

LOAN DOCUMENT

PHOTOGRAPH THIS SHEET

①

DTIC ACCESSION NUMBER

LEVEL

INVENTORY

Work Plan for Expanded Bioventing System...

DOCUMENT IDENTIFICATION
Dec 95

DISTRIBUTION STATEMENT A
Approved for Public Release
Distribution Unlimited

DISTRIBUTION STATEMENT

ACCESSION FOR	
NTIS	GRAM
DTIC	TRAC
UNANNOUNCED	
JUSTIFICATION	
BY	
DISTRIBUTION/	
AVAILABILITY CODES	
DISTRIBUTION	AVAILABILITY AND/OR SPECIAL
A-1	

DISTRIBUTION STAMP

DATE ACCESSIONED

DATE RETURNED

REGISTERED OR CERTIFIED NUMBER

20001122 035

DATE RECEIVED IN DTIC

REGISTERED OR CERTIFIED NUMBER

PHOTOGRAPH THIS SHEET AND RETURN TO DTIC-FDAC

H
A
N
D
L
E

W
I
T
H

C
A
R
E

**Work Plan for Expanded Bioventing System
Aircraft Ground Equipment (AGE) Maintenance Area
IRP Site 11**



**BEALE AIR FORCE BASE
CALIFORNIA**

Prepared for

Air Force Center for Environmental Excellence

Brooks Air Force Base

San Antonio, Texas

and

9 CES/CEVR

Beale Air Force Base, California

December 1995

Prepared by

PARSONS ENGINEERING SCIENCE, INC.

1301 MARINA VILLAGE PARKWAY, ALAMEDA, CALIFORNIA 94501 (510) 769-0100
OFFICES IN PRINCIPAL CITIES

DEFENSE TECHNICAL INFORMATION CENTER REQUEST FOR SCIENTIFIC AND TECHNICAL REPORTS

Title AFCEE Collection

1. Report Availability (Please check one box) <input checked="" type="checkbox"/> This report is available. Complete sections 2a - 2f. <input type="checkbox"/> This report is not available. Complete section 3.	2a. Number of Copies Forwarded	2b. Forwarding Date
	<u>1 each</u>	<u>July/2000</u>

2c. Distribution Statement (Please check ONE box)

DoD Directive 5230.24, "Distribution Statements on Technical Documents," 18 Mar 87, contains seven distribution statements, as described briefly below. Technical documents MUST be assigned a distribution statement.

DISTRIBUTION STATEMENT A: Approved for public release. Distribution is unlimited.

DISTRIBUTION STATEMENT B: Distribution authorized to U.S. Government Agencies only.

DISTRIBUTION STATEMENT C: Distribution authorized to U.S. Government Agencies and their contractors.

DISTRIBUTION STATEMENT D: Distribution authorized to U.S. Department of Defense (DoD) and U.S DoD contractors only.

DISTRIBUTION STATEMENT E: Distribution authorized to U.S. Department of Defense (DoD) components only.

DISTRIBUTION STATEMENT F: Further dissemination only as directed by the controlling DoD office indicated below or by higher authority.

DISTRIBUTION STATEMENT X: Distribution authorized to U.S. Government agencies and private individuals or enterprises eligible to obtain export-controlled technical data in accordance with DoD Directive 5230.25, Withholding of Unclassified Technical Data from Public Disclosure, 6 Nov 84.

2d. Reason For the Above Distribution Statement (in accordance with DoD Directive 5230.24)

2e. Controlling Office <u>HQ AFCEE</u>	2f. Date of Distribution Statement Determination <u>15 Nov 2000</u>
---	--

3. This report is NOT forwarded for the following reasons. (Please check appropriate box)

It was previously forwarded to DTIC on (date) and the AD number is

It will be published at a later date. Enter approximate date if known.

In accordance with the provisions of DoD Directive 3200.12, the requested document is not supplied because:

Print or Type Name <u>Laura Peña</u>	Signature <u>Laura Peña</u>
Telephone <u>210-536-1431</u>	(For DTIC Use Only) AQ Number <u>M01-01-0321</u>

**WORK PLAN FOR
EXPANDED BIOVENTING SYSTEM
AIRCRAFT GROUND EQUIPMENT
(AGE) MAINTENANCE AREA
IRP SITE 11**

at

BEALE AIR FORCE BASE, CALIFORNIA

Prepared for

**AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
BROOKS AIR FORCE BASE
SAN ANTONIO, TEXAS**

and

**9 CES/CEVR
BEALE AIR FORCE BASE, CALIFORNIA**

DECEMBER 1995

Prepared by

PARSONS ENGINEERING SCIENCE, INC.
PLANNING • DESIGN • CONSTRUCTION MANAGEMENT
1301 MARINA VILLAGE PARKWAY, ALAMEDA, CA 94501 • 510/769-0100
OFFICES IN PRINCIPAL CITIES
726876.20142/ALA-25-04

TABLE OF CONTENTS

**WORK PLAN FOR
EXPANDED BIOVENTING SYSTEM
AIRCRAFT GROUND EQUIPMENT (AGE)
MAINTENANCE AREA
IRP SITE 11**

	<u>Page</u>
SECTION 1 INTRODUCTION	1-1
SECTION 2 SITE BACKGROUND	2-1
2.1 Site Location and History	2-1
2.2 Site Geology	2-1
2.3 Site Contamination	2-5
SECTION 3 PILOT TEST DESIGN AND CONSTRUCTION	3-1
3.1 Test Configuration	3-1
3.2 Air Injection Bioventing	3-1
3.2.1 System Operation	3-1
3.2.2 <i>In Situ</i> Biodegradation Rates	3-3
3.2.3 Initial and One-Year Soil and Soil Vapor Sampling Results	3-3
3.2.4 Recommendation for Full-Scale Bioventing	3-3
SECTION 4 EXPANDED BIOVENTING SYSTEM	4-1
4.1 Objective	4-1
4.2 System Design	4-1
4.2.1 Construction of Vent Wells (VWs)	4-2
4.2.2 Construction of Vapor Monitoring Point (VMP)	4-2
4.2.3 Air Supply and Flow Rate	4-5
4.3 System Operation	4-5
4.3.1 System Start-up	4-5
4.3.2 System Operation and Maintenance	4-6
4.4 Soil and Soil Vapor Sampling	4-6
4.5 System Monitoring	4-7
4.6 Handling of Drill Cuttings and Construction Debris	4-7
4.7 Quality Assurance/Quality Control (QA/QC)	4-8
4.8 Construction Schedule	4-8
5.0 BASE SUPPORT REQUIREMENTS	5-1

LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1.1 Vicinity Map.....	1-3
1.2 Bioventing Removal Action and The Air Force IRP	1-4
2.1 Site Location Map	2-2
2.2 Site Plan.....	2-3
2.3 Previous Soil Boring, Shallow Soil Sampling, and Monitoring Well Locations	2-4
2.4 Soil Vapor Concentration Contours for TPH and TCE.....	2-10
3.1 As-Built VW, VMP, and Blower Locations.....	3-2
4.1 Existing and Proposed VWs and VMPs.....	4-3
4.2 Construction Details for Proposed VWs and VMPs	4-4

LIST OF TABLES

<u>Table</u>	<u>Page</u>
2.1 Soil, Soil Vapor, and Groundwater Analytical Data, Maximum Detected Concentrations	2-7
2.2 Summary of Soil Vapor Analytical Data Collected in 1994 at Locations within the Influence of the Proposed Bioventing system	2-8
2.3 Summary of Soil Analytical Data Collected in 1994 at Locations within the Influence of the Proposed Bioventing system	2-9
3.1 Respiration and Biodegradation Rates	3-4
3.2 Initial and One-Year Soil and Soil Gas Analytical Results.....	3-5

SECTION 1

INTRODUCTION

SECTION 1

INTRODUCTION

This Work Plan presents the scope for an expanded bioventing system for *in situ* treatment of fuel-contaminated soils at the Aircraft Ground Equipment (AGE) Maintenance Area at Beale Air Force Base (AFB), Yuba County, California. The AGE Maintenance Area has been designated as Installation Restoration Program (IRP) Site 11. Beale AFB is located approximately 10 miles east of Marysville and 130 miles northeast of San Francisco (Figure 1.1). The proposed expanded system activities will be performed by Parsons Engineering Science, Inc. (Parsons ES) [formerly Engineering-Science, Inc. (ES)] for the Air Force Center for Environmental Excellence (AFCEE), Technology Transfer Division (ERT), under contract F41624-92-D-8036, Delivery Order 0017.

The primary objectives of the system upgrade are:

- To supply oxygen throughout the remaining contaminated soil volume;
- To continue *in situ* remediation of fuel-contaminated soils by aerobic biodegradation; and
- To sustain *in situ* biodegradation until fuel-contaminated soils within the unsaturated zone are remediated to regulatory-approved standards.

Additional background information on the development and recent success of the bioventing technology is found in the document entitled "Test Plan and Technical Protocol for a Field Treatability Test for Bioventing" (Hinchee et al 1992). This protocol document will also serve as the primary reference for well designs and detailed procedures which will be used during site testing and sampling.

The U.S. Air Force considers bioventing a proven source-removal technology for fuel-hydrocarbon contaminated soils and an appropriate implementation of the "presumptive remedy" approach and the USEPA's Superfund Accelerated Cleanup Model (SACM). Under these approaches, during site assessment activities early short-term actions, such as the proposed expanded bioventing system described in this report, are taken to reduce contaminant sources while further site investigations are continued and long-term remedial strategies are evaluated. These early short-term actions are limited to presumptive remedies that are known or proven to be effective at sites with similar characteristics to the site in question.

Following short-term removal actions, the site remedial decision is evaluated with additional investigation results, taking into account other contamination such as halogenated VOCs or

groundwater contamination and any remaining residual fuel-hydrocarbon contamination. Figure 1.2 shows the integration of bioventing within the U.S. Air IRP. Law Environmental, Inc. (LAW) prepared a Site Characterization Summary Report describing extent of contamination (LAW 1995a) and have prepared a draft screening report of soil and groundwater remedial alternatives for Site 11 (LAW 1995b). One of the feasible cost effective options identified in the draft screening report was bioventing. The proposed expanded bioventing system described in this work plan is intended to be a short-term action to remediate the remaining fuel-hydrocarbon contamination in the soils. The groundwater affected by chlorinated hydrocarbons will be addressed as part of a multi-site evaluation in the flight line area.

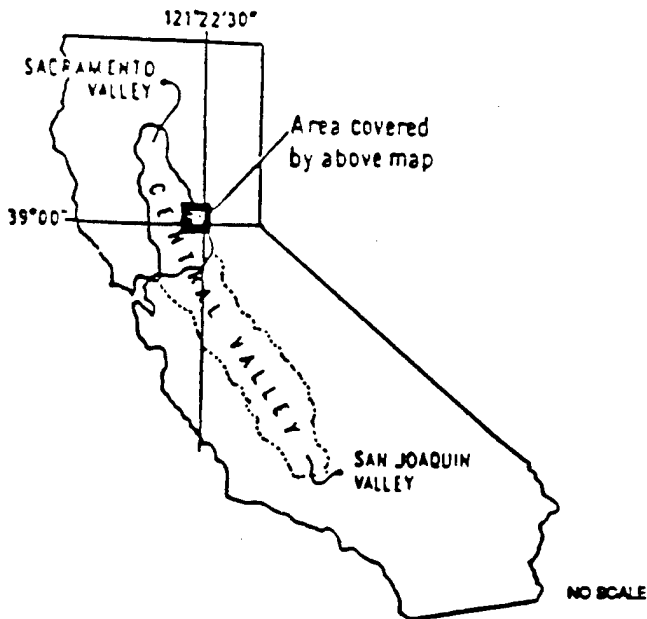
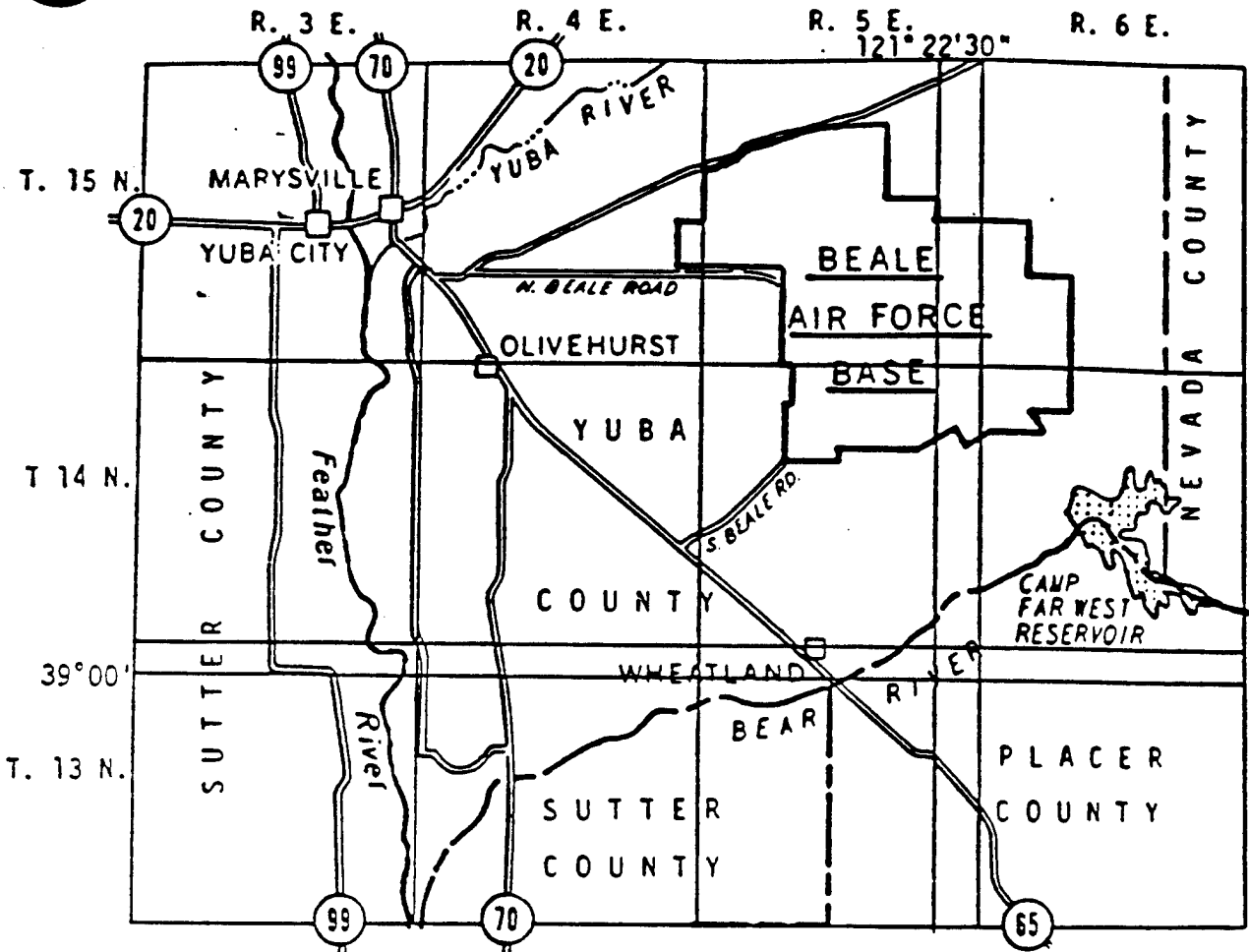
A one-year bioventing pilot test was performed by Parsons ES at this site from May 1993 to June 1994 to determine if *in situ* bioventing would be a feasible remediation technology for the fuel-contaminated soils within the unsaturated zone in the source area (ES, 1993a; HQ AFCEE/ERT 1995). The radius of oxygen influence during the pilot test was estimated to be between approximately 55 and 70 feet from the vent well (VW). The air injection flow rate used during the pilot test was approximately 55 standard cubic feet per minute (scfm).

Following the one-year pilot test, confirmatory soil and soil vapor samples were collected for laboratory analysis. Based on laboratory results from soil and soil vapor samples taken from the most contaminated areas, a reduction in soil vapor concentrations between 91% and 99% occurred at the VW and the vapor monitoring points (VMPs). Results after one year of air injection showed order of magnitude reductions of total volatile hydrocarbons (TVH) and BTEX in soil vapor; however reductions in soil were not observed, probably due to a heterogeneous distribution of contamination and the inherent variability of *in situ* soil samples. The most recent oxygen-utilization measurements indicate fuel biodegradation is still progressing at a measurable rate at the site. The success of bioventing at this site supports the recommendation of an expanded bioventing system as the most economical approach of remediating the remaining fuel-contaminated soils within the source area.

Pilot test data and previous site investigation results have been used to design the expanded remediation system. The expanded system will employ a total of three air injection vent wells: one installed previously during the initial one-year pilot test (VW-1), and two additional VWs to provide oxygen throughout the significantly contaminated soils which remain at the site.

This document is divided into six sections including this introduction. Section 2 discusses the site background and history and previous investigation results. Section 3 summarizes the results of the one-year pilot test conducted at the former UST excavation area at Site 11. Section 4 identifies the areas to be influenced by the system upgrade, provides construction details of the expanded system, recommends a proven, cost-effective approach for the remediation of the remaining fuel-contaminated soils at the site, and briefly discusses other remedial actions conducted and proposed to be conducted at Site 11. Section 5 provides key points of contact at Beale AFB, AFCEE, and Parsons ES. Section 6 provides the references cited in this document. Appendix A and Appendix B contain summary information from previous site investigations.

