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CORRECTIVE MEASURES STUDY REPORT ZONE H AREA OF CONCERN 653 AND SOLID WASTE MANAGEMENT UNIT 159 CNC CHARLESTON SC

5/23/2000

ENSAFE INC.

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY CHARLESTON NAVAL COMPLEX NORTH CHARLESTON, SOUTH CAROLINA CTO-029

ZONE H, AOC 653 CORRECTIVE MEASURES STUDY REPORT AND ZONE H, SWMU 159 CORRECTIVE MEASURES STUDY REPORT

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NORTH CHARLESTON, SOUTH CAROLINA

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CERTIFICATION PAGE

REGISTERED SOUTH CAROLINA PROFESSIONAL GEOLOGIST AND PROFESSIONAL ENGINEER CERTIFICATION. I certify that the data and interpretations presented in this *Zone H, AOC 653 Corrective Measures Study Report and Zone H, SWMU 159 Corrective Measure Study Report* are true and accurate to the best of our knowledge as a registered South Carolina Professional Geologist and Engineer.

Henry Fellers, P.E.
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5/23/00
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Date

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EXECUTIVE SUMMARY for AOC 653

AOC 653 is a former leaking underground hydraulic fluid storage tank (40 gallons) at the west end of Building 1508, one of the four buildings that made up the former automotive hobby shop complex in Zone H's north portion. Typical hobby shop activities included minor automotive maintenance, repair, painting, and washing. Based on these activities, various paints, solvents, thinners, and petroleum products have been used and stored onsite.

This site was recently designated for a Corrective Measures Study (CMS) by the project team, which was concerned about arsenic exceeding its maximum contaminant level (MCL) in groundwater. Volatile organic compounds were later added to the monitoring program by the project team. The 1996 RCRA Facility Investigation (RFI) had earlier recommended this AOC for a CMS because soil exceeded the total petroleum hydrocarbon (TPH) threshold of 100 parts per million (ppm) and because groundwater arsenic exceeded the residential risk threshold of 1E-06. Although several sections of this report overlap and cross-reference one another, the report attempts to present information in chronological order, according to the primary investigative phase - RFI, interim stabilization measures (ISM), and CMS. Furthermore, groundwater risk has been reassessed to present current site risk after the ISM and supplemental CMS sampling.

Although site soil risk as determined during the RFI was less than 1E-06, groundwater risk was 7.8E-04. Its sole driver was arsenic in a single well (NBCH653001) at 38.6 micrograms per liter (μg/L), which was measured during the second round of RFI sampling. Using a single data point likely overestimates overall site groundwater risk. Furthermore, the groundwater risk associated with background arsenic (21.5 μg/L upper tolerance limit) is 4.4E-04. Note that current site groundwater risk, 1E-03, as defined in this CMS, is based on the third, not second, RFI sampling round because arsenic's maximum detection (54.1 μg/L) was in the third RFI round and the RFI presented risk based only on the first two sampling rounds.

The RFI contaminant fate-and-transport evaluation did not identify any concerns regarding potential arsenic migration, or migration of any contaminant from soil to groundwater. Furthermore, a site-specific fate-and-transport evaluation was completed as part of the RFI addendum for SWMU 136/AOC 663, a Zone H site with similar soil and hydrogeological properties. Results of this extensive evaluation provided a site-specific soil screening level of 17 milligrams per kilogram (mg/kg) for arsenic at SWMU 136/AOC 663. In comparison, arsenic's maximum concentration at AOC 653 was 14.9 mg/kg and its background value was 15.6 and 22.5 mg/kg for surface and subsurface soils. Therefore, the arsenic detected at AOC 653 reflects naturally occurring background.

Navy DET ISM were completed in December 1996, with a revised objective of meeting the South Carolina Department of Health and Environmental Control (SCDHEC) petroleum cleanup criteria and United States Environmental Protection Agency (USEPA) risk-based concentrations (RBCs). This objective was met by removing 700 cubic yards of soil from AOC 653 which was backfilled with clean soil. Both RFI monitoring wells (NBCH653001 and NBCH653002) and the leaking underground hydraulic fluid storage tank were also removed. Confirmation samples were collected to document that the remaining soil met the petroleum cleanup criteria and RBCs. Fifteen of 16 samples were in compliance with all petroleum-related organic RBC requirements.

During the CMS, a single new groundwater monitoring well (NBCH653003) was installed in the area where impact from former site activities was most likely, between NBCH653001 and NBCH653002 and immediately downgradient of the former storage tank's excavation pit. The west half of Building 1508 was removed during the ISM so the tank could be removed, meaning that the CMS well is in the general footprint of the west portion of the building. Supplemental groundwater monitoring was conducted for two quarters during the CMS to determine if arsenic was present in the groundwater and if remedial action was required. Two nearby grid well pairs, (NBCHGRD003/03D and NBCHGRD006/06D) are located within 600 feet crossgradient and were also analyzed at this time to provide additional background information for comparison purposes only. Arsenic concentrations in all five wells were below the MCL during both additional CMS sampling rounds in 1998 and 1999. Acetone was the only VOC detected in two rounds of CMS

supplemental groundwater sampling at the five wells. All other VOCs were below detection limits. During both sampling rounds at NBCHGDH003, acetone was detected (10 μg/L and 190 μg/L); both values are below its tap-water RBC of 610 μg/L. Furthermore, acetone (and methylene chloride) in Zone H laboratory and field blanks was extensively evaluated for SWMU 159, a companion site in this CMS report. Results indicated that the VOC detections were probably laboratory artifacts.

No further action is recommended for AOC 653 based on the results of the DET ISM, supplemental CMS sampling, comparison to site-specific soil screening levels at a similar site, and review of Zone H blank samples for acetone (and methylene chloride).

ACRONYMS

AOC	Area of Concern
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
CMS	Corrective Measures Study
COC	Chemical of Concern
COPC	Chemical of Potential Concern
CR	Cancer Risk
DET	Navy Environmental Detachment
EBS	Environmental Baseline Survey
EPC	Exposure Point Concentration
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
ILCR	Incremental Lifetime Excess Cancer Risk
IRIS	Integrated Risk Information System
ISM	Interim Stabilization Measures
LWA	Lifetime-Weighted Average
MCL	Maximum Contaminant Level
PAHs	Polycyclic Aromatic Hydrocarbons
RA	Risk Assessment
RBC	Risk-Based Concentration
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RfD	Reference Dose
RFI	RCRA Facility Investigation
SCDHEC	South Carolina Department of Health and Environmental Control
SPLP	Synthetic Precipitation Leachate Procedure
SSL	Soil Screening Level
SVOC	Semivolatile Organic Compound
SWMU	Solid Waste Management Unit
TPH	Total Petroleum Hydrocarbons

UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound
mg/kg	milligram per kilogram
ppm	parts per million
μg/kg	micrograms per kilogram
μg/L	microgram per liter

1.0 INTRODUCTION

Zone H, Area of Concern (AOC) 653 was recently designated for a Corrective Measures Study (CMS) by the project team, which was concerned about arsenic exceeding its maximum contaminant level (MCL) in groundwater. The Resource Conservation and Recover Act (RCRA) Facility Investigation (RFI), EnSafe 1996, had earlier recommended this AOC for a CMS because soil exceeded the total petroleum hydrocarbon (TPH) threshold of 100 parts per million (ppm) and because groundwater arsenic exceeded the residential risk threshold of 1E-06. These issues are further addressed in this report.

The CMS work plan (EnSafe, 1998) proposed that a single new groundwater monitoring well (NBCH653003) be installed in an area where arsenic was most likely to be in groundwater. This new well, and nearby grid well pairs NBCHGRD003/03D and NBCHGRD006/06D (about 600 feet crossgradient), would be monitored for two quarters for arsenic. It is not known if the grid wells are hydraulically connected to the site well. These nearby wells were used with approval of the project team to determine if a larger arsenic problem was apparent and as means for comparison to background arsenic. At a later date, the project team requested that groundwater volatile organic compounds (VOCs) also be monitored during the CMS. The additional groundwater monitoring would determine whether or not arsenic was present and whether groundwater remedial action is required.

In addition, fate-and-transport potential was extensively evaluated by comparing arsenic's site-specific soil screening level (SSL) from a similar Zone H site, Solid Waste Management Unit (SWMU) 136/AOC 663, to arsenic soil concentrations at AOC 653. This evaluation indicated that arsenic did not have a potential to migrate from soil to groundwater (Section 3.1.1).

The project team agreed that this additional site work would satisfy the requirements to complete both the RFI and CMS. Furthermore, the project team acknowledged the fact that this additional

CMS work is more characteristic of an RFI being used to document the results of the Navy DET ISM (Navy Environmental Detachment interim stabilization measure) than an actual CMS which screens and identifies remedial alternatives.

AOC 653 was designated for a CMS prior to the evaluation of the ISM completed by the Navy DET. The ISM was performed to remove petroleum-related soil contamination from the site. This CMS report addresses the results of both CMS activities and the Navy DET's ISM in terms of a final site remedy. Because the additional CMS activities determined that groundwater remedial action is not required, it was not necessary to identify and screen technologies or evaluate alternatives as part of this CMS report.

In summary, this CMS report addresses the following issues:

- *RFI Recommendations* — TPH in soil and residential risk from groundwater arsenic.

- *Project Team Concerns* — Arsenic, and to a lessor extent VOCs, in groundwater.

- *Navy DET ISM Objectives* — TPH-related constituents exceeding South Carolina Department of Health and Environmental Control (SCDHEC) petroleum cleanup criteria and United States Environmental Protection Agency (USEPA) Region III risk-based concentrations (RBCs).

- *CMS Objectives* — Arsenic and VOCs in groundwater.

2.0 SITE DESCRIPTION

AOC 653 is a former leaking underground hydraulic fluid storage tank (40 gallons) at the west end of Building 1508, one of the four buildings that made up the automotive hobby shop complex in Zone H's north portion. According to the RCRA Facility Assessment (RFA) and Environmental Baseline Survey (EBS), EnSafe 1995 and 1996 respectively, typical hobby shop activities included minor automotive maintenance, repair, painting and washing. Based on these activities, various paints, solvents, thinners and petroleum products have likely been used and stored onsite. Other structures in the complex include Buildings 636, 1347, 1493, and 1508. An aerial photograph and vicinity map showing the approximate location of the site on the southern portion of the former naval base is provided as Figure 1. The site is mostly covered by barrier materials such as buildings and asphalt, although grass and gravel cover some areas.

The site boundaries pertinent site features, and locations of other nearby AOCs and SWMUs, as applicable, are provided on Figure 2. The site and its history are briefly described below.

In 1972, the approximately 1,500-square-foot automobile hobby shop was constructed on fill material (dredge spoils) covered by soil or some other unconsolidated material. Before being filled in, the area was a marsh based on a 1939 aerial photograph. In 1974, the surface area was paved and auto lifts were added to the west end of Building 1508. The use of the underground hydraulic fluid storage tank was initially discontinued due to suspected leakage, as reported during the EBS. Approximately 100 gallons of hydraulic fluid are reported to have leaked from this steel tank during its 22 years. The Navy DET removed the tank from the site during 1996 ISM, described in Section 3. Numerous stains and petroleum odors were noted near the hobby shop during the EBS. Two other 40-gallon aboveground hydraulic fluid storage tanks were located on the site as well. However, neither is known to have released any product.

ZONE H, AOC 653, CHARLESTON NAVAL COMPLEX, CHARLESTON, SC - JUNE 1998

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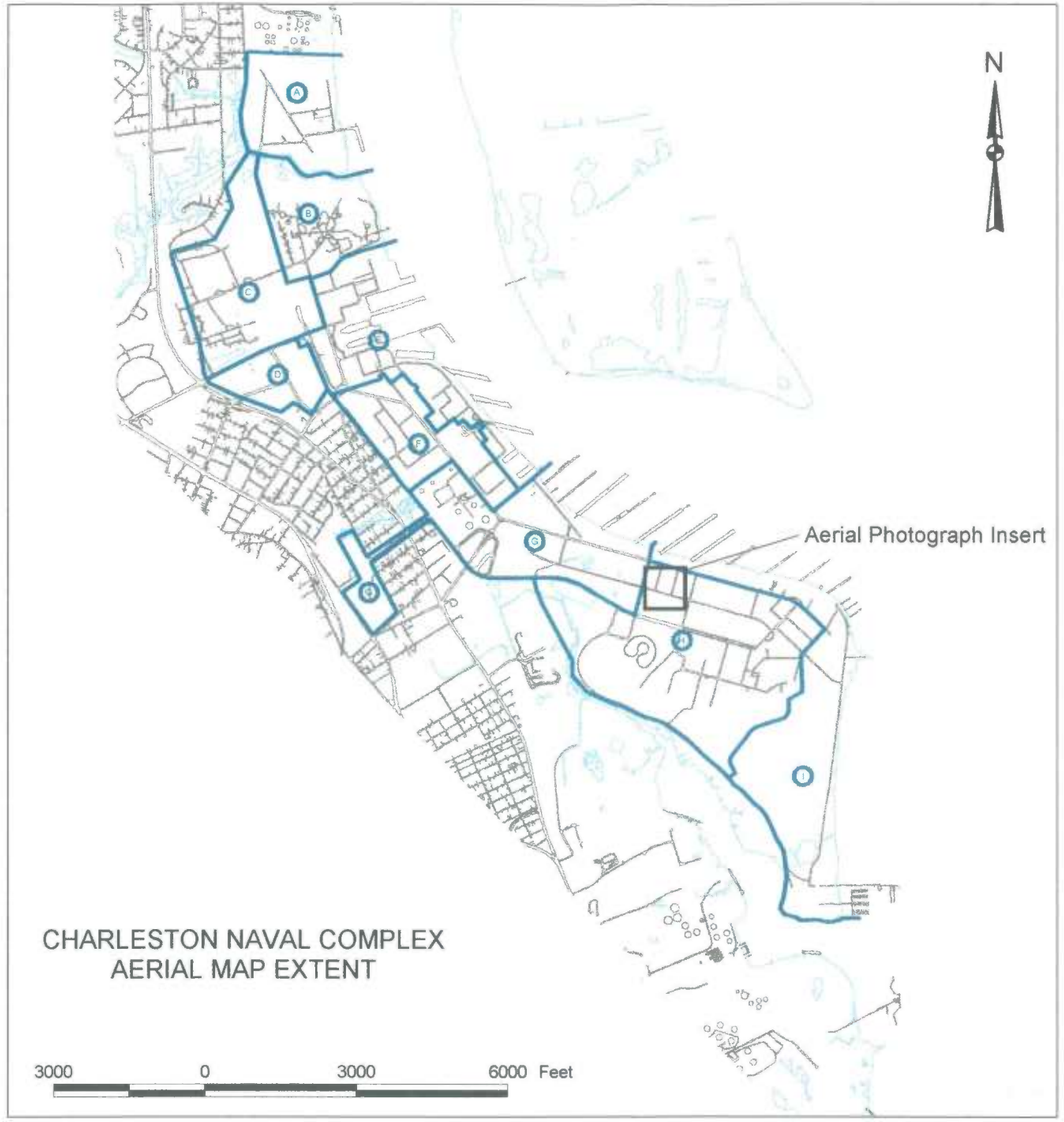

AOC 653
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Figure 1

AOC 653 Aerial and Vicinity Map

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FIGURE 2
AOC 653 AND
ADJACENT AREAS OF INVESTIGATION

Dr by: W. FAULK	Tr by: --	
Ck by: L. BOWERS	Appr by: T. HAVERKOST	Sheet 1
Date: 05/22/00	DWG Name: 2908C062	Of 1

2.1 Current Use

The site is currently used for boat and trailer storage by the United States Coast Guard, a recent federal tenant of the former naval base. The area excavated by the DET ISM has since been backfilled with sand and gravel. Most surrounding surface areas are paved.

2.2 Future Use

According to the Charleston Naval Complex Redevelopment Authority, this area will likely be used for industrial purposes in the future, which is consistent with its current use.

3.0 PREVIOUS INVESTIGATIVE ACTIVITIES

As stated in Section 2, various paints, solvents, thinners and petroleum products have been used and stored onsite. Furthermore, the auto hobby shop's underground hydraulic fluid storage tank was also suspected of leaking and subsequently removed for appropriate offsite disposal.

