FINAL

Remediation by Natural Attenuation Treatability Study for Site SS-04



Langley Air Force Base
Virginia

Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base, Texas
San Antonio, Texas

and

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Virginia

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FINAL

REMEDIATION BY NATURAL ATTENUATION TREATABILITY STUDY FOR SITE SS-04

at

LANGLEY AIR FORCE BASE
VIRGINIA

SEPTEMBER 1999

Prepared for:

AIR FORCE CENTER FOR ENVIRONENTAL EXCELLENCE
TECHNOLOGY TRANSFER DIVISION
BROOKS AIR FORCE BASE
SAN ANTONIO, TEXAS

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TABLE OF CONTENTS

Page

EXECUTIVE SUMMARY ES-1

LIST OF ACRONYMS AND ABBREVIATIONS vii

SECTION 1 - INTRODUCTION 1-1

1.1 Scope and Objectives 1-1
1.2 Background 1-3
1.2.1 Base and Operational History 1-3
1.2.2 Previous Investigations and Remedial Activities 1-5

SECTION 2 - SITE CHARACTERIZATION ACTIVITIES 2-1

2.1 Cone Penetrometry 2-1
2.1.1 Evaluation of Stratigraphy 2-1
2.1.2 Investigation of Residual and Mobile Hydrocarbons 2-3
2.1.3 CPT Hole Abandonment 2-4
2.1.4 Equipment Decontamination 2-4
2.2 Soil Sampling and Monitoring Point Installation 2-4
2.2.1 Geoprobe® and Hand Auger Operation and Soil Sampling Procedures 2-7
2.2.1.1 Pre-Drilling Activities 2-7
2.2.1.2 Equipment Decontamination and Fluids Handling Procedures 2-7
2.2.1.3 Drilling and Soil Sampling 2-8
2.2.2 Monitoring Point Installation 2-9
2.2.2.1 Materials Decontamination 2-11
2.2.2.2 Casing and Screen 2-11
2.2.2.3 Filter Pack and Annular Sealant 2-11
2.2.3 Monitoring Point Development 2-12
2.3 Groundwater and lnapl Sampling 2-12
2.3.1 Preparation for Groundwater Sampling 2-12
2.3.2 Well/Point Purging and Sample Collection 2-13
2.3.3 On-Site Measurement of Chemical Parameters 2-14
2.3.4 Sample Handling 2-14
2.4 Storm Sewer Sampling 2-15
2.5 Aquifer Testing 2-15
2.6 Surveying 2-16

TABLE OF CONTENTS (Continued)

Page

SECTION 3 - PHYSICAL CHARACTERISTICS OF THE STUDY AREA 3-1

3.1 Surface Features 3-1
3.1.1 Topography and Surface Water Hydrology 3-1
3.1.2 Anthropogenic Features 3-2
3.2 Regional Geology and Hydrogeology 3-2
3.3 Site Geology and Hydrogeology 3-4
3.3.1 Lithology and Stratigraphic Relationships 3-4
3.3.2 Groundwater Hydraulics 3-4
3.3.2.1 Flow Direction and Gradient 3-4
3.3.2.2 Hydraulic Conductivity 3-17
3.3.2.3 Effective Porosity 3-17
3.3.2.4 Advective Groundwater Velocity 3-17
3.3.2.5 Preferential Flow Paths 3-17
3.3.3 Groundwater Use 3-19
3.4 Climate 3-19

SECTION 4 - SOIL AND GROUNDWATER GEOCHEMISTRY AND NATURE AND EXTENT OF CONTAMINATION 4-1

4.1 Sources of Contamination 4-1
4.2 Physical and chemical characteristics of Petroleum Fuels and Their Fate in The Environment 4-1
4.2.1 Chemical Composition of Petroleum-Based Fuels 4-1
4.2.2 Fate Of Hydrocarbon Compounds In The Environment 4-3
4.2.3 Toxicity Of Fuel Hydrocarbon Compounds 4-5
4.3 Fuel Constituents in Source-Area Soils 4-6
4.3.1 Mobile LNAPL Contamination 4-6
4.3.2 Residual Contamination 4-8
4.3.2.1 LIF Assessment of LNAPL 4-8
4.3.2.2 BTEX and Fuel Hydrocarbons in Soil Samples 4-10
4.3.3 Total Organic Carbon and Moisture Content 4-14
4.4 Groundwater Chemistry - October 1996 to October 1997 4-14
4.4.1 Dissolved Fuel Hydrocarbons 4-14
4.4.1.1 BTEX in Groundwater 4-14
4.4.1.2 TVH-G in Groundwater 4-26
4.4.1.3 Chlorobenzene in Groundwater 4-26
4.4.2 Inorganic Chemistry and Geochemical Indicators of BTEX Biodegradation 4-29
4.4.2.1 Dissolved Oxygen 4-32
4.4.2.2 Nitrate 4-41
4.4.2.3 Ferrous Iron 4-42
4.4.2.4 Sulfate 4-45
4.4.2.5 Ammonium 4-45

TABLE OF CONTENTS (Continued)

Page

4.4.2.6 Methane in Groundwater 4-48
4.4.2.7 Oxidation-Reduction Potential 4-53
4.4.2.8 Alkalinity 4-53
4.4.2.9 pH 4-58
4.4.2.10 Temperature 4-58
4.4.3 Expressed Assimilative Capacity 4-58
4.5 Estimation of First-Order Rate Constants 4-60
4.6 Inspection and Sampling of Storm Sewer System 4-60

SECTION 5 - CONTAMINANT TRANSPORT EVALUATION 5-1

5.1 Description of Bioscreen Model 5-1
5.2 Modeling Objectives 5-2
5.3 Conceptual Model Design and Limiting Assumptions 5-2
5.4 Initial Model Input Data 5-3
5.4.1 Groundwater Flow Velocity 5-3
5.4.2 Dispersivity 5-3
5.4.3 Retardation Due to Adsorption 5-3
5.4.4 Instantaneous Reaction Data 5-5
5.4.5 Source Data 5-7
5.5 Model Calibration 5-9
5.6 Sensitivity Analysis 5-9
5.7 Simulation of Remedial Alternatives 5-12
5.7.1 Simulation of Remediation by Natural Attenuation 5-12
5.7.2 Simulation of Second Remedial Alternative 5-12
5.8 Conclusions 5-14

SECTION 6 - COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES 6-1

6.1 Remedial Alternative Evaluation Criteria 6-1
6.1.1 Long-Term Effectiveness and Permanence 6-1
6.1.2 Implementability 6-2
6.1.3 Cost 6-2
6.2 Factors Influencing Development of Alternatives 6-2
6.2.1 Program Objectives 6-2
6.2.2 Contaminant Properties 6-3
6.2.3 Site-Specific Conditions 6-4
6.2.3.1 Groundwater and Soil Characteristics 6-4
6.2.3.2 Potential Exposure Pathways 6-5
6.2.3.3 Remediation Goals for Shallow Groundwater 6-6
6.2.4 Summary of Remedial Technology Screening 6-7
6.3 Brief Description of Remedial Alternatives 6-12
6.3.1 Alternative 1—RNA and Institutional Controls with Long-Term Monitoring 6-12

TABLE OF CONTENTS (Continued)

Page

6.3.2 Alternative 2—Biosparging Along the Axis of the Benzene Plume, RNA, and Institutional Controls with Long-Term Monitoring 6-12
6.4 Evaluation of Alternatives 6-13
6.4.1 Alternative 1—RNA and Institutional Controls with Long-Term Monitoring 6-13
6.4.1.1 Effectiveness 6-13
6.4.1.2 Technical and Administrative Implementability 6-13
6.4.1.3 Cost 6-15
6.4.2 Alternative 2—Biosparging Along the Axis of the Benzene Plume, RNA, and Institutional Controls with Long-Term Monitoring 6-16
6.4.2.1 Effectiveness 6-16
6.4.2.2 Technical and Administrative Implementability 6-16
6.4.2.3 Cost 6-17
6.5 Recommended Remedial Approach 6-17

SECTION 7 - LONG-TERM MONITORING PLAN 7-1

7.1 Overview 7-1
7.2 Monitoring Network and Sampling Frequency 7-1
7.3 Analytical Protocols 7-3
7.4 Reporting 7-3
7.5 Schedule 7-8
7.6 Periodic Review of LTM Results 7-8

SECTION 8 - CONCLUSIONS AND RECOMMENDATIONS 8-1

SECTION 9 - REFERENCES 9-1

APPENDICES

A - Data From Previous Investigations
B - Field Data Forms and Slug Test Data Analysis
C - Laboratory Analytical Data
D - Model Calculations and Input Parameters
E - Model Input and Output
F - Remedial Alternative Cost Calculations
G - Response to Comemnts

TABLE OF CONTENTS (Continued)

LIST OF TABLES

No.	Title	Page
2.1	Monitoring Point Completion Data	2-6
2.2	Analytical Protocol for Groundwater and Soil Samples	2-10
3.1	Hydrogeologic Units Underlying Langley AFB	3-3
3.2	Summary of Groundwater Level Measurements, 26-Sep-96	3-8
3.3	Summary of Groundwater Level Measurements, 4-Nov-96	3-9
3.4	Summary of Groundwater Level Measurements, 7-Oct-97	3-11
3.5	Summary of Vertical Gradients	3-16
3.6	Slug Test Results	3-18
4.1	Concentrations of BTEX Constituents in JP-4	4-7
4.2	1996 Soil Analytical Results	4-11
4.3	Groundwater and LNAPL Analytical Results	4-15
4.4	Coupled Oxidation Reactions for BTEX Compounds	4-30
4.5	Groundwater Geochemical data	4-33
4.6	Expressed Assimilative Capacity of Site Groundwater	4-59
5.3	Bioscreen Sensitivity Analysis Results	5-11
6.1	Potential Regulatory Standards for BTEX Compounds in Water	6-7
6.2	Initial Screening of Technologies and Process Options for Groundwater Remediation	6-8
6.3	Estimated Costs for Alternative 1 (RNA with LTM)	6-15
6.4	Estimated Costs for Alternative 2 (RNA with LTM Plus Biosparging)	6-18
6.5	Summary of Remedial Alternatives Evaluation	6-19
7.1	Long-Term Groundwater Monitoring Wells	7-4
7.2	Long-Term Groundwater and Surface Water Monitoring Analytical Protocol	7-5
7.3	LTM Sampling Overview and Quality Assurance Summary	7-7

LIST OF FIGURES

No.	Title	Page
1.1	Base Location Map	1-4
1.2	Base Map With Site Location	1-6
1.3	Site SS-04 Vicinity Map	1-7
1.4	Potential Sources of Fuel Contamination	1-8
2.1	Cone Penetrometry Locations, September 1995	2-2
2.2	Locations of Existing Wells and Monitoring Points	2-5
3.1	Location of Hydrogeological Cross-Sections	2-5
3.2	Hydrogeological Cross-Section A-A'	3-6
3.3	Hydrogeological Cross-Section B-B'	3-7

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

No.	Title	Page
3.4	Shallow Water Table Surface, November 4, 1996	3-13
3.5	Shallow Water Table Surface, October 7, 1997	3-14
4.1	Laser-Induced Fluorescence Data, September 1995	4-9
4.2	Total BTEX Concentrations in Soil	4-13
4.3	BTEX Isopleth Map for Shallow Groundwater, October-November 1996	4-25
4.4	BTEX Isopleth Map for Shallow Groundwater, October 1997	4-27
4.5	TVH-G Isopleth Map for Shallow Groundwater, October-November 1996	4-28
4.6	Dissolved Oxygen Isopleth Map for Shallow Groundwater, Oct-Nov 1996	4-39
4.7	Dissolved Oxygen Isopleth Map for Shallow Groundwater, October 1997	4-40
4.8	Ferrous Iron Isopleth Map for Shallow Groundwater, Oct-Nov 1996	4-43
4.9	Ferrous Iron Isopleth Map for Shallow Groundwater, October 1997	4-44
4.10	Sulfate Isopleth Map for Shallow Groundwater, October-November 1996	4-46
4.11	Sulfate Isopleth Map for Shallow Groundwater, October 1997	4-47
4.12	Ammonia as N Isopleth Map for Shallow Groundwater, Oct-Nov 1996	4-49
4.13	Ammonia as Nitrogen in Shallow Groundwater, October 1997	4-50
4.14	Methane Isopleth Map for Shallow Groundwater, October-November 1996	4-51
4.15	Methane Isopleth Map for Shallow Groundwater, October 1997	4-52
4.16	ORP Isopleth Map for Shallow Groundwater, October-November 1996	4-54
4.17	ORP Isopleth Map for Shallow Groundwater, October 1997	4-55
4.18	Alkalinity Isopleth Map for Shallow Groundwater, Oct-Nov 1996	4-56
4.19	Alkalinity Isopleth Map for Shallow Groundwater, October 1997	4-57
4.20	Natural Log of Benzene Concentration vs Time	4-61
4.21	Storm Sewer Survey Results, October 7, 1997	4-62
5.1	Bioscreen Isopleths for Shallow Groundwater and Bioscreen Source Zone Assumption - October 1997	5-8
5.2	BIOSCREEN Predicted Benzene Concentrations Along the Plume Centerline for Ten-Year Model Calibration	5-10
5.3	BIOSCREEN Concentrations in the Source Area for Remedial Alternatives 1 and 2	13
6.1	Conceptual Layout Of Biosparging System	6-14
7.1	Proposed Long-Term Monitoring Points	7-2

LIST OF ACRONYMS AND ABBREVIATIONS

$Atm\text{-}m^3/mol$	atmosphere-cubic meters per mole
[H+]	Hydrogen ion concentration
°C	Degrees Celsius
°F	Degrees Fahrenheit
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
ACC	Air Combat Command
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
ASCII	American Standard Code for Information Interchange
bgs	Below ground surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
$CaCO_3$	Calcium carbonate
cm/s	Centimeters per second
CO_2	Carbon dioxide
CPT	Cone penetrometry testing
DO	Dissolved oxygen
EAL	Evergreen Analytical Laboratory
EPA	US Environmental Protection Agency
ETC	Earth Technology Corp.
$Fe^{2+} + Fe^{3+}$	Total iron
Fe^{2+}	Ferrous iron
ft/day	Feet per day
ft/ft	Foot per foot
ft/yr	Feet per year
ft^2/day	Square feet per day
ΔG_r^0	Gibbs free energy
HDPE	High density polyethylene
HMTC	Hazardous Materials Technical Center
ID	Inside-diameter
IRP	Installation Restoration Program
JRRA	James R. Reed and Associates
K	Hydraulic conductivity
kg/L	Kilograms per liter
L/kg	Liters per kilogram
Law	Law Environmental, Inc.
LIF	Laser-induced fluorescence
LNAPL	Light nonaqueous phase liquid
LTM	Long-term monitoring
MCL	Maximum contaminant level
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
mm Hg	millimeters of mercury
Mn^{2+}	Manganese
msl	Mean sea level
mV	Millivolts
N_2	Nitrogen gas

NAPL	non-aqueous phase liquid
NH_3	Ammonia
nitrate-N	Nitrate as nitrogen
NO_3^{2-}	Nitrite
NO_3^{3-}	Nitrate
O&M	Operation and maintenance
OD	Outside-diameter
ORP	Oxidation-reduction potential
PAH	Polynuclear aromatic hydrocarbon
Parsons ES	Parsons Engineering Science, Inc.
PID	Photoionization detector
POC	Point of compliance
ppmv	Parts per million, volume per volume
PVC	Polyvinyl chloride
QC	Quality control
RAOs	Remedial action objectives
RAP	Remedial action plan
RNA	Remediation by natural attenuation
S^{2-}	Sulfide
SAP	Sampling and analysis plan
SO_4^{2-}	Sulfate
SU	Standard unit
TAC	Tactical Air Command
TEMB	Tetramethylbenzene
TMB	Trimethylbenzene
TOC	Total organic carbon
TPH	Total petroleum hydrocarbons
TS	Treatability study
TVH-G	Total volatile hydrocarbons-gasoline
USACE	United States Army Corps of Engineers
USAF	United States Air Force
UST	Underground storage tank
VOCs	Volatile organic compounds
WAR	Water and Air Research, Inc.

EXECUTIVE SUMMARY

This report presents the results of a treatability study for remediation by natural attenuation (RNA TS), completed by Parsons Engineering Science, Inc. (Parsons ES) at IRP Site SS-04, Langley Air Force Base (AFB),Virginia. The TS evaluates the use of natural attenuation with long-term monitoring (LTM) as a remedial option for dissolved hydrocarbon fuel constituents in groundwater. The occurrence of groundwater and soil contamination at the site, as a consequence of leakage of petroleum-based fuel (jet fuel or JP-4), has been documented during previous investigations. This TS focuses primarily on the impact of dissolved fuel constituents, in particular benzene, toluene, ethylbenzene, and xylene isomers (BTEX), in the groundwater system at, and downgradient from, the source area. Residual fuel hydrocarbon contamination in soil surrounding the source area (the abandoned USTs) was remediated from 1992 through 1996 with a vapor extraction system. The site history and the results of previously-completed soil and groundwater investigations are summarized in this report.

Soil and groundwater samples were collected from the site and analyzed to obtain the information necessary for the transport evaluation and RNA demonstration. Physical and chemical data collected under this program were supplemented (where necessary) with data collected during previous site characterization investigations and monitoring events.

Biodegradation of fuel hydrocarbons can occur when an indigenous population of hydrocarbon-degrading microorganisms is present in the subsurface, and sufficient concentrations of electron acceptors, nutrients, and electron donors (including fuel hydrocarbons) are available to these organisms. Several lines of chemical and geochemical evidence indicate that dissolved BTEX constituents are undergoing biodegradation within and downgradient from the contaminant source area. Potential electron acceptors, including dissolved oxygen (DO), nitrate, ferric iron, carbon dioxide, and sulfate are available at concentrations sufficient to facilitate microbial consumption of fuel hydrocarbons. The occurrence of biodegradation of fuel constituents, and the presence of conditions favoring biodegradation, are supported by the following evidence:

- In November 1996, the extent of dissolved BTEX constituents in groundwater covered a total area of approximately 214,300 square feet (4.9 acres); the estimated length of the major plume axis (northeast to southwest) was about 820 feet, and the estimated length of the minor axis (northwest to southeast) was about 400 feet. By October 1997, the areal extent of dissolved BTEX constituents had decreased dramatically, and covered a total area of approximately 79,300 square feet (1.8 acres), with the major axis approximately 600 feet in length, and the minor axis about 130 feet long.

- In addition to the marked decline in areal extent, total dissolved BTEX concentrations also decreased throughout the plume during the period between the October-November 1996 and October 1997 monitoring events. In 1996, the highest total BTEX concentration detected in groundwater was 1,806 µg/L; by

October 1997, the concentrations of total BTEX detected in the groundwater sample from the same monitoring point had declined to 7.4 μg/L.

- The areal distribution of electron donors and electron acceptors provides strong qualitative evidence of microbial consumption of BTEX compounds. In general, areas at the site within which elevated concentrations of BTEX constituents are present in groundwater coincide with areas containing low DO, low concentrations of sulfate, and elevated concentrations of ferrous iron, ammonium, and methane.

- Additional indicators, such as oxidation/reduction potential (ORP), alkalinity, and ammonia further confirm that biodegradation reactions are occurring.

- The decline in concentrations of the BTEX constituents that occurred between November 1996 and October 1997 was evaluated to estimate the rate of biodegradation. The estimated degradation rates indicate that the total mass of BTEX compounds in the subsurface decreases by up to 1 percent every day.

In order to evaluate the possible future migration and fate of BTEX constituents dissolved in groundwater, the fate and transport of dissolved benzene was simulated using the screening-level model BIOSCREEN. The predictive model was developed using site-specific geologic, hydrologic, and laboratory analytical data, and conservative assumptions about governing physical and chemical processes, to predict the future extent and concentrations of dissolved constituents by simulating the combined effects of advection, dispersion, adsorption, and biodegradation. The results of simulations indicate that benzene will probably not migrate in groundwater further than about 100 feet from the source area. Under the most likely conditions, concentrations of benzene in the source area will decline to below its MCL as a consequence of natural processes in about 23 years. However, the predicted timeframe to achieve the benzene MCL of 5 μg/L is probably conservative because the model does not simulate the beneficial effects of nitrogen fixation and source biodegradation. The sensitivity analysis indicated that the selected model input parameters were reasonable, and the model predictions are believed to be useful approximations that can be used to assist in selecting an appropriate remedial approach.

Following a screening of technologies and process options, two alternatives were retained for further evaluation. Remedial Alternative 1 incorporates RNA and institutional controls with long-term groundwater monitoring. Alternative 2 retains all the elements of Alternative 1 and includes biosparging along the axis of the BTEX plume near the source area.

The potential effectiveness of biosparging at Site SS-04 also was simulated conceptually using the BIOSCREEN model. The results of these calculations indicate that, if biosparging is implemented at Site SS-04, the concentrations of benzene in groundwater beneath the site will probably decrease below the MCL within 8 years.

Implementation of Alternative 1 (RNA, institutional controls, and LTM) is recommended, because Alternative 1 will probably be nearly as effective as Alternative 2 in removing BTEX constituents from groundwater, and retains a significant cost advantage. Available data indicate that the magnitude and extent of the dissolved

BTEX plume is decreasing west, southwest, and south (downgradient) of the source area. Although groundwater beneath Langley AFB is not currently used as a source of potable water, model results suggest that drinking-water standards may be met in the source area by the year 2020. Periodic sampling and analysis of groundwater at the site will enable the continued effectiveness of RNA to be evaluated, and allow assessment of whether additional remedial measures should be considered or implemented; a monitoring plan was developed to address the requirements of LTM to be conducted as part of RNA. If the results of LTM through time demonstrate that the plume continues to recede, then the frequency of LTM could potentially be reduced.

SECTION 1

INTRODUCTION

This report was prepared by Parsons Engineering Science, Inc. (Parsons ES) and presents the results of a treatability study (TS) conducted to evaluate the use of remediation by natural attenuation (RNA) for groundwater contaminated by fuel hydrocarbons at Installation Restoration Program (IRP) Site SS-04 [a former military underground storage tank (UST) site] at Langley Air Force Base (AFB, the Base), in Hampton, Virginia. The results of previous investigations indicated that fuel hydrocarbons had been released into the soil and shallow groundwater at the site.

As used throughout this report, the term "remediation by natural attenuation" refers to a subsurface contaminant management strategy that relies on natural physical, chemical, and biological mechanisms to control exposure of potential receptors to contaminants in soils and groundwater at concentrations that exceed regulatory levels. Potential mechanisms which can facilitate RNA of a variety of anthropogenic chemicals include the processes of advection, dispersion, dilution due to recharge, sorption, volatilization, and biodegradation.

1.1 SCOPE AND OBJECTIVES

Parsons ES was retained by the United States Air Force Center for Environmental Excellence (AFCEE) to conduct site characterization and groundwater modeling to evaluate if RNA with long-term monitoring (LTM) would be a scientifically defensible remedial option for contaminated groundwater at IRP Site SS-04.

The intent of the RNA demonstration program sponsored by AFCEE is to develop a systematic process for scientifically investigating and documenting naturally-occurring subsurface attenuation processes that can be incorporated into overall site remediation plans. The objective of the program and this specific study at Langley AFB is to provide sound evidence of natural attenuation of dissolved fuel hydrocarbons in groundwater so that this information can be used by the Base and its prime environmental contractor(s) to develop an effective, and cost-effective, groundwater remediation strategy. As a result, these studies are not necessarily intended to fulfill specific federal or state requirements regarding site assessments, remedial action plans, or other mandated investigations and reports. A secondary goal of this multi-site initiative is to provide a database containing information from multiple sites that demonstrates that natural processes of contaminant degradation can reduce contaminant concentrations in groundwater to acceptable cleanup standards before potential receptor exposure pathways are completed.

The scope of work for this project included the following tasks:

- Reviewing existing hydrogeologic, soil, and groundwater quality data for the site;
- Conducting supplemental site characterization activities to assess the nature and extent of fuel hydrocarbon compounds in soil and groundwater, and to collect geochemical data to evaluate whether subsurface conditions favored RNA;
- Developing a conceptual hydrogeologic model of the shallow saturated zone, including the current distribution of contaminants in the subsurface;
- Determining whether processes of contaminant attenuation and destruction are occurring naturally in groundwater at the site;
- Simulating the fate and transport of fuel hydrocarbons [benzene, toluene, ethylbenzene, and xylenes (BTEX)] in groundwater under the influence of advection, dispersion, sorption, and biodegradation, using the analytical fate and transport screening model BIOSCREEN;
- Evaluating a range of model input parameters to determine the sensitivity of the model to those parameters and to consider several contaminant fate and transport scenarios;
- Evaluating whether naturally-occurring attenuation processes are sufficient to minimize BTEX plume expansion so that groundwater quality standards can be met at a downgradient point of compliance (POC);
- Developing remedial action objectives (RAOs) and reviewing available remedial technologies;
- Using the results of the analysis to identify an appropriate remedial option based on specific effectiveness, implementability, and cost criteria; and
- Providing a LTM plan that includes LTM well locations and a sampling and analysis plan (SAP).

Site characterization activities in support of this RNA TS, completed by Parsons ES in October and November 1996 and October 1997, included using the Geoprobe® system for soil sample collection and monitoring point installation; using a hand auger for collection of soil samples and installation of monitoring points; aquifer testing; and collection and analysis of groundwater samples from newly-installed monitoring points and existing monitoring wells. Results from a Cone Penetrometry Testing (CPT) investigation coupled with Laser-Induced Fluorescence (LIF) conducted by the United States Army Corps of Engineers (USACE) in September 1995 provided additional information regarding subsurface hydrogeology and the distribution of fuel constituents.

Site-specific data were used to simulate the fate and transport of benzene at the site using the analytical solute transport model BIOSCREEN. The BIOSCREEN model was used to simulate the movement of dissolved benzene in the shallow saturated zone under the influence of advection, dispersion, sorption, and biodegradation. Model

results were used to help assess the potential for completion of receptor exposure pathways involving groundwater, and to identify whether natural attenuation with LTM is an appropriate and defensible remedial option for contaminated groundwater.

Much of the hydrogeologic and groundwater chemical information from previous investigations conducted at this site was not available. The field work conducted under this program was oriented toward the collection of supplementary hydrogeologic and chemical data necessary to assess the extent of fuel hydrocarbons in soil and groundwater, and to document and simulate the effectiveness of RNA with LTM for groundwater containing fuel hydrocarbons.

This report contains nine sections, including this introduction, and six appendices. Section 2 summarizes site characterization activities. Section 3 summarizes the physical characteristics of the study area. Section 4 describes the nature and extent of soil and groundwater contamination and the geochemistry of soil and groundwater at the site. Section 5 describes the conceptual model for this site and the design of the BIOSCREEN model, lists model assumptions and input parameters, and describes sensitivity analyses and model output. Section 6 develops and presents a limited comparative analysis of remedial alternatives. Section 7 presents the LTM plan for the site, and Section 8 presents the conclusions of this work. The references used to develop this document are listed in Section 9. Appendix A contains pertinent figures and tables containing information collected during previous site investigations (Hazardous Materials Technical Center [HMTC], 1987; Law Environmental, Inc [Law], 1991). Appendix B contains Geoprobe® borehole logs; records of monitoring point installation, development and sampling; and slug test results. Appendix C presents analytical results for soil and groundwater samples. Appendix D contains calculations and model input parameters, and Appendix E contains BIOSCREEN model input and output in spreadsheet (EXCEL®) format on a diskette. Appendix F contains remedial alternative design and cost calculations.

1.2 BACKGROUND

The operational history of Langley AFB and IRP Site SS-04, and the results of previous environmental investigations at the site, are summarized below. Operational history information was derived primarily from reports prepared by Law (1991) and Water and Air Research (WAR, 1985).

1.2.1 Base and Operational History

Langley AFB is located in Hampton in southeastern Virginia. The Base covers approximately 2,900 acres and is located within the outer coastal plain physiographic province of Virginia (Figure 1.1). The Base is bordered by the city of Hampton on the south, the city of Poquoson on the north, and the city of Newport News approximately one mile to the west. Norfolk is approximately 12 miles south-southeast of the Base. The Back River forms the northeastern and southeastern borders of the Base and discharges into Chesapeake Bay, approximately 3 miles east of the Base. Predominant land uses outside of Langley AFB are residential, light industrial, and commercial.

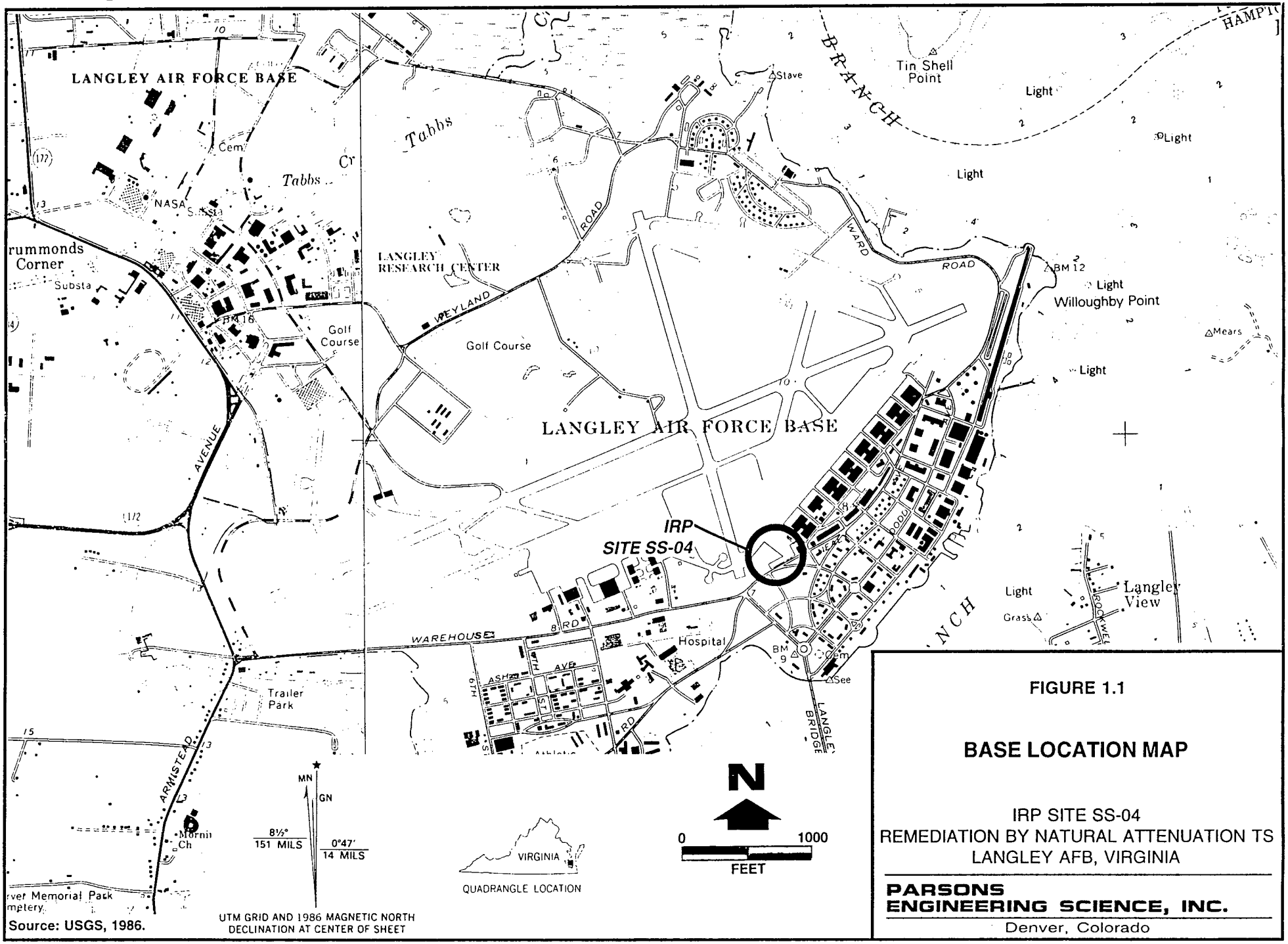


FIGURE 1.1

BASE LOCATION MAP

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

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Langley Field, the predecessor of Langley AFB, became operational in 1917. The mission of Langley Field varied throughout its period of operation. Langley Field officially became Langley AFB in January 1948, shortly after the formation of the US Air Force (USAF) Tactical Air Command (TAC) at the Field. Langley AFB became the headquarters for the USAF Air Combat Command (ACC) in June 1992, after the TAC was inactivated during USAF restructuring (USAF, 1993). The 1st Fighter Wing under the ACC is the host unit at Langley AFB. The primary mission of the Wing is to maintain rapid combat capability for rapid global deployment to conduct air superiority operations (USAF, 1994). Approximately 9,000 permanent military personnel are assigned to Langley AFB, and about 3,000 civilians are employed at the Base (USAF, 1993).

IRP Site SS-04 (the Site) is located along Sweeny Avenue near the intersection with Cook Avenue, in the southeastern part of the Base (Figures 1.2 and 1.3). The site is the location of an abandoned UST farm that was formerly used to store JP-4 aviation fuel. Previously, twenty-four 25,000-gallon underground fuel storage tanks were in operation at the site. The tanks were positioned in two groups of 12, north of Sweeny Avenue and southwest of Building 764 (Figure 1.4). The tanks were a part of the Base fuel distribution system that also included the JP-4 jet fuel transfer line and fuel distribution pipelines running north from the UST system toward the flight line (Figure 1.4). All 24 tanks were abandoned in 1987 by cleaning the tanks and backfilling them with a sand-cement slurry; the 6-inch diameter steel JP-4 fuel transfer pipeline is reported to have been abandoned in 1990 (V. Bartels, oral comm., August 7, 1998). It is not clear whether the fuel distribution pipelines that ran north from the tank field to the flight line are still in place. Leaks in the former tanks and the JP-4 distribution and transfer pipelines appear to have been the source of fuel contamination at the site.

1.2.2 Previous Investigations and Remedial Activities

In 1981, CH2M Hill (1981) performed a record search for IRP Site SS-04 and identified the site as a "possible fuel-saturated area." Based on the results of that evaluation, the following studies were conducted:

- A site confirmation and quantification assessment that included the installation of nine groundwater monitoring wells (S-4A through S-4I, which were subsequently destroyed) in which free product and dissolved-phase hydrocarbon fuels were detected (WAR, 1985).

- An organic soil vapor survey that characterized the extent of fuel contamination on the basis of soil gas samples from 44 auger holes [Earth Technology Corp. (ETC), 1986]. The survey also evaluated fire and explosion hazards by sampling for organic vapors at 32 locations, including storm sewers, electrical utility manholes, open excavations, monitoring wells, and auger holes. Potentially explosive conditions were identified at four locations.

- A Remedial Action Plan (RAP) that identified potential and actual hazards and evaluated remedial alternatives on the basis of previous investigation results (HMTC, 1987).

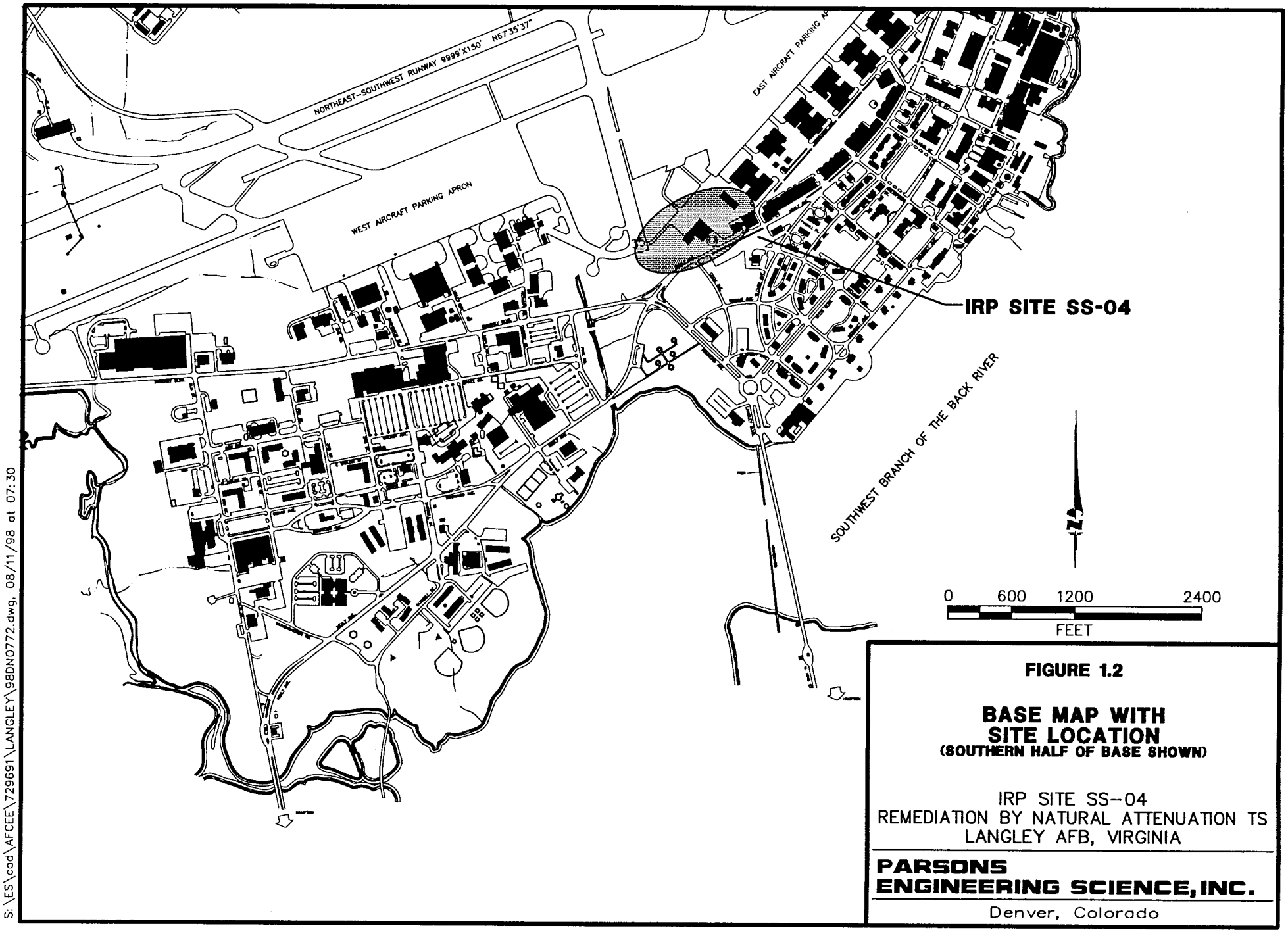


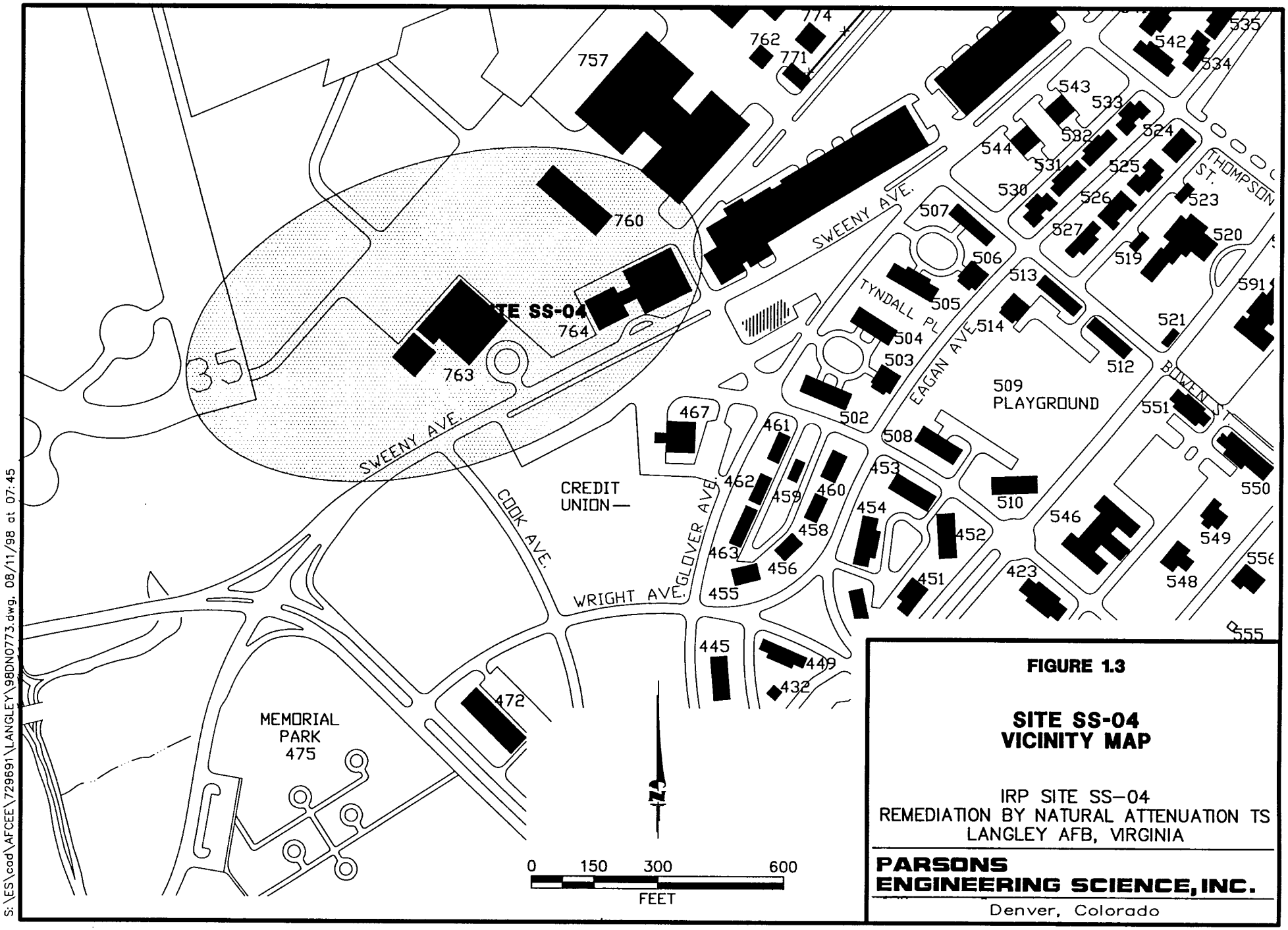
FIGURE 1.2

BASE MAP WITH SITE LOCATION
(SOUTHERN HALF OF BASE SHOWN)

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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FIGURE 1.3

SITE SS-04
VICINITY MAP

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

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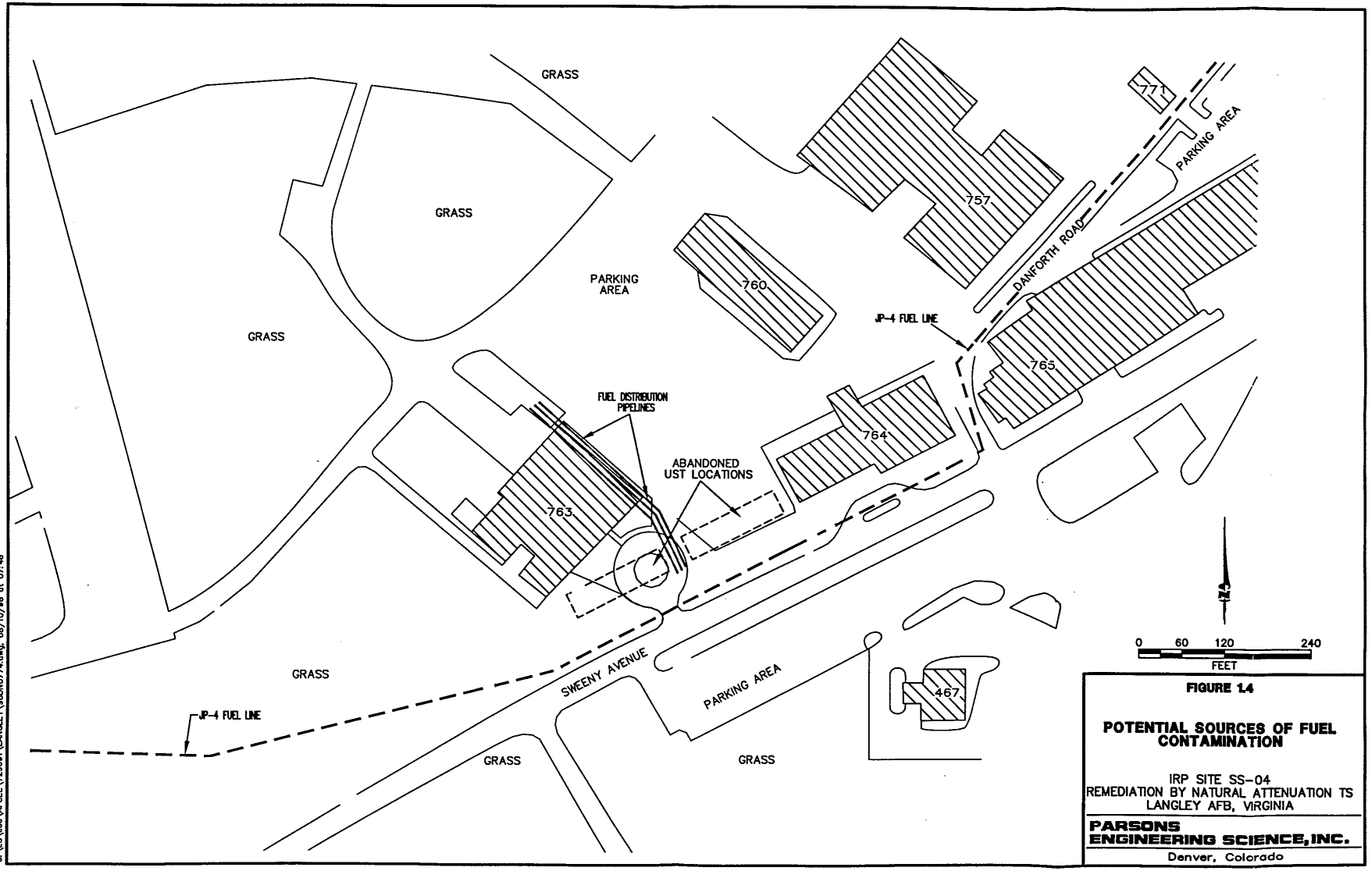


FIGURE 1.4

POTENTIAL SOURCES OF FUEL CONTAMINATION

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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- A hydrogeologic investigation, which included the installation of 15 monitoring wells (wells OW-1 through OW-15) to further delineate the floating and dissolved fuel plume (ETC, 1988) and aquifer testing to evaluate the hydraulic characteristics of subsurface materials.

- Two rounds of groundwater sampling and chemical analysis of groundwater samples from monitoring wells in 1988 [James R. Reed and Associates (JRRA), 1988].

- Investigations to support development of a Corrective Action Plan (CAP), including installation and development of monitoring wells (wells OW-102 through OW-107); measurement of depth to free product and to groundwater in wells; collection of soil samples, and chemical and geotechnical analyses; groundwater sampling and analysis; and slug testing of wells (Law, 1991). The CAP recommended a system of 15 vacuum-extraction recovery wells to lower the water table and recover free-phase fuel. The system installed in 1992 included 16 recovery wells connected to a main header pipe that discharged into a vacuum decanter tank. Water from the decanter was further treated with an oil/water separator and an air stripper. Air stripper effluent was discharged to a storm sewer.

- Monthly progress reports detailing the effectiveness of the fuel recovery system. These reports were submitted by Parsons ES (1995b, 1995c, 1995d, 1996b, and 1996c) from the time the system was placed in operation (July 1992) until the system was voluntarily shut down in April 1996. Reports included results of:

  - Monitoring of air stripper influent and effluent for BTEX and pH;

  - Final effluent monitoring for BTEX, total petroleum hydrocarbons (TPH), total lead, oil and grease, pH, and discharge quantities;

  - Measurement of free-product thickness and groundwater elevations; and

  - Analyses of groundwater samples collected from selected wells on a quarterly basis.

The system was shut down after nearly nondetectable BTEX concentrations were reported in the air-stripper influent through a two-year period. Over the operational period, a significant decrease in thickness of mobile light nonaqueous phase liquid (LNAPL) was observed; however, the areal extent of mobile LNAPL apparently increased. Additional details regarding the areal extent of fuel hydrocarbons are presented in Section 4 of this RNA TS.

SECTION 2

SITE CHARACTERIZATION ACTIVITIES

This section discusses the methods used by Parsons ES to collect site-specific data at IRP Site SS-04, Langley AFB, Virginia, and describes the conduct and results of the CPT/LIF investigation completed by the USACE in September 1995. To meet the objectives of the RNA demonstration, additional data were required to evaluate near-surface geology, aquifer properties, and the current extent of fuel constituents in soil and groundwater. Site-characterization activities included performing CPT with LIF, and soil sampling and installation of groundwater monitoring points using the Geoprobe® direct-push system or a hand auger. Groundwater samples were collected from newly-installed monitoring points and previously-installed monitoring wells. Well-displacement ("slug") tests were conducted at several of the previously-installed monitoring wells to evaluate the hydraulic conductivity of earth materials below the water table. Previously-collected data were integrated with data collected during the current program to develop the conceptual site model and to aid in interpretation of the hydrogeologic setting (Section 3) and distribution of fuel hydrocarbons in the subsurface (Section 4).

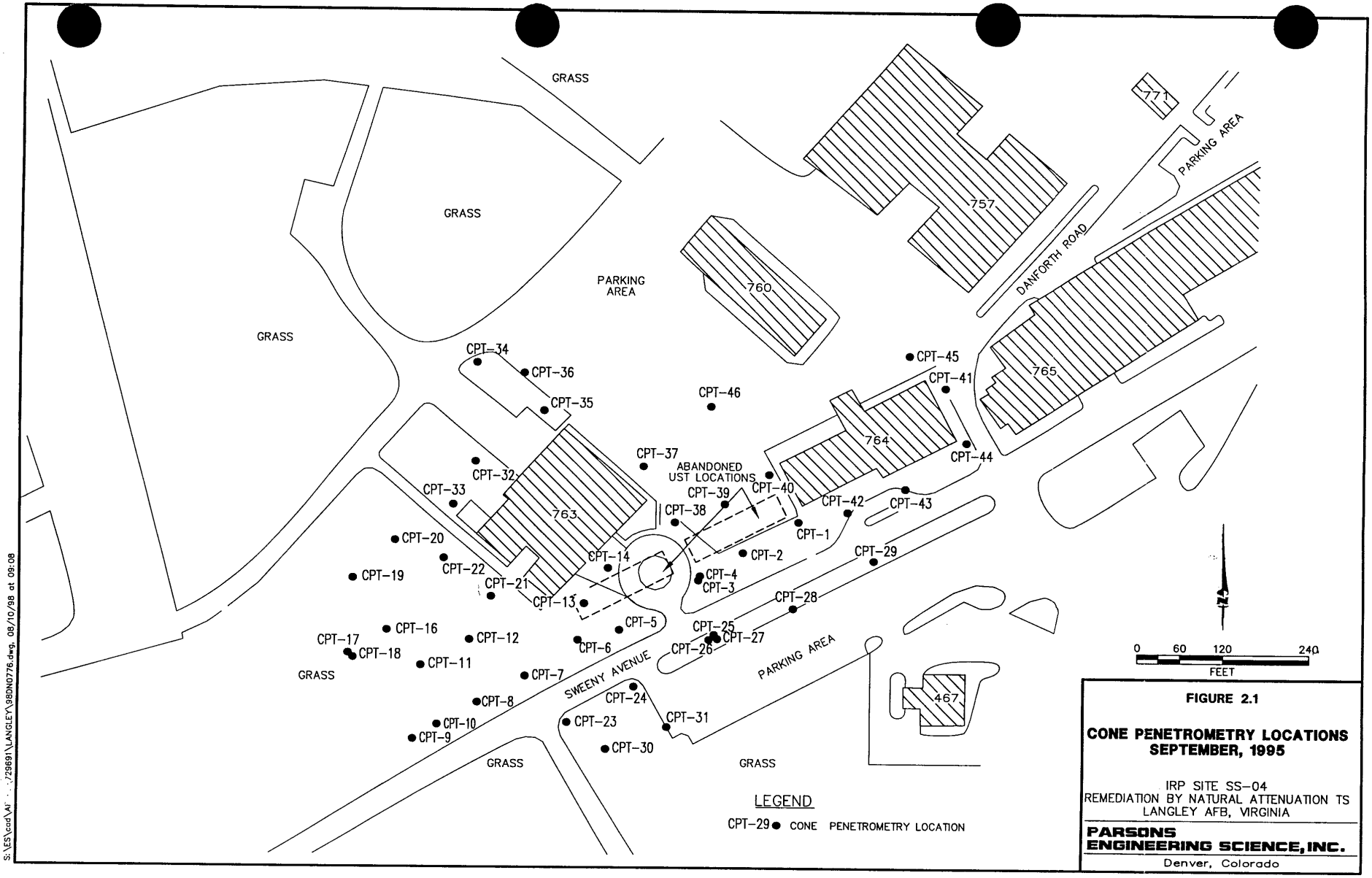
The following sections describe the procedures used during collection of site-specific data. Additional details regarding investigation activities conducted by Parsons ES are presented in the TS work plan (Parsons ES, 1996d).

2.1 CONE PENETROMETRY

Subsurface conditions at the site were characterized using CPT coupled with LIF from 21 through 23 September 1995. CPT pushes were performed at the locations labeled CPT-1 through CPT-46 to characterize subsurface stratigraphy (Figure 2.1). LIF was performed simultaneously at these locations to evaluate the extent of residual or mobile hydrocarbons in the soils and groundwater.

2.1.1 Evaluation of Stratigraphy

Cone penetrometry is an expeditious and effective means of analyzing the stratigraphy of a site by measuring the resistance of earth material against the conical probe of the penetrometer as it is pushed into the subsurface. Stratigraphy is evaluated by correlating the point stress at the probe tip and frictional stress on the side or "sleeve" of the cone assembly. The correlation between these two stress points varies depending on lithology. Stratigraphy as determined from the CPT is compared with previously-collected soil data, or is compared directly with stratigraphic information



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FIGURE 2.1

CONE PENETROMETRY LOCATIONS SEPTEMBER, 1995

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

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collected at the same location (or at nearby locations) to correlate the CPT readings with the lithologies present in the subsurface.

CPT was conducted using the USACE's cone penetrometer truck. This equipment consists of an instrumented probe that is forced into the ground using a hydraulic load frame mounted on a heavy truck, with the weight of the truck providing the necessary reaction mass. The penetrometer equipment is housed in a stainless steel, dual-compartment body mounted on a 43,000-pound, triple-axle Kenworth® truck chassis powered by a turbo-charged diesel engine. The weight of the truck and equipment is used as ballast to achieve the overall push capability of 39,000 pounds. This push capacity may be limited in tight soils by the stiffness of the 1.8-inch outside-diameter (OD) push rods, rather than by the weight of the truck. The current 39,000-pound limitation is intended to minimize the possibility of push-rod buckling. Penetration force is supplied by a pair of large hydraulic cylinders bolted to the truck frame. The penetrometer is usually advanced vertically into the soil at a constant rate of 2 centimeters per second (cm/s), although this rate must sometimes be reduced, such as when hard strata are encountered.

The penetrometer probe is of standard dimensions, having a 1.8-inch OD, 60-degree conical point with sacrificial tip, and an 8.0-inch-long by 1.8-inch-OD friction sleeve. Inside the probe, two load cells independently measure the vertical resistance against the conical tip and the side friction along the sleeve. Each load cell is a cylinder of uniform cross-section which is instrumented with four strain gauges in a full-bridge circuit. Forces are sensed by the load cells, and the data are transmitted from the probe assembly via a cable running through the push tubes. The analog data are digitized, recorded, and plotted by computer in the penetrometry truck. A grout tube also runs down the push cylinder to allow the introduction of cement grout to the hole in order to seal the CPT hole as the pushrods are withdrawn.

2.1.2 Investigation of Residual and Mobile Hydrocarbons

The known propensity of aromatic hydrocarbons to fluoresce under ultraviolet wavelengths has allowed the use of LIF technology, in conjunction with CPT technology, to evaluate soil characteristics and hydrocarbon contamination simultaneously. The LIF system has a 0.25-inch sapphire window in the side of the cone that allows a laser to scan the soil for fluorescent compounds as the CPT penetrometer rod pushes through soil. Fiber optic cables connected to the laser spectrometer and a 6-pair electrical conductor connected to the CPT data acquisition system, are routed through the interior of the push tubes to the CPT probe.

The basic components of the LIF instrument are a nitrogen laser, a fiber optic probe, a monochromator for wavelength resolution of the return fluorescence, a photomultiplier tube to convert photons into an electrical signal, a digital oscilloscope for waveform capture, and a control computer. The fiber optic probe for the cone penetrometer consists of delivery and collection optical fibers, a protective sheath, a fiber optic mount within the cone, and a 0.25-inch sapphire window. The wavelength used in the USACE CPT LIF system gives the strongest fluorescence signal (attributable to the presence of contamination) for naphthalene and heavier long-chained hydrocarbons. Thus, while the LIF is not entirely appropriate for detecting the

fluorescence of BTEX, it is useful for defining soil contamination because the heavier long-chained hydrocarbons are more preferentially sorbed to the soil matrix.

Graphical results of each LIF/CPT push were plotted by USACE staff at the conclusion of each penetration and were available minutes after the completion of each hole. The graphs showed cone resistance, sleeve friction, soil classification, fluorescence intensity, and maximum fluoresced wavelength. Final CPT logs are presented in Appendix B.

2.1.3 CPT Hole Abandonment

The CPT/LIF probe is equipped with a grout tube and sacrificial tip, enabling the CPT/LIF holes to be abandoned by backfilling with a Portland® cement grout as the CPT pushrod was withdrawn. If soil samples were collected with the Hoggen-Toggler® sampler, grouting could not be accomplished during pushrod withdrawal; therefore, these holes were abandoned with Portland® cement introduced from the ground surface after sample collection.

2.1.4 Equipment Decontamination

After sampling at each CPT location, CPT push rods were cleaned with the CPT steam-cleaning system (rod cleaner) as the rods were withdrawn from the ground. A vacuum system located beneath the CPT truck was used to recover cleaning water. Use of this system resulted in nearly 100-percent recovery of steam-cleaning rinseate from the rod cleaner. Rinseate was generated only as the rods moved past the cleaner, thereby minimizing liquid waste generation. Rinseate was collected in 55-gallon drums. The filled 55-gallon drums were labeled with the date, contents, generation location, and generators. Filled drums were left on site for disposal by the Base.

All soil sampling tools were cleaned onsite with a steam/hot-water spray prior to use and between each sampling event. Potable water used in CPT equipment cleaning, decontamination, or grouting was obtained from the Base water supply. Approval for use of water was verified by contacting the appropriate facility personnel. Precautions were taken to minimize any impact to the surrounding area that might result from decontamination operations.

2.2 SOIL SAMPLING AND MONITORING POINT INSTALLATION

Soil samples were collected and monitoring points were installed during the field efforts of October to November 1996 and October 1997. Field work was conducted using the Geoprobe® during the period October 25 through November 3, 1996, and consisted of soil sampling and installation of temporary groundwater monitoring points. Twenty-four monitoring points (points 4MP-1 through 4MP-4, 4MP-5S, 4MP-5D, 4MP-6 through 4MP-11, 4MP-12M, 4MP-12D, 4MP-13, 4MP-14S, 4MP-14D, and 4MP-15 through 4MP-21) were installed at 21 locations on Site SS-04 during this event to assist in characterization of the shallow groundwater flow system and the distribution of fuel constituents at the site. Monitoring-point locations are shown on Figure 2.2; Table 2.1 presents completion details. Nested points (4MP-5S and 4MP-5D,

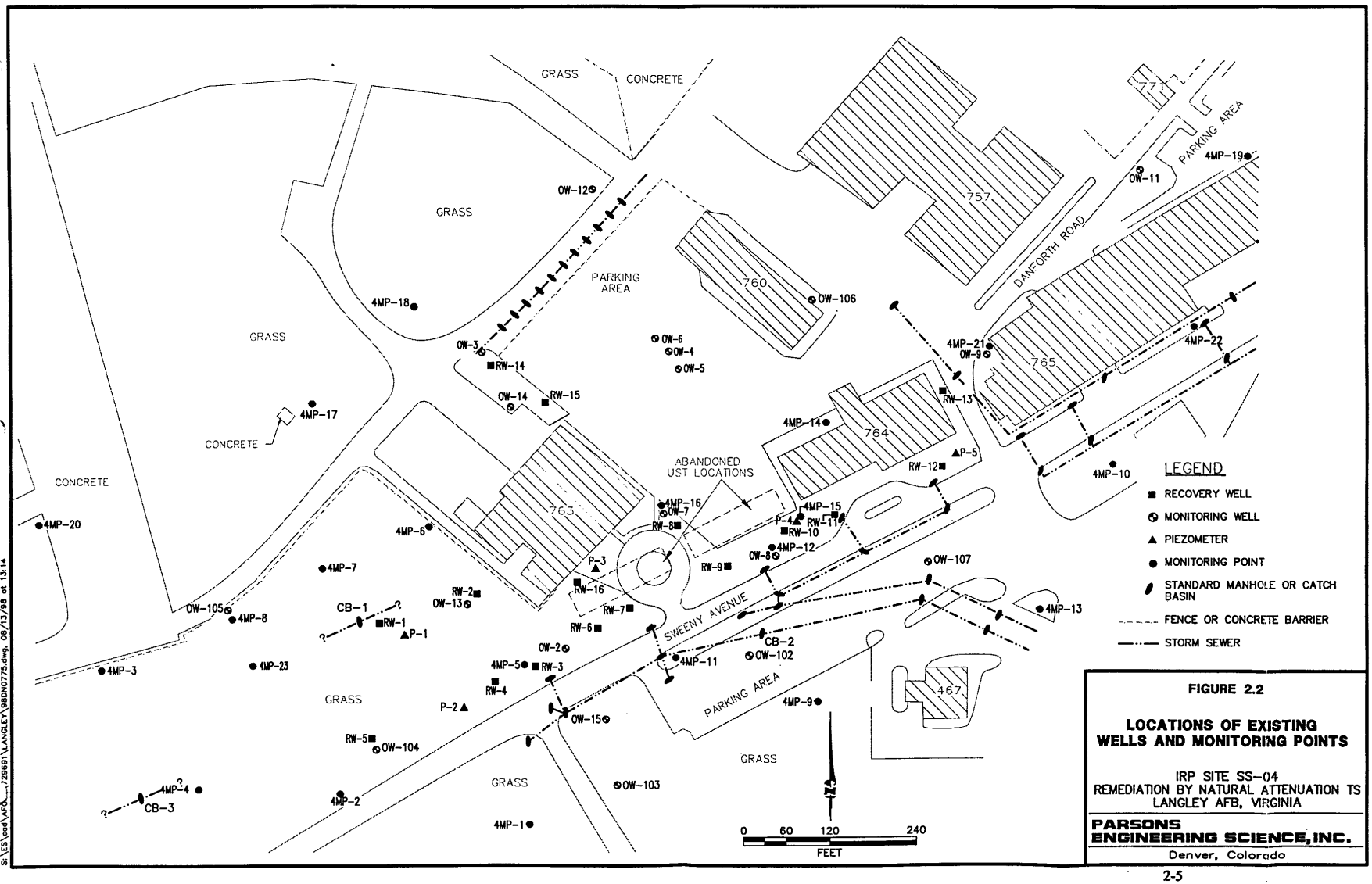


FIGURE 2.2

LOCATIONS OF EXISTING WELLS AND MONITORING POINTS

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

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Denver, Colorado

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TABLE 2.1
MONITORING POINT COMPLETION DATA
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Boring/ Point/Well Identification	Installation Date	Northing (feet)	Easting (feet)	Well Diameter[a/] (inches)	Borehole Diameter[b/] (inches)	Total Depth (ft. bgs)[c/]	Screened Interval (ft. bgs)	Elevation TOC (ft. msl)[d/]	Elevation Ground (ft. msl)
4MP-1	25-Oct-96	277830.68	2626348.25	0.75	2.25	11.8	1.8-11.8	7.73	8.0
4MP-2	26-Oct-96	277881.15	2626105.75	0.75	2.25	11.9	1.9-11.9	8.05	8.6
4MP-3	26-Oct-96	278040.09	2625773.61	0.75	2.25	11.5	1.5-11.5	8.24	8.6
4MP-4	26-Oct-96	277890.01	2625903.92	0.5	2.25	11.6	5.6-11.6	7.72	8.1
4MP-5S	26-Oct-96	278066.83	2626348.17	0.5	2.25	8.8	2.8-8.8	7.94	8.3
4MP-5D	28-Oct-96	278066.83	2626348.17	0.5	2.25	17.0	14.0-17.0	7.93	8.3
4MP-6	27-Oct-96	278257.98	2626219.13	0.5	2.25	10.0	4.0-10.0	8.57	8.8
4MP-7	27-Oct-96	278192.08	2626074.06	0.5	2.25	10.0	4.0-10.0	7.89	8.3
4MP-8	27-Oct-96	278120.10	2625963.94	0.5	2.25	27.0	24.0-27.0	8.66	9.1
4MP-9	28-Oct-96	278022.56	2626752.74	0.5	2.25	11.0	5.0-11.0	8.00	8.2
4MP-10	29-Oct-96	278357.92	2627146.27	0.5	2.25	12.0	6.0-12.0	7.60	8.1
4MP-11	29-Oct-96	278068.87	2626556.42	0.5	2.25	12.0	6.0-12.0	7.23	7.4
4MP-12M	31-Oct-96	278228.40	2626681.86	0.5	2.25	22.0	19.0-22.0	7.75	8.1
4MP-12D	31-Oct-96	278228.40	2626681.86	0.5	2.25	34.0	31.0-34.0	7.71	8.1
4MP-13	29-Oct-96	278154.49	2627053.96	0.5	2.25	12.0	6.0-12.0	7.98	8.2
4MP-14S	31-Oct-96	278406.06	2626754.89	0.75	2.25	12.0	2.0-12.0	8.30	8.7
[illegible]P-14D	1-Nov-96	278406.06	2626754.89	0.5	2.25	26.0	23.0-26.0	8.25	8.7
[illegible]P-15	31-Oct-96	278271.97	2626722.33	0.5	2.25	26.0	23.0-26.0	7.99	8.3
4MP-16	31-Oct-96	278290.83	2626535.03	0.5	2.25	26.0	23.0-26.0	8.54	8.8
4MP-17	31-Oct-96	278416.29	2626055.33	0.75	2.25	12.0	2.0-12.0	8.73	9.1
4MP-18	31-Oct-96	278561.02	2626190.61	0.75	2.25	12.0	2.0-12.0	8.42	8.7
4MP-19	1-Nov-96	278780.42	2627324.83	0.75	2.25	12.0	2.0-12.0	8.96	9.4
4MP-20	1-Nov-96	278247.08	2625684.27	0.75	2.25	12.0	2.0-12.0	7.81	8.2
4MP-21	1-Nov-96	278511.05	2626977.31	0.5	2.25	26.0	23.0-26.0	8.07	8.3
4MP-22	6-Oct-97	NA[e/]	NA	0.75	3	7.0	2.0-7.0	7.85	NA
4MP-23	6-Oct-97	NA	NA	0.75	3	8.5	3.5-8.5	8.17	NA

Notes:

[a/] Well diameter = inside diameter of installed casing.

[b/] Borehole diameter = diameter of drilled borehole.

[c/] ft. bgs = feet below ground surface.

[d/] TOC = top of casing; ft. msl = feet above mean sea level.

[e/] NA = Not available.

4MP-12M and 4MP-12D, and 4MP-14S and 4MP-14D) were installed in pairs adjacent to each other, or to existing wells. Points screened across the water table or in the upper ten feet of the saturated zone (i.e., shallow points) were designated by the suffix "S"; points screened at Geoprobe refusal (i.e., deep points) were designated by the suffix "D"; and points screened at intermediate depths (i.e., middle points) were designated by the suffix "M." Monitoring points 4MP-8, 4MP-15, 4MP-16, and 4MP-21 are screened at Geoprobe® refusal, but are not labeled with a "D" because they are not associated with nested pairs. Monitoring-point locations were selected to provide the hydrogeologic data necessary for implementation of a fate and transport model and to evaluate the occurrence and rate of natural attenuation. Shallow monitoring points 4MP-22 and 4MP-23 were installed with a hand auger on 6 and 7 October 1997 to further define the groundwater flow system, and extent of hydrocarbons in shallow groundwater.

Three of the new monitoring points (4MP-19, 4MP-21 and 4MP-22) were installed east of IRP Site SS-04, and were intended primarily to characterize the groundwater flow regime at IRP Site ST-27, in conjunction with existing wells OW-9 and OW-11 at Site ST-27. These activities were completed in accordance with the procedures described in the TS work plan (Parsons ES, 1996d) and in the following sections.

2.2.1 Geoprobe® and Hand Auger Operation and Soil Sampling Procedures

The Geoprobe® system is a hydraulically-powered percussion/probing machine used to advance sampling tools through unconsolidated soils. This system allows rapid and efficient collection of soil, soil gas, and groundwater samples at shallow depths, while minimizing the generation of investigation-derived waste materials. The hand auger produces a three-inch borehole, and is operated by manually turning the auger stem. For convenience, throughout this report, operation of Geoprobe® or hand auger equipment is referred to as "drilling".

2.2.1.1 Pre-Drilling Activities

All subsurface utility lines or other man-made subsurface features were located, and proposed drilling locations were cleared and approved by the Base prior to any drilling activities. Water used in equipment cleaning or grouting was obtained from an onsite potable water supply designated by the Base.

2.2.1.2 Equipment Decontamination and Fluids Handling Procedures

Prior to arriving at the site and between each drilling location, all probe rods, tips, sleeves, pushrods, samplers, tools, and other downhole equipment were decontaminated using an Alconox® detergent and potable water solution followed by a potable water wash. Fittings, tips, and samplers also underwent an additional rinse with isopropyl alcohol followed by a final rinse with deionized water. Precautions were taken to minimize impact to the areas surrounding decontamination operations. All decontamination activities were conducted so as to control and contain excess water.

All decontamination fluids were temporarily contained and screened for total volatile organic compounds (VOCs) with a photoionization detector (PID). All headspace

readings were less than 5 parts per million, volume per volume (ppmv); therefore, in accordance with the TS work plan, all decontamination water was released on-site.

Fuel, lubricants, and other similar substances were handled in a manner consistent with accepted safety procedures and standard operating practices. All well completion materials were factory sealed and were not stored near or in areas that could be affected by these substances.

2.2.1.3 Drilling and Soil Sampling

The boreholes were sampled continuously to the total depth of the boring. However, in some cases (i.e., 4MP-12, 4MP-14, 4MP-15, and 4MP-21), poor sample recovery occurred in the deeper sample intervals, as a consequence of heaving sands. A final borehole diameter of 2.25 inches was used for the installation of points 4MP-1 through 4MP-21, which were constructed using 0.5-inch or 0.75-inch inside-diameter (ID) casing. Points 4MP-22 and 4MP-23 consisted of 0.75-inch ID casing installed in a three-inch-diameter borehole.

The Parsons ES field geologist observed drilling and monitoring point installation activities and maintained a detailed descriptive log of recovered subsurface materials. Final geologic logs of boreholes are presented in Appendix B. These logs contain the following information:

- Sampled interval (top and bottom depth);
- Notes regarding presence or absence of hydrocarbons, based on odor, staining, and/or PID readings;
- Soil description, including color, major textural constituents, minor constituents, and other observations; and
- Lithologic contacts, with the depth to contacts and/or significant textural changes recorded to the nearest foot.

The soil samples collected with the Geoprobe® were obtained using 4-foot by 1.5-inch-ID and 2 foot by 1-1/16-inch-ID sampling devices. A probe-drive sampler attached to the leading end of the probe rods serves as both the driving point and the sample collector. To collect a soil sample, the sampler was pushed or driven to the desired sampling depth, the drive point was retracted to open the sampling barrel, and the sampler was subsequently pushed into the undisturbed soils at the targeted sampling depth. The soil cores were retained within a clear acetate liner inside the sampling barrel. The probe rods were then retracted, bringing the sampling device to the surface. The soil sample was then extruded from the liner for visual lithologic logging, PID headspace screening, or immediate packing in a 4-ounce jar for chemical analysis. Soil samples collected with the hand auger were removed from the auger bucket by hand for visual lithologic logging, PID headspace screening, or immediate packing in a 4-ounce jar for chemical analysis.

Ziploc™ bags containing soil samples collected for the headspace screening procedure were quickly sealed and stored for at least 15 minutes at the ambient

temperature. Semiquantitative measurements were made by puncturing the bag seal with the PID probe and reading the concentration of the headspace gases. The PID relates the concentration of VOCs in a sample to an isobutylene calibration standard. The PID also was used to monitor for VOCs in the worker breathing zone.

Soil samples were selected for laboratory chemical analyses based on proximity to the water table, and/or if PID headspace readings were elevated or visible contamination was present. Eleven soil samples were submitted for chemical analyses:

- Sample 4MP-5 (depth interval 4 - 6 feet below land surface);
- Sample 4MP-10 (depth interval 6 - 8 feet below land surface);
- Sample 4MP-12 (depth interval 5.75 - 6.25 feet below land surface);
- Samples 4MP-13 (depth intervals 5.75 - 6.25 and 9.75 - 10.25 feet below land surface);
- Sample 4MP-14 (depth interval 5.75 - 6.25 feet below land surface);
- Sample 4MP-15 (depth interval 3.5 - 4.0 feet below land surface);
- Sample 4MP-16 (depth interval 4.75 - 5.25 feet below land surface);
- Sample HA-4MP-1 (depth interval 3.0 - 3.5 feet below land surface); and
- Sample HA-4MP-11 and its duplicate (depth interval 3.0 - 3.5 feet below land surface).

For each soil sample, the Parsons ES field scientist recorded the following information:

- Sample interval (top and bottom depth);
- Sample identification;
- Sampling date; and,
- Sample collector's initials.

After the samples had been sealed and labeled, they were placed in a cooler with ice and held for overnight transport via Federal Express or same-day transport via Delta Dash to Evergreen Analytical Laboratory (EAL) in Wheat Ridge, Colorado. The analytical methods used for soil samples collected during the field investigation performed in support of RNA are summarized in Table 2.2. Soils generated during monitoring point installation and sampling operations were placed in 55-gallon drums located onsite, and labeled in accordance with the Langley AFB Investigation Derived Waste Management Plan (Versar, 1996) for later disposition by the Base.

2.2.2 Monitoring Point Installation

Groundwater monitoring points were installed in 26 boreholes at 23 locations in conjunction with this program (Figure 2.2). Detailed procedures for monitoring point installation are described in the following paragraphs.

TABLE 2.2
ANALYTICAL PROTOCOL FOR GROUNDWATER AND SOIL SAMPLES
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

MATRIX	METHOD	FIELD OR EAL[a] AND WHEN PERFORMED
GROUNDWATER		
Total Iron	Colorimetric, Hach Method 8008	Field, 96 and 97
Ferrous Iron (Fe^{+2})	Colorimetric, Hach Method 8146	Field, 96 and 97
Ferric Iron (Fe^{+3})	Difference between total and ferrous iron	Field, 96 and 97
Alkalinity as Calcium Carbonate ($CaCO_3$)	Titrimetric, Hach Method 8221	Field, 96 and 97
Ammonia as Nitrogen (NH_3-N)	CHEMetrics Method 1510, ASTM 4500: NH_3	Field, 96 and 97
Carbon Dioxide (CO_2)	CHEMetrics Method 1920, ASTM 4500: CO_2	Field, 96 and 97
Manganese (Mn^{+2})	Colorimetric, Hach Method 8034	Field, 96 and 97
Nitrate as Nitrogen (NO_3^{-1}-N)	Colorimetric, Hach Method 8039	Field, 96 and 97
Nitrite as Nitrogen (NO_2^{-1}-N)	Colorimetric, Hach Method 8507	Field, 96 and 97
Sulfate (SO_4^{-2})	Colorimetric, Hach Method 8051	Field, 96 and 97
Total Sulfide	Colorimetric, Hach Method 8131	Field, 96 and 97
Conductivity	Direct reading meter	Field, 96 and 97
Oxygen	Direct reading meter	Field, 96 and 97
pH	Direct reading meter	Field, 96 and 97
Redox Potential	Direct reading meter	Field, 96 and 97
Temperature	Direct reading meter	Field, 96 and 97
Alkalinity as Calcium Carbonate ($CaCO_3$)	E310.1	EAL, 96
BTEX & Aromatic Hydrocarbons	SW8020	EAL, 96 and 97
Methane (CH_4)	RSKSOP-175M	EAL, 96 and 97
Nitrate as Nitrogen (NO_3^{-1}-N)	E300.0	EAL, 96
Nitrite as Nitrogen (NO_2^{-1}-N)	E300.0	EAL, 96
Sulfate (SO_4^{-2})	E300.0	EAL, 96
Total Volatile Hydrocarbons, TVPH	SW8015, modified	EAL, 96
LNAPL[b/]		
BTEX & Aromatic Hydrocarbons	SW8020	EAL, 96
SOIL		
BTEX & Aromatic Hydrocarbons	SW8020	EAL, 96
Grain Size	Sieve Analysis, +1 through -400 mesh	EAL[c/], 96
Moisture	E160.3 (SW846)	EAL, 96
Total Organic Carbon	CO2COUL (SW9060, modified)	EAL[d/], 96
Total Volatile Hydrocarbons, TVPH	SW8015, modified	EAL, 96

a/ EAL = Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado.

b/ LNAPL = light non-aqueous phase liquid

c/ Subcontracted by EAL to Hazen Research, Inc. of Golden, Colorado.

d/ Subcontracted by EAL to Huffman Laboratories of Golden, Colorado

96 = Field effort performed October to November 1996

97 = Field effort performed October 1997

2.2.2.1 Materials Decontamination

Monitoring point completion materials were inspected by the field geologist and determined to be clean and acceptable prior to use. All monitoring point completion materials were factory sealed in plastic wrap. Pre-packaged casing, sand, and bentonite were used in well construction, and were inspected for possible external contamination before use. Materials that could not be cleaned to the satisfaction of the field geologist were not used.

2.2.2.2 Casing and Screen

Construction details for each monitoring point were noted on a monitoring point installation record and are summarized on Table 2.1. This information became part of the permanent field record for the site. Monitoring point installation records for the site are presented in Appendix B.

The shallow monitoring points were constructed of Schedule 40 polyvinyl chloride (PVC) riser pipe and Schedule 40 or Schedule 80 PVC screen having an ID of 0.5 or 0.75 inches. All well casing and screen sections were flush-threaded; glued joints were not used. The screened intervals for the shallow monitoring point screens were either 5 feet, 6 feet, or 10 feet long and were factory-slotted with 0.010-inch openings (Table 2.1).

The intermediate and deep monitoring points screened below the water were constructed of Schedule 40 PVC riser pipe and Schedule 80 PVC screen having an ID of 0.5 inches. All well casing and screen sections were flush-threaded; glued joints were not used. The screened intervals for the intermediate and deep monitoring point screens were 3 feet long and were factory-slotted with 0.010-inch openings.

The field geologist recorded the borehole depth, the lengths of all casing sections, and the depth to the top of all monitoring point completion materials placed in the annulus between the casing and borehole wall.

2.2.2.3 Filter Pack and Annular Sealant

A prepacked screen was utilized for all eight of the medium and deep points and eight of the 16 shallow points. The prepacked screens are in 3-foot sections with an OD of 1.5 inches and an ID of 0.5 inches. The inner component of the prepacked screen consists of 0.5-inch Schedule 80 PVC with 0.010-inch slots. The outer component of the screen is stainless steel wire mesh with a pore size of 0.011 inches. The screens are prepacked with 20/40 grade silica sand. A filter pack seal of hydrated sodium bentonite was placed above the prepacked screen.

Placement of a filter pack around the remaining 10 monitoring point casing screens was attempted immediately after inserting the PVC casing string. However, filter pack placement was only partially successful due to collapse of the borehole walls. Therefore, the monitoring points are naturally sand-packed with the formation materials. A seal of hydrated sodium bentonite was placed in that part of the hole above the screened interval which remained open following filter pack placement or collapse of the borehole walls.

2.2.3 Monitoring Point Development

Each monitoring point was developed prior to sampling. Typically, development removes sediment from inside the well casing and flushes fines, cuttings, and drilling fluids from the sand pack and the portion of the formation adjacent to the well screen. Use of the Geoprobe® system and hand auger to place monitoring points eliminates cuttings and drilling fluids. As a result, development of monitoring points is primarily intended to minimize the amount of fine sediment that might accumulate in the casing.

Monitoring point development was accomplished using a peristaltic pump with dedicated silicon and high density polyethylene (HDPE) tubing. The pump tubing was lowered to the bottom of the points so that fines were agitated and removed from the point in the development water. Development was continued until ten casing volumes of water were removed from the point and the groundwater pH, temperature, conductivity, and dissolved oxygen (DO) concentrations had stabilized. Several times, a monitoring point was completely emptied of water before ten casing volumes were removed. When this situation occurred, the well was allowed to recharge and then emptied again. This cycle was repeated several times. All development water was containerized on-site in 55-gallon drums.

2.3 GROUNDWATER AND LNAPL SAMPLING

This section describes the procedures used for collecting groundwater samples. The procedures described in the TS work plan (Parsons ES, 1996d) and summarized in subsequent sections were followed in order to maintain a high degree of quality control (QC) during this sampling event.

Groundwater sampling occurred during two events: October 28 through November 4, 1996 and 7 through 9 October 1997. In 1996, groundwater samples were collected from 23 monitoring points (all points except 4MP-14S, 4MP-22, and 4MP-23) and 23 of the previously-installed monitoring wells – wells OW-3, OW-4, OW-7, OW-8, OW-9, OW-11, OW-12, OW-13, OW-15, OW-102 through OW-107, P-1 through P-5, RW-6, RW-13, and RW-15. In 1997, groundwater samples were collected from 7 monitoring points and 12 of the previously-installed monitoring wells, including points 4MP-5S, 4MP-5D, 4MP-7, 4MP-15, 4MP-21, 4MP-22, 4MP-23, and wells OW-3, OW-4, OW-7, OW-8, OW-9, OW-11, P-1, P-4, P-5, RW-4, RW-6, and RW-15. Groundwater sampling forms were used to document the specific details of the sampling event at each location. Groundwater samples were analyzed for the parameters listed in Table 2.2. In addition to the groundwater sampling data collected under this program, analytical results from historic groundwater sampling events at Site SS-04 are provided in Appendix A.

2.3.1 Preparation for Groundwater Sampling

All equipment used for sampling was assembled and properly cleaned and calibrated (if required) prior to arriving in the field. Special care was taken to prevent contamination of the groundwater and extracted samples through cross-contamination from improperly cleaned equipment; therefore, water level indicators and sampling equipment were thoroughly cleaned before and after field use and between uses at

different sampling locations. In addition, a clean pair of new, disposable gloves was worn each time a different well/point was sampled.

All parts of sampling and test equipment that contacted the sample were thoroughly cleaned before use. This equipment included the water level probe and cable, equipment for measuring on-site groundwater chemical parameters, and other equipment that contacted the samples. The following cleaning protocol was used:

- Rinse with potable water;
- Rinse with isopropyl alcohol;
- Rinse with distilled or deionized water; and
- Air dry prior to use.

Any deviations from these procedures were documented in the field scientist's field notebook and on the groundwater sampling form. Decontamination fluids were contained and handled as described in Section 2.2.1.2.

As required, field analytical equipment was calibrated according to the manufacturers' specifications prior to field use. This requirement applied to direct-reading meters used for on-site chemical measurements of pH, conductivity, and DO, as well as the Hach® meter used for other on-site geochemical analysis.

Upon arrival at the monitoring well/point, the area around the well was cleared of foreign materials (brush, rocks, and debris) to prevent sampling equipment from inadvertently contacting debris around the monitoring well. Location preparation also included an inspection of the integrity of the well or monitoring point. At this time, irregularities with the protective cover, cap, lock, external surface seal, internal surface seal, well identification, well datum, and pad were noted.

Prior to removing any water from the well or point, the static water level was measured. In all groundwater wells and monitoring points, an electrical water-level probe or oil/water interface probe was used to measure the depth to groundwater below the well datum to the nearest 0.01 foot. In 1996, free-phase product (mobile LNAPL) was detected in permanent monitoring wells P-4, OW-9, and OW-11. After measurement of the static water level at each location, the water level probe was lowered to the bottom of the well/monitoring point for measurement of total well depth (recorded to the nearest 0.1 foot). Based on these measurements, the volume of water to be purged from the wells/points was estimated.

2.3.2 Well/Point Purging and Sample Collection

All monitoring points and monitoring wells, except monitoring point 4MP-14S, were purged and sampled using a peristaltic pump with dedicated HDPE and silicon tubing. Monitoring point 4MP-14S could not be purged or sampled during the 1996 and 1997 field efforts because it was filled with sediment. Purging consisted of removing at least three times the calculated casing volume prior to sample collection. After three casing volumes of water were removed from the well/point, purging continued until the pH,

DO concentration, oxidation-reduction potential (ORP), conductivity, and temperature stabilized.

LNAPL from monitoring well P-4 was sampled in 1996 prior to purging by utilizing a disposable bailer. The bailer was lowered slowly across the air/LNAPL interface to recover the sample.

Groundwater samples were collected from the monitoring wells/points within 24 hours of purging. The samples were transferred directly from the peristaltic discharge tubing into the appropriate sample containers. The water was carefully poured down the inner walls of the sample bottle to minimize aeration of the sample. Sample bottles for BTEX, total volatile hydrocarbons - gasoline (TVH-G), methane and Hach® field analyses were filled so that there was no headspace or air bubbles within the container. The analyses performed on groundwater samples are summarized in Table 2.2.

2.3.3 On-Site Measurement of Chemical Parameters

DO, ORP, pH, specific conductance, and temperature were measured at each sampling location at the time of sample collection. All measurements were collected using a flow-through cell at the discharge of the peristaltic pump. DO measurements were taken using a YSI® 55 DO meter. DO concentrations were recorded after the readings stabilized. Temperature was taken from the same YSI® meter as the DO readings. ORP and pH measurements were taken with an Orion® 250A meter. Either an Extech® Oyster meter or a Hach® combination TDS/conductivity meter was employed for the specific conductance measurements. All parameters were recorded on the groundwater sampling record.

An on-site laboratory staffed by Parsons ES personnel was established at Building 763 and was used to analyze groundwater samples for several indicator parameters (Table 2.2). A Hach® DR/700 colorimeter was used to measure ferrous iron (Fe^{2+}), total iron (Fe^{2+} + Fe^{3+}), sulfate (SO_4^{2-}), sulfide (S^{2-}), nitrate (NO_3^-), nitrite (NO_2^-), and manganese (Mn^{2+}). Titrations using Hach® reagents were conducted to measure alkalinity [as milligrams per liter (mg/L) calcium carbonate ($CaCO_3$)]; and CHEMetrics® color tests were used to measure ammonia (NH_3) and carbon dioxide (CO_2). Groundwater samples were collected directly into clean glass or polyethylene containers, capped, and transported to the Parsons ES on-Base laboratory for analysis. Special care was taken to collect samples without headspace because headspace can affect the dissolved concentrations of reduced species. The field holding time for each sample did not exceed one hour. Care also was taken to minimize sample temperature changes and exposure to sunlight. Concentrations of these indicator parameters were not quantitatively measured in soil samples.

2.3.4 Sample Handling

The fixed-base analytical laboratory (EAL) provided sample containers, including all required preservatives. The sample containers were filled as described in Section 2.3.2, and the container lids were tightly closed. The sample label was firmly attached to the container side, and the following information was legibly and indelibly written on the label:

- Facility name;
- Sample identification;
- Sample type (e.g., groundwater);
- Sampling date;
- Sampling time;
- Requested analyses;
- Included preservatives; and
- Sample collector's initials.

After the samples were sealed and labeled, they were packaged for transport to EAL in Wheat Ridge, Colorado. The following packaging and labeling procedures were followed:

- Samples were packaged to prevent leakage or vaporization from the containers;
- Samples were cushioned to avoid breakage; and
- Ice was added to the shipping cooler to keep the samples cool.

The packaged samples were delivered by overnight courier (Federal Express) or same-day courier (Delta Dash) to the laboratory. Chain-of-Custody procedures outlined in the TS work plan (Parsons ES, 1996d) were followed.

2.4 STORM SEWER SAMPLING

On October 7, 1997, water from three catch basins was collected for analysis of aromatic hydrocarbons using US Environmental Protection Agency (EPA) Method SW8020. These locations, CB-1 through CB-3, are presented in Figure 2.2. As discussed in Section 3.3.2, it appears that the shallow groundwater flow is influenced by the storm sewer system at Site SS-04. The purpose of these samples was to assess whether hydrocarbon-contaminated groundwater was discharging to the storm sewer system. A visual survey of other catch basins and manholes was also conducted, to determine whether water was present.

2.5 AQUIFER TESTING

Twelve monitoring wells were tested using well-displacement methods ("slug tests") to estimate the hydraulic conductivity of the shallow saturated zone at IRP Site SS-04. Slug tests are single-well tests used to estimate the hydraulic conductivity of a water-bearing unit in the immediate vicinity of the tested well. Slug tests can be used for confined and unconfined aquifers that have a transmissivity of less than about 7,000 square feet per day (ft^2/day). Slug tests can be conducted as rising-head or falling-head tests. Rising-head and falling-head tests were both used at this site. The tests were performed in monitoring wells OW-2, OW-7, OW-8, OW-9, OW-102, OW-103,

OW-104, OW-105, OW-107, P-2, P-3, and P-5 (Figure 2.2). Detailed slug testing procedures are presented in the *Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater* (Wiedemeier *et al.*, 1995).

Data obtained during slug testing were analyzed using AQTESOLV® software and the methods of Bouwer and Rice (1976) and Bouwer (1989) for unconfined conditions. The results of slug testing are presented in Section 3.3 and Appendix B.

2.6 SURVEYING

After completion of field work in 1997, the locations and elevations of monitoring points and selected monitoring wells were surveyed by Miller-Stephenson & Associates, P.C. of Virginia Beach, Virginia. The horizontal locations and the elevations of the measurement datum (top of PVC well/point casing) and the ground surface adjacent to the well casing were measured relative to existing on-Base survey control points. Horizontal locations were surveyed to the nearest 0.01 foot. Datum and ground surface elevations were surveyed to the nearest 0.01 foot. Survey data are presented in Table 2.1 and Appendix B.

Comparison of the monitoring well top-of-casing elevations measured by Miller-Stephenson and those reported from previous investigations were found to differ by an average of approximately 0.24 foot. Due to the shallow gradient at the site, these differences created sufficient uncertainty in the interpretation of the groundwater flow at the site that Parsons ES decided to re-survey the elevations of all of the monitoring points, recovery wells, observation wells, and piezometers. The elevations reported by Miller-Stephenson for the monitoring points were used as the reference datum. The top-of-casing elevations presented in this report are the survey measurements recorded by Parsons ES in 1997.

SECTION 3

PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section integrates data collected by Parsons ES in October and November 1996 and October 1997 with information provided in past Langley AFB environmental reports that is relevant to this TS. Investigative techniques used to assess the physical characteristics of the site are discussed in Section 2.

3.1 SURFACE FEATURES

3.1.1 Topography and Surface Water Hydrology

Langley AFB is located in the coastal plain of southeastern Virginia (Figure 1.1) on the York-James Peninsula, which is bounded by the York River on the northeast, Chesapeake Bay on the east, and the James River on the south and southwest. The peninsula is characterized by terrain with little topographic relief. The land surface at Langley AFB is relatively flat, with elevations ranging from 0 to 12 feet above mean sea level (the National Geodetic Vertical Data of 1929 --NGVD). Topographic elevations at IRP Site SS-04 range from approximately 7 to 9 feet NGVD. The streets surrounding the site are slightly lower in elevation to allow for adequate drainage.

Langley AFB is located on a broad peninsula where the Southwest and Northwest Branches of Back River join to form the Back River. Both branches of the Back River originate in nearby Newport News (to the west). From Langley AFB, the Back River flows 3 miles eastward and discharges into Chesapeake Bay (Figure 1.1). The Southwest Branch and Northwest Branch of Back River both experience tidal fluctuations. Normal tidal fluctuations in the area are about 2.5 feet in magnitude (Johnson, 1976). Surface water drainage from Langley AFB flows into Tabbs Creek, Tide Mill Creek, Southwest Branch of Back River, and Northwest Branch of Back River by direct runoff, runoff into artificial and natural drainage features that eventually discharge to these water bodies, and through the Base stormwater drainage system.

IRP Site SS-04 is located in a moderately-developed area of the Base, where surface water that does not percolate into the ground flows overland to the Base storm sewer network (Figure 2.2). Surface water from the western and northwestern areas of the site flows to the northwest to a storm sewer that routes collected water to the southwest and eventually discharges into an airfield drainage ditch, which in turn discharges to the Southwest Branch of the Back River near the intersection of Nealy Avenue and Pine Road. Surface water originating on the remaining areas of Site SS-04 is collected in storm sewers that drain to the southeast and discharge into the Southwest Branch of the Back River near Building 560 at the southeastern terminus of Bowen Street or near Building 422 at the southeastern terminus of Bryant Avenue. The Southwest Branch of

the Back River is approximately 1,400 feet southwest and 1,800 feet southeast of IRP Site SS-04.

3.1.2 Anthropogenic Features

Much of Site SS-04 is asphalt paved (4 to 8 inches in thickness) or covered with buildings (Figure 2.2). Other areas around the perimeter of the site are covered by manicured grass and shrubs. Because surface topography is relatively flat, and surface soils are sandy and permeable, most precipitation falling on unpaved areas probably infiltrates into the subsurface. Various types of underground utilities traverse the site and surrounding areas, including water main, storm sewer, sanitary sewer, electrical lines, fiber-optic cable (communications), and television cable lines. With the exceptions of the sanitary and storm sewer lines, most of these underground utilities are probably installed above the water table. Elevations of the sanitary and storm sewer inverts within and surrounding the Site were provided by 1 CES/CECN at Langley AFB. A sanitary sewer that flows south from Danforth Road across Building 765 has invert elevations below the water table, with an elevation at its lowest point of 0.76 feet NGVD. Many of the storm sewer inverts are also below the water table, with elevations of 1.47 feet NGVD at their lowest points. As discussed in Section 3.3.2, the storm sewers appear to influence groundwater flow at the site.

3.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

Langley AFB is located on the far eastern end of the York-James Peninsula in southeastern Virginia. Known as the Outer Coastal Plain, this area is characterized by a series of plains, created under subaqueous conditions, and scarps, former shorelines of Chesapeake Bay or the James River during the Pleistocene Epoch (Johnson, 1976). Langley AFB lies on the Hampton Flat, which is the principal physiographic feature of lower York County. The Peninsula is bounded on the southwest by the James River and on the east by Chesapeake Bay. Sediments exposed at land surface in this area are of Pliocene, Pleistocene, and Holocene (recent) age. Alluvium, marsh sediment, and beach and dune sand also can be found. Surficial soils at Langley AFB consist almost entirely of the Lynnhaven Member of the Tabb Formation, which is described as beach and nearshore marine sand and clay (Johnson, 1976). The Lynnhaven Member ranges in thickness from less than 0.5 foot to 8 feet in the area.

The Coastal Plain of Virginia is characterized by alternating sand and clay deposits that form a series of aquifers and confining units. A surficial aquifer, seven confined aquifers, and intervening confining units are formed by these deposits (Laczniak and Meng, 1988). A list of hydrogeologic units underlying Langley AFB, along with the estimated elevation of the top of each unit and the estimated thickness of each unit, is presented in Table 3.1.

The surficial aquifer at Langley AFB, the Columbia Aquifer, includes Holocene and Pleistocene age sediments and is approximately 45 feet thick beneath the site. Sediments of this aquifer include interbedded and intermixed sand, silt, and clay, overlying a gravelly base (Laczniak and Meng, 1988). Groundwater occurs approximately 5 feet below ground surface (bgs) (Law, 1991).

TABLE 3.1
HYDROGEOLOGIC UNITS UNDERLYING LANGLEY AFB
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Formation	Estimated Elevation of Top of Unit (feet msl)	Estimated Thickness of Unit (feet)
Columbia Aquifer	+5	45
Yorktown Confining Unit	-40	30
Yorktown-Eastover Aquifer	-70	155
St. Marys Confining Unit	-225	75
Calvert Confining Unit	-300	140
Chickahominy-Piney Point Aquifer	-440	160
Nanjemoy-Marlboro Confining Unit	-600	50
Upper Potomac Confining Unit	-650	70
Upper Potomac Aquifer	-720	120
Middle Potomac Confining Unit	-840	30
Middle Potomac Aquifer	-870	430
Lower Potomac Confining Unit	-1300	60
Lower Potomac Aquifer	-1360	1140
Bedrock	-2500	--

Source: Laczniak and Meng, 1988.

Underlying the Columbia Aquifer is the Yorktown Confining Unit, which is approximately 30 feet thick at Langley AFB. This unit consists mainly of silt and clay. Below the Yorktown Confining Unit is the Yorktown-Eastover Aquifer. This aquifer consists of sediments of Pliocene and early Miocene age and is approximately 155 feet thick at the Base. The main component of this aquifer is sand interbedded with silt, clay, shell beds, and gravel. These sediments were deposited during cyclic marine transgression (Laczniak and Meng, 1988).

3.3 SITE GEOLOGY AND HYDROGEOLOGY

3.3.1 Lithology and Stratigraphic Relationships

The subsurface sediments encountered and logged beneath IRP Site SS-04 during the Geoprobe® investigation in October and November 1996 consist mostly of silt and sand mixtures containing variable amounts of gravel, clay and shell fragments. Shell fragments were found in almost all of the borings, usually beginning at depths of approximately 5 to 10 feet bgs. Appearance of the shell fragments could be correlated with a sand layer identified by the CPT data collected in September 1995. The deepest boring installed during this investigation was driven to a depth of 34 feet bgs (4MP-12D). The shallowest confining unit, the Yorktown Confining Unit, is estimated to be about 50 feet bgs (- 40 feet NGVD, Table 3.1).

In order to illustrate these stratigraphic relationships, hydrogeologic cross sections were developed from subsurface data derived from the October to November 1996 Geoprobe® investigation and the September 1995 CPT investigation. The locations of two hydrogeologic cross-sections, constructed across the SS-04 site, are shown on Figure 3.1. The two hydrogeologic sections A-A' and B-B' (Figures 3.2 and 3.3) are approximately parallel and perpendicular, respectively, to the generalized direction of groundwater flow across the site.

3.3.2 Groundwater Hydraulics

3.3.2.1 Flow Direction and Gradient

The groundwater surface below IRP Site SS-04 was measured in November 1996 at depths ranging from 3 to 7 feet bgs and in October 1997 at depths from 4 to 8 feet bgs. Recharge of the shallow groundwater system from precipitation probably occurs in unpaved areas, on the northwestern, western, southwestern and southern parts of the site. A summary of groundwater measurements taken in September 1996, November 1996, and October 1997 are presented in Tables 3.2, 3.3, and 3.4, respectively.

Regionally, shallow groundwater flow is controlled by local recharge areas, and by the Southwest Branch of the Back River. Shallow groundwater at the site and surrounding areas exhibits variable flow directions. The configuration of the shallow potentiometric surface, based on measurements taken on November 4, 1996 and October 7, 1997, are presented on Figures 3.4 and 3.5 respectively. The storm sewer network with available invert elevations also is shown on these figures. The average groundwater elevation was approximately 1.2 feet lower on October 7, 1997 than it had been on November 4, 1996.

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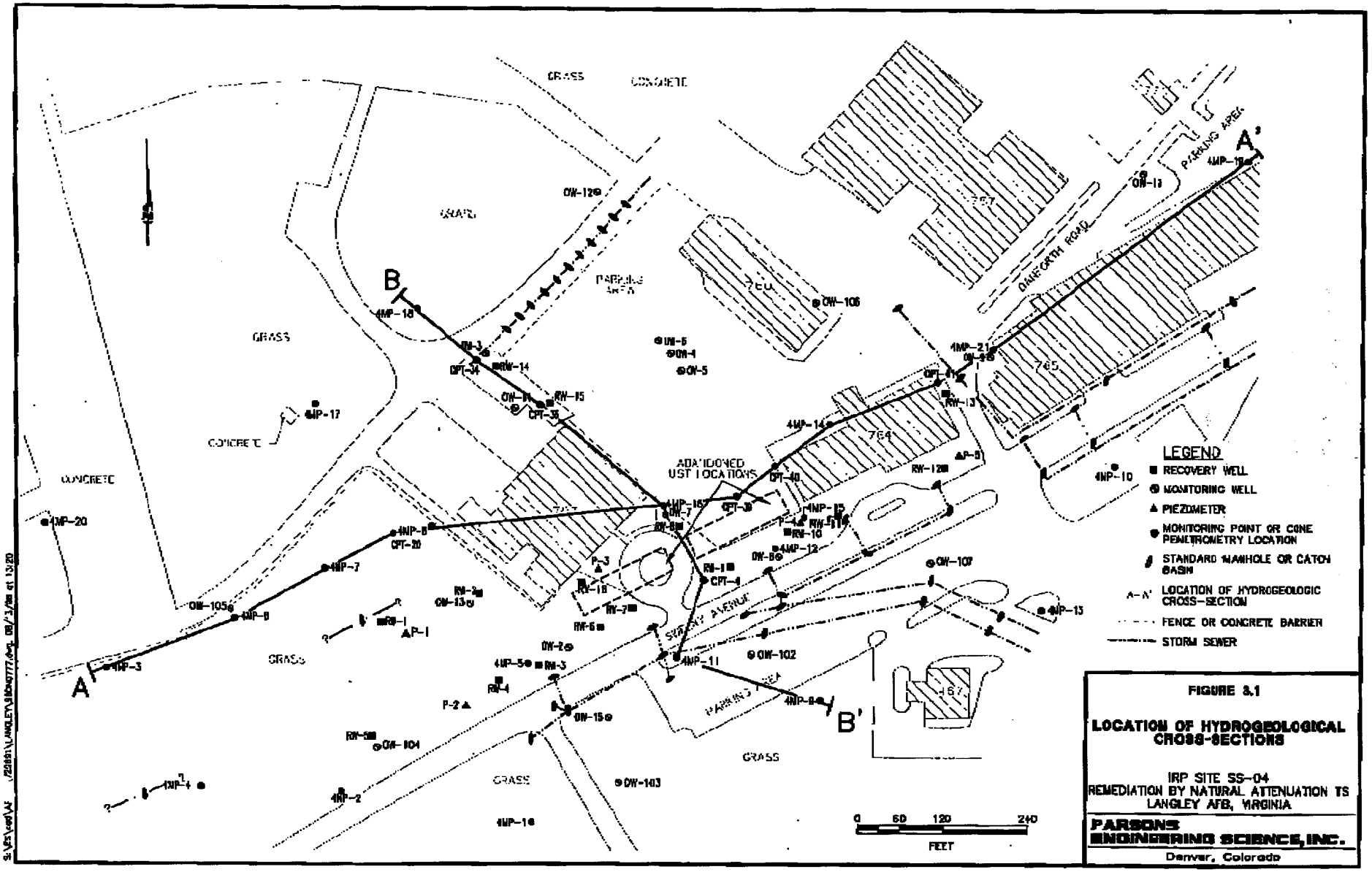


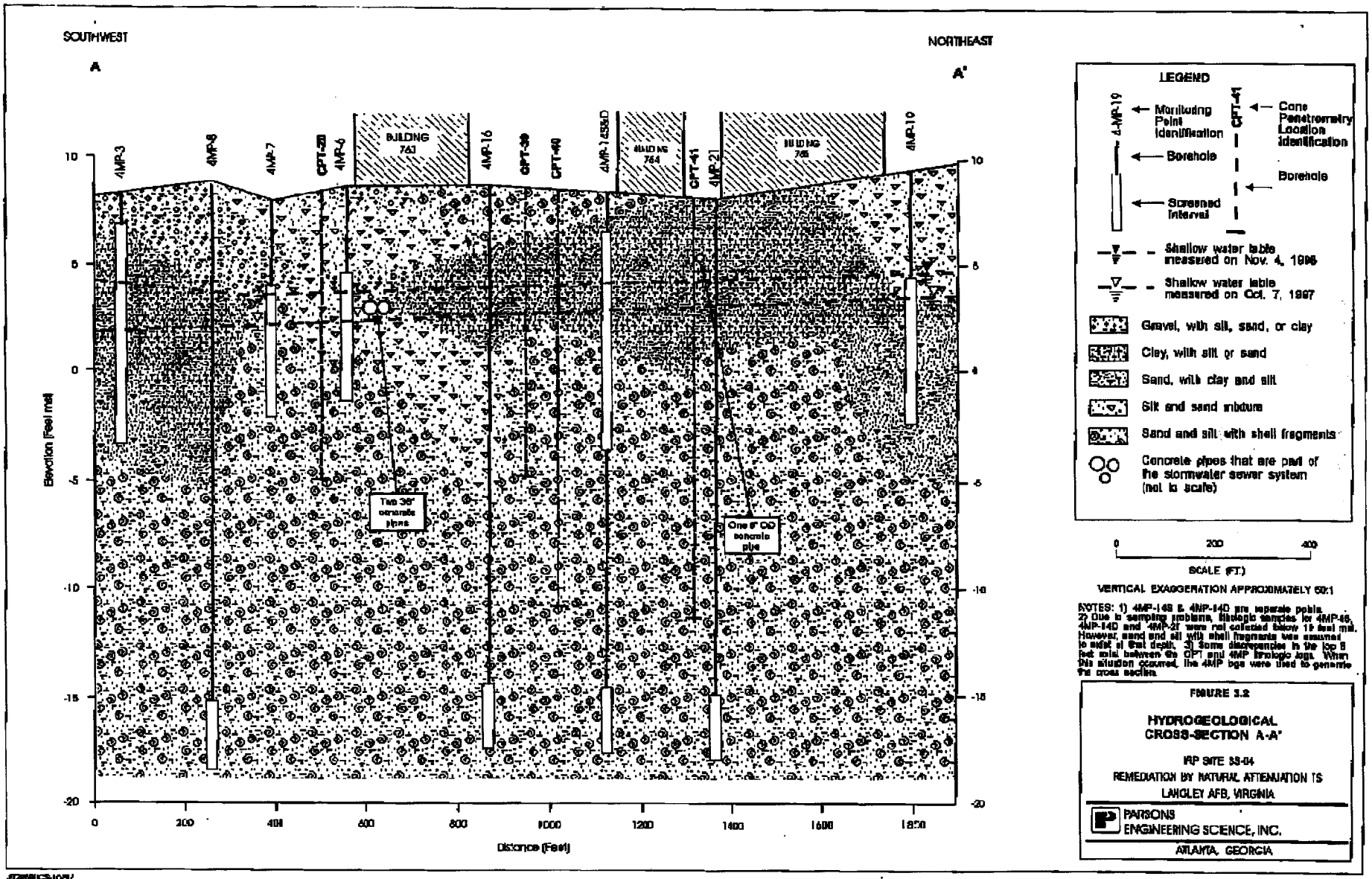
FIGURE 3.1

LOCATION OF HYDROGEOLOGICAL CROSS-SECTIONS

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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NOTES: 1) 4MP-14S & 4MP-14D are separate points. 2) Due to sampling problems, lithologic samples for 4MP-14S, 4MP-14D and 4MP-21 were not collected below 19 feet msl. However, sand and silt with shell fragments was assumed to exist at that depth. 3) Some discrepancies in the top 5 feet msl between the CPT and 4MP lithologic logs. When this situation occurred, the 4MP logs were used to generate the cross section.

FIGURE 3.2

HYDROGEOLOGICAL CROSS-SECTION A-A'

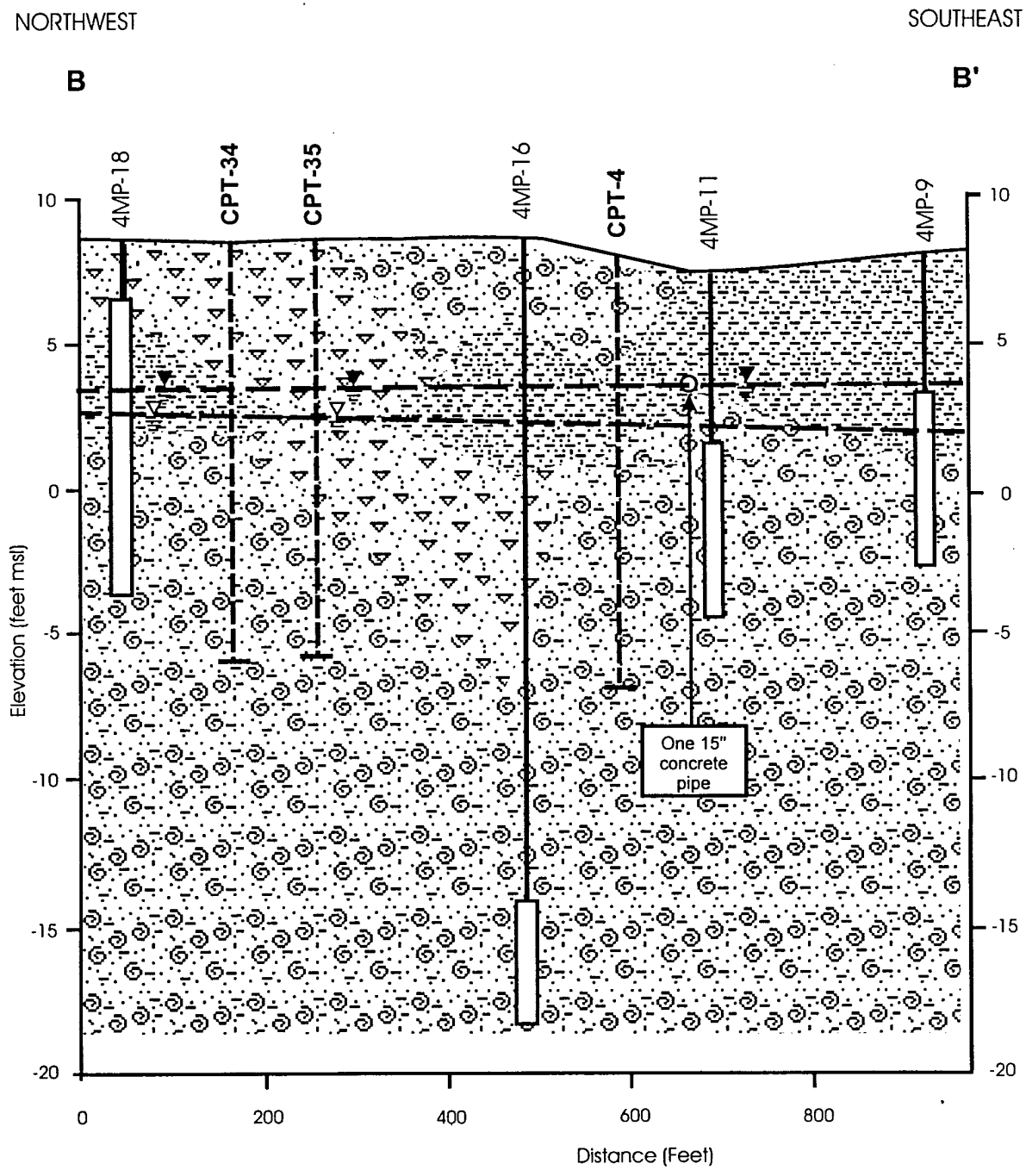
IRP SITE SS-04

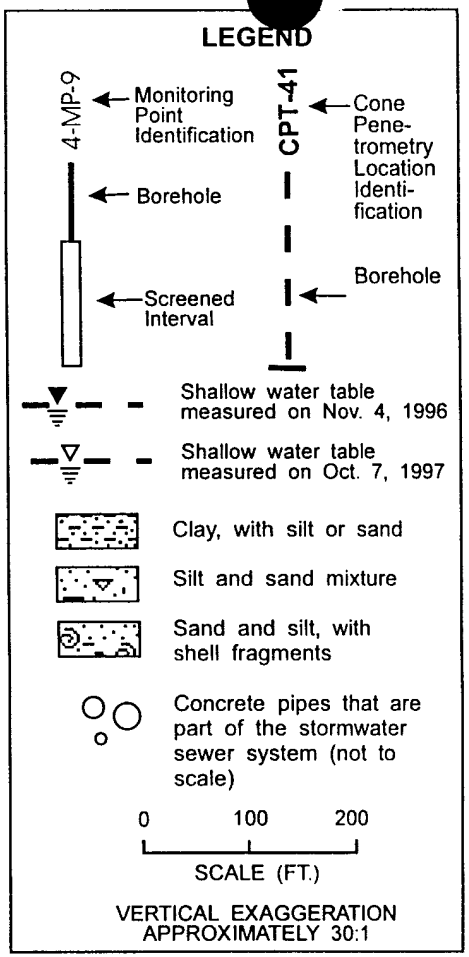
REMEDIATION BY NATURAL ATTENUATION TS

LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.

ATLANTA, GEORGIA





NOTE: Some discrepancies in the top 5 feet exist between the CPT and 4MP lithologic logs. When this situation occurred, the 4MP logs were used to generate the cross section.

FIGURE 3.3

HYDROGEOLOGICAL CROSS-SECTION B-B'

IRP SITE SS-04

REMEDIATION BY NATURAL ATTENUATION TS

LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.

ATLANTA, GEORGIA

TABLE 3.2
SUMMARY OF GROUNDWATER LEVEL MEASUREMENTS, 26-SEP-96
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Location	Top of Casing Elevation (ft msl) [a/]	Depth to Water 26-Sep-96 (ft btoc) [b/]	Depth to LNAPL (ft btoc) [b/]	LNAPL Thickness (feet)	Corrected[c/] Groundwater Elevation (ft msl) [a/]
OW-1	N/A[1d/]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
OW-2	7.57	4.10	ND[e/]	ND	3.47
OW-3	8.63	5.42	ND	ND	3.21
OW-4	8.59	4.59	ND	ND	4.00
OW-5	8.53	4.47	ND	ND	4.06
OW-6	8.56	4.57	ND	ND	3.99
OW-7	8.47	4.55	ND	ND	3.92
OW-8	7.69	3.82	ND	ND	3.87
OW-9	8.07	3.49	3.48	0.01	4.59 [c/]
OW-10	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
OW-11	8.38	4.40	4.38	0.02	4.00 [c/]
OW-12	8.60	N/A[2]	N/A[2]	N/A[2]	N/A[2]
OW-13	8.91	5.71	ND	ND	3.20
OW-14	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]
OW-15	7.67	4.20	ND	ND	3.47
OW-101	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
OW-102	6.52	3.16	ND	ND	3.36
OW-103	7.55	3.91	ND	ND	3.64
OW-104	8.36	5.39	ND	ND	2.97
OW-105	9.00	6.21	ND	ND	2.79
OW-106	8.44	3.85	ND	ND	4.59
OW-107	7.36	4.11	ND	ND	3.25
P-1	8.14	5.28	ND	ND	2.86
P-2	7.93	4.55	ND	ND	3.38
P-3	8.58	5.02	ND	ND	3.56
P-4	8.09	4.31	4.15	0.16	3.91 [c/]
P-5	8.05	3.51	ND	ND	4.54

Notes:

Casing elevations surveyed under the supervision of Parsons ES personnel.

[a/] ft msl = Feet above mean sea level.

[b/] ft btoc = Feet below top of casing.

[c/] corrected for LNAPL depression using a specific gravity of 0.8054.

[d/] N/A = Not available.

[e/] ND = Not detected.

[1] - Well destroyed.

[2] - Could not locate well due to overgrowth.

[3] - Well obstructed.

TABLE 3.3
SUMMARY OF GROUNDWATER LEVEL MEASUREMENTS, 4-NOV-96
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Location	Top of Casing Elevation (ft msl) [a/]	Depth to Water 4-NOV-96 (ft btoc) [b/]	Depth to LNAPL (ft btoc) [b/]	LNAPL Thickness (feet)	Corrected[c/] Groundwater Elevation (ft msl) [a/]
4MP-1	7.73	3.39	ND[d/]	ND	4.34
4MP-2	8.05	4.65	ND	ND	3.40
4MP-3	8.24	4.72	ND	ND	3.52
4MP-4	7.72	5.32	ND	ND	2.40
4MP-5S	7.94	3.79	ND	ND	4.15
4MP-5D	7.93	3.85	ND	ND	4.08
4MP-6	8.57	5.58	ND	ND	2.99
4MP-7	7.89	5.01	ND	ND	2.88
4MP-8	8.66	6.23	ND	ND	2.43
4MP-9	8.00	4.31	ND	ND	3.69
4MP-10	7.60	3.78	ND	ND	3.82
4MP-11	7.23	3.52	ND	ND	3.71
4MP-12M	7.75	3.89	ND	ND	3.86
4MP-12D	7.71	3.82	ND	ND	3.89
4MP-13	7.98	4.58	ND	ND	3.40
4MP-14S	8.30	N/A[1e/]	N/A[1]	N/A[1]	N/A[1]
4MP-14D	8.25	3.08	ND	ND	5.17
4MP-15	7.99	3.74	ND	ND	4.25
4MP-16	8.54	4.48	ND	ND	4.06
4MP-17	8.73	5.41	ND	ND	3.32
4MP-18	8.42	4.77	ND	ND	3.65
4MP-19	8.96	4.65	ND	ND	4.31
4MP-20	7.81	4.15	ND	ND	3.66
4MP-21	8.07	3.02	ND	ND	5.05
OW-1	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
OW-2	7.57	3.55	ND	ND	4.02
OW-3	8.63	5.52	ND	ND	3.11
OW-4	8.59	4.52	ND	ND	4.07
OW-5	8.53	4.32	ND	ND	4.21
OW-6	8.56	4.55	ND	ND	4.01
OW-7	8.47	4.39	ND	ND	4.08
OW-8	7.69	3.87	ND	ND	3.82
OW-9	8.07	2.98	ND	ND	5.09

TABLE 3.3 (Concluded)
SUMMARY OF GROUNDWATER LEVEL MEASUREMENTS, 4-NOV-96
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Location	Top of Casing Elevation (ft msl) [a]	Depth to Water 4-NOV-96 (ft btoc) [b]	Depth to LNAPL (ft btoc) [b]	LNAPL Thickness (feet)	Corrected [c] Groundwater Elevation (ft msl) [a]
OW-10	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
OW-11	8.38	4.07	ND	ND	4.31
OW-12	8.60	5.20	ND	ND	3.40
OW-13	8.91	5.41	ND	ND	3.50
OW-14	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
OW-15	7.67	3.61	ND	ND	4.06
OW-101	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
OW-102	6.52	2.98	ND	ND	3.54
OW-103	7.55	3.33	ND	ND	4.22
OW-104	8.36	5.01	ND	ND	3.35
OW-105	9.00	6.65	ND	ND	2.35
OW-106	8.44	3.68	ND	ND	4.76
OW-107	7.36	3.97	ND	ND	3.39
P-1	8.14	5.41	ND	ND	2.73
P-2	7.93	4.07	ND	ND	3.86
P-3	8.58	4.76	ND	ND	3.82
P-4	8.09	3.98	3.82	0.16	4.24 [c]
P-5	8.05	2.81	ND	ND	5.24
RW-1	8.18	5.65	ND	ND	2.53
RW-2	8.84	N/A[3]	N/A[3]	N/A[3]	N/A[3]
RW-3	8.02	4.94	ND	ND	3.08
RW-4	8.10	4.07	ND	ND	4.03
RW-5	8.43	5.32	ND	ND	3.11
RW-6	7.98	3.92	ND	ND	4.06
RW-7	7.93	3.96	ND	ND	3.97
RW-8	8.40	4.32	ND	ND	4.08
RW-9	7.88	4.12	ND	ND	3.76
RW-10	7.85	3.69	ND	ND	4.16
RW-11	8.37	3.91	ND	ND	4.46
RW-12	7.87	2.78	ND	ND	5.09
RW-13	8.10	2.80	ND	ND	5.30
RW-14	8.60	5.44	ND	ND	3.16
RW-15	9.29	5.92	ND	ND	3.37
RW-16	8.65	4.84	ND	ND	3.81

Notes:

[a] ft msl = Feet above mean sea level.

