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"ANNUAL OPERATIONS AND MAINTENANCE STATUS REPORT FOR AIR SPARGE, BIOSPARGE AND SOIL VAPOR EXTRACTION SYSTEM AT NORTH FUEL FARM AREA REMEDIATION PROJECT NAS CECIL FIELD FL"
2/1/2007
AGVIO ENVIRONMENTAL SERVICES

Annual
Operations and Monitoring
Status Report

Air Sparge, Biosparge and SVE System
North Fuel Farm Area Remediation Project

Naval Air Station Cecil Field
Jacksonville, Florida

July 2005 – September 2006

Contract No. N62467-03-D-0260
Task Order No. 0001

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U. S. Naval Facilities
Engineering Command
Southeast

February 2007

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A SVE Discontinuation Documentation
B Laboratory Analytical Results for Air and Groundwater Samples (provided on CD)

Acronyms

µg/L	micrograms per liter
AS	air sparge
bls	below land surface
BS	biosparge
BTEX	benzene, toluene, ethylbenzene, and xylenes
DO	dissolved oxygen
EPA	U.S. Environmental Protection Agency
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FL-PRO	Florida Petroleum Residual Organic
GCTLs	Groundwater Cleanup Target Levels
gpm	gallons per minute
HAPS	hazardous air pollutants
in Hg	inches of mercury
JVII	Joint Venture II
LNAPL	light non-aqueous phase liquid
mg/L	milligrams per liter
MNA	monitored natural attenuation
mV	millivolts
NAS	Naval Air Station
NAVFAC SE	U.S. Naval Facilities Engineering Command Southeast
NFF	North Fuel Farm
NGVD	National Geodetic Vertical Datum
NM	not measured
NTU	nephelometric turbidity unit
O&M	operations and maintenance
^{o}F	degrees Fahrenheit
ORP	oxygen reduction potential
PAH	polycyclic aromatic hydrocarbons
PLC	Programmable logic controller
ppbv	parts per billion volume
psig	pounds per square inch gauge
RAPA	Remedial Action Plan Addendum
scfm	standard cubic feet per minute
SVE	Soil Vapor Extraction
TEP	triethylphosphate
TO	Contract Task Order
TRPH	total recoverable petroleum hydrocarbon
VEW	vapor extraction well
VOC	volatile organic compounds
YSI	flow-through cell

1.0 Introduction

AGVIQ Environmental Services, LLC-CH2M HILL Constructors, Inc. Joint Venture II (JVII) was contracted by the U.S. Naval Facilities Engineering Command, Southeast (NAVFAC SE, hereafter referred to as "the Navy"), to provide operation and maintenance (O&M) services at the former North Fuel Farm (NFF) Area located at Former Naval Air Station (NAS) Cecil Field, Jacksonville, Florida. This work was performed under Contract No. N62467-03-D-0260, Task Order (TO) No. 0001.

The purpose of this Annual Operations and Monitoring Status Report is to provide information on the quarterly O&M activities associated with the operation of the air sparge (AS), bio-sparge (BS), and Soil Vapor Extraction (SVE) system installed by JVII at the NFF site, during the period from June 2005 to November 2006. This report also includes a summary of the analytical results from the baseline groundwater sampling event of January 2005 prior to the commencement of AS/BS/SVE treatment system operations and quarterly groundwater monitoring events following the commencement of full-scale operations in July 2005.

The design for the construction and installation of the AS/BS/SVE system was based on the Remedial Action Plan Addendum (RAPA) prepared by TetraTech NUS and submitted to the Navy during January 2004.

O&M activities prescribed in the RAPA included the following activities:

- Perform routine O&M checks of system (including recording meter and gauge measurements) and general maintenance and housekeeping of the treatment system area and sparge wellfield area.
- Adjust and balance flow rates.
- Collect water level measurements.
- Collect influent and effluent samples from the SVE system and groundwater samples from specified monitoring wells for treatment effectiveness and natural attenuation evaluations.

1.1 Objective

The remedial action objective behind the operation of the AS/BS/SVE system installed and operated at the NFF site is to reduce the concentrations of petroleum contaminants in the groundwater to levels sufficient to allow natural attenuation processes to complete achievement of groundwater cleanup to the Florida Department of Environmental Protection (FDEP) Groundwater Cleanup Target Levels (GCTLs). These GCTLs are specified in Table I of Chapter 62-777, Florida Administrative Code (FAC). The remediation is targeted at the petroleum-impacted media, ranging in depth from the water table to a confining unit that is approximately 110 feet below land surface (bls) at the site.

1.2 Site History

The NFF is located in the northwest corner of Aviation Avenue and Loop Road at NAS Cecil Field, and formerly contained six 595,000-gallon JP-5 jet fuel storage tanks. Figure 1-1 shows the location of the NFF site within the former NAS Cecil Field and Figure 1-2 shows the site layout. A release of approximately 900,000 gallons of fuel occurred at the site in 1991. In 2000 and 2001, all the storage tanks, the earth mound surrounding the tanks, and contaminated soil were removed.

During previous site investigations at the NFF site, over 100 monitoring wells were installed to evaluate the impact of the petroleum release. Analytical results from previous site investigations indicated that the following parameters were historically detected in groundwater at concentrations above the FDEP GCTLs: benzene, ethylbenzene, toluene, xylene, naphthalene, 1-methylnaphthalene, and 2-methylnaphthelene. Table 1-1 presents the maximum contaminant concentrations encountered during investigation of the site.

The extent of subsurface petroleum contamination extends vertically through the surficial aquifer from water table depths of approximately 5 feet bls to the top of a confining layer at depths ranging from 100 to 110 feet bls. The lateral extent of the plume based on existing data is estimated to be approximately 862,000 square feet.

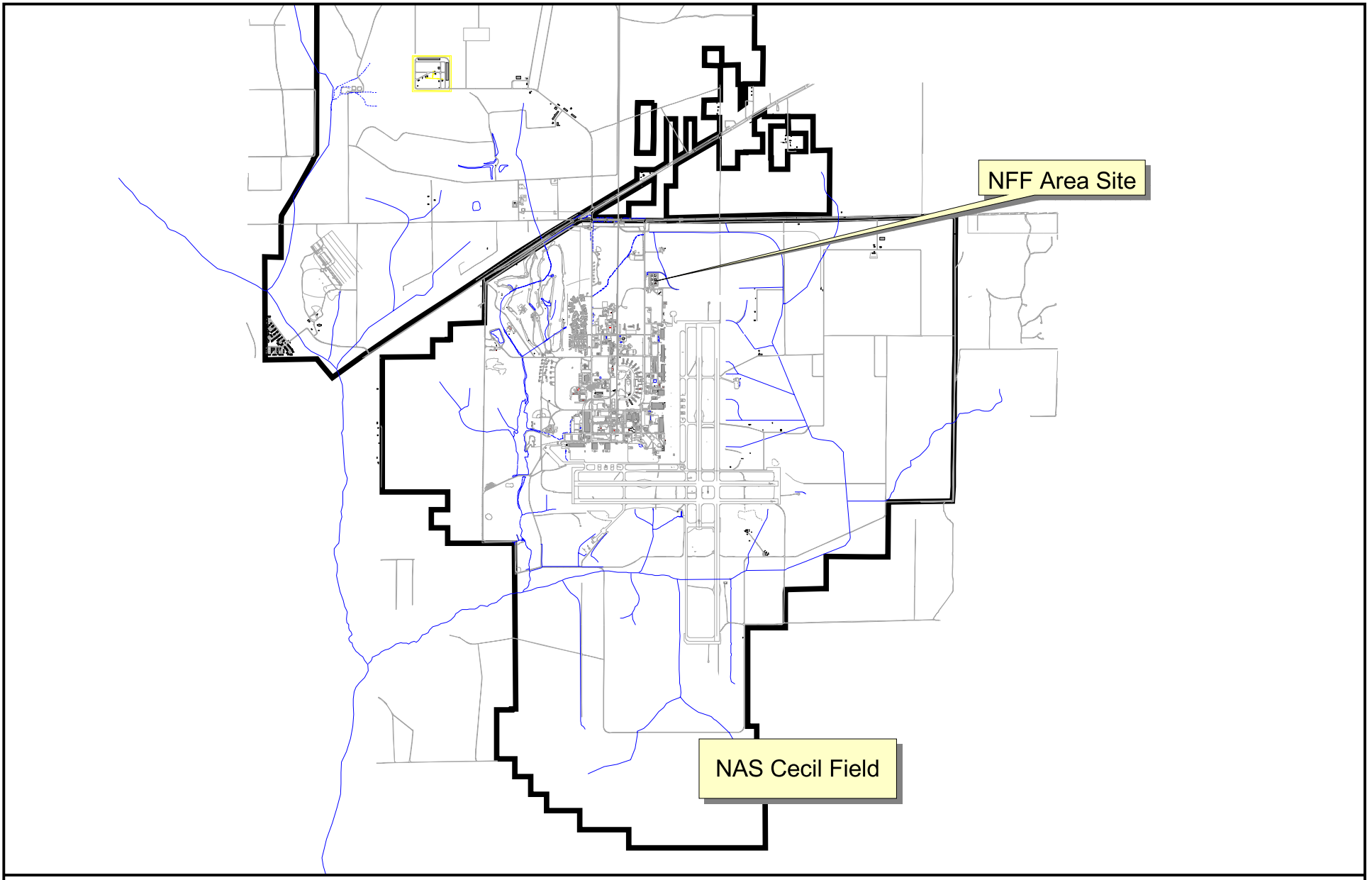
TABLE 1-1
Summary of Detected Maximum Concentrations of Chemicals of Concern, NFF Area Site, NAS Cecil Field

Chemical of Concern	Maximum Concentration Detected (ug/L)
Benzene	10,600
Toluene	6,470
Ethylbenzene	1,180
Xylenes	7,130
Naphthalene	165
1-Methylnaphthalene	61
2-Methylnaphthalene	83
Total Recoverable Petroleum Hydrocarbons (TRPH)	8,680

Also included in the NFF treatment area is the former Truck Stand Site (Facility 372), which is located approximately 300 feet southeast of the NFF facility, as shown on Figure 1-2. This site was investigated separately, and the treatment of the relatively small groundwater plume (approximately 8,000 square feet) was required. Because of the close proximity of the Truck Stand Site to the NFF, it was included under the scope of remedial activities for the NFF site.

1.3 Remediation System/Technology Description

The combined AS/BS/SVE systems have been implemented to remediate varying degrees of contamination based on benzene concentrations in groundwater. The AS system was installed in areas with benzene concentrations greater than 1,000 micrograms per liter (µg/L). The BS system was installed in areas with benzene concentrations between 100 µg/L and 1,000 µg/L.



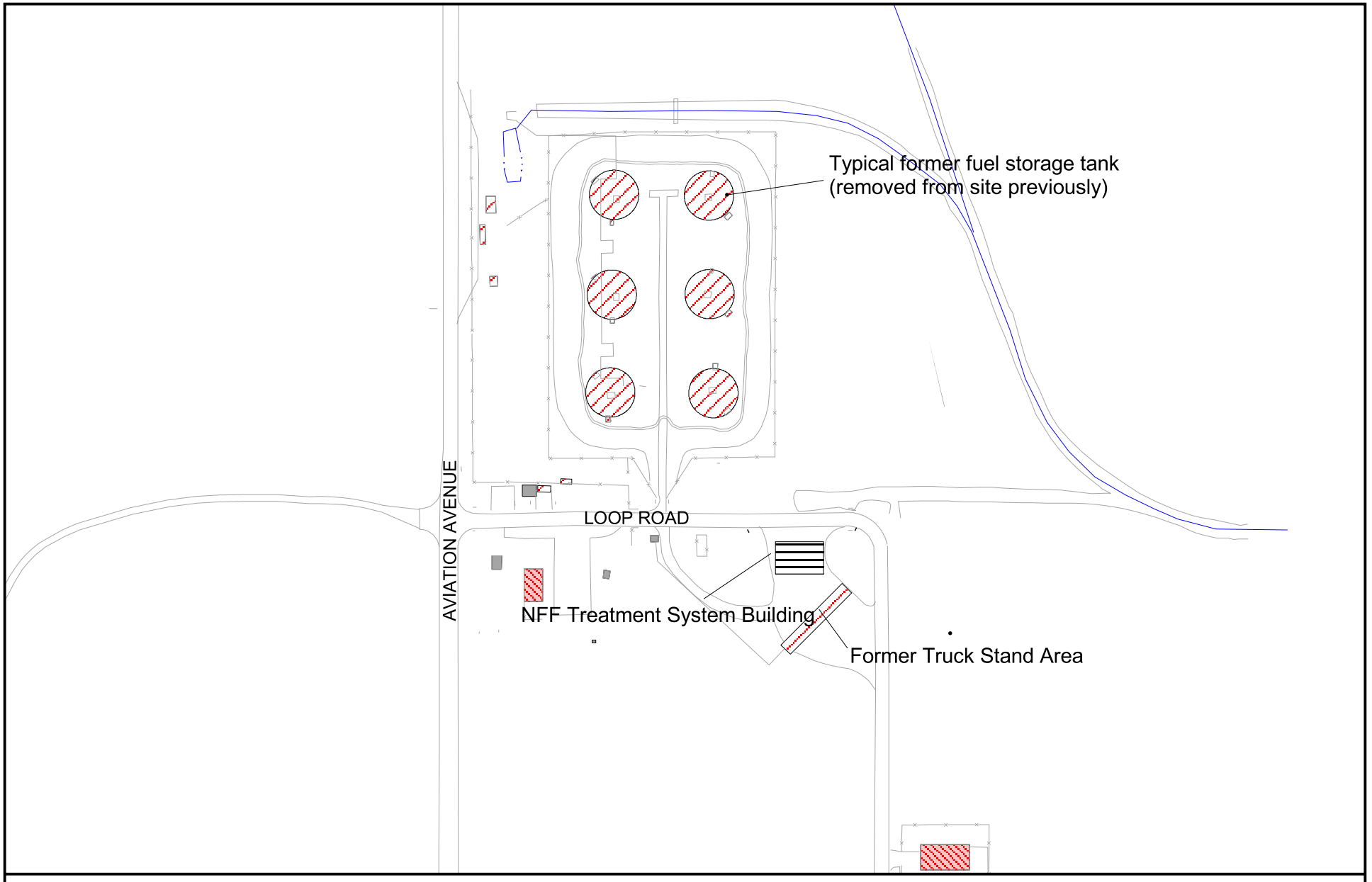
Surface Water
Roads
Property Line

N

0 3000 6000 Feet

1 inch = 5350.83 feet

Figure 1-1
Site Location
NFF Area Site
NAS Cecil Field, Jacksonville, FL



Surface Water
Roads
PERMANENT
DEMOLITION
PROPOSED-DEMOLITION

N

0 100 200 Feet

1 inch = 190.569 feet

Figure 1-2
Site Layout
North Fuel Farm Site
Former NAS Cecil Field, Jacksonville, FL

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File Path: c:\gis\nas_cecilfield.apr, Date: 04 Jan 2007 12:58, User: SNAIK1, NAS Cecil Field Area [Florida State Plane Coordinate System NAD 83 Units Feet] - Figure 1-2 Site Layout

The SVE system was installed within the footprint of the AS system in order to capture vapor released by the physical displacement of petroleum contamination within the subsurface as a result of the air sparging system. In addition, nutrients (nitrogen and phosphorus) were to be added with the injected air to the AS and BS systems to enhance natural attenuation processes. However, based on the results of the nutrient addition system at other NAS Cecil Field sites, the nutrient addition was not conducted due to the potential for impacting the geochemistry at the site. The RAPA indicates that the remediation of the groundwater plume with benzene concentration below 100 μg/L will be achieved by natural attenuation processes. The success of these processes to reduce benzene concentration will be evaluated as part of the monitored natural attenuation (MNA) monitoring and evaluation for the site.

The AS/BS treatment areas have been roughly divided into shallow and deep zones. The shallow zone wells were installed to a depth of about 50 feet bls, and the deep wells were installed to a depth between 80 and 110 feet bls.

Installations of AS and BS wells, and associated piping and treatment system components were completed between June 2004 and May 2005. Full-scale O&M at the site was begun in mid-July 2005.

1.3.1 Air Sparging System

Air sparging is a physical treatment method of expediting the physical transfer of VOCs from the soil and groundwater to gaseous medium. Compressed atmospheric air is injected into air sparge wells, which are screened within the groundwater contaminant plume. As the injected air propagates through the subsurface formation, physical stripping of the contaminants from the soil and groundwater into vapor is facilitated. The resulting upward flow of vapor through groundwater and soil to the vadose zone is captured by the soil vapor extraction system for further treatment, or if the vapor concentrations are below regulatory emission standards, they are released to the atmosphere through the unsaturated surface soil zone without further treatment.

The NFF AS system consists of 82 AS vertical wells (48 shallow and 34 deep) that were installed in areas with benzene concentrations greater than 1,000 μg/L. The shallow AS wells were installed to approximately 50 feet bls with a 2-foot screen section, and the deep AS wells from 80 to 110 feet bls, also with a 2-foot screen section. The AS system is designed for each AS well to operate at an airflow rate of 10 standard cubic feet per minute (scfm) with a system outlet pressure of a minimum of 70 pounds per square inch gauge (psig). The locations of the shallow and deep AS wells are shown on Figures 1-3 and 1-4, respectively.

The AS system is operated in a pulsed mode, where half of the AS wells are injected with compressed air for a 1-week period while compressed air supply to the other half is shut down. Therefore, half of the AS wellfield is being sparged at any given time.

1.3.2 Bio-Sparging System

The BS treatment system promotes the optimum environment for microbial activity and growth by injecting controlled volumes of air at controlled pressures, into the groundwater near the deepest point of contamination via sparge wells.

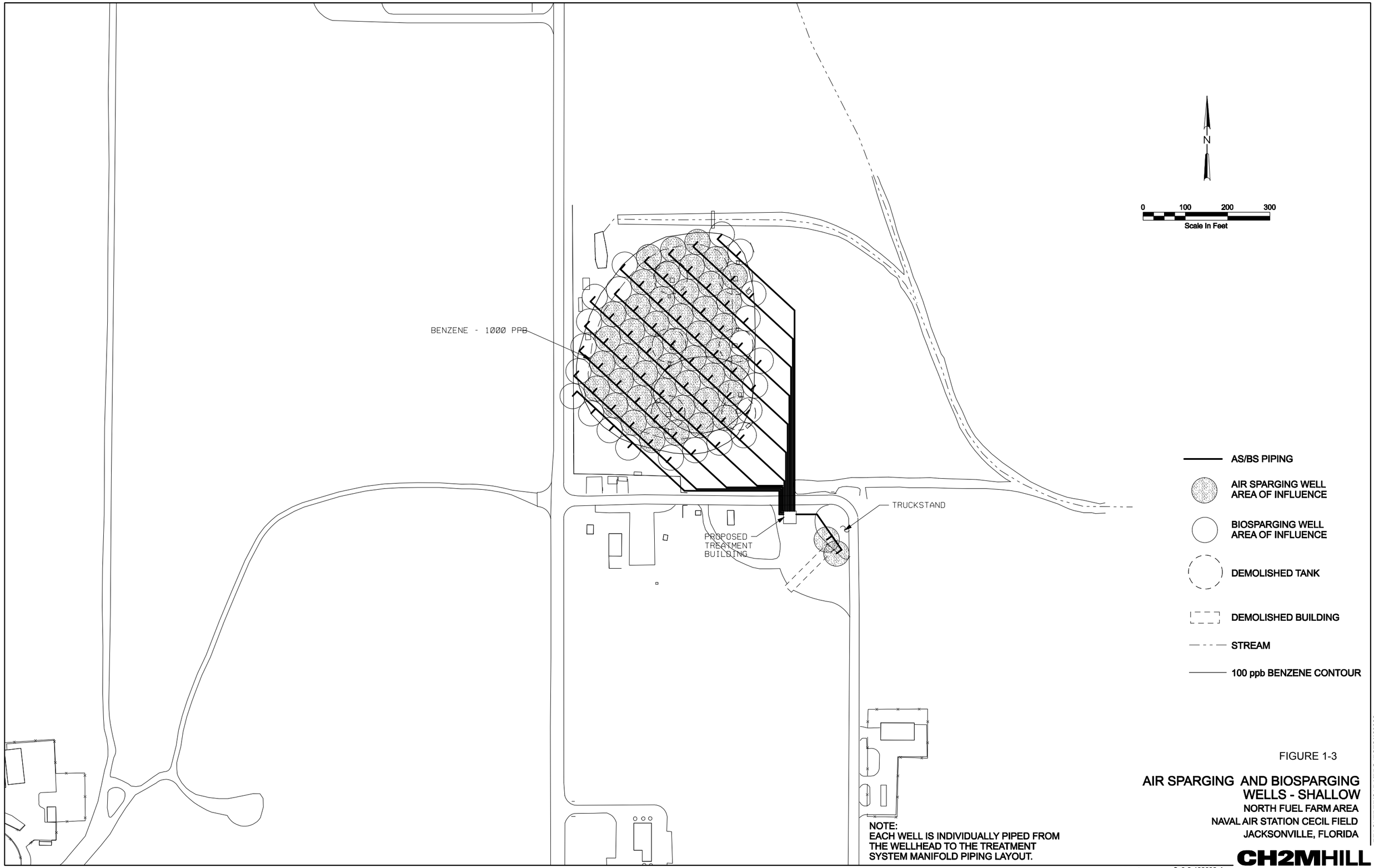


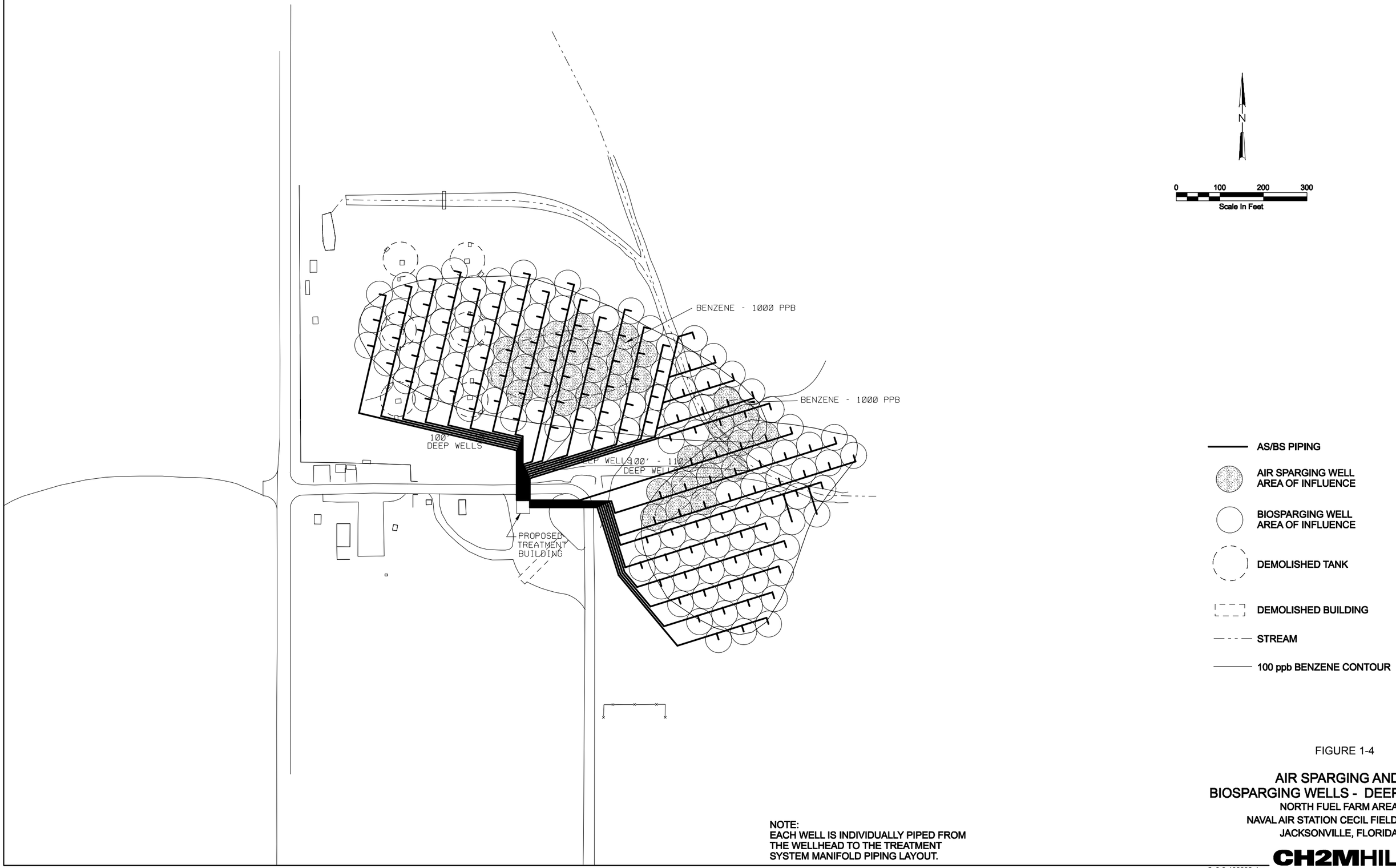
FIGURE 1-3

AIR SPARGING AND BIOSPARGING WELLS - SHALLOW

NORTH FUEL FARM AREA

NAVAL AIR STATION CECIL FIELD

JACKSONVILLE, FLORIDA



NOTE:
EACH WELL IS INDIVIDUALLY PIPED FROM THE WELLHEAD TO THE TREATMENT SYSTEM MANIFOLD PIPING LAYOUT.

FIGURE 1-4

AIR SPARGING AND BIOSPARGING WELLS - DEEP
NORTH FUEL FARM AREA
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

CH2MHILL

PEACHTREE/CAD1/PROJECTS/183092

15-DEC-2003 fig6-3-183092.dgn

The NFF biosparging system consists of 125 vertical biosparging wells (22 shallow and 103 deep wells) that were installed in areas with benzene concentrations between 100 µg/L and 1,000 µg/L. The BS wells have a 2-foot screen section. The shallow BS wells were installed to approximately 50 feet bls and the deep BS wells from 80 to 110 feet bls. The biosparging system is designed for each well to operate at a flow rate of 10 scfm and a minimum air compressor outlet pressure of 70 pounds per square inch gauge (psig). The locations of the shallow and deep BS wells are shown on Figure 1-3 and Figure 1-4, respectively.

The BS system is also operated in a pulsed mode, with each quarter of the BS wells being sparged in successive 12-hour periods, and shut down for the following 36 hours. Therefore, each quarter of the BS wellfield is sparged for 12 hours and then shut down the following 36 hours in order to allow the supplied oxygen to be consumed by subsurface microorganisms, and to facilitate bioremediation of the petroleum compounds.

Compressed air for the AS and BS systems at the NFF site is provided by a single air compressor located at the treatment system building. The discussion of the operational parameters for both the AS and BS systems has been combined in this report since the systems are operated by a single air compressor and control system.

1.3.3 Soil Vapor Extraction System

SVE is performed by applying a negative pressure, or vacuum, to vapor extraction wells (VEWs) or horizontal collection lines screened within the soil vadose zone.

Thirteen SVE collection lines were initially proposed to be installed per the RAPA design (as shown on Figure 1-5), but three SVE lines located on the eastern part of the site could not be installed because they were submerged even during the dry months due to a high water table in this low-lying area. Therefore, the SVE system at the NFF site consisted of 10 horizontal SVE collection lines (VEW-01 through VEW-10) installed at an approximate depth of 3 feet bls. The reduction in the number of SVE lines from 13 to 10 was proposed in a technical memorandum submitted by the JVII to the Navy and the FDEP during October 2004, and was approved by the FDEP (see Appendix A for a copy of the approval letter).

The SVE system is designed for a flow rate of 45 scfm in each line. The SVE system equipment includes a positive displacement blower, a moisture separation tank, and two 10,000-lb capacity granular activated carbon (GAC) units installed in series, to treat the extracted vapors prior to discharging it to the atmosphere. Due to heavy entrainment of groundwater resulting from a high water table at the site, the SVE system was shut down per FDEP approval on November 9, 2005. The recommendation to shut down the SVE system was supported by calculations of influent concentrations to the GAC filter, which indicated that the total emissions discharged on a daily basis from the SVE system were below the FDEP standard (for emissions treatment) of hazardous air pollutants of 13.7 pounds per day (lb/day).

1.3.4 Nutrient Addition System

The RAPA called for the inclusion of a nutrient amendment system to introduce nitrous oxide and triethylphosphate (TEP) as sources of nitrogen and phosphorus to further aid microorganism growth and biodegradation of the petroleum contamination. During construction of the treatment system, a spray aerator was included to atomize liquid TEP

and introduce it into the compressed air stream along with nitrous oxide. After preliminary testing to ensure its workability, the amendments were not introduced due to the possibility of adverse effects on the geochemistry observed at other sites at NAS Cecil Field, as well as other Navy installations. The naturally occurring levels of nitrogen and phosphorus at the site do not appear to be deficient for biodegradation.