Based on the observations listed above, a RCRA RFI was recommended. The site was also the subject of a Navy DET ISM in 1996 and 1997, and supplemental CMS sampling in 1998 and 1999. The RFI and ISM results are summarized below. The supplemental CMS sampling is discussed in Section 4.

3.1 RCRA Facility Investigation

The RFI sampling strategy was intended to assess the entire area potentially impacted by either the underground hydraulic fluid storage tank or the other fluids stored and used at the site (paints, solvents, thinners, and petroleum products). Generally, soil boring locations are proposed for areas where visual observations during the EBS and EnSafe's RFA indicate that site operations have the highest potential to adversely impact the environment, and around the perimeter of the expected area of contamination (Figure 3). The RFI work plan shows where soil and groundwater sample points were located. No sediment or surface water was available to sample at AOC 653.

In brief, soil samples were proposed from the underground hydraulic fluid storage tank area on the west end of Building 1508 and throughout the site to provide ample coverage for potential releases from former site operations. Soil samples were also proposed in an expanded area along the site's perimeter to provide additional spatial coverage. The samples were obtained from the upper and lower intervals (i.e., 1st and 2nd interval) representing the 0- to 1-foot and 3- to 5-foot depths, respectively. Two shallow RFI groundwater monitoring wells (NBCH653001 and NBCH653002) were installed near the center of the site and within an area likely to have been impacted by site activities.

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FIGURE 3
AOC 653
SAMPLE LOCATION MAP

Dr by: W. FAULK	Tr by: –	
Ck by: L. BOWERS	Appr by: T. HAVERKOST	Sheet 1
Date: 05/22/00	DWG Name: 2908C083	Of 1

The RFI Report which documented AOC 653 sampling, was originally submitted on July 5, 1996. The report was conditionally approved by the SCDHEC August 28, 1997. A complete analytical report for AOC 653 soil and groundwater samples is included in Appendix I of the RFI report. Tables 3.1 to 3.4 are presented here *only to summarize* the RFI results. Section 4 summarizes all six groundwater samplings (four RFI quarters and two CMS quarters) for the primary constituent of concern; arsenic.

Table 3.1
Zone H RFI (1996)
AOC 653
Organic Compounds in Soil (μg/kg)

Compound Name	Number of Detections (1st Interval/2nd Interval)	Range of Concentrations for Detections (1st Interval/2nd Interval)	Risk-Based Screening Level
Volatile Organic Compounds ***(6 Samples Collected — 4 Upper Interval Samples, 2 Lower Interval Samples, 1 Sample Duplicated)***			
Acetone	4/2	25-131.5/76-83	780,000
2-Butanone (MEK)	1/2	23.4/13-14	4,700,000
4-Methyl-2-Pentanone (MIBK)	1/0	1.6/0	390,000
Toluene	4/1	6-20/7	1,600,000
Xylene (total)	1/0	2.2/0	16,000,000
Acrylonitrile[a]	1/0	23.9/0	1,200
Semivolatile Organic Compounds ***(12 Samples Collected – 7 Upper Interval Samples, 5 Lower Interval Samples, 2 Samples Duplicated)***			
Benzo(a)anthracene	0/2	0/100-150	880
Benzo(b)fluoranthene	0/2	0/120-140	880
Benzo(k)fluoranthene	0/1	0/190	8,800
Benzo(a)pyrene	1/1	110/140	88
BEHP	4/1	110-6,695/110	46,000
4-Bromophenyl-phenylether	0/1	0/500	450,000
Butylbenzylphthalate	1/0	110/0	1,600,000
Chrysene	0/2	0/100-160	88,000
Fluorene	1/0	441/0	310,000
Fluoranthene	0/2	0/170-260	310,000
2-Methylnaphthalene	1/0	1,520/0	310,000

Table 3.1
Zone H RFI (1996)
AOC 653
Organic Compounds in Soil (μg/kg)

Compound Name	Number of Detections (1st Interval/2nd Interval)	Range of Concentrations for Detections (1st Interval/2nd Interval)	Risk-Based Screening Level
4-Methylphenol	1/0	260/0	39,000
Naphthalene	1/0	739/0	310,000
4-Nitrophenol	0/1	0/2,500	480,000
Phenanthrene	1/2	711/170-200	310,000
Pyrene	2/2	110-801/290-370	230,000
Pesticides *(12 Samples Collected – 7 Upper Interval Samples, 5 Lower Interval Samples, 2 Samples Duplicated)*			
4,4'-DDD	6/1	8-180/9	2,700
4,4'-DDE	7/1	5.8-320/8	1,900
alpha-Chlordane	2/0	2-2/0	470
gamma-Chlordane	3/0	3-4/0	alpha + gamma
Polychlorinated Biphenyls *(13 Samples Collected – 8 Upper Interval Samples, 5 Lower Interval Samples, 1 Sample Duplicated)*			
Aroclor-1248	1/0	88/0	83
Aroclor-1260	1/0	71/0	83
Total Petroleum Hydrocarbons *(6 Samples Collected – 4 Upper Interval Samples, 2 Lower Interval Samples, 1 Sample Duplicated)*			
Total Petroleum Hydrocarbons	5/2	730,000-42,000,000/400,000-440,000	Not Listed
Herbicides *(1 Duplicate Analysis – 1 Upper Interval Sample)*			
No herbicides detected.			
Organophosphate Pesticides *(1 Duplicate Analysis – 1 Upper Interval Sample)*			
Methyl parathion	1/0	33.2/0	2,000
Dioxins *(9 Samples Collected – 5 Upper Interval Samples, 4 Lower Interval Samples)*			
Total TEQ Values	5/4	1.489-43.411pg/g 0.541-8.068 pg/g	1,000 pg/g

Notes:

[a] = Compound included in the Appendix IX analysis but not in the SW-846 analysis.
TEQ = total equivalent
pg/g = picogram per gram
μg/kg = microgram per kilogram

Table 3.2
Zone H RFI (1996)
AOC 653
Inorganic Elements in Soil (mg/kg)

Inorganic Elements	Number of Analyses (1st Interval/2nd Interval)	Number of Detections (1st Interval/2nd Interval)	Range of Concentrations for Detections (1st Interval/2nd Interval)	Risk-Based Screening Level	Upper Tolerance Limit Background[c] (1st Interval/2nd Interval)
Aluminum[a]	4/2	4/2	2,590-4,580/10,100-13,400	7,900	25,310/46,180
Iron[a]	4/2	4/2	3,520-9,050/16,700-19,900	Not Listed	30,910/66,170
Lead	4/2	4/2	38.2-561/44.2-53.5	400	118/68.69
Nickel	4/2	4/2	5.5-12.7/8.1-8.3	160	33.38/29.9
Potassium[a]	4/2	0/0	0/0	Not Listed	Nutrient[e]
Silver	4/2	0/0	0/0	39	Not Valid[d]
Sodium[a]	4/2	4/2	117-460/865-1,460	Not Listed	Nutrient[e]
Thallium	4/2	0/0	0/0	0.63	0.63/1.3
Antimony	4/2	0/0	0/0	3.1	Not Valid[d]
Arsenic	4/2	4/2	4.7-9.3/14.1-14.9	0.43	15.6/22.5
Barium	4/2	3/2	36.1-49.8/20.6-24.2	550	40.33/43.80
Beryllium	4/2	4/2	0.26-0.39/0.72-0.75	0.15	1.466/1.62
Cadmium	4/2	3/0	0.70-0.94/0	3.9	1.05/1.10
Cobalt	4/2	4/2	1.9-5.4/4.7-4.9	470	5.863/14.88
Copper	4/2	4/2	7.7-25.35/17.2-18	290	27.6/31.62
Vanadium	4/2	4/2	12-18/38.3-39.9	55	77.38/131.6
Zinc	4/2	4/2	55.3-165.5/68.4-78.8	2,300	214.3/129.6
Selenium	4/2	0/0	0/0	39	2.0/2.7
Mercury	4/2	4/2	0.03-0.22/0.23-0.24	2.3	0.485/.74
Magnesium[a]	4/2	4/2	430-2,470/2,920-3,000	Not Listed	9,592/9,179
Manganese[a]	4/2	4/2	27.8-233/172-418	39	636.4/1,412
Calcium	4/2	4/2	18,400-225,000/9,020-12,000	Not Listed	Nutrient[e]
Chromium	4/2	4/2	11.5-18.2/21-23.5	39	85.65/83.86
Tin[a]	1/0	0/0	0/0	4,700	Not Valid[d]
Hexavalent Chromium[b]	1/0	0/0	0/0	39	Not Valid[d]

Table 3.2
Zone H RFI (1996)
AOC 653
Inorganic Elements in Soil (mg/kg)

Inorganic Elements	Number of Analyses (1st Interval/2nd Interval)	Number of Detections (1st Interval/2nd Interval)	Range of Concentrations for Detections (1st Interval/2nd Interval)	Risk-Based Screening Level	Upper Tolerance Limit Background[c] (1st Interval/2nd Interval)
Cyanide	4/2	0/0	0/0	160	Not Valid[d]

Notes:
[a] = Elements that are not included in both SW-846 and Appendix IX methods.
[b] = Included in duplicate sample analyses only.
[c] = See Appendix J of the RFI for upper tolerance limit (UTL) determination.
[d] = Number of nondetections prevented determination of UTL.
[e] = Elements considered to be nutrients; therefore, UTL was not determined.
mg/kg = Milligrams per kilogram

Table 3.3
Zone H RFI (1996)
AOC 653
Organic Compounds in Groundwater (μg/L)

Round 1: 2 Samples Collected, 0 Samples Duplicated
Round 2: 2 Samples Collected, 1 Sample Duplicated
Round 3: 2 Samples Collected, 0 Samples Duplicated
Round 4: 2 Samples Collected, 0 Samples Duplicated

Compound Name	Sampling Round	Number of Detections	Range of Concentrations for Detections	Risk-Based Screening Level	Max. Contam. Level
Volatile Organic Compounds (collected in round 1 only)					
No VOCs detected.					
Semivolatile Organic Compounds (collected in rounds 1, 2, 3 and 4)					
Benzoic acid	4	1	1.0	15,000	
bis(2-Ethylhexyl)phthalate (BEHP)	2	1	2.9	4.8	
Pesticides (collected in rounds 1, 2, 3 and 4)					
4,4'-DDT	1	1	0.06	0.2	
Polychlorinated Biphenyls (collected in rounds 1 and 4)					
No PCBs detected.					
Total Petroleum Hydrocarbons (collected in round 1 only)					
No TPH detected.					

Table 3.4
Zone H RFI (1996)
AOC 653
Inorganic Elements in Groundwater (μg/L)

Round 1: 2 Samples Collected, 0 Samples Duplicated
Round 2: 2 Samples Collected, 1 Sample Duplicated
Round 3: 2 Samples Collected, 0 Samples Duplicated
Round 4: 2 Samples Collected, 0 Samples Duplicated

Compound Name	Sampling Round	Number of Detections	Range of Concentrations for Detections	Risk-Based Screening Level	Upper Tolerance Limit of Background[b]	Max. Contam. Level
Aluminum [c]	1	0	—	3,700	Not Valid	Not Listed
	2	2	189-248			
	3	0	—			
	4	0	—			
Arsenic	1	0	—	0.045	21.5	50
	2	1	38.6			
	3	2	23.4-54.1			
	4	2	10.1-45.0			
Calcium[d]	1	2	44,300-108,000	Not Listed	Nutrient	Not Listed
	2	2	567,000-942,000			
	3	2	57,300-100,000			
	4	2	77,500-107,000			
Iron	1	2	6,230-9,280	Not Listed	45,760	Not Listed
	2	2	9,510-10,550			
	3	2	8,120-11,500			
	4	2	8,850-14,500			
Magnesium	1	2	59,900-86,200	Not Listed	3,866,000	Not Listed
	2	2	60,600-66,850			
	3	2	48,900-64,300			
	4	2	65,000-68,100			
Manganese	1	2	90.6-672	18	3,391	Not Listed
	2	2	128-680			
	3	2	109-719			
	4	2	154-779			
Potassium[d]	1	2	52,300-58,200	Not Listed	Nutrient	Not Listed
	2	2	37,850-44,300			
	3	2	42,000-45,600			
	4	2	36,100-44,700			
Selenium	1	2	0.9-1.2	18	3.154	50
	2	0	—			
	3	0	—			
	4	0	—			
Sodium[d]	1	2	598,000-707,000	Not Listed	Nutrient	Not Listed
	2	2	476,500-539,000			
	3	2	370,000-501,000			
	4	2	453,000-524,000			

Table 3.4
Zone H RFI (1996)
AOC 653
Inorganic Elements in Groundwater (μg/L)

Round 1: 2 Samples Collected, 0 Samples Duplicated
Round 2: 2 Samples Collected, 1 Sample Duplicated
Round 3: 2 Samples Collected, 0 Samples Duplicated
Round 4: 2 Samples Collected, 0 Samples Duplicated

Compound Name	Sampling Round	Number of Detections	Range of Concentrations for Detections	Risk-Based Screening Level	Upper Tolerance Limit of Background[b]	Max. Contam. Level
Thallium	1	1	1.2	0.29[e]	7.660	2
	2	0	—			
	3	0	—			
	4	1	2.8			
Vanadium[c]	1	1	4.6	26	Not Valid	Not Listed
	2	0	—			
	3	0	—			
	4	0	—			
Cyanide[c]	1	—	Not Detected			
	2	—	No Analysis			
	3	—				
	4	—				

Notes:
[a] = Only elements with detections are listed. Cyanide was a separate analysis.
[b] = See Appendix J of the RFI for UTL determinations.
[c] = High percentage of nondetects in background samples prevented determination of UTL.
[d] = Element considered to be a nutrient; therefore, UTL was not determined.
[e] = Thallium carbonate used as surrogate.
μg/L = Micrograms per liter.

3.1.1 RFI Contaminant Fate and Transport

The possibility of AOC 653 soil-to-groundwater, groundwater-to-surface-water and soil-to-air cross-media transport routes was evaluated during the RFI. None of these contaminant transport routes was considered to be a concern for this site.

Furthermore, arsenic was detected in four surface samples at concentrations ranging from 4.7 to 9.3 mg/kg and in two subsurface samples at concentrations ranging from 14.1 to 14.9 mg/kg. The upper tolerance limit (UTL) background value for arsenic in Zone H is 15.6 mg/kg for surface soil

and 22.5 mg/kg for subsurface soil. Therefore, the arsenic detected at AOC 653 reflects naturally occurring background levels.

As yet another means to assess arsenic's potential to leach from soil to groundwater, AOC 653 soil arsenic concentrations were compared to site-specific SSLs for SWMU 136/AOC 663 soil. This comparison is theoretically valid because each site is in Zone H and has similar soil and hydrogeologic characteristics. Site-specific SSLs can be determined by two methods: (1) calculating an emperically derived value through a site-specific leaching test using the synthetic precipitation leachate procedure (SPLP) and (2) calculating a theoretical value using site-specific soil and hydrogeological values and soil-to-water partitioning equation. The site-specific SSL calculated by the SPLP method at SWMU 136/AOC 663 was 1,500 mg/kg (dilution attenuation factor of 11) and 17 mg/kg (same dilution attenuation factor) using the partitioning equation. The most conservative of these two values, 17 mg/kg, exceeds the highest arsenic concentration (14.9 mg/kg) at AOC 653. This screening level is so conservative that even arsenic's subsurface background UTL of 22.5 mg/kg exceeds it.

3.1.2 RFI Ecological Risk Assessment

No ecological risk is anticipated for AOC 653 because of the lack of suitable habitat and ecological receptors.

3.1.3 RFI Human Health Risk Assessment

Surface soil risk at AOC 653 is less than 1E-06 (i.e., 9.1E-07). The primary drivers were BEQs and the Aroclors-1248 and -1260, which were all detected in only one of the seven surface samples collected (653SB001). Samples from around 653SB001 did not contain any detections of these constituents. Furthermore, the soil associated with this sample, and approximately 700 cubic yards of surrounding soil, were subsequently removed from the site, along with petroleum-impacted soil, during the Navy DET ISM (Figure 4).