[b] ft btoc = Feet below top of casing.

[c] Corrected for LNAPL depression using a specific gravity of 0.8054.

[d] ND = Not detected.

[e] N/A = Not available.

1 - Well destroyed

2 - Well obstructed

3 - Water leaking into well

TABLE 3.4
SUMMARY OF GROUNDWATER LEVEL MEASUREMENTS, 7-OCT-97
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Location	Top of Casing Elevation (ft msl) [a/]	Depth to Water 7-OCT-97 (ft btoc) [b/]	Depth to LNAPL (ft btoc) [b/]	LNAPL Thickness (feet)	Corrected[c/] Groundwater Elevation (ft msl) [a/]
4MP-1	7.73	5.70	ND[d/]	ND	2.03
4MP-2	8.05	6.20	ND	ND	1.85
4MP-3	8.24	6.23	ND	ND	2.01
4MP-4	7.72	5.80	ND	ND	1.92
4MP-5S	7.94	5.52	ND	ND	2.42
4MP-5D	7.93	5.52	ND	ND	2.41
4MP-6	8.57	6.28	ND	ND	2.29
4MP-7	7.89	5.81	ND	ND	2.08
4MP-8	8.66	6.72	ND	ND	1.94
4MP-9	8.00	5.73	ND	ND	2.27
4MP-10	7.60	5.42	ND	ND	2.18
4MP-11	7.23	4.80	ND	ND	2.43
4MP-12M	7.75	4.76	ND	ND	2.99
4MP-12D	7.71	4.65	ND	ND	3.06
4MP-13	7.98	6.12	ND	ND	1.86
4MP-14S	8.30	N/A[1e/]	N/A[1]	N/A[1]	N/A[1]
4MP-14D	8.25	4.10	ND	ND	4.15
4MP-15	7.99	4.76	ND	ND	3.23
4MP-16	8.54	5.35	ND	ND	3.19
4MP-17	8.73	6.53	ND	ND	2.20
4MP-18	8.42	5.92	ND	ND	2.50
4MP-19	8.96	6.23	ND	ND	2.73
4MP-20	7.81	5.88	ND	ND	1.93
4MP-21	8.07	4.19	ND	ND	3.88
4MP-22	7.85	5.29	ND	ND	2.56
4MP-23	8.17	6.34	ND	ND	1.83
OW-1	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
OW-2	7.57	5.15	ND	ND	2.42
OW-3	8.63	6.03	ND	ND	2.60
OW-4	8.59	5.29	ND	ND	3.30
OW-5	8.53	5.15	ND	ND	3.38
OW-6	8.56	5.29	ND	ND	3.27
OW-7	8.47	5.31	ND	ND	3.16
OW-8	7.69	4.81	ND	ND	2.88
OW-9	8.07	4.25	ND	ND	3.82

TABLE 3.4 (Concluded)
SUMMARY OF GROUNDWATER LEVEL MEASUREMENTS, 7-OCT-97
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Location	Top of Casing Elevation (ft msl) [a/]	Depth to Water 7-OCT-97 (ft btoc) [b/]	Depth to LNAPL (ft btoc) [b/]	LNAPL Thickness (feet)	Corrected[c/] Groundwater Elevation (ft msl) [a/]
OW-10	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
OW-11	8.38	5.45	ND	ND	2.93
OW-12	8.60	5.82	ND	ND	2.78
OW-13	8.91	6.55	ND	ND	2.36
OW-14	N/A[2]	N/A[2]	N/A[2]	N/A[2]	N/A[2]
OW-15	7.67	5.46	ND	ND	2.21
OW-101	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]
OW-102	6.52	4.03	ND	ND	2.49
OW-103	7.55	5.43	ND	ND	2.12
OW-104	8.36	6.50	ND	ND	1.86
OW-105	9.00	6.99	ND	ND	2.01
OW-106	8.44	4.53	ND	ND	3.91
OW-107	7.36	4.59	ND	ND	2.77
P-1	8.14	6.04	ND	ND	2.10
P-2	7.93	5.80	ND	ND	2.13
P-3	8.58	5.86	ND	ND	2.72
P-4	8.09	5.21	4.60	0.61	3.37 [c/]
P-5	8.05	4.13	ND	ND	3.92
RW-1	8.18	6.20	ND	ND	1.98
RW-2	8.84	6.54	ND	ND	2.30
RW-3	8.02	5.60	ND	ND	2.42
RW-4	8.10	5.82	ND	ND	2.28
RW-5	8.43	6.41	ND	ND	2.02
RW-6	7.98	5.82	ND	ND	2.16
RW-7	7.93	5.78	ND	ND	2.15
RW-8	8.40	5.27	ND	ND	3.13
RW-9	7.88	5.18	ND	ND	2.70
RW-10	7.85	4.68	ND	ND	3.17
RW-11	8.37	4.80	ND	ND	3.57
RW-12	7.87	4.10	ND	ND	3.77
RW-13	8.10	3.95	ND	ND	4.15
RW-14	8.60	6.00	ND	ND	2.60
RW-15	9.29	6.53	ND	ND	2.76
RW-16	8.65	5.97	ND	ND	2.68

Notes: Casing elevations for monitoring points surveyed by Miller-Stephenson of Virginia Beach, Virginia.

[a/] ft msl = Feet above mean sea level.

[b/] ft btoc = Feet below top of casing.

[c/] Corrected for LNAPL depression using a specific gravity of 0.8054.

[d/] ND = Not detected.

[e/] N/A = Not available.

1 - Well destroyed.

2 - Well obstructed.

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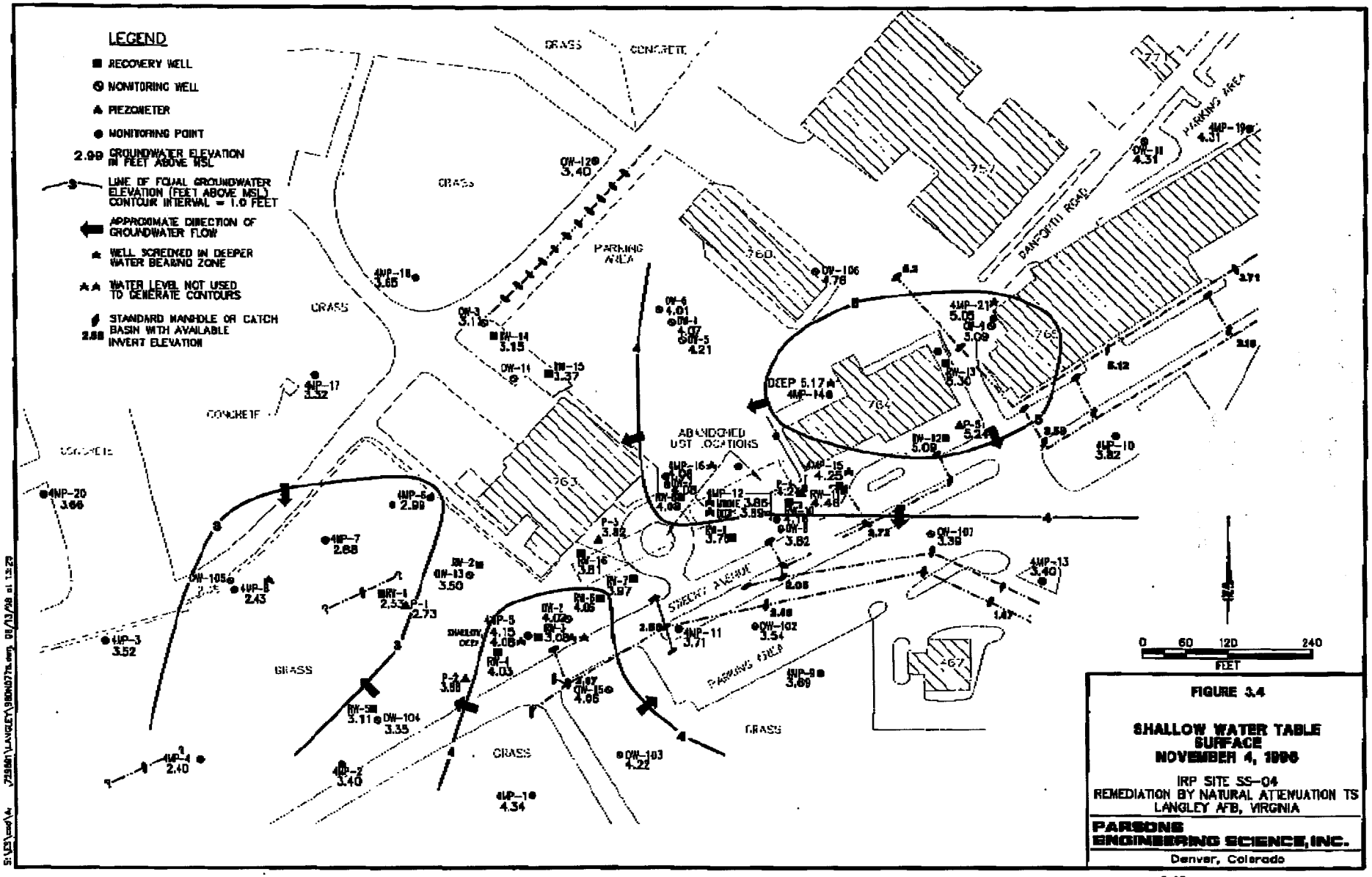


FIGURE 3.4

SHALLOW WATER TABLE SURFACE NOVEMBER 4, 1998

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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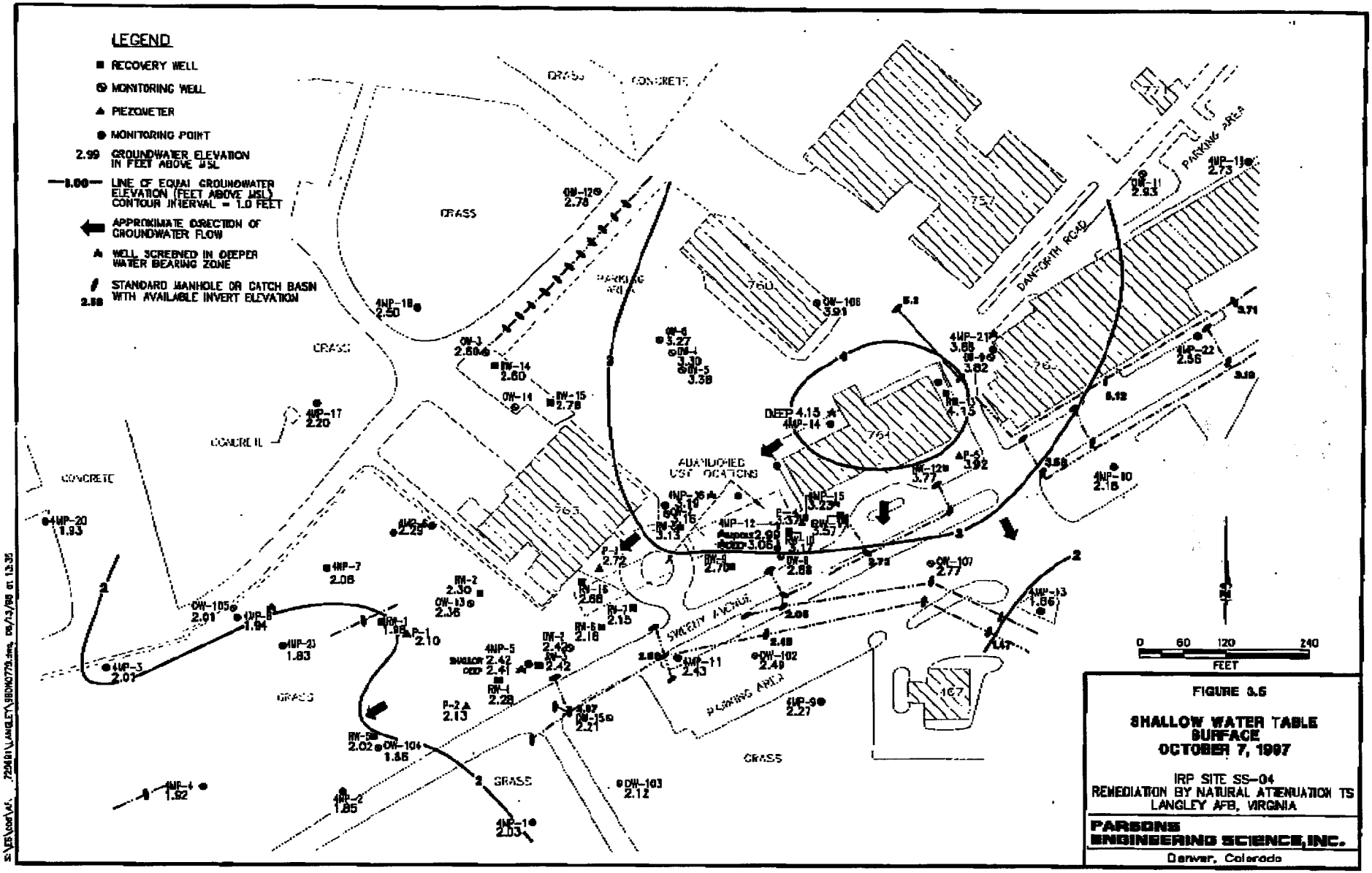


FIGURE 3.5

SHALLOW WATER TABLE SURFACE OCTOBER 7, 1997

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

A groundwater mound (a high) is apparent near well RW-13 in the potentiometric surfaces for November 1996 and October 1997 (Figures 3.4 and 3.5). There does not appear to a natural mechanism , such as a recharge area, creating this mound. Possible anthropogenic causes for the mound may include leaking water distribution pipes or sanitary sewers located in the area.

The contour maps also indicate that the storm sewer fill or the storm sewers themselves are influencing the configuration of the potentiometric surface, and resulting groundwater flow directions, in two areas (Figures 3.4 and 3.5). Comparison of the storm sewer invert elevations in the area south of the abandoned USTs (the line that that runs from 4MP-11 to OW-107 to 4MP-13), and beneath the grassy field west of Building 763 (the line that is inferred to run from RW-1 to 4MP-4) with water-table elevations in these areas indicates that the storm sewers are at least partially below the water table. During the 1996 groundwater measurement event, when water table elevations were higher than in the 1997 event, the storm sewer system had a greater influence on the shallow groundwater flow (Figure 3.4). During the 1997 event, the water table was lower, and less of the storm sewer system was submerged, so that the storm sewer had less influence on the water table (compare Figures 3.4 and 3.5).

Water levels were measured in site monitoring wells on a monthly basis from 1992 to 1996, while the pump-and-treat system was operational at Site SS-04. Comparison of water levels measured in wells assumed to be outside the area of influence of the recovery system, and water levels measured in wells during the events of November 4, 1996 and October 7, 1997, indicates that the 1997 gauging event is probably more representative of average conditions at Site SS-04 (Appendix B). Therefore, the flow regime as evaluated on October 7, 1997 was used in transport modeling (Section 5) to simulate average static conditions over the long term.

Horizontal hydraulic gradients within the shallow groundwater system at the site were estimated to range from approximately 0.001 foot/foot (ft/ft) to 0.012 ft/ft, with an average horizontal gradient of 0.005 ft/ft on November 4, 1996. On October 7, 1997, horizontal gradients ranged from approximately 0.001 ft/ft to 0.007 ft/ft, with an average of 0.003 ft/ft. The gradients are highest northeast of the abandoned USTs near the intersection of Danforth Road and Sweeny Avenue, and are lowest northwest and west of the abandoned USTs. The measured groundwater elevations generally decrease to the south and west of the abandoned USTs.

Vertical hydraulic gradients can be estimated using the head differences in adjacent shallow, intermediate, and deep monitoring points or wells, and the distance between the midpoints of their saturated screen length. Comparison of groundwater elevations measured in six monitoring point and well clusters at IRP Site SS-04 (well pairs OW-105/4MP-8, 4MP-5S/4MP-5D, OW-7/4MP-16, OW-8/4MP-12M/4MP-12D, P-4/4MP-15, and OW-9/4MP-21, with the shallower point or well listed first) indicates that the magnitude of vertical hydraulic gradients established between adjacent wells is generally less than 0.010 ft/ft (Table 3.5) and varies temporally. Vertical hydraulic gradients at site SS-04 are therefore judged to be insignificant.

TABLE 3.5
SUMMARY OF VERTICAL GRADIENTS
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Well Cluster	Groundwater Elevation (ft msl)	Middle of Screen Elevation (ft msl)	Date Measured	Vertical Gradient (ft/ft)	Gradient Direction
4MP-5S	4.15	6.3	4-Nov-96	-0.008	downward
4MP-5D	4.08	15.5	4-Nov-96		
4MP-5S	2.42	7.2	7-Oct-97	-0.001	downward
4MP-5D	2.41	15.5	7-Oct-97		
OW-105	2.35	9.3	4-Nov-96	0.005	upward
4MP-8	2.43	25.5	4-Nov-96		
OW-105	2.01	9.5	7-Oct-97	-0.004	downward
4MP-8	1.94	25.5	7-Oct-97		
OW-8	3.82	7.5	4-Nov-96	0.003	upward
4MP-12M	3.86	20.5	4-Nov-96		
4MP-12D	3.89	32.5	4-Nov-96		
OW-8	2.88	8.0	7-Oct-97	0.007	upward
4MP-12M	2.99	20.5	7-Oct-97		
4MP-12D	3.06	32.5	7-Oct-97		
P-4	4.24	9.4	4-Nov-96	0.001	upward
4MP-15	4.25	24.5	4-Nov-96		
P-4	3.37	9.9	7-Oct-97	-0.010	downward
4MP-15	3.23	24.5	7-Oct-97		
OW-7	4.08	8.2	4-Nov-96	-0.001	downward
4MP-16	4.06	24.5	4-Nov-96		
OW-7	3.16	8.7	7-Oct-97	0.002	upward
4MP-16	3.19	24.5	7-Oct-97		
OW-9	5.09	7.5	4-Nov-96	-0.002	downward
4MP-21	5.05	24.5	4-Nov-96		
OW-9	3.82	8.1	7-Oct-97	0.004	upward
4MP-21	3.88	24.5	7-Oct-97		

Notes:
ft msl = feet above mean sea level.
ft/ft = foot per foot.

3.3.2.2 Hydraulic Conductivity

Parsons ES estimated the horizontal hydraulic conductivity of the shallow saturated zone at wells OW-2, OW-7, OW-8, OW-9, OW-102, OW-103, OW-104, OW-105, OW-107, P-2, P-3, and P-5, using rising-head slug tests. The test data were analyzed using the method of Bouwer and Rice (1976), and the results of the slug tests are summarized in Table 3.6. The average hydraulic conductivity of subsurface materials at the site, as determined from these tests, is 8 feet per day (ft/day). Although this value is higher than the hydraulic conductivity estimated by Law (1991; average of 2.3 ft/day), it was lower than the hydraulic conductivity calculated for Site SS-16 in 1995 (average of 25 ft/day). The test data and analyses are included in Appendix B.

3.3.2.3 Effective Porosity

Because of the difficulty involved in accurately determining effective porosity, accepted literature values for the type of soil comprising the shallow saturated zone were used. Walton (1988) gives ranges of effective porosity for fine sand of 0.1 to 0.3. Because the presence of fines tends to decrease the effective porosity, and because lower effective porosities result in higher computed advective groundwater flow velocities, an effective porosity of 0.2 was assumed for this project.

3.3.2.4 Advective Groundwater Velocity

The advective velocity of groundwater in the direction parallel to the groundwater gradient is given by:

$$v = \frac{K}{n_e}\frac{dH}{dL}$$

where: v = Average advective groundwater velocity (seepage velocity)
K = Average hydraulic conductivity (8 ft/day)
dH/dL = Average hydraulic gradient (0.003 ft/ft; October 7, 1997)
n_e = Effective porosity (0.2).

Using this relationship in conjunction with site-specific data, the average advective groundwater velocity at the site in October 1997 was 0.12 ft/day, or approximately 44 feet per year (ft/yr).

3.3.2.5 Preferential Flow Paths

The storm sewer conduits or the storm sewers themselves are possible preferential flow paths. The apparent relationship between water table elevations and storm-sewer invert locations below the water table suggests that the storm sewer pipes, or the backfill surrounding the pipes, are influencing groundwater surface elevations, and the resulting groundwater flow directions, southeast and southwest of the abandoned USTs (Figures 3.4 and 3.5).

TABLE 3.6
SLUG TEST RESULTS
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Monitoring Well	Type of Test	Hydraulic Conductivity (cm/s)	Hydraulic Conductivity (ft/day)
OW-2	rising head	0.0006	2.0
OW-7	rising head	0.0017	5
OW-8	rising head	0.0053	15
OW-9	rising head	0.0016	4.7
OW-102	rising head	0.0082	22
OW-103	rising head	0.0011	3
OW-104	rising head	0.0053	15
OW-105	rising head	0.0011	3.2
OW-107	rising head	0.0047	13
P-2	rising head	0.0027	7.5
P-3	rising head	0.0009	3
P-5	rising head	0.0014	3.9
	Average	0.0029	8

Notes:
Monitoring well construction details not available for OW-2, OW-7, OW-8, OW-9, P-2, P-3, and P-5. Assumed same construction as well series OW-100's with 10 foot screens and no sumps. Total depths were as measured in November 1996.

3.3.3 Groundwater Use

Drinking-water wells were not identified on Langley AFB. The water supply for the Base is obtained from Big Bethel Reservoir, approximately 1 mile west of the Base.

3.4 CLIMATE

Langley AFB experiences a marine climate characterized by warm, humid, moderately wet summers and mild winters. Average winter temperatures, during the period December through February, are 42 degrees Fahrenheit (°F). Spring, summer, and fall mean daily temperatures range from 40°F to 86°F. The mean annual precipitation is 44.5 inches and the mean annual snowfall is 9 inches.

SECTION 4

SOIL AND GROUNDWATER GEOCHEMISTRY AND NATURE AND EXTENT OF CONTAMINATION

This section discusses hydrologic and chemical data collected from 1995 to 1997 at Site SS-04. Monitoring points and wells, including points 4MP-19, 4MP-21, 4MP-22, and wells OW-9 and OW-11, were also installed and sampled at Site ST-27, east of Site SS-04. Monitoring points and wells were sampled at Site ST-27, in conjunction with investigation activities at Site SS-04, because of the possibility that fuel constituents in groundwater beneath Site SS-04 had originated at sources on Site ST-27 (Section 2). Data collected for the Site ST-27 characterization have been forwarded to Langley AFB. Laboratory data sheets and Chain-of-Custody records from Site ST-27 are included in Appendix C.

4.1 SOURCES OF CONTAMINATION

The substances of potential concern at IRP Site SS-04 are constituents of petroleum-based fuel (JP-4); the suspected sources of contamination at the site include 24 former USTs used to store JP-4 jet fuel, fuel distribution lines running northwest from the USTs, and a JP-4 jet-fuel transmission line (Figure 1.4). The areas of concern are paved with asphalt or concrete, or are planted in grass. There are no indications that fuel constituents are present at land surface. The description of the facility is presented in Subsection 1.2.1, together with additional information regarding the suspected sources of hydrocarbons.

4.2 PHYSICAL AND CHEMICAL CHARACTERISTICS OF PETROLEUM FUELS AND THEIR FATE IN THE ENVIRONMENT

4.2.1 Chemical Composition of Petroleum-Based Fuels

Petroleum hydrocarbon compounds are composed of carbon and hydrogen atoms, arranged into an almost infinite number of discrete molecules. These molecules are classified as alkanes, alkenes, and aromatic hydrocarbons on the basis of their structure. Alkanes, or paraffins, are the major constituents of crude oil and usually the major constituents of refined petroleum products. Alkanes contain only carbon-carbon single bonds, and are subdivided into linear alkanes ("normal" alkanes), branched alkanes (isoalkanes), and naphthenes (cycloalkanes). Alkenes, or olefins, are not usually constituents of crude oil, but are formed during the refining process. Alkenes are linear, branched, or cyclic, with carbon-carbon double bonds; they make up a limited fraction of gasolines, and are not usually a significant component of higher-boiling-point products, including middle-distillate fuels. Alkanes and alkenes are virtually non-toxic, and most are nearly insoluble in water (Zemo *et al.*, 1995).

Aromatic hydrocarbon compounds are based on the benzene ring structure, with conjugated carbon-carbon double bonds, which imparts some unique properties. The monoaromatic compounds (benzene, toluene, ethylbenzene, xylene isomers, and substituted benzenes) are very soluble in water, as compared with alkanes and alkenes. Their high solubility causes aromatic compounds to be quite mobile in the environment. Polycyclic aromatic hydrocarbon compounds (PAHs) contain two or more benzene-ring structures, and range from moderately soluble to virtually insoluble in water. Aromatic hydrocarbon compounds are the most toxic constituents of petroleum products (Zemo *et al.*, 1995).

Middle-distillate-range fuels, including JP-4, are mixtures, consisting almost exclusively of hydrocarbons in the boiling-point range between 150°C and 275°C (Nyer and Skladany, 1989). There are probably several hundred different hydrocarbons, in varying proportions, in any given petroleum-based fuel (Neff *et al.*, 1994), but most of these constituents are relatively inert, and are readily degraded (Lyman *et al.*, 1990). Mid-range fuels are not corrosive, and are only poorly ignitable at the maximum residual concentrations detected in soils at the SS-04 UST site.

Probably the most complete review of the chemistry of JP-4 was conducted by Stelljes and Watkin (1993). This study characterized the chemistry of several fuels representing industrial reference standards and military-purchased JP-4. The results of the study suggest that while there may be some variation in the hydrocarbon composition of mid-range distillate fuel, the differences are ordinarily not large because the performance specifications that must be met restrict the ranges of several physical properties that are related to composition.

The chemical composition of a typical JP-4 fuel (Stelljes and Watkin, 1993) can be used as an analogue of the JP-4 in the subsurface at the SS-04 UST site. The class of saturated hydrocarbon compounds, including the normal alkanes, comprise over 60 percent of the mass of a typical JP-4 fuel. The alkanes from decane (10 carbon atoms in a chain, or "C-10") through octadecane (18 carbon atoms, or "C-18") are most abundant; higher-molecular-weight normal alkanes also occur, but abundance tends to decrease with increasing molecular weight (Neff *et al.*, 1994).

A typical mid-range fuel contains the volatile BTEX constituents and styrene in relatively low concentrations; the BTEX constituents comprise less than five percent of the mass of a virgin JP-4 fuel (Stelljes and Watkin, 1993). The most abundant non-BTEX aromatic hydrocarbons in mid-range fuels include trimethylbenzenes, tetralins/indans, tetramethylbenzenes, naphthalene, methylnaphthalenes, and dimethylnaphthalenes, (Heath *et al.*, 1993; Neff *et al.*, 1994).

The number of carbon atoms present in a hydrocarbon compound has a major effect on its properties (Nyer and Skladany, 1989). For example, alkane chains up to 17 carbon atoms in length are liquids, with densities less than water. Pure alkane compounds, composed of chains 18 or more carbon atoms in length, are actually solids at room temperature, and are commonly referred to as waxes. Alkane solubility rapidly decreases as the number of carbon atoms in the compound increases; vapor pressures also decrease as alkane carbon numbers increase. High vapor pressures indicate that a compound is readily volatilized; low vapor pressures are associated with chemicals that are semi-volatile or non-volatile. For all classes of hydrocarbons, aqueous solubility decreases,

and the tendency of the hydrocarbon compound to sorb to soil particles (or "partition" to soil), increases as the number of carbon atoms and compound molecular weight increase (Neff *et al.*, 1994; Nyer and Skladany, 1989). As a general rule, hydrocarbon compounds with an aqueous solubility less than about 0.1 mg/L will have limited mobility in soils, and are unlikely to migrate to groundwater. According to this definition, the most mobile hydrocarbons include monoaromatic hydrocarbons (benzenes) with molecular weights less than that of n-hexylbenzene, and saturated hydrocarbons with molecular weights less than that of nonane ("C-9").

4.2.2 Fate Of Hydrocarbon Compounds In The Environment

Nearly all soils contain colonies of bacteria and fungi that are capable of biodegrading at least some petroleum hydrocarbons. Soil bacteria and fungi are tremendously diverse, and readily adapt to utilizing different types of organic molecules as their sole or supplemental carbon source (Scow, 1990). Many genera of microorganisms are able to completely oxidize saturated, and to a lesser extent, aromatic hydrocarbons and heterocyclic compounds, to carbon dioxide and water. Although all chemical compounds found in petroleum-based fuels can be degraded by bacteria (Dragun, 1988), the rates of hydrocarbon degradation are much lower under anoxic than oxygen-rich conditions (Nyer and Skladany, 1989). Following a release of petroleum-derived fuel to soil, different hydrocarbon classes are degraded simultaneously, but at widely varying rates, by indigenous microbiota. Normal alkanes of low molecular weight (C-8 to C-22) are metabolized most rapidly, followed by isoalkanes and higher-molecular-weight normal alkanes, olefins, monoaromatic compounds (benzenes), and polycyclic aromatic hydrocarbon (PAH) compounds (Howard *et al.*, 1991; Neff *et al.*, 1994).

Two of the principal models proposed by researchers to describe biodegradation processes at the cell level, the biofilm and Monod kinetic models, can be simplified to a first-order kinetic approximation under certain limiting conditions or at field scales (Bouwer and McCarty, 1984; MacQuarrie *et al.*, 1990). In addition, several authors have noted that first-order kinetics approximate the rate of BTEX degradation observed at individual study sites (Berry-Spark *et al.*, 1988; Chiang *et al.*, 1989; Hathaway and Andrews, 1990; Kemblowski *et al.*, 1987; Tucker *et al.*, 1986). The use of first-order kinetics assumes that the rate of change in concentration with time **(t)** is dependent only on the concentration of the dissolved constituent **(C)**:

$$\frac{\partial C}{\partial t} = \mu C \qquad (1)$$

where μ is a first-order rate constant.

The constituent concentration at a given time can be found by integrating Equation 1 to:

$$C = C_0 e^{-\mu t} \qquad 2$$

where C_0 is the initial concentration of the dissolved constituent.

The problem then becomes one of choosing a representative first-order rate coefficient for an individual site, and then properly incorporating this value into a meaningful descriptive model.

Several transport processes control the physical movement of petroleum chemicals through soils, as non-aqueous liquid (NAPL), dissolved (aqueous), and sorbed (solid) phases. When released to the subsurface environment, petroleum hydrocarbons are usually in the NAPL (oil) phase. Once petroleum hydrocarbons are introduced into the environment, they interact with the surrounding soils. The major process affecting chemicals in the subsurface include sorption to soil, diffusion, dissolution, chemical and biological degradation, and volatilization (Nyer and Skladany, 1989).

In general, low-molecular-weight hydrocarbons will volatilize (evaporate) and diffuse upward in soil gas. Included in this category are alkanes up through dodecane, and aromatic compounds through naphthalene (Neff *et al.*, 1994). The rates of volatilization of different hydrocarbons are directly proportional to their vapor pressures.

Chemicals with higher aqueous solubilities will tend to dissolve into the aqueous phase, and to migrate slowly through soil, transported by ground water. Dissolved-phase transport can occur in either the unsaturated or saturated zone. The unsaturated zone extends from land surface to the top of the water table, while the saturated zone generally includes all earth material below the water table. Dissolved hydrocarbons can enter the unsaturated zone via infiltration of water which contains hydrocarbons, dissolved from an above-ground surface source, or hydrocarbons can become dissolved as percolating water passes over hydrocarbons in soil.

Subsurface transport of fuel hydrocarbons, like movement of any liquid in the subsurface, is driven by potential gradients. In the unsaturated zone, potential gradients are primarily vertical, producing a downward flow direction. Dissolved hydrocarbon compounds are carried downward by percolating water ("advective transport"), and volatilized hydrocarbon compounds are carried upward as a result of concentration gradients between soil moisture and air-filled pore spaces ("diffusive transport"). The transport rate of dissolved hydrocarbons in the unsaturated zone depends primarily on the permeability of the soil, its water content, and the concentrations of hydrocarbon compounds in percolating water. The transport of volatilized hydrocarbons in the unsaturated zone depends primarily on the permeability of the soil, its water content, and the ambient air temperature and barometric pressure. Below the water table, there are no continuous air-filled pores, and vapor-phase transport does not occur. The primary mechanism by which dissolved hydrocarbon compounds migrate in the saturated zone is advective transport, and the direction and rate of advective transport are controlled primarily by the hydraulic conductivity of the soil, and local hydraulic gradients (Neff *et al.*, 1994; Reilly *et al.*, 1987; U.S. EPA, 1989a).

The rate of migration of hydrocarbons in the subsurface also depends on the tendency of hydrocarbon compounds to sorb (attach) to soil particles. All hydrocarbon compounds sorb to soil, to a greater or lesser degree; the fraction of sorbed hydrocarbons increases as the concentration of organic carbon in the soil increases. The organic carbon "partition coefficient" (K_{oc}) is a measure of the tendency of a given compound to be adsorbed to

soil. Compounds having larger values of partition coefficients will be more strongly adsorbed to soil, and less mobile in the environment (Nyer and Skladany, 1989). Most constituents of JP-4 fuel have relatively large partition coefficient values, are strongly sorbed to soil particles, and travel only slowly in the dissolved (aqueous) phase. Furthermore, because the hydrocarbon compounds comprising JP-4 fuel have generally low solubilities, and relatively high vapor pressures, dissolution is not as important as volatilization in removing hydrocarbons from released fuel.

A problem with assessing the extent of a fuel spill is that individual chemical constituents of the fuel do not occur in each of the three phases (volatilized, dissolved, sorbed). The compounds that have low volatility, low solubility, and strong adsorption characteristics will be most prevalent in soil; the compounds with higher solubility will be more prevalent in ground water; and the compounds with higher vapor pressures will be most prevalent in soil gas. In other words, there tends to be a natural separation of the various chemical components of any petroleum product (Nyer and Skladany, 1989). As a further complication, the absolute composition of the petroleum product in the environment changes through time (the fuel "weathers"), as dissolution and volatilization of the soluble and volatile fractions occur, and because some fuel constituents are more readily degraded than others (Fogel *et al.*, 1993). The net result is that the composition of the "weathered" petroleum product is much different than the composition of the virgin fuel originally introduced to soil. In general, as petroleum products weather in the environment, the processes of volatilization, dissolution in water, and biodegradation remove the low-boiling-point, soluble hydrocarbon fractions, leaving a residual mass that is increasingly dominated by molecules with large, complex structures and low solubility (Zemo *et al.*, 1995).

4.2.3 Toxicity Of Fuel Hydrocarbon Compounds

Very few refined petroleum products have been extensively tested for toxicological properties, beyond highly selective toxic endpoints (American Petroleum Institute, 1994; Heath *et al.*, 1993; Magee *et al.*, 1993). Some petroleum products have been evaluated for carcinogenicity in skin painting assays, a toxicological endpoint that provides important information for occupational exposure situations (dermal contact with neat liquids), but provides no dose-response relationship for extrapolation to environmental exposures at low to moderate concentrations. The toxicological evaluation of petroleum products in the environment is also complicated by the effects of weathering. For example, JP-4 fuel contains a small percentage of volatile, low-boiling-point constituents. A spill results in the immediate potential for inhalation exposure to the volatile constituents; the potential for long-term exposure, however, will occur via dermal exposure to, or ingestion of the lower-volatility, higher-boiling-point constituents remaining in near-surface soil. Similarly, the small percentage of soluble hydrocarbon compounds in JP-4 fuel that will dissolve in ground water are transported in the subsurface, resulting in the potential for ingestion or dermal exposure to the soluble constituents. Again, the long-term exposure potential results from dermal exposure to, or ingestion of the lower-solubility, higher-boiling-point constituents remaining in subsurface soil. Accordingly, *the evaluation of the potential toxicological impact of a petroleum product in the environment is not a function of the mere presence of the product*. Not only is there a scarcity of information concerning the toxicity of most refined petroleum products, there is also a low probability that the hydrocarbon mixture present in the

environment approximates the composition of the original petroleum product for which the toxicity information was derived (Zemo *et al.*, 1995).

Because of the lack of toxicological data concerning refined fuels, properly assessing the potential toxic effects of a petroleum fuel requires an evaluation of the *individual fuel constituents* present in the environment. As previously noted, a product such as JP-4 fuel can have hundreds of individual constituents. Fortunately, while any constituent is potentially toxic at a high enough dose, the toxicity of petroleum products can be defined by the toxicity of relatively few constituents that have either a serious toxic effect, or produce effects at levels of exposure considerably lower than the major constituent fraction (ASTM, 1994; Heath *et al.*, 1993; Zemo *et al.*, 1995). This is the approach adopted by the California Department of Health Services' Leaking Underground Fuel Tank Task Force, which used benzene as an indicator compound when evaluating the toxicity of gasoline (California Department of Health Services, 1988, p. 21).

The low-molecular-weight normal alkanes (number of carbon atoms less than C-14) are volatile, but with the exception of n-hexane are not appreciably toxic. Hexane is metabolized to a neurotoxic compound; but is not present in most JP-4 fuels (Heath *et al.*, 1993). The longer-chain alkanes (C-14 and greater) are not volatile, and are non-toxic at concentrations likely to occur at fuel spill sites (ASTM, 1994; Zemo *et al.*, 1995).

Most potential toxic effects arising from petroleum-based fuels are associated with the aromatic hydrocarbon constituents. Monoaromatic hydrocarbons include the BTEX constituents, all of which are assumed to have significant toxicity. Benzene is a known carcinogen; however, the substituted benzenes are not considered to be carcinogenic, and have a low potential for non-carcinogenic health effects. The naphthalenes are the simplest members of the PAH group of fuel constituents; these compounds are moderately volatile, and moderately soluble, but are not significantly toxic.

The BTEX constituents can be used as indicator constituents for refined petroleum products, since most of the potential toxicological effects due to a petroleum product are attributable to these constituents. The remaining constituents, comprising the vast majority of most refined petroleum products, do not represent a potential threat to human health even at high concentrations. The use of indicator constituents also addresses, to a large extent, the potential non-health-based environmental effects of petroleum products, since the indicator compounds include the water-soluble fraction of petroleum hydrocarbon compounds (ASTM, 1994; Heath *et al.*, 1993; Neff *et al.*, 1994; Zemo *et al.*, 1995).

4.3 FUEL CONSTITUENTS IN SOURCE-AREA SOILS

4.3.1 Mobile LNAPL Contamination

Mobile LNAPL is defined as that fraction of LNAPL that is free to move in the subsurface, and that will flow from a porous medium into a well under the influence of gravity. At this site, the mobile LNAPL was characterized by direct measurement and analysis of LNAPL in monitoring wells.

On September 26, 1996, mobile LNAPL was observed in monitoring wells OW-9, OW-11, and P-4 at a thickness of 0.01, 0.02 and 0.16 feet, respectively. On November

4, 1996, mobile LNAPL was observed only in monitoring well P-4 at a thickness of 0.16 feet, and at a thickness of 0.61 feet on October 7, 1997. The increase in LNAPL thickness may be a result of a lower water table during the 1997 monitoring event. The thickness of LNAPL observed inside a monitoring well generally increases with a falling water table (Lundy, 1988; Kemblowski and Chiang, 1988). The corrected water table elevation[1] at P-4 dropped from 4.24 feet NGVD on November 4, 1996 to 3.37 feet NGVD on October 7, 1997.

A sample of mobile LNAPL, collected from well P-4 during the 1996 monitoring event, was analyzed for fuel constituents including BTEX. Table 4.1 compares the concentrations of BTEX constituents in fresh JP-4 with those measured in the LNAPL collected from monitoring well P-4. Compared with "fresh" JP-4, the LNAPL from well P-4 is weathered with respect to all BTEX compounds.

TABLE 4.1
CONCENTRATIONS OF BTEX CONSTITUENTS IN JP-4
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

COMPOUND	CONCENTRATION IN FRESH JP-4 [a/] (mg/L)[c/]	CONCENTRATION IN PRODUCT FROM P-4 [b/] (mg/L)
Benzene	3.750	<8.05
Toluene	9.975	<8.05
Ethylbenzene	2.775	459
Total Xylenes	17.400	668

[a/] Data from Martel (1987).
[b/] Analyzed by Evergreen Analytical Laboratories by EPA Method 8020.
[c/] mg/L = Milligrams per liter.

The relationship between measured LNAPL thickness and the amount of mobile LNAPL in the subsurface at a site is difficult to quantify. It is well documented that the thickness of an LNAPL layer, measured in groundwater monitoring wells, is not indicative of actual mobile LNAPL thickness in the formation (de Pastrovich *et al.*, 1979; Blake and Hall, 1984; Hall *et al.*, 1984; Hughes *et al.*, 1988; Abdul *et al.*, 1989; Testa and Paczkowski, 1989; Kemblowski and Chiang, 1990; Lehnard and Parker, 1990; Mercer and Cohen, 1990; Ballestero *et al.*, 1994). Rather, the thickness of LNAPL measured in a monitoring well is greater than the actual mobile LNAPL thickness present in the aquifer and, according to Mercer and Cohen (1990), the thickness of an LNAPL phase, measured in wells, is typically 2 to 10 times greater than

[1] Because a free-product phase on the water table depresses the water surface, potentiometric elevations at points below a free-product phase must be corrected to account for the effects of the water-table depression.

the actual thickness of the mobile LNAPL phase in the formation. Furthermore, only a fraction of the mobile phase may be recoverable, because as mobile LNAPL is removed from the formation, formerly mobile LNAPL can lose its mobility. One method of evaluating the actual thickness of LNAPL in the formation is the baildown test. This test was not conducted at well P-4 because the observed thicknesses of LNAPL (0.16 feet and 0.61 feet) were less the than minimum 1-foot thickness of product required to complete the test successfully (Wiedemeier *et al.*, 1995).

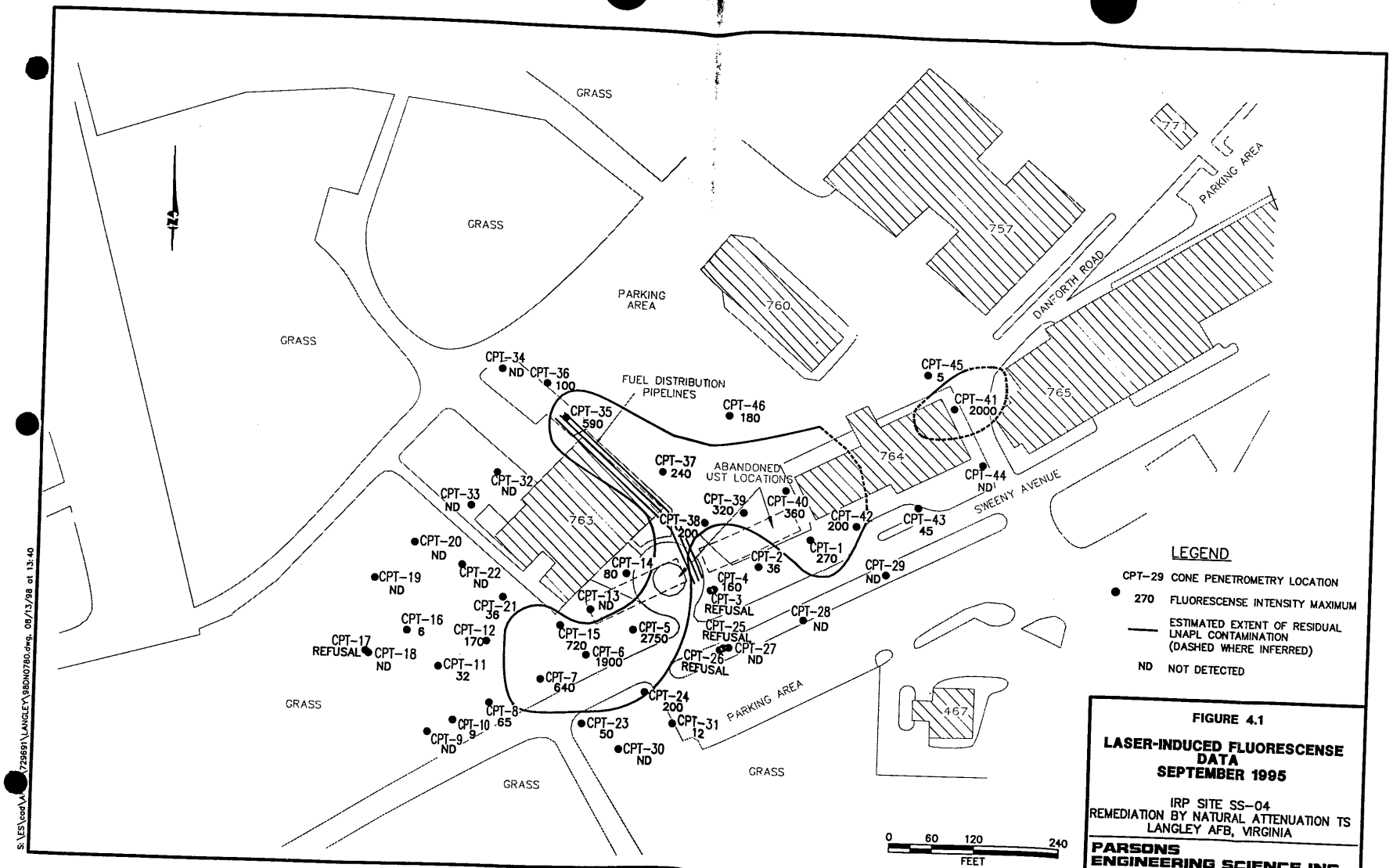
4.3.2 Residual Contamination

Residual LNAPL is defined to be that fraction of LNAPL that is trapped in earth materials in the subsurface by the processes of cohesion and capillarity, and will therefore not move in the subsurface, and will not flow from a porous medium into a well under the influence of gravity. At this site, residual LNAPL was characterized by CPT, combined with LIF technology and analysis of soil samples.

4.3.2.1 LIF Assessment of LNAPL

The LIF component of the CPT may be used to indirectly evaluate the extent of LNAPL at a release site. It is important to note that the LIF does not differentiate between residual and mobile LNAPL in the subsurface. The area identified as containing mobile LNAPL is therefore usually an interpretation of LIF fluorescence intensity and its depth in relation to the groundwater table. The LIF data for IRP Site SS-04 were collected in September 1995; but groundwater elevation data were collected in October-November 1996, and in October 1997. For this reason, LIF data are assumed to be indicative of residual LNAPL contamination only.

LIF data collected during CPT activities (Appendix B) indicated that petroleum hydrocarbons were present in soil as an LNAPL phase, in September 1995, over the approximate extent depicted on Figure 4.1. Because all soils fluoresce at varying background levels, a varying soil matrix can result in changing fluorescence intensities. When a fluctuation occurs gradually or is not greatly elevated above background soil levels, the fluctuation can be difficult to distinguish from a small increase in fluorescence caused by hydrocarbons; therefore, results of the laser fluorescence were reviewed in conjunction with 1996 soil and groundwater analytical results to define the boundaries of residual LNAPL contamination. A laser fluorescence intensity of 200 counts was identified as representative of fluorescence in native soils, and used to establish the boundary (Figure 4.1). LIF measurements suggest that most of the residual LNAPL has a thickness of 1 to 3 feet. The minimum depth to residual LNAPL was 2 feet bgs at drive point CPT-6; in general, residual LNAPL was encountered at 3 to 5 feet bgs. This depth corresponds to the elevation of the water table, and is indicative of a residual LNAPL phase ("smear zone").



LEGEND

CPT-29 CONE PENETROMETRY LOCATION

270 FLUORESCENSE INTENSITY MAXIMUM

ESTIMATED EXTENT OF RESIDUAL LNAPL CONTAMINATION (DASHED WHERE INFERRED)

ND NOT DETECTED

FIGURE 4.1

LASER-INDUCED FLUORESCENSE DATA SEPTEMBER 1995

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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LIF fluorescence was observed through a maximum depth interval of approximately 12.5 feet at drive point CPT-7, near the southwest corner of Building 763 (Figure 4.1). Because the interval began to fluoresce at a depth of about two feet bgs, continuing to a depth of about 14.5 feet bgs, this suggests that LNAPL was present at depths of about nine feet below the water table at that location. This appears to be unlikely; rather, LIF techniques are known to exhibit positive interferences, due to components of the soil matrix, including naturally-occurring organic material, and calcium carbonate (calcite, aragonite; Bruce Nielsen, oral communication, August 11, 1998). The unconsolidated deposits in the shallow subsurface contain varying proportions of shell material, composed of calcite or aragonite (Section 3); a thick interval of this material is suspected to have caused the LIF probe to record fluorescence at depth in drive point CPT-7.

4.3.2.2 BTEX and Fuel Hydrocarbons in Soil Samples

During October and November 1996, ten soil samples were collected at nine locations, and were analyzed for BTEX, TVH-G, total organic carbon (TOC), and/or percent moisture (Table 4.2). One or more of the BTEX compounds were detected in seven of the samples. Five of these sample locations (4MP-5, 4MP-12, 4MP-14, 4MP-15, and 4MP-16) are within the estimated extent of residual soil contamination (Figure 4.2). Fuel odors were also noted during collection of soil samples from locations 4MP-5, 4MP-14, 4MP-15, and 4MP-16. Two soil samples (samples HA-4MP-1 and HA-4MP-11) contained total BTEX at concentrations of 2.0 and 1.2 micrograms per kilogram [µg/kg], respectively; these locations are outside the area of residual LNAPL contamination, but the samples were collected from the depth interval of 3.0 to 3.5 feet bgs, near the water table. BTEX constituents in these samples may represent a sorbed phase, transported from the source area in groundwater. The other three samples, collected from the depth interval 6 to 8 feet bgs at location 4MP-10 and from the depth intervals 5.75 to 6.25 feet bgs and 9.75 to 10.25 feet bgs at location 4MP-13, were outside the area presumed to contain residual LNAPL, and were analyzed for TOC and TVH-G only (Table 4.2). The highest concentration of total BTEX (425,000 µg/kg) was detected in the soil sample from the depth interval 3.5 to 4.0 feet bgs at location 4MP-15. Sample point 4MP-15 is immediately adjacent to the abandoned USTs, and is adjacent to well P-4 where mobile LNAPL has regularly been observed. The second highest concentration of total BTEX (50,500 µg/kg) was detected in the depth interval from 4 to 6 feet bgs at location 4MP-5. A particularly high CPT fluorescence was recorded at drive point CPT-6, near sample point 4MP-5.

Volatile fuel hydrocarbons in the elution range of gasoline (TVH-G) were detected in five of the 10 soil samples, at concentrations ranging from 14 milligrams per kilogram (mg/kg) at location 4MP-16, to 13,000 mg/kg at location 4MP-15 (Table 4.2). BTEX constituents were also detected in the five soil samples; the sample having the highest concentration of TVH-G 4MP-15) also had the highest concentrations of BTEX constituents.

Chlorobenzene was detected in the soil samples collected at locations 4MP-5 and 4MP-14 at concentrations of 5,100 µg/kg and 1,700 µg/kg, respectively. These soil samples also contained elevated concentrations of BTEX constituents.

TABLE 4.2
1996 SOIL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

		Sample ID, Interval, and Date						
		4MP-5	4MP-10	4MP-12	4MP-13	4MP-13	4MP-14	4MP-15
		4-6'	6-8'	5.75-6.25'	5.75-6.25'	9.75-10.25'	5.75-6.25'	3.5-4.0'
Parameters	**Units**	10/26/1996	10/29/1996	10/29/1996	10/29/1996	10/29/1996	10/30/1996	10/31/1996
Benzene	µg/kg	6,700	NM	2.5 U	NM	NM	330	15,000
Toluene	µg/kg	660 U	NM	2.5 U	NM	NM	17,000	150,000
Ethylbenzene	µg/kg	6,800	NM	56	NM	NM	4,000	140,000
Total Xylenes	µg/kg	37,000	NM	97	NM	NM	28,000	120,000
Total BTEX	µg/kg	50,500	NM	153	NM	NM	49,330	425,000
Chlorobenzene	µg/kg	5,100	NM	2.5 U	NM	NM	1,700	240 U
1,2,3-Trimethylbenzene	µg/kg	41,000	NM	160	NM	NM	16,000	75,000
1,2,4-Trimethylbenzene	µg/kg	65,000	NM	170	NM	NM	82,000	68,000
1,3,5-Trimethylbenzene (mesitylene)	µg/kg	47,000	NM	140	NM	NM	22,000	86,000
1,2,3,4-Tetramethylbenzene	µg/kg	51,000	NM	600	NM	NM	47,000	190,000
TVH-Gasoline components	mg/kg	3,300	0.1 U	21	0.1 U	0.1 U	1,800	13,000
Total organic carbon	percent	NM	0.16	NM	0.10	0.07 U	NM	NM
Moisture	percent	24.2	NM	NM	NM	NM	NM	15.5

Notes:
All analyses performed by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado or its subcontractors
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
NM = not measured
U = not detected above the reporting limits
4MP-10 labeled as A in chain-of-custody
4MP-12 labeled as I in chain-of-custody
4MP-13 labeled as Y in chain-of-custody
4MP-14 labeled as D1 in chain-of-custody
4MP-15 labeled as H in chain-of-custody

TABLE 4.2 (Concluded)
1996 SOIL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

		Sample ID, Interval, and Date			
		4MP-16	HA-4MP-1	HA-4MP-11	HA-4MP-11 (Dup)
		4.75-5.25'	3.0-3.5'	3.0-3.5'	3.0-3.5'
Parameters	**Units**	10/31/1996	11/6/1996	11/6/1996	11/6/1996
Benzene	µg/kg	49	0.5 U	0.5 U	0.5 U
Toluene	µg/kg	75	1.3	0.6	0.5
Ethylbenzene	µg/kg	56	0.5 U	0.5 U	0.5 U
Total Xylenes	µg/kg	120	0.7	0.6	2.0
Total BTEX	µg/kg	300	2.0	1.2	2.5
Chlorobenzene	µg/kg	2.4 U	0.5 U	0.5 U	0.5 U
1,2,3-Trimethylbenzene	µg/kg	18	0.5 U	0.5 U	0.5 U
1,2,4-Trimethylbenzene	µg/kg	58	0.5 U	0.5 U	0.5 U
1,3,5-Trimethylbenzene (mesitylene)	µg/kg	68	0.5 U	0.5 U	0.5 U
1,2,3,4-Tetramethylbenzene	µg/kg	100	0.6 U	0.6 U	0.6 U
TVH-Gasoline components	mg/kg	14	0.1 U	0.1 U	0.1 U
Total organic carbon	percent	NM	NM	NM	NM
Moisture	percent	16.2	NM	NM	NM

Notes:

All analyses performed by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado or its subcontractors

BTEX = benzene, toluene, ethylbenzene, and total xylenes

TVH = total volatile hydrocarbons

NM = not measured

µg/kg = micrograms per kilogram

mg/kg = milligrams per kilogram

U = not detected above the reporting limits

E = extrapolated value, value exceeded calibration range

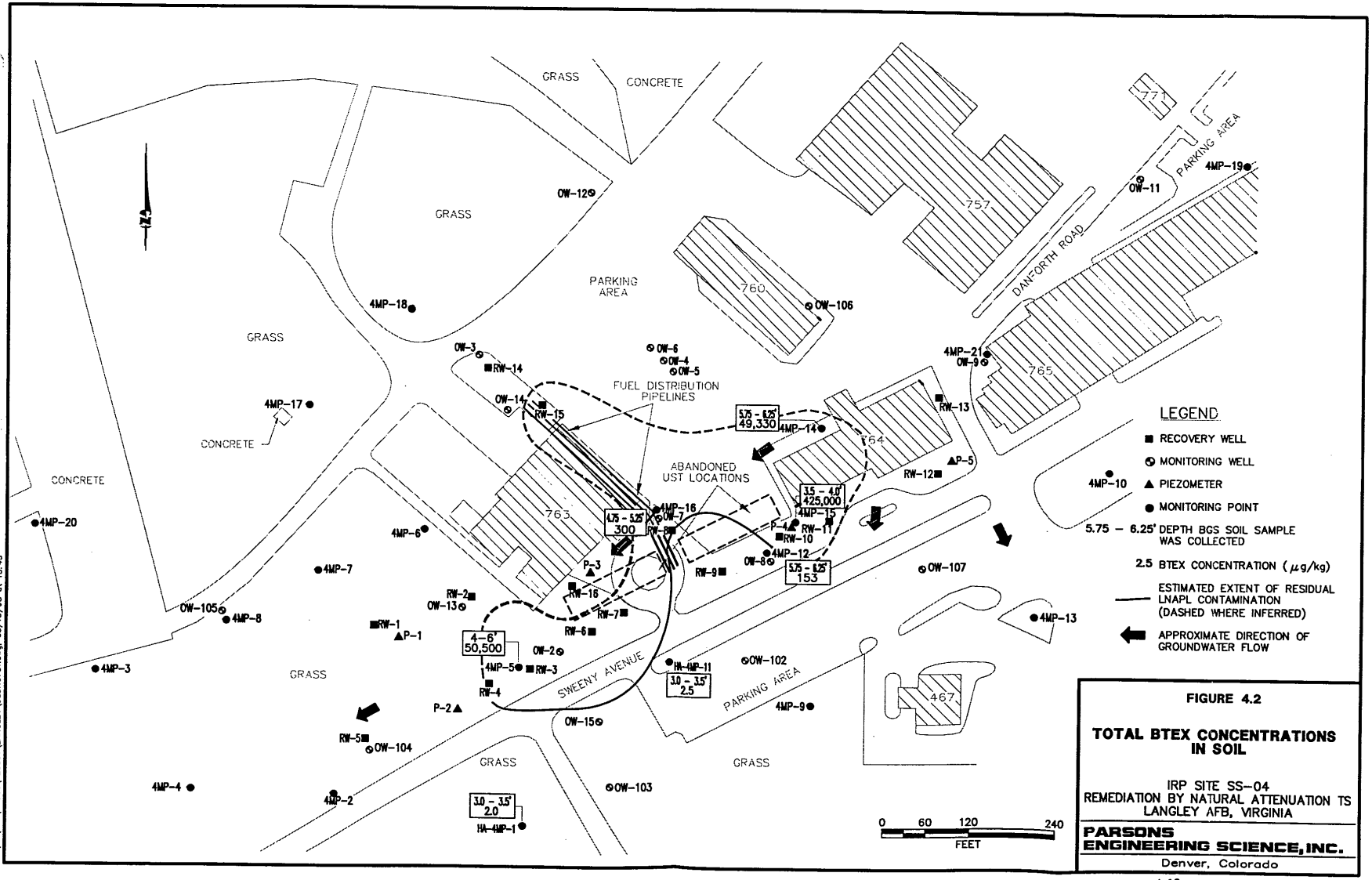
4MP-16 labeled as G in chain-of-custody

4MP-21 labeled as C in chain-of-custody

HA-4MP-1 = hand auger adjacent to 4MP-1

HA-4MP-11 = hand auger adjacent to 4MP-11

HA-4MP-11 (Dup) = duplicate of HA-4MP-1, labeled as HA-4MP-22 in chain-of-custody



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FIGURE 4.2

TOTAL BTEX CONCENTRATIONS IN SOIL

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

4.3.3 Total Organic Carbon and Moisture Content

Concentrations of TOC are used to estimate the amount of organic matter within a soil matrix, or sorbed to soil particles. The TOC content of soils in the saturated zone is used to estimate the partitioning of chemicals between the sorbed and dissolved phases, which slows ("retards") chemical movement in the saturated zone, relative to the average advective velocity of groundwater flow. Three soil samples were analyzed for TOC (Table 4.2); organic carbon was detected in two of the samples, at levels ranging from 0.10 percent by weight (at location 4MP-13) to 0.16 percent by weight (at location 4MP-10).

Soil samples were collected from locations 4MP-15, 4MP-16, 4MP-1, and 4MP-5, at depths above the water table, and were analyzed for moisture content, so that relative saturation could be estimated. Moisture contents ranged from 15.5 percent to 24.2 percent.

4.4 GROUNDWATER CHEMISTRY - OCTOBER 1996 TO OCTOBER 1997

Three lines of evidence can be used to document the occurrence of natural attenuation: 1) presence/absence of geochemical indicators, and their relative concentrations; 2) documented loss of contaminant mass at the field scale; and 3) laboratory microcosm studies. Geochemical evidence is examined in this section as possible evidence to document the occurrence of natural attenuation at IRP Site SS-04. Because this line of evidence strongly suggests that natural attenuation is occurring at this site, laboratory microcosm studies were judged to be un-necessary. The rate of reduction of contaminant mass at the field scale was also examined, by comparing the results of groundwater monitoring completed during two events (November 1996, and October 1997), separated by a period of nearly one year.

4.4.1 Dissolved Fuel Hydrocarbons

Laboratory analytical results for groundwater samples collected during the Law (1991) investigation indicated that fuel hydrocarbons were present in groundwater at shallow depth beneath the suspected source areas (Appendix A). Groundwater samples collected in October and November 1996, and October 1997, by Parsons ES personnel confirmed the results of the Law investigation. The results of analyses of groundwater samples for LNAPL, BTEX, TVH-G, trimethylbenzene (TMB), and tetramethylbenzene (TEMB) are summarized in Table 4.3. Samples were analyzed for TMB and TEMB because these fuel constituents are relatively water-soluble, and are considered to be relatively recalcitrant to biological degradation under anaerobic conditions; therefore, TMB and TEMB can be used as indicator compounds for evaluating anaerobic decay rates for BTEX. Analytical results from the 1996 and 1997 investigations are discussed further in the following subsections.

4.4.1.1 BTEX in Groundwater

BTEX constituents were detected in 19 of 42 groundwater samples collected during the monitoring event of October and November 1996, at total BTEX concentrations ranging from 0.4 to 1,806 micrograms per liter (µg/L). The highest concentration of

TABLE 4.3
GROUNDWATER AND LNAPL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date							
			4MP-1	4MP-2	4MP-3	4MP-4	4MP-5S		4MP-5D	
			1-Nov-96	1-Nov-96	28-Oct-96	1-Nov-96	1-Nov-96	7-Oct-97	1-Nov-96	7-Oct-97
Parameter	**Units**	**Method**								
Benzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	1300	0.4 U	71	3.3
Toluene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	8.0 U	0.4 U	7.2	0.4 U
Ethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	96	2	13	2.9
Total Xylenes	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	410	5.4	54	9.6
Total BTEX	µg/L	8020	1.6 U	1.6 U	1.6 U	1.6 U	1806	7.4	145.2	15.8
TVH - Gasoline components	mg/L	8015 mod	0.1 U	0.1 U	0.1 U	0.1 U	9.0	NM	2.2	NM
TVH - Jet Fuel #5 (JP5) components	mg/L	8015 mod	NM	NM	NM	NM	NM	NM	NM	NM
1,2,3-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	93	1.6	20	6.1
1,2,4-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	820	14	150	93
1,3,5-Trimethylbenzene (mesitylene)	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	190	0.75	40	5.8
Total Trimethylbenzene	µg/L	8020	0.12 U	0.12 U	0.12 U	0.12 U	1103	16.4	210	105
1,2,3,4-Tetramethylbenzene	µg/L	8020	0.5 U	0.5 U	0.5 U	0.5 U	210	16	60	50
Chlorobenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	8.0 U	0.4	0.4 U	0.4 U

Notes:
All analyses done by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
NM = not measured
µg/L = micrograms per liter
mg/L = milligrams per liter
U = not detected above the reporting limits

TABLE 4.3 (Continued)
GROUNDWATER AND LNAPL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date							
			4MP-6	4MP-7		4MP-8	4MP-9	4MP-10	4MP-11	
			31-Oct-96	31-Oct-96	8-Oct-97	28-Oct-96	31-Oct-96	31-Oct-96	1-Nov-96	1-Nov-96
Parameter	**Units**	**Method**								Duplicate
Benzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Toluene	µg/L	8020	0.4 U	1.1	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Ethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Total Xylenes	µg/L	8020	0.4 U	0.4 U	0.8 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Total BTEX	µg/L	8020	1.6 U	1.1	2.0 U	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U
TVH - Gasoline components	mg/L	8015 mod	0.1 U	0.1 U	NM	0.1 U	0.4	0.1 U	0.1 U	0.1 U
TVH - Jet Fuel #5 (JP5) components	mg/L	8015 mod	NM	NM	NM	NM	NM	NM	NM	NM
1,2,3-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
1,2,4-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
1,3,5-Trimethylbenzene (mesitylene)	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Total Trimethylbenzene	µg/L	8020	0.12 U	0.12 U	1.2 U	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
1,2,3,4-Tetramethylbenzene	µg/L	8020	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U

Notes:
All analyses done by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
NM = not measured
µg/L = micrograms per liter
mg/L = milligrams per liter
U = not detected above the reporting limits
Duplicate of 4MP-11 was labeled OW-113 on chain-of-custody

TABLE 4.3 (Continued)
GROUNDWATER AND LNAPL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date							
			4MP-12M	4MP-12D	4MP-13	4MP-14D	4MP-14D	4MP-15		4MP-16
			3-Nov-96	3-Nov-96	1-Nov-96	3-Nov-96	3-Nov-96	3-Nov-96	9-Oct-97	3-Nov-96
Parameter	**Units**	**Method**					Duplicate			
Benzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	7.0	0.4 U	7.5
Toluene	µg/L	8020	2.9	0.4 U	0.4 U	0.4 U	1.3	0.4 U	0.4 U	0.4 U
Ethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4	0.4 U	30	2.1	5.3
Total Xylenes	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.7	1.8	0.98	12
Total BTEX	µg/L	8020	2.9	1.6 U	1.6 U	0.4	2.0	38.8	3.1	24.8
TVH - Gasoline components	mg/L	8015 mod	0.1	0.1 U	0.1 U	0.2	0.3	0.6	NM	0.7
TVH - Jet Fuel #5 (JP5) components	mg/L	8015 mod	NM	NM	NM	NM	NM	NM	NM	NM
1,2,3-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.7	1.0	2.2	1.1	12
1,2,4-Trimethylbenzene	µg/L	8020	0.6	0.4 U	0.4 U	8.0	8.2	9.7	0.78	27
1,3,5-Trimethylbenzene (mesitylene)	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.7	0.4 U	0.4 U	8.2
Total Trimethylbenzene	µg/L	8020	0.6	0.12 U	0.12 U	8.7	9.9	11.9	1.9	47.2
1,2,3,4-Tetramethylbenzene	µg/L	8020	9.3	1.1	0.5 U	7.7	7.9	45	8.9	34
Chlorobenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.5	0.55	0.4 U

Notes:
All analyses done by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
NM = not measured
µg/L = micrograms per liter
mg/L = milligrams per liter
U = not detected above the reporting limits
Duplicate of 4MP-14D was labeled OW-114 on chain-of-custody

TABLE 4.3 (Continued)
GROUNDWATER AND LNAPL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date							
			4MP-17	4MP-18	4MP-20	4MP-23	OW-3		OW-4	
			2-Nov-96	1-Nov-96	2-Nov-96	8-Oct-97	28-Oct-96	8-Oct-97	30-Oct-96	8-Oct-97
Parameter	**Units**	**Method**								
Benzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Toluene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	2.0	0.4 U
Ethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	3.4	5.4	2.8	1.7
Total Xylenes	µg/L	8020	0.4 U	0.4 U	0.4 U	0.8 U	0.6	2.5	0.4 U	0.8 U
Total BTEX	µg/L	8020	1.6 U	1.6 U	1.6 U	2.0 U	4	7.9	4.8	1.7
TVH - Gasoline components	mg/L	8015 mod	0.1 U	0.1 U	0.1 U	NM	1.7	NM	1.5	NM
TVH - Jet Fuel #5 (JP5) components	mg/L	8015 mod	NM	NM	NM	NM	NM	NM	NM	NM
1,2,3-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
1,2,4-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	6.5	3.1	2.3
1,3,5-Trimethylbenzene (mesitylene)	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Total Trimethylbenzene	µg/L	8020	0.12 U	0.12 U	0.12 U	1.2 U	0.12 U	6.5	3.1	2.3
1,2,3,4-Tetramethylbenzene	µg/L	8020	0.5 U	0.5 U	0.5 U	0.5 U	77	80	87	23
Chlorobenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.9	1.4	0.4 U	0.54

Notes:
All analyses done by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
NM = not measured
µg/L = micrograms per liter
mg/L = milligrams per liter
U = not detected above the reporting limits

TABLE 4.3 (Continued)
GROUNDWATER AND LNAPL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date						
			OW-7		OW-8		OW-12	OW-13	
Parameter	Units	Method	29-Oct-96	8-Oct-97	30-Oct-96	8-Oct-97	31-Oct-96	29-Oct-96	29-Oct-96 Duplicate
Benzene	µg/L	8020	97	32	0.4 U	0.4 U	11	0.4 U	0.4 U
Toluene	µg/L	8020	0.7	0.4U	0.4 U	0.4 U	6.4	0.4 U	0.4 U
Ethylbenzene	µg/L	8020	3.8	4.1	0.7	0.4 U	3.7	0.4 U	0.4 U
Total Xylenes	µg/L	8020	6.1	9	0.4 U	0.8 U	0.4 U	0.4 U	0.4 U
Total BTEX	µg/L	8020	107.6	45.1	0.7	2.0 U	21.1	1.6 U	1.6 U
TVH - Gasoline components	mg/L	8015 mod	1.8	NM	0.3	NM	2.0	0.5	0.5
TVH - Jet Fuel #5 (JP5) components	mg/L	8015 mod	NM	NM	NM	NM	NM	NM	NM
1,2,3-Trimethylbenzene	µg/L	8020	10	7.1	0.7	0.4 U	0.4 U	20	20
1,2,4-Trimethylbenzene	µg/L	8020	17	9.2	2.0	1.1	2.6	8.5	8.4
1,3,5-Trimethylbenzene (mesitylene)	µg/L	8020	1.9	1.2	0.4 U	0.4 U	0.4 U	7	7
Total Trimethylbenzene	µg/L	8020	28.9	17.5	2.7	1.1	2.6	35.5	35.4
1,2,3,4-Tetramethylbenzene	µg/L	8020	100	79	2.9	3.7	42	20	20
Chlorobenzene	µg/L	8020	0.8	0.74	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U

Notes:
All analyses done by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
NM = not measured
µg/L = micrograms per liter
mg/L = milligrams per liter
U = not detected above the reporting limits
Duplicate of OW-13 was labeled OW-110 on chain-of-custody

TABLE 4.3 (Continued)
1996 GROUNDWATER AND LNAPL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date				
			OW-15	OW-102	OW-103	OW-104	OW-105
			30-Oct-96	30-Oct-96	30-Oct-96	29-Oct-96	28-Oct-96
Parameter	**Units**	**Method**					
Benzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Toluene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Ethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Total Xylenes	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Total BTEX	µg/L	8020	1.6 U	1.6 U	1.6 U	1.6 U	1.6 U
TVH - Gasoline components	mg/L	8015 mod	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
TVH - Jet Fuel #5 (JP5) components	mg/L	8015 mod	NM	NM	NM	NM	NM
1,2,3-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
1,2,4-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
1,3,5-Trimethylbenzene (mesitylene)	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Total Trimethylbenzene	µg/L	8020	0.12 U	0.12 U	0.12 U	0.12 U	0.12 U
1,2,3,4-Tetramethylbenzene	µg/L	8020	1.0	0.5 U	0.5 U	0.5 U	0.5 U
Chlorobenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U

Notes:
All analyses done by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
NM = not measured
µg/L = micrograms per liter
mg/L = milligrams per liter
U = not detected above the reporting limits

TABLE 4.3 (Continued)
GROUNDWATER AND LNAPL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date					
			OW-106	OW-107	P-1		P-2	P-3
			30-Oct-96	30-Oct-96	29-Oct-96	8-Oct-97	29-Oct-96	29-Oct-96
Parameter	**Units**	**Method**						
Benzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U
Toluene	µg/L	8020	0.4 U	0.4 U	2.3	1.8	0.4 U	2.8
Ethylbenzene	µg/L	8020	0.4 U	0.4 U	2.9	0.93	0.4 U	1.1
Total Xylenes	µg/L	8020	0.4 U	0.4 U	0.4	0.8 U	0.4 U	0.4 U
Total BTEX	µg/L	8020	1.6 U	1.6 U	5.6	2.7	1.6 U	3.9
TVH - Gasoline components	mg/L	8015 mod	0.1 U	0.1 U	0.4	NM	0.1 U	1.0
TVH - Jet Fuel #5 (JP5) components	mg/L	8015 mod	NM	NM	NM	NM	NM	NM
1,2,3-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	1.5	0.4 U	0.4 U	0.4 U
1,2,4-Trimethylbenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	1.4	0.4 U	4.8
1,3,5-Trimethylbenzene (mesitylene)	µg/L	8020	0.4 U	0.4 U	0.5	0.4 U	0.4 U	5
Total Trimethylbenzene	µg/L	8020	0.12 U	0.12 U	2	1.4	0.12 U	9.8
1,2,3,4-Tetramethylbenzene	µg/L	8020	0.5 U	0.5 U	17	2.7	0.5 U	1.7
Chlorobenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	1.5

Notes:
All analyses done by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
NM = not measured
µg/L = micrograms per liter
mg/L = milligrams per liter
U = not detected above the reporting limits

TABLE 4.3 (Continued)
GROUNDWATER AND LNAPL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date						
				P-4			P-5		RW-4
			4-Nov-96	4-Nov-96	9-Oct-97	9-Oct-97	30-Oct-96	9-Oct-97	9-Oct-97
Parameter	**Units**	**Method**		LNAPL		Duplicate			
Benzene	µg/L	8020	25	8,054 U	170	81	0.4 U	0.4 U	0.4 U
Toluene	µg/L	8020	0.4 U	8,054 U	0.4 U	0.4 U	5.6	0.4 U	1.2
Ethylbenzene	µg/L	8020	41	459,078	140	70	5.9	3.5	0.89
Total Xylenes	µg/L	8020	13	668,482	8.9	11	3.3	5.7	1.2
Total BTEX	µg/L	8020	79	1,127,560	319	162	14.8	9.2	3.3
TVH - Gasoline components	mg/L	8015 mod	2.8	120,810	NM	NM	2.6	NM	NM
TVH - Jet Fuel #5 (JP5) components	mg/L	8015 mod	NM	579,888	NM	NM	NM	NM	NM
1,2,3-Trimethylbenzene	µg/L	8020	9.9	491,294	14	20	150 E	0.4 U	0.4 U
1,2,4-Trimethylbenzene	µg/L	8020	42	571,834	30	33	0.5	0.4 U	1.8
1,3,5-Trimethylbenzene (mesitylene)	µg/L	8020	10	322,160	4.2	6.3	5.9	0.4 U	0.4 U
Total Trimethylbenzene	µg/L	8020	61.9	1,385,288	48.2	59.3	156.4	1.2 U	1.8
1,2,3,4-Tetramethylbenzene	µg/L	8020	99	3,060,520	150	94	31	0.5 U	37
Chlorobenzene	µg/L	8020	1.0	805,400	1.2	2.1	1.1	0.4 U	0.4 U

Notes:
All analyses done by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
NM = not measured
µg/L = micrograms per liter
mg/L = milligrams per liter
U = not detected above the reporting limits
LNAPL = light nonaqueous phase liquid
P-4 LNAPL analytical results were converted from µg/kg to µg/L and from mg/kg to mg/L by multiplying by a specific gravity of 0.8054
Duplicate of P-4 dated 9-OCT-97 was labeled OW-112 on chain-of-custody
E = extrapolated value, value exceeded calibration range

TABLE 4.3 (Concluded)
GROUNDWATER AND LNAPL ANALYTICAL RESULTS
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date					
				RW-6		RW-13	RW-15	
			30-Oct-96	30-Oct-96	8-Oct-97	3-Nov-96	3-Nov-96	8-Oct-97
Parameter	**Units**	**Method**		Duplicate				
Benzene	µg/L	8020	12	13	43	0.4 U	0.4 U	0.4 U
Toluene	µg/L	8020	3.3	3.5	0.4 U	0.4 U	18	0.4 U
Ethylbenzene	µg/L	8020	1.3	1.4	2.8	1.0	0.4 U	1.3
Total Xylenes	µg/L	8020	4.4	5.0	5.5	0.4 U	0.4 U	0.8 U
Total BTEX	µg/L	8020	21	22.9	51.3	1.0	18	1.3
TVH - Gasoline components	mg/L	8015 mod	1.1	1.2	NM	0.2	0.2	NM
TVH - Jet Fuel #5 (JP5) components	mg/L	8015 mod	NM	NM	NM	NM	NM	NM
1,2,3-Trimethylbenzene	µg/L	8020	13	14	14	0.4 U	0.4 U	0.4 U
1,2,4-Trimethylbenzene	µg/L	8020	27	29	23	1.5	0.5	1.4
1,3,5-Trimethylbenzene (mesitylene)	µg/L	8020	13	14	11	0.4 U	0.4 U	0.4 U
Total Trimethylbenzene	µg/L	8020	53	57	48	1.5	0.5	1.4
1,2,3,4-Tetramethylbenzene	µg/L	8020	46	51	36	24	6.4	4.1
Chlorobenzene	µg/L	8020	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U

Notes:
All analyses done by Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado
BTEX = benzene, toluene, ethylbenzene, and total xylenes
TVH = total volatile hydrocarbons
NM = not measured
µg/L = micrograms per liter
mg/L = milligrams per liter
U = not detected above the reporting limits

Duplicate of RW-6 was labeled OW-111 on chain-of-custody

total BTEX constituents (1,806 μg/L) was detected in the sample from monitoring point 4MP-5S (Table 4.3). The highest concentration of benzene (1,300 μg/L) was also detected in the groundwater sample from this well. Benzene was the only constituent detected in groundwater samples collected during the 1996 event that exceeded potential regulatory standards (the Federal MCL of 5 μg/L; USEPA, 1996); the MCL for benzene was exceeded in 8 of the 42 groundwater samples. Toluene was detected in 11 groundwater samples, at concentrations ranging from 1.3 to 18 μg/L; ethylbenzene was detected in 15 samples, at concentrations ranging from 0.7 to 96 μg/L; and total xylene isomers were detected in ten samples, at concentrations ranging from 0.4 to 410 μg/L. The highest concentrations of ethylbenzene (96 μg/L) and total xylenes isomers (410 μg/L) were detected in the groundwater sample collected from monitoring point 4MP-5S. The Federal MCLs (USEPA, 1996) for toluene (1,000 μg/L), ethylbenzene (700 μg/L) and xylenes (10,000 μg/L) were not exceeded in any groundwater sample, collected during the 1996 monitoring event.

Seven of the 42 groundwater samples analyzed in 1996 were collected from deeper wells in the shallow groundwater system. The concentrations of total BTEX declined with increasing depth at all locations (Table 4.3).

During the monitoring event of October 1997, BTEX constituents were detected in 12 of 15 groundwater samples, at concentrations of total BTEX ranging from 1.3 μg/L to 319 μg/L (Table 4.3). The highest concentration of total BTEX (319 μg/L) was detected in the groundwater sample from well P-4. The highest concentration of benzene (170 μg/L) was also detected in the groundwater sample from that well. Concentrations of benzene detected in groundwater samples, collected during the 1997 event, exceeded the Federal MCL (5 μg/L) in three of the 15 groundwater samples (groundwater samples from wells OW-7, P-4, and RW-6).

Toluene was detected in a single groundwater sample, at a concentration of 1.2 μg/L; ethylbenzene was detected in 12 samples, at concentrations ranging from 0.89 to 140 μg/L; and total xylene isomers were detected in nine samples, at concentrations ranging from 0.98 to 9 μg/L. The highest concentrations of ethylbenzene (140 μg/L) were detected in the groundwater sample collected from well P-4, and the highest concentrations of total xylenes isomers (9 μg/L) were detected in the groundwater sample collected from well OW-7. The Federal MCLs for toluene and xylenes were not exceeded in any groundwater sample collected during the 1997 monitoring event.

Four of the 15 groundwater samples analyzed in 1997 were collected from two well pairs. The concentrations of total BTEX constituents were lower in the deep well (well 4MP-15) of the P-4/4MP-15 pair (319 μg/L in well P-4 as compared with 3.1 μg/L in well 4MP-15), and were higher in the deep well (well 4MP-5D) of the 4MP-5S/4MP-5D pair (7.4 μg/L in well 4MP-5S as compared with 15.8 μg/L in well 4MP-5D).

The areal distribution of total dissolved BTEX constituents detected in groundwater samples during the October-November 1996 sampling event is presented on Figure 4.3. In November 1996, the extent of the dissolved BTEX plume, as defined by the 10μg/L contour, covered a total area of approximately 214,300 square feet (4.9 acres); the estimated length of the major axis (northwest to southeast) was about 820 feet, and the

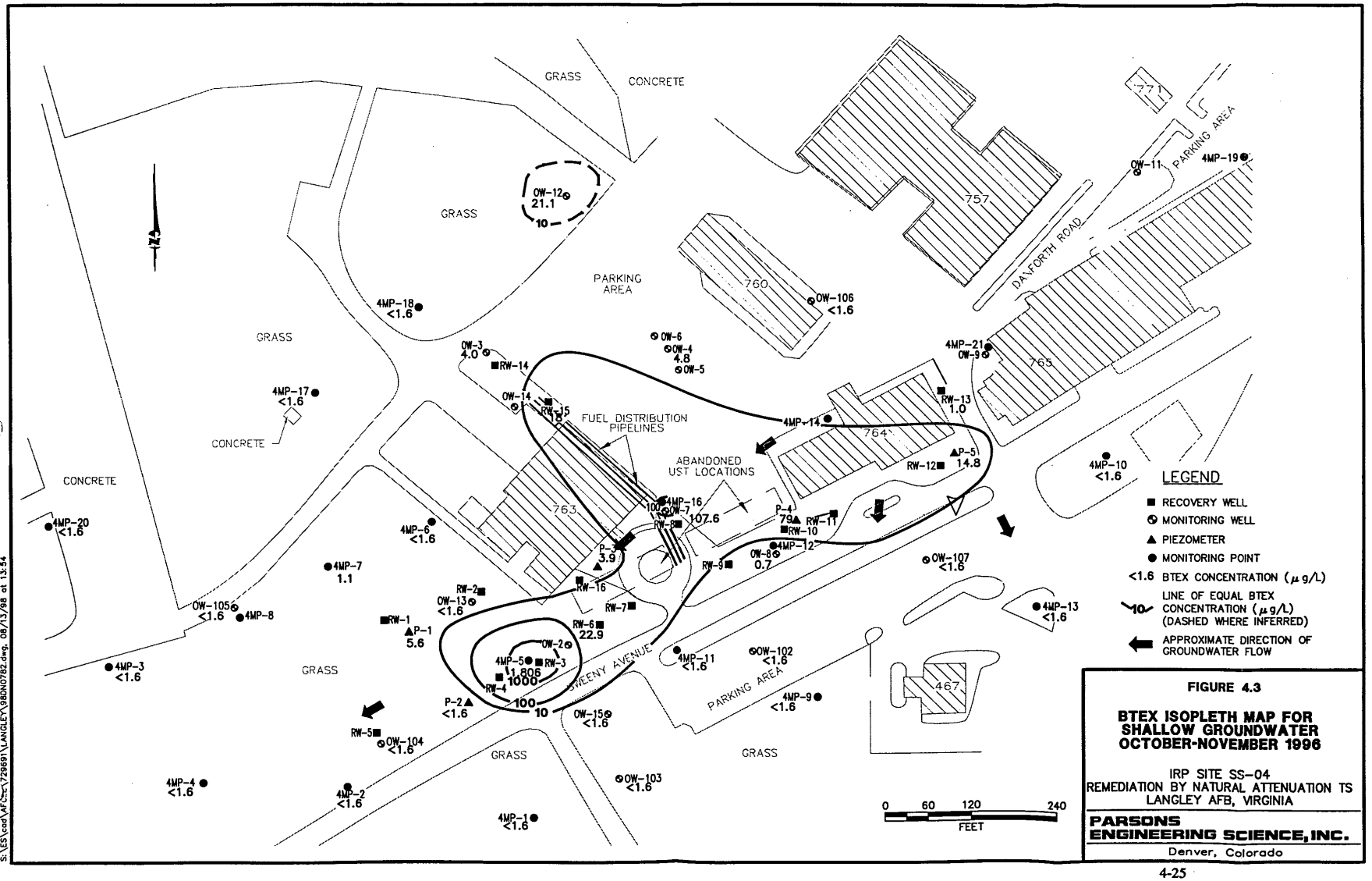


FIGURE 4.3

BTEX ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER-NOVEMBER 1996

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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estimated length of the minor axis (northwest to southeast) was about 400 feet. By October 1997, the areal extent of the dissolved BTEX plume (defined by the 10 µg/L contour), had decreased dramatically, and covered a total area of approximately 79,300 square feet (1.8 acres), with a major axis approximately 600 feet in length, and a minor axis about 130 feet long (Figure 4.4). The centroid of the plume, in 1996 and 1997, was located in the vicinity of the abandoned USTs (Figures 4.3 and 4.4). In light of the probable direction of groundwater flow at the site (northeast to southwest), the isolated, low concentrations of benzene, toluene, and ethylbenzene detected in the groundwater sample collected from well OW-12 in October 1996 (Table 4.3), are not believed to be associated with the SS-04 UST site.

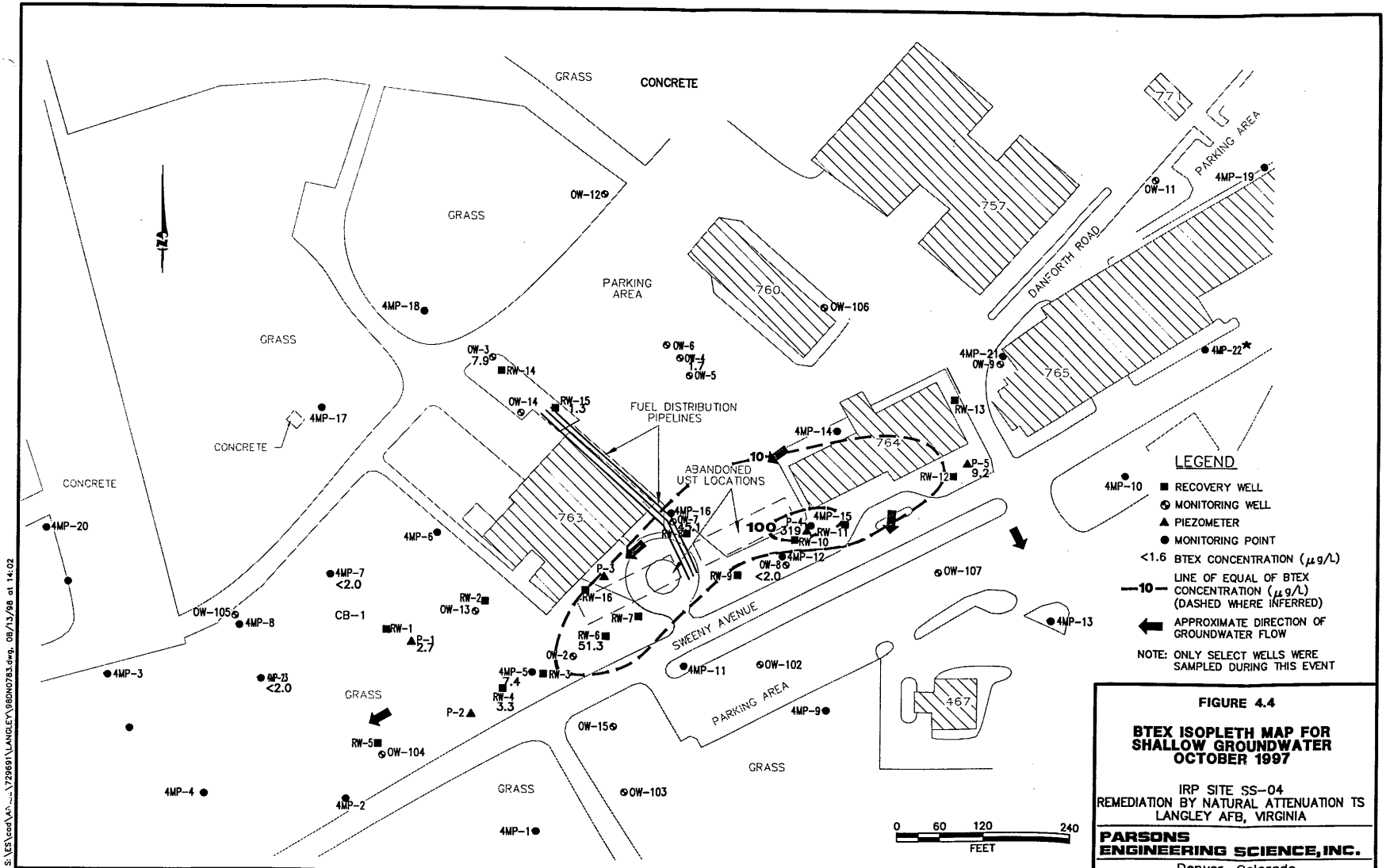
In addition to the marked decline in areal extent, the concentrations of total dissolved BTEX concentrations also decreased throughout the plume, during the period between the monitoring events of October-November 1996 and October 1997. In 1996, the highest concentration of total BTEX constituents detected in groundwater was 1,806 µg/L, detected in the sample from monitoring point 4MP-5S (Table 4.3). By October 1997, the concentrations of total BTEX, detected in the groundwater sample from monitoring point 4MP-5S, had declined to 7.4 µg/L. The highest concentration of total BTEX constituents in 1997 was detected in the groundwater sample from well P-4 (319 µg/L); and the concentrations of total BTEX also declined significantly at other locations (e.g., well OW-7, which declined from 107.6 µg/L in 1996 to 45.1 µg/L in 1997). The only significant increase in concentrations of total BTEX was in the groundwater sample, collected from well P-4 (79 µg/L in 1996, increasing to 319 µg/L in 1997). Monitoring well P-4 was the only well in which an LNAPL phase was observed in October 1997.

4.4.1.2 TVH-G in Groundwater

Groundwater samples, collected during the monitoring event of October-November 1996, were analyzed for TVH-G (Figure 4.5). The areal distribution of TVH-G was similar to the distribution of BTEX compounds (compare Figures 4.3 and 4.5). The concentrations of TVH-G that were detected ranged from 0.1 to 9.0 mg/L (Table 4.3).

4.4.1.3 Chlorobenzene in Groundwater

Forty-two groundwater samples collected during the 1996 monitoring event were analyzed for chlorobenzene. Chlorobenzene was detected in six of the samples (samples from wells 4MP-15, OW-3, OW-7, P-3, P-4, and P-5), at concentrations ranging from 0.4 µg/L to 1.1 µg/L (Table 4.3). BTEX constituents were also detected in each of these samples. In 1997, 15 groundwater samples were analyzed for chlorobenzene. Chlorobenzene was detected in five of the samples (samples from wells 4MP-5S, 4MP-15, OW-3, OW-7, and P-4) at concentrations ranging from 0.4 µg/L to 2.1 µg/L (Table 4.3). BTEX constituents also were detected in each of these samples. The Federal MCL for chlorobenzene (100 µg/L) was not exceeded in any groundwater sample.



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FIGURE 4.4

BTEX ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER 1997

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

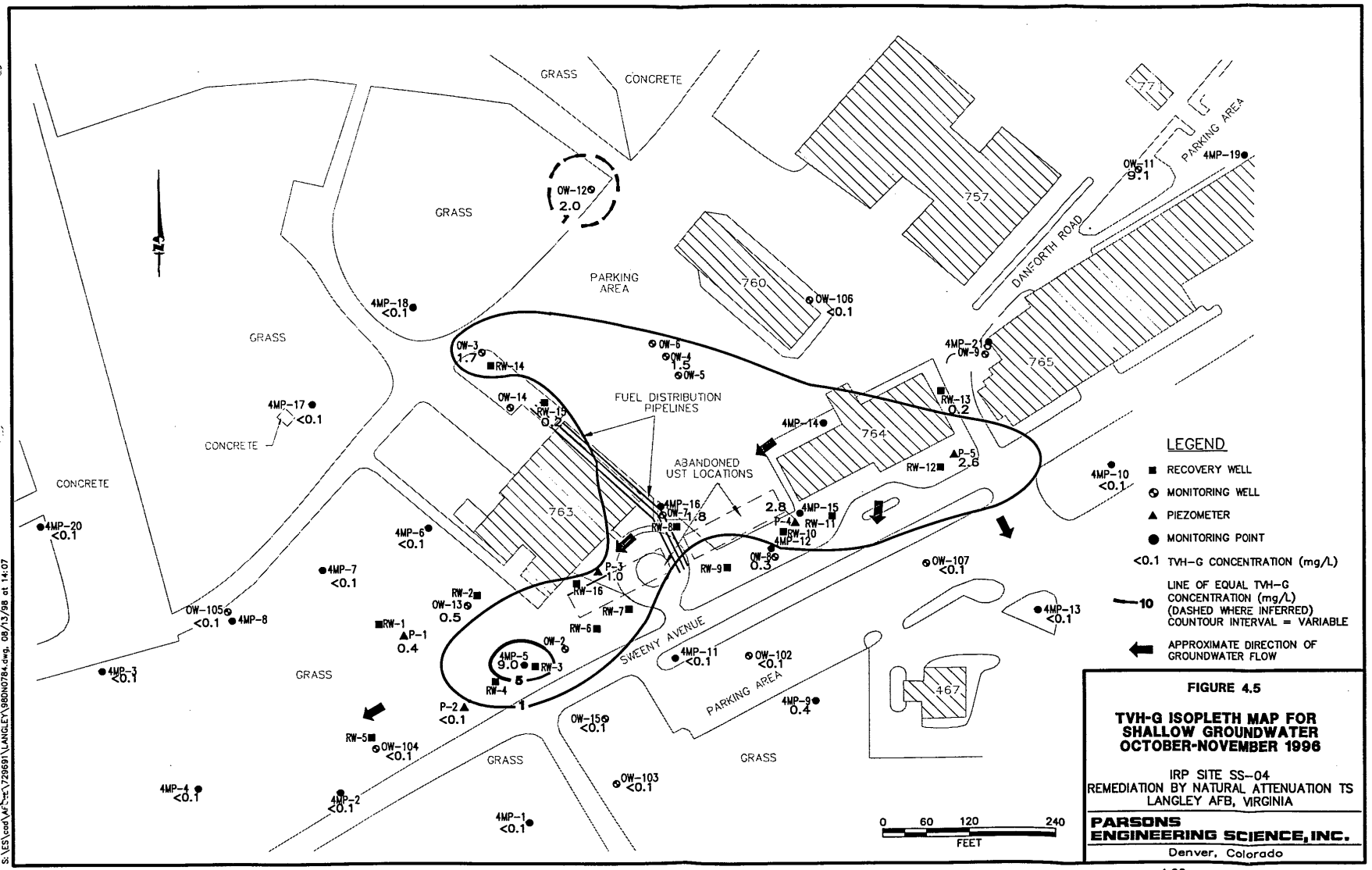


FIGURE 4.5

TVH-G ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER-NOVEMBER 1996

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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4.4.2 Inorganic Chemistry and Geochemical Indicators of BTEX Biodegradation

Numerous laboratory and field studies have demonstrated that microflora/microfauna (bacteria) can degrade many of the chemical components of jet fuel and gasoline, including the BTEX compounds (e.g., Jamison *et al.*, 1975; Atlas, 1981, 1984, and 1988; Gibson and Subramanian, 1984; Reinhard *et al.*, 1984; Young, 1984; Bartha, 1986; Wilson *et al.*, 1986, 1987, and 1990; Barker *et al.*, 1987; Baedecker *et al.*, 1988; Lee, 1988; Chiang *et al.*, 1989; Grbic-Galic, 1990; Cozzarelli *et al.*, 1990; Leahy and Colewell, 1990; Alvarez and Vogel, 1991; Edwards *et al.*, 1992; Evans *et al.*, 1991a and 1991b; Hutchins *et al.*, 1991a and 1991b; Beller *et al.*, 1992; Bouwer, 1992; Edwards and Grbic-Galic, 1992; Thierrin *et al.*, 1992; Malone *et al.*, 1993; Davis *et al.*, 1994). Biodegradation of fuel hydrocarbons can occur when an indigenous population of hydrocarbon-degrading microorganisms is present in the subsurface, and sufficient concentrations of electron acceptors, nutrients, and electron donors (including fuel hydrocarbons) are available to these organisms.

Microorganisms obtain energy for cell production and maintenance by facilitating thermodynamically advantageous oxidation/reduction reactions involving the transfer of electrons, from electron donors to available electron acceptors, thereby oxidizing the electron donor and reducing the electron acceptor. Possible electron donors include natural organic carbon and fuel hydrocarbon compounds. Fuel hydrocarbons are completely degraded or detoxified if they are utilized as the primary electron donor for microbial metabolism (Bouwer, 1992). Electron acceptors are elements or compounds that occur in relatively oxidized states, and include but are not limited to oxygen, nitrate, sulfate, ferric iron, nitrogen, and carbon dioxide.

The driving force of BTEX degradation is electron transfer, which is quantified by the Gibbs free energy of the reaction ($\Delta G°_r$; (Stumm and Morgan, 1981; Bouwer, 1994; Godsey, 1994). The value of $\Delta G°_r$ represents the amount of energy consumed or yielded to the system during the reaction. Table 4.4 presents the stoichiometry of the redox equations involving BTEX, and the $\Delta G°_r$ that results from each reaction. Although thermodynamically favorable, most of the reactions involved in BTEX oxidation cannot proceed abiotically because of the lack of activation energy. Microorganisms are capable of providing the necessary activation energy; however, they will facilitate only those redox reactions that have a net yield of energy (i.e., $\Delta G°_r < 0$). Microorganisms preferentially utilize electron acceptors while metabolizing fuel hydrocarbons (Bouwer, 1992). DO is utilized first, as the prime electron acceptor. After DO is consumed, anaerobic microorganisms use electron acceptors in the following order of preference: nitrate, ferric iron hydroxide, sulfate, nitrate, and carbon dioxide.

Depending on the types and concentrations of electron acceptors present (e.g., nitrate, sulfate, carbon dioxide), local pH conditions, and ORP, anaerobic biodegradation can occur via the processes of denitrification, ferric-iron reduction, sulfate reduction, or methanogenesis (which uses carbon dioxide as the electron acceptor). Anaerobic destruction of the BTEX compounds is therefore associated with the accumulation of fatty acids, production of methane, solubilization of iron, and reduction of nitrate and sulfate (Cozzarelli *et al.*, 1990; Wilson *et al.*, 1990). Other, less common anaerobic degradation mechanisms such as manganese reduction, nitrate

TABLE 4.4
COUPLED OXIDATION REACTIONS FOR BTEX COMPOUNDS
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Coupled Benzene Oxidation Reactions	$\Delta G°_r$ (kcal/mole Benzene)	$\Delta G°_r$ (kJ/mole Benzene)	Stoichiometric Mass Ratio of Electron Acceptor/Byproduct to Compound
$7.5O_2 + C_6H_6 \Rightarrow 6CO_{2,g} + 3H_2O$ *Benzene oxidation /aerobic respiration*	-765.34	-3202	3.07:1
$6NO_3^- + 6H^+ + C_6H_6 \Rightarrow 6CO_{2,g} + 6H_2O + 3N_{2,g}$ *Benzene oxidation / denitrification*	-775.75	-3245	4.77:1
$3.75\,NO_3^- + C_6H_6 + 7.5\,H^+ + 0.75\,H_2O \Rightarrow 6\,CO_2 + 3.75\,NH_4^+$ *Benzene oxidation / nitrate reduction*	-524.1	-2193	2.98:1
$60H^- + 30Fe(OH)_{3,a} + C_6H_6 \Rightarrow 6CO_2 + 30Fe^{2+} + 78\,H_2O$ *Benzene oxidation / iron reduction*	-560.10	-2343	21.5:1
$7.5H^+ + 3.75SO_4^{2-} + C_6H_6 \Rightarrow 6\,CO_{2,g} + 3.75\,H_2S^o + 3H_2O$ *Benzene oxidation / sulfate reduction*	-122.93	-514.3	4.61:1
$5\,N_2 + C_6H_6 + 10\,H^+ + 12\,H_2O \Rightarrow 6\,CO_2 + 10\,NH_4^+$ *Benzene oxidation / nitrogen fixation*	-104.8	-437.9	2.31:1
$4.5\,H_2O + C_6H_6 \Rightarrow 2.25\,CO_{2,g} + 3.75\,CH_4$ *Benzene oxidation / methanogenesis*	-32.40	-135.6	0.77:1

Coupled Toluene Oxidation Reactions	$\Delta G°_r$ (kcal/mole Toluene)	$\Delta G°_r$ (kJ/mole Toluene)	Stoichiometric Mass Ratio of Electron Acceptor/Byproduct to Compound
$9O_2 + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 4H_2O$ *Toluene oxidation /aerobic respiration*	-913.76	-3823	3.13:1
$7.2NO_3^- + 7.2H^+ + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 7.6H_2O + 3.6N_{2,g}$ *Toluene oxidation / denitrification*	-926.31	-3875	4.85:1
$4.5NO_3^- + 9H^+ + 0.5H_2O + C_6H_5CH_3 \Rightarrow 7CO_2 + 4.5NH_4^+$ *Toluene oxidation / nitrate reduction*	-624.24	-2609	3.03:1
$72H^+ + 36Fe(OH)_{3,a} + C_6H_5CH_3 \Rightarrow 7CO_2 + 36Fe^{2+} + 94H_2O$ *Toluene oxidation / iron reduction*	-667.21	-2792	21.86:1
$9H^+ + 4.5SO_4^{2-} + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 4.5H_2S^n + 4H_2O$ *Toluene oxidation / sulfate reduction*	-142.86	-597.7	4.7:1
$6\,N_2 + C_6H_5CH_3 + 12\,H^+ + 14\,H_2O \Rightarrow 7\,CO_2 + 12\,NH_4^+$ *Toluene oxidation / nitrogen fixation*	-121.0	-505.8	2.35:1
$5H_2O + C_6H_5CH_3 \Rightarrow 2.5CO_{2,g} + 4.5CH_4$ *Toluene oxidation / methanogenesis*	-34.08	-142.6	0.78:1

TABLE 4.4 (Concluded)
COUPLED OXIDATION REACTIONS FOR BTEX COMPOUNDS
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Coupled Ethylbenzene Oxidation reactions	$\Delta G°_r$ (kcal/mole Ethyl-benzene)	$\Delta G°_r$ (kJ/mole Ethyl-benzene)	Stoichiometric Mass Ratio of Electron Acceptor/Byproduct to Compound
$10.5O_2 + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 5H_2O$ *Ethylbenzene oxidation /aerobic respiration*	-1066.13	-4461	3.17:1
$8.4NO_3^- + 8.4H^+ + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 9.2H_2O + 4.2N_{2,g}$ *Ethylbenzene oxidation / denitrification*	-1080.76	-4522	4.92:1
$5.25NO_3^- + 10.5H^+ + 0.25H_2O + C_6H_5C_2H_5 \Rightarrow 8CO_2 + 5.25NH_4^+$ *Ethylbenzene oxidation / nitrate reduction*	-746.04	-3118	3.07:1
$84H^+ + 42Fe(OH)_{3,a} + C_6H_5C_2H_5 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H_2O$ *Ethylbenzene oxidation / iron reduction*	-778.48	-3257	22:1
$10.5H^+ + 5.25SO_4^{2-} + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 5.25H_2S^n + 5H_2O$ *Ethylbenzene oxidation / sulfate reduction*	-166.75	-697.7	4.75:1
$7N_2 + C_6H_5C_2H_5 + 14H^+ + 16H_2O \Rightarrow 8CO_2 + 14NH_4^+$ *Ethylbenzene oxidation / nitrogen fixation*	-138.4	-578.5	2.38:1
$5.5H_2O + C_6H_5C_2H_5 \Rightarrow 2.75CO_{2,g} + 5.25CH_4$ *Ethylbenzene oxidation / methanogenesis*	-39.83	-166.7	0.79:1

Coupled m-Xylene Oxidation Reactions	$\Delta G°_r$ (kcal/mole *m*-xylene)	$\Delta G°_r$ (kJ/mole *m*-xylene)	Stoichiometric Mass Ratio of Electron Acceptor/Byproduct to Compound
$10.5O_2 + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 5H_2O$ *m-Xylene oxidation /aerobic respiration*	-1063.25	-4448	3.17:1
$8.4NO_3^- + 8.4H^+ + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 9.2H_2O + 4.2N_{2,g}$ *m-Xylene oxidation / denitrification*	-1077.81	-4509	4.92:1
$5.25NO_3^- + 10.5H^+ + 0.25H_2O + C_6H_4(CH_3)_2 \Rightarrow 8CO_2 + 5.25NH_4^+$ *m-Xylene oxidation / nitrate reduction*	-743.52	-3108	3.07:1
$84H^+ + 42Fe(OH)_{3,a} + D_6H_4(CH_3)_2 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H2O$ *m-Xylene oxidation / iron reduction*	-775.61	-3245	22:1
$10.5H^+ + 5.25SO_4^{2-} + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 5.25H_2S^n + 5H_2O$ *m-Xylene oxidation / sulfate reduction*	-163.87	-685.6	4.75:1
$7N_2 + C_6H_4(CH_3)_2 + 14H^+ + 16H_2O \Rightarrow 8CO_2 + 14NH_4^+$ *m-Xylene oxidation / nitrogen fixation*	-141.3	-590.6	2.38:1
$5.5H_2O + C_6H_4(CH_3)_2 \Rightarrow 2.75CO_{2,g} + 5.25CH_4$ *m-Xylene oxidation / methanogenesis*	-36.95	-154.6	0.79:1

reduction, or nitrogen fixation, may become predominant if the physical and chemical conditions in the subsurface favor these electron-transfer processes. Environmental conditions and microbial competition ultimately determine which processes will dominate. Vroblesky and Chapelle (1994) show that the dominant terminal-electron-accepting process can vary both temporally and spatially in an aquifer that contains fuel hydrocarbons.

Groundwater data concerning electron acceptors, collected as part of the RNA investigation at Site SS-04, indicate that natural attenuation of hydrocarbons in the shallow aquifer may be proceeding by aerobic respiration, ferric-iron reduction, sulfate reduction, nitrogen fixation, and methanogenesis, as evidenced by significant changes in groundwater geochemistry near the hydrocarbon source area, compared with background conditions. Areas of the site which show the greatest variation in concentrations of geochemical parameters generally correspond well with areas of low ORP and high concentrations of BTEX constituents. Geochemical information, collected in conjunction with the RNA investigation at Site SS-04, is summarized in Table 4.5, and discussed in the following sections.

In the following sections, the assumption has been made that BTEX can be treated as a single species, comprising the individual BTEX constituents, for two reasons. First, rates of biodegradation for each of the compounds tend to be similar. Secondly, while degradation pathways for fuel hydrocarbons are relatively well understood, the preferential degradation of one BTEX compound over another is difficult to predict from site to site, either spatially or temporally. The BTEX compounds are therefore treated as a single species, to avoid drawing inaccurate conclusions regarding which individual constituent is degraded, and the locations or times at which degradation in the groundwater system occurs. This assumption thus provides a basis for more reliable conclusions regarding the spatial and temporal occurrence of BTEX biodegradation.

4.4.2.1 Dissolved Oxygen

Concentrations of DO were measured at monitoring wells and monitoring points during the sampling events of October-November 1996, and October 1997; the concentrations of DO that were measured are summarized in Table 4.5; and the areal distribution of DO in groundwater is presented graphically on Figures 4.6 and 4.7. Concentrations of DO ranged from 0.17 to 4.11 mg/L in 1996, and from 0.19 to 4.35 mg/L in 1997. The locations at which the lowest DO concentrations were noted, during both monitoring events, are associated with the locations at which the highest concentrations of BTEX constituents were detected (compare Figures 4.3 and 4.6, and Figures 4.4 and 4.7). These data provide strong evidence that aerobic biodegradation of the BTEX compounds is occurring at this site.

