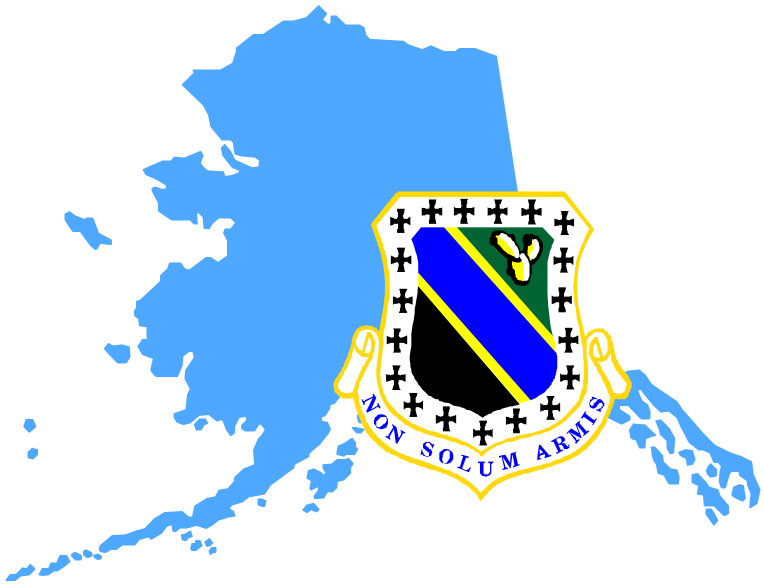


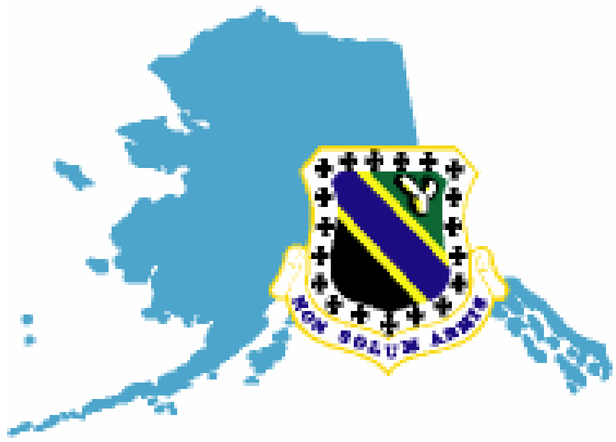
UNITED STATES AIR FORCE
ELMENDORF AIR FORCE BASE, ALASKA

ENVIRONMENTAL RESTORATION PROGRAM

FIELD SAMPLING PLAN
SOIL SAMPLING AT BIOVENTING SYSTEMS
ST32 TANKS 7 AND 8, ST61 AND ST68
ELMENDORF AFB, ALASKA

FINAL

AUGUST 2004



FINAL

FIELD SAMPLING PLAN

SOIL SAMPLING AT BIOVENTING SYSTEMS
ST32 TANKS 7 AND 8, ST61 AND ST68

Elmendorf AFB, Alaska

Prepared for:

3rd Civil Engineer Squadron/Environmental Restoration
and

Air Force Center for Environmental Excellence

Contract No. F41624-03-D-8622/TO 0042
Project No. FXSB20047311

August 2004

PREFACE

This project is being performed under contract agreement (Contract No. F41624-03-D-8622-0042) with the United States Air Force Center for Environmental Excellence (AFCEE). This FSP has been prepared for the AFCEE Statement of Work (SOW) entitled, *Environmental Monitoring and System Optimization of Basewide Bioventing Systems, Elmendorf AFB, Alaska,* dated 15 January 2004. The SOW also called for sampling at bioventing system ST32 Tank 2. However, during a meeting held between 3 CES/CEVR and the Alaska Department of Environmental Conservation (ADEC) on 30 June 2004, it was agreed that no further action, including sampling, is required for the soil at ST32 Tank 2. This agreement was made because remaining soil contamination at this site is limited to the "smear zone". Bioventing systems are unable to effectively treat soil saturated with water including those in the smear zone. The groundwater at this site will continue to be monitored under the Basewide Groundwater Monitoring Program.

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LIST OF ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ACM	Alaska Cleanup Matrix
ADEC	Alaska Department of Environmental Conservation
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liabilities Act
CES/CEVR	Civil Engineer Squadron/Environmental Restoration
CIH	Certified Industrial Hygienist
COC	Chain-of-Custody
COR	Contracting Officer's representative
DI	De-ionized
DRO	Diesel Range Organics
EPA	Environmental Protection Agency
ERPIMS	Environmental Resource Program Information Management System
FFA	Federal Facilities Agreement
FSP	Field Sampling Plan
GRO	Gasoline Range Organics
HSP	Healthy and Safety Plan
IDW	Investigative Derived Wastes
Kg	Kilogram
mg	milligram

LIST OF ACRONYMS AND ABBREVIATIONS *(Continued)*

NPL	National Priorities List
PAH	Polynuclear Aromatic Hydrocarbon
PHSC	Program Health and Safety Coordinator
PID	Photoionization detector
POL	Petroleum, Oil, and Lubricant
PPE	Personal Protective Equipment
QA	Quality Assurance
QAPP	Quality Assurance Program Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SERA	State-Elmendorf Environmental Restoration Agreement
SSHO	Site Safety and Health Officer
USAF	United States Air Force
UST	Underground Storage Tank

1.0 INTRODUCTION

This Field Sampling Plan (FSP) presents, in specific terms, the requirements and procedures for conducting field operations and investigations. This project specific FSP has been prepared to ensure: (1) the data quality objectives specified for this project are met, (2) the field sampling protocols are documented and reviewed in a consistent manner, and (3) the data collected are scientifically valid and defensible.

The purpose of this project is to perform soil sampling at Elmendorf Air Force Base (AFB), Alaska at ST32 Tanks 7 and 8, ST61, and ST68 to determine the level of contamination remaining at each site. This project is coordinated and directed by the 3rd Civil Engineer Squadron/Environmental Restoration (3 CES/CEVR) on Elmendorf AFB.

A Quality Assurance Project Plan (QAPP), conforming to the Air Force Center for Environmental Excellence (AFCEE) QAPP, titled, *Quality Assurance Project Plan, Basewide Groundwater monitoring, Elmendorf AFB, Alaska,* (USAF, 2003a*)*, has been prepared under separate cover. This site specific FSP and the QAPP shall constitute, by definition, a Sampling and Analysis Plan (SAP).

A site specific Health and Safety Plan (HSP), submitted under separate cover, titled, *Health and Safety Plan, Environmental Monitoring and System Optimization of Basewide Bioventing Systems, Elmendorf Air Force Base, Alaska* (USAF, 2004a) has been prepared for this project. The HSP was prepared for the environmental monitoring and system optimization field effort as well as the soil sampling discussed in this FSP.

1.1 DATA QUALITY OBJECTIVES

Quality Assurance (QA) objectives were developed for this project to provide guidelines for field and laboratory procedures. The objectives of the sampling and analysis effort is to produce data of acceptable quality to show that contaminant concentrations in treated soils have been remediated to below cleanup standards by sampling subsurface soil at ST32 Tanks 7 and 8, ST61, and ST68.

A primary QA objective is that all measurements be representative of actual soils and that all data resulting from sampling and analysis activities be comparable. The use of accepted and published sampling and analysis methods, as well as the use of standardized units, will aid in ensuring data comparability.

1.2 DOCUMENT ORGANIZATION

This document is organized as follows:

- Sections 1, 2, 3 and 4 provide the introduction, project background, project purpose and scope, and project organization and responsibility, respectively;
- Section 5 provides information on field operations;

- Section 6 provides information on environmental sampling procedures;
- Section 7 provides field measurement instruments and methods;
- Section 8 provides a brief discussion on record keeping; and
- Section 9 provides references that were used to prepare this FSP.

Appendix A includes field forms that will be used during the execution of this project.

2.0 PROJECT BACKGROUND

Elmendorf AFB was placed on the United States Environmental Protection Agency (EPA) National Priority List (NPL) in August 1990. This listing designated the facility as a federal site subject to the remedial response requirements of the Comprehensive Environmental Response, Compensation, and Liabilities Act (CERCLA), often referred to as the "Superfund". The United States Air Force (USAF), EPA, and Alaska Department of Environmental Conservation (ADEC) signed a Federal Facilities Agreement (FFA) for Elmendorf AFB on November 22, 1991. The FFA divided contaminated sites at Elmendorf AFB into seven operable units (OUs), each to be managed as a separate area and investigated according to a sequenced schedule.

In October 1992, the Air Force developed a cooperative agreement with ADEC to address the assessment and remediation of solid waste and petroleum, oil, and lubricant (POL)-contaminated sites on Elmendorf AFB. This agreement is known as the State-Elmendorf Environmental Restoration Agreement (SERA). The nature and extent of contamination and the potential risks to public health and the environment at SERA sites were evaluated by site assessments. Conclusions were that fuel and fuel constituents were present at a number of source areas. The treatment method selected for remediation of these source areas was bioventing.