FIGURE 1.1

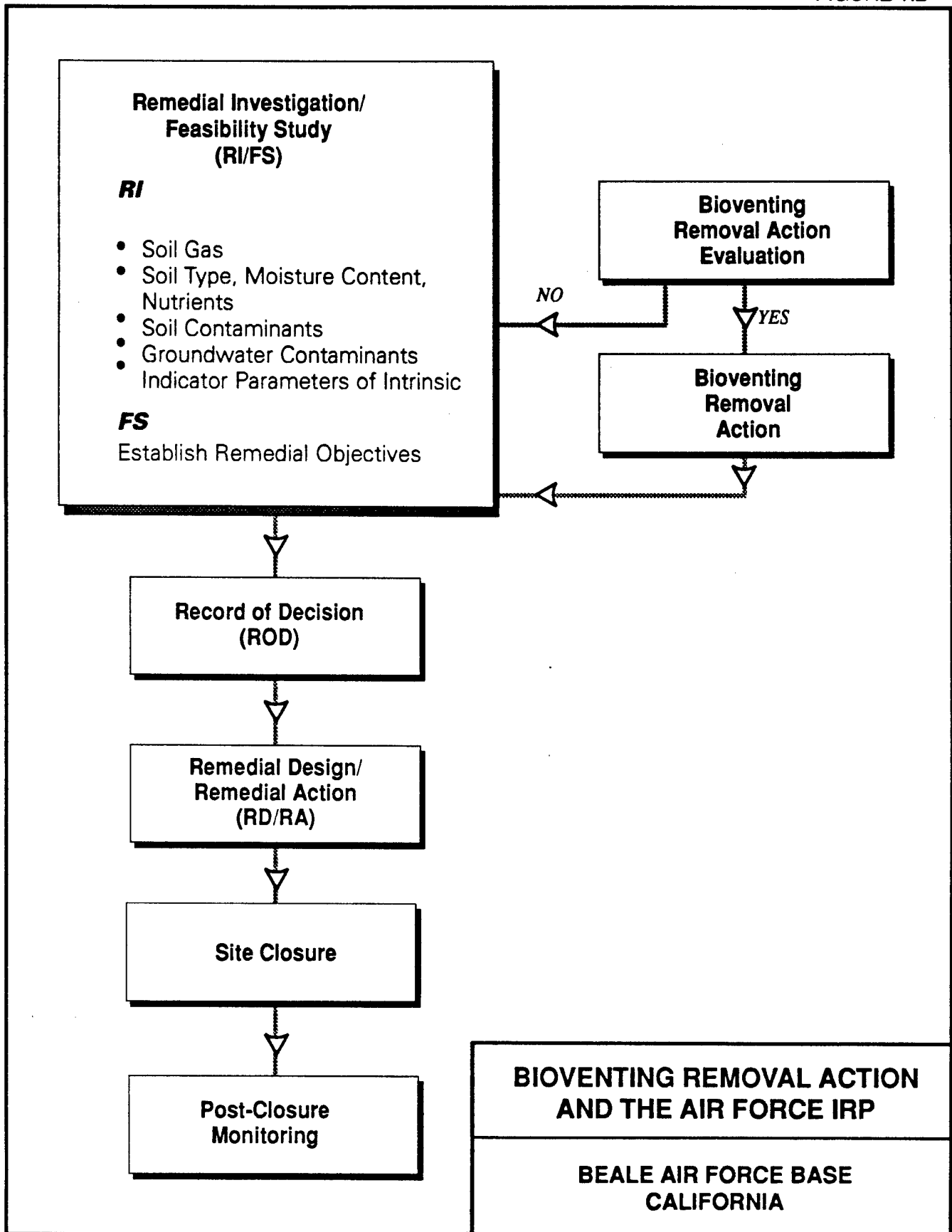


NO SCALE

SOURCE: GROUNDWATER CONDITIONS AT BEALE AIR FORCE BASE AND VICINITY, CALIFORNIA. U.S. GEOLOGICAL SURVEY OPEN-FILE REPORT 80-204. PAGE 1980

VICINITY MAP
IRP SITE 11
BEALE AFB, CALIFORNIA

FIGURE 1.2



SECTION 2

SITE BACKGROUND

SECTION 2

SITE BACKGROUND

2.1 SITE LOCATION AND HISTORY

IRP Site 11 consists of Building 1225, three above ground storage tanks (ASTs), a small pump island, a backfilled underground storage tank (UST) excavation, paved vehicle parking areas, landscaped areas, and unlined drainage channels (Figures 2.1 and 2.2).

AGE maintenance activities have been performed at Site 11 over the past 30 years. These activities have included storage of gasoline, diesel, and JP-4 jet fuel in three former USTs connected to a fuel pump island. In addition, aircraft ground support vehicles have been stored and operated from the paved areas south of Building 1225 and these vehicles have been known to leak oil and hydraulic fluids.

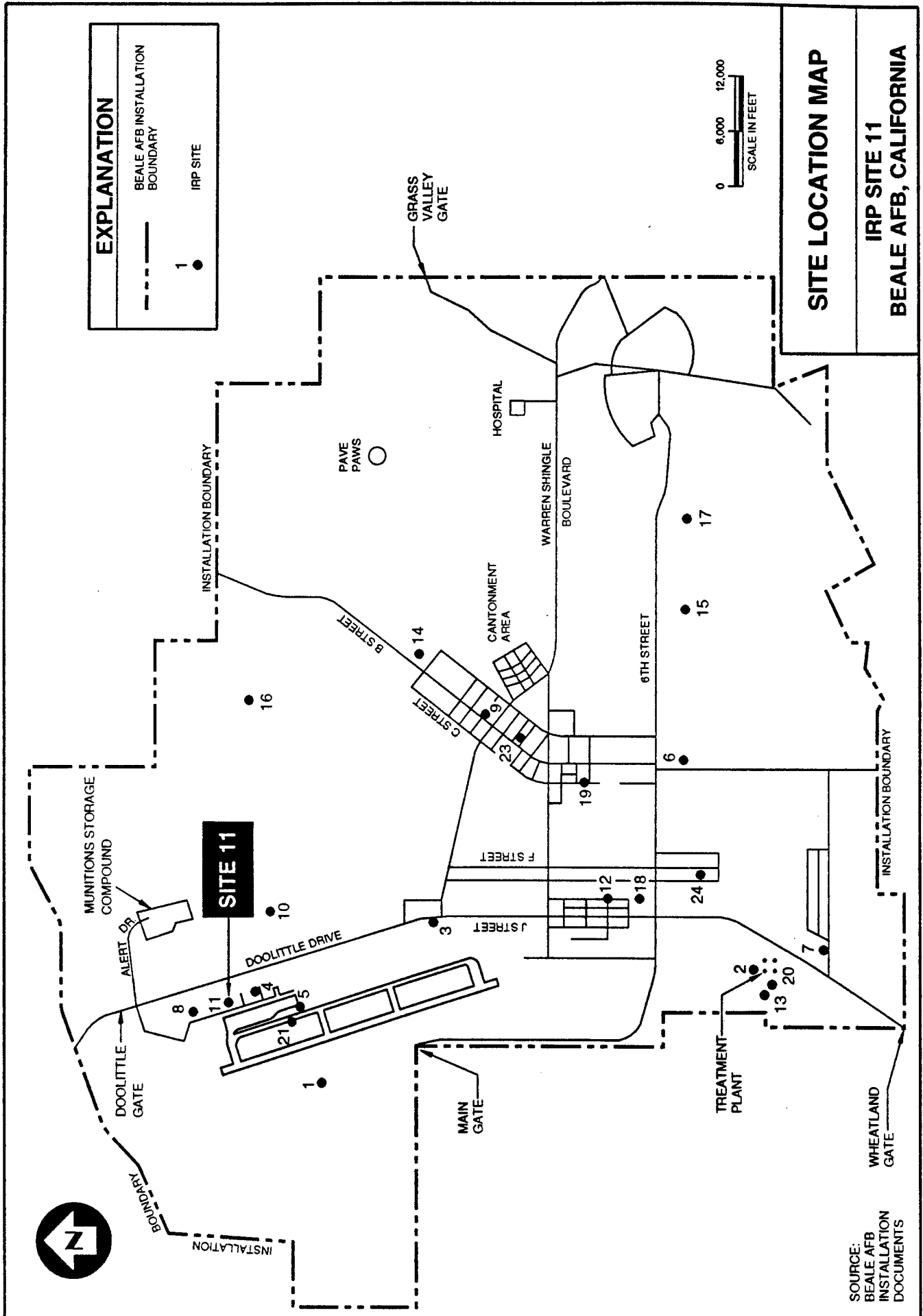
In June 1992, three existing USTs were removed and replaced by the three ASTs shown on Figure 2.2. During soil excavation and UST removal operations, soil contamination was observed in the soil beneath all three USTs. Although soil around and beneath the tanks was removed, some contaminated soil was left in place. The maximum depth of the excavation was 30 feet below ground surface (bgs), and the excavated area was backfilled to the surface with clean fill. An initial bioventing pilot test was completed in the vicinity of the former UST area. A summary of results from this pilot test are presented in Section 3.

Previous investigations have adequately defined the extent of contamination (LAW, 1995a). The extent of subsurface soil contamination seems to be limited to the area near the oil/water separator, the unlined drainage channel east of Building 1225, the former UST location, and the areas surrounding the pump island. Groundwater at the site is also impacted. Appendix B contains tables from previous reports summarizing soil, soil vapor, and groundwater sampling results. Soil boring, shallow soil sampling, and groundwater monitoring well locations are shown on Figure 2.3.

2.2 SITE GEOLOGY

The uppermost geologic unit in the western portion of Beale AFB, including Site 11, has been mapped as the Laguna Formation. This formation consists of Plio-Pleistocene alluvial sequence of silt, sand, clay, and unsorted gravels. Sediments encountered during drilling completed during the fall of 1994 indicated a generalized sequence of interbedded silty sands and sandy gravels (LAW, 1995a).

FIGURE 2.1

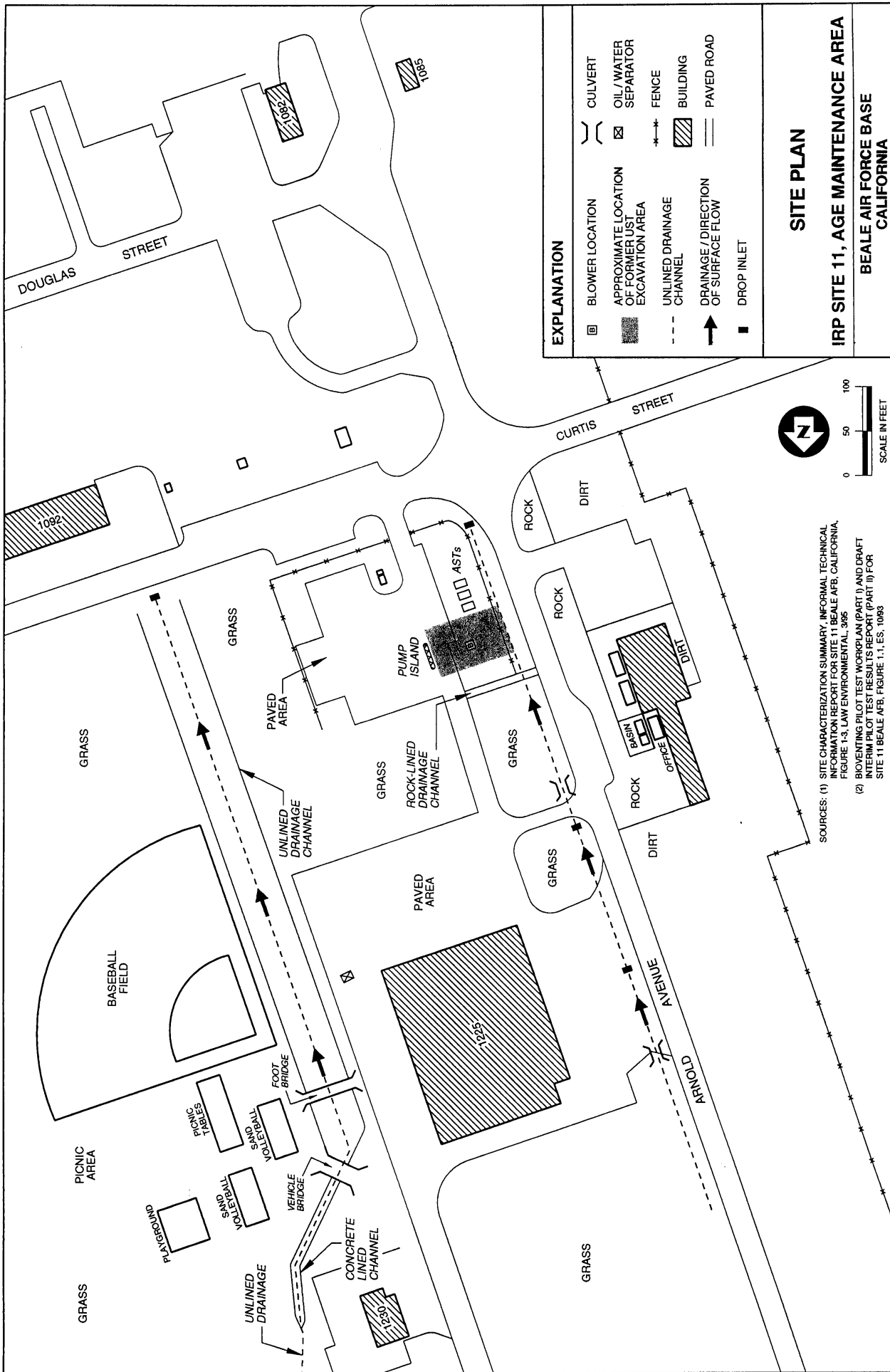


EXPLANATION	
—	BEALE AFB INSTALLATION BOUNDARY
- - -	INSTALLATION BOUNDARY
●	IRP SITE

SITE LOCATION MAP
IRP SITE 11
BEALE AFB, CALIFORNIA

SOURCE:
 BEALE AFB
 INSTALLATION
 DOCUMENTS

FIGURE 2.2



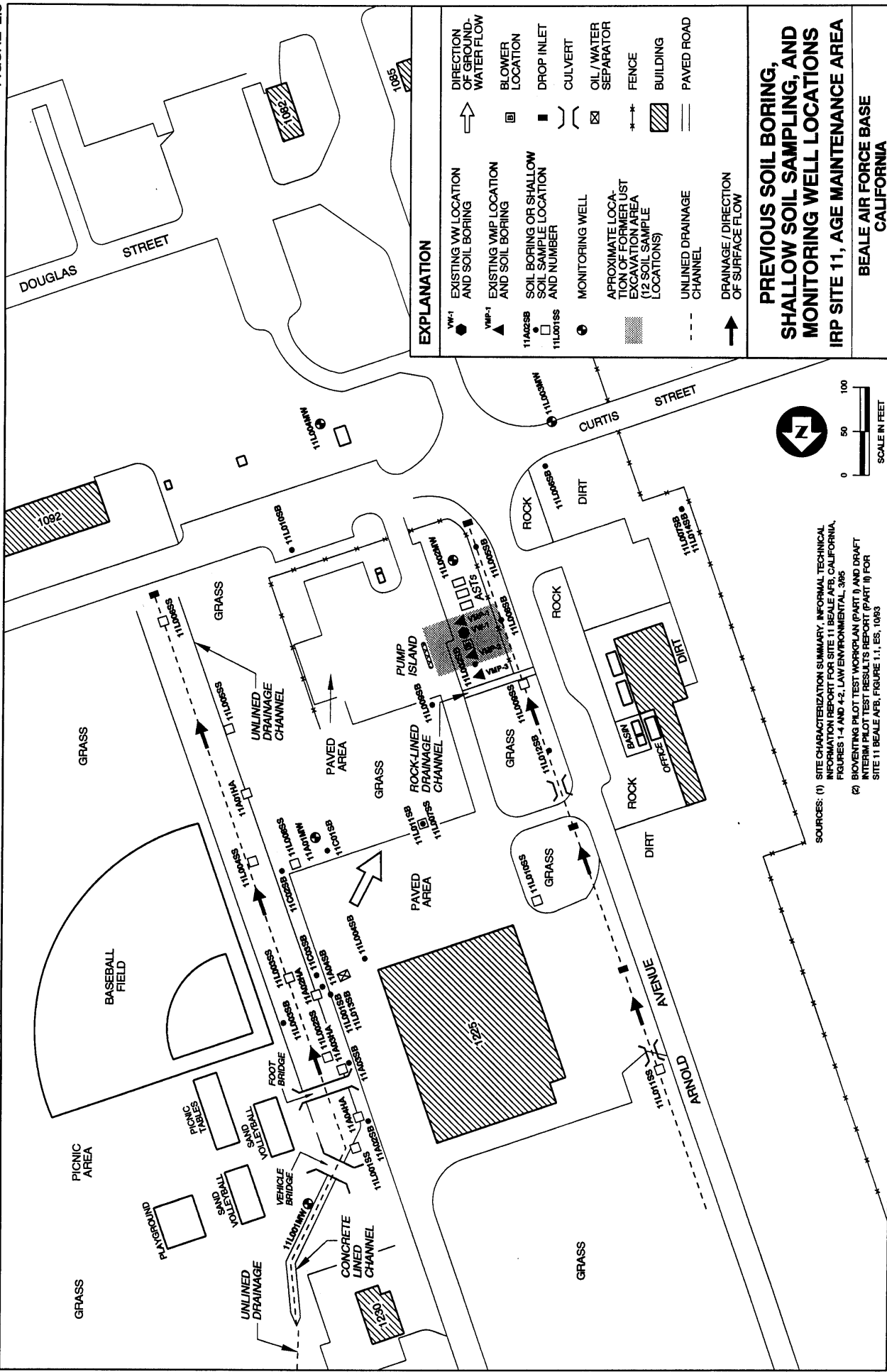
SOURCES: (1) SITE CHARACTERIZATION SUMMARY, INFORMAL TECHNICAL INFORMATION REPORT FOR SITE 11 BEALE AFB, CALIFORNIA, FIGURE 1-3, LAW ENVIRONMENTAL, 3/95
 (2) BIOVENTING PILOT TEST WORKPLAN (PART II) AND DRAFT INTERIM PILOT TEST RESULTS REPORT (PART II) FOR SITE 11 BEALE AFB, FIGURE 1.1, ES, 10/93

EXPLANATION	
	BLOWER LOCATION
	APPROXIMATE LOCATION OF FORMER UTILITY EXCAVATION AREA
	UNLINED DRAINAGE CHANNEL
	DRAINAGE / DIRECTION OF SURFACE FLOW
	DROP INLET
	CULVERT
	OIL / WATER SEPARATOR
	FENCE
	BUILDING
	PAVED ROAD

SITE PLAN

IRP SITE 11, AGE MAINTENANCE AREA
BEALE AIR FORCE BASE
CALIFORNIA

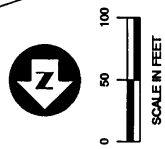
FIGURE 2.3



EXPLANATION	
	EXISTING VW LOCATION AND SOIL BORING
	EXISTING VMP LOCATION AND SOIL BORING
	SOIL BORING OR SHALLOW SOIL SAMPLE LOCATION AND NUMBER
	MONITORING WELL
	APPROXIMATE LOCATION OF FORMER LST EXCAVATION AREA (12 SOIL SAMPLE LOCATIONS)
	UNLINED DRAINAGE CHANNEL
	DRAINAGE / DIRECTION OF SURFACE FLOW
	DIRECTION OF GROUND-WATER FLOW
	BLOWER LOCATION
	DROP INLET
	CULVERT
	OIL / WATER SEPARATOR
	FENCE
	BUILDING
	PAVED ROAD

