FINAL

CORRECTIVE ACTION PLAN
FOR THE RISK-BASED CLOSURE OF THE
BASE EXCHANGE SERVICE STATION, AREA OF CONCERN - A
(ST-06)
KEESLER AIR FORCE BASE, MISSISSIPPI

AETC Contract No. F41689-96-D-0710
Order No. 5015

Prepared for
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE
TECHNOLOGY TRANSFER DIVISION
BROOKS AIR FORCE BASE, TEXAS

and

81 CES/CEVR
KEESLER AIR FORCE BASE, MISSISSIPPI

April 1999

Prepared by

PARSONS ENGINEERING SCIENCE, INC.
1700 Broadway, Suite 900
Denver, Colorado 80290
and
5390 Triangle Parkway, Suite 100
Norcross, Georgia 30092

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SECTION 1
INTRODUCTION

Parsons Engineering Science, Inc. (Parsons ES) was retained by the Air Force Center for Environmental Excellence, Technology Transfer Division (AFCEE/ERT) under Air Education and Training Command (AETC) Contract No. F41689-96-D-0710, Order No. 5015 to prepare a corrective action plan (CAP) to support a risk-based remediation decision for contaminated soil and groundwater at the Base Exchange (BX) Service Station at Keesler Air Force Base (AFB) in Mississippi, United States Environmental Protection Agency (USEPA) ID# MS2 570 024 164. The BX Service Station also is known as Area of Concern - A (AOC-A) and Site ST-06.

1.1 DESCRIPTION OF THE RISK-BASED APPROACH

The objective of risk-based remediation is to reduce the risk of specific chemicals to human health and/or ecological receptors such as animals or plant life. For any chemical to pose a risk, four elements must exist at the site:

- A source of chemical contamination that exceeds or could generate chemical contamination above health-protective or aesthetic standards;
- A mechanism of contaminant release;
- A human or ecological receptor available for chemical contact; and
- A completed pathway through which that receptor will contact the chemical.

If any one of these four elements is absent at a site, there is no current risk. The reduction or elimination of risk can be accomplished by limiting or removing any one of these four elements from the site.

The goal of this risk-based remediation approach is to find the most cost-effective method of reducing present and future risk by combining three risk reduction techniques:

- Chemical Source Reduction - Achieved by natural attenuation processes over time or by engineered removals such as free product recovery, soil vapor extraction (SVE), or *in situ* bioventing.
- Chemical Migration Control - Examples include natural attenuation of a groundwater plume, and SVE to prevent migration of hazardous vapors to a receptor exposure point.
- Receptor Restriction - Land use controls and site fencing to eliminate chemical exposure until natural attenuation and/or engineered remediation reduce the chemical source and/or eliminate the potential for chemical migration to an exposure point.

1.2 RISK-BASED APPROACH TASKS

The major tasks of this risk-based project are:

- Assessing available data and collecting any supplemental site characterization data necessary to define the nature, magnitude, and extent of soil and groundwater contamination and to document to what degree natural attenuation processes are operating at the selected sites;

- Determining whether an unacceptable risk to human health or the environment currently exists or may exist in the foreseeable future using applicable Mississippi Department of Environmental Quality (MDEQ) guidance and regulations, quantitative contaminant fate and transport models, and exposure concentration estimates;

- Evaluating and recommending a remedial alternative that both reduces the source of contamination and minimizes or eliminates risks to potential receptors; and

- Documenting the remedial action selection process in a report that satisfies MDEQ and USEPA Region IV requirements.

1.3 REGULATORY REQUIREMENTS

The USEPA Region IV is currently the lead agency regulating environmental investigation and remediation of the BX Service Station, AOC-A (ST-06). For petroleum-related sites, the USEPA Region IV uses MDEQ underground storage tank (UST)-related guidance and regulatory criteria. Typical cleanup levels mandated by the UST Division of the MDEQ, Office of Pollution Control (OPC) are listed in Table 1.1.

The USTs removed at the BX Service Station were used to store automotive gasoline. Therefore, cleanup levels of 100 ppm BTEX for soil and 18 ppm BTEX for groundwater apply to this site.

Other cleanup levels may be considered using a tiered approach with risk-based analysis and screening of chemicals of potential concern (COPCs). Two options of this approach are:

Tier 1: Using generic, risk-based screening levels (RBSLs) calculated by the MDEQ and available on "look-up" tables (MDEQ, 1996); or

Tier 2: Based on the completion of a limited risk assessment, using site-specific human health risks to develop site-specific cleanup levels in accordance with American Society for Testing and Materials (ASTM) Guidance 1739 for Risk-Based Corrective Action Applied At Petroleum Release Sites (ASTM, 1995).

A tiered approach would employ the Tier 1 screening criteria to determine if current site conditions warrant further evaluation of potential human health risks through a Tier 2 assessment. If the screening process (Tier 1) or limited risk assessment (Tier 2) indicates that no contamination is present above the selected site action levels, then no type of remediation is warranted and the site can proceed to closure.

1.4 REPORT ORGANIZATION

This CAP consists of eight sections, including this introduction, and six appendices. Site background, including operating history and a review of environmental site investigations conducted to date, is provided in the remainder of this section. Section 2 summarizes the 1998 site characterization activities performed by Parsons ES. Physical characteristics of the BX Service Station and surrounding environs are described in Section 3. A Tier 1 evaluation is completed in Section 4 to identify those site contaminants that are considered chemicals of potential concern (COPCs). Section 5 summarizes the nature and extent of COPC contamination at the site. The Tier 2 evaluation is detailed in Section 6. Section 7 addresses the effects of natural chemical attenuation processes that are documented to be occurring at the site, and presents quantitative chemical fate and transport and receptor exposure analyses and conclusions. Section 8 presents a long-term monitoring plan (LTM). Section 9 presents references used in preparing this CAP.

Analytical data sheets and chain-of-custody records are in Appendix A. Pertinent information from prior investigations is presented in Appendix B. Boring logs, groundwater sampling forms, and well construction diagrams for all sampling activities completed by Parsons ES during the February 1998 field effort are included in Appendix C. Appendix D includes the input and output from the aquifer slug test analysis. Appendix E includes the input and output from the IEUBK lead model.

1.5 SITE DESCRIPTION AND BACKGROUND

Keesler AFB is located within the city limits of Biloxi, Harrison County, Mississippi, approximately 80 miles east of New Orleans, Louisiana, and 60 miles west of Mobile, Alabama. It is bordered on the north by the Back Bay of Biloxi (Back Bay) and on the west, south, and east by residential and commercial areas of the city. The Mississippi Sound is located approximately 0.5 mile south of the Base (Figure 1.1). The Base comprises 1,494 acres of federally owned land and 117 acres of leased, permit, and easement lands.

The BX Service Station is located at Larcher Boulevard and Meadows Drive (Figures 1.2 and 1.3). The station is currently active and includes service bays and pump islands. USTs containing gasoline and diesel fuel are located at the western portion of the site. These tanks currently meet federally mandated upgrade requirements for UST systems and have not leaked. In 1987, Environmental Science & Engineering (ESE) removed 10 USTs used to store automotive gasoline. Six of the tanks were located along the eastern side of Building 1504, and four were located just south of the building. Physical evidence, such as stained soils and high organic vapor readings, observed during the excavation showed that one or more of the tanks had leaked in the past [Engineering-Science, Inc. (ES) (now Parsons ES), 1994]. Previous investigation activities have included:

Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA): In September 1987, an RFA report for Keesler AFB was prepared (A.T. Kearney, Inc. *et al.*, 1987). This report identified all Solid Waste Management Units (SWMUs) at the Base, as well as other AOCs. Related information from a file review and a visual site inspection were used to assess the potential for contamination and to determine what further measures, if any, should be taken to safeguard human health and the environment. The BX Service Station was determined to be an AOC.

Site Characterization under the Installation Restoration Program (IRP): A field effort for a site characterization of Keesler AFB was initiated by ESE under the IRP in November 1987 (ESE, 1991), and the results are reported in the final site characterization report dated January 1991. This effort was performed in three sampling events in November and December 1987, April 1988, and October and November 1989. During the 1987 removal of 10 USTs at the BX Service Station, 16 soil samples were collected and analyzed for TPH and inorganic extraction procedure (EP) toxicity. Analysis of soil gas samples collected in the excavation area indicated a hydrocarbon anomaly adjacent to the east-northeast side of the service station. Based on this information, five monitoring wells (MW8-1 through 8-5) were installed at the site to evaluate potential groundwater contamination (Figure 1.3). Groundwater samples were collected from these wells in 1988 and 1989. The BX Service Station was identified as Site 8 in the ESE (1991) report.

RCRA Facility Investigation (RFI): ES performed an RFI in 1992 to assess the horizontal and vertical extent of contamination in soil and groundwater (ES, 1994; Parsons ES, 1998). Soil contamination at AOC-A was defined through installation of 13 soil borings and associated soil sampling. Eight additional monitoring wells (MWA-6 through A-13) were installed at the site to monitor for possible free floating product on the groundwater surface, and to determine the lateral extent of the dissolved hydrocarbon contamination (Figure 1.3). The site was further characterized by performing a soil organic vapor survey in which BTEX, carbon dioxide (CO_2), and oxygen (O_2) concentrations were determined for each soil gas sample.

Well Assessment Report: A Well Assessment Report was produced by BCM Environmental Inc. (BCM) in September 1996. This report summarizes the location, construction, and condition of the 13 monitoring wells at AOC-A. Five of the monitoring wells were reported to be in fair condition. The remaining eight wells were in good condition (BCM, 1996).

Previous and current interim remedial actions include:

Bioventing: In April 1993, initial testing was conducted for a bioventing system, and six shallow vent wells (three extraction wells and three injection wells) were installed in the vicinity of the former USTs by Battelle-Columbus, Inc. (Battelle). The bioventing system was initiated on May 21, 1993. Confirmatory soil and soil gas samples were collected after one year of operation. Average TPH concentrations in vadose zone soils were reduced by 78 percent and average TPH concentrations in soil gas were reduced by 89 percent as compared to initial concentrations (Battelle, 1995).

Density-Driven Convection (DDC) In-Well Aeration System: Wasatch Environmental, Inc. (WEI) performed a large-scale test of a DDC in-well aeration system at AOC-A. The system, which includes 32 DDC wells, 6 soil vapor extraction wells, and three blowers, began operating on May 9, 1996. The primary objective of the DDC system was to reduce saturated zone soil contamination because the previous bioventing system had already reduced vadose zone soil concentrations. A draft final report was submitted to USEPA and MDEQ on November 21, 1997 (WEI, 1997). Results of preliminary confirmatory soil sampling indicate a significant decrease in soil total petroleum hydrocarbons (TPH) in the 7-10 feet below ground surface (bgs) interval. WEI soil data is discussed further in Section 7.3.1.

TABLE 1.1
TYPICAL CLEANUP LEVELS FOR USTS
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Type of Petroleum Storage Tank Removed	Media	Typical Cleanup Levels (ppm)[a/]
Gasoline	Soil Water	100 ppm BTEX[b/] 18 ppm BTEX
Diesel and/or Waste Oil	Soil Water	100 ppm TPH[c/] 18 ppm TPH

Notes:
Source: MDEQ, 1993
a/ ppm = Parts per million
b/ BTEX = Benzene, toluene, ethylbenzene, and total xylenes
c/ TPH = Total petroleum hydrocarbons

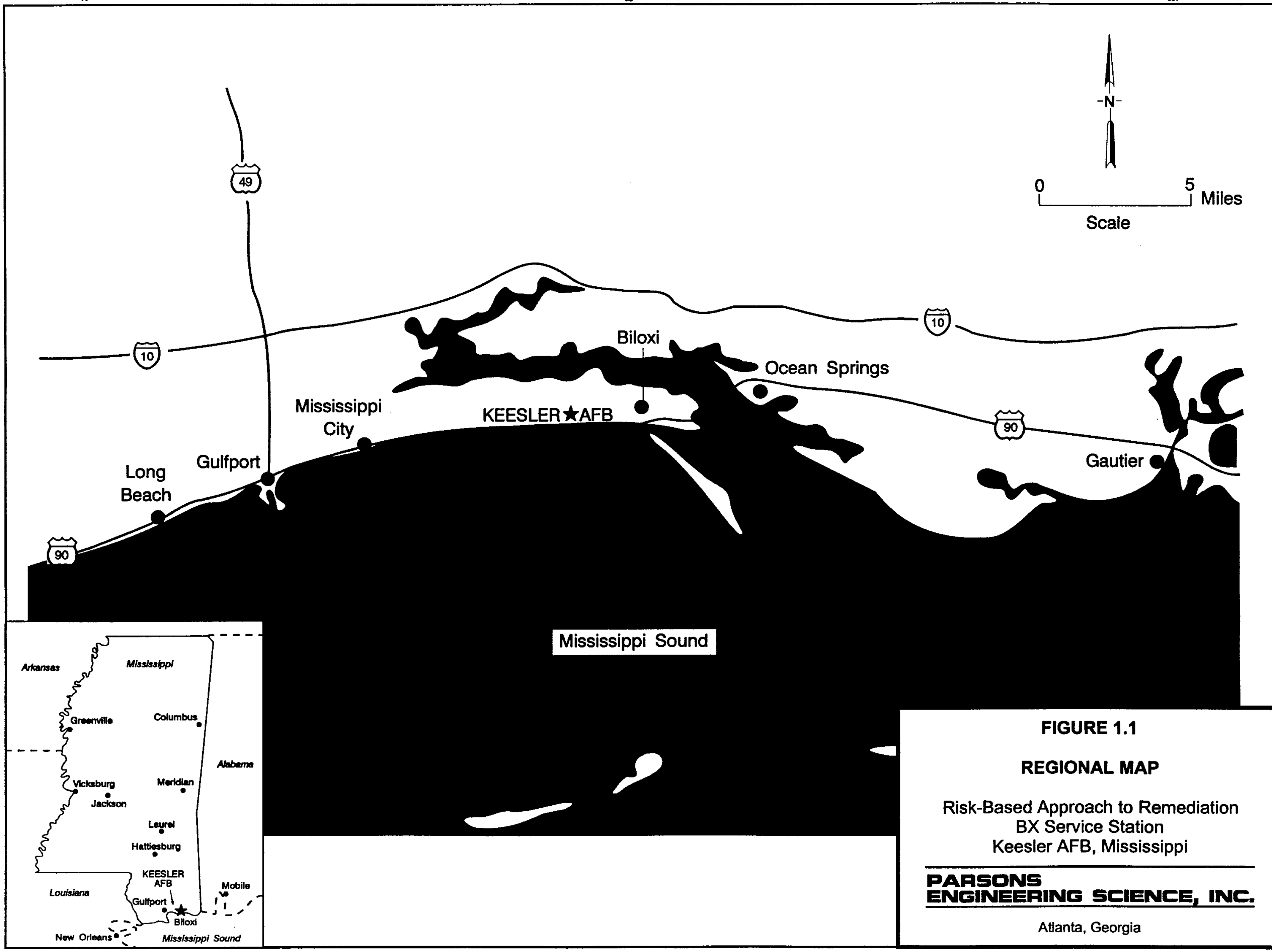

FIGURE 1.1

REGIONAL MAP

Risk-Based Approach to Remediation
BX Service Station
Keesler AFB, Mississippi

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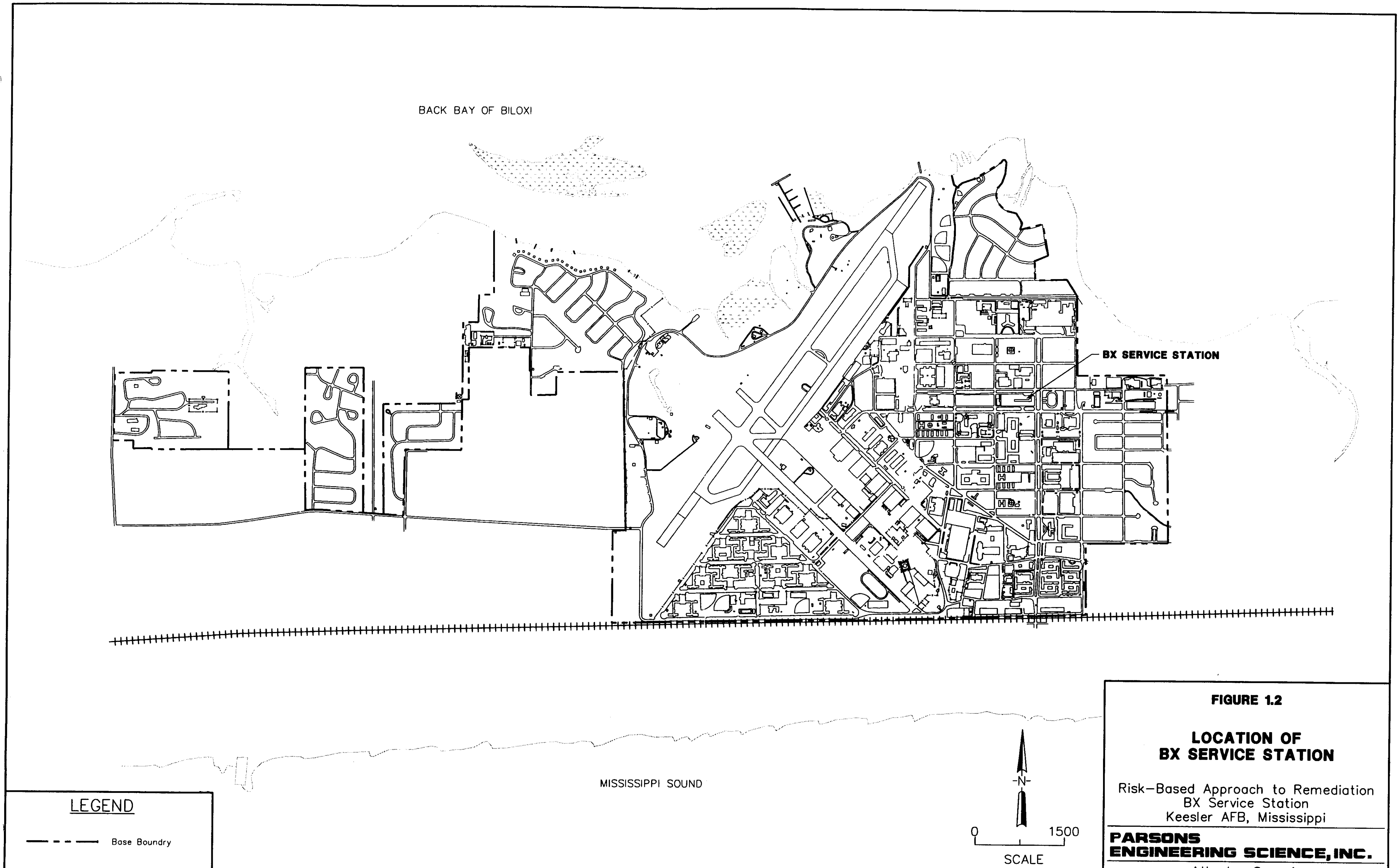

FIGURE 1.2

LOCATION OF BX SERVICE STATION

Risk-Based Approach to Remediation
BX Service Station
Keesler AFB, Mississippi

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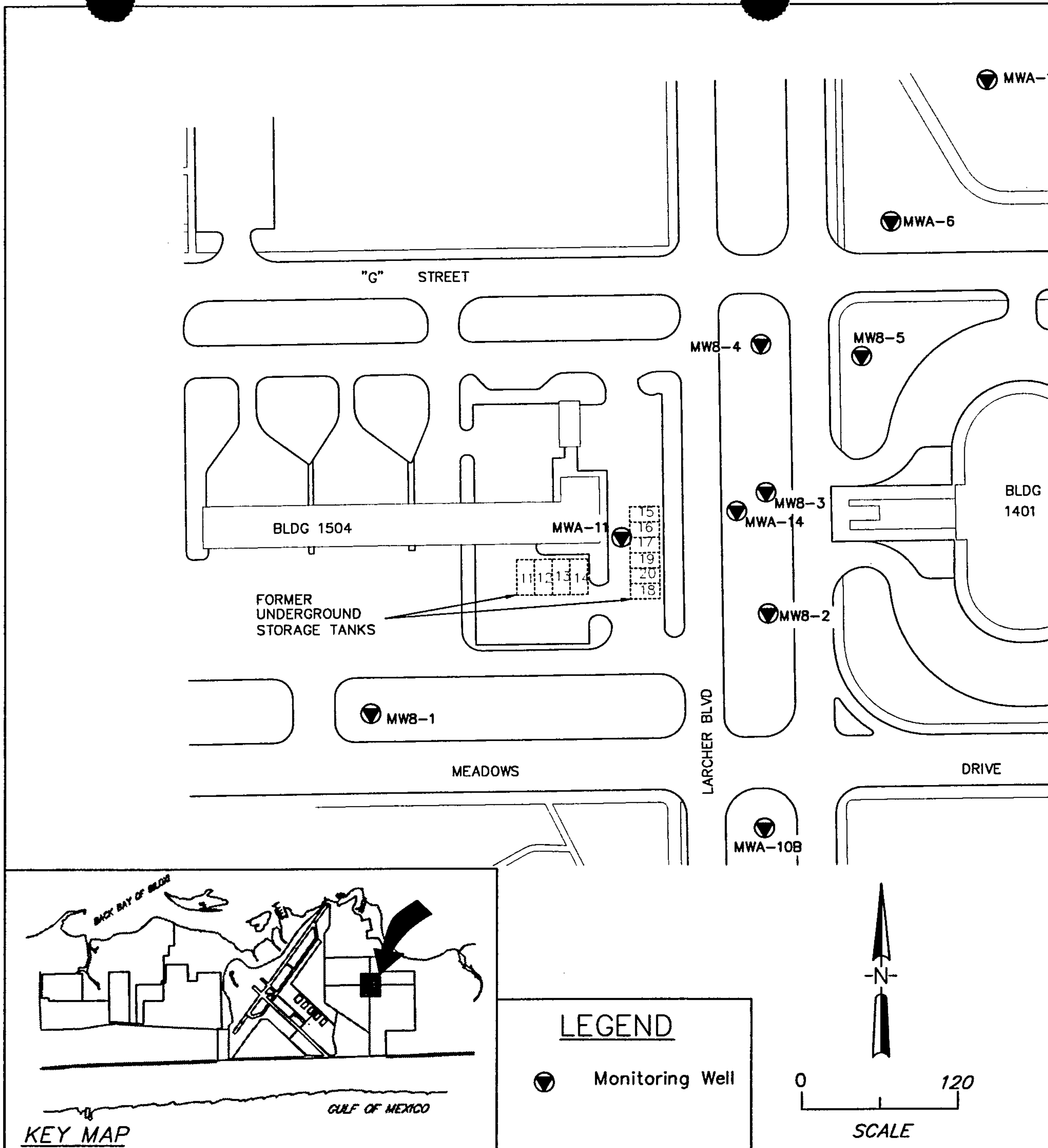

FIGURE 1.3

SITE LAYOUT

Risk-Based Approach to Remediation
BX Service Station
Keesler AFB, Mississippi

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SECTION 2
SITE CHARACTERIZATION ACTIVITIES

Since 1987, several soil and groundwater investigations have been conducted at the BX Service Station. These investigations focused on characterizing and delineating dissolved hydrocarbons in groundwater and residual fuel hydrocarbons in soils. Parsons ES conducted an investigation at the site during February 1998 to collect site-specific data relevant to quantifying the effects of natural contaminant attenuation processes and to facilitate development and implementation of a risk-based remedial action for the BX Service Station. Soil gas, soil, and groundwater were sampled to:

- Further delineate the extent of contamination;
- Assess temporal trends in soil and groundwater contaminant concentrations;
- Support contaminant fate and transport analyses; and
- Develop appropriate exposure-point concentrations to compare to final remediation goals.

To the extent practicable, data collected during previous investigations were used to augment this study. Emphasis was placed on collecting data documenting the natural biodegradation and attenuation of fuel hydrocarbons in soils and groundwater at the site.

The February 1998 supplemental site characterization activities performed by Parsons ES at the BX Service Station are briefly described in the remainder of this section. Most site characterization procedures (i.e., soil, soil gas, and groundwater sampling procedures) are described in detail in the project Sampling and Analysis Plan (SAP) (Parsons ES, 1997a).

2.1 SCOPE OF DATA COLLECTION ACTIVITIES

As part of the risk-based remedial approach for the BX Service Station, field data collection efforts focused on investigating specific chemical constituents that potentially pose a threat to human health or the environment. The chemicals targeted for study at this site were identified from previous site investigations and the chemical composition of the primary contaminant source (i.e., release(s) of gasoline from the former USTs). The petroleum hydrocarbon and associated constituents identified and addressed as part of this study include BTEX; polynuclear aromatic hydrocarbons (PAHs); and lead. These analytes were targeted based on previous site assessment results.

The risk-based investigation for the BX Service Station was conducted according to the methodologies presented in the *Final Work Plan for the Risk-Based Investigation and Closure of the Base Exchange Service Station, Area of Concern - A(ST-06)* (Parsons ES, 1997b), hereafter referred to as the work plan. The work plan was developed according to available guidelines and requirements of the MDEQ to support site closure.

The following sampling and testing activities were performed by Parsons ES during February 1998 at the site as part of this investigation:

- Drilled seven soil borings;
- Collected 11 subsurface soil samples for fixed-base laboratory analysis from the seven boreholes;
- Installed two small-diameter groundwater monitoring wells;
- Collected groundwater samples from eight existing groundwater monitoring wells and the two newly installed wells;
- Collected three soil gas samples for laboratory analysis from three locations; and
- Performed aquifer (slug) tests in three monitoring wells to obtain aquifer hydraulic conductivity estimates.

Analytical method detection limit (MDL) requirements were considered before site characterization work was initiated under the risk-based remediation investigation. Suitable analytical methods and quality control (QC) procedures were selected (Parsons ES, 1997a) to ensure that the data collected under this program are of sufficient quality to be used in a quantitative risk assessment.

Soil and groundwater samples were analyzed in the field and by Quanterra, Inc. of Arvada, Colorado and Dallas, Texas. Soil gas samples were analyzed in the field and by Air Toxics, Ltd. of Folsom, California. The laboratory data sheets and chain-of-custody records are presented in Appendix A. The analytical protocol for all samples is summarized in Table 2.1. Table 2.2 summarizes the field and fixed-base laboratory analyses performed by sampling location. These analyses and measurements were performed for various inorganic, geochemical, and physical parameters to document natural biodegradation processes and to assess the potential effectiveness of low-cost source reduction technologies.

2.2 SUBSURFACE SOIL SAMPLING

Soil samples were collected from seven soil boreholes (SBA-14 through SBA-20) to obtain soil total organic carbon (TOC) data and to further characterize soil contamination at the site at locations where previous investigations indicated relatively high soil contaminant concentrations (Appendix B). Soils were sampled to facilitate evaluation of the potential for contaminant partitioning from soil into groundwater and soil gas, and to assess the magnitude of any changes in contaminant concentrations that have occurred over time. The soil boring locations are presented on Figure 2.1. These borings were advanced using a Geoprobe® hydraulic sampling rig as described in the SAP (Parsons ES, 1997a).

Soil samples for laboratory or field analysis were collected at regular intervals from all boreholes, both above and below the groundwater surface. A total of 11 soil samples and one duplicate sample from the seven boreholes were submitted to Quanterra Inc for laboratory analysis. Samples from all seven boreholes were described for lithology and field screened for volatile organic vapors using a organic vapor meter (OVM). Soil borehole information is summarized in Table 2.3, and borehole logs and completion diagrams for the newly-installed wells are included in Appendix C. Soil analytical results are summarized and discussed in Sections 4 and 5.

2.3 MONITORING WELL INSTALLATION AND DEVELOPMENT

Two monitoring wells (MWA-10B and MWA-14) were installed during the field effort. MWA-10B was installed to replace destroyed monitoring well MWA-10, and MWA-14 was installed to assess the vertical extent of dissolved hydrocarbon concentrations. Table 2.3 summarizes the monitoring well completions, and Figure 2.1 presents the well locations.

The monitoring wells were constructed of Schedule 80 PVC screen having an internal diameter (ID) of 0.5 inch. All well casing and screen sections were flush-threaded; glued joints were not used. The lengths of the screened intervals for the shallow monitoring well screen (MWA-10B) and the deep monitoring well screen (MWA-14) were 6 feet and 3 feet, respectively. The field geologist recorded the borehole depth, the lengths of all casing sections, and the depth to the top of all monitoring well completion materials placed in the annulus between the casing and borehole wall.

A prepacked screen was utilized for both wells. The prepacked screens are in 3-foot sections with an outside diameter (OD) of 1.5 inches and an ID of 0.5 inch. The inner component of the prepacked screen consists of 0.5-inch Schedule 80 PVC with 0.01 inch slots. The outer component of the screen is stainless steel wire mesh with a pore size of 0.011 inch. The screens are prepacked with 20/40 grade silica sand. A filter pack seal of hydrated sodium bentonite was placed above the prepacked screen.

Prior to sampling, monitoring wells were developed. 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 to place monitoring wells eliminates cuttings and drilling fluids. As a result, development of monitoring wells was primarily intended to minimize the amount of fine sediment that might accumulate in the casing.

Monitoring well development was accomplished using a peristaltic pump with dedicated silicon and HDPE tubing. The pump tubing was lowered to the bottom of the wells so that fines were agitated and removed from the well in the development water. Development was continued until ten casing volumes of water were removed from the well and the groundwater pH, temperature, conductivity, and dissolved oxygen (DO) concentrations had stabilized.

2.4 GROUNDWATER SAMPLING

Groundwater samples were collected from the two newly installed monitoring wells and eight existing monitoring wells at the site in February 1998. The groundwater sampling locations are shown on Figure 2.1. Samples collected from the 10 wells were analyzed for fuel-related contaminants and for various inorganic and geochemical indicators to evaluate natural chemical and physical attenuation processes that are occurring at the site. Field and laboratory analytical data collected at each groundwater sampling location are summarized in Table 2.2.

All monitoring wells were purged and sampled using a peristaltic pump with dedicated HDPE and silicon tubing. Purging consisted of removing groundwater from the well until the pH, DO concentration, oxidation-reduction potential (ORP), conductivity, and temperature stabilized.

