N60508.AR.002465
NAS WHITING FIELD
5090.3a

REMEDIAL ACTION PLAN FOR SITES 1438 AND 1439 NAS WHITING FIELD FL
5/1/2002
TETRA TECH

Remedial Action Plan
for
Site 1438/1439

Naval Air Station Whiting Field
Milton, Florida

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888

Contract Task Order 0200

May 2002

REMEDIAL ACTION PLAN
FOR
SITE 1438/1439

NAVAL AIR STATION WHITING FIELD
MILTON, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Tetra Tech NUS, Inc.
Foster Plaza 7
661 Andersen Drive
Pittsburgh, Pennsylvania 15220-2745

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0200

MAY 2002

PREPARED UNDER THE SUPERVISION OF:

Joe D. Ferrant (for)

PAUL CALLIGAN, P.G.
TASK ORDER MANAGER
TETRA TECH NUS, INC.
TAMPA, FLORIDA

APPROVED FOR SUBMITTAL BY:

Debra M Wroblewski

DEBBIE WROBLEWSKI
PROGRAM MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

The professional opinions rendered in this decision document identified as Remedial Action Plan for Site 1438/1439, Naval Air Station Whiting Field, Milton, Florida were developed in accordance with commonly accepted procedures consistent with applicable standards of practice. Decision documents were prepared under the supervision of the signing engineer and are based on information obtained from others. If conditions are determined to exist differently than those described in this document, then the undersigned professional engineer should be notified to evaluate the effects of any additional information on the project described in this document.

Steven L Brashers
05-28-2002

Steven L. Brashers, P.E.
Professional Engineering Number FL 47151
Tetra Tech NUS, Inc. Engineering Number 7988

TABLE OF CONTENTS

SECTION **PAGE**

ACRONYMS ..... **vii**

EXECUTIVE SUMMARY **ES-1**

1.0 INTRODUCTION **1-1**
1.1 PURPOSE AND SCOPE 1-1
1.2 SITE DESCRIPTION 1-1
1.3 SITE HISTORY 1-4
1.4 REPORT ORGANIZATION 1-7

2.0 PREVIOUS INVESTIGATION FINDINGS AND CONCLUSIONS **2-1**
2.1 LITHOLOGIC FINDINGS 2-1
2.2 GROUNDWATER AND AQUIFER CHARACTERISTICS 2-1
2.3 CONTAMINATED SOIL ASSESSMENT 2-5
2.4 CONTAMINATED GROUNDWATER ASSESSMENT 2-6
2.5 FREE PRODUCT 2-6
2.6 PREVIOUS INVESTIGATION CONCLUSIONS AND RECOMMENDATIONS 2-6

3.0 REMEDIAL ACTION PLAN GOALS **3-1**
3.1 SOIL TARGET LEVELS 3-1

4.0 CONTAMINANT DISTRIBUTION **4-1**
4.1 ESTIMATED MASS OF CONTAMINANTS IN SOIL 4-1

5.0 TREATABILITY STUDY **5-1**
5.1 AIR INJECTION WELL AND MONITORING POINT LOCATIONS 5-1
5.2 SOIL BORINGS 5-1
5.3 BACTERIAL ENUMERATION SAMPLES 5-2
5.4 AIR INJECTION WELL AND MONITORING POINT INSTALLATION 5-2
5.5 PRE-TEST EMISSIONS SAMPLING 5-2
5.6 SOIL PERMEABILITY TEST 5-2
5.7 POST-TEST EMISSIONS SAMPLING 5-3
5.8 TREATABILITY STUDY RESULTS 5-3

6.0 REMEDIAL ALTERNATIVE TECHNOLOGY SCREENING **6-1**
6.1 EVALUATION OF SOIL TREATMENT ALTERNATIVES 6-1
6.1.1 Excavation and Disposal/Treatment 6-1
6.1.2 SVE 6-2
6.1.3 Active Bioventing 6-4
6.1.4 Passive Barometric Bioventing 6-4
6.2 COST COMPARISON AND RATIONALE FOR SELECTION 6-5

7.0 REMEDIAL SYSTEM DESIGN **7-1**
7.1 BASEWIDE BUILDING CODES 7-1
7.2 SVE SYSTEM DESIGN DETAILS 7-1
7.2.1 SVE Well Installation 7-1
7.2.2 Piping Network 7-5
7.2.3 Vapor Extraction Blower 7-5
7.2.4 System Equipment and Controls 7-8
7.3 OFF-GAS TREATMENT 7-8
7.4 ELECTRICAL AND CONTROLS 7-8
7.4.1 Control Panel 7-8

8.0 OPERATION & MAINTENANCE AND MONITORING 8-1
8.1 SVE SYSTEM START-UP 8-1
8.2 DOCUMENTATION 8-1
8.3 MONITORING SOIL REMEDIATION PROGRESS 8-2
8.4 SYSTEM O&M 8-2
8.5 STATUS REPORTS 8-3
8.6 SYSTEM DEACTIVATION 8-3

9.0 REMEDIAL ACTION PLAN SUMMARY 9-1

REFERENCES R-1

APPENDICES

A CONTAMINANT MASS CALCULATIONS A-1
B TREATABILITY STUDY INFORMATION B-1
C REMEDIAL ALTERNATIVE COST ESTIMATES C-1
D ESTIMATED REMEDIAL TIME CALCULATIONS D-1
E DESIGN SPECIFICATIONS E-1
F REMEDIAL ACTION PLAN SUMMARY F-1

TABLES

NUMBER **PAGE**

2-1 Water Table Elevation and Monitoring Well Construction Data 2-3
2-2 Summary of Soil Sample Analytical Results (SPLP) 2-8
3-1 Chemicals of Concern and Associated GCTLs 3-1
6-1 Soil Remedial Alternatives Summary 6-3
7-1 SVE Well Construction Details 7-4

FIGURES

NUMBER **PAGE**

1-1 Facility Location Map 1-2
1-2 Site Location Map 1-3
1-3 Site Plan 1-5
1-4 Soil Boring Locations 1-6
2-1 Site Lithology 2-2
2-2 Groundwater Potentiometric 2-4
2-3 Soil Analyte Detection Map 2-9
2-4 SPLP Exceedance Area 2-10
7-1 Proposed Shallow Zone SVE Well Locations 7-2
7-2 Proposed Deep Zone SVE Well Locations 7-3
7-3 Shallow SVE Well Construction Detail 7-6
7-4 Deep SVE Well Construction Detail 7-7
7-5 Process and Instrumentation Diagram 7-9

ACRONYMS

ABB-ES	ABB Environmental Services, Inc.
AVGAS	Aviation Gasoline
bls	Below Land Surface
cfm	Cubic Feet per Minute
CFU/g	Colony Forming Units per Gram
CLEAN	Comprehensive Long-term Environmental Action Navy
cm2	Squared Centimeters
COC	Chemical of Concern
CTO	Contract Task Order
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FID	Flame Ionization Detector
ft	Feet (Foot)
ft^2	Square Feet
GAC	Granular Activated Carbon
GCTLs	Groundwater Cleanup Target Levels
HLA	Harding Lawson Associates
HOA	Hands-On-Auto
hp	Horsepower
ID	Inside Diameter
lbs	Pounds
µg/L	Micrograms per Liter
mg/kg	Milligrams per Kilogram
MTBE	Methyl Tert Butyl Ether
NAS	Naval Air Station
Navy	United States Navy
NEMA	National Electrical Manufacturers Association
NR	Not Reported
NS	Not Sampled
O&M	Operations & Maintenance
OSHA	Occupational Health and Safety Administration
OVA	Organic Vapor Analyzer
PAH	Polynuclear Aromatic Hydrocarbons
PCA	Preliminary Contamination Assessment
PVC	Polyvinyl Chloride

ACRONYMS (Continued)

RAP	Remedial Action Plan
ROI	Radius of Influence
SA	Site Assessment
SAR	Site Assessment Report
SCTLs	Soil Cleanup Target Levels
SPLP	Synthetic Precipitation Leaching Procedure
SVE	Soil Vapor Extraction
TCE	Tetrachloroethene
TRPH	Total Recoverable Petroleum Hydrocarbons
TS	Treatability Study
TtNUS	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VAC	Voltage Alternating Current
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

Tetra Tech NUS, Inc. (TtNUS) has completed a Remedial Action Plan (RAP) for Tank Site 1438/1439 at Naval Air Station (NAS) Whiting Field in accordance with the requirements of Chapter 62-770, Florida Administrative Code (FAC). This RAP is being submitted to the Florida Department of Environmental Protection (FDEP) for approval.

TtNUS performed the following tasks during the preparation of this RAP:

- Reviewed the information provided in the Site Assessment Report (SAR) [ABB Environmental Services, Inc. (ABB-ES), 1998], the Supplemental Assessment Results [Harding Lawson Associates (HLA), 2000], and the Supplemental Assessment Report (Harding ESE, 2000).

- Evaluated remedial alternatives for soil at Site 1438/1439.

- Prepared a RAP to provide a conceptual design for the remediation of soil and provide remedial equipment specifications.

- Specified a monitoring plan to track the remediation status of the site.

- Specified a system start-up and Operations and Maintenance (O&M) plan to operate the system.

This RAP identified soil vapor extraction (SVE) as the selected remedial alternative to address soil contamination in the shallow zone that ranges from 0 to 20 feet (ft) below land surface (bls) and the deep zone which ranges from 20 to 60 ft bls. SVE was selected as the remedial alternative as it offered a timely and cost-effective method to remediate soil exhibiting constituents in excess of FDEP Synthetic Precipitation Leaching Procedure (SPLP) guidelines. The nature of the aviation gasoline (AVGAS) contamination present at the site is to readily volatize with an SVE system. As a result, SVE remediation is expected to treat site soil contamination in less time than bioremediation, which relies on biological degradation of the constituents. Also, with the volume of contaminated soil, it would be impractical to choose excavation and disposal for the site.

It is expected to require approximately two years to remediate the shallow and deep zone soil contamination by means of SVE.

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This RAP was prepared by TtNUS for the United States Navy (Navy) Southern Division, Naval Facilities Engineering Command under Contract Task Order (CTO) 0200, for the Comprehensive Long-term Environmental Action Navy (CLEAN) III, Contract Number N62467-94-D-0888. This RAP was prepared to recommend treatment options for the contaminated soil at Site 1438/1439 at NAS Whiting Field, Milton, Florida. Figure 1-1 is a Facility Location Map for NAS Whiting Field.

Site 1438/1439 has been environmentally investigated on multiple occasions dating back to 1994. In 1998, ABB-ES completed a SAR of the site. In January 2000, additional soil borings were advanced and HLA submitted a Supplemental Assessment Results letter report in April 2000. In the FDEP response, additional soil borings were requested. In October 2000, Harding ESE further investigated the site by installing the requested borings. Harding ESE addressed these borings in a Supplemental Assessment Report in December 2000. In August 2001, TtNUS submitted the Work Plan for Pre-Design Data Collection Site 1438/1439 as a basis for a Treatability Study. The work for the treatability study was completed in November 2001.

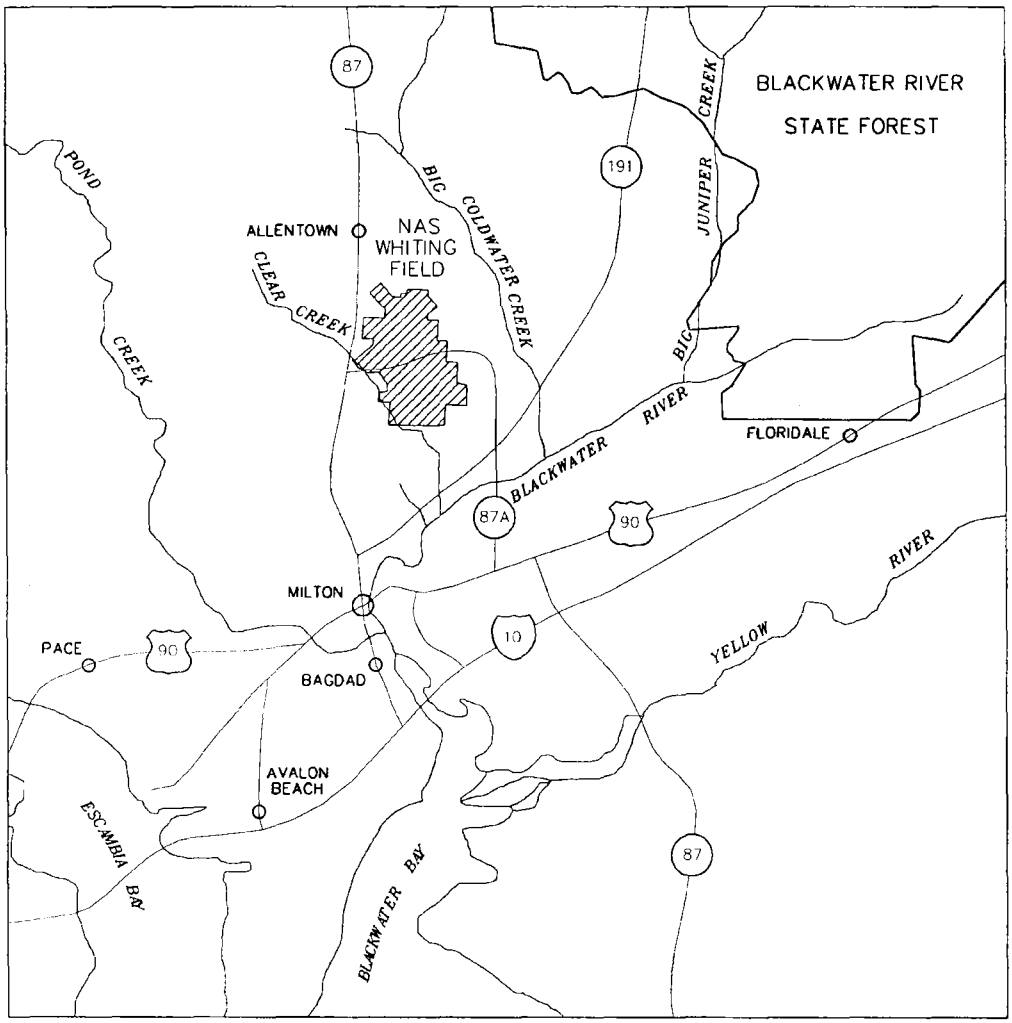
The purpose of this RAP is to select a remedial alternative that will remediate site soil in accordance with the requirements of Chapter 62-770, FAC. This RAP evaluates applicable alternatives to protect human health and the environment and reduce contaminant concentrations within impacted soil. This RAP also selects the preferred remedial alternative to remediate the site in a cost effective and timely manner, and provides a conceptual design for the selected alternative.

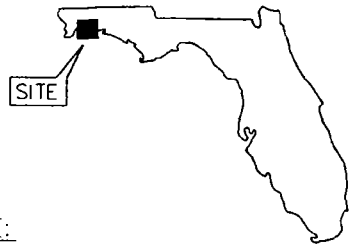
1.2 SITE DESCRIPTION

NAS Whiting Field is located in the northwest coastal area of Florida approximately 5.5 miles north of Milton and 25 miles northeast of Pensacola (Figure 1-1). NAS Whiting Field covers approximately 3,490 acres in north-central Santa Rosa County with easement rights to an additional 457 acres (HLA, 2000).

The station is divided into a North Field, used for fixed wing training, and a South Field, used for helicopter training. As shown on Figure 1-2, Site Location Map, support facilities at the base are located between the two fields. Site 1438/1439, the former location of storage tanks 1438 and 1439, is located in

ACAD: 4038cm01.dwg 06/22/01 HJP





0 5 10

SCALE IN MILES

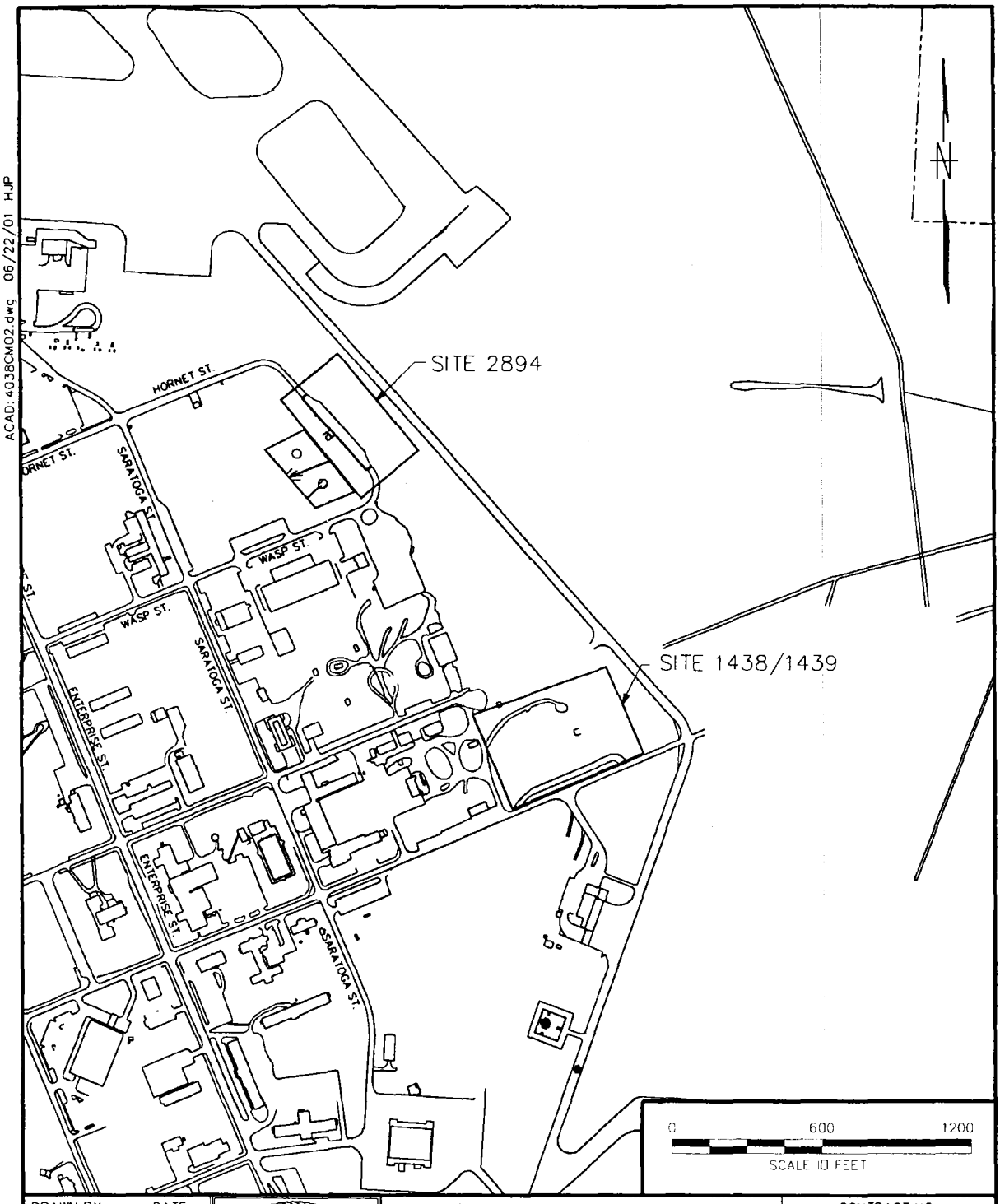
NOTE:

NAS = NAVAL AIR STATION

SOURCE: ABB ENVIRONMENTAL SERVICES INC. 1992

DRAWN BY HJP DATE 6/22/01	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	FACILITY LOCATION MAP NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-1 REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98



ACAD: 4038CM02.dwg 06/22/01 HJP

DRAWN BY HJP DATE 6/22/01	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	SITE LOCATION MAP NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-2 REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

the support facilities area on the west side of the aircraft tow road (HLA 2000). A site plan is provided as Figure 1-3.

1.3 SITE HISTORY

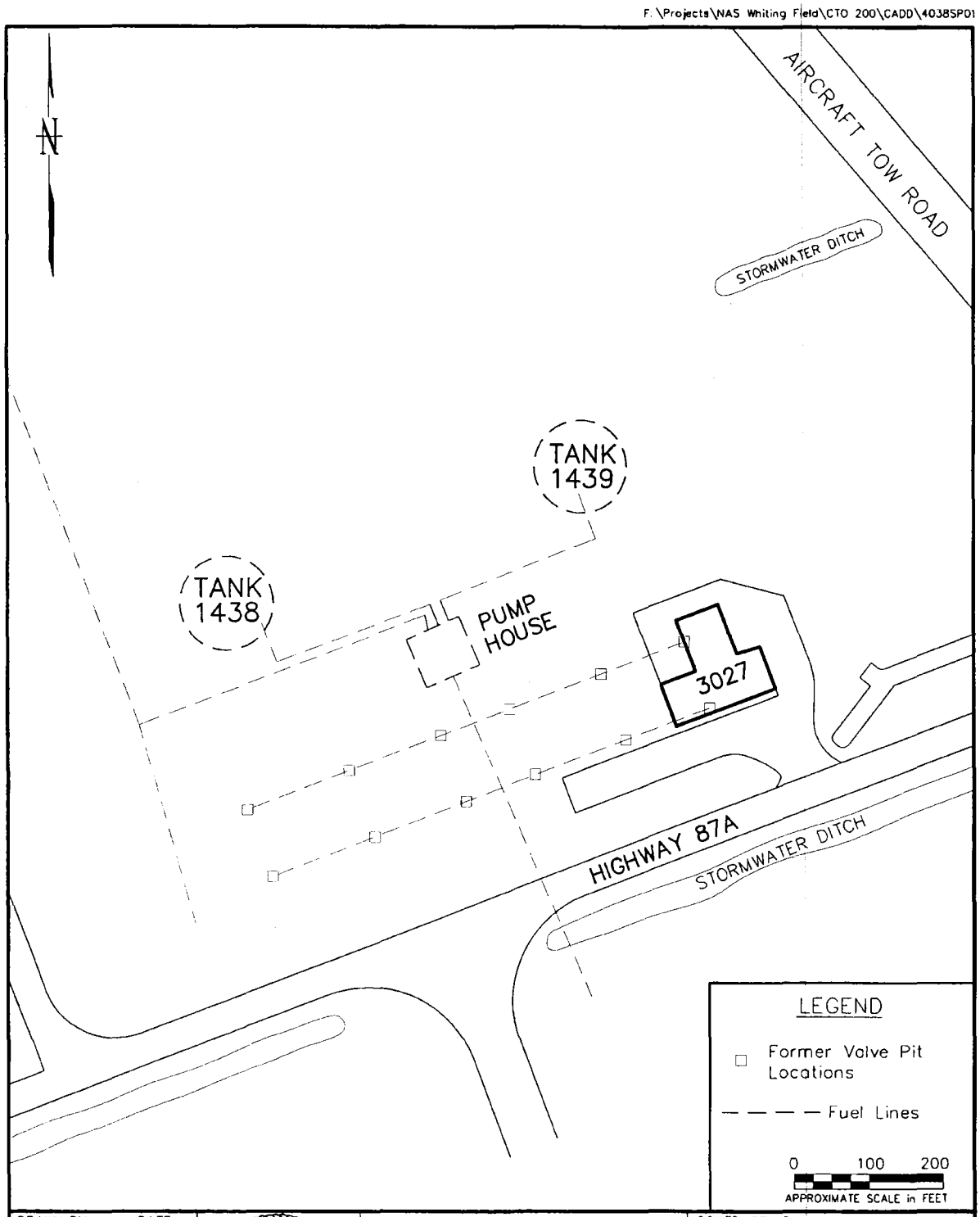
Tanks 1438 and 1439 were installed in 1943. The two storage tanks were constructed partially below ground surface and covered with fill dirt to form two large mounds. Each tank had a capacity to store 218,384 gallons of AVGAS. Fuel for flight operations was transported to the site by tanker truck and railroad car and offloaded at concrete valve pits located adjacent to the truck stand and railroad tracks south of the pump house. Fuel was pumped from the valve pits via underground pipelines to Tanks 1438 and 1439. Fuel stored in Tanks 1438 and 1439 was then pumped through underground pipelines from the pump house to the north and south airfield fueling stations. The tanks were decommissioned in 1980, at which time they were filled with water.

In 1985, Tank 1438, Tank 1439, and the pump house were demolished. According to the NAS Whiting Field Public Works Center, Tank 1438 was demolished and removed from the site. However, Tank 1439 was collapsed and abandoned in place. During demolition, free product was discovered in the excavation pit. The fuel transmission pipelines running to both the north and south airfields were reportedly abandoned in place and filled with concrete. A Storage Tank Closure Report was not filed with the State of Florida when Tank 1438, Tank 1439, and the pump house were demolished (HLA, 2000).

A SAR investigation was completed in 1998 by ABB-ES. From April 7 to April 29, 1997, 28 soil borings (07B026 through 07B053) were advanced to the water table (approximately 110 ft bls) to supplement the Terra-Probe soil assessment data collected during the 1994 preliminary contamination assessment (ABB-ES, 1998). Soil samples from soil boring 07B026 were collected at 2-ft intervals from the surface to 108 ft bls so that a complete lithological description of the site sediments could be obtained. Soil samples from the majority of the other borings were collected continuously to 20 ft bls, then at 5-ft intervals thereafter until the water table was encountered. Samples were screened using an organic vapor analyzer (OVA)-flame ionization detector (FID) in accordance with Chapter 62-770, FAC requirements. In addition, five soil samples were collected, sent to a fixed-based laboratory, and analyzed for natural attenuation parameters (HLA, 2000).

In December 1999, the Navy and FDEP decided that additional soil borings were necessary. HLA advanced 12 additional soil borings in January 2000. Soil boring locations 1438SB03, 1438SB06, 1438SB08, 1348SB09, 1438SB10, 1438SB12, 1348SB13, 1438SB14, 1438SB15, 1438SB16, 1438SB18, and 1438SB22 were sampled using a Geo-Probe direct push drill rig and 4-ft sampling sleeves. Soil boring locations are shown on Figure 1-4. Soil was screened using a FID to determine if laboratory

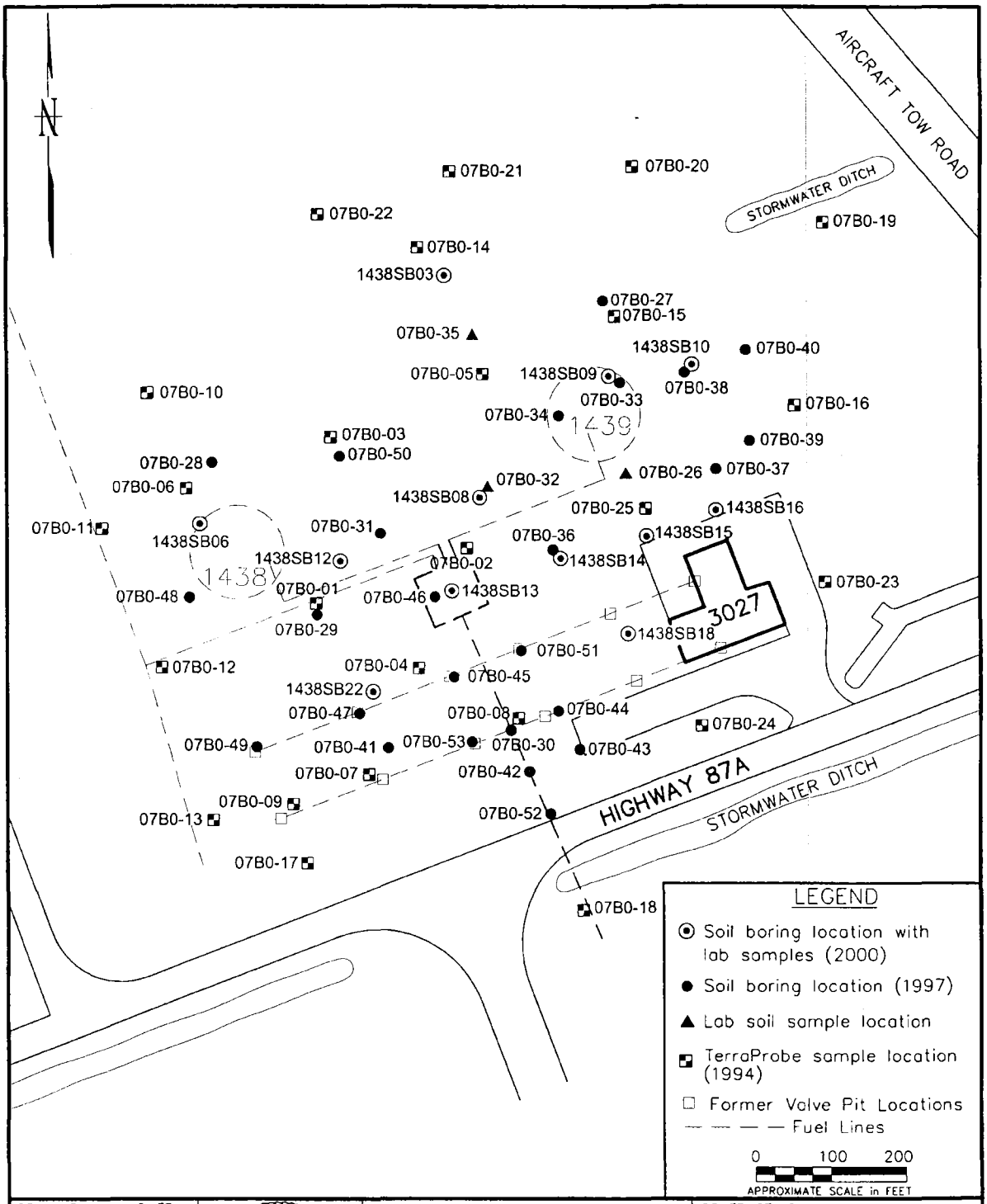
F:\Projects\NAS Whiting Field\CTO 200\CADD\40385P01



DRAWN BY LLK DATE 1/22/02	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	SITE PLAN TANKS 1438 and 1439 REMEDIAL ACTION PLAN NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-3 REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

F:\Projects\NAS Whiting Field\CTO 200\CADD\4038SB01



DRAWN BY LLK DATE 1/23/02	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	SOIL BORING LOCATIONS TANKS 1438 and 1439 REMEDIAL ACTION PLAN NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-4 REV. 0

FORM CADD NO. SDIV_AV.DWG – REV 0 – 1/20/98

analysis was necessary, and 31 soil samples were collected. A Supplemental Assessment Results letter report, dated April 14, 2000, was completed detailing the findings of this investigation. Subsequently, the Navy suggested No Further Action (NFA) at the site. However, the FDEP requested more sampling at the site to determine if a RAP was necessary.

On October 2, 2000 Harding ESE (formerly HLA) returned to the site and advanced three additional soil borings. The borings were adjacent to borings 1438SB08, 1438SB14, and 1438SB15. Based on the findings of this investigation it was recommended that a RAP be completed for the site (Harding ESE, 2000).

In order to determine the effectiveness of in-situ remediation technologies, TtNUS performed a treatability study at the site in November 2001. Two injection wells and six monitoring points were installed at the site. Soil permeability tests were performed at Site1438/1439.

1.4 REPORT ORGANIZATION

This report is organized into eight sections. Below is a list of the sections and a brief description of their purpose:

Section 1.0	Introduction	Summarizes the report's purpose, scope, site information, and report organization.
Section 2.0	Previous Investigation Findings and Conclusions	Reviews the approved SAR and other investigations and summarizes their findings and conclusions.
Section 3.0	RAP Goals	Establishes the soil treatment objectives for the remedial system/plan.
Section 4.0	Contaminant Distribution	Estimates the mass of contaminants in the soil.
Section 5.0	Treatability Study	Presents the procedures and results of the treatability study completed to gather additional information.
Section 6.0	Remedial Alternative Technology Screening	Presents the alternatives for remediation, determines the suitability for the site, and develops budgetary costs for each.

Section 7.0	Remedial System Design	Presents all of the assumptions made and provides the detailed design of the preferred remedial alternative.
Section 8.0	O&M and Monitoring	Establishes start-up and O&M procedures and provides a monitoring plan for the remediation system and sampling frequencies to evaluate the system's effectiveness.
Section 9.0	Remedial Action Plan Summary	Presents the completed FDEP RAP summary checklist.
	References	Lists references used in this report.

2.0 PREVIOUS INVESTIGATION FINDINGS AND CONCLUSIONS

Three site investigations (SAR, Supplemental Assessment Results, and Supplemental Assessment Report) were previously conducted at Site 1438/1439 between 1997 and 2001. The following is a summary of the data and information presented in these reports.

2.1 LITHOLOGIC FINDINGS

The site is underlain by an assortment of lithologies between land surface and 120 ft bls, the maximum depth drilled during the contamination assessment investigations (TtNUS, 2001). The shallow zone, from ground surface to approximately 20 ft bls, consists predominately of silty sand. The intermediate zone, from approximately 20 to 30 ft bls, has upper and lower clay horizons with clayey sand between the clay layers. The deep zone, below 30 ft bls, consists largely of sand and clayey sand units, which extend to approximately 110 ft bls. At 110 ft bls, a clay and clayey sand unit approximately 10-ft thick is encountered (TtNUS, 2001). Site lithology is depicted on Figure 2-1. Boring logs are contained within the SAR.

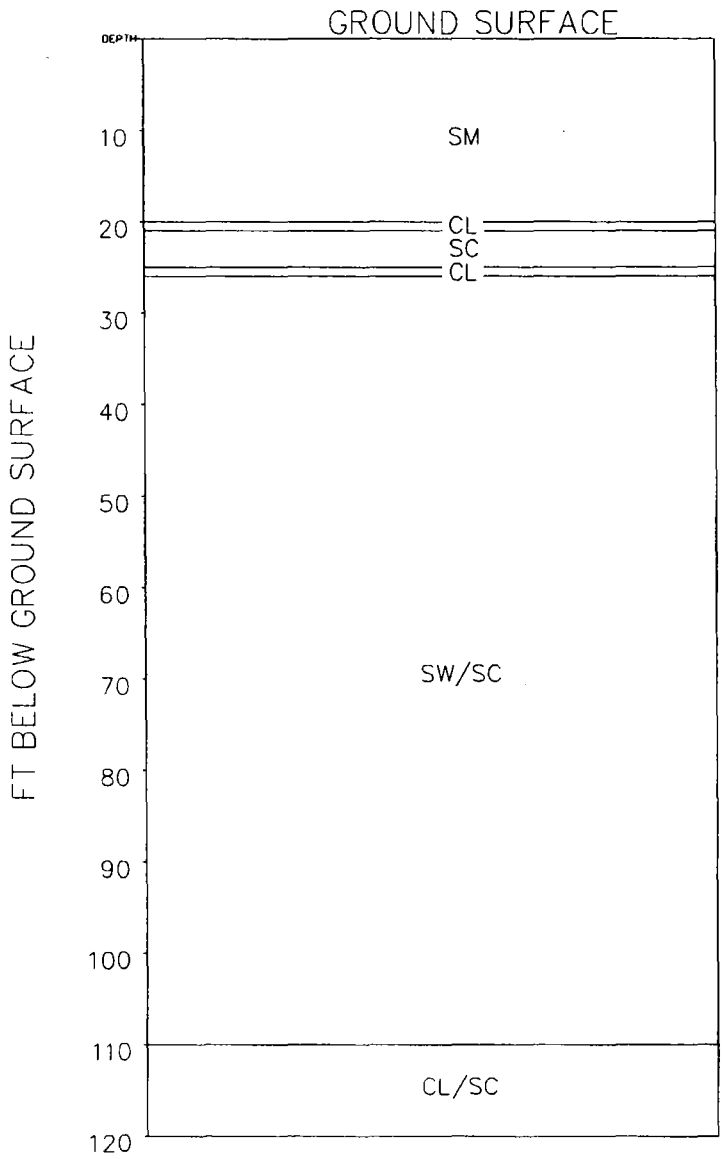
2.2 GROUNDWATER AND AQUIFER CHARACTERISTICS

The depth to groundwater is approximately 100 to 110 ft bls at the site. Groundwater flow in the surficial aquifer is toward the south-southwest. A shallow perched water table (10-15 ft bls) exists in the northeast corner of the site, but does not significantly affect site hydrology. Groundwater flow in the perched zone is to the north-northeast. Table 2-1 presents the monitoring well construction data and groundwater elevations from August 7, 1997 and January 26, 1998. Figure 2-2 presents the groundwater potentiometric surface map from January 26, 1998.

The following aquifer parameter were estimated in the SAR (ABB-ES, 1998).

Hydraulic conductivity	K	=	9.77 ft per day or 3.447×10^{-3} centimeters per second
Hydraulic gradient	i	=	0.009 feet per foot
Seepage Velocity	Vs	=	32.8 ft per year
Porosity	n_e	=	0.25 (unitless)

F:\Projects\NAS Whiting Field\CTO 200\CADD\RAP CADD\lithology



0 20 40
SCALE IN FEET

DRAWN BY LK DATE 4/25/02	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	SITE LITHOLOGY REMEDIAL ACTION PLAN NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2-1 REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

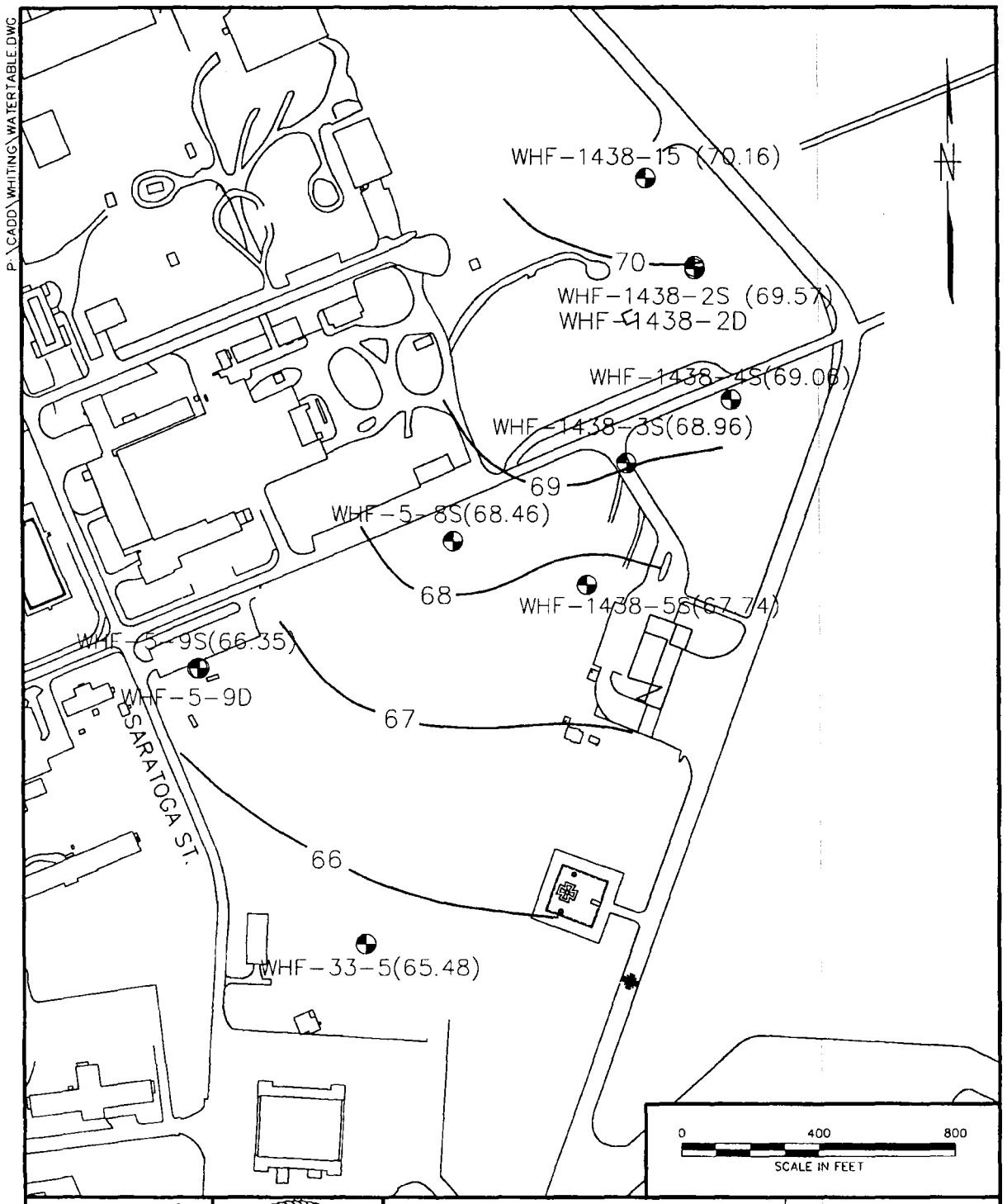
Table 2-1
Water Table Elevation and Monitoring Well Construction Data

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Monitoring Well ID	Screened Interval Depth (ft bls)	Top-of-Casing Elevation (ft)	7-Aug-97		26-Jan-98	
			Depth to Water Below Top-of-Casing (ft)	Water Elevation (ft)	Depth to Water Below Top-of-Casing (ft)	Water Elevation (ft)
WHF-1438-01S	97-112	172.05	100.89	71.16	101.89	70.16
WHF-1438-02S	102-117	174.35	103.93	70.42	104.78	69.57
WHF-1438-02D	148-153	174.44	NI	NI	104.75	69.69
WHF-1438-03S	95-110	175.54	105.98	69.56	106.58	68.96
WHF-1438-04S	100-115	174.17	114.05	60.12	105.11	69.06
WHF-1438-05S	102-117	176.66	NI	NI	108.92	67.74
WHF-1438-06S	101-116	175.01	NI	NI	106.63	68.38
WHF-5-8S	110-125	177.44	108.38	69.06	108.98	68.46
WHF-5-8D	164-174	177.86	109.5	68.36	109.94	67.92
WHF-5-9S	118-128	175.55	109.22	66.33	109.2	66.35
WHF-5-9D	170-180	175.97	109.83	66.14	109.58	66.39
WHF-33-5	110-125	178.39	112.79	65.60	112.91	65.48

Notes:
NI=Not installed at that time

(SAR, 1998)



DRAWN BY LR DATE 4/8/02	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	GROUNDWATER POTENTIOMETRIC MAP REMEDIAL ACTION PLAN NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2-2 REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

2.3 CONTAMINATED SOIL ASSESSMENT

The vertical and horizontal extent of petroleum impacted soil in the vadose zone was assessed through three site assessments (SAs). In 1994 ABB-ES submitted a Preliminary Contamination Assessment (PCA), in 1998 ABB-ES submitted a Site Assessment Report, and in 2000, HLA and Harding ESE each submitted a Supplemental SAR. The following is a summary of results from the site investigations:

- In November 1994, ABB-ES performed a PCA at Site 1438-1439. Soil samples were collected from borings at 25 locations to assess the extent of petroleum contamination. Soil samples were screened with an OVA to a depth of 35 ft bls using direct-push technology. The preliminary assessment indicated that excessively contaminated soil (i.e. >500 ppm) was present from 6 feet bls to a depth greater than 37 ft bls at 10 of the 25 borings installed at Site 1438-1439. During the PCA, soil samples were not analyzed by a fixed-based laboratory, but analyzed by a portable gas chromatograph. The PCA recommended further investigation at the site.

