalation SF of 116,000 $(mg/kg\text{-}day)^{-1}$.

10.1.6.5 Risk Characterization

Surface Soil Pathways

Exposure to surface soil onsite was evaluated under both residential and industrial (site worker) scenarios. For these scenarios, the incidental ingestion and dermal contact exposure pathways were evaluated. For noncarcinogenic contaminants evaluated for future site residents, hazard was computed separately to address child and adult exposure. Tables 10.1.6.8 and 10.1.6.9 present the computed carcinogenic risks and/or HQs associated with the incidental ingestion of and dermal contact with site surface soil, respectively.

Hypothetical Site Residents

The ingestion ILCR (based on the adult and child lifetime weighted average) for combined SWMU 5 surface soil is 5E-5. The dermal pathway ILCR is 1E-5. Arsenic, beryllium, and BEQs were the primary contributors to the ingestion and dermal pathways.

The computed hazard indices (HIs) for the adult resident was 0.1 for the soil ingestion pathway and 0.03 for the dermal contact pathway. The computed HIs for the child ingestion and dermal contact pathways were 1 and 0.1, respectively. The primary contributors to cumulative HI projections are antimony, arsenic, copper, and zinc.

Hypothetical Site Workers

Site worker ILCRs are 6E-6 and 4E-6 for the ingestion and dermal contact pathways, respectively. Arsenic, beryllium, and BEQs were the primary contributors for each pathway. HIs for the ingestion and dermal pathways were both projected to be 0.05 and 0.02 for the hypothetical site worker scenario.

Groundwater Pathways

Exposure to shallow groundwater onsite was evaluated under a residential scenario based on the results of the first quarter sampling event. The ingestion exposure pathway was evaluated assuming the site groundwater will be used for potable and/or domestic purposes and that an unfiltered well, drawing from the corresponding water-bearing zone, will be installed. For noncarcinogenic contaminants evaluated relative to future site residents, hazard was computed for the more sensitive child receptors. Since no VOCs were identified as COPCs at combined SWMU 5, the inhalation pathway was not considered.

Future Site Residents

As mentioned in Section 10.1.6.2, the COPCs identified in combined SWMU 5 monitoring wells sampled during the first quarter include antimony, arsenic, barium, lead, and dioxin equivalents. Table 10.1.6.10 presents the point risk and hazard associated with the COPCs identified for combined SWMU 5 groundwater. Concentrations of antimony and arsenic in groundwater sampled from three monitoring wells (NBCE605001, NBCE605002, and NBCE605003) equal the HIs ranging from 1 to 10. Concentrations of arsenic and dioxin in groundwater sampled from two monitoring wells (NBCE605001 and NBCE605003) equal risk estimates ranging from 1E-05 to 1E-03.

Current Site Workers

Shallow groundwater is not currently used as a potable water source for combined SWMU 5 or other areas of Zone E. In the absence of a completed exposure pathway, no threat to human health is posed by reported shallow groundwater contamination.

Lead Toxicity

Background

Currently, USEPA has not established an oral SF or reference dose for lead. USEPA believes that the available studies in animals and humans do not provide sufficient quantitative information for their calculation. Although lead is currently classified as a B2 carcinogen, USEPA considers the noncarcinogenic neurotoxic effects in children to be the critical toxic effect for establishing health-based environmental cleanup objectives. The neurotoxic effects of chronic low-level lead exposure in children may occur at blood levels as low as 10 micrograms per deciliter (μg/dL).

In the absence of lead health criteria, USEPA Region IV's Office of Health Assessment sanctions the use of the Lead Uptake/Biokinetics Model (Version 0.99d; Lead Model) to predict mean blood lead levels in children based on exposure to impacted environmental media. An alternative assessment was also provided using USEPA's *Interim Approach to Assessing Risk Associated with Adult Exposures to Lead in Soil* (December 1996; Adult Lead Model) to evaluate health impact of lead under the more likely future industrial scenario. These models were used to assess the potential health effects of elevated lead levels reported in surface soil and groundwater at combined SWMU 5.

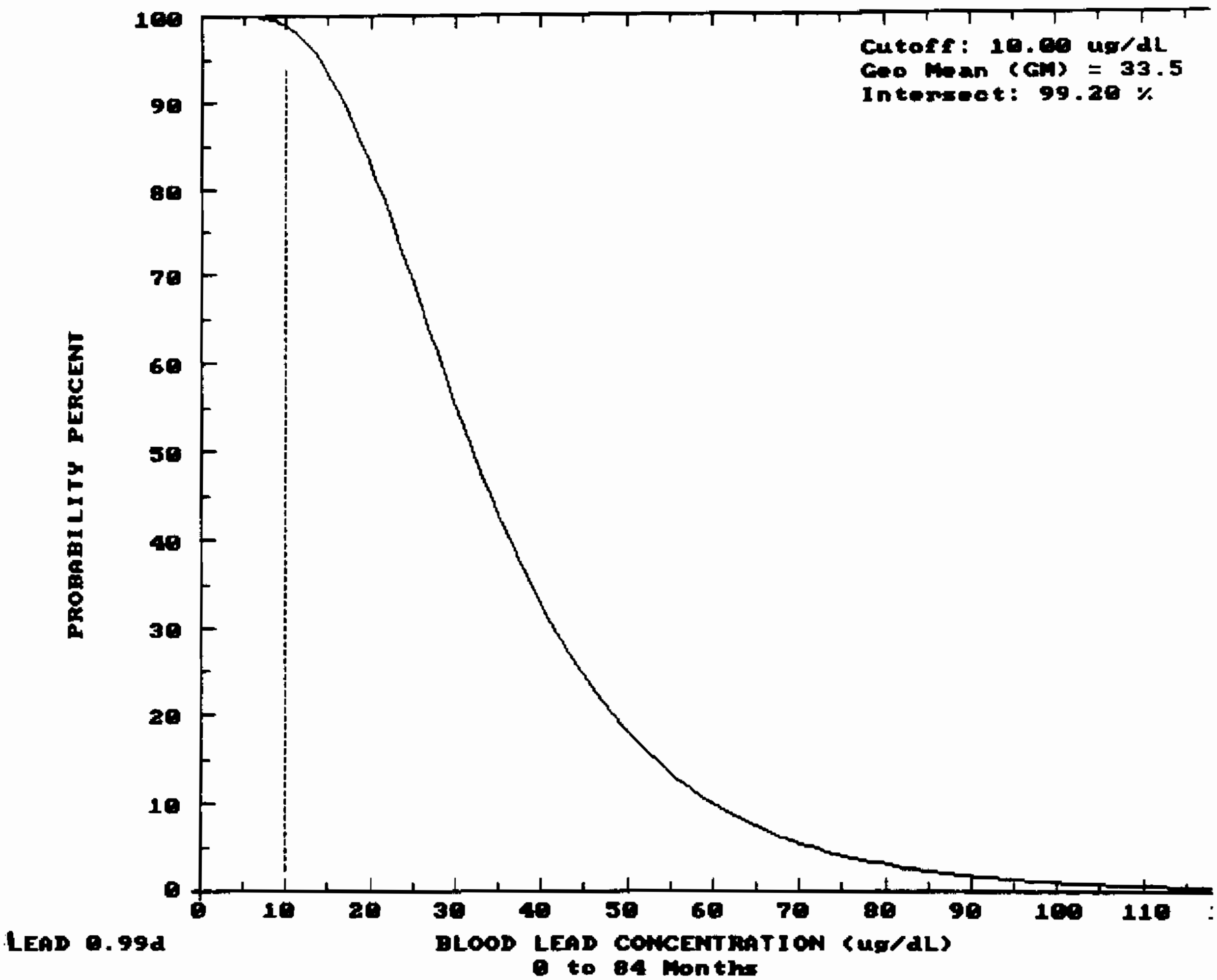
Future Residential Scenario

The Lead Model default concentrations are used for exposure to air (0.1 Pb grams per cubic meter [g/m^3]) and maternal blood lead level (2.5 Pb per μg/dL). In the case of combined SWMU 5 surface soil, an area of elevated lead concentrations was identified as boring location 005SB002 and the four closest sampling locations surrounding this point (locations 018SB001, 018SB004, 018SB005, and 605SB002). The total area encompassed by these locations is approximately one quarter acre. The mean surface soil lead concentration at these sample points (3,038 mg/kg) was used as the input for soil and house dust. The maximum groundwater concentration of lead (426 μg/L) detected in the sample collected from monitoring well NBCE605002 was used as the input for drinking water. The Lead Model was run for a child ages 0-7 years using the inputs listed above. Table 10.1.6.11 summarizes the lead model results under these exposure conditions.

Figure 10.1.3 shows the probability percentage of blood lead levels for a child 0 to 7 years old. Based on this model output using the mean soil lead concentration in the "hot spot" and maximum groundwater results, the geometric mean blood concentrations is estimated to be 33.5 μg/dL, and the probability of blood lead concentration exceeding 10 μg/dL is 99.2%. USEPA generally considers that media concentrations resulting in probability percentage estimates of 5% or less sufficiently protect potential child receptors. As a result, both surface soil and groundwater lead would require corrective action under this hypothetical exposure scenario.

Current Commercial/Industrial

USEPA Region IV has developed an interim approach for assessing risk due to adult exposures to lead in soil. The Adult Lead Model considers a woman of child-bearing age and sets a maternal blood lead level which is protective of a developing fetus. This model was used to evaluate the significance of lead in soil at combined SWMU 5. The only media of concern under the current industrial scenario is soil since groundwater is not currently used as a source of potable water. Using the default model parameters and the mean soil lead concentration in the "hot spot" (3,038 mg/kg) produces a central estimate of blood lead concentrations in women of child-bearing age of 2.3 μg/dL. A maternal blood lead level below 3.3 μg/dL is considered protective of a developing fetus. As a result, surface soil lead at combined SWMU 5 would not require specific action under this hypothetical exposure scenario.



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

FIGURE 10.1.3
SWMUs 5, 18, AND AOC 605
LEAD MODEL RESULTS
– FUTURE RESIDENTIAL

DWG DATE: 10/23/97 | DWG NAME: BOARD

Future Commercial/Industrial Scenario

In coordination with USEPA Region IV's Office of Health Assessment, a conservative exposure scenario was developed to assess the significance of surface soil lead concentrations at combined SWMU 5 under an future industrial scenario. This scenario involves a child (age 5 to 6) who gains access to the most heavily contaminated area for one day and is maximally exposed. Additionally, the same child ingests 1 liter of water drawn from monitoring well NBCE605002. The scenario was based on the proposed future use of this area. Base reuse plans indicate that the area will maintain its current industrial use. The exposure frequency was based on the child accompanying a parent to work at a nearby building on a one-time basis and wandering into the area of contaminated soil. This exposure scenario also assumes that the building's potable water supply is drawn from the maximally contaminated portion of the shallow aquifer.

Exposure to site soil and groundwater was addressed as an additional exposure relative to typical exposures encountered at the child's place of residence. This additional exposure was presented as an alternate source within the constraints of the Lead Model. The only modification made to standard default assumptions in the lead model was raising the drinking water lead concentration to the TTAL of 15 μg/L. This change was made to provide a conservative estimate of daily intake from sources unrelated to combined SWMU 5.

The assumption was made that this child would ingest 0.1 grams of soil from the most heavily contaminated area and 1 liter of contaminated groundwater. In the case of combined SWMU 5 surface soil, the lead hot spot is represented by boring locations 005SB002, 018SB001, 018SB004, 018SB005, and 605SB002. The total area encompassed by these locations is approximately a quarter acre, and the mean surface soil lead concentration is 3,038 mg/kg. Within the Lead Model, an alternate source was entered to account for exposure to site soil and groundwater as previously discussed. The bioavailability of lead ingested from the alternate source (combined SWMU 5 surface soil) was equal to that of lead ingested through water consumption from the standard residential default source. The annual alternate source exposure was estimated to be 2 μg lead/day. Table 10.1.6.12 summarizes the lead model results under these exposure conditions.

Figure 10.1.4 shows the probability percentage of blood lead levels for a child 5 to 6 years old. Based on this model output, the geometric mean blood level is estimated to be 4 μg/dL, and the probability of blood lead levels in excess of 10 μg/dL is 2.39%. USEPA generally considers media concentrations that result in probability percentage estimates of 5% or less sufficiently protective of potential child receptors. As a result, neither surface soil nor groundwater lead at combined SWMU 5 would require specific action under this hypothetical future exposure scenario.

Current exposure to child receptors is highly unlikely at combined SWMU 5 due to the industrialized nature of the area. Current exposure to site workers is limited to soil pathways only since groundwater is not currently used to provide potable or process water.

COCs Identified

COCs were identified based on cumulative (all pathway) risk and hazard projected for this site on a medium-specific basis. USEPA has established a generally acceptable risk range of 1E-4 to 1E-6, and a HI threshold of 1.0 (unity). As recommended by SCDHEC, a COC was considered to be any chemical contributing to a cumulative risk level of 1E-6 or greater and/or a cumulative HI above 1.0, and whose individual ILCR exceeds 1E-6 or whose HQ exceeds 0.1. For carcinogens, this approach is relatively conservative, because a cumulative risk level of 1E-4 (and individual ILCR of 1E-6) is recommended by USEPA Region IV as the trigger for establishing COCs. The COC selection method presented was used in order to provide a more comprehensive evaluation of chemicals contributing to carcinogenic risk or noncarcinogenic hazard during the RGO development process. Table 10.1.6.13 presents the COCs identified for combined SWMU 5 surface soil.

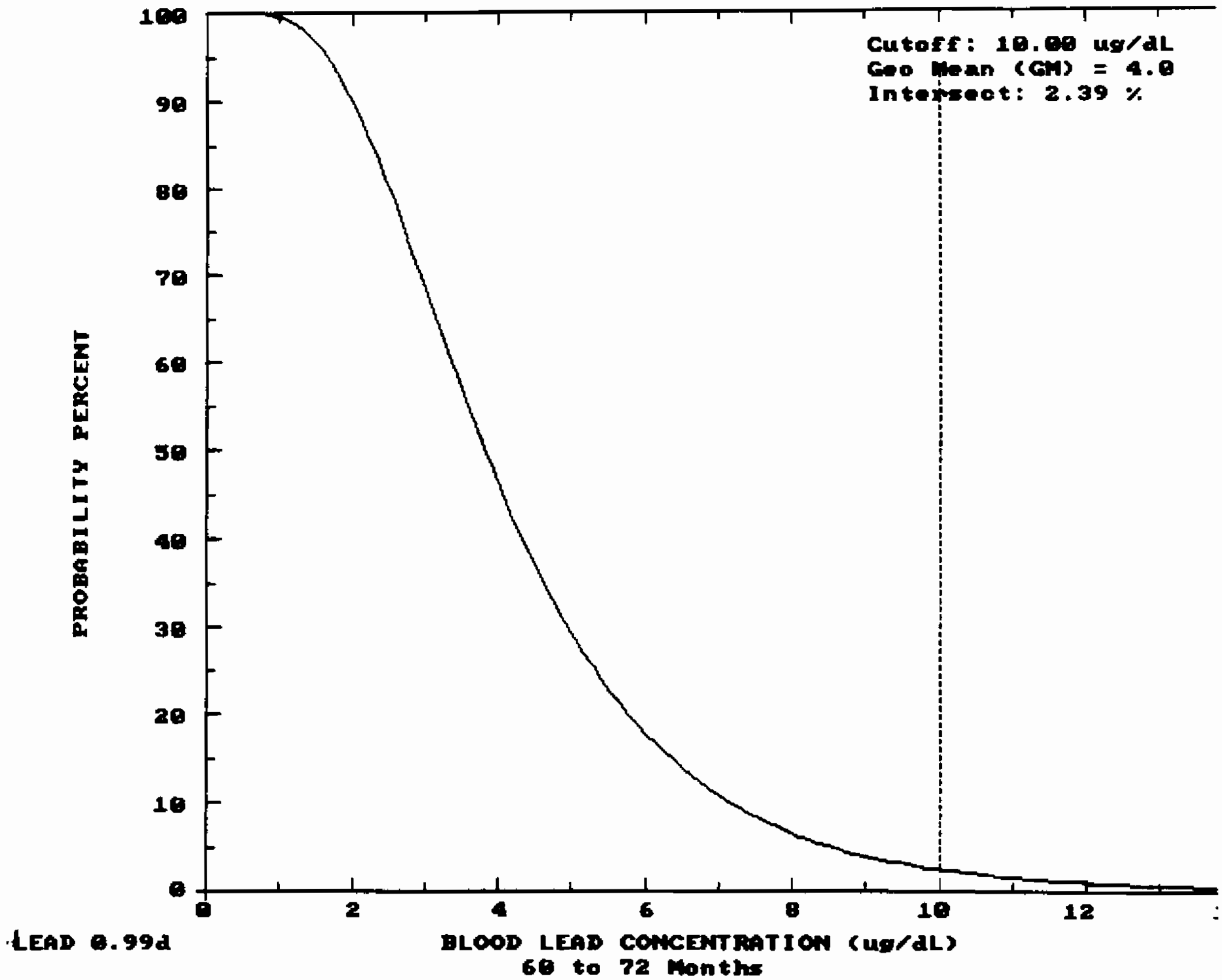


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FIGURE 10.1.4
SWMUs 5 AND 18, AND AOC 605
LEAD MODEL RESULTS
– FUTURE INDUSTRIAL

DWG DATE: 10/23/97 | DWG NAME: BOARD

Surface Soil

Future Site Residents: Arsenic, BEQs, and beryllium were identified as the soil pathway COCs based on their contribution to cumulative ILCR projections. Antimony, arsenic, copper, and zinc were identified as soil pathway COCs based on their contribution to cumulative HI projections. Lead was identified as a COC based on blood lead level projections above 10 μg/dL for a 0-7 year old child.

Future Site Workers: Arsenic, BEQs, and beryllium were identified as the soil pathway COCs based on their contribution to cumulative ILCR projections.

The extent of the COCs identified in surface soil is briefly discussed below. To facilitate this discussion of the extent of COC concentrations, residential soil RBCs were compared to each reported concentration for each COC identified above. Antimony was detected above its residential RBC in 13 of 24 surface soil samples. Arsenic was detected above its residential RBC in all 24 surface soil samples; however, it was only detected in one sample above its background reference concentration. Beryllium was detected above the residential soil RBC in 21 of 24 surface soil samples. However, the background concentration for beryllium was exceeded only once and the mean concentration for combined SWMU 5 surface soil (0.97 mg/kg) was below the background concentration (3.3 mg/kg). Copper was detected above its residential RBC in only three of 24 surface soil samples; its mean detected concentration (229 mg/kg) was below its RBC (310 mg/kg). Lead was detected above its residential RBC in 12 of 24 surface soil samples. Zinc was detected above its residential RBC in only two of 24 surface soil samples; its mean detected concentration (746 mg/kg) was below its RBC (2,300 mg/kg). BEQs were detected above the residential RBC in 19 of 24 surface soil samples collected for combined SWMU 5. Elevated BEQs were identified in surface soil sample 605SB004, otherwise they tend to be evenly distributed across the site.

First Quarter Groundwater

Groundwater COCs have not been formally identified for combined SWMU 5; however, RGOs for all of the Zone E groundwater COPCs can be found in Section 7, Table 7.3.3.

Future Site Residents: Concentrations of antimony, arsenic, and dioxin equivalents contributed to elevated risk and/or HI in three of the five combined SWMU 5 monitoring wells. Lead was detected in a first quarter groundwater sample at a concentration above the TTAL.

10.1.6.6 Risk Uncertainty

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. The exposure assumptions in the site worker scenario are highly protective and would tend to overestimate exposure.

Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use of Zone E, specifically as a marine cargo terminal and drydock. If this area were to be used as a residential site, the buildings and other structures would be demolished, and the surface soil conditions would likely change — the soil could be covered with landscaping soil and/or a house. Interim measures removed soil from the lead "hot spot" and surrounding area. Consequently, exposure to surface soil conditions as represented by samples collected during the RFI would not be likely under a true future residential scenario. These factors indicate that exposure pathways assessed in this HHRA would generally overestimate the risk and hazard posed to current site workers and future site residents.

Groundwater is not currently used at combined SWMU 5 for potable or industrial purposes. A basewide system provides drinking and process water to buildings throughout Zone E. This system is to remain in operation under the current base reuse plan. As a result, shallow groundwater would not be expected to be used under future site use scenarios. Therefore, the scenario established to project risk/hazard associated with shallow groundwater exposure is highly conservative, and associated pathways are not expected to be completed.

Determination of Exposure Point Concentrations

The 95% UCL soil concentrations were used as the exposure point concentrations for this site. Use of UCL concentrations represent conservative assumptions when applied as the EPC such that it is unlikely for the true mean concentration of a constituent to exceed these levels. Groundwater risk/hazard was calculated for each monitoring well using the concentration of each COPC as an EPC. Calculating risk/hazard for each monitoring well location eases any potential bias due to sampling goals based on identifying "clean" areas of the underlying aquifer.

Frequency of Detection and Spatial Distribution

Antimony, arsenic, and beryllium were detected at concentrations above their RBCs in 13, 24, and 21, respectively, of 24 surface soil samples. Conversely, copper and zinc (both two of 24) were infrequently detected above their RBCs. BEQ compounds were detected above RBCs concentrations in 19 of 24 surface soil samples; however, background levels of BEQs at NAVBASE have also exceeded RBCs concentrations. Additionally, many of the soil sample locations were underneath asphalt, which may explain the presence of these constituents.

Antimony, arsenic, lead, and dioxin contributed to elevated risk estimates for the groundwater pathway. Arsenic and lead were each detected above respective background reference concentrations in only one groundwater sample out of five first quarter samples analyzed. Dioxin equivalents were only detected in one first quarter groundwater sample. Antimony was detected in three of five first quarter groundwater samples.

Quantification of Risk/Hazard

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

Soil

A conservative screening process was used to identify COPCs for combined SWMU 5. The potential for eliminating CPSSs with the potential for cumulative HI greater than 1 was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Dioxin was added to the list of soil COPCs since it was identified as a groundwater COC. Of the CPSSs screened and eliminated from formal assessment, barium, cadmium, mercury, and technical chlordane were reported at a concentration close to the RBC (e.g., within 10% of their RBCs).

Groundwater

The same conservative screening process used for soil is also used for groundwater. Of the CPSSs screened and eliminated from formal assessment, dibenzofuran was reported in one of five monitoring wells at a concentrations close to its RBC.

Lead was reported in the fourth quarter groundwater sample from monitoring well NBCE605002 at a concentration of 1,970 μg/L which is higher than the lead concentration from the first quarter sample. Conversely, the groundwater concentration of dioxin equivalents dropped considerably in subsequent sampling rounds. As a result, risk projections may have been underestimated with respect to lead in groundwater and overestimated with respect to dioxin equivalents in groundwater.

Groundwater is not currently used as a potable water source at combined SWMU 5, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.

Background-Related Risk

Aluminum, arsenic and manganese were detected in combined SWMU 5 surface soil at concentrations above their RBCs. Arsenic and manganese were detected at concentrations in combined SWMU 5 groundwater above their respective RBCs. These elements were eliminated from consideration in the risk assessment based on comparison to background concentrations. It is not unusual for naturally occurring or background concentrations of some elements to exceed RBCs concentrations. The risk assessment identifies excess risk and/or hazard, or that which is above background levels. The following discusses the residential scenario risk/hazard associated with background concentrations of these elements.

The maximum surface soil concentrations of aluminum (15,000 mg/kg) and manganese (302 mg/kg) for combined SWMU 5 equate to HQs of 0.2 and 0.1, respectively. The maximum surface soil arsenic concentration (31.4 mg/kg) for combined SWMU 5 equals a risk of 8E-05; however, the Zone E background surface soil concentration for arsenic (18.7 mg/kg) equals a risk of 5E-05.

The maximum groundwater arsenic concentration (45.9 μg/L) for combined SWMU 5 groundwater equates with a risk of 1E-03. In comparison, the Zone E background concentration of arsenic (18.7 μg/L) which equates to a risk of 4E-04. The maximum groundwater manganese concentration for combined SWMU 5 (365 μg/L) equates to an HQ of 1; however, the Zone E background concentration of manganese in groundwater (2,560 μg/L) equates to an HQ of 7.

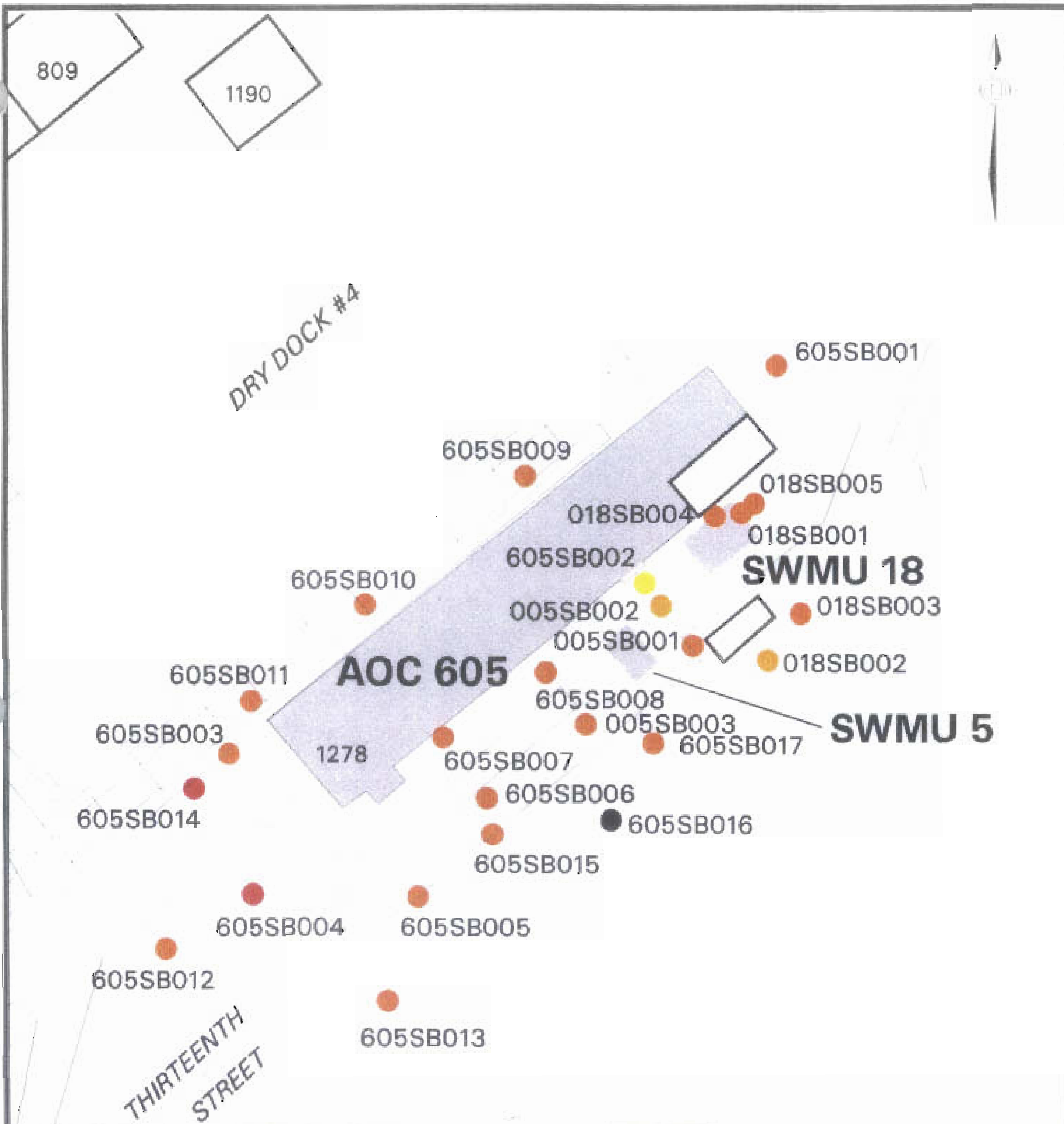
10.1.6.7 Risk Summary

The risk and hazard posed by contaminants at combined SWMU 5 were assessed for the future site worker and the future site resident under RME assumptions. Surface soil incidental ingestion and dermal contact pathways were assessed. The groundwater FRE was based on ingestion of shallow groundwater represented by first quarter groundwater data. Table 10.1.6.14 summarizes the risk for each soil pathway/receptor group evaluated for combined SWMU 5.

Soil — Residential Scenario

Residential soil pathway COCs identified for combined SWMU 5 include antimony, arsenic, BEQs, beryllium, copper, and zinc. Figures 10.1.5 and 10.1.6 illustrate point risk and HIs for combined SWMU 5 surface soil exposure by potential future site residents. Table 10.1.6.15 summarizes the risk and hazard contribution of each COPC at each sample location. This point risk map is based on the unlikely assumption that a future site resident will be chronically exposed to specific points. Exposure to surface soil conditions is more likely the result of uniform exposure to the soil conditions of the entire site (or exposure unit area) rather than specific points. With this in mind, risk maps supplemented by the tables allow the reader to visualize how chemicals driving risk estimates are spatially distributed across the site.

Arsenic, BEQs, and beryllium, all of which were identified as COCs in the formal risk assessment, contribute to risk estimate above 1E-06 at nearly all sample locations. Risk estimates ranged from 3E-06 (605SB002) to 2E-04 (605SB004). Although it was not identified as a COC



LEGEND - CUMULATIVE SOIL RISK

- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 120

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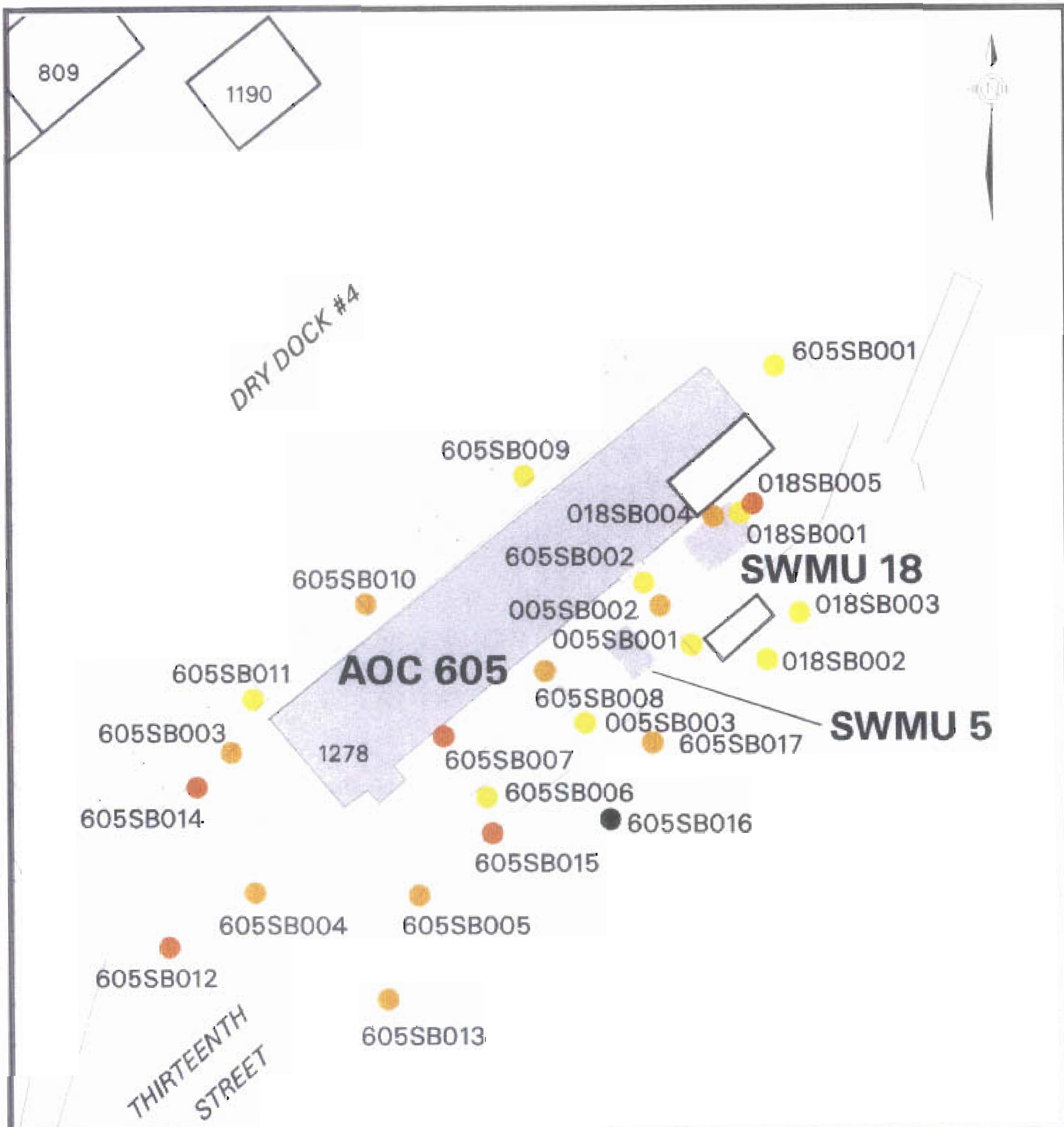
FIGURE 10.1.5
CUMULATIVE SOIL RISK
RESIDENTIAL SCENARIO
SWMU 5,18 AOC 605



LEGEND - CUMULATIVE SOIL HAZARD

- NO COPCs DETECTED
- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

0 feet 120

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FIGURE 10.1.6
CUMULATIVE SOIL HAZARD
RESIDENTIAL SCENARIO
SWMU 5,18 AOC 605

in the formal risk assessment, Aroclor-1260 was detected at concentrations equating to a risk projection above slightly above 1E-06 at three surface soil sample locations (605SB012, 605SB013, and 605SB015). Hazard indices only slightly exceed unity at five sample locations — 018SB005, 605SB007, 605SB012, 605SB014, and 605SB015 — driven mostly by antimony, arsenic, and copper. Although zinc was identified as a COC in the formal risk assessment, it was not a major contributor to overall surface soil pathway hazard index.

Soil — Site Worker Scenario

Site worker soil pathway COCs identified for combined SWMU 5 include arsenic, beryllium, and BEQs. Figure 10.1.7 illustrates point risk estimates for combined SWMU 5 surface soil exposure by potential future site workers. Table 10.1.6.16 summarizes the risk and hazard contribution of each COPC at each sample location. As shown in Figure 10.1.7, the distribution of risk due to arsenic, BEQ compounds and beryllium in soil is similar to the residential scenario with risks ranging from 5E-07 (605SB002) to 3E-05 (605SB004). HIs for the site worker scenario do not exceed unity at any sample location.

Groundwater — Residential Scenario

As shown in Figure 10.1.8, concentrations of antimony and arsenic in groundwater sampled from three monitoring wells (NBCE605001, NBCE605002 and NBCE605003) equate to HIs ranging from 1 to 10. As shown in Figure 10.1.9, concentrations of arsenic and dioxin in groundwater sampled from two monitoring wells (NBCE605001 and NBCE605003) equate to risks ranging from 1E-05 to 1E-03.

Lead Summary

The maximum surface soil lead concentration reported was 10,500 mg/kg at location 005SB002. The maximum groundwater lead concentration of 426 μg/L was from the sample collected from monitoring well NBCE605002. Figures 10.1.10 and 10.1.11 show the distribution of lead

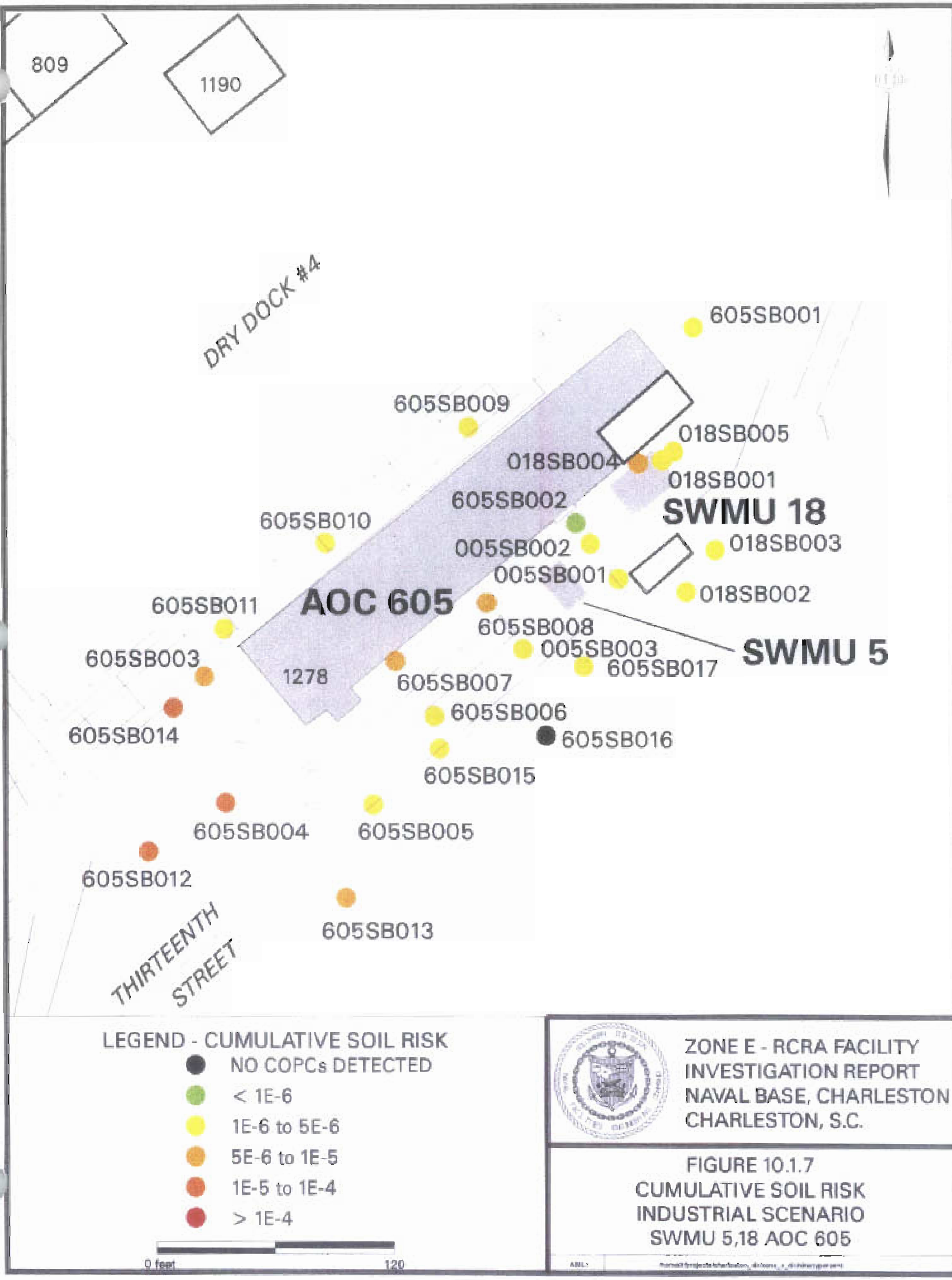

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FIGURE 10.1.7
CUMULATIVE SOIL RISK
INDUSTRIAL SCENARIO
SWMU 5,18 AOC 605

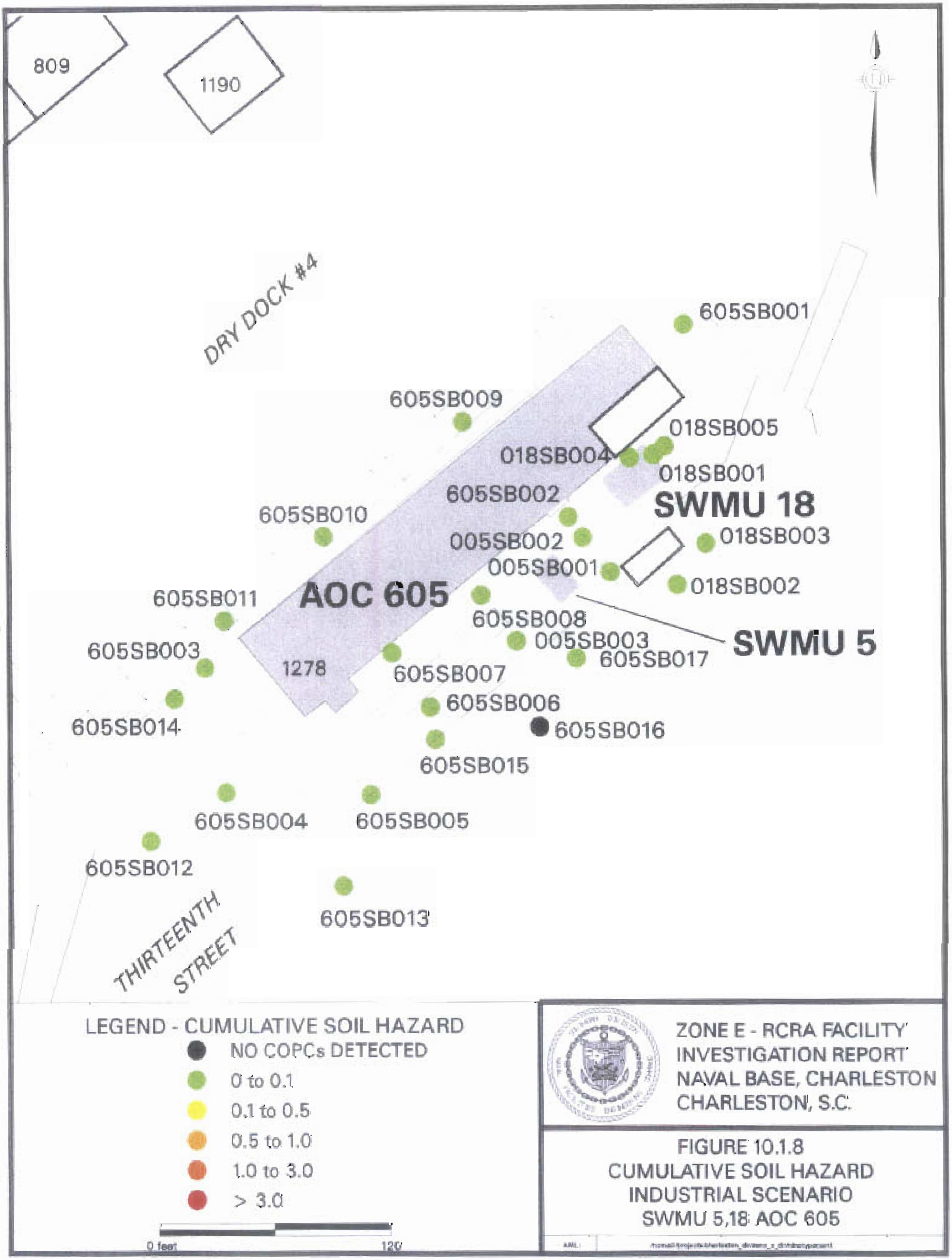

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FIGURE 10.1.8
CUMULATIVE SOIL HAZARD
INDUSTRIAL SCENARIO
SWMU 5,18 AOC 605

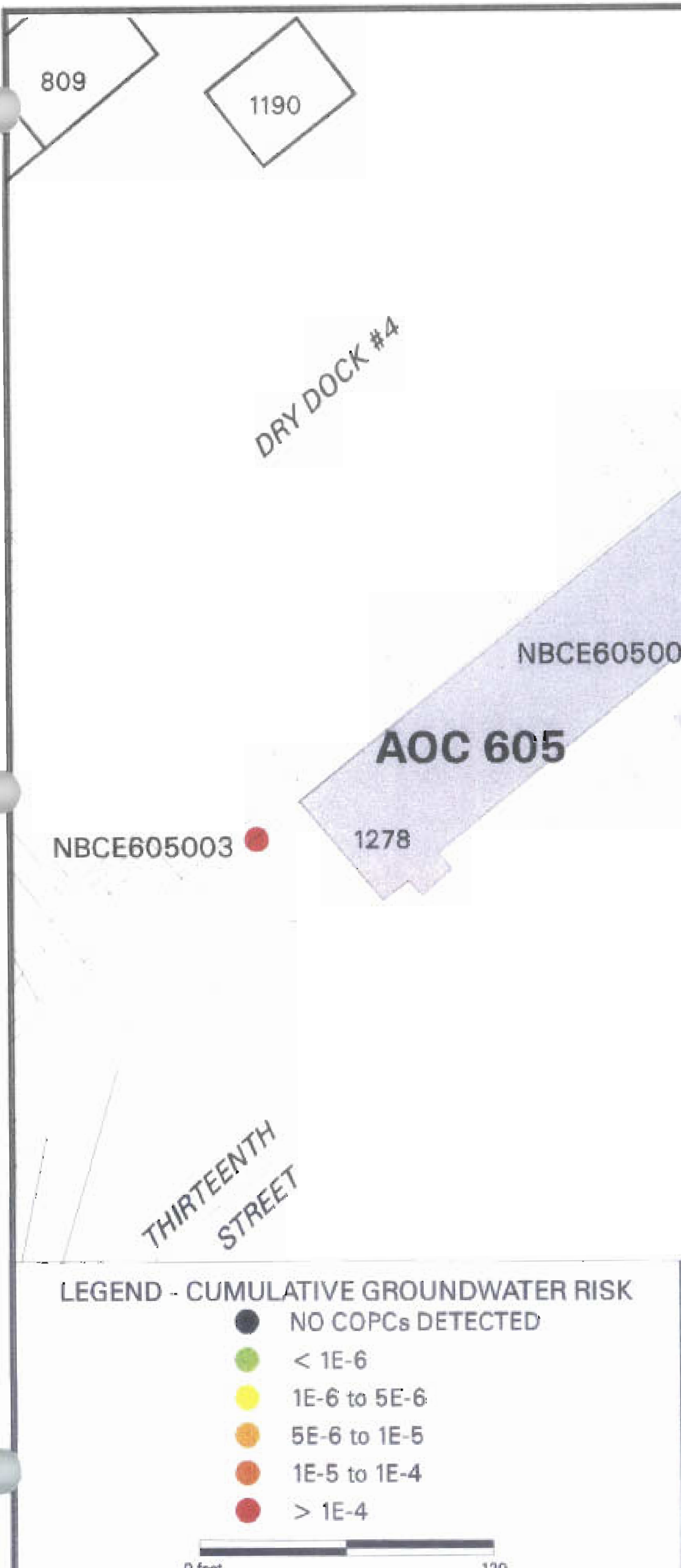

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FIGURE 10.1.9
CUMULATIVE GROUNDWATER RISK IN WELLS
SWMU 5,18 AOC 605

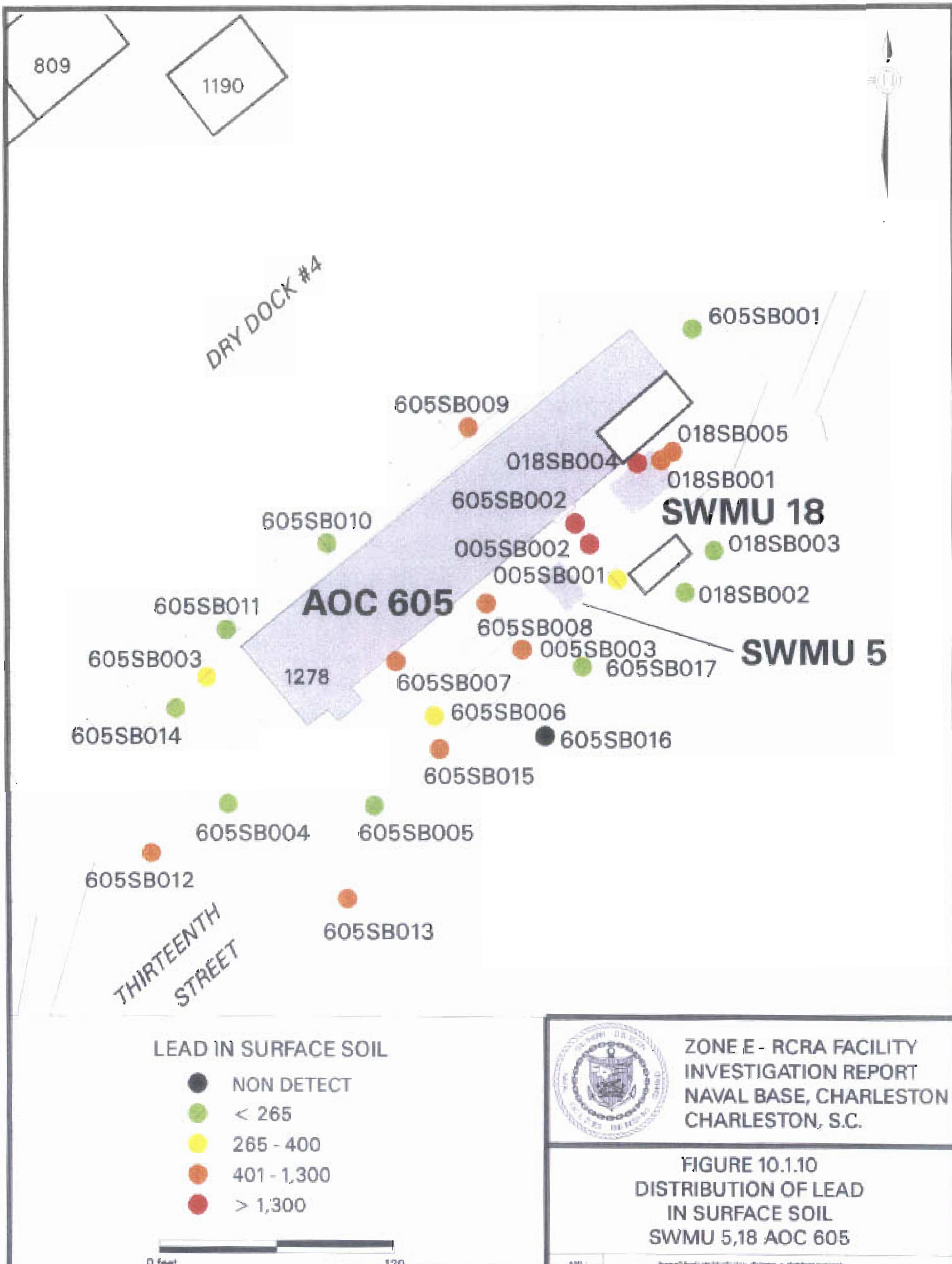

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FIGURE 10.1.10
DISTRIBUTION OF LEAD IN SURFACE SOIL
SWMU 5,18 AOC 605

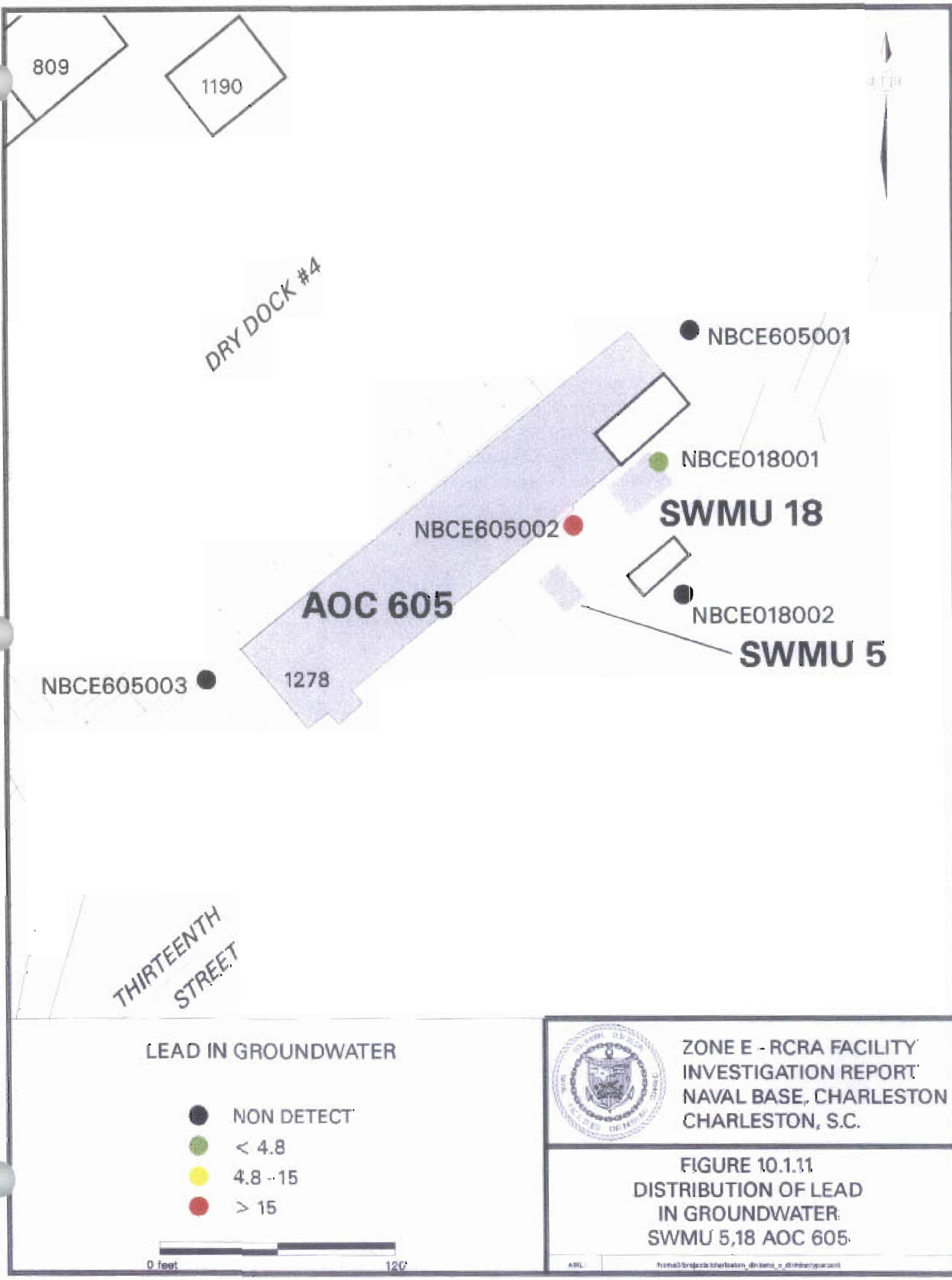

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FIGURE 10.1.11
DISTRIBUTION OF LEAD IN GROUNDWATER
SWMU 5,18 AOC 605

concentrations in combined SWMU 5 soil and groundwater, respectively. Lead was detected in all 24 surface soil samples and exceeded the residential cleanup level of 400 mg/kg at 12 of 24 locations spread somewhat evenly throughout the site. A soil cleanup/screening level for lead of 1,300 mg/kg was calculated for the Zone H RFI using the Adult Lead Model. Three surface soil samples collected just to the north of SWMU 5 had lead concentrations which exceed 1,300 mg/kg. Interim measures removed the lead-contaminated soil in this area. The mean surface soil concentration for combined SWMU 5 (958 mg/kg) falls below the USEPA adult cleanup/screening level although the levels within the identified hot spot exceed this value. Lead was detected in two of five monitoring wells (NBCE018GW001, 4.6 μg/L; and NCBE605GW002, 426 μg/L) in samples collected during the first quarter. Monitoring well NCBE605GW002 was installed in the area of surface soil sample 005SB002 which had a lead concentration of 10,500 mg/kg.

10.1.6.8 Remedial Goal Options

Soil

RGOs for carcinogens were based on the lifetime weighted average site resident or site worker as presented in Table 10.1.6.17 for surface soil. Hazard-based RGOs were calculated based on the hypothetical child resident or site worker, as noted in the table.

Groundwater

Groundwater RGOs based on the generic site resident and site worker scenarios are shown in Tables 7.3.3 and 7.3.4, respectively.

Table 10.1.6.1
Summary of Chemicals Present in Site Samples
SWMU 5, SWMU 18, AOC 605 - Surface Soil
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Conc.	Range of SQL	Screening Concentration RBC	Screening Concentration Reference	Units	Number Exceeding RBC	Number Exceeding Ref.
Inorganics											
Aluminum (Al)		24	24	85.1 - 15000	3145.84	NA - NA	7800	26600	mg/kg	1	
Antimony (Sb)	*	23	24	1.1 - 26	7.51	0.48 - 0.48	3.1	1.77	mg/kg	13	16
Arsenic (As)	*	24	24	1.1 - 31.4	6.92	NA - NA	0.43	23.9	mg/kg	24	1
Barium (Ba)		24	24	10.9 - 117	41.83	NA - NA	550	130	mg/kg		
Beryllium (Be)	*	21	24	0.2 - 3.7	0.98	0.11 - 0.13	0.15	1.7	mg/kg	21	4
Cadmium (Cd)		17	24	0.15 - 1.4	0.53	0.11 - 0.44	3.9	1.5	mg/kg		
Calcium (Ca)	N	24	24	246 - 124000	25639.42	NA - NA	NA	NA	mg/kg		
Chromium (Cr)		24	24	1.4 - 75.6	34.55	NA - NA	39	94.6	mg/kg	9	
Chromium (Hexavalent)		1	4	0.586 - 0.586	0.59	0.053 - 0.307	39	NA	mg/kg		
Cobalt (Co)		22	24	0.4 - 36.1	10.07	0.22 - 0.25	470	19	mg/kg		4
Copper (Cu)	*	24	24	3.8 - 1900	229.47	NA - NA	310	66	mg/kg	3	16
Cyanide (CN)		4	23	0.27 - 0.35	0.31	0.21 - 0.25	160	0.5	mg/kg		
Iron (Fe)	N	24	24	482 - 20000	9140.50	NA - NA	NA	NA	mg/kg		
Lead (Pb)	*	24	24	8.7 - 10500	957.71	NA - NA	400	265	mg/kg	12	15
Magnesium (Mg)	N	23	24	38.3 - 2240	761.45	12.5 - 12.5	NA	NA	mg/kg		
Manganese (Mn)		24	24	1.1 - 227	95.20	NA - NA	180	302	mg/kg	2	
Mercury (Hg)		21	21	0.03 - 1.8	0.37	NA - NA	2.3	2.6	mg/kg		
Nickel (Ni)	*	24	24	0.77 - 270	47.37	NA - NA	160	77.1	mg/kg	3	3
Potassium (K)	N	23	24	232 - 1770	537.09	12.5 - 12.5	NA	NA	mg/kg		
Selenium (Se)		5	23	0.63 - 0.85	0.74	0.53 - 0.65	39	1.7	mg/kg		
Silver (Ag)		7	23	0.22 - 1.1	0.48	0.21 - 0.65	39	NA	mg/kg		
Sodium (Na)	N	20	24	82.7 - 738	264.39	38 - 82.2	NA	NA	mg/kg		
Tin (Sn)		21	24	4.8 - 225	39.48	6.1 - 6.5	4700	59.4	mg/kg		3
Vanadium (V)		24	24	1.2 - 40	11.56	NA - NA	55	94.3	mg/kg		
Zinc (Zn)	*	24	24	5.3 - 3180	745.62	NA - NA	2300	827	mg/kg	2	6

Table 10.1.6.1
Summary of Chemicals Present in Site Samples
SWMU 5, SWMU 18, AOC 605 - Surface Soil
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Conc.	Range of SQL	Screening Concentration RBC	Screening Concentration Reference	Units	Number Exceeding RBC	Number Exceeding Ref.
Pesticides/PCBs											
Aldrin		1	23	1.78 - 1.78	1.78	1.38 - 1.71	38	NA	ug/kg		
Aroclor-1260	*	3	23	230 - 350	276.67	70.9 - 88.2	83	NA	ug/kg	3	
Technical Chlordane		2	4	114 - 328	221.00	1.41 - 1.44	490	NA	ug/kg		
alpha-Chlordane		3	23	3.5 - 5.7	4.33	1.38 - 1.71	490	NA	ug/kg		
gamma-Chlordane		2	23	5.7 - 11.2	8.45	1.38 - 1.71	490	NA	ug/kg		
4,4'-DDD		6	23	4.59 - 19	8.50	2.65 - 3.2	2700	NA	ug/kg		
4,4'-DDE		11	23	3.04 - 15	6.23	2.7 - 3.29	1900	NA	ug/kg		
4,4'-DDT		16	23	4.56 - 43	18.21	2.78 - 3.2	1900	NA	ug/kg		
Dieldrin		3	23	3.04 - 6.96	5.00	2.6 - 3.61	40	NA	ug/kg		
Endosulfan II		2	23	4.63 - 6	5.32	2.65 - 3.29	47000	NA	ug/kg		
Endrin aldehyde		5	23	3.6 - 18.2	12.12	2.6 - 3.29	2300	NA	ug/kg		
Endrin ketone		4	23	3.84 - 7.02	5.51	2.6 - 3.2	2300	NA	ug/kg		
Heptachlor epoxide		1	23	2.34 - 2.34	2.34	1.38 - 1.71	70	NA	ug/kg		
Carcinogenic PAHs											
Benzo(a)pyrene Equiv.	*	22	22	0.86 - 6200.9	787.67	NA - NA	88	NA	ug/kg	19	
Benzo(a)anthracene	*	19	24	80 - 5700	627.74	750 - 850	880	NA	ug/kg	2	
Benzo(a)pyrene	*	19	24	100 - 4000	582.63	750 - 850	88	NA	ug/kg	19	
Benzo(b)fluoranthene	*	15	24	100 - 4400	852.00	730 - 850	880	NA	ug/kg	6	
Benzo(k)fluoranthene		22	24	86 - 3400	574.05	760 - 760	8800	NA	ug/kg		
Chrysene		20	24	82 - 6900	787.60	760 - 850	88000	NA	ug/kg		
Dibenz(a,h)anthracene	*	10	23	76 - 860	284.60	460 - 850	88	NA	ug/kg	9	
Indeno(1,2,3-cd)pyrene	*	18	24	49 - 2900	444.50	730 - 850	880	NA	ug/kg	1	
				-		-					
Semivolatile Organics				-		-					
Acenaphthene		5	23	47 - 470	227.40	350 - 870	470000	NA	ug/kg		
Acenaphthylene		2	23	99 - 150	124.50	350 - 870	310000	NA	ug/kg		
Anthracene		7	23	97 - 1100	335.29	370 - 850	2300000	NA	ug/kg		
Benzo(g,h,i)perylene		18	24	57 - 2400	439.61	730 - 850	230000	NA	ug/kg		

Table 10.1.6.1
Summary of Chemicals Present in Site Samples
SWMU 5, SWMU 18, AOC 605 - Surface Soil
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection	Average Detected Conc.	Range of SQL	Screening Concentration RBC	Screening Concentration Reference	Units	Number Exceeding RBC	Number Exceeding Ref.
Carbazole	2	9	88 - 110	99.00	400 - 760	32000	NA	ug/kg		
4-Chloroaniline	1	23	190 - 190	190.00	350 - 870	31000	NA	ug/kg		
Di-n-butylphthalate	2	23	39 - 160	99.50	370 - 870	780000	NA	ug/kg		
Di-n-octyl phthalate	1	23	220 - 220	220.00	350 - 850	160000	NA	ug/kg		
Dibenzofuran	4	23	79 - 150	111.75	350 - 850	31000	NA	ug/kg		
Diethylphthalate	1	23	220 - 220	220.00	350 - 870	6300000	NA	ug/kg		
bis(2-Ethylhexyl)phthalate	21	24	69 - 2400	520.43	760 - 850	46000	NA	ug/kg		
Fluoranthene	22	24	77 - 8500	963.59	780 - 850	310000	NA	ug/kg		
Fluorene	4	23	66 - 340	186.50	350 - 850	310000	NA	ug/kg		
2-Methylnaphthalene	3	23	47 - 70	55.67	350 - 870	310000	NA	ug/kg		
4-Methylphenol	1	23	75 - 75	75.00	350 - 870	39000	NA	ug/kg		
Naphthalene	5	23	59 - 450	193.80	350 - 850	310000	NA	ug/kg		
Phenanthrene	16	24	73 - 4400	544.63	700 - 850	310000	NA	ug/kg		
Pyrene	22	24	78 - 9800	1008.45	780 - 850	230000	NA	ug/kg		
Volatile Organics										
2-Butanone	1	23	30 - 30	30.00	11 - 13	4700000	NA	ug/kg		
Acetone	5	23	40 - 180	93.00	11 - 22	780000	NA	ug/kg		
Dichlorodifluoromethane	1	4	7 - 7	7.00	5 - 6	1600000	NA	ug/kg		
TCDD Equivalents										
Dioxin Equiv.	4	4	0.3276 - 3.0067	1.20	NA - NA	1000	NA	ng/kg		

Notes:
* - Identified as a COPC
N - Essential Nutrient
SQL - Sample Quantitation Limit
mg/kg - milligram per kilogram
ug/kg - microgram per kilogram
ng/kg - nanogram per kilogram

Table 10.1.6.2
Summary of Chemicals Present in Site Samples
SWMU 5, SWMU 18, AOC 605 - Shallow Groundwater
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Conc.	Range of SQL	Screening Concentration RBC	Screening Concentration Reference	Units	Number Exceeding RBC	Number Exceeding Ref.
Inorganics											
Aluminum (Al)		3	5	142 - 1220	566.00	61.8 - 93.4	3700	2810	ug/L		
Antimony (Sb)	*	3	5	5.8 - 6.6	6.23	4 - 4	1.5	NA	ug/L	3	
Arsenic (As)	*	2	5	6.8 - 45.9	26.35	5 - 5	0.045	18.7	ug/L	2	1
Barium (Ba)	*	1	5	291 - 291	291.00	30.8 - 105	260	211	ug/L	1	1
Calcium (Ca)	N	4	5	53400 - 117000	91525.00	21800 - 21800	NA	NA	ug/L		
Chromium (Cr)		3	5	1.1 - 3.8	2.03	1 - 1	18	12.3	ug/L		
Cobalt (Co)		1	5	3 - 3	3.00	2 - 2	220	2.5	ug/L		1
Iron (Fe)	N	5	5	354 - 24200	12046.80	NA - NA	NA	NA	ug/L		
Lead (Pb)	*	2	5	4.6 - 426	215.30	3 - 3	15	4.8	ug/L	1	1
Magnesium (Mg)	N	1	5	28100 - 28100	28100.00	6750 - 20700	NA	NA	ug/L		
Manganese (Mn)		5	5	13.4 - 365	206.54	NA - NA	84	2560	ug/L	3	
Nickel (Ni)		3	5	1.1 - 15.4	6.80	1 - 1	73	15.2	ug/L		1
Potassium (K)	N	2	5	13200 - 14300	13750.00	5950 - 9300	NA	NA	ug/L		
Sodium (Na)	N	2	5	104000 - 115000	109500.00	35600 - 75000	NA	NA	ug/L		
Vanadium (V)		3	5	1 - 1.7	1.33	1 - 1	26	11.4	ug/L		
Zinc (Zn)		3	5	41.2 - 109	76.73	4 - 4.7	1100	27.3	ug/L		3
Semivolatile Organics											
Acenaphthene		3	8	2 - 15	7.00	10 - 10	220	NA	ug/L		
Anthracene		1	5	1 - 1	1.00	10 - 10	1100	NA	ug/L		
Butylbenzylphthalate		1	5	2 - 2	2.00	10 - 10	730	NA	ug/L		
Dibenzofuran		1	5	5 - 5	5.00	10 - 10	15	NA	ug/L		
Fluoranthene		1	5	2 - 2	2.00	10 - 10	150	NA	ug/L		
Fluorene		1	5	7 - 7	7.00	10 - 10	150	NA	ug/L		
2-Methylnaphthalene		1	5	4 - 4	4.00	10 - 10	150	NA	ug/L		
Naphthalene		1	5	9 - 9	9.00	10 - 10	150	NA	ug/L		

Table 10.1.6.2
Summary of Chemicals Present in Site Samples
SWMU 5, SWMU 18, AOC 605 - Shallow Groundwater
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Conc.	Range of SQL	Screening Concentration RBC	Screening Concentration Reference	Units	Number Exceeding RBC	Number Exceeding Ref.
Phenanthrene		1	5	11 - 11	11.00	10 - 10	150	NA	ug/L		
Pyrene		1	5	1 - 1	1.00	10 - 10	110	NA	ug/L		
Organotins											
Tributyltin		1	5	14 - 14	14.00	2 - 2	NA	NA	ug/L		
TCDD Equivalents											
Dioxin Equiv.	*	1	1	62.6 - 62.6	62.60	NA - NA	0.43	NA	pg/L	1	

Notes:
* - Identified as a COPC
N - Essential Nutrient
SQL - Sample Quantitation Limit
ug/L - microgram per liter
pg/L - nanogram per liter

Table 10.1.6.3
Exposure Pathways Summary — SWMUs 5, 18; AOC 605
NAVBASE — Zone E
Charleston, South Carolina

Potentially Exposed Population	Medium and Exposure Pathway	Pathway Selected for Evaluation?	Reason for Selection or Exclusion
Current Land Uses			
Current Site Users/Maintenance	Air, Inhalation of gaseous contaminants emanating from soil	No	Fate and transport screening did not identify any COPCs for this indirect exposure pathway.
	Air, Inhalation of chemicals entrained in fugitive dust	No	This exposure pathway was considered insignificant compared to the other pathways.
	Shallow groundwater, Ingestion of contaminants during potable or general use	No	Shallow groundwater is not currently used as a source of potable or non-residential water at combined SWMU 5.
	Shallow groundwater, Inhalation of volatilized shallow groundwater contaminants	No	Shallow groundwater is not currently used as a source of potable or non-residential water at combined SWMU 5.
	Soil, Incidental ingestion	No (Qualified)	Future land use assessment is considered to be protective of current receptors.
	Soil, Dermal contact	No (Qualified)	Future land use assessment is considered to be protective of current receptors.
Future Land Uses			
Future Site Residents (Child and Adult) and Future Site Worker	Air, Inhalation of gaseous contaminants emanating from soil	No	Fate and transport screening did not identify any COPCs for this indirect exposure pathway.
	Air, Inhalation of chemicals entrained in fugitive dust	No	This exposure pathway was considered insignificant compared to the other pathways.
	Shallow groundwater, Ingestion of contaminants during potable or general use	Yes	Shallow groundwater is not likely to be used as a source of potable or non-residential water at combined SWMU 5. A FRE was provided for this pathway for use in remedial decisions
	Shallow groundwater, Inhalation of volatilized contaminants during domestic use	No	Volatile COPCs were not identified subsequent to risk-based screening comparisons.
	Soil, Incidental ingestion	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Soil, Dermal contact	Yes	COPCs were identified subsequent to risk-based and background screening comparisons.
	Wild game or domestic animals, Ingestion of tissue impacted by media contamination	No	Hunting/taking of game and/or raising livestock is prohibited within the Charleston, South Carolina city limits.
	Fruits and vegetables, Ingestion of plant tissues grown in media	No	The potential for significant exposure via this pathway is low relative to that of other exposure pathways assessed.