Within 24 hours of the purge event, groundwater samples were collected from the monitoring wells. The samples were transferred directly from the peristaltic pump 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, methane, and/or Hach® field analyses were filled so that there was no headspace or air bubbles within the container. One duplicate sample, one trip blank, and one ambient condition water blank were collected during the groundwater sampling event.

Field and laboratory groundwater analytical results are discussed in Sections 4 and 5 of this report. These analytical results are used in Section 7 to evaluate the natural physical, chemical, and biological processes that are affecting the chemicals of concern (COCs) at this site.

2.5 SOIL GAS MEASUREMENTS

Soil gas sampling was performed at the site using both field (semi-quantitative) and fixed-base laboratory (quantitative) analyses. The purpose of soil gas sampling was to assess the potential risk to future workers at the site from inhalation of volatilized contaminants, and to determine whether or not sufficient O_2 is available in the soil gas to sustain aerobic fuel hydrocarbon biodegradation. If O_2 concentrations are significantly lower than background values, and CO_2 concentrations are higher than background levels, then the occurrence of aerobic fuel hydrocarbon biodegradation can be inferred. In addition, the O_2 levels allow an assessment of whether there is sufficient O_2 to sustain continuing aerobic biodegradation without engineered addition of oxygen via *in situ* bioventing.

Soil gas samples were collected at the three locations (SG-1 through SG-3) shown on Figure 2.1. All soil gas samples were screened using field instruments to measure O_2 and CO_2, collected in SUMMA® canisters, and submitted to Air Toxics, Ltd. in Folsom, California for analysis of total petroleum hydrocarbons (TPH) and BTEX using USEPA Method TO-3. All samples were field screened using the test equipment and methods specified in the SAP (Parsons ES, 1997a). Analytical results for soil gas samples are summarized in Sections 4 and 5.

2.6 AQUIFER TESTING

Slug tests are single-well tests used to determine the hydraulic conductivity of an aquifer 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 7,000 square feet per day (ft^2/day). Slug testing can be performed using either a rising-head or a falling-head test. Both rising-head and falling-head tests were used at this site. Hydraulic characteristics of the surficial aquifer were estimated by performing slug tests in site monitoring wells MW8-3, MWA-9, and MWA-11 which are located along the plume flow path. These slug tests were performed in accordance with 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 D.

2.7 EQUIPMENT DECONTAMINATION PROCEDURES

All downhole soil sampling tools (e.g., stainless steel Geoprobe pipe) were cleaned prior to collection of each sample with a clean water/phosphate-free detergent mix followed by a clean water rinse. Decontaminated tools also were used for installation of the two monitoring wells and soil gas sampling.

New, disposable high-density polyethylene (HDPE) and silicone tubing was used to collect the groundwater sample from each well. The only other groundwater sampling equipment requiring decontamination was the water level indicator probe. The probe was decontaminated prior to each use with a clean water/phosphate-free detergent mix followed by a distilled water rinse.

2.8 INVESTIGATION-DERIVED WASTES (IDW)

Soil cuttings and unused soil samples were stockpiled on plastic at the golf course maintenance center's limited access compost pile. Decontamination and purge water was placed into 55-gallon, US Department of Transportation (DOT)-approved drums and discharged into an oil/water separator.

2.9 ANALYTICAL DATA QUALITY ASSESSMENT

2.9.1 Introduction

A Parsons ES electronic Level III validation was performed on the February 1998 analytical results obtained from the fixed-base laboratories. The validation included internal data checks and application of data qualifiers to the analytical results based on adherence to method protocols and project-specific control limits. Method protocols reviewed included:

- Analytical holding times,
- Method blanks,
- Trip blanks,
- Surrogate spikes,
- Matrix spikes/matrix spike duplicates (MS/MSDs),
- Laboratory control samples (LCSs), and
- Sample temperatures during shipping and storage.

Data qualifiers were applied to analytical results during the data validation process. All data were validated using method applicable guidelines and in accordance with the *National Functional Guidelines for Organic Data Review* (USEPA 1994a) and the *National Functional Guidelines for Inorganic Data Review* (USEPA 1994b). The following definitions provide explanations of the USEPA (1994a and 1994b) qualifiers assigned to analytical results during data validation. The data qualifiers described were applied to both inorganic and organic results.

- U - The analyte was not present above the reported sample quantitation limit (SQL).
- J - The analyte was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environmental sample. The data should be considered acceptable as a basis for decision-making and are usable for many purposes.
- UJ - The analyte was not present above the reported SQL. The associated numerical value may not accurately or precisely represent the concentration necessary to detect the analyte in the sample.
- J1 - The analyte is qualified as an estimated value solely because it is greater than the MDL and less than the SQL, indicating no laboratory quality issues.

2.9.2 Data Quality

Data quality for each QC parameter where exceptions were noted during the validation is summarized in this section. Only results that exceeded QA/QC criteria are presented. All frequency requirements for field sample collection of QA/QC samples (MS/MSDs and blanks) were met. The frequency requirements for laboratory specific method criteria QA/QC were met overall.

2.9.2.1 Matrix Spike

MS/MSD validation flags were applied only to the parent sample for a non-compliant MS/MSD. Sample results were not qualified on a total analytical batch basis. Soil sample SBA-19 (8.5-10) for lead was qualified as estimated for exceeding matrix spike limits and is believed to be related to matrix interference. Overall MS/MSD accuracy and precision is acceptable.

2.9.2.2 Database Laboratory Flag Review

Qualifiers were applied by the laboratory to sample results in the database for failure to meet method criteria. Three soil and four water samples for lead exceeding post-digestion spike criteria. Post-digestion spikes demonstrate matrix-related effects on sample data with respect to accuracy. All results were qualified as estimated concentrations.

2.9.3 Conclusions

Samples were collected and analyzed as specified in the methods with exception of those issues discussed in this report. All samples are representative of the site and comparable with previous and future investigations (when used in accordance with the validation qualifiers).

All sample results qualified as "U, UJ, J, or J1" and used in accordance with data validation qualifiers applied are usable for the purposes intended. Results qualified as such represent an association to non-compliant QC criteria which has caused the reported concentration to be estimated. Project objectives do not exclude the use of estimated concentrations and therefore the usability of that data point for project purposes.

In summary, accuracy and precision were in control and are considered acceptable with the exception of lead. All method specific criteria were in control.

TABLE 2.1
ANALYTICAL PROTOCOL FOR
GROUNDWATER, SOIL, AND SOIL GAS SAMPLES
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

MATRIX	METHOD	WHERE ANALYZED
GROUNDWATER		
Ferrous Iron (Fe^{+2})	Colorimetric, Hach Method 8146	Field
Alkalinity as Calcium Carbonate ($CaCO_3$)	Titrimetric, Hach Method 8221	Field
Ammonia as Nitrogen (NH_3-N)	CHEMetrics Method 1510, ASTM 4500: NH_3	Field
Manganese (Mn^{+2})	Colorimetric, Hach Method 8034	Field
Sulfate (SO_4^{-2})	Colorimetric, Hach Method 8051	Field
Total Sulfide	Colorimetric, Hach Method 8131	Field
Conductivity	Direct reading meter	Field
Oxygen	Direct reading meter	Field
pH	Direct reading meter	Field
Redox Potential	Direct reading meter	Field
Temperature	Direct reading meter	Field
BTEX	SW8020	QUANTERRA[a/]
Methane (CH_4)	RSK-175	QUANTERRA
Nitrate as Nitrogen (NO_3^{-1}-N)	E300.0	QUANTERRA
Lead	SW7421	QUANTERRA
SOIL		
BTEX	SW8020A	QUANTERRA
Naphthalene	SW8310	QUANTERRA
Lead	SW7421	QUANTERRA
Total Organic Carbon	SW9060	QUANTERRA
SOIL GAS		
BTEX & Aromatic Hydrocarbons	TO-3	Air Toxics[b/]
TPH	TO-3	Air Toxics
Oxygen	Direct reading meter	Field
Carbon Dioxide	Direct reading meter	Field

Notes:
a/ Quanterra, Inc. of Arvada, Colorado.
b/ Air Toxics LTD. of Folsom, California

TABLE 2.2
SAMPLE ANALYSES BY LOCATION
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Sampling Location	Sample Matrix	Sample Depth (ft. bgs) [a/]	Analytes and Analysis								
			BTEX 8020	Naphthalene 8310	Total Lead 7421	TOC 9060	CH_4 RSK-175	NITRATE 300.0	ORP Field	Alkalinity Field	Conductivity Field
SBA-14	Soil	7 - 8	X								
SBA-14	Soil	9 - 11	X	X	X						
SBA-15	Soil	9 - 10			X	X					
SBA-16	Soil	9 - 10			X	X					
SBA-16	Soil	11 - 12				X					
SBA-17	Soil	9.5 - 10.5	X	X	X						
SBA-18	Soil	8.5 - 9.5	X	X	X						
SBA-19	Soil	6.5 - 8	X	X	X						
SBA-19	Soil	8.5 - 10	X	X	X						
SBA-20	Soil	6 - 7	X		X						
SBA-20	Soil	9.5 - 10.5	X	X	X						
MW8-1	Groundwater	NA	X		X		X	X	X	X	X
MW8-3	Groundwater	NA	X		X		X	X	X	X	X
MW8-4	Groundwater	NA	X		X		X	X	X	X	X
MW8-5	Groundwater	NA	X		X		X	X	X	X	X
MWA-6	Groundwater	NA	X						X	X	X
MWA-9	Groundwater	NA	X		X		X	X	X	X	X
MWA-10B	Groundwater	NA	X		X		X	X	X	X	X
MWA-11	Groundwater	NA	X		X		X	X	X	X	X
MWA-13	Groundwater	NA	X						X	X	X
MWA-14	Groundwater	NA	X						X		X
SG-1	Soil Gas	4									
SG-2	Soil Gas	4									
SG-3	Soil Gas	4									

Notes:
[a/] ft. bgs = feet below ground surface
NA = not applicable

BTEX = Benzene, Toluene, Ethylbenzene, and Xylene
TOC = Total Organic Carbon

DO = Dissolved Oxygen
ORP = Oxidation Reduction Potential

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TABLE 2.2 (Continued)
SAMPLE ANALYSES BY LOCATION
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Sampling Location	Sample Matrix	Depth (ft. bgs) [a/]	Analytes and Analysis								
			DO Field	Temperature Field	pH Field	Fe^{2+} Field	Sulfate Field	Sulfides Field	NH_3 Field	Mn^{2+} Field	BTEX/TPH TO-3
SBA-14	Soil	7 - 8									
SBA-14	Soil	9 - 11									
SBA-15	Soil	9 - 10									
SBA-16	Soil	9 - 10									
SBA-16	Soil	11 - 12									
SBA-17	Soil	9.5 - 10.5									
SBA-18	Soil	8.5 - 9.5									
SBA-19	Soil	6.5 - 8									
SBA-19	Soil	8.5 - 10									
SBA-20	Soil	6 - 7									
SBA-20	Soil	9.5 - 10.5									
MW8-1	Groundwater	NA	X	X	X	X	X	X	X	X	
MW8-3	Groundwater	NA	X	X	X	X	X	X	X	X	
MW8-4	Groundwater	NA	X	X	X	X	X	X	X	X	
MW8-5	Groundwater	NA	X	X	X	X	X	X	X	X	
MWA-6	Groundwater	NA	X	X	X	X	X	X	X	X	
MWA-9	Groundwater	NA	X	X	X	X	X	X	X	X	
MWA-10B	Groundwater	NA	X	X	X	X	X	X	X	X	
MWA-11	Groundwater	NA	X	X	X	X	X	X	X	X	
MWA-13	Groundwater	NA	X	X	X	X	X	X	X	X	
MWA-14	Groundwater	NA	X	X	X						
SG-1	Soil Gas	4									X
SG-2	Soil Gas	4									X
SG-3	Soil Gas	4									X

Notes:
[a/] ft. bgs = feet below ground surface
NA = not applicable
BTEX = Benzene, Toluene, Ethylbenzene, and Xylene
TOC = Total Organic Carbon
DO = Dissolved Oxygen
ORP = Oxidation Reduction Potential

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TABLE 2.3
SOIL BORING AND MONITORING WELL INSTALLATION SUMMARY
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Well ID	Groundwater Zone	Installation Date	Top of Casing Elevation (ft msl)[a/]	Depth to Top of Screen (ft bgs)[b/]	Depth to Bottom of Screen (ft bgs)	Casing/ Screen ID (inches)	Total Depth (ft bgs)
Soil Borings							
SBA-14	NA[c/]	2/17/98	NA	NA	NA	NA	25.0
SBA-15	NA	2/18/98	NA	NA	NA	NA	14.0
SBA-16	NA	2/18/98	NA	NA	NA	NA	12.0
SBA-17	NA	2/18/98	NA	NA	NA	NA	12.0
SBA-18	NA	2/18/98	NA	NA	NA	NA	12.0
SBA-19	NA	2/18/98	NA	NA	NA	NA	12.0
SBA-20	NA	2/18/98	NA	NA	NA	NA	12.0
Groundwater Monitoring Wells							
MWA-10B	Shallow	2/17/98	19.32	4.70	10.70	0.50	10.7
MWA-14	Deep	2/18/98	19.36	21.00	24.00	0.50	24.0

a/ ft msl = feet above mean sea level
b/ ft bgs = feet below ground surface
c/ NA = not applicable

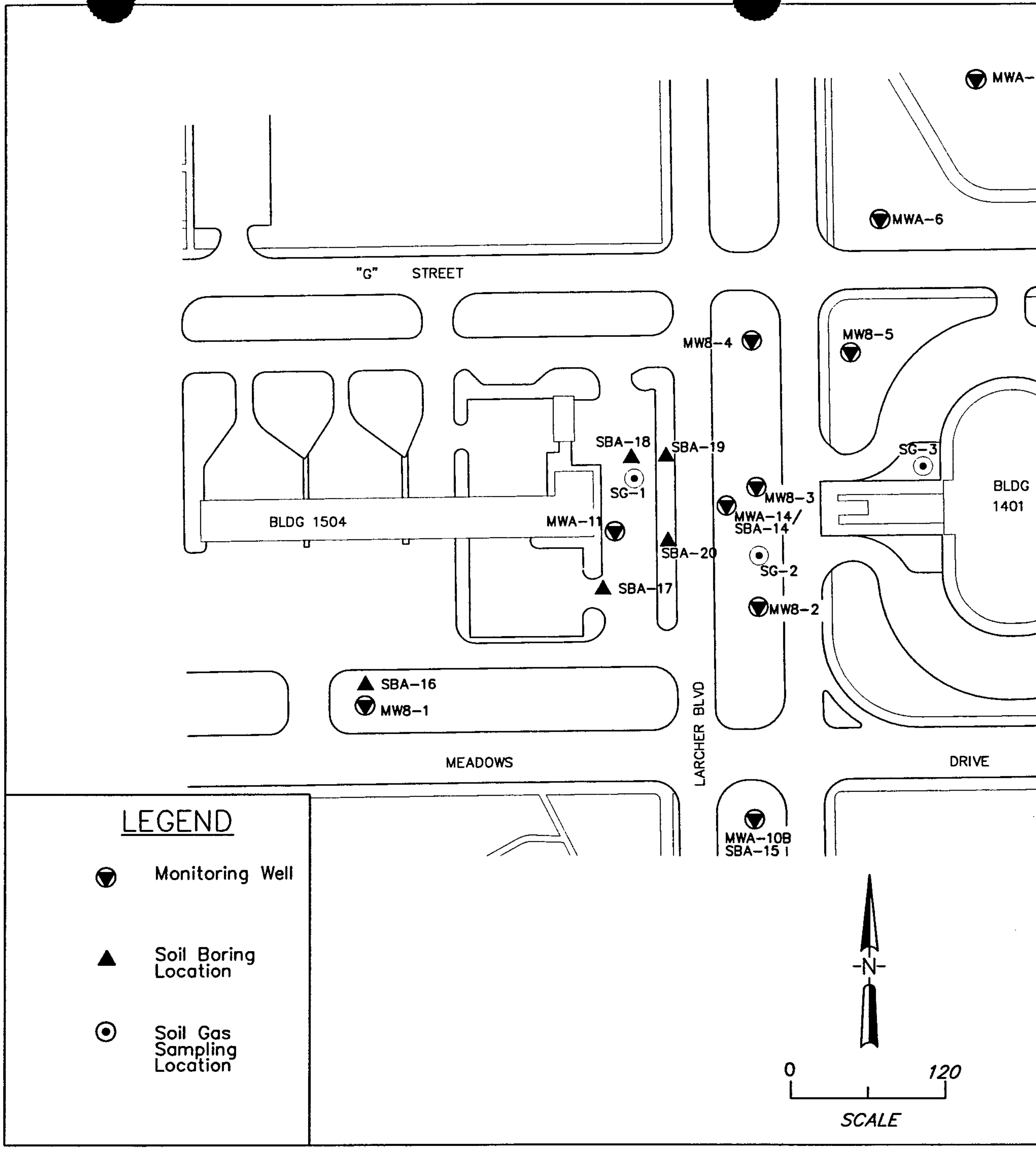

FIGURE 2.1

SAMPLING LOCATION MAP

Risk-Based Approach to Remediation
BX Service Station
Keesler AFB, Mississippi

PARSONS ENGINEERING SCIENCE, INC.
Atlanta, Georgia

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SECTION 3
PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section describes the physical characteristics of the BX Service Station and adjacent environs at Keesler AFB, as determined from data collected during previous site investigations (ES, 1994; WEI, 1997) and by Parsons ES in February 1998 as part of the risk-based investigation. A summary of site characterization activities completed by Parsons ES to supplement existing data is presented in Section 2 of this CAP.

3.1 SITE TOPOGRAPHY AND SURFACE WATER HYDROLOGY

The BX Service Station and the surrounding area has relatively flat topography, with ground elevations at the site at approximately 30 feet above the mean sea level. Surface water hydrology around the site is dominated by the stormwater sewer system. Two small manmade lakes are present on the golf course. There is no central stream which drains the Base, however, there are small tidal creeks that provide drainage into the Back Bay along the northern edge of the Base.

3.2 REGIONAL GEOLOGY AND HYDROGEOLOGY

Several major hydrogeologic units exist in the area of Keesler AFB: the Coastal Deposits surficial aquifer, the Citronelle Aquifer, and the Miocene aquifer system. The surficial aquifer, which underlies the BX Service Station, occurs under water table conditions within the Pamlico Sand. This formation consists of Holocene- or Pleistocene-age unconsolidated terrace or alluvial deposits of sand. The water table occurs as a subdued replica of the topographic surface and slopes gently toward the Back Bay and Mississippi Sound. The axis of the topographic ridge and the groundwater divide are almost coincident, with steeper topographic slopes and hydraulic gradients south of the Base, and flatter topographic slopes and hydraulic gradients to the north. Localized variations in gradient and flow direction occur within the Base due to minor variations in ground cover and grading. These variations do not affect the overall flow and appear to produce only localized areas of stagnant water, or conversely, localized areas in which the flow rates are higher than the site average. The underlying Citronelle aquifer consists of the Citronelle Formation. The Miocene aquifer system consists of the Graham Ferry Formation, Pascagoula Formation, Hattiesburg Formation, and the Catahoula Sandstone. A hydrogeologic cross-section and geologic map depicting these units are contained in Appendix B.

The surficial aquifer is generally of poor quality, which can be attributed to both natural and artificial causes. As early as the 1940s, Brown, *et al.* (1944) reported a deterioration of local water quality due to contamination by sewage. Locally, the water contains hydrogen sulfides and dissolved organic matter which are responsible for a rotten egg odor and a dark brown color, respectively. The dissolved organic matter is largely attributed to peat resulting from the decay of plant and animal matter. Regionally, the surficial aquifer contains saline water from salt water intrusion. The majority of the region's industrial, municipal, and drinking water is supplied by the Citronelle Aquifer and the Miocene aquifer system.

3.3 SITE GEOLOGY AND HYDROGEOLOGY

AOC-A is underlain by fine- to medium-grained sands to a depth of about 20 feet bgs, with some peat present between 15 and 20 feet bgs. A soft, olive-blue-gray clay was encountered at approximately 20 feet bgs in five of the eight well borings advanced in 1992 and at 20 to 23 feet bgs at SBA-14 in February 1998. These borings were located to the east and northeast of the site. The thickness and possible continuity of this clay layer are unknown. The surficial aquifer at the site is estimated to be 20 feet thick, assuming that the clay layer is continuous beneath the site.

Groundwater at the BX Service Station is encountered at a depth of 5 to 9 feet bgs. Groundwater surface elevations measured in February 1998 are summarized on Table 3.1 and Figure 3.1. Groundwater contour maps from previous investigations are presented in Appendix B. The horizontal groundwater flow direction is toward the northeast at the former UST location. Groundwater flows to the southeast from MWA-12, which is located northeast of the former UST location. Groundwater eventually discharges into the Back Bay of Biloxi approximately 2,100 feet northeast of the BX Service Station. The hydraulic gradients at the site range between 0.003 foot per foot (ft/ft) and 0.0083 ft/ft. Slug tests were performed at monitoring wells MW8-3, MWA-9, MWA-11. Slug test results are presented in Appendix D. Using the slug withdrawal portion of the tests, the average hydraulic conductivity is 40 feet per day (ft/day). This value is similar to the hydraulic conductivity of 61 ft/day that was determined from aquifer pump tests performed in background areas during the RFI (ES, 1994) and is similar to the hydraulic conductivity of 32 ft/day that was determined by WEI (1997). Using an average gradient of 0.005 ft/ft and an estimated effective porosity of 0.25, the horizontal groundwater flow rate is calculated to be 0.8 ft/day (292 feet per year [ft/yr]).

3.4 CLIMATOLOGICAL CHARACTERISTICS

The subtropical climate of the region around Keesler AFB is characterized by mild winters and warm, moist summers. These conditions reflect the moderating influence of the Gulf of Mexico. The monthly mean temperature at the Base varies from a low of 52°F in January to a high of 83°F in July and August. The average yearly temperature is 69°F with average highs of 76°F and average lows of 61°F. High temperatures in the summer frequently exceed 90°F, but rarely exceed 100°F. In the winter, low temperatures at Keesler AFB fall below freezing an average of 11 times per year. Annual precipitation averages 60.7 inches and is evenly distributed throughout the year; however, October and November tend to be somewhat drier than the other months. It rarely snows in this region. Flooding is a concern in the vicinity of the Base; major portions of the facility lie within the 100-year flood plain (ES, 1994).

Annual wind direction frequency is bimodal with winds predominantly from the north and south. Seasonally, autumn and winter winds tend to be northerly dominated, while spring and summer winds demonstrate a more frequent southerly component. Wind velocity at the Base averages approximately 6 miles per hour; however, wind speeds as high as 130 mph have been recorded at the Base (ES, 1994).

Climatic data compiled by the National Oceanic and Atmospheric Administration (NOAA) show that pan evaporation for the Gulfport/Biloxi area is approximately 64 inch/year; lake evaporation for the same area is approximately 48 inch/year (ES, 1994).

ESE (1991) reported an evapotranspiration rate at Keesler AFB of 39.3 inch/year. The difference in the mean annual precipitation and the mean annual evapotranspiration rate is the amount of surface water available for runoff, groundwater infiltration, and aquifer recharge. This net precipitation is approximately 20 inch/year in the vicinity of Keesler AFB.

TABLE 3.1
SUMMARY OF MONITORING WELL GAUGING DATA
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi
February 18, 1998

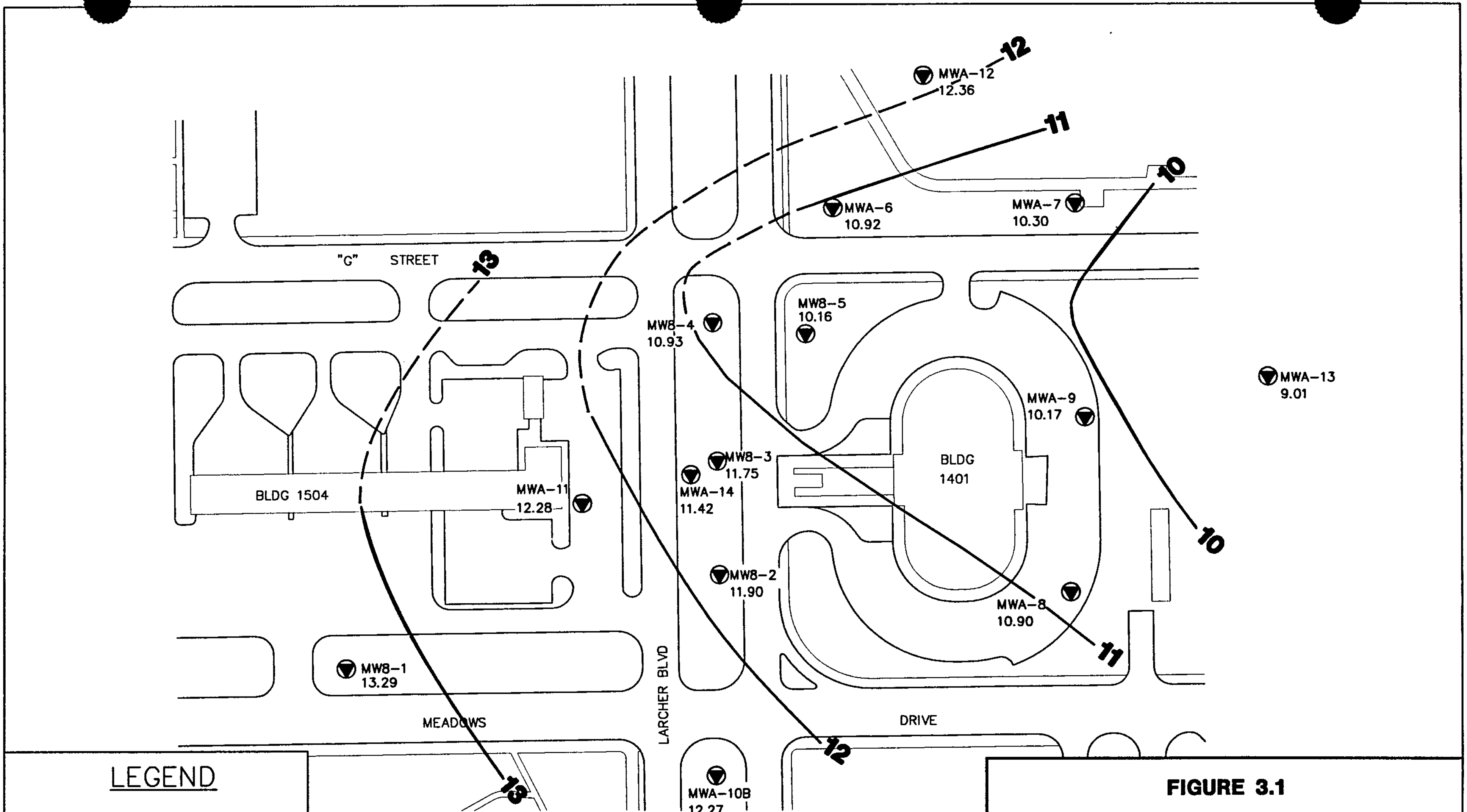
Well Identification	Top of Casing Elevation (ft msl)[a/]	Depth of Screened Interval (ft bgs)[b/]	Depth to Water (feet btoc)[c/]	Water Table Elevation (ft msl)
MW8-1	19.13	6-16	5.84	13.29
MW8-2	19.57	6-16	7.67	11.90
MW8-3	19.65	6-16	7.90	11.75
MW8-4	19.08	6-16	8.15	10.93
MW8-5	19.68	6-16	9.52	10.16
MWA-6	18.44	8-23	7.52	10.92
MWA-7	18.95	7-22	8.65	10.30
MWA-8	19.23	7-22	8.33	10.90
MWA-9	19.29	8-23	9.12	10.17
MWA-10B	19.32	5-11	7.05	12.27
MWA-11	20.09	6-21	7.81	12.28
MWA-12	19.26	8-23	6.90	12.36
MWA-13	18.43	7-22	9.42	9.01
MWA-14	19.36	21-24	7.94	11.42

Notes:

a/ ft msl = feet above mean sea level

b/ ft bgs = feet below ground surface

c/ ft btoc = feet below top of casing



LEGEND

13.29 Monitoring Well with Groundwater Elevation in Feet Above Mean Sea Level

—13— Line of Equal Groundwater Elevation Dashed Where Inferred

MWA-14 Is Screened in a Deeper Water Bearing Zone

FIGURE 3.1

SHALLOW ZONE GROUNDWATER ELEVATIONS FEBRUARY 18, 1998

Risk-Based Approach to Remediation
BX Service Station
Keesler AFB, Mississippi

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Atlanta, Georgia

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SECTION 4
TIER 1 ANALYSIS AND IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

This section presents a screening-level Tier 1 analysis used to select the COPCs that are the focus of this CAP. The COPCs for the site are identified in the Tier 1 analysis based on estimated risks to human health posed by maximum detected contaminant concentrations.

4.1 REGULATORY REVIEW OF THE TIER 1 SCREENING PROCESS

As an initial step in determining the necessity for remedial action, maximum concentrations of site contaminants are compared to the Typical Cleanup Levels mandated by MDEQ (Table 1.1). If representative concentrations of petroleum contaminants exceed these cleanup levels, individual constituents are then compared to generic RBSLs calculated by the MDEQ and available on "look-up" tables (MDEQ, 1996).

Those analytes with site concentrations that exceed the appropriate RBSLs for soil and groundwater are considered to be COPCs, and are retained for further analysis concerning the risk-reduction requirements for the site. The nature and extent of these COPCs are described more fully in Section 5. Site-specific risks resulting from exposure to COPCs and fate and transport analyses for the dissolved BTEX plume are presented in Sections 6 and 7, respectively. These analyses were conducted to assess the degree to which COPCs pose significant risks to potential receptors, and the persistence and migration potential of the dissolved BTEX plume.

4.2 CONTAMINANT SOURCE ASSESSMENT

Contaminant sources at the BX Service Station (AOC-A) consist of soils containing fuel-related organic compounds. These COPCs are present as a result of past overfills of and/or leaks from the tanks.

4.3 LAND USE

This site is located within the current business/administrative section of the Base, and is an active commercial service station. The Base Master Plan currently has this site and surrounding area designated for administrative and commercial land use. Future development of the site is unlikely to require use of the surficial aquifer because the existing drinking water distribution system is adequate.