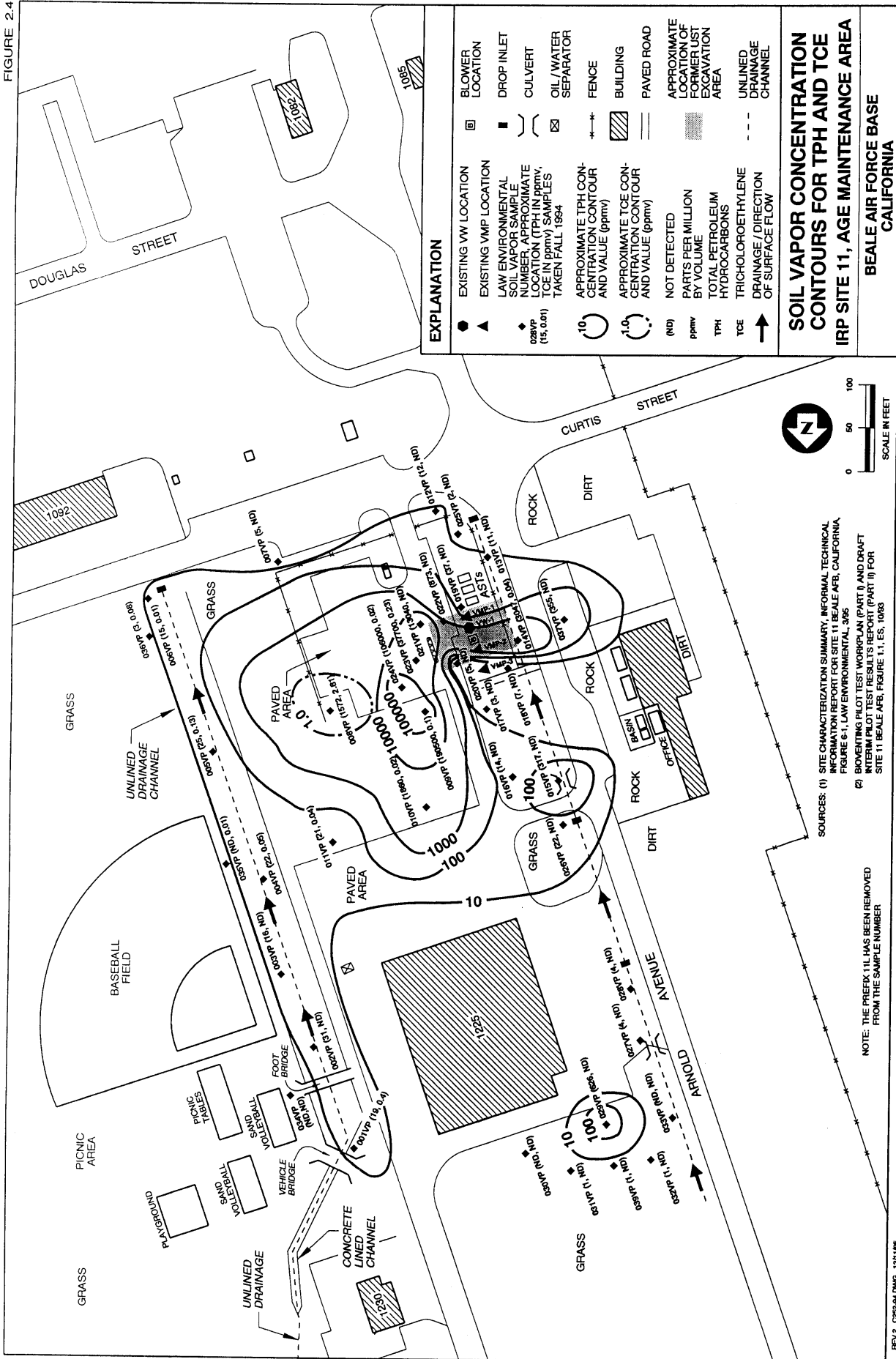
PREVIOUS SOIL BORING, SHALLOW SOIL SAMPLING, AND MONITORING WELL LOCATIONS

BEALE AIR FORCE BASE CALIFORNIA



SOURCES: (1) SITE CHARACTERIZATION SUMMARY, INFORMAL TECHNICAL INFORMATION REPORT FOR SITE 11 BEALE AFB, CALIFORNIA, FIGURES 1-4 AND 4-2, LAW ENVIRONMENTAL, 3/85
 (2) BIOVENTING PILOT TEST WORKPLAN (PART II) AND DRAFT INTERIM PILOT TEST RESULTS REPORT (PART II) FOR SITE 11 BEALE AFB, FIGURE 1.1, ES, 10/83

FIGURE 2-4



EXPLANATION	
●	EXISTING VW LOCATION
▲	EXISTING VMP LOCATION
◆ (15,000)	LAW ENVIRONMENTAL SOIL VAPOR SAMPLE LOCATION (TPH IN ppmv, TCE IN ppmv) SAMPLES TAKEN FALL 1984
10	APPROXIMATE TPH CONCENTRATION CONTOUR AND VALUE (ppmv)
1,0	APPROXIMATE TCE CONCENTRATION CONTOUR AND VALUE (ppmv)
(ND)	NOT DETECTED
ppmv	PARTS PER MILLION BY VOLUME
TPH	TOTAL PETROLEUM HYDROCARBONS
TCE	TRICHLOROETHYLENE
→	DRAINAGE / DIRECTION OF SURFACE FLOW
□	BLOWER LOCATION
■	DROP INLET
∩	CULVERT
⊠	OIL / WATER SEPARATOR
—+—	FENCE
▨	BUILDING
▬	PAVED ROAD
▨	APPROXIMATE LOCATION OF FORMER LUST EXCAVATION AREA
---	UNLINED DRAINAGE CHANNEL

SOIL VAPOR CONCENTRATION CONTOURS FOR TPH AND TCE
IRP SITE 11, AGE MAINTENANCE AREA
BEALE AIR FORCE BASE CALIFORNIA

SCALE IN FEET
 0 50 100

SOURCES: (1) SITE CHARACTERIZATION SUMMARY, INFORMAL TECHNICAL INFORMATION REPORT FOR SITE 11, BEALE AFB, CALIFORNIA, FIGURE 6-1, LAW ENVIRONMENTAL 285
 (2) SOVENTING PILOT TEST, WORKSHEET PART 8, AND DRAFT INTERIM PILOT TEST RESULTS REPORT (PART 10) FOR SITE 11, BEALE AFB, FIGURE 1.1, ES, 1028

NOTE: THE PREFIX 11L HAS BEEN REMOVED FROM THE SAMPLE NUMBER

REV. 2 C262-44-DWG 12/71/86

PARSONS ENGINEERING SCIENCE, INC.

Sampling conducted by Parsons ES during installation of the bioventing pilot test system indicated layers of gravelly sand, silts, and clays (ES, 1993a). The backfill materials for the former excavation is composed of silty clay with common gravel-sized fragments up to 2 inches in diameter. The base of this backfill material was found in VMP-1, VMP-2 and VW-1 at depths between 15 and 20 feet bgs.

Groundwater levels were measured between 95 and 102 feet bgs in site monitoring wells during field monitoring conducted in November 1994 (LAW, 1995a). The first groundwater flow zone is generally unconfined and is expected to flow in a southwest direction based on these groundwater levels. The first flow zone is composed of slightly silty sand and slightly gravelly sand.

2.3 SITE CONTAMINATION

Subsurface soil contaminants at Site 11 are primarily fuel hydrocarbons, although low levels of chlorinated VOCs were detected in some prior investigations. Lead was detected in surface soil samples at concentrations ranging from 9 mg/kg to 200 mg/kg. The maximum detected concentrations in soil, soil vapor, and groundwater at the time of UST removal and for the two most recent sampling events are shown in Table 2.1. The soil vapor and soil analytical sampling results within the radius of the proposed bioventing system for the two most recent sampling events are shown in Table 2.2 and 2.3, respectively. Sampling locations are shown on Figure 2.3. Appendix B is a summary of the analytical results from previous site investigations for Site 11.

The maximum contaminant concentrations in soil were found in the vicinity of the pump island and former USTs. The maximum concentrations of fuel hydrocarbons were: 6,000 mg/kg total petroleum hydrocarbons as diesel (TPH-d), 860 mg/kg total petroleum hydrocarbons as gasoline (TPH-g), 2,900 mg/kg SR-71 jet fuel (JP-7), 1,200 mg/kg test grade jet fuel (JP-TS), 48 mg/kg benzene, and 721 mg/kg total BTEX.

Soil vapor samples were taken during the bioventing pilot test in the vicinity of the former USTs and, during the 1994 site characterization by Law Environmental, at locations throughout the site at depths between 3 and 10 feet bgs. Soil vapor concentration contours for TPH and TCE based on 1994 site characterization activities, are shown on Figure 2.4. The highest concentrations of TPH and benzene in soil vapor samples were found north and east of the pump island. These contours do not include any samples collected from the VMPs of the bioventing pilot test system, which was operating during the 1994 sampling activities. Soil vapor sampling results from the bioventing pilot test system are discussed in Section 3.

The concentrations of HVOCs detected during site characterization activities in the fall of 1994 are in the low part per million by volume (ppmv) range for vapor samples collected at Site 11. The highest concentration of HVOCs appears to be located at the eastern edge of the paved area near soil vapor sampling point 008VP. HVOCs are also found in the groundwater at Site 11 and upgradient and downgradient of the site, and appear to be a part of a larger area of affected sites along the flight line area.

Based on photoionization detector (PID) readings and petroleum odors indicated on the soil boring log for soil boring 11L009SB (Appendix A) and based on the TPH vapor concentration contours shown on Figure 2.4, it is likely that significant soil contamination also exists north and west of the pump island. However, no soil samples for laboratory analysis were collected between the ground surface and 75 feet bgs in 11L009SB or at other borings in this area during the 1994 investigation. A possible source of contamination in these areas is runoff from the paved area in the vicinity of the pump island onto the unpaved area.

TABLE 2.1
Soil, Soil Vapor, and Groundwater Analytical Data
Maximum Detected Concentrations
IRP Site 11 - AGE Maintenance Area
Beale AFB, California

Medium	Analyte	Max. Detected Concentration	Sample Location	Depth (ft bgs)
Soil	TPH-g	860 mg/kg	UST Excavation Pit	10
Soil	TPH-d	6,000 mg/kg	UST Excavation Pit	30
Soil	JP-7	2,900 mg/kg	11L002SB	9-10.5
Soil	JP-TS	1,200 mg/kg	11L002SB	61.5-63.0
Soil	Benzene	48 mg/kg	UST Excavation Pit	30
Soil	Toluene	190 mg/kg	UST Excavation Pit	30
Soil	Ethylbenzene	83 mg/kg	UST Excavation Pit	30
Soil	Total Xylenes	400 mg/kg	UST Excavation Pit	30
Soil	1,2-DCA	0.003 mg/kg	11L008SB	100
Soil	Lead	200 mg/kg	11L0009SS	0.2-0.7
Soil Vapor	TPH	190,500 ppmv	11L009VP	10
Soil Vapor	Benzene	260 ppmv	11L024VP	8
Soil Vapor	Toluene	170 ppmv	11L009VP	10
Soil Vapor	Ethylbenzene	5 ppmv	11L023VP	9
Soil Vapor	Total Xylenes	19 ppmv	11L023VP	9
Soil Vapor	1,2-DCE	31 ppmv	11L008VP	7
Soil Vapor	1,2-DCA	5.80 ppmv	11L009VP	10
Soil Vapor	TCE	2.81 ppmv	11L008VP	7
Soil Vapor	PCE	0.33 ppmv	11L001VP	9
Groundwater	TPH-g	330 µg/L	11L002MW	--
Groundwater	Toluene	22 µg/L	11L002MW	--
Groundwater	Total Xylenes	48 µg/L	11L002MW	--
Groundwater	TCE	15 µg/L	11L004MW	--
Groundwater	trans-1,2-dichloroethene	0.5 µg/L	11L004MW	--
Groundwater	Chloroform	1 µg/L	11L002MW	--
Groundwater	1,1,2,2-Tetrachloroethane	13 µg/L	11L002MW	--

Notes:

- bgs - below ground surface
- TPH-d - total petroleum hydrocarbons as diesel
- TPH-g - total petroleum hydrocarbons as gasoline
- TPH - total petroleum hydrocarbons
- JP-7 - SR-71 jet fuel
- JP-TS - volatile jet fuel
- 1,2-DCE - 1,2-dichloroethene
- 1,2-DCA - 1,2-dichloroethane
- TCE - Trichloroethene

Sources:

- 1. LAW 1995
- 2. ES 1993

TABLE 2.2
SUMMARY OF SOIL VAPOR ANALYTICAL DATA COLLECTED IN 1994
AT LOCATIONS WITHIN INFLUENCE OF PROPOSED BIOVENTING SYSTEM
IRP SITE 11
BEALE AFB, CALIFORNIA

Sample Location	Sample Date	Depth (ft bgs)	Petroleum Hydrocarbons					HVOCs						
			TPH	Benzene	Toluene	Ethylbenzene	Total Xylenes	TCE	PCE	1,2-DCE	1,1-DCE	1,2-DCA	1,1,1-TCA	Methylene Chloride
all results in ppmv														
11L008VP	8/15/94	7.0	1,572	10.15	3.46	0.39	1.52	2.81	ND	31.0	0.27	ND	ND	ND
11L009VP	8/16/94	10.0	190,500	242.44	170.05	4.84	17.83	0.11	ND	0.42	0.50	5.8	ND	0.75
11L010VP	8/16/94	8.0	1,860	6.3	2.45	0.14	0.64	0.02	0.01	0.09	ND	0.05	0.02	ND
11L013VP	8/16/94	10.0	11	0.17	0.24	0.02	0.15	ND	ND	ND	ND	ND	ND	ND
11L014VP	8/16/94	10.0	3,047	28.08	18.88	4.51	17.16	0.04	ND	0.12	ND	0.16	ND	ND
11L016VP	8/16/94	10.0	14	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11L017VP	8/16/94	10.0	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11L018VP	8/16/94	10.0	7	0.03	0.14	0.08	0.73	ND	ND	ND	ND	ND	ND	ND
11L019VP	8/16/94	10.0	37	0.1	0.29	0.63	5.41	ND	ND	ND	ND	ND	ND	ND
11L020VP	8/16/94	10.0	5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11L021VP	8/16/94	4.5	13,040	70.58	1.57	ND	0.25	ND	ND	ND	ND	ND	ND	ND
11L022VP	8/16/94	5.0	873	6.56	0.61	0.91	3.72	ND	ND	ND	ND	ND	ND	ND
11L023VP	8/16/94	9.0	37,700	114.72	80.12	4.78	19.02	0.23	ND	ND	ND	ND	ND	ND
11L024VP	8/17/94	8.0	106,000	259.65	87.14	ND	6.41	0.02	ND	ND	ND	0.71	ND	0.15
11L037VP	9/14/94	7.5	345	3.77	1.45	0.27	0.44	ND	ND	ND	ND	ND	ND	ND
VW1	7/12/94	10-50	7	0.008	ND	0.006	0.12	NA	NA	NA	NA	NA	NA	NA
VMP1	7/12/94	24.0	3,500	1.2	12	10	140	NA	NA	NA	NA	NA	NA	NA
VMP3	7/12/94	24.0	4,900	2.7	26	12	390	NA	NA	NA	NA	NA	NA	NA

Notes:

ppmv - parts per million, by volume

ft bgs - feet below ground surface

ND - Not Detected

NA - Not Analyzed

TPH and BTEX analyses by EPA Methods 8015 and 8020, respectively for all sample results except for VW1, VMP1, and VMP3.

Samples collected from VW1, VMP1, and VMP3 were analyzed by EPA TO-3.

Halogenated volatile organic compounds (HVOCs) by EPA Method 8010.

Source: Law 1995 and HQ AFCEE/EERT 1995

TABLE 2.3
 SUMMARY OF SOIL ANALYTICAL DATA COLLECTED IN 1994
 AT LOCATIONS WITHIN INFLUENCE OF PROPOSED BIOVENTING SYSTEM
 IRP SITE 11
 BEALE AFB, CALIFORNIA

Analytical Method : Sample Location	Total Petroleum Hydrocarbons										HVOCs			
	TPH-g	TPH-d	TPH-jf	JP-ts	TRPH	Benzene	Toluene	Ethyl-benzene	Total Xylenes	1,2-DCA	2-Butanone	2-Hexanone	4-Methyl-2-Pentanone	
	SW8015M										SW8260			
	all results in mg/kg													
11L002SB	5.0	ND	24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11L002SB	10.0	ND	2,000	2,900	ND	ND	9 JH	5 JH	39	ND	ND	ND	ND	ND
11L002SB	15.0	610 J	ND	350	ND	0.02	0.56	0.27	3.6	ND	ND	ND	ND	ND
11L002SB	34.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11L002SB	39.5	ND	ND	ND	ND	ND	ND	ND	0.001 J	ND	ND	ND	0.015 J	0.006 J
11L002SB	45.5	0.56 J	ND	ND	ND	ND	ND	0.002	0.002	ND	ND	ND	ND	0.007 J
11L002SB	46.5	0.64 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11L002SB	47.5	1.0 J	6.0 J	ND	ND	ND	ND	ND	ND	ND	0.016 JH	ND	ND	ND
11L002SB	49.5	ND	ND	ND	ND	ND	ND	ND	0.003	ND	ND	ND	ND	ND
11L002SB	62.5	760 J	ND	1,200	ND	ND	ND	1 JH	16 JH	ND	ND	ND	ND	ND
11L008SB	75.0	ND	ND	ND	ND	ND	ND	ND	0.001	ND	ND	ND	ND	ND
11L008SB	100.0	ND	ND	ND	ND	ND	ND	ND	0.003	0.002 R	ND	ND	ND	ND
11L009SB	75.0	ND	20	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11L009SB	105.5	ND	ND	ND	ND	ND	0.06	0.004	0.4	ND	ND	ND	ND	ND
11L009SS	0.4	ND	390	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.005 J
VW-1	30.0	NA	NA	NA	86	0.0005	0.013	0.0076	0.074		NA	NA	NA	NA
VMP-1	24.5	NA	NA	NA	1,010	ND	ND	ND	10		NA	NA	NA	NA
VMP-2	25.5	NA	NA	NA	3,680	ND	ND	13	720		NA	NA	NA	NA

ppmv - parts per million, by volume
 ft bgs - feet below ground surface
 ND - Not Detected
 NA - Not Analyzed

TPH-d: Total Petroleum Hydrocarbons-diesel
 TPH-g: Total Petroleum Hydrocarbons-gasoline
 TPH-jf: Total Petroleum Hydrocarbons-Jet fuel
 TPH-ts: Total Petroleum Hydrocarbons-Test grade jet fuel
 TRPH: Total Recoverable Petroleum Hydrocarbons

Data Qualifiers:

JH - Results are estimated due to high bias is indicated for positive results.
 J - Results are estimated due to lack of precision.
 R - The sample results are rejected as unusable.