- From April 1997 to January 1998, ABB-ES performed a SA at Site 1428-1439. To assess the vertical and horizontal extent of petroleum contamination, soil samples were collected from 28 borings. Results of the SA indicated OVA headspace readings ranged from 0 ppm to greater than 5000 ppm. Excessively contaminated soil as defined by Chapter 62-770 FAC, was detected in the vicinity of the former locations of Tank 1439, the pump house, the associated fuel lines and several valve pits. Of the soil samples analyzed, two soil samples (07B32A05 and 07B02605) exceeded either Chapter 62-770 FAC leachability target levels and/or SPLP analysis parameters. The SAR recommended a RAP for soil at Site 1438/1439.

- In January 2000, HLA performed a supplemental SA with the installation of 12 additional soil borings. The soil boring and sample locations were chosen based on the results of the previous soil sampling events. Additional soil samples were collected to assess and confirm with laboratory analyses the horizontal and vertical extent of petroleum-contaminated soil in the unsaturated zone, and correlate past and present soil headspace data to laboratory analyses and determine if NFA could be recommended for soils at the site. HLA determined that OVA-FID readings of 1,000 ppm or less correlate to laboratory contaminant concentration of non-detect. OVA-FID readings ranging from 2,000 ppm to greater than 5000 ppm indicate a correlation with extremely low contaminant concentrations. Laboratory samples confirmed that OVA-FID readings of greater than 5,000 ppm indicate minimal contaminant concentrations in which neither residential nor industrial SCTLs are exceeded. OVA-FID readings of approximately 2000 ppm to greater than 5000 ppm indicate concentrations may exceed groundwater leachability criteria. Based on the results of the January 2000 confirmatory sampling event, HLA concluded that the analytical results at all soil-boring

locations were below the residential and industrial soil cleanup target levels (SCTLs). HLA also concluded that benzene, toluene, ethylbenzene, and xylenes were detected above the leachability criteria. The Supplemental SAR recommended, based on the results of data obtained during the assessment, no further action was recommended for soil at Site 1438/1439, and that all leachability exceedances be further investigated under the Site 40, facility wide groundwater investigation program.

- In October 2000, Harding ESE performed a supplemental SA. Harding ESE collected six soil samples for SPLP analysis at the request of the FDEP, to determine if contaminants could potentially leach to the groundwater. On October 2, 2000, Harding ESE advanced three soil borings, 1438SB08A, 1438SB14A, and 1438SB15A, and soil samples were collected at depths of 20, 40, and 60 ft bls. The soil samples collected were analyzed for volatile organic compounds (VOCs) by the SPLP method. The SPLP VOC results at 1438SB14A40, 1438SB15A20, and 1438SB08A40 exhibited detection of benzene, toluene, ethylbenzene, and/or xylenes above the Florida Groundwater Cleanup Target Levels (GCTLs). The Supplemental SAR concluded that based on the results of the October 2000 sampling event, the SPLP analytical results indicate exceedances of GCTLs at Site 1438/1439. The report recommended the preparation of a RAP to address soil contamination above leachability levels at soil borings 1438SB08, 1438SB14, and 1438SB15.

2.4 CONTAMINATED GROUNDWATER ASSESSMENT

This RAP does not address groundwater contamination. Groundwater issues at the site will be addressed under the Site 40, facility-wide groundwater investigation program.

2.5 FREE PRODUCT

According to previous reports, free product was observed when the tanks were demolished in 1985. However, free product was not detected at Site 1438/1439 during site investigation activities.

2.6 PREVIOUS INVESTIGATION CONCLUSIONS AND RECOMMENDATIONS

The results to the various SA conducted at Site 1438/1439 indicate unique site characteristics. The OVA data collected at the site does not correspond to contaminant concentrations which may exceed FDEP SCTLs. As a result, Harding ESE recommended the preparation of a RAP to address soil contamination at the locations where soil contamination presents a leaching potential to groundwater as indicated by the SPLP analysis.

As a result of the site conditions at Site 1438/1439, the soil results were presented to the NAS Whiting Field Partnering Team during preparation of this RAP. The Partnering Team agreed that due to site circumstances the soil remedial area would be relegated to the area of SPLP exceedances. Soil samples were collected during the previous investigations and analyzed for FDEP SPLP criteria exceedances. Table 2-2 summarizes the SPLP analytical results from the confirmatory soil sample analysis and indicates FDEP GCTL exceedances. A soil analyte detection map is provided as Figure 2-3. The extent of soil contamination is defined on Figure 2-4.

Table 2-2
Summary of Soil Sample Analytical Results (SPLP)

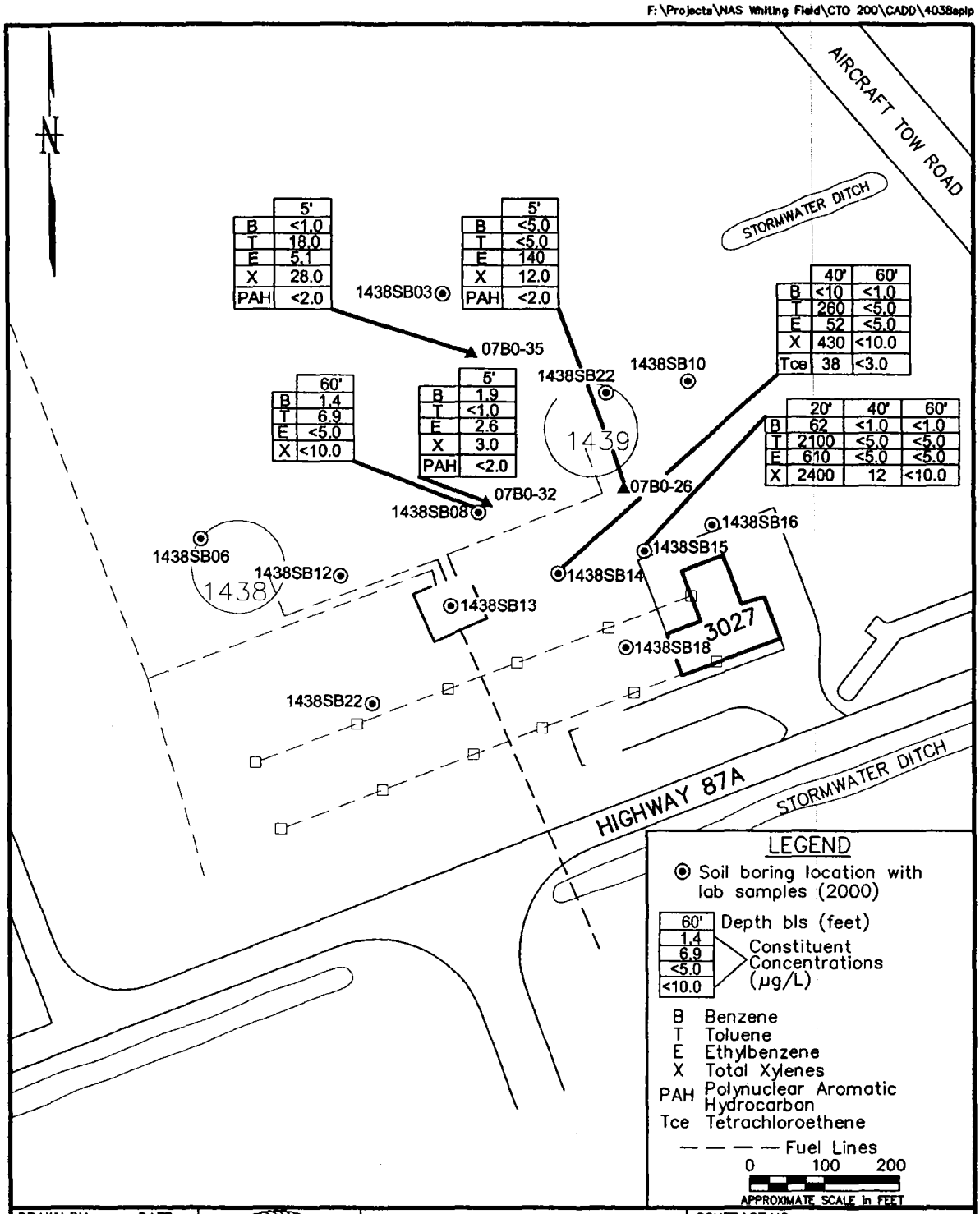
Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Compound	GCTL (µg/L)	Sample Identifier, Boring Designation, and Date Sampled		
		U7B03505 07B035 9/25/97	U7B032A05 07B032 9/26/97	U7B02605 07B026 9/26/97
Benzene	1	<1	**1.9**	**<5**
Ethylbenzene	30	5.1	2.6	**140**
MTBE	35	<1	<1	<5
Toluene	40	18	<1	<5
Total Xylenes	20	**28**	3	12
Total PAH	>0.2	**<2**	**<2**	**<2**
As reported in SAR (ABB-ES, 1998)				

Compound	GCTL (µg/L)	Sample Identifier, Boring Designation, and Date Sampled					
		1438SB08A60 SB08 10/2/00	1438SB14A40 SB14 10/2/00	1438SB14A60 SB14 10/2/00	1438SB15A20 SB15 10/2/00	1438SB15A40 SB15 10/2/00	1438SB15A60 SB15 10/2/00
Benzene	1	**1.4**	**<10**	<1	**62**	<1	<1
Ethylbenzene	30	<5.0	**52**	<5	**610**	<5	<5
Toluene	40	6.9	**260**	<5	**2100**	<5	<5
Total Xylenes	20	<10	**430**	<10	**2400**	12	<10
Tetrachlorethene	3	NR	**38**	<3	NR	NR	NR
Source: Supplemental Assessment Report (Harding ESE, 2000)							

Notes:
µg/L = micrograms per liter
MTBE = Methyl Tert Butyl Ether
PAH = Polynuclear Aromatic Hydrocarbons
NR = Not Reported
BOLD = Exceedances of GCTLs

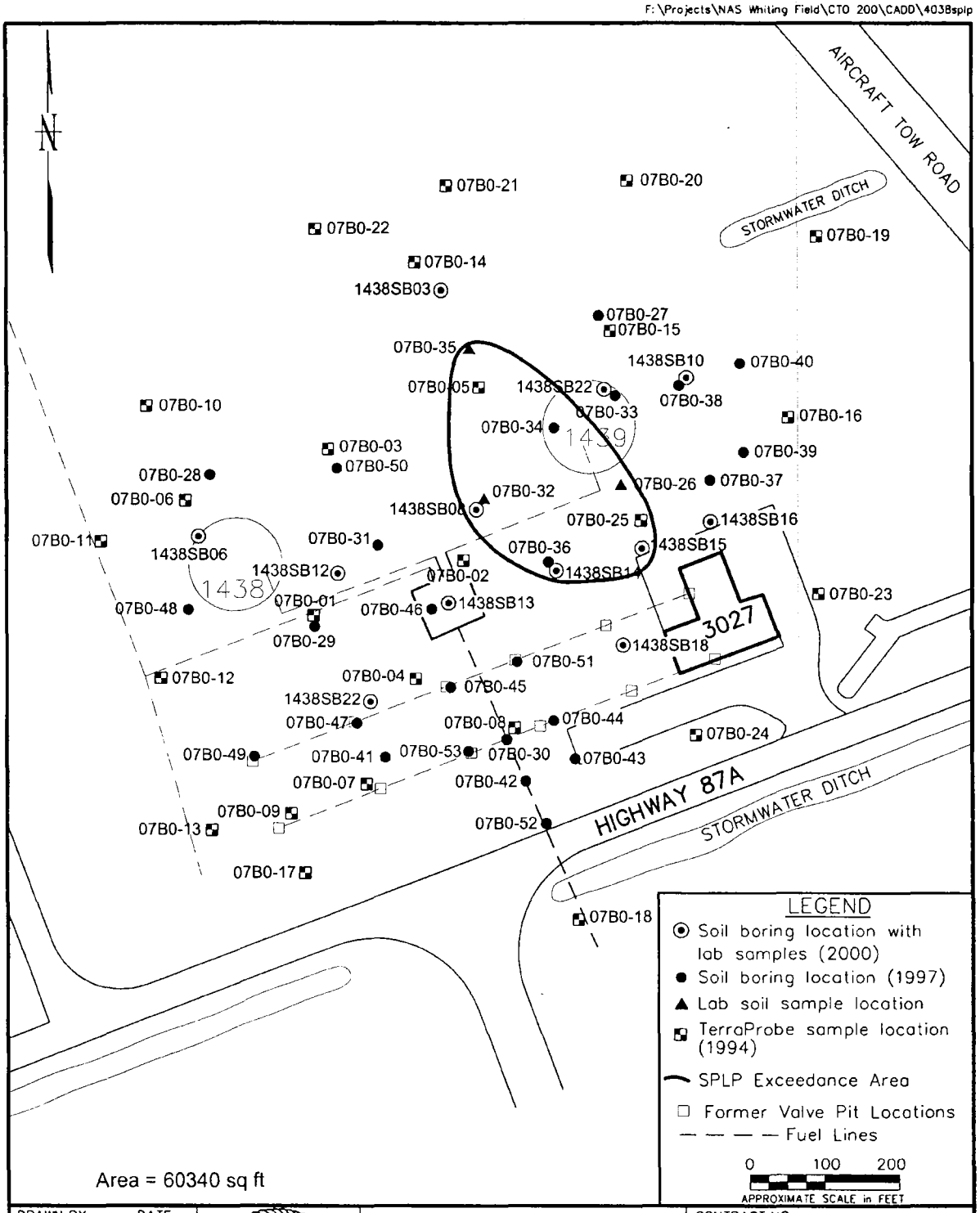
F:\Projects\NAS Whiting Field\CTO 200\CADD\4038aplp



DRAWN BY LLK DATE 4/16/02	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	SOIL ANALYTE DETECTION MAP TANKS 1438 and 1439 REMEDIAL ACTION PLAN NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 2-3 REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

F:\Projects\NAS Whiting Field\CTO 200\CADD\4038splp



DRAWN BY LLK DATE 1/23/02	SPLP EXCEEDANCE AREA REMEDIAL ACTION PLAN TANKS 1438 and 1439 NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038	
CHECKED BY DATE		APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 2-4	REV. 0

FORM CADD NO. SDIV_AV.DWG – REV 0 – 1/20/98

3.0 REMEDIAL ACTION PLAN GOALS

The objective of this RAP is to present a technology relevant and cost-effective to:

- Reduce the petroleum-impacted soil and leaching to groundwater at the site.
- Protect human health and the environment by reducing the concentrations of hydrocarbons detected at the site to target cleanup levels.

The goals and expected accomplishments of the RAP include the following:

- Identify a method to reduce or remove petroleum-impacted soil that exhibits SPLP exceedances.
- Select a remedial alternative that will result in a reduction of the leaching of hydrocarbon constituents to the groundwater matrix.
- Be protective of nearby water bodies.

The target cleanup concentrations for the soil at the subject site are based on analytes detected in the soil in exceedance of Chapter 62-777, FAC. The following subsections list the target levels for the site-specific chemicals of concern (COCs).

3.1 SOIL TARGET LEVELS

SPLP exceedances are based on FDEP Groundwater Cleanup Target Levels. Based on the GCTLs listed in Table V of Chapter 62-777, FAC, Table 3-1 presents the SPLP soil remediation goals for the site-specific COCs.

Table 3-1
Chemicals of Concern and SPLP Associated GCTLs

Site-Specific COCs	Concentrations
Benzene	1 µg/L
Ethylbenzene	30 µg/L
Toluene	40 µg/L
Total Xylenes	20 µg/L
MTBE	35 µg/L
Total PAH	>0.2 µg/L
TCE	3 µg/L

Notes:
Concentrations from GCTLs Table I, 62-777, FAC.
TCE = Tetrachloroethene

4.0 CONTAMINANT DISTRIBUTION

4.1 ESTIMATED MASS OF CONTAMINANTS IN SOIL

Data acquired during the multiple site assessments indicate that soil contamination exists within the vadose zone from land surface to 60 ft bls and the lateral limits of the soil contamination area have been defined as depicted on Figure 2-4. The area of contamination is 60,340 square feet (ft^2). In order to calculate the estimated mass of contamination, a total recoverable petroleum hydrocarbons (TRPH) concentration of 58 milligrams per kilogram was used. This concentration was selected, as it was the highest TRPH concentration detected from the fixed-based laboratory analysis of the soil samples collected. An average TRPH concentration was not used because the average TRPH concentration did not reflect the elevated soil vapor concentrations. Based on this information, the estimated quantity of adsorbed hydrocarbons within the smear zone is 21,732 pounds (lbs). Figure 2-4 defines the area where contaminated soil exceeding SPLP criteria exists. Appendix A presents calculations for the estimated mass of impacted soil. Soil vapor readings and analytical results are included in the previous investigation reports.

5.0 TREATABILITY STUDY

The investigation activities of a Treatability Study (TS) at Site 1438/1439 were conducted to provide additional data for the design of a vadose zone soil remediation system.

5.1 AIR INJECTION WELL AND MONITORING POINT LOCATIONS

The TS at Site 1438/1439 was conducted near the former location of Tank 1439, where the highest soil headspace readings had been reported by previous investigations. The selection of investigation locations was dependent on site conditions, including ease of access and utility locations.

The screened interval and horizontal spacing of the injection wells and monitoring points was based on descriptions of site geology provided in the SAR (ABB-ES, 1998). The shallow zone, from ground surface to approximately 20 ft bls, consists predominately of silty sand. The intermediate zone, from approximately 20 to 30 ft bls, has upper and lower clay horizons with clayey sand between the clay horizons. The deep zone, below 30 ft bls, consists largely of sand and clayey sand units, which extend to approximately 110 ft bls. At 110 ft bls, a clay and clayey sand unit, approximately 10-ft thick, is encountered.

Air injections and monitoring points were screened from 10 to 15 ft bls, near the base of the shallow zone, and from 35 to 40 ft bls, near the top of the deep zone. Horizontal spacing of the monitoring points from the air injection wells was based on the lithology of the screened zone and the depth to the top of the screen. The shallow zone monitoring points were installed at radii of 15, 30, and 60 ft. The deep zone monitoring points were installed at radii of 20, 40, and 60 ft. A depiction of monitoring and injection points including depths and lithologies is included in Appendix B.

5.2 SOIL BORINGS

Soil borings were advanced using a hollow stem auger rig capable of installing 2 inch inside diameter (ID) monitoring wells. The drilling crew hand augered from ground surface to 4 ft bls at each soil boring location to detect underground utilities, if present. Soil samples were collected using 4-ft split spoon soil samplers. Soil samples were screened with an OVA-FID following procedures for headspace analysis specified in Chapter 62-770, FAC. Boring logs and well completion logs are included in Appendix B.

5.3 BACTERIAL ENUMERATION SAMPLES

A soil sample was collected from each monitoring point soil boring for bacterial enumeration analysis. The soil samples were collected from depths correlating to the screened interval of the monitoring point. Soil samples were collected using a 4-ft split spoon sampler and sent to a fixed-based laboratory for analysis.

5.4 AIR INJECTION WELL AND MONITORING POINT INSTALLATION

An air injection well or monitoring point was installed at each soil boring location. The shallow zone air injection well and monitoring points are screened from 10 to 15 ft bls. The deep zone air injection well and monitoring points were screened from 35 to 40 ft bls.

Each of the air injection wells and monitoring points was constructed of 2 inch ID, schedule 80 polyvinyl chloride (PVC) pipe. Each air injection well and monitoring point has a 5-ft length of 0.020-inch slot well screen. The air injection wells and monitoring points are backfilled with 20-30 silica sand filter pack material to a depth 2 ft above the top of the well screen. Two ft of 30-65 fine sand was placed above the top of the filter pack to act as a seal. The remainder of the borings were grouted to ground surface.

5.5 PRE-TEST EMISSIONS SAMPLING

Prior to installation of the air injection equipment, soil vapor samples were collected from each of the six monitoring points installed for the soil permeability test. Each monitoring point was purged using a sampling pump connected to the sampling port on the well head. After the monitoring point was purged, the soil vapor sample was collected in a Tedlar bag connected to the sampling pump. The air emissions samples were sent to an offsite laboratory for analysis. Following sample collection, an organic vapor concentration reading was taken from the sampling port using an OVA-FID. The pre-test sampling was used to determine baseline conditions in the vadose zone at the site.

5.6 SOIL PERMEABILITY TEST

Before the soil permeability tests began, the site was inspected for structures, including monitoring wells, which may act as air conduits during the test. The air injection system was installed and a brief system check was conducted to ensure proper operation of the blower and monitoring equipment. Following the system check, separate soil permeability tests were run for the shallow and deep zones. The soil permeability tests were conducted in accordance with the United States Environmental Protection

Agency (USEPA) Bioventing Principles and Practice Manual (USEPA, 1995). Pertinent portions of the guidance manual are included in Appendix B.

During each soil permeability test, the injection pressure and airflow in the injection was monitored. The pressure changes in each of the monitoring points was measured and recorded.

The shallow zone soil permeability test was run first, to minimize the potential for interference from the deeper zone. The deep zone soil permeability test was run 13 hours after the completion of the shallow test. Each soil permeability test was run until pressure changes at the outermost monitoring point were less than 10 percent over a 1-hour interval.

5.7 POST-TEST EMISSIONS SAMPLING

Immediately following the soil permeability test for each zone, soil vapor samples were collected from the three monitoring points screened in the tested zone. The post-test sampling was used to evaluate the influence of air injection on the soil vapor chemistry in the vadose zone at the site. Each monitoring point was purged using a sampling pump connected to the sampling port on the well head. After the monitoring point was purged, the soil vapor sample was collected in a Tedlar bag connected to the sampling pump. The air emissions samples were sent to an offsite laboratory for analysis. Following sample collection, organic vapor concentration readings were taken from the sampling port.

5.8 TREATABILITY STUDY RESULTS

Results from the permeability test and prior respirosity test results from Site 2894 were used to evaluate potential soil remediation alternatives and design the selected remediation system. The test results give insight into the characteristics of the indigent soil at the site. Radius of Influence (ROI) aids in the determination of the number of injection, extraction, and/or vent wells that will be necessary for each alternative. Soil permeability data is used to develop system specifications, evaluate potential effectiveness, and cost of the system. Respirosity is used to determine the potential effectiveness of bioremediation technologies.

The data gathered from the treatability study was entered into Battelle's Bioventing Design Tool program, and was used to calculate ROI and permeability as follows:

Shallow Zone

ROI = 25 ft

Permeability = 2.96×10^{-2} square centimeters (cm^2)

Deep Zone

ROI = 60 ft

Permeability = 1.08×10^{-3} cm^2

In addition bacterial enumeration samples were collected and analyzed by a laboratory to determine the feasibility of bioremediation. Bacterial enumeration is a measure of colony forming units per gram (CFU/g). A result greater than 1000 CFU/g suggests bioremediation is generally effective. Results less than 1000 CFU/g suggest that bioremediation may be effective, however, the hydrocarbon contamination levels may be toxic to bacteria. In order to account for contamination levels that may be toxic to bacteria, a longer remediation than initially calculated should be used. The following are the results collected during the treatability study:

Shallow Zone

MP_1 @ 11 ft bls = Too numerous to count

MP_2 @ 11 ft bls = 470 CFU/g

MP_3 @ 11 ft bls = 394 CFU/g

Deep Zone

MP_4 @ 36 ft bls = 454 CFU/g

MP_5 @ 36 ft bls = 2880 CFU/g

MP_6 @ 36 ft bls = 12 CFU/g

These results show that bioremediation should be effective at the site, however, an increase in the calculated remediation time should be accounted for. Calculations are presented in Appendix B.

Respirosity tests were performed at nearby Site 2894 for a separate RAP (ABB-ES, 1995). The results from those tests will be used for the purpose of this design. The respirosity test results are used mainly to determine the potential effectiveness of the system design. The tests measure the oxygen utilization rate of the soil zone. Results indicate that bioremediation should be effective at the site. Respirosity results are included in Appendix B.

6.0 REMEDIAL ALTERNATIVE TECHNOLOGY SCREENING

TtNUS conducted a screening of available technologies in order to determine a timely and cost-effective remedial alternative for the subject site. Potential remedial technologies and process options for the soil remediation have been identified and evaluated based on their ability to meet clean-up objectives (effectiveness), applicability based on site conditions, feasibility of implementation, reliability, anticipated duration, and cost.

6.1 EVALUATION OF SOIL TREATMENT ALTERNATIVES

Based on the SAR and following investigation data, a total volume of approximately 60,340 ft^2 of soil exhibits hydrocarbon contamination to a depth of 60 ft, as defined by SPLP exceedances. TtNUS has investigated alternate methods for the removal of hydrocarbons from the soils at the site. The evaluation of alternatives was conducted by analyzing alternatives for the two separate zones of contamination: the shallow zone (0 to 20 ft) and the deep zone (20 to 60 ft). The following actions have been identified for remediation of soil and evaluated in this RAP:

Shallow Zone:

- Excavation and disposal
- SVE
- Active Bioventing

Deep Zone:

- SVE
- Active Bioventing
- Passive Barometric Bioventing

The following sections briefly discuss each of these soil remedial actions with respect to their suitability for implementation at this site.

6.1.1 Excavation and Disposal/Treatment

This alternative consists of the physical removal and off-site treatment and/or disposal of impacted soils with hydrocarbon constituents exceeding the SPLP SCTLs. To complete excavation of impacted soils, removal of soil from the surface to the depth of the shallow zone (approximately 20 ft bls) would be required.

Removal operations can be accomplished with standard and specialized equipment. Following removal and immediate transportation or stockpiling of the impacted soil, samples collected from excavation sidewalls and bottom would be analyzed to confirm achievement of the RAP goals. The excavation would be backfilled with clean fill material and the site would be restored to its original condition. Any soil or other debris generated during excavation would be sampled, characterized, loaded, and transported to an off-site facility for treatment and/or disposal.

In order to complete the excavation and disposal of contaminated soil, certain site conditions must be considered that may affect operation of the remediation process and total cost of the project. For instance, due to the depth of the excavation, a 1-ft horizontal step-out for every 2 ft of vertical excavation is required to provide a slope for safety measures and in accordance with Occupational Health and Safety Administration (OSHA) regulations. When excavating near Building 3027, shoring would be necessary for support as it is too close to the excavation area to allow for a proper OSHA slope.

Estimated costs were based on the conceptual design (including shoring, OSHA slope, etc.). The estimated cost for soil excavation, transportation, off-site treatment/disposal, and site restoration is presented in Table 6-1 and Appendix C, Table C1.

6.1.2 SVE

SVE involves the introduction of a pressure gradient across the soil matrix to extract hydrocarbon vapors and enhance volatilization of adsorbed hydrocarbons. A typical SVE system consists of vapor extraction wells, a vacuum blower, associated piping and safety controls. During SVE operation, a vacuum is applied to extraction wells situated within the vadose zone. As air is forced through the soil pores, soil gas is typically displaced and is drawn to the extraction wells and subsequently above ground via piping for treatment. Extracted vapors are typically treated with an air-phase treatment unit (activated carbon) prior to discharge to the atmosphere. As the process continues, adsorbed and dissolved-phase hydrocarbons remaining in the vadose zone are gradually stripped from the soil matrix. The SVE system can be designed and constructed using explosion-proof equipment.

The SVE system promotes oxygen recharge, which also stimulates existing biological activity in the soil and enhanced aerobic biodegradation. The indigenous soil microbes, present at virtually all hydrocarbon release sites, tend to multiply rapidly in the presence of oxygen, which increases hydrocarbon digestion, and results in an accelerated remediation process.

Table 6-1
Soil Remedial Alternatives Summary

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Alternative	Capital Cost	Annual 0&M	Estimated Years of Operation	Present Worth Total Cost[1]	Recommendation / Conclusion
Shallow Zone					
Excavation and Disposal	$3,883,000	$0	6 months	$3,883,000	Eliminate - Impractical, High Cost
SVE	$146,000	$38,000	2	$223,000	Retain - Cost Effective, Historically Effective for AVGAS
Bioventing	$125,000	$35,000	4	$252,000	Eliminate- Higher Cost than SVE, better for heavier constituents
Deep Zone					
SVE	$138,000	$38,000	2	$215,000	Retain - Cost Effective, Historically Effective for AVGAS
Bioventing	$111,000	$35,000	4	$238,000	Eliminate- Higher Cost than SVE, better for heavier constituents
Barometric Pumping	$131,000	$16,000	14	$280,000	Eliminate- Higher Cost than SVE, long remediation time

Notes:
[1]Present Worth Total Cost also includes work plans and contingency cost not included in capital or annual 0&M costs.

In order to calculate remediation time, Shell's HyperVentilate© SVE design program was used. The program returned remediation times of one year for each zone. However, a factor of safety of two was used and the times were doubled. Therefore, it is estimated that soil remediation may be achieved in approximately two years in the shallow zone and two years in the deep zone (calculations are presented in Appendix D). The estimated costs of SVE implementation in each zone with two years of O&M are presented in Table 6-1 and Appendix C, Tables C2 and C3.

6.1.3 Active Bioventing

Bioventing is an in-situ remediation technology that uses indigenous microorganisms to biodegrade organic constituents adsorbed to soils in the unsaturated zone. In bioventing, the activity of the indigenous bacteria is enhanced by inducing air (or oxygen) flow into the unsaturated zone (using extraction or injection wells) and, if necessary by adding nutrients (USEPA, 1995).

When extraction wells are used for bioventing, the process is similar to SVE. However, while SVE removes constituents primarily through volatilization, bioventing systems promote biodegradation of constituents (generally by using lower airflow rates than for SVE). All aerobically biodegradable constituents can be treated by bioventing. In particular, bioventing has proven to be very effective in remediating releases of petroleum products including gasoline, jet fuels, kerosene, and diesel fuel. Bioventing is most often used at sites with mid-weight petroleum products (i.e., diesel fuel and jet fuel), because lighter products (i.e., gasoline) tend to volatilize readily and can be removed rapidly using SVE. Heavier products (e.g. fuel oils) generally take longer to biodegrade than the lighter products (USEPA, 1995).

For conceptual design and costing purposes, TtNUS calculated estimated remediation time for the shallow and deep-zone active bioventing systems; however, the results were inordinately low. Based on past experience, TtNUS has found that most bioventing systems require approximately twice as much time to remediate sites as SVE systems. Hence, it was estimated that the necessary remediation times are four years for the shallow zone and four years for the deep zone. The calculations are presented in Appendix D. The estimated costs of bioventing implementation in each zone with four years of O&M are presented in Table 6-1 and Appendix C, Tables C4 and C5.

6.1.4 Passive Barometric Bioventing

Passive barometric bioventing, or barometric pumping, uses the same principles as active bioventing without using a blower. Barometric pumping is an in-situ remediation method in which wells are installed and screened at distinct areas of the vadose zone and left open to the atmosphere. These wells allow

pressure gradients, caused by short-term diurnal changes and long-term weather front changes, to inject and extract air from the vadose zone. This movement of air through the vadose zone encourages natural biological processes to break down organic contaminants in the area of the systems influence. Locations with deep vadose zones (greater than 100 ft) are most effective with passive bioventing as they offer greater pressure gradients than those with shallow zones.

There are two types of barometric pumping wells that, when used in conjunction, create the necessary conditions for passive bioventing. The first type of well is a vapor extraction well, which has a check valve that allows only movement of vapor from the vadose zone to the atmosphere. These wells are installed in the source area to relieve pressure and soil gases from the area. The other type of well is an air injection well. Air injection wells are mounted with a check valve that allows atmospheric air to move into the vadose zone. These wells are installed around the perimeter of the contaminant area and supply air for bioremediation.

The relatively simple construction of a passive bioventing system leads to lower installation O&M costs. In addition, the lack of a blower or other electrical equipment eliminates the need to bring power to the remediation site. However, remediation times may increase based on the passive nature of the system.

In order to estimate remediation time, it was assumed that an average flow rate of 0.25 cubic feet per minute (cfm) would occur at each injection well for average time of eight hours per day. Based on this assumption, it is estimated that soil remediation may be achieved in approximately fourteen years (calculations are presented in Appendix D). An estimated cost of Passive Bioventing implementation with fourteen years of O&M is presented in Table 6-1 and Appendix C, Table C6.

6.2 COST COMPARISON AND RATIONALE FOR SELECTION

Based on a review of the advantages, disadvantages, and costs, TtNUS recommends SVE for the shallow zone and the deep zone remedial alternative.

For the remediation of both zones SVE has been chosen as it was calculated to be a timely and cost-effective remedial alternative. Excavation and disposal was deemed impractical, as it is cost-prohibitive. Active bioventing was not chosen due to the higher costs and longer remediation times than SVE. Also, the nature of the contamination (AVGAS) is to volatize rapidly which indicates that SVE would be more effective than bioventing. Based on the number of passive barometric bioventing wells necessary to remediate the area, the capital cost is similar to that of SVE. Also, even though barometric pumping has a lower annual O&M cost the length of remediation causes the overall cost to surpass that of SVE.

7.0 REMEDIAL SYSTEM DESIGN

The preferred remedial alternatives presented in this RAP were selected based on being timely and cost-effective methods for treatment of hydrocarbons within the vadose zone. The potential remedial technologies and process options for soil remediation were identified and screened, and the results were presented in Section 6.0. The selected alternative is SVE for both zones of contamination.

7.1 BASEWIDE BUILDING CODES

NAS Whiting Field has standards for construction at the base. All system enclosures built on-site shall conform to all NAS Whiting Field requirements.

7.2 SVE SYSTEM DESIGN DETAILS

Based on the soil contamination area and the estimated 25-ft ROI from the TS, 34 soil vapor extraction wells are proposed to remediate the soil in the shallow zone. The deep zone shall require seven vapor extraction wells based on a 60-ft ROI. The locations of the proposed SVE wells are presented on Figures 7-1 and 7-2 respectively.

Major components of SVE include the following:

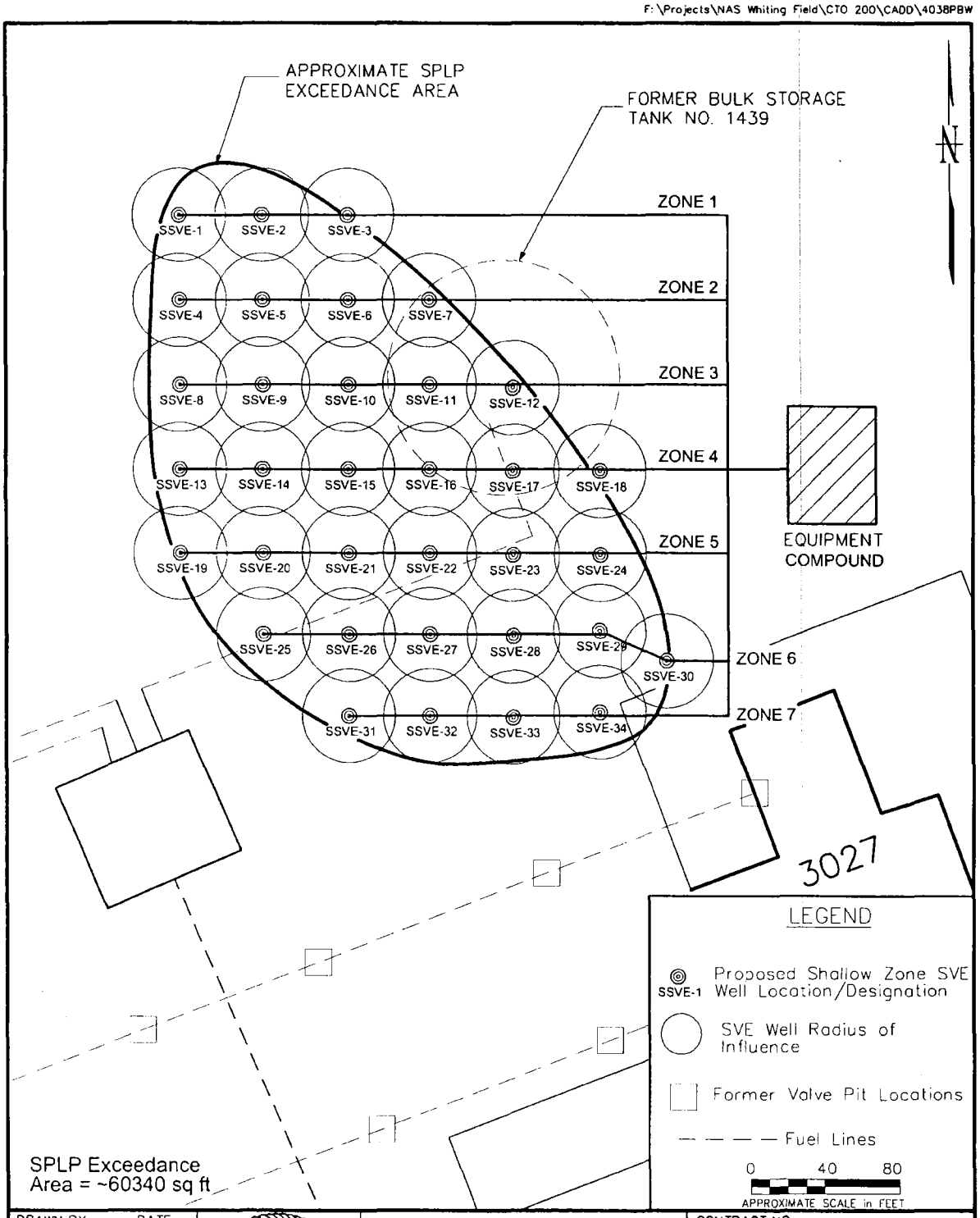
- SVE well installation
- Piping network
- Vapor extraction system

7.2.1 SVE Well Installation

Thirty-four SVE wells will be installed to a depth of approximately 20 ft bls at the locations depicted on Figure 7-1. This depth was chosen as the SAR reported a clay layer at 20 ft bls. The wells shall be installed via hollow stem auger. The well casings will be constructed of 2-inch diameter schedule 40 PVC pipe, with 2-inch diameter schedule 40, 0.010-inch slot PVC screen from 5 to 20 ft bls.

Seven deep zone SVE wells will be installed to a depth of approximately 60 ft bls at the locations depicted on Figure 7-2. The wells shall be installed via hollow stem auger or mud rotary drilling. The well casings will be constructed of 2-inch diameter schedule 40 PVC pipe, with 2-inch diameter schedule 40, 0.010 inch slot PVC screen from 20 to 60 ft bls. Construction details for the SVE wells are presented in Table 7-1.

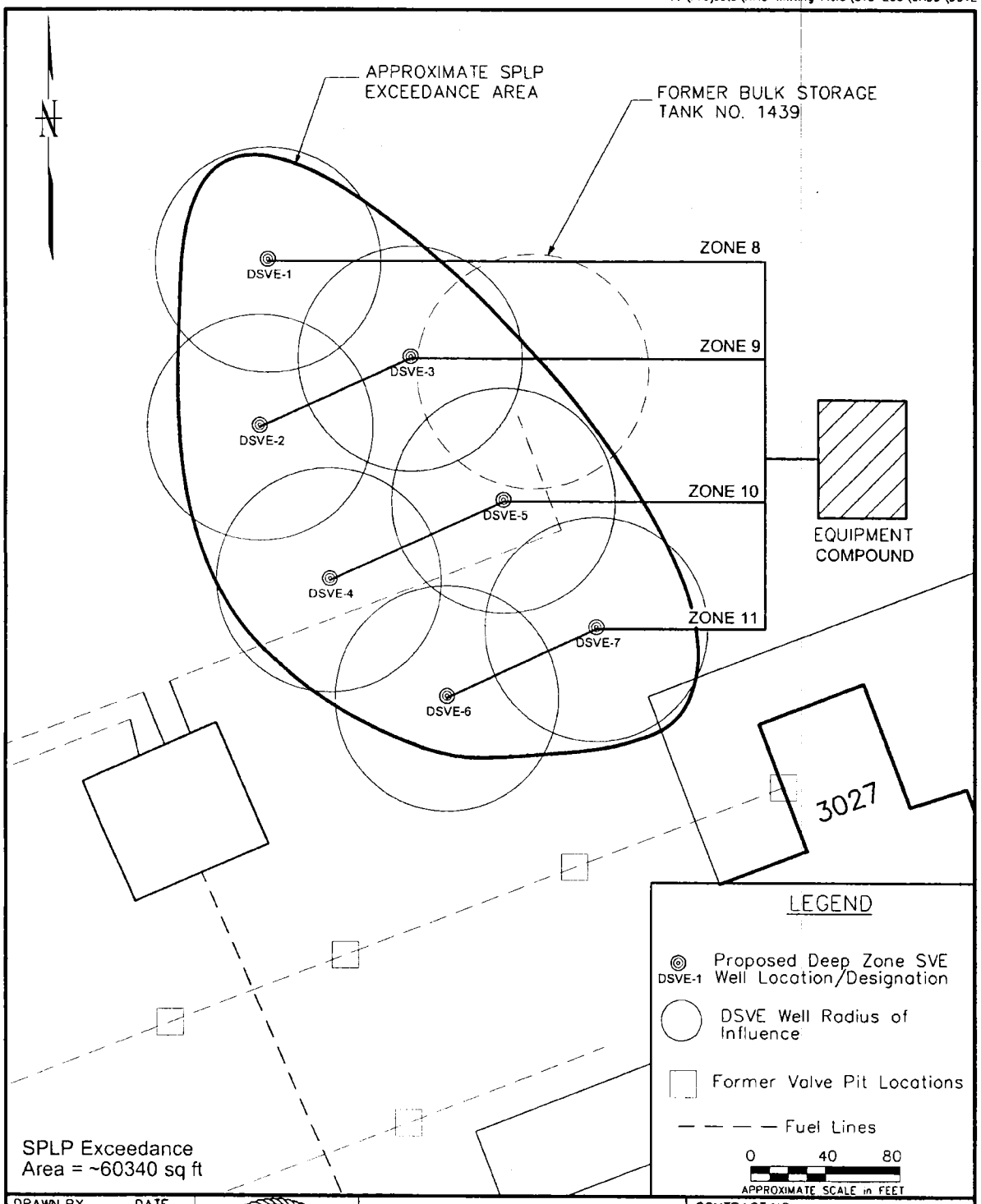
F:\Projects\NAS Whiting Field\CTO 200\CADD\4038PBW



DRAWN BY LLK DATE 1/23/02	PROPOSED SHALLOW ZONE SVE WELL LOCATIONS TANKS 1438 and 1439 NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038	
CHECKED BY DATE		APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 7-1	REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

F:\Projects\NAS Whiting Field\CTO 200\CADD\DSVE



DRAWN BY LLK DATE 1/23/02	PROPOSED DEEP ZONE SVE WELL LOCATIONS TANKS 1438 and 1439 NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038	
CHECKED BY DATE		APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 7-2	REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

Table 7-1
SVE Well Construction Details

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

SVE Well ID	Total Depth (ft bls)	Screen Interval (ft bls)	SVE Well ID	Total Depth (ft bls)	Screen Interval (ft bls)
SSVE-1	20	5-20	SSVE-21	20	5-20
SSVE-2	20	5-20	SSVE-22	20	5-20
SSVE-3	20	5-20	SSVE-23	20	5-20
SSVE-4	20	5-20	SSVE-24	20	5-20
SSVE-5	20	5-20	SSVE-25	20	5-20
SSVE-6	20	5-20	SSVE-26	20	5-20
SSVE-7	20	5-20	SSVE-27	20	5-20
SSVE-8	20	5-20	SSVE-28	20	5-20
SSVE-9	20	5-20	SSVE-29	20	5-20
SSVE-10	20	5-20	SSVE-30	20	5-20
SSVE-11	20	5-20	SSVE-31	20	5-20
SSVE-12	20	5-20	SSVE-32	20	5-20
SSVE-13	20	5-20	SSVE-33	20	5-20
SSVE-14	20	5-20	SSVE-34	20	5-20
SSVE-15	20	5-20	DSVE-1	60	30-60
SSVE-16	20	5-20	DSVE-2	60	30-60
SSVE-17	20	5-20	DSVE-3	60	30-60
SSVE-18	20	5-20	DSVE-4	60	30-60
SSVE-19	20	5-20	DSVE-5	60	30-60
SSVE-20	20	5-20	DSVE-6	60	30-60
			DSVE -7	60	30-60

Notes:
ID = Identification
SSVE = Shallow Soil Vapor Extraction Well
DSVE = Deep Soil Vapor Extraction Well

7.2.2 Piping Network

The PVC wells will be used to remove soil vapors by connecting it to a vapor extraction system via 2-inch PVC piping. The construction details for the SVE wells are provided as Figure 7-3 (shallow) and Figure 7-4 (deep). The piping will run to a manifold, which will be attached to the SVE system.