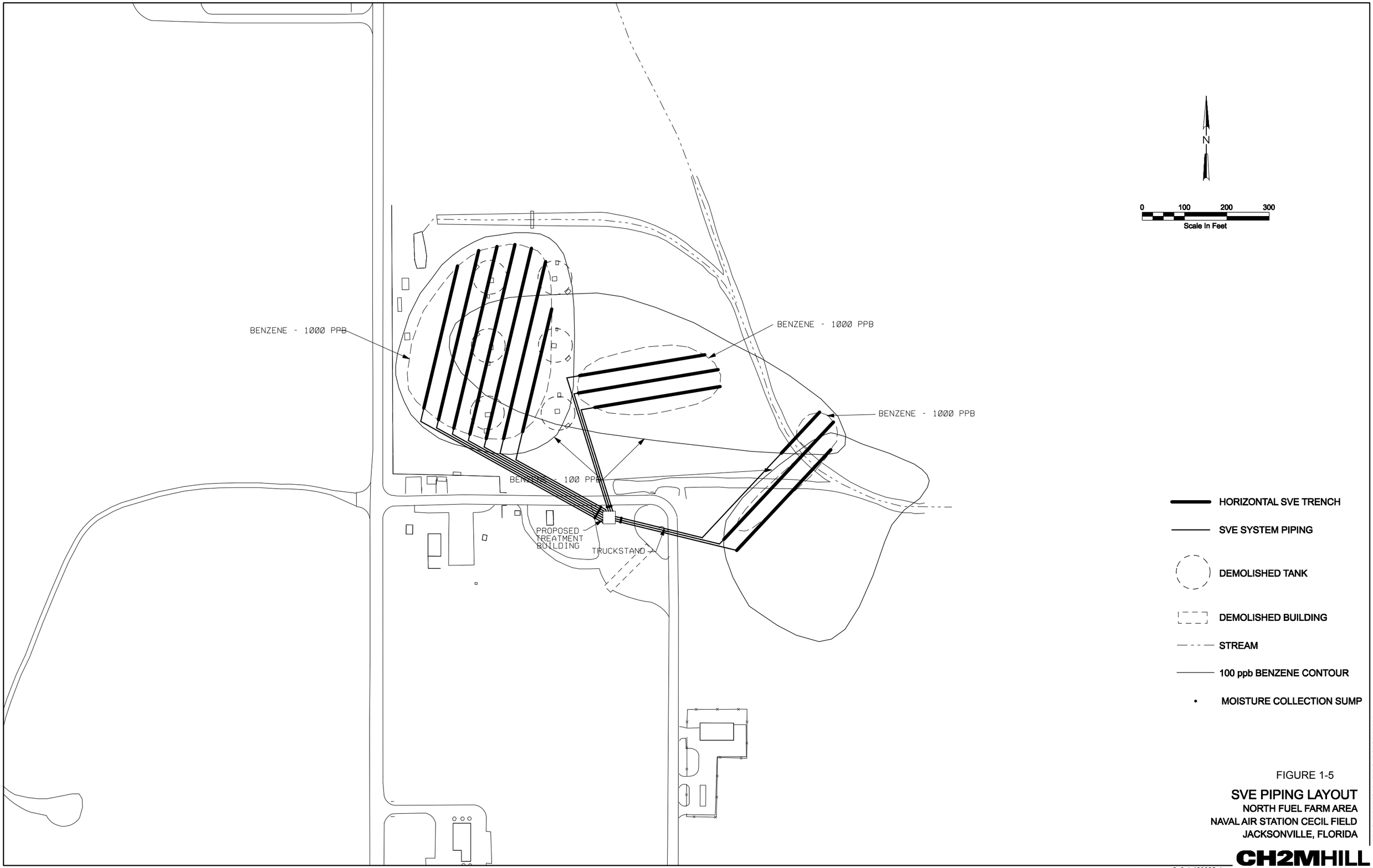


FIGURE 1-5

SVE PIPING LAYOUT

NORTH FUEL FARM AREA
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

CH2MHILL

PEACHTREE/CAD1/PROJECTS/183092

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2.0 System Performance Monitoring

Routine O&M checks of the system were performed weekly. During an O&M check, a preventive maintenance checklist (based upon manufacturer's recommendations) was completed, and any required maintenance activity was performed. The meters and gauges in the equipment area were read and recorded during the O&M check on a weekly basis during the first month, monthly during the first quarter and quarterly thereafter as prescribed in the RAPA. Additionally, a weekly site visit was conducted to troubleshoot and maintain the treatment system equipment. The meters and gauges in the AS/BS/SVE manifolds were recorded during O&M checks on a monthly basis.

2.1 Operational Efficiencies

2.1.1 Air Sparge/Biosparging System

AS/BS system operational efficiencies are listed in Table 2-1.

TABLE 2-1
AS/BS Operational Efficiencies

Third Quarter 2005	Operational Period	Overall
Hours of Possible Operation	2,264	2,264
Hours of Actual Operation	1,084	1,084
Percent Hours of Operation	74.3%	74.3%
Fourth Quarter 2005	**Operational Period**	**Overall**
Hours of Possible Operation	2,448	4,712
Hours of Actual Operation	1,682	2,766
Percent Hours of Operation	68.7%	58.7%
First Quarter 2006	**Operational Period**	**Overall**
Hours of Possible Operation	1,893	6,605
Hours of Actual Operation	1,606	4,372
Percent Hours of Operation	84.8%	66.2%
Second Quarter 2006	**Operational Period**	**Overall**
Hours of Possible Operation	1,963	8,568
Hours of Actual Operation	1,166	5,372
Percent Hours of Operation	52%	66.2%
Third Quarter 2006	**Operational Period**	**Overall**
Hours of Possible Operation	2,127	10,695
Hours of Actual Operation	1,807	7,219
Percent Hours of Operation	84.9%	67.5%

2.1.2 Soil Vapor Extraction System

SVE system operational efficiencies are listed in Table 2-2.

TABLE 2-2
SVE Operational Efficiencies

Third Quarter 2005	Operational Period	To Date
Hours of Possible Operation	2,264	2,264
Hours of Actual Operation	743	743
Percent Hours of Operation	32.8%	32.8%
Fourth Quarter 2005	**Operational Period**	**Overall**
Hours of Possible Operation	977	3,241
Hours of Actual Operation	533	1,286
Percent Hours of Operation	54.6%	39.7%

2.2 Summary of Maintenance and System Downtime

2.2.1 AS/BS System

During the June 27, 2005 to September 15, 2006 period, the air sparging system ran a total of 301 days out of a possible 445 days, resulting in 3,476 hours of downtime. A majority of the downtime (1,412 hours) was associated with an automatic shut-off actuated by high water levels in the moisture separator tank, which was caused by the extraction of groundwater by the SVE system (see Section 2.3.2). This condition was rectified with the shut down of the SVE system. The air/bio-sparging system downtime per quarter is detailed as follows:

- **3d Quarter 2005 (June 27 to September 29, 2005)**
  - Down for a total of 62.5 hours due to a power failure. After each occurrence the air compressor was inspected and restarted.
  - Down for a total of 575 hours due to high storage tank water levels.
  - Manual shut down for 543 hours for groundwater sampling events and maintenance activities.
- **4th Quarter 2005 (September 29, 2005 to January 9, 2006)**
  - Down for a total of 91 hours due to high storage tank water levels.
  - Manual shut down for 388 hours for groundwater sampling events.
  - System shut down for a total of 287 hours due to troubleshooting, repair and replacement of programmable logic controller (PLC) hardware.
- **1st Quarter 2006 (January 10 to March 29, 2006)**
  - Manual shut down for 233 hours for groundwater sampling events.
  - Manual system shut down for 40 hours for preventive maintenance service.
  - System shut down for a total of 11.5 hours due to PLC maintenance. PLC was reset and system restarted.

- **Second Quarter 2006 (March 30 to June 30, 2006)**
  - Down for a total of 74.6 hours due to a power failure. After each occurrence the air compressor was inspected and restarted.
  - Manual shut down for 415 hours for groundwater sampling events.
  - Down for a total of 307 hours due to high storage tank water levels. The condition causing air compressor shutdown due to high water level in the moisture separator tank was corrected with the installation of a drainage pipe to convey the moisture separator tank water back into the wellfield using one of the discontinued, non-perforated SVE collection pipes.
- **Third Quarter 2006 (July 1 to September 30, 2006)**
  - Down for a total of 8 hours due to a power failure. After each occurrence the air compressor was inspected and restarted.
  - Manual shut down for 312 hours for groundwater sampling events.

2.2.2 Soil Vapor Extraction System

During the June 27, 2005 to January 9, 2006 period, the SVE system ran a total of 53.6 days out of a possible 135 days, resulting in 1,960 hours of downtime. The SVE system downtime is detailed as follows:

- **Third Quarter 2005 (June 27 to September 29, 2005)**
  - Down for a total of 244 hours due to a power failure. After each occurrence the air compressor was inspected and restarted.
  - Down for a total of 684 hours due to high tank water levels.
  - Manual system shut down for 210 hours for system upgrades and preventive maintenance service.
- **Fourth Quarter 2005 (September 30, 2005 to January 9, 2006)**
  - Down for a total of 342 hours due to a power failure. After each occurrence the air compressor was inspected and restarted.
  - Down for a total of 102 hours due to high moisture collection tank water levels.
  - The system was shutdown on November 9, 2005 after FDEP approval was received.

2.3 Pressure/Flow Rate Monitoring

2.3.1 Air/Biosparging System

During the June 27, 2005 to September 15, 2006 monitoring period, air supply pressure, air compressor temperature, and receiver tank pressure were measured on a weekly basis from the air/biosparging system. AS/BS system data is summarized in Table 2-3. Average flows of 10 scfm to the AS and BS wells respectively were observed during this period.

TABLE 2-3
AS/BS System Measurements, O&M Period July 2005-September, 2006

Date	Air Compressor Supply Pressure (psig)	Air Compressor Temperature (^oF)	Receiver Tank Supply Pressure (psig)
07/11/05	101	171	100
07/12/05	96	176	95
07/13/05	96	179	95
07/14/05	95	179	95
07/15/05	95	179	95
07/18/05	96	178	95
07/20/05	94	182	94
07/25/05	93	179	93
07/26/05	94	174	94
07/27/05	92	181	92
07/29/05	91	180	90
08/02/05	90	175	90
08/03/05	89	177	90
08/05/05	90	177	90
08/09/05	94	174	94
08/10/05	91	175	90
08/12/05	93	175	90
08/16/05	90	181	90
08/19/05	85	180	85
08/23/05	95	176	95
08/24/05	95	182	95
08/26/05	92	177	90
08/29/05	95	181	95
09/01/05	85	174	85
09/02/05	90	178	90
09/06/05	96	177	95
09/07/05	99	172	95
09/08/05	99	180	95
09/09/05	99	176	95
09/12/05	90	177	90
09/13/05	90	175	90
09/14/05	93	179	90
09/20/05	102	181	100
09/22/05	103	174	100
09/23/05	103	173	100
09/28/05	80	177	80
09/29/05	89	181	89
10/03/05	106	178	105
10/04/05	106	179	106
10/06/05	107	177	105
11/09/05	96	175	95
11/21/05	100	175	95
12/09/05	104	173	102
01/09/06	100	171	99
01/11/06	110	171	110
01/12/06	104	172	100

TABLE 2-3
AS/BS System Measurements, O&M Period July 2005-September, 2006

Date	Air Compressor Supply Pressure (psig)	Air Compressor Temperature (^oF)	Receiver Tank Supply Pressure (psig)
01/18/06	105	176	100
01/23/06	102	171	100
02/01/06	100	174	100
02/07/06	101	169	100
02/16/06	102	175	100
02/24/06	102	168	100
03/02/06	95	174	92
03/15/06	78	173	75
03/16/06	82	174	80
03/20/06	104	180	100
03/23/06	108	172	105
03/24/06	104	173	100
03/27/06	69	174	65
03/29/06	70	174	70
03/31/06	70	173	70
04/05/06	87	174	85
04/07/06	101	185	100
04/13/06	71	173	70
05/19/06	106	177	105
05/23/06	91	183	90
05/30/06	57	173	55
06/05/06	73	169	70
06/08/06	68	178	65
06/13/06	56	177	55
06/16/06	56	178	55
06/19/06	72	175	70
06/30/06	49	180	49
07/14/06	54	179	54
07/28/06	53	187	52
08/04/06	71	192	70
08/17/06	92	175	90
08/18/06	80	177	80
08/25/06	65	171	65
08/29/06	72	180	72
09/14/06	70	175	70
09/20/06	55	178	55

psig - pounds per square inch gauge

(^oF) - degrees Fahrenheit

2.3.2 SVE System

During the O&M period of July 11, 2005, to November 9, 2006, the average vacuum pressure for the VEWs was 10.2 inches of mercury. The average total flow rate for the vapor extraction system was approximately 17.7 scfm during the period compared to a design flow rate of 15 scfm. Individual VEW vacuum pressure and flow are tabulated in Tables 2-4 and 2-5, respectively.

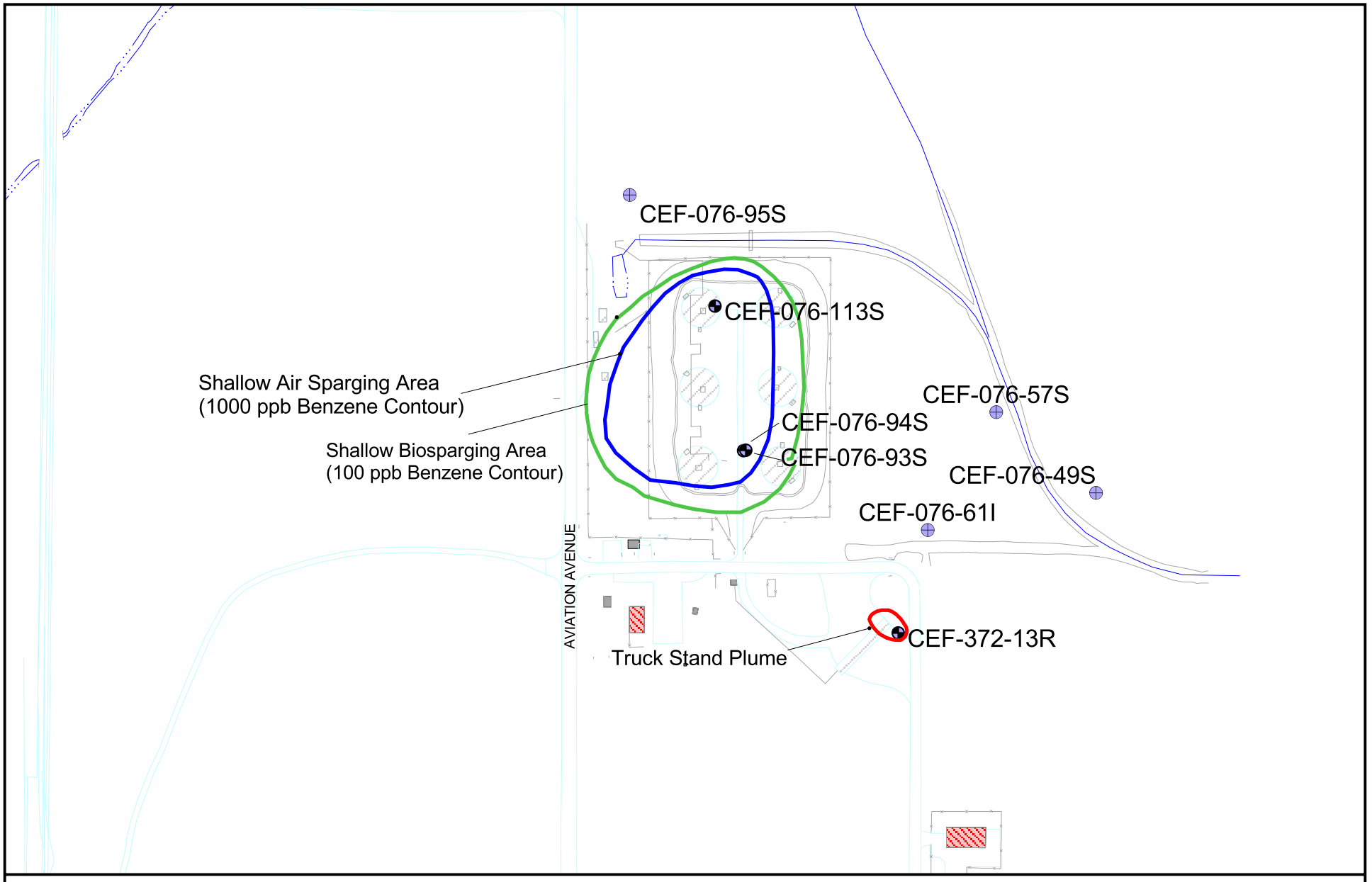
Due to the shallow water table (between 2 to 5 feet bls), the SVE system extracted large quantities of water (5 to 10 gallons per minute [gpm]) even at minimal vacuum and flows into the moisture separator tank at the site. This resulted in repeated shutdowns of the air sparge system due to an automatic shutoff interlock programmed into the system as required by regulations. The excess water was discharged into a sewer line operated by the Jacksonville Electric Authority after obtaining the necessary permits. The influent samples at the vapor filtration unit showed an emission rate of less than 13.7 lb/day of hazardous air pollutants based on mass loading calculations performed by JVII (see Section 3.1). This emission rate was below the FDEP standard of 13.7 lbs/day of hazardous air pollutants (HAPs) that would require treatment of vapor emissions from the SVE system prior to atmospheric discharge. Since the extracted vapor from the SVE system did not exceed the FDEP maximum daily discharge standard prior to treatment (influent side of the GAC filtration units), and the continued water entrainment caused repeated shutdowns of the SVE system and the air compressor, the SVE system was recommended for permanent shutdown. A technical memorandum (including the mass loading calculations) recommending shutdown of the SVE system was prepared by JVII and submitted to FDEP and the Navy. This recommendation was approved by FDEP in a letter dated October 24, 2005 (see Appendix A for a copy of the technical memo approval). The SVE system was shut down on November 9, 2005.

2.4 Water Level Measurements

Depth to groundwater measurements were recorded from select monitoring wells during groundwater sampling events in January, June, and November 2005; and May and August 2006.

As per the RAPA, eight existing monitoring wells were selected for baseline and quarterly groundwater monitoring to measure changes in contaminant concentrations. A separate set of eight existing wells were selected for measuring changes in natural attenuation parameters for MNA monitoring and evaluating downgradient migration of the contaminant plume. Figures 2-1 and 2-2 show the locations and well identification numbers for these 16 wells in relation to the footprints of the shallow and deep AS and BS wells. The results of the groundwater level measurements are provided in Table 2-6. No free product or light non-aqueous phase liquid (LNAPL) was detected in monitoring wells during the 2005 to 2006 O&M period.

No potentiometric maps were developed due to the small number of monitoring wells (relative to the large footprint of the treatment area) sampled each quarter. Historical potentiometric maps presented in the RAPA indicated a generally southeastern groundwater flow direction.



1000ppb Benzene Plume (Pre-treatment)
100 ppb Benzene Plume (Pre-Treatment)
Shallow Zone Treatment Monitoring Wells
Shallow Zone MNA Monitoring Wells

N

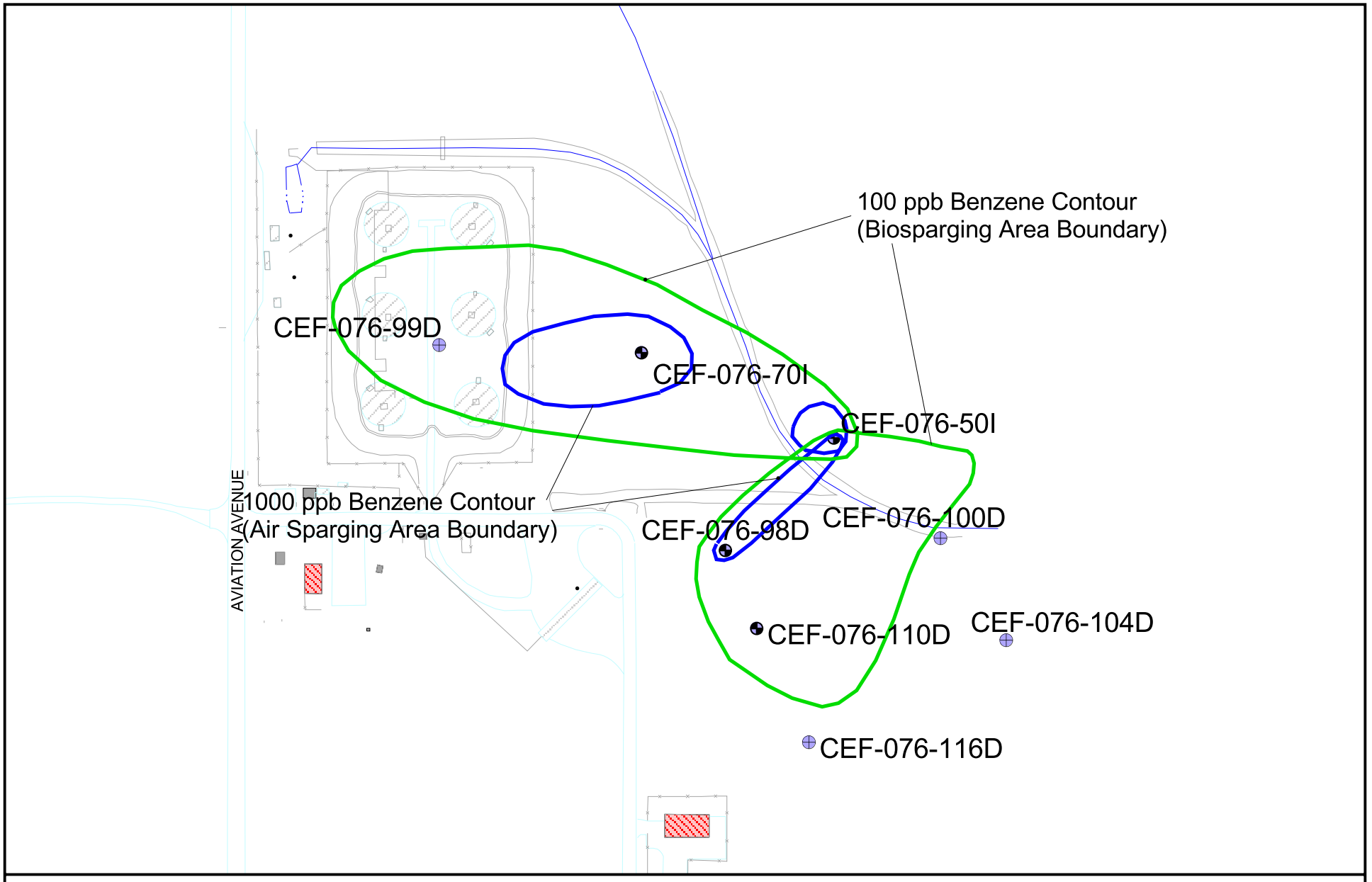
0 200 400 Feet

1 inch = 218.212 feet

Figure 2-1
Shallow Zone (Water Table and Upper Intermediate Zone)
Monitoring Well Locations
NFF Site, NAS Cecil Field, Jacksonville, Fl

CH2MHILL

File Path: c:\gis\nas_cecilfield.apr, Date: 30 Jan 2007 14:55, User: SNAIK1, NAS Cecil Field Area [Florida State Plane Coordinate System NAD 83 Units Feet] - Figure 3-1 Shallow Zone (Water Table and Upper Intermediate Zone)



100ppb Benzene Contour (Pre-Treatment)
1000ppb Benzene Contour (Pre-Treatment)
Deep Zone Treatment Monitoring Wells
Deep Zone MNA Monitoring Wells

N

0 200 400 Feet

1 inch = 231 feet

Figure 2-2
Lower Intermediate and Deep Zone
Monitoring Well Locations
NFF Site, NAS Cecil Field, Jacksonville, FL

CH2MHILL

File Path: c:\gis\nas_cecilfield.apr, Date: 30 Jan 2007 15:40, User: SNAIK1, NAS Cecil Field Area [Florida State Plane Coordinate System NAD 83 Units Feet] - Figure 3-2 Lower Intermediate and Deep Zone

TABLE 2-4
SVE System, Vapor Extraction Well Pressure Measurements, Annual O&M Period July 2005- November 2005

Date	WELL ID									
	VEW-01	VEW-02	VEW-03	VEW-04	VEW-05	VEW-06	VEW-07	VEW-08	VEW-09	VEW-10
	vacuum in inches of Hg									
07/11/05	12.0	6.0	12.0	7.0	12.0	13.0	12.0	12.0	14.0	12.0
07/12/05	12.5	6.0	12.0	6.5	11.0	13.5	12.0	12.5	14.0	12.5
07/13/05	13.5	6.5	12.5	6.5	11.5	13.5	12.5	13.0	14.0	12.5
07/14/05	13.0	6.5	12.5	6.5	11.5	13.5	12.5	13.0	14.0	12.5
07/18/05	13.0	6.5	12.5	5.5	11.5	14.0	12.5	13.5	15.0	13.0
07/20/05	14.5	7.0	14.0	7.0	12.5	15.5	14.0	14.5	15.0	13.0
07/25/05	13.0	6.5	12.0	5.5	12.0	14.0	12.5	13.0	14.0	12.5
07/26/05	17.5	6.0	12.0	6.5	11.0	13.0	12.0	12.0	14.0	12.0
07/27/05	14.5	7.0	13.0	7.0	12.0	14.0	12.5	13.5	14.0	13.0
07/29/05	13.5	6.5	13.0	7.0	12.0	14.5	13.0	13.5	15.0	13.5
08/02/05	9.0	6.0	9.0	6.0	8.0	9.5	8.5	8.0	9.0	8.0
08/03/05	12.0	6.5	12.0	7.0	10.5	12.5	12.0	12.0	13.0	12.0
08/05/05	12.0	6.0	11.5	7.0	10.0	12.5	11.5	12.0	13.0	11.5
08/09/05	13.0	7.0	12.0	7.0	10.5	13.0	12.0	12.0	14.0	12.0
08/10/05	12.5	6.0	12.0	6.0	11.0	13.0	12.0	12.0	14.0	12.0
08/12/05	14.0	7.0	13.5	7.5	12.0	15.0	12.0	13.0	14.0	12.5
08/16/05	15.0	7.0	14.5	7.0	12.5	15.0	13.5	14.0	16.0	14.0
08/19/05	15.0	7.0	14.0	7.0	12.5	15.0	14.0	14.0	14.0	14.0
08/23/05	12.0	6.0	11.5	6.0	10.0	12.5	11.0	11.5	12.5	11.0
08/24/05	13.0	5.0	12.0	5.0	10.0	13.0	11.5	12.0	13.0	10.0
08/26/05	5.0	5.0	8.0	5.0	7.0	9.0	7.0	8.0	8.0	7.0
08/29/05	14.0	5.0	13.0	5.0	11.5	13.5	12.0	12.5	14.0	12.0
09/01/05	11.5	6.0	11.5	6.0	10.0	12.0	11.0	11.0	12.0	11.0
09/02/05	8.0	6.0	12.0	5.0	10.0	12.5	11.0	12.0	13.0	11.0
09/06/05	9.0	5.0	9.0	5.0	8.0	10.0	9.0	9.0	10.0	9.0
09/07/05	10.0	6.0	9.0	6.0	9.0	10.0	9.0	9.0	10.0	9.0
09/08/05	12.0	7.0	11.0	7.0	10.0	12.0	11.0	11.0	12.0	11.0

TABLE 2-4
SVE System, Vapor Extraction Well Pressure Measurements, Annual O&M Period July 2005- November 2005

Date	WELL ID									
	VEW-01	VEW-02	VEW-03	VEW-04	VEW-05	VEW-06	VEW-07	VEW-08	VEW-09	VEW-10
	vacuum in inches of Hg									
09/09/05	13.0	7.0	12.0	6.0	10.0	12.0	11.0	12.0	12.0	11.0
09/12/05	6.0	7.0	11.0	6.0	10.0	12.0	11.0	12.0	13.0	10.0
09/13/05	5.0	6.0	11.0	6.0	10.0	11.0	10.0	10.0	12.0	7.0
09/14/05	5.0	5.0	10.0	5.0	10.0	10.0	10.0	10.0	10.0	6.0
09/20/05	11.0	5.0	11.5	5.0	10.0	12.0	11.0	11.0	12.0	5.0
09/22/05	10.0	6.0	10.0	6.0	10.0	11.0	10.0	10.0	11.0	6.0
09/23/05	8.0	6.0	10.0	7.0	10.0	10.0	10.0	10.0	11.0	5.0
09/28/05	15.0	5.0	11.0	5.0	10.0	12.0	11.0	12.0	12.0	5.0
09/29/05	15.0	5.0	12.0	5.0	10.0	12.0	12.0	12.0	14.0	5.0
10/03/05	11.0	5.0	5.0	5.0	5.0	7.0	6.0	5.0	7.0	5.0
10/04/05	10.0	5.0	10.0	5.0	9.0	10.0	9.0	9.0	10.0	5.0
10/06/05	10.0	5.0	8.0	5.0	8.0	9.0	8.0	8.0	9.0	5.0
11/09/05	5.0	7.0	10.0	7.0	9.0	9.0	9.0	8.0	9.0	7.0
	SHUT DOWN SVE									

TABLE 2-5
SVE System Vapor Extraction Well Flow Readings, Annual O&M Period July 2005- August 2006