Source: Law 1995 and HQ AFCEE/EERT 1995

SECTION 3

PILOT TEST DESIGN AND CONSTRUCTION

SECTION 3

PILOT TEST DESIGN AND CONSTRUCTION

A bioventing pilot test was conducted by Parsons ES at Site 11 between May 1993 and June 1994. The objectives of the initial bioventing pilot test were:

- to assess the potential for supplying oxygen throughout the contaminated soil zone;
- to determine the rate at which indigenous microorganisms will degrade the fuel in the soil when stimulated by oxygen-rich soil vapor, and;
- to evaluate the potential for sustaining these rates of fuel biodegradation until the contamination is remediated below regulatory standards.

If bioventing proved to be a feasible technology for this site, the pilot test data would then be used to design a full-scale remediation system.

3.1 TEST CONFIGURATION

Based on site investigation data collected through 1993, the maximum contamination was expected to be in the former UST excavation area. One vent well (VW), designated VW-1, three vapor monitoring points (VMPs), and a regenerative blower were installed within or near the former UST excavation area between 19 and 22 April 1993. Figure 3.1 shows the location of the VW, the three VMPs, and the blower.

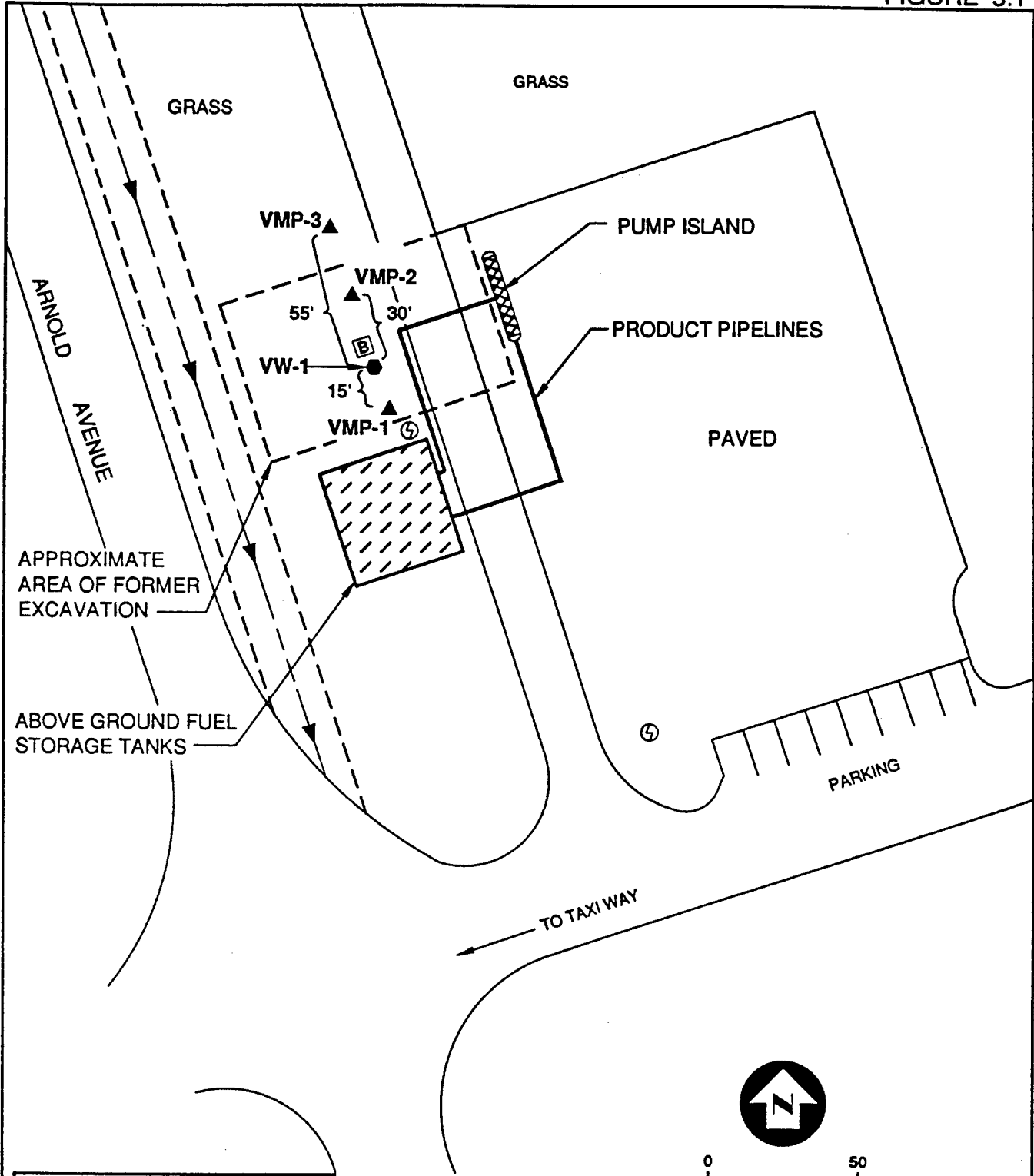
VW-1 was located near the center of the former UST excavation area. The radius of venting influence around the VW-1 was expected to be at least 60 feet based on the composition of the soils. The three VMPs were located within a 55-foot radius of the VW-1 including one VMP (VMP-3) located outside the former UST excavation area. The VMPs were screened at discrete depths between 24 and 50 feet bgs. The VMPs were installed to monitor the *in situ* biodegradation rates, as well as to determine the radius of oxygen influence.

3.2 AIR INJECTION BIOVENTING

3.2.1 System Operation

An initial air permeability (AP) test was conducted on 11 and 12 May 1993. Air was injected into VW-1 for approximately 18 hours at a rate of 33 standard cubic feet per minute (scfm).

FIGURE 3.1



EXPLANATION	
●	VW-1 VW LOCATION
▲	VMP-1 VMP LOCATION
⊠	BLOWER LOCATION
⊕	UTILITY POLE
—▶—▶—▶	UNLINED DRAINAGE CHANNEL

**AS-BUILT VW, VMP, AND BLOWER LOCATIONS
IRP SITE 11, AGE MAINTENANCE AREA -
UST EXCAVATION AREA**

**BEALE AIR FORCE BASE
CALIFORNIA**

SOURCE: MODIFIED FROM CH2M HILL, 1989

Calculated permeability values ranged from 22 to 43 darcys, values typical for the sandy soils which were found at Site 11. The permeability values indicate the site soils are very permeable to air. Based on measured pressure response, which is an indicator of long-term oxygen transport, and the change in oxygen levels during the AP test, it was anticipated that the radius of oxygen influence at the site would be at least 55 feet from VW-1. Follow-up monitoring of oxygen levels and pressure response in the VMPs during the one-year pilot test confirmed that the radius of influence was at least 55 feet and may be as high as 70 feet from VW-1. Weekly system checks were conducted to ensure consistent operation and performance.

3.2.2 In Situ Biodegradation Rates

Initial, six-month, and one-year *in situ* respiration (ISR) tests were conducted in May 1993, December 1993, and July 1994, respectively. Soil and soil vapor sampling for laboratory analysis was also conducted during the May 1993 and June 1994 events. These monitoring and sampling events were designed to evaluate the long-term performance of the bioventing system. Table 3.1 shows the estimated fuel biodegradation rates in mg TPH per kg soil per year at the three VMPs, based on the initial, six-month, and one-year ISR tests.

Initial biodegradation rates ranged from 50 to 530 mg TPH per kg soil per year. At the end of the one-year testing period, biodegradation rates decreased or remained generally the same as initial degradation rates. A decrease in the biodegradation rate over time is an indicator of contaminant removal and is expected as the contaminant levels in the soil drop due to continued biodegradation. Biodegradation rates measured during the ISR test conducted in July 1994, the most recent test, indicate that fuel residuals remain in the soil.

3.2.3 Initial and One-Year Soil and Soil Vapor Sampling Results

Upon completion of the one-year study, confirmatory soil and soil vapor samples were collected from the initial sample locations. Table 3.2 provides a summary of initial and one-year soil and soil vapor sampling results for total recoverable petroleum hydrocarbons (TRPH), total volatile hydrocarbons (TVH), and BTEX. Results after one year of air injection showed order of magnitude reductions of TVH and BTEX in soil vapor; however, reductions in soil were not observed, probably due to a heterogeneous distribution of contamination and the inherent variability of *in situ* soil samples.

3.2.4 Recommendation for Full-Scale Bioventing

Based on the one-year testing results, AFCEE has provided funding and contractual support for an expanded bioventing system at the Site 11. AFCEE has retained Parsons ES to continue bioventing services at Beale AFB and to complete installation of an expanded bioventing system at Site 11. Section 4 provides details on the design, construction, and operation of the expanded system.

TABLE 3.1
SITE 11
RESPIRATION AND BIODEGRADATION RATES
BEALE AFB, CALIFORNIA

Location-Depth	Initial - May 1993			6-Month-December 1993			1-Year-July 1994		
	O ₂ -utilization	Biodegradation	Soil Temp.	O ₂ -utilization	Biodegradation	Soil Temp.	O ₂ -utilization	Biodegradation	Soil Temp.
	Rate, k _o (%O ₂ /hr)	Rate, K _b (mg/kg/year) ¹	(°C)	Rate, k _o (%O ₂ /hr)	Rate, K _b (mg/kg/year) ²	(°C)	Rate, k _o (%O ₂ /hr)	Rate, K _b (mg/kg/year)	(°C)
VMP1-24	0.12	50	21.6	0.039	47	23.5	0.036	71	20.7
VMP1-40.5	NS ³	NS	22.8	NS	NS	20.4	NS	NS	20.6
VMP2-24	0.047	130	NS	0.038	110	NS	0.023	63	NS
VMP3-30.5	0.18	530	NS	0.016	47	NS	0.039	110	NS

Notes:

- ¹ Milligrams of hydrocarbons per kilogram of soil per year.
- ² Assumes moisture content of soil is average of initial and final moistures.
- ³ NS = Not Sampled

SECTION 4

EXPANDED BIOVENTING SYSTEM

SECTION 4

EXPANDED BIOVENTING SYSTEM

The purpose of the expanded bioventing system is to provide oxygen and to stimulate aerobic biodegradation of the remaining soil contamination present at Site 11. Based upon the previous site investigation studies, two additional air injection VWs along with the existing VW (VW-1), should be capable of providing oxygen to the soils at the site with the highest levels of fuel hydrocarbon contamination.

4.1 OBJECTIVE

The primary objectives of the expanded bioventing system are:

- Optimize the system in order to fully influence the contaminated area;
- Monitor the system to ensure continuous operation;
- Reduce the existing contamination levels in soil to acceptable regulatory cleanup criteria;
- Provide the most cost-effective remediation alternative for contaminated site soils, while eliminating unnecessary impacts to the operations of this area of the base.

The bioventing system is not specifically designed to remediate the low levels of HVOCs detected at site 11. However, recent laboratory and field-scale studies have shown that some HVOCs, notably TCE and TCA, can be degraded under certain site conditions resulting in the production of DCE and DCA as intermediate byproducts (Bower, et al. 1981; Nelson, et al. 1987; Vogel, et al. 1987). The detection of these compounds in soil vapor at the site provides good evidence that these processes are occurring at Site 11. However, the investigation of the degradation of HVOCs is beyond the scope of this project.

4.2 SYSTEM DESIGN

The proposed upgrade to the existing bioventing system will incorporate the addition of two new VWs and two new VMPs. The additional VWs, to be designated VW-2 and VW-3, will be located north and northeast of VW-1 (Figure 4.1). Based on the most recent bioventing pilot test results, the radius of influence of the VWs is as large as 70 feet. The two new VMPs, to be designated VMP-4 and VMP-5, will be placed at the edge of the expected radius of influence of VW-2 and VW-3 and used to monitor oxygen influence and soil vapor concentrations at discrete depths. It is anticipated that significant TPH contamination is present in the vicinity of VMP-4 due to the strong petroleum odors and the PID

measurements indicated on the log for soil boring 11L009SB (Appendix A) and based on the TPH vapor concentration contours (see Figure 2.4).

4.2.1 Construction of Vent Wells (VWs)

Figure 4.2 shows construction details for the proposed VWs. The VWs will be constructed of 2- or 4-inch inside diameter (ID) Schedule 40 polyvinyl chloride (PVC) casing, with an interval of 0.04-inch slotted screen set between a minimum of 10 feet bgs down to the base of contamination as determined by field organic vapor analysis (OVA) of soil samples. Flush-threaded PVC casing and screen will be used with no organic solvents or glues. The filter pack will be clean Lone Star sand with a 6-12 grain size and will be placed in the annular space of the screened interval. A 3-foot layer of bentonite will be placed directly over the filter pack. The remainder of the annular space, except for a 2-foot open area directly below the ground surface, will be filled with a bentonite/cement grout. A complete seal is critical to prevent the short-circuiting of air from the surface during air injection. Additional details on VW construction are found in Section 4 of the protocol document.

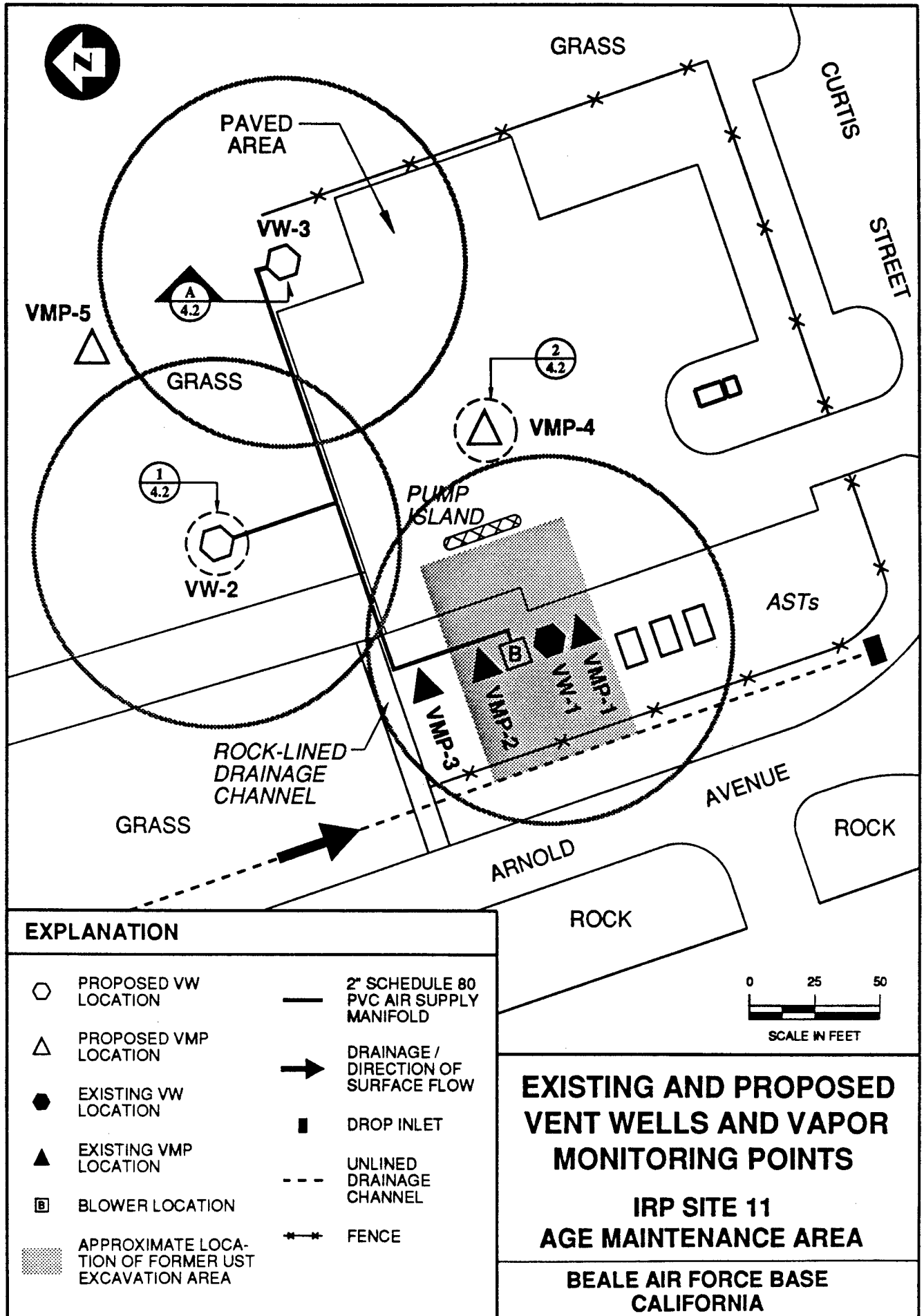
The depth selected as the base of contamination will be based on an evaluation of physical and visual evidence of contamination (e.g. odors and staining), site lithology, as well as headspace screening using both hydrocarbon vapor analyzer and a photoionization detector. Two to three additional headspace readings will be taken at increasing depths beyond the apparent end of contamination to ensure that the vertical extent of contamination has been delineated. Based on previous soil borings and soil vapor monitoring, it is estimated that the maximum depth of the VWs will be between 50 and 100 feet bgs. A Total Hydrocarbon Vapor Analyzer (THVA) will be used for field OVA readings. This platinum catalyst combustion detector is calibrated with hexane, which provides a conservative reading representative of total petroleum hydrocarbon vapors present.

4.2.2 Construction of Vapor Monitoring Points (VMP)s

Figure 4.2 showed the construction detail for the proposed VMPs. Two additional VMPs will be installed at the site to monitor oxygen influence throughout the treatment area. The VMPs will be constructed of 0.50-inch ID, Schedule 80 PVC casing and 1-inch ID slotted screen intervals (0.020-inch slot size). Flush threaded PVC casing and screen will be used with no organic solvents or glues. The annular space between the vapor monitoring screen filter packs will be sealed with bentonite to isolate the monitoring intervals.

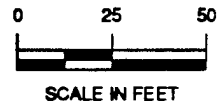
The VMPs will be screened to a maximum of three depths. Depths will be selected which provide good vertical coverage between the ground surface and the base of contamination and through different soil types. Multi-depth monitoring will determine the concentration of oxygen across the entire soil profile and will be used to calculate oxygen-utilization rates and fuel biodegradation rates at all monitored depths. The deepest screen will be placed at or near the bottom of contamination as determined by field instrumentation. Oxygen and carbon dioxide concentrations in soil vapor will be monitored using these vapor monitoring screens.