7.2.3 Vapor Extraction Blower

The SVE system is designed to extract soil vapor at a rate of approximately 10 cfm per well. Hence, the blower selected for this system should be capable of extracting a minimum of 410 cfm. Vacuum extraction pressures of 100 inches of water in the shallow zone and 3 inches of water in the deep zone have been selected to overcome the head losses and provide an extraction flow rate at the blower of 410 cfm. Valves shall be included in the SVE system that will regulate the vacuum pressure from the deep wells to control flow rate. The vapor extraction blower should be designed for continuous industrial service delivering clean air, free of oils or any other debris.

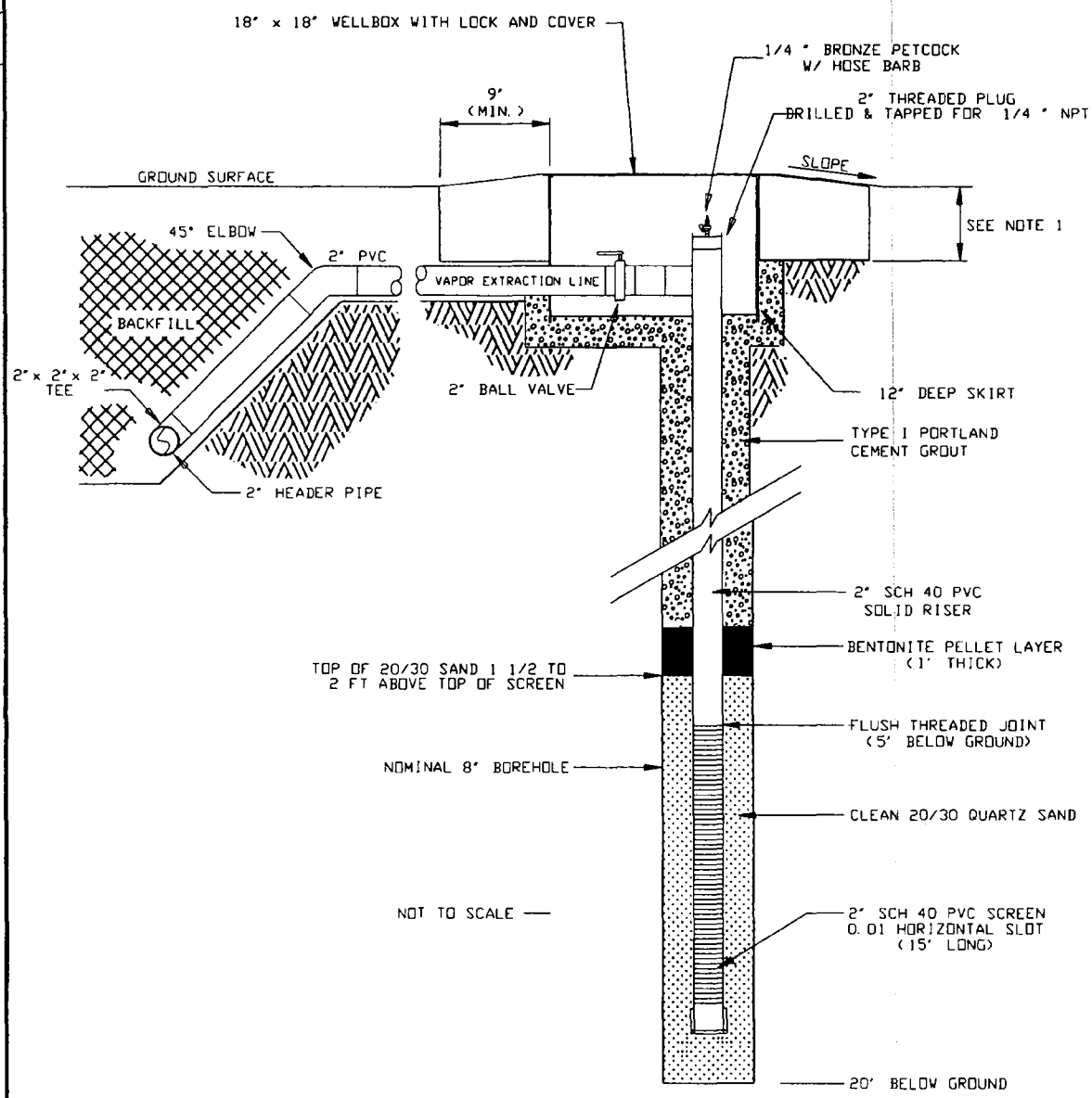
For conceptual design purposes, a quote was obtained from Carbonair for a skid mounted SVE system. The system includes the following:

- 410 standard cfm (scfm), 100" water column vacuum, Roots Model 59 URAI PD blower
- 15 horsepower (hp), 230/460 Volt, 3 phase, XP motor
- 100 gallon moisture separator
- Inlet filter
- High level alarm and pump operation switches
- Vacuum relief valve
- Discharge pressure gauge
- Discharge temperature gauge
- Air flow meter
- 5 gallons per minute, ¾ hp, 230 V, 3 phase, XP motor, Myers CT centrifugal transfer pump
- National Electrical Manufacturers Association (NEMA) 4 control panel with alarms, control logic, Hand-On-Auto (HOA) switches, and motor starters.

The moisture separator, or knockout tank, will be installed in line prior to the vacuum unit to separate and contain entrained liquids. The separator will include a back-up automatic shutoff valve for controlling airflow when a critical high water level is reached within the containment reservoir. The moisture separator will have a centrifugal transfer pump to transfer water to a separate storage tank.

P:\CADD\Whiting\mwelldetail.dwg

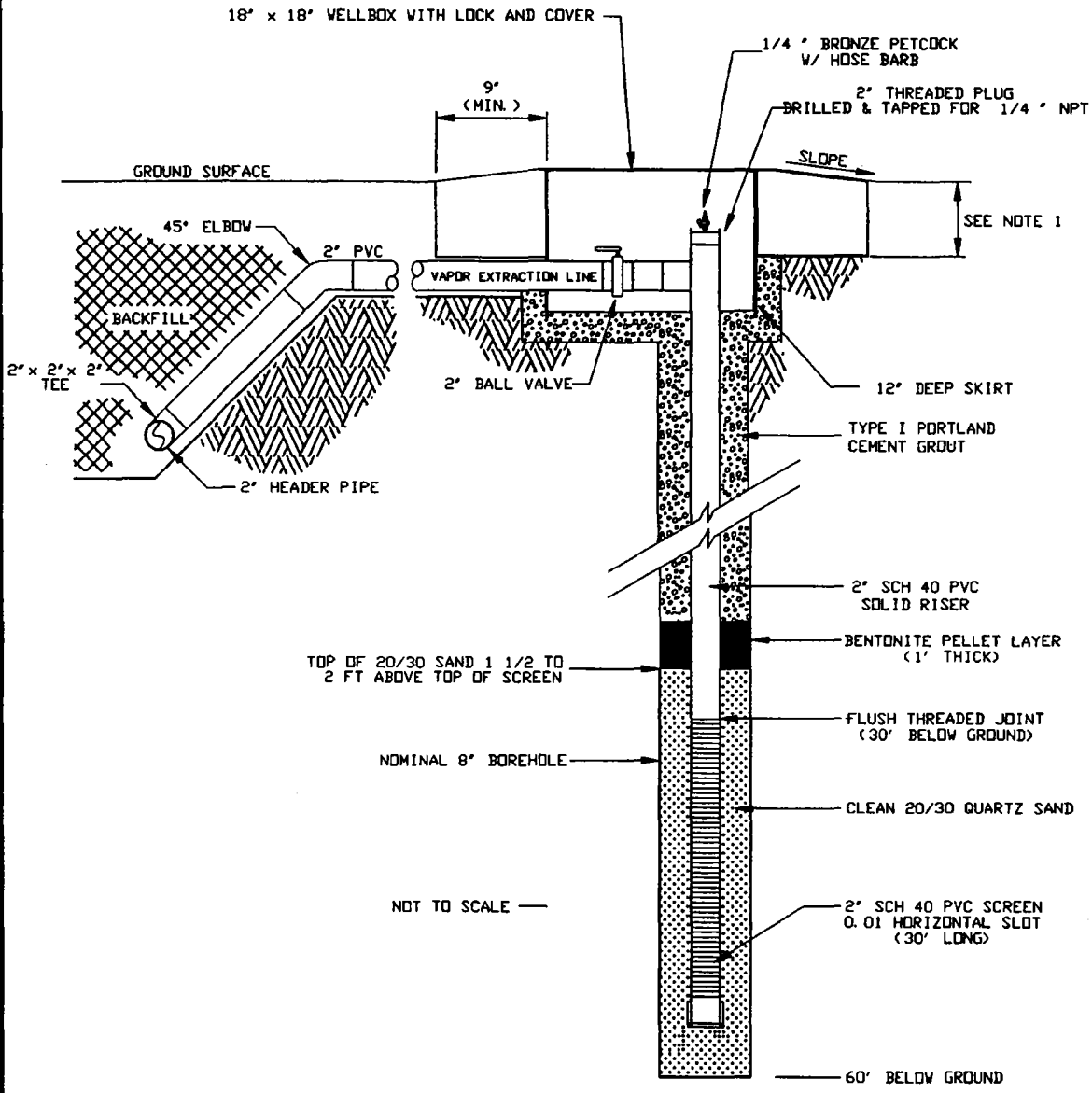
NOTE:
1) CONCRETE THICKNESS SHALL BE DETERMINED BY THE ENGINEERING REPRESENTATIVE.



DRAWN BY LR DATE 4/8/02	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD	SHALLOW SVE WELL CONSTRUCTION DETAIL REMEDIAL ACTION PLAN NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. 7-3 REV. 0

P:\CADD\Whiting\DMWelldetail.dwg

NOTE:
1) CONCRETE THICKNESS SHALL BE DETERMINED BY THE ENGINEERING REPRESENTATIVE.



DRAWN BY LR DATE 4/8/02	DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMMAND	DEEP SVE WELL CONSTRUCTION DETAIL REMEDIAL ACTION PLAN NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. 7-4 REV. 0

7.2.4 System Equipment and Controls

The vapor extraction system will be skid mounted and equipped with pressure and vacuum gauges, adjustable pressure relief valves, a flow meter, and a thermometer. The blower will be explosion proof and will be operated by a control panel located on the skid.

The control panel will cause a shutdown of the blower if any of the following occur:

- The thermometer on the blower reads temperatures at or higher than those set by the blower manufacturer.
- A critical high water level is reached in the knockout tank.
- A critical high water level is reached in the condensate storage tank.
- In case of a shut off, the system will be serviced and the blower manually restarted.

Further descriptions of the equipment and controls are included in the quote attached as Appendix E. Figure 7-5 includes process and instrumentation diagrams for the system.

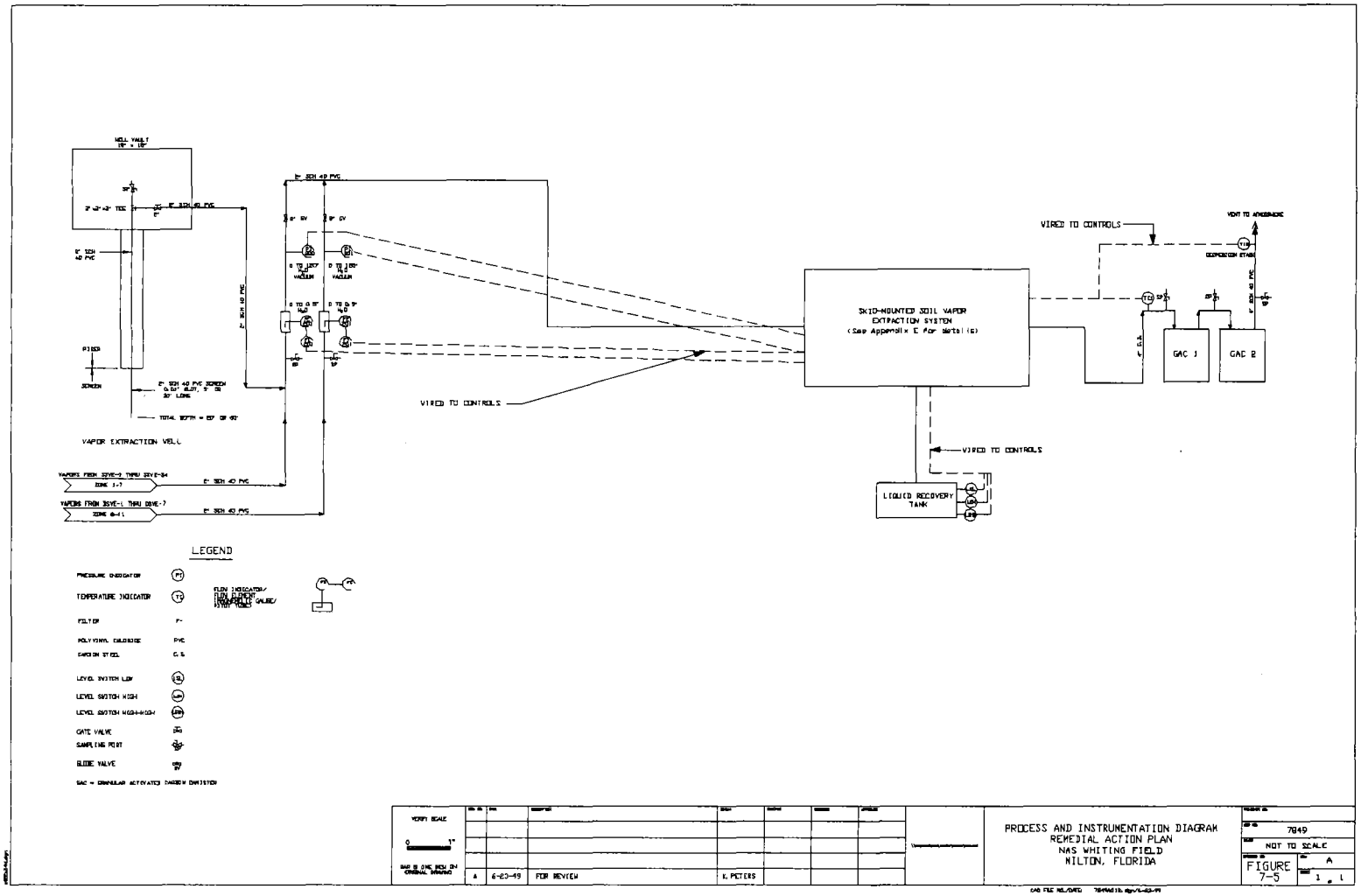
7.3 OFF-GAS TREATMENT

Soil vapor recovered from the vadose zone may also need to be treated. If the system extracts more than 13.7 lbs per day of hydrocarbon vapors, it must be treated per Chapter 62-770, FAC. The exhaust vapor will be treated using granular activated carbon (GAC) filters. Vapors at the effluent port of the SVE system will be treated before atmospheric discharge using two 2,000-lb GAC vessels that will remove the volatile organic hydrocarbon compounds. After the first 30 days of operation, the amount of hydrocarbon exhaust will be re-measured. If the emissions are below action levels, the use of the GAC filters can be discontinued.

7.4 ELECTRICAL AND CONTROLS

7.4.1 Control Panel

Based on the operations nearby the site, it is assumed that electrical power is available to the area, and a power drop shall be installed to provide electrical power to the SVE system. This may require a power pole installed adjacent to the system, pending a recommendation by the Navy on utility connection.


WELL VAULT
VAPOR EXTRACTION WELL
SKID-MOUNTED SOIL VAPOR EXTRACTION SYSTEM (See Appendix E for details)
VIRED TO CONTROLS
VENT TO ATMOSPHERE
GAC 1
GAC 2
LIQUID RECOVERY TANK
LEGEND
PRESSURE INDICATOR
TEMPERATURE INDICATOR
FILTER
POLYVINYL CHLORIDE
CARBON STEEL
LEVEL SWITCH LOW
LEVEL SWITCH HIGH
LEVEL SWITCH HIGH-HIGH
GATE VALVE
SAMPLING POINT
GLOBE VALVE
GAC = GRANULAR ACTIVATED CARBON EMISSION
PROCESS AND INSTRUMENTATION DIAGRAM
REMEDIAL ACTION PLAN
NAS WHITING FIELD
MILTON, FLORIDA
7849
NOT TO SCALE
FIGURE 7-5
A
6-23-99
FOR REVIEW
K. PETERS

There shall be a power drop provided for the SVE system with a 240-volt, two-pole, 100-amp breaker in a weatherproof box. A telephone service connection box is also recommended although not required.

There will be a single field-mounted control panel for the SVE system. There will be a single "ON" switch with additional subsystem control switches and individual HOA switches for individual motors. When in "ON" position, all devices which are equipped with HOA switches will operate when their switch is in the "HAND" position and will be enabled when their switch is in the "AUTO" position.

The control panel will be designed and fabricated to receive three-phase, 240-voltage alternating current (VAC) as well as 120 VAC and 240 VAC single-phase power from a breaker panel. Individual power sources (circuit breakers) for each load will be provided in the power panel, to be wired directly to the individual motor starters. The control panel will be designed to properly operate system electrical equipment. The control panel will contain all relays, motor starters, terminal blocks, transformers, and other components necessary for operation of the electrical equipment. The panel will be pre-wired and fabricated in accordance with the National Electric Code and will utilize readily available electrical components.

The control panel will contain motor starters with thermal overload and overcurrent protection, automatic reset, HOA switches, and on/off control logic for the blower. The panel will also contain all relays, terminal blocks, and other components necessary for automatic operation of the SVE system. All alarm circuits will be equipped with indicator lights at the control panel to serve as "first out enunciators" when alarm conditions occur.

The electrical control panel will be located outside, therefore a NEMA 4 external flange mounted enclosure surrounding a NEMA 1 enclosure that is complete with externally-mounted pump hour meters, HOA pump switches, reset button, and high liquid level indicator lights will be required. The NEMA 4 enclosure will have a locking cover for controlled access.

8.0 OPERATION & MAINTENANCE AND MONITORING

The following sections establish procedures for the start-up of the system, O&M of the remediation equipment, monitoring of the operating parameters, and final system deactivation.

8.1 SVE SYSTEM START-UP

Following the final design, installation, final inspection, and acceptance by the Navy, the system will be set for initial start-up. Prior to start-up, the SVE wells in the area will be surveyed in reference to elevation to establish a baseline top of casing elevation for each remedial well.

8.2 DOCUMENTATION

An SVE operation manual and maintenance plans will be provided at the time of system installation and start-ups. The plans will provide all necessary information for the proper O&M of the systems and maintenance of the product monitoring and recovery plans. The plans will include at a minimum the following:

- System start-up instructions.
- System shutdown instructions.
- Electrical controls and wiring diagram.
- System "as-built" drawings.
- Equipment manufacturers' product operation manuals for each piece of equipment.
- Equipment warranty and guarantee information.
- Equipment service and repair vendor information.
- System troubleshooting guide.
- Equipment and system maintenance schedule and checklist.
- Material safety data sheets for materials used or being stored.
- Monitoring schedule, including sample frequency, sampling locations, required analyses, parameters for field measurements, vapor monitoring requirements, and vacuum measurement requirements.
- Instructions for maintaining a site activity log.

The operation manuals and maintenance plans will be assembled and bound in a manner suitable for use in the field.

8.3 MONITORING SOIL REMEDIATION PROGRESS

On a weekly basis, for the first three months and a monthly basis for the remainder of the first year of operation, vapor extraction emissions will be monitored for volatile organic hydrocarbons using a FID. Vapor monitoring will be performed on the soil vapor airstream before treatment and following carbon treatment, so that GAC filters can be changed before system breakthrough. The monitoring plan for the remaining term of the remediation will be based on an evaluation of the first three months of data collected on the operation of the systems.

The air emissions after controls (after GAC treatment) will be monitored to meet the requirements of Chapter 62-770, FAC. Samples will be collected in a Tedlar bag and analyzed by USEPA Method TO 14 to determine total VOC concentrations in the discharge.

The monitoring data will be used to determine if the objectives of the RAP and standards of the design criteria are being met. The remedial system will be modified if the monitoring data indicates that the cleanup goals cannot be met in the time frame as specified in the RAP. Modifications of the remedial system will be based on the site-specific monitoring data.

8.4 SYSTEM O&M

The proposed remedial systems are designed to operate automatically with minimal maintenance. Site visits for system inspection and maintenance will be performed by a trained and qualified technician and will be performed in conjunction with system monitoring to reduce costs.

The following O&M items are scheduled to be performed weekly for the first month and monthly thereafter:

- Maintain good housekeeping measures for the entire remediation system compound, picking up trash and cutting weeds as necessary.
- Log all inspection activities and repairs performed.

8.5 STATUS REPORTS

During the implementation and operation of the remedial systems described in this RAP, quarterly status reports will be prepared and submitted to Navy. The reports will summarize all remedial activities and will contain at a minimum the following information:

- Startup date.
- Recent groundwater contour maps.
- A graph of cumulative mass degraded versus operation time.
- Summary of system operational data.
- Conclusions as to the effectiveness of the remedial systems, and recommendations on future monitoring and operations of the systems.

8.6 SYSTEM DEACTIVATION

The following criteria must be met for the active remediation to be deemed complete and prior to deactivation of the SVE system:

- Soil effluent vapor samples contain no detectable constituents.

After the SVE system meets the above criteria, the system will be deactivated. The following steps will be followed during system deactivation:

- Deactivate the vapor extraction blower and allow it to cool down.
- De-energize the control panel via the service disconnect.
- Piping and recovery wells will remain on site until after the post-closure monitoring verifies that the site has been properly remediated, at which point they will be removed from the site as directed by the Navy.

Following system deactivation, a Post Active Remediation Monitoring Plan must be developed for the site and approved by the FDEP. The contents of this plan are included in Chapter 62-770.750, FAC. This monitoring will occur for a minimum of one year.

9.0 REMEDIAL ACTION PLAN SUMMARY

The Remedial Action Plan Summary checklist is included in Appendix F.

REFERENCES

ABB-ES (ABB Environmental Services, Inc.), 1995. *Remedial Action Plan Site 2894,* Naval Air Station Whiting Field, Milton, Florida.

ABB-ES (ABB Environmental Services, Inc.), 1998. *Site Assessment Report Site 1438-1439,* Naval Air Station Whiting Field, Milton, Florida.

Harding ESE, 2000. *Supplemental Assessment Report, Site 1438/1439*, Naval Air Station Whiting Field, Milton, Florida. December.

HLA (Haring Lawson Associates), 2000. *Letter Report, Supplemental Assessment Results, Site 1438/1439*, Naval Air Station Whiting Field, Milton, Florida. April.

TtNUS (Tetra Tech NUS, Inc.), 2001. *Work Plan for Pre-design Data Collection, Site 1438/1439 and Semi-Annual Monitoring, Site 2894*, Naval Air Station Whiting Field, Milton, Florida. August.

USEPA (United States Environmental Protection Agency), 1995. *Bioventing Principles and Practices Manual*, EPA/540/R-95/534a. September.

APPENDIX A

CONTAMINANT MASS CALCULATIONS

Table A1
Estimated Volume of Contaminated Area

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Volume Estimate For Shallow Zone SPLP Exceedances Area (from 0 to 20 feet bls)

Area which Exceeded SPLP Analysis	Area[1]	ft^2	Volume[2]	ft^3
Estimated Impacted Area from 0 to 20 ft bls	60,340	ft^2	1,206,800	ft^3
			44696.296	yd^3

Volume Estimate For SPLP Exceedances Area (from 20 to 60 feet bls)

Area which Exceeded SPLP Analysis	Area[1]	ft^2	Volume[3]	ft^3
Estimated Impacted Area from 20 to 60 ft bls	60,340	ft^2	2,413,600	ft^3
			89392.593	yd^3

[1] From fixed laboratory analysis of soil samples which exceeded SPLP analysis, SB08A, SB14A, SB15A, 07B035, 07B032, and 07B026 (See Figure 2-4, SPLP exceedance area)
[2]Volume calculated by multiplying impacted area by 20 ft (from 0 to 20 ft bls).
[3]Volume calculated by multiplying impacted area by 40 ft (from 20 to 60 ft bls).

Prepared By_____ Checked By_____
Date

Table A2
Estimated Mass of Contaminants in SPLP Exceedance Area

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

	Shallow Zone		Deep Zone	
INPUT:				
Estimated Impacted Volume[1]	1,206,800 ft^3	34172 m^3	2,413,600 ft^3	68345 m^3
Average TRPH Concentration	58.0 mg/kg		58.0 mg/kg	
CALCULATIONS:				
Estimated Mass of Impacted Unsaturated Soil[2]	62,575 tons	56767872 kg	125,150 tons	113535744 kg
Estimated Mass of Hydrocarbons in Soil[3]	7244 lbs	3293 kg	14488 lbs	6585 kg

NOTES:

TRPH - Total recoverable petroleum hydrocarbons
mg/kg - milligrams per kilogram
ft^2 - square feet
ft^3 - cubic feet
lbs - pounds
m^3 - cubic meters

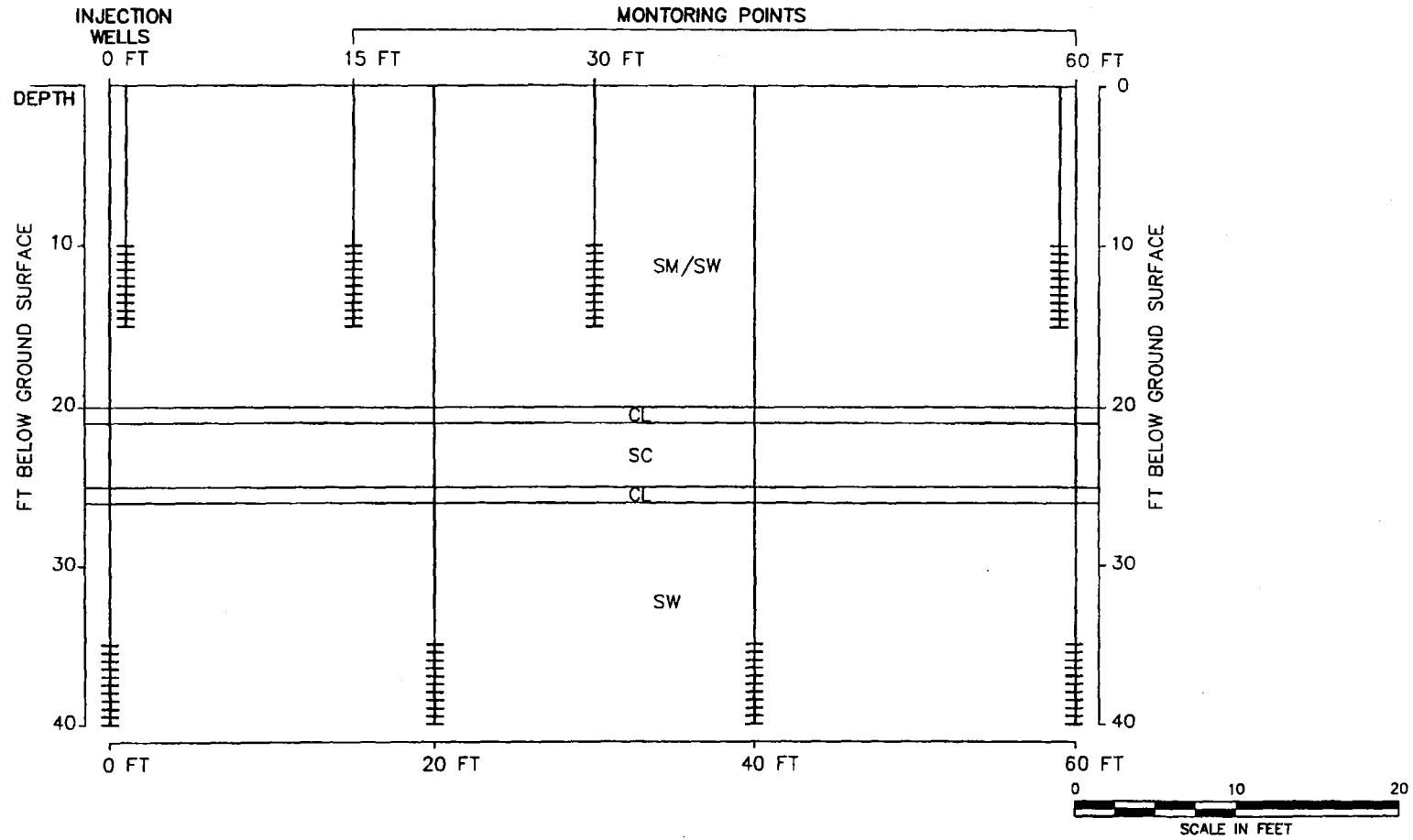
[1]From Table C-1
[2]Estimated Mass of Impacted Unsaturated Soil = impacted volume (ft^3) x (1 yd^3/27 ft^3) x (1.4 tons/1 yd^3) x (907.2 kg/ton)
[3]Estimated mass of hydrocarbons = hydrocarbon concentration (mg/kg) x impacted volume (ft^3) (1 yd^3/27 ft^3) x (1.4 tons/1 yd^3) x (907.2 kg/ton) x (kg/10^6 mg) x (2.2 lb/kg)

Prepared By _____ Checked By _____
Date

APPENDIX B

TREATABILITY STUDY INFORMATION

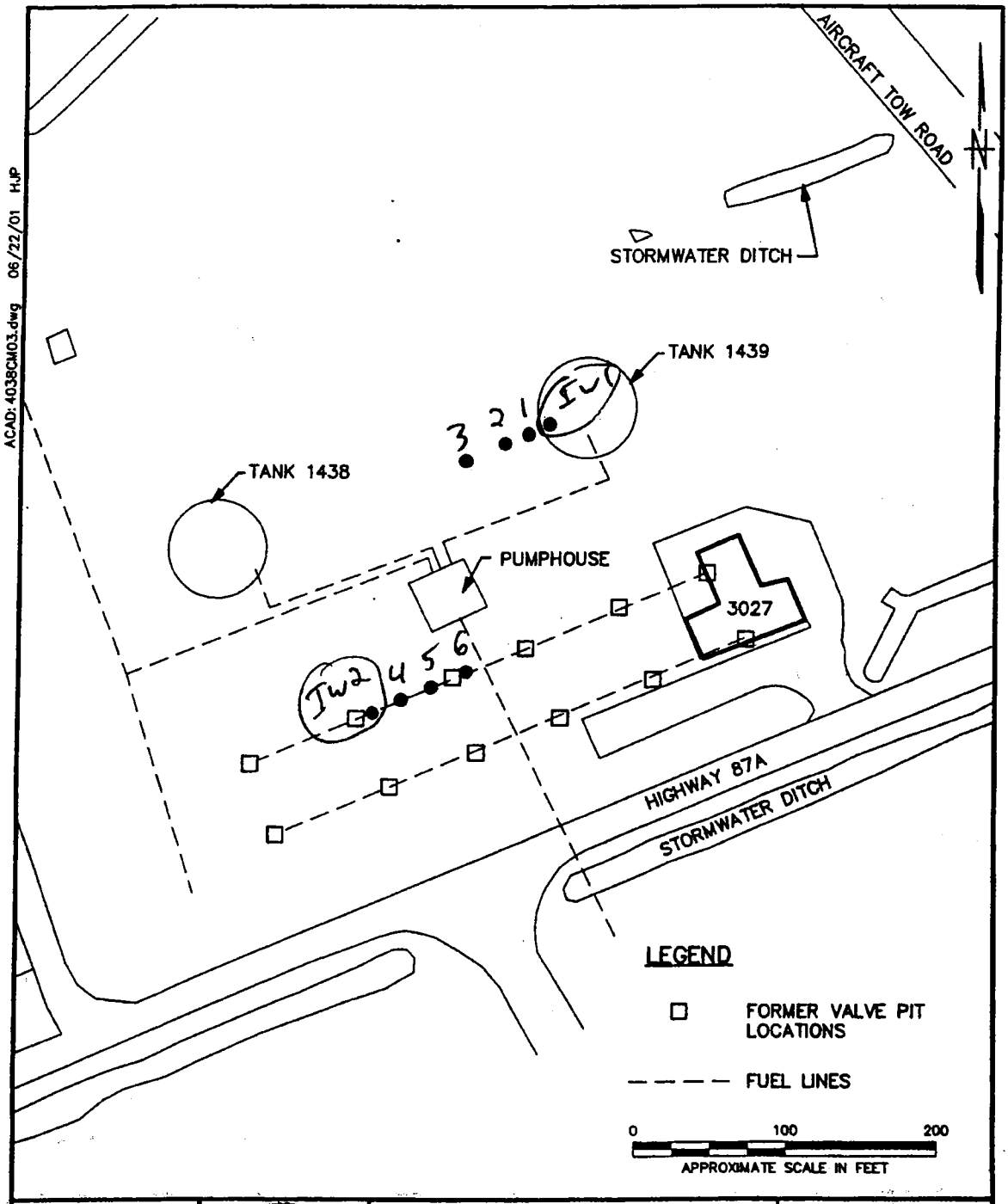
ACAD: 4038CX01.dwg 06/22/01 HJP



DRAWN BY HJP DATE 6/22/01			CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 3-1 REV. 0

SOIL PERMEABILITY TEST
INJECTION AND MONITORING POINT LAYOUT
NAS WHITING FIELD
MILTON, FLORIDA

FORM CADD NO. SDIV_AHLDWG - REV 0 - 1/20/98



ACAD: 4038CM03.dwg 06/22/01 HJP

DRAWN BY HJP DATE 6/22/01		SITE PLAN 1438/1439 NAS WHITING FIELD MILTON, FLORIDA	CONTRACT NO. 4038
CHECKED BY DATE			APPROVED BY DATE
COST/SCHED-AREA			APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-3 REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAS Whiting Field - Site 1438/1439
Project No.: CTO-200 / N4038

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 1438SLM0111
Sample Location: WHF1438-SVMW1
Sampled By: Jason Bourgeois
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
11/1/01	1110	11 to 15 feet	blue-grey	clay, no moisture
Method:		Split Spoon	red-orange	clayey sand
split spoon				
Monitor Readings		NA		
(Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Bacterial Enumeration (SM 9215C)	Sterile Plastic Jar	/	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAS Whiting Field - Site 1438/1439
Project No.: CTO-200 / N4038

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 1438SLM0211
Sample Location: WHF1438-SVMW2
Sampled By: Jason Bourgeois
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
11/1/01	1025	11 to 15 feet	red-orange	clayey sand
Method:		Split Spoon	white	clay
split spoon				
Monitor Readings		NA		
(Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Bacterial Enumeration (SM 9215C)	Sterile Plastic Jar	1	

OBSERVATIONS / NOTES:

MAP:

Circle If Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAS Whiting Field - Site 1438/1439
Project No.: CTO-200 / N4038

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 1438SLM0311
Sample Location: WHF1438-SVMW3
Sampled By: Jason Bourgeois
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
11/1/01	0945	11 to 15 feet	white	clay
Method:		Split Spoon	Orange	clayey Sand
Split spoon				
Monitor Readings		NA		
(Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Bacterial Enumeration (SM 9215C)	Sterile Plastic Jar	/	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAS Whiting Field - Site 1438/1439
Project No.: CTO-200 / N4038

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 1438SLM0436
Sample Location: WHF1438-SVMW4
Sampled By: Jason Bourgeois
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:		white w/ some grey	Sand, no moisture
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
10/31/01	1133	36 to 40 feet		
Method: Split spoon		Split Spoon		
Monitor Readings (Range in ppm):		NA		

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Bacterial Enumeration (SM 9215C)	Sterile Plastic Jar	/	

OBSERVATIONS / NOTES:

MAP:

Circle If Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAS Whiting Field - Site 1438/1439
Project No.: CTO-200 / N4038

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 1438SLM0536
Sample Location: WHF1438-SVMW5
Sampled By: Jason Bourgeois
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
10/31/01		36 to 40 feet	white w/	Sand, no moisture
Method:		Split Spoon	some grey	
Split Spoon				
Monitor Readings		NA		
(Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Bacterial Enumeration (SM 9215C)	Sterile Plastic Jar	/	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Project Site Name: NAS Whiting Field - Site 1438/1439
Project No.: CTO-200 / N4038

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 1438SLM0636
Sample Location: WHF1438-SVMW6
Sampled By: Jason Bourgeois
C.O.C. No.:

Type of Sample:
[X] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date:	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
10/31/01	1558	36 to 40 feet	white w/	Sand, no moisture
Method:		Split Spoon	Some gray	
Split spoon				
Monitor Readings		NA		
(Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other
Bacterial Enumeration (SM 9215C)	Sterile Plastic Jar	1	

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

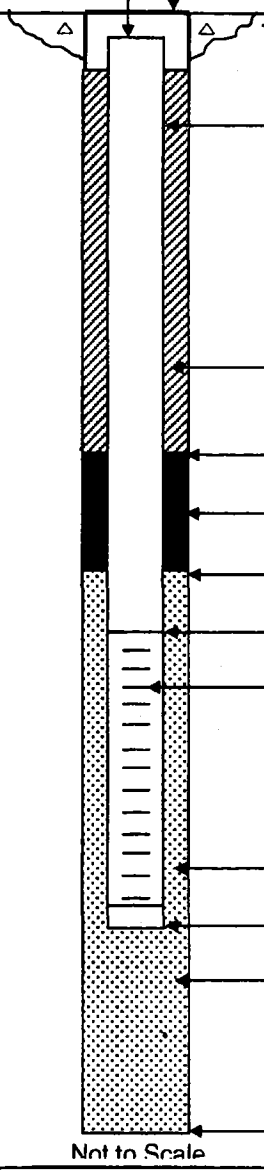
Tetra Tech NUS, Inc.

WELL No.: WHF1438-SVIW1

MONITORING WELL SHEET

PROJECT:	NAS Whiting Field	DRILLING Co.:	Prosonic	BORING No.:	
PROJECT No.:	CTO200/N4038	DRILLER:	M. Stockton	DATE COMPLETED:	11/1/01
SITE:	1438/1439	DRILLING METHOD:	~~HAS~~ HSA	NORTHING:	
GEOLOGIST:	J. Bougeois	DEV. METHOD:	NA	EASTING:	

Ground Elevation =
Datum:



Elevation / Depth of Top of Riser:		NA/
Elevation / Height of Top of Surface Casing:		NA/
I.D. of Surface Casing:	NA	
Type of Surface Casing:	NA	
Type of Surface Seal:	NA	
I.D. of Riser:	2-inch	
Type of Riser:	SCH 80 PVC	
Borehole Diameter:	~ 8-inch	
		/
Type of Backfill: Cement/Bentonite Slurry	Type I Portland	
Elevation / Depth of Seal:		/ 6 ft.
Type of Seal:	30-65 Fine Sand	
Elevation / Depth of Top of Filter Pack:		/ 8 ft.
Elevation / Depth of Top of Screen:		/ 10 ft.
Type of Screen:	SCH 80 PVC	
Slot Size x Length:	0.010" x 5'	
I.D. of Screen:	2-inch	
Type of Filter Pack:	20-30 Silica Sand	
Elevation / Depth of Bottom of Screen:		/ 15 ft.
Elevation / Depth of Bottom of Filter Pack:		/ 15 ft.
Type of Backfill Below Well: 20-30 Silica Sand		
Elevation / Total Depth of Borehole:		/ 15 ft.

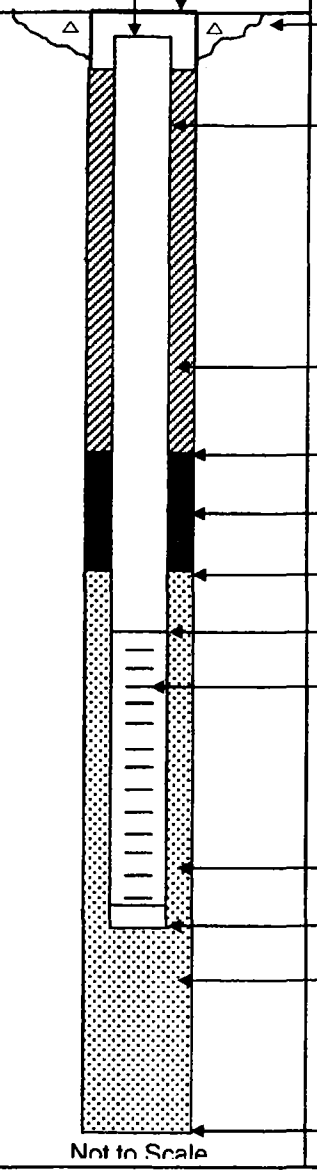
Tetra Tech NUS, Inc.

WELL No.: WHF1438-SVIW2

MONITORING WELL SHEET

PROJECT:	NAS Whiting Field	DRILLING Co.:	Prosonic	BORING No.:	
PROJECT No.:	CTO200/N4038	DRILLER:	M. Stockton	DATE COMPLETED:	11/1/01
SITE:	1438/1439	DRILLING METHOD:	HAS	NORTHING:	
GEOLOGIST:	J. Bougeois	DEV. METHOD:	NA	EASTING:	

Ground Elevation =
Datum:



Elevation / Depth of Top of Riser:		NA/
Elevation / Height of Top of Surface Casing:		NA/
I.D. of Surface Casing:	NA	
Type of Surface Casing:	NA	
Type of Surface Seal:	NA	
I.D. of Riser:	2-inch	
Type of Riser:	SCH 80 PVC	
Borehole Diameter:	~ 8-inch	
		/
Type of Backfill:	Type I Portland Cement/Bentonite Slurry	
Elevation / Depth of Seal:		/ ~~31~~ 29 ft.
Type of Seal:	30-65 Fine Sand	
Elevation / Depth of Top of Filter Pack:		/ ~~33~~ 32 ft.
Elevation / Depth of Top of Screen:		/ 35 ft.
Type of Screen:	SCH 80 PVC	
Slot Size x Length:	0.010" x 5'	
I.D. of Screen:	2-inch	
Type of Filter Pack:	20-30 Silica Sand	
Elevation / Depth of Bottom of Screen:		/ 40 ft.
Elevation / Depth of Bottom of Filter Pack:		/ 40 ft.
Type of Backfill Below Well:	20-30 Silica Sand	
Elevation / Total Depth of Borehole:		/ 40 ft.