The stoichiometry of BTEX mineralization, to carbon dioxide and water, as mediated by aerobic microbial biodegradation, is presented in Table 4.4. The average mass ratio of oxygen to total BTEX in the reaction is approximately 3.14 to 1, indicating that approximately 0.32 mg of BTEX will be mineralized for every 1.0 mg of DO consumed. The average concentration of DO in groundwater, up-gradient of hydrocarbon surce areas, can be used to estimate the assimilative capacity of an aquifer

TABLE 4.5
GROUNDWATER GEOCHEMICAL DATA
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date								
		Analysis	4MP-1	4MP-2	4MP-3	4MP-4	4MP-5S		4MP-5D		4MP-6
		in Field or	1-Nov-96	1-Nov-96	28-Oct-96	1-Nov-96	1-Nov-96	7-Oct-97	1-Nov-96	7-Oct-97[b/]	31-Oct-96
Parameter	**Units**	**at EAL[a/]**									
Ferrous Iron	mg/L	Field	0.27	0.007 U	1.62	0.84	44.9	5.90	8.60	2.36	0.11
Total Iron	mg/L	Field	0.17	0.01	2.33	0.75	45.0	NA	8.35	5.80	0.11
Alkalinity	mg/L	Field	264	305	155	305	345	270	460	432	388
Alkalinity	mg/L	EAL	NM	NM	160	278	NM	NM	NM	NM	NM
Ammonia-N	mg/L	Field	1 U	1 U	1 U	1 U	4	1	1 U	1	1 U
Carbon Dioxide	mg/L	Field	45	35	130	35	140	NA	100	>100	60
Manganese	mg/L	Field	0.4	0.33 U	0.33 U	1.6	1.8	0.33 U	0.33 U	0.33 U	0.33 U
Methane	mg/L	EAL	0.002 U	0.002 U	0.002	0.049	6.1	0.39	2.84	5.6	0.002 U
Nitrate-N	mg/L	Field	0.66 U	0.66 U	0.66 U	0.66 U	NM	NA	0.66 U	0.66 U	0.9
Nitrate-N	mg/L	EAL	0.14	1	0.056 U	0.056 U	0.056 U	NM	0.056 U	NM	1.4
Nitrite-N	mg/L	Field	0.0038 U	0.008	0.0038 U	0.0038 U	0.025	NA	0.0038 U	0.0038 U	0.0038 U
Nitrite-N	mg/L	EAL	0.076 U	0.076 U	0.076 U	0.76 U	0.076 U	NM	0.076 U	NM	0.076 U
Sulfate	mg/L	Field	54.52	47.49	64.89	29.57	7.96	1.20	1.21	13.35	56.31
Sulfate	mg/L	EAL	43.1	38.1	48.7	32.1	3.3	NM	2.8	NM	44.8
Sulfide	mg/L	Field	0.010 U	0.010 U	0.090	0.017	0.011	0.012	0.010 U	0.019	0.022
Conductivity	µS/cm	Field	572	613	420	1,530	700	616	873	814	806
Dissolved Oxygen	mg/L	Field	1.04	4.11	2.01	0.93	0.23	3.13	0.35	0.32	1.01
ORP	mV	Field	29.9	98.4	119.8	-0.8	-179.9	-75.4	-332.1	-115.6	97.9
pH	SU	Field	7.03	7.11	6.32	6.85	6.79	6.84	7.22	6.56	7.38
Temperature	Deg C	Field	18.2	19.5	23.0	19.3	18.0	24.7	18.2	21.3	21.6

Notes:

[a/] Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado

[b/] Sample was aerated and/or limited due to poor recovery

ORP = oxidation-reduction potential

mg/L = milligrams per liter

SU = standard units

U = Compound not detected above the reporting limit

µS/cm = microsiemen per centimeter

mV = millivolts

Deg C = degrees Celsius

NM = not measured

> = greater than

TABLE 4.5 (Continued)
GROUNDWATER GEOCHEMICAL DATA
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date									
		Analysis	4MP-7		4MP-8	4MP-9	4MP-10	4MP-11	4MP-12M	4MP-12D	4MP-13	4MP-14D
		in Field or	31-Oct-96	8-Oct-97	28-Oct-96	31-Oct-96	31-Oct-96	1-Nov-96	3-Nov-96	3-Nov-96	1-Nov-96	3-Nov-96
Parameter	**Units**	**at EAL[a/]**										
Ferrous Iron	mg/L	Field	0.07	0.02	2.22	0.20	0.61	2.66	1.40	4.95	2.64	3.16
Total Iron	mg/L	Field	0.04	0.34	2.07	0.19	0.53	2.53	1.43	4.73	2.44	1.74
Alkalinity	mg/L	Field	358	249	274	332	134	250	325	420	340	280
Alkalinity	mg/L	EAL	NM	NM	NM	NM	231	NM	NM	NM	NM	304
Ammonia-N	mg/L	Field	1 U	0.3	1 U	1 U	1 U	1 U	1 U	1	1 U	1 U
Carbon Dioxide	mg/L	Field	25	10 U	25	80	25	25	35	40	70	25
Manganese	mg/L	Field	0.33 U	0.33 U	0.33 U	0.33 U	0.6	0.7	0.33 U	0.33 U	0.33 U	0.33 U
Methane	mg/L	EAL	0.002 U	.0012U	0.003	0.002	0.002 U	0.002	0.12	1.84	0.002 U	0.69
Nitrate-N	mg/L	Field	0.66 U	0.66 U	0.66 U	0.66 U	1.4	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U
Nitrate-N	mg/L	EAL	0.11	NM	0.056 U	0.056 U	0.55	0.056 U	0.056 U	0.056 U	0.13	0.056 U
Nitrite-N	mg/L	Field	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.010	0.0038 U
Nitrite-N	mg/L	EAL	0.76 U	NM	0.076 U	0.076 U	0.076 U	0.076 U	0.076 U	0.076 U	0.076 U	0.076 U
Sulfate	mg/L	Field	166.85	38.38	16.92	43.05	57.76	58.01	109.48	191.85	182.25	34.43
Sulfate	mg/L	EAL	139	NM	14.6	39.6	49	55.5	74.7	114	137	56.7
Sulfide	mg/L	Field	0.013	0.011	0.012	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.019	0.010 U
Conductivity	µS/cm	Field	3,790	796	NM	637	559	704	430	NM	947	740
Dissolved Oxygen	mg/L	Field	1.02	NA	1.08	1.46	1.51	0.36	4.95	0.13	1.01	0.29
ORP	mV	Field	147.2	-46.1	-138.5	94.1	59.3	-194.3	-125.5	-198.5	-97.3	-224.1
pH	SU	Field	7.20	7.29	7.77	6.87	7.33	7.12	7.43	6.96	6.88	7.12
Temperature	Deg C	Field	19.3	23.5	19.7	19.2	18.6	21.3	17.7	17.7	20.8	15.8

Notes:

[a/] Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado

ORP = oxidation-reduction potential
mg/L = milligrams per liter
SU = standard units
U = Compound not detected above the reporting limit
µS/cm = microsiemen per centimeter
mV = millivolts
Deg C = degrees Celsius
NM = not measured

TABLE 4.5 (Continued)
GROUNDWATER GEOCHEMICAL DATA
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date								
		Analysis	4MP-15		4MP-16	4MP-17[c]	4MP-18	4MP-20[c]	4MP-23[b]	OW-3	
		in Field or	3-Nov-96	9-Oct-97[b]	3-Nov-96	2-Nov-96	1-Nov-96	2-Nov-96	8-Oct-97	28-Oct-96	8-Oct-97
Parameter	**Units**	**at EAL[a]**									
Ferrous Iron	mg/L	Field	18.3	9.25	2.92	0.06	0.90	0.09	0.007 U	0.30	0.06
Total Iron	mg/L	Field	17.1	14.8	2.23	0.17	1.00	0.07	0.01	0.38	0.19
Alkalinity	mg/L	Field	375	401	315	395	235	125	360	168	161
Alkalinity	mg/L	EAL	NM	NM	NM	NM	NM	NM	NM	172	NM
Ammonia-N	mg/L	Field	7	1	1 U	1 U	1 U	1 U	0.4	NM	0.2
Carbon Dioxide	mg/L	Field	50	12	18	35	20	20	35	11	10 U
Manganese	mg/L	Field	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U
Methane	mg/L	EAL	0.07	0.23	0.022	0.002 U	0.009	0.002 U	0.0012U	4.3	5.8
Nitrate-N	mg/L	Field	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	NA	0.66 U	0.66 U
Nitrate-N	mg/L	EAL	0.056 U	NM	0.056 U	0.056 U	0.056 U	0.11	NM	0.056 U	NM
Nitrite-N	mg/L	Field	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	NA	0.0038 U	0.0038 U
Nitrite-N	mg/L	EAL	0.076 U	NM	0.076 U	0.076 U	0.076 U	0.076 U	NM	0.076 U	NM
Sulfate	mg/L	Field	934.80	1027.40	75.17	84.70	17.66	32.95	49.90	0.85	1.10
Sulfate	mg/L	EAL	865	NM	46	77.4	17.7	20.6	NM	0.25 U	NM
Sulfide	mg/L	Field	0.010 U	0.020	0.010 U	0.010 U	0.052	0.010 U	0.048	0.010 U	0.028
Conductivity	µS/cm	Field	2,070	1,230	636	853	505	302	720	390	400
Dissolved Oxygen	mg/L	Field	0.39	0.81	1.02	0.39	0.09	1.26	4.35	1.22	0.21
ORP	mV	Field	-218.4	-110.9	-202.8	5.6	-95.4	22.1	29.6	-156.6	-200.1
pH	SU	Field	6.89	7.03	7.39	6.79	7.16	6.83	7.14	7.65	7.23
Temperature	Deg C	Field	16.9	20.9	14.0	16.8	18.9	16.6	28.3	20.0	22.7

Notes:

[a] Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado

[b] Sample was aerated and/or limited due to poor recovery

[c] Samples from 4MP-17 and 4MP-20 that were sent to EAL for Nitrate-N, Nitrite-N and Sulfate analysis were collected on 3-Nov-96

ORP = oxidation-reduction potential

mg/L = milligrams per liter

SU = standard units

U = Compound not detected above the reporting limit

µS/cm = microsiemen per centimeter

mV = millivolts

Deg C = degrees Celsius

NM = not measured

TABLE 4.5 (Continued)
GROUNDWATER GEOCHEMICAL DATA
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date								
		Analysis	OW-4		OW-7		OW-8		OW-12	OW-13	OW-15
		in Field or	30-Oct-96	8-Oct-97	29-Oct-96	8-Oct-97	30-Oct-96	8-Oct-97	31-Oct-96	29-Oct-96	30-Oct-96
Parameter	**Units**	**at EAL[a/]**									
Ferrous Iron	mg/L	Field	5.10	1.39	3.83	3.08	0.86	1.68	0.87	8.68	2.46
Total Iron	mg/L	Field	5.06	1.44	3.76	3.47	0.81	1.75	0.83	10.04	2.29
Alkalinity	mg/L	Field	235	210	320	264	474	332	202	441	396
Alkalinity	mg/L	EAL	NM	NM	NM	NM	NM	NM	NM	433	NM
Ammonia-N	mg/L	Field	1	0.6	2	2	1	2	1 U	2	1 U
Carbon Dioxide	mg/L	Field	25	30	70	>100	100	13	21	145	80
Manganese	mg/L	Field	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U	4.7	1.4
Methane	mg/L	EAL	5.8	3.3	4.21	5.5	0.6	2	2.1	0.65	0.23
Nitrate-N	mg/L	Field	0.66 U	0.66 U	0.66 U	0.66 U	0.9	0.66 U	0.66 U	0.66 U	0.66 U
Nitrate-N	mg/L	EAL	0.056 U	NM	0.056 U	NM	0.056 U	NM	0.056 U	0.056 U	0.056 U
Nitrite-N	mg/L	Field	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U
Nitrite-N	mg/L	EAL	0.076 U	NM	0.076 U	NM	0.076 U	NM	0.076 U	0.076 U	0.076 U
Sulfate	mg/L	Field	3.18	6.08	2.70	0.91	19.82	42.16	2.83	57.86	35.40
Sulfate	mg/L	EAL	3.3	NM	0.25 U	NM	18.7	NM	2.9	47.1	35.3
Sulfide	mg/L	Field	0.019	0.021	0.030	0.010 U	0.157	0.044	0.017	0.117	0.018
Conductivity	µS/cm	Field	469	504	626	558	925	781	464	1,060	776
Dissolved Oxygen	mg/L	Field	0.25	0.21	0.29	0.19	0.40	0.22	0.31	0.51	0.24
ORP	mV	Field	-221.8	-212.2	-173.5	-196.8	-273.7	-260.1	-212.4	-232.1	-178.0
pH	SU	Field	7.35	7.15	7.20	6.71	7.16	7.40	7.53	6.92	6.78
Temperature	Deg C	Field	23.3	25.3	21.1	23.4	20.3	21.7	20.9	18.0	19.3

Notes:

[a/] Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado

ORP = oxidation-reduction potential
mg/L = milligrams per liter
SU = standard units
U = Compound not detected above the reporting limit
µS/cm = microsiemen per centimeter
mV = millivolts
Deg C = degrees Celsius
NM = not measured
> = greater than

TABLE 4.5 (Continued)
GROUNDWATER GEOCHEMICAL DATA
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date									
		Analysis	OW-102	OW-103	OW-104	OW-105	OW-106	OW-107	P-1		P-2	P-3
		in Field or	30-Oct-96	30-Oct-96	29-Oct-96	28-Oct-96	30-Oct-96	30-Oct-96	29-Oct-96	8-Oct-97	29-Oct-96	29-Oct-96
Parameter	**Units**	**at EAL[a/]**										
Ferrous Iron	mg/L	Field	0.13	0.02	0.03	0.007 U	0.63	0.10	19.9	10.2	1.77	29.0
Total Iron	mg/L	Field	0.15	0.007 U	0.03	0.03	0.79	0.07	19.7	22.7	1.82	32.4
Alkalinity	mg/L	Field	388	256	234	347	294	215	403	340	424	648
Alkalinity	mg/L	EAL	360	NM	NM	NM	NM	NM	NM	NM	NM	NM
Ammonia-N	mg/L	Field	1 U	1 U	1 U	1 U	1	1 U	2	1	1 U	7
Carbon Dioxide	mg/L	Field	105	30	30	60	35	30	140	>100	160	225
Manganese	mg/L	Field	0.33 U	0.33 U	0.33 U	0.33 U	0.4	0.33 U	2.8	8.0	0.33 U	4.1
Methane	mg/L	EAL	0.011	0.002 U	0.002 U	0.002 U	0.08	0.021	1.57	0.57	0.05	0.37
Nitrate-N	mg/L	Field	0.66 U	0.66 U	1.3	1.2	0.66 U	0.66 U	0.66 U	0.66 U	0.9	0.66 U
Nitrate-N	mg/L	EAL	0.056 U	0.056 U	0.67	0.056 U	0.056 U	0.056 U	0.056 U	NM	0.056 U	0.056 U
Nitrite-N	mg/L	Field	0.0038 U	0.0038 U	0.005	0.0038 U	0.004	0.0038 U	0.012	0.0038 U	0.006	0.004
Nitrite-N	mg/L	EAL	0.076 U	0.076 U	0.076 U	0.076 U	0.076 U	0.076 U	0.076 U	NM	0.076 U	0.076 U
Sulfate	mg/L	Field	50.31	48.18	40.40	67.97	1.67	15.94	0.16	45.60	20.79	515.75
Sulfate	mg/L	EAL	42.4	41	31	53.4	8.5	10.8	1.7	NM	18.1	460
Sulfide	mg/L	Field	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.011	0.033	0.010	0.103	0.073
Conductivity	µS/cm	Field	821	521	710	690	546	244	710	271	814	1,908
Dissolved Oxygen	mg/L	Field	0.32	0.35	1.18	2.22	0.17	0.17	0.35	NA	0.26	0.27
ORP	mV	Field	65.2	122.1	56.6	184.8	-0.1	73.0	-173.4	-163.5	-176.8	-139.8
pH	SU	Field	6.71	6.88	7.09	7.14	6.85	6.76	7.23	6.69	6.78	7.14
Temperature	Deg C	Field	23.8	19.9	18.7	21.2	21.0	24.7	19.2	27.0	19.4	20.1

Notes:

[a/] Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado

ORP = oxidation-reduction potential
mg/L = milligrams per liter
SU = standard units
U = Compound not detected above the reporting limit
µS/cm = microsiemen per centimeter
mV = millivolts
Deg C = degrees Celsius
NM = not measured
> = greater than

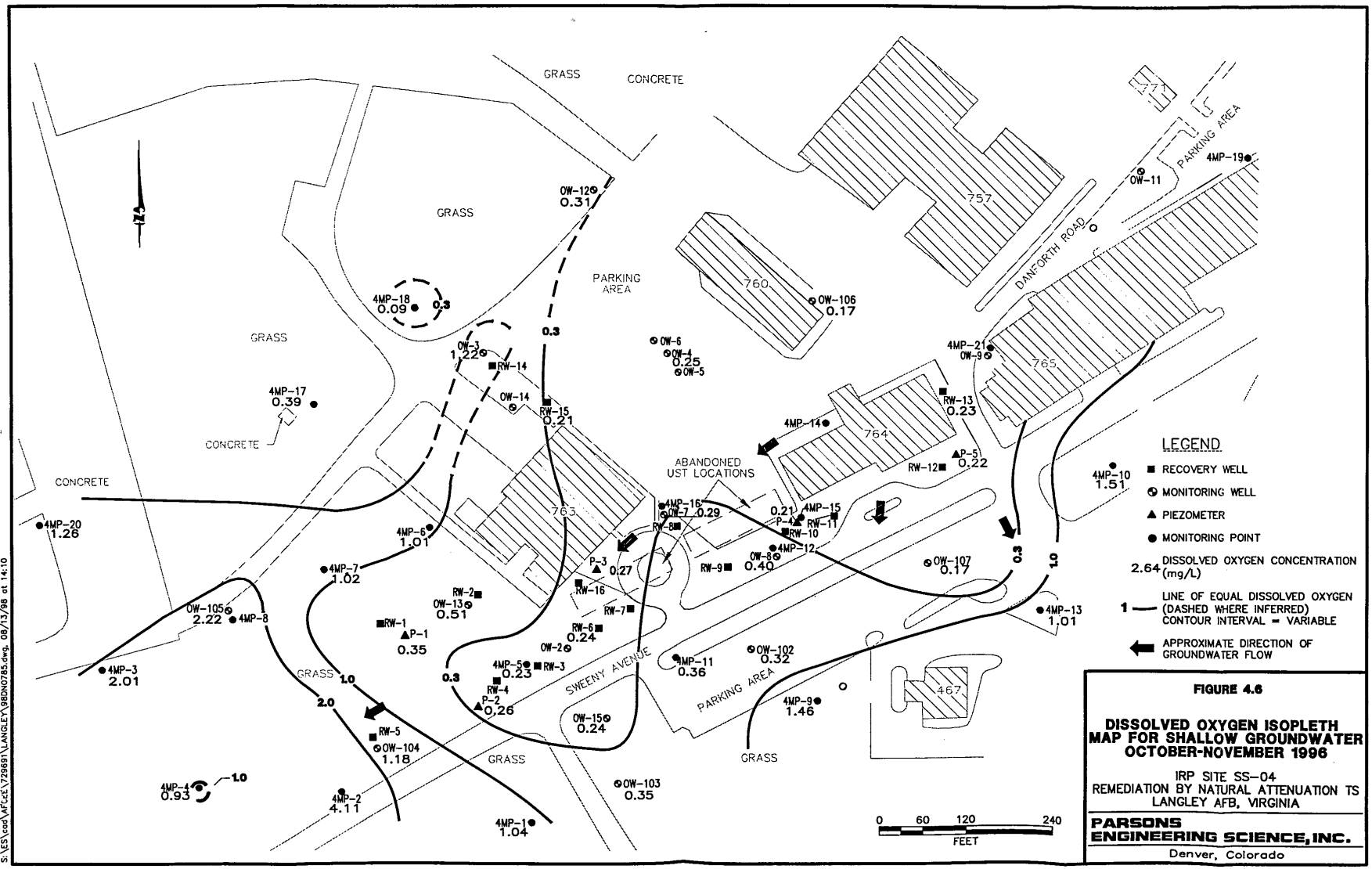
TABLE 4.5 (Concluded)
GROUNDWATER GEOCHEMICAL DATA
SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

			Well or Point ID and Sample Date									
		Analysis	P-4		P-5		RW-4	RW-6		RW-13	RW-15	
Parameter	Units	in Field or at EAL[a/]	4-Nov-96	9-Oct-97	30-Oct-96	9-Oct-97	9-Oct-97	30-Oct-96	8-Oct-97	3-Nov-96	3-Nov-96	8-Oct-97
Ferrous Iron	mg/L	Field	5.01	3.28	12.6	2.85	12.5	4.78	8.90	19.0	6.55	4.15
Total Iron	mg/L	Field	4.60	3.50	12.9	3.16	13.6	4.72	12.1	19.0	7.02	5.50
Alkalinity	mg/L	Field	270	225	464	272	460	242	332	330	300	264
Alkalinity	mg/L	EAL	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
Ammonia-N	mg/L	Field	1 U	1	1.5	1	3	4	10	3	2.5	3
Carbon Dioxide	mg/L	Field	25	20	100	18	350	50	>100	70	50	>100
Manganese	mg/L	Field	0.33 U	0.33 U	0.5	0.33 U	1.3	0.33 U	0.33 U	0.33 U	0.33 U	0.33 U
Methane	mg/L	EAL	6.8	8.8	8.1	2.4	7.7	5.4	4.5	4.1	1.2	2.8
Nitrate-N	mg/L	Field	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U
Nitrate-N	mg/L	EAL	0.056 U	NM	0.056 U	NM	NM	0.056 U	NM	0.056 U	0.056 U	NM
Nitrite-N	mg/L	Field	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U	0.0038 U
Nitrite-N	mg/L	EAL	0.076 U	NM	0.076 U	NM	NM	0.076 U	NM	0.076 U	0.076 U	NM
Sulfate	mg/L	Field	1.42	5.18	6.96	33.68	4.50	4.65	1.57	9.58	3.49	2.19
Sulfate	mg/L	EAL	1.2	NM	0.25 U	NM	NM	0.25 U	NM	0.68	8.5	NM
Sulfide	mg/L	Field	0.011	0.017	0.010 U	0.033	0.112	0.101	0.089	0.020	0.016	0.016
Conductivity	µS/cm	Field	540	501	924	605	863	484	693	636	688	592
Dissolved Oxygen	mg/L	Field	0.21	0.32	0.22	0.28	0.22	0.24	0.22	0.23	0.21	0.20
ORP	mV	Field	-183.4	-160.2	-192.0	-92.8	-152.3	-264.2	-178.2	-176.1	-228.7	-134.4
pH	SU	Field	7.46	7.40	7.17	6.85	6.72	7.21	6.69	7.11	6.92	6.88
Temperature	Deg C	Field	19.4	22.1	21.3	22.5	22.0	20.0	21.7	19.8	20.2	21.4

Notes:

[a/] Evergreen Analytical Laboratory, Inc. of Wheat Ridge, Colorado

ORP = oxidation-reduction potential
mg/L = milligrams per liter
SU = standard units
U = Compound not detected above the reporting limit
µS/cm = microsiemen per centimeter
mV = millivolts
Deg C = degrees Celsius
NM = not measured
> = greater than



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FIGURE 4.6

DISSOLVED OXYGEN ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER-NOVEMBER 1996

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

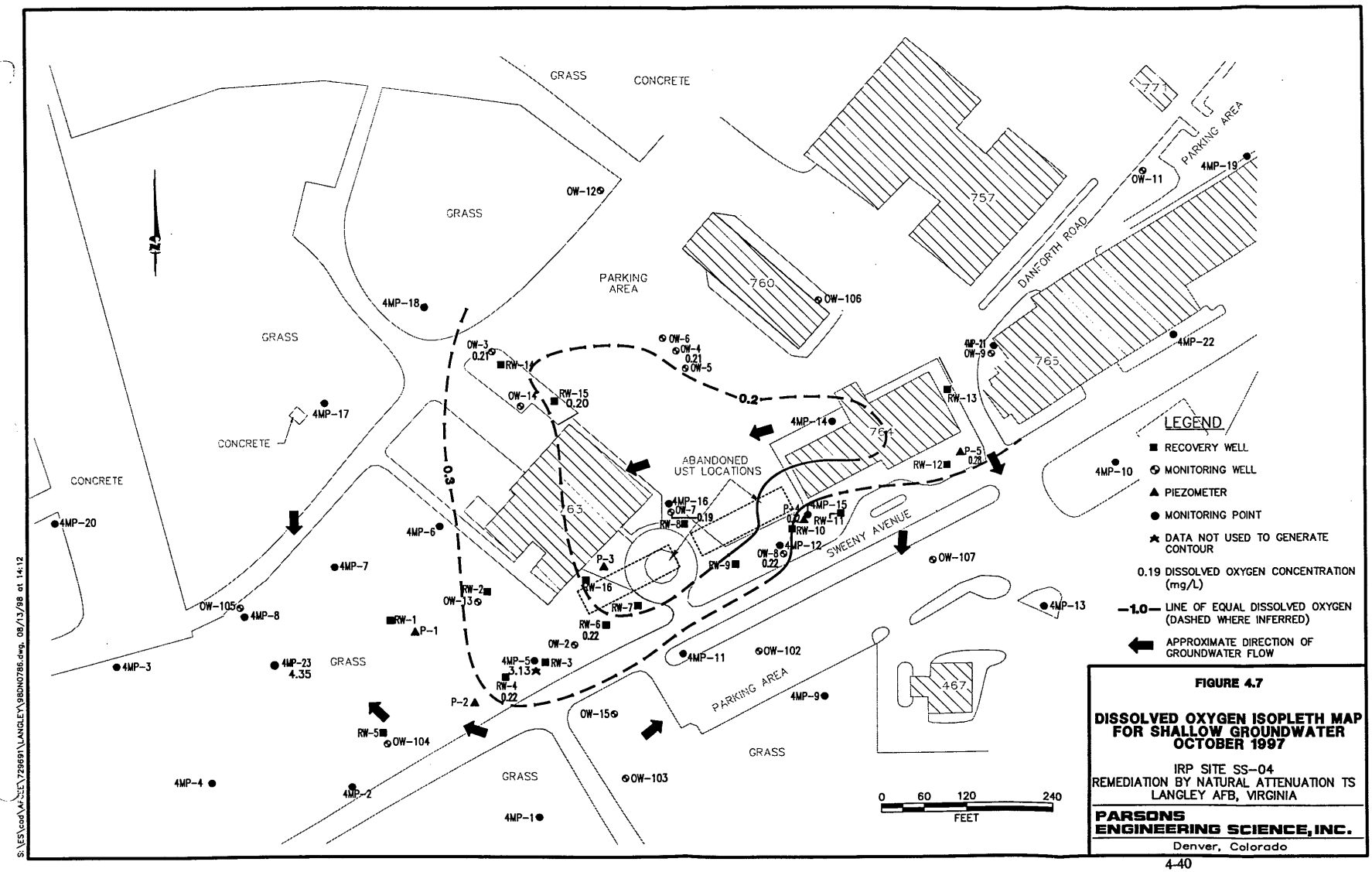


FIGURE 4.7

DISSOLVED OXYGEN ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER 1997

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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in which aerobic biodegradation of fuel hydrocarbons is occurring. However, an upgradient source of groundwater (and DO) appears to be the mound in the groundwater table near well RW-13, within the distal edge of the BTEX plume (Figures 3.5 and 3.6). Measurement of DO concentrations in groundwater indicate that this area is relatively depleted in oxygen. Nevertheless, because DO is recharged to shallow groundwater through rainwater infiltration, a small, periodic contribution of DO to the groundwater system probably occurs. If the groundwater mound is a transient feature, additional DO would probably move into the hydrocarbon source area at Site SS-04 from the north or northeast, as the regional groundwater flow regime is re-established (Figures 3.5 and 3.6). The concentrations of DO detected in nearby wells, a few hundred feet from the immediate area of the BTEX plume (e.g., wells 4MP-1 and 4MP-13; Figures 4.6 and 4.7), suggest that the background concentration of DO in groundwater is about 1 mg/L.

As the microbial population in a groundwater system increases in response to the introduction of fuel hydrocarbons to the subsurface, some of the fuel is used to generate cell mass. When cell mass production is accounted for, the mineralization of benzene to carbon dioxide and water can be expressed as:

$$C_6H_6 + 2.5O_2 + HCO_3 + NH_4 \rightarrow C_5H_7O_2N + 2CO_2 + 2H_2O$$

This indicates that 5.0 fewer moles of DO are required to mineralize 1 mole of benzene when cell mass production is taken into account. On a mass basis, the ratio of DO to benzene is given by:

Benzene $6(12) + 1(6) = 78$ gm

Oxygen $2.5(32) = 80$ gm

Mass Ratio of Oxygen to Benzene = $80/78 = 1.03:1$

On the basis of these stoichiometric relationships, 1.03 mg of oxygen is required to mineralize 1 mg of benzene, if cell mass production is taken into account. Similar calculations can be made for toluene, ethylbenzene, and the xylene isomers, indicating that approximately 0.97 mg of BTEX, as an undifferentiated species, is mineralized to carbon dioxide and water for every 1.0 mg of DO consumed.

Although electron acceptors are more efficiently utilized in this process, it is only applicable as long as the net cell mass of the microbial population continues to increase. Because fuel hydrocrabons have been present in groundwater at IRP Site SS-04 for a number of years, it is likely that biomass mass production has reached steady-state. Therefore, application of the cell-mass-reaction equations would probably overestimate BTEX mineralization.

4.4.2.2 Nitrate

Nitrate as nitrogen (nitrate-N) was analyzed in groundwater samples, collected during the monitoring events of October and November 1996 and October 1997 (Table 4.5). In 1996, nitrate-N was detected in only six samples; the highest concentration detected was 1.4 mg/L in the samples from wells 4MP-6 and 4MP-10. Nitrate-N was

not detected in any groundwater samples analyzed during the monitoring event of 1997. Nitrate is therefore not considered to be an important electron acceptor at this site.

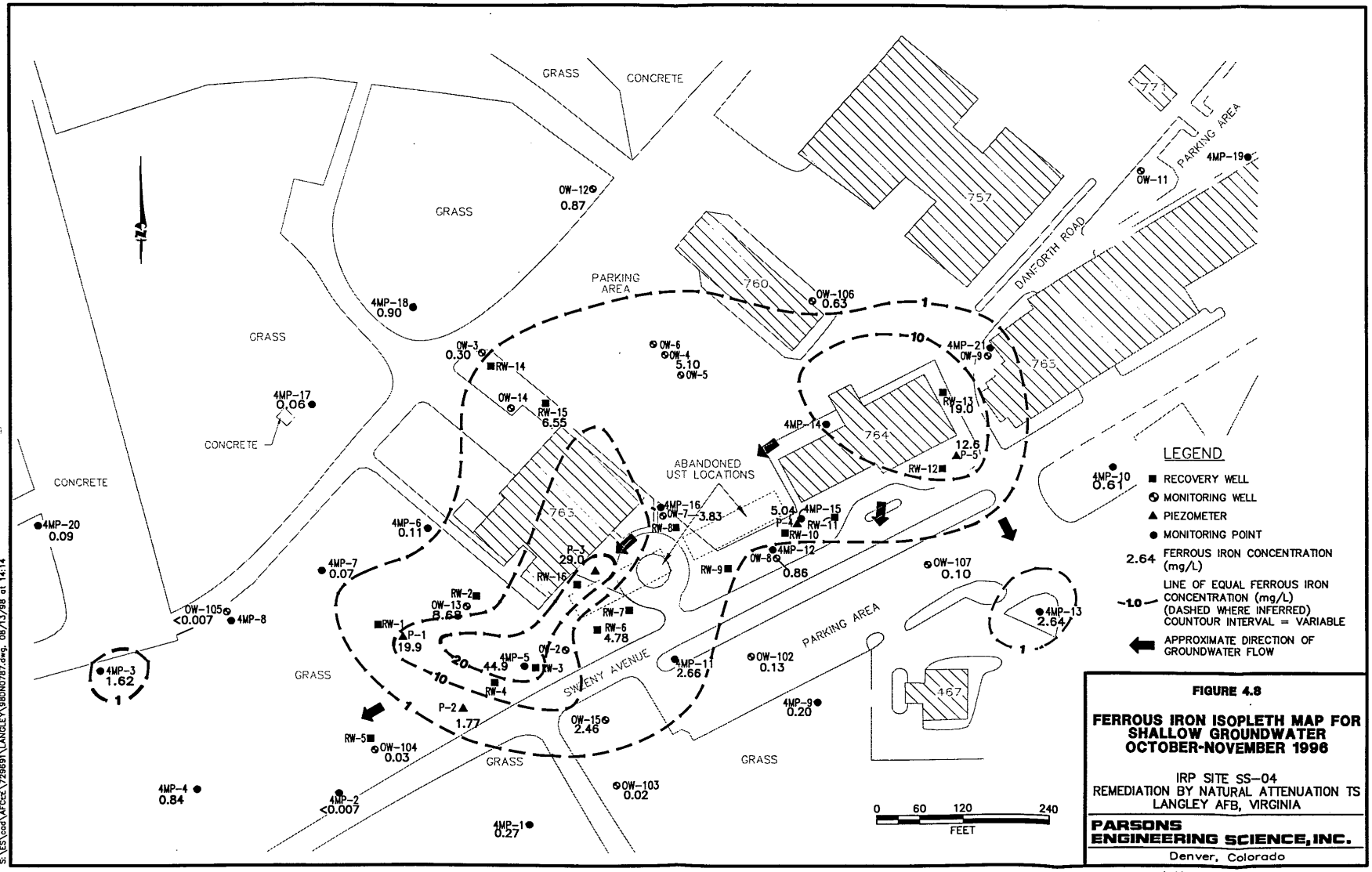
4.4.2.3 Ferrous Iron

Concentrations of ferrous iron (Fe^{2+}) were measured in groundwater samples collected during the monitoring events of October and November 1996 and October 1997 (Table 4.5). In 1996, ferrous iron concentrations ranged from less than 0.007 mg/L to 44.90 mg/L the highest concentrations of ferrous iron were detected in groundwater samples from wells adjacent to, and down-gradient from the hydrocarbon source area (Table 4.5 and Figure 4.8). Concentrations of ferrous iron detected in groundwater samples collected in October 1997 ranged from less than 0.007 mg/L to 12.45 mg/L (Table 4.5 and Figure 4.9). If the groundwater samples in which no fuel hydrocarbons were detected are assumed to be representative of background conditions, then the background concentration of ferrous iron in groundwater was about 0.75 mg/L in 1996, and about 0.01 mg/L in 1997.

The areas within which elevated concentrations of ferrous iron were detected, during both monitoring events, correspond with the areas containing the highest concentrations of BTEX constituents (compare Figures 4.3 and 4.8, and Figures 4.4 and 4.9), indicating that ferric iron hydroxide (Fe^{3+}) is being reduced to ferrous iron in the presence of BTEX compounds. The decrease in concentrations of ferrous iron, between the monitoring events of October-November 1996 and October 1997, may be a result of the significant drop in BTEX concentrations during the same time period, or a change in redox conditions at the site to a more reducing environment (i.e., an environment more favorable to sulfate reduction, nitrogen fixation, and methanogenesis).

The stoichiometry of BTEX oxidation to carbon dioxide, ferrous iron, and water by iron reduction through anaerobic microbial biodegradation is presented in Table 4.4. On average, 37.5 moles of ferric iron hydroxide are required to metabolize one mole of total BTEX; this reaction produces 37.5 moles of ferrous iron. On a mass basis, this indicates that approximately 21.8 mg ferrous iron are produced for each 1 mg of total BTEX metabolized. Assuming that the background concentration of ferrous iron was approximately 0.75 mg/L, and using the maximum concentration of ferrous iron detected in groundwater during the 1996 event (44.90 mg/L), the calculated assimilative capacity of groundwater, in October-November 1996, was approximately 2.02 mg/L (2,020 µg/L) of total BTEX consumed via iron reduction. The background ferrous iron concentration of approximately 0.01 mg/L and maximum concentration of ferrous iron of 12.45 mg/L, detected in October 1997, corresponds to an assimilative capacity of approximately 0.57 mg/L (570 µg/L) of total BTEX consumed via iron reduction. This is a conservative estimate of the assimilative capacity associated with iron reduction, because the calculation is based on observed ferrous iron concentrations, rather than on the amount of ferric hydroxide available in the subsurface; the actual assimilative capacity, associated with iron reduction, may be greater.

Recent evidence suggests that the reduction of ferric iron to ferrous iron cannot proceed at all without microbial mediation (Lovley and Phillips, 1988; Lovley *et al.*, 1991; Chapelle, 1993). The elevated concentrations of ferrous iron, detected in



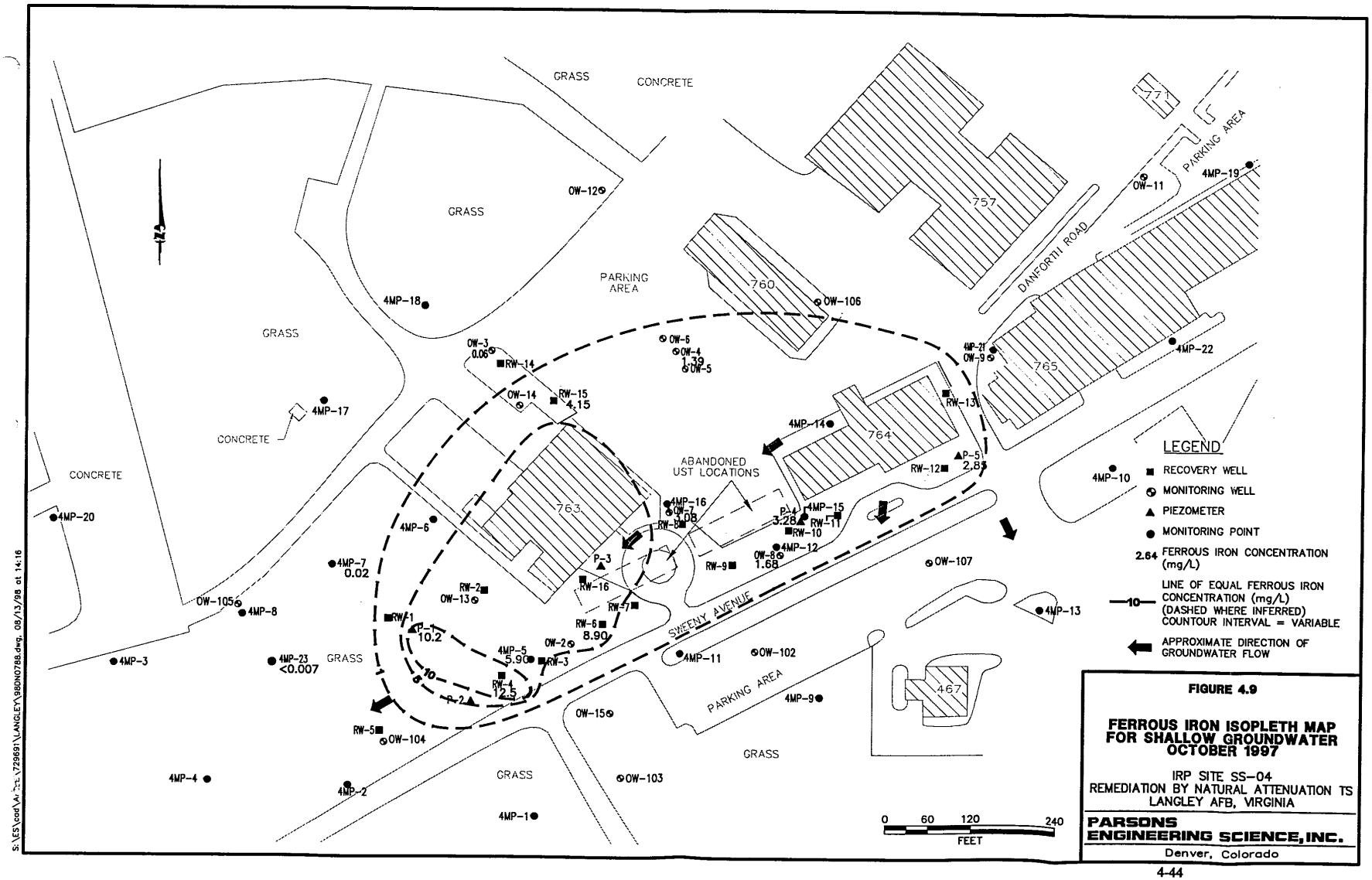
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FIGURE 4.8

FERROUS IRON ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER-NOVEMBER 1996

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
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FIGURE 4.9

FERROUS IRON ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER 1997

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groundwater near hydrocarbons source areas at the site, therefore provide strong evidence of microbial activity.

4.4.2.4 Sulfate

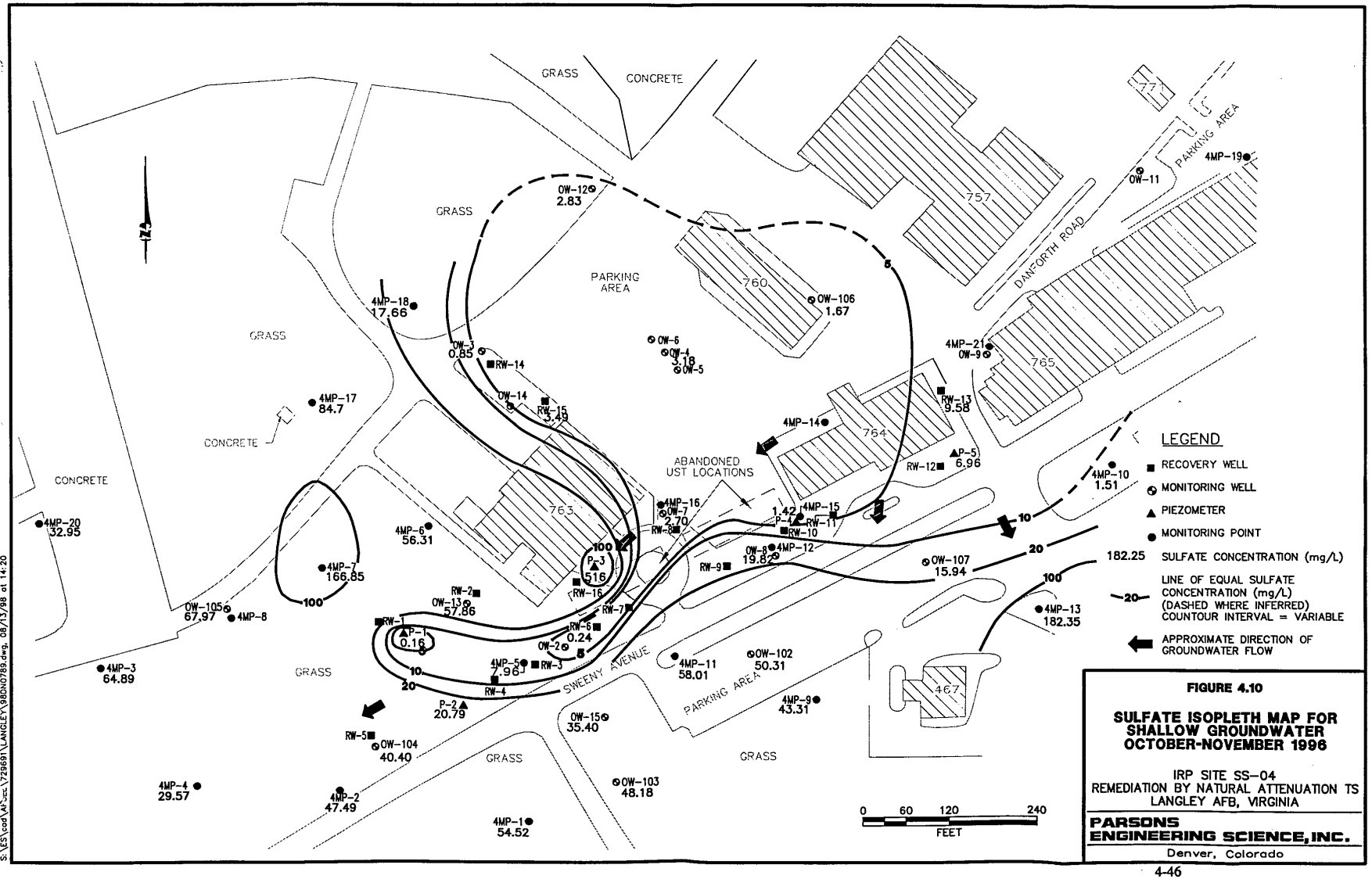
Concentrations of sulfate were measured in groundwater samples collected during the monitoring events of October and November 1996 and October 1997 (Table 4.5). In 1996, sulfate concentrations ranged from 0.16 mg/L to 496.56 mg/L; the lowest concentrations of sulfate (less than 5 mg/L) were generally detected in groundwater samples from wells adjacent to, and immediately down-gradient from abandoned USTs (Table 4.5 and Figure 4.10). Concentrations of sulfate detected in groundwater samples, collected in October 1997, ranged from 0.91 mg/L to 49.9 mg/L (Table 4.5 and Figure 4.11). The well at which the highest concentration of sulfate was detected in 1996 (well P-3) was not re-sampled in 1997. Between November 1996 and October 1997, sulfate concentrations declined significantly in groundwater samples from well 4MP-7 (from 166.85 mg/L to 38.38 mg/L), and increased significantly in groundwater samples from wells P-1 (from 0.16 mg/L to 45.6 mg/L), P-5 (from 6.96 mg/L to 33.68 mg/L), and OW-8 (from 19.82 mg/L to 42.16 mg/L). If the groundwater samples in which no fuel hydrocarbons were detected are assumed to be representative of background conditions, then the background concentration of sulfate in groundwater was about 48.3 mg/L in 1996, and about 44.1 mg/L in 1997.

The areas within which low concentrations of sulfate were detected during both monitoring events correspond with the areas containing the highest concentrations of BTEX constituents (compare Figures 4.3 and 4.10, and Figures 4.4 and 4.11), indicating that anaerobic biodegradation of BTEX compounds is occurring in groundwater through the microbially mediated process of sulfate reduction. The area of depleted sulfate concentrations, as defined by the 10 mg/L isopleth, decreased between November 1996 and October 1997, possibly as a result of the decline in BTEX concentrations during the same time period, or a change in local redox conditions.

The stoichiometry of BTEX mineralization to carbon dioxide, sulfur, and water via the mechanism of sulfate reduction, mediated by anaerobic microbial biodegradation, is presented in Table 4.4. The average mass ratio of sulfate to total BTEX is approximately 4.7 to 1, indicating that approximately 0.21 mg of total BTEX is mineralized for every 1.0 mg of sulfate consumed. Assuming that the background concentration of sulfate was approximately 48.3 mg/L in November 1996, the calculated assimilative capacity of groundwater, in October-November 1996, was approximately 10.14 mg/L (10,140 µg/L) of total BTEX. The assumed background sulfate concentration of approximately 44.1 mg/L, in October 1997, corresponds to an assimilative capacity of approximately 9.26 mg/L (9,260 µg/L) of total BTEX consumed via sulfate reduction.

4.4.2.5 Ammonium

Concentrations of ammonia as nitrogen (ammonia-N) were measured in groundwater samples collected during the monitoring events of October and November 1996 and October 1997 (Table 4.5). The areas within which elevated concentrations of ammonia-N were detected, during both monitoring events, correspond with the areas



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FIGURE 4.10

SULFATE ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER-NOVEMBER 1996

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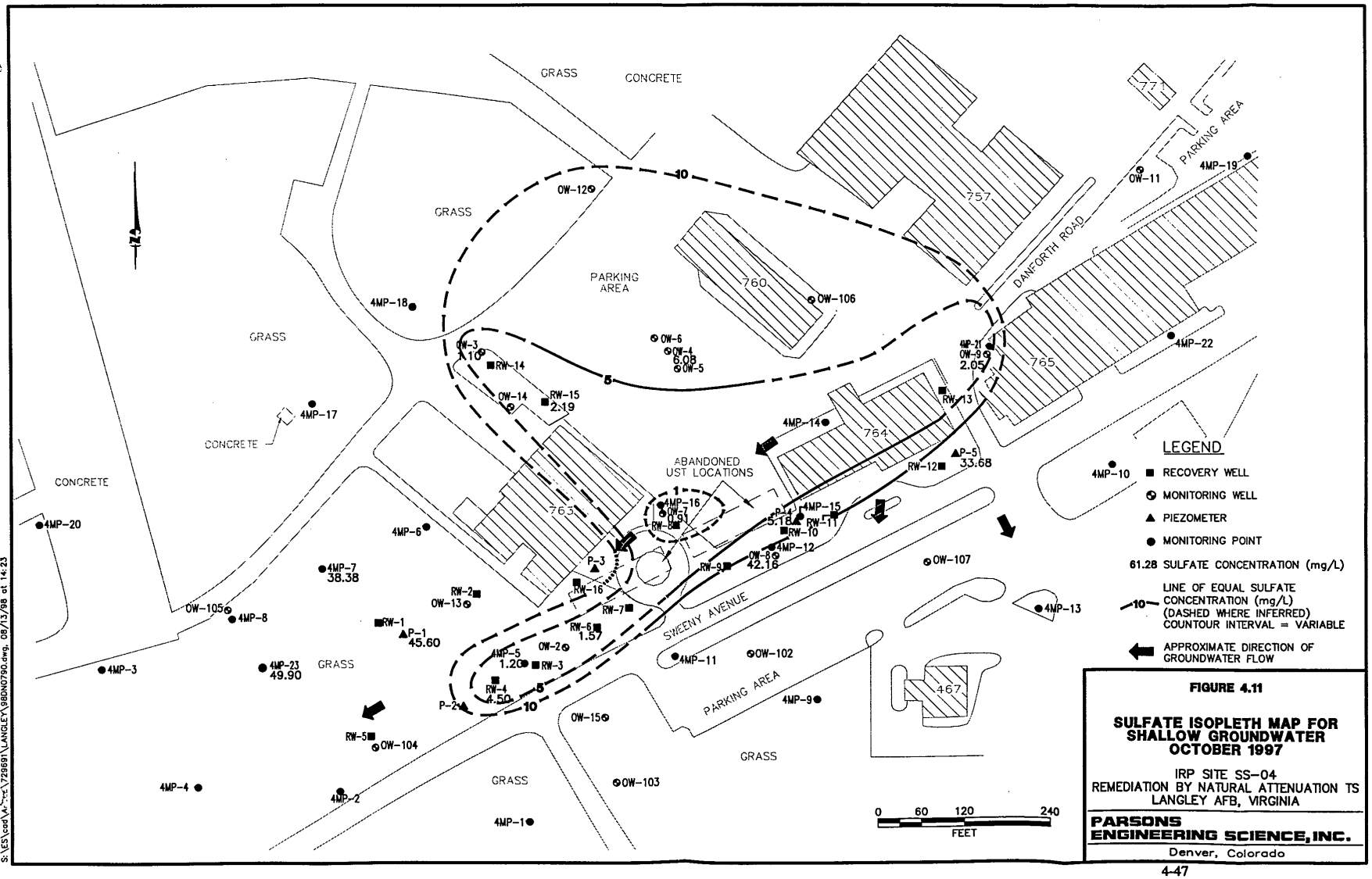


FIGURE 4.11

SULFATE ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER 1997

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containing the highest concentrations of BTEX constituents (compare Figures 4.3 and 4.12, and Figures 4.4 and 4.13). Ammonia (as nitrogen) in groundwater can result from either nitrate reduction (facilitated by microbes) or through fixing of atmospheric nitrogen (also a microbial process). As discussed in Section 4.3.2.1, ammonium also may be used in the production of cell mass; however, because fuel hydrocarbons have been present in groundwater at IRP Site SS-04 for a number of years, it is likely that biomass mass production has reached steady-state, and the effects of cell-mass production are expected to be minimal.

The concentrations of ammonia-N, detected in groundwater samples collected during the monitoring event of 1996, ranged from less than 1 mg/L to 7 mg/L (Table 4.5); the concentrations of ammonia-N, detected in groundwater samples collected during 1997 ranged from 0.2 mg/L to 10 mg/L. As discussed in Section 4.3.2.2, nitrate was either not detected or was detected at very low concentrations during both monitoring events. Therefore, the ammonia-N that was detected was probably produced through nitrogen fixation.

The stoichiometry of BTEX oxidation to carbon dioxide and ammonium via the mechanism of microbial nitrogen fixation is presented in Table 4.4. On average, 6.25 moles of nitrogen gas (N_2) are required to metabolize one mole of total BTEX. Conversely, an average of 12.5 moles of ammonium are produced for each mole of total BTEX consumed. On a mass basis, approximately 2.4 mg of ammonium are produced for each 1 mg of total BTEX metabolized. This calculation assumes that ammonia-N is reported as ammonium (NH_4^+) rather than elemental nitrogen (N). The ammonia-N concentrations presented in Table 4.5 are reported as N, and must be multiplied by 1.29 to convert them to concentrations of ammonium as NH_4^+. Assuming a background concentration of ammonium (as NH_4^+) of less than 1 mg/L, and using the maximum concentration of ammonium detected (9 mg/L as NH_4^+), the calculated assimilative capacity of groundwater in October-November 1996, was approximately 3.33 mg/L (3,330 μg/L) of total BTEX. An assumed background concentration of ammonium (as NH_4^+) of approximately 13 mg/L (as NH_4^+), in October 1997, corresponds to an assimilative capacity of approximately 5.42 mg/L (5,420 μg/L) of total BTEX consumed via nitrogen fixation. This is a conservative estimate of the assimilative capacity of groundwater at the site, through the mechanism of nitrogen fixation because the calculation is based on observed ammonium concentrations and not on the amount of nitrogen gas available in the subsurface. The nitrogen fixation assimilative capacity could therefore be much greater.

4.4.2.6 Methane in Groundwater

Concentrations of methane were measured in groundwater samples collected during the monitoring events of October and November 1996 and October 1997 (Table 4.5). In 1996, methane concentrations ranged from less than 0.002 mg/L to 8.1 mg/L (Figure 4.14). Concentrations of methane detected in groundwater samples collected in October 1997 ranged from less than 0.012 mg/L to 8.8 mg/L (Figure 4.15). The areas within which elevated concentrations of methane were detected during both monitoring events correspond with the areas containing the highest concentrations of BTEX constituents (compare Figures 4.3 and 4.14, and Figures 4.4 and 4.15),

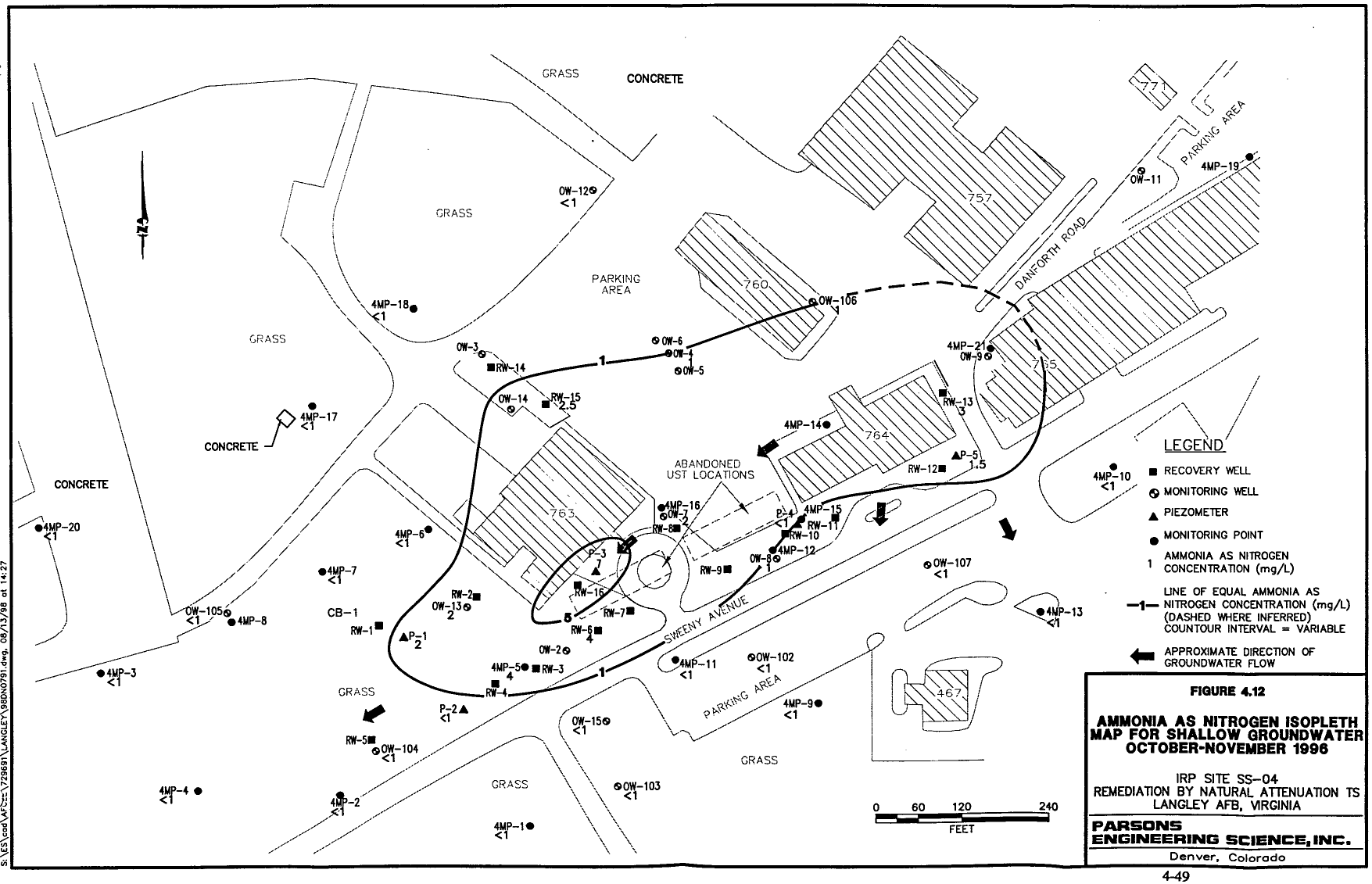


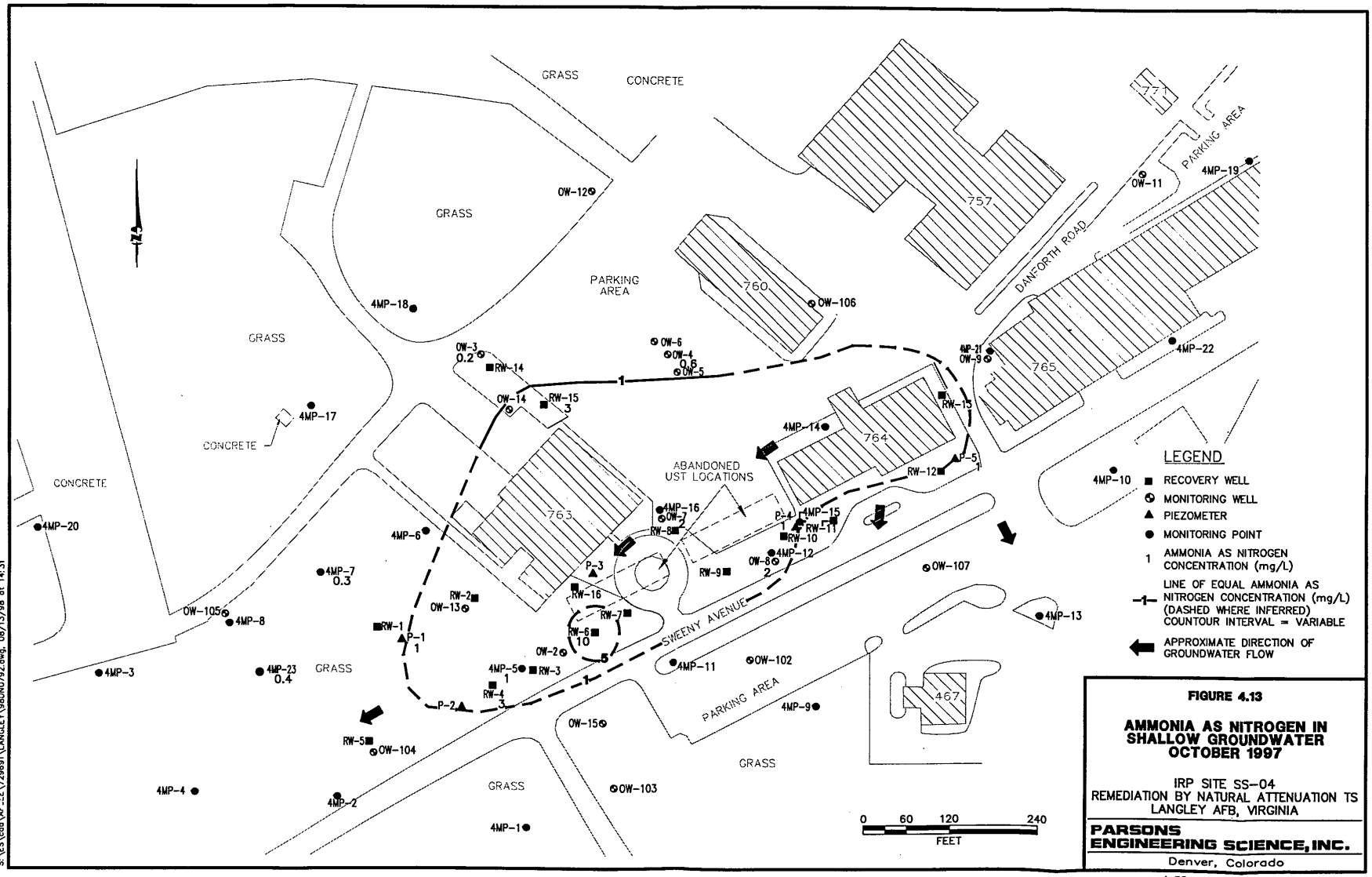
FIGURE 4.12

AMMONIA AS NITROGEN ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER-NOVEMBER 1996

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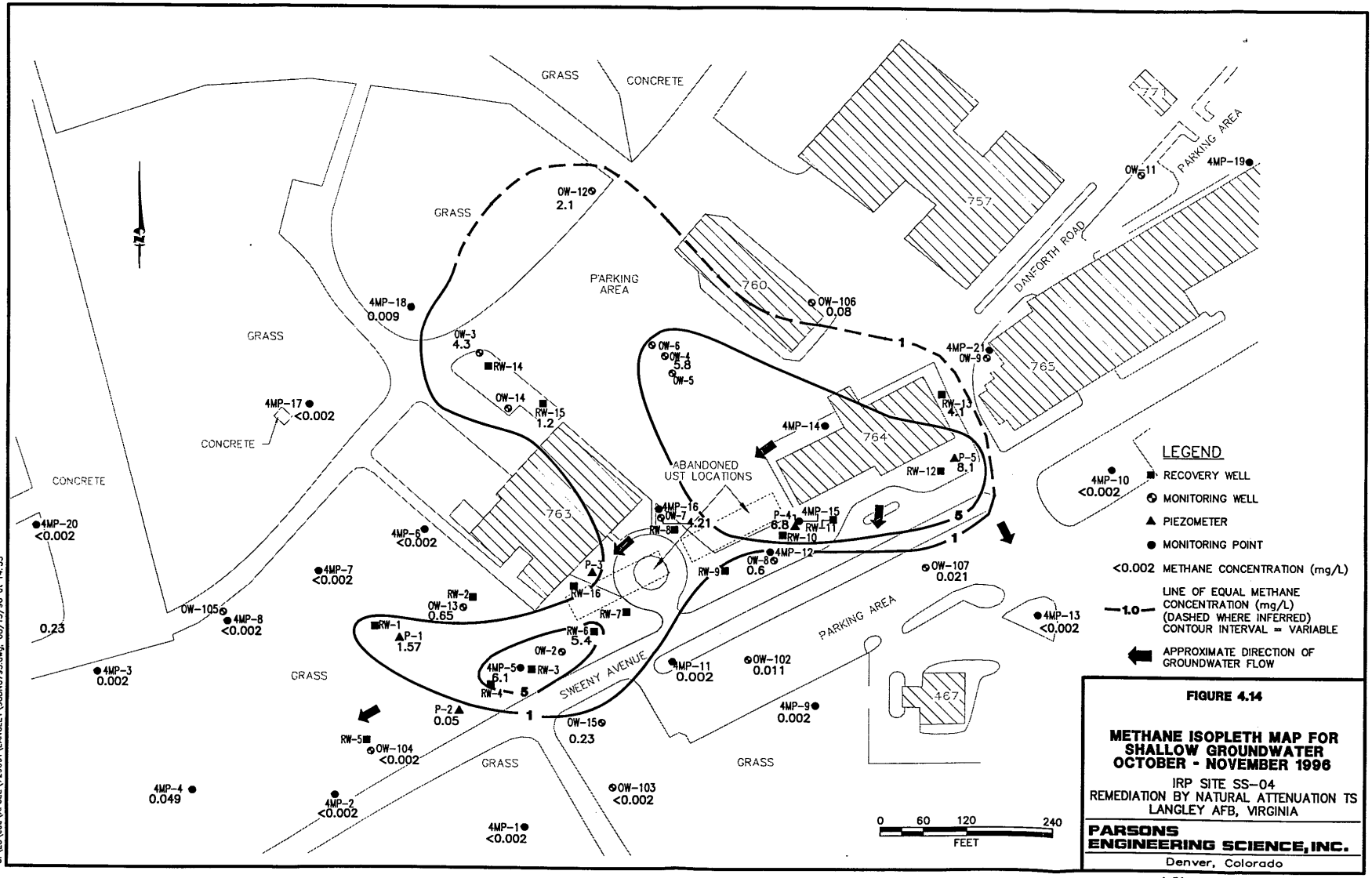
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FIGURE 4.13

AMMONIA AS NITROGEN IN SHALLOW GROUNDWATER OCTOBER 1997

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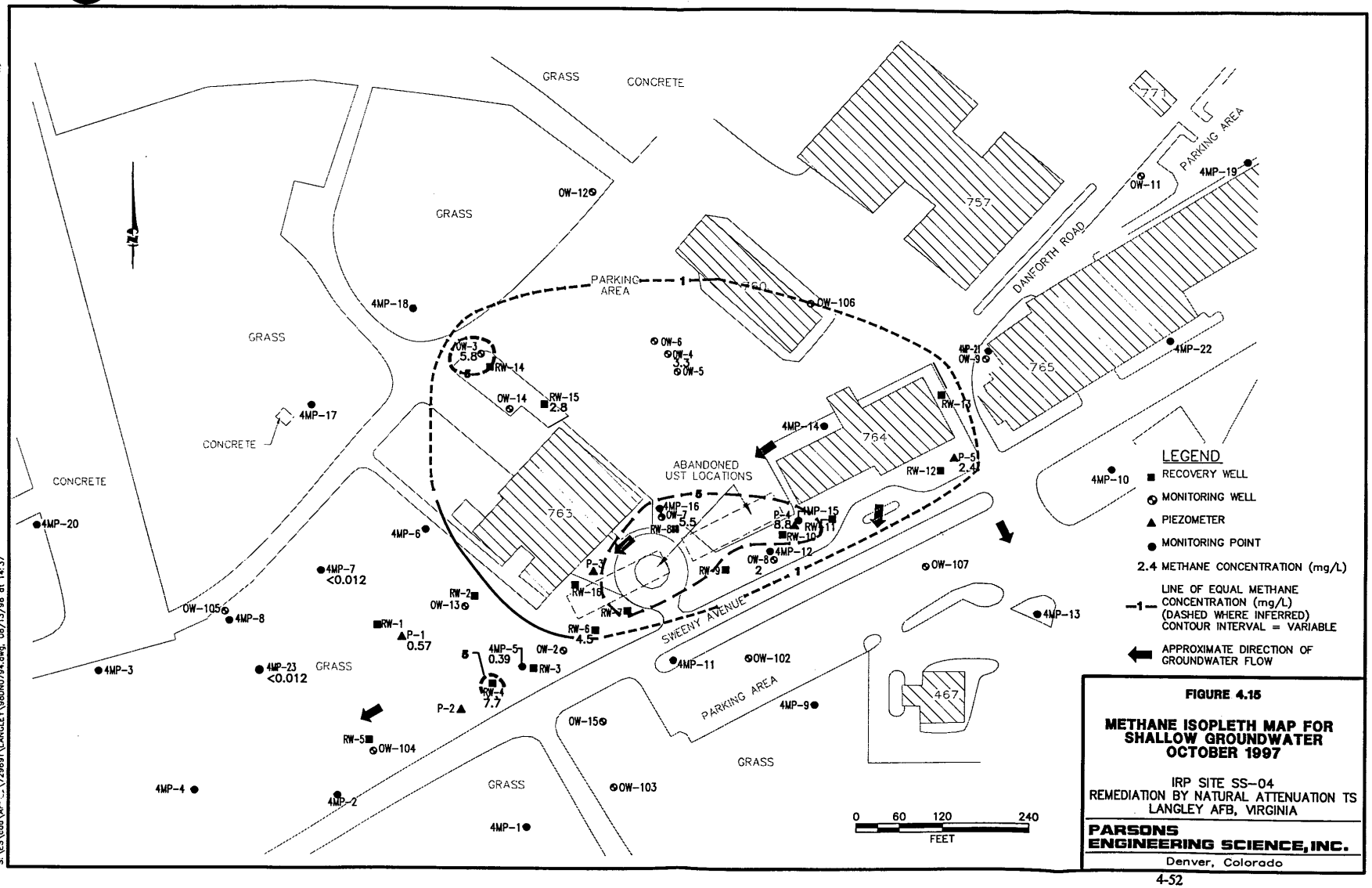
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FIGURE 4.14

METHANE ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER - NOVEMBER 1996

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FIGURE 4.15

METHANE ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER 1997

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providing evidence that anaerobic biodegradation of BTEX via methanogenesis is occurring at the site.

The stoichiometry of BTEX oxidation to carbon dioxide and methane by methanogenesis is presented in Table 4.4. On average, approximately 1 mg of total BTEX is degraded for every 0.78 mg of methane produced. Using the maximum concentration of methane detected in groundwater in 1996 (8.1 mg/L), the assimilative capacity of groundwater is calculated to have been approximately 10.4 mg/L (10,400 μg/L) of total BTEX consumed through methanogenesis in October-November 1996. The maximum concentration of 8.8 mg/L of methane, detected in groundwater samples collected in October 1997, corresponds to an assimilative capacity of 11.3 mg/L (11,300 μg/L) of total BTEX. These are conservative estimates of the assimilative capacity through methanogenesis because the calculations are based on observed methane concentrations, rather than on the amount of carbon dioxide (the electron acceptor in methanogenesis) available in the subsurface. Because methanogenesis produces more carbon dioxide than it consumes, an unlimited supply of carbon dioxide is theoretically available once the process of methanogenesis has been initiated. Therefore, methanogenesis is limited only by the rate of reaction rather than the source of electron acceptors.

4.4.2.7 Oxidation-Reduction Potential

Oxidation-reduction potential was measured at groundwater monitoring wells and monitoring points during both monitoring events. ORP is a measure of the relative tendency of a solution to accept or transfer electrons. The ORP of a groundwater system can indicate which electron acceptors are being reduced by microbes during BTEX oxidation. The values of ORP measured in groundwater samples at the site ranged from -274 millivolts (mV) to +185 mV in 1996 (Table 4.5 and Figure 4.16), and from -260 mV to +30 mV in 1997 (Table 4.5 and Figure 4.17). Areas at the site within which groundwater ORP is low coincide with areas containing elevated concentrations of BTEX constituents, low DO, low sulfate concentrations, and elevated concentrations of ferrous iron, ammonium, and methane (Figures 4.3, 4.4, 4.6 through 4.17).

The values of ORP that were measured were less than -100 mV throughout the area within which the concentrations of total BTEX exceed 10 μg/L; however, this is not as low as theoretically predicted for some of the electron acceptor reactions (Norris *et al.*, 1994). This discrepancy is a common occurrence, and is associated with measuring ORP using field instruments, because the platinum electrode probe used in an ORP meter is probably not sensitive to some of the ORP couples (e.g., sulfate/sulfide).

4.4.2.8 Alkalinity

Total alkalinity (as calcium carbonate) was measured in groundwater samples collected in October and November 1996 and in October 1997 (Table 4.5). Alkalinity can be a measure of the ability of groundwater to buffer changes in pH caused by the addition of biologically-generated acids. Total alkalinity at the site varied from 125 mg/L to 648 mg/L in 1996 (Table 4.5 and Figure 4.18), and from 161 mg/L to 460 mg/L in 1997 (Table 4.5 and Figure 4.19). This level of alkalinity is sufficient to

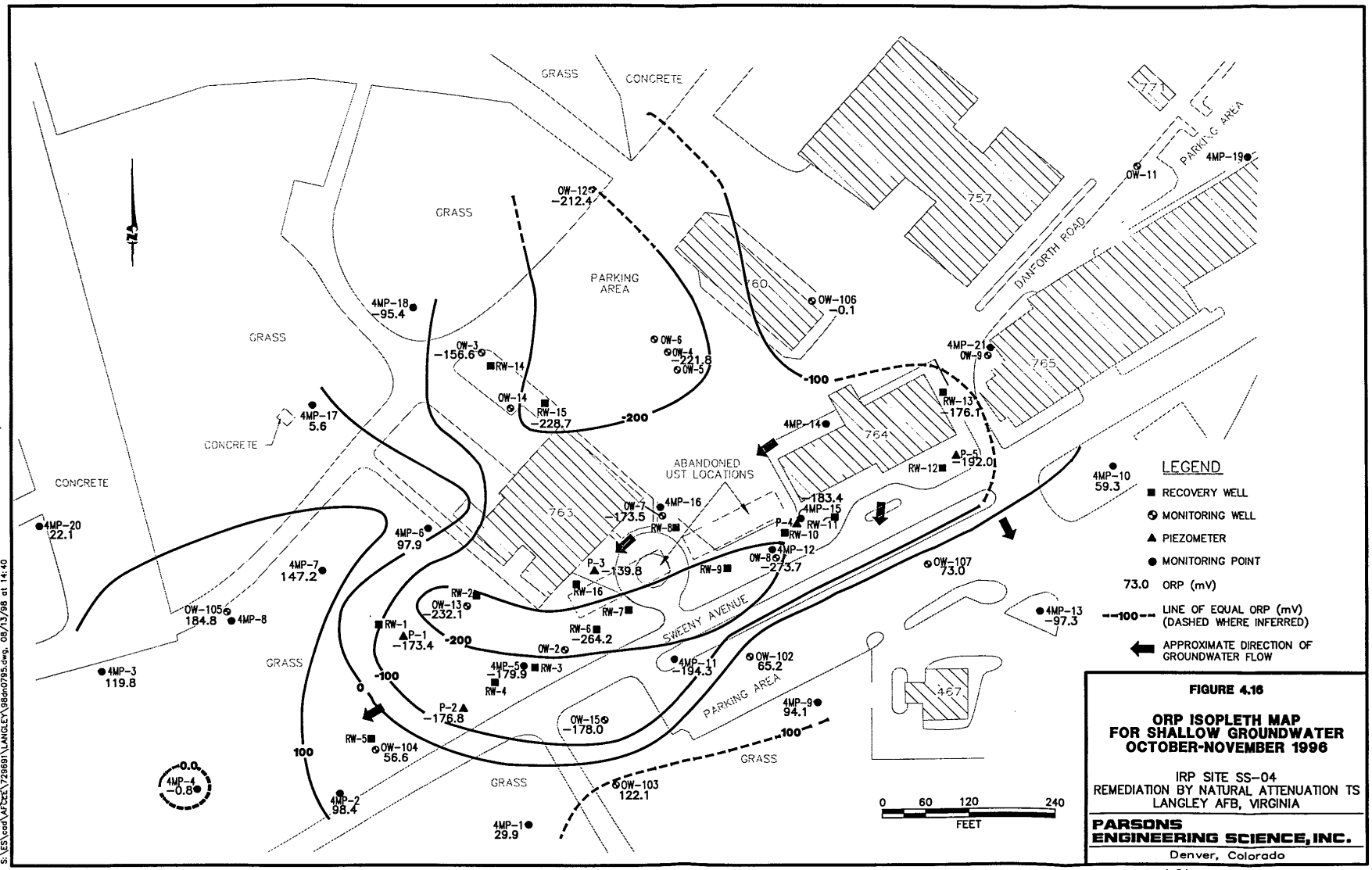


FIGURE 4.16

ORP ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER-NOVEMBER 1996

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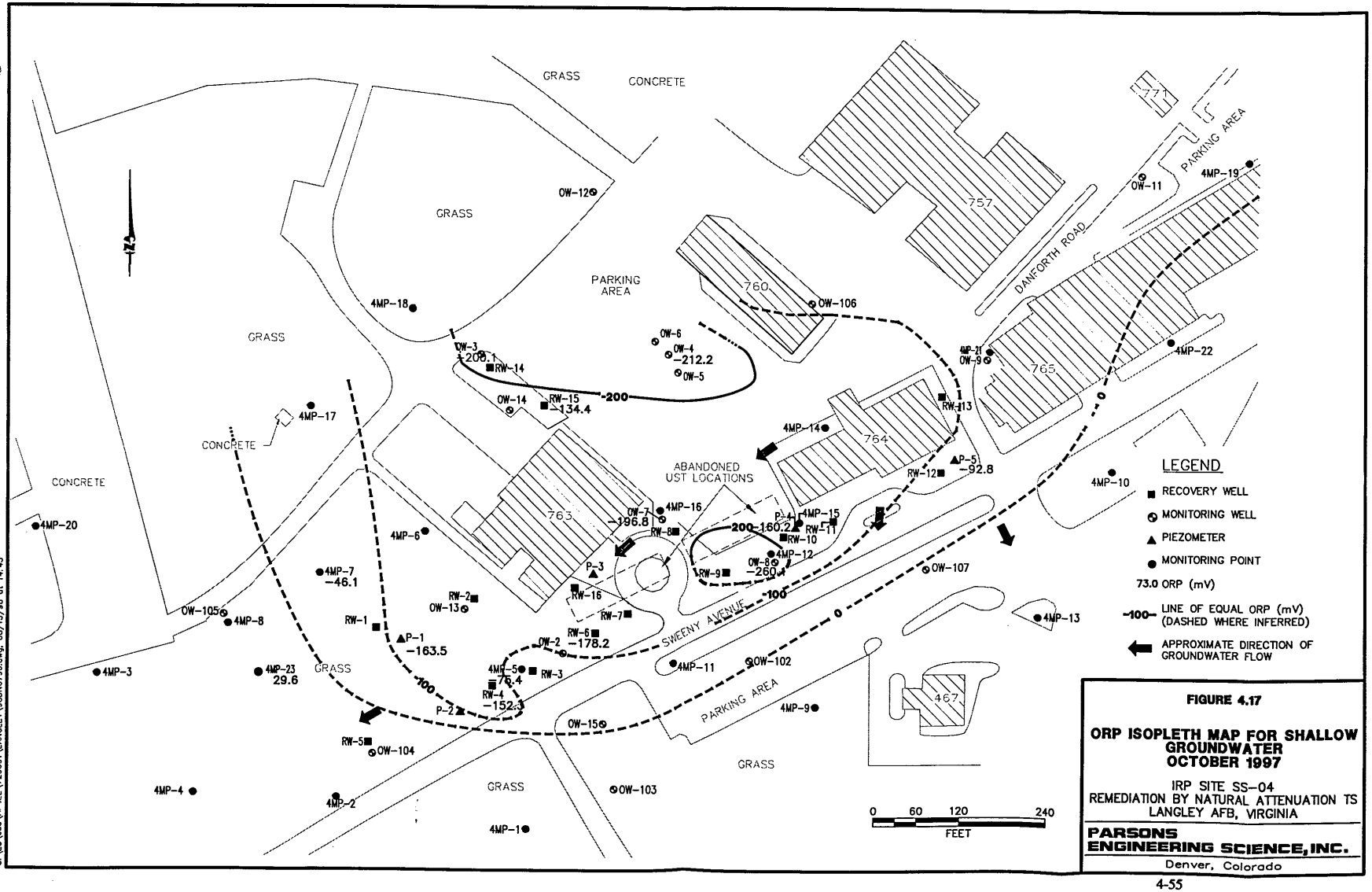


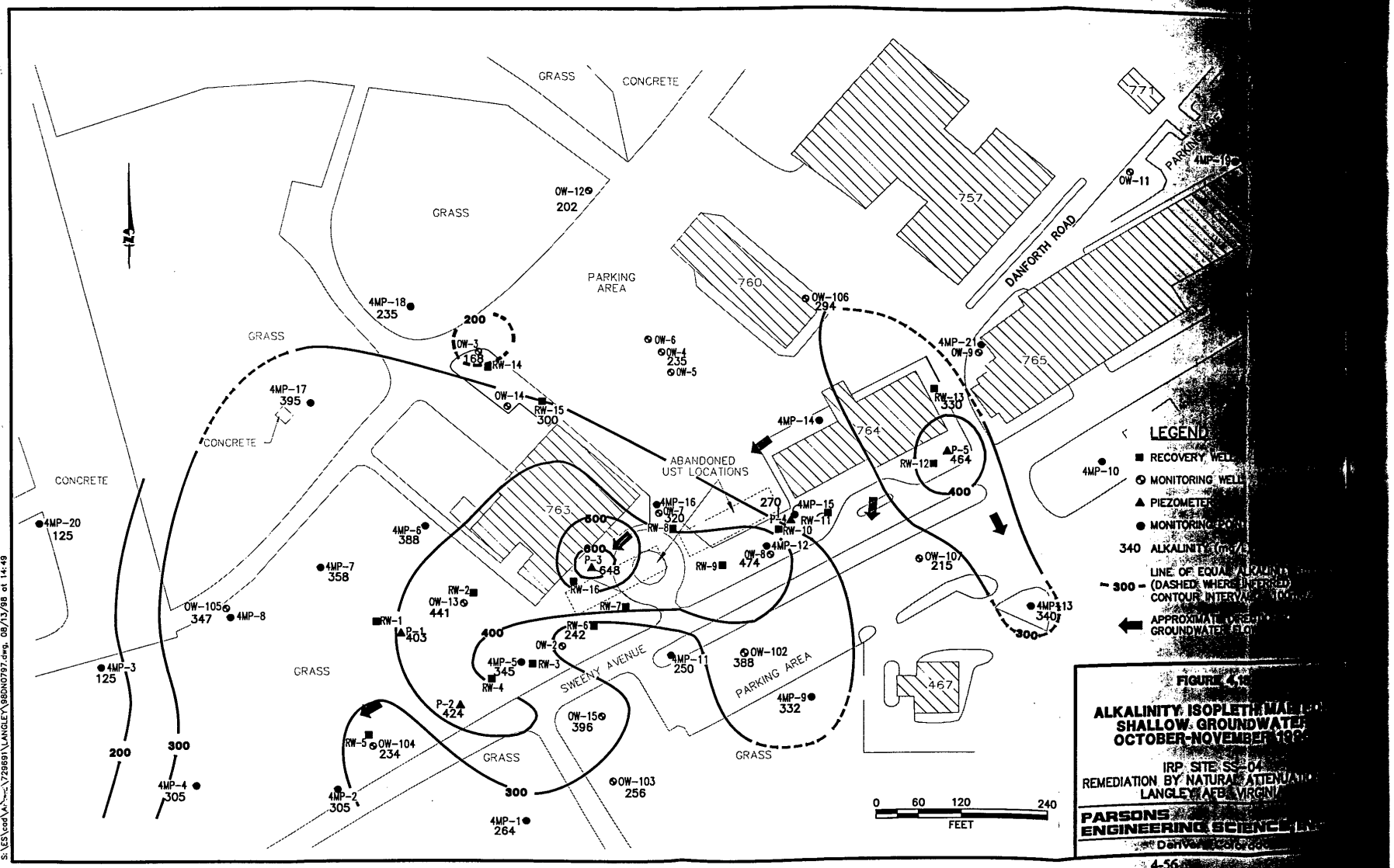
FIGURE 4.17

ORP ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER 1997

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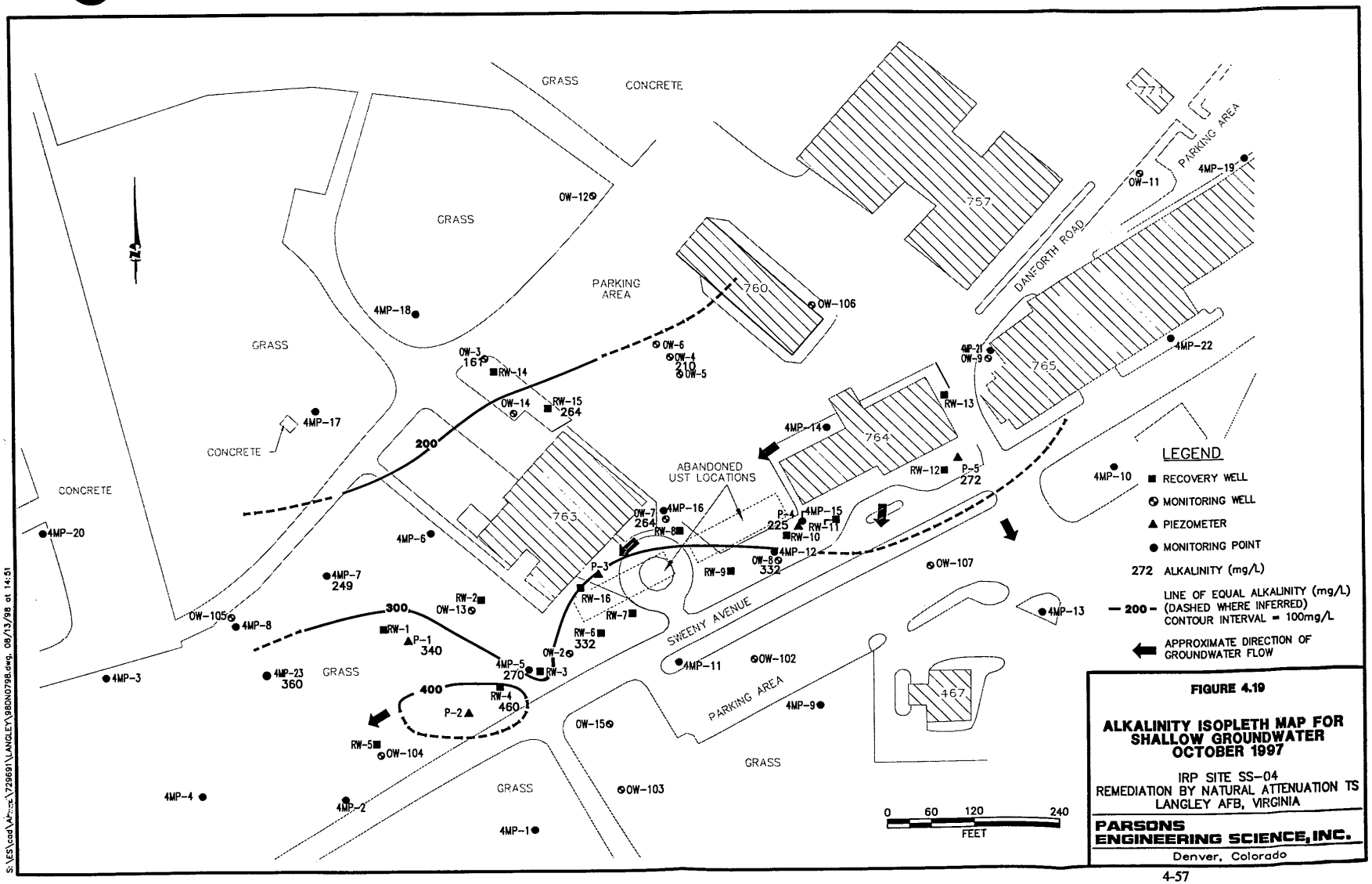


FIGURE 4.19

ALKALINITY ISOPLETH MAP FOR SHALLOW GROUNDWATER OCTOBER 1997

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buffer potential changes in pH caused by biologically-mediated BTEX oxidation reactions.

In general, areas containing elevated concentrations of fuel hydrocarbons exhibit a total alkalinity that is higher than in background areas. This occurs because the microbially-mediated reactions that degrade fuel hydrocarbons cause an increase in the total alkalinity in the system (Wiedemeier *et al.*, 1995). Comparison of Figures 4.3 and 4.18 suggests that areas containing elevated concentrations of total BTEX are associated with with elevated alkalinity; the association is not as clear in the data collected in 1997 (compare Figures 4.4 and 4.19).

4.4.2.9 pH

pH was measured in groundwater samples collected from groundwater monitoring points and monitoring wells in October and November 1996 and in October 1997 (Table 4.5). The pH of groundwater samples ranged from 6.3 standard units (SU) to 7.7 SU in 1996, and from 6.5 SU to 7.4 SU in 1997. This range includes the optimal range for BTEX-degrading microbes (approximately neutral water).

4.4.2.10 Temperature

The temperature of groundwater samples was measured at groundwater monitoring points and monitoring wells in October and November 1996 and in October 1997 (Table 4.5). Temperature affects the types and growth rates of bacteria that can be supported in the subsurface environment, with higher temperatures generally producing higher growth rates. Temperatures in the groundwater system varied from 15.8 degrees Celsius (°C) to 24.7 °C in 1996, and from 21.4 °C to 27.0 °C in 1997. These are moderately warm temperatures for groundwater, suggesting that bacterial growth rates will be adequately stimulated.

4.4.3 Expressed Assimilative Capacity

The data presented in the preceding sections suggest that mineralization of BTEX compounds is occurring via the microbially mediated processes of aerobic respiration, iron reduction, sulfate reduction, nitrogen fixation, and methanogenesis. On the basis of the stoichiometry presented in Table 4.4, the calculated assimilative capacity of the groundwater system at IRP Site SS-04 for BTEX consumption, considering all active processes, was at least 25,890 µ/L in 1996, and at least 26,550 µ/L in 1997 (Table 4.6).

A system, containing 2 liters of water, can be used to visualize the physical meaning of assimilative capacity. Assume that the first liter of water contains no fuel hydrocarbons, but does contain fuel-degrading microorganisms and has an assimilative capacity of exactly "x"µg of fuel hydrocarbons. The second liter has no assimilative capacity; however, it contains fuel hydrocarbons. As long as these 2 liters of water are kept separate, biodegradation of the fuel hydrocarbons will not occur. If these 2 liters are combined in a closed system, biodegradation will commence and continue until the fuel hydrocarbons are depleted, the electron acceptors are depleted, or the environment becomes acutely toxic to the fuel degrading microorganisms. Assuming a nonlethal

TABLE 4.6
EXPRESSED ASSIMILATIVE CAPACITY OF SITE GROUNDWATER
IRP SITE SS-04
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Electron Acceptor or Process	Oct-Nov 1996 Expressed BTEX Assimilative Capacity (μg/L)	October 1997 Expressed BTEX Assimilative Capacity (μg/L)
Iron Reduction	2,020	570
Sulfate Reduction	10,140	9,260
Nitrogen Fixation	3,330	5,420
Methanogenesis	10,400	11,300
Total Expressed Assimilative Capacity	25,890	26,550

environment, if fewer than "*x*" µg of fuel hydrocarbons were present in the second liter, all of the fuel hydrocarbons would eventually degrade, given sufficient time; likewise, if greater than "x" µg of fuel hydrocarbons were in the second liter of water, only "*x*" µg of fuel hydrocarbons would ultimately degrade.

The groundwater beneath a site is an open system, which continually receives additional electron acceptors from the movement of water in the aquifer and the percolation of precipitation (or influx of storm-sewer water). This means that the assimilative capacity of a groundwater system is not fixed, as it is in a closed system; rather, the expressed assimilative capacity of groundwater is intended to serve as a qualitative measure of the capacity for hydrocarbon degradation. The expressed assimilative capacity at this site much greater than the highest measured concentration of total BTEX (1,806 µg/L in 1996 and 319 µg/L in 1997), providing strong indication that biodegradation is occurring.

On the basis of expressed assimilative capacity calculations and the observed decrease in the areal extent of the plume, and in BTEX concentrations at Site SS-04 between 1996 and 1997, the groundwater system appears to have sufficient assimilative capacity to degrade the remaining BTEX contaminant mass and limit plume migration over time. Furthermore, the calculations of assimilative capacity presented in the earlier sections are conservative because they do not account for microbial cell mass production, and the measured concentrations of ferrous iron, ammonium, and methane may not be the maximum achievable. There is also the potential for the influx of electron acceptors (particularly oxygen) through rainwater infiltration at the site. The addition of water through precipitation, or movement from up-gradient areas, may further enhance the assimilative capacity of the site groundwater.

4.5 ESTIMATION OF FIRST-ORDER RATE CONSTANTS

The results of analyses of groundwater samples, collected from five wells (wells 4MP-5S, 4MP-5D, 4MP-15, OW-7, and RW-6) during the monitoring events of 1996 and 1997, were examined and compared to estimate the rate of biodegradation of the BTEX constituents in groundwater (assuming first-order degradation kinetics). The estimation of first-order rate coefficients was conducted by rearranging Equation 2 (Section 4.2.2) to obtain:

$$\mu = \frac{\ln\left(\frac{C}{Co}\right)}{t} \qquad 3$$

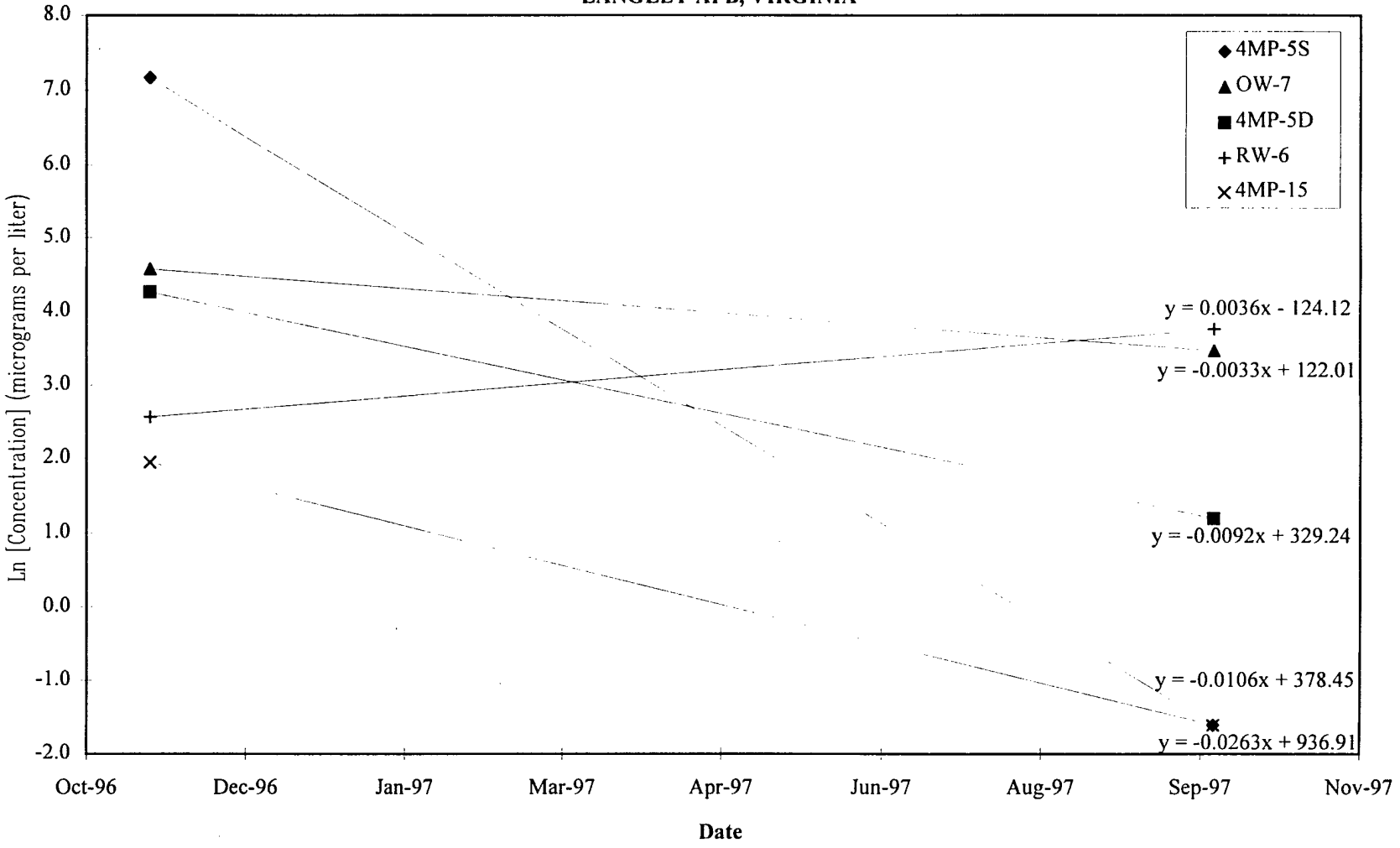
and performing a least-squares fit to the time and log concentration (**ln C/C$_0$**) data (Figure 4.20).

The slopes of the fitted lines for each of the wells represent an estimate of the rate of biodegradation, occurring through the nearly one-year period between November 1996 and October 1997. The slopes are remarkably similar, indicating that the range of estimated first-order approximations of the degradation rate is relatively narrow, in spite of the variation in subsurface conditions that would be expected at the different well locations. The estimated first-order rate coefficients range from 0.003 to 0.02 per day (approximately one order of magnitude range), indicating that the total mass of BTEX compounds in the subsurface decreases by up to 1 percent every day.

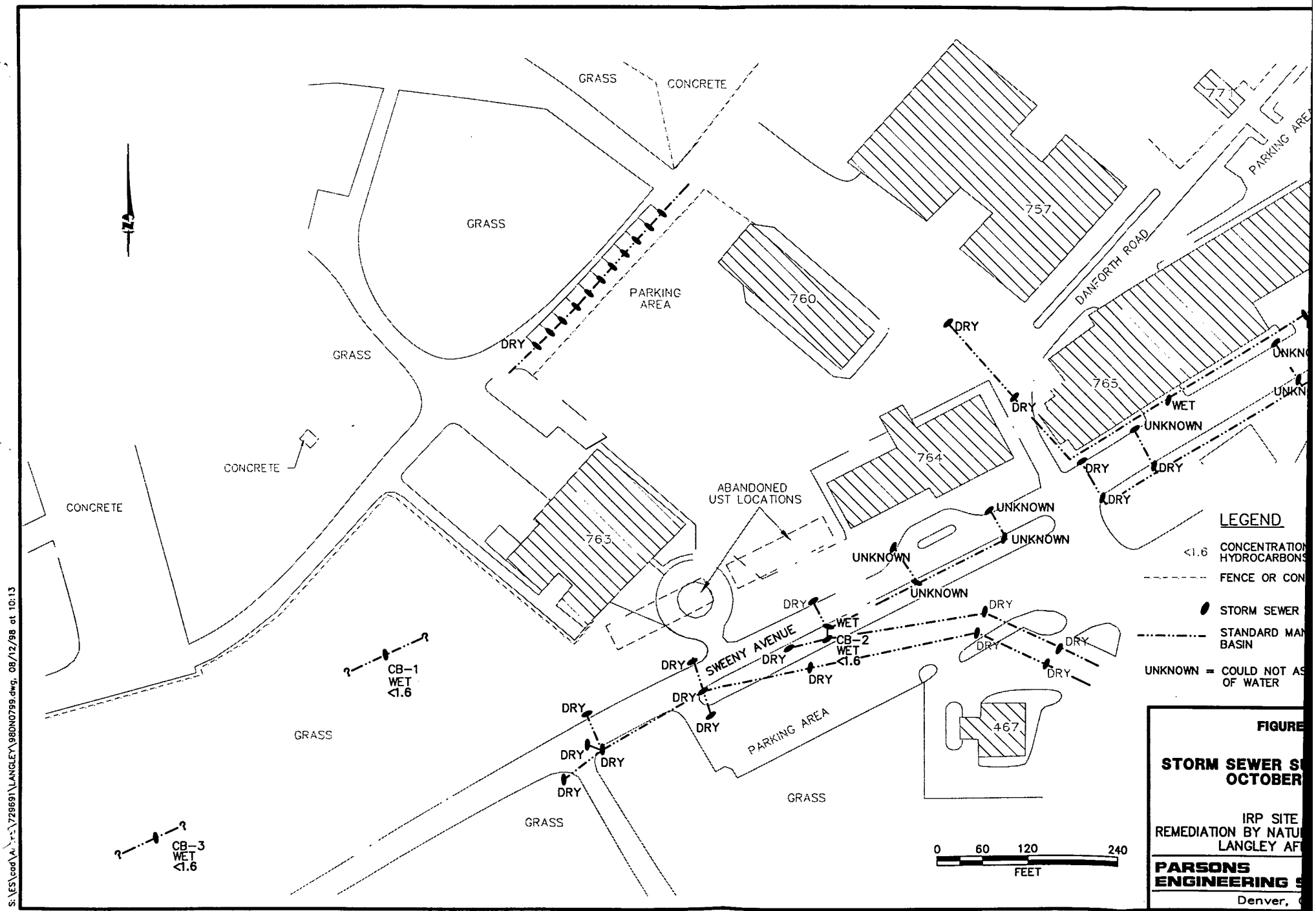
4.6 INSPECTION AND SAMPLING OF STORM SEWER SYSTEM

On October 7, 1997, water samples were collected from three catch basins (Basins CB-1, CB-2, and CB-3; Figure 4-21), and were analyzed for aromatic hydrocarbons using EPA Method SW8020. A visual survey of other catch basins and manholes also was conducted to determine whether water was present. Some of the inspection points are labeled "Unknown", because Parsons ES personnel could not access the inspection point. BTEX constituents were not detected in any of the three samples that were analyzed, indicating that groundwater containing fuel hydrocarbons is not moving into the storm-sewer system. However, potentiometric data (Section 3.3.2) strongly indicate that granular fill, placed as backfill around the storm sewers, may function as a preferential flowpath for groundwater.

FIGURE 4.20
NATURAL LOG OF BENZENE CONCENTRATION VS TIME
IRP SITE SS-04
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FIGURE

STORM SEWER SU
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SECTION 5

CONTAMINANT TRANSPORT EVALUATION

The fate and transport of benzene in groundwater at Langley AFB IRP Site SS-04 were modeled using BIOSCREEN (Newell *et al.*, 1996) to evaluate biodegradation and natural attenuation of the dissolved plume. A BIOSCREEN model was developed using site-specific data and conservative assumptions.

5.1 DESCRIPTION OF BIOSCREEN MODEL

BIOSCREEN is a public-domain, screening-level computer model, which can be used to simulate remediation of dissolved hydrocarbons at petroleum release sites due to natural attenuation (Newell *et al.*, 1996). The software consists of a Microsoft® Excel spreadsheet based on an implementation of the Domenico (1987) analytical solute transport model. The model can simulate the processes of advection, dispersion, adsorption, first-order decay reactions, and aerobic and anaerobic instantaneous decay reactions.

BIOSCREEN can be used to evaluate three different general cases of solute transport either separately or combined (Newell *et al.*, 1996):

- Solute transport due to advection and dispersion with no decay or retardation (No Biodegradation Model).
- Solute transport with solute biodegradation modeled as a first-order decay process (single, lumped parameter approach) (First-Order Decay Model); and
- Solute transport with solute biodegradation modeled as an instantaneous oxidation/reduction (redox) reaction (Instantaneous Reaction Model).

The first general model type is appropriate for predicting the movement of a conservative (non-degrading) solute such as chloride. The only attenuation mechanisms simulated are dispersion in the longitudinal, transverse, and vertical directions. The solute transport model implemented in BIOSCREEN assumes a homogeneous, isotropic porous media with a constant groundwater flow velocity. The basic solute transport model can be used with or without solute retardation due to sorption onto soil organic carbon. Biodegradation of petroleum products occurs at almost all petroleum release sites. It can be verified by demonstrating the consumption of aerobic and anaerobic electron acceptors and the associated decreases in concentrations of hydrocarbon compounds. Results from the No Biodegradation model are intended only to be used for comparison purposes and to demonstrate the effects of biodegradation on plume migration.

Solute biodegradation can also be modeled as a first-order decay process with BIOSCREEN. This method assumes the solute degradation rate is proportional to the solute concentration ("first-order" conditions). This is the conventional method for simulating biodegradation of dissolved hydrocarbon plumes. All methods of hydrocarbon removal are lumped together in a single calibration parameter (the first-order rate constant) when using the First-Order Decay model. The First-Order Decay model does not account for site-specific information such as the availability of electron acceptors.

The Instantaneous Reaction model in BIOSCREEN computes solute biodegradation based on availability of electron acceptors. Site-specific data for available oxygen are used to compute aerobic degradation of dissolved hydrocarbons, and site-specific data for nitrogen, sulfate, ferrous iron, and methane are used to compute anaerobic degradation. For sites such as SS-04 at Langley AFB, where electron acceptor and metabolic byproduct concentration data are available, the Instantaneous Reaction model is preferred, either alone or in conjunction with the First-Order Decay Model (Newell *et al.*, 1996).

5.2 MODELING OBJECTIVES

Benzene is the only BTEX constituent in groundwater at Langley AFB Site SS-04 that is currently, or has historically, been detected at concentrations exceeding potential regulatory criteria (e.g., its federal MCL). Benzene is therefore the only compound modeled using BIOSCREEN. The BIOSCREEN simulations for this site were constructed to address the following questions:

- What would be the maximum migration distance of the benzene plume from the source area through time?
- What would be the time required for concentrations of benzene in the plume to attenuate to concentrations below the federal MCL of 5μg/l?
- How will source remediation affect the dissolved benzene plume concentrations?

5.3 CONCEPTUAL MODEL DESIGN AND LIMITING ASSUMPTIONS

BIOSCREEN is based on an analytical solution to the advection-dispersion equation describing solute transport in porous media. It therefore has the following limitations:

- Groundwater flow is steady state and horizontal;
- Solute transport in the x-direction is due to advection and longitudinal dispersion, with optional adsorption and biodegradation;
- Solute transport in the y-direction is due only to transverse dispersion and optional adsorption and biodegradation;
- The aquifer is two-dimensional in plan view (no vertical flow or transport);
- The aquifer is infinite in areal extent, homogeneous, and isotropic; and

- The aquifer has a constant saturated thickness.

BIOSCREEN is a screening tool that can only be used to approximate the more complicated processes at a site. The model is not capable of simulating a complicated flow regime, so the hydraulic input parameters for the model are based on field data averages collected along the primary path of groundwater flow at the site (northeast to southwest through the source area surrounding the abandoned USTs).

5.4 INITIAL MODEL INPUT DATA

Input data for the BIOSCREEN model are used to calculate groundwater flow velocity, contaminant plume dispersion, contaminant retardation coefficient, first-order contaminant decay coefficient, contaminant source half-life, and dimensions of the source area. Model input data are presented in Table 5.1 and discussed in detail below.

5.4.1 Groundwater Flow Velocity

The advective groundwater velocity beneath the site is computed based on site-specific hydraulic conductivity and hydraulic gradient data and an assumed effective porosity of 20 percent, based on published values for silty sand (Spitz and Moreno, 1996; Wolff, 1982). The value of hydraulic conductivity used in the model (11.9 ft/day [4.2 x 10^{-3} cm/sec]) is near the median of hydraulic conductivity values calculated from slug tests conducted at the site in November 1996 (Section 3). The hydraulic gradient value of 0.003 ft/ft used in the BIOSCREEN model was calculated from groundwater elevation data collected in October 1997. The advective groundwater flow velocity calculated by BIOSCREEN using the hydraulic parameters listed above is 65.8 feet per year (ft/yr) (Table 5.1).

5.4.2 Dispersivity

Dispersion is the process whereby dissolved constituents are spread out longitudinally (in the direction of groundwater flow), transversely (perpendicular to groundwater flow), and vertically downward due to mechanical mixing and chemical diffusion in the aquifer. The initial values of longitudinal and transverse dispersivity used in this application were calculated by BIOSCREEN from the estimated current benzene plume length of 350 feet. The longitudinal dispersivity calculated by BIOSCREEN was 15 feet, and the transverse dispersivity calculated by BIOSCREEN was 1.5 feet (transverse dispersivity equals one-tenth the longitudinal dispersivity). Vertical dispersivity is not used by this application, because groundwater flow is being simulated in a two-dimensional plane with no vertical flow.

5.4.3 Retardation Due to Adsorption

Dissolved petroleum hydrocarbons can be retarded relative to the advective groundwater velocity when the organic molecules are adsorbed to organic carbon in the aquifer matrix. The retardation coefficient is a mathematical representation of adsorption and is computed according to the relation:

TABLE 5.1
BIOSCREEN INPUT PARAMETERS
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Data Type	Parameter	Value				Data Source
Hydrogeology	Groundwater Flow Velocity (v) (ft/yr)	65.8				Calculated from v = KI/n
	Hydraulic Conductivity (K)	4.2E-3 cm/sec (11.9 ft/day)				Average of site slug tests
	Hydraulic Gradient (I)	0.0030				Groundwater level measurements from October 1997
	Effective Porosity (n)	0.2				Assumed literature value
Dispersion	Longitudinal Dispersivity (ft)	9				Based on estimated benzene plume length of 350 ft
	Transverse Dispersivity (ft)	0.9				and Xu/Eckstein relationship
	Vertical Dispersivity (ft)	0				
Adsorption	Retardation Factor	1.1				Calculated from: R = 1+Koc x foc x rb/n
	Soil Bulk Density (ρ_b) (kg/L)	1.7				Estimated from literature values
	foc	0.0001				Soil TOC data from borehole 4MP-13 (Table 4.2)
	Benzene Koc (L/kg)	79				Literature value for benzene (Wiedemeier *et al*., 1995)
Biodegradation	**Electron Acceptors:**	O_2	NO_3	SO_4		
	Avg. Background Concentration (mg/L)	0.21	0.5	35.25		Site geochemial data from November 1996 and October 1997
	Minimum Plume Concentration (mg/L)	0.19	0.66U	0.91		Note: Shaded values are BIOSCREEN input
	Delta Concentration = (Avg. Bkgd. - Avg. Plume)	0.02	0.0	34.34		
	30% Reduction for non-BTEX compounds	0.01	0.0	24.04		
	50% Reduction for TEX compounds	0.0	0.0	12.02		
	Metabolic Byproducts:	Fe^{2+}	CH_4			
	Average Plume Concentration (mg/L)	8.90	4.0			
	30% Reduction for non-BTEX compounds	6.23	2.8			
	50% Reduction for TEX compounds	3.12	1.4			
General	Model Area Length (ft)	480				Based on estimated affected area
	Model Area Width (ft)	480				
	Simulation Time (yrs)	1 to 33				
Source Data	Source Width (ft)	120				Apparent source area width perpendicular to groundwater flow
	Source Thickness (ft)	1				CPT/LIF data (Section 4)
	Source Concentration (mg/L)	0.5 to 0.25				Benzene groundwater sampling results from October 1997
Field Comparison Data	Location	P4	100 µg/L contour	RW-6	4MP-5D	Benzene groundwater sampling results from October 1997
	Distance from Source (ft)	0	150	340	430	(Figure 5.1)
	Benzene Concentration (mg/L)	0.17	0.1	0.043	0.003	

$$R = 1 + \frac{K_d \bullet \rho_b}{n}$$

where:

R = retardation coefficient (unitless);

K_d = distribution coefficient (L/kg)

$= K_{oc} \bullet f_{oc}$;

K_{oc} = organic carbon-water partition coefficient (L/kg);

f_{oc} = fraction organic carbon on uncontaminated soil (unitless - determined from soil TOC data);

ρ_b = bulk density (kg/L); and

n = porosity (fraction).

A retardation coefficient value of one (1.0) indicates that the solute is not retarded relative to the average groundwater flow, while increasing the retardation coefficient to values greater than one decreases the solute velocity relative to the average groundwater flow velocity. Using an estimated fraction organic carbon of 0.0001 (based on soil TOC data from borehole 4MP-13; Table 4.2), an estimated soil bulk density of 1.7 kilograms per liter (kg/L), and a partition coefficient for benzene of 79 liters per kilogram (L/kg) (Wiedemeier *et al.*, 1995), a retardation coefficient for benzene of 1.1 was calculated for input to the BIOSCREEN model (Table 5.1).

5.4.4 Instantaneous Reaction Data

The BIOSCREEN Instantaneous Reaction option uses field data for certain electron acceptors and metabolic byproducts to calculate biodegradation of benzene. Electron acceptor input data consist of the difference between an average background concentration and the minimum source area concentration for dissolved oxygen, nitrate, and sulfate. Metabolic byproduct concentrations in the source area can also be input for ferrous iron and methane.

Geochemical data collected in November 1996 and October 1997 were used to compute the electron acceptor and metabolic byproduct concentrations for input to the BIOSCREEN model (Tables 5.1 and 5.2). For oxygen, the difference between an average background concentration of 0.21 mg/L and the minimum source area concentration of 0.19 mg/L is only 0.02 mg/L, indicating that oxygen reduction is a negligible process for benzene biodegradation at this site. A delta dissolved oxygen concentration of 0.0 mg/L was therefore input into the BIOSCREEN model, and oxygen reduction was not simulated. For nitrate, the average background concentrations range from 0.5 mg/L to non-detect (at less than 0.66 mg/L) (Table 5.2), and nitrate was not detected in the plume. This small difference between background and the minimum plume value indicates that denitrification is not a significant BTEX biodegradation process at the site. A nitrate value of 0.0 was therefore input into

TABLE 5.2
CALCULATION OF BIOSCREEN INSTANTANEOUS REACTION INPUT DATA
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Upgradient or Background Wells

Parameter	Units	4MP-7 8-Oct-97	4MP-22 8-Oct-97	OW-4 8-Oct-97	Min	Max	Avg[f]
Ferrous Iron	mg/L[c]	0.02	0.14	1.39	0.02	1.39	0.52
Methane	mg/L	0.0012U[e]	NA	3.3	3.30	3.30	3.30
Nitrate-N	mg/L	0.66 U	0.5	0.66 U	0.66 U	0.5	**0.5**
Sulfate	mg/L	38.38	61.28	6.08	6.08	61.28	**35.25**
DO[a]	mg/L	NA[f]	NA	0.21	0.21	0.21	**0.21**
ORP[b]	mV[d]	-46.1	NA	-212.2	-212.20	-46.10	-129.15

Contaminated Wells

Parameter	Units	4MP-5S 01-Nov-96	4MP-5S 07-Oct-97	4MP-5D 1-Nov-96	4MP-5D 7-Oct-97	4MP-15 3-Nov-96	4MP-15 9-Oct-97	4MP-16 3-Nov-96	OW-7 29-Oct-96	OW-7 8-Oct-97	P-4 4-Nov-96	P-4 9-Oct-97
Ferrous Iron	mg/L	44.9	5.9	8.60	2.36	18.30	9.25	2.92	3.83	3.08	5.01	3.28
Methane	mg/L	6.1	0.39	2.84	5.6	0.07	0.23	0.022	4.21	5.5	6.8	8.8
Nitrate-N	mg/L	NA	NA	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U
Sulfate	mg/L	7.96	1.2	1.21	13.35	934.80	1027.40	75.17	2.70	0.91	1.42	5.18
DO	mg/L	0.23	3.13	0.35	0.32	0.39	0.81	1.02	0.29	0.19	0.21	0.32
ORP	mV	-179.9	-75.4	-332.1	-115.6	-218.4	-110.9	-202.8	-173.5	-196.8	-183.4	-160.2
Benzene (B)	ug/l	1300	0.4 U	71.0	3.3	7.00	0.4 U	7.5	97.0	32.0	25.0	170.0
Toluene	ug/l	8.0 U	0.4 U	7.2	0.4 U	0.4 U	0.4 U	0.4 U	0.7	0.4 U	0.4 U	0.4 U
Ethylbenzene	ug/l	96	2	13.0	2.9	30	2.1	5.3	3.8	4.1	41.0	140.0
Xylenes	ug/l	410	5.4	54.0	9.6	1.80	0.98	12.0	6.1	9.0	13.0	8.9
Total BTEX	ug/l	1806	7.4	145.20	15.8	38.8	3.1	24.8	107.6	45.1	79.0	319.0
Ratio B/BTEX		0.72		0.49	0.21	0.18		0.30	0.90	0.71	0.32	0.53

Parameter	Units	P-5 30-Oct-96	P-5 9-Oct-97	RW-4 9-Oct-97	RW-6 30-Oct-96	RW-6 8-Oct-97	RW-15 3-Nov-96	RW-15 8-Oct-97	Min	Max	Avg[g]
Ferrous Iron	mg/L	12.60	2.85	12.5	4.78	8.90	6.55	4.15	2.36	44.9	**8.9**
Methane	mg/L	8.1	2.4	7.7	5.4	4.5	1.2	2.8	0.02	8.8	**4.0**
Nitrate-N	mg/L	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	0.66 U	**0.66 U**	0.66 U	0.66 U
Sulfate	mg/L	6.96	33.68	4.50	4.65	1.57	3.49	2.19	**0.91**	1027.4	6.1
DO	mg/L	0.22	0.28	0.22	0.24	0.22	0.21	0.20	**0.19**	3.13	0.49
ORP	mV	-192.0	-92.8	-152.3	-264.2	-178.2	-228.7	-134.4	-332.10	-75.4	-177.3
Benzene (B)	ug/l	0.4 U	0.4 U	0.4 U	12.0	43.0	0.4 U	0.4 U			
Toluene	ug/l	5.6	0.4 U	1.2	3.3	0.4 U	18.0	0.4 U			
Ethylbenzene	ug/l	5.9	3.5	0.9	1.3	2.8	0.4 U	1.3			
Xylenes	ug/l	3.3	5.7	1.2	4.4	5.5	0.4 U	0.8 U			
Total BTEX	ug/l	14.8	9.2	3.3	21.0	51.3	18.0	1.3	1.30	1806.00	150.59
Ratio B/BTEX					0.57	0.84			0.18	0.90	**0.52**

[a] DO = dissolved oxygen.

[b] ORP = oxidation-reduction potential.

[c] mg/L = milligrams per liter.

[d] mV = millivolts.

[e] U = not detected above laboratory reporting limits.

[f] Shaded values are used to compute BIOSCREEN instantaneous reaction input data in Table 5-1.

[g] Average for sulfate excludes greater than background sulfate values for wells 4MP-15 and 4MP-16.
Average Ratio of benzene to BTEX is computed for those wells where benzene was detected at concentrations >10 ug/L

BIOSCREEN, and denitrification was not simulated. For sulfate, the difference between an average background concentration of 35.25 mg/L and the minimum source area concentration of 0.91 mg/L is 34.34 mg/L. For ferrous iron, the average observed concentration in the source area was 8.9 mg/L, and for methane, the average observed concentration in the source area was 4.0 mg/L.

Because the Site SS-04 BIOSCREEN model simulates only benzene biodegradation, the instantaneous reaction input values for sulfate, ferrous iron, and methane were further reduced to account for the biodegradation of other organic compounds. The input values were first reduced by 30% to account for the non-BTEX constituents in groundwater as recommended in the BIOSCREEN documentation (Newell *et al.*, 1996). The values were then reduced by an additional 50% to account for the site-specific ratio of benzene to total BTEX. Calculation of benzene to BTEX ratios for the site is presented in Table 5.2, and the resulting instantaneous reaction input values are shown in Table 5.1. In addition to correcting the instantaneous reaction input values for the simulation of benzene only, the stoichiometric mass ratios for electron acceptors and metabolic byproducts in BIOSCREEN were modified to simulate the biodegradation of benzene only. For benzene biodegradation the values are 3.07 mg for oxygen, 4.77 mg for nitrate, 4.61 mg for sulfate, 21.5 mg for ferrous iron, and 0.77 mg for methane (Table 4.4).

The Instantaneous Reaction Model results probably overpredict the time required to achieve federal MCLs because the beneficial effects of nitrogen fixation were not simulated by this model. As discussed in Section 4.4.2.5, site data indicate that dissolved BTEX compounds are being biodegraded via nitrogen fixation. Stoichiometric calculations indicate that this process accounted for 13 to 20 percent of the BTEX assimilative capacity of the groundwater system in 1996 and 1997 (Table 4.6).

5.4.5 Source Data

BIOSCREEN assumes that the source of hydrocarbons is represented by a fully-penetrating vertical plane oriented perpendicular to the direction of groundwater flow. This vertical plane can be divided into one, three, or five zones with different concentrations. For Site SS-04, the benzene source area is estimated as 120 feet in width and is divided into three zones for model input purposes (Figure 5.1). The source width corresponds to the benzene plume width in the source area. The maximum concentration in source area Zone 3 was estimated at 0.25 mg/L based on the maximum benzene concentration of 0.17 mg/L at well P-4 in October 1997 and model calibration. A benzene concentration of 0.05 mg/L was assigned to source area Zones 2 and 4. The benzene source thickness was set at one foot based on CPT/LIF data (Section 4).

BIOSCREEN includes two options for defining a contaminant source. The first option is an infinite or constant source, and the second option calculates a decaying source concentration over time. The declining source term assumes the mass of

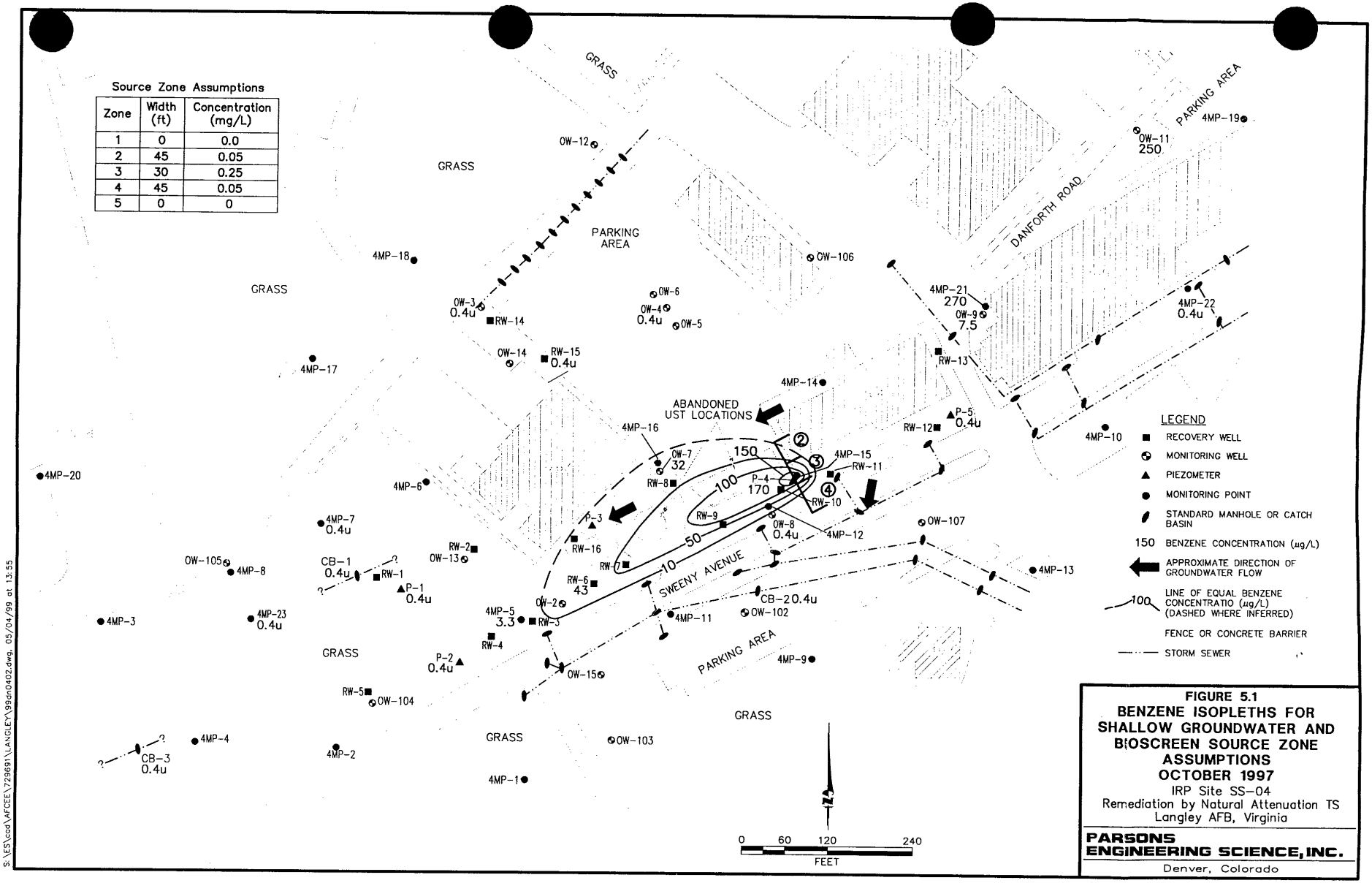


FIGURE 5.1
BENZENE ISOPLETHS FOR SHALLOW GROUNDWATER AND BIOSCREEN SOURCE ZONE ASSUMPTIONS
OCTOBER 1997
IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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contaminant in the source area dissolves slowly as fresh groundwater passes through and removes contaminant mass. The change in source mass is approximated as a first-order decay process. Based on an input value for source mass, BIOSCREEN computes an estimated source half-life for the first-order source decay.

The benzene source term for Site SS-04 is simulated as a decaying finite source. The Site SS-04 tanks were removed in 1987, and the BIOSCREEN source term for this model represents residual benzene soil contamination present in the source area since 1987. A source area mass of 6 kg was estimated from benzene concentrations in soil collected during October 1997 (Appendix D). The BIOSCREEN model may underpredict the rate of source reduction because it does not account for source biodegradation in addition to dissolution-related reductions.

5.5 MODEL CALIBRATION

The BIOSCREEN model for Site SS-04 was calibrated to benzene concentration data collected during October 1997 (Figure 5.1). Using the source term and model parameters described above, transport simulations were run for a time frame of ten years (1987-1997). To achieve model calibration, the values of longitudinal and transverse dispersivity were adjusted to 9.0 and 0.9 feet, respectively. With these adjustments, computed benzene concentrations for the Instantaneous Reaction model approximately match field data from the site, and the model correctly predicts a plume length of approximately 360 to 380 feet (Figure 5.2). The calibrated BIOSCREEN model input parameters and results are included as Appendix D.

5.6 SENSITIVITY ANALYSIS

A model calibration sensitivity analysis was performed to evaluate the range of model parameters considered reasonable for the site. Select model input parameters were varied to evaluate the sensitivity of the model to each parameter. Model sensitivity was evaluated by examining the model predicted benzene concentration in groundwater at the source area and plume length. The parameters varied include hydraulic conductivity, longitudinal dispersivity, and the concentrations of delta sulfate, ferrous iron, and methane. Sensitivity analysis results are presented in Table 5.3.

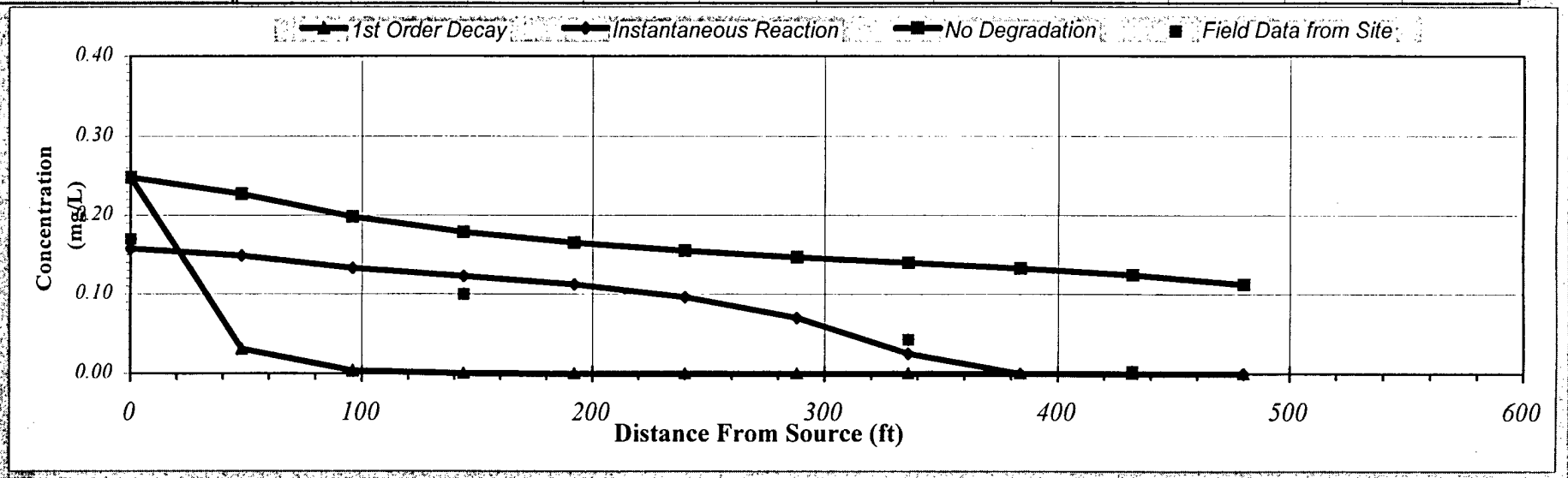
Hydraulic conductivity was varied between the minimum and maximum values calculated from slug tests at the site (Table 3.6). Model results are sensitive to the hydraulic conductivity value. Using the site maximum hydraulic conductivity value resulted in BIOSCREEN significantly underpredicting the source area concentration after a ten-year simulation time, and using the minimum hydraulic conductivity value resulted in BIOSCREEN significantly underpredicting the plume length (Table 5.3). The calibrated hydraulic conductivity value of 0.0042 cm/sec (11.9 ft/day) appears to be a reasonable average value for the site.

Longitudinal and transverse horizontal dispersivity were varied during model calibration and the sensitivity analysis, and model results are also quite sensitive to dispersivity values. During the sensitivity analysis, longitudinal dispersivity was varied by doubling and then halving its value. Transverse horizontal dispersivity is automatically computed as one-tenth the longitudinal dispersivity by BIOSCREEN.

FIGURE 5.2. BIOSCREEN PREDICTED BENZENE CONCENTRATIONS (mg/L) ALONG THE PLUME CENTERLINE FOR TEN-YEAR MODEL CALIBRATION.
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	48	96	144	192	240	288	336	384	432	480
No Degradation	0.248	0.227	0.198	0.179	0.165	0.155	0.147	0.140	0.133	0.124	0.112
1st Order Decay	0.248	0.031	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.158	0.149	0.133	0.123	0.112	0.096	0.070	0.025	0.000	0.000	0.000
Field Data from Site	0.170			0.100				0.043		0.003	



Calculate Animation
Next Timestep
Prev Timestep
Time:
10.0 Years
Return to Input
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TABLE 5.3
BIOSCREEN SENSITIVITY ANALYSIS RESULTS
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Simulation #	Methane (mg/L)	Fe^{2+} (mg/L)	ΔO_2 (mg/L)	ΔNO_3 (mg/L)	ΔSO_4 (mg/L)	K (cm/sec)	K (ft/day)	α_L (ft)	t (yrs)	Model Computed Benzene Concentration at x=0 (source) (mg/L)	(% Difference)	Approx. Distance from Source to Benzene < 5 ug/l (ft)	(% Difference)
original	1.4	3.12	0.0	0.0	12.02	0.0042	11.9	9.0	10	0.158		360	
1	1.4	3.12	0.0	0.0	12.02	**0.0082**	23.2	9.0	10	0.086	-45.6%	330	-8.3%
2	1.4	3.12	0.0	0.0	12.02	**0.0006**	1.7	9.0	10	0.236	49.4%	45	-87.5%
3	1.4	3.12	0.0	0.0	12.02	0.0042	11.9	**18.0**	10	0.158	0.0%	190	-47.2%
4	1.4	3.12	0.0	0.0	12.02	0.0042	11.9	**4.5**	10	0.158	0.0%	480	33.3%
5	**2.8**	3.12	0.0	0.0	12.02	0.0042	11.9	9.0	10	0.155	-1.9%	380	5.6%
6	**0.7**	3.12	0.0	0.0	12.02	0.0042	11.9	9.0	10	0.159	0.6%	380	5.6%
7	1.4	**6.24**	0.0	0.0	12.02	0.0042	11.9	9.0	10	0.127	-19.6%	330	-8.3%
8	1.4	**1.56**	0.0	0.0	12.02	0.0042	11.9	9.0	10	0.170	7.6%	380	5.6%
9	1.4	3.12	0.0	0.0	**24.04**	0.0042	11.9	18.0	10	0.114	-27.8%	330	-8.3%
10	1.4	3.12	0.0	0.0	**6.01**	0.0042	11.9	18.0	10	0.182	15.2%	380	5.6%

Notes:

Fe^{2+} = ferrous iron.
O_2 = dissolved oxygen.
NO_3 = nitrate.
SO_4 = sulfate.
K = hydraulic conductivity.
α_L = longitudinal dispersivity
mg/L = milligrams per liter.
cm/sec = centimeters per second.
ft = feet
ft/day = feet per day
yrs = years.
Bolded Values indiate the parameter that was varied.