FIGURE 4.1



EXPLANATION

- | | | | |
|---|--|-------|--|
| ○ | PROPOSED VW LOCATION | — | 2" SCHEDULE 80 PVC AIR SUPPLY MANIFOLD |
| △ | PROPOSED VMP LOCATION | ➔ | DRAINAGE / DIRECTION OF SURFACE FLOW |
| ● | EXISTING VW LOCATION | ■ | DROP INLET |
| ▲ | EXISTING VMP LOCATION | - - - | UNLINED DRAINAGE CHANNEL |
| ⊠ | BLOWER LOCATION | * * * | FENCE |
| ▨ | APPROXIMATE LOCATION OF FORMER UST EXCAVATION AREA | | |

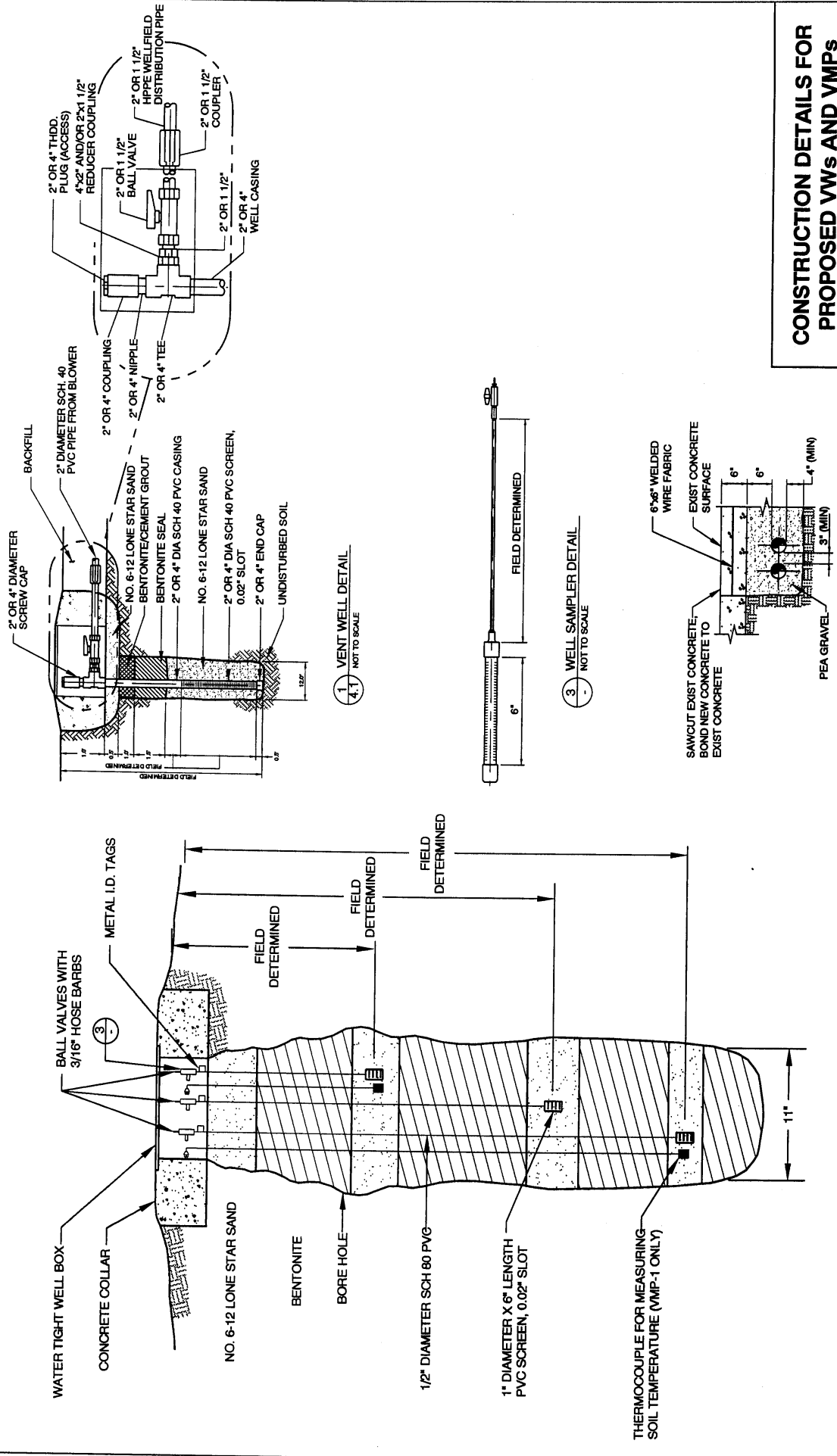


EXISTING AND PROPOSED VENT WELLS AND VAPOR MONITORING POINTS

**IRP SITE 11
AGE MAINTENANCE AREA**

**BEALE AIR FORCE BASE
CALIFORNIA**

FIGURE 4.2



CONSTRUCTION DETAILS FOR PROPOSED VWs AND VMPs

BEALE AIR FORCE BASE
CALIFORNIA

PARSONS ENGINEERING SCIENCE, INC.

4.2.3 Air Supply and Flow Rate

Air supply piping that will be used as the conduit for the injected air to flow from the blower to the VWs will be constructed of solid 2-inch ID, Schedule 80 PVC. The two new VWs and the existing VW will be manifolded to a new, larger capacity air blower which will replace the existing blower. All electrical work will be performed by a Parsons ES subcontractor with base approval. The new blower will be located in the same location as the existing blower. A separate flow control valve and pressure gauge will be installed for each VW in order to adjust individual air flows to each VW.

Based on data collected during the bioventing pilot test, a maximum injection rate of 50 scfm at each VW should be sufficient to supply oxygen to the contaminated soils within the influence of the three VWs and sustain *in situ* fuel biodegradation. The radius of influence around each VW is expected to be between 55 and 80 feet, based on data collected during the bioventing pilot test.

4.3 SYSTEM OPERATION

Following system installation, preparation of an operation and maintenance (O&M) plan, monitoring plan, and as-built system drawings will be prepared.

4.3.1 System Start-up

At startup, air will not be injected into VW-1, but only into VW-2 and VW-3, for the first two to three weeks in order to assess the potential for vapor migration from the two new VWs. All five VMPs will be used to evaluate potential vapor migration from the areas of the site undergoing air injection for the first time.

Flow rate optimization of the air injection rate will be completed for VW-2 and VW-3 to ensure proper operation of the blower system. Flow rate optimization is accomplished by gradually increasing the flow rate to each VW until all VMPs within the radius of influence of VW-2 and VW-3 reach a minimum oxygen concentration of approximately 10 percent. Oxygen levels in excess of 10 percent at the outer VMPs may indicate that the volume of air passing through the soil exceeds the biological oxygen demand. The blower system will be optimized to ensure that it is producing the required flow rate and pressure for air injection.

During system start-up, ambient air monitoring will be conducted with a photoionization detector and a total hydrocarbon meter as detailed in the Health and Safety Plan (Parsons ES 1995). Based on previous surface air sampling results during pilot testing of bioventing systems at IRP Sites 10 and 11 and at bioventing sites nationwide, significant atmospheric emissions of either hydrocarbons or HVOCs is not expected. In the unlikely event that the hand-held meters indicate significant atmospheric emissions may be occurring, the system flow rate will be lowered as needed or the system will be shutdown pending more thorough surface air emissions sampling.

It is expected that the system will reach steady-state pressure and *in situ* oxygen and vapor concentrations within the first few weeks of operation. Soil vapor sampling as described in Section 4.4 will be conducted after two to three weeks of operation to assess potential vapor

migration. If results indicate that no vapor migration is occurring, the system will be adjusted so that air is injected at all three VWs. The air injection rate at VW-1 will be optimized such that VMP-1 and VMP-2 will reach a minimum oxygen concentration of approximately 10 percent. The flow rate at VW-2 and VW-3 will remain unchanged.

4.3.2 System Operation and Maintenance

Bioventing systems have minimal O&M requirements. Regenerative blowers are virtually maintenance-free. The only recurring maintenance required on these units is a monthly check of the air filter, which is generally replaced when a pressure difference of 10 to 15 inches of water is reached across the inlet filter. The time period between filter changes is dependent on site conditions, but is typically every three to six months.

4.4 SOIL AND SOIL VAPOR SAMPLING

One soil sample will be collected from each new boring from the most contaminated interval. Soil samples will be analyzed for purgeable and extractable petroleum hydrocarbons (EPA Method 8015 modified), BTEX using EPA Method 8020, HVOCs by EPA Method 8010, moisture content, and soluble petroleum hydrocarbons (California Title 22 DI-WET Method). All peaks in the extractable petroleum hydrocarbon range will be reported and quantified.

Soil samples will be collected using a split-spoon sampler containing brass tube liners. Soil samples collected in the brass tubes will be immediately trimmed and the ends sealed with Teflon[®] tape held in place by plastic caps. Soil samples will be labeled following the nomenclature specified in Section 5.5 of the protocol document, wrapped in plastic, and placed in an ice chest for shipment. A chain-of-custody form will be filled out and the ice chest shipped for analysis to an analytical laboratory which has been audited by the U.S. Air Force and which meets all quality assurance/quality control and certification requirements for the State of California.

A maximum of five soil vapor samples will be collected in Summa[™] canisters from the additional VWs and VMPs. Samples will be analyzed for BTEX and TVH using EPA Method TO-3 and HVOCs by EPA Method TO-14. These initial soil vapor samples will be used to determine the reduction in contaminant concentrations over time, and future soil vapor sampling will be used as screening indicators. After two or three weeks of operation, soil vapor samples will be recollected from the same locations in order to evaluate potential vapor migration.

Soil vapor samples will be packed to prevent excessive movement during shipment. They will not be sent on ice in order to prevent condensation of hydrocarbons. A completed chain-of-custody record will accompany the ice chest, which will be shipped to the Air Toxics Ltd. laboratory in Folsom, California for analysis.

Sampling for HVOCs in soil or soil vapor described above may be decreased or eliminated if the results of the analysis of the initial soil and soil vapor samples show HVOCs present only in an isolated area of the site and that vapor migration of HVOCs is not occurring. If the future elimination of HVOC sampling is recommended, analytical and monitoring results in

support of the recommendation will be submitted to local regulatory agencies for concurrence before proceeding.

4.5 SYSTEM MONITORING

Monitoring of the bioventing system will include weekly system checks by base personnel of the blower operation, including outlet pressures, inlet vacuum, and exhaust temperature. Additionally, system performance monitoring will include a system monitoring event after two to three weeks to evaluate the potential of vapor migration and one annual visit. The results of the system monitoring after two to three weeks of operation will be summarized in a Letter Report and submitted to the local regulatory agencies. Additional monitoring after the first two to three weeks will be subject to the results of the monitoring event or conducted only when changes are made to the system air flow rates.

During the annual visit a comprehensive system check will be completed to ensure that oxygen continues to reach all VMPs in the contaminated soils and to perform an *in situ* respiration (ISR) test at the VMPs to ensure that biodegradation is continuing at acceptable levels. Additional details on ISR testing are found in the protocol document.

Confirmation of the contaminant removal rates is predicted from the data collected during the ISR tests, quantitative estimates of the long-term biodegradation rates, and decreases in soil vapor concentrations. Oxygen-utilization data from the one-year ISR test will be used to estimate biodegradation rates and to evaluate the progress of contaminant removal and system effectiveness. Typically, as the fuel residuals in the soil are depleted, the respiration activity of the indigenous microorganisms is reduced and slower oxygen-utilization rates result. Once oxygen-utilization rates in previously contaminated areas approach the values in uncontaminated (background) soil, confirmatory sampling and analysis should be conducted. The use of oxygen-utilization rates and soil vapor chemistry as screening indicators decreases the likelihood of premature and expensive soil sampling events. Soil and soil vapor sampling and analyses methods are discussed in Section 4.5.

The monitoring schedule for the full-scale system will be:

<u>Event</u>	<u>Frequency</u>
Blower Vacuum, Pressure, and Temperature	Weekly
Soil Vapor Sampling	System start-up, after two to three weeks, and after one year
<i>In Situ</i> Respiration Testing	After one year
Soil Sampling	Initially, then as required

4.6 HANDLING OF DRILL CUTTINGS AND CONSTRUCTION DEBRIS

All drill cuttings will be collected in labeled drums or bins after each borehole is drilled. Drill cuttings will be characterized prior to disposal. Characterization will determine the method of disposal in accordance with local regulatory and Beale AFB requirements (California RWQCB, 1995). Parsons ES or its subcontractor will transport characterized drill cuttings to appropriate base disposal facilities, unless characterization results indicate that

off-base disposal is required. Parsons ES will subcontract off-Base disposal of the drums, if necessary. Beale AFB will be responsible for providing their USEPA generator identification and signing the manifest prior to disposal.

4.7 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

To achieve all QA/QC objectives, procedures for all aspects of this project will follow protocols outlined in the Quality Assurance Project Plan (ES, 1993b).

4.8 CONSTRUCTION SCHEDULE

Following review and approval of the system upgrade work plan by AFCEE/ERT, Beale AFB, and local regulatory agencies, field work will begin. The following schedule is contingent upon timely approval of this work plan:

<u>Event</u>	<u>Date</u>
Draft Work Plan to AFCEE and Beale AFB	11 August 1995
Final Work Plan to AFCEE and Beale AFB	13 December 1995
Approval of Work Plan/Notice To Proceed	5 January 1996
Begin Field Activities/ Construction of Expanded System	16 January 1996
Complete Construction/System Startup	26 January 1996

SECTION 5

BASE SUPPORT REQUIREMENTS

SECTION 5

BASE SUPPORT REQUIREMENTS

The following base support is needed prior to the arrival of a driller and the Parsons ES test team:

- Obtain all necessary regulatory permits for the installation of the vent well and vapor monitoring points.
- Obtain any required base digging permits or permits to install wells.
- Obtain the required permits so that photographs may be taken at the site.
- Obtain any written permission necessary to allow Parsons ES subcontractors to perform electrical work.
- Provide any paperwork required to obtain gate passes and security badges for approximately three Parsons ES employees and one driller. Vehicle passes will be needed for two trucks and a drill rig. The passes must be valid for the expected duration of drilling operations and the initial testing (about one month).

Following the initial testing and for the duration of remediation activities, the following additional base support is required:

- Base personnel are required to check the blower system once each week to ensure that it is operating, change filters as needed, and to record air injection pressures and temperatures. Parsons ES will provide a maintenance procedures manual, data collection sheets, and a brief training session.
- If any blowers stop working, notify: Mr. Michael Phelps, Parsons ES-Alameda, (510) 769-0100 or Mr. John Ratz, Parsons ES-Denver, (303) 831-8100.

SECTION 6

KEY POINTS OF CONTACT

SECTION 6
KEY POINTS OF CONTACT

John Gullock
9 CES/CEVR
6541 B Street
Beale Air Force Base, CA 95903-1708
(916) 634-2642
Fax (916) 634-2845

Carol Gaudette
9 CES/CEVR
6541 B Street
Beale Air Force Base, CA 95903-1708
(916) 634-2619
Fax (916)634-2845

Lt. Maryann M. Jenner
AFCEE/ERT
8001 Arnold Drive
Brooks Air Force Base, TX 78235-5357
(210) 536-4364
Fax (210) 536-4330

Michael Phelps
Parsons Engineering Science, Inc.
1301 Marina Village Parkway, Suite 200
Alameda, CA 94501
(510) 769-0100
Fax (510) 769-9244

John Ratz
Parsons Engineering Science, Inc.
1700 Broadway, Suite 900
Denver, CO 80290
(303) 831-8100
Fax (303) 831-8208

SECTION 7

REFERENCES

SECTION 7

REFERENCES

- Bower, E.S., B.C. Rittman and P.L. McCarty 1981. Anaerobic Degradation of Halogenated 1- and 2-Carbon Compounds. *Envir. Sci. Tech.* 15:596-599.
- California Regional Water Quality Control Board 1995. Letter to Beale Air Force Base, Subject: Hydrocarbon Contaminated Soil Treatment Cell Draft Waste Discharge Requirements, Beale Air Force Base. 4 April
- Engineering-Science, Inc. 1993a. Bioventing Pilot Test Work Plan (Part I) and Draft Interim Pilot Test Results (Part II) for Aircraft Ground Equipment Maintenance Area (Site 11), Beale Air Force Base, California
- Engineering-Science, Inc. 1993b. Project Management Plan, AFCEE Bioventing Pilot Tests. Updated January 1993
- HQ AFCEE/ERT 1995. Memorandum to Beale Air Force Base, Subject: Completion of One Year Bioventing Test, Site 11. 2 February
- Hinchee et al. 1992. Test Plan and Technical Protocol for a Field Treatability Test for Bioventing, U.S. Air Force Center for Environmental Excellence (AFCEE). January
- Law Environmental, Inc. 1995a. Site Characterization Summary Informal Technical Information Report for Site 11, Beale Air Force Base, California (Draft). March
- Law Environmental, Inc. 1995b. Initial Screening of Remedial Alternatives, Site 11, Aircraft Ground Equipment Maintenance Area, Beale Air Force Base, California (Draft). August
- Nelson, M.J.K., S. Montgomery, W.R. Mahaffey and P.H. Pritchard 1987. Biodegradation of Trichloroethylene and Involvement of an Aromatic Biodegradation Pathway, *Appl. Environ. Micro.* 53:949-954.
- Parsons ES, Inc. 1995 Addendum to the Program Health and Safety Plan for the Bioventing Test Initiative (Draft). July
- Vogel, T.M. and P.L. McCarty 1987. Abiotic and Biotic Transformations of 1,1,1-Trichloroethane under Methanogenic Conditions. *Envir. Sci. Tech.* 21:1208-1213.

APPENDIX A

**SOIL BORING LOG FOR 11L009SB
(excerpted from LAW 1995)**

BEALE AIR FORCE BASE SOIL BORING RECORD

BORING # 11L009SB

ELEVATION (FEET MSU)	DEPTH (FEET)	DESCRIPTION	WL Symbol	Sample Interval (ppm)	REMARKS
125.6	0.0	FILL, sandy, silty, gravelly: (SM); dry; [FILL].			
		CLAY, sandy: (CL); medium grain sand; moist; brown (7.5YR 4/4); medium plasticity; few gravel to 40mm; [SDCL].			
120.6	5.0	GRAVEL, clayey: (GC); fine to medium gravel, well rounded; moist; matrix brown (7.5YR 4/4); gravels are varicolored to 30mm in diameter; [GVCL].			
		at 7 feet, becomes slightly silty; gravels are granitic.			
		CLAY: (CH); dark brown to black (10YR 2/2); slight petroleum odor; fat clay; [CLAY].			
115.6	10.0	GRAVEL, clayey: (GC); fine to medium gravel; moist; light gray (2.5Y 6/1); [GVCL].			
110.6	15.0	GRAVEL, slightly sandy, clean: (GW); fine to coarse gravel, subangular to subrounded; dry; light gray (2.5Y 7/1); strong petroleum odor; [GVL].			
105.6	20.0	SAND, slightly silty: (SP-SM); fine to medium grain sand; medium dense; moist; dark gray; nonplastic; strong petroleum odor; [SD].			
100.6	25.0	SAND, silty: (SM); very fine to fine grain sand; medium dense; moist; dark gray (N 4/4); few lenses of light brown clay; strong petroleum odor; [SDSL].			
95.6	30.0	GRAVEL, sandy, clean: (GP); medium grain gravel, well rounded; dense; dry; pinkish gray (5YR6/2); gravel to 50mm in diameter; slight petroleum odor; [GVL].			
		SILT, sandy: (ML); stiff; reddish brown (5YR 5/3); few gravel; [SDSL].			
		SAND, clean: (SP); fine to medium grain sand, rounded; medium dense; grayish brown (2.5Y 5/2); few cemented clasts; [SD].			
90.6	35.0				
85.6	40.0	SAND, clayey: (SC); fine to medium grain sand, rounded; dense; dry; brown (7.5Y 4/4); low plasticity [SDCL].			