Table 10.1.6.4
Summary of Statistical Analysis
Surface Soil COPCs; SWMUs 5, 18; AOC 605
Naval Base Charleston, Zone E
Charleston, South Carolina

COPC	Natural Log Transformed n	mean	SD	H-stat	UCL (mg/kg)	MAX (mg/kg)	EPC (mg/kg)	
Inorganic								
Antimony (Sb)	24	1.39	1.16	2.74	15	26	15	UCL
Arsenic (As)	24	1.60	0.83	2.31	10	31	10	UCL
Beryllium (Be)	24	-0.65	1.10	2.66	1.74	3.7	1.74	UCL
Copper (Cu)	24	4.52	1.42	3.12	631	1900	631	UCL
Lead (Pb)	24	5.88	1.43	3.13	2519	10500	2519	UCL
Nickel (Ni)	24	2.92	1.46	3.18	142	246	142	UCL
Zinc (Zn)	24	5.84	1.61	3.41	3914	3020	3020	MAX
PCBs								
Aroclor-1260	23	-3.03	0.65	2.12	0.08	0.35	0.08	UCL
Semivolatile Organics								
Benzo(a)pyrene equivalen	24	-1.01	1.11	2.67	1.24	6.2	1.24	UCL
Dioxin (as 2,3,7,8-TCDD)	4	NA	NA	NA	NA	3E-06	3E-06	MAX

Notes:
n - Number of samples analyzed
mean - Arithmetic mean of the logtransformed data
SD - Standard deviation for a sample of data
H-stat - "H" statistic from Gilbert 1987; cuboidal interpolation was used to determine the value in accordance with USEPA Supplemental Guidance to RAGS, Calculating the Concentration Term
NA - Not applicable
EPC - Exposure point concentration
UCL - 95 percentile upper confidence level mean
MAX - Maximum reported concentration

Table 10.1.6.5
Chronic Daily Intakes (CDI)
Incidental Ingestion of Surface Soil
SWMUs 5, 18; AOC 605
Naval Base Charleston, Zone E
Charleston, South Carolina

Chemical	Fraction Ingested from Contaminated Source *	Exposure Point Concentration (mg/kg)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Current Worker adult H-CDI (mg/kg-day)	Current Worker adult C-CDI (mg/kg-day)
Inorganic							
Antimony (Sb)	1	15.32	2.10E-05	1.96E-04	2.40E-05	7.49E-06	2.68E-06
Arsenic (As)	1	10.44	1.43E-05	1.33E-04	1.63E-05	5.11E-06	1.82E-06
Beryllium (Be)	1	1.74	2.39E-06	2.23E-05	2.73E-06	8.53E-07	3.05E-07
Copper (Cu)	1	631.12	8.65E-04	8.07E-03	9.88E-04	3.09E-04	1.10E-04
Lead (Pb)	1	2518.77	3.45E-03	3.22E-02	3.94E-03	1.23E-03	4.40E-04
Nickel (Ni)	1	141.82	1.94E-04	1.81E-03	2.22E-04	6.94E-05	2.48E-05
Zinc (Zn)	1	3020.00	4.14E-03	3.86E-02	4.73E-03	1.48E-03	5.28E-04
PCBs							
Aroclor-1260	1	0.08	1.09E-07	1.02E-06	1.25E-07	3.90E-08	1.39E-08
Semivolatile Organics							
Benzo(a)pyrene equivalen	1	1.24	1.70E-06	1.59E-05	1.94E-06	6.07E-07	2.17E-07
Dioxin (as 2,3,7,8-TCDD)	1	0.000003	4.11E-12	3.84E-11	4.70E-12	1.47E-12	5.24E-13

Notes:
lwa - Lifetime weighted average; used to calculate carcinogenic CDI, RAGS Parts A and B
CDI - Chronic Daily Intake in mg/kg-day
H-CDI - CDI for hazard quotient
C-CDI - CDI for excess cancer risk
* - Reflects the estimated fraction of the site impacted by the corresponding COPC.

Table 10.1.6.6
Chronic Daily Intakes (CDI)
Dermal Contact with Surface Soil
SWMUs 5, 18; AOC 605
Naval Base Charleston, Zone E
Charleston, South Carolina

Chemical	Fraction Contacted fro Contaminated Source *	Exposure Point Concentratio (mg/kg)	Dermal Absorption Factor (unitless)	Future Resident adult H-CDI (mg/kg-day)	Future Resident child H-CDI (mg/kg-day)	Future Resident lwa C-CDI (mg/kg-day)	Current Worker adult H-CDI (mg/kg-day)	Current Worker adult C-CDI (mg/kg-day)
Inorganic								
Antimony (Sb)	1	15	0.001	8.60E-07	2.84E-06	5.38E-07	6.15E-07	2.19E-07
Arsenic (As)	1	10	0.001	5.86E-07	1.94E-06	3.67E-07	4.19E-07	1.50E-07
Beryllium (Be)	1	1.74	0.001	9.80E-08	3.23E-07	6.13E-08	7.00E-08	2.50E-08
Copper (Cu)	1	631	0.001	3.54E-05	1.17E-04	2.22E-05	2.53E-05	9.04E-06
Lead (Pb)	1	2519	0.001	1.41E-04	4.67E-04	8.85E-05	1.01E-04	3.61E-05
Nickel (Ni)	1	142	0.001	7.97E-06	2.63E-05	4.99E-06	5.69E-06	2.03E-06
Zinc (Zn)	1	3020	0.001	1.70E-04	5.60E-04	1.06E-04	1.21E-04	4.33E-05
PCBs								
Aroclor-1260	1	0.08	0.01	4.48E-08	1.48E-07	2.80E-08	3.20E-08	1.14E-08
Semivolatile Organics								
Benzo(a)pyrene equivalen	1	1.24	0.01	6.96E-07	2.30E-06	4.36E-07	4.97E-07	1.78E-07
Dioxin (as 2,3,7,8-TCDD)	1	0.000003	0.01	1.68E-12	5.56E-12	1.05E-12	1.20E-12	4.30E-13

Notes:
CDI - Chronic Daily Intake in mg/kg-day
H-CDI - CDI for hazard quotient
C-CDI - CDI for excess cancer risk
* - Reflects the estimated fraction of the site impacted by the corresponding COPC.
The dermal absorption factor was applied to the exposure point concentration to reflect the ability for trans-dermal migration of inorganic and organic chemicals

Table 10.1.6.7
Toxicological Database Information for Chemical of Potential Concern
SWMUs 5, 18; AOC 605
NAVBASE - Charleston, Zone E
Charleston, South Carolina

	Noncarcinogenic Effects							Carcinogenic Effects					
Parameter	Oral RfD		Inhalation RfD	Confidence Level	Critical Effect; Target Organ	Uncertainty Factor Oral	Oral Slope Factor		Inhalation Slope Factor		Weight of Evidence	Tumor Type
Semivolatile Organics												
Benzo(a)pyrene Equivalents	ND		ND				7.3	a	0.61	c	B2	forestomach, squamous cell papillomas and carcinomas
2,3,7,8-TCDD Equivalents	ND		ND				150000	b	150000	b	B2	respiratory system and liver tumors
Pesticides/PCBs												
Aroclor-1260	ND		ND				2	a	2	a	B2	Hepatocellular carcinoma
Inorganics												
Antimony	0	a	ND	Low	Decreased lifespan; whole body	1000	ND		ND			
Arsenic	0	a	ND	Medium	Hyperpigmentation, keratosis; skin	3	1.5	a	50	b	A	Various
Beryllium	0.01	a	ND	Low	Microscopic changes; various organs	100	4.3	a	8.4	b	B2	Osteosarcoma, lung tumors
Copper	0.04	b	ND	NA	NA	NA	ND	a	ND		D	
Lead	ND		ND				ND		ND		B2	Various
Nickel	0.02	a	ND	Medium	Decreased weight; whole body	300	ND		0.84	b	B2	Respiratory system
Zinc	0.3	a	ND	Medium	Decreased enzyme levels	3	ND	a	ND		D	

Notes:

a - Integrated Risk Information System (IRIS)
b - Health Effects Assessment Summary Tables (HEAST)
c - EPA Environmental Criteria and Assessment Office - Cincinnati (provisional)
RfD and Slope Factor values are in mg/kg/day (milligram/kilogram/day)
NA - Not applicable or not available
ND - Not determined due to lack of information

Table 10.1.6.8
Hazard Quotients and Incremental Lifetime Cancer Risks
Incidental Surface Soil Ingestion
SWMUs 5, 18; AOC 605
Naval Base Charleston, Zone E
Charleston, South Carolina

Chemical	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Current Worker Adult Hazard Quotient	Current Worker Adult ILCR
Inorganic							
Antimony (Sb)	0.0004	NA	5.25E-02	4.90E-01	ND	1.87E-02	ND
Arsenic (As)	0.0003	1.5000	4.77E-02	4.45E-01	2.45E-05	1.70E-02	2.74E-06
Beryllium (Be)	0.0050	4.3000	4.78E-04	4.46E-03	1.17E-05	1.71E-04	1.31E-06
Copper (Cu)	0.0400	NA	2.16E-02	2.02E-01	ND	7.72E-03	ND
Lead (Pb)	NA	NA	ND	ND	ND	ND	ND
Nickel (Ni)	0.0200	NA	9.71E-03	9.07E-02	ND	3.47E-03	ND
Zinc (Zn)	0.3000	NA	1.38E-02	1.29E-01	ND	4.92E-03	ND
PCBs							
Aroclor-1260	NA	2.0000	ND	ND	2.50E-07	ND	2.79E-08
Semivolatile Organics							
Benzo(a)pyrene equivalen	NA	7.3000	ND	ND	1.42E-05	ND	1.58E-06
Dioxin (as 2,3,7,8-TCDD)	NA	156000.0000	ND	ND	7.33E-07	ND	8.18E-08
SUM Hazard Index/ILCR			1.46E-01	1.36E+00	5.14E-05	5.20E-02	5.74E-06

Notes:
NA - Not available
ND - Not Determined due to lack of available information
Lwa - Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR - Incremental Lifetime Cancer Risk

Table 10.1.6.9
Hazard Quotients and Incremental Lifetime Cancer Risks
Dermal Contact With Surface Soil
SWMUs 5, 18; AOC 605
Naval Base Charleston, Zone E
Charleston, South Carolina

Chemical	Dermal Adjustment	Oral RfD Used (mg/kg-day)	Oral SF Used (mg/kg-day)-1	Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Current Worker Adult Hazard Quotient	Current Worker Adult ILCR
Inorganic								
Antimony (Sb)	0.2	0.00008	NA	1.08E-02	3.55E-02	ND	7.68E-03	ND
Arsenic (As)	0.2	0.00006	7.5	9.77E-03	3.23E-02	2.75E-06	6.98E-03	1.12E-06
Beryllium (Be)	0.2	0.001	21.5	9.80E-05	3.23E-04	1.32E-06	7.00E-05	5.37E-07
Copper (Cu)	0.2	0.008	NA	4.43E-03	1.46E-02	ND	3.16E-03	ND
Lead (Pb)	0.2	NA	NA	ND	ND	ND	ND	ND
Nickel (Ni)	0.2	0.004	NA	1.99E-03	6.57E-03	ND	1.42E-03	ND
Zinc (Zn)	0.2	0.06	NA	2.83E-03	9.33E-03	ND	2.02E-03	ND
PCBs								
Aroclor-1260	0.5	NA	4	ND	ND	1.12E-07	ND	4.57E-08
Semivolatile Organics								
Benzo(a)pyrene equivalen	0.5	NA	14.6	ND	ND	6.36E-06	ND	2.59E-06
Dioxin (as 2,3,7,8-TCDD)	0.5	NA	312000	ND	ND	3.29E-07	ND	1.34E-07
SUM Hazard Index/ILCR				2.99E-02	9.86E-02	1.09E-05	2.13E-02	4.43E-06

Notes:
NA - Not available
ND - Not Determined due to lack of available information
Lwa - Lifetime weighted average; used to calculate excess carcinogenic risk derived from RAGS Part A
ILCR - Incremental Lifetime Cancer Risk
1 - Dermal to absorbed dose adjustment factor is applied to adjust for Oral SF and RfD (i.e., the oral RfD is based on oral absorption efficiency which should not be applied to dermal exposure and dermal CDI)

Table 10.1.6.10
Point Estimates of Risk and Hazard - Groundwater Pathway
Residential Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
018	G001	Antimony (Sb)	5.80	UG/L	NA		0.9269	100.00
018	G001	Arsenic (As)	ND	UG/L	NA		NA	
018	G001	Barium (Ba)	ND	UG/L	NA		NA	
018	G001	Lead (Pb)	4.60	UG/L	NA		NA	
		Total			NA		0.9269	
018	G002	Antimony (Sb)	ND	UG/L	NA		NA	
018	G002	Arsenic (As)	ND	UG/L	NA		NA	
018	G002	Barium (Ba)	291.00	UG/L	NA		0.2658	100.00
018	G002	Lead (Pb)	ND	UG/L	NA		NA	
		Total			NA		0.2658	
605	G001	Antimony (Sb)	ND	UG/L	NA		NA	
605	G001	Arsenic (As)	6.80	UG/L	151.7025	100.00	1.4490	100.00
605	G001	Barium (Ba)	ND	UG/L	NA		NA	
605	G001	Lead (Pb)	ND	UG/L	NA		NA	
		Total			151.7025		1.4490	
605	G002	Antimony (Sb)	6.60	UG/L	NA		1.0548	100.00
605	G002	Arsenic (As)	ND	UG/L	NA		NA	
605	G002	Barium (Ba)	ND	UG/L	NA		NA	
605	G002	Lead (Pb)	426.00	UG/L	NA		NA	
		Total			NA		1.0548	
605	G003	Antimony (Sb)	6.30	UG/L	NA		1.0068	9.33
605	G003	Arsenic (As)	45.90	UG/L	1023.9922	98.60	9.7808	90.67
605	G003	Barium (Ba)	ND	UG/L	NA		NA	
605	G003	Dioxin Equiv.	62.60	PG/L	14.5242	1.40	NA	
605	G003	Lead (Pb)	ND	UG/L	NA		NA	
		Total			1038.5164		10.7877	

Table 10.1.6.11
Lead Model Results - Future Residential Scenario
SWMU 5, SWMU 18, and AOC 605
NAVBASE - Charleston, Zone E
Charleston, South Carolina

LEAD MODEL Version 0.99d
AIR CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
Indoor AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT
DRINKING WATER Conc: 426.00 ug Pb/L
WATER Consumption: DEFAULT
SOIL & DUST:
Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	3038.0	3038.0
1-2	3038.0	3038.0
2-3	3038.0	3038.0
3-4	3038.0	3038.0
4-5	3038.0	3038.0
5-6	3038.0	3038.0
6-7	3038.0	3038.0

Additional Dust Sources: None DEFAULT
MATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)	Diet Uptake (ug/day)	Water Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	29.8	60.82	38.34	1.37	21.08	0.02
1-2:	37.3	99.59	52.70	1.24	45.62	0.03
2-3:	36.6	107.25	55.64	1.47	50.08	0.06
3-4:	36.5	114.46	58.88	1.49	54.02	0.07
4-5:	34.7	111.90	48.24	1.59	62.00	0.07
5-6:	33.1	115.93	45.52	1.76	68.56	0.09
6-7:	31.4	118.69	44.46	2.01	72.13	0.09

Table 10.1.6.12
Lead Model Results - Future Industrial Scenario
SWMU 5, SWMU 18, and AOC 605
NAVBASE - Charleston, Zone E
Charleston, South Carolina

LEAD MODEL Version 0.99d
AIR CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
Indoor AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT
DRINKING WATER Conc: 15.00 ug Pb/L
WATER Consumption: DEFAULT
SOIL & DUST:
Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	200.0	200.0
1-2	200.0	200.0
2-3	200.0	200.0
3-4	200.0	200.0
4-5	200.0	200.0
5-6	200.0	200.0
6-7	200.0	200.0

Additional Dust Sources: None DEFAULT
ALTERNATIVE SOURCE Intake: varied by year as follows:
0-1: 0.00 ug Pb/day
1-2: 0.00 ug Pb/day
2-3: 0.00 ug Pb/day
3-4: 0.00 ug Pb/day
4-5: 0.00 ug Pb/day
5-6: 2.00 ug Pb/day
6-7: 0.00 ug Pb/day

MATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL
CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)	Diet Uptake (ug/day)	Water Uptake (ug/day)	Alt Source Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	4.6	8.52	4.63	2.51	1.36	0.00	0.02
1-2:	5.4	13.16	7.21	2.57	3.34	0.00	0.03
2-3:	5.1	13.81	7.30	2.93	3.52	0.00	0.06
3-4:	4.9	13.97	7.41	2.85	3.64	0.00	0.07
4-5:	4.3	12.34	5.61	2.81	3.86	0.00	0.07
5-6:	4.0	13.15	5.07	2.97	4.08	0.94	0.09
6-7:	3.6	12.42	4.83	3.31	4.19	0.00	0.09

Table 1[illegible].13
Summary of Risk and Hazard-based COCs
SWMUs 5, 18; AOC 605
NAVBASE - Charleston, Zone E
Charleston, South Carolina

Medium	Exposure Pathway		Future Resident Adult Hazard Quotient	Future Resident Child Hazard Quotient	Future Resident lwa ILCR	Current Site Worker Hazard Quotient	ILCR	Identification of COCs			
Surface Soil	Incidental	**Inorganic**									
	Ingestion	Antimony (Sb)	5.25E-02	4.90E-01	ND	1.87E-02	ND	1			
		Arsenic (As)	4.77E-02	4.45E-01	2.45E-05	1.70E-02	2.74E-06	1	2		4
		Beryllium (Be)	4.78E-04	4.46E-03	1.17E-05	1.71E-04	1.31E-06		2		4
		Copper (Cu)	2.16E-02	2.02E-01	ND	7.72E-03	ND	1			
		Lead (Pb)	ND	ND	ND	ND	ND				
		Nickel (Ni)	9.71E-03	9.07E-02	ND	3.47E-03	ND				
		Zinc (Zn)	1.38E-02	1.29E-01	ND	4.92E-03	ND	1			
		PCBs									
		Aroclor-1260	ND	ND	2.50E-07	ND	2.79E-08				
		Semivolatile Organics									
		Benzo(a)pyrene equivalen	ND	ND	1.42E-05	ND	1.58E-06		2		4
		Dioxin (as 2,3,7,8-TCDD)	ND	ND	7.33E-07	ND	8.18E-08				
	Dermal	**Inorganic**									
		Antimony (Sb)	1.08E-02	3.55E-02	ND	7.68E-03	ND				
		Arsenic (As)	9.77E-03	3.23E-02	2.75E-06	6.98E-03	1.12E-06		2		4
		Beryllium (Be)	9.80E-05	3.23E-04	1.32E-06	7.00E-05	5.37E-07		2		
		Copper (Cu)	4.43E-03	1.46E-02	ND	3.16E-03	ND				
		Lead (Pb)	ND	ND	ND	ND	ND				
		Nickel (Ni)	1.99E-03	6.57E-03	ND	1.42E-03	ND				
		Zinc (Zn)	2.83E-03	9.33E-03	ND	2.02E-03	ND				
		PCBs									
		Aroclor-1260	ND	ND	1.12E-07	ND	4.57E-08				
		Semivolatile Organics									
		Benzo(a)pyrene equivalen	ND	ND	6.36E-06	ND	2.59E-06		2		4
		Dioxin (as 2,3,7,8-TCDD)	ND	ND	3.29E-07	ND	1.34E-07				
Surface Soil Pathway Sum			1.76E-01	1.46E+00	6.23E-05	7.34E-02	1.02E-05				

Notes:

ND - Not Determined due to the lack of available risk information.

ILCR - Incremental excess Lifetime Cancer Risk

HI - Hazard Index

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

2- Chemical is a COC by virtue of projected future resident lifetime ILCR.

3- Chemical is a COC by virtue of projected site worker noncarcinogenic hazard.

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

Table 10.1.6.14
Summary of Risk and Hazard
SWMUs 5, 18; AOC 605
Naval Base Charleston, Zone E
Charleston, South Carolina

Medium	Exposure Pathway	HI (Adult)	HI (Child)	ILCR (LWA)	HI (Worker)	ILCR (Worker)
Surface Soil	Incidental Ingestion	0.15	1	5.14E-05	0.05	5.74E-06
	Dermal Contact	0.03	0.10	1.09E-05	0.02	4.43E-06
Sum of Soil Pathways		0.18	1	6.23E-05	0.07	1.02E-05

Notes:
ILCR - Indicates incremental lifetime cancer risk
HI - Indicates hazard index

Table 10.1.6.15
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
005	B001	Antimony (Sb)	1.3	MG/KG	NA		0.0446	15.66
005	B001	Aroclor-1260	ND	UG/KG	NA		NA	
005	B001	Arsenic (As)	4.2	MG/KG	10.9704	43.83	0.1920	67.44
005	B001	B(a)P Equiv.	704.35	UG/KG	11.6643	46.60	NA	
005	B001	Beryllium (Be)	0.32	MG/KG	2.3961	9.57	0.0009	0.31
005	B001	Copper (Cu)	60.3	MG/KG	NA		0.0207	7.26
005	B001	Lead (Pb)	338	MG/KG	NA		NA	
005	B001	Nickel (Ni)	8.7	MG/KG	NA		0.0060	2.10
005	B001	Zinc (Zn)	451	MG/KG	NA		0.0206	7.24
		Total			25.0307		0.2847	
005	B002	Antimony (Sb)	14.3	MG/KG	NA		0.4902	82.59
005	B002	Aroclor-1260	ND	UG/KG	NA		NA	
005	B002	Arsenic (As)	2.1	MG/KG	5.4852	62.27	0.0960	16.17
005	B002	B(a)P Equiv.	200.68	UG/KG	3.3233	37.73	NA	
005	B002	Beryllium (Be)	ND	MG/KG	NA		NA	
005	B002	Copper (Cu)	15.8	MG/KG	NA		0.0054	0.91
005	B002	Lead (Pb)	10500	MG/KG	NA		NA	
005	B002	Nickel (Ni)	1.4	MG/KG	NA		0.0010	0.16
005	B002	Zinc (Zn)	21.2	MG/KG	NA		0.0010	0.16
		Total			8.8085		0.5935	
005	B003	Antimony (Sb)	2.9	MG/KG	NA		0.0994	24.99
005	B003	Aroclor-1260	ND	UG/KG	NA		NA	
005	B003	Arsenic (As)	5.2	MG/KG	13.5824	72.36	0.2377	59.74
005	B003	B(a)P Equiv.	1.282	UG/KG	0.0212	0.11	NA	
005	B003	Beryllium (Be)	0.69	MG/KG	5.1665	27.53	0.0019	0.48
005	B003	Copper (Cu)	91	MG/KG	NA		0.0312	7.84
005	B003	Lead (Pb)	462	MG/KG	NA		NA	
005	B003	Nickel (Ni)	17.6	MG/KG	NA		0.0121	3.03
005	B003	Zinc (Zn)	342	MG/KG	NA		0.0156	3.93
		Total			18.7702		0.3979	
018	B001	Antimony (Sb)	3.7	MG/KG	NA		0.1268	38.97
018	B001	Aroclor-1260	ND	UG/KG	NA		NA	
018	B001	Arsenic (As)	3.5	MG/KG	9.1420	36.68	0.1600	49.15
018	B001	B(a)P Equiv.	862.51	UG/KG	14.2834	57.31	NA	
018	B001	Beryllium (Be)	0.2	MG/KG	1.4975	6.01	0.0005	0.17
018	B001	Copper (Cu)	69.2	MG/KG	NA		0.0237	7.29
018	B001	Lead (Pb)	404	MG/KG	NA		NA	
018	B001	Nickel (Ni)	10.3	MG/KG	NA		0.0071	2.17
018	B001	Zinc (Zn)	160	MG/KG	NA		0.0073	2.25
		Total			24.9230		0.3255	

Table 10.1.6.15
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
018	B002	Antimony (Sb)	ND	MG/KG	NA		NA	
018	B002	Aroclor-1260	ND	UG/KG	NA		NA	
018	B002	Arsenic (As)	3.2	MG/KG	8.3584	100.00	0.1463	97.75
018	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
018	B002	Beryllium (Be)	ND	MG/KG	NA		NA	
018	B002	Copper (Cu)	5.2	MG/KG	NA		0.0018	1.19
018	B002	Lead (Pb)	8.7	MG/KG	NA		NA	
018	B002	Nickel (Ni)	1.7	MG/KG	NA		0.0012	0.78
018	B002	Zinc (Zn)	9.3	MG/KG	NA		0.0004	0.28
		Total			8.3584		0.1496	
018	B003	Antimony (Sb)	1.6	MG/KG	NA		0.0548	14.19
018	B003	Aroclor-1260	ND	UG/KG	NA		NA	
018	B003	Arsenic (As)	6.8	MG/KG	17.7616	74.28	0.3108	80.42
018	B003	B(a)P Equiv.	176.99	UG/KG	2.9310	12.26	NA	
018	B003	Beryllium (Be)	0.43	MG/KG	3.2197	13.46	0.0012	0.31
018	B003	Copper (Cu)	27.7	MG/KG	NA		0.0095	2.46
018	B003	Lead (Pb)	42.4	MG/KG	NA		NA	
018	B003	Nickel (Ni)	6.3	MG/KG	NA		0.0043	1.12
018	B003	Zinc (Zn)	128	MG/KG	NA		0.0059	1.51
		Total			23.9123		0.3865	
018	B004	Antimony (Sb)	7.2	MG/KG	NA		0.2468	37.82
018	B004	Aroclor-1260	ND	UG/KG	NA		NA	
018	B004	Arsenic (As)	6.6	MG/KG	17.2392	35.86	0.3017	46.22
018	B004	B(a)P Equiv.	1649.6	UG/KG	27.3179	56.82	NA	
018	B004	Beryllium (Be)	0.47	MG/KG	3.5192	7.32	0.0013	0.20
018	B004	Copper (Cu)	177	MG/KG	NA		0.0607	9.30
018	B004	Lead (Pb)	1960	MG/KG	NA		NA	
018	B004	Nickel (Ni)	16.7	MG/KG	NA		0.0114	1.75
018	B004	Zinc (Zn)	672	MG/KG	NA		0.0307	4.71
		Total			48.0763		0.6526	
018	B005	Antimony (Sb)	26	MG/KG	NA		0.8913	65.17
018	B005	Aroclor-1260	ND	UG/KG	NA		NA	
018	B005	Arsenic (As)	7.8	MG/KG	20.3736	77.36	0.3565	26.07
018	B005	B(a)P Equiv.	152.04	UG/KG	2.5178	9.56	NA	
018	B005	Beryllium (Be)	0.46	MG/KG	3.4444	13.08	0.0013	0.09
018	B005	Copper (Cu)	193	MG/KG	NA		0.0662	4.84
018	B005	Lead (Pb)	724	MG/KG	NA		NA	
018	B005	Nickel (Ni)	22.8	MG/KG	NA		0.0156	1.14
018	B005	Zinc (Zn)	803	MG/KG	NA		0.0367	2.68
		Total			26.3358		1.3676	

Table 10.1.6.15
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
605	B001	Antimony (Sb)	1.7	MG/KG	NA		0.0583	14.96
605	B001	Aroclor-1260	ND	UG/KG	NA		NA	
605	B001	Arsenic (As)	5.7	MG/KG	14.8884	66.88	0.2605	66.89
605	B001	B(a)P Equiv.	214.72	UG/KG	3.5558	15.97	NA	
605	B001	Beryllium (Be)	0.51	MG/KG	3.8187	17.15	0.0014	0.36
605	B001	Copper (Cu)	111	MG/KG	NA		0.0381	9.77
605	B001	Lead (Pb)	205	MG/KG	NA		NA	
605	B001	Nickel (Ni)	20.5	MG/KG	NA		0.0141	3.61
605	B001	Zinc (Zn)	376	MG/KG	NA		0.0172	4.41
		Total			22.2630		0.3895	
605	B002	Antimony (Sb)	8.8	MG/KG	NA		0.3017	85.21
605	B002	Aroclor-1260	ND	UG/KG	NA		NA	
605	B002	Arsenic (As)	1.1	MG/KG	2.8732	91.59	0.0503	14.20
605	B002	B(a)P Equiv.	15.93	UG/KG	0.2638	8.41	NA	
605	B002	Beryllium (Be)	ND	MG/KG	NA		NA	
605	B002	Copper (Cu)	3.8	MG/KG	NA		0.0013	0.37
605	B002	Lead (Pb)	1600	MG/KG	NA		NA	
605	B002	Nickel (Ni)	0.77	MG/KG	NA		0.0005	0.15
605	B002	Zinc (Zn)	5.3	MG/KG	NA		0.0002	0.07
		Total			3.1370		0.3540	
605	B003	Antimony (Sb)	6.5	MG/KG	NA		0.2228	26.28
605	B003	Aroclor-1260	ND	UG/KG	NA		NA	
605	B003	Arsenic (As)	10.9	MG/KG	28.4708	53.62	0.4982	58.76
605	B003	B(a)P Equiv.	1107.26	UG/KG	18.3366	34.53	NA	
605	B003	Beryllium (Be)	0.84	MG/KG	6.2897	11.85	0.0023	0.27
605	B003	Copper (Cu)	165	MG/KG	NA		0.0566	6.67
605	B003	Lead (Pb)	270	MG/KG	NA		NA	
605	B003	Nickel (Ni)	38.8	MG/KG	NA		0.0266	3.14
605	B003	Zinc (Zn)	906	MG/KG	NA		0.0414	4.88
		Total			53.0971		0.8479	
605	B004	Antimony (Sb)	1.5	MG/KG	NA		0.0514	5.50
605	B004	Aroclor-1260	ND	UG/KG	NA		NA	
605	B004	Arsenic (As)	18.6	MG/KG	48.5832	31.10	0.8502	91.00
605	B004	B(a)P Equiv.	6200.9	UG/KG	102.6888	65.74	NA	
605	B004	Beryllium (Be)	0.66	MG/KG	4.9419	3.16	0.0018	0.19
605	B004	Copper (Cu)	37.5	MG/KG	NA		0.0129	1.38
605	B004	Lead (Pb)	113	MG/KG	NA		NA	
605	B004	Nickel (Ni)	11.6	MG/KG	NA		0.0080	0.85
605	B004	Zinc (Zn)	219	MG/KG	NA		0.0100	1.07
		Total			156.2140		0.9342	

Table 10.1.6.15
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
605	B005	Antimony (Sb)	5.3	MG/KG	NA		0.1817	25.21
605	B005	Aroclor-1260	ND	UG/KG	NA		NA	
605	B005	Arsenic (As)	7.2	MG/KG	18.8064	53.31	0.3291	45.67
605	B005	B(a)P Equiv.	ND	UG/KG	NA		NA	
605	B005	Beryllium (Be)	2.2	MG/KG	16.4730	46.69	0.0060	0.84
605	B005	Copper (Cu)	291	MG/KG	NA		0.0998	13.84
605	B005	Lead (Pb)	249	MG/KG	NA		NA	
605	B005	Nickel (Ni)	73.8	MG/KG	NA		0.0506	7.02
605	B005	Zinc (Zn)	1170	MG/KG	NA		0.0535	7.42
		Total			35.2794		0.7207	
605	B006	Antimony (Sb)	2.7	MG/KG	NA		0.0926	34.01
605	B006	Aroclor-1260	ND	UG/KG	NA		NA	
605	B006	Arsenic (As)	2.5	MG/KG	6.5300	53.54	0.1143	41.99
605	B006	B(a)P Equiv.	201.98	UG/KG	3.3449	27.43	NA	
605	B006	Beryllium (Be)	0.31	MG/KG	2.3212	19.03	0.0009	0.31
605	B006	Copper (Cu)	82.1	MG/KG	NA		0.0281	10.34
605	B006	Lead (Pb)	399	MG/KG	NA		NA	
605	B006	Nickel (Ni)	16.3	MG/KG	NA		0.0112	4.11
605	B006	Zinc (Zn)	550	MG/KG	NA		0.0251	9.24
		Total			12.1961		0.2721	
605	B007	Antimony (Sb)	9.5	MG/KG	NA		0.3257	31.68
605	B007	Aroclor-1260	ND	UG/KG	NA		NA	
605	B007	Arsenic (As)	3.2	MG/KG	8.3584	21.95	0.1463	14.23
605	B007	B(a)P Equiv.	121.99	UG/KG	2.0202	5.30	NA	
605	B007	Beryllium (Be)	3.7	MG/KG	27.7046	72.75	0.0101	0.99
605	B007	Copper (Cu)	746	MG/KG	NA		0.2557	24.88
605	B007	Lead (Pb)	1190	MG/KG	NA		NA	
605	B007	Nickel (Ni)	245	MG/KG	NA		0.1680	16.34
605	B007	Zinc (Zn)	2670	MG/KG	NA		0.1220	11.87
		Total			38.0832		1.0278	
605	B008	Antimony (Sb)	2.1	MG/KG	NA		0.0720	13.70
605	B008	Aroclor-1260	ND	UG/KG	NA		NA	
605	B008	Arsenic (As)	8.8	MG/KG	22.9856	47.87	0.4022	76.57
605	B008	B(a)P Equiv.	1226.66	UG/KG	20.3139	42.31	NA	
605	B008	Beryllium (Be)	0.63	MG/KG	4.7173	9.82	0.0017	0.33
605	B008	Copper (Cu)	65	MG/KG	NA		0.0223	4.24
605	B008	Lead (Pb)	460	MG/KG	NA		NA	
605	B008	Nickel (Ni)	21.9	MG/KG	NA		0.0150	2.86
605	B008	Zinc (Zn)	264	MG/KG	NA		0.0121	2.30
		Total			48.0168		0.5253	

Table 10.1.6.15
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
605	B009	Antimony (Sb)	4.5	MG/KG	NA		0.1543	36.60
605	B009	Aroclor-1260	ND	UG/KG	NA		NA	
605	B009	Arsenic (As)	3.3	MG/KG	8.6196	51.27	0.1508	35.79
605	B009	B(a)P Equiv.	205.34	UG/KG	3.4005	20.23	NA	
605	B009	Beryllium (Be)	0.64	MG/KG	4.7922	28.50	0.0018	0.42
605	B009	Copper (Cu)	161	MG/KG	NA		0.0552	13.10
605	B009	Lead (Pb)	731	MG/KG	NA		NA	
605	B009	Nickel (Ni)	39.2	MG/KG	NA		0.0269	6.38
605	B009	Zinc (Zn)	712	MG/KG	NA		0.0325	7.72
		Total			16.8122		0.4215	
605	B010	Antimony (Sb)	1.1	MG/KG	NA		0.0377	9.08
605	B010	Aroclor-1260	ND	UG/KG	NA		NA	
605	B010	Arsenic (As)	7.3	MG/KG	19.0676	76.49	0.3337	80.31
605	B010	B(a)P Equiv.	150.48	UG/KG	2.4920	10.00	NA	
605	B010	Beryllium (Be)	0.45	MG/KG	3.3695	13.52	0.0012	0.30
605	B010	Copper (Cu)	65.7	MG/KG	NA		0.0225	5.42
605	B010	Lead (Pb)	120	MG/KG	NA		NA	
605	B010	Nickel (Ni)	9.3	MG/KG	NA		0.0064	1.53
605	B010	Zinc (Zn)	305	MG/KG	NA		0.0139	3.36
		Total			24.9291		0.4154	
605	B011	Antimony (Sb)	1.7	MG/KG	NA		0.0583	25.66
605	B011	Aroclor-1260	ND	UG/KG	NA		NA	
605	B011	Arsenic (As)	1.5	MG/KG	3.9180	35.71	0.0686	30.19
605	B011	B(a)P Equiv.	0.86	UG/KG	0.0142	0.13	NA	
605	B011	Beryllium (Be)	0.94	MG/KG	7.0385	64.16	0.0026	1.14
605	B011	Copper (Cu)	131	MG/KG	NA		0.0449	19.78
605	B011	Lead (Pb)	177	MG/KG	NA		NA	
605	B011	Nickel (Ni)	33	MG/KG	NA		0.0226	9.96
605	B011	Zinc (Zn)	659	MG/KG	NA		0.0301	13.27
		Total			10.9707		0.2271	
605	B012	Antimony (Sb)	22.9	MG/KG	NA		0.7850	38.21
605	B012	Aroclor-1260	230	UG/KG	1.0435	1.46	NA	
605	B012	Arsenic (As)	14.9	MG/KG	38.9188	54.43	0.6810	33.15
605	B012	B(a)P Equiv.	638.21	UG/KG	10.5690	14.78	NA	
605	B012	Beryllium (Be)	2.8	MG/KG	20.9657	29.32	0.0077	0.37
605	B012	Copper (Cu)	730	MG/KG	NA		0.2503	12.18
605	B012	Lead (Pb)	984	MG/KG	NA		NA	
605	B012	Nickel (Ni)	270	MG/KG	NA		0.1851	9.01
605	B012	Zinc (Zn)	3180	MG/KG	NA		0.1454	7.07
		Total			71.4970		2.0545	

Table 10.1.6.15
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston, Zone E
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
605	B013	Antimony (Sb)	9.5	MG/KG	NA		0.3257	49.64
605	B013	Aroclor-1260	350	UG/KG	1.5880	3.76	NA	
605	B013	Arsenic (As)	4	MG/KG	10.4480	24.75	0.1828	27.87
605	B013	B(a)P Equiv.	1369.99	UG/KG	22.6875	53.75	NA	
605	B013	Beryllium (Be)	1	MG/KG	7.4877	17.74	0.0027	0.42
605	B013	Copper (Cu)	179	MG/KG	NA		0.0614	9.35
605	B013	Lead (Pb)	627	MG/KG	NA		NA	
605	B013	Nickel (Ni)	53.1	MG/KG	NA		0.0364	5.55
605	B013	Zinc (Zn)	1030	MG/KG	NA		0.0471	7.18
		Total			42.2112		0.6561	
605	B014	Antimony (Sb)	13.3	MG/KG	NA		0.4559	22.83
605	B014	Aroclor-1260	ND	UG/KG	NA		NA	
605	B014	Arsenic (As)	31.4	MG/KG	82.0168	74.06	1.4352	71.87
605	B014	B(a)P Equiv.	1459	UG/KG	24.1615	21.82	NA	
605	B014	Beryllium (Be)	0.61	MG/KG	4.5675	4.12	0.0017	0.08
605	B014	Copper (Cu)	127	MG/KG	NA		0.0435	2.18
605	B014	Lead (Pb)	125	MG/KG	NA		NA	
605	B014	Nickel (Ni)	35	MG/KG	NA		0.0240	1.20
605	B014	Zinc (Zn)	799	MG/KG	NA		0.0365	1.83
		Total			110.7458		1.9969	
605	B015	Antimony (Sb)	23.4	MG/KG	NA		0.8022	46.55
605	B015	Aroclor-1260	250	UG/KG	1.1343	4.03	NA	
605	B015	Arsenic (As)	1.1	MG/KG	2.8732	10.20	0.0503	2.92
605	B015	B(a)P Equiv.	464.3	UG/KG	7.6890	27.30	NA	
605	B015	Beryllium (Be)	2.2	MG/KG	16.4730	58.48	0.0060	0.35
605	B015	Copper (Cu)	1900	MG/KG	NA		0.6513	37.80
605	B015	Lead (Pb)	1120	MG/KG	NA		NA	
605	B015	Nickel (Ni)	170	MG/KG	NA		0.1166	6.76
605	B015	Zinc (Zn)	2120	MG/KG	NA		0.0969	5.62
		Total			28.1694		1.7233	
605	B017	Antimony (Sb)	1.2	MG/KG	NA		0.0411	12.48
605	B017	Arsenic (As)	5.2	MG/KG	13.5824	66.58	0.2377	72.09
605	B017	B(a)P Equiv.	203.77	UG/KG	3.3745	16.54	NA	
605	B017	Beryllium (Be)	0.46	MG/KG	3.4444	16.88	0.0013	0.38
605	B017	Copper (Cu)	73	MG/KG	NA		0.0250	7.59
605	B017	Lead (Pb)	176	MG/KG	NA		NA	
605	B017	Nickel (Ni)	13	MG/KG	NA		0.0089	2.70
605	B017	Zinc (Zn)	343	MG/KG	NA		0.0157	4.76
		Total			20.4013		0.3297	

Table 10.1.6.16
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
005	B001	Arsenic (As)	4.20	MG/KG	1.5519	36.41	0.0097	99.54
005	B001	B(a)P Equiv.	704.35	UG/KG	2.3716	55.64	NA	
005	B001	Beryllium (Be)	0.32	MG/KG	0.3390	7.95	0.00004	0.46
005	B001	Lead (Pb)	338.00	MG/KG	NA		NA	
		Total			4.2625		0.0097	
005	B002	Arsenic (As)	2.10	MG/KG	0.7760	53.45	0.0048	100.00
005	B002	B(a)P Equiv.	200.68	UG/KG	0.6757	46.55	NA	
005	B002	Beryllium (Be)	ND	MG/KG	NA		NA	
005	B002	Lead (Pb)	10500.00	MG/KG	NA		NA	
		Total			1.4517		0.0048	
005	B003	Arsenic (As)	5.20	MG/KG	1.9214	72.33	0.0120	99.21
005	B003	B(a)P Equiv.	1.28	UG/KG	0.0043	0.16	NA	
005	B003	Beryllium (Be)	0.69	MG/KG	0.7309	27.51	0.0001	0.79
005	B003	Lead (Pb)	462.00	MG/KG	NA		NA	
		Total			2.6566		0.0121	
018	B001	Arsenic (As)	3.50	MG/KG	1.2933	29.33	0.0080	99.66
018	B001	B(a)P Equiv.	862.51	UG/KG	2.9042	65.86	NA	
018	B001	Beryllium (Be)	0.20	MG/KG	0.2119	4.80	0.0000	0.34
018	B001	Lead (Pb)	404.00	MG/KG	NA		NA	
		Total			4.4093		0.0081	
018	B002	Arsenic (As)	3.20	MG/KG	1.1824	100.00	0.0074	100.00
018	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
018	B002	Beryllium (Be)	ND	MG/KG	NA		NA	
018	B002	Lead (Pb)	8.70	MG/KG	NA		NA	
		Total			1.1824		0.0074	
018	B003	Arsenic (As)	6.80	MG/KG	2.5126	70.50	0.0156	99.62
018	B003	B(a)P Equiv.	176.99	UG/KG	0.5960	16.72	NA	
018	B003	Beryllium (Be)	0.43	MG/KG	0.4555	12.78	0.0001	0.38
018	B003	Lead (Pb)	42.40	MG/KG	NA		NA	
		Total			3.5641		0.0157	
018	B004	Arsenic (As)	6.60	MG/KG	2.4387	28.72	0.0152	99.57
018	B004	B(a)P Equiv.	1649.60	UG/KG	5.5544	65.42	NA	
018	B004	Beryllium (Be)	0.47	MG/KG	0.4978	5.86	0.0001	0.43
018	B004	Lead (Pb)	1960.00	MG/KG	NA		NA	
		Total			8.4910		0.0152	

Table 10.1.6.16
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
018	B005	Arsenic (As)	7.80	MG/KG	2.8822	74.26	0.0179	99.65
018	B005	B(a)P Equiv.	152.04	UG/KG	0.5119	13.19	NA	
018	B005	Beryllium (Be)	0.46	MG/KG	0.4873	12.55	0.0001	0.35
018	B005	Lead (Pb)	724.00	MG/KG	NA		NA	
		Total			3.8814		0.0180	
605	B001	Arsenic (As)	5.70	MG/KG	2.1062	62.51	0.0131	99.47
605	B001	B(a)P Equiv.	214.72	UG/KG	0.7230	21.46	NA	
605	B001	Beryllium (Be)	0.51	MG/KG	0.5402	16.03	0.0001	0.53
605	B001	Lead (Pb)	205.00	MG/KG	NA		NA	
		Total			3.3694		0.0132	
605	B002	Arsenic (As)	1.10	MG/KG	0.4065	88.34	0.0025	100.00
605	B002	B(a)P Equiv.	15.93	UG/KG	0.0536	11.66	NA	
605	B002	Beryllium (Be)	ND	MG/KG	NA		NA	
605	B002	Lead (Pb)	1600.00	MG/KG	NA		NA	
		Total			0.4601		0.0025	
605	B003	Arsenic (As)	10.90	MG/KG	4.0276	46.59	0.0251	99.54
605	B003	B(a)P Equiv.	1107.26	UG/KG	3.7283	43.12	NA	
605	B003	Beryllium (Be)	0.84	MG/KG	0.8898	10.29	0.0001	0.46
605	B003	Lead (Pb)	270.00	MG/KG	NA		NA	
		Total			8.6457		0.0252	
605	B004	Arsenic (As)	18.60	MG/KG	6.8728	24.16	0.0428	99.79
605	B004	B(a)P Equiv.	6200.90	UG/KG	20.8793	73.39	NA	
605	B004	Beryllium (Be)	0.66	MG/KG	0.6991	2.46	0.0001	0.21
605	B004	Lead (Pb)	113.00	MG/KG	NA		NA	
		Total			28.4512		0.0429	
605	B005	Arsenic (As)	7.20	MG/KG	2.6605	53.31	0.0166	98.20
605	B005	B(a)P Equiv.	ND	UG/KG	NA		NA	
605	B005	Beryllium (Be)	2.20	MG/KG	2.3304	46.69	0.0003	1.80
605	B005	Lead (Pb)	249.00	MG/KG	NA		NA	
		Total			4.9908		0.0169	
605	B006	Arsenic (As)	2.50	MG/KG	0.9238	47.81	0.0057	99.26
605	B006	B(a)P Equiv.	201.98	UG/KG	0.6801	35.20	NA	
605	B006	Beryllium (Be)	0.31	MG/KG	0.3284	16.99	0.0000	0.74
605	B006	Lead (Pb)	399.00	MG/KG	NA		NA	
		Total			1.9322		0.0058	

Table 10.1.6.16
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
605	B007	Arsenic (As)	3.20	MG/KG	1.1824	21.45	0.0074	93.51
605	B007	B(a)P Equiv.	121.99	UG/KG	0.4108	7.45	NA	
605	B007	Beryllium (Be)	3.70	MG/KG	3.9192	71.10	0.0005	6.49
605	B007	Lead (Pb)	1190.00	MG/KG	NA		NA	
		Total			5.5124		0.0079	
605	B008	Arsenic (As)	8.80	MG/KG	3.2517	40.40	0.0202	99.57
605	B008	B(a)P Equiv.	1226.66	UG/KG	4.1303	51.31	NA	
605	B008	Beryllium (Be)	0.63	MG/KG	0.6673	8.29	0.0001	0.43
605	B008	Lead (Pb)	460.00	MG/KG	NA		NA	
		Total			8.0493		0.0203	
605	B009	Arsenic (As)	3.30	MG/KG	1.2194	47.10	0.0076	98.85
605	B009	B(a)P Equiv.	205.34	UG/KG	0.6914	26.71	NA	
605	B009	Beryllium (Be)	0.64	MG/KG	0.6779	26.19	0.0001	1.15
605	B009	Lead (Pb)	731.00	MG/KG	NA		NA	
		Total			2.5887		0.0077	
605	B010	Arsenic (As)	7.30	MG/KG	2.6974	73.28	0.0168	99.63
605	B010	B(a)P Equiv.	150.48	UG/KG	0.5067	13.77	NA	
605	B010	Beryllium (Be)	0.45	MG/KG	0.4767	12.95	0.0001	0.37
605	B010	Lead (Pb)	120.00	MG/KG	NA		NA	
		Total			3.6808		0.0168	
605	B011	Arsenic (As)	1.50	MG/KG	0.5543	35.69	0.0034	96.38
605	B011	B(a)P Equiv.	0.86	UG/KG	0.0029	0.19	NA	
605	B011	Beryllium (Be)	0.94	MG/KG	0.9957	64.12	0.0001	3.62
605	B011	Lead (Pb)	177.00	MG/KG	NA		NA	
		Total			1.5529		0.0036	
605	B012	Arsenic (As)	14.90	MG/KG	5.5057	51.84	0.0343	98.89
605	B012	B(a)P Equiv.	638.21	UG/KG	2.1489	20.23	NA	
605	B012	Beryllium (Be)	2.80	MG/KG	2.9659	27.93	0.0004	1.11
605	B012	Lead (Pb)	984.00	MG/KG	NA		NA	
		Total			10.6205		0.0346	
605	B013	Arsenic (As)	4.00	MG/KG	1.4780	20.67	0.0092	98.52
605	B013	B(a)P Equiv.	1369.99	UG/KG	4.6129	64.51	NA	
605	B013	Beryllium (Be)	1.00	MG/KG	1.0593	14.81	0.0001	1.48
605	B013	Lead (Pb)	627.00	MG/KG	NA		NA	
		Total			7.1502		0.0093	

Table 10.1.6.16
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMUs 5, 18 and AOC 605
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
605	B014	Arsenic (As)	31.40	MG/KG	11.6025	67.61	0.0722	99.88
605	B014	B(a)P Equiv.	1459.00	UG/KG	4.9127	28.63	NA	
605	B014	Beryllium (Be)	0.61	MG/KG	0.6461	3.77	0.0001	0.12
605	B014	Lead (Pb)	125.00	MG/KG	NA		NA	
		Total			17.1613		0.0723	
605	B015	Arsenic (As)	1.10	MG/KG	0.4065	9.45	0.0025	89.29
605	B015	B(a)P Equiv.	464.30	UG/KG	1.5634	36.36	NA	
605	B015	Beryllium (Be)	2.20	MG/KG	2.3304	54.19	0.0003	10.71
605	B015	Lead (Pb)	1120.00	MG/KG	NA		NA	
		Total			4.3002		0.0028	
605	B017	Arsenic (As)	5.20	MG/KG	1.9214	62.09	0.0120	99.47
605	B017	B(a)P Equiv.	203.77	UG/KG	0.6861	22.17	NA	
605	B017	Beryllium (Be)	0.46	MG/KG	0.4873	15.74	0.0001	0.53
605	B017	Lead (Pb)	176.00	MG/KG	NA		NA	
		Total			3.0948		0.0120	

Table 10.1.6.17
Remedial Goal Options for Soil
SWMUs 5, 18; AOC 605
Naval Base Charleston, Zone E
Charleston, South Carolina

Chemical	Slope Factor mg/kg-day)-	Reference Dose (mg/kg-day)	EPC mg/kg	Hazard-Based Remedial Goal Options 3 mg/kg	1 mg/kg	0.1 mg/kg	Risk-Based Remedial Goal Options 0.000001 mg/kg	0.00001 mg/kg	0.0001 mg/kg	Background mg/kg
Residential-Based Remedial Goal Options										
Inorganic										
Antimony (Sb)	NA	0.0004	15	88	29	2.92	ND	ND	ND	NA
Arsenic (As)	1.5	0.0003	10.44	66	22	2.19	0.38	3.83	38	9.44
Beryllium (Be)	4.3	0.005	1.74	1094	365	36	0.13	1.34	13	NA
Copper (Cu)	NA	0.04	631	8751	2917	292	ND	ND	ND	165
Zinc (Zn)	NA	0.3	3020	65634	21878	2188	ND	ND	ND	207.6
Semivolatile Organics										
Benzo(a)pyrene equivalen	7.3	NA	1.24	ND	ND	ND	0.06	0.60	6	NA
Worker-Based Remedial Goal Options										
Inorganic										
Antimony (Sb)	1.5	0.0003	10.44	1305	435	43	2.71	27	271	9.44
Beryllium (Be)	4.3	0.005	1.74	21745	7248	725	0.94	9.44	94	NA
Semivolatile Organics										
Benzo(a)pyrene equivalen	7.3	NA	1.24	ND	ND	ND	0.30	2.97	30	NA

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

10.1.7 Corrective Measures Considerations

For SWMUs 5 and 18 and AOC 605, the upper and lower soil intervals and shallow groundwater were investigated. Based on the analytical results and the risk assessment, COCs requiring further evaluation through the CMS process were identified for the upper soil interval and shallow groundwater. However, residential use of the site is not expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use. However, the industrial exposure risk for the upper soil interval exceeds 1E-06 for arsenic, beryllium, and BEQs. The Navy conducted an interim action which excavated and disposed offsite the upper and lower soil interval, thus eliminating the associated risk.

Assuming the interim measure has not been conducted, a corrective measures evaluation for the upper soil interval would consider the risk of existing soil conditions and residential remedial goals. Antimony, arsenic, beryllium, copper, zinc, and BEQs were identified as COCs in the upper soil interval. The equated soil pathway residential exposure risk is 6E-05 and the HI is 1. Both are between USEPA's acceptable ranges of 1E-06 and 1E-04 for risk and 3 and 0.1 for HI.

Lead was identified at several locations above USEPA's residential acceptable residential level of 400 mg/kg. The highest concentration of lead occurred in a 220-foot by 50-foot area around SWMUs 5 and 18. Residential risk-based remedial goals for surface soil set for arsenic, beryllium, and BEQs were 0.38, 0.13, and 0.06 mg/kg, respectively, based on a target risk of 1E-06. Hazard-based remedial goals for surface soil set for antimony, copper, and zinc were 2.9, 292, and 2,188 mg/kg, respectively, based on a target HI of 1. Lead has a target residential remedial goal of 400 mg/kg. Potential corrective measures, in addition to no further action for soil and respective COCs, are presented in Table 10.1.7.1.

In addition to the concerns for the upper soil interval, and based on detected concentrations of antimony, arsenic, barium, lead, and nickel, the lower soil interval requires further evaluation for protection of groundwater through the CMS process. Corrective measures that prevent infiltration and percolation will be considered, in addition to stabilization.

Table 10.1.7.1
Potential Corrective Measures for SWMUs 5 and 18 and AOC 605

Medium	Compounds	Potential Corrective Measures
Soil*	Antimony, arsenic, beryllium, copper, lead, and benzo(a)pyrene	a) No Action b) Intrinsic Remediation and Monitoring c) Containment by capping d) Excavation and Landfill, if RCRA-nonhazardous waste e) In-Situ, Chemical, and Physical Treatment f) Ex-Situ, Chemical and Physical Treatment
Shallow Groundwater	Arsenic and lead	a) No Action b) Intrinsic Remediation and Monitoring c) Ex-Situ, Chemical and Physical Treatment

Note:
* = The Navy conducted an interim action to remove the surface soil over a 340-foot by about 50-foot area on the southeast side of Building 1278 to a depth of 5 feet in the vicinity of SWMUs 5 and 18. Corrective measures for soil will be based on the confirmation samples of the interim action.

Antimony and arsenic were identified in shallow groundwater at concentrations that equal a risk above 1E-06 and/or an HI above 1. Dioxin was detected above 1E-06 risk in the first sampling round but dramatically decreased in the second-, third-, and fourth-quarter samples to below 1E-06 risk levels. Shallow groundwater-associated risk at monitoring wells NBCE605001 and NBCE605003 is 2E-04 and 1E-03, respectively, for arsenic. The concentration of antimony detected in the groundwater sample from monitoring well NBCE605003 equaled an HI of 10. Lead is also a concern with shallow groundwater. Based on data collected, a groundwater plume is not indicated but may exist. Potential corrective measures for the impacted media and respective COCs are in Table 10.1.7.1. Corrective measures for SWMUs 5 and 18 and AOC 605 are detailed in Section 9.

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10.5 SWMU 53, Satellite Accumulation Area, Building 212; and AOC 526, Paint Area, Building 212

SWMU 53, once contained former Satellite Accumulation Area (SAA) 29, which was used as an element of the CNSY hazardous waste management system. Wastes were accumulated in 55-gallon drums on an asphalt surface. The unit had no containment system. Use of the SAA has been discontinued and the unit has been removed from the site. The operation dates of this SAA are not known.

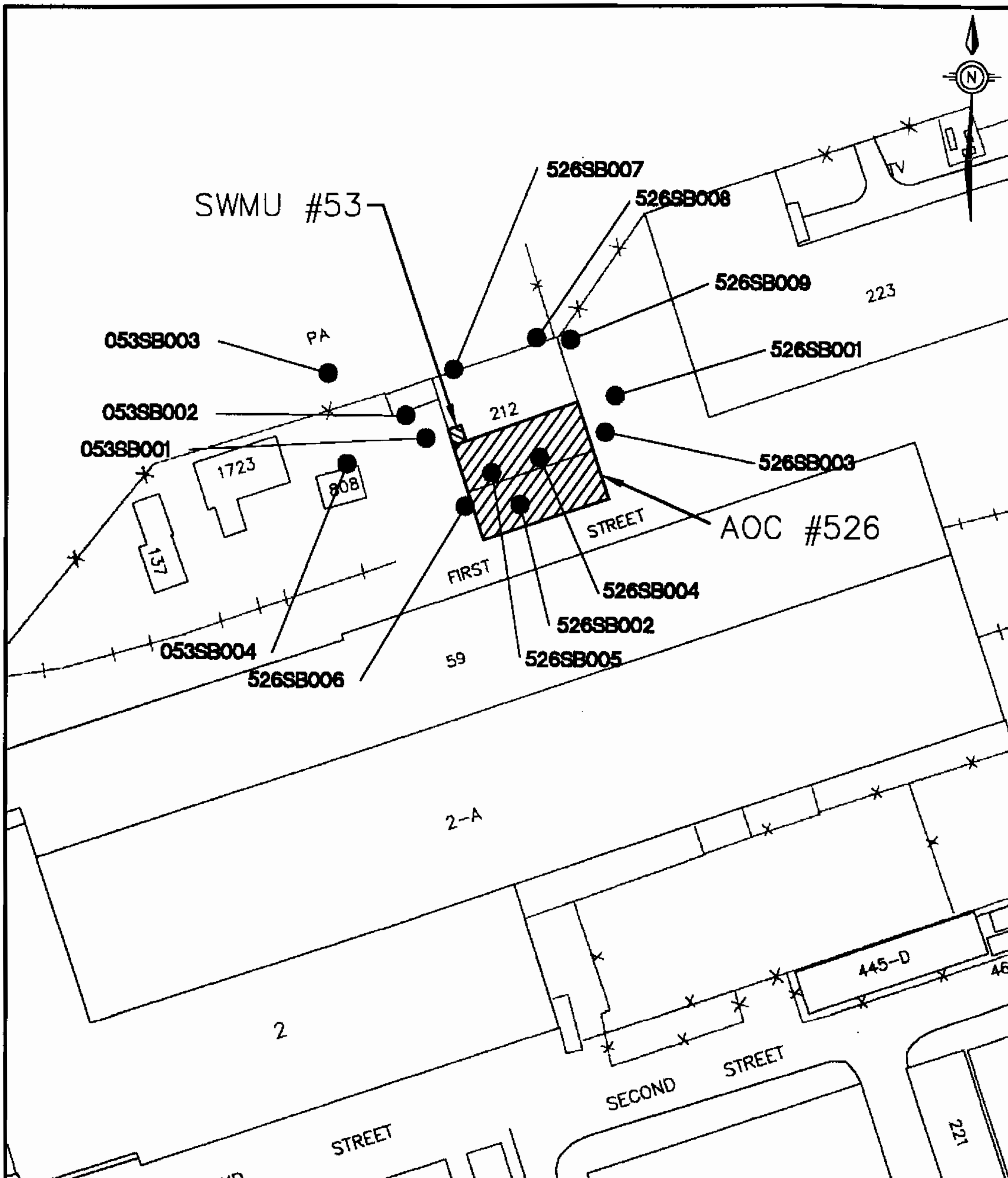
AOC 526, a paint area, formerly operated in Building 212, was used for spray painting ship components. Two types of metal-based paints were used for this process. Operations commenced in 1974 and continued until approximately 1993. This unit has been cleaned and all waste sludge has been removed and properly disposed of.

Materials of concern at SWMU 53, identified in the *Final Zone E RFI Work Plan* (E/A&H, June 1995), include acids, metals, solvents, petroleum hydrocarbons, and paints. At AOC 526, the materials of concern are metals, solvents, and paints (some of which contain organotin and tributyltin). Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure.

To fulfill the RFI objectives for these units, soil and groundwater samples were collected in accordance with the *Final Zone E RFI Work Plan* and Section 3 of this report to determine whether contamination resulted from onsite activities.

10.5.1 Soil Sampling and Analysis

Soil was sampled in two rounds at SWMU 53 and AOC 526 from the locations shown in Figure 10.5.1. The *Final Zone E RFI Work Plan* proposed collecting eight soil samples from the



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.5.1
SOIL BORING LOCATIONS
SWMU #53 AND AOC #526
BUILDING 212
PAINT AREA

DWG DATE: 09/02/97 | DWG NAME: 10-5-1

upper interval and eight samples from the lower interval. Soil samples were also collected at both intervals for the three shallow monitoring well locations proposed at this site.

First-round Sampling — During the first round of sampling, 10 of the 11 proposed upper-interval samples and 10 of the 11 proposed lower-interval samples were collected. At AOC 526, an obstruction directly beneath the asphalt surface prevented the collection of one upper and one lower-interval sample at 526SB001.

All first-round samples were submitted for analysis at DQO Level III for organotins and the standard suite of parameters which includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide. Three samples (two upper-interval and one lower-interval) selected as duplicates were analyzed at DQO Level IV for Appendix IX analytical parameters, which includes the suite of parameters proposed for the site, plus a more comprehensive list of VOCs, SVOCs, as well as herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. Table 10.5.1.1 summarizes the first round of soil sampling.

Second-round Sampling — Second-round sampling was performed at SWMU 53 after first round analytical results were compared to the USEPA Region III RBCs (April 1996). Two upper-interval and two lower-interval samples were proposed during second-round sampling to determine the extent of constituents detected during the initial round of soil sampling. Both upper-interval and both lower-interval samples were collected.

Table 10.5.1.1
SWMU 53 and AOC 526
First Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	11	10	Standard Suite[a], organotins	Standard Suite[a], organotins	Surface obstructions prevented the collection of one sample at AOC 526
Lower	11	10	Standard Suite[a], organotins	Standard Suite[a], organotins	Subsurface obstructions prevented the collection of one sample at AOC 526

Note:
a = Standard Suite includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide

All second-round samples were submitted for analysis at DQO Level III for organotins and the standard suite of parameters which includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide. Two upper-interval samples selected as duplicates were analyzed at DQO Level IV for Appendix IX analytical parameters, which includes the suite of parameters proposed for the site, plus a more comprehensive list of VOCs, SVOCs, as well as herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. Table 10.5.1.2 summarizes the second round of soil sampling.