4.4 EXPOSURE PATHWAYS AND POTENTIAL RECEPTORS

The groundwater exposure pathways of concern to the MDEQ include migration of dissolved contaminants to a receptor exposure point (e.g., drinking water well or surface water body). No known potable wells are completed in the surficial aquifer near the site. The nearest existing well is Base supply well 4, located about 300 feet southwest (upgradient) of the site. This well is completed at a depth of more than 600 feet. Base supply well 8, located about 2,200 feet east (downgradient) of the site, is also more than 600 feet deep. Clay layers between the surficial aquifer and the screened well interval would effectively prevent COPCs from reaching these wells. Although no drinking water wells are completed in the surficial aquifer, the aquifer is protected as a potential drinking water source and is considered an exposure pathway of concern and receptor exposure point.

Groundwater discharging to surface water is not currently considered a potentially completed pathway. The closest surface water body is the Back Bay of Biloxi located 2,100 feet to the northeast.

Any surface water runoff from the site is channeled into the storm water drainage system; the ultimate discharge point for this water is not known. However, the surface water runoff pathway is not considered complete because the site is mostly paved, and runoff should not contact contaminated soils.

In addition to potential future risks posed by migration of dissolved contaminants to potential receptor exposure points, volatile chemicals in soil and groundwater can potentially be released by volatilization to ambient air or accumulated in nearby structures. Current and future receptors may be exposed to these chemicals by inhalation. Potentially exposed receptors currently include personnel working at or near the site. Potential future receptors include intrusive site workers and building occupants.

Exposure pathways for ecological receptors near the site are not considered complete because the majority of the site is paved. The asphalt cover precludes vegetation growth and erosion. No COPCs were identified that would pose risk to vegetation. In addition, no pathway for wildlife exposure to subsurface soils was identified. The site is expected to continue as a paved, urbanized environment; therefore, future risks to ecological receptors are unlikely. However, if dissolved contaminants are discharged to surface water, ecological receptors may be impacted .

4.5 TIER 1 SCREENING ANALYSIS

MDEQ (1993) Typical Cleanup Levels (Table 1.1) are used if there are no sensitive environmental receptors such as public or private wells, geologic recharge areas, or vapors in homes. If potential receptors exist or these levels are exceeded, MDEQ (1996) Tier 1 RBSLs are compared to site data. These levels are based on distance from the source to potential receptors.

4.5.1 Tier 1 Screening Analysis for Soil

The typical cleanup level for soil at a gasoline site is 100 parts per million (ppm, approximately 100 mg/kg) of total BTEX. The maximum total BTEX concentration exceeded this value. Therefore, concentrations of individual chemicals were compared to the MDEQ (1996) RBSLs. The closest receptor to the site is the Back Bay of Biloxi, which is approximately 2,100 feet northeast of the site. The MDEQ look-up tables have RBSLs for receptors located 1,400 feet and 2,600 feet from the source. To be conservative, the 1,400 feet RBSLs were selected as the appropriate set of Tier 1 screening values for soil at the BX Service Station. However, these values do not include a RBSL for lead. The USEPA (1994c) Office of Solid Waste directive on risk assessment and cleanup of residential soil lead recommends that soil lead levels less than 400 ppm be considered safe for residential use; this level is used as the RBSL for lead in soil. Table 4.1 compares the maximum site concentrations for each compound measured in soil at the site to the appropriate RBSL. Based on these comparisons, there were no exceedences of Tier 1 RBSLs in soil. As shown in the table, site soils have not been analyzed for several compounds. However, these compounds should not be considered COPCs. Even if these compounds were at the maximum possible concentration in source area soils, they would not be a risk to a receptor 1,400 feet downgradient, as shown in the MDEQ (1996) RBSL tables.

4.3.2 Tier 1 Screening Analysis for Groundwater

The typical cleanup level for groundwater at a gasoline site is 18 mg/L of total BTEX. The maximum total BTEX concentration exceeded this value. Therefore, individual chemicals were compared to the MDEQ (1996) RBSLs. As with soil screening levels, the 1,400-feet-to-receptor levels were selected as the appropriate set of Tier 1 screening values for groundwater at the BX Service Station. The groundwater RBSLs also do not include a value for total lead in groundwater. Therefore, the USEPA (1996) maximum contaminant level (MCL) of 15 micrograms per liter (μg/L) was used for this value. Comparisons of the RBSLs for groundwater to maximum concentrations of compounds detected in groundwater samples collected at the site are presented in Table 4.2. Based on these comparisons total lead is the only constituent identified as a COPC in site groundwater.

4.3.3 Tier 1 Screening Analysis for Soil Gas

MDEQ guidance does not provide RBSLs for screening soil gas concentrations or for directly screening ambient air values. As a means of assessing the potential for exposure via inhalation of volatiles, soil gas samples collected in February 1998 were analyzed for BTEX, and maximum detections of each compound were compared to the chemical-specific Occupational Safety and Health Administration (NIOSH, 1997) 8-hour time-weighted average Permissible Exposure Limits (PELs). Table 4.3 presents the results of this comparison. No BTEX constituents were detected above the OSHA PELs.

4.3.4 Summary of Site COPCs

Based on comparisons of the maximum soil, groundwater, and soil gas concentrations to MDEQ (1993) Typical Cleanup Levels, MDEQ (1996) RBSLs, and OSHA PELs (NIOSH, 1997), only lead in groundwater is identified as a COPC for the BX Service Station.

TABLE 4.1
COMPARISON OF MAXIMUM SITE SOIL CONCENTRATIONS TO TARGET CLEANUP LEVELS
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Chemical Name	Units	Maximum Concentration Detected	Location of Maximum Detection	Date of Maximum Detection	Target Levels[a/]	Number of Times Exceeded
Total BTEX	mg/kg[b/]	166.2	SBA-18	18-Feb-98	100	1
Lead	mg/kg	8.7	SBA-18	18-Feb-98	400	0
Acenaphthene	mg/kg	NA[c/]	NA	NA	>res[d/]	0
Acenaphthylene	mg/kg	NA	NA	NA	>res	0
Anthracene	mg/kg	NA	NA	NA	>res	0
Benzene	mg/kg	0.22	SBA-17	18-Feb-98	>res	0
Benzo(b)fluoranthene	mg/kg	NA	NA	NA	>res	0
Benzo (g,h,i)perylene	mg/kg	NA	NA	NA	>res	0
Benzo(k)fluoranthene	mg/kg	NA	NA	NA	>res	0
Benzo(a)pyrene	mg/kg	NA	NA	NA	>res	0
Chrysene	mg/kg	NA	NA	NA	>res	0
Dibenzo(a,h)anthracene	mg/kg	NA	NA	NA	>res	0
Ethylbenzene	mg/kg	4.2	SBA-18	18-Feb-98	>res	0
Fluoranthene	mg/kg	NA	NA	NA	>res	0
Fluorene	mg/kg	NA	NA	NA	>res	0
Indeno(1,2,3-cd)pyrene	mg/kg	NA	NA	NA	>res	0
Naphthalene	mg/kg	10	SBA-20	18-Feb-98	>res	0
Phenanthrene	mg/kg	NA	NA	NA	>res	0
Pyrene	mg/kg	NA	NA	NA	>res	0
Toluene	mg/kg	12	SBA-18	18-Feb-98	>res	0
Xylenes, Total	mg/kg	150	SBA-18	18-Feb-98	>res	0

Notes: Shading indicates maximum site concentration is above target level.

[a/] Total BTEX based on MDEQ Typical Cleanup Level (Table 1.1), lead based on USEPA (1994c), all other Target Levels based on MDEQ RBSL "look-up" tables and a distance to receptor of 1,400 feet.

[b/] mg/kg = Milligrams per kilogram.

[c/] NA = Not available.

[d/] >res = the RBSL exceeds the expected soil residual contamination under free product (worst case) conditions.

TABLE 4.2
COMPARISON OF MAXIMUM SITE GROUNDWATER CONCENTRATIONS TO TARGET CLEANUP LEVELS
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Chemical Name	Units	Maximum Concentration Detected	Location of Maximum Detection	Date of Maximum Detection	Target Levels[a/]	Number of Times Exceeded
Total BTEX	μg/L [b/]	22,400	MW8-3	20-Feb-98	18,000	1
Total Lead	μg/L	21	MW8-3	20-Feb-98	15	3
Acenaphthene	μg/L	1	MWA-11	20-Nov-92	>sol[e/]	0
Acenaphthylene	μg/L	10 U[c/]	NA[d/]	20-Nov-92	>sol	0
Anthracene	μg/L	10 U	NA	20-Nov-92	>sol	0
Benzene	μg/L	2,500	MW8-3	20-Feb-98	56,000	0
Benzo(b)fluoranthene	μg/L	10 U	NA	20-Nov-92	>sol	0
Benzo (g,h,i)perylene	μg/L	10 U	NA	20-Nov-92	>sol	0
Benzo(k)fluoranthene	μg/L	10 U	NA	20-Nov-92	>sol	0
Benzo(a)pyrene	μg/L	10 U	NA	20-Nov-92	>sol	0
Chrysene	μg/L	10 U	NA	20-Nov-92	>sol	0
Dibenzo(a,h)anthracene	μg/L	10 U	NA	20-Nov-92	>sol	0
Ethylbenzene	μg/L	1,700	MW8-3	20-Feb-98	>sol	0
Fluoranthene	μg/L	10 U	NA	20-Nov-92	>sol	0
Fluorene	μg/L	10 U	NA	20-Nov-92	>sol	0
Indeno(1,2,3-cd)pyrene	μg/L	10 U	NA	20-Nov-92	150.00	0
Naphthalene	μg/L	320	MW8-3	19-Nov-92	>sol	0
Phenanthrene	μg/L	10 U	NA	20-Nov-92	>sol	0
Pyrene	μg/L	10 U	NA	20-Nov-92	>sol	0
Toluene	μg/L	10,000	MW8-3	20-Feb-98	>sol	0
Xylenes, Total	μg/L	8,200	MW8-3	20-Feb-98	>sol	0

Notes: Shading indicates maximum site concentration is above target level.

[a/] Total BTEX based on MDEQ Typical Cleanup Level (Table 1.1), lead based on USEPA (1996), all other Target Levels based on MDEQ RBSL "look-up" tables and a distance to receptor of 1,400 feet.

[b/] μg/L = Micrograms per Liter.

[c/] U = Analyte not detected above corresponding number.

[d/] NA = Not available. [e/] >sol = greater than the maximum solubility possible.

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TABLE 4.3
COMPARISON OF MAXIMUM SITE SOIL GAS CONCENTRATIONS TO OSHA PERMISSIBLE EXPOSURE LIMITS
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Chemical	Maximum Detected Concentration (ppmv [a/])	OSHA PEL (ppmv) [b/]	Maximum Concentration Above PEL?
Benzene	ND	1	No
Toluene	.006 M[d/]	200	No
Ethylbenzene	0.020	100	No
Xylenes	0.041	100	No
TPH [e/]	1.943	-- [f/]	--

Notes:

[a/] ppmv = Parts per million, volume per volume.

[b/] Occupational Safety and Health Administration (NIOSH, 1997) 8-hour time-weighted average permissible exposure limit.

[c/] ND = Not detected above reporting limits.

[d/] M data qualifier indicates potential bias due to matrix interferences.

[e/] TPH = Total petroleum hydrocarbons.

[f/] "--" = No PEL available.

SECTION 5
ANALYTICAL DATA SUMMARY AND MAGNITUDE AND EXTENT OF CHEMICALS OF POTENTIAL CONCERN

5.1 OVERVIEW

This section presents analytical results from the February 1998 field sampling event in tabular form, and summarizes the magnitude and extent of COPC contamination in sampled media at the BX Service Station. Discussion in this section is primarily limited to those chemicals that were identified as COPCs based on the Tier 1 screening analysis presented in Section 4 (i.e., lead in groundwater).

5.2 SOIL SAMPLING RESULTS

Soil sampling was performed as part of the recent risk-based investigation; analytical results are summarized in Table 5.1. Soil borings were advanced in "hotspots" of fuel contamination (based on previous investigations) to determine worst case hydrocarbon and lead concentrations in soil. In addition, soil borings were advanced downgradient from the source area to determine the lateral extent of soil contamination. As shown in Table 4.1, total BTEX at SBA-18 (8.5-9.5 feet bgs) exceeded the typical cleanup level for soils. Therefore, maximum detected concentrations of individual fuel hydrocarbon-related compounds were compared to RBSLs (also Table 4.1). Available soil analytical data indicate that there are no exceedences of RBSLs and, therefore, no soil COPCs.

5.3 GROUNDWATER SAMPLING RESULTS

Groundwater sampling was performed as part of the recent risk-based investigation; analytical results are summarized in Table 5.2. Sampled monitoring wells were selected based on the results of previous investigations. The sampling strategy was to determine extent and magnitude of fuel hydrocarbon and total lead concentrations in groundwater. As shown in Table 4.2, total BTEX at MW8-3 exceeded the typical cleanup level for groundwater. Therefore, individual fuel compounds and total lead concentrations were compared to RBSLs (also Table 4.2). The Tier 1 screening results indicate that lead is the only groundwater COPC.

During the February 1998 field effort, lead was detected slightly above the USEPA MCL of 15 μg/L at MWA-10B (16J μg/L), MW8-3 (21 μg/L), and MWA-11 (21 μg/L). The distributions of total BTEX and total lead in groundwater are presented on Figure 5.1. The highest total lead concentrations were found at the same locations as the highest BTEX concentrations (MW8-3 and MWA-11). Historically, lead has been detected above the MCL since the 1988 field effort (Table 5.3). The highest lead concentrations were generally detected in November 1992. During this sampling event, all thirteen wells sampled had total lead concentrations above the MCL. However, lead concentrations have decreased from 1992 to 1998.

MWA-14, which is located near MW8-3, is screened deeper in the water bearing zone. It was installed in an area of high BTEX concentrations to determine the vertical extent of contamination. As shown on Figure 5.1, BTEX concentrations decrease by over an order of magnitude from MW8-3 to MWA-14

5.4 SOIL GAS SAMPLING RESULTS

Soil gas samples were collected at the site to facilitate assessment of the potential risk to future workers at the site from inhalation of VOCs, and to determine whether or not sufficient O_2 is available in the soil gas to sustain aerobic fuel hydrocarbon biodegradation. Three soil gas samples were collected and analyzed in the field for concentrations of O_2 and CO_2. All three samples also were submitted to Air Toxics, Ltd of Folsom California for analysis of BTEX and TPH (referenced to gasoline and propane). Field and laboratory analytical results for 1997 soil gas samples are summarized in Table 5.4. Comparison of maximum soil gas BTEX concentrations to OSHA 8-hour time-weighted average PELs (Table 4.3) indicated that no hydrocarbons pose a potential inhalation risk to future intrusive workers.

The field screening data indicate that the soil gas O_2 level at SG-2, has decreased due to microbial respiration during aerobic biodegradation of the fuel compounds. There probably is sufficient O_2 at SG-2 to allow aerobic biodegradation to occur. The concentration of CO_2, which is a metabolic byproduct of biodegradation reactions, is correspondingly elevated. At SG-1, which is located in the source area (former tank pits), O_2 and CO_2 levels did not indicate biodegradation of fuel compounds, however, the interim remediation systems, which include air sparging and soil vapor extraction, probably affected the O_2 and CO_2 levels at this location. At SG-3, which is located farther downgradient of the highest soil BTEX concentrations, O_2 and CO_2 levels were not significantly elevated or depleted due to the absence of vadose zone soil or capillary fringe contamination.

TABLE 5.1
SUMMARY OF SOIL ANALYTICAL DATA
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Analyte	Units	Sample Locations, Intervals, and Dates											
		SBA-14 (7 - 8)[a/] 17-Feb-98	SBA-14 (9 - 11) 18-Feb-98	SBA-15 (9 - 10) 18-Feb-98	SBA-16 (11 - 12) 18-Feb-98	SBA-16 (9 - 10) 18-Feb-98	WEI-B3 SBA-17 (9.5 - 10.5) 18-Feb-98	SBA-18 (8.5 - 9.5) 18-Feb-98	WEI-B1 SBA-19 (6.5 - 8) 18-Feb-98	SBA-19 (8.5 - 10) 18-Feb-98	SBA-100 (8.5 - 10) 18-Feb-98	SBA-20 (6 - 7) 18-Feb-98	SBA-20 (9.5 - 10.5) 18-Feb-98
Benzene	mg/Kg[b/]	0.0054U	0.017	NM	NM	NM	0.22	5.4U	0.0055U	0.28U	0.37U[c/]	4.6U	2.4U
Ethylbenzene	mg/Kg	0.0022U	0.0089	NM	NM	NM	0.09	4.2	0.0022U	0.28U	0.15U	1.9	0.95U
Toluene	mg/Kg	0.0054U	0.072	NM	NM	NM	0.75	12	0.0055U	0.11U	0.37U	4.6U	2.4U
Xylenes (total)	mg/Kg	0.0054U	0.034	NM	NM	NM	0.58	150	0.0055U	0.28U	0.37U	3.1J1[d/]	10
Total BTEX	mg/Kg	0.0184U	0.1319	NM	NM	NM	1.64	166.2	0.0187U	0.95U	1.26U	5	10
Naphthalene	mg/Kg	NM	0.26U	NM	NM	NM	0.27	2.1	0.22U	0.12J1	0.22U	NM	10
Lead	mg/Kg	NM	0.46J[e/]	0.40J	NM	0.18J	0.34J	8.7	4.2	NM	2.2	1.1	7.4
Total Organic Carbon	mg/Kg	NM	NM	2000U	2970	2000U	NM	NM	NM	NM	NM	NM	NM

Notes:

a/ depth in feet below ground surface.

b/ mg/kg = Milligrams per kilogram.

c/ U = The analyte was analyzed for and is not present above the reporting limit.

d/ J1 = The analyte was positively identified and has a concentration between the method detection limit and the reporting limit.

e/ J = The analyte was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environment.
The data should be considered as a basis of decision-making and are usable.

Analysis methods are SW7421 for lead, SW8020 for aromatic VOCs, and SW9060 for total organic carbon.

SBA-100 (8.5-10) is a duplicate of SBA-19 (8.5-10)

All analyses performed by Quanterra Laboratories of Arvada, Colorado

NM = Not Measured

BTEX = Benzene, Toluene, Ethylbenzene, and Total Xylenes

TABLE 5.2
SUMMARY OF GROUNDWATER ANALYTICAL DATA
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Analyte	Units	Sampling Location and Date										
		MW8-1 20-Feb-98	MW8-3 20-Feb-98	MW8-4 20-Feb-98	MW8-5 20-Feb-98	MWA-6 19-Feb-98	MWA-9 19-Feb-98	MWA-10B 20-Feb-98	MWA-11 19-Feb-98	MWA-11 19-Feb-98 Duplicate	MWA-13 19-Feb-98	MWA-14 19-Feb-98
Benzene	µg/L	2U	2,500	880	1,400	2U	0.33J1[c/]	2U	750	760	2U	170
Ethylbenzene	µg/L	2U	1,700	210	930	2U	7.7	2U	250	240	2U	250
Toluene	µg/L	2U	10,000	89	100U	2U	0.97J1	2U	1,700	1,700	2U	130
Xylenes (total)	µg/L	2U	8,200	600	530	2U	44	2U	500	500	2U	750
Total BTEX	µg/L	8U	22,400	1,779	2,860	8U	53	8U	3,200	3,200	8U	1,300
Lead	µg/L	5 U[a/]	21	5 U	5 UJ[b/]	NM	5 U	16 J[d/]	20.000	21	NM	NM

Notes:

a/ U = The analyte was analyzed for and is not present above the reporting limit.

b/ UJ = The analyte was analyzed for was not present above the SQL. The associated numerical value may not accurately or precisely represent the concentration necessary to detect the analyte in the sample.

c/ J1 = The analyte was positively identified and has a concentration between the method detection limit and the reporting limit.

d/ J = The analyte was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environment. The data should be considered as a basis of decision-making and are usable.

µg/L = micrograms per liter.

Analysis methods are SW7421 for lead and SW8020 for aromatic VOCs.

MWA-11duplicate named TW-11 on chain-of-custody

All analyses performed by Quanterra Laboratories of Arvada, Colorado

NM = Not Measured

BTEX = Benzene, Toluene, Ethylbenzene, and Total Xylenes

TABLE 5.3
HISTORICAL SUMMARY OF TOTAL LEAD CONCENTRATIONS IN GROUNDWATER
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Date	Units	Sampling Location										
		MW8-1	MW8-2	MW8-3	MW8-4	MW8-5	MWA-6	MWA-7	MWA-8	MWA-9	MWA-10	MWA-10B[d/]
January-88	μg/L	21.0	24.0	27.0	21.0	16.0	NM	NM	NM	NM	NM	NM
April-88	μg/L	7.0	20.0	45.0	9.0	14.0	NM	NM	NM	NM	NM	NM
October-89	μg/L	9.9	24.1	23.4	43.5	52.9	NM	NM	NM	NM	NM	NM
November-92	μg/L	39J[a/]	58.7J	37.8J	25.3J	15.7J	88.1J	15.8J	42.3J	31.6J	71.4J	NM
September-96	μg/L	0.5U[b/]	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	NM	NM
February-98	μg/L	5U	NM	21	5U	5UJ[c/]	NM	NM	NM	5U	NM	16J

Notes:

a/ J = The analyte was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environment. The data should be considered as a basis of decision-making and are usable.

b/ U = The analyte was analyzed for and is not present above the reporting limit.

c/ UJ = The analyte was analyzed for was not present above the SQL. The associated numerical value may not accurately or precisely represent the concentration necessary to detect the analyte in the sample.

d/ MWA-10 destroyed and replaced by MWA-10B.

μg/L = Micrograms per liter.

NM = Not Measured.

TABLE 5.3 (Continued)
HISTORICAL SUMMARY OF TOTAL LEAD CONCENTRATIONS IN GROUNDWATER
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Date	Units	Sampling Location		
		MWA-11	MWA-12	MWA-13
January-88	µg/L	NM	NM	NM
April-88	µg/L	NM	NM	NM
October-89	µg/L	NM	NM	NM
November-92	µg/L	47J	66.7J	51.8J
September-96	µg/L	0.5U	0.5U	0.5U
February-98	µg/L	21	NM	NM

Notes:

a/ J = The analyte was positively identified, but the associated numerical value may not be consistent with the amount actually present in the environment. The data should be considered as a basis of decision-making and are usable.

b/ U = The analyte was analyzed for and is not present above the reporting limit.

c/ UJ = The analyte was analyzed for was not present above the SQL. The associated numerical value may not accurately or precisely represent the concentration necessary to detect the analyte in the sample.

d/ MWA-10 destroyed and replaced by MWA-10B.

µg/L = Micrograms per liter.

NM = Not Measured.

TABLE 5.4
SUMMARY OF SOIL GAS ANALYTICAL DATA
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

	Sample Locations, Dates, and Units								
	SG-1 19-Feb-98			SG-2 19-Feb-98			SG-3 19-Feb-98		
Analyte	ppmv	µg/L	percent	ppmv	µg/L	percent	ppmv	µg/L	percent
Benzene	<0.0039	<0.013	NA	<0.0039	<0.013	NA	<0.0039	<0.013	NA
Toluene	**.006 M**	**0.023 M**	NA	<0.0039	<0.015	NA	<0.0039	<0.015	NA
Ethylbenzene	**0.020**	**0.088**	NA	<0.0039	<0.017	NA	**0.004**	**0.018**	NA
Xylenes (total)	**0.041**	**0.18**	NA	<0.0039	<0.017	NA	<0.0039	<0.017	NA
Total BTEX	**0.067**	**0.291**	NA	<0.0156	<0.062	NA	**0.004**	**0.018**	NA
TPH (C5+ Hydrocarbons)	**0.043**	**0.18**	NA	**0.051**	**0.21**	NA	<0.039	<0.16	NA
C2 - C4 Hydrocarbons	**1.9**	**3.5**	NA	**0.16**	**0.29**	NA	**0.18**	**0.33**	NA
Oxygen	NA	NA	**20.17**	NA	NA	**9.8**	NA	NA	**19.8**
Carbon Dioxide	NA	NA	**0.2**	NA	NA	**7.8**	NA	NA	**0.8**

Notes:
ppmv = parts per million volume per volume
µg/L = micrograms per liter
M = Reported values may be biased due to apparent matrix interference
Analysis method is TO-3 (Aromatic Volatiles in Air)
Analysis performed by Air Toxics Ltd. of Folsom, California
Oxygen and Carbon Dioxide measurements performed in the field
BTEX = Benzene, Toluene, Ethylbenzene, and Total Xylenes
TPH = Total Petroleum Hydrocarbons
TPH referenced to gasoline (molecular weight = 100)
C2 - C4 Hydrocarbons referenced to propane (molecular weight = 44)
NA = Not Analyzed

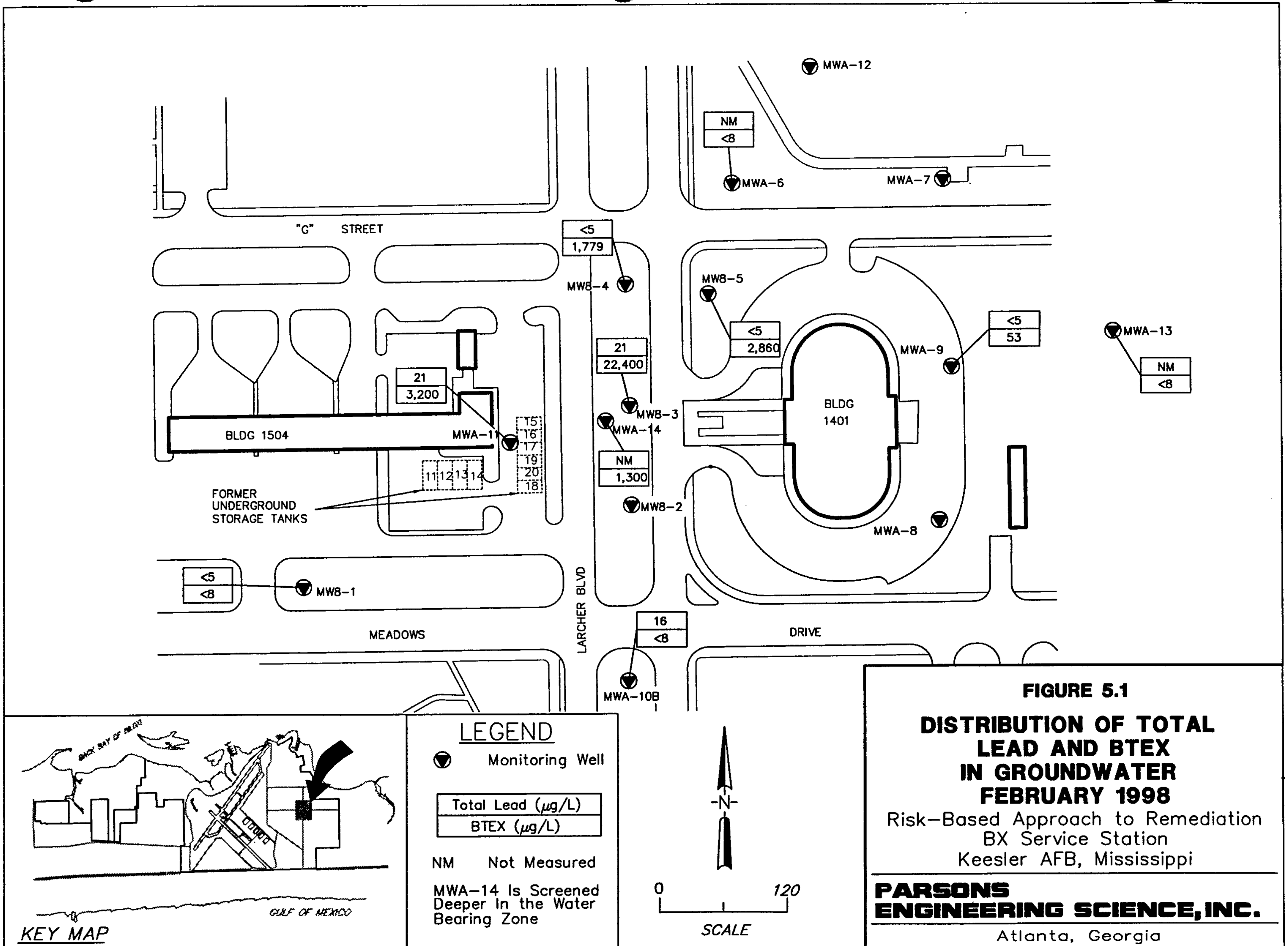

FIGURE 5.1

DISTRIBUTION OF TOTAL LEAD AND BTEX IN GROUNDWATER FEBRUARY 1998

Risk-Based Approach to Remediation
BX Service Station
Keesler AFB, Mississippi

PARSONS ENGINEERING SCIENCE, INC.
Atlanta, Georgia

J;\731854\CADD\KEESLER\BX-GW

SECTION 6
TIER 2 ANALYSIS AND IDENTIFICATION OF FINAL CHEMICALS OF CONCERN

6.1 OBJECTIVE OF SITE-SPECIFIC EVALUATION

The Tier 1 analysis conducted in this CAP (Section 4) identified total lead as a COPC in groundwater. This analyte is evaluated in detail to better define/assess the potential adverse health effects it may cause in current or future human receptors.

The Tier 1 screening process is considered protective of human health because the Tier 1 risk-based screening criteria are based on conservative exposure assumptions. However, analytes identified as COPCs in Section 4 of this CAP (i.e., analytes with representative site concentrations exceeding Tier 1 RBSLs) should not automatically be considered to be present at the BX Service Station at levels that pose unacceptable threats to human health given the current and future exposure potential at this site. Rather, the exceedances of the screening criteria indicate that further evaluation under more site-specific exposure scenarios is warranted.

In summary, the objectives of developing SSTLs that include exposure assumptions more representative of actual site conditions are 1) to determine whether current or predicted future site concentrations of COPCs present an unacceptable risk to current and future receptors; and 2) to provide a mechanism or reference to assess the cost and time required to lower site concentrations to achieve adequate risk reduction at the site.

6.2 TIER II ANALYSIS

Given that the maximum detected concentration of total lead in groundwater was identified as a COPC, it was evaluated for potential effects on the future residential child receptor using the EPA Integrated Exposure Uptake Biokinetic (IEUBK) model (USEPA, 1994). The IEUBK model provides an estimate of potential blood lead levels in residential children associated with exposure to all site media (soil and groundwater contaminated with lead).