Date	WELL ID										
	VEW-01	VEW-02	VEW-03	VEW-04	VEW-05	VEW-06	VEW-07	VEW-08	VEW-09	VEW-10	AVERAGE
	scfm										
07/11/05	1.0	NM	2.0	1.0	3.0	3.0	3.0	NM	NM	NM	2.17
07/12/05	1.0	NM	2.0	2.0	3.0	3.0	2.0	NM	NM	NM	2.17
07/13/05	2.0	NM	2.0	2.0	2.0	2.0	2.0	NM	NM	NM	2.00
07/14/05	2.0	NM	2.0	2.0	2.0	1.0	2.0	NM	NM	NM	1.83
07/18/05	1.0	NM	1.5	1.5	2.0	1.0	1.0	NM	NM	NM	1.33
07/20/05	1.0	NM	NM	1.0	NM	2.0	2.0	NM	NM	NM	1.50
07/25/05	1.0	NM	NM	NM	2.0	2.0	1.0	NM	NM	NM	1.50
07/26/05	2.0	NM	NM	2.0	3.0	3.0	2.0	NM	NM	NM	2.40
07/27/05	1.0	NM	NM	1.0	3.0	3.0	2.0	NM	NM	NM	2.00
07/29/05	1.0	NM	1.0	1.0	4.0	5.0	2.0	NM	NM	NM	2.33
08/02/05	1.0	1.0	1.0	2.0	2.0	2.0	1.0	NM	NM	NM	1.43
08/03/05	1.0	1.0	1.0	2.0	2.0	2.0	2.0	NM	NM	NM	1.57
08/05/05	1.0	1.0	1.0	2.0	2.0	2.0	2.0	NM	NM	NM	1.57
08/09/05	1.0	1.0	1.0	2.0	2.0	2.0	2.0	NM	NM	NM	1.57
08/10/05	1.0	1.0	1.0	2.0	2.0	2.0	2.0	NM	NM	NM	1.57
08/12/05	1.0	1.0	1.0	2.0	2.0	2.0	2.0	NM	NM	NM	1.57
08/16/05	1.0	1.0	1.0	2.0	2.0	2.0	2.0	NM	NM	NM	1.57
08/19/05	3.0	2.0	3.0	2.0	1.0	1.0	1.0	NM	NM	NM	1.86
08/23/05	4.0	2.0	4.0	2.0	4.0	2.0	2.0	NM	NM	NM	2.86
08/24/05	6.5	4.0	7.0	1.0	5.0	4.0	1.0	NM	NM	NM	4.07
08/26/05	7.0	2.0	7.5	2.0	5.0	4.0	1.0	NM	NM	NM	4.07
08/29/05	7.0	2.0	7.5	2.0	5.0	4.0	2.0	NM	NM	NM	4.21
09/01/05	3.0	2.0	4.0	2.0	3.0	2.0	2.0	NM	NM	NM	2.57
09/02/05	4.0	4.0	5.0	2.0	3.0	3.0	2.0	NM	NM	NM	3.29
09/06/05	5.0	5.0	6.0	2.0	4.0	4.0	2.0	NM	NM	NM	4.00
09/07/05	2.0	2.0	2.0	3.0	2.0	2.0	3.0	NM	NM	NM	2.29
09/08/05	3.0	2.0	2.0	2.0	4.0	2.0	2.0	NM	NM	NM	2.43
09/09/05	3.0	2.0	3.0	2.0	3.0	3.0	2.0	NM	NM	NM	2.57

TABLE 2-5
SVE System Vapor Extraction Well Flow Readings, Annual O&M Period July 2005- August 2006

Date	WELL ID										
	VEW-01	VEW-02	VEW-03	VEW-04	VEW-05	VEW-06	VEW-07	VEW-08	VEW-09	VEW-10	AVERAGE
	scfm										
09/12/05	5.0	2.0	4.0	2.0	3.0	2.0	2.0	NM	NM	NM	2.86
09/13/05	7.0	2.0	6.0	2.0	3.0	3.0	2.0	NM	NM	NM	3.57
09/14/05	7.0	2.0	7.0	2.0	4.0	4.0	2.0	NM	NM	NM	4.00
09/20/05	7.0	2.0	7.0	2.0	4.0	4.0	2.0	NM	NM	NM	4.00
09/22/05	3.0	2.0	3.0	2.0	4.0	3.0	3.0	NM	NM	NM	2.86
09/23/05	3.0	2.0	3.0	3.0	3.0	4.0	3.0	NM	NM	NM	3.00
09/28/05	2.0	2.0	3.0	2.0	2.0	3.0	2.0	NM	NM	NM	2.29
09/29/05	4.0	2.0	6.5	2.0	2.0	4.0	2.0	NM	NM	NM	3.21
10/03/05	4.0	2.0	5.0	2.0	2.0	3.0	2.0	NM	NM	NM	2.86
10/04/05	2.0	2.0	2.0	4.0	2.0	2.0	2.0	NM	NM	NM	2.29
10/06/05	2.0	2.0	2.0	2.0	2.0	2.0	2.0	NM	NM	NM	2.00
11/09/05	2.0	2.0	2.0	2.0	5.0	4.0	2.0	NM	NM	NM	2.71
	SHUT DOWN										

scfm - standard cubic feet per minute
NM - Not Measured

TABLE 2-6
Groundwater Level Measurements, Annual O&M Period July 2005- August 2006

Well Identification	Date	Top of Casing Elevation (Feet)	Depth to Water (Feet)	Water Level Elevation (Feet)
76-116D	7/29/2005	NA	7.65	NM
	11/18/2005		11.87	NM
	5/15/2006		13.56	NM
	8/17/2006		14.97	NM
76-49S	7/29/2005	78.14	3.30	74.84
	11/18/2005		6.14	72.00
	5/16/2006		8.15	69.99
	8/17/2006		9.72	68.42
76-50I	7/29/2005	78.17	1.54	76.63
	11/18/2005		5.35	72.82
	5/15/2006		8.08	70.09
76-57S	7/29/2005	77.74	2.12	75.62
	11/18/2005		5.71	72.03
	5/17/2006		7.58	70.16
	8/17/2006		9.16	68.58
76-61I	7/29/2005	81.12	11.90	69.22
	11/18/2005		8.95	72.17
	5/17/2006		11.06	70.06
	8/16/2006		12.86	68.26
76-70I	7/29/2005	78.21	2.10	76.11
	11/18/2005		5.24	72.97
	5/11/2006		7.85	70.36
	8/15/2006		9.70	68.51
76-86S	7/29/2005	78.35	2.69	75.66
	11/18/2005		7.73	70.62
76-87S	7/29/2005	81.53	3.85	77.68
	11/18/2005		8.11	73.42
76-93S	7/29/2005	81.59	3.70	77.89
	11/18/2005		7.24	74.35
	5/10/2006		9.56	72.03
	8/14/2006		10.53	71.06
76-94S	7/29/2005	81.59	NM	NM
	11/18/2005		9.06	72.53
	5/10/2006		10.07	71.52
	8/14/2006		13.25	68.34
76-98D	7/29/2005	81.39	4.51	76.88
	11/18/2005		8.45	72.94
	5/11/2006		11.19	70.20
	8/15/2006		13.60	67.79
76-95S	7/29/2005	80.88	5.71	75.17
	11/18/2005		6.82	74.06
	5/16/2006		9.35	71.53
	8/16/2006		11.25	69.63
76-99D	7/29/2005	81.69	NM	NM
	11/18/2005		13.97	67.72
	5/17/2006		11.44	70.25
	8/16/2006		13.82	67.87

TABLE 2-6
Groundwater Level Measurements, Annual O&M Period July 2005- August 2006

Well Identification	Date	Top of Casing Elevation (Feet)	Depth to Water (Feet)	Water Level Elevation (Feet)
76-100D	7/29/2005	80.15	4.85	75.30
	11/18/2005		8.92	71.23
	5/16/2006		10.73	69.42
	8/17/2006		12.02	68.13
76-104D	7/29/2005	79.08	NM	NM
	11/18/2005		8.14	70.94
	5/15/2006		10.05	69.03
	8/17/2006		11.33	67.75
76-110D	7/29/2005	82.51	4.80	77.71
	11/18/2005		10.41	72.10
	5/11/2006		12.85	69.66
	8/14/2006		14.60	67.91
76-113S	7/29/2005	81.22	3.51	77.71
	11/18/2005		8.72	72.50
	5/10/2006		10.62	70.60
	8/14/2006		12.71	68.51
372-13R	7/29/2005	81.25	0.05	81.20
	11/18/2005		6.05	75.20
	5/15/2006		9.14	72.11
	8/15/2006		10.71	70.54
372-23S	7/29/2005	79.63	3.62	76.01
	11/18/2005		7.89	71.74

bgs = below ground surface
Elevation is referenced to National Geodetic Vertical Datum 1929 (NGVD 1929)

Depth to water measured from top of casing

NM = not measured

3.0 Summary of Sampling and Laboratory Analytical Results

3.1 Vapor Monitoring

Vapor samples were collected weekly from the influent and effluent sides of the GAC units for the first 6 weeks of operation of the SVE system. These samples were analyzed for volatile organic compounds (VOCs) by U.S. Environmental Protection Agency (EPA) Method TO-15. Copies of the analytical data sheets results are presented in Appendix B and analytical results are summarized in Table 3-1.

The FDEP Bureau of Petroleum Cleanup Program requires that the total HAP emissions from air sparging and SVE systems not exceed 13.7 lbs/day, and that air emissions monitoring are allowed to be discontinued, if the measured air emissions of total HAPs do not exceed 13.7 lbs/day after 30 days of operation. Mass loading calculations for each influent and effluent sample are provided in Appendix A. The calculations indicate that the discharge limit was not exceeded at any time during the first 6 weeks of operation, and that the limit was unlikely to be exceeded in the future.

3.2 Groundwater Monitoring

Five groundwater sampling events were conducted at the NFF facility from January 2005 to November 2006. The first was the baseline groundwater characterization event conducted in January 2005 followed by 4 quarterly O&M sampling events in July 2005, November 2005, May 2006 and August 2006. Beginning with the November 2005 sampling event, groundwater samples for MNA parameters were analyzed to evaluate natural attenuation processes at the site.

3.2.1 Baseline Contaminant Characterization and O&M Sampling

The baseline contaminant characterization sampling event was conducted in January 2005 to establish the configuration of the dissolved hydrocarbon plume prior to the start of remediation. The O&M sampling was conducted on a quarterly basis to monitor the effectiveness of the remedial system.

The following existing groundwater monitoring wells were sampled for monitoring pre-treatment baseline conditions and contaminant reduction during treatment:

- CEF-372-13R (Truck Stand area)
- CEF-76-94S (water table zone)
- CEF-76-113S (upper intermediate zone)
- CEF-CEF-76-93S (upper intermediate zone)
- CEF-76-50I (lower intermediate zone)
- CEF-76-70I (lower intermediate zone)
- CEF-76-98D (deep zone)
- CEF-76-110D (deep zone)

TABLE 3-1
Influent/Effluent Vapor Concentrations at GAC Filtration Unit, SVE System, Annual O&M Period July 2005 to November 2005

Station ID	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**
Sample ID	**1-NFF-SVE-E-A-0720-05**	**1-NFF-SVE-E-A-0727-05**	**1-NFF-SVE-E-A-0803-05**	**1-NFF-SVE-E-A-0810-05**	**1-NFF-SVE-E-A-0824-05**	**1-NFF-SVE-E-A-0901-05**	**1-NFF-SVE-I-A-0720-05**	**1-NFF-SVE-I-A-0727-05**	**1-NFF-SVE-I-A-0803-05**	**1-NFF-SVE-I-A-0810-05**	**1-NFF-SVE-I-A-0824-05**	**1-NFF-SVE-I-A-0901-05**
Sample Date	**7/20/2005**	**7/27/2005**	**8/3/2005**	**8/10/2005**	**8/24/2005**	**9/1/2005**	**7/20/2005**	**7/27/2005**	**8/3/2005**	**8/10/2005**	**8/24/2005**	**9/1/2005**
Parameter												
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1,2-trichloro-1,2,2-trifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,2,4-Trichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,2,4-Trimethylbenzene	**0.67**	<0.5	<0.5	<0.5	<0.5	**0.171**	**9.77**	**13**	<5	<5	<5	<5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,3,5-Trimethylbenzene (Mesitylene)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**17.5**	**36.2**	**8.35**	**5.71**	**10.7**	<5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,4-Dichlorobenzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Benzene	**0.39**	<0.5	**0.174**	<0.5	<0.5	<0.5	**51**	**45.8**	**39.7**	**10.4**	**14.7**	<5
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Carbon disulfide	**1.08**	**0.505**	**0.708**	**10.9**	**9.69**	**7.64**	**10.9**	**34.5**	**10.1**	**16.7**	**19.4**	**12**
Carbon tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Ethylbenzene	**0.492**	**0.713**	**0.292**	<0.5	<0.5	**0.206**	**24.5**	**11.3**	**4.11**	<5	**3.45**	<5
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
m,p-Xylene (sum of isomers)	**1.02**	**1.47**	**0.58**	<0.5	<0.5	0.5	**52.1**	**38.8**	**10.2**	<5	**8.17**	<5
Methylene chloride	**1.48**	**1.24**	**2.13**	**1.15**	<0.5	**0.294**	**2.62**	5	**6.21**	<5	**1.44**	<5
n-hexane	<0.5	<0.5	<0.5	**0.795**	**1.43**	**0.567**	**206**	**448**	**439**	**258**	**356**	**128**
o-Xylene (1,2-Dimethylbenzene)	**1.07**	**1.2**	**0.545**	<0.5	<0.5	<0.5	**76**	**77.8**	**27.2**	**9.11**	**22.4**	<5
Styrene	**1.25**	**0.785**	**0.602**	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
tert-butyl methyl ether	0.5	0.5	0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Tetrachloroethene (PCE)	**4.33**	**16.9**	0.5	**0.951**	<0.5	<0.5	**11.3**	<5	<5	<5	<5	<5
Toluene	**1.48**	**8.98**	**0.765**	**1.07**	**0.783**	**0.667**	**45**	**40.4**	**46.8**	**9.23**	**7.94**	<5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Trichloroethene (TCE)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Vinyl chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5

Notes:
All concentrations reported in parts per billion volume (ppbv).
J - estimated value
B-The analyte was detected in the associated method and/or calibration blank.
JB- Estimate value. The analyte was detected in the associated method and/or calibration blank.

The groundwater samples were analyzed for the following parameters: VOCs EPA Method 8260B, polycyclic aromatic hydrocarbons (PAHs) by EPA Method 8310, and total recoverable petroleum hydrocarbon (TRPH) by the Florida Petroleum Residual Organic (FL PRO) method.

The baseline characterization and O&M groundwater analytical results are summarized in Table 3-2. The groundwater in each monitoring well was field-tested for pH, conductivity, turbidity, dissolved oxygen (DO), oxidation reduction potential (ORP) and temperature. The results of the field tests are summarized in Table 3-3. The analytical laboratory and data validation reports for the groundwater sampling event are provided in Appendix B.

3.2.2 MNA Sampling

According to the RAPA, the locations of the MNA sampling focus on an area downgradient of the AS/BS treatment area. Wells were selected to represent the area of treatment downgradient of the AS/BS area to help assess if MNA was occurring in areas downgradient of the target treatment area. One monitoring well (CEF-0CEF-76-95S) in the shallow zone was located upgradient of the shallow zone contaminant plume to provide information on background groundwater conditions.

The following existing groundwater monitoring wells were identified in the RAPA for baseline and quarterly MNA sampling:

- CEF-76-95S (upgradient monitoring well)
- CEF-76-49S (upper intermediate zone well)
- CEF--76-57S (upper intermediate zone well)
- CEF--76-61I (lower intermediate zone well)
- CEF-76-99D (deep zone well)
- CEF-76-100D (downgradient deep zone well)
- CEF-76-104D (downgradient deep zone well)
- CEF-76-116D (downgradient deep zone well)

The groundwater samples from the MNA wells were analyzed for the following parameters: VOCs by EPA Method 8021B, PAHs by EPA Method 8310, dissolved hydrogen by method RSK 175, dissolved methane by EPA Method 8315, nitrate and nitrite by EPA Method 353.2, sulfate by EPA Method 375.4, sulfide by USEPA Method 376.2, total organic carbon by EPA Method 9060 or 415.1, inorganic carbon by EPA Method 5310B or 415.1, and total phosphorus by EPA Method 365.1.

The analytical results of groundwater sampling from these wells are summarized in Table 3-4. The VOC and PAH analyses is presented on Table 3-2. The groundwater in each monitoring well was tested for pH, conductivity, turbidity, DO, ORP, temperature, and pH. Additionally, DO was measured on select wells using a Hach® Kit and a Chemetric® Test Kit using the Winkler titration method in addition to the flow-through cell (YSI) during the May 2006 and August 2006 sampling events to evaluate differences between the methods. Reliable readings were not obtained from these test kits, possibly due to the presence of elevated hydrogen sulfide in the aquifer.

TABLE 3-2

Analytical Results from Groundwater Sampling, O&M Period July 2005-August 2006, NFF Site, NAS Cecil Field

Groundwater Cleanup Target Level[1]			**1**	**30**	**40**	**20**	**6300**	**700**	**70**	**3**	**28**	**28**	**280**	**20**	**210**	**NA**	**0.8**	**4200**	**560**	**NA**	**5**	**14**	**100**	**5000**
Natural Attenuation Default Concentration			**10**	**300**	**400**	**200**	**63000**	**7000**	**700**	**30**	**280**	**280**	**2800**	**200**	**2100**	**NA**	**8**	**42000**	**5600**	**NA**	**50**	**140**	**1000**	**50000**
WELL	**Sample ID**	**Sample Date**	**Benzene**	**Ethylbenzene**	**Toluene**	**Xylenes, total**	**Acetone**	**Carbon disulfide**	**cis-1,2-Dichloroethene**	**Trichloroethene (TCE)**	**1-methylnaphthalene**	**2-Methylnaphthalene**	**2-Hexanone**	**Acenaphthene**	**Acenaphthylene**	**Cyclohexane**	**Isopropylbenzene (Cumene)**	**Methyl ethyl ketone (2-butanone)**	**Methyl isobutyl ketone (4-methyl-2-pentanone)**	**methylcyclohexane**	**Methylene chloride**	**Naphthalene**	**Styrene**	**Petroleum Hydrocarbons**
372-13R	01-372-13R-Q1-05	1/24/2005	ND	18.3	ND	7.18	ND	1.19 J	ND	ND	ND	ND	ND	ND	ND	1.31 J	**8.22**	ND	ND	2.54 J	ND	**122 J**	ND	**8480 JB**
	1-372-13R-Q4-05	11/18/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**1.92 J**	ND	ND	ND	ND	ND	ND	436 JB
	1-372-13R-Q1-06	2/13/2006	ND	ND	ND	ND	3.57 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.86 JB	ND	ND	491 JB
	1-372-13R-Q2-06	5/15/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	901
	137213RQ306	8/15/2006	ND	ND	ND	ND	2.28 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	190 JB
76-116D	1-76-11Xc-Q4-05	11/17/2005	**176**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-11Xc-Q1-06	2/15/2006	**324**	ND	ND	ND	13.8 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-11Xc-Q2-06	5/15/2006	**517**	ND	ND	ND	18.6 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	17611XCQ306	8/17/2006	**256**	ND	ND	ND	128 J	16.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.75 J	ND	ND	ND	ND	ND	NA
76-49S	1-76-49S-Q4-05	11/17/2005	**2.2**	ND	ND	ND	10.2 J	ND	ND	ND	ND	ND	ND	ND	ND	5.6	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-49S-Q1-06	2/16/2006	**1.61**	ND	ND	8.23	8.2 JB	ND	ND	ND	ND	ND	ND	ND	ND	7.12	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-49S-Q2-06	5/16/2006	ND	ND	ND	3.71 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.42 J	ND	ND	ND	ND	ND	ND	ND	NA
	17649SQ306	8/17/2006	ND	ND	ND	8.17	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
76-50I	01-76-50I-Q1-05	1/25/2005	**318**	ND	ND	**1910**	ND	ND	ND	ND	ND	ND	ND	4.48 J	ND	473	ND	ND	ND	10.8 J	ND	**141 J**	ND	3310 JB
	1-76-50I-Q4-05	11/21/2005	**3360 J**	ND	ND	**2400**	905	ND	ND	ND	ND	ND	ND	ND	ND	202 J	ND	ND	ND	ND	ND	**54 J**	ND	3080 JB
	1-76-50I-Q1-06	2/14/2006	**5020**	**71.2 J**	ND	**586**	528 JB	ND	ND	ND	ND	ND	ND	ND	ND	121 J	ND	ND	ND	ND	**277 JB**	**21.2 J**	ND	1840 JB
	1-76-50I-Q2-06	5/15/2006	**7200**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	12.9 J	ND	1050
	17650IQ206	8/15/2006	**2230 J**	15.8 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.96 J	ND	183 JB
76-57S	1-76-57S-Q4-05	11/17/2005	**33.6**	11.7	ND	ND	10.6 J	ND	ND	ND	ND	ND	ND	ND	ND	45.7	**3.46 J**	ND	ND	9.66	ND	ND	ND	NA
	1-76-57S-Q1-06	2/15/2006	**81.8**	6.2	ND	ND	5.15 JB	ND	ND	ND	ND	ND	ND	ND	ND	19	**2.81 J**	ND	1.16 J	4.23 J	ND	ND	ND	NA
	1-76-57S-Q2-06	5/17/2006	**23.7**	2.01 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	7.61	ND	ND	2.59 J	3.86 J	ND	ND	ND	NA
	17657SQ306	8/17/2006	**7.02**	1.72 J	ND	3.21 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.23 J	ND	ND	ND	ND	ND	ND	ND	NA
76-61I	1-76-61I-Q4-05	11/17/2005	ND	**36.9 J**	ND	**73.8**	38.1 J	ND	ND	ND	ND	ND	ND	ND	ND	53.7 J	**9.41 J**	3 J	ND	42.4 J	ND	ND	ND	NA
	1-76-61I-Q1-06	2/15/2006	**1.36**	22.8	ND	**24.2**	ND	12.7	ND	ND	ND	ND	ND	ND	ND	85.4	**21.9**	2.07 J	ND	80.8	ND	ND	ND	NA
	1-76-61I-Q2-06	5/17/2006	**1.58**	10.9	ND	18	10 J	7.53	ND	ND	24.2 J	ND	ND	ND	ND	41.6	**18.9**	ND	ND	31.3	ND	**76.5 J**	ND	NA
	17661IQ306	8/16/2006	ND	3.06 J	ND	5.2	ND	ND	ND	ND	11 J	ND	ND	ND	ND	22.7	**10.9 J**	ND	ND	16	3.02 JB	**45.2 J**	ND	NA

TABLE 3-2
Analytical Results from Groundwater Sampling, O&M Period July 2005-August 2006, NFF Site, NAS Cecil Field

WELL	Sample ID	Sample Date	Benzene	Ethylbenzene	Toluene	Xylenes, total	Acetone	Carbon disulfide	cis-1,2-Dichloroethene	Trichloroethene (TCE)	1-methylnaphthalene	2-Methylnaphthalene	2-Hexanone	Acenaphthene	Acenaphthylene	Cyclohexane	Isopropylbenzene (Cumene)	Methyl ethyl ketone (2-butanone)	Methyl isobutyl ketone (4-methyl-2-pentanone)	methylcyclohexane	Methylene chloride	Naphthalene	Styrene	Petroleum Hydrocarbons
Groundwater Cleanup Target Level[1]			**1**	**30**	**40**	**20**	**6300**	**700**	**70**	**3**	**28**	**28**	**280**	**20**	**210**	**NA**	**0.8**	**4200**	**560**	**NA**	**5**	**14**	**100**	**5000**
Natural Attenuation Default Concentration			**10**	**300**	**400**	**200**	**63000**	**7000**	**700**	**30**	**280**	**280**	**2800**	**200**	**2100**	**NA**	**8**	**42000**	**5600**	**NA**	**50**	**140**	**1000**	**50000**
76-70I	01-76-70I-Q1-05	1/25/2005	**834**	**50.3**	11.1 J	**3680**	ND	ND	ND	ND	ND	ND	ND	ND	ND	885	**63.7**	ND	ND	199	ND	**40.7 J**	ND	**9210 JB**
	1-76-70I-Q4-05	11/21/2005	**300**	ND	ND	**2340**	804	ND	ND	ND	ND	ND	ND	ND	ND	422	**57.5 JB**	35 JB	ND	92.1 J	ND	**104 J**	ND	496 B
	1-76-70I-Q1-06	2/14/2006	**206**	ND	ND	**2630**	897 JB	ND	ND	ND	ND	ND	ND	ND	ND	607	**39.9 J**	ND	ND	132	ND	**34.2**	ND	3780 JB
	1-76-70I-Q2-06	5/11/2006	**231**	ND	ND	**2810**	1290 JB	ND	ND	ND	ND	ND	ND	ND	ND	799	**72.6 J**	ND	ND	198	ND	**65.3 J**	ND	**5170**
	17670IQ306	8/15/2006	**70.8**	ND	ND	**1320**	ND	ND	ND	ND	ND	ND	ND	ND	ND	172	**70.1**	ND	ND	52.3	**10.4 JB**	**77.4 J**	ND	1640 JB
76-93S	01-76-93S-Q1-05	1/24/2005	**1890**	**1300**	**7800**	**5610**	ND	ND	ND	ND	ND	ND	ND	ND	ND	1340	**72.8 J**	ND	ND	648	ND	3.73 J	52.2 J	**12100 JB**
	1-76-93S-Q4-05	11/18/2005	**27.2**	**83.5**	**235**	**443**	ND	ND	ND	ND	ND	ND	ND	ND	ND	120	**9.22 J**	ND	ND	86.4	**7.85 JB**	**30.8 J**	5.01 J	1620 JB
	1-76-93S-Q1-06	2/13/2006	**11.8**	**75.4**	**193**	**502**	139 JB	ND	ND	ND	8.96 J	6.46 J	26.3 J	ND	7.28 J	109	**4.5 J**	ND	ND	47.1	ND	**26.6 J**	ND	112 JB
	1-76-93S-Q2-06	5/10/2006	**37.9**	**259**	**607**	**1640**	565 JB	ND	ND	ND	18	ND	ND	ND	ND	373	**27.7 J**	ND	ND	164	ND	**66.9 J**	ND	**7790 J**
	17693SQ306	8/14/2006	**23.1**	**318**	**515**	**2090**	ND	ND	ND	ND	**31.9**	ND	ND	ND	ND	439	**27.6**	ND	ND	251	**14 JB**	**93.9 J**	ND	4520 JB
76-94S	01-76-94S-Q1-05	1/25/2005	**3040**	**1310**	**3800**	**4850**	ND	ND	ND	ND	ND	ND	ND	ND	ND	1340	**86.5 J**	ND	ND	594	ND	**193 J**	ND	**15500 JB**
	1-76-94S-Q4-05	11/18/2005	ND	ND	ND	ND	270 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.1	ND	404 JB
	1-76-94S-Q1-06	2/13/2006	0.993 J	ND	ND	ND	36 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.47 J	ND	ND	2.98 JB	ND	ND	200 JB
	1-76-94S-Q2-06	5/10/2006	**1.6**	ND	ND	ND	23.3 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1.57 J	ND	ND	ND	0.696	ND	304
	17694SQ306	8/14/2006	ND	ND	ND	ND	10.4 JB	ND	1.24 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	97 JB
76-95S	1-76-95S-Q4-05	11/16/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-95S-Q1-06	2/14/2006	ND	ND	ND	ND	2.86 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-95S-Q2-06	5/16/2006	ND	ND	ND	ND	6.39 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	17695SQ306	8/16/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.54 JB	ND	ND	NA
76-98D	01-76-98D-Q1-05	1/25/2005	**1090 J**	8.33 J	ND	**62.3**	ND	ND	ND	ND	ND	ND	ND	ND	ND	27.9 J	ND	ND	ND	11.6 J	ND	**20.3**	ND	811 B
	1-76-98D-Q4-05	11/21/2005	**283**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	5.06	ND	**9340 B**
	1-76-98D-Q1-06	2/14/2006	**1.54**	ND	ND	ND	5.28 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.41 JB	5.07	ND	82.8 JB
	1-76-98D-Q2-06	5/11/2006	**4.62**	ND	ND	ND	1.04 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	312 J
	17698DQ306	8/15/2006	**22.3**	ND	ND	6.82	15.7 JB	2.95 J	ND	ND	ND	ND	ND	ND	ND	2.36 J	ND	ND	ND	ND	1.05 JB	2.18	ND	137 JB

TABLE 3-2
Analytical Results from Groundwater Sampling, O&M Period July 2005-August 2006, NFF Site, NAS Cecil Field

Groundwater Cleanup Target Level[1]			**1**	**30**	**40**	**20**	**6300**	**700**	**70**	**3**	**28**	**28**	**280**	**20**	**210**	**NA**	**0.8**	**4200**	**560**	**NA**	**5**	**14**	**100**	**5000**
Natural Attenuation Default Concentration			**10**	**300**	**400**	**200**	**63000**	**7000**	**700**	**30**	**280**	**280**	**2800**	**200**	**2100**	**NA**	**8**	**42000**	**5600**	**NA**	**50**	**140**	**1000**	**50000**
76-99D	1-76-99D-Q4-05	11/16/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-99D-Q1-06	2/15/2006	ND	ND	ND	ND	3.18 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-99D-Q2-06	5/17/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	17699DQ306	8/16/2006	ND	ND	ND	ND	1.59 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.62 JB	ND	ND	NA
76-100D	1-76-100D-Q4-05	11/17/2005	**23.2**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-100D-Q1-06	2/16/2006	**5**	ND	ND	ND	2.9 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-100D-Q2-06	5/16/2006	**1.27**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	176100DQ306	8/17/2006	**1.07**	ND	ND	ND	ND	ND	ND	2.06 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
76-104D	1-76-104D-Q4-05	11/16/2005	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-104D-Q1-06	2/15/2006	ND	ND	ND	ND	2.71 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	1-76-104D-Q2-06	5/15/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
	176104DQ306	8/17/2006	0.838 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.948 J	ND	ND	NA
76-110D	01-76-110D-Q1-05	1/25/2005	**1150**	ND	ND	**88.8**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	499 JB
	1-76-110D-Q4-05	11/21/2005	**597**	ND	ND	**38.2 J**	ND	42.6 J	ND	ND	ND	ND	ND	ND	ND	ND	**19.2 JB**	ND	ND	ND	ND	2.57 J	ND	2700 B
	1-76-110D-Q1-06	2/14/2006	**434**	ND	ND	**42.3 J**	26.9 JB	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**28.6 JB**	2.55 J	ND	309 JB
	1-76-110D-Q2-06	5/11/2006	**559**	ND	ND	ND	169 JB	125	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.31	ND	370
	176110DQ306	8/14/2006	**497**	ND	ND	17.1 J	59.4 JB	15.4 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**9.25 JB**	3.33	ND	430 JB
76-113S	01-76-113S-Q1-05	1/25/2005	**7730**	**1130**	**85.3 J**	**4740**	ND	ND	ND	ND	ND	ND	ND	ND	ND	1350	**87.7 J**	ND	ND	515	ND	**87.3 J**	62.6 J	**12700 JB**
	1-76-113S-Q4-05	11/18/2005	**7940**	**878 J**	ND	**4010**	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	**400 J**	ND	ND		ND	**293 J**	ND	**6090 JB**
	1-76-113S-Q1-06	2/13/2006	**9680**	**953 J**	ND	**1790**	569 JB	ND	ND	ND	**38.6 J**	26.2 J	ND	ND	ND	469 J	ND	ND	ND	ND	**315 JB**	**150 J**	ND	3510 JB
	1-76-113S-Q2-06	5/10/2006	**13100**	**1060**	ND	**1880**	545 JB	ND	ND	ND	23.1 J	ND	ND	ND	ND	684 J	ND	ND	ND	ND	ND	**103 J**	ND	**7290**
	176113SQ306	8/14/2006	**10500**	**1300**	ND	**2500**	ND	ND	ND	ND	27.1 J	ND	ND	ND	ND	518	ND	ND	ND	ND	**195 JB**	**157 J**	ND	4060 JB

Notes:

All concentrations reported in micrograms per liter (ug/L).