COMMENTS:

DRILLED BY Water Development Corp.
METHOD: Sonic
BORING DIA: 4.8 inch
LOGGED BY EK
CHECKED BY CWV

PROJECT 2216-40004
DATE STARTED 02 SEP 94
DATE COMPLETED 02 SEP 94
NORTHING: 541486.94
EASTING: 2161159.70

BEALE AIR FORCE BASE SOIL BORING RECORD

BORING # 11L009SB

ELEVATION (FEET MSL)	DEPTH (FEET)	DESCRIPTION	WL Symbol	PID Sample (ppm) Interval	REMARKS
85.6	40.0	SC continued.		10	
		SAND, silty: (SM); fine to medium grain sand, rounded; dense; dry; grayish brown {10YR 5/2}; low plasticity; trace gravel to 20mm; [SDSL].			
		at 44 feet, increase in clay content; color changes to reddish brown.			
80.6	45.0				
		SAND, clean: (SP); medium grain sand; dense; dry; light gray {10YR 7/2}; [SD].			
		at 56 feet, increase in sand size; gravels to 30mm.			
75.6	50.0				
		SAND, gravelly, clean: (SW); medium to coarse grain sand; fine to medium gravel, subrounded to rounded; light gray {10YR 7/2}; gravel to 80mm in diameter; hornblende crystals; some granitic gravel; [SDGR].			
		at 60 feet, gravels are reddish and volcanic.			
		at 60.5 feet, sand is gray {N 6/1}; gravels are andesitic.		10	
		at 64 feet, becomes slightly moist.			
65.6	60.0				
		SAND, gravelly, clean: (SW); medium to coarse grain sand; fine to medium gravel, subrounded to rounded; light gray {10YR 7/2}; gravel to 80mm in diameter; hornblende crystals; some granitic gravel; [SDGR].			
		at 70 feet, encounter 2-5cm lense of dark reddish brown {5YR 3/4}.		7	
		at 73 feet, encounter 100mm granitic cobble.			
60.6	65.0				
		SAND, gravelly, clean: (SW); medium to coarse grain sand; fine to medium gravel, subrounded to rounded; light gray {10YR 7/2}; gravel to 80mm in diameter; hornblende crystals; some granitic gravel; [SDGR].			
		at 76 feet, becomes moist to wet; pocket of well graded sand.		6	
		at 77 feet decrease in moisture content; andesitic gravel to 60mm; increasing silt content.			
55.6	70.0				
		SAND, gravelly, clean: (SW); medium to coarse grain sand; fine to medium gravel, subrounded to rounded; light gray {10YR 7/2}; gravel to 80mm in diameter; hornblende crystals; some granitic gravel; [SDGR].			
		at 76 feet, becomes moist to wet; pocket of well graded sand.		6	
		at 77 feet decrease in moisture content; andesitic gravel to 60mm; increasing silt content.			
50.6	75.0				11L009SB-001SO
					Rig chatter, moderate drilling rate
45.6	80.0				

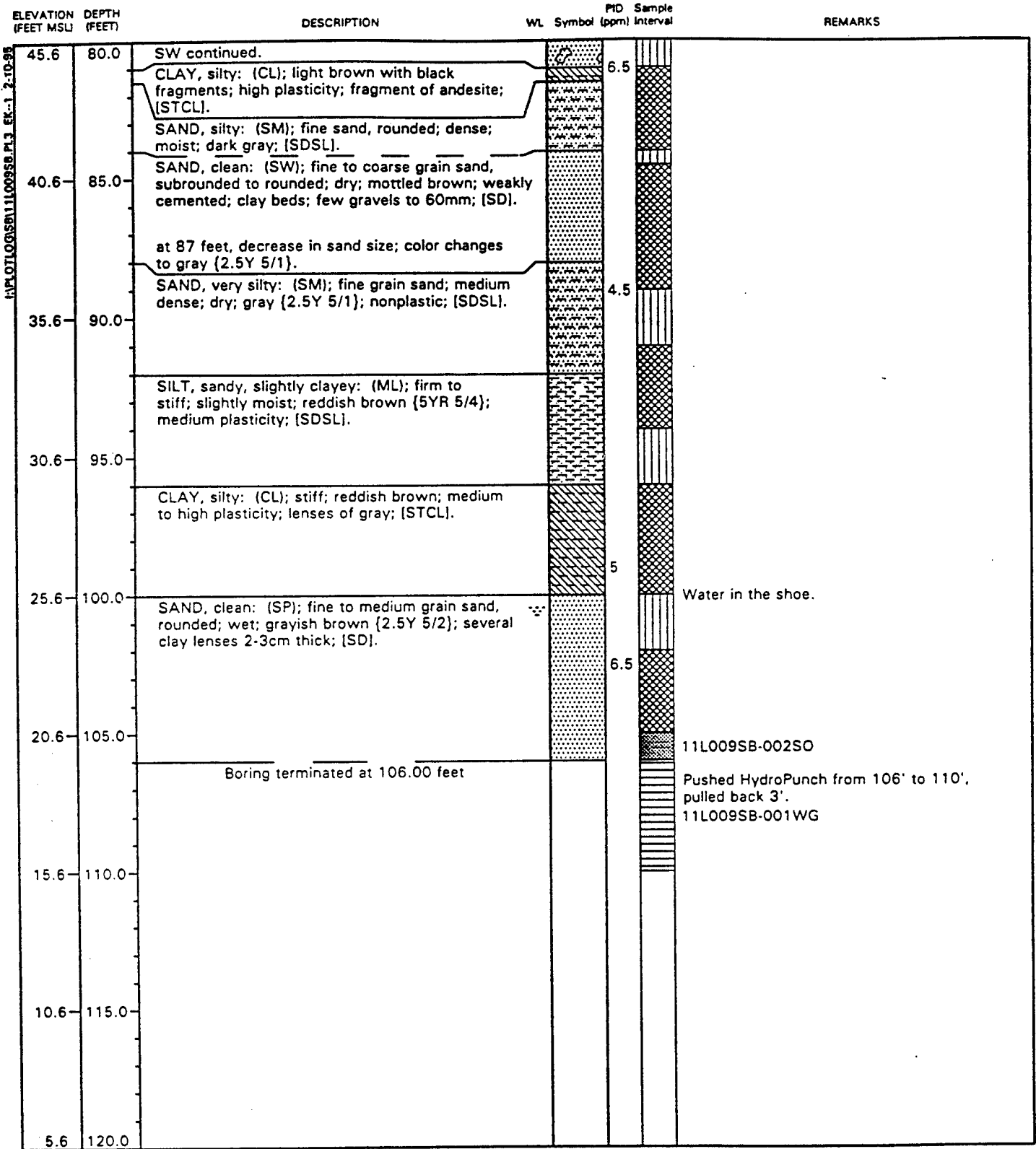
COMMENTS:

DRILLED BY Water Development Corp.
METHOD: Sonic
BORING DIA: 4.8 inch
LOGGED BY EK
CHECKED BY CWV

PROJECT 2216-40004
DATE STARTED 02 SEP 94
DATE COMPLETED 02 SEP 94
NORTHING: 541486.94
EASTING: 2161159.70

BEALE AIR FORCE BASE
SOIL BORING RECORD

BORING # 11L009SB



COMMENTS:
Borehole grouted from total depth to surface with cement/bentonite grout.

DRILLED BY Water Development Corp.
METHOD: Sonic
BORING DIA: 4.8 inch
LOGGED BY EK
CHECKED BY CWV

PROJECT 2216-40004
DATE STARTED 02 SEP 94
DATE COMPLETED 02 SEP 94
NORTHING: 541486.94
EASTING: 2161159.70

APPENDIX B

**SUMMARY OF RESULTS FROM
PREVIOUS SITE INVESTIGATIONS**

SUMMARY OF ORGANIC COMPOUNDS DETECTED IN SOIL VAPOR SAMPLES

Site Characterization Summary ITR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Location Number	Sample Number	Sample Date	Total Depth (ft bgs)	Sample Depth (ft bgs)	Detected Compound	Result (ppmv)
11L001VP	- 001SV	8/15/94	9.0	9.0	cis-1,2-DCE	0.38
					TCE	0.41
					PCE	0.33
					Benzene	0.15
					TPH	19
					TPH	31
11L002VP	- 001SV	8/15/94	5.0	5.0	TPH	16
11L003VP	- 001SV	8/15/94	5.5	5.5	TPH	0.02
11L004VP	- 001SV	8/15/94	5.5	5.5	trans-1,2-DCE	0.05
					TCE	22
					TPH	0.02
11L004VP	- 002SV	8/15/94	5.5	5.5	trans-1,2-DCE	0.05
					TCE	20
					TPH	0.22
11L005VP	- 001SV	8/15/94	4.5	4.5	trans-1,2-DCE	0.08
					cis-1,2-DCE	0.13
					TCE	25
					TPH	0.01
11L006VP	- 001SV	8/15/94	10.0	10.0	trans-1,2-DCE	0.02
					cis-1,2-DCE	0.01
					TCE	15
					TPH	5
11L007VP	- 001SV	8/15/94	6.5	6.5	TPH	0.27
11L008VP	- 001SV	8/15/94	7.0	7.0	1,1-DCE	7.64
					trans-1,2-DCE	23.36
					cis-1,2-DCE	2.81
					TCE	10.15
					Benzene	3.46
					Toluene	0.39
					Ethylbenzene	1.52
					Total Xylenes	1572
					TPH	

SUMMARY OF ORGANIC COMPOUNDS DETECTED IN SOIL VAPOR SAMPLES
 Site Characterization Summary ITIR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

Location Number	Sample Number	Sample Date	Total Depth (ft bgs)	Sample Depth (ft bgs)	Detected Compound	Result (ppmv)
11L009VP	- 001SV	8/16/94	10.0	10.0	1,1-DCE	0.50
					Methylene chloride	0.75
					cis-1,2-DCE	0.42
					1,2-DCA	5.80
					TCE	0.11
					Benzene	242.44
					Toluene	170.05
					Ethylbenzene	4.84
					Total Xylenes	17.83
					TPH	190,500
11L010VP	- 001SV	8/16/94	10.0	8.0	cis-1,2-DCE	0.09
					1,1,1-TCA	0.02
					1,1-DCA	0.05
					TCE	0.02
					PCE	0.01
					Benzene	6.30
					Toluene	2.45
					Ethylbenzene	0.14
					Total Xylenes	0.64
					TPH	1860
11L011VP	- 001SV	8/16/94	7.5	7.5	cis-1,2-DCE	0.10
					1,2-DCA	0.09
					TCE	0.04
					Benzene	8.55
					Toluene	5.02
					Ethylbenzene	0.12
					Total Xylenes	0.56
					TPH	21

SUMMARY OF ORGANIC COMPOUNDS DETECTED IN SOIL VAPOR SAMPLES
 Site Characterization Summary ITHR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

Location Number	Sample Number	Sample Date	Total Depth (ft bgs)	Sample Depth (ft bgs)	Detected Compound	Result (ppmv)
11L012VP	- 001SV	8/16/94	10.0	10.0	Benzene	0.22
					Toluene	0.22
					Total Xylenes	0.13
11L013VP	- 001SV	8/16/94	10.0	10.0	TPH	12
					Benzene	0.17
					Toluene	0.24
11L014VP	- 001SV	8/16/94	10.0	10.0	Ethylbenzene	0.02
					Total Xylenes	0.15
					TPH	11
11L015VP	- 001SV	8/16/94	10.0	10.0	trans-1,2-DCE	0.01
					cis-1,2-DCE	0.11
					1,2-DCA	0.16
					TCE	0.04
					Benzene	28.08
					Toluene	18.88
					Ethylbenzene	4.51
					Total Xylenes	17.16
					TPH	3,047
					Methylene chloride	0.03
11L016VP	- 001SV	8/16/94	10.0	10.0	1,2-DCA	0.02
					Benzene	4.54
					Toluene	4.49
11L017VP	- 001SV	8/16/94	10.0	10.0	Ethylbenzene	0.75
					Total Xylenes	4.65
					TPH	317
11L018VP	- 001SV	8/16/94	10.0	10.0	TPH	14
					TPH	3
					TPH	3
					Benzene	0.03
					Toluene	0.14
					Ethylbenzene	0.08
					Total Xylenes	0.73

SUMMARY OF ORGANIC COMPOUNDS DETECTED IN SOIL VAPOR SAMPLES
Site Characterization Summary IIR
Site 11, AGE Maintenance Area
Beale Air Force Base, California

Location Number	Sample Number	Sample Date	Total Depth (ft bgs)	Sample Depth (ft bgs)	Detected Compound	Result (ppmv)
11L019VP	- 001SV	8/16/94	10.0	10.0	TPH	7
					Benzene	0.10
					Toluene	0.29
					Ethylbenzene	0.63
11L020VP	- 001SV	8/16/94	10.0	10.0	Total Xylenes	5.41
					TPH	37
					TPH	5
					Benzene	70.58
					Toluene	1.57
11L021VP	- 001SV	8/16/94	4.5	4.5	Total Xylenes	0.25
					TPH	13.040
11L022VP	- 001SV	8/16/94	7.0	5.0	Benzene	6.56
					Toluene	0.61
					Ethylbenzene	0.91
11L023VP	- 001SV	8/16/94	9.0	9.0	Total Xylenes	3.72
					TPH	873
					TCE	0.23
					Benzene	114.72
					Toluene	80.12
11L024VP	- 001SV	8/17/94	8.0	8.0	Ethylbenzene	4.78
					Total Xylenes	19.02
					TPH	37,700
					Methylene chloride	0.15
					1,2-DCA	0.71
					TCE	0.02
					Benzene	259.65
					Toluene	87.14
					Total Xylenes	6.41
					TPH	106,000

SUMMARY OF ORGANIC COMPOUNDS DETECTED IN SOIL VAPOR SAMPLES

Site Characterization Summary ITIR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Location Number	Sample Number	Sample Date	Total Depth (ft bgs)	Sample Depth (ft bgs)	Detected Compound	Result (ppmv)
11L025VP	- 001SV	8/17/94	10.0	10.0	Benzene	0.07
					Toluene	0.13
					Ethylbenzene	0.05
					Total Xylenes	0.11
11L025VP	- 002SV	8/17/94	10.0	10.0	TPH	2
					Benzene	0.06
					Toluene	0.12
					Ethylbenzene	0.04
11L026VP	- 001SV	8/17/94	7.5	3.0	Total Xylenes	0.10
					TPH	3
					cis-1,2-DCE	0.03
					Benzene	0.23
11L027VP	- 001SV	8/17/94	6.0	5.5	Toluene	0.35
					Ethylbenzene	0.03
					Total Xylenes	0.18
					TPH	22
11L028VP	- 001SV	8/17/94	10.0	7.0	Benzene	0.04
					Toluene	0.02
					TPH	4
					TPH	4
11L029VP	- 001SV	8/17/94	10.0	10.0	1,2-DCA	0.04
					Benzene	4.18
					Toluene	2.23
					Ethylbenzene	0.05
11L031VP	- 001SV	9/14/94	9.0	9.0	Total Xylenes	0.20
					TPH	626
					TPH	1
					TPH	1
11L032VP	- 001SV	9/14/94	9.5	9.5	TPH	1
					TPH	1
11L035VP	- 001SV	9/14/94	9.0	9.0	TCE	0.01

SUMMARY OF ORGANIC COMPOUNDS DETECTED IN SOIL VAPOR SAMPLES
Site Characterization Summary ITIR
Site 11, AGE Maintenance Area
Beale Air Force Base, California

Location Number	Sample Number	Sample Date	Total Depth (ft bgs)	Sample Depth (ft bgs)	Detected Compound	Result (ppmv)
11L036VP	- 001SV	9/14/94	6.0	5.0	TCE	0.08
					Benzene	0.04
					Toluene	0.02
11L037VP	- 001SV	9/14/94	7.5	7.5	TPH	3
					Benzene	3.62
					Toluene	2.29
					Ethylbenzene	0.44
					Total Xylenes	0.64
11L037VP	- 002SV	9/14/94	7.5	7.5	TPH	355
					Benzene	3.77
					Toluene	1.45
					Ethylbenzene	0.27
					Total Xylenes	0.44
11L039VP	- 001SV	9/14/94	7.5	7.0	TPH	345
					TCE	0.01
					TPH	1

Prepared/Date: MRM/3-14-95
Checked/Date: KTL/3-14-95

Notes:

- Dichloroethane
- Dichloroethene
- Feet below ground surface
- Tetrachloroethene
- Parts per million by volume
- Soil vapor sample
- Trichloroethane
- Trichloroethene
- Total petroleum hydrocarbons
- Vapor point

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES
 Site Characterization Summary ITR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
Soil Boring Samples						
111.002SB-001SO	4.5 - 5.5	Lead	SW3050/SW7421	21	mg/kg	3
		THT-Diesel	SW3550/SW8015M-D	24	mg/kg	12
		Methylene chloride	SW8260	0.002 JB	mg/kg	0.002
111.002SB-002SO	9.5 - 10.5	Lead	SW3050/SW7421	8.9	mg/kg	3
		THT-Diesel	SW3550/SW8015M-D	2000	mg/kg	630
		JP-7	SW5550/SW8015M-D	2900	mg/kg	630
		Ethylbenzene	SW8260	5 JII	mg/kg	1
		Toluene	SW8260	9 JII	mg/kg	1
111.002SB-003SO	14.5 - 15.5	Xylenes (Total)	SW8260	39	mg/kg	1
		Lead	SW3050/SW7421	3.9	mg/kg	0.6
		JP-TS	SW3550/SW8015M-D	350	mg/kg	120
		THT-Gasoline	SW5030/SW8015M-G	610 J	mg/kg	1200
		Benzene	SW8260	0.02	mg/kg	0.02
		Ethylbenzene	SW8260	0.27	mg/kg	0.02
		Toluene	SW8260	0.56	mg/kg	0.02
Xylenes (Total)	SW8260	3.6	mg/kg	0.02		