Except for site-specific groundwater and soil concentrations, input parameters used in the model are default values provided by USEPA (USEPA, 1994). The input parameters are provided in Appendix E. The default input parameters include:

<u>**Air Parameters**</u>

- The default air concentration of 0.1 ug Pb/m3 represents the approximate average 1990 urban air lead concentration.
- The indoor air lead concentration was assumed to be 30% of the outdoor lead concentration.
- Age-specific defaults for time spent outdoors (1 to 4 hours/day) and ventilation rate (2.0 to 7.0 m^3/day) were based on USEPA data.
- An assumed lung absorption of 32% was used. Values ranging from 25 to 45% have been established by USEPA, and the value of 32% was used as the default.

Dietary Intake Default

- Age-specific estimated dietary lead intake values were obtained from USEPA. The values were based primarily on a FDA (Food and Drug Administration) Market Basket Survey.

Drinking Water Default

- Age-specific water consumption values for children used in the model ranged from 0.2 to 0.59 L/day. These values are based on USEPA values provided in the USEPA's Exposure Factors Handbook (1997a, EPA/600/P-95/002Fa).

Soil and Dust Defaults

- Age-specific default values for total intake of soil ranged from 85 to 135 mg/day. These values have been reviewed and are within the range of values provided by both USEPA and other investigators.
- No additional sources of dust (other than soil) were assumed.
- A soil to dust coefficient of 0.7 was assumed (fraction of household dust that comes from soil). Measured values for this parameter have ranged from 0.09 to 0.85.
- The contribution of outdoor airborne lead to indoor airborne lead was assumed to be 100%.

Paint Intake Default

- No lead-containing paint was assumed to be ingested.

Although the IEUBK model stipulates that the model be evaluated using mean, and not maximum, concentrations of lead in environmental media, the maximum detected concentration of lead in groundwater (21 ug/L) was used in the BX Service Station evaluation to provide a conservative assessment of potential risk. The maximum soil concentration of 8.7 mg/kg was also used as a model input.

Per USEPA (1994) guidance, the probability of an individual in a population having a blood lead level exceeding 10 micrograms per deciliter (ug/dL) should be less than 5 percent. The results of the IEUBK lead model at BX Service Station indicate that an individual in a population at this site would have only a 0.5 percent chance of exceeding a blood lead level of 10 ug/dL. This percentage falls below the criteria of 5 percent, therefore, the impacts of lead in site media on potential future residents are not considered to be significant. The geometric mean blood lead level derived for the population was 3 ug/dL, which is well below the level of 10 ug/dL. The results of this very conservative exposure scenario and the IEUBK model are provided in Appendix E.

6.3 SUMMARY

Tier 1 and Tier 2 analyses indicate that there are no soil, groundwater, or soil gas COCs to be remediated at the BX Service Station.

SECTION 7
CHEMICAL FATE ASSESSMENT

7.1 INTRODUCTION

As discussed in Section 6, there are no final COCs for the BX Service Station. However, biodegradation of dissolved fuel constituents and the future migration and persistence of the dissolved BTEX plume are assessed in this section to support development of a long-term monitoring (LTM) plan that can be used to ensure that downgradient receptors (Back Bay) will not be impacted by the BTEX plume.

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

This section summarizes and interprets specific site characterization data relevant to documenting the effectiveness of RNA at minimizing dissolved BTEX migration and reducing BTEX concentration, mass, and toxicity over time.

7.2 OPERATIVE MECHANISMS OF CONTAMINANT ATTENUATION

Understanding the fate of BTEX in environmental media is critical to evaluating and predicting contaminant distribution patterns. There are several physical, chemical, and biological processes that influence how a chemical behaves in soil and groundwater.

Nondestructive attenuation processes can be described as those physical and chemical processes that may prohibit significant contaminant migration but will not result in a permanent reduction in contaminant mass. Examples of nondestructive attenuation processes include volatilization, sorption, dilution from recharge, advection, and hydrodynamic dispersion. These processes must be evaluated when determining whether some type of remediation is warranted because chemical contamination poses or has the potential to pose a risk to human or ecological receptors. If contamination cannot reach a potential receptor exposure point, the contamination poses no risk.

In comparison to nondestructive chemical attenuation processes, destructive chemical attenuation processes result in the permanent removal of contaminant mass from the environment. Documenting and distinguishing the effects of destructive attenuation processes, such as biodegradation, from nondestructive attenuation processes is critical to evaluating the potential for RNA to bring about a reduction in contaminant mass over time. The effectiveness of destructive attenuation processes at reducing contaminant mass at a site depends on how susceptible the chemical is to biodegradation and whether the site is characterized by physical, chemical, and biological conditions favorable to such processes.

Numerous laboratory and field studies have shown that hydrocarbon-degrading bacteria can participate in the degradation of many of the chemical components of different types of fuels (e.g., gasoline) under both aerobic and anaerobic conditions. Biodegradation of fuel hydrocarbons will occur when an indigenous population of hydrocarbon-degrading microorganisms is present in the soil and groundwater, and sufficient concentrations of electron acceptors and nutrients, including fuel hydrocarbons, are available to these organisms. Soils and groundwater with a history of exposure to fuel hydrocarbon compounds, such as at the BX Service Station, generally contain microbial populations capable of facilitating biodegradation reactions (Wiedemeier *et al.,* 1995). The chemical basis for the biodegradation of BTEX is described in more detail in Section 7.4, where geochemical data relevant to documenting biodegradation at the field scale at the BX Service Station are presented.

7.3 EVIDENCE OF CONTAMINANT BIODEGRADATION OVER TIME

The first step in determining whether BTEX constituents are biodegrading in soils and groundwater at the BX Service Station was to compare contaminant concentrations at selected sampling locations over time. The purpose of this comparison was to assess the evidence of field-scale contaminant mass loss. Decreases in the magnitude of contaminant concentrations at a site over time that cannot be explained by physical processes (e.g., source removal, mass transport in groundwater) may be the first indication that contaminants are biodegrading at the site.

7.3.1 BTEX Concentration Trends in Soil

Biodegradation of soil BTEX present in the vadose zone can proceed if the soil particles to which the contaminants are adsorbed are covered with a water film that supports microbial populations. The presence of abundant soil moisture in the vadose zone can be inferred from the shallow water table depth, the relatively warm ambient air temperature, and presence of the asphalt/concrete cap that would inhibit evaporation of subsurface moisture into the atmosphere. These conditions are favorable to the growth of fuel-degrading microorganisms, and most likely result in anaerobic biodegradation of vadose zone contaminants over time.

Soil BTEX concentrations have decreased significantly since 1992. However, as discussed in Section 1.5, interim remediation systems have been in operation since May 1993. It is difficult to differentiate between BTEX reduction due to biodegradation and the interim remediation systems.

Results from the WEI (1997) report indicate that hydrocarbon concentrations decreased over the 1.5-year duration of their study as presented in Appendix B. The system was still operational (but not functioning at peak operating efficiency) when Parsons ES collected two soil samples in February 1998 (21 months after the DDC system began operation) to confirm the WEI results. As shown on Table 7.1 and Figure 7.1, hydrocarbon concentrations oscillated over the operational period, reflecting spatial heterogeneity in soil contaminant concentrations. However, the two most recent samples indicate an overall decrease in hydrocarbon concentrations.

7.3.2 BTEX Concentration Trends in Groundwater

Total BTEX concentrations measured at all monitoring wells from 1988 to 1998 are summarized in Table 7.2. Substantial oscillation in dissolved BTEX concentrations at the plume core (MW8-3, MW8-4, MW8-5, and MWA-11) during this period have been measured. These oscillations can be attributed to groundwater table fluctuations and the operation of interim remediation systems since May 1993. Furthermore, these oscillations, which range up to an order of magnitude, make it difficult to identify temporal trends in dissolved BTEX concentrations. However, the total BTEX plume length appears to have been relatively stable, as evidenced by consistent BTEX concentrations in downgradient well MWA-9. In addition, no BTEX concentrations have been detected in cross-gradient and downgradient monitoring wells MWA-6, MWA-7, MWA-8, MWA-10, MWA-10B, and MWA-13. Stable plume length indicates that the mass of BTEX input into the groundwater system in the source area (through leaching from residual BTEX in soils) is approximately equal to the mass of BTEX being removed via destructive attenuation processes (e.g., biodegradation).

7.4 EVIDENCE OF CONTAMINANT BIODEGRADATION VIA MICROBIALLY MEDIATED REDOX REACTIONS

BTEX constituents are typically utilized as electron donors in biologically mediated redox reactions under a wide range of geochemical conditions. Therefore, analytical data for potential electron acceptors can be used as geochemical indicators of BTEX biodegradation (Wiedemeier *et al.,* 1995). Reductions in the concentrations of oxidized chemical species that are used by microorganisms to facilitate the oxidation of fuel hydrocarbon compounds within contaminated media are an indication that contaminants are biodegrading. Alternately, an increase in the metabolic byproducts resulting from the reduction of electron acceptors can be used as an indicator of contaminant biodegradation. The availability of potential electron acceptors to participate in contaminant biodegradation reactions can be used to estimate the total contaminant mass that can be biodegraded over time at this site. Coupled with the biodegradation rates that will be determined later, this information can be used to predict how much and how quickly BTEX can be removed from saturated soils and groundwater at the BX Service Station as a result of natural processes only.

7.4.1 Relevance of Redox Couples in Biodegradation

Microorganisms obtain energy to replenish enzymatic systems and to reproduce by oxidizing organic matter. Biodegradation of dissolved BTEX is the result of a series of redox reactions that maintain the charge balance within the natural environment. Microorganisms facilitate the degradation of these organic compounds by transferring electrons from the electron donor (i.e., fuel hydrocarbons and native organic carbon) to available electron acceptors. Electron acceptors are elements or compounds that occur in relatively oxidized states and can participate in redox reactions involving these available electron donors. Electron acceptors known to be present in saturated soil and groundwater at the BX Service Station are oxygen, nitrate/nitrogen, sulfate, ferric iron, and carbon dioxide.

Microorganisms facilitate fuel hydrocarbon biodegradation to produce energy for their use. The amount of energy that can be released when a reaction occurs or is required to drive the reaction to completion is quantified by the free energy of the reaction (Stumm and Morgan, 1981). Microorganisms are able to utilize electron transport systems and chemiosmosis to combine energetically favorable and unfavorable reactions to produce energy for life processes (i.e., cell production and maintenance). Microorganisms will facilitate only those redox reactions that will yield energy. By coupling the oxidation of fuel hydrocarbon compounds, which requires energy, to the reduction of other compounds (e.g., oxygen, nitrate/nitrite, manganese, ferric iron, sulfate, and carbon dioxide), which yields energy, the overall reaction will yield energy. Detailed information on the redox reactions required to biodegrade dissolved BTEX is included in Table 7.3. The reader is encouraged to review this information to more fully understand the chemical basis of biodegradation.

Figure 7.1 illustrates the sequence of microbially mediated redox processes based on the amount of free energy released for microbial use. In general, reactions yielding more energy tend to take precedence over processes that yield less energy (Stumm and Morgan, 1981). As Figure 7.1 shows, oxygen reduction would be expected to occur in an aerobic environment with microorganisms capable of aerobic respiration because oxygen reduction yields significant energy. However, once the available oxygen is depleted and anaerobic conditions dominate the interior regions of the contaminant plume, anaerobic microorganisms can utilize other electron acceptors in the following order of preference: nitrate/nitrite, manganese, ferric iron, sulfate, and finally carbon dioxide. Each successive redox reaction provides less energy to the system, and each step down in redox energy yield would have to be paralleled by an ecological succession of microorganisms capable of facilitating the pertinent redox reactions.

The expected sequence of redox processes can be estimated by the oxidation/reduction potential (ORP) of the groundwater. The ORP measures the relative tendency of a solution or chemical reaction to accept or transfer electrons, and can be measured in the field. This measurement can be used as a crude indicator of which redox reactions may be operating at a site. High ORPs mean that the solution (or available redox couple) has a relatively high oxidizing potential.

Microorganisms can only facilitate the biodegradation (oxidation) of the fuel hydrocarbon compounds using redox couples that have a higher ORP than the contaminants. This is why these electron acceptors can be used to oxidize the fuel hydrocarbon compounds. The reduction of highly oxidized species results in an overall decrease in the oxidizing potential of the groundwater. As shown in Figure 7.1, the reduction of oxygen and nitrate will reduce the oxidizing potential to levels at which ferric iron (Fe^{3+}) reduction can occur. As each chemical species that can be used to oxidize the contaminants is exhausted, the microorganisms are forced to use other available electron acceptors with lower oxidizing capacity. When sufficiently low (negative) ORP levels have been developed as a result of these redox reactions, sulfate reduction, and methanogenesis can occur almost simultaneously (Stumm and Morgan, 1981).

ORP values measured in shallow groundwater at the BX Service Station in February 1998 ranged from -136.5 to -280 millivolts (mV) (Table 7.4). Areas with the lowest ORP measurements generally coincided with the presence of fuel-contaminated groundwater, indicating that the progressive use of electron acceptors in the order shown on Figure 7.1 has caused the groundwater in the contaminated areas to become more reducing. These data imply that oxygen, nitrate, manganese, and ferric iron may be used to biodegrade fuel hydrocarbon contaminants at this site. However, it has been noted that field ORP data alone cannot be used to reliably predict all of the electron acceptors that may be operating at a site, because the platinum electrode probes are not sensitive to some redox couples (e.g., sulfate/sulfide) (Stumm and Morgan, 1981). Analytical data on oxidized and reduced species are presented in the following subsections to verify which electron acceptors are actually being used to biodegrade the BTEX in saturated soil and groundwater at the BX Service Station.

Throughout the following subsections, the distributions of geochemical parameters are examined by comparing background concentrations to BTEX plume core concentrations. Analytical data from upgradient well MW8-1 and cross-gradient wells MWA-6 and MWA-10B are used for background concentrations. Analytical data from MW8-3, MW8-4 and MW8-5 are used for BTEX plume core concentrations. Although MWA-11 is located in source area (former UST pits), it is not used as plume core well because the active interim remediation system may have affected the geochemistry of the groundwater in this area.

7.4.2 Dissolved Oxygen

Almost all types of fuel hydrocarbons can be biodegraded under aerobic conditions (Borden, 1994). Mineralization of fuel hydrocarbons to carbon dioxide and water under aerobic conditions involves the use of oxygen as a cosubstrate during the initial stages of metabolism, and as a terminal electron acceptor during the later stages of metabolism for energy production. The reduction of molecular oxygen during the oxidation of the fuel hydrocarbon compounds yields a significant amount of free energy that the microorganisms could utilize.

DO concentrations were measured at groundwater sampling locations in February 1998. Table 7.4 presents the analytical results for DO by sampling location. As shown on the table, DO concentrations were uniformly low at all sampling locations (0.04 to 1.48 mg/l). The presence of the lowest observed DO concentration in the core of the dissolved BTEX plume and the highest DO concentration in a cross-gradient well is an indication that biodegradation through aerobic respiration is occurring. However, the overall low magnitude of DO concentrations indicates that oxygen is not currently a significant electron acceptor during microbially mediated degradation of fuel hydrocarbons at the BX Service Station.

7.4.3 Nitrate

Because anaerobic conditions generally prevail in the site groundwater, nitrate can be used as an electron acceptor by indigenous facultative anaerobes that mineralize fuel hydrocarbon compounds via either denitrification or nitrate reduction processes. Concentrations of nitrate (as nitrogen [N]) measured at the site in February 1998 are summarized in Table 7.4. Background nitrate (as N) concentrations measured in upgradient to cross-gradient wells MW8-1, MWA-6, and MWA-10B ranged from 0.65 to 1.21 mg/L and averaged 0.93 mg/L. Conversely, nitrate (as N) concentrations measured in plume core area wells exhibiting dissolved fuel contamination (MW8-3, MW8-4, and MW8-5) were all below the detection limit of 0.5 mg/L. These data indicate that nitrate concentrations within the dissolved plume are depleted relative to measured background concentrations. The results indicate that nitrate is being used to oxidize fuel hydrocarbons in the anaerobic core of the dissolved plumes via denitrification or nitrate reduction. The use of nitrate as an electron acceptor in microbially facilitated redox reactions is consistent with the range of ORP values measured at the BX Service Station (Figure 7.1). However, the low background nitrate (as N) concentrations appear to limit the importance of this degradation reaction at this site.

7.4.4 Ammonia

The presence of ammonia in groundwater can result from either nitrate reduction (facilitated by microbes) or fixing of atmospheric nitrogen (also a microbial process). Nitrate is not widespread in groundwater within the aquifer; however, the fixation of atmospheric nitrogen may occur under the anaerobic, methanogenic conditions observed at the site. The presence of ammonia in groundwater is a strong indication of microbial activity.

Ammonia (as N) concentrations measured in groundwater samples collected in February 1998 are summarized in Table 7.4. Ammonia was detected in all of the samples analyzed. The pale-yellow natural color of the shallow groundwater may have interfered with the ammonia analysis, causing the concentrations to be biased high. Ammonia concentrations detected in shallow groundwater varied across the site, with elevated ammonia concentrations occurring in the BTEX plume core area. Therefore, production of ammonia appears to be occurring due to increased microbial activity stimulated by the relative abundance of organic carbon (fuel hydrocarbons).

7.4.5 Manganese

Manganese also can be used as an electron acceptor to facilitate the oxidation of the fuel hydrocarbons in groundwater under anaerobic and slightly reducing conditions. As shown on Figure 7.1, manganese reduction can be microbially facilitated in groundwater conditions similar to those required to support denitrification. The reduction of manganese during the oxidation of fuel hydrocarbon compounds yields essentially as much free energy to the system as aerobic respiration. Under anaerobic and slightly reducing groundwater conditions, manganese reduction is the second-most energetically favorable redox reaction that can be used to oxidize (degrade) fuel hydrocarbon compounds.

Reduced forms of manganese were targeted for analysis at groundwater sampling locations in February 1998. Reduced forms of manganese would be produced locally if oxidized forms of manganese were being used as electron acceptors to oxidize other compounds, such as fuel hydrocarbons. As shown on Table 7.4, reduced manganese was not detected. Although the ORP data collected at the site imply that manganese could be involved in fuel hydrocarbon degradation reactions, the lack of significant concentrations of manganese minimizes the importance of this degradation reaction at the BX Service Station.

7.4.6 Ferrous Iron

Although relatively little is known about the anaerobic metabolic pathways involving the reduction of ferric iron (Fe^{3+}), this process has been shown to be a major metabolic pathway for some microorganisms (Lovley and Phillips, 1988; Chapelle, 1993). Elevated concentrations of ferrous iron (Fe^{2+}) often are found in anaerobic, fuel-contaminated groundwater systems. Concentrations of dissolved ferrous iron once were attributed to the spontaneous and reversible reduction of ferric oxyhydroxides, which are thermodynamically unstable in the presence of organic compounds such as benzene. However, more recent studies suggest that the reduction of ferric iron cannot proceed at all without microbial mediation (Lovley and Phillips, 1988; Lovley *et al.*, 1991; Chapelle, 1993). None of the common organic compounds found in low-temperature, neutral, reducing groundwater could reduce ferric oxyhydroxides to ferrous iron under sterile laboratory conditions (Lovley *et al.*, 1991). This means that the reduction of ferric iron to ferrous iron requires mediation by microorganisms with the appropriate enzymatic capabilities.

To determine if ferric iron is being used as an electron acceptor for fuel biodegradation at the BX Service Station, ferrous (reduced) iron concentrations were measured at groundwater sampling locations in February 1998. Low ferrous iron concentrations were detected in the BTEX plume core wells (0.05 mg/L to 1.11 mg/L). The occurrence of ferrous iron concentrations within contaminated areas indicates that ferric iron is acting as an electron acceptor at these locations. In addition, the measured redox potentials of the groundwater at this site are within the range that would be expected for the ferric iron-reducing conditions implied by the observed ferrous iron distributions (Figure 7.1).

7.4.7 Sulfate

Sulfate also may be used as an electron acceptor during microbial degradation of fuel hydrocarbons under anaerobic conditions (Grbic-Galic, 1990). Sulfate can be reduced to sulfide during the oxidation of the fuel hydrocarbon compounds. The presence of decreased concentrations of sulfate (and increased concentrations of sulfide) in the source area relative to background concentrations indicates that sulfate is participating in redox reactions at the site. To investigate the potential for sulfate reduction at the BX Service Station, sulfate and sulfide concentrations were measured during the February 1998 groundwater sampling event.

Table 7.4 shows the analytical results for sulfate and sulfide in groundwater at the BX Service Station. In general, areas characterized by elevated concentrations of dissolved BTEX are depleted in sulfate concentrations relative to measured background concentrations. Background concentrations of sulfate at the site ranged from 7.38 mg/L at well MWA-10B to 30.11 mg/L at MWA-6. Sulfate concentrations measured at plume core area wells exhibiting dissolved fuel contamination (MW8-3, MW8-4, and MW8-5) ranged from 2.11 mg/L to 4.79 mg/L. This general depletion of sulfate within the contaminated areas indicates that this compound is acting as an electron acceptor during fuel biodegradation reactions.

Table 7.4 also shows that elevated concentrations of sulfide, which can be produced when sulfate is reduced during fuel hydrocarbon oxidation, generally coincide with depleted sulfate concentrations and elevated fuel hydrocarbon concentrations. The apparent production of sulfide within the contaminated area supports the observation that microbial populations are using sulfate to oxidize fuel hydrocarbons at the site.

The measured ORPs of the groundwater at this site are not within the range that would be expected for the sulfate-reducing conditions implied by the observed sulfate and sulfide distributions. However, as described in Section 7.4.1, field ORP data alone cannot be used to reliably predict the electron acceptors that may be operating at a site.

7.4.8 Dissolved Methane

On the basis of free energy yield and the oxidizing potential of the site groundwater, the carbon dioxide/methane (CO_2/CH_4) redox couple also could be used to oxidize fuel hydrocarbon compounds to carbon dioxide and water once the groundwater is sufficiently reducing. To attain these reducing levels, other highly oxidizing chemical species such as oxygen, nitrate, ferric iron, and sulfate must first be reduced. This redox reaction is called methanogenesis or methane fermentation. Methanogenesis yields the least free energy to the system in comparison to other chemical species (Figure 7.1 and Table 7.3). The presence of methane in groundwater at elevated concentrations relative to background concentrations is a good indicator of methane fermentation.

Dissolved methane was measured at groundwater monitoring wells sampled during the February 1998 sampling event. Table 7.4 presents the analytical data for methane. Methane concentrations detected at the contaminant source area were substantially elevated relative to background concentrations. Methane concentrations measured at plume core area wells MW8-3, MW8-4, and MW8-5 ranged from 1.1 mg/L to 4.9 mg/L and averaged 3.6 mg/L. In contrast, background concentrations ranged from 0.0031 mg/L to 0.062 mg/L. The presence of elevated methane levels in groundwater at the BX Service Station strongly indicates that biodegradation is occurring via methanogenesis.

7.4.9 pH

The pH of groundwater samples collected from groundwater monitoring wells in February 1998 was measured (Table 7.4). The pH of a solution is the negative logarithm of the hydrogen ion concentration [H^+]. Groundwater pH values measured at the site were slightly acidic, ranging from 5.51 to 6.68 standard units. This range of pH is within or near the optimal range for fuel hydrocarbon-degrading microbes of 6 to 8. The presence of more acidic pH values indicates that the groundwater alkalinity may be insufficient to fully buffer the groundwater pH against the organic acids produced during microbial reactions.

7.4.10 Temperature

Groundwater temperature was measured at groundwater monitoring wells in February 1998 (Table 7.4). Temperature affects the types and growth rates of bacteria that can be supported in the groundwater environment, with higher temperatures generally resulting in higher growth rates. The temperature of groundwater samples collected from the shallow monitoring wells varied from 19.3 degrees Celsius (°C) to 23.0 °C. These relatively warm temperatures should promote microbial growth and may enhance rates of hydrocarbon biodegradation.

7.5 THEORETICAL ASSIMILATIVE CAPACITY ESTIMATES

The preceding discussions have been devoted to determining if fuel hydrocarbons are biodegrading in saturated soils and groundwater at the BX Service Station. Analytical data on reduced and oxidized chemical species indicate that indigenous microorganisms are facilitating the oxidation of fuel hydrocarbons and the reduction of electron acceptors to generate free energy for cell maintenance and production. The question of how much contaminant mass can be biodegraded must be addressed to assess the full potential for long-term intrinsic bioremediation to minimize plume size and mass over time.

Mass balance relationships can be used to determine how much contaminant mass can be degraded by each of the redox reactions that the microorganisms might use to make free energy available for cell maintenance and production. The stoichiometric relationship between the contaminant and the electron acceptor can be used to estimate the expressed assimilative capacity of the groundwater. Once the redox reactions operating at the site have been defined, it is possible to estimate how much contaminant mass can be assimilated or oxidized by available electron acceptors.

Table 7.3 presents the coupled redox reactions that represent the biodegradation of the individual BTEX compounds, including the stoichiometric mass ratio of electron acceptors needed to oxidize each compound. These stoichiometric mass ratios can be used to estimate the assimilative capacity of the groundwater at the BX Service Station. For oxygen, nitrate, and sulfate, this is accomplished by first determining the initial (background) mass of each electron acceptor available in the groundwater. Data on these chemical species were collected at sampling locations upgradient and cross-gradient from the dissolved plume. As groundwater slowly migrates into the source area, electron acceptors are brought into contact with hydrocarbon-degrading microorganisms and site contamination. The change in the electron acceptor mass from background sampling locations to sampling locations within the plume core is divided by the mass of electron acceptors required to mineralize BTEX. For ferrous iron, ammonia, and methane, the highest observed concentration in the BTEX plume core wells is the divided by the mass of electron acceptors required to mineralize BTEX. However, the change in ammonia mass was used to correct for the natural yellow color of the groundwater at the site. These numbers are summed to estimate the expressed intrinsic capacity of the groundwater to biodegrade BTEX.

Estimates of the background and plume core concentrations were used to calculate the expressed assimilative capacity of the groundwater system attributable to aerobic respiration and sulfate reduction (Table 7.5). Table 7.5 also presents the source area concentrations of ammonia, ferrous iron, and methane. These concentrations are used to "back-calculate" the expressed assimilative capacity that is attributable to nitrogen fixation, ferric iron reduction, and methanogenesis. Nitrate is not listed in Table 7.5. As discussed above, nitrate is ultimately reduced to ammonia; however, ammonia can be produced from the reduction of nitrate and from fixation of atmospheric nitrogen. Therefore, only ammonia is used to calculate the intrinsic capacity. On the basis of these calculations, one pore volume of saturated soils and groundwater at the BX Service Station has the capacity to oxidize an average BTEX concentration of approximately 11.2 mg/L (11,200 µg/L). As shown in Table 7.5, this capacity is lower than the maximum BTEX concentration detected in groundwater at the BX Service Station.

This estimate essentially represents an estimate of the BTEX reduction capability of one pore volume of groundwater at the BX Service Station. The estimate identifies how much contaminant mass can be theoretically oxidized as one pore volume travels through the plume core. In reality, over 4 pore volumes are expected to move through the contaminated aquifer material in the source area each year based on the estimated groundwater velocity of 460 ft/yr.

A closed system containing 2 liters of water can be used to help visualize the physical meaning of assimilative capacity. Assume that the first liter contains no fuel hydrocarbons, but it contains fuel-degrading microorganisms and has an assimilative capacity of exactly "x" mg 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 fuel hydrocarbons will not occur. If these 2 liters are combined in a closed system, biodegradation will commence and continue until the fuel hydrocarbons or electron acceptors are depleted. If less than "x" mg of fuel hydrocarbons are in the second liter, all of the fuel hydrocarbons will eventually degrade given a sufficient time; likewise, if greater than "x" mg of fuel hydrocarbons were in the second liter of water, only "x" mg of fuel hydrocarbons would ultimately degrade.

This example shows that in a closed system, the measured expressed assimilative capacity eventually should be equivalent to the loss in contaminant mass; however, the groundwater beneath the site is an open system. Electron acceptors can continually enter the system from upgradient flow. Furthermore, contaminant mass can be added to the system through dissolution or leaching from LNAPL or contaminated soils. This means that the assimilative capacity is not fixed as it would be in a closed system, and therefore should not be quantitatively compared to concentrations of dissolved contaminants in the groundwater. Rather, the expressed assimilative capacity of groundwater is intended to serve as a qualitative tool. The fate of BTEX in groundwater is dependent on the relationship between the kinetics of biodegradation and the solute transport velocities (Chapelle, 1994).

7.6 FATE AND TRANSPORT OF BTEX

7.6.1 Migration of BTEX Without Biodegradation

In the absence of biodegradation, the dissolved BTEX migration distance can be approximated by dividing the seepage velocity (V_s) by the retardation coefficient (R).

7.6.1.1 Seepage Velocity (V_s)

Seepage velocity is the actual interstitial groundwater velocity. It is defined as the hydraulic conductivity (K) times the hydraulic gradient (dH/dL) divided by the effective porosity (n_e).

$$V_s = \left(\frac{K}{n_e}\right)\left(\frac{dH}{dL}\right)$$

Seepage velocity was calculated in Section 3.3 to be approximately 292 feet per year.

7.6.1.2 Retardation Coefficient (R)

The retardation coefficient is a measure of the degree of retardation of dissolved organic chemical movement through the aquifer. Retardation coefficients are calculated using the following formula:

$$R=1+(K_d\rho_b/n_e)$$

where

$K_d = (K_{oc})(f_{oc})$

K_{oc} = Organic Carbon Partition Coefficient

f_{oc} = Fraction Organic Carbon

ρ_b = Soil Bulk Density of Aquifer Matrix

n_e = Effective Porosity

An average retardation value for the dissolved BTEX plume at the BX Service Station of 4.27 was calculated in Table 7.6.

