N61165.AR.003678
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FUEL DISTRIBUTION SYSTEM LETTER REPORTS ZONE G CNC CHARLESTON
2/18/2000
ENSAFE

ZONE G

CHARLESTON NAVAL COMPLEX
FUEL
DISTRIBUTION SYSTEM

LETTER REPORTS

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

February 18, 2000

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Area 15, Charleston Naval Complex, South Carolina (SCDHEC No. 01187)

Dear Mr. Magwood:

This Final Letter Report supplements the Fuel Distribution System (FDS) Contamination Assessment Report (CAR) dated September 10, 1998. The enclosed letter report (2 copies) reflects the results of the surface and subsurface soil samples collected and the previously collected groundwater data at Area 15. The submittal is concurrently being sent to SCDHEC (2 copies), as we discussed in our recent phone conversation.

Should you have any questions or concerns regarding this submittal, please contact me.

Sincerely,

ENSAFE, INC.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

December 17, 1999

Commanding Officer
Attn: Gabriel Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Carolina, SC 29419-9010

RE: Sampling and Analysis Plan Schedule, Fuel Distribution System, Charleston Naval Complex, Charleston, SC (CTO 0144)

Dear Mr. Magwood:

Attached are two copies of the draft Sampling and Analysis Plan development schedule for Areas 2 through 6, Area 8, Areas 9 and 10 and Areas 12, 13, and 14 for your review. Please contact me with any changes you may require. I plan to submit the approved schedule to Mr. Paul Bristol SCDHEC prior to the December 31, 1999 requested due date.

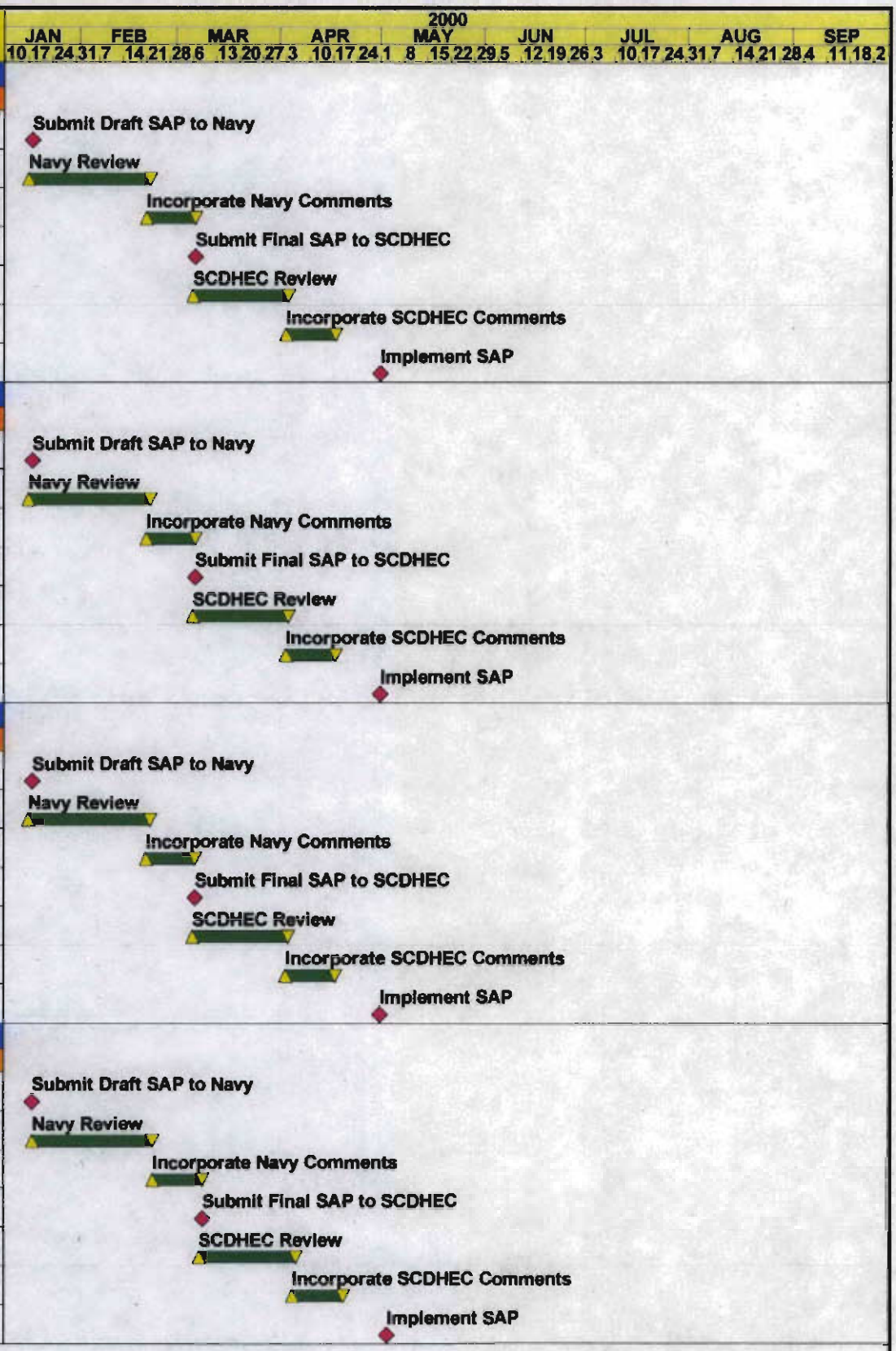
Sincerely,

ENSAFE, INC.

Craig R. Smith

Attachments

Task	Early Start	Early Finish
Areas 2, 3, 4, 5 and 6		
#01181		
01441000		17JAN00*
01441001	17JAN00	21FEB00
01441002	21FEB00	06MAR00
01441003		06MAR00
01441004	06MAR00	03APR00
01441005	03APR00	17APR00
01441006	01MAY00	
Area 8		
#01183		
01442000		17JAN00*
01442001	17JAN00	21FEB00
01442002	21FEB00	06MAR00
01442003		06MAR00
01442004	06MAR00	03APR00
01442005	03APR00	17APR00
01442006	01MAY00	
Areas 9 and 10		
#01184		
01443000		17JAN00*
01443001	17JAN00	21FEB00
01443002	21FEB00	06MAR00
01443003		06MAR00
01443004	06MAR00	03APR00
01443005	03APR00	17APR00
01443006	01MAY00	
Areas 12, 13 and 14		
#01186		
01444000		17JAN00*
01444001	18JAN00	22FEB00
01444002	23FEB00	08MAR00
01444003		08MAR00
01444004	08MAR00	05APR00
01444005	05APR00	19APR00
01444006	03MAY00	



Start Date 10JAN00
Finish Date 02MAY00
Data Date 10JAN00
Run Date 16DEC99 14:10

Early Bar
Progress Bar
Critical Activity

GFDS Sheet 1 of 1

EnSafe Inc.

Sampling & Analysis Plan Development

Classic Schedule Layout

ENSAFE

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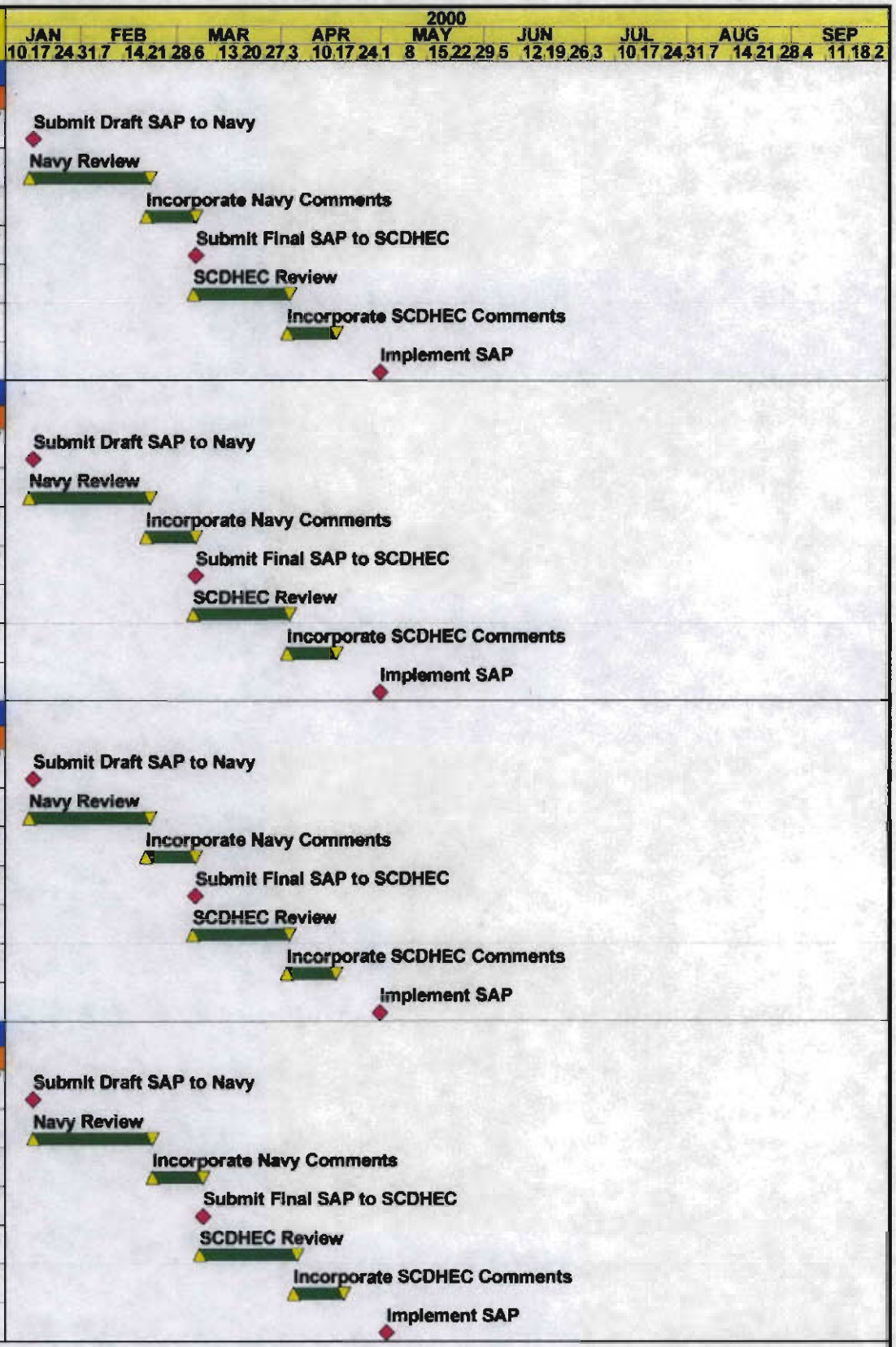
Task	Early Start	Early Finish
Areas 2, 3, 4, 5 and 6		
#01181		
01441000		17JAN00*
01441001	17JAN00	21FEB00
01441002	21FEB00	06MAR00
01441003		06MAR00
01441004	06MAR00	03APR00
01441005	03APR00	17APR00
01441006	01MAY00	
Area 8		
#01183		
01442000		17JAN00*
01442001	17JAN00	21FEB00
01442002	21FEB00	06MAR00
01442003		06MAR00
01442004	06MAR00	03APR00
01442005	03APR00	17APR00
01442006	01MAY00	
Areas 9 and 10		
#01184		
01443000		17JAN00*
01443001	17JAN00	21FEB00
01443002	21FEB00	06MAR00
01443003		06MAR00
01443004	06MAR00	03APR00
01443005	03APR00	17APR00
01443006	01MAY00	
Areas 12, 13 and 14		
#01186		
01444000		17JAN00*
01444001	18JAN00	22FEB00
01444002	23FEB00	08MAR00
01444003		08MAR00
01444004	08MAR00	05APR00
01444005	05APR00	19APR00
01444006	03MAY00	



Start Date 10JAN00
Finish Date 02MAY00
Data Date 10JAN00
Run Date 16DEC99 14:10

Early Bar
Progress Bar
Critical Activity

GFDS Sheet 1 of 1

EnSafe Inc.

Sampling & Analysis Plan Development

Classic Schedule Layout

ENSAFE

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ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

January 27, 2000

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Area 15, Charleston Naval Complex, South Carolina (SCDHEC # 01187)

Dear Mr. Magwood:

This draft-final letter report supplements the Fuel Distribution System (FDS) Contamination Assessment Report (CAR) dated September 10, 1998. In November 1998, SCDHEC requested "an appropriate and reasonable assessment and/or remedial action plan", for Area 15. We discussed this issue during our phone conference of November 30, 1998. When SCDHEC requested information on area reuse plans, we responded with a discussion of likely reuse alternatives on December 18, 1998. SCDHEC has not responded to this submittal. A letter report containing a brief reworking of the CAR was submitted for your review in June, 1999. The enclosed revised letter report reflects the results of the subsurface soil sample you requested at Area 15. As with the previous letter report, EnSafe's submittal of the current revision to the SCDHEC is your option.

Should you have any questions or concerns regarding this submittal, please contact me. We await your approval prior to submitting to SCDHEC.

Sincerely,

ENSAFE INC.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

Area 15
(SCDHEC #01187)

Background

Area 15 of the Fuel Distribution System (FDS) is associated with Phase I surface soil sample FDSSH02301. The sample was located just outside the western corner of the containment dike for Facility 3901A, on the north side of Building 3926. Six-inch pipe lines intersect and connect to Building 3926 approximately three feet from FDSSH02301.

Facility 3901A is a 103,194 gallon welded steel ballast and sludge storage tank, which has been used for waste oil storage since 1945. The tank is connected to sludge lines which extend to various parts of the base, paralleling the fuel lines of the FDS. Building 3926 is a 15-foot high metal oil water separator mounted on a concrete pad. The facility originally used a Wemco unit to treat ballast water from tanks 39-A and 39D. The Wemco unit was replaced with the current baffle operated system in 1991.

Surface soil was sampled at Area 15 because it was most likely to be impacted by area activities or associated with a release at the site. As reported in the FDS *Contamination Assessment Report* (CAR), FDSSH02301 exhibited total petroleum hydrocarbons-gasoline range organics of 501 micrograms per kilogram (μg/kg), which prompted Phase II soil and groundwater sampling within Area 15. Phase II soil sampling revealed surface soil naphthalene (1,700 μg/kg) and total naphthalenes (8,500 μg/kg) above the respective RBSLs for these analytes (210 μg/kg for each analyte) at FDSSH02301.

Based on these results, a 3- to 5-foot subsurface soil sample, FDSSH02302, was collected and analyzed to determine the vertical extent of naphthalenes at Area 15. Table 1 presents the surface soil results, as published in the CAR, and the newly acquired subsurface soil results.

Table 1
Analytes Detected in Surface and Subsurface Soil
Area 15
Fuel Distribution System

Parameters	Location	Surface Conc.	Subsurface Conc.	RBSL/SSL	Exceeds RBSL
TPH - GRO (μg/kg)					
Gasoline	FDSSH023	501	NT	NL/NL	NA
Volatile Organic Compounds (μg/kg)					
1,1-Dichloroethane	FDSSH023	85	ND	NL/23,000	NA
1,1,1-Trichloroethane	FDSSH023	48	ND	NL/2,000	NA
Benzene	FDSSH023	ND	2	5/30	NA
Ethylbenzene	FDSSH023	130	ND	1,260/13,000	No
Methylene chloride	FDSSH023	ND	2	NL/20	NA
Tetrachloroethene	FDSSH023	13	ND	NL/60	NA
Toluene	FDSSH023	22	ND	1,622/12,000	No
Xylene (Total)	FDSSH023	1800	ND	42,471/148,000	No
Semivolatile Organic Compounds (μg/kg)					
Total Naphthalenes	FDSSH023	**8500**	25	210/84,000	Yes
2-Methylnaphthalene	FDSSH023	6800	ND	NL/126,000	NA
Naphthalene	FDSSH023	**1700**	25	210/84,000	Yes
bis(2-ethylhexyl)phthalate	FDSSH023	ND	130	NL/3600000	NA
Chrysene	FDSSH023	240	ND	12,998/160,000	No
Fluorene	FDSSH023	1900	ND	NL/560,000	NA
Phenanthrene	FDSSH023	1900	ND	NL/1,380,000	NA
Pyrene	FDSSH023	590	ND	NL/4,200,000	NA
Pesticides/PCB (μg/kg)					
4,4'-DDE	FDSSH023	ND	12	NL/54000	NA
Aroclor- 1260	FDSSH023	ND	53	NL/1,000	NA
Endrin	FDSSH023	20	ND	NL/1,000	NA
Heptachlor	FDSSH023	5.3	ND	NL/23,000	NA
Heptachlor epoxide	FDSSH023	ND	2.8	NL/23,000	NA
gamma-Chlordane	FDSSH023	3.4	3.2	NL/10,000	NA

Table 1
Analytes Detected in Surface and Subsurface Soil
Area 15
Fuel Distribution System

Parameters	Location	Surface Conc.	Subsurface Conc.	RBSL/SSL	Exceeds RBSL
Inorganics (mg/kg)					
Aluminum (Al)	FDSSH023	2820	6,950	NL/1,000,000	NA
Arsenic (As)	FDSSH023	1.8	2.4	NL/29	NA
Barium (Ba)	FDSSH023	13.1	31.3	NL/1600	NA
Beryllium (Be)	FDSSH023	ND	0.31	NL/63	NA
Cadmium (Cd)	FDSSH023	0.19	ND	NL/8	NA
Calcium (Ca)	FDSSH023	13,100	1,220	NL/NL	NA
Chromium (Cr)	FDSSH023	9.3	13.5	NL/1,000,000	NA
Cobalt (Co)	FDSSH023	1.3	1.5	NL/2,000	NA
Copper (Cu)	FDSSH023	ND	2.4	NL/920	NA
Iron (Fe)	FDSSH023	4,860	10,500	NL/NL	NA
Lead (Pb)	FDSSH023	29.5	7.9	NL/400	NA
Magnesium (Mg)	FDSSH023	499	646	NL/NL	NA
Manganese (Mn)	FDSSH023	29.6	34.3	NL/1,100	NA
Mercury (Hg)	FDSSH023	0.07	0.05	NL/2.1	NA
Nickel (Ni)	FDSSH023	4.2	2.9	NL/130	NA
Potassium (K)	FDSSH023	240	321	NL/NL	NA
Selenium (Se)	FDSSH023	ND	0.51	NL/5	NA
Sodium (Na)	FDSSH023	ND	249	NL/NL	NA
Thallium (Tl)	FDSSH023	0.47	ND	NL/0.95	NA
Tin (Sn)	FDSSH023	ND	4.9	NL/11,088	NA
Vanadium (V)	FDSSH023	10.6	16.1	NL/6,000	NA
Zinc (Zn)	FDSSH023	66.8	14.8	NL/12,000	NA

Notes:
NL = Not listed
NA = Not applicable
NT = Not taken
μg/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram
RBSLs for ingestion or dermal contact with surficial soil from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998) and soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996) were used as reference concentrations.
Bolded concentrations exceed RBSL or the SSL (if no RBSL is available).

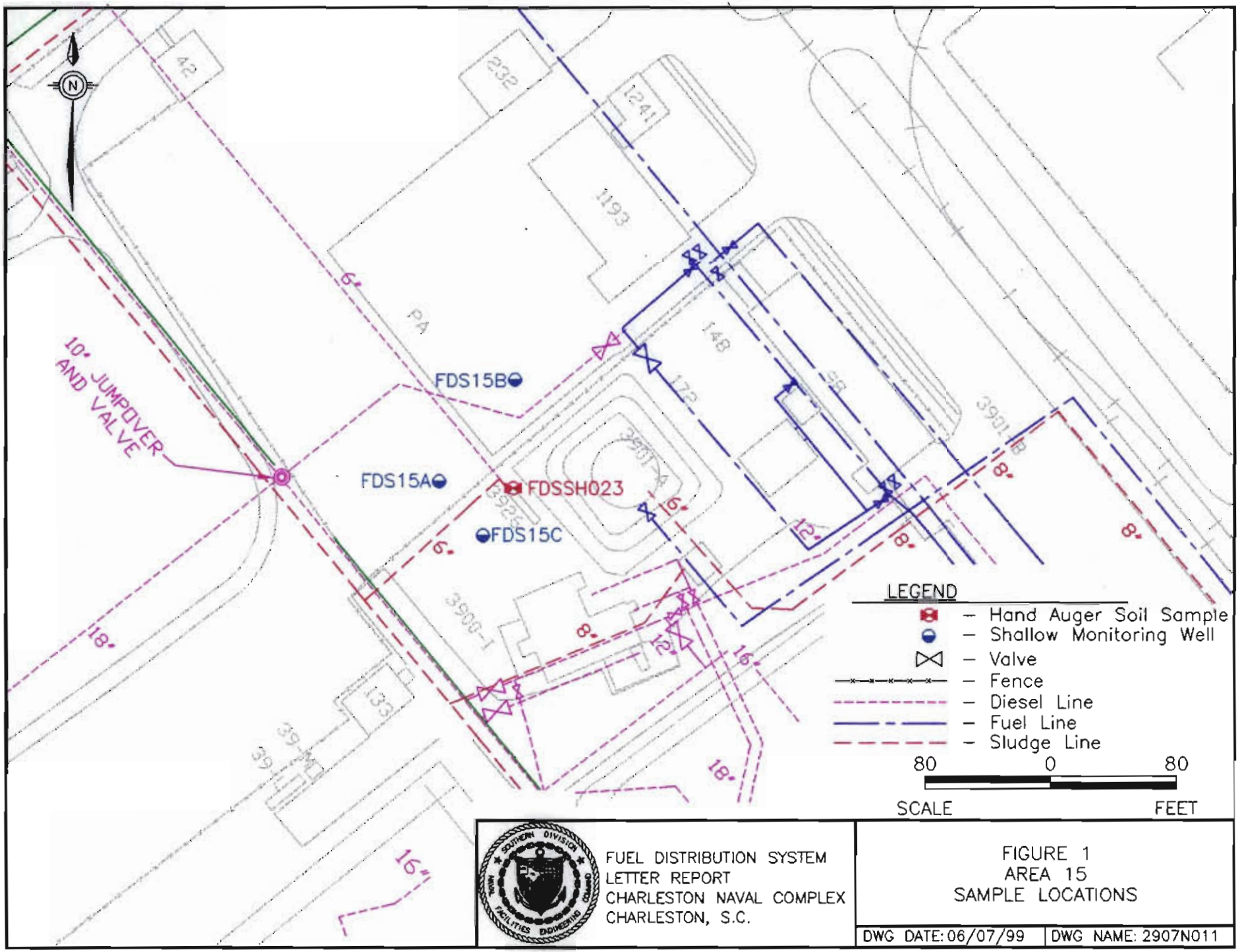
As can be seen by the table, no subsurface soil concentration exceeded an appropriate SSL. Attachment A contains the analytical results from the post-CAR sampling.

The FDS CAR discusses the first and second groundwater sampling events at Area 15 (please see the CAR [EnSafe 1998]). No groundwater organic RBSL parameters were detected during the second sampling event of the Phase II groundwater investigation at Area 15. No groundwater inorganic detection at Area 15 exceeded a RBSL during the second sampling event. Figure 1 depicts the Area 15 sample locations.

Conclusions and Recommendations

A review of analytical results from FDSSH02301 reveals that naphthalene and total naphthalenes exceeded surficial soil RBSLs. Sample FDSSH02302 reveals no subsurface soil-to-groundwater concerns. In addition, an evaluation of Phase II groundwater results reveals that no naphthalenes were detected in shallow groundwater at Area 15. No other analytes detected in shallow groundwater exceeded their respective groundwater RBSLs. The lack of RBSL constituents in shallow groundwater suggests there is no leaching of parameters from surface or subsurface soil to groundwater at Area 15.

Groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a basewide potable water system provides drinking and process water to buildings at CNC. This system is to remain in operation under the current base reuse plan. In addition, the shallow aquifer for this investigation contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which makes this water-bearing unit a questionable potable water source.



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREA 15
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907N011

The absence of parameters detected in surface or subsurface soil in groundwater at Area 15 supports the recommendation for no further evaluation and for no corrective action for this site under the South Carolina petroleum program. Currently, the location containing Area 15 is included in an area zoned for Marine Industrial use. Under this zoning use, Area 15 would likely remain a fuel farm. Also, potential risk to ecological receptors is low based on the Area 15 location inland from the Cooper River and its distance from any wetland areas within CNC. It is therefore inappropriate to undertake excavation of the site's slightly contaminated soils, which are currently not impacting groundwater. Accordingly, no further action for soil or groundwater is recommended for Area 15.

Attachment A
Analytical Data

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

CYANIDE

SAMPLE ID -------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/21/96
DATE ANALYZED --->	10/24/96
MATRIX ---------->	Soil
UNITS ---------->	MG/KG

CAS #	Parameter	27339	VAL
57-12-5	Cyanide (CN)	0.53	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW846-META

SAMPLE ID ------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/22/96
DATE ANALYZED --->	10/24/96
MATRIX ---------->	Soil
UNITS ----------->	MG/KG

CAS #	Parameter	27339	VAL
7439-97-6	Mercury (Hg)	0.07	
7429-90-5	Aluminum (Al)	2820.	
7439-92-1	Lead (Pb)	29.5	
7440-36-0	Antimony (Sb)	0.33	U
7439-95-4	Magnesium (Mg)	499.	
7440-38-2	Arsenic (As)	1.8	
7782-49-2	Selenium (Se)	0.33	U
7440-39-3	Barium (Ba)	13.1	
7440-41-7	Beryllium (Be)	0.23	U
7440-43-9	Cadmium (Cd)	0.19	J
7440-70-2	Calcium (Ca)	13100.	
7440-47-3	Chromium (Cr)	9.3	
7440-48-4	Cobalt (Co)	1.3	J
7440-50-8	Copper (Cu)	10.6	U
7439-89-6	Iron (Fe)	4860.	
7439-96-5	Manganese (Mn)	29.6	
7440-02-0	Nickel (Ni)	4.2	J
7440-09-7	Potassium (K)	240.	J
7440-22-4	Silver (Ag)	0.21	U
7440-23-5	Sodium (Na)	164.	U
7440-28-0	Thallium (Tl)	0.47	J
7440-31-5	Tin (Sn)	2.	U
7440-62-2	Vanadium (V)	10.6	
7440-66-6	Zinc (Zn)	66.8	

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW846-PEST

SAMPLE ID ------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	FDSSH02301
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/20/96
DATE ANALYZED --->	10/28/96
MATRIX ---------->	Soil
UNITS ---------->	UG/KG

CAS #	Parameter	27339	VAL
319-84-6	alpha-BHC	1.4	U
319-85-7	beta-BHC	1.4	U
319-86-8	delta-BHC	1.4	U
58-89-9	gamma-BHC (Lindane)	1.4	U
76-44-8	Heptachlor	5.3	J
309-00-2	Aldrin	1.4	U
1024-57-3	Heptachlor epoxide	1.4	U
959-98-8	Endosulfan I	1.4	U
60-57-1	Dieldrin	2.8	U
72-55-9	4,4'-DDE	2.8	U
72-20-8	Endrin	20.	
33213-65-9	Endosulfan II	2.8	U
72-54-8	4,4'-DDD	2.8	U
1031-07-8	Endosulfan sulfate	2.8	U
50-29-3	4,4'-DDT	11.	U
72-43-5	Methoxychlor	14.	U
53494-70-5	Endrin ketone	2.8	U
7421-93-4	Endrin aldehyde	2.8	U
5103-71-9	alpha-Chlordane	1.4	U
5103-74-2	gamma-Chlordane	3.4	
8001-35-2	Toxaphene	92.	U
12674-11-2	Aroclor-1016	37.	U
11104-28-2	Aroclor-1221	37.	U
11141-16-5	Aroclor-1232	37.	U
53469-21-9	Aroclor-1242	37.	U
12672-29-6	Aroclor-1248	37.	U
11097-69-1	Aroclor-1254	74.	U
11096-82-5	Aroclor-1260	170.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW846-SVOA

SAMPLE ID -------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/20/96
DATE ANALYZED --->	11/01/96
MATRIX ---------->	Soil
UNITS ---------->	UG/KG

CAS #	Parameter	27339	VAL
108-95-2	Phenol	1800.	U
111-44-4	bis(2-Chloroethyl)ether	1800.	U
95-57-8	2-Chlorophenol	1800.	U
541-73-1	1,3-Dichlorobenzene	1800.	U
106-46-7	1,4-Dichlorobenzene	1800.	U
100-51-6	Benzyl alcohol	1800.	U
95-50-1	1,2-Dichlorobenzene	1800.	U
95-48-7	2-Methylphenol (o-Cresol)	1800.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	1800.	U
106-44-5	4-Methylphenol (p-Cresol)	1800.	U
621-64-7	N-Nitroso-di-n-propylamine	1800.	U
67-72-1	Hexachloroethane	1800.	U
98-95-3	Nitrobenzene	1800.	U
78-59-1	Isophorone	1800.	U
88-75-5	2-Nitrophenol	1800.	U
105-67-9	2,4-Dimethylphenol	1800.	U
65-85-0	Benzoic acid	8900.	U
111-91-1	bis(2-Chloroethoxy)methane	1800.	U
120-83-2	2,4-Dichlorophenol	1800.	U
120-82-1	1,2,4-Trichlorobenzene	1800.	U
91-20-3	Naphthalene	1700.	J
106-47-8	4-Chloroaniline	1800.	U
87-68-3	Hexachlorobutadiene	1800.	U
59-50-7	4-Chloro-3-methylphenol	1800.	U
91-57-6	2-Methylnaphthalene	6800.	
77-47-4	Hexachlorocyclopentadiene	1800.	U
88-06-2	2,4,6-Trichlorophenol	1800.	U
95-95-4	2,4,5-Trichlorophenol	8900.	U
91-58-7	2-Chloronaphthalene	1800.	U
88-74-4	2-Nitroaniline	8900.	U
131-11-3	Dimethyl phthalate	1800.	U
208-96-8	Acenaphthylene	1800.	U
606-20-2	2,6-Dinitrotoluene	1800.	U
99-09-2	3-Nitroaniline	8900.	U
83-32-9	Acenaphthene	1800.	U
51-28-5	2,4-Dinitrophenol	8900.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW846-SVOA

SAMPLE ID ------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/20/96
DATE ANALYZED --->	11/01/96
MATRIX ---------->	Soil
UNITS ----------->	UG/KG

CAS #	Parameter	27339	VAL
100-02-7	4-Nitrophenol	8900.	U
132-64-9	Dibenzofuran	1800.	U
121-14-2	2,4-Dinitrotoluene	1800.	U
84-66-2	Diethylphthalate	1800.	U
7005-72-3	4-Chlorophenylphenylether	1800.	U
86-73-7	Fluorene	1900.	
100-01-6	4-Nitroaniline	8900.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	8900.	U
86-30-6	N-Nitrosodiphenylamine	1800.	U
101-55-3	4-Bromophenyl-phenylether	1800.	U
118-74-1	Hexachlorobenzene	1800.	U
87-86-5	Pentachlorophenol	8900.	U
85-01-8	Phenanthrene	1900.	
120-12-7	Anthracene	1800.	U
84-74-2	Di-n-butylphthalate	1800.	U
206-44-0	Fluoranthene	1800.	U
129-00-0	Pyrene	590.	J
85-68-7	Butylbenzylphthalate	1800.	U
91-94-1	3,3'-Dichlorobenzidine	3700.	U
56-55-3	Benzo(a)anthracene	1800.	U
218-01-9	Chrysene	240.	J
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	1800.	U
117-84-0	Di-n-octyl phthalate	1800.	U
205-99-2	Benzo(b)fluoranthene	1800.	U
207-08-9	Benzo(k)fluoranthene	1800.	U
50-32-8	Benzo(a)pyrene	1800.	U
193-39-5	Indeno(1,2,3-cd)pyrene	1800.	U
53-70-3	Dibenz(a,h)anthracene	1800.	U
191-24-2	Benzo(g,h,i)perylene	1800.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW846-VOA

SAMPLE ID -------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE ANALYZED --->	10/22/96
MATRIX ---------->	Soil
UNITS ---------->	UG/KG

CAS #	Parameter	27339	VAL
74-87-3	Chloromethane	56.	U
74-83-9	Bromomethane	56.	U
75-01-4	Vinyl chloride	56.	U
75-00-3	Chloroethane	56.	U
75-09-2	Methylene chloride	28.	U
67-64-1	Acetone	56.	U
75-15-0	Carbon disulfide	28.	U
75-35-4	1,1-Dichloroethene	28.	U
75-34-3	1,1-Dichloroethane	85.	J
540-59-0	1,2-Dichloroethene (total)	28.	U
67-66-3	Chloroform	28.	U
107-06-2	1,2-Dichloroethane	28.	U
78-93-3	2-Butanone (MEK)	56.	U
71-55-6	1,1,1-Trichloroethane	48.	J
56-23-5	Carbon tetrachloride	28.	U
75-27-4	Bromodichloromethane	28.	U
78-87-5	1,2-Dichloropropane	28.	U
10061-01-5	cis-1,3-Dichloropropene	28.	U
79-01-6	Trichloroethene	28.	U
124-48-1	Dibromochloromethane	28.	U
79-00-5	1,1,2-Trichloroethane	28.	U
71-43-2	Benzene	28.	U
10061-02-6	trans-1,3-Dichloropropene	28.	U
75-25-2	Bromoform	28.	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	56.	U
591-78-6	2-Hexanone	56.	UJ
127-18-4	Tetrachloroethene	13.	J
79-34-5	1,1,2,2-Tetrachloroethane	28.	UJ
108-88-3	Toluene	22.	J
108-90-7	Chlorobenzene	28.	UJ
100-41-4	Ethylbenzene	130.	J
100-42-5	Styrene	28.	UJ
1330-20-7	Xylene (Total)	1800.	J
108-05-4	Vinyl acetate	56.	UJ
110-75-8	2-Chloroethyl vinyl ether	56.	UR

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

TPH-DRO

SAMPLE ID -------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/24/96
DATE ANALYZED --->	11/04/96
MATRIX ---------->	Soil
UNITS ---------->	MG/KG

CAS #	Parameter	27339	VAL
68334-30-5	Diesel	55.6	U
8008-20-6	Kerosene	55.6	U
9999000-35-1	JP-4 C6-C14	55.6	U
9999000-48-6	NAPHTHA C6-C12	55.6	U
68553-00-4	Fuel oil no. 6	55.6	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

TPH-GRO							
	SAMPLE ID ------->	FDS-S-H023-01					
	ORIGINAL ID ----->	FDSSH02301					
	LAB SAMPLE ID --->	FDSSH02301					
	ID FROM REPORT -->	FDSSH02301					
	SAMPLE DATE ----->	10/17/96					
	DATE ANALYZED --->	10/22/96					
	MATRIX ---------->	Soil					
	UNITS ---------->	UG/KG					
CAS #	Parameter	27339 VAL					
86290-81-5	Gasoline	501. J					

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

CYANIDE							
	SAMPLE ID ------->	FDS-S-H023-02					
	ORIGINAL ID ----->	FDSSH02302					
	LAB SAMPLE ID --->	40518.01					
	ID FROM REPORT -->	FDSSH02302					
	SAMPLE DATE ----->	09/30/99					
	DATE EXTRACTED -->	10/07/99					
	DATE ANALYZED --->	10/08/99					
	MATRIX ---------->	Soil					
	UNITS ---------->	MG/KG					
CAS #	Parameter	40518	VAL				
57-12-5	Cyanide (CN)	0.17	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW-META

SAMPLE ID -------->	FDS-S-H023-02
ORIGINAL ID ----->	FDSSH02302
LAB SAMPLE ID --->	40518.01
ID FROM REPORT -->	FDSSH02302
SAMPLE DATE ----->	09/30/99
DATE EXTRACTED -->	10/06/99
DATE ANALYZED --->	10/07/99
MATRIX ---------->	Soil
UNITS ---------->	MG/KG

CAS #	Parameter	40518	VAL
7439-97-6	Mercury (Hg)	0.05	
7440-38-2	Arsenic (As)	2.4	
7440-39-3	Barium (Ba)	31.3	
7440-43-9	Cadmium (Cd)	0.03	U
7440-47-3	Chromium (Cr)	13.5	
7439-92-1	Lead (Pb)	7.9	
7782-49-2	Selenium (Se)	0.51	B
7440-22-4	Silver (Ag)	0.14	U
7440-36-0	Antimony (Sb)	0.31	NU
7440-41-7	Beryllium (Be)	0.31	B
7440-70-2	Calcium (Ca)	1220.	
7440-48-4	Cobalt (Co)	1.5	B
7440-50-8	Copper (Cu)	2.4	
7439-89-6	Iron (Fe)	10500.	
7439-95-4	Magnesium (Mg)	646.	
7439-96-5	Manganese (Mn)	34.3	N
7440-02-0	Nickel (Ni)	2.9	B
7440-09-7	Potassium (K)	321.	
7440-23-5	Sodium (Na)	249.	B
7440-28-0	Thallium (Tl)	0.4	U
7440-62-2	Vanadium (V)	16.1	
7440-66-6	Zinc (Zn)	14.8	
7440-31-5	Tin (Sn)	4.9	B
7429-90-5	Aluminum (Al)	6950.	

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW-SVOA

SAMPLE ID -------->	FDS-S-H023-02
ORIGINAL ID ----->	FDSSH02302
LAB SAMPLE ID --->	40518.01
ID FROM REPORT -->	FDSSH02302
SAMPLE DATE ----->	09/30/99
DATE EXTRACTED -->	10/11/99
DATE ANALYZED --->	10/12/99
MATRIX ---------->	Soil
UNITS ---------->	UG/KG

CAS #	Parameter	40518	VAL
108-95-2	Phenol	380.	U
111-44-4	bis(2-Chloroethyl)ether	380.	U
95-57-8	2-Chlorophenol	380.	U
541-73-1	1,3-Dichlorobenzene	380.	U
106-46-7	1,4-Dichlorobenzene	380.	U
100-51-6	Benzyl alcohol	380.	U
95-50-1	1,2-Dichlorobenzene	380.	U
95-48-7	2-Methylphenol (o-Cresol)	380.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	380.	U
106-44-5	4-Methylphenol (p-Cresol)	380.	U
621-64-7	N-Nitroso-di-n-propylamine	380.	U
67-72-1	Hexachloroethane	380.	U
98-95-3	Nitrobenzene	380.	U
78-59-1	Isophorone	380.	U
88-75-5	2-Nitrophenol	380.	U
105-67-9	2,4-Dimethylphenol	380.	U
65-85-0	Benzoic acid	380.	U
111-91-1	bis(2-Chloroethoxy)methane	380.	U
120-83-2	2,4-Dichlorophenol	380.	U
120-82-1	1,2,4-Trichlorobenzene	380.	U
91-20-3	Naphthalene	25.	JB
106-47-8	4-Chloroaniline	380.	U
87-68-3	Hexachlorobutadiene	380.	U
59-50-7	4-Chloro-3-methylphenol	380.	U
91-57-6	2-Methylnaphthalene	380.	U
77-47-4	Hexachlorocyclopentadiene	380.	U
88-06-2	2,4,6-Trichlorophenol	380.	U
95-95-4	2,4,5-Trichlorophenol	950.	U
91-58-7	2-Chloronaphthalene	380.	U
88-74-4	2-Nitroaniline	950.	U
131-11-3	Dimethyl phthalate	380.	U
208-96-8	Acenaphthylene	380.	U
99-09-2	3-Nitroaniline	950.	U
83-32-9	Acenaphthene	380.	U
51-28-5	2,4-Dinitrophenol	950.	U
100-02-7	4-Nitrophenol	950.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW-SVOA							
	SAMPLE ID ------->	FDS-S-H023-02					
	ORIGINAL ID ----->	FDSSH02302					
	LAB SAMPLE ID --->	40518.01					
	ID FROM REPORT -->	FDSSH02302					
	SAMPLE DATE ----->	09/30/99					
	DATE EXTRACTED -->	10/11/99					
	DATE ANALYZED --->	10/12/99					
	MATRIX ---------->	Soil					
	UNITS ---------->	UG/KG					
CAS #	Parameter	40518	VAL				
132-64-9	Dibenzofuran	380.	U				
121-14-2	2,4-Dinitrotoluene	380.	U				
606-20-2	2,6-Dinitrotoluene	380.	U				
84-66-2	Diethylphthalate	380.	U				
7005-72-3	4-Chlorophenylphenylether	380.	U				
86-73-7	Fluorene	380.	U				
100-01-6	4-Nitroaniline	950.	U				
534-52-1	2-Methyl-4,6-Dinitrophenol	950.	U				
86-30-6	N-Nitrosodiphenylamine	380.	U				
101-55-3	4-Bromophenyl-phenylether	380.	U				
118-74-1	Hexachlorobenzene	380.	U				
87-86-5	Pentachlorophenol	950.	U				
85-01-8	Phenanthrene	380.	U				
120-12-7	Anthracene	380.	U				
84-74-2	Di-n-butylphthalate	380.	U				
206-44-0	Fluoranthene	380.	U				
129-00-0	Pyrene	380.	U				
85-68-7	Butylbenzylphthalate	380.	U				
91-94-1	3,3'-Dichlorobenzidine	380.	U				
56-55-3	Benzo(a)anthracene	380.	U				
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	130.	JB				
218-01-9	Chrysene	380.	U				
117-84-0	Di-n-octyl phthalate	380.	U				
205-99-2	Benzo(b)fluoranthene	380.	U				
207-08-9	Benzo(k)fluoranthene	380.	U				
50-32-8	Benzo(a)pyrene	380.	U				
193-39-5	Indeno(1,2,3-cd)pyrene	380.	U				
53-70-3	Dibenz(a,h)anthracene	380.	U				
191-24-2	Benzo(g,h,i)perylene	380.	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW-VOA

SAMPLE ID -------->	FDS-S-H023-02
ORIGINAL ID ----->	FDSSH02302
LAB SAMPLE ID --->	40518.01
ID FROM REPORT -->	FDSSH02302
SAMPLE DATE ----->	09/30/99
DATE ANALYZED --->	10/08/99
MATRIX ---------->	Soil
UNITS ---------->	UG/KG

CAS #	Parameter	40518	VAL
71-43-2	Benzene	2.	J
100-41-4	Ethylbenzene	7.	U
108-88-3	Toluene	7.	U
1330-20-7	Xylene (Total)	7.	U
74-87-3	Chloromethane	7.	U
74-83-9	Bromomethane	7.	U
75-01-4	Vinyl chloride	7.	U
75-00-3	Chloroethane	7.	U
75-09-2	Methylene chloride	2.	J
67-64-1	Acetone	7.	U
75-15-0	Carbon disulfide	7.	U
75-35-4	1,1-Dichloroethene	7.	U
75-34-3	1,1-Dichloroethane	7.	U
540-59-0	1,2-Dichloroethene (total)	7.	U
67-66-3	Chloroform	7.	U
107-06-2	1,2-Dichloroethane	7.	U
78-93-3	2-Butanone (MEK)	7.	U
71-55-6	1,1,1-Trichloroethane	7.	U
56-23-5	Carbon tetrachloride	7.	U
108-05-4	Vinyl acetate	7.	U
75-27-4	Bromodichloromethane	7.	U
78-87-5	1,2-Dichloropropane	7.	U
10061-01-5	cis-1,3-Dichloropropene	7.	U
79-01-6	Trichloroethene	7.	U
124-48-1	Dibromochloromethane	7.	U
79-00-5	1,1,2-Trichloroethane	7.	U
10061-02-6	trans-1,3-Dichloropropene	7.	U
75-25-2	Bromoform	7.	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	7.	U
591-78-6	2-Hexanone	7.	U
127-18-4	Tetrachloroethene	7.	U
79-34-5	1,1,2,2-Tetrachloroethane	7.	U
108-90-7	Chlorobenzene	7.	U
100-42-5	Styrene	7.	U
110-75-8	2-Chloroethyl vinyl ether	7.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15

SW846-PEST

SAMPLE ID -------->	FDS-S-H023-02
ORIGINAL ID ----->	FDSSH02302
LAB SAMPLE ID --->	40518.01
ID FROM REPORT -->	FDSSH02302
SAMPLE DATE ----->	09/30/99
DATE EXTRACTED -->	10/03/99
DATE ANALYZED --->	10/05/99
MATRIX ---------->	Soil
UNITS ---------->	UG/KG

CAS #	Parameter	40518	VAL
12674-11-2	Aroclor-1016	39.	U
11104-28-2	Aroclor-1221	39.	U
11141-16-5	Aroclor-1232	39.	U
53469-21-9	Aroclor-1242	39.	U
12672-29-6	Aroclor-1248	39.	U
11097-69-1	Aroclor-1254	39.	U
11096-82-5	Aroclor-1260	53.	
319-84-6	alpha-BHC	1.5	U
319-85-7	beta-BHC	1.5	U
319-86-8	delta-BHC	1.5	U
58-89-9	gamma-BHC (Lindane)	1.5	U
76-44-8	Heptachlor	1.5	U
309-00-2	Aldrin	1.5	U
1024-57-3	Heptachlor epoxide	2.8	P
959-98-8	Endosulfan I	1.5	U
60-57-1	Dieldrin	3.	U
72-55-9	4,4'-DDE	12.	
72-20-8	Endrin	3.	U
33213-65-9	Endosulfan II	3.	U
72-54-8	4,4'-DDD	3.	U
1031-07-8	Endosulfan sulfate	3.	U
50-29-3	4,4'-DDT	3.	U
7421-93-4	Endrin aldehyde	3.	U
72-43-5	Methoxychlor	15.	U
5103-71-9	alpha-Chlordane	1.5	U
5103-74-2	gamma-Chlordane	3.2	P
8001-35-2	Toxaphene	99.	U
53494-70-5	Endrin ketone	3.	U

*** Validation Complete ***

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

October 1, 1999

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Areas 2, 3, 4, 5, and 6, Charleston Naval Complex, South Carolina (SCDHEC No. 01181)

Dear Mr. Magwood:

This final letter report supplements the Fuel Distribution System (FDS) Contamination Assessment Report (CAR) dated September 10, 1998. This letter report incorporates the results of follow-on investigative activities performed in accordance with recommendations in the CAR, and to address any SCDHEC comments concerning these areas.