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES

Site Characterization Summary ITR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
11L0025B-004SO	34.0 - 35.0	Lead	SW3050/SW7421	2.8	mg/kg	0.6
		Acetone	SW8260	0.016 JB	mg/kg	0.012
		Methylene chloride	SW8260	0.016 JB	mg/kg	0.002
11L0025B-005SO	39.0 - 40.5	Lead	SW3050/SW7421	8.7	mg/kg	3
		2-Hexanone	SW8260	0.015 J	mg/kg	0.011
		4-Methyl-2-Pentanone	SW8260	0.006 J	mg/kg	0.011
		Acetone	SW8260	0.052 JB	mg/kg	0.011
		Methylene chloride	SW8260	0.003 JB	mg/kg	0.002
		Xylenes (Total)	SW8260	0.001 J	mg/kg	0.002
11L0025B-006SO	45.0 - 46.0	Lead	SW3050/SW7421	3.3 J	mg/kg	0.5
		TPII-Gasoline	SW5030/SW8015M-G	0.56 J	mg/kg	1.0
		4-Methyl-2-Pentanone	SW8260	0.007 J	mg/kg	0.010
		Acetone	SW8260	0.011 JB	mg/kg	0.010
		Ethylbenzene	SW8260	0.002	mg/kg	0.002
		Methylene chloride	SW8260	0.006 JB	mg/kg	0.002
		Xylenes (Total)	SW8260	0.002	mg/kg	0.002

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES

Site Characterization Summary FTIR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
111.002SB-007SO	-46.0 - -47.0	Lead	SW3050/SW7421	8.9 J	mg/kg	3
		TFH-Gasoline	SW5030/SW8015M-G	0.64 J	mg/kg	1.1
		Acetone	SW8260	0.019 JB	mg/kg	0.011
		Methylene chloride	SW8260	0.012 JB	mg/kg	0.002
111.002SB-008SO	-47.0 - -48.0	Lead	SW3050/SW7421	7.4	mg/kg	3
		TFH-Diesel	SW3550/SW8015M-D	6.0 J	mg/kg	13
		TFH-Gasoline	SW5030/SW8015M-G	1.0 J	mg/kg	1.3
		2-Butanone	SW8260	0.016 JH	mg/kg	0.013
		Acetone	SW8260	0.045 JB	mg/kg	0.013
		Methylene chloride	SW8260	0.019 JB	mg/kg	0.002
111.002SB-009SO	-49.0 - 50.5	Lead	SW3050/SW7421	4.1	mg/kg	0.6
		Methylene chloride	SW8260	0.002 JB	mg/kg	0.002
		Xylenes (Total)	SW8260	0.003	mg/kg	0.002
111.002SB-010SO	62.0 - 63.0	Lead	SW3050/SW7421	3.2	mg/kg	0.6
		JP-1'S	SW3550/SW8015M-D	1200	mg/kg	110
		TFH-Gasoline	SW5030/SW8015M-G	760 J	mg/kg	1100

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES

Site Characterization Summary ITR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
111.002SB-010SO	62.0 - 63.0	Ethylbenzene	SW8260	1 JII	mg/kg	1
		Xylenes (Total)	SW8260	16 JII	mg/kg	1
111.003SB-001SO	98.5 - 100.0	Lead	SW3050/SW7421	5	mg/kg	0.6
111.004SB-001SO	101.5 - 102.5	Lead	SW3050/SW7421	3.6	mg/kg	0.6
111.005SB-001SO	91.0 - 91.9	Lead	SW3050/SW7421	8	mg/kg	3
		Methylene chloride	SW8260	0.002 JIB	mg/kg	0.002
111.005SB-002SO	94.9 - 95.6	Lead	SW3050/SW7421	7	mg/kg	3
		Methylene chloride	SW8260	0.004 JIB	mg/kg	0.002
111.006SB-001SO	94.5 - 95.5	Lead	SW3050/SW7421	6.5	mg/kg	1
		Acetone	SW8260	0.035 JIB	mg/kg	0.012
		Methylene chloride	SW8260	0.003 JIB	mg/kg	0.002
111.007SB-001SO	100.0 - 101.0	Lead	SW3050/SW7421	4.6	mg/kg	0.7
		Acetone	SW8260	0.008 JIB	mg/kg	0.013
111.008SB-001SO	74.5 - 75.5	Lead	SW3050/SW7421	1.6	mg/kg	0.6

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES

Site Characterization Summary FTIR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
111.008SB-001SO	74.5 - 75.5	Acetone	SW8260	0.007 JB	mg/kg	0.011
		Methylene chloride	SW8260	0.006	mg/kg	0.002
		Xylenes (Total)	SW8260	0.001	mg/kg	0.002
111.008SB-002SO	99.5 - 100.5	Lead	SW3050/SW7421	12	mg/kg	4
		1,2-Dichloroethane	SW8260	0.003	mg/kg	0.003
		2-Butanone	SW8260	0.002 R	mg/kg	0.016
		Acetone	SW8260	0.009 JB	mg/kg	0.016
		Methylene chloride	SW8260	0.01	mg/kg	0.003
111.009SB-001SO	74.5 - 75.5	Lead	SW3050/SW7421	19	mg/kg	3
		TFH-Diesel	SW3550/SW8015M-D	20	mg/kg	11
		Acetone	SW8260	0.009 J	mg/kg	0.011
		Methylene chloride	SW8260	0.003	mg/kg	0.002
111.009SB-002SO	105.0 - 106.0	Lead	SW3050/SW7421	4.4	mg/kg	0.8
		Acetone	SW8260	0.04 J	mg/kg	0.083
		Ethylbenzene	SW8260	0.04	mg/kg	0.02
		Methylene chloride	SW8260	0.02 JB	mg/kg	0.02

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES
Site Characterization Summary ITHR
Site 11, AGE Maintenance Area
Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
111.009SB-002SO	105.0 - 106.0	Toluene	SW8260	0.06	mg/kg	0.02
		Xylenes (Total)	SW8260	0.40	mg/kg	0.02
111.010SB-001SO	101.5 - 102.5	Lead	SW3050/SW7421	2.9 JL	mg/kg	0.6
111.011SB-001SO	98.5 - 99.5	Lead	SW3050/SW7421	4.5	mg/kg	0.6
111.012SB-001SO	88.5 - 89.5	Lead	SW3050/SW7421	4.5	mg/kg	0.6
111.013SB-001SO	5.0 - 6.0	Methylene chloride	SW8260	0.012	mg/kg	0.003
		Lead	SW3050/SW7421	29	mg/kg	6
		TFFI-Diesel	SW3550/SW8015M-D	100	mg/kg	12
111.013SB-002SO	15.0 - 16.0	2-Butanone	SW8260	0.027: JII	mg/kg	0.024
		Acetone	SW8260	0.10 JB	mg/kg	0.024
		Methylene chloride	SW8260	0.001 JB	mg/kg	0.004
		Lead	SW3050/SW7421	10	mg/kg	6
111.013SB-002SO	15.0 - 16.0	TFFI-Diesel	SW3550/SW8015M-D	38	mg/kg	11
		Acetone	SW8260	0.021 JB	mg/kg	0.011
111.013SB-002SO	15.0 - 16.0	Methylene chloride	SW8260	0.002 JB	mg/kg	0.002

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES

Site Characterization Summary IIR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
111.013SB-003SO	21.0 - 22.0	Lead	SW3050/SW7421	4.7	mg/kg	0.6
		Methylene chloride	SW8260	0.003 JB	mg/kg	0.002
111.013SB-004SO	25.0 - 26.0	Lead	SW3050/SW7421	4.3	mg/kg	0.6
		Methylene chloride	SW8260	0.005 JB	mg/kg	0.002
111.013SB-005SO	26.0 - 27.0	Lead	SW3050/SW7421	3.3	mg/kg	0.6
		TFH-Diesel	SW3550/SW8015M-1D	23	mg/kg	13
		Methylene chloride	SW8260	0.002 JB	mg/kg	0.002
111.013SB-006SO	30.0 - 31.0	Lead	SW3050/SW7421	2.8	mg/kg	0.6
		Acetone	SW8260	0.020 JB	mg/kg	0.013
111.013SB-007SO	35.0 - 36.0	Lead	SW3050/SW7421	7.1	mg/kg	6
		Acetone	SW8260	0.015 JB	mg/kg	0.012
111.013SB-008SO	45.0 - 46.0	Lead	SW3050/SW7421	3.6	mg/kg	0.6
		Methylene chloride	SW8260	0.001 JB	mg/kg	0.002
111.013SB-009SO	56.5 - 57.5	Lead	SW3050/SW7421	1.8	mg/kg	0.6
		Methylene chloride	SW8260	0.001 JB	mg/kg	0.002

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES

Site Characterization Summary ITHR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
11L013SB-010SO	60.5 - 61.5	Lead	SW3050/SW7421	2.1	mg/kg	0.6
Surface Soil Samples						
11L001SS-001SO	0.0 - 0.5	Lead	SW3050/SW7421	60	mg/kg	10
		TFH-Diesel	SW3550/SW8015M-D	520	mg/kg	100
		Acetone	SW8260	0.20 JL	mg/kg	0.051
		Methylene chloride	SW8260	0.006 JB	mg/kg	0.01
11L002SS-001SO	0.0 - 0.5	Lead	SW3050/SW7421	10	mg/kg	3
		TFH-Diesel	SW3550/SW8015M-D	81	mg/kg	12
11L003SS-001SO	0.0 - 0.5	Lead	SW3050/SW7421	10	mg/kg	3
		TFH-Diesel	SW3550/SW8015M-D	110	mg/kg	12
11L004SS-001SO	0.0 - 0.5	Lead	SW3050/SW7421	9	mg/kg	3
		TFH-Diesel	SW3550/SW8015M-D	18	mg/kg	13
11L005SS-001SO	0.5 - 0.8	Lead	SW3050/SW7421	30	mg/kg	5
		TFH-Diesel	SW3550/SW8015M-D	33	mg/kg	10
		Acetone	SW8260	0.037 JB	mg/kg	0.010

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES

Site Characterization Summary ITR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
111.005SS-001SO	0.5 - 0.8	Methylene chloride	SW8260	0.002 JB	mg/kg	0.002
111.006SS-001SO	0.2 - 0.7	Lead	SW3050/SW7421	48	mg/kg	10
		TFH-Diesel	SW3550/SW8015M-D	38	mg/kg	10
		2-Butanone	SW8260	0.009 J	mg/kg	0.020
		4-Methyl-2-Pentanone	SW8260	0.007 J	mg/kg	0.020
		Acetone	SW8260	0.091 J	mg/kg	0.020
		Ethylbenzene	SW8260	0.002 J	mg/kg	0.004
		Methylene chloride	SW8260	0.11 JB	mg/kg	0.004
		Toluene	SW8260	0.004 J	mg/kg	0.004
111.006SS-002SO	0.2 - 0.7	Lead	SW3050/SW7421	46	mg/kg	10
		TFH-Diesel	SW3550/SW8015M-D	44	mg/kg	10
		2-Butanone	SW8260	0.006 J	mg/kg	0.010
		Acetone	SW8260	0.042 J	mg/kg	0.010
		Methylene chloride	SW8260	0.008 JB	mg/kg	0.002
111.007SS-001SO	0.1 - 0.6	Lead	SW3050/SW7421	130	mg/kg	50
		TFH-Diesel	SW3550/SW8015M-D	72	mg/kg	11

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES
 Site Characterization Summary ITHR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDI
111.007SS-001SO	0.1 - 0.6	Acetone	SW8260	0.026 JH	mg/kg	0.011
		Methylene chloride	SW8260	0.002 JB	mg/kg	0.002
111.008SS-001SO	0.1 - 0.3	Lead	SW3050/SW7421	80	mg/kg	10
		TFH-Diesel	SW3550/SW8015M-D	260	mg/kg	110
111.009SS-001SO	0.2 - 0.7	Lead	SW3050/SW7421	200	mg/kg	60
		TFH-Diesel	SW3550/SW8015M-D	390	mg/kg	120
		4-Methyl-2-Pentanone	SW8260	0.005 J	mg/kg	0.012
		Methylene chloride	SW8260	0.025 JB	mg/kg	0.002
111.010SS-001SO	0.2 - 0.3	Lead	SW3050/SW7421	76	mg/kg	20
		TFH-Diesel	SW3550/SW8015M-D	380	mg/kg	180
		2-Butanone	SW8260	0.003 J	mg/kg	0.018
		Acetone	SW8260	0.076 J	mg/kg	0.018
		Methylene chloride	SW8260	0.007 JB	mg/kg	0.004
111.011SS-001SO	0.4 - 0.7	Lead	SW3050/SW7421	180	mg/kg	50
		TFH-Diesel	SW3550/SW8015M-D	69	mg/kg	10
		2-Butanone	SW8260	0.039 J	mg/kg	0.020

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES

Site Characterization Summary IIR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
11L011SS-001SO	0.4 - 0.7	Acetone	SW8260	0.11 J	mg/kg	0.020
		Methylene chloride	SW8260	0.029 JB	mg/kg	0.004

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN SOIL SAMPLES

Site Characterization Summary ITR

Site II, AGE Maintenance Area

Beale Air Force Base, California

Notes:

D = Diesel
G = Gasoline
mg/kg = Milligrams per kilograms
M = Modified

Data Qualifiers:

- J = The sample results are estimated. This qualifier is used in cases where a lack of precision is a cause for qualification. This may be caused by poor precision of the matrix spike and duplicate matrix spike, poor correlation of the initial calibration curve, or interference. Sample concentrations that are between the method detection limit and the reporting detection limit are qualified as estimated.
- JB = The sample results are estimated. Analytes detected in the sample are also detected in a method blank, equipment blank, trip blank, or ambient blank above the method detection limit. The sample concentration is less than ten times the blank concentration for common laboratory contaminants, or five times the amount for other compounds.
- JL = The sample results are estimated. This qualifier is used in cases where positive results are reported but the quality control checks indicate a low bias. The low bias may be indicated by low matrix spike recoveries, low surrogate recoveries, or low laboratory control standard recoveries that are outside of the acceptance criteria.
- JH = The sample results are estimated. This qualifier is when a high bias is indicated for positive results. High bias may be caused by high matrix spike recoveries, high surrogate recoveries, or high laboratory control standard recoveries that are outside of the acceptance limits.
- R = The sample results are rejected as unusable. Rejection of the sample results may be caused by very low or very high recoveries of the matrix spikes, surrogates, or laboratory control standards.

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN GROUNDWATER SAMPLES
 Site Characterization Summary ITIR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

Sample Number	Date Collected	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDI
Ground Water Samples 11A001MW-002WG	11/10/94	117.0 - 137.0	Lead	SW3020/SW7421	0.012	mg/L	0.005
			THH-Gasoline	SW5030/SW8015M-G	12 J	ug/L	50
			1,1,2,2-Tetrachloroethane	SW8260	12	ug/L	2
			Toluene	SW8260	0.6 J	ug/L	1
			Trichloroethene	SW8260	5	ug/L	1
111.001MW-001WG	10/21/94	95.1 - 115.1	Lead	SW3020/SW7421	0.002 J	mg/L	0.005
			1,1,1-Trichloroethane	SW3020/SW7421	0.004 J	mg/L	0.005
111.001MW-002WG	11/10/94	95.1 - 115.1	1,1,1-Trichloroethane	SW8260	0.5 U	ug/L	1
			Methylene chloride	SW8260	1 JB	ug/L	1
			Trichloroethene	SW8260	0.5 J	ug/L	1
111.002MW-001WG	10/21/94	94.6 - 114.6	Lead	SW3020/SW7421	0.004 J	mg/L	0.005
			THH-Gasoline	SW5030/SW8015M-G	8.2 J	ug/L	50
			1,1,2,2-Tetrachloroethane	SW8260	4	ug/L	2
			Chloroform	SW8260	1	ug/L	1
			Trichloroethene	SW8260	4	ug/L	1

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN GROUNDWATER SAMPLES

Site Characterization Summary FTIR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Sample Number	Date Collected	Sample Interval	Analyte	Preparation/		Concentration	Units	RDL
				Analytical Method	SW			
111.002MW-002WG	11/09/94	9-1.6 - 11-1.6	TFH-Gasoline	SW5030/SW8015M-G	330 J	ug/L	500	
			1,1,2,2-Tetrachloroethane	SW8260	12	ug/L	2	
			Chloroform	SW8260	0.6 J	ug/L	1	
			Ethylbenzene	SW8260	3	ug/L	2	
			Methylene chloride	SW8260	1	ug/L	1	
			Toluene	SW8260	22	ug/L	1	
			Trichloroethene	SW8260	4	ug/L	1	
			Xylenes (Total)	SW8260	48	ug/L	2	
			TFH-Gasoline	SW5030/SW8015M-G	290 J	ug/L	500	
			1,1,2,2-Tetrachloroethane	SW8260	13	ug/L	2	
111.002MW-003WG	11/09/94	9-1.6 - 11-1.6	Chloroform	SW8260	0.5 J	ug/L	1	
			Ethylbenzene	SW8260	2	ug/L	2	
			Toluene	SW8260	18	ug/L	1	
			Trichloroethene	SW8260	4	ug/L	1	
			Xylenes (Total)	SW8260	39	ug/L	2	
			Lead	SW3020/SW7421	0.004 J	mg/L	0.005	
			1,1,2,2-Tetrachloroethane	SW8260	6	ug/L	2	

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN GROUNDWATER SAMPLES
 Site Characterization Summary FTIR
 Site II, AGE Maintenance Area
 Beale Air Force Base, California

Sample Number	Date Collected	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
111.003MW-001WG	10/18/94	93.0 - 113.0	Methylene chloride	SW8260	1 JB	ug/L	1
			Trichloroethene	SW8260	2	ug/L	1
111.003MW-002WG	11/09/94	93.0 - 113.0	Lead	SW3020/SW7421	0.006 JII	mg/L	0.005
			Methylene chloride	SW8260	1	ug/L	1
			Trichloroethene	SW8260	1	ug/L	1
111.004MW-001WG	10/18/94	97.0 - 117.0	1,1,2,2-Tetrachloroethane	SW8260	3	ug/L	2
			Methylene chloride	SW8260	1 JB	ug/L	1
			Trichloroethene	SW8260	15	ug/L	1
111.004MW-002WG	11/09/94	97.0 - 117.0	1,1,2,2-Tetrachloroethane	SW8260	5	ug/L	2
			Trichloroethene	SW8260	10	ug/L	1
			trans-1,2-Dichloroethene	SW8260	0.5 J	ug/L	1
111.005MW-001WG	10/18/94	91.5 - 111.5	Lead	SW3020/SW7421	0.004 J	mg/L	0.005
			1,1,2,2-Tetrachloroethane	SW8260	3	ug/L	2
			Methylene chloride	SW8260	1 JB	ug/L	1
			Trichloroethene	SW8260	3	ug/L	1