1 = Ch 62-777 FAC Groundwater Cleanup Target Levels (**GCTLs**) reported in µg/L

NA - Not Available at time of rule adoption

ND - Not detected

J - Result is estimated

JB- Estimate value. The analyte was detected in the associated method and/or calibration blank.

Values Bolded are concentrations that exceed the Groundwater Target Cleanup Level (**GCTL**)

Values Shaded are concentrations that exceed Natural Attenuation Default Concentration (NADC)

Values Bold and Shade are concentrations that exceed both **GCTL** and **NADC**

TABLE 3-3
Field Measurements of Groundwater Geochemical Parameters, Annual O&M Period July 2005-August 2006

Well Identification	Sample Date	pH	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature (°C)	ORP (mV)	HACH Test Kit / Dissolved Oxygen (mg/L)	Chemetrics Test Kit / Dissolved Oxygen (mg/L)
372-13R	1/24/2005	5.56	.490	30.0	3.78	20.11	-120	NS	NS
	11/18/2005	6.53	0.158	23.50	0.16	23.70	-29	NS	NS
	2/13/2006	6.69	0.166	22.00	0.00	20.19	39	NS	NS
	5/15/2006	5.85	0.401	15.60	2.21	23.90	0.3	NA	1.50
	8/15/2006	6.18	0.181	20.10	1.53	27.50	27.6	NA	NA
76-116D	11/17/2005	5.29	0.410	2.03	0.14	20.50	7	NS	NS
	2/15/2006	5.25	0.037	2.39	0.00	21.39	-37	NS	NS
	8/17/2006	3.93	5.418	0.34	0.40	22.90	36.7	<1.00	NA
76-49S	11/17/2005	4.80	0.210	1.34	0.05	21.80	76	NS	NS
	2/16/2006	4.00	0.456	1.97	0.00	21.02	235	NS	NS
	5/16/2006	3.55	0.703		0.34	21.90	281	NA	NA
	8/17/2006	3.19	0.994	1.78	0.23	23.80	275.3	NA	0.00
76-57S	11/17/2005	5.71	0.124	55.30	0.05	22.40	-5	NS	NS
	2/15/2006	4.71	0.706	18.10	0.00	22.60	39	NS	NS
	5/17/2006	3.78	1.847		0.46	23.10	224	NA	NA
	8/17/2006	3.51	2.117	6.59	0.14	24.10	158.2	NA	0.00
76-50I	1/25/2005	5.87	5.14	4.6	0.16	20.60	-24	NS	NS
	11/21/2005	4.71	0.103	5.93	0.04	22.10	-4	NS	NS
	2/14/2006	4.91	0.091	9.88	0.00	21.33	-54	NA	NA
	5/15/2006	4.47	0.155		0.97	22.90	135	NA	NA
	8/15/2006	4.54	0.392	0.96	0.21	24.50	-55.4	NA	0.10
76-61I	11/17/2005	4.85	0.590	4.40	0.13	21.20	38	NS	NS
	2/15/2006	4.13	0.299	8.13	0.00	21.51	106	NS	NS
	5/17/2006	4.18	0.479		-0.20	22.10	136	NA	NA
	8/16/2006	3.51	1.482	0.84	0.14	23.20	228.4	1.80	NA
76-70I	1/25/2005	5.40	0.056	10.5	0.04	20.61	-79	NS	NS
	11/21/2005	4.98	0.480	14.00	0.28	22.80	-14	NS	NS
	2/14/2006	4.96	0.041	37.60	0.00	21.63	-51	NS	NS
	5/11/2006	4.81	0.560	17.90	0.10	23.60	60	NA	NA
	8/15/2006	4.99	0.142	8.48	0.80	24.50	8.48	NA	NA
76-93S	1/24/2005	6.06	0.356	32.5	1.37	19.76	-172	NS	NS
	11/18/2005	6.22	0.157	592.00	0.01	23.40	-93	NS	NS
	2/13/2006	5.98	0.188	567.00	0.00	18.67	-78	NA	NA
	5/10/2006	5.80	0.183	118.00	0.04	23.60	-77.2	NA	NA
	8/14/2006	6.01	0.177	46.10	1.44	28.10	46.1	NA	NA

TABLE 3-3
Field Measurements of Groundwater Geochemical Parameters, Annual O&M Period July 2005-August 2006
NFF Site, NAS Cecil Field

Well Identification	Sample Date	pH	Conductivity (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temperature (^{o}C)	ORP (mV)	HACH Test Kit / Dissolved Oxygen (mg/L)	Chemetrics Test Kit / Dissolved Oxygen (mg/L)
76-94S	1/25/2005	6.43	0.501	10.3	1.57	21.67	-193	NS	NS
	11/18/2005	2.96	4.570	2.74	0.19	24.00	373	NS	NS
	2/13/2006	2.76	5.830	7.68	0.00	22.52	401	NA	NA
	5/10/2006	2.34	3.710	3.49	0.44	24.10	505.1	NA	NA
	8/14/2006	2.43	3.094	0.64	2.06	25.95	577.9	NA	NA
76-95S	11/16/2005	6.00	0.131	240.00	3.07	23.50	111	NS	NS
	2/14/2006	6.04	0.091	43.00	0.30	19.05	168	NS	NS
	5/16/2006	5.02	0.640	NM	1.45	21.00	348	NA	NA
	8/16/2006	5.61	0.770	>1000	1.33	25.30	31.2	NA	NA
76-98D	1/25/2005	7.00	0.483	0.0	0.22	21.45	-158	NS	NS
	11/21/2005	6.67	0.421	3.68	0.12	23.30	-113	NS	NS
	2/14/2006	6.26	0.745	18.80	0.00	21.00	-127	NA	NA
	5/11/2006	6.62	0.693	42.70	2.61	25.00	-21.3	NA	NA
	8/15/2006	4.84	5.731	25.90	0.47	25.90	-48.8	NA	<1.0
76-99D	11/16/2005	6.88	1.920	2.08	0.20	25.30	-99	NS	NS
	2/15/2006	6.31	2.950	3.47	0.00	22.94	29	NS	NS
	5/17/2006	6.25	3.145	3.68	0.58	25.40	34.6	NA	NA
	8/16/2006	6.19	3.020	0.89	0.50	27.30	31.1	NA	0.20
76-100D	11/17/2005	7.04	0.455	1.21	0.20	21.30	-142	NS	NS
	2/16/2006	6.79	0.392	0.99	0.00	19.50	-105	NS	NS
	5/16/2006	6.57	0.580	1.17	0.73	21.60	-50	NA	NA
	8/17/2006	6.63	0.841	0.78	0.30	23.58	-134.2	NA	0.05
76-104D	11/16/2005	5.94	0.103	1.23	0.31	22.90	-4	NS	NS
	2/15/2006	5.75	0.093	1.19	0.00	20.01	-15	NS	NS
	5/17/2006	4.91	0.125	10.40	3.71	21.00	191	NA	NA
	8/17/2006	5.85	0.143	1.90	0.27	21.50	-49.2	NA	NA
76-110D	1/25/2005							NS	NS
	11/21/2005	3.65	0.772	16.50	0.12	21.90	174	NS	NS
	2/14/2006	3.88	0.439	1.04	0.00	21.89	194	NA	NA
	5/11/2006	3.01	3.987	5.55	1.81	23.80	227	NA	NA
	8/14/2006	3.14	4.432	0.99	0.20	24.80	145.9	NA	0.20
76-113S	1/25/2005	5.62	0.074	4.70	0.47	21.83	-23	NS	NS
	11/18/2005	4.22	0.738	13.20	0.22	25.50	158	NS	NS
	2/13/2006	3.95	1.580	71.80	0.00	23.90	32	NA	NA
	5/10/2006	3.27	1.454	3.02	-0.14	25.90	105.8	NA	NA
	8/14/2006	3.21	1.908	4.28	0.11	26.30	109.7	NA	0.20

Notes: All measurements taken using direct reading instruments in the field.
Dissolved Oxygen field testing using Chemtrics/Hach kits may differ from YSI results due to high levels of Hydrogen Sulfide in this region.

mS/cm = millisiemans per centimeter

NTU = nephelometric turbidity units

mg/L = milligrams per liter

^{o}C = degrees Celsius

ORP = oxygen reducing potential

mV = millivolts

% = percent

TABLE 3-4
Groundwater Analytical Results of MNA Parameters, Annual O&M Period July 2005 - August 2006

WELL	Sample ID	Sample Date	Total Inorganic Carbon	Total nitrate\nitrite	Phosphorus, total (as p)	Sulfate (as SO4)	Sulfide	Total organic carbon	Carbon Dioxide free	Methane
76-116D	NFF-11Xc-092304	09/23/2004	24000JB	20JB	86J	10U	264	6500JB	NA	1400
	1-76-11Xc-Q4-05	11/17/2005	9600 JB	13	135 J	ND	1060	2600	NA	1060
	1-76-11Xc-Q1-06	2/15/2006	7500	143	134 J	2200 J	909	4600	NA	927
	1-76-11Xc-Q2-06	5/15/2006	3500	112	79 J	2180000	10 J	2200	150000	766
	1-7611XCQ306	8/17/2006	8100	137	162 J	5000000	151	6200	107000	276
76-49S	NFF-49S-092304	09/23/04	16500JB	28JB	ND	ND	301	9900JB	NA	3500
	1-76-49S-Q4-05	11/17/2005	13900 JB	36	ND	55700	7 J	4000	NA	255
	1-76-49S-Q1-06	2/16/2006	2900 JB	36	ND	235000 B	20 J	7000 JB	NA	34.3
	1-76-49S-Q2-06	5/16/2006	7900	78	ND	281000	ND	6500	94900	18.6
	17649SQ306	8/17/2006	10800	74	ND	832000	30	7400	136000	12
76-57S	NFF-57S-092304	09/23/2004	13400JB	31	103	10U	827	18600	NA	2460
	1-76-57S-Q4-05	11/17/2005	16400 JB	31	145 J	7600	154	12700	NA	2460
	1-76-57S-Q1-06	2/15/2006	6700	71	ND	352000	228	13500	NA	552
	1-76-57S-Q2-06	5/17/2006	10000 JB	131	114 J	1140000	NA	11300 JB	117000 JB	146
	176-57S-Q3-06	8/17/2006	5600	136	228	1370000	135	13500	117000	95.3
76-61I	NFF-61I-092304	09/23/2004	9200JB	30	ND	ND	615	11300	NA	770
	1-76-61I-Q4-05	11/17/2005	15200 JB	5	ND	6500	470 J	8300	NA	415 J
	1-76-61I-Q1-06	2/15/2006	5500	43	ND	186000	1440	9500	NA	315
	1-76-61I-Q2-06	5/17/2006	13500 JB	64	ND	178000	NA	9700 JB	181000 JB	248
	1-76-61I-Q3-06	8/16/2006	8900 JB	138	ND	836000	448	13600 JB	161000 JB	180
76-95S	NFF-95S-092304	09/23/2004	8300	47	11	8500	33	8000	NA	0.6
	1-76-95S-Q4-05	11/16/2005	15400	79	177 J	ND	187	7600	NA	6.09
	1-76-95S-Q1-06	2/14/2006	7000	186	96 J	5000 J	68 J	6800	NA	ND
	1-76-95S-Q2-06	5/16/2006	5600	243	331	ND	310	15000	95900	1.41 J
	1-76-95S-Q3-06	8/16/2006	8300 JB	471	769	ND	2050	34700 JB	112000 JB	147

TABLE 3-4
Groundwater Analytical Results of MNA Parameters, Annual O&M Period July 2005 - August 2006

WELL	Sample ID	Sample Date	Total Inorganic Carbon	Total nitrate\nitrite	Phosphorus, total (as p)	Sulfate (as SO4)	Sulfide	Total organic carbon	Carbon Dioxide free	Methane
76-99D	NFF-99D-092304	09/23/2004	31900JB	15JB	134J	ND	61	12800	NA	1100
	1-76-99D-Q4-05	11/16/2005	66700	11	246	488000	8 J	ND	NA	1.8 J
	1-76-99D-Q1-06	2/15/2006	35100	104	46 J	1340000	43	11800	NA	
	1-76-99D-Q2-06	5/17/2006	78900 JB	37	68 J	1280000	ND	ND	727000 JB	400
	1-76-99D-Q3-06	8/16/2006	71000 JB	3	ND	1410000	55	7400 JB	428000 JB	1.29 J
76-100D	NFF-100D-092304	09/24/2004	31000JB	21JB	694	ND	29	8600	NA	320
	1-76-100D-Q4-05	11/17/2005	13300 JB	8	680	ND	10 J	4600	NA	1020
	1-76-100D-Q1-06	2/16/2006	6800 JB	129	821	13300 B	58	7700 JB	NA	1260
	1-76-100D-Q2-06	5/16/2006	16900	5	876	65800	ND	5900	76100	1110
	1-76-100D-Q3-06	8/17/2006	19100	85	827	166000	99	4300	137000	1220
76-104D	NFF-104D-092304	09/24/2004	27400JB	22JB	390	ND	20	9200JB	NA	630
	1-76-104D-Q4-05	11/16/2005	13300	6	1870	ND	23	8500	NA	246
	1-76-104D-Q1-06	2/15/2006	7800	110	1600	4100 J	50	5800	NA	357
	1-76-104D-Q2-06	5/15/2006	4100	6	2120	ND	ND	2600	166000	262
	1-76-104D-Q3-06	8/17/2006	11300	ND	1700	ND	80	4200	146000	377

Notes:

All concentrations reported in micrograms per liter (ug/L).

ND- Not
detected.

J - Result is estimated

JB- Estimate value. The analyte was detected in the associated method and/or calibration blank.

Carbon dioxide measurement was also added to the MNA parameter list since the May 2006 sampling event, to provide an indicator of microbial respiration and metabolic processes.

A summary of the field parameter test results is shown in Table 3-3. The analytical laboratory and data validation reports for the groundwater sampling events are provided in Appendix B.

3.2.3 Baseline Contaminant Characterization and O&M Sampling Analytical Results

Because the analytical results are being used to evaluate the effectiveness of the remediation system, the discussion of the results will be based on the most recent data from the August 2006 quarterly sampling event and compared to the baseline data. The following monitoring wells are located within the area and the depth interval of the active remediation system:

- CEF-372-13R (shallow biosparging area)
- CEF-76-94S (shallow air sparging area)
- CEF-76-113S (shallow air sparging area)
- CEF-76-93S (shallow air sparging area)
- CEF-76-50I (deep air sparging area)
- CEF-76-70I (deep air sparging area)
- CEF-76-98D (deep air sparging area)
- CEF-76-110D (deep biosparging area)

Three MNA wells, CEF-76-61I (located within the deep biosparging area), CEF-76-99D (located within the deep biosparging area), and CEF-76-100D (located just outside the deep biosparging area), sampled as part of the MNA sampling scheme could be experiencing influence from the AS/BS sparge wells due to their proximity to these sparge wells. Therefore, the analytical results for these wells will be included in this discussion on treatment effectiveness. A discussion of the analytical result of the wells outside the influence of the remediation system is presented in Section 3.2.4.

The following parameters were detected at a concentration above the GCTLs during the August 2006 sampling event:

- Benzene in wells CEF-76-11Xc, CEF-76-50I, CEF-76- 57S, CEF-76-70I, CEF-76-93S, CEF-76-98D, CEF-76-100D, CEF-76-110D, and CEF-76-113S
- Ethylbenzene in wells CEF-76-93S and CEF-76-113S
- Toluene in well CEF-76-93S; total xylenes in CEF-76-70I, CEF-76-93S, and CEF-76-113S
- Isopropylbenzene in wells CEF-76-61I, CEF-76-70I, and CEF-76-93S; methylene chloride in wells CEF-76-70I, CEF-76-93S, CEF-76-110D, and CEF-76-113S
- Naphthalene in wells CEF-76-61I, CEF-76-70I, CEF-76-93S and CEF-76-113S
- 1-methylnaphthalene in well CEF-76-93S

The following parameters also exceeded the FDEP Natural Attenuation Default Concentrations:

- Benzene in wells CEF-76-11Xc, CEF-76-50I, CEF-76-70I, CEF-76-93S, CEF-76-98D, CEF-76-110D, and CEF-76-113S
- Ethylbenzene in wells CEF-76-93S and CEF-76-113S
- Toluene in well CEF-76-93S; total xylenes in CEF-76-70I, CEF-76-93S, and CEF-76-113S
- Isopropylbenzene in wells CEF-76-61I, CEF-76-70I, and CEF-76-93S

Methylene chloride was detected in the associated method and calibration blanks and historically; the parameter has not been consistently detected at the site. Methylene chloride is a common laboratory-introduced artifact and is not considered a chemical of concern at this site. Therefore, the detections of methylene chloride during the August 2006 sampling event are not considered representative of groundwater quality conditions at the site. The detections of isopropylbenzene at the site were not anticipated and will be monitored in the future.

Figures 3-1 through 3-9 show trend charts of concentrations versus time for benzene, ethylbenzene, toluene, xylenes (total), isopropylbenzene, and naphthalene in select wells which showed exceedances during the treatment period. In general, the August 2006 contaminant concentrations in wells within the influence of the remediation systems have shown a generally-decreasing trend when compared to concentrations from the pre-treatment and historic sampling events.

As shown on Figures 3-1 and 3-2, benzene concentrations have decreased in wells CEF-76-93S, CEF-76-94S, CEF-76-98D, CEF-76-100D, and CEF-76-110D; increased in CEF-76-50I, and remained similar in CEF-76-113S. Figure 3-3 indicates that ethylbenzene concentrations have decreased in wells CEF-76-93S and CEF-76-94S, and remained similar in CEF-76-113S. Figure 3-4 shows that toluene concentrations have decreased in wells CEF-76-93S, CEF-76-94S, and CEF-76-113S. Figure 3-5 shows that xylene concentrations have decreased in wells CEF-76-94S and CEF-76-110D, and remained the same in CEF-76-70I, CEF-76-93S, and CEF-76-113S. Figures 3-6 and 3-7 show that isopropylbenzene concentrations have decreased in wells CEF-76-50I, CEF-76-93S, CEF-76-94S, CEF-76-98D, and CEF-76-113S, and remained similar in CEF-76-70I. Figures 3-8 and 3-9 show that naphthalene concentrations have decreased in wells CEF-76-50I and CEF-76-94S; increased in CEF-76-61I, and remained similar in CEF-76-70I, CEF-76-98D, and CEF-76-113S.

Based on the analytical results presented in Figures 3-1 to 3-9 and Table 3-2, the remediation system appears to have been effective at reducing parameter concentrations in wells CEF-76-93S, CEF-76-94S, CEF-76-98D, CEF-76-100D, and CEF-76-110D and partially effective in well CEF-76-50I. The remediation system does not appear to have had a contaminant-reducing effect yet in wells CEF-76-70I and CEF-76-113S. This could be due to a heavier contaminant mass present in this area, which is immediately downgradient of the historical leak and spill from the fuel storage tanks.