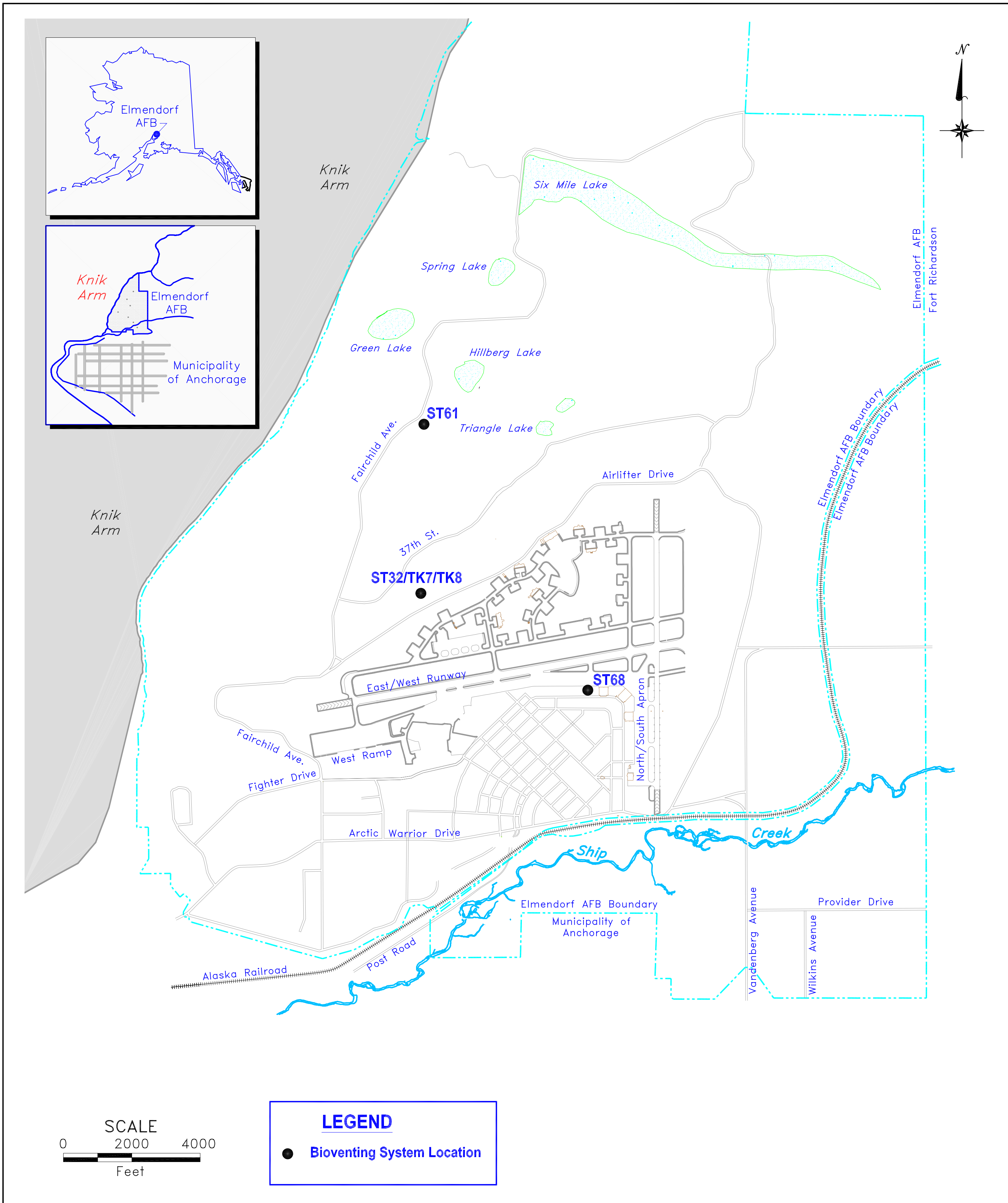
SERA was dissolved on 21 October, 2002, by mutual agreement between the USAF and ADEC. The sites and programs formerly addressed by SERA, underground storage tanks (UST) and oil and other hazardous substance discharges, will be addressed in accordance with 18 Alaska Administrative Code (AAC) 78 (Underground Storage Tanks) and 18 AAC 75 (Oil and Other Hazardous Substances Pollution Control).

Bioventing systems operate by increasing the flow of air (e.g. oxygen) into soils contaminated with POL. Soils naturally contain microorganisms that decompose POL. Bioventing increases the amount of oxygen available to these microorganisms, which speeds up their growth and enables them to more rapidly decompose POL. This project includes soil sampling for bioventing systems at the following SERA locations: ST32 Tanks 7 and 8; ST61; and ST68. The locations of these bioventing systems on Elmendorf AFB are illustrated on Figure 2-1.

The data collected during the sampling activities will be used to: (1) determine if contaminant levels have been cleaned to below regulatory allowable levels; (2) determine if operation of bioventing systems can be discontinued; or (3) determine time frame to cleanup.

2.1 INSTALLATION ENVIRONMENTAL SETTING

Elmendorf AFB is the largest Air Force installation in Alaska. The AFB is located adjacent to Anchorage, Alaska, the largest population center in the State with associated agricultural, industrial and residential sectors. Over half of the base is undeveloped. The developed portion of the base supports airfield operations, base support operations, personnel housing, and recreational facilities.



DATE: 28 JUN 2004	UNITED STATES AIR FORCE	
JOB NO: 20077.043.042.003	**BIOVENTING SYSTEM LOCATIONS**	
FILE: Fig 2-1.dwg		
DRAWN BY:SJ	ELMENDORF AIR FORCE BASE ANCHORAGE, ALASKA	**FIGURE 2-1**

3.0 PROJECT PURPOSE AND SCOPE

The purpose of this project is to perform soil sampling at sites ST32 Tanks 7 and 8, ST61, and ST68 to: (1) determine if contaminant levels have been cleaned to below regulatory allowable levels; (2) determine if operation of bioventing systems should be discontinued; or (3) determine time frame to cleanup. Soil sampling will consist of drilling soil borings as follows:

- ST32 Tank 7 – Three borings;
- ST32 Tank 8 – Two borings;
- ST61 – Two borings; and
- ST68 – One boring.

The sections below provide a brief background discussion of each site and describe the sampling activities to be performed at each site.

3.1 BIOVENTING SYSTEM ST32 TANK 7

This section provides a brief discussion of previous investigations at ST32 Tank 7 and the planned soil sampling field activities to be performed during 2004.

3.1.1 Bioventing System ST32 Tank 7 Background

During the 1994 SERA Phase II Assessment, Tank 7 was the only one of 29 tanks at ST32 not excavated. The tank was left in place for confined space entry and operational procedures training. The tank was located between two side roads north of Airlifter Drive (formerly known as Burns Road). A total of five soil borings were advanced during the SERA Phase II Assessment and one was completed as a monitoring well. Bioventing vapor monitoring probes were installed in the other four boreholes. Soil samples were collected from the soil borings and analyzed for diesel range organics (DRO), gasoline range organics (GRO), and benzene, toluene, ethylbenzene, and xylenes (BTEX).

Elevated concentrations of petroleum hydrocarbons were detected in soil samples collected from all five borings. The highest concentrations were from the samples collected from 59BH91 at 15 feet below ground surface (bgs) and from 59WL29 at 12 feet bgs. GRO concentrations were detected at 12,000 milligrams per kilogram (mg/Kg) in both of these samples. Elevated BTEX concentrations were also detected in both of these samples, with concentrations reported as high as 63 mg/Kg for benzene, 250 mg/Kg for toluene, 68 mg/Kg for ethylbenzene, and 320 mg/kg for total xylenes. Groundwater was encountered at 26 to 30 feet bgs in the soil borings. Analytical results of the soil samples are summarized in Table 3-1 (USAF, 1995b). Soil sample locations are depicted on Figure 3-1. On September 8, 1998, Tank 7 and associated piping were removed (USAF, 1999).

Table 3-1 ST32 Tank 7 1994 and Soil Boring Analytical Results

Year	Location	Depth (feet bgs)	Analytical Results (mg/Kg)					
			DRO	GRO	Benzene	Toluene	Ethylbenzene	Total Xylenes
1994	59BH84	14.5	ND	140	ND	1	0.4	2.1
		27	ND	3.7	**0.051**	0.12	0.1	0.36
	59BH90	24	ND	3.6	**0.033**	0.04	ND	ND
		23.5	ND	4.4	**0.029**	0.033	ND	0.037
		32	ND	11	**0.051**	0.081	ND	0.046
	59BH91	7.5	12	210	**0.045**	0.85	0.61	0.098
		15	23	**12,000**	**63**	**250**	**62**	**320**
		25	ND	6	**0.17**	0.43	0.076	0.48
	59BH92	12.5	15	**3,800**	ND	**18**	**7.4**	3.2
		25	ND	13	**0.53**	1.1	0.14	0.86
	59WL29	12	300	**12,000**	ND	**71**	**68**	**160**
		11.5	52	180	ND	0.74	0.95	4.7
		27	ND	10	**0.15**	0.36	0.076	0.36

bgs – below ground surface DRO – diesel range organics GRO – gasoline range organics
mg/Kg – milligrams per kilogram ND – analyte not detected at or above reporting limit
Bold values exceed cleanup standard

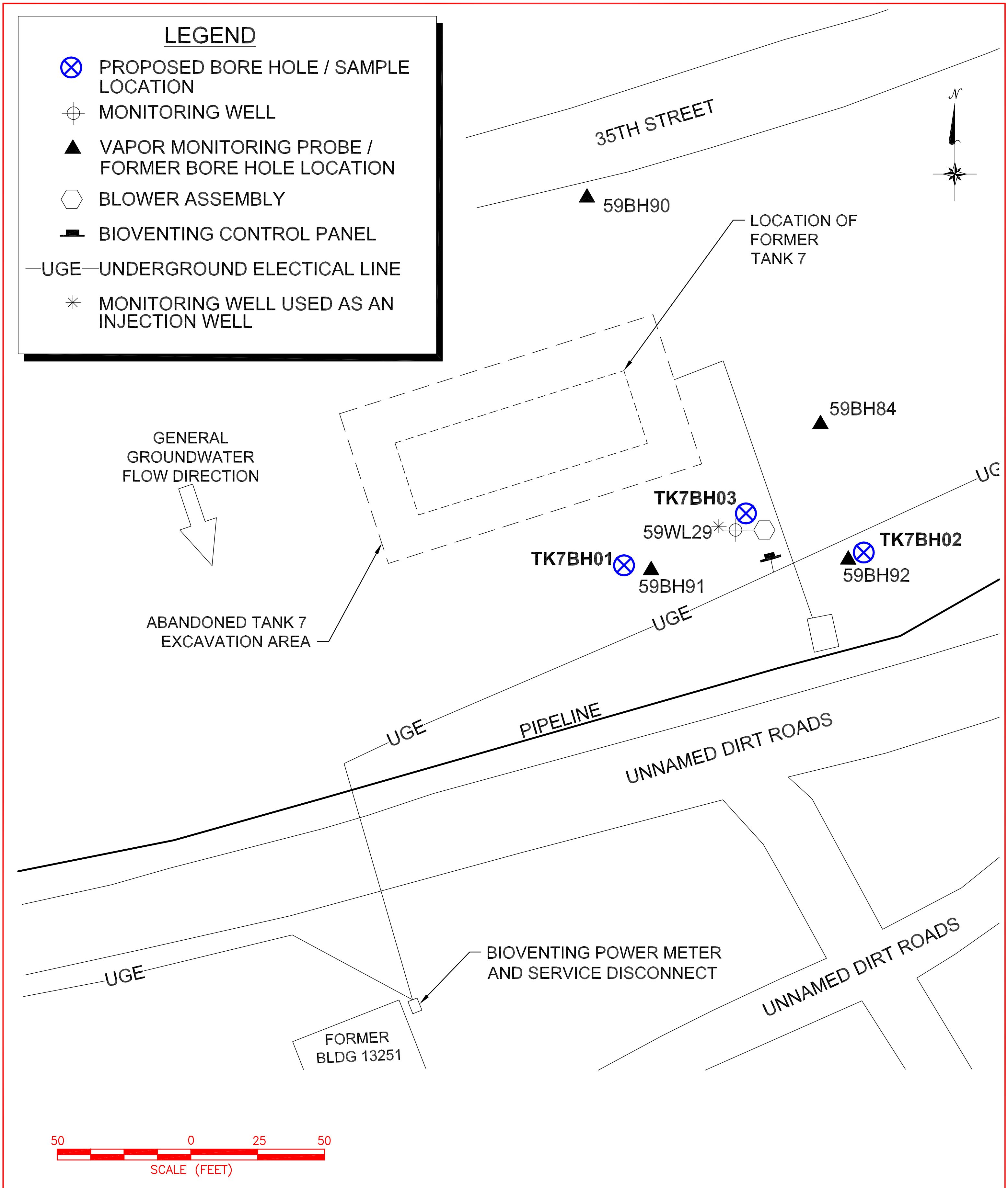
3.1.2 Bioventing System ST32 Tank 7 2004 Field Activities

2004 soil sampling at ST32 Tank 7 will consist of drilling three soil borings and collecting a minimum of two samples from each boring. The boreholes will be advanced as close as possible to the three boreholes drilled during 1994 with the highest concentrations of contaminants, 59BH91, 59BH92, and 59WL29. Proposed borehole locations where samples will be collected are shown on Figure 3-1. Sample collection procedures are provided in Section 6 of this FSP.