In accordance with the Statement of Work, two copies of this report are attached. Two copies are also being sent to Paul Bristol of the South Carolina Department of Health and Environmental Control.

Should you have any questions or concerns regarding this submittal, please contact me.

Sincerely,

ENSAFE INC.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

Areas 2, 3, 4, 5, and 6

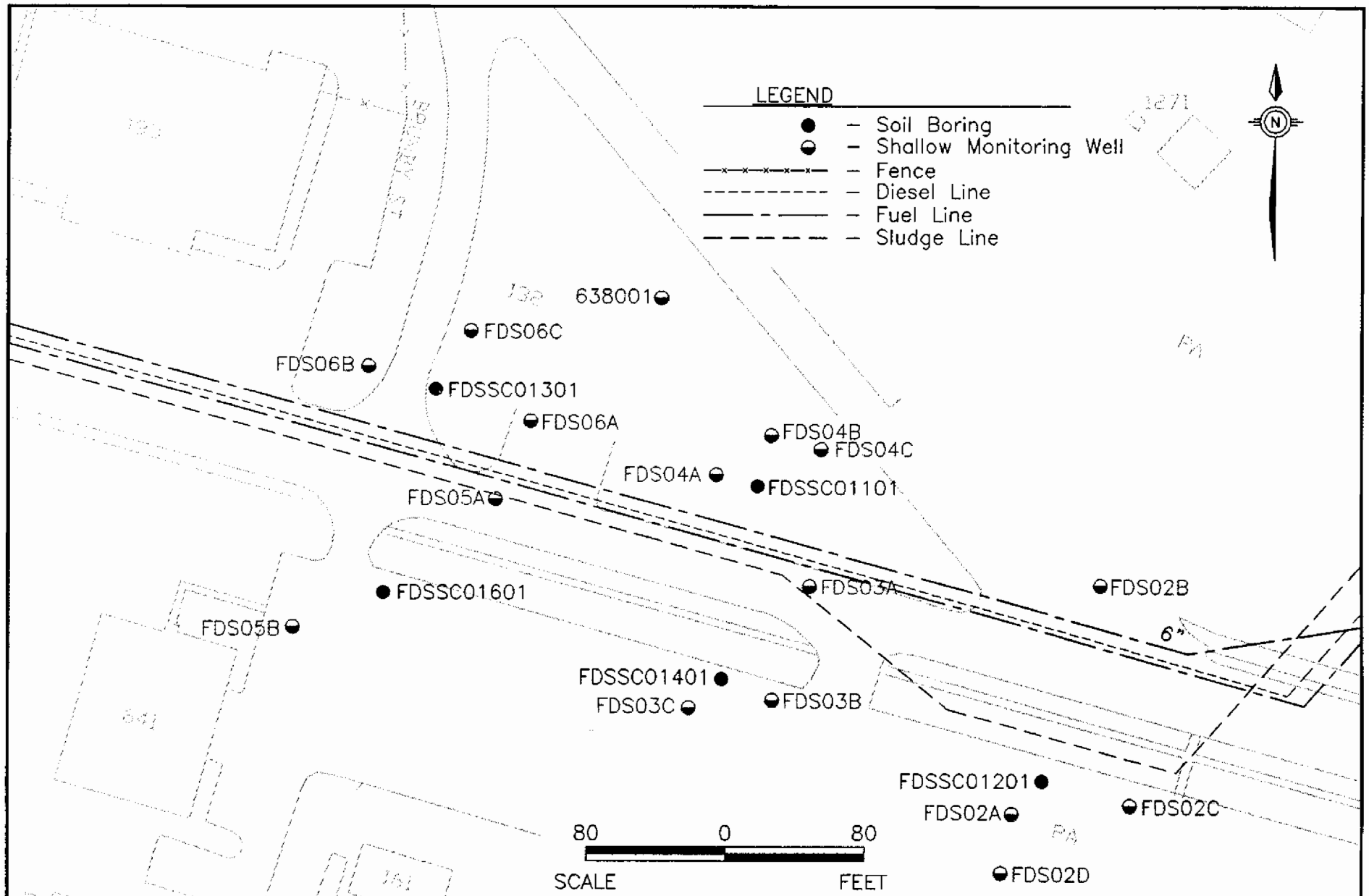
(SCDHEC No. 01181)

Background

The combined Areas 2, 3, 4, 5, and 6 of the Fuel Distribution System (FDS) are associated with Phase I soil samples FDSSC01101 through FDSSC01401, and FDSSC01601. As reported in the *FDS Contamination Assessment Report (CAR),* these samples exhibited total petroleum hydrocarbons-gasoline range organics ranging from 61.8 micrograms per kilogram (μg/kg) at FDSSC01101 to 124,000 μg/kg at FDSSC01301. These Phase I soil results prompted subsequent Phase II soil and groundwater sampling at the combined areas. Phase II soil sampling revealed chemicals of concern (COCs) for the soil. Benzene was detected at 100 μg/kg at sample FDSSC01201 which exceeded the risk-based screening level (RBSL) of 5 μg/kg. Total naphthalenes of 159,000 μg/kg and 5,490 μg/kg at FDSSC01201 and FDSSC01301, respectively, exceeded the RBSL of 210 μg/kg. To determine if groundwater has been adversely impacted by these petroleum COCs, 14 shallow groundwater monitoring wells were installed and sampled in the combined areas during Phase II. Data from nearby well 638001 were also incorporated into the investigation. The Phase II groundwater investigation revealed the RBSL for total polycyclic aromatic hydrocarbons (PAHs) was exceeded at well FDS06B during both the first and second sampling events, while the RBSL for 2-methylnaphthalene was exceeded at this well during the first event (CAR, EnSafe 1998). Figure 1 depicts the Areas 2, 3, 4, 5, and 6 sample locations.

Follow-on Activities

The FDS CAR recommended and South Carolina Department of Health and Environmental Control (SCDHEC) concurred that removal/remediation of the soil at FDSSC012 was necessary to mitigate the threat of benzene and naphthalene leaching to groundwater at this location. To fill a potential data gap at Areas 2, 3, 4, 5, and 6, the FDS CAR also recommended installation of a monitoring well downgradient of FDSSC012 to determine if these COCs were leaching to



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREAS 2, 3, 4, 5, AND 6
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907N003

groundwater. Monitoring well FDS02D was installed downgradient from FDSSC012 in February, 1999, and all area wells were resampled for RBSL parameters in March 1999. Figure 1 depicts the combined Areas 2, 3, 4, 5, and 6 sample locations, including the location of the new well. Attachment A contains the monitoring well construction diagram and well development record for the new well, FDS02D. The FDS CAR contains the boring logs and development records for the previously installed wells in the combined area.

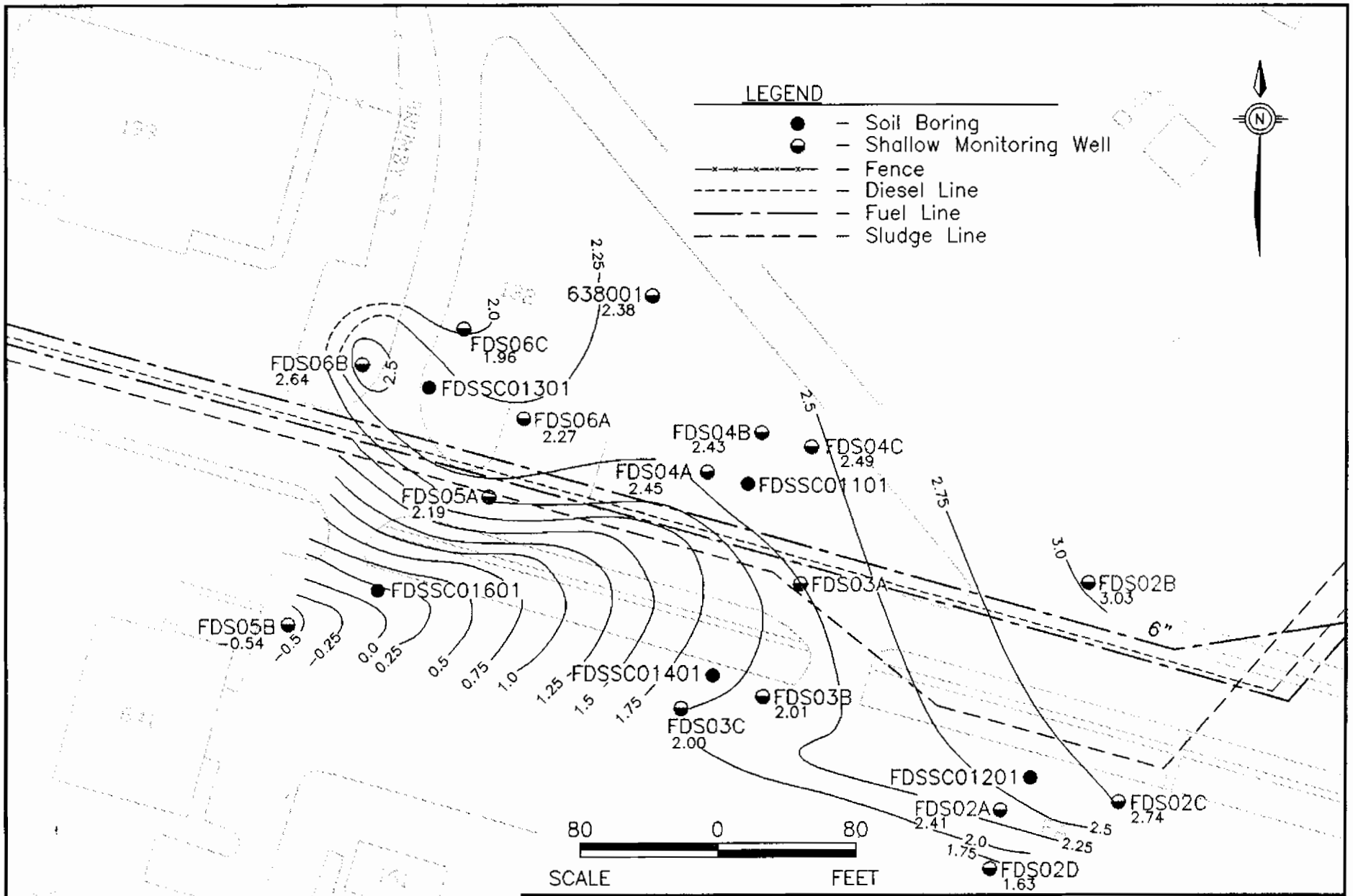
Results

Figure 2 presents the shallow groundwater piezometric surface at Areas 2, 3, 4, 5, and 6 as measured in March 1999 at low-tide. Groundwater flow is generally to the southwest near FDS05B and the south southwest near FDS02D, which is similar to the low-tide flow direction shown in the CAR (EnSafe 1998). This flow regime places the new well directly downgradient from the area of contaminated soil.

Analytes detected in shallow groundwater at Areas 2, 3, 4, 5, and 6 during the post-CAR sampling are summarized in Table 1. These most recent results revealed no detections of volatile organic compounds (VOCs). The only semivolatile organic compounds (SVOCs) detected were benzo(k)fluoranthene at 0.9 micrograms per liter (μg/L) and benzo(b)fluoranthene at 0.9 μg/L, detected in well FDS06C. Both concentrations were below their individual RBSLs of 10 μg/L. These concentrations contributed to a total PAH concentration of 1.80 μg/L, at FDS06C. Four inorganics were also present at concentrations below their respective RBSLs. Attachment B contains the analytical data from the post-CAR sampling. The FDS CAR contains the analytical data from all previous sampling at the combined areas.

Conclusions and Recommendations

As reported in the CAR, the benzene concentration detected in Phase I soil sample FDSSC01201 was 100 μg/kg, which exceeds the RBSL of 5 μg/kg. The concentration of total naphthalenes at



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 2
AREAS 2, 3, 4, 5, AND 6
SHALLOW GROUNDWATER
PIEZOMETRIC MAP

DWG DATE: 09/30/99 | DWG NAME: 2907R007

Table 1
Analytes Detected in Shallow Groundwater
Post-CAR Sampling, Areas 2, 3, 4, 5, and 6
Fuel Distribution System

Parameters	Location	Sample Results	RBSL (μg/L)	Exceeds RBSL
Organics (μg/L)				
Total PAHs	FDS06C	1.8	25	No
Benzo(b)fluoranthene	FDS06C	0.9	10	No
Benzo(k)fluoranthene	FDS06C	0.9	10	No
Inorganics (μg/L)				
Arsenic (As)	FDS02A	3.1	50	No
	FDS02C	6.2		No
	FDS02D	11.2		No
	FDS03B	3.5		No
	FDS03C	3.4		No
	FDS05A	3.4		No
	FDS06A	6.6		No
	FDS06C	24.3		No
Barium (Ba)	FDS02A	140	2,000	No
	FDS02B	46.2		No
	FDS02C	25.2		No
	FDS02D	84.9		No
	FDS03A	28.5		No
	FDS03B	27.4		No
	FDS03C	22.3		No
	FDS04A	12.1		No
	FDS04B	25.7		No
	FDS04C	14.9		No
	FDS05A	43.5		No
	FDS05B	39.7		No
	FDS06A	15.4		No
	FDS06B	28.9		No
	FDS06C	31		No
Chromium (Cr)	FDS02A	1.4	100	No
	FDS02B	0.81		No
	FDS02C	0.99		No
	FDS04A	0.81		No
	FDS04B	0.84		No
	FDS04C	0.83		No
	FDS05A	1.5		No
	FDS05B	0.87		No
	FDS06A	11.1		No
	FDS06B	1.5		No
	FDS06C	5.6		No
Lead (Pb)	FDS06A	1.8	15	No
	FDS06C	2		No

Notes:
μg/L = Micrograms per liter
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998).

FDSSC01201 (159,000 μg/kg) and FDSSC01301 (5,490 μg/kg) also exceeded the RBSL (210 μg/kg). Because these samples were collected below the water table at depths between 4.3 and 6.8 feet, they are effectively samples of the aquifer matrix and therefore Site Specific Target Levels would not be applicable. The concentrations at FDSSC01201 also exceed their respective soil-to-groundwater soil screening levels (SSL [DAF=20]) of 30 μg/kg (benzene) and 84,000 μg/kg (naphthalene), (from the *Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting a potential for migration of these constituents from soil to groundwater. However, groundwater analytical data from downgradient wells FDS02C and FDS02D confirms leaching is not occurring at FDSSC01201. In addition, groundwater analytical data from monitoring wells FDS06C and FDS05A confirms no leaching of naphthalene from FDSSC01301. Because the soil at locations FDSSC012 and FDSSC013 do not appear to be causing a groundwater problem, intrinsic remediation is recommended for the impacted soil at the combined Areas 2, 3, 4, 5, and 6. To support this recommendation, monitoring of groundwater is proposed. Monitoring wells FDS02A and FDS02D, located directly downgradient of FDSSC012 and FDS05A and FDS06C located near FDSSC013 should be monitored quarterly for a period of one year. These samples should be analyzed for RBSL VOCs and SVOCs to ensure that constituents detected in soil are not migrating to groundwater.

The groundwater results presented in the CAR show a significant decrease in total PAH concentrations at well FDS06B from 104 μg/L to 27 μg/L. The post-CAR groundwater results show these concentrations have decreased to below the reporting limits. This trend illustrates that intrinsic remediation of groundwater constituents is occurring. The groundwater monitoring program recommended to document intrinsic remediation of soil constituents should be sufficient to also demonstrate that concentrations in groundwater are decreasing by natural attenuation. In addition, groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a basewide potable water system provides drinking and process water to buildings at CNC. This system is to remain in operation under the current base reuse plan. In

addition, the shallow aquifer for this investigation contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which makes this water-bearing unit a questionable potable water source.

Attachment A
Monitoring Well Construction Diagram/Well Development Record

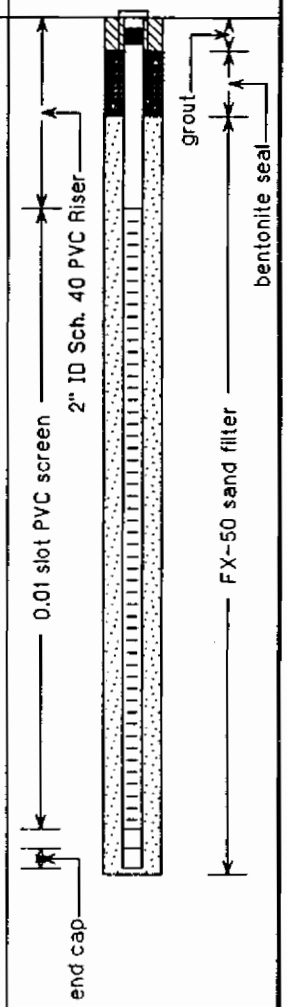
ENSAFE

Monitoring Well NBCGFDS02D

Project: *Fuel Distribution System – Naval Base Charleston*	Coordinates: *371954.90 E, 2321716.18 N*
Location: *Charleston, SC*	Surface Elevation: *7.3 feet msl*
Started at *0830 on 2-02-99*	TOC Elevation: *7.08 feet msl*
Completed at *1040 on 2-02-99*	Depth to Groundwater: *5.42 feet TOC* Measured: *1.66*
Drilling Method: *4.25" ID (8.0" OD) HSA with split spoon*	Groundwater Elevation: *3/3/99 feet msl*
Drilling Company: *Alliance (SC Cert. #889)*	Total Depth: *12.9 feet*
Geologist: *P. Bayley*	Well Screen: *2.9 to 12.3 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	OVA (ppm)	% RECOVERY	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: Asphalt.	
							SP SW	Sand: brown; vf/f w/ trace med.; trace silt; damp; soft.	6.3
					35		CL		5.6
							SM	Clay: dk. gray-brown; trace vf sand; firm; plastic.	5.3 / 5.1
					65		OL	Sand: dk. gray-brown; vf/f w/ trace med.; silty; some damp, soft clay; faint chemical odor.	4 / 3.3
5								Silt: dk. gray-black; clayey; soft; plastic; moist; @4.2', pebbly.	2
					65		OL	Silt: as above.	1.3
							ML CL	Silt: olive-brown; clayey; trace vf sand; calcareous; soft; plastic; damp; Marl fill; f/crs sand lenses at 7.4', 7.8', & 7.9'.	.6
					100		SW	Sand: gray; f/crs; trace f/crs PO_4 shell frags; loose; wet.	-.7 / -1.6
10					45		ML CL	Silt: olive-brown; clayey; w/ vf sand; firm; moist to wet; marl fill.	-2.7
							SW	Sand: gray; f/crs w/ trace f/crs PO_4 shell frags; wet.	-3.8 / -4.2
					75		SP SM	Sand: gray; vf/f w/ trace med.; some silt; trace black PO_4 grains; trace shell frags; soft; soupy; wet.	-4.9
					50		OL	Silt: dk. gray; some vf sand; soft; wet.	-5.6 / -5.7
15									
20									

WELL DIAGRAM



ENSAFE
CHARLESTON NAVAL COMPLEX
WELL DEVELOPMENT STATUS REPORT
ZONE G FDS

WELL DEVELOPMENT SUMMARY

Well:NBCG\FDS02D

Summary Log of well development progress.
Readings are final readings for each visit.
Volume data are cumulative from start of development.

DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-24-99	15	6.81	999	16.9	19.1	-
2-24-99	25	6.93	-10	19.1	21.3	-
2-24-99	35	6.95	-10	19.8	20.8	-
2-24-99	40	6.94	-10	20.2	21.8	-
2-24-99	45	6.93	-10	19.8	21.5	-
2-24-99	50	6.93	-10	20.0	21.4	-
2-24-99	55	6.93	-10	20.0	21.3	-

Well Development Completed on: 2-24-99

COMMENTS:

Attachment B
Analytical Data

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-VOA													
	SAMPLE ID ------->	FDS-G-W02A-03		FDS-G-W02B-03		FDS-G-W02C-03		FDS-G-W02D-01		FDS-G-W03A-03		FDS-G-W03B-03	
	ORIGINAL ID ----->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	LAB SAMPLE ID --->	37602.06		37631.01		37602.07		37602.04		37631.02		37602.03	
	ID FROM REPORT -->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	SAMPLE DATE ----->	03/03/99		03/04/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE ANALYZED --->	03/08/99		03/08/99		03/08/99		03/08/99		03/08/99		03/05/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37631	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
71-43-2	Benzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
100-41-4	Ethylbenzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
108-88-3	Toluene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
1330-20-7	Xylene (Total)	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-VOA													
	SAMPLE ID ------->	FDS-G-W03C-03		FDS-G-W04A-03		FDS-G-W04B-03		FDS-G-W04C-03		FDS-G-W05A-03		FDS-G-W05B-03	
	ORIGINAL ID ----->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	LAB SAMPLE ID --->	37602.02		37602.08		37602.09		37602.10		37631.03		37602.05	
	ID FROM REPORT -->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	SAMPLE DATE ----->	03/03/99		03/03/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE ANALYZED --->	03/05/99		03/08/99		03/08/99		03/08/99		03/08/99		03/05/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37602	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
71-43-2	Benzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
100-41-4	Ethylbenzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
108-88-3	Toluene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
1330-20-7	Xylene (Total)	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-VOA											
	SAMPLE ID ------->	FDS-G-W06A-03		FDS-G-W06B-03		FDS-G-W06C-03					
	ORIGINAL ID ----->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	LAB SAMPLE ID --->	37631.04		37631.05		37631.06					
	ID FROM REPORT -->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	SAMPLE DATE ----->	03/04/99		03/04/99		03/04/99					
	DATE ANALYZED --->	03/08/99		03/08/99		03/08/99					
	MATRIX ---------->	Water		Water		Water					
	UNITS ---------->	UG/L		UG/L		UG/L					
CAS #	Parameter	37631	VAL	37631	VAL	37631	VAL				
71-43-2	Benzene	5.	U	5.	U	5.	U				
100-41-4	Ethylbenzene	5.	U	5.	U	5.	U				
108-88-3	Toluene	5.	U	5.	U	5.	U				
1330-20-7	Xylene (Total)	5.	U	5.	U	5.	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA													
	SAMPLE ID ------->	FDS-G-W02A-03		FDS-G-W02B-03		FDS-G-W02C-03		FDS-G-W02D-01		FDS-G-W03A-03		FDS-G-W03B-03	
	ORIGINAL ID ----->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	LAB SAMPLE ID --->	37602.06		37631.01		37602.07		37602.04		37631.02		37602.03	
	ID FROM REPORT -->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	SAMPLE DATE ----->	03/03/99		03/04/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/05/99		03/06/99		03/05/99		03/05/99		03/06/99		03/05/99	
	DATE ANALYZED --->	03/11/99		03/10/99		03/11/99		03/11/99		03/10/99		03/11/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37631	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
108-95-2	Phenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
111-44-4	bis(2-Chloroethyl)ether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-57-8	2-Chlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
541-73-1	1,3-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-46-7	1,4-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
100-51-6	Benzyl alcohol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-50-1	1,2-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-48-7	2-Methylphenol (o-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-44-5	4-Methylphenol (p-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
621-64-7	N-Nitroso-di-n-propylamine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
67-72-1	Hexachloroethane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
98-95-3	Nitrobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
78-59-1	Isophorone	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-75-5	2-Nitrophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
105-67-9	2,4-Dimethylphenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
65-85-0	Benzoic acid	0.9	J	25.	U	25.	U	0.6	J	0.6	J	25.	U
111-91-1	bis(2-Chloroethoxy)methane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
120-83-2	2,4-Dichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
120-82-1	1,2,4-Trichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-20-3	Naphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-47-8	4-Chloroaniline	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
87-68-3	Hexachlorobutadiene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
59-50-7	4-Chloro-3-methylphenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-57-6	2-Methylnaphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
77-47-4	Hexachlorocyclopentadiene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-06-2	2,4,6-Trichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-95-4	2,4,5-Trichlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
91-58-7	2-Chloronaphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-74-4	2-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
131-11-3	Dimethyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
208-96-8	Acenaphthylene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
99-09-2	3-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
83-32-9	Acenaphthene	10.	U	10.	U	10.	U	10.	U	2.	J	10.	U
51-28-5	2,4-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
100-02-7	4-Nitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA															
	SAMPLE ID ------->	FDS-G-W02A-03		FDS-G-W02B-03		FDS-G-W02C-03		FDS-G-W02D-01		FDS-G-W03A-03		FDS-G-W03B-03	
	ORIGINAL ID ----->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	LAB SAMPLE ID --->	37602.06		37631.01		37602.07		37602.04		37631.02		37602.03	
	ID FROM REPORT -->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	SAMPLE DATE ----->	03/03/99		03/04/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/05/99		03/06/99		03/05/99		03/05/99		03/06/99		03/05/99	
	DATE ANALYZED --->	03/11/99		03/10/99		03/11/99		03/11/99		03/10/99		03/11/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37631	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
132-64-9	Dibenzofuran	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
121-14-2	2,4-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
606-20-2	2,6-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
84-66-2	Diethylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
7005-72-3	4-Chlorophenylphenylether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
86-73-7	Fluorene	10.	U	10.	U	10.	U	10.	U	4.	J	10.	U
100-01-6	4-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
86-30-6	N-Nitrosodiphenylamine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
101-55-3	4-Bromophenyl-phenylether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
118-74-1	Hexachlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
87-86-5	Pentachlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
85-01-8	Phenanthrene	10.	U	10.	U	10.	U	10.	U	0.6	J	10.	U
120-12-7	Anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
84-74-2	Di-n-butylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
206-44-0	Fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
129-00-0	Pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
85-68-7	Butylbenzylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-94-1	3,3'-Dichlorobenzidine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
56-55-3	Benzo(a)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	3.	J	10.	U	1.	J	1.	J	10.	U	10.	U
218-01-9	Chrysene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
117-84-0	Di-n-octyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
50-32-8	Benzo(a)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
53-70-3	Dibenz(a,h)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
191-24-2	Benzo(g,h,i)perylene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA													
	SAMPLE ID ------->	FDS-G-W03C-03		FDS-G-W04A-03		FDS-G-W04B-03		FDS-G-W04C-03		FDS-G-W05A-03		FDS-G-W05B-03	
	ORIGINAL ID ----->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	LAB SAMPLE ID --->	37602.02		37602.08		37602.09		37602.10		37631.03		37602.05	
	ID FROM REPORT -->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	SAMPLE DATE ----->	03/03/99		03/03/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/05/99		03/05/99		03/05/99		03/05/99		03/06/99		03/05/99	
	DATE ANALYZED --->	03/11/99		03/11/99		03/11/99		03/11/99		03/10/99		03/11/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37602	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
108-95-2	Phenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
111-44-4	bis(2-Chloroethyl)ether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-57-8	2-Chlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
541-73-1	1,3-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-46-7	1,4-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
100-51-6	Benzyl alcohol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-50-1	1,2-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-48-7	2-Methylphenol (o-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-44-5	4-Methylphenol (p-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
621-64-7	N-Nitroso-di-n-propylamine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
67-72-1	Hexachloroethane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
98-95-3	Nitrobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
78-59-1	Isophorone	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-75-5	2-Nitrophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
105-67-9	2,4-Dimethylphenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
65-85-0	Benzoic acid	0.5	J	0.6	J	25.	U	25.	U	0.8	J	25.	U
111-91-1	bis(2-Chloroethoxy)methane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
120-83-2	2,4-Dichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
120-82-1	1,2,4-Trichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-20-3	Naphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-47-8	4-Chloroaniline	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
87-68-3	Hexachlorobutadiene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
59-50-7	4-Chloro-3-methylphenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-57-6	2-Methylnaphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
77-47-4	Hexachlorocyclopentadiene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-06-2	2,4,6-Trichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-95-4	2,4,5-Trichlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
91-58-7	2-Chloronaphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-74-4	2-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
131-11-3	Dimethyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
208-96-8	Acenaphthylene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
99-09-2	3-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
83-32-9	Acenaphthene	10.	U	10.	U	10.	U	10.	U	2.	J	10.	U
51-28-5	2,4-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
100-02-7	4-Nitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA															
	SAMPLE ID ------->	FDS-G-W03C-03		FDS-G-W04A-03		FDS-G-W04B-03		FDS-G-W04C-03		FDS-G-W05A-03		FDS-G-W05B-03	
	ORIGINAL ID ----->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	LAB SAMPLE ID --->	37602.02		37602.08		37602.09		37602.10		37631.03		37602.05	
	ID FROM REPORT -->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	SAMPLE DATE ----->	03/03/99		03/03/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/05/99		03/05/99		03/05/99		03/05/99		03/06/99		03/05/99	
	DATE ANALYZED --->	03/11/99		03/11/99		03/11/99		03/11/99		03/10/99		03/11/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37602	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
132-64-9	Dibenzofuran	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
121-14-2	2,4-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
606-20-2	2,6-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
84-66-2	Diethylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
7005-72-3	4-Chlorophenylphenylether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
86-73-7	Fluorene	10.	U	10.	U	10.	U	10.	U	5.	J	10.	U
100-01-6	4-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
86-30-6	N-Nitrosodiphenylamine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
101-55-3	4-Bromophenyl-phenylether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
118-74-1	Hexachlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
87-86-5	Pentachlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
85-01-8	Phenanthrene	10.	U	10.	U	10.	U	10.	U	4.	J	10.	U
120-12-7	Anthracene	10.	U	10.	U	10.	U	10.	U	0.6	J	10.	U
84-74-2	Di-n-butylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
206-44-0	Fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
129-00-0	Pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
85-68-7	Butylbenzylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-94-1	3,3'-Dichlorobenzidine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
56-55-3	Benzo(a)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U	1.	J	9.	J	0.9	J	10.	U	0.5	J
218-01-9	Chrysene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
117-84-0	Di-n-octyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
50-32-8	Benzo(a)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
53-70-3	Dibenz(a,h)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
191-24-2	Benzo(g,h,i)perylene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA											
	SAMPLE ID ------->	FDS-G-W06A-03		FDS-G-W06B-03		FDS-G-W06C-03					
	ORIGINAL ID ----->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	LAB SAMPLE ID --->	37631.04		37631.05		37631.06					
	ID FROM REPORT -->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	SAMPLE DATE ----->	03/04/99		03/04/99		03/04/99					
	DATE EXTRACTED -->	03/06/99		03/06/99		03/06/99					
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99					
	MATRIX ---------->	Water		Water		Water					
	UNITS ---------->	UG/L		UG/L		UG/L					
CAS #	Parameter	37631	VAL	37631	VAL	37631	VAL				
108-95-2	Phenol	10.	U	10.	U	12.	U				
111-44-4	bis(2-Chloroethyl)ether	10.	U	10.	U	12.	U				
95-57-8	2-Chlorophenol	10.	U	10.	U	12.	U				
541-73-1	1,3-Dichlorobenzene	10.	U	10.	U	12.	U				
106-46-7	1,4-Dichlorobenzene	10.	U	10.	U	12.	U				
100-51-6	Benzyl alcohol	10.	U	10.	U	12.	U				
95-50-1	1,2-Dichlorobenzene	10.	U	10.	U	12.	U				
95-48-7	2-Methylphenol (o-Cresol)	10.	U	10.	U	12.	U				
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U	10.	U	12.	U				
106-44-5	4-Methylphenol (p-Cresol)	10.	U	10.	U	12.	U				
621-64-7	N-Nitroso-di-n-propylamine	10.	U	10.	U	12.	U				
67-72-1	Hexachloroethane	10.	U	10.	U	12.	U				
98-95-3	Nitrobenzene	10.	U	10.	U	12.	U				
78-59-1	Isophorone	10.	U	10.	U	12.	U				
88-75-5	2-Nitrophenol	10.	U	10.	U	12.	U				
105-67-9	2,4-Dimethylphenol	10.	U	10.	U	12.	U				
65-85-0	Benzoic acid	25.	U	0.6	J	3.	J				
111-91-1	bis(2-Chloroethoxy)methane	10.	U	10.	U	12.	U				
120-83-2	2,4-Dichlorophenol	10.	U	10.	U	12.	U				
120-82-1	1,2,4-Trichlorobenzene	10.	U	10.	U	12.	U				
91-20-3	Naphthalene	10.	U	10.	U	12.	U				
106-47-8	4-Chloroaniline	10.	U	10.	U	12.	U				
87-68-3	Hexachlorobutadiene	10.	U	10.	U	12.	U				
59-50-7	4-Chloro-3-methylphenol	10.	U	10.	U	12.	U				
91-57-6	2-Methylnaphthalene	10.	U	10.	U	12.	U				
77-47-4	Hexachlorocyclopentadiene	10.	U	10.	U	12.	U				
88-06-2	2,4,6-Trichlorophenol	10.	U	10.	U	12.	U				
95-95-4	2,4,5-Trichlorophenol	25.	U	25.	U	31.	U				
91-58-7	2-Chloronaphthalene	10.	U	10.	U	12.	U				
88-74-4	2-Nitroaniline	25.	U	25.	U	31.	U				
131-11-3	Dimethyl phthalate	10.	U	10.	U	12.	U				
208-96-8	Acenaphthylene	10.	U	10.	U	12.	U				
99-09-2	3-Nitroaniline	25.	U	25.	U	31.	U				
83-32-9	Acenaphthene	10.	U	10.		12.	U				
51-28-5	2,4-Dinitrophenol	25.	U	25.	U	31.	U				
100-02-7	4-Nitrophenol	25.	U	25.	U	31.	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA										
	SAMPLE ID ------->	FDS-G-W06A-03		FDS-G-W06B-03		FDS-G-W06C-03				
	ORIGINAL ID ----->	FDSGW06A03		FDSGW06B03		FDSGW06C03				
	LAB SAMPLE ID --->	37631.04		37631.05		37631.06				
	ID FROM REPORT -->	FDSGW06A03		FDSGW06B03		FDSGW06C03				
	SAMPLE DATE ----->	03/04/99		03/04/99		03/04/99				
	DATE EXTRACTED -->	03/06/99		03/06/99		03/06/99				
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99				
	MATRIX ---------->	Water		Water		Water				
	UNITS ---------->	UG/L		UG/L		UG/L				
CAS #	Parameter	37631	VAL	37631	VAL	37631	VAL			
132-64-9	Dibenzofuran	10.	U	1.	J	12.	U			
121-14-2	2,4-Dinitrotoluene	10.	U	10.	U	12.	U			
606-20-2	2,6-Dinitrotoluene	10.	U	10.	U	12.	U			
84-66-2	Diethylphthalate	10.	U	10.	U	12.	U			
7005-72-3	4-Chlorophenylphenylether	10.	U	10.	U	12.	U			
86-73-7	Fluorene	10.	U	2.	J	12.	U			
100-01-6	4-Nitroaniline	25.	U	25.	U	31.	U			
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U	25.	U	31.	U			
86-30-6	N-Nitrosodiphenylamine	10.	U	10.	U	12.	U			
101-55-3	4-Bromophenyl-phenylether	10.	U	10.	U	12.	U			
118-74-1	Hexachlorobenzene	10.	U	10.	U	12.	U			
87-86-5	Pentachlorophenol	25.	U	25.	U	31.	U			
85-01-8	Phenanthrene	10.	U	10.	U	12.	U			
120-12-7	Anthracene	10.	U	10.	U	12.	U			
84-74-2	Di-n-butylphthalate	10.	U	10.	U	12.	U			
206-44-0	Fluoranthene	10.	U	10.	U	12.	U			
129-00-0	Pyrene	10.	U	10.	U	0.6	J			
85-68-7	Butylbenzylphthalate	10.	U	10.	U	12.	U			
91-94-1	3,3'-Dichlorobenzidine	10.	U	10.	U	12.	U			
56-55-3	Benzo(a)anthracene	10.	U	10.	U	12.	U			
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U	10.	U	12.	U			
218-01-9	Chrysene	10.	U	10.	U	12.	U			
117-84-0	Di-n-octyl phthalate	10.	U	10.	U	12.	U			
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	0.9	J			
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	12.	U			
50-32-8	Benzo(a)pyrene	10.	U	10.	U	12.	U			
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U	10.	U	12.	U			
53-70-3	Dibenz(a,h)anthracene	10.	U	10.	U	12.	U			
191-24-2	Benzo(g,h,i)perylene	10.	U	10.	U	12.	U			

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-META													
	SAMPLE ID ------->	FDS-G-W02A-03		FDS-G-W02B-03		FDS-G-W02C-03		FDS-G-W02D-01		FDS-G-W03A-03		FDS-G-W03B-03	
	ORIGINAL ID ----->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	LAB SAMPLE ID --->	37602.06		37631.01		37602.07		37602.04		37631.02		37602.03	
	ID FROM REPORT -->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	SAMPLE DATE ----->	03/03/99		03/04/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/09/99		03/09/99		03/09/99		03/09/99		03/09/99		03/09/99	
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99		03/10/99		03/10/99		03/10/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37631	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
7439-97-6	Mercury (Hg)	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
7440-38-2	Arsenic (As)	3.1	J	2.9	U	6.2	J	11.2		2.9	U	3.5	J
7440-39-3	Barium (Ba)	140.		46.2		25.2		84.9		28.5		27.4	
7440-43-9	Cadmium (Cd)	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
7440-47-3	Chromium (Cr)	1.4	J	0.81	J	0.99	J	0.7	U	0.7	U	0.7	U
7439-92-1	Lead (Pb)	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U
7782-49-2	Selenium (Se)	3.1	U	3.1	U	3.1	U	3.1	U	3.1	U	3.1	U
7440-22-4	Silver (Ag)	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-META													
	SAMPLE ID ------->	FDS-G-W03C-03		FDS-G-W04A-03		FDS-G-W04B-03		FDS-G-W04C-03		FDS-G-W05A-03		FDS-G-W05B-03	
	ORIGINAL ID ----->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	LAB SAMPLE ID --->	37602.02		37602.08		37602.09		37602.10		37631.03		37602.05	
	ID FROM REPORT -->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	SAMPLE DATE ----->	03/03/99		03/03/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/09/99		03/09/99		03/09/99		03/09/99		03/09/99		03/09/99	
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99		03/10/99		03/10/99		03/10/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37602	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
7439-97-6	Mercury (Hg)	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
7440-38-2	Arsenic (As)	3.4	J	2.9	U	2.9	U	2.9	U	3.4	J	2.9	U
7440-39-3	Barium (Ba)	22.3	J	12.1	J	25.7		14.9	J	43.5		39.7	
7440-43-9	Cadmium (Cd)	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
7440-47-3	Chromium (Cr)	0.7	U	0.81	J	0.84	J	0.83	J	1.5	J	0.87	J
7439-92-1	Lead (Pb)	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U
7782-49-2	Selenium (Se)	3.1	U	3.1	U	3.1	U	3.1	U	3.1	U	3.1	U
7440-22-4	Silver (Ag)	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-META											
	SAMPLE ID ------->	FDS-G-W06A-03		FDS-G-W06B-03		FDS-G-W06C-03					
	ORIGINAL ID ----->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	LAB SAMPLE ID --->	37631.04		37631.05		37631.06					
	ID FROM REPORT -->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	SAMPLE DATE ----->	03/04/99		03/04/99		03/04/99					
	DATE EXTRACTED -->	03/09/99		03/09/99		03/09/99					
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99					
	MATRIX ---------->	Water		Water		Water					
	UNITS ---------->	UG/L		UG/L		UG/L					
CAS #	Parameter	37631	VAL	37631	VAL	37631	VAL				
7439-97-6	Mercury (Hg)	0.1	U	0.1	U	0.1	U				
7440-38-2	Arsenic (As)	6.6	J	2.9	U	24.3					
7440-39-3	Barium (Ba)	15.4	J	28.9		31.					
7440-43-9	Cadmium (Cd)	0.3	U	0.3	U	0.3	U				
7440-47-3	Chromium (Cr)	11.1		1.5	J	5.6	J				
7439-92-1	Lead (Pb)	1.8	J	1.5	U	2.	J				
7782-49-2	Selenium (Se)	3.1	U	3.1	U	3.1	U				
7440-22-4	Silver (Ag)	1.4	U	1.4	U	1.4	U				

*** Validation Complete ***

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

October 4, 1999

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Area 7, Charleston Naval Complex, South Carolina (SCDHEC No. 01182)

Dear Mr. Magwood:

This final letter report supplements the Fuel Distribution System (FDS) Contamination Assessment Report (CAR) dated September 10, 1998. This letter report incorporates the results of follow-on investigative activities performed in accordance with recommendations in the CAR, and to address any SCDHEC comments concerning Area 7.

In accordance with the Statement of Work, two copies of this report are attached. Two copies are also being sent to Paul Bristol of the South Carolina Department of Health and Environmental Control.

Should you have any questions or concerns regarding this submittal, please contact me.

Sincerely,

ENSAFE INC.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

Area 7

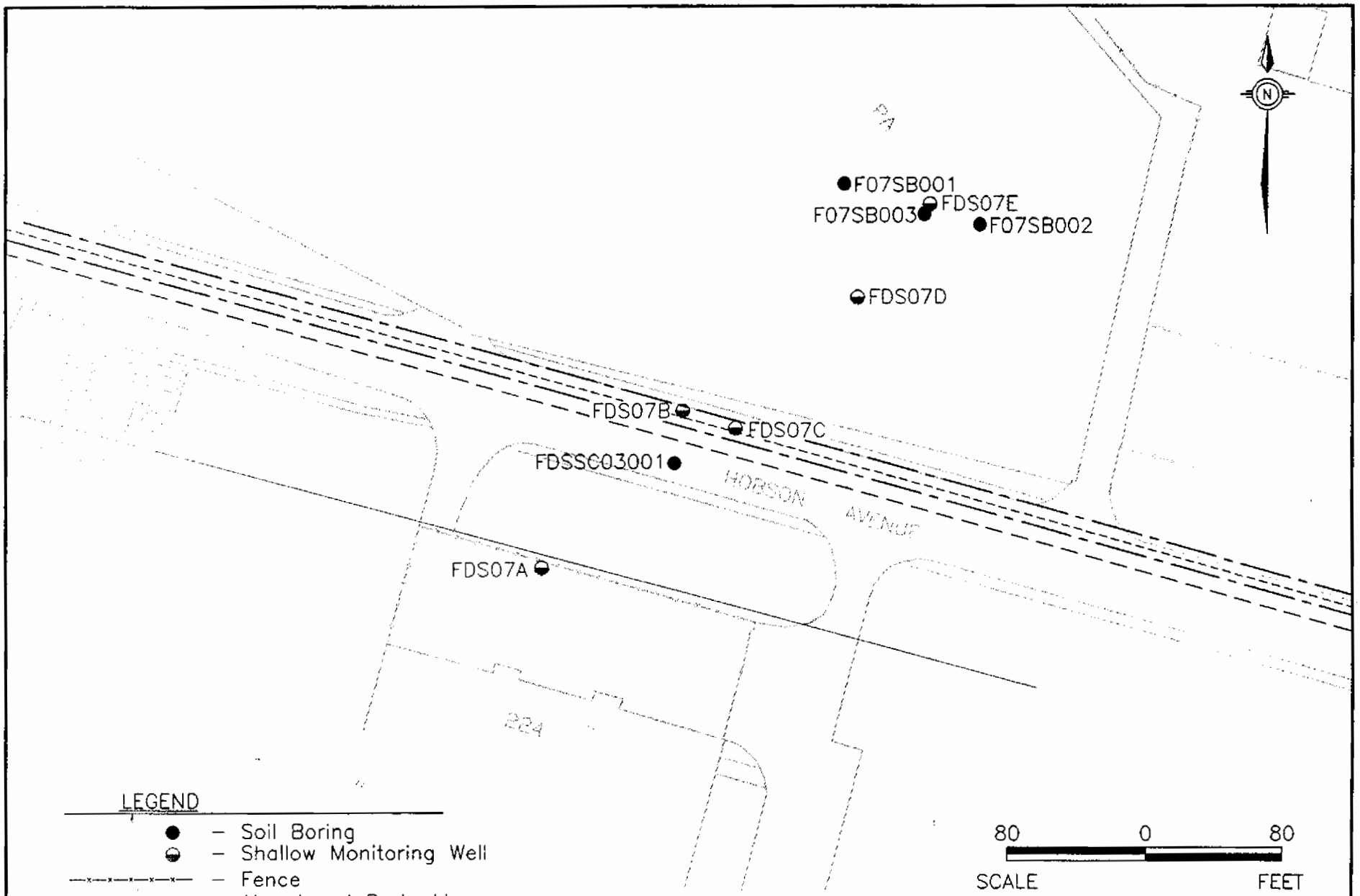
(SCDHEC No. 01182)

Background

Area 7 of the Fuel Distribution System (FDS) is associated with Phase I soil sample FDSSC03001, which exhibited total petroleum hydrocarbons-diesel range organics of 102 milligrams per kilogram (mg/kg), which prompted Phase II soil and groundwater sampling within Area 7. Phase II revealed no soil contamination attributable to the FDS. The arsenic concentration detected in soil at FDSS03001 exceeded its USEPA generic soil screening level (SSL). However, arsenic detections in Area 7 groundwater samples were all below the groundwater risk-based screening level (RBSL) and Zone G shallow groundwater background concentrations for arsenic. No free-phase petroleum product was observed in Area 7 monitoring wells. The RBSLs for total polycyclic aromatic hydrocarbons (PAHs) and four individual PAHs were exceeded in groundwater samples from well FDS07D, which was installed approximately 100 feet upgradient of the FDS pipeline corridor *(Contamination Assessment Report* [CAR], EnSafe 1998).