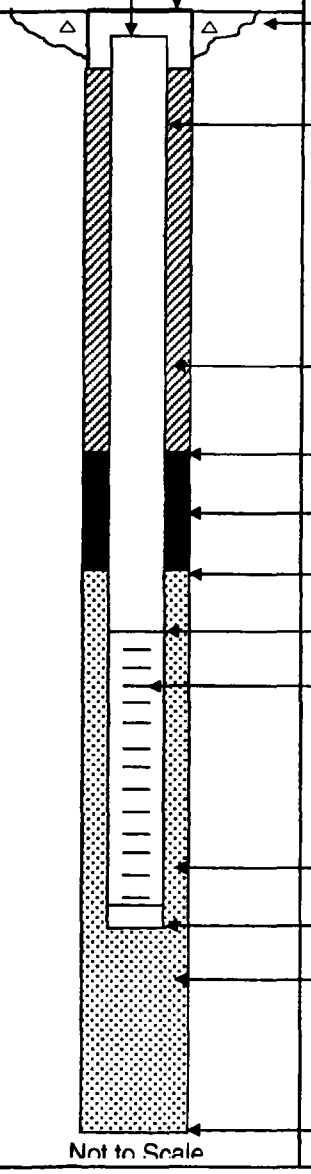
Tetra Tech NUS, Inc.

WELL No.: WHF1438-SVMW1

MONITORING WELL SHEET

PROJECT:	NAS Whiting Field	DRILLING Co.:	Prosonic	BORING No.:	
PROJECT No.:	CTO200/N4038	DRILLER:	Mr Stockton	DATE COMPLETED:	1/1/01
SITE:	1438/1439	DRILLING METHOD:	HAS	NORTHING:	
GEOLOGIST:	J. Bougeois	DEV. METHOD:	NA	EASTING:	

Ground Elevation =
Datum:



Elevation / Depth of Top of Riser:		NA/
Elevation / Height of Top of Surface Casing:		NA/
I.D. of Surface Casing:	NA	
Type of Surface Casing:	NA	
Type of Surface Seal:	NA	
I.D. of Riser:	2-inch	
Type of Riser:	SCH 80 PVC	
Borehole Diameter:	~ 8-inch	
		/
Type of Backfill:	Type I Portland Cement/Bentonite Slurry	
Elevation / Depth of Seal:		/ ~~8~~ 5 ft.
Type of Seal:	30-65 Fine Sand	
Elevation / Depth of Top of Filter Pack:		/ 8 ft.
Elevation / Depth of Top of Screen:		/ 10 ft.
Type of Screen:	SCH 80 PVC	
Slot Size x Length:	0.010" x 5'	
I.D. of Screen:	2-inch	
Type of Filter Pack:	20-30 Silica Sand	
Elevation / Depth of Bottom of Screen:		/ 15 ft.
Elevation / Depth of Bottom of Filter Pack:		/ 15 ft.
Type of Backfill Below Well:	20-30 Silica Sand	
Elevation / Total Depth of Borehole:		/ 15 ft.

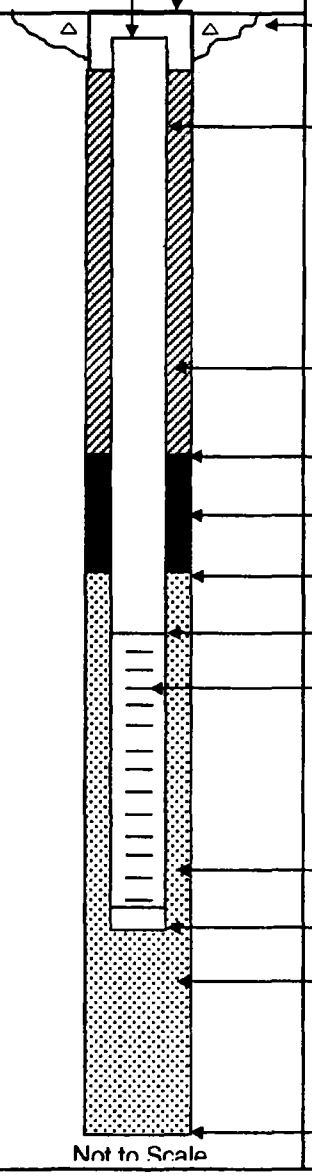
Tetra Tech NUS, Inc.

WELL No.: WHF1438-SVMW2

MONITORING WELL SHEET

PROJECT:	NAS Whiting Field	DRILLING Co.:	Prosonic	BORING No.:	
PROJECT No.:	CTO200/N4038	DRILLER:	M. Stockton	DATE COMPLETED:	11/1/01
SITE:	1438/1439	DRILLING METHOD:	HAS	NORTHING:	
GEOLOGIST:	J. Bougeois	DEV. METHOD:	NA	EASTING:	

Ground Elevation =
Datum:



Elevation / Depth of Top of Riser:		NA/
Elevation / Height of Top of Surface Casing:		NA/
I.D. of Surface Casing:	NA	
Type of Surface Casing:	NA	
Type of Surface Seal:	NA	
I.D. of Riser:	2-inch	
Type of Riser:	SCH 80 PVC	
Borehole Diameter:	~ 8-inch	
		/
Type of Backfill: Cement/Bentonite Slurry	Type I Portland	
Elevation / Depth of Seal:		/ 6 ft.
Type of Seal:	30-65 Fine Sand	
Elevation / Depth of Top of Filter Pack:		/ 8 ft.
Elevation / Depth of Top of Screen:		/ 10 ft.
Type of Screen:	SCH 80 PVC	
Slot Size x Length:	0.010" x 5'	
I.D. of Screen:	2-inch	
Type of Filter Pack:	20-30 Silica Sand	
Elevation / Depth of Bottom of Screen:		/ 15 ft.
Elevation / Depth of Bottom of Filter Pack:		/ 15 ft.
Type of Backfill Below Well: 20-30 Silica Sand		
Elevation / Total Depth of Borehole:		/ 15 ft.

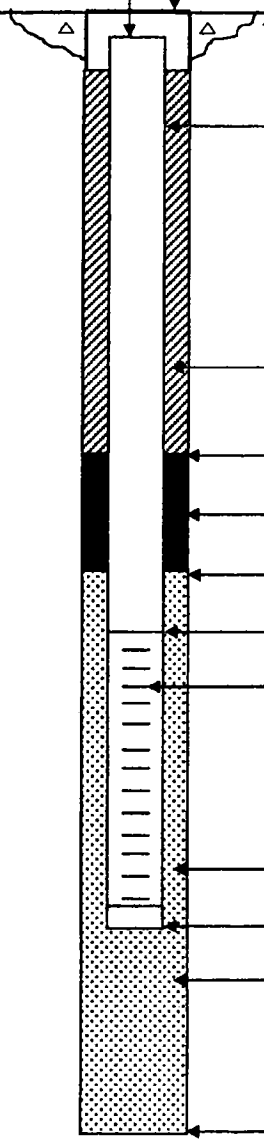
Tetra Tech NUS, Inc.

WELL No.: WHF1438-SVMW3

MONITORING WELL SHEET

PROJECT:	NAS Whiting Field	DRILLING Co.:	Prosonic	BORING No.:	
PROJECT No.:	CTO200/N4038	DRILLER:	M. Stockton	DATE COMPLETED:	11/1/01
SITE:	1438/1439	DRILLING METHOD:	HAS	NORTHING:	
GEOLOGIST:	J. Bougeois	DEV. METHOD:	NA	EASTING:	

Ground Elevation =
Datum:



Not to Scale

Elevation / Depth of Top of Riser:		NA/
Elevation / Height of Top of Surface Casing:		NA/
I.D. of Surface Casing:	NA	
Type of Surface Casing:	NA	
Type of Surface Seal:	NA	
I.D. of Riser:	2-inch	
Type of Riser:	SCH 80 PVC	
Borehole Diameter:	~ 8-inch	
		/
Type of Backfill:	Type I Portland Cement/Bentonite Slurry	
Elevation / Depth of Seal:		/ 6 ft.
Type of Seal:	30-65 Fine Sand	
Elevation / Depth of Top of Filter Pack:		/ 8 ft.
Elevation / Depth of Top of Screen:		/ 10 ft.
Type of Screen:	SCH 80 PVC	
Slot Size x Length:	0.010" x 5'	
I.D. of Screen:	2-inch	
Type of Filter Pack:	20-30 Silica Sand	
Elevation / Depth of Bottom of Screen:		/ 15 ft.
Elevation / Depth of Bottom of Filter Pack:		/ 15 ft.
Type of Backfill Below Well:	20-30 Silica Sand	
Elevation / Total Depth of Borehole:		/ 15 ft.

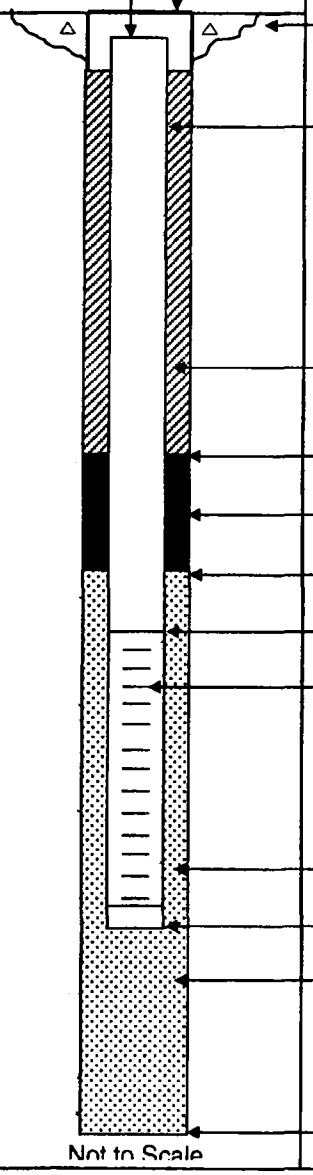
Tetra Tech NUS, Inc.

WELL No.: WHF1438-SVMW4

MONITORING WELL SHEET

PROJECT:	NAS Whiting Field	DRILLING Co.:	Prosonic	BORING No.:	
PROJECT No.:	CTO200/N4038	DRILLER:	M. Stockton	DATE COMPLETED:	10/31/01
SITE:	1438/1439	DRILLING METHOD:	HAS	NORTHING:	
GEOLOGIST:	J. Bougeois	DEV. METHOD:	NA	EASTING:	

Ground Elevation =
Datum:



Elevation / Depth of Top of Riser:		NA/
Elevation / Height of Top of Surface Casing:		NA/
I.D. of Surface Casing:	NA	
Type of Surface Casing:	NA	
Type of Surface Seal:	NA	
I.D. of Riser:	2-inch	
Type of Riser:	SCH 80 PVC	
Borehole Diameter:	~ 8-inch	
		/
Type of Backfill:	Type I Portland Cement/Bentonite Slurry	
Elevation / Depth of Seal:		/ 31 ft.
Type of Seal:	30-65 Fine Sand	
Elevation / Depth of Top of Filter Pack:		/ ~~33 ft.~~ 32
Elevation / Depth of Top of Screen:		/ 35 ft.
Type of Screen:	SCH 80 PVC	
Slot Size x Length:	0.010" x 5'	
I.D. of Screen:	2-inch	
Type of Filter Pack:	20-30 Silica Sand	
Elevation / Depth of Bottom of Screen:		/ 40 ft.
Elevation / Depth of Bottom of Filter Pack:		/ 40 ft.
Type of Backfill Below Well:	20-30 Silica Sand	
Elevation / Total Depth of Borehole:		/ 40 ft.

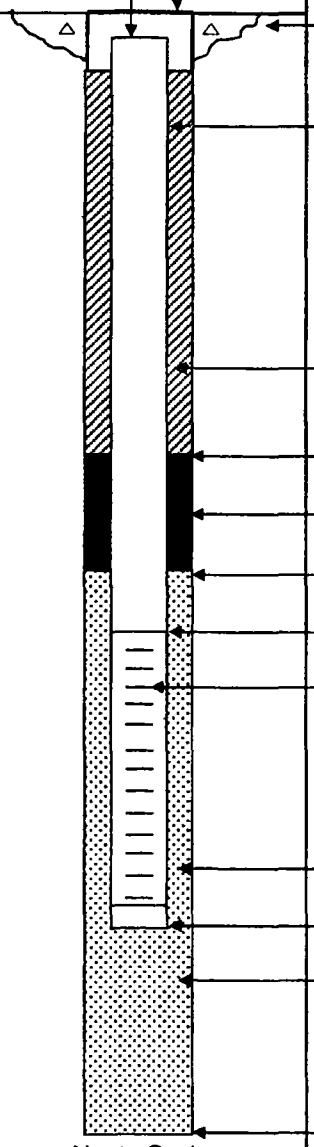
Tetra Tech NUS, Inc.

WELL No.: WHF1438-SVMW5

MONITORING WELL SHEET

PROJECT:	NAS Whiting Field	DRILLING Co.:	Prosonic	BORING No.:	
PROJECT No.:	CTO200/N4038	DRILLER:	M. Stockton	DATE COMPLETED:	10/31/01
SITE:	1438/1439	DRILLING METHOD:	HAS	NORTHING:	
GEOLOGIST:	J. Bougeois	DEV. METHOD:	NA	EASTING:	

Ground Elevation =
Datum:



Not to Scale

Elevation / Depth of Top of Riser:		NA/
Elevation / Height of Top of Surface Casing:		NA/
I.D. of Surface Casing:	NA	
Type of Surface Casing:	NA	
Type of Surface Seal:	NA	
I.D. of Riser:	2-inch	
Type of Riser:	SCH 80 PVC	
Borehole Diameter:	~ 8-inch	
		/
Type of Backfill:	Type I Portland Cement/Bentonite Slurry	
Elevation / Depth of Seal:		/ 31 ft.
Type of Seal:	30-65 Fine Sand	
Elevation / Depth of Top of Filter Pack:		/ 33 ft.
Elevation / Depth of Top of Screen:		/ 35 ft.
Type of Screen:	SCH 80 PVC	
Slot Size x Length:	0.010" x 5'	
I.D. of Screen:	2-inch	
Type of Filter Pack:	20-30 Silica Sand	
Elevation / Depth of Bottom of Screen:		/ 40 ft.
Elevation / Depth of Bottom of Filter Pack:		/ 40 ft.
Type of Backfill Below Well:	20-30 Silica Sand	
Elevation / Total Depth of Borehole:		/ 40 ft.

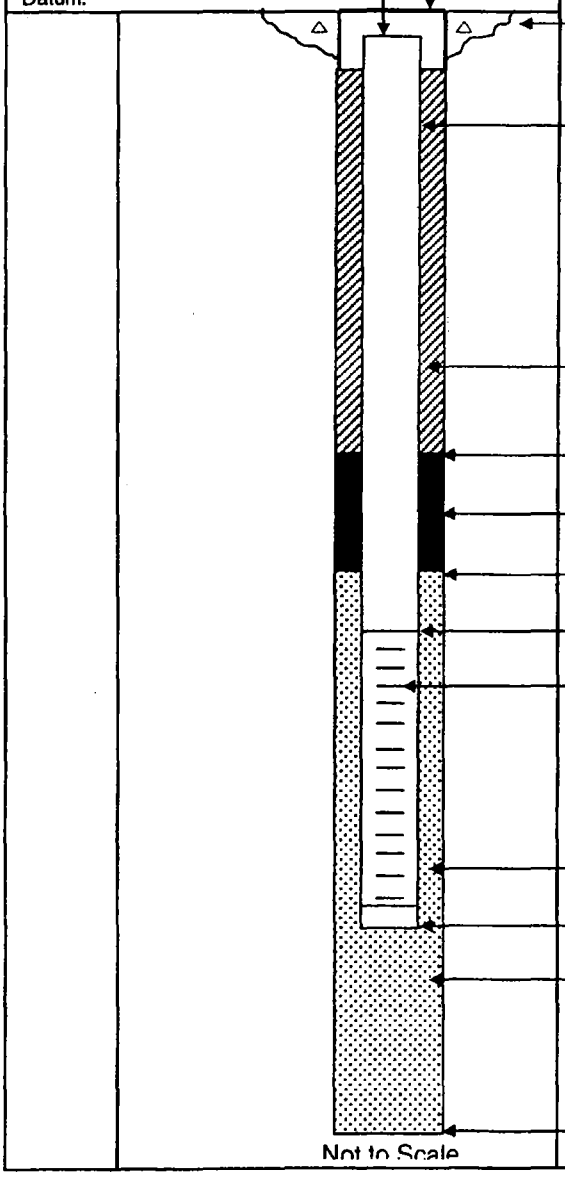
Tetra Tech NUS, Inc.

WELL No.: WHF1438-SVMW6

MONITORING WELL SHEET

PROJECT:	NAS Whiting Field	DRILLING Co.:	Prosonic	BORING No.:	
PROJECT No.:	CTO200/N4038	DRILLER:	Mr. Stockton	DATE COMPLETED:	10/31/01
SITE:	1438/1439	DRILLING METHOD:	HAS	NORTHING:	
GEOLOGIST:	J. Bougeois	DEV. METHOD:	NA	EASTING:	

Ground Elevation =
Datum:



Elevation / Depth of Top of Riser:		NA/
Elevation / Height of Top of Surface Casing:		NA/
I.D. of Surface Casing:	NA	
Type of Surface Casing:	NA	
Type of Surface Seal:	NA	
I.D. of Riser:	2-inch	
Type of Riser:	SCH 80 PVC	
Borehole Diameter:	~ 8-inch	
		/
Type of Backfill:	Type I Portland Cement/Bentonite Slurry	
Elevation / Depth of Seal:		/ 31 ft.
Type of Seal:	30-65 Fine Sand	
Elevation / Depth of Top of Filter Pack:		/ ~~33 ft.~~ 32
Elevation / Depth of Top of Screen:		/ 35 ft.
Type of Screen:	SCH 80 PVC	
Slot Size x Length:	0.010" x 5'	
I.D. of Screen:	2-inch	
Type of Filter Pack:	20-30 Silica Sand	
Elevation / Depth of Bottom of Screen:		/ 40 ft.
Elevation / Depth of Bottom of Filter Pack:		/ 40 ft.
Type of Backfill Below Well:	20-30 Silica Sand	
Elevation / Total Depth of Borehole:		/ 40 ft.

Report of Analysis

Client Sample ID:	1438SLM0111		
Lab Sample ID:	F11387-6	Date Sampled:	11/01/01
Matrix:	SO - Soil	Date Received:	11/02/01
		Percent Solids:	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed By	Method
Plate Count, Total [a]	TNTC	0	CFU/g	1	11/11/01 SUB	SM18 9215B M

(a) Too Numerous to Count

RL = Reporting Limit

Report of Analysis

Client Sample ID:	1438SLM0211		
Lab Sample ID:	F11387-5	Date Sampled:	11/01/01
Matrix:	SO - Soil	Date Received:	11/02/01
		Percent Solids:	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed By	Method
Plate Count, Total	470	0	CFU/g	1	11/11/01 SUB	SM18 9215B M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	1438SLM0311		
Lab Sample ID:	F11387-4	Date Sampled:	11/01/01
Matrix:	SO - Soil	Date Received:	11/02/01
		Percent Solids:	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed By	Method
Plate Count, Total	394	0	CFU/g	1	11/11/01 SUB	SM18 9215B M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	1438SLM0436		
Lab Sample ID:	F11387-3	Date Sampled:	10/31/01
Matrix:	SO - Soil	Date Received:	11/02/01
		Percent Solids:	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed By	Method
Plate Count, Total	454	0	CFU/g	1	11/11/01 SUB	SM18 9215B M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	1438SLM0536		
Lab Sample ID:	F11387-2	Date Sampled:	10/31/01
Matrix:	SO - Soil	Date Received:	11/02/01
		Percent Solids:	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed By	Method
Plate Count, Total	2880	0	CFU/g	1	11/11/01 SUB	SM18 9215B M

RL = Reporting Limit

Report of Analysis

Client Sample ID:	1438SLM0636		
Lab Sample ID:	F11387-1	Date Sampled:	10/31/01
Matrix:	SO - Soil	Date Received:	11/02/01
		Percent Solids:	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

General Chemistry

Analyte	Result	RL	Units	DF	Analyzed By	Method
Plate Count, Total	12	0	CFU/g	1	11/11/01 SUB	SM18 9215B M

RL = Reporting Limit

RECEIVED
TETRA TECH NUS
JACKSONVILLE FL

Tetra Tech NUS, Inc. **Internal Correspondence**

TO: **Mr. Paul Calligan** **DATE: January 10, 2002**

FROM: **Suzanne I. Smith** **CC: File**

SUBJECT: **Organic Data Validation – VOC and TPH**
CTO200 – NAS Whiting Field
SDG F11504

SAMPLES: **12/Air**

WHF 1438 ELM0101	**WHF 1438 ELM0102**	**WHF 1438 ELM0201**
WHF 1438 ELM0202	**WHF 1438 ELM0301**	**WHF 1438 ELM0302**
WHF 1438 ELM0401	**WHF 1438 ELM0402**	**WHF 1438 ELM0501**
WHF 1438 ELM0502	**WHF 1438 ELM0601**	**WHF 1438 ELM0602**

OVERVIEW

The sample set for CTO200 SDG F11504; Naval Air Station Cecil Field, Jacksonville, Florida consists of twelve (12) air samples. The samples were analyzed for select Volatile Organic Compounds (VOCs) and Total Petroleum Hydrocarbons (TPH). The same samples were analyzed for carbon dioxide and oxygen under SDG F11504R.

The samples were collected by Tetra Tech NUS on November 13, 2001 and analyzed by Accutest Southeast Laboratories, Inc. All analyses were performed in accordance with Naval Facilities Engineering Service Center (NFESC) Quality Assurance/Quality Control (QA/QC) criteria and analyzed according to Method TO-3/EPA 18 (VOCs and TPH) analytical and reporting protocols. The data in this SDG was validated with regard to the following parameters:

* • Data Completeness
* • Holding Times
* • Laboratory method/field quality control blank results
* • Detection Limits

The symbol (*) indicates that all quality control criteria were met for this parameter.

Volatiles Fraction

All quality control criteria were met for this fraction.

Total Petroleum Hydrocarbon Fraction

All quality control criteria were met for this fraction.

Executive Summary

Laboratory performance: None.

Other factors affecting data quality: None.

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (February, 1996), and the NFESC guidelines "Navy Installation Restoration Chemical Data Quality Manual" (September, 1999). The text of the report has been formulated to address only those problems affecting data quality.

"I attest that the data referenced herein was validated according to the agreed upon validation criteria as specified in the NFESC Guidelines and the Quality Assurance Project Plan (QAPP)."

Suzanne I. Smith

Suzanne I. Smith

Project Chemist
Tetra Tech NUS, Inc.

APPENDIX A

Qualified Analytical Results

Qualifier Codes:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration (i.e., % RSDs, %Ds, ICVs, CCVs, RPDs, RRFs, etc.) Noncompliance
D = MS/MSD Noncompliance
E = LCS/LCSD Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = GFAA PDS - GFAA MSA's r < 0.995
K = ICP Interference - include ICSAB % R's
L = Instrument Calibration Range Exceedance
M = Sample Preservation
N = Internal Standard Noncompliance
O = Poor Instrument Performance (i.e., base-time drifting)
P = Uncertainty near detection limit (< 2 x IDL for inorganics and <CRQL for organics)
Q = Other problems (can encompass a number of issues)
R = Surrogates Recovery Noncompliance
S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = Pest/PCB D% between columns for positive results
V = Non-linear calibrations, tuning r < 0.995 (correlation coefficient)
W = EMPC result
X = Signal to noise response drop
Y = % Solid content is less than 30%

DATA QUALIFIER DEFINITIONS:

U - Value is a nondetected result as reported by the laboratory and should not be considered present.

J - Positive result is estimated as a result of a value below the CRQL or a technical noncompliance.

UJ - Nondetected result is considered to be estimated as a result of technical noncompliances.

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0101			WHF 1438 ELM0101			WHF 1438 ELM0102			WHF 1438 ELM0102		
SAMPLE DATE:	11/13/01			11/13/01			11/13/01			11/13/01		
LABORATORY ID:	F11504-1			F11504-1			F11504-4			F11504-4		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
BENZENE	0.32	U		~~0.32~~ 0.1	U		0.32	U		0.32	U	
ETHYLBENZENE	134			~~134~~ 36.8			26			26		
METHYL TERT-BUTYL ETHER	0.36	U		~~0.36~~ 0.1	U		0.36	U		0.36	U	
TOLUENE	0.38	U		~~0.38~~ 0.1	U		0.38	U		0.38	U	
TOTAL XYLENES	39			~~39~~ 9.1			2.9			2.9		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0201			WHF 1438 ELM0201			WHF 1438 ELM0202			WHF 1438 ELM0202		
SAMPLE DATE:	11/13/01			11/13/01			11/13/01			11/13/01		
LABORATORY ID:	F11504-2			F11504-2			F11504-5			F11504-5		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
BENZENE	0.32	U		0.32	U		0.32	U		0.32	U	
ETHYLBENZENE	170			170			108			108		
METHYL TERT-BUTYL ETHER	0.36	U		0.36	U		0.36	U		0.36	U	
TOLUENE	0.38	U		0.38	U		0.38	U		0.38	U	
TOTAL XYLENES	98.4			98.4			64.6			64.6		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0301			WHF 1438 ELM0301			WHF 1438 ELM0302			WHF 1438 ELM0302		
SAMPLE DATE:	11/13/01			11/13/01			11/13/01			11/13/01		
LABORATORY ID:	F11504-3			F11504-3			F11504-6			F11504-6		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
BENZENE	0.32 •	U		0.32	U		0.32 •	U		0.32	U	
ETHYLBENZENE	57.2 •			57.2			9.5 •			9.5		
METHYL TERT-BUTYL ETHER	0.36 •	U		0.36	U		0.36 •	U		0.36	U	
TOLUENE	0.38 •	U		0.38	U		0.38 •	U		0.38	U	
TOTAL XYLENES	37 •			37			6.9 •			6.9		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0401			WHF 1438 ELM0401			WHF 1438 ELM0402			WHF 1438 ELM0402		
SAMPLE DATE:	11/14/01			11/14/01			11/14/01			11/14/01		
LABORATORY ID:	F11504-7			F11504-7			F11504-10			F11504-10		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
BENZENE	27			27			26			26		
ETHYLBENZENE	38			38			29			29		
METHYL TERT-BUTYL ETHER	0.36	U		0.36	U		0.36	U		0.36	U	
TOLUENE	108			108			100			100		
TOTAL XYLENES	142			142			89.7			89.7		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0501			WHF 1438 ELM0501			WHF 1438 ELM0502			WHF 1438 ELM0502		
SAMPLE DATE:	11/14/01			11/14/01			11/14/01			11/14/01		
LABORATORY ID:	F11504-8			F11504-8			F11504-11			F11504-11		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
BENZENE	3.2			3.2			1.5			1.5		
ETHYLBENZENE	22			22			7.4			7.4		
METHYL TERT-BUTYL ETHER	0.36	U		0.36	U		0.36	U		0.36	U	
TOLUENE	31			31			15			15		
TOTAL XYLENES	100			100			32			32		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0601			WHF 1438 ELM0601			WHF 1438 ELM0602			WHF 1438 ELM0602		
SAMPLE DATE:	11/14/01			11/14/01			11/14/01			11/14/01		
LABORATORY ID:	F11504-9			F11504-9			F11504-12			F11504-12		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
VOLATILES												
BENZENE	24			24			23			23		
ETHYLBENZENE	84.5			84.5			122			122		
METHYL TERT-BUTYL ETHER	0.36	U		0.36	U		0.36	U		0.36	U	
TOLUENE	112			112			108			108		
TOTAL XYLENES	209			209			276			276		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0101			WHF 1438 ELM0101			WHF 1438 ELM0102			WHF 1438 ELM0102		
SAMPLE DATE:	11/13/01			11/13/01			11/13/01			11/13/01		
LABORATORY ID:	F11504-1			F11504-1			F11504-4			F11504-4		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
TPH (C1-C4)	19500			~~13500~~ 29800			~~31400~~ 20500			31400		
TPH (C5-C10)	105000			~~105000~~ 35800			~~22600~~ 66600			22600		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0201			WHF 1438 ELM0201			WHF 1438 ELM0202			WHF 1438 ELM0202		
SAMPLE DATE:	11/13/01			11/13/01			11/13/01			11/13/01		
LABORATORY ID:	F11504-2			F11504-2			F11504-5			F11504-5		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
TPH (C1-C4)	6940 ~~10600~~			10600			~~13000~~ 9100			13900		
TPH (C5-C10)	43000 ~~14600~~			14600			~~45000~~ 45000			45000		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0301			WHF 1438 ELM0301			WHF 1438 ELM0302			WHF 1438 ELM0302		
SAMPLE DATE:	11/13/01			11/13/01			11/13/01			11/13/01		
LABORATORY ID:	F11504-3			F11504-3			F11504-6			F11504-6		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
TPH (C1-C4)	30.4 ~~40.4~~			46.4			~~26.0~~ 17.6			26.9		
TPH (C5-C10)	5270 ~~1790~~			1790			1450			1450		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:	WHF 1438 ELM0401			WHF 1438 ELM0401			WHF 1438 ELM0402			WHF 1438 ELM0402		
SAMPLE DATE:	11/14/01			11/14/01			11/14/01			11/14/01		
LABORATORY ID:	F11504-7			F11504-7			F11504-10			F11504-10		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
UNITS:	MG/M3			PPMV			MG/M3			PPMV		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
TPH (C1-C4)	~~8570~~ 2340			3570			~~8470~~ 2270			3470		
TPH (C5-C10)	~~11900~~ 35000			11900			33300			33300		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:		WHF 1438 ELM0501			WHF 1438 ELM0501			WHF 1438 ELM0502			WHF 1438 ELM0502	
SAMPLE DATE:		11/14/01			11/14/01			11/14/01			11/14/01	
LABORATORY ID:		F11504-8			F11504-8			F11504-11			F11504-11	
QC_TYPE:		NORMAL			NORMAL			NORMAL			NORMAL	
% SOLIDS:		100.0 %			100.0 %			100.0 %			100.0 %	
UNITS:		MG/M3			PPMV			MG/M3			PPMV	
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
TPH (C1-C4)	606 ~~926~~			926			~~559~~ 366			559		
TPH (C5-C10)	5710 ~~1940~~			1940			~~974~~ 2870			974		

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, NJ
SDG: F11504

SAMPLE NUMBER:		WHF 1438 ELM0601			WHF 1438 ELM0601			WHF 1438 ELM0602			WHF 1438 ELM0602	
SAMPLE DATE:		11/14/01			11/14/01			11/14/01			11/14/01	
LABORATORY ID:		F11504-9			F11504-9			F11504-12			F11504-12	
QC_TYPE:		NORMAL			NORMAL			NORMAL			NORMAL	
% SOLIDS:		100.0 %			100.0 %			100.0 %			100.0 %	
UNITS:		MG/M3			PPMV			MG/M3			PPMV	
FIELD DUPLICATE OF:												
		RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
TPH (C1-C4)	1610	~~2460~~			2460			~~2450~~ 1600			2450		
TPH (C5-C10)	26200	8900			8900			~~8470~~ 24900			8470		

F11504

HOLDING TIME
01/03/02

Units	Nsample	Lab Id	Qc Type	Sdg	Sort	Samp Date	Extr Date	Anal Date	SAMP_DATE TO EXTR_DATE	EXTR_DATE TO ANAL_DATE	SAMP_DATE TO ANAL_DATE
PPMV	WHF 1438 ELM0101	F11504-1	NORMAL	F11504	BTEX	11/13/01	/ /	11/16/01	0	0	3
MG/M3	WHF 1438 ELM0102	F11504-4	NORMAL	F11504	BTEX	11/13/01	/ /	11/16/01	0	0	3
MG/M3	WHF 1438 ELM0201	F11504-2	NORMAL	F11504	BTEX	11/13/01	/ /	11/16/01	0	0	3
PPMV	WHF 1438 ELM0202	F11504-5	NORMAL	F11504	BTEX	11/13/01	/ /	11/16/01	0	0	3
MG/M3	WHF 1438 ELM0301	F11504-3	NORMAL	F11504	BTEX	11/13/01	/ /	11/16/01	0	0	3
MG/M3	WHF 1438 ELM0302	F11504-6	NORMAL	F11504	BTEX	11/13/01	/ /	11/16/01	0	0	3
MG/M3	WHF 1438 ELM0401	F11504-7	NORMAL	F11504	BTEX	11/14/01	/ /	11/16/01	0	0	2
MG/M3	WHF 1438 ELM0402	F11504-10	NORMAL	F11504	BTEX	11/14/01	/ /	11/16/01	0	0	2
MG/M3	WHF 1438 ELM0501	F11504-8	NORMAL	F11504	BTEX	11/14/01	/ /	11/16/01	0	0	2
PPMV	WHF 1438 ELM0502	F11504-11	NORMAL	F11504	BTEX	11/14/01	/ /	11/16/01	0	0	2
PPMV	WHF 1438 ELM0601	F11504-9	NORMAL	F11504	BTEX	11/14/01	/ /	11/16/01	0	0	2
MG/M3	WHF 1438 ELM0602	F11504-12	NORMAL	F11504	BTEX	11/14/01	/ /	11/16/01	0	0	2
PPMV	WHF 1438 ELM0101	F11504-1	NORMAL	F11504	TPH	11/13/01	/ /	11/16/01	0	0	3
MG/M3	WHF 1438 ELM0102	F11504-4	NORMAL	F11504	TPH	11/13/01	/ /	11/16/01	0	0	3
MG/M3	WHF 1438 ELM0201	F11504-2	NORMAL	F11504	TPH	11/13/01	/ /	11/16/01	0	0	3
PPMV	WHF 1438 ELM0202	F11504-5	NORMAL	F11504	TPH	11/13/01	/ /	11/16/01	0	0	3
MG/M3	WHF 1438 ELM0301	F11504-3	NORMAL	F11504	TPH	11/13/01	/ /	11/16/01	0	0	3
PPMV	WHF 1438 ELM0302	F11504-6	NORMAL	F11504	TPH	11/13/01	/ /	11/16/01	0	0	3
MG/M3	WHF 1438 ELM0401	F11504-7	NORMAL	F11504	TPH	11/14/01	/ /	11/16/01	0	0	2
PPMV	WHF 1438 ELM0402	F11504-10	NORMAL	F11504	TPH	11/14/01	/ /	11/16/01	0	0	2
MG/M3	WHF 1438 ELM0501	F11504-8	NORMAL	F11504	TPH	11/14/01	/ /	11/16/01	0	0	2
MG/M3	WHF 1438 ELM0502	F11504-11	NORMAL	F11504	TPH	11/14/01	/ /	11/16/01	0	0	2
MG/M3	WHF 1438 ELM0601	F11504-9	NORMAL	F11504	TPH	11/14/01	/ /	11/16/01	0	0	2
MG/M3	WHF 1438 ELM0602	F11504-12	NORMAL	F11504	TPH	11/14/01	/ /	11/16/01	0	0	2

APPENDIX B

Results as Reported by the Laboratory

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0101		
Lab Sample ID:	F11504-1	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20373.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	30.8	0.10	ppmv		134	0.43	mg/m3
1330-20-7		Xylenes (total)	9.1	0.10	ppmv		39	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	29800	5.0	ppmv		19500	3.3	mg/m3
		TPH (C5-C10) as Pentane	35800	5.0	ppmv		105000	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	116%		69-128%
460-00-4	4-Bromofluorobenzene	99%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-01

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0101	Vapor	13 Nov. 01 11:11	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	9.8	0.020	%	AM20GAX	bc	11/28/01
Oxygen	3.9	0.020	%		bc	11/28/01

Should be part of SDG F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0201		
Lab Sample ID:	F11504-2	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20387.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	39.2	0.10	ppmv		170	0.43	mg/m3
1330-20-7		Xylenes (total)	22.7	0.10	ppmv		98.4	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	10600	5.0	ppmv		6940	3.3	mg/m3
		TPH (C5-C10) as Pentane	14600	5.0	ppmv		43000	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	101%		69-128%
460-00-4	4-Bromofluorobenzene	102%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-02

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0201	Vapor	13 Nov. 01 11:21	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	7.6	0.020	%	AM20GAX	bc	11/28/01
Oxygen	12	0.020	%		bc	11/28/01

F11504R, not F11504

7

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0301		
Lab Sample ID:	F11504-3	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20376.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	13.2	0.10	ppmv		57.2	0.43	mg/m3
1330-20-7		Xylenes (total)	8.6	0.10	ppmv		37	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	46.4	5.0	ppmv		30.4	3.3	mg/m3
		TPH (C5-C10) as Pentane	1790	5.0	ppmv		5270	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	91%		69-128%
460-00-4	4-Bromofluorobenzene	93%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-03

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0301	Vapor	13 Nov. 01 11:27	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	3.4	0.020	%	AM20GAX	bc	11/28/01
Oxygen	17	0.020	%		bc	11/28/01

F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0102		
Lab Sample ID:	F11504-4	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20377.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	6.0	0.10	ppmv		26	0.43	mg/m3
1330-20-7		Xylenes (total)	0.68	0.10	ppmv		2.9	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	31400	5.0	ppmv		20500	3.3	mg/m3
		TPH (C5-C10) as Pentane	22600	5.0	ppmv		66600	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	109%		69-128%
460-00-4	4-Bromofluorobenzene	102%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-04

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0102	Vapor	13 Nov. 01 18:10	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	9.6	0.020	%	AM20GAX	bc	11/28/01
Oxygen	3.7	0.020	%		bc	11/28/01

F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0202		
Lab Sample ID:	F11504-5	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20378.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	25.0	0.10	ppmv		108	0.43	mg/m3
1330-20-7		Xylenes (total)	14.9	0.10	ppmv		64.6	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	13900	5.0	ppmv		9100	3.3	mg/m3
		TPH (C5-C10) as Pentane	15300	5.0	ppmv		45000	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	115%		69-128%
460-00-4	4-Bromofluorobenzene	127%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-05

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0202	Vapor	13 Nov. 01 18:12	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	4.2	0.020	%	AM20GAX	bc	11/28/01
Oxygen	14	0.020	%		bc	11/28/01

F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0302		
Lab Sample ID:	F11504-6	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20379.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	2.2	0.10	ppmv		9.5	0.43	mg/m3
1330-20-7		Xylenes (total)	1.6	0.10	ppmv		6.9	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	26.9	5.0	ppmv		17.6	3.3	mg/m3
		TPH (C5-C10) as Pentane	492	5.0	ppmv		1450	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	107%		69-128%
460-00-4	4-Bromofluorobenzene	114%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-06

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0302	Vapor	13 Nov. 01 18:14	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	4.3	0.020	%	AM20GAX	bc	11/28/01
Oxygen	16	0.020	%		bc	11/28/01

F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0401		
Lab Sample ID:	F11504-7	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20380.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	8.4	0.10	ppmv		27	0.32	mg/m3
108-88-3		Toluene	28.6	0.10	ppmv		108	0.38	mg/m3
100-41-4		Ethylbenzene	8.9	0.10	ppmv		38	0.43	mg/m3
1330-20-7		Xylenes (total)	32.8	0.10	ppmv		142	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	3570	5.0	ppmv		2340	3.3	mg/m3
		TPH (C5-C10) as Pentane	11900	5.0	ppmv		35000	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	108%		69-128%
460-00-4	4-Bromofluorobenzene	102%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-07

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0401	Vapor	14 Nov. 01 8:41	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	7.6	0.020	%	AM20GAX	bc	11/28/01
Oxygen	5.0	0.020	%		bc	11/28/01

F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0501		
Lab Sample ID:	F11504-8	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20381.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	1.0	0.10	ppmv		3.2	0.32	mg/m3
108-88-3		Toluene	8.2	0.10	ppmv		31	0.38	mg/m3
100-41-4		Ethylbenzene	5.2	0.10	ppmv		22	0.43	mg/m3
1330-20-7		Xylenes (total)	23.1	0.10	ppmv		100	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	926	5.0	ppmv		606	3.3	mg/m3
		TPH (C5-C10) as Pentane	1940	5.0	ppmv		5710	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	102%		69-128%
460-00-4	4-Bromofluorobenzene	98%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-08

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0501	Vapor	14 Nov. 01 8:45	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	1.9	0.020	%	AM20GAX	bc	11/28/01
Oxygen	15	0.020	%		bc	11/28/01

F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0601		
Lab Sample ID:	F11504-9	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20382.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	7.5	0.10	ppmv		24	0.32	mg/m3
108-88-3		Toluene	29.9	0.10	ppmv		112	0.38	mg/m3
100-41-4		Ethylbenzene	19.5	0.10	ppmv		84.5	0.43	mg/m3
1330-20-7		Xylenes (total)	48.2	0.10	ppmv		209	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	2460	5.0	ppmv		1610	3.3	mg/m3
		TPH (C5-C10) as Pentane	8900	5.0	ppmv		26200	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	107%		69-128%
460-00-4	4-Bromofluorobenzene	96%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-09

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0601	Vapor	14 Nov. 01 8:50	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	9.0	0.020	%	AM20GAX	bc	11/28/01
Oxygen	2.2	0.020	%		bc	11/28/01

F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0402		
Lab Sample ID:	F11504-10	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20383.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	8.1	0.10	ppmv		26	0.32	mg/m3
108-88-3		Toluene	26.6	0.10	ppmv		100	0.38	mg/m3
100-41-4		Ethylbenzene	6.8	0.10	ppmv		29	0.43	mg/m3
1330-20-7		Xylenes (total)	20.7	0.10	ppmv		89.7	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	3470	5.0	ppmv		2270	3.3	mg/m3
		TPH (C5-C10) as Pentane	11300	5.0	ppmv		33300	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	106%		69-128%
460-00-4	4-Bromofluorobenzene	102%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-10

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0402	Vapor	14 Nov. 01 13:10	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	8.8	0.020	%	AM20GAX	bc	11/28/01
Oxygen	3.2	0.020	%		bc	11/28/01

F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0502		
Lab Sample ID:	F11504-11	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20384.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	0.48	0.10	ppmv		1.5	0.32	mg/m3
108-88-3		Toluene	4.0	0.10	ppmv		15	0.38	mg/m3
100-41-4		Ethylbenzene	1.7	0.10	ppmv		7.4	0.43	mg/m3
1330-20-7		Xylenes (total)	7.4	0.10	ppmv		32	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	559	5.0	ppmv		366	3.3	mg/m3
		TPH (C5-C10) as Pentane	974	5.0	ppmv		2870	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	112%		69-128%
460-00-4	4-Bromofluorobenzene	104%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-11

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0502	Vapor	14 Nov. 01 13:15	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	1.3	0.020	%	AM20GAX	bc	11/28/01
Oxygen	15	0.020	%		bc	11/28/01

F11504R, not F11504

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0602		
Lab Sample ID:	F11504-12	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20385.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	7.1	0.10	ppmv		23	0.32	mg/m3
108-88-3		Toluene	28.8	0.10	ppmv		108	0.38	mg/m3
100-41-4		Ethylbenzene	28.1	0.10	ppmv		122	0.43	mg/m3
1330-20-7		Xylenes (total)	63.6	0.10	ppmv		276	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	2450	5.0	ppmv		1600	3.3	mg/m3
		TPH (C5-C10) as Pentane	8470	5.0	ppmv		24900	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	113%		69-128%
460-00-4	4-Bromofluorobenzene	101%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-12

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0602	Vapor	14 Nov. 01 13:20	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	9.0	0.020	%	AM20GAX	bc	11/28/01
Oxygen	1.7	0.020	%		bc	11/28/01

F11504R, not F11504

CHAIN OF CUSTODY

ACCUTEST

4405 VINELAND ROAD • SUITE C-15
ORLANDO, FL 32811
TEL: 407-425-6700 • FAX: 407-425-0707

ACCUTEST JOB #: F11504
ACCUTEST QUOTE #: 00

CLIENT INFORMATION

NAME: Tetra Tech Nus, Inc.
ADDRESS: 1401 Oven Park Dr. STE 102
CITY, STATE, ZIP: Tallahassee FL 32312
SEND REPORT TO: Paul Calligan
PHONE #: (850) 385-9499

FACILITY INFORMATION

PROJECT NAME: 1438 Treatability Study
LOCATION: Site 1438, NAS Whiting Field
PROJECT NO.: N6038 KS005 0105
FAX #:

ANALYTICAL INFORMATION

BTEX/TPH/GRO EPA 10-3

MATRIX CODES

DW - DRINKING WATER
GW - GROUND WATER
WW - WASTE WATER
SO - SOIL
SL - SLUDGE
OI - OIL
LIQ - OTHER LIQUID
SOL - OTHER SOLID

ACCUTEST SAMPLE #	FIELD ID / POINT OF COLLECTION	COLLECTION DATE	COLLECTION TIME	SAMPLED BY:	MATRIX	# OF BOTTLES	PRESERVATION HCl	NaOH	HNO3	H2SO4	NONE	BTEX/TPH/GRO EPA 10-3	LAB USE ONLY
1	WHF 1438 ELM 0101	11/13/01	1401	JF	Air	1					X	X	
2	WHF 1438 ELM 0201	11/13/01	1404	JF		1					X	X	
3	WHF 1438 ELM 0301	11/13/01	1406	JF		1					X	X	
4	WHF 1438 ELM 0102	11/13/01	1810	JF		1					X	X	
5	WHF 1438 ELM 0202	11/13/01	1812	JF		1					X	X	
6	WHF 1438 ELM 0302	11/13/01	1814	JF		1					X	X	
7	WHF 1438 ELM 0401	11/14/01	0840	JF		1					X	X	
8	WHF 1438 ELM 0501	11/14/01	0845	JF		1					X	X	
9	WHF 1438 ELM 0601	11/14/01	0850	JF		1					X	X	
10	WHF 1438 ELM 0402	11/14/01	1310	JF		1					X	X	
11	WHF 1438 ELM 0502	11/14/01	1315	JF		1					X	X	
12	WHF 1438 ELM 0602	11/14/01	1320	JF		1					X	X	

DATA TURNAROUND INFORMATION

- [x] STANDARD
- [ ] 48 HOUR RUSH
- [ ] 24 HOUR EMERGENCY
- [ ] OTHER

APPROVED BY:

EMERGENCY OR RUSH IS FAX DATA UNLESS PREVIOUSLY APPROVED

DATA DELIVERABLE INFORMATION

- [x] STANDARD
- [ ] COMMERCIAL "B"
- [x] DISK DELIVERABLE
- [ ] STATE FORMS
- [ ] OTHER (SPECIFY)

COMMENTS/REMARKS

WR-8

SAMPLE CUSTODY MUST BE DOCUMENTED BELOW EACH TIME SAMPLES CHANGE POSSESION, INCLUDING COURIER DELIVERY

RELINQUISHED BY SAMPLER:	DATE TIME:	RECEIVED BY:	RELINQUISHED BY:	DATE TIME:	RECEIVED BY:
1. [signature]	1432 / 11/14/01	1.	2.		2. [signature] 11/15/01 - 0900
RELINQUISHED BY: 3.	DATE TIME:	RECEIVED BY: 3.	RELINQUISHED BY: 4.	DATE TIME:	RECEIVED BY: 4.
RELINQUISHED BY: 5.	DATE TIME:	RECEIVED BY: 5.	SEAL #	PRESERVE WHERE APPLICABLE ☐	ON ICE ☐ TEMPERATURE [illegible] C

ACCUTEST

AIR.