TK7BH01 will be drilled as close to 59BH91 as possible. This boring must be at least eight feet from the underground electrical line shown on Figure 3-2. Soil samples will be collected at 7.5, 15, and 25 feet bgs, where soil samples were found with elevated concentrations of contaminants during the SERA Phase II Assessment (USAF, 1995b). If elevated levels of hydrocarbons are discovered at a shallower depth using field-screening techniques, a soil sample will be collected to document contaminant levels at that depth.

TK7BH02 will be drilled as close to 59BH92 as possible. This boring must be at least eight feet from the underground electrical line shown on Figure 3-2. One soil sample will be collected at a depth of 12.5 feet bgs, where the highest concentrations of contaminants were found at this location during the SERA Phase II Assessment (USAF, 1995b). An additional sample will be collected at 25 feet bgs. If elevated levels of hydrocarbons are discovered at a shallower depth using field-screening techniques, a soil sample will be collected to document contaminant levels at that depth.

TK7BH03 will be drilled as close to 59WL29 as possible. One soil sample will be collected at a depth of 12 feet bgs, where the highest concentrations of contaminants were found at this location during the SERA Phase II Assessment (USAF, 1995b). An additional sample will be



DATE: 28 JUN 2004	UNITED STATES AIR FORCE	
JOB NO: 20077.043.042.0003	**PROPOSED BORE HOLE / SAMPLE LOCATIONS SOURCE AREA ST32, TANK 7**	
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DRAWN BY:SJ		**FIGURE 3-1**

collected at 27 feet bgs. If elevated levels of hydrocarbons are discovered at a shallower depth using field-screening techniques, a soil sample will be collected to document contaminant levels at that depth.

The basis for cleanup standards for ST32 Tank 7 soil is the USAF Decision Document for ST32 (USAF, 2003b). Cleanup standards are provided in Table 3-2.

Table 3-2 ST32 Tank 7 Soil Cleanup Standards

Contaminant of Concern	Cleanup Standards (mg/Kg)
Diesel Range Organics	2000
Gasoline Range Organics	1000
Benzene	0.02
Toluene	5.4
Ethylbenzene	5.5
Total Xylenes	78

Benzene, toluene, ethylbenzene, and total xylene values from 18 AAC 75 Table B1, Under 40-inch zone criteria.
mg/Kg – milligram per kilogram.

3.2 BIOVENTING SYSTEM ST32 TANK 8

This section provides a brief discussion of previous investigations at ST32 Tank 8 and the planned soil sampling field activities to be performed during 2004.

3.2.1 Bioventing System ST32 Tank 8 Background

Tank 8 was excavated and removed in 1993. The tank was formerly located approximately 150 feet north of Airlifer Drive (formerly Burns Road) and 30 feet east of the road connecting Airlifter Drive to 37th Street (formerly Ridge Road). Soil samples collected from the base of excavation during the 1993 removal contained elevated levels of petroleum hydrocarbons, with DRO reported at 42.9 mg/Kg, and GRO at 119 mg/Kg. BTEX constituents were not detected. Soil samples collected immediately to the south of Tank 8 during a 1993 geotechnical investigation for a sewer line contained petroleum hydrocarbon concentrations up to 2,500 mg/Kg GRO, 490 mg/Kg DRO, and 53.9 mg/Kg BTEX.

During the SERA Phase II Site Assessment in 1994, a total of 5 soil borings, 59BH66, 59BH67, 59BH68, 59BH69, and 59WL20, were drilled and soil samples were collected from the borings. Boring 59WL20 was completed as a groundwater monitoring well. Biovent vapor monitoring probes were installed in 59BH67, 59BH68, and 59BH69. According to the assessment report, groundwater was encountered at approximately 27.5 to 39.5 feet bgs at the site. The highest contaminant concentrations occurred around 10 to 20 feet bgs (USAF, 1995b).

Soil sampling was conducted at the site in June 2001 (USAF, 2002b). Reported sample data from two of the three soil borings drilled in 2001 had elevated contaminant concentrations. Data from SB03 (near 59BH69) met the current cleanup levels for soil at this site. Sample results are summarized in Table 3-3. Boring Locations are depicted on Figure 3-2.

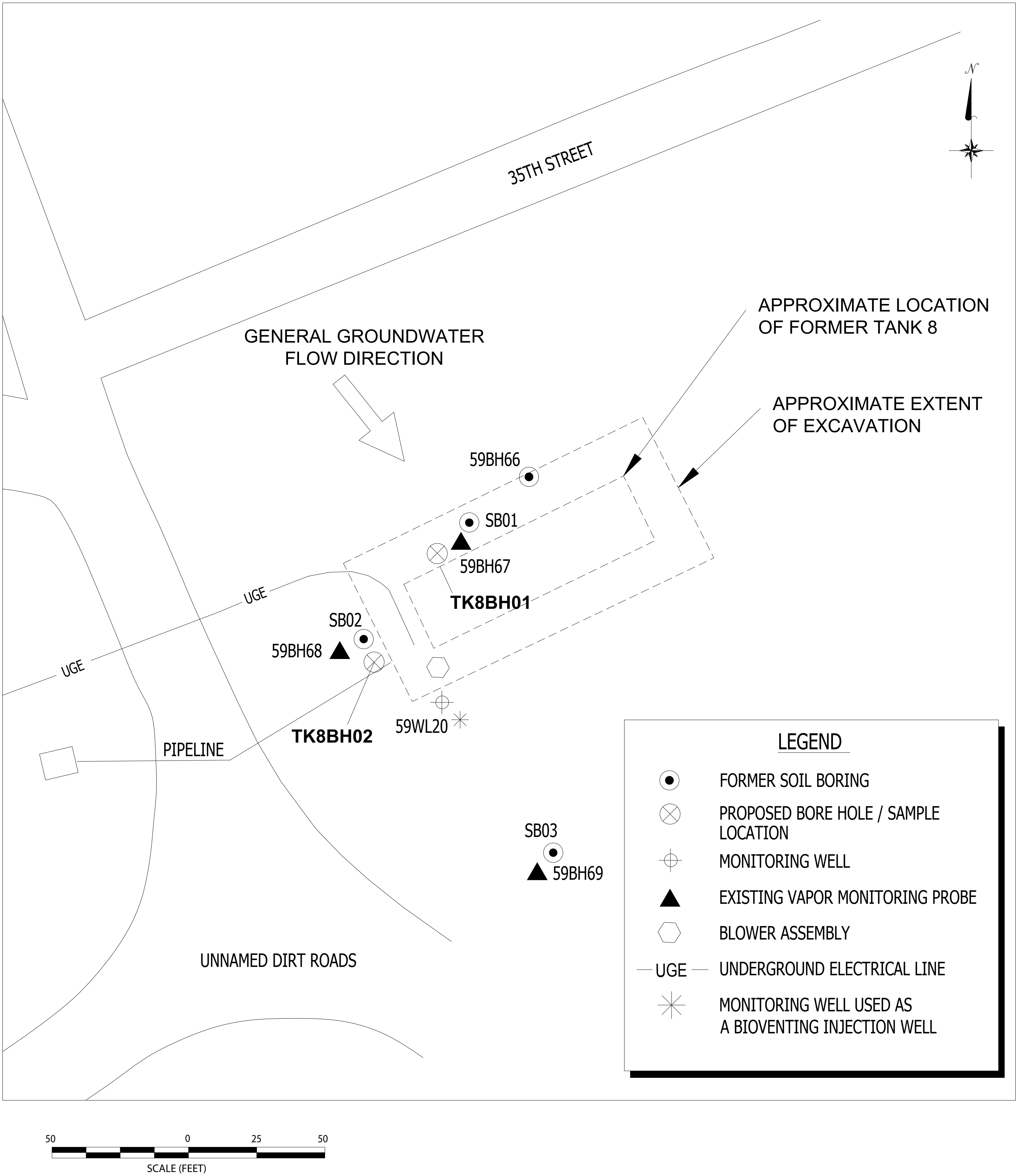
Table 3-3 ST32 Tank 8 1994 and 2001 Soil Boring Analytical Results

Year	Location	Depth (feet bgs)	Analytical Results (mg/Kg)					
			DRO	GRO	Benzene	Toluene	Ethylbenzene	Total Xylenes
1994	59BH66	28.5	ND	18	ND	0.046	0.054	0.79
		39	13	3.4	**0.045**	ND	ND	0.036
	59BH67	18.5	170	**11,000**	**10**	**46**	ND	**100**
		32.5	ND	11	**0.056**	0.062	0.082	0.33
	59BH68	13.5	240	**5,300**	**12**	**32**	**42**	**190**
		23.5	ND	130	**1.1**	0.7	1.9	4.5
		31	ND	47	**0.062**	0.4	0.4	2.1
	59BH69	11	130	500	ND	0.2	3.1	22
		26	ND	69	**0.88**	1.9	0.61	2.1
	59WL20	13.5	1100	**1,300**	**6.3**	**8.6**	**16**	37
		23.5	ND	5	**0.11**	0.071	0.11	0.2
		33.5	ND	30	**0.86**	0.069	0.26	0.4
2001	SB1 (near 59BH67)	24-26	8.1	ND (3.2)	**0.029**	0.045	0.013	0.058
		29-31	9.6	ND (3.1)	**0.032**	0.045	0.017	0.098
		36-37	8.8	ND (3.6)	ND (.013)	0.014	ND (0.02)	ND (.034)
	SB2 (near 59BH68)	19-21	800	710	ND (0.16)	ND (1.3)	**9.1**	13
		24-26	300	97	**0.037**	0.3	ND (0.25)	2.6
		24-26	110	250	**0.041**	ND (0.13)	ND (0.92)	4.3
		34-35	290	520	ND (.053)	ND (0.25)	3.8	ND (0.46)
	SB3 (near 59BH69)	9-11	8.5	ND (3.1)	ND (0.11)	0.023	ND (0.01)	ND (0.29)
		24-26	7.9	ND (3.2)	ND (0.012)	ND (0.008)	ND (0.01)	ND (0.30)
		29-31	6.9	ND (3.2)	0.014	ND (0.008)	ND (0.01)	ND (0.30)

bgs – below ground surface
DRO – diesel range organics
GRO – gasoline range organics
mg/Kg – milligrams per kilogram
Bold values exceed cleanup standard
ND – analyte not detected at or above reporting limit

The contaminant concentrations at this site are generally decreasing, indicating that the bioventing system has been effective at reducing soil contaminant levels. In-situ respiration test data from 2000 indicate that bioventing continues to help degrade contaminants in the soils at the upper and middle soil vapor monitoring probe locations near 59BH68 (USAF, 2002b).