Follow-on Activities

The CAR recommended and South Carolina Department of Health and Environmental Control (SCDHEC) concurred that additional assessment was required at Area 7 to identify the source of the groundwater contamination detected in FDS07D. This additional assessment included collection of three surface and three subsurface soil samples at locations upgradient from FDS07D, and installation of an additional upgradient monitoring well, FDS07E. Monitoring well FDS07E was installed and developed in February 1999. During March, 1999, the three soil borings were advanced, with surface and subsurface soil samples collected for comparison to soil RBSL parameters. Water levels were remeasured in all Area 7 wells in March 1999. An additional round of groundwater samples were collected from all Area 7 wells and analyzed for RBSL semivolatile organic compounds (SVOCs) only. Figure 1 depicts the Area 7



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREA 7
SAMPLE LOCATIONS

DWG DATE: 06/10/99 | DWG NAME: 2907R003

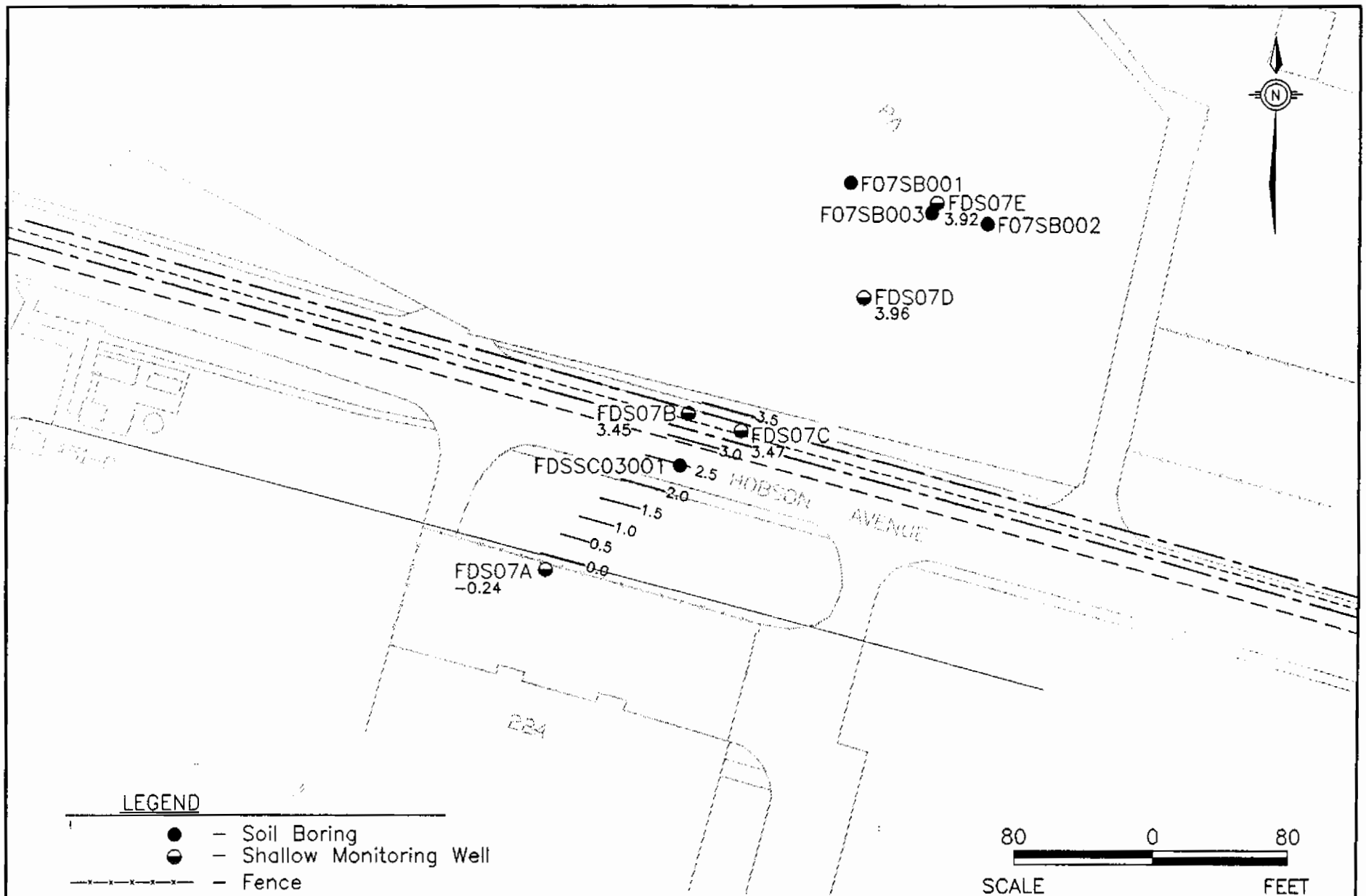
sample locations. Attachment A contains the monitoring well construction diagram and well development record for the newly installed FDS07E. The CAR contains the boring logs and development records for all previously installed Area 7 wells.

Results

Figure 2 presents the shallow groundwater low-tide potentiometric surface at Area 7 measured in March 1999. Groundwater flow is generally to the southwest which is consistent with the low-tide flow direction shown in the CAR (EnSafe 1998). The water level elevations suggest the possibility of a groundwater divide between FDS07D and FDS07E. This feature would explain the difference in flow directions between Area 7 and SWMU 6 and 7 located to the north of the site. Slug testing at FDS07E determined a horizontal hydraulic conductivity of 4.74 feet per day for the shallow aquifer at Area 7. Attachment B contains the aquifer test results for Area 7.

Table 1 summarizes the results of the post-CAR soil sampling at Area 7. No RBSL parameters were detected in any of the three surface soil samples collected during the post-CAR soil sampling at Area 7. Two volatile organic compounds (VOCs) and five PAHs were detected in subsurface soil samples; however, all subsurface detections were below their respective RBSLs.

Table 2 summarizes the results of the post-CAR groundwater sampling at Area 7. No groundwater RBSLs were exceeded at Area 7. Naphthalene was detected in well FDS07D at a concentration of 0.7 micrograms per liter (μg/L), below it's groundwater RBSL (10 μg/L). These results document a reduction in naphthalene from the previous sampling event at FDS07D, which had a naphthalene concentration of 24 μg/L. 2-methylnaphthalene was detected at FDS07B at 1.0 μg/L and FDS07C at 0.70 μg/L, below the RBSL. Total PAH concentrations were below the RBSL for all locations at Area 7. Attachment C contains the analytical data from the post-CAR sampling. The FDS CAR contains the analytical data from previous sampling at Area 7.



LEGEND

- Soil Boring
- Shallow Monitoring Well
- Fence
- Abandoned Drain Line
- Diesel Line
- Fuel Line
- Sludge Line

FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 2
AREA 7
SHALLOW GROUNDWATER
PIEZOMETRIC MAP

DWG DATE: 06/28/99 | DWG NAME: 2907R005

Table 1
Analytes Detected in Surface and Subsurface Soil
Post-CAR Sampling, Area 7
Fuel Distribution System

Parameters	Location	Surface Conc.	Subsurface Conc.	RBSL/SSL (μg/kg)	Exceeds RBSL
Volatile Organic Compounds (μg/kg)					
Ethylbenzene	F07SB001	ND	1.0	1,260/13,000	No
Xylene (total)	F07SB001	ND	3.0	42,471/148,000	No
Semivolatile Organic Compounds (μg/kg)					
Benzo(a)anthracene	F07SB001	ND	95	73,084/2,000	No
	F07SB002	ND	34		No
	F07SB003	ND	56		No
Benzo(b)fluoranthene	F07SB001	ND	95	29,097/5,000	No
	F07SB002	ND	32		No
	F07SB003	ND	74		No
Benzo(k)fluoranthene	F07SB001	ND	79	231,109/49,000	No
	F07SB002	ND	31		No
	F07SB003	ND	59		No
Chrysene	F07SB001	ND	120	12,998/160,000	No
	F07SB002	ND	40		No
	F07SB003	ND	79		No
Naphthalene	F07SB001	ND	94	210/84,000	No
	F07SB002	ND	84		No
	F07SB003	ND	110		No

Notes:

ND = Not detected.
μg/kg = Micrograms per kilograms.
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998) (RBSLs for Sandy Soil) and generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996) were used as reference concentrations.

Table 2
Analytes Detected in Shallow Groundwater
Post-CAR Sampling, Area 7
Fuel Distribution System

Parameters	Location	Sample Results	RBSL (μg/L)	Exceeds RBSL
Semivolatile Organic Compounds (μg/L)				
Total PAHs	FDS07B	1.0	25	No
	FDS07C	0.7		No
	FDS07D	0.7		No
Naphthalene	FDS07D	0.7	10	No
2-Methylnapthalene	FDS07B	1.0	10	No
	FDS07C	0.7		No

Notes:

μg/L = Micrograms per liter
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998).

Conclusions and Recommendations

Post-CAR sampling detected VOCs and SVOCs in subsurface soil which may have sourced the site. None of these parameters exceeded RBSLs. All post-CAR subsurface soil detections were also below their respective generic soil-to-groundwater soil screening levels (SSLs [DAF=20]) from the (*Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting migration to groundwater is unlikely.

Phase II groundwater results revealed that the RBSLs for total PAHs and four individual PAHs were exceeded in groundwater samples from well FDS07D, located upgradient of the FDS pipeline corridor. No RBSLs were exceeded in post-CAR groundwater sampling of Area 7 wells for RBSL SVOC parameters. These most recent results revealed a reduced naphthalene concentration detection at FDS07D, below the naphthalene RBSL. 2-methylnaphthalene was detected at wells FDS07B and FDS07C. Concentrations of this compound were also reduced from those reported in the CAR. Total PAHS were also below the RBSL, and reduced from those reported in the CAR.

Groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a basewide potable water system provides drinking and process water to buildings at CNC. This system is to remain in operation under the current base reuse plan. In addition, the shallow aquifer for this investigation contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which makes this water-bearing unit a questionable potable water source.

No soil RBSLs were exceeded at Area 7. In groundwater, concentrations of individual and total PAHs have declined from some exceeding RBSLs to all below RBSLs in the most recent sampling event. Because concentrations of chemicals of concern in both media are below applicable RBSLs, no further action is recommended for Area 7.

Attachment A
Monitoring Well Construction Diagram/Well Development Record

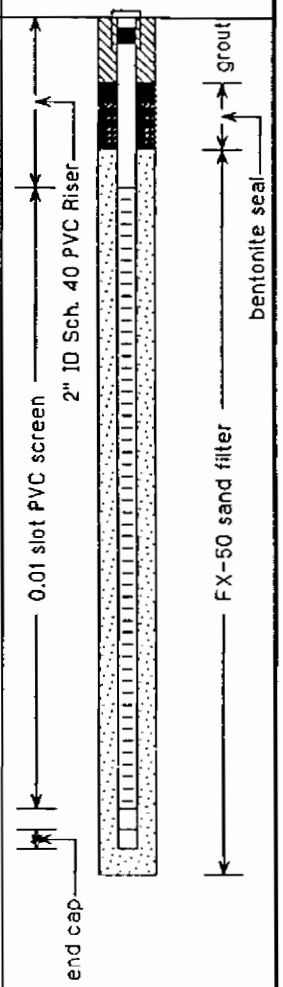
ENSAFE

Monitoring Well NBCGFDS07E

Project: *Fuel Distribution System –Charleston Naval Complex*	Coordinates: *2320716.32 E, 372544.91 N*
Location: *Charleston, SC*	Surface Elevation: *6.4 feet msl*
Started at *1430 on 02-02-99*	TOC Elevation: *6.27 feet msl*
Completed at *1600 on 02-02-99*	Depth to Groundwater: *2.82 feet TOC* Measured: *3/5/99*
Drilling Method: *4.25" ID (8.0" OD) HSA with split spoon*	Groundwater Elevation: *3.45 feet msl*
Drilling Company: *Alliance Environmental (SC Cert. # 889)*	Total Depth: *12.6 feet*
Geologist: *P. Bayley*	Well Screen: *2.6 to 12.0 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	OVA (ppm)	% RECOVERY	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: Asphalt.	
							SP SM	Sand: brown; vf/f; tr silt; loose; dry.	5.4
									4.3
			1		55		GM	Gravel: black; 1 cm dia.; silty sand matrix; wet; hydrocarbon odor.	3.4
							SM		2.7
							CL	Sand: brown w/ tr orange; vf; silty; loose; wet.	2.2
5			2		80		ML CL	Clay: olive-brown w/ tr orange; sm silt; sm vf sand; stiff; plastic; wet.	1.8 / 1.4 / .7
			3		35			Clay: blue-green w/ sm brown; silty; sm vf sand; soft-firm; plastic; wet.	
			4		0		OL	Silt: dk gray-black; clayey; sticky; soft; wet.	2.6
10			5		95		OL	Silt: as above.	4.5 / 4.8
			6		90				6.4
15									
20									

WELL DIAGRAM



ENSAFE

CHARLESTON NAVAL COMPLEX
WELL DEVELOPMENT STATUS REPORT
ZONE G FDS

WELL DEVELOPMENT SUMMARY

Well:NBCG\FDS07E

Summary Log of well development progress.
Readings are final readings for each visit.
Volume data are cumulative from start of development.

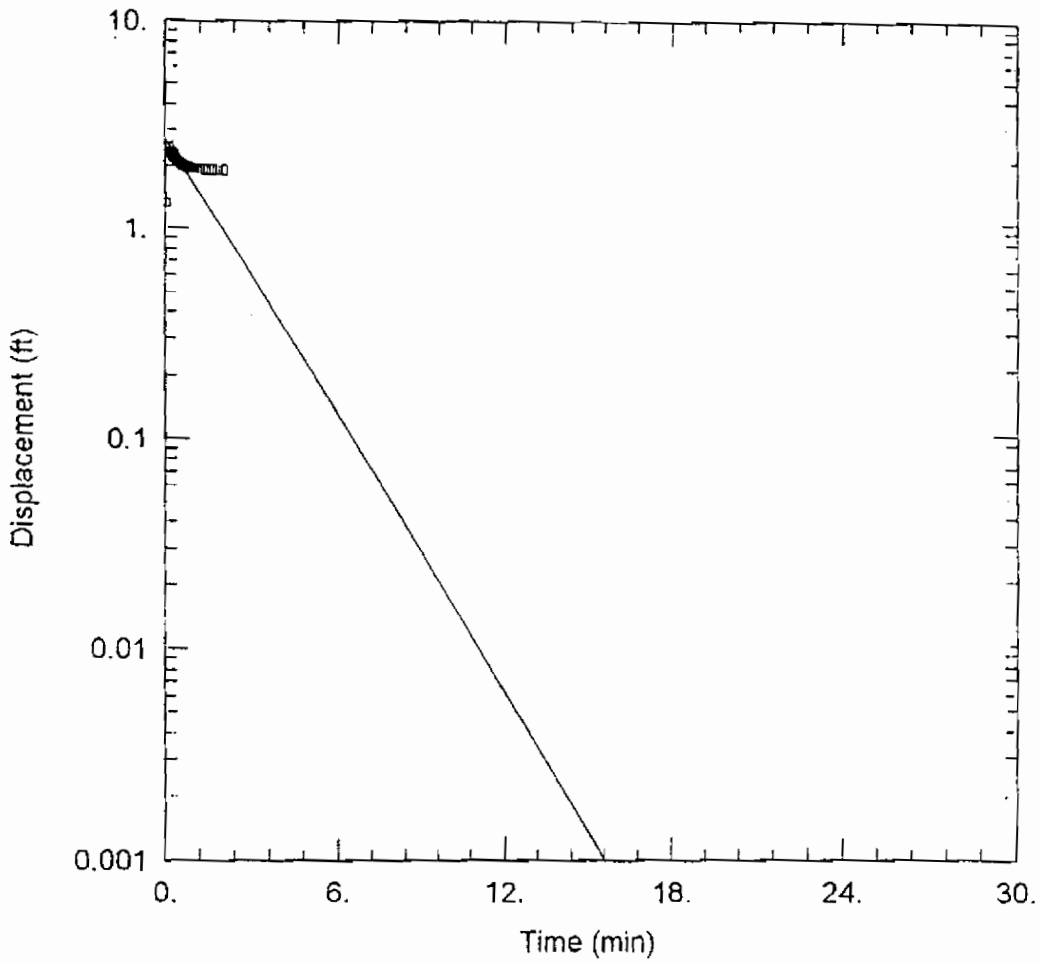
DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-25-99	12	5.42	999	35.0	19.5	-
2-25-99	19	5.48	340	35.6	20.3	-
2-25-99	23	7.29	137	35.3	20.4	-
2-25-99	27	7.42	292	35.2	20.3	-
2-25-99	33	5.54	518	35.4	18.3	-
2-25-99	38	6.52	62	34.9	19.6	-
2-25-99	42	6.01	67	35.0	19.7	-
2-25-99	45	6.27	46	34.5	20.6	-
2-25-99	48	6.29	47	34.1	20.5	-
2-25-99	50	6.26	31	34.2	20.7	-
2-25-99	52	6.77	156	34.3	20.4	-
2-25-99	53.5	6.34	40	33.9	20.2	-
2-25-99	55	6.21	227	32.4	20.3	-
2-25-99	60	6.15	34	32.4	20.0	-
2-25-99	62.5	6.17	16	34.1	20.2	-

DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-25-99	65	6.59	15	34.0	20.1	-
2-25-99	67	6.28	23	34.0	19.9	-
2-25-99	69	6.23	18	34.3	20.1	-
2-25-99	71	6.26	20	34.0	19.9	-

Well Development Completed on: 2-25-99

COMMENTS:

Attachment B
Aquifer Test Results



FDS07E INJECTION

Data Set: C:\TEMP\CHARLE~1\2-07D.AQT
Date: 10/01/99 Time: 10:44:21

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Test Location: Charleston
Test Well: FDS07E
Test Date: 6/3/99

AQUIFER DATA

Saturated Thickness: 40. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.325 ft Water Column Height: 4.64 ft
Casing Radius: 0.0833 ft Wellbore Radius: 0.333 ft
Screen Length: 10. ft Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined K = 0.003288 ft/min

Data Set: C:\TEMP\CHARLE~1\2-07D.AQT
Title: FDS07E Injection
Date: 10/01/99
Time: 16:08:49

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Location: Charleston
Test Date: 6/3/99
Test Well: FDS07E

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 1.

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: FDS07E

X Location: 0. ft
Y Location: 0. ft

No. of observations: 72

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.1166	2.556	0.3166	2.197	0.7	2.014
0.125	2.487	0.325	2.228	0.7166	2.011
0.1333	2.395	0.3333	2.219	0.7333	1.995
0.1416	2.449	0.35	2.197	0.75	1.979
0.15	2.446	0.3666	2.178	0.7666	1.992
0.1583	2.395	0.3833	2.168	0.7833	1.995
0.1666	2.395	0.4	2.156	0.8	1.992
0.175	2.402	0.4166	2.143	0.8166	1.992
0.1833	2.348	0.4333	2.121	0.8333	1.979
0.1916	2.37	0.45	2.134	0.85	1.979
0.2	2.367	0.4666	2.108	0.8666	1.976
0.2083	2.332	0.4833	2.102	0.8833	1.97
0.2166	2.332	0.5	2.093	0.9	1.97
0.225	2.345	0.5166	2.083	0.9166	1.966
0.2333	2.26	0.5333	2.074	0.9333	1.963
0.2416	2.263	0.55	2.067	0.95	1.96
0.25	2.329	0.5666	2.039	0.9666	1.957
0.2583	2.288	0.5833	2.058	0.9833	1.957

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.2666	2.256	0.6	2.042	1.	1.954
0.275	2.313	0.6166	2.036	1.2	1.938
0.2833	2.216	0.6333	2.033	1.4	1.925
0.2916	2.19	0.65	2.023	1.6	1.919
0.3	2.291	0.6666	2.02	1.8	1.913
0.3083	2.244	0.6833	2.014	2.	1.91

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.003288	ft/min
y0	2.721	ft

Attachment C
Analytical Data

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

October 25, 1999

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Area 7, Charleston Naval Complex, South Carolina (SCDHEC No. 01182)

Dear Mr. Magwood:

Please find attached revised Attachment C - Analytical Data for the above referenced final letter report.

In accordance with the Statement of Work, a copy is also being sent to Paul Bristol of the South Carolina Department of Health and Environmental Control.

Should you have any questions or concerns regarding this attachment, please contact me.

Sincerely,

ENSAFE INC.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREA 7

SW-SVOA											
	SAMPLE ID ------->	FDS-G-W07A-03		FDS-G-W07B-03		FDS-G-W07C-03		FDS-G-W07D-03		FDS-G-W07E-01	
	ORIGINAL ID ----->	FDSGW07A03		FDSGW07B03		FDSGW07C03		FDSGW07D03		FDSGW07E01	
	LAB SAMPLE ID --->	37648.02		37631.07		37631.08		37631.09		37648.01	
	ID FROM REPORT -->	FDSGW07A03		FDSGW07B03		FDSGW07C03		FDSGW07D03		FDSGW07E01	
	SAMPLE DATE ----->	03/05/99		03/04/99		03/04/99		03/04/99		03/05/99	
	DATE EXTRACTED -->	03/08/99		03/06/99		03/06/99		03/06/99		03/08/99	
	DATE ANALYZED --->	03/15/99		03/10/99		03/10/99		03/10/99		03/15/99	
	MATRIX ---------->	Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37648	VAL	37631	VAL	37631	VAL	37631	VAL	37648	VAL
108-95-2	Phenol	10.	U	10.	U	10.	U	10.	U	10.	U
111-44-4	bis(2-Chloroethyl)ether	10.	U	10.	U	10.	U	10.	U	10.	U
95-57-8	2-Chlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U
541-73-1	1,3-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U
106-46-7	1,4-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U
100-51-6	Benzyl alcohol	10.	U	10.	U	10.	U	10.	U	10.	U
95-50-1	1,2-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U
95-48-7	2-Methylphenol (o-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U	10.	U	10.	U	10.	U	10.	U
106-44-5	4-Methylphenol (p-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U
621-64-7	N-Nitroso-di-n-propylamine	10.	U	10.	U	10.	U	10.	U	10.	U
67-72-1	Hexachloroethane	10.	U	10.	U	10.	U	10.	U	10.	U
98-95-3	Nitrobenzene	10.	U	10.	U	10.	U	10.	U	10.	U
78-59-1	Isophorone	10.	U	10.	U	10.	U	10.	U	10.	U
88-75-5	2-Nitrophenol	10.	U	10.	U	10.	U	0.7	J	10.	U
105-67-9	2,4-Dimethylphenol	10.	U	10.	U	10.	U	10.	U	10.	U
65-85-0	Benzoic acid	25.	U	1.	J	1.	J	0.8	J	6.	J
111-91-1	bis(2-Chloroethoxy)methane	10.	U	10.	U	10.	U	10.	U	10.	U
120-83-2	2,4-Dichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U
120-82-1	1,2,4-Trichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U
91-20-3	Naphthalene	10.	U	10.	U	10.	U	0.7	J	10.	U
106-47-8	4-Chloroaniline	10.	U	10.	U	10.	U	10.	U	10.	U
87-68-3	Hexachlorobutadiene	10.	U	10.	U	10.	U	10.	U	10.	U
59-50-7	4-Chloro-3-methylphenol	10.	U	10.	U	10.	U	10.	U	10.	U
91-57-6	2-Methylnaphthalene	10.	U	1.	J	0.7	J	10.	U	10.	U
77-47-4	Hexachlorocyclopentadiene	10.	U	10.	U	10.	U	10.	U	10.	U
88-06-2	2,4,6-Trichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U
95-95-4	2,4,5-Trichlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U
91-58-7	2-Chloronaphthalene	10.	U	10.	U	10.	U	10.	U	10.	U
88-74-4	2-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U
131-11-3	Dimethyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U
208-96-8	Acenaphthylene	10.	U	10.	U	10.	U	10.	U	10.	U
99-09-2	3-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U
83-32-9	Acenaphthene	10.	U	1.	J	1.	J	15.		10.	U
51-28-5	2,4-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U
100-02-7	4-Nitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREA 7

SW-SVOA											
	SAMPLE ID ------->	FDS-G-W07A-03		FDS-G-W07B-03		FDS-G-W07C-03		FDS-G-W07D-03		FDS-G-W07E-01	
	ORIGINAL ID ----->	FDSGW07A03		FDSGW07B03		FDSGW07C03		FDSGW07D03		FDSGW07E01	
	LAB SAMPLE ID --->	37648.02		37631.07		37631.08		37631.09		37648.01	
	ID FROM REPORT -->	FDSGW07A03		FDSGW07B03		FDSGW07C03		FDSGW07D03		FDSGW07E01	
	SAMPLE DATE ----->	03/05/99		03/04/99		03/04/99		03/04/99		03/05/99	
	DATE EXTRACTED -->	03/08/99		03/06/99		03/06/99		03/06/99		03/08/99	
	DATE ANALYZED --->	03/15/99		03/10/99		03/10/99		03/10/99		03/15/99	
	MATRIX ---------->	Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37648	VAL	37631	VAL	37631	VAL	37631	VAL	37648	VAL
132-64-9	Dibenzofuran	10.	U	1.	J	1.	J	2.	J	10.	U
121-14-2	2,4-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U
606-20-2	2,6-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U
84-66-2	Diethylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U
7005-72-3	4-Chlorophenylphenylether	10.	U	10.	U	10.	U	10.	U	10.	U
86-73-7	Fluorene	10.	U	2.	J	2.	J	5.	J	10.	U
100-01-6	4-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U
86-30-6	N-Nitrosodiphenylamine	10.	U	10.	U	10.	U	10.	U	10.	U
101-55-3	4-Bromophenyl-phenylether	10.	U	10.	U	10.	U	10.	U	10.	U
118-74-1	Hexachlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U
87-86-5	Pentachlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U
85-01-8	Phenanthrene	10.	U	1.	J	1.	J	3.	J	1.	J
120-12-7	Anthracene	10.	U	10.	U	0.6	J	1.	J	10.	U
84-74-2	Di-n-butylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U
206-44-0	Fluoranthene	10.	U	10.	U	10.	U	1.	J	10.	U
129-00-0	Pyrene	10.	U	10.	U	10.	U	0.7	J	10.	U
85-68-7	Butylbenzylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U
91-94-1	3,3'-Dichlorobenzidine	20.	U	10.	U	10.	U	10.	U	20.	U
56-55-3	Benzo(a)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U	10.	U	10.	U	10.	U	10.	U
218-01-9	Chrysene	10.	U	10.	U	10.	U	10.	U	10.	U
117-84-0	Di-n-octyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U
50-32-8	Benzo(a)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U
53-70-3	Dibenz(a,h)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U
191-24-2	Benzo(g,h,i)perylene	10.	U	10.	U	10.	U	10.	U	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SOIL SAMPLING
AREA 7

SW846-SVOA													
	SAMPLE ID ------->	F07-S-B001-01		F07-S-B001-02		F07-S-B002-01		F07-S-B002-02		F07-S-B003-01		F07-S-B003-02	
	ORIGINAL ID ----->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301		F07SB00302	
	LAB SAMPLE ID --->	37736.05		37736.06		37736.01		37736.02		37736.03		37736.04	
	ID FROM REPORT -->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301		F07SB00302	
	SAMPLE DATE ----->	03/15/99		03/15/99		03/15/99		03/15/99		03/15/99		03/15/99	
	DATE EXTRACTED -->	03/16/99		03/16/99		03/16/99		03/16/99		03/16/99		03/16/99	
	DATE ANALYZED --->	03/19/99		03/27/99		03/19/99		03/19/99		03/19/99		03/19/99	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ---------->	UG/KG		UG/KG		UG/KG		UG/KG		UG/KG		UG/KG	
CAS #	Parameter	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL
91-20-3	Naphthalene	380.	U	94.	J	380.	U	84.	J	370.	U	110.	J
56-55-3	Benzo(a)anthracene	380.	U	95.	J	380.	U	34.	J	370.	U	56.	J
218-01-9	Chrysene	380.	U	120.	J	380.	U	40.	J	370.	U	79.	J
205-99-2	Benzo(b)fluoranthene	380.	U	95.	J	380.	U	32.	J	370.	U	74.	J
207-08-9	Benzo(k)fluoranthene	380.	U	79.	J	380.	U	31.	J	370.	U	59.	J

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SOIL SAMPLING
AREA 7

SW846-VOA											
	SAMPLE ID ------->	F07-S-B001-01		F07-S-B001-02		F07-S-B002-01		F07-S-B002-02		F07-S-B003-01	
	ORIGINAL ID ----->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301	
	LAB SAMPLE ID --->	37736.05		37736.06		37736.01		37736.02		37736.03	
	ID FROM REPORT -->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301	
	SAMPLE DATE ----->	03/15/99		03/15/99		03/15/99		03/15/99		03/15/99	
	DATE ANALYZED --->	03/19/99		03/19/99		03/19/99		03/19/99		03/19/99	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil	
	UNITS ---------->	UG/KG		UG/KG		UG/KG		UG/KG		UG/KG	
CAS #	Parameter	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL
71-43-2	Benzene	6.	U	5.	U	6.	U	8.	UJ	6.	U
100-41-4	Ethylbenzene	6.	U	1.	J	6.	U	8.	UJ	6.	U
108-88-3	Toluene	6.	U	5.	U	6.	U	8.	UJ	6.	U
1330-20-7	Xylene (Total)	6.	U	3.	J	6.	U	8.	UJ	6.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SAMPLING
AREA 7

SW846-SVOA

	SAMPLE ID ------->	FDS-G-W07A-03		FDS-G-W07B-03		FDS-G-W07C-03		FDS-G-W07D-03		FDS-G-W07E-01	
	ORIGINAL ID ----->	FDSGW07A03		FDSGW07B03		FDSGW07C03		FDSGW07D03		FDSGW07E01	
	LAB SAMPLE ID --->	37648.02		37631.07		37631.08		37631.09		37648.01	
	ID FROM REPORT -->	FDSGW07A03		FDSGW07B03		FDSGW07C03		FDSGW07D03		FDSGW07E01	
	SAMPLE DATE ----->	03/05/99		03/04/99		03/04/99		03/04/99		03/05/99	
	DATE EXTRACTED -->	03/08/99		03/06/99		03/06/99		03/06/99		03/08/99	
	DATE ANALYZED --->	03/15/99		03/10/99		03/10/99		03/10/99		03/15/99	
	MATRIX ---------->	Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37648	VAL	37631	VAL	37631	VAL	37631	VAL	37648	VAL
91-20-3	Naphthalene	10.	U	10.	U	10.	U	0.7	J	10.	U
56-55-3	Benzo(a)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U
218-01-9	Chrysene	10.	U	10.	U	10.	U	10.	U	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SOIL SAMPLING
AREA 7

SW846-META													
	SAMPLE ID ------->	F07-S-B001-01		F07-S-B001-02		F07-S-B002-01		F07-S-B002-02		F07-S-B003-01		F07-S-B003-02	
	ORIGINAL ID ----->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301		F07SB00302	
	LAB SAMPLE ID --->	37736.05		37736.06		37736.01		37736.02		37736.03		37736.04	
	ID FROM REPORT -->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301		F07SB00302	
	SAMPLE DATE ----->	03/15/99		03/15/99		03/15/99		03/15/99		03/15/99		03/15/99	
	DATE EXTRACTED -->	03/22/99		03/22/99		03/22/99		03/22/99		03/22/99		03/22/99	
	DATE ANALYZED --->	03/23/99		03/23/99		03/23/99		03/23/99		03/23/99		03/23/99	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ---------->	MG/KG		MG/KG		MG/KG		MG/KG		MG/KG		MG/KG	
CAS #	Parameter	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL
7439-97-6	Mercury (Hg)	0.03	U	0.03	U	0.03	U	0.04	U	0.03	U	0.06	
7440-38-2	Arsenic (As)	1.3	U	11.4		1.5		11.7		3.2		77.6	
7440-39-3	Barium (Ba)	11.1		35.8		18.8		31.3		13.6		58.	
7440-43-9	Cadmium (Cd)	0.06	J	0.26	J	0.03	U	0.3	J	0.12	J	0.31	J
7440-47-3	Chromium (Cr)	4.9		28.8		8.3		23.8		6.9		33.6	
7439-92-1	Lead (Pb)	2.6		93.1		4.1		85.5		3.5		102.	
7782-49-2	Selenium (Se)	0.53	U	0.51	U	0.56	J	0.58	U	2.1		0.71	
7440-22-4	Silver (Ag)	0.14	U	0.13	U	0.13	U	0.15	U	0.14	U	0.16	U

*** Validation Complete ***

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

October 4, 1999

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Area 8, Charleston Naval Complex, South Carolina (SCDHEC No. 01183)

Dear Mr. Magwood:

This final letter report supplements the Fuel Distribution System (FDS) Contamination Assessment Report (CAR) dated September 10, 1998. This letter report incorporates the results of follow-on investigative activities performed in accordance with recommendations in the CAR, and to address any SCDHEC comments concerning Area 8.

In accordance with the Statement of Work, two copies of this report are attached. Two copies are also being sent to Paul Bristol of the South Carolina Department of Health and Environmental Control.

Should you have any questions or concerns regarding this submittal, please contact me.

Sincerely,

ENSAFE INC.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

Area 8

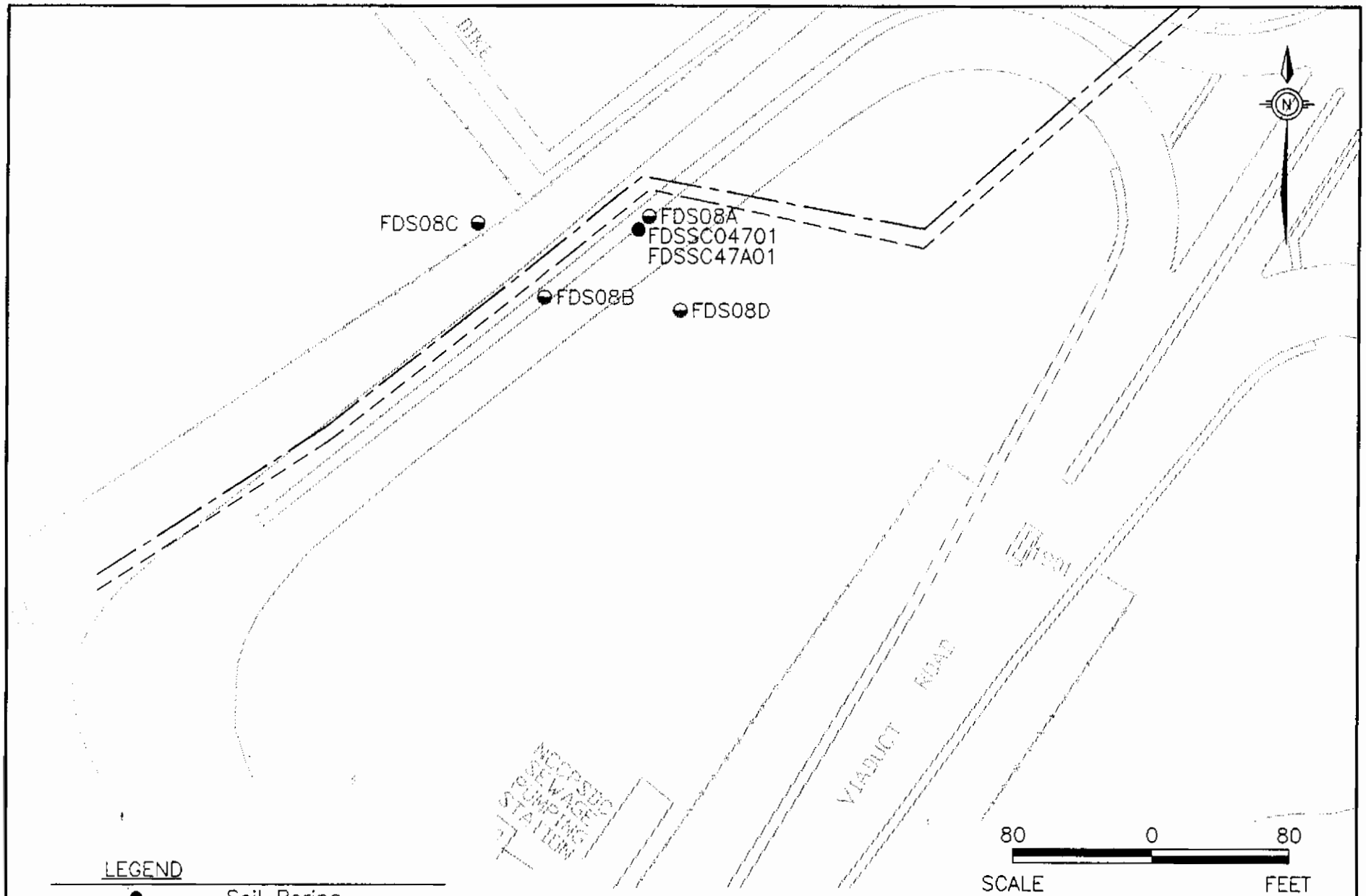
(SCDHEC No. 01183)

Background

Area 8 of the Fuel Distribution System (FDS) is associated with Phase I soil sample FDSSC04701, which exhibited total petroleum hydrocarbons-gasoline range organics of 19,000 micrograms per kilogram (μg/kg), which prompted Phase II soil and groundwater sampling within Area 8. Phase II soil sampling revealed total naphthalenes of 5,210 μg/kg which exceeded the risk-based screening levels (RBSL) of 210 μg/kg at sample FDSSC47A01. To determine if groundwater has been adversely impacted by these petroleum constituents, three shallow groundwater monitoring wells were installed and sampled during Phase II. No groundwater RBSLs for inorganics were exceeded at Area 8. Total PAHs exceeded their RBSLs during the first sampling event at FDS08B, but decreased to below the RBSLs during the second sampling event (*Contamination Assessment Report* [CAR], EnSafe 1998).

Follow-on Activities

Analysis of site hydrology as presented in the CAR revealed that groundwater at Area 8 flows to the southeast. To fill a potential data gap at Area 8 and complete delineation of the area of presumed petroleum contamination, the CAR recommended and South Carolina Department of Health and Environmental Control (SCDHEC) concurred, a fourth monitoring well should be installed downgradient from boring FDSSC47A01 to determine if semivolatile organic compounds (SVOCs), specifically total naphthalenes have impacted groundwater. Monitoring well FDS08D was installed downgradient from FDSSC47A01 in February, 1999, and was sampled in March, 1999 for RBSL volatile organic compounds (VOCs), SVOCs, and inorganics. As recommended and agreed upon by SCDHEC, only FDS08D was sampled during the follow-on sampling; other Area 8 wells were not re-sampled. Figure 1 depicts the Area 8 sample locations, including the location of the new well. Attachment A contains the monitoring well construction diagram and well development record for FDS08D. The FDS CAR contains the boring logs and development records for previously installed Area 8 wells.



LEGEND

- ● – Soil Boring
- ◒ – Shallow Monitoring Well
- —x—x—x—x—x— – Fence
- —— - —— – Fuel Line
- — — — — — – Sludge Line

FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREA 8
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907N049

Results

Figure 2 presents the shallow groundwater piezometric surface at Area 8 as measured in March 1999 at low-tide. Groundwater flow is generally to the east-southeast which differs slightly from the southeast low-tide flow direction shown in the CAR (EnSafe 1998). Aquifer slug testing at FDS08D determined an average horizontal hydraulic conductivity of 0.24 feet per day for the shallow aquifer. Attachment B contains the aquifer test results for Area 8.

Analytes detected in Area 8 shallow groundwater during the post-CAR sampling are summarized in Table 1. No VOCs or SVOCs were detected at FDS08D. The only inorganic analyte detected was barium at 38.9 μg/L, below the RBSL of 2,000 μg/L. Attachment C contains the analytical data from the post-CAR sampling. The FDS CAR contains the analytical data from all previous sampling at Area 8.

Table 1
Analytes Detected in Shallow Groundwater
Post-CAR Sampling, Area 8
Fuel Distribution System

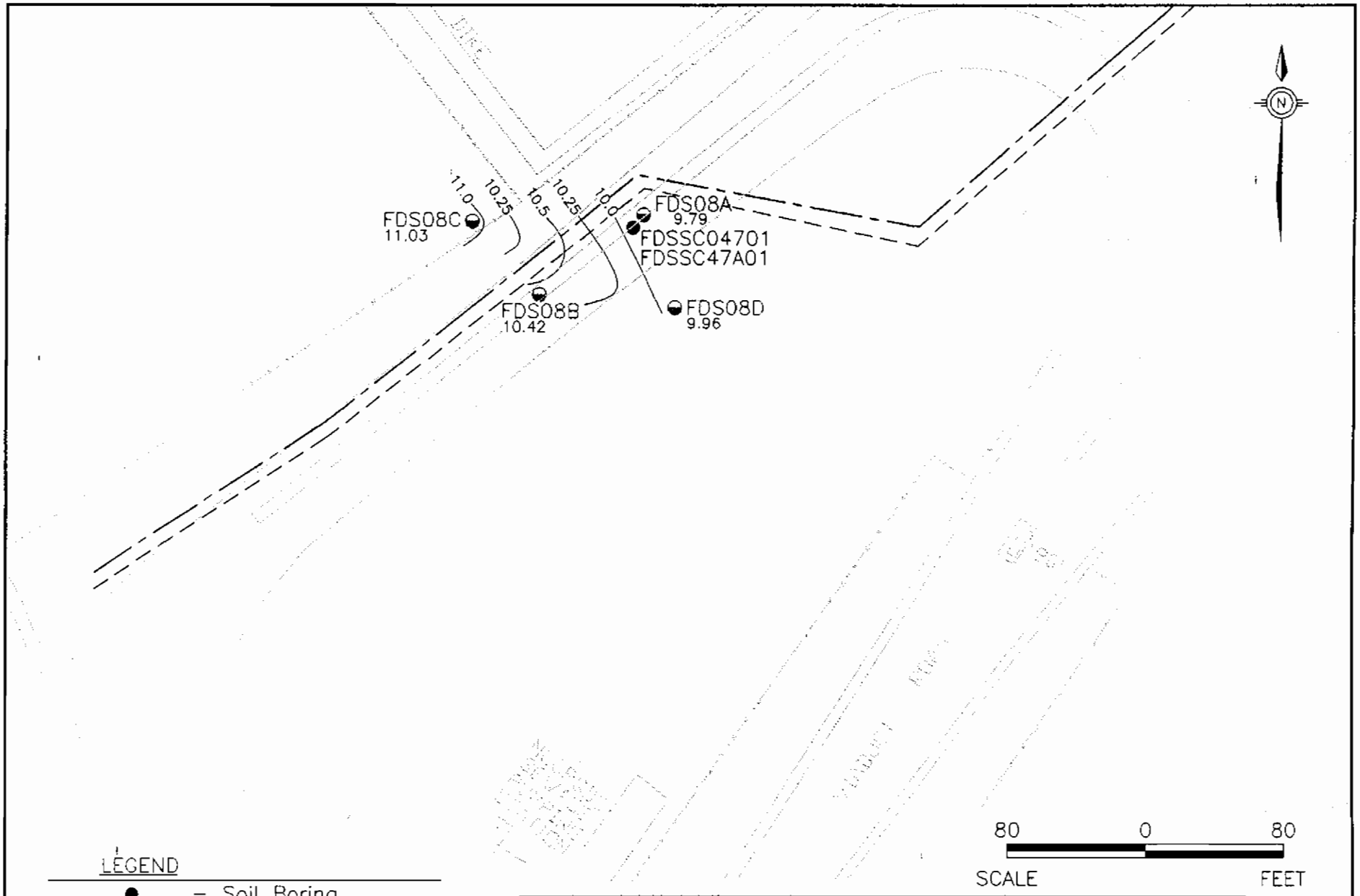
Parameters	Location	Sample Results	RBSL (μg/L)	Exceeds RBSL
Inorganics (μg/L)				
Barium (Ba)	FDS08D	38.9	2000	No

Notes:

μg/L = Micrograms per liter
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998).

Conclusions and Recommendations

As reported in the CAR, the total naphthalene concentration detected in soil sample FDSSC47A01 was 5,210 μg/kg which exceeds the RBSL of 210 μg/kg. Because this sample was collected below the water table at a depth of 13.5 to 15.5 feet, it is effectively a sample of the aquifer matrix, and therefore generation of a Site Specific Target Level would not be applicable. This concentration



LEGEND

- Soil Boring
- Shallow Monitoring Well
- Fence
- Fuel Line
- Sludge Line

FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 2
AREA 8
SHALLOW GROUNDWATER
PIEZOMETRIC MAP

DWG DATE: 09/30/99 | DWG NAME: 2907R006

is below the generic soil-to-groundwater soil screening level (SSL [DAF=20]) of 84,000 μg/kg (from the *Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting migration to groundwater is unlikely. Previous groundwater results which exceeded RBSLs have decreased to below RBSL concentrations. During the most recent sampling event for each well, no analytes were detected in groundwater at concentrations exceeding the RBSL.

Groundwater analytical data confirms leaching is not occurring. Groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a basewide potable water system provides drinking and process water to buildings at CNC. This system is to remain in operation under the current base reuse plan. In addition, the shallow aquifer for this investigation contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which makes this water-bearing unit a questionable potable water source.

Organic chemicals of concern (COCs) exceeding RBSLs were detected in subsurface soil at boring FDSSC47A01. To demonstrate that these constituents are not adversely impacting groundwater at Area 8, monitoring wells FDS08A and FDS08D should be monitored twice at three-month intervals to ensure that groundwater constituent concentrations are consistent or decreasing and that no further leaching of organics is taking place.

If concentrations remain below groundwater RBSLs during this monitoring program, these results should be sufficient to support a no further action decision for soil and groundwater at Area 8.