CHAIN OF CUSTODY

4405 VINELAND ROAD • SUITE C-15
ORLANDO, FL 32811
TEL: 407-425-6700 • FAX: 407425-0707

ACCUTEST JOB #:

ACCUTEST QUOTE #: 29

CLIENT INFORMATION

NAME: AISE

ADDRESS:

CITY, STATE, ZIP:

SEND REPORT TO:
PHONE #:

FACILITY INFORMATION

PROJECT NAME: F11504-

LOCATION:

PROJECT NO.:

FAX #:

ANALYTICAL INFORMATION

EPA TO3 BTEX tpH GND

MATRIX CODES

DW- DRINKING WATER
GW - GROUND WATER
WW - WASTE WATER
SO- SOIL
SL - SLUDGE
OI- OIL
LIQ - OTHER LIQUID
SOL - OTHER SOLID

ACCUTEST SAMPLE #	FIELD ID / POINT OF COLLECTION	COLLECTION DATE	COLLECTION TIME	SAMPLED BY:	MATRIX	# OF BOTTLES	PRESERVATION HCl	NaOH	HNO3	H2SO4	NONE	EPA TO3 BTEX tpH GND	LAB USE ONLY
	F11504-1	11/13/01	1401	TTUMS	AIR	1					X	X	
	-2		1404			1							
	-3		1406			1							
	-4		1810			1							
	-5		1812			1							BS
	-6		1814			1							
	-7	11/14/01	0940			1							
	-8		0845			1							
	-9		0850			1							
	-10		1310			1							
	-11		1315			1							
	-12		1320			1							

DATA TURNAROUND INFORMATION

- ☐ STANDARD
- ☐ 48 HOUR RUSH
- ☐ 24 HOUR EMERGENCY
- ☐ OTHER

APPROVED BY:

EMERGENCY OR RUSH IS FAX DATA UNLESS PREVIOUSLY APPROVED

DATA DELIVERABLE INFORMATION

- ☐ STANDARD
- ☐ COMMERCIAL "B"
- ☐ DISK DELIVERABLE
- ☐ STATEFORMS
- ☐ OTHER (SPECIFY)

COMMENTS/REMARKS

-11 received partially deflated / mJB 11-16-01
ALUJ

SAMPLE CUSTODY MUST BE DOCUMENTED BELOW EACH TIME SAMPLES CHANGE POSSESION, INCLUDING COURIER DELIVERY

RELINQUISHED BY:	DATE TIME:	RECEIVED BY:	RELINQUISHED BY:	DATE TIME:	RECEIVED BY:
1. James Bazzel	11/15/01-1600	1. FedEx	2. FedEx	11-16-01 1000	2.
3.		3.	4.		4.
5.		5.	SEAL #	PRESERVE WHERE APPLICABLE ☐	ON ICE ☐ TEMPERATURE ____ C

Tetra Tech NUS, Inc. **Internal Correspondence**

TO: Mr. Paul Calligan **DATE:** February 20, 2002

FROM: Michael T. Akers **CC:** File

SUBJECT: Organic Data Validation – Carbon Dioxide (%CO2) and Oxygen (%O2)
CTO200 – NAS Whiting Field
SDG F11504R

SAMPLES: 12/Air

WHF 1438 ELM-0101	WHF 1438 ELM-0102	WHF 1438 ELM-0201
WHF 1438 ELM-0202	WHF 1438 ELM-0301	WHF 1438 ELM-0302
WHF 1438 ELM-0401	WHF 1438 ELM-0402	WHF 1438 ELM-0501
WHF 1438 ELM-0502	WHF 1438 ELM-0601	WHF 1438 ELM-0602

OVERVIEW

The sample set for CTO200 SDG F11504R; Naval Air Station Cecil Field, Jacksonville, Florida consists of twelve (12) air samples. The samples were analyzed for Carbon Dioxide and Oxygen.

The samples were collected by Tetra Tech NUS on November 13th and 14th, 2001 and analyzed by Accutest Southeast Laboratories, Inc. All analyses were performed in accordance with Naval Facilities Engineering Service Center (NFESC) Quality Assurance/Quality Control (QA/QC) criteria and analyzed according to Microseeps' Method AM20GAx analytical and reporting protocols. The data in this SDG was validated with regard to the following parameters:

* • Data Completeness
  • Holding Times
* • Laboratory method/field quality control blank results
* • Detection Limits

The symbol (*) indicates that all quality control criteria were met for this parameter.

Carbon Dioxide and Oxygen Fraction:

Method AM20GAx has no written holding time associated with it. Laboratory recommended holding time was stated to be 14 days. It should be noted that samples associated with this SDG were analyzed on day 15, and have been qualified with a "H" for holding time exceedance.

Executive Summary

Laboratory performance:	All samples associated with this SDG were analyzed outside of laboratory recommended holding time.
Other factors affecting data quality:	None.

The data for these analyses were reviewed with reference to the EPA Functional Guidelines for Organic Data Validation (February, 1996), and the NFESC guidelines "Navy Installation Restoration Chemical Data Quality Manual" (September, 1999). The text of the report has been formulated to address only those problems affecting data quality.

"I attest that the data referenced herein was validated according to the agreed upon validation criteria as specified in the NFESC Guidelines and the Quality Assurance Project Plan (QAPP)."

Michael T. Akers

Project Chemist
Tetra Tech NUS, Inc.

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, Orlando
SDG: F11504R

SAMPLE NUMBER:	WHF-1438-ELM-0101	WHF-1438-ELM-0102	WHF-1438-ELM-0201	WHF-1438-ELM-0202
SAMPLE DATE:	11/13/01	11/13/01	11/13/01	11/13/01
LABORATORY ID:	F11504R-1	F11504R-4	F11504R-2	F11504R-5
QC_TYPE:	NORMAL	NORMAL	NORMAL	NORMAL
% SOLIDS:	100.0 %	100.0 %	100.0 %	100.0 %
FIELD DUPLICATE OF:				

	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
INORGANIC PARAMETERS												
CARBON DIOXIDE(%)	9.8	J	H	9.6	J	H	7.6	J	H	4.2	J	H
OXYGEN(%)	3.9	J	H	3.7	J	H	12	J	H	14	J	H

CTO200-NAS WHITING FIELD
AIR DATA
Accutest, Orlando
SDG: F11504R

SAMPLE NUMBER:	WHF-1438-ELM-0301			WHF-1438-ELM-0302			WHF-1438-ELM-0401			WHF-1438-ELM-0402		
SAMPLE DATE:	11/13/01			11/13/01			11/13/01			11/13/01		
LABORATORY ID:	F11504R-3			F11504R-6			F11504R-7			F11504R-10		
QC_TYPE:	NORMAL			NORMAL			NORMAL			NORMAL		
% SOLIDS:	100.0 %			100.0 %			100.0 %			100.0 %		
FIELD DUPLICATE OF:												
	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
INORGANIC PARAMETERS												
CARBON DIOXIDE(%)	3.4	J	H	4.3	J	H	7.6	J	H	8.8	J	H
OXYGEN(%)	17	J	H	16	J	H	5	J	H	3.2	J	H

SAMPLE NUMBER:	WHF-1438-ELM-0501	WHF-1438-ELM-0502	WHF-1438-ELM-0601	WHF-1438-ELM-0602
SAMPLE DATE:	11/13/01	11/13/01	11/13/01	11/13/01
LABORATORY ID:	F11504R-8	F11504R-11	F11504R-9	F11504R-12
QC_TYPE:	NORMAL	NORMAL	NORMAL	NORMAL
% SOLIDS:	100.0 %	100.0 %	100.0 %	100.0 %
FIELD DUPLICATE OF:				

	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE	RESULT	QUAL	CODE
INORGANIC PARAMETERS												
CARBON DIOXIDE(%)	1.9	J	H	1.3	J	H	9	J	H	9	J	H
OXYGEN(%)	15	J	H	15	J	H	2.2	J	H	1.7	J	H

F11504R

HOLDING TIME
01/31/02

Units	Nsample	Lab Id	Qc Type	Sdg	Sort	Samp Date	Extr Date	Anal Date	SAMP_DATE TO EXTR_DATE	EXTR_DATE TO ANAL_DATE	SAMP_DATE TO ANAL_DATE
%	WHF-1438-ELM-0101	F11504R-1	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0102	F11504R-4	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0201	F11504R-2	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0202	F11504R-5	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0301	F11504R-3	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0302	F11504R-6	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0401	F11504R-7	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0402	F11504R-10	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0501	F11504R-8	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0502	F11504R-11	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0601	F11504R-9	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0602	F11504R-12	NORMAL	F11504R	CO2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0101	F11504R-1	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0102	F11504R-4	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0201	F11504R-2	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0202	F11504R-5	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0301	F11504R-3	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0302	F11504R-6	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0401	F11504R-7	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0402	F11504R-10	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0501	F11504R-8	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0502	F11504R-11	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0601	F11504R-9	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15
%	WHF-1438-ELM-0602	F11504R-12	NORMAL	F11504R	O2	11/13/01	11/28/01	11/28/01	15	0	15

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0101		
Lab Sample ID:	F11504-1	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20373.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	30.8	0.10	ppmv		134	0.43	mg/m3
1330-20-7		Xylenes (total)	9.1	0.10	ppmv		39	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	29800	5.0	ppmv		19500	3.3	mg/m3
		TPH (C5-C10) as Pentane	35800	5.0	ppmv		105000	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	116%		69-128%
460-00-4	4-Bromofluorobenzene	99%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-01

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0101	Vapor	13 Nov. 01 11:11	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	9.8	0.020	%	AM20GAX	bc	11/28/01
Oxygen	3.9	0.020	%		bc	11/28/01

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0201		
Lab Sample ID:	F11504-2	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20387.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	39.2	0.10	ppmv		170	0.43	mg/m3
1330-20-7		Xylenes (total)	22.7	0.10	ppmv		98.4	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	10600	5.0	ppmv		6940	3.3	mg/m3
		TPH (C5-C10) as Pentane	14600	5.0	ppmv		43000	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	101%		69-128%
460-00-4	4-Bromofluorobenzene	102%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-02

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0201	Vapor	13 Nov. 01 11:21	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	7.6	0.020	%	AM20GAX	bc	11/28/01
Oxygen	12	0.020	%		bc	11/28/01

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0301		
Lab Sample ID:	F11504-3	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20376.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	13.2	0.10	ppmv		57.2	0.43	mg/m3
1330-20-7		Xylenes (total)	8.6	0.10	ppmv		37	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	46.4	5.0	ppmv		30.4	3.3	mg/m3
		TPH (C5-C10) as Pentane	1790	5.0	ppmv		5270	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	91%		69-128%
460-00-4	4-Bromofluorobenzene	93%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-03

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0301	Vapor	13 Nov. 01 11:27	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	3.4	0.020	%	AM20GAX	bc	11/28/01
Oxygen	17	0.020	%		bc	11/28/01

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0102		
Lab Sample ID:	F11504-4	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20377.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	6.0	0.10	ppmv		26	0.43	mg/m3
1330-20-7		Xylenes (total)	0.68	0.10	ppmv		2.9	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	31400	5.0	ppmv		20500	3.3	mg/m3
		TPH (C5-C10) as Pentane	22600	5.0	ppmv		66600	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	109%		69-128%
460-00-4	4-Bromofluorobenzene	102%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-04

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0102	Vapor	13 Nov. 01 18:10	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	9.6	0.020	%	AM20GAX	bc	11/28/01
Oxygen	3.7	0.020	%		bc	11/28/01

UNCLASSIFIED

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0202		
Lab Sample ID:	F11504-5	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20378.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	25.0	0.10	ppmv		108	0.43	mg/m3
1330-20-7		Xylenes (total)	14.9	0.10	ppmv		64.6	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	13900	5.0	ppmv		9100	3.3	mg/m3
		TPH (C5-C10) as Pentane	15300	5.0	ppmv		45000	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	115%		69-128%
460-00-4	4-Bromofluorobenzene	127%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-05

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0202	Vapor	13 Nov. 01 18:12	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	4.2	0.020	%	AM20GAX	bc	11/28/01
Oxygen	14	0.020	%		bc	11/28/01

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0302		
Lab Sample ID:	F11504-6	**Date Sampled:**	11/13/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20379.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	ND	0.10	ppmv		ND	0.32	mg/m3
108-88-3		Toluene	ND	0.10	ppmv		ND	0.38	mg/m3
100-41-4		Ethylbenzene	2.2	0.10	ppmv		9.5	0.43	mg/m3
1330-20-7		Xylenes (total)	1.6	0.10	ppmv		6.9	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	26.9	5.0	ppmv		17.6	3.3	mg/m3
		TPH (C5-C10) as Pentane	492	5.0	ppmv		1450	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	107%		69-128%
460-00-4	4-Bromofluorobenzene	114%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-06

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0302	Vapor	13 Nov. 01 18:14	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	4.3	0.020	%	AM20GAX	bc	11/28/01
Oxygen	16	0.020	%		bc	11/28/01

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0401		
Lab Sample ID:	F11504-7	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20380.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	8.4	0.10	ppmv		27	0.32	mg/m3
108-88-3		Toluene	28.6	0.10	ppmv		108	0.38	mg/m3
100-41-4		Ethylbenzene	8.9	0.10	ppmv		38	0.43	mg/m3
1330-20-7		Xylenes (total)	32.8	0.10	ppmv		142	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	3570	5.0	ppmv		2340	3.3	mg/m3
		TPH (C5-C10) as Pentane	11900	5.0	ppmv		35000	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	108%		69-128%
460-00-4	4-Bromofluorobenzene	102%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-07

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0401	Vapor	14 Nov. 01 8:41	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	7.6	0.020	%	AM20GAX	bc	11/28/01
Oxygen	5.0	0.020	%		bc	11/28/01

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0501		
Lab Sample ID:	F11504-8	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20381.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	1.0	0.10	ppmv		3.2	0.32	mg/m3
108-88-3		Toluene	8.2	0.10	ppmv		31	0.38	mg/m3
100-41-4		Ethylbenzene	5.2	0.10	ppmv		22	0.43	mg/m3
1330-20-7		Xylenes (total)	23.1	0.10	ppmv		100	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	926	5.0	ppmv		606	3.3	mg/m3
		TPH (C5-C10) as Pentane	1940	5.0	ppmv		5710	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	102%		69-128%
460-00-4	4-Bromofluorobenzene	98%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-08

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0501	Vapor	14 Nov. 01 8:45	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	1.9	0.020	%	AM20GAX	bc	11/28/01
Oxygen	15	0.020	%		bc	11/28/01

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0601		
Lab Sample ID:	F11504-9	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20382.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	7.5	0.10	ppmv		24	0.32	mg/m3
108-88-3		Toluene	29.9	0.10	ppmv		112	0.38	mg/m3
100-41-4		Ethylbenzene	19.5	0.10	ppmv		84.5	0.43	mg/m3
1330-20-7		Xylenes (total)	48.2	0.10	ppmv		209	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	2460	5.0	ppmv		1610	3.3	mg/m3
		TPH (C5-C10) as Pentane	8900	5.0	ppmv		26200	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	107%		69-128%
460-00-4	4-Bromofluorobenzene	96%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-09

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0601	Vapor	14 Nov. 01 8:50	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	9.0	0.020	%	AM20GAX	bc	11/28/01
Oxygen	2.2	0.020	%		bc	11/28/01

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0402		
Lab Sample ID:	F11504-10	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20383.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	8.1	0.10	ppmv		26	0.32	mg/m3
108-88-3		Toluene	26.6	0.10	ppmv		100	0.38	mg/m3
100-41-4		Ethylbenzene	6.8	0.10	ppmv		29	0.43	mg/m3
1330-20-7		Xylenes (total)	20.7	0.10	ppmv		89.7	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	3470	5.0	ppmv		2270	3.3	mg/m3
		TPH (C5-C10) as Pentane	11300	5.0	ppmv		33300	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	106%		69-128%
460-00-4	4-Bromofluorobenzene	102%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-10

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0402	Vapor	14 Nov. 01 13:10	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	8.8	0.020	%	AM20GAX	bc	11/28/01
Oxygen	3.2	0.020	%		bc	11/28/01

MICROTECH

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0502		
Lab Sample ID:	F11504-11	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20384.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	0.48	0.10	ppmv		1.5	0.32	mg/m3
108-88-3		Toluene	4.0	0.10	ppmv		15	0.38	mg/m3
100-41-4		Ethylbenzene	1.7	0.10	ppmv		7.4	0.43	mg/m3
1330-20-7		Xylenes (total)	7.4	0.10	ppmv		32	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	559	5.0	ppmv		366	3.3	mg/m3
		TPH (C5-C10) as Pentane	974	5.0	ppmv		2870	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	112%		69-128%
460-00-4	4-Bromofluorobenzene	104%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-11

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0502	Vapor	14 Nov. 01 13:15	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	1.3	0.020	%	AM20GAX	bc	11/28/01
Oxygen	15	0.020	%		bc	11/28/01

Accutest Laboratories

Report of Analysis

Client Sample ID:	WHF 1438 ELM0602		
Lab Sample ID:	F11504-12	**Date Sampled:**	11/14/01
Matrix:	AIR - Air	**Date Received:**	11/15/01
Method:	TO 3/EPA 18	**Percent Solids:**	n/a
Project:	NAS Whiting Field PO#NOO52-MSA0200-014		

	File ID	DF	Analyzed	By	Prep Date	Prep Batch	Analytical Batch
Run #1	QR20385.D	1	11/16/01	ANJ	n/a	n/a	N:GQR980
Run #2							

Purgeable Aromatics

CAS No.	MW	Compound	Result	RL	Units	Q	Result	RL	Units
71-43-2		Benzene	7.1	0.10	ppmv		23	0.32	mg/m3
108-88-3		Toluene	28.8	0.10	ppmv		108	0.38	mg/m3
100-41-4		Ethylbenzene	28.1	0.10	ppmv		122	0.43	mg/m3
1330-20-7		Xylenes (total)	63.6	0.10	ppmv		276	0.43	mg/m3
1634-04-4		Methyl Tert Butyl Ether	ND	0.10	ppmv		ND	0.36	mg/m3
		TPH (C1-C4) as Methane	2450	5.0	ppmv		1600	3.3	mg/m3
		TPH (C5-C10) as Pentane	8470	5.0	ppmv		24900	15	mg/m3

CAS No.	Surrogate Recoveries	Run# 1	Run# 2	Limits
460-00-4	4-Bromofluorobenzene	113%		69-128%
460-00-4	4-Bromofluorobenzene	101%		69-128%

ND = Not detected
RL = Reporting Limit
E = Indicates value exceeds calibration range

J = Indicates an estimated value
B = Indicates analyte found in associated method blank
N = Indicates presumptive evidence of a compound

Order #: P0111282
Report Date: 11/30/01
Client Proj Name: NAS Whiting Field
Client Proj #: N4038

Client Name: Accutest Labs
Contact: Jennifer Fenell
Address: 4405 South Vineland Road
Suite C15
Orlando, FL 32811

Lab Sample #: P0111282-12

Sample Description	Matrix	Sampled Date/Time	Received
WHF1438 ELM0602	Vapor	14 Nov. 01 13:20	16 Nov. 01

Analyte(s)	Result	PQL	Units	Method #	Analyst	Analysis Date
RiskAnalysis						
Vapor						
Carbon dioxide	9.0	0.020	%	AM20GAX	bc	11/28/01
Oxygen	1.7	0.020	%		bc	11/28/01

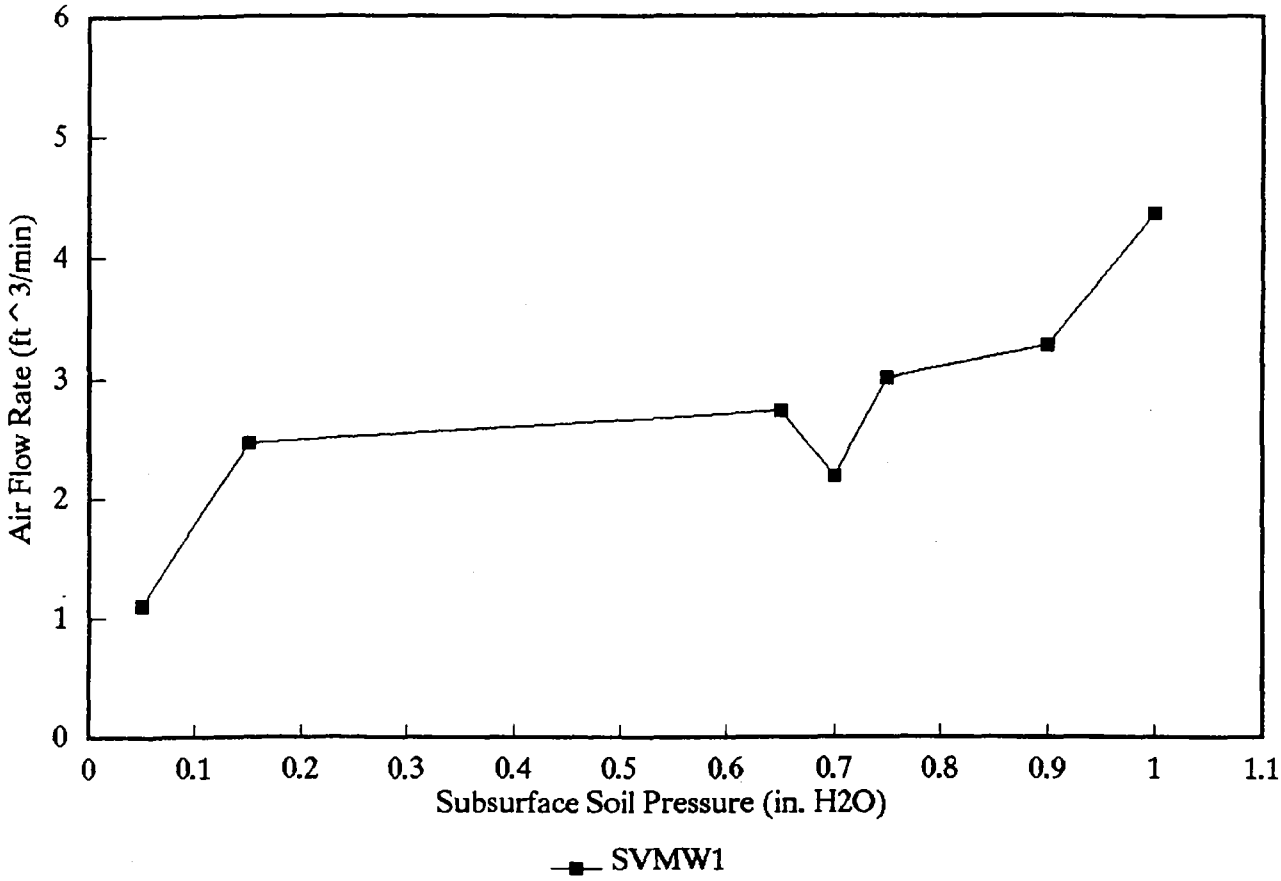
Pressure Test # 1 : Vent Well

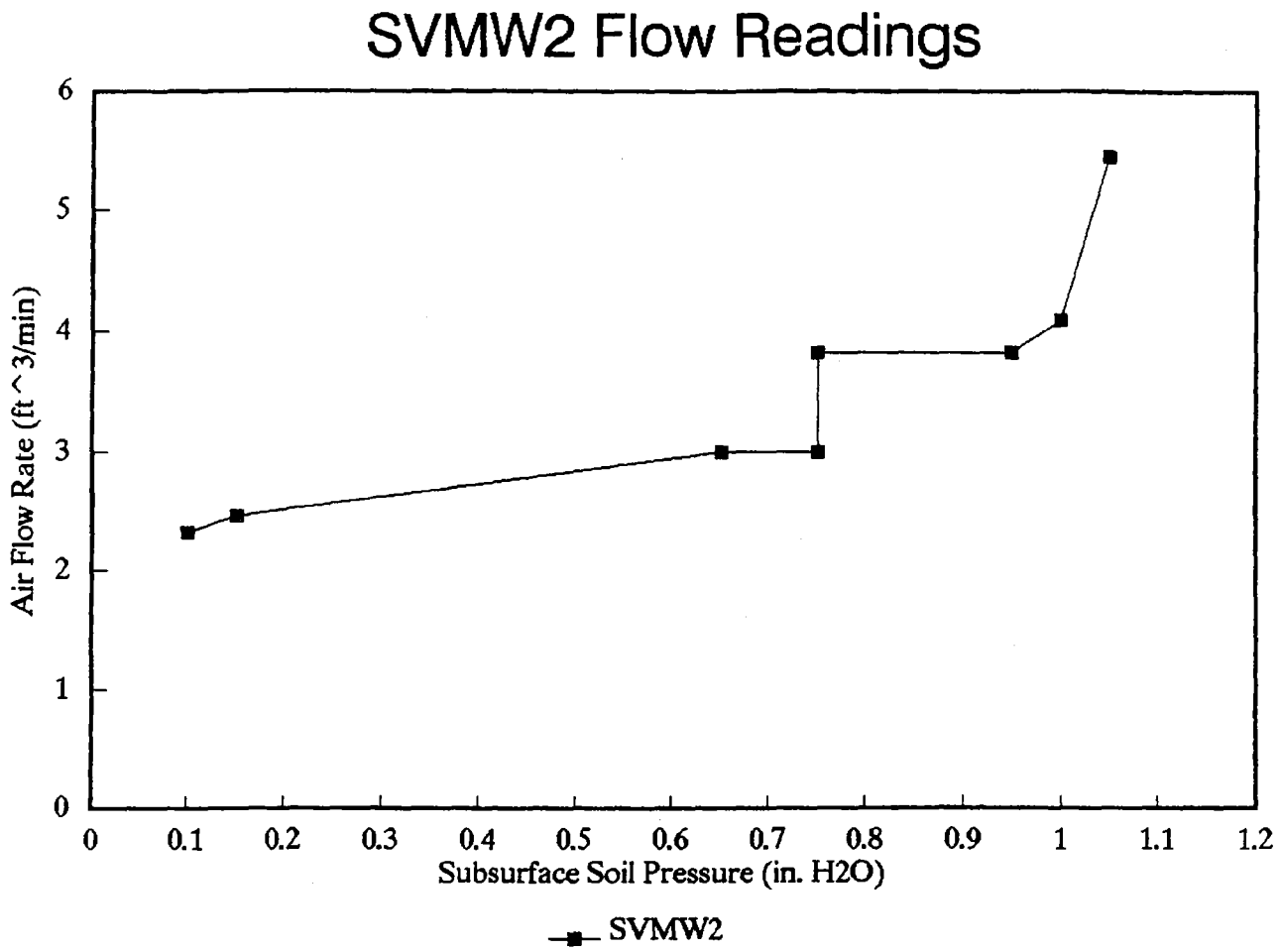
Contained Pressure	Uncontained Flow*	Wellhead Pressure	Wellhead Flow**	
(1) 0.10" H_2O	180 fpm	0.10" H_2O	50 fpm	
	150 fpm			
(2) 0.10" H_2O	150 fpm	0.10" H_2O	50 fpm	
(3) 0.20" H_2O	225 fpm.	0.15" H_2O	75 fpm	
(4) 1.0" H_2O	450 fpm	0.5" H_2O	150 fpm.	

Pressure Test # 2 : Inlet Well

Contained	Uncontained Flow*	Wellhead Pressure	Wellhead Flow**	
(1) 0.10" H_2O	200 fpm	0.10" H_2O	0 fpm	
(2) 1" H_2O	450 fpm	1" H_2O	0 fpm	
(3) 0.20" H_2O	225 fpm	0.2" H_2O	0 fpm	

SVMW1 Flow Readings




SVMW2 Flow Readings
Air Flow Rate (ft^3/min)
0
1
2
3
4
5
6
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
Subsurface Soil Pressure (in. H2O)
SVMW2

4.0 TEST WELLS AND EQUIPMENT

This section describes the test wells and equipment that are required to conduct the field treatability tests. It must be recognized that site-specific flexibility will be required, and thus, details will vary. Local and/or state regulatory agencies and at times individual Air Force bases will have specific requirements that differ from specifications in this test plan. All testing must comply with regulations, and must be acceptable to the host base.

Field notes will be maintained describing all vent well and monitoring point construction. Deviations from standard design will be noted in the final report.

4.1 Vent Wells

A vent well and blower system will be established to provide airflow through the subsurface, creating a pressure/vacuum gradient for air permeability testing and increasing subsurface oxygen levels for in situ respiration testing. This 2- to 4-in. vent well will be placed with the screened section in contaminated soil and will be located near the center of the fuel spill. The siting and construction of tile venting well will follow these general criteria:

1. The vent well will be sited as near to the center of the spill area as possible.
   This location will ensure that data gathered from the test will be as representative as possible of contaminated soil conditions. On many small sites, the vent well used during the treatability test can be converted into the primary vent well for extended testing.

2. The diameter of the vent well may vary between 2 and 4 in. and will depend on the ease of drilling and the area and depth of the contaminated volume. On most sites a 2-in.diameter vent will provide adequate airflow for air permeability/radius of influence testing. For sites with contamination extending below 30 ft, a 3- or 4-in. vent well is recommended. The cost of a larger well is a minor component of the total drilling cost because a drill rig will be required to drill to this depth, regardless of well diameter. Groundwater monitoring points screened several ft above the existing water table can also be converted to vent wells. This option is appropriate for air injection systems but will be less successful for air extraction systems because the applied vacuum will cause a rise in the water table which could rapidly submerge the screened interval.

3. The vent well will normally be constructed of schedule 40 polyvinyl chloride (PVC), and will be screened with a slot size that maximizes airflow through the soil. The screened interval will extend through as much of the contaminated profile as possible, with the bottom of the screen corresponding to the top of the capillary fringe. For shallow sites with groundwater less than 20 ft deep, the vent well will be screened over the bottom half of the unsaturated zone. For deeper wells, care must be taken in determining the depth of the top of the screen. A deeper screen is normally better. If the top of the screen is close to the ground surface, much of the airflow may follow the shortest path from near the top of the screen to the ground surface.

4. Hollow-stem augering is the recommended drilling method; however, a solid-stem auger is also acceptable in more cohesive soils. Whenever possible, the diameter of the annular space will be at least two times greater than the vent well outside diameter. The annular space corresponding to the screened interval will be filled with silica sand or equivalent. In shallow softer soils, hand-augering may be feasible. The annular space above the screened interval will be sealed with wet bentonite and grout to prevent short-circuiting of air to or from the surface. Figure 4-1 shows a typical vent well.

4.2 Soil Gas Monitoring Points

Soil gas monitoring points will be used for pressure and soil gas measurements and will be installed at a minimum of three locations, and at each location to at least three depths. The total number will vary, with up to six monitoring point locations, and six or more depths, depending on site conditions.

To the extent possible the monitoring points will be located in contaminated soils with >1,000 mg/kg of total petroleum hydrocarbon. These soils will have a strong odor and will feel oily to the touch. It may not be possible to locate all monitoring points in contaminated soil, especially the points furthest from the vent well. If this is the case, it is important to ensure that the point closest to the vent well be located in contaminated soil, and if possible, the intermediate point be placed in contaminated soils. If no monitoring points are located in contaminated soil, no meaningful in situ respiration test can be conducted. If the initial oxygen levels in the soil gas are not low, i.e., below 2 to 5%, and the soil gas hydrocarbon levels are not high, say above 10,000 ppm for relatively fresh JP-4 fuel, the monitoring point may not be suitable for an in situ respiration test.

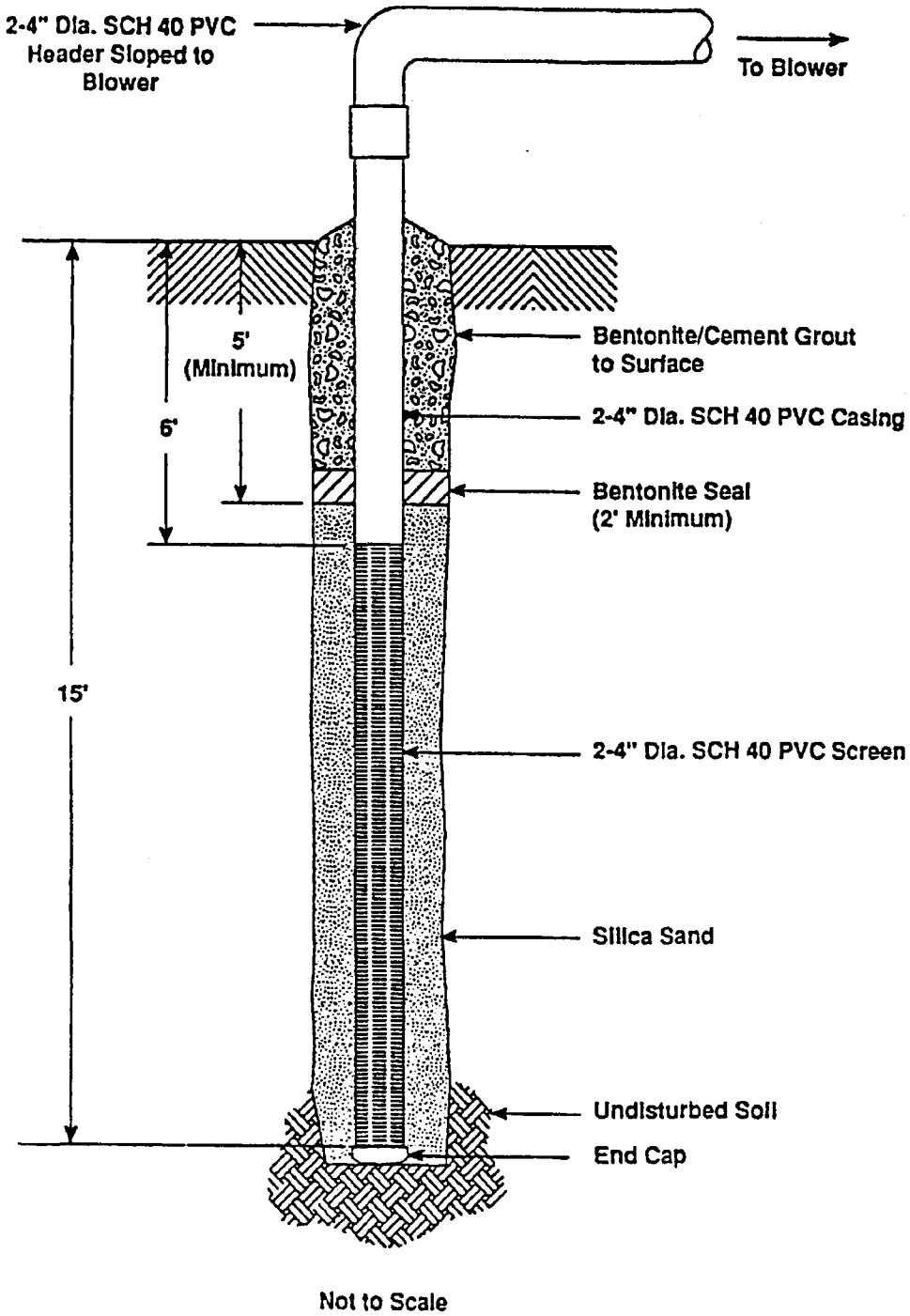


Figure 4-1. Typical Injection/Vacuum Venting Well Construction.

Higher oxygen concentrations would indicate that the microbial activity is not oxygen-limited or that there is sufficient exchange of air with the atmosphere to keep the soil gas well-aerated. In either case, bioventing will not increase biodegradation rates. At some sites, where less contaminated soils and low O2 concentrations are encountered, bioventing may still be feasible. If these conditions are found, care must be taken to place the monitoring points in the most contaminated soil possible.

4.2.1 Location of Monitoring Points

A minimum of 3 monitoring points is recommended; ideally these will be in a straight line and at the intervals recommended in Table 4-1. In an unobstructed heterogeneous site, 3 monitoring points at these spacings are appropriate. Additional monitoring point locations may be necessary for a variety of site-specific reasons including, but not limited to, spatial heterogeneities, obstructions, or the desire to monitor a specific location. Additional discussion related to monitoring point placement is found in Section 5.0, Test Procedures.

4.2.2 Depth of Monitoring Points

In general, each monitoring point will be screened to at least 3 depths. The deepest screen will be placed either at or near the bottom of contamination if a water table is not encountered, or a minimum of 2 to 3 ft above the water table if it is encountered. Consideration will be given to potential seasonal water table fluctuations and soil type in finalizing the depth. In a more permeable soil the monitoring point can be screened closer to the water table. In a less permeable soil it must be screened further above the water table. The shallowest screen will normally be 3 to 5 ft below land surface. The intermediate screen will be placed at a reasonable interval at a depth corresponding to the center to upper 1/4 of the depth of the vent well screen.

As an example, in a sandy soil with groundwater at 30 ft and a vent well screened from 17.5 to 27.5 ft below land surface, reasonable screened depths for the monitoring points would be 28 ft, 22.5 ft, and 3 ft. For sites with vent wells deeper than 30 ft, more depths may be screened. depending on stratigraphy.

It will be necessary in some cases to add additional screened depths to ensure a well-oiled soil is encountered, to monitor differing stratigraphic intervals, or to adequately monitor deeper sites with broadly screened vent wells. If air injection is being considered in the bioventing test, a monitoring point must be located between the vent well and any buildings that may be at risk to assure that they are well beyond the radius of influence.

TABLE 4-1. Recommended Spacing for Monitoring Points

Soil Type	Depth to Top of Vent Well Screen (ft)[1]	Spacing Interval (ft)[2]
Coarse Sand	5	5-10-20
	10	10-20-40
	>15	20-30-60
Medium Sand	5	10-20-30
	10	15-25-40
	>15	20-40-60
Fine Sand	5	10-20-40
	10	15-30-60
	>15	20-40-80
Silts	5	10-20-40
	10	15-30-60
	>15	20-40-80
Clays	5	10-20-30
	10	10-20-40
	>15	15-30-60

(1) Assuming 10 ft of vent well screen, if more screen is used, the >15-ft spacing will be used.

(2) Note that monitoring point intervals are based on a venting flow rate range of 1 cfm/ft screened interval for clays to 3 cfm/ft screened interval for coarse sands.

4.2.3 Construction of Monitoring Points

Most state and local regulatory agencies do not regulate unsaturated zone soil gas monitoring point construction. Nevertheless, prior to construction it is necessary to check with regulators to assure compliance with any regulations that may exist.