Groundwater risk at the site during the RFI was determined to be 7.8E-04. The sole driver was arsenic in a single well (NBCH653001) at 38.6 micrograms per liter (μg/L). This value was determined during the second RFI sampling round. The use of this single data point (one well, one quarter) likely overestimates overall site groundwater risk. Furthermore, the groundwater risk associated with background arsenic (21.5 μg/L UTL) is 4.4E-04. Current site groundwater risk, 1E-03, as defined in Section 5, is based on the third, not second, RFI sampling because the maximum arsenic detection (54.1 μg/L) was in the third RFI round and the RFI presented risk based only on the first two rounds of sampling.

Table 3.5 summarizes risk and hazard for the combined incidental ingestion and dermal pathways for AOC 653 soil and groundwater, as presented in the RFI. Note that this table represents risk before the Navy DET ISM to be described in the following section. The excavation activities completed by the Navy DET, in December 1996, removed approximately 700 cubic yards of petroleum-impacted site material. As described in Section 5, site groundwater risk did not significantly change as a result. However, arsenic did not exceed the MCL during the two supplemental CMS sampling rounds and background groundwater risk still remains at 4.4E-04 which far exceeds 1E-06. Residual soil risk post the ISM would likely have further departed from the 1E-06 threshold.

3.1.4 RFI Recommendation

The RFI recommended a CMS for AOC 653 because soil TPH concentrations exceeded 100 mg/kg and groundwater residential risk exceeded 1E-06. However, the exceedance of the groundwater risk threshold was caused by arsenic, a naturally occurring inorganic, which marginally exceeded its MCL only during the third of four RFI sampling rounds. This resulted in a risk that slightly exceeded the background risk of 4.4E-04. Even background levels of groundwater arsenic (21.5 μg/L) exceed the 1E-06 risk threshold.

Table 3.5
Zone H RFI (1996)
Summary of
Carcinogenic Risk and Noncarcinogenic Hazard
and Identification of Chemicals of Concern
AOC 653 Surface Soil and Groundwater

Medium/Pathway	Chemical	Potential Future Resident Adult Hazard Quotient	Potential Future Resident Child Hazard Quotient	Potential Future Resident LWA ILCR	Site Worker Hazard Quotient	Site Worker ILCR
Soil/Incidental Ingestion	Aroclor-1248	ND	ND	2.1E-07	ND	2.4E-08
	Aroclor-1260	ND	ND	1.7E-07	ND	1.9E-08
	Benzo(a)pyrene Eqv.	ND	ND	2.5E-07	ND	2.8E-08
Soil/Incidental Ingestion Pathway Total		**ND**	**ND**	**6.3E-07**	**ND**	**7.1E-08**
Soil/Dermal Contact	Aroclor-1248	ND	ND	9.5E-08	ND	3.9E-08
	Aroclor-1260	ND	ND	7.7E-08	ND	3.1E-08
	Benzo(a)pyrene Eqv.	ND	ND	1.1E-07	ND	4.6E-08
Soil/Dermal Contact Pathway Total		**ND**	**ND**	**2.8E-07**	**ND**	**1.2E-07**
Shallow Groundwater/Ingestion	Arsenic	3.2	7.4	7.8E-04	1.1	1.8E-04
Shallow Groundwater/Ingestion Pathway Total		**3.2**	**7.4**	**7.8E-04**	**1.1**	**2E-04**
All Pathways Cumulative Total Risk/Hazard		**3.2**	**7.4**	**7.8E-04**	**1.1**	**2E-04**

Notes:
ND = Not determined due to lack of available information.
NA = Not applicable.
LWA = Lifetime-weighted average.
ILCR = Incremental lifetime excess cancer risk.

3.2 Navy DET ISM

Interim stabilization measures were conducted by the Navy DET in December 1996; their purpose is to eliminate sources of environmental contamination or to limit the spread of environmental contaminants before completion of the CMS. Although total petroleum hydrocarbons (TPH) was not identified as a chemical of concern (COC), it was detected in all soil samples; the highest concentration (42,000 milligrams per kilogram [mg/kg]) was at sample location 653SB003. TPH also exceeded its 100 mg/kg screening level in all four surface interval samples. Only two second-

interval samples were analyzed for TPH; it exceeded the screening level in both. Based on this level of petroleum-related contamination, the project team decided to implement an ISM at this site.

The Navy DET's 1997 site completion report includes background information, cleanup criteria, figures of the excavation areas and confirmation sampling locations, and analytical results of the confirmation sampling and stock-piled soils characterization.

3.2.1 ISM Objective

Based on the original guidance for soil excavation, the primary objective of the ISM was to remove and dispose of any petroleum-related soil contamination in which TPH exceeded 100 mg/kg. During interim measures, the project team changed the controlling guidance for soil excavation to soil with petroleum-related contamination exceeding SCDHEC Soil and Groundwater Petroleum Remediation Guidance (March 1996) criteria and the USEPA Region III RBCs. This change resulted in a risk-based ISM cleanup directed at VOCs (BTEX [benzene, toluene, ethylbenzene and xylene] and naphthalene) and SVOCs (PAHs [polycyclic aromatic hydrocarbons]).

Though the ISM objective did not specifically target the removal of soil impacted by BEQs and Aroclor-1248, and -1260 at AOC 653 (i.e., sample 653SB001), this soil and approximately 700 cubic yards of soil surrounding 653SB001 were removed. Analysis of soil from the RFI samples taken from around 653SB001 prior to the ISM did not contain BEQs or Aroclor-1248, or -1260.

3.2.2 ISM Components

The following activities were conducted as part of the Navy DET's interim measures at AOC 653:

- A metal structure housing the hydraulic lifts on the west side of Building 1508 was removed and disposed of.

- Two RFI groundwater monitoring wells (NBCH653001 and NBCH653002) were removed to avoid cross contamination during soil excavation.

- Approximately 4,500 square feet (ft^2) of asphalt were removed and disposed of.

- Approximately 1,000 ft^2 of concrete from a pad were removed and disposed of.

- All hydraulic components, including rams, supply tanks and a vault were removed, decontaminated and disposed of.

- An estimated 700 cubic yards of petroleum-impacted soil were removed. The soil was visibly stained and contaminated with TPH at concentrations exceeding 100 mg/kg.

- Confirmation samples were taken of the remaining sidewalls and bottom of the excavated area to ensure compliance with the SCDHEC petroleum cleanup criteria and USEPA RBCs.

- The site was cleared of all visible debris and all excavated areas were backfilled with clean soil.

- All excavated soil was sampled and characterized as nonhazardous and stockpiled onsite subsequent to offsite disposal.

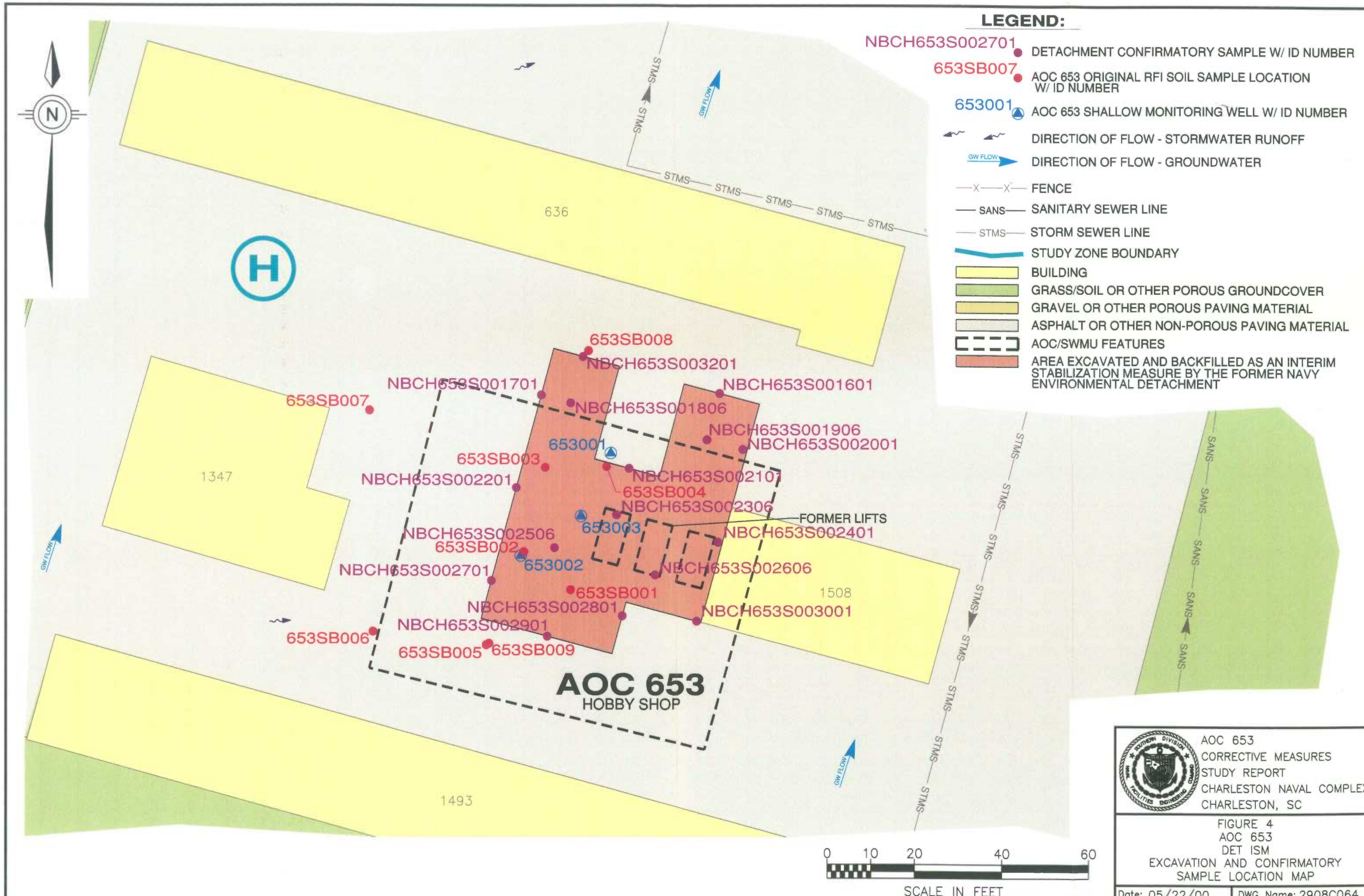
3.2.3 ISM Confirmation Sampling

The RFI soil investigation findings were used to determine where to begin excavating. Figure 4 shows the excavation area. Immunoassay field samples were taken during excavation as a field screening to determine whether petroleum-related contaminants were present.

Following excavation, 16 confirmatory samples were collected from the bottom and sidewalls of all four excavated areas and analyzed for five volatile compounds (the 4 BTEX constituents and naphthalene), 16 extractable organics (PAHs), eight RCRA metals and TPH. All 16 samples were below the detection limits for BTEX and naphthalene. Thirteen samples were below the detection limits for all PAHs. Of the three samples in which PAHs were detected, only one confirmation sample contained a benzo(a)pyrene detection (285 μg/kg) exceeding the residential RBC (88 μg/kg). Although all 16 confirmation samples exceeded arsenic's RBC, only one (38.2 mg/kg) exceeded its background reference concentration (15.6 and 22.5 mg/kg for upper and lower intervals). This sample (NBCH653002101) was obtained from a southerly extending appendage off the excavation's north wall. Arsenic did not exceed background in any surrounding confirmation sample. All other metals were below the residential RBC.

No COCs were identified for surface soil. The revised objective of achieving SCDHEC petroleum cleanup criteria and USEPA RBCs was met by removing 700 cubic yards of soil from AOC 653, which was then filled with clean soil. Confirmation sampling was performed to document that the remaining soil meets SCDHEC petroleum cleanup criteria and USEPA RBC requirements. Fifteen of the 16 samples were in compliance with petroleum-related organic RBC requirements.

Furthermore, it's important to note that the primary health-related and regulated issues associated with TPH involve BTEX, PAHs, and naphthalene. All these constituents are considered during the RFI risk assessment process. As previously stated, site risk *prior* to the ISM was already less than 1E-06.


LEGEND:
NBCH653S002701 DETACHMENT CONFIRMATORY SAMPLE W/ ID NUMBER
653SB007 AOC 653 ORIGINAL RFI SOIL SAMPLE LOCATION W/ ID NUMBER
653001 AOC 653 SHALLOW MONITORING WELL W/ ID NUMBER
DIRECTION OF FLOW - STORMWATER RUNOFF
GW FLOW DIRECTION OF FLOW - GROUNDWATER
FENCE
SANS SANITARY SEWER LINE
STMS STORM SEWER LINE
STUDY ZONE BOUNDARY
BUILDING
GRASS/SOIL OR OTHER POROUS GROUNDCOVER
GRAVEL OR OTHER POROUS PAVING MATERIAL
ASPHALT OR OTHER NON-POROUS PAVING MATERIAL
AOC/SWMU FEATURES
AREA EXCAVATED AND BACKFILLED AS AN INTERIM STABILIZATION MEASURE BY THE FORMER NAVY ENVIRONMENTAL DETACHMENT
N
H
636
1347
1508
1493
STMS
SANS
GW FLOW
653SB008
NBCH653S003201
NBCH653S001701
NBCH653S001601
653SB007
NBCH653S001806
NBCH653S001906
NBCH653S002001
653001
653SB003
NBCH653S002201
NBCH653S002101
653SB004
NBCH653S002306
FORMER LIFTS
653003
NBCH653S002401
NBCH653S002506
653SB002
653002
NBCH653S002606
NBCH653S002701
653SB001
NBCH653S002801
NBCH653S003001
NBCH653S002901
653SB006
653SB005
653SB009
AOC 653
HOBBY SHOP
0 10 20 40 60
SCALE IN FEET
AOC 653
CORRECTIVE MEASURES
STUDY REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC
FIGURE 4
AOC 653
DET ISM
EXCAVATION AND CONFIRMATORY
SAMPLE LOCATION MAP
Date: 05/22/00
DWG Name: 2908C064

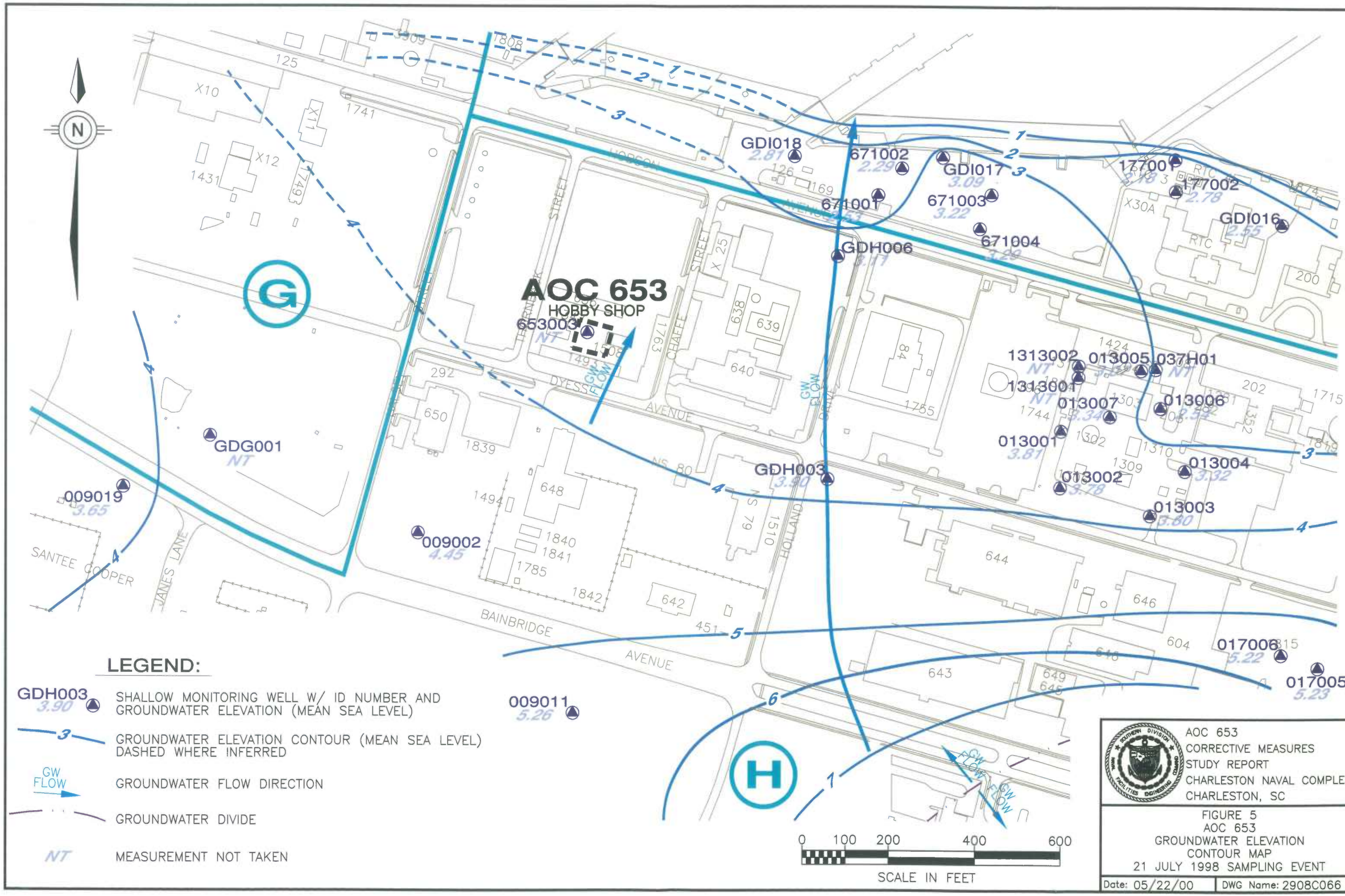
4.0 SUPPLEMENTAL CMS SAMPLING

Arsenic is the sole contributor to groundwater risk and hazard at this site. Therefore, the project team requested additional groundwater sampling at AOC 653 during the CMS (i.e., supplemental CMS sampling). The influence of naturally occurring groundwater iron on site hazard is discussed in Section 5. At a later date, the project team also requested that VOCs be monitored at the site.