Attachment A
Monitoring Well Construction Diagram/Well Development Record

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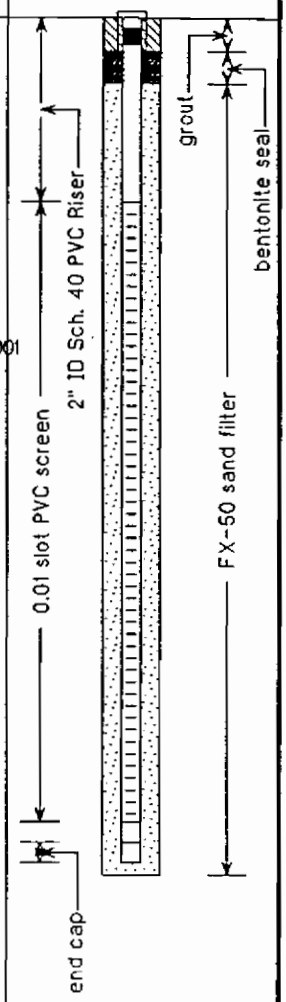
Monitoring Well NBCGFDS08D

Project: *Fuel Distribution System -Charleston Naval Complex*	Coordinates: *2319473.27 E, 372172.15 N*
Location: *Charleston, SC*	Surface Elevation: *14.9 feet msl*
Started at *1730 on 02-02-99*	TOC Elevation: *14.76 feet msl*
Completed at *1900 on 02-02-99*	Depth to Groundwater: *5.60 feet TOC* Measured: *3/5/99*
Drilling Method: *4.25" ID (8.0" OD) HSA with split spoon*	Groundwater Elevation: *9.16 feet msl*
Drilling Company: *Alliance Environmental (SC cert #889)*	Total Depth: *12.8 feet*
Geologist: *P. Bayley*	Well Screen: *2.8 to 12.2 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	OVA (ppm)	% RECOVERY	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: Grass.	
							CL	Clay: yellow-brown; tr silt; stiff; plastic; damp; pebble base.	13.9
							ML CL	Silt: olive-brown; clayey; calcareous; plastic; stiff; damp. Marl fill.	13.2
			1		100				11.9
5			2		0		ML CL	Silt: dk. brown; tr-sm clay; tr vf sand; loose; tr plastic; damp.	9.900001
							SP		9.2
							SM	Sand: gray; vf; sm silt; soft; wet.	8.8
			3		80		ML SM	Silt: olive-gray; w/ vf sand; soft; wet.	8.3 / 7.9
							OL	Silt: dk gray-black; clayey; soft; wet.	7
			4		45				
10									
			5		0		SC	Sand: gray; vf; w/ plastic, soft, blue-green clay in matrix; firm; plastic; wet.	3.9
									2.8
			6		55				
15									
20									

WELL DIAGRAM



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CHARLESTON NAVAL COMPLEX
WELL DEVELOPMENT STATUS REPORT
ZONE G FDS

WELL DEVELOPMENT SUMMARY

Well:NBCG\FDS08D

Summary Log of well development progress.
Readings are final readings for each visit.
Volume data are cumulative from start of development.

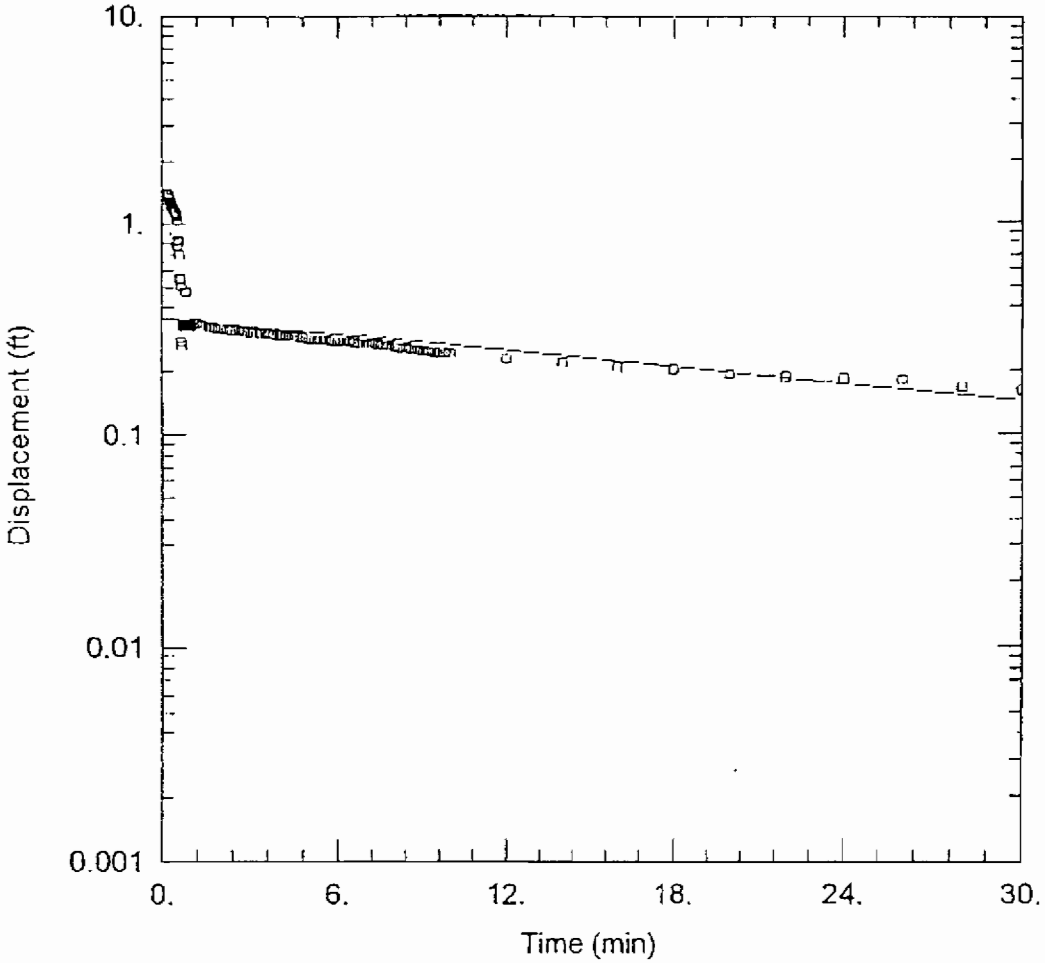
DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-25-99	17.5	7.06	68	2.81	16.5	-
2-25-99	20	7.12	127	2.73	17.8	-
2-25-99	22.5	7.16	88	2.76	17.9	-
2-25-99	25	7.08	136	2.83	18	-
2-25-99	27	7.10	138	2.80	17.9	-
2-25-99	29	7.15	89	2.79	17.7	-
2-25-99	31	6.52	58	2.82	18.0	-
2-25-99	33	6.27	73	2.53	17.8	-
2-25-99	34	6.55	90	2.79	17.9	-
2-25-99	35	6.65	59	2.63	17.8	-
2-25-99	36	6.66	60	2.79	17.2	-
2-25-99	38	6.64	58	2.81	17.8	-
2-25-99	39.5	6.65	30	2.82	17.5	-
2-25-99	41	6.82	19	2.79	17.1	-
2-25-99	42	6.68	11	2.52	17.0	-
2-25-99	43	6.52	17	2.51	17.4	-

DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-25-99	44	6.46	12	2.52	17.1	-

Well Development Completed on:2-25-99

COMMENTS:

Attachment B
Aquifer Test Results



FDS08D INJECTION

Data Set: C:\TEMP\CHARLE~1\4-08D.AQT
Date: 06/21/99 Time: 11:54:12

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Test Location: Charleston
Test Well: FDS08D
Test Date: 6/3/99

AQUIFER DATA

Saturated Thickness: 31. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.405 ft
Casing Radius: 0.0833 ft
Screen Length: 10. ft
Water Column Height: 7.8 ft
Wellbore Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 0.0001962 ft/min

Data Set: C:\TEMP\CHARLE~1\4-08D.AQT
Title: FDS08D Injection
Date: 06/21/99
Time: 14:38:39

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Location: Charleston
Test Date: 6/3/99
Test Well: FDS08D

AQUIFER DATA

Saturated Thickness: 31. ft
Anisotropy Ratio (Kz/Kr): 1.

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: FDS08D

X Location: 0. ft
Y Location: 0. ft

No. of observations: 131

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.1666	1.405	0.7333	0.326	6.6	0.27
0.175	1.402	0.75	0.326	6.8	0.267
0.1833	1.389	0.7666	0.33	7.	0.267
0.1916	1.377	0.7833	0.33	7.2	0.267
0.2	1.364	0.8	0.326	7.4	0.264
0.2083	1.355	0.8166	0.477	7.6	0.26
0.2166	1.345	0.8333	0.336	7.8	0.26
0.225	1.333	0.85	0.333	8.	0.257
0.2333	1.323	0.8666	0.333	8.2	0.254
0.2416	1.311	0.8833	0.33	8.4	0.254
0.25	1.339	0.9	0.33	8.6	0.251
0.2583	1.282	0.9166	0.326	8.8	0.248
0.2666	1.282	0.9333	0.33	9.	0.245
0.275	1.273	0.95	0.326	9.2	0.245
0.2833	1.263	0.9666	0.326	9.4	0.242
0.2916	1.254	0.9833	0.326	9.6	0.242
0.3	1.248	1.	0.326	9.8	0.242
0.3083	1.238	1.2	0.339	10.	0.238

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.3166	1.229	1.4	0.33	12.	0.226
0.325	1.219	1.6	0.323	14.	0.216
0.3333	1.21	1.8	0.32	16.	0.207
0.35	1.194	2.	0.317	18.	0.201
0.3666	1.178	2.2	0.314	20.	0.191
0.3833	1.166	2.4	0.311	22.	0.185
0.4	1.15	2.6	0.311	24.	0.182
0.4166	1.138	2.8	0.308	26.	0.179
0.4333	1.125	3.	0.301	28.	0.166
0.45	1.109	3.2	0.301	30.	0.16
0.4666	1.097	3.4	0.301	32.	0.157
0.4833	1.087	3.6	0.298	34.	0.15
0.5	1.075	3.8	0.295	36.	0.147
0.5166	1.034	4.	0.292	38.	0.147
0.5333	0.792	4.2	0.292	40.	0.141
0.55	0.839	4.4	0.289	42.	0.141
0.5666	0.829	4.6	0.289	44.	0.132
0.5833	0.814	4.8	0.286	46.	0.125
0.6	0.707	5.	0.282	48.	0.122
0.6166	0.553	5.2	0.279	50.	0.119
0.6333	0.54	5.4	0.279	52.	0.116
0.65	0.509	5.6	0.279	54.	0.113
0.6666	0.273	5.8	0.276	56.	0.106
0.6833	0.26	6.	0.273	58.	0.106
0.7	0.326	6.2	0.273	60.	0.106
0.7166	0.326	6.4	0.273		

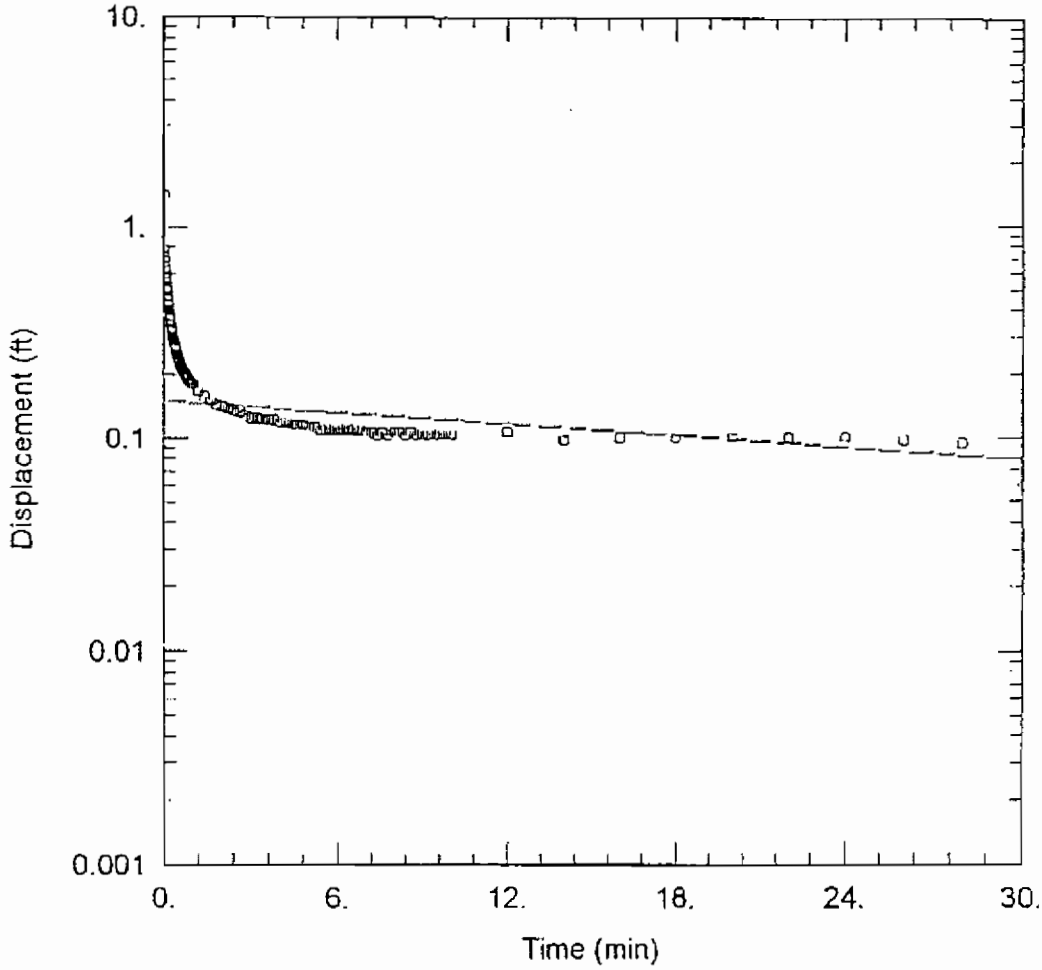
SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0001962	ft/min
y0	0.3544	ft



FDS08D WITHDRAWAL

Data Set: C:\TEMP\CHARLE~1\4-18D.AQT
Date: 06/21/99 Time: 12:04:28

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Test Location: Charleston
Test Well: FDS08D
Test Date: 6/3/99

AQUIFER DATA

Saturated Thickness: 31. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.405 ft
Casing Radius: 0.0833 ft
Screen Length: 10. ft
Water Column Height: 7.8 ft
Wellbore Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 0.0001395 ft/min

Data Set: C:\TEMP\CHARLE~1\4-18D.AQT
Title: FDS08D Withdrawal
Date: 06/21/99
Time: 14:39:08

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Location: Charleston
Test Date: 6/3/99
Test Well: FDS08D

AQUIFER DATA

Saturated Thickness: 31. ft
Anisotropy Ratio (Kz/Kr): 1.

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: FDS08D

X Location: 0. ft
Y Location: 0. ft

No. of observations: 133

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0166	0.788	0.45	0.254	3.4	0.122
0.025	0.763	0.4666	0.251	3.6	0.122
0.0333	0.738	0.4833	0.245	3.8	0.122
0.0416	0.713	0.5	0.242	4.	0.119
0.05	0.685	0.5166	0.238	4.2	0.119
0.0583	0.644	0.5333	0.235	4.4	0.116
0.0666	0.641	0.55	0.229	4.6	0.116
0.075	0.619	0.5666	0.226	4.8	0.116
0.0833	0.6	0.5833	0.223	5.	0.113
0.0916	0.581	0.6	0.22	5.2	0.113
0.1	0.565	0.6166	0.216	5.4	0.11
0.1083	0.549	0.6333	0.216	5.6	0.11
0.1166	0.534	0.65	0.213	5.8	0.11
0.125	0.518	0.6666	0.21	6.	0.11
0.1333	0.502	0.6833	0.207	6.2	0.11
0.1416	0.487	0.7	0.204	6.4	0.11
0.15	0.474	0.7166	0.204	6.6	0.11
0.1583	0.462	0.7333	0.201	6.8	0.11

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.1666	0.449	0.75	0.201	7.	0.106
0.175	0.436	0.7666	0.198	7.2	0.106
0.1833	0.427	0.7833	0.194	7.4	0.103
0.1916	0.418	0.8	0.194	7.6	0.106
0.2	0.405	0.8166	0.194	7.8	0.103
0.2083	0.399	0.8333	0.191	8.	0.106
0.2166	0.389	0.85	0.188	8.2	0.106
0.225	0.38	0.8666	0.188	8.4	0.103
0.2333	0.374	0.8833	0.188	8.6	0.106
0.2416	0.364	0.9	0.185	8.8	0.103
0.25	0.355	0.9166	0.185	9.	0.103
0.2583	0.352	0.9333	0.185	9.2	0.103
0.2666	0.342	0.95	0.182	9.4	0.103
0.275	0.336	0.9666	0.179	9.6	0.103
0.2833	0.33	0.9833	0.179	9.8	0.103
0.2916	0.326	1.	0.179	10.	0.103
0.3	0.32	1.2	0.166	12.	0.106
0.3083	0.314	1.4	0.157	14.	0.097
0.3166	0.311	1.6	0.15	16.	0.1
0.325	0.304	1.8	0.144	18.	0.1
0.3333	0.301	2.	0.141	20.	0.1
0.35	0.292	2.2	0.138	22.	0.1
0.3666	0.286	2.4	0.135	24.	0.1
0.3833	0.279	2.6	0.132	26.	0.097
0.4	0.27	2.8	0.128	28.	0.094
0.4166	0.267	3.	0.125		
0.4333	0.26	3.2	0.125		

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0001395	ft/min
y0	0.1497	ft

Attachment C
Analytical Data

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

October 25, 1999

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Area 8, Charleston Naval Complex, South Carolina (SCDHEC No. 01183)

Dear Mr. Magwood:

Please find attached revised Attachment C - Analytical Data for the above referenced final letter report.

In accordance with the Statement of Work, a copy is also being sent to Paul Bristol of the South Carolina Department of Health and Environmental Control.

Should you have any questions or concerns regarding this attachment, please contact me.
Sincerely,

ENSAFE INC.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREA 8

SW-SVOA

SAMPLE ID -------> FDS-G-W08D-01
ORIGINAL ID -----> FDSGW08D01
LAB SAMPLE ID ---> 37648.03
ID FROM REPORT --> FDSGW08D01
SAMPLE DATE -----> 03/05/99
DATE EXTRACTED --> 03/08/99
DATE ANALYZED ---> 03/15/99
MATRIX ----------> Water
UNITS -----------> UG/L

CAS #	Parameter	37648	VAL
108-95-2	Phenol	10.	U
111-44-4	bis(2-Chloroethyl)ether	10.	U
95-57-8	2-Chlorophenol	10.	U
541-73-1	1,3-Dichlorobenzene	10.	U
106-46-7	1,4-Dichlorobenzene	10.	U
100-51-6	Benzyl alcohol	10.	U
95-50-1	1,2-Dichlorobenzene	10.	U
95-48-7	2-Methylphenol (o-Cresol)	10.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U
106-44-5	4-Methylphenol (p-Cresol)	10.	U
621-64-7	N-Nitroso-di-n-propylamine	10.	U
67-72-1	Hexachloroethane	10.	U
98-95-3	Nitrobenzene	10.	U
78-59-1	Isophorone	10.	U
88-75-5	2-Nitrophenol	10.	U
105-67-9	2,4-Dimethylphenol	10.	U
65-85-0	Benzoic acid	25.	U
111-91-1	bis(2-Chloroethoxy)methane	10.	U
120-83-2	2,4-Dichlorophenol	10.	U
120-82-1	1,2,4-Trichlorobenzene	10.	U
91-20-3	Naphthalene	10.	U
106-47-8	4-Chloroaniline	10.	U
87-68-3	Hexachlorobutadiene	10.	U
59-50-7	4-Chloro-3-methylphenol	10.	U
91-57-6	2-Methylnaphthalene	10.	U
77-47-4	Hexachlorocyclopentadiene	10.	U
88-06-2	2,4,6-Trichlorophenol	10.	U
95-95-4	2,4,5-Trichlorophenol	25.	U
91-58-7	2-Chloronaphthalene	10.	U
88-74-4	2-Nitroaniline	25.	U
131-11-3	Dimethyl phthalate	10.	U
208-96-8	Acenaphthylene	10.	U
99-09-2	3-Nitroaniline	25.	U
83-32-9	Acenaphthene	10.	U
51-28-5	2,4-Dinitrophenol	25.	U
100-02-7	4-Nitrophenol	25.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREA 8

SW-SVOA

SAMPLE ID ------->	FDS-G-W08D-01
ORIGINAL ID ----->	FDSGW08D01
LAB SAMPLE ID --->	37648.03
ID FROM REPORT -->	FDSGW08D01
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/08/99
DATE ANALYZED --->	03/15/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
132-64-9	Dibenzofuran	10.	U
121-14-2	2,4-Dinitrotoluene	10.	U
606-20-2	2,6-Dinitrotoluene	10.	U
84-66-2	Diethylphthalate	10.	U
7005-72-3	4-Chlorophenylphenylether	10.	U
86-73-7	Fluorene	10.	U
100-01-6	4-Nitroaniline	25.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U
86-30-6	N-Nitrosodiphenylamine	10.	U
101-55-3	4-Bromophenyl-phenylether	10.	U
118-74-1	Hexachlorobenzene	10.	U
87-86-5	Pentachlorophenol	25.	U
85-01-8	Phenanthrene	10.	U
120-12-7	Anthracene	10.	U
84-74-2	Di-n-butylphthalate	10.	U
206-44-0	Fluoranthene	10.	U
129-00-0	Pyrene	10.	U
85-68-7	Butylbenzylphthalate	10.	U
91-94-1	3,3'-Dichlorobenzidine	20.	U
56-55-3	Benzo(a)anthracene	10.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U
218-01-9	Chrysene	10.	U
117-84-0	Di-n-octyl phthalate	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U
50-32-8	Benzo(a)pyrene	10.	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U
53-70-3	Dibenz(a,h)anthracene	10.	U
191-24-2	Benzo(g,h,i)perylene	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREA 8

SW846-META

SAMPLE ID ------->	FDS-G-W08D-01
ORIGINAL ID ----->	FDSGW08D01
LAB SAMPLE ID --->	37648.03
ID FROM REPORT -->	FDSGW08D01
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/18/99
DATE ANALYZED --->	03/19/99
MATRIX ---------->	Water
UNITS ---------->	UG/L

CAS #	Parameter	37648	VAL
7439-97-6	Mercury (Hg)	0.1	U
7440-38-2	Arsenic (As)	3.3	U
7440-39-3	Barium (Ba)	38.9	
7440-43-9	Cadmium (Cd)	0.3	U
7440-47-3	Chromium (Cr)	0.7	U
7439-92-1	Lead (Pb)	2.1	U
7782-49-2	Selenium (Se)	4.5	U
7440-22-4	Silver (Ag)	1.4	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREA 8

SW846-VOA

SAMPLE ID ------->	FDS-G-W08D-01
ORIGINAL ID ----->	FDSGW08D01
LAB SAMPLE ID --->	37648.03
ID FROM REPORT -->	FDSGW08D01
SAMPLE DATE ----->	03/05/99
DATE ANALYZED --->	03/10/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
71-43-2	Benzene	5.	U
100-41-4	Ethylbenzene	5.	U
108-88-3	Toluene	5.	U
1330-20-7	Xylene (Total)	5.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SAMPLING
AREA 8

SW846-META

SAMPLE ID ------->	FDS-G-W08D-01
ORIGINAL ID ----->	FDSGW08D01
LAB SAMPLE ID --->	37648.03
ID FROM REPORT -->	FDSGW08D01
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/18/99
DATE ANALYZED --->	03/19/99
MATRIX ---------->	Water
UNITS ---------->	UG/L

CAS #	Parameter	37648	VAL
7439-97-6	Mercury (Hg)	0.1	U
7440-38-2	Arsenic (As)	3.3	U
7440-39-3	Barium (Ba)	38.9	
7440-43-9	Cadmium (Cd)	0.3	U
7440-47-3	Chromium (Cr)	0.7	U
7439-92-1	Lead (Pb)	2.1	U
7782-49-2	Selenium (Se)	4.5	U
7440-22-4	Silver (Ag)	1.4	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SAMPLING
AREA 8

SW846-SVOA

SAMPLE ID ------->	FDS-G-W08D-01
ORIGINAL ID ----->	FDSGW08D01
LAB SAMPLE ID --->	37648.03
ID FROM REPORT -->	FDSGW08D01
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/08/99
DATE ANALYZED --->	03/15/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
91-20-3	Naphthalene	10.	U
56-55-3	Benzo(a)anthracene	10.	U
218-01-9	Chrysene	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SAMPLING
AREA 8

SW846-VOA

SAMPLE ID ------->	FDS-G-W08D-01
ORIGINAL ID ----->	FDSGW08D01
LAB SAMPLE ID --->	37648.03
ID FROM REPORT -->	FDSGW08D01
SAMPLE DATE ----->	03/05/99
DATE ANALYZED --->	03/10/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
71-43-2	Benzene	5.	U
100-41-4	Ethylbenzene	5.	U
108-88-3	Toluene	5.	U
1330-20-7	Xylene (Total)	5.	U

*** Validation Complete ***

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

October 1, 1999

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Areas 9 and 10, Charleston Naval Complex, South Carolina (SCDHEC No. 01184)

Dear Mr. Magwood:

This final letter report supplements the Fuel Distribution System (FDS) Contamination Assessment Report (CAR) dated September 10, 1998. This letter report addresses SCDHEC comments concerning intrinsic remediation recommended for Areas 9 and 10.

In accordance with the Statement of Work, two copies of this report are attached. Two copies are also being sent to Paul Bristol of the South Carolina Department of Health and Environmental Control.

Should you have any questions or concerns regarding this submittal, please contact me.

Sincerely,

ENSAFE INC.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

Areas 9 and 10

(SCDHEC No. 01184)

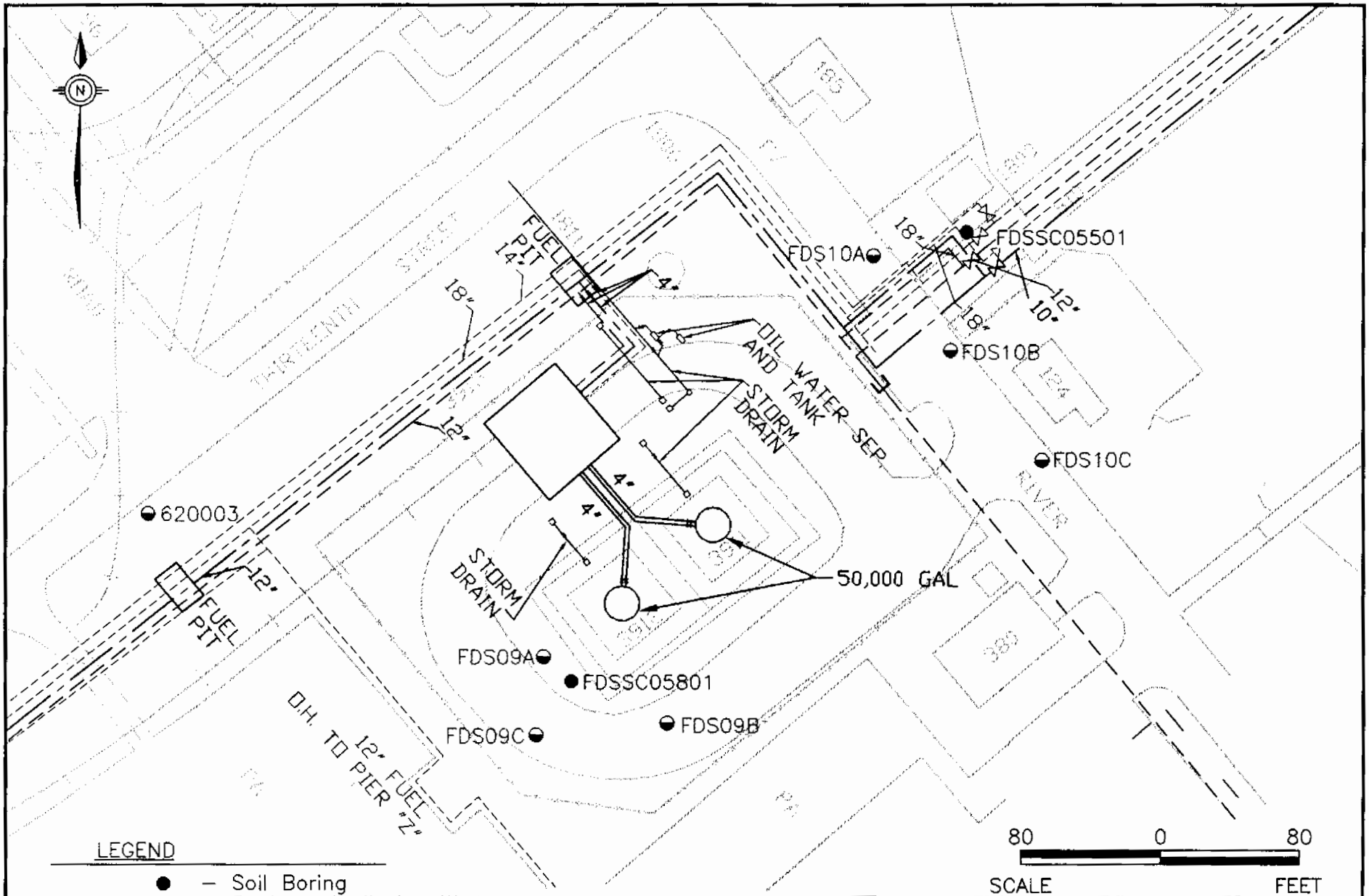
Background

The combined Areas 9 and 10 of the Fuel Distribution System (FDS) are associated with Phase I soil samples FDSSC05501 and FDSSC05801. As reported in the *FDS Contamination Assessment Report* (CAR), these samples exhibited total petroleum hydrocarbons-gasoline range organics of 63.7 micrograms per kilogram (μg/kg) at FDSSC05501 and 10 μg/kg at FDSSC05801, which prompted Phase II soil and groundwater sampling within Areas 9 and 10. Phase II soil sampling revealed total naphthalenes of 250 μg/kg in sample FDSSC05801 which exceeded the risk-based screening level (RBSL) of 210 μg/kg. To determine if groundwater has been adversely impacted by these petroleum chemicals of concern (COCs), 6 shallow groundwater monitoring wells were installed and sampled in the combined area during Phase II. No COCs exceeded their respective RBSLs at the combined area during the Phase II groundwater investigation (CAR EnSafe 1998). Figure 1 depicts the Areas 9 and 10 sample locations.

No follow-on investigative activities were performed at Areas 9 and 10.

Conclusions and Recommendations

As reported in the CAR, the total naphthalene concentration detected in soil sample FDSSC5801 was 250 μg/kg which exceeds the RBSL of 210 μg/kg. Because this sample was collected below the water table at a depth of 5 to 9 feet, it is effectively a sample of the aquifer matrix, and therefore Site Specific Target Levels would not apply. This concentration is also below the generic soil-to-groundwater soil screening level (SSL [DAF=20]) of 84,000 μg/kg (from the *Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting migration to groundwater is unlikely. This is further substantiated by the fact that no naphthalene was detected in the Phase II groundwater sampling at Areas 9 and 10 in two sampling events.



LEGEND

- ● – Soil Boring
- ◒ – Shallow Monitoring Well
- ⋈ – Valve
- –×–×–×–×– – Fence
- - - - - - - - – Diesel Line
- —— - —— – Fuel Line
- — — — — — – Sludge Line

FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREAS 9 AND 10
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907N006

No groundwater COCs exceeded their RBSLs at Areas 9 and 10, and there is an apparent lack of leaching of RBSL parameters from soil-to-groundwater. To demonstrate that the naphthalene in soil is not adversely impacting groundwater, the Navy proposes to monitor groundwater at this site. The program will consist of two quarterly sampling events during which the wells surrounding FDSSC05801 (FDS09A, FDS09B, FDS09C) will be sampled for polycyclic aromatic hydrocarbon COCs. If no RBSLs are exceeded in these monitoring samples, the site should be considered for no further action.

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

October 1, 1999

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Areas 12, 13, and 14, Charleston Naval Complex, South Carolina (SCDHEC No. 01186)

Dear Mr. Magwood:

This final letter report supplements the Fuel Distribution System (FDS) Contamination Assessment Report (CAR) dated September 10, 1998. This letter report incorporates the results of follow-on investigative activities performed in accordance with recommendations in the CAR, and to address any SCDHEC comments concerning Areas 12, 13, and 14.

In accordance with the Statement of Work, two copies of this report are attached. Two copies are also being sent to Paul Bristol of the South Carolina Department of Health and Environmental Control.

Should you have any questions or concerns regarding this submittal, please contact me.

Sincerely,

ENSAFE INC.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

Areas 12, 13, and 14

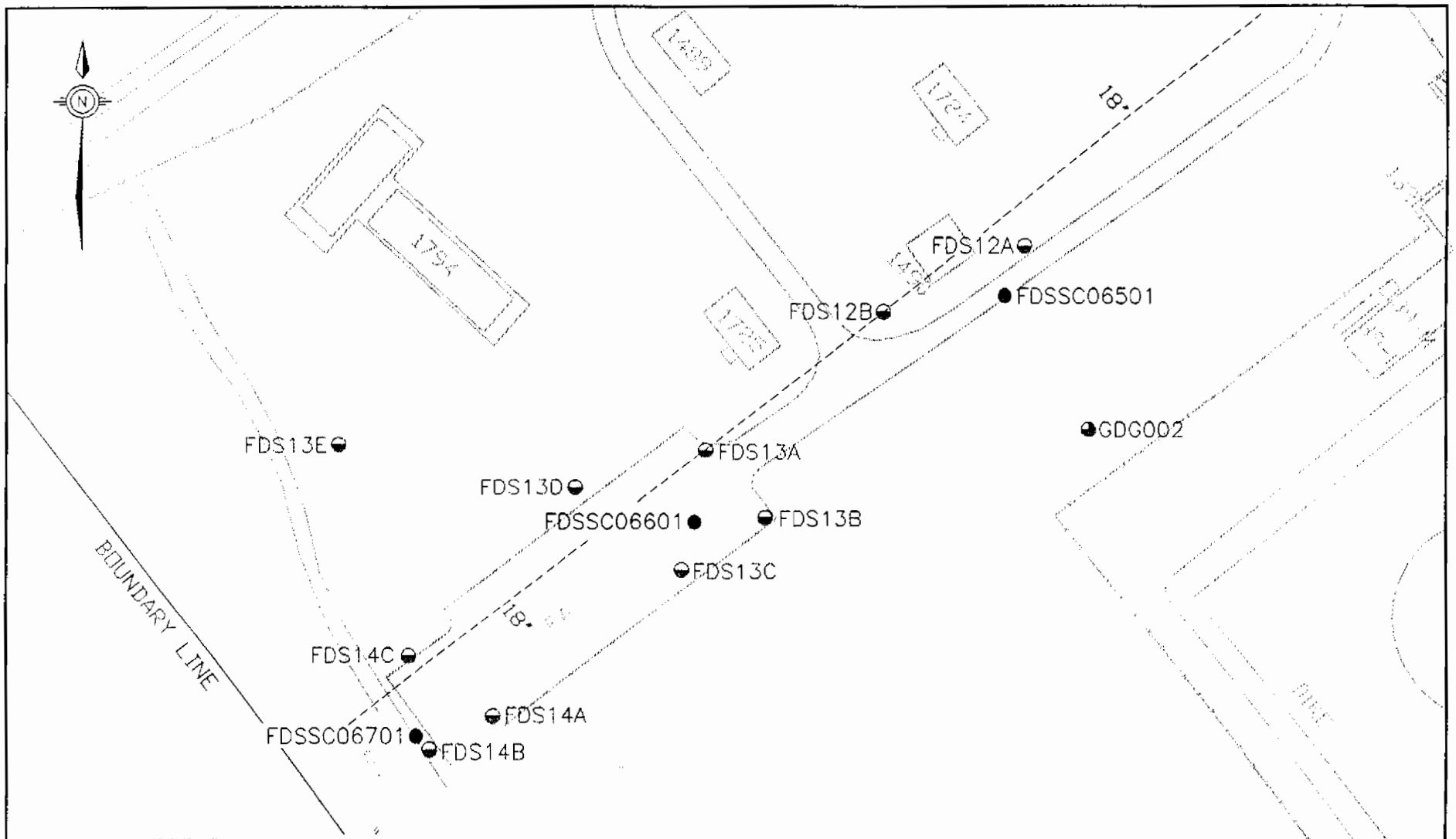
(SCDHEC No. 01186)

Background

The combined Areas 12, 13, and 14 of the Fuel Distribution System (FDS) are associated with Phase I soil samples FDSSC06501 through FDSSC06701. These samples exhibited total petroleum hydrocarbons-gasoline range organics ranging from 67 micrograms per kilogram (μg/kg) at FDSSC06601 to 147 μg/kg at FDSSC06501. The Phase I soil results prompted subsequent Phase II soil and groundwater sampling at the combined areas. Phase II soil sampling revealed total naphthalenes of 6,500 μg/kg and 4,700 μg/kg at FDSSC06601 and FDSSC06701, respectively, which exceeded the risk-based screening level (RBSL) of 210 μg/kg. To determine if groundwater has been adversely affected by petroleum constituents, 10 shallow groundwater monitoring wells were installed and sampled in the combined areas during Phase II. Data from nearby shallow grid well GDG002 were also incorporated into the investigation. During the first sampling event 50.3 micrograms per liter (μg/L) of arsenic was detected at FDS14A, which slightly exceeded the RBSL of 50 μg/L. Arsenic was detected at 21.8 μg/L at FDS14A during the second sampling, which was below the RBSL. Arsenic was detected at 210 μg/L at FDS13A during the second sampling event. No groundwater RBSLs for organics were exceeded at the combined areas *(Contamination Assessment Report* [CAR], EnSafe 1998). Figure 1 depicts the Areas 12, 13, and 14 sample locations.

Follow-on Activities

The CAR recommended and South Carolina Department of Health and Environmental Control (SCDHEC) concurred that intrinsic remediation was appropriate to address the total naphthalenes detected in soil at Areas 12, 13, and 14. The CAR also recommended that monitoring well FDS13A be resampled for arsenic. This sampling was completed in March 1999.



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREAS 12, 13, AND 14
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907N008

Results

Post-CAR sampling at FDS13A detected 18.3 μg/L of arsenic in groundwater, well below the RBSL of 50 μg/L, as shown in Table 1. Attachment A contains the analytical data from the resampling of FDS13A. The CAR contains analytical data from previous sampling.

Table 1
Analytes Detected in Shallow Groundwater
Post-CAR Sampling, Area 13
Fuel Distribution System

Parameters	Location	Sample Results	RBSL (μg/L)	Exceeds RBSL
Inorganics (μg/L)				
Arsenic (As)	FDS13A	18.3	50	No

Notes:

μg/L = Micrograms per liter
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998).

Conclusions and Recommendations

As reported in the CAR, concentrations of total naphthalenes in soil at FDSSC06601 (6,500 μg/kg) and FDSSC06701 (4,700 μg/kg) exceed the RBSL of 210 μg/kg. Because these samples were collected below the water table at a depth of 8.5 to 10.5 feet, they are effectively samples of the aquifer matrix and therefore Site Specific Target Levels would not be applicable. These concentrations are also below the 84,000 μg/kg soil-to-groundwater soil screening level (SSL [DAF=20]) from the (*Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting migration to groundwater is unlikely.

To support the CAR's recommendation of intrinsic remediation for the total naphthalenes detected in soil, limited monitoring of groundwater is recommended. Groundwater at well FDS14B downgradient of FDSSC06701 and wells FDS13B and FDS13C downgradient of FDSSC06601 should be sampled and analyzed for RBSL SVOCs two more times at three-month intervals to demonstrate that soil contaminants are not adversely impacting groundwater.

The results of the resampling of monitoring well FDS13A for arsenic in shallow groundwater revealed a detection of 18.3 μg/L, below the RBSL of 50 μg/L. This concentration is comparable to the Zone G background concentration of 17.8 μg/L. It is also comparable to the 27 μg/L of arsenic detected in the initial sampling event. These concentrations suggest that the 210 μg/L detected during the second sampling event was an anomalously high concentration. In accordance with the recommendation presented in the CAR and as agreed to by SCDHEC in the November 18, 1998 letter, no further action is recommended for groundwater at the combined Areas 12, 13 and 14. In addition, groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a basewide potable water system provides drinking and process water to buildings at CNC. This system is to remain in operation under the current base reuse plan. This shallow aquifer contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which make this water-bearing unit a questionable potable water source.

Attachment A
Analytical Data

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 12, 13, AND 14

ARSENIC

SAMPLE ID ------->	FDS-G-W13A-03
ORIGINAL ID ----->	FDSGW13A03
LAB SAMPLE ID --->	37648.04
ID FROM REPORT -->	FDSGW13A03
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/09/99
DATE ANALYZED --->	03/10/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
7440-38-2	Arsenic (As)	18.3	

*** Validation Complete ***

Area 15

(SCDHEC #01187)

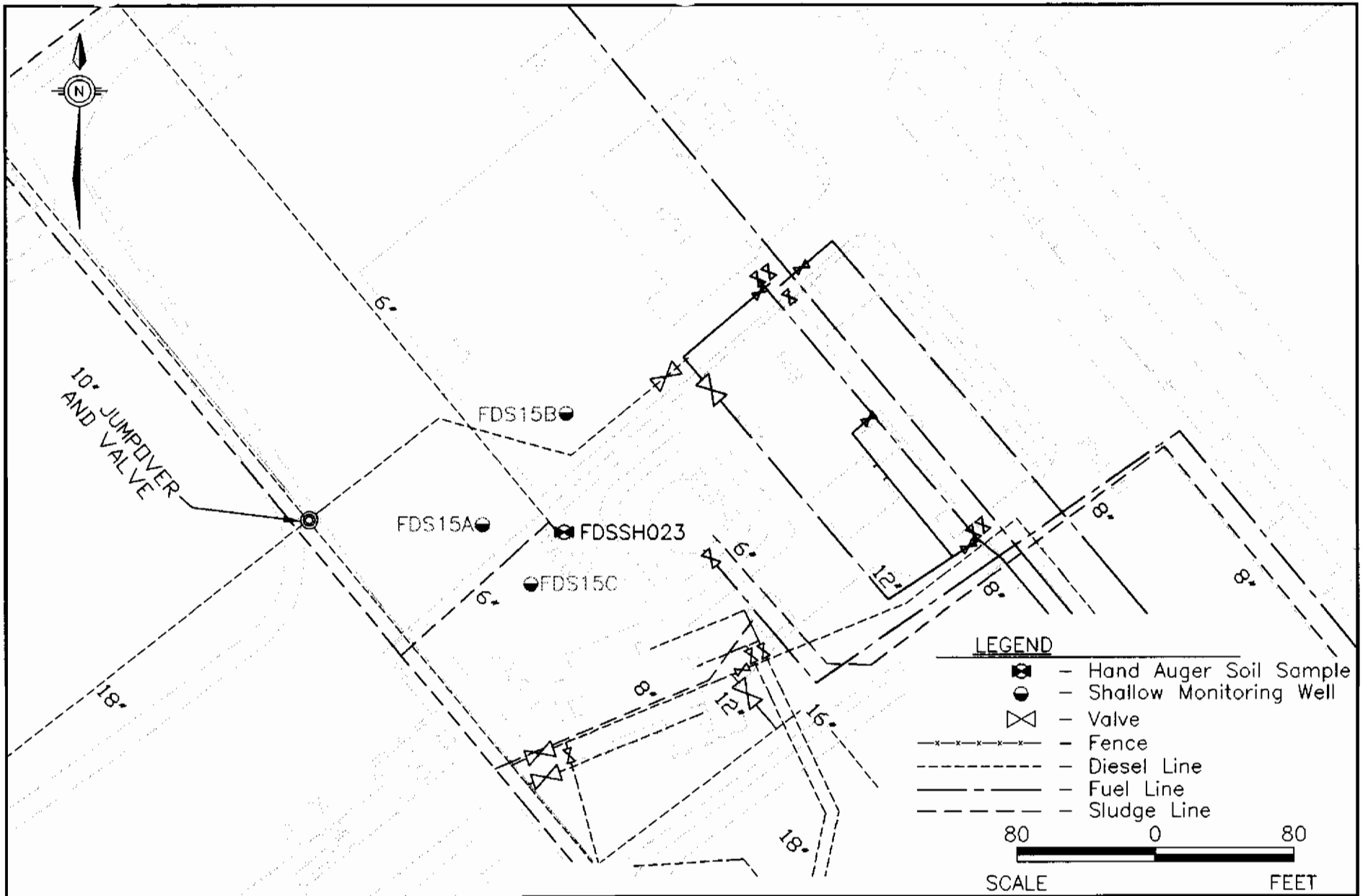
Background

Area 15 of the Fuel Distribution System (FDS) is associated with Phase I surface soil sample FDSSH02301. The sample was located just outside the western corner of the containment dike for Facility 3901A, on the north side of Building 3926. Six-inch pipelines intersect and connect to Building 3926 approximately three feet from FDSSH02301. Figure 1 presents the site features.

Facility 3901A is a 103,194 gallon welded steel ballast and sludge storage tank, which has been used for waste oil storage since 1945. The tank is connected to sludge lines which extend to various parts of the base, paralleling the fuel lines of the FDS. Building 3926 is a 15-foot high metal oil water separator mounted on a concrete pad. The facility originally used a Wemco unit to treat ballast water from tanks 39A and 39D. The Wemco unit was replaced with the current baffle operated system in 1991.