Figure 3-1
Benzene Concentrations - Shallow Wells

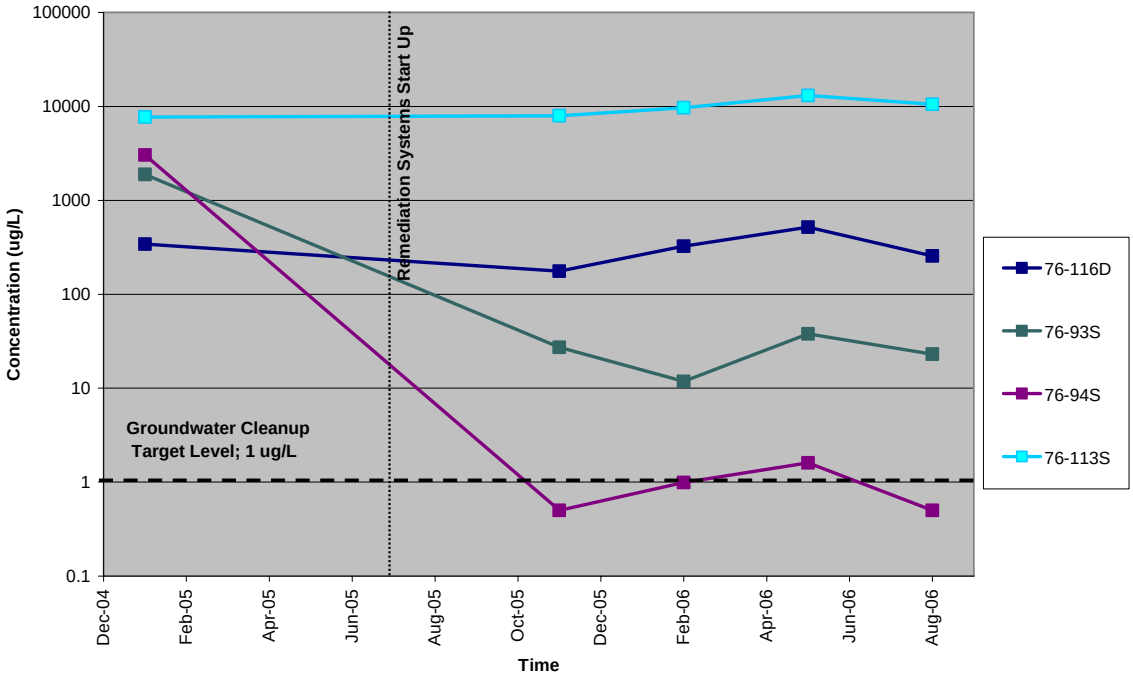


Figure 3-2
Benzene Concentrations Deep Wells

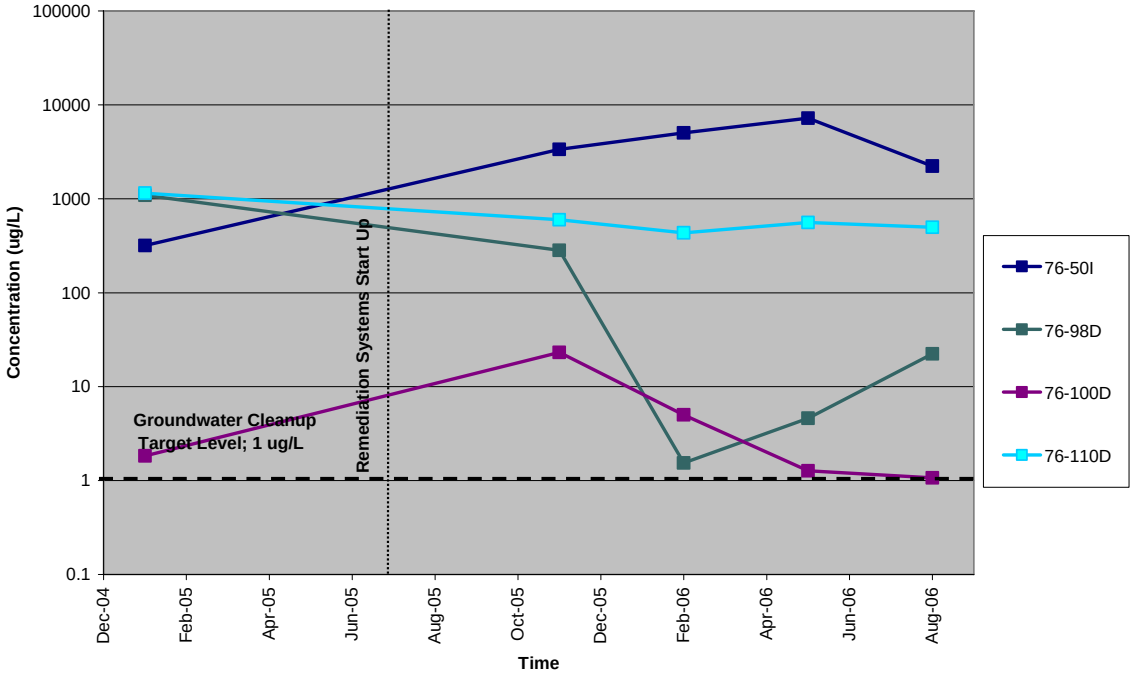


Figure 3-3
Ethylbenzene Concentrations

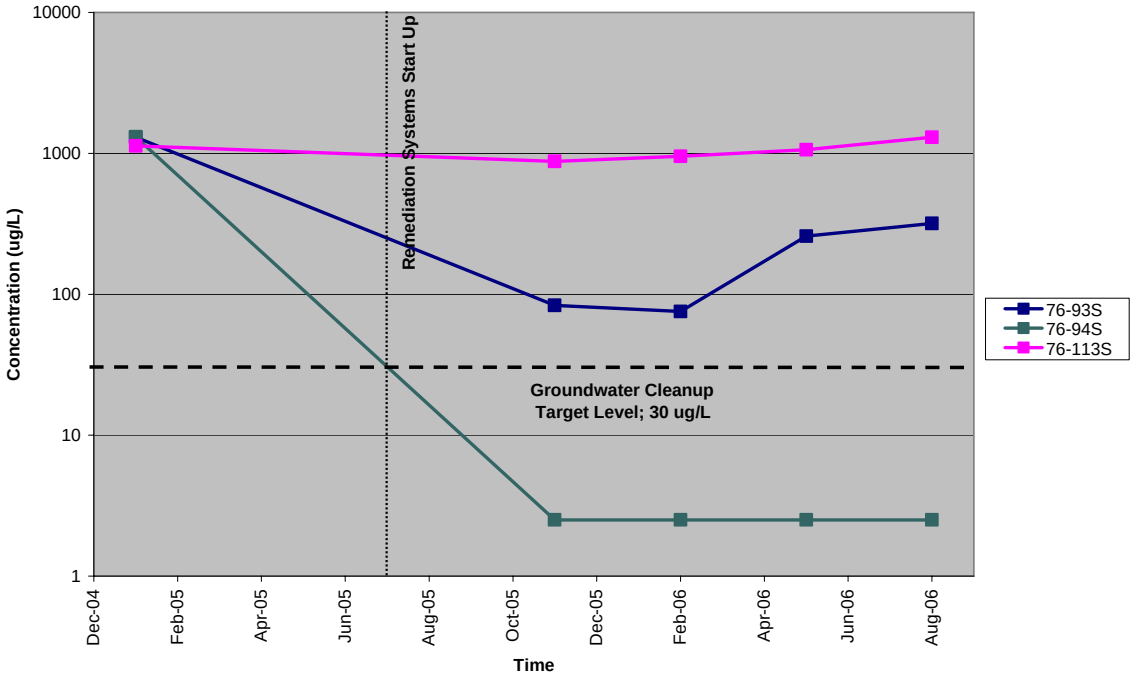


Figure 3-4
Toluene Concentrations

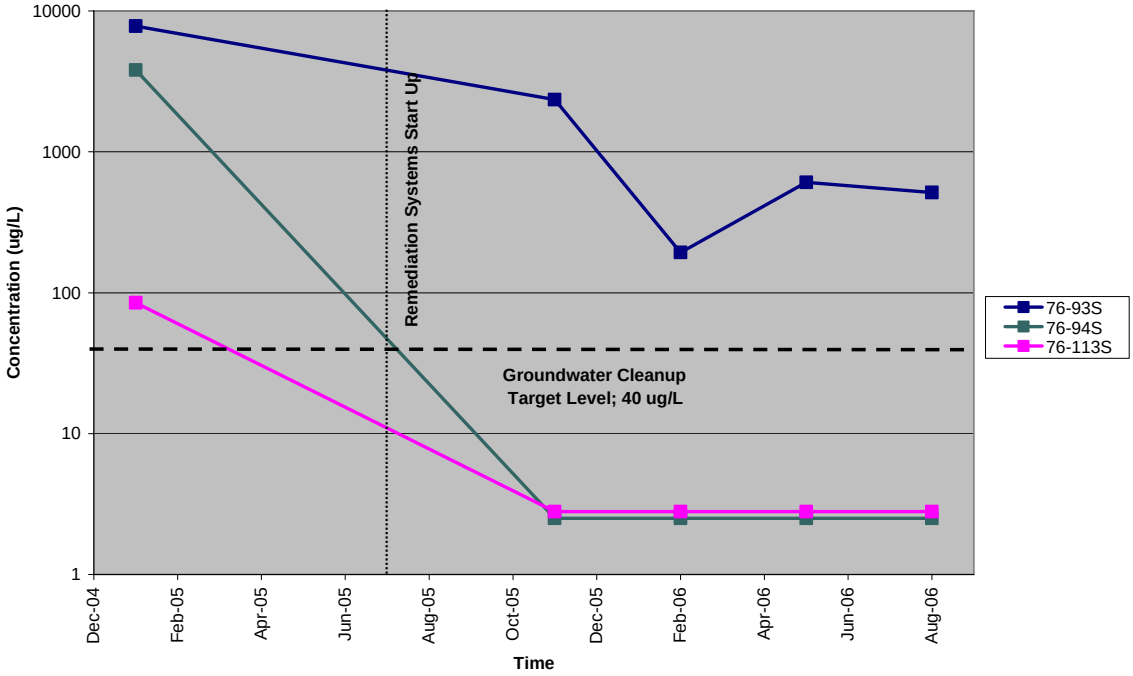


Figure 3-5
Xylenes (Total) Concentrations

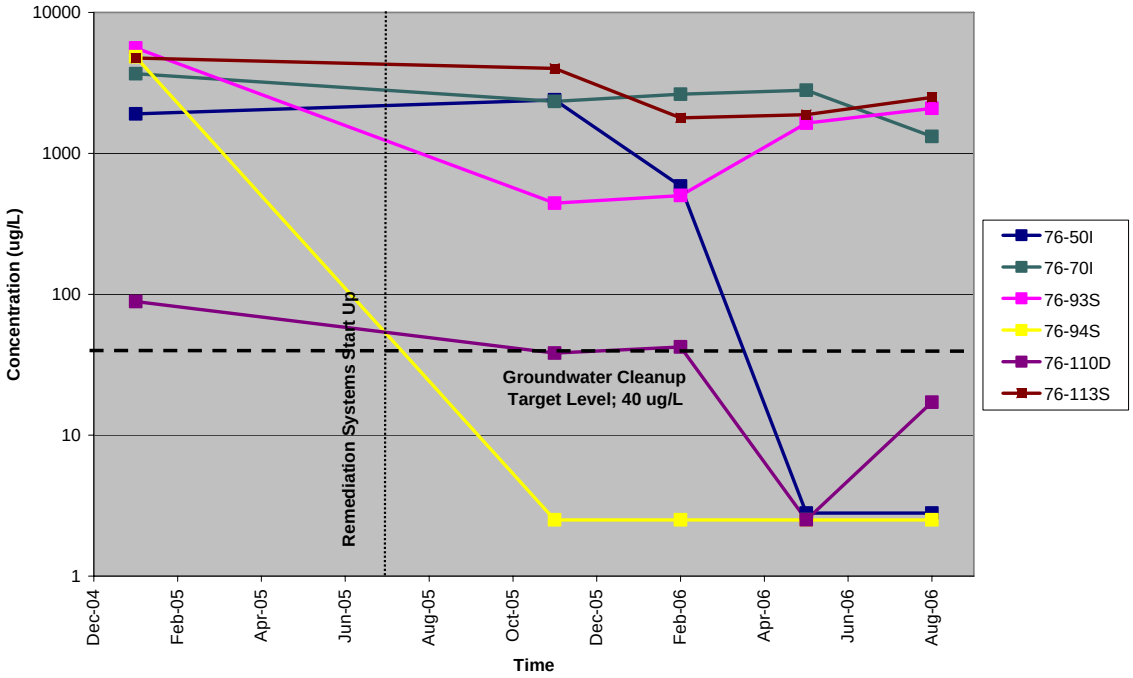


Figure 3-6
Isopropylbenzene Concentrations - Shallow Wells

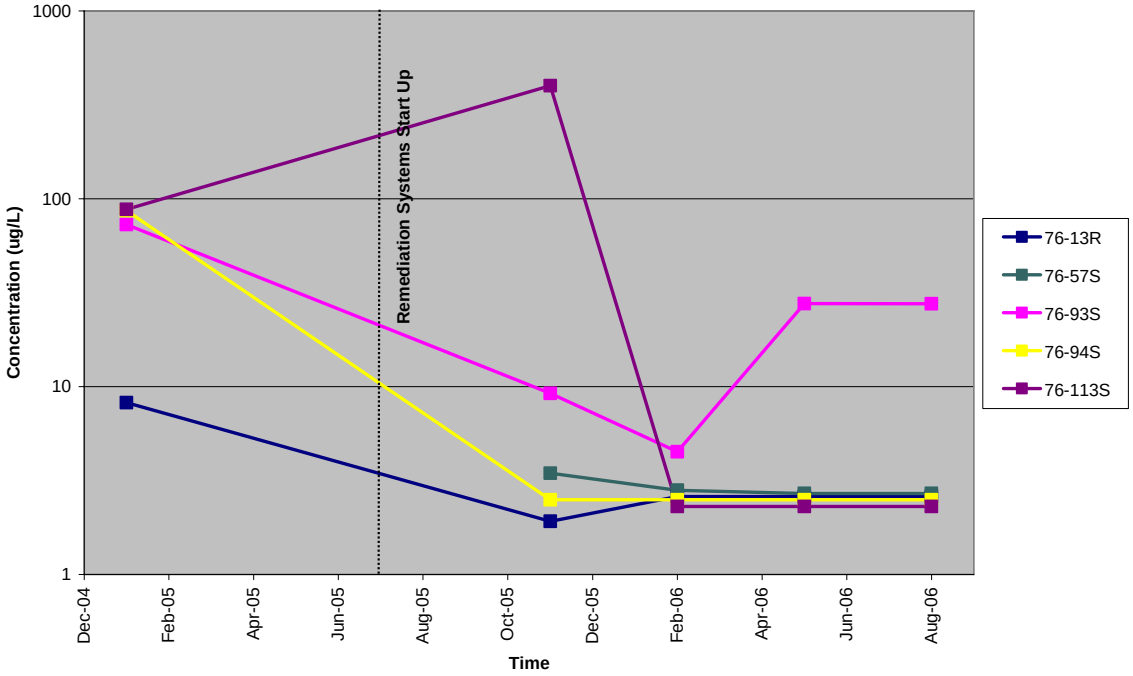


Figure 3-7
Isopropylbenzene Concentrations - Deep Wells

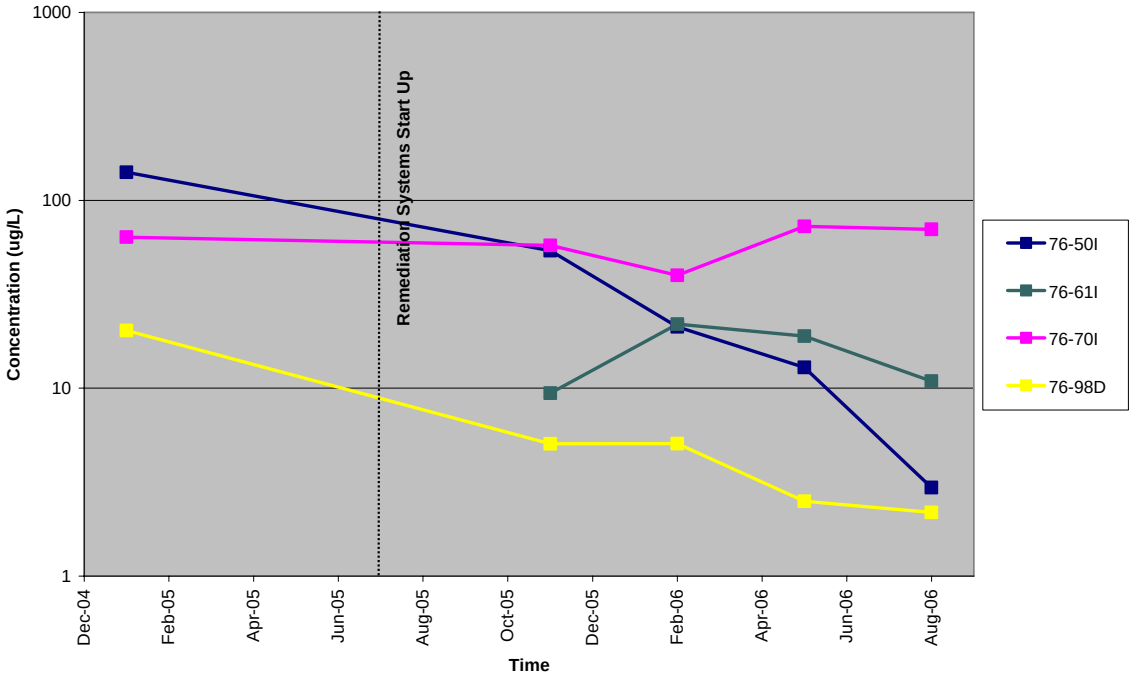


Figure 3-8
Naphthalene Concentrations - Shallow Wells

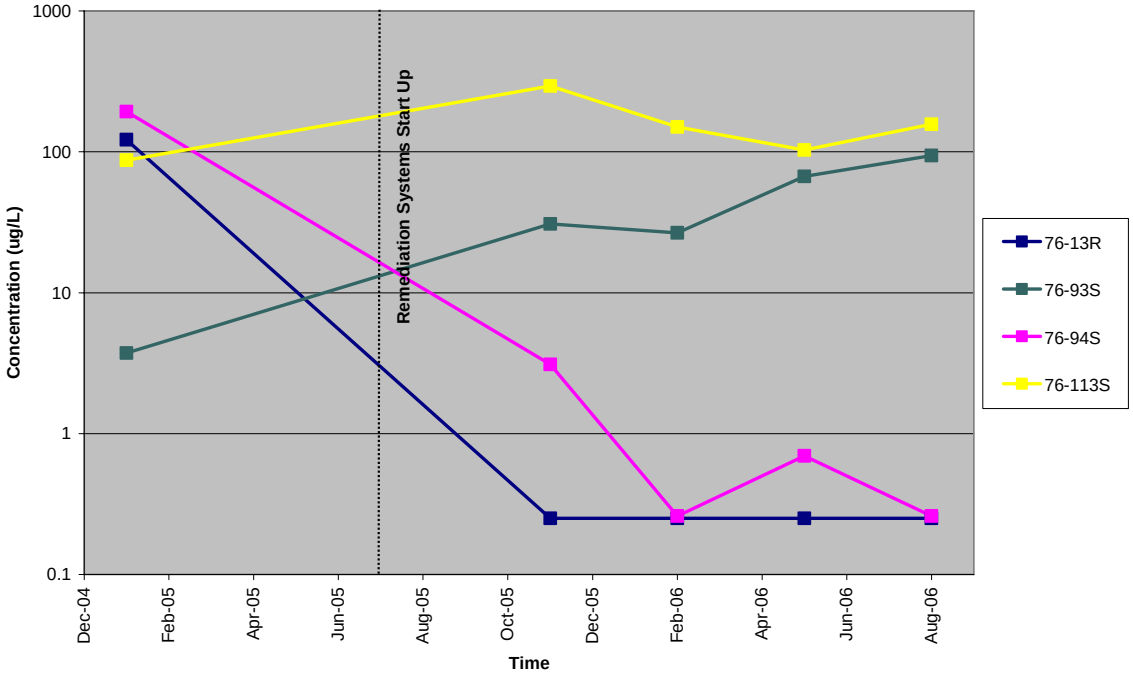
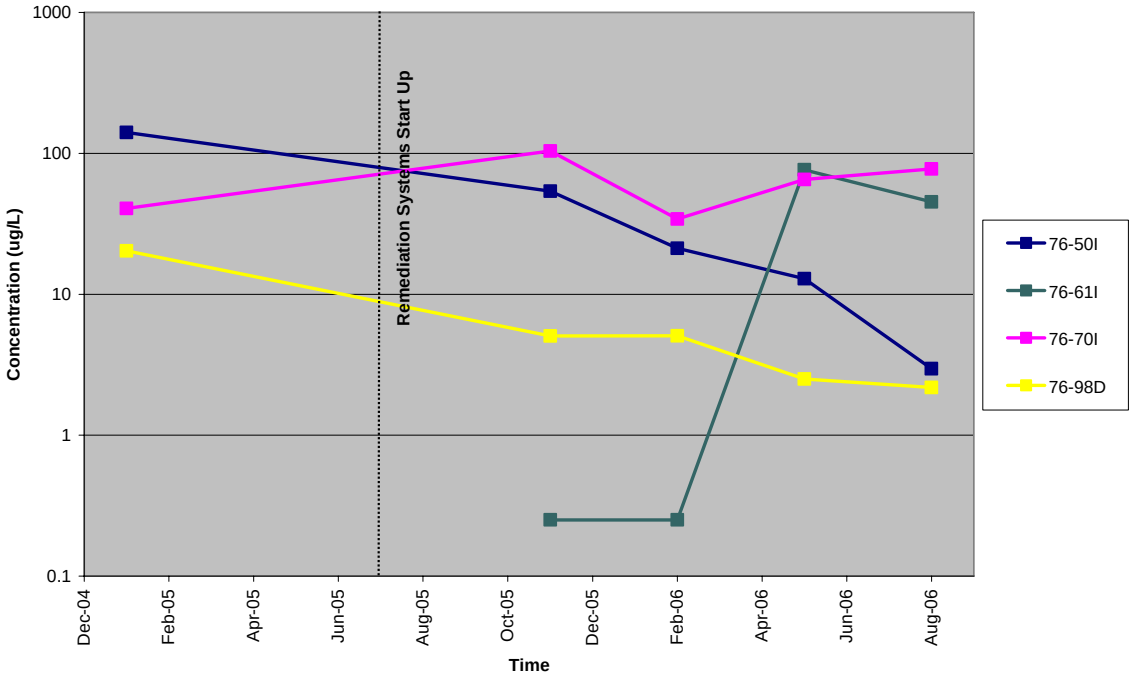


Figure 3-9
Naphthalene Concentrations - Deep Wells



3.2.4 Analytical Results of MNA Parameter Sampling

Water quality data was evaluated to determine if natural attenuation is continuing to occur in groundwater downgradient of the target treatment area, as indicated by decreasing contaminant concentrations. To facilitate this evaluation, August 2006 data from MNA monitoring wells that could potentially be influenced by the sparge wells (CEF-76-49S, CEF-76-57S, CEF-76-61I, CEF-76-99D, CEF-76-100D, CEF-76-104D, and CEF-76-116D) will be compared to background values obtained from upgradient MNA well CEF-76-95S, which is sufficiently farther away from the influence of the sparge wells. The parameters evaluated include DO, ORP, nitrate/nitrite, sulfate/sulfide, carbon dioxide, methane and VOCs. These parameters were measured to evaluate whether aerobic and anaerobic biological degradation of hydrocarbons was occurring in the subsurface aquifer at the site. Table 3-4 shows a summary of detections of these parameters from the four O&M quarterly sampling events.

A discussion of the results of each parameter is presented in the following subsections.

3.2.4.1 Dissolved Oxygen

DO measurements were recorded in select monitoring wells during the August 2006 groundwater sampling event. Typically, DO concentrations below 1.0 milligram per liter (mg/L) indicate that geochemical conditions are anoxic and that a reducing environment is present. DO concentrations in groundwater at the site measured after shutdown of the treatment system, ranged from 0.14 mg/L (CEF-76-57S and CEF-76-61I) to 1.33 mg/L (CEF-76-95S). DO concentrations measured in each well were below the background well

CEF-76-95S level. The measured DO data suggests that subsurface conditions are suboptimal for aerobic hydrocarbon biodegradation. However, contaminant concentration reductions indicate some type of biological treatment is occurring. Based on DO data alone, it is not possible to conclude whether contaminant reductions are the result of aerobic or anaerobic treatment. Microbial analysis could help determine the dominant organisms in the system and indicate the relative contributions of aerobes and anaerobes to contaminant reduction.

Additionally, an accurate measurement of DO levels during sparging operations has not been possible due to the pressure in the aquifer forcing a "geysering" in monitoring wells. An alternate method of measuring DO with a downhole sensor or tubing and additional retrofitting of wellheads is being evaluated to collect DO measurements during the air/biosparging operation.

3.2.4.2 Oxidation/Reduction (Redox) Potential

Redox potential is a measure of the relative tendency of ions in solution to transfer electrons. As electron acceptors are utilized, the redox potential of the groundwater decreases. As DO is consumed, the redox potential will decline and perhaps become negative. Redox potentials among MNA wells at the site ranged from –134.2 millivolts (mV) to 275.3 mV. Only two wells (CEF-76-100D and CEF-76-104D) of the eight MNA wells showed negative ORP values during the August 2006 event.

3.2.4.3 pH

The pH of groundwater has an effect on the presence and activity of microbial populations in groundwater. Microbes capable of degrading petroleum hydrocarbons generally prefer pH values varying from 6 to 8 standard units. The pH values in the MNA wells range from 3.51 (CEF-76-61I) to 6.63 (CEF-76-100D), with a background value of 5.61 (CEF-76-95S). In general, pH values are below the optimal range for microbial activity and could limit the effectiveness of bioremediation.

3.2.4.4 Nitrates/Nitrite

After dissolved oxygen has been depleted, biodegradation of hydrocarbons may continue anaerobically using total nitrate/nitrite as electron acceptors (denitrification). Nitrate/nitrite concentrations will be lower in the wells containing hydrocarbons (such as BTEX), if biodegradation is occurring. Nitrate and nitrite were detected in seven of the eight monitoring wells in which the parameters were analyzed. The nitrate/nitrite concentrations (ranging from non-detect to 138 µg/L) in the downgradient wells were lower compared with the background well CEF-76-95S (471 µg/L). Denitrification is favored within pH values ranging from 6.2 to 10.2 and corresponding redox potential of 665 mV to –20 mV. The presence of nitrate/nitrite in the areas of impacted groundwater and low pH values suggest that reducing conditions favorable for denitrification are not present .

3.2.4.5 Sulfate/Sulfide

After DO and total nitrogen have been depleted in the aquifer, sulfate may be used as an electron acceptor for anaerobic biodegradation. This process is termed sulfate reduction, and results in the production of sulfide. Portions of the hydrocarbon plume undergoing

anaerobic biodegradation may have depleted sulfate concentrations and caused elevated sulfide concentrations. Sulfate reducing conditions are favorable at redox potentials of –200 mV and ph of 7.

Sulfate was detected in six of the eight MNA wells and not detected in the background well (CEF-76-95S). The presence of sulfate in the areas of impacted groundwater, low pH values, and high redox potential suggest that conditions favorable for sulfate reduction are not present.

3.2.4.6 Carbon Dioxide

Metabolic processes operating during biodegradation of fuel hydrocarbons result in the production of carbon dioxide (CO_2). The presence of CO_2 at levels higher than background may be indicative of reducing conditions. CO_2 levels were similar in the background well (CEF-76-95S) as compared to downgradient wells with the exception of well CEF-76-99D, where the CO_2 concentration was approximately 4 times greater than background.

3.2.4.7 Methane

The presence of methane in groundwater at concentrations above background is a good indicator that methanogenesis is occurring. During methanogenesis, carbon dioxide is used as an electron acceptor and methane is formed. The presence of methane in groundwater is also indicative of strong reducing conditions. Methane was detected in all eight MNA wells. The concentration of methane exceeded background in four wells (CEF-76-116D, CEF-76-57S, CEF-76-100D, and CEF-76-104D). Because methane is not present in gasoline or diesel fuel, the presence of methane above background concentrations may be indicative of anaerobic microbial degradation of hydrocarbons also taking place at the site.

3.2.4.8 VOC Concentrations

In general, VOC concentrations detected in MNA wells located outside the areas of the active remediation have generally shown a decreasing trend. As shown on Figures 3-1 and 3-2, benzene concentrations have decreased in wells CEF-76-49S and CEF-76-57S, and remained similar in CEF-76-116D. Figure 3-3 shows that isopropylbenzene concentrations have decreased in wells CEF-372-13R and CEF-76-57S. These VOC concentration reductions are attributed to the natural attenuation process at the site.

3.2.4.9 MNA Summary

Like DO and ORP data, the analytical results discussed above can be used to help assess terminal electron accepting processes. While the objective of the AS/BS treatment system is to facilitate aerobic respiration, many of the constituents in the contaminant plume can also be degraded via anaerobic processes. The one significant exception to this statement is benzene, which typically does not degrade aerobically to an appreciable level, in contrast to other constituents. The fact the methane is being produced at most wells in the MNA zone indicates the presence of reducing conditions.

4.0 Conclusions and Recommendations

The AS/BS system operated continuously during the June 27, 2005 to September 15, 2006 monitoring period. The overall operational efficiency of the AS/BS system was 67.5 percent; however the operational efficiency during the quarter ending in August 2006 was nearly 85 percent and the system is currently running at or near this level of efficiency. A majority of the downtime was associated with high storage tank water levels caused by the extraction of groundwater by the SVE system. This issue was resolved with the shutdown of the SVE system. Based on the analytical and field parameter testing, it appears that biological activity is occurring at the site.

The SVE system operated during the June 27, 2005 to November 09, 2005 monitoring period. The overall operational efficiency of the SVE system was 39.7 percent due to periodic shutdown of the SVE system resulting from high groundwater intrusion into the SVE collection system and moisture separation tank. During a period of 6 weeks in July to August 2005, extracted groundwater was discharged into a nearby manhole after securing a permit form the local utility company. During this period, the SVE system ran without interruption and the influent and effluent air samples collected at the vapor filtration unit showed an emission rate of less than 13.7 lbs/day of hazardous air pollutants. This emission rate is below the FDEP standard that would require treatment of vapor emissions before atmospheric discharge. Since the extracted vapor from the SVE system did not exceed this standard, the SVE system was recommended for shutdown. This recommendation was approved by FDEP and the SVE system was shut down in November 2005.

The following parameters were detected concentrations above the GCTLs during the August 2006 sampling event: benzene in wells CEF-76-11Xc, CEF-76-50I, CEF-76- 57S, CEF-76-70I, CEF-76-93S, CEF-76-98D, CEF-76-100D, CEF-76-110D, and CEF-76-113S; ethylbenzene and toluene in wells CEF-76-93S and CEF-76-113S; total xylenes in CEF-76-70I, CEF-76-93S, and CEF-76-113S; isopropylbenzene in wells CEF-76-61I, CEF-76-70I, and CEF-76-93S; methylene chloride in wells CEF-76-70I, CEF-76-93S, CEF-76-110D, and CEF-76-113S; naphthalene in wells CEF-76-61I, CEF-76-70I, CEF-76-93S and CEF-76-113S; and 1-methylnaphthalene in well CEF-76-93S.

Based on a comparison of baseline groundwater data versus the data collected after activation of the remediation system, the AS/BS system appears to be successful in reducing contaminant concentrations in groundwater in several portions of the treatment area. Based on MNA analytical and field parameter testing results, biological activity is continuing to occur at the site.

JVII recommends continuing the operation of the AS/BS remediation system.

An optimization study report is being prepared by CH2M HILL to assist optimization of the existing treatment system parameters. The result of this effort is expected to optimize and redirect flows to areas that show persistent contamination in the subsurface, while eliminating areas that have shown successful treatment to natural attenuation levels, and allow natural attenuation processes to continue to cleanup groundwater to FDEP GCTLs.

During the next year of operation and maintenance, a sitewide groundwater monitoring event is recommended to evaluate the current configuration of the groundwater plume (areas showing benzene concentrations exceeding 100 µg/L and 1,000 µg/L) in each of the four aquifer zones at the site (water table, upper intermediate, lower intermediate and deep zones). This effort will help revise the conceptual site model for the site and assist in the optimization efforts. Additionally, measurement and evaluation of dissolved oxygen and redox potential during operation of the AS/BS treatment system is recommended to enable an accurate assessment of aerobic and anaerobic microbial processes occurring at the site.

Appendix A

SVE Filtration System Influent and Effluent Concentrations

SVE Vapor Mass Loading Calculations

SVE Discontinuation Documentation

TECHNICAL MEMORANDUM

Recommendation to Discontinue Operation of SVE System, NFF Site, Former NAS Cecil Field, Jacksonville, FL.

PREPARED FOR:	David Grabka, Florida Department of Environmental Protection
PREPARED BY:	Sam Naik, CH2M HILL
COPIES:	Brenda Schwelling, ROICC, NAS Jacksonville Gabe Magwood, SOUTHDIV Joseph Colella, JV II Scott Smith, JV II
DATE:	October 12, 2005
PROJECT NUMBER:	283092.06.01

Introduction

An air sparging (AS), biosparging(BS) and soil vapor extraction system (SVE) (AS/BS/SVE) was constructed by AGVIQ-CH2M HILL Joint Venture II (JV II) during 2004-2005 at the North Fuel Farm Site, former NAS Cecil Field, Jacksonville, FL., to remediate groundwater contamination from a previous JP-5 fuel spill at the site. As part of the AS/BS/SVE system, 213 AS and BS wells were installed, and compressed air lines were installed below ground surface to each individual AS and BS well. The compressed air is being supplied from a 150 horse power(hp) 880 scfm air compressor, at a design air pressure of 70 psi and a flow rate of 10 standard cubic feet per minute (scfm) as per the design document *Final Remedial Action Plan Addendum, North Fuel Farm, Naval Air Station Cecil Field, Revision 1,* (TetraTech 2004) (RAPA). Figures 1 and 2 show the NFF remediation site layout with the AS and BS well locations as installed at the site. Figure 3 shows the layout of the as-built SVE collection lines. Figures 4 and 5 show the as-built drawings of the AS/BS and SVE system equipment. Photographs 1, 2 and 3 show the treatment system after completion of construction.

Thirteen SVE horizontal collection lines were initially proposed to be installed per the original design, but due to high water table in the low-lying areas in the eastern part of the site, three SVE lines could not be installed since they were submerged even during the dry months. Therefore, only 8 SVE lines were installed. The reduction in the number of SVE lines was proposed in a technical memorandum submitted by the JV II to the U.S. Navy (Navy) and the Florida Department of Environmental Protection (FDEP) during October 2004, and was approved by the FDEP.

The completion of the AS, BS and SVE piping installations were significantly hampered and delayed by the long hurricane season of 2004, which caused severe water-logging of the NFF site for several weeks at a time.

Construction of the NFF treatment system was completed during March 2005. Startup and testing of the treatment system was conducted during March and April 2005. However, the AS/BS system could not be operated on a continuous basis because the SVE system had to be periodically shut down due to water-logging of the SVE collection lines. The control system operating the treatment system equipment has been programmed to prevent the AS/BS system from running in the absence of vapor collection from the SVE system. The storms during the wet months of the spring further elevated the water table at the site and caused periodic shutdown of the SVE system, thereby shutting down the AS/BS system.

The lack of a permeable cover over the soil vapor collection area and the sandy soils in the upper 10 feet of the lithology at the site provide easy percolation of rain water into the SVE lines. Water is being collected in the moisture separator of the SVE system at a rate of more than 10 gallons per minute (gpm), even during dry periods.

In order to prevent water entrainment into the granular activated carbon filters, and to keep the SVE system running without interruption, JV II decided to install a drain pipe to the outlet of the moisture separator tank and discharge excess groundwater into a nearby a manhole which is part of the sanitary sewer system operated by the Jacksonville Electric Authority (JEA). JV II applied for a groundwater discharge permit from JEA, and was granted a temporary discharge permit on June 7, 2004.

As part of the JEA groundwater discharge permit requirements, field conditions had to be met :

- installation of a chain-link fence around the discharge manhole
- the maximum discharge flow rate to not exceed 10 gpm
- discharge flow measurements to be recorded using a totalizer
- two groundwater samples to be collected monthly for measurement of pH and zinc.

These conditions have been met since the permit was approved and discharge was begun in July 2005.

Full-scale operation and maintenance (O&M) at the site was begun in mid-July 2005.

The AS/BS system has been operating with minimal disruption, except for periodic shutdowns due to SVE system shutdowns and for maintenance. The SVE system has suffered a higher shutdown rate because the quantity of water being accumulated in the SVE system is higher than the discharge flow rate of 10 gpm, resulting in periodic triggering a shutdown of the system.

During the first month of O&M operation, vapor samples were collected at the influent and effluent sides of the GAC filters using Tedlar bags. The RAPA requires these samples to be analyzed for benzene, ethylbenzene, toluene and xylenes (BTEX). However, JV II decided to analyze the vapor samples for the entire VOC list for EPA Method TO-15 in order to quantify the total hazardous air pollutant (HAP) emission loading from the SVE system. The RAPA called for four weekly samples during the first month of O&M. JV II has collected six weekly vapor samples during the first six weeks of operation during July and August 2005. These samples were analyzed at an offsite laboratory using EPA Method TO-

15. Attached Table 1 presents the analytical results from influent and effluent samples collected during July and August 2005, and the mass loading calculations for each effluent sample.

The FDEP Bureau of Petroleum Cleanup Program requires that the total HAP emissions from air sparging and SVE systems not exceed 13.7 lbs/day, and that air emissions monitoring are allowed to be discontinued, if the measured air emissions of total HAPs do not exceed 13.7 lb/day after 30 days of operation (per BPSS-4 Vacuum Extraction, Multi-Phase Extraction, Pilot Studies, Air Emissions Treatment and Monitoring Requirements). The attached tables demonstrate that this limit has not been exceeded at any time during the first six weeks of operation, and that this limit is unlikely to be exceeded in the future.

The JEA groundwater discharge permit is temporary and cannot be extended indefinitely. The continuing problem with groundwater collection in the SVE lines even during the dry months of the year will continue to hamper the operation of the AS/BS system, which is the primary treatment method for the reduction of groundwater contamination at this site.

Based on a low emission loading (roughly two to three orders of magnitude below the 13.7 lb/day limit), the lack of a permeable cover over the vapor collection area and the high water table at the site which is flooding the SVE system, continued operation of the SVE system at the NFF site is not feasible. Therefore, JV II recommends discontinuation of the SVE system. This will allow the AS/BS system to function without interruption and expedite cleanup of the groundwater contamination at the site.