7.6.1.3 BTEX Migration

Using the values described above, the average BTEX migration distance in the absence of biodegradation should be approximately 68 feet per year. As described in Section 1.5, the fuel release was discovered in 1987 during tank closure activities; it is likely that the release occurred before 1987. If 1986 is conservatively assumed to be the release year (12 years of plume migration), the calculated plume length should be approximately 815 feet if biodegradation was not occurring. As shown on Figure 5.1, the maximum plume length in 1998 was approximately 520 feet. Furthermore, the data in Table 7.2 indicate that the plume length has been stable for at least 6 years (since 1992). The stable plume length and the disparity between the calculated plume length in the absence of biodegradation and measured site conditions support the conclusions of Sections 7.4 and 7.5 that significant biodegradation of dissolved BTEX is occurring at the BX Service Station.

7.7 CONCLUSIONS

The following conclusions can be drawn:

- Concentrations of target analytes in all sampled media do not exceed applicable MDEQ (1996) RBSLs or OSHA PELs (NIOSH, 1997), and detected concentrations of total lead in groundwater do not pose a risk to potential receptors;
- Geochemical data strongly indicate that biodegradation of fuel hydrocarbons is occurring at the site, primarily via the anaerobic processes of sulfate reduction, nitrogen fixation, and methanogenesis;
- Previous and current interim source removal efforts have reduced hydrocarbon concentrations in vadose and saturated zone soils, and the current system does not have an adverse effect on the natural attenuation processes at the site;
- Available data indicate that the dissolved plume is stable, is entirely contained within the existing monitoring well network, and should not impact potential downgradient receptors;
- Keesler AFB is an active Base where institutional controls can be maintained with a high level of confidence; and
- None of the potential exposure pathways described in Section 4.4 are considered complete.

The USEPA Office of Solid Waste and Emergency Response (OSWER) has written the Interim Final *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites* (USEPA, 1997b). This document outlines a process for determining if a site would be appropriate for monitored natural attenuation.

Per the above conclusions, monitored natural attenuation is appropriate for the BX Service Station. A LTM plan is outlined in Section 8.

Institutional controls should be implemented to ensure that exposure pathways to receptors cannot be completed. The institutional controls will be in accordance with the Land Use Controls Assurance Plan (LUCAP) that is currently being prepared for Keesler Air Force Base. The LUCAP will be prepared in accordance with EPA Region 4 Federal Facilities Branch Policy (Memorandum from EPA Region 4 Federal Facilities Branch, Assuring Land Use Controls at Federal Facilities, undated). The specific land use controls will be listed in the Land Use Control Implementation Plan (LUCIP) which will be attached to Decision Document that will be prepared for this site.

Continued operation of the interim system is not required to meet MDEQ (1996) RBSLs. Therefore, unless further assessment of the effectiveness of the system is desired, system operation should be discontinued.

TABLE 7.1
HISTORICAL COMPARISON OF SOIL ANALYTICAL DATA
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Analyte	Units	Sample Locations, Intervals, and Dates							
		B3 9[a/] 23-Apr-96	B3 9 29-Apr-97	B3 10 24-Oct-97	SBA-17 9.5 - 10.5 18-Feb-98	B1 9 23-Apr-96	B1 9 29-Apr-97	B1 9 24-Oct-97	SBA-18 8.5 - 9.5 18-Feb-98
Benzene	mg/Kg[b/]	4.9	0.06	3.1	0.22	28	0.28 U[c/]	0.10 U	5.4 U
Ethylbenzene	mg/Kg	7	0.08	37	0.09	72	0.34	5.7	4.2
Toluene	mg/Kg	30	0.48	95	0.75	180	1.6	29	12
Xylenes (total)	mg/Kg	51	1.7	190	0.58	360	11	150	150
Total BTEX[d/]	mg/Kg	92.9	2.32	325.1	1.64	640	12.94	184.7	166.2
Naphthalene	mg/Kg	9.4	0.65	31	0.27	41	3.3	51	2.1

Notes:

a/ depth in feet below ground surface.

b/ mg/kg = Milligrams per kilogram.

c/ U = The analyte was analyzed for and is not present above the reporting limit.

BTEX = benzene, toluene, ethylbenzene, and total xylenes

B3 was advanced by Wasatch at the same location as SBA-17

B1 was advanced by Wasatch at the same location as SBA-18

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TABLE 7.2
HISTORICAL SUMMARY OF BTEX CONCENTRATIONS IN GROUNDWATER
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Date	Units	Sampling Location										
		MW8-1	MW8-2	MW8-3	MW8-4	MW8-5	MWA-6	MWA-7	MWA-8	MWA-9	MWA-10[c/]	MWA-10B
January-88	µg/L[a/]	NM[b/]	4,413	37,110	415	1,588	NM	NM	NM	NM	NM	NM
April-88	µg/L	NM	12,890	14,196	895	184	NM	NM	NM	NM	NM	NM
November-92	µg/L	4U	3,251	21,700	12	272	4U	4U	4U	159	4U	NM
May-96	µg/L	NM	NM	14,000	2,490	NM	NM	NM	NM	159	NM	NM
June-96	µg/L	NM	NM	1,052	1,088	NM	NM	NM	NM	37	NM	NM
July-96	µg/L	NM	NM	1,670	436	NM	NM	NM	NM	20	NM	NM
August-96	µg/L	NM	NM	5,184	512	NM	NM	NM	NM	56	NM	NM
September-96	µg/L	NM	NM	28,700	1,240	NM	NM	NM	NM	26	NM	NM
November-96	µg/L	NM	NM	33,100	1,520	NM	NM	NM	NM	NM	NM	NM
January-97	µg/L	NM	NM	11,090	1,770	NM	NM	NM	NM	NM	NM	NM
April-97	µg/L	NM	NM	9,040	3,170	NM	NM	NM	NM	NM	NM	NM
August-97	µg/L	NM	NM	13,100	2,560	NM	NM	NM	NM	8U	NM	NM
October-97	µg/L	NM	NM	17,600	1,060	NM	NM	NM	NM	NM	NM	NM
February-98	µg/L	8U	NM	22,400	1,779	2,860	8U	NM	NM	53	NM	8U

Notes:
a/ µg/L = Micrograms per liter.
b/ NM = Not Measured.
c/ MW-10 was destroyed and replaced with MW-10B.
BTEX = Benzene, Toluene, Ethylbenzene, and Total Xylenes.

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TABLE 7.2 (Continued)
HISTORICAL SUMMARY OF BTEX CONCENTRATIONS IN GROUNDWATER
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

		Sampling Location				Averages		
Date	Units	MWA-11	MWA-12	MWA-13		MW8-3, MW8-4, MW8-5	MW8-3, MW8-4, MW8-11	All MWs
January-88	µg/L	NM	NM	NM		13,038	NM	NM
April-88	µg/L	NM	NM	NM		5,092	NM	NM
November-92	µg/L	3,790	4U	4U		7,328	8,501	4,864
May-96	µg/L	2,090	NM	NM		NM	6,193	NM
June-96	µg/L	4,912	NM	NM		NM	2,351	NM
July-96	µg/L	2,423	NM	NM		NM	1,510	NM
August-96	µg/L	2,260	NM	NM		NM	2,652	NM
September-96	µg/L	2,150	NM	NM		NM	10,697	NM
November-96	µg/L	12,940	NM	NM		NM	15,853	NM
January-97	µg/L	7,000	NM	NM		NM	6,620	NM
April-97	µg/L	1,320	NM	NM		NM	4,510	NM
August-97	µg/L	420	NM	NM		NM	5,360	NM
October-97	µg/L	80	NM	NM		NM	6,247	NM
February-98	µg/L	3,200	NM	8U		9,013	9,126	6,058

Notes:
a/ µg/L = Micrograms per liter.
b/ NM = Not Measured.
c/ MW-10 was destroyed and replaced with MW-10B.
BTEX = Benzene, Toluene, Ethylbenzene, and Total Xylenes.

TABLE 7.3
COUPLED OXIDATION REACTIONS FOR BTEX COMPOUNDS
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Coupled Benzene Oxidation Reactions	ΔG°_r (kcal/mole Benzene)	ΔG°_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
$60H^+ + 30\underline{Fe(OH)_{3,a}} + C_6H_6 \Rightarrow 6CO_2 + 30Fe^{2+} + 78H_2O$ *Benzene oxidation / iron reduction*	-560.10	-2343	21.5:1
$7.5H^+ + 3.75SO_4^{2-} + C_6H_6 \Rightarrow 6CO_{2,g} + 3.75H_2S^o + 3H_2O$ *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
$4.5H_2O + C_6H_6 \Rightarrow 2.25CO_{2,g} + 3.75CH_4$ *Benzene oxidation / methanogenesis*	-32.40	-135.6	0.77:1

Coupled Toluene Oxidation Reactions	ΔG°_r (kcal/mole Toluene)	ΔG°_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
$72H^+ + 36\underline{Fe(OH)_{3,a}} + C_6H_5CH_3 \Rightarrow 7CO_2 + 36Fe^{2+} + 94H_2O$ *Toluene oxidation / iron reduction*	-667.21	-2792	21.86:1
$9H^+ + 4.5SO_4^{2-} + C_6H_5CH_3 \Rightarrow 7CO_{2,g} + 4.5H_2S^o + 4H_2O$ *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 7.3 (CONTINUED)
COUPLED OXIDATION REACTIONS FOR BTEX COMPOUNDS
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Coupled Ethylbenzene Oxidation reactions	ΔG°_r (kcal/mole Ethyl-benzene)	ΔG°_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
$84H^+ + \underline{42Fe(OH)_{3,a}} + C_6H_5C_2H_5 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H_2O$ *Ethylbenzene oxidation / iron reduction*	-778.48	-3257	22:1
$10.5H^+ + 5.25SO_4^{2-} + C_6H_5C_2H_5 \Rightarrow 8CO_{2,g} + 5.25H_2S^o + 5H_2O$ *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	ΔG°_r (kcal/mole *m*-xylene)	ΔG°_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
$84H^+ + \underline{42Fe(OH)_{3,a}} + C_6H_4(CH_3)_2 \Rightarrow 8CO_2 + 42Fe^{2+} + 110H_2O$ *m-Xylene oxidation / iron reduction*	-775.61	-3245	22:1
$10.5H^+ + 5.25SO_4^{2-} + C_6H_4(CH_3)_2 \Rightarrow 8CO_{2,g} + 5.25H_2S^o + 5H_2O$ *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

TABLE 7.4
SUMMARY OF GROUNDWATER GEOCHEMICAL DATA
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

		Sample Location and Date									
Analyte	**Units**	MW8-1 20-Feb-98	MW8-3 20-Feb-98	MW8-4 20-Feb-98	MW8-5 20-Feb-98	MWA-6 19-Feb-98	MWA-9 19-Feb-98	MWA-10B 20-Feb-98	MWA-11 19-Feb-98	MWA-13 19-Feb-98	MWA-14 19-Feb-98
Ferrous Iron	mg/L	0.09	1.11	0.05	0.33	1.46	0.23	4.14	0.47	1.50	NM
Manganese	mg/L	.33U	.33U	.33U	.33U	.33U	.33U	.33U	.33U	.33U	NM
Sulfate	mg/L	17.00	4.79	2.11	3.80	30.11	13.66	7.38	38.50	27.64	NM
Sulfide	mg/L	0.235	1.140	1.625	2.800	0.118	0.590	0.027	2.025	0.066	NM
Alkalinity	mg/L	74	228	164	32	30	72	207	52	78	NM
Ammonia-N	mg/L	0.6	2	3	2	0.8	0.4	0.8	2	0.4	NM
Methane	mg/L	0.062	1.1	4.7	4.9	NM	0.078	0.0031	0.750	NM	NM
Nitrate-N	mg/L	1.21J	0.14J	0.5U	0.5U	NM	0.65	0.65	0.5U	NM	NM
Temperature	Deg C	20.4	20.2	20.4	23.0	19.9	22.0	19.3	22.7	20.2	23.4
pH	SU	5.88	6.26	6.17	5.51	5.71	6.17	6.68	6.31	6.01	5.56
Conductivity	µS/cm	219	450	325	98	189	200	405	180	210	70
Dissolved Oxygen	mg/L	0.33	0.26	0.04	0.16	0.30	0.41	1.48	0.24	0.29	0.20
ORP	mV	-184.0	-259.6	-280.0	-232.0	-134.0	-204.0	-136.5	-264.9	-172.9	-244.0

Notes:

Methane and Nitrate analysis performed by Quanterra Laboratories of Arvada, Colorado; all other analyses performed in the field.

J1 = The analyte was positively identified and has a concentration between the method detection limit and the reporting limit.

U = The analyte was analyzed for and is not present above the reporting limit.

ORP = oxidation reduction potential

mg/L = milligrams per Liter — µS/cm = microsiemen per centimeter

Deg C = degrees Celcius — mV = millivolt

SU = Standard Units — NM = not measured

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TABLE 7.5
ESTIMATED ASSIMILATIVE CAPACITY OF SATURATED SOIL AND GROUNDWATER
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Electron Acceptor or Metabolic Byproduct	Background Concentration (mg/L)[b/]	Concentration in Core of Plume (mg/L)	Mass Ratio of Electron Acceptor/ Byproduct to BTEX (unitless)	BTEX Assimilative Capacity[a/] (mg/L)
Oxygen	0.70	0.04	3.14	0.21
Ferrous Iron	NA[c/]	1.11	21.8	0.05
Sulfate	18.16	2.11	4.7	3.41
Ammonia[d/]	0.90	3.87	2.36	1.26
Methane	NA	4.90	0.78	6.28
	Total			11.22
	Max. 1998 Concentration			22.40

a/ Calculation based on the ratio of the total mass of electron acceptor required to oxidize a given mass of BTEX.

b/ mg/L = milligrams per liter.

c/ NA = Not Applicable.

d/ Concentration of ammonia = concentration of ammonia reported as N x 1.29 to convert to ammonia as NH_4.

TABLE 7.6
RETARDATION COEFFICIENT CALCULATION
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Compound	K_{oc} (L/kg [a/])	Average Fraction Organic Carbon [b/]	Distribution Coefficient K_d (L/kg) Average[c/]	Bulk Density (kg/L)[d/]	Effective Porosity [e/]	Coefficient of Retardation
Benzene	79	0.0017	0.1343	1.7	0.25	1.91
Toluene	190	0.0017	0.323	1.7	0.25	3.20
Ethylbenzene	468	0.0017	0.7956	1.7	0.25	6.41
m-xylene	405	0.0017	0.6885	1.7	0.25	5.68
o-xylene	422	0.0017	0.7174	1.7	0.25	5.88
p-xylene	357	0.0017	0.6069	1.7	0.25	5.13
Average[f/]						4.27

Notes:

a/ From technical protocol (Wiedemeier *et al.*, 1996)

b/ From laboratory analyses of site soil samples

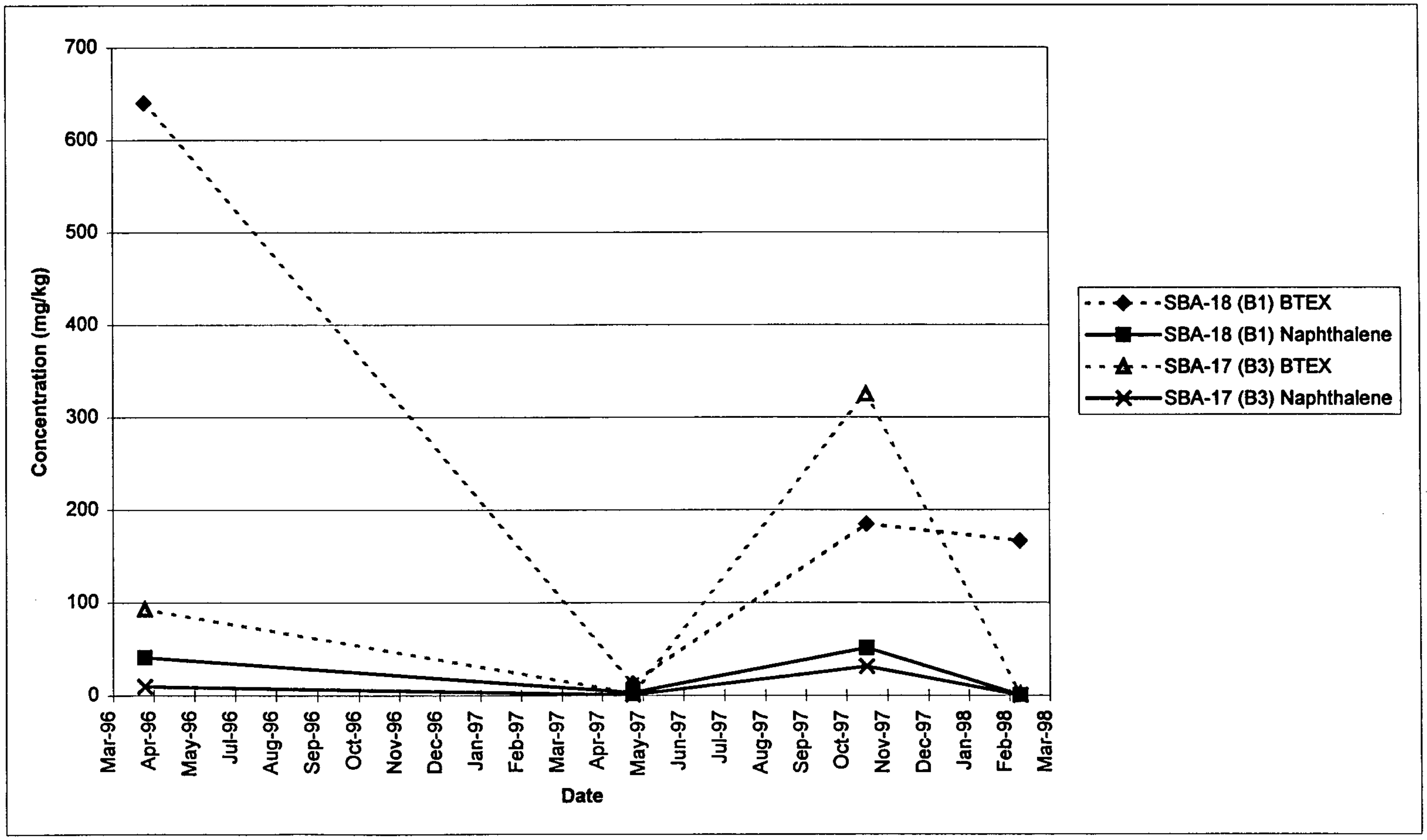
c/ K_d = Average Fraction Organic Carbon x K_{oc}

d/ Estimated Value

e/ Estimated Value

f/ Average is the average of benzene, toluene, ethylbenzene, and total xylenes

FIGURE 7.1
HISTORICAL COMPARISON OF SOIL ANALYTICAL DATA
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi



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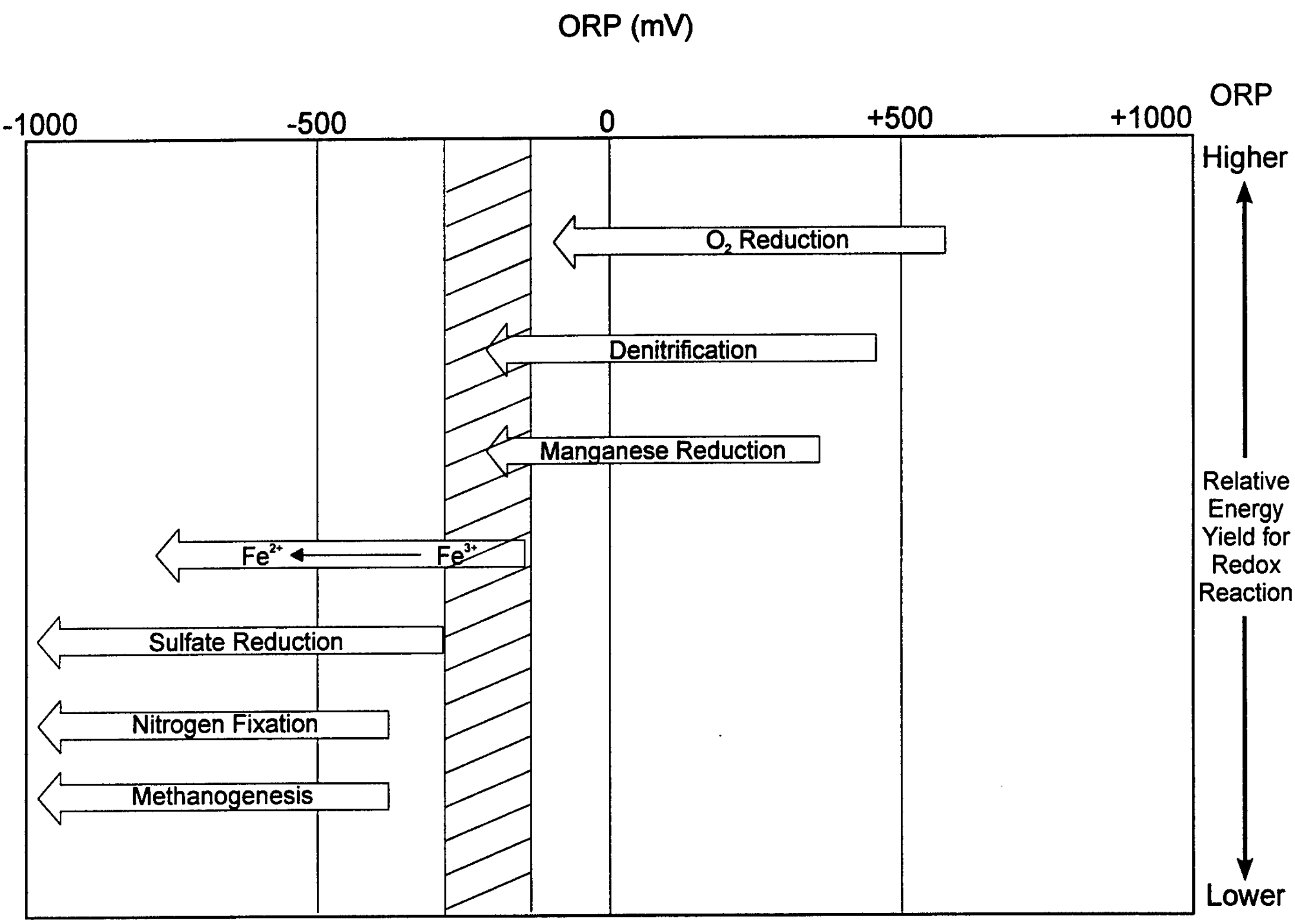

Notes

ORP = Oxidation Reduction Potential

Range of ORP measured at the BX Service Station

1. These reactions would be expected to occur in sequence if the system is moving toward equilibrium.

2. These redox processes occur in order of their energy-yielding potential (provided microorganisms are available to mediate a specific reaction). Reduction of a highly oxidized species decreases the ORP of the system.

3. The ORP of the system determines which electron acceptors are available for organic carbon oxidation.

4. Redox reaction sequence is paralleled by an ecological succession of biological mediators.

Adapted from Stumm and Morgan, 1981.

FIGURE 7.2

SEQUENCE OF MICROBIALLY MEDIATED REDOX PROCESSES

Risk-Based Approach to Remediation
BX Service Station
Keesler AFB, Mississippi

PARSONS ENGINEERING SCIENCE, INC.
Atlanta, Georgia

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SECTION 8
LONG-TERM MONITORING PLAN

8.1 OVERVIEW

At the BX Service Station, a long-term monitoring (LTM) plan that combines three tasks is recommended. These tasks include 1) performance monitoring; 2) institutional controls; and 3) long-term managed care. A full scale LTM plan including a Sampling and Analysis Plan (SAP) and a Health and Safety Plan (HSP) should be developed before these tasks are implemented.

8.2 PERFORMANCE MONITORING

The objectives of the performance monitoring are as follows:

- Demonstrate that natural attenuation is occurring according to expectations;
- Determine if the dissolved plume is expanding (either downgradient, laterally or vertically);
- Ensure no impact to downgradient receptors;
- Detect new releases of contaminants to the environment that could impact the effectiveness of the natural attenuation remedy;
- Demonstrate the efficacy of institutional controls that were put in place to protect potential receptors; and
- Detect changes in environmental conditions that may reduce the efficacy of any of the natural attenuation processes (USEPA, 1997).

The performance monitoring task of the LTM plan consists of identifying groundwater sampling locations and developing a sampling and analysis strategy. In the event that data collected under this LTM program indicate that RNA is insufficient to be protective of human health and the environment, additional engineered controls to augment the beneficial effects of RNA may be necessary. A site-specific groundwater SAP should be prepared prior to initiating the LTM program.

8.2.1 Performance Monitoring Wells

A total of 9 monitoring wells should be included in the LTM program. These wells include MW8-1, MW8-3, MW8-4, MW8-5, MWA-7, MWA-8, MWA-9, MWA-11, and MWA-13. The wells include four wells without hydrocarbon concentrations (one upgradient and three downgradient) and five wells with historical hydrocarbon concentrations (Figure 2.1 and Table 7.2).

8.2.2 Sampling Duration and Frequency

As discussed in Section 7.7, groundwater contaminant levels are below the required cleanup levels as long as land utilization does not change. Typically, groundwater monitoring is continued after cleanup levels have been achieved to ensure that concentration levels are stable and remain below target levels (USEPA, 1997). Five years of groundwater monitoring is recommended to accomplish this objective.

Monitoring should occur quarterly for the first year and annually for the second through fifth years.

8.2.3 Analytical Protocol

All performance monitoring wells will be sampled and analyzed to verify the effectiveness of naturally-occurring remediation processes at the site. At the beginning of each sampling event, water levels should be measured in all site monitoring wells. Groundwater samples collected from the performance monitoring wells should be analyzed for the parameters listed in Table 8.1. Any changes to the analytical protocol, such as the addition of MTBE, will be addressed in the SAP.

8.3 INSTITUTIONAL CONTROLS

As discussed in Section 7.7, institutional controls need to be implemented at the BX Service Station to ensure protectiveness of human health and the environment. Appropriate land use controls will be determined by the Base LUCAP and site-specific LUCIP. These plans will be reviewed by the USEPA and MDEQ prior to implementation of the LTM plan.

8.4 LONG-TERM MANAGED CARE

If the five-year monitoring period confirms that contamination has remained below target cleanup levels, performance monitoring and source removal system operation would cease and the site would be placed in an inactive (but managed) status. Groundwater monitoring would be resumed if land use and/or ownership at the site changed (e.g. became residential). Implementation of this alternative would require that the site remain administratively "on the books" during the inactive period so that the proper institutional controls were enforced (e.g. restriction of water withdrawal points from the shallow aquifer) and the appropriate personnel remained aware of the site's status.

TABLE 8.1
LONG-TERM GROUNDWATER MONITORING ANALYTICAL PROTOCOL
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
Ferrous Iron (Fe^{2+})	Colorimetric A3500-Fe D or Hach 25140-25	Filter if turbid	May indicate an anaerobic degradation process due to the depletion of oxygen, nitrate, and manganese	Each sampling event	Collect 100 mL of water in a glass container; for Method A3500-FeD, acidify with hydrochloric acid per method	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 well-head using a flow-through cell	Field
Dissolved Oxygen	Dissolved oxygen meter	Measure at well-head; refer to Method A4500 for a comparable laboratory procedure	Purging adequacy; concentrations less than 1 mg/L generally indicate an anaerobic pathway	Each sampling event	Measure at well-head using a flow-through cell	Field
pH	E150.1/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
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
Ammonia (NH_3)	CHEMetrics Method 1510, ASTM 4500: NH3	Filter if turbid	Most reduced form of nitrogen; metabolic byproduct of anaerobic microbial respiration	Each sampling event	Collect 100 mL of water in a glass or plastic container	Field

TABLE 8.1 (Continued)
LONG-TERM GROUNDWATER MONITORING ANALYTICAL PROTOCOL
BX Service Station, Area of Concern A (ST-06)
Keesler AFB
Biloxi, Mississippi

Analyte	Method/Reference	Comments	Data Use	Recommended Frequency of Analysis	Sample Volume, Sample Container, Sample Preservation	Field or Fixed-Base Laboratory
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)
Oxidation-Reduction Potential (ORP)	A2580 B, direct-reading meter	Measurements are made with electrodes; results are displayed on a meter; samples should be protected from exposure to atmospheric oxygen	The redox potential of groundwater influences and is influenced by biologically 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
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 the USEPA National Risk Management Research Laboratory	The presence of methane indicates the presence of sufficiently reducing conditons 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
Aromatic Volatile Organics	GC method SW8021B	Replaces Method SW8020	Measured for regulatory compliance. BTEX is the primary target analyte for monitoring natural attenuation.	Each sampling event	Collect water samples in a 40 mL VOA vial; cool to 4°C; add hydrochloric acid to pH < 2	Fixed-base

Notes:
a/ Handbook refers to the AFCEE (1993) "Handbook for the Installation Restoration Program (IRP) Remedial Investigations and Feasibility Studies (RI/FS)."

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APPENDIX A
LABORATORY ANALYTICAL DATA SHEETS AND CHAIN-OF-CUSTODY RECORDS FROM FEBRUARY 1998 SAMPLING EVENT

@AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 9802265

Work Order Summary

CLIENT: Mr. Doug Downey
Parsons Engineering Science
1700 Broadway, Suite 900
Denver, CO 80290

BILL TO: Same

PHONE: 303-831-8100
FAX: 303-831-8208
DATE RECEIVED: 2/23/98
DATE COMPLETED: 3/20/98

P.O. # 731854.06
PROJECT # 731854.06 SRBIC KEESLER

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
01A	SG-1	TO-3	0.4 psi
02A	SG-2	TO-3	0.4 psi
03A	SG-3	TO-3	0.4 psi
04A	Method Spike	TO-3	NA
05A	Lab Blank	TO-3	NA

LAB NARRATIVE:
The second source recoveries for benzene, toluene, ethyl benzene and total xylenes exceeded the project specific QAPP requirements of +/-15%. The recoveries ranged from 121 - 125%.

CERTIFIED BY: Debbie Peacock
Laboratory Director

DATE: 4-13-98

Certification numbers: CA ELAP - 1149, NY ELAP - 11291, UT ELAP - E-217

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA 95630
(916) 985-1000 • (800) 985-5955 • FAX (916) 985-1020

AIR TOXICS LTD.