Soil Sample Results

Surface soil was sampled at Area 15 because it was most likely to be impacted by area activities or associated with a release at the site. As reported in the FDS *Contamination Assessment Report* (CAR), sample FDSSH02301 exhibited total petroleum hydrocarbons-gasoline range organics of 501 micrograms per kilogram (μg/kg), which prompted Phase II soil and groundwater sampling within Area 15. Phase II soil sampling revealed surface soil naphthalene (1,700 μg/kg) and total naphthalenes (8,500 μg/kg) above the respective groundwater protective Risk-Based Screening Levels (RBSLs) for these analytes (210 μg/kg for each analyte) at FDSSH02301. The ingestion and dermal contact RBSLs for napthalenes and total naphthalenes (3.1E+06 μg/kg for each analyte) was not exceeded.



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREA 15
SAMPLE LOCATIONS

DWG DATE: 02/15/00 | DWG NAME: 2907N011

Based on these results, a subsurface soil sample from the 3- to 5-foot below ground surface (bgs) interval, sample FDSSH02302, was collected and analyzed to determine the vertical extent and leachability potential of naphthalenes in subsurface soil at Area 15. Table 1 presents the surface soil results, as published in the CAR, and the recently acquired subsurface soil results. As presented in the CAR and Table 1, surface soil analytical results exceeded the groundwater protective RBSLs for napthalene and total napthlenes (210 μg/kg each analyte). No groundwater protective RBSLs were exceeded in the subsurface soil data. These results document that the naphthalene detected in the surficial interval is limited to that interval, thus delineating the vertical extent of this Contaminant of Concern (COC).

Groundwater Sample Results

Table 2 presents the groundwater analytical results, as published in the CAR. No groundwater organic RBSL parameters were detected during the most recent sampling event of the Phase II groundwater investigation at Area 15. Specifically, no naphthalene compounds were detected in shallow groundwater. No groundwater inorganic detection at Area 15 exceeded a RBSL during any sampling event. Figure 1 also depicts the Area 15 sample locations.

Conclusions and Recommendations

A review of analytical results from the surface soil data reveals that naphthalene and total naphthalenes in surficial soil exceeded the groundwater protective RBSL, but did not exceed the ingestion and dermal contact RBSL. The subsurface soil results document that these exceedances are limited to the surficial interval. In addition, an evaluation of Phase II groundwater results reveals that no naphthalenes were detected in shallow groundwater at Area 15. No other analytes detected in shallow groundwater exceeded their respective groundwater RBSLs.

Groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a base wide potable water system provides drinking and process water to buildings

at CNC. This system is to remain in operation under the current base reuse plan. In addition, the shallow aquifer for this investigation contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which makes this water-bearing unit a questionable potable water source.

Area 15 is currently zoned for marine industrial use, and will likely remain a fuel farm under this usage scenario. Since the napthalene detected in surficial soil does not exceed the ingestion and dermal contact RBSL and is not leaching to shallow groundwater at the site, no further action is recommended for Area 15.

Table 1
Analytes Detected in Surface and Subsurface Soil
Area 15
Fuel Distribution System

Parameters	Location	Surface Conc.	Ingestion/Dermal Contact RBSL	Subsurface Conc.	Groundwater Protection RBSL	Exceeds Ingestion-Dermal RBSL/Groundwater Protection RBSL
TPH - GRO (μg/kg)						
Gasoline	FDSSH023	501	NL	NT	NL	NA/NA
Volatile Organic Compounds (μg/kg)						
1,1-Dichloroethane	FDSSH023	85	NL	ND	NL	NA/NA
1,1,1-Trichloroethane	FDSSH023	48	NL	ND	NL	NA/NA
Benzene	FDSSH023	ND	22,000	2	5	No/No
Ethylbenzene	FDSSH023	130	7.8E+06	ND	1,260	No/No
Methylene chloride	FDSSH023	ND	NL	ND	NL	NA/NA
Tetrachloroethene	FDSSH023	13	NL	ND	NL	NA/NA
Toluene	FDSSH023	22	1.6E+06	ND	1,622	No/No
Xylene (Total)	FDSSH023	1800	1.6E+08	ND	42,471	No/No
Semivolatile Organic Compounds (μg/kg)						
Total Naphthalenes	FDSSH023	**8500**	3.1E+06	ND	210	No/Yes
2-Methylnaphthalene	FDSSH023	6800	NL	ND	NL	NA/NA
Naphthalene	FDSSH023	**1700**	3.1E+06	ND	210	No/Yes
bis(2-ethylhexyl)phthalate	FDSSH023	ND	NL	ND	NL	NA/NA
Chrysene	FDSSH023	240	88,000	ND	12,998	No/No

Table 1
Analytes Detected in Surface and Subsurface Soil
Area 15
Fuel Distribution System

Parameters	Location	Surface Conc.	Ingestion/Dermal Contact RBSL	Subsurface Conc.	Groundwater Protection RBSL	Exceeds Ingestion-Dermal RBSL/Groundwater Protection RBSL
Fluorene	FDSSH023	1900	NL	ND	NL	NA/NA
Phenanthrene	FDSSH023	1900	NL	ND	NL	NA/NA
Pyrene	FDSSH023	590	NL	ND	NL	NA/NA
Pesticides/PCB (μg/kg)						
4,4'-DDE	FDSSH023	ND	NL	12	NL	NA/NA
Aroclor- 1260	FDSSH023	ND	NL	53	NL	NA/NA
Endrin	FDSSH023	20	NL	ND	NL	NA/NA
Heptachlor	FDSSH023	5.3	NL	ND	NL	NA/NA
Heptachlor epoxide	FDSSH023	ND	NL	ND	NL	NA/NA
gamma-Chlordane	FDSSH023	3.4	NL	3.2	NL	NA/NA
Inorganics (mg/kg)						
Aluminum (Al)	FDSSH023	2820	NL	6,950	NL	NA/NA
Arsenic (As)	FDSSH023	1.8	NL	2.4	NL	NA/NA
Barium (Ba)	FDSSH023	13.1	NL	31.3	NL	NA/NA
Beryllium (Be)	FDSSH023	ND	NL	0.31	NL	NA/NA
Cadmium (Cd)	FDSSH023	0.19	NL	ND	NL	NA/NA
Calcium (Ca)	FDSSH023	13,100	NL	1,220	NL	NA/NA

Table 1
Analytes Detected in Surface and Subsurface Soil
Area 15
Fuel Distribution System

Parameters	Location	Surface Conc.	Ingestion/Dermal Contact RBSL	Subsurface Conc.	Groundwater Protection RBSL	Exceeds Ingestion-Dermal RBSL/Groundwater Protection RBSL
Chromium (Cr)	FDSSH023	9.3	NL	13.5	NL	NA/NA
Cobalt (Co)	FDSSH023	1.3	NL	1.5	NL	NA/NA
Copper (Cu)	FDSSH023	ND	NL	2.4	NL	NA/NA
Iron (Fe)	FDSSH023	4,860	NL	10,500	NL	NA/NA
Lead (Pb)	FDSSH023	29.5	NL	7.9	NL	NA/NA
Magnesium (Mg)	FDSSH023	499	NL	646	NL	NA/NA
Manganese (Mn)	FDSSH023	29.6	NL	34.3	NL	NA/NA
Mercury (Hg)	FDSSH023	0.07	NL	0.05	NL	NA/NA
Nickel (Ni)	FDSSH023	4.2	NL	2.9	NL	NA/NA
Potassium (K)	FDSSH023	240	NL	321	NL	NA/NA
Selenium (Se)	FDSSH023	ND	NL	0.51	NL	NA/NA
Sodium (Na)	FDSSH023	ND	NL	249	NL	NA/NA
Thallium (Tl)	FDSSH023	0.47	NL	ND	NL	NA/NA
Tin (Sn)	FDSSH023	ND	NL	ND	NL	NA/NA
Vanadium (V)	FDSSH023	10.6	NL	16.1	NL	NA/NA
Zinc (Zn)	FDSSH023	66.8	NL	14.8	NL	NA/NA

Notes:

NL = Not listed
NA = Not applicable
NT = Not taken
µg/kg = Micrograms per kilogram
mg/kg = Milligrams per kilogram

RBSLs for ingestion or dermal contact with surficial soil from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998) were used as reference concentrations.
Bolded concentrations exceed RBSL.

Table 2
Analytes Detected in Shallow Groundwater
Area 15
Fuel Distribution System

Parameters	Location	First Sampling Event	Second Sampling Event	RBSL/Tap Water RBC (μg/L)	Shallow Background
Volatile Organic Compounds (μg/L)					
Toluene	FDS15A	3	ND	1000/75	NA
Chlorobenzene	FDS15A	*6*	ND	NL/3.9	NA
Semivolatile Organic Compounds (μg/L)					
Phenol	FDS15A	1	ND	NL/2200	NA
4-Methylphenol (p-cresol)	FDS15A	*23*	2	NL/18	NA
Benzoic acid	FDS15A	6	ND	NL/15000	NA
Pesticides/PCBs (μg/L)					
beta-BHC	FDS15A	*0.057*	ND	NL/0.037	NA
Inorganics (μg/L)					
Aluminum (Al)	FDS15A	100	503	NL/3700	692
	FDS15B	3,010	209		
	FDS15C	962	474		
Antimony (Sb)	FDS15C	3.5	ND	NL/1.5	4.85
Arsenic (As)	FDS15A	19.4	26.7	50/0.045	17.8
	FDS15B	4.1	4.6		
Barium (Ba)	FDS15A	55.2	94.5	2000/260	31
	FDS15B	68.6	70.6		
	FDS15C	159	153		
Calcium (Ca)	FDS15A	126000	235000	NL/NL	NL
	FDS15B	98800	119000		
	FDS15C	268000	284000		
Chromium (Cr)	FDS15A	0.92	1.5	100/11	3.88
	FDS15B	4.7	ND		
	FDS15C	1.9	ND		
Cobalt (Co)	FDS15B	8.1	6.8	NL/220	1.45
	FDS15C	1.3	ND		
Copper (Cu)	FDS15A	3.6	ND	NL/150	8.33
Cyanide (CN)	FDS15A	3	NT	NL/73	3.8
	FDS15B	7	NT		
Iron (Fe)	FDS15A	4920	6620	NL/1100	30,400
	FDS15B	2060	675		
	FDS15C	1920	3040		

Table 2
Analytes Detected in Shallow Groundwater
Area 15
Fuel Distribution System

Parameters	Location	First Sampling Event	Second Sampling Event	RBSL/Tap Water RBC (μg/L)	Shallow Background
Magnesium (Mg)	FDS15A	12200	15800	NL/NL	NL
	FDS15B	26200	22800		
	FDS15C	19300	14000		
Manganese (Mn)	FDS15A	721	515	NL/73	2906
	FDS15B	1050	813		
	FDS15C	806	465		
Nickel (Ni)	FDS15A	3.7	0.84	NL/73	4.08
	FDS15B	3.2	1.6		
	FDS15C	1.7	0.9		
Potassium (K)	FDS15A	10800	5130	NL/NL	NL
	FDS15B	7410	8050		
	FDS15C	3440	3450		
Sodium (Na)	FDS15A	78300	157000	NL/NL	NL
	FDS15B	92400	158000		
	FDS15C	117000	114000		
Thallium (Tl)	FDS15C	*3.3*	ND	NL/0.26	ND
Vanadium (V)	FDS15A	1.3	1.6	NL/26	15.4
	FDS15B	6	1.1		
	FDS15C	1.9	1.6		

Notes:
NL = Not listed
NA = Not applicable
ND = Not detected
NT = Not taken
μg/L = Micrograms per liter
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998) and tap water RBCs (THQ=0.1) from *Risk Based Concentration Table* (USEPA, October 7, 1999) were used as reference concentrations.
Italicized concentrations exceed the Tap Water RBC. For inorganics, italicized concentrations exceed the shallow groundwater background concentration and the tap water RBC.
All background values for Zone G are based on twice the means of the grid sample concentrations. Background values for groundwater are based on two sampling rounds in two wells at each depth.

Attachment A
Analytical Data

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

CYANIDE							
	SAMPLE ID ------->	FDS-S-H023-01					
	ORIGINAL ID ----->	FDSSH02301					
	LAB SAMPLE ID --->	27355.10					
	ID FROM REPORT -->	FDSSH02301					
	SAMPLE DATE ----->	10/17/96					
	DATE EXTRACTED -->	10/21/96					
	DATE ANALYZED --->	10/24/96					
	MATRIX ---------->	Soil					
	UNITS ---------->	MG/KG					
CAS #	Parameter	27339	VAL				
57-12-5	Cyanide (CN)	0.53	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW846-META

SAMPLE ID ------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/22/96
DATE ANALYZED --->	10/24/96
MATRIX ---------->	Soil
UNITS ----------->	MG/KG

CAS #	Parameter	27339	VAL
7439-97-6	Mercury (Hg)	0.07	
7429-90-5	Aluminum (Al)	2820.	
7439-92-1	Lead (Pb)	29.5	
7440-36-0	Antimony (Sb)	0.33	U
7439-95-4	Magnesium (Mg)	499.	
7440-38-2	Arsenic (As)	1.8	
7782-49-2	Selenium (Se)	0.33	U
7440-39-3	Barium (Ba)	13.1	
7440-41-7	Beryllium (Be)	0.23	U
7440-43-9	Cadmium (Cd)	0.19	J
7440-70-2	Calcium (Ca)	13100.	
7440-47-3	Chromium (Cr)	9.3	
7440-48-4	Cobalt (Co)	1.3	J
7440-50-8	Copper (Cu)	10.6	U
7439-89-6	Iron (Fe)	4860.	
7439-96-5	Manganese (Mn)	29.6	
7440-02-0	Nickel (Ni)	4.2	J
7440-09-7	Potassium (K)	240.	J
7440-22-4	Silver (Ag)	0.21	U
7440-23-5	Sodium (Na)	164.	U
7440-28-0	Thallium (Tl)	0.47	J
7440-31-5	Tin (Sn)	2.	U
7440-62-2	Vanadium (V)	10.6	
7440-66-6	Zinc (Zn)	66.8	

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW846-PEST

SAMPLE ID ------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	FDSSH02301
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/20/96
DATE ANALYZED --->	10/28/96
MATRIX ---------->	Soil
UNITS ----------->	UG/KG

CAS #	Parameter	27339	VAL
319-84-6	alpha-BHC	1.4	U
319-85-7	beta-BHC	1.4	U
319-86-8	delta-BHC	1.4	U
58-89-9	gamma-BHC (Lindane)	1.4	U
76-44-8	Heptachlor	5.3	J
309-00-2	Aldrin	1.4	U
1024-57-3	Heptachlor epoxide	1.4	U
959-98-8	Endosulfan I	1.4	U
60-57-1	Dieldrin	2.8	U
72-55-9	4,4'-DDE	2.8	U
72-20-8	Endrin	20.	
33213-65-9	Endosulfan II	2.8	U
72-54-8	4,4'-DDD	2.8	U
1031-07-8	Endosulfan sulfate	2.8	U
50-29-3	4,4'-DDT	11.	U
72-43-5	Methoxychlor	14.	U
53494-70-5	Endrin ketone	2.8	U
7421-93-4	Endrin aldehyde	2.8	U
5103-71-9	alpha-Chlordane	1.4	U
5103-74-2	gamma-Chlordane	3.4	
8001-35-2	Toxaphene	92.	U
12674-11-2	Aroclor-1016	37.	U
11104-28-2	Aroclor-1221	37.	U
11141-16-5	Aroclor-1232	37.	U
53469-21-9	Aroclor-1242	37.	U
12672-29-6	Aroclor-1248	37.	U
11097-69-1	Aroclor-1254	74.	U
11096-82-5	Aroclor-1260	170.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW846-SVOA

SAMPLE ID ------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/20/96
DATE ANALYZED --->	11/01/96
MATRIX ---------->	Soil
UNITS ---------->	UG/KG

CAS #	Parameter	27339	VAL
108-95-2	Phenol	1800.	U
111-44-4	bis(2-Chloroethyl)ether	1800.	U
95-57-8	2-Chlorophenol	1800.	U
541-73-1	1,3-Dichlorobenzene	1800.	U
106-46-7	1,4-Dichlorobenzene	1800.	U
100-51-6	Benzyl alcohol	1800.	U
95-50-1	1,2-Dichlorobenzene	1800.	U
95-48-7	2-Methylphenol (o-Cresol)	1800.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	1800.	U
106-44-5	4-Methylphenol (p-Cresol)	1800.	U
621-64-7	N-Nitroso-di-n-propylamine	1800.	U
67-72-1	Hexachloroethane	1800.	U
98-95-3	Nitrobenzene	1800.	U
78-59-1	Isophorone	1800.	U
88-75-5	2-Nitrophenol	1800.	U
105-67-9	2,4-Dimethylphenol	1800.	U
65-85-0	Benzoic acid	8900.	U
111-91-1	bis(2-Chloroethoxy)methane	1800.	U
120-83-2	2,4-Dichlorophenol	1800.	U
120-82-1	1,2,4-Trichlorobenzene	1800.	U
91-20-3	Naphthalene	1700.	J
106-47-8	4-Chloroaniline	1800.	U
87-68-3	Hexachlorobutadiene	1800.	U
59-50-7	4-Chloro-3-methylphenol	1800.	U
91-57-6	2-Methylnaphthalene	6800.	
77-47-4	Hexachlorocyclopentadiene	1800.	U
88-06-2	2,4,6-Trichlorophenol	1800.	U
95-95-4	2,4,5-Trichlorophenol	8900.	U
91-58-7	2-Chloronaphthalene	1800.	U
88-74-4	2-Nitroaniline	8900.	U
131-11-3	Dimethyl phthalate	1800.	U
208-96-8	Acenaphthylene	1800.	U
606-20-2	2,6-Dinitrotoluene	1800.	U
99-09-2	3-Nitroaniline	8900.	U
83-32-9	Acenaphthene	1800.	U
51-28-5	2,4-Dinitrophenol	8900.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW846-SVOA

SAMPLE ID ------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/20/96
DATE ANALYZED --->	11/01/96
MATRIX ---------->	Soil
UNITS ----------->	UG/KG

CAS #	Parameter	27339	VAL
100-02-7	4-Nitrophenol	8900.	U
132-64-9	Dibenzofuran	1800.	U
121-14-2	2,4-Dinitrotoluene	1800.	U
84-66-2	Diethylphthalate	1800.	U
7005-72-3	4-Chlorophenylphenylether	1800.	U
86-73-7	Fluorene	1900.	
100-01-6	4-Nitroaniline	8900.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	8900.	U
86-30-6	N-Nitrosodiphenylamine	1800.	U
101-55-3	4-Bromophenyl-phenylether	1800.	U
118-74-1	Hexachlorobenzene	1800.	U
87-86-5	Pentachlorophenol	8900.	U
85-01-8	Phenanthrene	1900.	
120-12-7	Anthracene	1800.	U
84-74-2	Di-n-butylphthalate	1800.	U
206-44-0	Fluoranthene	1800.	U
129-00-0	Pyrene	590.	J
85-68-7	Butylbenzylphthalate	1800.	U
91-94-1	3,3'-Dichlorobenzidine	3700.	U
56-55-3	Benzo(a)anthracene	1800.	U
218-01-9	Chrysene	240.	J
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	1800.	U
117-84-0	Di-n-octyl phthalate	1800.	U
205-99-2	Benzo(b)fluoranthene	1800.	U
207-08-9	Benzo(k)fluoranthene	1800.	U
50-32-8	Benzo(a)pyrene	1800.	U
193-39-5	Indeno(1,2,3-cd)pyrene	1800.	U
53-70-3	Dibenz(a,h)anthracene	1800.	U
191-24-2	Benzo(g,h,i)perylene	1800.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW846-VOA

SAMPLE ID ------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE ANALYZED --->	10/22/96
MATRIX ---------->	Soil
UNITS ----------->	UG/KG

CAS #	Parameter	27339	VAL
74-87-3	Chloromethane	56.	U
74-83-9	Bromomethane	56.	U
75-01-4	Vinyl chloride	56.	U
75-00-3	Chloroethane	56.	U
75-09-2	Methylene chloride	28.	U
67-64-1	Acetone	56.	U
75-15-0	Carbon disulfide	28.	U
75-35-4	1,1-Dichloroethene	28.	U
75-34-3	1,1-Dichloroethane	85.	J
540-59-0	1,2-Dichloroethene (total)	28.	U
67-66-3	Chloroform	28.	U
107-06-2	1,2-Dichloroethane	28.	U
78-93-3	2-Butanone (MEK)	56.	U
71-55-6	1,1,1-Trichloroethane	48.	J
56-23-5	Carbon tetrachloride	28.	U
75-27-4	Bromodichloromethane	28.	U
78-87-5	1,2-Dichloropropane	28.	U
10061-01-5	cis-1,3-Dichloropropene	28.	U
79-01-6	Trichloroethene	28.	U
124-48-1	Dibromochloromethane	28.	U
79-00-5	1,1,2-Trichloroethane	28.	U
71-43-2	Benzene	28.	U
10061-02-6	trans-1,3-Dichloropropene	28.	U
75-25-2	Bromoform	28.	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	56.	U
591-78-6	2-Hexanone	56.	UJ
127-18-4	Tetrachloroethene	13.	J
79-34-5	1,1,2,2-Tetrachloroethane	28.	UJ
108-88-3	Toluene	22.	J
108-90-7	Chlorobenzene	28.	UJ
100-41-4	Ethylbenzene	130.	J
100-42-5	Styrene	28.	UJ
1330-20-7	Xylene (Total)	1800.	J
108-05-4	Vinyl acetate	56.	UJ
110-75-8	2-Chloroethyl vinyl ether	56.	UR

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

TPH-DRO

SAMPLE ID -------->	FDS-S-H023-01
ORIGINAL ID ----->	FDSSH02301
LAB SAMPLE ID --->	27355.10
ID FROM REPORT -->	FDSSH02301
SAMPLE DATE ----->	10/17/96
DATE EXTRACTED -->	10/24/96
DATE ANALYZED --->	11/04/96
MATRIX ---------->	Soil
UNITS ---------->	MG/KG

CAS #	Parameter	27339	VAL
68334-30-5	Diesel	55.6	U
8008-20-6	Kerosene	55.6	U
9999000-35-1	JP-4 C6-C14	55.6	U
9999000-48-6	NAPHTHA C6-C12	55.6	U
68553-00-4	Fuel oil no. 6	55.6	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

TPH-GRO							
	SAMPLE ID ------->	FDS-S-H023-01					
	ORIGINAL ID ----->	FDSSH02301					
	LAB SAMPLE ID --->	FDSSH02301					
	ID FROM REPORT -->	FDSSH02301					
	SAMPLE DATE ----->	10/17/96					
	DATE ANALYZED --->	10/22/96					
	MATRIX ---------->	Soil					
	UNITS ---------->	UG/KG					
CAS #	Parameter	27339	VAL				
86290-81-5	Gasoline	501.	J				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

CYANIDE							
	SAMPLE ID ------->	FDS-S-H023-02					
	ORIGINAL ID ----->	FDSSH02302					
	LAB SAMPLE ID --->	40518.01					
	ID FROM REPORT -->	FDSSH02302					
	SAMPLE DATE ----->	09/30/99					
	DATE EXTRACTED -->	10/07/99					
	DATE ANALYZED --->	10/08/99					
	MATRIX ---------->	Soil					
	UNITS ---------->	MG/KG					
CAS #	Parameter	40518	VAL				
57-12-5	Cyanide (CN)	0.17	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW-META

SAMPLE ID -------->	FDS-S-H023-02
ORIGINAL ID ----->	FDSSH02302
LAB SAMPLE ID --->	40518.01
ID FROM REPORT -->	FDSSH02302
SAMPLE DATE ----->	09/30/99
DATE EXTRACTED -->	10/06/99
DATE ANALYZED --->	10/07/99
MATRIX ---------->	Soil
UNITS ---------->	MG/KG

CAS #	Parameter	40518	VAL
7439-97-6	Mercury (Hg)	0.05	J
7440-38-2	Arsenic (As)	2.4	J
7440-39-3	Barium (Ba)	31.3	
7440-43-9	Cadmium (Cd)	0.03	U
7440-47-3	Chromium (Cr)	13.5	
7439-92-1	Lead (Pb)	7.9	
7782-49-2	Selenium (Se)	0.51	J
7440-22-4	Silver (Ag)	0.14	U
7440-36-0	Antimony (Sb)	0.31	UJ
7440-41-7	Beryllium (Be)	0.31	J
7440-70-2	Calcium (Ca)	1220.	
7440-48-4	Cobalt (Co)	1.5	J
7440-50-8	Copper (Cu)	2.4	
7439-89-6	Iron (Fe)	10500.	
7439-95-4	Magnesium (Mg)	646.	
7439-96-5	Manganese (Mn)	34.3	J
7440-02-0	Nickel (Ni)	2.9	J
7440-09-7	Potassium (K)	321.	
7440-23-5	Sodium (Na)	249.	J
7440-28-0	Thallium (Tl)	0.4	U
7440-62-2	Vanadium (V)	16.1	
7440-66-6	Zinc (Zn)	14.8	
7440-31-5	Tin (Sn)	4.9	U
7429-90-5	Aluminum (Al)	6950.	

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW-SVOA

SAMPLE ID ------->	FDS-S-H023-02
ORIGINAL ID ----->	FDSSH02302
LAB SAMPLE ID --->	40518.01
ID FROM REPORT -->	FDSSH02302
SAMPLE DATE ----->	09/30/99
DATE EXTRACTED -->	10/11/99
DATE ANALYZED --->	10/12/99
MATRIX ---------->	Soil
UNITS ----------->	UG/KG

CAS #	Parameter	40518	VAL
108-95-2	Phenol	380.	U
111-44-4	bis(2-Chloroethyl)ether	380.	U
95-57-8	2-Chlorophenol	380.	U
541-73-1	1,3-Dichlorobenzene	380.	U
106-46-7	1,4-Dichlorobenzene	380.	U
100-51-6	Benzyl alcohol	380.	U
95-50-1	1,2-Dichlorobenzene	380.	U
95-48-7	2-Methylphenol (o-Cresol)	380.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	380.	U
106-44-5	4-Methylphenol (p-Cresol)	380.	U
621-64-7	N-Nitroso-di-n-propylamine	380.	U
67-72-1	Hexachloroethane	380.	U
98-95-3	Nitrobenzene	380.	U
78-59-1	Isophorone	380.	U
88-75-5	2-Nitrophenol	380.	U
105-67-9	2,4-Dimethylphenol	380.	U
65-85-0	Benzoic acid	380.	U
111-91-1	bis(2-Chloroethoxy)methane	380.	U
120-83-2	2,4-Dichlorophenol	380.	U
120-82-1	1,2,4-Trichlorobenzene	380.	U
91-20-3	Naphthalene	380.	U
106-47-8	4-Chloroaniline	380.	U
87-68-3	Hexachlorobutadiene	380.	U
59-50-7	4-Chloro-3-methylphenol	380.	U
91-57-6	2-Methylnaphthalene	380.	U
77-47-4	Hexachlorocyclopentadiene	380.	U
88-06-2	2,4,6-Trichlorophenol	380.	U
95-95-4	2,4,5-Trichlorophenol	950.	U
91-58-7	2-Chloronaphthalene	380.	U
88-74-4	2-Nitroaniline	950.	U
131-11-3	Dimethyl phthalate	380.	U
208-96-8	Acenaphthylene	380.	U
99-09-2	3-Nitroaniline	950.	U
83-32-9	Acenaphthene	380.	U
51-28-5	2,4-Dinitrophenol	950.	UR
100-02-7	4-Nitrophenol	950.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW-SVOA

SAMPLE ID ------->	FDS-S-H023-02
ORIGINAL ID ----->	FDSSH02302
LAB SAMPLE ID --->	40518.01
ID FROM REPORT -->	FDSSH02302
SAMPLE DATE ----->	09/30/99
DATE EXTRACTED -->	10/11/99
DATE ANALYZED --->	10/12/99
MATRIX ---------->	Soil
UNITS ----------->	UG/KG

CAS #	Parameter	40518	VAL
132-64-9	Dibenzofuran	380.	U
121-14-2	2,4-Dinitrotoluene	380.	U
606-20-2	2,6-Dinitrotoluene	380.	U
84-66-2	Diethylphthalate	380.	U
7005-72-3	4-Chlorophenylphenylether	380.	U
86-73-7	Fluorene	380.	U
100-01-6	4-Nitroaniline	950.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	950.	UR
86-30-6	N-Nitrosodiphenylamine	380.	U
101-55-3	4-Bromophenyl-phenylether	380.	U
118-74-1	Hexachlorobenzene	380.	U
87-86-5	Pentachlorophenol	950.	U
85-01-8	Phenanthrene	380.	U
120-12-7	Anthracene	380.	U
84-74-2	Di-n-butylphthalate	380.	U
206-44-0	Fluoranthene	380.	U
129-00-0	Pyrene	380.	U
85-68-7	Butylbenzylphthalate	380.	U
91-94-1	3,3'-Dichlorobenzidine	380.	U
56-55-3	Benzo(a)anthracene	380.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	380.	U
218-01-9	Chrysene	380.	U
117-84-0	Di-n-octyl phthalate	380.	U
205-99-2	Benzo(b)fluoranthene	380.	U
207-08-9	Benzo(k)fluoranthene	380.	U
50-32-8	Benzo(a)pyrene	380.	U
193-39-5	Indeno(1,2,3-cd)pyrene	380.	U
53-70-3	Dibenz(a,h)anthracene	380.	U
191-24-2	Benzo(g,h,i)perylene	380.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW-VOA			
	SAMPLE ID ------->	FDS-S-H023-02	
	ORIGINAL ID ----->	FDSSH02302	
	LAB SAMPLE ID --->	40518.01	
	ID FROM REPORT -->	FDSSH02302	
	SAMPLE DATE ----->	09/30/99	
	DATE ANALYZED --->	10/08/99	
	MATRIX ---------->	Soil	
	UNITS ---------->	UG/KG	

CAS #	Parameter	40518	VAL
71-43-2	Benzene	2.	J
100-41-4	Ethylbenzene	7.	U
108-88-3	Toluene	7.	U
1330-20-7	Xylene (Total)	7.	U
74-87-3	Chloromethane	7.	U
74-83-9	Bromomethane	7.	U
75-01-4	Vinyl chloride	7.	U
75-00-3	Chloroethane	7.	U
75-09-2	Methylene chloride	7.	U
67-64-1	Acetone	7.	U
75-15-0	Carbon disulfide	7.	U
75-35-4	1,1-Dichloroethene	7.	U
75-34-3	1,1-Dichloroethane	7.	U
540-59-0	1,2-Dichloroethene (total)	7.	U
67-66-3	Chloroform	7.	U
107-06-2	1,2-Dichloroethane	7.	U
78-93-3	2-Butanone (MEK)	7.	U
71-55-6	1,1,1-Trichloroethane	7.	U
56-23-5	Carbon tetrachloride	7.	U
108-05-4	Vinyl acetate	7.	U
75-27-4	Bromodichloromethane	7.	U
78-87-5	1,2-Dichloropropane	7.	U
10061-01-5	cis-1,3-Dichloropropene	7.	U
79-01-6	Trichloroethene	7.	U
124-48-1	Dibromochloromethane	7.	U
79-00-5	1,1,2-Trichloroethane	7.	U
10061-02-6	trans-1,3-Dichloropropene	7.	U
75-25-2	Bromoform	7.	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	7.	U
591-78-6	2-Hexanone	7.	U
127-18-4	Tetrachloroethene	7.	U
79-34-5	1,1,2,2-Tetrachloroethane	7.	U
108-90-7	Chlorobenzene	7.	U
100-42-5	Styrene	7.	U
110-75-8	2-Chloroethyl vinyl ether	7.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 SOIL SAMPLE RESULTS

SW846-PEST

SAMPLE ID ------->	FDS-S-H023-02
ORIGINAL ID ----->	FDSSH02302
LAB SAMPLE ID --->	40518.01
ID FROM REPORT -->	FDSSH02302
SAMPLE DATE ----->	09/30/99
DATE EXTRACTED -->	10/03/99
DATE ANALYZED --->	10/05/99
MATRIX ---------->	Soil
UNITS ---------->	UG/KG

CAS #	Parameter	40518	VAL
12674-11-2	Aroclor-1016	39.	U
11104-28-2	Aroclor-1221	39.	U
11141-16-5	Aroclor-1232	39.	U
53469-21-9	Aroclor-1242	39.	U
12672-29-6	Aroclor-1248	39.	U
11097-69-1	Aroclor-1254	39.	U
11096-82-5	Aroclor-1260	53.	
319-84-6	alpha-BHC	1.5	U
319-85-7	beta-BHC	1.5	U
319-86-8	delta-BHC	1.5	U
58-89-9	gamma-BHC (Lindane)	1.5	U
76-44-8	Heptachlor	1.5	U
309-00-2	Aldrin	1.5	U
1024-57-3	Heptachlor epoxide	2.8	U
959-98-8	Endosulfan I	1.5	U
60-57-1	Dieldrin	3.	U
72-55-9	4,4'-DDE	12.	
72-20-8	Endrin	3.	U
33213-65-9	Endosulfan II	3.	U
72-54-8	4,4'-DDD	3.	U
1031-07-8	Endosulfan sulfate	3.	U
50-29-3	4,4'-DDT	3.	U
7421-93-4	Endrin aldehyde	3.	U
72-43-5	Methoxychlor	15.	U
5103-71-9	alpha-Chlordane	1.5	U
5103-74-2	gamma-Chlordane	3.2	
8001-35-2	Toxaphene	99.	U
53494-70-5	Endrin ketone	3.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 GROUNDWATER SAMPLE RESULTS

CYANIDE											
	SAMPLE ID ------->	FDS-G-W15A-01		FDS-G-W15B-01		FDS-G-W15C-01					
	ORIGINAL ID ----->	FDSGW15A01		FDSGW15B01		FDSGW15C01					
	LAB SAMPLE ID --->	28308.01		28308.02		28308.03					
	ID FROM REPORT -->	FDSGW15A01		FDSGW15B01		FDSGW15C01					
	SAMPLE DATE ----->	01/28/97		01/28/97		01/28/97					
	DATE EXTRACTED -->	01/31/97		01/31/97		01/31/97					
	DATE ANALYZED --->	02/01/97		02/01/97		02/01/97					
	MATRIX ---------->	Water		Water		Water					
	UNITS ---------->	UG/L		UG/L		UG/L					
CAS #	Parameter	28308	VAL	28308	VAL	28308	VAL				
57-12-5	Cyanide (CN)	3.	J	7.	J	2.	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 GROUNDWATER SAMPLE RESULTS

SW846-META													
	SAMPLE ID ------->	FDS-G-W15A-01		FDS-G-W15A-02		FDS-G-W15B-01		FDS-G-W15B-02		FDS-G-W15C-01		FDS-G-W15C-02	
	ORIGINAL ID ----->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	LAB SAMPLE ID --->	28308.01		29707.04		28308.02		29730.06		28308.03		29730.07	
	ID FROM REPORT -->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	SAMPLE DATE ----->	01/28/97		06/13/97		01/28/97		06/16/97		01/28/97		06/16/97	
	DATE EXTRACTED -->	01/31/97		06/20/97		01/31/97		06/20/97		01/31/97		06/20/97	
	DATE ANALYZED --->	01/31/97		07/02/97		01/31/97		07/02/97		01/31/97		07/02/97	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	28308	VAL	29707	VAL	28308	VAL	29707	VAL	28308	VAL	29707	VAL
7429-90-5	Aluminum (Al)	100.	J	503.		3010.		209.		962.		474.	
7440-36-0	Antimony (Sb)	2.1	U	1.6	U	2.1	U	1.6	U	3.5	J	1.6	U
7440-38-2	Arsenic (As)	19.4		26.7		4.1	J	4.6	J	2.5	U	2.1	U
7440-39-3	Barium (Ba)	55.2	J	94.5		68.6	J	70.6		159.	J	153.	
7440-41-7	Beryllium (Be)	0.34	U	0.35	U	0.59	U	0.29	U	0.59	U	0.42	U
7440-43-9	Cadmium (Cd)	0.5	U	0.3	U	0.5	U	0.3	U	0.5	U	0.3	U
7440-70-2	Calcium (Ca)	126000.	J	235000.		98800.	J	119000.		268000.	J	284000.	
7440-47-3	Chromium (Cr)	0.92	J	1.5	J	4.7	J	1.	U	1.9	J	1.	U
7440-48-4	Cobalt (Co)	0.9	U	0.8	U	8.1	J	6.8	J	1.3	J	0.8	U
7440-50-8	Copper (Cu)	3.6	J	1.4	U	1.2	U	1.4	U	0.6	U	1.4	U
7439-89-6	Iron (Fe)	4920.	J	6620.		2060.	J	675.		1920.	J	3040.	
7439-92-1	Lead (Pb)	1.7	U	0.9	U	1.7	U	0.9	U	1.7	U	0.9	U
7439-95-4	Magnesium (Mg)	12200.	J	15800.		26200.	J	22800.		19300.	J	14000.	
7439-96-5	Manganese (Mn)	721.	J	515.		1050.	J	813.		806.	J	465.	
7439-97-6	Mercury (Hg)	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
7440-02-0	Nickel (Ni)	3.7	J	0.84	J	3.2	J	1.6	J	1.7	J	0.9	J
7440-09-7	Potassium (K)	10800.		5130.		7410.		8050.		3440.	J	3450.	J
7782-49-2	Selenium (Se)	2.8	U	3.4	U	2.8	U	3.4	U	2.8	U	3.4	U
7440-22-4	Silver (Ag)	1.2	U	1.	U	1.2	U	1.	U	1.2	U	1.	U
7440-23-5	Sodium (Na)	78300.		157000.		92400.		158000.		117000.		114000.	
7440-28-0	Thallium (Tl)	2.7	U	5.3	U	2.7	U	5.1	U	3.3	J	5.7	U
7440-31-5	Tin (Sn)	2.6	U	14.	U	2.6	U	14.	U	2.6	U	14.	U
7440-62-2	Vanadium (V)	1.3	J	1.6	J	6.	J	1.1	J	1.9	J	1.6	J
7440-66-6	Zinc (Zn)	35.6	U	5.8	U	7.1	U	11.9	U	5.3	U	9.8	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 GROUNDWATER SAMPLE RESULTS

SW846-PEST													
	SAMPLE ID ------->	FDS-G-W15A-01		FDS-G-W15A-02		FDS-G-W15B-01		FDS-G-W15B-02		FDS-G-W15C-01		FDS-G-W15C-02	
	ORIGINAL ID ----->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	LAB SAMPLE ID --->	28308.01		29707.04		28308.02		29730.06		28308.03		29730.07	
	ID FROM REPORT -->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	SAMPLE DATE ----->	01/28/97		06/13/97		01/28/97		06/16/97		01/28/97		06/16/97	
	DATE EXTRACTED -->	01/29/97		06/16/97		01/29/97		06/18/97		01/29/97		06/18/97	
	DATE ANALYZED --->	01/31/97		06/19/97		01/31/97		06/20/97		01/31/97		06/20/97	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	28308	VAL	29707	VAL	28308	VAL	29707	VAL	28308	VAL	29707	VAL
319-84-6	alpha-BHC	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
319-85-7	beta-BHC	0.057	J	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
319-86-8	delta-BHC	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
58-89-9	gamma-BHC (Lindane)	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
76-44-8	Heptachlor	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
309-00-2	Aldrin	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
1024-57-3	Heptachlor epoxide	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
959-98-8	Endosulfan I	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
60-57-1	Dieldrin	0.08	UJ	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
72-55-9	4,4'-DDE	0.08	UJ	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
72-20-8	Endrin	0.08	UJ	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
33213-65-9	Endosulfan II	0.08	UJ	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
72-54-8	4,4'-DDD	0.08	UJ	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
1031-07-8	Endosulfan sulfate	0.08	UJ	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
50-29-3	4,4'-DDT	0.08	UJ	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
72-43-5	Methoxychlor	0.38	UJ	0.38	U	0.38	U	0.38	U	0.38	U	0.38	U
53494-70-5	Endrin ketone	0.08	UJ	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
7421-93-4	Endrin aldehyde	0.08	UJ	0.08	U	0.08	U	0.08	U	0.08	U	0.08	U
5103-71-9	alpha-Chlordane	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
5103-74-2	gamma-Chlordane	0.04	UJ	0.04	U	0.04	U	0.04	U	0.04	U	0.04	U
8001-35-2	Toxaphene	2.5	UJ	2.5	U	2.5	U	2.5	U	2.5	U	2.5	U
12674-11-2	Aroclor-1016	1.	UJ	1.	U	1.	U	1.	U	1.	U	1.	U
11104-28-2	Aroclor-1221	1.	UJ	1.	U	1.	U	1.	U	1.	U	1.	U
11141-16-5	Aroclor-1232	1.	UJ	1.	U	1.	U	1.	U	1.	U	1.	U
53469-21-9	Aroclor-1242	1.	UJ	1.	U	1.	U	1.	U	1.	U	1.	U
12672-29-6	Aroclor-1248	1.	UJ	1.	U	1.	U	1.	U	1.	U	1.	U
11097-69-1	Aroclor-1254	2.	UJ	2.	U	2.	U	2.	U	2.	U	2.	U
11096-82-5	Aroclor-1260	2.	UJ	2.	U	2.	U	2.	U	2.	U	2.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 GROUNDWATER SAMPLE RESULTS

SW846-SVOA													
	SAMPLE ID ------->	FDS-G-W15A-01		FDS-G-W15A-02		FDS-G-W15B-01		FDS-G-W15B-02		FDS-G-W15C-01		FDS-G-W15C-02	
	ORIGINAL ID ----->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	LAB SAMPLE ID --->	28308.01		29707.04		28308.02		29730.06		28308.03		29730.07	
	ID FROM REPORT -->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	SAMPLE DATE ----->	01/28/97		06/13/97		01/28/97		06/16/97		01/28/97		06/16/97	
	DATE EXTRACTED -->	01/29/97		06/16/97		01/29/97		06/18/97		01/29/97		06/18/97	
	DATE ANALYZED --->	01/31/97		06/23/97		01/30/97		06/25/97		01/30/97		06/25/97	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	28308	VAL	29707	VAL	28308	VAL	29707	VAL	28308	VAL	29707	VAL
108-95-2	Phenol	1.	J	10.	U	10.	U	12.	U	10.	U	12.	U
111-44-4	bis(2-Chloroethyl)ether	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
95-57-8	2-Chlorophenol	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
541-73-1	1,3-Dichlorobenzene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
106-46-7	1,4-Dichlorobenzene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
100-51-6	Benzyl alcohol	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
95-50-1	1,2-Dichlorobenzene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
95-48-7	2-Methylphenol (o-Cresol)	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
106-44-5	4-Methylphenol (p-Cresol)	23.		2.	J	10.	U	12.	U	10.	U	12.	U
621-64-7	N-Nitroso-di-n-propylamine	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
67-72-1	Hexachloroethane	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
98-95-3	Nitrobenzene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
78-59-1	Isophorone	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
88-75-5	2-Nitrophenol	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
105-67-9	2,4-Dimethylphenol	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
65-85-0	Benzoic acid	6.	J	50.	U	50.	U	62.	U	50.	U	60.	U
111-91-1	bis(2-Chloroethoxy)methane	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
120-83-2	2,4-Dichlorophenol	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
120-82-1	1,2,4-Trichlorobenzene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
91-20-3	Naphthalene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
106-47-8	4-Chloroaniline	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
87-68-3	Hexachlorobutadiene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
59-50-7	4-Chloro-3-methylphenol	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
91-57-6	2-Methylnaphthalene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
77-47-4	Hexachlorocyclopentadiene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
88-06-2	2,4,6-Trichlorophenol	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
95-95-4	2,4,5-Trichlorophenol	50.	U	50.	U	50.	U	62.	U	50.	U	60.	U
91-58-7	2-Chloronaphthalene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
88-74-4	2-Nitroaniline	50.	U	50.	U	50.	U	62.	U	50.	U	60.	U
131-11-3	Dimethyl phthalate	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
208-96-8	Acenaphthylene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
606-20-2	2,6-Dinitrotoluene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
99-09-2	3-Nitroaniline	50.	U	50.	U	50.	U	62.	U	50.	U	60.	U
83-32-9	Acenaphthene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
51-28-5	2,4-Dinitrophenol	50.	U	50.	U	50.	U	62.	U	50.	U	60.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 GROUNDWATER SAMPLE RESULTS

SW846-SVOA													
	SAMPLE ID ------->	FDS-G-W15A-01		FDS-G-W15A-02		FDS-G-W15B-01		FDS-G-W15B-02		FDS-G-W15C-01		FDS-G-W15C-02	
	ORIGINAL ID ----->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	LAB SAMPLE ID --->	28308.01		29707.04		28308.02		29730.06		28308.03		29730.07	
	ID FROM REPORT -->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	SAMPLE DATE ----->	01/28/97		06/13/97		01/28/97		06/16/97		01/28/97		06/16/97	
	DATE EXTRACTED -->	01/29/97		06/16/97		01/29/97		06/18/97		01/29/97		06/18/97	
	DATE ANALYZED --->	01/31/97		06/23/97		01/30/97		06/25/97		01/30/97		06/25/97	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	28308	VAL	29707	VAL	28308	VAL	29707	VAL	28308	VAL	29707	VAL
100-02-7	4-Nitrophenol	50.	U	50.	U	50.	U	62.	U	50.	U	60.	U
132-64-9	Dibenzofuran	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
121-14-2	2,4-Dinitrotoluene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
84-66-2	Diethylphthalate	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
7005-72-3	4-Chlorophenylphenylether	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
86-73-7	Fluorene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
100-01-6	4-Nitroaniline	50.	U	50.	U	50.	U	62.	U	50.	U	60.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	50.	U	50.	U	50.	U	62.	U	50.	U	60.	U
86-30-6	N-Nitrosodiphenylamine	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
101-55-3	4-Bromophenyl-phenylether	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
118-74-1	Hexachlorobenzene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
87-86-5	Pentachlorophenol	50.	U	50.	U	50.	U	62.	U	50.	U	60.	U
85-01-8	Phenanthrene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
120-12-7	Anthracene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
84-74-2	Di-n-butylphthalate	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
206-44-0	Fluoranthene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
129-00-0	Pyrene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
85-68-7	Butylbenzylphthalate	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
91-94-1	3,3'-Dichlorobenzidine	20.	U	20.	U	20.	U	25.	U	20.	U	24.	U
56-55-3	Benzo(a)anthracene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
218-01-9	Chrysene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
117-84-0	Di-n-octyl phthalate	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
50-32-8	Benzo(a)pyrene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
53-70-3	Dibenz(a,h)anthracene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U
191-24-2	Benzo(g,h,i)perylene	10.	U	10.	U	10.	U	12.	U	10.	U	12.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
LETTER REPORT
AREA 15 GROUNDWATER SAMPLE RESULTS

SW846-VOA													
	SAMPLE ID ------->	FDS-G-W15A-01		FDS-G-W15A-02		FDS-G-W15B-01		FDS-G-W15B-02		FDS-G-W15C-01		FDS-G-W15C-02	
	ORIGINAL ID ----->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	LAB SAMPLE ID --->	28308.01		29707.04		28308.02		29730.06		28308.03		29730.07	
	ID FROM REPORT -->	FDSGW15A01		FDSGW15A02		FDSGW15B01		FDSGW15B02		FDSGW15C01		FDSGW15C02	
	SAMPLE DATE ----->	01/28/97		06/13/97		01/28/97		06/16/97		01/28/97		06/16/97	
	DATE ANALYZED --->	01/30/97		06/17/97		01/30/97		06/19/97		01/30/97		06/19/97	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	28308	VAL	29707	VAL	28308	VAL	29707	VAL	28308	VAL	29707	VAL
74-87-3	Chloromethane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
74-83-9	Bromomethane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
75-01-4	Vinyl chloride	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
75-00-3	Chloroethane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
75-09-2	Methylene chloride	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
67-64-1	Acetone	13.	U	10.	U	10.	U	10.	U	10.	U	10.	U
75-15-0	Carbon disulfide	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
75-35-4	1,1-Dichloroethene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
75-34-3	1,1-Dichloroethane	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
540-59-0	1,2-Dichloroethene (total)	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
67-66-3	Chloroform	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
107-06-2	1,2-Dichloroethane	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
78-93-3	2-Butanone (MEK)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
71-55-6	1,1,1-Trichloroethane	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
56-23-5	Carbon tetrachloride	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
75-27-4	Bromodichloromethane	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
78-87-5	1,2-Dichloropropane	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
10061-01-5	cis-1,3-Dichloropropene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
79-01-6	Trichloroethene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
124-48-1	Dibromochloromethane	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
79-00-5	1,1,2-Trichloroethane	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
71-43-2	Benzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
10061-02-6	trans-1,3-Dichloropropene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
75-25-2	Bromoform	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
108-10-1	4-Methyl-2-Pentanone (MIBK)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
591-78-6	2-Hexanone	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
127-18-4	Tetrachloroethene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
79-34-5	1,1,2,2-Tetrachloroethane	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
108-88-3	Toluene	3.	J	5.	U	5.	U	5.	U	5.	U	5.	U
108-90-7	Chlorobenzene	6.		5.	U	5.	U	5.	U	5.	U	5.	U
100-41-4	Ethylbenzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
100-42-5	Styrene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
1330-20-7	Xylene (Total)	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
108-05-4	Vinyl acetate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
110-75-8	2-Chloroethyl vinyl ether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U

*** Validation Complete ***

ENSAFE

ENSAFE INC. ENVIRONMENTAL AND MANAGEMENT CONSULTANTS

201 North Palafox Street, Suite 200 • Pensacola, FL 32501 • Telephone 850-434-2230 • Facsimile 850-434-2288 • www.ensafe.com

October 1, 1999

Commanding Officer
ATTN: Mr. Gabriel L. Magwood, Code 1849
Naval Facilities Engineering Command
Southern Division
2155 Eagle Drive
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Fuel Distribution System, Area 18, Charleston Naval Complex, South Carolina (SCDHEC No. 01188)

Dear Mr. Magwood:

This final letter report supplements the Fuel Distribution System (FDS) Contamination Assessment Report (CAR) dated September 10, 1998. This letter report incorporates the results of follow-on investigative activities performed in response to SCDHEC comments concerning Area 18.