Analytical Data and Total Mass Loading of Hazardous Air Pollutants from SVE System
North Fuel Farm Site, Former NAS Cecil Field

Station ID	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**
Sample ID	**1-NFF-SVE-E-A-0720-05**	**1-NFF-SVE-E-A-0727-05**	**1-NFF-SVE-E-A-0803-05**	**1-NFF-SVE-E-A-0810-05**	**1-NFF-SVE-E-A-0824-05**	**1-NFF-SVE-E-A-0901-05**	**1-NFF-SVE-I-A-0720-05**	**1-NFF-SVE-I-A-0727-05**	**1-NFF-SVE-I-A-0803-05**	**1-NFF-SVE-I-A-0810-05**	**1-NFF-SVE-I-A-0824-05**	**1-NFF-SVE-I-A-0901-05**
Sample Date	**7/20/2005**	**7/27/2005**	**8/3/2005**	**8/10/2005**	**8/24/2005**	**9/1/2005**	**7/20/2005**	**7/27/2005**	**8/3/2005**	**8/10/2005**	**8/24/2005**	**9/1/2005**
Units in ppbv												
Method-TO15												
Parameter												
1,1,1-Trichloroethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,1,2,2-Tetrachloroethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,1,2-trichloro-1,2,2-trifluoroethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,1,2-Trichloroethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,1-Dichloroethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,1-Dichloroethene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,2,4-Trichlorobenzene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,2,4-Trimethylbenzene	**0.67**	0.5	0.5	0.5	0.5	**0.171**	**9.77**	**13**	5	5	5	5
1,2-Dichlorobenzene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,2-Dichloroethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,2-Dichloropropane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,3,5-Trimethylbenzene (Mesitylene)	0.5	0.5	0.5	0.5	0.5	0.5	**17.5**	**36.2**	**8.35**	**5.71**	**10.7**	5
1,3-Dichlorobenzene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
1,4-Dichlorobenzene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Benzene	**0.39**	0.5	**0.174**	0.5	0.5	0.5	**51**	**45.8**	**39.7**	**10.4**	**14.7**	5
Bromodichloromethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Bromoform	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Bromomethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Carbon disulfide	**1.08**	**0.505**	**0.708**	**10.9**	**9.69**	**7.64**	**10.9**	**34.5**	**10.1**	**16.7**	**19.4**	**12**
Carbon tetrachloride	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Chlorobenzene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Chloroethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Chloroform	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Chloromethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
cis-1,2-Dichloroethene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
cis-1,3-Dichloropropene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Dibromochloromethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Ethylbenzene	**0.492**	**0.713**	**0.292**	0.5	0.5	**0.206**	**24.5**	**11.3**	**4.11**	5	**3.45**	5
Hexachlorobutadiene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
m,p-Xylene (sum of isomers)	**1.02**	**1.47**	**0.58**	0.5	0.5	0.5	**52.1**	**38.8**	**10.2**	5	**8.17**	5
Methylene chloride	**1.48**	**1.24**	**2.13**	**1.15**	0.5	**0.294**	**2.62**	5	**6.21**	5	**1.44**	5
n-hexane	0.5	0.5	0.5	**0.795**	**1.43**	**0.567**	**206**	**448**	**439**	**258**	**356**	**128**
o-Xylene (1,2-Dimethylbenzene)	**1.07**	**1.2**	**0.545**	0.5	0.5	0.5	**76**	**77.8**	**27.2**	**9.11**	**22.4**	5
Styrene	**1.25**	**0.785**	**0.602**	0.5	0.5	0.5	2.5	5	5	5	5	5
tert-butyl methyl ether	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Tetrachloroethene (PCE)	**4.33**	**16.9**	0.5	**0.951**	0.5	0.5	**11.3**	5	5	5	5	5
Toluene	**1.48**	**8.98**	**0.765**	**1.07**	**0.783**	**0.667**	**45**	**40.4**	**46.8**	**9.23**	**7.94**	5
trans-1,2-Dichloroethene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
trans-1,3-Dichloropropene	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Trichloroethene (TCE)	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Trichlorofluoromethane	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5
Vinyl chloride	0.5	0.5	0.5	0.5	0.5	0.5	2.5	5	5	5	5	5

Notes:
Values Bold and Shaded are Hits
U - The analyte was analyzed for , but not detected.
J - estimated value
B-The analyte was detected in the associated method and/or calibration blank.
UJ- Value non-detected estimated.
JB- Estimate value..The analyte was detected in the associated method and/or calibration blank.

Analytical Data and Total Mass Loading of Hazardous Air Pollutants from SVE System
North Fuel Farm Site, Former NAS Cecil Field

Station ID	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	INFLUENT	INFLUENT	INFLUENT	INFLUENT	INFLUENT	INFLUENT
Sample ID	1-NFF-SVE-E-A-0720-05	1-NFF-SVE-E-A-0727-05	1-NFF-SVE-E-A-0803-05	1-NFF-SVE-E-A-0810-05	1-NFF-SVE-E-A-0824-05	1-NFF-SVE-E-A-0901-05	1-NFF-SVE-I-A-0720-05	1-NFF-SVE-I-A-0727-05	1-NFF-SVE-I-A-0803-05	1-NFF-SVE-I-A-0810-05	1-NFF-SVE-I-A-0824-05	1-NFF-SVE-I-A-0901-05
Sample Date	7/20/2005	7/27/2005	8/3/2005	8/10/2005	8/24/2005	9/1/2005	7/20/2005	7/27/2005	8/3/2005	8/10/2005	8/24/2005	9/1/2005
Conversion of PPBV to mg/m^3												
1,1,1-Trichloroethane	0.00273	0.00273	0.00273	0.00273	0.00273	0.00273	0.01364	0.02728	0.02728	0.02728	0.02728	0.02728
1,1,2,2-Tetrachloroethane	0.00343	0.00343	0.00343	0.00343	0.00343	0.00343	0.01716	0.03433	0.03433	0.03433	0.03433	0.03433
1,1,2-trichloro-1,2,2-trifluoroethane	0.00383	0.00383	0.00383	0.00383	0.00383	0.00383	0.01916	0.03832	0.03832	0.03832	0.03832	0.03832
1,1,2-Trichloroethane	0.00273	0.00273	0.00273	0.00273	0.00273	0.00273	0.01364	0.02728	0.02728	0.02728	0.02728	0.02728
1,1-Dichloroethane	0.00202	0.00202	0.00202	0.00202	0.00202	0.00202	0.01012	0.02024	0.02024	0.02024	0.02024	0.02024
1,1-Dichloroethene	0.00198	0.00198	0.00198	0.00198	0.00198	0.00198	0.00991	0.01983	0.01983	0.01983	0.01983	0.01983
1,2,4-Trichlorobenzene	0.00371	0.00371	0.00371	0.00371	0.00371	0.00371	0.01855	0.03711	0.03711	0.03711	0.03711	0.03711
1,2,4-Trimethylbenzene	0.00329	0.00246	0.00246	0.00246	0.00246	0.00084	0.04803	0.06390	0.02458	0.02458	0.02458	0.02458
1,2-Dichlorobenzene	0.00301	0.00301	0.00301	0.00301	0.00301	0.00301	0.01503	0.03006	0.03006	0.03006	0.03006	0.03006
1,2-Dichloroethane	0.00202	0.00202	0.00202	0.00202	0.00202	0.00202	0.01012	0.02024	0.02024	0.02024	0.02024	0.02024
1,2-Dichloropropane	0.00231	0.00231	0.00231	0.00231	0.00231	0.00231	0.01155	0.02311	0.02311	0.02311	0.02311	0.02311
1,3,5-Trimethylbenzene (Mesitylene)	0.00246	0.00246	0.00246	0.00246	0.00246	0.00246	0.08603	0.17795	0.04105	0.02807	0.05260	0.02458
1,3-Dichlorobenzene	0.00301	0.00301	0.00301	0.00301	0.00301	0.00301	0.01503	0.03006	0.03006	0.03006	0.03006	0.03006
1,4-Dichlorobenzene	0.00301	0.00301	0.00301	0.00301	0.00301	0.00301	0.01503	0.03006	0.03006	0.03006	0.03006	0.03006
Benzene	0.00125	0.00160	0.00056	0.00160	0.00160	0.00160	0.16293	0.14632	0.12683	0.03322	0.04696	0.01597
Bromodichloromethane	0.00335	0.00335	0.00335	0.00335	0.00335	0.00335	0.01675	0.03350	0.03350	0.03350	0.03350	0.03350
Bromoform	0.00517	0.00517	0.00517	0.00517	0.00517	0.00517	0.02584	0.05168	0.05168	0.05168	0.05168	0.05168
Bromomethane	0.00194	0.00194	0.00194	0.00194	0.00194	0.00194	0.00971	0.01942	0.01942	0.01942	0.01942	0.01942
Carbon disulfide	0.00336	0.00157	0.00220	0.03394	0.03017	0.02379	0.03394	0.10742	0.03145	0.05200	0.06041	0.03736
Carbon tetrachloride	0.00315	0.00315	0.00315	0.00315	0.00315	0.00315	0.01573	0.03146	0.03146	0.03146	0.03146	0.03146
Chlorobenzene	0.00230	0.00230	0.00230	0.00230	0.00230	0.00230	0.01151	0.02302	0.02302	0.02302	0.02302	0.02302
Chloroethane	0.00132	0.00132	0.00132	0.00132	0.00132	0.00132	0.00660	0.01319	0.01319	0.01319	0.01319	0.01319
Chloroform	0.00244	0.00244	0.00244	0.00244	0.00244	0.00244	0.01221	0.02442	0.02442	0.02442	0.02442	0.02442
Chloromethane	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00516	0.01033	0.01033	0.01033	0.01033	0.01033
cis-1,2-Dichloroethene	0.00198	0.00198	0.00198	0.00198	0.00198	0.00198	0.00991	0.01983	0.01983	0.01983	0.01983	0.01983
cis-1,3-Dichloropropene	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.01135	0.02270	0.02270	0.02270	0.02270	0.02270
Dibromochloromethane	0.00426	0.00426	0.00426	0.00426	0.00426	0.00426	0.02130	0.04259	0.04259	0.04259	0.04259	0.04259
Ethylbenzene	0.00214	0.00310	0.00127	0.00217	0.00217	0.00089	0.10638	0.04906	0.01785	0.02171	0.01498	0.02171
Hexachlorobutadiene	0.00533	0.00533	0.00533	0.00533	0.00533	0.00533	0.02666	0.05333	0.05333	0.05333	0.05333	0.05333
m,p-Xylene (sum of isomers)	0.00443	0.00638	0.00252	0.00217	0.00217	0.00217	0.22621	0.16847	0.04429	0.02171	0.03547	0.02171
Methylene chloride	0.00514	0.00431	0.00740	0.00400	0.00174	0.00102	0.00910	0.01737	0.02157	0.01737	0.00500	0.01737
n-hexane	0.00176	0.00176	0.00176	0.00280	0.00504	0.00200	0.72610	1.57909	1.54736	0.90938	1.25481	0.45117
o-Xylene (1,2-Dimethylbenzene)	0.00465	0.00521	0.00237	0.00217	0.00217	0.00217	0.32999	0.33780	0.11810	0.03955	0.09726	0.02171
Styrene	0.00532	0.00334	0.00256	0.00213	0.00213	0.00213	0.01065	0.02130	0.02130	0.02130	0.02130	0.02130
tert-butyl methyl ether	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	0.00901	0.01803	0.01803	0.01803	0.01803	0.01803
Tetrachloroethene (PCE)	0.02937	0.11464	0.00339	0.00645	0.00339	0.00339	0.07665	0.03392	0.03392	0.03392	0.03392	0.03392
Toluene	0.00558	0.03384	0.00288	0.00403	0.00295	0.00251	0.16956	0.15223	0.17635	0.03478	0.02992	0.01884
trans-1,2-Dichloroethene	0.00198	0.00198	0.00198	0.00198	0.00198	0.00198	0.00991	0.01982	0.01982	0.01982	0.01982	0.01982
trans-1,3-Dichloropropene	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.01135	0.02270	0.02270	0.02270	0.02270	0.02270
Trichloroethene (TCE)	0.00269	0.00269	0.00269	0.00269	0.00269	0.00269	0.01344	0.02687	0.02687	0.02687	0.02687	0.02687
Trichlorofluoromethane	0.00281	0.00281	0.00281	0.00281	0.00281	0.00281	0.01405	0.02809	0.02809	0.02809	0.02809	0.02809
Vinyl chloride	0.00128	0.00128	0.00128	0.00128	0.00128	0.00128	0.00639	0.01278	0.01278	0.01278	0.01278	0.01278
TOTAL VOC	0.14991	0.26183	0.11300	0.14754	0.13961	0.12614	2.39140	3.66650	3.01630	2.04926	2.48887	1.52189

Analytical Data and Total Mass Loading of Hazardous Air Pollutants from SVE System
North Fuel Farm Site, Former NAS Cecil Field

Station ID	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**
Sample ID	**1-NFF-SVE-E-A-0720-05**	**1-NFF-SVE-E-A-0727-05**	**1-NFF-SVE-E-A-0803-05**	**1-NFF-SVE-E-A-0810-05**	**1-NFF-SVE-E-A-0824-05**	**1-NFF-SVE-E-A-0901-05**	**1-NFF-SVE-I-A-0720-05**	**1-NFF-SVE-I-A-0727-05**	**1-NFF-SVE-I-A-0803-05**	**1-NFF-SVE-I-A-0810-05**	**1-NFF-SVE-I-A-0824-05**	**1-NFF-SVE-I-A-0901-05**
Sample Date	**7/20/2005**	**7/27/2005**	**8/3/2005**	**8/10/2005**	**8/24/2005**	**9/1/2005**	**7/20/2005**	**7/27/2005**	**8/3/2005**	**8/10/2005**	**8/24/2005**	**9/1/2005**
Calculation of Mass Loading Rate (lbs/day)												
Flow Rate	650	624	650	650	684	628	650	624	650	650	684	628
1,1,1-Trichloroethane	0.00016	0.00015	0.00016	0.00016	0.00017	0.00015	0.00080	0.00153	0.00159	0.00159	0.00168	0.00154
1,1,2,2-Tetrachloroethane	0.00020	0.00019	0.00020	0.00020	0.00021	0.00019	0.00100	0.00193	0.00201	0.00201	0.00211	0.00194
1,1,2-trichloro-1,2,2-trifluoroethane	0.00022	0.00021	0.00022	0.00022	0.00024	0.00022	0.00112	0.00215	0.00224	0.00224	0.00236	0.00216
1,1,2-Trichloroethane	0.00016	0.00015	0.00016	0.00016	0.00017	0.00015	0.00080	0.00153	0.00159	0.00159	0.00168	0.00154
1,1-Dichloroethane	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00059	0.00114	0.00118	0.00118	0.00124	0.00114
1,1-Dichloroethene	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00058	0.00111	0.00116	0.00116	0.00122	0.00112
1,2,4-Trichlorobenzene	0.00022	0.00021	0.00022	0.00022	0.00023	0.00021	0.00108	0.00208	0.00217	0.00217	0.00228	0.00210
1,2,4-Trimethylbenzene	0.00019	0.00014	0.00014	0.00014	0.00015	0.00005	0.00281	0.00359	0.00144	0.00144	0.00151	0.00139
1,2-Dichlorobenzene	0.00018	0.00017	0.00018	0.00018	0.00018	0.00017	0.00088	0.00169	0.00176	0.00176	0.00185	0.00170
1,2-Dichloroethane	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00059	0.00114	0.00118	0.00118	0.00124	0.00114
1,2-Dichloropropane	0.00014	0.00013	0.00014	0.00014	0.00014	0.00013	0.00068	0.00130	0.00135	0.00135	0.00142	0.00130
1,3,5-Trimethylbenzene (Mesitylene)	0.00014	0.00014	0.00014	0.00014	0.00015	0.00014	0.00503	0.00998	0.00240	0.00164	0.00323	0.00139
1,3-Dichlorobenzene	0.00018	0.00017	0.00018	0.00018	0.00018	0.00017	0.00088	0.00169	0.00176	0.00176	0.00185	0.00170
1,4-Dichlorobenzene	0.00018	0.00017	0.00018	0.00018	0.00018	0.00017	0.00088	0.00169	0.00176	0.00176	0.00185	0.00170
Benzene	0.00007	0.00009	0.00003	0.00009	0.00010	0.00009	0.00952	0.00821	0.00741	0.00194	0.00289	0.00090
Bromodichloromethane	0.00020	0.00019	0.00020	0.00020	0.00021	0.00019	0.00098	0.00188	0.00196	0.00196	0.00206	0.00189
Bromoform	0.00030	0.00029	0.00030	0.00030	0.00032	0.00029	0.00151	0.00290	0.00302	0.00302	0.00318	0.00292
Bromomethane	0.00011	0.00011	0.00011	0.00011	0.00012	0.00011	0.00057	0.00109	0.00113	0.00113	0.00119	0.00110
Carbon disulfide	0.00020	0.00009	0.00013	0.00198	0.00186	0.00134	0.00198	0.00603	0.00184	0.00304	0.00371	0.00211
Carbon tetrachloride	0.00018	0.00018	0.00018	0.00018	0.00019	0.00018	0.00092	0.00176	0.00184	0.00184	0.00193	0.00178
Chlorobenzene	0.00013	0.00013	0.00013	0.00013	0.00014	0.00013	0.00067	0.00129	0.00135	0.00135	0.00142	0.00130
Chloroethane	0.00008	0.00007	0.00008	0.00008	0.00008	0.00007	0.00039	0.00074	0.00077	0.00077	0.00081	0.00074
Chloroform	0.00014	0.00014	0.00014	0.00014	0.00015	0.00014	0.00071	0.00137	0.00143	0.00143	0.00150	0.00138
Chloromethane	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00030	0.00058	0.00060	0.00060	0.00063	0.00058
cis-1,2-Dichloroethene	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00058	0.00111	0.00116	0.00116	0.00122	0.00112
cis-1,3-Dichloropropene	0.00013	0.00013	0.00013	0.00013	0.00014	0.00013	0.00066	0.00127	0.00133	0.00133	0.00140	0.00128
Dibromochloromethane	0.00025	0.00024	0.00025	0.00025	0.00026	0.00024	0.00124	0.00239	0.00249	0.00249	0.00262	0.00240
Ethylbenzene	0.00012	0.00017	0.00007	0.00013	0.00013	0.00005	0.00622	0.00275	0.00104	0.00127	0.00092	0.00123
Hexachlorobutadiene	0.00031	0.00030	0.00031	0.00031	0.00033	0.00030	0.00156	0.00299	0.00312	0.00312	0.00328	0.00301
m,p-Xylene (sum of isomers)	0.00026	0.00036	0.00015	0.00013	0.00013	0.00012	0.01322	0.00945	0.00259	0.00127	0.00218	0.00123
Methylene chloride	0.00030	0.00024	0.00043	0.00023	0.00011	0.00006	0.00053	0.00097	0.00126	0.00102	0.00031	0.00098
n-hexane	0.00010	0.00010	0.00010	0.00016	0.00031	0.00011	0.04243	0.08859	0.09043	0.05314	0.07717	0.02547
o-Xylene (1,2-Dimethylbenzene)	0.00027	0.00029	0.00014	0.00013	0.00013	0.00012	0.01928	0.01895	0.00690	0.00231	0.00598	0.00123
Styrene	0.00031	0.00019	0.00015	0.00012	0.00013	0.00012	0.00062	0.00119	0.00124	0.00124	0.00131	0.00120
tert-butyl methyl ether	0.00011	0.00010	0.00011	0.00011	0.00011	0.00010	0.00053	0.00101	0.00105	0.00105	0.00111	0.00102
Tetrachloroethene (PCE)	0.00172	0.00643	0.00020	0.00038	0.00021	0.00019	0.00448	0.00190	0.00198	0.00198	0.00209	0.00191
Toluene	0.00033	0.00190	0.00017	0.00024	0.00018	0.00014	0.00991	0.00854	0.01031	0.00203	0.00184	0.00106
trans-1,2-Dichloroethene	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00058	0.00111	0.00116	0.00116	0.00122	0.00112
trans-1,3-Dichloropropene	0.00013	0.00013	0.00013	0.00013	0.00014	0.00013	0.00066	0.00127	0.00133	0.00133	0.00140	0.00128
Trichloroethene (TCE)	0.00016	0.00015	0.00016	0.00016	0.00017	0.00015	0.00079	0.00151	0.00157	0.00157	0.00165	0.00152
Trichlorofluoromethane	0.00016	0.00016	0.00016	0.00016	0.00017	0.00016	0.00082	0.00158	0.00164	0.00164	0.00173	0.00159
Vinyl chloride	0.00007	0.00007	0.00007	0.00007	0.00008	0.00007	0.00037	0.00072	0.00075	0.00075	0.00079	0.00072
TOTAL VOC	**0.00876**	**0.01469**	**0.00660**	**0.00862**	**0.00859**	**0.00712**	**0.13975**	**0.20570**	**0.17627**	**0.11976**	**0.15306**	**0.08593**

Analytical Data and Total Mass Loading of Hazardous Air Pollutants from SVE System
North Fuel Farm Site, Former NAS Cecil Field

Station ID	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	EFFLUENT	INFLUENT	INFLUENT	INFLUENT	INFLUENT	INFLUENT	INFLUENT
Sample ID	1-NFF-SVE-E-A-0720-05	1-NFF-SVE-E-A-0727-05	1-NFF-SVE-E-A-0803-05	1-NFF-SVE-E-A-0810-05	1-NFF-SVE-E-A-0824-05	1-NFF-SVE-E-A-0901-05	1-NFF-SVE-I-A-0720-05	1-NFF-SVE-I-A-0727-05	1-NFF-SVE-I-A-0803-05	1-NFF-SVE-I-A-0810-05	1-NFF-SVE-I-A-0824-05	1-NFF-SVE-I-A-0901-05
Sample Date	7/20/2005	7/27/2005	8/3/2005	8/10/2005	8/24/2005	9/1/2005	7/20/2005	7/27/2005	8/3/2005	8/10/2005	8/24/2005	9/1/2005
Calculation of theoretical concentration (mg/m^3) that would result in 13.1 pounds/day of Total VOCs												
TOTAL VOC	224.16022	233.50023	224.16022	224.16022	213.01776	232.01297	224.16022	233.50023	224.16022	224.16022	213.01776	232.01297
1,1,1-Trichloroethane	4.07969	2.43322	5.41262	4.14529	4.16293	5.01838	1.27876	1.73759	2.02766	2.98451	2.33521	4.15951
1,1,2,2-Tetrachloroethane	5.13279	3.06131	6.80979	5.21532	5.23752	6.31378	1.60885	2.18612	2.55107	3.75491	2.93800	5.23322
1,1,2-trichloro-1,2,2-trifluoroethane	5.72967	3.41730	7.60168	5.82180	5.84657	7.04799	1.79594	2.44034	2.84772	4.19156	3.27965	5.84177
1,1,2-Trichloroethane	4.07969	2.43322	5.41262	4.14529	4.16293	5.01838	1.27876	1.73759	2.02766	2.98451	2.33521	4.15951
1,1-Dichloroethane	3.02629	1.80495	4.01504	3.07495	3.08803	3.72260	0.94858	1.28893	1.50411	2.21389	1.73224	3.08550
1,1-Dichloroethene	2.96452	1.76811	3.93309	3.01218	3.02500	3.64662	0.92921	1.26263	1.47341	2.16870	1.69688	3.02252
1,2,4-Trichlorobenzene	5.54865	3.30934	7.36152	5.63787	5.66186	6.82532	1.73920	2.36324	2.75776	4.05913	3.17604	5.65721
1,2,4-Trimethylbenzene	4.92470	2.19194	4.87590	3.73424	3.75013	1.54610	4.50185	4.06976	1.82660	2.68856	2.10365	3.74705
1,2-Dichlorobenzene	4.49525	2.68106	5.96394	4.56752	4.58696	5.52954	1.40901	1.91458	2.23420	3.28851	2.57307	4.58319
1,2-Dichloroethane	3.02598	1.80476	4.01463	3.07463	3.08772	3.72222	0.94848	1.28880	1.50395	2.21366	1.73207	3.08518
1,2-Dichloropropane	3.45499	2.06063	4.58381	3.51054	3.52548	4.24994	1.08295	1.47152	1.71718	2.52751	1.97763	3.52258
1,3,5-Trimethylbenzene (Mesitylene)	3.67515	2.19194	4.87590	3.73424	3.75013	4.52075	8.06370	11.33272	3.05042	3.07034	4.50181	3.74705
1,3-Dichlorobenzene	4.49525	2.68106	5.96394	4.56752	4.58696	5.52954	1.40901	1.91458	2.23420	3.28851	2.57307	4.58319
1,4-Dichlorobenzene	4.49525	2.68106	5.96394	4.56752	4.58696	5.52954	1.40901	1.91458	2.23420	3.28851	2.57307	4.58319
Benzene	1.86298	1.42452	1.10274	2.42684	2.43716	2.93798	15.27232	9.31814	9.42545	3.63431	4.01938	2.43516
Bromodichloromethane	5.00957	2.98782	6.64630	5.09011	5.11177	6.16220	1.57022	2.13364	2.48982	3.66476	2.86746	5.10758
Bromoform	7.72793	4.60911	10.25282	7.85219	7.88561	9.50603	2.42228	3.29143	3.84089	5.65339	4.42345	7.87913
Bromomethane	2.90336	1.73163	3.85196	2.95005	2.96260	3.57139	0.91005	1.23658	1.44301	2.12396	1.66188	2.96017
Carbon disulfide	5.02824	1.40229	4.37326	51.56395	46.03497	43.75438	3.18134	6.84120	2.33713	5.68793	5.17002	5.69624
Carbon tetrachloride	4.70409	2.80563	6.24102	4.77973	4.80007	5.78644	1.47448	2.00353	2.33800	3.44129	2.69261	4.79613
Chlorobenzene	3.44184	2.05279	4.56636	3.49718	3.51206	4.23376	1.07883	1.46592	1.71064	2.51789	1.97010	3.50918
Chloroethane	1.97288	1.17667	2.61746	2.00460	2.01313	2.42681	0.61839	0.84028	0.98055	1.44327	1.12927	2.01148
Chloroform	3.65069	2.17735	4.84344	3.70938	3.72517	4.49066	1.14429	1.55487	1.81444	2.67067	2.08965	3.72211
Chloromethane	1.54387	0.92080	2.04829	1.56870	1.57537	1.89910	0.48392	0.65756	0.76733	1.12943	0.88371	1.57408
cis-1,2-Dichloroethene	2.96452	1.76811	3.93309	3.01218	3.02500	3.64662	0.92921	1.26263	1.47341	2.16870	1.69688	3.02252
cis-1,3-Dichloropropene	3.39353	2.02398	4.50227	3.44809	3.46276	4.17433	1.06368	1.44535	1.68663	2.48254	1.94245	3.45992
Dibromochloromethane	6.36875	3.79846	8.44956	6.47115	6.49869	7.83411	1.99625	2.71253	3.16535	4.65907	3.64546	6.49335
Ethylbenzene	3.19420	2.76084	2.51513	3.29833	3.31237	1.64513	9.97138	3.12462	1.32620	2.37472	1.28208	3.30965
Hexachlorobutadiene	7.97347	4.75556	10.57858	8.10167	8.13616	9.80806	2.49925	3.39600	3.96292	5.83301	4.56400	8.12947
m,p-Xylene (sum of isomers)	6.62213	5.69205	4.99580	3.29833	3.31237	3.99304	21.20444	10.72877	3.29129	2.37472	3.03611	3.30965
Methylene chloride	7.68795	3.84171	14.67940	6.06979	2.65027	1.87859	0.85318	1.10621	1.60328	1.90005	0.42816	2.64810
n-hexane	2.63520	1.57169	3.49617	4.25733	7.69043	3.67588	68.06157	100.56382	114.99416	99.47371	107.39673	68.78091
o-Xylene (1,2-Dimethylbenzene)	6.94674	4.64657	4.69433	3.29833	3.31237	3.99304	30.93162	21.51284	8.77677	4.32675	8.32422	3.30965
Styrene	7.96094	2.98179	5.08663	3.23557	3.24935	3.91706	0.99813	1.35627	1.58268	2.32954	1.82273	3.24668
tert-butyl methyl ether	2.69544	1.60762	3.57609	2.73877	2.75043	3.31562	0.84487	1.14802	1.33967	1.97185	1.54286	2.74817
Tetrachloroethene (PCE)	43.91774	102.23336	6.72825	9.80076	5.17480	6.23818	7.18492	2.15995	2.52052	3.70995	2.90282	5.17055
Toluene	8.33872	30.17643	5.71846	6.12560	4.50164	4.62274	15.89431	9.69482	13.10544	3.80439	2.56069	2.87225
trans-1,2-Dichloroethene	2.96421	1.76792	3.93269	3.01187	3.02469	3.64624	0.92912	1.26250	1.47325	2.16848	1.69671	3.02221
trans-1,3-Dichloropropene	3.39353	2.02398	4.50227	3.44809	3.46276	4.17433	1.06368	1.44535	1.68663	2.48254	1.94245	3.45992
Trichloroethene (TCE)	4.01793	2.39638	5.33067	4.08253	4.09990	4.94240	1.25940	1.71129	1.99696	2.93932	2.29985	4.09654
Trichlorofluoromethane	4.20078	2.50544	5.57327	4.26832	4.28649	5.16733	1.31671	1.78917	2.08785	3.07309	2.40452	4.28297
Vinyl chloride	1.91111	1.13983	2.53552	1.94184	1.95011	2.35084	0.59903	0.81397	0.94985	1.39808	1.09392	1.94850