Increasing longitudinal dispersivity to 18 feet resulted in BIOSCREEN underpredicting the plume length by approximately 50%, and halving the longitudinal dispersivity to 4.5 feet resulted in BIOSCREEN overpredicting the plume length by approximately one third (Table 5.3).

The instantaneous reaction input parameters of delta sulfate, ferrous iron, and methane were also evaluated during the sensitivity analysis by doubling and then halving their values while holding constant the calibration values for hydraulic conductivity and dispersivity. The BIOSCREEN model results for Site SS-04 are somewhat sensitive to changes in sulfate and methane concentrations and least sensitive to changes in ferrous iron concentrations. Model calibration results are most sensitive to values of hydraulic conductivity and longitudinal dispersivity.

5.7 SIMULATION OF REMEDIAL ALTERNATIVES

Subsequent to model calibration, the BIOSCREEN model was used to evaluate two remedial alternatives for Site SS-04.

5.7.1 Simulation of Remediation by Natural Attenuation

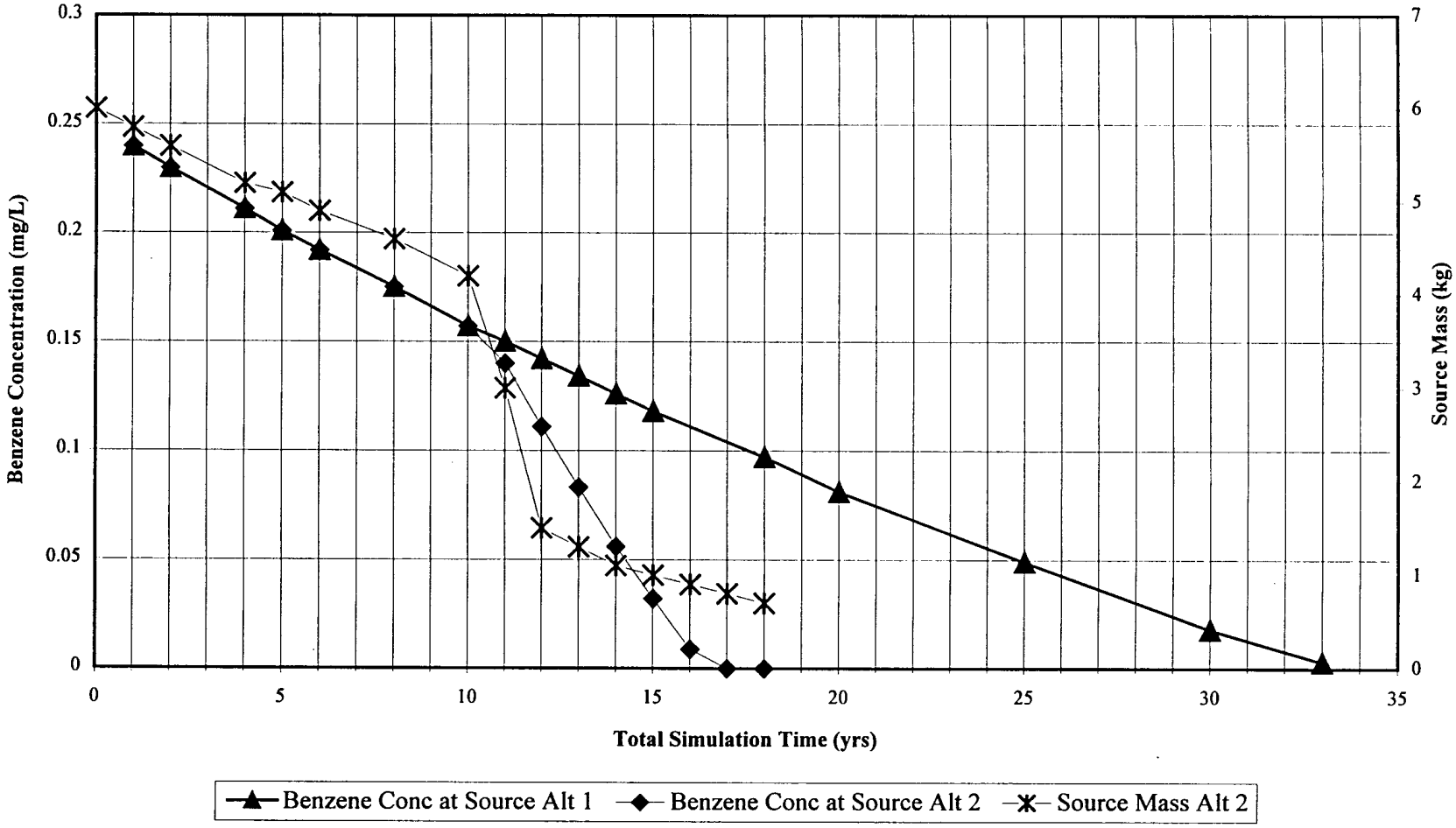
To evaluate benzene RNA, the calibrated model was run in a predictive mode for various simulation periods. Results for 20-, 25-, 30-, and 33-year simulation times (10, 15, 20, and 23 years from 1997, respectively) are presented in Appendix D. The RNA predictive simulations assume first-order source weathering based on the input finite source mass (Newell *et al.*, 1996). After 15 years of RNA (25-year total simulation time), BIOSCREEN predicts benzene groundwater concentrations of approximately 0.05 mg/L (a 70% reduction) in the source area (Figure 5.3) and a plume length of approximately 260 feet. After 20 years of RNA (30-year total simulation time), BIOSCREEN predicts maximum benzene groundwater concentrations of approximately 0.02 mg/L (an 88% reduction) in the source area and a plume of length less than 100 feet. Source area benzene concentrations in groundwater are reduced to below 0.005 mg/L after 23 years of RNA (33-year total simulation time) based on BIOSCREEN simulations (Appendix D).

5.7.2 Simulation of Second Remedial Alternative

The second remedial alternative (biosparging) was also evaluated with the calibrated BIOSCREEN benzene model for Site SS-04. A biosparging system consists of small-diameter wells or wellpoints connected to a blower via pipes and a manifold. The blower injects air below the water table through the manifold and piping to increase the dissolved oxygen concentration in the shallow saturated zone. The increased DO promotes aerobic biodegradation of BTEX in the groundwater system. In addition, VOCs are stripped from the sparged groundwater and transferred into the vadose zone.

Biosparging at Site SS-04 was simulated using BIOSCREEN by assuming that biosparging in the source area will decrease the source area benzene concentration by 50% per year for two years (Figure 5.3). Separate BIOSCREEN model runs were performed to represent the decreasing source mass and the resulting benzene concentrations in groundwater beneath the source area as shown on Figure 5.3. The

FIGURE 5.3 BIOSCREEN PREDICTED BENZENE CONCENTRATIONS BENEATH THE SOURCE AREA FOR REMDIAL ALTERNATIVES 1 AND 2
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA



BIOSCREEN simulations predict that benzene groundwater concentrations would be reduced to below 0.005 mg/L in the source area after two years of biosparging and five years of subsequent RNA (17-year total simulation time). Alternative 2 cost estimates presented in Section 6 extend LTM one year past the predicted attainment of MCLs in the source area for a total LTM period of eight years.

5.8 CONCLUSIONS

The following conclusions can be drawn from the BIOSCREEN model results and sensitivity analysis for Site SS-04:

- Benzene comprises approximately 50% of the total BTEX dissolved in groundwater.
- The best match of computed benzene concentrations along the plume centerline to site field data is obtained using an average hydraulic conductivity of 11.9 ft/day (4.2×10^{-3} cm/sec), a longitudinal dispersivity of 9 ft, and a transverse dispersivity of 0.9 ft.
- The BIOSCREEN model is most sensitive to values of hydraulic conductivity and dispersivity. The model is less sensitive to the instantaneous reaction parameters.
- The Instantaneous Reaction model for benzene biodegradation provides a good match to site field data. Instantaneous Reaction input data were reduced first by 30% to account for the non-BTEX constituents and then by 50% to account for the simulation of benzene only.
- The benzene plume reached its maximum migration distance of 360 to 380 feet in 1997. The BIOSCREEN model predicts the benzene plume receding after the 10-year simulation (1987-1997) in good agreement with site field data.
- Benzene concentrations in groundwater beneath the source area are predicted to decrease below the Federal MCL of 5 µg/l after 23 years of RNA. A maximum of 23 years of LTM would be required for Remedial Alternative 1.
- The BIOSCREEN model probably overpredicts the time required to achieve the benzene MCL in groundwater because it does not account for benzene biodegradation via nitrogen fixation (Section 4.4.2.5) and for biodegradation of the source (Section 5.4.5). Therefore, the required LTM period for Alternative 1 is likely to be less than 23 years.
- If biosparging is implemented for two years to reduce benzene concentrations in the source area by 50% per year, groundwater benzene concentrations beneath the source area are predicted to decrease below the Federal MCL of 5 µg/l after 7 years of RNA. Eight years of LTM would be required for Remedial Alternative 2.

SECTION 6

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section presents the development and comparative analysis of two remedial alternatives for groundwater at Site SS-04 at Langley AFB. The intent of this evaluation is to determine whether RNA is an appropriate and cost-effective remedial approach to consider when developing final remedial strategies for the site, especially when compared with other remedial technologies.

Section 6.1 presents the criteria used to evaluate groundwater remedial alternatives. Section 6.2 discusses the development of remedial alternatives considered as part of this demonstration project. Section 6.3 provides a brief description of each of these remedial alternatives. Section 6.4 provides a more detailed analysis of the remedial alternatives using the defined evaluation criteria. The results of this evaluation process are summarized in Section 6.5.

6.1 REMEDIAL ALTERNATIVE EVALUATION CRITERIA

The evaluation criteria used to identify appropriate remedial alternatives for shallow groundwater contamination at the site were adapted from those recommended by USEPA (1988) for selecting remedies for Superfund sites (OSWER Directive 9355.3-01). These criteria include (1) long-term effectiveness and permanence, (2) technical and administrative implementability, and (3) relative cost. The following sections briefly describe the scope and purpose of each evaluation criterion. This report focuses on the potential use of RNA to reduce the concentrations of BTEX in shallow groundwater to EPA MCLs.

6.1.1 Long-Term Effectiveness and Permanence

Each remedial approach or remedial alternative (which can be a combination of remedial approaches such as RNA and institutional controls) was analyzed to determine how effectively it will decrease BTEX concentrations in groundwater at the site so that groundwater quality standards can be achieved. The expected remedial effectiveness based on case histories from other sites with similar conditions also is evaluated where feasible. The ability to minimize potential impacts on surrounding areas, facilities, and operations is considered. Also, the ability of each remedial alternative to protect current and potential future receptors from potential exposures associated with site-related contamination in shallow groundwater is qualitatively assessed by conservatively evaluating the potential for completion of exposure pathways involving groundwater, now and in the future. This evaluation criterion also includes permanence and the ability to reduce contaminant mass, toxicity, and volume. Time to implementation and time until the regulatory standard is achieved are estimated. Long-term reliability for

providing continued protection, including an assessment of potential for failure of the technology and the potential threats resulting from such a failure, also are evaluated.

6.1.2 Implementability

The technical implementation of each remedial technology/approach or remedial alternative was evaluated in terms of technical feasibility and availability. Potential logistical shortcomings and difficulties in construction, operations, and monitoring are presented and weighed against perceived benefits. Requirements for any post-implementation site controls such as LTM and land or groundwater use restrictions are described. Administrative feasibility in terms of public acceptance and the ability to obtain necessary approvals is discussed.

6.1.3 Cost

The total cost (present worth) of each remedial alternative was estimated for relative comparison, using USEPA (1993) guidance. An estimate of capital costs and operations and post-implementation costs for site monitoring and controls is included. An annual adjustment (discount) factor of 7 percent was assumed in present-worth calculations (USEPA, 1993).

6.2 FACTORS INFLUENCING DEVELOPMENT OF ALTERNATIVES

Several factors were considered during the identification and screening of remedial technologies for addressing shallow groundwater contamination at the site. Factors considered included the objectives of the natural attenuation demonstration program; contaminant, groundwater, and soil properties; present and future land uses; and potential receptor exposure pathways. The following section briefly describes each of these factors and how they were used to narrow the list of potentially applicable remedial technologies to the final remedial alternatives considered for the site.

6.2.1 Program Objectives

The intent of the RNA demonstration program sponsored by AFCEE is to develop a systematic process for scientifically investigating and documenting naturally occurring subsurface attenuation processes that can be factored into overall site remediation plans. The objective of this program and the specific Site SS-04 study is to provide solid evidence of RNA of fuel hydrocarbons so that this information can be used to develop an effective groundwater remediation strategy. RNA of fuel hydrocarbons dissolved in the shallow groundwater also is qualitatively discussed. A secondary goal of this multi-site initiative is to provide a series of regional case studies that demonstrate that natural processes of contaminant degradation can often reduce contaminant concentrations in groundwater to below acceptable cleanup standards before completion of potential exposure pathways.

Because the objective of this program is to study natural processes in the saturated zone rather than all contaminated media (vadose zone soil, soil gas, etc.), approaches and technologies have been evaluated based primarily on their potential impact on shallow groundwater and soils below the water table. Technologies that can reduce vadose zone contamination and partitioning of contaminants into groundwater also have

been evaluated. Several of the source removal technologies evaluated in this section also will reduce soil and soil gas contamination, but it is important to emphasize that the remedial alternatives developed in this document are not necessarily intended to remediate all contaminated media.

Additional program objectives set forth by AFCEE include cost-effectiveness and minimization of waste. Approaches and technologies that may meet these criteria include institutional controls, soil vapor extraction, air sparging, limited groundwater pump and treat, and RNA. Soil excavation, slurry walls, sheet piling, carbon adsorption, *ex situ* biological or chemical treatment, and onsite/offsite disposal generally are not attractive technology candidates under this program.

6.2.2 Contaminant Properties

The primary contaminants considered as part of this demonstration at Site SS-04 are BTEX compounds. Groundwater contamination at Site SS-04 results from residual petroleum fuel constituents adsorbed to soils, as mobile LNAPL at the water table, and dissolved in groundwater in the vicinity of the former UST areas and underground fuel distribution pipelines at the site. The physiochemical characteristics of the BTEX compounds will greatly influence the effectiveness and selection of a remedial technology.

The BTEX compounds are generally volatile, highly soluble in water, and adsorb less strongly to soil than other hydrocarbons in a petroleum mixture (Subsection 4.2). These characteristics allow the BTEX compounds to leach rapidly from the contaminated soil into groundwater and to migrate as dissolved contamination (Lyman *et al.*, 1992). All of the BTEX compounds are highly amenable to *in situ* degradation by both biotic and abiotic mechanisms. The degradation of BTEX compounds is addressed in Sections 4.2 and 4.4.

Benzene is very volatile, with a vapor pressure of 76 millimeters of mercury (mm Hg) at 20°C and a Henry's Law Constant of approximately 0.0054 atmosphere-cubic meters per mole (atm-m^3/mol) at 25°C (Hine and Mookerjee, 1975; Jury *et al.*, 1984). The solubility of pure benzene in water at 20°C has been reported to be 1,780 mg/L (Verschueren, 1983). Benzene is normally biodegraded to carbon dioxide, with catechol as a short-lived intermediate (Hopper, 1978; Ribbons and Eaton, 1992).

Toluene is also volatile, with a vapor pressure of 22 mm Hg at 20°C and a Henry's Law Constant of about 0.0067 atm-m^3/mol at 25°C (Pankow and Rosen, 1988; Hine and Mookerjee, 1975). Toluene sorbs more readily to soil media relative to benzene, but still is very mobile. The solubility of pure toluene in water at 20°C is approximately 515 mg/L at 20°C (Verschueren, 1983). Toluene has been shown to degrade to pyruvate, acetaldehyde, and completely to carbon dioxide via the intermediate catechol (Hopper, 1978; Wilson *et al.*, 1986; Ribbons and Eaton, 1992).

Ethylbenzene has a vapor pressure of 7 mm Hg at 20°C and a Henry's Law Constant of 0.0066 atm-m^3/mol (Pankow and Rosen, 1988; Valsaraj, 1988). Ethylbenzene tends to sorb more strongly to soils than benzene but less strongly than toluene (Abdul *et al.*, 1987). Pure ethylbenzene is also less soluble than benzene and toluene in water at 152 mg/L at 20°C (Verschueren, 1983; Miller *et al.*, 1985). Ethylbenzene ultimately

degrades to carbon dioxide via its intermediate 3-ethylcatechol (Hopper, 1978; Ribbons and Eaton, 1992).

The three isomers of xylene have vapor pressures ranging from 7 to 9 mm Hg at 20°C and Henry's Law Constants of between 0.005 and 0.007 atm-m^3/mol at 25°C (Mackay and Wolkoff, 1973; Hine and Mookerjee, 1975; Pankow and Rosen, 1988). Of all of the BTEX compounds, xylenes sorb most strongly to soil, but still can leach from soil into the groundwater (Abdul *et al.*, 1987). Pure xylenes have water solubilities of 152 to 160 mg/L at 20°C (Bohon and Claussen, 1951; Mackay and Shiu, 1981; Isnard and Lambert, 1988). Xylenes can degrade to carbon dioxide via pyruvate carbonyl intermediates (Hopper, 1978; Ribbons and Eaton, 1992).

On the basis of these characteristics, natural attenuation, soil vapor extraction, air sparging, groundwater extraction, and air stripping technologies could all be effective options for collecting, destroying, and/or treating BTEX contaminants at Site SS-04.

6.2.3 Site-Specific Conditions

Two general categories of site-specific characteristics were considered when identifying remedial technologies for comparative evaluation as part of this demonstration project. The first category was physical characteristics such as groundwater depth, gradient, flow direction, and soil type, which influence the types of remedial technologies most appropriate for the site. The second category involved assumptions about future land uses and potential receptor exposure pathways. Each of these site-specific characteristics have influenced the selection of remedial alternatives included in the comparative evaluation.

6.2.3.1 Groundwater and Soil Characteristics

Site geology and hydrogeology will have a profound effect on the transport of contaminants and the effectiveness and scope of required remedial technologies at a given site. Hydraulic conductivity is perhaps the most important aquifer parameter governing groundwater flow and contaminant transport in the subsurface. The velocity of the groundwater and dissolved contamination is directly related to the hydraulic conductivity of the saturated zone. Slug tests conducted at Site SS-04 indicate that earth materials in the saturated zone have a relatively low to moderate hydraulic conductivity. Estimated values of hydraulic conductivity for these deposits range from less than 3 ft/day to greater than 20 ft/day (Table 3.6).

Although higher hydraulic conductivities can result in plume expansion and migration, this same characteristic also will enhance the effectiveness of other remedial technologies, such as groundwater and soil vapor extraction, air sparging, and RNA. For example, it should be less expensive and time-consuming to capture and treat the contaminant plume using a network of extraction wells in areas of high hydraulic conductivity. Rates of contaminant recovery may also be increased when contaminants are not significantly sorbed to soil ("retarded"). The effectiveness of air sparging also may be increased in highly conductive aquifers because of reduced entry pressures and increased radius of influence. Greater hydraulic conductivity also would increase the amount of contaminant mass traveling through an air sparging network within a given time period.

The movement of contaminants within the subsurface away from the source also may influence the effectiveness of natural biodegradation processes by distributing the contaminant mass into areas characterized by varying geochemical conditions. In addition, because BTEX compounds are retarded relative to the advective flow velocity, relatively fresh groundwater containing electron acceptors will migrate through the source and plume areas, further increasing the potential for biodegradation.

Indigenous microorganisms capable of degrading BTEX constituents are common in most soil environments. Indigenous microorganisms have a distinct advantage over microorganisms injected into the subsurface to enhance biodegradation because indigenous microorganisms are already well adapted to the physical and chemical conditions of the subsurface in which they reside (Goldstein *et al.*, 1985). Therefore, microbe addition is not considered a viable remedial technology for this site. In addition, comparison of the results of previous monitoring events (November 1996 with October 1997) indicates that biodegradation of BTEX constituents is currently proceeding effectively in the subsurface (Section 4).

6.2.3.2 Potential Exposure Pathways

An exposure pathway analysis identifies the human and ecological receptors that could potentially come into contact with site-related contamination and the contaminant migration pathways through which these receptors might be exposed. To have a completed exposure pathway, there must be a source of contamination, a mechanism(s) of release, a pathway of transport to an exposure point, an exposure point, and a receptor. If any of these elements do not exist, the exposure pathway is considered incomplete, and receptors will not come into contact with site-related contamination. Evaluation of the potential long-term effectiveness of any remedial technology or remedial alternative as part of this demonstration project includes determining whether the approach will be sufficient and adequate to minimize plume expansion so that potential receptor exposure pathways involving shallow groundwater contaminants are incomplete.

Assumptions about current and future land uses at a site form the basis for identifying potential receptors, potential exposure pathways, reasonable exposure scenarios, and appropriate remediation goals. USEPA (1991) advises that the land use associated with the highest (most conservative) potential level of exposure and risk that can reasonably be expected to occur should be used to guide the identification of potential exposure pathways and to determine the level to which the site must be remediated.

Site SS-04 is located within the boundaries of Langley AFB, an active U.S. military installation. Because access to the Base is strictly controlled, opportunities for inadvertent or casual exposure to groundwater containing fuel constituents originating at Site SS-04 are limited. Furthermore, the depth of groundwater containing fuel constituents is generally greater than three feet bgs and groundwater beneath the Base is not utilized as a drinking-water supply (Sections 3 and 4).

Any reasonable evaluation of potential exposure must, therefore, acknowledge the probable short duration of exposure. In light of current institutional and physical constraints, the population most likely to be exposed to fuel constituents in groundwater

consists of a Base worker conducting maintenance or repairs on a subsurface utility line or sewer buried at a depth of at least three feet within the spill area at Site SS-04. It is unlikely that subsurface utility maintenance activities would be conducted at a frequency greater than five days per year; and potential exposure to BTEX constituents in soil or groundwater could be reduced or eliminated by implementing appropriate engineering controls or safety practices during maintenance activities.

Assumptions about hypothetical future land uses must also be made to ensure that the remedial technology or alternative considered for shallow groundwater at the site is adequate and sufficient to provide long-term protection. The future use of Site SS-04 and the surrounding area is projected to be unchanged from the current use described above (active military installation). Therefore, potential future receptors (Base maintenance workers) are the same as those listed in the preceding paragraph. The potential future exposure pathways involving Base workers are identical to those under current conditions, provided shallow groundwater is not used to meet industrial water demands, or to provide a potable water supply.

In summary, the use of RNA at this site will require that the source area be maintained as industrial property and that restrictions on shallow groundwater and surface water use be enforced at Site SS-04, and in areas downgradient from the site, until natural attenuation processes reduce the concentrations of BTEX constituents to levels that meet regulatory standards. If source removal technologies such as soil vapor extraction or groundwater pump and treat are implemented, they will have some impact on the short- and long-term land use options and also will require some level of institutional control and worker protection during remediation.

6.2.3.3 Remediation Goals for Shallow Groundwater

Potentially applicable state and federal water-quality criteria are summarized in Table 6.1. These criteria are included in this document as potential groundwater cleanup criteria. The appropriateness and/or applicability of these standards to Site SS-04 is not evaluated as part of the RNA TS. These criteria are presented only to provide a numerical endpoint to be used to compare the effectiveness of different remedial technologies/approaches.

Benzene is the only constituent of potential concern that is currently, or has historically been detected in groundwater samples from Site SS-04 at concentrations that exceed potential water-quality criteria or remedial action objectives. During the monitoring event of October 1997, benzene was detected above its federal MCL of 5 μg/L in groundwater samples collected from three wells (wells OW-7, P-4, and RW-6) at concentrations of 32, 170, and 43 μg/L, respectively. Consequently, benzene will be the focus of subsequent discussions about the best approach to effective groundwater remediation.

TABLE 6.1
POTENTIAL REGULATORY STANDARDS FOR BTEX COMPOUNDS IN WATER
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Compound	USEPA MCL[a/] (µg/L)[b/]	State of Virginia Drinking Water Standard[c/] (µg/L)
Benzene	5	5
Ethylbenzene	700	700
Toluene	1,000	1,000
Xylenes (total)	10,000	10,000

[a/] USEPA MCL = US Environmental Protection Agency (1996) Maximum Contaminant Level.
[b/] µg/L = micrograms per liter.
[c/] Virginia Administrative Code, VAC 12.5.590, Section 440 *et seq.*

Use of RNA assumes that short-term compliance with promulgated drinking water standards is not necessary if groundwater will not be used as a potable water supply. Thus, the magnitude of remediation required in areas that can and will be placed under institutional control is different from the remediation that is required in areas that may be available for unrestricted groundwater use. The primary remedial action objective for groundwater at Site SS-04 is reducing the concentrations of BTEX in groundwater to levels below potentially applicable regulatory standards or guidelines. Institutional controls are likely to be a necessary component of any groundwater remediation strategy for this site. The required duration of these institutional controls may vary depending on the effectiveness of the selected remedial technology at reducing contaminant mass and concentrations in the groundwater.

6.2.4 Summary of Remedial Technology Screening

Several remedial technologies were identified and screened for use in treating groundwater at the site. Table 6.2 identifies the initial remedial technologies considered as part of this demonstration and those retained for detailed comparative analysis. Screening was conducted systematically by considering the program objectives of the AFCEE RNA demonstration, the physiochemical properties of benzene, and other site-specific characteristics including hydrogeology, land use assumptions, potential exposure pathways, and potential target cleanup criteria. All of these factors will influence the technical effectiveness, implementation, and relative cost of technologies for remediating shallow groundwater underlying and migrating from the site.

The remedial approaches and source-removal technologies retained for development of remedial alternatives and comparative analysis include institutional controls, RNA combined with LTM, and biosparging in the source area of the benzene plume.

TABLE 6.2
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIATION
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

General Response Action	Technology Type	Process Option	Implementability and General Comments	Effectiveness	Relative Cost	Retain?
Long-Term Monitoring	Periodic Groundwater Monitoring	Long-Term Monitoring Wells	Some existing wells are available to confirm the progress of remediation. Additional wells could be installed immediately downgradient of the source area to track any future migration of the plume.	Necessary for all remediation strategies	Low	Yes
Institutional Controls	Groundwater Use Control	Land Use Control/Regulate Well Permits	The plume currently lies within the Base boundary and is under the Base jurisdiction. Regulation of land use should not be difficult.	Necessary component of LTM program	Low	Yes
		Seal/Abandon Existing Wells	No production wells are known to exist in the current or predicted plume area.	Not required at this site	Low	No
		Point-of-Use Treatment	No shallow groundwater is extracted from the plume area for any use.	Not required at this site	Moderate	No
	Public Education	Meetings/ Newsletters	Base public relations and environmental management offices have many information avenues to workers and other potentially affected populations.	Necessary for all remediation strategies	Low	Yes
Extraction/ Containment of Plume	Hydraulic Controls	Interceptor Trench Collection	A groundwater extraction trench could be installed at the downgradient extent of the contaminant plume to prevent dissolved contamination from migrating off-site. Treatment of extracted water would be necessary.	High	High	No
		Groundwater Extraction Wells	Groundwater extraction wells could be installed at the downgradient extent of the contaminant plume to prevent dissolved contamination from migrating off-site. Treatment of extracted water would be necessary.	High	Moderate	No
	Physical Controls	Slurry Walls/Grout Curtains	Could be installed as part of a funnel and gate system to direct plume through a relatively short treatment zone.	Low to Moderate	High	No
		Sheet Piling	Could be installed as part of a funnel and gate system to direct plume through a relatively short treatment zone. May have more long-term integrity than slurry wall.	Moderate to High	High	No

TABLE 6.2 (Continued)
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIATION
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

General Response Action	Technology Type	Process Option	Implementability	Effectiveness	Relative Cost	Retain?
In Situ Groundwater Treatment	Biological	Oxygen and/or Nutrient Enhanced Biodegradation (Biosparging)	Differs from RNA in that oxygen and/or nutrients are injected in or downgradient from plume to limit plume migration by enhancing biodegradation and reducing contaminant concentrations as the plume moves downgradient from the source area. Limited radius of influence and short-circuiting are common problems.	Low to moderate	Low	Yes
	Chemical/ Physical	Natural Attenuation	A combination of natural biological, chemical, and physical removal mechanisms which occur to varying degrees on every site. Groundwater sampling at the site indicates that this is an ongoing remediation process in localized areas.	Low to High (varies spatially in study area)	Low	Yes
		Air Sparging (Volatilization)	Injection of air into contaminated aquifer creating a mass transfer of BTEX into air bubbles and into vadose zone. Limited radius of influence and short-circuiting are common problems, but installation in a gravel-filled trench could minimize these problems.	Low to moderate	Low to moderate	No
		Permeable Reaction Wall (Iron Filings Trench)	A permeable reaction wall can be installed at the downgradient extent of the contaminant plume. New, relatively unproven technology. Potential problems with clogging, and effective lifespan not known.	Moderate to High (if not clogged)	High	No
Aboveground Groundwater Treatment	Chemical/ Physical	Air Stripping	Cost-effective technology for removing varying concentrations of BTEX at higher flow rates and concentrations. Potential permitting for air emissions.	High	High	No
		Activated Carbon	Cost prohibitive for more concentrated BTEX or long remediation times due to frequent carbon disposal and replacement. More cost effective than air stripping for low BTEX concentrations and/or low flow rates.	High	Moderate	No
		UV/Ozone Reactors	May require excessive retention times and large, expensive reactors.	Moderate	High	No

TABLE 6.2 (Continued))
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIATION
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

General Response Action	Technology Type	Process Option	Implementability	Effectiveness	Relative Cost	Retain
	Chemical/ Physical (cont.)	Direct Discharge to Industrial Waste Water Treatment Plant (IWWTP)	Viable option when an IWWTP is readily available and capable of handling BTEX and hydraulic loading. Groundwater extraction not retained.	High	Moderate	No
Treated Groundwater Disposal	Discharge to IWWTP or Sanitary Sewer	IWWTP	Viable option when an IWWTP is available and capable of handling hydraulic loading. Groundwater extraction not retained.	High	High	No
		Sanitary Sewer	Viable option when access to sanitary sewer exists and hydraulic loading is acceptable. Sanitary sewer is potentially available, but groundwater extraction not retained.	High	Moderate to High	No
	Treated Groundwater Reinjection	Vertical Injection Wells	Not recommended due to clogging and high maintenance.	Moderate	High	No
		Injection Trenches	Require large trenches and can be subject to injection well permitting.	Moderate	High	No
	Discharge to Surface Waters	Storm Drains or Discharge Ditches	Generally requires discharge permit.	High	Low	No
Source Removal/Soil Remediation	Excavation/ Treatment	Landfilling	Excavation is not necessary at this site.	High	High	No
		Ex situ soil vapor extraction	Excavation is not necessary at this site.	Moderate	High	No
		Thermal Desorption	Excavation is not necessary at this site).	Moderate	High	No

TABLE 6.2 (Concluded)
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER REMEDIATION
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

General Response Action	Technology Type	Process Option	Implementability	Effectiveness	Relative Cost	Retain
Source Removal/Soil Remediation (continued)	*In Situ*	Bioventing	Air injection/extraction to increase soil oxygen levels and stimulate biodegradation of residual contamination.	High	Low	No
		Soil Vapor Extraction	Vapor extraction has been successfully implemented at other sites. Requires off-gas treatment.	High	Moderate	No
		Surfactant Flushing	Additional pore volumes of water and/or surfactant solution are forced through aquifer material to enhance the partitioning of contaminants into the groundwater. Potential method to remove LNAPL. Most effective in homogeneous sandy soils.	Low	High	No

6.3 BRIEF DESCRIPTION OF REMEDIAL ALTERNATIVES

This section describes how remedial technologies retained through the screening process were combined into two remedial alternatives for Site SS-04. Sufficient information is provided for each remedial alternative to facilitate a comparative analysis of effectiveness, implementability, and cost in Section 6.4.

6.3.1 Alternative 1—RNA and Institutional Controls with Long-Term Monitoring

RNA is achieved when naturally occurring attenuation mechanisms reduce the total mass of a contaminant in soil or groundwater. RNA results from the integration of several subsurface attenuation mechanisms that are classified as either destructive or nondestructive. Destructive attenuation mechanisms include biodegradation, abiotic oxidation, and hydrolysis. Nondestructive attenuation mechanisms include adsorption, dilution (caused by dispersion and infiltration), and volatilization. In many instances, RNA will reduce dissolved contaminant concentrations below applicable numerical concentration goals that are protective of human health and the environment. As indicated by examination of the evidence of RNA presented in Section 4, these processes are occurring across large areas of the SS-04 site, particularly south and southeast of the source area, and will continue to reduce the mass of contaminants in the subsurface. Long-term monitoring would be required to periodically document chemical conditions in the groundwater system, and verify that RNA was proceeding at an acceptable rate. Periodic site reviews also could be conducted using data collected during the LTM program. The purpose of these reviews would be to evaluate the extent of contamination, assess contaminant migration and attenuation through time, document the effectiveness of institutional controls at the site, and reevaluate the need for additional remedial actions at the site.

Implementation of Alternative 1 would require use of institutional controls, such as restrictions on land use and use of groundwater, together with LTM. Land use restrictions may include placing long-term restrictions on deep soil excavation in areas of contamination and on groundwater well installations within and downgradient from the plume area. The intent of these restrictions would be to reduce potential receptor exposure to contaminants by legally restricting activities within areas affected by site-related contamination.

Public education programs regarding the selected alternative would be developed to inform Base personnel and residents of the scientific principles underlying RNA. Education could be accomplished through public meetings, presentations, fact sheets, press releases, and posting of signs where appropriate

6.3.2 Alternative 2—Biosparging Along the Axis of the Benzene Plume, RNA, and Institutional Controls with Long-Term Monitoring

Alternative 2 is identical to Alternative 1, except that biosparging points would be installed in a line along the axis of the benzene plume, between wells P-4 and OW-7. A biosparging system consists of small-diameter wells or wellpoints, connected to a blower via pipes and a manifold. The blower delivers air at positive pressure, through the manifold and piping to the wells, where the air is injected into the subsurface,

below the water table. The radius of influence of a sparging well is typically between 10 and 15 feet; consequently, approximately 14 biosparging wells, spaced at 20-foot intervals, should be sufficient to deliver oxygen to the axis of the benzene plume in the source area between wells P-4 and OW-7 (Figure 6.1).

The biosparging points would be positioned to deliver oxygen to those areas of the plume where benzene has been detected in groundwater. Operation of a biosparging system could potentially increase the rate of biodegradation of BTEX constituents in the plume source area, by increasing DO concentrations in groundwater and by promoting the growth of indigenous microorganisms. Introduction of air at positive pressure below the water table also would remove those chemicals that have high vapor pressures (including the BTEX constituents) by the mechanism of volatilization.

Because biosparging is a type of active remediation that relies on proper operation of mechanical and electrical equipment, routine system operation and maintenance would be required. In addition, implementation of Alternative 2 would require LTM (perhaps for a period as long as Alternative 1), and would probably require use of institutional controls, including restrictions on land use and use of groundwater, until remedial action objectives had been achieved. Periodic site reviews also would be conducted to evaluate the extent of contamination and the effectiveness of the biosparging system, to assess contaminant migration and attenuation through time, document the effectiveness of institutional controls at the site, and to reevaluate the need for additional remedial actions at the site.

6.4 EVALUATION OF ALTERNATIVES

This section provides a comparative analysis of each of the remedial alternatives based on the effectiveness, implementability, and cost criteria. A summary of this evaluation is presented in Section 6.5.

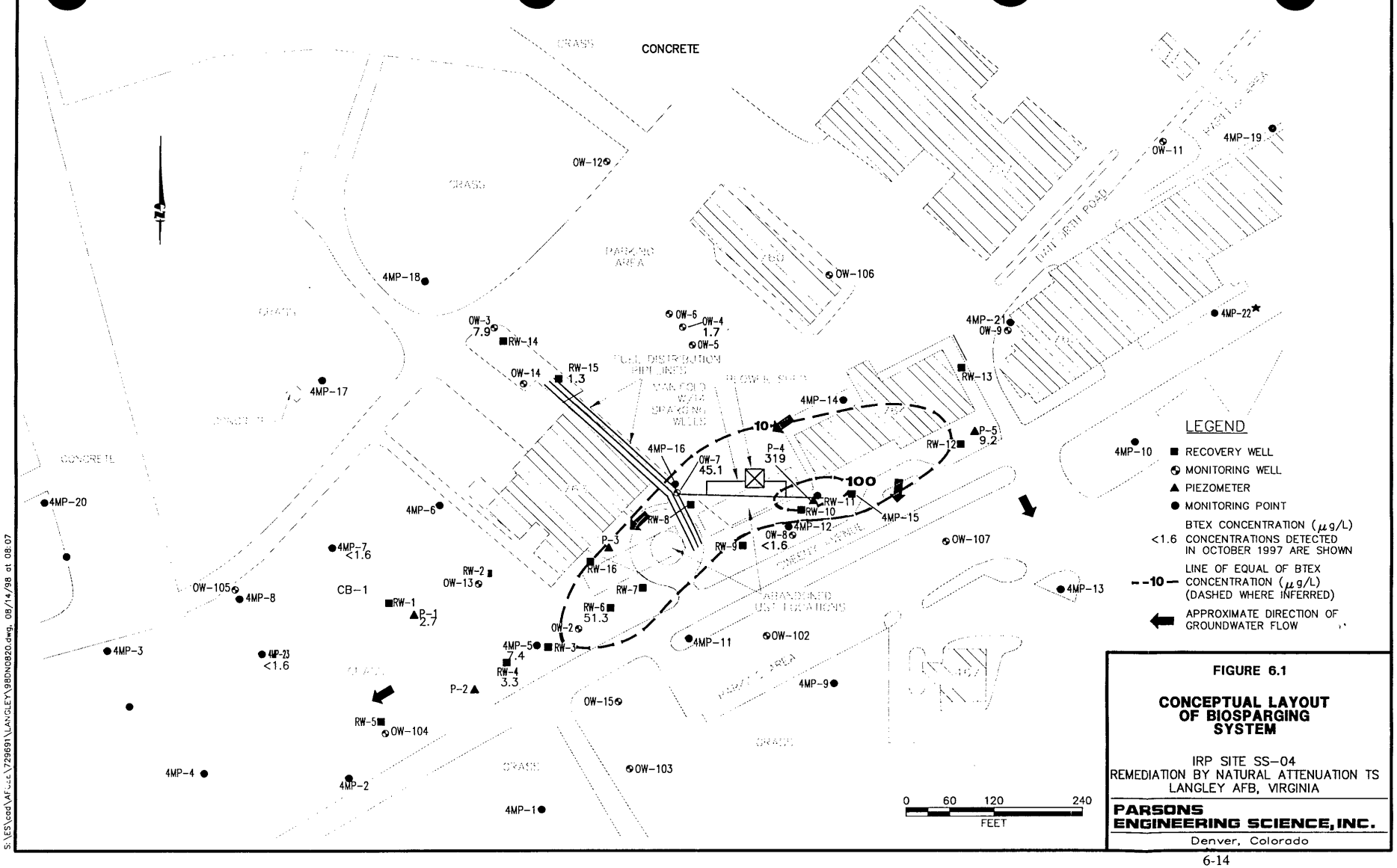
6.4.1 Alternative 1—RNA and Institutional Controls with Long-Term Monitoring

6.4.1.1 Effectiveness

Natural attenuation processes are known to be effective in removing hydrocarbon compounds from soil and groundwater. Site-specific evidence (Section 4) indicates that attenuation processes are currently degrading hydrocarbon compounds in groundwater at a relatively rapid rate. The results of calculations, conducted to simulate natural attenuation processes in the subsurface at the SS-04 site, indicate that the concentrations of benzene in groundwater beneath the site will probably be below the federal MCL of 5 μg/L within about 23 years (Section 5). During this time, the benzene plume is not expected to migrate more than 100 feet further downgradient. No potential exposure pathways to receptors are likely to be complete, given reasonable site access restrictions. RNA is therefore judged to be relatively effective in achieving the remedial action objectives for groundwater at the site.

6.4.1.2 Technical and Administrative Implementability

Alternative 1 is not technically difficult to implement. Installation of any additional LTM wells and monitoring of groundwater are standard procedures. A 23-year



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FIGURE 6.1

CONCEPTUAL LAYOUT OF BIOSPARGING SYSTEM

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

corrective action/compliance period should pose few administrative difficulties. In conjunction with the LTM plan, long-term management efforts would be required to ensure that proper sampling procedures are followed. The LTM plan would need to address the collection of data necessary to document the continued progress of RNA. Periodic site reviews should be conducted to confirm the adequacy and completeness of LTM data, and to verify the effectiveness of this remediation approach.

Future land use within the plume area may be affected if contaminated soil and groundwater are left in place. Any proposed change in land use to other than an industrial use, or any proposed groundwater pumping near the lateral or leading edges of the dissolved contaminant plume, should be carefully evaluated. Any future construction or maintenance activities in this area should be planned to minimize deep excavations (i.e., greater than 3 feet bgs) in locations near the source area, and to protect the network of long-term monitoring wells. Wells should remain locked and protected against damage, tampering, or vandalism. Regulators and the public will have to be informed of the benefits and limitations of the RNA option, but educational programs are not difficult to implement. Although there may be administrative concerns associated with long-term enforcement of restrictions on groundwater use, the projected 23-year corrective action/compliance period should pose few administrative difficulties.

6.4.1.3 Cost

The present-worth cost of implementing Alternative 1, beginning in the Fall of 1998, is summarized in Table 6.3. Cost estimates assume that two additional LTM wells would be installed; that groundwater samples would be collected from 14 wells annually for a 5-year period and biennially for a subsequent 18-year period. The total length of time projected for RNA with LTM to achieve remedial action objectives is 23 years. Details of cost estimates are provided in Appendix F.

TABLE 6.3
ESTIMATED COSTS FOR ALTERNATIVE 1 (RNA with LTM)
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Capital Costs (rounded)	Present Worth Cost
Field Work (Installation of 3 Additional LTM Wells)	$9,000
Operation and Maintenance Costs (rounded)	
Annual LTM, 1998 - 2002	$68,883
Biennial LTM, 2003 - 2020	$58,207
Site Management (23-Year Period)	$67,633
Total Present Worth of Alternative 1 [a/]	$203,724

[a/] Based on an annual adjustment factor of 7 percent (USEPA, 1993).

Note: Costs assume that LTM well installations are completed by local personnel.

6.4.2 Alternative 2—Biosparging Along the Axis of the Benzene Plume, RNA, and Institutional Controls with Long-Term Monitoring

6.4.2.1 Effectiveness

This alternative is identical to Alternative 1, with the addition of 14 biosparging points along the axis of the benzene plume. The primary goal of biosparging would be to increase the DO concentration in saturated soils and groundwater, providing additional oxygen to encourage aerobic degradation and potentially reducing the time necessary for benzene concentrations to decline to below its federal MCL of 5 μg/L. Volatilization of dissolved BTEX may occur as a result of biosparging; incidental bioventing of vadose zone soils also may occur, as oxygen injected into the subsurface diffuses through soils below the water table and at the capillary fringe. The reduction of contamination in the source area via incidental bioventing will reduce the total mass of fuel constituents available to leach into groundwater. Soil gas flux testing would be performed during startup of the biosparging system to assure that BTEX vapors do not migrate from the subsurface at potentially hazardous concentrations.

The potential effectiveness of biosparging at Site SS-04 was simulated conceptually using the BIOSCREEN model (Section 5) by fixing the concentration of DO in the instantaneous reaction model at 12 mg/L (saturation limit of oxygen in water). Simulation results indicate that the concentrations of benzene in groundwater beneath the site will probably be below the MCL of 5 μg/L within a period of 8 years (Section 5). However, these calculations assume that the DO concentration in groundwater through the entire period remains at 12 mg/L (i.e., the biosparging system is in operation for 8 years). Experience demonstrates that most potential chemical removal, using biosparging techniques, occurs during the first year of operation; accordingly, for costing purposes, we have assumed that the system would be in operation for a period of two years. Monitoring of conditions in the subsurface would continue to be necessary after the system was shut down. The incremental effectiveness of biosparging with RNA and LTM, over un-stimulated RNA is therefore uncertain, although biosparging is judged to be relatively effective in achieving the remedial action objectives for groundwater at the site.

6.4.2.2 Technical and Administrative Implementability

The implementability issues described for Alternative 1 in Section 6.4.1.2 also are applicable for Alternative 2. Regulatory acceptance of this alternative may be more positive than with Alternative 1, as a consequence of the perceived greater effectiveness of active remediation techniques.

Alternative 2 should not be difficult to implement technically or administratively. The biosparging system would require installation of air sparging points, buried air lines manifolded to each air injection well, and an aboveground positive-pressure air injection blower system. The blower system would be housed in a shed, near the former UST locations and electrical service would be obtained from the Base power grid. All equipment required for the air sparging system can be installed at the site with a minimal degree of difficulty. Trenching for the air-line installation would be restricted to shallow depths to avoid encountering groundwater in excavations. Standard mechanical and electrical construction and equipment would be used; no

special techniques or equipment should be necessary. All equipment needed for this alternative is commercially available.

In general, the reliability of a shallow air sparging system is high, and the maintenance required is relatively low. These are simple mechanical systems. Motors are sealed and do not require lubrication; air filters provide protection for the air blower, and generally require replacement every 90 to 180 days.

Because Alternative 2 depends on RNA to remove fuel constituents from groundwater at locations distal from the source area, administrative implementation of Alternative 2 is approximately the same as would be required if natural chemical attenuation processes alone were relied on to achieve MCLs. As with Alternative 1, any proposed change in land use to other than an industrial use, or any proposed groundwater pumping near the lateral or leading edges of the dissolved contaminant plume, should be carefully evaluated. Any future construction or maintenance activities in this area should be planned to minimize deep excavations (i.e., greater than 3 feet bgs) in locations near the source area, and to protect the air sparging system, the blower, the underground piping associated with the system, and the network of long-term monitoring wells. Wells should remain locked and protected against damage, tampering, or vandalism. An eight-year corrective action/compliance period should pose few administrative difficulties, but provides little additional benefit when compared with the 23-year compliance period projected for Alternative 1

6.4.2.3 Cost

The estimated capital and operating costs of Alternative 2 are presented in Table 6.4; details of the cost estimates are provided in Appendix F. Cost estimates assume that three additional LTM wells would be installed and that groundwater samples would be collected from 14 wells annually for a 8-year period. Additional capital and long-term costs are associated with installation and operation of the biosparging system, which is assumed to operate for two years. The total length of time projected for biosparging with RNA and LTM to achieve remedial action objectives is eight years.

The total present-worth cost of Alternative 2 is nearly one-and-a-half times the present-worth cost estimated for Alternative 1 (RNA with LTM). This is a consequence of the capital and maintenance costs associated with the biosparging system.

6.5 RECOMMENDED REMEDIAL APPROACH

Two alternatives have been evaluated for remediation of the shallow groundwater at Site SS-04. Components of the alternatives evaluated included biosparging along the axis of the benzene plume, RNA with LTM of groundwater, and institutional controls. Table 6.5 summarizes the results of the evaluation based upon effectiveness, implementability, and cost criteria.

TABLE 6.4
ESTIMATED COSTS FOR ALTERNATIVE 2
(RNA WITH LTM PLUS BIOSPARGING)
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Capital Costs (rounded)	Present Worth Cost
Field Work (Installation of 3 Additional LTM Wells)	$9,000
Biosparging System Installation Costs	$111,800
Operation and Maintenance Costs (rounded)	
	$45,200
Annual O&M for Biosparging Unit (1998-1999)	$68,883
Annual LTM, 1998 - 2005	
Site Management (8-Year Period)	$35,828
Total Present Worth of Alternative 2 [a/]	**$302,146**

[a/] Based on an annual adjustment factor of 7 percent (USEPA, 1993).

Note: Costs assume that LTM well installations are completed by local personnel.

Alternative 1 makes maximum use of natural attenuation mechanisms to reduce plume migration and toxicity. Alternative 2 is projected to provide a slight increase in the biodegradation rate of benzene. Implementation of Alternative 2 may not greatly reduce the time frame required for remediation, but would require significantly greater capital and operation and maintenance (O&M) expenditures.

Each of the alternatives has implementability concerns. Implementation of either alternative may require an extended period of LTM, and imposition of institutional controls in the plume area would be required. However, if future LTM results indicate that the plume is either stable or receding, and that potential receptor exposure pathways will not be completed, then the frequency of LTM sampling events could be reduced. Alternative 2 would probably be more acceptable to the public and regulatory agencies because it represents a more aggressive remedial approach.

The estimated present worth cost for Alternative 2 is substantially higher than for Alternative 1 due to the addition of an engineered biosparging system. Operation and maintenance of a biosparging system would require annual expenditure of additional funds during the operational lifetime of this system.

On the basis of this evaluation, Alternative 1 (RNA with LTM and institutional controls) is recommended. Available data suggest that the BTEX plume is declining in magnitude and extent at a relatively rapid rate. The degree to which RNA will prevent further downgradient migration of the plume is not known with certainty, but will become more apparent as successive LTM sampling events are completed. As described above, if LTM results demonstrate that the plume is stable or receding and that potential receptor exposure pathways will not be completed in the future, then the frequency of LTM could potentially be reduced (e.g., to biennial events). Periodic

TABLE 6.5
SUMMARY OF REMEDIAL ALTERNATIVES EVALUATION
GROUNDWATER REMEDIATION
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Remedial Alternative	Effectiveness	Implementability	Present-Worth Cost Estimate
Alternative 1 - Natural Attenuation - Institutional Controls - Long-term Monitoring	Contaminant mass, volume, and toxicity will be slowly reduced over time. Potentially lengthy LTM period required.	Readily implementable. Groundwater quality monitoring is required for an estimated 23 years. Institutional controls, including land and groundwater use controls, are required. Minimal exposure to potential receptors is to be expected if institutional controls are implemented. Includes installation of 3 new monitoring wells.	$203,724
Alternative 2 - Natural Attenuation - Institutional Controls - Long-term Monitoring - Biosparging	Similar to Alternative 1. Significant decrease in time necessary for biodegradation of benzene and, therefore, time necessary for LTM.	Similar to Alternative 1. Also would require the design and installation of the biosparging system, installation of 14 biosparging wells, and regular O&M of the biosparging system for two years. Time to compliance reduced to from 23 years to 8 years.	$302,146

sampling and analysis of groundwater from selected wells will allow the effectiveness of RNA to be monitored, and should enable assessment of whether additional engineering controls should be implemented.

SECTION 7

LONG-TERM MONITORING PLAN

7.1 OVERVIEW

A plan for conducting long-term groundwater monitoring was developed to address the requirements of the preferred remedial alternative for the Langley AFB SS-04 site (Section 6). The purpose of this component of the preferred remedial alternative for the site is to assess site conditions over time, so that the effectiveness of naturally occurring processes at reducing contaminant mass and minimizing contaminant migration can be assessed, and the need for additional remediation can be periodically re-evaluated.

The LTM plan developed for the site is based on currently-available information and on the results of the contaminant-transport evaluation, which indicated that the constituent of primary concern in groundwater (benzene) would attenuate to concentrations below potential regulatory standards in a period of 23 years (Section 5). The LTM plan therefore assumes, for planning and budgeting purposes, that monitoring will continue through a 23-year period. As RNA proceeds at Site SS-04, the LTM program may be progressively revised through the monitoring period, as additional information becomes available.

The LTM plan consists of identifying the locations of LTM wells and developing a groundwater monitoring strategy to accomplish the following objectives:

- Monitor changes in site conditions, including concentrations and extent of fuel constituents in groundwater through time;
- Evaluate the degradation rates of fuel constituents, and assess the effectiveness of naturally occurring processes at reducing the mass of fuel constituents and minimizing constituent migration;
- Assess the need for additional remedial action; and
- Verify the predictions of the analytical contaminant fate and transport model.

7.2 MONITORING NETWORK AND SAMPLING FREQUENCY

The monitoring network proposed for LTM at Site SS-04 consists of 13 monitoring wells, including 11 existing wells and monitoring points (monitoring points 4MP-5S, 4MP-5D, 4MP-6, 4MP-11, 4MP-13, 4MP-15, 4MP-16, and wells OW-7, P-4, OW-106, and RW-6), and 3 proposed, new monitoring points. Two of the three additional monitoring points would be installed as a well pair. These new monitoring well locations are shown of figure 7.1.

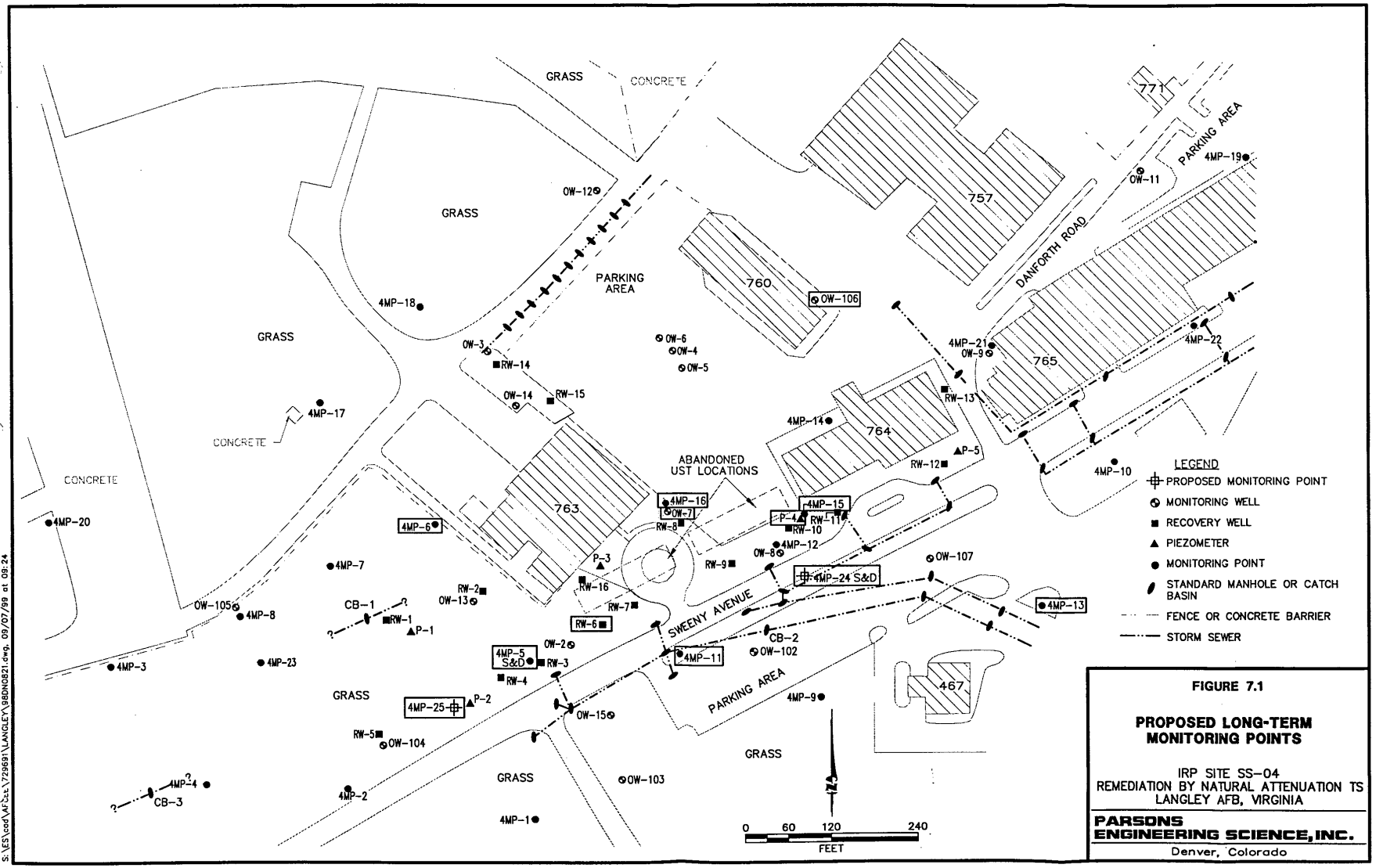


FIGURE 7.1

PROPOSED LONG-TERM MONITORING POINTS

IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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One shallow monitoring point would be installed into backfill material surrounding the storm sewer line, south of the UST site, to evaluate whether the storm sewer or backfill material surrounding the sewer line is functioning as a preferential pathway for movement of groundwater and migration of fuel constituents in the subsurface (Section 3). The other new well would be installed adjacent to the shallow well, and would be the deeper of the pair. Both new wells would be installed using Geoprobe® methods; the deeper well would be completed at the depth of refusal of the Geoprobe® equipment, estimated on the basis of previous experience at the site to occur at a total depth of about 30 feet bgs. The monitoring locations, proposed to be sampled for the LTM program, are itemized in Table 7.1, together with the rationale for inclusion of each monitoring point/well.

Groundwater samples will be collected at each location on an annual basis for a period of five years (1998 through 2002), to augment the historical water-quality database for the site. At the conclusion of the 5-year period, the results of the LTM program will be evaluated; if the results indicate that RNA is achieving the remediation goals for the site, the frequency of monitoring may be reduced so that groundwater samples will be collected biennially (every other year) through the succeeding 18-year period.

Following each LTM sampling event, the results of monitoring will be evaluated to assess whether the plume appears to be stable, expanding, or contracting, and whether samples should be collected from additional wells further downgradient. Estimates of the rate and direction of movement of fuel constituents in groundwater will be progressively refined as LTM data are reviewed. Estimates of the site-specific degradation rates of fuel constituents also will be refined as new data are obtained, to update contaminant fate and transport predictions. The actual duration of monitoring, and frequency of monitoring events, will be adjusted based on a review of LTM data.

7.3 ANALYTICAL PROTOCOLS

All LTM wells in the monitoring program will be sampled, and the groundwater samples will be analyzed to assess compliance with chemical-specific remediation goals and to verify the effectiveness of RNA at the site. Water-level measurements will be collected in each monitoring well or monitoring point at the beginning of each sampling event. Groundwater samples from all wells in the LTM program will be analyzed for the parameters listed in Table 7.2. Quality assurance/quality control samples, of the types listed in Table 7.3, also will be collected and analyzed in conjunction with each monitoring event, at the frequencies specified in Table 7.2.

7.4 REPORTING

Monitoring activities, described in this LTM plan, will be conducted no more frequently than once per year. The results of each monitoring event, including the results of measurement of groundwater elevations in wells, collection and chemical analysis of groundwater samples, and an evaluation of the continued effectiveness RNA at the site, will be documented and presented to AFCEE and the appropriate agency(ies), in a letter report, to be issued within 60 days of completion of field activities during the monitoring event.

TABLE 7.1
LONG-TERM GROUNDWATER MONITORING WELLS
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Well	Rationale
P-4	Benzene concentration of 170 µ/L in 10/97; collect sample to monitor benzene concentration over time.
RW-6	Benzene concentration of 43 µg/L in 10/97; collect sample to monitor benzene concentration over time.
OW-7	Benzene concentration of 32 µg/L in 10/97; collect sample to monitor benzene concentration over time.
4MP-SS	Benzene concentration of < 0.4 µg/L in 10/97; collect sample to mark downgradient extent of benzene plume in shallow part of surficial aquifer.
4MP-5D	Benzene concentration of 3.3 µg/L in 10/97; collect sample to mark downgradient extent of benzene plume in deeper part of surficial aquifer
4MP- 15	Deep well near P-4; collect sample to mark vertical extent of benzene plume.
4MP-16	Deep well near OW-7; collect sample to mark vertical extent of benzene plume.
4MP-1 1	Downgradient well just south of sewer line; collect sample to mark downgradient extent of benzene plume.
4MP-6	Cross-gradient well west of current benzene plume; collect sample for background geochemical data and to mark cross-gradient extent of benzene plume.
OW-106	Upgradient well northeast of current benzene plume; collect sample for background geochemical data and to mark upgradient extent of benzene plume.
4MP-13	Cross-gradient well southeast of current benzene plume; collect sample for background geochemical data and to mark cross-gradient extent of benzene plume.
4MP-245	Proposed monitoring point installed into fill around storm sewer line south of site; collect sample to mark downgradient extent of benzene plume in shallow part of surficial aquifer.
4MP-25	Proposed monitoring point installed into fill around storm sewer line south of site; collect sample to mark downgradient extent of benzene plume in deeper part of surficial aquifer.

TABLE 7.2
LONG-TERM GROUNDWATER AND SURFACE WATER MONITORING ANALYTICAL PROTOCOL
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Analyte	Method/Reference	Comments	Data U#	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
BTEX	OS/MS method SW8260A or GC Method SW80121B	Handbook methods	Measured for regulatory compliance	Each sampling event	Collect water samples in a 40 mL VOA vial; cool to 4°C; add hydrochloric acid to pH < 2	Fixed-base
Ferrous Iron Fe2+)	Colorimetric A3500-Fe D or Hach25140-25	Filter if turbid	May indicate an anaerobic degradation process due to the anaerobic microbial respiration of ferric iron	Each sampling event	Collect 100 mL of water in a glass container; for Method A3500-FeD, acidify with hydrochloric acid pa method	Field
Methane	RSKSOP-114 modified to analyze water samples for methane by headspace sampling with dual thermal conductivity and flame ionization detection.	Method published and used by USEPA National Risk Management Research Laboratory '	The presence of methane indicates the presence of sufficiently reducing conditions for reductive dehalogenation to occur	Each sampling event	Collect water samples in 40 mL volatile organic analysis (VOA) vials with butyl gray/Teflon-lined caps (zero headspace); cool to 4°C	Fixed-base
Sulfate (SO_4^{2-})	IC method E300 or method SW9056 or Hach SulfaVer 4 method	Method E300 is a Handbook method; method SW9056 is an equivalent procedure. Hach method is Photometric	Substrate for anaerobic microbial respiration		Each sampling event Collect up to 40 mL of water in a glass or plastic container; cool to 4°C	Fixed-base or field (for Hach method)
Nitrate (NO_3^{-1})	IC method E300 or method SW9056; colorimetric, method E353.2	Method E300 is a Handbook! method; method SW9056 is an equivalent procedure	Substrate for microbial respiration if oxygen is depleted		Each sampling event Collect up to 40 mL of water in a glass or plastic container; cool to 4°C; analyze within 48 hours	Fixed-base

TABLE 7.2 (Concluded)
LONG-TERM GROUNDWATER AND SURFACE WATER MONITORING ANALYTICAL PROTOCOL
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Presentation	Field or Fixed-Base Laboratory
Dissolved	Dissolved oxygen meter	Measure at well-head; refer to Method A4500 for a comparable laboratory procedure	Purging adequacy; concentrations less than I mg/L generally indicate anaerobic conditions	Each sampling event	Measure at well-head using a flow- through cell	Field
Oxygen Oxidation-Reduction Potential (ORP)	A2S80 B, direct-reading meter electrodes; results are influenced by biologically	Measurements are made with displayed on a meter, samples should be protected from exposure to atmospheric oxygen	The redox potential of groundwater influences and is mediated reactions; the redox potential of groundwater may range from more than 200 mV to less than -400 mV	Each sampling event	Measure at well-head using a flow- through cell	Field
Conductivity	E120. 1/SW9050, direct-reading meter	Measure at well-head	General water quality parameter used as a marker to verify that site samples are obtained from the same groundwater system	Each sampling event	Collect 100-250 mL of water in a glass or plastic container or measure at wellhead using flow through cell	Field
pH	EIS0.1/SW9040, direct-reading meter	Measure at well-head	Purging adequacy; aerobic and anaerobic processes are pH-sensitive	Each sampling event	Measure at well-head using a flow- through cell	Field
Temperature	E170.1, direct-reading meter	Measure at well-head	Purging adequacy; metabolism rates for microorganisms depend on temperature	Each sampling event	Measure at ell-head using a flow- through cell	Field

TABLE 7.3
LTM SAMPLING OVERVIEW AND QUALITY ASSURANCE SUMMARY
IRP SITE SS-04
REMEDIATION BY NATURAL ATTENUATION TS
LANGLEY AFB, VIRGINIA

Analytical Parameter	No. of Samples	No. of Field/Trip Blanks	No. of Rinseate Blanks	No. of Duplicates	No. of MS/MSD	Approximate No. of Analyses
BTEX	14	1 per cooler	1	1	1	15
Ferrous Iron	14	0	0	1	0	15
Methane	14	1 per cooler	0	1	1	17
Sulfate	14	0	0	1	0	15
Nitrate	14	0	0	1	1	16
Dissolved oxygen	14	0	0	0	0	14
ORP	14	0	0	0	0	14
Conductivity	14	0	0	0	0	14
pH	14	0	0	0	0	14
Temperatur	14	0	0	0	0	14

7.5 SCHEDULE

Groundwater sampling events were completed in November 1996 and October 1997. Parsons ES proposes that, in order to maintain consistency with the available historical record and to minimize possible variance in water-level elevations and chemical concentrations attributable to seasonal fluctuations in the groundwater system, LTM shall commence in October 1998. Subsequent monitoring events also would be conducted during the month of October, through the required period of monitoring.

7.6 PERIODIC REVIEW OF LTM RESULTS

The results of the RNA program at Site SS-04 will be reviewed at the conclusion of the first two-year period, and biennially thereafter, among representatives of AFCEE, the sampling contractor, and the appropriate agency(ies). Based on monitoring results, the LTM plan may be revised, as appropriate, in consultation with the appropriate agency(ies). For example, if the results of monitoring, obtained during the initial 5-year monitoring period during which annual sampling is conducted, demonstrate that the plume is receding toward the source area, then sampling frequency may be reduced. If the data collected at any time during the monitoring period indicate the need for additional remedial activities at the site, sampling frequency will be adjusted accordingly. If sampling results indicate that other geochemical parameters within the plume (e.g., nitrate, sulfate, and ferrous iron concentrations) are stable over time, then the sampling frequency could be reduced for these parameters.

SECTION 8

CONCLUSIONS AND RECOMMENDATIONS

This report presents the results of a TS conducted to evaluate the feasibility of natural attenuation for remediation of BTEX-contaminated groundwater at IRP Site SS-04 (formerly the location of a tank farm containing USTs), Langley AFB, Virginia. In order to evaluate the possible future migration and fate of BTEX constituents dissolved in groundwater, the fate and transport of dissolved benzene was simulated using the screening-level model BIOSCREEN. Soil and groundwater samples were collected from the site and analyzed to obtain the information necessary for the transport evaluation and RNA demonstration. Physical and chemical data collected under this program were supplemented (where necessary) with data collected during previous site characterization investigations and monitoring events.

Several lines of chemical and geochemical evidence indicate that fuel hydrocarbons, including the BTEX constituents, are undergoing biodegradation within and downgradient from the source area at Site SS-04. Potential electron acceptors, including nitrate, ferric iron, carbon dioxide (methanogenesis) and sulfate are available at concentrations sufficient to facilitate microbial consumption of fuel hydrocarbons.

The predictive model was developed using site-specific geologic, hydrologic, and laboratory analytical data, and conservative assumptions about governing physical and chemical processes, to predict the future extent and concentrations of dissolved constituents by simulating the combined effects of advection, dispersion, adsorption, and biodegradation. The results of simulations indicate that benzene will probably not migrate in groundwater further than about 100 feet from the source area, in the vicinity of the abandoned USTs. This prediction correlates well to the results of historic groundwater monitoring, which demonstrate that a significant reduction in plume extent and decreases in the concentrations of BTEX constituents in the source area have occurred in the year between November 1996 and October 1997. Under the most likely conditions, concentrations of benzene in the source area will decline to below its MCL, as a consequence of natural processes, in a period of about 23 years.

The sensitivity analysis indicated that the selected model input parameters were reasonable, and the model predictions are believed to be useful approximations that can be used to assist in selecting an appropriate remedial approach.

Following a screening of technologies and process options, two alternatives were retained for further evaluation. Remedial Alternative 1 incorporates RNA and institutional controls with long-term groundwater monitoring. Alternative 2 retains all

the elements of Alternative 1 and includes biosparging along the axis of the BTEX plume near the source area.

The potential effectiveness of biosparging at Site SS-04 also was simulated conceptually using the BIOSCREEN model. The results of these calculations indicate that, if biosparging is implemented at Site SS-04, the concentrations of benzene in groundwater beneath the site will probably be below its MCL within a period of 8 years.

Implementation of Alternative 1 (RNA, institutional controls, and LTM) is recommended, because Alternative 1 will probably be nearly as effective as Alternative 2 in removing BTEX constituents from groundwater, and retains a significant cost advantage. Available data indicate that the magnitude and extent of the BTEX plume is decreasing west, southwest, and south (downgradient) of the source area. Although groundwater beneath Langley AFB is not currently used as a source of potable water, model results suggest that drinking-water standards may be met in the source area by the year 2020. Periodic sampling and analysis of groundwater at the site will enable the continued effectiveness of RNA to be evaluated, and allow assessment of whether additional remedial measures should be considered or implemented. If the results of LTM through time demonstrate that the plume continues to recede, then the frequency of LTM could potentially be reduced.

SECTION 9

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APPENDIX A

DATA FROM PREVIOUS INVESTIGATIONS

DATA FROM HAZARDOUS MATERIALS TECHNICAL CENTER, 1987

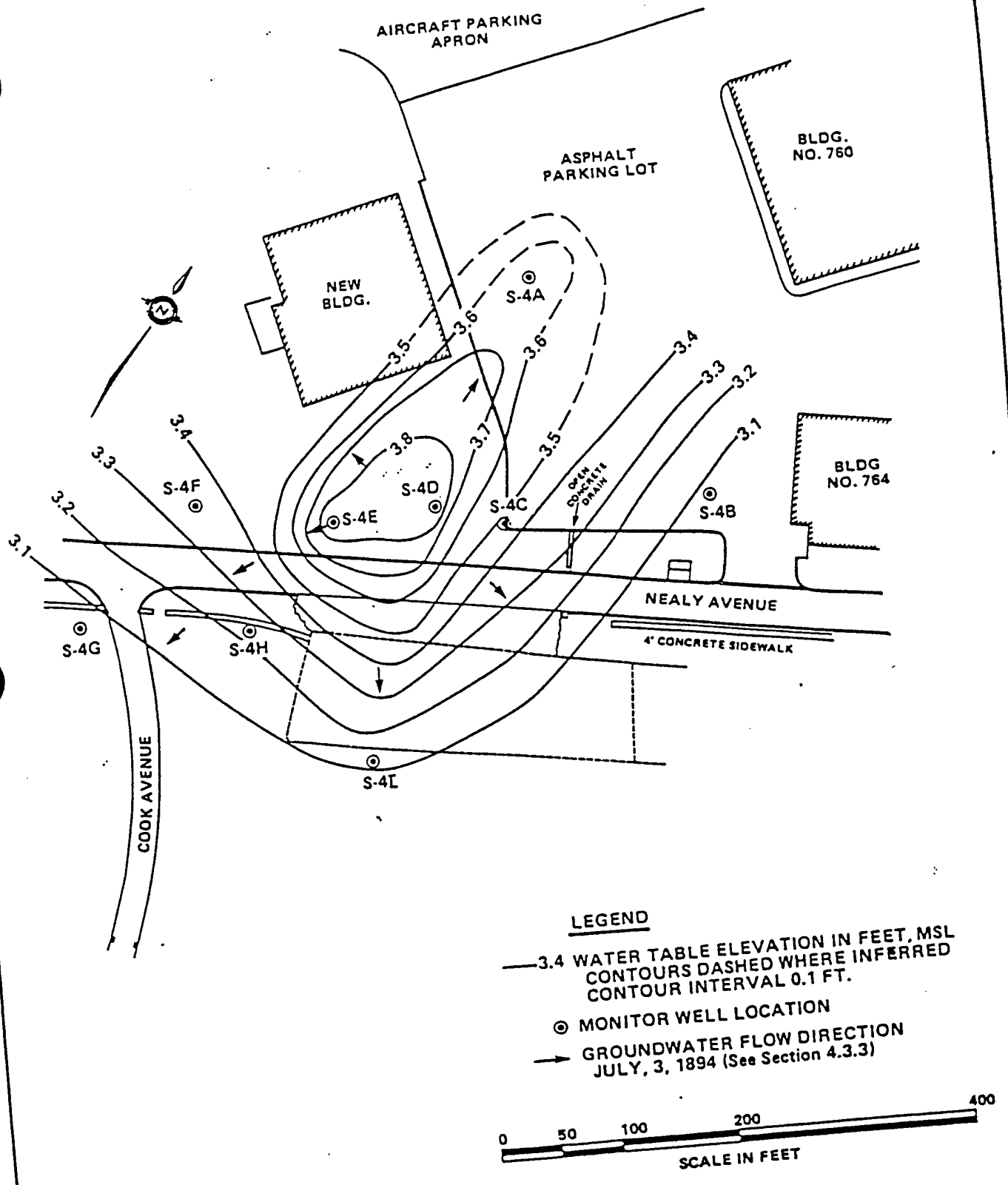


Figure 1-4. Water Table Elevation Contour Map for Site 4, Based on Groundwater Level Observations Dated July 3, 1984.

From: Phase II IRP Report

Table 1-2. Results of Analyses of Groundwater Samples Collected in the Vicinity of Site 4, Langley AFB, Virginia, July 1984.

Parameter	Well Number/WAR Sample Number									
	S-4A* 16039	S-4A* 16032	S-4B 16036	S-4C 16035	S-4D 16033	S-4E 16037	S-4F 16038	S-4G 16040	S-4H 16031	S-41 16034
pH	7.2	NA	6.2	7.7	6.9	7.0	6.9	7.3	7.3	7.1
Sp. cond. @25°C, umhos/cm	250	NA	440	425	770	690	575	450	485	450
Lead, mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Oil and grease, mg/l	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Benzene, ug/l	0.5	17.5†	6,180†	99.4†	0.2	19.**	428**	0.2	7.4**	<0.2
Toluene, ug/l	1.4	3.3	6,700†	4.1	<0.2	1.8**	122**	<0.2	3.6††	<0.2
o-Xylene, ug/l	2.1	5.7	1,660†	8.9†	<0.2	0.9**	56.7**	<0.2	3.0**	<0.2
m-Xylene, ug/l	<0.2	<0.2	<10	<0.2	0.3	<0.2	121**	<0.2	1.5**	<0.2
p-Xylene, ug/l	<0.2	1.2	4,190†	75.6†	<0.2	10.2**	108**	<0.2	2.8**	<0.2
Ethyl benzene, ug/l	<0.2	<0.2	1,020†	<0.2	<0.2	<0.2	16.2**	<0.2	0.6**	<0.2
Free-floating fuel, ft	ND	ND	±0.9	±0.1	±0.1	ND	±1.5	ND	ND	ND

* Field duplicate samples.
† Chromatographic difficulties on the second column precluded confirmation.
** Confirmed by second GC column. Confirmation samples for wells S-4E, S-4F, and S-4H were collected July 16, 1984.
†† Not observed on second column.

NA = Not analyzed.
ND = No free-floating fuel product detected.
Note 1: Second column was used if benzene exceeded 0.7 ug/l or if other volatile aromatics exceeded 10 ug/l (OEHL, 1984)
Note 2: All wells were sampled July 3, 1984. Five VOA samples were broken in shipment to LLI. The replacement samples were collected July 16, 1984.

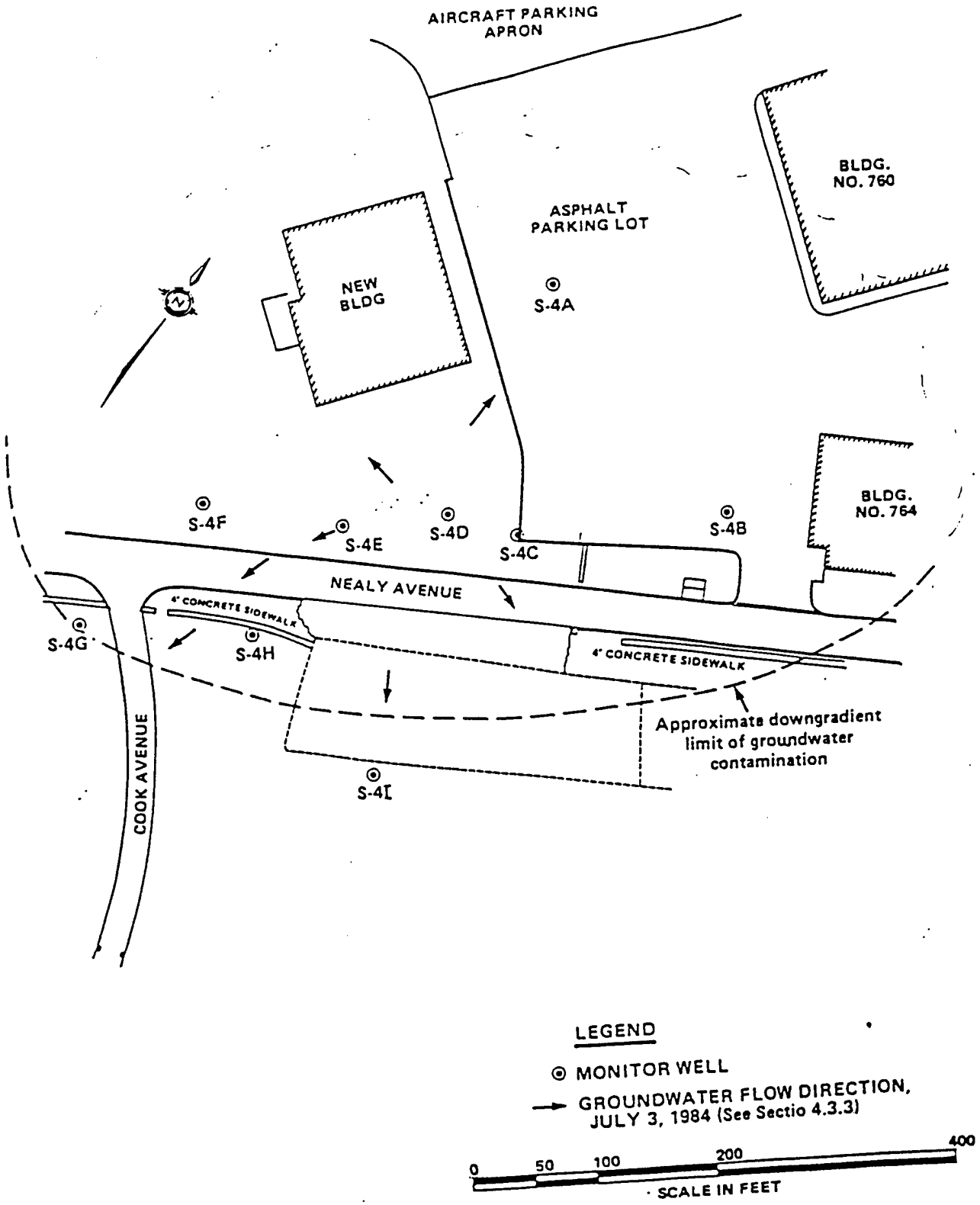


Figure 1-5. Approximate Down-gradient Limit of Groundwater Contamination at Site 4 as Indicated by the Groundwater Monitoring Wells.

From: Phase II IRP Report

DATA FROM LAW ENVIRONMENTAL, 1991

14-Feb-91
17:02

CHEMICAL DATA FROM ANALYSES OF GROUND-WATER SAMPLES COLLECTED FROM EXISTING WELLS
Corrective Action Plan - IRP Site 4
Langley Air Force Base, Virginia

Analytical Parameter	Sampling Date	Units	Nominal Limit	CONCENTRATION OW-1	OW-3	OW-4	OW-9	OW-10	OW-12	OW-IRP4-E (a) (RPD)	OW-15	OW-IRP4-E2 (b) (RPD)
VOLATILE ORGANICS-BTEX (EPA 8020):												
Benzene	May 1990	ug/L	0.3	0.3 U+	0.3 U+	0.3 U+	1400 +	0.3 U+	0.3 U+	0.3 U+ (NC)	0.3 U+	--
	Dec 1990	ug/L	0.2	0.2 U	1.2	13	F	0.2 U	2.2	--	0.8 *	0.8 * (NC)
Toluene	May 1990	ug/L	0.3	0.3 U+	0.3 U+	1.7 T+	7 *+	0.3 U+	0.5 T+	0.6 T+ (NC)	0.3 U+	--
	Dec 1990	ug/L	0.2	0.2 U	0.6 *	22	F	0.2 U	2.6	--	1.7	1.3 * (NC)
Ethylbenzene	May 1990	ug/L	0.3	0.3 U+	0.3 U+	0.3 U+	3 U+	0.3 U+	0.3 U+	0.3 U+ (NC)	5.9 +	--
	Dec 1990	ug/L	0.2	0.2 U	0.2 U	6	F	0.2 U	3.5	--	2	1.8 * (NC)
Xylenes, total	May 1990	ug/L	0.3	0.3 U+	16 +	31 +	190 +	0.3 U+	4.5 +	0.3 U+ (NC)	7.2 +	--
	Dec 1990	ug/L	0.2	0.2 U	2.4	19	F	0.4 *	1.1 *	--	11	6.4 (53)
dilution factor	May 1990		1	1	1	1	10	1	1	1 --	1	--
	Dec 1990		1	1	1	2	--	1	2	--	1	1
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS ("TRPH": EPA 418.1):												
TRPH	May 1990	mg/L	0.5	0.5 U	0.6 *	1.4 *	4.1	1.9	0.5 U	0.5 U (NC)	1.0 *	--
dilution factor			1	1	1	1	1	1	1	1 --	1	
LEAD (EPA 3020/7421):												
Lead, total		ug/L	3.0	13.9 B	58.2	35.4 B	76.0 B	106	83.2	84.1 (1.1)	13.4 B	--
dilution factor			1	1	1	1	1	1	1	1 --	1	
Lead, dissolved (c)		ug/L	3.0	6.2 B	3.5 *	32.6 B	8.1 B	3.0 U	3.0 U	4.7 B (NC)	9.1 B	--
dilution factor			1	1	1	1	1	1	1	1 --	1	

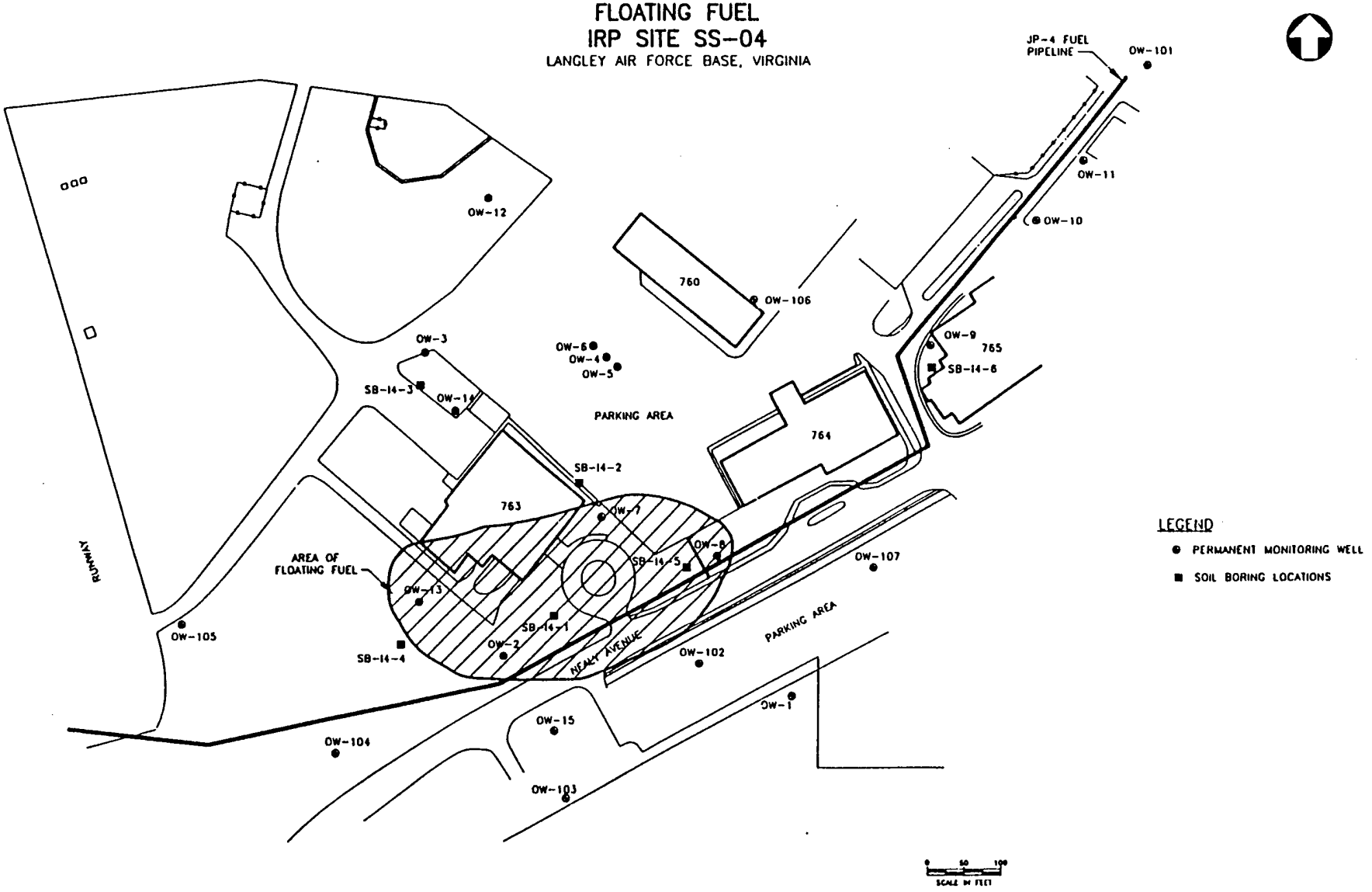
U Analyzed for and not detected; value reported is quantitation limit
+ Estimated value; alternate method used
* Quantitation estimated; value reported is less than 5 times detection limit
a Field duplicate for "OW-12"; value in parentheses is RPD ("NC" = not calculable)
b Field duplicate for "OW-15"; value in parentheses is RPD ("NC" = not calculable)
c Samples filtered in field through 0.45 um filter
T Value reported may be biased high or a false positive, based upon applicable trip blank data
B Value reported may be biased high or a false positive, based upon applicable method blank data
F Location not sampled in December 1990 due to presence of floating fuel

File = \LANGLEY4\WDATA-4E.wk1

FIGURE 2-2

FLOATING FUEL
IRP SITE SS-04

LANGLEY AIR FORCE BASE, VIRGINIA

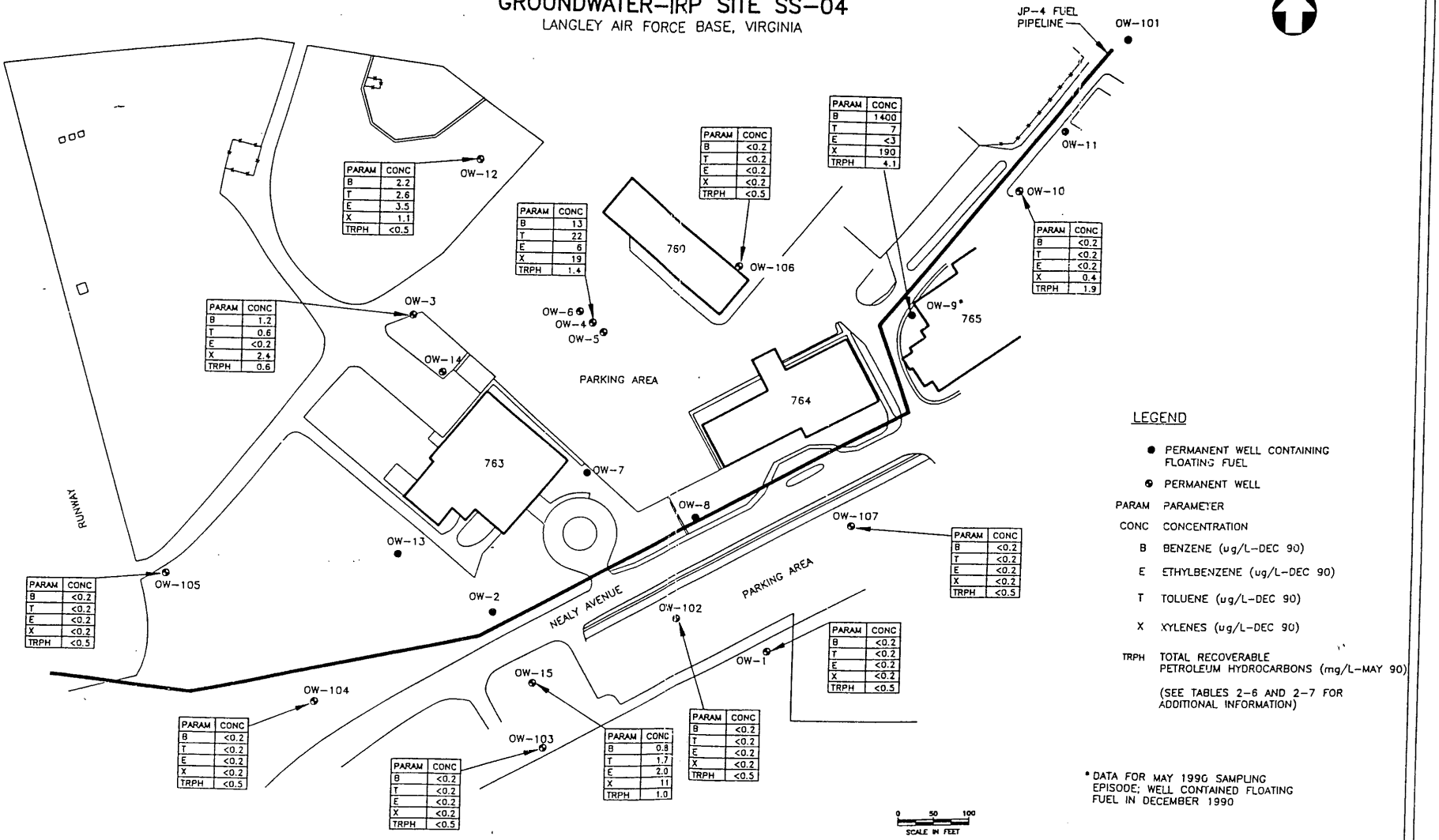


LAW ENVIRONMENTAL INC
GOVERNMENT SERVICES DIVISION

FIGURE 2-3

ANALYTICAL DATA FOR GROUNDWATER-IRP SITE SS-04

LANGLEY AIR FORCE BASE, VIRGINIA



PARAM	CONC
B	2.2
T	2.6
E	3.5
X	1.1
TRPH	<0.5

PARAM	CONC
B	13
T	22
E	6
X	19
TRPH	1.4

PARAM	CONC
B	<0.2
T	<0.2
E	<0.2
X	<0.2
TRPH	<0.5

PARAM	CONC
B	1400
T	7
E	<3
X	190
TRPH	4.1

PARAM	CONC
B	<0.2
T	<0.2
E	<0.2
X	0.4
TRPH	1.9

PARAM	CONC
B	1.2
T	0.6
E	<0.2
X	2.4
TRPH	0.6

PARAM	CONC
B	<0.2
T	<0.2
E	<0.2
X	<0.2
TRPH	<0.5

PARAM	CONC
B	<0.2
T	<0.2
E	<0.2
X	<0.2
TRPH	<0.5

PARAM	CONC
B	<0.2
T	<0.2
E	<0.2
X	<0.2
TRPH	<0.5

PARAM	CONC
B	<0.2
T	<0.2
E	<0.2
X	<0.2
TRPH	<0.5

PARAM	CONC
B	0.8
T	1.7
E	2.0
X	11
TRPH	1.0

PARAM	CONC
B	<0.2
T	<0.2
E	<0.2
X	<0.2
TRPH	<0.5

PARAM	CONC
B	<0.2
T	<0.2
E	<0.2
X	<0.2
TRPH	<0.5

LEGEND

- ● PERMANENT WELL CONTAINING FLOATING FUEL
- ⊗ PERMANENT WELL
- PARAM PARAMETER
- CONC CONCENTRATION
- B BENZENE (ug/L-DEC 90)
- E ETHYLBENZENE (ug/L-DEC 90)
- T TOLUENE (ug/L-DEC 90)
- X XYLENES (ug/L-DEC 90)
- TRPH TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (mg/L-MAY 90)

(SEE TABLES 2-6 AND 2-7 FOR ADDITIONAL INFORMATION)

* DATA FOR MAY 1990 SAMPLING EPISODE; WELL CONTAINED FLOATING FUEL IN DECEMBER 1990

LAW ENVIRONMENTAL INC.
GOVERNMENT SERVICES DIVISION

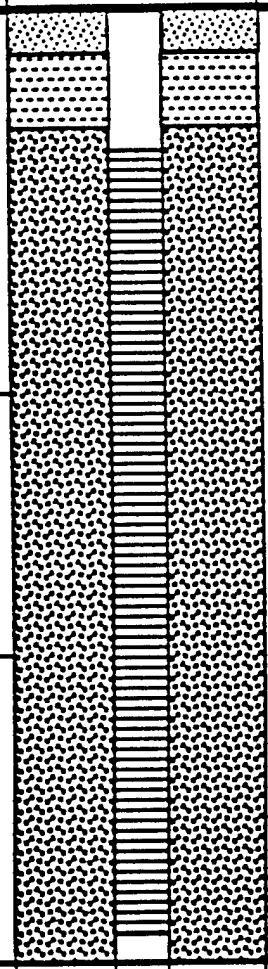
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER OW-107
JOB NUMBER 11-0546
DATE STARTED 5-9-90
DATE COMPLETED 5-9-90
DRILLED BY LAW ENGR./NORFOLK
LOGGED BY ASM
CHECKED BY RDM

REMARKS:

CASING DIAMETER: 2" PVC
RISER: 2.5' RISER
SCREEN: 10'
HAND AUGERED TO 11'

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
8.05	0.0	Loose dark brown silty LOAM (SM)				
3.05	5.0	Organic firm sandy SILT with shell fragments (Yorktown Formation) (SM)				
-0.45	8.5	Same as above - gray Yorktown Formation (SM)			G	
-4.45	12.5	Boring Terminated at 12.5'				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER SB-I4-1
JOB NUMBER 11-0546
DATE STARTED 5-8-90
DATE COMPLETED 5-8-90
DRILLED BY LAW ENGR./NORFOLK
LOGGED BY ASM
CHECKED BY RDM

REMARKS:

Hand Augered to 5.0 feet

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALU
	0.0	Topsoil fine brown silty organic SOIL with some gravel (no odor) (Pf)				
		(Slight fuel odor)				
		Dark brown to black Silty SAND (SM)				
		(Wet sample)		▼	C	
		Black silty soil				
		(Noticeable but slight fuel odor no free product) (SM)				
	5.0	Boring Terminated at 5.0'				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER SB-I4-2
JOB NUMBER 11-0546
DATE STARTED 5-9-90
DATE COMPLETED 5-9-90
DRILLED BY LAW ENGR./NORFOLK
LOGGED BY ASM
CHECKED BY RDM

REMARKS: Hand Augered to 5.0 feet

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	0.0	Clayey SILT (strong fuel odor all the way down to the bottom of the boring) gray to black (SC)				
				▼	C	
	5.0	Boring Terminated at 5.0'				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER SB-I4-3
JOB NUMBER 11-0546
DATE STARTED 5-8-90
DATE COMPLETED 5-8-90
DRILLED BY LAW ENGR./NORFOLK
LOGGED BY ASM
CHECKED BY RDM

REMARKS:

Hand Augered to 6.0 feet

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SP N VAL
	0.0	Brown silty SAND (no odor) (SM)				
		Brown-gray clayey silty SAND (no odor) (SC)				
		SAB (no odor)				
		(Strong fuel odors)				
		(Strong fuel odors)		▼	C	
		(Strong fuel odors)				
	6.0	Boring Terminated at 6.0'				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER SB-14-4
JOB NUMBER 11-0546
DATE STARTED 5-8-90
DATE COMPLETED 5-8-90
DRILLED BY LAW ENGR./NORFOLK
LOGGED BY ASM
CHECKED BY RDM

REMARKS: Hand Augered to 6.0 feet

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	0.0	Topsoil Light gray tan very fine silty SAND (no odor) (SM)				
		(no odor)				
		(no odor)				
		(no odor)				
		(no odor)				
		(no odor) (wet)			C	
	6.0	Boring Terminated at 6.0'				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER SB-I4-5
JOB NUMBER 11-0546
DATE STARTED 5-9-90
DATE COMPLETED 5-9-90
DRILLED BY LAW ENGR./NORFOLK
LOGGED BY ASM
CHECKED BY RDM

REMARKS:

Hand Augered to 5.0 feet

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALU
	0.0	6" of ASPHALT				
	0.5	Clay SILT with gravel (no odor) (SC)				
	4.0	(Strong fuel odor at 4.0 feet) Dark clayey SILT			C	
	5.0	Boring Terminated at 5.0'				

APPENDIX D

MONITORING WELL DEVELOPMENT RECORDS

MONITORING WELLS

OW-102
OW-103
OW-104
OW-105
OW-106
OW-107

TYPE II MONITORING WELL INSTALLATION DIAGRAM

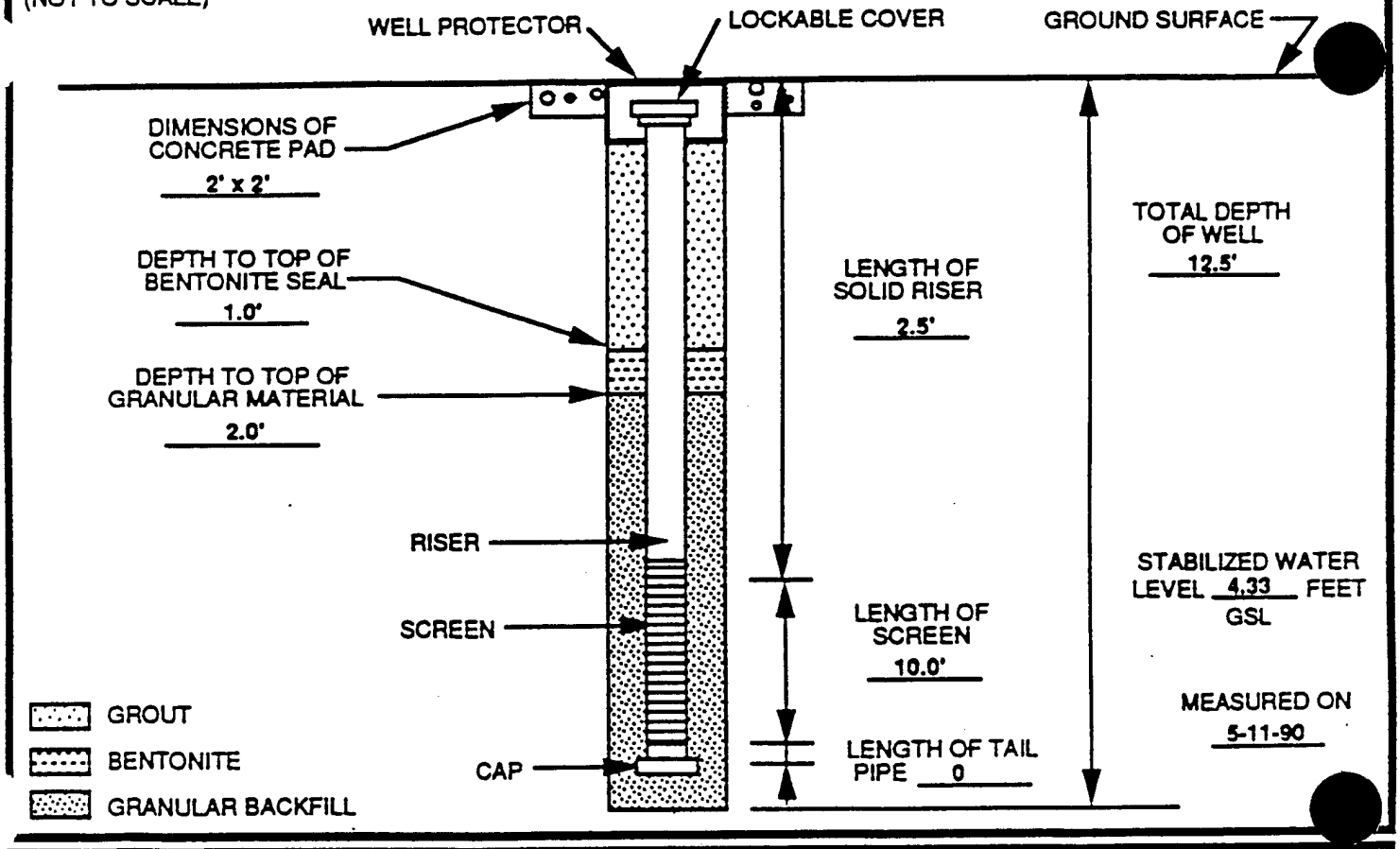
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME: LANGLEY AFB - IRP-4
WELL NO.: OW-107 JOB NO: 11-0546
DATE: 5-8-90 TIME:
WELL LOCATION:

GROUND SURFACE ELEVATION: 8.05
TOP OF SCREEN ELEVATION: 5.55
REFERENCE POINT ELEVATION:
TYPE SAND PACK: SILICA SAND GRADATION: 20/40
SAND PACK MANUFACTURER: FOSTER-DIXIANA
SCREEN MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER DIAMETER: 2.0" ID
DRILLING TECHNIQUE: POWER AUGER
AUGER SIZE AND TYPE: 3 3/4" ID; 8" OD

BENTONITE TYPE: POWDER
MANUFACTURER: QUIK-GEL
CEMENT TYPE: PORTLAND CEMENT
MANUFACTURER: NA
BOREHOLE DIAMETER: 8.0"
SCREEN DIAMETER: 2.0" SLOT SIZE: 0.02"
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE: A.S. McDOWELL
DRILLING CONTRACTOR: LAW ENGINEERING/NORFOLK
AMOUNT BENTONITE USED: ~50 lbs.
AMOUNT CEMENT USED: N/A
AMOUNT SAND USED: ~200 lbs
STATIC WATER DEPTH (after dev.): 4.33' (TOB)

(NOT TO SCALE)



QA / QC

INSTALLED BY: WK INSTALLATION OBSERVED BY: ASM
DISCREPANCIES:

TYPE II MONITORING WELL INSTALLATION DIAGRAM

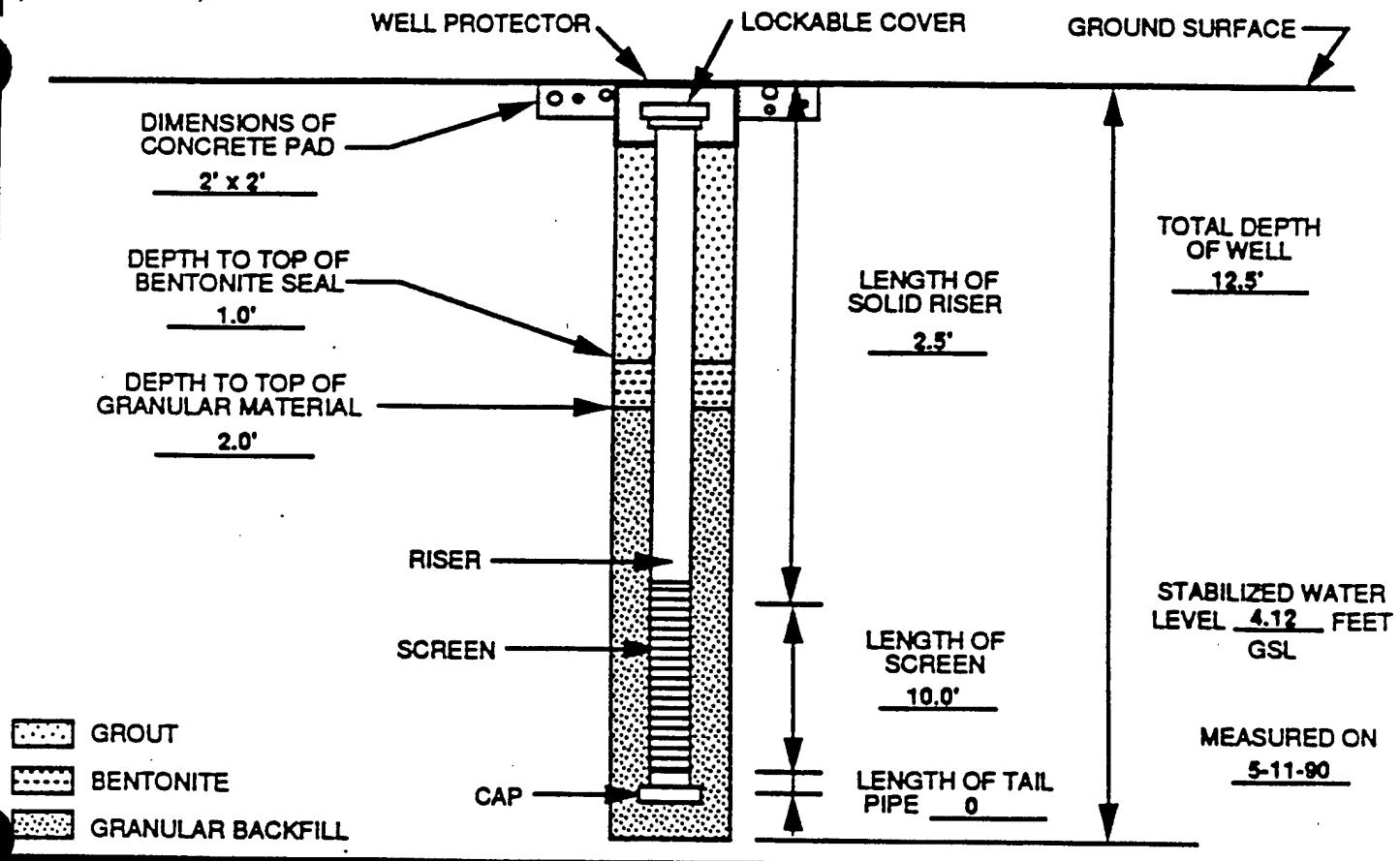
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME: LANGLEY AFB - IRP-4
WELL NO.: OW-106 JOB NO: 11-0546
DATE: 5-9-90 TIME:
WELL LOCATION: JUST NORTH OF BLDG #760

GROUND SURFACE ELEVATION: 8.92
TOP OF SCREEN ELEVATION: 6.42
REFERENCE POINT ELEVATION:
TYPE SAND PACK: SILICA SAND GRADATION: 20/40
SAND PACK MANUFACTURER: FOSTER-DIXIANA
SCREEN MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER DIAMETER: 2.0" ID
DRILLING TECHNIQUE: POWER AUGER
AUGER SIZE AND TYPE: 3 3/4" ID; 8" OD

BENTONITE TYPE: POWDER
MANUFACTURER: QUIK-GEL
CEMENT TYPE: PORTLAND CEMENT
MANUFACTURER: NA
BOREHOLE DIAMETER: 8.0"
SCREEN DIAMETER: 2.0" SLOT SIZE: 0.02"
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE: A.S. McDOWELL
DRILLING CONTRACTOR: LAW ENGINEERING/NORFOLK
AMOUNT BENTONITE USED: ~50 lbs.
AMOUNT CEMENT USED: N/A
AMOUNT SAND USED: ~200 lbs
STATIC WATER DEPTH (after dev.): 4.12' (TOB)

(NOT TO SCALE)



QA / QC

INSTALLED BY: MK INSTALLATION OBSERVED BY: ASM
DISCREPANCIES:

TYPE II MONITORING WELL INSTALLATION DIAGRAM

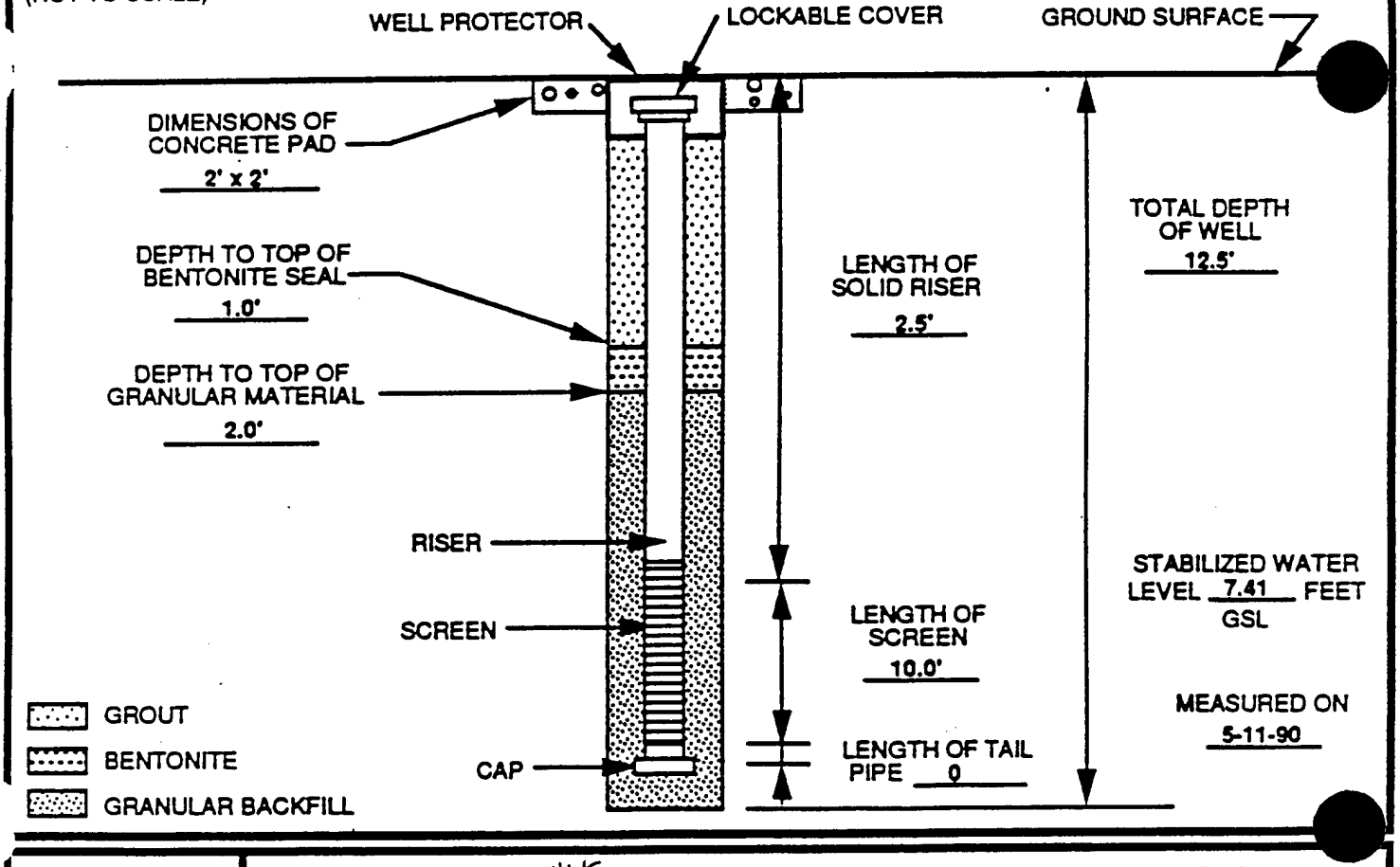
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME: LANGLEY AFB - IRP-4
WELL NO.: OW-105 JOB NO: 11-0546
DATE: 5-8-90 TIME:
WELL LOCATION: SOUTHWEST OF BLDG #763

GROUND SURFACE ELEVATION: 9.56
TOP OF SCREEN ELEVATION: 7.06
REFERENCE POINT ELEVATION:
TYPE SAND PACK: SILICA SAND GRADATION: 20/40
SAND PACK MANUFACTURER: FOSTER-DIXIANA
SCREEN MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER DIAMETER: 2.0" ID
DRILLING TECHNIQUE: POWER AUGER
AUGER SIZE AND TYPE: 3 3/4" ID; 8" OD

BENTONITE TYPE: POWDER
MANUFACTURER: QUIK-GEL
CEMENT TYPE: PORTLAND CEMENT
MANUFACTURER: NA
BOREHOLE DIAMETER: 8.0"
SCREEN DIAMETER: 2.0" SLOT SIZE: 0.02"
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE: A.S. McDOWELL
DRILLING CONTRACTOR: LAW ENGINEERING/NORFOLK
AMOUNT BENTONITE USED: ~50 lbs.
AMOUNT CEMENT USED: N/A
AMOUNT SAND USED: ~200 lbs
STATIC WATER DEPTH (after dev.): 7.41' (TOB)

(NOT TO SCALE)



QA / QC

INSTALLED BY: MK INSTALLATION OBSERVED BY: ASM
DISCREPANCIES:

TYPE II MONITORING WELL INSTALLATION DIAGRAM

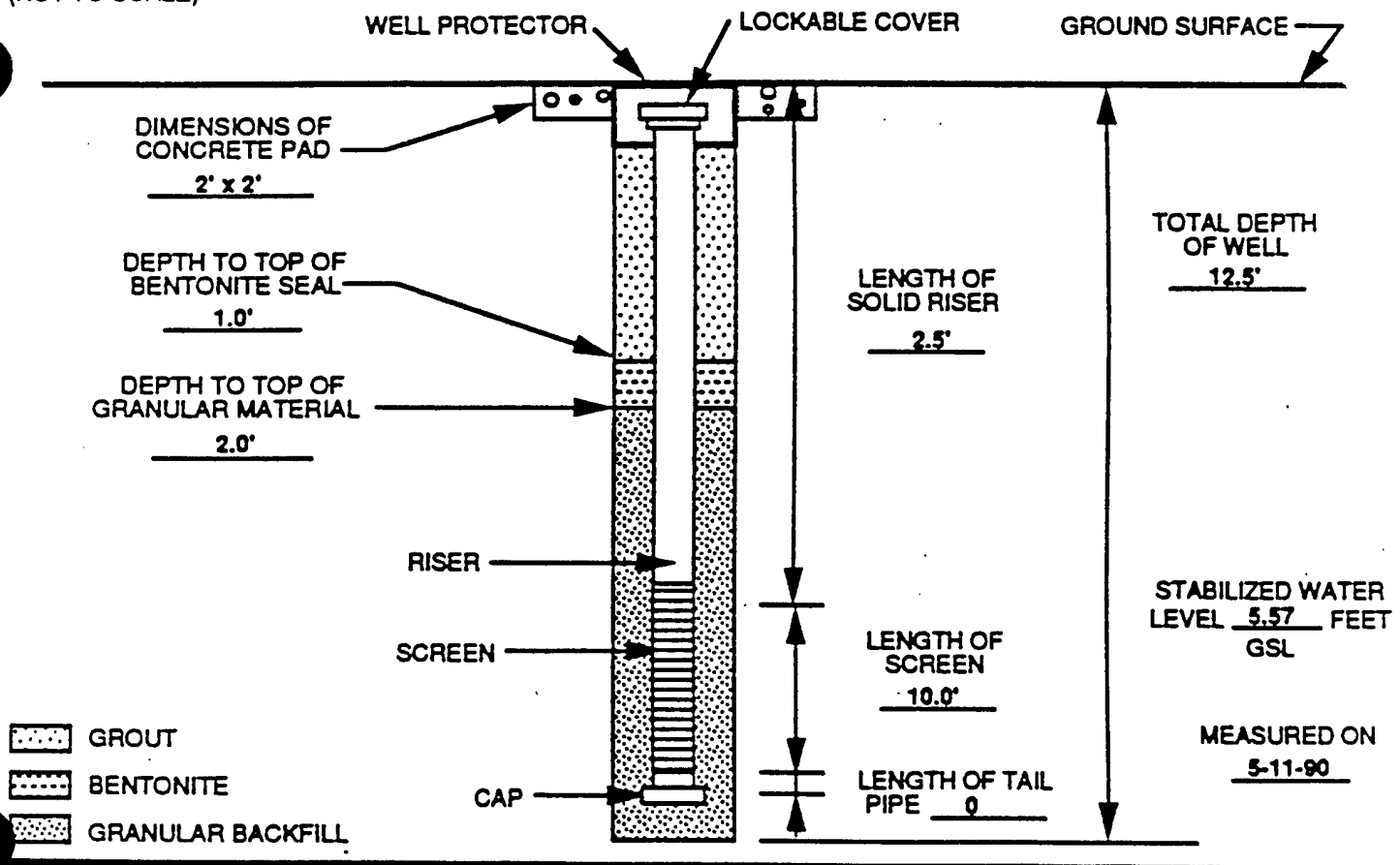
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME: LANGLEY AFB - IRP-4
WELL NO.: OW-104 JOB NO: 11-0545
DATE: 5-8-90 TIME:
WELL LOCATION: SOUTH OF BLDG #763

GROUND SURFACE ELEVATION: 8.83
TOP OF SCREEN ELEVATION: 6.33
REFERENCE POINT ELEVATION:
TYPE SAND PACK: SILICA SAND GRADATION: 20/40
SAND PACK MANUFACTURER: FOSTER-DIXIANA
SCREEN MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER DIAMETER: 2.0" ID
DRILLING TECHNIQUE: POWER AUGER
AUGER SIZE AND TYPE: 3 3/4" ID; 8" OD

BENTONITE TYPE: POWDER
MANUFACTURER: QUIK-GEL
CEMENT TYPE: PORTLAND CEMENT
MANUFACTURER: NA
BOREHOLE DIAMETER: 8.0"
SCREEN DIAMETER: 2.0" SLOT SIZE: 0.02"
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE: A.S. McDOWELL
DRILLING CONTRACTOR: LAW ENGINEERING/NORFOLK
AMOUNT BENTONITE USED: ~50 lbs.
AMOUNT CEMENT USED: N/A
AMOUNT SAND USED: ~200 lbs
STATIC WATER DEPTH (after dev.): 5.57'

(NOT TO SCALE)



QA / QC

INSTALLED BY: MK INSTALLATION OBSERVED BY: ASM
DISCREPANCIES:

TYPE II MONITORING WELL INSTALLATION DIAGRAM

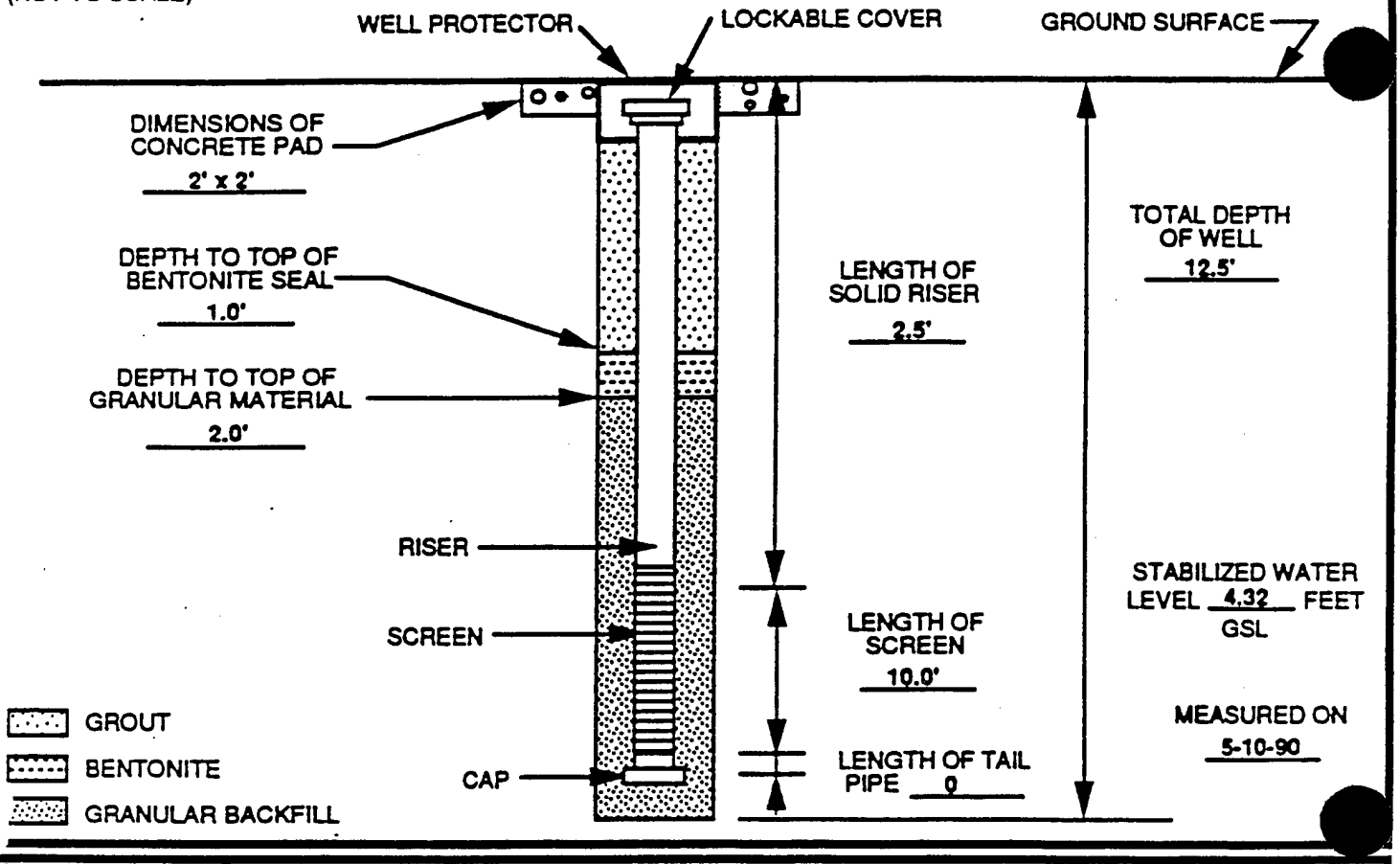
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME: LANGLEY AFB - IRP-4
WELL NO.: OW-103 JOB NO: 11-0546
DATE: 5-9-90 TIME:
WELL LOCATION: SOUTHEAST OF BLDG #763

GROUND SURFACE ELEVATION: 8.29
TOP OF SCREEN ELEVATION: 5.79
REFERENCE POINT ELEVATION:
TYPE SAND PACK: SILICA SAND GRADATION: 20/40
SAND PACK MANUFACTURER: FOSTER-DIXIANA
SCREEN MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER DIAMETER: 2.0" ID
DRILLING TECHNIQUE: POWER AUGER
AUGER SIZE AND TYPE: 3 3/4" ID; 8" OD

BENTONITE TYPE: POWDER
MANUFACTURER: QUIK-GEL
CEMENT TYPE: PORTLAND CEMENT
MANUFACTURER: NA
BOREHOLE DIAMETER: 8.0"
SCREEN DIAMETER: 2.0" SLOT SIZE: 0.02"
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE: A.S. McDOWELL
DRILLING CONTRACTOR: LAW ENGINEERING/NORFOLK
AMOUNT BENTONITE USED: ~50 lbs.
AMOUNT CEMENT USED: N/A
AMOUNT SAND USED: ~200 lbs
STATIC WATER DEPTH (after dev.): 4.32'

(NOT TO SCALE)



QA / QC

INSTALLED BY: MK INSTALLATION OBSERVED BY: ASM
DISCREPANCIES:

TYPE II MONITORING WELL INSTALLATION DIAGRAM

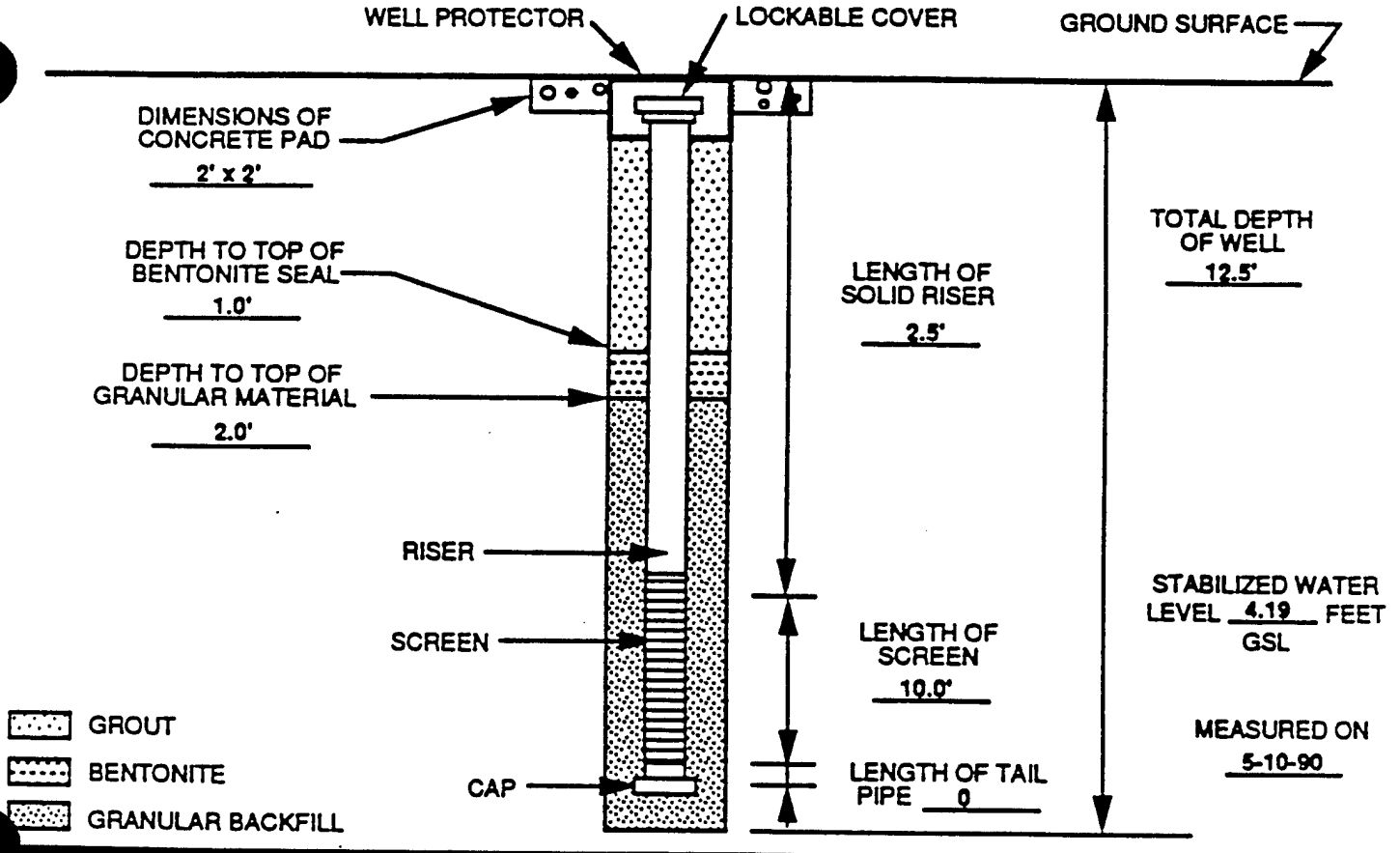
LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION
KENNESAW, GEORGIA

JOB NAME: LANGLEY AFB - IRP-4
WELL NO.: OW-102 JOB NO: 11-054
DATE: 5-8-90 TIME:
WELL LOCATION: PARKING LOT EAST OF BLDG #763

GROUND SURFACE ELEVATION: 6.97
TOP OF SCREEN ELEVATION: 4.47
REFERENCE POINT ELEVATION:
TYPE SAND PACK: SILICA SAND GRADATION: 20/40
SAND PACK MANUFACTURER: FOSTER-DIXIANA
SCREEN MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER MATERIAL: PVC
MANUFACTURER: BRAINARD KILMAN
RISER DIAMETER: 2.0" ID
DRILLING TECHNIQUE: POWER AUGER
AUGER SIZE AND TYPE: 3 3/4" ID; 8" OD

BENTONITE TYPE: POWDER
MANUFACTURER: QUIK-GEL
CEMENT TYPE: PORTLAND CEMENT
MANUFACTURER: NA
BOREHOLE DIAMETER: 8.0"
SCREEN DIAMETER: 2.0" SLOT SIZE: 0.02"
LAW ENVIRONMENTAL, INC. FIELD REPRESENTATIVE: A.S. McDOWELL
DRILLING CONTRACTOR: LAW ENGINEERING/NORFOLK
AMOUNT BENTONITE USED: ~50 lbs.
AMOUNT CEMENT USED: N/A
AMOUNT SAND USED: ~200 lbs
STATIC WATER DEPTH (after dev.): 4.19' TOB

(NOT TO SCALE)



QA / QC

INSTALLED BY: [illegible] INSTALLATION OBSERVED BY: ASM
DISCREPANCIES:

APPENDIX C

MONITORING WELL INSTALLATION RECORDS

MONITORING WELLS

OW-102
OW-103
OW-104
OW-105
OW-106
OW-107

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER SB-I4-6
JOB NUMBER 11-0546
DATE STARTED 5-9-90
DATE COMPLETED 5-9-90
DRILLED BY LAW ENGR./NORFOLK
LOGGED BY ASM
CHECKED BY RDM

REMARKS:

Hand Augered to 6.0 feet

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	0.0	Topsoil - fine gray SILT and dark organic SOIL				
		Orange - brown clayey SILT (no odor) (SC)				
		(no odor)				
		(no odor)				
		(no odor)			C	
		(no odor)		▼		
	6.0	Boring Terminated at 6.0'				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER SB-I4-5
JOB NUMBER 11-0546
DATE STARTED 5-9-90
DATE COMPLETED 5-9-90
DRILLED BY LAW ENGR./NORFOLK
LOGGED BY ASM
CHECKED BY RDM

REMARKS:

Hand Augered to 5.0 feet

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	0.0	6" of ASPHALT				
	0.5	Clay SILT with gravel (no odor) (SC)				
	4.0	(Strong fuel odor at 4.0 feet) Dark clayey SILT			C	
	5.0	Boring Terminated at 5.0'		▼		

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

TEST BORING RECORD

BORING NUMBER SB-I4-4
JOB NUMBER 11-0546
DATE STARTED 5-8-90
DATE COMPLETED 5-8-90
DRILLED BY LAW ENGR./NORFOLK
LOGGED BY ASM
CHECKED BY RDM

REMARKS:

Hand Augered to 6.0 feet

ELEV. IN FEET	DEPTH IN FEET	DESCRIPTION	MONITORING WELL CONSTRUCTION	SYM-BOLS	LAB TESTS	SPT N VALUE
	0.0	Topsoil Light gray tan very fine silty SAND (no odor) (SM)				
		(no odor)				
		(no odor)				
		(no odor)				
		(no odor)			C	
		(no odor) (wet)		▼		
	6.0	Boring Terminated at 6.0'				

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

JOB NAME LANGLEY AFB, IRP SITE 4 JOB No. 11-0546

BY RDM DATE 5-9-90 SHEET 1 OF 1

WELL DEVELOPMENT DATA

1. Well No. OW-102
2. Date of Installation : 5-8-90
3. Date of Development : 5-9-90
4. Static Water Level : Before Development 4.19 ft.: 24 Hours After 4.19 ft
5. Quantity of Water Loss During Drilling, If Used NONE USED Gal.
6. Quantity of Standing Water in Well and Annulus Before Development 7 Gal.