In accordance with the Statement of Work, two copies of this report are attached. Two copies are also being sent to Paul Bristol of the South Carolina Department of Health and Environmental Control.

Should you have any questions or concerns regarding this submittal, please contact me.

Sincerely,

EnSafe Inc.

Craig R. Smith

Attachment

cc: T. Haverkost, EnSafe - Charleston
0144 File

Area 18

(SCDHEC No. 01188)

Background

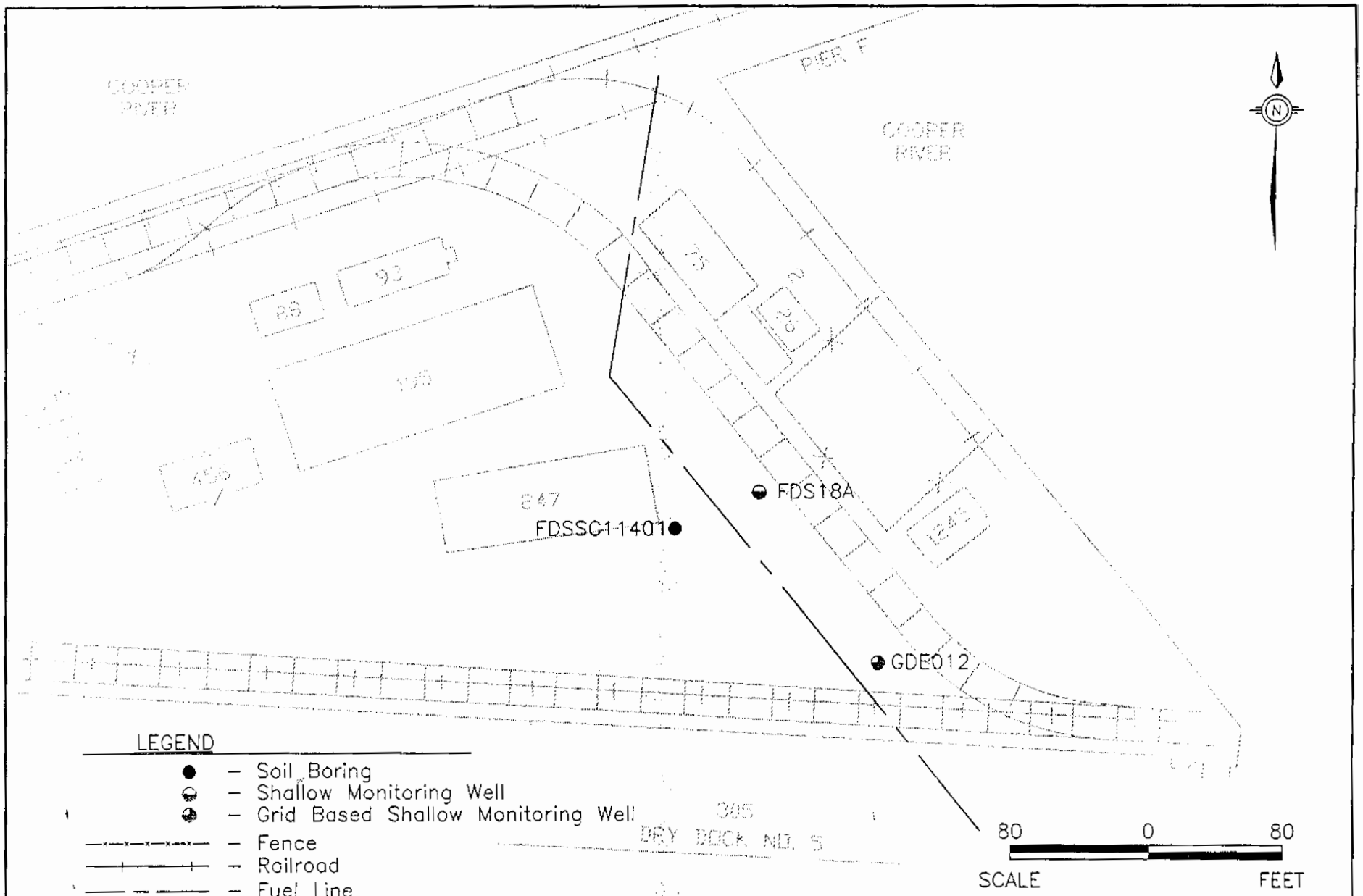
Area 18 of the Fuel Distribution System (FDS) is associated with Phase I soil sample FDSSC11401, which exhibited total petroleum hydrocarbons-diesel range organics of 366 milligrams per kilogram (mg/kg), which prompted Phase II soil and groundwater sampling within Area 18. Phase II soil sampling revealed that no risk-based screening levels (RBSLs) were exceeded. Phase II also included installation and sampling of monitoring well FDS18A. Groundwater analytical results identified no exceedances of RBSL chemicals of concern. The only constituent of interest at Area 18 was pentachlorophenol (PCP), which was detected above its USEPA tap water risk-based concentration (RBC) at FDS18A during the second sampling event only (*Contamination Assessment Report* [CAR], EnSafe 1998). Figure 1 shows the sample locations at Area 18.

Follow-on Activities

Because no petroleum chemicals of concern were exceeded at monitoring well FDS18A or in the soil sample FDSSC11401, the CAR recommended no further action for soil and groundwater at Area 18. The South Carolina Department of Health and Environmental Control recommended resampling of FDS18A for semi-volatile organic compounds (SVOCs) including PCP. This sampling effort was completed in March 1999.

Results

Monitoring well FDS18A was resampled in March 1999 for SVOCs and PCP. No organic compounds were detected in this sample. Attachment A contains the analytical results from the post-CAR sampling.



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREA 18
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907R001

Conclusions and Recommendations

Because no soil or groundwater RBSLs were exceeded at Area 18 and PCP was not detected in the follow-on groundwater sample, no further action is recommended for soil and groundwater at Area 18.

Attachment A
Analytical Data

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST CAR GROUNDWATER SAMPLING
AREA 18

SVOA+PCP

SAMPLE ID ------->	FDS-G-W18A-03
ORIGINAL ID ----->	FDSGW18A03
LAB SAMPLE ID --->	37648.05
ID FROM REPORT -->	FDSGW18A03
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/08/99
DATE ANALYZED --->	03/15/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
91-20-3	Naphthalene	10.	U
56-55-3	Benzo(a)anthracene	10.	U
218-01-9	Chrysene	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U
87-86-5	Pentachlorophenol	25.	U

*** Validation Complete ***

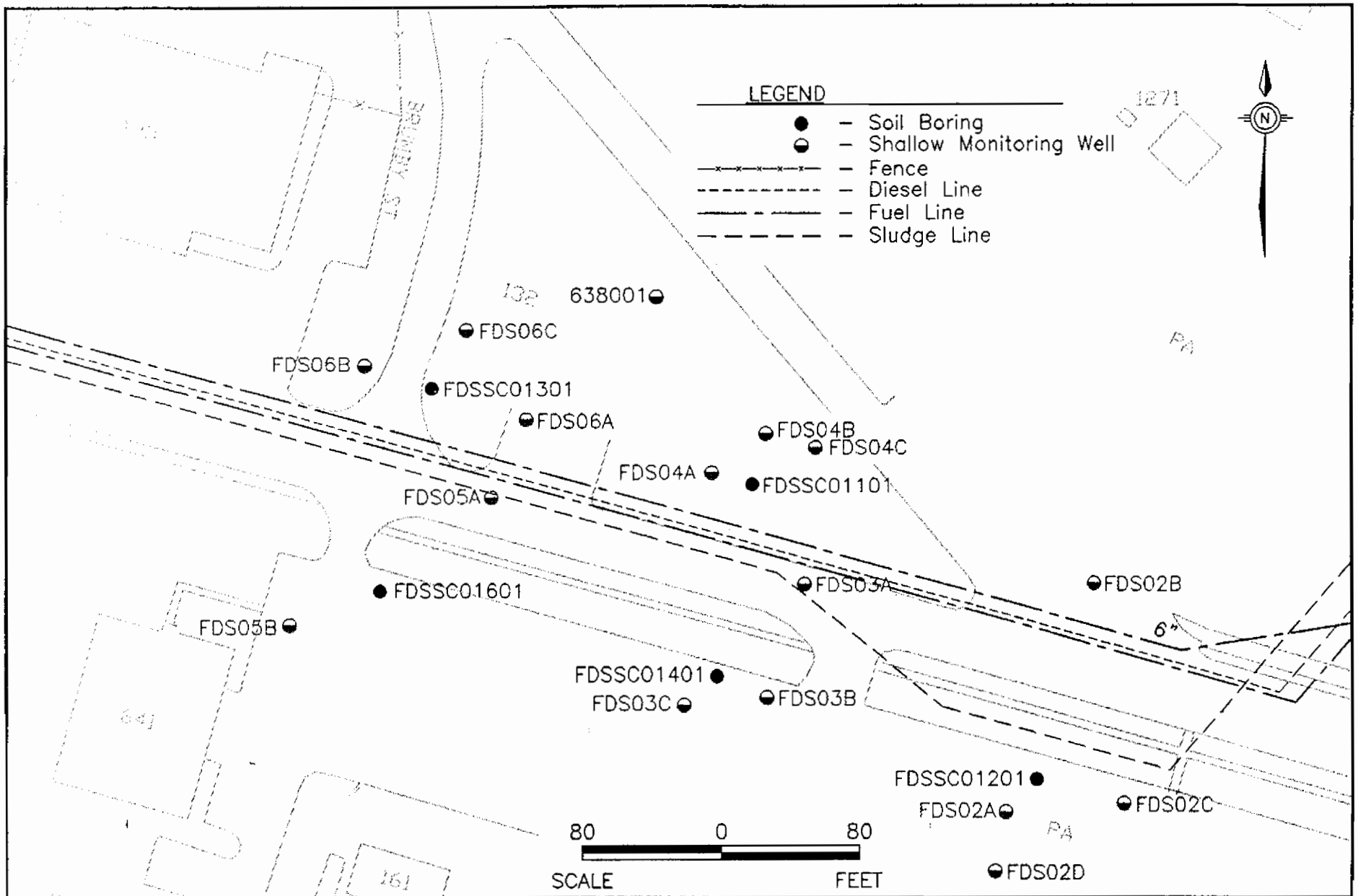
Areas 2, 3, 4, 5, and 6
(SCDHEC No. 01181)

Background

The combined Areas 2, 3, 4, 5, and 6 of the Fuel Distribution System (FDS) are associated with Phase I soil samples FDSSC01101 through FDSSC01401, and FDSSC01601. As reported in the *FDS Contamination Assessment Report (CAR),* these samples exhibited total petroleum hydrocarbons-gasoline range organics ranging from 61.8 micrograms per kilogram (μg/kg) at FDSSC01101 to 124,000 μg/kg at FDSSC01301. These Phase I soil results prompted subsequent Phase II soil and groundwater sampling at the combined areas. Phase II soil sampling revealed chemicals of concern (COCs) for the soil. Benzene was detected at 100 μg/kg at sample FDSSC01201 which exceeded the risk-based screening level (RBSL) of 5 μg/kg. Total naphthalenes of 159,000 μg/kg and 5,490 μg/kg at FDSSC01201 and FDSSC01301, respectively, exceeded the RBSL of 210 μg/kg. To determine if groundwater has been adversely impacted by these petroleum COCs, 14 shallow groundwater monitoring wells were installed and sampled in the combined areas during Phase II. Data from nearby well 638001 were also incorporated into the investigation. The Phase II groundwater investigation revealed the RBSL for total polycyclic aromatic hydrocarbons (PAHs) was exceeded at well FDS06B during both the first and second sampling events, while the RBSL for 2-methylnaphthalene was exceeded at this well during the first event (CAR, EnSafe 1998). Figure 1 depicts the Areas 2, 3, 4, 5, and 6 sample locations.

Follow-on Activities

The FDS CAR recommended and South Carolina Department of Health and Environmental Control (SCDHEC) concurred that removal/remediation of the soil at FDSSC012 was necessary to mitigate the threat of benzene and naphthalene leaching to groundwater at this location. To fill a potential data gap at Areas 2, 3, 4, 5, and 6, the FDS CAR also recommended installation of a monitoring well downgradient of FDSSC012 to determine if these COCs were leaching to



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREAS 2, 3, 4, 5, AND 6
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907N003

groundwater. Monitoring well FDS02D was installed downgradient from FDSSC012 in February, 1999, and all area wells were resampled for RBSL parameters in March 1999. Figure 1 depicts the combined Areas 2, 3, 4, 5, and 6 sample locations, including the location of the new well. Attachment A contains the monitoring well construction diagram and well development record for the new well, FDS02D. The FDS CAR contains the boring logs and development records for the previously installed wells in the combined area.

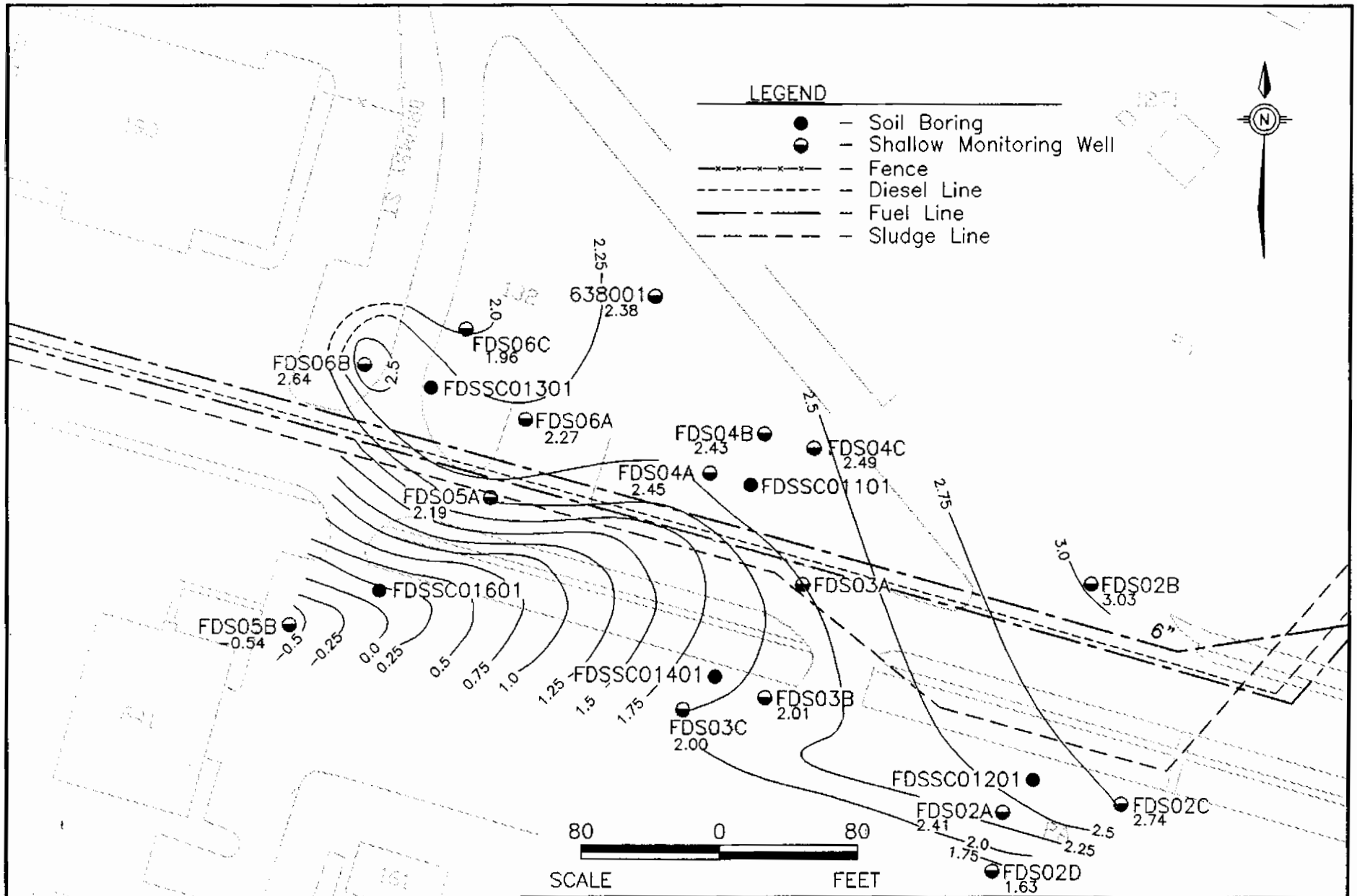
Results

Figure 2 presents the shallow groundwater piezometric surface at Areas 2, 3, 4, 5, and 6 as measured in March 1999 at low-tide. Groundwater flow is generally to the southwest near FDS05B and the south southwest near FDS02D, which is similar to the low-tide flow direction shown in the CAR (EnSafe 1998). This flow regime places the new well directly downgradient from the area of contaminated soil.

Analytes detected in shallow groundwater at Areas 2, 3, 4, 5, and 6 during the post-CAR sampling are summarized in Table 1. These most recent results revealed no detections of volatile organic compounds (VOCs). The only semivolatile organic compounds (SVOCs) detected were benzo(k)fluoranthene at 0.9 micrograms per liter (μg/L) and benzo(b)fluoranthene at 0.9 μg/L, detected in well FDS06C. Both concentrations were below their individual RBSLs of 10 μg/L. These concentrations contributed to a total PAH concentration of 1.80 μg/L, at FDS06C. Four inorganics were also present at concentrations below their respective RBSLs. Attachment B contains the analytical data from the post-CAR sampling. The FDS CAR contains the analytical data from all previous sampling at the combined areas.

Conclusions and Recommendations

As reported in the CAR, the benzene concentration detected in Phase I soil sample FDSSC01201 was 100 μg/kg, which exceeds the RBSL of 5 μg/kg. The concentration of total naphthalenes at



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 2
AREAS 2, 3, 4, 5, AND 6
SHALLOW GROUNDWATER
PIEZOMETRIC MAP

DWG DATE: 09/30/99 | DWG NAME: 2907R007

Table 1
Analytes Detected in Shallow Groundwater
Post-CAR Sampling, Areas 2, 3, 4, 5, and 6
Fuel Distribution System

Parameters	Location	Sample Results	RBSL (μg/L)	Exceeds RBSL
Organics (μg/L)				
Total PAHs	FDS06C	1.8	25	No
Benzo(b)fluoranthene	FDS06C	0.9	10	No
Benzo(k)fluoranthene	FDS06C	0.9	10	No
Inorganics (μg/L)				
Arsenic (As)	FDS02A	3.1	50	No
	FDS02C	6.2		No
	FDS02D	11.2		No
	FDS03B	3.5		No
	FDS03C	3.4		No
	FDS05A	3.4		No
	FDS06A	6.6		No
	FDS06C	24.3		No
Barium (Ba)	FDS02A	140	2,000	No
	FDS02B	46.2		No
	FDS02C	25.2		No
	FDS02D	84.9		No
	FDS03A	28.5		No
	FDS03B	27.4		No
	FDS03C	22.3		No
	FDS04A	12.1		No
	FDS04B	25.7		No
	FDS04C	14.9		No
	FDS05A	43.5		No
	FDS05B	39.7		No
	FDS06A	15.4		No
	FDS06B	28.9		No
	FDS06C	31		No
Chromium (Cr)	FDS02A	1.4	100	No
	FDS02B	0.81		No
	FDS02C	0.99		No
	FDS04A	0.81		No
	FDS04B	0.84		No
	FDS04C	0.83		No
	FDS05A	1.5		No
	FDS05B	0.87		No
	FDS06A	11.1		No
	FDS06B	1.5		No
	FDS06C	5.6		No
Lead (Pb)	FDS06A	1.8	15	No
	FDS06C	2		No

Notes:
μg/L = Micrograms per liter
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998).

FDSSC01201 (159,000 μg/kg) and FDSSC01301 (5,490 μg/kg) also exceeded the RBSL (210 μg/kg). Because these samples were collected below the water table at depths between 4.3 and 6.8 feet, they are effectively samples of the aquifer matrix and therefore Site Specific Target Levels would not be applicable. The concentrations at FDSSC01201 also exceed their respective soil-to-groundwater soil screening levels (SSL [DAF=20]) of 30 μg/kg (benzene) and 84,000 μg/kg (naphthalene), (from the *Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting a potential for migration of these constituents from soil to groundwater. However, groundwater analytical data from downgradient wells FDS02C and FDS02D confirms leaching is not occurring at FDSSC01201. In addition, groundwater analytical data from monitoring wells FDS06C and FDS05A confirms no leaching of naphthalene from FDSSC01301. Because the soil at locations FDSSC012 and FDSSC013 do not appear to be causing a groundwater problem, intrinsic remediation is recommended for the impacted soil at the combined Areas 2, 3, 4, 5, and 6. To support this recommendation, monitoring of groundwater is proposed. Monitoring wells FDS02A and FDS02D, located directly downgradient of FDSSC012 and FDS05A and FDS06C located near FDSSC013 should be monitored quarterly for a period of one year. These samples should be analyzed for RBSL VOCs and SVOCs to ensure that constituents detected in soil are not migrating to groundwater.

The groundwater results presented in the CAR show a significant decrease in total PAH concentrations at well FDS06B from 104 μg/L to 27 μg/L. The post-CAR groundwater results show these concentrations have decreased to below the reporting limits. This trend illustrates that intrinsic remediation of groundwater constituents is occurring. The groundwater monitoring program recommended to document intrinsic remediation of soil constituents should be sufficient to also demonstrate that concentrations in groundwater are decreasing by natural attenuation. In addition, groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a basewide potable water system provides drinking and process water to buildings at CNC. This system is to remain in operation under the current base reuse plan. In

addition, the shallow aquifer for this investigation contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which makes this water-bearing unit a questionable potable water source.

Attachment A
Monitoring Well Construction Diagram/Well Development Record

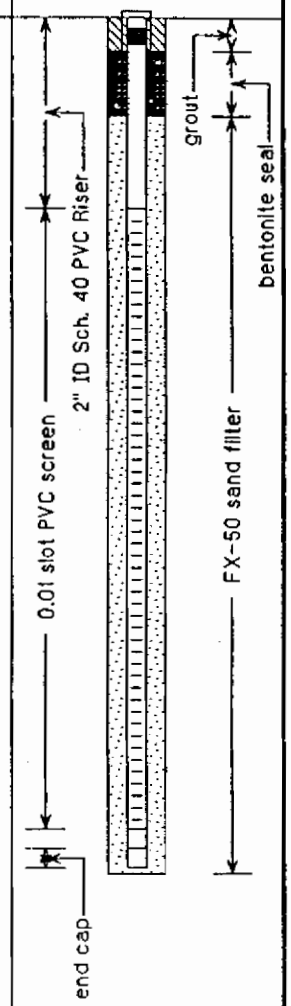
ENSAFE

Monitoring Well NBCGFDS02D

Project: *Fuel Distribution System – Naval Base Charleston*	Coordinates: *371954.90 E, 2321716.18 N*
Location: *Charleston, SC*	Surface Elevation: *7.3 feet msl*
Started at *0830 on 2-02-99*	TOC Elevation: *7.08 feet msl*
Completed at *1040 on 2-02-99*	Depth to Groundwater: *5.42 feet TOC* Measured: *1.66*
Drilling Method: *4.25" ID (8.0" OD) HSA with split spoon*	Groundwater Elevation: *3/3/99 feet msl*
Drilling Company: *Alliance (SC Cert. #889)*	Total Depth: *12.9 feet*
Geologist: *P. Bayley*	Well Screen: *2.9 to 12.3 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	OVA (ppm)	% RECOVERY	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: Asphalt.	
							SP SW	Sand: brown; vf/f w/ trace med.; trace silt; damp; soft.	6.3 / 5.6
					35		CL SM	Clay: dk. gray-brown; trace vf sand; firm; plastic.	5.3 / 5.1
					65		OL	Sand: dk. gray-brown; vf/f w/ trace med.; silty; some damp, soft clay; faint chemical odor.	4 / 3.3
5								Silt: dk. gray-black; clayey; soft; plastic; moist; @4.2', pebbly.	2
					65		OL	Silt: as above.	1.3
							ML CL	Silt: olive-brown; clayey; trace vf sand; calcareous; soft; plastic; damp; Marl fill; f/crs sand lenses at 7.4', 7.8', & 7.9'.	.6
					100		SW	Sand: gray; f/crs; trace f/crs PO_4 shell frags; loose; wet.	-.7 / -1.6
10					45		ML CL	Silt: olive-brown; clayey; w/ vf sand; firm; moist to wet; marl fill.	-2.7
							SW	Sand: gray; f/crs w/ trace f/crs PO_4 shell frags; wet.	-3.8 / -4.2
					75		SP SM	Sand: gray; vf/f w/ trace med.; some silt; trace black PO_4 grains; trace shell frags; soft; soupy; wet.	-4.9 / -5.6
					50		OL	Silt: dk. gray; some vf sand; soft; wet.	-5.7
15									
20									

WELL DIAGRAM



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CHARLESTON NAVAL COMPLEX
WELL DEVELOPMENT STATUS REPORT
ZONE G FDS

WELL DEVELOPMENT SUMMARY

Well:NBCG\FDS02D

Summary Log of well development progress.
Readings are final readings for each visit.
Volume data are cumulative from start of development.

DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-24-99	15	6.81	999	16.9	19.1	-
2-24-99	25	6.93	-10	19.1	21.3	-
2-24-99	35	6.95	-10	19.8	20.8	-
2-24-99	40	6.94	-10	20.2	21.8	-
2-24-99	45	6.93	-10	19.8	21.5	-
2-24-99	50	6.93	-10	20.0	21.4	-
2-24-99	55	6.93	-10	20.0	21.3	-

Well Development Completed on: 2-24-99

COMMENTS:

Attachment B
Analytical Data

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-VOA													
	SAMPLE ID ------->	FDS-G-W02A-03		FDS-G-W02B-03		FDS-G-W02C-03		FDS-G-W02D-01		FDS-G-W03A-03		FDS-G-W03B-03	
	ORIGINAL ID ----->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	LAB SAMPLE ID --->	37602.06		37631.01		37602.07		37602.04		37631.02		37602.03	
	ID FROM REPORT -->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	SAMPLE DATE ----->	03/03/99		03/04/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE ANALYZED --->	03/08/99		03/08/99		03/08/99		03/08/99		03/08/99		03/05/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37631	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
71-43-2	Benzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
100-41-4	Ethylbenzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
108-88-3	Toluene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
1330-20-7	Xylene (Total)	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-VOA																			
	SAMPLE ID ------->	FDS-G-W03C-03		FDS-G-W04A-03		FDS-G-W04B-03		FDS-G-W04C-03		FDS-G-W05A-03		FDS-G-W05B-03	
	ORIGINAL ID ----->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	LAB SAMPLE ID --->	37602.02		37602.08		37602.09		37602.10		37631.03		37602.05	
	ID FROM REPORT -->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	SAMPLE DATE ----->	03/03/99		03/03/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE ANALYZED --->	03/05/99		03/08/99		03/08/99		03/08/99		03/08/99		03/05/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37602	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
71-43-2	Benzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
100-41-4	Ethylbenzene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
108-88-3	Toluene	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U
1330-20-7	Xylene (Total)	5.	U	5.	U	5.	U	5.	U	5.	U	5.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-VOA												
		SAMPLE ID ------->	FDS-G-W06A-03		FDS-G-W06B-03		FDS-G-W06C-03					
		ORIGINAL ID ----->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
		LAB SAMPLE ID --->	37631.04		37631.05		37631.06					
		ID FROM REPORT -->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
		SAMPLE DATE ----->	03/04/99		03/04/99		03/04/99					
		DATE ANALYZED --->	03/08/99		03/08/99		03/08/99					
		MATRIX ---------->	Water		Water		Water					
		UNITS ---------->	UG/L		UG/L		UG/L					
CAS #	Parameter		37631	VAL	37631	VAL	37631	VAL				
71-43-2	Benzene		5.	U	5.	U	5.	U				
100-41-4	Ethylbenzene		5.	U	5.	U	5.	U				
108-88-3	Toluene		5.	U	5.	U	5.	U				
1330-20-7	Xylene (Total)		5.	U	5.	U	5.	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA													
	SAMPLE ID ------->	FDS-G-W02A-03		FDS-G-W02B-03		FDS-G-W02C-03		FDS-G-W02D-01		FDS-G-W03A-03		FDS-G-W03B-03	
	ORIGINAL ID ----->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	LAB SAMPLE ID --->	37602.06		37631.01		37602.07		37602.04		37631.02		37602.03	
	ID FROM REPORT -->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	SAMPLE DATE ----->	03/03/99		03/04/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/05/99		03/06/99		03/05/99		03/05/99		03/06/99		03/05/99	
	DATE ANALYZED --->	03/11/99		03/10/99		03/11/99		03/11/99		03/10/99		03/11/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37631	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
108-95-2	Phenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
111-44-4	bis(2-Chloroethyl)ether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-57-8	2-Chlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
541-73-1	1,3-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-46-7	1,4-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
100-51-6	Benzyl alcohol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-50-1	1,2-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-48-7	2-Methylphenol (o-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-44-5	4-Methylphenol (p-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
621-64-7	N-Nitroso-di-n-propylamine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
67-72-1	Hexachloroethane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
98-95-3	Nitrobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
78-59-1	Isophorone	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-75-5	2-Nitrophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
105-67-9	2,4-Dimethylphenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
65-85-0	Benzoic acid	0.9	J	25.	U	25.	U	0.6	J	0.6	J	25.	U
111-91-1	bis(2-Chloroethoxy)methane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
120-83-2	2,4-Dichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
120-82-1	1,2,4-Trichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-20-3	Naphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-47-8	4-Chloroaniline	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
87-68-3	Hexachlorobutadiene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
59-50-7	4-Chloro-3-methylphenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-57-6	2-Methylnaphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
77-47-4	Hexachlorocyclopentadiene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-06-2	2,4,6-Trichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-95-4	2,4,5-Trichlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
91-58-7	2-Chloronaphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-74-4	2-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
131-11-3	Dimethyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
208-96-8	Acenaphthylene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
99-09-2	3-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
83-32-9	Acenaphthene	10.	U	10.	U	10.	U	10.	U	2.	J	10.	U
51-28-5	2,4-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
100-02-7	4-Nitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA													
	SAMPLE ID ------->	FDS-G-W02A-03		FDS-G-W02B-03		FDS-G-W02C-03		FDS-G-W02D-01		FDS-G-W03A-03		FDS-G-W03B-03	
	ORIGINAL ID ----->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	LAB SAMPLE ID --->	37602.06		37631.01		37602.07		37602.04		37631.02		37602.03	
	ID FROM REPORT -->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	SAMPLE DATE ----->	03/03/99		03/04/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/05/99		03/06/99		03/05/99		03/05/99		03/06/99		03/05/99	
	DATE ANALYZED --->	03/11/99		03/10/99		03/11/99		03/11/99		03/10/99		03/11/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37631	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
132-64-9	Dibenzofuran	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
121-14-2	2,4-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
606-20-2	2,6-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
84-66-2	Diethylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
7005-72-3	4-Chlorophenylphenylether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
86-73-7	Fluorene	10.	U	10.	U	10.	U	10.	U	4.	J	10.	U
100-01-6	4-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
86-30-6	N-Nitrosodiphenylamine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
101-55-3	4-Bromophenyl-phenylether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
118-74-1	Hexachlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
87-86-5	Pentachlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
85-01-8	Phenanthrene	10.	U	10.	U	10.	U	10.	U	0.6	J	10.	U
120-12-7	Anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
84-74-2	Di-n-butylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
206-44-0	Fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
129-00-0	Pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
85-68-7	Butylbenzylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-94-1	3,3'-Dichlorobenzidine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
56-55-3	Benzo(a)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	3.	J	10.	U	1.	J	1.	J	10.	U	10.	U
218-01-9	Chrysene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
117-84-0	Di-n-octyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
50-32-8	Benzo(a)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
53-70-3	Dibenz(a,h)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
191-24-2	Benzo(g,h,i)perylene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA																			
	SAMPLE ID ------->	FDS-G-W03C-03		FDS-G-W04A-03		FDS-G-W04B-03		FDS-G-W04C-03		FDS-G-W05A-03		FDS-G-W05B-03	
	ORIGINAL ID ----->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	LAB SAMPLE ID --->	37602.02		37602.08		37602.09		37602.10		37631.03		37602.05	
	ID FROM REPORT -->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	SAMPLE DATE ----->	03/03/99		03/03/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/05/99		03/05/99		03/05/99		03/05/99		03/06/99		03/05/99	
	DATE ANALYZED --->	03/11/99		03/11/99		03/11/99		03/11/99		03/10/99		03/11/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37602	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
108-95-2	Phenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
111-44-4	bis(2-Chloroethyl)ether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-57-8	2-Chlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
541-73-1	1,3-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-46-7	1,4-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
100-51-6	Benzyl alcohol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-50-1	1,2-Dichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-48-7	2-Methylphenol (o-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-44-5	4-Methylphenol (p-Cresol)	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
621-64-7	N-Nitroso-di-n-propylamine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
67-72-1	Hexachloroethane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
98-95-3	Nitrobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
78-59-1	Isophorone	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-75-5	2-Nitrophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
105-67-9	2,4-Dimethylphenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
65-85-0	Benzoic acid	0.5	J	0.6	J	25.	U	25.	U	0.8	J	25.	U
111-91-1	bis(2-Chloroethoxy)methane	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
120-83-2	2,4-Dichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
120-82-1	1,2,4-Trichlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-20-3	Naphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
106-47-8	4-Chloroaniline	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
87-68-3	Hexachlorobutadiene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
59-50-7	4-Chloro-3-methylphenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-57-6	2-Methylnaphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
77-47-4	Hexachlorocyclopentadiene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-06-2	2,4,6-Trichlorophenol	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
95-95-4	2,4,5-Trichlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
91-58-7	2-Chloronaphthalene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
88-74-4	2-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
131-11-3	Dimethyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
208-96-8	Acenaphthylene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
99-09-2	3-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
83-32-9	Acenaphthene	10.	U	10.	U	10.	U	10.	U	2.	J	10.	U
51-28-5	2,4-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
100-02-7	4-Nitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA													
	SAMPLE ID ------->	FDS-G-W03C-03		FDS-G-W04A-03		FDS-G-W04B-03		FDS-G-W04C-03		FDS-G-W05A-03		FDS-G-W05B-03	
	ORIGINAL ID ----->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	LAB SAMPLE ID --->	37602.02		37602.08		37602.09		37602.10		37631.03		37602.05	
	ID FROM REPORT -->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	SAMPLE DATE ----->	03/03/99		03/03/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/05/99		03/05/99		03/05/99		03/05/99		03/06/99		03/05/99	
	DATE ANALYZED --->	03/11/99		03/11/99		03/11/99		03/11/99		03/10/99		03/11/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37602	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
132-64-9	Dibenzofuran	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
121-14-2	2,4-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
606-20-2	2,6-Dinitrotoluene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
84-66-2	Diethylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
7005-72-3	4-Chlorophenylphenylether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
86-73-7	Fluorene	10.	U	10.	U	10.	U	10.	U	5.	J	10.	U
100-01-6	4-Nitroaniline	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
86-30-6	N-Nitrosodiphenylamine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
101-55-3	4-Bromophenyl-phenylether	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
118-74-1	Hexachlorobenzene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
87-86-5	Pentachlorophenol	25.	U	25.	U	25.	U	25.	U	25.	U	25.	U
85-01-8	Phenanthrene	10.	U	10.	U	10.	U	10.	U	4.	J	10.	U
120-12-7	Anthracene	10.	U	10.	U	10.	U	10.	U	0.6	J	10.	U
84-74-2	Di-n-butylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
206-44-0	Fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
129-00-0	Pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
85-68-7	Butylbenzylphthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
91-94-1	3,3'-Dichlorobenzidine	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
56-55-3	Benzo(a)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U	1.	J	9.	J	0.9	J	10.	U	0.5	J
218-01-9	Chrysene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
117-84-0	Di-n-octyl phthalate	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
50-32-8	Benzo(a)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
53-70-3	Dibenz(a,h)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U
191-24-2	Benzo(g,h,i)perylene	10.	U	10.	U	10.	U	10.	U	10.	U	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA											
	SAMPLE ID ------->	FDS-G-W06A-03		FDS-G-W06B-03		FDS-G-W06C-03					
	ORIGINAL ID ----->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	LAB SAMPLE ID --->	37631.04		37631.05		37631.06					
	ID FROM REPORT -->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	SAMPLE DATE ----->	03/04/99		03/04/99		03/04/99					
	DATE EXTRACTED -->	03/06/99		03/06/99		03/06/99					
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99					
	MATRIX ---------->	Water		Water		Water					
	UNITS ---------->	UG/L		UG/L		UG/L					
CAS #	Parameter	37631	VAL	37631	VAL	37631	VAL				
108-95-2	Phenol	10.	U	10.	U	12.	U				
111-44-4	bis(2-Chloroethyl)ether	10.	U	10.	U	12.	U				
95-57-8	2-Chlorophenol	10.	U	10.	U	12.	U				
541-73-1	1,3-Dichlorobenzene	10.	U	10.	U	12.	U				
106-46-7	1,4-Dichlorobenzene	10.	U	10.	U	12.	U				
100-51-6	Benzyl alcohol	10.	U	10.	U	12.	U				
95-50-1	1,2-Dichlorobenzene	10.	U	10.	U	12.	U				
95-48-7	2-Methylphenol (o-Cresol)	10.	U	10.	U	12.	U				
108-60-1	2,2'-oxybis(1-Chloropropane)	10.	U	10.	U	12.	U				
106-44-5	4-Methylphenol (p-Cresol)	10.	U	10.	U	12.	U				
621-64-7	N-Nitroso-di-n-propylamine	10.	U	10.	U	12.	U				
67-72-1	Hexachloroethane	10.	U	10.	U	12.	U				
98-95-3	Nitrobenzene	10.	U	10.	U	12.	U				
78-59-1	Isophorone	10.	U	10.	U	12.	U				
88-75-5	2-Nitrophenol	10.	U	10.	U	12.	U				
105-67-9	2,4-Dimethylphenol	10.	U	10.	U	12.	U				
65-85-0	Benzoic acid	25.	U	0.6	J	3.	J				
111-91-1	bis(2-Chloroethoxy)methane	10.	U	10.	U	12.	U				
120-83-2	2,4-Dichlorophenol	10.	U	10.	U	12.	U				
120-82-1	1,2,4-Trichlorobenzene	10.	U	10.	U	12.	U				
91-20-3	Naphthalene	10.	U	10.	U	12.	U				
106-47-8	4-Chloroaniline	10.	U	10.	U	12.	U				
87-68-3	Hexachlorobutadiene	10.	U	10.	U	12.	U				
59-50-7	4-Chloro-3-methylphenol	10.	U	10.	U	12.	U				
91-57-6	2-Methylnaphthalene	10.	U	10.	U	12.	U				
77-47-4	Hexachlorocyclopentadiene	10.	U	10.	U	12.	U				
88-06-2	2,4,6-Trichlorophenol	10.	U	10.	U	12.	U				
95-95-4	2,4,5-Trichlorophenol	25.	U	25.	U	31.	U				
91-58-7	2-Chloronaphthalene	10.	U	10.	U	12.	U				
88-74-4	2-Nitroaniline	25.	U	25.	U	31.	U				
131-11-3	Dimethyl phthalate	10.	U	10.	U	12.	U				
208-96-8	Acenaphthylene	10.	U	10.	U	12.	U				
99-09-2	3-Nitroaniline	25.	U	25.	U	31.	U				
83-32-9	Acenaphthene	10.	U	10.		12.	U				
51-28-5	2,4-Dinitrophenol	25.	U	25.	U	31.	U				
100-02-7	4-Nitrophenol	25.	U	25.	U	31.	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW-SVOA											
	SAMPLE ID ------->	FDS-G-W06A-03		FDS-G-W06B-03		FDS-G-W06C-03					
	ORIGINAL ID ----->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	LAB SAMPLE ID --->	37631.04		37631.05		37631.06					
	ID FROM REPORT -->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	SAMPLE DATE ----->	03/04/99		03/04/99		03/04/99					
	DATE EXTRACTED -->	03/06/99		03/06/99		03/06/99					
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99					
	MATRIX ---------->	Water		Water		Water					
	UNITS ---------->	UG/L		UG/L		UG/L					
CAS #	Parameter	37631	VAL	37631	VAL	37631	VAL				
132-64-9	Dibenzofuran	10.	U	1.	J	12.	U				
121-14-2	2,4-Dinitrotoluene	10.	U	10.	U	12.	U				
606-20-2	2,6-Dinitrotoluene	10.	U	10.	U	12.	U				
84-66-2	Diethylphthalate	10.	U	10.	U	12.	U				
7005-72-3	4-Chlorophenylphenylether	10.	U	10.	U	12.	U				
86-73-7	Fluorene	10.	U	2.	J	12.	U				
100-01-6	4-Nitroaniline	25.	U	25.	U	31.	U				
534-52-1	2-Methyl-4,6-Dinitrophenol	25.	U	25.	U	31.	U				
86-30-6	N-Nitrosodiphenylamine	10.	U	10.	U	12.	U				
101-55-3	4-Bromophenyl-phenylether	10.	U	10.	U	12.	U				
118-74-1	Hexachlorobenzene	10.	U	10.	U	12.	U				
87-86-5	Pentachlorophenol	25.	U	25.	U	31.	U				
85-01-8	Phenanthrene	10.	U	10.	U	12.	U				
120-12-7	Anthracene	10.	U	10.	U	12.	U				
84-74-2	Di-n-butylphthalate	10.	U	10.	U	12.	U				
206-44-0	Fluoranthene	10.	U	10.	U	12.	U				
129-00-0	Pyrene	10.	U	10.	U	0.6	J				
85-68-7	Butylbenzylphthalate	10.	U	10.	U	12.	U				
91-94-1	3,3'-Dichlorobenzidine	10.	U	10.	U	12.	U				
56-55-3	Benzo(a)anthracene	10.	U	10.	U	12.	U				
117-81-7	bis(2-Ethylhexyl)phthalate (BEHP)	10.	U	10.	U	12.	U				
218-01-9	Chrysene	10.	U	10.	U	12.	U				
117-84-0	Di-n-octyl phthalate	10.	U	10.	U	12.	U				
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	0.9	J				
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	12.	U				
50-32-8	Benzo(a)pyrene	10.	U	10.	U	12.	U				
193-39-5	Indeno(1,2,3-cd)pyrene	10.	U	10.	U	12.	U				
53-70-3	Dibenz(a,h)anthracene	10.	U	10.	U	12.	U				
191-24-2	Benzo(g,h,i)perylene	10.	U	10.	U	12.	U				