SAMPLE NAME: SG-1
ID#: 9802265-01A

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6022423		Date of Collection: 2/19/98	
Dil. Factor:	3.94		Date of Analysis: 2/24/98	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.0039	0.013	Not Detected	Not Detected
Toluene	0.0039	0.015	0.006 M	0.023 M
Ethyl Benzene	0.0039	0.017	0.020	0.088
Total Xylenes	0.0039	0.017	0.041	0.18

Surrogate	% Recovery	Method Limits
Fluorobenzene	31 Q	50-150

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name:	6022423		Date of Collection: 2/19/98	
Dil. Factor:	3.94		Date of Analysis: 2/24/98	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C5+ Hydrocarbons)	0.039	0.16	0.043	0.18
C2 - C4** Hydrocarbons	0.039	0.072	1.9	3.5

*TPH referenced to Gasoline (MW=100)
**C2 - C4 Hydrocarbons referenced to Propane (MW=44)

Surrogate	% Recovery	Method Limits
Fluorobenzene	100	50-150

M = Reported value may be biased due to apparent matrix interferences.
Q = Exceeds Quality Control limits of 50% to 150%.

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: SG-2

ID#: 9802265-02A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name: 6022425 **Date of Collection:** 2/19/98

Dil. Factor: 3.94 **Date of Analysis:** 3/24/98

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.0039	0.013	Not Detected	Not Detected
Toluene	0.0039	0.015	Not Detected	Not Detected
Ethyl Benzene	0.0039	0.017	Not Detected	Not Detected
Total Xylenes	0.0039	0.017	Not Detected	Not Detected

Surrogate	% Recovery	Method Limits
Fluorobenzene	32 Q	50-150

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name: 6022425 **Date of Collection:** 2/19/98

Dil. Factor: 3.94 **Date of Analysis:** 3/24/98

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C5+ Hydrocarbons)	0.039	0.16	0.051	0.21
C2 - C4** Hydrocarbons	0.039	0.072	0.16	0.29

*TPH referenced to Gasoline (MW=100)

**C2 - C4 Hydrocarbons referenced to Propane (MW=44)

Surrogate	% Recovery	Method Limits
Fluorobenzene	110	50-150

Q = Exceeds Quality Control limits of 50% to 150%, due to matrix effects.

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: SG-3

ID#: 9802265-03A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name: 6022424 **Date of Collection:** NA

Dil. Factor: 3.94 **Date of Analysis:** 3/24/98

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.0039	0.013	Not Detected	Not Detected
Toluene	0.0039	0.015	Not Detected	Not Detected
Ethyl Benzene	0.0039	0.017	0.004	0.018
Total Xylenes	0.0039	0.017	Not Detected	Not Detected

Surrogate	% Recovery	Method Limits
Fluorobenzene	32 Q	50-150

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name: 6022424 **Date of Collection:** NA

Dil. Factor: 3.94 **Date of Analysis:** 3/24/98

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C5+ Hydrocarbons)	0.039	0.16	Not Detected	Not Detected
C2 - C4** Hydrocarbons	0.039	0.072	0.18	0.33

*TPH referenced to Gasoline (MW=100)

**C2 - C4 Hydrocarbons referenced to Propane (MW=44)

Surrogate	% Recovery	Method Limits
Fluorobenzene	104	50-150

Q = Exceeds Quality Control limits of 50% to 150%, due to matrix effects.

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: Method Spike
ID#: 9802265-04A

EPA METHOD TO-3
(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6022411	Date of Collection: NA	
Dil. Factor:	1.00	Date of Analysis: 3/24/98	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	% Recovery
Benzene	0.001	0.003	125
Toluene	0.001	0.004	121
Ethyl Benzene	0.001	0.004	123
Total Xylenes	0.001	0.004	122

Surrogate	% Recovery	Method Limits
Fluorobenzene	121	50-150

TOTAL PETROLEUM HYDROCARBONS
GC/FID
(Quantitated as Gasoline)

File Name:	6022411	Date of Collection: NA	
Dil. Factor:	1.00	Date of Analysis: 3/24/98	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	% Recovery
TPH* (C5+ Hydrocarbons)	0.010	0.042	81
C2 - C4** Hydrocarbons	0.010	0.018	81

*TPH referenced to Gasoline (MW=100)

**C2 - C4 Hydrocarbons referenced to Propane (MW=44)

Surrogate	% Recovery	Method Limits
Fluorobenzene	120	50-150

Container Type: NA

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 9802265-05A

EPA METHOD TO-3

(Aromatic Volatile Organics in Air)

GC/PID

File Name:	6022416		**Date of Collection: NA**	
Dil. Factor:	1.00		**Date of Analysis: 3/24/98**	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.001	0.003	Not Detected	Not Detected
Toluene	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected

Surrogate	% Recovery	Method Limits
Fluorobenzene	112	50-150

TOTAL PETROLEUM HYDROCARBONS

GC/FID

(Quantitated as Gasoline)

File Name:	6022416		**Date of Collection: NA**	
Dil. Factor:	1.00		**Date of Analysis: 3/24/98**	

Compound	Rpt. Limit (ppmv)	Rpt. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
TPH* (C5+ Hydrocarbons)	0.010	0.042	Not Detected	Not Detected
C2 - C4** Hydrocarbons	0.010	0.018	Not Detected	Not Detected

*TPH referenced to Gasoline (MW=100)

**C2 - C4 Hydrocarbons referenced to Propane (MW=44)

Surrogate	% Recovery	Method Limits
Fluorobenzene	112	50-150

Container Type: NA

AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

180 BLUE RAVINE ROAD, [illegible]B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX: (916) 985-1020

CHAIN-OF-CUSTODY RECORD

№ 014294

Page 1 of 1

Contact Person Brad Lewis
Company PARSONS ES
Address 5390 Triangle Pkwy City Norcross State GA Zip 30092
Phone (404) 235-2300 FAX
Collected By: Signature [signature]

Project Info:
P.O. # 731854.06
Project # 731854.06
Project Name SRBIC KEESLER

Turn Around Time:
[X] Normal
☐ Rush ______ Specify

Lab I.D.	Field Sample I.D.	Date & Time		Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
01A	SG-1	2/19/98	1720	BTEX ~~HE~~ USEPA TO-3	28" Hg	0" Hg	0.4 psi
02A	SG-2	2/19/98	1630	BTEX USEPA TO-3	28" Hg	0" Hg	0.4 psi
03A	SG-3	2/19/98	1700	BTEX USEPA TO-3	28" Hg	0" Hg	0.4 psi

Relinquished By: (Signature) [signature] Date/Time 2/20/98 1000 Print Name Brad Lewis
Relinquished By: (Signature) Date/Time Received By: (Signature) [signature] Date/Time 2/23/98 1339
Relinquished By: (Signature) Date/Time Received By: (Signature) Date/Time

Notes:
CANISTER # 12039 INCLUDED IN SHIPMENT, HOWEVER, ERROR IN SAMPLING DO NOT ANALYZE

Lab Use Only	Shipper Name	Air Bill #	Opened By:	Date/Time	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
	Fed Ex	1717142210	[signature]	2/23/98 1339	Ambient	GOOD	Yes No None N/A	9802265

Form 1293 rev. 06

Quanterra

Environmental Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

ANALYTICAL RESULTS
FOR
PARSONS ENGINEERING SCIENCE, INC.

QUANTERRA INCORPORATED, DENVER
PROJECT NUMBER 059173

MARCH 21, 1998

Written by: Ellen La Riviere

Ellen La Riviere, Program Manager

Quanterra
Environmental Services

Table Of Contents

Standard Deliverables With Supporting Documentation

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Overview

On February 20, 1998, Quanterra Incorporated; Denver Laboratory received twelve soil samples and seven aqueous samples from Parsons Engineering Science, Inc.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

Overview
Sample Description Information/Analytical Test Requests
Analytical Results
Quality Control Report

Aromatic Volatile Organics Data Review

Each sample was analyzed to achieve the lowest possible reporting limits within the constraints of the method. In some cases, due to interferences or analytes present at concentrations above the linear calibration range of the instrument, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilutions required. Quanterra samples 059173-0007-SA, -0012-SA, -0013-SA, -0014-SA and –0018-SA were analyzed at dilutions for Method 8020A due to the concentration of target compounds present in the samples. Samples 059173-0009-SA, -0010-SA and –0011-SA were analyzed at dilutions for Method 8020A due to the presence of non-target compounds in the samples. As a result of the dilutions required, the surrogates were diluted to less than detectable concentrations in samples 059173-0007-SA, -0011-SA and -0012-SA.

Extractable Petroleum Hydrocarbons Data Review

Sample 059173-0007-SA was analyzed at a dilution for Method 8015M, reported as diesel range organics, due to the concentration of target compounds in the samples. The reporting limit has been adjusted accordingly. As a result of the dilution required, the surrogates were diluted to less than detectable concentrations in this sample.

Polynuclear Aromatic Hydrocarbons Data Review

Sample 059173-0012-SA was analyzed at a dilution for Naphthalene by Method 8310 due to the concentration of the target compound present in the sample. The reporting limits have been raised relative to the dilutions required.

Metals Data Review

For matrix spike analyses, the project specific quality control results contain the analytical results form both analyses along with the spike level and percent recovery. The percent recovery calculation is not performed if the spike level is less than or equal to 25 percent of the value of the sample. The percent

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Services

recovery and relative percent difference (RPD) are reported as not calculated for lead due to the concentration of that analyte in the sample.

Methane Data Review

Analyses for methane by RSK-175 were performed by Quanterra's Austin laboratory.

Samples 059173-0013-SA and –0014-SA were analyzed at dilutions for methane due to the concentration of the target analyte present in the samples. The reporting limits have been raised relative to the dilutions required.

With the above noted exception, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory quality control samples analyzed in conjunction with the samples in this project were within established control limits.

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Footnotes and Data Qualifiers

The data sheets contained in this report may contain a variety of footnotes and data qualifiers. Some footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that may not be discussed in the Overview. These are described below:

B Compound is also detected in the blank. The indicated compound was detected in the sample as well as the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to the matrix of the sample. Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration. Most commonly, a "J" value indicates that the reported result for the analyte is below the stated reporting limit and is an estimated value. "J" values are applied to organic analytes detected above the MDL but below the reporting limit and for inorganic analytes detected above the IDL but below the reporting limit. Analytes which are not detected at or below the reporting limit are reported as "ND" and do not have "J" flags. Because "J" values may represent false positive concentrations, care should be used when interpreting these data. If there is uncertainty about the quantitation of an analyte such as due to metals serial dilution failure, this footnote may also indicate that a reported result is an estimated concentration, even if it is above the reporting limit.

N Spiked sample recovery not within limits. This qualifier is applied to the parent sample when MS/MSD recoveries are not within acceptable limits.

r This footnote is analyst defined. The data sheets will list "r" footnotes with consecutive numbers. The electronic data deliverable will show "r" data qualifiers. Please see datasheet for exact definition.

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LIMs Report Key

Section	Description
Cover Letter	Signature page, report narrative as applicable.
Sample Description Information	Tabulated cross-reference between the Lab ID and Client ID, including matrix, date and time sampled, and the date received for all samples in the project.
Sample Analysis Results Sheets	Lists sample results, test components, reporting limits, dates prepared and analyzed, and any data qualifiers. Pages are organized by test.
QC LOT Assignment Report	Cross-reference between lab IDs and applicable QC batches (DCS, LCS, Blank, MS/SD, DU)
Duplicate Control Sample Report	Percent recovery and RPD results, with acceptance limits, for the laboratory duplicate control samples for each test are tabulated in this report. These are measures of accuracy and precision for each test. Acceptance limits are based upon laboratory historical data.
Laboratory Control Sample Report	Percent recovery results for a single Laboratory Control Sample (if applicable) are tabulated in this report, with the applicable acceptance limits for each test.
Matrix Spike/Matrix Spike Duplicate Report	Percent recovery and RPD results for matrix-specific QC samples and acceptance limits, where applicable. This report can be used to assess matrix effects on an analysis.
Single Control Sample Report	A tabulation of the surrogate recoveries for the blank for organic analyses.
Method Blank Report	A summary of the results of the analysis of the method blank for each test.

List of Abbreviations and Terms

Abbreviation	Term	Abbreviation	Term
DCS	Duplicate Control Sample	MSD	Matrix Spike Duplicate
DU	Sample Duplicate	QC Run	Preparation Batch
EB	Equipment Blank	QC Category	LIMs QC Category
FB	Field Blank	QC Lot	DCS Batch
FD	Field Duplicate	ND	Not Detected at or above the reporting limit expressed
IDL	Instrument Detection Limit (Metals)	QC Matrix	Matrix of the laboratory control sample(s)
LCS	Laboratory Control Sample	RL	Reporting Limit
MB	Method Blank	QC	Quality Control
MDL	Method Detection Limit	SA	Sample
MS	Matrix Spike	SD	Spike Duplicate
RPD	Relative Percent Difference	TB	Trip Blank
ppm (part-per-million)	mg/L or mg/kg (usually)	ppb (part-per-billion)	ug/L or ug/kg (usually)
QUAL	Qualifier flag	DIL	Dilution Factor

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SAMPLE DESCRIPTION INFORMATION
for
Parsons Engineering Science

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
059173-0001-SA	SBA-14 (7.00-8.00)	SOIL	17 FEB 98	11:15	20 FEB 98
059173-0002-SA	SBA-14 (9.00-11.00)	SOIL	17 FEB 98	17:00	20 FEB 98
059173-0003-SA	SBA-15 (9.00-10.00)	SOIL	18 FEB 98	07:20	20 FEB 98
059173-0004-SA	SBA-16 (9.00-10.00)	SOIL	18 FEB 98	08:30	20 FEB 98
059173-0005-SA	SBA-16 (11.00-12.00)	SOIL	18 FEB 98	08:40	20 FEB 98
059173-0006-SA	SBA-17 (9.50,10.50)	SOIL	18 FEB 98	09:40	20 FEB 98
059173-0007-SA	SBA-18 (8.50,9.50)	SOIL	18 FEB 98	10:30	20 FEB 98
059173-0008-SA	SBA-19 (6.50,8.00)	SOIL	18 FEB 98	13:15	20 FEB 98
059173-0009-SA	SBA-19 (8.50,10.00)	SOIL	18 FEB 98	13:18	20 FEB 98
059173-0009-MS	SBA-19 (8.50-10.00)	SOIL	18 FEB 98	13:18	20 FEB 98
059173-0009-SD	SBA-19 (8.50,10.00)	SOIL	18 FEB 98	13:18	20 FEB 98
059173-0010-SA	SBA-100 (8.50,10.00)	SOIL	18 FEB 98	18:30	20 FEB 98
059173-0011-SA	SBA-20 (6.00-7.00)	SOIL	18 FEB 98	13:45	20 FEB 98
059173-0012-SA	SBA-20 (9.50,10.50)	SOIL	18 FEB 98	13:53	20 FEB 98
059173-0013-SA	TW-11 (0.00,0.00)	GRND-H2O	19 FEB 98	08:30	20 FEB 98
059173-0014-SA	MWA-11 (0.00,0.00)	GRND-H2O	19 FEB 98	09:40	20 FEB 98
059173-0015-SA	MWA-13 (0.00,0.00)	GRND-H2O	19 FEB 98	11:46	20 FEB 98
059173-0016-SA	MWA-9 (0.00,0.00)	GRND-H2O	19 FEB 98	11:50	20 FEB 98
059173-0017-TB	TRIP_BLANK (0.00,0.00)	GRND-H2O	19 FEB 98	00:00	20 FEB 98
059173-0018-SA	MWA-14 (0.00,0.00)	GRND-H2O	19 FEB 98	15:05	20 FEB 98
059173-0019-SA	MWA-6 (0.00,0.00)	GRND-H2O	19 FEB 98	15:45	20 FEB 98

Quanterra
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ANALYTICAL TEST REQUESTS
for
Parsons Engineering Science

Lab ID: 059173	Group Code	Analysis Description	Custom Test?
0013 - 0014, 0016	A	Method EPA-9 RSK-175 by GC/FID	Y
		AFCEE	Y
		Aromatic VOAs by Method 8020A with MTBE & TMBs	Y
		GC Prep For Waters	N
		AFCEE	Y
		Aromatic VOAs by Method 8020A with MTBE & TMBs	Y
		AFCEE	N
		Nitrate, Ion Chromatography	N
		AFCEE	N
		Lead, Furnace AA (Totals)	N
		Prep - Total Metals, Furnace AA	N
0002 , 0009, 0010 , 0012	B	Percent Water	N
		AFCEE	Y
		Aromatic Volatile Organics with MTBE	Y
		GC Prep For Soils	N
		AFCEE	Y
		Polynuclear Aromatic Hydrocarbons, HPLC	Y
		AFCEE	N
		Prep - Polynuclear Aromatic Hydrocarbons, HPLC	N
		AFCEE	Y
		Polynuclear Aromatic Hydrocarbons, HPLC (ConfirYat	
		Lead, Furnace AA	N
		Prep - Total Metals, Furnace AA	N
		AFCEE	Y
		Aromatic Volatile Organics with MTBE (Second CoYum	
0005	C	Total Organic Carbon (TOC)	N
		Prep - Total Organic Carbon	N
		Total Organic Carbon (TOC)	N
		Total Organic Carbon (TOC)	N
		Total Organic Carbon (TOC)	N
0001	D	Percent Water	N
		AFCEE	Y
		Aromatic Volatile Organics with MTBE	Y
		GC Prep For Soils	N
		AFCEE	Y
		Aromatic Volatile Organics with MTBE (Second CoYum	
0006 - 0007	E	Percent Water	N
		AFCEE	Y
		Aromatic Volatile Organics with MTBE	Y

Quanterra
Environmental Services

ANALYTICAL TEST REQUESTS
for
Parsons Engineering Science

Lab ID: 059173	Group Code	Analysis Description	Custom Test?
		GC Prep For Soils	N
		AFCEE	Y
		Polynuclear Aromatic Hydrocarbons, HPLC	Y
		AFCEE	N
		Prep - Polynuclear Aromatic Hydrocarbons, HPLC	N
		AFCEE	Y
		Polynuclear Aromatic Hydrocarbons, HPLC (ConfirYat	
		Lead, Furnace AA	N
		Prep - Total Metals, Furnace AA	N
		AFCEE	N
		Extractable Petroleum Hydrocarbons	N
		Prep - Hydrocarbons by GC	N
		AFCEE	Y
		Aromatic Volatile Organics with MTBE (Second CoYum	
0015 , 0017, 0018 - 0019	G	AFCEE	Y
		Aromatic VOAs by Method 8020A with MTBE & TMBs	Y
		GC Prep For Waters	N
		AFCEE	Y
		Aromatic VOAs by Method 8020A with MTBE & TMBs	Y
0003 - 0004	H	Total Organic Carbon (TOC)	N
		Prep - Total Organic Carbon	N
		Total Organic Carbon (TOC)	N
		Total Organic Carbon (TOC)	N
		Total Organic Carbon (TOC)	N
		Lead, Furnace AA	N
		Prep - Total Metals, Furnace AA	N
0008	I	Percent Water	N
		AFCEE	Y
		Aromatic Volatile Organics with MTBE	Y
		GC Prep For Soils	N
		AFCEE	N
		Aromatic Volatile Organics with MTBE (Second CoNum	
		AFCEE	N
		Polynuclear Aromatic Hydrocarbons, HPLC	N
		AFCEE	N
		Prep - Polynuclear Aromatic Hydrocarbons, HPLC	N
		Lead, Furnace AA	N
		Prep - Total Metals, Furnace AA	N
0011	J	Percent Water	N

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ANALYTICAL TEST REQUESTS
for
Parsons Engineering Science

Lab ID: 059173	Group Code	Analysis Description	Custom Test?
		AFCEE	Y
		Aromatic Volatile Organics with MTBE	Y
		GC Prep For Soils	N
		AFCEE	N
		Aromatic Volatile Organics with MTBE (Second CoNum	
		Lead, Furnace AA	N
		Prep - Total Metals, Furnace AA	N

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Environmental Services

AFCEE^Aromatic Volatile Organics
Method 8020A

Client Name: Parsons Engineering Science
Client ID: SBA-14 (7.00-8.00)
LAB ID: 059173-0001-SA
Matrix: SOIL
Authorized: 20 FEB 98
Instrument: GCPID-H

Sampled: 17 FEB 98
Prepared: 24 FEB 98
Dilution: 1.0

Received: 20 FEB 98
Analyzed: 24 FEB 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		0.0054	0.00054	mg/kg
Toluene	ND		0.0054	0.0013	mg/kg
Ethylbenzene	ND		0.0022	0.00054	mg/kg
Xylenes (total)	ND		0.0054	0.0016	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	98	%	34 - 175
Fluorobenzene	89	%	34 - 175

Percent moisture is 8.0%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Dan Appelhans

Approved By: Audrey Cornell

Quanterra Environmental Services

AFCEE^Aromatic Volatile Organics
Method 8020A

Client Name: Parsons Engineering Science
Client ID: SBA-14 (9.00-11.00)
LAB ID: 059173-0002-SA
Matrix: SOIL   Sampled: 17 FEB 98   Received: 20 FEB 98
Authorized: 20 FEB 98   Prepared: 24 FEB 98   Analyzed: 24 FEB 98
Instrument: GCPID-H   Dilution: 1.0

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	0.017	M	0.0065	0.00065	mg/kg
Toluene	0.073	d	0.0065	0.0015	mg/kg
Ethylbenzene	0.0089	M	0.0026	0.00065	mg/kg
Xylenes (total)	0.034	M	0.0065	0.0019	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	96	%	34 - 175
Fluorobenzene	92	%	34 - 175

Percent moisture is 22.6%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Dan Appelhans   Approved By: Audrey Cornell

Quanterra Environmental Services

AFCEE^Aromatic Volatile Organics (Second Column)
Method 8020A

Client Name: Parsons Engineering Science
Client ID: SBA-14 (9.00-11.00)
LAB ID: 059173-0002-SA
Matrix: SOIL Sampled: 17 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 24 FEB 98 Analyzed: 24 FEB 98
Instrument: GCPID-H Dilution: 1.0

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	0.018	d	0.0065	0.00065	mg/kg
Toluene	0.072	M	0.0065	0.0015	mg/kg
Ethylbenzene	0.0089	d	0.0026	0.00065	mg/kg
Xylenes (total)	0.037	d	0.0065	0.0019	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	103	%	34 - 175
Fluorobenzene	92	%	34 - 175

Percent moisture is 22.6%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Dan Appelhans Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic Volatile Organics
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	SBA-17 (9.50,10.50)		
LAB ID:	059173-0006-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 24 FEB 98	Analyzed: 25 FEB 98
Instrument:	GCPID-H	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	0.22	M	0.12	0.012	mg/kg
Toluene	0.77	d	0.12	0.030	mg/kg
Ethylbenzene	0.090	M	0.049	0.012	mg/kg
Xylenes (total)	0.58	d	0.12	0.037	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	86	%	34 - 175
Fluorobenzene	84	%	34 - 175

Percent moisture is 18.7%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic Volatile Organics (Second Column)
Method 8020A

Client Name: Parsons Engineering Science
Client ID: SBA-17 (9.50,10.50)
LAB ID: 059173-0006-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 24 FEB 98 Analyzed: 25 FEB 98
Instrument: GCPID-H Dilution: 1.0

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	0.22	d	0.12	0.012	mg/kg
Toluene	0.75	M	0.12	0.030	mg/kg
Ethylbenzene	0.092	d	0.049	0.012	mg/kg
Xylenes (total)	0.58	M	0.12	0.037	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	88	%	34 - 175
Fluorobenzene	84	%	34 - 175

Percent moisture is 18.7%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Shawn Hadley Approved By: Audrey Cornell

Quanterra
Environmental
Services

AFCEE^Aromatic Volatile Organics
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	SBA-18 (8.50,9.50)		
LAB ID:	059173-0007-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 24 FEB 98	Analyzed: 25 FEB 98
Instrument:	GCPID-H	Dilution: 50	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		5.4	0.54	mg/kg
Toluene	17	d	5.4	1.3	mg/kg
Ethylbenzene	4.2	M	2.2	0.54	mg/kg
Xylenes (total)	170	d	5.4	1.6	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	ND	%	34 - 175
Fluorobenzene	ND	%	34 - 175

Percent moisture is 7.6%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
M = Preferred Result
ND = Not Detected

Reported By: Shawn Hadley Approved By: Audrey Cornell

Quanterra Environmental Services

AFCEE^Aromatic Volatile Organics (Second Column)
Method 8020A

Client Name: Parsons Engineering Science
Client ID: SBA-18 (8.50,9.50)
LAB ID: 059173-0007-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 24 FEB 98 Analyzed: 25 FEB 98
Instrument: GCPID-H Dilution: 50

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		5.4	0.54	mg/kg
Toluene	12	M	5.4	1.3	mg/kg
Ethylbenzene	5.3	d	2.2	0.54	mg/kg
Xylenes (total)	150	M	5.4	1.6	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	ND	%	34 - 175
Fluorobenzene	ND	%	34 - 175

Percent moisture is 7.6%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
M = Preferred Result
ND = Not Detected

Reported By: Shawn Hadley Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic Volatile Organics
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	SBA-19 (6.50,8.00)		
LAB ID:	059173-0008-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 24 FEB 98	Analyzed: 24 FEB 98
Instrument:	GCPID-H	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		0.0055	0.00055	mg/kg
Toluene	ND		0.0055	0.0013	mg/kg
Ethylbenzene	ND		0.0022	0.00055	mg/kg
Xylenes (total)	ND		0.0055	0.0017	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	99	%	34 - 175
Fluorobenzene	89	%	34 - 175

Percent moisture is 9.1%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Dan Appelhans

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic Volatile Organics
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	SBA-19 (8.50,10.00)		
LAB ID:	059173-0009-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 24 FEB 98	Analyzed: 25 FEB 98
Instrument:	GCPID-H	Dilution: 2.5	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		0.28	0.028	mg/kg
Toluene	ND		0.28	0.067	mg/kg
Ethylbenzene	ND		0.11	0.028	mg/kg
Xylenes (total)	ND		0.28	0.083	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	92	%	34 - 175
Fluorobenzene	89	%	34 - 175

Percent moisture is 9.9%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic Volatile Organics
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	SBA-100 (8.50,10.00)		
LAB ID:	059173-0010-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 24 FEB 98	Analyzed: 25 FEB 98
Instrument:	GCPID-H	Dilution: 3.3	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		0.37	0.037	mg/kg
Toluene	ND		0.37	0.089	mg/kg
Ethylbenzene	ND		0.15	0.037	mg/kg
Xylenes (total)	ND		0.37	0.11	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	91	%	34 - 175
Fluorobenzene	89	%	34 - 175

Percent moisture is 10.6%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic Volatile Organics
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	SBA-20 (6.00-7.00)		
LAB ID:	059173-0011-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 24 FEB 98	Analyzed: 25 FEB 98
Instrument:	GCPID-H	Dilution: 40	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		4.6	0.46	mg/kg
Toluene	ND		4.6	1.1	mg/kg
Ethylbenzene	1.9	M	1.8	0.46	mg/kg
Xylenes (total)	3.1	JM	4.6	1.4	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	ND	%	34 - 175
Fluorobenzene	ND	%	34 - 175

Percent moisture is 12.2%. All results and limits are reported on a dry weight basis.

J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result
ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic Volatile Organics (Second Column)
Method 8020A

Client Name: Parsons Engineering Science
Client ID: SBA-20 (6.00-7.00)
LAB ID: 059173-0011-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 24 FEB 98 Analyzed: 25 FEB 98
Instrument: GCPID-H Dilution: 40

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		4.6	0.46	mg/kg
Toluene	ND		4.6	1.1	mg/kg
Ethylbenzene	3.5	d	1.8	0.46	mg/kg
Xylenes (total)	3.4	Jd	4.6	1.4	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	ND	%	34 - 175
Fluorobenzene	ND	%	34 - 175

Percent moisture is 12.2%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
J = Result is detected below the reporting limit or is an estimated concentration.
ND = Not Detected

Reported By: Shawn Hadley Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic Volatile Organics
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	SBA-20 (9.50,10.50)		
LAB ID:	059173-0012-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 24 FEB 98	Analyzed: 25 FEB 98
Instrument:	GCPID-H	Dilution: 20	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.4	0.24	mg/kg
Toluene	ND		2.4	0.57	mg/kg
Ethylbenzene	ND		0.95	0.24	mg/kg
Xylenes (total)	15	d	2.4	0.72	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	ND	%	34 - 175
Fluorobenzene	ND	%	34 - 175

Percent moisture is 16.1%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic Volatile Organics . : (Second Column)
Method 8020A

Client Name: Parsons Engineering Science
Client ID: SBA-20 (9.50,10.50)
LAB ID: 059173-0012-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 24 FEB 98 Analyzed: 25 FEB 98
Instrument: GCPID-H Dilution: 20

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.4	0.24	mg/kg
Toluene	ND		2.4	0.57	mg/kg
Ethylbenzene	ND		0.95	0.24	mg/kg
Xylenes (total)	10	M	2.4	0.72	mg/kg

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	ND	%	34 - 175
Fluorobenzene	ND	%	34 - 175

Percent moisture is 16.1%. All results and limits are reported on a dry weight basis.