4.1 Activities

During the Navy DET ISM, both RFI groundwater monitoring wells (NBCH653001 and NBCH653002) were removed to facilitate soil excavation. Based on the project team's concern about arsenic in groundwater, a single new groundwater monitoring well (NBCH653003) was installed in the area most likely to have been impacted by former site activities. This CMS well was constructed immediately downgradient of former well NBCH653002 and the former underground hydraulic fluid storage tank excavation pit. It was approximately halfway between the two former RFI wells. The west half of Building 1508 was removed during the ISM so the tank could be removed; in essence the CMS well (NBCH653003) is also in the general footprint of the west portion of the building. Flow direction for groundwater at AOC 653 is mostly from south to north toward the Cooper River (Figure 5). Groundwater was monitored two additional quarters during the CMS to determine whether or not arsenic is in the groundwater and to determine if remedial action was required.

Two nearby grid well pairs (NBCHGRD003/03D and NBCHGRD006/06D) were also analyzed during the two additional rounds of CMS sampling *only* to provide additional background information for comparison to site data. The grid wells, which are within 600 feet crossgradient of the single AOC 653 well, NBCH653003, are screened at the same depth range in the same shallow unconfined aquifer as the single CMS site well. Figure 3 shows the location of all current and previous monitoring wells.


N
AOC 653
HOBBY SHOP
653003
GDI018
2.81
671002
2.29
GDI017
3.09
671001
671003
3.22
671004
GDH006
177001
177002
2.78
GDI016
2.55
1313002
013005
037H01
1313001
013007
013006
013001
3.81
013004
3.32
013002
3.78
013003
3.80
GDH003
3.90
GDG001
NT
009019
3.65
009002
4.45
009011
5.26
017006
5.22
017005
5.23
GW FLOW
HOBBY SHOP STREET
DYESS AVENUE
CHAFFEE AVENUE
HOLLAND
BAINBRIDGE AVENUE
SANTEE COOPER
JAMES LANE
G
H
LEGEND:
GDH003 3.90 SHALLOW MONITORING WELL W/ ID NUMBER AND GROUNDWATER ELEVATION (MEAN SEA LEVEL)
3 GROUNDWATER ELEVATION CONTOUR (MEAN SEA LEVEL) DASHED WHERE INFERRED
GW FLOW GROUNDWATER FLOW DIRECTION
GROUNDWATER DIVIDE
NT MEASUREMENT NOT TAKEN
0 100 200 400 600
SCALE IN FEET
AOC 653
CORRECTIVE MEASURES
STUDY REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, SC
FIGURE 5
AOC 653
GROUNDWATER ELEVATION
CONTOUR MAP
21 JULY 1998 SAMPLING EVENT
Date: 05/22/00
DWG Name: 2908C066

4.2 Results

Arsenic concentrations in all five wells (one site well and two nearby grid well pairs) were below the MCL in both additional CMS sampling rounds (1998 and 1999). Acetone was the only VOC detected in two rounds of CMS supplemental groundwater sampling at the five wells. All other VOCs were below detection limits. During both sampling rounds at NBCHGDH003, acetone was detected (10 μg/L and 190 μg/L); both values are below its tap-water RBC of 610 μg/L. Furthermore, an extensive evaluation regarding acetone (and methylene chloride) in laboratory and field blanks is presented in Section 4.2.1 of the SWMU 159 CMS report (a companion site to this report).

The chain-of-custody form, validation form, and analytical report for supplemental CMS sampling are provided in Appendix A. Table 4.1 summarizes the groundwater trend data obtained during the RFI and CMS for the three site wells and two nearby grid well pairs.

Table 4.1
AOC 653 CMS (1999)
Groundwater Trend Data for AOC 653 and Nearby Grid Wells
Arsenic (μg/L)

Well ID	1st Round 11/94	2nd Round 3-4/95	3rd Round 9-10/95	4th Round 3-4/96	5th Round 7-11/98	6th Round 11/98-1/99	Range	MCL Exceedances (>50 μg/L)	Background Exceedances (>21.5 μg/L)
Site Wells									
NBCH653001	28.4U	38.6	**54.1**	45	A	A	ND - 54.1	1	3
NBCH653002	14.3U	17UJ	23.4	10.1	A	A	ND - 23.4	0	1
NBCH653003	NI	NI	NI	NI	9.2J	3.8J	3.8 - 9.2	0	0
Nearby Grid Wells									
NBCHGRD003	26.6U	24.8	41J	42.1	43	41.9	ND - 43	0	5
NBCHGRD003D	3.8U	2.6U	2.6U	4.6U	4.6U	2.9U	ND	0	0
NBCHGRD006	7.2J	7.3	42.7	27.8	13.9U	49.6	ND - 49.6	0	3
NBCHGRD006D	8.2J	2.6U	–	–	4.5U	2.9U	ND - 8.2	0	0

Notes:

U	=	The material was analyzed but, not detected at the listed numerical quantitation limit.
UJ	=	The material was analyzed but, not detected at the estimated numerical quantitation limit.
J	=	The associated numerical value is an estimated quantity.
A	=	Well was not available for sampling because it was removed during the Navy DET ISM.
NI	=	Well was not available for sampling because it was not yet installed.
Bold	=	MCL exceedance.

5.0 CURRENT SITE RISK

5.1 Abstract

The 1996 final RFI baseline human health risk assessment (HHRA) for AOC 653 evaluates groundwater exposure based on the results of two rounds of samples collected from 1994 to 1996 from two monitoring wells. The original shallow groundwater samples were analyzed for various compounds such as inorganics, VOCs, SVOCs, pesticides, and dioxins.

In the original HHRA for AOC 653, arsenic was the only chemical of potential concern (COPC) identified for a groundwater exposure pathway. During the Charleston Naval Complex investigation, a chemical was determined to be a groundwater COPC if the maximum detected concentration exceeded its tap-water RBC (USEPA, 1999) and any applicable background concentration. The tap-water RBC is the concentration of a given chemical in drinking water that is not expected to cause toxic effects based on conservative USEPA default consumption rates. Based on the revised screening comparisons, arsenic and iron were identified as COPCs.

No CMS samples had higher contaminant concentrations than those associated with the original RFI. However, only the first two rounds of data from the RFI wells were included in the original report. Iron, which is considered an essential nutrient, was not included in the original quantitative HHRA. Because its exclusion was not acceptable to SCDHEC, iron risk numbers have been calculated here for the CMS. Iron concentrations are naturally high in the area, but no background concentration has been calculated for iron in Zone H shallow groundwater.

Rather than rewriting the entire HHRA for this site based on a few additional samples, it is more efficient to summarize the estimated risk from the only two COPCs identified at AOC 653 (arsenic and iron), based on the hypothetical consumption of groundwater pathway. Refer to the SWMU 196 baseline HHRA for methodology and to the original AOC 653 baseline HHRA for detailed site information.

5.2 Background Information

For groundwater, ingestion was the only pathway evaluated because exposure by other pathways was considered insignificant. If a person were to shower with this water, for instance, the short duration of the average shower would make the dermal and inhalation pathway insignificant.

Carcinogenic and noncarcinogenic effects are evaluated separately in a quantitative HHRA. Each is described in the relevant risk summary sections that follow.

5.3 Determination of EPCs

For calculating risk, a groundwater exposure point concentration (EPC) is the hypothetical concentration at which a human receptor would be exposed continually. For example, in a residential scenario, the risk level is based on an adult consuming two liters a day of unfiltered groundwater containing the EPC of the chemical in question.

There are different ways to calculate EPCs for groundwater. USEPA Region IV guidance suggests using the arithmetic average of the COPC from the most highly concentrated area of the plume. For this risk assessment (RA), two EPCs have been evaluated for each risk scenario: maximum detected concentrations of individual chemicals, and the arithmetic average of the well with the highest concentrations. When determining the arithmetic average, one-half the sample quantification limit was used for nondetects (there was one nondetect for arsenic at well NBCH653001).

For both arsenic and iron, the highest concentrations were from well NBCH653001. The maximum arsenic concentration detected out of 10 total sampling events was 54.1 μg/L. For iron the maximum detected concentration was 14,500 μg/L. Arsenic's average concentration at well NBCH653001 for the four sampling events was 37 μg/L. Iron's was 11,460 μg/L.

5.4 Risk Summary

The following risk summary tables show the estimated carcinogenic and noncarcinogenic risks to each receptor population originally evaluated in the Zone H HHRAs.

5.4.1 Noncarcinogenic Risks

For noncarcinogenic effects, a hazard quotient (HQ) is calculated for each receptor population, COPC, and pathway (i.e., ingestion) by dividing the intake dose by an oral reference dose (RfD). An RfD is the concentration of a chemical in a medium (e.g., tap-water) that USEPA has determined is unlikely to lead to adverse toxic effects over a lifetime of exposure (including sensitive subpopulations). The oral RfDs used for this RA were obtained from sources considered appropriate by the USEPA: Arsenic, 0.0003 mg/kg/day and iron, 0.3 mg/kg/day. Arsenic's value was determined from IRIS, the Integrated Risk Information System. Iron's RfD was a provisional value provided by the National Center for Environmental Assessment.

If the following two conditions are met, the COPC is considered a contaminant of concern (COC) for the receptor population being evaluated (e.g., residential child). First, the sum of the population's HQs, for all COPCs and pathways must exceed 1. The sum of the HQs is known as the hazard index (HI). Second, the total HI for all pathways for any given COPC must exceed 0.1.

Table 5.1
AOC 653 CMS (2000)
Resident Adult Hazard Index

COPC	Ingestion HQ Based on Maximum Concentration	Ingestion HQ Based on Average Concentration at Well NBCH653001
Arsenic	5	3
Iron	1	1
TOTAL HI	**6**	**4**

For the hypothetical future resident adult and child and site worker consuming groundwater, arsenic and iron are identified as COCs because their cumulative HI is greater than 1 and their individual HQs are greater than 0.1 (reference Tables 5.1, 5.2, & 5.3).

Table 5.2
AOC 653 CMS (2000)
Resident Child Hazard Index

COPC	Ingestion HQ Based on Maximum Concentration*	Ingestion HQ Based on Average Concentration at Well NBCH653001
Arsenic	10	8
Iron	3	2
TOTAL HI	**13**	**10**

Note:
* Because hazard values are expressed to one significant digit, the total may not equal the sum of the individual values due to rounding error.

Table 5.3
AOC 653 CMS (2000)
General Worker Hazard Index

COPC	Ingestion HQ Based on Maximum Concentration*	Ingestion HQ Based on Average Concentration at Well NBCH653001
Arsenic	2	1
Iron	0.5	0.4
TOTAL HI	**3**	**1**

Note:
* Because hazard values are expressed to one significant digit, the total may not equal the sum of the individual values due to rounding error.

5.4.2 Carcinogenic Risks

For carcinogenic effects, a risk value is derived by multiplying the slope factor for each COPC and pathway (i.e., ingestion) by an intake dose. The slope factor is derived from dose-response analysis of relevant animal and human cancer studies.

Arsenic is classified as a group A carcinogen, meaning there is sufficient evidence of carcinogenic effects in exposed human receptors. According to IRIS, arsenic's oral slope factor is 1.5E+00 kg-day/mg. No slope factor is published for iron because it is not considered a carcinogen.

For the former base, groundwater's intake rate is the quantity of tap-water a typical person would consume daily based on conservative, default assumptions suggested by the USEPA. For more details, refer to the SWMU 196 HHRA.

The USEPA has established a generally acceptable total cancer risk (CR) range of 1E-06 to 1E-04 by all chemicals and pathways. This means that the sum of CRs for each pathway and chemical should not exceed 1E-04. SCDHEC recommends a more conservative CR value of 1E-06 for screening COCs. If the total risk from all COPCs is greater than 1E-06, and the cumulative CR for the COPC being evaluated also exceeds 1E-06, the COPC is considered a COC.

Table 5.4
AOC 653 CMS (2000)
Resident Adult Risk

COPC	Ingestion CR Based on Maximum Concentration	Ingestion CR Based on the Average Concentration at well NBCH653001
Arsenic	1E-03	8E-04
Iron	NA	NA
TOTAL CR	**1E-03**	**8E-04**

For the hypothetical future resident adult consuming shallow groundwater, the cumulative CR due to arsenic exceeds SCDHEC's acceptable range of 1E-06. The cumulative risk also exceeds USEPA's generally acceptable risk level of 1E-04. Arsenic is considered a groundwater COC for this population (reference Table 5.4).

Table 5.5
AOC 653 CMS (2000)
General Worker Risk

COPC	Ingestion CR Based on Maximum Concentration	Ingestion CR Based on Average Concentration at Well NBCH653001
Arsenic	3E-04	2E-04
Iron	NA	NA
TOTAL CR	**3E-04**	**2E-04**

For the site worker consuming shallow groundwater, the cumulative risk from arsenic exceeds SCDHEC's acceptable range of 1E-06. Arsenic is therefore considered a groundwater COC for this population by this conservative approach (reference Table 5.5).

5.5 Risk Uncertainty

The risk values calculated here are for illustration only. The results of this analysis assume that an individual is drinking unfiltered groundwater from the most contaminated well. The range of arsenic detections at AOC 653 was very broad (3.8 to 54.1 μg/L). As mentioned previously, the well with the highest detections was NBCH653001. Out of four sampling events, the first round was a nondetect. The three detections ranged from 38.6 to 54.1 μg/L. In well NBCH653002, arsenic was detected twice during four sampling events; concentrations were 23.4 and 10.1 μg/L (third and fourth quarters). In well NBCH653003, arsenic was detected twice during two sampling events (9.2 and 3.8 μg/L).

The assumptions on which these risk numbers are based are overly conservative. Potable water near the former base is provided by the city of Charleston. Shallow groundwater in the area is naturally high in sodium, sulfur, and iron, and therefore very unattractive as a potable water source. There are no indications that deep groundwater would be impacted from site activities.

As explained in the 1996 AOC 653 baseline HHRA, no arsenic site sources have been identified, and arsenic was not identified as a surface soil COPC. High background levels of arsenic and iron

in groundwater have been determined in other Zones at the naval base, and a background level of 21.5 μg/L has been established for arsenic in Zone H. Although no background has been calculated for iron in Zone H groundwater, it is expected that background levels contribute significantly to site risk.

The groundwater background concentration for Zone H arsenic of 21.5 μg/L is approximately 60% of the average concentration at well NBCH653001 (37.5 μg/L), while the background concentration is nearly 40% of the maximum detected concentration of 54.1 μg/L. Background therefore accounts for approximately 40-60% of the arsenic risk from groundwater consumption at AOC 653, depending on the assumptions.