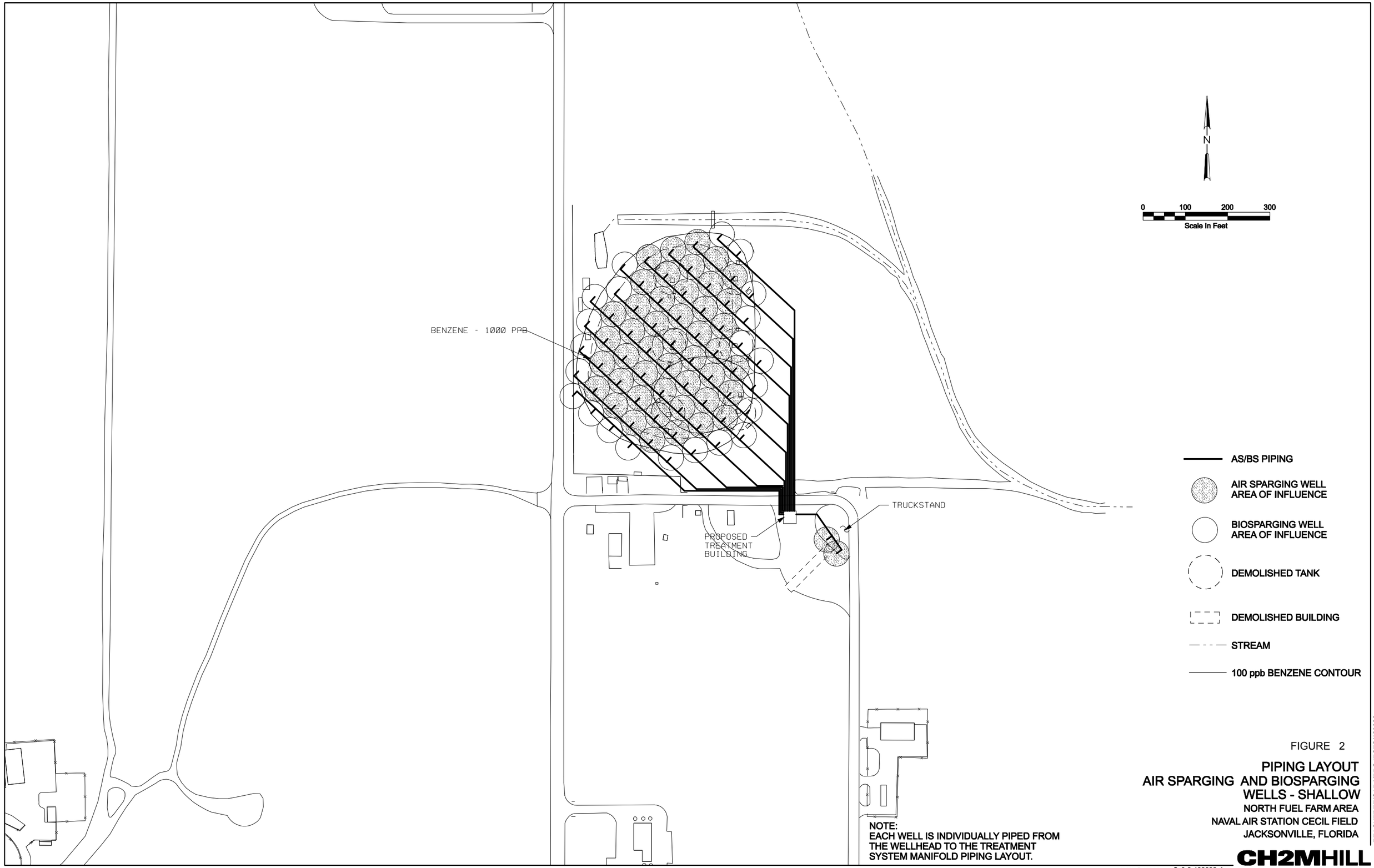
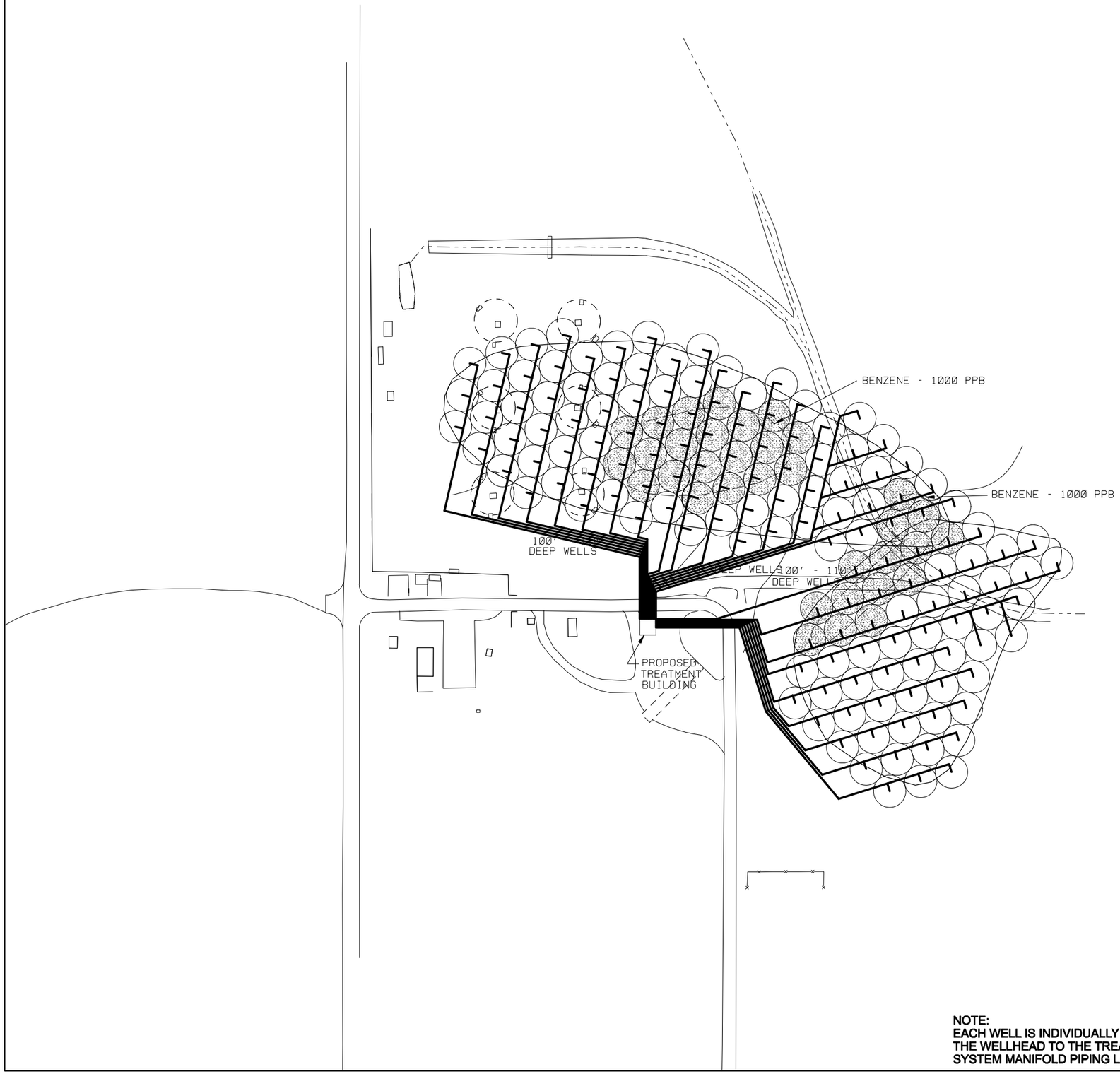
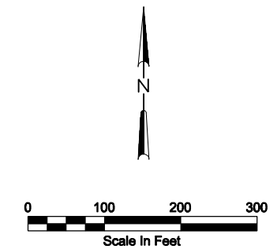


FIGURE 2

PIPING LAYOUT
AIR SPARGING AND BIOSPARGING
WELLS - SHALLOW
NORTH FUEL FARM AREA
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA





AS/BS PIPING

AIR SPARGING WELL AREA OF INFLUENCE

BIOSPARGING WELL AREA OF INFLUENCE

DEMOLISHED TANK

DEMOLISHED BUILDING

STREAM

100 ppb BENZENE CONTOUR

NOTE:
EACH WELL IS INDIVIDUALLY PIPED FROM THE WELLHEAD TO THE TREATMENT SYSTEM MANIFOLD PIPING LAYOUT.

FIGURE 3

PIPING LAYOUT AIR SPARGING AND BIOSPARGING WELLS - DEEP

NORTH FUEL FARM AREA
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

CH2MHILL

PEACHTREE/CAD1/PROJECTS/183092

15-DEC-2003 fig6-3-183092.dgn

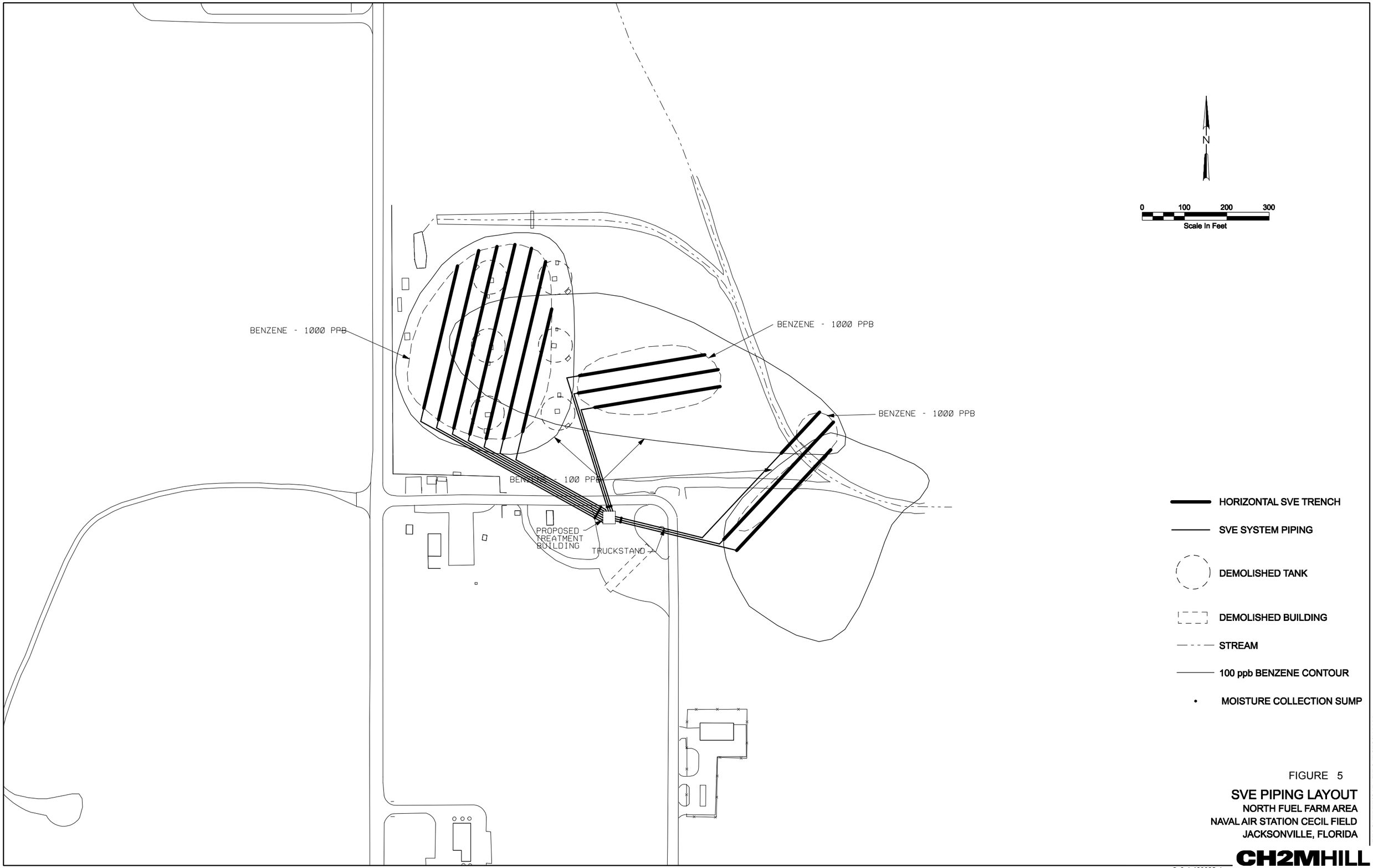


FIGURE 5

SVE PIPING LAYOUT

NORTH FUEL FARM AREA
NAVAL AIR STATION CECIL FIELD
JACKSONVILLE, FLORIDA

CH2MHILL

PEACHTREE/CAD1/PROJECTS/183092

15-DEC-2003 fig6-4-183092.dgn

MASTER BILL OF MATERIAL

ITEM	QTY	DESCRIPTION
100	1	VACUUM BLOWER, KAESER MODEL DB235C, 25 HP 3PH 230/460V – 4" FLEX INLET/OUTLET W/ENCLOSURE
101	1	HEAT EXCHANGER, AMERICAN INDUSTRIAL MODEL ACA6361-94386, 3 HP – 3PH 230/460V – 5" ANSI FLNG
102	1	TRANSFER PUMP, GRUNDFOS MODEL HS-100-05, 1/2 HP – 3PH 230/460V TEFC, 1-1/4" x 1"
103	1	AIR/WATER SEPARATOR, TETRASOLV MODEL MV-24, 60 GAL WORKING CAPACITY, 4" ANSI FLNG
106	2	ACTIVATED CARBON COLUMNS, TETRASOLV FILTRATION MODEL VF-10000, 6" FNPT
201	1	SILENCER / AIR FILTER, SOLBERG MODEL FS-15-200, 2" MNPT
204	1	STRAINER, VIKING MODEL F-10130RN-20, CAST IRON / 20 MESH, 1-1/4" FNPT
401	13	DIAPHRAGM VALVE, GIE MODEL WTCX223B2.0, 2" FNPT
402	17	BALL VALVE, RUB MODEL S92, FULL PORT, BRONZE, TFE, 1/4" FNPT
403	1	BUTTERFLY VALVE, CRANE MODEL 02A1061012, WAFER, ALUM BRONZE DISC, BUNA N, 2"
404	1	BUTTERFLY VALVE, CRANE MODEL 06A1061012, WAFER, ALUM BRONZE DISC, BUNA N, 6"
405	1	BALL VALVE, RUB MODEL S92, FULL PORT, BRONZE, TFE, 1" FNPT
406	1	CHECK VALVE, STRATA-FLO MODEL 400, SPRING CHECK, BRONZE, 1" FNPT
802	15	VACUUM GAUGE, DWYER MODEL 63030V, 0-30" HG, 1/4" NPT LB, 2-1/2" DIAL, LIQUID FILLED
803	13	FLOW METER, ERDCO MODEL 3213-08T1, 2" MNPT
804	1	TEMPERATURE TRANSMITTER, MCMASTER-CARR MODEL 38705K44 , -50~400 F, 4-20 MA RTD
805	1	PRESSURE TRANSMITTER, DWYER MODEL 604D-100, 0-100 IN, 4-20 MA
806	3	PRESSURE GAUGE, DWYER MODEL 61060, 0-60" WC, 1/4" NPT LB, 2-1/2" DIAL
807	1	MASS FLOWMETER, EPI MODEL 9840MPNH-SSS-133, 1/2" PROBE, 4-20 MA
900	1	LEVEL SWITCH, FLOW PLUS, 316 SS FLOATS (1513 SDT), LEVELS [L3(R)=10", L2(Y)=18", L3(B)=32"] OAL=34"

SYSTEM INTERLOCKS

ALARM	ACTION
–	–

NOTES

1. ALL QUICK CONNECT FITTINGS ALUMINUM WITH BUNA-N GASKETS
2. ALL HOSE GOODYEAR PLICORD HOSE / SYNTHETIC RUBBER
3. PRIMARY SYSTEM VOLTAGE 480V 3 PHASE 60 HZ

BILL OF MATERIAL TAG LEGEND

1XX – SPECIALIZED PROCESS EQUIPMENT	6XX – HEATING AND VENTILATION
2XX – STANDARD PROCESS EQUIPMENT	7XX – NOT USED
3XX – CONTROL PANELS	8XX – INSTRUMENTATION
4XX – VALVES	9XX – OTHER
5XX – LIGHTING	0XX – NOT USED

PROCESS

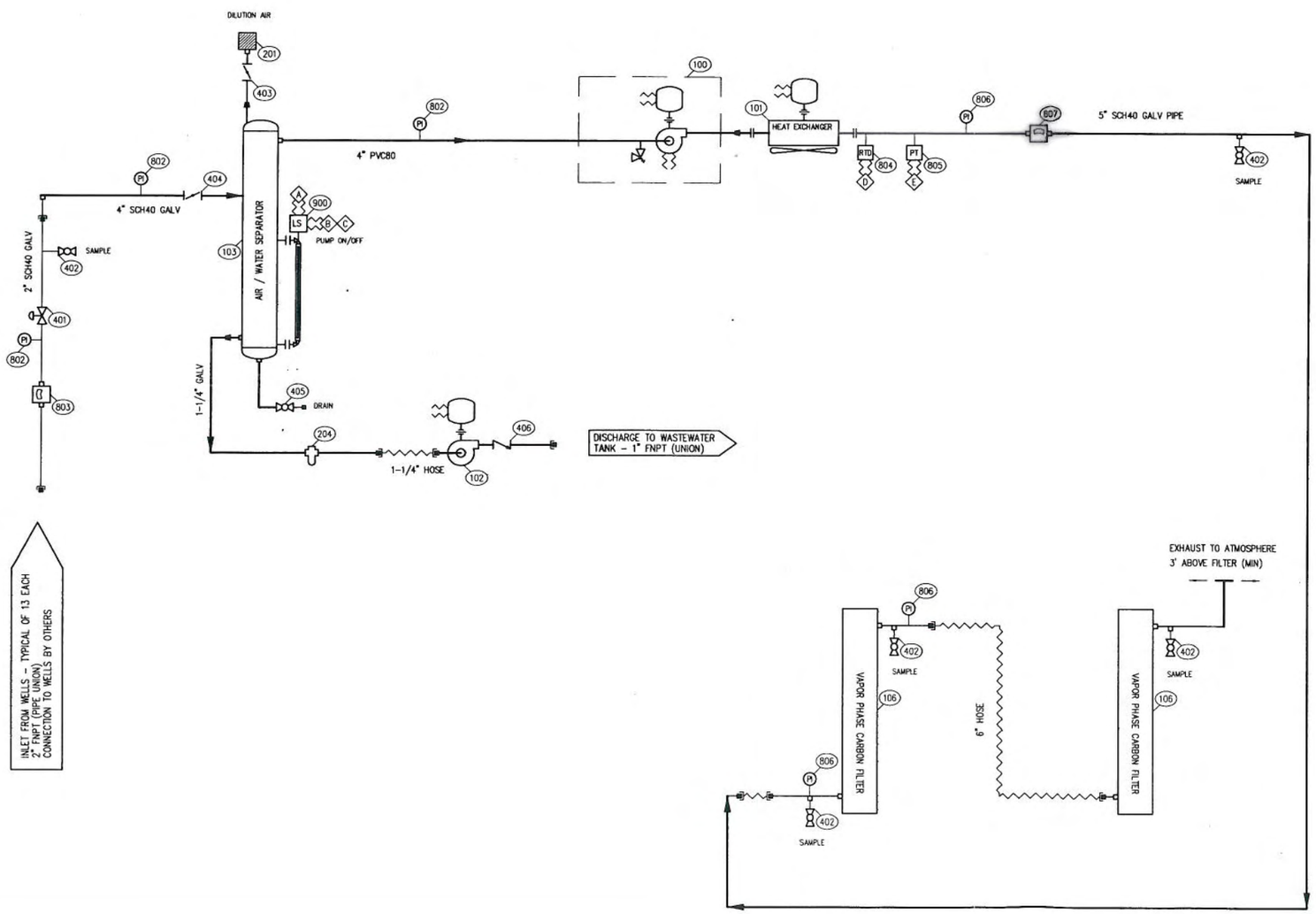


FIGURE 4

ELECTRICAL TERMINATIONS

- A – HIGH LIQUID LEVEL SHUTDOWN SEPARATOR – NO [ISR]
- B – TRANSFER PUMP ON LIQUID LEVEL SENSOR – NO [ISR]
- C – TRANSFER PUMP OFF LIQUID LEVEL SENSOR – NO [ISR]
- D – HEAT XCHG GAS TEMP – 4-20 MA RTD [ISR]
- E – PROCESS FLOW RATE – 4-20 MA [ISR]
- F
- G
- H
- I
- J
- K
- L
- M
- N
- O
- P
- Q

PNEUMATIC TERMINATIONS

- 0 –

BILL OF MAT'L TAG	SWING CHECK VALVE	LS – LIQUID LEVEL SWITCH
PNEUMATIC TAG	PISTON CHECK VALVE	LS H – LEVEL SENSOR – HIGH
ELECTRICAL TAG	IN-LINE CHECK VALVE	LS L – LEVEL SENSOR – LOW
PI – PRESSURE GAUGE	BUTTERFLY CHECK VALVE	PS D – PRESSURE SENSOR – DIFFERENTIAL
PI – DIFF. PRESS. GAUGE	DIAPHRAGM VALVE	PS L – PRESSURE SENSOR – LOW
TI – THERMOMETER	REGULATOR VALVE	PS H – PRESSURE SENSOR – HIGH
GAUGE IN PANEL	REGULATOR/RELIEF VALVE	TS H – TEMPERATURE SENSOR – HIGH
CAM FITTING OR UNION	IN LINE FILTER	RTD – RESISTANT TEMPERATURE DETECTOR
GATE VALVE	"Y" – STRAINER	MAIN PROCESS PIPING
BALL VALVE	FLOW METER	UTILITY PIPING
GLOBE VALVE	ORIFICE PITOT TUBE SENSOR	FUTURE PIPING / PIPING BY OTHERS
NEEDLE VALVE	PT – PRESSURE/VACUUM TRANSDUCER	INST. TUBING AIR, GAS, or OIL
RELIEF VALVE	FS – FLOW SWITCH	PROCESS HOSE

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NAPLES, FLORIDA 34109
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Fx: (239) 596-3768

CUSTOMER	PROJECT
AGVIQ ENVIRONMENTAL SERVICES	SVE SYSTEM / CECIL FIELD

PROCESS AND INSTRUMENTATION FLOW DIAGRAM
FOR
SOIL VAPOR EXTRACTION SYSTEM

DWN BY	CHK'D BY	APP'D BY	DATE	SCALE	JOB No.	DRAWING No.	REV
DB (TF)	TB (TF)	EP (TF)	AUG 05/04	NTS			0

MASTER BILL OF MATERIAL

ITEM	QTY	DESCRIPTION
100	1	ROTARY COMPRESSOR PACKAGE – MODEL DSD-150, 150 HP – 3PH 230/460V – W/SOUND ENCLOSURE 883 SCFM @ 110 PSIG, 1000 GAL AIR RECEIVER 150 PSIG, FILTERS, AQUAMAT 6 COLLECTION SYSTEM
200	1	STORAGE TANK – IMG, 500 GAL POLYETHYLENE 46" x 77"
401	214	DIAPHRAGM VALVE, GIE MODEL WTCX223B1.0, 1" FNPT
402	214	PRESSURE REGULATOR, MASTER PNEUMATIC MODEL R180 VI-8, 1" FNPT
403	214	SOLENOID VALVE, BURKERT MODEL 6213LB-A20, 1" FNPT, 120VAC , NC
404	6	BUTTERFLY VALVE, CRANE MODEL 04A1061012, WAFER, ALUM BRONZE DISC, BUNA N, 4"
405	6	BALL VALVE, RUB MODEL S92, FULL PORT, BRONZE, TFE, 1" FNPT
801	214	PRESSURE GAUGE, DWYER MODEL 63060, 0-60 PSIG, 1/4" NPT LB, 2 1/2" DIAL
802	214	FLOW METER, ERDCO MODEL 3214-04T0, 0-30" HG, 1" NPT, 2-20 SCFM
900	1	LEVEL SWITCH, FLOW PLUS, 316 SS FLOATS (1513 SDT), LEVELS [L3(R)=20"] OAL=24"

NOTES

1. ALL QUICK CONNECT FITTINGS ALUMINUM WITH BUNA-N GASKETS
2. ALL HOSE GOODYEAR PLICORD HOSE / SYNTHETIC RUBBER
3. PRIMARY SYSTEM VOLTAGE 480V 3 PHASE 60 HZ

SYSTEM INTERLOCKS

ALARM	ACTION
–	–

BILL OF MATERIAL TAG LEGEND

- 1XX – SPECIALIZED PROCESS EQUIPMENT
- 2XX – STANDARD PROCESS EQUIPMENT
- 3XX – CONTROL PANELS
- 4XX – VALVES
- 5XX – LIGHTING
- 6XX – HEATING AND VENTILATION
- 7XX – NOT USED
- 8XX – INSTRUMENTATION
- 9XX – OTHER
- 0XX – NOT USED

PROCESS

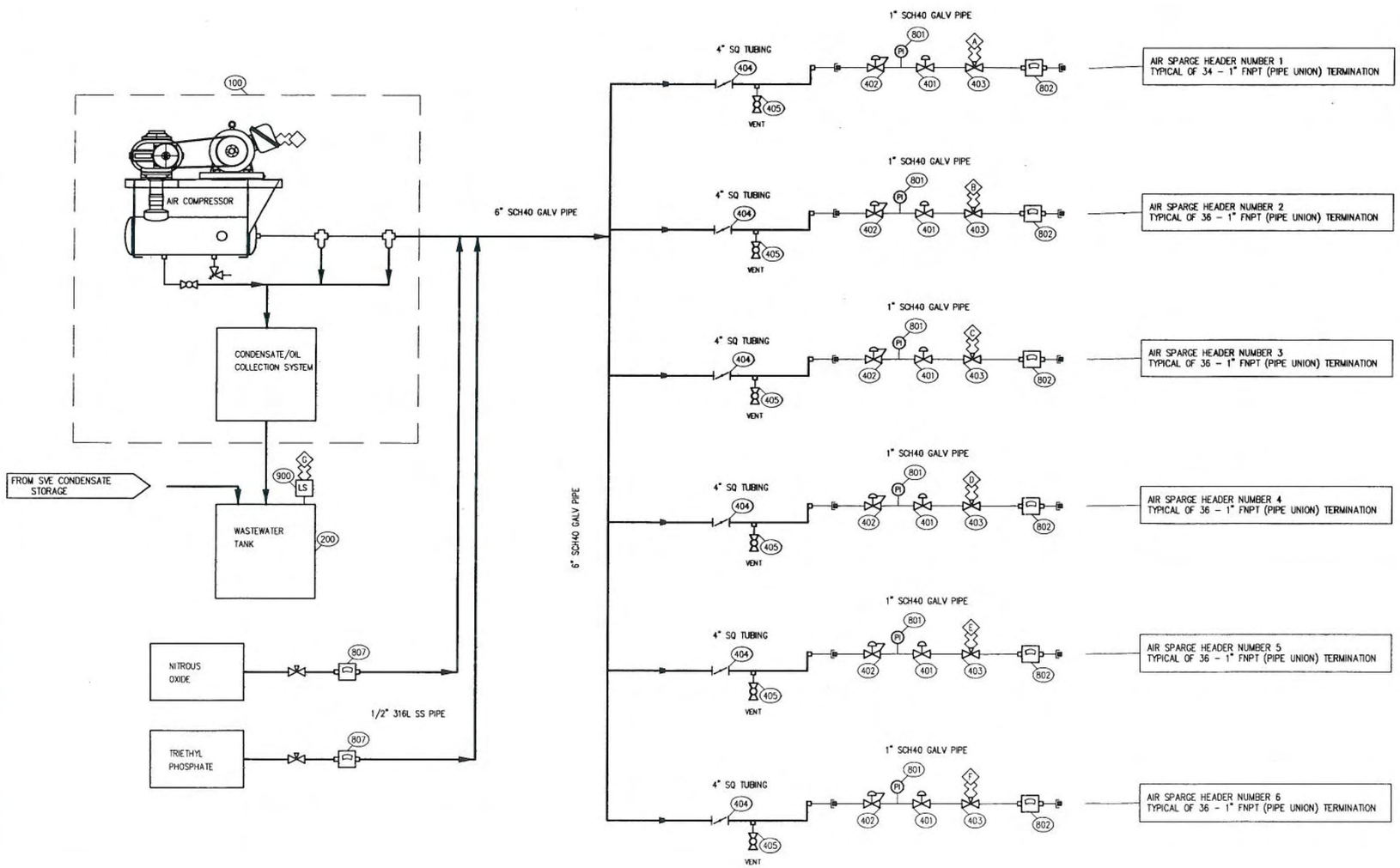

FIGURE 5

ELECTRICAL TERMINATIONS

- A – SOLENOID VALVE 120 VAC – NC (1-01, 1-02 ...)
- B – SOLENOID VALVE 120 VAC – NC (2-01, 2-02 ...)
- C – SOLENOID VALVE 120 VAC – NC (3-01, 3-02 ...)
- D – SOLENOID VALVE 120 VAC – NC (4-01, 4-02 ...)
- E – SOLENOID VALVE 120 VAC – NC (5-01, 5-02 ...)
- F – SOLENOID VALVE 120 VAC – NC (6-01, 6-02 ...)
- G – HIGH LIQUID LEVEL SHUTDOWN WASTEWATER STORAGE – NO
- H – HIGH LIQUID LEVEL SHUTDOWN AIR RECEIVER – NO
- I
- J
- K
- L
- M
- N
- O
- P
- Q

PNEUMATIC TERMINATIONS

- 0 –

- BILL OF MAT'L TAG
- PNEUMATIC TAG
- ELECTRICAL TAG
- PI – PRESSURE GAUGE
- DP – DIFF. PRESS. GAUGE
- TI – THERMOMETER
- GAUGE IN PANEL
- CAM FITTING OR UNION
- GATE VALVE
- BALL VALVE
- GLOBE VALVE
- SOLENOID VALVE
- RELIEF VALVE
- SWING CHECK VALVE
- PISTON CHECK VALVE
- IN-LINE CHECK VALVE
- BUTTERFLY CHECK VALVE
- DIAPHRAGM VALVE
- REGULATOR VALVE
- REGULATOR/RELIEF VALVE
- IN LINE FILTER
- "Y" – STRAINER
- FM – FLOW METER
- ORIFICE PITOT TUBE SENSOR
- PT – PRESSURE/VACUUM TRANSDUCER
- FS – FLOW SWITCH
- LS – LIQUID LEVEL SWITCH
- LSH – LEVEL SENSOR – HIGH
- LSL – LEVEL SENSOR – LOW
- PSD – PRESSURE SENSOR – DIFFERENTIAL
- PSL – PRESSURE SENSOR – LOW
- PSH – PRESSURE SENSOR – HIGH
- TSH – TEMPERATURE SENSOR – HIGH
- RTD – RESISTANT TEMPERATURE DETECTOR
- MAIN PROCESS PIPING
- UTILITY PIPING
- FUTURE PIPING / PIPING BY OTHERS
- INST. TUBING AIR, GAS, or OIL
- PROCESS HOSE

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PROJECT: SVE SYSTEM / CECIL FIELD

PROCESS AND INSTRUMENTATION FLOW DIAGRAM
FOR
AIR SPARGE SYSTEM

DWN BY	CHK'D BY	APP'D BY	DATE	SCALE	JOB No.	DRAWING No.	REV
DB (TF)	TB (TF)	EP (TF)	AUG 25/04	NTS			0

AGVIQ
CHAM HILL

Department of Environmental Protection

Jeb Bush
Governor

Twin Towers Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Colleen M. Castille
Secretary

October 24, 2005

Commanding Officer
Attn: Mr. Gabe Magwood
Code ES24 (UST RPM)
Southern Division
Naval Facilities Engineering Command
P.O. Box 190010
North Charleston, South Carolina 29419-9010

RE: Technical Memorandum, Recommendation to Discontinue Operation of SVE System, North Fuel Farm Site, Former Naval Air Station Cecil Field, Jacksonville, Florida

Dear Mr. Magwood:

The Department has completed its review of the Technical Memorandum, Recommendation to Discontinue Operation of SVE System, North Fuel Farm Site, Former Naval Air Station Cecil Field, dated October 12, 2005 (received by e-mail October 20, 2005), prepared and submitted by CH2M Hill, Inc. With the low mass removal rates, consistently less than 0.2 lbs./day, the Department concurs with the recommendation to discontinue operation of the Soil Vapor Extraction system.