Table 10.5.1.2
SWMU 53 and AOC 526
Second Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	2	2	Standard Suite[a], organotins	Standard Suite[a], organotins	None

Table 10.5.1.2
SWMU 53 and AOC 526
Second Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Lower	2	2	Standard Suite[a], organotins	Standard Suite[a], organotins	None

Note:
a = Standard Suite includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide

10.5.2 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.5.2.1. Inorganic analytical results for soil are summarized in Table 10.5.2.2. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.5.2.1
SWMU 53 and AOC 526
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs (μg/kg)						
Acetone	Upper	2/12	120 - 150	135	20,000,000	0
Carbon disulfide	Lower	1/12	5.00	5.00	NA	NA
SVOCs (μg/kg)						
Acenaphthylene	Upper	1/12	200	200	8,200,000	0
Anthracene	Upper	1/12	230	230	61,000,000	0
	Lower	1/12	1,100	1,100	NA	NA
Benzo(g,h,i)perylene	Upper	4/12	170 - 1,600	553	8,200,000	0
	Lower	3/12	150 - 5,800	2,080	8,200,000	0
Di-n-butylphthalate	Upper	1/12	93.0	93.0	20,000,000	0
	Lower	1/12	110	110	NA	NA

Table 10.5.2.1
SWMU 53 and AOC 526
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (μg/kg)						
Fluoranthene	Upper	3/12	120 - 780	347	8,200,000	0
	Lower	3/12	200 - 12,000	4,170	NA	NA
Phenanthrene	Upper	1/12	170	170	8,200,000	0
	Lower	2/12	97.0 - 4,500	2,300	NA	NA
Pyrene	Upper	4/12	180 - 810	358	6,100,000	0
	Lower	3/12	240 - 14,000	4860	NA	NA
SVOCs (B(a)P Equivalents) (μg/kg)						
B(a)P Equiv.	Upper	4/12	323 - 2,320	837	780	1
	Lower	4/12	28.2 - 10,600	2,710	NA	NA
Benzo(a)anthracene	Upper	3/12	130 - 700	323	7,800	0
	Lower	3/12	120 - 5,500	1,930	NA	NA
Benzo(b)fluoranthene	Upper	4/12	300 - 1,200	590	7,800	0
	Lower	3/12	150 - 260	193	NA	NA
Benzo(k)fluoranthene	Upper	4/12	230 - 2,500	868	78,000	0
	Lower	4/12	110 - 7,800	2,060	NA	NA
Benzo(a)pyrene	Upper	4/12	210 - 1,300	513	780	1
	Lower	2/12	160 - 6,500	3,330	NA	NA
Chrysene	Upper	3/12	200 - 1,000	480	780,000	0
	Lower	3/12	140 - 5,700	2,010	NA	NA
Dibenz(a,h)anthracene	Upper	2/12	79.0 - 700	390	780	0
	Lower	1/12	3,000	3,000	NA	NA
Indeno(1,2,3-cd)pyrene	Upper	4/12	130 - 1,000	378	7,800	0
	Lower	3/12	110 - 4,400	1,560	NA	NA
Pesticides/PCBs (μg/kg)						
delta-BHC	Lower	2/12	3.90 - 5.40	4.65	NA	NA

Table 10.5.2.1
SWMU 53 and AOC 526
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Pesticides/PCBs (μg/kg)						
alpha-Chlordane	Upper	1/12	1.70	1.70	4,400	0
gamma-Chlordane	Upper	2/12	2.30 - 3.40	2.85	4,400	0
4,4'-DDD	Upper	4/12	3.00 - 7.60	4.83	24,000	0
4,4'-DDE	Upper	7/12	3.20 - 140	33.9	17,000	0
	Lower	2/12	8.60 - 12.0	10.3	NA	NA
4,4'-DDT	Upper	6/12	4.50 - 58.0	25.1	17,000	0
	Lower	1/12	11.0	11.0	NA	NA
Endrin aldehyde	Upper	1/12	3.20	3.20	61,000	0
	Lower	1/12	3.50	3.50	NA	NA
Heptachlor	Upper	2/12	1.60 - 2.00	1.80	1,300	0
	Lower	2/12	2.20	2.20	NA	NA
Methoxychlor	Lower	2/12	32.0 - 150	91.0	NA	NA
Aroclor-1260	Upper	1/12	55.0	55.0	740	0
Dioxins (ng/kg)						
Dioxin Equiv.	Upper	4/4	0.575 - 8.49	2.97	1,000	0
	Lower	1/1	0.159	0.159	NA	NA
1234678-HpCDD	Upper	4/4	1.28 - 257	87.7	NA	NA
	Lower	1/1	5.72	5.72	NA	NA
1234678-HpCDF	Upper	4/4	1.84 - 126	43.6	NA	NA
	Lower	1/1	4.29	4.29	NA	NA
123678-HxCDD	Upper	1/4	7.43	7.43	NA	NA
123478-HxCDF	Upper	1/4	4.03	4.03	NA	NA
123678-HxCDF	Upper	2/4	6.85 - 14.9	10.9	NA	NA
123789-HxCDD	Upper	1/4	3.96	3.96	NA	NA

Table 10.5.2.1
SWMU 53 and AOC 526
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Dioxins (ng/kg)						
OCDD	Upper	4/4	13.6 - 1,760	611	NA	NA
	Lower	1/1	51.8	51.8	NA	NA
OCDF	Upper	4/4	0.626 - 270	86.2	NA	NA
	Lower	1/1	6.67	6.67	NA	NA
12378-PeCDF	Upper	1/4	2.53	2.53	NA	NA

Notes:
μg/kg = Micrograms per kilogram
ng/kg = Nanograms per kilogram
RBC = Risk-based concentration
NA = No industrial RBC established

Table 10.5.2.2
SWMU 53 and AOC 526
Inorganic Detections for Soil (mg/kg)

Element	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Aluminum (Al)	Upper	12/12	1,450 - 6,570	3,480	100,000	26,600	0
	Lower	12/12	721 - 8,950	4,930	NA	41,100	NA
Antimony (Sb)	Upper	7/12	0.610 - 2.60	1.12	82.0	1.77	0
Arsenic (As)	Upper	11/12	2.20 - 10.7	5.88	3.80	23.9	0
	Lower	11/12	1.10 - 8.30	4.15	NA	19.9	NA
Barium (Ba)	Upper	10/12	9.50 - 24.0	17.4	14,000	130	0
	Lower	10/12	10.8 - 26.7	16.7	NA	94.1	NA
Beryllium (Be)	Upper	10/12	0.160 - 0.390	0.243	1.30	1.70	0
	Lower	10/12	0.210 - 0.510	0.316	NA	2.71	NA
Cadmium (Cd)	Upper	8/12	0.0600 - 0.500	0.255	100	1.50	0
	Lower	2/12	0.290 - 0.390	0.340	NA	0.960	NA

Table 10.5.2.2
SWMU 53 and AOC 526
Inorganic Detections for Soil (mg/kg)

Element	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Calcium (Ca)	Upper	12/12	1,810 - 46,100	7,590	NA	NA	NA
	Lower	12/12	672 - 116,000	17,100	NA	NA	NA
Chromium (Cr)	Upper	12/12	4.00 - 193	42.1	1,000	94.6	0
	Lower	12/12	4.80 - 24.3	13.9	NA	75.2	NA
Cobalt (Co)	Upper	12/12	1.000 - 12.3	4.58	12,000	19.0	0
	Lower	12/12	0.650 - 4.80	1.80	NA	14.9	NA
Copper (Cu)	Upper	12/12	6.10 - 42.7	17.7	8,200	66.0	0
	Lower	12/12	0.970 - 26.7	7.61	NA	152	NA
Iron (Fe)	Upper	12/12	2,460 - 12,800	6,480	61,000	NA	0
	Lower	12/12	1,440 - 18,000	6,360	NA	NA	NA
Lead (Pb)	Upper	12/12	11.8 - 105	45.7	1,300	265	0
	Lower	12/12	2.30 - 309	41.1	NA	173	NA
Magnesium (Mg)	Upper	12/12	213 - 4,350	940	NA	NA	NA
	Lower	12/12	130 - 1,920	678	NA	NA	NA
Manganese (Mn)	Upper	12/12	28.2 - 75.5	52.8	4,700	302	0
	Lower	12/12	14.4 - 110	41.2	NA	881	NA
Mercury (Hg)	Upper	12/12	0.0600 - 8.80	0.938	61.0	2.60	0
	Lower	10/12	0.0300 - 0.190	0.0860	NA	1.59	NA
Nickel (Ni)	Upper	12/12	2.40 - 49.4	9.74	4,100	77.1	0
	Lower	12/12	1.10 - 9.30	3.28	NA	57.0	NA
Potassium (K)	Upper	4/12	278 - 735	475	NA	NA	NA
	Lower	4/12	174 - 1,050	744	NA	NA	NA
Selenium (Se)	Upper	3/12	0.580 - 0.740	0.673	1,000	1.70	0
	Lower	4/12	0.570 - 1.000	0.760	NA	2.40	NA
Silver (Ag)	Upper	3/12	1.40 - 2.20	1.90	1,000	NA	0
	Lower	2/12	0.450 - 0.470	0.460	NA	NA	NA

Table 10.5.2.2
SWMU 53 and AOC 526
Inorganic Detections for Soil (mg/kg)

Element	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Sodium (Na)	Upper	1/12	73.6	73.6	NA	NA	NA
	Lower	3/12	92.5 - 326	174	NA	NA	NA
Thallium (Tl)	Upper	2/12	0.590 - 1.10	0.845	16.0	NA	NA
	Lower	2/12	0.670 - 0.960	0.815	NA	NA	NA
Tin (Sn)	Upper	2/12	2.60 - 40.5	21.6	100,000	59.4	0
	Lower	1/12	2.70	2.70	NA	9.23	NA
Vanadium (V)	Upper	12/12	3.90 - 17.5	7.80	1,400	94.3	0
	Lower	12/12	2.20 - 40.7	12.3	NA	155	NA
Zinc (Zn)	Upper	12/12	19.0 - 376	113	61,000	827	0
	Lower	12/12	5.10 - 111	26.5	NA	886	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Risk-based concentration
RC = Reference concentration
NA = No industrial RBC or RC established

Volatile Organic Compounds in Soil

Two VOCs were detected in soil samples collected at SWMU 53 and AOC 526. Two detections occurred in the upper interval and one in the lower interval. No VOC was detected above its respective industrial RBC in the upper interval or respective SSL in the lower interval.

Semivolatile Organic Compounds in Soil

Fourteen SVOCs were detected in soil samples collected at SWMU 53 and AOC 526. Thirty-nine detections occurred in the upper interval and 32 in the lower interval. One SVOC — benzo(a)pyrene — exceeded its respective industrial RBC in the upper interval. Four SVOCs — benzo(a)anthracene, benzo(k)fluoranthene, benzo(a)pyrene, and chrysene — exceeded their respective SSLs in the lower interval.

Benzo(a)pyrene was detected in four of 12 upper-interval samples with a range of 210 to 1,300 μg/kg and a mean of 513 μg/kg. One upper-interval sample (526SB002, 1,300 μg/kg) exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg. Benzo(a)pyrene was detected in two of 12 lower-interval samples with a range of 160 to 6,500 μg/kg and a mean of 3,330 μg/kg. One lower-interval sample (053SB002, 6,500 μg/kg) exceeded the benzo(a)pyrene SSL of 4,000 μg/kg.

Benzo(a)anthracene was detected in three of 12 lower-interval samples with a range of 120 to 5,500 μg/kg and a mean of 1,930 μg/kg. One lower-interval sample (053SB002, 5,500 μg/kg) exceeded the benzo(a)anthracene SSL of 700 μg/kg.

Benzo(k)fluoranthene was detected in four of 12 lower-interval samples with a range of 110 to 7,800 μg/kg and a mean of 2,060 μg/kg. One lower-interval sample (053SB002, 2,060 μg/kg) exceeded the benzo(k)fluoranthene SSL of 4,000 μg/kg.

Chrysene was detected in three of 12 lower-interval samples with a range of 140 to 5,700 μg/kg and a mean of 2,010 μg/kg. One lower-interval sample (053SB002, 5,700 μg/kg) exceeded the chrysene SSL of 1,000 μg/kg.

In accordance with recent cPAH guidance, BEQs were calculated for cPAHs at SWMU 53 and AOC 526. The upper-interval BEQ was calculated for four samples with a range of 323 to 2,320 μg/kg and a mean of 837 μg/kg. One sample (526SB002, 2,320 μg/kg) exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg.

Pesticides and PCBs in Soil

Nine pesticides were detected in soil samples collected at SWMU 53 and AOC 526. Twenty-three detections occurred in the upper interval and 10 in the lower interval. No pesticides exceeded their respective industrial RBC in the upper interval or SSL in the lower interval.

One PCB (Aroclor-1260) was detected in soil samples collected at SWMU 53 and AOC 526, with one detection in the upper interval and zero in the lower interval. The PCB did not exceed its respective industrial RBC in the upper interval. No SSL has been established for Aroclor-1260.

Other Organic Compounds in Soil

Nine dioxins were detected in soil samples collected at SWMU 53 and AOC 526. Twenty-two detections occurred in the upper interval and four in the lower interval. No industrial RBCs or SSLs has been established for dioxin.

In accordance with recent dioxin guidance, TEQs (dioxin equivalent) were calculated for the upper-interval samples. The TEQ was calculated for four samples with a range of 0.575 to 8.49 ng/kg and a mean of 2.97 ng/kg. The TEQ was below the industrial RBC of 1,000 ng/kg.

Inorganic Elements in Soil

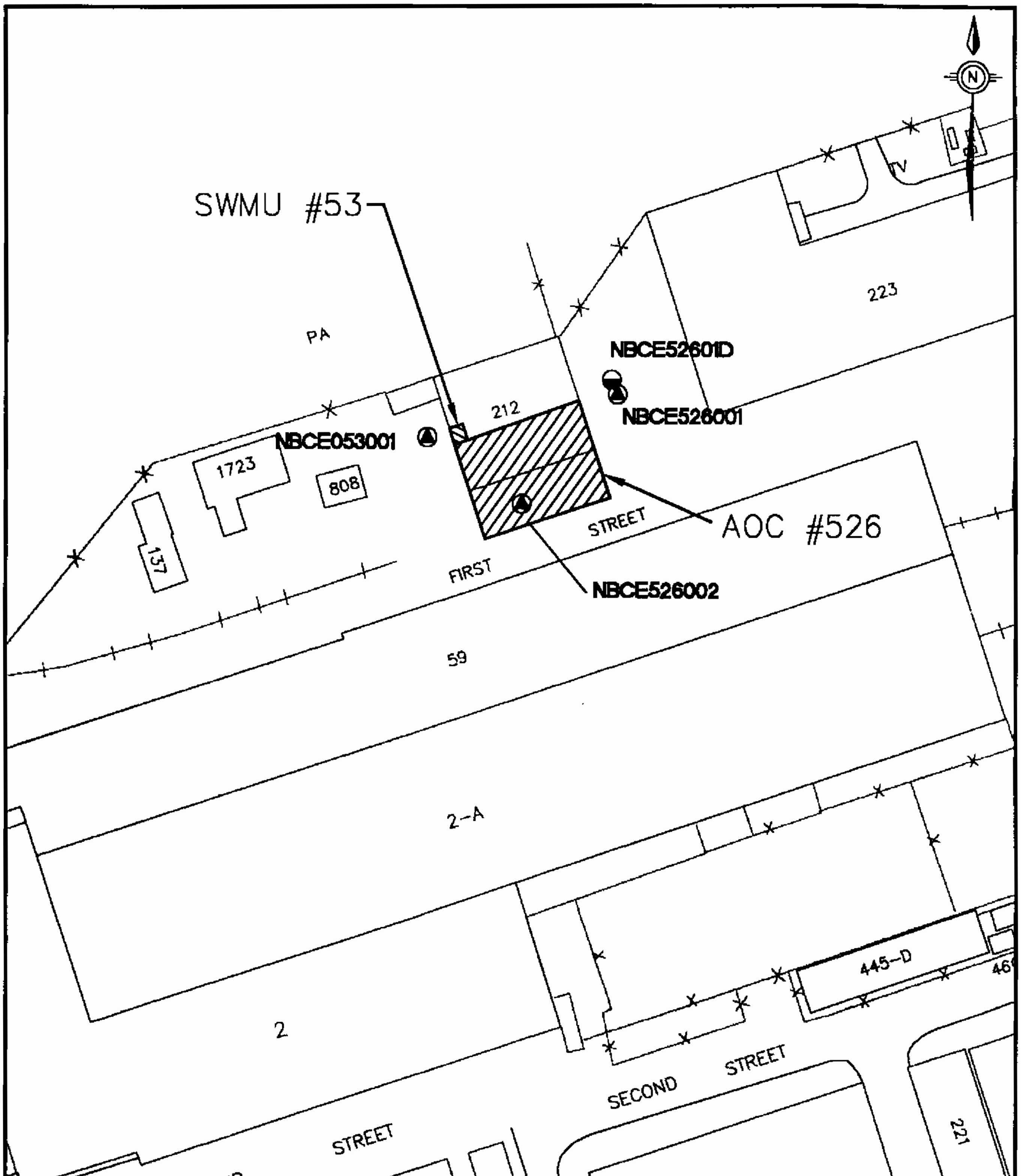
Twenty-four metals were detected in soil samples collected at SWMU 53 and AOC 526. Two hundred and seventeen detections occurred in the upper interval and 203 in the lower interval.

No metal exceeded both its respective industrial RBC and background RC in the upper interval or respective SSL and background RC in the lower interval.

10.5.3 Groundwater Sampling and Analysis

One deep monitoring well and three shallow monitoring wells were installed and sampled to assess groundwater quality at SWMU 53 and AOC 526 as shown in Figure 10.5.2. The wells were installed as follows:

- Shallow Well installed at SWMU 53 — NBCE053001
- Shallow Wells installed at AOC 526 — NBCE526001 and NBCE526002
- Deep Well installed at AOC 526 — NBCE52601D



LEGEND

- SOIL BORINGS
- CORE SAMPLES
- DEEP MONITORING WELLS
- SHALLOW MONITORING WELLS
- SEDIMENT SAMPLES
- THICKNESS SAMPLES
- WIPE SAMPLES
- SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.5.2
MONITORING WELL LOCATIONS
SWMU #53 AND AOC #526
BUILDING 212
PAINT AREA

DWG DATE: 09/02/97 | DWG NAME: 10-5-2

Groundwater samples were submitted for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, chlorides, sulfates, TDS, and organotins at DQO Level III. No duplicate samples were collected at this site. Table 10.5.3.1 summarizes groundwater sampling and analysis at SWMU 53 and AOC 526.

Table 10.5.3.1
SWMU 53 and AOC 526
Groundwater Sampling Summary

Depth	Wells Proposed	Wells Installed	Analyses Proposed	Analyses Collected	Deviations
Shallow	3	3	Standard Suite[a], chlorides, sulfates, and TDS	Standard Suite[a], chlorides, sulfates, and TDS	None
Deep	1	1	Standard Suite[a], chlorides, sulfates, and TDS	Standard Suite[a], chlorides, sulfates, and TDS	None

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs

The shallow monitoring wells were installed at 12.5 feet bgs in the surficial aquifer. The deep well was installed at 58.2 feet bgs at the base of the surficial aquifer. All wells were installed in accordance with Section 3.3 of this report.

10.5.4 Nature of Contamination in Groundwater

Organic compound analytical results for shallow groundwater are summarized in Table 10.5.4.1. No organic compounds were detected in deep groundwater at this site. Inorganic analytical results for shallow and deep groundwater are summarized in Tables 10.5.4.2 and 10.5.4.3, respectively. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.5.4.1
SWMU 53 and AOC 526
Organic Compounds Detected in First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	MCL	Number of Samples Exceeding RBC
VOCs						
1,2-Dichloroethene (total)	1/3	1.000	1.000	5.50	70.0	0

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level

Table 10.5.4.2
SWMU 53 and AOC 526
Inorganic Detections for First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Aluminum (Al)	2/3	399 - 1,110	755	3,700	2,810	NA	0
Arsenic (As)	1/3	9.40	9.40	0.0450	18.7	50.0	0
Calcium (Ca)	3/3	66,600 - 151,000	112,000	NA	NA	NA	NA
Chromium (Cr)	1/3	2.00	2.00	18.0	12.3	100	0
Cobalt (Co)	1/3	2.20	2.20	220	2.5	NA	0
Copper (Cu)	1/3	3.30	3.30	150	2.7	1,300	0
Iron (Fe)	3/3	1,180 - 9,650	5,640	1,100	NA	NA	3
Lead (Pb)	1/3	3.30	3.30	NA	4.8	15.0*	0
Magnesium (Mg)	3/3	6,020 - 28,000	20,400	NA	NA	NA	NA
Manganese (Mn)	3/3	69.7 - 439	312	84.0	2,560	NA	0
Nickel (Ni)	1/3	2.00	2.00	73.0	15.2	100	0
Potassium (K)	3/3	15,600 - 21,400	18,400	NA	NA	NA	NA

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
RC = Reference concentration
NA = No RBC, MCL, or RC established
* = TTAL

Table 10.5.4.3
SWMU 53 and AOC 526
Inorganic Detections for First-Quarter Groundwater (μg/L)
Deep Monitoring Well

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Calcium (Ca)	1/1	89,600	89,600	NA	NA	NA	NA
Magnesium (Mg)	1/1	12,000	12,000	NA	NA	NA	NA
Manganese (Mn)	1/1	56.7	56.7	84.0	869	NA	0

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
RC = Reference concentration
NA = No RBC, MCL, or RC established

Volatile Organic Compounds in Groundwater

Shallow Groundwater

One VOC was detected in shallow groundwater samples collected at SWMU 53 and AOC 526. The sample did not exceed its tap-water RBC or MCL.

Inorganic Elements in Groundwater

Shallow Groundwater

Twelve metals were detected in shallow groundwater samples collected at SWMU 53 and AOC 526. One metal — iron — exceeded its tap-water RBC.

Iron was detected in three of three samples with a range of 1,180 to 9,650 μg/L and a mean of 5,640 μg/L. Three samples from wells NBCE053001 (9,650 μg/L), NBCE526001 (1,180 μg/L), and NBCE526002 (6,090 μg/L) exceeded the iron tap-water RBC of 1,100 μg/L. No shallow groundwater RC or MCL has been established for iron.

Deep Groundwater

Three inorganics were detected in the deep groundwater sample collected at AOC 526 (no deep groundwater wells were installed at SWMU 53). No metal exceeded its respective tap-water RBC or RC (where available). No MCLs have been established for the detected inorganics in deep groundwater.

10.5.5 Fate and Transport Assessment for SWMU 53 and AOC 526

Combined SWMU 53 consists of SWMU 53, which is the former Satellite Accumulation Area (SAA) 29, and AOC 526, a paint area. The sites and the area around them are paved. Environmental media sampled as part of the combined SWMU 53 RFI include surface soil, subsurface soil, and shallow and deep groundwater. Potential constituent migration pathways investigated for combined SWMU 53 include soil to groundwater, groundwater to surface water, and emission of volatiles from surface soil to air.

10.5.5.1 Soil-to-Groundwater Cross-Media Transport: Tier One

Table 10.5.5.1 compares maximum detected organic constituent concentrations in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels, or (b) background reference concentrations. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 10:1, with no attenuation of constituents in soil (DAF=10).

Four organic compounds — benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, and delta-BHC — were detected in combined SWMU 53 soil at concentrations greater than groundwater protection SSLs. None of the four compounds was also detected in groundwater, indicating an incomplete pathway from soil to groundwater. Three PAH exceedances occurred in one subsurface sample (053SB002). The concentrations of the three PAHs in this sample were within one order of magnitude of their respective SSLs. Delta-BHC was detected in two subsurface soil samples (053SB001 and 526SB007) exceeding its SSL for delta-BHC. However, the detected concentrations were within the same order of magnitude as the SSLs.

Three inorganics — antimony, chromium, and mercury — were detected in single surface soil samples at concentrations above their respective groundwater protection SSLs or background reference values, and were carried over to the second-tier screen. No inorganic exceeded its SSL in subsurface samples. Chromium was the only one of the three that was also detected in groundwater, indicating a completed pathway from soil to groundwater. The antimony exceedance (526SB002) was only marginally higher than its generic SSL. The chromium and mercury exceedances, both from sample 053SB003, were both within one order of magnitude of their respective background reference values. The chromium detection in groundwater was four orders of magnitude lower than chromium's tap water RBC.

10.5.5.2 Groundwater-to-Surface Water Cross-Media Transport: Tier One

Table 10.5.5.1 also compares maximum detected organic constituent concentrations in shallow groundwater samples to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background reference concentrations for groundwater, as well as to the saltwater/surface water chronic values. To provide a conservative first-tier screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

No organic constituents were detected in shallow groundwater at concentrations above tap water RBCs or saltwater/surface water chronic screening levels.

No inorganic constituents were detected in groundwater at concentrations exceeding their tap water RBCs. Copper was the only inorganic detected above its saltwater/surface water chronic screening level, but only marginally (3.3 μg/L vs. 2.9 μg/L), in a single sample.

10.5.5.3 Soil and Groundwater-to-Surface Water Transport: Tier Two

Table 10.5.5.2 provides a second screening tier for all constituents detected in soil or groundwater at concentrations exceeding any of the first-tier screening levels. Constituent concentrations in groundwater are compared to combined ecological/human health RBCs that have been adjusted upward for site-specific dilution by surface water in the Cooper River, while soil constituent concentrations are compared to calculated SSLs that are based on the adjusted RBCs rather than the original target leachate concentrations. For the second-tier screen, no dilution of leachate by groundwater or attenuation of constituents in soil is assumed (DAF=1).

No organic or inorganic constituents detected in soil or groundwater samples at combined SWMU 53 exceeded their adjusted SSLs or RBCs, indicating that site constituents in soil and groundwater pose no threat to human health or the environment in the Cooper River through the associated migration pathway. The organic compounds detected in soil in the second-tier screen were two to four orders of magnitude lower than the corresponding adjusted SSLs. Considering that the adjusted SSLs were obtained assuming a DAF of 1, while the calculated site-specific DAF for combined SWMU 53 is 62, taking into account dilution only, the margin between detected soil concentrations and levels protective of the Cooper River is actually much greater than indicated by the table. Copper, the only first-tier constituent exceeding tap water RBCs, background reference values, or saltwater surface water chronic screening levels, was five orders of magnitude lower than the adjusted ecological/human health groundwater screening level of the second tier.

10.5.5.4 Soil-to-Air Cross-Media Transport

Table 10.5.5.3 lists the only VOC (acetone) detected in surface soil samples collected at combined SWMU 53 along with its corresponding soil-to-air volatilization screening level. Little or no surface soil is exposed at combined SWMU 53. In addition, acetone was not reported at a maximum concentration exceeding its corresponding soil-to-air volatilization screening level. As a result, the soil-to-air migration pathway is not expected to be significant at Combined SWMU 53.

10.5.5.5 Fate and Transport Summary

Four organic compounds (three PAHs and one pesticide) were detected in soil samples at concentrations exceeding their groundwater protection SSLs; none were detected in groundwater. The three PAH exceedances were detected in a single subsurface soil sample, while the pesticide (delta-BHC) was detected in only two subsurface samples. Three inorganic constituents exceeded their groundwater protection SSLs in individual samples, but only one of them (chromium) was also detected in groundwater. Copper, in one sample, was the only constituent detected in groundwater which exceeded its tap water RBCs or surface water screening levels.

None of the constituents exceeding first-tier screening values also exceeded the adjusted screening values of the second-tier comparisons, indicating no threat to surface water in the Cooper River via the evaluated migration pathways.

Table 10.5.5.1
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, and Deep Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMU 53 and AOC 526
Charleston, South Carolina

	Max. Concentration		Max. Concentration		Screening Concentration *							
Parameter	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds												
Acetone	150	ND	ND	ND	8000	3700	NA	UG/KG	UG/L	NO	NO	NO
Carbon disulfide	ND	5	ND	ND	16000	1000	NA	UG/KG	UG/L	NO	NO	NO
1,2-Dichloroethene (total)	ND	ND	1	ND	200	55	NA	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Acenaphthylene	200	ND	ND	ND	150000	1500	NA	UG/KG	UG/L	NO	NO	NO
Anthracene	230	1100	ND	ND	5900000	11000	NA	UG/KG	UG/L	NO	NO	NO
Benzo(g,h,i)perylene	1600	5800	ND	ND	2.33E+08	1500	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	700	5500	ND	ND	800	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(a)pyrene	1300	6500	ND	ND	4000	0.0092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(b)fluoranthene	1200	260	ND	ND	2500	0.092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(k)fluoranthene	2500	7800	ND	ND	24500	0.92	NA	UG/KG	UG/L	NO	NO	NO
Chrysene	1000	5700	ND	ND	80000	9.2	NA	UG/KG	UG/L	NO	NO	NO
Dibenzo(a,h)anthracene	700	3000	ND	ND	800	0.0092	NA	UG/KG	UG/L	YES	NO	NO
Indeno(1,2,3-cd)pyrene	1000	4400	ND	ND	7000	0.092	NA	UG/KG	UG/L	NO	NO	NO
Di-n-butylphthalate	93	110	ND	ND	2300000	3700	3.4	UG/KG	UG/L	NO	NO	NO
Fluoranthene	780	12000	ND	ND	2150000	1500	1.6	UG/KG	UG/L	NO	NO	NO
Phenanthrene	170	4500	ND	ND	690000	1500	NA	UG/KG	UG/L	NO	NO	NO
Pyrene	810	1400	ND	ND	2100000	1100	NA	UG/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
Aroclor-1260	55	ND	ND	ND	1000	0.0087	0.03	UG/KG	UG/L	NO	NO	NO
delta-BHC	ND	5.4	ND	ND	1.5	0.037	NA	UG/KG	UG/L	YES	NO	NO
alpha-Chlordane	1.7	ND	ND	ND	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
gamma-Chlordane	3.4	ND	ND	ND	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
4,4'-DDD	7.6	ND	ND	ND	8000	0.28	0.025	UG/KG	UG/L	NO	NO	NO
4,4'-DDE	140	12	ND	ND	27000	0.2	0.14	UG/KG	UG/L	NO	NO	NO
4,4'-DDT	58	11	ND	ND	16000	0.2	0.001	UG/KG	UG/L	NO	NO	NO
Endrin aldehyde	3.2	3.5	ND	ND	500	11	NA	UG/KG	UG/L	NO	NO	NO
Heptachlor	2	2.2	ND	ND	11500	0.0023	0.0036	UG/KG	UG/L	NO	NO	NO
Methoxychlor	ND	150	ND	ND	80000	180	0.03	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	8.49	0.159	ND	NA	950	0.43	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	6570	8950	1110	ND	41100	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	2.6	ND	ND	ND	2.5	15	NA	MG/KG	UG/L	YES	NO	NO
Arsenic	10.7	8.3	9.4	ND	23.9	18.7	36	MG/KG	UG/L	NO	NO	NO
Barium	24	26.7	ND	ND	820	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	0.39	0.51	ND	ND	32	1.2	NA	MG/KG	UG/L	NO	NO	NO
Cadmium	0.5	0.39	ND	ND	4	18	9.3	MG/KG	UG/L	NO	NO	NO
Chromium (total)	193	24.3	2	ND	94.6	37000	103	MG/KG	UG/L	YES	NO	NO
Cobalt	12.3	4.8	2.2	ND	19	2200	NA	MG/KG	UG/L	NO	NO	NO
Copper	42.7	26.7	3.3	ND	152	1500	2.9	MG/KG	UG/L	NO	NO	YES
Lead	105	309	3.3	ND	400	15	8.5	MG/KG	UG/L	NO	NO	NO
Manganese	75.5	110	439	56.7	881	2560	NA	MG/KG	UG/L	NO	NO	NO
Mercury	8.8	0.19	ND	ND	2.6	11	0.2	MG/KG	UG/L	YES	NO	NO
Nickel	49.4	9.3	2	ND	77.1	730	42.2	MG/KG	UG/L	NO	NO	NO
Selenium	0.74	1	ND	ND	2.5	180	71	MG/KG	UG/L	NO	NO	NO
Silver	2.2	0.47	ND	ND	17	180	0.23	MG/KG	UG/L	NO	NO	NO
Thallium	1.1	0.96	ND	ND	2.8	2.9	21.3	MG/KG	UG/L	NO	NO	NO
Tin	40.5	2.7	ND	ND	59.4	22000	NA	MG/KG	UG/L	NO	NO	NO

Table 10.5.5.1
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, and Deep Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMU 53 and AOC 526
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Vanadium	17.5	40.7	ND	ND	3000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	376	111	ND	ND	6000	11000	86	MG/KG	UG/L	NO	NO	NO

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 10, adapted from 1996 EPA Soil Screening Guidance or calculated using values from Table 6.2
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, June 3, 1996
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November, 1995; Table 2
In each case, the value shown is the greater of the relevant screening value or the corresponding background reference value

Units: See notes for Table 10.1.5.1

Table 10.5.5.2
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, or Deep Groundwater at Concentrations Exceeding any Initial Screening Concentration
Comparison to Combined Ecological/Human Health RBCs Adjusted for Surface Water Dilution, and to SSLs Based on Adjusted Ecological/Human Health RBCs: Tier Two
NAVBASE-Charleston, Zone E: SWMU 53 and AOC 526
Charleston, South Carolina

	Max. Concentration		Max. Concentration		Initial Screening Concentrations *			Adjusted Screening Concentrations #					Units		Screening Results	
Parameter	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Combined Eco/HH Surf. Wtr. RBC	Adjusted Eco/HH GW RBC	Target Leachate Conc. (DAF=1)	SSL Multi-plier	Adjusted SSL (DAF=1)	Soil Units	Water Units	Leaching Potential	Surface-Water Migration Concern
Semivolatile Organic Compounds																
Benzo(a)pyrene equivalents																
Benzo(a)anthracene	700	5500	ND	ND	800	0.092	NA	0.092	9.48E+03	0.1	9.48E+04	7.58E+06	UG/KG	UG/L	NO	NO
Benzo(a)pyrene	1300	6500	ND	ND	4000	0.0092	NA	0.0092	9.48E+02	0.2	4.74E+03	1.90E+06	UG/KG	UG/L	NO	NO
Dibenzo(a,h)anthracene	700	3000	ND	ND	800	0.0092	NA	0.0092	9.48E+02	0.01	9.48E+04	7.58E+06	UG/KG	UG/L	NO	NO
Pesticides/PCB Compounds																
delta-BHC	ND	5.4	ND	ND	1.5	0.037	NA	0.037	3.81E+03	0.05	7.62E+04	1.14E+04	UG/KG	UG/L	NO	NO
Inorganic Compounds																
Antimony	2.6	ND	ND	ND	2.5	15	NA	15	1.55E+06	6	2.58E+05	6.44E+04	MG/KG	UG/L	NO	NO
Chromium (total)	193	24.3	2	ND	19	180	50	50	5.15E+06	100	5.15E+04	9.79E+04	MG/KG	UG/L	NO	NO
Copper	42.7	26.7	3.3	ND	458	1500	2.9	2.9	2.99E+05	1300	2.30E+02	1.05E+04	MG/KG	UG/L	NO	NO
Mercury	8.8	0.19	ND	ND	1.04	11	0.2	0.2	2.06E+04	2	1.03E+04	1.07E+03	MG/KG	UG/L	NO	NO

* Initial Screening Concentrations: See notes for Table 10.1.5.2
In this table, the screening values shown are not adjusted for background reference values.

\# Adjusted Screening Concentrations: See notes for Table 10.1.5.2
Adjusted Eco/HH Groundwater RBC - Combined Eco/HH Surface Water RBCs multiplied by site-specific surface water dilution factor of 103,000: GW concentrations protective of surface water

Units: See notes for Table 10.1.5.2

Table 10.5.5.3
Soil-to-Air Volatilization Screening Analysis
NAVBASE-Charleston, Zone E: SWMU 53 and AOC 526
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Acetone	150	62000000	UG/KG	NO

* - Soil screening levels for transfers from soil to air were obtained from USEPA Region III Risk-Based Concentration Table, June 1996.

10.5.6 Fixed-Point Risk Evaluation for SWMUs 53 and AOC 526

10.5.6.1 Site Background and Investigative Approach

SWMU 53 is the former satellite accumulation area (Building 212), and AOC 526 represents a site that was formerly used for spray painting ship components. The following refers to these sites as combined SWMU 53. All are located in a highly industrialized portion of Zone E. As a result, the risk assessment for this site is presented as a FRE following the framework presented in Section 7.3. Due to their proximity, the investigational effort for these sites was combined. As a result, the risk evaluation will combine the environmental data from all three sites.

A total of twelve surface soil samples, collected as part of the 1995 RFI, were considered in the combined SWMU 53 FRE. Three shallow monitoring wells and one deep monitoring well were installed as part of the 1995 RFI. Groundwater data generated from the first-quarter sampling event are used to represent point risk/hazard for the combined SWMU 53 FRE. Sections 10.5.1 and 10.5.3 contain summaries of the sampling effort for combined SWMU 53 soil and groundwater.

10.5.6.2 Fixed-Point Risk Evaluation for Soil

Residential Scenario

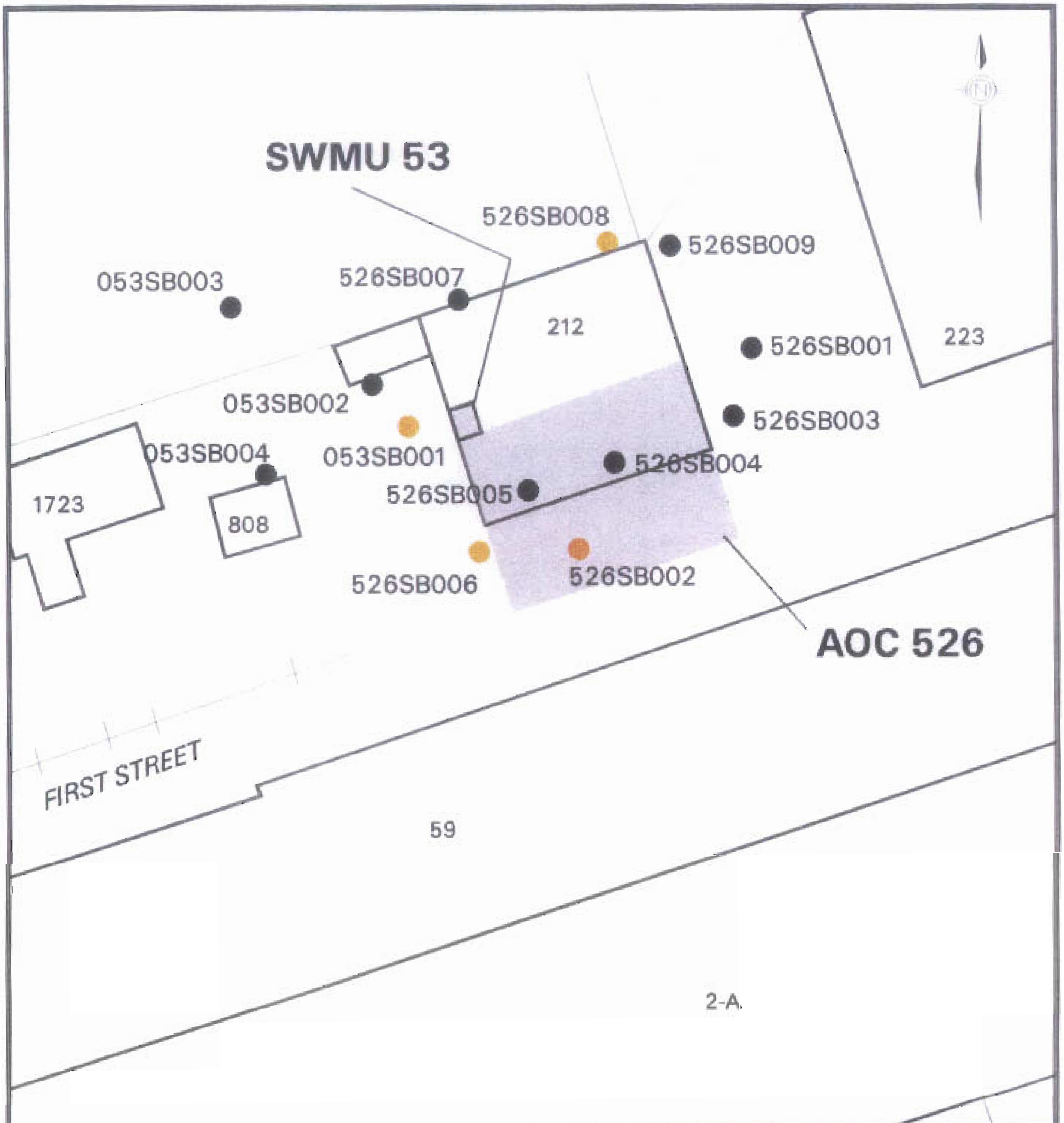
Table 10.5.6.1 provides CPSS summaries for combined SWMU 53 soil and identifies COPCs based on comparison to residential and industrial RBCs and background RCs. Based on residential RBCs, three COPCs (BEQs, chromium, and mercury) were identified for combined SWMU 53 soil. Chromium, which predominantly exists in either the trivalent or hexavalent state, was identified as a COPC based on a conservative comparison of the maximum concentration (regardless of valence) to the RBC for its hexavalent species (39mg/kg). Analyses for hexavalent chromium were nondetect which indicates that the trivalent valence state predominates for combined SWMU 53 surface soil. The RBC for trivalent chromium is 7,800 mg/kg. Since it is evident that combined SWMU 53 chromium in soil predominantly exists in the trivalent state, chromium was eliminated as a COPC. Arsenic, beryllium, and thallium were detected in combined SWMU 53 soil at concentrations above their RBCs but were eliminated from consideration in the residential FRE based on comparison to their background concentrations. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration.

Table 10.5.6.2 summarizes the residential COPCs detected at each combined SWMU 53 sample location with contribution to risk and hazard. As shown, BEQs are the only contributors to risk for combined SWMU 53, exceeding 1E-06 at four of 12 locations. No carcinogenic COPC were detected at sample locations 053SB002, 053SB003, 053SB004, 526SB003, 526SB004, 526SB005, 526SB007, and 526SB009. Figure 10.5.3 is a spatial presentation of residential risk estimates for combined SWMU 53 soil. For samples with concentrations of carcinogenic COPCs, risk estimates range from 5E-06 to 4E-05 with an arithmetic mean risk of 5E-06. The arithmetic mean was calculated assuming a de minimus risk level of 1E-07 for locations where no carcinogenic COPC were detected.

HI projections did not exceeded the threshold of unity at any sample location. HI estimates ranged from 0.003 to 0.4 with an arithmetic mean HI of 0.04.

Industrial Scenario

Based on industrial RBCs, BEQs were identified as COPCs for combined SWMU 53 soil. Arsenic was detected in combined SWMU 53 soil at concentrations above its industrial RBC but was eliminated from consideration in the industrial FRE 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 based on background concentration.



LEGEND - CUMULATIVE SOIL RISK

- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 100

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

FIGURE 10.5.3
CUMULATIVE SOIL RISK
RESIDENTIAL SCENARIO
SWMU 53 AOC 526

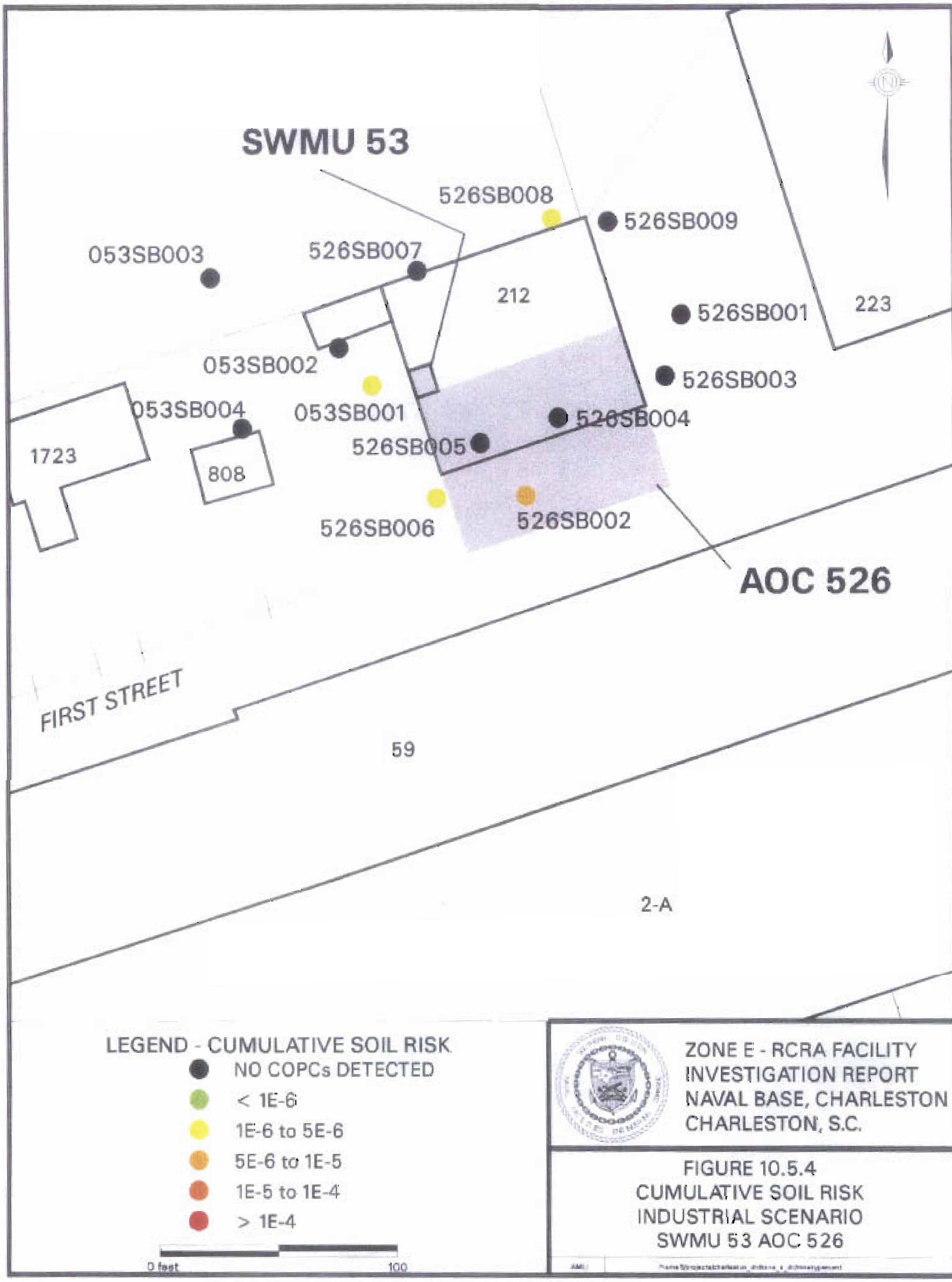
Table 10.5.6.3 summarizes the industrial COPCs detected at each combined SWMU 53 sample location with contribution to risk and hazard. As shown, BEQs are the only contributors to risk for combined SWMU 53, exceeding 1E-06 at four of 19 locations based on the industrial scenario. No carcinogenic COPC were detected in eight of the surface soil samples (listed above). Figure 10.5.4 is a spatial presentation of industrial scenario risk estimates for combined SWMU 53 surface soil. For the samples with concentrations of carcinogenic COPCs, risk estimates range from 1E-06 to 8E-06 with an arithmetic mean risk of 1E-06, assuming a de minimus risk of 1E-07 for sample locations where no carcinogenic COPCs were detected.

No industrial COPC were identified that would have contributed to HI projections.

10.5.6.3 Fixed-Point Risk Evaluation for Groundwater

Residential Scenario

Table 10.5.6.4 provides separate CPSS summaries for combined SWMU 53 shallow and deep groundwater and identifies COPCs. No COPC were identified in shallow or deep groundwater based on comparison of first-quarter groundwater concentrations to tap-water RBCs and background RCs. Arsenic and manganese were detected in combined SWMU 53 shallow groundwater at concentrations above their respective RBCs, however, their maximium concentrations were below their corresponding background concentrations. Combined SWMU 53 shallow groundwater data were not sufficient to perform Wilcoxon rank sum test analyses. As a result, arsenic and manganese were eliminated from consideration in the shallow groudwater FRE based on direct comparison of their maximum concentrations to their background RCs.



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

FIGURE 10.5.4
CUMULATIVE SOIL RISK
INDUSTRIAL SCENARIO
SWMU 53 AOC 526

10.5.6.4 Uncertainty

SWMU 53 uncertainty issues specific to the FRE and essential to the risk management process are presented in the following paragraphs.

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure. Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use of Zone E, specifically as a marine cargo terminal and drydocking facility. The ground surface around SWMUs 53 and AOC 526 is currently covered with either asphalt or concrete. As a result, chronic exposure to current soil conditions is highly unlikely and the associated direct contact exposure pathways evaluation overestimates risk and hazard. If this area were to be redeveloped, the buildings and other structures would be demolished, and the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, chronic exposure to current surface soil conditions would not be likely under any future use scenario. These factors indicate that exposure pathways assessed in this FRE would generally overestimate the risk and hazard posed to current/future site workers and future site residents.

Groundwater is not currently used as a potable water source at combined SWMU 53, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.

COPC Selection

Chromium was identified as a COPC in soil based on a conservative comparison to the RBC for the hexavalent species. Four surface soil samples were analyzed for hexavalent chromium and had no detectable concentrations. Chromium was therefore eliminated as a soil COPC based on comparison to the RBC for trivalent chromium. The maximum concentration of chromium (193 mg/kg) was detected in surface soil sample 053SB003, one of the four mentioned above. Hexavalent chromium analysis conducted on this surface soil sample and, as previously mentioned, was nondetect. These findings indicate that uncertainty associated with the elimination of chromium as a COPC is minimal.

Quantification of Risk/Hazard

Soil

A conservative screening process was used to identify COPCs for combined SWMU 53. The potential for eliminating CPSSs with the potential for cumulative HI greater than one was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment based on comparison to RBCs, none was reported at a concentration close to its RBC (e.g. within 10% of its RBC). Arsenic, beryllium, and thallium were present in combined SWMU 53 soil at concentrations above their RBC benchmarks and were eliminated from consideration in the FRE based on comparison to their background concentrations. As a result, their contribution to soil pathway risk and hazard has not been considered in this FRE.

Groundwater

The same conservative screening process used for soil was also applied to groundwater. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, none was reported at concentrations close to their RBCs (e.g. within 10% of their RBCs). Arsenic and manganese were present in combined SWMU 53 groundwater at concentrations above their RBC benchmarks and were eliminated from consideration in the FRE based on comparison to their background concentrations. As a result, their contribution to groundwater pathway risk and hazard has not been considered in this FRE.

10.5.6.5 FRE Summary

The risk and hazard posed by contaminants at combined SWMU 53 were assessed for the future site worker and the future site resident as sample point-specific estimates. In surface soils, the incidental ingestion and dermal contact pathways are reflected. The groundwater FRE was based on first-quarter data and considers the ingestion and inhalation (VOCs only) pathways. Risk and HI estimates are presented on Tables 10.5.6.2 and 10.5.6.3 such that a risk (E-06) or HI that exceed one for any COPC at any given sample location is an indication that the concentration of that COPC exceeds its RGO. Section 7, Tables 7.3.1, 7.3.2, and 7.3.3 provide residential, industrial, and residential groundwater RGOs, respectively, for all of the COPCs identified for Zone E.

Soil — Residential Scenario

BEQs were detected in combined SWMU 53 surface soil at concentrations above their residential RGOs.

Soil — Site Worker Scenario

BEQs were detected in combined SWMU 53 surface soil at concentrations above their industrial RGOs.

Groundwater — Residential Scenario

No COPCs were detected in combined SWMU 53 groundwater.

Table 10.5.6.1
Chemicals Present in Site Samples
SWMU 53; AOC 526 - Surface Soil
NAVBASE - Charleston
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration: Residential RBC	Industrial RBC	Reference	Units	Number Exceeding: Res. RBC	Ind. RBC	Ref.
Carcinogenic PAHs													
B(a)P Equiv.	* *	4	12	322.84 - 2316	837.29	785.74 - 1848.8	88	780	NA	UG/KG	4	1	
Benzo(a)anthracene		3	12	130 - 700	323.33	340 - 800	880	7800	NA	UG/KG			
Benzo(a)pyrene	* *	4	12	210 - 1300	512.50	340 - 800	88	780	NA	UG/KG	4	1	
Benzo(b)fluoranthene	*	4	12	300 - 1200	590.00	340 - 800	880	7800	NA	UG/KG	1		
Benzo(k)fluoranthene		4	12	230 - 2500	867.50	340 - 800	8800	78000	NA	UG/KG			
Chrysene		3	12	200 - 1000	480.00	340 - 800	88000	780000	NA	UG/KG			
Dibenz(a,h)anthracene	*	2	12	79 - 700	389.50	340 - 800	88	780	NA	UG/KG	1		
Indeno(1,2,3-cd)pyrene	*	4	12	130 - 1000	377.50	340 - 800	880	7800	NA	UG/KG	1		
TCDD Equivalents													
Dioxin Equiv.		4	4	0.5749 - 8.489	2.97	NA - NA	1000	1000	NA	NG/KG			
Inorganics													
Aluminum (Al)		12	12	1450 - 6570	3481.67	NA - NA	7800	100000	26600	MG/KG			
Antimony (Sb)		7	12	0.61 - 2.6	1.12	0.43 - 1.2	3.1	82	1.77	MG/KG			1
Arsenic (As)		11	12	2.2 - 10.7	5.88	1.8 - 1.8	0.43	3.8	23.9	MG/KG	11	7	
Barium (Ba)		10	12	9.5 - 24	17.38	8 - 10.8	550	14000	130	MG/KG			
Beryllium (Be)		10	12	0.16 - 0.39	0.24	0.14 - 0.17	0.15	1.3	1.7	MG/KG	10		
Cadmium (Cd)		8	12	0.06 - 0.5	0.26	0.11 - 0.12	3.9	100	1.5	MG/KG			
Calcium (Ca)	N	12	12	1810 - 46100	7585.83	NA - NA	NA	NA	NA	MG/KG			
Chromium (Cr)	*	12	12	4 - 193	42.11	NA - NA	39	1000	94.6	MG/KG	4		1
Chromium (Hexavalent)		0	4	NA - NA	NA	0.053 - 0.054	39	1000	NA	MG/KG			
Cobalt (Co)		12	12	1 - 12.3	4.58	NA - NA	470	12000	19	MG/KG			
Copper (Cu)		12	12	6.1 - 42.7	17.68	NA - NA	310	8200	66	MG/KG			
Iron (Fe)	N	12	12	2460 - 12800	6481.67	NA - NA	NA	NA	NA	MG/KG			
Lead (Pb)		12	12	11.8 - 105	45.70	NA - NA	400	1300	265	MG/KG			
Magnesium (Mg)	N	12	12	213 - 4350	939.58	NA - NA	NA	NA	NA	MG/KG			
Manganese (Mn)		12	12	28.2 - 75.5	52.79	NA - NA	180	4700	302	MG/KG			
Mercury (Hg)	*	12	12	0.06 - 8.8	0.94	NA - NA	2.3	61	2.6	MG/KG	1		1
Nickel (Ni)		12	12	2.4 - 49.4	9.74	NA - NA	160	4100	77.1	MG/KG			
Potassium (K)	N	4	12	278 - 735	474.50	75.9 - 601	NA	NA	NA	MG/KG			
Selenium (Se)		3	12	0.58 - 0.74	0.67	0.32 - 0.58	39	1000	1.7	MG/KG			
Silver (Ag)		3	12	1.4 - 2.2	1.90	0.2 - 0.22	39	1000	NA	MG/KG			
Sodium (Na)	N	1	12	73.6 - 73.6	73.60	40.8 - 85	NA	NA	NA	MG/KG			
Thallium (Tl)		2	12	0.59 - 1.1	0.85	0.36 - 0.58	0.63	16	2.8	MG/KG	1		
Tin (Sn)		2	12	2.6 - 40.5	21.55	2.1 - 4.2	4700	6100	59.4	MG/KG			
Vanadium (V)		12	12	3.9 - 17.5	7.80	NA - NA	55	1400	94.3	MG/KG			
Zinc (Zn)		12	12	19 - 376	113.44	NA - NA	2300	61000	827	MG/KG			

Table 10.5.6.1
Chemicals Present in Site Samples
SWMU 53; AOC 526 - Surface Soil
NAVBASE - Charleston
Charleston, South Carolina

Parameter	Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Screening Concentration Industrial RBC	Reference	Units	Number Exceeding Res. RBC	Number Exceeding Ind. RBC	Number Exceeding Ref.
Pesticides												
4,4'-DDD	4	12	3 - 7.6	4.83	2.6 - 3	2700	24000	NA	UG/KG			
4,4'-DDE	7	12	3.2 - 140	33.93	2.6 - 3	1900	17000	NA	UG/KG			
4,4'-DDT	6	12	4.5 - 58	25.08	2.6 - 3	1900	17000	NA	UG/KG			
alpha-Chlordane	1	12	1.7 - 1.7	1.70	1.4 - 1.6	470	2200	NA	UG/KG			
Aroclor-1260	1	12	55 - 55	55.00	70 - 79	83	740	NA	UG/KG			
Endrin aldehyde	1	12	3.2 - 3.2	3.20	2.6 - 3	2300	61000	NA	UG/KG			
gamma-Chlordane	2	12	2.3 - 3.4	2.85	1.4 - 1.6	470	2200	NA	UG/KG			
Heptachlor	2	12	1.6 - 2	1.80	1.4 - 1.5	140	1300	NA	UG/KG			
Semivolatile Organics												
Acenaphthylene	1	12	200 - 200	200.00	340 - 800	310000	8200000	NA	UG/KG			
Anthracene	1	12	230 - 230	230.00	340 - 800	2300000	61000000	NA	UG/KG			
Benzo(g,h,i)perylene	4	12	170 - 1600	552.50	340 - 800	310000	8200000	NA	UG/KG			
Di-n-butylphthalate	1	12	93 - 93	93.00	340 - 800	780000	20000000	NA	UG/KG			
Fluoranthene	3	12	120 - 780	346.67	340 - 800	310000	8200000	NA	UG/KG			
Phenanthrene	1	12	170 - 170	170.00	340 - 800	310000	8200000	NA	UG/KG			
Pyrene	4	12	180 - 810	357.50	340 - 800	230000	6100000	NA	UG/KG			
Volatile Organics												
Acetone	2	12	120 - 150	135.00	10 - 38	780000	20000000	NA	UG/KG			

Notes:
* - Identified as a residential COPC
** - Identified as an industrial COPC
N - Essential nutrient
MG/KG - milligrams per kilogram
UG/KG - micrograms per kilogram
NG/KG - nanograms per kilogram
SQL - Sample quantitation limit
RBC - Risk-based concentration
NA - Not applicable

Table 10.5.6.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 53/AOC 526
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
053	B001	B(a)P Equiv.	352.50	UG/KG	5.8375	100.00	NA	
053	B001	Mercury (Hg)	8.80	MG/KG	NA		0.4022	100.00
		Total			5.8375		0.4022	
053	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
053	B002	Mercury (Hg)	0.31	MG/KG	NA		0.0142	100.00
		Total			NA		0.0142	
053	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
053	B003	Mercury (Hg)	0.70	MG/KG	NA		0.0320	100.00
		Total			NA		0.0320	
053	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
053	B004	Mercury (Hg)	0.28	MG/KG	NA		0.0128	100.00
		Total			NA		0.0128	
526	B002	B(a)P Equiv.	2316.00	UG/KG	38.3537	100.00	NA	
526	B002	Mercury (Hg)	0.19	MG/KG	NA		0.0087	100.00
		Total			38.3537		0.0087	
526	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
526	B003	Mercury (Hg)	0.11	MG/KG	NA		0.0050	100.00
		Total			NA		0.0050	
526	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
526	B004	Mercury (Hg)	0.09	MG/KG	NA		0.0041	100.00
		Total			NA		0.0041	
526	B005	B(a)P Equiv.	ND	UG/KG	NA		NA	
526	B005	Mercury (Hg)	0.22	MG/KG	NA		0.0101	100.00
		Total			NA		0.0101	
526	B006	B(a)P Equiv.	357.80	UG/KG	5.9253	100.00	NA	
526	B006	Mercury (Hg)	0.30	MG/KG	NA		0.0137	100.00
		Total			5.9253		0.0137	
526	B007	B(a)P Equiv.	ND	UG/KG	NA		NA	
526	B007	Mercury (Hg)	0.10	MG/KG	NA		0.0046	100.00
		Total			NA		0.0046	
526	B008	B(a)P Equiv.	322.84	UG/KG	5.3463	100.00	NA	
526	B008	Mercury (Hg)	0.10	MG/KG	NA		0.0046	100.00
		Total			5.3463		0.0046	
526	B009	B(a)P Equiv.	ND	UG/KG	NA		NA	
526	B009	Mercury (Hg)	0.06	MG/KG	NA		0.0027	100.00
		Total			NA		0.0027	

Table 10.5.6.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 53/AOC 526
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
053	B001	B(a)P Equiv.	352.50	UG/KG	1.1869	100.00	NA	
		Total			1.1869		NA	
053	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
053	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
053	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
526	B002	B(a)P Equiv.	2316.00	UG/KG	7.7983	100.00	NA	
		Total			7.7983		NA	
526	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
526	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
526	B005	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
526	B006	B(a)P Equiv.	357.80	UG/KG	1.2048	100.00	NA	
		Total			1.2048		NA	
526	B007	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	
526	B008	B(a)P Equiv.	322.84	UG/KG	1.0870	100.00	NA	
		Total			1.0870		NA	
526	B009	B(a)P Equiv.	ND	UG/KG	NA		NA	
		Total			NA		NA	

Table 10.5.6.4
Chemicals Present in Site Samples
SWMU 53; AOC 526 - Groundwater
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Conc. Residential RBC	Screening Conc. Reference	Units	Number Exceeding Res.	Number Exceeding Ref.
Deep wells											
Inorganics											
Calcium (Ca)	N	1	1	89600 - 89600	89600	NA - NA	NA	NA	UG/L		
Magnesium (Mg)	N	1	1	12000 - 12000	12000	NA - NA	NA	NA	UG/L		
Manganese (Mn)		1	1	56.7 - 56.7	56.7	NA - NA	84	869	UG/L		
Shallow Wells											
Inorganics											
Aluminum (Al)		2	3	399 - 1110	754.5	25 - 25	3700	2810	UG/L		
Arsenic (As)		1	3	9.4 - 9.4	9.4	5 - 5	0.045	18.7	UG/L	1	
Calcium (Ca)	N	3	3	66600 - 151000	111866.7	NA - NA	NA	NA	UG/L		
Chromium (Cr)		1	3	2 - 2	2	1 - 1	18	12.3	UG/L		
Cobalt (Co)		1	3	2.2 - 2.2	2.2	2 - 2	220	2.5	UG/L		
Copper (Cu)		1	3	3.3 - 3.3	3.3	2 - 10	150	2.7	UG/L		1
Iron (Fe)	N	3	3	1180 - 9650	5640	NA - NA	1100	NA	UG/L		
Lead (Pb)		1	3	3.3 - 3.3	3.3	3 - 3	15	4.8	UG/L		
Magnesium (Mg)	N	3	3	6020 - 28000	20440	NA - NA	NA	NA	UG/L		
Manganese (Mn)		3	3	69.7 - 439	311.9	NA - NA	84	2560	UG/L	2	
Nickel (Ni)		1	3	2 - 2	2	1 - 1.5	73	15.2	UG/L		
Potassium (K)	N	3	3	15600 - 21400	18400	NA - NA	NA	NA	UG/L		
Volatile Organics											
1,2-Dichloroethene (total)		1	3	1 - 1	1	5 - 5	5.5	NA	UG/L		

Notes:
N - Essential Nutrient
UG/L - micrograms per liter
SQL - Sample quantitation limit

10.5.7 Corrective Measures Considerations

For SWMU 53 and AOC 526, the upper and lower soil intervals and the shallow and deep groundwater were investigated. All samples were collected beneath asphalt or concrete pavement. Based on the analytical results and the FRE, COCs requiring further evaluation through the CMS process were identified for the upper soil interval. However, residential use of the site is not expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use as a marine cargo terminal and drydock. Since the ground surface is capped with either asphalt or concrete, chronic exposure to current soil conditions is highly unlikely. A FRE substituted for a full risk assessment.

Three COPCs were identified for combined SWMU 53 soil: chromium, mercury, and BEQs. Chromium was eliminated from the COPCs because it was identified as trivalent, not the more-toxic hexavalent form. Arsenic, beryllium, and thallium were detected in combined SWMU 53 soil at concentrations above their RBCs but were eliminated because they were below their background concentrations. The combined ingestion and dermal residential exposure risk ranges between 5E-06 to 4E-05 with an arithmetic mean risk of 5E-06 and an HI between 0.003 to 0.4 with an arithmetic mean HI of 0.04, which is between USEPA's acceptable range of 1E-06 and 1E-04 and HI of 3 to 0.1.

No COPCs were identified in the shallow and deep groundwater. Arsenic and manganese were detected in the groundwater above their respective RBCs but were eliminated in the FRE based on comparison to background concentrations. No carcinogenic COPCs were detected.

Based on data collected, a groundwater plume is not indicated but may exist. No clear, definable source or release is associated with these units. Potential corrective measures for the impacted media and respective COCs are in Table 10.5.7.1.

Table 10.5.7.1
Potential Corrective Measures for SWMU 53 and AOC 526

Medium	Compounds	Potential Corrective Measures
Soil	None	No Action
Shallow and Deep Groundwater	None	No Action

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10.6 SWMU 65, Lead Storage (Includes AOC 544, Former Pickling Plant, and AOC 546, Galvanizing/Pickling Shop)

SWMU 65 consists of a lead storage area in which lead blankets and shielding materials are stored on pallets and shelves inside and on a paved area south of Building 221. The majority of the lead is encased in rubber but some exposed lead is stored beneath a tarp inside the building. This site is also a staging area for scrap lead awaiting disposal.

AOC 544 is the site of a former pickling plant at Building 221. From 1940 to 1970, the pickling plant consisted of an open-air facility with only the pickling tanks covered by a roof. In 1970, a single-story structure was built to house the pickling operations. The process used a series of chemical baths and water rinses. Until 1974, spent pickling bath solutions were discharged via the storm drainage system into the Cooper River. After 1974, a private contractor disposed of the wastes. Operations were discontinued in 1984 and the process equipment was removed. Currently this site is used as a lead storage area.

AOC 546 consisted of a galvanizing/pickling shop that operated within Building 1025 from the early 1920s until 1967. Building 1025 was at the current location of Building 3 until 1942, when it was relocated to southwest of Building 74. No information was found regarding its operational processes. Currently both sites are now covered with pavement or structures.

Materials of concern, identified in the *Final Zone E RFI Work Plan*, include acids, lead and other metals, solvents and petroleum hydrocarbons. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure.

To fulfill the RFI objectives for SWMU 65 and AOC 544, and the CSI objectives for AOC 546, soil and groundwater samples were collected in accordance with the *Final Zone E RFI Work Plan* and Section 3 of this report to determine whether contamination resulted from onsite activities.