5.6 Risk Conclusion

Table 5.6 shows the revised summary hazard and risk estimates for the COCs identified at AOC 653. The risk values for soil are the same as in the 1996 RFI report. The table has simply been updated with the more recent CMS groundwater values for arsenic and iron. The summary table shows the risk calculated using both the maximum detected concentration as the EPC, as well as the mean concentration of arsenic and iron.

Table 5.6
AOC 653 CMS (2000)
Summary of Carcinogenic and Noncarcinogenic Hazard and Risk
Surface Soil and Groundwater

		Hypothetical Future Resident			Site Worker	
Medium/Pathway	**Chemical**	**Adult HQ**	**Child HQ**	**ILCR**	**Hazard Quotient**	**ILCR**
Soil/Incidental Ingestion	Aroclor-1248	ND	ND	2.1E-07	ND	2.4E-08
	Aroclor-1260	ND	ND	1.7E-07	ND	1.9E-08
	Benzo(a)pyrene Eqv.	ND	ND	2.5E-07	ND	2.8E-08
Soil/Incidental Ingestion Pathway Total		**ND**	**ND**	**6.3E-07**	**ND**	**7.1E-08**
Soil/Dermal Contact	Aroclor-1248	ND	ND	9.5E-08	ND	3.9E-08
	Aroclor-1260	ND	ND	7.7E-08	ND	3.1E-08
	Benzo(a)pyrene Eqv.	ND	ND	1.1E-07	ND	4.6E-08
Soil/Dermal Contact Pathway Total		**ND**	**ND**	**2.8E-07**	**ND**	**1.2E-07**
Groundwater/Ingestion	Arsenic**	5 / 3*	10 / 8	1E-03 / 8E-04	2 / 1	3E-04 / 2E-04
	Iron**	1 / 1	3 / 2	NA	0.5 / 0.4	NA
Shallow Groundwater/Ingestion Pathway Total		**6 / 4**	**13 / 10**	**1E-03 / 8E-04**	**3 / 1**	**3E-04 / 2E-04**
All Pathways Total Risk		**6 / 4**	**13 / 10**	**1E-03 / 8E-04**	**3 / 1**	**3E-04 / 2E-04**

Notes:
* = Risk calculated for the groundwater pathway is presented in pairs. The first value uses an EPC based on maximum concentration (first value / XX). The second value uses an EPC based on average concentration (XX / second value).
** = COC
ILCR = Incremental lifetime excess cancer risk.
HQ = Hazard quotient.

6.0 CONCLUSIONS

6.1 Soil

As determined during the RFI, AOC 653 soil did not exceed 1E-06 residential risk. Only three constituents contributed to the 9.1E-07 site risk: BEQs and the Aroclors-1248, and -1260, which were detected in one soil sample (633SB001), which was then excavated during the ISM. Surrounding RFI soil samples were all nondetect for these constituents. More than 700 cubic yards of petroleum-impacted soil surrounding this sample point were removed during the ISM. Based on the pre-ISM risk, as determined by the RFI and the post-ISM confirmation sample results; no further action is recommended.

Furthermore, comparing AOC 653 RFI soil results to arsenic site-specific SSL at SWMU 136/AOC 663 (a Zone H site similar in soil and hydrogeology characteristics) provided additional basis for no further action.

6.2 Groundwater

As explained in the RFI baseline risk assessment, no arsenic site sources have been identified, and arsenic was not identified as a surface soil chemical of potential concern. As a comparison, site-pecific SSLs for arsenic at a similar site, SWMU 136/AOC 663, were not exceeded in AOC 653 soil. High arsenic groundwater background concentrations have been determined throughout the former naval base and in nearby grid wells; it is reasonable to attribute the high AOC 653 groundwater arsenic detections to background rather than anthropogenic site activity. Furthermore, supplemental CMS sampling showed that site groundwater complies with arsenic MCLs. Therefore, no further action is recommended for groundwater at AOC 653.

7.0 REFERENCES

EnSafe/Allen & Hoshall, Inc. (1995). *Final RCRA Facility Assessment*, Memphis, Tennessee, 1995.

EnSafe/Allen & Hoshall, Inc. (1997). *Final RCRA Environmental Baseline Survey,* Memphis, Tennessee, 1996.

EnSafe/Allen & Hoshall, Inc. (1996). *Final RCRA Facility Investigation Report, Zone H, Naval Base Charleston*, Volumes I, II, III, IV, V, VI and VII, Memphis, Tennessee, July 5, 1996.

EnSafe/Allen & Hoshall, Inc. (1997). *Final Comprehensive Corrective Measures Study Project Management Plan and Work Plan,* Volumes I and II, Memphis, Tennessee, June 25, 1997.

EnSafe Inc. (1998). *Zone H, Corrective Measures Study Work Plan*, Memphis, Tennessee, April 13, 1998.

EnSafe Inc. (1999). *Draft Zone H, SWMU 159 and AOC 653 Corrective Measures Study Reports,* Memphis, Tennessee, June 17, 1999.

Environmental Detachment Charleston, South Carolina (1997); *Completion Report, Interim Stabilization Measure for AOC 653*, Naval Base Charleston, Charleston, South Carolina; July 7, 1997.

8.0 SIGNATORY REQUIREMENT

Condition I.E. of the Hazardous and Solid Waste Amendments (HSWA) portion of RCRA Part B Permit (EPA SCO 170 022 560) states: *All applications, reports, or information submitted to the Regional Administrator shall be signed and certified in accordance with 40 CFR §270.11.* The certification reads as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Matthew A. Hunt

Matthew A. Hunt, P.E.
BRAC Environmental Coordinator, Charleston

5/22/00
Date

APPENDIX A

Chain-of-Custody Form

Validation Form

Analytical Report

BPA/So# P.O. 4
Rel #52

Environmental and Safety Designs, Inc.

EN SAFE (SM)

5724 SUMMER TREES DR. MEMPHIS, TN 38134 #1-800-588-7962
CINCINNATI, OH, CHARLESTON, SC, JACKSON, TN, KNOXVILLE, TN
NASHVILLE, TN, NORFOLK, VA, PENSACOLA, FL, RALEIGH, NC

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1

CLIENT Naval Base Charleston
ADDRESS Zone HCMS
PROJECT NAME/NUMBER 2908-001-14-090-00
PROJECT MANAGER Charlie Vernay
TELEPHONE NO. (843) 884-0029
FAX NO. (843) 856-0107
SAMPLERS: (SIGNATURE) Krista Collins

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOCs	SVOCs	Pest/PCBs	Metals	CN	Asbestos		REMARKS
NBCH009GW02601	8/13/98	920	GW	40ml, 1L amber 500ml, 250ml	4°C	VOC = HCL CN = NaOH metals = HNO3	8	X	X	X	X	X			OK
NBCH009GW02901		950	GW	" "			8	X	X	X	X	X			
NBCH1596GW00101		1530	GW	40ml		HCL	2	X							
NBCH1596GW00201		1420	GW	40ml		HCL	2	X							
NBCH017GW00901		1500	GW	40ml, 1L amber 250ml		VOC = HCL CN = NaOH	7	X	X	X		X			
NBCH1653GW00301		1345	GW	40ml, 500ml		VOC = HCL metals = HNO3	3	X					X		
NBCH009TW02901		—	W	40 ml			1	X							

RELINQUISHED BY:	DATE	RECEIVED BY	DATE	RELINQUISHED BY:	DATE	RECEIVED BY	DATE
SIGNATURE Krista Collins	8/13/98	SIGNATURE		SIGNATURE		SIGNATURE	
PRINTED KRISTA Collins	TIME 1800	PRINTED	TIME	PRINTED	TIME	PRINTED	TIME
COMPANY CnSAFE		COMPANY		COMPANY		COMPANY	
REASON		REASON		REASON		REASON	

METHOD OF SHIPMENT: FedEx
SHIPMENT NO. 4548175426
SPECIAL INSTRUCTION: Ship to lab

COMMENTS: all Samples DQ03 & TICs

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☐ DISPOSED OF
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS
- ☐ RETURNED TO CUSTOMER

CHANCUST

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

CHAIN OF CUSTODY RECORD

PAGE ____ OF ____

PROJECT/JOB NO: 29080010 4 00
COC NO:
PO NO: 4
REL NO: 72
LAB NAME: SW LABS

CLIENT: ENSAFE
PROJECT MANAGER: T BLAHNIK
LOCATION: CHARLESTON NAVSTATION
TELE/FAX NO. 8005887962
SAMPLERS: (SIGNATURE)

ANALYSIS REQUIRED

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	SW 846 VOCs	Arsenic	Dioxins								REMARKS
159GW00102	11.12.98	1230	H_2O	4 [illegible]	4°C	HCl	2	X										
159EW00102		1300				HCl	2	X										
159TW00102		1300				HCl	2	X										
159HCL0102		1230				—	2	X										
653GW00302		1200		2x40ml/1L poly		HCl/HNO_3	3	X	X									
656GW00106		1100		2x40ml/1L 2x[illegible]		HCl/—	4	X		X								
6[illegible]DHGW06D06		0945		2x40ml/1L poly		HCl/HNO_3	3	X	X									

RELINQUISHER:	DATE 11/12/98	RECEIVER:	DATE	RELINQUISHER:	DATE	RECEIVER:	DATE
PRINTED: T BLAHNIK	TIME 1730	PRINTED:	TIME	PRINTED:	TIME	PRINTED:	TIME
COMPANY: ENSAFE		COMPANY:		COMPANY:		COMPANY:	

METHOD OF SHIPMENT: FEDEX
SHIPMENT NO. 808625948252
SEND RESULTS TO: SW LABS

COMMENTS:

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

ENSCOC2
REV. 05/98

ENSAFE

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

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1
PROJECT/JOB NO: 2908-00-09-014-00
COC NO:
PO NO: 4
REL NO: 77
LAB NAME: Southwest labs

CLIENT: Naval Base Charleston
PROJECT MANAGER: Charlie Vernoy
LOCATION: Zone H
TELE/FAX NO. 843-881-0029/856-0107
SAMPLERS: (SIGNATURE)

ANALYSIS REQUIRED

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOA	TSS	Metals *								REMARKS
NBCH\653GW00303	1/20/99	1100	W	40 mL VOA vial 500 mL Poly	4°C	~~TAL~~ VOA: HCL TSS: N/a	3	X	X									
NBCH\653GW00303	1/20/99	1100	W	1L Poly	4°C	HNO_3	1			X								
NBCH\653GW003F3	1/20/99	1100	W	1L Poly	4°C	HNO_3	1			X								
~~NBTBT~~																		
NBCH\653TW00303	1/20/99	—	W	40mL vial	4°C	HCL	2	X										

RELINQUISHER	DATE	RECEIVER	DATE	RELINQUISHER	DATE	RECEIVER	DATE
PRINTED: Todd B. Temple	1/20/99	PRINTED:	TIME	PRINTED:	TIME	PRINTED:	TIME
COMPANY: ENSAFE	TIME 1730	COMPANY:		COMPANY:		COMPANY:	

METHOD OF SHIPMENT: FedEx
SHIPMENT NO. 808625948399
SEND RESULTS TO:

COMMENTS: Metals = Sb, As, Be, Cr, Pb, Hg, Tl
DQO III

ANALYTICAL DATA RECEIVED BY (INITIALS/DATE)

ENSCOC2

ENSAFE

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

CHAIN OF CUSTODY RECORD

PAGE 1 OF 1
PROJECT/JOB NO: 29Ø8-ØØ1-Ø9-Ø14
COC NO:
PO NO: 4
REL NO: 129
LAB NAME: SWL

CLIENT: Naval Base Charleston
LOCATION: Zone H
SAMPLERS: (SIGNATURE) Andrew West

PROJECT MANAGER: Charlie Vernoy
TELE/FAX NO. (843) 884-ØØ29/856-Ø1Ø7

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION TEMP.	PRESERVATION CHEMICAL	NO. OF CONTAINERS	VOCs + TICs	SVOCs + TICs	TAL Metals + Tin	Dioxin / Furan	Hydrazine	Explosives	Tetryl				REMARKS
NBCH GDHGWØØ3C1	1Ø/2Ø/99	1ØØØ	W	See Comments	4°C	See Comments	1Ø	X	X	X	X	X	X					
NBCH 653GWØØ3C1	↓	1Ø05	↓	↓	↓	↓	1Ø	X	X	X	X	X	X					
NBCH ØØ9GWØ13C1	↓	14Ø5	↓	↓	↓	↓	1Ø	X	X	X	X	X	X					
NBCH ØØ9TWØ13C1	↓	—	↓	2-4Ø mL vial	↓	HCl	2	X										

Andrew West
1Ø/2Ø/99

RELINQUISHER	DATE	RECEIVER	DATE	RELINQUISHER	DATE	RECEIVER	DATE
Andrew West	1Ø/2Ø/99						
PRINTED: Andrew Wertz	TIME 153Ø	PRINTED:	TIME	PRINTED:	TIME	PRINTED:	TIME
COMPANY: EnSafe		COMPANY:		COMPANY:		COMPANY:	

METHOD OF SHIPMENT: Fed Ex
SHIPMENT NO. 4849148382
SEND RESULTS TO: Charlie Vernoy

COMMENTS: 2-4Øml vial-HCl ; 6-1L amber-None ; 1-1L poly-HNO_3 ; 1-5ØØ ml poly-HCl

DQO III 14 Day TAT

VALIDATA

Chemical Services, Inc.

P. O. Box 930422, Norcross, GA 30003

(770) 923-3890
(770) 923-8769 (Fax)

DATA VALIDATION SUMMARY REPORT

COMPANY:	Ensafe, Inc.
SITE NAME:	Charleston Naval Base, Zone H
SERVICE ORDER NUMBER:	0307
CONTRACTED LAB:	Southwest Laboratory of Oklahoma, Inc.
QA/QC LEVEL:	EPA Level III
EPA METHOD:	EPA SOW 3-90 or SW-846
VALIDATION GUIDELINES:	*USEPA CLP National Functional Guidelines for Organic Data Review,* 1994; *USEPA CLP National Functional Guidelines for Inorganic Data Review,* 1994
SAMPLE MATRIX:	Water
TYPES OF ANALYSES:	Total Volatiles, Semivolatiles, Pesticides / PCB's, Total Metals, Cyanide
SDG NUMBER:	35269 (Level III)

Client Sample #	Lab Sample #	Matrix	Volatile Organics	Semi-volatiles	Pesticides/ PCB's	Metals Cyanide
009GW02601	35269.01	Water	X	X	X	X
009GW02901	35269.02	Water	X	X	X	X
017GW00901	35269.05	Water	X	X	X	X*
159GW00101	35269.03	Water	X			
159GW00201	35269.04	Water	X			
653GW00301	35269.06	Water	X			
009GW02601MS	35269.01MS	Water	+			
009GW02601MSD	35269.01MSD	Water	+			

MS = MATRIX SPIKE, MSD = MATRIX SPIKE DUPLICATE

* - Analysis consisted of cyanide only.

DATA REVIEWER(S): Amy L. Hogan, Marvin L. Smith, Jean M. Delashmit

RELEASE SIGNATURE: Jean M. Delashmit

Data Qualifier Definitions

J	-	The associated numerical value is an estimated quantity.
R	-	The data are unusable (the compound/analyte may or may not be present). Resampling and reanalysis are necessary for verification.
U	-	The compound/analyte was analyzed for, but not detected. The associated numerical value is the sample quantitation limit.
UJ	-	The compound/analyte was analyzed for, but not detected. The sample quantitation limit is an estimated quantity.

DATA QUALIFICATION SUMMARY

Southwest Laboratory of Oklahoma, Inc. - 35269 CLP Organics and Inorganics

SAMPLES: 009GW02601, 009GW02901, 017GW00901, 159GW00101, 159GW00201, 653GW00301, 009GW02601MS, 009GW02601MSD

VOLATILE ORGANICS

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC / MS Tuning:

All GC / MS Tuning criteria were met, so no action was required.

III.) Calibration:

Initial Calibration:

The Average Relative Response Factor (RRF) for 2-chloroethyl vinyl ether was 0.014 for the standards analyzed on 7/27/98 on instrument C, which was below the 0.050 QC limit. All results for this compound in the associated samples, which consisted entirely of non-detects, were rejected (R). The associated samples were 009GW02601, 009GW02901, 017GW00901, 159GW00101, 159GW00201 and 653GW00301.