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-META													
	SAMPLE ID ------->	FDS-G-W02A-03		FDS-G-W02B-03		FDS-G-W02C-03		FDS-G-W02D-01		FDS-G-W03A-03		FDS-G-W03B-03	
	ORIGINAL ID ----->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	LAB SAMPLE ID --->	37602.06		37631.01		37602.07		37602.04		37631.02		37602.03	
	ID FROM REPORT -->	FDSGW02A03		FDSGW02B03		FDSGW02C03		FDSGW02D01		FDSGW03A03		FDSGW03B03	
	SAMPLE DATE ----->	03/03/99		03/04/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/09/99		03/09/99		03/09/99		03/09/99		03/09/99		03/09/99	
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99		03/10/99		03/10/99		03/10/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37631	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
7439-97-6	Mercury (Hg)	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
7440-38-2	Arsenic (As)	3.1	J	2.9	U	6.2	J	11.2		2.9	U	3.5	J
7440-39-3	Barium (Ba)	140.		46.2		25.2		84.9		28.5		27.4	
7440-43-9	Cadmium (Cd)	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
7440-47-3	Chromium (Cr)	1.4	J	0.81	J	0.99	J	0.7	U	0.7	U	0.7	U
7439-92-1	Lead (Pb)	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U
7782-49-2	Selenium (Se)	3.1	U	3.1	U	3.1	U	3.1	U	3.1	U	3.1	U
7440-22-4	Silver (Ag)	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-META													
	SAMPLE ID ------->	FDS-G-W03C-03		FDS-G-W04A-03		FDS-G-W04B-03		FDS-G-W04C-03		FDS-G-W05A-03		FDS-G-W05B-03	
	ORIGINAL ID ----->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	LAB SAMPLE ID --->	37602.02		37602.08		37602.09		37602.10		37631.03		37602.05	
	ID FROM REPORT -->	FDSGW03C03		FDSGW04A03		FDSGW04B03		FDSGW04C03		FDSGW05A03		FDSGW05B03	
	SAMPLE DATE ----->	03/03/99		03/03/99		03/03/99		03/03/99		03/04/99		03/03/99	
	DATE EXTRACTED -->	03/09/99		03/09/99		03/09/99		03/09/99		03/09/99		03/09/99	
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99		03/10/99		03/10/99		03/10/99	
	MATRIX ---------->	Water		Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37602	VAL	37602	VAL	37602	VAL	37602	VAL	37631	VAL	37602	VAL
7439-97-6	Mercury (Hg)	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U	0.1	U
7440-38-2	Arsenic (As)	3.4	J	2.9	U	2.9	U	2.9	U	3.4	J	2.9	U
7440-39-3	Barium (Ba)	22.3	J	12.1	J	25.7		14.9	J	43.5		39.7	
7440-43-9	Cadmium (Cd)	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U	0.3	U
7440-47-3	Chromium (Cr)	0.7	U	0.81	J	0.84	J	0.83	J	1.5	J	0.87	J
7439-92-1	Lead (Pb)	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U	1.5	U
7782-49-2	Selenium (Se)	3.1	U	3.1	U	3.1	U	3.1	U	3.1	U	3.1	U
7440-22-4	Silver (Ag)	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U	1.4	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 2, 3, 4, 5, AND 6

SW846-META											
	SAMPLE ID ------->	FDS-G-W06A-03		FDS-G-W06B-03		FDS-G-W06C-03					
	ORIGINAL ID ----->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	LAB SAMPLE ID --->	37631.04		37631.05		37631.06					
	ID FROM REPORT -->	FDSGW06A03		FDSGW06B03		FDSGW06C03					
	SAMPLE DATE ----->	03/04/99		03/04/99		03/04/99					
	DATE EXTRACTED -->	03/09/99		03/09/99		03/09/99					
	DATE ANALYZED --->	03/10/99		03/10/99		03/10/99					
	MATRIX ---------->	Water		Water		Water					
	UNITS ---------->	UG/L		UG/L		UG/L					
CAS #	Parameter	37631	VAL	37631	VAL	37631	VAL				
7439-97-6	Mercury (Hg)	0.1	U	0.1	U	0.1	U				
7440-38-2	Arsenic (As)	6.6	J	2.9	U	24.3					
7440-39-3	Barium (Ba)	15.4	J	28.9		31.					
7440-43-9	Cadmium (Cd)	0.3	U	0.3	U	0.3	U				
7440-47-3	Chromium (Cr)	11.1		1.5	J	5.6	J				
7439-92-1	Lead (Pb)	1.8	J	1.5	U	2.	J				
7782-49-2	Selenium (Se)	3.1	U	3.1	U	3.1	U				
7440-22-4	Silver (Ag)	1.4	U	1.4	U	1.4	U				

*** Validation Complete ***

Area 7

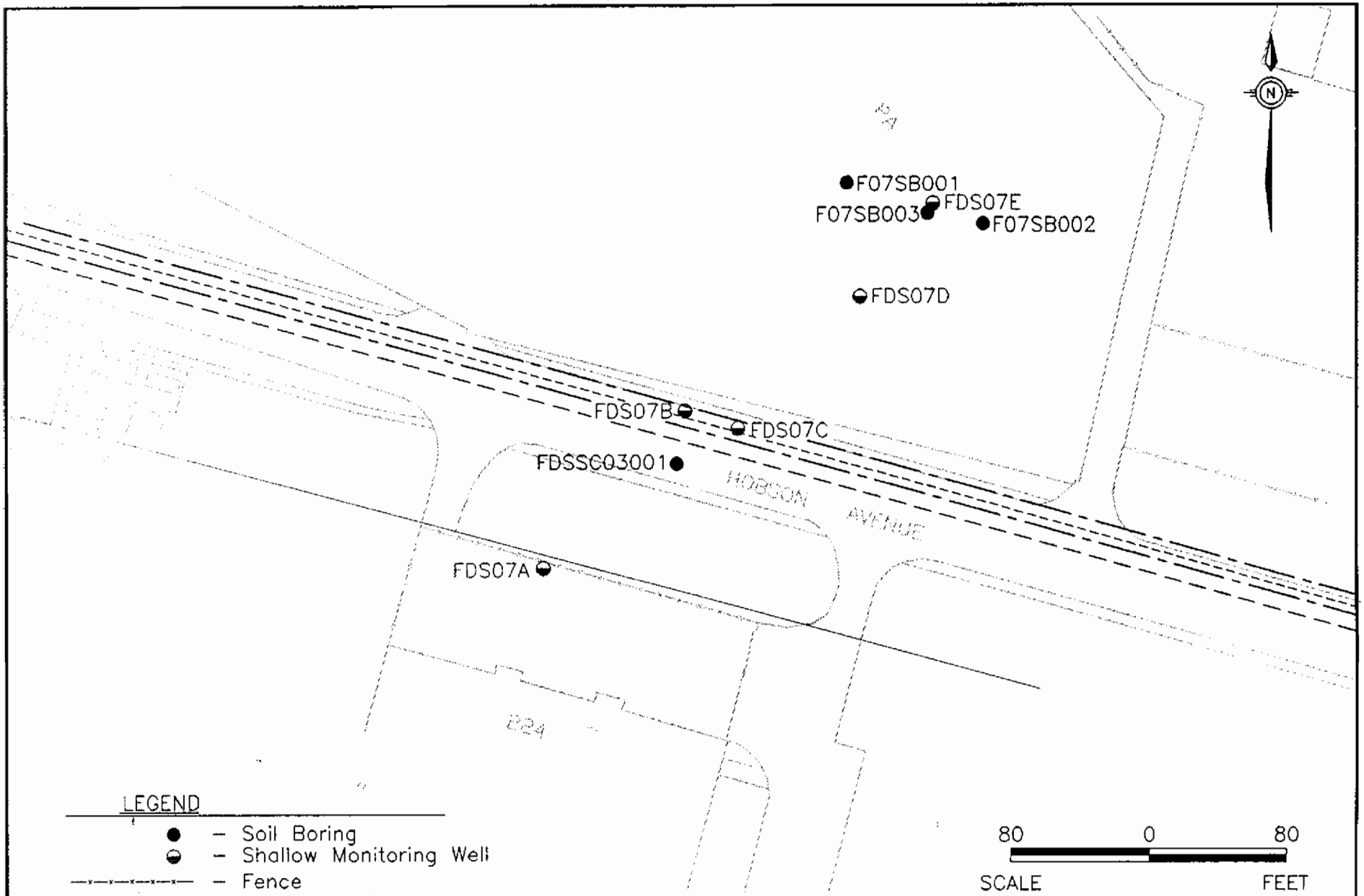
(SCDHEC No. 01182)

Background

Area 7 of the Fuel Distribution System (FDS) is associated with Phase I soil sample FDSSC03001, which exhibited total petroleum hydrocarbons-diesel range organics of 102 milligrams per kilogram (mg/kg), which prompted Phase II soil and groundwater sampling within Area 7. Phase II revealed no soil contamination attributable to the FDS. The arsenic concentration detected in soil at FDSS03001 exceeded its USEPA generic soil screening level (SSL). However, arsenic detections in Area 7 groundwater samples were all below the groundwater risk-based screening level (RBSL) and Zone G shallow groundwater background concentrations for arsenic. No free-phase petroleum product was observed in Area 7 monitoring wells. The RBSLs for total polycyclic aromatic hydrocarbons (PAHs) and four individual PAHs were exceeded in groundwater samples from well FDS07D, which was installed approximately 100 feet upgradient of the FDS pipeline corridor *(Contamination Assessment Report* [CAR], EnSafe 1998).

Follow-on Activities

The CAR recommended and South Carolina Department of Health and Environmental Control (SCDHEC) concurred that additional assessment was required at Area 7 to identify the source of the groundwater contamination detected in FDS07D. This additional assessment included collection of three surface and three subsurface soil samples at locations upgradient from FDS07D, and installation of an additional upgradient monitoring well, FDS07E. Monitoring well FDS07E was installed and developed in February 1999. During March, 1999, the three soil borings were advanced, with surface and subsurface soil samples collected for comparison to soil RBSL parameters. Water levels were remeasured in all Area 7 wells in March 1999. An additional round of groundwater samples were collected from all Area 7 wells and analyzed for RBSL semivolatile organic compounds (SVOCs) only. Figure 1 depicts the Area 7



LEGEND

- Soil Boring
- Shallow Monitoring Well
- Fence
- Abandoned Drain Line
- Diesel Line
- Fuel Line
- Sludge Line

FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREA 7
SAMPLE LOCATIONS

DWG DATE: 06/10/99 | DWG NAME: 2907R003

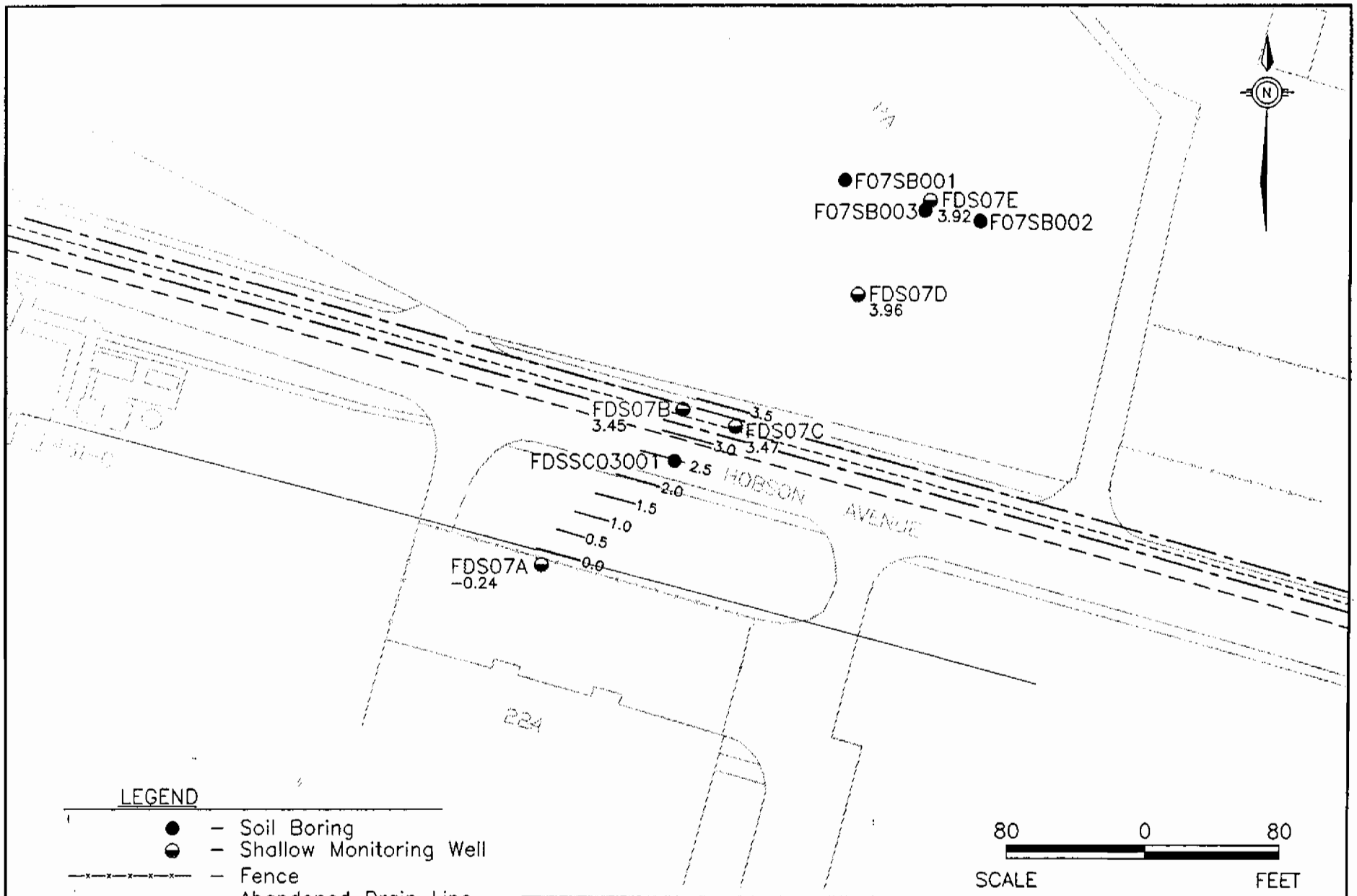
sample locations. Attachment A contains the monitoring well construction diagram and well development record for the newly installed FDS07E. The CAR contains the boring logs and development records for all previously installed Area 7 wells.

Results

Figure 2 presents the shallow groundwater low-tide potentiometric surface at Area 7 measured in March 1999. Groundwater flow is generally to the southwest which is consistent with the low-tide flow direction shown in the CAR (EnSafe 1998). The water level elevations suggest the possibility of a groundwater divide between FDS07D and FDS07E. This feature would explain the difference in flow directions between Area 7 and SWMU 6 and 7 located to the north of the site. Slug testing at FDS07E determined a horizontal hydraulic conductivity of 4.74 feet per day for the shallow aquifer at Area 7. Attachment B contains the aquifer test results for Area 7.

Table 1 summarizes the results of the post-CAR soil sampling at Area 7. No RBSL parameters were detected in any of the three surface soil samples collected during the post-CAR soil sampling at Area 7. Two volatile organic compounds (VOCs) and five PAHs were detected in subsurface soil samples; however, all subsurface detections were below their respective RBSLs.

Table 2 summarizes the results of the post-CAR groundwater sampling at Area 7. No groundwater RBSLs were exceeded at Area 7. Naphthalene was detected in well FDS07D at a concentration of 0.7 micrograms per liter (μg/L), below it's groundwater RBSL (10 μg/L). These results document a reduction in naphthalene from the previous sampling event at FDS07D, which had a naphthalene concentration of 24 μg/L. 2-methylnaphthalene was detected at FDS07B at 1.0 μg/L and FDS07C at 0.70 μg/L, below the RBSL. Total PAH concentrations were below the RBSL for all locations at Area 7. Attachment C contains the analytical data from the post-CAR sampling. The FDS CAR contains the analytical data from previous sampling at Area 7.



LEGEND

- Soil Boring
- Shallow Monitoring Well
- Fence
- Abandoned Drain Line
- Diesel Line
- Fuel Line
- Sludge Line

FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 2
AREA 7
SHALLOW GROUNDWATER
PIEZOMETRIC MAP

DWG DATE: 06/28/99 | DWG NAME: 2907R005

Table 1
Analytes Detected in Surface and Subsurface Soil
Post-CAR Sampling, Area 7
Fuel Distribution System

Parameters	Location	Surface Conc.	Subsurface Conc.	RBSL/SSL (μg/kg)	Exceeds RBSL
Volatile Organic Compounds (μg/kg)					
Ethylbenzene	F07SB001	ND	1.0	1,260/13,000	No
Xylene (total)	F07SB001	ND	3.0	42,471/148,000	No
Semivolatile Organic Compounds (μg/kg)					
Benzo(a)anthracene	F07SB001	ND	95	73,084/2,000	No
	F07SB002	ND	34		No
	F07SB003	ND	56		No
Benzo(b)fluoranthene	F07SB001	ND	95	29,097/5,000	No
	F07SB002	ND	32		No
	F07SB003	ND	74		No
Benzo(k)fluoranthene	F07SB001	ND	79	231,109/49,000	No
	F07SB002	ND	31		No
	F07SB003	ND	59		No
Chrysene	F07SB001	ND	120	12,998/160,000	No
	F07SB002	ND	40		No
	F07SB003	ND	79		No
Naphthalene	F07SB001	ND	94	210/84,000	No
	F07SB002	ND	84		No
	F07SB003	ND	110		No

Notes:

ND = Not detected.
μg/kg = Micrograms per kilograms.
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998) (RBSLs for Sandy Soil) and generic soil-to-groundwater SSLs (DAF=20) from the *Soil Screening Guidance: Technical Background Document* (USEPA, 1996) were used as reference concentrations.

Table 2
Analytes Detected in Shallow Groundwater
Post-CAR Sampling, Area 7
Fuel Distribution System

Parameters	Location	Sample Results	RBSL (μg/L)	Exceeds RBSL
Semivolatile Organic Compounds (μg/L)				
Total PAHs	FDS07B	1.0	25	No
	FDS07C	0.7		No
	FDS07D	0.7		No
Naphthalene	FDS07D	0.7	10	No
2-Methylnapthalene	FDS07B	1.0	10	No
	FDS07C	0.7		No

Notes:

μg/L = Micrograms per liter
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998).

Conclusions and Recommendations

Post-CAR sampling detected VOCs and SVOCs in subsurface soil which may have sourced the site. None of these parameters exceeded RBSLs. All post-CAR subsurface soil detections were also below their respective generic soil-to-groundwater soil screening levels (SSLs [DAF=20]) from the (*Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting migration to groundwater is unlikely.

Phase II groundwater results revealed that the RBSLs for total PAHs and four individual PAHs were exceeded in groundwater samples from well FDS07D, located upgradient of the FDS pipeline corridor. No RBSLs were exceeded in post-CAR groundwater sampling of Area 7 wells for RBSL SVOC parameters. These most recent results revealed a reduced naphthalene concentration detection at FDS07D, below the naphthalene RBSL. 2-methylnaphthalene was detected at wells FDS07B and FDS07C. Concentrations of this compound were also reduced from those reported in the CAR. Total PAHS were also below the RBSL, and reduced from those reported in the CAR.

Groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a basewide potable water system provides drinking and process water to buildings at CNC. This system is to remain in operation under the current base reuse plan. In addition, the shallow aquifer for this investigation contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which makes this water-bearing unit a questionable potable water source.

No soil RBSLs were exceeded at Area 7. In groundwater, concentrations of individual and total PAHs have declined from some exceeding RBSLs to all below RBSLs in the most recent sampling event. Because concentrations of chemicals of concern in both media are below applicable RBSLs, no further action is recommended for Area 7.

Attachment A
Monitoring Well Construction Diagram/Well Development Record

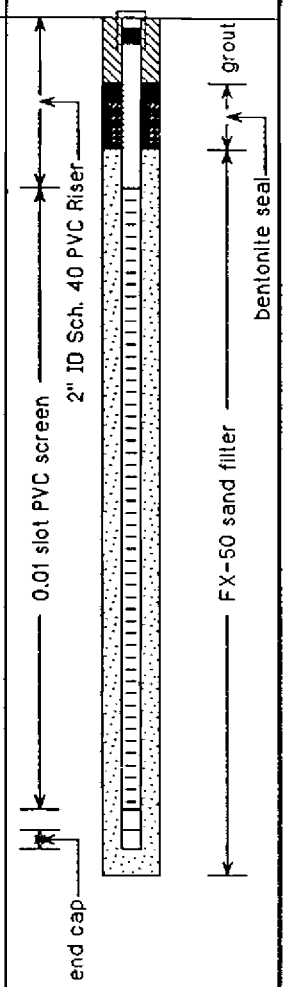
ENSAFE

Monitoring Well NBCGFDS07E

Project: *Fuel Distribution System –Charleston Naval Complex*	Coordinates: *2320716.32 E, 372544.91 N*
Location: *Charleston, SC*	Surface Elevation: *6.4 feet msl*
Started at *1430 on 02-02-99*	TOC Elevation: *6.27 feet msl*
Completed at *1600 on 02-02-99*	Depth to Groundwater: *2.82 feet TOC* Measured: *3/5/99*
Drilling Method: *4.25" ID (8.0" OD) HSA with split spoon*	Groundwater Elevation: *3.45 feet msl*
Drilling Company: *Alliance Environmental (SC Cert. # 889)*	Total Depth: *12.6 feet*
Geologist: *P. Bayley*	Well Screen: *2.6 to 12.0 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	OVA (ppm)	% RECOVERY	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft-msl)
								Surface conditions: Asphalt.	
							SP SM	Sand: brown; vf/f; tr silt; loose; dry.	5.4
									4.3
			1		55		GM	Gravel: black; 1 cm dia.; silty sand matrix; wet; hydrocarbon odor.	3.4
							SM		2.7
							CL	Sand: brown w/ tr orange; vf; silty; loose; wet.	2.2
5			2		80		ML CL	Clay: olive-brown w/ tr orange; sm silt; sm vf sand; stiff; plastic; wet.	1.8 / 1.4
								Clay: blue-green w/ sm brown; silty; sm vf sand; soft-firm; plastic; wet.	.7
			3		35				
			4		0		OL	Silt: dk gray-black; clayey; sticky; soft; wet.	2.6
10									
			5		95		OL	Silt: as above.	4.5 / 4.8
			6		90				6.4
15									
20									

WELL DIAGRAM



ENSAFE

CHARLESTON NAVAL COMPLEX
WELL DEVELOPMENT STATUS REPORT
ZONE G FDS

WELL DEVELOPMENT SUMMARY

Well:NBCG\FDS07E

Summary Log of well development progress.
Readings are final readings for each visit.
Volume data are cumulative from start of development.

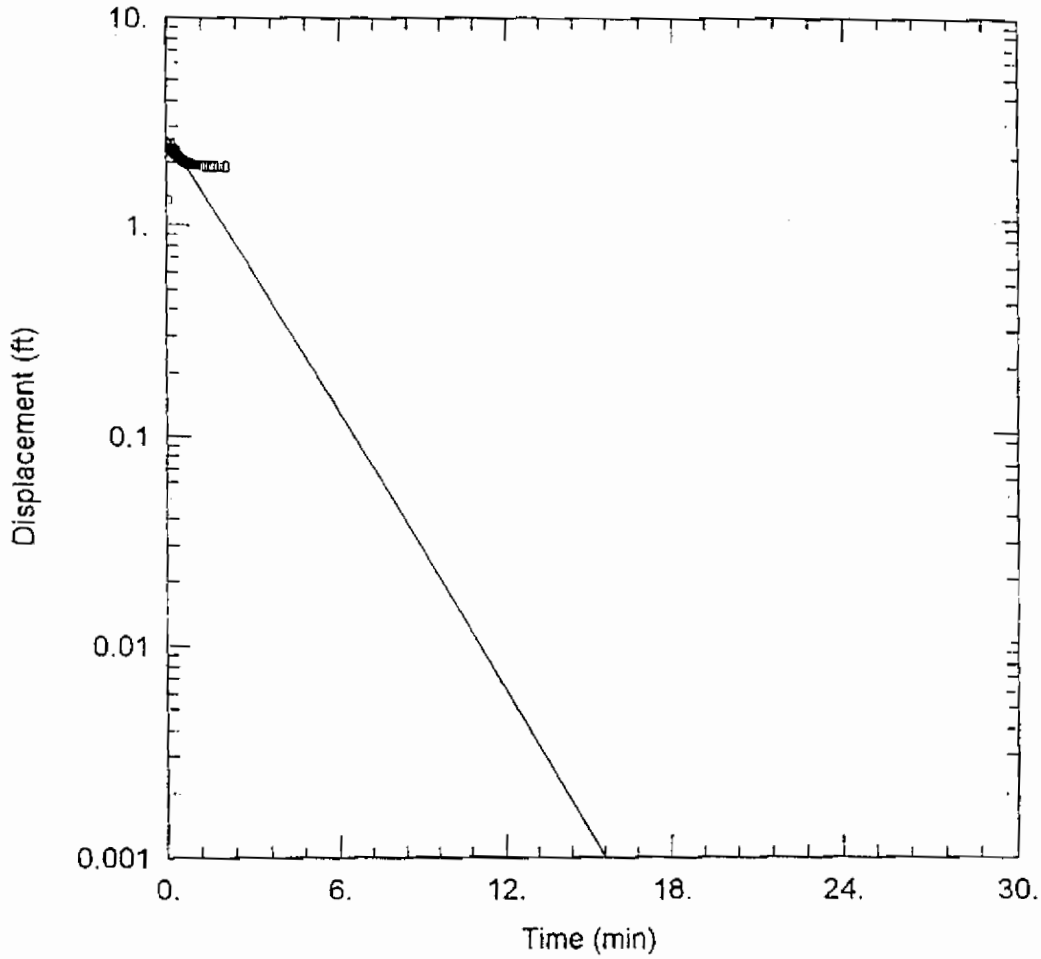
DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-25-99	12	5.42	999	35.0	19.5	-
2-25-99	19	5.48	340	35.6	20.3	-
2-25-99	23	7.29	137	35.3	20.4	-
2-25-99	27	7.42	292	35.2	20.3	-
2-25-99	33	5.54	518	35.4	18.3	-
2-25-99	38	6.52	62	34.9	19.6	-
2-25-99	42	6.01	67	35.0	19.7	-
2-25-99	45	6.27	46	34.5	20.6	-
2-25-99	48	6.29	47	34.1	20.5	-
2-25-99	50	6.26	31	34.2	20.7	-
2-25-99	52	6.77	156	34.3	20.4	-
2-25-99	53.5	6.34	40	33.9	20.2	-
2-25-99	55	6.21	227	32.4	20.3	-
2-25-99	60	6.15	34	32.4	20.0	-
2-25-99	62.5	6.17	16	34.1	20.2	-

DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-25-99	65	6.59	15	34.0	20.1	-
2-25-99	67	6.28	23	34.0	19.9	-
2-25-99	69	6.23	18	34.3	20.1	-
2-25-99	71	6.26	20	34.0	19.9	-

Well Development Completed on: 2-25-99

COMMENTS:

Attachment B
Aquifer Test Results



FDS07E INJECTION

Data Set: C:\TEMP\CHARLE~1\2-07D.AQT
Date: 10/01/99 Time: 10:44:21

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Test Location: Charleston
Test Well: FDS07E
Test Date: 6/3/99

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.325 ft
Water Column Height: 4.64 ft
Casing Radius: 0.0833 ft
Wellbore Radius: 0.333 ft
Screen Length: 10. ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 0.003288 ft/min

Data Set: C:\TEMP\CHARLE~1\2-07D.AQT
Title: FDS07E Injection
Date: 10/01/99
Time: 16:08:49

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Location: Charleston
Test Date: 6/3/99
Test Well: FDS07E

AQUIFER DATA

Saturated Thickness: 40. ft
Anisotropy Ratio (Kz/Kr): 1.

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: FDS07E

X Location: 0. ft
Y Location: 0. ft

No. of observations: 72

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.1166	2.556	0.3166	2.197	0.7	2.014
0.125	2.487	0.325	2.228	0.7166	2.011
0.1333	2.395	0.3333	2.219	0.7333	1.995
0.1416	2.449	0.35	2.197	0.75	1.979
0.15	2.446	0.3666	2.178	0.7666	1.992
0.1583	2.395	0.3833	2.168	0.7833	1.995
0.1666	2.395	0.4	2.156	0.8	1.992
0.175	2.402	0.4166	2.143	0.8166	1.992
0.1833	2.348	0.4333	2.121	0.8333	1.979
0.1916	2.37	0.45	2.134	0.85	1.979
0.2	2.367	0.4666	2.108	0.8666	1.976
0.2083	2.332	0.4833	2.102	0.8833	1.97
0.2166	2.332	0.5	2.093	0.9	1.97
0.225	2.345	0.5166	2.083	0.9166	1.966
0.2333	2.26	0.5333	2.074	0.9333	1.963
0.2416	2.263	0.55	2.067	0.95	1.96
0.25	2.329	0.5666	2.039	0.9666	1.957
0.2583	2.288	0.5833	2.058	0.9833	1.957

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.2666	2.256	0.6	2.042	1.	1.954
0.275	2.313	0.6166	2.036	1.2	1.938
0.2833	2.216	0.6333	2.033	1.4	1.925
0.2916	2.19	0.65	2.023	1.6	1.919
0.3	2.291	0.6666	2.02	1.8	1.913
0.3083	2.244	0.6833	2.014	2.	1.91

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.003288	ft/min
y0	2.721	ft

Attachment C
Analytical Data

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SOIL SAMPLING
AREA 7

SW846-SVOA													
	SAMPLE ID ------->	F07-S-B001-01		F07-S-B001-02		F07-S-B002-01		F07-S-B002-02		F07-S-B003-01		F07-S-B003-02	
	ORIGINAL ID ----->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301		F07SB00302	
	LAB SAMPLE ID --->	37736.05		37736.06		37736.01		37736.02		37736.03		37736.04	
	ID FROM REPORT -->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301		F07SB00302	
	SAMPLE DATE ----->	03/15/99		03/15/99		03/15/99		03/15/99		03/15/99		03/15/99	
	DATE EXTRACTED -->	03/16/99		03/16/99		03/16/99		03/16/99		03/16/99		03/16/99	
	DATE ANALYZED --->	03/19/99		03/27/99		03/19/99		03/19/99		03/19/99		03/19/99	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ---------->	UG/KG		UG/KG		UG/KG		UG/KG		UG/KG		UG/KG	
CAS #	Parameter	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL
91-20-3	Naphthalene	380.	U	94.	J	380.	U	84.	J	370.	U	110.	J
56-55-3	Benzo(a)anthracene	380.	U	95.	J	380.	U	34.	J	370.	U	56.	J
218-01-9	Chrysene	380.	U	120.	J	380.	U	40.	J	370.	U	79.	J
205-99-2	Benzo(b)fluoranthene	380.	U	95.	J	380.	U	32.	J	370.	U	74.	J
207-08-9	Benzo(k)fluoranthene	380.	U	79.	J	380.	U	31.	J	370.	U	59.	J

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SOIL SAMPLING
AREA 7

SW846-VOA											
	SAMPLE ID ------->	F07-S-B001-01		F07-S-B001-02		F07-S-B002-01		F07-S-B002-02		F07-S-B003-01	
	ORIGINAL ID ----->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301	
	LAB SAMPLE ID --->	37736.05		37736.06		37736.01		37736.02		37736.03	
	ID FROM REPORT -->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301	
	SAMPLE DATE ----->	03/15/99		03/15/99		03/15/99		03/15/99		03/15/99	
	DATE ANALYZED --->	03/19/99		03/19/99		03/19/99		03/19/99		03/19/99	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil	
	UNITS ---------->	UG/KG		UG/KG		UG/KG		UG/KG		UG/KG	
CAS #	Parameter	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL
71-43-2	Benzene	6.	U	5.	U	6.	U	8.	UJ	6.	U
100-41-4	Ethylbenzene	6.	U	1.	J	6.	U	8.	UJ	6.	U
108-88-3	Toluene	6.	U	5.	U	6.	U	8.	UJ	6.	U
1330-20-7	Xylene (Total)	6.	U	3.	J	6.	U	8.	UJ	6.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SAMPLING
AREA 7

SW846-SVOA											
	SAMPLE ID ------->	FDS-G-W07A-03		FDS-G-W07B-03		FDS-G-W07C-03		FDS-G-W07D-03		FDS-G-W07E-01	
	ORIGINAL ID ----->	FDSGW07A03		FDSGW07B03		FDSGW07C03		FDSGW07D03		FDSGW07E01	
	LAB SAMPLE ID --->	37648.02		37631.07		37631.08		37631.09		37648.01	
	ID FROM REPORT -->	FDSGW07A03		FDSGW07B03		FDSGW07C03		FDSGW07D03		FDSGW07E01	
	SAMPLE DATE ----->	03/05/99		03/04/99		03/04/99		03/04/99		03/05/99	
	DATE EXTRACTED -->	03/08/99		03/06/99		03/06/99		03/06/99		03/08/99	
	DATE ANALYZED --->	03/15/99		03/10/99		03/10/99		03/10/99		03/15/99	
	MATRIX ---------->	Water		Water		Water		Water		Water	
	UNITS ---------->	UG/L		UG/L		UG/L		UG/L		UG/L	
CAS #	Parameter	37648	VAL	37631	VAL	37631	VAL	37631	VAL	37648	VAL
91-20-3	Naphthalene	10.	U	10.	U	10.	U	0.7	J	10.	U
56-55-3	Benzo(a)anthracene	10.	U	10.	U	10.	U	10.	U	10.	U
218-01-9	Chrysene	10.	U	10.	U	10.	U	10.	U	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U	10.	U	10.	U	10.	U	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SOIL SAMPLING
AREA 7

SW846-META													
	SAMPLE ID ------->	F07-S-B001-01		F07-S-B001-02		F07-S-B002-01		F07-S-B002-02		F07-S-B003-01		F07-S-B003-02	
	ORIGINAL ID ----->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301		F07SB00302	
	LAB SAMPLE ID --->	37736.05		37736.06		37736.01		37736.02		37736.03		37736.04	
	ID FROM REPORT -->	F07SB00101		F07SB00102		F07SB00201		F07SB00202		F07SB00301		F07SB00302	
	SAMPLE DATE ----->	03/15/99		03/15/99		03/15/99		03/15/99		03/15/99		03/15/99	
	DATE EXTRACTED -->	03/22/99		03/22/99		03/22/99		03/22/99		03/22/99		03/22/99	
	DATE ANALYZED --->	03/23/99		03/23/99		03/23/99		03/23/99		03/23/99		03/23/99	
	MATRIX ---------->	Soil		Soil		Soil		Soil		Soil		Soil	
	UNITS ---------->	MG/KG		MG/KG		MG/KG		MG/KG		MG/KG		MG/KG	
CAS #	Parameter	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL	37736	VAL
7439-97-6	Mercury (Hg)	0.03	U	0.03	U	0.03	U	0.04	U	0.03	U	0.06	
7440-38-2	Arsenic (As)	1.3	U	11.4		1.5		11.7		3.2		77.6	
7440-39-3	Barium (Ba)	11.1		35.8		18.8		31.3		13.6		58.	
7440-43-9	Cadmium (Cd)	0.06	J	0.26	J	0.03	U	0.3	J	0.12	J	0.31	J
7440-47-3	Chromium (Cr)	4.9		28.8		8.3		23.8		6.9		33.6	
7439-92-1	Lead (Pb)	2.6		93.1		4.1		85.5		3.5		102.	
7782-49-2	Selenium (Se)	0.53	U	0.51	U	0.56	J	0.58	U	2.1		0.71	
7440-22-4	Silver (Ag)	0.14	U	0.13	U	0.13	U	0.15	U	0.14	U	0.16	U

*** Validation Complete ***

Area 8

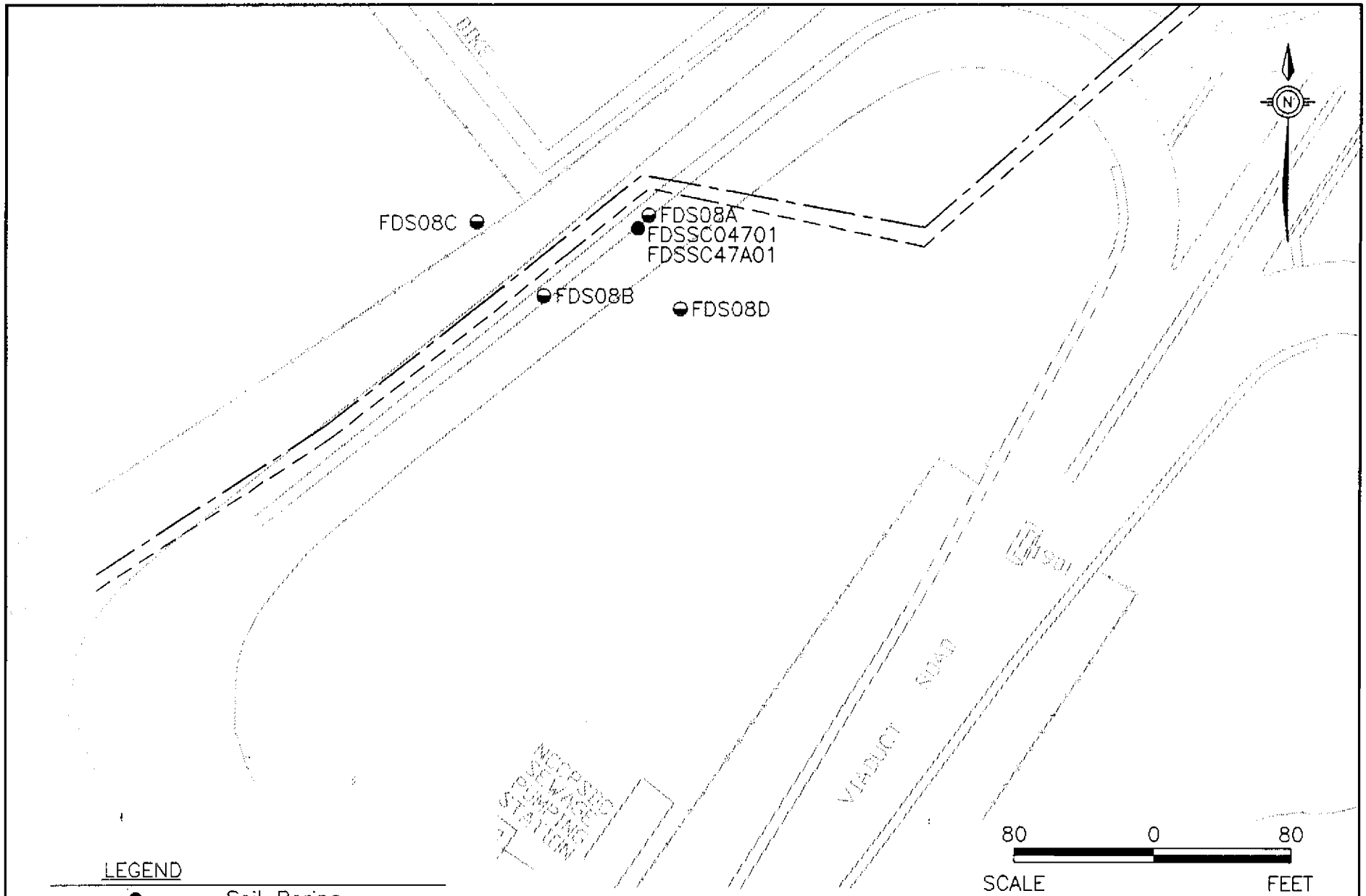
(SCDHEC No. 01183)

Background

Area 8 of the Fuel Distribution System (FDS) is associated with Phase I soil sample FDSSC04701, which exhibited total petroleum hydrocarbons-gasoline range organics of 19,000 micrograms per kilogram (μg/kg), which prompted Phase II soil and groundwater sampling within Area 8. Phase II soil sampling revealed total naphthalenes of 5,210 μg/kg which exceeded the risk-based screening levels (RBSL) of 210 μg/kg at sample FDSSC47A01. To determine if groundwater has been adversely impacted by these petroleum constituents, three shallow groundwater monitoring wells were installed and sampled during Phase II. No groundwater RBSLs for inorganics were exceeded at Area 8. Total PAHs exceeded their RBSLs during the first sampling event at FDS08B, but decreased to below the RBSLs during the second sampling event (*Contamination Assessment Report* [CAR], EnSafe 1998).

Follow-on Activities

Analysis of site hydrology as presented in the CAR revealed that groundwater at Area 8 flows to the southeast. To fill a potential data gap at Area 8 and complete delineation of the area of presumed petroleum contamination, the CAR recommended and South Carolina Department of Health and Environmental Control (SCDHEC) concurred, a fourth monitoring well should be installed downgradient from boring FDSSC47A01 to determine if semivolatile organic compounds (SVOCs), specifically total naphthalenes have impacted groundwater. Monitoring well FDS08D was installed downgradient from FDSSC47A01 in February, 1999, and was sampled in March, 1999 for RBSL volatile organic compounds (VOCs), SVOCs, and inorganics. As recommended and agreed upon by SCDHEC, only FDS08D was sampled during the follow-on sampling; other Area 8 wells were not re-sampled. Figure 1 depicts the Area 8 sample locations, including the location of the new well. Attachment A contains the monitoring well construction diagram and well development record for FDS08D. The FDS CAR contains the boring logs and development records for previously installed Area 8 wells.



LEGEND

- ● – Soil Boring
- ◒ – Shallow Monitoring Well
- –·–·–·– – Fence
- ——— – Fuel Line
- – – – – – Sludge Line

FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREA 8
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907N049

Results

Figure 2 presents the shallow groundwater piezometric surface at Area 8 as measured in March 1999 at low-tide. Groundwater flow is generally to the east-southeast which differs slightly from the southeast low-tide flow direction shown in the CAR (EnSafe 1998). Aquifer slug testing at FDS08D determined an average horizontal hydraulic conductivity of 0.24 feet per day for the shallow aquifer. Attachment B contains the aquifer test results for Area 8.

Analytes detected in Area 8 shallow groundwater during the post-CAR sampling are summarized in Table 1. No VOCs or SVOCs were detected at FDS08D. The only inorganic analyte detected was barium at 38.9 μg/L, below the RBSL of 2,000 μg/L. Attachment C contains the analytical data from the post-CAR sampling. The FDS CAR contains the analytical data from all previous sampling at Area 8.