According to the 2001 Basewide Bioventing Systems Annual Report (USAF, 2002a), a remediation effort of approximately three years was estimated to reduce contaminant concentrations in the interval from 19-21 feet bgs near vapor monitoring probe 59BH68 to concentrations below cleanup levels. Remediation of remaining contamination from middle and lower depths at 59BH67 and the lower depth near 59BH68 was estimated to take less than one year of additional remediation.



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UNITED STATES AIR FORCE

PROPOSED BORE HOLE / SAMPLE LOCATIONS
SOURCE AREA ST32, TANK 8

ELMENDORF AIR FORCE BASE
ANCHORAGE, ALASKA

FIGURE 3-2

3.2.2 Bioventing System ST32 Tank 8 2004 Field Activities

2004 soil sampling at ST32 Tank 8 will consist of drilling two soil borings and collecting a minimum of two soil samples from each boring. The boreholes will be advanced as close as possible to the two boreholes drilled during the 2001 soil sampling with remaining concentrations of contaminants above cleanup standards. A third borehole will not be required because the 2001 soil samples collected from SB03 (near 1994 boring 59BH69) met cleanup standards. Figure 3-2 depicts the proposed borehole locations where samples will be collected.

TK8BH01 will be drilled as close to 2001 SB01, (near 1994 borehole 59BH67) as possible. One soil sample will be collected at a depth of 18.5 feet bgs, where the highest concentrations of contaminants were found during 1994. Two additional samples will be collected at 25 and 32.5 feet bgs, where concentrations of benzene were found at this location during previous sampling events. The samples will be analyzed for BTEX. If elevated levels of hydrocarbons are discovered at a shallower depth using field-screening techniques, a soil sample will be collected to document contaminant levels at that depth.

TK8BH02 will be drilled as close to SB02 (near 1994 boring 59BH68) as possible. This boring must be located at least eight feet from the underground electrical line shown on Figure 3-3. Soil samples will be collected at a depth of 13.5, 25, and 31 feet bgs where concentrations of contaminants were found during previous sampling events. The samples will be analyzed for BTEX. If elevated levels of hydrocarbons are discovered at a shallower depth using field-screening techniques, a soil sample will be collected to document contaminant levels at that depth.

The basis for Cleanup standards for ST32 Tank 8 soil is the USAF Decision Document for ST32 (USAF, 2003b). Cleanup standards are provided in Table 3-4.

Table 3-4 ST32 Tank 8 Soil Cleanup Standards

Contaminant of Concern	Established Cleanup Level (mg/Kg)
Diesel Range Organics	2000
Gasoline Range Organics	1000
Benzene	0.02
Toluene	5.4
Ethylbenzene	5.5
Total Xylenes	78

Benzene, toluene, ethylbenzene, and total xylene values from 18 AAC 75 Table B1, Under 40-inch zone criteria.
mg/Kg – milligram per kilogram

3.3 BIOVENTING SYSTEM ST61

This section provides a brief discussion of previous investigations at ST61 and the planned soil sampling field activities to be performed during 2004.

3.3.1 Bioventing System ST61 Background

A vehicle maintenance facility was built at ST61 in 1943 and demolished in 1992 to allow construction of the current naval facility. The naval construction site has been the subject of several environmental investigations. During these investigations, contamination attributed to a former UST was designated as ST61. The ST61 investigations, from the installation of soil borings and monitoring wells, determined that petroleum contamination was present in the soil and groundwater. A pilot scale bioventing system was installed at ST61 in 1993 and is still present at the site.

Soil sampling was conducted by the Air Force at ST61 during 2000. The results of this soil sampling can be found in the Year 2000 Bioventing Closure Effort Report (USAF, 2001). Data in this report suggest that contaminated groundwater is creating a “smear zone” in overlying soils and that this contamination just above the water table will not be remediated via the bioventing system currently in place.

The Bioventing Closure Effort Report recommended that the ST61 bioventing system should be decommissioned since remaining contamination exists only in the smear zone where bioventing is not effective. The report also suggested that groundwater monitoring in the ST61 area should be continued through the Basewide Groundwater Monitoring Program. The 2000 soil sampling effort is summarized below.

Previous subsurface investigations at this site indicated the vertical extent of contamination extends from 10 to 17 feet bgs; therefore, the three boreholes were drilled to 17 feet bgs in order to encompass the full extent of contamination. Based on water levels in nearby monitoring wells, the depth to groundwater was approximately 11 to 16 feet bgs.

Laboratory results for samples collected at ST61 during 2000 are summarized in Table 3-5. Results of soil samples collected during the 1994 SERA Phase I Investigation are also summarized in Table 3-5. Sample locations are depicted on Figure 3-3. No contaminants were detected above detection limits in samples from 45BH04. In samples from 45BH05 and 45BH06, elevated concentrations of DRO were found at all depths sampled.

Analytical results from the 2000 soil sampling at ST61 indicate that GRO, BTEX, and polynuclear aromatic hydrocarbon (PAH) constituents were not detected above the site closure criteria. DRO, however, was present at concentrations above the site closure criteria. According to the *Year 2000 Bioventing Closure Effort Report* (USAF, 2001), because GRO, BTEX, & PAH constituents were not detected above the site closure criteria, they can be eliminated as contaminants of concern.

Table 3-5 ST61 1994 and 2000 Soil Boring Analytical Results

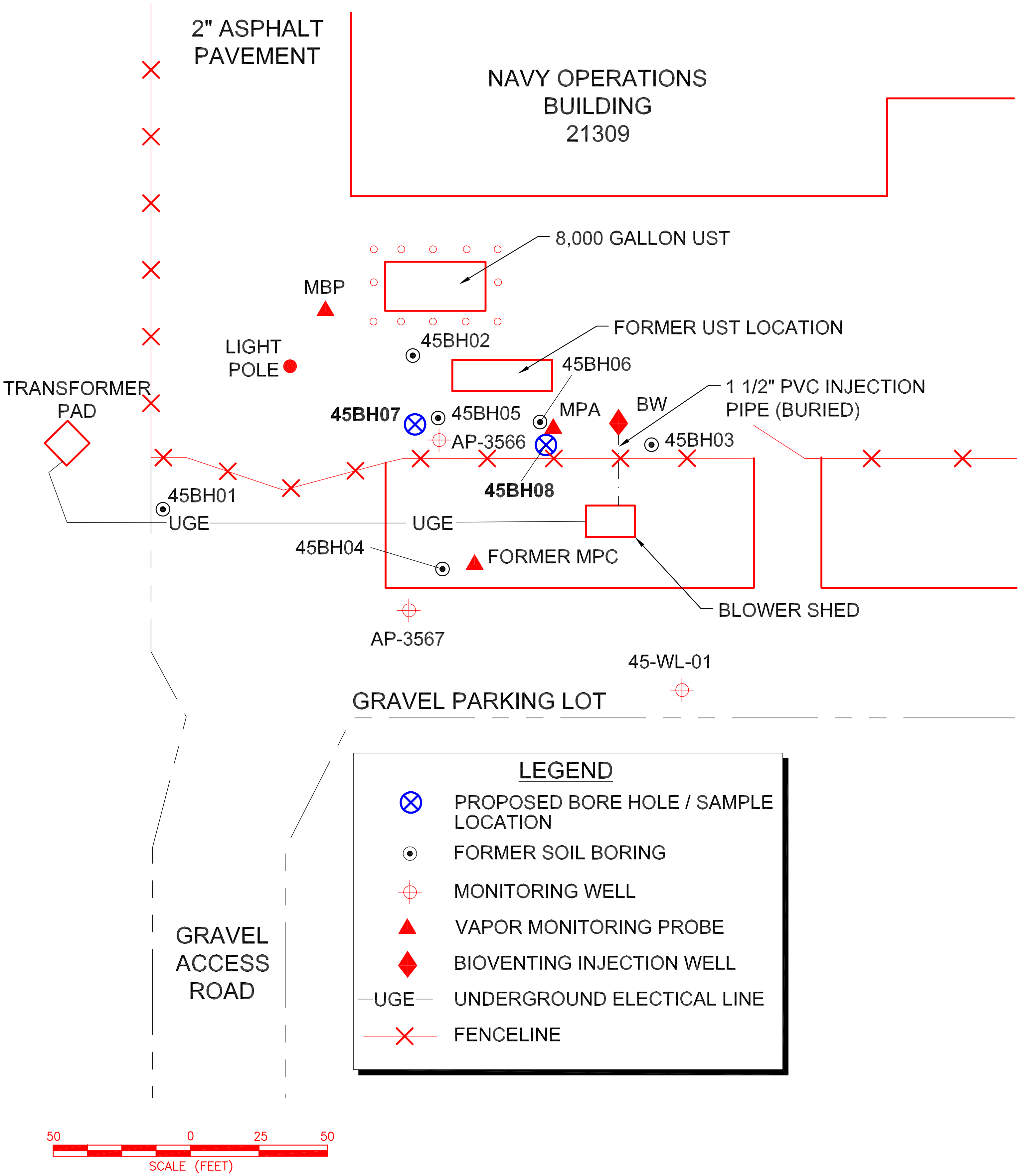
Year	Location	Depth (feet bgs)	Analytical Results (mg/Kg)					
			DRO	GRO	Benzene	Toluene	Ethylbenzene	Total Xylenes
1994	45BH01	15.5	ND	--	ND	ND	ND	ND
		24	70	--	ND	ND	ND	0.032
	45BH02	8.5	ND	--	ND	ND	ND	ND
		21	ND	--	ND	ND	ND	ND
	45BH03	5.5	240	--	ND	0.031	0.035	0.079
		20.5	ND	--	ND	ND	ND	ND
	45-WL-01	6	ND	--	ND	ND	ND	ND
		16	ND	--	ND	ND	ND	ND
	45-WL-02	8	ND	--	ND	ND	ND	ND
		16	ND	--	ND	ND	ND	ND
2000	45BH04	11 – 13	ND	ND	ND	ND	ND	ND
		13 – 15	ND	ND	ND	ND	ND	ND
		15 – 17	ND	ND	ND	ND	ND	ND
	45BH05	11 – 13	**1,210**	23.2	ND	ND	ND	0.0172
		13 – 15	**3,560**	20.6	ND	0.0150	0.0170	0.0556
		13 – 15 FD	**3,730**	31.8	ND	0.0146	0.0148	0.0443
		15 – 17	**3,150**	14.6	ND	0.0171	0.0156	0.0537
	45BH06	9 – 11	**1,850**	6.62	ND	0.0212	0.0166	0.0376
		11 – 13	**6,350**	9.05	ND	0.0168	0.0139	0.0442
		15 – 17	**1,440**	11.7	ND	ND	0.0272	0.0552