Please note that the Department is still awaiting the engineering drawings ("as-built" drawings), signed and sealed by a Professional Engineer, required by Florida Administrative Code Rule 62-770.700(12).

If I can be of any further assistance with this matter, please contact me at (850) 245-8997.

Sincerely,

David P. Grabka, P.G.
Remedial Project Manager

cc: Mike Fitzsimmons, FDEP Northeast District
Mark Speranza, Tetra Tech NUS, Pittsburgh

Mark Davidson, SouthDiv
Doyle Brittain, EPA Region 4
Mike Halil, CH2M Hill, Jacksonville

JJC _____ ESN _____

Analytical Data and Total Mass Loading of Hazardous Air Pollutants from SVE System
North Fuel Farm Site, Former NAS Cecil Field

Station ID	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**EFFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**	**INFLUENT**
Sample ID	**1-NFF-SVE-E-A-0720-05**	**1-NFF-SVE-E-A-0727-05**	**1-NFF-SVE-E-A-0803-05**	**1-NFF-SVE-E-A-0810-05**	**1-NFF-SVE-E-A-0824-05**	**1-NFF-SVE-E-A-0901-05**	**1-NFF-SVE-I-A-0720-05**	**1-NFF-SVE-I-A-0727-05**	**1-NFF-SVE-I-A-0803-05**	**1-NFF-SVE-I-A-0810-05**	**1-NFF-SVE-I-A-0824-05**	**1-NFF-SVE-I-A-0901-05**
Sample Date	**7/20/2005**	**7/27/2005**	**8/3/2005**	**8/10/2005**	**8/24/2005**	**9/1/2005**	**7/20/2005**	**7/27/2005**	**8/3/2005**	**8/10/2005**	**8/24/2005**	**9/1/2005**
Parameter												
1,1,1-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1,2-trichloro-1,2,2-trifluoroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1,2-Trichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,1-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,2,4-Trichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,2,4-Trimethylbenzene	**0.67**	<0.5	<0.5	<0.5	<0.5	**0.171**	**9.77**	**13**	<5	<5	<5	<5
1,2-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,2-Dichloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,2-Dichloropropane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,3,5-Trimethylbenzene (Mesitylene)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**17.5**	**36.2**	**8.35**	**5.71**	**10.7**	<5
1,3-Dichlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
1,4-Dichlorobenzene	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Benzene	**0.39**	<0.5	**0.174**	<0.5	<0.5	<0.5	**51**	**45.8**	**39.7**	**10.4**	**14.7**	<5
Bromodichloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Bromoform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Bromomethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Carbon disulfide	**1.08**	**0.505**	**0.708**	**10.9**	**9.69**	**7.64**	**10.9**	**34.5**	**10.1**	**16.7**	**19.4**	**12**
Carbon tetrachloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Chlorobenzene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Chloroethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Chloroform	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Chloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
cis-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
cis-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Dibromochloromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Ethylbenzene	**0.492**	**0.713**	**0.292**	<0.5	<0.5	**0.206**	**24.5**	**11.3**	**4.11**	<5	**3.45**	<5
Hexachlorobutadiene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
m,p-Xylene (sum of isomers)	**1.02**	**1.47**	**0.58**	<0.5	<0.5	0.5	**52.1**	**38.8**	**10.2**	<5	**8.17**	<5
Methylene chloride	**1.48**	**1.24**	**2.13**	**1.15**	<0.5	**0.294**	**2.62**	5	**6.21**	<5	**1.44**	<5
n-hexane	<0.5	<0.5	<0.5	**0.795**	**1.43**	**0.567**	**206**	**448**	**439**	**258**	**356**	**128**
o-Xylene (1,2-Dimethylbenzene)	**1.07**	**1.2**	**0.545**	<0.5	<0.5	<0.5	**76**	**77.8**	**27.2**	**9.11**	**22.4**	<5
Styrene	**1.25**	**0.785**	**0.602**	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
tert-butyl methyl ether	0.5	0.5	0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Tetrachloroethene (PCE)	**4.33**	**16.9**	0.5	**0.951**	<0.5	<0.5	**11.3**	<5	<5	<5	<5	<5
Toluene	**1.48**	**8.98**	**0.765**	**1.07**	**0.783**	**0.667**	**45**	**40.4**	**46.8**	**9.23**	**7.94**	<5
trans-1,2-Dichloroethene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Trichloroethene (TCE)	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Trichlorofluoromethane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5
Vinyl chloride	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2.5	<5	<5	<5	<5	<5

Notes:
All concentrations reported in parts per billion volume (ppbv).
J - estimated value
B-The analyte was detected in the associated method and/or calibration blank.
JB- Estimate value..The analyte was detected in the associated method and/or calibration blank.

Conversion of PPBV to mg/m^3												
1,1,1-Trichloroethane	0.00273	0.00273	0.00273	0.00273	0.00273	0.00273	0.01364	0.02728	0.02728	0.02728	0.02728	0.02728
1,1,2,2-Tetrachloroethane	0.00343	0.00343	0.00343	0.00343	0.00343	0.00343	0.01716	0.03433	0.03433	0.03433	0.03433	0.03433
1,1,2-trichloro-1,2,2-trifluoroethane	0.00383	0.00383	0.00383	0.00383	0.00383	0.00383	0.01916	0.03832	0.03832	0.03832	0.03832	0.03832
1,1,2-Trichloroethane	0.00273	0.00273	0.00273	0.00273	0.00273	0.00273	0.01364	0.02728	0.02728	0.02728	0.02728	0.02728
1,1-Dichloroethane	0.00202	0.00202	0.00202	0.00202	0.00202	0.00202	0.01012	0.02024	0.02024	0.02024	0.02024	0.02024
1,1-Dichloroethene	0.00198	0.00198	0.00198	0.00198	0.00198	0.00198	0.00991	0.01983	0.01983	0.01983	0.01983	0.01983
1,2,4-Trichlorobenzene	0.00371	0.00371	0.00371	0.00371	0.00371	0.00371	0.01855	0.03711	0.03711	0.03711	0.03711	0.03711
1,2,4-Trimethylbenzene	0.00329	0.00246	0.00246	0.00246	0.00246	0.00084	0.04803	0.06390	0.02458	0.02458	0.02458	0.02458
1,2-Dichlorobenzene	0.00301	0.00301	0.00301	0.00301	0.00301	0.00301	0.01503	0.03006	0.03006	0.03006	0.03006	0.03006
1,2-Dichloroethane	0.00202	0.00202	0.00202	0.00202	0.00202	0.00202	0.01012	0.02024	0.02024	0.02024	0.02024	0.02024
1,2-Dichloropropane	0.00231	0.00231	0.00231	0.00231	0.00231	0.00231	0.01155	0.02311	0.02311	0.02311	0.02311	0.02311
1,3,5-Trimethylbenzene (Mesitylene)	0.00246	0.00246	0.00246	0.00246	0.00246	0.00246	0.08603	0.17795	0.04105	0.02807	0.05260	0.02458
1,3-Dichlorobenzene	0.00301	0.00301	0.00301	0.00301	0.00301	0.00301	0.01503	0.03006	0.03006	0.03006	0.03006	0.03006
1,4-Dichlorobenzene	0.00301	0.00301	0.00301	0.00301	0.00301	0.00301	0.01503	0.03006	0.03006	0.03006	0.03006	0.03006
Benzene	0.00125	0.00160	0.00056	0.00160	0.00160	0.00160	0.16293	0.14632	0.12683	0.03322	0.04696	0.01597
Bromodichloromethane	0.00335	0.00335	0.00335	0.00335	0.00335	0.00335	0.01675	0.03350	0.03350	0.03350	0.03350	0.03350
Bromoform	0.00517	0.00517	0.00517	0.00517	0.00517	0.00517	0.02584	0.05168	0.05168	0.05168	0.05168	0.05168
Bromomethane	0.00194	0.00194	0.00194	0.00194	0.00194	0.00194	0.00971	0.01942	0.01942	0.01942	0.01942	0.01942
Carbon disulfide	0.00336	0.00157	0.00220	0.03394	0.03017	0.02379	0.03394	0.10742	0.03145	0.05200	0.06041	0.03736
Carbon tetrachloride	0.00315	0.00315	0.00315	0.00315	0.00315	0.00315	0.01573	0.03146	0.03146	0.03146	0.03146	0.03146
Chlorobenzene	0.00230	0.00230	0.00230	0.00230	0.00230	0.00230	0.01151	0.02302	0.02302	0.02302	0.02302	0.02302
Chloroethane	0.00132	0.00132	0.00132	0.00132	0.00132	0.00132	0.00660	0.01319	0.01319	0.01319	0.01319	0.01319
Chloroform	0.00244	0.00244	0.00244	0.00244	0.00244	0.00244	0.01221	0.02442	0.02442	0.02442	0.02442	0.02442
Chloromethane	0.00103	0.00103	0.00103	0.00103	0.00103	0.00103	0.00516	0.01033	0.01033	0.01033	0.01033	0.01033
cis-1,2-Dichloroethene	0.00198	0.00198	0.00198	0.00198	0.00198	0.00198	0.00991	0.01983	0.01983	0.01983	0.01983	0.01983
cis-1,3-Dichloropropene	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.01135	0.02270	0.02270	0.02270	0.02270	0.02270
Dibromochloromethane	0.00426	0.00426	0.00426	0.00426	0.00426	0.00426	0.02130	0.04259	0.04259	0.04259	0.04259	0.04259
Ethylbenzene	0.00214	0.00310	0.00127	0.00217	0.00217	0.00089	0.10638	0.04906	0.01785	0.02171	0.01498	0.02171
Hexachlorobutadiene	0.00533	0.00533	0.00533	0.00533	0.00533	0.00533	0.02666	0.05333	0.05333	0.05333	0.05333	0.05333
m,p-Xylene (sum of isomers)	0.00443	0.00638	0.00252	0.00217	0.00217	0.00217	0.22621	0.16847	0.04429	0.02171	0.03547	0.02171
Methylene chloride	0.00514	0.00431	0.00740	0.00400	0.00174	0.00102	0.00910	0.01737	0.02157	0.01737	0.00500	0.01737
n-hexane	0.00176	0.00176	0.00176	0.00280	0.00504	0.00200	0.72610	1.57909	1.54736	0.90938	1.25481	0.45117
o-Xylene (1,2-Dimethylbenzene)	0.00465	0.00521	0.00237	0.00217	0.00217	0.00217	0.32999	0.33780	0.11810	0.03955	0.09726	0.02171
Styrene	0.00532	0.00334	0.00256	0.00213	0.00213	0.00213	0.01065	0.02130	0.02130	0.02130	0.02130	0.02130
tert-butyl methyl ether	0.00180	0.00180	0.00180	0.00180	0.00180	0.00180	0.00901	0.01803	0.01803	0.01803	0.01803	0.01803
Tetrachloroethene (PCE)	0.02937	0.11464	0.00339	0.00645	0.00339	0.00339	0.07665	0.03392	0.03392	0.03392	0.03392	0.03392
Toluene	0.00558	0.03384	0.00288	0.00403	0.00295	0.00251	0.16956	0.15223	0.17635	0.03478	0.02992	0.01884
trans-1,2-Dichloroethene	0.00198	0.00198	0.00198	0.00198	0.00198	0.00198	0.00991	0.01982	0.01982	0.01982	0.01982	0.01982
trans-1,3-Dichloropropene	0.00227	0.00227	0.00227	0.00227	0.00227	0.00227	0.01135	0.02270	0.02270	0.02270	0.02270	0.02270
Trichloroethene (TCE)	0.00269	0.00269	0.00269	0.00269	0.00269	0.00269	0.01344	0.02687	0.02687	0.02687	0.02687	0.02687
Trichlorofluoromethane	0.00281	0.00281	0.00281	0.00281	0.00281	0.00281	0.01405	0.02809	0.02809	0.02809	0.02809	0.02809
Vinyl chloride	0.00128	0.00128	0.00128	0.00128	0.00128	0.00128	0.00639	0.01278	0.01278	0.01278	0.01278	0.01278
TOTAL VOC	0.14991	0.26183	0.11300	0.14754	0.13961	0.12614	2.39140	3.66650	3.01630	2.04926	2.48887	1.52189

Calculation of Mass Loading Rate (lbs/day)

Flow Rate	650	624	650	650	684	628	650	624	650	650	684	628
1,1,1-Trichloroethane	0.00016	0.00015	0.00016	0.00016	0.00017	0.00015	0.00080	0.00153	0.00159	0.00159	0.00168	0.00154
1,1,2,2-Tetrachloroethane	0.00020	0.00019	0.00020	0.00020	0.00021	0.00019	0.00100	0.00193	0.00201	0.00201	0.00211	0.00194
1,1,2-trichloro-1,2,2-trifluoroethane	0.00022	0.00021	0.00022	0.00022	0.00024	0.00022	0.00112	0.00215	0.00224	0.00224	0.00236	0.00216
1,1,2-Trichloroethane	0.00016	0.00015	0.00016	0.00016	0.00017	0.00015	0.00080	0.00153	0.00159	0.00159	0.00168	0.00154
1,1-Dichloroethane	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00059	0.00114	0.00118	0.00118	0.00124	0.00114
1,1-Dichloroethene	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00058	0.00111	0.00116	0.00116	0.00122	0.00112
1,2,4-Trichlorobenzene	0.00022	0.00021	0.00022	0.00022	0.00023	0.00021	0.00108	0.00208	0.00217	0.00217	0.00228	0.00210
1,2,4-Trimethylbenzene	0.00019	0.00014	0.00014	0.00014	0.00015	0.00005	0.00281	0.00359	0.00144	0.00144	0.00151	0.00139
1,2-Dichlorobenzene	0.00018	0.00017	0.00018	0.00018	0.00018	0.00017	0.00088	0.00169	0.00176	0.00176	0.00185	0.00170
1,2-Dichloroethane	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00059	0.00114	0.00118	0.00118	0.00124	0.00114
1,2-Dichloropropane	0.00014	0.00013	0.00014	0.00014	0.00014	0.00013	0.00068	0.00130	0.00135	0.00135	0.00142	0.00130
1,3,5-Trimethylbenzene (Mesitylene)	0.00014	0.00014	0.00014	0.00014	0.00015	0.00014	0.00503	0.00998	0.00240	0.00164	0.00323	0.00139
1,3-Dichlorobenzene	0.00018	0.00017	0.00018	0.00018	0.00018	0.00017	0.00088	0.00169	0.00176	0.00176	0.00185	0.00170
1,4-Dichlorobenzene	0.00018	0.00017	0.00018	0.00018	0.00018	0.00017	0.00088	0.00169	0.00176	0.00176	0.00185	0.00170
Benzene	0.00007	0.00009	0.00003	0.00009	0.00010	0.00009	0.00952	0.00821	0.00741	0.00194	0.00289	0.00090
Bromodichloromethane	0.00020	0.00019	0.00020	0.00020	0.00021	0.00019	0.00098	0.00188	0.00196	0.00196	0.00206	0.00189
Bromoform	0.00030	0.00029	0.00030	0.00030	0.00032	0.00029	0.00151	0.00290	0.00302	0.00302	0.00318	0.00292
Bromomethane	0.00011	0.00011	0.00011	0.00011	0.00012	0.00011	0.00057	0.00109	0.00113	0.00113	0.00119	0.00110
Carbon disulfide	0.00020	0.00009	0.00013	0.00198	0.00186	0.00134	0.00198	0.00603	0.00184	0.00304	0.00371	0.00211
Carbon tetrachloride	0.00018	0.00018	0.00018	0.00018	0.00019	0.00018	0.00092	0.00176	0.00184	0.00184	0.00193	0.00178
Chlorobenzene	0.00013	0.00013	0.00013	0.00013	0.00014	0.00013	0.00067	0.00129	0.00135	0.00135	0.00142	0.00130
Chloroethane	0.00008	0.00007	0.00008	0.00008	0.00008	0.00007	0.00039	0.00074	0.00077	0.00077	0.00081	0.00074
Chloroform	0.00014	0.00014	0.00014	0.00014	0.00015	0.00014	0.00071	0.00137	0.00143	0.00143	0.00150	0.00138
Chloromethane	0.00006	0.00006	0.00006	0.00006	0.00006	0.00006	0.00030	0.00058	0.00060	0.00060	0.00063	0.00058
cis-1,2-Dichloroethene	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00058	0.00111	0.00116	0.00116	0.00122	0.00112
cis-1,3-Dichloropropene	0.00013	0.00013	0.00013	0.00013	0.00014	0.00013	0.00066	0.00127	0.00133	0.00133	0.00140	0.00128
Dibromochloromethane	0.00025	0.00024	0.00025	0.00025	0.00026	0.00024	0.00124	0.00239	0.00249	0.00249	0.00262	0.00240
Ethylbenzene	0.00012	0.00017	0.00007	0.00013	0.00013	0.00005	0.00622	0.00275	0.00104	0.00127	0.00092	0.00123
Hexachlorobutadiene	0.00031	0.00030	0.00031	0.00031	0.00033	0.00030	0.00156	0.00299	0.00312	0.00312	0.00328	0.00301
m,p-Xylene (sum of isomers)	0.00026	0.00036	0.00015	0.00013	0.00013	0.00012	0.01322	0.00945	0.00259	0.00127	0.00218	0.00123
Methylene chloride	0.00030	0.00024	0.00043	0.00023	0.00011	0.00006	0.00053	0.00097	0.00126	0.00102	0.00031	0.00098
n-hexane	0.00010	0.00010	0.00010	0.00016	0.00031	0.00011	0.04243	0.08859	0.09043	0.05314	0.07717	0.02547
o-Xylene (1,2-Dimethylbenzene)	0.00027	0.00029	0.00014	0.00013	0.00013	0.00012	0.01928	0.01895	0.00690	0.00231	0.00598	0.00123
Styrene	0.00031	0.00019	0.00015	0.00012	0.00013	0.00012	0.00062	0.00119	0.00124	0.00124	0.00131	0.00120
tert-butyl methyl ether	0.00011	0.00010	0.00011	0.00011	0.00011	0.00010	0.00053	0.00101	0.00105	0.00105	0.00111	0.00102
Tetrachloroethene (PCE)	0.00172	0.00643	0.00020	0.00038	0.00021	0.00019	0.00448	0.00190	0.00198	0.00198	0.00209	0.00191
Toluene	0.00033	0.00190	0.00017	0.00024	0.00018	0.00014	0.00991	0.00854	0.01031	0.00203	0.00184	0.00106
trans-1,2-Dichloroethene	0.00012	0.00011	0.00012	0.00012	0.00012	0.00011	0.00058	0.00111	0.00116	0.00116	0.00122	0.00112
trans-1,3-Dichloropropene	0.00013	0.00013	0.00013	0.00013	0.00014	0.00013	0.00066	0.00127	0.00133	0.00133	0.00140	0.00128
Trichloroethene (TCE)	0.00016	0.00015	0.00016	0.00016	0.00017	0.00015	0.00079	0.00151	0.00157	0.00157	0.00165	0.00152
Trichlorofluoromethane	0.00016	0.00016	0.00016	0.00016	0.00017	0.00016	0.00082	0.00158	0.00164	0.00164	0.00173	0.00159
Vinyl chloride	0.00007	0.00007	0.00007	0.00007	0.00008	0.00007	0.00037	0.00072	0.00075	0.00075	0.00079	0.00072
TOTAL VOC	**0.00876**	**0.01469**	**0.00660**	**0.00862**	**0.00859**	**0.00712**	**0.13975**	**0.20570**	**0.17627**	**0.11976**	**0.15306**	**0.08593**

Calculation of theoretical concentration (mg/m^3) that would result in 13.1 pounds/day of Total VOCs

TOTAL VOC	224.16022	233.50023	224.16022	224.16022	213.01776	232.01297	224.16022	233.50023	224.16022	224.16022	213.01776	232.01297
1,1,1-Trichloroethane	4.07969	2.43322	5.41262	4.14529	4.16293	5.01838	1.27876	1.73759	2.02766	2.98451	2.33521	4.15951
1,1,2,2-Tetrachloroethane	5.13279	3.06131	6.80979	5.21532	5.23752	6.31378	1.60885	2.18612	2.55107	3.75491	2.93800	5.23322
1,1,2-trichloro-1,2,2-trifluoroethane	5.72967	3.41730	7.60168	5.82180	5.84657	7.04799	1.79594	2.44034	2.84772	4.19156	3.27965	5.84177
1,1,2-Trichloroethane	4.07969	2.43322	5.41262	4.14529	4.16293	5.01838	1.27876	1.73759	2.02766	2.98451	2.33521	4.15951
1,1-Dichloroethane	3.02629	1.80495	4.01504	3.07495	3.08803	3.72260	0.94858	1.28893	1.50411	2.21389	1.73224	3.08550
1,1-Dichloroethene	2.96452	1.76811	3.93309	3.01218	3.02500	3.64662	0.92921	1.26263	1.47341	2.16870	1.69688	3.02252
1,2,4-Trichlorobenzene	5.54865	3.30934	7.36152	5.63787	5.66186	6.82532	1.73920	2.36324	2.75776	4.05913	3.17604	5.65721
1,2,4-Trimethylbenzene	4.92470	2.19194	4.87590	3.73424	3.75013	1.54610	4.50185	4.06976	1.82660	2.68856	2.10365	3.74705
1,2-Dichlorobenzene	4.49525	2.68106	5.96394	4.56752	4.58696	5.52954	1.40901	1.91458	2.23420	3.28851	2.57307	4.58319
1,2-Dichloroethane	3.02598	1.80476	4.01463	3.07463	3.08772	3.72222	0.94848	1.28880	1.50395	2.21366	1.73207	3.08518
1,2-Dichloropropane	3.45499	2.06063	4.58381	3.51054	3.52548	4.24994	1.08295	1.47152	1.71718	2.52751	1.97763	3.52258
1,3,5-Trimethylbenzene (Mesitylene)	3.67515	2.19194	4.87590	3.73424	3.75013	4.52075	8.06370	11.33272	3.05042	3.07034	4.50181	3.74705
1,3-Dichlorobenzene	4.49525	2.68106	5.96394	4.56752	4.58696	5.52954	1.40901	1.91458	2.23420	3.28851	2.57307	4.58319
1,4-Dichlorobenzene	4.49525	2.68106	5.96394	4.56752	4.58696	5.52954	1.40901	1.91458	2.23420	3.28851	2.57307	4.58319
Benzene	1.86298	1.42452	1.10274	2.42684	2.43716	2.93798	15.27232	9.31814	9.42545	3.63431	4.01938	2.43516
Bromodichloromethane	5.00957	2.98782	6.64630	5.09011	5.11177	6.16220	1.57022	2.13364	2.48982	3.66476	2.86746	5.10758
Bromoform	7.72793	4.60911	10.25282	7.85219	7.88561	9.50603	2.42228	3.29143	3.84089	5.65339	4.42345	7.87913
Bromomethane	2.90336	1.73163	3.85196	2.95005	2.96260	3.57139	0.91005	1.23658	1.44301	2.12396	1.66188	2.96017
Carbon disulfide	5.02824	1.40229	4.37326	51.56395	46.03497	43.75438	3.18134	6.84120	2.33713	5.68793	5.17002	5.69624
Carbon tetrachloride	4.70409	2.80563	6.24102	4.77973	4.80007	5.78644	1.47448	2.00353	2.33800	3.44129	2.69261	4.79613
Chlorobenzene	3.44184	2.05279	4.56636	3.49718	3.51206	4.23376	1.07883	1.46592	1.71064	2.51789	1.97010	3.50918
Chloroethane	1.97288	1.17667	2.61746	2.00460	2.01313	2.42681	0.61839	0.84028	0.98055	1.44327	1.12927	2.01148
Chloroform	3.65069	2.17735	4.84344	3.70938	3.72517	4.49066	1.14429	1.55487	1.81444	2.67067	2.08965	3.72211
Chloromethane	1.54387	0.92080	2.04829	1.56870	1.57537	1.89910	0.48392	0.65756	0.76733	1.12943	0.88371	1.57408
cis-1,2-Dichloroethene	2.96452	1.76811	3.93309	3.01218	3.02500	3.64662	0.92921	1.26263	1.47341	2.16870	1.69688	3.02252
cis-1,3-Dichloropropene	3.39353	2.02398	4.50227	3.44809	3.46276	4.17433	1.06368	1.44535	1.68663	2.48254	1.94245	3.45992
Dibromochloromethane	6.36875	3.79846	8.44956	6.47115	6.49869	7.83411	1.99625	2.71253	3.16535	4.65907	3.64546	6.49335
Ethylbenzene	3.19420	2.76084	2.51513	3.29833	3.31237	1.64513	9.97138	3.12462	1.32620	2.37472	1.28208	3.30965
Hexachlorobutadiene	7.97347	4.75556	10.57858	8.10167	8.13616	9.80806	2.49925	3.39600	3.96292	5.83301	4.56400	8.12947
m,p-Xylene (sum of isomers)	6.62213	5.69205	4.99580	3.29833	3.31237	3.99304	21.20444	10.72877	3.29129	2.37472	3.03611	3.30965
Methylene chloride	7.68795	3.84171	14.67940	6.06979	2.65027	1.87859	0.85318	1.10621	1.60328	1.90005	0.42816	2.64810
n-hexane	2.63520	1.57169	3.49617	4.25733	7.69043	3.67588	68.06157	100.56382	114.99416	99.47371	107.39673	68.78091
o-Xylene (1,2-Dimethylbenzene)	6.94674	4.64657	4.69433	3.29833	3.31237	3.99304	30.93162	21.51284	8.77677	4.32675	8.32422	3.30965
Styrene	7.96094	2.98179	5.08663	3.23557	3.24935	3.91706	0.99813	1.35627	1.58268	2.32954	1.82273	3.24668
tert-butyl methyl ether	2.69544	1.60762	3.57609	2.73877	2.75043	3.31562	0.84487	1.14802	1.33967	1.97185	1.54286	2.74817
Tetrachloroethene (PCE)	43.91774	102.23336	6.72825	9.80076	5.17480	6.23818	7.18492	2.15995	2.52052	3.70995	2.90282	5.17055
Toluene	8.33872	30.17643	5.71846	6.12560	4.50164	4.62274	15.89431	9.69482	13.10544	3.80439	2.56069	2.87225
trans-1,2-Dichloroethene	2.96421	1.76792	3.93269	3.01187	3.02469	3.64624	0.92912	1.26250	1.47325	2.16848	1.69671	3.02221
trans-1,3-Dichloropropene	3.39353	2.02398	4.50227	3.44809	3.46276	4.17433	1.06368	1.44535	1.68663	2.48254	1.94245	3.45992
Trichloroethene (TCE)	4.01793	2.39638	5.33067	4.08253	4.09990	4.94240	1.25940	1.71129	1.99696	2.93932	2.29985	4.09654
Trichlorofluoromethane	4.20078	2.50544	5.57327	4.26832	4.28649	5.16733	1.31671	1.78917	2.08785	3.07309	2.40452	4.28297
Vinyl chloride	1.91111	1.13983	2.53552	1.94184	1.95011	2.35084	0.59903	0.81397	0.94985	1.39808	1.09392	1.94850

Appendix B

Laboratory Analytical Results for Air and Groundwater Samples

(provided on CD)