	Start	During		End
7. Specific Conductance (umhos/cm)	610	610	615	610
Temperature (c°)	22	23	22	22
pH (s.u.)	6.6	6.7	6.6	6.7

8. Depth From Top of Well Casing to Bottom of Well 12.5 ft.
9. Screen Length 10.0 ft.
10. Depth to Top of Sediment : Before Development 12.5 ft.; After Development 12.5 ft.
11. Physical Character of Water : REASONABLY CLEAR
12. Type and Size of Well Development Equipment : 2" DIA. COMPRESSED AIR PUMP (QED)
13. Description of Surge Technique, If Used : SURGE BLOCK
14. Height of Well Casing Above Ground Surface : 0 ft.
15. Quantity of Water Removed : 55 Gal. Time for Removal : 2/0 Hr./Min
16. 1-Liter Water Sample Collected : 0830 (Time)
17. Turbidity in Nephelometric Units 55 NTUs

*Development Conditions : 1) Well Water if Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

JOB NAME LANGLEY AFB, IRP SITE 4 JOB No. 11-0546

BY RDM DATE 5-9-90 SHEET 1 OF 1

WELL DEVELOPMENT DATA

1. Well No. OW-103
2. Date of Installation : 5-9-90
3. Date of Development : 5-9-90
4. Static Water Level : Before Development 4.32 ft.: 24 Hours After 4.32 ft
5. Quantity of Water Loss During Drilling, If Used NONE USED Gal.
6. Quantity of Standing Water in Well and Annulus Before Development 7 Gal.

	Start	During		End
7. Specific Conductance (umhos/cm)	600	610	615	620
Temperature (c°)	20	22	24	22
pH (s.u.)	6.4	6.7	6.7	6.7

8. Depth From Top of Well Casing to Bottom of Well 12.5 ft.
9. Screen Length 10.0 ft.
10. Depth to Top of Sediment : Before Development 12.5 ft.; After Development 12.5 ft.
11. Physical Character of Water : REASONABLY CLEAR
12. Type and Size of Well Development Equipment : 2" DIA. COMPRESSED AIR PUMP (QED)
13. Description of Surge Technique, If Used : SURGE BLOCK
14. Height of Well Casing Above Ground Surface : 0 ft.
15. Quantity of Water Removed : 55 Gal. Time for Removal : 2/0 Hr./Min.
16. 1-Liter Water Sample Collected : 2000 (Time)
17. Turbidity in Nephelometric Units 49 NTUs

*Development Conditions : 1) Well Water if Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

JOB NAME LANGLEY AFB, IRP SITE 4 JOB No. 11-0546

BY RDM DATE 5-9-90 SHEET 1 OF 1

WELL DEVELOPMENT DATA

1. Well No. OW-104
2. Date of Installation : 5-8-90
3. Date of Development : 5-9-90
4. Static Water Level : Before Development 5.57 ft.: 24 Hours After 5.57 ft
5. Quantity of Water Loss During Drilling, If Used NONE USED Gal.
6. Quantity of Standing Water in Well and Annulus Before Development 7 Gal.

	Start	During		End
7. Specific Conductance (umhos/cm)	620	610	610	620
Temperature (c°)	20	21	21	21
pH (s.u.)	7.2	7.0	6.9	6.9

8. Depth From Top of Well Casing to Bottom of Well 12.5 ft.
9. Screen Length. 10.0 ft.
10. Depth to Top of Sediment : Before Development 12.5 ft.; After Development 12.5 ft.
11. Physical Character of Water : REASONABLY CLEAR
12. Type and Size of Well Development Equipment : 2" DIA. COMPRESSED AIR PUMP (QED)
13. Description of Surge Technique, If Used : SURGE BLOCK
14. Height of Well Casing Above Ground Surface : 0 ft.
15. Quantity of Water Removed : 55 Gal. Time for Removal : 2/0 Hr./Min
16. 1-Liter Water Sample Collected : 1400 (Time)
17. Turbidity in Nephelometric Units 56 NTUs

*Development Conditions : 1) Well Water if Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

JOB NAME LANGLEY AFB, IRP SITE 4 JOB No. 11-0546

BY RDM DATE 5-9-90 SHEET 1 OF 1

WELL DEVELOPMENT DATA

1. Well No. OW-105
2. Date of Installation : 5-8-90
3. Date of Development : 5-9-90
4. Static Water Level : Before Development 7.41 ft.: 24 Hours After 7.41 ft
5. Quantity of Water Loss During Drilling, If Used NONE USED Gal.
6. Quantity of Standing Water in Well and Annulus Before Development 7 Gal.

	Start	During		End
7. Specific Conductance (umhos/cm)	700	700	690	690
Temperature (c°)	22	20	21	20
pH (s.u.)	7.1	7.0	6.9	6.9

8. Depth From Top of Well Casing to Bottom of Well 12.5 ft.
9. Screen Length 10.0 ft.
10. Depth to Top of Sediment : Before Development 12.5 ft.; After Development 12.5 ft.
11. Physical Character of Water : REASONABLY CLEAR
12. Type and Size of Well Development Equipment : 2" DIA. COMPRESSED AIR PUMP (QED)
13. Description of Surge Technique, If Used : SURGE BLOCK
14. Height of Well Casing Above Ground Surface : 0 ft.
15. Quantity of Water Removed : 55 Gal. Time for Removal : 2/0 Hr./Min.
16. 1-Liter Water Sample Collected : 1600 (Time)
17. Turbidity in Nephelometric Units 59 NTUs

*Development Conditions : 1) Well Water If Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

JOB NAME LANGLEY AFB, IRP SITE 4 JOB No. 11-0546

BY RDM DATE 5-9-90 SHEET 1 OF 1

WELL DEVELOPMENT DATA

1. Well No. OW-106
2. Date of Installation : 5-9-90
3. Date of Development : 5-9-90
4. Static Water Level : Before Development 4.12 ft.: 24 Hours After 4.12 ft
5. Quantity of Water Loss During Drilling, If Used NONE USED Gal.
6. Quantity of Standing Water in Well and Annulus Before Development 7 Gal.

	Start	During		End
7. Specific Conductance (umhos/cm)	620	630	620	630
Temperature (c°)	24	23	21	21
pH (s.u.)	6.6	6.7	6.7	6.8

8. Depth From Top of Well Casing to Bottom of Well 12.5 ft.
9. Screen Length 10.0 ft.
10. Depth to Top of Sediment : Before Development 12.5 ft.; After Development 12.5 ft.
11. Physical Character of Water : REASONABLY CLEAR
12. Type and Size of Well Development Equipment : 2" DIA. COMPRESSED AIR PUMP (QED)
13. Description of Surge Technique, If Used : SURGE BLOCK
14. Height of Well Casing Above Ground Surface : 0 ft.
15. Quantity of Water Removed : 55 Gal. Time for Removal : 2/0 Hr./Min.
16. 1-Liter Water Sample Collected : 1800 (Time)
17. Turbidity in Nephelometric Units 62 NTUs

*Development Conditions : 1) Well Water If Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

LAW ENVIRONMENTAL, INC.
GOVERNMENT SERVICES DIVISION

JOB NAME LANGLEY AFB, IRP SITE 4 JOB No. 11-0546

BY RDM DATE 5-9-90 SHEET 1 OF 1

WELL DEVELOPMENT DATA

1. Well No. OW-107
2. Date of Installation : 5-8-90
3. Date of Development : 5-9-90
4. Static Water Level : Before Development 4.33 ft.: 24 Hours After 4.33 ft
5. Quantity of Water Loss During Drilling, If Used NONE USED Gal.
6. Quantity of Standing Water in Well and Annulus Before Development 7 Gal.

	Start	During		End
7. Specific Conductance (umhos/cm)	610	610	615	610
Temperature (c°)	22	22	22	22
pH (s.u.)	6.8	6.7	6.8	6.8

8. Depth From Top of Well Casing to Bottom of Well 12.5 ft.
9. Screen Length 10.0 ft.
10. Depth to Top of Sediment : Before Development 12.5 ft.; After Development 12.5 ft.
11. Physical Character of Water : REASONABLY CLEAR
12. Type and Size of Well Development Equipment : 2" DIA. COMPRESSED AIR PUMP (QED)
13. Description of Surge Technique, If Used : SURGE BLOCK
14. Height of Well Casing Above Ground Surface : 0 ft.
15. Quantity of Water Removed : 55 Gal. Time for Removal : 2/0 Hr./Min.
16. 1-Liter Water Sample Collected : 1030 (Time)
17. Turbidity in Nephelometric Units 57 NTUs

*Development Conditions : 1) Well Water if Reasonably Clear
2) Sediment Thickness 5% of Screen Length
3) Removal of 5 Well Volumes, Including Saturated Filter Annulus
4) Stabilization of Specific Conductance and Water Temperature

APPENDIX E

PHYSICAL TESTING RESULTS

MONITORING WELLS

OW-102 - 10 feet
OW-103 - 6 feet
OW-104 - 7.5 feet
OW-105 - 10 feet
OW-106 - 12 feet
OW-107 - 9 feet

LAW ENVIRONMENTAL, INC.
112 TOWNPARK DRIVE
KENNESAW, GEORGIA 30144-5599
404-421-3400

PARTICLE SIZE DISTRIBUTION & PHYSICAL PROPERTIES

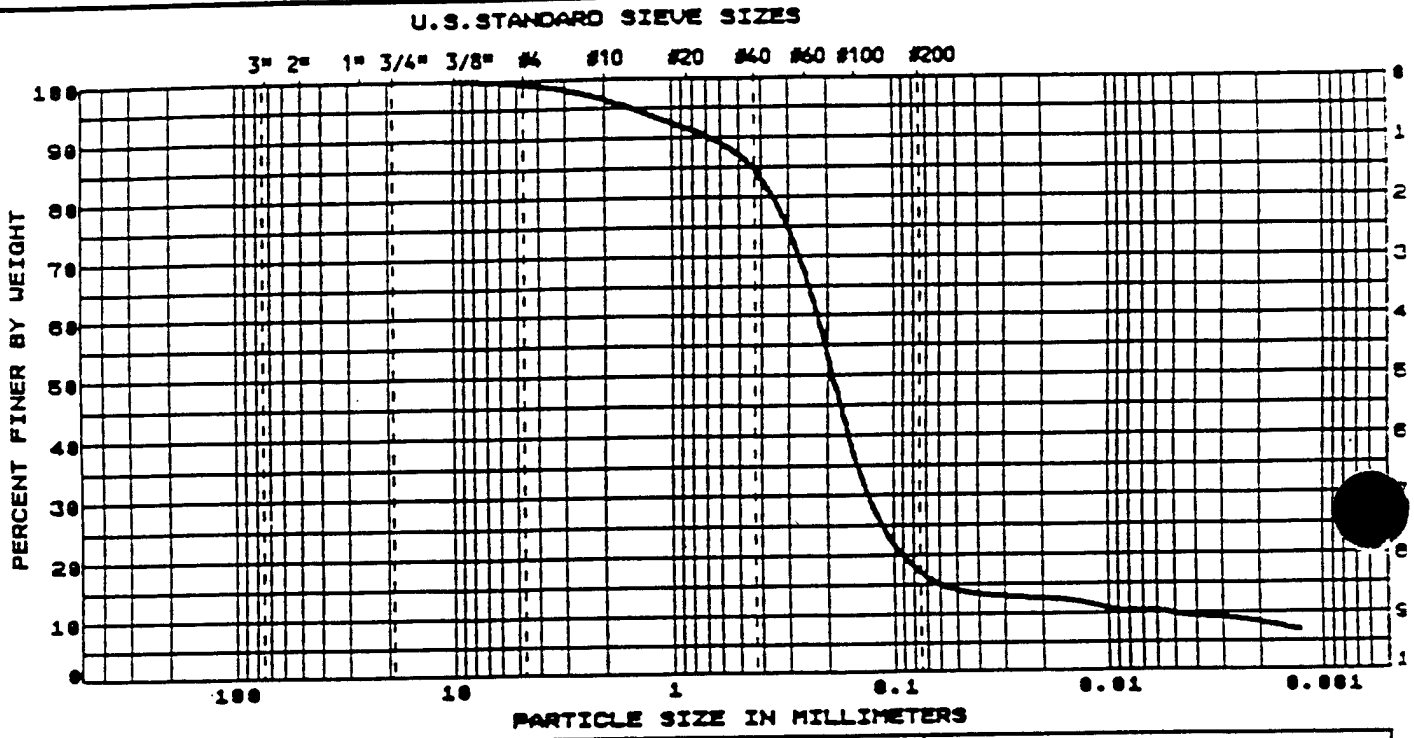
CLIENT Corps of Engineers

JOB NO. 11-8548 Task I81 DATE May 18, 1998

LAB NO. 9919 PAGE 2

PROJECT Langley A.F.B., IRP Site 4 Wells

SAMPLE ID OW-182 18.8'



COBBLES	GRAVEL		SAND			SILT & CLAY
	COARSE	MEDIUM	CO.	MEDIUM	FINE	

U.S. STANDARD SIEVE SIZE		PERCENT PASSING		HYDROMETER
SIEVE NO.	SIEVE SIZE (MILLIMETERS)			PARTICLE DIAMETER (MILLIMETERS)
3"	75			0.050
2"	50		12.5	0.020
1-1/2"	37.5		9.7	0.005
1"	25		7.9	0.002
3/4"	19			0.001
1/2"	12.5			
3/8"	9.5	100.0		
#4	4.75	99.3		
#10	2.00	96.6		
#20	0.850	91.6		
#40	0.425	84.2		
#60	0.250	65.9		
#100	0.150	38.3		
#200	0.075	17.1		

POROSITY (%) _____

EFFECTIVE SIZE (mm) _____

COEFFICIENT OF UNIFORMITY _____

COEFFICIENT OF CURVATURE _____

LIQUID LIMIT NP

PLASTIC LIMIT NP

PLASTICITY INDEX NP

CLASSIFICATION SILTY SAND (SM)

WATER CONTENT (%) 38.4

DRY DENSITY (PCF) _____

SPECIFIC GRAVITY _____

HYDRAULIC CONDUCTIVITY (cm/sec - 20C) _____

TEST PROCEDURES: ASTM D422, D2216

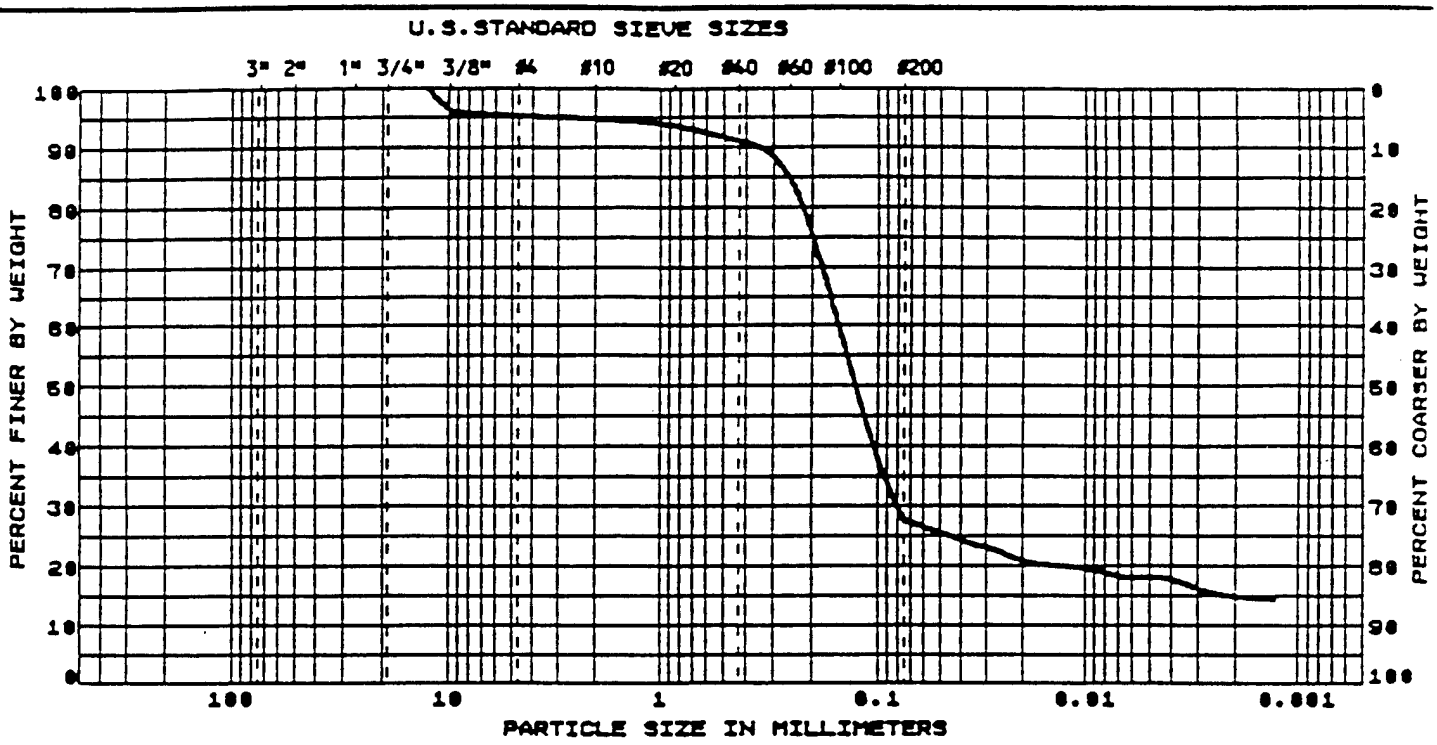
LAW ENVIRONMENTAL, INC.

Jack McCarthy

LAW ENVIRONMENTAL, INC.
112 TOWNPARK DRIVE
KENNESAW, GEORGIA 30144-5599
404-421-3400

PARTICLE SIZE DISTRIBUTION & PHYSICAL PROPERTIES

CLIENT Corps of Engineers
JOB NO. 11-0648 Task I01 DATE May 18, 1990
LAB NO. 9920 PAGE 3
PROJECT Langley A.F.B., IRP Site 4 Wells
SAMPLE ID OW-103 8.0'



COBBLES	GRAVEL		SAND			SILT & CLAY
	COARSE	MEDIUM	CO.	MEDIUM	FINE	

U.S. STANDARD SIEVE SIZE		PERCENT PASSING		HYDROMETER
SIEVE NO.	SIEVE SIZE (MILLIMETERS)			PARTICLE DIAMETER (MILLIMETERS)
3"	75			0.050
2"	50		21.0	0.020
1-1/2"	37.5		18.0	0.005
1"	25		15.3	0.002
3/4"	19			0.001
1/2"	12.5	100.0		
3/8"	9.5	95.9		
#4	4.75	95.4		
#10	2.00	94.8		
#20	0.850	93.7		
#40	0.425	91.0		
#60	0.250	84.3		
#100	0.150	59.6		
#200	0.075	27.6		

POROSITY (%) _____
EFFECTIVE SIZE (mm) _____
COEFFICIENT OF UNIFORMITY _____
COEFFICIENT OF CURVATURE _____
LIQUID LIMIT 35
PLASTIC LIMIT 26
PLASTICITY INDEX 9
CLASSIFICATION SILTY SAND (SM)

WATER CONTENT (%) 26.2
DRY DENSITY (PCF) _____
SPECIFIC GRAVITY _____
HYDRAULIC CONDUCTIVITY (cm/sec - 20C) _____
TEST PROCEDURES: ASTM D422, D2216, D4318

LAW ENVIRONMENTAL, INC.

LAW ENVIRONMENTAL, INC.
112 TOWNPARK DRIVE
KENNESAW, GEORGIA 30144-5599
404-421-3400

PARTICLE SIZE DISTRIBUTION & PHYSICAL PROPERTIES

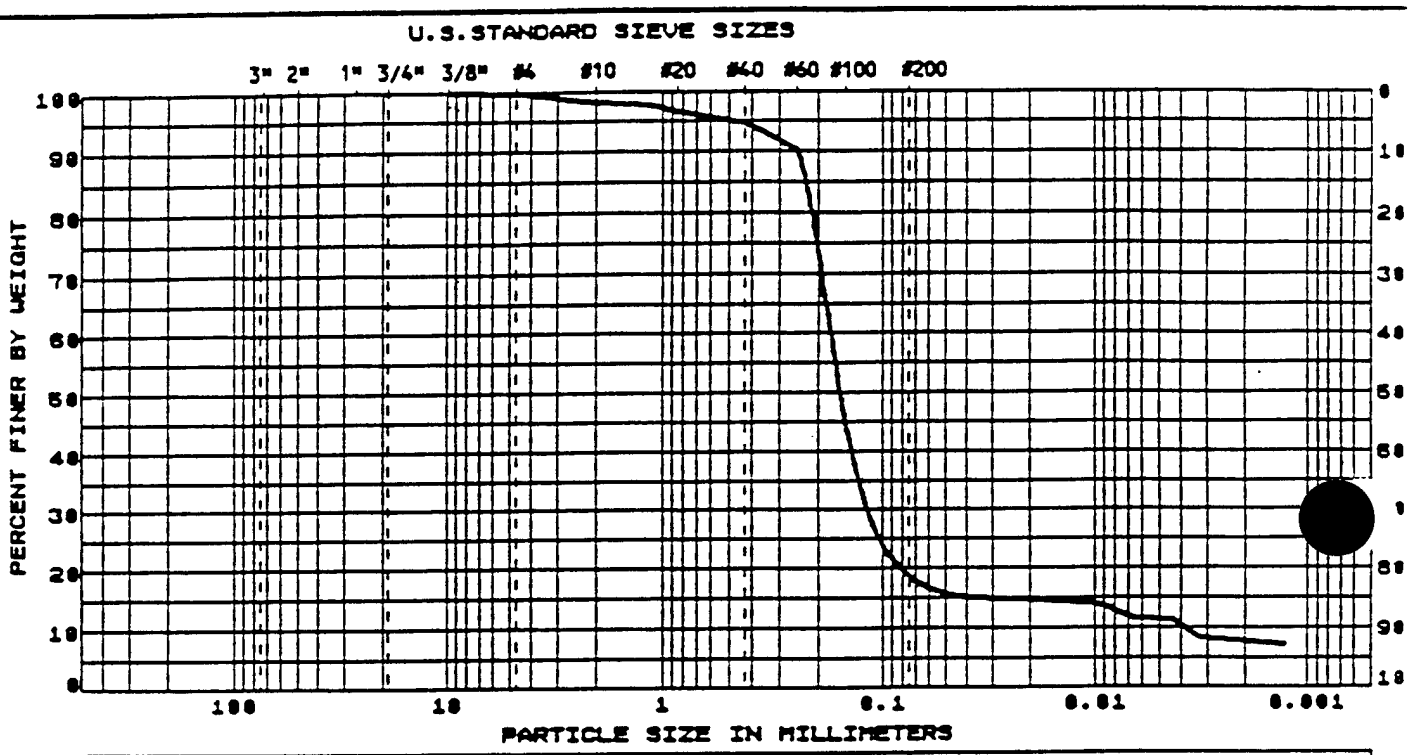
CLIENT Corps of Engineers

JOB NO. 11-0546 Task I01 DATE May 18, 1990

LAB NO. 9921 PAGE 4

PROJECT Langley A.F.B., IRP Site 4 Wells

SAMPLE ID OW-104 7.5'



COBBLES	GRAVEL		SAND			SILT & CLAY
	COARSE	MEDIUM	CO.	MEDIUM	FINE	

U.S. STANDARD SIEVE SIZE		PERCENT PASSING		HYDROMETER
SIEVE NO.	SIEVE SIZE (MILLIMETERS)			PARTICLE DIAMETER (MILLIMETERS)
3"	75			0.050
2"	50		14.6	0.020
1-1/2"	37.5		11.4	0.005
1"	25		7.6	0.002
3/4"	19			0.001
1/2"	12.5			
3/8"	9.5	100.0		
#4	4.75	99.8		
#10	2.00	98.2		
#20	0.850	96.6		
#40	0.425	94.7		
#60	0.250	90.3		
#100	0.150	45.3		
#200	0.075	18.7		

POROSITY (%) _____

EFFECTIVE SIZE (mm) _____

COEFFICIENT OF UNIFORMITY _____

COEFFICIENT OF CURVATURE _____

LIQUID LIMIT NP

PLASTIC LIMIT NP

PLASTICITY INDEX NP

CLASSIFICATION SILTY SAND (SM)

WATER CONTENT (%) 32.6

DRY DENSITY (PCF) _____

SPECIFIC GRAVITY _____

HYDRAULIC CONDUCTIVITY (cm/sec - 20C) _____

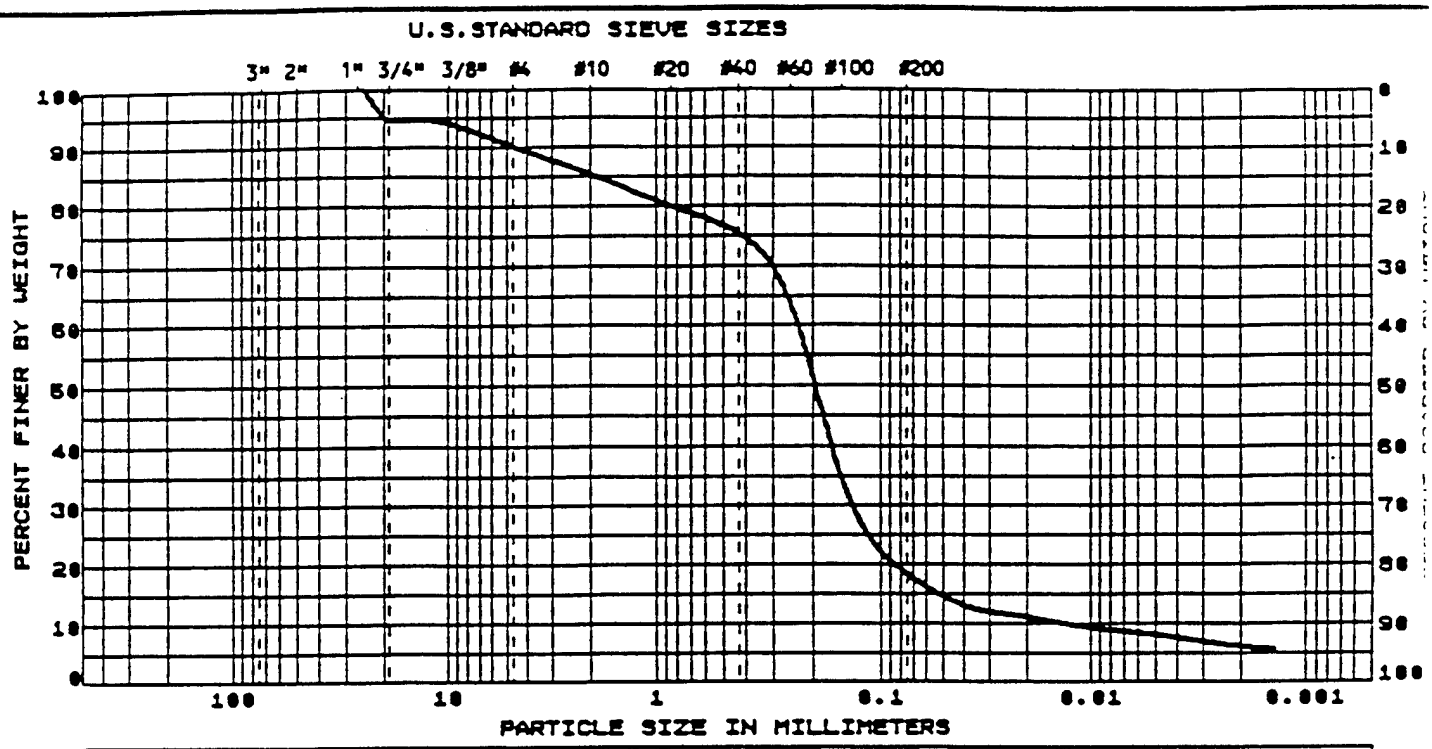
TEST PROCEDURES: ASTM D422, D221[illegible]

LAW ENVIRONMENTAL, INC.

LAW ENVIRONMENTAL, INC.
112 TOWNPARK DRIVE
KENNESAW, GEORGIA 30144-5599
404-421-3400

PARTICLE SIZE DISTRIBUTION & PHYSICAL PROPERTIES

CLIENT Corps of Engineers
JOB NO. 11-8546 Task I81 DATE May 18, 1998
LAB NO. 9923 PAGE 6
PROJECT Langley A.F.B., IRP Site 4 Wells
SAMPLE ID OW-186 12.0'



COBBLES	GRAVEL		SAND			SILT & CLAY
	COARSE	MEDIUM	CO.	MEDIUM	FINE	

U.S. STANDARD SIEVE SIZE		PERCENT PASSING		HYDROMETER
SIEVE NO.	SIEVE SIZE (MILLIMETERS)			PARTICLE DIAMETER (MILLIMETERS)
3"	75			0.050
2"	50		11.8	0.020
1-1/2"	37.5		8.0	0.005
1"	25	100.0	6.2	0.002
3/4"	19	94.6		0.001
1/2"	12.5	94.6		
3/8"	9.5	94.6		
#4	4.75	98.3		
#10	2.00	85.5		
#20	0.850	80.0		
#40	0.425	75.2		
#60	0.250	63.1		
#100	0.150	34.9		
#200	0.075	18.4		

POROSITY (%) _____
EFFECTIVE SIZE (mm) _____
COEFFICIENT OF UNIFORMITY _____
COEFFICIENT OF CURVATURE _____
LIQUID LIMIT 39
PLASTIC LIMIT 28
PLASTICITY INDEX 11
CLASSIFICATION SILTY SAND (SM)

WATER CONTENT (%) 28.7
DRY DENSITY (PCF) _____
SPECIFIC GRAVITY _____
HYDRAULIC CONDUCTIVITY (cm/sec - 20C) _____
TEST PROCEDURES: ASTM D422, D2216, D431

LAW ENVIRONMENTAL, INC.
Jack McCarthy

LAW ENVIRONMENTAL, INC.
112 TOWNPARK DRIVE
KENNESAW, GEORGIA 30144-5599
404-421-3400

PARTICLE SIZE DISTRIBUTION & PHYSICAL PROPERTIES

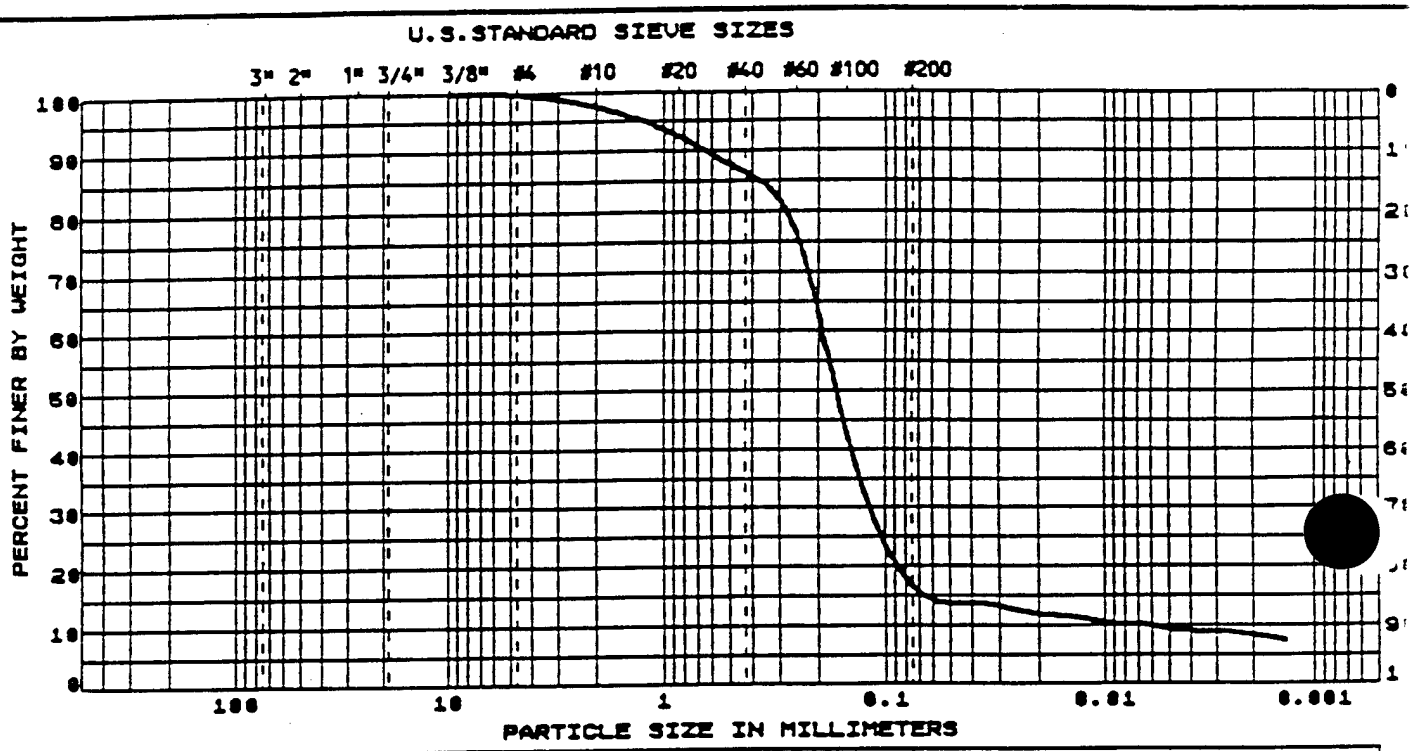
CLIENT Corps of Engineers

JOB NO. 11-6546 Task 101 DATE May 18, 1998

LAB NO. 9924 PAGE 7

PROJECT Langley A.F.B., IRP Site 4 Wells

SAMPLE ID OW-107 9.8'



COBBLES	GRAVEL		SAND			SILT & CLAY
	COARSE	MEDIUM	CO.	MEDIUM	FINE	

U.S. STANDARD SIEVE SIZE		PERCENT PASSING		HYDROMETER
SIEVE NO.	SIEVE SIZE (MILLIMETERS)			PARTICLE DIAMETER (MILLIMETERS)
3"	75			0.050
2"	50		11.9	0.020
1-1/2"	37.5		9.2	0.005
1"	25		8.0	0.002
3/4"	19			0.001
1/2"	12.5			
3/8"	9.5	100.0		
#4	4.75	99.7		
#10	2.00	97.5		
#20	0.850	92.5		
#40	0.425	86.3		
#60	0.250	76.5		
#100	0.150	43.2		
#200	0.075	16.8		

POROSITY (%) _____

EFFECTIVE SIZE (mm) _____

COEFFICIENT OF UNIFORMITY _____

COEFFICIENT OF CURVATURE _____

LIQUID LIMIT NP

PLASTIC LIMIT NP

PLASTICITY INDEX NP

CLASSIFICATION SILTY SAND (SM)

WATER CONTENT (%) 36.2

DRY DENSITY (PCF) _____

SPECIFIC GRAVITY _____

HYDRAULIC CONDUCTIVITY (cm/sec - 20C) _____

TEST PROCEDURES: ASTM D422, D2216, D43

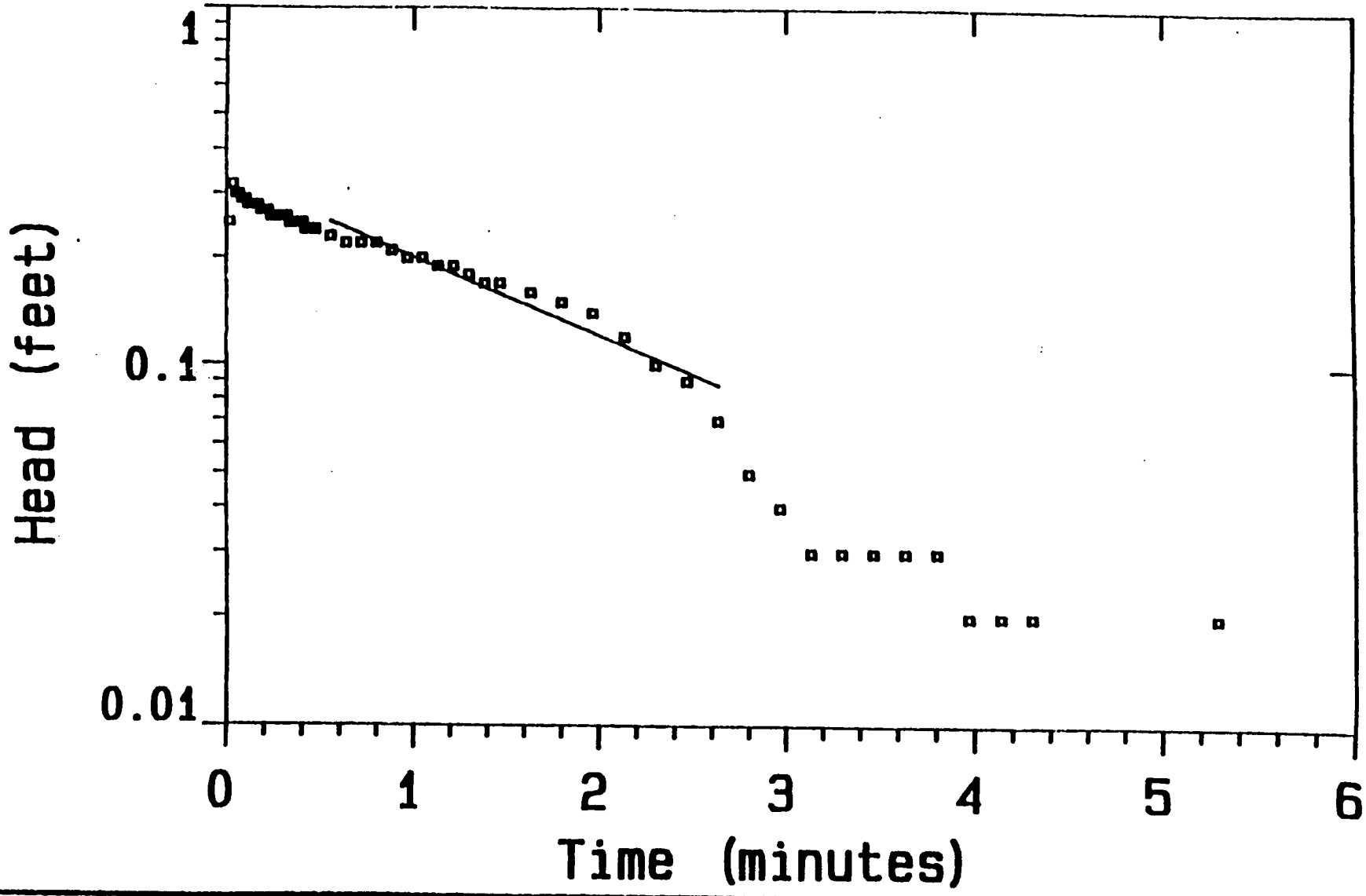
LAW ENVIRONMENTAL, INC.

Jack Ellis Beatty

IRP SITE 4
LANGLEY AIR FORCE BASE, VIRGINIA

SUMMARY OF HYDRAULIC CONDUCTIVITY DATA

Location	Hydraulic Conductivity (ft/min)	
	Slug In	Slug Out
OW-106	0.0006942	0.002154
OW-107	0.0007013	0.0009867



MODEL TYPE: BOUWER and RICE

CONDUCTIVITY: .0006942 ft/min

TRANSMISSIVITY: .6935 sq. ft/min

INITIAL [redacted]: 1.190 ft

for: USACOE

by: Law Environmental Inc.

WELL DATA: Units: ft

AQUIFER: SURFICIAL

THICKNESS: 999.0

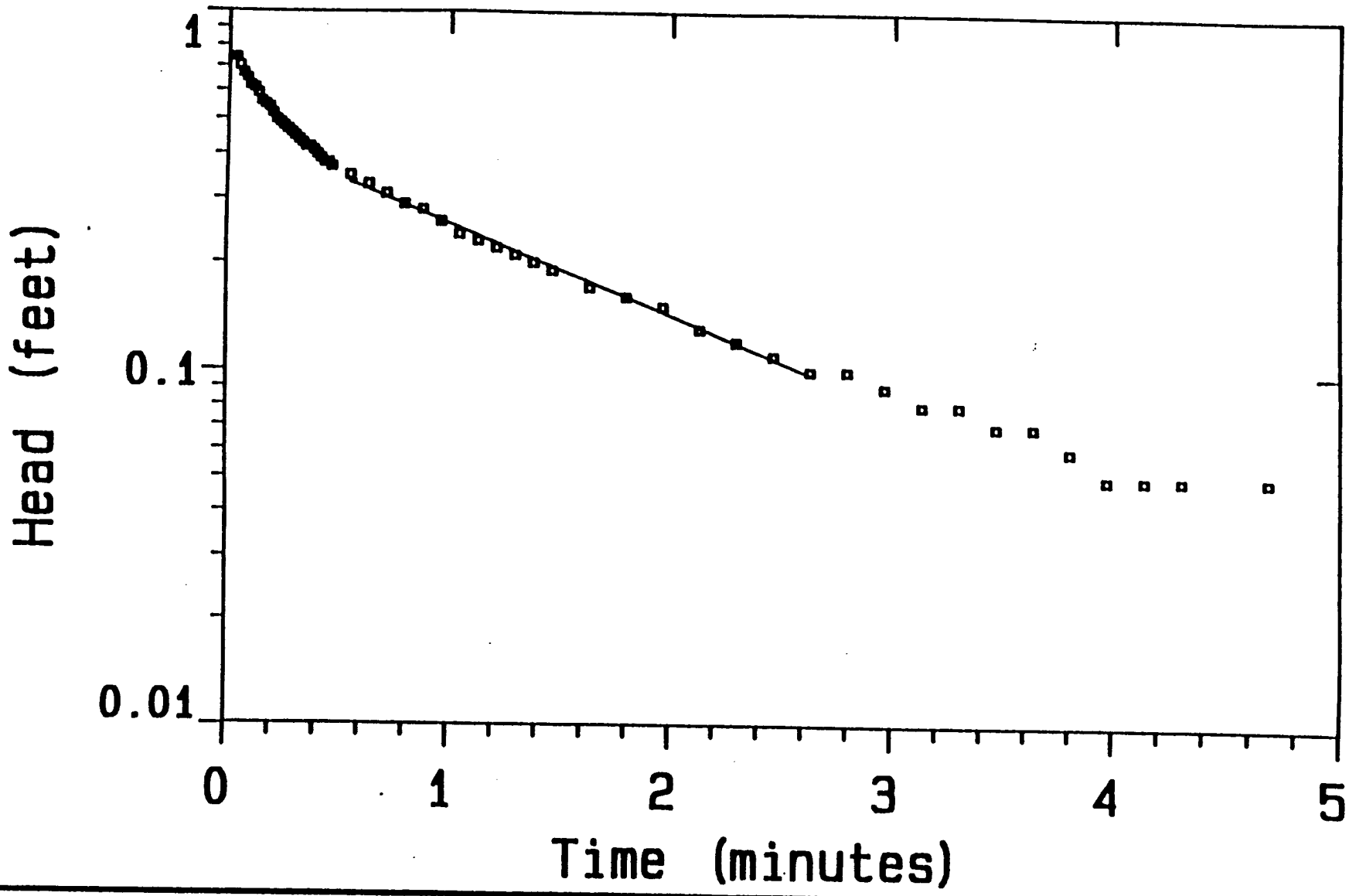
SCREEN: top: 2.50 [redacted]se: 12.50

DIAMETER: casing: [redacted] Intake: [redacted]

SLUG IN TEST DATA

Well: OW106

LANGLE[redacted]



MODEL TYPE: BOUWER and RICE

CONDUCTIVITY: .0007013 ft/min

TRANSMISSIVITY: .7006 sq. ft/min

for: USACOE

by: Law Environmental Inc.

WELL DATA: Units: ft

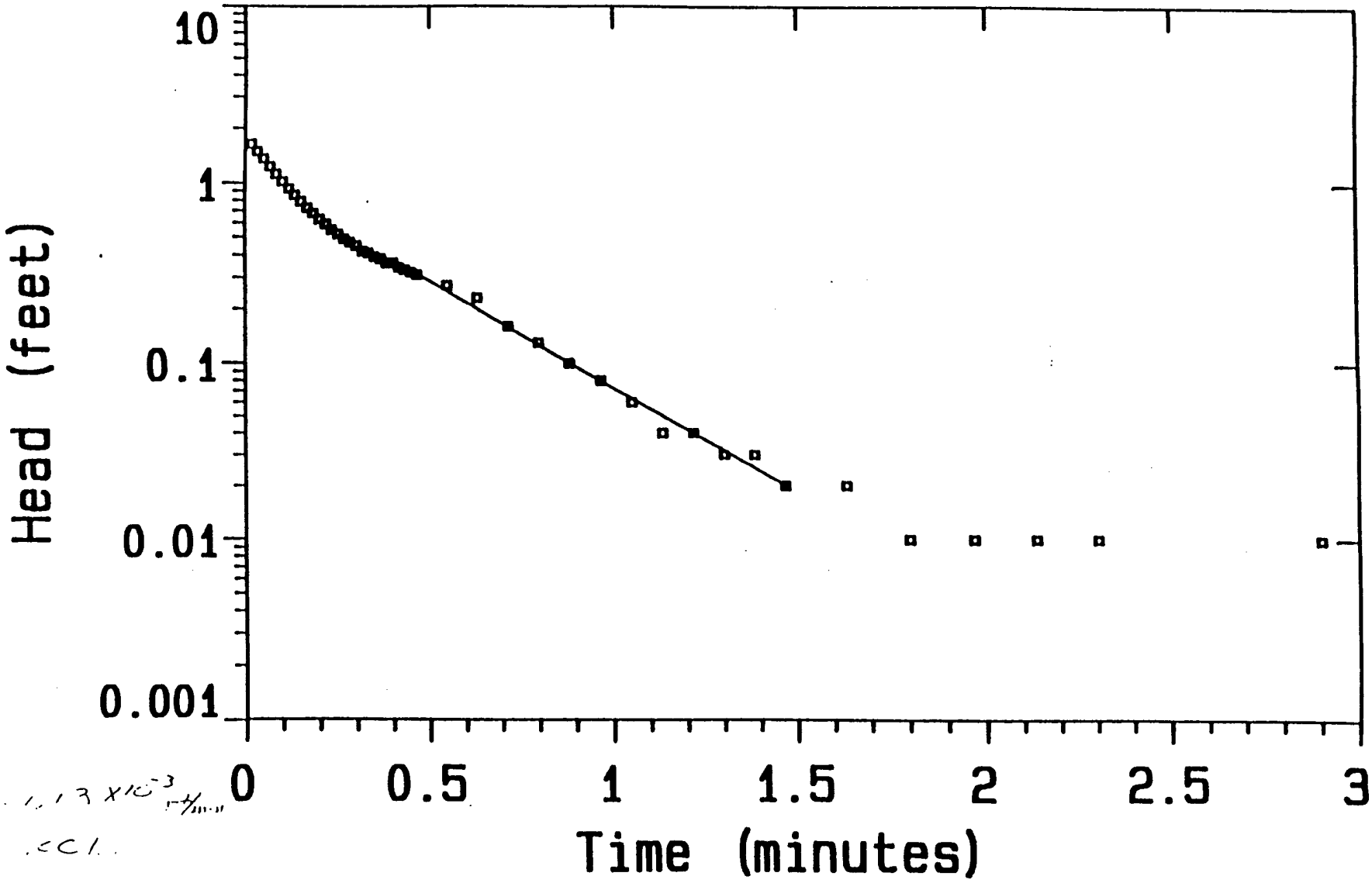
AQUIFER: SURFICIAL

THICKNESS: 999.0

SLUG IN TEST DATA

Well: OW1?7

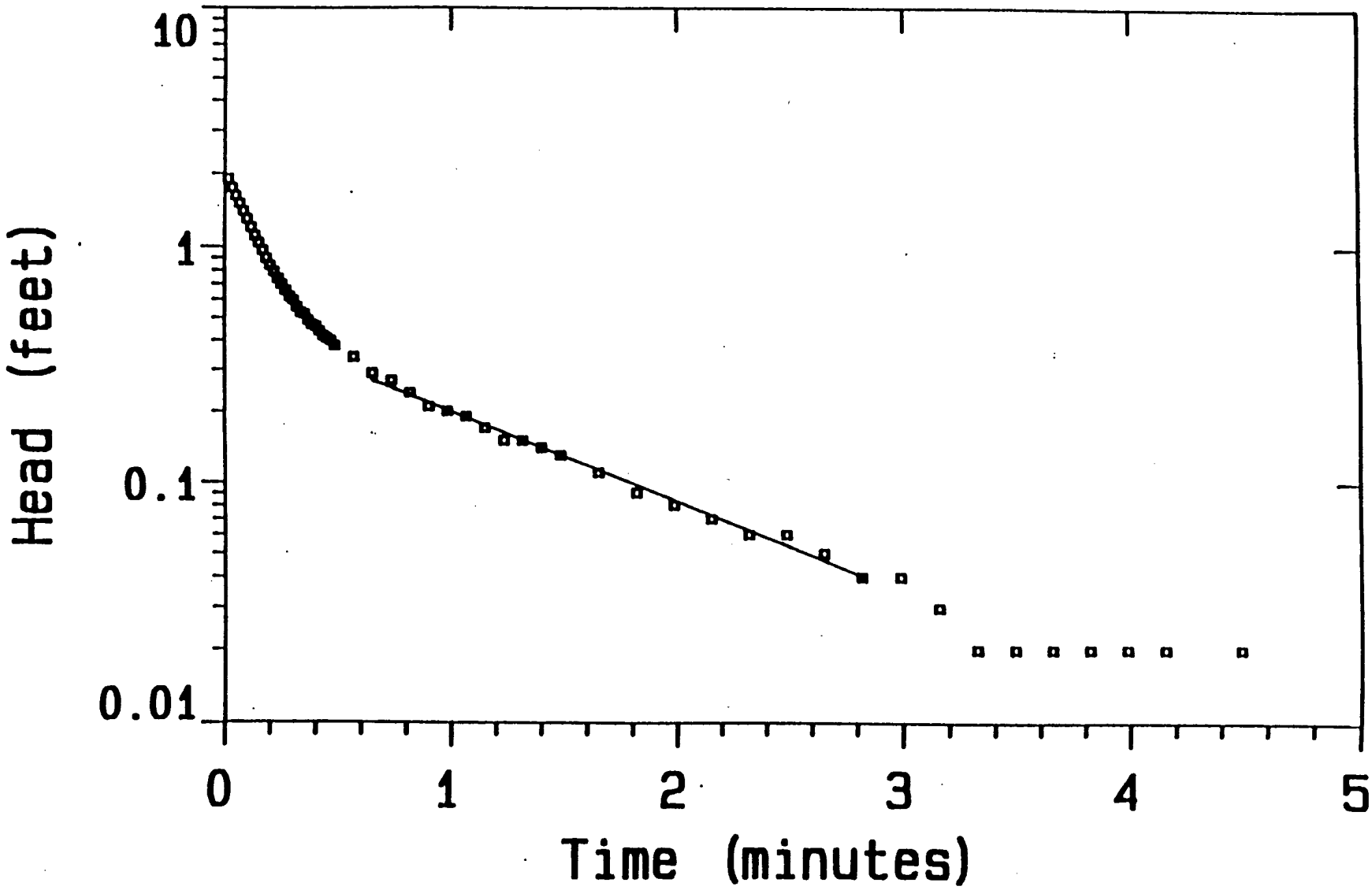
LANGLEY



1.13 X 10^-3 ft/min

.cc/.

MODEL TYPE: BOUWER and RICE	for: USACOE	SLUG OUT TEST DATA
CONDUCTIVITY: .002154 ft/min	by: Law Environmental Inc.	Well: OW106 LANGLEY AFB
TRANSMISSIVITY: 2.152 sq. ft/min	WELL DATA: Units: ft	
INITIAL [illegible]: 1.810 ft	AQUIFER: SURFICIAL	
Data Set: OW106 | Date: 6-JUNE-90	THICKNESS: 999.0	
	SCREEN: top: 2.5[illegible] base: 12.50	
	DIAMETER: casing [illegible]66 intake: .6866	
	DEPTH: Water Table: 4.120 TD: 12.50	



MODEL TYPE: BOUWER and RICE

CONDUCTIVITY: .0009867 ft/min

TRANSMISSIVITY: .9857 sq. ft/min

INITIAL HEAD: 2.160 ft

Data Set: OW107 | Date: 5-JUNE-90

for: USACOE

by: Law Environmental Inc.

WELL DATA: Units: ft

AQUIFER: SURFICIAL

THICKNESS: 999.0

SCREEN: top: 2.500 base: 12.50

DIAMETER: casing: .1666 intake: .6666

DEPTH: Water Table: 4.330 TD: 12.50

SLUG OUT TEST DATA

Well: OW107 LANGLEY AFB

IRP SITE 4
LANGLEY AIR FORCE BASE, VIRGINIA

SUMMARY OF SURVEY DATA

Location	North	East	Elevation (ft)
OW-01	278038.59	2626789.41	8.59
OW-02	278088.434	2626403.406	8.04
OW-03	278503.042	2626284.719	9.19
OW-04	278496.442	2626534.119	9.12
OW-05	278483.592	2626549.543	9.18
OW-06	278512.272	2626515.250	9.10
OW-07	278291.419	2626537.739	8.94
OW-08	278226.482	2626683.583	8.19
OW-09	278512.703	2626979.931	8.53
OW-10	278685.153	2627124.215	8.49
OW-11	278764.840	2627187.124	9.31
OW-12	278717.390	2626370.07	9.30
OW-13	278169.155	2626268.874	9.30
OW-14	278416.691	2626324.123	9.27
OW-15	277990.12	2626460.72	8.06
OW-101	278894.73	2627222.36	8.37
OW-102	278082.13	2626660.75	6.97
OW-103	277899.57	2626477.16	8.29
OW-104	277961.29	2626158.20	8.83
OW-105	278137.93	2625946.64	9.56
OW-106	278574.89	2626740.29	8.92
OW-107	278215.80	2626900.69	8.05

APPENDIX B

FIELD DATA FORMS AND SLUG TEST DATA ANALYSIS

GEOLOGIC BORING LOGS

4MP-1 THROUGH 4MP-23

GEOLOGIC BORING LOG

BORING NO.: Q 4MP-1 CONTRACTOR: Parsons ES DATE SPUD: 10/25 300 pm
CLIENT: AFCEE RIG TYPE: Geoprobe DATE CMPL.: 10/25 445 pm
JOB NO.: 729691.20220 DRLG METHOD: Geoprobe ELEVATION: ~5' msl
LOCATION: Langley BORING DIA.: 2 1/4" TEMP: 70°
GEOLOGIST: R. Nagel DRLG FLUID: none WEATHER: sunny breeze
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pond Res	PID (ppm)	FLV (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1			0-1 top soil								
				1-2 slightly clayey SAND	1	3						
				4-6 Dark brown clayey SAND					8.0			
	5	▼		6-10 Orange SAND	2	6			10.4			
					3	9			17.6			
	10			10-12 Grey clayey sand	4	12						
									24.0			
	15											
	20											
	25											
	30											
	35											

NOTES
bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: R UMP-2 CONTRACTOR: Parsons ES DATE SPUD: 10/26 840am
CLIENT: AFCEE RIG TYPE: Geoprobe DATE CMPL.: " 940am
JOB NO.: 729691.20210 DRLG METHOD: Geoprobe ELEVATION: ~5'
LOCATION: LAngley AFB BORING DIA.: 2¼" TEMP: 60°
GEOLOGIST: RDN DRLG FLUID: — WEATHER: Overcast, humid
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pend Res	PID (ppm)	FLV (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1			0-1 topsoil								
				1-3 very clayey SAND w/intervals of sandy CLAY (light brown)	1	3			48.0			
	5			4-5 orange clayey sandy CLAY w/gray clayey SAND and quartz fragments (¼" to ½" ø)	2	5			7.0			
	10			8-12 orange SAND w/ layers of gray SAND	3	12			19.3			
	15											
	20											
	25											
	30											
	35											

NOTES
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SAMPLE TYPE
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▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: U 4MP-3 CONTRACTOR: PARSONS ES DATE SPUD: 10/26/96 1030
CLIENT: AFCEE RIG TYPE: GEOPROBE DATE CMPL.: 10/26/96 1050
JOB NO.: 729691.20220 DRLG METHOD: GEOPROBE ELEVATION: ~6
LOCATION: LANGLEY AFB BORING DIA.: 2 1/4" TEMP: 65°F
GEOLOGIST: S. RATZLAFF DRLG FLUID: WEATHER: OVERCAST, HUMID
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pond Res	PID(ppm)	FLY(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1			0-2 TOP SOIL W/ MINOR GRAVEL (#57 & SMALLER STONE)				2	25.5			
	5			2-4 CLAY W/ LITTE SAND 1" SAND MED. @ 3', ORANG-BRWN.				4	31.1			
	10			4-6 NO RECOVERY								
				6-8 ORANGE BROWN TO GRAY, 6-7' CLAYEY SAND, ORANGE. 7'-8' GRAY CLAY WITH LITTLE SAND. MOIST				6	25.4			
	15											
				8-10 CLAYEY SILTY SAND, WET. ORANGE.				10	19.3			
	20											
				8-12 FINE SAND W/ MINOR SILT & CLAY ORANGE-BROWN, WET.				12	29.0			
	25											
	30											
	35											

NOTES

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SAMPLE TYPE

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C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: S 4MP-4 | CONTRACTOR: PARSONS ES | DATE SPUD: 10/26/96 1450
CLIENT: AFCEE | RIG TYPE: GEOPROBE | DATE CMPL.: 10/26/96 1515
JOB NO.: 729691 | DRLG METHOD: GEOPROBE | ELEVATION:
LOCATION: SITE 4 | BORING DIA.: 2¼" | TEMP: 70
GEOLOGIST: RATZLAFF | DRLG FLUID: | WEATHER: OVERCAST
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Recd Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1			0-1 TOPSOIL		1			~~10.9~~ → 1.0			
				1-2 CLAY W/ SOME SAND, TRACE GRAVEL, ORANGE-BROWN, DRY		2			10.9			
	5											
				2-3 FINE SAND WITH MINOR CLAY AND TRACE GRAVEL (4-5 mm) MOIST, DARK ORANGE to BROWN.		8			0			
	10											
				10-12 FINE SAND W/ SOME SILT & CLAY, DARK ORANGE, WET		12			45			
	15											
				8-10 FINE SAND W/ SOME SILT, WET, DARK ORANGE.		10			1.8			
	20											
	25											
	30											
	35											

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SAMPLE TYPE
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▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: O 4MP-5 | CONTRACTOR: | DATE SPUD: 10/26/96 1615
CLIENT: AFCEE | RIG TYPE: | DATE CMPL.: 10/26/96 1640
JOB NO.: | DRLG METHOD: | ELEVATION:
LOCATION: | BORING DIA.: | TEMP: 70
GEOLOGIST: J. RATZLAFF | DRLG FLUID: | WEATHER: OVERCAST, HUMID
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pcnd Res	PID(ppm)	FLY(ppm)	TOTAL BTEX(ppm)	TPH (ppm)	
	1			0-1 TOP SOIL									
				1-2 CLAY AND SAND, FINE TRACE GRAVEL, LT. BROWN, DRY		2			172				
	5			2-4 CLAY AND SAND, FINE TRACE GRAVEL (4-5mm) DARK ORANGE TO BROWN, MOIST		4			6,800				
	10			4-6 SILT & CLAY W/ SOME FINE SAND & SHELL FRAGS. PETROLEUM ODOR MED BROWN, MOIST		6			>9,999				SAMPLE 4-6 TO EVERGR
	15			6-8 SILT W/ SHELL FRAGS AND TRACE FINE SAND PETROLEUM ODOR. OLIVE-BROWN, DAMP.		8			72				
	20			8-10 SILT W/ SHELL FRAGS, TRACE F. SAND, WET, OLIVE GRAY, FUEL ODOR		10			20.6				
	25			10-12 SAME AS ABOVE MED. GRAY. FUEL ODOR.		12			30.2				
	30												
	35												

NOTES
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SAMPLE TYPE
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C – CORE
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▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

4MP-SD

GEOLOGIC BORING LOG

BORING NO.: 0 (28') CONTRACTOR: ParsonsES DATE SPUD: 10/28 7:30
CLIENT: AFCEE RIG TYPE: Geoprobe DATE CMPL.: 12:30, 10/28
JOB NO.: 725691.20220 DRLG METHOD: Geoprobe ELEVATION: ~5 msl
LOCATION: Langley BORING DIA.: 2¼" TEMP: ~70° Sunny
GEOLOGIST: RN DRLG FLUID: — WEATHER: Sunny
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pend Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1			follow location 0 point to 12' bls		2						
						4						
	5					6						
						8						
	10					10						
				gray silty SAND		12			63.4			
						14			43.8			
	15					16			70.4			
						18			50.1			
	20					20			402			
						~~22~~			46.0			
						~~24~~			97.2			
	25					26						
						28						
	30											
	35											

NOTES
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SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: 4MP-6 "P" CONTRACTOR: PARSONS ES DATE SPUD: 10/27/96 0720
CLIENT: AFCEE RIG TYPE: GEOPROBE DATE CMPL.: 10/27/96 0745
JOB NO.: 729691.2022 DRLG METHOD: GEOPROBE ELEVATION:
LOCATION: SITE 4, LAFB BORING DIA.: 2¼" TEMP: 65
GEOLOGIST: RATZLAFF DRLG FLUID: WEATHER: OVERCAST, HUMID
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pand Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1			0-1 TOPSOIL W/ GRAVEL AT 1'								
	5			1-2 SILTY SAND, DRY, FINE, DARK TAN		2			31.6			
				2-4 SAND WITH SOME SILT, FINE, DRY, TAN. CLAY AT 4', STIFF TO ~~MOIST~~ MOLDABLE, MOIST, MED BROWN		4			50.8			
	10			4-6 SILT AND CLAY WITH TRACE F. SAND AND GRAVEL, MOIST, MED BROWN		6			41.8			
	15			6-8 FINE SAND W/ SOME SILT, WET, MED BROWN W/ DARK ORANGE.		8			31.7			
	20			8-9 S.A.A.								
				9-10 SILT AND SAND, FINE WITH SHELL FRAGS (1mm), WET, MED. GRAY		10			43.6			
	25			10-12 S.A.A		12			34.9			
	30											
	35											

NOTES
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SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: 4MP-7 "X" CONTRACTOR: PARSONS ES DATE SPUD: 10/27/96 0845
CLIENT: AFCEE RIG TYPE: GEOPROBE DATE CMPL.: 10/27/96 ~~08~~ 09
JOB NO.: 729691.20220 DRLG METHOD: GEOPROBE ELEVATION:
LOCATION: SITE 4, LANGLEY BORING DIA.: 2 ¼" TEMP: 70°F
GEOLOGIST: RATZLAFF DRLG FLUID: WEATHER: OVERCAST, HUMID
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pend Res	PID(ppm)	FLY(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1			0-1 TOP SOIL								
100% REC				1-2 FINE SAND W/SILT, DRY MED BROWN		2			27.2			
	5			2-4 SILT, CLAY, AND F. SAND W/ GRAVEL, ~~DRY~~, MOIST, DARK ORANGE.		4			15.5			
25%												
	10			4-8 F. SAND W/SILT AND LARGE SHELL FRAGS (UP TO 2 CM) GRADING TO SAND, SILT, CLAY W/ MINOR GRAVEL, WET. MED ORANGE.		8			26.7			
	15			8-10 S.A.A.		10			35.3			
	20			10-12 SILT W/ LITTLE F. SAND AND SHELL FRAGS, WET, MED. GRAY.		12			36.0			
	25											
	30											
	35											

NOTES
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SAMPLE TYPE
D – DRIVE
C – CORE
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▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: 4MP-8 "T" | CONTRACTOR: Parsons ES | DATE SPUD: 10/27/96 1015
CLIENT: AFCEE | RIG TYPE: Geoprobe | DATE CMPL.: 10/27/96 1330
JOB NO.: 709691.20220 | DRLG METHOD: Geoprobe | ELEVATION:
LOCATION: Site 4 Langley | BORING DIA.: 2 1/4" | TEMP: 70° F
GEOLOGIST: RDN | DRLG FLUID: — | WEATHER: Humid overcast
COMENTS:

Elev (ft)	Depth (ft)	Profile	USCS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pend Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1			0-1 Topsoil								
90%				1-3 #57 stone + smaller		2	2		0.0			
				3-4 Tan clay w/pebbles		4	4		1.8			
50%	5			4-5 Gray sand w/pebbles								
				5-8 Orange clayey SAND w/ sandy CLAY Layers		6	6		8.4			
						8	8		12.4			
80%	10					10			0.0			
				9-14 orange slightly CLAYEY Sand		12			0.0			
100%				14-16 gray Sand, FINE AND SOME SILT WITH SHELL FRAGS (1mm), WET		14			—			
	15											
						16			0.0			
100%				17-19 SAA		19			0.5			
	20			19-21 S.A.A.		21			0.0			
100%												
100%				21-23 S.A.A. (No ODOR)		23			316			
100%				23-25 SAA. GRADING TO SHELL FRAGS (UP TO 1 cm) AND SILT, GREY, WET.		25			14.8			
	25											
50%												
				25-27 SILT AND SHELL FRAGS, GREY GRADING TO FINE SAND WITH SILT, GRAY, WET.		27			14.9			
	30											
	35											

NOTES
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SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

4mp-9

GEOLOGIC BORING LOG

BORING NO.: J | CONTRACTOR: Parsons ES | DATE SPUD: 10/28 420
CLIENT: AFCEE | RIG TYPE: Geoprobe | DATE CMPL.: 10/29 450
JOB NO.: 729691.20220 | DRLG METHOD: Geoprobe | ELEVATION: ~5' msl
LOCATION: LANGLEY AFB | BORING DIA.: 2 1/4" | TEMP: 75
GEOLOGIST: RDN | DRLG FLUID: — | WEATHER: Sunny
COMENTS: We spelled comments wrong

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Paint Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
80%	1			0-0.5 Topsoil								
				0.5-7 sandy silty clay		2			31.8			
						4			11.8			
	5					6			22.9			
75%				7-8 orange sandy silty clay w/ shell fragments		8			27.8			
80%	10					10			23.2			
				8-12 gray SAND w/ heavy shell fragments		12			2.0			
	15											
	20											
	25											
	30											
	35											

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SAMPLE TYPE
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▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

4MP-10

GEOLOGIC BORING LOG

BORING NO.: 4 A
CLIENT: AFCEE
JOB NO.: 729691.20220
LOCATION: Langley AFB
GEOLOGIST: RDN
COMENTS: No petroleum odors

CONTRACTOR: Parsons ES
RIG TYPE: Geoprobe
DRLG METHOD: Geoprobe
BORING DIA.: 2¼"
DRLG FLUID: —

DATE SPUD: 10/28 715 AM
DATE CMPL.: 10/28 800 AM
ELEVATION:
TEMP: 70°
WEATHER: Sunny

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pend Res	PID(ppm)	FLY(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	0			0-0.5 Topsoil								
	1			0.5-3.5 Brown Clayey sand		2			44.2			
						4			27.5			
	5			3.5-8 Orange silty Sand		6			14.2			
						8			20.6			
	10			8-12 Gray SAND w/shell fragments		10			9.9			
						12			51.6			
	15											
	20											
	25											
	30											
	35											

NOTES
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GS – Ground Surface
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SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: K 4mp-11 CONTRACTOR: Parsons ES DATE SPUD: 10/28 ~~9~~ 3:45 pm
CLIENT: AFCEE RIG TYPE: Geoprobe DATE CMPL.: 10/29 935
JOB NO.: 729691.02.20 DRLG METHOD: Geoprobe ELEVATION: ~5' msl
LOCATION: Langley AFB BORING DIA.: 2¼ TEMP: 75°
GEOLOGIST: RDN DRLG FLUID: — WEATHER: sunny
COMENTS: restart 900 10/29

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pocket Pen Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
15	1			0-1 top soil								
				1-4 silty sandy CLAY orange			2		31.0			
							4		23.9			
10	5			4-5 sandy silty CLAY								
				5-6 orange clayey SAND			6		36.5			
				6-9 Orange and gray silty SAND w/ shell fragments			8		46.0			
10	10						10		49.7			
				9-12 gray SAND w/shell fragments			12		58.7			
	15											
	20											
	25											
	30											
	35											

NOTES
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SAMPLE TYPE
D – DRIVE
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G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: I 4MW-12M
CLIENT: AFCEE
JOB NO.: 729691.76220
LOCATION:
GEOLOGIST: RDN
COMENTS: Petroleum odor

CONTRACTOR: Parsons
RIG TYPE: Geoprobe
DRLG METHOD: Geoprobe
BORING DIA.: 2¼"
DRLG FLUID: —

DATE SPUD: 10/25/96 1300
DATE CMPL:
ELEVATION: —
TEMP: 65°F
WEATHER: Sunny

Elev (ft)	Depth (ft)	Profile	USCS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pend Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
75%	1			0-0.5 Topsoil		2						
				0.5-5 brown sandy SILT		4			15.0			
	5								34.4			
50%				5-7 brown sandy CLAY w/shell fragments		6			54.1			
						8			25.5			
80%	10			7-8 ~~Gray~~ Shell fragments w/ orange silty SAND		10			7.0			
						12			13.3			
				9- Gray silty SAND w/shell frag.		14			18.1			
	15					16			26.7			
						18			42.4			
	20					20						
						22						
						24						
	25					26						
						28						
	30					30						
						32						
						34						
	35											

NOTES
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SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: 4 4MP-13 CONTRACTOR: Parsons ES DATE SPUD: 10/29 600 am
CLIENT: AFCEE RIG TYPE: Geoprobe DATE CMPL.: 10/29 640
JOB NO.: 729[illegible].820220 DRLG METHOD: Geoprobe ELEVATION:
LOCATION: Langley AFB BORING DIA.: 2 1/4" TEMP: 55°
GEOLOGIST: RDN DRLG FLUID: - WEATHER: ~~Sunny~~ Clear
COMENTS: No petroleum odors

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Panel Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
80 0/1	1			0-1 Topsoil								
				1-8 Orange silty SAND		2			57.7			
						4			60.8			
	5											
80 0/4						6			51.8			
						8			56.6			
100 0/1	10			8-12 Gray SAND w/shell fragments		10			51.2			
						12			55.7			
	15											
	20											
	25											
	30											
	35											

NOTES
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SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: D1 4mp-145 CONTRACTOR: Parsons ES DATE SPUD: 10/30/96
CLIENT: AFCEE RIG TYPE: Geoprobe DATE CMPL.: 10/30/96
JOB NO.: 729691.20220 DRLG METHOD: Geoprobe ELEVATION: —
LOCATION: Langley AFB BORING DIA.: 2¼" TEMP: 81° F
GEOLOGIST: RDSJ DRLG FLUID: — WEATHER: Windy, sunny
COMENTS:

Elev (ft)	Depth (ft)	Profile	USCS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pcnd Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
60	1			0-0.5 Topsoil								
				0.5-1.5 tan silty SAND w/ shells		2			47.3			
				~~1.5-2~~		4			>1999			
15	5			1.5-7 Gray silty CLAY tight ODOR!		6		~2	8500			
						8		~	3500			
		▼										
100	10			7-8 Tan-orange ~~silty SA~~ sandy silt w/shells		10		~	2000			
						12			63.7			
	15			8-12 Gray SAND w/shells								
	20											
	25											
	30											
	35											

NOTES
bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: H 4MP-15 | CONTRACTOR: Parsons ES | DATE SPUD: 10/31/96
CLIENT: AFCEE | RIG TYPE: Geoprobe | DATE CMPL.: 10/31/96
JOB NO.: 729691.20220 | DRLG METHOD: Geoprobe | ELEVATION: —
LOCATION: Langley AFB RDN | BORING DIA.: 2¼" | TEMP: 60°
GEOLOGIST: — | DRLG FLUID: — | WEATHER: Clear, breeze
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pond Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	1			0-2 brown silty SAND w/ rocks		2		~	4000			
				2-5 Stained silty SAND (Petroleum odor)		4		>	9999			
	5					6		>	9999			
				5-7 sandy silty CLAY		8		~	9200			
				7-11 silty sand w/ shell frags		10		~	8700			
	10					12			520			
				11-16 Gray sand		14			705			
	15					16			225			
				Could obtain any further samples		18						
	20			Preprobed down to 18'bls.		20						
						22						
						24						
	25					26						
						28						
	30											
	35											

NOTES
bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: GMP-16 | CONTRACTOR: PARSONS ES | DATE SPUD: 10/31/96
CLIENT: AFCEE | RIG TYPE: Geoprobe | DATE CMPL.: 10/31/96
JOB NO.: 729691.20220 | DRLG METHOD: Geoprobe | ELEVATION: —
LOCATION: Langley AFB | BORING DIA.: 2¼" | TEMP: ~~Sunny~~ 70°
GEOLOGIST: RDN | DRLG FLUID: — | WEATHER: Sunny
COMENTS:

Elev (ft)	Depth (ft)	Profile	USCS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Head Res	PID(ppm)	FLY(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
80%	1			0.5-0 topsoil								
				0.5-3 Brown sandy silt w/shell fragments		2		RN	2106	105		
	5			3-5 Stained gray very sand clay		4		~	2100			
60%						6		>	9999			
				5-8 Gray clayey sand		8		>	9999			
80%	10					10			265			
				8-13 Gray silty sand		12		>	9999			
90%						14			824			
	15			13-16 Grey silty sand w/shell fragments		16			573			
				Couldnt obtain deeper samples								
	20											
	25											
	30											
	35											

NOTES
bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

4MP-17

GEOLOGIC BORING LOG

BORING NO.: DW W | CONTRACTOR: Parsons | DATE SPUD: 10/31/96
CLIENT: AFCEE | RIG TYPE: Geoprobe | DATE CMPL.:
JOB NO.: 729691.2022 | DRLG METHOD: Geoprobe | ELEVATION: —
LOCATION: Langley AFB | BORING DIA.: 2¼ | TEMP: 70°
GEOLOGIST: RDN | DRLG FLUID: — | WEATHER: Sunny, breeze
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pond Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
	0											
90%	1			0-0.5 Topsoil								
				0.5-3 Dark brown silty SAND		2			55			
						4			64			
	5			3-6 Orange and Gray silty CLAY very sandy		6			124			
50%						8			101			
				6-11 ~~Gray and~~ orange silty SAND w/ shell fragments		10			71			
70%	10					12			17.2			
				11-12 Gray sand w/ shell fragments								
	15											
	20											
	25											
	30											
	35											

NOTES
bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: V 4MP-20 CONTRACTOR: Parsons DATE SPUD: 11/6/96
CLIENT: AFCEE RIG TYPE: Geo[redacted] DATE CMPL.: 11/7/96
JOB NO.: 729691.20220 DRLG METHOD: G[redacted] ELEVATION: —
LOCATION: Langley AFB BORING DIA.: [redacted] TEMP:
GEOLOGIST: RDN DRLG FLUID: — WEATHER:
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pcnd Res	PID(ppm)	FLY(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
60%	1			0-0.5 Topsoil and gray								
				0.5-7 Tan ~~silty stiff~~ very sandy clay		2			60.3			
						4			63.4			
80%	5			7-11 Tan-orange silty sand		6			81.0			
						8			72.0			
100%	10			11-12 Gray sand		10			50.2			
						12			23.4			
	15											
	20											
	25											
	30											
	35											

NOTES

bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE

D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS
ENGINEERING SCIENCE, INC.
Denver, Colorado

GEOLOGIC BORING LOG

BORING NO.: C 4MP-21 CONTRACTOR: Parsons ES DATE SPUD: 11/1/96
CLIENT: AFCEE RIG TYPE: Geoprobe DATE CMPL.: 11/1/96
JOB NO.: 729691.20220 DRLG METHOD: Geoprobe ELEVATION: —
LOCATION: Langley AFB BORING DIA.: 2¼" TEMP: 70°
GEOLOGIST: RN DRLG FLUID: — WEATHER: Overcast
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Pocket Pen Res	PID (ppm)	FLY (ppm)	TOTAL BTEX (ppm)	TPH (ppm)
75%	1			0-0.5 Top soil								
				0.5-7 sandy silty CLAY (Gray)		2			250			
	5			0.5-1.5 CLAYEY SILT (Gray)		4		>	9999			
100%						6		>	9999			
				7-9 brown silty sand w/shell frags stained gray		8		>	9999			
100%	10					10			330			
						12			650			
100%				9-18 gray sand w/shell frags		14			400			
	15					16			190			
						18			175			
	20					20						
				#4-		22						
				Heavy product green liquid leaching from gray stained soil		24						
	25					26						
						28						
	30			Couldn't sample due to sloughing of sand and cracking liners								
	35											

NOTES
bgs – Below Ground Surface
GS – Ground Surface
TOC – Top of Casing
NS – Not Sampled
SAA – Same As Above

SAMPLE TYPE
D – DRIVE
C – CORE
G – GRAB

▼ Water level drilled

FIGURE 3.3

GEOLOGIC BORING LOG

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

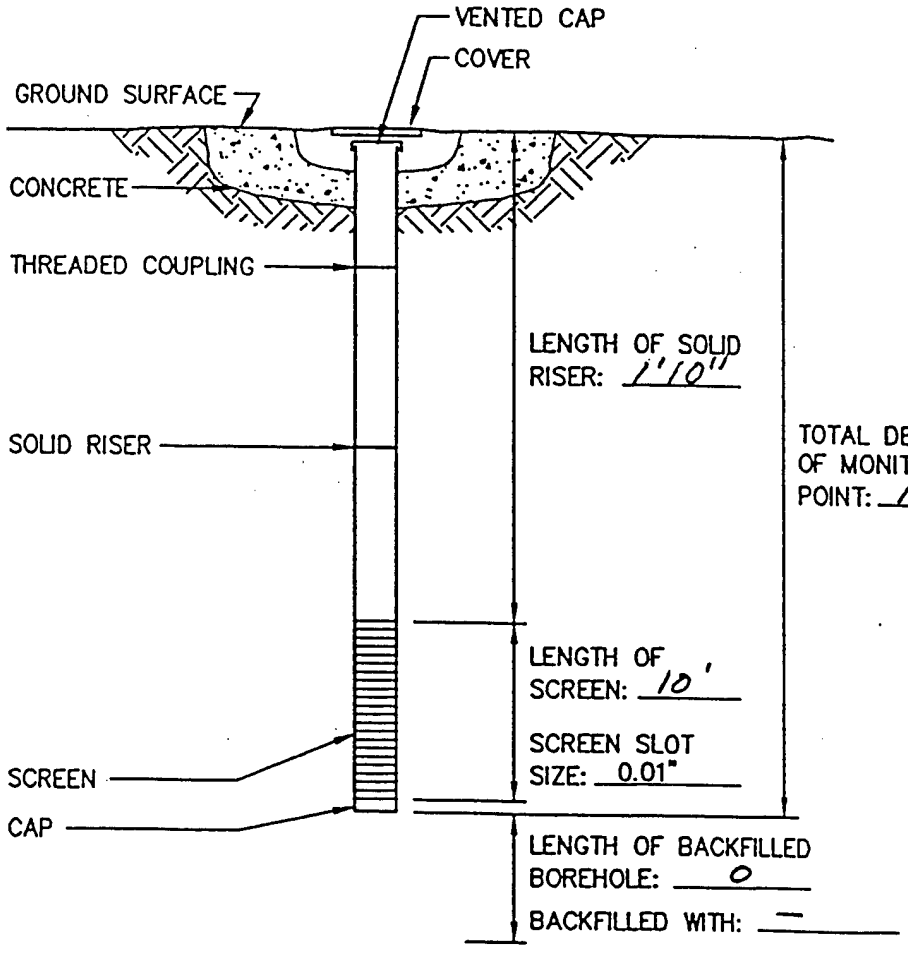
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORDS

4MP-1 THROUGH 4MP-23

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER Q14MP-1
JOB NUMBER 729691.20220 INSTALLATION DATE 10-25-96 LOCATION
DATUM ELEVATION GROUND SURFACE ELEVATION
DATUM FOR WATER LEVEL MEASUREMENT top of casing
SCREEN DIAMETER & MATERIAL 0.75" / PVC SLOT SIZE 0.10
RISER DIAMETER & MATERIAL 0.75/PVC BOREHOLE DIAMETER 2¼"
ES REPRESENTATIVE RDN



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

* #1 sand placed in annulus up to ground surface prior to grouting

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER R(4MP-2)

JOB NUMBER 729691.20220 INSTALLATION DATE 10/26 LOCATION

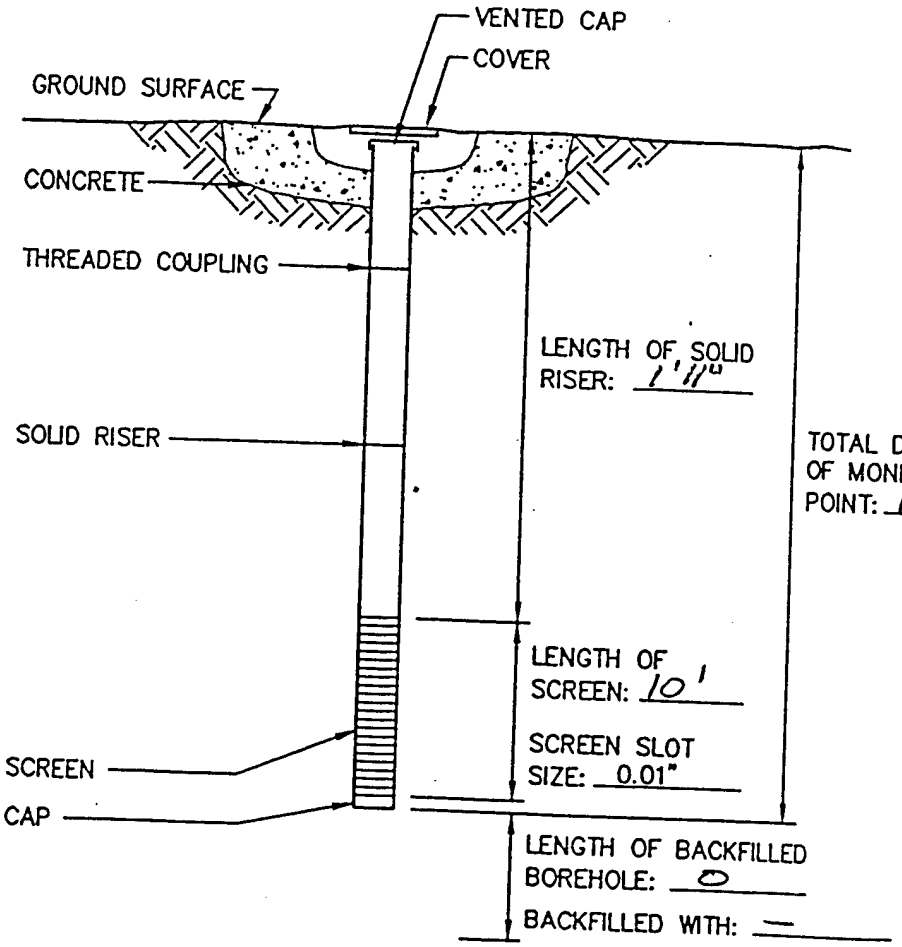
DATUM ELEVATION GROUND SURFACE ELEVATION

DATUM FOR WATER LEVEL MEASUREMENT TOC

SCREEN DIAMETER & MATERIAL 3/4" PVC SLOT SIZE 0.10

RISER DIAMETER & MATERIAL 3/4" PVC BOREHOLE DIAMETER 2.25"

ES REPRESENTATIVE RN



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER U 4MP-3

JOB NUMBER 729691.20220 INSTALLATION DATE 10/26/96 LOCATION

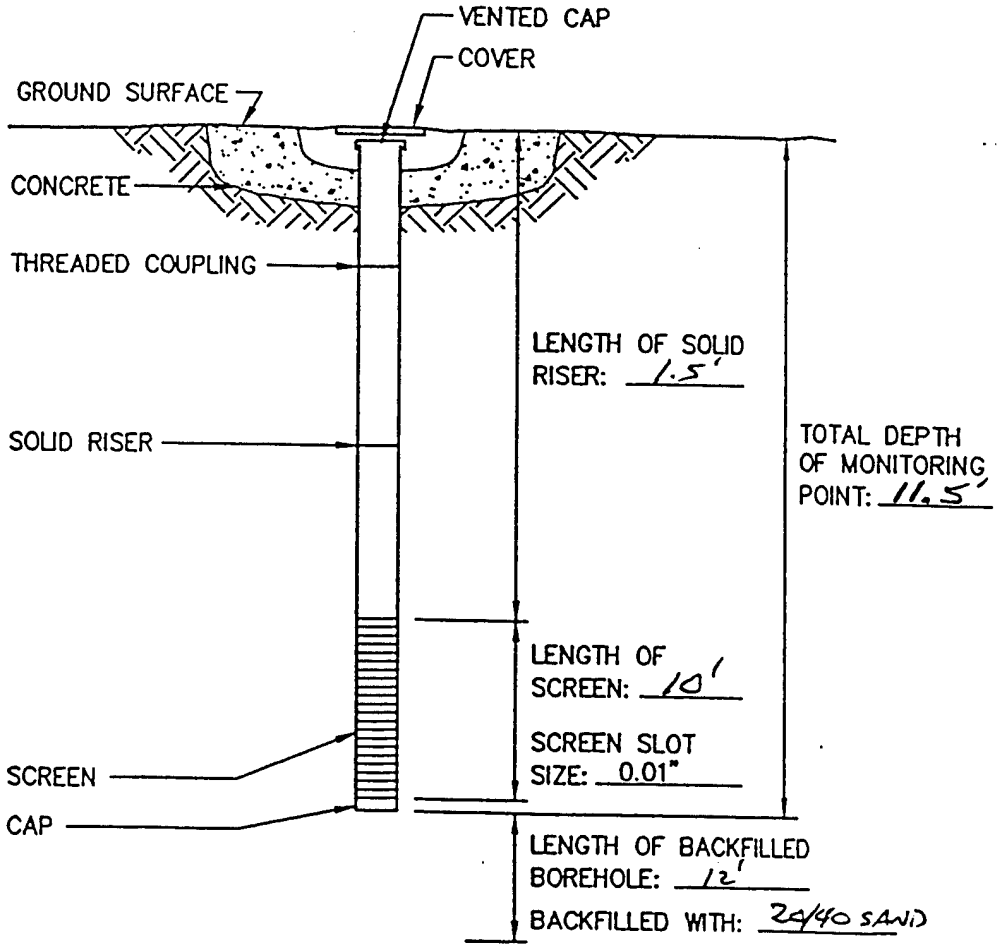
DATUM ELEVATION GROUND SURFACE ELEVATION

DATUM FOR WATER LEVEL MEASUREMENT TOC

SCREEN DIAMETER & MATERIAL 3/4" SCH 40 PVC SLOT SIZE 0.01"

RISER DIAMETER & MATERIAL 3/4" SCH 40 PVC BOREHOLE DIAMETER 2 1/4"

ES REPRESENTATIVE RATZLAFF



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER S MP-4

JOB NUMBER 729691.20220 INSTALLATION DATE 10/26/96 LOCATION SITE 4

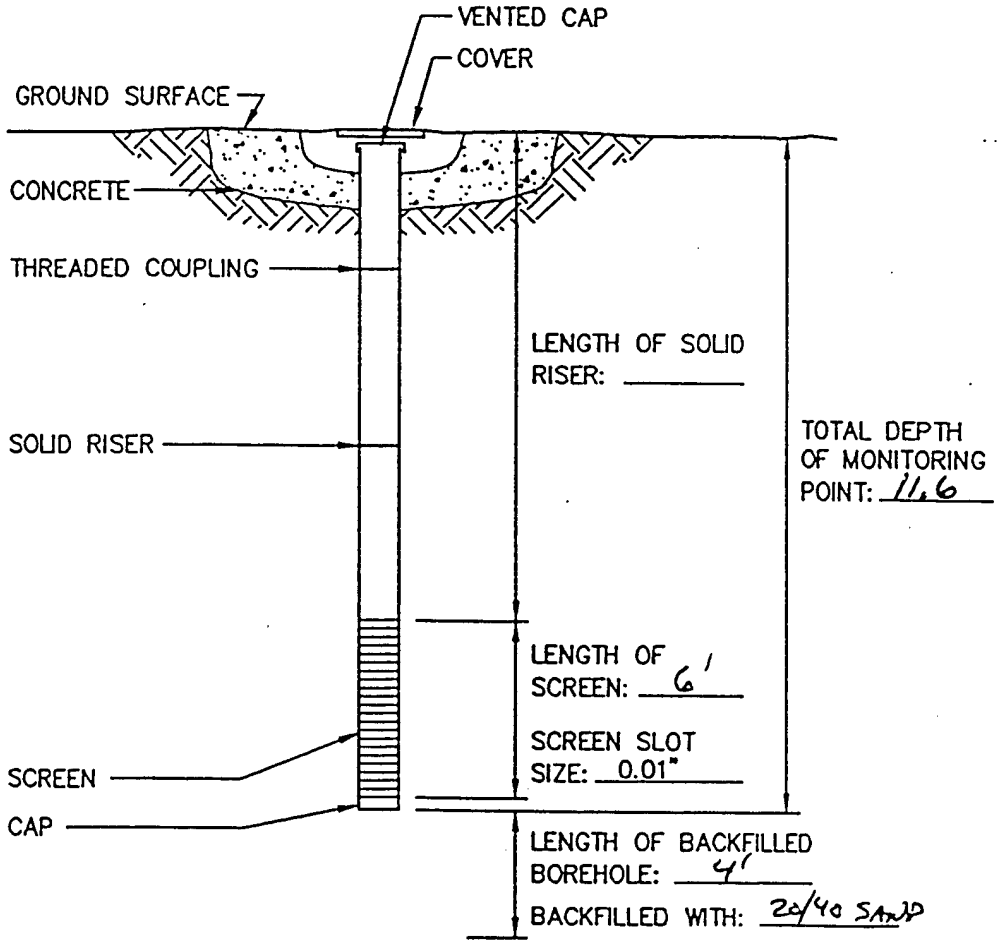
DATUM ELEVATION _____ GROUND SURFACE ELEVATION _____

DATUM FOR WATER LEVEL MEASUREMENT TOC

SCREEN DIAMETER & MATERIAL ½" ID 1¼" OD PRE PACKED SCREEN SLOT SIZE 0.01"

RISER DIAMETER & MATERIAL ½" ID SCH 40 PVC BOREHOLE DIAMETER 2¼"

ES REPRESENTATIVE RATZLAFF



(NOT TO SCALE)

STABILIZED WATER LEVEL 6.1 TEMP TOC FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER 01 4MP-5S

JOB NUMBER 729691.20220 INSTALLATION DATE 10/26/96 LOCATION

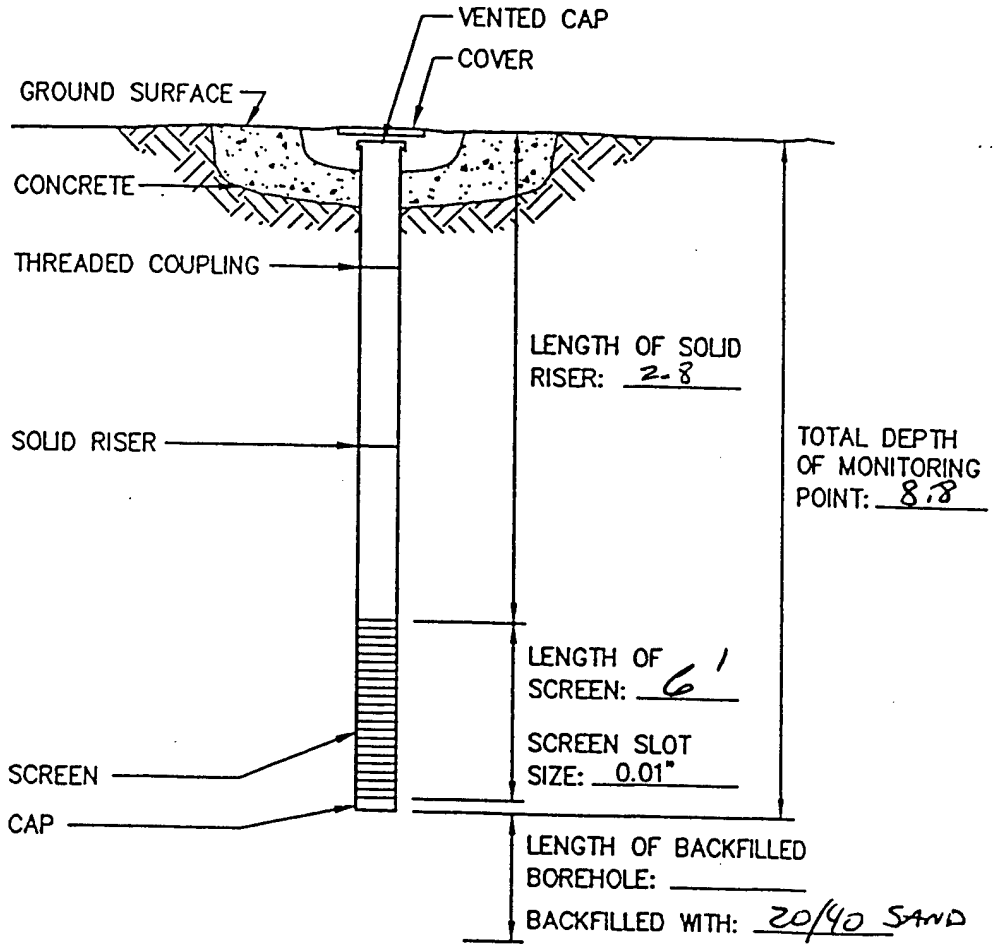
DATUM ELEVATION GROUND SURFACE ELEVATION

DATUM FOR WATER LEVEL MEASUREMENT

SCREEN DIAMETER & MATERIAL $\frac{1}{2}$" ID 1$\frac{1}{2}$" OD PREPACKED SLOT SIZE 0.01"

RISER DIAMETER & MATERIAL $\frac{1}{2}$" ID SCH 40 BOREHOLE DIAMETER 2$\frac{1}{4}$"

ES REPRESENTATIVE RATZLAFF



(NOT TO SCALE)

STABILIZED WATER LEVEL 4.4 BGS FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 8.8 FEET BELOW DATUM.