Soil Gas Permeability (Dynamic Method)

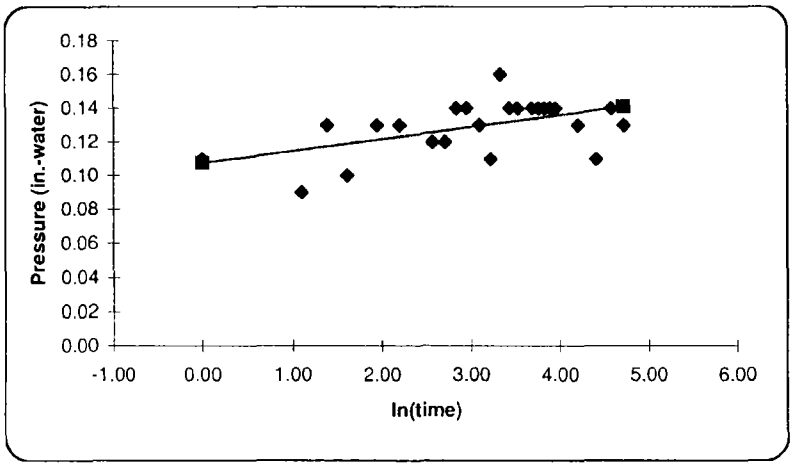
Site Name: Site 1438/1439

Operator(s): JF & LM

Date: ######

Volumetric flow rate from the vent well (cm^3/s)	Q	2360.00
Stratum thickness, generally the vent well screened interval (cm)	m	152.40
Viscosity of Air (1.80×10^{-04} g/cm-s at 64.4 °F (18 °C)	μ	1.80E-04

Elapsed Time (min.)	ln(time)	Vacuum (inches of water) at Monitoring Points (MPs)								
		MP-1	MP-2	MP-3	MP-4	MP-5	MP-6	MP-7	MP-8	MP-9
0.00		0.02	0.00							
1.00	0.00	0.11	0.03							
3.00	1.10	0.09	0.03							
4.00	1.39	0.13	0.05							
5.00	1.61	0.10	0.03							
7.00	1.95	0.13	0.03							
9.00	2.20	0.13	0.03							
13.00	2.56	0.12	0.03							
15.00	2.71	0.12	0.03							
17.00	2.83	0.14	0.05							
19.00	2.94	0.14	0.05							
22.00	3.09	0.13	0.03							
25.00	3.22	0.11	0.03							
28.00	3.33	0.16	0.05							
31.00	3.43	0.14	0.03							
34.00	3.53	0.14	0.02							
40.00	3.69	0.14	0.02							
43.00	3.76	0.14	0.02							
46.00	3.83	0.14	0.02							
49.00	3.89	0.14	0.02							
52.00	3.95	0.14	0.02							
67.00	4.20	0.13	0.01							
82.00	4.41	0.11	0.01							
97.00	4.57	0.14	0.01							
112.00	4.72	0.13	0.01							



MP: MP-1

Permeability, k
3129764 darcy

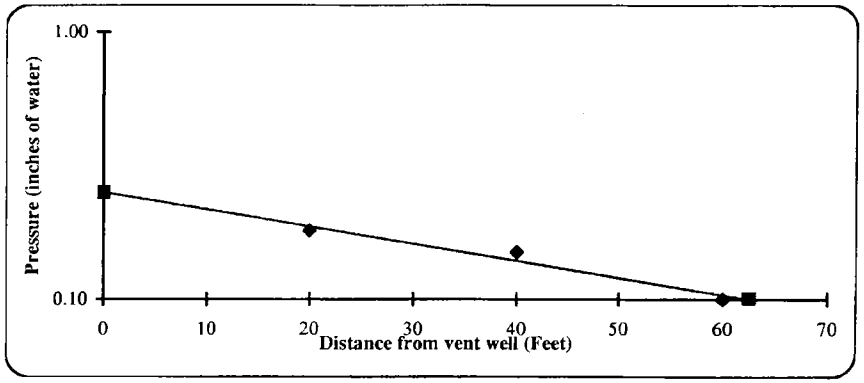
Radius of Influence

Site Name: Site 1438/1439 **Operator(s):** JF & LM **Date:** 11/21/01

MP	MP1	MP2	MP3				MPC	MPC	MPC	MPD	MPD	MPD	MPE	MPE	MPE
Depth	35.0'	35.0'	35.0'												
Distance (ft)	20.00	40.00	60.00												
Time (min)	Vacuum (inches of H_20)														
0.0 ○	0.07	0.06	0.02												
14.0 ○	0.11	0.09	0.02												
32.0 ○	0.05	0.02	0.01												
45.0 ○	0.13	0.11	0.06												
61.0 ◉	0.18	0.15	0.10												
90.0 ○	0.32	0.29	0.24												
120.0 ○	0.59	0.55	0.52												
150.0 ○	0.88	0.80	0.76												
180.0 ○	1.10	1.09	1.02												
240.0 ○	1.21	1.18	1.12												

R_I (ft): _____

Regression Statistics	
Slope	-0.006
Intercept	0.2506
Determination Coef.	0.9542
No. of Data Points	3



Soil Gas Permeability (Dynamic Method)

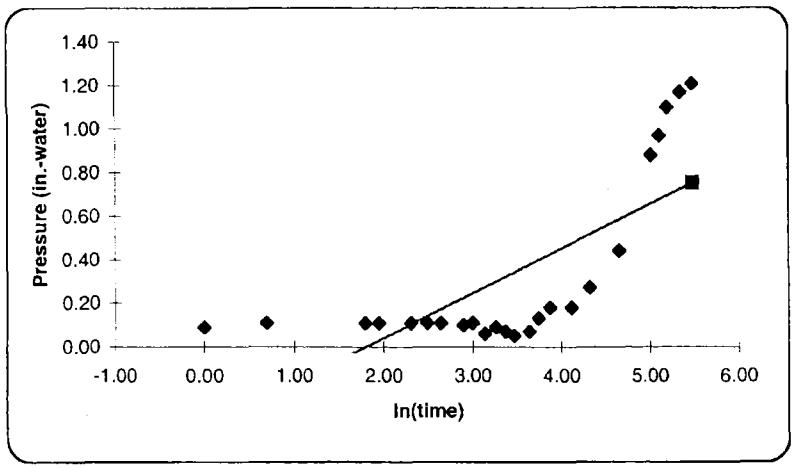
Site Name: Site 1438/1439

Operator(s): JF & LM

Date: ######

Volumetric flow rate from the vent well (cm^3/s)	Q	2360.00
Stratum thickness, generally the vent well screened interval (cm)	m	152.40
Viscosity of Air (1.80×10^{-04} g/cm-s at 64.4 °F (18 °C)	μ	1.80E-04

Elapsed Time (min.)	ln(time)	Vacuum (inches of water) at Monitoring Points (MPs)								
		MP-1	MP-2	MP-3	MP-4	MP-5	MP-6	MP-7	MP-8	MP-9
0.00					0.07	0.06	0.02			
1.00	0.00				0.09	0.06	0.05			
2.00	0.69				0.11	0.07	0.03			
6.00	1.79				0.11	0.07	0.03			
7.00	1.95				0.11	0.07	0.02			
10.00	2.30				0.11	0.06	0.02			
12.00	2.48				0.11	0.06	0.00			
14.00	2.64				0.11	0.09	0.02			
18.00	2.89				0.10	0.07	0.02			
20.00	3.00				0.11	0.07	0.02			
23.00	3.14				0.06	0.03	0.00			
26.00	3.26				0.09	0.05	0.01			
29.00	3.37				0.07	0.02	0.01			
32.00	3.47				0.05	0.02	0.02			
38.00	3.64				0.07	0.03	0.01			
42.00	3.74				0.13	0.11	0.06			
48.00	3.87				0.18	0.15	0.10			
61.00	4.11				0.18	0.15	0.10			
75.00	4.32				0.27	0.24	0.19			
105.00	4.65				0.44	0.40	0.35			
150.00	5.01				0.88	0.80	0.76			
165.00	5.11				0.97	0.96	0.92			
180.00	5.19				1.10	1.09	1.02			
210.00	5.35				1.17	1.14	1.07			
240.00	5.48				1.21	1.18	1.12			



MP: MP-4

Permeability, k	
108341.7	darcy

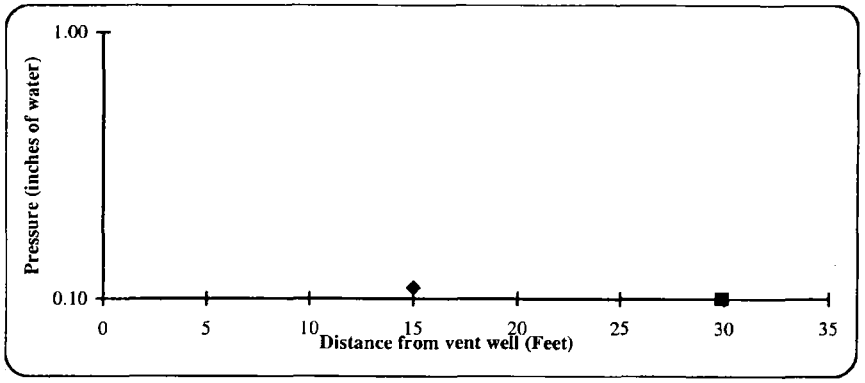
Radius of Influence

Site Name: Site 1438/1439 **Operator(s):** A. BB **Date:** 3/15/96

MP	MP1	MP2
Depth	10.0'	10.0'
Distance (ft)	15.00	30.00
Time (min)	Vacuum (inches of H_20)	
0.0 ○	0.02	0.00
5.0 ○	0.10	0.03
8.0 ○	0.13	0.03
19.0 ○	0.14	0.05
34.0 ○	0.14	0.02
40.0 ○	0.14	0.02
46.0 ○	0.14	0.02
52.0 ○	0.14	0.02
82.0 ◉	0.11	0.01
112.0 ○	0.13	0.01

R_I (ft): 29.90

Regression Statistics	
Slope	0.1333
Intercept	1E-05
Determination Coef.	0.5647
No. of Data Points	3



SOIL RESPIRATION TEST
NAS Whiting Field, Site 2894

Soil Respiration Testing Procedure

Prior to designing a soil remediation system, a respiration test was performed on the three soil zones using the test wells for the soil permeability test.

The testing procedure is as follows:

- Using the same blower/test well setup as the permeability test, an additional 40 hours of air injection into the soil zone was added to the eight hour permeability test. This helps to more fully oxygenate the soil over the area of concern.
- During these 40 hours, periodic oxygen and carbon dioxide percentages of the total soil gas were measured. To do this, an existing well volume of air was evacuated from the test well using a vacuum pump. Then using a soil gas analyzer, the percent of oxygen and carbon dioxide were measured for each monitoring point well.
- Following the additional 40 hours of air injection, the blower assembly was removed and oxygen and carbon dioxide percentages in total soil gas were measured periodically for a total of three days to determine the oxygen consumption rate.
- Values for oxygen consumption rate and biodegradation rate are calculated using the methods below.

Data Analysis

The following methods for respiration test data evaluation are presented in the Test Plan and Technical Protocol for a Field Treatability Test for Bioventing, published by the Air Force Center for Environmental Excellence (AFCEE) in May 1992. Test data and calculations are presented in the following spreadsheets. Oxygen utilization rates are determined from the data obtained during the bioventing tests. The rates of oxygen utilization for each soil zone are calculated at the percent of oxygen change over time. The respiration test produced an oxygen utilization rate of 1.0 $\%O_2$/hr at the test well, an oxygen utilization rate of 0.5 $\%O_2$/hr at 15 feet from the test well, and an oxygen utilization rate of 0.9 $\%O_2$/hr at 30 feet from the test well. This gives an average oxygen consumption rate of 0.8 $\%O_2$/hr.

Biodegradation rates of hydrocarbon can be determined using the oxygen utilization rate. The following stoichiometric relationship for the oxidation of the hydrocarbon will be used. Hexane will be used as a representative hydrocarbon to determine the biodegradation rate.

$$C_6H_{14} + 9.5O_2 \rightarrow 6CO_2 + 7H_2O$$

Using the oxygen utilization rate of 0.8 $\%O_2$/hr the biodegradation rate may be

calculated using the following equation.

$$K_B = -K_o\ A\ D_o\ C/100$$

Where:

K_B = biodegradation rate (mg TPH/kg day)
K_O = oxygen utilization rate (percent per day)
A = volume of air/kg of soil (l/kg)
D_O = density of oxygen gas (mg/l)
C = Mass ratio of hydrocarbon to oxygen required for mineralization.

To perform this equation the following assumptions are made:

- soil porosity of 0.25,
- soil bulk density of 1,440 kg/m^3,
- oxygen density of 1,330 mg/l (varies with temperature, altitude, and atmospheric pressure), and
- hydrocarbon-to-oxygen ratio of 1/3.5 from the stoichiometric equation above.

Based on these assumptions the term A, volume of air/kg of soil, is calculated to be 0.17 by the following equation.

$$A = \frac{1}{SoilBulkDensity\frac{kg}{m^3}} \times 1000\frac{liters}{m^3} \times Porosity$$

The resulting biodegradation equation is:

$$K_b = -(K_o)(0.17\frac{l}{kg})(1330\frac{mg}{l})(1/3.5)/100$$

FILL ZONE SOIL RESPIRATION TEST DATA ANALYSIS -- BIODEGRADATION RATE CALCULATION
NAS Whiting Field, Site 2894

Date: August 16, 1995 Engineer: BGS Checked by:

Symbol	Value	Units	Description	Source
hy mass	86	grams	Grams Hexane from stoichiometric equation	calculated
Oxy mass	304	grams	Grams Oxygen from stoichiometric equation	calculated
C	0.28	unitless	Oxygen Hydrocarbon Mineralization Constant	calculated
Do	1330	mg/l	Density of Oxygen Gas	given
p	0.25	unitless	Porosity	assumed
kg soil	1440	kg/m^3	Bulk Density of Soil	assumed
A	0.17	l/kg	Volume of Air Per kg of Soil	calculated
Ko	1.94	%/Day	Percent of O2 Consumption per Day	calculated
Kb	*-1.26723*	*mg TPH/kg day*	*Biodegradation Rate*	calculated

WHT_2894.RAP
DLH.10.95

SAND SOIL ZONE RESPIRATION TESTS

5-19-95 0915 HOURS

TIME	SVRW2 (SAND ZONE)			SVMW1 (SAND ZONE)			SVMW2 (SAND ZONE)			SVMW3 (SAND ZONE)			SVMW4 (SAND ZONE)		
(Hour)	CH4	CO2	O2	CH4	CO2	O2	CH4	CO2	O2	CH4	CO2	O2	CH4	CO2	O2
-48															
-40				1.8	16.3	2	0.6	0.5	20.2	0.1	7.8	9	0.1	8.8	3.2
-25				1.8	6.9	12.6	0.2	0	20.5	0.2	8.4	8.8	0.4	9.6	3.3
-16				1.9	4.5	15	0.4	0	20.6	0.1	6.3	14	0	9.2	3.4
0	0	0	20.4	1.7	3.4	16.5	0.8	0	20.5	0.1	1.1	19.6	0	9.5	3.4
7	0	0	20.4	1.8	5.3	14	0.4	0	20.5	0	1.1	19.4	0	9	3.5
12	0	0	20.5	0	0	20.6	0	0	20.6	0	0	20.5	0	8.8	4.1
24	0	0	20.8	1.4	6.5	12.6	0.5	0.1	20.2	0	2.2	18.1	0	9	3.6
30	0	0	20.6	1.7	6.5	12.1	0.6	0	20.1	0.1	1.6	18.2	0	7.6	5.1
36	0.1	0	20.3	1.9	6.7	12.5	0.5	0.2	20	0.1	2.1	17.9	0	0	20.3
48	0.1	0	21	1.7	6.7	11.9	0.1	0.7	19.5	0.2	2.4	17.6	0	7.5	4.7
60	0.1	0	20	1.5	7.2	11	0.8	0.6	19.2	NA	NA	NA	NA	NA	NA
72	0.1	0	20.8	1.6	7.4	10.6	0.3	0	21.1	0.1	3.5	16.2	0	7.6	4.2
Oxygen Utilization			-0.01 %			0.08 %			-0.01 %			0.05 %			-0.01 %

FILL SOIL ZONE RESPIRATION TEST

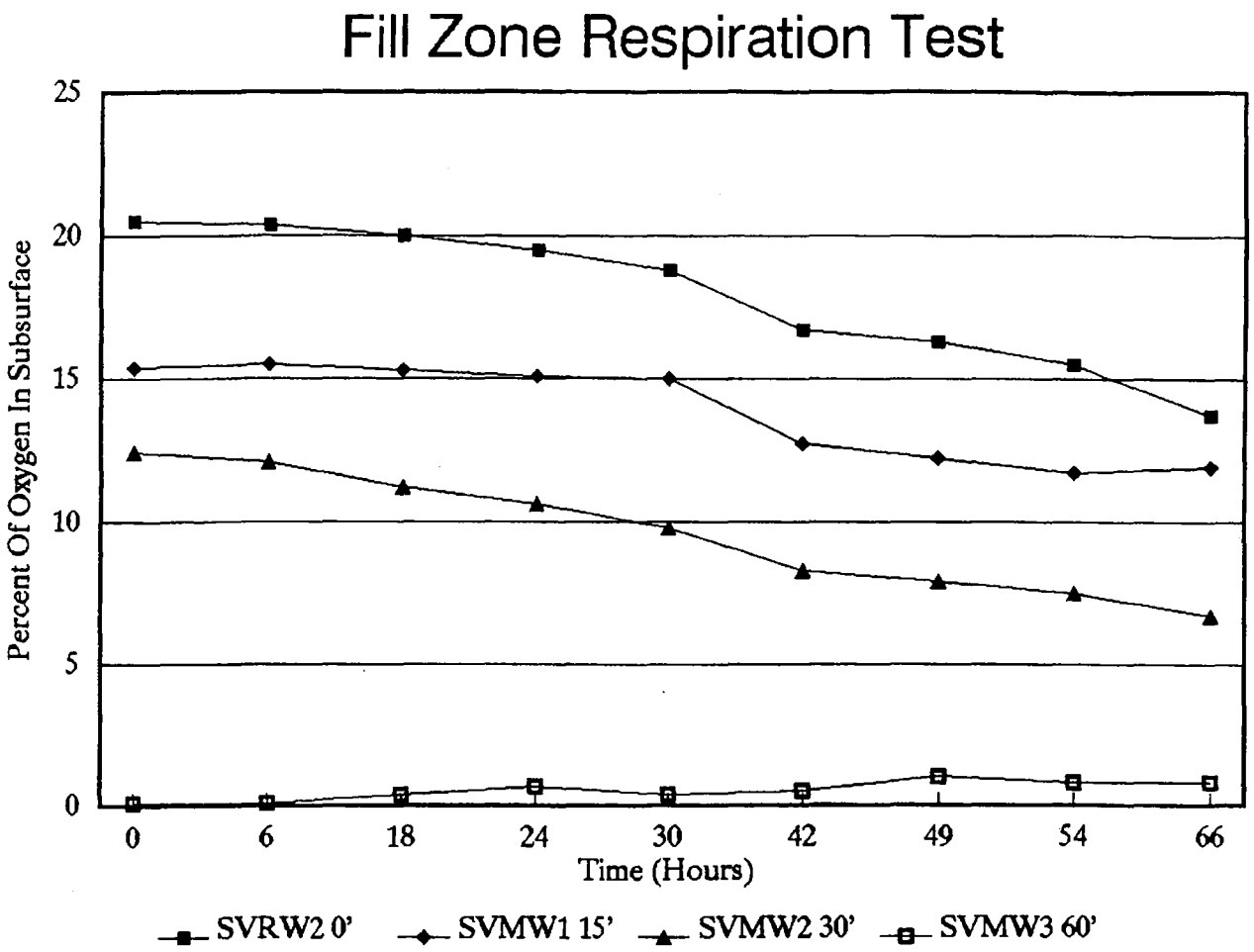
5-24-95 1454 HOURS

TIME	SVRW1 (FILL ZONE)			SVMW1 (FILL ZONE)			SVMW2 (FILL ZONE)			SVMW3 (FILL ZONE)			SVMW4 (FILL ZONE)		
(Hour)	CH4	CO2	O2	CH4	CO2	O2	CH4	CO2	O2	CH4	CO2	O2	CH4	CO2	O2
-48															
-43				14.2	11.6	1.3	10.8	13.4	0.2	40.9	14.8	0.3	0	10.1	8.4
-29				10.1	10.2	6	6.1	13.6	1.7	40.6	16.5	0.2	0.1	10.8	8.2
-25				6.8	7.2	10.1	4.2	11.4	4.5	39.4	16.3	0.1	0.1	10.9	7.9
-19				4.5	4.1	14.9	2.8	9.7	7.4	41	15.7	0.1	0	10.7	7.8
-7				4.9	4.8	14.6	2.6	7.3	10.8	42.6	16.3	0.1	0.4	10	7.9
0	0	0	20.5	4.2	4.3	15.4	2.3	6.1	12.4	42.5	15.8	0.1	0.1	11.8	7.6
6	0	0	20.4	3.5	4	15.5	1.8	6.2	12.1	43.5	16.2	0.1	0	11.6	7.7
18	0	0	20	4.2	4.2	15.3	1.9	6.4	11.2	43.3	14	0.4	0	10.6	7.7
24	0	0	19.5	3.8	4.1	15.1	2.1	6.6	10.6	43.4	13.8	0.7	0	10.9	7.8
30	0	0	18.8	2.9	3.5	15	1.5	7	9.8	44	14.4	0.4	0	10.8	7.7
42	0.1	0.3	16.7	3.8	4.6	12.7	1.7	7.4	8.3	44.9	13.5	0.5	0	10.8	7.7
49	0	0.2	16.3	3.5	4.2	12.2	1.4	7.4	7.9	42.4	13.7	1	0.1	10.7	7.6
54	0	0.3	15.5	3.1	4.5	11.7	0	11.4	7.5	44	14.2	0.8	0	11.4	7.5
66	0.1	0.7	13.7	3	3.9	11.9	1.4	8.2	6.7	43.8	13.9	0.8	0.1	11.1	7.7
Oxygen Utilization			0.10 %			0.05 %			0.09 %			-0.01 %			-0.00 %

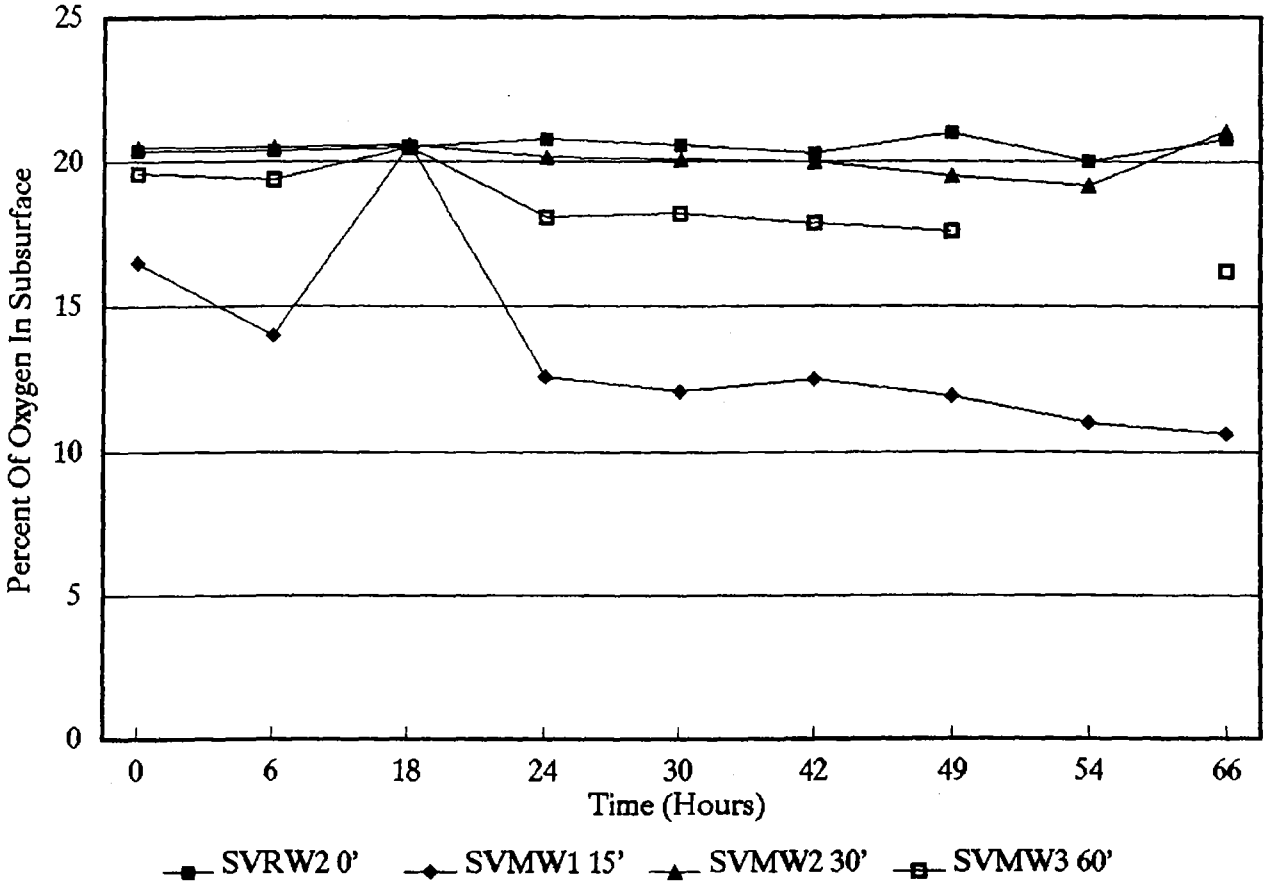
CLAY SOIL ZONE RESPIRATION TEST

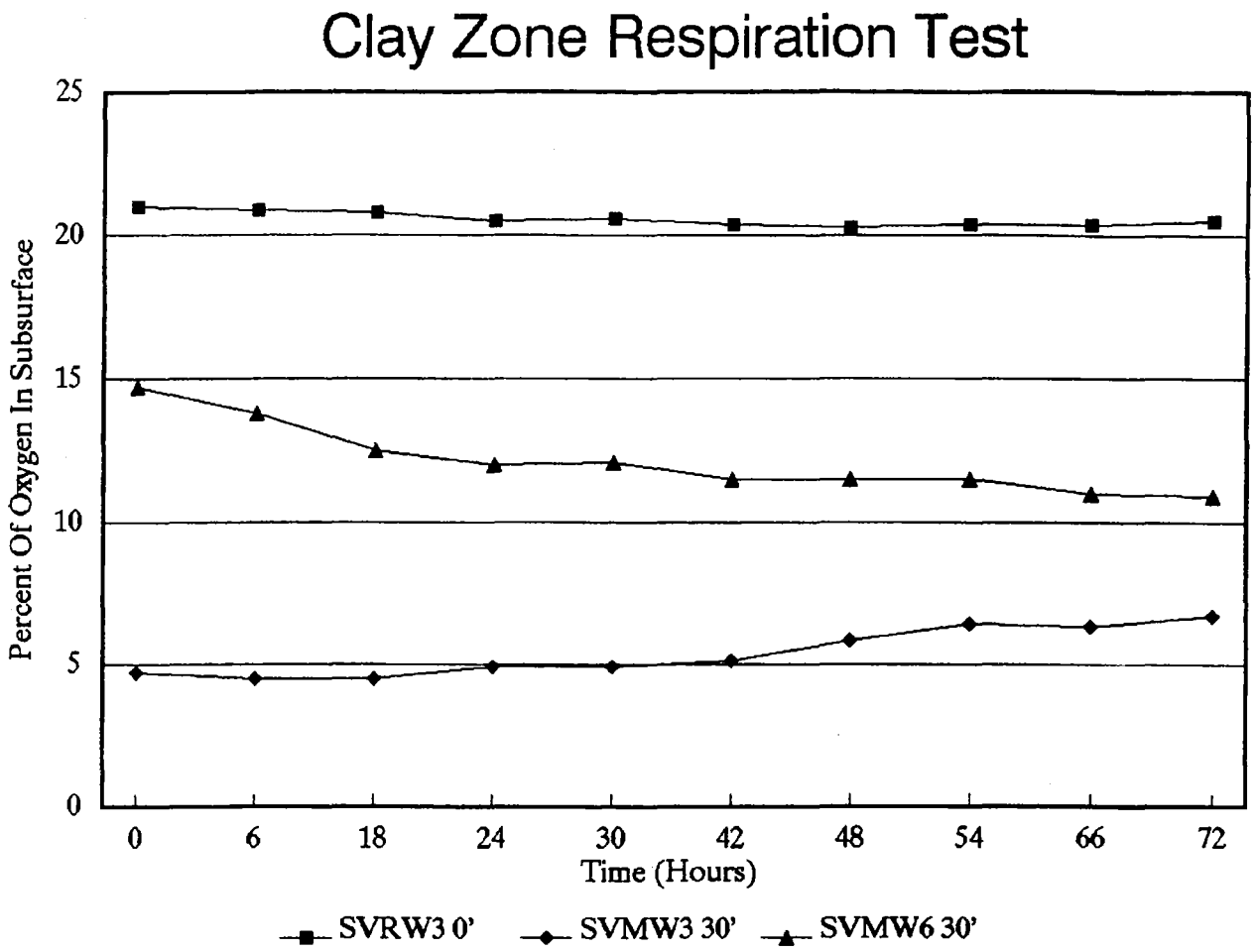
6-3-95 1430 HOURS

TIME	SVRW3 (CLAY ZONE)			SVMW3 (CLAY ZONE)			SVMW6 (CLAY ZONE)			SVMW5 (CLAY ZONE)		
(Hour)	CH4	CO2	O2	CH4	CO2	O2	CH4	CO2	O2	CH4	CO2	O2
-48												
-30				1	12.2	4.3	1.4	2.6	18.3	0.1	6	5.5
-24				1.6	12.2	4.4	2	2.5	18.1	0.1	5.9	5.5
-18				0.8	12.7	4.4	2.3	3.1	17.5	0.1	6.2	5.5
-6				0.9	12.8	4.2	3.5	4.6	15.8	0.2	6.4	5.4
0	0	0	21	0.8	12.6	4.7	3.9	4.9	14.7	0	5.8	5.5
6	0.2	0	20.9	0.8	12.2	4.5	4.3	5.8	13.8	0.1	5.9	5.5
18	0.1	0	20.8	1.1	13.3	4.5	6	7	12.5	0.2	6.2	5.5
24	0.3	0	20.5	1	12.8	4.9	5.8	7.5	12	0.1	6.2	5.5
30	0.2	0	20.6	0.8	12.7	4.9	5	6.7	12.1	0.1	6.2	5.3
42	0.2	0.1	20.4	0.7	13.5	5.1	5.2	7.9	11.5	0.1	6.7	5.3
48	0.2	0.1	20.3	1	13.2	5.8	5.4	7.7	11.5	0	6.6	5.1
54	0.1	0	20.4	0.8	12.8	6.4	4.8	7.3	11.5	0	6.3	5.1
66	0.3	0.1	20.4	1	13	6.3	5.4	8	11	0.1	6.7	5
72	0.2	0	20.5	0.8	13	6.7	5.3	8	10.9	0.1	6.5	5
Oxygen Utilization			0.01 %			-0.03 %			0.04 %			0.01 %


Fill Zone Respiration Test
Percent Of Oxygen In Subsurface
25
20
15
10
5
0
0
6
18
24
30
42
49
54
66
Time (Hours)
SVRW2 0'
SVMW1 15'
SVMW2 30'
SVMW3 60'

Sand Zone Respiration Test




Clay Zone Respiration Test
Percent Of Oxygen In Subsurface
25
20
15
10
5
0
0
6
18
24
30
42
48
54
66
72
Time (Hours)
SVRW3 0'
SVMW3 30'
SVMW6 30'

Inhalation Valve Feasibility Test

Prior to designing a soil remediation system for the deep soil zone, a valve feasibility test was performed to identify the operational range of inhalation valves proposed in the remedial design.

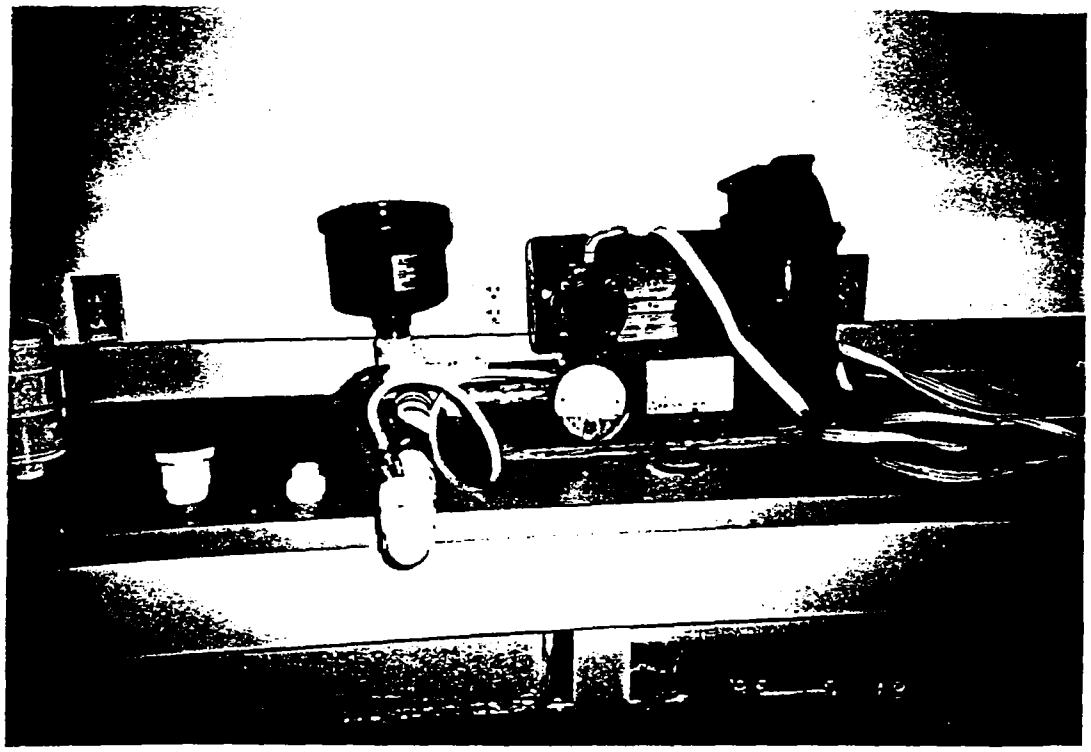
The testing procedure is as follows:

- A 505 Rotron blower is set up (Picture 1) using an inlet restriction plug, a pressure bleed valve at a tee, and a globe valve to restrict the 505 blower to the range of measured field conditions.
- The air flow is fully restricted and a contained pressure reading is measured. The air flow is then released and an unrestricted air flow velocity is measured using an anemometer.
- Contained pressure and unrestricted flow velocity are then compared to measured field conditions to ensure the proper range for the test is being maintained.
- Once the valve assembly (Picture 2) is added to the system, valve restricted back pressures and valve restricted air flow velocities are measured. The valve restricted air flow velocity is measured by placing a known diameter pipe after the valve to measure the flow rate through that pipe.
- Contained pressure and unrestricted flow rate are then graphed against valve restricted pressure and valve restricted flow to determine the effectiveness of the valve assembly (Graph 1).

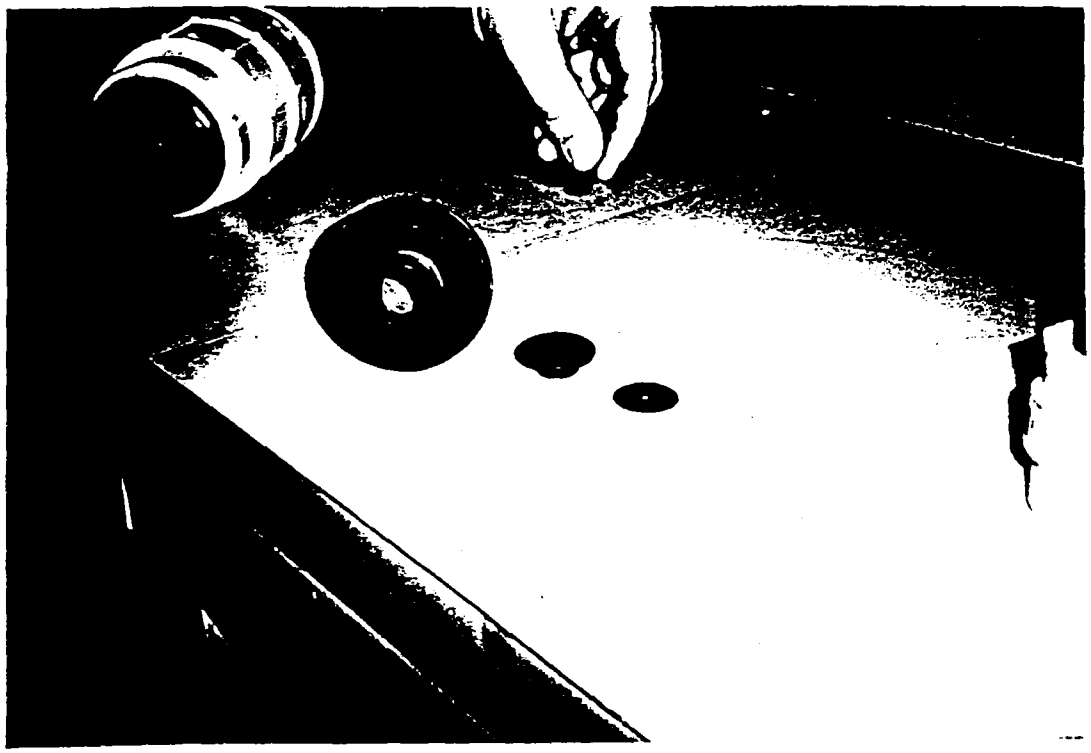
A direct ratio can then be measured between open pipe assembly and the valve assembly. At back pressures of 0.1 inches of water, two tests were run for which ratios of 0.47 and 0.59 valve assembly flow rate to unrestricted flow rate can be determined. At pressures of 0.2 and 1.0 inches of water back pressure, a ratio of 0.59 valve assembly flow rate to unrestricted flow rate was determined for each case.

From these readings it is determined that the inhalation valves will restrict the flow rate to approximately six tenths of the measured field flow rates once the valve assembly is attached to the barometric pumping well head.

From the inlet well assembly pressure test, it can be determined that the inhalation valve assembly will work well as a check valve. One way flow will be maintained in the range of pressures and flow rates experienced by the barometric pumping well head.