-- - constituent not analyzed bgs – below ground surface DRO – diesel range organics
FD – field duplicate GRO – gasoline range organics mg/Kg – milligrams per kilogram
Bold values exceed cleanup standards ND – analyte not detected at or above reporting limit

3.3.2 Bioventing System ST61 2004 Field Activities

2004 soil sampling at ST61will consist of drilling two soil borings and collecting a minimum of two soil samples from each boring. The boreholes will be advanced as close as possible to the two boreholes drilled during 2000 with remaining elevated DRO concentrations. A third borehole will not be required because 45BH04 met cleanup criteria during the 2000 sampling event. Proposed borehole locations where samples will be collected is shown on Figure 3-3. Sample collection procedures are provided in Section 6 of this FSP.

45BH07 will be drilled as close to 45BH05 as possible. Soil samples will be collected at 12, 14, and 16 feet bgs where concentrations of DRO were found at this location during the 2000 soil sampling event (USAF, 2001). If elevated levels of hydrocarbons are discovered at a shallower depth using field-screening techniques, a soil sample will be collected to document contaminant levels at that depth. If groundwater or water saturated soil is encountered at a shallower depth than that where collection is planned, no sample will be collected at that depth.



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DRAWN BY:SJ

UNITED STATES AIR FORCE

PROPOSED BORE HOLE / SAMPLE LOCATIONS
SOURCE AREA ST61

ELMENDORF AIR FORCE BASE
ANCHORAGE, ALASKA

FIGURE 3-3

45BH08 will be drilled as close to 45BH06 as possible. Soil samples will be collected at 10, 12, and 16 feet bgs, where concentrations of DRO were found at this location during the 2000 soil sampling event (USAF, 2001). If elevated levels of hydrocarbons are discovered at a shallower depth using field-screening techniques, a soil sample will be collected to document contaminant levels at that depth. If groundwater or water saturated soil is encountered at a shallower depth than that where collection is planned, no sample will be collected at that depth.

The basis for cleanup standards for ST61 media is ADEC Method 2. Cleanup standards are provided in Table 3-6. Because the 2000 sampling data shows that BTEX and PAH constituents are below cleanup standards in 18 AAC 75.341 Table B1, no additional BTEX or PAH sampling is required in this sampling effort in order to use the ADEC Method 2 cleanup standards.

Table 3-6 ST61 Soil Cleanup Standards

Contaminant of Concern	Cleanup Standard (mg/Kg)
Diesel Range Organics	250

mg/Kg – milligram per kilogram

3.4 BIOVENTING SYSTEM ST68

This section provides a brief discussion of previous investigations at ST68 and the planned soil sampling field activities to be performed during 2004.

3.4.1 Bioventing System ST68 Background

ST68 is located north of Slammer Avenue (previously O Street) and west of the north-south runway adjacent to Building 11567 (formerly building 11-680). ST68 investigations began in March 1992 when a tightness integrity test of the Flight Line refueling system was conducted and indicated a leak in the pipeline connecting the return-to-bulk header pipe to the above ground manifold pipe. A confirmatory tightness test performed in June 1992 indicated that a segment of the connecting pipeline was leaking between the aboveground manifold and valve pit 3-A. This connecting pipe segment was excavated, and it was determined that a flange gasket was missing on the vertical section of pipe connecting the aboveground manifold to the underground piping. Hydrocarbon odors and apparent hydrocarbon pooling within the excavation were reported. Repairs were completed and a tightness test conducted during July 1992 determined the repairs made were acceptable.

Site contamination investigation activities began in 1994 and determined the presence of petroleum contamination in soil and groundwater. Because of contaminated soil, a bioventing system was installed at ST68. Remedial activities began in 1996 and three soil borings were completed at ST68 in 2000 to assess the site progress towards remediation. Historic subsurface investigations conducted at this site indicated that the vertical extent of contamination extends from 12 to 32 feet bgs; therefore, the three boreholes advanced in 2000 were drilled to 33 feet bgs in order to encompass the full extent of contamination. The local depth to groundwater is approximately 25 feet bgs with the smear zone extending up to 21 feet bgs (USAF, 2001).

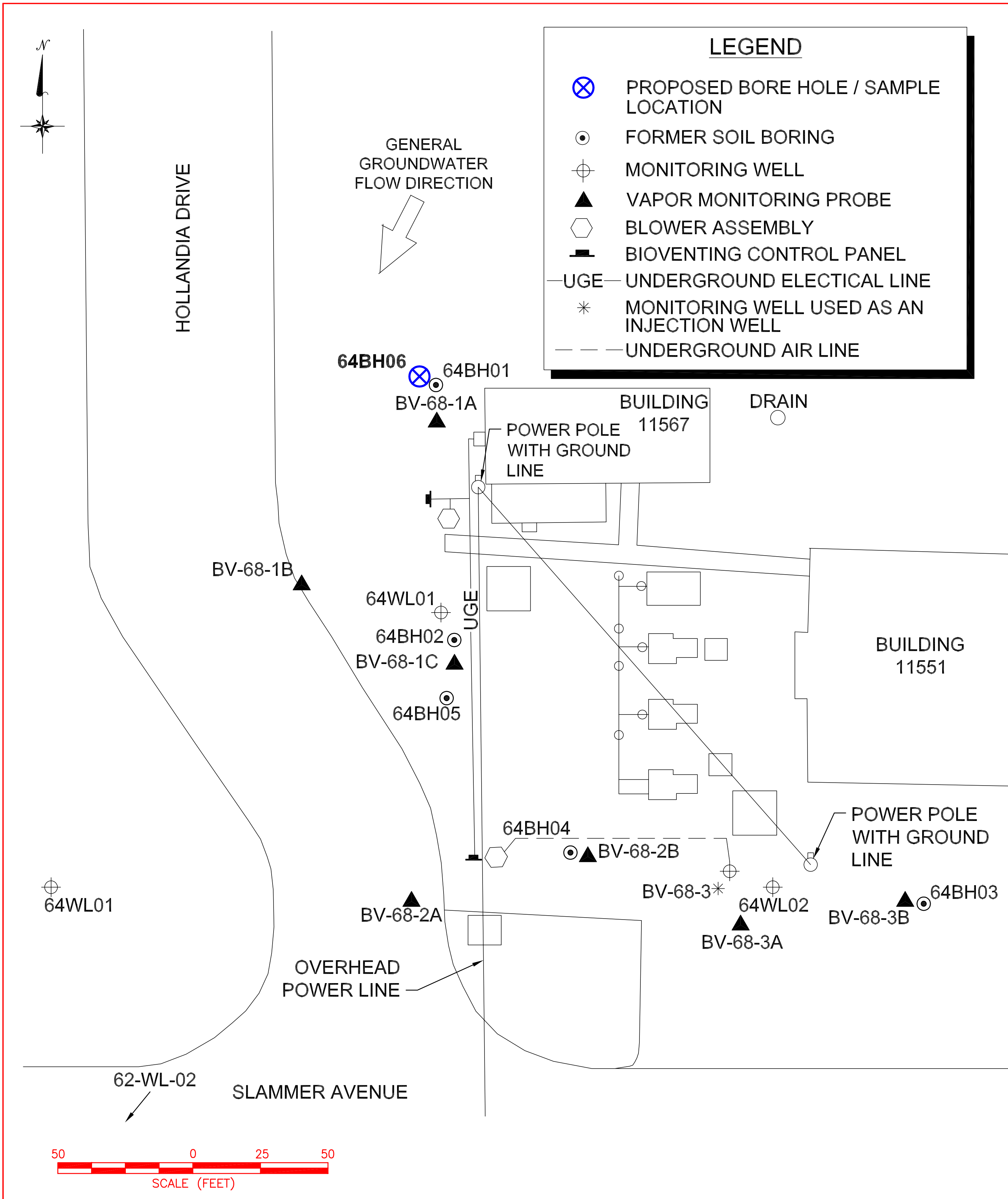
Analytical results from the Year 2000 soil sampling is summarized in Table 3-7. Sample locations are depicted on Figure 3-4.