Continuing Calibration:

The Relative Response Factors (RRF's) for acetone (0.047) and 2-chloroethyl vinyl ether (0.014) were below the 0.050 QC limit for the standard analyzed on 8/18/98 at 08:52 on instrument C. All results for acetone in the associated samples, which consisted entirely of non-detects, were rejected (R). The associated samples were 009GW02601, 009GW02901, 017GW00901, 159GW00101, 159GW00201 and 653GW00301. The results for 2-chloroethyl vinyl ether in the associated samples were previously rejected because of a low RRF in the initial calibration. No further action was required.

The Percent Differences (%D's) exceeded the 25% QC limit for the standard analyzed on 8/18/98 at 08:52 on instrument C for the following compounds:

chloromethane	29.5%
methylene chloride	29.9%
vinyl acetate	53.9%
2-butanone	49.5%
bromoform	27.8%
xylene	187%

All positive and non-detect results for these compounds in the associated samples were flagged as estimated (J) and (UJ). The associated samples were 009GW02601, 009GW02901, 017GW00901, 159GW00101, 159GW00201 and 653GW00301.

IV.) Blanks:

There were no positive detections in the method blanks. No action was required.

Tentatively Identified Compounds (TIC')s:

There were no TIC's detected in the method blanks. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was taken.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

All MS / MSD criteria were met. No action was required.

VII.) Laboratory Control Samples (LCS):

One LCS was analyzed for this SDG. All LCS Recovery criteria were met. No action was necessary.

VIII.) Field Duplicates:

There were no field duplicate samples in this SDG. No action was required.

IX.) Internal Standards Performance (ISTD):

All ISTD criteria were met. No action was required.

X.) TCL Compound Identification:

All TCL criteria were met. No action was required.

XI.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

All CRQL criteria were met. No action was necessary.

XII.) Tentatively Identified Compounds (TIC's):

All TIC Identification criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was taken.

XIV.) Overall Assessment of Data/General:

All non-detect results for acetone and 2-chloroethyl vinyl ether in the SDG samples were rejected because of low RRF's in the initial and continuing calibrations. All other laboratory data were acceptable with qualifications.

SEMIVOLATILE ORGANICS

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) GC / MS Tuning:

All GC / MS Tuning criteria were met, so no action was required.

III.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

Bis(2-ethylhexyl)phthalate was detected at 2 ug/L in method blank SBLK1. All positive results for this compound in the associated samples, less than 10X the blank amount, were flagged as undetected (U) with the analytical results being replaced with the detection limit. The associated samples were 009GW02601 and 009GW02901.

Tentatively Identified Compounds (TIC')s:

There were no TIC's detected in the method blanks. No action was required.

V.) Surrogate Recoveries:

The Surrogate Percent Recovery (%R) of 2-fluorobiphenyl was below the QC limits of 43-116% in sample 009GW02601. Since only one surrogate recovery was below the QC limits, no action was required.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were not performed in this fraction of the SDG. No action was required.

VII.) Laboratory Control Samples (LCS):

One LCS was analyzed for this SDG. Several LCS Recoveries were outside their respective QC limits. Data validation action based on LCS criteria was not required. No action was taken.

VIII.) Field Duplicates:

There were no field duplicate samples this SDG. No action was required.

IX.) Internal Standards Performance (ISTD):

All ISTD criteria were met. No action was required.

X.) TCL Compound Identification:

All TCL criteria were met. No action was required.

XI.) Compound Quantitation and Reported Contract Required Quantitation Limits (CRQL's):

All CRQL criteria were met. No action was necessary.

XII.) Tentatively Identified Compounds (TIC's):

All TIC Identification criteria were met. No action was required.

XIII.) System Performance:

All System Performance criteria were met. No action was taken.

XIV.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualifications.

PESTICIDES/PCB's

I.) Holding Times:

All Holding Time criteria were met. No action was required.

II.) Instrument Performance:

The Percent Difference (%D) exceeded the 25% QC limit for the PEM analyzed on 8/27/98 at 22:47 on the primary column for 4,4'-DDT (26.0%). All results for this compound in the associated samples, which consisted entirely of non-detects, were flagged as estimated (UJ). The associated samples were 009GW02601, 009GW02901 and 017GW00901.

III.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was required.

IV.) Blanks:

There were no positive detections in the method blanks. No action was required.

V.) Surrogate Recoveries:

All Surrogate Recovery criteria were met. No action was required.

VI.) Matrix Spike / Matrix Spike Duplicate (MS / MSD):

MS / MSD analyses were not performed in this fraction of the SDG. No action was required.

VII.) TCL Compound Identification:

Pesticide/PCB Identification Summary (PIS):

All PIS criteria were met. No action was required.

VIII.) Field Duplicates:

There were no field duplicate samples in this SDG. No action was required.

IX.) Pesticide Cleanup Check:

Florisil Cartridge Check:

Florisil Cleanup data was not submitted for this SDG. No action was taken.

Gel Permeation Chromatography (GPC):

GPC was not required for this SDG. No action was taken.

X.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualifications.

TOTAL METALS AND CYANIDE

I.) Holding Times:

All Holding Time criteria were met. No action was taken.

II.) Calibration:

All Initial and Continuing Calibration criteria were met. No action was necessary.

III.) Blanks:

The following blank results represent the highest detections associated with the samples and were used for data qualification:

Blank Type/ID#	Analyte	Max. Conc.	Action Level
CCB3	antimony	3.50 ug/L	17.5 ug/L
CCB3	beryllium	0.70 ug/L	3.50 ug/L
PBW	cadmium	8.12 ug/L	40.6 ug/L
PBW	chromium	3.86 ug/L	19.3 ug/L
PBW	copper	23.8 ug/L	119 ug/L
PBW	lead	1.85 ug/L	9.25 ug/L
ICB	potassium	586 ug/L	2930 ug/L
CCB3	sodium	497 ug/L	2485 ug/L
PBW	zinc	16.4 ug/L	82.0 ug/L

CCB = Continuing Calibration Blank, ICB = Initial Calibration Blank,
PBW = Preparation Blank (Water)

All results greater than the IDL but less than 5X the blank amounts (Action Level, ug/L for water samples) for which the contaminated blank was an associated calibration or preparation blank were flagged as undetected (U).

The following analytes had negative results with absolute values greater than the IDL:

Blank Type/ID#	Analyte	Neg. Conc.	5X Conc.
CCB1	selenium	-4.10 ug/L	20.5 ug/L
CCB1	cyanide	-2.60 ug/L	13.0 ug/L

CCB = Continuing Calibration Blank

All associated positive sample results less than 5X the absolute value of the negative blank results and all associated non-detects were flagged as estimated (J) and (UJ).

IV.) ICP Interference Check Sample Results:

All Percent Recovery criteria were met. No action was taken.

The following analytes were detected in ICS Solution A at concentrations greater than the IDL:

barium	5 ug/L
chromium	3 ug/L
copper	10 ug/L
manganese	6 ug/L
sodium	177 ug/L

These analytes should not be present. Since neither aluminum, calcium, iron nor magnesium was present in the samples at a concentration comparable to or greater than the amount in Solution A, no action was required.

Negative results were observed in ICS Solution A at an absolute concentration greater than the IDL for the following analytes:

antimony	-15 ug/L
beryllium	-1 ug/L
cadmium	-20 ug/L
cobalt	-3 ug/L
nickel	-10 ug/L
potassium	-337 ug/L
silver	-4 ug/L
tin	-25 ug/L
vanadium	-19 ug/L

Since neither aluminum, calcium, iron nor magnesium was present in the samples at a concentration comparable to or greater than the amount in Solution A, no action was required.

V.) ICP Serial Dilution Analysis:

Serial Dilution analysis was not performed in this SDG. No action was required.

VI.) Laboratory Control Samples (LCS):

All LCS Recovery criteria were met. No action was required.

VII.) Duplicate Sample Analysis:

Duplicate Sample Analysis was not performed in this fraction of the SDG. No action was required.

VIII.) Matrix Spike Recoveries:

Matrix Spike Analysis was not performed in this fraction of the SDG. No action was required.

IX.) Field Duplicates:

There were no field duplicate samples in this SDG. No action was required.

X.) Graphite Furnace Atomic Absorption QC (GFAA):

Graphite Furnace analyses were not used for the samples in this SDG. No action was necessary.

XI.) Sample Result, Calculation/Transcription Verification:

All criteria were met. No action was required.

XII.) Quarterly Verification of Instrumental Parameters:

All criteria were met. No action was taken.

XIII.) Overall Assessment of Data/General:

All laboratory data were acceptable with qualifications.

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#:	36383
Date:	January 21, 1999
Client Name:	Ensafe
Project/Site Name:	Charleston Zone H
Date Sampled:	November 11 - 13, 1998
Number of Samples:	18 Aqueous Sample(s) with 0 MS/MSD(s)
Laboratory:	Southwest Laboratory of Oklahoma
Validation Guidance:	National Functional Guidelines for Organic and Inorganic Data, February, 1994
QA/QC Level:	DQO Level III
Method(s) Utilized:	SW846 Third Edition
Analytical Fractions:	Volatiles, Semivolatiles, PCBs, Arsenic, Dioxin/Furans

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

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

Craig G. Searson
for Paul B. Humburg, President

1-21-99.
Date

4127 Plaza 94 South • St. Charles, MO 63304
(314) 936-1332 • Fax (314) 936-1335

SDG# 36383

Samples and Fractions Reviewed

Sample Identifications | Analytical Fractions

ENSAFE ID	MATRIX	VOA		SVOA		PCB		AS		D/F	
017002DNAP	WATER	X		X		X					
017FRESUMP	WATER	X		X		X					
159HCL0102	WATER	X									
159GW00102	WATER	X									
159TW00102	WATER	X									
159EW00102	WATER	X									
159GW00202	WATER	X									
653GW00302	WATER	X						X			
656GW00106	WATER	X								X	
GDHGW00306	WATER	X						X			
GDHGW00606	WATER	X						X			
GDHTW00606	WATER	X									
GDHEW00606	WATER	X						X			
GDHGW03D06	WATER	X						X			
GDHGW06D06	WATER	X						X			
655GW00106	WATER							X			
655HW00106	WATER							X			
655GW00206	WATER							X			
Total Billable Samples (Water/Soil)		15	0	2	0	2	0	9	0	1	0

VOA= Volatiles
SVOA= Semivolatiles
PCB= PCBs
AS= Arsenic
D/F= Dioxin/Furans

DATA ASSESSMENT NARRATIVES

DATA ASSESSMENT AND NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8260; the National Functional Guidelines for Organic Data Review, and DQO Level III. All comments made within this report should be considered when examining the analytical results.

SDG # 36383

A validation was performed on the Volatile Data from SDG 36383. The data was evaluated based on the following parameters.

* Data Completeness
* Holding Times
* GC/MS Tuning
  Calibrations
* Internal Standard Performance
* Blanks
* Surrogate Recoveries
* Laboratory Control Samples
* Field Duplicates
  Compound Identification /Quantitation

* - All criteria were met for this parameter

DATA ASSESSMENT AND NARRATIVE

VOLATILE ANALYSIS

PAGE - 2

Initial Calibration

The initial calibration, analyzed on 11-08-98, contained compounds with RRFs less than 0.050. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as rejected (UR).

017-0-02DN-AP	acetone (0.038)

Continuing Calibration

The continuing calibration, K25232.D, contained compounds with %Ds greater than 25% and less than 50%. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J).

159-G-W002-02	acetone (29.5%)

The continuing calibration, R31348.D, contained compounds with %Ds greater than 90%. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as rejected (UR).

017-F-RESU-MP	vinyl acetate (92.3%)

The continuing calibration, R31348.D, contained compounds with %Ds greater than 50% and less than 90%. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as estimated (UJ).

017-F-RESU-MP	chloromethane (63.6%)
	2-chloroethyl vinyl ether (61.4%)

The continuing calibration, UL7061.D, contained compounds with RRFs less than 0.050. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as rejected (UR).

017-0-02DN-AP	acetone (0.043)
	2-chloroethyl vinyl ether (0.026%)

System Performance and Overall Assessment

The data as presented requires qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

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

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

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
017-0-02DN-AP	acetone	+/-	J/UR
159-G-W002-02	acetone	+	J
017-F-RESU-MP	vinyl acetate	+/-	J/UR
017-F-RESU-MP	chloromethane 2-chloroethyl vinyl ether	+/-	J/UJ
017-0-02DN-AP	acetone 2-chloroethyl vinyl ether	+/-	J/UR

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

DATA ASSESSMENT AND NARRATIVE

SEMIVOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8270; the National Functional Guidelines for Organic Data Review, and DQO Level III. All comments made within this report should be considered when examining the analytical results.

SDG # 36383

A validation was performed on the Semivolatile Data from SDG 36383. The data was evaluated based on the following parameters.

* Data Completeness
  Holding Times
* GC/MS Tuning
* Calibrations
* Internal Standard Performance
* Blanks
* Surrogate Recoveries
* Laboratory Control Samples
* Field Duplicates
  Compound Identification /Quantitation

* - All criteria were met for this parameter

Holding Times

The following samples exceeded the seven (7) day extraction holding time by one (1) day. Qualify all positive results as estimated (J).

017-0-02DN-AP
017-0-02DN-AP-DL

Compound Identification /Quantitation

Do not use E-flagged compound results, in favor of the diluted D-flagged compound results, for sample 017-0-02DN-AP.

System Performance and Overall Assessment

The data as presented requires qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

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

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

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
017-0-02DN-AP 017-0-02DN-AP-DL	all compounds	+	J
017-0-02DN-AP	all E-flagged compounds	+	do not use
017-0-02DN-AP-DL	all compounds except D-flagged compounds	+/-	do not use

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

DATA ASSESSMENT NARRATIVE

AROCLORS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC performance, and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Methods 8081; the National Functional Guidelines for Organic Data Validation, February 1994; and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDG # 36383

A validation was performed on the Aroclor Data from SDG 36383. The data was evaluated based on the following parameters:

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

* - All criteria were met for this parameter.

Holding Times

The extraction holding time for the following sample was exceeded by one (1) day. For the following sample, the positive results are qualified as estimated, J.

017002DNAPDL

Compound Quantitation

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

1. No qualifications are required for positive sample results which exhibited column quantitation differences < 40%. The "P" flag is removed from the result.

2. The positive sample result which exhibited a column quantitation difference >40%, but ≤100% is qualified as estimated, J.

3. The positive single component pesticide sample result which exhibited a column quantitation difference >100% and is <10X the respective compound CRQL, is qualified as non-detect, U. (All multi-component results are exempt from this rule.)

4. The positive single component pesticide sample result which exhibited a column quantitation difference >100% and >10X the respective compound CRQL, is qualified as presumptively present at an estimated concentration, NJ. (All multi-component results are exempt from this rule.)

5. The positive multi-component pesticide sample result which exhibited a column quantitation difference >100% and <10% the respective multi-component CRQL is qualified as presumptively present at an estimated concentration, NJ.

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

Sample ID	Compound	%D	Lab Qual.	HESI Qual.	Ref. #
017FRESUMP	Aroclor-1260	26.0%	P		1

For the following sample the reported result for Aroclor 1260 is not used in favor of the corresponding D flagged result reported from the dilution analysis. All other results from the dilution analysis are not used in favor of the results reported from the undiluted analysis.

017002DNAP Aroclor-1260

System Performance and Overall Assessment

The data required qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

NJ = Result is considered presumptively present at an estimated concentration

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

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

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

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

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
017002DNAPDL	ALL	+	J
ALL	All P < 40%	+	
ALL	All P > 40% But ≤ 100%	+	J
ALL	single component pests All P > 100% And < 10X CRQL	+	U
ALL	single component pests All P > 100% And > 10X CRQL	+	NJ
ALL	multi- component pests All P > 100% And < 10X CRQL	+	NJ
017002DNAP	Aroclor-1260	+	do not use
017002DNAPDL	all others	+/-	do not use

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

DATA ASSESSMENT NARRATIVE
ARSENIC ONLY

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDGs # 36383

A validation was performed on the arsenic Data from SDG 36383. The data was evaluated based on the following parameters.