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN GROUNDWATER SAMPLES
 Site Characterization Summary ITR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

Sample Number	Date Collected	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
111.005MW-002WG	10/18/94	91.5 - 111.5	Lead	SW3020/SW7421	0.003 J	mg/L	0.005
			1,1,2,2-Tetrachloroethane	SW8260	3	ug/L	2
			Methylene chloride	SW8260	2 JB	ug/L	1
			Trichloroethene	SW8260	3	ug/L	1
111.005MW-003WG	11/10/94	91.5 - 111.5	Lead	SW3020/SW7421	0.017	mg/L	0.005
			Methylene chloride	SW8260	1 JB	ug/L	1
			Trichloroethene	SW8260	2	ug/L	1
Groundwater Screening Samples							
111.003SB-001WG		107.0 - 110.0	TF11-Gasoline	SW5030/SW8015M-G	4.1 JB	ug/L	50
			2-Butanone	SW8260	5 J	ug/L	5
			Acetone	SW8260	20 J	ug/L	5
111.003SB-002WG		109.0 - 111.0	Lead	SW3020/SW7421	3	mg/L	0.2
			JP-TS	SW3520/SW8015M-D	1100	ug/L	250
111.004SB-001WG		108.0 - 113.0	Lead	SW3020/SW7421	0.22	mg/L	0.02
			TF11-Diesel	SW3520/SW8015M-D	820	ug/L	250
			TF11-Gasoline	SW5030/SW8015M-G	2.5 J	ug/L	50

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN GROUNDWATER SAMPLES
 Site Characterization Summary ITHR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
111.004SB-001WG	108.0 - 113.0	Acetone	SW8260	10 JB	ug/L	5
111.005SB-001WG	104.0 - 106.0	Lead	SW3020/SW7421	2.9	mg/L	0.5
		TFH-Diesel	SW3520/SW8015M-D	130 J	ug/L	250
		TFH-Gasoline	SW5030/SW8015M-G	480	ug/L	50
		Acetone	SW8260	10 JB	ug/L	5
		Ethylbenzene	SW8260	5	ug/L	2
		Methylene chloride	SW8260	1 JB	ug/L	1
		Toluene	SW8260	17	ug/L	1
		Trichloroethene	SW8260	2	ug/L	1
111.006SB-001WG	101.5 - 103.0	Xylenes (Total)	SW8260	56	ug/L	2
		Lead	SW3020/SW7421	1.5	mg/L	0.3
		TFH-Diesel	SW3520/SW8015M-D	550	ug/L	250
111.008SB-001WG	100.5 - 103.0	Acetone	SW8260	7 JB	ug/L	5
		Trichloroethene	SW8260	2	ug/L	1
		Lead	SW3020/SW7421	1.5	mg/L	0.3
		TFH-Diesel	SW3520/SW8015M-D	600	ug/L	250

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN GROUNDWATER SAMPLES

Site Characterization Summary FTIR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDI,
111.008SB-001WG	100.5 - 104.0	Acetone	SW8260	4 JB	ug/L	5
111.009SB-001WG	106.0 - 110.0	Lead	SW3020/SW7421	0.046	mg/L	0.005
		TFH-Diesel	SW3520/SW8015M-D	770	ug/L	250
		TFH-Gasoline	SW5030/SW8015M-G	9.7 J	ug/L	50
		Acetone	SW8260	14 JB	ug/L	5
111.010SB-001WG	102.5 - 105.5	Lead	SW3020/SW7421	0.072	mg/L	0.005
		TFH-Gasoline	SW5030/SW8015M-G	2.9 J	ug/L	50
		Acetone	SW8260	6 JB	ug/L	5
		Methylene chloride	SW8260	1 JB	ug/L	1
		Trichloroethene	SW8260	2	ug/L	1
111.011SB-001WG	103.0 - 111.0	Lead	SW3020/SW7421	0.4	mg/L	0.05
		TFH-Diesel	SW3520/SW8015M-D	590	ug/L	250
		TFH-Gasoline	SW5030/SW8015M-G	4.8 J	ug/L	50
		Acetone	SW8260	21 JB	ug/L	5
111.012SB-001WG	103.0 - 106.0	Lead	SW3020/SW7421	3.6	mg/L	0.5
		TFH-Diesel	SW3520/SW8015M-D	1900	ug/L	250

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN GROUNDWATER SAMPLES

Site Characterization Summary ITR
 Site II, AGE Maintenance Area
 Beale Air Force Base, California

Sample Number	Sample Interval	Analyte	Preparation/ Analytical Method	Concentration	Units	RDL
11L012SB-001WG	103.0 - 106.0	TPH-Gasoline	SW5030/SW8015M-G	9.5 J	ug/L	50
		Acetone	SW8260	9 JB	ug/L	5
11L014SB-001WG	96.0 - 102.0	Lead	SW3020/SW7421	0.14	mg/L	0.03
		TPH-Gasoline	SW5030/SW8015M-G	8.9 J	ug/L	50
		2-Butanone	SW8260	6 J	ug/L	5
		Acetone	SW8260	43 JB	ug/L	10

SUMMARY OF ORGANIC COMPOUNDS AND LEAD DETECTED IN GROUNDWATER SAMPLES

Site Characterization Summary ITIR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

Notes:

mg/L = Milligrams per liter
RDL = Reporting detection limit
ug/L = Micrograms per liter
M = Modified
D = Diesel
G = Gasoline

Data Qualifiers:

- U = Sample results are not detected. This qualifier is used in cases when analytes are not present above the method detection limit.
- J = The sample results are estimated. This qualifier is used in cases where a lack of precision is a cause for qualification. This may be caused by poor precision of the matrix spike and duplicate matrix spike, poor correlation of the initial calibration curve, or interference. Sample concentrations that are between the method detection limit and the reporting detection limit are qualified as estimated.
- JB = The sample results are estimated. Analytes detected in the sample are also detected in a method blank, equipment blank, trip blank, or ambient blank above the method detection limit. The sample concentration is less than ten times the blank concentration for common laboratory contaminants, or five times the amount for other compounds.
- JH = The sample results are estimated. This qualifier is when a high bias is indicated for positive results. High bias may be caused by high matrix spike recoveries, high surrogate recoveries, or high laboratory control standard recoveries that are outside of the acceptance limits.

SUMMARY OF ANALYTES DETECTED IN PREVIOUS SOIL INVESTIGATIONS

Site Characterization Summary ITR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

PARAMETER	METHOD	UNITS	11-1-S1		11-2-S1		11-2-S2		11-3-S1		11-3-S2		11-4-S1		11-4-S2	
			10/24/85	0.015	1.5'	10/24/85	0.033	6.5'	10/24/85	0.029	1.5'	10/24/85	0.031	6.5'	10/24/85	0.003
Methylene chloride	SW8010	mg/g	0.007	0.015	0.033	0.029	0.031	0.016	0.004	0.003	0.014	0.014	0.003	0.014	0.014	0.014
Trans 1,2-Dichloroethene	SW8010	mg/g	ND	ND	0.0002	0.0001	0.0004	0.0001	0.0004	ND	ND	ND	ND	ND	ND	ND
Chloroform	SW8010	mg/g	0.0007	0.001	0.006	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.0001	0.001	0.001
1,1,1-Trichloroethane	SW8010	mg/g	ND	ND	0.0001	ND	0.0001	ND	0.0001	ND	ND	ND	0.0001	0.0001	ND	ND
Trichloroethene	SW8010	mg/g	0.0001	0.0001	0.003	ND	0.005	ND	0.005	ND	ND	ND	ND	ND	ND	ND
Tetrachloroethane	SW8010	mg/g	ND	ND	ND	ND	0.002	ND	0.002	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	SW8010	mg/g	ND	ND	ND	ND	0.001	ND	0.001	ND	ND	ND	ND	ND	ND	ND
Dichlorobenzene	SW8020	mg/g	ND	ND	0.0005	ND	0.0055	ND	0.0055	0.0032	0.013	0.013	<0.02	0.013	0.013	0.013
Chlorobenzene	SW8020	mg/g	ND	ND	0.032	ND	0.001	ND	0.001	0.0006	0.004	0.004	3.4	0.004	0.004	0.004
Benzene	SW8020	mg/g	ND	ND	0.011	ND	0.0007	ND	0.0007	0.0015	0.0045	0.0045	1.6	0.0045	0.0045	0.0045
Toluene	SW8020	mg/g	ND	ND	0.034	ND	0.0014	ND	0.0014	0.0005	0.0015	0.0015	1.3	0.0015	0.0015	0.0015
Ethylbenzene	SW8020	mg/g	ND	ND	0.03	ND	0.0006	ND	0.0006	0.0003	0.0003	0.0003	2.4	0.0003	0.0003	0.0003
Xylenes	SW8020	mg/g	ND	ND	0.03	ND	0.0003	ND	0.0003	0.0002	0.0002	0.0002	1.6	0.0002	0.0002	0.0002
Phenols	SW8270	mg/g	<1	<1	1.6	<1	1	<1	1	<1	<1	<1	<1	<1	<1	<1
Oil and Grease	E413.2	mg/g	<100	<100	7000	<100	3900	<100	3900	<100	<100	<100	1500	<100	<100	<100

SUMMARY OF ANALYTES DETECTED IN PREVIOUS SOIL INVESTIGATIONS

Site Characterization Summary ITR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

PARAMETER	METHOD	UNITS	11-1-H1 0.5' 10/25/85	11-2-H1 0.5' 10/25/85	11-2-H12 1.5' 10/25/85	11-3-H1 0.5' 10/25/85	11-3-H2 1.5' 10/25/85	11-4-H1 0.5' 10/25/85	11-4-H2 1.5' 10/25/85
Methylene chloride	SW8010	mg/g	0.002	0.002	0.003	0.004	0.003	0.002	0.002
Chloroform	SW8010	mg/g	0.00057	0.00043	0.00069	0.00037	0.00042	0.00042	0.00039
1,1,1-Trichloroethane	SW8010	mg/g	0.00002	ND	ND	ND	ND	ND	ND
Chlorobenzene	SW8020	mg/g	ND	ND	ND	0.0003	ND	ND	ND
Toluene	SW8020	mg/g	ND	ND	ND	0.0003	ND	0.0002	0.0002
Ethylbenzene	SW8020	mg/g	0.0012	0.0021	0.0017	0.001	0.0011	0.0011	0.0008

SUMMARY OF ANALYTES DETECTED IN PREVIOUS SOIL INVESTIGATIONS
 Site Characterization Summary ITR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

PARAMETER	METHOD	UNITS	11-C-1SB		11-C-2SB		11-C-3SB		11-C-3SB f	
			1.5'	6.5'	1.5'	7.5'	1.5'	3.0'	1.5'	3.0'
TFH-Diescl	TFH-D1	mg/kg	ND	ND	ND	ND	84	ND	ND	ND
TFH-Gas	TFH-GA	mg/kg	ND	ND	32	ND	ND	ND	ND	ND
Methylene chloride	SW8010	mg/kg	ND	ND	ND	ND	0.053	0.050 a	0.009 a	0.009 a
Acetone	SW8240	mg/kg	0.036	0.025	0.008 b	0.025	0.053	0.35 a	0.035 a	0.035 a
Carbon Disulfide	SW8240	mg/kg	ND	ND	ND	ND	0.006 b	0.007 a	ND	ND
2-Butanone	SW8240	mg/kg	ND	ND	ND	0.095	0.012 b	0.027 a	0.012 b	0.012 b
Trichoroethene	SW8240	mg/kg	ND	ND	ND	ND	0.014	ND	ND	ND
Toluene	SW8240	mg/kg	0.047	0.030	0.056	0.063	0.14	0.017	0.065	0.065
N-nitrosodimethylamine	SW8270	mg/kg	ND	ND	ND	ND	0.063 b,R	0.077 b,R	0.093 b,R	0.093 b,R
Phenol	SW8270	mg/kg	2.1 a	2.3 a	ND	ND	ND R	ND R	ND R	ND R
N-nitrosodiphenylamine	SW8270	mg/kg	0.048 b	ND	ND	ND	ND R	ND R	ND R	ND R
Di-n-butylphthalate	SW8270	mg/kg	0.081 a,b	1.0 a	ND	0.18 b	ND R	ND R	ND R	ND R
bis(2-ethylhexyl)phthalate	SW8270	mg/kg	0.22 a,b	0.33 a,b	0.087 a,b	0.16 a,b	0.65 R	0.14 b,R	0.14 b,R	0.14 b,R

SUMMARY OF ANALYTES DETECTED IN PREVIOUS SOIL INVESTIGATIONS

Site Characterization Summary ITR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

PARAMETER	METHOD	UNITS	S1	S2	S3	S4	S5	S6	NW
			30'	30'	30'	30'	30'	30'	
			Jun-92	Jun-92	Jun-92	Jun-92	Jun-92	Jun-92	Jun-92
TPH-Gasoline	SW5030/801	mg/kg	NA	NA	NA	NA	NA	NA	ND
TPH-Diesel	SW3550/801	mg/kg	1500	1000	2800	920	2600	6000	2.4
Benzene	SW8020	mg/kg	9.5	0.15	48	4.0	9.8	28	ND
Toluene	SW8020	mg/kg	66	1.4	190	52	80	140	ND
Ethylbenzene	SW8020	mg/kg	45	0.98	83	18	41	51	ND
Total Xylenes	SW8020	mg/kg	250	5.3	400	120	230	250	ND

SUMMARY OF ANALYTES DETECTED IN PREVIOUS SOIL INVESTIGATIONS
 Site Characterization Summary ITR
 Site 11, AGE Maintenance Area
 Beale Air Force Base, California

PARAMETER	METHOD	UNITS	NEW	SWW	SEW	NWBC	SWBC
			10' Jun-92	5' Jun-92	30' Jun-92	15' Jun-92	10' Jun-92
TPH-Gasoline	SW5030/801	mg/kg	ND	6.0	ND	540	860
TPH-Diesel	SW3550/801	mg/kg	1.5	45	1.9	1300	1000
Benzene	SW8020	mg/kg	ND	ND	ND	2.4	1.7
Toluene	SW8020	mg/kg	ND	ND	ND	19	22
Ethylbenzene	SW8020	mg/kg	ND	ND	ND	8.6	11
Total Xylenes	SW8020	mg/kg	ND	0.55	ND	48	25

Prepared/Date: MRM/3-14-95
 Checked/Date: KTL/3-14-95

- Notes:
- mg/kg = Milligram per kilogram
 - NA = Not analyzed
 - ND = Not detected
 - TFH = Total fuel hydrocarbons
 - a = Analyte detected in blank
 - b = Estimated value, below quantification limit
 - R = Resampled on 05/03/89

Reference:
 Installation Restoration Program Stage 2-1, Remedial Investigation, CH2M HILL, January 1991

SUMMARY OF ANALYTES DETECTED IN PREVIOUS GROUNDWATER SAMPLING EVENTS

Site Characterization Summary ITR

Site 11, AGE Maintenance Area

Beale Air Force Base, California

PARAMETER	METHOD	UNITS	11A001MW Ref. 1 1/6/86	11A001MW Ref. 1 4/16/86	11A001MW Ref. 2 4/4/89	11A001MW Ref. 2 8/31/89	11A001MW r Ref. 2 8/31/89
Methylene chloride	SW8010/E601/8260	µg/L	0.6 ^a	ND	ND	ND	ND
Trichloroethene	SW8010/E601/8260	µg/L	0.4	ND	ND	ND	ND
Ethylbenzene	SW8010/E601/8260	µg/L	0.9	ND	ND	ND	ND
N-Nitrosodiphenylamine	SW 8270	µg/L	NA	NA	ND	5 c,d	7 c,d
Toluene	SW8020/E601/8260	µg/L	16 b	ND	1	ND	ND
Oil and Grease	E413.2	mg/L	3.3	7.2	ND	ND	NA
Phenols	E420.1	µg/L	<1	6	ND	ND	NA
TFH-Diesel	SW8015M	mg/L	NA	NA	NA	NA	NA
Calcium	SW 6010	mg/L	NA	NA	11.1	12.2	12.2
Iron	SW 6010	mg/L	NA	NA	ND	0.128	ND
Magnesium	SW 6010	mg/L	NA	NA	4.28	4.70	4.72
Sodium	SW 6010	mg/L	NA	NA	27.9	27.3	27.1
Potassium	SW 6010	mg/L	NA	NA	1	ND	ND

SUMMARY OF ANALYTES DETECTED IN PREVIOUS GROUNDWATER SAMPLING EVENTS
Site Characterization Summary ITIR
Site 11, AGE Maintenance Area
Beale Air Force Base, California

PARAMETER	METHOD	UNITS	11A001MW Ref. 3 11/11/92	11A001MW-311WL Ref. 4 8/26/93	11A001MW-321WL Ref. 5 12/2/93
Methylene chloride	SW8010/E601/8260	µg/L	NA	ND	ND
Trichloroethene	SW8010/E601/8260	µg/L	NA	ND	ND
Ethylbenzene	SW8010/E601/8260	µg/L	ND	ND	ND
N-Nitrosodiphenylamine	SW 8270	µg/L	ND	ND	ND
Toluene	SW8020/E601/8260	µg/L	ND	ND	ND
Oil and Grease	E413.2	mg/L	NA	NA	NA
Phenols	E420.1	µg/L	NA	4	NA
TFH-Diesel	SW8015M	mg/L	NA	ND	0.071 JB
Calcium	SW 6010	mg/L	NA	NA	NA
Iron	SW 6010	mg/L	NA	NA	NA
Magnesium	SW 6010	mg/L	NA	NA	NA
Sodium	SW 6010	mg/L	NA	NA	NA
Potassium	SW 6010	mg/L	NA	NA	NA

Prepared/Date: MBS/03-14-95
Checked/Date: KTL/03-14-95

Notes:
JB = Analyte detected in ambient blank

NA = Not analyzed

ND = Not detected

µg/L = Micrograms per liter

mg/L = Milligrams per liter

TPII = Total fuel hydrocarbons

a = Below normal laboratory background level

b = Confirmed by GC/MS Method 624

c = Analyte detected in blank

d = Estimated value, below quantification limit

References:

- 1 - Installation Restoration Program Stage 1, Phase II - Confirmation/Quantification, AeroVironment, Inc., May 1987
- 2 - Installation Restoration Program Stage 2-1, Remedial Investigation, CH2M HILL, January 1991
- 3 - Analytical Data Informal Technical Information Report, Basewide Groundwater Monitoring D.O. 2 Round 92-1, Law Environmental, Inc., December 1993
- 4 - Analytical Data Informal Technical Information Report, Basewide Groundwater Monitoring D.O. 17 Round 93-1, Law Environmental, Inc., April 1994
- 5 - Analytical Data Informal Technical Information Report, Basewide Groundwater Monitoring D.O. 17 Round 93-2, Law Environmental, Inc., April 1994