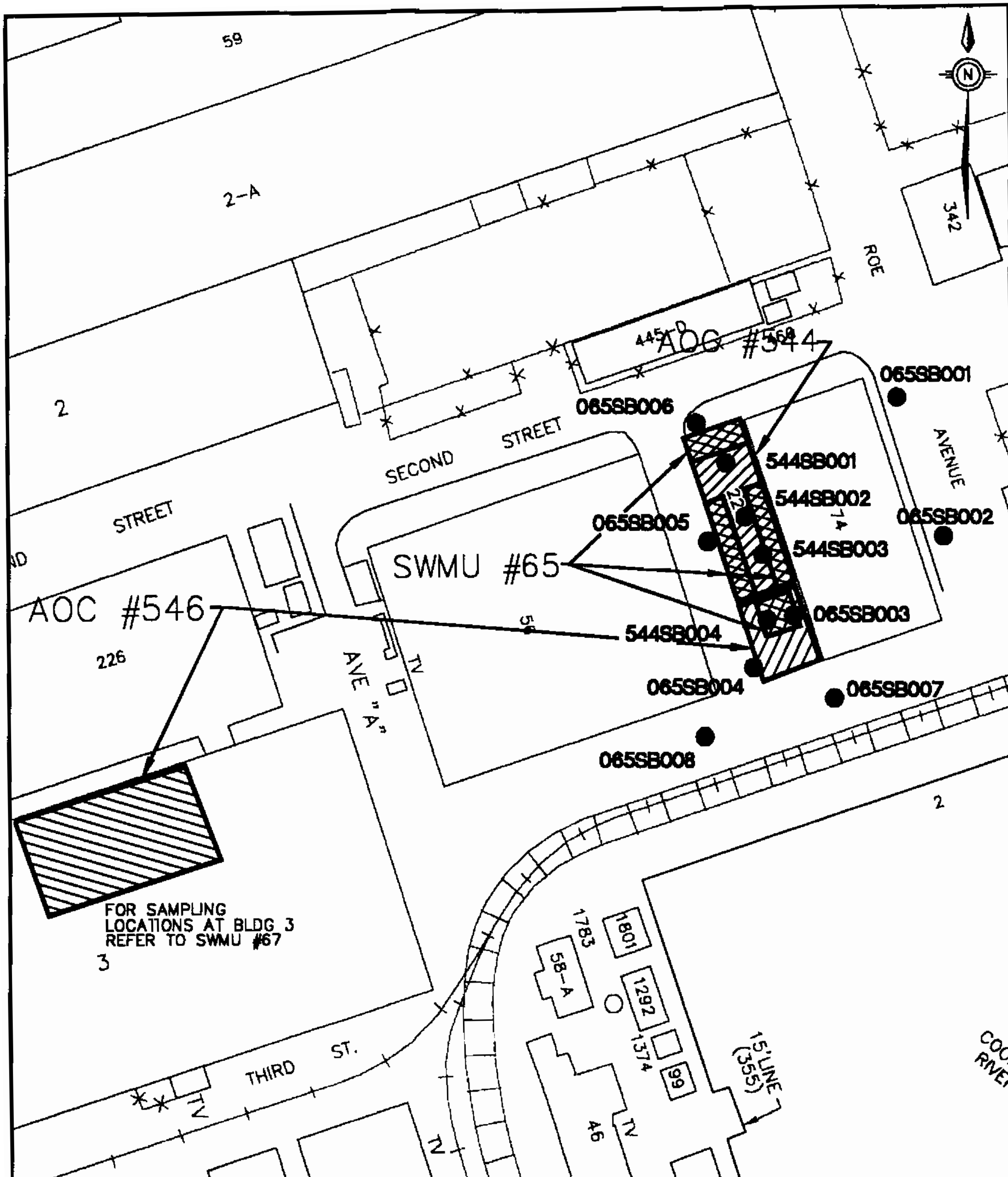
10.6.1 Soil Sampling and Analysis

Soil was sampled in two rounds at SWMU 65 and AOCs 544 and 546 from the locations shown in Figure 10.6.1. The *Final Zone E RFI Work Plan* proposed collecting five soil samples from the upper interval and five samples from the lower interval. Soil samples were also collected at both intervals for the six shallow monitoring well locations proposed at this site.

First-round Sampling — During the first round of sampling, 10 of the proposed 11 upper-interval samples were collected and 8 of the proposed 11 lower-interval samples were collected.

At SWMU 65, two lower-interval samples could not be collected due to subsurface obstructions in the form of large rocks at a depth of greater than two feet bgs. At AOC 546, one upper and one lower-interval sample at location 546SB001 could not be collected due to surface and subsurface obstructions in the form of large rocks. Instead, one sediment sample was collected from a storm drain (catch basin) in the location of AOC 546.

All first round samples were submitted for analysis at DQO Level III for pH, organotins and the standard suite of parameters which includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide. Four samples (two upper-interval and two lower-interval) selected as duplicates were analyzed at DQO Level IV for Appendix IX analytical parameters, which includes the suite of parameters proposed for the site, plus a more comprehensive list of VOCs, SVOCs, as well as herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. Table 10.6.1.1 summarizes first round soil sampling at SWMU 65 and associated sites.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- ◒ – DEEP MONITORING WELLS
- Ⓐ – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.6.1
SOIL BORING LOCATIONS
SWMU #65, LEAD STORAGE AREA
AOC #544, PICKLING PLANT
AOC #546, GALVANIZING SHOP

DWG DATE: 09/02/97 | DWG NAME: 10-6-1

Table 10.6.1.1
SWMU 65 and AOCs 544 and 546
First Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	11	10	Standard Suite[a], pH, and organotins	Standard Suite[a], pH and organotins/ SVOCs, and metals	Subsurface obstruction prevented the collection of one sample
Lower	11	8	Standard Suite[a], pH, and organotins	Standard Suite[a], pH and organotins/ SVOCs, and metals	Subsurface obstructions prevented the collection of three samples.

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, and pesticides/PCBs

Second-round Sampling — Second round sampling was performed at SWMU 65 during the installation of two additional shallow monitoring wells. Soil samples were collected from both intervals for the two additional shallow monitoring wells installed during the second round. Second round samples were submitted for analysis of SVOCs and metals. Table 10.6.1.2 summarizes the second round soil sampling at SWMU 65 and AOCs 544 and 546.

Table 10.6.1.2
SWMU 65 and AOCs 544 and 546
Second Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	2	2	SVOCs, metals	SVOCs, metals	None
Lower	2	2	SVOCs, metals	SVOCs, metals	None

Additional Sampling — During drilling, free product was noted in soil boring 065SB006, prompting the collection of an additional soil sample (065SB00603). The sample was collected from 11.5 to 13.5 feet bls at the northern end of SWMU 65 and submitted for VOC, PCB, TPH-GRO, TPH-DRO, metals, and cyanide analysis. The sample results are discussed separately at the end of Section 10.6.2.

10.6.2 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.6.2.1. Inorganic analytical results for soil are summarized in Table 10.6.2.2. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.6.2.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs ($\mu g/kg$)						
Acetone	Upper	6/10	14.0 - 290	122	20,000,000	0
	Lower	6/8	18.0 - 520	143	NA	NA
2-Butanone (MEK)	Lower	3/8	17.0 - 75.0	37.7	NA	NA
Carbon disulfide	Upper	1/10	2.00	2.00	20,000,000	0
	Lower	3/8	2.00	2.00	NA	NA
Carbon tetrachloride	Upper	1/10	5.00	5.00	4,4000	0
	Lower	1/8	4.00	4.00	NA	NA
1,2-Dichloroethene (total)	Upper	1/10	2.00	2.00	1,800,000	0
	Lower	2/8	2.00 - 4.00	3.00	NA	NA
Ethylbenzene	Lower	1/8	2.00	2.00	NA	NA
Methylene chloride	Upper	3/10	19.0 - 60.0	34.3	760,000	0
	Lower	3/8	28.0 - 35.0	32.3	NA	NA
Vinyl chloride	Lower	1/8	7.00	7.00	NA	NA
Xylene (Total)	Lower	1/8	5.00	5.00	NA	NA
SVOCs ($\mu g/kg$)						
Acenaphthene	Upper	3/12	77.0 - 170	122	12,000,000	0
	Lower	5/10	55.0 - 15,000	3,140	NA	NA
Acenaphthylene	Lower	2/10	46.0 - 530	288	NA	NA

Table 10.6.2.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (μg/kg)						
Anthracene	Upper	1/12	540	540	61,000,000	0
	Lower	3/10	46.0 - 5,200	1,370	NA	NA
Benzo(g,h,i)perylene	Upper	2/12	70.0 - 74.0	72.0	8,200,000	0
	Lower	5/10	93.0 - 360	207	NA	NA
bis(2-Ethylhexyl)phthalate	Upper	2/12	300 - 1,300	800	410,000	0
4-Chloroaniline	Upper	1/12	100	100	820,000	0
4-Chloro-3-methylphenol	Upper	1/12	120	120	NA	NA
	Lower	1/10	90.0	90.0	NA	NA
2-Chlorophenol	Upper	1/12	96.0	96.0	1,000,000	0
Dibenzofuran	Upper	2/12	74.0 - 75.0	74.5	820,000	0
	Lower	2/10	310 - 4,000	2,160	NA	NA
Di-n-butylphthalate	Upper	1/12	220	220	20,000,000	0
Fluoranthene	Upper	4/12	75.0 - 840	464	8,200,000	0
	Lower	9/10	46.0 - 15,000	1,810	NA	NA
Fluorene	Upper	2/12	61.0 - 190	126	8,200,000	0
	Lower	5/10	52.0 - 12,000	2,560	NA	NA
2-Methylnaphthalene	Upper	1/12	130	130	8,200,000	0
	Lower	3/10	140 - 990	500	NA	NA
Naphthalene	Upper	3/12	42.0 - 390	264	8,200,000	0
	Lower	5/10	56.0 - 2,000	803	NA	NA
Phenanthrene	Upper	5/12	38.0 - 800	212	8,200,000	0
	Lower	7/10	64.0 - 20,000	2,730	NA	NA

Table 10.6.2.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (μg/kg)						
Phenol	Upper	1/12	110	110	100,000,000	0
Pyrene	Upper	4/12	58.0 - 730	390	6,100,000	0
	Lower	9/10	48.0 - 17,000	2,060	NA	NA
SVOCs (B(a)P Equivalents) (μg/kg)						
B(a)P Equiv.	Upper	3/12	124 - 265	201	780	0
	Lower	10/10	0.480 - 1,870	408	NA	NA
Benzo(a)anthracene	Upper	3/12	130 - 230	187	7,800	0
	Lower	7/10	88.0 - 2,900	571	NA	NA
Benzo(b)fluoranthene	Upper	3/12	94.0 - 240	185	7,800	0
	Lower	3/10	290 - 1,600	827	NA	NA
Benzo(k)fluoranthene	Upper	3/12	110 - 270	200	78,000	0
	Lower	9/10	48.0 - 1,600	413	NA	NA
Benzo(a)pyrene	Upper	3/12	100 - 210	157	780	0
	Lower	7/10	120 - 1,200	358	NA	NA
Chrysene	Upper	3/12	130 - 420	277	780,000	0
	Lower	7/10	150 - 2,900	686	NA	NA
Dibenz(a,h)anthracene	Lower	3/10	85.0 - 170	125	NA	NA
Indeno(1,2,3-cd)pyrene	Upper	2/12	72.0	72.0	7,800	0
	Lower	4/10	140 - 390	245	NA	NA
Pesticides/PCBs (μg/kg)						
Aldrin	Upper	1/10	349	349	340	1
	Lower	2/8	1.61 - 2.38	2.00	NA	NA

Table 10.6.2.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Pesticides/PCBs ($\mu g/kg$)						
beta-BHC	Upper	1/10	11.7	11.7	3,200	0
	Lower	1/8	2.80	2.80	NA	NA
delta-BHC	Upper	2/10	2.41 - 96.0	49.2	910	0
	Lower	3/8	2.52 - 8.64	5.49	NA	NA
gamma-BHC (Lindane)	Upper	1/10	9.54	9.54	4,400	0
alpha-Chlordane	Upper	1/10	13.0	13.0	4,400	0
	Lower	1/8	2.60	2.60	NA	NA
gamma-Chlordane	Upper	1/10	16.0	16.0	4,400	0
4,4'-DDE	Upper	2/10	2.97 - 10.5	6.74	17,000	0
	Lower	2/8	5.10 - 10.3	7.70	NA	NA
4,4'-DDT	Upper	1/10	3.20	3.20	17,000	0
Dieldrin	Upper	4/10	15.1 - 586	223	360	1
	Lower	4/8	6.17 - 33.2	20.7	NA	NA
Endosulfan I	Lower	1/8	5.20	5.20	NA	NA
Endosulfan II	Upper	1/10	9.01	9.01	1,200,000	0
Endrin	Upper	1/10	4.91	4.91	61,000	0
	Lower	1/8	5.20	5.20	NA	NA
Endrin aldehyde	Upper	1/10	4.73	4.73	61,000	0
Heptachlor	Upper	1/10	1.80	1.80	1,300	0
	Lower	1/8	1.70	1.70	1,300	0
Heptachlor epoxide	Upper	2/10	2.86 - 19.0	10.9	630	0
	Lower	2/8	2.03 - 5.30	3.67	NA	NA

Table 10.6.2.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Dioxins (ng/kg)						
Dioxin Equiv.	Upper	2/2	0.0461 - 0.963	0.505	1,000	0
	Lower	2/2	0.0494 - 0.406	0.228	NA	NA
1234678-HpCDD	Upper	2/2	1.77 - 36.1	18.9	NA	NA
	Lower	2/2	2.06 - 2.51	2.29	NA	NA
1234678-HpCDF	Upper	2/2	0.720 - 15.7	8.21	NA	NA
	Lower	2/2	0.521 - 7.02	3.77	NA	NA
123478-HxCDF	Upper	1/2	1.55	1.55	NA	NA
	Lower	1/2	0.736	0.736	NA	NA
OCDD	Upper	2/2	21.2 - 237	129	NA	NA
	Lower	2/2	17.2 - 23.6	20.4	NA	NA
OCDF	Upper	1/2	53.9	53.9	NA	NA
	Lower	1/2	9.69	9.69	NA	NA
12378-PeCDD	Lower	1/2	0.420	0.420	NA	NA

Notes:

$\mu g/kg$	=	Micrograms per kilogram
ng/kg	=	Nanograms per kilogram
RBC	=	Risk-based concentration
NA	=	No industrial RBC established

Table 10.6.2.2
SWMU 65 and AOCs 544 and 546
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Aluminum (Al)	Upper	10/12	1,230 - 6,490	3,160	100,000	26,600	0
	Lower	8/10	1,360 - 14,800	4,700	NA	41,100	NA
Antimony (Sb)	Upper	4/12	0.610 - 2.90	1.45	82.0	1.77	0
	Lower	3/10	1.20 - 3.60	2.20	NA	1.60	NA
Arsenic (As)	Upper	10/12	0.700 - 7.70	2.37	3.80	23.9	0
	Lower	8/10	0.870 - 21.0	5.37	NA	19.9	NA
Barium (Ba)	Upper	10/12	5.40 - 25.1	12.5	14,000	130	0
	Lower	8/10	6.60 - 31.1	16.4	NA	94.1	NA
Beryllium (Be)	Upper	5/12	0.130 - 0.440	0.296	1.30	1.70	0
	Lower	6/10	0.140 - 1.000	0.350	NA	2.71	NA
Cadmium (Cd)	Upper	7/12	0.140 - 1.50	0.539	100	1.50	0
	Lower	4/10	0.130 - 2.20	0.845	NA	0.960	NA
Calcium (Ca)	Upper	12/12	381 - 94,800	21,600	NA	NA	NA
	Lower	8/10	554 - 20,400	4,660	NA	NA	NA
Chromium (Cr)	Upper	12/12	3.80 - 36.5	14.8	1,000	94.6	0
	Lower	10/10	4.60 - 30.1	13.3	NA	75.2	NA
Chromium (Hexavalent)	Upper	1/2	0.167	0.167	1,000	NA	0
Cobalt (Co)	Upper	10/12	0.600 - 505	60.8	12,000	19.0	0
	Lower	8/10	0.410 - 6.30	3.05	NA	14.9	NA
Copper (Cu)	Upper	11/12	4.90 - 102	32.7	8,200	66.0	0
	Lower	10/10	6.40 - 221	60.6	NA	152	NA
Cyanide (CN)	Lower	2/8	0.710 - 3.40	2.06	NA	NA	NA
Iron (Fe)	Upper	10/12	1,450 - 6,880	3,640	61,000	NA	0
	Lower	8/10	1,540 - 26,700	6,800	NA	NA	NA

Table 10.6.2.2
SWMU 65 and AOCs 544 and 546
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Lead (Pb)	Upper	10/12	6.60 - 165	45.0	1,300	265	0
	Lower	8/10	10.8 - 272	92.1	NA	173	NA
Magnesium (Mg)	Upper	10/12	80.4 - 2,570	572	NA	NA	NA
	Lower	8/10	115 - 3,140	683	NA	NA	NA
Manganese (Mn)	Upper	10/12	8.90 - 87.3	31.7	4,700	302	0
	Lower	8/10	10.7 - 418	80.2	NA	881	NA
Mercury (Hg)	Upper	10/12	0.0300 - 0.220	0.0910	61.0	2.60	0
	Lower	8/10	0.1000 - 8.20	1.26	NA	1.59	NA
Nickel (Ni)	Upper	10/12	1.90 - 49.4	11.0	4,100	77.1	0
	Lower	7/10	1.40 - 16.0	8.06	NA	57.0	NA
Potassium (K)	Upper	8/12	179 - 1,150	601	NA	NA	NA
	Lower	7/10	442 - 2,590	876	NA	NA	NA
Selenium (Se)	Upper	3/12	0.450 - 1.40	0.873	1,000	1.70	0
	Lower	1/10	0.660	0.660	NA	2.40	NA
Silver (Ag)	Upper	1/12	0.380	0.380	1,000	NA	0
Sodium (Na)	Upper	8/12	71.5 - 441	229	NA	NA	NA
	Lower	7/10	69.8 - 559	287	NA	NA	NA
Tin (Sn)	Upper	4/12	2.60 - 34.6	12.8	100,000	59.4	0
	Lower	5/10	3.70 - 33.2	16.2	NA	9.23	NA
Vanadium (V)	Upper	11/12	2.20 - 18.8	7.75	1,400	94.3	0
	Lower	8/10	3.70 - 62.8	14.8	NA	155	NA
Zinc (Zn)	Upper	10/12	6.40 - 303	81.2	61,000	827	0
	Lower	8/10	9.60 - 363	141	NA	886	NA

Table 10.6.2.2
SWMU 65 and AOCs 544 and 546
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
pH (SU)							
pH	Upper	10/10	7.62 - 11.3	9.22	NA	NA	NA
	Lower	8/8	7.21 - 8.99	8.00	NA	NA	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Risk-based concentration
RC = Reference concentration
NA = No industrial RBC or RC established
SU = Standard units

Volatile Organic Compounds in Soil

Nine VOCs were detected in soil samples collected at SWMU 65 and AOCs 544 and 546. Twelve detections occurred in the upper interval and 21 in the lower interval. No VOC exceeded its respective industrial RBC in the upper interval or respective SSL in the lower interval.

Semivolatile Organic Compounds in Soil

Twenty-four SVOCs were detected in soil samples collected at SWMU 65 and AOCs 544 and 546. Fifty-one detections occurred in the upper interval and 96 in the lower interval. No SVOC exceeded its respective industrial RBC in the upper interval. However, two SVOCs — benzo(a)anthracene and chrysene — exceeded their respective SSLs in the lower interval.

Benzo(a)anthracene was detected in seven of 10 lower-interval samples with a range of 88 to 2,900 μg/kg and a mean of 571 μg/kg. One lower-interval sample (065SB007, 2,900 μg/kg) exceeded the benzo(a)anthracene SSL of 700 μg/kg.

Chrysene was detected in seven of 10 lower-interval samples with a range of 150 to 2,900 μg/kg and a mean of 686 μg/kg. One lower-interval sample (065SB007, 2,900 μg/kg) exceeded the chrysene SSL of 1,000 μg/kg.

In accordance with recent cPAH guidance, BEQs were calculated for cPAHs at SWMU 65 and AOCs 544 and 546. The upper-interval BEQ calculated for three of 12 samples ranged from 124 to 265 μg/kg with a mean of 201 μg/kg. No samples exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg.

Pesticides and PCBs in Soil

Sixteen pesticides were detected in soil samples collected at SWMU 65 and AOCs 544 and 546. Twenty detections occurred in the upper interval and 18 occurred in the lower interval. Two pesticides — aldrin and dieldrin — exceeded their respective industrial RBC in the upper interval. Additionally, two pesticides — beta-BHC and dieldrin — exceeded their respective SSL in the lower interval.

Aldrin was detected in one of ten upper-interval samples at 349 μg/kg. One upper-interval sample (544SB001, 349 μg/kg) exceeded the aldrin industrial RBC of 340 μg/kg.

Beta-BHC was detected in one of eight lower-interval samples at 2.80 μg/kg. One lower-interval sample (544SB001) exceeded the beta-BHC SSL of 2.00 μg/kg.

Dieldrin was detected in four of ten upper-interval samples with a range of 15.1 to 586 μg/kg and a mean of 223 μg/kg. One upper-interval sample (544SB001, 586 μg/kg) exceeded the dieldrin industrial RBC of 360 μg/kg. Dieldrin was detected in four of eight lower-interval samples with a range of 6.17 to 33.2 μg/kg and a mean of 20.7 μg/kg. Three lower-interval samples

(544SB001, 29.0 μg/kg; 544SB002, 14.4 μg/kg, and 544SB003, 33.2 μg/kg) exceeded the dieldrin SSL of 1.0 μg/kg.

No PCBs were detected in soil samples collected at SWMU 65 and AOCs 544 and 546.

Other Organic Compounds in Soil

Six dioxins were detected in the duplicate soil samples collected at SWMU 65 and AOCs 544 and 546. Eight detections occurred in the upper interval and nine in the lower interval. No industrial RBCs or SSLs have been established for the detected dioxins.

In accordance with recent dioxin guidance, TEQs (dioxin equivalent) were calculated for the upper-interval samples. The TEQ calculated for the two duplicate samples ranged from 0.0461 to 0.963 ng/kg with a mean of 0.505 ng/kg. The calculated TEQ did not exceed the industrial RBC of 1,000 ng/kg.

Inorganic Elements in Soil

Twenty-five metals were detected in soil samples collected at SWMU 65 and AOCs 544 and 546. One hundred and ninety-seven detections occurred in the upper interval and 158 in the lower interval. No metal exceeded both its respective industrial RBC and background RC in the upper interval. One metal — arsenic — exceeded both its respective SSL and background RC in the lower interval.

Arsenic was detected in eight of 10 lower-interval samples with a range of 0.870 to 21.0 mg/kg and a mean of 5.37 mg/kg. One lower-interval sample (065SB001, 21.0 mg/kg) exceeded both the arsenic SSL of 15.0 mg/kg and the background RC of 19.9 mg/kg.

Additional Sample Results

Soil sample 065SB00603, collected from 11.5 to 13.5 feet bls, was described in the field as a very fine to fine sand with oily stains in laminations. The sample was submitted for the analysis of VOCs, PCBs, TPH-GRO, TPH-DRO, metals, and cyanide. No PCBs, TPH-GRO, or cyanide were detected in the sample. Two VOCs, TPH-GRO, and fifteen metals were detected in the sample; however, none of the detected concentrations exceeded its respective SSL.

10.6.3 Groundwater Sampling and Analysis

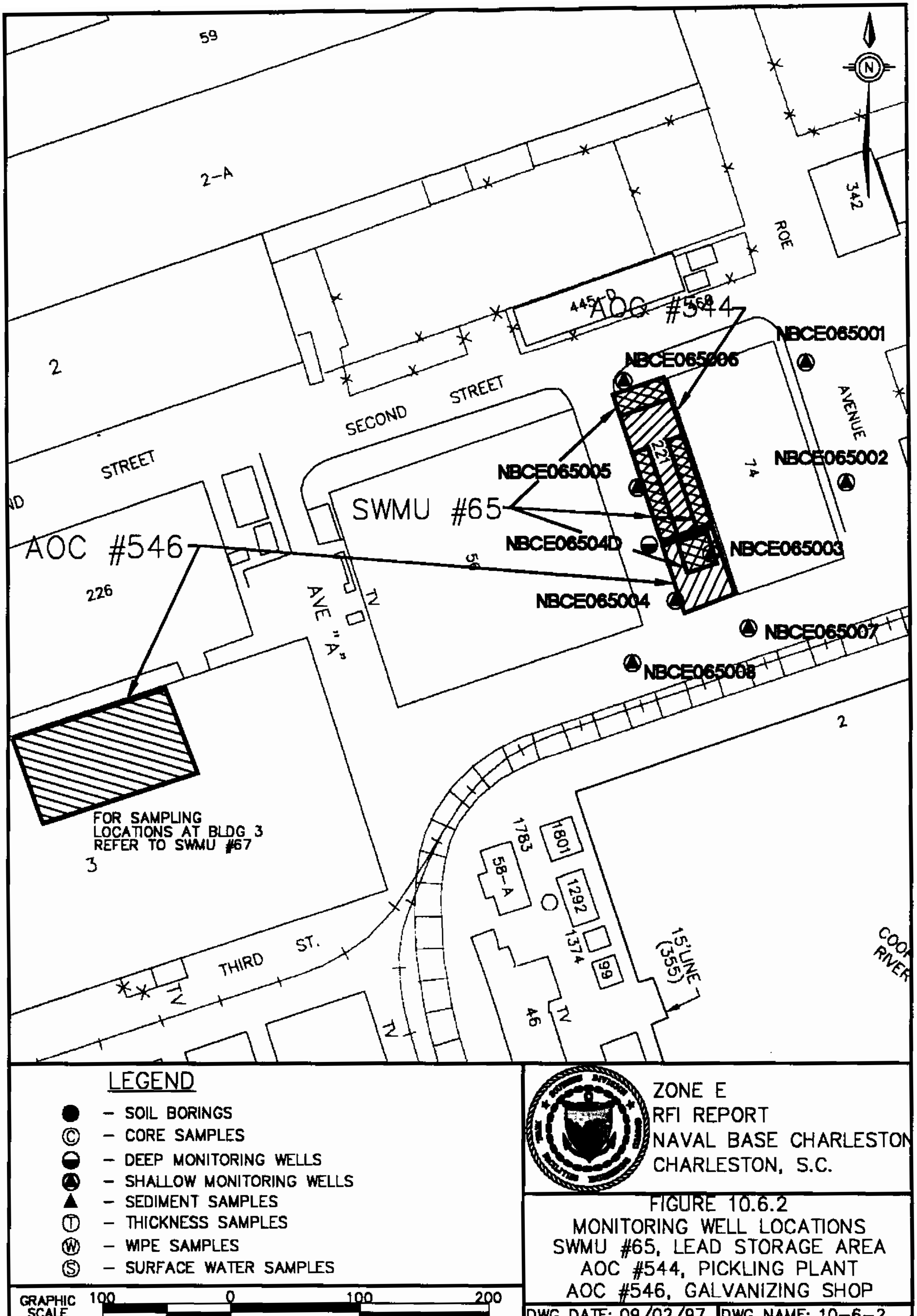
Groundwater monitoring wells were installed in two rounds at SWMU 65 and AOCs 544 and 546 at the locations shown in Figure 10.6.2. The wells were installed as follows:

- Shallow Wells installed at SWMU 65 — NBCE065001, NBCE065002, NBCE65003, NBCE065004, NBCE065005, NBCE065006, NBCE065007, and NBCE065008

- Deep Well installed at SWMU 65 — NBCE06504D

The *Final Zone E RFI Work Plan* proposed installing and sampling one deep monitoring well and six shallow monitoring wells to assess groundwater quality at SWMU 65 and AOCs 544 and 546. Two additional shallow monitoring wells were installed at SWMU 65 after first-round analytical results were compared to USEPA Region III RBCs (April 1996).

All first-round groundwater samples were submitted for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, pH, chlorides, sulfates, TDS, and organotins at DQO Level III. One shallow groundwater sample was duplicated and submitted for analysis at DQO Level IV for the suite of parameters listed above plus a more comprehensive list of VOCs and SVOCs, as well as herbicides, organophosphorus pesticides dioxin and hexavalent chromium. Table 10.6.3.1 summarizes groundwater sampling and analysis at SWMU 65 and AOCs 544 and 546.



ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.6.2
MONITORING WELL LOCATIONS
SWMU #65, LEAD STORAGE AREA
AOC #544, PICKLING PLANT
AOC #546, GALVANIZING SHOP

DWG DATE: 09/02/97 | DWG NAME: 10-6-2

Table 10.6.3.1
SWMU 65 and AOCs 544 and 546
Groundwater Sampling Summary

Depth	Wells Proposed	Wells Installed	Analyses Proposed	Analyses Collected	Deviations
Shallow	6	8	Standard Suite[a], pH, chlorides, sulfates, and TDS	Standard Suite[a], pH, chlorides, sulfates, and TDS	Two additional wells were installed and sampled for a reduced list of parameters
Deep	1	1	Standard Suite[a], pH, chlorides, sulfates, and TDS	Standard Suite[a], pH, chlorides, sulfates, and TDS	None

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs

Second-round monitoring wells were submitted for a reduced list if analytical parameters based upon first-round analytical results. These included VOCs, SVOCs, pesticides/PCBs, metals, cyanide, chlorides, sulfates, and TDS.

The shallow monitoring wells were installed at 12.5 feet bgs in the surficial aquifer. The deep well was installed at 40.5 feet bgs at the base of the surficial aquifer. All wells were installed in accordance with Section 3.3 of this report.

Additional Sampling — During drilling of the shallow well boring at location 065SB006, free product was encountered at a depth of approximately 2 to 3 feet bls. The boring was terminated due to an obstruction at approximately 7 ft bgs. After allowing adequate time for the fluid to accumulate, a groundwater sample (065SBFP602) was collected from the open borehole. The sample was analyzed for SVOCs to characterize the free product. The analytical results of the free product sample are discussed separately at the end of Section 6.3.4.

10.6.4 Nature of Contamination in Groundwater

Organic compound analytical results for shallow and deep groundwater are summarized in Tables 10.6.4.1 and 10.6.4.2, respectively. Inorganic analytical results for shallow and deep groundwater are summarized in Tables 10.6.4.3 and 10.6.4.4, respectively. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.6.4.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in First-Quarter Groundwater
Shallow Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap-Water RBC	MCL	Number of Samples Exceeding RBC
VOCs (μg/L)						
Acetone	1/8	380	380	370	NA	1
Carbon disulfide	1/8	1.000	1.000	100	NA	0
1,2-Dichloroethene (total)	1/8	7.00	7.00	5.50	70.0	1
Vinyl chloride	1/8	6.00	6.00	0.0190	2.00	1
Xylene (Total)	1/8	1.000	1.000	1,200	10,000	0
SVOCs (μg/L)						
Acenaphthene	2/8	2.00 - 41.0	21.5	220	NA	0
Acenaphthylene	1/8	1.000	1.000	150	NA	0
Anthracene	1/8	2.00	2.00	1,100	NA	0
Benzoic acid	3/8	1.000 - 2.00	1.67	15,000	NA	0
Dibenzofuran	1/8	12.0	12.0	15.0	NA	0
Fluoranthene	2/8	1.000 - 4.00	2.50	150	NA	0
Fluorene	1/8	20.0	20.0	150	NA	0
2-Methylnaphthalene	1/8	2.00	2.00	150	NA	0
Phenanthrene	1/8	12.0	12.0	150	NA	0
Pyrene	2/8	1.000 - 2.00	1.50	110	NA	0

Table 10.6.4.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in First-Quarter Groundwater
Shallow Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap-Water RBC	MCL	Number of Samples Exceeding RBC
Pesticides/PCBs (μg/L)						
beta-BHC	1/8	0.0480	0.0480	0.0370	NA	1
alpha-BHC	1/8	0.130	0.130	0.0110	NA	1
Dioxins (pg/L)						
Dioxin Equiv.	1/1	2.42	2.42	0.4	NA	1
1234678-HpCDD	1/1	115	115	NA	NA	NA
OCDD	1/1	1,270	1,270	NA	NA	NA

Notes:
μg/L = Micrograms per liter
pg/L = Picograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
NA = No RBC or MCL established

Table 10.6.4.2
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in First-Quarter Groundwater (μg/L)
Deep Monitoring Well

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap-Water RBC	MCL	Number of Samples Exceeding RBC
VOCs						
1,1-Dichloroethane	1/1	2.00	2.00	81.0	NA	0
1,2-Dichloroethene (total)	1/1	10.0	10.0	5.50	70.0	1
Trichloroethene	1/1	8.00	8.00	1.60	5.00	1
Vinyl chloride	1/1	6.00	6.00	0.0190	2.00	1

Table 10.6.4.2
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in First-Quarter Groundwater (μg/L)
Deep Monitoring Well

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap-Water RBC	MCL	Number of Samples Exceeding RBC
SVOCs						
Acenaphthene	1/1	2.00	2.00	220	NA	0
Dibenzofuran	1/1	1.000	1.000	15.0	NA	0
Fluorene	1/1	1.000	1.000	150	NA	0

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
NA = No MCL established

Table 10.6.4.3
SWMU 65 and AOCs 544 and 546
Inorganic Detections for First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap-Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Aluminum (Al)	5/8	101 - 21,500	5,310	3,700	2,810	NA	2
Antimony (Sb)	3/8	4.50 - 42.0	17.2	1.50	NA	6.00	3
Arsenic (As)	5/8	7.80 - 58.8	23.6	0.0450	18.7	50.0	2
Barium (Ba)	2/8	31.7 - 54.9	43.3	260	211	2,000	0
Beryllium (Be)	2/8	1.20 - 2.00	1.60	0.0160	0.43	4.00	2
Cadmium (Cd)	2/8	1.000 - 6.90	3.95	1.80	NA	5.00	1
Calcium (Ca)	7/8	34,400 - 116,000	66,200	NA	NA	NA	NA
Chromium (Cr)	4/8	0.960 - 245	104	18.0	12.3	100	2
Cobalt (Co)	1/8	2.50	2.50	220	2.5	NA	0
Copper (Cu)	2/8	178 - 536	357	150	2.7	1,300	2
Cyanide (CN)	2/8	10.2 - 13.4	11.8	73.0	7.9	200	0

Table 10.6.4.3
SWMU 65 and AOCs 544 and 546
Inorganic Detections for First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap-Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Iron (Fe)	8/8	2,710 - 13,100	8,530	1,100	NA	NA	8
Lead (Pb)	5/8	1.70 - 1,690	404	NA	4.8	15.0*	2
Magnesium (Mg)	6/8	7,860 - 56,800	20,600	NA	NA	NA	NA
Manganese (Mn)	8/8	72.9 - 964	494	84.0	2,560	NA	0
Mercury (Hg)	2/8	0.810 - 5.90	3.36	1.10	NA	2.00	1
Nickel (Ni)	5/8	2.10 - 36.0	13.4	73.0	15.2	100	0
Potassium (K)	6/8	2,810 - 33,700	17,700	NA	NA	NA	NA
Sodium (Na)	5/8	50,200 - 574,000	265,000	NA	NA	NA	NA
Tin (Sn)	2/8	162 - 219	191	2,200	NA	NA	0
Vanadium (V)	3/8	4.30 - 167	77.9	26.0	11.4	NA	2
Zinc (Zn)	4/8	5.70 - 1,290	428	1,100	27.3	NA	1

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
RC = Reference concentration
NA = No RBC, MCL, or RC established
* = TTAL

Table 10.6.4.4
SWMU 65 and AOCs 544 and 546
Inorganic Detections for First-Quarter Groundwater (μg/L)
Deep Monitoring Well

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap-Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Arsenic (As)	1/1	22.8	22.8	0.0450	16.4	50.0	1
Calcium (Ca)	1/1	66,600	66,600	NA	NA	NA	NA

Table 10.6.4.4
SWMU 65 and AOCs 544 and 546
Inorganic Detections for First-Quarter Groundwater (μg/L)
Deep Monitoring Well

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap-Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Iron (Fe)	1/1	2,790	2,790	1,100	NA	NA	1
Magnesium (Mg)	1/1	41,000	41,000	NA	NA	NA	NA
Manganese (Mn)	1/1	140	140	84.0	869	NA	0
Potassium (K)	1/1	13,500	13,500	NA	NA	NA	NA
Sodium (Na)	1/1	518,000	518,000	NA	NA	NA	NA

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
RC = Reference concentration
NA = No RBC, MCL, or RC established

Volatile Organic Compounds in Groundwater

Shallow Groundwater

Five VOCs were detected in shallow groundwater samples collected at SWMU 65 (no shallow wells were installed at AOC 544 or 546). Three VOCs — acetone, 1,2-dichloroethene (total), and vinyl chloride — exceeded their respective tap-water RBCs.

Acetone was detected in one of eight samples in well NBCE065002 (380 μg/L), exceeding its tap-water RBC of 370 μg/L. No MCL has been established for acetone.

1,2-Dichloroethene (total) was detected in one of eight samples in well NBCE065003 (7.00 μg/L), exceeding its tap-water RBC of 5.50 μg/L. The detection did not exceed the 1,2-dichloroethene (total) MCL of 70.0 μg/L.

Vinyl chloride was detected in one of eight samples in well NBCE065003 (6.00 μg/L), exceeding its tap-water RBC of 0.019 μg/L. The detection also exceeded the vinyl chloride MCL of 2.00 μg/L.

Deep Groundwater

Four VOCs were detected in the deep groundwater sample collected at SWMU 65 (no deep wells were installed at AOC 544 or 546). Three VOCs — 1,2-dichloroethene (total), trichloroethene, and vinyl chloride — exceeded their respective tap-water RBCs.

1,2-Dichloroethene (total) was detected in well NBCE06504D (10.00 μg/L), exceeding its tap-water RBC of 5.50 μg/L. The detection did not exceed the 1,2-dichloroethene (total) MCL of 70.0 μg/L.

Trichloroethene was detected in well NBCE06504D (8.00 μg/L), exceeding its tap-water RBC of 1.6 μg/L. The detection also exceeded the trichloroethene MCL of 5.00 μg/L.

Vinyl chloride was detected in well NBCE06504D (6.00 μg/L), exceeding its tap-water RBC of 0.0190 μg/L. The detection also exceeded the vinyl chloride MCL of 2.00 μg/L.

Semivolatile Organic Compounds in Groundwater

Shallow Groundwater

Ten SVOCs were detected in shallow groundwater samples collected at SWMU 65. None of the SVOCs exceeded their respective tap-water RBC.

Deep Groundwater

Three SVOCs were detected in the deep groundwater sample collected at SWMU 65. None of the SVOCs exceeded their respective tap-water RBC.

Pesticides and PCBs in Groundwater

Shallow Groundwater

Two pesticides were detected in shallow groundwater samples collected at SWMU 65. Both pesticides — alpha-BHC and beta-BHC — exceeded their respective tap-water RBCs.

Alpha-BHC was detected in one of eight samples in well NBCE065004 (0.130 μg/L), exceeding its tap-water RBC of 0.0110 μg/L. No MCL has been established for alpha-BHC.

Beta-BHC was detected in one of eight samples in well NBCE065004 (0.0480 μg/L), exceeding its tap-water RBC of 0.0370 μg/L. No MCL has been established for beta-BHC.

Other Organic Compounds in Soil

Shallow Groundwater

Two dioxins were detected in the duplicate shallow groundwater sample collected at SWMU 65. No tap-water RBCs or MCLs have been established for the detected dioxins.

In accordance with recent dioxin guidance, the TEQ (dioxin equivalent) was calculated at 2.42 pg/L, which exceeded the 2,3,7,8-TCDD tap-water RBC of 0.4 pg/L. No MCL has been established for dioxin equivalents.

Inorganic Elements in Groundwater

Shallow Groundwater

Twenty-two metals were detected in shallow groundwater samples collected at SWMU 65. Twelve metals — aluminum, antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, mercury, vanadium, and zinc — exceeded both their respective tap-water RBCs and shallow groundwater RCs. Six metals — antimony, arsenic, cadmium, chromium, lead, and mercury — also exceeded their respective MCLs (where available).

Aluminum was detected in five of eight samples with a range of 101 to 21,500 μg/L and a mean of 5,310 μg/L. Two samples from wells NBCE065003 (21,500 μg/L) and NBCE065004 (4,510 μg/L) exceeded both the aluminum tap-water RBC of 3,700 μg/L and the shallow groundwater RC of 2,810 μg/L. No MCL has been established for aluminum.

Antimony was detected in three of eight samples with a range of 4.50 to 42.0 μg/L and a mean of 17.2 μg/L. Three samples from wells NBCE065003 (42 μg/L), NBCE065004 (5.1 μg/L), and NBCE065005 (4.5 μg/L) exceeded the antimony tap-water RBC of 1.50 μg/L. No shallow groundwater RC has been established for antimony. The sample from well NBCE065003 also exceeded the antimony MCL of 6.00 μg/L.

Arsenic was detected in five of eight samples with a range of 7.80 to 58.8 μg/L and a mean of 23.6 μg/L. Two samples from wells NBCE065003 (22.6 μg/L) and NBCE065004 (58.8 μg/L) exceeded both the arsenic tap-water RBC of 0.0450 μg/L and the shallow groundwater RC of 18.7 μg/L. The sample from well NBCE065004 also exceeded the arsenic MCL of 50.0 μg/L.

Beryllium was detected in two of eight samples with a range of 1.20 to 2.00 μg/L and a mean of 1.60 μg/L. Two samples from wells NBCE065003 (1.2 μg/L) and NBCE065004 (2.0 μg/L) exceeded both the beryllium tap-water RBC of 0.0160 μg/L and shallow groundwater RC of 0.43 μg/L. Neither detection exceeded the beryllium MCL of 4.00 μg/L.

Cadmium was detected in two of eight samples with a range of 1.000 to 6.90 μg/L and a mean of 3.95 μg/L. One sample from well NBCE065003 (6.9 μg/L) exceeded the cadmium tap-water RBC of 1.80 μg/L. No shallow groundwater RC has been established for cadmium. The sample from well NBCE065003 also exceeded the cadmium MCL of 5.00 μg/L.

Chromium was detected in four of eight samples with a range of 0.960 to 245 μg/L and a mean of 104 μg/L. Two samples from wells NBCE065003 (245 μg/L) and NBCE065004 (169 μg/L) exceeded both the chromium tap-water RBC of 18.0 μg/L and shallow groundwater RC of 12.3 μg/L. Both detections also exceeded the chromium MCL of 100 μg/L.

Copper was detected in two of eight samples with a range of 178 to 536 μg/L and a mean of 357 μg/L. Two samples from wells NBCE065003 (536 μg/L) and NBCE065004 (178 μg/L) exceeded both the copper tap-water RBC of 150 μg/L and shallow groundwater RC of 2.7 μg/L. Neither sample exceeded the copper MCL of 1,300 μg/L.

Iron was detected in eight of eight samples with a range of 2,710 to 13,100 μg/L and a mean of 8,530 μg/L. Samples from the following six wells exceeded the iron tap-water RBC of 1,100 μg/L:

NBCE065001 (6,290 μg/L)	NBCE065004 (11,300 μg/L)
NBCE065002 (7,010 μg/L)	NBCE065005 (13,100 μg/L)
NBCE065003 (7,970 μg/L)	NBCE065006 (12,600 μg/L)

No shallow groundwater RC or MCL has been established for iron.

Lead was detected in five of eight samples with a range of 1.70 to 1,690 μg/L and a mean of 404 μg/L. Two samples from wells NBCE065003 (1,690 μg/L) and NBCE065004 (315 μg/L) exceeded both the TTAL for lead 15.0 μg/L (which has been substituted for both the tap-water RBC and MCL) and the RC of 4.8 μg/L.

Mercury was detected in two of eight samples with a range of 0.810 to 5.90 μg/L and a mean of 3.36 μg/L. One sample from well NBCE065004 (5.90 μg/L) exceeded the mercury tap-water

RBC of 1.10 μg/L. No shallow groundwater RC has been established for mercury. The sample also exceeded the mercury MCL of 2.00 μg/L.

Vanadium was detected in three of eight samples with a range of 4.30 to 167 μg/L and a mean of 77.9 μg/L. Two samples from wells NBCE065003 (62.5 μg/L) and NBCE065004 (167 μg/L) exceeded both the vanadium tap-water RBC of 26.0 μg/L and shallow groundwater RC of 11.4 μg/L. No MCL has been established for vanadium.

Zinc was detected in four of eight samples with a range of 5.70 to 1,290 μg/L and a mean of 428 μg/L. One sample from well NBCE065003 (1,290 μg/L) exceeded both the zinc tap-water RBC of 1,100 μg/L and shallow groundwater RC of 27.3 μg/L. No MCL has been established for zinc.

Deep Groundwater

Seven metals were detected in the deep groundwater sample collected at SWMU 65. Two metals — arsenic and iron — exceeded both their respective tap-water RBCs and deep groundwater RCs.

Arsenic was detected in NBCE06504D at 22.8 μg/L, exceeding both its tap-water RBC of 0.0450 μg/L and deep groundwater RC of 16.4 μg/L. The sample did not exceed the arsenic MCL of 50.0 μg/L.

Iron was detected in NBCE06504D at 2,790 μg/L, exceeding its tap-water RBC of 1,100 μg/L. No deep groundwater RC or MCL has been establihsed for iron.

Additional Sample Results

The groundwater/free product sample (065SBFP602) from soil boring location 065SB0006 was analyzed for SVOCs. Seven SVOCs were detected in the groundwater sample. Six of the detected

SVOCs — benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, phenanthrene, and pyrene — exceeded their respective tap-water RBCs and MCLs (where available) as documented below.

Benzo(a)anthracene was detected in sample 065SBFP602 at 170 μg/L, exceeding its tap-water RBC of 0.092 μg/L. No MCL has been established for benzo(a)anthracene.

Benzo(a)pyrene was detected in sample 065SBFP602 at 130 μg/L, exceeding its tap-water RBC of 0.0092 μg/L. The detected concentration also exceeded the benzo(a)pyrene MCL of 2 μg/L.

Chrysene was detected in sample 065SBFP602 at 310 μg/L, exceeding its tap-water RBC of 9.2 μg/L. No MCL has been established for chrysene.

Fluoranthene was detected in sample 065SBFP602 at 300 μg/L, exceeding its tap-water RBC of 150 μg/L. No MCL has been established for fluoranthene.

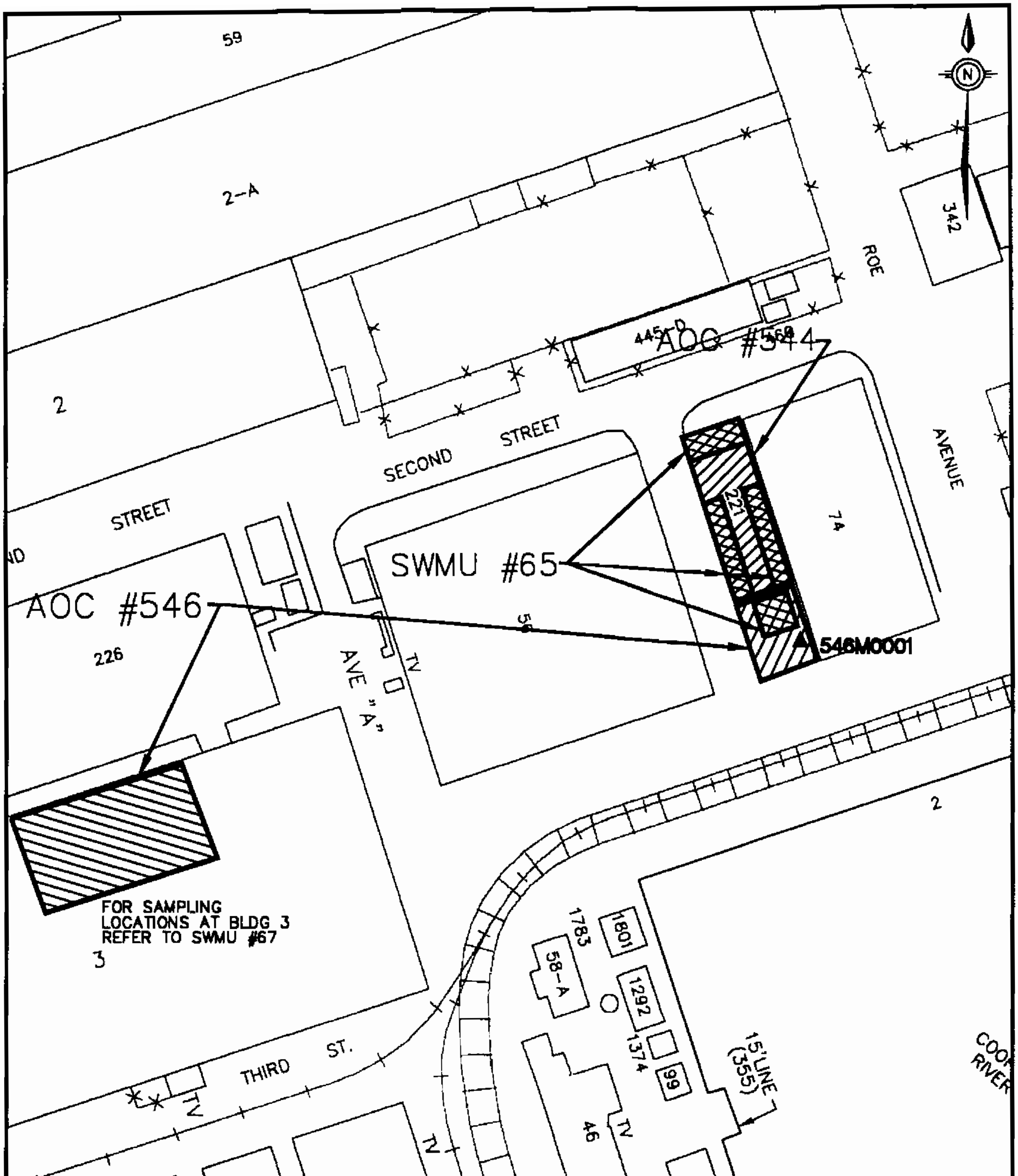
Phenanthrene was detected in sample 065SBFP602 at 360 μg/L, exceeding its tap-water RBC of 150 μg/L. No MCL has been established for phenanthrene.

Pyrene was detected in sample 065SBFP602 at 430 μg/L, exceeding its tap-water RBC of 110 μg/L. No MCL has been established for pyrene.

10.6.5 Sediment Sampling and Analysis

The *Final Zone E RFI Work Plan* did not propose collecting a sediment sample from this site, however, due to the existing storm drain at AOC 546 one sediment sample was collected in the location originally proposed for a soil boring as shown in Figure 10.6.3.

The sediment sample was submitted for analysis at DQO Level III for the pH, organotins and the standard suite of parameters which includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- ⊖ – DEEP MONITORING WELLS
- ◭ – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.6.3
SEDIMENT SAMPLE LOCATIONS
SWMU #65, LEAD STORAGE AREA
AOC #544, PICKLING PLANT
AOC #546, GALVANIZING SHOP

DWG DATE: 09/02/97 | DWG NAME: 10-6-3

No samples were selected as duplicates at this site. Table 10.6.5.1 summarizes sediment sampling and analysis at SWMU 65 and AOCs 544 and 546.

Table 10.6.5.1
SWMU 65 and AOCs 544 and 546
Sediment Sampling Summary

Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviation
0	1	None	Standard Suite[a], pH, and organotins	This sediment sample replaced a soil boring at AOC 546.

Note:
a = Standard suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs

10.6.6 Nature of Contamination in Sediment

Organic compound analytical results for sediment are summarized in Table 10.6.6.1. Inorganic analytical results for sediment are summarized in Table 10.6.6.2. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.6.6.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in Sediment (μg/kg)

Compound	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial Soil RBC	Number of Samples Exceeding RBC
VOCs						
2-Butanone (MEK)	Upper	1/1	28.0	28.0	100,000,000	0
Carbon disulfide	Upper	1/1	4.00	4.00	20,000,000	0
SVOCs						
Acenaphthene	Upper	1/1	2,700	2,700	12,000,000	0
Anthracene	Upper	1/1	7,400	7,400	61,000,000	0

Table 10.6.6.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in Sediment (μg/kg)

Compound	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial Soil RBC	Number of Samples Exceeding RBC
SVOCs						
Benzo(g,h,i)perylene	Upper	1/1	6,900	6,900	8,200,000	0
bis(2-Ethylhexyl)phthalate	Upper	1/1	27,000	27,000	410,000	0
Butylbenzylphthalate	Upper	1/1	740	740	410,000	0
Dibenzofuran	Upper	1/1	2,100	2,100	820,000	0
Di-n-butylphthalate	Upper	1/1	6,800	6,800	NA	NA
Di-n-octyl phthalate	Upper	1/1	2,400	2,400	4,100,000	0
Fluoranthene	Upper	1/1	33,000	33,000	8,200,000	0
Fluorene	Upper	1/1	3,200	3,200	8,200,000	0
2-Methylnaphthalene	Upper	1/1	910	910	8,200,000	0
Naphthalene	Upper	1/1	2,100	2,100	8,200,000	0
Phenanthrene	Upper	1/1	30,000	30,000	8,200,000	0
Pyrene	Upper	1/1	25,000	25,000	6,100,000	0
SVOCs (B(a)P Equivalents)						
B(a)P Equiv.	Upper	1/1	17,000	17,000	780	1
Benzo(a)anthracene	Upper	1/1	15,000	15,000	7,800	1
Chrysene	Upper	1/1	15,000	15,000	780,000	0
Dibenz(a,h)anthracene	Upper	1/1	3,700	3,700	780	1
Indeno(1,2,3-cd)pyrene	Upper	1/1	6,100	6,100	7,800	0
Benzo(k)fluoranthene	Upper	1/1	19,000	19,000	78,000	0
Benzo(a)pyrene	Upper	1/1	11,000	11,000	780	1
Pesticides						
alpha-Chlordane	Upper	1/1	7.90	7.90	4,400	0
4,4'-DDE	Upper	1/1	7.00	7.00	17,000	0

Table 10.6.6.1
SWMU 65 and AOCs 544 and 546
Organic Compounds Detected in Sediment (μg/kg)

Compound	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial Soil RBC	Number of Samples Exceeding RBC
Pesticides						
Dieldrin	Upper	1/1	15.0	15.0	360	0
Endrin	Upper	1/1	15.0	15.0	61,000	0

Notes:
μg/kg = Micrograms per kilogram
RBC = Risk-based concentration
NA = No industrial soil RBC established
* = For the purposes of this investigation, sediment collected from storm and floor drain catch basins are treated as soil and compared to industrial RBCs instead of RAGS sediment screening values.

Table 10.6.6.2
SWMU 65 and AOCs 544 and 546
Inorganic Detections in Sediment

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial Soil RBC	Number of Samples Exceeding RBC
Inorganic Elements (mg/kg)					
Aluminum (Al)	1/1	4,250	4,250	1,000,000	0
Antimony (Sb)	1/1	24.3	24.3	820	0
Arsenic (As)	1/1	9.90	9.90	3.8	1
Barium (Ba)	1/1	164	164	140,000	0
Beryllium (Be)	1/1	0.520	0.520	1.3	0
Cadmium (Cd)	1/1	15.1	15.1	1,000	0
Calcium (Ca)	1/1	3,140	3,140	NA	NA
Chromium (Cr)	1/1	286	286	10,000	0
Cobalt (Co)	1/1	15.1	15.1	120,000	0
Copper (Cu)	1/1	8,560	8,560	82,000	0
Cyanide (CN)	1/1	0.460	0.460	41,000	0
Iron (Fe)	1/1	89,800	89,800	610,000	0

Table 10.6.6.2
SWMU 65 and AOCs 544 and 546
Inorganic Detections in Sediment

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial Soil RBC	Number of Samples Exceeding RBC
Inorganic Elements (mg/kg)					
Lead (Pb)	1/1	3,130	3,130	1,300	1
Magnesium (Mg)	1/1	4,010	4,010	NA	NA
Manganese (Mn)	1/1	400	400	4,700	0
Mercury (Hg)	1/1	0.340	0.340	610	0
Nickel (Ni)	1/1	1,320	1,320	41,000	0
Selenium (Se)	1/1	2.40	2.40	10,000	0
Silver (Ag)	1/1	5.40	5.40	10,000	0
Sodium (Na)	1/1	198	198	NA	NA
Tin (Sn)	1/1	267	267	1,000,000	0
Vanadium (V)	1/1	47.8	47.8	14,000	0
Zinc (Zn)	1/1	2,990	2,990	610,000	0
pH (SU)					
pH	1/1	6.99	6.99	NA	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Risk-based concentration
NA = No industrial soil RBC established
SU = Standard units
* = For the purposes of this investigation, sediment collected from storm and floor drain catch basins are treated as soil and compared to industrial RBCs instead of RAGS sediment screening values.

Volatile Organic Compounds in Sediment

Two VOCs — 2-butanone (MEK) and carbon disulfide — were detected in sediment samples collected at SWMU 65 and AOCs 544 and 546. Neither VOC exceeded its respective industrial RBC. 2-Butanone is considered a common laboratory artifact or contaminant by the National Functional Guidelines, February 1994.

Semivolatile Organic Compounds in Sediment

Twenty SVOCs were detected in the sediment sample collected at SWMU 65 and AOCs 544 and 546. Three SVOCs exceeded their respective industrial soil RBCs in sample 546M0001.

Benzo(a)anthracene was detected in one of one upper-interval samples at 15,000 μg/kg, exceeding the benzo(a)anthracene industrial soil RBC of 7,800 μg/kg.

Dibenz(a,h)anthracene was detected in one of one upper-interval samples at 3,700 μg/kg, exceeding the dibenz(a,h)anthracene industrial soil RBC of 780 μg/kg.

Benzo(a)pyrene was detected in one of one upper-interval samples at 11,000 μg/kg, exceeding the benzo(a)pyrene industrial soil RBC of 780 μg/kg.

In accordance with recent cPAH guidance, BEQs were calculated for cPAHs at SWMU 65 and AOCs 544 and 546. The upper-interval BEQ was calculated at 17,000 μg/kg, exceeding the benzo(a)pyrene industrial RBC of 780 μg/kg (546MO001).

Pesticides and PCBs in Sediment

Four pesticides were detected in the sediment sample collected at SWMU 65 and AOCs 544 and 546. No pesticides were detected above their respective industrial soil RBCs.

No PCBs were detected in sediment samples collected at SWMU 65 and AOCs 544 and 546.

Other Organic Compounds in Sediment

No organotins were detected in sediment samples collected at SWMU 65 and AOCs 544 and 546.

Inorganic Elements in Sediment

Twenty-three metals were detected in the sediment sample collected at SWMU 65 and AOCs 544 and 546. Two metals exceeded their respective industrial soil RBCs in sample 546M0001.

Arsenic was detected in one of one upper-interval samples at 9.90 mg/kg, exceeding the arsenic industrial soil RBC of 3.8 mg/kg.

Lead was detected in one of one upper-interval samples at 3,130 mg/kg, exceeding the lead industrial soil RBC of 400 mg/kg.

pH in Sediment

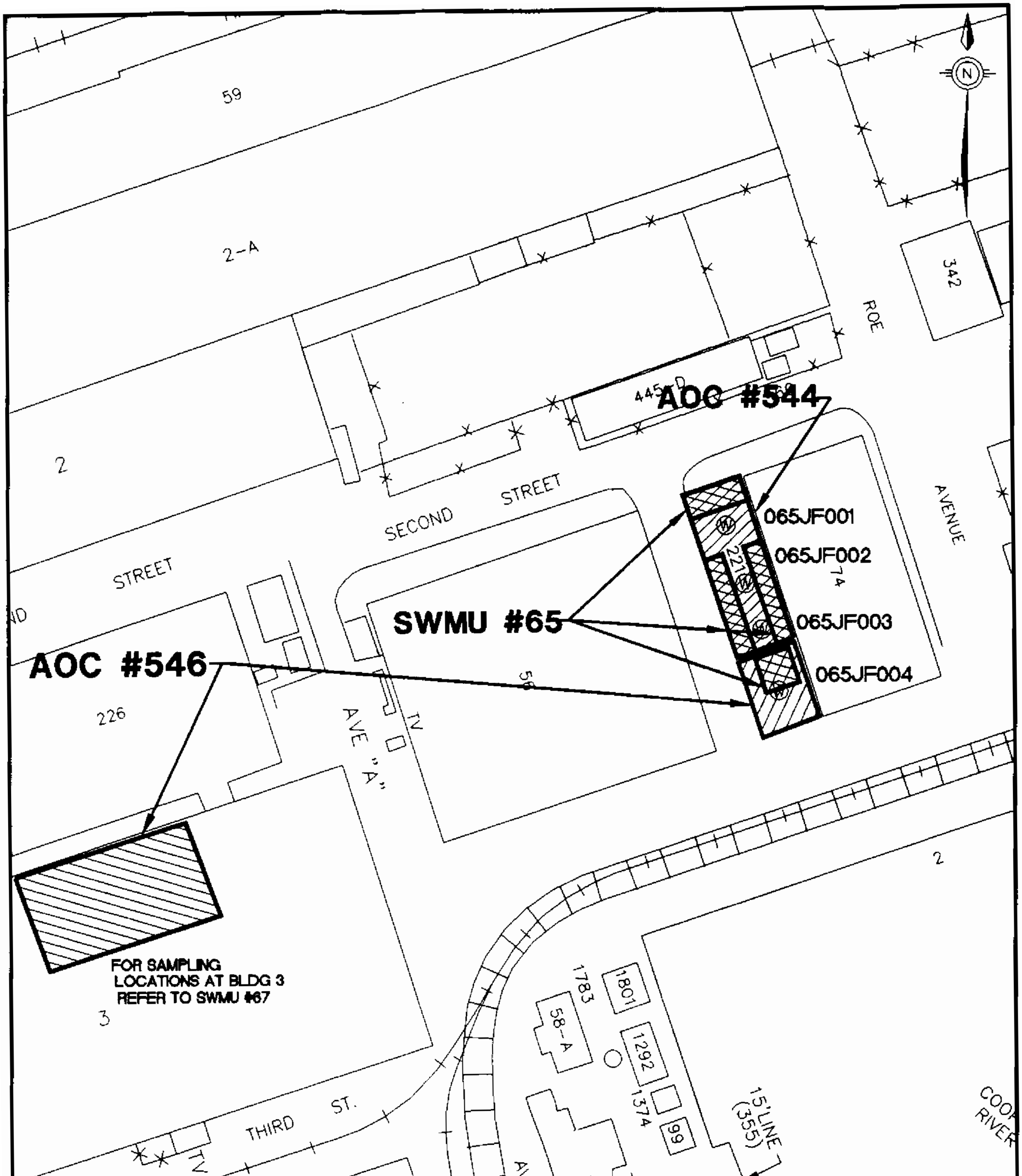
The pH of the sediment sample collected at SWMU 65 and AOCs 544 and 546 was 6.99 SU. No industrial soil RBC has been established for pH.

10.6.7 Wipe Sampling and Analysis

The *Final Zone E RFI Work Plan* did not propose the collection of wipe samples at this SWMU, however, four wipe samples were collected. Sample locations were determined in the field and are shown on Figure 10.6.4. Sample locations were determined in the field and were biased in an attempt to identify worst case situations. Samples were collected where lead ingots and weights used to be stored. Table 10.6.7.1 summarizes the wipe sample analytical results for SWMU 65.

Table 10.6.7.1
SWMU 65
Wipe Sampling Summary

Samples Proposed	Samples Collected	Analyses Proposed	Analyses Performed	Deviations
4	4	Lead	Lead	Collection of 4 wipe samples



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.6.4
WIPE SAMPLE LOCATIONS
SWMU #65, LEAD STORAGE AREA
AOC #544, PICKLING PLANT
AOC #546, GALVANIZING SHOP

DWG DATE: 09/02/97 | DWG NAME: 10-06-4

10.6.8 Nature of Contamination in Dust

No organic compound analytical testing was performed on wipe samples. Analytical results for lead detections in wipe samples are summarized in Table 10.6.8.1. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.6.8.1
SWMU 65 and AOCs 544 and 546
Inorganic Detections in Wipe Samples

Element	Freq. of Detection	Range of Detected Conc. (mg/wipe)	Mean of Detected Conc. (mg/wipe)
Lead (Pb)	3/4	60.6 - 210	140

Note:
mg/wipe = Milligrams per wipe sample

Inorganic Elements Detected on Surfaces

Lead was detected in three of four wipe samples collected at SWMU 65, with a range of 60.6 to 210 mg/wipe and a mean of 140 mg/wipe. No residential or industrial RBCs exist for wipe samples.

10.6.9 Fate and Transport Assessment for SWMUs 65 and AOCs 544 and 546

Combined SWMU 65 is comprised of a lead storage area, former pickling plant, and galvanizing/pickling shop. Nearly the entire combined SWMU 65 area is covered by approximately 2 to 3 feet of concrete. Only those well locations and soil boring locations outside of former Building 221 vicinity lie in the asphalt paved shoulders of Second and Third Street. Environmental media sampled as part of the combined SWMU 65 RFI include surface soil, subsurface soil, shallow and deep groundwater, catch-basin sediment, and wipe samples. Potential constituent migration pathways investigated for combined SWMU 65 include soil to groundwater, groundwater to surface water, surface soil to sediment, and emission of volatiles from surface soil to air.

10.6.9.1 Soil-to-Groundwater Cross-Media Transport: Tier One

Table 10.6.9.1 compares maximum detected organic constituent concentrations in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels, or (b) background reference concentrations. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 10:1, with no attenuation of constituents in soil (DAF=10).

Seven organic compounds — methylene chloride, benzo(a)anthracene, aldrin, beta-BHC, delta-BHC, gamma-BHC (Lindane), and dieldrin — were detected in combined SWMU 65 soil at concentrations greater than or equal to groundwater protection SSLs and were carried over to the second-tier screen. Of the seven compounds, only beta-BHC was detected in groundwater samples, indicating that the current soil-groundwater equilibrium is sufficiently protective of the surficial aquifer for all other constituents. Maximum surface soil concentrations were higher than subsurface soil concentrations except for benzo(a)anthracene; however, subsurface soil concentrations still exceeded groundwater protection SSLs for each of the seven organic compounds except aldrin and gamma BHC (Lindane). The greatest percentage exceedance was dieldrin with a concentration of 586 μg/kg in surface soil sample 544SB001, more than two orders of magnitude higher than its generic SSL of 2 μg/kg. Dieldrin also had the greatest number of exceedances with four at each sampling depth. Benzo(a)anthracene exceeded its groundwater protection SSL in a single subsurface soil sample; aldrin exceeded in one surface soil sample; beta-BHC exceeded in one surface and one subsurface sample; delta-BHC exceeded in two surface and three subsurface samples; and gamma-BHC (Lindane) exceeded in one surface soil sample. The maximum surface soil concentrations for four of the pesticides — aldrin, delta-BHC, gamma-BHC (Lindane), and dieldrin — were detected in sample 544SB001. The single beta-BHC surface soil detection and the maximum delta-BHC subsurface concentration were detected in sample 544SB002.

Four inorganics — antimony, cobalt, copper, and mercury — were detected in soil above their respective groundwater protection SSLs or background reference values, and were carried over to the second-tier screen. All inorganics, except cobalt, had greater maximum subsurface soil concentrations than surface soil concentrations. All four of these inorganic constituents were also detected in groundwater, indicating a completed pathway from soil to groundwater. Antimony was detected in groundwater above its tap water RBC, while copper and mercury were detected above their saltwater surface water chronic screening values. Cobalt was detected at 505 mg/kg in surface soil sample 544SB004; two other cobalt exceedances, also in surface soil, were detected above cobalt's background reference value of 19 mg/kg. Antimony, copper, and mercury exceeded their respective groundwater protection standards in no more than one soil sample at each depth. Mercury and copper exceedances in subsurface soil occurred in the same soil sample (544SB003).