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

* - All criteria were met for this parameter.

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

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
all "B" results	all analytes	B	J

DATA ASSESSMENT AND NARRATIVE

Dioxin/Furans

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard recoveries. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA SW846, Method 8290; National Functional Guidelines for Organic Data Review, and DQO Level III. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 36383 Level III

A validation was performed on the Dioxin/Furans Data from SDG 36383. The data was evaluated based on the following parameters.

*	•	Data Completeness
*	•	Holding Times
*	•	Mass Resolution Checks
*	•	Column Performance
*	•	Calibrations
	•	Internal Standard Performance
*	•	Blanks
*	•	Matrix Spike/Matrix Spike Duplicate
*	•	Field Duplicates
	•	Congener Identification /Quantitation

* - All criteria were met for this parameter

Internal Standard Recoveries

One sample required qualifications for non compliant internal standard recoveries. Qualify the positive and non detect results for the congeners associated with them as estimated (J/UJ).

656GW00106	$^{13}C_{12}$-OCDD	33%	J/UJ
	$^{13}C_{12}$-2,3,7,8-TCDF	33%	J/UJ
	$^{13}C_{12}$-1,2,3,7,8-PeCDF	36%	J/UJ

Congener Identification/Quantitation

Do not report the results for 656GW00106RE. Report the first analysis due to non compliant internal standard recoveries in the reanalysis.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D= Result value is based on the dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.

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

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	CONGENER ID	DL	QL
656GW00106	OCDD, TCDF, PeCDFs	+/-	J/UJ
656GW00106RE	All	+/-	do not use

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

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#:	37156
Date:	March 8, 1999
Client Name:	Ensafe
Project/Site Name:	Charleston Zone H
Date Sampled:	January 20, 1999
Number of Samples:	4 Aqueous Sample(s) with 0 MS/MSD(s)
Laboratory:	Southwest Laboratory of Oklahoma
Validation Guidance:	National Functional Guidelines for Organic and Inorganic Data, February, 1994
QA/QC Level:	DQO Level III
Method(s) Utilized:	SW846 Third Edition
Analytical Fractions:	Volatiles, Metals, and Total Suspended Solids

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

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

for Erica K. Ketchum
Paul B. Humburg, President

3/8/99
Date

4127 Plaza 94 South • St. Charles, MO 63304
(314) 936-1332 • Fax (314) 936-1335

SDG# 37156

Samples and Fractions Reviewed

Sample Identifications | Analytical Fractions

ENSAFE ID	MATRIX	VOA		TAL		TSS	
653GW00303	WATER	X				X	
653TW00303	WATER	X					
653GW003F3	WATER			X			
653GW003U3	WATER			X			
Total Billable Samples (Water/Soil)		2	0	2	0	1	0

VOA= SW846 Volatiles
TAL= SW846 Metals
TSS= Total Suspended Solids

DATA ASSESSMENT NARRATIVES

DATA ASSESSMENT AND NARRATIVE

VOLATILE ORGANICS

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, surrogate and matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard areas. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW846 Method 8260; the National Functional Guidelines for Organic Data Review, and DQO Level III. All comments made within this report should be considered when examining the analytical results.

SDG # 37156

A validation was performed on the Volatile Data from SDG 37156. The data was evaluated based on the following parameters.

* Data Completeness
* Holding Times
* GC/MS Tuning
  Calibrations
* Internal Standard Performance
* Blanks
* Surrogate Recoveries
* Laboratory Control Samples
* Field Duplicates
* Compound Identification /Quantitation

* - All criteria were met for this parameter

Initial Calibration

The initial calibration, analyzed on 01-21-99, contained compounds with RRFs less than 0.050. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as rejected (UR).

All samples	acetone (0.024) 2-chloroethyl vinyl ether (0.015)

Continuing Calibration

The continuing calibration, UL7878.D, contained compounds with RRFs less than 0.050. For the samples and non-compliant compounds listed below, qualify all positive results as estimated (J) and non detects as rejected (UR).

653-G-W003-03	acetone (0.027) 2-chloroethyl vinyl ether (0.034)

System Performance and Overall Assessment

The data as presented requires qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.

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

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

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
All samples	acetone 2-chloroethyl vinyl ether	+/-	J/UR
653-G-W003-03	acetone 2-chloroethyl vinyl ether	+/-	J/UR

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

DATA ASSESSMENT NARRATIVE
METALS AND WET CHEMISTRY

General

The inorganic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike and LCS recoveries, matrix duplicates and calibration results. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW 846 Methods; the Functional Guidelines for Inorganic Data Validation, February 1994, and DQO Level III requirements. All comments made within this report should be considered when examining the analytical results. Please refer the specific findings found in each category to the Summary of Data Qualification table.

SDGs # 37156

A validation was performed on the Metals and wet chemistry Data from SDG 37156. The data was evaluated based on the following parameters.

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

* - All criteria were met for this parameter.

Preparation and Field Blanks

The calibration blanks exhibited contamination for the following elements.

Elements	Conc.	Samples affected
Beryllium	0.1 ug/l	no impact

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

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

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
all "B" results	all analytes	B	J

HEARTLAND
ENVIRONMENTAL SERVICES, INC.

Data Validation Report

SDG#:	40799
Date:	December 2, 1999
Client Name:	Ensafe
Project/Site Name:	Charleston Zone H
Date Sampled:	October 20, 1999
Number of Samples:	4 Aqueous Sample(s) with 0 MS/MSD(s)
Laboratory:	Southwest Laboratory of Oklahoma
Validation Guidance:	National Functional Guidelines for Organic and Inorganic Data, February, 1994
QA/QC Level:	EPA DQO Level III
Method(s) Utilized:	SW846 Third Edition
Analytical Fraction:	Volatiles, Semivolatiles, Metals, Dioxins / Furans, Hydrazine and Tetryl

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

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

Craig G. Searson
for Paul B. Humburg, President

12-6-99
Date

4127 Plaza 94 South • St. Charles, MO 63304
(636) 936-1332 • Fax (636) 936-1335

SDG# 40799

Samples and Fractions Reviewed

Sample Identifications | Analytical Fractions

ENSAFE ID	MATRIX	VOA		SVOA		MET		DIOX		HYD		EXP	
009GW013C1	WATER	X		X		X		X		X		X	
009TW013C1	WATER	X											
653GW003C1	WATER	X		X		X		X		X		X	
GDHGW003C1	WATER	X		X		X		X		X		X	
Total Billable Samples (Water/Soil)		4	0	3	0	3	0	3	0	3	0	3	0

VOA= Volatiles
SVOA= Semivolatiles
MET= Metals
DIOX= Dioxins / Furans
HYD= Hydrazine
EXP= Tetryl

DATA ASSESSMENT NARRATIVE

VOLATILE ORGANICS

General

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

SDG # 40799

A validation was performed on the Volatile Data from SDG 40799. The data was evaluated based on the following parameters:

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

* - All criteria were met for this parameter.

Calibrations

The continuing calibration I53813.D exhibited one (1) compound with a RRF less than 0.05.. For the following samples and non-compliant compound, the reported positive results are qualified as estimated, J, and the non-detect results are rejected, UR.

GDHGW003C1	2-chloroethyl vinyl ether (0.032)
653GW003C1	
009GW013C1	

Compound Quantitation

For the following sample, the reported results are not used in favor of the results reported from the original analysis of the sample. Both analyses exhibited similar surrogate recoveries.

653GW003C1RE

System Performance and Overall Assessment

The data, as reported, required qualifications/rejections.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

L = Result is estimated and biased low.

K = Result is estimated and biased high.

R = Result is rejected and unusable

D = Result value is based on dilution analysis

BLANK QUALIFICATION CODES

CRQL =	The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.
U =	The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.
No Action =	The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDHGW003C1 653GW003C1 009GW013C1	2-chloroethyl vinyl ether	+/-	J/UJ
653GW003C1RE	All Compounds	+/-	Do Not Use

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

DATA ASSESSMENT NARRATIVE

SEMIVOLATILE ORGANICS

General

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

SDG # 40799

A validation was performed on the Semivolatile Data from SDG 40799. The data was evaluated based on the following parameters:

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

* - All criteria were met for this parameter.

Blanks

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

Associated blank	Compound	Concentration	Action Level
SBLK1	bis(2-ethylhexyl)phthalate	6J ug/L	60 ug/L

Blanks (continued)

Samples	Compound	Qualifications
GDHGW003C1	bis(2-ethylhexyl)phthalate	CRQL
653GW003C1 009GW013C1	bis(2-ethylhexyl)phthalate	U

System Performance and Overall Assessment

The data, as reported, required qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported Quantitation limit is qualified as estimated

L = Result is estimated and biased low.

K = Result is estimated and biased high.

R = Result is rejected and unusable

D = Result value is based on dilution analysis

BLANK QUALIFICATION CODES

CRQL =	The sample result for the blank contaminant is less than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that compound is reported.
U =	The sample result for the blank contaminant is greater than the sample CRQL and is less than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is qualified as non detected at the compound value reported.
No Action =	The sample result for the blank contaminant is greater than the sample CRQL and is greater than 5X (10X for common laboratory contaminants) the method blank value. The sample result for the blank contaminant is not qualified with any blank qualifiers.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL
GDHGW003C1	bis(2-ethylhexyl)phthalate	+B	CRQL
653GW003C1 009GW013C1	bis(2-ethylhexyl)phthalate	+B	U

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

DATA ASSESSMENT NARRATIVE

TETRYL

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, calibration data, blank analysis results, surrogate recoveries and LCS recoveries. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the SW-846 Method 8330; the National Functional Guidelines for Organic Data Review, February 1994, where applicable; and EPA DQO Level III requirements. Please refer the specific findings found in each category to the Summary of Data Qualifications table.

SDG# 40799

A validation was performed on the Tetryl data from SDG 40799. The data was evaluated based on the following parameters.

* • Data Completeness
* • Holding Times
* • HPLC Performance
* • Calibrations
* • Blanks
* • Surrogate Recoveries
* • LCS Recoveries
* • Field Duplicates
* • Identification/Quantitation

* - All criteria were met for this parameter.

Overall Performance

The data did not require qualifications.

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

NJ = Result is considered presumptively present at an estimated concentration

UR = Result is rejected and unusable

D = Result value is based on dilution analysis

METHOD BLANK QUALIFICATION CODES

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

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

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

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	COMPOUND ID	DL	QL

NO QUALIFICATIONS WERE REQUIRED.

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

DATA ASSESSMENT NARRATIVE

Dioxin/Furans

General

The organic findings offered in this screening report assumes that all analytical results are correct as reported and is based upon the examination of the reported holding times, blank analysis results, matrix spike recoveries, GC/MS performance, tuning results, calibration results and internal standard recoveries. This report was prepared in compliance relative to the analytical and deliverable requirements specified in the U.S. EPA SW846, Method 8290; National Functional Guidelines for Organic Data Review, and DQO Level III. All comments made within this report should be considered when examining the analytical results (Form I's).

SDG # 40779 Level III

A validation was performed on the Dioxin/Furans Data from SDG 40779. The data was evaluated based on the following parameters.

* • Data Completeness
* • Holding Times
* • Mass Resolution Checks
* • Column Performance
* • Calibrations
* • Internal Standard Performance
  • Blanks
* • Field Duplicates
* • Congener Identification /Quantitation

* - All criteria were met for this parameter

Blanks

Blank ID	Congener	Conc.	Action Limit (5X)
DFBLK1	OCDD	7.391	36.955

Sample ID	Congener	Conc.	Qualifier	Assoc. Blank
653-GW003-C1	OCDD	20.99	U	DFBLK1
GDH-G-W003-C1	OCDD	15.91	U	DFBLK1

GLOSSARY OF DATA QUALIFIERS

QUALIFICATION CODES

U = Not detected

J = Estimated value

UJ = Reported quantitation limit is qualified as estimated

UR = Result is rejected and unusable

D= Result value is based on the dilution analysis

METHOD BLANK QUALIFICATION CODES

CRQL = The sample result for the blank contaminant is less than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is rejected and the CRQL for that analyte is reported.

U = The sample result for the blank contaminant is greater than the sample CRQL and is less than 10X the method blank value. The sample result for the blank contaminant is qualified as non detected at the analyte value reported.

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

The specific findings will be noted in numerical form on the Form Is in this data validation report. These specific finding footnotes will reflect the conclusions found in the data validation process that resulted in the qualification of the data.

SUMMARY OF DATA QUALIFICATIONS

SAMPLE ID	CONGENER ID	DL	QL
653-GW003-C1 GDH-G-W003-C1	OCDD	+B	U

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

DATA ASSESSMENT NARRATIVE
METALS AND HYDRAZINE

General

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

SDGs # 40799

A validation was performed on the Metals and hydrazine Data from SDG 40799. The data was evaluated based on the following parameters.

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

* - All criteria were met for this parameter.

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

SUMMARY OF DATA QUALIFICATIONS

Sample ID	Analyte	DL	QL
all "B" results	all analytes	B	J

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

ARSENIC

SAMPLE ID ------->	653-G-W003-02
ORIGINAL ID ----->	653GW00302
LAB SAMPLE ID --->	36402.05
ID FROM REPORT -->	653GW00302
SAMPLE DATE ----->	11/12/98
DATE EXTRACTED -->	11/19/98
DATE ANALYZED --->	11/21/98
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	36383	VAL
7440-38-2	Arsenic (As)	9.2	J

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

HYDRAZINE

SAMPLE ID -------->	653-G-W003-C1
ORIGINAL ID ----->	653GW003C1
LAB SAMPLE ID --->	40799.02
ID FROM REPORT -->	653GW003C1
SAMPLE DATE ----->	10/20/99
DATE ANALYZED --->	10/25/99
MATRIX ---------->	Water
UNITS ---------->	MG/L

CAS #	Parameter	40799	VAL
302-01-2	Hydrazine	5.	U

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW-VOA

SAMPLE ID -------->	653-G-W003-01
ORIGINAL ID ----->	653GW00301
LAB SAMPLE ID --->	35269.06
ID FROM REPORT -->	653GW00301
SAMPLE DATE ----->	08/13/98
DATE ANALYZED --->	08/18/98
MATRIX ---------->	Water
UNITS ---------->	UG/L

CAS #	Parameter	35269	VAL
74-87-3	Chloromethane	5.	UJ
74-83-9	Bromomethane	5.	U
75-01-4	Vinyl chloride	5.	U
75-00-3	Chloroethane	5.	U
75-09-2	Methylene chloride	5.	UJ
67-64-1	Acetone	5.	UR
75-15-0	Carbon disulfide	5.	U
75-35-4	1,1-Dichloroethene	5.	U
75-34-3	1,1-Dichloroethane	5.	U
540-59-0	1,2-Dichloroethene (total)	5.	U
67-66-3	Chloroform	5.	U
107-06-2	1,2-Dichloroethane	5.	U
78-93-3	2-Butanone (MEK)	5.	UJ
71-55-6	1,1,1-Trichloroethane	5.	U
56-23-5	Carbon tetrachloride	5.	U
108-05-4	Vinyl acetate	5.	UJ
75-27-4	Bromodichloromethane	5.	U
78-87-5	1,2-Dichloropropane	5.	U
10061-01-5	cis-1,3-Dichloropropene	5.	U
10061-02-6	trans-1,3-Dichloropropene	5.	U
79-01-6	Trichloroethene	5.	U
124-48-1	Dibromochloromethane	5.	U
79-00-5	1,1,2-Trichloroethane	5.	U
71-43-2	Benzene	5.	U
75-25-2	Bromoform	5.	UJ
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.	U
591-78-6	2-Hexanone	5.	U
127-18-4	Tetrachloroethene	5.	U
79-34-5	1,1,2,2-Tetrachloroethane	5.	U
108-88-3	Toluene	5.	U
108-90-7	Chlorobenzene	5.	U
100-41-4	Ethylbenzene	5.	U
100-42-5	Styrene	5.	U
1330-20-7	Xylene (Total)	5.	UJ
110-75-8	2-Chloroethyl vinyl ether	5.	UR
156-59-2	cis-1,2-Dichloroethene	NR	
156-60-5	trans-1,2-Dichloroethene	NR	