Table 3-7 ST 68 1994 and 2000 Soil Analytical Results

Year	Location	Depth (feet bgs)	Analytical Results (mg/Kg)					
			DRO	GRO	Benzene	Toluene	Ethylbenzene	Total Xylenes
1994	64BH01	16	120	**1,100**	**1.4**	**19**	**20**	6.3
		21	88	**2,000**	**1.1**	**29**	**35**	74
	64BH02	12	ND	ND	ND	ND	ND	ND
		23.5	16	26	**0.049**	0.23	0.099	0.46
	64-WL-01	19.5	530	**1,900**	**4.4**	**7**	**18**	70
		22.5	390	**6,100**	**13**	**43**	**260**	9.3
	64-WL-02	24.5	43	550	**5.2**	3.8	**12**	49
		27	770	**3,400**	**3.3**	**18**	**82**	4.8
	64-WL-03	12	ND	4.9	ND	0.079	0.039	0.25
		27	ND	1.9	ND	ND	ND	0.073
2000	64BH03	21 – 23	ND	11.7	**0.0842**	0.0359	0.0742	0.0726
		25 – 27	ND	5.97	**0.0248**	0.0723	0.0375	0.0375
		29 – 31	127	455	ND	ND	0.173	0.280
	64BH04	21 – 23	ND	95.6	**0.0929**	0.828	0.866	1.60
		25 – 27	11.1	163	ND	0.134	0.232	ND
		25 – 27	33.7	14.6	**0.0701**	0.280	0.141	0.0596
		31 – 33	12.9	76.7	**0.0892**	ND	0.576	0.0727
	64BH05	23 – 25	ND	8.63	**0.0543**	0.348	0.0901	0.168
		25 – 27	702	576	ND	0.423	0.361	3.33
		27 – 29	1,040	**3,170**	**1.31**	0.922	**12.8**	23.5

-- - constituent not analyzed
mg/Kg – milligrams per kilogram
Bold values exceed cleanup standards
FD – field duplicate
GRO – gasoline range organics
ND – analyte not detected at or above method reporting limit
bgs – below ground surface
DRO – diesel range organics

Analytical results from the Year 2000 soil sampling at ST 68 indicate that DRO, toluene, and total xylenes meet the soil cleanup standards and can be eliminated as contaminants of concern at ST 68. However, GRO, benzene, and ethylbenzene are present in and below the smear zone at concentrations above the site cleanup standards. In particular, benzene levels in all boreholes exceeded remedial objectives, as did ethylbenzene and GRO concentrations in 64BH05. Therefore, the soils in and below the smear zone at ST68 do not currently meet the established remedial objectives.



DATE: 28 JUN 2004	UNITED STATES AIR FORCE	
JOB NO: 20077.043.042.0003	**PROPOSED BORE HOLE / SAMPLE LOCATIONS** **SOURCE AREA ST68**	
FILE: Biovent_3.dwg	ELMENDORF AIR FORCE BASE ANCHORAGE, ALASKA	
DRAWN BY:SJ		**FIGURE 3-4**

3.4.2 Bioventing System ST68 2004 Field Activities

2004 Soil sampling at ST68 will consist of drilling a single soil boring (64BH06) and collecting one soil sample from the boring. The borehole will be advanced as close as possible to the borehole drilled during 1994 (64BH01) with elevated GRO and BTEX concentrations. The proposed borehole location where samples will be collected is shown on Figure 3-4.

One soil sample will be collected at a depth of 16 feet bgs, where elevated concentrations of GRO and BTEX were found above the smear zone at this location during the 1994 soil sampling (USAF, 1995a). If elevated levels of hydrocarbons are discovered at a shallower depth using field-screening techniques, a soil sample will be collected to document contaminant levels at that depth.

The basis for cleanup standards for ST68 media is ADEC Alaska Cleanup Matrix (ACM) Level D (USAF, 2001). Cleanup standards are provided in Table 3-8. Sample collection procedures are provided in Section 6 of this FSP.

Table 3-8 ST68 Soil Cleanup Standards

Contaminant of Concern	Cleanup Standard (mg/Kg)
Gasoline Range Organics	1,000
Benzene	0.02
Toluene	5.4
Ethylbenzene	5.5
Total Xylenes	78

Benzene, toluene, ethylbenzene, and total xylene values from 18 AAC 75 Table B1, Under 40-inch zone criteria.
mg/Kg – milligram per kilogram

3.5 SUMMARY OF 2004 SOIL SAMPLING ACTIVITIES

Table 3-9 provides a summary of the planned 2004 soil sampling activities.

Table 3-9 Summary of 2004 Soil Sampling Activities

Bioventing Location	Borehole I.D.	Sample Depth[1] (feet bgs)	Sample Analysis
ST32 Tank 7	TK7BH01	7.5	BTEX, GRO, DRO
		15	BTEX, GRO, DRO
		25	BTEX, GRO, DRO
	TK7BH02	12.5	BTEX, GRO, DRO
		25	BTEX, GRO, DRO
	TK7BH03	12	BTEX, GRO, DRO
		27	BTEX, GRO, DRO
ST32 Tank 8	TK8BH01	18.5	BTEX
		25	BTEX
		32.5	BTEX
	TK8BH02	13.5	BTEX
		25	BTEX
		31	BTEX
ST61	45BH07	12	DRO
		14	DRO
		16	DRO
	45BH08	10	DRO
		12	DRO
		16	DRO
ST68	64BH06	16	BTEX, GRO

[1] no samples will be collected at or below the depth water saturated soil is encountered
bgs – below ground surface
BTEX – benzene, toluene, ethylbenzene, and xylenes
DRO – diesel range organics
GRO – gasoline range organics

3.6 SAMPLE ANALYSIS SUMMARY

Samples will be collected using the split-spoon sampling technique. All drilling equipment that enters the soil boring will be decontaminated prior to drilling each borehole.

Soil samples will be submitted for laboratory analysis of GRO by Alaska Method 101, BTEX by EPA Method SW8021B, and DRO by Alaska Method 102. Table 3-10 presents a summary of the number of analytical samples and quality assurance/quality control (QA/QC) samples required for this task. QA/QC sampling, discussed in Section 6.4, will include duplicate samples, equipment blanks, trip blanks, and temperature blanks.

Table 3-10 Soil Sample Analysis Summary

Site	Method	Field Samples	Field Duplicates[1]	Trip Blanks[2]	Equipment Blanks[3]	Total # Samples
ST32 Tank 7	BTEX by SW8021B GRO by AK101 DRO by AK102	7	1	1	0	9
ST32 Tank 8	BTEX by SW8021B	6	0	1	0	7
ST61	DRO by AK102	6	0	1	1	8
ST68	BTEX by SW8021B GRO by AK101	1	1	1	0	3
Total		20	2	4	1	27

[1] Field duplicates are collected at a frequency of one per 10 field samples.
[2] Trip blanks are collected at a frequency of one per cooler that contains samples for BTEX.
[3] Equipment blanks are collected at a frequency of one per 20 samples that are collected with non-disposable equipment requiring decontamination.
BTEX = benzene, toluene, ethylbenzene, and xylenes
DRO = diesel range organics
GRO = gasoline range organics

4.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Project management, technical support, and engineering support will be provided from the Contractor's Anchorage, AK office. An organizational chart showing the reporting relationships of the persons involved in QA/QC for this project is provided in Figure 4-1. The chart shows the lines of authority from the 3 CES/CEVR Remedial Project Manager and AFCEE Contracting Officer and Contracting Officer's Representative (COR) through the program, project, and on-site personnel. An independent Program QA Officer will ensure that the work performed on the project is effectively implemented through independent audits. As shown, the Project QA Officer has direct reporting lines to the Program Manager and Project Manager. The Sections that follow describe the specific functions and authority of each of these persons.

4.1 PROGRAM MANAGER

The Program Manager, Mr. Frank Janicek, will have overall responsibility for all technical, contractual, and administrative matters for the Contractor. He will be responsible for ensuring that a high degree of client responsiveness is maintained.

4.2 PROGRAM HEALTH AND SAFETY COORDINATOR/CERTIFIED INDUSTRIAL HYGIENIST

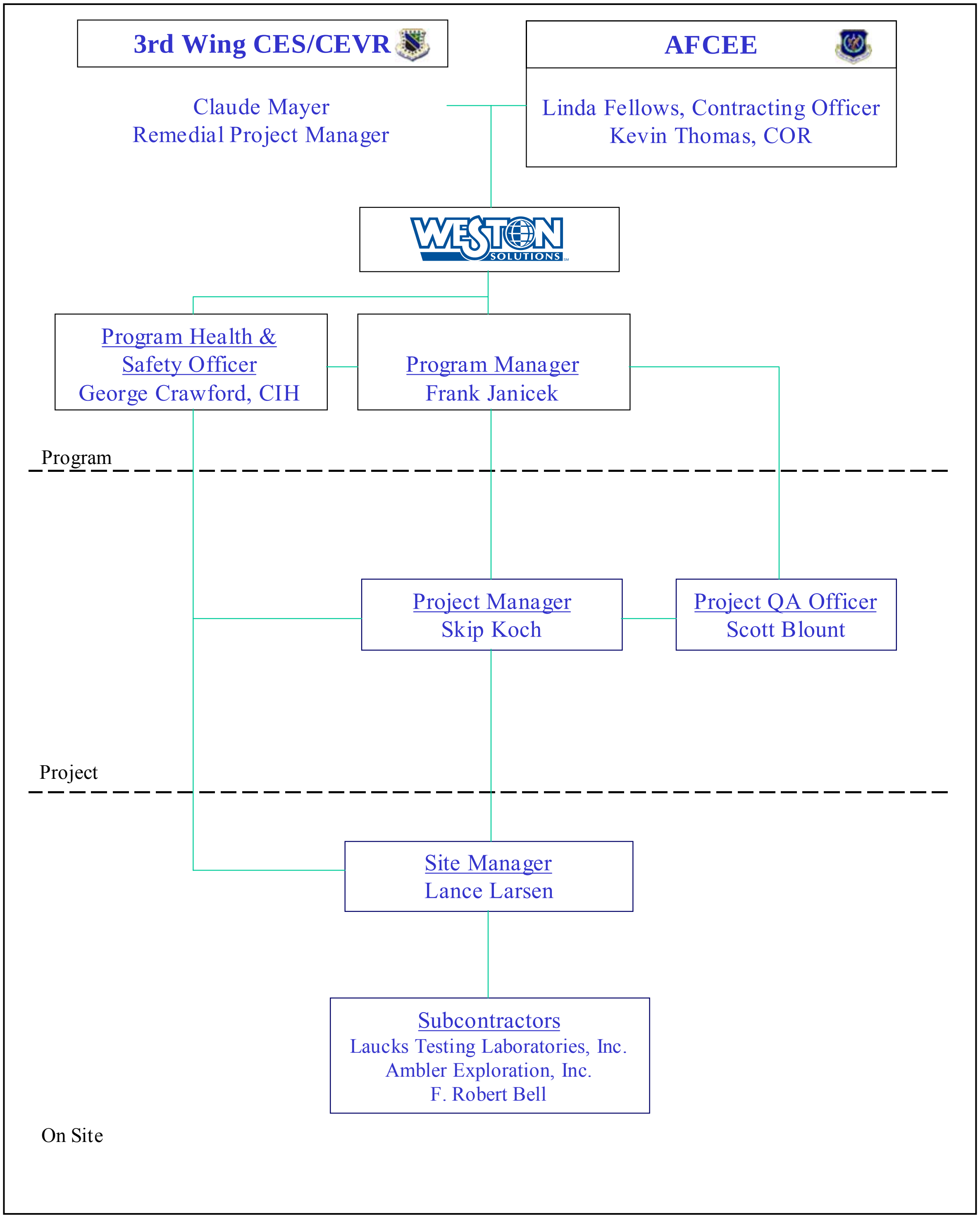
The Program Health and Safety Coordinator/Certified Industrial Hygienist (PHSC/CIH) for this project is Mr. George Crawford. Mr. Crawford is certified in comprehensive practice of industrial hygiene by the American Board of Industrial Hygiene. He has over 25 years of industrial hygiene and safety experience. The PHSC will have final approval of the site specific Health and Safety Plan (HSP) and will ensure that the HSP complies with all federal, state, and local health and safety requirements. He will also assist in modifying specific aspects of the HSP to adjust for on-site changes that affect safety, evaluate and authorize any changes to the HSP in conjunction with the Site Manager, and assist in acting as liaison with government officials regarding health and safety related matters.