GROUND SURFACE FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

MMP-5D

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER 02 (17')

JOB NUMBER 729691.20220 INSTALLATION DATE 10/28 LOCATION

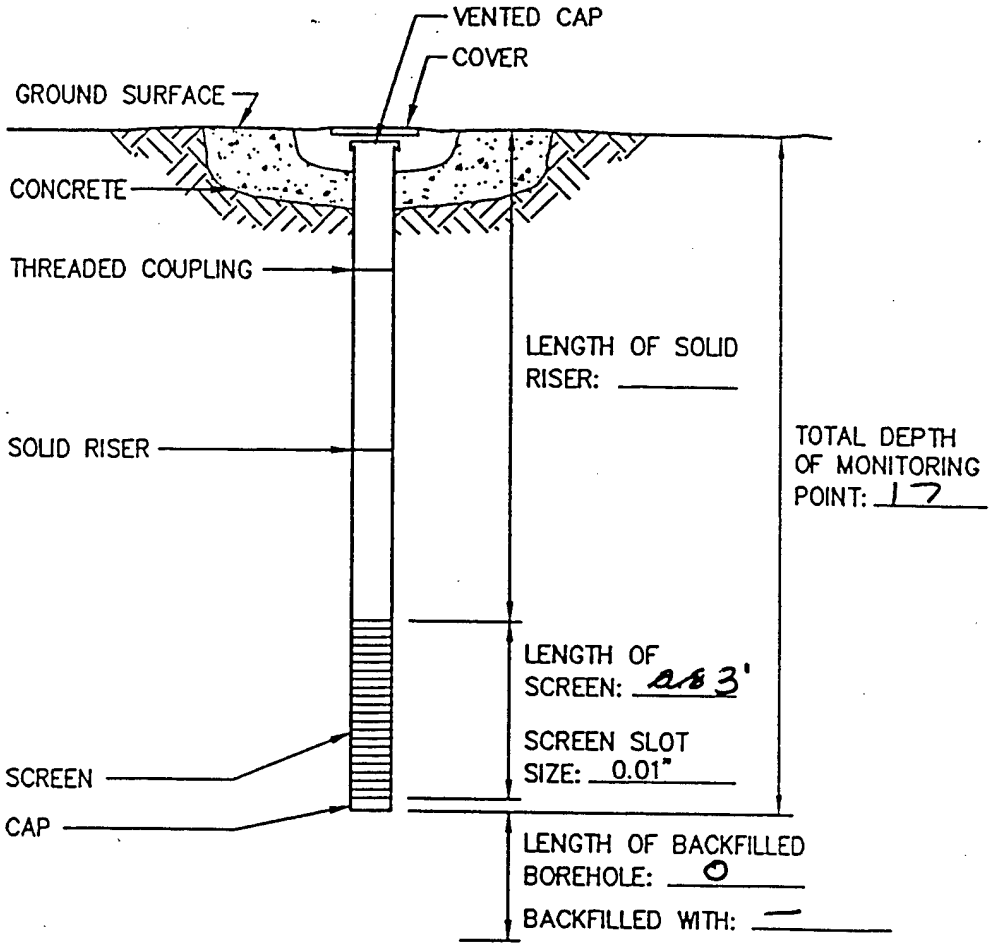
DATUM ELEVATION GROUND SURFACE ELEVATION

DATUM FOR WATER LEVEL MEASUREMENT TOC

SCREEN DIAMETER & MATERIAL Stainless Steel 0.5" prepacked SLOT SIZE 0.10

RISER DIAMETER & MATERIAL PVC 0.5" BOREHOLE DIAMETER 2¼"

ES REPRESENTATIVE RDN



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER 4MP-6 "P"

JOB NUMBER 729691.20220 INSTALLATION DATE 10/27/96 LOCATION SITE 4

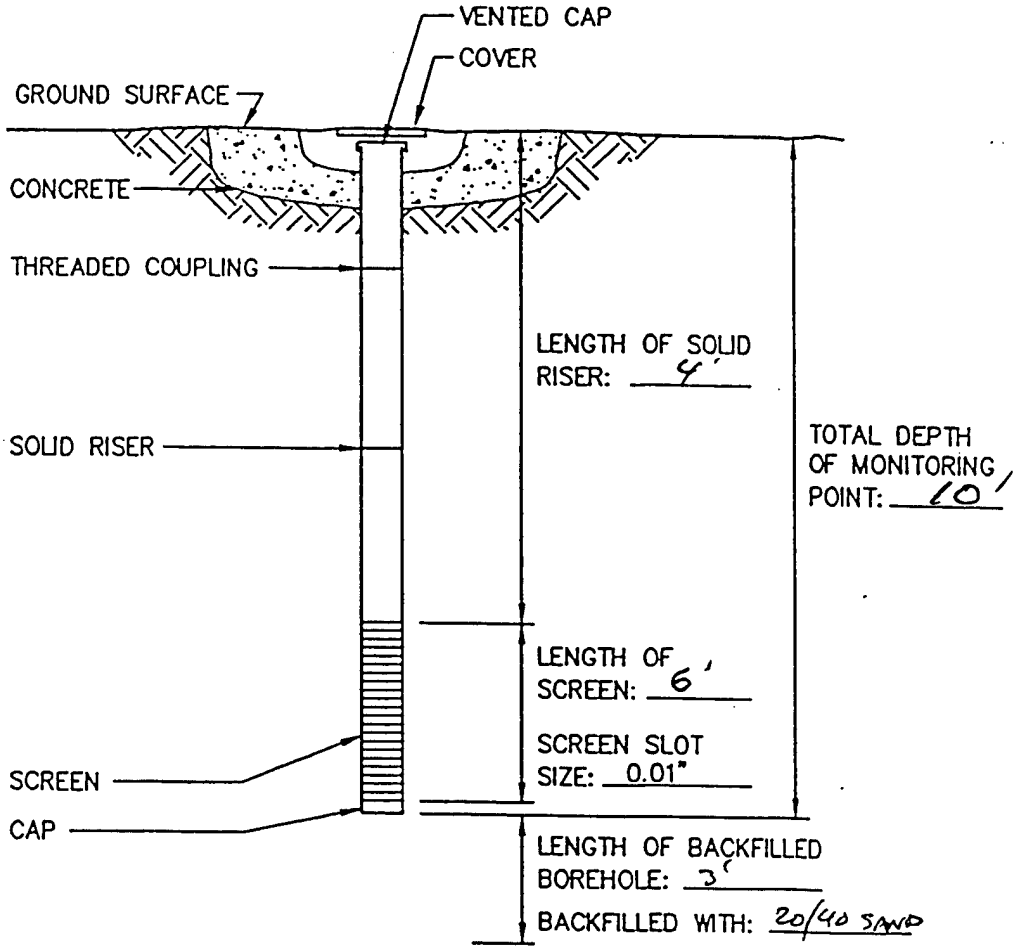
DATUM ELEVATION _____ GROUND SURFACE ELEVATION _____

DATUM FOR WATER LEVEL MEASUREMENT _____

SCREEN DIAMETER & MATERIAL 2" ID 1½" OD PREPACKED SLOT SIZE 0.01

RISER DIAMETER & MATERIAL 2" ID SCH 40 PVC BOREHOLE DIAMETER 2¼"

ES REPRESENTATIVE RATZLAFF



(NOT TO SCALE)

STABILIZED WATER LEVEL 6.3' TEMP TOC FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 10.0 BGS FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER 4MP-7 "X"

JOB NUMBER 729691.20220 INSTALLATION DATE 10/27/96 LOCATION SITE 4

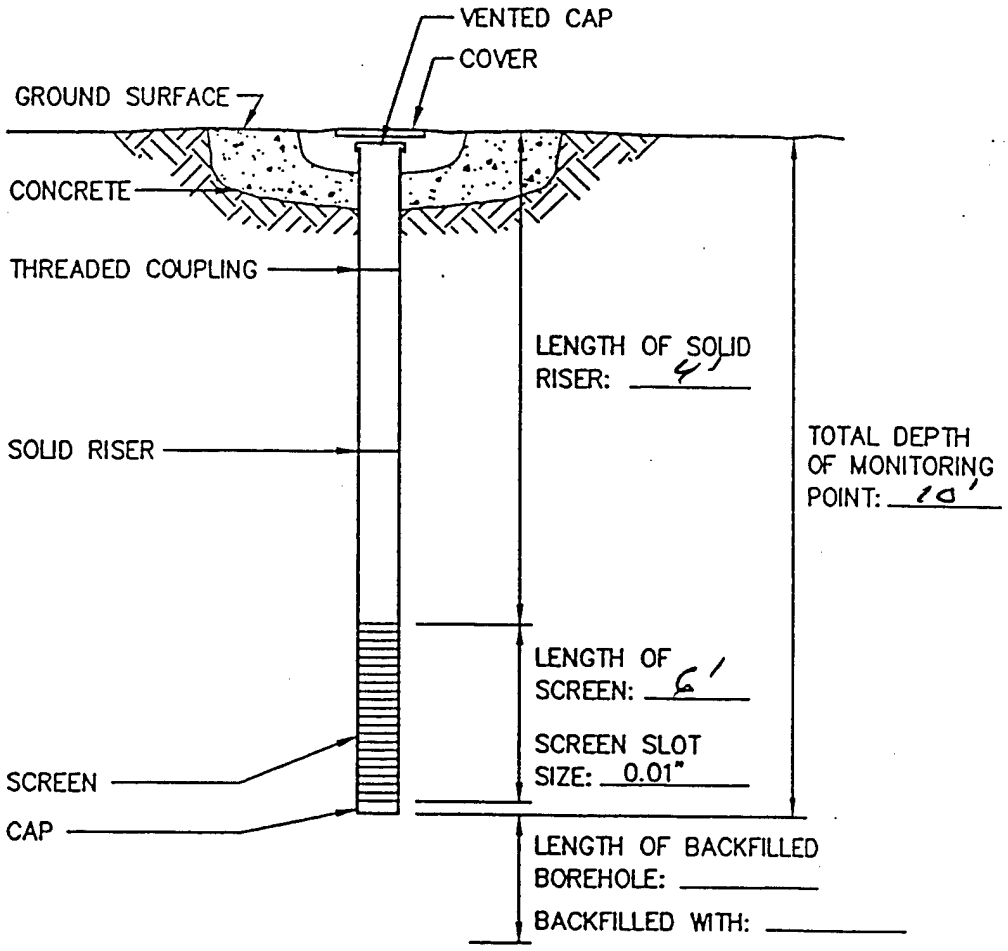
DATUM ELEVATION _____ GROUND SURFACE ELEVATION _____

DATUM FOR WATER LEVEL MEASUREMENT _____

SCREEN DIAMETER & MATERIAL $\frac{1}{2}$" ID 1$\frac{1}{2}$" OD PREPACKED SLOT SIZE 0.01"

RISER DIAMETER & MATERIAL $\frac{1}{2}$" ID SCH 40 PVC BOREHOLE DIAMETER 2$\frac{1}{4}$"

ES REPRESENTATIVE RATZLAFF



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH 9.9 FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER 4MP-8

JOB NUMBER 729691.20220 INSTALLATION DATE 10/27/96 LOCATION S. SIDE 4

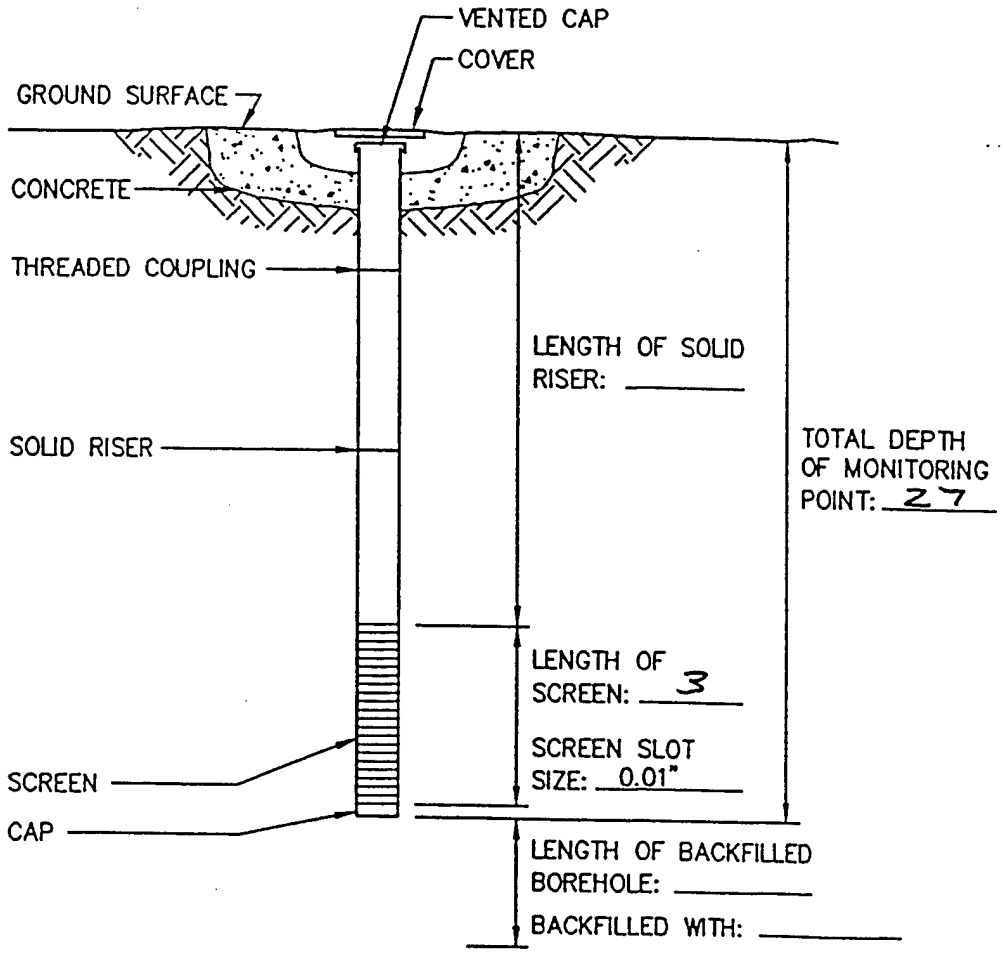
DATUM ELEVATION _____ GROUND SURFACE ELEVATION _____

DATUM FOR WATER LEVEL MEASUREMENT _____

SCREEN DIAMETER & MATERIAL ½" ID, 1¼ OD PREPACKED SLOT SIZE 0.01

RISER DIAMETER & MATERIAL ½" ID SCH 40 PVC BOREHOLE DIAMETER 2¼

ES REPRESENTATIVE RATZLAFF



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER J 4MP-9

JOB NUMBER 729691.20220 INSTALLATION DATE 10/28 LOCATION _____

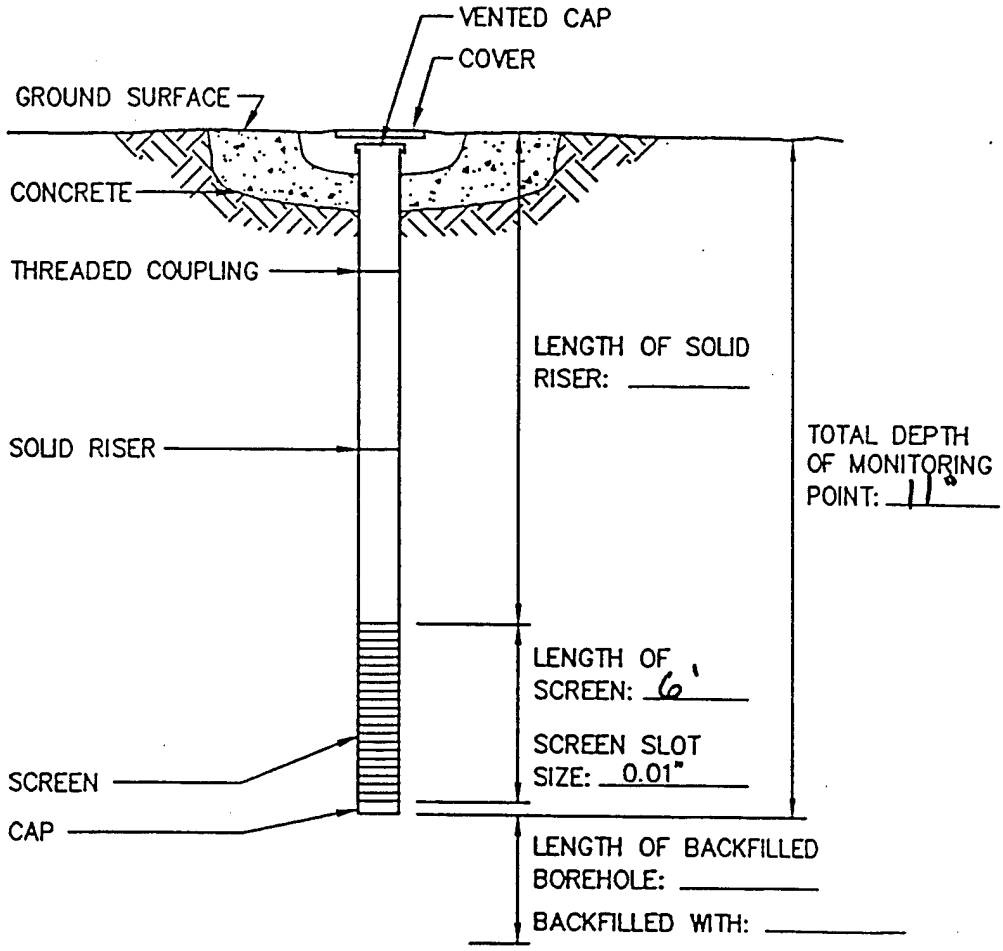
DATUM ELEVATION _____ GROUND SURFACE ELEVATION _____

DATUM FOR WATER LEVEL MEASUREMENT _____

SCREEN DIAMETER & MATERIAL Prepack SLOT SIZE 0.10

RISER DIAMETER & MATERIAL 0.5" BOREHOLE DIAMETER 24"

ES REPRESENTATIVE RDN



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER I1 4MP-12M

JOB NUMBER 729691.20220 INSTALLATION DATE 10/31/96 LOCATION —

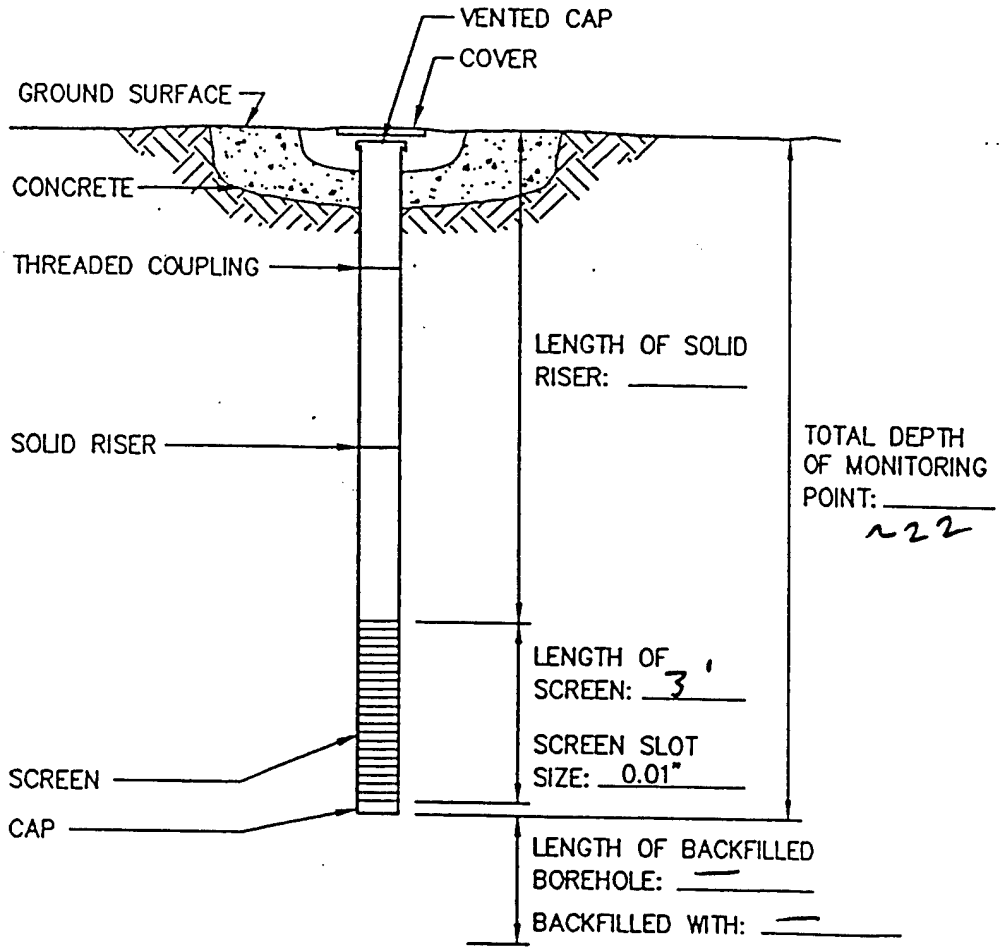
DATUM ELEVATION _____ GROUND SURFACE ELEVATION —

DATUM FOR WATER LEVEL MEASUREMENT —

SCREEN DIAMETER & MATERIAL 0.5 - Prepacked PVC SLOT SIZE 0.10

RISER DIAMETER & MATERIAL 0.5 - PVC BOREHOLE DIAMETER 2¼

ES REPRESENTATIVE RN



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

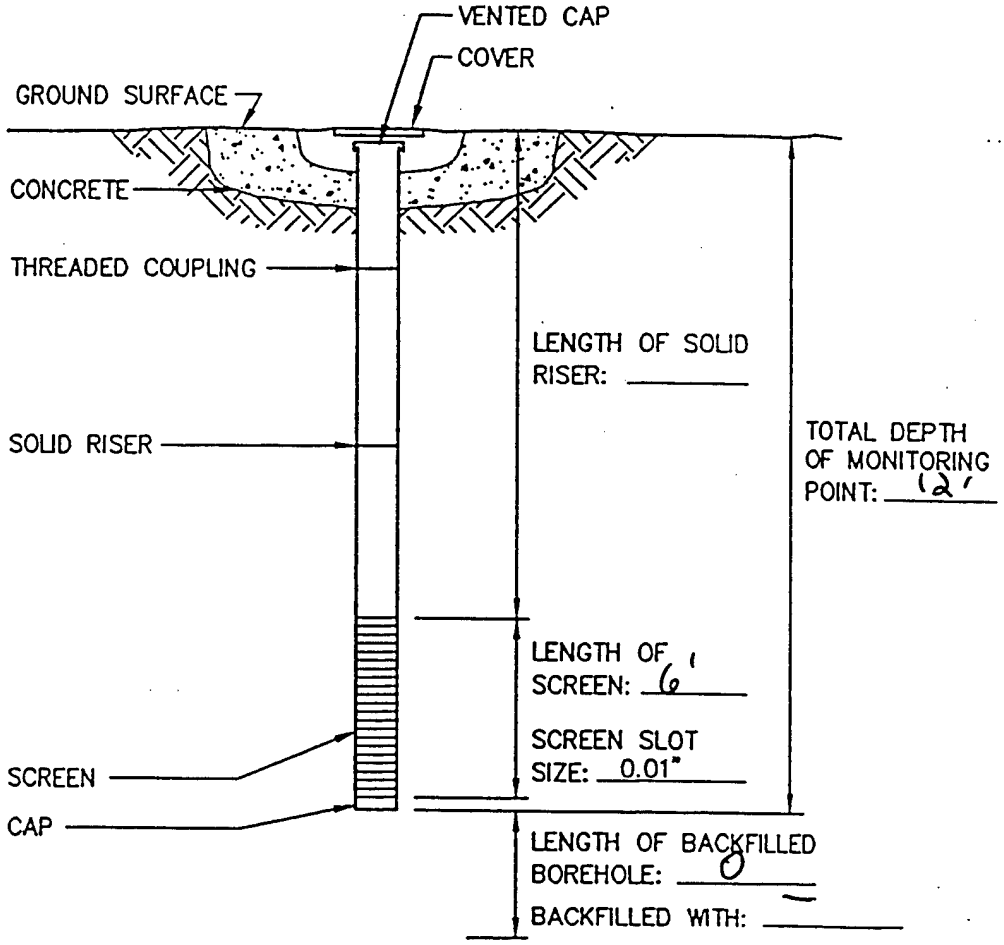
IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

K:\AFCEE\729691\LANGLEY\96DN0769, 09/24/96 at 10:50

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER 4 4MP-13
JOB NUMBER 729691.20220 INSTALLATION DATE 10/29 LOCATION
DATUM ELEVATION GROUND SURFACE ELEVATION
DATUM FOR WATER LEVEL MEASUREMENT
SCREEN DIAMETER & MATERIAL 0.5" Prepacked PVC SLOT SIZE 0.10
RISER DIAMETER & MATERIAL 0.5" PVC BOREHOLE DIAMETER 2 1/4"
ES REPRESENTATIVE RDN



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER A D 4MP14S

JOB NUMBER 729691.20220 INSTALLATION DATE ~~10/30~~ 10/31 LOCATION

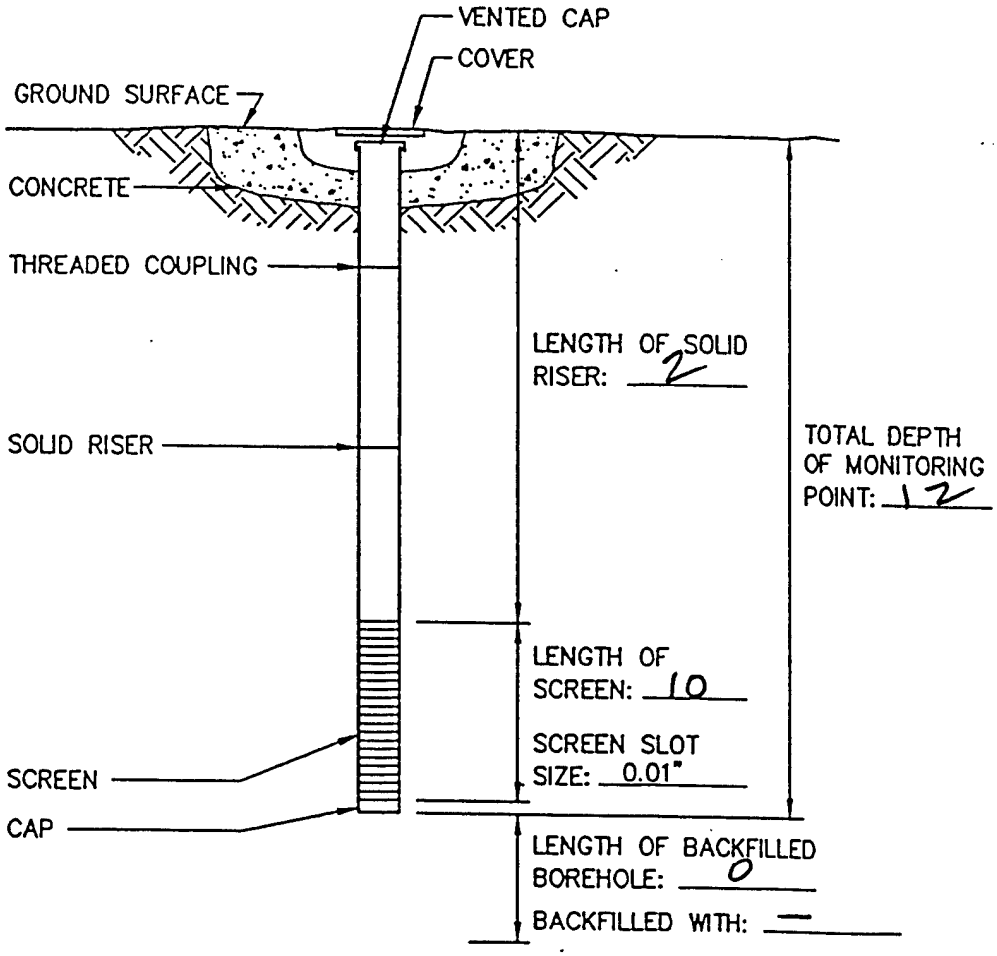
DATUM ELEVATION GROUND SURFACE ELEVATION

DATUM FOR WATER LEVEL MEASUREMENT

SCREEN DIAMETER & MATERIAL ~~2"~~ SLOT SIZE 0.10

RISER DIAMETER & MATERIAL ~~2"~~ .75" BOREHOLE DIAMETER 2 1/4

ES REPRESENTATIVE



(NOT TO SCALE)

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

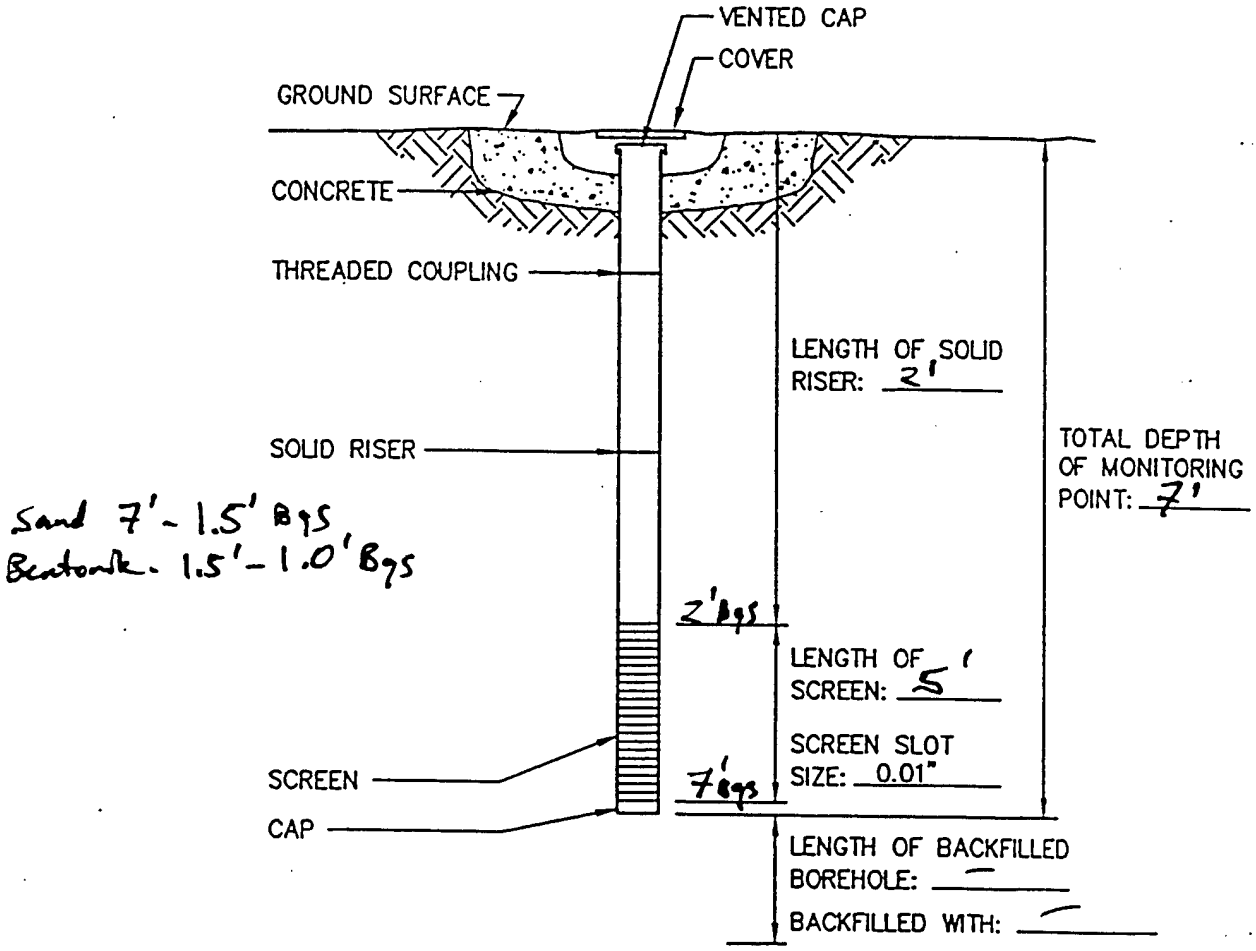
MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER 4mp22
JOB NUMBER 729691.2010 INSTALLATION DATE 10/6/97 LOCATION
DATUM ELEVATION GROUND SURFACE ELEVATION
DATUM FOR WATER LEVEL MEASUREMENT
SCREEN DIAMETER & MATERIAL PVC 3/4" I.D. SLOT SIZE .010
RISER DIAMETER & MATERIAL PVC 3/4" I.D. BOREHOLE DIAMETER [redacted] .3"
ES REPRESENTATIVE RB + BL



Sand 7' - 1.5' BgS
Bentonite 1.5' - 1.0' BgS

(NOT TO SCALE)

Completed [redacted] 1745

with 10' casing
Initial water level ~ 9.32' below T.O.C.

STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT INSTALLATION RECORD

JOB NAME Langley AFB Site SS-04 MONITORING POINT NUMBER 4mp-23

JOB NUMBER 729691.2010 INSTALLATION DATE 10/6 LOCATION

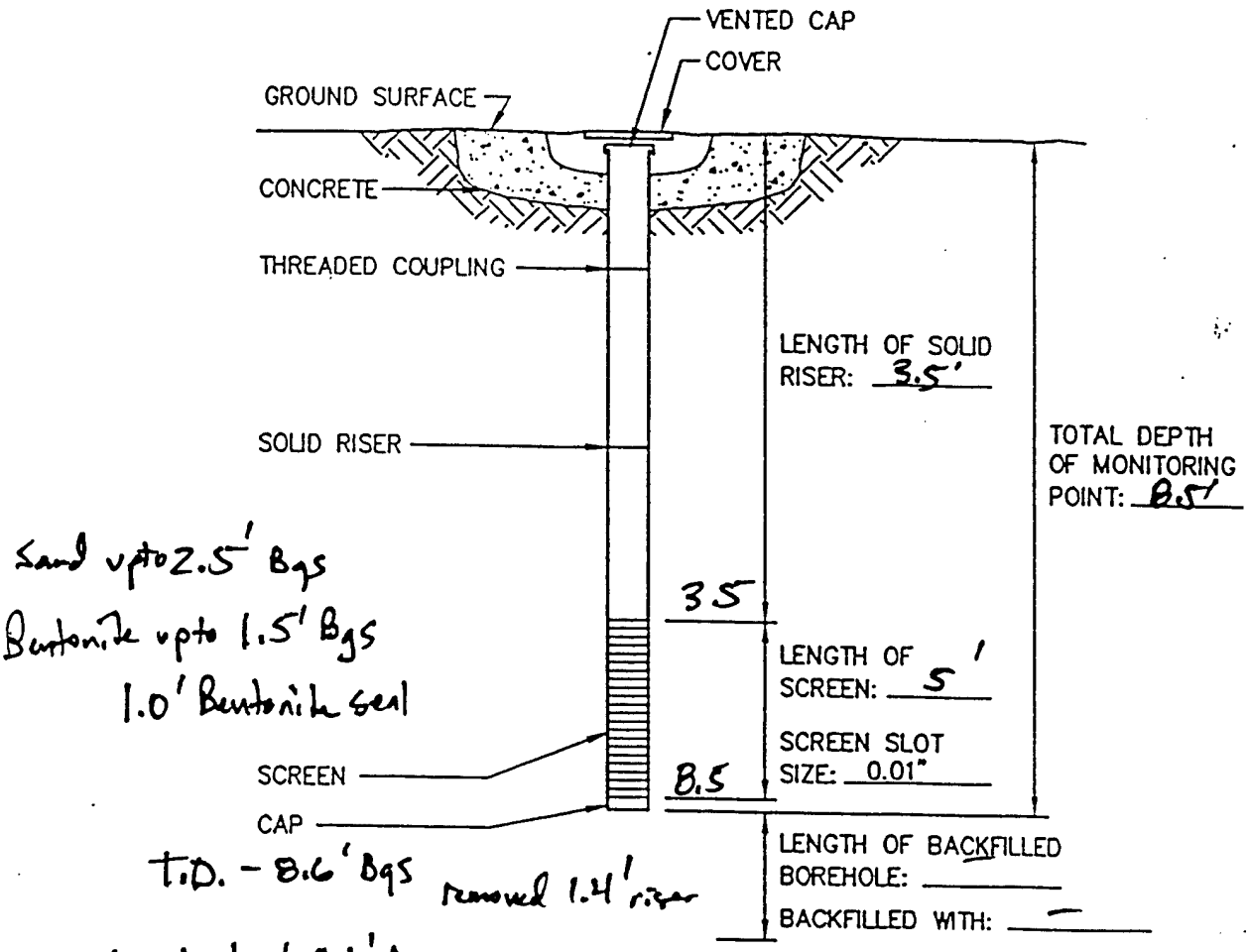
DATUM ELEVATION GROUND SURFACE ELEVATION

DATUM FOR WATER LEVEL MEASUREMENT

SCREEN DIAMETER & MATERIAL SLOT SIZE

RISER DIAMETER & MATERIAL BOREHOLE DIAMETER

ES REPRESENTATIVE



STABILIZED WATER LEVEL _____ FEET BELOW DATUM.

TOTAL MONITORING POINT DEPTH _____ FEET BELOW DATUM.

GROUND SURFACE _____ FEET

FIGURE 3.4

MONITORING POINT INSTALLATION RECORD

IRP Site SS-04
Remediation by Natural Attenuation TS
Langley AFB, Virginia

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

MONITORING POINT DEVELOPMENT RECORDS

4MP-1 THROUGH 4MP-23

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-1

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/1, 1996
Measurement Datum TEMP TOC

Pre-Development Information 3/4" ID

Time (Start): 0620

Water Level: 3.80' TOC

Total Depth of Well: 10.4 TOC

Water Characteristics

Color CLOUDY ORANGE Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 7.16 Temperature(°C) 18.0
Specific Conductance(µS/cm) 664

Interim Water Characteristics

Gallons Removed	0.1	0.5	1.0	
pH	7.16	7.07	7.08	7.05
Temperature (°C)	18.0	18.2	18.3	18.3
Specific Conductance(µS/cm)	664	617	610	609

Post-Development Information

Time (Finish): 0655

Water Level: _____

Total Depth of Well: _____

Approximate Volume Removed: _____

Water Characteristics

Color _____ Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH _____ Temperature(°C) _____
Specific Conductance(µS/cm) _____

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MA-2

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/1, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 0925

Water Level: 5.10

Total Depth of Well: 11.26 TEMP TOC

Water Characteristics

Color ORANGE Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 7.54 Temperature(°C) 19.3
Specific Conductance(µS/cm) 517

Interim Water Characteristics

	0.5	1.0	1.5	
Gallons Removed				
pH				
Temperature (°C)				
Specific Conductance(µS/cm)				

PUMPED POINT DRY AFTER EVACUATING 0.5 gallons @ 0932
DTW = 10.35 @ 0937
DTW = 9.48 @ 0937
DTW = 8.32 @ 0942
DTW = 7.02 @ 0950

Post-Development Information

Time (Finish): _____

Water Level: _____

Total Depth of Well: _____

Approximate Volume Removed: _____

Water Characteristics

Color _____ Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH _____ Temperature(°C) _____
Specific Conductance(µS/cm) _____

Comments: SCREEN IS LIKELY CLOGGED WITH FINE SAND. PROCEEDING TO PURGE & SAMPLE.

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-3 "U"

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 10/28, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 10:50

Water Level: 5.64 BTOC (TEMP) Total Depth of Well: 10.1 BTOC (TEMP)

Water Characteristics

Color CLOUDY, ORANGE Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 6.66 Temperature(°C) 23.9
Specific Conductance(µS/cm) 400

10.10
− 5.64
4.46
× .023
1338
892
0.10258 gallons
0.1 gal PV.

Interim Water Characteristics

Gallons Removed	0.5	0.75	1.0	1.25
pH	6.51	6.20	6.22	6.31
Temperature (°C)	24.1	23.4	23.3	23.5
Specific Conductance(µS/cm)	450	430	426	410

Post-Development Information

Time (Finish): 11:25

Water Level: 7.64' BTOC (TEMP) Total Depth of Well: 10.1 BTOC

Approximate Volume Removed: 1.5 GALLONS

Water Characteristics

Color CLEAR (Clear) Cloudy
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 6.24 Temperature(°C) 24.0
Specific Conductance(µS/cm) 420

Comments: PERISTALTIC PUMP SETTING OF 23.25

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-4 1/2 10

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/1, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 1240

Water Level: 5.69

Total Depth of Well: 11.67

Water Characteristics

Color ORANGE-BROWN Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 6.83 Temperature(°C) 19.6
Specific Conductance(µS/cm) 2,460

Interim Water Characteristics

Gallons Removed ~~0.2~~	0.2	0.4	0.6
pH ~~6.83~~	6.77	6.72	6.77
Temperature (°C)	19.6	19.6	19.6
Specific Conductance(µS/cm)	2,370	2,258	2,120

Post-Development Information

Time (Finish): 1250

Water Level: _____

Total Depth of Well: _____

Approximate Volume Removed: 0.8 gal

Water Characteristics

Color YELLOW/ORANGE Clear (SL. Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 6.79 Temperature(°C) 19.6
Specific Conductance(µS/cm) 2,100

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-55

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/1, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 1650

Water Level: 4.62

Total Depth of Well: ~10

Water Characteristics

Color BROWN Clear (Cloudy)
Odor: None Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 7.40 Temperature(°C) 17.7
Specific Conductance(µS/cm) 735

Interim Water Characteristics

Gallons Removed	0.2	0.4	0.6
pH 7.40	7.07	6.92	6.88
Temperature (°C)	18.1	18.2	18.2
Specific Conductance(µS/cm)	717	719	712

Post-Development Information

Time (Finish): 1703

Water Level:

Total Depth of Well:

Approximate Volume Removed:

Water Characteristics

Color TAN Clear (SL Cloudy)
Odor: None Weak Moderate (Strong)
Any Films or Immiscible Material NOTICE
pH Temperature(°C)
Specific Conductance(µS/cm)

Comments:

4.49. 4.62
13.43

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-5D "02"

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/1 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 1600

Water Level: 4.49

Total Depth of Well: 16.2

Water Characteristics

Color LIGHT BROWN Clear (Cloudy)
Odor: None Weak Moderate (Strong)
Any Films or Immiscible Material NO
pH 7.42 Temperature(°C) 18.8
Specific Conductance(µS/cm) 797

Interim Water Characteristics

Gallons Removed	0.5	1.0	1.5	
pH	7.33	7.23	7.22	
Temperature (°C)	18.6	18.5	18.5	
Specific Conductance(µS/cm)	814	851	854	

Post-Development Information

Time (Finish): 1620

Water Level:

Total Depth of Well:

Approximate Volume Removed: 1.5 gal.

Water Characteristics

Color SL. CLOUDY YELLOW Clear Cloudy
Odor: None Weak (Moderate) Strong
Any Films or Immiscible Material NO
pH 7.22 Temperature(°C) 18.5
Specific Conductance(µS/cm) 854

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-6 "P"

Job Name: AFCEE-RNA
by: SR/RN/GK (TS) Date: 10/31, 1996
Measurement Datum: TOC

Pre-Development Information Time (Start): 1115

Water Level: 6.37' TB Total Depth of Well: 10.37

Water Characteristics

Color: BROWN Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material: NONE
pH: 7.10 Temperature(°C): 21.3
Specific Conductance(µS/cm): 818

Interim Water Characteristics

Gallons Removed	0.2	0.4	0.6	0.8	1.0	
pH	6.65	6.67	6.82	6.71	6.67	
Temperature (°C)	21.1	20.9	20.7	20.6	20.6	
Specific Conductance(µS/cm)	812	811	810	810	810	

Post-Development Information Time (Finish): 1150

Water Level: Total Depth of Well:

Approximate Volume Removed: 1.0 GALLON

Water Characteristics

Color: LIGHT BROWN Clear (Cloudy)
Odor: None Weak Moderate Strong
Any Films or Immiscible Material: NO
pH: 6.67 Temperature(°C): 20.6
Specific Conductance(µS/cm): 810

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-7

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 10/31, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 1605

Water Level: 5.85

Total Depth of Well: 9.99

Water Characteristics

Color TAN Clear (Cloudy)
Odor: None Weak (Moderate) Strong
Any Films or Immiscible Material NONE
pH 7.2 Temperature(°C) 19.6
Specific Conductance(µS/cm) 4,040

Interim Water Characteristics

Gallons Removed 0.2

pH 7.17

Temperature (°C) 19.6

Specific Conductance(µS/cm) ~~4,320~~ 4,030

Post-Development Information

Time (Finish): 1620

Water Level:

Total Depth of Well: 9.99

Approximate Volume Removed: 0.6

Water Characteristics

Color CLEAR (Clear) Cloudy
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 7.17 Temperature(°C) 19.6
Specific Conductance(µS/cm) 4,030

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-8

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 10/28, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 1545

Water Level: 7.10

Total Depth of Well: 24.0 w/ W.L. IND

Water Characteristics

Color CLEAR, YELLOW TINT Clear Cloudy
Odor: ~~None~~ (Weak) Moderate Strong
Any Films or Immiscible Material NONE
pH 7.81 Temperature(°C) 23.0
Specific Conductance(µS/cm) 620

Interim Water Characteristics

Gallons Removed	0.5	1.0	1.5	2.0
pH	7.78	7.73	7.75	7.73
Temperature (°C)	23.0	21.6	20.9	20.5
Specific Conductance(µS/cm)	480	540	320*	*
COLOR	GREY GREEN CLOUDY	SLIGHTLY YELLOW	CLEAR	

Post-Development Information

Time (Finish): 1700

Water Level:

Total Depth of Well: 24'

Approximate Volume Removed: 2.5 GALLONS

Water Characteristics

Color LT. YELLOW (Clear) Cloudy
Odor: None Weak (Moderate) Strong
Any Films or Immiscible Material NONE
pH 7.73 Temperature(°C) 20.3
Specific Conductance(µS/cm) *

Comments:

* CONDUCTIVITY METER READINGS VARYING ~~BETWEEN~~ ±100

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-9

Job Name: AFCEE-RNA
by: SR/RN/GK (BL) Date: 10/31, 1996
Measurement Datum: TOC

Pre-Development Information

Time (Start): 0700

Water Level: 4.85

Total Depth of Well: 8.9'

Water Characteristics

Color: BROWN Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material: NONE
pH: 6.51 Temperature(°C): ~~643~~ 17.2
Specific Conductance(µS/cm): 643

Interim Water Characteristics

Gallons Removed	10 ~~0.5~~	0.25	0.40
pH	6.66	6.76	6.80
Temperature (°C)	17.2	17.1	17.7
Specific Conductance(µS/cm)	644	645	642

Post-Development Information

Time (Finish): 0720

Water Level:

Total Depth of Well: 8.9'

Approximate Volume Removed: 0.5

Water Characteristics

Color: LIGHT BROWN Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material: NONE
pH: 6.79 Temperature(°C): 18.2
Specific Conductance(µS/cm): 644

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: MW-10 "A"

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 10/31, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 0710

Water Level: 4.71 BELOW TEMP TOC

Total Depth of Well: 11.65 BTEMP TOC

Water Characteristics

Color ORANGE TAN Clear (Cloudy) — MODERATE
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH _____ Temperature(°C) _____
Specific Conductance(µS/cm) _____

Interim Water Characteristics

		0722	0730	0740	0750
Gallons Removed	0.2	0.4	0.6	0.8	1.0
pH	7.11	7.05	7.05	7.12	7.18
Temperature (°C)	18.3	18.6	18.7	18.5	18.5
Specific Conductance(µS/cm)	—	589	599	570	568
DO	1.66	1.53	1.52	1.77	1.70
Redox	~~183.2~~	~~179.3~~	~~178.2~~	~~238~~	

Post-Development Information

Time (Finish): 0750

Water Level: _____

Total Depth of Well: _____

Approximate Volume Removed: _____

Water Characteristics

Color _____ (Clear) Cloudy
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material NO
pH see above Temperature(°C) _____
Specific Conductance(µS/cm) _____

Comments: PERISTALTIC SETTING = 3

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-11

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/1, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 1415

Water Level: 4.08

Total Depth of Well: 11.45

Water Characteristics

Color Brown Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material ND
pH 7.27 Temperature(°C) 21.2
Specific Conductance(µS/cm) 688

Interim Water Characteristics

Gallons Removed	0.2	0.4	0.6	0.8
pH	7.19	7.17	7.14	7.12
Temperature (°C)	21.5	21.5	21.5	21.5
Specific Conductance(µS/cm)	692	695	700	701

Post-Development Information

Time (Finish): 1435

Water Level:

Total Depth of Well:

Approximate Volume Removed: 0.8 gal

Water Characteristics

Color SL Cloudy Yellow Clear Cloudy
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material ND
pH 7.12 Temperature(°C) 21.5
Specific Conductance(µS/cm) 701

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-12(S)

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 4/3, 1996
Measurement Datum TOC

Pre-Development Information

Time (Start):_____

Water Level:_____ Total Depth of Well:_____

Water Characteristics

Color_____ Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH_____ Temperature(°C)_____
Specific Conductance(µS/cm)_____

Interim Water Characteristics

Gallons Removed_____

pH_____

Temperature (°C)_____

Specific Conductance(µS/cm)_____

Post-Development Information

Time (Finish):_____

Water Level:_____ Total Depth of Well:_____

Approximate Volume Removed: _____

Water Characteristics

Color_____ Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH_____ Temperature(°C)_____
Specific Conductance(µS/cm)_____

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-12(d)

Job Name: AECEE-RNA
by: SR/RN/GK Date: 11/3, 1996
Measurement Datum TOC

Pre-Development Information

Time (Start):_____

Water Level:_____ Total Depth of Well:_____

Water Characteristics

Color_____Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH_____Temperature(°C)_____
Specific Conductance(µS/cm)_____

Interim Water Characteristics

Gallons Removed_____

pH_____

Temperature (°C)_____

Specific Conductance(µS/cm)_____

Post-Development Information

Time (Finish):_____

Water Level:_____ Total Depth of Well:_____

Approximate Volume Removed: _____

Water Characteristics

Color_____Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH_____Temperature(°C)_____
Specific Conductance(µS/cm)_____

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-13 (Y)

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/1, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 0805

Water Level: 5.60'

Total Depth of Well: 11.70'

Water Characteristics

Color LIGHT TAN Clear (Cloudy)
Odor: None Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 7.21 Temperature(°C) _____
Specific Conductance(µS/cm) _____

Interim Water Characteristics

Gallons Removed	0.1	0.2	0.4	0.7
pH	7.21	6.92	6.91	6.93
Temperature (°C)	19.9	20.5	20.7	20.7
Specific Conductance(µS/cm)	867	907	1007	1087

Post-Development Information

Time (Finish): 0820

Water Level: —

Total Depth of Well: 11.70'

Approximate Volume Removed: 0.7

Water Characteristics

Color SLIGHTLY CLOUDY - TAN Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH 6.93 Temperature(°C) 20.7
Specific Conductance(µS/cm) 1087

Comments:

PERISTALTIC SETTING = 3.5

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-14S (D1)

Job Name: AFCEE-RNA
by: SR/RN/GK Date: [illegible], 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start):_____

Water Level:_____ Total Depth of Well:_____

Water Characteristics

Color_____ Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH_____ Temperature(°C)_____
Specific Conductance(µS/cm)_____

Interim Water Characteristics

Gallons Removed_____

pH_____

Temperature (°C)_____

Specific Conductance(µS/cm)_____

Post-Development Information

Time (Finish):_____

Water Level:_____ Total Depth of Well:_____

Approximate Volume Removed: _____

Water Characteristics

Color_____ Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH_____ Temperature(°C)_____
Specific Conductance(µS/cm)_____

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: MP-14D

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/3/96, 1996
Measurement Datum TOC

Pre-Development Information

Time (Start): 0920

Water Level: 2.89

Total Depth of Well: 21.37

Water Characteristics

Color ____ (Clear) Cloudy
Odor: None (Weak) Moderate Strong
Any Films or Immiscible Material NONE
pH 7.16 Temperature(°C) 15.4
Specific Conductance(µS/cm) 749

Interim Water Characteristics

Gallons Removed	0.5	1.0	1.5	2.0
pH	7.17	7.15	7.15	7.14
Temperature (°C)	15.4	15.4	15.7	15.9
Specific Conductance(µS/cm)	751	748	745	743

Post-Development Information

Time (Finish): ____

Water Level: ____

Total Depth of Well: ____

Approximate Volume Removed: ____

Water Characteristics

Color ____ (Clear) Cloudy
Odor: None (Weak) Moderate Strong
Any Films or Immiscible Material NONE
pH ____ Temperature(°C) ____
Specific Conductance(µS/cm) ____

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-15

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/3/96 1996
Measurement Datum TOC

Pre-Development Information

Time (Start): 1125

Water Level: 3.71

Total Depth of Well: 25.25

Water Characteristics

Color TAN

Clear (MOD) Cloudy

Odor: None Weak (Moderate) Strong

Any Films or Immiscible Material NONE

pH 7.22 Temperature(°C) 16.7

Specific Conductance(µS/cm) 1615

Interim Water Characteristics

Gallons Removed	0.5	1.5	2.0	2.5
pH	7.00	6.98	6.91	6.92
Temperature (°C)	16.2	16.3	17.2	17.0
Specific Conductance(µS/cm)	1,858	1,916	2,030	2,060

Post-Development Information

Time (Finish): 1245

Water Level:

Total Depth of Well:

Approximate Volume Removed: 2.6 gal.

Water Characteristics

Color NONE

(Clear) Cloudy

Odor: None (Weak) ~~Moderate~~ Strong

Any Films or Immiscible Material NONE

pH Temperature(°C)

Specific Conductance(µS/cm)

Comments: SLOW PRODUCER (i.e. AMP setting = 10, Low flow, no air)

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: MW-16 (6)

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/3/96, 1996
Measurement Datum TOC

Pre-Development Information

Time (Start): 0625

Water Level: 4.50

Total Depth of Well: 26.3

Water Characteristics

Color BROWN Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 7.06 Temperature(°C) 13.7
Specific Conductance(µS/cm) 638

Interim Water Characteristics

Gallons Removed	0.5	1.0	1.5	2.0
pH	7.36	7.37	7.37	7.33
Temperature (°C)	13.7	13.7	13.8	13.7
Specific Conductance(µS/cm)	663	651	643	641

Post-Development Information

Time (Finish): 0725

Water Level:

Total Depth of Well:

Approximate Volume Removed: 2.2

Water Characteristics

Color TAN Clear SL Cloudy
Odor: None Weak (Moderate) Strong
Any Films or Immiscible Material NONE
pH Temperature(°C)
Specific Conductance(µS/cm)

Comments:

SLOW PRODUCER

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: UMP-17 (W)

Job Name: AFCEE-RNA
by: SR/RN/GK
Date: 11/2/96, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 1210

Water Level: 6.41

Total Depth of Well: 11.21

Water Characteristics

Color BROWN Clear (Cloudy)
Odor: None Weak Moderate Strong
Any Films or Immiscible Material ALONE
pH 6.94 Temperature(°C) _____
Specific Conductance(µS/cm) 819

Interim Water Characteristics

Gallons Removed	0.25	0.5	1.0	1.5
pH	6.94	6.88	6.81	6.78
Temperature (°C)	15.3	15.0	16.7	16.8
Specific Conductance(µS/cm)	819	835	867	872

Post-Development Information

Time (Finish): 1230

Water Level: _____

Total Depth of Well: _____

Approximate Volume Removed: _____

Water Characteristics

Color TAN Clear (SL Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material _____
pH _____ Temperature(°C) _____
Specific Conductance(µS/cm) _____

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-19

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/2/96 1996
Measurement Datum TKMP TOC

Pre-Development (B) Information

Time (Start): 1510

Water Level: 5.09

Total Depth of Well: 11.55

Water Characteristics

Color BROWN Clear (Cloudy)
Odor: None Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 7.10 Temperature(°C) 17.5
Specific Conductance(µS/cm) 520

Interim Water Characteristics

Gallons Removed ~~0.5~~	0.5	1.0	0.25	
pH	6.85	7.15		
Temperature (°C)	16.5	15.8		
Specific Conductance(µS/cm)	542	563		

PUMPED WELL DRY @ 1.2 gal AT SETTING OF 2 ON PUMP (WILL NOT PRODUCE AT A SETTING LESS THAN 2). SHUT PUMP OFF TO LET RECOVER.

Post-Development Information

Time (Finish): _____

Water Level: _____

Total Depth of Well: _____

Approximate Volume Removed: _____

Water Characteristics

Color _____ Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH _____ Temperature(°C) _____
Specific Conductance(µS/cm) _____

Comments: PERISTALTIC SETTING = ~~5~~ ~~3~~ ~~2.5~~ ~~2.0~~ ~~2~~ 2

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 4MP-20 (V)

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 11/2, 1996
Measurement Datum TEMP TOC

Pre-Development Information

Time (Start): 1332

Water Level: 4.72

Total Depth of Well: 11.72

Water Characteristics

Color BROWN Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material NONE
pH 7.13 Temperature(°C) 16.7
Specific Conductance(µS/cm) 419

Interim Water Characteristics

Gallons Removed	0.5	1.0	1.5	1.75 ~~2.0~~	2.0
pH	7.13	7.14	6.93	6.90	6.89
Temperature (°C) 16.7 ~~17.0~~		17.0	17.4	17.3	17.4
Specific Conductance(µS/cm)	419	413	407	377	379

Post-Development Information

Time (Finish): 1355

Water Level: _____

Total Depth of Well: _____

Approximate Volume Removed: _____

Water Characteristics

Color SL. CLOUDY BROWN Clear (SL Cloudy)
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH _____ Temperature(°C) _____
Specific Conductance(µS/cm) _____

Comments:

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: 12MP-22

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 10/8 1996
Measurement Datum _____

Pre-Development Information

Time (Start): 1400

Water Level: 5.31

Total Depth of Well: 6.85

Water Characteristics

Color _____ Clear (Cloudy)
Odor: (None) Weak Moderate Strong
Any Films or Immiscible Material _____
pH 6.89 Temperature(°C) 32.3
Specific Conductance(µS/cm) 690

Interim Water Characteristics

Gallons Removed WELL WENT DRY ~ .5 gallons

pH _____

Temperature (°C) _____

Specific Conductance(µS/cm) _____

Post-Development Information

Time (Finish): _____

Water Level: _____

Total Depth of Well: _____

Approximate Volume Removed: _____

Water Characteristics

Color _____ Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH _____ Temperature(°C) _____
Specific Conductance(µS/cm) _____

Comments: WELL DRY IMMEDIATELY

MONITORING POINT DEVELOPMENT RECORD

Job Number: 729691.20220
Location: Langley AFB, IRP Site 4
Well Number: MW-23

Job Name: AFCEE-RNA
by: SR/RN/GK Date: 10/8, 1996
Measurement Datum _____

Pre-Development Information

Time (Start): 1520

Water Level: 6.47

Total Depth of Well: 8.35

Water Characteristics

Color Rust-Brown Clear (Cloudy)
Odor: ~~None~~ Weak Moderate Strong
Any Films or Immiscible Material _____
pH 10.85 Temperature(°C) 25.3
Specific Conductance(µS/cm) _____

Interim Water Characteristics

Gallons Removed _____

pH 10.90

Temperature (°C) 25.5

Specific Conductance(µS/cm) .704 mS/cm

Post-Development Information

Time (Finish): _____

Water Level: _____

Total Depth of Well: 8.35

Approximate Volume Removed: _____

Water Characteristics

Color _____ Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material _____
pH _____ Temperature(°C) _____
Specific Conductance(µS/cm) _____

Comments:

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-18
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/1, 1996 5:18 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: 60° overcast
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [X] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: NON EXISTANT
INNER PVC CASING CONDITION IS: Perfect
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH Isopropanol + distilled water
Items Cleaned (List): Probe

2 [ ] PRODUCT DEPTH — FT. BELOW DATUM
Measured with: —

WATER DEPTH 5.95 FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Cloudy brown
Odor: none
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: 1.5 gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: none
Other comments:

TD = 11.30

11.45
- 5.95
5.50/4 = 1.5 gallons

187

Groundwater Sampling Record

Monitoring Well No. MW-16 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: Peristaltic
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	16:01	16:08	1615			Measured with
Temp (°C)	18.5	18.9	18.9			
pH	7.17	7.16	7.16			
Cond (µS/cm)	521	513	505			
DO (mg/L)	0.12	0.12	0.09			
Redox (mV)	-40.2	-77.4	-95.4			
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size):
7 VOAs
1 Poly

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL GMP-19 (B) (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/2/96, 1996 1630 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER:
DATUM FOR WATER DEPTH MEASUREMENT (Describe):

MONITORING WELL CONDITION:

[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with:

WATER DEPTH 5.09 FT. BELOW DATUM
Measured with: SOL/INST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP.
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-19 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1615	1620	1622	1626		Measured with
Temp (°C)	13.6	16.8	17.5	17.0		
pH 7.78	~~8.04~~	7.04	6.98	6.99		
Cond (µS/cm)	569	562	566	563		
DO (mg/L)	5.32	3.96	3.74	3.67		
Redox (mV)	+0.2	-7.9	-7.8	-11.3		
Salinity						
~~Nitrate~~	250ml	750ml	1250ml	1500ml		
Sulfate						
Ferrous Iron						

← LIKELY AREA

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH
(3) 40ml VOAs - Methane
(1) 125 ml POLY - ANIONS @ 11/3/96 0835

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: "SLOW PRODUCER" PERISTALTIC SETTING = 2.5

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-20 (V?) (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/20/96, 1996 1415 a.m./p.m.
SAMPLE COLLECTED BY: RN/SRYBL/GK of Parsons ES
WEATHER: OVERCAST, WIND?, 40°F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:

[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PEDIS
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. MP-20 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type:_
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1402	1406	1410			Measured with
Temp (°C)	16.7	16.6	16.6			YSI
pH	6.85	6.80	6.83			
Cond (µS/cm)	377	327	302			HACH
DO (mg/L)	1.20	1.17	1.26			
Redox (mV)	+30.5	+18.6	+22.1			
Salinity						
~~Nitrate~~	0.2 gal	0.4 gal	0.6 gal			
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40 ml VOAs – BTEX/TVH-6
(3) 40 ml VOAs – METHANE
(1) 125 ml POLY-ANIONS @ 11/3/96 0825

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-21
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/3 ,1996 225 a.m/p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: 60° Clear
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC
DTW = 2.76

MONITORING WELL CONDITION:
[ ] LOCKED: [X] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: Good
INNER PVC CASING CONDITION IS: Good
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH isopropanol + distilled water
Items Cleaned (List): probes

2 [ ] PRODUCT DEPTH — FT. BELOW DATUM
Measured with: —

WATER DEPTH 2.76 FT. BELOW DATUM
Measured with: Solinst water level indicator

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: clear
Odor: none
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: 2.5 gallons
Observations: Water (slightly - very) cloudy clear
Water level (rose - fell - no change)
Water odors: none
Other comments:

24
.3
2.3 gal

Groundwater Sampling Record

Monitoring Well No. MW-27 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: _____

[X] Pump, type: Peristaltic

[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1:55	2:01	2:17	2:22		Measured with
Temp (°C)	18.6	18.5	18.1	17.9		YSI 55
pH	6.88	6.83	6.83	6.83		Orion 250A
Cond (µS/cm)	100	170	910	920		Oyster
DO (mg/L)	1.86	2.53	2.20	2.32		YSI 55
Redox (mV)	+117.2	-130.6	-110.5	-120.4		Orion 250A
Salinity	/	/	/	/	/	/
Nitrate	/	/	/	/	/	/
Sulfate	/	/	/	/	/	/
Ferrous Iron	/	/	/	/	/	/

7 [ ] SAMPLE CONTAINERS (material, number, size):

7 VOAs

1 Poly

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method _____ Containers: _____

Method _____ Containers: _____

Method _____ Containers: _____

[ ] Preservatives added:

Method HCl Containers: VOAs

Method _____ Containers: _____

Method _____ Containers: _____

Method _____ Containers: _____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled

[X] Container Lids Taped

[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-3
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/28/96, 1996 0945 (a.m.)/p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: PARTY CLOUDY, TEMP IN 70s
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS: GOOD
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH N/A FT. BELOW DATUM
Measured with:

WATER DEPTH FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: FUEL ODOR
Other comments:

TIME	0915	0920	0930	0935	0940
pH	7.53	7.58	7.55	7.60	7.65
TEMP(°C)	20.0	20.1	20.1	19.9	20.0
COND	470	410	400	390	390
DO	1.58	1.15	1.28	1.23	1.22
REDOX	12.2	-160.4	-167.6	-166	-156.6
GAL	0.5	1.5	2.5	3.5	4

Groundwater Sampling Record

Monitoring Well No. MW-3 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time						Measured with
Temp (°C)						
pH						
Cond (µS/cm)						
DO (mg/L)						
Redox (mV)						
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (3) 40 ml VOAs - methane; (4) 40ml VOAs - BTEX/TVH; (1) 125 ml Plastic - ANIONS; (1) 250 ml Plastic - Alkalinity

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-4
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/30/96, 1996 0820 (a.m.)/p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: OVERCAST 65°F, WINDY
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 4.47 TD = 13.0 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR CLOUDY - DARK GREY SEDIMENT
Odor: MODERATE FUEL
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. MW-3 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time						Measured with
Temp (°C)						
pH						
Cond (µS/cm)						
DO (mg/L)						
Redox (mV)						
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (3) 40 ml VOAs - Methane; (4) 40ml VOAs - BTEX/TVH; (1) 125 ml Plastic - ANIONS; (1) 250 ml Plastic - Alkalinity

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL GMP-7 "x" (number)
½" ID

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/31/96, 1996 1635 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 70°F, MOD. WIND
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:

[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with: SOLNIST

WATER DEPTH 5.85 TEMP TOC TD = 9.99 FT. BELOW DATUM
Measured with: SOLN

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: MOD. CLOUDY - TAN
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-7 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1622	1624	1627	1629		Measured with
Temp (°C)	19.6	19.3	19.3	19.3		YSI 55
pH	7.17	7.18	7.21	7.20		
Cond (µS/cm)	4,020	3,910	3,830	3,790		HACH
DO (mg/L)	1.24	1.19	1.08	1.02		
Redox (mV)	+185.4	+166.1	+162.7	+147.2		~~YSI 55~~
Salinity						
~~Nitrate~~ gal	0.1	0.2	0.3	0.4		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4)
(3)
(1)

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL GMP-8 "T"
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/28/96, 1996 1730 a.m. (p.m.)
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: MOSTLY SUNNY, 70's
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP. TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with:

WATER DEPTH 7.10' TOC (TEMP) TD = 24' FT. BELOW DATUM
Measured with: SOLINST W.L. PROBE

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method:
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-8 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1703	~~1713~~ 1712	1720			Measured with
Temp (°C)	20.0	19.9	19.7			YSI 55
pH	7.74	7.79	7.77			
Cond (µS/cm)	—	—	—			
DO (mg/L)	1.28	1.33	1.08			
Redox (mV)	-109.0	-130.5	-138.5			
Salinity						
~~Nitrate~~ REM	0.2	0.4	0.6			
Sulfate						
Ferrous Iron						

6 GALLONS

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40 ml VOAs - BTEX/TVH-G
(3) 40 ml VOAs - Methane
(1) 125 ml Plastic - Anions

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL MP-9
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 1931, 1996 0740 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BD/GK of Parsons ES
WEATHER: CLEAR SKY, SUNNY, 60°F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOP OF CASING + 4" AGS

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):
WELL HAS NOT BEEN COMPLETED

Check-off
1 [ ] EQUIPMENT CLEANED BEFORE USE WITH DI + ISO
Items Cleaned (List): USE NEW HOSE

2 [ ] PRODUCT DEPTH — FT. BELOW DATUM
Measured with:

WATER DEPTH 4.85 TD = 8.9' FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SLIGHTLY CLOUDY
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed: 0.15 GALLONS
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: NONE
Other comments:

Groundwater Sampling Record

Monitoring Well No. MW-9 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

post-SAMPLING

Time	0725	0730	0735	0750		Measured with
Temp (°C)	18.7	18.5	18.6	19.2		
pH	6.79	6.80	6.81	6.87		
Cond (µS/cm)	651	641	642	637		
DO (mg/L)	0.40	0.38	0.41	1.46	→ BOBBED DO PROBE	
Redox (mV)	124.2	131.2	124.6	94.1		
Salinity						
~~Nitrate~~ gal	0.1	0.15	0.20	2.0		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): BTEX/TVH-6A - 4 40ml glass
METHANE 3 40ml glass
ANIONS 1 plastic

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: CALIBRATE INSTRUMENTS
ORION 250A 7.00 - 7.00 4.08 - 4.01 SLOPE = 93.5

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL MP-10 "A"
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/31/96, 1996 0845 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR 70°F NO WIND
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:

[ ] LOCKED: [X] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with:

WATER DEPTH 4.71 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-10 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	~~0752~~ 0755	0805	0810			Measured with
Temp (°C)	18.5	18.6	18.6			YSI 55
pH	7.25	7.33	7.33			
Cond (µS/cm)	565	559	559			
DO (mg/L)	1.63	1.54	1.51			
Redox (mV)	+37.1	+79.4	+59.3			
Salinity						
~~Nitrate~~	0.1 gal	0.2 gal	0.3 gal.			
Sulfate						
Ferrous Iron						

Redox Probe Reading Incorrectly! New Redox Probe

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH-6
(3) 40ml VOAs - Methane
(1) 125 ml POLY ANIONS
(1) 250 ml POLY Alkalinity

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL GMP-11 (K)
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/1/96, 1996 1345 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: OVERCAST, 70°F, WINDY
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with:

WATER DEPTH 4.08 FT. BELOW DATUM
Measured with: SONIST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERIS.
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-11 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[ ] Pump, type: PER
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1437	1439	1442			Measured with
Temp (°C)	21.3	21.3	21.3			YSI
pH	7.12	7.11	7.12			
Cond (µS/cm)	702	703	704			
DO (mg/L)	0.34	0.34	0.36			
Redox (mV)	-191.0	-192.9	-194.3			
Salinity						
~~Nitrate~~	0.1 gal.	0.2 gal	0.3 gal			
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40 ml VOAs - BTEX/TVH-G
(3) 40 ml VOAs - methane
(1) 125 ml POLY - ANIONS

DUPLICATE GW-113 TIME OF 1515

8 [ ] ON-SITE SAMPLE ~~TREATMENT~~:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-12SM
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/3/96 1996 1315 a.m./p.m.
SAMPLE COLLECTED BY (RM/SR/BL/GK) of Parsons ES
WEATHER: 50° clear
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [X] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: good
INNER PVC CASING CONDITION IS: good
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH isopropanol + distilled water
Items Cleaned (List): probes

2 [ ] PRODUCT DEPTH — FT. BELOW DATUM
Measured with: —

WATER DEPTH 3.85 FT. BELOW DATUM
Measured with: Solinst water level indicator

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: silty gray
Odor: none
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: ½ gallons purged dry twice
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: none
Other comments:

15.40
3.77

Groundwater Sampling Record

Monitoring Well No. 4MP-12BM (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____

[X] Pump, type: Peristaltic

[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1209					Measured with
Temp (°C)	17.7					45I 55
pH	7.43					Orion 250A
Cond (µS/cm)	4630					Oyster
DO (mg/L)	4.95					45I 55 ← aerated
Redox (mV)	~125.5					Orion-250A
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 7 VOAs, 1 Poly

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[X] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-12(d)
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/3, 1996 1158 (a.m./p.m.)
SAMPLE COLLECTED BY: (RN/SR/BL/GK) of (Parsons ES)
WEATHER: 50° clear
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [X] UNLOCKED
WELL NUMBER (IS / IS NOT) APPARENT
STEEL CASING CONDITION IS: good
INNER PVC CASING CONDITION IS: good
WATER DEPTH MEASUREMENT DATUM (IS / IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH Isopropanol + distilled water
Items Cleaned (List): Probes

2 [ ] PRODUCT DEPTH — FT. BELOW DATUM
Measured with: —

WATER DEPTH 3.77 FT. BELOW DATUM
Measured with: ~~Solinst~~ Solinst water level indicator

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: slightly cloudy
Odor: none
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: 4.5 gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: None
Other comments:

TD = 33.0'

Groundwater Sampling Record

Monitoring Well No. MP-12(d) (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: _____

[X] Pump, type: Peristaltic

[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1124	1137	1149			Measured with
Temp (°C)	10.0	17.8	17.7			YSI 55
pH	6.91	6.95	6.96			Orion 250A
Cond (µS/cm)	—	—	—	—	—	—
DO (mg/L)	0.31	0.16	0.12			YSI 55
Redox (mV)	+24.6	-177.5	-198.5			Orion 250A
Salinity	—	~~1.6~~	~~1.3~~			YSI 55
Nitrate	—	—				
Sulfate	—	—				
Ferrous Iron	—	—				

7 [ ] SAMPLE CONTAINERS (material, number, size): _____

7 VOAs

1 Poly

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

[ ] Preservatives added:

Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[X] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL GMP-13
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/1, 1996 0835 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: OVERCAST, 70°F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with: SOL/INST

WATER DEPTH 5.60 TD = 11.70 FT. BELOW DATUM
Measured with: SOL/INST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP.
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. MW-L3 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0723	0726	0729	0731		Measured with
Temp (°C)	20.5	20.7	20.8	20.8		YSI
pH	6.91	6.91	6.89	6.88		
Cond (µS/cm)	970	957	947	947		
DO (mg/L)	0.91	0.91	0.92	1.01		
Redox (mV)	-79.6	-96.5	-97.3	-97.3		ORION
Salinity						
~~Nitrate~~	0.1 gal	0.2 gal	0.3 gal	0.4		
Sulfate						
Ferrous Iron						

REDOX INCONSISTENT

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH-G
(3) 40 ml VOAs - METHANE
(1) 125ml POLY - ANIONS

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-14D
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/3/96, 1996 1010 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 46°F, WINDY
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:

[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 2.89 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: WEAK
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. MP-14D (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type:__
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0950	0953	0956			Measured with
Temp (°C)	16.0	15.9	15.8			
pH	7.14	7.15	7.12			
Cond (µS/cm)	747	747	740			
DO (mg/L)	0.34	0.32	0.29			
Redox (mV)	-219.6	-220.9	-224.1			
Salinity						
~~Nitrate~~	0.2 gal	0.4 gal	0.6 gal.			
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4)
(3)
(1)
(1) ALK
DUPLICATE: OW-114 @ TIME OF 1045

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-15 (14) (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/3/96, 1996 1315 a.m./p.m.
SAMPLE COLLECTED BY: RN/~~SR~~/BL/GK of Parsons ES
WEATHER: CLEAR, 45°F, WINDY
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:

[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH None FT. BELOW DATUM
Measured with:

WATER DEPTH 3.71 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: SLIGHT FUEL
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-15 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type:__
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1252	1300	1310			Measured with
Temp (°C)	16.7	17.0	16.9			
pH	6.91	6.90	6.89			
Cond (µS/cm)	2070	2060	2070			
DO (mg/L)	0.41	0.43	0.39			
Redox (mV)	-240.3	-242.6	-218.4			
Salinity						
~~Nitrate~~	0.8	0.4	0.86			
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4)_____
(3)_____
(1)_____

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL MP-16 (#6) (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/3/96, 1996 0740 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 35°, WIND4
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOP OF CASING

MONITORING WELL CONDITION:

[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with: SOLINST

WATER DEPTH 4.50 FT. BELOW DATUM
Measured with: SOLNIST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY
Odor: MODERATE FUEL
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-16 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type:_
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0728	0735	0739			Measured with
Temp (°C)	13.7°	13.8	14.0			YSI 55
pH	7.37	7.38	7.39			ORION 250
Cond (µS/cm)	638	638	636			HACH
DO (mg/L)	1.12	1.06	1.02			YSI 55
Redox (mV)	-203.2	-203.6	-202.8			ORION 250
~~Salinity~~ gal	0.2	0.4	0.6			
~~Nitrate~~						
Sulfate						
Ferrous Iron						

← few small air bubbles possibly aerated

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/MTBE-6
(3) 40ml VOAs - METHANOL
(1) 125ml POLY - ANIONS.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-17 (W)
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/2/96, 1996 1245 a.m./p.m.
SAMPLE COLLECTED BY: RNASR/BI/GK of Parsons ES
WEATHER: OVERCAST, DRIZZLE, 45°, WINDY!
DATUM FOR WATER DEPTH MEASUREMENT (Describe): PEMP TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with: SOLINST

WATER DEPTH 6.41 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. MW-17 (Cont'd)
(W)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type:_
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1135	1138	1141			Measured with
Temp (°C)	16.9	16.9	16.8			
pH	6.80	6.79	6.79			
Cond (µS/cm)	856	849	853			
DO (mg/L)	0.38	0.36	0.39			
Redox (mV)	+5.46	+5.5	+5.59			
Salinity						
~~Nitrate~~	0.2 gal	0.4 gal	0.6 gal.			
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40 ml
(3) 40 ml
(1) 125 ml POLY ANIONS @ 11/3/96 0810

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-5D
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/1/96, 1996 1635 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: OVERCAST
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with:

WATER DEPTH 4.49 FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY
Odor: MODERATE FUEL
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. MW-5D (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type:__
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1622	1625	1628			Measured with
Temp (°C)	18.3	18.2	18.2			
pH	7.25	7.23	7.22			
Cond (µS/cm)	861	872	873			
DO (mg/L)	0.32	0.33	0.35			
Redox (mV)	-327.8	-335.0	-332.1			
Salinity						
~~Nitrate~~	0.2	0.4	0.6			
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4)
(3)
(1)

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-55
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/1/96, 1996 1720 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: OVERCAST, 60°F, LIGHT WIND
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 4.62 FT. BELOW DATUM
Measured with: JSL INST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY
Odor: STRONG FUEL
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-55 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PER
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	~~1705~~ 1707	1710	1715			Measured with
Temp (°C)	18.1	18.0	18.0			
pH	6.83	6.79	6.79			
Cond (µS/cm)	710	702	700			
DO (mg/L)	0.22	0.25	0.23			
Redox (mV)	-172	~~-178.5~~	-179.9			
Salinity						
~~Nitrate~~	0.1 g/L	0.2 g/L	0.3 g/L			
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4)_____
(3)_____
(1)_____

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL GMP-4
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/1, 1996 1320 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: OVERCAST, 70°F, CALM
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with: SOUNST

WATER DEPTH 5.69 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. MW-4 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1252	1254	1257			Measured with
Temp (°C)	19.4	19.4	19.3			
pH	6.83	6.84	6.85			
Cond (µS/cm)	1,720	1,660	1,530			
DO (mg/L)	0.90	0.90	0.93			
Redox (mV)	9.4	4.9	-0.8			
Salinity						
~~Nitrate~~	0.2 g/l	0 g/l.	0 g/l	0.4 g/l		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH-G
(3) 40ml VOAs - Methane
(1) 125 ml POLY - ANIONS
(1) 250 ml POLY ALKALINITY.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-3
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/28/96, 1996 1200 am/pm Mon
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: MOSTLY SUNNY, 70s
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with:

WATER DEPTH 5.64 FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: NONE
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-3 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC AMD
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1135	1145	1150	1155		Measured with
Temp (°C)	24.0	23.3	23.1	23.0		YSI 55
pH	6.16	6.29	6.35	6.32		
Cond (µS/cm)	590	420	400	420		
DO (mg/L)	2.26	1.80	2.11	2.01		YSI 55
Redox (mV)	156.2	135.0	119.6	119.8		
Salinity						
~~Nitrate~~ VOL. (GAL)	0.1	0.2	0.3	0.4		
Sulfate						
Ferrous Iron						

VOL. REMOVED (GAL)

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH-G
(3) 40 ml VOAs - Methane
(1) 125ml Anions
(1) ~~250~~ 250 ml Plastic - Alkalinity

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL GMP-2
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/6, 1996 1200 ~~a.m./p.m.~~ NOON
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: OVERCAST
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP, TOC.

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method:
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. YMP-2 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[ ] Pump, type:_
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	10:07	1013	1018			Measured with
Temp (°C)	19.6	19.6	19.5			
pH	7.22	7.04	7.11			
Cond (µS/cm)	626	614	613			
DO (mg/L)	4.95	4.36	4.11			
Redox (mV)	+110.3	+106.4	+98.4			
Salinity						
~~Nitrate~~	.1	.2	.3			
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOA - BTEX/TVH-G
(3) 40ml VOA - METHANE
(1) 125ml ~~VOA~~ POLY - ANIONS

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL GMP-1 (number) 21 Q 4

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/1, 1996 0710 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: OVERCAST, 65°, LIGHT DRIZZLE OFF AND ON
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TEMP TOC

MONITORING WELL CONDITION:

[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with:

WATER DEPTH 3.80 TEMP TOC FT. BELOW DATUM
Measured with: SOUNDER

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. MW-1 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____

[X] Pump, type: PERISTALTIC

[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0750	0703	0706			Measured with
Temp (°C)	18.2	18.2	18.2			YSI
pH	7.04	7.03	7.03			
Cond (µS/cm)	575	574	572			HACH.
DO (mg/L)	0.95	1.03	1.04			YSI
Redox (mV)	+12.8	+516	+29.9			
Salinity						
~~Nitrate~~ & NE	0.15	0.3	0.5			
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs – BTEX/TVH-G
(3) 40ml VOAs – methane
(1) 125 ml POLY – ANIONS

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-6
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/31, 1996 1215 a.m./(p.m.)
SAMPLE COLLECTED BY: RN/SR/BD/GK of Parsons ES
WEATHER: SUNNY 78°F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):
WELL NOT COMPLETED

Check-off
1 [ ] EQUIPMENT CLEANED BEFORE USE WITH DI, ISO
Items Cleaned (List): W/C IND

2 [ ] PRODUCT DEPTH NA FT. BELOW DATUM
Measured with:
WATER DEPTH 6.37 TD = 10.37 FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: BROWN CLOUDY
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: NONE
Other comments:

Groundwater Sampling Record

Monitoring Well No. 4MP-6 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[ ] Pump, type:_
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1158	1204	1208	1210		Measured with
Temp (°C)	21.7	21.7	21.5	21.6		
pH	7.30	7.38	7.38	7.38		
Cond (µS/cm)	810	807	808	806		
DO (mg/L)	1.96	1.19	1.04	1.01		
Redox (mV)	114.2	107.9	102.9	97.9		
Salinity						
~~Nitrate~~ mg/l	0.2	0.5	0.8	0.9		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): BTEX/MTBE 4 - 40ml glass
METHANE 3 - 40ml glass
ANIONS 1 125ml plastic

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

Groundwater Sampling Record

Monitoring Well No. OW-4 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: Peristaltic
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0750	0759	0803	0810		Measured with
Temp (°C)	23.3	23.2	23.3	23.3		
pH	7.35	7.35	7.32	7.35		
Cond (µS/cm)	524	505	482	469		
DO (mg/L)	0.34	0.29	0.25	0.25		
Redox (mV)	-256.9	-243.2	-235.2	-221.8		
Salinity						
Nitrate	1 gal.	2 gal	3 gal	4.5 gal.		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOA-BTEX/TVH-G
(3) 40ml - Methane
(1) 125 - Anions

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-7
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10 29 96, 1996 1755 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 60°F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 4.30 TD=12.0 FT. BELOW DATUM
Measured with: SOUNDER

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Clear
Odor: No odor
Other Comments:

4 [ ] WELL EVACUATION:
Method:
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. CL-1 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[ ] Pump, type: Peristaltic
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1720	1735	1738	1745		Measured with
Temp (°C)	20.7	21.1	21.2	21.1		
pH	7.43	7.14	7.21	7.20		
Cond (µS/cm)	720	664	645	626		
DO (mg/L)	0.55	0.31	0.30	0.29		
Redox (mV)	-162.6	-172.2	-173.5	-173.5		
Salinity						
Nitrate						
Sulfate	1.0 mL	2.0 mL	3.0 mL	4.0 gl		
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (2) 40 ml VOA's - Preserved HCl
2, 500 ml Poly's - Unpreserved.
(1) 125 ml Plastic - Preserved.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-8
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/30/96, 1996 1735 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 70s, LIGHT WIND
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with: SOUNST

WATER DEPTH 3.73 TD=11.23 FT. BELOW DATUM
Measured with: SOUNST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLOUDY - DARK GREY (SEDIMENT IN WELL)
Odor: STRONG ODOR
Other Comments: SHEEN

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. OW-8 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC PUMP
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1708	1714	1725	1730		Measured with
Temp (°C)	20.4	20.3	20.6	20.3		YSI
pH	6.97	7.12	7.16	7.16		
Cond (µS/cm)	919	915	~~922~~ 921	925		HACH
DO (mg/L)	0.44	0.37	0.34	0.40		
Redox (mV)	-271.9	-274.0	-282.7	-273.7		
Salinity						
~~Nitrate~~	1gal	2gal.	3gal	4gal		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH-G
(3) 40ml VOAs - methane
(1) 125ml Poly - Anions

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-9
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/4/96, 1996 1005 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 45°, CALM
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC, NOTCH

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with: SOLINST INTERFACE METER MODEL 122
WATER DEPTH 2.98' TD=11.85' FT. BELOW DATUM
Measured with: SAA

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: BROWN - GREY
Odor: STRONG FUEL ODOR
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. OW-9 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0935	0940	0946	0954	1000	Measured with
Temp (°C)	19.5	19.6	19.7	19.7	19.8	
pH	6.87	6.85	6.85	6.86	6.86	
Cond (µS/cm)	526	559	574	586	593	
DO (mg/L)	0.35	0.28	0.25	0.23	0.22	
Redox (mV)	-167.3	-188.2	-196.0	-204.5	-209.1	
Salinity						
~~Nitrate~~	1 gal	2 gal.	3 gal.	4 gal	5 gal	
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4)
(3)
(1)

DUPLICATE OW-115 @ 1415 ← TIME ON BOTTLE

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-11
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/4/96, 1996 1145 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR 60°, LIGHT WIND.
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH 4.06 ~~TD~~ FT. BELOW DATUM
Measured with: SOLINST

WATER DEPTH 4.07 TD = 13.20 FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: GREY-BROWN (SEDIMENT IN WELL BOTTOM
Odor: STRONG FUEL
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. OW-11 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type:_
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1117	1125	1130	1135	1140	Measured with
Temp (°C)	20.5	20.5	20.5	20.6	20.6	
pH	6.85	6.85	6.87	6.90	6.88	
Cond (µS/cm)	776	824	851	874	889	
DO (mg/L)	0.41	0.33	0.32	0.33	0.33	
Redox (mV)	-227.3	-231.8	-228.4	-225.5	-224.2	
Salinity						
~~Nitrate~~	1gal	2gal	3gal	4gal	5gal	
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) (3) (1)

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-12
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/31/96, 1996 1500 a.m./p.m.
SAMPLE COLLECTED BY: RN/SRBL/GK of Parsons ES
WEATHER: CLEAR, 75°F, MOD. WIND
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.21 T.D=12.8 FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: DARK GREY — SEDIMENT FROM WELL BOTTOM
Odor: ORGANIC
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. OW-12 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type:_
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1435	1440	1445	1455		Measured with
Temp (°C)	20.9	20.9	20.8	20.9		YSI 55
pH	7.19	7.30	7.48	7.53		
Cond (µS/cm)	590	550	480	464		
DO (mg/L)	0.42	0.37	0.32	0.31		
Redox (mV)	-190.7	-209.7	-188.8	-212.4		
Salinity						
~~Nitrate~~	1gal	2gal	3gal.	4gal		
Sulfate						
Ferrous Iron						

REDOX READING FLUCTUATING

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40 ml VOAs - BTEX/TVH-6
(3) 40 ml VOAs - Methane
(1) 125 ml Plastic - ANIONS

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-13
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/29, 1996 0725 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BD/GK of Parsons ES
WEATHER: CLEAR,
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOP OF CASING, FLUSH MOUNT

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS: GOOD
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.31 BTOC TD = 13.15 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: MODERATE FUEL ODOR
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. MW-13 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

used flow through cell ok on D.O.

Time	0632	0640	~~0698~~ 0652	0705	0715	Measured with
Temp (°C)	16.1	16.4	17.4	18.4	18.0	YSI 55
pH	7.04	7.22	6.93	7.02	6.92	
Cond (µS/cm)	1,080	1,040	1,050	1,050	1060	OAKTON
DO (mg/L)	1.71	1.22	1.72	0.47	0.51	YSI 55
Redox (mV)	-166.7	-178.5	-172.4	-225.1	-232.1	
Salinity						
~~Nitrate~~ (Not Removed)	1.0 gal.	2.0	3.0 gal.	4.0 gal	4.5 gal	
Sulfate						
Ferrous Iron	AIR TEMP = 12.2°C					

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs – BTEX/TVH-G
(3) 40ml VOAs – METHANE ; (1) 125ml Plastic

DUPLICATE OW-110 → TIME ON LABEL = 0830

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-15
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/30/96, 1996 1005 (a.m)/p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: PARTY CLOUDY, 65°F, WINDY!
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 3.45 TOC TD=13 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. OW-15 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0940	0945	0953	1040 ~~0957~~		Measured with
Temp (°C)	19.1	19.1	19.3	19.3		YSI 55
pH	6.93	6.98	6.79	6.78		
Cond (µS/cm)	778	793	781	776		HACH
DO (mg/L)	0.43	0.35	0.26	0.24		
Redox (mV)	-62.5	-136.1	-166.6	-178.0		
Salinity						
~~Nitrate~~	1 gal	2 gal	3.5 gal	5.0 gal		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40 ml
(3)
(1)

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[X] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL GW-102
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/30, 1996 0645 (a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: Clear, 60°F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH None. FT. BELOW DATUM
Measured with:

WATER DEPTH 2.86 TD = 12.0 FT. BELOW DATUM
Measured with: SOUNST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: SL. FUEL ODOR.
Other Comments: NONE

4 [ ] WELL EVACUATION:
Method:
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. OW-102 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[ ] Pump, type:_
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0610	0625	0631	0639		Measured with
Temp (°C)	23.4	23.8	23.9	23.8		
pH	6.55	6.64	6.67	6.71		
Cond (µS/cm)	849	823	814	821		
DO (mg/L)	0.40	0.31	0.33	0.32		
Redox (mV)	+90.7	+76.2	+74.5	+65.2		
Salinity						
~~Nitrate~~	1 gal	3 gal	4 gal	5 gal		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH-G
(3) 40ml VOAs - Methane
(1) 125 ml Plastic - Anions
(1) 250 ml Plastic - Alkalinity

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[X] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW 103
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/30 1996 1033 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: Windy 65° Overcast
DATUM FOR WATER DEPTH MEASUREMENT (Describe):

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: fair
INNER PVC CASING CONDITION IS: fair
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH ~~Probes~~ Isopropanol
Items Cleaned (List): Probes

2 [ ] PRODUCT DEPTH — FT. BELOW DATUM
Measured with: —

WATER DEPTH 3.14 FT. BELOW DATUM
Measured with: Solinst water level indicator

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: clear
Odor: none
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: 5 gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: none
Other comments:

Groundwater Sampling Record

Monitoring Well No. OW103 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: Peristaltic
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1008	1015	1026	1031		Measured with
Temp (°C)	20.0	19.9	19.9	19.9		YSI 55
pH	6.82	6.84	6.87	6.88		Orion 250A
Cond (µS/cm)	510	515	519	521		Orion 140
DO (mg/L)	1.30	1.01	0.43	0.35		YSI 55
Redox (mV)	115.8	121.8	122.7	122.1		Orion 250A
Salinity (‰)	13.4	10.7	21.7	3.9		YSI 55
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size):
7 VOAs
Poly

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-104
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/29/96, 1996 _____ a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 65°
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: _____
INNER PVC CASING CONDITION IS: _____
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH _____
Items Cleaned (List): _____

2 [ ] PRODUCT DEPTH _____ FT. BELOW DATUM
Measured with: _____

WATER DEPTH 4.76 BTOC TD = 12.25' BTOC FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: NONE
Other Comments: _____

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed: _____
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: _____
Other comments: _____

Groundwater Sampling Record

Monitoring Well No. MW-104 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0850	0852	0905	0914		Measured with
Temp (°C)	18.6	18.9	18.7	18.7		
pH	7.38	7.23	7.28	7.09		
Cond (µS/cm)	750	700	700	710		
DO (mg/L)	1.44	1.23	1.19	1.18		
Redox (mV)	16.9	41.5	55.8	56.6		
Salinity						
~~Nitrate~~ GAL	1.0	2.0	3.0	4.0		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX / TVH-G
(3) 40ml VOAs - Methane
(1) 125ml Plastic - Anions

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-105
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/28, 1996 _____ a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: SUNNY, 70s
DATUM FOR WATER DEPTH MEASUREMENT (Describe):

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: NO MANHOLE COVER
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH _____ FT. BELOW DATUM
Measured with:

WATER DEPTH 6.56 TD = 12.02 FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR W/ SLIGHT YELLOW TINT
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic Pump
Volume Removed: ≥ 3 GALLONS
Observations: Water (slightly - very) cloudy CLEAR
Water level (rose - fell - no change)
Water odors: NONE
Other comments:

Groundwater Sampling Record

Monitoring Well No. OW-105 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC PUMP
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	14:35	14:45	1510	1525		Measured with
Temp (°C)	21.1	—	22.2	21.2		YSI 55
pH	7.03	PUMPED	7.05	7.14		
Cond (µS/cm)	730	DRY	660	690		
DO (mg/L)	2.18	~~3.75~~	3.75	2.22		YSI 55
Redox (mV)	219.2	—	193.1	184.8		
Salinity		—				
~~Nitrate~~ (CAL)	1	1.5	1.9	2.0		
Sulfate						
Ferrous Iron						

VOL. REMOVED

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH-G
(3) 40ml VOAs - Methane
(1) 125 ml Plastic - ANIONS

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: PUMPED WELL DRY.

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL ~~5110~~ OW106
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/30, 1996 1215 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: Sunny, windy 75°
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: fair
INNER PVC CASING CONDITION IS: fair
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH Isopropanol + distilled water
Items Cleaned (List): Probes

2 [ ] PRODUCT DEPTH — FT. BELOW DATUM
Measured with: —

WATER DEPTH 7.8 FT. BELOW DATUM
Measured with: Solinst water level indicator

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: clear
Odor: none
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: 2.5 gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: none
Other comments:

12.5
- 7.8
4.7/2 = 2.3

Groundwater Sampling Record

Monitoring Well No. OW-106 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: Peristaltic
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1125	1145	1150	1207	1215	Measured with
Temp (°C)	21.5	22.3	21.5	21.0	21.0	YSI 55
pH	6.89	6.96	6.86	7.15	6.85	Orion 250A
Cond (µS/cm)	532	534	537	544	546	Orion 1-10
DO (mg/L)		1.28	0.35	0.19	0.17	YSI 55
Redox (mV)	51.2	25.8	6.2	0.3	-0.1	Orion 250A
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size):
7 VOAs
1 Poly

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: Dry at 11:25, allowed to recharge

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-107
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/30, 1996 935 (a.m)/p.m.
SAMPLE COLLECTED BY: (RN)SR/BL/GK of (Parsons ES)
WEATHER: 55° Overcast, breezy.
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOP of CASING

MONITORING WELL CONDITION:
[ ] LOCKED: [✓] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: fair
INNER PVC CASING CONDITION IS: fair
WATER DEPTH MEASUREMENT DATUM (IS - (IS NOT)) APPARENT
[✓] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): None

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH Isopropyl alcohol and distilled water
Items Cleaned (List): Probes

2 [ ] PRODUCT DEPTH - FT. BELOW DATUM
Measured with: ~~Solinst~~

WATER DEPTH 4.40 FT. BELOW DATUM
Measured with: Solinst water level indicator

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: clear
Odor: none
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: 5 gallons
Observations: ~~Water (slightly - very) cloudy~~
Water level (rose - fell - no change)
Water odors: none
Other comments:

12.5
- 4.4
8.1
4 gallons

Groundwater Sampling Record

Monitoring Well No. OW-107 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: Peristaltic
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	905	912	918	927		Measured with
Temp (°C)	24.6	24.8	24.8	24.7		YSI 55
pH	6.37	6.70	6.77	6.76		Orion 250A
Cond (µS/cm)	203	224	252	244		Orion 140
DO (mg/L)	0.66	0.49	0.50	0.17		YSI 55
Redox (mV)	193.6	172.8	163.0	73.0		Orion 250A
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size):_____
7 VOAs
1 Poly

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method HCl Containers: VOAs
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL RW-6
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/31/96, 1996 1605 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER:
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC 6" CASING; BLACK DOT ON TOP.

MONITORING WELL CONDITION:
[ ] LOCKED: [X] UNLOCKED (NO LOCK)
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with: SOUNDER

WATER DEPTH ~~4.05~~ 3.80 TD = 15' FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLOUDY - DARK GREY (SEDIMENT IN BOTTOM OF WELL)
Odor: MODERATE; FUEL
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. RW-6 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1530	1535	1545	1555		Measured with
Temp (°C)	20.0	20.0	20.0	20.0		
pH	6.96	7.00	7.12	7.21		
Cond (µS/cm)	479.0	493	484			
DO (mg/L)	0.45	0.38	0.30	0.24		
Redox (mV)	-169.8	-201.3	-256.5	-264.2		
Salinity						
~~Nitrate~~	1 gal	2 gal	4 gal	6 gal.		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40 ml VOAs – BTEX/TVH-G
(3) 40 ml VOAs – Methane
(1) 125 ml Poly – Anions.

DUPLICATE SAMPLE: OW-111

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL RW-13
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/3, 1996 _____ a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 50°F, CALM
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC @ 6" CASING WHICH NARROWS TO A 2" WELL; BLACK DOT. TOC IS ~ @ 2-3" BELOW GROUND SURFACE.
MONITORING WELL CONDITION:
[ ] LOCKED: [X] UNLOCKED
WELL NUMBER (IS) IS NOT) APPARENT
STEEL CASING CONDITION IS: _____
INNER PVC CASING CONDITION IS: _____
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH _____
Items Cleaned (List): _____

2 [ ] PRODUCT DEPTH NONE, POSSIBLE SHEEN FT. BELOW DATUM
Measured with: SOLINST

WATER DEPTH 2.85 TD=14.7 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: MODERATE FUEL
Other Comments: _____

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed: _____
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: _____
Other comments: _____

Groundwater Sampling Record

Monitoring Well No. RW-13 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1700	1708	1716	1720	1725	Measured with
Temp (°C)	19.8	19.9	20.0	19.9	19.8	
pH	7.15	7.16	7.14	7.14	7.11	
Cond (µS/cm)	659	649	640	638	636	
DO (mg/L)	0.37	0.29	0.25	0.24	0.23	
Redox (mV)	~~655~~ 54	-35.0	-155.5	-164.	-176.1	
Salinity						
~~Nitrate~~	1 gal	2 gal	3 gal	5 gal	6 gal.	
~~Sulfate~~						
~~Ferrous Iron~~						

R changed Redox Probe

7 [ ] SAMPLE CONTAINERS (material, number, size): (4)
(3)
(1)

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[X] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL RW-15
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/3/96, 1996 1610 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 50°F, LIGHT WIND
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC ON 6" CASING WHICH NARROWS TO A 2" WELL. BLACK MARK

MONITORING WELL CONDITION:
[ ] LOCKED: [X] UNLOCKED
WELL NUMBER (IS / IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH NONE FT. BELOW DATUM
Measured with: SOLINST HYDRO CARBON.

WATER DEPTH 5.82' TD = 15.1 FT. BELOW DATUM
Measured with: SOLINST HYDRO

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR WITH SOME ORGANIC MATTER (GRASS CLIPINGS?)
Odor: MODERATE FUEL
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. RW-15 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1537	1544	1550	1556	1601	Measured with
Temp (°C)	20.0	20.1	20.1	20.2	20.2	YSI 55
pH	6.83	6.89	6.91	6.97	6.92	ORION 250
Cond (µS/cm)	780	732	718	698	688	HACH
DO (mg/L)	0.45	0.30	0.26	0.23	0.21	YSI 55
Redox (mV)	-152	-206.4	-217.9	-227.3	-228.7	ORION 250
Salinity						
~~Nitrate~~	1 gal	2 gal	3 gal	4 gal	5 gal.	
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) (3) (1)

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[X] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

ST

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL R-1
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/29/96, 1996 1200 a.m./p.m. Noon
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 65°F, WINDY,
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.01 BTOC TD=15.05' BTOC FT. BELOW DATUM
Measured with: SOUNDST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: MODERATE FUEL ODOR
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. P-1 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: _____
[X] Pump, type: PERISTALTIC
[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1130	1142	1146	1155		Measured with
Temp (°C)	—	19.4	19.3	19.2		
pH	7.11	7.21	7.04	7.23		
Cond (µS/cm)	670	770	706	710		
DO (mg/L)	0.36	0.38	0.39	0.35		
Redox (mV)	-175.6	-178.9	-169.3	-173.4		
Salinity						
~~Nitrate~~ gal	1 gal	2.5 gal	3.5 gal	5 gal		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/MTBE-G
(3) 40ml VOAs - METHANE
(1) 125ml Plastic - ANIONS

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL P-2
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/29/96, 1996 1505 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: SUNNY 70°F, WINDY
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 3.94 TD = 15.2 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: CLEAR
Odor: NONE
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. P-2 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

HACH CONDUCTIVITY CAL.B. 1452 → 1413

Time	1425	1432	1446	1455	1500	Measured with
Temp (°C)	19.5	19.8	19.7	19.3	19.4	
pH	7.38	7.31	7.31	6.95	6.78	
Cond (µS/cm)	786	802	805	813	814	HACH COND/TDS
DO (mg/L)	0.71	0.50	0.40	0.27	0.26	
Redox (mV)	-122.7	-135.0	-161.4	-170.2	-176.4	
Salinity						
~~Nitrate~~	1.5gal	3.0gal	4.5gal	6.0gal	6.5	
~~Sulfate~~	ODOR					
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH-6
(3) 40ml VOAs - METHANE
(1) <25ml Plastic - ANIONS

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL P-3
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/29, 1996 1640 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 75°F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 4.61 BTOC TD = 15.0 FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: SL. CLOUDY (GREY)
Odor: STRONG FUEL ODOR
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC PUMP
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. P-3 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	16.06	1614	1622	1628		Measured with
Temp (°C)	20.1	20.1	20.1	20.1		
pH	7.03	7.26	7.13	7.14		
Cond (µS/cm)	1,862	1,881	1,903	1908		
DO (mg/L)	0.476	0.51	0.34	0.27		
Redox (mV)	-142.3	-143.2	-141.1	-139.8		
Salinity						
~~Nitrate~~ gal	1.5	3.0	4.5	6.0		
~~Sulfate~~						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size):_____

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL P-4
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 11/4/96, 1996 0825 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 32°F, LIGHT WIND
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH 3.82 BROWN BLACK FT. BELOW DATUM
Measured with:

WATER DEPTH 3.98 FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: BROWN-GREY
Odor: VERY STRONG
Other Comments:

4 [ ] WELL EVACUATION:
Method: PERISTALTIC
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. P-4 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type:_
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0848	0855	0810	0820		Measured with
Temp (°C)	19.2	19.3	19.4	19.4		
pH	6.93	7.25	7.44	7.46		
Cond (µS/cm)	533	534	537	540		
DO (mg/L)	0.38	0.30	0.23	0.21		
Redox (mV)	-139.4	-155.5	-175.8	-183.4		
Salinity						
~~Nitrate~~	1 gal	2 gal	4 gal	6 gal		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4)
(3)
(1)

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/27/96 - 11/3/96

GROUND WATER SAMPLING RECORD - MONITORING WELL ~~OW~~ SR P-5
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/30/96, 1996 1215 a.m./p.m.
SAMPLE COLLECTED BY: RN/SR/BL/GK of Parsons ES
WEATHER: CLEAR, 75°F, WINDY
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[X] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 3.35' TOC TD=15' FT. BELOW DATUM
Measured with: SOLINST

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method:
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors:
Other comments:

Groundwater Sampling Record

Monitoring Well No. P-5 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: PERISTALTIC
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1140	1145	1155	1205		Measured with
Temp (°C)	21.2	21.2	21.2	21.3		
pH	7.14	7.18	7.20	7.17		
Cond (µS/cm)	865	894	920	924		
DO (mg/L)	0.38	0.29	0.24	0.22		
Redox (mV)	-175.8	-187.6	-190.2	-192.0		
Salinity						
~~Nitrate~~	1.0 gal.	2.0 gal	4.0 gal	6.0 gal		
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (4) 40ml VOAs - BTEX/TVH-6
(3) 40 ml VOAs - Methane
(1) 125 ml Plastic - Anions

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[X] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL 4mp-53 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/7/97, 1996 1930 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH See Tab Book FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: slightly cloudy
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: —
Other comments: —

Groundwater Sampling Record

Monitoring Well No. Emp-55 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[ ] Pump, type: geopump 2
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS: Well went dry didnot recover well

Time	7:15pm					Measured with
Temp (°C)	24.7					
pH	6.84					
Cond (µS/cm)	.616					
DO (mg/L)	3.13					
Redox (mV)	-75.4					
Salinity	X					
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 voas!
3 methane
3 aromatic

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added: HCl to all

Method Methane Containers: 3 voas
Method Aromatics Containers: 3 voas
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL 4mp-5d (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/7/97, 1996 1100 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear and Sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): Toc

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: Slightly rusted
INNER PVC CASING CONDITION IS: good
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [X] EQUIPMENT CLEANED BEFORE USE WITH Isopropal
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.51' FT. BELOW DATUM
Measured with: Water level indicator Slope Ind Co.

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Brownish - Cloudy silt
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic Pump
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: —
Other comments:

Total depth - 15.5

Groundwater Sampling Record

Monitoring Well No. MP-5d (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: None
[ ] Pump, type: grundfos pump 2
[ ] Other, describe:

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS: start time 11:45

Time	1150	1200	1215	1225		Measured with
Temp (°C)	22.6	21.5	21.9	21.3		
pH	6.18	6.42	6.52	6.56		
Cond (µS/cm)	.689	.816	.814	.814		
DO (mg/L)	.92	.40	.35	.32		
Redox (mV)	120.1	-51.8	-112.2	-115.6		
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 VOAs 3 are Three 3 Aromatic

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method____ Containers:____
Method____ Containers:____
Method____ Containers:____

[ ] Preservatives added: HCl: all 6

Sample time 1225.

Method Aromatics Containers: 3 VOAs
Method MeThane Containers: 3 VOAs
Method____ Containers:____
Method____ Containers:____

9 [ ] CONTAINER HANDLING:

[✓] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL GMP-7 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10-8-97, 1996 1510 a.m. (p.m.)
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER:
DATUM FOR WATER DEPTH MEASUREMENT (Describe):

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH Isopropanol / water
Items Cleaned (List): DO meter, pH/Redox meter, Conductivity meter

2 [ ] PRODUCT DEPTH N/A FT. BELOW DATUM
Measured with:

WATER DEPTH FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method: peristaltic pump - Geopump I
Volume Removed:
Observations: Water (slightly) very) cloudy
Water level (rose - fell - no change)
Water odors: NO
Other comments:

Groundwater Sampling Record

Monitoring Well No. _____ (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: _____
[X] Pump, type: geopump 1
[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1430	14:40	14:50	1500	1510	Measured with
Temp (°C)	23.8	23.7	23.6	23.5	23.5	
pH	7.59	7.11	7.12	7.27	7.29	
Cond (mS/cm)	.841	.822	.802	.797	.796	
DO (mg/L)	17.19	14.92	10.50	10.41	10.21	MEMBRANE BRACED
Redox (mV)	-70.6	-74.9	-51.1	-47.5	-46.1	
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (6) 40 mL VOA's preserved w/ HCL

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration:
Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

[ ] Preservatives added:

Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

Calibrated Instruments 0715

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-15 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/9/97, 1996 0830 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL - of Parsons ES
WEATHER: Clear, Sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: Rusty
INNER PVC CASING CONDITION IS: Good
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH FT. BELOW DATUM
Measured with: ~~Solinst / oil-water interface probe~~ RB
slope intercept - water level gauge

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Clear
Odor: None
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: about 3/4 gallon
Observations: Water (slightly - very) cloudy Clear
Water level (rose - fell - no change)
Water odors: None
Other comments:

DTW - 4.76'
T.D. - 26.00'

21.24 need approx 2 gals

Groundwater Sampling Record

Monitoring Well No. _____ (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: _____

[X] Pump, type: geopump 2

[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS: Well went dry right after 1st reading at slowest pumping rate

Time	0800					Measured with
Temp (°C)	20.9					
pH	7.03					
Cond (µS/cm)	1,230					
DO (mg/L)	.81					
Redox (mV)	-110.9					
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 VOAs:
3 Methane
3 Aromatics

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration:
Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

[ ] Preservatives added:
Method Methane Containers: 3 VOAs
Method Aromatics Containers: 3 VOAs
Method _____ Containers: _____
Method _____ Containers: _____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL Amp-21 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/8/97, 1996 1800 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear, sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS: Good
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 4.24' FT. BELOW DATUM
Measured with: slope indicator - Water level gauge

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Clear
Odor: None
Other Comments: -

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: @ 1.5 gal
Observations: Water (~~slightly - very~~) cloudy - None
Water level (rose - fell - no change)
Water odors: None
Other comments:

DTW - 4.24'
T.D. - 25.28'
21.00
10.5 1.5
5.25 1.5
about (2.5) - 3 gal

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Groundwater Sampling Record

Monitoring Well No. Hmp-21 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD: Very slow pumping rate

[ ] Bailer made of: _____

[ ] Pump, type: geopump z

[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS: Very slow pumping rate

Time	~~1730~~ RB 1745	~~1750~~ RB 1750	1755	1800		Measured with
Temp (°C)	22.2	21.1	20.9	20.8		
pH	6.74	6.75	6.76	6.77		
Cond (µS/cm)	.955	.940	.937	.936		
DO (mg/L)	.59	.41	.34	.31		
Redox (mV)	-110.8	-107.6	-106.7	-106.9		
Salinity						
Nitrate	X	X	X	X	X	
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 voas:
3 methane
3 Aromatics.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

[ ] Preservatives added: HCL

Method methane Containers: 3 voas
Method Aromatics Containers: 3 voas
Method _____ Containers: _____
Method _____ Containers: _____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL 4mp-22 (RB) (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/8/97, 1996 1400 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: clear sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:

[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: good
INNER PVC CASING CONDITION IS: good
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.31' FT. BELOW DATUM
Measured with: slope indicator - water level gauge

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: at first silty then cleared up
Odor: None
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed:
Observations: Water (slightly very) cloudy - then cleared up
Water level (rose - fell - no change)
Water odors: little or none
Other comments:

DTW - 5.31
T.D. - 6.85

1.5' column
- Need @ .5 gal

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Groundwater Sampling Record

Monitoring Well No. 4mp-22 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: —
[ ] Pump, type: geopump 2
[ ] Other, describe:

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS: Well went Dry at slowest pumping rate also in the sun (couldn't avoid

Time	1400					Measured with
Temp (°C)	32.3					
pH	6.89					
Cond (µS/cm)	.690					
DO (mg/L)	4.63					
Redox (mV)	174.3					
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 RB VOCs
3 RB Methane
3 RB Aromatics.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method____ Containers:____
Method____ Containers:____
Method____ Containers:____

[ ] Preservatives added: HCL

Method Methane Containers: 3 RB VOAs
Method Aromatics Containers: 3 VOAs
Method____ Containers: RB
Method____ Containers:____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL 4MP-23 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 8 Oct., 1996 ~~1637~~ 1630 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER:
DATUM FOR WATER DEPTH MEASUREMENT (Describe):

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH Isopropanol / water
Items Cleaned (List): DO/temp meter
pH / redox meter
Conductivity meter

2 [ ] PRODUCT DEPTH None FT. BELOW DATUM
Measured with:

WATER DEPTH 6.47 FT. BELOW DATUM
Measured with: Interface Meter

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method:
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: None
Other comments:

Groundwater Sampling Record

Monitoring Well No. _____ (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: _____
[ ] Pump, type: _____
[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1555	10:05	16:15	10:30		Measured with
Temp (°C)	25.7	28.4	27.6	28.3		
pH	6.92	7.09	7.14	7.14		
Cond (µS/cm)	.704	.704	.711	.720		
DO (mg/L)	fluctuating 13.2 - 29.2	16.5	14.5		≈4.35	
Redox (mV)		20.7	22.0	29.6		
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

well dry after bubbles in tube

DO (mg/L) 18.7

7 [ ] SAMPLE CONTAINERS (material, number, size): _____

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration:
Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

[ ] Preservatives added:

Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-3 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/8/97, 1996 1215 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear Sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS: Decent
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 6.07' FT. BELOW DATUM
Measured with: Slope indicator - Water level gauge

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: almost clear
Odor: None
Other Comments: Slight, very slight amt of sediment - blk.

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: None
Other comments:

DTW - 6.07

TD - 13.07

7.00 ≈ 3.5 gals

Groundwater Sampling Record

Monitoring Well No. MW-3 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: _____

[X] Pump, type: 9Cpump 2

[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1145	1155	1200	1205	1215	Measured with
Temp (°C)	23.2	22.8	22.7	22.7	22.7	
pH	6.97	7.08	7.15	7.19	7.23	
Cond (µS/cm)	.615	.488	.434	.412	.400	
DO (mg/L)	.73	.31	.24	.22	.21	
Redox (mV)	-76.2	-137.9	-182.7	-193.6	-200.1	
Salinity	X	X	X	X	X	
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 VOAs:
3 methanol
3 aromatics.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

[X] Preservatives added: HCl

Method Methanol Containers: 3 VIALS
Method Aromatics Containers: 3 VOAs
Method _____ Containers: _____
Method _____ Containers: _____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/14/97

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-4 (MS/MSD)
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/8/97, 1996 1930 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL - of Parsons ES
WEATHER: Clear Sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe):

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: Rusty
INNER PVC CASING CONDITION IS: OK
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.32' FT. BELOW DATUM
Measured with: Slope indicator - Water level gage

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Very clear
Odor: None
Other Comments: -

4 [ ] WELL EVACUATION:
Method: Peristaltic Pump
Volume Removed: ~~~ 3.5 gal~~ RB @ 4 gal
Observations: Water (~~slightly - very~~) cloudy None - clear
Water level (rose - fell - no change)
Water odors: None
Other comments: Very clear H2O

DTW - 5.32
T.D. - 13.12
6.8 @ 3.4 gal

Groundwater Sampling Record

Monitoring Well No. DN2-4 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____

[X] Pump, type: Geo pump 2

[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1855	1905	1915	1930		Measured with
Temp (°C)	24.4	25.1	25.3	25.3		
pH	7.17	7.09	7.12	7.15		
Cond (µS/cm)	.661	.573	.535	.504		
DO (mg/L)	.72	.31	.25	.21		
Redox (mV)	-139.5	-192.0	-203.6	-212.2		
Salinity	X	X	X	X	X	
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 18 VOAs:
9 Methane
9 Aromatics

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added: HCl

Method Methane Containers: 9 VOAs
Method Aromatics Containers: 9 VOAs
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-7 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/8/97, 1996 1100 (a.m)/p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear Sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: Rusty
INNER PVC CASING CONDITION IS: old
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.35' FT. BELOW DATUM
Measured with: slope indicator - water level gauge

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Relatively Clear
Odor: HC odor
Other Comments: Very slightly sedimented

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: @ 3.5 gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: Yes - somewhat HC
Other comments:

DTW 5.35'
T.D. 11.95'

6.60 ≈ 3.3 gal

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Groundwater Sampling Record

Monitoring Well No. OW-7 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[ ] Pump, type: Geopump 2
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1030	1045	1050	1100		Measured with
Temp (°C)	23.4	23.5	23.5	23.4		
pH	6.77	6.67	6.70	6.71		
Cond (µS/cm)	.734	.645	.575	.558		
DO (mg/L)	.57	.29	.22	.19		
Redox (mV)	-164.4	-174.8	-190.0	-196.8		
Salinity						
Nitrate	X	X	X	X	X	
Sulfate	X	X	X	X	X	
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 VOAs:
3 methane
3 aromatics.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added: HCL

Method Methane Containers: 3 VOAs
Method Aromatics Containers: 3 VOAs
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-8 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/8/97, 1996 1835 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER:
DATUM FOR WATER DEPTH MEASUREMENT (Describe):

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH isopropanol/water
Items Cleaned (List): DO meter
pH/redox meter
conductivity meter

2 [ ] PRODUCT DEPTH None FT. BELOW DATUM
Measured with:

WATER DEPTH 4.9' FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump geopump 1
Volume Removed:
Observations: Water (slightly / very) cloudy
Water level (rose - fell - no change)
Water odors: strong
Other comments:

Groundwater Sampling Record

Monitoring Well No. OW-8 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[ ] Pump, type:_____
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1755	18:10	1820	1835		Measured with
Temp (°C)	21.9	22.1	21.8	21.7		
pH	7.32	7.63	7.49	7.40		
Cond (µS/cm)	.964	.894	.799	.781		
DO (mg/L)	.86	.41	.31	.22		
Redox (mV)	-195.0	-243.6	-257.8	-260.1		
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (6) 40ml VOA's preserved w/ HCL

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-9 (Dup) OW-111
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/8/97, 1996 1615 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear, Sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 4.33' FT. BELOW DATUM
Measured with: Slope indicator - water level gauge

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Silty Dark Brn-Blk
Odor: Yes Somewhat strong
Other Comments: ~~slight sheen in bucket water~~ RB

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: @ 5 gal
Observations: Water (slightly - (very) cloudy — mid - very gray Blk color
Water level (rose - fell - no change)
Water odors: Yes fairly strong HC odor
Other comments: sheen in bucket water

DTW 4.33'

T.D. 12.80'

8.5 - Need ≈ 4.25 gal

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Groundwater Sampling Record

Monitoring Well No. OW-9 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[M] Pump, type: geopump 2
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1530	1540	1550	1605	1615	Measured with
Temp (°C)	24.0	24.5	23.8	23.2	23.1	
pH	6.74	6.57	6.53	6.51	6.50	
Cond (µS/cm)	.800	.790	.745	.733	.742	
DO (mg/L)	.53	.24	.22	.21	.19	
Redox (mV)	-139.0	-161.3	-172.9	-167.4	-172.1	
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 12 voas!
6 methane (3 Dup)
6 Aromatics (3 Dup)

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added: HCl

Method Aromatics Containers: 6 voas
Method Methane Containers: 6 voas
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[M] Container Sides Labeled
[ ] Container Lids Taped
[M] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL OW-11 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/9/97, 1996 1215 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear, sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: Rusty
INNER PVC CASING CONDITION IS: decent
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.60' FT. BELOW DATUM
Measured with: Slope indicator, RB - water level gage

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor: yes, strong (H2S) odor
Other Comments: some sediment apparent - Blk
Oily Sheen on wate

4 [ ] WELL EVACUATION:
Method: Peristaltic Pump
Volume Removed: 3.5 - 4.0 gal
Observations: Water (slightly - very) cloudy moderately w/ a lot of Sediment - t
Water level (rose - fell - no change)
Water odors: Yes strong H2S odor
Other comments: Fair amt. of Sediment in water - Blk
oily sheen on water

DTW - 5.60'
TD - 13.15'

7.55/.5

3.75 gal

- Eventually all the sedi[illegible] disappeared and H_2O beca[illegible]

Groundwater Sampling Record

Monitoring Well No. OW-11 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: geopump z
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1130	1140	1150	1200	1215	Measured with
Temp (°C)	23.4	23.7	24.0	24.0	23.9	
pH	6.62	6.60	6.58	6.56	6.57	
Cond (µS/cm)	.788	.778	.780	.791	.800	
DO (mg/L)	.94	.65	.57	.50	.47	
Redox (mV)	-153.0	-164.6	-174.5	-182.6	-186.0	
Salinity						
Nitrate	X	X	X	X	X	
Sulfate	X	X	X	X	X	
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size):_____

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL RW-4 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/9/97, 1996 1400 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear, sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: Rusty
INNER PVC CASING CONDITION IS: pretty good
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.82' FT. BELOW DATUM
Measured with: slope indicator - Water level gage

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Clear
Odor: ~
Other Comments: ~

4 [ ] WELL EVACUATION: Peristaltic Pump
Method:
Volume Removed: @ 4 gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: No
Other comments: Very sediment free

TD - 14.82
DTW - 5.82
9.00 (≈ 4.5 gal)

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Groundwater Sampling Record

Monitoring Well No. RW-4 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: _____

[X] Pump, type: geopump2

[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1310	1320	1330	1345	1400	Measured with
Temp (°C)	21.9	21.6	21.9	21.9	22.0	
pH	6.55	6.59	6.65	6.70	6.72	
Cond (µS/cm)	.924	.862	.851	.867	.863	
DO (mg/L)	.50	.26	.22	.21	.22	
Redox (mV)	-119.6	-124.4	-135.9	-149.4	-152.3	
Salinity						
Nitrate	X	X	X	X	X	
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 VOAs;
3 MeThane
3 Aromatics

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

[ ] Preservatives added: HCl

Method MeThane Containers: 3 VOAs
Method Aromatics Containers: 3 VOAs
Method _____ Containers: _____
Method _____ Containers: _____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL RW-6 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10-8-97, 1996 1000 (a.m)/p.m.
SAMPLE COLLECTED BY: RB/BB/BL - of Parsons ES
WEATHER: Clear Sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH 5.57 FT. BELOW DATUM
Measured with: Slope indicator - water level gauge

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: @ 4 Gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: [illegible] No
Other comments: Black sediment - Fair amt. (parti

DTW - 5.57'
T.D. - 14.95

9.38 ≈ 4.7 gals

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Groundwater Sampling Record

Monitoring Well No. RW-6 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: —
[ ] Pump, type: geo pump 2
[ ] Other, describe: —

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0920	0930	0937	0945	1000	Measured with
Temp (°C)	20.7	21.2	21.4	21.6	21.7	
pH	7.02	6.66	6.64	6.70	6.69	
Cond (µS/cm)	.750	.704	.698	.699	.693	
DO (mg/L)	.54	.33	.28	.24	.22	
Redox (mV)	-109.2	-135.4	-162.5	-173.1	-178.2	
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 voas
3 methane
3 Aromatics

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method ____ Containers: ____
Method ____ Containers: ____
Method ____ Containers: ____

[ ] Preservatives added: HCl

Method # Methane Containers: 3 voas
Method # Aromatics Containers: 3 voas
Method ____ Containers: ____
Method ____ Containers: ____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: ____

GROUNDWATER SAMPLING RECORD

Calibrated Instruments 0730

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL RW-15 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/8/97, 1996 0830 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear
DATUM FOR WATER DEPTH MEASUREMENT (Describe): Toc

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS: Decent
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH FT. BELOW DATUM
Measured with:

WATER DEPTH FT. BELOW DATUM
Measured with: Slope indicator co. Water level gauge

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Clear
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: 4 Gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: Very slight
Other comments: Some sediment in water slight

DTW = 6.61'
Well Bottom = 15.20'

8.6 - 4.3 gals purged = 3 vols

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Groundwater Sampling Record

Monitoring Well No. RW-15 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of: —
[ ] Pump, type: qed pump
[ ] Other, describe: _____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS: started 0800

Time	0800	0810	0815	0820	0830	Measured with
Temp (°C)	20.7	21.1	21.3	21.4	21.4	
pH	6.61	6.49	6.46	6.80	6.88	
Cond (µS/cm)	.750	.653	.621	.605	.592	
DO (mg/L)	.680	.350	.300	.230	.200	
Redox (mV)	-108.3	-87.6	-108.5	-123.7	-134.4	
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 VOAs
3 Methanol
3 Aromatics

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method _____ Containers: _____
Method _____ Containers: _____
Method _____ Containers: _____

[ ] Preservatives added: HCl

Method Methanol Containers: 3 VOAs
Method Aromatics Containers: 3 VOAs
Method _____ Containers: _____
Method _____ Containers: _____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: _____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/14/97

GROUND WATER SAMPLING RECORD - MONITORING WELL P-1 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10-8-97, 1996 1205 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER:
DATUM FOR WATER DEPTH MEASUREMENT (Describe):

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS:
INNER PVC CASING CONDITION IS:
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH isopropanol + water
Items Cleaned (List): DO meter
PH meter / Redox meter
conductivity meter

2 [ ] PRODUCT DEPTH N/A FT. BELOW DATUM
Measured with:

WATER DEPTH 6.2 FT. BELOW DATUM
Measured with: Interface Meter - Solinst

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump Cropump I
Volume Removed: 4.5 gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: odor
Other comments:

15
8.0

Groundwater Sampling Record

Monitoring Well No. D-1 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: Geopump1
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	1130	1145	1155	1205		Measured with
Temp (°C)	22.4	22.3	25.1	27.0		
pH	6.45	6.62	6.63	6.69		
Cond ~~(µS/cm)~~ mS/cm	2.86	2.55	2.59	2.71		
DO (mg/L)	~~4.15~~	~~4.36~~	2.19	5.19	→ DO METER MEMBRANE BROKE	
Redox (mV)	-117.1	-117.1	-153.2	-162.5		
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size):_____
(1) 40ml VOAs w/ HCL
Sampling for methane & Aromatics

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

4.76
26.00

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL MW-4 (Dup) DUP (well number) OW-11

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10/9/97, 1996 1010 a.m./p.m. TIME: 10
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Clear Sunny
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:

[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: Rust
INNER PVC CASING CONDITION IS: decent
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[X] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH
Items Cleaned (List):

2 [ ] PRODUCT DEPTH 4.65' FT. BELOW DATUM
Measured with: Solinst oil-water interface probe

WATER DEPTH 5.48' FT. BELOW DATUM
Measured with: Solinst oil-water interface probe

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor: Some HC odor strong
Other Comments: .83' product in well

4 [ ] WELL EVACUATION:
Method: Peristaltic Pump
Volume Removed: @ 3.5 gal - 4.0 gal
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: Yes strong
Other comments: product in well

4.65 DTP
5.48 - DTW
.83' product

TD - 15.00

10/.5 - 5 gal

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Groundwater Sampling Record

Monitoring Well No. MP-4 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____
[X] Pump, type: geopump 2
[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0930	0940	0950	1000	1010	Measured with
Temp (°C)	~~22.7~~	22.4	21.9	22.1	22.1	
pH	7.38	7.37	7.39	7.41	7.40	
Cond (µS/cm)	.526	.514	.500	.501	.501	
DO (mg/L)	1.40	.41	.33	.33	.32	
Redox (mV)	-129.9	-147.9	-155.9	-158.2	-160.2	
Salinity	X	X	X	X	X	
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): 12 VOAs
6 Methane
6 Aromatics

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration:
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added: HCl

Method Methane Containers: 6 VOAs
Method Aromatics Containers: 6 VOAs
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled
[ ] Container Lids Taped
[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:_____

GROUNDWATER SAMPLING RECORD

Sampling Location Langley AFB - IRP Site 4
Sampling Dates 10/6/97 - 10/10/97

GROUND WATER SAMPLING RECORD - MONITORING WELL P-5 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 10-9-97, 1996 1030 a.m./p.m.
SAMPLE COLLECTED BY: RB/BB/BL of Parsons ES
WEATHER: Sunny, clear
DATUM FOR WATER DEPTH MEASUREMENT (Describe): TOC

MONITORING WELL CONDITION:
[ ] LOCKED: [ ] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: rusty
INNER PVC CASING CONDITION IS: TOC cracked
WATER DEPTH MEASUREMENT DATUM (IS - IS NOT) APPARENT
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

Check-off

1 [ ] EQUIPMENT CLEANED BEFORE USE WITH Isopropanol / DI water
Items Cleaned (List): DO meter
pH/redox/temp meter
conductivity meter

2 [ ] PRODUCT DEPTH None FT. BELOW DATUM
Measured with:

WATER DEPTH 21.21' FT. BELOW DATUM
Measured with:

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance:
Odor:
Other Comments:

4 [ ] WELL EVACUATION:
Method: Peristaltic pump geopump I
Volume Removed:
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: Strong
Other comments: black sediment

Depth to bttm - 15.2'

L:\forms\gwsample.doc

Groundwater Sampling Record

Monitoring Well No. P-5 (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:_____

[X] Pump, type: Geopump I

[ ] Other, describe:_____

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

Time	0820	0830	0840	0800 BAB		Measured with
Temp (°C)	21.1	22.1	22.5			
pH	6.74	6.76	6.85	6.81		
Cond (µS/cm)	.518	.588	.605			
DO (mg/L)	1.33	.55	.28			
Redox (mV)	-171.2	-88.2	-92.8			
Salinity						
Nitrate						
Sulfate						
Ferrous Iron						

7 [ ] SAMPLE CONTAINERS (material, number, size): (6) 40 mL VOA's preserved w/ HCl to sample for Methane & Aromatics

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

[ ] Preservatives added:

Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____
Method_____ Containers:_____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: well went dry after 2.5 gallons removed allowing recharge and will collect a sample.