PICTURE 1



PICTURE 2

Site2894.RAP
RAP.8/94

Inhalation Valve Bench Scale Test

Soil Zone Simulated Pressure Test #1 : Vent Well Configuration

Fully Restricted Pressure Inches of Water	Unrestricted Velocity and Flow ft/min	ft^3/min*	Valve Restricted Pressure Inches of Water	Valve Restricted Velocity and Flow ft/min	ft^3/min**	Flow Rate Correlation
0.1	190	2.33	0.1	50	1.09	0.47
0.1	150	1.84	0.1	50	1.09	0.59
0.2	225	2.76	0.15	75	1.64	0.59
1	450	5.52	0.5	150	3.27	0.59

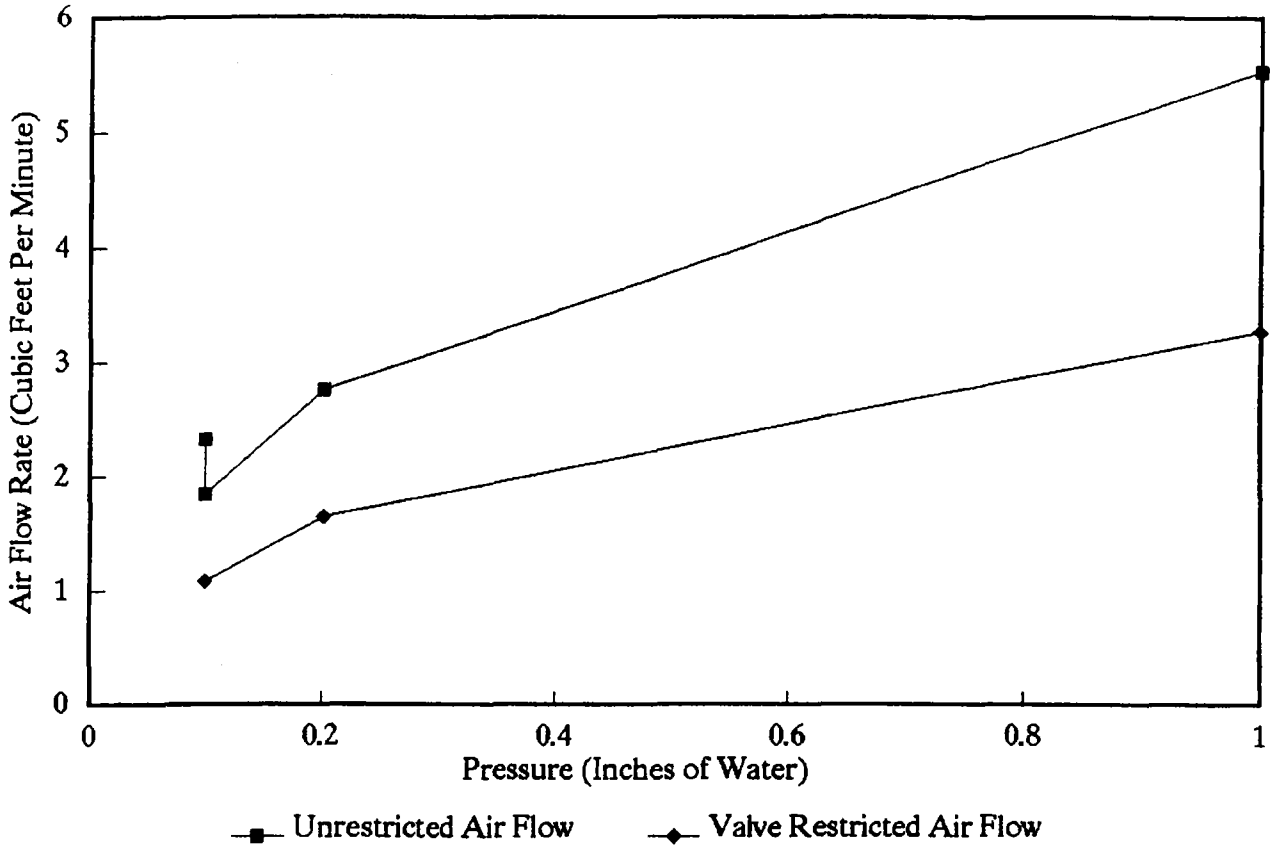
Soil Zone Simulated Pressure Test #2 : Inlet Well Configuration

Fully Restricted Pressure Inches of Water	Unrestricted Velocity and Flow ft/min	ft^3/min*	Valve Restricted Pressure Inches of Water	Valve Restricted Velocity and Flow ft/min	ft^3/min**	Flow Rate Correlation
0.1	200	2.45	0.1	0	0	0.00
0.2	225	2.76	0.2	0	0	0.00
1	450	5.52	1	0	0	0.00

* = 1.5 inch pipe diameter
** = 2.0 inch pipe diameter

Graph 1: Inhalation Valve

Bench Scale Test



APPENDIX C

REMEDIAL ALTERNATIVE COST ESTIMATES

Table C-1
Shallow Zone Excavation and Disposal Cost

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Estimator: RLM
Checked By:

COST SUMMARY TABLE (costs rounded to nearest $1000)

DIRECT COSTS	
Site Preparation and Mobilization	$12,000
Planning Documents	$32,000
Field Sampling & Oversight	$26,000
Excavation Activities	$140,000
Offsite Disposal of Soil	$2,943,000
Site Restoration and Demobilization	$360,000
Summary Data Report	$17,000
Costs for Excavation and Offsite Disposal	$3,530,000
Indirect Costs	
Contingency (@10%)	$353,000
TOTAL COSTS FOR EXCAVATION AND OFFSITE DISPOSAL	**$3,883,000**

Table C-1 (Continued)
Shallow Zone Excavation and Disposal Cost

DIRECT COSTS	Quantity	Unit	Unit Cost	Total Cost
Site Preparation and Mobilization				
Silt fencing/signs/misc. materials	1	ls	$5,000	$5,000
Decontamination pad	1	ls	$1,000	$1,000
Pressure washer (assume base will provide decon water)	60	day	$20	$1,200
Pick-up truck	8	wk	$400	$3,200
General site mob/demob (4 laborers, 1 foreman)	5	ea	$400	$2,000
Total For Site Preparation and Mobilization				**$12,400**
Site Sampling & Oversight				
Planning Documents (HASP, WP)				
Professional Engineer	40	hrs	$90	$3,600
Jr. Level Engineer	200	hrs	$45	$9,000
Sr. Scientist	80	hrs	$90	$7,200
Word Processor	80	hrs	$35	$2,800
CADD	160	hrs	$40	$6,400
ODCs	5	ls	$500	$2,500
Total for Workplan & Health & Safety Plan				**$31,500**
Field Sampling & Oversight				
Jr. Level Geologist	400	hrs	$35	$14,000
ODCs	1	ls	$5,000	$5,000
Volatile Organics, Method 8260, assume 15, 3 QC	18	ea	$125	$2,250
PAH, Method 8310, assume 15, 3 QC	18	ea	$145	$2,610
TRPH (FL-PRO) assume 15 samples, 3 QC	18	ea	$135	$2,430
Total for Field Sampling & Oversight				**$26,290**
Excavation				
Excavation of Soil				
Trackhoe operator labor included in costs				
2.5 CY, Track Loader (2 units)	800	hrs	$125	$100,000
Four laborers	1600	hrs	$25	$40,000
Subtotal for Excavation				**$140,000**
Offsite Disposal of Soil				
Transportation, and disposal of contaminated soil to a Subtitle D Facility	62574	ton	$47	$2,940,997
Characterization Sampling, 24 hr TAT (RCRA 8 metals, VOCs 8260, TRPH FL-PRO)	4	ea	$510	$2,040
Cost derived from quote from Andy Adams of Waste Transportation & Disposal Services (1-800-901-0081) cost quoted was $46.50/ton with treatment at an offsite soil burner.				
Subtotal for Offsite Disposal of Soil:				**$2,943,037**
Site Restoration and Demobilization				
	Quantity	Unit	Unit Cost	Total Cost
Common fill for backfill (load and haul) includes spreading and compaction	44,696	yd^3	$8	$357,568
Hydroseeding	2	acre	$400	$800
Demobilization of Equipment	2	ls	$1,000	$2,000
Subtotal Site Restoration and Demob:				**$360,368**

Table C-1 (Continued)
Shallow Zone Excavation and Disposal Cost

Summary Data Report

Summary Data Report			
Jr. Level Engineer	160 hrs	$45	$7,200
Senior Scientist	20 hrs	$80	$1,600
Mid-level Engineer	80 hrs	$60	$4,800
Word Processor	40 hrs	$35	$1,400
CADD	40 hrs	$40	$1,600
ODCs	1 ls	$500	$500
Total for Summary Data Report			**$17,100**

Table C-2
Shallow Zone SVE Cost Alternative

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Estimator: RLM
Checked By:

COST SUMMARY TABLE (costs rounded to nearest $1000)

DIRECT COSTS		
Site Preparation		$27,000
Piping and Equipment		$58,000
Total Installation labor		$19,000
TOTAL DIRECT COST		**$104,000**
INDIRECT COSTS		
Engineering and Design (20%)		$21,000
Contingency (20%)		$21,000
TOTAL INDIRECT COST		**$42,000**
Total Capital Costs (Direct + Indirect)		**$146,000**
OPERATIONS AND MAINTENANCE		
Administrative O&M		
Work Plan (WP) for Monitoring Activities		$9,000
Four Quarterly Site Activities Reports		$24,000
Total Administrative O&M, annual		**$24,000**
Present worth of O&M (7%, 2 yrs)	($43,392)	$43,000
Present worth O&M + Workplan		**$52,000**
Treatment System O&M		
System Maintenance		$9,000
Utilities		$5,000
Total Treatment System O&M, Annual		**$14,000**
Present Worth of Treatment System O&M (7%, 2 yrs)	($25,312)	$25,000
Present Worth O&M (Administrative + Treatment System O&M)		**$77,000**
Assumption - System will run for two years,		
TOTAL COST		**$223,000**

Table C-2 (Continued)
Shallow Zone SVE Cost Alternative

DIRECT COSTS	Quantity	Unit	Unit Cost	Total Cost
Site Preparation				
Storage trailer	1	mo	$106	$106
Treatment system concrete pad	1200	ft^2	$3	$3,600
Fencing, 30'x40'	140	ft	$13	$1,820
Gates for access to treatment system fence	1	ea	$726	$726
Utility connection for treatment system				
Including electric poles, cable, transformer, phone line for telemetry	1	ls	$15,000	$15,000
Pressure washer and water tank	1	mo	$504	$504
ODCs(Plastic sheeting, drums, pumps, hoses, supplies,etc.)	1	ls	$2,000	$2,000
Labor				
2 laborers, 4 days, 10 hrs/day	80	hr	$19	$1,520
1 foreman, 4 days, 10 hrs/day	40	hr	$35	$1,400
Total Site Preparation				**$26,676**
Note: 34 vertical SVE wells estimated based on an adjusted 25 ft ROI.				
SVE System				
Piping and Equipment				
Carbonair model CE5009 SVE system	1	ls	$12,626	$12,626
Polyethylene Skid Mounted Storage Tank	1	ea	$2,431	$2,431
500 scfm, 1200 lb fill, 8.5" pressure drop GAC	2	ea	$4,617	$9,234
2" Dia. PVC @ 20' Depth, Vertical pipe vent installed (34 points)	680	ft	$28	$19,040
System plumbing (piping, elbows, etc.)	1	ls	$4,000	$4,000
Misc construction materials	1	ls	$1,000	$1,000
Trenching (4' deep x 1' wide x 1000')	4000	cy	$1	$4,440
Site restoration (paving, hydroseeding, etc.)	1	ls	$1,000	$1,000
Remedial well survey (survey of new well locations)	1	ls	$2,000	$2,000
System start-up	1	ls	$2,000	$2,000
Total Piping and Equipment				**$57,771**
Labor for system connection & Start-up				
3 Laborers, 2 weeks @ 50 hrs/wk	300	hrs	$30	$9,000
1 Jr. Level Engineer, 2 weeks @ 50 hrs/wk	100	hrs	$45	$4,500
1 Sr. Engineer, 20 hours/week for 2 weeks	40	hrs	$90	$3,600
1 Electrician, 1 week @ 50 hrs/wk	50	hrs	$35	$1,750
Total Labor:				**$18,850**
TOTAL DIRECT COSTS				**$103,297**

Table C-2 (Continued)
Shallow Zone SVE Cost Alternative

OPERATIONS AND MAINTENANCE

Administrative O&M

Work Plan for Monitoring and O&M Activities

Labor	Quantity	Unit	Unit Cost	Total Cost
Jr.-Level Geologist/Scientist	80	hrs	$45	$3,600
Senior Geologist	16	hrs	$80	$1,280
ODC's, Production Support (editing, copying, binders, etc.)	1	ls	$1,000	$1,000
Word Processor	16	hrs	$35	$560
CADD, 8 hrs/figure, 4 figures	32	hrs	$40	$1,280
Editor	8	hrs	$60	$480
Copying: 50 pgs x 25 copies	1250	page	$0.10	$125
Binding/shipping, 25 copies	25	ea	$20	$500
Total Work Plan				**$8,825**

Table C-2 (Continued)
Shallow Zone SVE Cost Alternative

REPORTING	Quantity	Unit	Unit Cost	Total Cost
Site Activities Report (Quarterly)				
Jr. Level Engineer	40	hrs	$45	$1,800
Senior Engineer	16	hrs	$80	$1,280
Production:				
Word processing	12	hrs	$35	$420
Technical Expert	6	hrs	$75	$450
Editor	8	hrs	$60	$480
CADD operator, 3 dwgs per report @ 8 hours per dwg	24	hrs	$40	$960
Reproduction: 100 pgs @ 20 copies	2000	pg	$0.10	$200
Shipping/binding: 20 reports	20	ea	$20	$400
Total Report Cost:				**$5,990**
Note: Costs for As Built Drawings are included in the CADD time.				
TREATMENT SYSTEM O&M (annual)				
System Maintenance				
Labor				
Jr. Engineer, 4 hrs per month, system operating data, control	48	hr	$45	$2,160
Technician, 8 hrs per month	96	hr	$30	$2,880
Project Mgr, 2 hrs per month	24	hr	$100	$2,400
Electrician, 4 hours per year	4	hr	$60	$240
Misc. equip/supplies	1	yr	$500	$500
Air Sampling				
TO 14 Sampling, Tedlar Bag, 2 per quarter	8	each	$100	$800
Total System Maintenance (annual):				**$8,980**
Utilities				
Electricity	87600	kWh	$0.06	$5,256
Assume 10 kW*24 hr/day*365 day/yr= 525600KWh				
Total Utilities				**$5,256**
Total Treatment System O&M (Annual)				**$14,236**

Table C-3
Deep Zone SVE Cost Alternative

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Estimator: RLM
Checked By:

COST SUMMARY TABLE (costs rounded to nearest $1000)

DIRECT COSTS		
Site Preparation		$27,000
Piping and Equipment		$52,000
Total Installation labor		$19,000
TOTAL DIRECT COST		**$98,000**
INDIRECT COSTS		
Engineering and Design (20%)		$20,000
Contingency (20%)		$20,000
TOTAL INDIRECT COST		**$40,000**
Total Capital Costs (Direct + Indirect)		**$138,000**
OPERATIONS AND MAINTENANCE		
Administrative O&M		
Work Plan (WP) for Monitoring Activities		$9,000
Four Quarterly Site Activities Reports		$24,000
Total Administrative O&M, annual		**$24,000**
Present worth of O&M (7%, 2 yrs)	($43,392)	$43,000
Present worth O&M + Workplan		**$52,000**
Treatment System O&M		
Annual System Maintenance		$9,000
Utilities		$5,000
Total Treatment System O&M, Annual		**$14,000**
Present Worth of Treatment System O&M (7%, 2 yrs)	($25,312)	$25,000
Present Worth O&M (Administrative + Treatment System O&M)		**$77,000**
Assumption - System will run for two years,		
TOTAL COST		**$215,000**

Table C-3 (Continued)
Deep Zone SVE Cost Alternative

DIRECT COSTS	Quantity	Unit	Unit Cost	Total Cost
Site Preparation				
Storage trailer	1	mo	$106	$106
Treatment system concrete pad	1200	ft^2	$3	$3,600
Fencing, 30'x40'	140	ft	$13	$1,820
Gates for access to treatment system fence	1	ea	$726	$726
Utility connection for treatment system				
Including electric poles, cable, transformer, phone line for telemetry	1	ls	$15,000	$15,000
Pressure washer and water tank	1	mo	$504	$504
ODCs(Plastic sheeting, drums, pumps, hoses, supplies,etc.)	1	ls	$2,000	$2,000
Labor				
2 laborers, 4 days, 10 hrs/day	80	hr	$19	$1,520
1 foreman, 4 days, 10 hrs/day	40	hr	$35	$1,400
Total Site Preparation				**$26,676**
Note: Seven vertical SVE wells estimated based on 60 ft ROI.				
SVE System				
Piping and Equipment				
Carbonair model CE5009 SVE system	1	ls	$12,626	$12,626
Polyethylene Skid Mounted Storage Tank	1	ea	$2,431	$2,431
500 SCFM, 1200 lb fill, 8.5" pressure drop GAC	2	ea	$4,617	$9,234
2" Dia. PVC @ 60' Depth, Vertical pipe vent installed	420	ft	$27	$11,340
System plumbing (piping, elbows, etc.)	1	ls	$4,000	$4,000
Misc construction materials	1	ls	$1,000	$1,000
Trenching (4' deep x 1' wide x 1000')	4000	cy	$1	$4,440
Site restoration (paving, hydroseeding, etc.)	1	ls	$1,000	$1,000
Remedial well survey (survey of new well locations)	1	ls	$2,000	$2,000
System start-up	1	ls	$2,000	$2,000
One 90 CFM, 5 HP, Extraction Blower System	1	ea	$2,325	$2,325
Total Piping and Equipment				**$52,396**
Labor for system connection & Start-up				
3 Laborers, 2 weeks @ 50 hrs/wk	300	hrs	$30	$9,000
1 Jr. Level Engineer, 2 weeks @ 50 hrs/wk	100	hrs	$45	$4,500
1 Sr. Engineer, 20 hours per week	40	hrs	$90	$3,600
1 Electrician, 1 week @ 50 hrs/wk	50	hrs	$35	$1,750
Total Labor:				**$18,850**
TOTAL DIRECT COSTS				**$97,922**

Table C-3 (Continued)
Deep Zone SVE Cost Alternative

OPERATIONS AND MAINTENANCE

Administrative O&M

Work Plan for Monitoring and O&M Activities

Labor	Quantity	Unit	Unit Cost	Total Cost
Jr.-Level Geologist/Scientist	80	hrs	$45	$3,600
Senior Geologist	16	hrs	$80	$1,280
ODC's, Production Support (editing, copying, binders, etc.)	1	ls	$1,000	$1,000
Word Processor	16	hrs	$35	$560
CADD, 8 hrs/figure, 4 figures	32	hrs	$40	$1,280
Editor	8	hrs	$60	$480
Copying: 50 pgs x 25 copies	1250	page	$0.10	$125
Binding/shipping, 25 copies	25	ea	$20	$500
Total Work Plan				**$8,825**

Table C-3 (Continued)
Deep Zone SVE Cost Alternative

REPORTING	Quantity Unit	Unit Cost	Total Cost
Site Activities Report (Quarterly)			
1 Jr. Level Engineer	40 hrs	$45	$1,800
1 Senior Engineer	16 hrs	$80	$1,280
Production:			
Word processing	12 hrs	$35	$420
Technical Expert	6 hrs	$75	$450
Editor	8 hrs	$60	$480
CADD operator, 3 dwgs per report @ 8 hours per dwg	24 hrs	$40	$960
Reproduction: 100 pgs @ 20 copies	2000 pg	$0.10	$200
Shipping/binding: 20 reports	20 ea	$20	$400
Total Report Cost:			**$5,990**
Note: Costs for As Built Drawings are included in the CADD time.			
TREATMENT SYSTEM O&M (annual)			
System Maintenance			
Labor			
Jr. Engineer, 4 hrs per month, system operating data, control	48 hr	$45	$2,160
Technician, 8 hrs per month	96 hr	$30	$2,880
Project Mgr, 2 hrs per month	24 hr	$100	$2,400
Electrician, 4 hours per year	4 hr	$60	$240
Misc. equip/supplies	1 yr	$500	$500
Air Sampling			
TO 14 Sampling, Tedlar Bag, 2 per quarter	8 each	$100	$800
Total System Maintenance (annual):			**$8,980**
Utilities			
Electricity	87600 kWh	$0.06	$5,256
Assume 10 kW*24 hr/day*365 day/yr*1yr= 87600KWh			
Total Utilities			**$5,256**
Total Treatment System O&M (Annual)			**$14,236**

Table C-4
Shallow Zone Bioventing Cost Alternative

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Estimator: RLM
Checked By:

COST SUMMARY TABLE (costs rounded to nearest $1000)

DIRECT COSTS		
Site Preparation		$27,000
Piping and Equipment		$43,000
Total Installation labor		$19,000
TOTAL DIRECT COST		**$89,000**
INDIRECT COSTS		
Engineering and Design (20%)		$18,000
Contingency (20%)		$18,000
TOTAL INDIRECT COST		**$36,000**
Total Capital Costs (Direct + Indirect)		**$125,000**
OPERATIONS AND MAINTENANCE		
Administrative O&M		
Work Plan (WP) for Monitoring Activities		$9,000
Four Quarterly Site Activities Reports		$24,000
Total Administrative O&M, annual		**$24,000**
Present worth of O&M (7%, 4 yrs)	($81,293)	$81,000
Present worth O&M + SAP		**$90,000**
Treatment System O&M		
System Maintenance		$9,000
Utilities		$2,000
Total Treatment System O&M, Annual		**$11,000**
Present Worth of Treatment System O&M (7%, 4 yrs)	($37,259)	$37,000
Present Worth O&M (Administrative + Treatment System O&M)		**$127,000**
Assumption - System will run for four years.		
TOTAL COST		**$252,000**

Table C-4 (Continued)
Shallow Zone Bioventing Cost Alternative

DIRECT COSTS	Quantity	Unit	Unit Cost	Total Cost
Site Preparation				
Storage trailer	1	mo	$106	$106
Treatment system concrete pad	1200	ft^2	$3	$3,600
Fencing, 30'x40'	140	ft	$13	$1,820
Gates for access to treatment system fence	1	ea	$726	$726
Utility connection for treatment system				
Including electric poles, cable, transformer, phone line for telemetry	1	ls	$15,000	$15,000
Pressure washer and water tank	1	mo	$504	$504
Plastic sheeting, drums, pumps, hoses, supplies	1	ls	$2,000	$2,000
Labor				
2 laborers, 4 days, 10 hrs/day	80	hr	$19	$1,520
1 foreman, 4 days, 10 hrs/day	40	hr	$35	$1,400
Total Site Preparation				**$26,676**
Note: 34 vertical bioventing wells estimated based on an adjusted 25 ft ROI.				
Biovent System				
Piping and Equipment				
One 90 CFM, 5 HP, Extraction Blower System	1	ea	$2,325	$2,325
2" Dia. PVC @ 20' Depth, Vertical pipe installed	680	ft	$28	$19,040
System plumbing (piping, elbows, etc.)	1	ls	$4,000	$4,000
System control panel	1	ea	$3,000	$3,000
Misc construction materials	1	ls	$5,000	$5,000
Trenching (4' deep x 1' wide x 1000')	4000	cy	$1	$4,440
Site restoration (paving, hydroseeding, etc.)	1	ls	$1,000	$1,000
Remedial well survey (survey of new well locations)	1	ls	$2,000	$2,000
System start-up	1	ls	$2,000	$2,000
Total Piping and Equipment				**$42,805**
Labor for system connection & Start-up				
3 Laborers, 2 weeks @ 50 hrs/wk	300	hrs	$30	$9,000
1 Jr. Level Engineer, 2 weeks @ 50 hrs/wk	100	hrs	$45	$4,500
1 Sr. Engineer, 20 hours per week	40	hrs	$90	$3,600
1 Electrician, 1 week @ 50 hrs/wk	50	hrs	$35	$1,750
Total Labor:				**$18,850**
TOTAL DIRECT COSTS				**$88,331**

Table C-4 (Continued)
Shallow Zone Bioventing Cost Alternative

OPERATIONS AND MAINTENANCE

Administrative O&M

Work Plan for Monitoring and O&M Activities

Labor	Quantity	Unit	Unit Cost	Total Cost
Jr.-Level Engineer	80	hrs	$45	$3,600
Senior Engineer	16	hrs	$80	$1,280
ODC's, Production Support (editing, copying, binders, etc.)	1	ls	$1,000	$1,000
Word Processor	16	hrs	$35	$560
CADD, 8 hrs/figure, 4 figures	32	hrs	$40	$1,280
Editor	8	hrs	$60	$480
Copying: 50 pgs x 25 copies	1250	page	$0.10	$125
Binding/shipping, 25 copies	25	ea	$20	$500
Total Work Plan				**$8,825**

Table C-4 (Continued)
Shallow Zone Bioventing Cost Alternative

REPORTING	Quantity	Unit	Unit Cost	Total Cost
Site Activities Report (quarterly)				
1 Jr. Level Engineer	40	hrs	$45	$1,800
1 Senior Engineer	16	hrs	$80	$1,280
Production:				
Word processing	12	hrs	$35	$420
Technical Expert	6	hrs	$75	$450
Editor	8	hrs	$60	$480
CADD operator, 3 dwgs per report @ 8 hours per dwg	24	hrs	$40	$960
Reproduction: 100 pgs @ 20 copies	2000	pg	$0.10	$200
Shipping/binding: 20 reports	20	ea	$20	$400
Total Report Cost:				**$5,990**
Note: Costs for As Built Drawings are included in the CADD time.				
TREATMENT SYSTEM O&M (annual)				
System Maintenance				
Labor				
Jr. Engineer, 4 hrs per month, system operating data, control	48	hr	$45	$2,160
Technician, 8 hrs per month	96	hr	$30	$2,880
Project Mgr, 2 hrs per month	24	hr	$100	$2,400
Electrician, 4 hours per year	4	hr	$35	$140
Misc. equip/supplies	1	yr	$500	$500
Air Sampling				
TO 14 Sampling, Tedlar Bag, 2 per quarter	8	each	$100	$800
Total System Maintenance (annual):				**$8,880**
Utilities				
Electricity	29200	kWh	$0.06	$1,752
Assume 10 kW*8 hr/day*365 day/yr = 29200 kWh/yr				
Total Utilities				**$1,752**
Total Treatment System O&M (Annual)				**$10,632**

Table C-5
Deep Zone Bioventing Cost Alternative

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Estimator: RLM
Checked By:

COST SUMMARY TABLE (costs rounded to nearest $1000)

DIRECT COSTS		
Site Preparation		$27,000
Piping and Equipment		$33,000
Total Installation labor		$19,000
TOTAL DIRECT COST		**$79,000**
INDIRECT COSTS		
Engineering and Design (20%)		$16,000
Contigency (20%)		$16,000
TOTAL INDIRECT COST		**$32,000**
Total Capital Costs (Direct + Indirect)		**$111,000**
OPERATIONS AND MAINTENANCE		
Administrative O&M		
Work Plan (WP) for Monitoring Activities		$9,000
Four Quarterly Site Activities Reports		$24,000
Total Administrative O&M, annual		**$24,000**
Present worth of O&M (7%, 4 yrs)	($81,293)	$81,000
Present worth O&M + SAP		**$90,000**
Treatment System O&M		
System Maintenance		$9,000
Utilities		$2,000
Total Treatment System O&M, Annual		**$11,000**
Present Worth of Treatment System O&M (7%, 4 yrs)	($37,259)	$37,000
Present Worth O&M (Administrative + Treatment System O&M)		**$127,000**
TOTAL COST		**$238,000**

Table C-5 (Continued)
Deep Zone Bioventing Cost Alternative

DIRECT COSTS	Quantity	Unit	Unit Cost	Total Cost
Site Preparation				
Storage trailer	1	mo	$106	$106
Treatment system concrete pad	1200	ft^2	$3	$3,600
Fencing, 30'x40'	140	ft	$13	$1,820
Gates for access to treatment system fence	1	ea	$726	$726
Utility connection for treatment system				
Including electric poles, cable, transformer, phone line for telemetry	1	ls	$15,000	$15,000
Pressure washer and water tank	1	mo	$504	$504
Plastic sheeting, drums, pumps, hoses, supplies	1	ls	$2,000	$2,000
Labor				
2 laborers, 4 days, 10 hrs/day	80	hr	$19	$1,520
1 foreman, 4 days, 10 hrs/day	40	hr	$35	$1,400
Total Site Preparation				**$26,676**
Note: Seven vertical bioventing wells estimated based on 60 ft ROI.				
Biovent System				
Piping and Equipment				
One 90 CFM, 5 HP, Extraction Blower System	1	ea	$2,325	$2,325
2" Dia. PVC @ 60' Depth, Vertical pipe installed	360	ft	$27	$9,720
System plumbing (piping, elbows, etc.)	1	ls	$4,000	$4,000
System control panel	1	ea	$3,000	$3,000
Misc construction materials	1	ls	$5,000	$5,000
Trenching (4' deep x 1' wide x 1000')	4000	cy	$1	$4,440
Site restoration (paving, hydroseeding, etc.)	1	ls	$1,000	$1,000
Remedial well survey (survey of new well locations)	1	ls	$2,000	$2,000
System start-up	1	ls	$2,000	$2,000
Total Piping and Equipment				**$33,485**
Labor for system connection & Start-up				
3 Laborers, 2 weeks @ 50 hrs/wk	300	hrs	$30	$9,000
1 Jr. Level Engineer, 2 weeks @ 50 hrs/wk	100	hrs	$45	$4,500
1 Sr. Engineer, 20 hours per week	40	hrs	$90	$3,600
1 Electrician, 1 week @ 50 hrs/wk	50	hrs	$35	$1,750
Total Labor:				**$18,850**
TOTAL DIRECT COSTS				**$79,011**
OPERATIONS AND MAINTENANCE				
Administrative O&M				
Work Plan for Monitoring and O&M Activities				
Labor	Quantity	Unit	Unit Cost	$85,776
Jr.-Level Engineer	80	hrs	$45	$3,600
Senior Engineer	16	hrs	$80	$1,280
ODC's, Production Support (editing, copying, binders, etc.)	1	ls	$1,000	$1,000

Table C-5 (Continued)
Deep Zone Bioventing Cost Alternative

Word Processor	16 hrs	$35	$560
CADD, 8 hrs/figure, 4 figures	32 hrs	$40	$1,280
Editor	8 hrs	$60	$480
Copying: 50 pgs x 25 copies	1250 page	$0.10	$125
Binding/shipping, 25 copies	25 ea	$20	$500
Total Work Plan			**$8,825**

REPORTING	Quantity Unit	Unit Cost	Total Cost
Site Activities Report (quarterly)			
1 Jr. Level Engineer	40 hrs	$45	$1,800
1 Senior Engineer	16 hrs	$80	$1,280
Production:			
Word processing	12 hrs	$35	$420
Technical Expert	6 hrs	$75	$450
Editor	8 hrs	$60	$480
CADD operator, 3 dwgs per report @ 8 hours per dwg	24 hrs	$40	$960
Reproduction: 100 pgs @ 20 copies	2000 pg	$0.10	$200
Shipping/binding: 20 reports	20 ea	$20	$400
Total Report Cost:			**$5,990**

Note: Costs for As Built Drawings are included in the CADD time.

TREATMENT SYSTEM O&M (annual)			
System Maintenance			
Labor			
Jr. Engineer, 4 hrs per month, system operating data, control	48 hr	$45	$2,160
Technician, 8 hrs per month	96 hr	$30	$2,880
Project Mgr, 2 hrs per month	24 hr	$100	$2,400
Electrician, 4 hours per year	4 hr	$35	$140
Misc. equip/supplies	1 yr	$500	$500
Air Sampling			
TO 14 Sampling, Tedlar Bag, 2 per quarter	8 each	$100	$800
Total System Maintenance (annual):			**$8,880**
Utilities			
Electricity	29200 kWh	$0.06	$1,752
Assume 10 kW*8 hr/day*365 day/yr = 29200 kWh/yr			
Total Utilities			**$1,752**
Total Treatment System O&M (Annual)			**$10,632**

Table C-6
Deep Zone Barometric Pumping Cost Alternative

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

Estimator: RLM
Checked By:

COST SUMMARY TABLE (costs rounded to nearest $1000)

DIRECT COSTS		
Site Preparation		$6,000
Piping and Equipment		$81,000
Total Installation labor		$6,000
TOTAL DIRECT COST		**$93,000**
INDIRECT COSTS		
Engineering and Design (20%)		$19,000
Contingency (20%)		$19,000
TOTAL INDIRECT COST		**$38,000**
Total Capital Costs (Direct + Indirect)		**$131,000**
OPERATIONS AND MAINTENANCE		
Administrative O&M		
Work Plan (WP) for Monitoring Activities		$9,000
Two Semi-Annual Site Activities Report		$12,000
Total Administrative O&M, annual		**$12,000**
Present worth of Admin O&M (7%, 14 yrs)	($104,946)	$105,000
Present worth O&M + SAP		**$114,000**
Treatment System O&M		
System Maintenance		$4,000
Total Treatment System O&M, Annual		**$4,000**
Present Worth of Treatment System O&M (7%, 14 yrs)	($34,982)	$35,000
Present Worth O&M (Administrative + Treatment System O&M)		**$149,000**
Total Capital and O&M Cost		$280,000
TOTAL COST		**$280,000**

Table C-6 (Continued)
Deep Zone Barometric Pumping Cost Alternative

DIRECT COSTS	Quantity	Unit	Unit Cost	Total Cost
Site Preparation				
Storage trailer	1	mo	$106	$106
Pressure washer and water tank	1	mo	$504	$504
ODCs(Plastic sheeting, drums, pumps, hoses, supplies,etc.)	1	ls	$2,000	$2,000
Labor				
2 laborers, 5 days, 10 hrs/day	100	hr	$19	$1,900
1 foreman, 5 days, 10 hrs/day	50	hr	$35	$1,750
Total Site Preparation				**$6,260**
Note: 45 vertical barometric wells estimated based on 25 ft ROI.				
Barometric Pumping System				
Piping and Equipment				
2" Dia. PVC @ 60' Depth, Vertical pipe vent installed	2700	ft	$27	$72,900
Misc construction materials	1	ls	$5,000	$5,000
Site restoration (paving, hydroseeding, etc.)	1	ls	$1,000	$1,000
Remedial well survey	1	ls	$2,000	$2,000
Total Piping and Equipment				**$80,900**
Labor for system connection & Start-up				
1 Jr. Level Engineer, 2 weeks @ 50 hrs/wk	100	hrs	$45	$4,500
1 Sr. Engineer, 20 hours	20	hrs	$90	$1,800
Total Labor:				**$6,300**
TOTAL DIRECT COSTS				**$93,460**

Table C-6 (Continued)
Deep Zone Barometric Pumping Cost Alternative

OPERATIONS AND MAINTENANCE

Administrative O&M

Work Plan for Monitoring and O&M Activities			
Jr. Level Engineer	80 hrs	$45	$3,600
Senior Engineer	16 hrs	$80	$1,280
ODC's, Production Support (editing, copying, binders, etc.)	1 ls	$1,000	$1,000
Word Processor	16 hrs	$35	$560
CADD, 8 hrs/figure, 4 figures	32 hrs	$40	$1,280
Editor	8 hrs	$60	$480
Copying: 50 pgs x 25 copies	1250 page	$0.10	$125
Binding/shipping, 25 copies	25 ea	$20	$500
Total Work Plan			**$8,825**

Table C-6 (Continued)
Deep Zone Barometric Pumping Cost Alternative

REPORTING	Quantity Unit	Unit Cost	Total Cost
Site Activities Report (quarterly)			
1 Jr. Level Engineer	40 hrs	$45	$1,800
1 Senior Engineer	16 hrs	$80	$1,280
Production:			
Word processing	12 hrs	$35	$420
Technical Expert	6 hrs	$75	$450
Editor	8 hrs	$60	$480
CADD operator, 3 dwgs per report @ 8 hours per dwg	24 hrs	$40	$960
Reproduction: 100 pgs @ 20 copies	2000 pg	$0.10	$200
Shipping/binding: 20 reports	20 ea	$20	$400
Total Report Cost:			**$5,990**
Note: Costs for As Built Drawings are included in the CADD time.			
TREATMENT SYSTEM O&M (annual)			
System Maintenance			
Labor			
Jr. Engineer, 16 hrs per visit, quarterly	64 hr	$45	$2,880
Misc. equip/supplies	1 yr	$500	$500
Air Sampling			
TO 14 Sampling, Tedlar Bag, 2 per quarter	8 each	$100	$800
Total System Maintenance (annual):			**$4,180**
Total Treatment System O&M (Annual)			**$4,180**

APPENDIX D

ESTIMATED REMEDIAL TIME CALCULATIONS

Table D-1
Active Bioventing Estimated Time to Clean-up Shallow Zone

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

To determine M, mass of soil treated:

Assume flow rate at 34 biovent injection wells =	17	cfm			
There 480 minutes in 8 hours =	480	minutes/day			
Therefore the flow rate per day is =	8160	cf/day	or	231.01	m^3/day

From guidance document USEPA, 1996
Approximately 3 to 3.5 pounds of oxygen are needed to degrade 1 pound of petroleum.

Oxygen portion in air =	0.21	percent			
The flow rate of oxygen per day =	1713.60	cf/day	or	48.51	m^3/day

Density = mass/volume
Therefore,
mass = (density * volume)

The density of oxygen at STP =	1.21	kg/m^3			
1 atm at 68F					
The volume was =	48.51	m^3/day			
The mass of oxygen for treatment =	58.70	kg/day	or	129.14	lbs/day
mass= density*volume					
Therefore: lbs per day oxygen/3.5 =	36.90	lbs of petroleum product degraded per day.			

Approximately 3 to 3.5 pounds of oxygen are needed to degrade 1 pound of petroleum product.
Use 3.5 for conservative number.

lbs of petroleum degraded per day		36.896853	lbs
lbs total of petroleum in soil		7244	petroleum is soil
lbs of petroleum degraded per day / days		196.33	days
Multipy by 2 for factor of safety		392.66	days
(due to varying site conditions)	or	**1.1**	**years**

Table D-2
Active Bioventing Estimated Time to Clean-up Deep Zone

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

To determine M, mass of soil treated:

Assume flow rate at 7 biovent injection wells =	14	cfm			
There is 1440 minutes in a day	480	minutes/day			
Therefore the flow rate per day is =	6720	cf/day	or	190.24	m^3/day

From guidance document USEPA, 1996
Approximately 3 to 3.5 pounds of oxygen are needed to degrade 1 pound of petroleum.

Oxygen portion in air =	0.21	percent			
The flow rate of oxygen per day =	1411.20	cf/day	or	39.95	m^3/day

Density = mass/volume
Therefore,
mass = (density * volume)

The density of oxygen at STP =	1.21	kg/m^3			
1 atm at 68F					
The volume was =	39.95	m^3/day			
The mass of oxygen for treatment =	48.34	kg/day	or	106.35	lbs/day
mass= density*volume					
Therefore: lbs per day oxygen/3.5 =	30.39	lbs of petroleum product degraded per day.			

Approximately 3 to 3.5 pounds of oxygen are needed to degrade 1 pound of petroleum product.
Use 3.5 for conservative number.

lbs of petroleum degraded per day		30.385644	lbs
lbs total of petroleum in soil		14488	petroleum is soil
lbs of petroleum degraded per day / days		476.80	days
Multipy by 2 for factor of safety		953.61	days
(due to varying site conditions)	or	**2.6**	**years**

Table D-3
Passive Bioventing Estimated Time to Clean-up Deep Zone

Remedial Action Plan
Site 1438/1439
Naval Air Station Whiting Field
Milton, Florida

To determine M, mass of soil treated:

Assume flow rate at 11 barometric injection wells =	2.75	cfm			
There are 480 minutes 8 hours oper/day	480	minutes/day			
Therefore the flow rate per day is =	1320	cf/day	or	37.37	m^3/day

From guidance document USEPA, 1996
Approximately 3 to 3.5 pounds of oxygen are needed to degrade 1 pound of petroleum.

Oxygen portion in air =	0.21	percent			
The flow rate of oxygen per day =	277.2	cf/day	or	7.85	m^3/day

Density = mass/volume
Therefore,
mass = (density * volume)

The density of oxygen at STP =	1.21	kg/m^3			
1 atm at 68F					
The volume was =	7.85	m^3/day			
The mass of oxygen for treatment =	9.50	kg/day	or	20.89	lbs/day
mass= density*volume					
Therefore: lbs per day oxygen/3.5 =	5.97	lbs of petroleum product degraded per day.			

Approximately 3 to 3.5 pounds of oxygen are needed to degrade 1 pound of petroleum product.
Use 3.5 for conservative number.

lbs of petroleum degraded per day		5.969	lbs
lbs total of petroleum in soil		14488	petroleum is soil
lbs of petroleum degraded per day / days		2427.37	days
Multipy by 2 for factor of safety		4854.73	days
(due to varying site conditions)	or	**13.3**	**years**

APPENDIX E

DESIGN SPECIFICATIONS

CARBONAIR®
ENVIRONMENTAL SYSTEMS

2731 Nevada Avenue North
New Hope, Minnesota 55427-2806
800 526.4999
763.544.2154
763.544.2151
www.carbonair.com

FAX TRANSMITTAL

March 27, 2002

Lane Middleton
Tetra Tech NUS
Suite 250
7018 A.C. Skinner Pkwy
Jacksonville, FL 32256

Phone: 904-281-0400
Fax: 904-281-0070

Re: Proposal Number: 14640
Project Name: SVE system
Project Location: Unknown

Dear Lane,

Carbonair is pleased to quote products and services for the referenced project. The proposal is based on the information provided. Detailed product specifications are attached.

Summary

It is our understanding that Carbonair is to provide a soil vapor extraction (SVE) system for the above referenced site. The SVE system is to be capable of extracting 320 scfm of air from the formation at 100" wc vacuum. The system is to consist of a moisture separator, particulate filter, positive displacement blower, discharge silencer, and the appropriate instrumentation and controls. We recommend a Carbonair CE5009 SVE system for this application. A typical specification for the equipment is included below.

Budgetary Pricing

(1) Carbonair model CE5009 SVE system
- 15 hp, 230/460 V, 3 phase, XP motor
- Roots model 59 URAI PD blower (320 scfm @ 100" wc vacuum)
- 100 gallon moisture separator
- High level alarm and pump operation switches
- Sight Glass
- Vacuum relief valve
- Discharge silencer
- Inlet filter
- Differential pressure gauge across filter
- Inlet vacuum gauge (0-160" wc vacuum)
- Discharge pressure gauge (0-30" wc)
- Discharge temperature gauge (0-200 °F)
- (1) Air flow meter
  - 4" flow averaging pitot tube
  - Differential pressure gauge calibrated to read in cfm

CARBONAIR®
ENVIRONMENTAL SYSTEMS

- Common skid

(1) Myers CT centrifugal transfer pump
- 5 gpm @ 78' TDH
- ¾ hp, 230V, 3 phase, XP motor
- Discharge check valve, throttling valve, and pressure gauge

(1) Control panel
- NEMA 4 enclosure
- Inner door with disconnect switch
- (2) H.O.A. switches w/ lights
- (2) IEC Motor starters w/overloads
- Alarm interlocks w/ red lights
- Alarm reset button
- Intrinsic safety barriers
- UL Listing
- System interlocks and automatic control logic
- System interface contacts

Total Equipment Costs **$ 12,626.00**

General Conditions

- Terms of payment are 30% down with order, 30% after submittal approval, balance due Net 30 days after shipment of equipment to site with approved credit.
- Proposal is subject to the attached terms and conditions.
- Proposal and pricing valid for 30 days.
- This proposal and pricing is based on our interpretation of the sections of the RFP or specification that have been made available to us. Exceptions have been noted where ever possible. In the event of a conflict between the language in the specification and the proposal, the language in the proposal takes precedence and is the basis of the proposed pricing. Carbonair reserves the right to reject any order based on differences in pricing. Carbonair reserves the right to reject any order based on differences in interpretation of the specification, or for any reason, at the time an order is tendered.
- Carbonair will not initiate work with out a fully executed contract or purchase order. Fabrication will not be initiated until complete submittal approvals have been received.
- Submittals will be provided within two weeks of receipt of a fully executed contract or purchase order.
- The proposed equipment can generally be shipped within 6-8 weeks after receipt of completely approved submittals. Lead time will be updated at the time of order execution.
- Shipping charges are not included in the prices quoted unless explicitly stated in the proposal. Actual freight costs will be pre-paid and added to the invoice.
- Sales tax is not included in the prices quoted. All applicable Federal, State and Local sales or use taxes must be paid by the customer.

For **shipments** to the states of California, Florida, Michigan, Minnesota, New Jersey, New York, North Carolina, Ohio, Pennsylvania, South Carolina, South Dakota, Tennessee, Texas, Virginia, Washington, and Wisconsin: **State and local sales and use tax will be added to the invoice, unless a valid sales/use tax exemption certificate is supplied with the contract or purchase order for this project. Exemption certificates must be supplied at the time of order.**

For **shipments** to any other states: **The prices quoted do not include any state or local sales/use taxes. Customer is responsible for paying any applicable state and local taxes.**

If you have any questions or comments concerning this information, please feel free to call Mr. Ron Koehler or Mr. Chris Riddle at 763-544-2154. Thank you for the opportunity to bid on this project.

Sincerely,

Ron Koehler
National Sales and Marketing Director

Chris Riddle
Sales Development Manager

Accepted by:
The proposal and terms & conditions herein are acknowledged and accepted:

Name/Title

Date

Authorized Signature

Purchase Order Number

CARBONAIR

Terms & Conditions

ACCEPTANCE: This proposal is an invitation for an offer and will become a binding contract when accepted.

LIMITATION OF PROPOSAL: The prices and terms quoted in this proposal are subject to acceptance by the Purchaser within a period of (30) calendar days from the date heron.

EXCLUSIONS: This proposal is based solely and completely on specifications submitted to Carbonair Environmental Systems, Inc. (Carbonair) at the time of the writing of the proposal. General plans and specification not actually submitted shall not apply. This proposal, together with all annexed specifications, when accepted, shall be the complete agreement between the parties; and any alternations or unusual and undisclosed conditions or deviations from the above specifications involving extra costs shall be agreed upon in writing by both parties and shall become an additional charge over and above the proposal price set forth herein.

Delays or impossibility of performance by Carbonair because of strikes, accidents, or other reasons beyond the control of Carbonair shall relieve us from all liability herein.

SHIPMENT: Time of shipment shall be no longer than eight to ten (8-10) weeks after receipt of order and acceptance and final approval of all drawings and submittal.

TERMS OF PAYMENT: Subject to the payment terms described in the General Conditions section in the proposal. We reserve the right to cancel the contract or cease work if payments thereon are not received when due. 1.5% per month shall be charged on all unpaid balances.

TAXES: Any local, state or federal sales, excise or use tax imposed on the equipment or work covered by this proposal shall be paid by the Purchaser in addition to the prices quoted.

WARRANTY LIMITATION: There are no warranties which extend beyond the warranties herein after expressed.

WARRANTIES: All work shall be done in a workmanlike manner according to standard practices. We warrant performance against defects in workmanship for a period of twelve (12) months from date of shipment. We agree to pass on to the Purchaser such warranties, if any, as may be extended by the manufacturer for material supplied. Labor for replacing defective materials shall not be provided by us unless it is specifically spelled out in the proposal. We shall not be responsible for materials damaged, lost or stolen after delivery, through no fault of ours, or for failure to deliver and perform because of reasons beyond our control.

EXCLUSIVE REMEDIES: Remedies are limited to the repair or replacement at FOB point of delivery. Consequential damages are excluded. In no event shall Carbonair be responsible for consequential damages of any such defective material or workmanship including, but not limited to, the Purchaser's loss of material or profits, increased expenses of operation, downtime or reconstruction of the work, and in no event shall Carbonair's obligation under this warranty exceed the original contract price of the defective item. It is agreed that any action for breach of express or implied warranty shall be initiated within fifteen (15) months of the date of shipment by Carbonair and only those defects that are documented to have occurred within twelve (12) months of shipment will be covered by the warranty.

DISCLAIMER: Carbonair will not be responsible for damage to equipment or materials through improper installation, storage, improper services, or through attempts to operate it in excess of its rated capacity or recommended use, intentional or otherwise, by parties other than Carbonair or its authorized representatives.

CONDITIONS OF SALE: Prices quoted are those now in effect. Seller reserves the right to bill at the prices in effect at the time of shipment if the proposal is not accepted in writing within thirty (30) days, unless a longer term of validity is in writing on the proposal.

LIMITATIONS OF LIABILITY

A. Neither Seller nor its suppliers of any tier will be liable to Purchaser, whether in contract, in tort (including negligence and strict liability), under any warranty or otherwise, for any special, indirect, incidental, or consequential loss or damage whatsoever, or for loss of or to the plant, loss of use of equipment or power system, cost of capital, loss of profits or revenue or the loss of use thereof, cost of environmental damage or clean-up, or claims of customers of Purchaser. The remedies set forth herein are exclusive, and the total cumulative liability of seller and it suppliers under any purchase order or any act or omission in connection therewith or related thereto, whether in contract, in tort (including negligence and strict liability), under any warranty, or otherwise, will be limited to the price of the contract.