10.6.9.2 Groundwater-to-Surface Water Cross-Media Transport: Tier One

Table 10.1.5.1 also compares maximum detected organic constituent concentrations in shallow groundwater samples to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background reference concentrations for groundwater, as well as to the saltwater surface water chronic values. To provide a conservative first-tier screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

Five organic constituents — trichloroethene, vinyl chloride, alpha-BHC, beta-BHC, and dioxin TEQs — were detected in shallow groundwater samples at concentrations above tap water RBCs and were carried over to the second-tier screen. Acenaphthene and fluoranthene, which exceeded their saltwater surface water chronic screening levels were also carried over to the second-tier screen. The dioxin congeners 1234678-HpCDD and OCDD were detected in the single duplicate sample from well NBCE065004 at 115 pg/L and 1,270 pg/L, respectively. Preliminary analysis of second-round samples from well NBCE065004 indicates no detection of 1234678-HpCDD and a decrease in OCDD concentrations to 5.51 pg/L (EMPC code); however, 106 pg/L of 1234678-HpCDD and 375 pg/L of OCDD were detected in well NBCE065003 (dioxin TEQ of 1.44 pg/L) during second-round sampling, which is greater than the TEQ tap water RBC of 0.43 pg/L. Other dioxin cogeners were detected in trace amounts in wells NBCE065005 and NBCE065006 during second-round sampling.

Vinyl chloride was detected at 316 times its RBC in shallow groundwater in well NBCE065003 in first-quarter samples. Preliminary analysis of subsequent samples from this well indicate increases in related solvent concentrations — 1,2-dichloroethene (total) and trichloroethene — but decreasing vinyl chloride concentrations. Shallow groundwater samples from well NBCE065004 reported concentrations of alpha-BHC over an order of magnitude greater than its tap water RBC and a concentration of beta-BHC marginally greater than its RBC. The acenaphthene and fluoranthene exceedances were low multiples of their respective surface water standards and were also detected in shallow groundwater from well NBCE065007.

Vinyl chloride and trichloroethene were detected at 316 and 5 times their respective RBCs in deep groundwater in well NBCE06504D during first-round sampling. Preliminary analysis of subsequent sampling rounds indicates that vinyl chloride and trichloroethene concentrations had decreased to 3 and 4 μg/L, respectively, in fourth-round samples. However, total 1,2-dichloroethene concentrations had increased to 14 μg/L in fourth-round samples.

A groundwater/free product sample (065SBFP602) from soil boring location 065SB006 reported concentrations of six SVOCs exceeding their respective tap water RBCs, as described in Section 10.6.4. The SVOCs were carried over to the second-tier screening.

Antimony, arsenic, beryllium, and lead were detected at concentrations higher than their respective groundwater standards in first-round samples from shallow wells. Of these four metals, lead had the greatest percentage exceedances: 1,690 μg/L and 315 μg/L at 065003 and 065004, respectively, which are considerably higher than the lead action level of 15 μg/L. Increased lead concentrations in groundwater are likely related to use of the site as a lead storage facility. All metal exceedances in shallow groundwater were confined to well NBCE065003 and NBCE065004. Well NBCE065003 reported the highest first-round concentrations of aluminum, antimony, cadmium, chromium, cobalt, copper, lead, nickel, tin, and zinc. Concentrations of all of these metals in the second-round sample from this well were significantly lower, suggesting that the high concentrations in the first sampling round were related to well installation effects.

First-quarter arsenic, total chromium, copper, lead, mercury, and zinc concentrations exceeded their respective saltwater surface water chronic screening levels. Lead and copper exceedances were over two orders of magnitude above standards while zinc and mercury exceedances were more than one order of magnitude higher. Preliminary analysis of subsequent sampling rounds indicates that shallow groundwater at well NBCE065003 continued to indicate lead concentrations above its action level and surface water screening value. Chromium (total), copper, mercury, and zinc were also detected in concentrations above their respective saltwater surface water chronic screening values. All detected metals in subsequent sampling rounds at well NBCE065004 were below RBCs or saltwater surface water chronic screening values.

Arsenic was detected above its background reference value of 18.7 μg/L in deep groundwater at well NBCE06504D, the only deep well installed at combined SWMU 65. Preliminary analysis of subsequent sampling rounds indicates that arsenic concentrations declined below its reference value in second and third-round samples but increased to 44 μg/L during the fourth round. This fourth-round value exceeds both the arsenic background reference value and its saltwater surface water chronic screening level.

10.6.9.3 Soil and Groundwater-to-Surface Water Cross-Media Transport: Tier Two

Table 10.6.9.2 provides a second screening tier for all constituents detected in soil or groundwater at concentrations exceeding any of the first-tier screening levels. Constituent concentrations in groundwater are compared to combined ecological/human health RBCs that have been adjusted upward for site-specific dilution by surface water in the Cooper River, while soil constituent concentrations are compared to calculated SSLs that are based on the adjusted RBCs rather than the original target leachate concentrations. For the second-tier screen, no dilution of leachate by groundwater or attenuation of constituents in soil is assumed (DAF=1). The second screening tier identifies any constituents in soil or groundwater that pose a threat to surface water quality, after allowing for dilution of groundwater by surface water when the groundwater discharges into the river. The site-specific surface-water dilution factor calculated for combined SWMU 65 is 40,700:1 (see Table 6.2.1).

None of the first-tier constituent concentrations exceeded the adjusted screening levels of the second tier, indicating that site constituents in soil and groundwater pose no threat to human health or the environment in the Cooper River through the associated migration pathway. The elevated concentrations of PAHs and isolated high concentrations of several pesticides in surface and subsurface soil samples are not of concern because most chemicals from both groups are not particularly mobile in soil or groundwater. Dieldrin's maximum soil concentration of 586 mg/kg was the only organic compound detection within an order of magnitude of its adjusted SSL, while arsenic was the only inorganic with a soil detection within an order of magnitude of its groundwater protection standard. Six PAHs with concentrations exceeding their tap water RBCs in the groundwater/free product sample from soil boring 065SB006 in the first-tier screening did not exceed their adjusted RBCs in the second-tier screening. Maximum groundwater concentrations of all other constituents were roughly 2 to 5 orders of magnitude below their respective combined ecological/human health RBCs.

The adjusted SSLs for combined SWMU 65 were obtained assuming a DAF of 1, which implies zero attenuation of contaminants as leachate moves downward through subsurface soil toward the shallow aquifer. Due to a combination of high clay content and a localized layer of peat, combined SWMU 65 exhibits a perched water table that is approximately 3 feet higher than that of the shallow aquifer in the area around the site. Both clay particles and peat strongly attenuate any dissolved organic or inorganic constituents moving through the soil. Consequently, the margin between detected soil concentrations and levels protective of the Cooper River is actually much greater than indicated in the table.

10.6.9.4 Soil-to-Sediment Cross-Media Transport

Tables 10.6.6.1 and 10.6.6.2 present the organic and inorganic constituents detected in the only sediment sample (546M0001) collected at combined SWMU 65. Although organic and inorganic constituents detected in this catch-basin sediment sample generally reflect those detected in soils at combined SWMU 65, it is unlikely that constituents reported in surface soil are a source of contamination in catch basin sediment since the ground surface is entirely paved. Reported concentrations of PAHs and inorganic constituents were generally higher in sediment samples than in soil samples, while pesticide concentrations were higher in soil samples. High lead concentrations in sediment are undoubtedly related to lead storage at the site.

10.6.9.5 Soil-to-Air Cross-Media Transport

Table 10.6.9.3 lists the VOCs detected in surface soil samples collected at combined SWMU 65 along with corresponding soil-to-air volatilization screening levels. No exposed soil is evident at the site. In addition, none of the VOCs was reported at a maximum concentration exceeding its corresponding soil-to-air volatilization screening level. As a result, the soil-to-air migration pathway is not expected to be significant at combined SWMU 65.

10.6.9.6 Fate and Transport Summary

In the first-tier screen, seven organic compounds were detected in soil samples at concentrations greater than their respective SSLs, but only beta-BHC was additionally detected in groundwater. The beta-BHC groundwater concentration was marginally greater than its tap water RBC value. Five organics were present in groundwater at concentrations greater than their respective RBCs. Two SVOCs were detected in shallow groundwater at concentrations greater than their saltwater surface water chronic screening levels. The solvent constituents may be related to the galvanizing and pickling operations that historically occurred at the site. Pesticide concentrations appear to be isolated in soil at borings 544SB001 and 544SB002 and in groundwater at well NBCE065004. Dioxin TEQs were above RBCs at soil sample location 065004 only in first-round results and at location 065003 only in second-round results.

Of the four inorganics detected in soil above their respective SSLs, only antimony was detected in groundwater above its RBC. Copper and mercury also exceeded their surface water protective standards. Three other metals were detected in groundwater above their respective RBCs and four other metals exceeded their surface water screening levels. All metal exceedances in shallow groundwater were confined to shallow wells NBCE065003 and NBCE065004. Isolated elevated concentrations of lead, chromium, zinc, and copper in soil and groundwater are probably related to the pickling, galvanizing, and lead storage operations formerly conducted at the site.

None of the constituents exceeding first-tier screening values also exceeded the adjusted screening values of the second-tier comparisons, indicating that there is no threat to surface water in the Cooper River via the evaluated migration pathways.

Table 10.6.9.1
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, and Deep Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMU 65 and AOCs 544 and 546
Charleston, South Carolina

Parameter	Max. Concentration		Max. Concentration		Screening Concentration *							
	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Volatile Organic Compounds												
Acetone	290	520	380	ND	8000	3700	NA	UG/KG	UG/L	NO	NO	NO
2-Butanone (MEK)	ND	75	ND	ND	4000	1900	NA	UG/KG	UG/L	NO	NO	NO
Carbon disulfide	2	2	1	ND	16000	1000	NA	UG/KG	UG/L	NO	NO	NO
Carbon tetrachloride	5	4	ND	ND	35	0.16	1500	UG/KG	UG/L	NO	NO	NO
1,1-Dichloroethane	ND	ND	ND	2	11500	810	NA	UG/KG	UG/L	NO	NO	NO
1,2-Dichloroethene (total)	2	4	7	10	200	55	NA	UG/KG	UG/L	NO	NO	NO
Ethylbenzene	ND	2	ND	ND	6500	1300	4.3	UG/KG	UG/L	NO	NO	NO
Methylene chloride	60	35	ND	ND	10	4.1	2560	UG/KG	UG/L	YES	NO	NO
Trichloroethene	ND	ND	ND	8	30	1.6	NA	UG/KG	UG/L	NO	YES	NO
Vinyl chloride	ND	7	6	6	7	0.019	NA	UG/KG	UG/L	NO	YES	NO
Xylene (total)	ND	5	1	ND	71000	12000	NA	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Acenaphthene	170	15000	41	2	285000	2200	9.7	UG/KG	UG/L	NO	NO	YES
Acenaphthylene	ND	530	1	ND	150000	1500	NA	UG/KG	UG/L	NO	NO	NO
Anthracene	540	5200	2	ND	5900000	11000	NA	UG/KG	UG/L	NO	NO	NO
Benzoic acid	ND	ND	2	ND	200000	150000	NA	UG/KG	UG/L	NO	NO	NO
Benzo(g,h,i)perylene	74	360	ND	ND	2.33E+08	1500	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	230	2900	ND	ND	800	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(a)pyrene	210	1200	ND	ND	4000	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(b)fluoranthene	240	1600	ND	ND	2500	0.092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(k)fluoranthene	270	1600	ND	ND	24500	0.92	NA	UG/KG	UG/L	NO	NO	NO
Chrysene	420	2900	ND	ND	80000	9.2	NA	UG/KG	UG/L	NO	NO	NO
Dibenzo(a,h)anthracene	170	ND	ND	ND	800	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Indeno(1,2,3-cd)pyrene	72	390	ND	ND	7000	0.092	NA	UG/KG	UG/L	NO	NO	NO
4-Chloroaniline	100	ND	ND	ND	350	150	NA	UG/KG	UG/L	NO	NO	NO
4-Chloro-3-methylphenol	120	90	ND	ND	3150	180	NA	UG/KG	UG/L	NO	NO	NO
2-Chlorophenol	96	ND	ND	ND	2000	180	NA	UG/KG	UG/L	NO	NO	NO
Dibenzofuran	75	4000	12	1	NA	150	NA	UG/KG	UG/L	NO	NO	NO
Di-n-butylphthalate	220	ND	ND	ND	2300000	3700	3.4	UG/KG	UG/L	NO	NO	NO
bis(2-Ethylhexyl)phthalate (BEHP)	1300	ND	ND	ND	1800000	4.8	NA	UG/KG	UG/L	NO	NO	NO
Fluoranthene	840	15000	4	ND	2150000	1500	1.6	UG/KG	UG/L	NO	NO	YES
Fluorene	190	12000	20	1	280000	1500	NA	UG/KG	UG/L	NO	NO	NO
2-Methylnaphthalene	130	990	2	ND	63000	1500	NA	UG/KG	UG/L	NO	NO	NO
Naphthalene	390	2000	ND	ND	42000	1500	23.5	UG/KG	UG/L	NO	NO	NO
Phenanthrene	800	20000	12	ND	690000	1500	NA	UG/KG	UG/L	NO	NO	NO
Phenol	110	ND	ND	ND	50000	22000	58	UG/KG	UG/L	NO	NO	NO
Pyrene	730	17000	2	ND	2100000	1100	NA	UG/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
Aldrin	349	2.38	ND	ND	250	0.004	0.13	UG/KG	UG/L	YES	NO	NO
alpha-BHC	ND	ND	0.13	ND	0.25	0.011	1400	UG/KG	UG/L	NO	YES	NO
beta-BHC	11.7	2.8	0.048	ND	1.5	0.037	NA	UG/KG	UG/L	YES	YES	NO
delta-BHC	96	8.64	ND	ND	1.01	0.037	NA	UG/KG	UG/L	YES	NO	NO
gamma-BHC (Lindane)	9.54	ND	ND	ND	4.5	0.052	0.016	UG/KG	UG/L	YES	NO	NO
alpha-Chlordane	13	2.6	ND	ND	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
gamma-Chlordane	16	ND	ND	ND	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
4,4'-DDE	10.5	10.3	ND	ND	27000	0.2	0.14	UG/KG	UG/L	NO	NO	NO
4,4'-DDT	3.2	ND	ND	ND	16000	0.2	0.001	UG/KG	UG/L	NO	NO	NO
Dieldrin	586	33.2	ND	ND	2	0.0042	0.0019	UG/KG	UG/L	YES	NO	NO
Endosulfan I	5.2	9.01	ND	ND	9000	220	0.0087	UG/KG	UG/L	NO	NO	NO
Endrin	4.91	5.2	ND	ND	500	11	0.0023	UG/KG	UG/L	NO	NO	NO
Endrin aldehyde	4.73	ND	ND	ND	500	11	NA	UG/KG	UG/L	NO	NO	NO
Heptachlor	1.8	1.7	ND	ND	11500	0.0023	0.0036	UG/KG	UG/L	NO	NO	NO
Heptachlor epoxide	19	5.3	ND	ND	350	0.0012	0.0036	UG/KG	UG/L	NO	NO	NO

Table 10.6.9.1
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, and Deep Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMU 65 and AOCs 544 and 546
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Dioxin Compounds												
Dioxin (TCDD TEQ)	0.963	0.406	2.42	NA	950	0.43	10	NG/KG	PG/L	NO	YES	NO
TPH - Gasoline Range Organics												
Gasoline	ND	9.7	NA	NA	NA	NA	NA	UG/KG	UG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	6490	14800	21500	ND	41100	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	2.9	3.6	42	ND	2.5	15	NA	MG/KG	UG/L	YES	YES	NO
Arsenic	7.7	21	58.8	22.8	23.9	18.7	36	MG/KG	UG/L	NO	YES	YES
Barium	25.1	31.1	54.9	ND	820	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	0.44	1	2	ND	32	1.2	NA	MG/KG	UG/L	NO	YES	NO
Cadmium	1.5	2.2	6.9	ND	4	18	9.3	MG/KG	UG/L	NO	NO	NO
Chromium (total)	36.5	30.1	245	ND	94.6	37000	103	MG/KG	UG/L	NO	NO	YES
Chromium (hexavalent)	0.167	ND	ND	ND	19	180	50	MG/KG	UG/L	NO	NO	NO
Cobalt	505	6.3	2.5	ND	19	2200	NA	MG/KG	UG/L	YES	NO	NO
Copper	102	221	536	ND	152	1500	2.9	MG/KG	UG/L	YES	NO	YES
Cyanide	3.4	NA	13.4	ND	20	730	37.3	MG/KG	UG/L	NO	NO	NO
Lead	165	272	1690	ND	400	15	8.5	MG/KG	UG/L	NO	YES	YES
Manganese	87.3	418	964	140	881	2560	NA	MG/KG	UG/L	NO	NO	NO
Mercury	0.22	8.2	5.9	ND	2.6	11	0.2	MG/KG	UG/L	YES	NO	YES
Nickel	49.4	16	36	ND	77.1	730	42.2	MG/KG	UG/L	NO	NO	NO
Selenium	1.4	0.66	ND	ND	2.5	180	71	MG/KG	UG/L	NO	NO	NO
Silver	0.38	ND	ND	ND	17	180	0.23	MG/KG	UG/L	NO	NO	NO
Tin	34.6	33.2	219	ND	59.4	22000	NA	MG/KG	UG/L	NO	NO	NO
Vanadium	18.8	62.8	167	ND	3000	'260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	303	363	1290	ND	6000	11000	86	MG/KG	UG/L	NO	NO	YES

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 10, adapted from 1996 EPA Soil Screening Guidance or calculated using values from Table 6.2
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, June 3, 1996
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November, 1995; Table 2
In each case, the value shown is the greater of the relevant screening value or the corresponding background reference value

Units: See notes for Table 10.1.5.1

Table 10.6.9.2
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, or Deep Groundwater at Concentrations Exceeding any Initial Screening Concentration
Comparison to Combined Ecological/Human Health RBCs Adjusted for Surface Water Dilution, and to SSLs Based on Adjusted Ecological/Human Health RBCs: Tier Two
NAVBASE-Charleston, Zone E: SWMU 65 and AOCs 544 and 546
Charleston, South Carolina

	Max. Concentration		Max. Concentration		Initial Screening Concentrations *			Adjusted Screening Concentrations #					Units		Screening Results	
Parameter	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Combined Eco/HH Surf. Wtr. RBC	Adjusted Eco/HH GW RBC	Target Leachate Conc. (DAF=1)	SSL Multi-plier	Adjusted SSL (DAF=1)	Soil Units	Water Units	Leaching Potential	Surface Water Migration Concern
Volatile Organic Compounds																
Methylene chloride	60	35	ND	ND	10	4.1	2560	4.1	1.67E+05	5	3.34E+04	3.34E+04	UG/KG	UG/L	NO	NO
Trichloroethene	ND	ND	ND	8	30	1.6	NA	1.6	6.51E+04	5	1.30E+04	3.91E+04	UG/KG	UG/L	NO	NO
Vinyl chloride	ND	7	6	6	7	0.019	NA	0.019	7.73E+02	2	3.87E+02	2.71E+02	UG/KG	UG/L	NO	NO
Semivolatile Organic Compounds																
Acenaphthene	170	15000	41	2	285000	2200	9.7	9.7	3.95E+05	2000	1.97E+02	5.63E+06	UG/KG	UG/L	NO	NO
Benzo(a)pyrene equivalents																
Benzo(a)anthracene	230	2900	ND	ND	800	0.092	NA	0.092	3.74E+03	0.1	3.74E+04	3.00E+06	UG/KG	UG/L	NO	NO
Fluoranthene	840	15000	4	ND	2150000	1500	1.6	1.6	6.51E+04	1000	6.51E+01	1.04E+07	UG/KG	UG/L	NO	NO
Pesticides/PCB Compounds																
Aldrin	349	2.38	ND	ND	250	0.004	0.13	0.004	1.63E+02	0.005	3.26E+04	8.14E+05	UG/KG	UG/L	NO	NO
alpha-BHC	ND	ND	0.13	ND	0.25	0.011	1400	0.011	4.48E+02	0.01	4.48E+04	1.12E+03	UG/KG	UG/L	NO	NO
beta-BHC	11.7	2.8	0.048	ND	1.5	0.037	NA	0.037	1.51E+03	0.05	3.01E+04	4.52E+03	UG/KG	UG/L	NO	NO
delta-BHC	96	8.64	ND	ND	1.5	0.037	NA	0.037	1.51E+03	0.05	3.01E+04	4.52E+03	UG/KG	UG/L	NO	NO
gamma-BHC (Lindane)	9.54	ND	ND	ND	4.5	0.052	0.016	0.016	6.51E+02	0.2	3.26E+03	1.47E+03	UG/KG	UG/L	NO	NO
Dieldrin	586	33.2	ND	ND	2	0.0042	0.0019	0.0019	7.73E+01	0.005	1.55E+04	3.09E+03	UG/KG	UG/L	NO	NO
Dioxin Compounds																
Dioxin (TCDD TEQ)	0.963	0.406	2.42	NA	950	0.43	10	0.43	1.75E+04	30	5.83E+02	5.54E+04	NG/KG	PG/L	NO	NO
Inorganic Compounds																
Antimony	2.9	3.6	42	ND	2.5	15	NA	15	6.11E+05	6	1.02E+05	2.54E+04	MG/KG	UG/L	NO	NO
Arsenic	7.7	21	58.8	22.8	14.6	0.045	36	0.045	1.83E+03	50	3.66E+01	5.35E+01	MG/KG	UG/L	NO	NO
Beryllium	0.44	1	2	ND	32	0.016	NA	0.016	6.51E+02	4	1.63E+02	5.21E+02	MG/KG	UG/L	NO	NO
Chromium (total)	36.5	30.1	245	ND	19	180	50	50	2.04E+06	100	2.04E+04	3.87E+04	MG/KG	UG/L	NO	NO
Cobalt	505	6.3	2.5	ND	1040	2200	NA	2200	8.95E+07	2200	4.07E+04	1.00E+06	MG/KG	UG/L	NO	NO
Copper	102	221	536	ND	458	1500	2.9	2.9	1.18E+05	1300	9.08E+01	4.16E+03	MG/KG	UG/L	NO	NO
Lead	165	272	1690	ND	400	15	8.5	8.5	3.46E+05	15	2.31E+04	9.23E+05	MG/KG	UG/L	NO	NO
Mercury	0.22	8.2	5.9	ND	1.04	11	0.2	0.2	8.14E+03	2	4.07E+03	4.23E+02	MG/KG	UG/L	NO	NO
Zinc	303	363	1290	ND	6000	11000	86	86	3.50E+06	10000	3.50E+02	2.10E+05	MG/KG	UG/L	NO	NO

* Initial Screening Concentrations: See notes for Table 10.1.5.2
In this table, the screening values shown are not adjusted for background reference values.

\# Adjusted Screening Concentrations: See notes for Table 10.1.5.2
Adjusted Eco/HH Groundwater RBC - Combined Eco/HH Surface Water RBCs multiplied by site-specific surface water dilution factor of 40,700: GW concentrations protective of surface water

Units: See notes for Table 10.1.5.2

Table 10.6.9.3
Soil-to-Air Volatilization Screening Analysis
NAVBASE-Charleston, Zone E: SWMU 65 and AOCs 544 and 546
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Acetone	290	62000000	UG/KG	NO
Carbon disulfide	2	11000	UG/KG	NO
Carbon tetrachloride	5	200	UG/KG	NO
1,2-Dichloroethene (total)	2	1500000	UG/KG	NO
Methylene chloride	60	7000	UG/KG	NO

* - Soil screening levels for transfers from soil to air were obtained from USEPA Region III Risk-Based Concentration Table, June 1996.

10.6.10 Fixed-Point Risk Evaluation for SWMUs 65, and AOC 544, and AOC 546

10.6.10.1 Site Background and Investigative Approach

SWMU 65, Building 221, is a lead storage area. AOC 544 is a former pickling plant at Building 221 and AOC 546 is a former pickling/galvanizing shop that operated inside Building 1025. The following refers to these sites as combined SWMU 65. All are located in a highly industrialized portion of Zone E. As a result, the risk assessment for this site is presented as a FRE following the framework presented in Section 7.3. Due to their proximity, the investigational effort for these sites was combined. As a result, the risk evaluation will combine the environmental data from all three sites.

A total of twelve surface soil samples, collected as part of the 1995 RFI, were considered in the combined SWMU 65 FRE. Eight shallow monitoring wells and one deep monitoring well were installed as part of the 1995 RFI. Groundwater data generated from the first-quarter sampling event are used to represent point risk/hazard for the combined SWMU 65 FRE. Sections 10.6.1 and 10.6.3 contain summarys of the sampling effort for combined SWMU 65.

10.6.10.2 Fixed-Point Risk Evaluation for Soil

Residential Scenario

Table 10.6.10.1 provides CPSS summaries for combined SWMU 65 soil and identifies COPCs based on comparison to residential and industrial RBCs and background RCs. Based on residential RBCs, four COPCs (aldrin, BEQs, cobalt, and dieldrin) were identified for combined SWMU 65 soil. Arsenic and beryllium were detected in combined SWMU 65 soil at concentrations above their RBCs but were eliminated from consideration in the residential FRE based on comparison to their background concentrations. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration.

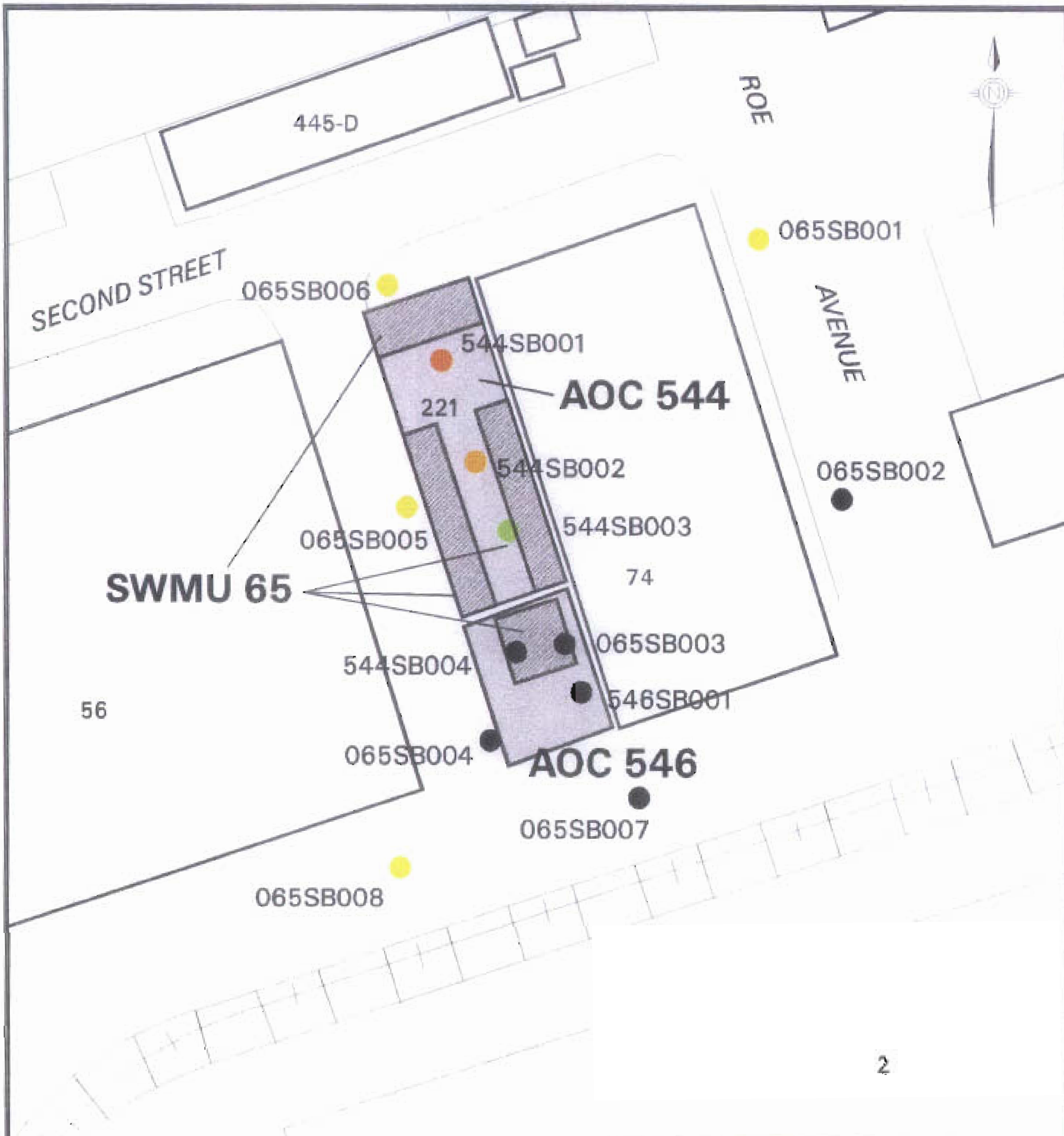
Table 10.6.10.2 summarizes the residential COPCs detected at each combined SWMU 65 sample location with contribution to risk and hazard. As shown, BEQs contribute to risk estimates for combined SWMU 65, exceeding 1E-06 at 3 of 12 locations (065SB001, 065SB006, and 065SB008). Additionally, concentrations of dieldrin and aldrin contribute to risk estimates above 1E-06 at sample locations 065SB005, 544SB001, and 544SB002. No carcinogenic COPC were detected at sample locations 065SB002, 065SB003, 065SB004, 065SB007, 544SB003, and 544SB004. Figure 10.6.5 is a spatial presentation of residential risk estimates for combined SWMU 65 soil. For samples with concentrations of carcinogenic COPCs, risk estimates range from 5E-07 to 3E-05 with an arithmetic mean risk of 5E-06. The arithmetic mean was calculated assuming a deminimus risk level of 1E-07 for locations where no carcinogenic COPC were detected.

HI projections did not exceeded the threshold of unity at any sample location. HI estimates range from 0.0001 to 0.4.

Industrial Scenario

Based on industrial RBCs, aldrin and dieldrin were identified as COPCs for combined SWMU 65 soil. Arsenic was detected in combined SWMU 65 soil at concentrations above its industrial RBC but was eliminated from consideration in the industrial FRE 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 based on background concentration.

Table 10.6.10.3 summarizes the industrial COPCs detected at each combined SWMU 65 sample location with contribution to risk and hazard. As shown, aldrin and dieldrin are the contributors to risk for combined SWMU 65, exceeding 1E-06 at two of 12 locations based on the industrial scenario. No carcinogenic COPCs were detected in eight of the surface soil samples (065SB001,



LEGEND - CUMULATIVE SOIL RISK
- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 100

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

FIGURE 10.6.5
CUMULATIVE SOIL RISK
RESIDENTIAL SCENARIO
SWMU 65 AOC 544,546

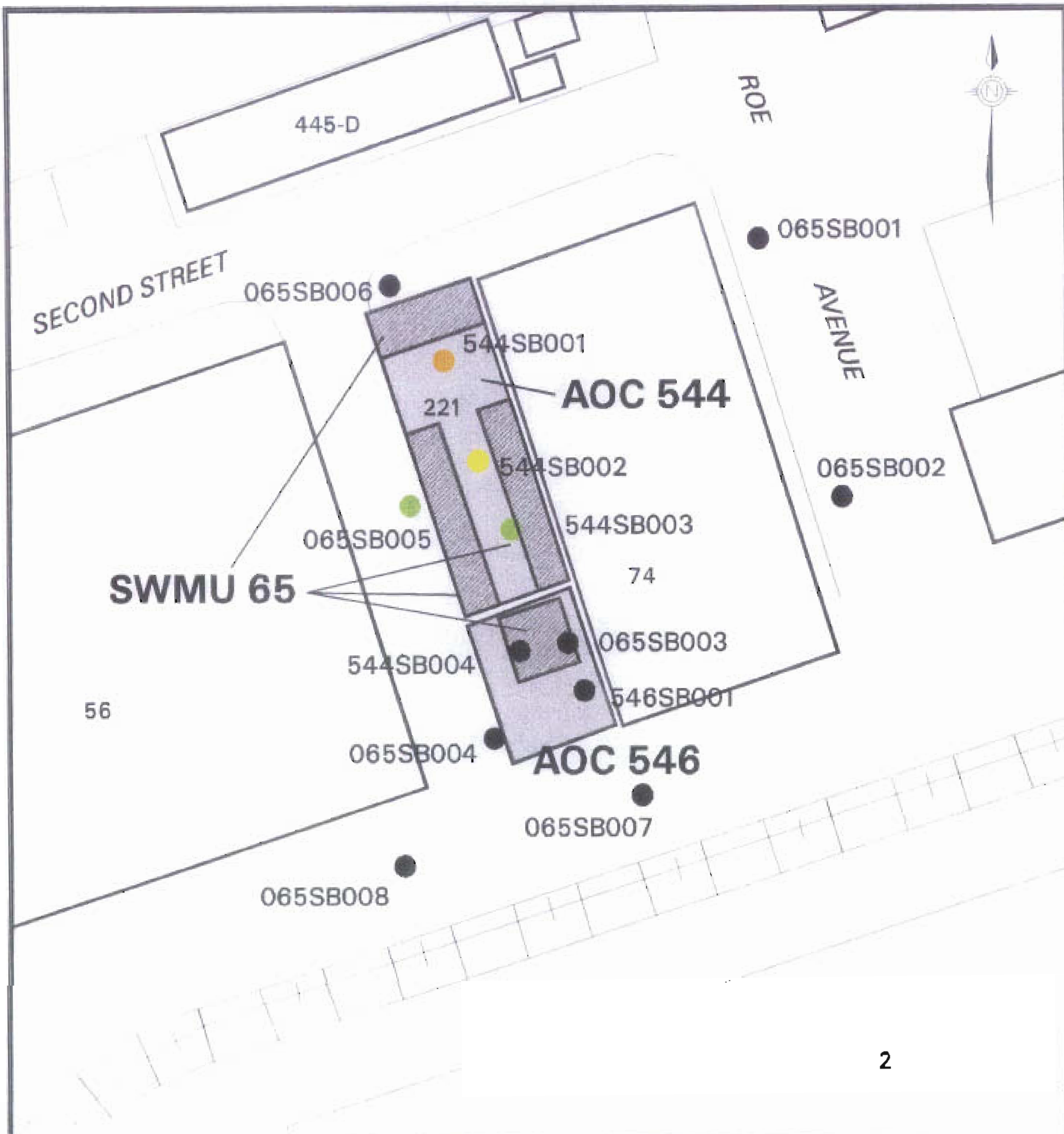
065SB002, 065SB003, 065SB004, 065SB006, 065SB007, 065SB008, and 544SB004). Figure 10.6.6 is a spatial presentation of industrial scenario risk estimates for combined SWMU 65 surface soil. For the samples with concentrations of carcinogenic COPCs, risk estimates range from 1E-07 to 7E-06 with an arithmetic mean risk of 8E-07, assuming a deminimus risk of 1E-07 for sample locations where no carcinogenic COPCs were detected.

HI projections did not exceed the threshold of unity at any sample locations based on the industrial scenario. For sample with concentrations of COPCs contributing to HI estimates, the range was from 0.0004 to 0.03.

10.6.10.3 Fixed-Point Risk Evaluation for Groundwater

Residential Scenario

Table 10.6.10.4 provides separate CPSS summaries for combined SWMU 65 shallow and deep groundwater and identifies COPCs. Arsenic, 1,2-dichloroethene (total), trichloroethene, and vinyl chloride were identified as COPCs in deep groundwater; acetone, aluminum, antimony, arsenic, beryllium, alpha-BHC, beta-BHC, cadmium, chromium, copper, 1,2-dichloroethene (total), dioxin equivalents, lead, mercury, vanadium, and vinyl chloride were identified as COPCs in shallow groundwater based on comparison of first-quarter groundwater concentrations to tap-water RBCs and background RCs. Manganese was detected in combined SWMU 65 shallow and deep groundwater at concentrations above its RBC but was eliminated from consideration in the FRE based on comparison to its background concentration. For shallow groundwater, Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration. Combined SWMU 65 deep groundwater data were not sufficient to perform Wilcoxon rank sum test analyses, and as a result, manganese was eliminated from the deep groundwater FRE based on direct comparison of its maximum concentration to its background RC.



2

LEGEND - CUMULATIVE SOIL RISK

- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

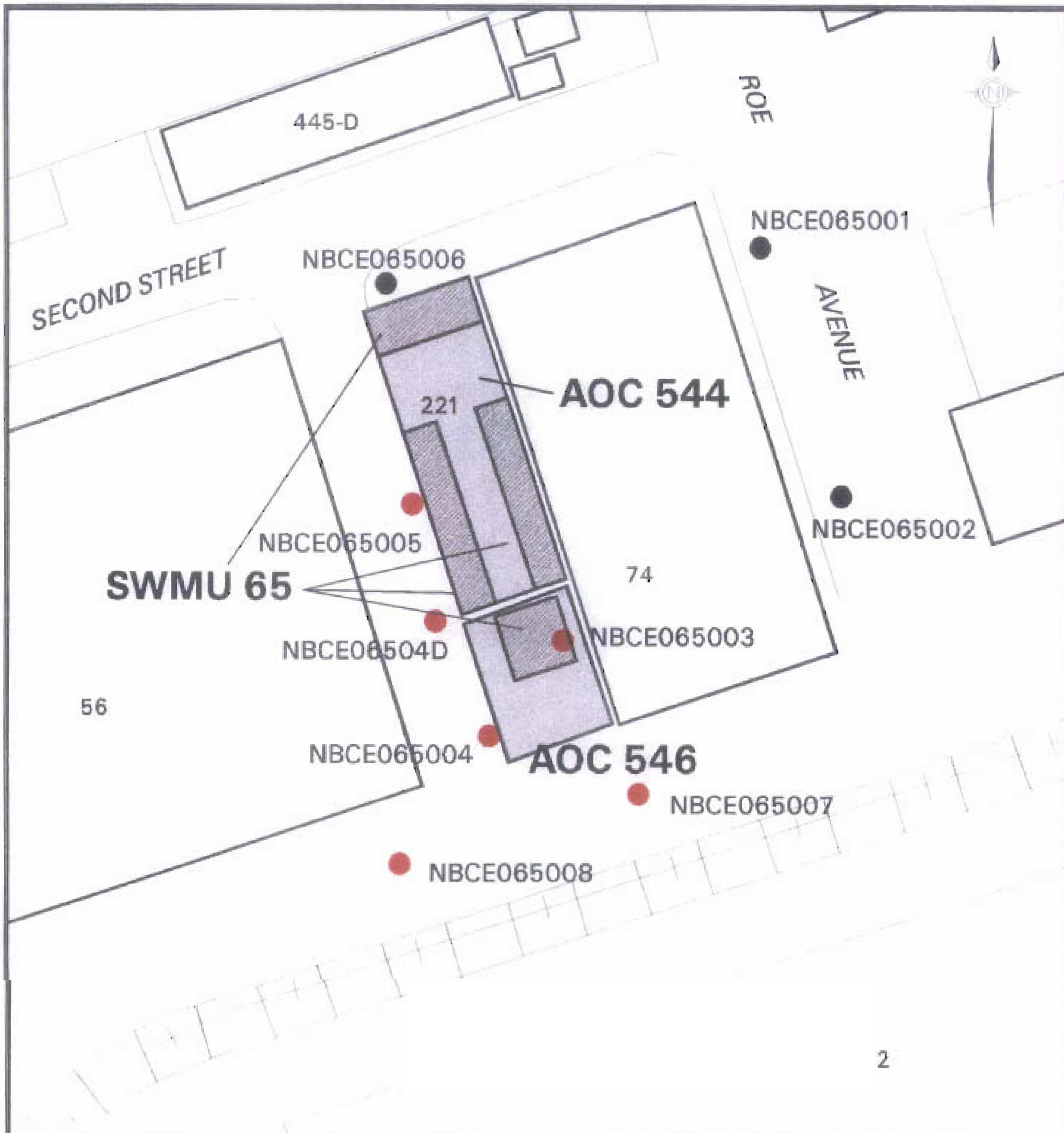
0 feet 100

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

FIGURE 10.6.6
CUMULATIVE SOIL RISK
INDUSTRIAL SCENARIO
SWMU 65 AOC 544,546

Table 10.6.10.5 summarizes the COPCs identified in combined SWMU 63 shallow and deep monitoring wells sampled during the first quarter. As shown, concentrations of arsenic, beryllium, BHC (alpha and beta), trichloroethene, and vinyl chloride contribute to risk estimates above 1E-06 in six of the nine first-quarter groundwater samples. Arsenic is the primary contributor to risk, accounting for 90 to 100% of the cumulative risk at all but location NBCE06504D and NBCE065003. Trichloroethene and vinyl chloride were the primary contributors to risk estimates associated with the first-quarter groundwater sample collected from monitoring well NBCE06504D. Beryllium, BHC (alpha and beta), and dioxin equivalents were secondary contributors to the risk estimates associated with the groundwater samples collected from monitoring well NBCE065004. No carcinogenic COPCs were identified in first-quarter groundwater samples collected from monitoring wells NBCE065001, NBCE065002, and NBCE065006. Risk estimates ranged from 1E-04 to 1E-03 for first-quarter groundwater sample with concentrations of carcinogenic COPCs. The arithmetic mean risk is 4E-04, assuming a de deminimus risk of 1E-07 for groundwater samples with no carcinogenic COPCs. Figure 10.6.7 is a spatial presentation of risk estimates for combined SWMU 65 groundwater.

Concentrations of aluminum, antimony, arsenic, cadmium, chromium, copper, mercury, vanadium, and zinc in groundwater samples collected from monitoring well NBCE065003 and NBCE065004 equate with cumulative HI estimates of 19 at each location. Concentrations of arsenic and antimony in groundwater samples collected from NBCE065005 equate with HI of 3. Arsenic is the only contributor to HI estimates above the threshold of unity for the groundwater samples collected from NBCE065007 and NBCE065008. The HIs range from 0.2 to 19, with a mean HI of 5, assuming a de deminimus HI of 0.01 for groundwater samples with no detectable concentrations of COPCs that would contribute to HI projections. Figure 10.6.8 is a spatial presentation of HI estimates for combined SWMU 65 groundwater.

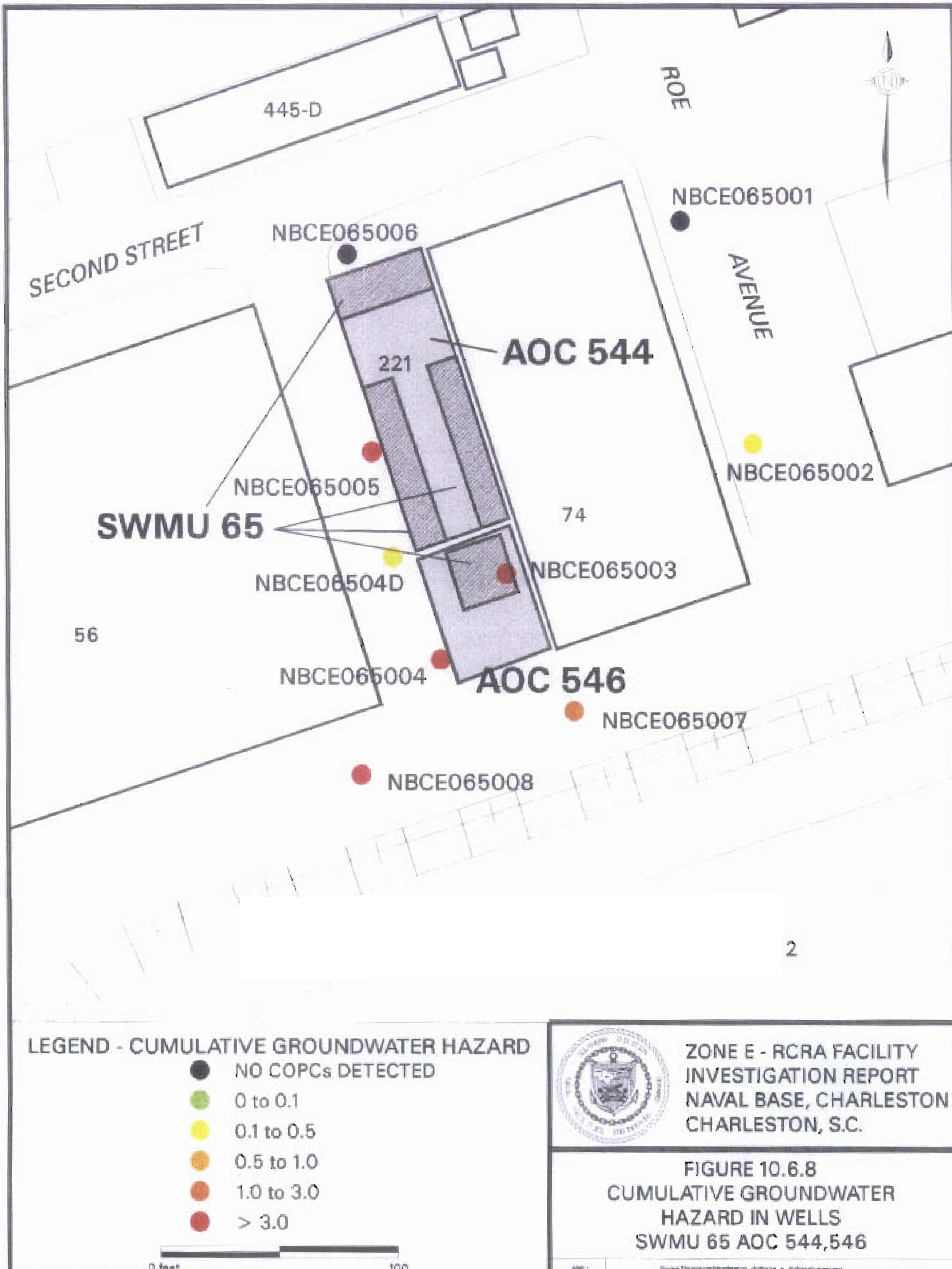


LEGEND - CUMULATIVE GROUNDWATER RISK
- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 100

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

FIGURE 10.6.7
CUMULATIVE GROUNDWATER RISK IN WELLS
SWMU 65 AOC 544,546



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

FIGURE 10.6.8
CUMULATIVE GROUNDWATER HAZARD IN WELLS
SWMU 65 AOC 544,546

Lead

Lead was detected in five of eight first-quarter shallow groundwater samples and exceeded its TTAL of 15μg/L in groundwater samples collected from monitoring wells NBCE065003 (1,690 μg/L) and NBCE065004 (315 μg/L). The mean lead concentration for first-quarter shallow groundwater samples is 403.8 μg/L. Figure 10.6.9 is a spatial presentation of lead concentrations for combined SWMU 65 groundwater.

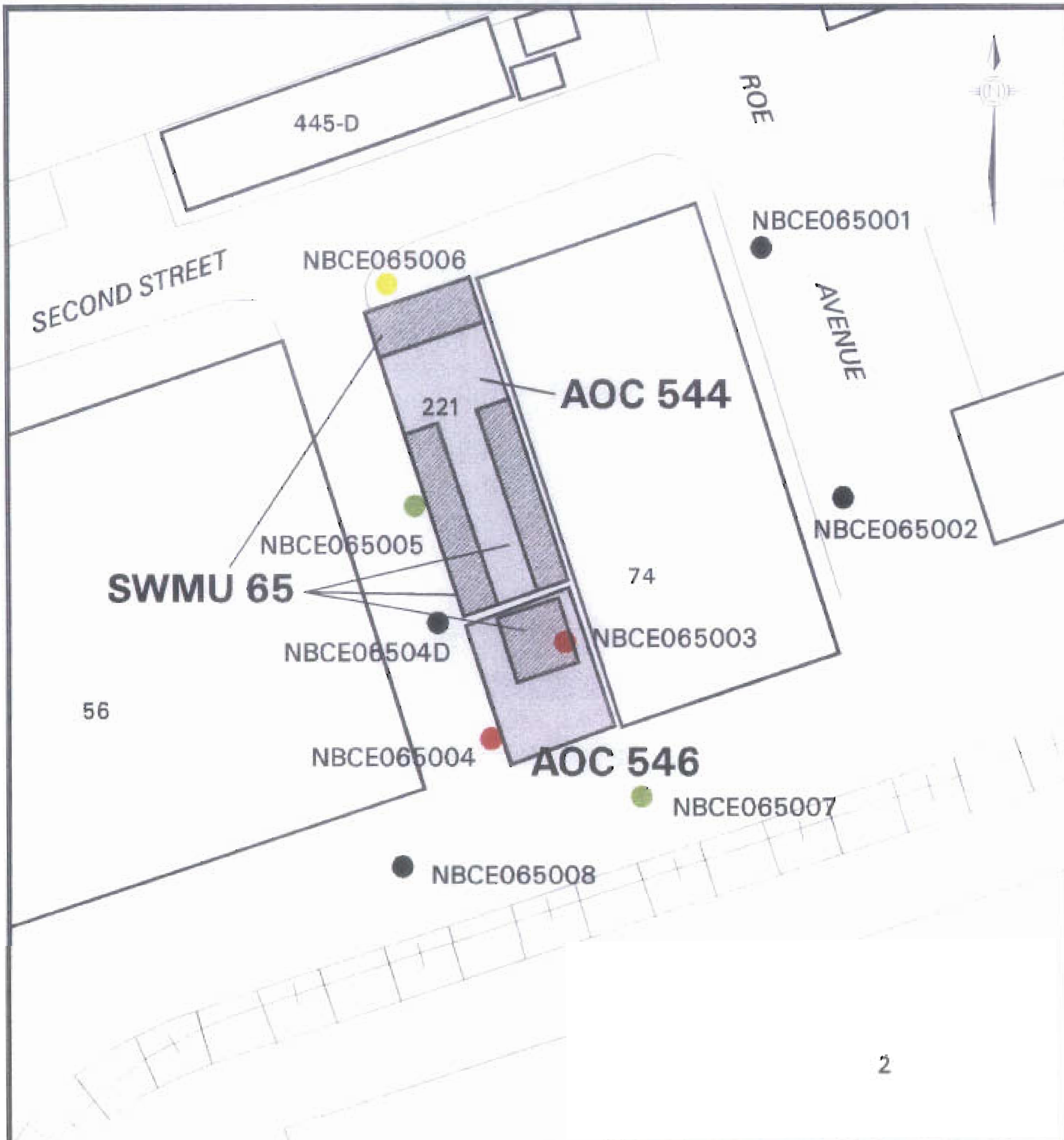
10.6.10.4 Uncertainty

SWMU 65 uncertainty issues specific to the FRE and essential to the risk management process are presented in the following paragraphs.

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure.

Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use of Zone E, specifically as a marine cargo terminal and drydocking facility. The ground surface around SWMUs 65 and AOCs 544 and 546 is currently covered with either asphalt or concrete. As a result, chronic exposure to current soil condition is highly unlikely and the associated direct contact exposure pathways evaluations overestimate risk and hazard. If this area were to be redeveloped, the buildings and other structures would be demolished, and the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, chronic exposure to current surface soil conditions would not be likely under any



LEAD IN GROUNDWATER

- NON DETECT
- < 4.8
- 4.8 - 15
- > 15

0 feet 100

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

FIGURE 10.6.9
DISTRIBUTION OF LEAD
IN GROUNDWATER
SWMU 65 AOC 544,546

future use scenario. These factors indicate that exposure pathways assessed in this FRE would generally overestimate the risk and hazard posed to current/future site workers and future site residents.

Groundwater is not currently used as a potable water source at combined SWMU 65, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.

COPC Selection

4-Chloro-3-methylphenol was detected in 1 of 12 surface soil samples at a concentration of 120 μg/kg. There are no RBCs listed for this chemical in the Region III RBC tables, nor are there toxicological data with which to calculate a RBC. As a result, 4-chloro-3-methylphenol was not included in the FRE for combined SWMU 65. The maximum 4-chloro-3-methylphenol concentration did not exceed the RBC for 2-chlorophenol (39,000 μg/kg). This minimizes the uncertainty associated with the elimination of 4-chloro-3-methylphenol from consideration in the FRE.

Quantification of Risk/Hazard

Soil

A conservative screening process was used to identify COPCs for combined SWMU 65. The potential for eliminating CPSSs with the potential for cumulative HI greater than one was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment based on comparison to RBCs, antimony and delta-BHC were reported at concentrations close to their RBCs (e.g. within 10% of their RBCs). Arsenic, and beryllium were present in combined SWMU 65 soil at concentrations above RBC benchmarks and were eliminated from consideration in the FRE based on comparison to their background concentrations. As a result, their contribution to soil pathway risk and hazard has not been considered in this FRE.

Groundwater

The same conservative screening process used for soil was also applied to groundwater. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, none was reported at concentrations close to their RBCs (e.g. within 10% of their RBCs). Manganese was present in combined SWMU 65 groundwater at concentrations above its RBC benchmark and was eliminated from consideration in the FRE based on comparison to background concentration. As a result, its contribution to groundwater pathway risk and hazard has not been considered in this FRE.

10.6.10.5 FRE Summary

The risk and hazard posed by contaminants at combined SWMU 65 were assessed for the future site worker and the future site resident as sample point-specific estimates. In surface soils, the incidental ingestion and dermal contact pathways are reflected. The groundwater FRE was based on first-quarter data and considers the ingestion and inhalation (VOCs only) pathways. Risk and HI estimates are presented on Tables 10.6.10.2, 10.6.10.3, and 10.6.10.5 such that a risk (E-06) or HI that exceed one for any COPC at any given sample location is an indication that the concentration of that COPC exceeds its RGO. Section 7, Tables 7.3.1, 7.3.2, and 7.3.3 provide residential, industrial, and residential groundwater RGOs, respectively, for all of the COPCs identified for Zone E.

Soil — Residential Scenario

Aldrin, BEQs, and dieldrin were detected in combined SWMU 65 surface soil at concentrations above their residential RGOs.

Soil — Site Worker Scenario

Aldrin and dieldrin were detected in combined SWMU 65 surface soil at concentrations above their industrial RGOs.

Groundwater — Residential Scenario

Aluminum, antimony, arsenic, beryllium, BHC (alpha and beta), chromium, dioxin equivalents, mercury, trichloroethene, vanadium, and vinyl chloride were above their RGOs in combined SWMU 65 groundwater. Lead was detected in shallow groundwater at concentrations above its TTAL.

Table 10.6.10.1
Chemicals Present in Site Samples
SWMU 65; AOC 544, 546 - Surface Soil
NAVBASE - Charleston
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Industrial RBC	Reference	Units	Number Exceeding Res. RBC	Ind. RBC	Ref.
Carcinogenic PAHs													
B(a)P Equiv.	*	3	12	123.63 - 264.68	200.88	878.18 - 2218.56	88	780	NA	UG/KG	3		
Benzo(a)anthracene		3	12	130 - 230	186.67	380 - 960	880	7800	NA	UG/KG			
Benzo(a)pyrene	*	3	12	100 - 210	156.67	380 - 960	88	780	NA	UG/KG	3		
Benzo(b)fluoranthene		3	12	94 - 240	184.67	380 - 960	880	7800	NA	UG/KG			
Benzo(k)fluoranthene		3	12	110 - 270	200.00	380 - 960	8800	78000	NA	UG/KG			
Chrysene		3	12	130 - 420	276.67	380 - 960	88000	780000	NA	UG/KG			
Indeno(1,2,3-cd)pyrene		2	12	72 - 72	72.00	380 - 960	880	7800	NA	UG/KG			
TCDD Equivalents													
Dioxin Equiv.		2	2	0.0461 - 0.9631	0.50	NA - NA	1000	1000	NA	NG/KG			
Inorganics													
Aluminum (Al)		10	12	1230 - 6490	3163.00	3650 - 5440	7800	100000	26600	MG/KG			
Antimony (Sb)		4	12	0.61 - 2.9	1.45	0.44 - 1.1	3.1	82	1.77	MG/KG			1
Arsenic (As)		10	12	0.7 - 7.7	2.37	4.3 - 17.9	0.43	3.8	23.9	MG/KG	10	2	
Barium (Ba)		10	12	5.4 - 25.1	12.50	16.8 - 24.1	550	14000	130	MG/KG			
Beryllium (Be)		5	12	0.13 - 0.44	0.30	0.11 - 0.41	0.15	1.3	1.7	MG/KG	4		
Cadmium (Cd)		7	12	0.14 - 1.5	0.54	0.11 - 0.36	3.9	100	1.5	MG/KG			1
Calcium (Ca)	N	12	12	381 - 94800	21584.00	NA - NA	NA	NA	NA	MG/KG			
Chromium (Cr)		12	12	3.8 - 36.5	14.80	NA - NA	39	1000	94.6	MG/KG			
Chromium (Hexavalent)		1	2	0.167 - 0.167	0.17	0.56 - 0.56	39	1000	NA	MG/KG			
Cobalt (Co)	*	10	12	0.6 - 505	60.77	4 - 5.5	470	12000	19	MG/KG	1		3
Copper (Cu)		11	12	4.9 - 102	32.74	4.2 - 4.2	310	8200	66	MG/KG			1
Iron (Fe)	N	10	12	1450 - 6880	3637.00	6240 - 9380	NA	NA	NA	MG/KG			
Lead (Pb)		10	12	6.6 - 165	45.00	4.2 - 71.3	400	1300	265	MG/KG			
Magnesium (Mg)	N	10	12	80.4 - 2570	572.04	974 - 1720	NA	NA	NA	MG/KG			
Manganese (Mn)		10	12	8.9 - 87.3	31.66	75 - 180	180	4700	302	MG/KG			
Mercury (Hg)		10	12	0.03 - 0.22	0.09	0.02 - 0.04	2.3	61	2.6	MG/KG			
Nickel (Ni)		10	12	1.9 - 49.4	11.00	9.1 - 25.4	160	4100	77.1	MG/KG			
Potassium (K)	N	8	12	179 - 1150	601.13	261 - 500	NA	NA	NA	MG/KG			
Selenium (Se)		3	12	0.45 - 1.4	0.87	0.37 - 0.65	39	1000	1.7	MG/KG			
Silver (Ag)		1	12	0.38 - 0.38	0.38	0.22 - 0.28	39	1000	NA	MG/KG			
Sodium (Na)	N	8	12	71.5 - 441	229.00	37.4 - 449	NA	NA	NA	MG/KG			
Tin (Sn)		4	12	2.6 - 34.6	12.78	1.1 - 7.1	4700	6100	59.4	MG/KG			
Vanadium (V)		11	12	2.2 - 18.8	7.75	12.9 - 12.9	55	1400	94.3	MG/KG			
Zinc (Zn)		10	12	6.4 - 303	81.18	22.5 - 104	2300	61000	827	MG/KG			
Pesticides													
4,4'-DDE		2	10	2.97 - 10.5	6.74	2.5 - 28.6	1900	17000	NA	UG/KG			
4,4'-DDT		1	10	3.2 - 3.2	3.20	2.5 - 28.6	1900	17000	NA	UG/KG			
Aldrin	* *	1	10	349 - 349	349.00	1.3 - 1.9	38	340	NA	UG/KG	1	1	

Table 10.6.10.1
Chemicals Present in Site Samples
SWMU 65; AOC 544, 546 - Surface Soil
NAVBASE - Charleston
Charleston, South Carolina

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Industrial RBC	Reference	Units	Number Exceeding Res. RBC	Ind. RBC	Ref.
alpha-Chlordane		1	10	13 - 13	13.00	1.3 - 14.9	470	2200	NA	UG/KG			
beta-BHC		1	10	11.7 - 11.7	11.70	1.3 - 14.9	350	3200	NA	UG/KG			
delta-BHC		2	10	2.41 - 96	49.21	1.3 - 1.9	100	910	NA	UG/KG			
Dieldrin	* *	4	10	15.1 - 586	222.53	2.5 - 3.6	40	360	NA	UG/KG	2	1	
Endosulfan II		1	10	9.01 - 9.01	9.01	2.5 - 3.6	47000	1200000	NA	UG/KG			
Endrin		1	10	4.91 - 4.91	4.91	2.5 - 28.6	2300	61000	NA	UG/KG			
Endrin aldehyde		1	10	4.73 - 4.73	4.73	2.5 - 3.6	2300	61000	NA	UG/KG			
gamma-BHC (Lindane)		1	10	9.54 - 9.54	9.54	1.3 - 1.9	490	4400	NA	UG/KG			
gamma-Chlordane		1	10	16 - 16	16.00	1.3 - 14.9	470	2200	NA	UG/KG			
Heptachlor		1	10	1.8 - 1.8	1.80	1.3 - 14.9	140	1300	NA	UG/KG			
Heptachlor epoxide		2	10	2.86 - 19	10.93	1.3 - 1.9	70	630	NA	UG/KG			
Semivolatile Organics													
2-Chlorophenol		1	12	96 - 96	96.00	370 - 960	39000	1000000	NA	UG/KG			
2-Methylnaphthalene		1	12	130 - 130	130.00	370 - 960	310000	8200000	NA	UG/KG			
4-Chloro-3-methylphenol		1	12	120 - 120	120.00	370 - 960	NA	NA	NA	UG/KG			
4-Chloroaniline		1	12	100 - 100	100.00	370 - 960	31000	820000	NA	UG/KG			
Acenaphthene		3	12	77 - 170	122.33	370 - 960	470000	12000000	NA	UG/KG			
Anthracene		1	12	540 - 540	540.00	370 - 960	2300000	61000000	NA	UG/KG			
Benzo(g,h,i)perylene		2	12	70 - 74	72.00	380 - 960	310000	8200000	NA	UG/KG			
bis(2-Ethylhexyl)phthalate (BEHP)		2	12	300 - 1300	800.00	380 - 960	46000	410000	NA	UG/KG			
Dibenzofuran		2	12	74 - 75	74.50	370 - 960	31000	820000	NA	UG/KG			
Di-n-butylphthalate		1	12	220 - 220	220.00	370 - 960	780000	20000000	NA	UG/KG			
Fluoranthene		4	12	75 - 840	463.75	380 - 960	310000	8200000	NA	UG/KG			
Fluorene		2	12	61 - 190	125.50	370 - 960	310000	8200000	NA	UG/KG			
Naphthalene		3	12	42 - 390	264.00	370 - 960	310000	8200000	NA	UG/KG			
Phenanthrene		5	12	38 - 800	212.00	380 - 960	310000	8200000	NA	UG/KG			
Phenol		1	12	110 - 110	110.00	370 - 960	4700000	1E+08	NA	UG/KG			
Pyrene		4	12	58 - 730	389.50	380 - 960	230000	6100000	NA	UG/KG			
Volatile Organics													
1,2-Dichloroethene (total)		1	10	2 - 2	2.00	6 - 7	70000	1800000	NA	UG/KG			
Acetone		6	10	14 - 290	122.00	6 - 2200	780000	20000000	NA	UG/KG			
Carbon disulfide		1	10	2 - 2	2.00	6 - 7	780000	20000000	NA	UG/KG			
Carbon tetrachloride		1	10	5 - 5	5.00	6 - 7	4900	44000	NA	UG/KG			
Methylene chloride		3	10	19 - 60	34.33	6 - 7	85000	760000	NA	UG/KG			

Notes:
* - Identified as a COPC
N - Essential nutrient
UG/L - micrograms per liter
SQL - Sample quantitation limit
NA - Not applicable

Table 10.6.10.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 65/AOCs 544 and 546
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
065	B001	Aldrin	ND	UG/KG	NA		NA	
065	B001	B(a)P Equiv.	123.63	UG/KG	2.0474	100.00	NA	
065	B001	Cobalt (Co)	3.40	MG/KG	NA		0.0008	100.00
065	B001	Dieldrin	ND	UG/KG	NA		NA	
		Total			2.0474		0.0008	
065	B002	Aldrin	ND	UG/KG	NA		NA	
065	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
065	B002	Cobalt (Co)	7.30	MG/KG	NA		0.0017	100.00
065	B002	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		0.0017	
065	B003	Aldrin	ND	UG/KG	NA		NA	
065	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
065	B003	Cobalt (Co)	4.00	MG/KG	NA		0.0009	100.00
065	B003	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		0.0009	
065	B004	Aldrin	ND	UG/KG	NA		NA	
065	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
065	B004	Cobalt (Co)	15.90	MG/KG	NA		0.0036	100.00
065	B004	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		0.0036	
065	B005	Aldrin	ND	UG/KG	NA		NA	
065	B005	B(a)P Equiv.	ND	UG/KG	NA		NA	
065	B005	Cobalt (Co)	11.00	MG/KG	NA		0.0025	20.81
065	B005	Dieldrin	29.00	UG/KG	1.0526	100.00	0.0096	79.19
		Total			1.0526		0.0121	
065	B006	Aldrin	ND	UG/KG	NA		NA	
065	B006	B(a)P Equiv.	214.32	UG/KG	3.5492	100.00	NA	
065	B006	Cobalt (Co)	0.60	MG/KG	NA		0.0001	100.00
065	B006	Dieldrin	ND	UG/KG	NA		NA	
		Total			3.5492		0.0001	
065	B007	B(a)P Equiv.	ND	UG/KG	NA		NA	
065	B007	Cobalt (Co)	ND	MG/KG	NA		NA	
		Total			NA		NA	
065	B008	B(a)P Equiv.	264.68	UG/KG	4.3832	100.00	NA	
065	B008	Cobalt (Co)	ND	MG/KG	NA		NA	
		Total			4.3832		NA	

Table 10.6.10.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 65/AOCs 544 and 546
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
544	B001	Aldrin	349.00	UG/KG	13.4592	38.75	0.1919	49.78
544	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
544	B001	Cobalt (Co)	1.30	MG/KG	NA		0.0003	0.08
544	B001	Dieldrin	586.00	UG/KG	21.2698	61.25	0.1933	50.15
		Total			34.7290		0.3855	
544	B002	Aldrin	ND	UG/KG	NA		NA	
544	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
544	B002	Cobalt (Co)	24.70	MG/KG	NA		0.0056	6.18
544	B002	Dieldrin	260.00	UG/KG	9.4371	100.00	0.0858	93.82
		Total			9.4371		0.0914	
544	B003	Aldrin	ND	UG/KG	NA		NA	
544	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
544	B003	Cobalt (Co)	34.50	MG/KG	NA		0.0079	61.28
544	B003	Dieldrin	15.10	UG/KG	0.5481	100.00	0.0050	38.72
		Total			0.5481		0.0129	
544	B004	Aldrin	ND	UG/KG	NA		NA	
544	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
544	B004	Cobalt (Co)	505.00	MG/KG	NA		0.1154	100.00
544	B004	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		0.1154	

Table 10.6.10.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 65/AOCs 544 and 546
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
065	B001	Aldrin	ND	UG/KG	NA		NA	
065	B001	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		NA	
065	B002	Aldrin	ND	UG/KG	NA		NA	
065	B002	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		NA	
065	B003	Aldrin	ND	UG/KG	NA		NA	
065	B003	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		NA	
065	B004	Aldrin	ND	UG/KG	NA		NA	
065	B004	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		NA	
065	B005	Aldrin	ND	UG/KG	NA		NA	
065	B005	Dieldrin	29.00	UG/KG	0.2140	100.00	0.0007	100.00
		Total			0.2140		0.0007	
065	B006	Aldrin	ND	UG/KG	NA		NA	
065	B006	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		NA	
065	B007	No COPCs	ND	UG/KG	NA		NA	
		Total			NA		NA	
065	B008	No COPCs	ND	UG/KG	NA		NA	
		Total			NA		NA	
544	B001	Aldrin	349.00	UG/KG	2.7366	38.75	0.0150	49.81
544	B001	Dieldrin	586.00	UG/KG	4.3247	61.25	0.0151	50.19
		Total			7.0613		0.0302	
544	B002	Aldrin	ND	UG/KG	NA		NA	
544	B002	Dieldrin	260.00	UG/KG	1.9188	100.00	0.0067	100.00
		Total			1.9188		0.0067	
544	B003	Aldrin	ND	UG/KG	NA		NA	
544	B003	Dieldrin	15.10	UG/KG	0.1114	100.00	0.0004	100.00
		Total			0.1114		0.0004	
544	B004	Aldrin	ND	UG/KG	NA		NA	
544	B004	Dieldrin	ND	UG/KG	NA		NA	
		Total			NA		NA	