4.3 PROJECT QUALITY ASSURANCE OFFICER

The Project QA Officer, Mr. Scott Blount, will be responsible for reviewing and approving planning documents, overseeing staff selection, monitoring contract and task funds and schedules, reviewing submittals, performance of field and office audits and review of analytical data submittals. Through implementation of the WP and this FSP, the Project QA Officer will execute QA programs for administrative, field, and analytical activities.

The QA procedures for field performance and analytical requirements vary in detail, but not in importance. To provide proficiency in both areas, QA personnel with specialized knowledge in these fields will assist the Project QA Officer in the management of these activities.

Figure 4-1 Project Organization



4.4 PROJECT MANAGER

The Project Manager, Mr. Skip Koch, will be responsible for daily supervision of project execution; establishment of work teams for specific tasks; allocation of assigned resources for optimum safe and quality work execution; resolution of issues regarding alternative approaches; direct and frequent liaison with the USAF staff; early identification and resolution of problems; identification of potential or desired modifications to the scope of work; cost, schedule, and field construction quality control; and preparations of project progress reports. The Program Manager and Project QA Officer will be regularly informed about the status of project activities and any change in the scope of work, milestone dates, or resource requirements.

4.5 SITE MANAGER

The Site Manager will report to the Project Manager and is responsible for field implementation of the project. The duties of the Site Manager include overseeing the subcontractors performing drilling activities and collecting the analytical and field screening samples. On this project, the Site Manager will also function as the Site QC Inspector and the Site Safety and Health Officer (SSHO) and is responsible for ensuring that all personnel adhere to the requirements of the Contractor's Health and Safety Program, and the site specific HSP.

4.6 SUBCONTRACTORS

The following is a list of subcontractors scheduled to be used during the project:

Laucks Testing Laboratories, Inc.—Analytical Laboratory
Ambler Exploration — Drilling Subcontractor
F. Robert Bell —Surveyor

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5.0 FIELD OPERATIONS

5.1 BOREHOLE DRILLING, LOGGING, AND ABANDONMENT

Because past detailed lithological logging has previously been completed, no additional detailed lithological logging of the borings is required.

5.1.1 General Drilling Procedures

All drilling activities shall conform to state and local regulations and shall be supervised by a state licensed geologist or state licensed engineer. The contractor shall obtain all permits, applications, and other documents required by state and local authorities.

The location of all soil borings shall be coordinated, in writing, with the base civil engineer or equivalent before drilling commences. When drilling boreholes through more than one water bearing zone or aquifer, the contractor shall take measures to prevent cross-connection or cross-contamination of the zones or aquifers.

The drill rig shall be cleaned and decontaminated in accordance with the procedure in Section 5.2. The drill rig shall not leak any fluids that may enter the borehole or contaminate equipment placed in the hole. The use of rags or absorbent materials to absorb leaking fluids is unacceptable.

Drilling fluids shall consist of air, water, or mud. If air is used, it shall be filtered to remove organic vapors, and filters shall be changed daily. The effectiveness of the air filter shall be checked at least every 4 hours using a photoionization detector (PID). If organic vapors are detected in air passing through the downstream end of the air line or drill stem, their source (i.e., filter, contaminated line, etc.) shall be decontaminated or replaced. If water is used, the contractor shall provide chemical analyses of the water for AFCEE approval. Only water from a pre-approved source shall be used as a drilling fluid and the water quality shall be monitored daily for suspected analytes of concern. Drilling mud, if used, shall consist of 100 percent sodium bentonite and shall be approved by the AFCEE. The prime contractor shall provide AFCEE with the chemical analyses of any drilling mud additive or substitute proposed for use prior to the start of drilling. The additives or substitutes shall be analyzed for all analytes of concern at the site. The analyses shall be delivered to the AFCEE for written approval prior to drilling system mobilization. Mud or other additives shall only be used as a last resort.

Lubricants shall not introduce or mask contaminants. The contractor shall provide chemical analyses of all lubricants proposed for downhole use. Chemical detection limits shall be equivalent to those used in analyzing project ground-water samples. Lubricants with constituents that are toxic or that increase, decrease, or mask the target chemical species of the investigation shall not be permitted. The contractor shall provide the analysis results to the AFCEE prior to drilling mobilization.

A log of drilling activities shall be kept in a bound field notebook. Information in the log book shall include location, time on site, personnel and equipment present, down time, materials used, samples collected, measurements taken, and any other observations or information that would be necessary to reconstruct field activities at a later date. At the end of each day of drilling the drilling supervisor shall complete a Daily Drilling Log. All items on the log must be completed, if known.

The contractor shall dispose of all trash, cuttings, and drilling fluids as coordinated with the base civil engineer or representative and Section 5.3 of this FSP.

5.1.2 Abandonment

Boreholes shall be abandoned in accordance with applicable federal, state or local requirements. Nine boreholes will be drilled and abandoned during the soil sampling effort. The Contractor's Site Manager will oversee the drilling subcontractor throughout the soil sampling effort.

Bentonite chips will be added to seal the to the boreholes. Enough potable water will be added to hydrate the bentonite chips. All abandoned boreholes will be checked 24 to 48 hours after bentonite emplacement to determine whether curing is occurring properly. More specific curing specifications or QA checks may be recommended by the manufacturer and will be followed. Additionally, if significant settling has occurred, a sufficient amount of bentonite chips will be added to attain its initial level. These bentonite curing checks and any addition of bentonite chips will be recorded in the field logs.

5.1.3 Surveying

All borehole locations will be surveyed, using a Trimble Pro XR GPS unit (accurate to within 1-foot) or equivalent, and their locations documented in the Soil Sampling Report. Locations of boreholes will be surveyed to satisfy the Environmental Resource Program Information Management System (ERPIMS) submittal (northing and easting).

5.2 EQUIPMENT DECONTAMINATION

All equipment that may directly or indirectly contact samples shall be decontaminated in a designated decontamination area. In addition, the contractor shall take care to prevent the sample from coming into contact with potentially contaminating substances, such as tape, oil, engine exhaust, corroded surfaces, and soil.

The Environmental Drilling Subcontractor shall decontaminate all drilling equipment that enters the soil boring (e.g., auger, drill pipe, bit, etc.), prior to drilling each soil borehole in a designated decontamination area inside the 3 CES/CEVR contractor staging area on Elmendorf AFB. Decontamination shall be performed with a high-pressure steam cleaner or hot water wash (>180 °F and >200 pounds per square inch) and Alconox™ detergent or equivalent to ensure proper decontamination of the drilling equipment.

5.3 WASTE HANDLING

Potential wastes include both general refuse and investigative derived wastes (IDW). IDW accumulated during drilling and sampling activities will include the following:

- general refuse (e.g., paper towels, plastic bags, plastic distilled water containers);
- expended personal protective equipment (PPE);
- soil drill cuttings; and
- wastewater generated during decontamination of equipment.

All IDW collected during soil drilling and sample collection will be contained in 55-gallon drums. During soil sampling activities, the Drilling Subcontractor will haul all drums of IDW to the 3 CES/CEVR contractor staging area on Elmendorf AFB. General refuse and expended PPE will be disposed of at the Anchorage Municipal Landfill. Specific requirements for labeling and marking of containers will be in accordance with the most current Elmendorf 3rd Wing OPLAN 19-3 (USAF, 2003c).

An estimated 55 gallons of water IDW will be collected during the soil sampling effort. The water will be characterized using soil analytical results from the soil sampling effort. No additional sampling is required for disposal. It is assumed that concentrations of POL-constituents in the water will not exceed levels requiring disposal as a hazardous waste under the Resource Conservation and Recovery Act (RCRA) or ADEC maximum allowable levels and may be disposed of in the Elmendorf AFB Contractor Staging Area Yard water treatment system.

An estimated 9 drums of soil IDW will be collected during the soil sampling effort. The soil will be characterized using soil analytical results from the soil sampling effort. No additional sampling is required. If the concentrations of POL-constituents in the soil do not exceed allowable levels, the soil will be disposed of in a landfill on Base and the drums will be cleaned and disposed of. Soil in drums, which is above allowable levels for POL only, will be thermally treated and disposed of and the drums will be cleaned and disposed of. All drums will be removed from the temporary staging area prior to 10 October 2004.

In the event that analytical results demonstrate that waste soil has concentrations of contaminants other than POL exceeding ADEC allowable levels (Category A criteria in 18 AAC 75.341 Table A1 Part B), they will be turned over to the Base hazardous waste facility for subsequent disposal.

5.4 CORRECTIVE ACTION

The initial responsibility for monitoring the quality of field measurements and observations lies with the field personnel. The Site QC Inspector is responsible for verifying that all QC procedures are followed. This requires that the Site QC Inspector assess the correctness of field methods and the ability to meet QA objectives. If a problem that might jeopardize the integrity of the project or cause some specific QA objective not to be met occurs, the Site QC Inspector will notify the Project Manager and the Program QA Officer.

An appropriate corrective action will then be decided upon and implemented. The Site QC Inspector will document the problem, the corrective action, and results using the form shown in Figure 5-1. Copies of the documentation form will be provided to the Project Manager and the appropriate technical QA Office.

Figure 5-1 Corrective Action Documentation Form

DATA/ORIGINATOR ____________________ AUDIT REPORT # ______________

PERSON RESPONSIBLE FOR RESPONSE ____________________ PAGE ___ OF ___

DESCRIPTION OF PROBLEM and when identified:

____

____

____

____

State the cause of problem if known or suspected:

____

____

SEQUENCE OF CORRECTIVE ACTION: (If no responsible person is identified, bring this form directly to the QA Coordinator.)

State the date, person, and action planned: ______________________________________

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CA Initially Approved By: ______________________________ Date: ______________

Follow-up dates: ____

Description of follow-up: ____

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Final CA Approval By: ______________________________ Date: ______________

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6.0 ENVIRONMENTAL SAMPLING

6.1 SAMPLING PROCEDURES

The construction material of the sampling devices (e.g., plastic, PVC, metal) discussed below shall be appropriate for the contaminant of concern and shall not interfere with the chemical analyses being performed.