M = Preferred Result
ND = Not Detected

Reported By: Shawn Hadley Approved By: Audrey Cornell

Quanterra
Environmental
Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name: Parsons Engineering Science
Client ID: TW-11 (0.00,0.00)
LAB ID: 059173-0013-SA
Matrix: GRND-H20
Authorized: 20 FEB 98
Instrument: GCPID-H

Sampled: 19 FEB 98
Prepared: 26 FEB 98
Dilution: 50

Received: 20 FEB 98
Analyzed: 26 FEB 98

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	780	d	100	2.8	ug/L
Toluene	1700	d	100	7.5	ug/L
Ethylbenzene	240	M	100	2.7	ug/L
Xylenes (total)	530	d	100	7.5	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	109	%	44 - 165
Fluorobenzene	82	%	44 - 165

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Steven McKee

Approved By: Audrey Cornell

Quanterra Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	TW-11 (0.00,0.00)		
LAB ID:	059173-0013-SA		
Matrix:	GRND-H2O	Sampled: 19 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 50	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	760	M	100	2.8	ug/L
Toluene	1700	M	100	7.5	ug/L
Ethylbenzene	250	d	100	2.7	ug/L
Xylenes (total)	500	M	100	7.5	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	95	%	44 - 165
Fluorobenzene	81	%	44 - 165

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Steven McKee

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MWA-11 (0.00,0.00)		
LAB ID:	059173-0014-SA		
Matrix:	GRND-H2O	Sampled: 19 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 50	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	750	M	100	2.8	ug/L
Toluene	1700	d	100	7.5	ug/L
Ethylbenzene	250	d	100	2.7	ug/L
Xylenes (total)	530	d	100	7.5	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	104	%	44 - 165
Fluorobenzene	83	%	44 - 165

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Steven McKee

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MWA-11 (0.00,0.00)		
LAB ID:	059173-0014-SA		
Matrix:	GRND-H20	Sampled: 19 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 50	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	760	d	100	2.8	ug/L
Toluene	1700	M	100	7.5	ug/L
Ethylbenzene	250	M	100	2.7	ug/L
Xylenes (total)	500	M	100	7.5	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	93	%	44 - 165
Fluorobenzene	83	%	44 - 165

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Steven McKee

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name: Parsons Engineering Science
Client ID: MWA-13 (0.00,0.00)
LAB ID: 059173-0015-SA
Matrix: GRND-H2O Sampled: 19 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 26 FEB 98 Analyzed: 26 FEB 98
Instrument: GCPID-H Dilution: 1.0

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	ND		2.0	0.054	ug/L
Xylenes (total)	ND		2.0	0.15	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	96	%	44 - 165
Fluorobenzene	76	%	44 - 165

ND = Not Detected

Reported By: Steven McKee Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MWA-9 (0.00,0.00)		
LAB ID:	059173-0016-SA		
Matrix:	GRND-H20	Sampled: 19 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	0.33	Jd	2.0	0.056	ug/L
Toluene	0.97	JM	2.0	0.15	ug/L
Ethylbenzene	7.7	M	2.0	0.054	ug/L
Xylenes (total)	44	M	2.0	0.15	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	104	%	44 - 165
Fluorobenzene	81	%	44 - 165

d = See Preferred Result on Other Column
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result

Reported By: Steven McKee

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science				
Client ID:	MWA-9 (0.00,0.00)				
LAB ID:	059173-0016-SA				
Matrix:	GRND-H2O	Sampled:	19 FEB 98	Received:	20 FEB 98
Authorized:	20 FEB 98	Prepared:	26 FEB 98	Analyzed:	26 FEB 98
Instrument:	GCPID-H	Dilution:	1.0		

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	0.33	JM	2.0	0.056	ug/L
Toluene	1.0	Jd	2.0	0.15	ug/L
Ethylbenzene	7.9	d	2.0	0.054	ug/L
Xylenes (total)	44	d	2.0	0.15	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	96	%	44 - 165
Fluorobenzene	89	%	44 - 165

d = See Preferred Result on Other Column
J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result

Reported By: Steven McKee

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MWA-14 (0.00,0.00)		
LAB ID:	059173-0018-SA		
Matrix:	GRND-H2O	Sampled: 19 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 20	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	170	M	40	1.1	ug/L
Toluene	130	M	40	3.0	ug/L
Ethylbenzene	250	M	40	1.1	ug/L
Xylenes (total)	750	M	40	3.0	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	99	%	44 - 165
Fluorobenzene	86	%	44 - 165

M = Preferred Result

Reported By: Steven McKee

Approved By: Audrey Cornell

Quanterra Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name: Parsons Engineering Science
Client ID: MWA-14 (0.00,0.00)
LAB ID: 059173-0018-SA
Matrix: GRND-H20 Sampled: 19 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 26 FEB 98 Analyzed: 26 FEB 98
Instrument: GCPID-H Dilution: 20

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	170	d	40	1.1	ug/L
Toluene	130	d	40	3.0	ug/L
Ethylbenzene	260	d	40	1.1	ug/L
Xylenes (total)	760	d	40	3.0	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	92	%	44 - 165
Fluorobenzene	87	%	44 - 165

d = See Preferred Result on Other Column

Reported By: Steven McKee Approved By: Audrey Cornell

Quanterra Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MWA-6 (0.00,0.00)		
LAB ID:	059173-0019-SA		
Matrix:	GRND-H20	Sampled: 19 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	ND		2.0	0.054	ug/L
Xylenes (total)	ND		2.0	0.15	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	96	%	44 - 165
Fluorobenzene	75	%	44 - 165

ND = Not Detected

Reported By: Steven McKee

Approved By: Audrey Cornell

Quanterra
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QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059173-0001-SA	SOIL	8020-PR-LS	24 FEB 98-H	24 FEB 98-H
059173-0002-SA	SOIL	8020-PR-LS	24 FEB 98-H	24 FEB 98-H
059173-0002-SA	SOIL	8020-PR-LS	24 FEB 98-H	24 FEB 98-H
059173-0006-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0006-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0007-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0007-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0008-SA	SOIL	8020-PR-LS	24 FEB 98-H	24 FEB 98-H
059173-0009-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0009-MS	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0009-SD	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0010-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0011-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0011-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0012-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0012-SA	SOIL	8020-PR-MS	24 FEB 98-01	24 FEB 98-01
059173-0013-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0013-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0014-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0014-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0015-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0016-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0016-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0017-TB	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0018-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0018-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059173-0019-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H

Quanterra
Environmental Services

LABORATORY CONTROL SAMPLE REPORT
Organics by Chromatography
Project: 059173

Category: 8020-PAR-A Method 8020A - AFCEE Aromatic Volatile Organics with MTBE
Matrix: AQUEOUS Date Analyzed: 26 FEB 98
QC Run: 26 FEB 98-H
Concentration Units: ug/L

	Concentration		Accuracy(%)	
Analyte	Spiked	Measured	LCS	Limits
Benzene	20.0	19.8	99	75-125
Toluene	20.0	19.3	96	70-125
Chlorobenzene	20.0	19.3	96	75-129
Ethylbenzene	20.0	19.0	95	71-129
Xylenes (total)	60.0	58.3	97	71-133
1,3-Dichlorobenzene	20.0	19.4	97	70-131
1,2-Dichlorobenzene	20.0	19.4	97	61-134
1,4-Dichlorobenzene	20.0	19.6	98	75-126

	Concentration		Accuracy(%)	
Surrogates	Spiked	Measured	LCS	Limits
a,a,a-Trifluorotoluene	30.0	27.6	92	44-165
Fluorobenzene	30.0	26.6	89	44-165

Category: 8020-PR-LS Aromatic Volatile Organics (AFCEE-Low Level) with MTBE
Matrix: SOIL Date Analyzed: 24 FEB 98
QC Run: 24 FEB 98-H
Concentration Units: mg/kg

	Concentration		Accuracy(%)	
Analyte	Spiked	Measured	LCS	Limits
Benzene	0.0500	0.0416	83	66-135
Toluene	0.0500	0.0408	82	60-135
Chlorobenzene	0.0500	0.0462	92	66-139
Ethylbenzene	0.0500	0.0444	89	61-139
Xylenes (total)	0.150	0.136	90	61-143
1,3-Dichlorobenzene	0.0500	0.0473	95	60-141
1,4-Dichlorobenzene	0.0500	0.0486	97	66-136
1,2-Dichlorobenzene	0.0500	0.0469	94	51-144
Methyl-tert-butyl ether	0.0500	0.0442	88	25-175

	Concentration		Accuracy(%)	
Surrogates	Spiked	Measured	LCS	Limits
a,a,a-Trifluorotoluene	0.0750	0.0739	99	34-175
Fluorobenzene	0.0750	0.0674	90	34-175

Category: 8020-PR-MS Aromatic Volatile Organics with MBTE (AFCEE-Medium Level)
Matrix: SOIL Date Analyzed: 25 FEB 98
QC Run: 24 FEB 98-01
Concentration Units: mg/kg

	Concentration		Accuracy(%)	
Analyte	Spiked	Measured	LCS	Limits
Benzene	1.00	1.05	105	66-135

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8020-PR-LS Matrix: SOIL QC Lot: 24 FEB 98-H QC Run: 24 FEB 98-H Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	0.0750	0.0743	99	34-175
Fluorobenzene	0.0750	0.0662	88	34-175
Category: 8020-PR-MS Matrix: SOIL QC Lot: 24 FEB 98-01 QC Run: 24 FEB 98-01 Concentration Units: mg/kg				
a,a,a-Trifluorotoluene	1.50	1.47	98	34-175
Fluorobenzene	1.50	1.43	95	34-175
Category: 8020-PAR-A Matrix: AQUEOUS QC Lot: 26 FEB 98-H QC Run: 26 FEB 98-H Concentration Units: ug/L				
a,a,a-Trifluorotoluene	30.0	28.2	94	44-165
Fluorobenzene	30.0	27.1	90	44-165

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Organics by Chromatography
Project: 059173

Test: 8020-PAR-MDL-AP AFCEE Aromatic VOAs by Method 8020A with MTBE & TMBs
Matrix: AQUEOUS
QC Lot: 26 FEB 98-H QC Run: 26 FEB 98-H Date Analyzed: 26 FEB 98

Analyte	Result	Units	RL	MDL
Benzene	ND	ug/L	2.0	0.056
Toluene	ND	ug/L	2.0	0.15
Ethylbenzene	ND	ug/L	2.0	0.054
Xylenes (total)	ND	ug/L	2.0	0.15

Test: 8020-PAR-MDL-2-AP AFCEE Aromatic VOAs by Method 8020A with MTBE & TMBs
Matrix: AQUEOUS
QC Lot: 26 FEB 98-H QC Run: 26 FEB 98-H Date Analyzed: 26 FEB 98

Analyte	Result	Units	RL	MDL
Benzene	ND	ug/L	2.0	0.056
Toluene	ND	ug/L	2.0	0.15
Ethylbenzene	ND	ug/L	2.0	0.054
Xylenes (total)	ND	ug/L	2.0	0.15

Test: 8020-PAR-MDL-L-S AFCEE Aromatic Volatile Organics with MTBE
Matrix: SOIL
QC Lot: 24 FEB 98-H QC Run: 24 FEB 98-H Date Analyzed: 24 FEB 98

Analyte	Result	Units	RL	MDL
Benzene	ND	mg/kg	0.0050	0.00050
Toluene	ND	mg/kg	0.0050	0.0012
Ethylbenzene	ND	mg/kg	0.0020	0.00050
Xylenes (total)	ND	mg/kg	0.0050	0.0015

Test: 8020-PAR-MDL-M-S AFCEE Aromatic Volatile Organics with MBTE
Matrix: SOIL
QC Lot: 24 FEB 98-01 QC Run: 24 FEB 98-01 Date Analyzed: 25 FEB 98

Analyte	Result	Units	RL	MDL
Benzene	ND	mg/kg	0.10	0.010
Toluene	ND	mg/kg	0.10	0.024
Ethylbenzene	ND	mg/kg	0.040	0.010
Xylenes (total)	ND	mg/kg	0.10	0.030

ND = Not Detected

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography
Project: 059173

Test: 8020-PAR-MDL-2-L-S AFCEE Aromatic Volatile Organics with MTBE (Second Column)
Matrix: SOIL
QC Lot: 24 FEB 98-H QC Run: 24 FEB 98-H Date Analyzed: 24 FEB 98

Analyte	Result	Units	RL	MDL
Benzene	ND	mg/kg	0.0050	0.00050
Toluene	ND	mg/kg	0.0050	0.0012
Ethylbenzene	ND	mg/kg	0.0020	0.00050
Xylenes (total)	ND	mg/kg	0.0050	0.0015

Test: 8020-PAR-MDL-2-M-S AFCEE Aromatic Volatile Organics with MBTE (Second Column)
Matrix: SOIL
QC Lot: 24 FEB 98-01 QC Run: 24 FEB 98-01 Date Analyzed: 25 FEB 98

Analyte	Result	Units	RL	MDL
Benzene	ND	mg/kg	0.10	0.010
Toluene	ND	mg/kg	0.10	0.024
Ethylbenzene	ND	mg/kg	0.040	0.010
Xylenes (total)	ND	mg/kg	0.10	0.030

ND = Not Detected

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Organics by Chromatography
Project: 059173

Category: 8020-PR-MS Aromatic Volatile Organics with MBTE (AFCEE-Medium Level)
Matrix: SOIL
Sample: 059173-0009
MS Run: 24 FEB 98-01
Units mg/kg Units Qualifier: Dry weight

Analyte	Sample Result	Concentration MS Result	MSD Result	Amount Spiked MS	Amount Spiked MSD	% Recovery MS	% Recovery MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Benzene	ND	1.07	1.05	1.11	1.11	96	95	66-135	1.4	30
Toluene	ND	1.01	0.990	1.11	1.11	91	89	60-135	1.9	30
Chlorobenzene	NA	NA	NA	0.00	0.00	NC	NC	66-139	NC	30
Ethylbenzene	ND	1.02	1.00	1.11	1.11	92	90	61-139	1.6	30
Xylenes (total)	ND	3.11	3.08	3.33	3.33	93	93	61-143	0.9	30
1,3-Dichlorobenzene	NA	NA	NA	0.00	0.00	NC	NC	60-141	NC	30
1,4-Dichlorobenzene	NA	NA	NA	0.00	0.00	NC	NC	66-136	NC	30
1,2-Dichlorobenzene	NA	NA	NA	0.00	0.00	NC	NC	51-144	NC	30
Methyl-tert-butyl ether	NA	NA	NA	0.00	0.00	NC	NC	25-175	NC	50

Surrogates	%Recovery			Rec. Accept. Limits
a,a,a-Trifluorotoluene	92.0	93.0	88.3	34-175
Fluorobenzene	89.0	89.2	88.5	34-175

NA = Not Applicable
NC = Not Calculated, calculation not applicable.
ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
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QC LOT ASSIGNMENT REPORT
Semivolatile Organics by GC

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059173-0006-SA	SOIL	8015DAF-S	25 FEB 98-01	25 FEB 98-01
059173-0007-SA	SOIL	8015DAF-S	25 FEB 98-01	25 FEB 98-01

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Semivolatile Organics by GC
Project: 059173

Category: 8015DAF-S Diesel Range Organics in Solid Samples, AFCEE
Matrix: SOIL
QC Lot: 25 FEB 98-01
Concentration Units: mg/kg

Date Analyzed: 03 MAR 98

Analyte	Concentration Spiked	Measured DCS1	Qual	DCS2	Qual	AVG	Accuracy Average(%) DCS	Limits	Precision (RPD) DCS	Limit
Diesel Range Organics	20.0	18.7		18.9		18.8	94	51-153	0.90	50

Surrogate	Concentration Spiked	Measured DCS1	Qual	DCS2	Qual	Accuracy Average(%) DCS	Limits
o-Terphenyl	0.800	0.717		0.698		88	47-142
n-Octacosane	0.800	0.654		0.642		81	25-162

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

AFCEE^ Extractable Petroleum Hydrocarbons
Method M8015D

Client Name:	Parsons Engineering Science		
Client ID:	SBA-17 (9.50,10.50)		
LAB ID:	059173-0006-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 25 FEB 98	Analyzed: 03 MAR 98
Instrument:	GCFID-Z	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Diesel Range Organics	12	v1	4.9	1.2	mg/kg

Surrogate	Recovery		Acceptable Range
o-Terphenyl	74	%	47 - 142
n-Octacosane	69	%	25 - 162

Percent moisture is 18.7%. All results and limits are reported on a dry weight basis.

1 = Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.
v = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.

Reported By: Bret Collins

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^ Extractable Petroleum Hydrocarbons
Method M8015D

Client Name:	Parsons Engineering Science		
Client ID:	SBA-18 (8.50,9.50)		
LAB ID:	059173-0007-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 25 FEB 98	Analyzed: 03 MAR 98
Instrument:	GCFID-Z	Dilution: 20	

Parameter	Result	Qualifier	RL	MDL	Units
Diesel Range Organics	1100	v1	87	22	mg/kg

Surrogate	Recovery		Acceptable Range
o-Terphenyl	ND	%	47 - 142
n-Octacosane	ND	%	25 - 162

Percent moisture is 7.6%. All results and limits are reported on a dry weight basis.

1 = Sample resembles a hydrocarbon product occurring within the n-alkane range of C10-C26.
v = This sample has GC/FID characteristics for which reliable identification of a product could not be achieved.
ND = Not Detected

Reported By: Bret Collins

Approved By: Audrey Cornell

Quanterra
Environmental
Services

SINGLE CONTROL SAMPLE REPORT
Semivolatile Organics by GC

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8015DAF-S Matrix: SOIL QC Lot: 25 FEB 98-01 QC Run: 25 FEB 98-01 Concentration Units: mg/kg				
o-Terphenyl	0.800	0.706	88	47-142
n-Octacosane	0.800	0.683	85	25-162

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Semivolatile Organics by GC
Project: 059173

Test: 8015M-AF-DRO-MDL-S AFCEE Extractable Petroleum Hydrocarbons
Matrix: SOIL
QC Lot: 25 FEB 98-01 QC Run: 25 FEB 98-01 Date Analyzed: 03 MAR 98

Analyte	Result	Units	RL	MDL
Diesel Range Organics	ND	mg/kg	4.0	1.0

ND = Not Detected

Quanterra
Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC (Confirmation)
Method 8310

Client Name: Parsons Engineering Science
Client ID: SBA-17 (9.50,10.50)
LAB ID: 059173-0006-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 23 FEB 98 Analyzed: 17 FEB 98
Instrument: HPLC-Y Dilution: 1.0

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	0.27	M	0.25	0.057	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	110	%	22 - 167

Percent moisture is 18.7%. All results and limits are reported on a dry weight basis.

M = Preferred Result

Reported By: Blake Besser Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC
Method 8310

Client Name:	Parsons Engineering Science				
Client ID:	SBA-18 (8.50,9.50)				
LAB ID:	059173-0007-SA				
Matrix:	SOIL	Sampled:	18 FEB 98	Received:	20 FEB 98
Authorized:	20 FEB 98	Prepared:	23 FEB 98	Analyzed:	17 FEB 98
Instrument:	HPLC-Y	Dilution:	1.0		

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	2.1	M	0.22	0.050	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	88	%	22 - 167

Percent moisture is 7.6%. All results and limits are reported on a dry weight basis.

M = Preferred Result

Reported By: Blake Besser

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC
Method 8310

Client Name:	Parsons Engineering Science		
Client ID:	SBA-14 (9.00-11.00)		
LAB ID:	059173-0002-SA		
Matrix:	SOIL	Sampled: 17 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 23 FEB 98	Analyzed: 17 FEB 98
Instrument:	HPLC-Y	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	ND		0.26	0.059	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	110	%	22 - 167

Percent moisture is 22.6%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Blake Besser

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC
Method 8310

Client Name: Parsons Engineering Science
Client ID: SBA-17 (9.50,10.50)
LAB ID: 059173-0006-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 23 FEB 98 Analyzed: 17 FEB 98
Instrument: HPLC-Y Dilution: 1.0

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	0.27	d	0.25	0.057	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	110	%	22 - 167

Percent moisture is 18.7%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column

Reported By: Blake Besser Approved By: Audrey Cornell

Quanterra Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC (Confirmation)
Method 8310

Client Name:	Parsons Engineering Science				
Client ID:	SBA-18 (8.50,9.50)				
LAB ID:	059173-0007-SA				
Matrix:	SOIL	Sampled:	18 FEB 98	Received:	20 FEB 98
Authorized:	20 FEB 98	Prepared:	23 FEB 98	Analyzed:	17 FEB 98
Instrument:	HPLC-Y	Dilution:	1.0		

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	2.3	d	0.22	0.050	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	92	%	22 - 167

Percent moisture is 7.6%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column

Reported By: Blake Besser

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC
Method 8310

Client Name: Parsons Engineering Science
Client ID: SBA-19 (6.50,8.00)
LAB ID: 059173-0008-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 03 MAR 98 Analyzed: 06 MAR 98
Instrument: HPLC-Y Dilution: 1.0

Parameter	Result	Qualifier	RL	MDL	Units
Acenaphthene	ND		0.22	0.040	mg/kg
Acenaphthylene	ND		0.22	0.054	mg/kg
Anthracene	ND		0.022	0.0029	mg/kg
Benzo(a)anthracene	ND		0.0099	0.0037	mg/kg
Benzo(a)pyrene	ND		0.017	0.0024	mg/kg
Benzo(b)fluoranthene	ND		0.013	0.0028	mg/kg
Benzo(g,h,i)perylene	ND		0.055	0.0033	mg/kg
Benzo(k)fluoranthene	ND		0.012	0.0039	mg/kg
Chrysene	ND		0.044	0.0022	mg/kg
Dibenz(a,h)anthracene	ND		0.022	0.0037	mg/kg
Fluorene	ND		0.044	0.0070	mg/kg
Fluoranthene	ND		0.044	0.0026	mg/kg
Indeno(1,2,3-cd)pyrene	ND		0.033	0.0033	mg/kg
Naphthalene	ND		0.22	0.051	mg/kg
Phenanthrene	ND		0.044	0.0061	mg/kg
Pyrene	ND		0.044	0.0029	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	95	%	22 - 167

Percent moisture is 9.1%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Blake Besser Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC
Method 8310

Client Name:	Parsons Engineering Science		
Client ID:	SBA-19 (8.50,10.00)		
LAB ID:	059173-0009-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 23 FEB 98	Analyzed: 27 FEB 98
Instrument:	HPLC-Y	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	0.13	Jd	0.22	0.051	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	100	%	22 - 167

Percent moisture is 9.9%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column
J = Result is detected below the reporting limit or is an estimated concentration.

Reported By: Blake Besser

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC (Confirmation)
Method 8310

Client Name:	Parsons Engineering Science		
Client ID:	SBA-19 (8.50,10.00)		
LAB ID:	059173-0009-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 23 FEB 98	Analyzed: 27 FEB 98
Instrument:	HPLC-Y	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	0.12	JM	0.22	0.051	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	140	%	22 - 167

Percent moisture is 9.9%. All results and limits are reported on a dry weight basis.

J = Result is detected below the reporting limit or is an estimated concentration.
M = Preferred Result

Reported By: Blake Besser Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC
Method 8310

Client Name:	Parsons Engineering Science				
Client ID:	SBA-100 (8.50,10.00)				
LAB ID:	059173-0010-SA				
Matrix:	SOIL	Sampled:	18 FEB 98	Received:	20 FEB 98
Authorized:	20 FEB 98	Prepared:	23 FEB 98	Analyzed:	27 FEB 98
Instrument:	HPLC-Y	Dilution:	1.0		

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	ND		0.22	0.051	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	98	%	22 - 167

Percent moisture is 10.6%. All results and limits are reported on a dry weight basis.

ND = Not Detected

Reported By: Blake Besser

Approved By: Audrey Cornell

Quanterra Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC
Method 8310

Client Name: Parsons Engineering Science
Client ID: SBA-20 (9.50,10.50)
LAB ID: 059173-0012-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: 23 FEB 98 Analyzed: 10 MAR 98
Instrument: HPLC-Y Dilution: 5.0

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	11	d	1.2	0.27	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	100	%	22 - 167

Percent moisture is 16.1%. All results and limits are reported on a dry weight basis.

d = See Preferred Result on Other Column

Reported By: Blake Besser Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE
Polynuclear Aromatic Hydrocarbons, HPLC (Confirmation)
Method 8310

Client Name:	Parsons Engineering Science		
Client ID:	SBA-20 (9.50,10.50)		
LAB ID:	059173-0012-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: 23 FEB 98	Analyzed: 10 MAR 98
Instrument:	HPLC-Y	Dilution: 5.0	

Parameter	Result	Qualifier	RL	MDL	Units
Naphthalene	10	M	1.2	0.27	mg/kg

Surrogate	Recovery		Acceptable Range
Terphenyl-d14	100	%	22 - 167

Percent moisture is 16.1%. All results and limits are reported on a dry weight basis.

M = Preferred Result

Reported By: Blake Besser

Approved By: Audrey Cornell

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
High Performance Liquid Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059173-0002-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0006-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0006-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0007-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0007-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0008-SA	SOIL	8310AF-S	03 MAR 98-01	03 MAR 98-01
059173-0009-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0009-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0009-MS	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0009-SD	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0010-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0012-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03
059173-0012-SA	SOIL	8310AF-S	23 FEB 98-03	23 FEB 98-03

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
High Performance Liquid Chromatography

Category: 8310AF-S
Matrix: SOIL
QC Lot: 23 FEB 98-03
Concentration Units: mg/kg

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limits
Acenaphthene	NA	NA	NA	NC	NC	33-140	NC	50
Acenaphthylene	NA	NA	NA	NC	NC	39-135	NC	50
Anthracene	NA	NA	NA	NC	NC	44-135	NC	50
Benzo(a)anthracene	NA	NA	NA	NC	NC	29-145	NC	50
Benzo(a)pyrene	NA	NA	NA	NC	NC	42-135	NC	50
Benzo(b)fluoranthene	NA	NA	NA	NC	NC	25-147	NC	50
Benzo(g,h,i)perylene	NA	NA	NA	NC	NC	43-135	NC	50
Benzo(k)fluoranthene	NA	NA	NA	NC	NC	50-139	NC	50
Chrysene	NA	NA	NA	NC	NC	49-144	NC	50
Dibenz(a,h)anthracene	NA	NA	NA	NC	NC	41-135	NC	50
Fluorene	NA	NA	NA	NC	NC	43-135	NC	50
Fluoranthene	NA	NA	NA	NC	NC	32-135	NC	50
Indeno(1,2,3-cd)pyrene	NA	NA	NA	NC	NC	45-135	NC	50
Naphthalene	0.533	0.513	0.548	0.530	100	33-135	6.6	50
Phenanthrene	NA	NA	NA	NC	NC	42-139	NC	50
Pyrene	NA	NA	NA	NC	NC	45-135	NC	50
Terphenyl-d14	3.33	3.54	3.57	3.56	107	22-167	0.84	

Category: 8310AF-S
Matrix: SOIL
QC Lot: 03 MAR 98-01
Concentration Units: mg/kg

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limits
Acenaphthene	0.533	0.513	0.529	0.521	98	33-140	3.1	50
Acenaphthylene	0.533	0.533	0.565	0.549	103	39-135	5.8	50
Anthracene	0.533	0.478	0.482	0.480	90	44-135	0.83	50
Benzo(a)anthracene	0.533	0.528	0.522	0.525	98	29-145	1.1	50
Benzo(a)pyrene	0.533	0.483	0.479	0.481	90	42-135	0.83	50
Benzo(b)fluoranthene	0.533	0.527	0.526	0.526	99	25-147	0.19	50
Benzo(g,h,i)perylene	0.533	0.554	0.550	0.552	104	43-135	0.72	50
Benzo(k)fluoranthene	0.533	0.550	0.546	0.548	103	50-139	0.73	50
Chrysene	0.533	0.521	0.518	0.520	97	49-144	0.58	50
Dibenz(a,h)anthracene	0.533	0.549	0.543	0.546	102	41-135	1.1	50
Fluorene	0.533	0.539	0.549	0.544	102	43-135	1.8	50
Fluoranthene	0.533	0.542	0.544	0.543	102	32-135	0.37	50
Indeno(1,2,3-cd)pyrene	0.533	0.546	0.536	0.541	102	45-135	1.8	50
Naphthalene	0.533	0.559	0.563	0.561	105	33-135	0.71	50
Phenanthrene	0.533	0.548	0.553	0.550	103	42-139	0.91	50
Pyrene	0.533	0.548	0.552	0.550	103	45-135	0.73	50

ND = Not detected
NC = Not calculated, calculation not applicable
NA = Not applicable

Calculations are performed before rounding to avoid round-off errors in calculated results.

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DUPLICATE CONTROL SAMPLE REPORT
High Performance Liquid Chromatography (cont.)

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision (RPD) Limits
Category: 8310AF-S Matrix: SOIL QC Lot: 03 MAR 98-01 Concentration Units: mg/kg								
Terphenyl-d14	3.33	3.51	3.28	3.40	102	22-167	6.8	

Calculations are performed before rounding to avoid round-off errors in calculated results.

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SINGLE CONTROL SAMPLE REPORT
High Performance Liquid Chromatography

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
Category: 8310AF-S Matrix: SOIL QC Lot: 23 FEB 98-03 QC Run: 23 FEB 98-03 Concentration Units: mg/kg				
Terphenyl-d14	3.33	3.50	105	22-167
Category: 8310AF-S Matrix: SOIL QC Lot: 03 MAR 98-01 QC Run: 03 MAR 98-01 Concentration Units: mg/kg				
Terphenyl-d14	3.33	3.12	94	22-167

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
High Performance Liquid Chromatography
Project: 059173

Test: 8310-AFCEE-MDL-S AFCEE Polynuclear Aromatic Hydrocarbons, HPLC
Matrix: SOIL
QC Lot: 23 FEB 98-03 QC Run: 23 FEB 98-03 Date Analyzed: 27 FEB 98

Analyte	Result	Units	RL	MDL
Naphthalene	ND	mg/kg	0.20	0.046

QC Lot: 23 FEB 98-03 QC Run: 23 FEB 98-03 Date Analyzed: 27 FEB 98

Analyte	Result	Units	RL	MDL
Naphthalene	ND	mg/kg	0.20	0.046

QC Lot: 03 MAR 98-01 QC Run: 03 MAR 98-01 Date Analyzed: 06 MAR 98

Analyte	Result	Units	RL	MDL
Acenaphthene	ND	mg/kg	0.20	0.036
Acenaphthylene	ND	mg/kg	0.20	0.049
Anthracene	ND	mg/kg	0.020	0.0026
Benzo(a)anthracene	ND	mg/kg	0.0090	0.0034
Benzo(a)pyrene	ND	mg/kg	0.015	0.0022
Benzo(b)fluoranthene	ND	mg/kg	0.012	0.0025
Benzo(g,h,i)perylene	ND	mg/kg	0.050	0.0030
Benzo(k)fluoranthene	ND	mg/kg	0.011	0.0035
Chrysene	ND	mg/kg	0.040	0.0020
Dibenz(a,h)anthracene	ND	mg/kg	0.020	0.0034
Fluorene	ND	mg/kg	0.040	0.0064
Fluoranthene	ND	mg/kg	0.040	0.0024
Indeno(1,2,3-cd)pyrene	ND	mg/kg	0.030	0.0030
Naphthalene	ND	mg/kg	0.20	0.046
Phenanthrene	ND	mg/kg	0.040	0.0055
Pyrene	ND	mg/kg	0.040	0.0026

Test: 8310-AFCEE-MDL-2-S AFCEE Polynuclear Aromatic Hydrocarbons, HPLC (Confirmation)
Matrix: SOIL
QC Lot: 23 FEB 98-03 QC Run: 23 FEB 98-03 Date Analyzed: 27 FEB 98

Analyte	Result	Units	RL	MDL
Naphthalene	ND	mg/kg	0.20	0.046

ND = Not Detected

Quanterra
Environmental Services

Metals
Total Metals

Client Name:	Parsons Engineering Science		
Client ID:	SBA-14 (9.00-11.00)		
LAB ID:	059173-0002-SA		
Matrix:	SOIL	Sampled: 17 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	0.46	JW	1.0	0.15	0.65	mg/kg	SW7421	27 FEB 98	02 MAR 98

Percent moisture is 22.6%. All results and limits are reported on a dry weight basis.