Table 10.6.10.4
Chemicals Present in Site Samples
SWMU 65; AOC 544, 546 - Groundwater
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Conc. Residential RBC	Screening Conc. Reference	Units	Number Exceeding Res. RBC	Number Exceeding Ref.
Deep wells											
Inorganics											
Arsenic (As)	*	1	1	22.8 - 22.8	22.8	NA - NA	0.045	16.4	UG/L	1	1
Calcium (Ca)	N	1	1	1064 - 1064	1064	NA - NA	NA	NA	UG/L		
Iron (Fe)	N	1	1	2790 - 2790	2790	NA - NA	NA	NA	UG/L		
Magnesium (Mg)	N	1	1	41000 - 41000	41000	NA - NA	NA	NA	UG/L		
Manganese (Mn)		1	1	140 - 140	140	NA - NA	84	869	UG/L	1	
Potassium (K)	N	1	1	13500 - 13500	13500	NA - NA	NA	NA	UG/L		
Sodium (Na)	N	1	1	59248 59248	59248	NA NA	NA	NA	UG/L		
Semivolatile Organics											
Acenaphthene		1	1	2 - 2	2	NA - NA	220	NA	UG/L		
Dibenzofuran		1	1	1 - 1	1	NA - NA	15	NA	UG/L		
Fluorene		1	1	1 - 1	1	NA - NA	150	NA	UG/L		
Volatile Organics											
1,1-Dichloroethane		1	1	2 - 2	2	NA - NA	81	NA	UG/L		
1,2-Dichloroethene (total)	*	1	1	10 - 10	10	NA - NA	5.5	NA	UG/L	1	
Trichloroethene	*	1	1	8 - 8	8	NA - NA	1.6	NA	UG/L	1	
Vinyl chloride	*	1	1	6 - 6	6	NA - NA	0.019	NA	UG/L	1	
Shallow Wells											
TCDD Equivalents											
Dioxin Equiv.	*	1	1	2.42 - 2.42	2.42	NA - NA	0.43	NA	PG/L	1	
Inorganics											
Aluminum (Al)	*	5	8	101 - 21500	5312.2	25 - 88	3700	2810	UG/L	2	2
Antimony (Sb)	*	3	8	4.5 - 42	17.2	2.1 - 4	1.5	NA	UG/L	3	
Arsenic (As)	*	5	8	7.8 - 58.8	23.6	5 - 5	0.045	18.7	UG/L	5	2

Table 10.6.10.4
Chemicals Present in Site Samples
SWMU 65; AOC 544, 546 - Groundwater
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Conc. Residential RBC	Screening Conc. Reference	Units	Number Exceeding Res. RBC	Number Exceeding Ref.
Barium (Ba)		2	8	31.7 - 54.9	43.3	13.3 - 52.2	260	211	UG/L		
Beryllium (Be)	*	2	8	1.2 - 2	1.6	0.39 - 1	0.016	0.43	UG/L	2	2
Cadmium (Cd)	*	2	8	1 - 6.9	4.0	0.5 - 1	1.8	NA	UG/L	2	
Calcium (Ca)	N	7	8	34400 - 50464	66157.1	10600 - 10600	NA	NA	UG/L		
Chromium (Cr)	*	4	8	0.96 - 245	104.0	1 - 1	18	12.3	UG/L	2	2
Cobalt (Co)		1	8	2.5 - 2.5	2.5	0.9 - 2	220	2.5	UG/L		
Copper (Cu)	*	2	8	178 - 536	357.0	0.6 - 10	150	2.7	UG/L	2	2
Cyanide (CN)		2	8	10.2 - 13.4	11.8	2 - 4	73	7.9	UG/L		2
Iron (Fe)	N	8	8	2710 - 13100	8528.8	NA - NA	NA	NA	UG/L		
Lead (Pb)	*	5	8	1.7 - 1690	403.8	1.7 - 3	15	4.8	UG/L	2	3
Magnesium (Mg)	N	6	8	7860 - 56800	20580.0	1240 - 1650	NA	NA	UG/L		
Manganese (Mn)		8	8	72.9 - 964	494.0	NA - NA	84	2560	UG/L	7	
Mercury (Hg)	*	2	8	0.81 - 5.9	3.4	0.1 - 0.2	1.1	NA	UG/L	1	
Nickel (Ni)		5	8	2.1 - 36	13.4	0.8 - 2.9	73	15.2	UG/L		2
Potassium (K)	N	6	8	2810 - 33700	17735.0	6750 - 10400	NA	NA	UG/L		
Sodium (Na)	N	5	8	50200 - 49712	2696.0	30800 - 15764	NA	NA	UG/L		
Tin (Sn)		2	8	162 - 219	190.5	2.6 - 20	2200	NA	UG/L		
Vanadium (V)	*	3	8	4.3 - 167	77.9	1 - 4.7	26	11.4	UG/L	2	2
Zinc (Zn)	*	4	8	5.7 - 1290	427.7	4 - 27.2	1100	27.3	UG/L	1	2
Pesticides											
alpha-BHC	*	1	8	0.13 - 0.13	0.13	0.04 - 0.04	0.011	NA	UG/L	1	
beta-BHC	*	1	8	0.048 - 0.048	0.048	0.04 - 0.04	0.037	NA	UG/L	1	
Semivolatile Organics											
2-Methylnaphthalene		1	8	2 - 2	2	10 - 10	150	NA	UG/L		
Acenaphthene		2	8	2 - 41	21.5	10 - 10	220	NA	UG/L		
Acenaphthylene		1	8	1 - 1	1	10 - 10	150	NA	UG/L		
Anthracene		1	8	2 - 2	2	10 - 10	1100	NA	UG/L		
Benzoic acid		3	8	1 - 2	1.67	50 - 50	15000	NA	UG/L		
Dibenzofuran		1	8	12 - 12	12	10 - 10	15	NA	UG/L		

Table 10.6.10.4
Chemicals Present in Site Samples
SWMU 65; AOC 544, 546 - Groundwater
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Conc. Residential RBC	Reference	Units	Number Exceeding Res. RBC	Number Exceeding Ref.
Fluoranthene		2	8	1 - 4	2.5	10 - 10	150	NA	UG/L		
Fluorene		1	8	20 - 20	20	10 - 10	150	NA	UG/L		
Phenanthrene		1	8	12 - 12	12	10 - 10	150	NA	UG/L		
Pyrene		2	8	1 - 2	1.5	10 - 10	110	NA	UG/L		
Volatile Organics											
1,2-Dichloroethene (total)	*	1	8	7 - 7	7	5 - 5	5.5	NA	UG/L	1	
Acetone	*	1	8	380 - 380	380	10 - 26	370	NA	UG/L	1	
Carbon disulfide		1	8	1 - 1	1	5 - 5	100	NA	UG/L		
Vinyl chloride	*	1	8	6 - 6	6	10 - 10	0.019	NA	UG/L	1	
Xylene (Total)		1	8	1 - 1	1	5 - 5	1200	NA	UG/L		

Notes:
* - Identified as a COPC
N - Essential nutrient
UG/L - micrograms per liter
PG/L - picograms per liter
SQL - Sample quantitation limit
NA - Not applicable

Table 10.6.10.5
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMU 65/AOCs 544 and 546
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
065	G04D	1,2-Dichloroethene (total)	10.00	UG/L	NA		0.1421	45.45
065	G04D	Beryllium (Be)	ND	UG/L	NA		NA	
065	G04D	Trichloroethene	8.00	UG/L	2.0227	1.02	0.1705	54.55
065	G04D	Vinyl chloride	6.00	UG/L	196.3209	98.98	NA	
		Total			198.3436		0.3125	
065	G001	1,2-Dichloroethene (total)	ND	UG/L	NA		NA	
065	G001	Acetone	ND	UG/L	NA		NA	
065	G001	Aluminum (Al)	ND	UG/L	NA		NA	
065	G001	Antimony (Sb)	ND	UG/L	NA		NA	
065	G001	Arsenic (As)	ND	UG/L	NA		NA	
065	G001	Beryllium (Be)	ND	UG/L	NA		NA	
065	G001	Cadmium (Cd)	ND	UG/L	NA		NA	
065	G001	Chromium (Cr)	ND	UG/L	NA		NA	
065	G001	Copper (Cu)	ND	UG/L	NA		NA	
065	G001	Lead (Pb)	ND	UG/L	NA		NA	
065	G001	Mercury (Hg)	ND	UG/L	NA		NA	
065	G001	Trichloroethene	ND	UG/L	NA		NA	
065	G001	Vanadium (V)	ND	UG/L	NA		NA	
065	G001	Vinyl chloride	ND	UG/L	NA		NA	
065	G001	Zinc (Zn)	ND	UG/L	NA		NA	
065	G001	alpha-BHC	ND	UG/L	NA		NA	
065	G001	beta-BHC	ND	UG/L	NA		NA	
		Total			NA		NA	
065	G002	1,2-Dichloroethene (total)	ND	UG/L	NA		NA	
065	G002	Acetone	380.00	UG/L	NA		0.2429	100.00
065	G002	Aluminum (Al)	ND	UG/L	NA		NA	
065	G002	Antimony (Sb)	ND	UG/L	NA		NA	
065	G002	Arsenic (As)	ND	UG/L	NA		NA	
065	G002	Beryllium (Be)	ND	UG/L	NA		NA	
065	G002	Cadmium (Cd)	ND	UG/L	NA		NA	
065	G002	Chromium (Cr)	ND	UG/L	NA		NA	
065	G002	Copper (Cu)	ND	UG/L	NA		NA	
065	G002	Lead (Pb)	ND	UG/L	NA		NA	
065	G002	Mercury (Hg)	ND	UG/L	NA		NA	
065	G002	Trichloroethene	ND	UG/L	NA		NA	
065	G002	Vanadium (V)	ND	UG/L	NA		NA	
065	G002	Vinyl chloride	ND	UG/L	NA		NA	
065	G002	Zinc (Zn)	ND	UG/L	NA		NA	
065	G002	alpha-BHC	ND	UG/L	NA		NA	
065	G002	beta-BHC	ND	UG/L	NA		NA	
		Total			NA		0.2429	
065	G003	1,2-Dichloroethene (total)	7.00	UG/L	NA		0.0994	0.53

Table 10.6.10.5
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMU 65/AOCs 544 and 546
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
065	G003	Acetone	ND	UG/L	NA		NA	
065	G003	Aluminum (Al)	21500.00	UG/L	NA		1.3744	7.27
065	G003	Antimony (Sb)	42.00	UG/L	NA		6.7123	35.50
065	G003	Arsenic (As)	22.60	UG/L	504.1879	64.87	4.8158	25.47
065	G003	Beryllium (Be)	1.20	UG/L	76.7436	9.87	0.0153	0.08
065	G003	Cadmium (Cd)	6.90	UG/L	NA		0.8822	4.67
065	G003	Chromium (Cr)	245.00	UG/L	NA		3.1324	16.57
065	G003	Copper (Cu)	536.00	UG/L	NA		0.8566	4.53
065	G003	Lead (Pb)	1690.00	UG/L	NA		NA	
065	G003	Mercury (Hg)	0.81	UG/L	NA		0.1726	0.91
065	G003	Trichloroethene	ND	UG/L	NA		NA	
065	G003	Vanadium (V)	62.50	UG/L	NA		0.5708	3.02
065	G003	Vinyl chloride	6.00	UG/L	196.3209	25.26	NA	
065	G003	Zinc (Zn)	1290.00	UG/L	NA		0.2749	1.45
065	G003	alpha-BHC	ND	UG/L	NA		NA	
065	G003	beta-BHC	ND	UG/L	NA		NA	
		Total			777.2524		18.9069	
065	G004	1,2-Dichloroethene (total)	ND	UG/L	NA		NA	
065	G004	Acetone	ND	UG/L	NA		NA	
065	G004	Aluminum (Al)	4510.00	UG/L	NA		0.2883	1.51
065	G004	Antimony (Sb)	5.10	UG/L	NA		0.8151	4.27
065	G004	Arsenic (As)	58.80	UG/L	1311.7808	89.92	12.5297	65.61
065	G004	Beryllium (Be)	2.00	UG/L	127.9061	8.77	0.0256	0.13
065	G004	Cadmium (Cd)	1.00	UG/L	NA		0.1279	0.67
065	G004	Chromium (Cr)	169.00	UG/L	NA		2.1607	11.31
065	G004	Copper (Cu)	178.00	UG/L	NA		0.2845	1.49
065	G004	Dioxin Equiv.	2.42	PG/L	5.6150	0.38	NA	
065	G004	Lead (Pb)	315.00	UG/L	NA		NA	
065	G004	Mercury (Hg)	5.90	UG/L	NA		1.2572	6.58
065	G004	Trichloroethene	ND	UG/L	NA		NA	
065	G004	Vanadium (V)	167.00	UG/L	NA		1.5251	7.99
065	G004	Vinyl chloride	ND	UG/L	NA		NA	
065	G004	Zinc (Zn)	396.00	UG/L	NA		0.0844	0.44
065	G004	alpha-BHC	0.13	UG/L	12.1808	0.84	NA	
065	G004	beta-BHC	0.05	UG/L	1.2850	0.09	NA	
		Total			1458.7677		19.0984	
065	G005	1,2-Dichloroethene (total)	ND	UG/L	NA		NA	
065	G005	Acetone	ND	UG/L	NA		NA	
065	G005	Aluminum (Al)	337.00	UG/L	NA		0.0215	0.62
065	G005	Antimony (Sb)	4.50	UG/L	NA		0.7192	20.86
065	G005	Arsenic (As)	12.70	UG/L	283.3268	100.00	2.7062	78.51
065	G005	Beryllium (Be)	ND	UG/L	NA		NA	
065	G005	Cadmium (Cd)	ND	UG/L	NA		NA	

Table 10.6.10.5
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMU 65/AOCs 544 and 546
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
065	G005	Chromium (Cr)	ND	UG/L	NA		NA	
065	G005	Copper (Cu)	ND	UG/L	NA		NA	
065	G005	Lead (Pb)	3.60	UG/L	NA		NA	
065	G005	Mercury (Hg)	ND	UG/L	NA		NA	
065	G005	Trichloroethene	ND	UG/L	NA		NA	
065	G005	Vanadium (V)	ND	UG/L	NA		NA	
065	G005	Vinyl chloride	ND	UG/L	NA		NA	
065	G005	Zinc (Zn)	ND	UG/L	NA		NA	
065	G005	alpha-BHC	ND	UG/L	NA		NA	
065	G005	beta-BHC	ND	UG/L	NA		NA	
		Total			283.3268		3.4470	
065	G006	1,2-Dichloroethene (total)	ND	UG/L	NA		NA	
065	G006	Acetone	ND	UG/L	NA		NA	
065	G006	Aluminum (Al)	ND	UG/L	NA		NA	
065	G006	Antimony (Sb)	ND	UG/L	NA		NA	
065	G006	Arsenic (As)	ND	UG/L	NA		NA	
065	G006	Beryllium (Be)	ND	UG/L	NA		NA	
065	G006	Cadmium (Cd)	ND	UG/L	NA		NA	
065	G006	Chromium (Cr)	ND	UG/L	NA		NA	
065	G006	Copper (Cu)	ND	UG/L	NA		NA	
065	G006	Lead (Pb)	8.90	UG/L	NA		NA	
065	G006	Magnesium (Mg)	7860.00	UG/L	NA		NA	
065	G006	Mercury (Hg)	ND	UG/L	NA		NA	
065	G006	Trichloroethene	ND	UG/L	NA		NA	
065	G006	Vanadium (V)	ND	UG/L	NA		NA	
065	G006	Vinyl chloride	ND	UG/L	NA		NA	
065	G006	Zinc (Zn)	ND	UG/L	NA		NA	
065	G006	alpha-BHC	ND	UG/L	NA		NA	
065	G006	beta-BHC	ND	UG/L	NA		NA	
		Total			NA		NA	
065	G007	1,2-Dichloroethene (total)	ND	UG/L	NA		NA	
065	G007	Acetone	ND	UG/L	NA		NA	
065	G007	Aluminum (Al)	101.00	UG/L	NA		0.0065	0.38
065	G007	Antimony (Sb)	ND	UG/L	NA		NA	
065	G007	Arsenic (As)	7.80	UG/L	174.0117	100.00	1.6621	98.47
065	G007	Beryllium (Be)	ND	UG/L	NA		NA	
065	G007	Cadmium (Cd)	ND	UG/L	NA		NA	
065	G007	Chromium (Cr)	1.20	UG/L	NA		0.0153	0.91
065	G007	Copper (Cu)	ND	UG/L	NA		NA	
065	G007	Lead (Pb)	1.70	UG/L	NA		NA	
065	G007	Mercury (Hg)	ND	UG/L	NA		NA	
065	G007	Trichloroethene	ND	UG/L	NA		NA	
065	G007	Vanadium (V)	ND	UG/L	NA		NA	

Table 10.6.10.5
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMU 65/AOCs 544 and 546
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
065	G007	Vinyl chloride	ND	UG/L	NA		NA	
065	G007	Zinc (Zn)	19.10	UG/L	NA		0.0041	0.24
065	G007	alpha-BHC	ND	UG/L	NA		NA	
065	G007	beta-BHC	ND	UG/L	NA		NA	
		Total			174.0117		1.6880	
065	G008	1,2-Dichloroethene (total)	ND	UG/L	NA		NA	
065	G008	Acetone	ND	UG/L	NA		NA	
065	G008	Aluminum (Al)	113.00	UG/L	NA		0.0072	0.21
065	G008	Antimony (Sb)	ND	UG/L	NA		NA	
065	G008	Arsenic (As)	16.20	UG/L	361.4090	100.00	3.4521	98.29
065	G008	Beryllium (Be)	ND	UG/L	NA		NA	
065	G008	Cadmium (Cd)	ND	UG/L	NA		NA	
065	G008	Chromium (Cr)	0.96	UG/L	NA		0.0123	0.35
065	G008	Copper (Cu)	ND	UG/L	NA		NA	
065	G008	Lead (Pb)	ND	UG/L	NA		NA	
065	G008	Mercury (Hg)	ND	UG/L	NA		NA	
065	G008	Trichloroethene	ND	UG/L	NA		NA	
065	G008	Vanadium (V)	4.30	UG/L	NA		0.0393	1.12
065	G008	Vinyl chloride	ND	UG/L	NA		NA	
065	G008	Zinc (Zn)	5.70	UG/L	NA		0.0012	0.03
065	G008	alpha-BHC	ND	UG/L	NA		NA	
065	G008	beta-BHC	ND	UG/L	NA		NA	
		Total			361.4090		3.5120	

10.6.11 Corrective Measures Considerations

For SWMU 65 and AOCs 544 and 546, the upper and lower soil intervals and the shallow and deep groundwater were investigated. All soil samples were collected beneath asphalt or concrete pavement. Based on the analytical results and the FRE, COCs requiring further evaluation through the CMS process were identified for the upper soil interval and the shallow groundwater. However, residential use of the site is not expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use, marine cargo terminal, and drydock. Since the ground surface is capped with either asphalt or concrete, chronic exposure to current soil conditions is highly unlikely. A FRE substituted for a full risk assessment. The FRE conservatively assumed that the site was not paved.

Four COPCs were identified for combined SWMU 65 soil below pavement: aldrin, cobalt, dieldrin, and BEQs. Arsenic and beryllium were detected in combined SWMU 65 soil below pavement at concentrations above their RBCs but were eliminated because they were below their background concentrations. The combined ingestion and dermal residential exposure risk ranges between 5E-07 to 3E-05 with an arithmetic mean risk of 5E-06 and an HI between 0.0001 to 0.4, which is between USEPA's acceptable range of 1E-06 and 1E-04 and HI of 3 to 0.1.

Dieldrin and aldrin concentrations in soil below pavement at sample locations 065SB005, 544SB001, and 544SB002 contributed the risk estimates above 1E-06. BEQs contributed to risk estimates above 1E-06 in soil below pavement at sample locations 065SB001, 065SB006, and 065SB008. Therefore, no further action is recommended for soil.

COPCs were identified in the shallow and deep groundwater. Risk estimates ranged from 1E-04 to 1E-03 with the arithmetic mean of 4E-04. The HIs ranged from 0.2 to 19 with the mean HI of 5. Arsenic, 1,2-dichloroethene (total), trichloroethene, and vinyl chloride were identified as COPCs in the deep groundwater. Acetone, aluminum, antimony, arsenic, beryllium, alpha-BHC, beta-BHC, cadmium, chromium, copper, 1,2-dichloroethene (total), dioxin equivalents, lead, mercury, vanadium, and vinyl chloride were identified as COPCs in the shallow groundwater. Manganese was detected in the groundwater above its RBC but was eliminated in the FRE based on comparison to background concentrations. Arsenic contributed to risk estimates above 1E-06 in six of the nine first-quarter groundwater samples (NCBE06504D, NBCE065003, NBCE065004, NBCE065005, NBCE065007, and NBCE065008). Vinyl chloride was detected in monitoring wells NBCE06504D and NBCE065003.

Based on data collected, a groundwater plume is not indicated but may exist. No clear, definable source or release is associated with these units. Based on the above facts, no further action may be appropriate for soil and further assessment of the groundwater at NBCE06504D and NBCE065003. Potential corrective measures for the impacted media and respective COCs are in Table 10.6.11.1.

Table 10.6.11.1
Potential Corrective Measures for SWMU 65 and AOC 544 and AOC 546

Medium	Compounds	Potential Corrective Measures
Soil	None	a) No Action
Deep Groundwater	Arsenic, 1,2-dichloroethene (total), trichloroethene, and vinyl chloride	a) No Action b) Assessment Monitoring c) Ex-Situ, Chemical and Physical Treatment
Shallow Groundwater	Acetone, aluminum, antimony, arsenic, beryllium, alpha-BHC, beta-BHC, cadmium, chromium, copper, 1,2-dichloroethene (total), dioxin equivalents, lead, mercury, vanadium, and vinyl chloride	a) No Action b) Assessment Monitoring c) Ex-Situ, Chemical and Physical Treatment

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10.7 SWMU 67, Mercury Gauge Room, Building 3

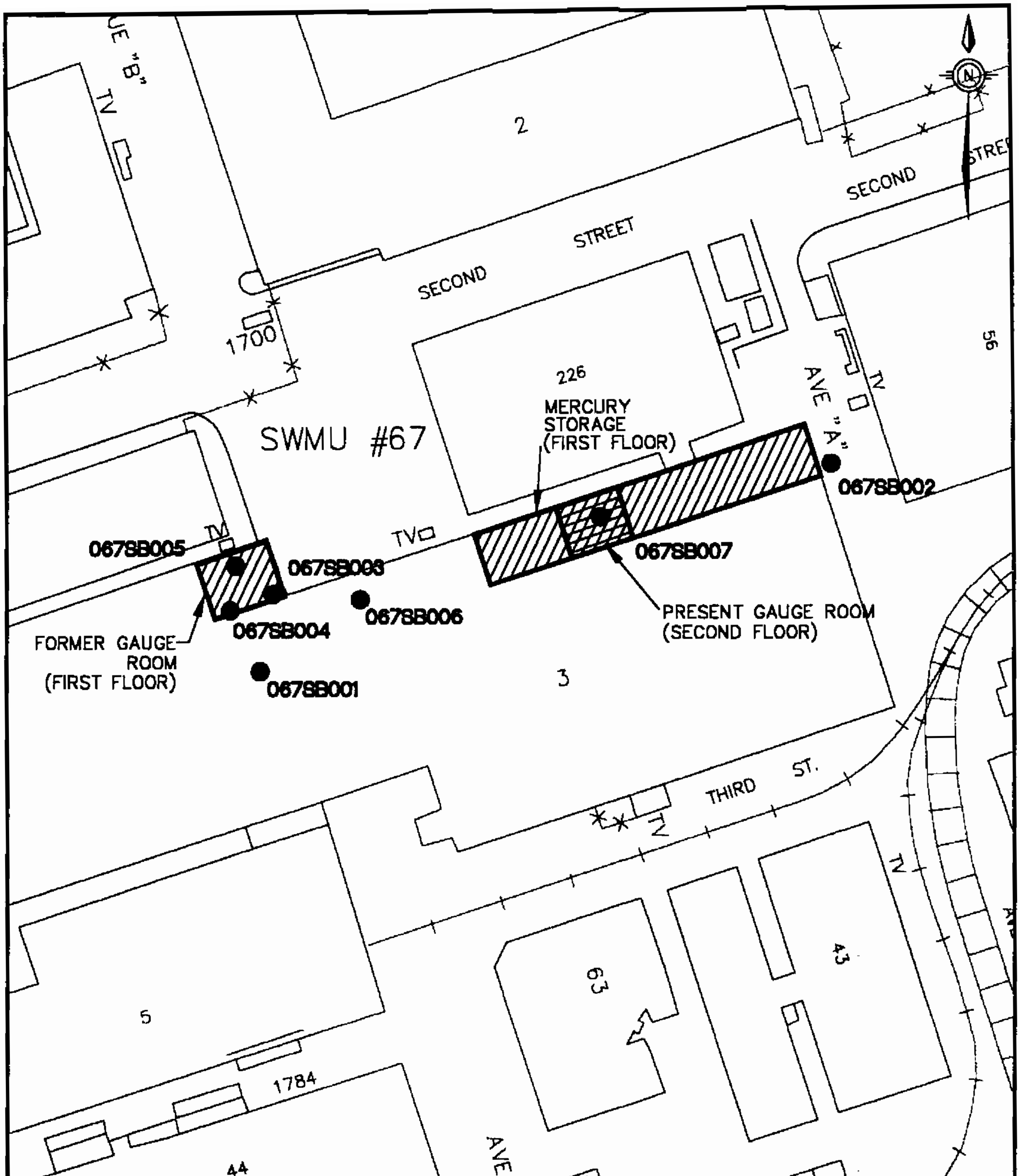
SWMU 67 consists of a mercury gauge room, a former mercury gauge room, and a mercury storage area, each in separate locations within Building 3. The building was constructed in 1905, with additions in 1939 and 1943. The mercury gauge room is used to calibrate and tests gauges for leaks. The current gauge room is on the mezzanine level. A room near the middle of the northwest wall of the ground floor was originally intended to serve as the gauge room. It is not known whether mercury gauges were ever handled in this room. Mercury gauge operations are known to have been conducted for 25 years in this building.

At SWMU 67, mercury is the material of concern identified in the *Final Zone E RFI Work Plan*. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure. The subsurface utility distribution system (including storm and sanitary sewers) in this area has acted as a conduit for moving any product or waste released within Zone E, and thus could expose personnel working on any of these subsurface systems, as well as providing a contaminant route to the Cooper River, which borders Zone E along its northeastern side. The Cooper River could receive contaminated sediment, surface water runoff, and groundwater discharges, thus exposing biological receptors other than humans.

To fulfill the CSI objectives for SWMU 67, soil, groundwater, wipe, and air samples were collected in accordance with the *Final Zone E RFI Work Plan*, and Section 3 of this report to determine whether any contamination resulted from onsite activities.

10.7.1 Soil Sampling and Analysis

Soil was sampled in one round at SWMU 67 from the locations shown in Figure 10.7.1. The *Final Zone E RFI Work Plan* proposed collecting five soil samples from the upper interval and five samples from the lower interval. Soil samples were also collected at both intervals for the two shallow monitoring well locations proposed at this site.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.7.1
SOIL BORING LOCATIONS
SWMU #67
GAUGE ROOM
BUILDING 3

DWG DATE: 09/02/97 | DWG NAME: 10-7-1

All seven of the proposed upper- and lower-interval samples were collected and submitted for analysis at DQO Level III for mercury. Two lower-interval samples were selected as duplicates. One duplicate was analyzed at DQO Level IV for Appendix IX analytical parameters, which includes the proposed parameters for the site plus herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. The other duplicated sample was analyzed for mercury only; it was not analyzed at DQO Level IV and was not analyzed for Appendix IX parameters. Table 10.7.1.1 summarizes soil sampling at SWMU 67.

Table 10.7.1.1
SWMU 67
Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	7	7	Mercury	Mercury	One duplicate not analyzed at DQO Level IV for Appendix IX parameters
Lower	7	7	Mercury	Mercury	None

10.7.2 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.7.2.1. Inorganic analytical results for soil are summarized in Table 10.7.2.2. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.7.2.1
SWMU 67
Organic Compounds Detected in Soil (ng/kg)

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Dioxins						
Dioxin Equiv.	Lower	1/1	0.0303	0.0303	NA	NA
1234678-HpCDD	Lower	1/1	0.476	0.476	NA	NA
234678-HxCDF	Lower	1/1	0.230	0.230	NA	NA
OCDD	Lower	1/1	2.58	2.58	NA	NA

Notes:
ng/kg = Nanograms per kilogram
RBC = Risk-based concentration
NA = No industrial RBC established

Table 10.7.2.2
SWMU 67
Inorganic Detections for Soil (mg/kg)

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Mercury (Hg)	Upper	3/7	0.0400 - 0.210	0.107	61.0	2.60	0
	Lower	2/7	0.0300 - 0.0800	0.0550	NA	1.59	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Risk-based concentration
RC = Reference Concentration
NA = No industrial RBC established

Dioxins in Soil

Three dioxins were detected in the lower-interval duplicate soil sample collected from SWMU 67. Industrial RBCs do not apply to the lower interval.

In accordance with recent dioxin guidance, TEQs (dioxin equivalent) were calculated for the lower-interval duplicate soil sample. The TEQ calculated for the sample was 0.0303 ng/kg.

Inorganic Elements in Soil

One metal — mercury — was detected in soil samples collected at SWMU 67. Three detections occurred in the upper interval and two in the lower interval. None of the detections exceeded both the mercury industrial RBC and background RC in the upper interval or the mercury SSL and background RC in the lower interval.

10.7.3 Groundwater Sampling and Analysis

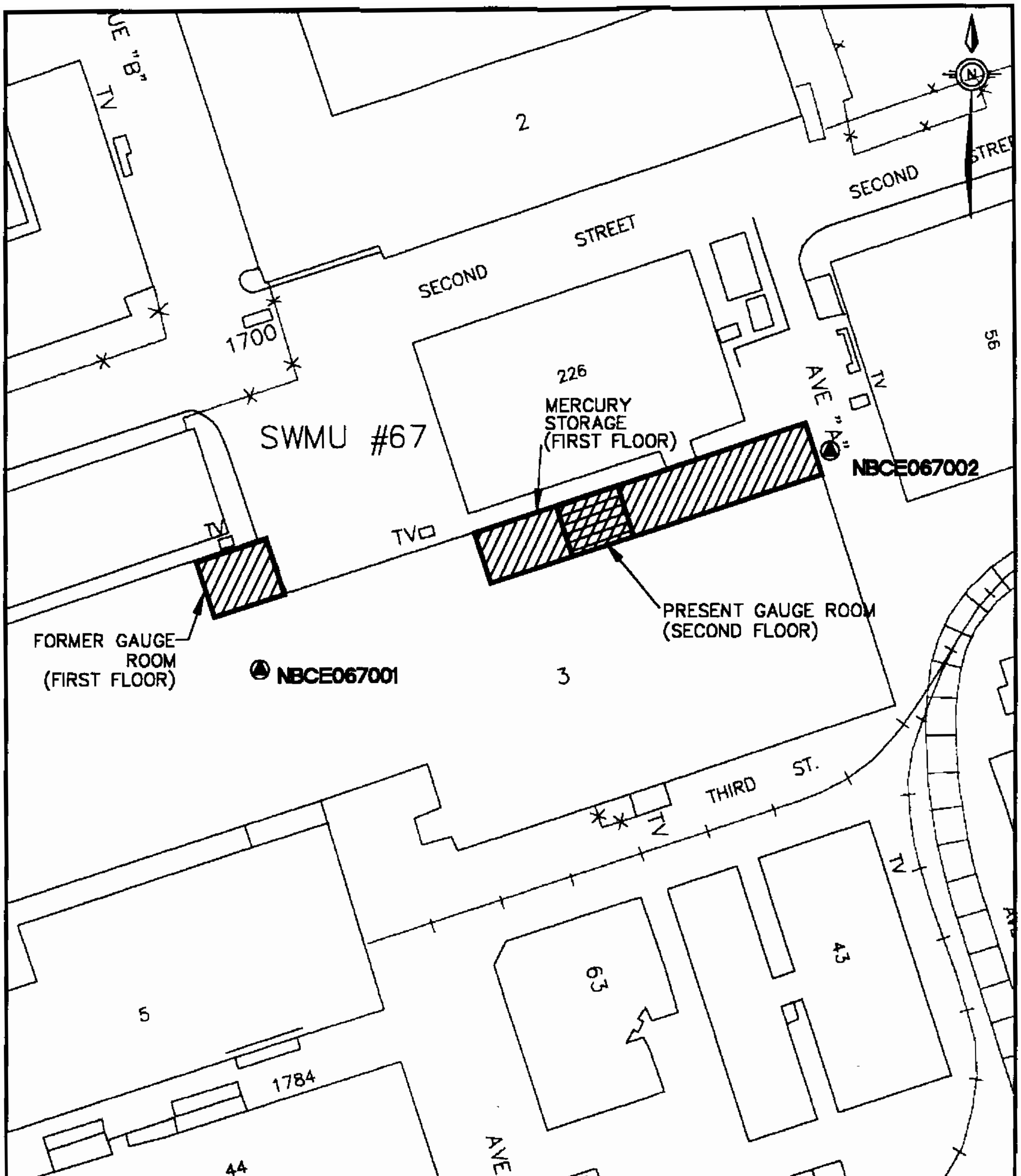
Two shallow monitoring wells were installed and sampled to assess groundwater quality at SWMU 67 as shown in Figure 10.7.2. The wells were installed as follows:

- Shallow Wells — NBCE067001 and NBCE067002

Groundwater samples were submitted for analysis at DQO Level III for mercury, chlorides, sulfates, and TDS. No duplicate samples were collected at this site. Table 10.7.3.1 summarizes groundwater sampling and analysis at SWMU 67.

Table 10.7.3.1
SWMU 67
Groundwater Sampling Summary

Depth	Wells Proposed	Wells Installed	Analyses Proposed	Analyses Collected	Deviations
Shallow	2	2	Mercury, chlorides, sulfates, and TDS	Mercury, chlorides, sulfates, and TDS	None



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- – DEEP MONITORING WELLS
- – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.7.2
MONITORING WELL LOCATIONS
SWMU #67
GAUGE ROOM
BUILDING 3

DWG DATE: 09/02/97 | DWG NAME: 10-7-2

The shallow monitoring wells were installed at 13 to 13.5 feet bgs in the surficial aquifer in accordance with Section 3.3 of this report.

10.7.4 Nature of Contamination in Groundwater

Inorganic Elements in Groundwater

Mercury was not detected in the shallow groundwater samples collected at SWMU 67. Appendix H contains the complete data report for all samples collected in Zone E.

10.7.5 Wipe Sampling and Analysis

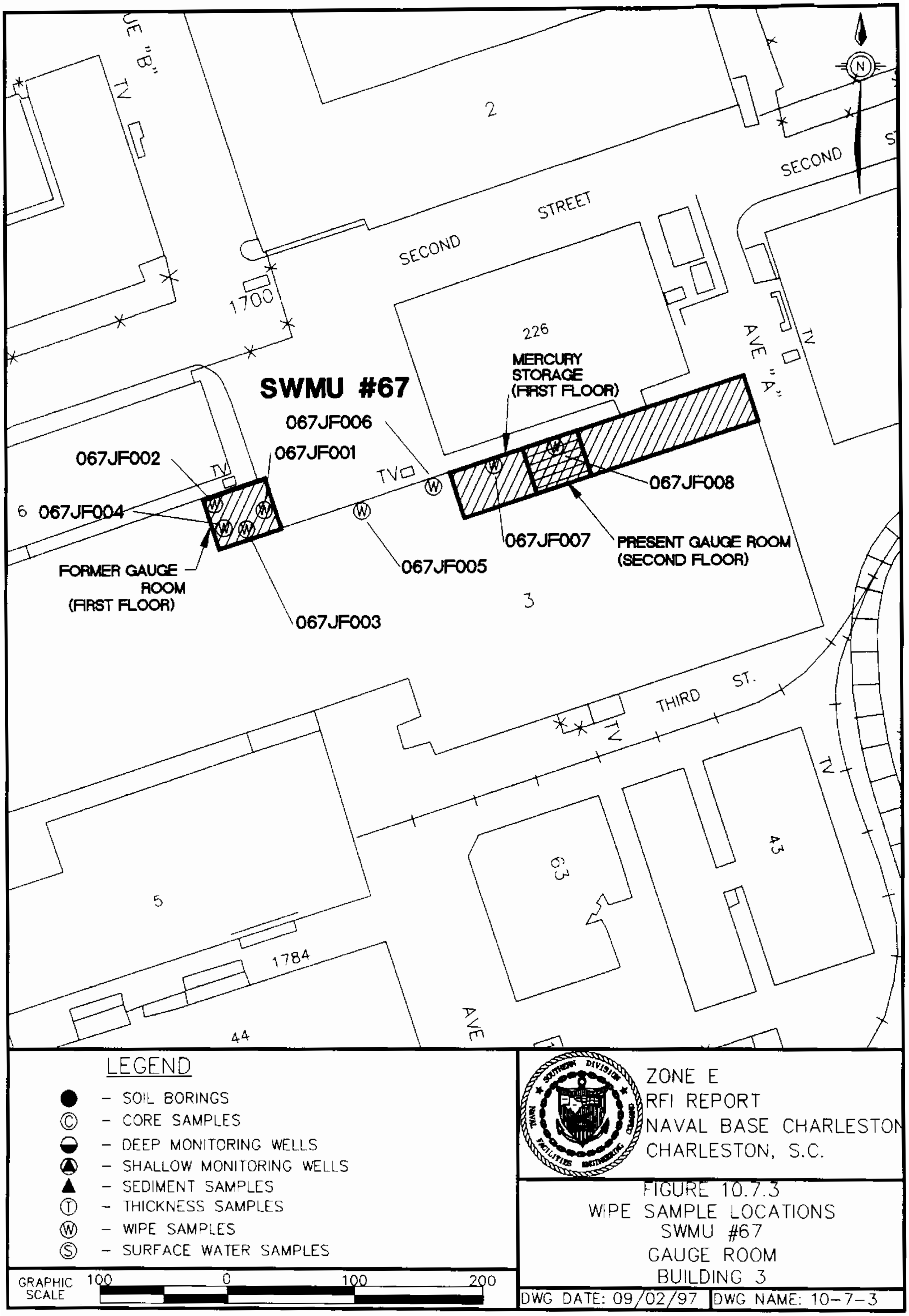
The *Final Zone E RFI Work Plan* proposed the collection of seven wipe samples at SWMU 67. Eight wipe samples were collected and analyzed for mercury. Sample locations were determined in the field and are shown on Figure 10.7.3. Table 10.7.5.1 summarizes wipe sampling activity for SWMU 67.

Table 10.7.5.1
SWMU 67
Wipe Sampling Summary

Samples Proposed	Samples Collected	Analyses Proposed	Analyses Performed	Deviations
7	8	Mercury	Mercury	1 additional sample was collected

10.7.6 Nature of Contamination in Dust

Table 10.7.6.1 summarizes the wipe sample analytical results for SWMU 67. Sample locations were determined in the field and were biased in an attempt to identify worst case situations. Samples were collected in areas where lead ingots and weights had been stored.



SWMU #67
067JF001
067JF002
067JF003
067JF004
067JF005
067JF006
067JF007
067JF008
MERCURY STORAGE (FIRST FLOOR)
PRESENT GAUGE ROOM (SECOND FLOOR)
FORMER GAUGE ROOM (FIRST FLOOR)
SECOND STREET
SECOND
THIRD ST.
AVE "A"
AVE "B"
AVE
TV
226
1700
1784
2
3
5
6
43
44
63
N
LEGEND
- SOIL BORINGS
- CORE SAMPLES
- DEEP MONITORING WELLS
- SHALLOW MONITORING WELLS
- SEDIMENT SAMPLES
- THICKNESS SAMPLES
- WIPE SAMPLES
- SURFACE WATER SAMPLES
GRAPHIC SCALE
100
0
100
200
ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.
FIGURE 10.7.3
WIPE SAMPLE LOCATIONS
SWMU #67
GAUGE ROOM
BUILDING 3
DWG DATE: 09/02/97
DWG NAME: 10-7-3

Table 10.7.6.1
SWMU 67
Wipe Sampling Analytical Results

Parameter	Frequency of Detection	Range of Detections (mg/wipe)
Mercury	8/8	0.05 to 0.30

Inorganic Elements Detected on Surfaces

Mercury was detected in eight of eight samples with a range of 0.05 to 0.30 mg/wipe. No residential or industrial RBCs exist for wipe samples.

10.7.7 Air Sampling and Analysis

A Jerome Mercury Vapor Analyzer was used to screen for ambient mercury vapor in the old and current mercury gauge rooms. The instrument was placed in the survey mode during all qualitative sampling. The survey mode is useful for locating spills or to assess areas of potential high mercury vapor concentration. Each room in the current area was assessed for the presence of mercury vapor. All surveying was performed at floor level to detect any contamination from spills. The baseboards of each room were frisked with the mercury vapor analyzer. The survey activity also involved disturbing vinyl floor tiles in the former room. All other suspect areas (i.e., cabinets, under shelves, etc.) also were surveyed for the presence of mercury vapor.

10.7.8 Nature of Contamination in Air

The following section summarizes the results for the air samples collected from the former and current mercury gauge areas in Building 3.

Qualitative Air Monitoring Results

The qualitative monitoring effort identified two areas in SWMU 67 with detectable mercury vapor in ambient air. The classroom area in the old mercury gauge area had mercury vapor concentrations ranging from 0.006 mg/m^3 to 0.024 mg/m^3. These readings were obtained by removing a section of floor tile and immediately sampling the exposed area. No detectable quantities of mercury vapor were present in the classroom when the floor tiles were undisturbed. The office area in the current mercury gauge area contained detectable quantities of mercury vapor. Mercury sample readings ranged from 0.003 mg/m^3 to 0.044 mg/m^3 for the west end of the office area.

10.7.9 Fate and Transport Assessment for SWMU 67

SWMU 67 consists of a mercury gauge room, a former mercury gauge room, and a mercury storage area, located in separate areas within Building 3. All of the ground is covered concrete. Environmental media sampled as part of the SWMU 67 RFI include surface soil, subsurface soil, shallow groundwater, and air and wipe samples. The focus of the SWMU 67 RFI was on mercury and, as a result, most of the environmental media were analyzed for mercury only. Potential constituent migration pathways investigated for SWMU 67 include soil to groundwater and groundwater to surface water. The surface soil to air migration pathway was not assessed since no samples were analyzed for VOCs.

10.7.9.1 Soil-to-Groundwater Cross-Media Transport: Tier One

Table 10.7.9.1 compares maximum detected organic compound concentrations in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels, or (b) background reference concentrations. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 10:1, with no attenuation of constituents in soil (DAF=10).

No constituents were detected in SWMU 67 soil above groundwater protection SSLs.

10.7.9.2 Groundwater-to-Surface Water Cross-Media Transport: Tier One

Table 10.7.9.1 also compares maximum detected organic compound concentrations in shallow groundwater samples to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background reference concentrations for groundwater, as well as to the saltwater surface water chronic values. To provide a conservative first-tier screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

No constituents were detected in SWMU 67 groundwater above groundwater or surface water screening values.

10.7.9.3 Fate and Transport Summary

None of the constituents exceeded first-tier screening values, indicating that there is neither a threat to groundwater nor a threat to surface water in the Cooper River via the evaluated migration pathways.

Table 10.7.9.1
Chemicals Detected in Surface Soil, Subsurface Soil, and Shallow Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMU 67
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Subsurface Soil	Max. Concentration Shallow GW	Deep GW	Screening Concentration * Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Dioxin Compounds												
Dioxin (TCDD TEQ)	ND	0.0303	NA	NA	950	0.43	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Mercury	0.21	0.08	ND	NA	2.6	11	0.2	MG/KG	UG/L	NO	NO	NO

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 10, adapted from 1996 EPA Soil Screening Guidance or calculated using values from Table 6.2
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, June 3, 1996
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November, 1995; Tabl
In each case, the value shown is the greater of the relevant screening value or the corresponding background reference value

Units: See notes for Table 10.1.5.1

10.7.10 Fixed-Point Risk Evaluation for SWMU 67

10.7.10.1 Site Background and Investigative Approach

SWMU 67 consists of a mercury gauge room, a former mercury gauge room, and a mercury storage area; each in separate locations within Building 3. This site is located in a highly industrialized portion of Zone E. As a result, the risk assessment for this site is presented as a FRE following the framework presented in Section 7.3.

A total of seven surface soil samples were considered in the SWMU 67 FRE. Two monitoring wells were installed as part of the 1995 RFI. Both monitoring wells were installed into the shallow aquifer. Groundwater data generated from the first-quarter RFI sampling event are used to represent point risk/hazard for the SWMU 67 FRE. Sections 10.7.1 and 10.7.3 contain summaries of the sampling effort for SWMU 67 soil and groundwater.

10.7.10.2 Fixed-Point Risk Evaluation for Soil

Table 10.7.10.1 provides CPSS summaries for SWMU 67 soil and identifies COPCs based on comparison to residential and industrial RBCs and background RCs. No COPCs were identified for SWMU 67 soil for either the residential or industrial scenarios.

10.7.10.3 Fixed-Point Risk Evaluation for Groundwater

SWMU 67 first-quarter groundwater samples were analyzed for mercury, chloride, sulfate, and total dissolved solids. No COPCs were identified for SWMU 67 groundwater.

10.7.10.4 FRE Summary

Data collected for SWMU 67 were screened according to the process presented in Section 7.3.4. No COPCs were identified subsequent to this screening.

Table 10.7.10.1
Chemicals Present in Site Samples
SWMU 67 - Surface Soil
NAVBASE - Charleston
Charleston, South Carolina

					Screening Concentration				Number Exceeding		
Parameter	Frequency of Detection	Range of Detection	Average Detected Concentration	Range of SQL	Residential RBC	Industrial RBC	Reference	Units	Res. RBC	Ind. RBC	Ref.
Mercury (Hg)	3 7	0.04 - 0.21	0.11	0.11 - 0.11	2.3	61	2.6	MG/KG			

Notes:
MG/KG - milligrams per kilogram
SQL - Sample quantitation limit
RBC - Risk-based concentration

10.7.11 Corrective Measures Considerations

For SWMU 67, the upper and lower soil intervals and the shallow groundwater were investigated. All soil samples were collected beneath asphalt or concrete pavement. Based on the analytical results and the FRE, no COCs requiring further evaluation through the CMS process were identified for the upper and lower soil interval and shallow groundwater. Residential use of the site is not expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use as a marine cargo terminal and drydock. Since the ground surface is capped with either asphalt or concrete, chronic exposure to current soil conditions is highly unlikely. An FRE substituted for a full risk assessment. The FRE conservatively assumed that the site was not paved.

Potential corrective measures for this SWMU are given in Table 10.7.11.1.

Table 10.7.11.1
Potential Corrective Measures for SWMU 67

Medium	Compounds	Potential Corrective Measures
Soil	None	No Action
Shallow Groundwater	None	No Action

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10.8 SWMU 70, Building 5 Dip Tank; AOC 548, Hydraulic Elevator, Building 5; and AOC 549, Scrap Yard 1054, Building 5

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

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

AOC 549 is the site of a former scrap yard north of Building 5. The scrap yard was operated in the 1920s and 1930s. No information was found concerning its operating practices. Currently this area is paved with concrete and asphalt.

Materials of concern identified in the *Final Zone E RFI Work Plan* include: at SWMU 70, acids, metals, and solvents; at AOC 548, hydraulic fluid and petroleum hydrocarbons; and at AOC 549, metals and petroleum hydrocarbons. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure.

To fulfill RFI objectives for SWMU 70 and AOC 549, and CSI objectives for AOC 548, soil and groundwater samples were collected in accordance with the *Final Zone E RFI Work Plan* and Section 3 of this report to determine whether any contamination resulted from onsite activities.

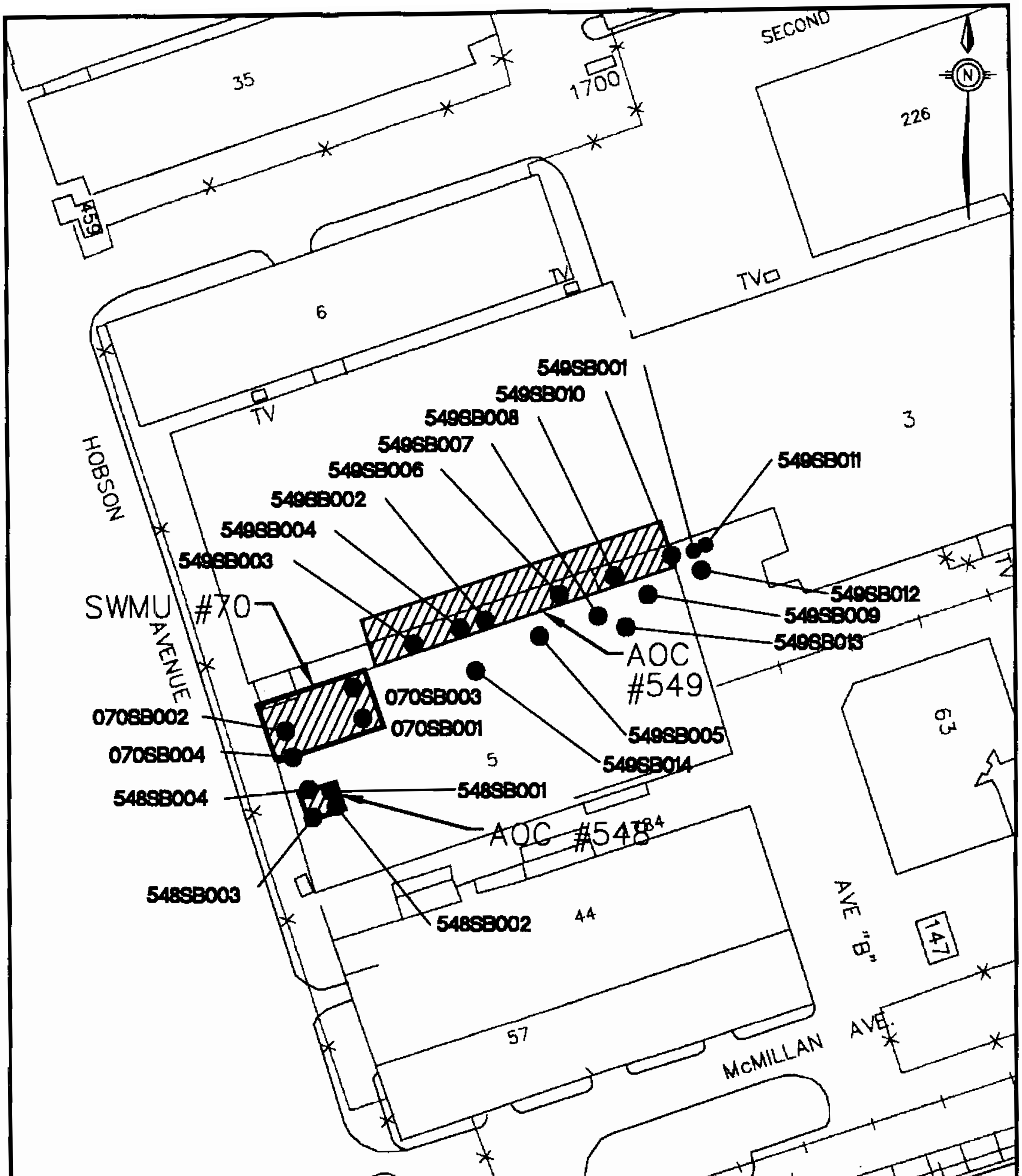
10.8.1 Soil Sampling and Analysis

Soil was sampled in two rounds at SWMU 70 and AOCs 548 and 549 from the locations shown in Figure 10.8.1. The *Final Zone E RFI Work Plan* proposed collecting 13 soil samples from the upper interval and 13 samples from the lower interval. Soil samples were also collected at both intervals for the five shallow monitoring well locations proposed at this site.

First-round Sampling — During the first round of sampling, all 18 proposed upper-interval samples were collected and seventeen of the proposed 18 lower-interval samples were collected. At AOC 549, one lower-interval sample was not collected due to a subsurface obstruction.

All first round samples were submitted for analysis at DQO Level III for pH, organotins and the standard suite of parameters which includes VOCs, SVOCs, pesticides/PCBs, metals, and cyanide. One upper-interval sample selected as a duplicate was analyzed at DQO Level IV for Appendix IX analytical parameters, which includes the suite of parameters proposed for the site plus a more comprehensive list of VOCs and SVOCs as well as herbicides, hexavalent chromium, organophosphorus pesticides, and dioxins. Table 10.8.1.1 summarizes first round soil sampling at SWMU 70 and associated sites.

Second-round Sampling — Second round sampling was performed at AOC 549 after first round analytical results were compared to the USEPA Region III RBCs (April 1996). Five upper-interval and five lower-interval samples were proposed during second round sampling to determine the extent of constituents detected during the initial round of soil sampling. Four of the five upper-interval samples and four of the five lower-interval samples were collected.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- DEEP MONITORING WELLS
- SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.8.1
SOIL BORING LOCATIONS
SWMU #70, DIP TANK AREA, BUILD 5
AOC #548, ELEVATOR, BUILD 5
AOC #549, SCRAP YARD

DWG DATE: 09/02/97 | DWG NAME: 10-8-1

Table 10.8.1.1
SWMU 70 and AOCs 548 and 549
First Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	18	18	Standard Suite[a], pH, and organotins	Standard Suite[a], pH, and organotins	None
Lower	18	17	Standard Suite[a], pH, and organotins	Standard Suite[a], pH, and organotins	One sample could not be collected due to subsurface obstruction

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, and pesticides/PCB

The upper- and lower-interval samples proposed at the location inside Building 3 could not be collected due to surface obstructions in the form of heavy equipment and machinery. All second round samples were submitted for analysis of SVOCs and metals. No duplicated samples were collected. Table 10.8.1.2 summarizes the second round soil sampling at SWMU 70 and AOCs 548 and 549.

Table 10.8.1.2
SWMU 70 and AOCs 548 and 549
Second Round Soil Sampling Summary

Interval	Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
Upper	5	4	SVOCs, metals	SVOCs, metals	One sample could not be collected due to surface obstruction
Lower	5	4	SVOCs, metals	SVOCs, metals	One sample could not be collected due to surface obstruction

10.8.2 Nature of Contamination in Soil

Organic compound analytical results for soil are summarized in Table 10.8.2.1. Inorganic analytical results for soil are summarized in Table 10.8.2.2. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.8.2.1
SWMU 70 and AOCs 548 and 549
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
VOCs (μg/kg)						
Acetone	Lower	1/17	14.0	14.0	NA	NA
Carbon disulfide	Lower	1/17	2.00	2.00	NA	NA
Methylene chloride	Upper	5/18	10.0 - 14.0	11.0	760,000	0
	Lower	4/17	9.00 - 14.0	11.5	NA	NA
Toluene	Upper	4/18	1.000 - 3.00	1.75	41,000,000	0
	Lower	1/17	2.00	2.00	NA	NA
Vinyl acetate	Lower	1/17	5.00	5.00	NA	NA
Xylene (Total)	Upper	4/18	1.000 - 4.00	2.25	100,000,000	0
	Lower	3/17	2.00 - 3.00	2.33	NA	NA
SVOCs (μg/kg)						
Anthracene	Upper	4/22	52.0 - 78.0	66.8	61,000,000	0
	Lower	3/21	39.0 - 76.0	52.0	NA	NA
Benzo(g,h,i)perylene	Upper	10/22	40.0 - 2,900	406	8,200,000	0
	Lower	5/21	51.0 - 210	97.6	NA	NA
Benzoic acid	Lower	2/21	45.0 - 60.0	52.5	NA	NA
bis(2-Ethylhexyl)phthalate	Upper	2/22	64.0 - 82.0	73.0	410,000	0
	Lower	2/21	54.0 - 66.0	60.0	NA	NA

Table 10.8.2.1
SWMU 70 and AOCs 548 and 549
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs ($\mu g/kg$)						
2-Chlorophenol	Upper	1/22	68.0	68.0	1,000,000	0
Dibenzofuran	Upper	1/22	44.0	44.0	820,000	0
Di-n-butylphthalate	Lower	1/21	46.0	46.0	NA	NA
Diethylphthalate	Lower	1/21	110	110	NA	NA
Di-n-octyl phthalate	Upper	1/22	57.0	57.0	4,100,000	0
Fluoranthene	Upper	15/22	36.0 - 720	283	8,200,000	0
	Lower	7/21	49.0 - 590	197	NA	NA
2-Methylnaphthalene	Lower	1/21	110	110	NA	NA
Naphthalene	Lower	1/21	88.0	88.0	NA	NA
Phenanthrene	Upper	12/22	40.0 - 400	181	8,200,000	0
	Lower	5/21	44.0 - 380	180	NA	NA
Pyrene	Upper	15/22	43.0 - 4,600	559	6,100,000	0
	Lower	8/21	55.0 - 580	172	NA	NA
SVOCs (B(a)P Equivalents) ($\mu g/kg$)						
B(a)P Equiv.	Upper	14/22	0.520 - 4,670	539	780	2
	Lower	7/21	27.4 - 654	161	NA	NA
Benzo(a)anthracene	Upper	13/22	41.0 - 560	188	7,800	0
	Lower	6/21	42.0 - 380	136	NA	NA
Benzo(b)fluoranthene	Upper	10/22	64.0 - 4,900	668	7,800	0
	Lower	6/21	54.0 - 480	152	NA	NA
Benzo(k)fluoranthene	Upper	14/22	52.0 - 2,800	361	78,000	0
	Lower	6/21	52.0 - 310	125	NA	NA

Table 10.8.2.1
SWMU 70 and AOCs 548 and 549
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
SVOCs (B(a)P Equivalents) (μg/kg)						
Benzo(a)pyrene	Upper	12/22	41.0 - 3,100	434	780	1
	Lower	6/21	44.0 - 480	140	NA	NA
Chrysene	Upper	13/22	67.0 - 2,200	343	780,000	0
	Lower	7/21	40.0 - 380	120	NA	NA
Dibenz(a,h)anthracene	Upper	4/22	39.0 - 790	268	780	1
	Lower	1/21	62.0	62.0	NA	NA
Indeno(1,2,3-cd)pyrene	Upper	10/22	42.0 - 2,000	302	7,800	0
	Lower	4/21	46.0 - 230	103	NA	NA
Pesticides/PCBs (μg/kg)						
delta-BHC	Upper	3/18	1.90 - 4.80	3.00	910	0
	Lower	1/17	4.00	4.00	NA	NA
alpha-Chlordane	Upper	1/18	5.40	5.40	4,400	0
gamma-Chlordane	Upper	4/18	1.60 - 4.90	3.53	4,400	0
4,4'-DDE	Upper	4/18	2.70 - 49.0	16.8	17,000	0
	Lower	3/17	6.90 - 14.0	9.93	NA	NA
4,4'-DDT	Upper	3/18	6.70 - 40.0	19.9	17,000	0
Endosulfan II	Upper	2/18	3.90	3.90	1,200,000	0
Endrin	Upper	2/18	4.30 - 18.0	11.2	61,000	0
Endrin aldehyde	Upper	8/18	2.60 - 5.50	3.60	61,000	0
	Lower	4/17	2.70 - 4.20	3.50	NA	NA
Heptachlor epoxide	Upper	1/18	1.70	1.70	630	0
Methoxychlor	Lower	1/17	36.0	36.0	NA	NA
Aroclor-1260	Upper	1/18	68	68.0	740	0

Table 10.8.2.1
SWMU 70 and AOCs 548 and 549
Organic Compounds Detected in Soil

Compound	Sampling Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Number of Samples Exceeding RBC
Dioxins (ng/kg)						
Dioxin Equiv.	Upper	1/1	0.103	0.103	1,000	0
1234678-HpCDD	Upper	1/1	0.855	0.855	NA	NA
1234678-HpCDF	Upper	1/1	1.41	1.41	NA	NA
123789-HxCDF	Upper	1/1	0.684	0.684	NA	NA
OCDD	Upper	1/1	11.2	11.2	NA	NA
OCDF	Upper	1/1	1.10	1.10	NA	NA

Notes:
μg/kg = Micrograms per kilogram
ng/kg = Nanograms per kilogram
RBC = Risk-based concentration
NA = No industrial RBC established

Table 10.8.2.2
SWMU 70 and AOCs 548 and 549
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Aluminum (Al)	Upper	22/22	1,430 - 10,700	4,540	100,000	26,600	0
	Lower	21/21	1,370 - 9,780	4,800	NA	41,100	NA
Antimony (Sb)	Upper	4/22	1.10 - 2.50	1.65	82.0	1.77	0
	Lower	1/21	0.480	0.480	NA	1.60	NA
Arsenic (As)	Upper	22/22	1.40 - 12.6	3.89	3.80	23.9	0
	Lower	21/21	0.560 - 16.8	2.80	NA	19.9	NA
Barium (Ba)	Upper	22/22	8.10 - 46.5	26.9	14,000	130	0
	Lower	20/21	6.00 - 47.2	21.3	NA	94.1	NA

Table 10.8.2.2
SWMU 70 and AOCs 548 and 549
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Beryllium (Be)	Upper	14/22	0.130 - 0.390	0.185	1.30	1.70	0
	Lower	11/21	0.120 - 0.410	0.267	NA	2.71	NA
Cadmium (Cd)	Upper	12/22	0.1000 - 1.80	0.592	100	1.50	0
	Lower	5/21	0.0800 - 0.480	0.240	NA	0.960	NA
Calcium (Ca)	Upper	20/22	274 - 20,300	3,630	NA	NA	NA
	Lower	19/21	138 - 4,760	742	NA	NA	NA
Chromium (Cr)	Upper	22/22	2.90 - 31.4	8.69	1,000	94.6	0
	Lower	21/21	2.20 - 12.1	5.43	NA	75.2	NA
Cobalt (Co)	Upper	22/22	0.1000 - 196	19.9	12,000	19.0	0
	Lower	19/21	0.280 - 5.60	1.50	NA	14.9	NA
Copper (Cu)	Upper	22/22	0.760 - 18,200	1,020	8,200	66.0	1
	Lower	17/21	0.320 - 260	47.7	NA	152	NA
Iron (Fe)	Upper	20/22	1,710 - 9,440	5,090	61,000	NA	0
	Lower	19/21	1,000 - 19,800	4,760	NA	NA	NA
Lead (Pb)	Upper	22/22	4.90 - 1,620	163	1,300	265	1
	Lower	21/21	1.90 - 178	29.7	NA	173	NA
Magnesium (Mg)	Upper	20/22	81.2 - 662	309	NA	NA	NA
	Lower	19/21	79.5 - 553	223	NA	NA	NA
Manganese (Mn)	Upper	20/22	10.8 - 102	39.7	4,700	302	0
	Lower	19/21	5.20 - 86.7	25.0	NA	881	NA
Mercury (Hg)	Upper	10/22	0.0600 - 0.780	0.348	61.0	2.60	0
	Lower	1/21	0.870	0.870	NA	1.59	NA
Nickel (Ni)	Upper	22/22	0.960 - 112	16.6	4,100	77.1	0
	Lower	21/21	0.660 - 35.1	4.10	NA	57.0	NA

Table 10.8.2.2
SWMU 70 and AOCs 548 and 549
Inorganic Detections for Soil

Element	Sample Interval	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Industrial RBC	Reference Conc.	Number of Samples Exceeding RBC and RC
Inorganic Elements (mg/kg)							
Potassium (K)	Upper	13/22	203 - 712	389	NA	NA	NA
	Lower	6/21	179 - 591	482	NA	NA	NA
Selenium (Se)	Upper	3/22	0.360 - 0.730	0.503	1,000	1.70	0
	Lower	2/21	0.400 - 0.420	0.410	NA	2.40	NA
Silver (Ag)	Upper	1/22	3.80	3.80	1,000	NA	0
Sodium (Na)	Upper	15/22	32.2 - 173	79.2	NA	NA	NA
	Lower	18/21	18.5 - 160	58.5	NA	NA	NA
Tin (Sn)	Upper	11/22	2.30 - 1,800	187	100,000	59.4	0
	Lower	4/21	2.90 - 7.00	4.38	NA	9.23	NA
Vanadium (V)	Upper	22/22	3.00 - 12.3	7.50	1,400	94.3	0
	Lower	21/21	1.80 - 18.7	7.14	NA	155	NA
Zinc (Zn)	Upper	22/22	3.70 - 591	129	61,000	827	0
	Lower	21/21	1.60 - 173	38.7	NA	886	NA
pH (SU)							
pH	Upper	18/18	6.54 - 10.3	8.16	NA	NA	NA
	Lower	17/17	4.63 - 8.54	7.23	NA	NA	NA

Notes:
mg/kg = Milligrams per kilogram
RBC = Risk-based concentration
RC = Reference concentration
NA = No industrial RBC or RC established
SU = Standard units

Volatile Organic Compounds in Soil

Six VOCs were detected in soil samples collected at SWMU 70 and AOCs 548 and 549. Thirteen detections occurred in the upper interval and 11 in the lower interval. No VOC exceeded its respective industrial RBC in the upper interval or respective SSL in the lower interval.

Semivolatile Organic Compounds in Soil

Twenty-one SVOCs were detected in soil samples collected at SWMU 70 and AOCs 548 and 549. One hundred and thirty-seven detections occurred in the upper interval and 79 in the lower interval. Two SVOCs — dibenz(a,h)anthracene and benzo(a)pyrene — exceeded their respective industrial RBC in the upper interval. No SVOC exceeded its respective SSL in the lower interval.

Dibenz(a,h)anthracene was detected in four of 22 upper-interval samples with a range of 39.0 to 790 μg/kg and a mean of 268 μg/kg. One upper-interval sample (549SB002, 790 μg/kg) exceeded the industrial RBC of 780 μg/kg.

Benzo(a)pyrene was detected in 12 of 22 upper-interval samples with a range of 41.0 to 3,100 μg/kg and a mean of 434 μg/kg. One upper-interval sample (549SB002, 3,100 μg/kg) exceeded the industrial RBC of 780 μg/kg.

In accordance with recent cPAH guidance, BEQs were calculated for cPAHs at SWMU 70 and AOCs 548 and 549. The upper-interval BEQ was calculated for 14 samples with a range of 0.520 to 4,670 μg/kg and a mean of 539 μg/kg. Two upper-interval samples (549SB002, 4,670 μg/kg and 549SB010, 900 μg/kg) exceeded the benzo(a)pyrene industrial RBC of 780 μg/kg.

Pesticides and PCBs in Soil

Ten pesticides were detected in soil samples collected at SWMU 70 and AOCs 548 and 549. Twenty-eight detections occurred in the upper interval and nine occurred in the lower interval. No pesticide exceeded its respective industrial RBC in the upper interval or respective SSL in the lower interval.