All drilling and sampling equipment shall be decontaminated according to the specifications in Section 5.2 prior to any sampling activities and shall be protected from contamination until ready for use.

6.1.1 Split-Spoon Samples

When soil samples are to be submitted for laboratory analysis, they shall be collected using stainless steel, continuous drive, split-spoon samplers, or equivalent. Soil sampling will be conducted following state, AFCEE, and Air Force guidance.

Soil sampling will consist of drilling soil borings at each system and collecting soil samples from each boring. The Environmental Drilling Subcontractor will drill soil borings with a hollow-stem auger. Samples will be collected using the split-spoon sampling technique. All drilling equipment that enters the soil boring will be decontaminated, according to Section 5.2, prior to drilling each borehole.

Each vertical borehole will be approximately 15 to 30 feet deep. Drilling and sampling will be for targeted lithological intervals only. Because past detailed lithological logging has previously been completed, no additional detailed lithological logging of the borings is required.

As soon as the split-spoon is opened, the open ends of the brass/stainless steel rings shall be monitored for organic vapors using the PID. Air monitor results shall be recorded on the boring log and in the field log book.

Samples shall be collected by extruding the soil out of the brass/stainless steel rings. Samples collected for BTEX and GRO analysis will be collected first. Soil samples shall be placed in 8 or 16-ounce, laboratory cleaned, EPA-approved glass containers with Teflon® lined lids. This shall be done using disposable sampling tools. The sample shall then be transferred into the appropriate sample container, sealed, labeled, and placed in an iced cooler held at a temperature below 4^{o}C.

If initial screening results indicate the presence of organic vapors, a headspace analysis shall be conducted on remaining portions of the sample. Headspace screening procedures are provided in Section 7.4.

6.2 SAMPLE HANDLING

6.2.1 Sample Containers

Sample containers will be purchased, precleaned, and treated according to EPA specifications for the methods. Containers will be stored in clean areas to prevent exposure to fuels, solvents, and other contaminants.

6.2.2 Sample Volumes, Container Types, and Preservation Requirements

Sample volumes, container types, and preservation requirements for the analytical methods performed on USAF samples are listed in Table 6-1. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods required routinely for USAF work is also specified in Table 6-1.

6.2.3 Sample Identification

Samples collected during field activities will be given a unique identification that will reflect the source of the sample and the date the sample was collected. The identification system to be used is as follows:

1. Site: The borehole id (i.e. TK8BH01), from which the sample was collected.

2. Depth of sample collected in feet bgs (top of sample): 16.5 = began collecting sample at 16.5 feet bgs.

3. Finally, a numeric date will be the last six numbers of the sample identification number:

   073104 = 31 July 2004

Examples of this sample identification nomenclature would be interpreted as follows:

> TK8BH01-18-073104 = A soil sample collected on 31 July 2004 beginning at 18 feet bgs, from borehole TK8BH01 at Site ST32 Tank 8.

Table 6-1 Soil Sample Container Requirements

ANALYSES	ANALYTICAL METHODS	CONTAINER	PRESERVATION	MINIMUM SAMPLE VOLUME OR WEIGHT	MAXIMUM HOLDING TIME
GRO/BTEX	AK101/SW8021B	Pre-weighed, Glass	Methanol, 4ºC	4 ounce	14 days
DRO	AK102/103	Glass	4ºC	8 ounce	14 days

BTEX = benzene, toluene, ethylbenzene, and xylenes
DRO = diesel range organics
GRO = gasoline range organics

6.3 SAMPLE CUSTODY

Sample custody includes procedures to ensure the custody and integrity of the samples beginning at the time of sampling and continuing through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

The contractor shall maintain chain-of-custody records for all field and field QC samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession; (2) it is in their view, after being in their possession; (3) it was in their possession and they locked it up; or (4) it is in a designated secure area.

All sample containers shall be sealed in a manner that shall prevent or detect tampering if it occurs. In no case shall tape be used to seal sample containers. Samples shall not be packaged with activated carbon.

The following minimum information concerning the sample shall be documented on the chain-of-custody (COC) form.

- Unique sample identification;
- Date and time of sample collection;
- Source of sample (including name, location, and sample type);
- Preservative used;
- Analyses require;
- Name of collector(s);
- Pertinent field data (pH, temperature, etc.);
- Serial numbers of custody seals and transportation cases (if used); and
- Custody transfer signatures, dates, and times of sample transfer from the field to transporters, and to the laboratory or laboratories.

All samples shall be uniquely identified, labeled, and documented in the field at the time of collection, in accordance with Section 6.2.

Samples collected in the field shall be transported to the laboratory or field-testing site as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during collection and transportation. During transit, it is not always possible to rigorously control the temperature of the samples. As a general rule, storage at low temperature is the best way to preserve most samples. A temperature blank shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory.

6.4 FIELD QUALITY CONTROL SAMPLES

6.4.1 Field Duplicate Samples

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection. Duplicate sample results are used to assess precision of the sample collection process. Duplicate samples will be collected at a frequency of one per ten field samples.

6.4.2 Equipment Blank

One equipment blank will be collected per ten samples to demonstrate proper decontamination procedures were incorporated. Equipment blanks will be collected from reusable field equipment that is used and decontaminated. Following decontamination procedures, the equipment will be rinsed with de-ionized (DI) water that will be collected and placed in sample containers. Equipment blanks will be collected whenever reusable sampling equipment is used, decontaminated, and reused during the same sampling event. Equipment blanks will be collected at a frequency of one per twenty field samples.

6.4.3 Trip Blank

The trip blank consists of a 4-ounce container prepared by the laboratory with Ottawa sand and high purity methanol containing a surrogate standard, transported to the sampling site, handled like an environmental sample, and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks will be prepared only when BTEX samples are taken and are analyzed only for BTEX analytes. Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. One trip blank will accompany each cooler of samples sent to the laboratory for analysis of BTEX.

6.4.4 Temperature Blanks

Temperature blanks will be supplied by the laboratory and remain inside each sample cooler throughout sample collection and subsequent sample shipment to the laboratory.

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7.0 FIELD MEASUREMENTS

7.1 PARAMETERS

The following table lists parameters to be measured in the field and the instruments that will be used to measure these parameters.

Table 7-1 Field Sampling Parameters and Instruments

Media	Parameter	Instrument
Soil	Volatile Hydrocarbons	Photoionization detector (PID)

7.2 EQUIPMENT CALIBRATION AND QUALITY CONTROL

Field equipment calibration procedures, quality control checks, and equipment checklists will be developed and maintained on site. Equipment calibration will be done in accordance with the manufacturers recommended procedures for each instrument. Operation and maintenance manuals will be carried with the instruments for reference at all times. Equipment will be calibrated at the beginning of each day and each use to ensure proper operation of the meters.

7.3 EQUIPMENT MAINTENANCE AND DECONTAMINATION

All field measurement equipment shall be decontaminated according to the specifications in Section 5.2 prior to any measurement activities and shall be protected from contamination until ready for use.

7.4 FIELD MONITORING MEASUREMENTS DURING SOIL SAMPLING

This section describes field detection sampling methods and procedures to be used for collecting environmental samples from soil. A PID will be used as a field-screening device for detecting petroleum contaminants in the field during soil sampling activities.

The following headspace screening procedure (as stated in the ADEC UST Procedures Manual) to obtain and analyze field-screening samples will be adhered to when using the PID:

(1) Partially fill (one-third to one-half) a clean jar or clean zip lock bag with the sample to be analyzed; total capacity of the jar or bag may not be less than eight ounces (app. 250 ml), but the container should not be so large as to allow vapor diffusion and stratification effects to significantly affect the sample.

(2) Samples collected from an excavation or soil pile will be collected from freshly uncovered soil.

(3) If a jar is used, its top will be quickly covered with clean aluminum foil or a jar lid; screw tops or thick rubber bands will be used to tightly seal the jar; if a zip lock bag is used, it will be quickly sealed shut.

(4) Headspace vapors will be allowed to develop in the container for at least 10 minutes but no longer than one hour; containers will be shaken or agitated for 15 seconds at the beginning and end of the headspace development period to assist volatilization; temperatures of the headspace will be warmed to at least 40 °F (approximately 5 °C); with instruments calibrated for the temperature used.

(5) After headspace development, the instrument sampling probe will be inserted to a point about one-half the headspace depth; the container opening will be minimized and care will be taken to avoid uptake of water droplets and soil particulates.

(6) After probe insertion, the highest meter reading will be taken and recorded on the Boring Log, which normally will occur between two and five seconds after probe insertion; if erratic meter response occurs at high organic vapor concentrations or conditions of elevated headspace moisture, a note to that effect will accompany headspace data.

(7) To ensure that field instruments will be properly calibrated and remain operable in the field, the procedures set out in Section 7.1 of *ADEC UST Procedure Manual* will be used. Calibration of the PID field instrument will follow the procedures:

a. The PID must be calibrated before each testing session to yield "total organic vapors" in parts per million to a benzene equivalent. The PID instrument must be operated with a lamp source that is able to detect the contaminants of concern, operates at a minimum of 10.6 eV, and is capable of ionizing those contaminates of concern.

b. Field instruments will be calibrated on site.

c. All standards used to calibrate field instruments will meet the minimum requirements for source and purity recommended in the equipment's operation manual.

d. If the instrument's operation manual recommends specific calibration requirements for other criteria in calibrating the instrument (such as pH, conductivity, temperature, etc.), those criteria will be adhered to.

e. Acceptance criteria for calibration will be determined depending on the potential contaminant(s) and will be within the limits set in the manufacturer's operations manual.

f. The dates, times, and results of all calibrations and repairs to field instruments will be recorded in the field record and in the instrument's log.

g. All users of the instrument will be trained in the proper calibration and operation of the instrument and will be required to read the operation manual before initial use.

(8) All field screening results will be documented in the field record in Appendix A or field logbook.

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8.0 RECORD KEEPING

The following information shall be recorded in a log book for all field activities: (1) location, (2) date and time, (3) identity of people performing activity, and (4) weather conditions. For field measurements (1) the numerical value and units of each measurement, and (2) the identity of and calibration results for each field instrument shall also be recorded.

The following additional information shall be recorded for all sampling activities: (1) sample type and sampling method; (2) the identity of each sample; (3) the amount of each sample; (4) sample description (e.g., color, odor, clarity); (5) identification of sampling devices; and (6) identification of conditions that might affect the representativeness of a sample (e.g., refueling operations, damaged casing).

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