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW-VOA							
	SAMPLE ID ------->	653-G-W003-01					
	ORIGINAL ID ----->	653GW00301					
	LAB SAMPLE ID --->	35269.06					
	ID FROM REPORT -->	653GW00301					
	SAMPLE DATE ----->	08/13/98					
	DATE ANALYZED --->	08/18/98					
	MATRIX ---------->	Water					
	UNITS ---------->	UG/L					
CAS #	Parameter	35269	VAL				
1634-04-4	Methyl tert-butyl ether	NR					

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW846-DIOX

SAMPLE ID ------->	653-G-W003-C1
ORIGINAL ID ----->	653GW003C1
LAB SAMPLE ID --->	40799.02
ID FROM REPORT -->	653GW003C1
SAMPLE DATE ----->	10/20/99
DATE EXTRACTED -->	10/22/99
DATE ANALYZED --->	11/02/99
MATRIX ---------->	Water
UNITS ----------->	PG/L

CAS #	Parameter	40799	VAL
1746-01-6	2378-TCDD	2.074	U
40321-76-4	12378-PeCDD	2.926	U
39227-28-6	123478-HxCDD	1.412	U
57653-85-7	123678-HxCDD	1.434	U
19408-74-3	123789-HxCDD	1.384	U
35822-46-9	1234678-HpCDD	1.811	U
3268-87-9	OCDD	20.99	U
51207-31-9	2378-TCDF	1.944	U
57117-41-6	12378-PeCDF	1.586	U
57117-31-4	23478-PeCDF	1.597	U
70648-26-9	123478-HxCDF	1.413	U
57117-44-9	123678-HxCDF	1.434	U
72918-21-9	123789-HxCDF	1.884	U
60851-34-5	234678-HxCDF	1.408	U
67562-39-4	1234678-HpCDF	1.712	U
55673-89-7	1234789-HpCDF	2.631	U
39001-02-0	OCDF	4.18	U
41903-57-5	Total Tetra-Dioxins	2.074	U
36088-22-9	Total Penta-Dioxins	2.926	U
34465-46-8	Total Hexa-Dioxins	1.434	U
37871-00-4	Total Hepta-Dioxins	1.811	U
55722-27-5	Total Tetra-Furans	1.944	U
30602-15-4	Total Penta-Furans	1.597	U
55684-94-1	Total Hexa-Furans	1.434	U
38998-75-3	Total Hepta-Furans	1.712	U

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW846-META

SAMPLE ID ------->	653-G-W003-C1
ORIGINAL ID ----->	653GW003C1
LAB SAMPLE ID --->	40799.02
ID FROM REPORT -->	653GW003C1
SAMPLE DATE ----->	10/20/99
DATE EXTRACTED -->	10/27/99
DATE ANALYZED --->	10/28/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	40799	VAL
7429-90-5	Aluminum (Al)	940.	
7440-36-0	Antimony (Sb)	5.	U
7440-38-2	Arsenic (As)	3.3	U
7440-39-3	Barium (Ba)	44.	
7440-41-7	Beryllium (Be)	0.3	U
7440-43-9	Cadmium (Cd)	0.3	U
7440-70-2	Calcium (Ca)	11900.	
7440-47-3	Chromium (Cr)	1.1	J
7440-48-4	Cobalt (Co)	1.7	U
7440-50-8	Copper (Cu)	1.	U
7439-89-6	Iron (Fe)	14500.	
7439-92-1	Lead (Pb)	2.1	U
7439-95-4	Magnesium (Mg)	1590.	
7439-96-5	Manganese (Mn)	89.2	
7439-97-6	Mercury (Hg)	0.1	U
7440-02-0	Nickel (Ni)	0.8	U
7440-09-7	Potassium (K)	1830.	J
7782-49-2	Selenium (Se)	2.9	U
7440-22-4	Silver (Ag)	2.	U
7440-23-5	Sodium (Na)	9120.	
7440-28-0	Thallium (Tl)	2.3	U
7440-62-2	Vanadium (V)	1.2	J
7440-66-6	Zinc (Zn)	14.8	J
7440-31-5	Tin (Sn)	29.5	U

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW846-SVOA

SAMPLE ID -------->	653-G-W003-C1
ORIGINAL ID ----->	653GW003C1
LAB SAMPLE ID --->	40799.02
ID FROM REPORT -->	653GW003C1
SAMPLE DATE ----->	10/20/99
DATE EXTRACTED -->	10/22/99
DATE ANALYZED --->	11/05/99
MATRIX ---------->	Water
UNITS ---------->	UG/L

CAS #	Parameter	40799	VAL
62-75-9	N-Nitrosodimethylamine	NR	
99-09-2	3-Nitroaniline	25.	U
108-95-2	Phenol	10.	U
83-32-9	Acenaphthene	10.	U
62-53-3	Aniline	NR	
51-28-5	2,4-Dinitrophenol	25.	U
111-44-4	bis(2-Chloroethyl)ether	10.	U
100-02-7	4-Nitrophenol	25.	U
95-57-8	2-Chlorophenol	10.	U
132-64-9	Dibenzofuran	10.	U
541-73-1	1,3-Dichlorobenzene	10.	U
121-14-2	2,4-Dinitrotoluene	10.	U
106-46-7	1,4-Dichlorobenzene	10.	U
84-66-2	Diethylphthalate	10.	U
100-51-6	Benzyl alcohol	10.	U
7005-72-3	4-Chlorophenylphenylether	10.	U
95-50-1	1,2-Dichlorobenzene	10.	U
86-73-7	Fluorene	10.	U
95-48-7	2-Methylphenol (o-Cresol)	10.	U
100-01-6	4-Nitroaniline	25.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U
106-44-5	4-Methylphenol (p-Cresol)	10.	U
86-30-6	N-Nitrosodiphenylamine	10.	U
621-64-7	N-Nitroso-di-n-propylamine	10.	U
103-33-3	Azobenzene	NR	
67-72-1	Hexachloroethane	10.	U
101-55-3	4-Bromophenyl-phenylether	10.	U
98-95-3	Nitrobenzene	10.	U
118-74-1	Hexachlorobenzene	10.	U
78-59-1	Isophorone	10.	U
87-86-5	Pentachlorophenol	25.	U
88-75-5	2-Nitrophenol	10.	U
85-01-8	Phenanthrene	10.	U
105-67-9	2,4-Dimethylphenol	10.	U
120-12-7	Anthracene	10.	U

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW846-SVOA

SAMPLE ID ------->	653-G-W003-C1
ORIGINAL ID ----->	653GW003C1
LAB SAMPLE ID --->	40799.02
ID FROM REPORT -->	653GW003C1
SAMPLE DATE ----->	10/20/99
DATE EXTRACTED -->	10/22/99
DATE ANALYZED --->	11/05/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	40799	VAL
65-85-0	Benzoic acid	10.	U
84-74-2	Di-n-butylphthalate	10.	U
111-91-1	bis(2-Chloroethoxy)methane	10.	U
206-44-0	Fluoranthene	10.	U
120-83-2	2,4-Dichlorophenol	10.	U
92-87-5	Benzidine	NR	
120-82-1	1,2,4-Trichlorobenzene	10.	U
129-00-0	Pyrene	10.	U
91-20-3	Naphthalene	10.	U
85-68-7	Butylbenzylphthalate	10.	U
106-47-8	4-Chloroaniline	10.	U
91-94-1	3,3'-Dichlorobenzidine	10.	U
87-68-3	Hexachlorobutadiene	10.	U
56-55-3	Benzo(a)anthracene	10.	U
59-50-7	4-Chloro-3-methylphenol	10.	U
218-01-9	Chrysene	10.	U
91-57-6	2-Methylnaphthalene	10.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	18.	U
77-47-4	Hexachlorocyclopentadiene	10.	U
117-84-0	Di-n-octyl phthalate	10.	U
88-06-2	2,4,6-Trichlorophenol	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U
95-95-4	2,4,5-Trichlorophenol	25.	U
207-08-9	Benzo(k)fluoranthene	10.	U
91-58-7	2-Chloronaphthalene	10.	U
50-32-8	Benzo(a)pyrene	10.	U
88-74-4	2-Nitroaniline	25.	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U
131-11-3	Dimethyl phthalate	10.	U
53-70-3	Dibenz(a,h)anthracene	10.	U
208-96-8	Acenaphthylene	10.	U
191-24-2	Benzo(g,h,i)perylene	10.	U
606-20-2	2,6-Dinitrotoluene	10.	U

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW846METAL									
	SAMPLE ID ------->	653-G-W003-F3		653-G-W003-U3					
	ORIGINAL ID ----->	653GW003F3		653GW003U3					
	LAB SAMPLE ID --->	37156.03		37156.02					
	ID FROM REPORT -->	653GW003F3		653GW003U3					
	SAMPLE DATE ----->	01/20/99		01/20/99					
	DATE EXTRACTED -->	01/22/99		01/22/99					
	DATE ANALYZED --->	01/22/99		01/22/99					
	MATRIX ---------->	Water		Water					
	UNITS ---------->	UG/L		UG/L					
CAS #	Parameter	37156	VAL	37156	VAL				
7439-97-6	Mercury (Hg)	0.1	U	0.1	U				
7440-36-0	Antimony (Sb)	3.2	J	2.7	U				
7440-38-2	Arsenic (As)	2.9	U	3.8	J				
7440-41-7	Beryllium (Be)	0.1	U	0.1	U				
7440-47-3	Chromium (Cr)	0.7	U	0.7	U				
7439-92-1	Lead (Pb)	1.5	U	1.5	U				
7440-28-0	Thallium (Tl)	3.1	U	3.1	U				

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW846_VOA									
	SAMPLE ID ------->	653-G-W003-03		653-G-W003-C1					
	ORIGINAL ID ----->	653GW00303		653GW003C1					
	LAB SAMPLE ID --->	37156.01		40799.02					
	ID FROM REPORT -->	653GW00303		653GW003C1					
	SAMPLE DATE ----->	01/20/99		10/20/99					
	DATE ANALYZED --->	01/22/99		11/01/99					
	MATRIX ---------->	Water		Water					
	UNITS ---------->	UG/L		UG/L					
CAS #	Parameter	37156	VAL	40799	VAL				
74-87-3	Chloromethane	5.	U	5.	U				
74-83-9	Bromomethane	5.	U	5.	U				
75-01-4	Vinyl chloride	5.	U	5.	U				
75-00-3	Chloroethane	5.	U	5.	U				
75-35-4	1,1-Dichloroethene	5.	U	5.	U				
75-09-2	Methylene chloride	5.	U	5.	U				
75-34-3	1,1-Dichloroethane	5.	U	5.	U				
67-66-3	Chloroform	5.	U	5.	U				
71-55-6	1,1,1-Trichloroethane	5.	U	5.	U				
56-23-5	Carbon tetrachloride	5.	U	5.	U				
71-43-2	Benzene	5.	U	5.	U				
107-06-2	1,2-Dichloroethane	5.	U	5.	U				
79-01-6	Trichloroethene	5.	U	5.	U				
78-87-5	1,2-Dichloropropane	5.	U	5.	U				
75-27-4	Bromodichloromethane	5.	U	5.	U				
108-88-3	Toluene	5.	U	5.	U				
79-00-5	1,1,2-Trichloroethane	5.	U	5.	U				
127-18-4	Tetrachloroethene	5.	U	5.	U				
124-48-1	Dibromochloromethane	5.	U	5.	U				
108-90-7	Chlorobenzene	5.	U	5.	U				
100-41-4	Ethylbenzene	5.	U	5.	U				
100-42-5	Styrene	5.	U	5.	U				
75-25-2	Bromoform	5.	U	5.	U				
79-34-5	1,1,2,2-Tetrachloroethane	5.	U	5.	U				
67-64-1	Acetone	5.	UR	5.	U				
75-15-0	Carbon disulfide	5.	U	5.	U				
108-05-4	Vinyl acetate	5.	U	5.	U				
78-93-3	2-Butanone (MEK)	5.	U	5.	U				
110-75-8	2-Chloroethyl vinyl ether	5.	UR	5.	UR				
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.	U	5.	U				
10061-01-5	cis-1,3-Dichloropropene	5.	U	5.	U				
10061-02-6	trans-1,3-Dichloropropene	5.	U	5.	U				
591-78-6	2-Hexanone	5.	U	5.	U				
1330-20-7	Xylene (Total)	5.	U	5.	U				
540-59-0	1,2-Dichloroethene (total)	5.	U	5.	U				

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW_VOA		
	SAMPLE ID ------->	653-G-W003-02
	ORIGINAL ID ----->	653GW00302
	LAB SAMPLE ID --->	36402.05
	ID FROM REPORT -->	653GW00302
	SAMPLE DATE ----->	11/12/98
	DATE ANALYZED --->	11/19/98
	MATRIX ---------->	Water
	UNITS ---------->	UG/L

CAS #	Parameter	36383	VAL
74-87-3	Chloromethane	5.	U
74-83-9	Bromomethane	5.	U
75-01-4	Vinyl chloride	5.	U
75-00-3	Chloroethane	5.	U
75-09-2	Methylene chloride	5.	U
67-64-1	Acetone	5.	U
75-15-0	Carbon disulfide	5.	U
75-35-4	1,1-Dichloroethene	5.	U
75-34-3	1,1-Dichloroethane	5.	U
67-66-3	Chloroform	5.	U
107-06-2	1,2-Dichloroethane	5.	U
78-93-3	2-Butanone (MEK)	5.	U
71-55-6	1,1,1-Trichloroethane	5.	U
56-23-5	Carbon tetrachloride	5.	U
108-05-4	Vinyl acetate	5.	U
75-27-4	Bromodichloromethane	5.	U
78-87-5	1,2-Dichloropropane	5.	U
10061-01-5	cis-1,3-Dichloropropene	5.	U
10061-02-6	trans-1,3-Dichloropropene	5.	U
79-01-6	Trichloroethene	5.	U
124-48-1	Dibromochloromethane	5.	U
79-00-5	1,1,2-Trichloroethane	5.	U
71-43-2	Benzene	5.	U
75-25-2	Bromoform	5.	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	5.	U
591-78-6	2-Hexanone	5.	U
127-18-4	Tetrachloroethene	5.	U
79-34-5	1,1,2,2-Tetrachloroethane	5.	U
108-88-3	Toluene	5.	U
108-90-7	Chlorobenzene	5.	U
100-41-4	Ethylbenzene	5.	U
100-42-5	Styrene	5.	U
1330-20-7	Xylene (Total)	5.	U
110-75-8	2-Chloroethyl vinyl ether	5.	U
156-59-2	cis-1,2-Dichloroethene	5.	U
156-60-5	trans-1,2-Dichloroethene	5.	U
1634-04-4	Methyl tert-butyl ether	5.	U

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

SW_VOA							
	SAMPLE ID ------->	653-G-W003-02					
	ORIGINAL ID ----->	653GW00302					
	LAB SAMPLE ID --->	36402.05					
	ID FROM REPORT -->	653GW00302					
	SAMPLE DATE ----->	11/12/98					
	DATE ANALYZED --->	11/19/98					
	MATRIX ---------->	Water					
	UNITS ---------->	UG/L					
CAS #	Parameter	36383	VAL				
540-59-0	1,2-Dichloroethene (total)	NR					

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

TETRYL

SAMPLE ID ------->	653-G-W003-C1
ORIGINAL ID ----->	653GW003C1
LAB SAMPLE ID --->	40799.02
ID FROM REPORT -->	653GW003C1
SAMPLE DATE ----->	10/20/99
DATE EXTRACTED -->	10/22/99
DATE ANALYZED --->	11/01/99
MATRIX ---------->	Water
UNITS ---------->	UG/L

CAS #	Parameter	40799	VAL
479-45-8	Tetryl	0.51	U

*** Validation Complete ***

CHARLESTON - ZONE H
CHARLESTON ZONE H - CMS GROUNDWATER
SITE 653 CMS GROUNDWATER SAMPLES

TSS							
	SAMPLE ID ------->	653-G-W003-03					
	ORIGINAL ID ----->	653GW00303					
	LAB SAMPLE ID --->	37156.01					
	ID FROM REPORT -->	653GW00303					
	SAMPLE DATE ----->	01/20/99					
	DATE ANALYZED --->	01/25/99					
	MATRIX ---------->	Water					
	UNITS ---------->	MG/L					
CAS #	Parameter	37156 VAL					
9999900-03-7	Total Suspended Solids (TSS)	6.					

*** Validation Complete ***