One PCB — Aroclor-1260 — was detected in one of eight upper-interval soil samples collected at SWMU 70 and AOCs 548 and 549. The PCB did not exceed its respective industrial RBC. No lower-interval samples were analyzed for PCBs.

Other Organic Compounds in Soil

Five dioxins were detected in upper-interval soil samples at SWMU 70 and AOCs 548 and 549. No industrial RBCs exist for these parameters. No lower-interval samples were analyzed for dioxins.

In accordance with recent dioxin guidance, TEQs (dioxin equivalent) were calculated for the upper-interval samples. The upper-interval TEQ was calculated at 0.013 ng/kg; below the industrial RBC of 1,000 ng/kg.

Inorganic Elements in Soil

Twenty-three metals were detected in soil samples collected at SWMU 70 and AOCs 548 and 549. Three hundred and eighty-three detections occurred in the upper interval and 327 in the lower interval. One metal — lead — exceeded both its respective industrial RBC and background RC in the upper interval. No metal exceeded both its respective SSL and background RC in the lower interval.

Copper was detected in 22 of 22 upper-interval samples with a range of 0.760 to 18,200 mg/kg and a mean of 1,020 mg/kg. One upper-interval sample (549SB009, 18,200 mg/kg) exceeded the copper industrial RBC of 8,200 mg/kg and the background RC of 66.0 mg/kg.

Lead was detected in 22 of 22 upper-interval samples with a range of 4.90 to 1,620 mg/kg and a mean of 163 mg/kg. One upper-interval samples (549SB010, 1,620 mg/kg) exceeded the lead industrial RBC of 1,300 mg/kg and the background RC of 265 mg/kg.

10.8.3 Groundwater Sampling and Analysis

One deep monitoring well and five shallow monitoring wells were installed and sampled to assess groundwater quality at SWMU 70 and AOCs 548 and 549 as shown in Figure 10.8.2. The wells were installed as follows:

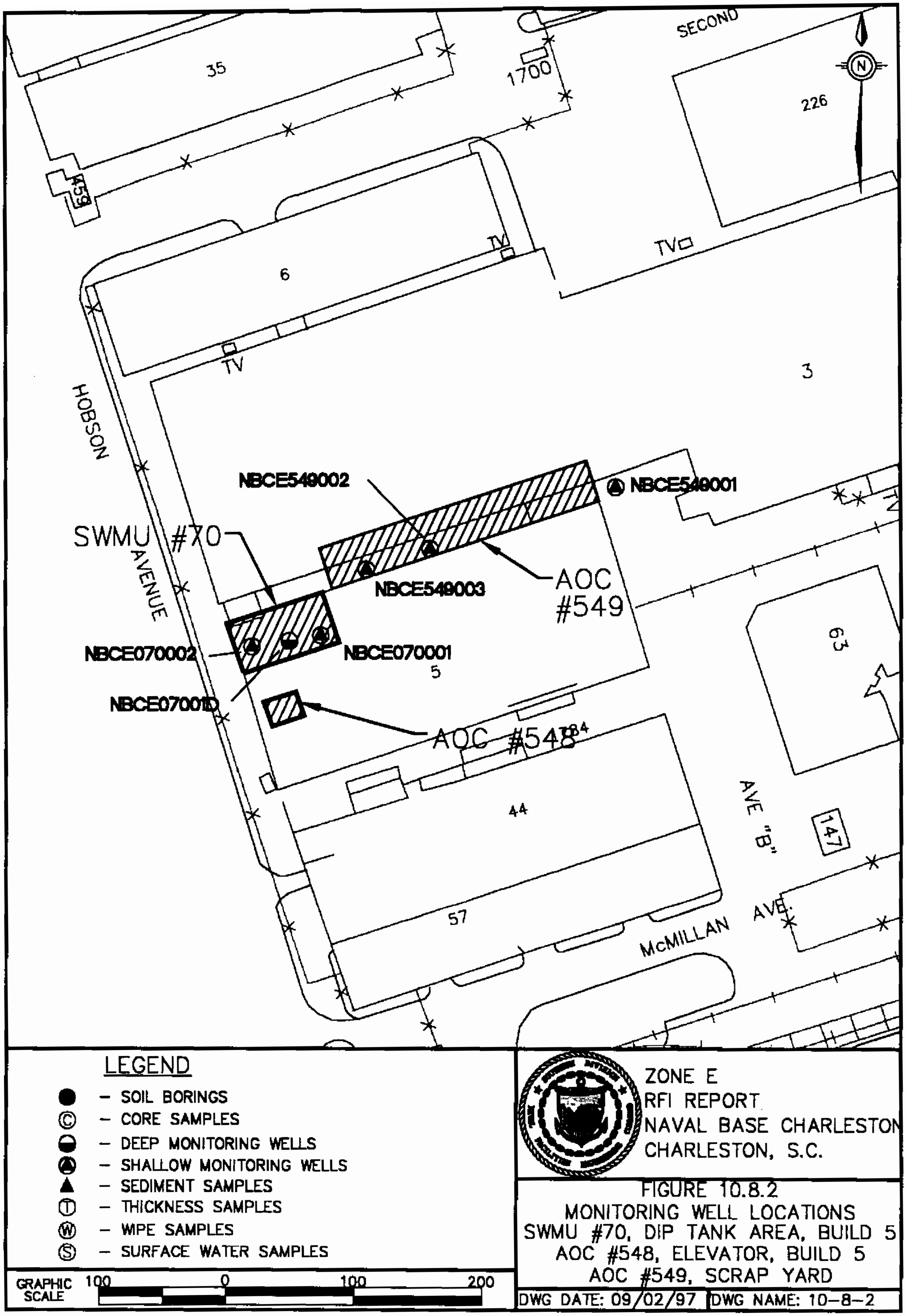
- Shallow Wells installed at SWMU 70 — NBCE07001 and NBCE07002
- Deep Well installed at SWMU 70 — NBCE07001D
- Shallow Wells installed at AOC 549 — NBCE549001, NBCE549002, and NBCE549003

Groundwater samples were submitted for analysis at DQO Level III for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, pH, chlorides, sulfates, TDS, and organotins. No samples were selected as duplicates at this site. Table 10.8.3.1 summarizes groundwater sampling and analysis at SWMU 70 and AOCs 548 and 549.

Table 10.8.3.1
SWMU 70 and AOCs 548 and 549
Groundwater Sampling Summary

Depth	Wells Proposed	Wells Installed	Analyses Proposed	Analyses Collected	Deviations
Shallow	5	5	Standard Suite[a], pH, chlorides, TDS, sulfates	Standard Suite[a], pH, chlorides, sulfates, and TDS	None
Deep	1	1	Standard Suite[a], pH, chlorides, TDS, sulfates	Standard Suite[a], pH, chlorides, sulfates, and TDS	None

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs



ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.8.2
MONITORING WELL LOCATIONS
SWMU #70, DIP TANK AREA, BUILD 5
AOC #548, ELEVATOR, BUILD 5
AOC #549, SCRAP YARD

DWG DATE: 09/02/97 | DWG NAME: 10-8-2

The shallow monitoring wells were installed at 12.5 to 14.9 feet bgs in the surficial aquifer. The deep well was installed at 33.1 feet bgs at the base of the surficial aquifer. All wells were installed in accordance with Section 3.2.3 of this report.

10.8.4 Nature of Contamination in Groundwater

Organic compound analytical results for shallow and deep groundwater are summarized in Tables 10.8.4.1 and 10.8.4.2. Inorganic analytical results for shallow and deep groundwater are summarized in Tables 10.8.4.3 and 10.8.4.4, respectively. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.8.4.1
SWMU 70 and AOCs 548 and 549
Organic Compounds Detected in First-Quarter Groundwater (μg/L)
Shallow Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	MCL	Number of Samples Exceeding RBC
VOCs						
Benzene	1/5	2.00	2.00	0.360	5.00	1
Chlorobenzene	1/5	29.0	29.0	3.90	NA	1
1,2-Dichloroethene (total)	3/5	6.00 - 18.0	11.3	5.50	70.0	3
Trichloroethene	3/5	6.00 - 15.0	9.00	1.60	5.00	3
Xylene (Total)	1/5	2.00	2.00	1,200	10,000	0
SVOCs						
Benzoic acid	2/5	1.000 - 4.00	2.50	15,000	NA	0
bis(2-Ethylhexyl)phthalate	1/5	1.000	1.000	4.80	NA	0
Di-n-butylphthalate	1/5	2.00	2.00	370	NA	0
Naphthalene	3/5	1.000 - 3.00	2.00	150	NA	0

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
NA = No MCL established

Table 10.8.4.2
SWMU 70 and AOCs 548 and 549
Organic Compounds Detected in First-Quarter Groundwater (μg/L)
Deep Monitoring Wells

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	MCL	Number of Samples Exceeding RBC
VOCs						
Chloroform	1/1	7.00	7.00	0.150	100	1
1,2-Dichloroethene (total)	1/1	10.0	10.0	5.50	70.0	1
Tetrachloroethene	1/1	8.00	8.00	1.10	5.00	1
Trichloroethene	1/1	22.0	22.0	1.60	5.00	1

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level

Table 10.8.4.3
SWMU 70 and AOCs 548 and 549
Inorganic Detections for First-Quarter Groundwater
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (μg/L)							
Aluminum (Al)	3/5	339 - 6,490	3,440	3,700	2,810	NA	1
Antimony (Sb)	2/5	7.70 - 24.2	16.0	1.50	NA	6.00	2
Arsenic (As)	2/5	5.70 - 7.90	6.80	0.0450	18.7	50.0	0
Barium (Ba)	5/5	9.60 - 30.7	22.6	260	211	2,00	0
Cadmium (Cd)	2/5	1.70 - 3.50	2.60	1.80	NA	5.00	1
Calcium (Ca)	5/5	5,020 - 34,600	20,300	NA	NA	NA	NA
Chromium (Cr)	3/5	440 - 7,350	3,210	18.0	12.3	100	3
Cobalt (Co)	1/5	2.40	2.40	220	2.5	NA	0
Copper (Cu)	2/5	2.10 - 4.40	3.25	150	2.7	1300	0

Table 10.8.4.3
SWMU 70 and AOCs 548 and 549
Inorganic Detections for First-Quarter Groundwater
Shallow Monitoring Wells

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (μg/L)							
Iron (Fe)	5/5	280 - 4,830	3,010	1,100	NA	NA	4
Magnesium (Mg)	5/5	780 - 8,340	3,940	NA	NA	NA	NA
Manganese (Mn)	5/5	34.0 - 64.1	49.3	84.0	2,560	NA	0
Nickel (Ni)	2/5	4.50 - 7.90	6.20	73.0	15.2	100	0
Potassium (K)	5/5	2,390 - 7,070	5,040	NA	NA	NA	NA
Sodium (Na)	5/5	4,590 - 922,000	199,000	NA	NA	NA	NA
Vanadium (V)	3/5	1.70 - 12.3	7.27	26.0	11.4	NA	0
Zinc (Zn)	3/5	5.50 - 58.0	25.4	1,100	27.3	NA	0
pH (SU)							
pH	5.5	1.82 - 6.72	4.67	NA	NA	NA	NA

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
NA = No RBC or MCL established
SU = Standard units

Table 10.8.4.4
SWMU 70 and AOCs 548 and 549
Inorganic Detections for First-Quarter Groundwater
Deep Monitoring Well

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (μg/L)							
Antimony (Sb)	1/1	115	115	1.50	NA	6.00	1
Arsenic (As)	1/1	12.5	12.5	0.0450	16.4	50.0	0

Table 10.8.4.4
SWMU 70 and AOCs 548 and 549
Inorganic Detections for First-Quarter Groundwater
Deep Monitoring Well

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Tap Water RBC	Reference Conc.	MCL	Number of Samples Exceeding RBC and RC
Inorganic Elements (μg/L)							
Barium (Ba)	1/1	17.9	17.9	260	218	2,000	0
Calcium (Ca)	1/1	68,900	68,900	NA	NA	NA	NA
Chromium (Cr)	1/1	52,500	52,500	18.0	15.5	100	1
Cyanide (CN)	1/1	4.40	4.40	73.0	37.3	200	0
Iron (Fe)	1/1	1,070	1,070	1,100	NA	NA	0
Magnesium (Mg)	1/1	14,300	14,300	NA	NA	NA	NA
Manganese (Mn)	1/1	220	220	84.0	869	NA	0
Nickel (Ni)	1/1	46.8	46.8	73.0	42.2	100	0
Potassium (K)	1/1	7,180	7,180	NA	NA	NA	NA
Sodium (Na)	1/1	80,300	80,300	NA	NA	NA	NA
Thallium (Tl)	1/1	9.50	9.50	0.290	NA	2.00	1
Vanadium (V)	1/1	5.00	5.00	26.0	5.3	NA	0
Zinc (Zn)	1/1	21.5	21.5	1,100	11.8	NA	0
pH (SU)							
pH	1/1	13.1	13.1	NA	NA	NA	NA

Notes:
μg/L = Micrograms per liter
RBC = Risk-based concentration
MCL = Maximum contaminant level
RC = Reference concentration
NA = No RBC, MCL, or RC established

Volatile Organic Compounds in Groundwater

Shallow Groundwater

Five VOCs were detected in shallow groundwater samples collected at SWMU 70 and AOC 549 (no shallow wells were installed at AOC 548). Four VOCs — benzene, chlorobenzene, 1,2-dichlorobenzene (total), and trichloroethene — exceeded their respective tap-water RBC. One VOC — trichloroethene — exceeded its drinking water MCL.

Benzene was detected in one of five samples at 2.00 μg/L. The sample from well NBCE549002 exceeded the benzene tap-water RBC of 0.360 μg/L. The sample did not exceed the benzene MCL of 5.00 μg/L.

Chlorobenzene was detected in one of five samples at 29.0 μg/L. The sample from well NBCE549001 exceeded the chlorobenzene tap-water RBC of 3.90 μg/L. No MCL has been established for chlorobenzene.

1,2-Dichloroethene (total) was detected in three of five samples with a range of 6.00 to 18.0 μg/L and a mean of 11.3 μg/L. Three samples from wells NBCE070001 (6 μg/L), NBCE549002 (10 μg/L), and NBCE549003 (18 μg/L) exceeded the 1,2-dichloroethene (total) tap-water RBC of 5.50 μg/L but were below the 1,2-dichloroethene (total) MCL of 70.0 μg/L.

Trichloroethene was detected in three of five samples with a range of 6.00 to 15.0 μg/L and a mean of 9.00 μg/L. Three samples from wells NBCE070001(15 μg/L), NBCE070002 (6 μg/L), and NBCE549003 (6 μg/L) exceeded the trichloroethene tap-water RBC of 1.60 μg/L. The samples also exceeded the trichloroethene MCL of 5.0 μg/L.

Deep Groundwater

Four VOCs were detected in the deep groundwater sample collected at SWMU 70 (no deep wells were installed at AOCs 548 and 549). All four VOCs — chloroform, 1,2-dichloroethene, tetrachloroethene, and trichloroethene — exceeded their respective tap-water RBCs. Two of the VOCs — tetrachloroethene and trichloroethene — also exceeded their respective MCLs.

Chloroform was detected in well NBCE07001D at 7.00 μg/L which exceeded the chloroform tap-water RBC of 0.150 μg/L. The sample did not exceed the chloroform MCL of 100 μg/L.

1,2-dichloroethene (total) was detected in well NBCE07001D at 10.0 μg/L, which exceeded the 1,2-dichloroethene tap-water RBC of 5.5 μg/L. The sample did not exceed the 1,2-dichloroethene (total) MCL of 70 μg/L.

Tetrachloroethene was detected in well NBCE07001D at 8.00 μg/L, which exceeded the tetrachloroethene tap-water RBC of 1.10 μg/L. The sample also exceeded the tetrachloroethene MCL of 5.0 μg/L.

Trichloroethene was detected in well NBCE07001D at 22.00 μg/L, which exceeded the trichloroethene tap-water RBC of 1.60 μg/L. The sample also exceeded the trichloroethene MCL of 5.0 μg/L.

Semivolatile Organic Compounds in Groundwater

Shallow Groundwater

Four SVOCs were detected in shallow groundwater samples collected at SWMU 70 and AOC 549. No SVOC exceeded its respective tap-water RBC. No MCLs have been established for the detected SVOCs.

Inorganic Elements in Groundwater

Shallow Groundwater

Seventeen metals were detected in shallow groundwater samples collected at SWMU 70 and AOC 549. Five metals — aluminum, antimony, cadmium, chromium, and iron — exceeded both their respective tap-water RBC and background shallow groundwater RC. Two metals — antimony and chromium — also exceeded their respective MCL.

Aluminum was detected in three of five samples with a range of 339 to 6,490 μg/L and a mean of 3,440 μg/L. One sample from well NBCE070002 (6,490 μg/L) exceeded both the aluminum tap-water RBC of 3,700 μg/L and shallow groundwater RC of 2,810 μg/L. No MCL has been established for aluminum.

Antimony was detected in two of five samples with a range of 7.70 to 24.2 μg/L and a mean of 16.0 μg/L. Two samples from wells NBCE070001 (24.2 μg/L) and NBCE549003 (7.7 μg/L) exceeded the antimony tap-water RBC of 1.50 μg/L. No shallow groundwater RC has been established for antimony; however, both samples exceeded the antimony MCL of 6.0 μg/L.

Cadmium was detected in two of five samples with a range of 1.70 to 3.50 μg/L and a mean of 2.60 μg/L. One sample from well NBCE070001 (3.5 μg/L) exceeded the cadmium tap-water RBC of 1.80 μg/L. No shallow groundwater RC has been established for cadmium, and neither sample exceeded the cadmium MCL of 5.0 μg/L.

Chromium was detected in three of five samples with a range of 440 to 7,350 μg/L and a mean of 3,210 μg/L. Three samples from wells NBCE070001 (7,350 μg/L), NBCE070002 (440 μg/L), and NBCE549003 (1,850 μg/L) exceeded both the chromium tap-water RBC of 18.0 μg/L and the shallow groundwater RC of 12.3 μg/L. All three samples also exceeded the chromium MCL of 100.0 μg/L.

Iron was detected in five of five samples with a range of 280 to 4,830 μg/L and a mean of 3,010 μg/L. Four samples from wells NBCE070001 (3,420 μg/L), NBCE070002 (4,760 μg/L), NBCE549001 (1,740 μg/L), and NBCE549002 (4,830 μg/L) exceeded the iron tap-water RBC of 1,100 μg/L. No shallow groundwater RC or MCL has been established for iron.

Deep Groundwater

Fifteen metals were detected in the deep groundwater sample collected at SWMU 70. Three metals — antimony, chromium, and thallium — exceeded their respective tap-water RBC, MCL, and background deep groundwater RC.

Antimony was detected in well NBCE07001D at 115 μg/L which exceeded the antimony tap-water RBC of 1.50 μg/L; no deep groundwater RC exists for antimony. The sample also exceeded the antimony MCL of 6.00 μg/L.

Chromium was detected in well NBCE07001D at 52,500 μg/L, which exceeded both the chromium tap-water RBC of 18.0 μg/L and deep groundwater RC of 15.5 μg/L. The sample also exceeded the chromium MCL of 100 μg/L.

Thallium was detected in well NBCE07001D at 9.50 μg/L which exceeded the thallium tap-water RBC of 0.290 μg/L; no deep groundwater RC exists for thallium. The sample also exceeded the thallium MCL of 2.00 μg/L.

pH in Groundwater

Shallow Groundwater

The five shallow groundwater samples were analyzed for pH. The pH ranged from 1.82 to 6.72 SU with a mean of 4.67 SU. No tap-water RBC or MCL has been established for pH in groundwater.

Deep Groundwater

The deep groundwater sample was analyzed for pH. The pH of the groundwater sample was 13.1 SU. No tap-water RBC or MCL has been established for pH in groundwater.

10.8.5 Fate and Transport Assessment for SWMU 70, and AOCs 548 and 549

Combined SWMU 70 comprises SWMU 70, a former dip tank at the northwest corner of Building 5, AOC 548, an electric hydraulic elevator located on the western side of Building 5, and AOC 549, a former scrap yard located north of Building 5. Currently this area is paved with concrete and asphalt. Environmental media sampled as part of the combined SWMU 70 RFI include surface soil, subsurface soil, and shallow and deep groundwater. Potential constituent migration pathways investigated for combined SWMU 70 include soil to groundwater, groundwater to surface water, and emission of volatiles from surface soil to air.

10.8.5.1 Soil-to-Groundwater Cross-Media Transport: Tier One

Table 10.8.5.1 compares maximum detected organic constituent concentrations in surface soil and subsurface soil samples to risk-based soil screening levels considered protective of groundwater. For inorganics, maximum concentrations in soil are compared to the greater of (a) risk-based soil screening levels, or (b) background reference concentrations. To provide a conservative screen, generic soil screening levels are used; leachate entering the aquifer is assumed to be diluted by a ratio of 10:1, with no attenuation of constituents in soil (DAF=10).

Three organic compounds — methylene chloride, benzo(b)fluoranthene, and delta-BHC — were detected in combined SWMU 70 soil at concentrations greater than groundwater protection SSLs. Methylene chloride was detected above its generic SSL in five surface soil samples and three subsurface soil samples. Benzo(b)fluoranthene, detected in 16 samples, exceeded its SSL in only one surface soil sample (549SB002). Delta-BHC was detected in three surface soil samples and one subsurface soil sample at concentrations greater than its SSL. None of these organic compounds were detected in groundwater through four quarters of groundwater sampling.

Five inorganics — cobalt, copper, lead, nickel, and tin — were detected in soil at concentrations above their respective groundwater protection SSLs or background reference values, and were carried over to the second-tier screen. Three of the five (excluding lead and tin) were also detected in groundwater, indicating a completed pathway from soil to groundwater. Of these three, copper and nickel were detected in groundwater at concentrations above their salt water surface water chronic screening levels. None of the five inorganics exceeding groundwater protection SSLs were detected in groundwater at concentrations above their tap water RBCs.

Cobalt and tin were detected in soil at concentrations more than an order of magnitude greater than their respective background reference values. Copper was detected in soil at a concentration more than two orders of magnitude greater than its background reference value. Cobalt concentrations exceeded its background reference value of 19 mg/kg in six surface soil samples. The maximum cobalt surface soil concentration was 196 mg/kg (549SB005), while the maximum subsurface soil concentration was 5.6 mg/kg (549SB012). Tin concentrations exceeded its background reference value of 59.4 mg/kg in only two surface soil samples (189 mg/kg in 549SB001 and 1,800 mg/kg in 549SB009). Copper detections were reported above its background reference value of 152 mg/kg in five surface soil samples (1,900 mg/kg in 549SB001, 342 mg/kg in 549SB008, 18,200 mg/kg in 549SB009, 255 mg/kg in 549SB010, and 1,320 mg/kg in 549SB012) and one subsurface soil sample (260 mg/kg in 549SB009). Although the generic SSL (assuming DAF=10) for hexavalent chromium is 19 mg/kg, it was not applied to the chromium site results for two reasons: (1) hexachrome was not detected in duplicate surface soil sample 070SB001, the only sample at combined SWMU 70 with a hexachrome analysis; and (2) for all of Zone E, hexachrome was detected in only four of 59 surface soil samples (maximum concentration of 0.586 mg/kg) and in zero of 27 subsurface soil samples in which it was analyzed. According to EPA guidance (*1996*

Soil Screening Guidance: Technical Background Document) included as Appendix A, trivalent chromium as a contaminant in soil is not considered a threat to groundwater at any concentration. Although chromium was reported in shallow and deep groundwater at concentrations greater than its groundwater screening values, it is not likely the result of soil to groundwater migration. Alternatively, groundwater chromium concentrations are potentially the result of plating and pickling operations releases from SWMU 70.

Of the two other inorganics detected above their SSLs, lead and nickel exceeded their screening levels in two surface soil samples each. All of the inorganic exceedances of SSLs and background reference values in soil occurred in the AOC 549 area, which was formerly used to store scrap metal.

10.8.5.2 Groundwater-to-Surface Water Cross-Media Transport: Tier One

Table 10.8.5.1 also compares maximum detected organic constituent concentrations in shallow groundwater samples to risk-based concentrations for drinking water, and to chronic ambient saltwater quality criteria values for the protection of aquatic life (saltwater surface water chronic screening values). For inorganics, maximum concentrations in groundwater are compared to the greater of (a) risk-based drinking water concentrations, or (b) background reference concentrations for groundwater, as well as to the saltwater/surface water chronic values. To provide a conservative first-tier screen, no attenuation or dilution of constituents in groundwater is assumed before comparison to the relevant standards.

Four organic compounds — benzene, chloroform, tetrachloroethene, and trichloroethene — were detected in groundwater at concentrations above tap water RBCs. None of these compounds was detected above saltwater surface water chronic screening levels. Trichloroethene has no listed surface water screening value. Benzene was detected in the first-round groundwater sample collected from monitoring well NBCE549001. Chloroform and tetrachloroethene were detected in the first round groundwater sample collected from monitoring well NBCE07001D. Trichloroethene was detected in first-round groundwater samples collected from monitoring wells NBCE070001, NBCE07001D, NBCE070002, and NBCE549003.

Three inorganics — antimony, chromium, and thallium — were detected in groundwater at concentrations exceeding their tap water RBCs in the first sampling round. Three inorganic constituents — chromium, copper and nickel — were detected in groundwater at concentrations above their saltwater/surface water chronic screening values. Chromium concentrations exceeded its surface water standard of 103 μg/L in four of six samples and exceeded its tap water RBC in one sample, with a maximum reported value of 52,500 μg/L in the first-round sample from deep well NBCE07001D. Antimony, thallium, and nickel all exceeded their corresponding groundwater screening levels in the same first round sample collected from well NBCE07001D. Antimony exceeded its tap water RBC in the first-round sample collected from well NBCE070001 and copper exceeded its salt water surface water chronic screening level in the first-round sample from well NBCE070002.

Elevated chromium concentrations were detected in first-round samples from three shallow wells and one deep well centered around SWMU 70:

NBCE070001:	7,350 μg/L
NBCE070002:	440 μg/L
NBCE549003:	1,850 μg/L
NBCE07001D:	52,500 μg/L

Samples from subsequent rounds confirm the first-round results but reveal a trend of gradually decreasing concentrations. Although SWMU 70 was the site of a dip vat used to treat wood, it is approximately 100 feet north of SWMU 25 (the former site of an electroplating operation) and approximately 150 feet northwest of SWMU 22 (the former site of the wastewater treatment system for the plating shop). Figure 2-6A, the potentiometric map for shallow wells, shows SWMU 70 to be roughly ongradient with SWMU 25 and downgradient from SWMU 22; Figure 2-6B, the potentiometric map for deep wells, shows SWMU 70 to be downgradient from both SWMU 25 and SWMU 22. First-round samples from shallow wells at SWMU 25 detected chromium concentrations as high as 843 μg/L; no deep wells were installed at the site. Solvent detections in groundwater samples from SWMU 70 may be related to past activities at combined SWMU 22.

Combined SWMU 70 is located on the northwest side of the groundwater flow divide referred to as anomaly A, as discussed in Section 2.3.2. All of the groundwater at the site apparently flows to the depression referred to as anomaly E, near the boundary of Zones C, D, and E. Possible fates for groundwater flowing to anomaly E are presented in Section 2.3.2.1.

10.8.5.3 Soil and Groundwater-to-Surface Water Transport: Tier Two

Table 10.8.5.2 provides a second screening tier for all constituents detected in soil or groundwater at concentrations exceeding any of the first-tier screening levels. Constituent concentrations in groundwater are compared to combined ecological/human health RBCs that have been adjusted upward for site-specific dilution by surface water in the Cooper River, while soil constituent concentrations are compared to calculated SSLs that are based on the adjusted RBCs rather than the original target leachate concentrations. For the second-tier screen, no dilution of leachate by groundwater or attenuation of constituents in soil is assumed (DAF=1).

Except for copper, no organic or inorganic constituents detected in soil or groundwater samples at combined SWMU 70 were detected at concentrations exceeding their corresponding adjusted SSLs or ecological/human health RBCs, indicating that most site constituents pose no threat to human health or the environment in the Cooper River through the associated migration pathway.

Copper was detected in a single surface soil sample at a concentration approximately 60% higher than its adjusted SSL. The maximum copper subsurface soil concentration was nearly two orders of magnitude below its adjusted SSL and the maximum copper concentration in groundwater was nearly five orders of magnitude lower than the adjusted ecological/human health RBC. These findings indicate that although the maximum surface soil copper concentrations indicate a potential impact to the Cooper River, current data do not support this migration pathway.

10.8.5.4 Soil-to-Air Cross-Media Transport

Table 10.8.5.3 lists the VOCs detected in surface soil samples collected at combined SWMU 70 along with corresponding soil-to-air volatilization screening levels. Little or no surface soil is exposed at combined SWMU 70. In addition, none of the VOCs was reported at a maximum concentration exceeding its corresponding soil-to-air volatilization screening level. As a result, the soil-to-air migration pathway is not expected to be significant at combined SWMU 70.

10.8.5.5 Fate and Transport Summary

Three organic and five inorganic constituents were detected at concentrations above their respective generic SSLs or background reference values. Three of the inorganics were also detected in groundwater samples, indicating completed migration pathways from soil to groundwater. Additionally, copper and nickel were detected in groundwater at concentrations exceeding their salt water surface water chronic screening levels.

Four VOCs — benzene, chloroform, tetrachloroethene, and trichloroethene — and five inorganics — antimony, chromium, copper, nickel, and thallium — were detected in first-round groundwater samples at concentrations exceeding their groundwater screening levels. Except for benzene, the exceedances identified in combined SWMU 70 groundwater were detected in samples collected from monitoring wells established in the SWMU 70 area (NBCE070001, NBCE07001D, NBCE070002, and 549SB003).

Except for copper, none of the constituents exceeding first-tier screening values for soil or groundwater exceeded the adjusted screening values of the second-tier comparisons, indicating that most site constituents present no threat to surface water in the Cooper River via the evaluated migration pathways. Copper was reported in a single surface soil sample at a concentration above its second-tier adjusted SSL; however, its concentration in subsurface soil was nearly two orders of magnitude lower than the adjusted SSL and its concentration in surface soil was nearly five orders of magnitude lower that its adjusted ecological/human health groundwater RBC.

Table 10.8.5.1
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, and Deep Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMU 70 and AOCs 548 and 549
Charleston, South Carolina

	Max. Concentration		Max. Concentration		Screening Concentration *						Ground-	Surface
					Soil to		Salt Wtr.				Water	Water
	Surface	Subsurface	Shallow	Deep	GW	Tap Water	Surf. Wtr.	Soil	Water	Leaching	Migration	Migration
Parameter	Soil	Soil	GW	GW	SSL	RBC	Chronic	Units	Units	Potential	Concern	Concern
Volatile Organic Compounds												
Acetone	ND	14	ND	ND	8000	3700	NA	UG/KG	UG/L	NO	NO	NO
Benzene	ND	ND	2	ND	15	0.36	109	UG/KG	UG/L	NO	YES	NO
Carbon disulfide	ND	2	ND	ND	16000	1000	NA	UG/KG	UG/L	NO	NO	NO
Chlorobenzene	ND	ND	29	ND	350	39	105	UG/KG	UG/L	NO	NO	NO
Chloroform	ND	ND	ND	7	300	0.15	815	UG/KG	UG/L	NO	YES	NO
1,2-Dichloroethene (total)	ND	ND	18	10	200	55	NA	UG/KG	UG/L	NO	NO	NO
Methylene chloride	14	14	ND	ND	10	4.1	2560	UG/KG	UG/L	YES	NO	NO
Tetrachloroethene	ND	ND	ND	8	30	1.1	45	UG/KG	UG/L	NO	YES	NO
Toluene	3	2	ND	ND	6000	750	37	UG/KG	UG/L	NO	NO	NO
Trichloroethene	ND	ND	15	22	30	1.6	NA	UG/KG	UG/L	NO	YES	NO
Vinyl acetate	ND	5	ND	ND	85000	37000	NA	UG/KG	UG/L	NO	NO	NO
Xylene (total)	4	3	2	ND	71000	12000	NA	UG/KG	UG/L	NO	NO	NO
Semivolatile Organic Compounds												
Anthracene	78	76	ND	ND	5900000	11000	NA	UG/KG	UG/L	NO	NO	NO
Benzoic acid	ND	60	4	ND	200000	150000	NA	UG/KG	UG/L	NO	NO	NO
Benzo(g,h,i)perylene	2900	210	ND	ND	2.33E+08	1500	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene equivalents												
Benzo(a)anthracene	560	380	ND	ND	800	0.092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(a)pyrene	3100	480	ND	ND	4000	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Benzo(b)fluoranthene	4900	480	ND	ND	2500	0.092	NA	UG/KG	UG/L	YES	NO	NO
Benzo(k)fluoranthene	2800	310	ND	ND	24500	0.92	NA	UG/KG	UG/L	NO	NO	NO
Chrysene	2200	380	ND	ND	80000	9.2	NA	UG/KG	UG/L	NO	NO	NO
Dibenzo(a,h)anthracene	790	62	ND	ND	800	0.0092	NA	UG/KG	UG/L	NO	NO	NO
Indeno(1,2,3-cd)pyrene	2000	230	ND	ND	7000	0.092	NA	UG/KG	UG/L	NO	NO	NO
2-Chlorophenol	68	ND	ND	ND	2000	180	NA	UG/KG	UG/L	NO	NO	NO
Dibenzofuran	44	ND	ND	ND	NA	150	NA	UG/KG	UG/L	NO	NO	NO
Di-n-butylphthalate	ND	46	2	ND	2300000	3700	3.4	UG/KG	UG/L	NO	NO	NO
Diethylphthalate	ND	110	ND	ND	235000	29000	75.9	UG/KG	UG/L	NO	NO	NO
Di-n-octylphthalate	57	ND	ND	ND	10000000	730	NA	UG/KG	UG/L	NO	NO	NO
bis(2-Ethylhexyl)phthalate (BEHP)	82	66	1	ND	1800000	4.8	NA	UG/KG	UG/L	NO	NO	NO
Fluoranthene	720	590	ND	ND	2150000	1500	1.6	UG/KG	UG/L	NO	NO	NO
2-Methylnaphthalene	ND	110	ND	ND	63000	1500	NA	UG/KG	UG/L	NO	NO	NO
Naphthalene	ND	88	3	ND	42000	1500	23.5	UG/KG	UG/L	NO	NO	NO
Phenanthrene	400	380	ND	ND	690000	1500	NA	UG/KG	UG/L	NO	NO	NO
Pyrene	4600	580	ND	ND	2100000	1100	NA	UG/KG	UG/L	NO	NO	NO
Pesticides/PCB Compounds												
Aroclor-1260	68	ND	ND	ND	1000	0.0087	0.03	UG/KG	UG/L	NO	NO	NO
delta-BHC	4.8	4	ND	ND	1.5	0.037	NA	UG/KG	UG/L	YES	NO	NO
alpha-Chlordane	5.4	ND	ND	ND	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
gamma-Chlordane	4.9	ND	ND	ND	5000	0.052	0.004	UG/KG	UG/L	NO	NO	NO
4,4'-DDE	49	14	ND	ND	27000	0.2	0.14	UG/KG	UG/L	NO	NO	NO
4,4'-DDT	40	ND	ND	ND	16000	0.2	0.001	UG/KG	UG/L	NO	NO	NO
Endosulfan II	3.9	ND	ND	ND	9000	220	0.0087	UG/KG	UG/L	NO	NO	NO
Endrin	18	ND	ND	ND	500	11	0.0023	UG/KG	UG/L	NO	NO	NO
Endrin aldehyde	5.5	4.2	ND	ND	500	11	NA	UG/KG	UG/L	NO	NO	NO
Heptachlor epoxide	1.7	ND	ND	ND	350	0.0012	0.0036	UG/KG	UG/L	NO	NO	NO
Methoxychlor	ND	36	ND	ND	80000	180	0.03	UG/KG	UG/L	NO	NO	NO
Dioxin Compounds												
Dioxin (TCDD TEQ)	0.103	ND	NA	NA	950	0.43	10	NG/KG	PG/L	NO	NO	NO
Inorganic Compounds												
Aluminum	10700	9780	6490	ND	41100	37000	NA	MG/KG	UG/L	NO	NO	NO
Antimony	2.5	0.48	24.2	115	2.5	15	NA	MG/KG	UG/L	NO	YES	NO

Table 10.8.5.1
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, and Deep Groundwater
Comparison to SSLs, Tap Water RBCs, Salt Water Surface Water Chronic Screening Levels, and Background Concentrations: Tier One
NAVBASE-Charleston, Zone E: SWMU 70 and AOCs 548 and 549
Charleston, South Carolina

Parameter	Max. Concentration Surface Soil	Max. Concentration Subsurface Soil	Max. Concentration Shallow GW	Max. Concentration Deep GW	Screening Concentration * Soil to GW SSL	Screening Concentration * Tap Water RBC	Screening Concentration * Salt Wtr. Surf. Wtr. Chronic	Soil Units	Water Units	Leaching Potential	Ground-Water Migration Concern	Surface Water Migration Concern
Arsenic	12.6	16.8	7.9	12.5	23.9	18.7	36	MG/KG	UG/L	NO	NO	NO
Barium	46.5	47.2	30.7	17.9	820	2600	NA	MG/KG	UG/L	NO	NO	NO
Beryllium	0.39	0.41	ND	ND	32	1.2	NA	MG/KG	UG/L	NO	NO	NO
Cadmium	1.8	0.48	3.5	ND	4	18	9.3	MG/KG	UG/L	NO	NO	NO
Chromium (total)	31.4	12.1	7350	52500	94.6	37000	103	MG/KG	UG/L	NO	YES	YES
Cobalt	196	5.6	2.4	ND	19	2200	NA	MG/KG	UG/L	YES	NO	NO
Copper	18200	260	4.4	ND	152	1500	2.9	MG/KG	UG/L	YES	NO	YES
Cyanide	ND	ND	ND	4.4	20	730	37.3	MG/KG	UG/L	NO	NO	NO
Lead	1620	178	ND	ND	400	15	8.5	MG/KG	UG/L	YES	NO	NO
Manganese	102	86.7	64.1	220	881	2560	NA	MG/KG	UG/L	NO	NO	NO
Mercury	0.78	0.87	ND	ND	2.6	11	0.2	MG/KG	UG/L	NO	NO	NO
Nickel	112	35.1	7.9	46.8	77.1	730	42.2	MG/KG	UG/L	YES	NO	YES
Selenium	0.73	0.42	ND	ND	2.5	180	71	MG/KG	UG/L	NO	NO	NO
Silver	3.8	ND	ND	ND	17	180	0.23	MG/KG	UG/L	NO	NO	NO
Thallium	ND	ND	ND	9.5	2.8	2.9	21.3	MG/KG	UG/L	NO	YES	NO
Tin	1800	7	ND	ND	59.4	22000	NA	MG/KG	UG/L	YES	NO	NO
Vanadium	12.3	18.7	12.3	5	3000	260	NA	MG/KG	UG/L	NO	NO	NO
Zinc	591	173	58	21.5	6000	11000	86	MG/KG	UG/L	NO	NO	NO

* Screening Concentrations:
Soil to GW - Generic SSLs based on DAF = 10, adapted from 1996 EPA Soil Screening Guidance or calculated using values from Table 6.2
Tap Water RBC - From EPA Region III Risk-Based Concentration Table, June 3, 1996
Salt Water Surface Water Chronic - From EPA Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment, November, 1995; Table 2
In each case, the value shown is the greater of the relevant screening value or the corresponding background reference value

Units: See notes for Table 10.1.5.1

Table 10.8.5.2
Chemicals Detected in Surface Soil, Subsurface Soil, Shallow Groundwater, or Deep Groundwater at Concentrations Exceeding any Initial Screening Concentration
Comparison to Combined Ecological/Human Health RBCs Adjusted for Surface Water Dilution, and to SSLs Based on Adjusted Ecological/Human Health RBCs: Tier Two
NAVBASE-Charleston, Zone E: SWMU 70 and AOCs 548 and 549
Charleston, South Carolina

	Max. Concentration		Max. Concentration		Initial Screening Concentration *			Adjusted Screening Concentrations #					Units		Screening Results	
Parameter	Surface Soil	Subsurface Soil	Shallow GW	Deep GW	Soil to GW SSL	Tap Water RBC	Salt Wtr. Surf. Wtr. Chronic	Combined Eco/HH Surf. Wtr. RBC	Adjusted Eco/HH GW RBC	Target Leachate Conc. (DAF=1)	SSL Multi-plier	Adjusted SSL (DAF=1)	Soil Units	Water Units	Leaching Potential	Surface Water Migration Concern
Volatile Organic Compounds																
Benzene	ND	ND	2	ND	15	0.36	109	0.36	3.96E+04	5	7.92E+03	1.19E+04	UG/KG	UG/L	NO	NO
Chloroform	ND	ND	ND	7	300	0.15	815	0.15	1.65E+04	100	1.65E+02	4.95E+03	UG/KG	UG/L	NO	NO
Methylene chloride	14	14	ND	ND	10	4.1	2560	4.1	4.51E+05	5	9.02E+04	9.02E+04	UG/KG	UG/L	NO	NO
Tetrachloroethene	ND	ND	ND	8	30	1.1	45	1.1	1.21E+05	5	2.42E+04	7.26E+04	UG/KG	UG/L	NO	NO
Trichloroethene	ND	ND	15	22	30	1.6	NA	1.6	1.76E+05	5	3.52E+04	1.06E+05	UG/KG	UG/L	NO	NO
Semivolatile Organic Compounds																
Benzo(a)pyrene equivalents																
Benzo(b)fluoranthene	4900	480	ND	ND	2500	0.092	NA	0.092	1.01E+04	0.1	1.01E+05	1.04E+07	UG/KG	UG/L	NO	NO
Pesticides/PCB Compounds																
delta-BHC	4.8	4	ND	ND	1.5	0.037	NA	0.037	4.07E+03	0.05	8.14E+04	1.22E+04	UG/KG	UG/L	NO	NO
Inorganic Compounds																
Antimony	2.5	0.48	24.2	115	2.5	15	NA	15	1.65E+06	6	2.75E+05	6.88E+04	MG/KG	UG/L	NO	NO
Chromium (total)	31.4	12.1	7350	52500	19	180	50	50	5.50E+06	100	5.50E+04	1.05E+05	MG/KG	UG/L	NO	NO
Cobalt	196	5.6	2.4	ND	1040	2200	NA	2200	2.42E+08	2200	1.10E+05	1.00E+06	MG/KG	UG/L	NO	NO
Copper	18200	260	4.4	ND	458	1500	2.9	2.9	3.19E+05	1300	2.45E+02	1.12E+04	MG/KG	UG/L	YES	NO
Lead	1620	178	ND	ND	400	15	8.5	8.5	9.35E+05	15	6.23E+04	1.00E+06	MG/KG	UG/L	NO	NO
Nickel	112	35.1	7.9	46.8	65	730	42.2	42.2	4.64E+06	100	4.64E+04	3.02E+05	MG/KG	UG/L	NO	NO
Thallium	ND	ND	ND	9.5	0.36	2.9	21.3	2.9	3.19E+05	2	1.60E+05	5.74E+03	MG/KG	UG/L	NO	NO
Tin	1800	7	ND	ND	55000	22000	NA	22000	2.42E+09	22000	1.10E+05	1.00E+06	MG/KG	UG/L	NO	NO

* Initial Screening Concentrations: See notes for Table 10.1.5.2
In this table, the screening values shown are not adjusted for background reference values.

\# Adjusted Screening Concentrations: See notes for Table 10.1.5.2
Adjusted Eco/HH Groundwater RBC - Combined Eco/HH Surface Water RBCs multiplied by site-specific surface water dilution factor of 110,000: GW concentrations protective of surface water

Units: See notes for Table 10.1.5.2

Table 10.8.5.3
Soil-to-Air Volatilization Screening Analysis
NAVBASE-Charleston, Zone E: SWMU 70 and AOCs 548 and 549
Charleston, South Carolina

VOCs	Maximum Concentration in Surface Soil	Soil to Air SSL*	Units	Exceeds SSL
Methylene chloride	14	7000	UG/KG	NO
Toluene	3	520000	UG/KG	NO
Xylene (total)	4	320000	UG/KG	NO

* - Soil screening levels for transfers from soil to air were obtained from USEPA Region III Risk-Based Concentration Table, June 1996.

10.8.6 Fixed-Point Risk Evaluation for SWMU 70, and AOC 548, and AOC 549

10.8.6.1 Site Background and Investigative Approach

SWMU 70 is a former dip tank that was located at the northwest corner of Building 5. AOC 548 is a hydraulic elevator located in Building 5 and AOC 549 is a former scrap yard located to the north of Building 5. The following refers to these sites as combined SWMU 70. All are located in a highly industrialized portion of Zone E. As a result, the risk assessment for this site is presented as a FRE following the framework presented in Section 7.3. Due to their proximity, the investigational effort for these sites was combined. As a result, the risk evaluation will combine the environmental data from all three sites.

A total of 22 surface soil samples, collected as part of the 1995 RFI, were considered in the combined SWMU 70 FRE. Five shallow monitoring wells and one deep monitoring well were installed as part of the 1995 RFI. Groundwater data generated from the first-quarter sampling event are used to represent point risk/hazard for the combined SWMU 70 FRE. Sections 10.8.1 and 10.8.3 contain summaries of the sampling effort for combined SWMU 70.

10.8.6.2 Fixed-Point Risk Evaluation for Soil

Residential Scenario

Table 10.8.6.1 provides CPSS summaries for combined SWMU 70 soil and identifies COPCs based on comparison to residential and industrial RBCs and background RCs. Based on residential RBCs, three COPCs (BEQs, copper, and lead) were identified for combined SWMU 70 soil. Aluminum, arsenic and beryllium were detected in combined SWMU 70 soil at concentrations above their RBCs but were eliminated from consideration in the residential FRE based on comparison to their background concentrations. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration.

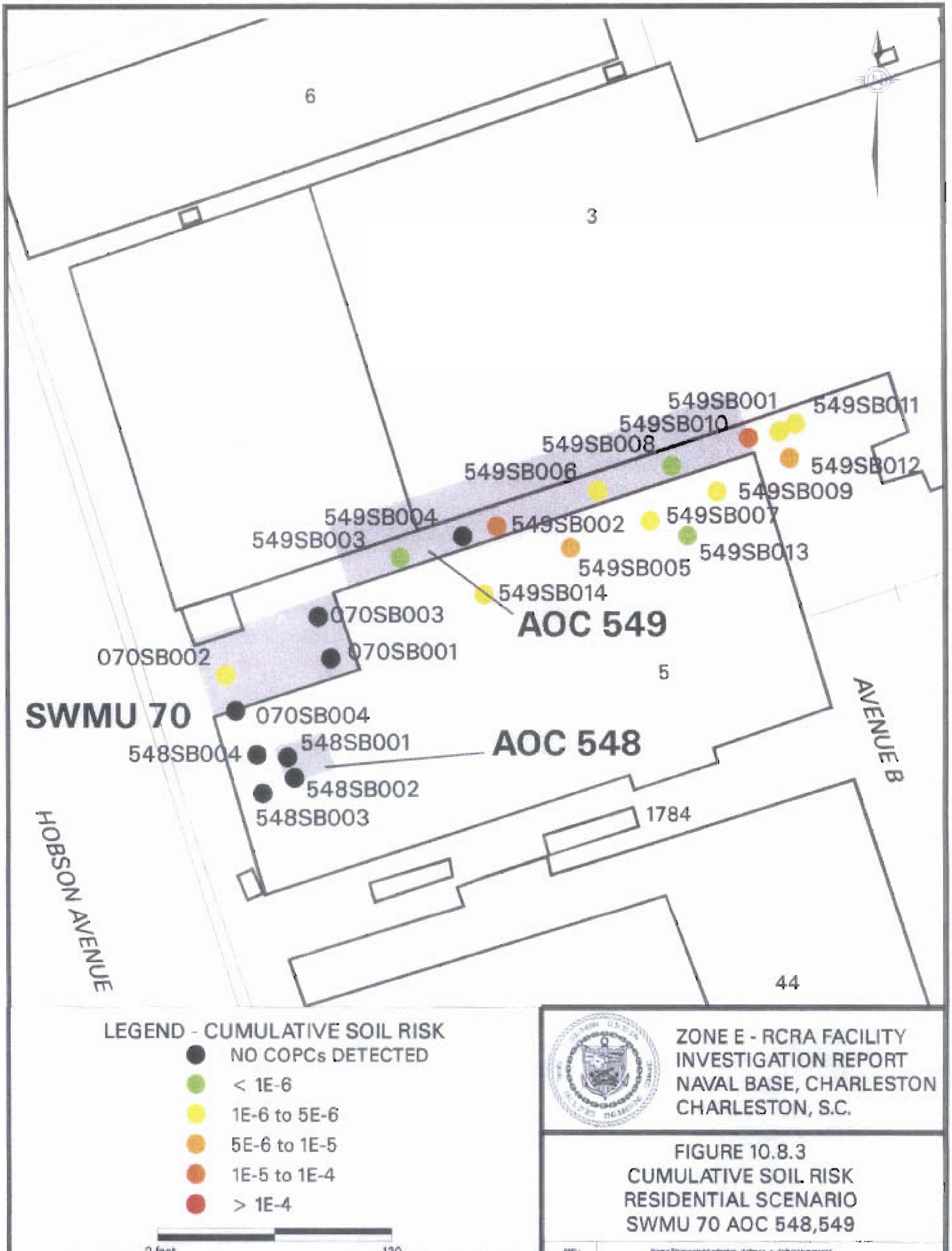
Table 10.8.6.2 summarizes the residential COPCs detected at each combined SWMU 70 sample location with contribution to risk and hazard. As shown, BEQ compounds contribute to risk estimates for combined SWMU 70, exceeding 1E-06 at 11 of 22 locations. No carcinogenic COPC were detected at sample locations 070SB001, 070SB003, 070SB004, 548SB001, 548SB002, 548SB003, 548SB004, and 549SB004. Figure 10.8.3 is a spatial presentation of residential risk estimates for combined SWMU 70 soil. For samples with concentrations of carcinogenic COPCs, risk estimates range from 9E-09 to 8E-05 with an arithmetic mean risk of 6E-06. The arithmetic mean was calculated assuming a deminimus risk level of 1E-07 for locations where no carcinogenic COPC were detected.

HI projections exceeded the threshold of unity at one sample location (549SB009) due to copper detected in the associated soil sample. HI estimates range from 0.0003 to 6 with an arithmetic mean HI of 0.4. Figure 10.8.4 is a spatial presentation of residential HI estimates for combined SWMU 70 soil.

Industrial Scenario

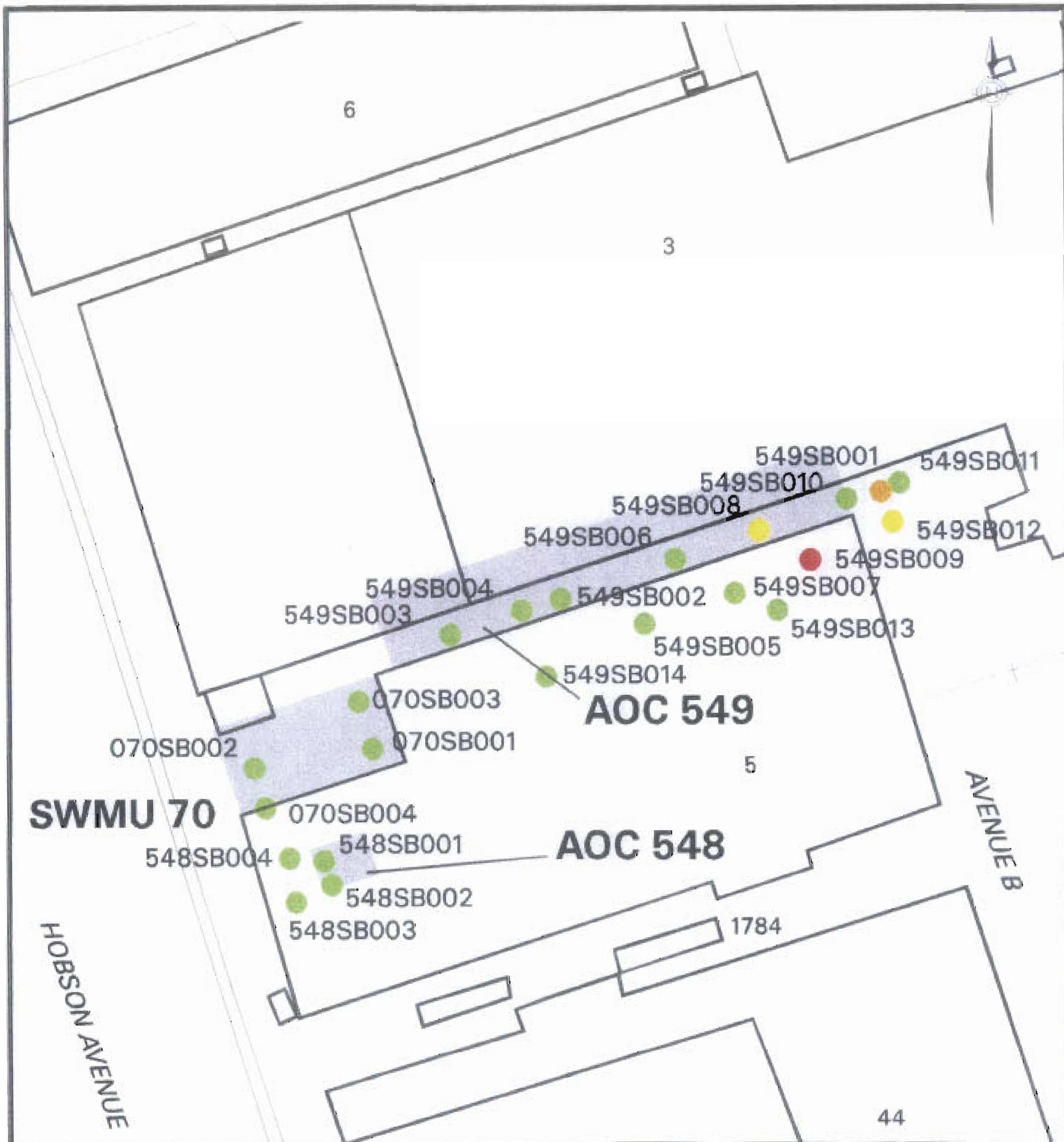
Based on industrial RBCs, BEQs, copper, and lead were identified as COPCs for combined SWMU 70 soil. Arsenic was detected in combined SWMU 70 soil at concentrations above its industrial RBC but was eliminated from consideration in the industrial FRE based on comparison to its background concentration. Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration.

Table 10.8.6.3 summarizes the industrial COPCs detected at each combined SWMU 70 sample location with contribution to risk and hazard. As shown, BEQs are the contributors to risk for combined SWMU 65, exceeding 1E-06 at four of 22 locations based on the industrial scenario. No carcinogenic COPCs were detected in eight of the surface soil samples (same as the residential



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

FIGURE 10.8.3
CUMULATIVE SOIL RISK
RESIDENTIAL SCENARIO
SWMU 70 AOC 548,549



LEGEND - CUMULATIVE SOIL HAZARD

- NO COPCs DETECTED
- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

0 feet 120

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NAVAL BASE, CHARLESTON
CHARLESTON, S.C.

FIGURE 10.8.4
CUMULATIVE SOIL HAZARD
RESIDENTIAL SCENARIO
SWMU 70 AOC 548,549

scenario). Figure 10.8.5 is a spatial presentation of industrial scenario risk estimates for combined SWMU 70 surface soil. For the samples with concentrations of carcinogenic COPCs, risk estimates range from 2E-09 to 2E-05 with an arithmetic mean risk of 1E-06, assuming a deminimus risk of 1E-07 for sample locations where no carcinogenic COPCs were detected.

HI projections did not exceed the threshold of unity at any sample locations based on the industrial scenario. For sample with concentrations of COPCs contributing to HI estimates, the range was from 0.00001 to 0.3.

Lead

Lead was detected in all 22 surface soil samples collected at combined SWMU 70. Soil concentrations ranged from 4.9 to 1,620 mg/kg and exceeded the residential clean up level of 400 mg/kg in 2 of 22 samples and exceeds the industrial cleanup level of 1,300 mg/kg in 1 of 22 samples. The mean detected lead concentration for combined SWMU 70 is 162.7 mg/kg which does not exceed either the action level of 400 mg/kg, considered protective of children under a residential scenario, or the industrial cleanup level of 1,300 mg/kg, considered protective of adults under an industrial scenario. Figure 10.8.6 is a spatial presentation of lead soil concentrations, using the surface soil background concentration of 265 mg/kg, the residential soil lead cleanup level of 400 mg/kg, and the industrial soil lead cleanup concentration of 1,300 mg/kg as benchmark levels to illustrate the lead soil concentrations for combined SWMU 70.

10.8.6.3 Fixed-Point Risk Evaluation for Groundwater

Residential Scenario

Table 10.8.6.4 provides separate CPSS summaries for combined SWMU 70 shallow and deep groundwater and identifies COPCs. Antimony, chloroform, chromium, 1,2-dichloroethene (total), tetrachloroethene, thallium, and trichloroethene were identified as COPCs in deep groundwater;

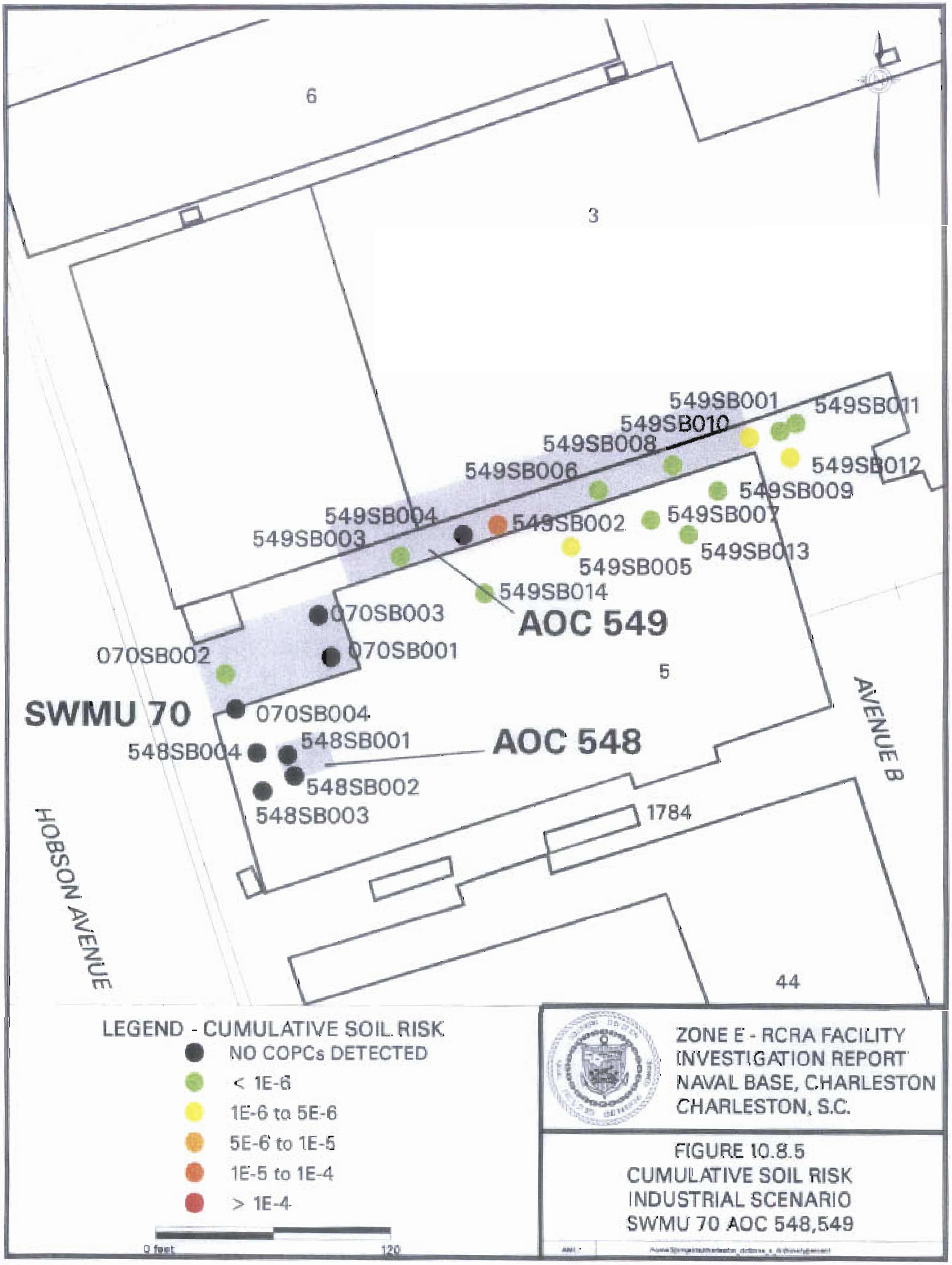

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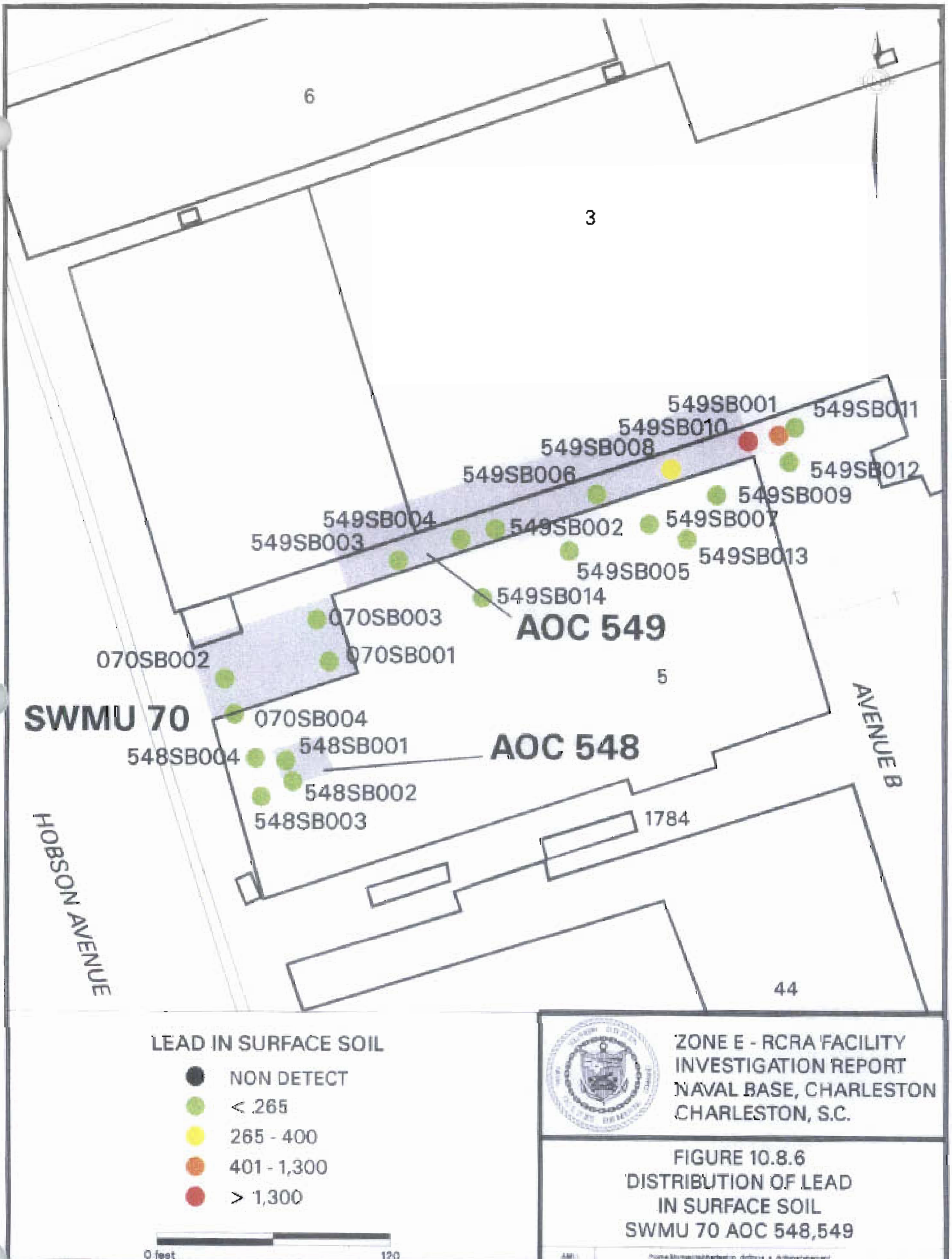
FIGURE 10.8.5
CUMULATIVE SOIL RISK
INDUSTRIAL SCENARIO
SWMU 70 AOC 548,549



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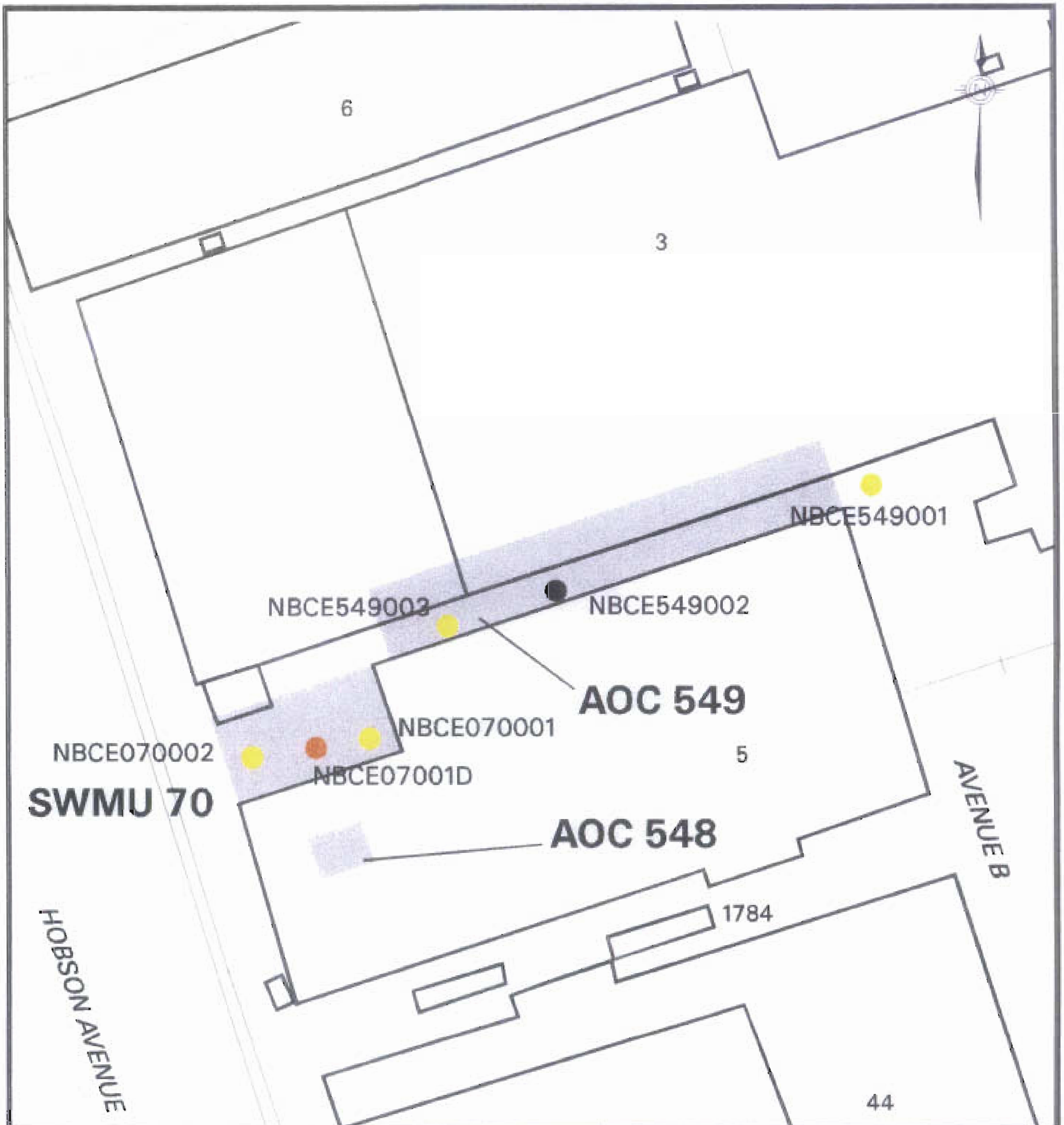
CHARLESTON, S.C.