HACH ANALYSIS RECORDS

OCT. - NOV. 1996

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/1/96

SAMPLE I.D.: 4MP-1

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0722	0725	0.27 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0728	0738	-0.000 mg/L	sample
						mg/L	sample
~~Nitrate~~ TOTAL IRON	~~50.05.1~~	0 - 30.0 mg/L	1	0736	0739	0.17 mg/L	sample
						mg/L	sample
~~Total Iron~~ Nitrate	50.03.1	0 - 5.10 mg/L	1	~~0730~~ 0736	0740	-0.4 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	~~0750~~ 0756	0756	28.39 mg/L	DI or (50) mg/L
						26.13 mg/L	(DI) or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	0743	0746	0.4 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L		0752	0757	-0.008 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 50ml / 1.6N DM=2 — 132 digits

Chloride Sample Size = — N/A digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 45 ppm

Technician: B LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/1/96

SAMPLE I.D.: UMP-2

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1034	1042	0.00 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1043	1053	+0.008 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1050	1056	0.5 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1051	1054	+0.091 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1110	1116	48.36 mg/L	DI or 50mg/L
						46.61 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1002	1004	-0.1 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1109	1114	-0.016 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20mL 1.6N DM=5 — 61 digits

Chloride Sample Size = — N/A digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 35 ppm

Technician: BLEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/28/96

SAMPLE I.D.: 4 MP-3

FILTERED (circle): YES (NO)

COLOR / ODOR: LIGHT YELLOW NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1222	1225	1.62	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1227	38	0.000	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1233	1239	-0.7*	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1236	1240	2.33	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1245	1251	56.62	mg/L	(DI) or 50mg/L
						57.80	mg/L	DI or (50mg/L)
Manganese	52.13.1	0 - 20.0 mg/L	1	1243	1246	0.3	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1302	1307	0.090	mg/L	DI
							mg/L	DI

DILUTE 2X
30.65
34.24

HACH Titrations:

Alkalinity — Sample Size = 100 — 1.6N DM = 1.0 — 155 digits

~~Chloride — Sample Size =~~ ~~digits~~

CHEMet Color Tests:

Ammonia: 0 ppm

CO_2: (0 mL A-1910 added for sulfide interference) — 130 ppm

Technician: BL

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

* YELLOW COLOR INTERFERENCE

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/1/96

SAMPLE I.D.: 4MP-4

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1343	1346	0.84 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1348	1358	0.003 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1355	1401	0.1 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1356	1359	0.75 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1407	1412	29.26 mg/L	DI or (50) mg/L
						29.88 mg/L	(DI) or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1402	1404	1.6 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1409	1414	0017 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20 ml 1.6N DM=5 — 61 digits

Chloride Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 35 ppm

Technician: BRAD LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 1/11/96

SAMPLE I.D.: LMP-5 SHALLOW

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	10	1821	1824	4.49	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1826	1836	0.025	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1830	1836	~~1.36~~	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	10	1834	1838	4.50	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1844	1849	6.67	mg/L	DI or 50mg/L
						9.24	mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1840	1842	1.8	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1847	1852	~~0.000~~	mg/L	DI
						0.011	mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20 — Titrate with 1.6 N H_2SO_4 — Digit Multiplier = 5 — 69 digits

CHEMet Color Tests:

Ammonia	4	ppm
CO_2 (0 mL A-1910 added for sulfide interference)	140	ppm

Technician: BLEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/1/96

SAMPLE I.D.: 4MP-5 DEEP

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR/STRONG HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1642	1645	1.72	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1647	1657	-0.003	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1654	1700	0.2	mg/L	sample
					X		mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	1656	1659	1.67	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1704	1709	0.77	mg/L	DI or (50)mg/L
						1.64	mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1700	1702	0.1	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1707	1712	0.008	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20ml 1.6N DM=5 — 92 digits

Chloride Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 100 ppm

Technician: BC

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/31/96

SAMPLE I.D.: GMP-6

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1247	1250	0.11 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1252	1302	0.000 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1304	1310	0.9 mg/L	sample
				~~1305~~	~~1316~~	0.11 mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1308	1311	~~0.00~~ mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	1324	1329	29.00 mg/L	DI or 50mg/L
						27.31 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1314	1316	0.00 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	~~1327~~	1333	.022 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 50ml 1.6N DM-2 — 194 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 — (0 mL A-1910 added for sulfide interference) — 60 ppm

Technician: BLEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/31/96

SAMPLE I.D.: GMP-7

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1645	1648	0.07 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1651	1701	-0.001 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1657	1703	-0.4 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1659	1702	0.04 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	10	1700	1718	18.89 mg/L	DI or 50mg/L
						14.48 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1705	1707	0.1 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1700	1716	0.013 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 50 1.6N 2.0 — 179 digits

Chloride Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 25 ppm

Technician: BRAD LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/28/96

SAMPLE I.D.: GMP-8

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR AFTER → STRONG ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1736	1740	2.22 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		1742	1753	0.000 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		1748	1754	0.05 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L		1752	1755	2.07 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L		1758	1804	14.68 mg/L	DI or 50mg/L
						19.15 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L		1907	1810	0.1 mg/L	sample
						~~0.1~~ mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L		1810	1816	0.012 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 1.6N DM=1.0 — 274 digits

~~Chloride Sample Size = digits~~

CHEMet Color Tests:

Ammonia	0	ppm
CO_2 (0 mL A-1910 added for sulfide interference)	25	ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

2C

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/31/96

SAMPLE I.D.: 4MP-9

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0839	0842	~~0~~0.20 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0854	0854	0.00~~2~~ mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0851	0857	0.3 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0852	0855	0.19 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	0902	0907	44.15 mg/L	DI or 50mg/L
						41.94 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	0858	0900	0.2 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	0904	0910	0.008 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 50 mL 1.6N DM=2 — 166 digits

Chloride Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 80 ppm

Technician: BRAD LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/31/96

SAMPLE I.D.: 4MP-10

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0921	0925	0.61	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0929	0939	0.002	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0936	0942	1.4	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0938	0941	0.53	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	1001	1007	30.19	mg/L	DI or (50) mg/L
						27.57	mg/L	(DI) or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	0948	0950	0.6	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	102	1017	0.008	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 134 digits

Chloride Sample Size = NA digits

CHEMet Color Tests:

Ammonia 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) 25 ppm

Technician: BLEWS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/31/96

SAMPLE I.D.: 4MP-10 DUPLICATE

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0922	0926	0.54 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0929	0939	0.002 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0936	0942	0.4 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0938	0941	0.54 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	1001	1007	29.62 mg/L	DI or (50mg/L)
						26.54 mg/L	(DI) or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	0948	0950	0.2 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1012	1017	0.000 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 119 digits

Chloride Sample Size = NA digits

CHEMet Color Tests:

Ammonia 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) 50 ppm

Technician: BC

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 1/11/96

SAMPLE I.D.: GMP-11

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / SLIGHT HYDRO CARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1500	1503	2.66	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1505	1515	0.000	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1511	1517	0.1	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1513	1516	2.53	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2 X	1523	1528	29.67	mg/L	DI or 50mg/L
						28.34	mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1618	1620	0.7	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1525	1531	-0.0	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20 ml 1.6N DM = ~~25.0~~ 50 digits

Chloride Sample Size = NA digits

CHEMet Color Tests:

Ammonia 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) 25 ppm

Technician: BRAD LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
COLUMBUS AIR FORCE BASE, VA

SAMPLE DATE: 11/3/96

SAMPLE I.D.: AMP-12 MEDIUM

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / SLIGHT HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1353	1356	1.40 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1357	1407	0.000 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1403	1404	0.5 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1405	1408	1.43 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	5	1414	1419	21.34 mg/L	DI or 50mg/L
						22.45 mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L				NA mg/L	DI
						mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	1411	1413	0.0 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1416	1422	0.000 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20 — Titrate with 1.6 N H_2SO_4 — Digit Multiplier = 5 — 65 digits

CHEMet Color Tests:

Ammonia	0 ppm
CO_2 (0 mL A-1910 added for sulfide interference)	35 ppm

Technician: TJL

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY ~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/3/96

SAMPLE I.D.: GMP-12 DEEP

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR SLIGHT HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1210	1213	0.99 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1214	1224	-.004 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1219	1224	0.1 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1221	1224	~~4.38~~ mg/L	sample
						4.73 mg/L	sample
Sulfate	45.000	0 - 100 mg/L	10	1239	1244	15.20 mg/L	DI or 50mg/L
						20.17 mg/L	(DI) or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L	~~1~~	~~1~~	~~1~~	NA mg/L	DI
						mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	1031	1033	0.3 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1241	1246	0.00 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20 Digit Multiplier = 5 → 84 digits

Titrate with 1.6 N H_2SO_4

CHEMet Color Tests:

Ammonia	1 ppm
CO_2 (0 mL A-1910 added for sulfide interference)	40 ppm

Technician: BL

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

REPLACED WATER CAP FOR SAMPLE BLANK

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/1/96

SAMPLE I.D.: 4MP-13

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0845	0849	2.64 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0853	0903	0.010 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0900	0906	~0.7 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0901	0904	2.44 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	10	0920	0928	19.82 mg/L	DI or 50mg/L
						16.63 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	0910	0912	~0.1 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	0925	0932	0.019 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20mL 1.6N DM=5 — 68 digits

Chloride Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 70 ppm

Technician: BLEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/1/96

SAMPLE I.D.: ~~GMP-13~~ DUPLICATE

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0846	0850	2.66	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0853	0903	-0.004	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	6900	0906	1.3	mg/L	sample
					~~0904~~	~~2.42~~	mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0901	0904	2.42	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	10	0920	0928	17.51	mg/L	DI or (50)mg/L
						14.17	mg/L	(DI) or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	~~0910~~	0912	-0.2	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	0934	~~0939~~	0.016	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20ml 1.6N DM=5 — 67 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 — (0 mL A-1910 added for sulfide interference) — 70 ppm

Technician: B LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
~~COLUMBUS~~ LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/3/96

SAMPLE I.D.: 4MP-14 ORIP

FILTERED (circle): (YES) NO

COLOR / ODOR: NONE / SLIGHT HYDROCARBON

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1013	1016	3.16 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1015	1026	-0.014 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1024	1030	-0.04 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1026	1029	1.74 mg/L	sample
						31.43 mg/L	sample
Sulfate	45.000	0 - 100 mg/L		1039	1045	~~25.74~~ mg/L	DI or 50mg/L
						34.43 mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L		~~1035~~	~~1037~~	NA mg/L	DI
						mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L		1035	1037	0.0 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L		1042	1048	0.038 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20 — Titrate with 1.6 N H_2SO_4 — Digit Multiplier = 5 — 56 digits

CHEMet Color Tests:

Ammonia: 0	ppm
CO_2 (0 mL A-1910 added for sulfide interference): 25	ppm

Technician: TBC

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

cal. 95-1
sulfide
0.20 mg/L

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
COLUMBUS AIR FORCE BASE, VA

SAMPLE DATE: 11/3/96

SAMPLE I.D.: UMP-15

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution		Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5		1306	1309	3.66	mg/L	sample
								mg/L	sample
								mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1		1311	1321	-0.001	mg/L	sample
								mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1		1318	1324	0.1	mg/L	sample
								mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5		1319	1322	3.41	mg/L	sample
								mg/L	sample
Sulfate	45.000	0 - 100 mg/L	20		1336	1341	45.96	mg/L	DI or 50mg/L
			TWENTY				475.2	mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L					NA	mg/L	DI
								mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1		1326	1329	-0.0	mg/L	sample
								mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1		1338	1343	0.004	mg/L	DI
								mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20 — Titrate with 1.6 N H_2SO_4 — Digit Multiplier = 5 — 25 digits

CHEMet Color Tests:

Ammonia	1	ppm
CO_2 (0 mL A-1910 added for sulfide interference)	50	ppm

Technician: BC

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

WORKLEY

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/3/-16

SAMPLE I.D.: GMP-16

FILTERED (circle): (YES) NO

COLOR / ODOR: NO / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0750	0755	2.92 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0851	0851	-0.04 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		0815	0821	-0.7 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0817	0820	2.83 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	0835	0840	42.14 mg/L	DI or 50mg/L
						32.98 mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L				N/A mg/L	DI
						mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	0832	0834	-0.2 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L		0837	0843	-0.03 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = Digit Multiplier = 5 63 digits

Titrate with N H_2SO_4

CHEMet Color Tests:

Ammonia		ppm
CO_2	(0 mL A-1910 added for sulfide interference)	1.1 ppm

Technician: BL

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

36D

LINDAUER

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/3/96

SAMPLE I.D.: 4-MP-16 DUP

FILTERED (circle): (YES) NO

COLOR / ODOR: NO/ HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0752	0755	2.54	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0801	0811	-0.001	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0815	0821	-0.7	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0817	0825	2.19	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	0835	0840	37.15	mg/L	DI or 50mg/L
						39.14	mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L				NA	mg/L	DI
							mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	0832	0834	-0.2	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	0833	0843	0026	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20 — Titrate with 1.6 N H_2SO_4 — Digit Multiplier = 5 — 54 digits

CHEMet Color Tests:

Ammonia	0	ppm
CO_2 (0 mL A-1910 added for sulfide interference)	11	ppm

Technician: BL

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 1/2/96

SAMPLE I.D.: LMW 17

FILTERED (circle): YES NO

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1310	1313	0.06 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1319	1328	-0.001 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1325	1331	-0.5 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1327	1330	0.17 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2 ½	1340	1345	41.89 mg/L	DI or 50mg/L
						42.81 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1334	1336	-0.2 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1336	1341	-0.000 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20 Digit Multiplier = 5 29 digits

Titrate with 1.6 N H_2SO_4

CHEMet Color Tests:

Ammonia 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) ~~3.5~~ ppm 35

Technician: BLEWIS

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/1/96

SAMPLE I.D.: MW-14

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / SLIGHT HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1733	1736	0.90	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1739	1749	0.001	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1748	1753	-0.1	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1750	1755	1.00	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1803	1808	14.79 30.53	mg/L	DI or 60mg/L
			1	1756	1800	0.1	mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1759	1800	0.1	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1805	1810	0.052	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = DM=5 — 47 digits

Chloride Sample Size = NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 20 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

31D

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 1/11/96

SAMPLE I.D.: UMP-18 DUP

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR/SLIGHT HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1733	1736	0.90 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1739	1749	0.018 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1748	1753	-0.1 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1750	1755	0.78 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1803	1805	1684 mg/L	DI or 50mg/L
						21.87 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1758	1800	0.2 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1805	1810	-0.040 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20 mL; Titrate with 1.6 N H_2SO_4; Digit Multiplier 50; 59 digits

CHEMet Color Tests:

Ammonia		0 ppm
CO_2	(0 mL A-1910 added for sulfide interference)	18 ppm

Technician: BL

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

A USED SOME UNFILTERED SAMPLE TO COMPLETE DUPLICATE OF SULFIDE

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/2/96

SAMPLE I.D.: CB~~GA~~ GM1-19

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a,b]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1652	1655	0.30	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1655	1705	-0.004	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1703	1709	-0.7	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1701	1707	0.20	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1720	1725	13.64	mg/L	DI or 50mg/L
						11.00	mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1709	1711	-0.2	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1709	1713	0.018	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20

Titrate with 1.6 N H_2SO_4

Digit Multiplier = 5 → 60 digits

CHEMet Color Tests:

Ammonia: 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference): 25 ppm

Technician: BL

[a] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 11/2/96

SAMPLE I.D.: 4MP-20

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1428	1431	0.09 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1437	1443	-0.003 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1439	1445	-0.7 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1441	1444	0.07 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1453	1511	33.91 mg/L	DI or 50mg/L
						31.99 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L				mg/L	sample
			1	1446	1449	-0.2 mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L				mg/L	DI
			1	1455	1500	0.008 mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 mL
Titrate with 1.6 N H_2SO_4
Digit Multiplier = 5
25 digits

CHEMet Color Tests:

Ammonia: 0 ppm
CO_2: (0 mL A-1910 added for sulfide interference) 80 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY ~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/3/96

SAMPLE I.D.: 4MP-21

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1443	1446	0.93	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1504	1516	0.006	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1513	1519	0.3	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	2	1514	1518	2.148	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	1529	1535	1.57	mg/L	DI or 50mg/L
						-0.11	mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L				NA	mg/L	DI
							mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	1522	1525	0.1	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1532	1537	-0.004	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity: Sample Size = 20 mL; Titrate with 1.6 N H_2SO_4; Digit Multiplier = 5; 99 digits

CHEMet Color Tests:

Ammonia: 0 ppm

CO_2: (0 mL A-1910 added for sulfide interference) 45 ppm

Technician: TSL

[a/] Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

41D

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY ~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/3/96

SAMPLE I.D.: GMP-21 DUPLICATE

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1443	1446	0.94 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1504	1516	0.000 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1513	1519	0.3 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	2	1514	1518	2.46 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	1529	1535	1.62 mg/L	DI or 50mg/L
						-0.05 mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L				NA mg/L	DI
						mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	1522	1525	0.1 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1532	1537	0.024 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20 Digit Multiplier = 5 99 digits

Titrate with 1.6 N H_2SO_4

CHEMet Color Tests:

Ammonia 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) 70 ppm

Technician: BL

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/28/96

SAMPLE I.D.: OW-3

FILTERED (circle): YES NO

COLOR / ODOR: CLEAR, HYDROCARBON ODOR

Direct Meter Measurements:

Temp	20.0	°C/°F (circle)
pH	7.65	SU
Conductivity	390	µS/cm
Dissolved Oxygen	1.22	mg/L
Redox Potential	-156.6	mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1X	0950	900953	0.30 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L				mg/L	sample
			1	1000	1011	0.000 mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1004	1010	0.3 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1013	1017	0.36 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1035	1041	0.31 mg/L	(DI) or 50mg/L
						1.39 mg/L	DI or (50)mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1025	1028	0.0 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1047			0.008 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100ml 1.6N DM = 1.0 — 168 digits

Chloride Sample Size = _____ digits

CHEMet Color Tests:

Ammonia _____ ppm

CO_2 (0 mL A-1910 added for sulfide interference) 11 ppm

Technician: BRAD LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/28/96

SAMPLE I.D.: 10W-3 DUPLICATE

FILTERED (circle): YES (NO)

COLOR / ODOR:

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1X	0951	0954	0.31	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1000	1011	0.005	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1004	1010	0.2	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1014	1018	0.36	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1035	1042	1.18	mg/L	(DI) or 50mg/L
			1			1.95	mg/L	DI or (50)mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1022	1025	0.1	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1			-0.016	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = NA digits

Chloride Sample Size = NA digits

CHEMet Color Tests:

Ammonia NA ppm

CO_2 (____mL A-1910 added for sulfide interference) ~~NA~~ ppm

Technician: Brad Lewis

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/96

SAMPLE I.D.: GW4

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	0826	0829	1.02 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0831	0841	0.002 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0837	0843	-0.0 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	2	0840	0843	2.53 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	0852	0857	3.90 mg/L	DI or 50mg/L
						2.46 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	0846	0848	-0.0 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	0855	0900	0.019 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20ml 1.6N DM=5.0 — 47 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — ppm

CO_2 — (0 mL A-1910 added for sulfide interference) — 25 ppm

Technician: BL

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/29/96

SAMPLE I.D.: MW-7

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1757	1800	3.83 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	~~1802~~ 1	1802	1812	0.001 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	~~1807~~ 1	1807	1813	-0.1 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	~~1809~~ 1	1809	1814	3.76 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1819	1824	3.03 mg/L	DI or (50)mg/L
						2.36 mg/L	(DI) or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	~~1815~~ 1	1815	1818	0.0 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1823	1829	0.030 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 100ml 1.6N DM=1.0 — 320 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 2 ppm

CO_2 — (0 mL A-1910 added for sulfide interference) — 70 ppm

Technician: B LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/96

SAMPLE I.D.: OW-8

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / STRONG HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1740	1743	0.86 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1744	1754	-0.004 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1750	1757	0.9 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1751	1754	0.81 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1801	1806	20.89 mg/L	DI or (50)mg/L
						18.74 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1758	1800	0.2 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1804	1809	0.157 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 50 1.6N DM-2 — 237 digits

Chloride Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 1 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 100 ppm

Technician: BRAD LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY ~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/4/96

SAMPLE I.D.: OW-9

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1034	1037	3.11 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1037	1048	-0.002 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1045	1051	0.01 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	1047	1050	3.64 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1056	~~1101~~	2.98 mg/L	DI or (50mg/L)
						2.63 mg/L	(DI) or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L	~~1~~	~~1~~	~~1~~	NA mg/L	DI
						mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	1052	1055	0.9 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1059	1104	0.079 mg/L	DI
						mg/L	DI

Sulfide TURNED LIGHT BLUE

HACH Titrations:

Alkalinity Sample Size = 20 mL; Titrate with 1.6 N H_2SO_4; Digit Multiplier = 5; 68 digits

CHEMet Color Tests:

Ammonia	3	ppm
CO_2 (0 mL A-1910 added for sulfide interference)	100	ppm

Technician: BL

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY ~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/4/96

SAMPLE I.D.: OW-11

FILTERED (circle): (YES) NO

☆ COLOR / ODOR: CLEAR STRONG HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1200	1203	3.68	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1205	1215	0.000	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1216	1222	4-0.1	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	1220	1223	4.01	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1235	1240	10.04	mg/L	DI or 50mg/L
					9.89		mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L				NA	mg/L	DI
							mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	1230	1232	1.6	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1239	1244	0.132	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20 Digit Multiplier = 5 | 96 digits

Titrate with 1.6 N H_2SO_4

CHEMet Color Tests:

Ammonia	3	ppm
CO_2 (0 mL A-1910 added for sulfide interference)	150	ppm

Technician: BLEWIS

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

☆ SAMPLE TURNED YELLOW DURING DURATION

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY ~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/4/96

SAMPLE I.D.: OW-11- DUPLICATE

FILTERED (circle): (YES) NO

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

COLOR / ODOR: PALE CLEAR / STRONG HYDROGEN SULFIDE ODOR
TURNED YELLOW BY END OF

HACH DR/700 Measurements: SAMPLING

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1200	1203	3.68 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1205	1215	0.004 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1216	1222	1.98* mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	1220	1223	3.79 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1235	1240	9.08 mg/L	DI or 50mg/L
						9.08 mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L				NA mg/L	DI
						mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	1230	1232	1.3 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L		1234	1244	0.137 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20 Digit Multiplier = 5 93 digits

Titrate with 1.6 N H_2SO_4

CHEMet Color Tests:

Ammonia 3 ppm

CO_2 (0 mL A-1910 added for sulfide interference) 130 ppm

Technician: BLEWIS

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

* USED SAMPLE CELL USUALLY USED FOR DI BLANK ON SULFATE

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/31/96

SAMPLE I.D.: OW-12

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / STRONG HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1506	1509	0.87 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1510	1520	-0.001 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1515	1521	-0.1 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1517	1520	0.83 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1527	1532	3.85 mg/L	DI or (50)mg/L
						1.80 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1523	1525	-0.0 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1530	1536	0.017 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = DM = 2 — 10(0) digits

Chloride Sample Size = N/A digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 21 ppm

Technician: BRAD LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/29/96

SAMPLE I.D.: DW-13

FILTERED (circle): YES (NO)

COLOR / ODOR: PALE YELLOW / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	2	1:37	1:40	4.34	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		0742	~~0753~~ 0745	-0.004	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		0746	0753	0.3	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0748	0754	7.51	mg/L	sample
			2	0754	0759	5.02	mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	0813	0818	30.24	mg/L	DI or 50mg/L
			2			27.62	mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L		0759	0801	4.7	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L		0816	0821	0.117	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 441 digits

~~Chloride Sample Size = digits~~

CHEMet Color Tests:

Ammonia 2 ppm

CO_2 (0 mL A-1910 added for sulfide interference) 145 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/96

SAMPLE I.D.: OW 15

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1030	1033	2.46 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1036	1046	-.002 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1042	1048	-0.6 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1044	1047	2.29 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1053	1058	37.12 mg/L	DI or 50mg/L
						33.6 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1049	1051	1.4 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1055	1100	0.048 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 50ml 1.6N DM=2 — 198 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 — (1 mL A-1910 added for sulfide interference) — 80 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/96

SAMPLE I.D.: OW-102

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / SLIGHT HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0647	0650	0.13 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0653	0703	0.001 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0705	0713	0.1 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0710	0714	0.15 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	0725	0730	24.08 mg/L	DI or (50)mg/L
						26.23 mg/L	(DI) or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	0720	0722	0.2 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	0735	0740	0.009 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 100ml 1.6N DM=1.0 — 388 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 — (0 mL A-1910 added for sulfide interference) — 1.75 ppm

Technician: TSC

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/96

SAMPLE I.D.: OW102 DUPLICATE

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / SLIGHT HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0650	0653	0.15 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0654	0704	0.003 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0705	0713	-0.4 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0710	0714	0.15 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	0725	0730	21.87 mg/L	DI or (50)mg/L
						23.72 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	0720	0722	0.3 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	0735	0740	0.014 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 100ml 1.6N DM=1.0 — 386 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — ~~1.4~~ 0 ppm

CO_2 — (0 mL A-1910 added for sulfide interference) — 100 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/95

SAMPLE I.D.: OW103

FILTERED (circle): YES (NO)

COLOR / ODOR: No color or odor

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1100	1103	0.02 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1109	1114	-0.002 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1110	1116	-0.7 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1111	1115	-0.02 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1121	1126	48.7a mg/L	DI or 50mg/L
						47.64 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1117	1119	-0.2 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1123	1129	0.00 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 50 1.6N DM=2.0 — 128 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 — (0 mL A-1910 added for sulfide interference) — 30 ppm

Technician: B LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/29/96

SAMPLE I.D.: GW104

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR/ NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0926	0930	.03 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0935	0945	.005 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0937	0943	1.3 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0948	0953	0.03 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	1000	1007	22.02 mg/L	DI or (50mg/L)
						18.34 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	0952	0955	0.1 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1006	1011	-0.016 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 ml 1.6N DM=1.0 — 234 digits

~~Chloride Sample Size =~~ ~~digits~~

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (___ mL A-1910 added for sulfide interference) — 30 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/29/96

SAMPLE I.D.: OW104 - DUPLICATE

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0926	0930	.02	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0935	0945	0.000	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0937	0943	1.4	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0948	0953	0.00	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	1000	1004	21.25	mg/L	DI or 50mg/L
				0952	0955	17.71	mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1000	1005	0.1	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1006	1012	-0.032	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100ml 1.6 DM = 1.0 — 262 digits

~~Chloride~~ Sample Size = ——— digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 45 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/28/96

SAMPLE I.D.: OW-105

FILTERED (circle): YES (NO)

COLOR / ODOR: PALE YELLOW / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1519	1522	0.00 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1525	1535	0.000 mg/L	sample
						1.2* mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1530	1536	~~5.0~~ mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1532	1536	0.03 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	1552	1600	31.98 mg/L	DI or 50mg/L
						35.99 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1539	1542	0.3 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1550	1555	0.000 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 100 — 1.6 N — DM = 1.0 — 347 digits

~~Chloride~~ — Sample Size = _____ — _____ digits

CHEMet Color Tests:

Ammonia	0	ppm
CO_2 (0 mL A-1910 added for sulfide interference)	60	ppm

Technician: _____

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

* YELLOW COLOR PROBABLY AFFECTING NITRATE

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/96

SAMPLE I.D.: AW 106

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1242	1245	0.63 mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L				mg/L	sample
			1	1300	1310	0.004 mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L				mg/L	sample
			1	1306	1313	0.4 mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L				mg/L	sample
			1	1308	1315	0.79 mg/L	sample
Sulfate	45.000	0 - 100 mg/L				mg/L	sample
			1	1323	1328	3.18 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L				0.15 mg/L	DI or 50mg/L
			1	1318	1320	0.4 mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L				mg/L	sample
			1	1325	1331	.008 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 50 ml 1.6N OM=2.0 — 147 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 1 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 35 ppm

Technician: BLEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

16D

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/96

SAMPLE I.D.: OW106 DUP

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1249	1252	0.41	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1300	1310	0.003	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1306	1313	0.4	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1308	1315	0.77	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1323	1328	4.06	mg/L	DI or (50)mg/L
						1.23	mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1318	1320	0.5	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1325	1331	.009	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 50ml 1.6 DM=2.0 — 160 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 1 ppm

CO_2 — (0 mL A-1910 added for sulfide interference) — 40 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/96

SAMPLE I.D.: OW 107

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / NO ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0947	0950	0.10	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0951	1001	0.000	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0956	1002	-0.5	mg/L	sample
				~~0958~~	~~1001~~		mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	0958	1001	0.07	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1004	1014	18.48	mg/L	DI or (50)mg/L
						13.40	mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1005	1007	0.2	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L				*0.011	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20ml 1.6N DM=5.0 — 43 digits

Chloride Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 30 ppm

Technician: B LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/96

SAMPLE I.D.: RW-6

FILTERED (circle): (YES) NO

COLOR / ODOR: PALE YELLOW / STRONG HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1612	1615	4.78 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1618	1624	-0.004 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1623	1630	-0.3 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1625	1624	4.72 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1635	1640	6.32 mg/L	DI or 50mg/L
						2.98 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	~~X~~ 1	1632	1634	0 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1638	1643	.101 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 50 1.6N DM=20 121 digits

Chloride Sample Size = N/A digits

CHEMet Color Tests:

Ammonia 4 ppm

CO_2 (0 mL A-1910 added for sulfide interference) 50 ppm

Technician: B LEWIS

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY ~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/3/96

SAMPLE I.D.: RW-13

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / MOD HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1739	1743	3.80 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1744	1756	0.004 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1751	1758	1.78 mg/L	sample
			1	1800	1806	-0.7 mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	1755	1758	3.80 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1809	1819	8.70 mg/L	DI or 50mg/L
						10.26 mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L				NA mg/L	DI
						mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	1800	1802	0.0 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1811	1816	0.020 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20 — Titrate with 1.6 N H_2SO_4 — Digit Multiplier = 5 — 16 digits

CHEMet Color Tests:

Ammonia ~~3~~ ppm

CO_2 (0 mL A-1910 added for sulfide interference) 10 ppm

Technician: BL

[a/] Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

USED SAMPLE COL FOR SULFATE BY ACCIDENT MAY HAVE BARIUM SULFATE BUILD UP ON GLASS

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
COLUMBUS AIR FORCE BASE, VA

SAMPLE DATE: 11/3/96

SAMPLE I.D.: RW-15

FILTERED (circle): YES NO

COLOR / ODOR: * CLEAR/ STRONG HYDROCARBON/FUEL ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1613	1617	1.31	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1618	1628	0.000	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1625	1631	0.4	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	2	1627	1630	3.51	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1637	1642	3.19	mg/L	DI or 50mg/L
						3.79	mg/L	DI or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L				NA	mg/L	DI
							mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	1632	1635	-0.1	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1639	1644	0.016	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20 — Titrate with 1.6 N H_2SO_4 — Digit Multiplier = 5 — 80 digits

CHEMet Color Tests:

Ammonia	2.5	ppm
CO_2 (0 mL A-1910 added for sulfide interference)	50	ppm

Technician: BC

[a/] Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

* SAMPLE TURNED PALE YELLOW DURING TESTING

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/29/96

SAMPLE I.D.: P-1

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR / STRONG HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	4	1208	1211	4.98 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1216	1226	.012 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1221	1228	0.6 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	8	1224	1229	2.59 mg/L	sample
			4	1231	1235	4.93 mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1241	1246	-1.74 mg/L	DI or 50mg/L
						2.05 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1234	1237	2.8 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1250	1255	.033 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 100ml 1.6N DM=1.0 — 403 digits

Chloride — Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 2 ppm

CO_2 — (0 mL A-1910 added for sulfide interference) — 140 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/29/96

SAMPLE I.D.: P-2

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR/ HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1506	1509	1.77 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1510	1520	0.006 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1516	1522	0.9 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1518	1522	1.82 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1532	1537	22.37 mg/L	DI or (50)mg/L
						19.20 mg/L	(DI) or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1528	1530	0.2 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1535	1542	0.103 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 424 digits

Chloride Sample Size = N/A digits

CHEMet Color Tests:

Ammonia 0 ppm

CO_2 (0 mL A-1910 added for sulfide interference) 160 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: ~~P00-3~~ 10/29/96

SAMPLE I.D.: P9-3

FILTERED (circle) YES NO

COLOR / ODOR: COLOR NONE / STRONG HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]	
Ferrous	50.01.1	0 - 5.10 mg/L	8	1648	1651	3.62	mg/L	sample	
							mg/L	sample	
							mg/L	sample	
Nitrite	50.08.1	0 - 0.350 mg/L	1	1654	1704	0.004	mg/L	sample	NOT DETECTED
							mg/L	sample	
Nitrate	50.05.1	0 - 30.0 mg/L	1	1700	1706	0.4	mg/L	sample	
							mg/L	sample	
Total Iron	50.03.1	0 - 5.10 mg/L	10	1701	1705	3.24	mg/L	sample	
							mg/L	sample	
Sulfate	45.000	0 - 100 mg/L	10	1710	1715	49.65	mg/L	(D) or 50mg/L	
			20	1719	1724	26.75	mg/L	(D) or 50mg/L	
Manganese	52.13.1	0 - 20.0 mg/L	1	1726	1729	4.1	mg/L	sample	(NOT PURPLE OR PINK)
							mg/L	sample	
Sulfide	61.12.1	0 - 0.600 mg/L	~~1724~~	1728	1733	0.073	mg/L	DI	
							mg/L	DI	

HACH Titrations:

Alkalinity Sample Size = 100 ml 1.6N DM=1.0 — 648 digits

Chloride Sample Size = — NA digits

CHEMet Color Tests:

Ammonia — 7 ppm

CO_2 (0 mL A-1910 added for sulfide interference) — 225 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY ~~COLUMBUS~~ AIR FORCE BASE, VA

SAMPLE DATE: 11/14/96

SAMPLE I.D.: D-4

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / STRONG HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0941	0944	5.01	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0945	0956	0.002	mg/L	sample
							mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0950	0956	0.7	mg/L	sample
							mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	2	0955	0959	2.30	mg/L	sample
							mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	0905	0908	0.91	mg/L	DI or (50mg/L)
						1.92	mg/L	(DI) or 50mg/L
Chloride	45.02.1	0 - 20.0 mg/L	~~1~~	~~1~~	~~1~~	NA	mg/L	DI
							mg/L	DI
Manganese	52.13.1	0 - 20.0 mg/L	1	0900	0902	-0.0	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	0907	0910	0.011	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 20 — Titrate with 1.6 N H_2SO_4 — Digit Multiplier = 5 — 54 digits

CHEMet Color Tests:

Ammonia	0	ppm
CO_2 (5 mL A-1910 added for sulfide interference)	25	ppm

Technician: BL

a/ Sulfate, sulfide, and chloride blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/30/91

SAMPLE I.D.: P-5

FILTERED (circle): (YES) NO

COLOR / ODOR: CLEAR / STRONG & BECAME PALE YELLOW HYDROCARBON ODOR

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1248	1251	2.52 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	1336	1346	-0.002 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	1342	1348	-0.01 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	1344	1347	2.57 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1354	1359	9.14 mg/L	DI or (50) mg/L
						4.77 mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L	1	1250	1252	0.5 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L	1	1356	1401	-0.000 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 50 ml 1.6N DM=2.0 — 232 digits

Chloride Sample Size = — N/A digits

CHEMet Color Tests:

Ammonia — 1.5 ppm

CO_2 (2 mL A-1910 added for sulfide interference) — 100 ppm

Technician: BRAD LEWIS

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

MB

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/28/96

SAMPLE I.D.: METHOD BLANK

FILTERED (circle) YES NO

COLOR / ODOR:

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L		1133	1136	0.00 mg/L	sample
						mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		1129	1134	0.000 mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		1124	1135	0.3 mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L		1125	1128	0.00 mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L		1136	1141	0.01 mg/L	~~DI~~ or 50mg/L
						mg/L	DI or 50mg/L
Manganese	52.13.1	0 - 20.0 mg/L		1146	1148	0.0 mg/L	sample
						mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L		1125	1130	-0.008 mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = NA digits

~~Chloride Sample Size = digits~~

CHEMet Color Tests:

Ammonia NA ppm

CO_2 (____mL A-1910 added for sulfide interference) NA ppm

Technician: _____

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

MS

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/29/96

SAMPLE I.D.: MS ON DI

FILTERED (circle): YES NO

COLOR / ODOR:

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L				NA	mg/L	sample
							mg/L	sample
						NA	mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L				NA	mg/L	sample
							mg/L	sample
Nitrate (5.0mg/L)	50.05.1	0 - 30.0 mg/L	-	1059	1105	7.8	mg/L	sample
							mg/L	sample
Total Iron (2.0mg/L)	50.03.1	0 - 5.10 mg/L	-	1118	1121	1.71	mg/L	sample
							mg/L	sample
Sulfate (25mg/L)	45.000	0 - 100 mg/L	-	1125	1130	27.82	mg/L	DI or 50mg/L
						29.41	mg/L	DI or 50mg/L
Manganese (2.0mg/L)	52.13.1	0 - 20.0 mg/L	-	1047	1049	2.0	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L				NA	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = NA digits

Chloride Sample Size = NA digits

CHEMet Color Tests:

Ammonia NA ppm

CO_2 (____mL A-1910 added for sulfide interference) NA ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

* ON 10 mg/L STANDARD DR/700 = 9.4 mg/L
ON NO_3-N

MSD

ON-SITE MEASUREMENTS
HACH AND CHEMets ANALYSES
LANGLEY AIR FORCE BASE, VA

SAMPLE DATE: 10/29/96

SAMPLE I.D.: MSD ON DI

FILTERED (circle): YES NO

COLOR / ODOR:

Direct Meter Measurements:

Temp		°C/°F (circle)
pH		SU
Conductivity		µS/cm
Dissolved Oxygen		mg/L
Redox Potential		mV

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Time Reagent Mixed	Time Measured	Reading		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L				NA	mg/L	sample
							mg/L	sample
							mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L				NA	mg/L	sample
							mg/L	sample
Nitrate (5.0mg/L)	50.05.1	0 - 30.0 mg/L	-	1059	1105	7.3	mg/L	sample
							mg/L	sample
Total Iron (3.0mg/L)	50.03.1	0 - 5.10 mg/L	-	1118	1121	1.59	mg/L	sample
							mg/L	sample
Sulfate (25 mg/L)	45.000	0 - 100 mg/L	-	1125	1130	36.29	mg/L	DI or 50mg/L
						38.04	mg/L	DI or 50mg/L
Manganese (2.0mg/L)	52.13.1	0 - 20.0 mg/L	-	1047	1049	1.7	mg/L	sample
							mg/L	sample
Sulfide	61.12.1	0 - 0.600 mg/L				NA	mg/L	DI
							mg/L	DI

HACH Titrations:

Alkalinity Sample Size = NA digits

Chloride Sample Size = NA digits

CHEMet Color Tests:

Ammonia NA ppm

CO_2 (____mL A-1910 added for sulfide interference) NA ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron and manganese blanks should be diluted accordingly if samples are diluted.

HACH ANALYSIS RECORDS

OCT. - NOV. 1997

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/7/97	TIME SAMPLED	1930
SAMPLE I.D.	GMP-055	TIME ANALYSIS START	
		TIME ANALYSIS END	

FILTERED (circle) (YES) NO

COLOR / ODOR: SLIGHT ODOR / CLEAR → WATER FROM FILTERING FLASK

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	~~0.44~~ 1.18		mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L		0.11		mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		—		mg/L	sample
				—		mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		—		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L		0.0		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L		1.2		mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.012		mg/L	DI
						mg/L	DI

ELEMENTEK

NEAR

HACH Titrations:

Alkalinity Sample Size = 50

Titrate with 1.6 N H_2SO_4

	digits
	digits
135	total digits

NEAR

55X5 270

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 270

CHEMetrics Color Tests:

Ammonia	1	ppm
CO_2 (mL A-1910 added for sulfide interference)	—	ppm

Technician: _____

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

2 SAMPLE AERATED AND LIMITED

1

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/7/97	TIME SAMPLED	1225
SAMPLE I.D.	4MP5D	TIME ANALYSIS START	1315
		TIME ANALYSIS END	

FILTERED (circle) YES (NO)

COLOR / ODOR: ODOR/ PALE YELLOW / INCREASE INTENSITY OVERTIME

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	2.36	mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	2	2.90	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	-0.7	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	-0.004	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.1	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	13.57	mg/L	DI or (50)mg/L
			1	12.54	mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.019	mg/L	DI
					mg/L	DI

HACH Titrations:

		Titrate with	$N\ H_2SO_4$
Alkalinity	Sample Size =		
	Phenolphthalein Alkalinity	digits	
	BGR	digits	
		total digits	

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 432

CHEMetrics Color Tests:

Ammonia		1	ppm
CO_2	(mL A-1910 added for sulfide interference)	12	ppm

710 >

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are dilute

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/8/97	TIME SAMPLED	1510
SAMPLE I.D.	GMP-7	TIME ANALYSIS START	1550
		TIME ANALYSIS END	

FILTERED (circle) (YES) NO

COLOR / ODOR: CLEAR / NO ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L		0.02	mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L		0.34	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		<0.1	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		<0.001	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L		0.2	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L			mg/L	DI or 50mg/L
				38.38	mg/L	DI or (50) mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.011	mg/L	DI
					mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

	Phenolphthalein Alkalinity digits
	BGR digits
249	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 249

CHEMetrics Color Tests:

Ammonia	0.2 ppm
CO_2 (mL A-1910 added for sulfide interference)	<10 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/9/97	TIME SAMPLED	0830
SAMPLE I.D.	4MP-15	TIME ANALYSIS START	0840
		TIME ANALYSIS END	0905

FILTERED (circle) (YES) NO

COLOR / ODOR:

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1.85	mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	2.95	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0.2	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0.050	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.1	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L	20	4250	mg/L	DI or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.000	mg/L	DI
					mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity – digits

BGR 401 digits

401 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 401

CHEMetrics Color Tests:

Ammonia 1 ppm

CO_2 (mL A-1910 added for sulfide interference) 12 ppm

Technician: _____

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted

15D

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/9/97	TIME SAMPLED	0830
		TIME ANALYSIS START	0840
SAMPLE I.D.	SMP-15 DUP	TIME ANALYSIS END	0905

FILTERED (circle) (YES) NO

COLOR / ODOR:

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1.54	mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	2.62	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0.5	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	DO3	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.3	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L	20	51.37	mg/L	DI or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.020	mg/L	DI
					mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	— digits
BGR	398 digits
	398 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 398

CHEMetrics Color Tests:

Ammonia		1 ppm
CO_2	(mL A-1910 added for sulfide interference)	13 ppm

Technician: _____

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE: ~~4/5~~ 10/8/97
TIME SAMPLED: 1400
TIME ANALYSIS START: 1825
TIME ANALYSIS END: 1845
SAMPLE I.D.: GMP-21
FILTERED (circle): (YES) NO
COLOR / ODOR: CLEAR SLIGHT ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1.21	0.05 mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	2	3.31	0.62 mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0-2	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0.003	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.1	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	0.98	mg/L	(DI) or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.024	mg/L	DI
					mg/L	DI

HACH Titrations:
Alkalinity Sample Size = 50 Titrate with 1.6 N H_2SO_4

	digits
	digits
258	total digits

258 x 2

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 2

CHEMetrics Color Tests:
Ammonia: 1 ppm
CO_2 (mL A-1910 added for sulfide interference): 400 ppm

Technician: TV

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/8/97	TIME SAMPLED	1400
		TIME ANALYSIS START	1500
SAMPLE I.D.	UMP-22	TIME ANALYSIS END	

FILTERED (circle) (YES) NO

COLOR / ODOR: CLEAR NO ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0.14		mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L		0.15		mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		0.5		mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		0.003		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L		0.2		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	2	30.64	600	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.020		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 50 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	digits
BGR	142 digits
	142 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 284

CHEMetrics Color Tests:

Ammonia		0.8 ppm
CO_2	(mL A-1910 added for sulfide interference)	<10 ~~7000~~ ppm

Technician: _____

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE: 10/8/97

SAMPLE I.D.: ~~10/8/97~~ 4MP-23

TIME SAMPLED: 1630

TIME ANALYSIS START: 1720

TIME ANALYSIS END: 1745

FILTERED (circle): YES (NO)

COLOR / ODOR: CLEAR NO ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L		0.00	mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L		0.01	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L			mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	NOT ENOUGH SAMPLE		mg/L	sample
					mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	49.90	mg/L	DI or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.048	mg/L	DI
					mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20

Titrate with 1.6 N H_2SO_4

	digits
	digits
72	total digits

5 X 72

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) =

CHEMetrics Color Tests:

Ammonia	0.4 ppm
CO_2 (mL A-1910 added for sulfide interference)	35 ppm

Technician: BV

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/8/97	TIME SAMPLED	1415
SAMPLE I.D.	OW-3	TIME ANALYSIS START	1320
		TIME ANALYSIS END	

FILTERED (circle) (YES) NO

COLOR / ODOR: CLEAR SLIGHT ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L		0.06	mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L		0.19	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		0.1	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		0.000	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L		0.0	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L		1.10	mg/L	DI or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.024	mg/L	DI
					mg/L	DI

HACH Titrations:

Alkalinity Sample Size =

	Titrate with	$N\ H_2SO_4$
Phenolphthalein Alkalinity		digits
BGR		digits
		total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 161

CHEMetrics Color Tests:

Ammonia 0.2 ppm

CO_2 (mL A-1910 added for sulfide interference) ~~150~~ ppm <10

Technician: _____

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/8/97	TIME SAMPLED	1930
SAMPLE I.D.	GW-4	TIME ANALYSIS START	1940
		TIME ANALYSIS END	2005

FILTERED (circle) (YES) NO

COLOR / ODOR: CLEAR SLIGHT ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	1.39		mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	1.44		mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	-0.7		mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	~~-0.004~~ 0.004		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L				mg/L	DI or 50mg/L
			1	6.08		mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.021		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size =

Titrate with	$N\ H_2SO_4$
	digits
	digits
210	total digits

Phenolphthalein Alkalinity

BGR

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 210

CHEMetrics Color Tests:

Ammonia	0.6	ppm
CO_2 (mL A-1910 added for sulfide interference)	30	ppm

Technician: _____

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are dilute

5

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/8/97	TIME SAMPLED	1100
		TIME ANALYSIS START	1200
SAMPLE I.D.	OW-7	TIME ANALYSIS END	1225

FILTERED (circle) YES NO

COLOR / ODOR:

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	(	3.08	mg/L	sample
				3.	mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L		3.47	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		-0.4	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		0.000	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L		0.1	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L		0.91	mg/L	DI or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.009	mg/L	DI
					mg/L	DI

HACH Titrations:

Alkalinity	Sample Size =	Titrate with $N\ H_2SO_4$
	Phenolphthalein Alkalinity	digits
	BGR	digits
		total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 264

CHEMetrics Color Tests:

Ammonia	2	ppm
CO_2 (mL A-1910 added for sulfide interference)	75	ppm

7100

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/8/97	TIME SAMPLED	1835
SAMPLE I.D.	OW-8	TIME ANALYSIS START	1910
		TIME ANALYSIS END	

FILTERED (circle) (YES) NO

COLOR / ODOR: CLEAR SLIGHT ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L		1.68	mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L		1.75	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		0.1	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		0.001	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L		0.1	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L		4.16	mg/L	DI or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.044	mg/L	DI
					mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	digits
BGR	digits
332	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 332

CHEMetrics Color Tests:

Ammonia	2 ppm
CO_2 (mL A-1910 added for sulfide interference)	13 ppm

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

10

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/8/97	TIME SAMPLED	
		TIME ANALYSIS START	1700
SAMPLE I.D.	OW-9	TIME ANALYSIS END	1730

FILTERED (circle) YES NO

COLOR / ODOR:

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	4.04	20.2	mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	10	3.20	32	mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	-0.6		mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	-0.004		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	1.5		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1.26		mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.043		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20 Titrate with 1.6 N H_2SO_4

	digits
	digits
81	total digits

81 x 5

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = ~~81~~

CHEMetrics Color Tests:

Ammonia	5 ppm
CO_2 (mL A-1910 added for sulfide interference)	300 ppm

Technician: BL

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

10D

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/8/97	TIME SAMPLED	1615
SAMPLE I.D.	OW-9	TIME ANALYSIS START	1700
		TIME ANALYSIS END	1730

FILTERED (circle) YES NO

COLOR / ODOR:

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	4.50	22.5	mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	10	3.33	33.3	mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	-0.7		mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0.004		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	1.4		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	2.05		mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.035		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20

Titrate with N H_2SO_4

	digits
	digits
83	total digits

Phenolphthalein Alkalinity

BGR

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 83x5

CHEMetrics Color Tests:

Ammonia	5 ppm
CO_2 (mL A-1910 added for sulfide interference)	250 ppm

Technician: BL

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/9/97	TIME SAMPLED	1215
SAMPLE I.D.	OW-11	TIME ANALYSIS START	1255
		TIME ANALYSIS END	

FILTERED (circle) (YES) NO

COLOR / ODOR: CLEAR ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	2.67	13.35	mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	3.07	15.35	mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	-0.7		mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0.082		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	1.2		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	10.01		mg/L	~~DI~~ or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.134		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	digits
BGR	444 digits
	444 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 444

CHEMetrics Color Tests:

Ammonia		1 ppm
CO_2	(mL A-1910 added for sulfide interference)	400 ppm

Technician: JC

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE: 10/9/97
SAMPLE I.D.: RW-4
FILTERED (circle): (YES) NO
COLOR / ODOR: CLEAR / odor

TIME SAMPLED: 400
TIME ANALYSIS START: 405
TIME ANALYSIS END: 427

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a,b]
Ferrous	50.01.1	0 - 5.10 mg/L	5	2.49	12.45	mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	2.72	13.6	mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	-0.4		mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0.002		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	1.3		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	4.50		mg/L	(DI) or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.112		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 20
Titrate with 1.6 N H_2SO_4
Phenolphthalein Alkalinity — digits
BGR 92 digits
92 total digits 5 x 92

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) =

CHEMetrics Color Tests:

Ammonia 3 ppm
CO_2 (mL A-1910 added for sulfide interference) 350 ppm

Technician: BL

[a] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE: 10/8/97

SAMPLE I.D.: RW-6

TIME SAMPLED: ~~0850~~ 1000
TIME ANALYSIS START: 1010
TIME ANALYSIS END:

FILTERED (circle): (YES) NO

COLOR / ODOR: ODOR PALE YELLOW

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	1.78	8.9	mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	2.41	12.05	mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		-0.7		mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		-0.004		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L		0.1		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L		1.57		mg/L	(DI) or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.089		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

—	digits
332	digits
332	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 332

CHEMetrics Color Tests:

Ammonia: 10 ppm

CO_2 (~ mL A-1910 added for sulfide interference): ~~15~~ ppm 7100

Technician: JL

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

3

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE: 10/8/97

SAMPLE I.D.: RW-15

TIME SAMPLED: 0830
TIME ANALYSIS START: 0900
TIME ANALYSIS END: 0940

FILTERED (circle): (YES) NO

COLOR / ODOR: ORGN / CLEAR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L		4.15		mg/L	sample
				1.10		mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	5.50	5.50	mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		0.1		mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		-0.005		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L		-0.2		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L		4.29		mg/L	DI or 50mg/L
				.10		mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.016		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size =

	Titrate with $N\ H_2SO_4$
Phenolphthalein Alkalinity	digits
BGR	digits
	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 264

CHEMetrics Color Tests:

Ammonia: 3 ppm

CO_2 (mL A-1910 added for sulfide interference): 14 ppm

7100

Technician: BL

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/8/97	TIME SAMPLED	1405
SAMPLE I.D.	P-1	TIME ANALYSIS START	1440
		TIME ANALYSIS END	

FILTERED (circle) (YES) NO

COLOR / ODOR: ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	5	2.04	10.2	mg/L	sample
						mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	5	4.53	22.65	mg/L	sample
						mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L		-0.3		mg/L	sample
						mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L		0.002		mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L		8.0		mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L		44.24		mg/L	DI or 50mg/L
				46.96		mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.010		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = Titrate with $N\ H_2SO_4$

Phenolphthalein Alkalinity	digits
BGR	digits
	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 340

CHEMetrics Color Tests:

Ammonia		ppm
CO_2	(mL A-1910 added for sulfide interference)	H ppm

7102

Technician: _____

[a/] Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

[b/] Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/9/97	TIME SAMPLED	1010
SAMPLE I.D.	P-4	TIME ANALYSIS START	1100
		TIME ANALYSIS END	

FILTERED (circle) (YES) NO

COLOR / ODOR: CLEAR STRONG ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	3.28	mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	3.50	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	-0.7	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	-0.004	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.1	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	5.1	mg/L	DI or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.017	mg/L	DI
					mg/L	DI

HACH Titrations: 100

Alkalinity Sample Size =
Phenolphthalein Alkalinity
BGR

Titrate with 1.6 N H_2SO_4

0	digits
225	digits
225	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 225

CHEMetrics Color Tests:

Ammonia	1	ppm
CO_2 (mL A-1910 added for sulfide interference)	20	ppm

Technician: BC

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are dilute

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Site SS-04, Langley AFB, 1-year update

SAMPLE DATE	10/9/97	TIME SAMPLED	1030
		TIME ANALYSIS START	1011 20
SAMPLE I.D.	P-5	TIME ANALYSIS END	

FILTERED (circle) (YES) NO

COLOR / ODOR: CLEAR SULFAT ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	2.85	mg/L	sample
					mg/L	sample
Total Iron	50.03.1	0 - 5.10 mg/L	1	3.16	mg/L	sample
					mg/L	sample
Nitrate	50.05.1	0 - 30.0 mg/L	1	0.3	mg/L	sample
					mg/L	sample
Nitrite	50.08.1	0 - 0.350 mg/L	1	0.001	mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.3	mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L		33.68	mg/L	(DI) or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L		0.033	mg/L	DI
					mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	— digits
BGR	272 digits
	272 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 272

CHEMetrics Color Tests:

Ammonia	1	ppm
CO_2 (mL A-1910 added for sulfide interference)	18	ppm

Technician: BC

a/ Sulfate and sulfide blanks contain respective reagents;
Ferrous iron, total iron, nitrate, nitrite, and manganese blanks are without reagents.

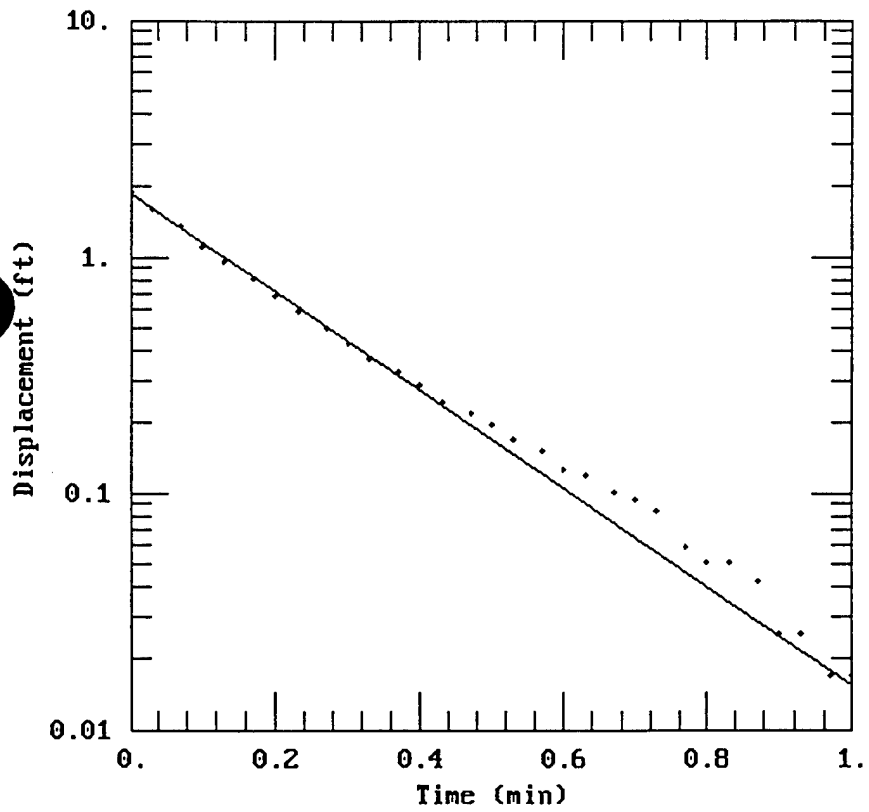
b/ Ferrous, total iron, nitrate, nitrite, and manganese blanks should be diluted accordingly if samples are diluted.

SLUG TEST DATA ANALYSIS RECORDS

OCT. - NOV. 1996

CLIENT: AFCEE/Langley AFB	COMPANY: Parsons Engineering Science
LOCATION: Site SS-04	PROJECT: RNA TS

Slug Test Analysis



DATA SET:
OW102.DAT
08/10/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: 11/6/96
test well: NA
obs. well: OW-102

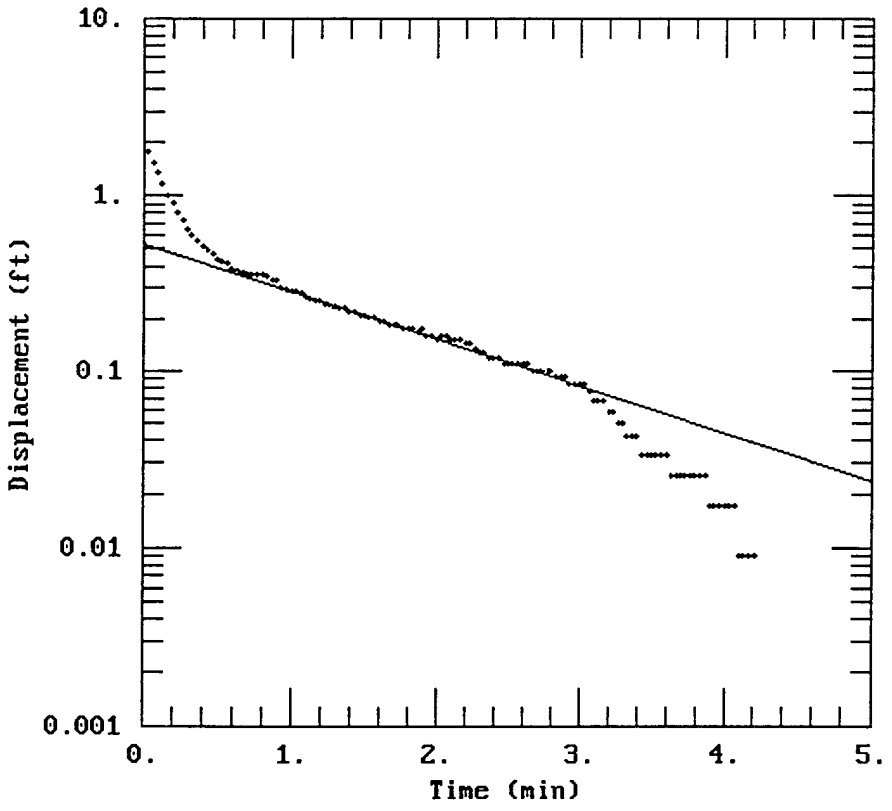
TEST DATA:
H0= 1.901 ft
r_c= 0.083 ft
r_w= 0.333 ft
L = 10. ft
b = 60. ft
H = 8.3 ft

PARAMETER ESTIMATES:
K = 0.01609 ft/min
y0 = 1.853 ft

AQTESOLV

CLIENT: AFCEE/Langley AFB	COMPANY: Parsons Engineering Science
LOCATION: Site SS-04	PROJECT: RNA TS

Slug Test Analysis



DATA SET:
OW103.DAT
08/12/98

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: 11/6/96
test well: NA
obs. well: OW-103

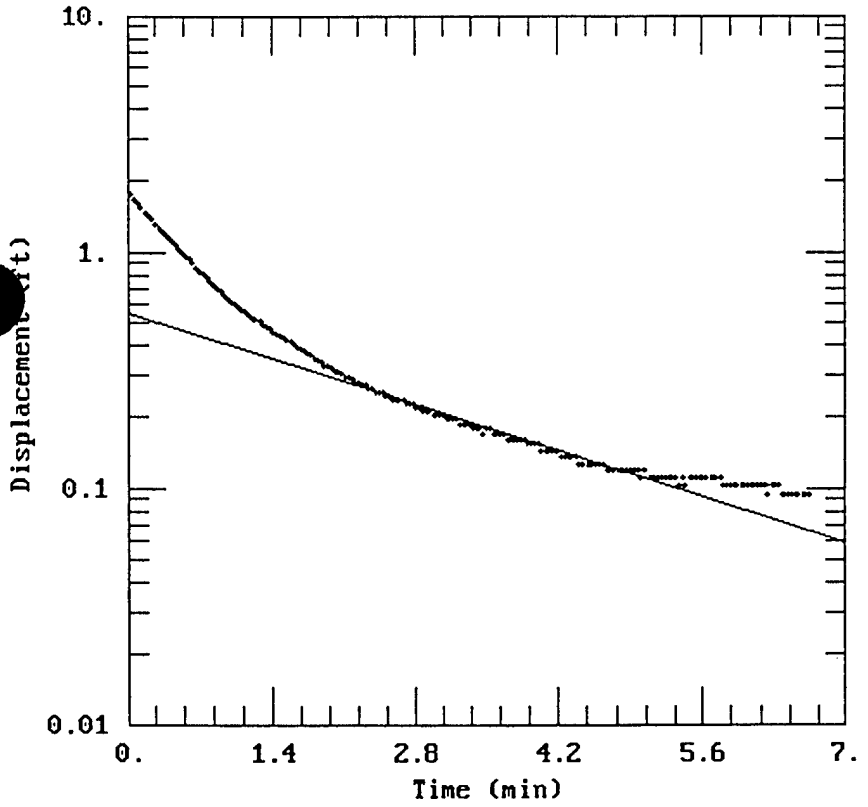
TEST DATA:
H0= 1.783 ft
r_c= 0.083 ft
r_w= 0.333 ft
L = 10. ft
b = 60. ft
H = 8.2 ft

PARAMETER ESTIMATES:
K = 0.002103 ft/min
y0 = 0.5377 ft

AQTESO

CLIENT: AFCEE/Langley AFB	COMPANY: Parsons Engineering Science
LOCATION: Site SS-04	PROJECT: RNA TS

Slug Test Analysis



DATA SET:
OW2.DAT
08/12/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: 11/6/96
test well: NA
obs. well: OW-2

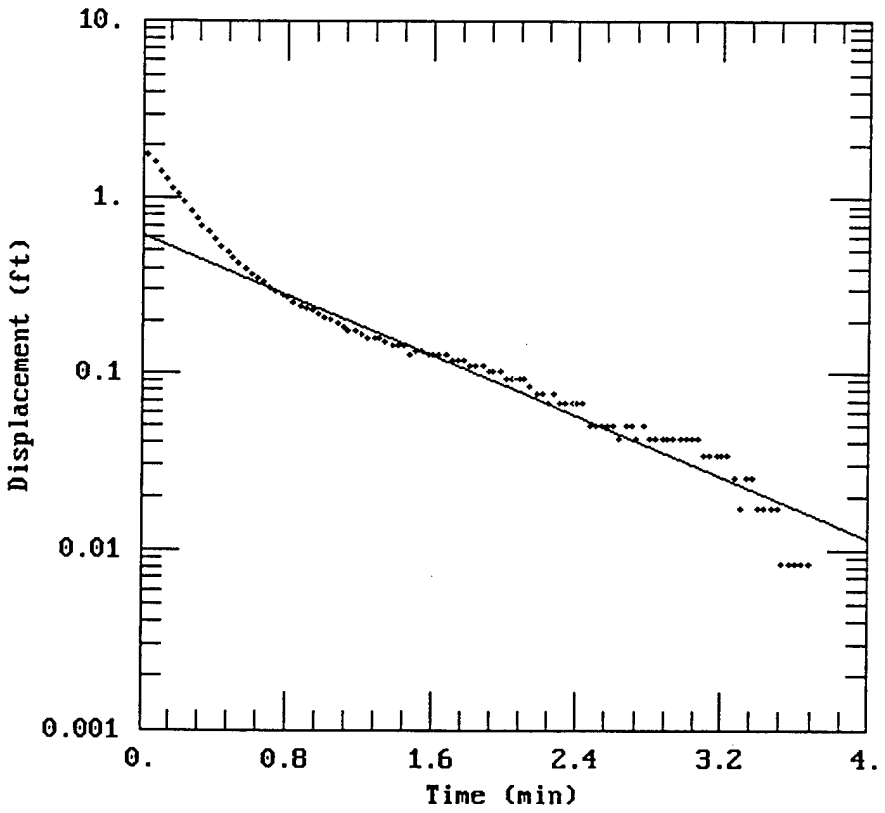
TEST DATA:
H0= 1.758 ft
r_c= 0.083 ft
r_w= 0.333 ft
L = 10. ft
b = 60. ft
H = 9.2 ft

PARAMETER ESTIMATES:
K = 0.001091 ft/min
y0 = 0.5527 ft

AQTESOLV

CLIENT: AFCEE/Langley AFB	COMPANY: Parsons Engineering Science
LOCATION: Site SS-04	PROJECT: RNA TS

Slug Test Analysis



DATA SET:
OW7.DAT
08/12/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: 11/6/96
test well: NA
obs. well: OW-7

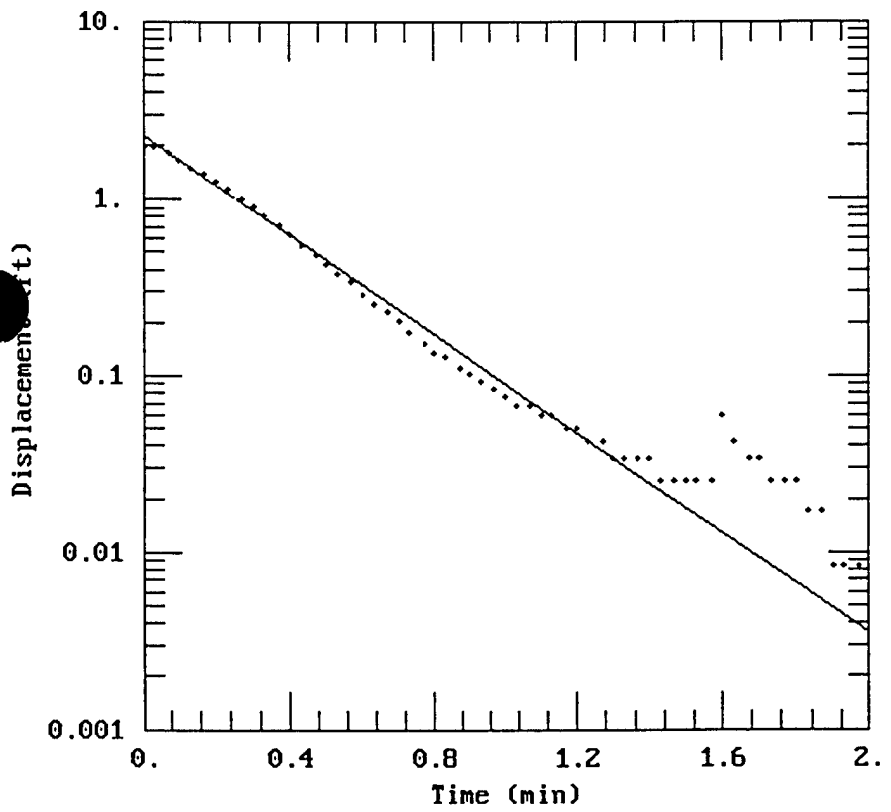
TEST DATA:
H0= 1.774 ft
r_c= 0.083 ft
r_w= 0.333 ft
L = 10. ft
b = 60. ft
H = 7.5 ft

PARAMETER ESTIMATES:
K = 0.003265 ft/min
y0 = 0.6113 ft

AQTESO

CLIENT: AFCEE/Langley AFB	COMPANY: Parsons Engineering Science
LOCATION: Site SS-04	PROJECT: RNA TS

Slug Test Analysis



DATA SET:
OW8.DAT
08/10/98

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: 11/6/96
test well: NA
obs. well: OW-8

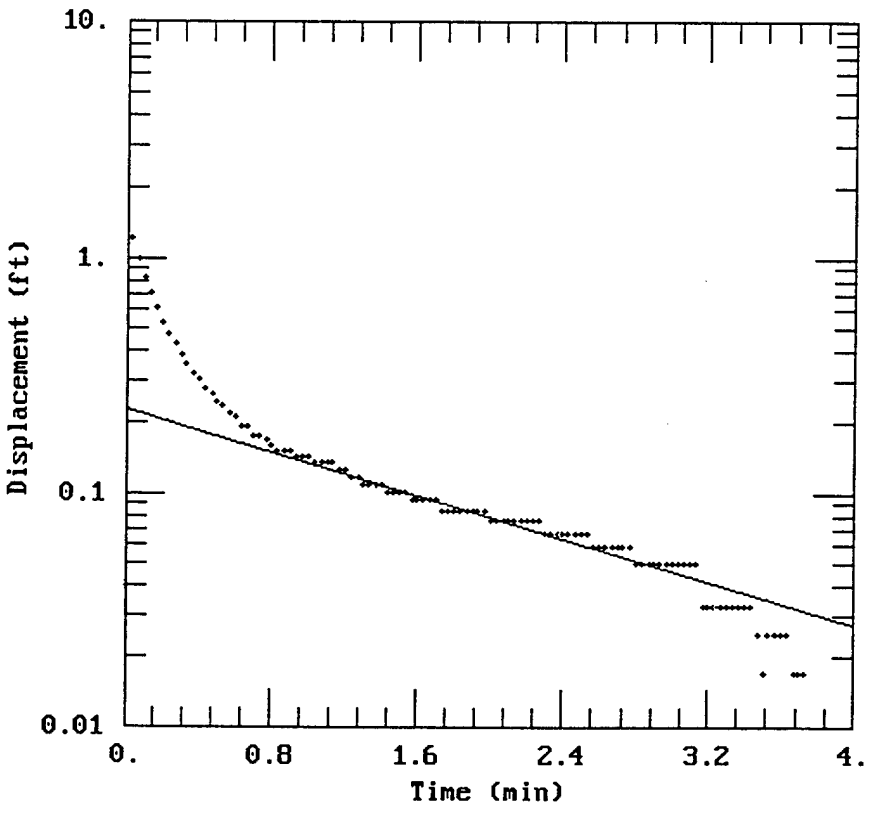
TEST DATA:
H0= 1.96 ft
r_c= 0.083 ft
r_w= 0.333 ft
L = 10. ft
b = 60. ft
H = 7.3 ft

PARAMETER ESTIMATES:
K = 0.01053 ft/min
y0 = 2.27 ft

AQTESOLV

CLIENT: AFCEE/Langley AFB	COMPANY: Parsons Engineering Science
LOCATION: Site SS-04	PROJECT: RNA TS

Slug Test Analysis



DATA SET:
P3.DAT
08/12/98

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

PROJECT DATA:
test date: 11/6/96
test well: NA
obs. well: P-3

TEST DATA:
H0= 1.224 ft
r_c= 0.083 ft
r_w= 0.333 ft
L = 10. ft
b = 60. ft
H = 10.1 ft

PARAMETER ESTIMATES:
K = 0.001845 ft/min
y0 = 0.2249 ft

AQTE

APPENDIX C

LABORATORY ANALYTICAL DATA

OCT. - NOV. 1996

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-1	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-01	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: WATER
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104008
Date Prepared	: 11/4/96	Method Blank	: MB2110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/4/96	U	0.1	mg/L
Benzene	71-43-2	11/4/96	U	0.4	ug/L
Toluene	108-88-3	11/4/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	U	0.5	ug/L
D Surrogate Recovery:		104%		70%-126%	(Limits)
Surrogate Recovery:		106%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blicher
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-2	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-03	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: WATER
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104010
Date Prepared	: 11/4/96	Method Blank	: MB2110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/4/96	U	0.1	mg/L
Benzene	71-43-2	11/4/96	U	0.4	ug/L
Toluene	108-88-3	11/4/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	U	0.5	ug/L
FID Surrogate Recovery:		106%		70%-126%	(Lir.
PID Surrogate Recovery:		109%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Bleiker
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-3	Client	: Langley AFB
Lab Sample Number	: 96-3845-03	Lab Work Order	: 96-3845
Date Sampled	: 10/28/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030018
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	10/30/96	U	0.1	mg/L
Benzene	71-43-2	10/30/96	U	0.4	ug/L
Toluene	108-88-3	10/30/96	U	0.4	ug/L
Chlorobenzene	108-90-7	10/30/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	10/30/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/30/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/30/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/30/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/30/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/30/96	U	0.5	ug/L
Surrogate Recovery:		96%		70%-126%	(Limits)
Surrogate Recovery:		102%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

K. Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-4	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-04	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: WATER
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104011
Date Prepared	: 11/4/96	Method Blank	: MB2110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/4/96	U	0.1	mg/L
Benzene	71-43-2	11/4/96	U	0.4	ug/L
Toluene	108-88-3	11/4/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	U	0.5	ug/L
FID Surrogate Recovery:		105%		70%-126%	(Limits)
PID Surrogate Recovery:		111%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-5S	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-09	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: WATER
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104038
Date Prepared	: 11/5/96	Method Blank	: MB2110596
FID Dilution Factor	: 20		
PID Dilution Factor	: 20		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/5/96	9.0	2.0	mg/L
Benzene	71-43-2	11/5/96	1300	8.0	ug/L
Toluene	108-88-3	11/5/96	U	8.0	ug/L
Chlorobenzene	108-90-7	11/5/96	U	8.0	ug/L
Ethyl Benzene	100-41-4	11/5/96	96	8.0	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/5/96	410	8.0	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/5/96	190	8.0	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/5/96	820	8.0	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/5/96	93	8.0	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	210	10.0	ug/L
Surrogate Recovery:		118%		70%-126%	(Limits)
PID Surrogate Recovery:		117%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-5D	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-06	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: WATER
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104023,39
Date Prepared	: 11/4/96	Method Blank	: MB2110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0, 10		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/5/96	2.2	0.1	mg/L
Benzene	71-43-2	11/5/96	71	0.4	ug/L
Toluene	108-88-3	11/5/96	7.2	0.4	ug/L
Chlorobenzene	108-90-7	11/5/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/5/96	13	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/5/96	54	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/5/96	40	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/5/96	150	4.0	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/5/96	20	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	60	0.5	ug/L
FID Surrogate Recovery:		HI *		70%-126%	
PID Surrogate Recovery:		HI *,112%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-6	Client Project Number	: Langley AFB
Lab Sample Number	: 96-3882-03	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Matrix	: Water
Date Received	: 11/1/96	Lab File Number(s)	: TVB11104025
Date Prepared	: 11/5/96	Method Blank	: MB1110596
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/5/96	U	0.1	mg/L
Benzene	71-43-2	11/5/96	U	0.4	ug/L
Toluene	108-88-3	11/5/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/5/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/5/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/5/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/5/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/5/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/5/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	U	0.5	ug/L
FID Surrogate Recovery:		99%		50%-150%	(Limits)
PID Surrogate Recovery:		104%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

K. Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-7	Client Project Number	: Langley AFB
Lab Sample Number	: 96-3882-05	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Matrix	: Water
Date Received	: 11/1/96	Lab File Number(s)	: TVB11104029
Date Prepared	: 11/5/96	Method Blank	: MB1110596
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/6/96	U	0.1	mg/L
Benzene	71-43-2	11/6/96	U	0.4	ug/L
Toluene	108-88-3	11/6/96	1.1	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	U	0.5	ug/L
FID Surrogate Recovery:		106%		50%-150%	(L
PID Surrogate Recovery:		111%		50%-150%	(Lim

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

K. Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-8	Client	: Langley AFB
Lab Sample Number	: 96-3845-05	Lab Work Order	: 96-3845
Date Sampled	: 10/28/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030022
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	10/30/96	U	0.1	mg/L
Benzene	71-43-2	10/30/96	U	0.4	ug/L
Toluene	108-88-3	10/30/96	U	0.4	ug/L
Chlorobenzene	108-90-7	10/30/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	10/30/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/30/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/30/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/30/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/30/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/30/96	U	0.5	ug/L
PID Surrogate Recovery:		96%		70%-126%	(Limits)
FID Surrogate Recovery:		101%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blevins
Analyst

K. Hollman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-9	Client Project Number	: Langley AFB
Lab Sample Number	: 96-3882-01	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Matrix	: Water
Date Received	: 11/1/96	Lab File Number(s)	: TVB11104019
Date Prepared	: 11/5/96	Method Blank	: MB1110596
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/5/96	0.4	0.1	mg/L
Benzene	71-43-2	11/5/96	U	0.4	ug/L
Toluene	108-88-3	11/5/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/5/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/5/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/5/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/5/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/5/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/5/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	U	0.5	ug/L
FID Surrogate Recovery:		102%		50%-150%	
PID Surrogate Recovery:		109%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

H. Diane Mills
Analyst

K. Hollman
Approved

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-10	Client Project Number	: Langley AFB
Lab Sample Number	: 96-3882-02	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Matrix	: Water
Date Received	: 11/1/96	Lab File Number(s)	: TVB11104024
Date Prepared	: 11/5/96	Method Blank	: MB1110596
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/5/96	U	0.1	mg/L
Benzene	71-43-2	11/5/96	U	0.4	ug/L
Toluene	108-88-3	11/5/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/5/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/5/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/5/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/5/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/5/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/5/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	U	0.5	ug/L
FID Surrogate Recovery:		101%		50%-150%	(Limits)
PID Surrogate Recovery:		105%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

Approved

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-11	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-05	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: WATER
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104012
Date Prepared	: 11/4/96	Method Blank	: MB2110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/4/96	U	0.1	mg/L
Benzene	71-43-2	11/4/96	U	0.4	ug/L
Toluene	108-88-3	11/4/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	U	0.5	ug/L
.					
FID Surrogate Recovery:		100%		70%-126%	(L
PID Surrogate Recovery:		108%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Bleeker
Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-12M	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-09	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21106014
Date Prepared	: 11/6/96	Method Blank	: MB2110696
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/7/96	0.1	0.1	mg/L
Benzene	71-43-2	11/7/96	U	0.4	ug/L
Toluene	108-88-3	11/7/96	2.9	0.4	ug/L
Chlorobenzene	108-90-7	11/7/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/7/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/7/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/7/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/7/96	0.6	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/7/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/7/96	9.3	0.5	ug/L
Surrogate Recovery:		107%		70%-126%	(Limits)
PID Surrogate Recovery:		110%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-12D	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-08	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21104068
Date Prepared	: 11/5/96	Method Blank	: MB2110596B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/6/96	U	0.1	mg/L
Benzene	71-43-2	11/6/96	U	0.4	ug/L
Toluene	108-88-3	11/6/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	1.1	0.5	ug/L
FID Surrogate Recovery:		108%		70%-126%	(Limits)
PID Surrogate Recovery:		109%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-13	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-02	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: WATER
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104009
Date Prepared	: 11/4/96	Method Blank	: MB2110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/4/96	U	0.1	mg/L
Benzene	71-43-2	11/4/96	U	0.4	ug/L
Toluene	108-88-3	11/4/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	U	0.5	ug/L
Surrogate Recovery:		99%		70%-126%	(Limits)
Surrogate Recovery:		109%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-14D	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-05	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21104066
Date Prepared	: 11/5/96	Method Blank	: MB2110596B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/6/96	0.2	0.1	mg/L
Benzene	71-43-2	11/6/96	U	0.4	ug/L
Toluene	108-88-3	11/6/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	0.4	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	8.0	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	0.7	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	7.7	0.5	ug/L
FID Surrogate Recovery:		109%		70%-126%	(Limits)
PID Surrogate Recovery:		114%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-15	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-07	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21106013
Date Prepared	: 11/6/96	Method Blank	: MB2110696
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration		RL	Units
TVH-Gasoline	----	11/7/96	0.6		0.1	mg/L
Benzene	71-43-2	11/7/96	7.0		0.4	ug/L
Toluene	108-88-3	11/7/96		U	0.4	ug/L
Chlorobenzene	108-90-7	11/7/96	0.5		0.4	ug/L
Ethyl Benzene	100-41-4	11/7/96	30		0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/7/96	1.8		0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/7/96		U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/7/96	9.7		0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/7/96	2.2		0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/7/96	45		0.5	ug/L
Surrogate Recovery:		140%	*		70%-126%	(Limits)
D Surrogate Recovery:		129%	*		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

K Hollman
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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-16	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-04	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21106012
Date Prepared	: 11/6/96	Method Blank	: MB2110696
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration		RL	Units
TVH-Gasoline	---	11/6/96	0.7		0.1	mg/L
Benzene	71-43-2	11/6/96	7.5		0.4	ug/L
Toluene	108-88-3	11/6/96		U	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96		U	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	5.3		0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	12		0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	8.2		0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	27		0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	12		0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	34		0.5	ug/L
FID Surrogate Recovery:		137%	*		70%-126%	(Limits)
PID Surrogate Recovery:		128%	*		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-17	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-01	Lab Work Order	: 96-3906
Date Sampled	: 11/2/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21104063
Date Prepared	: 11/5/96	Method Blank	: MB2110596B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/6/96	U	0.1	mg/L
Benzene	71-43-2	11/6/96	U	0.4	ug/L
Toluene	108-88-3	11/6/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	U	0.5	ug/L
Surrogate Recovery:		89%		70%-126%	(Limits)
PID Surrogate Recovery:		105%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-18	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-10	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: WATER
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104028
Date Prepared	: 11/4/96	Method Blank	: MB2110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/5/96	U	0.1	mg/L
Benzene	71-43-2	11/5/96	U	0.4	ug/L
Toluene	108-88-3	11/5/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/5/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/5/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/5/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/5/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/5/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/5/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	U	0.5	ug/L
FID Surrogate Recovery:		102%		70%-126%	(Limits
PID Surrogate Recovery:		101%		76%-127%	(Limits

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-19	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-03	Lab Work Order	: 96-3906
Date Sampled	: 11/2/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21104065
Date Prepared	: 11/5/96	Method Blank	: MB2110596B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/6/96	U	0.1	mg/L
Benzene	71-43-2	11/6/96	U	0.4	ug/L
Toluene	108-88-3	11/6/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	U	0.5	ug/L
Surrogate Recovery:		101%		70%-126%	(Limits)
PID Surrogate Recovery:		107%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-20	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-02	Lab Work Order	: 96-3906
Date Sampled	: 11/2/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21104064
Date Prepared	: 11/5/96	Method Blank	: MB2110596B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/6/96	U	0.1	mg/L
Benzene	71-43-2	11/6/96	U	0.4	ug/L
Toluene	108-88-3	11/6/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	U	0.5	ug/L
FID Surrogate Recovery:		93%		70%-126%	(Limits)
PID Surrogate Recovery:		104%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-21	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-10	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21106015,26
Date Prepared	: 11/6,7/96	Method Blanks	: MB2110696, MB2110796
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0; 10		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/7/96	1.8	0.1	mg/L
Benzene	71-43-2	11/7/96	280	4.0	ug/L
Toluene	108-88-3	11/7/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/7/96	3.5	0.4	ug/L
Ethyl Benzene	100-41-4	11/7/96	2.4	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/7/96	3.1	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/7/96	2.9	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/7/96	22	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/7/96	4.4	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/7/96	30	0.5	ug/L
D Surrogate Recovery:		140%*		70%-126%	(Limits)
PID Surrogate Recovery:		129%*;105%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 0W-3	Client	: Langley AFB
Lab Sample Number	: 96-3845-02	Lab Work Order	: 96-3845
Date Sampled	: 10/28/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030025
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	10/30/96	1.7	0.1	mg/L
Benzene	71-43-2	10/30/96	U	0.4	ug/L
Toluene	108-88-3	10/30/96	U	0.4	ug/L
Chlorobenzene	108-90-7	10/30/96	0.9	0.4	ug/L
Ethyl Benzene	100-41-4	10/30/96	3.4	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/30/96	0.6	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/30/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/30/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/30/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/30/96	77	0.5	ug/L
FID Surrogate Recovery:		88%		70%-126%	(Limits)
PID Surrogate Recovery:		126%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-4	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-03	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: WATER
Date Received	: 10/31/96	Lab File Number(s)	: TVB31030047
Date Prepared	: 11/1/96	Method Blank	: MB3110196
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration		RL	Units
TVH-Gasoline	---	11/1/96	1.5		0.1	mg/L
Benzene	71-43-2	11/1/96		U	0.4	ug/L
Toluene	108-88-3	11/1/96	2.0		0.4	ug/L
Chlorobenzene	108-90-7	11/1/96		U	0.4	ug/L
Ethyl Benzene	100-41-4	11/1/96	2.8		0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/1/96		U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/1/96		U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/1/96	3.1		0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/1/96		U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/1/96	87		0.5	ug/L
PID Surrogate Recovery:		98%			70%-130%	(Limits)
FID Surrogate Recovery:		110%			70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-7	Client	: Langley AFB
Lab Sample Number	: 96-3845-12	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030031
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	10/31/96	1.8	0.1	mg/L
Benzene	71-43-2	10/31/96	97	0.4	ug/L
Toluene	108-88-3	10/31/96	0.7	0.4	ug/L
Chlorobenzene	108-90-7	10/31/96	0.8	0.4	ug/L
Ethyl Benzene	100-41-4	10/31/96	3.8	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/31/96	6.1	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/31/96	1.9	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/31/96	17	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/31/96	10	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/31/96	100	0.5	ug/L
FID Surrogate Recovery:		119%		70%-126%	(Limits)
PID Surrogate Recovery:		HI *		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-8	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-12	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: WATER
Date Received	: 10/31/96	Lab File Number(s)	: TVB31104027
Date Prepared	: 11/4/96	Method Blank	: MB3110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/5/96	0.3	0.1	mg/L
Benzene	71-43-2	11/5/96	U	0.4	ug/L
Toluene	108-88-3	11/5/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/5/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/5/96	0.7	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/5/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/5/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/5/96	2.0	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/5/96	0.7	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	2.9	0.5	ug/L
[redacted] Surrogate Recovery:		102%		70%-130%	(Limits)
PID Surrogate Recovery:		99%		70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
[redacted]H = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-9	Client Project Number	: 729791.20210
Lab Sample Number	: 96-3916-03	Lab Work Order	: 96-3916
Date Sampled	: 11/4/96	Matrix	: Water
Date Received	: 11/5/96	Lab File Number(s)	: TVB31106012*
Date Prepared	: 11/6,14/96	Method Blanks	: MB3110696*
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0; 10		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/6/96	5.3	0.1	mg/L
Benzene	71-43-2	11/6/96	84	0.4	ug/L
Toluene	108-88-3	11/6/96	7.3	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	0.4	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	53	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	80	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	20	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/14/96	440	4.0	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/14/96	270	4.0	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/14/96	170	5.0	ug/L
FID Surrogate Recovery:		125%		50%-150%	
PID Surrogate Recovery:		HI**; 89%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = TVB31111091 and MB3111496
** = High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-11	Client Project Number	: 729791.20210
Lab Sample Number	: 96-3916-04	Lab Work Order	: 96-3916
Date Sampled	: 11/4/96	Matrix	: Water
Date Received	: 11/5/96	Lab File Number(s)	: TVB31106016
Date Prepared	: 11/6/96	Method Blank	: MB3110696
FID Dilution Factor	: 10		
PID Dilution Factor	: 10		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/6/96	9.1	1.0	mg/L
Benzene	71-43-2	11/6/96	720	4.0	ug/L
Toluene	108-88-3	11/6/96	67	4.0	ug/L
Chlorobenzene	108-90-7	11/6/96	U	4.0	ug/L
Ethyl Benzene	100-41-4	11/6/96	240	4.0	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	520	4.0	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	150	4.0	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	590	4.0	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	300	4.0	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	190	5.0	ug/L
[redacted] Surrogate Recovery:		93%		50%-150%	(Limits)
[redacted] Surrogate Recovery:		106%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-12	Client Project Number	: Langley AFB
Lab Sample Number	: 96-3882-04	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Matrix	: Water
Date Received	: 11/1/96	Lab File Number(s)	: TVB11104028
Date Prepared	: 11/5/96	Method Blank	: MB1110596
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/6/96	2.0	0.1	mg/L
Benzene	71-43-2	11/6/96	11	0.4	ug/L
Toluene	108-88-3	11/6/96	6.4	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	3.7	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	2.6	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	42	0.5	ug/L
FID Surrogate Recovery:		103%		50%-150%	
PID Surrogate Recovery:		109%		50%-150%	(Limits

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

Analyst

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 0W-13	Client	: Langley AFB
Lab Sample Number	: 96-3845-06	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030038
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	10/31/96	0.5	0.1	mg/L
Benzene	71-43-2	10/31/96	U	0.4	ug/L
Toluene	108-88-3	10/31/96	U	0.4	ug/L
Chlorobenzene	108-90-7	10/31/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	10/31/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/31/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/31/96	7.0	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/31/96	8.5	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/31/96	20	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/31/96	20	0.5	ug/L
Surrogate Recovery:		113%		70%-126%	(Limits)
PID Surrogate Recovery:		116%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
= Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-15	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-04	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: WATER
Date Received	: 10/31/96	Lab File Number(s)	: TVB31030048
Date Prepared	: 11/1/96	Method Blank	: MB3110196
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration		RL	Units
TVH-Gasoline	----	11/1/96	U		0.1	mg/L
Benzene	71-43-2	11/1/96	U		0.4	ug/L
Toluene	108-88-3	11/1/96	U		0.4	ug/L
Chlorobenzene	108-90-7	11/1/96	U		0.4	ug/L
Ethyl Benzene	100-41-4	11/1/96	U		0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/1/96	U		0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/1/96	U		0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/1/96	U		0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/1/96	U		0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/1/96	1.0		0.5	ug/L
FID Surrogate Recovery:		118%			70%-130%	(Limits)
PID Surrogate Recovery:		133%		*	70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = High surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Bleda
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-102	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-02	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: WATER
Date Received	: 10/31/96	Lab File Number(s)	: TVB31030046
Date Prepared	: 11/1/96	Method Blank	: MB3110196
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/1/96	U	0.1	mg/L
Benzene	71-43-2	11/1/96	U	0.4	ug/L
Toluene	108-88-3	11/1/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/1/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/1/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/1/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/1/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/1/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/1/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/1/96	U	0.5	ug/L
Surrogate Recovery:		96%		70%-130%	(Limits)
PID Surrogate Recovery:		98%		70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Bleiker
Analyst

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-103	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-07	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: WATER
Date Received	: 10/31/96	Lab File Number(s)	: TVB31104022
Date Prepared	: 11/4/96	Method Blank	: MB3110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/4/96	U	0.1	mg/L
Benzene	71-43-2	11/4/96	U	0.4	ug/L
Toluene	108-88-3	11/4/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	U	0.5	ug/L
FID Surrogate Recovery:		86%		70%-130%	(Limits)
PID Surrogate Recovery:		98%		70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Bleaker
Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 0W-104	Client	: Langley AFB
Lab Sample Number	: 96-3845-08	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030029
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	10/31/96	U	0.1	mg/L
Benzene	71-43-2	10/31/96	U	0.4	ug/L
Toluene	108-88-3	10/31/96	U	0.4	ug/L
Chlorobenzene	108-90-7	10/31/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	10/31/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/31/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/31/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/31/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/31/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/31/96	U	0.5	ug/L
[illegible] Surrogate Recovery:		95%		70%-126%	(Limits)
PID Surrogate Recovery:		99%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
[illegible]H = Total Volatile Hydrocarbons.

M. Rhodes
Analyst

K. Hollman
Approved

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 0W-105	Client	: Langley AFB
Lab Sample Number	: 96-3845-04	Lab Work Order	: 96-3845
Date Sampled	: 10/28/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030019
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	10/30/96	U	0.1	mg/L
Benzene	71-43-2	10/30/96	U	0.4	ug/L
Toluene	108-88-3	10/30/96	U	0.4	ug/L
Chlorobenzene	108-90-7	10/30/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	10/30/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/30/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/30/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/30/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/30/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/30/96	U	0.5	ug/L
FID Surrogate Recovery:		94%		70%-126%	(Limits)
PID Surrogate Recovery:		102%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Rhodes
Analyst

K. Hellman
Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-106	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-08	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: WATER
Date Received	: 10/31/96	Lab File Number(s)	: TVB31104023
Date Prepared	: 11/4/96	Method Blank	: MB3110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/4/96	U	0.1	mg/L
Benzene	71-43-2	11/4/96	U	0.4	ug/L
Toluene	108-88-3	11/4/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	U	0.5	ug/L
Surrogate Recovery:		92%		70%-130%	(Limits)
PID Surrogate Recovery:		100%		70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blicha
Analyst

Approved

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-107	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-06	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: WATER
Date Received	: 10/31/96	Lab File Number(s)	: TVB31104021
Date Prepared	: 11/4/96	Method Blank	: MB3110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/4/96	U	0.1	mg/L
Benzene	71-43-2	11/4/96	U	0.4	ug/L
Toluene	108-88-3	11/4/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	U	0.5	ug/L
FID Surrogate Recovery:		82%		70%-130%	(Limits)
PID Surrogate Recovery:		94%		70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Bleeker
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 0W-110	Client	: Langley AFB
Lab Sample Number	: 96-3845-07	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB2103003[illegible]
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	10/31/96	0.5	0.1	mg/L
Benzene	71-43-2	10/31/96	U	0.4	ug/L
Toluene	108-88-3	10/31/96	U	0.4	ug/L
Chlorobenzene	108-90-7	10/31/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	10/31/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/31/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/31/96	7.0	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/31/96	8.4	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/31/96	20	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/31/96	20	0.5	ug/L
[illegible] Surrogate Recovery:		100%		70%-126%	(Limits)
PID Surrogate Recovery:		118%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
[illegible]H = Total Volatile Hydrocarbons.

M. Oleska
Analyst

K. Hollman
Approved

EVERGREEN ANALYTICAL, INC.
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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	:	OW-111	Client Project Number	:	Langley AFB
Lab Sample Number	:	95-3864-11	Lab Work Order	:	96-3864
Date Sampled	:	10/30/96	Matrix	:	WATER
Date Received	:	10/31/96	Lab File Number(s)	:	TVB31104026
Date Prepared	:	11/4/96	Method Blank	:	MB3110496
FID Dilution Factor	:	1.0			
PID Dilution Factor	:	1.0			

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/4/96	1.2	0.1	mg/L
Benzene	71-43-2	11/4/96	13	0.4	ug/L
Toluene	108-88-3	11/4/96	3.5	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	1.4	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	5.0	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	14	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	29	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	14	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	51	0.5	ug/L
FID Surrogate Recovery:		124%		70%-130%	(Limits)
PID Surrogate Recovery:		121%		70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

K. Hollman
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EVERGREEN ANALYTICAL, INC.
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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-113	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-08	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: WATER
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104025
Date Prepared	: 11/4/96	Method Blank	: MB2110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/5/96	U	0.1	mg/L
Benzene	71-43-2	11/5/96	U	0.4	ug/L
Toluene	108-88-3	11/5/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/5/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/5/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/5/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/5/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/5/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/5/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	U	0.5	ug/L
FID Surrogate Recovery:		95%		70%-126%	(Limits)
PID Surrogate Recovery:		103%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Bleiker
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-114	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-06	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21104067
Date Prepared	: 11/5/96	Method Blank	: MB2110596B
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration		RL	Units
TVH-Gasoline	----	11/6/96	0.3		0.1	mg/L
Benzene	71-43-2	11/6/96		U	0.4	ug/L
Toluene	108-88-3	11/6/96	1.3		0.4	ug/L
Chlorobenzene	108-90-7	11/6/96		U	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96		U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	0.7		0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	0.7		0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	8.2		0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	1.0		0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	7.9		0.5	ug/L
Surrogate Recovery:		115%			70%-126%	(Limits)
PID Surrogate Recovery:		115%			76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
= Total Volatile Hydrocarbons.

M Blecha
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: OW-115	Client Project Number	: 729791.20210
Lab Sample Number	: 96-3916-06	Lab Work Order	: 96-3916
Date Sampled	: 11/4/96	Matrix	: Water
Date Received	: 11/5/96	Lab File Number(s)	: TVB31106015*
Date Prepared	: 11/6,14/96	Method Blank	: MB3110696*
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0; 10		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/6/96	5.3	0.1	mg/L
Benzene	71-43-2	11/6/96	78	0.4	ug/L
Toluene	108-88-3	11/6/96	7.7	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	0.6	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	50	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	78	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	24	4.0	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/14/96	450	4.0	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/14/96	280	4.0	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/14/96	180	5.0	ug/L
FID Surrogate Recovery:		121%		50%-150%	(Limits)
PID Surrogate Recovery:		HI**; 98%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * =TVB31111090 and MB3111496
** = High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hillman
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: RW-6	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-10	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: WATER
Date Received	: 10/31/96	Lab File Number(s)	: TVB31104025
Date Prepared	: 11/4/96	Method Blank	: MB3110496
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/4/96	1.1	0.1	mg/L
Benzene	71-43-2	11/4/96	12	0.4	ug/L
Toluene	108-88-3	11/4/96	3.3	0.4	ug/L
Chlorobenzene	108-90-7	11/4/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/4/96	1.3	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/4/96	4.4	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/4/96	13	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/4/96	27	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/4/96	13	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/4/96	46	0.5	ug/L
Surrogate Recovery:		120%		70%-130%	(Limits)
PID Surrogate Recovery:		114%		70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: RW-13	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-12	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21106025
Date Prepared	: 11/7/96	Method Blank	: MB2110796
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration		RL	Units
TVH-Gasoline	----	11/7/96	0.2		0.1	mg/L
Benzene	71-43-2	11/7/96		U	0.4	ug/L
Toluene	108-88-3	11/7/96		U	0.4	ug/L
Chlorobenzene	108-90-7	11/7/96		U	0.4	ug/L
Ethyl Benzene	100-41-4	11/7/96	1.0		0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/7/96		U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/7/96		U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/7/96	1.5		0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/7/96		U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/7/96	24		0.5	ug/L
FID Surrogate Recovery:		116%			70%-126%	(Limits)
PID Surrogate Recovery:		114%			76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: RW-15	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3906-11	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Matrix	: WATER
Date Received	: 11/4/96	Lab File Number(s)	: TVB21106016
Date Prepared	: 11/6/96	Method Blank	: MB2110696
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/7/96	0.2	0.1	mg/L
Benzene	71-43-2	11/7/96	U	0.4	ug/L
Toluene	108-88-3	11/7/96	18	0.4	ug/L
Chlorobenzene	108-90-7	11/7/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	11/7/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/7/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/7/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/7/96	0.5	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/7/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/7/96	6.4	0.5	ug/L
FID Surrogate Recovery:		96%		70%-126%	(Limits)
PID Surrogate Recovery:		121%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: P-1	Client	: Langley AFB
Lab Sample Number	: 96-3845-09	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030033
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration		RL	Units
TVH-Gasoline	----	10/31/96	0.4		0.1	mg/L
Benzene	71-43-2	10/31/96		U	0.4	ug/L
Toluene	108-88-3	10/31/96	2.3		0.4	ug/L
Chlorobenzene	108-90-7	10/31/96		U	0.4	ug/L
Ethyl Benzene	100-41-4	10/31/96	2.9		0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/31/96	0.4		0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/31/96	0.5		0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/31/96		U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/31/96	1.5		0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/31/96	17		0.5	ug/L
FID Surrogate Recovery:		119%			70%-126%	(Limits)
PID Surrogate Recovery:		123%			76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: HA-4MP-11(3')	Client Project Number	: 72969.20210
Lab Sample Number	: 96-3942-02	Lab Work Order	: 96-3942
Date Sampled	: 11/6/96	Matrix	: SOIL
Date Received	: 11/7/96	Lab File Number(s)	: TVB11109027
Date Prepared	: 11/9/96	Method Blank	: MB1110996
FID Dilution Factor	: 1.0	Soil Extracted?	: NO
PID Dilution Factor	: 1.0	Soil Moisture	: 17.87%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/9/96	U	0.1	mg/kg
Benzene	71-43-2	11/9/96	U	0.5	ug/kg
Toluene	108-88-3	11/9/96	0.6	0.5	ug/kg
Chlorobenzene	108-90-7	11/9/96	U	0.5	ug/kg
Ethyl Benzene	100-41-4	11/9/96	U	0.5	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/9/96	0.6	0.5	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/9/96	U	0.5	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/9/96	U	0.5	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/9/96	U	0.5	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/9/96	U	0.6	ug/kg
[illegible] Surrogate Recovery:		40%*		50%-150%	(Limits)
[illegible] Surrogate Recovery:		40%*		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * **See TVB11109052 to confirm low surrogate recovery.**

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

H. Diane Mills
Analyst

K. Hollman
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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: HA-4MP-22(3')	Client Project Number	: 72969.20210
Lab Sample Number	: 96-3942-03	Lab Work Order	: 96-3942
Date Sampled	: 11/6/96	Matrix	: SOIL
Date Received	: 11/7/96	Lab File Number(s)	: TVB11109028
Date Prepared	: 11/9/96	Method Blank	: MB1110996
FID Dilution Factor	: 1.0	Soil Extracted?	: NO
PID Dilution Factor	: 1.0	Soil Moisture	: 14.03%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/9/96	U	0.1	mg/kg
Benzene	71-43-2	11/9/96	U	0.5	ug/kg
Toluene	108-88-3	11/9/96	0.5	0.5	ug/kg
Chlorobenzene	108-90-7	11/9/96	U	0.5	ug/kg
Ethyl Benzene	100-41-4	11/9/96	U	0.5	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/9/96	2.0	0.5	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/9/96	U	0.5	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/9/96	U	0.5	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/9/96	U	0.5	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/9/96	U	0.6	ug/kg
FID Surrogate Recovery:		37%*		50%-150%	(Limits)
PID Surrogate Recovery:		37%*		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:* SeeTVB11109029 and 31 Matrix Spike and Matrix Spike Duplicate to confirm low surrogate recovery

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

X. Diane Mills
Analyst

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Approved

EVERGREEN ANALYTICAL, INC.
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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: A	Client Project	: Langley AFB
Lab Sample Number	: 96-3845-14	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: SOIL
Date Received	: 10/30/96	Lab File Number(s)	: TVB11101012
Date Prepared	: 11/1/96	Method Blank	: MB1110196
FID Dilution Factor	: 1.0	Soil Extracted?	: NO
PID Dilution Factor	: 1.0	Soil Moisture	: 23.46%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/1/96	U	0.1	mg/kg
D Surrogate Recovery:		86%		50%-132%	(Limits)
D Surrogate Recovery:	NA			72%-118%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K Hollman
Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: C(4')	Client Project Number	: 729691.20210
Lab Sample Number	: 96-3899-11	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Matrix	: SOIL
Date Received	: 11/2/96	Lab File Number(s)	: TVB21104032
Date Prepared	: 11/4/96	Method Blank	: MEB2110496
FID Dilution Factor	: 250	Soil Moisture:	: 20.52%
PID Dilution Factor	: 250		

Compound Name	Cas Number	Analysis Date	Sample# Concentration		RL#	Units
TVH-Gasoline	----	11/5/96	2300		25	mg/kg
Benzene	71-43-2	11/5/96	960		126	ug/kg
Toluene	108-88-3	11/5/96		U	126	ug/kg
Chlorobenzene	108-90-7	11/5/96		U	126	ug/kg
Ethyl Benzene	100-41-4	11/5/96	7600		126	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/5/96	17000		126	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/5/96	14000		126	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/5/96	37000	E	126	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/5/96	19000		126	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	50000	E	158	ug/kg
FID Surrogate Recovery:		HI *			50%-150%	(Limits)
PID Surrogate Recovery:		HI *			50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: # = Based on dry weight.
* = High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

K. Hollman
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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: D1(6')	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-13	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: SOIL
Date Received	: 10/31/96	Lab File Number(s)	: TVB31104030,40,49
Date Prepared	: 11/5/96	Method Blank	: MB3110596,*
FID Dilution Factor	: 250	Soil Extracted?	: YES
PID Dilution Factor	: 5.0; 1250	Soil Moisture	: 22.67%

Compound Name	Cas Number	Analysis Date	Sample# Concentration	RL#	Units
TVH-Gasoline	----	11/5/96	1800	32	mg/kg
Benzene	71-43-2	11/5/96	330	26	ug/kg
Toluene	108-88-3	11/5/96	17000	650	ug/kg
Chlorobenzene	108-90-7	11/5/96	1700	650	ug/kg
Ethyl Benzene	100-41-4	11/5/96	4000	650	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/5/96	28000	650	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/5/96	22000	650	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/5/96	82000	650	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/5/96	16000	650	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	47000	810	ug/kg
Surrogate Recovery:		HI **		50%-150%	(Limits)
PID Surrogate Recovery:		HI**; 116%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: # = Based on dry weight.
* = MEB110596; ** High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: G(5')	Client Project Number	: Langley AFB
Lab Sample Number	: 96-3882-07	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Matrix	: Soil
Date Received	: 11/1/96	Lab File Number(s)	: TVB11106011
Date Prepared	: 11/6/96	Method Blank	: MB1110696A
FID Dilution Factor	: 5.0	Soil Extracted?	: NO
PID Dilution Factor	: 5.0	Soil Moisture	: 16.23%

Compound Name	Cas Number	Analysis Date	Sample# Concentration	RL#	Units
TVH-Gasoline	----	11/6/96	14	0.6	mg/kg
Benzene	71-43-2	11/6/96	49	2.4	ug/kg
Toluene	108-88-3	11/6/96	75	2.4	ug/kg
Chlorobenzene	108-90-7	11/6/96	U	2.4	ug/kg
Ethyl Benzene	100-41-4	11/6/96	56	2.4	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/6/96	120	2.4	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/6/96	68	2.4	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/6/96	58	2.4	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/6/96	18	2.4	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	100	3.0	ug/kg
FID Surrogate Recovery:		128%		50%-150%	(L
PID Surrogate Recovery:		107%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: # = Dry Basis

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: H(4')	Client Project Number	: Langley AFB
Lab Sample Number	: 96-3882-08	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Matrix	: Soil
Date Received	: 11/1/96	Lab File Number(s)	: TVB11106040,12
Date Prepared	: 11/6,7/96	Method Blank	: MEB1110696
FID Dilution Factor	: 2500	Soil Extracted?	: YES
PID Dilution Factor	: 2500, 500	Soil Moisture	: 15.53%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/7/96	13000	300	mg/kg
Benzene	71-43-2	11/7/96	15000	1200	ug/kg
Toluene	108-88-3	11/7/96	150000	1200	ug/kg
Chlorobenzene	108-90-7	11/6/96	U	240	ug/kg
Ethyl Benzene	100-41-4	11/7/96	140000	1200	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/7/96	120000	1200	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/7/96	86000	1200	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/7/96	68000	1200	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/7/96	75000	1200	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/7/96	190000	1500	ug/kg
PID Surrogate Recovery:		HI*		50%-150%	(Limits)
FID Surrogate Recovery:		HI*, HI		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = High surrogate recoveries due to hydrocarbon interference.
= Dry Basis

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

H. Diane Mills
Analyst

Approved

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: I	Client Project	: Langley AFB
Lab Sample Number	: 96-3845-17	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: SOIL
Date Received	: 10/30/96	Lab File Number(s)	: TVB11101020
Date Prepared	: 11/1/96	Method Blank	: MB1110196
FID Dilution Factor	: 5.0	Soil Extracted?	: NO
PID Dilution Factor	: 5.0	Soil Moisture	: 19.54%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/1/96	21	0.6	mg/kg
Benzene	71-43-2	11/1/96	U	2.5	ug/kg
Toluene	108-88-3	11/1/96	U	2.5	ug/kg
Chlorobenzene	108-90-7	11/1/96	U	2.5	ug/kg
Ethyl Benzene	100-41-4	11/1/96	56	2.5	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/1/96	97	2.5	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/1/96	140	2.5	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/1/96	170	2.5	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/1/96	160	2.5	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/1/96	600	3.1	ug/kg
FID Surrogate Recovery:		127%		50%-132%	
PID Surrogate Recovery:		106%		72%-118%	

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

N. Diane Mills
Analyst

K. Hollman
Approved

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: Y(6')	Client Project	: Langley AFB
Lab Sample Number	: 96-3845-15	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: SOIL
Date Received	: 10/30/96	Lab File Number(s)	: TVB11101014
Date Prepared	: 11/1/96	Method Blank	: MB1110196
FID Dilution Factor	: 1.0	Soil Extracted?	: NO
PID Dilution Factor	: 1.0	Soil Moisture	: 18.34%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/1/96	U	0.1	mg/kg
D Surrogate Recovery:		74%		50%-132%	(Limits)
D Surrogate Recovery:		NA		72%-118%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

H. Diane Mills
Analyst

K. Hoffman
Approved

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(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: Y(10')	Client Project	: Langley AFB
Lab Sample Number	: 96-3845-16	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: SOIL
Date Received	: 10/30/96	Lab File Number(s)	: TVB11101019
Date Prepared	: 11/1/96	Method Blank	: MB1110196
FID Dilution Factor	: 1.0	Soil Extracted?	: NO
PID Dilution Factor	: 1.0	Soil Moisture	: 23.96%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/1/96	U	0.1	mg/kg
FID Surrogate Recovery:		57%		50%-132%	(L
PID Surrogate Recovery:		NA		72%-118%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: HA-4MP-1(3')	Client Project Number	: 72969.20210
Lab Sample Number	: 96-3942-01	Lab Work Order	: 96-3942
Date Sampled	: 11/6/96	Matrix	: SOIL
Date Received	: 11/7/96	Lab File Number(s)	: TVB11106057
Date Prepared	: 11/7/96	Method Blank	: MB1110796
FID Dilution Factor	: 1.0	Soil Extracted?	: NO
PID Dilution Factor	: 1.0	Soil Moisture	: 15.43%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/7/96	U	0.1	mg/kg
Benzene	71-43-2	11/7/96	U	0.5	ug/kg
Toluene	108-88-3	11/7/96	1.3	0.5	ug/kg
Chlorobenzene	108-90-7	11/7/96	U	0.5	ug/kg
Ethyl Benzene	100-41-4	11/7/96	U	0.5	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/7/96	0.7	0.5	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/7/96	U	0.5	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/7/96	U	0.5	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/7/96	U	0.5	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/7/96	U	0.6	ug/kg
PID Surrogate Recovery:		71%		50%-150%	(Limits)
FID Surrogate Recovery:		76%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: 4MP-5-4'-6'	Client Project	: Langley AFB
Lab Sample Number	: 96-3845-01	Lab Work Order	: 96-3845
Date Sampled	: 10/26/96	Matrix	: SOIL
Date Received	: 10/30/96	Lab File Number(s)	: TVB11104008
Date Prepared	: 11/1/96	Method Blank	: MEB1110496A
FID Dilution Factor	: 1250	Soil Extracted?	: YES
PID Dilution Factor	: 1250	Soil Moisture	: 24.23%

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	11/5/96	3300	165	mg/kg
Benzene	71-43-2	11/5/96	6700	660	ug/kg
Toluene	108-88-3	11/5/96	U	660	ug/kg
Chlorobenzene	108-90-7	11/5/96	5100	660	ug/kg
Ethyl Benzene	100-41-4	11/5/96	6800	660	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/5/96	37000	660	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/5/96	47000	660	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/5/96	65000	660	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/5/96	41000	660	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/5/96	51000	825	ug/kg
FID Surrogate Recovery:		High*		65%-129%	
PID Surrogate Recovery:		High*		65%-129%	(Limits

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:* High surrogate recovery due to hydrocarbon interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: P-4	Client Project Number	: 729791.20210
Lab Sample Number	: 96-3916-02	Lab Work Order	: 96-3916
Date Sampled	: 11/4/96	Matrix	: Water
Date Received	: 11/5/96	Lab File Number(s)	: TVB31106023
Date Prepared	: 11/6/96	Method Blank	: MB3110696
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/6/96	2.8	0.1	mg/L
Benzene	71-43-2	11/6/96	25	0.4	ug/L
Toluene	108-88-3	11/6/96	U	0.4	ug/L
Chlorobenzene	108-90-7	11/6/96	1.0	0.4	ug/L
Ethyl Benzene	100-41-4	11/6/96	41	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/6/96	13	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/6/96	10	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/6/96	42	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/6/96	9.9	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/6/96	99	0.5	ug/L
FID Surrogate Recovery:		104%		50%-150%	(Limits)
PID Surrogate Recovery:		115%		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

PMcClella
Approved

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: P-5	Client Project Number	: Langley AFB
Lab Sample Number	: 95-3864-05	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Matrix	: WATER
Date Received	: 10/31/96	Lab File Number(s)	: TVB31030049*
Date Prepared	: 11/1,14/1996	Method Blanks	: MB3110196*
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration		RL	Units
TVH-Gasoline	----	11/1/96	2.6		0.1	mg/L
Benzene	71-43-2	11/1/96		U	0.4	ug/L
Toluene	108-88-3	11/1/96	5.6		0.4	ug/L
Chlorobenzene	108-90-7	11/1/96	1.1		0.4	ug/L
Ethyl Benzene	100-41-4	11/1/96	5.9		0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	11/1/96	3.3		0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	11/1/96	5.9		0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	11/1/96	0.5		0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	11/1/96	150	E+	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	11/1/96	31		0.5	ug/L
FID Surrogate Recovery:		110%			70%-130%	(Limits)
PID Surrogate Recovery:		122%			70%-130%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = TVB31111077 and MB3111496
+ = Reanalyzed out of holding time at a DF=10 to quantitate 1,2,3-TMB giving a Concentration of 210 ug/L.

QUALIFIERS and DEFINITIONS:

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U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

M. Blecha
Analyst

K. Hoffman
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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: P-2	Client	: Langley AFB
Lab Sample Number	: 96-3845-10	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030030
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	----	10/31/96	U	0.1	mg/L
Benzene	71-43-2	10/31/96	U	0.4	ug/L
Toluene	108-88-3	10/31/96	U	0.4	ug/L
Chlorobenzene	108-90-7	10/31/96	U	0.4	ug/L
Ethyl Benzene	100-41-4	10/31/96	U	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/31/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/31/96	U	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/31/96	U	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/31/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/31/96	U	0.5	ug/L
[illegible]D Surrogate Recovery:		96%		70%-126%	(Limits)
PID Surrogate Recovery:		101%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
[illegible]H = Total Volatile Hydrocarbons.

M. Blucher
Analyst

K. Hallman
Approved

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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: P-3	Client	: Langley AFB
Lab Sample Number	: 96-3845-11	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Matrix	: WATER
Date Received	: 10/30/96	Lab File Number(s)	: TVB21030037
Date Prepared	: 10/30/96	Method Blank	: MB2103096
FID Dilution Factor	: 1.0		
PID Dilution Factor	: 1.0		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	10/31/96	1.0	0.1	mg/L
Benzene	71-43-2	10/31/96	U	0.4	ug/L
Toluene	108-88-3	10/31/96	2.8	0.4	ug/L
Chlorobenzene	108-90-7	10/31/96	1.5	0.4	ug/L
Ethyl Benzene	100-41-4	10/31/96	1.1	0.4	ug/L
Total Xylenes (m,p,o)	1330-20-7	10/31/96	U	0.4	ug/L
1,3,5-Trimethylbenzene	108-67-8	10/31/96	5.0	0.4	ug/L
1,2,4-Trimethylbenzene	95-63-6	10/31/96	4.8	0.4	ug/L
1,2,3-Trimethylbenzene	526-73-8	10/31/96	U	0.4	ug/L
1,2,3,4-Tetramethylbenzene	488-23-3	10/31/96	1.7	0.5	ug/L
FID Surrogate Recovery:		95%		70%-126%	
PID Surrogate Recovery:		101%		76%-127%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments:

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

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Analyst

K. Hollman
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Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample Number	: P-4 LNAPL	Client Project Number	: 729791.20210
Lab Sample Number	: 96-3916-01	Lab Work Order	: 96-3916
Date Sampled	: 11/4/96	Matrix	: OIL
Date Received	: 11/5/96	Lab File Number(s)	: TVB21106021*
Date Prepared	: 11/6,13/96	Method Blank	: MEB110696
FID Dilution Factor	: 25000		
PID Dilution Factor	: 25000; 50000		

Compound Name	Cas Number	Analysis Date	Sample Concentration	RL	Units
TVH-Gasoline	---	11/13/96	150000	2500	mg/kg
Benzene	71-43-2	11/13/96	U	10000	ug/kg
Toluene	108-88-3	11/13/96	U	10000	ug/kg
Chlorobenzene	108-90-7	11/13/96	1000000	10000	ug/kg
Ethyl Benzene	100-41-4	11/13/96	570000	10000	ug/kg
Total Xylenes (m,p,o)	1330-20-7	11/13/96	830000	10000	ug/kg
1,3,5-Trimethylbenzene	108-67-8	11/13/96	400000	10000	ug/kg
1,2,4-Trimethylbenzene	95-63-6	11/13/96	710000	10000	ug/kg
1,2,3-Trimethylbenzene	526-73-8	11/13/96	610000	10000	ug/kg
1,2,3,4-Tetramethylbenzene	488-23-3	11/7/96	3800000	25000	ug/kg
PID Surrogate Recovery:		HI **		50%-150%	(Limits)
FID Surrogate Recovery:		HI **		50%-150%	(Limits)

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Comments: * = and TVB21111067; ** = High Surrogate Recovery due to Hydrocarbon Interference.

QUALIFIERS and DEFINITIONS:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
RL = Reporting Limit.
NA = Not Available/Not Applicable.
PID = Photoionization detector.
FID = Flame ionization detector.
TVH = Total Volatile Hydrocarbons.

K. Hollman
Analyst

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Anion Report

Date Sampled	: 11/04/96	Client Project ID.	: Langley AFB 729791.20210
Date Received	: 11/05/96	Lab Project Number	: 96-3916
Date Prepared	: 11/05/96	Method	: EPA 300.0
Date Analyzed	: 11/05/96	Detection Limit	: 0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
96-3916-02	P-4	Water	<0.056	1
96-3916-02 Duplicate	P-4 Duplicate	Water	<0.056	1
96-3916-03	OW-9	Water	<0.056	1
96-3916-04	OW-11	Water	<0.056	1
96-3916-06	OW-115	Water	<0.056	1
Method Blank	(WB110596)	Water	<0.056	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3916-02	P-4 Matrix Spike	10.0	<0.25	10.0	100
96-3916-02	P-4 Matrix Spike Dup	10.0	<0.25	9.9	99
MS/MSD RPD					0.20

* = Quality assurance results reported as Nitrate (NO_3).

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Anion Report

Date Sampled	: 11/03/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 11/04/96	Lab Project Number	: 96-3906
Date Prepared	: 11/04/96	Method	: EPA 300.0
Date Analyzed	: 11/04/96	Detection Limit	: 0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
96-3906-01	4MP-17	Water	<0.056	1
96-3906-02	4MP-20	Water	0.11	1
96-3906-03	4MP-19	Water	<0.056	1
96-3906-04	4MP-16	Water	<0.056	1
96-3906-04 Duplicate	4MP-16 Duplicate	Water	<0.056	1
96-3906-05	4MP-14D	Water	<0.056	1
96-3906-06	OW-114	Water	<0.056	1
96-3906-07	4MP-15	Water	<0.056	1
96-3906-08	4MP-12D	Water	<0.056	1
96-3906-09	4MP-12M	Water	<0.056	1
96-3906-10	4MP-21	Water	<0.056	1
Method Blank	(WB110496)	Water	<0.056	
	(WB110596)	Water	<0.056	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3906-04	4MP-16 Matrix Spike	10.0	<0.25	9.9	99
96-3906-04	4MP-16 Matrix Spike Dup	10.0	<0.25	9.7	97
MS/MSD RPD					2.0

* = Quality asurance results reported as Nitrate (NO_3)

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 11/03/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 11/04/96	Lab Project Number	: 96-3906
Date Prepared	: 11/04/96	Method	: EPA 300.0
Date Analyzed	: 11/05/96	Detection Limit	: 0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
96-3906-11	RW-15	Water	<0.056	1
96-3906-12	RW-13	Water	<0.056	1

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Anion Report

729691.20210

Date Sampled	: 11/01/96	Client Project ID.	: Langley AFB
Date Received	: 11/02/96	Lab Project Number	: 96-3899
Date Prepared	: 11/02/96	Method	: EPA 300.0
Date Analyzed	: 11/02/96	Detection Limit	: 0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
96-3899-01	4MP-1	Water	0.14	1
96-3899-01 Duplicate	4MP-1 Duplicate	Water	0.13	1
96-3899-02	4MP-13	Water	0.13	1
96-3899-03	4MP-2	Water	1.0	1
96-3899-04	4MP-4	Water	<0.056	1
96-3899-05	4MP-11	Water	<0.056	1
96-3899-06	4MP-5D	Water	<0.056	1
96-3899-08	OW-113	Water	<0.056	1
96-3899-09	4MP-5S	Water	<0.056	1
96-3899-10	4MP-18	Water	<0.056	1
Method Blank	(11/02/96)	Water	<0.056	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3899-01	4MP-1 Matrix Spike	10.0	0.60	10.1	95
96-3899-01	4MP-1 Matrix Spike Dup	10.0	0.60	10.0	94
MS/MSD RPD					1.4

* = Quality assurance results reported as Nitrate (NO_3).

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(303) 425-6021

Anion Report

729691.20210

Date Sampled	: 10/31/96	Client Project ID.	: Langley AFB
Date Received	: 11/01/96	Lab Project Number	: 96-3882
Date Prepared	: 11/01/96	Method	: EPA 300.0
Date Analyzed	: 11/01/96	Detection Limit	: 0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
96-3882-01	4MP-9	Water	<0.056	1
96-3882-02	4MP-10	Water	0.55	1
96-3882-03	4MP-6	Water	1.4	1
96-3882-04	OW-12	Water	<0.056	1
96-3882-04 Duplicate	OW-12 Duplicate	Water	<0.056	1
96-3882-05	4MP-7	Water	0.11	1
Method Blank	(11/01/96)	Water	<0.056	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3882-04	OW-12 Matrix Spike	10.0	<0.25	9.1	91
96-3882-04	OW-12 Matrix Spike Dup	10.0	<0.25	9.2	92
MS/MSD RPD					0.2

* = Quality assurance results reported as Nitrate (NO_3).

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

729691.20210

Date Sampled	: 10/30/96	Client Project ID.	: Langley AFB
Date Received	: 10/31/96	Lab Project Number	: 96-3864
Date Prepared	: 10/31/96	Method	: EPA 300.0
Date Analyzed	: 10/31/96	Detection Limit	: 0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
96-3864-02	OW-102	Water	<0.056	1
96-3864-03	OW-4	Water	<0.056	1
96-3864-03 Duplicate	OW-4 Duplicate	Water	<0.056	1
96-3864-04	OW-15	Water	<0.056	1
96-3864-05	P-5	Water	<0.056	1
96-3864-06	OW-107	Water	<0.056	1
96-3864-07	OW-103	Water	<0.056	1
96-3864-08	OW-106	Water	<0.056	1
96-3864-10	RW-6	Water	<0.056	1
96-3864-11	OW-111	Water	<0.056	1
96-3864-12	OW-8	Water	<0.056	1
Method Blank	(10/31/96)	Water	<0.056	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3864-03	OW-4 Matrix Spike	10.0	<0.25	9.3	93
96-3864-03	OW-4 Matrix Spike Dup	10.0	<0.25	9.4	94
MS/MSD RPD					1.4

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 10/29/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 10/30/96	Lab Project Number	: 96-3845
Date Prepared	: 10/30/96	Method	: EPA 300.0
Date Analyzed	: 10/30/96	Detection Limit	: 0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
96-3845-08	OW-104	Water	0.67	1
96-3845-09	P-1	Water	<0.056	1
96-3845-10	P-2	Water	<0.056	1
96-3845-11	P-3	Water	<0.056	1
96-3845-12	OW-7	Water	<0.056	1

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Anion Report

Date Sampled	: 10/28,29/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 10/30/96	Lab Project Number	: 96-3845
Date Prepared	: 10/30/96	Method	: EPA 300.0
Date Analyzed	: 10/30/96	Detection Limit	: 0.056 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrate-N mg/L	Dilution Factor
96-3845-02	OW-3	Water	<0.056	1
96-3845-02 Duplicate	OW-3 Duplicate	Water	<0.056	1
96-3845-03	4MP-3	Water	<0.056	1
96-3845-04	OW-105	Water	<0.056	1
96-3845-05	4MP-8	Water	<0.056	1
96-3845-06	OW-13	Water	<0.056	1
96-3845-07	OW-110	Water	<0.056	1
Method Blank (10/30/96)			<0.056	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3845-02	OW-3 Matrix Spike	10.0	<0.25	9.3	93
96-3845-02	OW-3 Matrix Spike Dup	10.0	<0.25	9.3	93
MS/MSD RPD					0.4

* = Quality assurance results reported as Nitrate (NO_3).