Table 1
Analytes Detected in Shallow Groundwater
Post-CAR Sampling, Area 8
Fuel Distribution System

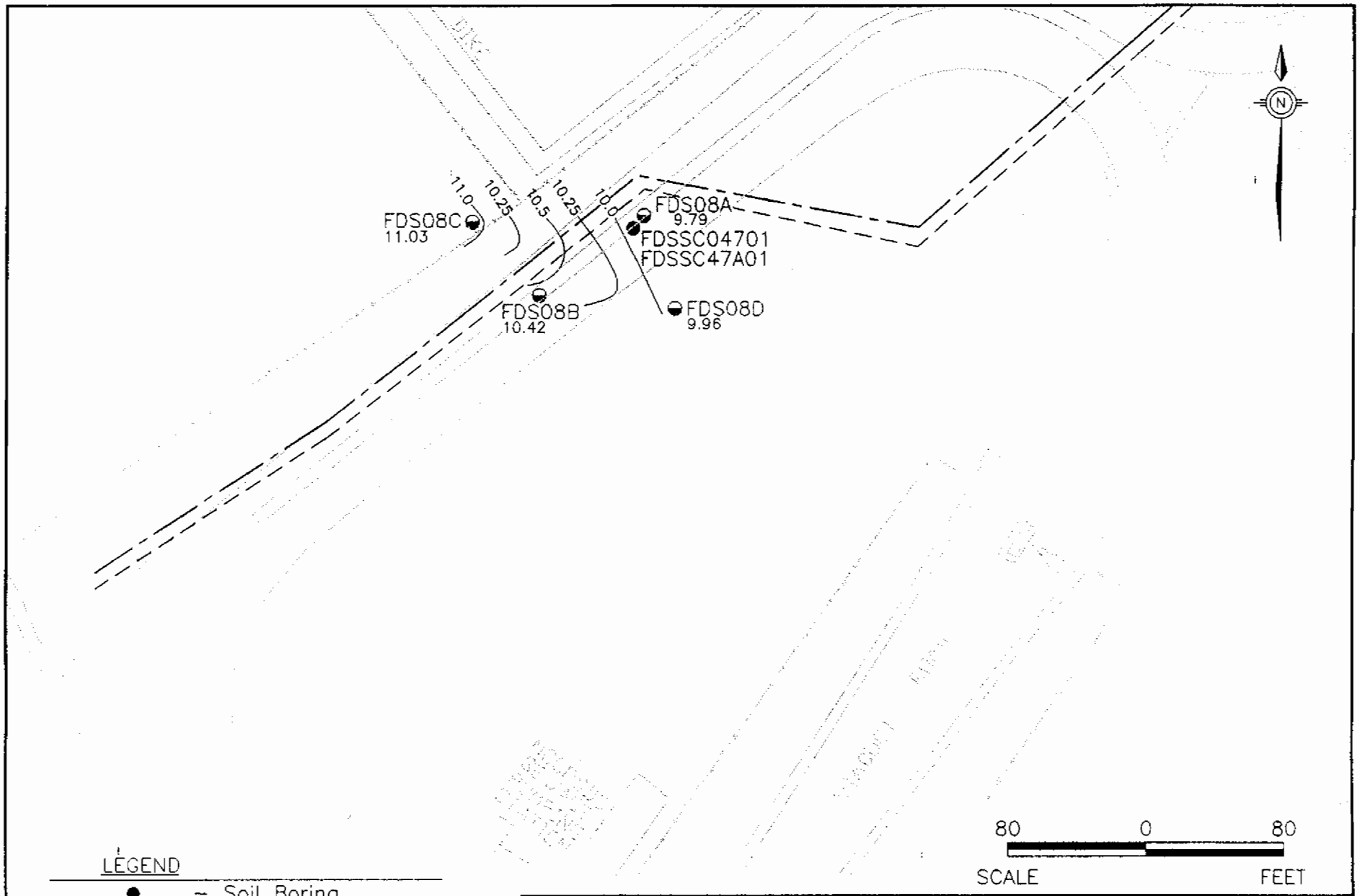
Parameters	Location	Sample Results	RBSL (μg/L)	Exceeds RBSL
Inorganics (μg/L)				
Barium (Ba)	FDS08D	38.9	2000	No

Notes:

μg/L = Micrograms per liter
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998).

Conclusions and Recommendations

As reported in the CAR, the total naphthalene concentration detected in soil sample FDSSC47A01 was 5,210 μg/kg which exceeds the RBSL of 210 μg/kg. Because this sample was collected below the water table at a depth of 13.5 to 15.5 feet, it is effectively a sample of the aquifer matrix, and therefore generation of a Site Specific Target Level would not be applicable. This concentration



LEGEND

- Soil Boring
- Shallow Monitoring Well
- Fence
- Fuel Line
- Sludge Line

FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 2
AREA 8
SHALLOW GROUNDWATER
PIEZOMETRIC MAP

DWG DATE: 09/30/99 | DWG NAME: 2907R006

is below the generic soil-to-groundwater soil screening level (SSL [DAF=20]) of 84,000 μg/kg (from the *Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting migration to groundwater is unlikely. Previous groundwater results which exceeded RBSLs have decreased to below RBSL concentrations. During the most recent sampling event for each well, no analytes were detected in groundwater at concentrations exceeding the RBSL.

Groundwater analytical data confirms leaching is not occurring. Groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a basewide potable water system provides drinking and process water to buildings at CNC. This system is to remain in operation under the current base reuse plan. In addition, the shallow aquifer for this investigation contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which makes this water-bearing unit a questionable potable water source.

Organic chemicals of concern (COCs) exceeding RBSLs were detected in subsurface soil at boring FDSSC47A01. To demonstrate that these constituents are not adversely impacting groundwater at Area 8, monitoring wells FDS08A and FDS08D should be monitored twice at three-month intervals to ensure that groundwater constituent concentrations are consistent or decreasing and that no further leaching of organics is taking place.

If concentrations remain below groundwater RBSLs during this monitoring program, these results should be sufficient to support a no further action decision for soil and groundwater at Area 8.

Attachment A
Monitoring Well Construction Diagram/Well Development Record

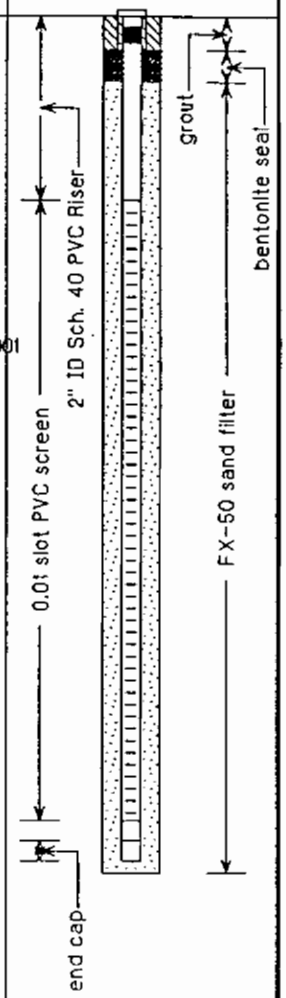
ENSAFE

Monitoring Well NBCGFDS08D

Project: *Fuel Distribution System –Charleston Naval Complex*	Coordinates: *2319473.27 E, 372172.15 N*
Location: *Charleston, SC*	Surface Elevation: *14.9 feet msl*
Started at *1730 on 02–02–99*	TOC Elevation: *14.76 feet msl*
Completed at *1900 on 02–02–99*	Depth to Groundwater: *5.60 feet TOC* Measured: *3/5/99*
Drilling Method: *4.25" ID (8.0" OD) HSA with split spoon*	Groundwater Elevation: *9.16 feet msl*
Drilling Company: *Alliance Environmental (SC cert #889)*	Total Depth: *12.8 feet*
Geologist: *P. Bayley*	Well Screen: *2.8 to 12.2 feet*

DEPTH IN FEET	LITHOLOGIC SAMPLE	ANALYTICAL SAMPLE	SAMPLE NO.	OVA (ppm)	% RECOVERY	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	ELEV. (ft–msl)
								Surface conditions: Grass.	13.9
							CL	Clay: yellow–brown; tr silt; stiff; plastic; damp; pebble base.	13.2
			1		100		ML CL	Silt: olive–brown; clayey; calcareous; plastic; stiff; damp. Marl fill.	11.9
5			2		0		ML CL	Silt: dk. brown; tr–sm clay; tr vf sand; loose; tr plastic; damp.	9.900001
							SP		9.2
							SM	Sand: gray; vf; sm silt; soft; wet.	8.8
			3		80		ML SM	Silt: olive–gray; w/ vf sand; soft; wet.	8.3 / 7.9
							OL	Silt: dk gray–black; clayey; soft; wet.	7
			4		45				
10									
			5		0		SC	Sand: gray; vf; w/ plastic, soft, blue–green clay in matrix; firm; plastic; wet.	3.9
									2.8
			6		55				
15									
20									

WELL DIAGRAM



ENSAFE

CHARLESTON NAVAL COMPLEX
WELL DEVELOPMENT STATUS REPORT
ZONE G FDS

WELL DEVELOPMENT SUMMARY

Well:NBCG\FDS08D

Summary Log of well development progress.
Readings are final readings for each visit.
Volume data are cumulative from start of development.

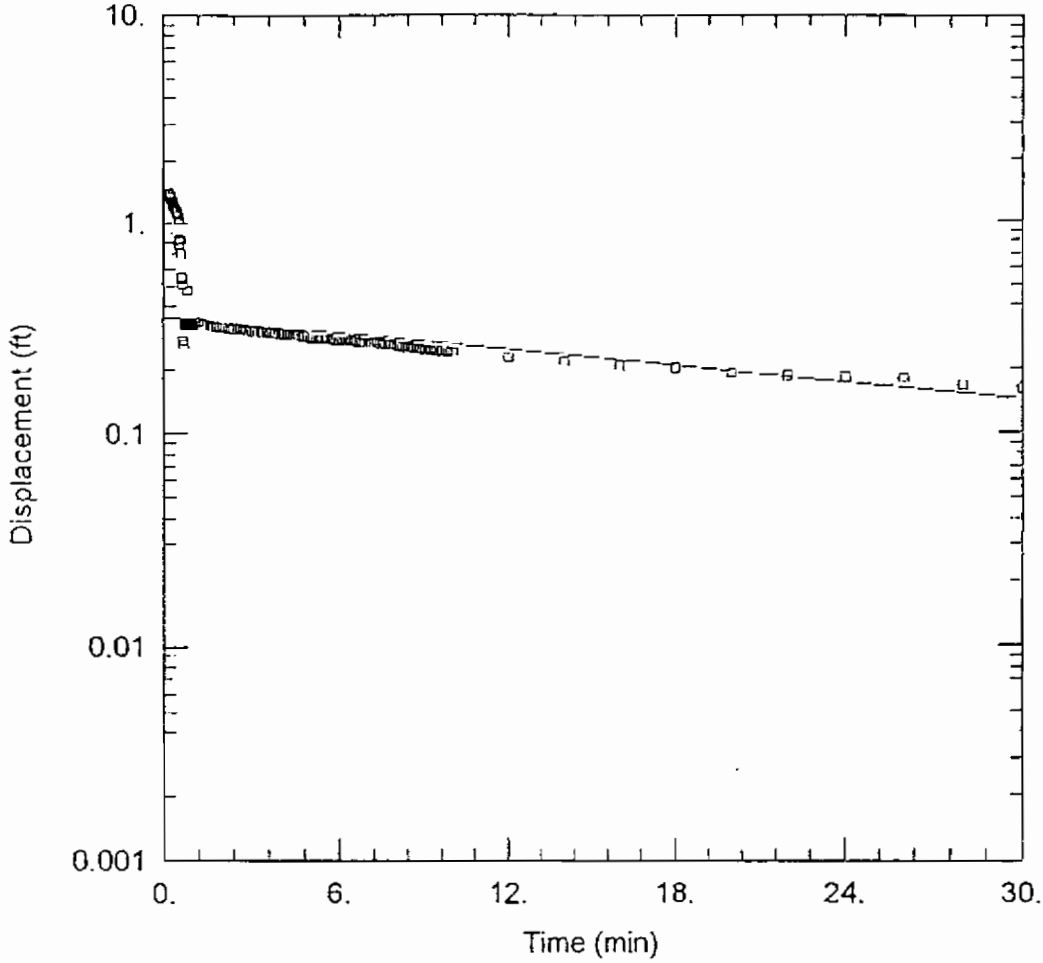
DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-25-99	17.5	7.06	68	2.81	16.5	-
2-25-99	20	7.12	127	2.73	17.8	-
2-25-99	22.5	7.16	88	2.76	17.9	-
2-25-99	25	7.08	136	2.83	18	-
2-25-99	27	7.10	138	2.80	17.9	-
2-25-99	29	7.15	89	2.79	17.7	-
2-25-99	31	6.52	58	2.82	18.0	-
2-25-99	33	6.27	73	2.53	17.8	-
2-25-99	34	6.55	90	2.79	17.9	-
2-25-99	35	6.65	59	2.63	17.8	-
2-25-99	36	6.66	60	2.79	17.2	-
2-25-99	38	6.64	58	2.81	17.8	-
2-25-99	39.5	6.65	30	2.82	17.5	-
2-25-99	41	6.82	19	2.79	17.1	-
2-25-99	42	6.68	11	2.52	17.0	-
2-25-99	43	6.52	17	2.51	17.4	-

DATE	VOLUME Gallons	pH	Turb NTU	Cond mS/cm	Temp Celsius	Sal %
2-25-99	44	6.46	12	2.52	17.1	-

Well Development Completed on:2-25-99

COMMENTS:

Attachment B
Aquifer Test Results



FDS08D INJECTION

Data Set: C:\TEMP\CHARLE~1\4-08D.AQT
Date: 06/21/99 Time: 11:54:12

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Test Location: Charleston
Test Well: FDS08D
Test Date: 6/3/99

AQUIFER DATA

Saturated Thickness: 31. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.405 ft
Casing Radius: 0.0833 ft
Screen Length: 10. ft
Water Column Height: 7.8 ft
Wellbore Radius: 0.333 ft
Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined
K = 0.0001962 ft/min

Data Set: C:\TEMP\CHARLE~1\4-08D.AQT
Title: FDS08D Injection
Date: 06/21/99
Time: 14:38:39

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Location: Charleston
Test Date: 6/3/99
Test Well: FDS08D

AQUIFER DATA

Saturated Thickness: 31. ft
Anisotropy Ratio (Kz/Kr): 1.

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: FDS08D

X Location: 0. ft
Y Location: 0. ft

No. of observations: 131

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.1666	1.405	0.7333	0.326	6.6	0.27
0.175	1.402	0.75	0.326	6.8	0.267
0.1833	1.389	0.7666	0.33	7.	0.267
0.1916	1.377	0.7833	0.33	7.2	0.267
0.2	1.364	0.8	0.326	7.4	0.264
0.2083	1.355	0.8166	0.477	7.6	0.26
0.2166	1.345	0.8333	0.336	7.8	0.26
0.225	1.333	0.85	0.333	8.	0.257
0.2333	1.323	0.8666	0.333	8.2	0.254
0.2416	1.311	0.8833	0.33	8.4	0.254
0.25	1.339	0.9	0.33	8.6	0.251
0.2583	1.282	0.9166	0.326	8.8	0.248
0.2666	1.282	0.9333	0.33	9.	0.245
0.275	1.273	0.95	0.326	9.2	0.245
0.2833	1.263	0.9666	0.326	9.4	0.242
0.2916	1.254	0.9833	0.326	9.6	0.242
0.3	1.248	1.	0.326	9.8	0.242
0.3083	1.238	1.2	0.339	10.	0.238

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.3166	1.229	1.4	0.33	12.	0.226
0.325	1.219	1.6	0.323	14.	0.216
0.3333	1.21	1.8	0.32	16.	0.207
0.35	1.194	2.	0.317	18.	0.201
0.3666	1.178	2.2	0.314	20.	0.191
0.3833	1.166	2.4	0.311	22.	0.185
0.4	1.15	2.6	0.311	24.	0.182
0.4166	1.138	2.8	0.308	26.	0.179
0.4333	1.125	3.	0.301	28.	0.166
0.45	1.109	3.2	0.301	30.	0.16
0.4666	1.097	3.4	0.301	32.	0.157
0.4833	1.087	3.6	0.298	34.	0.15
0.5	1.075	3.8	0.295	36.	0.147
0.5166	1.034	4.	0.292	38.	0.147
0.5333	0.792	4.2	0.292	40.	0.141
0.55	0.839	4.4	0.289	42.	0.141
0.5666	0.829	4.6	0.289	44.	0.132
0.5833	0.814	4.8	0.286	46.	0.125
0.6	0.707	5.	0.282	48.	0.122
0.6166	0.553	5.2	0.279	50.	0.119
0.6333	0.54	5.4	0.279	52.	0.116
0.65	0.509	5.6	0.279	54.	0.113
0.6666	0.273	5.8	0.276	56.	0.106
0.6833	0.26	6.	0.273	58.	0.106
0.7	0.326	6.2	0.273	60.	0.106
0.7166	0.326	6.4	0.273		

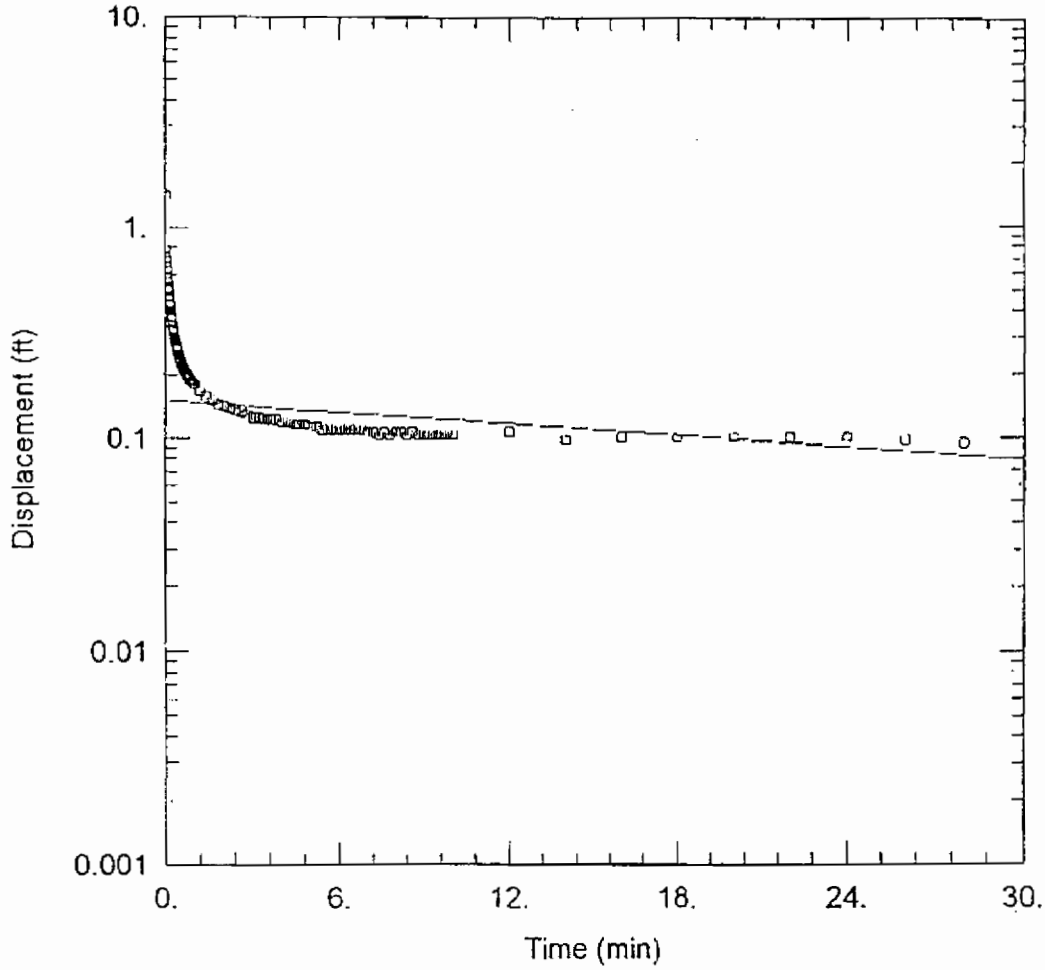
SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0001962	ft/min
y0	0.3544	ft



FDS08D WITHDRAWAL

Data Set: C:\TEMP\CHARLE~1\4-18D.AQT
Date: 06/21/99 Time: 12:04:28

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Test Location: Charleston
Test Well: FDS08D
Test Date: 6/3/99

AQUIFER DATA

Saturated Thickness: 31. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.405 ft Water Column Height: 7.8 ft
Casing Radius: 0.0833 ft Wellbore Radius: 0.333 ft
Screen Length: 10. ft Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined K = 0.0001395 ft/min

Data Set: C:\TEMP\CHARLE~1\4-18D.AQT
Title: FDS08D Withdrawal
Date: 06/21/99
Time: 14:39:08

PROJECT INFORMATION

Company: EnSafe
Client: SouthDiv
Project: 0144
Location: Charleston
Test Date: 6/3/99
Test Well: FDS08D

AQUIFER DATA

Saturated Thickness: 31. ft
Anisotropy Ratio (Kz/Kr): 1.

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: FDS08D

X Location: 0. ft
Y Location: 0. ft

No. of observations: 133

Observation Data

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.0166	0.788	0.45	0.254	3.4	0.122
0.025	0.763	0.4666	0.251	3.6	0.122
0.0333	0.738	0.4833	0.245	3.8	0.122
0.0416	0.713	0.5	0.242	4.	0.119
0.05	0.685	0.5166	0.238	4.2	0.119
0.0583	0.644	0.5333	0.235	4.4	0.116
0.0666	0.641	0.55	0.229	4.6	0.116
0.075	0.619	0.5666	0.226	4.8	0.116
0.0833	0.6	0.5833	0.223	5.	0.113
0.0916	0.581	0.6	0.22	5.2	0.113
0.1	0.565	0.6166	0.216	5.4	0.11
0.1083	0.549	0.6333	0.216	5.6	0.11
0.1166	0.534	0.65	0.213	5.8	0.11
0.125	0.518	0.6666	0.21	6.	0.11
0.1333	0.502	0.6833	0.207	6.2	0.11
0.1416	0.487	0.7	0.204	6.4	0.11
0.15	0.474	0.7166	0.204	6.6	0.11
0.1583	0.462	0.7333	0.201	6.8	0.11

Time (min)	Displacement (ft)	Time (min)	Displacement (ft)	Time (min)	Displacement (ft)
0.1666	0.449	0.75	0.201	7.	0.106
0.175	0.436	0.7666	0.198	7.2	0.106
0.1833	0.427	0.7833	0.194	7.4	0.103
0.1916	0.418	0.8	0.194	7.6	0.106
0.2	0.405	0.8166	0.194	7.8	0.103
0.2083	0.399	0.8333	0.191	8.	0.106
0.2166	0.389	0.85	0.188	8.2	0.106
0.225	0.38	0.8666	0.188	8.4	0.103
0.2333	0.374	0.8833	0.188	8.6	0.106
0.2416	0.364	0.9	0.185	8.8	0.103
0.25	0.355	0.9166	0.185	9.	0.103
0.2583	0.352	0.9333	0.185	9.2	0.103
0.2666	0.342	0.95	0.182	9.4	0.103
0.275	0.336	0.9666	0.179	9.6	0.103
0.2833	0.33	0.9833	0.179	9.8	0.103
0.2916	0.326	1.	0.179	10.	0.103
0.3	0.32	1.2	0.166	12.	0.106
0.3083	0.314	1.4	0.157	14.	0.097
0.3166	0.311	1.6	0.15	16.	0.1
0.325	0.304	1.8	0.144	18.	0.1
0.3333	0.301	2.	0.141	20.	0.1
0.35	0.292	2.2	0.138	22.	0.1
0.3666	0.286	2.4	0.135	24.	0.1
0.3833	0.279	2.6	0.132	26.	0.097
0.4	0.27	2.8	0.128	28.	0.094
0.4166	0.267	3.	0.125		
0.4333	0.26	3.2	0.125		

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	0.0001395	ft/min
y0	0.1497	ft

Attachment C
Analytical Data

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SAMPLING
AREA 8

SW846-META

SAMPLE ID ------->	FDS-G-W08D-01
ORIGINAL ID ----->	FDSGW08D01
LAB SAMPLE ID --->	37648.03
ID FROM REPORT -->	FDSGW08D01
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/18/99
DATE ANALYZED --->	03/19/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
7439-97-6	Mercury (Hg)	0.1	U
7440-38-2	Arsenic (As)	3.3	U
7440-39-3	Barium (Ba)	38.9	
7440-43-9	Cadmium (Cd)	0.3	U
7440-47-3	Chromium (Cr)	0.7	U
7439-92-1	Lead (Pb)	2.1	U
7782-49-2	Selenium (Se)	4.5	U
7440-22-4	Silver (Ag)	1.4	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SAMPLING
AREA 8

SW846-SVOA

SAMPLE ID ------->	FDS-G-W08D-01
ORIGINAL ID ----->	FDSGW08D01
LAB SAMPLE ID --->	37648.03
ID FROM REPORT -->	FDSGW08D01
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/08/99
DATE ANALYZED --->	03/15/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
91-20-3	Naphthalene	10.	U
56-55-3	Benzo(a)anthracene	10.	U
218-01-9	Chrysene	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U

*** Validation Complete ***

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR SAMPLING
AREA 8

SW846-VOA

SAMPLE ID ------->	FDS-G-W08D-01
ORIGINAL ID ----->	FDSGW08D01
LAB SAMPLE ID --->	37648.03
ID FROM REPORT -->	FDSGW08D01
SAMPLE DATE ----->	03/05/99
DATE ANALYZED --->	03/10/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
71-43-2	Benzene	5.	U
100-41-4	Ethylbenzene	5.	U
108-88-3	Toluene	5.	U
1330-20-7	Xylene (Total)	5.	U

*** Validation Complete ***

Areas 9 and 10

(SCDHEC No. 01184)

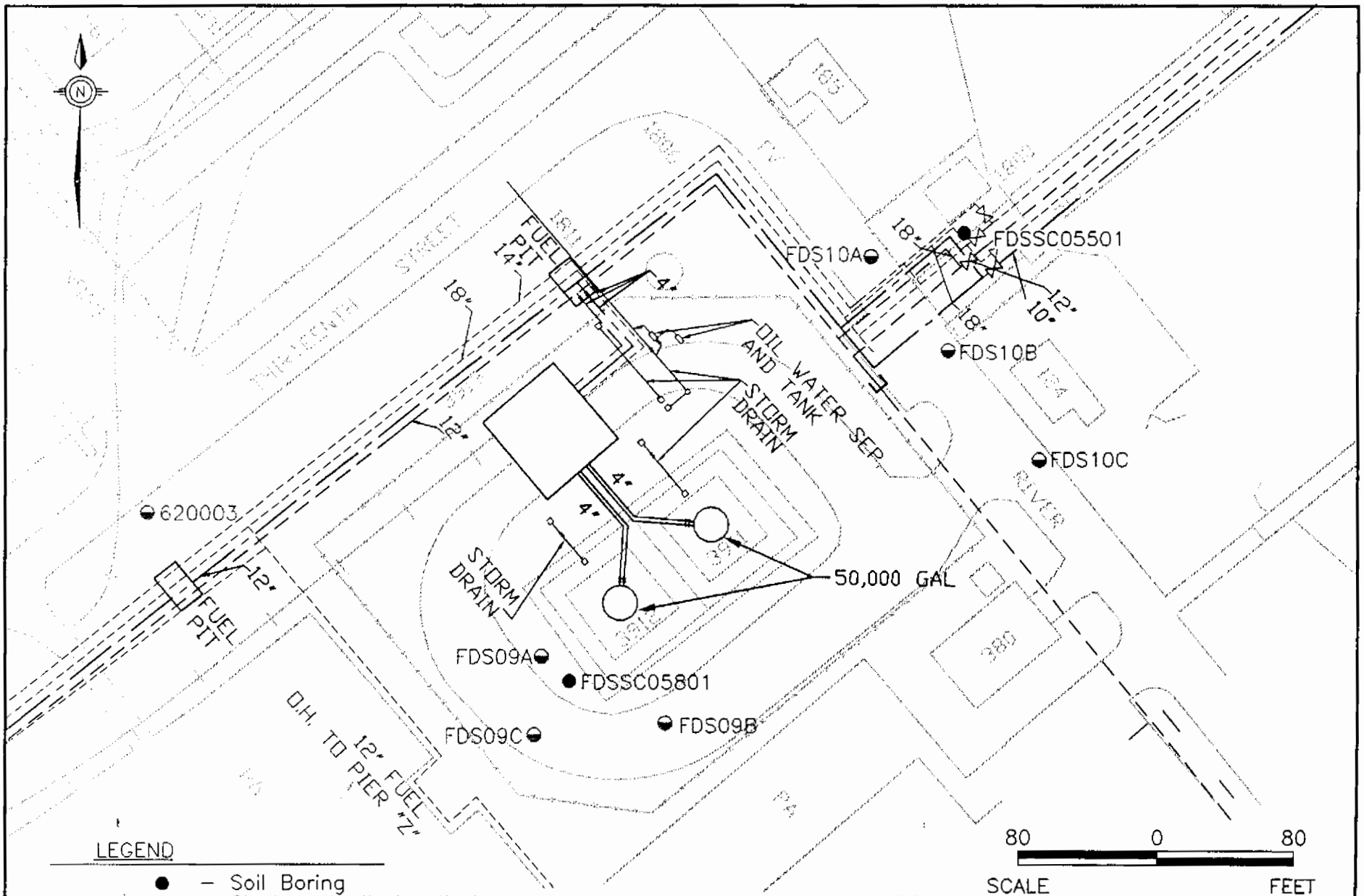
Background

The combined Areas 9 and 10 of the Fuel Distribution System (FDS) are associated with Phase I soil samples FDSSC05501 and FDSSC05801. As reported in the *FDS Contamination Assessment Report* (CAR), these samples exhibited total petroleum hydrocarbons-gasoline range organics of 63.7 micrograms per kilogram (μg/kg) at FDSSC05501 and 10 μg/kg at FDSSC05801, which prompted Phase II soil and groundwater sampling within Areas 9 and 10. Phase II soil sampling revealed total naphthalenes of 250 μg/kg in sample FDSSC05801 which exceeded the risk-based screening level (RBSL) of 210 μg/kg. To determine if groundwater has been adversely impacted by these petroleum chemicals of concern (COCs), 6 shallow groundwater monitoring wells were installed and sampled in the combined area during Phase II. No COCs exceeded their respective RBSLs at the combined area during the Phase II groundwater investigation (CAR EnSafe 1998). Figure 1 depicts the Areas 9 and 10 sample locations.

No follow-on investigative activities were performed at Areas 9 and 10.

Conclusions and Recommendations

As reported in the CAR, the total naphthalene concentration detected in soil sample FDSSC5801 was 250 μg/kg which exceeds the RBSL of 210 μg/kg. Because this sample was collected below the water table at a depth of 5 to 9 feet, it is effectively a sample of the aquifer matrix, and therefore Site Specific Target Levels would not apply. This concentration is also below the generic soil-to-groundwater soil screening level (SSL [DAF=20]) of 84,000 μg/kg (from the *Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting migration to groundwater is unlikely. This is further substantiated by the fact that no naphthalene was detected in the Phase II groundwater sampling at Areas 9 and 10 in two sampling events.



LEGEND

- ● – Soil Boring
- ◒ – Shallow Monitoring Well
- ⋈ – Valve
- —·—·—·— – Fence
- - - - - - - - - – Diesel Line
- —— - —— – Fuel Line
- — — — — — – Sludge Line

FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREAS 9 AND 10
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907N006

No groundwater COCs exceeded their RBSLs at Areas 9 and 10, and there is an apparent lack of leaching of RBSL parameters from soil-to-groundwater. To demonstrate that the naphthalene in soil is not adversely impacting groundwater, the Navy proposes to monitor groundwater at this site. The program will consist of two quarterly sampling events during which the wells surrounding FDSSC05801 (FDS09A, FDS09B, FDS09C) will be sampled for polycyclic aromatic hydrocarbon COCs. If no RBSLs are exceeded in these monitoring samples, the site should be considered for no further action.

Areas 12, 13, and 14

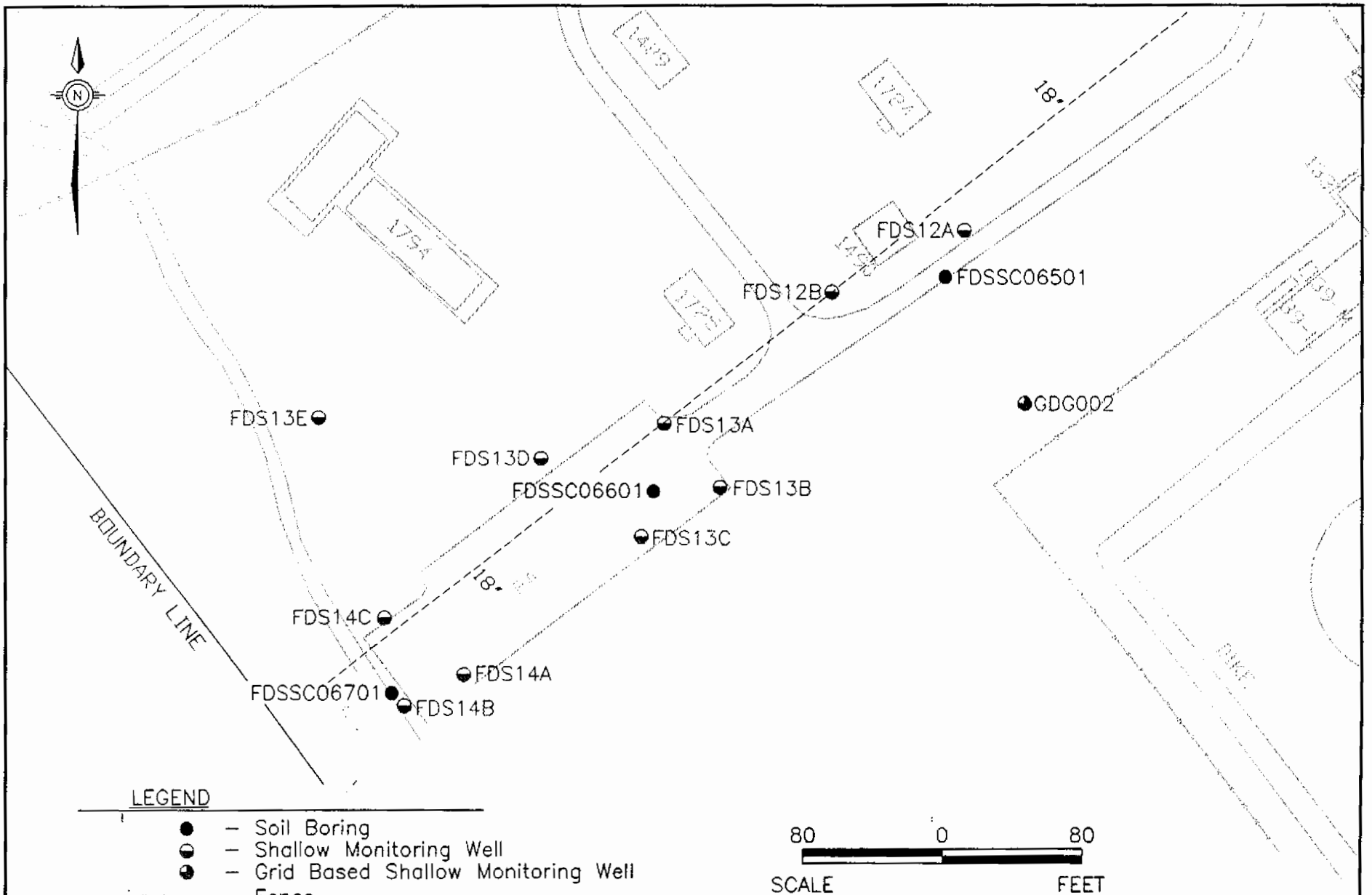
(SCDHEC No. 01186)

Background

The combined Areas 12, 13, and 14 of the Fuel Distribution System (FDS) are associated with Phase I soil samples FDSSC06501 through FDSSC06701. These samples exhibited total petroleum hydrocarbons-gasoline range organics ranging from 67 micrograms per kilogram (μg/kg) at FDSSC06601 to 147 μg/kg at FDSSC06501. The Phase I soil results prompted subsequent Phase II soil and groundwater sampling at the combined areas. Phase II soil sampling revealed total naphthalenes of 6,500 μg/kg and 4,700 μg/kg at FDSSC06601 and FDSSC06701, respectively, which exceeded the risk-based screening level (RBSL) of 210 μg/kg. To determine if groundwater has been adversely affected by petroleum constituents, 10 shallow groundwater monitoring wells were installed and sampled in the combined areas during Phase II. Data from nearby shallow grid well GDG002 were also incorporated into the investigation. During the first sampling event 50.3 micrograms per liter (μg/L) of arsenic was detected at FDS14A, which slightly exceeded the RBSL of 50 μg/L. Arsenic was detected at 21.8 μg/L at FDS14A during the second sampling, which was below the RBSL. Arsenic was detected at 210 μg/L at FDS13A during the second sampling event. No groundwater RBSLs for organics were exceeded at the combined areas *(Contamination Assessment Report* [CAR], EnSafe 1998). Figure 1 depicts the Areas 12, 13, and 14 sample locations.

Follow-on Activities

The CAR recommended and South Carolina Department of Health and Environmental Control (SCDHEC) concurred that intrinsic remediation was appropriate to address the total naphthalenes detected in soil at Areas 12, 13, and 14. The CAR also recommended that monitoring well FDS13A be resampled for arsenic. This sampling was completed in March 1999.



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREAS 12, 13, AND 14
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907N008

Results

Post-CAR sampling at FDS13A detected 18.3 μg/L of arsenic in groundwater, well below the RBSL of 50 μg/L, as shown in Table 1. Attachment A contains the analytical data from the resampling of FDS13A. The CAR contains analytical data from previous sampling.

Table 1
Analytes Detected in Shallow Groundwater
Post-CAR Sampling, Area 13
Fuel Distribution System

Parameters	Location	Sample Results	RBSL (μg/L)	Exceeds RBSL
Inorganics (μg/L)				
Arsenic (As)	FDS13A	18.3	50	No

Notes:

μg/L = Micrograms per liter
RBSLs from the *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, January 5, 1998).

Conclusions and Recommendations

As reported in the CAR, concentrations of total naphthalenes in soil at FDSSC06601 (6,500 μg/kg) and FDSSC06701 (4,700 μg/kg) exceed the RBSL of 210 μg/kg. Because these samples were collected below the water table at a depth of 8.5 to 10.5 feet, they are effectively samples of the aquifer matrix and therefore Site Specific Target Levels would not be applicable. These concentrations are also below the 84,000 μg/kg soil-to-groundwater soil screening level (SSL [DAF=20]) from the (*Soil Screening Guidance: Technical Background Document* [USEPA 1996]), suggesting migration to groundwater is unlikely.

To support the CAR's recommendation of intrinsic remediation for the total naphthalenes detected in soil, limited monitoring of groundwater is recommended. Groundwater at well FDS14B downgradient of FDSSC06701 and wells FDS13B and FDS13C downgradient of FDSSC06601 should be sampled and analyzed for RBSL SVOCs two more times at three-month intervals to demonstrate that soil contaminants are not adversely impacting groundwater.

The results of the resampling of monitoring well FDS13A for arsenic in shallow groundwater revealed a detection of 18.3 μg/L, below the RBSL of 50 μg/L. This concentration is comparable to the Zone G background concentration of 17.8 μg/L. It is also comparable to the 27 μg/L of arsenic detected in the initial sampling event. These concentrations suggest that the 210 μg/L detected during the second sampling event was an anomalously high concentration. In accordance with the recommendation presented in the CAR and as agreed to by SCDHEC in the November 18, 1998 letter, no further action is recommended for groundwater at the combined Areas 12, 13 and 14. In addition, groundwater is not currently used at Charleston Naval Complex (CNC) as a source of potable or process water; a basewide potable water system provides drinking and process water to buildings at CNC. This system is to remain in operation under the current base reuse plan. This shallow aquifer contains significant concentrations of naturally occurring chlorides and elevated total dissolved solids, which make this water-bearing unit a questionable potable water source.

Attachment A
Analytical Data

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST-CAR GROUNDWATER SAMPLING
AREAS 12, 13, AND 14

ARSENIC

SAMPLE ID ------->	FDS-G-W13A-03
ORIGINAL ID ----->	FDSGW13A03
LAB SAMPLE ID --->	37648.04
ID FROM REPORT -->	FDSGW13A03
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/09/99
DATE ANALYZED --->	03/10/99
MATRIX ---------->	Water
UNITS ---------->	UG/L

CAS #	Parameter	37648	VAL
7440-38-2	Arsenic (As)	18.3	

*** Validation Complete ***

Area 18

(SCDHEC No. 01188)

Background

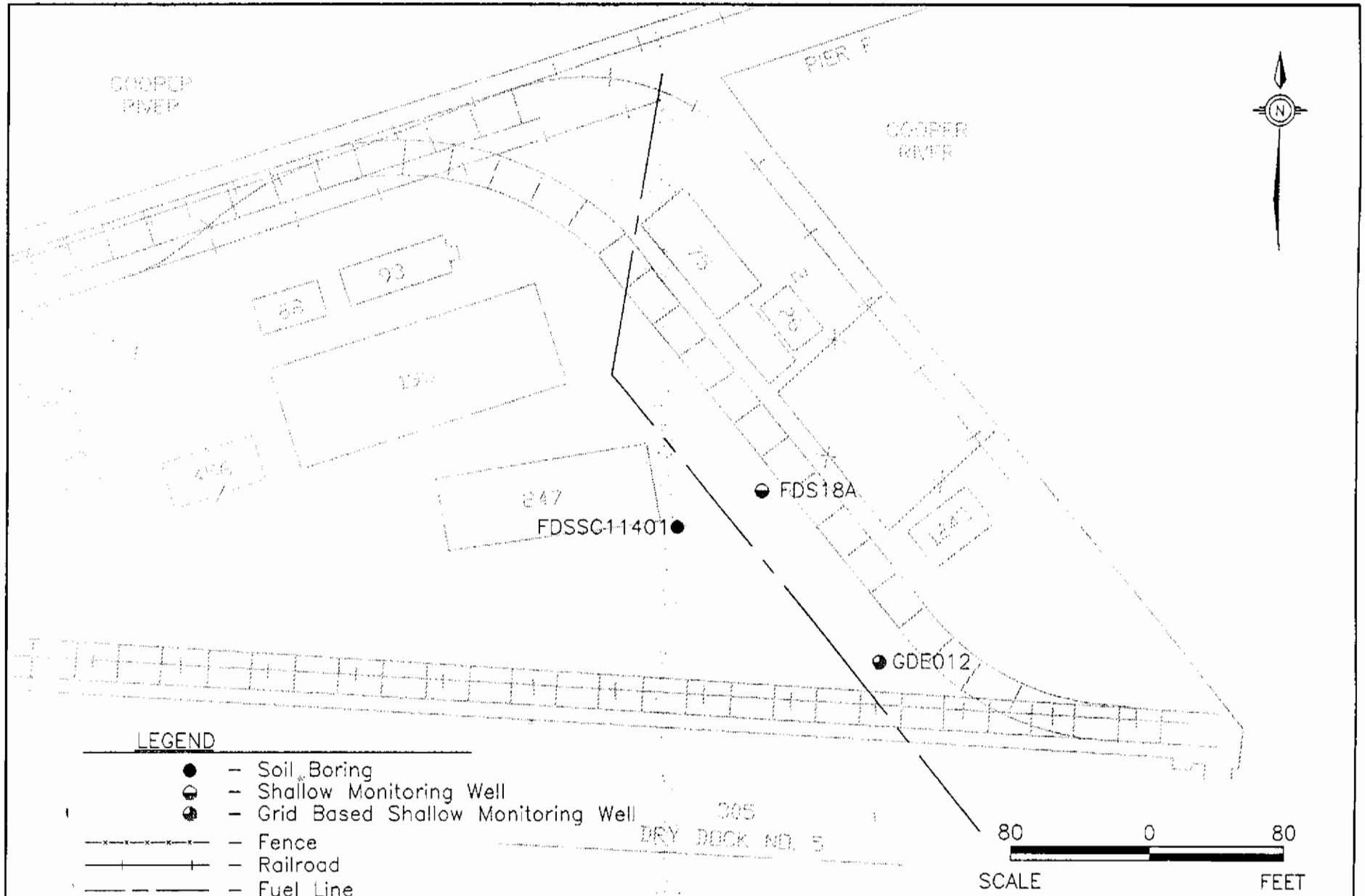
Area 18 of the Fuel Distribution System (FDS) is associated with Phase I soil sample FDSSC11401, which exhibited total petroleum hydrocarbons-diesel range organics of 366 milligrams per kilogram (mg/kg), which prompted Phase II soil and groundwater sampling within Area 18. Phase II soil sampling revealed that no risk-based screening levels (RBSLs) were exceeded. Phase II also included installation and sampling of monitoring well FDS18A. Groundwater analytical results identified no exceedances of RBSL chemicals of concern. The only constituent of interest at Area 18 was pentachlorophenol (PCP), which was detected above its USEPA tap water risk-based concentration (RBC) at FDS18A during the second sampling event only (*Contamination Assessment Report* [CAR], EnSafe 1998). Figure 1 shows the sample locations at Area 18.

Follow-on Activities

Because no petroleum chemicals of concern were exceeded at monitoring well FDS18A or in the soil sample FDSSC11401, the CAR recommended no further action for soil and groundwater at Area 18. The South Carolina Department of Health and Environmental Control recommended resampling of FDS18A for semi-volatile organic compounds (SVOCs) including PCP. This sampling effort was completed in March 1999.

Results

Monitoring well FDS18A was resampled in March 1999 for SVOCs and PCP. No organic compounds were detected in this sample. Attachment A contains the analytical results from the post-CAR sampling.



FUEL DISTRIBUTION SYSTEM
LETTER REPORT
CHARLESTON NAVAL COMPLEX
CHARLESTON, S.C.

FIGURE 1
AREA 18
SAMPLE LOCATIONS

DWG DATE: 06/07/99 | DWG NAME: 2907R001

CHARLESTON CTO-0144 FUEL DISTRIBUTION
POST CAR GROUNDWATER SAMPLING
AREA 18

SVOA+PCP

SAMPLE ID ------->	FDS-G-W18A-03
ORIGINAL ID ----->	FDSGW18A03
LAB SAMPLE ID --->	37648.05
ID FROM REPORT -->	FDSGW18A03
SAMPLE DATE ----->	03/05/99
DATE EXTRACTED -->	03/08/99
DATE ANALYZED --->	03/15/99
MATRIX ---------->	Water
UNITS ----------->	UG/L

CAS #	Parameter	37648	VAL
91-20-3	Naphthalene	10.	U
56-55-3	Benzo(a)anthracene	10.	U
218-01-9	Chrysene	10.	U
205-99-2	Benzo(b)fluoranthene	10.	U
207-08-9	Benzo(k)fluoranthene	10.	U
87-86-5	Pentachlorophenol	25.	U

*** Validation Complete ***