FIGURE 10.8.6
DISTRIBUTION OF LEAD IN SURFACE SOIL
SWMU 70 AOC 548,549

aluminum, antimony, benzene, cadmium, chromium, chlorobenzene, 1,2-dichloroethene (total), and trichloroethene, were identified as COPCs in shallow groundwater based on comparison of first-quarter groundwater concentrations to tap water RBCs and background RCs. Arsenic and manganese were detected in combined SWMU 70 deep groundwater at concentrations above their RBCs and arsenic was detected in shallow groundwater above its RBC. Each was eliminated from consideration in the FRE based on comparison to background concentrations. For shallow groundwater, Wilcoxon rank sum test analyses did not result in the inclusion of any parameter that had been screened out based on background concentration. Combined SWMU 70 deep groundwater data were not sufficient to perform Wilcoxon rank sum test analyses, and as a result, arsenic and manganese were eliminated from the deep groundwater FRE based on comparison of their maximum concentrations with their background RCs.

Table 10.8.6.5 summarizes the COPCs identified in combined SWMU 70 shallow and deep monitoring wells sampled during the first quarter. As shown, concentrations of benzene, chloroform, tetrachloroethene, and trichloroethene contribute to risk estimates above 1E-06 in five of the six first-quarter groundwater samples. Concentration of trichloroethene were associated with risk estimates above 1E-06 based on groundwater samples collected from four of the six monitoring wells including the deep monitoring well (NBCE07001D). Chloroform and tetrachloroethene were also associated with risk estimates above 1E-06 based on the groundwater sample collected from the deep monitoring well. Benzene was associated with risk estimates above 1E-06 based on the groundwater sample collected from monitoring well NBCE549001. No carcinogenic COPCs were identified in first-quarter groundwater samples collected from monitoring well NBCE549002. Risk estimates ranged from 2E-06 to 2E-05 for first-quarter groundwater sample with concentrations of carcinogenic COPCs. The arithmetic mean risk is 5E-06, assuming a deminimus risk of 1E-07 for the groundwater sample with no carcinogenic COPCs. Figure 10.8.7 is a spatial presentation of risk estimates for combined SWMU 70 groundwater.



LEGEND - CUMULATIVE GROUNDWATER RISK

- NO COPCs DETECTED
- < 1E-6
- 1E-6 to 5E-6
- 5E-6 to 1E-5
- 1E-5 to 1E-4
- > 1E-4

0 feet 120

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FIGURE 10.8.7
CUMULATIVE GROUNDWATER RISK IN WELLS
SWMU 70 AOC 548,549

Concentrations of aluminum, antimony, cadmium, chromium, 1,2-dichloroethene (total), tetrachloroethene, thallium, and trichloroethene are associated with cumulative HI estimates above unity in four of the six monitoring wells (NBCE07001D, NBCE070001, NBCE070002, and NBCE549003). Concentrations of chromium (assumed to be hexavalent) is the primary contributor to HI estimates, contributing approximately 90 percent of the cumulative HI estimate at each location. The HIs range from 0.1 to 698, with a mean HI of 138. Figure 10.8.8 is a spatial presentation of HI estimates for combined SWMU 70 groundwater.

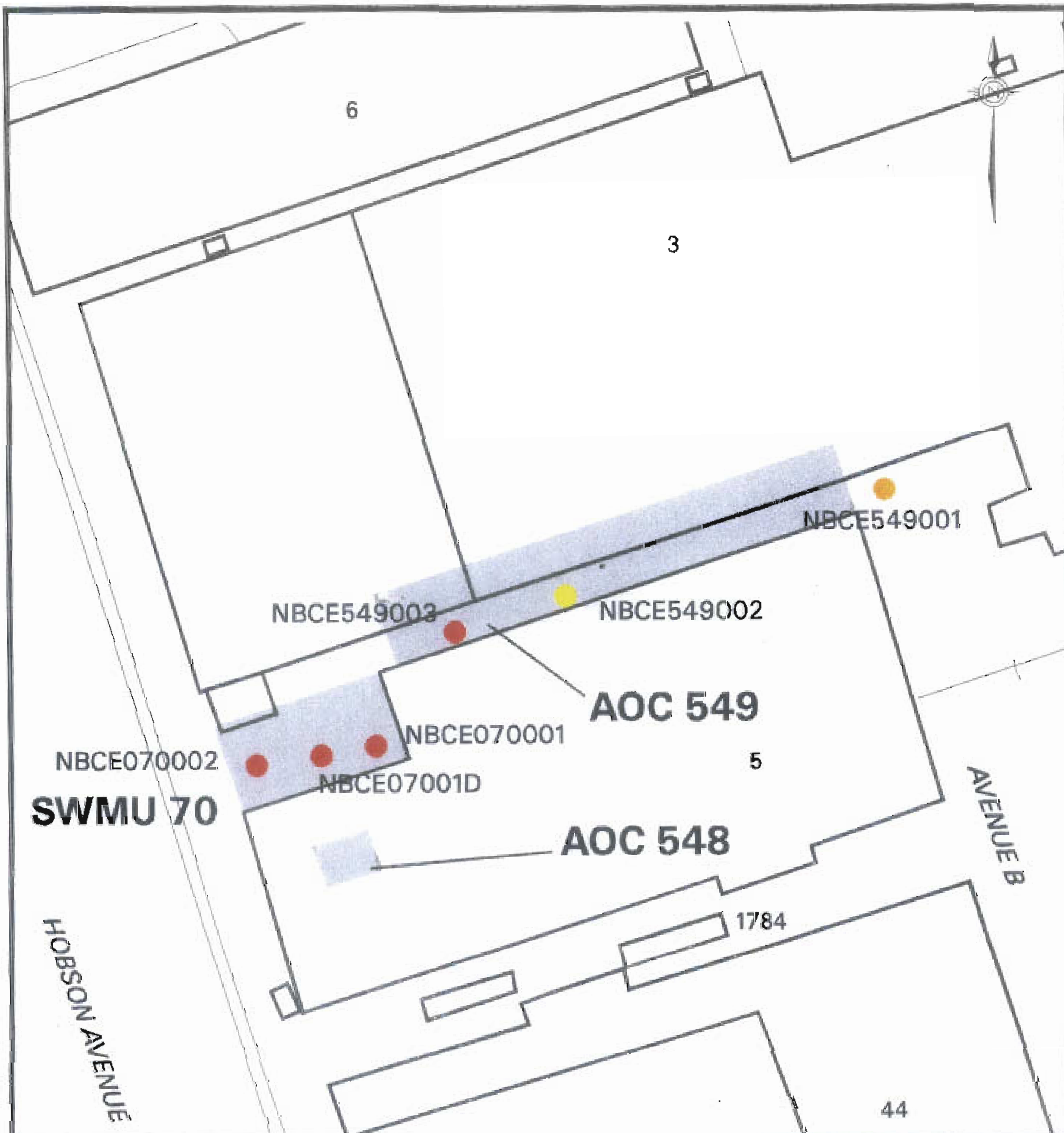
10.8.6.4 Uncertainty

SWMU 70 uncertainty issues specific to the FRE and essential to the risk management process are presented in the following paragraphs.

Characterization of Exposure Setting and Identification of Exposure Pathways

The potential for high bias is introduced through the exposure setting and pathway selection due to the highly conservative assumptions (i.e., future residential use) recommended by USEPA Region IV when assessing potential future and current exposure. The exposure assumptions made in the site worker scenario are highly protective and would tend to overestimate exposure.

Residential use of the site would not be expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use of Zone E, specifically as a marine cargo terminal and drydocking facility. The ground surface around SWMUs 70 and AOCs 548 and 549 is currently covered with either asphalt or concrete. As a result, chronic exposure to current soil condition is highly unlikely and the associated direct contact exposure pathways evaluations overestimate risk and hazard. If this area were to be redeveloped, the buildings and other structures would be demolished, and the surface soil conditions would likely change — the soils could be covered with landscaping soil and/or a house. Consequently, chronic exposure to current surface soil conditions would not be likely under any



LEGEND - CUMULATIVE GROUNDWATER HAZARD

- NO COPCs DETECTED
- 0 to 0.1
- 0.1 to 0.5
- 0.5 to 1.0
- 1.0 to 3.0
- > 3.0

0 feet 120

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

FIGURE 10.8.8
CUMULATIVE GROUNDWATER HAZARD IN WELLS
SWMU 70 AOC 548,549

future use scenario. These factors indicate that exposure pathways assessed in this FRE would generally overestimate the risk and hazard posed to current/future site workers and future site residents.

Groundwater is not currently used as a potable water source at combined SWMU 70, nor is it used at NAVBASE or in the surrounding area. Municipal water is readily available. As previously mentioned, it is highly unlikely that the site will be developed as a residential area, and it is unlikely that a potable-use well would be installed onsite. It is probable that, if residences were constructed onsite and an unfiltered well were installed, the salinity and dissolved solids would preclude this aquifer from being an acceptable potable water source.

Quantification of Risk/Hazard

Soil

A conservative screening process was used to identify COPCs for combined SWMU 70. The potential for eliminating CPSSs with the potential for cumulative HI greater than one was addressed for noncarcinogens through the use of RBCs that were reduced one order of magnitude. For carcinogens the RBCs are based on a conservative target risk of 1E-06. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment based on comparison to RBCs, none was reported at a concentration close to its RBC (e.g. within 10% of its RBC). Aluminum, arsenic, and beryllium were present in combined SWMU 70 soil at concentrations above RBC benchmarks and were eliminated from consideration in the FRE based on comparison to their background concentrations. As a result, their contribution to soil pathway risk and hazard has not been considered in this FRE.

Groundwater

The same conservative screening process used for soil was also applied to groundwater. Use of conservative RBCs in combination with the use of maximum detected concentrations for comparison minimizes the likelihood of a significant contribution to risk/hazard based on eliminated CPSSs. Of the CPSSs screened and eliminated from formal assessment, none was reported at concentrations close to its RBC (e.g. within 10% of its RBC). Arsenic and manganese were present in combined SWMU 70 groundwater at concentrations above RBC benchmarks and were eliminated from consideration in the FRE based on comparison to their background concentrations. As a result, their contribution to groundwater pathway risk and hazard has not been considered in this FRE.

10.8.6.5 FRE Summary

The risk and hazard posed by contaminants at combined SWMU 70 were assessed for the future site worker and the future site resident as sample point-specific estimates. In surface soils, the incidental ingestion and dermal contact pathways are reflected. The groundwater FRE was based on first-quarter data and considers the ingestion and inhalation (VOCs only) pathways. Risk and HI estimates are presented on Tables 10.8.6.2, 10.8.6.3, and 10.8.6.5 such that a risk (E-06) or HI that exceed one for any COPC at any given sample location is an indication that the concentration of that COPC exceeds its RGO. Section 7, Tables 7.3.1, 7.3.2, and 7.3.3 provide residential, industrial, and residential groundwater RGOs, respectively, for all of the COPCs identified for Zone E.

Soil — Residential Scenario

BEQ compounds and copper were detected in combined SWMU 70 surface soil at concentrations above their residential RGOs.

Soil — Site Worker Scenario

BEQ compounds were detected in combined SWMU 70 surface soil at concentrations above their industrial RGO.

Groundwater — Residential Scenario

Antimony, benzene, chloroform, chromium, thallium, tetrachloroethene, and trichloroethene were above their RGOs in combined SWMU 70 shallow and deep groundwater. Similar chromium impacts to groundwater were seen at SWMU 25 which adjoins SWMU 70 to the south, suggesting a localized chromium plume in this area.

Table 10.8.6.1
Chemicals Present in Site Samples
SWMU 70; AOC 548, 549 - Surface Soil
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration Residential RBC	Screening Concentration Industrial RBC	Screening Concentration Reference	Units	Number Exceeding Res. RBC	Number Exceeding Ind. RBC	Number Exceeding Ref.
Carcinogenic PAHs													
B(a)P Equiv.	* *	14	22	0.52 - 4666.2	538.87	808.85 - 855.07	88	780	NA	UG/KG	11	2	
Benzo(a)anthracene		13	22	41 - 560	188.15	350 - 420	880	7800	NA	UG/KG			
Benzo(a)pyrene	* *	12	22	41 - 3100	433.75	350 - 420	88	780	NA	UG/KG	9	1	
Benzo(b)fluoranthene	*	10	22	64 - 4900	668.00	350 - 420	880	7800	NA	UG/KG	1		
Benzo(k)fluoranthene		14	22	52 - 2800	361.43	350 - 370	8800	78000	NA	UG/KG			
Chrysene		13	22	67 - 2200	343.23	350 - 420	88000	780000	NA	UG/KG			
Dibenz(a,h)anthracene	* *	4	22	39 - 790	267.50	350 - 420	88	780	NA	UG/KG	2	1	
Indeno(1,2,3-cd)pyrene	*	10	22	42 - 2000	301.50	350 - 420	880	7800	NA	UG/KG	1		
TCDD Equivalents													
Dioxin Equiv.		1	1	0.1033 - 0.1033	0.10	NA - NA	1000	1000	NA	NG/KG			
Inorganics													
Aluminum (Al)		22	22	1430 - 10700	4541.82	NA - NA	7800	100000	26600	MG/KG	1		
Antimony (Sb)		4	22	1.1 - 2.5	1.65	0.34 - 2.2	3.1	82	1.77	MG/KG			1
Arsenic (As)		22	22	1.4 - 12.6	3.89	NA - NA	0.43	3.8	23.9	MG/KG	22	8	
Barium (Ba)		22	22	8.1 - 46.5	26.90	NA - NA	550	14000	130	MG/KG			
Beryllium (Be)		14	22	0.13 - 0.39	0.19	0.11 - 0.23	0.15	1.3	1.7	MG/KG	9		
Cadmium (Cd)		12	22	0.1 - 1.8	0.59	0.11 - 0.12	3.9	100	1.5	MG/KG			1
Calcium (Ca)	N	20	22	274 - 20300	3630.60	4160 - 7310	NA	NA	NA	MG/KG			
Chromium (Cr)		22	22	2.9 - 31.4	8.69	NA - NA	39	1000	94.6	MG/KG			
Cobalt (Co)		22	22	0.1 - 196	19.92	NA - NA	470	12000	19	MG/KG			6
Copper (Cu)	* *	22	22	0.76 - 18200	1023.72	NA - NA	310	8200	66	MG/KG	4	1	7
Iron (Fe)	N	20	22	1710 - 9440	5092.00	6640 - 6750	NA	NA	NA	MG/KG			
Lead (Pb)	* *	22	22	4.9 - 1620	162.70	NA - NA	400	1300	265	MG/KG	2	1	3
Magnesium (Mg)	N	20	22	81.2 - 662	309.41	317 - 419	NA	NA	NA	MG/KG			
Manganese (Mn)		20	22	10.8 - 102	39.69	28.1 - 74	180	4700	302	MG/KG			
Mercury (Hg)		10	22	0.06 - 0.78	0.35	0.04 - 0.11	2.3	61	2.6	MG/KG			
Nickel (Ni)		22	22	0.96 - 112	16.64	NA - NA	160	4100	77.1	MG/KG			2
Potassium (K)	N	13	22	203 - 712	389.23	160 - 339	NA	NA	NA	MG/KG			
Selenium (Se)		3	22	0.36 - 0.73	0.50	0.35 - 0.59	39	1000	1.7	MG/KG			
Silver (Ag)		1	22	3.8 - 3.8	3.80	0.21 - 0.57	39	1000	NA	MG/KG			
Sodium (Na)	N	15	22	32.2 - 173	79.21	10.7 - 182	NA	NA	NA	MG/KG			
Tin (Sn)		11	22	2.3 - 1800	186.54	2.1 - 6.9	4700	6100	59.4	MG/KG			2
Vanadium (V)		22	22	3 - 12.3	7.50	NA - NA	55	1400	94.3	MG/KG			
Zinc (Zn)		22	22	3.7 - 591	128.96	NA - NA	2300	61000	827	MG/KG			
Pesticides													
4,4'-DDE		4	18	2.7 - 49	16.75	2.6 - 3.2	1900	17000	NA	UG/KG			
4,4'-DDT		3	18	6.7 - 40	19.90	2.6 - 3.2	1900	17000	NA	UG/KG			
alpha-Chlordane		1	18	5.4 - 5.4	5.40	1.4 - 1.7	470	2200	NA	UG/KG			
Aroclor-1260		1	18	68 - 68	68.00	70 - 86	83	740	NA	UG/KG			

Table 10.8.6.1
Chemicals Present in Site Samples
SWMU 70; AOC 548, 549 - Surface Soil
NAVBASE - Charleston
Charleston, SC

Parameter	Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Concentration: Residential RBC	Screening Concentration: Industrial RBC	Screening Concentration: Reference	Units	Number Exceeding: Res. RBC	Number Exceeding: Ind. RBC	Number Exceeding: Ref.
delta-BHC	3	18	1.9 - 4.8	3.00	1.4 - 1.5	100	910	NA	UG/KG			
Endosulfan II	2	18	3.9 - 3.9	3.90	2.6 - 3.2	47000	1200000	NA	UG/KG			
Endrin	2	18	4.3 - 18	11.15	2.6 - 3.2	2300	61000	NA	UG/KG			
Endrin aldehyde	8	18	2.6 - 5.5	3.60	2.6 - 3.2	2300	61000	NA	UG/KG			
gamma-Chlordane	4	18	1.6 - 4.9	3.53	1.4 - 1.5	470	2200	NA	UG/KG			
Heptachlor epoxide	1	18	1.7 - 1.7	1.70	1.4 - 1.7	70	630	NA	UG/KG			
Semivolatile Organics												
2-Chlorophenol	1	22	68 - 68	68.00	350 - 420	39000	1000000	NA	UG/KG			
Anthracene	4	22	52 - 78	66.75	350 - 420	2300000	61000000	NA	UG/KG			
Benzo(g,h,i)perylene	10	22	40 - 2900	405.70	350 - 420	310000	8200000	NA	UG/KG			
bis(2-Ethylhexyl)phthalate (BEHP)	2	22	64 - 82	73.00	350 - 420	46000	410000	NA	UG/KG			
Dibenzofuran	1	22	44 - 44	44.00	350 - 420	31000	820000	NA	UG/KG			
Di-n-octyl phthalate	1	22	57 - 57	57.00	350 - 420	160000	4100000	NA	UG/KG			
Fluoranthene	15	22	36 - 720	283.33	350 - 370	310000	8200000	NA	UG/KG			
Phenanthrene	12	22	40 - 400	181.17	350 - 420	310000	8200000	NA	UG/KG			
Pyrene	15	22	43 - 4600	558.80	350 - 370	230000	6100000	NA	UG/KG			
Volatile Organics												
Methylene chloride	5	18	10 - 14	11.00	5 - 48	85000	760000	NA	UG/KG			
Toluene	4	18	1 - 3	1.75	5 - 6	1600000	41000000	NA	UG/KG			
Xylene (Total)	4	18	1 - 4	2.25	5 - 6	16000000	100000000	NA	UG/KG			

* - Identified as a residential COPC
** - Identified as an industrial COPC
N - Essential nutrient
MG/KG - milligrams per kilogram
NG/KG - nanograms per kilogram
UG/KG - micrograms per kilogram
SQL - Sample quantitation limit
RBC - Risk-based concentration
NA - Not applicable

Table 10.8.6.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 70/AOCs 548 and 549
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
070	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
070	B001	Copper (Cu)	21.80	MG/KG	NA		0.0075	100.00
070	B001	Lead (Pb)	27.30	MG/KG	NA		NA	
		Total			NA		0.0075	
070	B002	B(a)P Equiv.	101.19	UG/KG	1.6757	100.00	NA	
070	B002	Copper (Cu)	25.70	MG/KG	NA		0.0088	100.00
070	B002	Lead (Pb)	13.40	MG/KG	NA		NA	
		Total			1.6757		0.0088	
070	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
070	B003	Copper (Cu)	13.40	MG/KG	NA		0.0046	100.00
070	B003	Lead (Pb)	9.00	MG/KG	NA		NA	
		Total			NA		0.0046	
070	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
070	B004	Copper (Cu)	1.70	MG/KG	NA		0.0006	100.00
070	B004	Lead (Pb)	13.50	MG/KG	NA		NA	
		Total			NA		0.0006	
548	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
548	B001	Copper (Cu)	1.10	MG/KG	NA		0.0004	100.00
548	B001	Lead (Pb)	6.80	MG/KG	NA		NA	
		Total			NA		0.0004	
548	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
548	B002	Copper (Cu)	1.20	MG/KG	NA		0.0004	100.00
548	B002	Lead (Pb)	7.90	MG/KG	NA		NA	
		Total			NA		0.0004	
548	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
548	B003	Copper (Cu)	0.96	MG/KG	NA		0.0003	100.00
548	B003	Lead (Pb)	5.70	MG/KG	NA		NA	
		Total			NA		0.0003	
548	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
548	B004	Copper (Cu)	0.76	MG/KG	NA		0.0003	100.00
548	B004	Lead (Pb)	4.90	MG/KG	NA		NA	
		Total			NA		0.0003	
549	B001	B(a)P Equiv.	104.05	UG/KG	1.7231	100.00	NA	
549	B001	Copper (Cu)	1900.00	MG/KG	NA		0.6513	100.00
549	B001	Lead (Pb)	516.00	MG/KG	NA		NA	
		Total			1.7231		0.6513	

Table 10.8.6.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 70/AOCs 548 and 549
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
549	B002	B(a)P Equiv.	4666.20	UG/KG	77.2737	100.00	NA	
549	B002	Copper (Cu)	42.60	MG/KG	NA		0.0146	100.00
549	B002	Lead (Pb)	98.70	MG/KG	NA		NA	
		Total			77.2737		0.0146	
549	B003	B(a)P Equiv.	0.52	UG/KG	0.0086	100.00	NA	
549	B003	Copper (Cu)	84.60	MG/KG	NA		0.0290	100.00
549	B003	Lead (Pb)	76.30	MG/KG	NA		NA	
		Total			0.0086		0.0290	
549	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
549	B004	Copper (Cu)	7.20	MG/KG	NA		0.0025	100.00
549	B004	Lead (Pb)	31.20	MG/KG	NA		NA	
		Total			NA		0.0025	
549	B005	B(a)P Equiv.	314.08	UG/KG	5.2013	100.00	NA	
549	B005	Copper (Cu)	47.80	MG/KG	NA		0.0164	100.00
549	B005	Lead (Pb)	53.70	MG/KG	NA		NA	
		Total			5.2013		0.0164	
549	B006	B(a)P Equiv.	138.93	UG/KG	2.3007	100.00	NA	
549	B006	Copper (Cu)	28.30	MG/KG	NA		0.0097	100.00
549	B006	Lead (Pb)	37.50	MG/KG	NA		NA	
		Total			2.3007		0.0097	
549	B007	B(a)P Equiv.	212.95	UG/KG	3.5265	100.00	NA	
549	B007	Copper (Cu)	16.30	MG/KG	NA		0.0056	100.00
549	B007	Lead (Pb)	22.10	MG/KG	NA		NA	
		Total			3.5265		0.0056	
549	B008	B(a)P Equiv.	46.06	UG/KG	0.7627	100.00	NA	
549	B008	Copper (Cu)	324.00	MG/KG	NA		0.1111	100.00
549	B008	Lead (Pb)	300.00	MG/KG	NA		NA	
		Total			0.7627		0.1111	
549	B009	B(a)P Equiv.	122.74	UG/KG	2.0326	100.00	NA	
549	B009	Copper (Cu)	18200.00	MG/KG	NA		6.2391	100.00
549	B009	Lead (Pb)	225.00	MG/KG	NA		NA	
		Total			2.0326		6.2391	
549	B010	B(a)P Equiv.	900.70	UG/KG	14.9159	100.00	NA	
549	B010	Copper (Cu)	255.00	MG/KG	NA		0.0874	100.00
549	B010	Lead (Pb)	1620.00	MG/KG	NA		NA	
		Total			14.9159		0.0874	

Table 10.8.6.2
Point Estimates of Risk and Hazard - Surface Soil Pathways
Residential Scenario
SWMU 70/AOCs 548 and 549
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
549	B011	B(a)P Equiv.	253.88	UG/KG	4.2043	100.00	NA	
549	B011	Copper (Cu)	145.00	MG/KG	NA		0.0497	100.00
549	B011	Lead (Pb)	62.90	MG/KG	NA		NA	
		Total			4.2043		0.0497	
549	B012	B(a)P Equiv.	397.38	UG/KG	6.5807	100.00	NA	
549	B012	Copper (Cu)	1320.00	MG/KG	NA		0.4525	100.00
549	B012	Lead (Pb)	188.00	MG/KG	NA		NA	
		Total			6.5807		0.4525	
549	B013	B(a)P Equiv.	27.76	UG/KG	0.4597	100.00	NA	
549	B013	Copper (Cu)	55.90	MG/KG	NA		0.0192	100.00
549	B013	Lead (Pb)	224.00	MG/KG	NA		NA	
		Total			0.4597		0.0192	
549	B014	B(a)P Equiv.	257.73	UG/KG	4.2681	100.00	NA	
549	B014	Copper (Cu)	28.60	MG/KG	NA		0.0098	100.00
549	B014	Lead (Pb)	35.60	MG/KG	NA		NA	
		Total			4.2681		0.0098	

Table 10.8.6.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 70/AOCs 548 and 549
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
070	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
070	B001	Copper (Cu)	21.80	MG/KG	NA		0.00038	100.00
070	B001	Lead (Pb)	27.30	MG/KG	NA		NA	
		Total			NA		0.00038	
070	B002	B(a)P Equiv.	101.19	UG/KG	0.3407	100.00	NA	
070	B002	Copper (Cu)	25.70	MG/KG	NA		0.00044	100.00
070	B002	Lead (Pb)	13.40	MG/KG	NA		NA	
		Total			0.3407		0.00044	
070	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
070	B003	Copper (Cu)	13.40	MG/KG	NA		0.00023	100.00
070	B003	Lead (Pb)	9.00	MG/KG	NA		NA	
		Total			NA		0.00023	
070	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
070	B004	Copper (Cu)	1.70	MG/KG	NA		0.000029	100.00
070	B004	Lead (Pb)	13.50	MG/KG	NA		NA	
		Total			NA		0.000029	
548	B001	B(a)P Equiv.	ND	UG/KG	NA		NA	
548	B001	Copper (Cu)	1.10	MG/KG	NA		0.000019	100.00
548	B001	Lead (Pb)	6.80	MG/KG	NA		NA	
		Total			NA		0.000019	
548	B002	B(a)P Equiv.	ND	UG/KG	NA		NA	
548	B002	Copper (Cu)	1.20	MG/KG	NA		0.000021	100.00
548	B002	Lead (Pb)	7.90	MG/KG	NA		NA	
		Total			NA		0.000021	
548	B003	B(a)P Equiv.	ND	UG/KG	NA		NA	
548	B003	Copper (Cu)	0.96	MG/KG	NA		0.000017	100.00
548	B003	Lead (Pb)	5.70	MG/KG	NA		NA	
		Total			NA		0.000017	
548	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
548	B004	Copper (Cu)	0.76	MG/KG	NA		0.000013	100.00
548	B004	Lead (Pb)	4.90	MG/KG	NA		NA	
		Total			NA		0.000013	
549	B001	B(a)P Equiv.	104.05	UG/KG	0.3503	100.00	NA	
549	B001	Copper (Cu)	1900.00	MG/KG	NA		0.0328	100.00
549	B001	Lead (Pb)	516.00	MG/KG	NA		NA	
		Total			0.3503		0.0328	

Table 10.8.6.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 70/AOCs 548 and 549
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
549	B002	B(a)P Equiv.	4666.20	UG/KG	15.7117	100.00	NA	
549	B002	Copper (Cu)	42.60	MG/KG	NA		0.0007	100.00
549	B002	Lead (Pb)	98.70	MG/KG	NA		NA	
		Total			15.7117		0.0007	
549	B003	B(a)P Equiv.	0.52	UG/KG	0.0018	100.00	NA	
549	B003	Copper (Cu)	84.60	MG/KG	NA		0.0015	100.00
549	B003	Lead (Pb)	76.30	MG/KG	NA		NA	
		Total			0.0018		0.0015	
549	B004	B(a)P Equiv.	ND	UG/KG	NA		NA	
549	B004	Copper (Cu)	7.20	MG/KG	NA		0.00012	100.00
549	B004	Lead (Pb)	31.20	MG/KG	NA		NA	
		Total			NA		0.00012	
549	B005	B(a)P Equiv.	314.08	UG/KG	1.0576	100.00	NA	
549	B005	Copper (Cu)	47.80	MG/KG	NA		0.00082	100.00
549	B005	Lead (Pb)	53.70	MG/KG	NA		NA	
		Total			1.0576		0.00082	
549	B006	B(a)P Equiv.	138.93	UG/KG	0.4678	100.00	NA	
549	B006	Copper (Cu)	28.30	MG/KG	NA		0.00049	100.00
549	B006	Lead (Pb)	37.50	MG/KG	NA		NA	
		Total			0.4678		0.00049	
549	B007	B(a)P Equiv.	212.95	UG/KG	0.7170	100.00	NA	
549	B007	Copper (Cu)	16.30	MG/KG	NA		0.0003	100.00
549	B007	Lead (Pb)	22.10	MG/KG	NA		NA	
		Total			0.7170		0.00028	
549	B008	B(a)P Equiv.	46.06	UG/KG	0.1551	100.00	NA	
549	B008	Copper (Cu)	324.00	MG/KG	NA		0.0056	100.00
549	B008	Lead (Pb)	300.00	MG/KG	NA		NA	
		Total			0.1551		0.0056	
549	B009	B(a)P Equiv.	122.74	UG/KG	0.4133	100.00	NA	
549	B009	Copper (Cu)	18200.00	MG/KG	NA		0.3139	100.00
549	B009	Lead (Pb)	225.00	MG/KG	NA		NA	
		Total			0.4133		0.3139	
549	B010	B(a)P Equiv.	900.70	UG/KG	3.0328	100.00	NA	
549	B010	Copper (Cu)	255.00	MG/KG	NA		0.0044	100.00
549	B010	Lead (Pb)	1620.00	MG/KG	NA		NA	
		Total			3.0328		0.0044	

Table 10.8.6.3
Point Estimates of Risk and Hazard - Surface Soil Pathways
Industrial Scenario
SWMU 70/AOCs 548 and 549
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
549	B011	B(a)P Equiv.	253.88	UG/KG	0.8548	100.00	NA	
549	B011	Copper (Cu)	145.00	MG/KG	NA		0.0025	100.00
549	B011	Lead (Pb)	62.90	MG/KG	NA		NA	
		Total			0.8548		0.0025	
549	B012	B(a)P Equiv.	397.38	UG/KG	1.3380	100.00	NA	
549	B012	Copper (Cu)	1320.00	MG/KG	NA		0.0228	100.00
549	B012	Lead (Pb)	188.00	MG/KG	NA		NA	
		Total			1.3380		0.0228	
549	B013	B(a)P Equiv.	27.76	UG/KG	0.0935	100.00	NA	
549	B013	Copper (Cu)	55.90	MG/KG	NA		0.0010	100.00
549	B013	Lead (Pb)	224.00	MG/KG	NA		NA	
		Total			0.0935		0.0010	
549	B014	B(a)P Equiv.	257.73	UG/KG	0.8678	100.00	NA	
549	B014	Copper (Cu)	28.60	MG/KG	NA		0.0005	100.00
549	B014	Lead (Pb)	35.60	MG/KG	NA		NA	
		Total			0.8678		0.0005	

Table 10.8.6.4
Chemicals Present in Site Samples
SWMU 70; AOC 548, 549 - Groundwater
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Conc. Residential RBC	Screening Conc. Reference	Units	Number Exceeding Res.	Number Exceeding Ref.
Deep wells											
Inorganics											
Antimony (Sb)	*	1	1	115 - 115	115	NA - NA	1.5	NA	UG/L	1	
Arsenic (As)		1	1	12.5 - 12.5	12.5	NA - NA	0.045	16.4	UG/L	1	
Barium (Ba)		1	1	17.9 - 17.9	17.9	NA - NA	260	218	UG/L		
Calcium (Ca)	N	1	1	68900 - 68900	68900	NA - NA	NA	NA	UG/L		
Chromium (Cr)	*	1	1	52500 - 52500	52500	NA - NA	18	15.5	UG/L	1	1
Cyanide (CN)		1	1	4.4 - 4.4	4.4	NA - NA	73	37.3	UG/L		
Iron (Fe)	N	1	1	1070 - 1070	1070	NA - NA	NA	NA	UG/L		
Magnesium (Mg)	N	1	1	14300 - 14300	14300	NA - NA	NA	NA	UG/L		
Manganese (Mn)		1	1	220 - 220	220	NA - NA	84	869	UG/L	1	
Nickel (Ni)		1	1	46.8 - 46.8	46.8	NA - NA	73	42.2	UG/L		1
Potassium (K)	N	1	1	7180 - 7180	7180	NA - NA	NA	NA	UG/L		
Sodium (Na)	N	1	1	80300 - 80300	80300	NA - NA	NA	NA	UG/L		
Thallium (Tl)	*	1	1	9.5 - 9.5	9.5	NA - NA	0.29	2	UG/L	1	1
Vanadium (V)		1	1	5 - 5	5	NA - NA	26	5.3	UG/L		
Zinc (Zn)		1	1	21.5 - 21.5	21.5	NA - NA	1100	11.8	UG/L		1
Volatile Organics											
1,2-Dichloroethene (total)	*	1	1	10 - 10	10	NA - NA	5.5	NA	UG/L	1	
Chloroform	*	1	1	7 - 7	7	NA - NA	0.15	NA	UG/L	1	
Tetrachloroethene	*	1	1	8 - 8	8	NA - NA	1.1	NA	UG/L	1	
Trichloroethene	*	1	1	22 - 22	22	NA - NA	1.6	NA	UG/L	1	
Shallow Wells											
Inorganics											
Aluminum (Al)	*	3	5	339 - 6490	3436	115 - 141	3700	2810	UG/L	1	2
Antimony (Sb)	*	2	5	7.7 - 24.2	15.95	4 - 4	1.5	NA	UG/L	2	
Arsenic (As)		2	5	5.7 - 7.9	6.80	5 - 5	0.045	18.7	UG/L	2	
Barium (Ba)		5	5	9.6 - 30.7	22.58	NA - NA	260	211	UG/L		
Cadmium (Cd)	*	2	5	1.7 - 3.5	2.60	1 - 1	1.8	NA	UG/L	2	1
Calcium (Ca)	N	5	5	5020 - 34600	20324	NA - NA	NA	NA	UG/L		
Chromium (Cr)	*	3	5	440 - 7350	3213	5 - 5	18	12.3	UG/L	3	3
Cobalt (Co)		1	5	2.4 - 2.4	2.40	2 - 2	220	2.5	UG/L		
Copper (Cu)		2	5	2.1 - 4.4	3.25	2 - 2	150	2.7	UG/L		1
Iron (Fe)	N	5	5	280 - 4830	3006	NA - NA	NA	NA	UG/L		

Table 10.8.6.4
Chemicals Present in Site Samples
SWMU 70; AOC 548, 549 - Groundwater
NAVBASE - Charleston
Charleston, SC

Parameter		Frequency of Detection		Range of Detection	Average Detected Concentration	Range of SQL	Screening Conc. Residential RBC	Screening Conc. Reference	Units	Number Exceeding Res.	Number Exceeding Ref.
Magnesium (Mg)	N	5	5	780 - 8340	3936	NA - NA	NA	NA	UG/L		
Manganese (Mn)		5	5	34 - 64.1	49.28	NA - NA	84	2560	UG/L		
Nickel (Ni)		2	5	4.5 - 7.9	6.20	1 - 1	73	15.2	UG/L		
Potassium (K)	N	5	5	2390 - 7070	5038	NA - NA	NA	NA	UG/L		
Sodium (Na)	N	5	5	4590 - 922000	198758	NA - NA	NA	NA	UG/L		
Vanadium (V)		3	5	1.7 - 12.3	7.27	1 - 1	26	11.4	UG/L		1
Zinc (Zn)		3	5	5.5 - 58	25.43	4 - 4	1100	27.3	UG/L		1
Semivolatile Organics											
Benzoic acid		2	5	1 - 4	2.5	50 - 50	15000	NA	UG/L		
bis(2-Ethylhexyl)phthalate (BEHP)		1	5	1 - 1	1	10 - 10	4.8	NA	UG/L		
Di-n-butylphthalate		1	5	2 - 2	2	10 - 10	370	NA	UG/L		
Naphthalene		3	5	1 - 3	2	10 - 10	150	NA	UG/L		
Volatile Organics											
1,2-Dichloroethene (total)	*	3	5	6 - 18	11.3	5 - 5	5.5	NA	UG/L	3	
Benzene	*	1	5	2 - 2	2	5 - 5	0.36	NA	UG/L	1	
Chlorobenzene	*	1	5	29 - 29	29	5 - 5	3.9	NA	UG/L	1	
Trichloroethene	*	3	5	6 - 15	9	5 - 5	1.6	NA	UG/L	3	
Xylene (Total)		1	5	2 - 2	2	5 - 5	1200	NA	UG/L		

Notes:
* - Identified as a COPC
N - Essential nutrient
UG/L - micrograms per liter
SQL - Sample quantitation limit
NA - Not applicable

Table 10.8.6.5
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMU 70/AOCs 548 and 549
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
070	G01D	1,2-Dichloroethene (total)	10.00	UG/L	NA		0.1421	0.02
070	G01D	1,2-Dichloropropane	ND	UG/L	NA		NA	
070	G01D	Antimony (Sb)	115.00	UG/L	NA		18.3790	2.63
070	G01D	Chloroform	7.00	UG/L	9.0159	42.92	0.0895	0.01
070	G01D	Chromium (Cr)	52500.00	UG/L	NA		671.2329	96.16
070	G01D	Tetrachloroethene	8.00	UG/L	6.4286	30.60	0.1023	0.01
070	G01D	Thallium (Tl)	9.50	UG/L	NA		7.5913	1.09
070	G01D	Trichloroethene	22.00	UG/L	5.5624	26.48	0.4688	0.07
070	G01D	bis(2-Ethylhexyl)phthalate (BEHP)	ND	UG/L	NA		NA	
		Total			21.0069		698.0058	
070	G001	1,2-Dichloroethene (total)	6.00	UG/L	NA		0.0852	0.09
070	G001	Aluminum (Al)	3480.00	UG/L	NA		0.2225	0.22
070	G001	Antimony (Sb)	24.20	UG/L	NA		3.8676	3.91
070	G001	Benzene	ND	UG/L	NA		NA	
070	G001	Cadmium (Cd)	3.50	UG/L	NA		0.4475	0.45
070	G001	Chlorobenzene	ND	UG/L	NA		NA	
070	G001	Chromium (Cr)	7350.00	UG/L	NA		93.9726	95.00
070	G001	Trichloroethene	15.00	UG/L	3.7926	100.00	0.3196	0.32
070	G001	Vinyl chloride	ND	UG/L	NA		NA	
		Total			3.7926		98.9150	
070	G002	1,2-Dichloroethene (total)	ND	UG/L	NA		NA	
070	G002	Aluminum (Al)	6490.00	UG/L	NA		0.4149	6.50
070	G002	Antimony (Sb)	ND	UG/L	NA		NA	
070	G002	Benzene	ND	UG/L	NA		NA	
070	G002	Cadmium (Cd)	1.70	UG/L	NA		0.2174	3.40
070	G002	Chlorobenzene	ND	UG/L	NA		NA	
070	G002	Chromium (Cr)	440.00	UG/L	NA		5.6256	88.10
070	G002	Trichloroethene	6.00	UG/L	1.5170	100.00	0.1279	2.00
070	G002	Vinyl chloride	ND	UG/L	NA		NA	
		Total			1.5170		6.3857	
549	G001	1,2-Dichloroethene (total)	ND	UG/L	NA		NA	
549	G001	Aluminum (Al)	ND	UG/L	NA		NA	
549	G001	Antimony (Sb)	ND	UG/L	NA		NA	
549	G001	Benzene	2.00	UG/L	1.7252	100.00	0.1495	26.38
549	G001	Cadmium (Cd)	ND	UG/L	NA		NA	
549	G001	Chlorobenzene	29.00	UG/L	NA		0.4174	73.62
549	G001	Chromium (Cr)	ND	UG/L	NA		NA	
549	G001	Trichloroethene	ND	UG/L	NA		NA	
549	G001	Vinyl chloride	ND	UG/L	NA		NA	
		Total			1.7252		0.5669	
549	G002	1,2-Dichloroethene (total)	10.00	UG/L	NA		0.1421	100.00
549	G002	Aluminum (Al)	ND	UG/L	NA		NA	
549	G002	Antimony (Sb)	ND	UG/L	NA		NA	
549	G002	Benzene	ND	UG/L	NA		NA	
549	G002	Cadmium (Cd)	ND	UG/L	NA		NA	
549	G002	Chlorobenzene	ND	UG/L	NA		NA	

Table 10.8.6.5
Point Estimates of Risk and Hazard - Groundwater Pathways
Residential Scenario
SWMU 70/AOCs 548 and 549
NAVBASE-Charleston
Charleston, South Carolina

Site	Location	Parameter	Concentration	Units	Risk (E-06)	% Risk	Hazard Index	% HI
549	G002	Chromium (Cr)	ND	UG/L	NA		NA	
549	G002	Trichloroethene	ND	UG/L	NA		NA	
549	G002	Vinyl chloride	ND	UG/L	NA		NA	
		Total			NA		0.1421	
549	G003	1,2-Dichloroethene (total)	18.00	UG/L	NA		0.2557	1.01
549	G003	Aluminum (Al)	339.00	UG/L	NA		0.0217	0.09
549	G003	Antimony (Sb)	7.70	UG/L	NA		1.2306	4.87
549	G003	Benzene	ND	UG/L	NA		NA	
549	G003	Cadmium (Cd)	ND	UG/L	NA		NA	
549	G003	Chlorobenzene	ND	UG/L	NA		NA	
549	G003	Chromium (Cr)	1850.00	UG/L	NA		23.6530	93.53
549	G003	Trichloroethene	6.00	UG/L	1.5170	100.00	0.1279	0.51
549	G003	Vinyl chloride	ND	UG/L	NA		NA	
		Total			1.5170		25.2888	

10.8.7 Corrective Measures Considerations

For SWMU 70 and AOCs 548 and 549, the upper and lower soil intervals and the shallow and deep groundwater were investigated. Based on the analytical results and the risk assessment, COCs requiring further evaluation through the CMS process were identified for the upper soil interval and the shallow and deep groundwater. However, residential use of the site is not expected, based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use. However, the industrial exposure risk for the upper soil interval exceeds 1E-06 for BEQs. Risk associated with the upper interval is diminished due the site being capped with concrete and asphalt. Direct exposure is unlikely.

Copper and BEQs were identified as COCs in the upper soil interval. The equated soil pathway residential exposure risk ranges from 9E-09 to 8E-05 with the arithmetic mean risk of 6E-06. The HI estimates range from 0.0003 to 6 with a mean HI of 0.4. Both are between USEPA's acceptable ranges of 1E-06 and 1E-04 for risk and 3 and 0.1 for HI.

Copper was significant at 549SB009 at 18,200 mg/kg. Lead was identified at several locations above USEPA's residential acceptable residential level of 400 mg/kg. The highest concentration of lead occurs in a 15-foot by 15-foot area around soil boring 549SB010. Since this soil is covered with either concrete or asphalt and the residential risk and HI are within USEPA's acceptable ranges, no further action is recommended for soil.

Antimony, chromium, thallium, chloroform, 1,2-dichloroethene (total), tetrachloroethene, and trichloroethene were identified in deep groundwater at concentrations that equal a risk above 1E-06 and/or an HI above 1 (2.1E-05 and 698, respectively). Chromium is the driver of the HI. Aluminum, antimony, cadmium, chromium, benzene, chlorbenzene, 1,2-dichloroethene (total), and trichloroethene were identified in the shallow groundwater as COPCs. The equated risk ranges from <1E-07 to 2.5E-05 with a arithmetic mean of 6.4E-06 and an HI range between

0.1 to 99 with an HI mean of 21.5. Chromium drives the HI at monitoring wells NBCE070001, NBCE070002, and NBCE549003. Chlorinated organics were detected the MCL in all of the groundwater monitoring wells. A plume of chromium and chlorinated organics appears to be present in shallow groundwater. Human health risk is not a significant factor since the groundwater is not used as a potable drinking water source. However, further assessment is needed to evaluate the natural attenuation process and potential discharge to surface water.

Potential corrective measures for the impacted media and respective COCs are in Table 10.8.7.1. Corrective measures for SWMU 70 and AOCs 548 and 549 are detailed in Section 9.

Table 10.8.7.1
Potential Corrective Measures for SWMU 70 and AOCs 548 and 549

Medium	Compounds	Potential Corrective Measures
Soil	Copper, lead, and benzo(a)pyrene	a) No Action
Deep Groundwater	Antimony, chromium, thallium, chloroform, 1,2-dichloroethene (total), tetrachloroethene, and trichloroethene	a) No Action b) Intrinsic Remediation and Monitoring c) Ex-Situ, Chemical and Physical Treatment
Shallow Groundwater	Aluminum, antimony, cadmium, chromium, benzene, chlorobenzene, 1,2-dichloroethene (total), and trichloroethene	a) No Action b) Intrinsic Remediation and Monitoring c) Ex-Situ, Chemical and Physical Treatment

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10.9 SWMU 81, Less-than-90-Day Accumulation Area, Building 1245

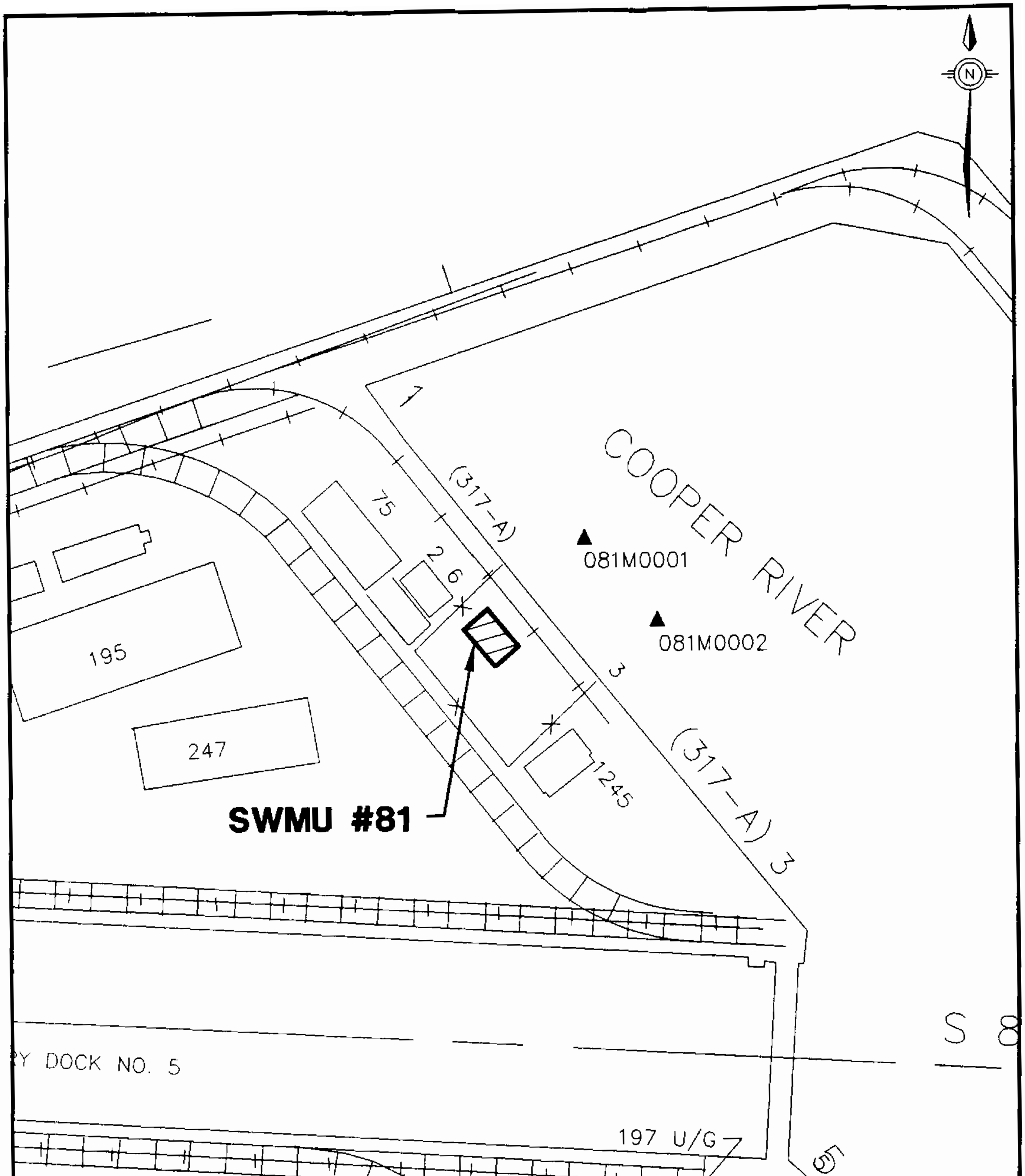
SWMU 81, the site of a former less-than-90-day accumulation area, is located east of Building 1245 in the northwest corner of the enclosed fence. The accumulation area stored hazardous waste for less than 90 days. The date of origin of the SAA is not known, but it was removed in May 1994. The structure had a wooden floor with no spill containment. Currently the area is paved with concrete and asphalt.

Materials of concern at SWMU 81 include lead and other metals, paints and solvents. Potential receptors that may be exposed to site contaminants include current and future building users and any site workers this area may support following base closure.

To fulfill the CSI objectives for SWMU 81, concrete core samples along with sediment samples from the Cooper River were collected in accordance with the *Final Zone E RFI Work Plan* and Section 3 of this report to determine whether any contamination resulted from onsite activities.

10.9.1 Concrete Core Sampling and Analysis

Concrete cores were sampled in one round at SWMU 81 as proposed in the *Final Zone E RFI Work Plan* from the locations shown on Figure 10.9.1. The proposed samples were collected and submitted for analysis for VOCs, SVOCs, pesticides/PCBs, metals, cyanide, and organotins at DQO Level III. No samples were selected as duplicates at SWMU 81. Table 10.9.1.1 summarizes concrete core sampling results at SWMU 81.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- ◒ – DEEP MONITORING WELLS
- ▲ – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9.1
SEDIMENT SAMPLE LOCATIONS
SWMU #81
BUILDING 1245
LESS THAN 90 DAY AREA

DWG DATE: 09/02/97 | DWG NAME: 10-09-1

Table 10.9.1.1
SWMU 81
Concrete Core Sampling Summary

Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviations
3	3	Standard Suite[a], organotins	Standard Suite[a], organotins	None

Note:
a = Standard Suite includes VOCs, SVOCs, metals, cyanide, and pesticides/PCBs

10.9.2 Nature of Contamination in Concrete

Analytical results for detected organic compounds in concrete are summarized in Table 10.9.2.1. Table 10.9.2.2 summarizes the analytical results for inorganic elements detected in concrete. Appendix H contains the complete data report for all samples collected in Zone E.

Table 10.9.2.1
SWMU 81
Organic Compounds Detected in Concrete Samples (μg/kg)

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.
VOCs			
Methylene chloride	1/3	13.0	13.0
SVOCs			
Benzoic acid	1/3	140	140
Dimethylphthalate	1/3	300	300

Note:
μg/kg = Micrograms per kilogram

Table 10.9.2.2
SWMU 81
Inorganic Elements Detected in Concrete Samples (mg/kg)

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.
Aluminum (Al)	3/3	1,390 - 5,900	4,330
Arsenic (As)	2/3	1.50 - 1.80	1.65
Barium (Ba)	3/3	15.7 - 87.2	58.6
Beryllium (Be)	2/3	0.260 - 0.270	0.265
Cadmium (Cd)	3/3	0.950 - 3.90	2.65
Calcium (Ca)	3/3	15,900 - 76,100	53,100
Chromium (Cr)	3/3	5.00 - 11.8	8.20
Cobalt (Co)	3/3	0.350 - 2.40	1.62
Copper (Cu)	3/3	10.2 - 134	66.0
Iron (Fe)	3/3	1,120 - 6,820	3,990
Lead (Pb)	3/3	8.00 - 22.5	15.4
Magnesium (Mg)	3/3	559 - 3,240	2,120
Manganese (Mn)	3/3	23.8 - 128	88.6
Nickel (Ni)	3/3	1.50 - 11.0	6.70
Potassium (K)	3/3	568 - 3,480	2,010
Sodium (Na)	3/3	139 - 1,440	727
Vanadium (V)	3/3	2.50 - 12.0	8.47
Zinc (Zn)	3/3	76.7 - 859	424

Note:
mg/kg = Milligrams per kilogram

Volatile Organic Compounds in Concrete

One VOC, methylene chloride, was detected in concrete samples at SWMU 81. Methylene chloride is considered a common laboratory artifact or contaminant by the National Functional Guidelines, February 1994.

Semivolatile Organic Compounds in Concrete

Two SVOCs, benzoic acid and dimethyl phthalate, were detected in concrete samples collected at SWMU 81. No cPAHs were detected in concrete samples and no BEQs were calculated.

Pesticides and PCBs in Concrete

No pesticides or PCBs were detected in the concrete samples collected at SWMU 81.

Other Organic Compounds in Concrete

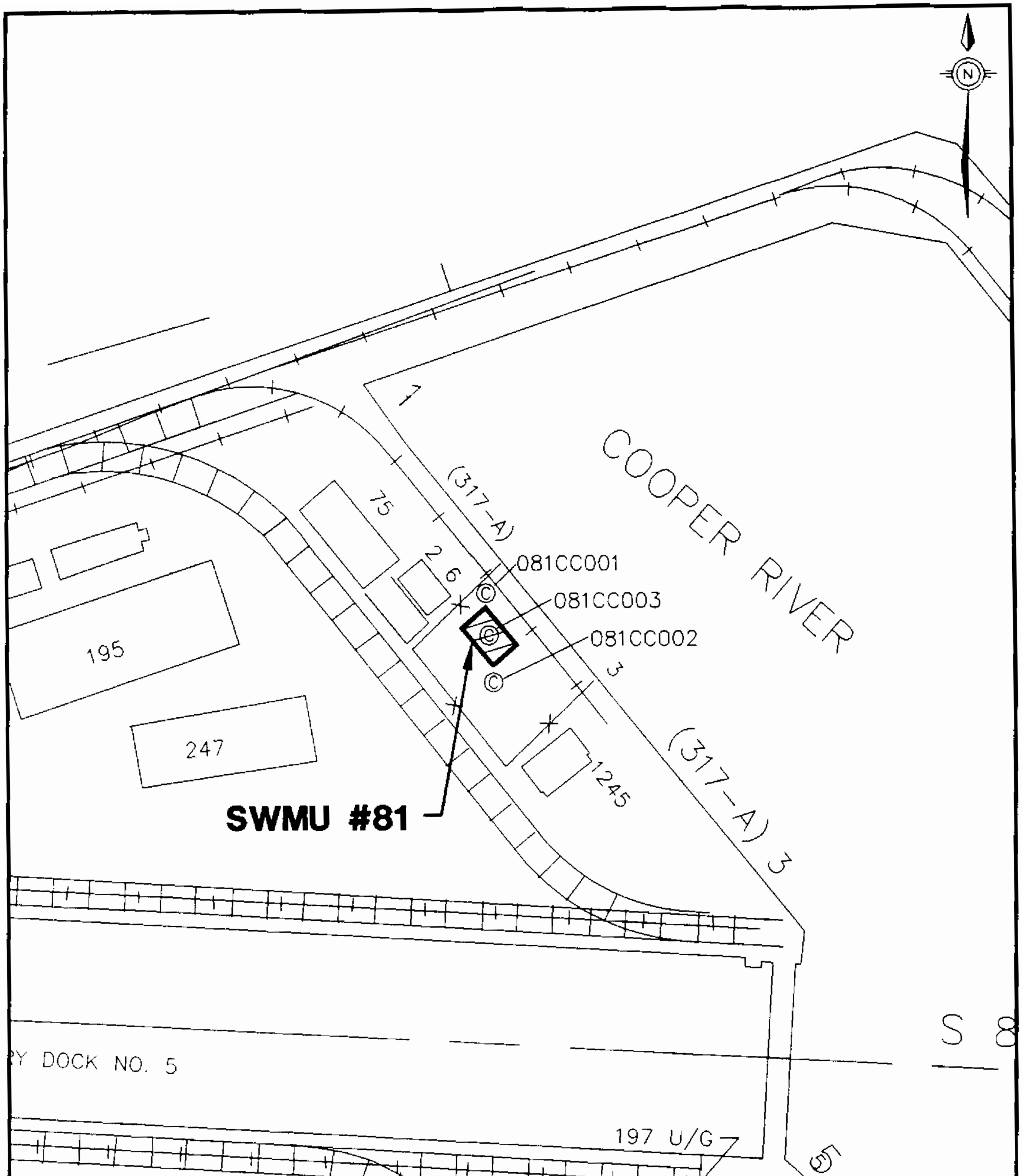
No other organics were detected in the concrete samples collected at SWMU 81.

Inorganic Elements in Concrete

Eighteen metals, with 52 total detections, were present in concrete samples collected at SWMU 81.

10.9.3 Sediment Sampling and Analysis

The *Final Zone E RFI Work Plan* proposed collecting two sediment samples at SWMU 81 from the locations shown in Figure 10.9.2. Two sediment samples were collected and submitted for analysis at DQO Level III for organotins and the standard suite of parameters which includes VOCs, SVOCs, pesticides/PCBs, metals and cyanide. No samples were selected as duplicates at this site. Table 10.9.3.1 summarizes sediment sampling and analysis at SWMU 81.



LEGEND

- ● – SOIL BORINGS
- Ⓒ – CORE SAMPLES
- ◒ – DEEP MONITORING WELLS
- ▲ – SHALLOW MONITORING WELLS
- ▲ – SEDIMENT SAMPLES
- Ⓣ – THICKNESS SAMPLES
- Ⓦ – WIPE SAMPLES
- Ⓢ – SURFACE WATER SAMPLES

GRAPHIC SCALE 100 0 100 200

ZONE E
RFI REPORT
NAVAL BASE CHARLESTON
CHARLESTON, S.C.

FIGURE 10.9.2
CONCRETE SAMPLE LOCATIONS
SWMU #81
BUILDING 1245
LESS THAN 90 DAY AREA

DWG DATE: 09/02/97 | DWG NAME: 10-09-2

Table 10.9.3.1
SWMU 81
Sediment Sampling Summary

Samples Proposed	Samples Collected	Analyses Proposed	Analyses Collected	Deviation
2	2	Standard Suite[a] and organotins	Standard Suite[a] and organotins	None

Note:
a = Standard suite includes VOCs, SVOCs, metals, cyanide, pesticides, and PCBs

10.9.4 Nature of Contamination in Sediment

Table 10.9.4.1 summarizes the organic analytical results for sediment. Table 10.9.4.2 summarizes the inorganic analytical results for sediment. Appendix H contains the complete analytical report for all samples collected in Zone E. Sediment analytical results were evaluated in Section 8, Ecological Risk Assessment, of this report.

Table 10.9.4.1
SWMU 81
Organic Compounds Detected in Sediment (μg/kg)

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Sediment Quality Criteria	Number of Samples Exceeding SSV
VOCs					
2-Butanone (MEK)	2/2	24.0 - 27.0	25.5	NA	NA
Carbon disulfide	2/2	18.0 - 21.0	19.5	NA	NA
SVOCs					
Fluoranthene	2/2	780 - 1,300	1,040	330	2
Pyrene	2/2	840 - 1,200	1,020	330	2
SVOCs (B(a)P Equivalents)					
B(a)P Equiv.	2/2	371 - 413	392	NA	NA

Table 10.9.4.1
SWMU 81
Organic Compounds Detected in Sediment (μg/kg)

Compound	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Sediment Quality Criteria	Number of Samples Exceeding SSV
SVOCs (B(a)P Equivalents)					
Benzo(a)anthracene	2/2	370 - 550	460	330	2
Benzo(b)fluoranthene	2/2	300 - 320	310	NA	NA
Benzo(k)fluoranthene	2/2	320 - 460	390	NA	NA
Benzo(a)pyrene	2/2	300 - 320	310	330	0
Chrysene	2/2	430 - 940	685	330	2

Notes:
μg/kg = Micrograms per kilogram
SSV = Sediment screening value
NA = No SSV established

Table 10.9.4.2
SWMU 81
Inorganic Detections in Sediment (mg/kg)

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Sediment Quality Criteria	Number of Samples Exceeding SSV
Aluminum (Al)	2/2	9,540 - 12,700	11,100	NA	NA
Arsenic (As)	2/2	15.6 - 18.7	17.2	7.24	2
Barium (Ba)	2/2	18.4 - 21.2	19.8	NA	NA
Beryllium (Be)	2/2	1.000 - 1.10	1.05	NA	NA
Calcium (Ca)	2/2	29,100 - 30,100	29,600	NA	NA
Chromium (Cr)	2/2	31.9 - 36.7	34.3	52.3	0
Cobalt (Co)	2/2	7.40 - 8.00	7.70	NA	NA
Copper (Cu)	2/2	25.6 - 27.5	26.6	18.7	2

Table 10.9.4.2
SWMU 81
Inorganic Detections in Sediment (mg/kg)

Element	Freq. of Detection	Range of Detected Conc.	Mean of Detected Conc.	Sediment Quality Criteria	Number of Samples Exceeding SSV
Iron (Fe)	2/2	22,100 - 26,000	24,100	NA	NA
Lead (Pb)	2/2	23.1 - 24.2	23.7	30.2	0
Magnesium (Mg)	2/2	8,230 - 9,160	8,700	NA	NA
Manganese (Mn)	2/2	412 - 551	482	NA	NA
Nickel (Ni)	2/2	10.5 - 11.4	11.0	15.9	0
Potassium (K)	2/2	4,370 - 4,760	4,570	NA	NA
Sodium (Na)	2/2	18,800 - 21,400	20,100	NA	NA
Vanadium (V)	2/2	40.2 - 50.7	45.5	NA	NA
Zinc (Zn)	2/2	73.5 - 77.5	75.5	124	0

Notes:
mg/kg = Milligrams per kilogram
SSV = Sediment Screening Value
NA = No SSV established

Volatile Organic Compounds in Sediment

Two VOCs — 2-butanone and carbon disulfide — were detected in both sediment samples collected at SWMU 81. No SSVs have been established for either compound.

Semivolatile Organic Compounds in Sediment

Seven SVOCs were detected in sediment samples collected at SWMU 81. Four SVOCs — benzo(a)anthracene, chrysene, fluoranthene, and pyrene — exceeded their respective SSVs in both sediment samples.

Benzo(a)anthracene was detected both sediment samples at a range of 370 to 550 μg/kg and a mean of 460 μg/kg. The detected concentration in both sediment samples (081M0001, 550 μg/kg; 081M0002, 370 μg/kg) exceeded the benzo(a)anthracene SSV of 330 μg/kg.

Chrysene was detected in both sediment samples at a range of 430 to 940 μg/kg and a mean of 685 μg/kg. The detected concentration in both sediment samples (081M0001, 940 μg/kg; 081M002, 430 μg/kg) exceeded the chrysene SSV of 330 μg/kg.

Fluoranthene was detected in both sediment samples at a range of 780 to 1,300 μg/kg and a mean of 1,040 μg/kg. The detected concentration in both sediment samples (081M0001, 1,300 μg/kg; and 081M0002, 780 μg/kg) exceeded the fluoranthene SSV of 330 μg/kg.

Pyrene was detected in both sediment samples at a range of 840 to 1,200 μg/kg and a mean of 1,020 μg/kg. The detected concentration in both sediment samples (081M0001, 1,200 μg/kg; 081M0002, 840 μg/kg) exceeded the pyrene SSV of 330 μg/kg.

Pesticides and PCBs in Sediment

No pesticides or PCBs were detected in sediment samples collected at SWMU 81.

Other Organic Compounds in Sediment

No other organic compounds were detected in sediment samples collected at SWMU 81.

Inorganic Elements in Sediment

Seventeen inorganic elements were detected in sediment samples collected at SWMU 81. Two inorganics — arsenic and copper — exceeded their respective SSVs.

Arsenic was detected in both sediment at a range of 15.6 to 18.7 mg/kg and a mean of 17.2 mg/kg. Both samples (081M0001, 18.7 mg/kg; 081M0002, 15.6 mg/kg) exceeded the arsenic SSV of 7.24 mg/kg. Copper was also detected in both upper-interval samples with a range of 25.6 to 27.5 mg/kg and a mean of 26.6 mg/kg. Both sediment samples (081M0001, 25.6 mg/kg; 081M0002, 27.5 mg/kg) exceeded the copper SSV of 18.7 mg/kg.

10.9.5 Fate and Transport Assessment for SWMU 81

SWMU 81 is the site of a former less-than-90-day accumulation area for hazardous waste. It is currently a flat, paved area next to the quay wall. Environmental media sampled as part of the SWMU 81 CSI include sediment from the Cooper River and concrete. Because no soil samples were collected at SWMU 81, the surface soil to sediment migration pathway was not investigated. Potential constituent migration pathways originating with Cooper River sediment will be examined in the Zone J RFI report.

10.9.6 Human Health Risk Assessment

Sediment and concrete samples were the only media sampled, therefore, a formal risk assessment was not conducted for SWMU 81.

10.9.7 Corrective Measures Considerations

For SWMU 81, sediment and concrete debris were investigated. All debris samples were collected from concrete pavement. Based on the analytical results, no COCs requiring further evaluation through the CMS process were identified. Residential use of the site is not expected based on current site uses and the nature of surrounding buildings. Current reuse plans call for continued commercial/industrial use as a marine cargo terminal and drydock.

Potential corrective measures for this SWMU are given in Table 10.9.7.1.

Table 10.9.7.1
Potential Corrective Measures for SWMU 81

Medium	Compounds	Potential Corrective Measures
Debris	None	No Action
Sediment	None	No Action