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Anion Report

Date Sampled	: 11/04/96	Client Project ID.	: Langley AFB 729791.20210
Date Received	: 11/05/96	Lab Project Number	: 96-3916
Date Prepared	: 11/05/96	Method	: EPA 300.0
Date Analyzed	: 11/05/96	Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
96-3916-02	P-4	Water	<0.076	1
96-3916-02 Duplicate	P-4 Duplicate	Water	<0.076	1
96-3916-03	OW-9	Water	<0.076	1
96-3916-04	OW-11	Water	<0.076	1
96-3916-06	OW-115	Water	<0.076	1
Method Blank	(WB110596)	Water	<0.076	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3916-02	P-4 Matrix Spike	10.0	<0.25	10.3	103
96-3916-02	P-4 Matrix Spike Dup	10.0	<0.25	10.0	100
MS/MSD RPD					3.2

* = Quality assurance results reported as Nitrite (NO_2).

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled : 11/03/96
Date Received : 11/04/96
Date Prepared : 11/04/96
Date Analyzed : 11/04/96

Client Project ID. : Langley AFB 729691.20210
Lab Project Number : 96-3906
Method : EPA 300.0
Detection Limit : 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
96-3906-01	4MP-17	Water	<0.076	1
96-3906-02	4MP-20	Water	<0.076	1
96-3906-03	4MP-19	Water	<0.076	1
96-3906-04	4MP-16	Water	<0.076	1
96-3906-04 Duplicate	4MP-16 Duplicate	Water	<0.076	1
96-3906-05	4MP-14D	Water	<0.076	1
96-3906-06	OW-114	Water	<0.076	1
96-3906-07	4MP-15	Water	<0.076	1
96-3906-08	4MP-12D	Water	<0.076	1
96-3906-09	4MP-12M	Water	<0.076	1
96-3906-10	4MP-21	Water	<0.076	1
Method Blank	(WB110496)	Water	<0.076	
	(WB110596)	Water	<0.076	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3906-04	4MP-16 Matrix Spike	10.0	<0.25	9.7	98
96-3906-04	4MP-16 Matrix Spike Dup	10.0	<0.25	9.7	97
MS/MSD RPD					0.62

* = Quality asurance results reported as Nitrite (NO_2)

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Anion Report

Date Sampled	: 11/03/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 11/04/96	Lab Project Number	: 96-3906
Date Prepared	: 11/04/96	Method	: EPA 300.0
Date Analyzed	: 11/05/96	Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
96-3906-11	RW-15	Water	<0.076	1
96-3906-12	RW-13	Water	<0.076	1

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Anion Report

729691.20210

Date Sampled	: 11/01/96	Client Project ID.	: Langley AFB
Date Received	: 11/02/96	Lab Project Number	: 96-3899
Date Prepared	: 11/02/96	Method	: EPA 300.0
Date Analyzed	: 11/02/96	Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
96-3899-01	4MP-1	Water	<0.076	1
96-3899-01 Duplicate	4MP-1 Duplicate	Water	<0.076	1
96-3899-02	4MP-13	Water	<0.076	1
96-3899-03	4MP-2	Water	<0.076	1
96-3899-04	4MP-4	Water	<0.76**	10
96-3899-05	4MP-11	Water	<0.076	1
96-3899-06	4MP-5D	Water	<0.076	1
96-3899-08	OW-113	Water	<0.076	1
96-3899-09	4MP-5S	Water	<0.076	1
96-3899-10	4MP-18	Water	<0.076	1
Method Blank	(11/02/96)	Water	<0.076	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3899-01	4MP-1 Matrix Spike	10.0	<0.25	9.4	94
96-3899-01	4MP-1 Matrix Spike Dup	10.0	<0.25	10.0	100
MS/MSD RPD					5.8

* = Quality assurance results reported as Nitrite (NO_2).
** = Raised detection limit due to matrix interference.

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

729691.20210

Date Sampled	: 10/31/96	Client Project ID.	: Langley AFB
Date Received	: 11/01/96	Lab Project Number	: 96-3882
Date Prepared	: 11/01/96	Method	: EPA 300.0
Date Analyzed	: 11/01/96	Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
96-3882-01	4MP-9	Water	<0.076	1
96-3882-02	4MP-10	Water	<0.076	1
96-3882-03	4MP-6	Water	<0.076	1
96-3882-04	OW-12	Water	<0.076	1
96-3882-04 Duplicate	OW-12 Duplicate	Water	<0.076	1
96-3882-05	4MP-7	Water	<0.76**	10
Method Blank	(11/01/96)	Water	<0.076	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3882-04	OW-12 Matrix Spike	10.0	<0.25	9.4	94
96-3882-04	OW-12 Matrix Spike Dup	10.0	<0.25	9.1	91
MS/MSD RPD					2.9

* = Quality assurance results reported as Nitrite (NO_2).
** = Raised detection limit due to matrix interference.

Analyst

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
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Anion Report

729691.20210

Date Sampled	: 10/30/96	Client Project ID.	: Langley AFB
Date Received	: 10/31/96	Lab Project Number	: 96-3864
Date Prepared	: 10/31/96	Method	: EPA 300.0
Date Analyzed	: 10/31/96	Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
96-3864-02	OW-102	Water	<0.076	1
96-3864-03	OW-4	Water	<0.076	1
96-3864-03 Duplicate	OW-4 Duplicate	Water	<0.076	1
96-3864-04	OW-15	Water	<0.076	1
96-3864-05	P-5	Water	<0.076	1
96-3864-06	OW-107	Water	<0.076	1
96-3864-07	OW-103	Water	<0.076	1
96-3864-08	OW-106	Water	<0.076	1
96-3864-10	RW-6	Water	<0.076	1
96-3864-11	OW-111	Water	<0.076	1
96-3864-12	OW-8	Water	<0.076	1
Method Blank	(10/31/96)	Water	<0.076	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3864-03	OW-4 Matrix Spike	10.0	<0.26	9.7	97
96-3864-03	OW-4 Matrix Spike Dup	10.0	<0.25	9.5	95
MS/MSD RPD					2.1

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(303) 425-6021

Anion Report

Date Sampled	: 10/29/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 10/30/96	Lab Project Number	: 96-3845
Date Prepared	: 10/30/96	Method	: EPA 300.0
Date Analyzed	: 10/30/96	Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
96-3845-08	OW-104	Water	<0.076	1
96-3845-09	P-1	Water	<0.076	1
96-3845-10	P-2	Water	<0.076	1
96-3845-11	P-3	Water	<0.076	1
96-3845-12	OW-7	Water	<0.076	1

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Anion Report

Date Sampled	: 10/28,29/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 10/30/96	Lab Project Number	: 96-3845
Date Prepared	: 10/30/96	Method	: EPA 300.0
Date Analyzed	: 10/30/96	Detection Limit	: 0.076 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Nitrite-N mg/L	Dilution Factor
96-3845-02	OW-3	Water	<0.076	1
96-3845-02 Duplicate	OW-3 Duplicate	Water	<0.076	1
96-3845-03	4MP-3	Water	<0.076	1
96-3845-04	OW-105	Water	<0.076	1
96-3845-05	4MP-8	Water	<0.076	1
96-3845-06	OW-13	Water	<0.076	1
96-3845-07	OW-110	Water	<0.076	1
Method Blank (10/30/96)			<0.076	

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3845-02	OW-3 Matrix Spike	10.0	<0.25	9.3	93
96-3845-02	OW-3 Matrix Spike Dup	10.0	<0.25	9.6	96
MS/MSD RPD					3.4

* = Quality assurance results reported as Nitrite (NO_2).

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(303) 425-6021

Anion Report

Date Sampled	: 11/04/96	Client Project ID.	: Langley AFB 729791.20210
Date Received	: 11/05/96	Lab Project Number	: 96-3916
Date Prepared	: 11/05/96	Method	: EPA 300.0
Date Analyzed	: 11/05/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
96-3916-02	P-4	Water	1.2	1
96-3916-02 Duplicate	P-4 Duplicate	Water	1.2	1
96-3916-03	OW-9	Water	<0.25	1
96-3916-04	OW-11	Water	<0.25	1
96-3916-06	OW-115	Water	<0.25	1
Method Blank	(WB110596)	Water	<0.25	1

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3916-02	P-4 Matrix Spike	10.0	1.2	10.8	96
96-3916-02	P-4 Matrix Spike Dup	10.0	1.2	10.9	97
MS/MSD RPD					0.83

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(303) 425-6021

Anion Report

Date Sampled	: 11/03/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 11/04/96	Lab Project Number	: 96-3906
Date Prepared	: 11/04,05/96	Method	: EPA 300.0
Date Analyzed	: 11/04,05/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
96-3906-01	4MP-17	Water	77.4	10
96-3906-02	4MP-20	Water	20.6	1
96-3906-03	4MP-19	Water	16.8	1
96-3906-04	4MP-16	Water	46.0	10
96-3906-04 Duplicate	4MP-16 Duplicate	Water	45.9	10
96-3906-05	4MP-14D	Water	56.7	10
96-3906-06	OW-114	Water	55.1	10
96-3906-07	4MP-15	Water	865	100
96-3906-08	4MP-12D	Water	114	10
96-3906-09	4MP-12M	Water	74.7	10
96-3906-10	4MP-21	Water	0.46	1
Method Blank	(WB110496)	Water	<0.25	
	(WB110596)	Water	<0.25	

Quality Assurance

Reference	True Value (mg/L)	Result (mg/L)	% Recovery
Alltech anion mixture A Lot # 711152	30.0	30.2	101

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Anion Report

Date Sampled	: 11/03/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 11/04/96	Lab Project Number	: 96-3906
Date Prepared	: 11/04/96	Method	: EPA 300.0
Date Analyzed	: 11/05/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
96-3906-11	RW-15	Water	8.5	1
96-3906-12	RW-13	Water	0.68	1

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(303) 425-6021

Anion Report

729691.20210

Date Sampled	: 11/01/96	Client Project ID.	: Langley AFB
Date Received	: 11/02/96	Lab Project Number	: 96-3899
Date Prepared	: 11/02/96	Method	: EPA 300.0
Date Analyzed	: 11/02/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
96-3899-01	4MP-1	Water	43.1	10
96-3899-01 Duplicate	4MP-1 Duplicate	Water	41.4	10
96-3899-02	4MP-13	Water	137	10
96-3899-03	4MP-2	Water	38.1	1
96-3899-04	4MP-4	Water	32.1	1
96-3899-05	4MP-11	Water	55.5	10
96-3899-06	4MP-5D	Water	2.8	1
96-3899-08	OW-113	Water	55.5	10
96-3899-09	4MP-5S	Water	3.3	1
96-3899-10	4MP-18	Water	17.7	1
Method Blank	(11/02/96)	Water	<0.25	1

Quality Assurance *

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3899-01	4MP-1 Matrix Spike	10.0	4.3	13.6	93
96-3899-01	4MP-1 Matrix Spike Dup	10.0	4.3	13.6	92
MS/MSD RPD					0.3

* = Quality assurance results reported on a 10X dilution factor.

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

729691.20210

Date Sampled	: 10/31/96	Client Project ID.	: Langley AFB
Date Received	: 11/01/96	Lab Project Number	: 96-3882
Date Prepared	: 11/01/96	Method	: EPA 300.0
Date Analyzed	: 11/01/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
96-3882-01	4MP-9	Water	39.6	1
96-3882-02	4MP-10	Water	49.0	10
96-3882-03	4MP-6	Water	44.8	10
96-3882-04	OW-12	Water	2.9	1
96-3882-04 Duplicate	OW-12 Duplicate	Water	3.0	1
96-3882-05	4MP-7	Water	139	10
Method Blank	(11/01/96)	Water	<0.25	1

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3882-04	OW-12 Matrix Spike	10.0	2.9	11.9	90
96-3882-04	OW-12 Matrix Spike Dup	10.0	2.9	11.9	90
MS/MSD RPD					0.7

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Anion Report

729691.20210

Date Sampled	: 10/30/96	Client Project ID.	: Langley AFB
Date Received	: 10/31/96	Lab Project Number	: 96-3864
Date Prepared	: 10/31/96	Method	: EPA 300.0
Date Analyzed	: 10/31/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
96-3864-02	OW-102	Water	42.4	10
96-3864-03	OW-4	Water	3.3	1
96-3864-03 Duplicate	OW-4 Duplicate	Water	3.3	1
96-3864-04	OW-15	Water	35.3	1
96-3864-05	P-5	Water	<0.25	1
96-3864-06	OW-107	Water	10.8	1
96-3864-07	OW-103	Water	41.0	10
96-3864-08	OW-106	Water	8.5	1
96-3864-10	RW-6	Water	<0.25	1
96-3864-11	OW-111	Water	<0.25	1
96-3864-12	OW-8	Water	18.7	1
Method Blank	(10/31/96)	Water	<0.25	1

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3864-03	OW-4 Matrix Spike	10.0	3.3	12.5	93
96-3864-03	OW-4 Matrix Spike Dup	10.0	3.3	12.5	92
MS/MSD RPD					0.9

Analyst

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Anion Report

Date Sampled	: 10/29/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 10/30/96	Lab Project Number	: 96-3845
Date Prepared	: 10/30,31/96	Method	: EPA 300.0
Date Analyzed	: 10/30,31/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
96-3845-08	OW-104	Water	31.0	1
96-3845-09	P-1	Water	1.7	1
96-3845-10	P-2	Water	18.1	1
96-3845-11	P-3	Water	460	100
96-3845-12	OW-7	Water	<0.25	1

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(303) 425-6021

Anion Report

Date Sampled	: 10/28,29/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 10/30/96	Lab Project Number	: 96-3845
Date Prepared	: 10/30/96	Method	: EPA 300.0
Date Analyzed	: 10/30/96	Detection Limit	: 0.25 mg/L

Evergreen Sample #	Client Sample ID.	Matrix	Sulfate mg/L	Dilution Factor
96-3845-02	OW-3	Water	<0.25	1
96-3845-02 Duplicate	OW-3 Duplicate	Water	<0.25	1
96-3845-03	4MP-3	Water	48.7	10
96-3845-04	OW-105	Water	53.4	10
96-3845-05	4MP-8	Water	14.6	1
96-3845-06	OW-13	Water	47.1	10
96-3845-07	OW-110	Water	47.7	10
Method Blank (10/30/96)			<0.25	

Quality Assurance

		Spike Amount (mg/L)	Sample Result (mg/L)	Spike Result (mg/L)	% Recovery
96-3845-02	OW-3 Matrix Spike	10.0	<0.25	9.4	94
96-3845-02	OW-3 Matrix Spike Dup	10.0	<0.25	9.3	93
MS/MSD RPD					0.3

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(303) 425-6021

Methane Report Form

Client Sample Number	: 4MP-1	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3899-01	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Dilution Factor	: 1.00
Date Received	: 11/2/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/7/96	Matrix	: Water
Date Analyzed	: 11/7/96	Lab File No.	: GAS1107007

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	: 72.1 F	Saturation Concentration	Meth		
Amount Injected	: 0.5 ml				
Total Volume of Sample	: 43 ml	Concentration in Head Space	Meth		
Head space created	: 4 ml				
Methane Area	: 0 ug				

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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(303) 425-6021

Methane Report Form

Client Sample Number	: 4MP-2	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3899-03	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Dilution Factor	: 1.00
Date Received	: 11/2/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/7/96	Matrix	: Water
Date Analyzed	: 11/7/96	Lab File No.	: GAS1107009

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

[illegible]erature	: 72.1 F	Saturation	Meth		0
[illegible]unt Injected	: 0.5 ml	Concentration			
Total Volume of Sample	: 43 ml	Concentration	Meth		0
Head space created	: 4 ml	in Head Space			
Methane Area	: 0 ug				

Atomic weight(Methane) : 16 g

Qualifiers
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Methane Report Form

Client Sample Number	: 4MP-3	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-03	Lab Work Order	: 96-3845
Date Sampled	: 10/28/96	Dilution Factor	: 1.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031008

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.002	0.002

Temperature	: 67.4 F	Saturation	Meth	0.00
Amount Injected	: 0.5 ml	Concentration		
Total Volume of Sample	: 43 ml	Concentration	Meth	0.0015940
Head space created	: 4 ml	in Head Space		
Methane Area	: 11.663 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
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(303) 425-6021

Methane Report Form

Client Sample Number	: 4MP-4	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3899-04	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Dilution Factor	: 1.00
Date Received	: 11/2/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/7/96	Matrix	: Water
Date Analyzed	: 11/7/96	Lab File No.	: GAS1107010

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.049	0.002

Temperature	: 72.2 F	Saturation Concentration	Meth	0.011869528
Amount Injected	: 0.5 ml			
Total Volume of Sample	: 43 ml	Concentration in Head Space	Meth	0.037384199
Head space created	: 4 ml			
Methane Area	: 276.02 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
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NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-5S	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3899-09	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Dilution Factor	: 50.00
Date Received	: 11/2/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/7/96	Matrix	: Water
Date Analyzed	: 11/7/96	Lab File No.	: GAS1107016

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	6.1	0.1

Temperature	: 72.3 F	Saturation	Meth	1.480[illegible]
Amount Injected	: 0.01 ml	Concentration		
Total Volume of Sample	: 43 ml	Concentration	Meth	4.6625924
Head space created	: 4 ml	in Head Space		
Methane Area	: 688.639 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
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NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-5D	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3899-06	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Dilution Factor	: 20.00
Date Received	: 11/2/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/7/96	Matrix	: Water
Date Analyzed	: 11/7/96	Lab File No.	: GAS1107013

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	2.84	0.04

[redacted]erature	: 72.2 F	Saturation Concentration	Meth	0.684232167
[redacted]unt Injected	: 0.025 ml			
Total Volume of Sample	: 43 ml	Concentration in Head Space	Meth	2.155053725
Head space created	: 4 ml			
Methane Area	: 795.574 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
N/A = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-6	Client Project No.	: Langly AFB
Lab Sample Number	: 96-3882-03	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Dilution Factor	: 1.00
Date Received	: 11/1/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/6/96	Matrix	: Water
Date Analyzed	: 11/6/96	Lab File No.	: GAS1106013

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	: 69.5 F	Saturation Concentration	Meth		
Amount Injected	: 0.5 ml				
Total Volume of Sample	: 43 ml	Concentration in Head Space	Meth		
Head space created	: 4 ml				
Methane Area	: 0 ug				

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-6	Client Project No.	: Langly AFB
Lab Sample Number	: 96-3882-03Dup	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Dilution Factor	: 1.00
Date Received	: 11/1/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/6/96	Matrix	: Water
Date Analyzed	: 11/6/96	Lab File No	: GAS1106014

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	: 69.4 F	Saturation Concentration	Meth		(
Amount Injected	: 0.5 ml				
Total Volume of Sample	: 43 ml	Concentration in Head Space	Meth		(
Head space created	: 4 ml				
Methane Area	: 0 ug				

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-7	Client Project No.	: Langly AFB
Lab Sample Number	: 96-3882-05	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Dilution Factor	: 1.00
Date Received	: 11/1/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/6/96	Matrix	: Water
Date Analyzed	: 11/6/96	Lab File No.	: GAS1106016

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	: 70 F			
Amount Injected	: 0.5 ml	Saturation Concentration	Meth	
Total Volume of Sample	: 43 ml			
Head space created	: 4 ml	Concentration in Head Space	Meth	
Methane Area	: 0 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-8	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-05	Lab Work Order	: 96-3845
Date Sampled	: 10/28/96	Dilution Factor	: 1.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031010

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.003	0.002

[redacted]erature	: 66 F	Saturation	Meth	0.000600787
[redacted]nt Injected	: 0.5 ml	Concentration		
Total Volume of Sample	: 43 ml	Concentration	Meth	0.001914564
Head space created	: 4 ml	in Head Space		
Methane Area	: 13.971 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

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Methane Report Form

Client Sample Number	: 4MP-9	Client Project No.	: Langly AFB
Lab Sample Number	: 96-3882-01	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Dilution Factor	: 1.00
Date Received	: 11/1/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/6/96	Matrix	: Water
Date Analyzed	: 11/6/96	Lab File No.	: GAS1106011

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.002	0.002

Temperature	: 69.7 F	Saturation Concentration	Meth	0.0
Amount Injected	: 0.5 ml			
Total Volume of Sample	: 43 ml	Concentration in Head Space	Meth	0.001662E
Head space created	: 4 ml			
Methane Area	: 12.218 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-12D	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-08	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Dilution Factor	: 20.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108030

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	1.84	0.04

[redacted]erature	: 73.7 F	Saturation Concentration	Meth	0.445349416
[redacted]ount Injected	: 0.025 ml			
Total Volume of Sample	: 43 ml	Concentration in Head Space	Meth	1.398723241
Head space created	: 4 ml			
Methane Area	: 517.819 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

Analyst

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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: 4MP-13	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3899-02	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Dilution Factor	: 1.00
Date Received	: 11/2/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/7/96	Matrix	: Water
Date Analyzed	: 11/7/96	Lab File No.	: GAS1107008

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	: 72 F	Saturation	Meth		
Amount Injected	: 0.5 ml	Concentration			
Total Volume of Sample	: 43 ml	Concentration	Meth		
Head space created	: 4 ml	in Head Space			
Methane Area	: 0 ug				

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: 4MP-14D	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-05	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Dilution Factor	: 10.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108025

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.69	0.02

[redacted]perature	: 72.6 F	Saturation	Meth	0.1668003
[redacted]nt Injected	: 0.05 ml	Concentration		
Total Volume of Sample	: 40 ml	Concentration	Meth	0.52498
Head space created	: 4 ml	in Head Space		
Methane Area	: 387.886 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

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(303) 425-6021

Methane Report Form

Client Sample Number	: 4MP-14D	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-05Dup	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Dilution Factor	: 10.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108027

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.68	0.02

Temperature	:	72.5 F	Saturation	Meth	0.16
Amount Injected	:	.05 ml	Concentration		
Head space created	:	4 ml	in Head Space		
Methane Area	:	382.357 ug			

Atomic weight(Methane) : 16 g

Qualifiers
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(303) 425-6021

Methane Report Form

Client Sample Number	: 4MP-15	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-07	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Dilution Factor	: 10.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108029

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.07	0.02

Temperature	: 72.6 F	Saturation Concentration	Meth	0.01737469
Amount Injected	: 0.05 ml			
Total Volume of Sample	: 43 ml	Concentration in Head Space	Meth	0.0546621
Head space created	: 4 ml			
Methane Area	: 40.404 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-16	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-04	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Dilution Factor	: 1.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108024

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.022	0.002

Te[illegible]rature	: 73.6 F	[illegible]uration Meth	0.005
A[illegible]t[illegible]	: 0.5	C[illegible]entration	
[illegible]	:	[illegible]	0.[illegible]
[illegible] space created	: 4 ml	[illegible] Head Space	
Methane Area	: 126.246 ug		

Atomic weight(Methane) : 16 g

Qualifiers
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RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-17	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-01	Lab Work Order	: 96-3906
Date Sampled	: 11/2/96	Dilution Factor	: 1.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108021

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

[redacted]erature	: 72.5 F	Saturation Concentration in Head Space	Meth	
[redacted]t Injected	: 0.5 ml			
[redacted] Volume of Sample	: 4.5 ml		Meth	
Head space created	: 4 ml			
Methane Area	: 0 ug			

Atomic weight(Methane) : 16 g

Qualifiers
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U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
"A =Not Available/Not Applicable.

[redacted]

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Methane Report Form

Client Sample Number	: 4MP-18	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3899-10	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Dilution Factor	: 1.00
Date Received	: 11/2/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/7/96	Matrix	: Water
Date Analyzed	: 11/7/96	Lab File No.	: GAS1107017

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.009	0.002

Temperature	: [illegible]	Saturation Meth	: 0.
Amount Injected	: 0.6 ml	Concentration	:
[illegible]	:	[illegible]	:
Head space created	: 4 ml	in Head Space	
Methane Area	: 49.096 ug		

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: 4MP-19	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-03	Lab Work Order	: 96-3906
Date Sampled	: 11/2/96	Dilution Factor	: 1.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108023

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

[redacted]erature	: 72.6 F	Saturation Concentration	Meth		
[redacted]nt Injected	: 0.5 ml				
Total Volume of Sample	: 43 ml	Concentration in Head Space	Meth		
Head space created	: 4 ml				
Methane Area	: 0 ug				

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

Analyst

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Methane Report Form

Client Sample Number	: 4MP-20	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-02	Lab Work Order	: 96-3906
Date Sampled	: 11/2/96	Dilution Factor	: 1.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108022

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	: 73 F	Saturation	Meth
Amount Injected	: 5 m	Concentration	
Head space creat	: 4 m	in Head Space	
Methane Area	: 0 ug		
Atomic weight(Methane)	: 16 g		

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: 4MP-21	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-10	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Dilution Factor	: 100.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108032

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	5.1	0.2

[illegible]erature	: 72.8 F	Saturation Concentration in Head Space	Meth	1.227495
[illegible]nt Injected	: 0.005 ml			
Total Volume [illegible] Sample	: 4[illegible] ml		Meth	3.68[illegible]
Head space created	: 4 ml			
Methane Area	: 285.448 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: OW-3	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-02	Lab Work Order	: 96-3845
Date Sampled	: 10/28/96	Dilution Factor	: 50.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031007

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	4.3	0.1

Temperature	:	68.2 F	Saturation Concentration	Meth	.01
Amount Injected	:	0.0 ml			
Total Volume of Sample	:	[illegible]	Correction	Meth	[illegible]
Head space created	:	[illegible]	[illegible]		
Methane Area	:	480.766 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: OW-4	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-03	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 100.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108008

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	5.8	0.2

Temperature	: 69.3 F	Saturation Concentration	Meth	: 1.3808679
Amount Injected	: 0.005 ml			
Total Volume of Sample	: .42 ml	Concentration in Head Space	Meth	: 4.3798[illegible]
Head space created	: 4 ml			
Methane Area	: 321.114 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: OW-7	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-12	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Dilution Factor	: 25.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031019

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	4.21	0.05

Temperature	: 70.6 F	Saturation	Meth	1.01
Amount Injected	: 0.0 ml	Concentration		
Head space created	: 4 ml	in Head Space		
Methane Area	: 942.548 ug			
Atomic weight(Methane)	: 16 g			

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: OW-8	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-12	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 100.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108018

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.6	0.2

Temperature	: 69.6 F	Saturation Concentration	Meth	0.13648532
Amount Injected	: 0.005 ml			
Total Volume of Sample	: 40 ml	Concentration in Head Space	Meth	0.43198998
Head space created	: 4 ml			
Methane Area	: 31.739 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: OW-9	Client Project No.	: 729791.20210
Lab Sample Number	: 96-3916-03	Lab Work Order	: 96-3916
Date Sampled	: 11/4/96	Dilution Factor	: 100.00
Date Received	: 11/5/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/6/96	Matrix	: Water
Date Analyzed	: 11/6/96	Lab File No.	: GAS1106019

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	7.6	0.2

mperature	: 68.9 F	Saturation	Meth	1.82
Am nd Injected	: 0.00 ml	Concentration		
Te Volume of Sa e	: 40 ml	Concentration	Meth	5.700
Methane Area	: 424.858 ug			
Atomic weight(Methane)	: 16 g			

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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(303) 425-6021

Methane Report Form

Client Sample Number	: OW-11	Client Project No.	: 729791.20210
Lab Sample Number	: 96-3916-04	Lab Work Order	: 96-3916
Date Sampled	: 11/4/96	Dilution Factor	: 50.00
Date Received	: 11/5/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/6/96	Matrix	: Water
Date Analyzed	: 11/6/96	Lab File No.	: GAS1106020

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	7.8	0.1

Temperature	: 69 F	Saturation Concentration	Meth	1.88244319
Amount injected	: 0.01 ml			
Volume of Sample	: 3 ml	Concentration in Head Space	Meth	5.9648382
Head Space created	: 4 ml			
Methane Area	: 875.508 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: OW-12	Client Project No.	: Langly AFB
Lab Sample Number	: 96-3882-04	Lab Work Order	: 96-3882
Date Sampled	: 10/31/96	Dilution Factor	: 50.00
Date Received	: 11/1/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/6/96	Matrix	: Water
Date Analyzed	: 11/6/96	Lab File No.	: GAS1106015

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	2.1	0.1

Temperature	:	69.8 F	Saturation	Meth	0.49
Amount Injected	:	1 ml	Concentration		
Total Volume of Sample	:	ml	Concentration	Meth	
[illegible]	:		[illegible]		
Methane Area	:	229.735 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: OW-13	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-06	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Dilution Factor	: 20.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031011

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.65	0.04

Temperature	: 68.4 F	Saturation Concentration	Meth	0.15487666
Amount injected	: 0.025 ml			
Total Volume of Sample	: [illegible]	Concentration in Head Space	Meth	0.4913[illegible]
Head space created	: 4 ml			
Methane Area	: 180.079 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: OW-13	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-06Dup	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Dilution Factor	: 20.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031012

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.62	0.04

Temperature	: 68	F	Saturation Concentration	Meth	0.1
[illegible]	: 0.0	ml			
[illegible]	:	ml	[illegible]	Meth	0.1
Headspace Created	: 4	ml	in Head Space		
Methane Area	: 172.597	ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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(303) 425-6021

Methane Report Form

Client Sample Number	: OW-15	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-04	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 10.00
Date Received	: 11/10/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108009

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.23	0.02

[redacted]erature	: 69.3 F	Saturation Concentration	Meth	0.05430904
[redacted]nt Injected	: 0.05 ml			
Total Volume in Sample	: 3 ml	Concentration in Head Space	Meth	0.17199671
Head space created	: 4 ml			
Methane Area	: 126.293 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: OW-102	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-02	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 1.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108007

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.011	0.002

Temperature	: 70.5 F	Saturation Concentration	Meth	0.00
Amount Injected	: 5 ml			
Total Volume Sampled	: 30 ml	Concentration	Meth	0.0
Head Space Created	: [illegible]	[illegible]		
Methane Area	: 59.297 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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(303) 425-6021

Methane Report Form

Client Sample Number	: OW-103	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-07	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 1.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108013

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	: 69.3 F	Saturation Concentration	Meth		
Amount Injected	: 0.5 ml				
Total Volume of Sample	: 40 ml	Concentration in Head Space	Meth		
Head space created	: 4 ml				
Methane Area	: 0 ug				

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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(303) 425-6021

Methane Report Form

Client Sample Number	: OW-104	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-08	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Dilution Factor	: 1.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031014

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	:	63.7	F	Saturation Concentration	Meth
Amount of water	:	0.E	ml		
Total volume of sample	:		ml	Concentration	Meth
Head space created	:	4	ml	in Head Space	
Methane Area	:	0	ug		

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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Methane Report Form

Client Sample Number	: OW-105	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-04	Lab Work Order	: 96-3845
Date Sampled	: 10/28/96	Dilution Factor	: 1.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031009

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	U	0.002

Temperature	: 66.2 F	Saturation Concentration	Meth	
Amount Injected	: 0.5 ml			
Total Volume of Sample	: [illegible] ml	Concentration in Head Space	Meth	
Head space created	: 4 ml			
Methane Area	: 0 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: OW-106	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-08	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 10.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108014

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.08	0.02

Temperature : 69.2 F Saturation Meth 0.01
Amount Injected : ml Calculation
Head space created : ml in Head Space
Methane Area : 47.259 ug

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: OW-107	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-06	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 1.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108011

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.021	0.002

[redacted]erature	: 69.6 F	Saturation	Meth	0.0051538
[redacted]nt Injected	: 0.5 ml	Concentration		
[redacted]	: [redacted]	[redacted]	Meth	0.0161[redacted]
Head space created	: 4 ml	in Head Space		
Methane Area	: 119.85 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: OW-107	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-06Dup	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 1.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108012

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.021	0.002

Temperature	:	69.8 F	Saturation Mth		0.[illegible]
Amount Injected	:	0.[illegible] ml	Concentration		
					1
Head space created	:	4 ml	in Head Space		
Methane Area	:	118.563 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Analysis Report

729691.20210

Date Sampled	: 10/31/96	Client Project ID.	: Langley AFB
Date Received	: 11/1/96	Lab Project Number	: 96-3882
Date Prepared	: 11/4/96	Method	: EPA 310.1
Date Analyzed	: 11/4/96	Detection Limit	: 5.0 mg $CaCO_3$/L

Evergreen Sample #	Client Sample ID.	Matrix	Total Alkalinity (mg $CaCO_3$/L)	Dilution Factor
96-3882-02	4MP-10	Water	231	1
96-3882-02 Duplicate	4MP-10 Duplicate	Water	231	1
Method Blank	(11/4/96)		<5.0	

Quality Assurance

Reference	True Value (mg$CaCO_3$/L)	Result (mg$CaCO_3$/L)	% Recovery
ERA Minerals	120	114	95

Lot # 0725-96-11

Analyst

Approved

EVERGREEN ANALYTICAL,
4036 Youngfield St. Wheat Ridge,
(303) 425-6021

Analysis Rep

Date Sampled : 11/1/96
Date Received : 11/2/96
Date Prepared : 11/5/96
Date Analyzed : 11/5/96

Evergreen Sample #	Client Sample I
96-3899-11	C (4')

Date Sampled : 10/28&29/96
Date Received : 10/30/96
Date Prepared : 11/4/96
Date Analyzed : 11/4/96

Client
Lab P
Meth
Detec

Evergreen Sample #	Client Sample ID.	Matrix	T Alk
96-3845-02	OW-3	Water	
96-3845-02 Duplicate	OW-3 Duplicate	Water	
96-3845-06	OW-13	Water	
96-3845-07	OW-110	Water	

Method Blank (11/4/)

Quality Assurance

Reference		True Value ($mgCaCO_3/L$)	Result ($mgCaCO_3/L$)
Minerals ERA	Lot 0725-96-11	120	114

Analyst

Analyst

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: P-5	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-05	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 100.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108010

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	8.1	0.2

[illegible]perature	: 69.2 F	Saturation	Meth	1.93204718
[illegible]nt Injected	: 0.005 ml	Concentration		
Total Volume in Sample	: 40 ml	[illegible]ntration	Meth	0.11972284
Head space created	: 4 ml	in Head Space		
Methane Area	: 449.288 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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AF3864.XLS

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Analysis Report

Date Sampled	: 10/28&29/96	Client Project ID.	: Langley AFB 729691.20210
Date Received	: 10/30/96	Lab Project Number	: 96-3845
Date Prepared	: 11/4/96	Method	: EPA 310.1
Date Analyzed	: 11/4/96	Detection Limit	: 5.0 mg $CaCO_3$/L

Evergreen Sample #	Client Sample ID.	Matrix	Total Alkalinity (mg $CaCO_3$/L)	Dilution Factor
96-3845-02	OW-3	Water	172	1
96-3845-02 Duplicate	OW-3 Duplicate	Water	173	1
96-3845-06	OW-13	Water	433	1
96-3845-07	OW-110	Water	434	1
Method Blank	(11/4/96)		<5.0	

Quality Assurance

Reference	True Value (mg$CaCO_3$/L)	Result (mg$CaCO_3$/L)	% Recovery
Minerals ERA Lot 0725-96-11	120	114	95

Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: P-3	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-11	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Dilution Factor	: 5.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031018

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.37	0.01

[redacted]erature	:	68 F	Saturation	Meth	0.0892676
[redacted]t Injected	:	0.1 ml	Concentration		
Total Volume of Sample	:	43 ml	Concentration	Meth	0.2322581
Head space created	:	4 ml	in Head Space		
Methane Area	:	415.175 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: P-4	Client Project No.	: 729791.20210
Lab Sample Number	: 96-3916-02	Lab Work Order	: 96-3916
Date Sampled	: 11/4/96	Dilution Factor	: 50.00
Date Received	: 11/5/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/6/96	Matrix	: Water
Date Analyzed	: 11/6/96	Lab File No.	: GAS1106017

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	6.8	0.1

Temperature : 69.4 F
Ambient Pressure : [illegible]
Saturation Concentration Meth [illegible]
Head space created : 4 ml in Head Space [illegible]
Methane Area : 761.31 ug

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Bill Michaelsen
Analyst

Approved

AF3916.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: P-1	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-09	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Dilution Factor	: 20.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031016

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	1.57	0.04

[illegible]erature	: 70.6 F	Saturation	Meth	0.3771897
[illegible]ume Injected	: 0.025 ml	Concentration		
Total Volume of Sample	: 43 ml	Concentration	Meth	1.191E-02
Head space created	: 4 ml	in Head Space		
Methane Area	: 438.568 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
"A = Not Available/Not Applicable.

Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: P-2	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-10	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Dilution Factor	: 5.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031017

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.05	0.01

[illegible]ture	:	70	Saturation [illegible]th		0 [illegible]
[illegible]ted	:	0.1 [illegible]	Co[illegible]ntration		
[illegible]	:	[illegible]	Concentration [illegible]		[illegible]
Head space created	:	4 ml	in Head Space		
Methane Area	:	54.697 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: RW-13	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-12	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Dilution Factor	: 100.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108034

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	4.1	0.2

[redacted]erature	: 74.2 F	Saturation Concentration	Meth	0.98002948
[redacted]nt Injected	: 0.005 ml			
Total Volume of Sample	: ml	Concentration in Head Space	Meth	3.67510E-5
Head space created	: 4 ml			
Methane Area	: 227.901 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

[redacted]

Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: RW-15	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-11	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Dilution Factor	: 100.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108033

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	1.2	0.2

Temperature	:	73.2 F	Saturation Meth	0.2
Atmospheric	:	0.01 F ml	Concentration	
				( )
Head space created	:	4 ml	in Head Space	
Methane Area	:	68.158 ug		

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: OW-115	Client Project No.	: 729791.20210
Lab Sample Number	: 96-3916-06	Lab Work Order	: 96-3916
Date Sampled	: 11/4/96	Dilution Factor	: 50.00
Date Received	: 11/5/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/6/96	Matrix	: Water
Date Analyzed	: 11/6/96	Lab File No.	: GAS1106021

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	7.3	0.1

Temperature	: 69.4 F	Saturation Concentration	Meth	1.7551502
Amount Injected	: 0.01 ml			
Total Volume of Sample	: 40 ml	Concentration in Head Space	Meth	5.5572201
Head space created	: 4 ml			
Methane Area	: 816.303 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: RW-6	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-10	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 100.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108016

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	5.4	0.2

Temperature : [illegible] F Saturation Meth 1.20
Atmospheric Pressure : [illegible] Concentration
Head space created : 4 ml in Head Space
Methane Area : 300.861 ug

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: OW-113	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3899-08	Lab Work Order	: 96-3899
Date Sampled	: 11/1/96	Dilution Factor	: 1.00
Date Received	: 11/2/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/7/96	Matrix	: Water
Date Analyzed	: 11/7/96	Lab File No.	: GAS1107014

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.002	0.002

[illegible]perature	: 72.3 F	Saturation	Meth	0.00050712
[illegible]nt injected	: 0.5 ml	Concentration		
[illegible] Volume of Sample	: 3 ml	Concentration	Meth	0.0015[illegible]
Head space created	: 4 ml	in Head Space		
Methane Area	: 11.793 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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AF3899.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: OW-114	Client Project No.	: 729691.20210
Lab Sample Number	: 96-3906-06	Lab Work Order	: 96-3906
Date Sampled	: 11/3/96	Dilution Factor	: 10.00
Date Received	: 11/4/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108028

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.65	0.02

Temperature	: 7.3 F	Saturation Concentration	Meth 0.1
Atmospheric Pressure	: 0 ml		
[illegible]	:	[illegible]	[illegible]
Head space created	: 4 ml	in Head Space	
Methane Area	: 365.546 ug		

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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AE3906.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: OW-110	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3845-07	Lab Work Order	: 96-3845
Date Sampled	: 10/29/96	Dilution Factor	: 20.00
Date Received	: 10/30/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 10/31/96	Matrix	: Water
Date Analyzed	: 10/31/96	Lab File No.	: GAS1031013

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	0.63	0.04

[illegible]perature	: 68 F	Saturation	Meth	0.1510141
[illegible]unt injected	: 0.025 ml	Concentration		
Total Volume in Sample	: 45 ml	Concentration	Meth	0.4[illegible]
Head space created	: 4 ml	in Head Space		
Methane Area	: 175.588 ug			

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

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AF3845.XLS

EVERGREEN ANALYTICAL, INC.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Methane Report Form

Client Sample Number	: OW-111	Client Project No.	: Langley AFB
Lab Sample Number	: 96-3864-11	Lab Work Order	: 96-3864
Date Sampled	: 10/30/96	Dilution Factor	: 100.00
Date Received	: 10/31/96	Method	: RSKSOP-175M
Date Extracted/Prepared	: 11/8/96	Matrix	: Water
Date Analyzed	: 11/8/96	Lab File No.	: GAS1108017

Compound Name	Cas Number	Sample Concentration mg/L	RL mg/L
Methane	74-82-8	5.2	0.2

Temperature	:	69.4 F	Saturation Meth	1.1
[illegible]	:	0.05 ml	[illegible]	
[illegible]	:	[illegible]	[illegible]	3
Head space created	:	4 ml	... Head Space	
Methane Area	:	288.92 ug		

Atomic weight(Methane) : 16 g

Qualifiers
E = Extrapolated value.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
RL = Reporting Limit.
NA = Not Available/Not Applicable.

Analyst

Approved

AF3864.XLS

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Analysis Report

729691.20210

Date Sampled	: 11/1/96	Client Project ID.	: Langley AFB
Date Received	: 11/2/96	Lab Project Number	: 96-3899
Date Prepared	: 11/4/96	Method	: EPA 310.1
Date Analyzed	: 11/4/96	Detection Limit	: 5.0 mg $CaCO_3$/L

Evergreen Sample #	Client Sample ID.	Matrix	Total Alkalinity (mg $CaCO_3$/L)	Dilution Factor
96-3899-04	4MP-4	Water	278	1
96-3899-04 Duplicate	4MP-4 Duplicate	Water	278	1
Method Blank	(11/4/96)		<5.0	

Quality Assurance

Reference	True Value (mg$CaCO_3$/L)	Result (mg$CaCO_3$/L)	% Recovery
ERA Minerals	120	114	95

Lot # 0725-96-11

Analyst

Approved

EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Analysis Report

729691.20210

Date Sampled	: 11/3/96	Client Project ID.	: Langley AFB
Date Received	: 11/4/96	Lab Project Number	: 96-3906
Date Prepared	: 11/6/96	Method	: EPA 310.1
Date Analyzed	: 11/6/96	Detection Limit	: 5.0 mg $CaCO_3$/L

Evergreen Sample #	Client Sample ID.	Matrix	Total Alkalinity (mg $CaCO_3$/L)	Dilution Factor
96-3906-05	4MP-14D	Water	304	1
96-3906-05	4MP-14D Duplicate	Water	307	1
Method Blank	(11/6/96)		<5.0	

Quality Assurance

Reference	True Value ($mgCaCO_3$/L)	Result ($mgCaCO_3$/L)	% Recovery
ERA Minerals	120	114	95

Lot # 0725-96-11

Analyst

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EVERGREEN ANALYTICAL, Inc.
4036 Youngfield St. Wheat Ridge, CO 80033
(303) 425-6021

Analysis Report

729791.20210

Date Sampled	: 11/4/96	Client Project ID.	: Langley AFB
Date Received	: 11/5/96	Lab Project Number	: 96-3916
Date Prepared	: 11/13/96	Matrix	: Organic
Date Analyzed	: 11/13/96	Method	: ASTM D 5057

Evergreen Sample #	Client Sample ID.	Specific Gravity @ 60° F
96-3916-01	P-4 LNAPL	0.8054

Analyst

Approved

OCT. - NOV. 1997

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : 4MP-5S
Lab Sample ID : 97-4059-06A
Date Collected : 10/07/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\015R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	0.4	0.4	µg/L
Ethylbenzene	100-41-4	2	0.4	µg/L
m,p-Xylene	1330-20-7	2.7	0.4	µg/L
o-Xylene	95-47-6	2.7	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	1.6	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	16	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		111%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

10/16/97 1:26:26 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : 4MP-5D
Lab Sample ID : 97-4059-05A
Date Collected : 10/07/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97 | **Lab File ID** : TVB21014\014R0101.D | **Effective Dilution** : 1
Date Analyzed : 10/14/97 | **Method Blank** : MB2101497

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	3.3	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	2.9	0.4	µg/L
m,p-Xylene	1330-20-7	5.5	0.4	µg/L
o-Xylene	95-47-6	4.1	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	5.8	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	8.1	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	50	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		137%	50 - 150	QC Limits

Date Prepared : 10/14/97 | **Lab File ID** : TVB21014\050R0101.D | **Effective Dilution** : 10
Date Analyzed : 10/15/97 | **Method Blank** : MB2101597

Compound Name	CAS Number	Concentration	RL	Units
1,2,4-Trimethylbenzene	95-63-6	93	4	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		130%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:
RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

10/16/97 1:26:24 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : 4MP-7
Lab Sample ID : 97-4059-13A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\023R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	U	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		100%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/16/97 1:26:42 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : 4MP-15
Lab Sample ID : 97-4059-19A
Date Collected : 10/09/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\031R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	0.55	0.4	µg/L
Ethylbenzene	100-41-4	2.1	0.4	µg/L
m,p-Xylene	1330-20-7	0.98	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	U	0.4	µg/L
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1,2,3-Trimethylbenzene	526-73-8	1.1	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	8.9	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		111%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/16/97 1:26:57 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : 4MP-21
Lab Sample ID : 97-4059-16A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\025R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Toluene	108-88-3	5.6	0.4	µg/L
Chlorobenzene	108-90-7	3.7	0.4	µg/L
Ethylbenzene	100-41-4	2.7	0.4	µg/L
m,p-Xylene	1330-20-7	2.3	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	3.5	0.4	µg/L
1,2,4-Trimethylbenzene	95-63-6	7.3	0.4	µg/L

Surrogate Recovery:	1,2,4-Trichlorobenzene	119%	50 - 150	QC Limits

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\051R0101.D
Method Blank : MB2101597
Effective Dilution : 10

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	27	4	µg/L
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

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10/16/97 1:26:51 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : 4MP-22
Lab Sample ID : 97-4059-12A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\022R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	U	0.4	µg/L
1,2,4-Trimethylbenzene	95-63-6	U	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	U	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		100%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

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10/16/97 1:26:40 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : 4MP-23
Lab Sample ID : 97-4059-15A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\024R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	U	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		99%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:
RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/16/97 1:26:47 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OW-3
Lab Sample ID : 97-4059-11A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\045R0101.D
Method Blank : MB2101597
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	1.4	0.4	µg/L
Ethylbenzene	100-41-4	5.4	0.4	µg/L
m,p-Xylene	1330-20-7	1.1	0.4	µg/L
o-Xylene	95-47-6	1.4	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	U	0.4	µg/L
1,2,4-Trimethylbenzene	95-63-6	6.3	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	80	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		116%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

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10/16/97 1:26:37 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OW-4
Lab Sample ID : 97-4059-18A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\030R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	0.54	0.4	µg/L
Ethylbenzene	100-41-4	1.7	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	23	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		105%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:
RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

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10/16/97 1:26:55 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OW-7
Lab Sample ID : 97-4059-09A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\018R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	32	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	0.74	0.4	µg/L
Ethylbenzene	100-41-4	4.1	0.4	µg/L
m,p-Xylene	1330-20-7	4	0.4	µg/L
o-Xylene	95-47-6	5	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	1.2	0.4	µg/L
1,2,4-Trichlorobenzene	120-82-1	0.2	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	7.1	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	79	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		142%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/16/97 1:26:33 PM

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OW-8
Lab Sample ID : 97-4059-17A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\026R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	3.7	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		103%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/16/97 1:26:53 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OW-9
Lab Sample ID : 97-4059-14A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\037R0101.D
Method Blank : MB2101597
Effective Dilution : 10

Compound Name	CAS Number	Concentration	RL	Units
1,2,4-Trimethylbenzene	95-63-6	470	4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	200	5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		104%	50 - 150	QC Limits

Comments:

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\046R0101.D
Method Blank : MB2101597
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	7.5	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	1.2	0.4	µg/L
Ethylbenzene	100-41-4	10	0.4	µg/L
m,p-Xylene	1330-20-7	10	0.4	µg/L
o-Xylene	95-47-6	2.6	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	8.7	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	21	0.4	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		164% S X	50 - 150	QC Limits

Comments: X = Poor surrogate recovery due to coelution of interference.

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:
RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/17/97 12:54:38 PM

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OW-11
Lab Sample ID : 97-4059-25A
Date Collected : 10/09/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/15/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\053R0101.D
Method Blank : MB2101597
Effective Dilution : 5

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	250	2	µg/L
Toluene	108-88-3	U	2	µg/L
Chlorobenzene	108-90-7	U	2	µg/L
Ethylbenzene	100-41-4	91	2	µg/L
m,p-Xylene	1330-20-7	190	2	µg/L
o-Xylene	95-47-6	5.8	2	µg/L
1,2,3-Trimethylbenzene	526-73-8	130	2	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	82	2.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		107%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/16/97 1:27:14 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OW-111
Lab Sample ID : 97-4059-20A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\038R0101.D
Method Blank : MB2101597
Effective Dilution : 20

Compound Name	CAS Number	Concentration	RL	Units
1,2,4-Trimethylbenzene	95-63-6	420	8	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	190	10	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		100%	50 - 150	QC Limits

Comments:

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\049R0101.D
Method Blank : MB2101597
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	8.6	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	1.4	0.4	µg/L
Ethylbenzene	100-41-4	12	0.4	µg/L
m,p-Xylene	1330-20-7	12	0.4	µg/L
o-Xylene	95-47-6	2.9	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	24	0.4	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		162% S X	50 - 150	QC Limits

Comments: X = Poor surrogate recovery due to coelution of interference.

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:
RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

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10/17/97 12:55:27 PM

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : OW-112
Lab Sample ID : 97-4059-22A
Date Collected : 10/09/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\052R0101.D
Method Blank : MB2101597
Effective Dilution : 5

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	81	2	µg/L
Ethylbenzene	100-41-4	70	2	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	94	2.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		108%	50 - 150	QC Limits

Comments:

Compound Name	CAS Number	Concentration	RL	Units
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	[illegible]	0.4	µg/L
[illegible]Xylene	[illegible]	[illegible]	0.4	µg/L
[illegible]	[illegible]	[illegible]	[illegible]	µg/L
[illegible]	[illegible]	[illegible]	[illegible]	µg/L
1,2,3-Trimethylbenzene	526-73-8	20	0.4	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		227% S X	50 - 150	QC Limits

Comments: X = Poor surrogate recovery due to coelution of interference.

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

11/7/97 4:37:08 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : RW-4
Lab Sample ID : 97-4059-26A
Date Collected : 10/09/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/15/97
Lab File ID : TVB21014\034R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	1.2	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	0.89	0.4	µg/L
m,p-Xylene	1330-20-7	0.7	0.4	µg/L
o-Xylene	95-47-6	0.5	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	U	0.4	µg/L
1,2,4-Trimethylbenzene	95-63-6	1.6	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	37	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		118%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:
RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

10/16/97 3:43:32 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : RW-6
Lab Sample ID : 97-4059-08A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\017R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	43	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	2.8	0.4	µg/L
m,p-Xylene	1330-20-7	2.6	0.4	µg/L
o-Xylene	95-47-6	2.9	0.4	µg/L
1,2,4-Trimethylbenzene	95-63-6	28	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	14	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	36	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		143%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/16/97 1:26:31 PM

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : RW-15
Lab Sample ID : 97-4059-07A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\016R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	1.3	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	U	0.4	µg/L
1,2,4-Trimethylbenzene	95-63-6	1.4	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	4.1	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		104%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/16/97 1:26:29 PM

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : P-1
Lab Sample ID : 97-4059-10A
Date Collected : 10/08/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\019R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	1.8	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	0.93	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	2.7	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		104%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

10/16/97 1:26:35 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : CB-1
Lab Sample ID : 97-4059-02A
Date Collected : 10/07/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\011R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	U	0.4	µg/L
1,2,4-Trimethylbenzene	95-63-6	U	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	U	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		101%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

10/16/97 1:26:14 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : CB-2
Lab Sample ID : 97-4059-03A
Date Collected : 10/07/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\012R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	U	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		100%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

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10/16/97 1:26:19 PM

Evergreen Analytical, Inc.

4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : CB-3
Lab Sample ID : 97-4059-04A
Date Collected : 10/07/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Water

Method: SW8020A — **BTEX +**

Date Prepared : 10/14/97
Date Analyzed : 10/14/97
Lab File ID : TVB21014\013R0101.D
Method Blank : MB2101497
Effective Dilution : 1

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	0.4	µg/L
Toluene	108-88-3	U	0.4	µg/L
Chlorobenzene	108-90-7	U	0.4	µg/L
Ethylbenzene	100-41-4	U	0.4	µg/L
m,p-Xylene	1330-20-7	U	0.4	µg/L
o-Xylene	95-47-6	U	0.4	µg/L
1,3,5-Trimethylbenzene	108-67-8	U	0.4	µg/L
[illegible]	[illegible]	U	0.4	µg/L
1,2,3-Trimethylbenzene	526-73-8	U	0.4	µg/L
1,2,3,4-Tetramethylbenzene	488-23-3	U	0.5	µg/L
Surrogate Recovery: 1,2,4-Trichlorobenzene		100%	50 - 150	QC Limits

Comments:

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:

E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:

RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

10/16/97 1:26:21 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methods 602/8020 and 5030/8015 Modified Data Report

Client Sample ID : IDW-SOIL
Lab Sample ID : 97-4059-01A
Date Collected : 10/07/97
Date Received : 10/10/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Sample Matrix : Soil
Percent Moisture : 18.27

Method: SW8020A — **BTEX +**

Date Prepared : 10/15/97
Date Analyzed : 10/15/97
Lab File ID : TVB11015\021R0101.D
Method Blank : MB1101597
Effective Dilution : 1.22

Compound Name	CAS Number	Concentration	RL	Units
Benzene	71-43-2	U	4.9	µg/Kg-dry
Toluene	108-88-3	U	4.9	µg/Kg-dry
Chlorobenzene	108-90-7	U	4.9	µg/Kg-dry
Ethylbenzene	100-41-4	U	4.9	µg/Kg-dry
m,p-Xylene	1330-20-7	U	4.9	µg/Kg-dry
o-Xylene	95-47-6	U	4.9	µg/Kg-dry
1,2,3-Trimethylbenzene	526-73-8	U	4.9	µg/Kg-dry
1,2,3,4-Tetramethylbenzene	488-23-3	U	6.1	µg/Kg-dry

Surrogate Recovery:				
	1,2,4-Trichlorobenzene	32% S X	50 - 150	QC Limits

Comments: X = Poor surrogate recovery exhibited in duplicate, indicating a matrix effect.

Notes: Total Xylenes consist of three isomers, two of which co-elute. The Xylene RL is for a single peak.

Qualifiers:
E = Extrapolated value. Value exceeds calibration range.
U = Compound analyzed for, but not detected.
B = Compound also found in the blank.
J = Indicates an estimated value when the compound is detected, but is below the Reporting Limit.
S = Spike Recovery outside accepted recovery limits.

Definitions:
RL = Reporting Limit.
TVH = Total Volatile Hydrocarbons
TEH = Total Extractable Hydrocarbons

Analyst

Approved

10/16/97 4:02:48 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methane

Method Number : RSKSOP-175M
Date Received : 10/10/97
Date Prepared : 10/17/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Units : mg/L

Lab Sample ID	Client Sample ID	Sample Matrix	Sample Date	Analysis Date	Dilution Factor	Sample Result	Reporting Limit
97-4059-11B	OW-3	Water	10/08/97	10/17/97	50	5.8	0.06
97-4059-12B	4MP-22	Water	10/08/97	10/17/97	1	U	0.0012
97-4059-13B	4MP-7	Water	10/08/97	10/17/97	1	U	0.0012
97-4059-14B	OW-9	Water	10/08/97	10/17/97	50	7.8	0.06
97-4059-15B	4MP-23	Water	10/08/97	10/17/97	1	U	0.0012
97-4059-16B	4MP-21	Water	10/08/97	10/17/97	100	9.9	0.12
97-4059-17B	OW-8	Water	10/08/97	10/17/97	50	2	0.06
97-4059-18B	OW-4	Water	10/08/97	10/17/97	50	3.3	0.06
97-4059-19B	4MP-15	Water	10/09/97	10/17/97	10	0.23	0.012
97-4059-20B	OW-111	Water	10/08/97	10/17/97	100	9.5	0.12
97-4059-21B	P-4	Water	10/09/97	10/17/97	50	8.8	0.06
97-4059-22B	OW-112	Water	10/09/97	10/17/97	100	8.6	0.12
97-4059-23B	P-5	Water	10/09/97	10/17/97	20	2.4	0.024
97-4059-25B	OW-11	Water	10/09/97	10/17/97	100	9.9	0.12
97-4059-26B	RW-4	Water	10/09/97	10/17/97	100	7.7	0.12

Qualifiers:
U = Analyzed for, but not detected.
B = Also found in the blank.
E = Extrapolated value. Value exceeds calibration range.

Definitions:
RL = Reporting Limit.

Analyst

Approved

10/22/97 1:30:55 PM

Evergreen Analytical, Inc.
4036 Youngfield St., Wheat Ridge, CO 80033
(303) 425-6021

Methane

Method Number : RSKSOP-175M
Date Received : 10/10/97
Date Prepared : 10/15/97

Client Project ID : 729691.20110
Lab Work Order : 97-4059
Units : mg/L

Lab Sample ID	Client Sample ID	Sample Matrix	Sample Date	Analysis Date	Dilution Factor	Sample Result	Reporting Limit
97-4059-05B	4MP-5D	Water	10/07/97	10/15/97	50	5.6	0.06
97-4059-06B	4MP-5S	Water	10/07/97	10/15/97	5	0.39	0.006
97-4059-07B	RW-15	Water	10/08/97	10/15/97	50	2.8	0.06
97-4059-08B	RW-6	Water	10/08/97	10/15/97	100	4.5	0.12
97-4059-09B	OW-7	Water	10/08/97	10/15/97	50	5.5	0.06

Qualifiers:
U = Analyzed for, but not detected.
B = Also found in the blank.
E = Extrapolated value. Value exceeds calibration range.

Definitions:
RL = Reporting Limit.

Analyst

Approved

10/22/97 1:30:51 PM

APPENDIX D

MODEL CALCULATIONS AND INPUT PARAMETERS

BIOSCREEN INPUT PARAMETERS
Site SS-04 Langley AFB
(See also Tables 5.1 and 5.2)

Hydrogeology

K	= 11.9 ft/day = 0.0042 cm/sec	(slug test data October-November 1996)
Dh/dl	= 0.003 ft/ft	(October 1997 water table map
Porosity	= 0.2	(literature value - Spitz and Moreno, 1996)

Dispersivity

Benzene plume length approximately 350 ft (1997 Benzene plume map – Figure 5.1)

Adsorption

Bulk Density	= 1.7 kg/L	(literature value, Wiedemeier et al., 1995)
K_{oc}	= 79 L/kg	(literature value, Wiedemeier et al., 1995)
f_{oc}	= 1e-04	(1997 site-specific analytical data)
R	= 1.1	(calculated by BIOSCREEN)

Instantaneous Reaction Biodegradation

See Table 5.1

Soluble Mass

Thickness = 1 foot (CPT/LIF data)
Area = 480 ft X 120 ft = 57,600 ft^2
Benzene Mass = 57,600 ft^2 X 1.7 kg/L X 28.3 L/ft^3 X (0.33 mg/kg X 15 mg/kg)$^{1/2}$ X 1e-6 kg/mg
= 6 kg

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

Langley AFB SS-04
RNA BENZENE ONLY

Data Input Instructions:

115 ↑ or 0.02

1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* ▸ Data used directly in model.
20 ▸ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	65.8	(ft/yr)
or		↑ or	
Hydraulic Conductivity	K	4.2E-03	(cm/sec)
Hydraulic Gradient	i	0.003	(ft/ft)
Porosity	n	0.2	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	9.0	(ft)
Transverse Dispersivity*	alpha y	0.9	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		↑ or	
Estimated Plume Length	Lp	350	(ft)

3. ADSORPTION

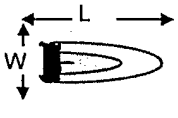
Retardation Factor*	R	1.1	(-)
or		↑ or	
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	1.0E-4	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	3.5E+0	(per yr)
or		↑ or	
Solute Half-Life	t-half	0.20	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	0	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	3.12	(mg/L)
Delta Sulfate*	SO4	12.02	(mg/L)
Observed Methane*	CH4	1.4	(mg/L)

5. GENERAL

Modeled Area Length*	480	(ft)
Modeled Area Width*	480	(ft)
Simulation Time*	10.0	(yr)



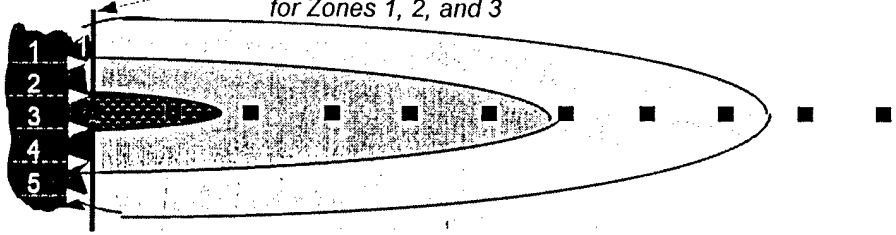
6. SOURCE DATA

Source Thickness in Sat.Zone* 1 (ft)

Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
45	0.05
30	0.25
45	0.05
0	0

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Source Halflife (see Help):

20	900	(yr)
Inst. React.	↑ 1st Order	
Soluble Mass	6	(Kg)

In Source NAPL, Soil

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	.17			.1				.043		.003	
Dist. from Source (ft)	0	48	96	144	192	240	288	336	384	432	480

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

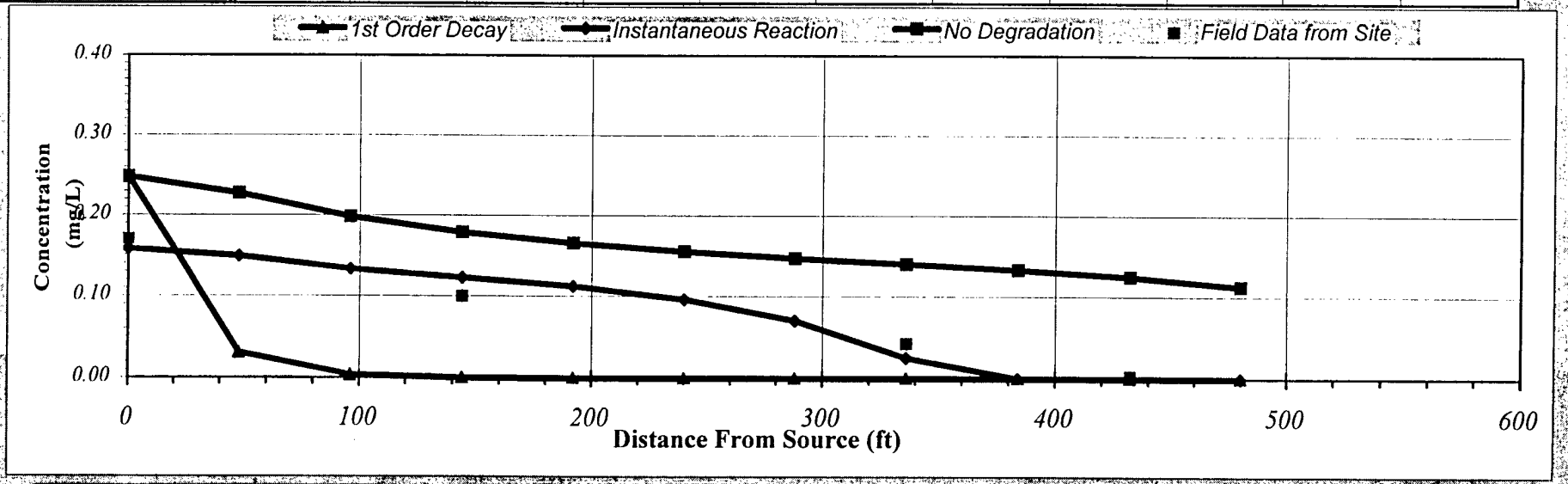
Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	**0**	**48**	**96**	**144**	**192**	**240**	**288**	**336**	**384**	**432**	**480**
No Degradation	0.248	0.227	0.198	0.179	0.165	0.155	0.147	0.140	0.133	0.124	0.112
1st Order Decay	0.248	0.031	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.158	0.149	0.133	0.123	0.112	0.096	0.070	0.025	0.000	0.000	0.000
Field Data from Site	0.170			0.100				0.043		0.003	



Calculate Animation
Next Timestep
Prev Timestep

Time:
10.0 Years

Return to Input

Recalculate This Sheet

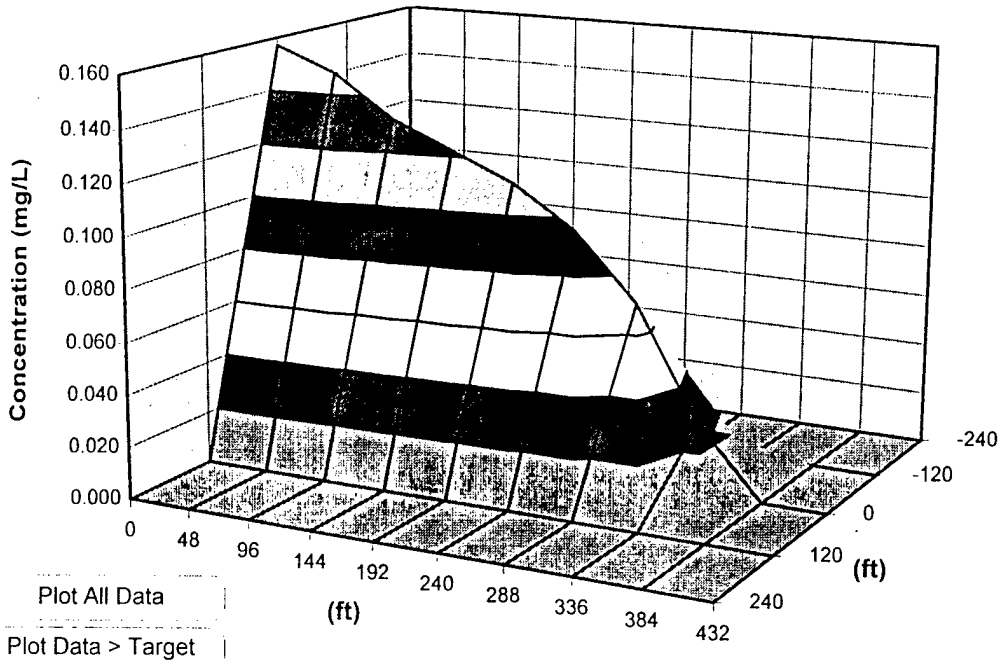
DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft) \ Distance from Source (ft)	0	48	96	144	192	240	288	336	384	432	480
240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.157	0.148	0.132	0.122	0.112	0.0959	0.070	0.027	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS FLUX (mg/day)	1.2E+1	1.8E+1	1.6E+1	1.5E+1	1.4E+1	1.2E+1	8.6E+0	3.3E+0	0.0E+0	0.0E+0	0.0E+0

Model to Display:

- No Degradation Model
- 1st Order Decay Model
- Instantaneous Reaction Model

Time: 10 Years Target Level: 0.005 mg/L Displayed Model: Inst. Reaction



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation	1.8	(Kg)
- Actual Plume Mass	0.0	(Kg)
= Plume Mass Removed by Biodeg	1.7	(Kg) (98 %)

Change in Electron Acceptor/Byproduct Masses:

Oxygen	Nitrate	Iron II	Sulfate	Methane	
+0.0	+0.0	+1.2	-4.6	+0.5	(Kg)

Contam. Mass in Source (t=0 Years)	6.0	(Kg)
Contam. Mass in Source Now (t=10Years)	4.2	(Kg)
Current Volume of Groundwater in Plume	0.2	(ac-ft)
Flowrate of Water Through Source Zone	0.036	(ac-ft/yr)

Mass HELP Recalculate

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

Langley AFB SS-04
RNA BENZENE ONLY

Data Input Instructions:

115 / ↑ or / 0.02

1. *Enter value directly....or*
2. *Calculate by filling in grey cells below. (To restore formulas, hit button below).*

Variable* — *Data used directly in model.*

20 — *Value calculated by model. (Don't enter any data).*

1. HYDROGEOLOGY

Seepage Velocity*	*Vs*	65.8	*(ft/yr)*
or		↑ or	
Hydraulic Conductivity	*K*	4.2E-03	*(cm/sec)*
Hydraulic Gradient	*i*	0.003	*(ft/ft)*
Porosity	*n*	0.2	*(-)*

2. DISPERSION

Longitudinal Dispersivity*	*alpha x*	9.0	*(ft)*
Transverse Dispersivity*	*alpha y*	0.9	*(ft)*
Vertical Dispersivity*	*alpha z*	0.0	*(ft)*
or		↑ or	
Estimated Plume Length	*Lp*	350	*(ft)*

3. ADSORPTION

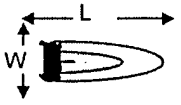
Retardation Factor*	*R*	1.1	*(-)*
or		↑ or	
Soil Bulk Density	*rho*	1.7	*(kg/l)*
Partition Coefficient	*Koc*	79	*(L/kg)*
FractionOrganicCarbon	*foc*	1.0E-4	*(-)*

4. BIODEGRADATION

1st Order Decay Coeff*	*lambda*	3.5E+0	*(per yr)*
or		↑ or	
Solute Half-Life	*t-half*	0.20	*(year)*
or Instantaneous Reaction Model			
Delta Oxygen*	*DO*	0	*(mg/L)*
Delta Nitrate*	*NO3*	0	*(mg/L)*
Observed Ferrous Iron*	*Fe2+*	3.12	*(mg/L)*
Delta Sulfate*	*SO4*	12.02	*(mg/L)*
Observed Methane*	*CH4*	1.4	*(mg/L)*

5. GENERAL

Modeled Area Length*	480	*(ft)*
Modeled Area Width*	480	*(ft)*
Simulation Time*	20.0	*(yr)*



6. SOURCE DATA

Source Thickness in Sat.Zone* 1 *(ft)*

Source Zones:

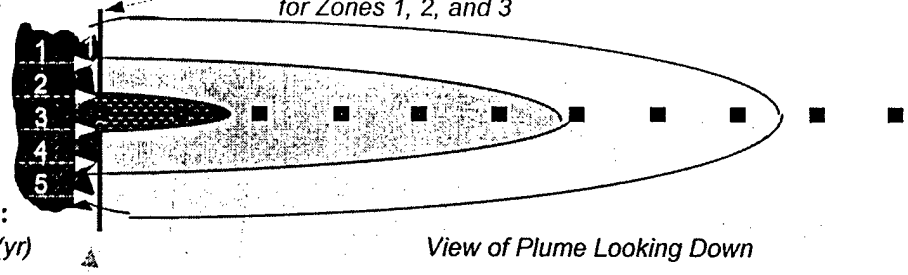
Width* (ft)	Conc. (mg/L)*
0	0
45	0.05
30	0.25
45	0.05
0	0

Source Halflife (see Help):

20	900	*(yr)*
Inst. React. ↑	↑ 1st Order	
Soluble Mass	6	*(Kg)*

In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	.17			.1				.043		.003	
Dist. from Source (ft)	0	48	96	144	192	240	288	336	384	432	480

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — **View Output**

RUN ARRAY — **View Output**

Help

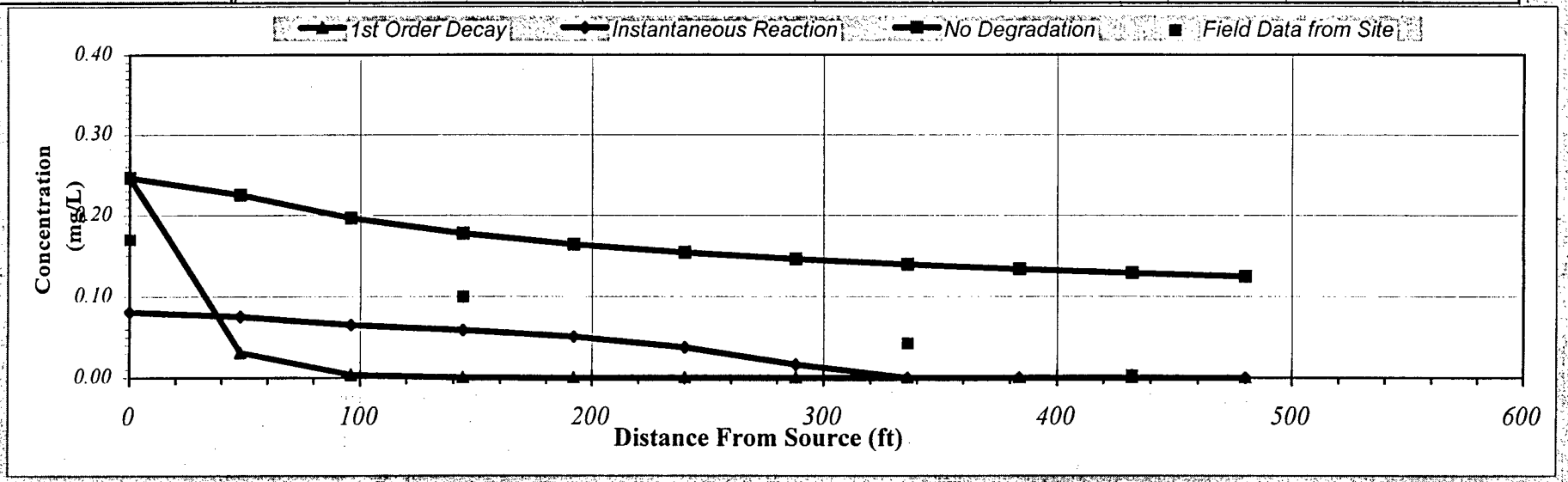
Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

TYPE OF MODEL	Distance from Source (ft) 0	48	96	144	192	240	288	336	384	432	480
No Degradation	0.246	0.225	0.197	0.177	0.164	0.154	0.146	0.139	0.134	0.129	0.125
1st Order Decay	0.246	0.031	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.081	0.076	0.065	0.059	0.051	0.038	0.017	0.000	0.000	0.000	0.000
Field Data from Site	0.170			0.100				0.043		0.003	



Calculate Animation

Next Timestep

Prev Timestep

Time: 20.0 Years

Return to Input

Recalculate This Sheet

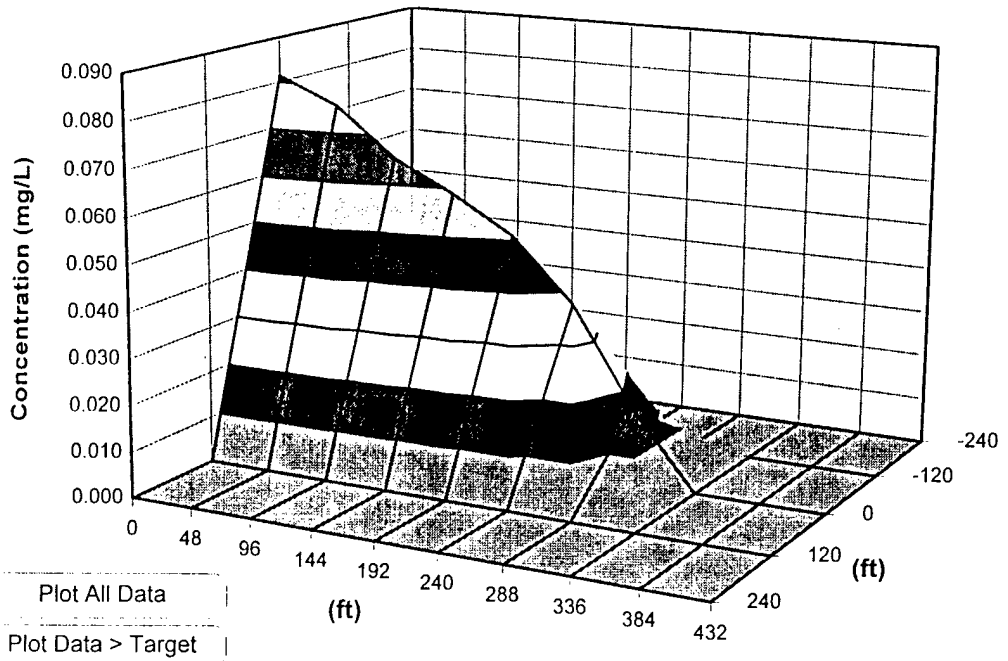
DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft) \ Distance from Source (ft)	0	48	96	144	192	240	288	336	384	432	480
240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.081	0.076	0.065	0.059	0.051	0.0376	0.017	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS FLUX (mg/day)	1.2E+1	9.3E+0	8.0E+0	7.2E+0	6.2E+0	4.6E+0	2.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0

Model to Display:

- No Degradation Model
- 1st Order Decay Model
- Instantaneous Reaction Model

Time: 20 Years Target Level: 0.005 mg/L Displayed Model: Inst. Reaction



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation	3.0	(Kg)
- Actual Plume Mass	0.0	(Kg)
= Plume Mass Removed by Biodeg	3.0	(Kg) (99 %)

Change in Electron Acceptor/Byproduct Masses:

Oxygen	Nitrate	Iron II	Sulfate	Methane	
+0.0	+0.0	+2.0	-7.9	+0.9	(Kg)

Contam. Mass in Source (t=0 Years)	6.0	(Kg)
Contam. Mass in Source Now (t=20Years)	3.0	(Kg)
Current Volume of Groundwater in Plume	0.2	(ac-ft)
Flowrate of Water Through Source Zone	0.036	(ac-ft/yr)

Mass HELP Recalculate

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

Langley AFB SS-04
RNA BENZENE ONLY

Data Input Instructions:

115 ↑ or 0.02

1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* ▸ Data used directly in model.
20 ▸ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	65.8	(ft/yr)
or		↑ or	
Hydraulic Conductivity	K	4.2E-03	(cm/sec)
Hydraulic Gradient	i	0.003	(ft/ft)
Porosity	n	0.2	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	9.0	(ft)
Transverse Dispersivity*	alpha y	0.9	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		↑ or	
Estimated Plume Length	Lp	350	(ft)

3. ADSORPTION

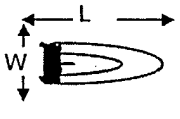
Retardation Factor*	R	1.1	(-)
or		↑ or	
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	1.0E-4	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	3.5E+0	(per yr)
or		↑ or	
Solute Half-Life	t-half	0.20	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	0	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	3.12	(mg/L)
Delta Sulfate*	SO4	12.02	(mg/L)
Observed Methane*	CH4	1.4	(mg/L)

5. GENERAL

Modeled Area Length*	480	(ft)
Modeled Area Width*	480	(ft)
Simulation Time*	25.0	(yr)



6. SOURCE DATA

Source Thickness in Sat.Zone* 1 (ft)

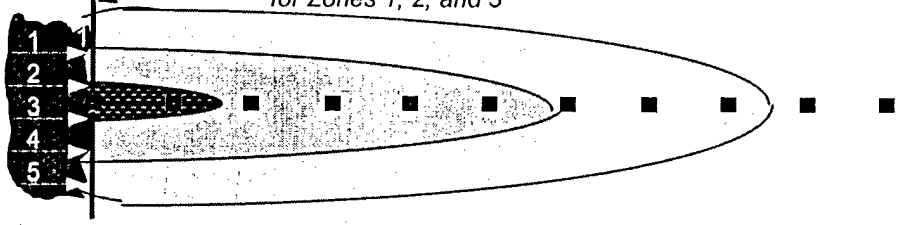
Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
45	0.05
30	0.25
45	0.05
0	0

Source Halflife (see Help):

20	900	(yr)
Inst. React.	↑ 1st Order	
Soluble Mass In Source NAPL, Soil	6	(Kg)

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	.17			.1				.043		.003	
Dist. from Source (ft)	0	48	96	144	192	240	288	336	384	432	480

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

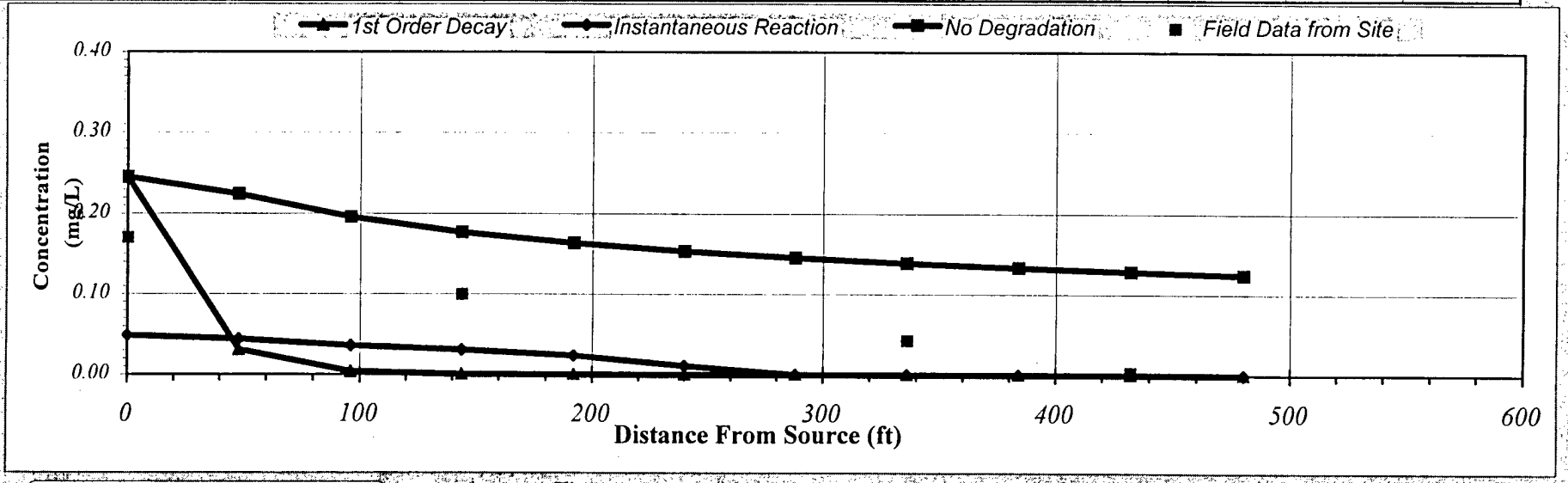
Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	48	96	144	192	240	288	336	384	432	480
No Degradation	0.245	0.225	0.196	0.177	0.163	0.153	0.145	0.139	0.133	0.129	0.124
1st Order Decay	0.245	0.031	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.049	0.044	0.036	0.031	0.024	0.011	0.000	0.000	0.000	0.000	0.000
Field Data from Site	0.170			0.100				0.043		0.003	



Calculate Animation
Next Timestep
Prev Timestep

Time:
25.0 Years

Return to Input

Recalculate This Sheet

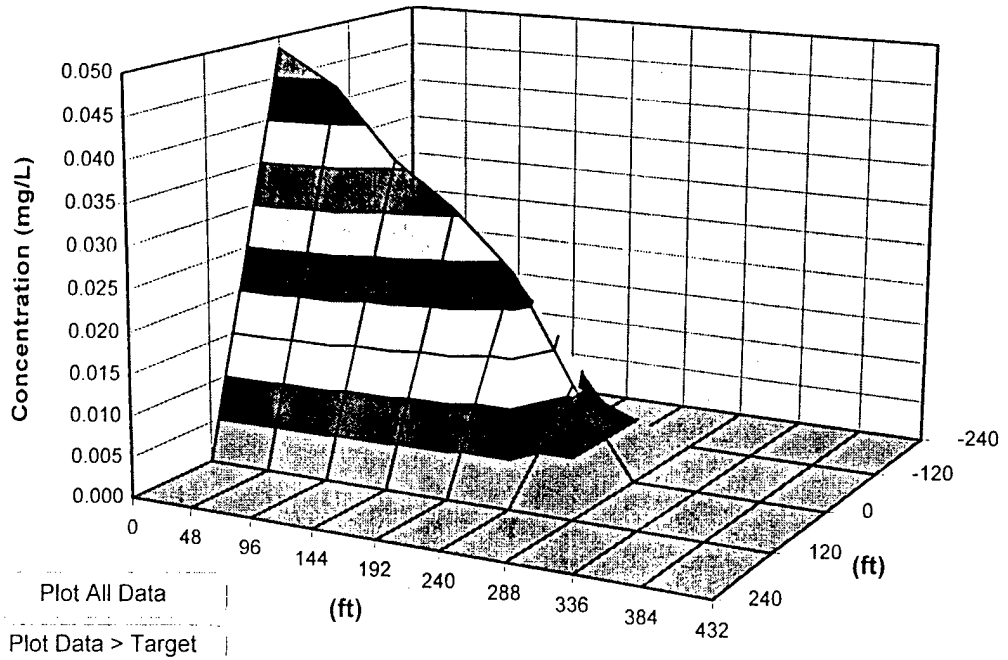
DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft)	Distance from Source (ft)										
	0	48	96	144	192	240	288	336	384	432	480
240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.049	0.044	0.036	0.031	0.024	0.0110	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS FLUX (mg/day)	1.2E+1	5.4E+0	4.4E+0	3.8E+0	2.9E+0	1.3E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0

Model to Display:

- *No Degradation Model*
- *1st Order Decay Model*
- *Instantaneous Reaction Model*

Time: **25 Years** Target Level: **0.005** mg/L Displayed Model: **Inst. Reaction**



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation	3.5	(Kg)
- Actual Plume Mass	0.0	(Kg)
= Plume Mass Removed by Biodeg	**3.5**	(Kg) (100 %)

Change in Electron Acceptor/Byproduct Masses:

Oxygen	*Nitrate*	*Iron II*	*Sulfate*	*Methane*	
+0.0	+0.0	+2.4	-9.1	+1.1	(Kg)

Contam. Mass in Source (t=0 Years)	6.0	(Kg)
Contam. Mass in Source Now (t=25Years)	2.5	(Kg)
Current Volume of Groundwater in Plume	0.2	(ac-ft)
Flowrate of Water Through Source Zone	0.036	(ac-ft/yr)

Mass HELP

Recalculate

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

Langley AFB SS-04
RNA BENZENE ONLY

Data Input Instructions:

115 ↑ or 0.02

1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* ▸ Data used directly in model.

20 ▸ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	*Vs*	65.8	*(ft/yr)*
or		↑ or	
Hydraulic Conductivity	*K*	4.2E-03	*(cm/sec)*
Hydraulic Gradient	*i*	0.003	*(ft/ft)*
Porosity	*n*	0.2	*(-)*

2. DISPERSION

Longitudinal Dispersivity*	*alpha x*	9.0	*(ft)*
Transverse Dispersivity*	*alpha y*	0.9	*(ft)*
Vertical Dispersivity*	*alpha z*	0.0	*(ft)*
or		↑ or	
Estimated Plume Length	*Lp*	350	*(ft)*

3. ADSORPTION

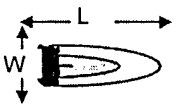
Retardation Factor*	*R*	1.1	*(-)*
or		↑ or	
Soil Bulk Density	*rho*	1.7	*(kg/l)*
Partition Coefficient	*Koc*	79	*(L/kg)*
FractionOrganicCarbon	*foc*	1.0E-4	*(-)*

4. BIODEGRADATION

1st Order Decay Coeff*	*lambda*	3.5E+0	*(per yr)*
or		↑ or	
Solute Half-Life	*t-half*	0.20	*(year)*
or Instantaneous Reaction Model			
Delta Oxygen*	*DO*	0	*(mg/L)*
Delta Nitrate*	*NO3*	0	*(mg/L)*
Observed Ferrous Iron*	*Fe2+*	3.12	*(mg/L)*
Delta Sulfate*	*SO4*	12.02	*(mg/L)*
Observed Methane*	*CH4*	1.4	*(mg/L)*

5. GENERAL

Modeled Area Length*	480	*(ft)*
Modeled Area Width*	480	*(ft)*
Simulation Time*	30.0	*(yr)*



6. SOURCE DATA

Source Thickness in Sat.Zone* 1 *(ft)*

Source Zones:

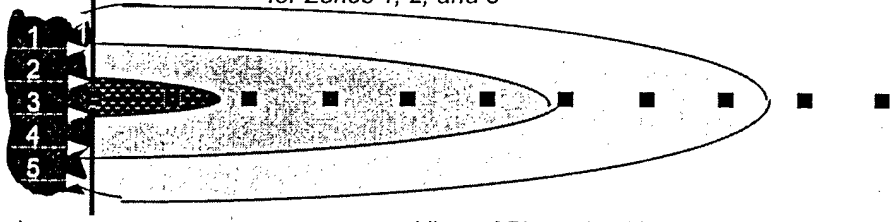
Width* (ft)	Conc. (mg/L)*
0	0
45	0.05
30	0.25
45	0.05
0	0

Source Halflife (see Help):

Inst. React.	1st Order	
20	900	*(yr)*

Soluble Mass 6 *(Kg)*
In Source NAPL, Soil

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	.17			.1				.043		.003	
Dist. from Source (ft)	0	48	96	144	192	240	288	336	384	432	480

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

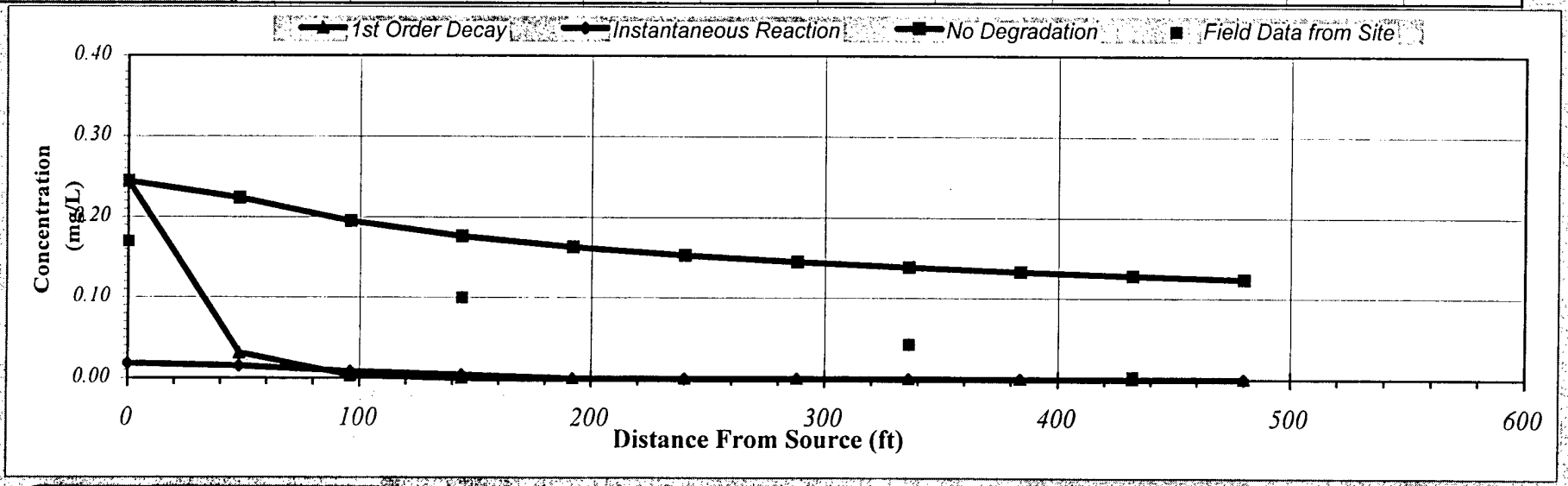
Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	48	96	144	192	240	288	336	384	432	480
No Degradation	0.244	0.224	0.195	0.176	0.163	0.153	0.145	0.138	0.133	0.128	0.124
1st Order Decay	0.244	0.031	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.018	0.015	0.009	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	0.170			0.100				0.043		0.003	



Calculate Animation
Next Timestep
Prev Timestep

Time: *30.0 Years*

Return to Input

Recalculate This Sheet

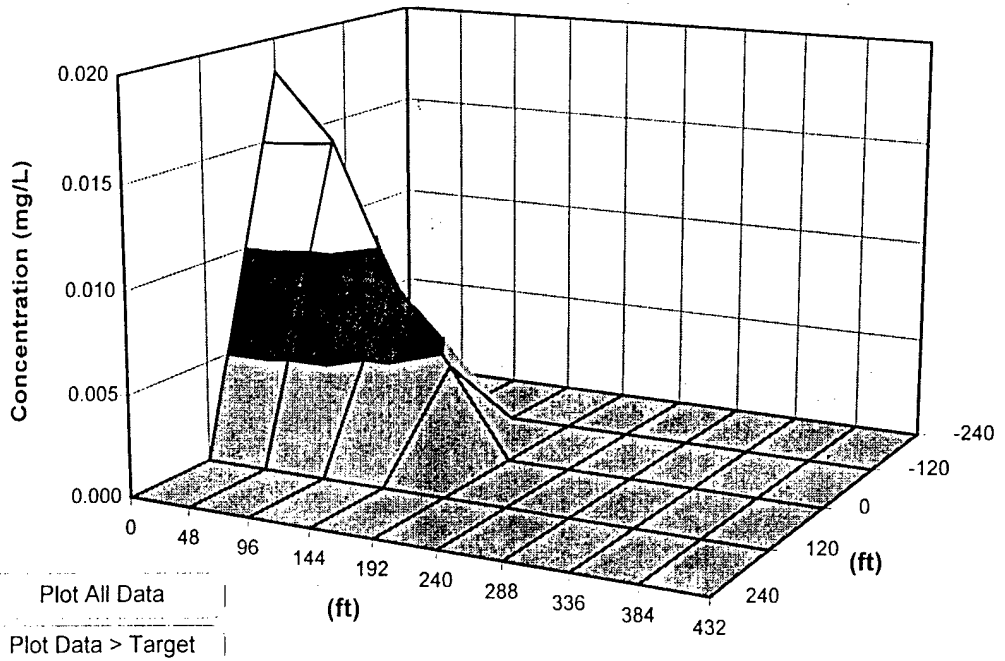
DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft)	Distance from Source (ft)										
	0	48	96	144	192	240	288	336	384	432	480
240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.018	0.015	0.009	0.004	0.000	0.0000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS FLUX (mg/day)	1.2E+1	1.9E+0	1.1E+0	5.4E-1	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0

Model to Display:

- No Degradation Model
- 1st Order Decay Model
- Instantaneous Reaction Model

Time: 30 Years Target Level: 0.005 mg/L Displayed Model: Inst. Reaction



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation: Can't Calc. (Kg)

- Actual Plume Mass: Can't Calc. (Kg)

= Plume Mass Removed by Biodeg: - (Kg)

Change in Electron Acceptor/Byproduct Masses:

Oxygen	Nitrate	Iron II	Sulfate	Methane	
-	-	-	-	-	(Kg)

Contam. Mass in Source (t=0 Years): 6.0 (Kg)

Contam. Mass in Source Now (t=30Years): 2.1 (Kg)

Current Volume of Groundwater in Plume: Can't Calc. (ac-ft)

Flowrate of Water Through Source Zone: Can't Calc. (ac-ft/yr)

Mass HELP Recalculate

BIOSCREEN Natural Attenuation Decision Support System

Air Force Center for Environmental Excellence — *Version 1.4*

Langley AFB SS-04
RNA BENZENE ONLY

Data Input Instructions:

115 ↑ or 0.02

1. Enter value directly....or
2. Calculate by filling in grey cells below. (To restore formulas, hit button below).

Variable* ▸ Data used directly in model.
20 ▸ Value calculated by model. (Don't enter any data).

1. HYDROGEOLOGY

Seepage Velocity*	Vs	65.2	(ft/yr)
or		↑ or	
Hydraulic Conductivity	K	4.2E-03	(cm/sec)
Hydraulic Gradient	i	0.003	(ft/ft)
Porosity	n	0.2	(-)

2. DISPERSION

Longitudinal Dispersivity*	alpha x	9.0	(ft)
Transverse Dispersivity*	alpha y	0.9	(ft)
Vertical Dispersivity*	alpha z	0.0	(ft)
or		↑ or	
Estimated Plume Length	Lp	350	(ft)

3. ADSORPTION

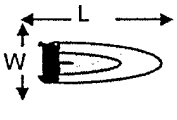
Retardation Factor*	R	1.1	(-)
or		↑ or	
Soil Bulk Density	rho	1.7	(kg/l)
Partition Coefficient	Koc	79	(L/kg)
FractionOrganicCarbon	foc	1.0E-4	(-)

4. BIODEGRADATION

1st Order Decay Coeff*	lambda	3.5E+0	(per yr)
or		↑ or	
Solute Half-Life	t-half	0.20	(year)
or Instantaneous Reaction Model			
Delta Oxygen*	DO	0	(mg/L)
Delta Nitrate*	NO3	0	(mg/L)
Observed Ferrous Iron*	Fe2+	3.12	(mg/L)
Delta Sulfate*	SO4	12.02	(mg/L)
Observed Methane*	CH4	1.4	(mg/L)

5. GENERAL

Modeled Area Length*	480	(ft)
Modeled Area Width*	480	(ft)
Simulation Time*	33.0	(yr)



6. SOURCE DATA

Source Thickness in Sat.Zone* 1 (ft)

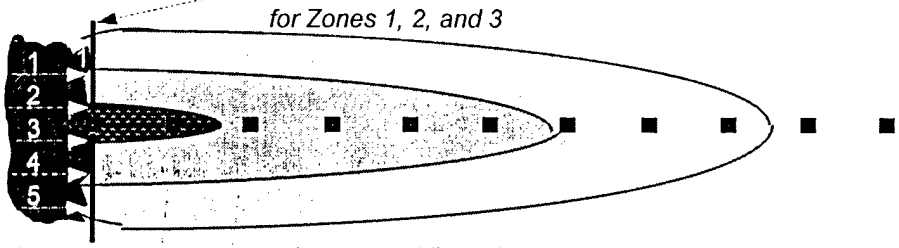
Source Zones:

Width* (ft)	Conc. (mg/L)*
0	0
45	0.05
30	0.25
45	0.05
0	0

Source Halflife (see Help):

20	900	(yr)
Inst. React.	1st Order	
Soluble Mass	6	(Kg)
In Source NAPL, Soil		

Vertical Plane Source: Look at Plume Cross-Section and Input Concentrations & Widths for Zones 1, 2, and 3



View of Plume Looking Down

Observed Centerline Concentrations at Monitoring Wells
If No Data Leave Blank or Enter "0"

7. FIELD DATA FOR COMPARISON

Concentration (mg/L)	.17			.1				.043		.003	
Dist. from Source (ft)	0	48	96	144	192	240	288	336	384	432	480

8. CHOOSE TYPE OF OUTPUT TO SEE:

RUN CENTERLINE — View Output

RUN ARRAY — View Output

Help

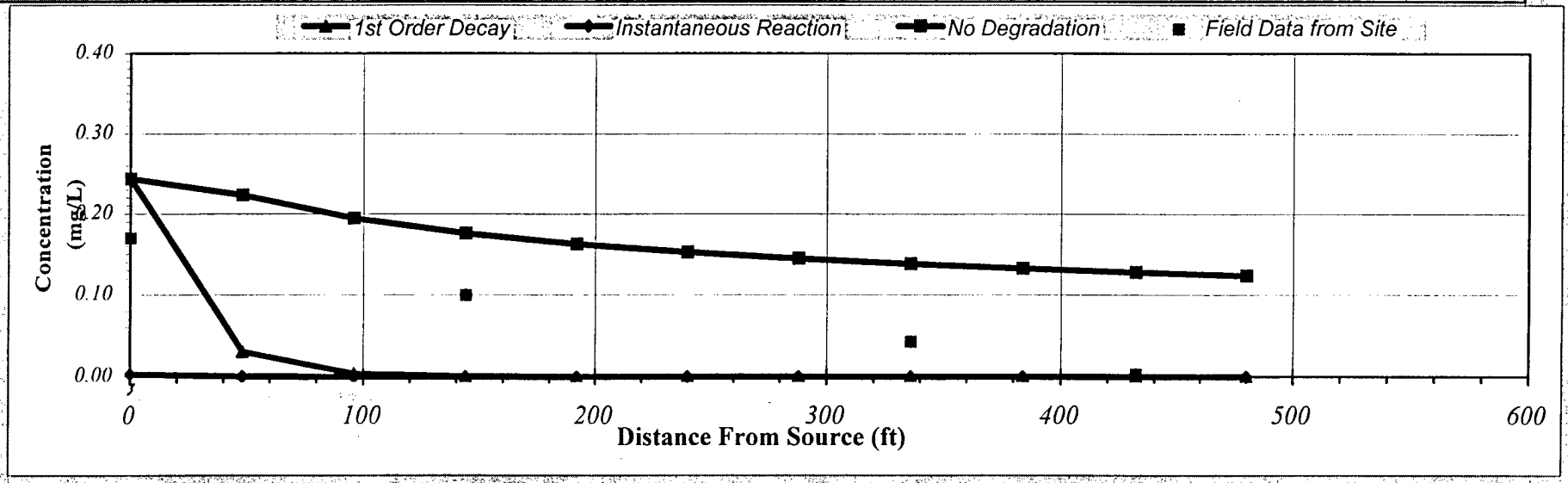
Recalculate This Sheet

Paste Example Dataset

Restore Formulas for Vs, Dispersivities, R, lambda, other

DISSOLVED HYDROCARBON CONCENTRATION ALONG PLUME CENTERLINE (mg/L at Z=0)

	Distance from Source (ft)										
TYPE OF MODEL	0	48	96	144	192	240	288	336	384	432	480
No Degradation	0.244	0.223	0.195	0.176	0.162	0.152	0.145	0.138	0.133	0.128	0.124
1st Order Decay	0.244	0.031	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Inst. Reaction	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Field Data from Site	0.170			0.100				0.043		0.003	



Calculate Animation
Next Timestep
Prev Timestep

Time:
33.0 Years

Return to Input

Recalculate This Sheet

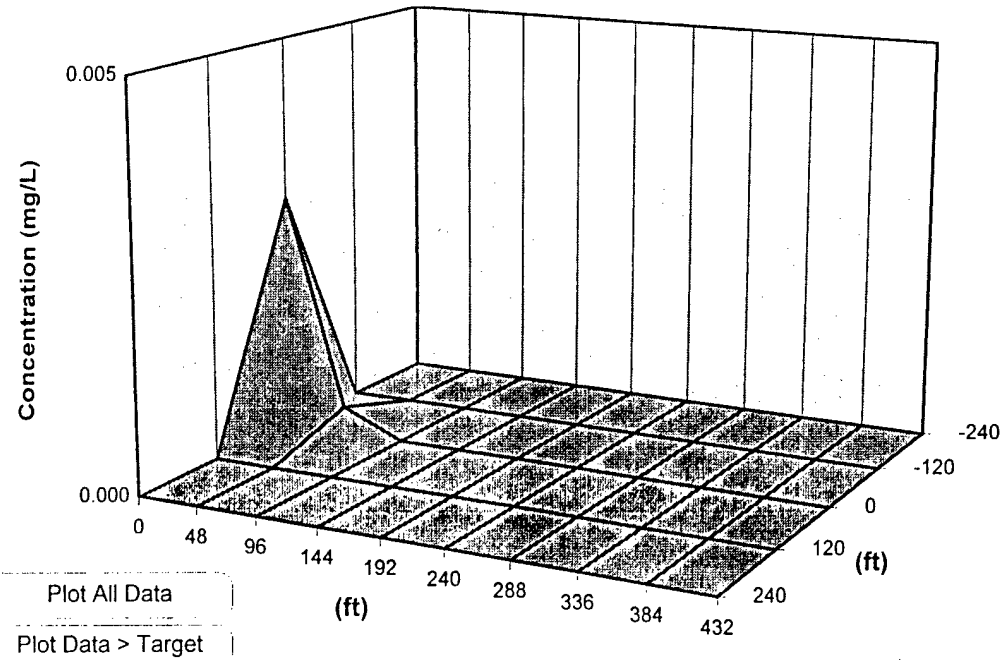
DISSOLVED HYDROCARBON CONCENTRATIONS IN PLUME (mg/L at Z=0)

Transverse Distance (ft)	*Distance from Source (ft)*										
	0	48	96	144	192	240	288	336	384	432	480
240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.003	0.000	0.000	0.000	0.000	0.0000	0.000	0.000	0.000	0.000	0.000
-120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-240	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MASS FLUX (mg/day)	1.2E+1	4.1E-2	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0	0.0E+0

Model to Display:

- *No Degradation Model*
- *1st Order Decay Model*
- *Instantaneous Reaction Model*

Time: **33 Years** Target Level: **0.005** mg/L Displayed Model: **Inst. Reaction**



Plot All Data

Plot Data > Target

Plume and Source Masses (Order-of-Magnitude Accuracy)

Plume Mass if No Biodegradation: Can't Calc. *(Kg)*

- Actual Plume Mass: Can't Calc. *(Kg)*

= Plume Mass Removed by Biodeg: - *(Kg)*

Change in Electron Acceptor/Byproduct Masses:

Oxygen	*Nitrate*	*Iron II*	*Sulfate*	*Methane*	
-	-	-	-	-	*(Kg)*

Contam. Mass in Source (t=0 Years): 6.0 *(Kg)*

Contam. Mass in Source Now (t=33Years): 1.9 *(Kg)*

Current Volume of Groundwater in Plume: Can't Calc. *(ac-ft)*

Flowrate of Water Through Source Zone: Can't Calc. *(ac-ft/yr)*

Mass HELP Recalculate

APPENDIX E

MODEL INPUT AND OUTPUT

APPENDIX F

REMEDIAL ALTERNATIVE COST CALCULATIONS

Alternative 1 -- RNA and LTM Cost Estimate
Langley AFB SS-04
729691.20250

Author: JWA
Date: 8/12/1998

23 Years of Long Term Monitoring Groundwater Sampling -- Years 1998-2020

Sampling Labor	40	hours x	$60	/hour	$2,400
14 Long-Term Monitoring Wells					
4 QA/QC					
18 Total Samples					
Analytical Subcontractor					
	18	BTEX	$60	/each	$1,080
	18	Methane/Ethene	$75	/each	$1,350
	18	Inorganic Constituent	$30	/each	$540
	18	Field Parameters	$20	/each	$360
Supplies			$700	lump sum	$700
Travel (assume local travel only)			$300	lump sum	$300
Data Management (40 hr x $60hr)	40	hours x	$60	/hour	$2,400
Data Validation (20 hr x $60/hr)	20	hours x	$60	/hour	$1,200
Reporting/Project Management Labor					
Word Processing	10	hours x	$25	/hour	$250
CADD	15	hours x	$50	/hour	$750
Reproduction	8	hours x	$20	/hour	$160
Staff Level	50	hours x	$60	/hour	$3,000
Proj. Manager	20	hours x	$80	/hour	$1,600
Editor	5	hours x	$60	/hour	$300
Reporting/Project Management ODCs			$400	lump sum	$400
Total for 1 Sampling Event (rounded)					**$16,800**

Alternative 2 -- RNA with LTM and Biosparging Cost Estimate
Langley AFB SS-04
729691.20250

Author: JWA (MLP)
Date: 8/12/1998 (4/28/1999)

Summary of Capital and Present Worth Costs

Capital Costs

Design/Construct 3 LTM Wells in 1998		$9,000
Biosparging Installation Costs		$111,800
	Total Capital Costs	**$120,800**

Operation and Maintenance

Annual O&M for Biosparging Unit - Labor, Materials, and Utilities (2 years)

	Annual Cost $25,000	
P/A i=7%, n=2	PWF = 1.8080182	
	Present Worth Cost	**$45,200**

Monitoring Costs

Annual Monitoring of 14 wells, 1998 - 2005 (8 years)

	Annual Cost $16,800	
P/A i=7%, n=8	PWF = 5.9712985	
	Present Worth Cost	**$100,318**

Site Management every year (8 years)

	Annual Cost $6,000	
P/A i=7% n=8	PWF = 5.9712985	
	Present Worth Cost	**$35,828**

Total Capital and Present Worth Costs of LTM Program: $302,146

APPENDIX G

RESPONSE TO COMEMNTS

PARSONS

Parsons Engineering Science, Inc. • A Unit of Parsons Infrastructure & Technology Group Inc.
1700 Broadway, Suite 900 • Denver, Colorado 80290 • (303) 831-8100 • Fax: (303) 831-8208 • www.parsons.com

May 13, 1999

Mr. Jerry Hansen
AFCEE/ERT
3207 North Road, Bldg. 532
Brooks AFB, TX 78235-5363

Subject: Responses to AFCEE/ERT Comments on the Draft Treatability Study in Support of Remediation by Natural Attenuation at Site SS-04, Langley Air Force Base, Virginia (Contract F41624-92-D-8036)

Dear Mr. Hansen:

This letter provides responses to comments received for the Draft Treatability Study (TS) in support of Remediation by Natural Attenuation (RNA) at Site SS-04, Langley Air Force Base (AFB), Virginia. The Draft RNA TS was prepared by Parsons Engineering Science, Inc. (Parsons ES) for the United States Air Force Center for Environmental Excellence, Technology Transfer Division (AFCEE/ERT). The intent of the RNA TS was to determine the role of natural attenuation in remediating fuel contamination in soil and groundwater at Site SS-04. The draft RNA TS was delivered on August 1998. AFCEE's comments on the draft RNA TS were received on January 22, 1999. Responses to those comments were prepared by Parsons ES and are presented below.

Responses to AFCEE/ERT Comments dated January 22, 1999:

GENERAL COMMENTS

Comment 1): As discussed in comment 13 below, the BIOSCREEN modeling needs to be reaccomplished because excessively high instantaneous reaction rate (observed concentration change) values were input to the model, resulting in artificially high simulated attenuation rates for the benzene plume. Additionally, because the length of time for simulated attenuation of the plume most likely will increase significantly, cost estimates for the remedial alternatives detailed in Section 6 will have to be recalculated.

Parsons ES Response: *The BIOSCREEN model for site SS-04 was reevaluated, and model simulations were revised as discussed in the comment. The revised BIOSCREEN simulations include reduced instantaneous reaction input values, calibration of model parameters to existing site data, and model predictions for long-term monitoring (LTM). Instantaneous reaction observed electron acceptor and metabolic byproduct concentrations were first reduced by 30% to account for the transport and biodegradation of non-BTEX constituents in groundwater as*

recommended in the BIOSCREEN documentation (Newell et al., 1996). Groundwater monitoring data from the Site SS-04 benzene plume were then tabulated to compute a site-specific ratio of benzene to total BTEX, and the instantaneous reaction input concentrations were then reduced by another 50% to account for the transport and biodegradation of benzene only.

The predicted length of time to accomplish RNA did increase from 12 years to 23 years as a result of these data input changes, and the cost estimates for remedial alternatives in Section 6 were recalculated. However, the predicted timeframe to achieve the benzene MCL of 5 µg/L is probably conservative because the model does not simulate the beneficial effects of nitrogen fixation (Section 4.7.2.5) and source biodegradaton (Section 5.4.5). The revised cost for Remedial Alternative 1 is $199,211, and the revised cost for Remedial Alternative 2 is $297,952. The RNA TS report conclusions did not change. Remedial Alternative 1 with institutional controls is still the preferred alternative for Site SS-04, because the plume is stable or receding, and there are no completed receptor exposure pathways. Text, figures and tables from Sections 5 and 6 of the draft RNA TS report were revised to address AFCEE comments and reflect the updated modeling effort. Attached to these responses to comments are a revised Section 5, Appendix D, and Section 6 cost tables. The final RNA TS report will include edits to the Executive Summary and Conclusions which appropriately reflect changes made to Sections 5 and 6.

SPECIFIC COMMENTS

Comment 2): Table of Contents:

a. Page iv: Tables 4.3 through 4.5 should be added.

b. Page vi: Suggest adding a list of appendices.

Parsons ES Response:

a. Tables 4.3, 4.4, and 4.5 will be listed in the final RNA TS Table of Contents.

b. A list of appendices will be added to the final RNA TS Table of Contents.

Comment 3): Page 2-6, Table 2.1: Recommend rounding northings and eastings to the nearest 0.1 foot to be consistent with Sec 2.6, page 2-16.

Parsons ES Response: The northings and eastings reported in Table 2.1 are correct, and the text of Section 2.6, page 2-16 is incorrect. In the final RNA TS, the Section 2.6 text will read "Horizontal locations were surveyed to the nearest 0.01 foot."

Comment 4): Page 3-3, Table 3.1: For the Columbia Aquifer, the estimated elevation of top of unit (ft msl) should be approximately five feet because the land elevation at the site is seven to nine feet msl (Sec 3.1.1). Additionally, the estimated thickness of this aquifer should be changed to 45 feet.

Parsons ES Response: *The estimated elevation of the top of the Columbia Aquifer will be changed to +5 ft msl, and the estimated aquifer thickness will be changed to 45 feet in Table 3.1 of the final RNA TS. In addition, the first sentence of Page 3-2, Section 3.2, Paragraph 3 will be changed to read "The surficial aquifer at Langley AFB, the Columbia Aquifer, includes Holocene and Pleistocene age sediments and is approximately 45 feet thick beneath the site".*

Comment 5): Page 3-15, Sec 3.3.2.1, Para 2, Line 11: To correct terminology, "groundwater table" should be changed to "water table."

Parsons ES Response: *The text of the final RNA TS, Section 3.3.2.1, Paragraph 2, Line 11 will read "During the 1997 event, the water table was lower, and less of the storm sewer system was submerged,..."*

Comment 6): Page 4-7, Table 4.1: To better reflect certainty/accuracy of these concentrations, suggest reporting results to three significant figures.

Parsons ES Response: *In the final RNA TS, Table 4.1 will report concentrations to three significant figures.*

Comment 7): Page 4-8, Sec 4.3.2.1, Para 2, Line 14: To correct terminology, "groundwater table" should be changed to "water table."

Parsons ES Response: *The text of the final RNA TS, Section 4.3.2.1, Paragraph 2, Line 14 will read "This depth corresponds to the elevation of the water table..."*

Comment 8): Page 4-14, Sec 4.3.3, Para 2, Last Sentence: Based on Table 4.2, moisture content ranges from 15.5 to 24.2 percent, not from 14 to 17.9 percent. This discrepancy should be corrected.

Parsons ES Response: *Based on Table 4.2, the final RNA TS Section 4.3.3, Paragraph 2 will read "Soil samples were collected from locations 4MP-15, 4MP-16, and 4MP-5, at depths above the water table, and were analyzed for moisture content, so that relative saturation could be estimated. Moisture content ranged from 15.5 to 24.2 percent."*

Comment 9): Page 4-14, Sec 4.4: Based on information presented in this section, the title should be changed by inserting **"1996"** after **"OCTOBER"** and changing **"NOVEMBER 1996"** to **"OCTOBER 1997."**

Parsons ES Response: *The title of Section 4.4 will be changed to **GROUNDWATER CHEMISTRY – OCTOBER 1996 to OCTOBER 1997** in the final RNA TS.*

Comment 10): Pages 4-14 and 4-24, Sec 4.4.1.1: The dramatic decrease in benzene reported for well 4MP-5S from 1,300 µg/L to nondetect in only one year is problematic. Suggest that Parsons inspect lab bench sheets to confirm these values. Numerous sources of potential error/variation in reported values encompass substandard well construction, well tampering, improper sampling/ decontamination techniques, mislabeling of samples, analytical errors, and data reduction errors. If no analytical or reporting error(s) can be identified, recommend that a confirmatory sample be collected as soon as possible for BTEX analysis.

Parsons ES Response: *Analytical results presented in Appendix C were reviewed to confirm the benzene concentrations reported in Section 4.4.1.1. No analytical or reporting errors were identified. Other potential errors (mislabeling) could not be determined. Parsons ES recommends reviewing future sampling results to confirm model predictions and previous laboratory results.*

Comment 11): Page 5-3, Sec 5.5.1, Sentence 2: Suggest placing "(11.9 ft/day)" after "(4.2 x 10^{-3} cm/sec)" because groundwater velocity is reported in units of ft/day here and hydraulic conductivity and groundwater velocity values are reported in ft/day in Section 3.3.2.4.

Parsons ES Response: *Hydraulic conductivity will be reported in unit of ft/day in addition to cm/sec in Section 5.5.1 of the final RNA TS.*

Comment 12): Page 5-4, Table 5.1: Under Dispersivity, suggest inserting "Benzene" in front of "Plume Length" for purposes of clarification.

Parsons ES Response: *The word "Benzene" will be inserted in front of "Plume Length" in Table 5.1 of the final RNA TS. In addition, Table 5.1 was revised to reflect calculation of the instantaneous reaction input parameters.*

Comment 13): Page 5-4, Table 5.1 and Page 5-5, Sec 5.5.4: Instantaneous reaction (observed concentration change) input data are total assimilative capacity for BETX, not benzene only. Consequently, these input values should be reduced by a factor of three to four to account for the other three constituents of BTEX. Using these total BTEX instantaneous reaction values results in erroneously high (nonconservative) attenuation rates for benzene in the BIOSCREEN simulations. Recommend, therefore, that the BIOSCREEN modeling be redone using appropriate and conservative benzene-only instantaneous reaction values.

Parsons ES Response: *The BIOSCREEN simulations were reevaluated, and instantaneous reaction input data were adjusted to account for biodegradation of*

benzene alone. Concentrations of electron acceptors and metabolic byproducts were first reduced by 30% to account for the non-BTEX dissolved organic constituents as recommended in the BIOSCREEN documentation (Newell et al., 1996). The electron acceptor and metabolic byproduct concentrations were then reduced by another 50% to account for the site-specific ratio of benzene to BTEX. Table 5.2 was modified to show the calculation of site-specific benzene to BTEX ratios, and the model was calibrated using benzene data for October 1997 prior to simulating remedial alternatives.

Comment 14): Page 5-5, Sec 5.6:

a. Sentence 2: Is the intention of this sentence to state that the plume will migrate approximately 200 feet downgradient of the source area or 200 feet farther downgradient than the 1997 plume as implicitly stated in Section 6.4.1.1 (p. 6-13)? Based on 1997 analytical data, benzene has migrated at least 400 feet downgradient of the modeled source area. The BIOSCREEN model prepared by Parsons predicts that under the instantaneous reaction model benzene will not migrate significantly beyond 100 feet downgradient from the source area. These inconsistencies in characterizing migration of the benzene plume should be resolved.

b. To enhance the discussion presented in this section, suggest that several BIOSCREEN-simulated plume maps (e.g., 4, 8, and 12 yrs after 1997) be added. Suggest that these maps show the trace of the vertical line simulating the source area. For comparison purposes, also recommend adding a figure depicting the benzene plume based on 1997 sampling data.

Parsons ES Response:

a. The text of Section 5.6 in the final RNA TS has been revised to reflect the modifications to the instantaneous reaction input data and the resulting changes in BIOSCREEN output.

b. Figure 5.1 has been added to Section 5 of the RNA TS to show the dissolved benzene plume based on the 1997 sampling data and the model source area configuration. BIOSCREEN output for various times will also be included.

Comment 15): Page 7-4, Table 7.1: The rationale for the two proposed monitoring wells that they will "mark downgradient extent of benzene plume" is incorrect because the location depicted on Figure 7.1 occurs in the upgradient portion of the 1997 plume. Consequently, this portion of the rationale statement needs to be revised. These wells also are located in a cross-gradient position.

Suggest designating the proposed monitoring wells as 4MP-24S and 4MP-24D to be consistent with Figure 7.1.

Parsons ES Response: *Table 7.1 in the final RNA TS will designate the two proposed monitoring wells as 4MP-24S and 4MP-24D as suggested. The rationale for these wells will indicate that they are to mark the southern (cross-gradient) extent of the benzene plume.*

Comment 16): Pages 7-1 and 7-2, Sec 7.2: Suggest proposing a downgradient (sentry) well southwest of well 4MP-5 approximately 100 to 200 feet. Some of the 1,300 µg/L of benzene reported for the 1996 sampling of 4MP-5S may be migrating toward this well.

Parsons ES Response: *An additional downgradient sentry well will be proposed approximately 100 feet southwest of 4MP-5 in the final RNA TS. The well will be designated 4MP-25, shown on Figure 7.1, and listed in Table 7.1.,*

Please contact me at (303) 831-8100 after you have received these responses to comments. Parsons ES will issue the final document following your concurrence that the responses are appropriate.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Bruce M. Henry

Bruce M. Henry
Project Manager