B. The provisions of this Article shall survive termination, cancellation or expiration of the purchase order and shall apply, notwithstanding any other provisions of this Agreement or any related document thereto, to the fullest extent permitted by law. Prior to the transfer of any equipment or material furnished or for which work is furnished hereunder from the project site (except temporarily for repair work or permanently for disposal), or the transfer of any interest therein or in the plant, Purchaser shall obtain for Seller written assurances from the transferee of limitation of and protection against liability following the proposed transfer at least equivalent to that afforded seller and its suppliers under the purchase order.

CARBONAIR

1. POSITIVE DISPLACEMENT SOIL VAPOR EXTRACTION SYSTEMS

Contractor shall provide Soil Vapor Extraction Systems utilizing rotary positive displacement vacuum blower(s) with the following specifications and appurtenances. The unit(s) shall be pre-assembled and entirely self contained on a carbon steel stand. The PD Soil Vapor Extraction System shall be of one manufacturer, Carbonair Model CE5009.

1.1. Materials of Construction

1.1.1. Blower
Blower shall be manufactured using a cast iron housing of the Roots URAI type. Blower shall be sized to achieve appropriate flow and vacuum at less than 80% of maximum speed rating.

1.1.2. Stand
Blower and components shall be mounted to a welded carbon steel stand. All welds shall be ground smooth and sharp corners shall be ground to a minimum radius. The stand shall take the form of a heavy-duty, unitized skid package.

1.1.3. Interconnecting Piping
Carbon steel piping shall be utilized on direct connection to blower. Flex connections and vibration dampers shall be placed appropriately to prevent loading of the blower.

1.1.4. Moisture Separator
Separator shall be constructed of rigid, heavy-duty FRP, or steel and be able to withstand 1.5X operating vacuum.

1.2. Design

1.2.1. Inlet & Outlet Silencers
System shall utilize appropriately sized silencers to meet noise levels as specified.

1.2.2. Moisture Separator
System shall be supplied with centrifugal moisture separator with easily removed, washable demister and in-line filter. Separator shall include connections for drain and level controls as well as an easily accessible removable roof.

1.2.3. Vacuum Relief Valve
A vacuum relief valve shall be installed on the inlet side of the blower. A vacuum gauge shall be mounted in-line with VRV to verify operation and calibration

1.2.4. Motor and Belt Guard
Motor, Belts, and sheaves shall be covered with an OSHA approved belt guard. Guard shall be designed to allow for maximum protection and heat dissipation. Belts shall meet RMA ISO standards for static conductivity.

1.3. Appurtenances

1.3.1. Moisture Separator Pump-Out
A pump-out system shall be incorporated with outside level controls to ease access and minimize the level of effort required for maintenance activities. A clear PVC sight glass shall be mounted outside the moisture separator to allow for visual monitoring of the separator level and for insertion of the stainless steel, fouling resistant level controls.

1.3.2. Pressure Gauge
If required pressure gauge shall be installed on the discharge piping to monitor discharge pressure. A differential pressure gauge shall be provided to monitor the pressure drop through the air filter.

1.3.3. Vacuum Gauge
a Vacuum gauge indicating negative pressure shall be installed on inlet process piping to monitor system performance.

1.3.4. Temperature Gauge
If required a bi-metal thermometer shall be installed on the discharge piping.

1.3.5. Blower
The SVE system shall be equipped with a remote coupled, belt-drive positive displacement blower capable of 320 SCFM at 100" wc. vacuum.

1.3.6 Air Flow Meter
The air flow meter is consist of a 4" flow averaging pitot tube with differential pressure magnehelic gauge and conversion chart.

1.3.7. Transfer Pump
The transfer pump is to be a direct drive, close coupled, centrifugal pump capable of pumping 5 gpm of water at 78' TDH. Discharge piping for the pump is to include a flow control valve, pressure gauge, and check valve.

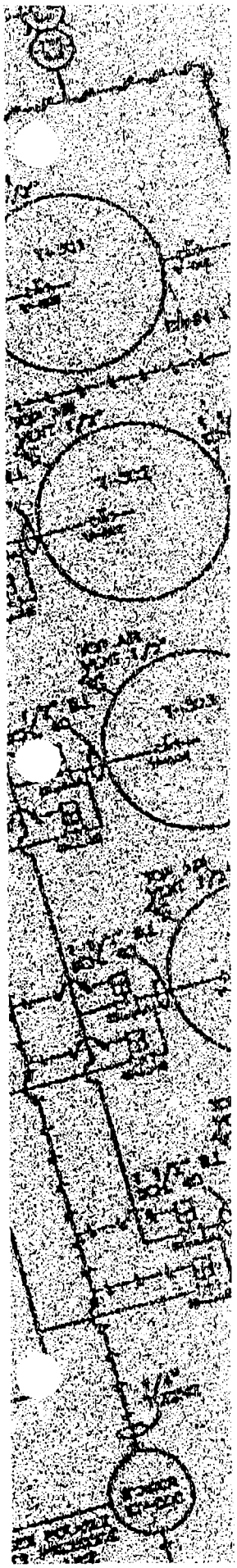
1.4. Optional Kits
The following kits are available as options for the Carbonair CE Positive Displacement Soil Vapor Extraction System(s). Each kit can be customized to meet the specific design parameters for an individual project.

Custom Influent Manifolds
Custom Instrumentation

1.5. Submittals
The manufacturer shall submit such drawings and/or catalog cut sheets required for the installation and operation of the PD blower soil vapor extraction system These drawings shall be accurate in every detail and shall contain all information necessary to relate the equipment to the specifications.

1.6. Modeling Support
If requested, manufacturer must supply verification calculations to support system performance modeling.

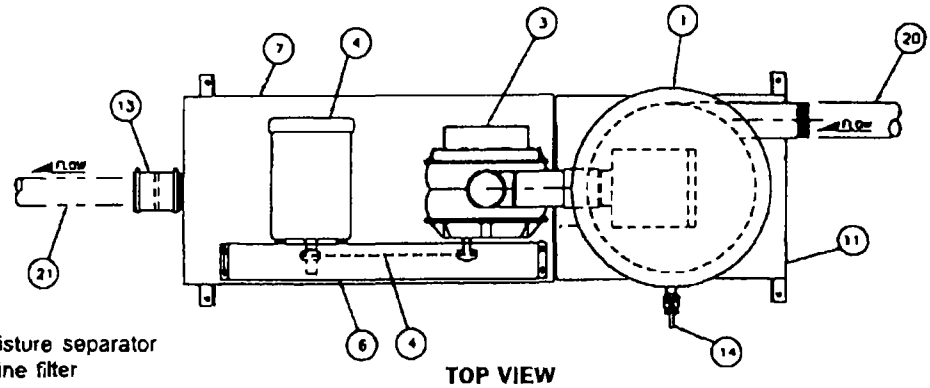
1.7. Manufacturer's O&M Manual
A comprehensive O&M manual shall be provided for the PD blower soil vapor extraction system and appurtenances. The manual shall include detailed procedures for installation, start-up, operation, trouble shooting, and maintenance. The manual shall also include safety precautions, spare parts listing, design curves, drawings, and a list of specific operating parameters.



CARBONAIR
Soil Treatment

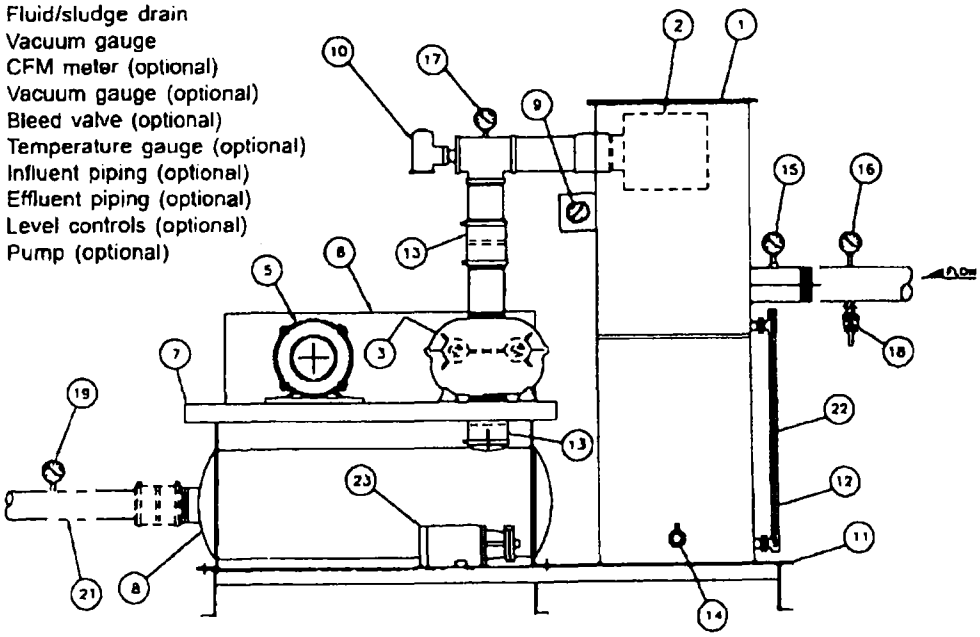
Positive Displacement (PD) Blower Soil Vapor Extraction (SVE) Systems

Carbonair's skid-mounted PD blower SVE systems are sized to meet your requirements and are designed for high performance and ease of installation and use. A complete line of standard packages are available for quick delivery. Custom packages can be designed to meet specific applications.



TOP VIEW

1. Moisture separator
2. In-line filter
3. Blower
4. Belt
5. Motor
6. Belt guard
7. Mounting stand
8. Silencer
9. Filter pressure drop indicator
10. Vacuum relief valve
11. Coated carbon steel frame
12. Sight glass
13. Flex connection (2)
14. Fluid/sludge drain
15. Vacuum gauge
16. CFM meter (optional)
17. Vacuum gauge (optional)
18. Bleed valve (optional)
19. Temperature gauge (optional)
20. Influent piping (optional)
21. Effluent piping (optional)
22. Level controls (optional)
23. Pump (optional)



ELEVATION VIEW

CARBONAIR®
ENVIRONMENTAL SYSTEMS
2731 Nevada Avenue North
New Hope, MN 55427
800-526-4999 *Toll-free*
763-544-2154 *Voice*
763-544-2151 *Fax*
www.Carbonair.com

Standard Features

- Appropriately sized PD blower and explosion-proof motor.
- Low loss in-line filter with replaceable filter element and pressure drop indicator.
- Centrifugal moisture separator/silencer with polypropylene demister for removal of over 99% of water droplets.
- 100 gallon moisture separator/silencers with manual drain and full access cover for servicing.
- Vacuum relief valve to provide blower protection from excessive vacuum inlet line restrictions.
- All system components mounted on a coated carbon steel skid.
- Clear PVC site glass with level switches.
- In-tank isolation of water from air.
- Reactive discharge silencer.
- System vacuum gauge.
- OSHA belt guard.

Options

- NEMA 7 (explosion proof; for hazardous locations) manual motor starter with thermal overload protection.
- NEMA 4 (waterproof/weather resistant) manual motor starter with thermal overload protection.
- Custom control panel with appropriate NEMA enclosure, with or without UL label.
- Discharge pump for moisture separator with explosion proof level control.
- Remote control and monitoring and communications package.
- Pressure relief, throttling and air make-up valves.
- High level alarm switch for moisture separator.
- Additional vacuum and temperature gauges.
- Trailer-mounted or custom enclosures.
- Calibrated flow monitoring assemblies.
- Piping packages.

Specifications

Model	CE 2002	CE 2004	CE 3003	CE 3006	CE 4007	CE 5009	CE 6015
scfm @ 3" Hg	45	95	125	210	340	555	1015
scfm @ 14" Hg	15	40	50	95	160	270	560**
Maximum vacuum (Hg)	14	14	14	14	14	14	12
Motor enclosure	XP	XP	XP	XP	XP	XP	XP
Motor horsepower	2-3	2-7.5	3-10	5-15	7.5-20	7.5-25	15-50
Voltage	115/230/460	115/230/460	115/230/460	230/460	230/460	230/460	230/460
Phase*	1 & 3	1 & 3	1 & 3	1 & 3	3	3	3
Discharge size	1" NPT	2" NPT	2" NPT	2.5" NPT	3" NPT	4" NPT	6" Flange
Dimensions: LxWxH	62"x30"x68"	62"x30"x68"	62"x30"x68"	62"x30"x68"	80"x30"x68"	80"x30"x68"	98"x34"x68"
Unit Weight	685 pounds	769 pounds	832 pounds	950.5 pounds	1,169 pounds	1,368 pounds	2,153 pounds

*Only use single phase power for motors less than 7.5 H.P.
**Flow at 12" Hg vacuum maximum.

All specifications subject to change without notice

©Carbonair Environmental Systems, Inc.
All rights reserved. PDBlowerSVE.PDS 03-01

Company: Carbonair Environmental Systems
Address: 2731 Nevada Avenue New Hope, MN 55427
763-544-2154 phone 763-544-2151 Fax
Contact: Chris Riddle

ROOTS BLOWER PERFORMANCE SUMMARY: (03/27/2002)

AMBIENT CONDITIONS:

Gas	AIR	
Relative Humidity	0.00%	
Molecular Wt.	28.97	
k-Value	1.397	
Specific Gravity	1.000	
Ambient Temp.	68	deg F
Ambient Pressure	14.65	PSIA
Elevation	100	feet

INPUT CONDITIONS:

Actual Volume	443	ICFM
Std. Volume	320	SCFM
Mass/Wt. Flow	25	#/min
System Inlet Pressure	100	in H2O Vac
Inlet Pr. Loss	0.5	PSI
Blower Inlet Pressure	10.54	PSIA
System Disch Pressure	14.65	PSIA
Disch Pr. Loss	0.5	PSI
Blower Disch Pressure	15.15	PSIA
Inlet Temperature	68	deg F

STANDARD CONDITIONS:

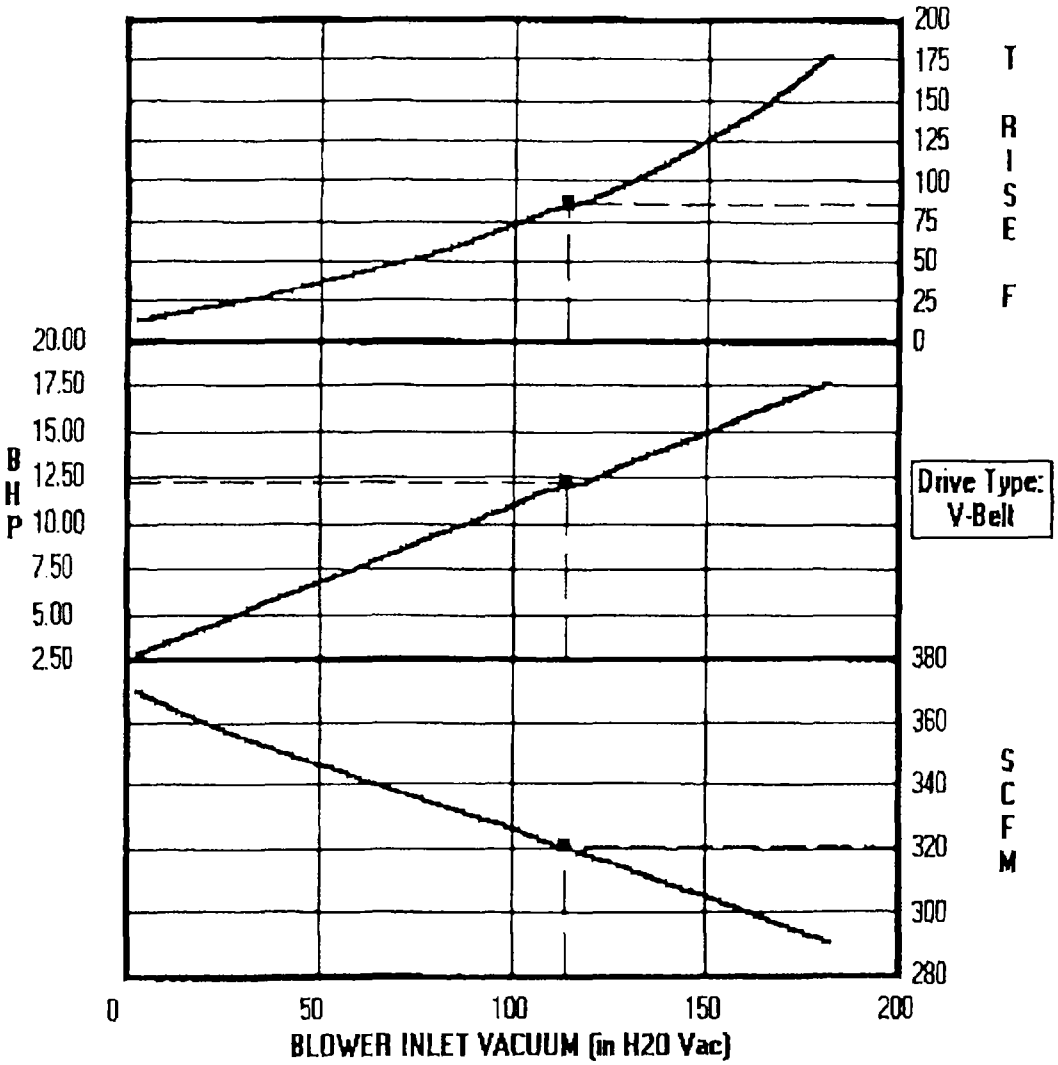
Pressure	14.7	PSIA
Temperature	68	deg F
Relative Humidity	36	%

SELECTED UNIT DETAIL:

Model	59	URAI	
Speed	1681	RPM	59.0%
Power at Blower Shaft	12.2	BHP	
Blower Differential Pressure	4.61	PSI	62.8%
Temperature Rise	86	deg F	38.1%
Discharge Temperature	154	deg F	
Discharge Volume	358	ACFM	
Gear Tip Speed	2202	FPM	
V-Belt: Est. B10 Brg Life:	167669	hours	
Coupling: Est. B10 Brg Life:	424762	hours	
Est. Free Field Noise @ 1 m.	82	dBa	
CFR	0.323		
Weight	204	lbs.	
Shaft Dia.	1.125	in.	
Min. Sheave Dia.	6	in.	
Inlet/Disch Conn.	4T		

59 URAI: Variable Pressure Performance

ROOTS DIVISION, DRESSER EQUIPMENT GROUP



COND'S: AIR
RH = .00%, MW = 28.97, k = 1.397, Tin = 68 deg F
DESIGN: Speed = 1681 RPM
System Inlet P = 100 in H20 Vac, Inlet P Loss = 0.5 PSI
System Disch P = 14.65 PSIA, Disch P Loss = 0.5 PSI
STD: RH = 36%, T = 68 deg F, P = 14.7 PSIA

Comprehensive Controls

Comprehensive Controls is Carbonair's peerless in-house controls division

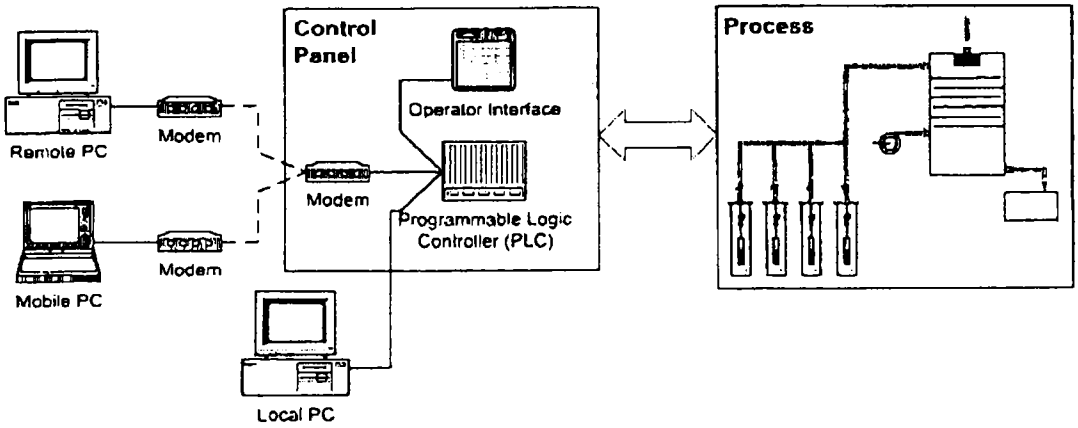
We say that because no other firm we know can match our knowledge of process requirements with controls know-how. Comprehensive Controls comprises in-house electrical engineers, programmers, technicians and process control instrumentation experts with many years of experience. This means you will receive a controls package that is ideally matched to your project.

Comprehensive Control systems combine selected automatic pump, blower and process control elements with motor control, protective, alarm and monitoring equipment. The system can be electromechanical or microprocessor based, with the client's preference and ease of use in mind. Panels are equipped to accommodate hazardous locations where necessary. All components are of high quality and reputable manufacture. Of course, all control panel systems are thoroughly tested prior to shipment.

Housed in rugged enclosures of suitable material and NEMA type, the control systems meet all specified job requirements, National Electric Code requirements as well as applicable industry and government standards. As an Underwriter's Laboratories Industrial Control Panel manufacturing facility we can provide UL labeling. Our high quality manufacturing standards include color-coded and numbered control circuit wiring.

All systems are furnished with complete documentation including AutoCAD©-generated wiring diagrams. Options for job-specific requirements include enclosure door and inner panel layouts, dimensional drawings, parts lists and operating instructions.

Comprehensive Controls can provide start-up assistance and service by phone or in the field. Each control system has a documentation file that is maintained at the factory for future reference. Most replacement and spare parts are available for immediate shipment.



Control System Block Diagram

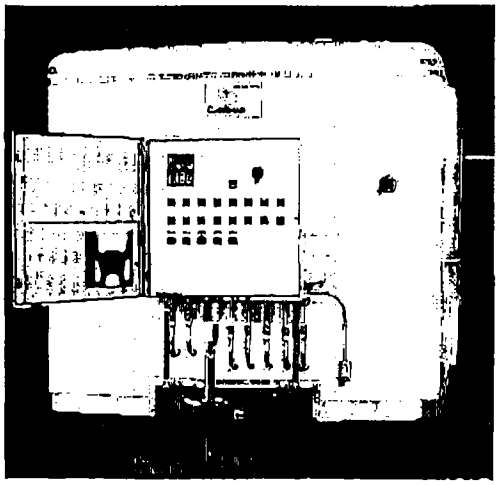
CARBONAIR®
ENVIRONMENTAL SYSTEMS
2731 Nevada Avenue North
New Hope, MN 55427
800-526-4999 *Toll-free*
763-544-2154 *Voice*
763-544-2151 *Fax*
www.Carbonair.com

Advanced Capabilities

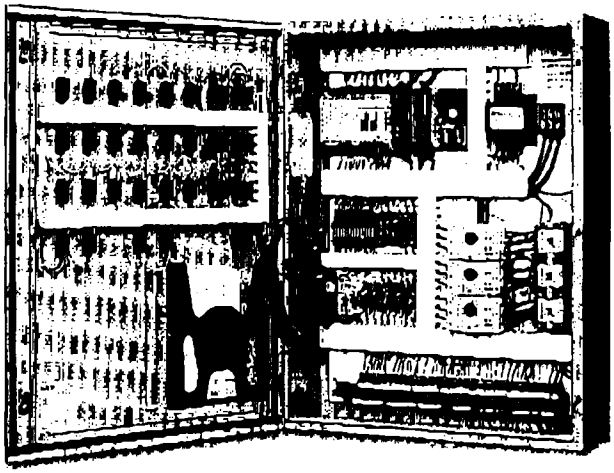
Our advanced control capabilities set us apart from our peers. Comprehensive Control systems are available with major manufacturer programmable logic controllers (PLC's), operator interface options from displays with keypads to touchscreens, and supervisory control and data acquisition (SCADA) systems.

A variety of remote communications options can be incorporated into our control systems. For example, alarms can be reported as a voice message, or data can be sent to a pager, computer, fax machine or an e-mail address on the Internet. In addition to reporting alarms, comprehensive site monitoring and remote control can be provided by RCAM, our Windows™ PC-based software package. Supported communication mediums include dial-up telephone line (including the Internet), dedicated phone line, cellular phone, radios of all types, fiber optic and hardwire cable.

SCADA systems with industry-standard communications and human-machine interface (HMI) software packages provide comprehensive local and remote site control and monitoring. Graphic displays, reports and process control and monitoring functions are configured to your project's specific requirements.



The control panel is often supplied as part of a factory-integrated liquid/vapor process treatment system where the equipment is skid, trailer or building-mounted. Our licensed electricians inter-wire the control panels with the process equipment, motors, valves, lights, receptacles, HVAC and electrical service entrance/distribution equipment.



Control panels incorporate major manufacturer components, whether they utilize a PLC (as shown) or relay/timer logic. The control logic can be integrated with motor control and alarm/monitoring components. Our high quality manufacturing standards include the use of wiring channel, color coded and numbered wiring, labeling of all door and sub-panel components and terminal blocks for all external connections.

©Carbonair Environmental Systems, Inc
All rights reserved Controls.PDS 03-01

Flowrate Estimation:

1) Choose Soil Type, or
   Optional - Enter your own permeability values (darcy)
2) Enter Well Radius (in)
3) Enter Radius of Influence (ft) & Interval Thickness*
4) Optional - Enter your own well vacuum (406" = max)
5) Click button to calculate Predicted Flowrate Ranges

- ○ Medium Sand
- ○ Fine Sand
- ◉ Silty Sand
- ○ Clayey Silts
- ○ Input Your Own Permeability Range

Permeability Range (darcy)

.1 to 1

Well Radius	2	in
Radius of Influence	25	ft
Interval Thickness*	10	ft

-->Calculate Flowrate Ranges<--

* thickness of screened interval, or permeable zone (whichever is smaller).

Predicted Flowrate Ranges

Well Vacuum P_w (in H_2O)	Flowrate (SCFM) (single well)		
5	0.05	to	0.55
10	0.11	to	1.09
20	0.22	to	2.16
40	0.42	to	4.21
60	0.61	to	6.15
120	1.13	to	11.31
100	1.13	to	11.31

4

About Soils (& Unit Conversions) | 8 | Info about Calculation

Vapor Concentration Estimation - Calculation

1. Type in Temperature (C) (hit <return>) — 20

2. Click to Enter Composition of Contaminant or Choose one of the Default Distributions
   - ○ Enter Distribution
   - ○ "Fresh" Gasoline
   - ◉ "Weathered" Gasoline

3. Click to View Distributions, (optional) — View Distributions

4. Click to Perform Calculations — ◉ Perform Calculations

Results:

Sum of Mass Fractions	1.00000	
Calc. Vapor Pressure	0.06296	atm
Calc. Vapor Concentration	222.40432	mg/l

How Do I Measure a Distribution? | 10 | About Calculation | Print Card

Maximum Removal Rate Estimates

select your unit preference below

- (●) [lb/d]
- ( ) [kg/d]

Note:

These are "maximum removal rates", and should only be used as screening estimates to determine if venting is even feasible at a given site. Continue on to the next card to assess if these rates are acceptable...

Temperature (C)	20		
Soil Type	Silty Sand		
Soil Permeability Range (darcy)	.1	to	1
Well Radius (in)	2		
Radius of Influence (ft)	25		
Contaminant Type	Weathered Gasoline		
Permeable Zone Thickness (ft)	10		

P_w - Well Vacuum (in H_2O)	Flowrate Estimates [SCFM] (single well)			Max. Removal Rate Estimates **[lb/d]** (single well)		
5	0.05	to	0.55	1.01	to	11.15
10	0.11	to	1.09	2.26	to	22.37
20	0.22	to	2.16	4.63	to	45.48
40	0.42	to	4.21	9.33	to	93.48
60	0.61	to	6.15	14.33	to	144.44
120	1.13	to	11.31	32.09	to	321.19
100	1.13	to	11.31	30.00	to	300.25

Print Card

Is Soil Venting Appropriate?

At this point, you compare the maximum possible removal rate with your desired removal rate.

If the maximum removal rate does not exceed your desired removal rate, then soil venting is not likely to meet your needs, and you should consider another treatment technology, or make your needs more realistic.

In the next cards, we will refine the removal rate estimates, in order to decide if venting can achieve your objectives.

1. Enter Estimated Spill Mass: 7244 ○ kg ◉ lb
2. Enter Desired Remediation Time: 365 days
3. --> Press to get Rates<--

Single Vertical Well Results

Desired Removal Rate:	19.8465	[lb/d]
Gauge Vacuum (in H2O):	120	[in H2O]
Min Flowrate @ 120in H2O	1.13	[SCFM]
Max Flowrate @ 120in H2O	11.31	[SCFM]
Max. Est. Removal Rate:		
(lower estimate) - per well	32.09	[lb/d]
(upper estimate) - per well	321.19	[lb/d]

Is Venting Appropriate?

This is a complete summary of the data and results. Based upon these numbers, a "minimum number of wells" has been calculated, which should give you some indication of how appropriate venting is for your application. Note that this is the number of wells if circumstances are ideal, which they rarely are.

The next card discusses some of the conditions that may limit the effectiveness

Temperature [ºC]:	20	
Contaminant Type:	Weathered Gasoline	
Soil Type:	Silty Sand	
Well Radius [m]:	2	
Est. Radius of Influence [ft]:	25	
Permeable Zone Thickness [ft]:	10	
Flowrate per Well (120" Vac) [SCFM]	1.13	
Flowrate per Well (120" Vac) [SCFM]	11.31	
Min. Vol. of Air [L/g-residual]:	112.75	
Estimated Spill Mass:	7244	lb
Desired Remediation Time [days]:	365	

1.55 < **Minimum # of Wells Based on Your Input Parameters** < 15.47

Design Input Parameters...

(soil stratigraphy & contaminant characteristics)

Select the total mass units that you prefer ○ [kg] ◉ [lb]

Clear All Entries

Please enter the required information for each distinct soil layer, Please enter the required information for each distinct soil layer, click on the "Update" button, and then proceed to the next card (i.e. click on right arrow at bottom).

	Description of Soil Unit	Depth BGS* [ft]			Description of Contamination	Contaminant Distribution radius [ft]	interval thickness [ft]	average conc. [mg/kg]	Calc. Total Mass [lb]
1	Shallow Zone	0	to	20	AVGAS	139	20	58	7478.5
2			to						0.0
3			to						0.0
4			to						0.0
5			to						0.0
6			to						0.0
7			to						0.0
8			to						0.0

* Below Ground Surface

Update

Return

SD2

Design Input Parameters...

Please enter the required information for each distinct soil layer, and then proceed to the next card.

Note: - click on any table heading to get more info
- use arrow key to move between cells

- Medium Sand
- Fine Sand
- Silty Sand
- Clayey Silts

	Description of Soil Unit	Permeability* [darcy]			Design Vacuum [in H2O]	Extraction Well Construction: well radius [in]	screen thickness [ft]	radius of influence [ft]	Critical Volume of Air** [L/g]	Efficiency [%]
1	Shallow Zone	0.1	to	1	100	2	10	25	112.75	50
2			to							
3			to							
4			to							
5			to							
6			to							
7			to							
8			to							

* Enter or choose from list at top right

** minimum volume of vapor required to achieve remediation

Clear All Entries | Return | SD3

Design Input Parameters...

Please enter (1) the desired time period for remediation, (2) the design gauge vacuum, and then (3) click the "update" button.

Note: - click on any table heading to get more info
- use arrow key to move between cells

③ Update

	Description of Soil Unit	① Time for Clean-up [days]	② Design Vacuum (in H2O)	Flowrate per Vapor Extraction Well [SCFM]			Minimum Number of Wells: Based on Area	Minimum Number of Wells: Based on Critical Volume**		
1	Shallow Zone	365	100	0.97	to	9.70	30.9	4.0	to	39.9
2				NA	to	NA	NA	NA	to	NA
3				NA	to	NA	NA	NA	to	NA
4				NA	to	NA	NA	NA	to	NA
5				NA	to	NA	NA	NA	to	NA
6				NA	to	NA	NA	NA	to	NA
7				NA	to	NA	NA	NA	to	NA
8				NA	to	NA	NA	NA	to	NA

NA - not enough input data

** minimum volume of vapor required to achieve remediation

Clear All Entries | Return | SD4

Flowrate Estimation:

1) Choose Soil Type, or
   Optional - Enter your own permeability values (darcy)
2) Enter Well Radius (in)
3) Enter Radius of Influence (ft) & Interval Thickness*
4) Optional - Enter your own well vacuum (406" = max)
5) Click button to calculate Predicted Flowrate Ranges

- (●) Medium Sand
- ( ) Fine Sand
- ( ) Silty Sand
- ( ) Clayey Silts
- ( ) Input Your Own Permeability Range

Permeability Range (darcy)

10 **to** 100

Well Radius	2	in
Radius of Influence	60	ft
Interval Thickness*	30	ft

-->Calculate Flowrate Ranges<--

* thickness of screened interval, or permeable zone (whichever is smaller).

Predicted Flowrate Ranges

Well Vacuum P_w (in H_2O)	Flowrate (SCFM) (single well)		
5	14.04	to	140.36
10	27.90	to	278.98
20	55.10	to	551.01
40	107.43	to	1074.25
60	156.97	to	1569.72
120	288.95	to	2889.49
3	8.44	to	84.42

4

About Soils (& Unit Conversions) | 8 | Info about Calculation

Vapor Concentration Estimation - Calculation

1. Type in Temperature (C) (hit <return>) — 20

2. Click to Enter Composition of Contaminant or Choose one of the Default Distributions
   - ○ Enter Distribution
   - ○ "Fresh" Gasoline
   - ◉ "Weathered" Gasoline

3. Click to View Distributions, (optional) — View Distributions

4. Click to Perform Calculations — ◉ Perform Calculations

Results:

Sum of Mass Fractions	1.00000	
Calc. Vapor Pressure	0.06296	atm
Calc. Vapor Concentration	222.40432	mg/l

How Do I Measure a Distribution? | 10 | About Calculation | Print Card

Maximum Removal Rate Estimates

select your unit preference below

- (•) [lb/d]
- ( ) [kg/d]

Note:

These are "maximum removal rates", and should only be used as screening estimates to determine if venting is even feasible at a given site. Continue on to the next card to assess if these rates are acceptable...

Temperature (C)	20		
Soil Type	Medium Sand		
Soil Permeability Range (darcy)	10	to	100
Well Radius (in)	2		
Radius of Influence (ft)	60		
Contaminant Type	Weathered Gasoline		
Permeable Zone Thickness (ft)	30		

P_w - Well Vacuum (in H_2O)	Flowrate Estimates [SCFM] (single well)			Max. Removal Rate Estimates **[lb/d]** (single well)		
5	14.04	to	140.36	284.60	to	2845.22
10	27.90	to	278.98	572.68	to	5726.42
20	55.10	to	551.01	1160.24	to	11602.58
40	107.43	to	1074.25	2385.49	to	23853.81
60	156.97	to	1569.72	3686.54	to	36865.90
120	288.95	to	2889.49	8205.88	to	82058.53
3	8.44	to	84.42	170.24	to	1702.79

Print Card

Is Soil Venting Appropriate?

At this point, you compare the maximum possible removal rate with your desired removal rate.

If the maximum removal rate does not exceed your desired removal rate, then soil venting is not likely to meet your needs, and you should consider another treatment technology, or make your needs more realistic.

In the next cards, we will refine the removal rate estimates, in order to decide if venting can achieve your objectives.

1. Enter Estimated Spill Mass: 14488 ○ kg ◉ lb
2. Enter Desired Remediation Time: 365 days
3. --> Press to get Rates<--

Single Vertical Well Results

Desired Removal Rate:	39.6931	[lb/d]
Gauge Vacuum (in H2O):	120	[in H2O]
Min Flowrate @ 120in H2O	288.95	[SCFM]
Max Flowrate @ 120in H2O	2889.49	[SCFM]
Max. Est. Removal Rate:		
(lower estimate) - per well	8205.88	[lb/d]
(upper estimate) - per well	82058.53	[lb/d]

Is Venting Appropriate?

This is a complete summary of the data and results. Based upon these numbers, a "minimum number of wells" has been calculated, which should give you some indication of how appropriate venting is for your application. Note that this is the number of wells if circumstances are ideal, which they rarely are.

The next card discusses some of the conditions that may limit the effectiveness

Temperature [œC]:	20	
Contaminant Type:	Weathered Gasoline	
Soil Type:	Medium Sand	
Well Radius [in]:	2	
Est. Radius of Influence [ft]:	60	
Permeable Zone Thickness [ft]:	30	
Flowrate per Well (120" Vac) [SCFM]	288.95	
Flowrate per Well (120" Vac) [SCFM]	2889.49	
Min. Vol. of Air [L/g-residual]:	112.75	
Estimated Spill Mass:	14488	lb
Desired Remediation Time [days]:	365	

0.01 < **Minimum # of Wells Based on Your Input Parameters** < 0.12

Design Input Parameters...

(soil stratigraphy & contaminant characteristics)

Select the total mass units that you prefer ○ [kg] ◉ [lb]

Clear All Entries

Please enter the required information for each distinct soil layer. Please enter the required information for each distinct soil layer, click on the "Update" button, and then proceed to the next card (i.e. click on right arrow at bottom).

	Description of Soil Unit	Depth BGS* [ft]			Description of Contamination	Contaminant Distribution radius [ft]	interval thickness [ft]	average conc. [mg/kg]	Calc. Total Mass [lb]
1	Shallow zone	20	to	60	gasoline	139	40	58	14956.9
2			to						0.0
3			to						0.0
4			to						0.0
5			to						0.0
6			to						0.0
7			to						0.0
8			to						0.0

* Below Ground Surface

Update

Return

SD2

Design Input Parameters...

Please enter the required information for each distinct soil layer, and then proceed to the next card.

Note: - click on any table heading to get more info
- use arrow key to move between cells

- Medium Sand
- Fine Sand
- Silty Sand
- Clayey Silts

	Description of Soil Unit	Permeability* [darcy]			Design Vacuum (in H2O)	Extraction Well Construction: well radius [in]	screen thickness [ft]	radius of influence [ft]	Critical Volume of Air** [L/g]	Efficiency (%)
1	Shallow zone	10	to	100	3	2	30	60	112.75	50
2			to							
3			to							
4			to							
5			to							
6			to							
7			to							
8			to							

* Enter or choose from list at top right

** minimum volume of vapor required to achieve remediation

Clear All Entries | Return | SD3

Design Input Parameters...

Please enter (1) the desired time period for remediation, (2) the design gauge vacuum, and then (3) click the "update" button.

Note: - click on any table heading to get more info
- use arrow key to move between cells

(3) Update

	Description of Soil Unit	(1) Time for Clean-up [days]	(2) Design Vacuum (in H2O)	Flowrate per Vapor Extraction Well [SCFM]			Minimum Number of Wells: Based on Area	Minimum Number of Wells: Based on Critical Volume**		
1	Shallow zone	365	3	8.44	to	84.38	5.4	1.2	to	12.1
2				NA	to	NA	NA	NA	to	NA
3				NA	to	NA	NA	NA	to	NA
4				NA	to	NA	NA	NA	to	NA
5				NA	to	NA	NA	NA	to	NA
6				NA	to	NA	NA	NA	to	NA
7				NA	to	NA	NA	NA	to	NA
8				NA	to	NA	NA	NA	to	NA

NA - not enough input data

** minimum volume of vapor required to achieve remediation

Clear All Entries | Return | SD4

APPENDIX F

REMEDIAL ACTION PLAN SUMMARY

Remedial Action Plan Summary

DEP Form # 62-770.900(4)
Form Title: Remedial Action Plan Summary
Effective Date: September 23, 1997

Site Name Site 1438/1439
Location Naval Air Station Whiting Field
Media Contaminated: ☐ Groundwater ☑ Soil

FDEP Facility ID No. _____
Current Date 4 / 17 /2002
Date of Last GW Analysis 1 / 26 / 98

Type(s) of Product(s) Discharged:
☑ Gasoline Analytical Group
☐ Kerosene Analytical Group (Diesel)
- Estimated Petroleum Mass (lbs):
  - Groundwater _____
  - Saturated Zone Soil _____
  - Vadose Zone Soil 21,732
- Area of Plume 60,340 (ft^2)
- Thickness of Plume 60 (ft)

Groundwater Recovery and Specifications:
- No. of Recovery Wells _____
  ☐ Vertical ☐ Horizontal
- Design Flow Rate/Well _____ (gpm)
- Total Flow Rate _____ (gpm)
- Hydraulic Conductivity _____ (ft/day)
- Recovery Well Screen Interval _____ (ft)
- Depth to Groundwater _____ (ft)

Method of Groundwater Remediation:
☐ Pump-and-Treat
- ☐ Air Stripper
  - ☐ Low Profile ☐ Packed Tower
- ☐ Diffused Aerator
- ☐ Activated Carbon
  - ☐ Primary Treatment ☐ Polishing

☐ In Situ Air Sparging
- No. of Sparge Points _____
  ☐ Vertical ☐ Horizontal
- Pressure _____ (psi)
- Design Air Flow Rate/Well _____ (cfm)
- Total Air Flow Rate _____ (cfm)

☐ Biosparging
- No. of Sparge Points _____
  ☐ Vertical ☐ Horizontal
- Design Air Flow Rate/Well _____ (cfm)

☐ Bioremediation
  ☐ In Situ ☐ Ex Situ

☐ Other _____

Method of Groundwater Disposal:
☐ Infiltration Gallery ☐ Sanitary Sewer
☐ Surface Discharge/NPDES ☐ Injection Well
☐ Other _____

Free Product Present: ☐ Yes ☑ No
- Estimated Volume _____ (gal)
- Maximum Thickness _____ (in)
- Method of Recovery (check all that apply):
  ☐ Manual Bailing ☐ Skimming Pump
  ☐ Other _____

Method of Soil Remediation:
☐ Excavation
  Volume to be Excavated _____ (yds^3)
- ☐ Thermal Treatment ☐ Land Farming On Site
- ☐ Landfill ☐ Bioremediation
- ☐ Other _____

☑ Vapor Extraction System (VES)
- No. of Venting Wells 41
  ☑ Vertical ☐ Horizontal
- VES - Applied Vacuum 100 (wg)
- Design Air Flow Rate 410 (cfm)
- Design Radius of Influence 25 to 60 (ft)
- Air Emissions Treatment
  ☐ Thermal Oxidizer ☐ Catalytic Converter
  ☑ Carbon ☐ Other _____

☐ Soil Bioventing
- No. of Venting Wells _____
  ☐ Vertical ☐ Horizontal
- Design Air Flow Rate _____ (cfm)

☐ In Situ Bioremediation
☐ Other _____

Natural Attenuation:
- Method of Evaluation
  ☐ Rule 62-770.690(1)(e), F.A.C.
  ☐ Rule 62-770.690(1)(f), F.A.C.

Estimated Time of Cleanup: 365 (days)
- Method of Estimation
  ☐ Pore Volumes (no. of pore vols. = _____)
  ☐ Exponential Decay (Decay Rate) ____ (day^{-1})
  ☐ Groundwater Model
  ☑ Other Hyper Ventilate Program

Estimated Cost:
- Est. Capital Cost (incl. install.) $ 284,000.00
- Est. O & M Cost (per year) $ 76,000.00
- Est. Total Cleanup Cost $ 438,000.00