J = Result is detected below the reporting limit or is an estimated concentration.
W = Post-digestion spike for furnace AA out of control limits while sample absorbance is less than 50% of spike absorbance

Reported By: Robin Proctor   Approved By: Jan Ecos

Quanterra
Environmental Services

Metals
Total Metals

Client Name:	Parsons Engineering Science		
Client ID:	SBA-15 (9.00-10.00)		
LAB ID:	059173-0003-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	0.40	JW	1.0	0.12	0.50	mg/kg	SW7421	02 MAR 98	03 MAR 98

J = Result is detected below the reporting limit or is an estimated concentration.
W = Post-digestion spike for furnace AA out of control limits while sample absorbance is less than 50% of spike absorbance

Reported By: Robin Proctor Approved By: Jan Ecos

Quanterra
Environmental Services

Metals
Total Metals

Client Name:	Parsons Engineering Science		
Client ID:	SBA-16 (9.00-10.00)		
LAB ID:	059173-0004-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	0.18	JW	1.0	0.12	0.50	mg/kg	SW7421	02 MAR 98	03 MAR 98

J = Result is detected below the reporting limit or is an estimated concentration.
W = Post-digestion spike for furnace AA out of control limits while sample absorbance is less than 50% of spike absorbance

Reported By: Robin Proctor

Approved By: Jan Ecos

Quanterra
Environmental Services

Metals
Total Metals

Client Name:	Parsons Engineering Science		
Client ID:	SBA-17 (9.50,10.50)		
LAB ID:	059173-0006-SA		
Matrix:	SOIL	Sampled: 18 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	0.34	JW	1.0	0.14	0.62	mg/kg	SW7421	27 FEB 98	02 MAR 98

Percent moisture is 18.7%. All results and limits are reported on a dry weight basis.

J = Result is detected below the reporting limit or is an estimated concentration.
W = Post-digestion spike for furnace AA out of control limits while sample absorbance is less than 50% of spike absorbance

Reported By: Robin Proctor Approved By: Jan Ecos

Quanterra
Environmental Services

Metals
Total Metals

Client Name: Parsons Engineering Science
Client ID: SBA-18 (8.50,9.50)
LAB ID: 059173-0007-SA
Matrix: SOIL   Sampled: 18 FEB 98   Received: 20 FEB 98
Authorized: 20 FEB 98   Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	8.7		1.0	0.12	0.54	mg/kg	SW7421	27 FEB 98	02 MAR 98

Percent moisture is 7.6%. All results and limits are reported on a dry weight basis.

Reported By: Robin Proctor   Approved By: Jan Ecos

Quanterra
Environmental Services

Metals
Total Metals

Client Name: Parsons Engineering Science
Client ID: SBA-19 (6.50,8.00)
LAB ID: 059173-0008-SA
Matrix: SOIL   Sampled: 18 FEB 98   Received: 20 FEB 98
Authorized: 20 FEB 98   Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	4.2		1.0	0.13	0.55	mg/kg	SW7421	02 MAR 98	03 MAR 98

Percent moisture is 9.1%. All results and limits are reported on a dry weight basis.

Reported By: Robin Proctor   Approved By: Jan Ecos

Quanterra
Environmental Services

Metals
Total Metals

Client Name: Parsons Engineering Science
Client ID: SBA-19 (8.50,10.00)
LAB ID: 059173-0009-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	7.6		1.0	0.13	0.55	mg/kg	SW7421	27 FEB 98	02 MAR 98

Percent moisture is 9.9%. All results and limits are reported on a dry weight basis.

Reported By: Robin Proctor Approved By: Jan Ecos

Quanterra
Environmental Services

Metals
Total Metals

Client Name: Parsons Engineering Science
Client ID: SBA-100 (8.50,10.00)
LAB ID: 059173-0010-SA
Matrix: SOIL
Authorized: 20 FEB 98

Sampled: 18 FEB 98
Prepared: See Below

Received: 20 FEB 98
Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	2.2		1.0	0.13	0.56	mg/kg	SW7421	27 FEB 98	02 MAR 98

Percent moisture is 10.6%. All results and limits are reported on a dry weight basis.

Reported By: Robin Proctor

Approved By: Jan Ecos

Quanterra
Environmental Services

Metals
Total Metals

Client Name: Parsons Engineering Science
Client ID: SBA-20 (6.00-7.00)
LAB ID: 059173-0011-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	1.1		1.0	0.13	0.57	mg/kg	SW7421	02 MAR 98	03 MAR 98

Percent moisture is 12.2%. All results and limits are reported on a dry weight basis.

Reported By: Robin Proctor Approved By: Jan Ecos

Quanterra
Environmental Services

Metals
Total Metals

Client Name: Parsons Engineering Science
Client ID: SBA-20 (9.50,10.50)
LAB ID: 059173-0012-SA
Matrix: SOIL   Sampled: 18 FEB 98   Received: 20 FEB 98
Authorized: 20 FEB 98   Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	7.4		1.0	0.14	0.60	mg/kg	SW7421	27 FEB 98	02 MAR 98

Percent moisture is 16.1%. All results and limits are reported on a dry weight basis.

Reported By: Robin Proctor   Approved By: Jan Ecos

Quanterra
Environmental Services

AFCEE
Total Metals

Client Name: Parsons Engineering Science
Client ID: TW-11 (0.00,0.00)
LAB ID: 059173-0013-SA
Matrix: GRND-H2O Sampled: 19 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	0.021		1.0	0.0012	0.0050	mg/L	SW7421	27 FEB 98	02 MAR 98

Reported By: Robin Proctor Approved By: Jan Ecos

Quanterra
Environmental
Services

AFCEE
Total Metals

Client Name:	Parsons Engineering Science		
Client ID:	MWA-11 (0.00,0.00)		
LAB ID:	059173-0014-SA		
Matrix:	GRND-H20	Sampled: 19 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim Units	Method	Prepared Date	Analyzed Date
Lead	0.020		1.0	0.0012	0.0050mg/L	SW7421	27 FEB 98	02 MAR 98

Reported By: Robin Proctor

Approved By: Jan Ecos

Quanterra
Environmental Services

AFCEE
Total Metals

Client Name: Parsons Engineering Science
Client ID: MWA-9 (0.00,0.00)
LAB ID: 059173-0016-SA
Matrix: GRND-H20 Sampled: 19 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	ND		1.0	0.0012	0.0050	mg/L	SW7421	27 FEB 98	02 MAR 98

ND = Not Detected

Reported By: Robin Proctor

Approved By: Jan Ecos

Quanterra
Environmental
Services

QC LOT ASSIGNMENT REPORT
Metals Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059173-0002-SA	SOIL	PB-FAA-S	27 FEB 98-R3	27 FEB 98-R3
059173-0003-SA	SOIL	PB-FAA-S	02 MAR 98-L4	02 MAR 98-L4
059173-0004-SA	SOIL	PB-FAA-S	02 MAR 98-L4	02 MAR 98-L4
059173-0006-SA	SOIL	PB-FAA-S	27 FEB 98-R3	27 FEB 98-R3
059173-0007-SA	SOIL	PB-FAA-S	27 FEB 98-R3	27 FEB 98-R3
059173-0008-SA	SOIL	PB-FAA-S	02 MAR 98-L4	02 MAR 98-L4
059173-0009-SA	SOIL	PB-FAA-S	27 FEB 98-R3	27 FEB 98-R3
059173-0009-MS	SOIL	PB-FAA-S	27 FEB 98-R3	27 FEB 98-R3
059173-0009-SD	SOIL	PB-FAA-S	27 FEB 98-R3	27 FEB 98-R3
059173-0010-SA	SOIL	PB-FAA-S	27 FEB 98-R3	27 FEB 98-R3
059173-0011-SA	SOIL	PB-FAA-S	02 MAR 98-L4	02 MAR 98-L4
059173-0012-SA	SOIL	PB-FAA-S	27 FEB 98-R3	27 FEB 98-R3
059173-0013-SA	AQUEOUS	PB-LAW-AT	27 FEB 98-R2	27 FEB 98-R2
059173-0014-SA	AQUEOUS	PB-LAW-AT	27 FEB 98-R2	27 FEB 98-R2
059173-0016-SA	AQUEOUS	PB-LAW-AT	27 FEB 98-R2	27 FEB 98-R2

Quanterra
Environmental Services

LABORATORY CONTROL SAMPLE REPORT
Metals Analysis and Preparation

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) LCS	Accuracy(%) Limits

Category: PB-LAW-AT
Matrix: AQUEOUS
QC Lot: 27 FEB 98-R2 QC Run: 27 FEB 98-R2
Concentration Units: mg/L

Analyte	Spiked	Measured	LCS	Limits
Lead	0.0400	0.0459	115	74-124

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) LCS	Accuracy(%) Limits

Category: PB-FAA-S
Matrix: SOIL
QC Lot: 27 FEB 98-R3 QC Run: 27 FEB 98-R3
Concentration Units: mg/kg

Analyte	Spiked	Measured	LCS	Limits
Lead	4.00	4.06	102	83-123

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) LCS	Accuracy(%) Limits

Category: PB-FAA-S
Matrix: SOIL
QC Lot: 02 MAR 98-L4 QC Run: 02 MAR 98-L4
Concentration Units: mg/kg

Analyte	Spiked	Measured	LCS	Limits
Lead	4.00	4.71	118	83-123

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Metals Analysis and Preparation
Project: 059173

Test: PB-AFCEE2-MDL-AT AFCEE Lead, Furnace AA (Totals)
Matrix: AQUEOUS
QC Lot: 27 FEB 98-R2 QC Run: 27 FEB 98-R2 Date Analyzed: 02 MAR 98

Analyte	Result	Units	RL	MDL
Lead	ND	mg/L	0.0050	0.0012

Test: PB-FAA-MDL-S Lead, Furnace AA
Matrix: SOIL
QC Lot: 27 FEB 98-R3 QC Run: 27 FEB 98-R3 Date Analyzed: 02 MAR 98

Analyte	Result	Units	RL	MDL
Lead	ND	mg/kg	0.30	0.069

QC Lot: 02 MAR 98-L4 QC Run: 02 MAR 98-L4 Date Analyzed: 03 MAR 98

Analyte	Result	Units	RL	MDL
Lead	ND	mg/kg	0.30	0.069

ND = Not Detected

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Metals Analysis and Preparation
Project: 059173

Category: PB-LAW-AT Lead, Furnace AA / Totals (England AFB)
Matrix: AQUEOUS
Sample: 059173-0013
MS Run: 27 FEB 98-R2
Units: mg/L

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS/MSD	%Recovery MS	%Recovery MSD	%RPD	Acceptance Limit Recov.	RPD
Lead	0.021	0.0623	0.0616	0.0400	103	102	1.1	74-124	15

Category: PB-FAA-S Lead, Furnace AA
Matrix: SOIL
Sample: 059173-0009
MS Run: 27 FEB 98-R3
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS/MSD	%Recovery MS	%Recovery MSD	%RPD	Acceptance Limit Recov.	RPD
Lead	6.9	6.13	5.96	4.00	NC	NC	NC	83-123	10

Category: PB-FAA-S Lead, Furnace AA
Matrix: SOIL
Sample: 059173-0003
MS Run: 02 MAR 98-L4
Units mg/kg Units Qualifier: Wet wt.

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS/MSD	%Recovery MS	%Recovery MSD	%RPD	Acceptance Limit Recov.	RPD
Lead	0.40 JW	4.71	4.70	4.00	108	108	0.2	83-123	10

J = Result is detected below the reporting limit or is an estimated concentration.
W = Post-digestion spike for furnace AA out of control limits while sample absorbance is less than 50% of spike absorbance
NC = Not Calculated, calculation not applicable.

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: SBA-15 (9.00-10.00)
LAB ID: 059173-0003-SA
Matrix: SOIL   Sampled: 18 FEB 98   Received: 20 FEB 98
Authorized: 20 FEB 98   Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Total Organic Carbon	ND		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98
Total Organic Carbon	ND		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98
Total Organic Carbon	ND		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98
Total Organic Carbon	ND		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98

ND = Not Detected

Reported By: Roxanne Sullivan   Approved By: Jan Ecos

Quanterra
Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: SBA-16 (9.00-10.00)
LAB ID: 059173-0004-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Total Organic Carbon	ND		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98
Total Organic Carbon	ND		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98
Total Organic Carbon	ND		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98
Total Organic Carbon	ND		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98

ND = Not Detected

Reported By: Roxanne Sullivan Approved By: Jan Ecos

Quanterra Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: SBA-16 (11.00-12.00)
LAB ID: 059173-0005-SA
Matrix: SOIL Sampled: 18 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Total Organic Carbon	2810		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98
Total Organic Carbon	2970		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98
Total Organic Carbon	2800		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98
Total Organic Carbon	2520		1.0	550	2000	mg/kg	9060	07 MAR 98	09 MAR 98

Reported By: Roxanne Sullivan Approved By: Jan Ecos

Quanterra
Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: TW-11 (0.00,0.00)
LAB ID: 059173-0013-SA
Matrix: GRND-H2O   Sampled: 19 FEB 98   Received: 20 FEB 98
Authorized: 20 FEB 98   Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Nitrate as N	ND		1.0	0.040	0.50	mg/L	9056	NA	20 FEB 98

ND = Not Detected

Reported By: Patty Jungk   Approved By: Jan Ecos

Quanterra Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: MWA-11 (0.00,0.00)
LAB ID: 059173-0014-SA
Matrix: GRND-H20 Sampled: 19 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Nitrate as N	ND		1.0	0.040	0.50	mg/L	9056	NA	20 FEB 98

ND = Not Detected

Reported By: Patty Jungk Approved By: Jan Ecos

Quanterra
Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: MWA-9 (0.00,0.00)
LAB ID: 059173-0016-SA
Matrix: GRND-H2O   Sampled: 19 FEB 98   Received: 20 FEB 98
Authorized: 20 FEB 98   Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Nitrate as N	0.65		1.0	0.040	0.50	mg/L	9056	NA	20 FEB 98

Reported By: Patty Jungk   Approved By: Jan Ecos

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Wet Chemistry Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059173-0003-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0003-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0003-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0003-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0004-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0004-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0004-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0004-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0005-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0005-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0005-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0005-SA	SOIL	TOC-MG-S	09 MAR 98-N1	08 MAR 98-N1
059173-0013-SA	AQUEOUS	NO3-PAR-A	20 FEB 98-S1	20 FEB 98-S1
059173-0014-SA	AQUEOUS	NO3-PAR-A	20 FEB 98-S1	20 FEB 98-S1
059173-0016-SA	AQUEOUS	NO3-PAR-A	20 FEB 98-S1	20 FEB 98-S1

Quanterra
Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Wet Chemistry Analysis and Preparation

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limits
Category: TOC-MG-S Matrix: SOIL QC Lot: 09 MAR 98-N1 Concentration Units: mg/kg								
Total Organic Carbon	120000	121000	120000	121000	101	91-111	0.41	10
Category: NO3-PAR-A Matrix: AQUEOUS QC Lot: 20 FEB 98-S1 Concentration Units: mg/L								
Nitrate as N	5.00	5.27	5.37	5.32	106	90-110	2.0	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Wet Chemistry Analysis and Preparation
Project: 059173

Test: NO3-AF-IC-PAR-MDL-A AFCEE Nitrate, Ion Chromatography
Matrix: AQUEOUS
QC Lot: 20 FEB 98-S1 QC Run: 20 FEB 98-S1 Date Analyzed: 20 FEB 98

Analyte	Result	Units	RL	MDL
Nitrate as N	ND	mg/L	0.50	0.040

Test: TOC-9060-MG-MDL-S Total Organic Carbon (TOC)
Matrix: SOIL
QC Lot: 09 MAR 98-N1 QC Run: 08 MAR 98-N1 Date Analyzed: 09 MAR 98

Analyte	Result	Units	RL	MDL
Total Organic Carbon	ND	mg/kg	2000	550

ND = Not Detected

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Wet Chemistry Analysis and Preparation
Project: 059173

Category: TOC-MG-S   Total Organic Carbon for soils reported in mg/kg.
(Limits for TOC-S also apply for this QC category)

Matrix: SOIL
Sample: 059173-0005
MS Run: 09 MAR 98-N1
Units: mg/kg

Analyte	Sample Result	Concentration MS Result	MSD Result	Amount Spiked MS/MSD	%Recovery MS	%Recovery MSD	%RPD	Acceptance Limit Recov.	Acceptance Limit RPD
Total Organic Carbon	2970	122000	125000	120000	99	102	2.7	91-111	10

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name:	Parsons Engineering Science		
Client ID:	TW-11 (0.00,0.00)		
LAB ID:	059173-0013-SA		
Matrix:	GRND-H2O	Sampled: 19 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: N/A	Analyzed: 03 MAR 98
Instrument:	GCFID-K1A	Dilution: 10	

Parameter	Result	Qualifier	RL	MDL	Units
Methane	610	B	5.0	0.52	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin

Approved By: Lynn S. Calvin

Quanterra
Environmental Services

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name: Parsons Engineering Science
Client ID: MWA-11 (0.00,0.00)
LAB ID: 059173-0014-SA
Matrix: GRND-H2O Sampled: 19 FEB 98 Received: 20 FEB 98
Authorized: 20 FEB 98 Prepared: N/A Analyzed: 03 MAR 98
Instrument: GCFID-K1A Dilution: 20

Parameter	Result	Qualifier	RL	MDL	Units
Methane	750	B	10	1.0	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin Approved By: Lynn S. Calvin

Quanterra
Environmental Services

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name:	Parsons Engineering Science		
Client ID:	MWA-9 (0.00,0.00)		
LAB ID:	059173-0016-SA		
Matrix:	GRND-H20	Sampled: 19 FEB 98	Received: 20 FEB 98
Authorized:	20 FEB 98	Prepared: N/A	Analyzed: 03 MAR 98
Instrument:	GCFID-K1A	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Methane	78	B	0.50	0.052	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin

Approved By: Lynn S. Calvin

Quanterra
Environmental
Services

QC LOT ASSIGNMENT REPORT
Subcontracted to Quanterra Lab

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059173-0013-SA	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1
059173-0014-SA	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1
059173-0016-SA	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1

Quanterra
Environmental
Services

LABORATORY CONTROL SAMPLE REPORT
Subcontracted to Quanterra Lab

Category: GAS-AUS-A
Matrix: AQUEOUS
QC Lot: 03 MAR 98-S1 QC Run: 03 MAR 98-S1
Concentration Units: ug/L

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) LCS	Accuracy(%) Limits
Methane	34.1	30.2	89	70-130
Ethane	63.9	57.0	89	70-130
Ethene	59.6	52.8	88	70-130

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

METHOD BLANK REPORT
Subcontracted to Quanterra Lab
Project: 059173

Test: GASES-AUSTIN-MDL-A Method EPA-9 RSK-175 by GC/FID
Matrix: AQUEOUS
QC Lot: 03 MAR 98-S1 QC Run: 03 MAR 98-S1 Date Analyzed: 03 MAR 98

Analyte	Result		Units	RL	MDL
Methane	0.12	J	ug/L	0.50	0.052

J = Result is detected below the reporting limit or is an estimated concentration.

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Subcontracted to Quanterra Lab
Project: 059173

Category: GAS-AUS-A Gases by Method AUS GC-0019 (Quanterra-Austin)
Matrix: AQUEOUS
Sample: 059189-0002
MS Run: 03 MAR 98-S1
Units: ug/L

Analyte	Concentration Sample Result	MS Result	MSD Result	Amount Spiked MS	Amount Spiked MSD	% Recovery MS	% Recovery MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Methane	62	101	117	33.9	34.3	115	160	70-130	14	30
Ethane	0.87	56.4	55.7	63.6	64.2	87	85	70-130	2.3	30
Ethene	ND	51.8	51.3	59.3	60.0	87	86	70-130	2.1	30

ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

Chain of Custody Record

Quanterra

QUA-4124

Client: Parsons ES	Project Manager: Brad Lewis	Date: 2/19/98	Chain Of Custody Number: 26966
Address: 5390 TRIANGLE PKWY STE 100	Telephone Number (Area Code)/Fax Number: (404) 235-2300	Lab Number: 59173	Page 1 of 2
City: NORCROSS State: GA Zip Code: 30092	Site Contact:		
Project Name: STREAMLINED RBIC - KEESLER	Carrier/Waybill Number:		
Contract/Purchase Order/Quote No.:			

	Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	BTEX 8020	Naphthalene 8310	Lead 7421	TOC 9060	TPH 8015M	METHANE RSK-175	NITRATE/NITRITE
01	SBA-14 (7-8')	2/17/98	1115	Soil		Acetate	1	—		X						
02	SBA-14 (9-11')	2/17/98	1700	Soil		Acetate	2	—		X	X	X				
03	SBA-15 (9-10')	2/18/98	0720	Soil		"	1	—					X			
04	SBA-16 (9-10')	"	0830	"		"	1	—					X			
05	SBA-16 (11-12')	"	0840	"		"	1	—					X			
06	SBA-17 (9.5-10.5')	"	0940	SOIL		"	2	—		X	X	X		X		
07	SBA-18 (8.5-9.5')	"	1030	"		"	2	—		X	X	X		X		
08	SBA-19 (6.5-8')	"	1315	"		"	1	—		X						
09	SBA-19 (8.5-10')	"	1318	"	8 oz	JAR	2	—		X	X	X				
10	SBA-100 (8.5-10')	"	1830	"	8 oz	"	2	—		X	X	X				
11	SBA-20 (6-7')	"	1345	"		ACETATE	1	—		X						
12	SBA-20 (9.5-10.5')	"	1353	"		"	2	—		X	X	X				
13	TW-11	2/19/98	0830	WATER	1.74L	VIAL/JAR	8	HCL/HNO3		X		X			X	X
14	MWA-11	"	0940	"	1.74L	"	8	"		X		X			X	X
15	MWA-13	"	1146	"	0.120L	"	3	HCL		X						
16	MWA-9	"	1150	"	1.74L	"	8	HCL/HNO3		X		X			X	X

Special Instructions: SBA-19 (6.5-8') is MS/MSD FOR SOIL

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months

Turn Around Time Required: ☒ Normal ☐ Rush

QC Level: ☐ I. ☐ II. ☐ III.

Project Specific (Specify):

1. Relinquished By: [signature]	Date: 2/19/98	Time: 1600	1. Received By: Priscilla Dalton	Date: 2-20-98	Time: 0835
2. Relinquished By:	Date:	Time:	2. Received By:	Date:	Time:
3. Relinquished By:	Date:	Time:	3. Received By:	Date:	Time:

Comments:

DISTRIBUTION: WHITE - Stays with Sample; CANARY - Returned to Client with Report; PINK - Field Copy

Chain of Custody Record

Quanterra

QUA-4124

Client: Parsons ES	Project Manager: Brad Lewis	Date: 2/19/98	Chain Of Custody Number: 26965
Address: 5390 Triangle Pkwy, STE 100	Telephone Number (Area Code)/Fax Number: (404) 235-2300	Lab Number: 59173	Page 2 of 2
City: NORCROSS; State: GA; Zip Code: 30092	Site Contact		
Project Name: STREAMLINED RBIC - KEESLER	Carrier/Waybill Number		
Contract/Purchase Order/Quote No.			

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	Analysis: BTEX 8020	~~Lead 7421~~	~~Methane RSK-175~~	~~Nitrate/Nitrite~~
17 TRIP BLANK	2/19/98		WATER	.08 L	VIALS	2			X			
18 MWA-14	"	1505	"	0.120 L	"	3			X			
19 MWA-6	"	1545	"	0.120 L	"	3			X			

Special Instructions

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months

Turn Around Time Required: ☐ Normal ☐ Rush

QC Level: ☐ I. ☐ II. ☐ III.

Project Specific (Specify)

1. Relinquished By: Dupre	Date: 2/19/98	Time: 1600	1. Received By: Priscilla Dalton	Date: 2-20-98	Time: 0835
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBU[TION:] WHITE - Stays with Sample; CANARY - Returned to Client with Report; PINK - Field Copy

I.8B260178

Chain of Custody Record

To: Austin

Quanterra Environmental Services

QUA-4149

Client: QES-Denver	Project Manager: Ellen LaRiviere	Date: 02/23/98	Chain Of Custody Number: 27532
Address:	Telephone Number (Area Code)/Fax Number:	Lab Number: 59173	Page ___ of ___
City: / State: / Zip Code:	Site Contact:		
Project Name: 59173 Parsons/Riverside AFB	Carrier/Waybill Number:		
Contract/Purchase Order/Quote No.:			

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	Analysis: OK 125
59173-13	02/19	0830	AQ	120 mL	40 mL	3		Good 4°C	X
-14	↓	0940	AQ	↓	↓	3		JM 2-25-98	X
-16		1150	AQ			3		↓	X

Special Instructions

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ____ Months

Turn Around Time Required: ☐ Normal ☐ Rush Due Before 13 Mar 98

QC Level: ☐ I. ☐ II. ☐ III.

Project Specific (Specify)

	Date	Time		Date	Time
1. Relinquished By: Kristi Bixby	2-23-98	1350	1. Received By: J. McNally	2-25-98	0939
2. Relinquished By			2. Received By		
3. Relinquished By			3. Received By		

Comments

DISTRIBUTION: WHITE - Stays with Sample; CANARY - Returned to Client with Report; PINK - Field Copy

Quanterra

SAMPLE CHECKLIST

Project #: 59173 Date/Time Received: 2-20-98 @ 0835

Company Name & Sampling Site: Parsons ES

*Cooler #(s): 1

Temperatures: 2.6

Unpacking & Labeling Check Points:

N/A	Yes	No		Initials
	✓		1. Radiation checked, record if reading > 0.5 mR/hr. (______ mR/hr)	PBD
	✓		2. Cooler seals intact.	
	✓		3. Chain of custody present.	
		✓	4. Bottles broken and/or are leaking, comment if yes.	

PHOTOGRAPH BROKEN BOTTLES

N/A	Yes	No		Initials
	✓		5. Containers labeled, comment if no.	
	✓		6. pH of all samples checked and meet requirements, note exceptions.	
	✓		7. Chain of custody includes "received by" and "relinquished" by signatures, dates, and times.	
*	✓		8. Receipt date(s) > 48 hours past the collection date(s)? If yes, notify PA/PM.	
	✓		9. Chain of custody agrees with bottle count, comment if no.	
	✓		10. Chain of custody agrees with labels, comment if no.	
* ☐	☐	✓	11. VOA samples filled completely, comment if no.	
☐	✓	☐	12. VOA bottles preserved, check for labels.	
		✓	13. Did samples require preservation with sodium thiosulfate?	
☐	☐	✓	14. If yes to #12, did the samples contain residual chlorine?	
✓	☐	☐	15. Sediment present in "D," dissolved, bottles.	
		✓	16. Are analyses with short holding times requested?	
✓	☐	☐	17. Is extra sample volume provided for MS, MSD or matrix duplicates?	
		✓	18. Multiphase samples present? If yes, comment below.	
	✓		19. Any subsampling for volatiles? If yes, list samples.	

PHOTOGRAPH MULTIPHASE SAMPLES

N/A	Yes	No		Initials
	✓		20. Clear picture taken, labeled, and stapled to project folder.	✓ PBD
☐	✓	☐	21. Subout COC signed and sent with samples to bottle prep?	KB
	✓		22. Was sample labeling double checked?	

Comments: Include action taken to resolve discrepancies/problems. Include a hard copy of e-mail or use extra paper if more space is needed. Samples 01 & 02 sampled 2-17, one of two trip blanks (?) have head space. ~~*Sample #08 is skipped in chain due to labeling problem~~

Initials: PBD

FAX TRANSMITTAL	# Pages 1 of 1	
To: John Hicks	From: Ellen La Riviere	
Co.: Parsons ES	Quanterra Denver	
Fax #: 831-8208	Phone: 421-6611	Fax: 431-7171

Quanterra Environmental Services

CONFIRMATION OF COMMUNICATION

Pursuant to our conversation today, the following is Quanterra's understanding of your instructions. We believe this ☐ is ☒ is not a contract change. An estimate of the schedule and cost impact (if any) will follow, so that change order negotiations may begin, if necessary. Meanwhile, Quanterra ☒ **will** ☐ **will not** perform according to the revised instructions, unless you instruct otherwise.

Client Name: Parsons Engineering Science	Program Name/LIMS Number: Keesler AFB
Quanterra Project Number: 059173	Contact at Laboratory: Ellen La Riviere
Date of Request: February 26, 1998	Contract/Order Number:
Date Change Order Submitted to Client: February 27, 1998	Authorized Client Representative: John Hicks

TYPE OF CHANGE:	DESCRIPTION OF MODIFICATION/CHANGE/DISCREPANCY/NOTIFICATION:		
☒ Method	On February 26, 1998, Mr. Brad Lewis of Parsons Engineering Science added the following analyses to samples in Quanterra's project number 059173:		
☐ Sample Delivery Schedule			
☐ SDA Criteria	**Sample ID**	**Client ID**	**Analysis**
☐ Matrix	059173-0003-SA	SBA-15 (9-10')	Lead
☐ QC Change	059173-0004-SA	SBA-16 (9-10')	Lead
☐ Bottles Received	059173-0008-SA	SBA-19 (6.5-8')	Lead, Naphthalene
☐ Deliverable	059173-0011-SA	SBA-20 (6-7')	Lead
☐ C of C Discrepancies			
☐ PROGRAM CHANGE			
☒ PROJECT CHANGE ONLY			

Date change is to be implemented: February 27, 1998	
APPROVED BY: **CLIENT REP:**	**QUANTERRA REP:** Ellen LaRiviere

Follow-up required:	☐ N/A
☒ Yes, Describe: Please sign acknowledgment and return to the laboratory.	

FAX TRANSMITTAL	# Pages 1 of 1	
To: John Hicks	From: Ellen La Riviere	
Co.: Parsons ES	Quanterra Denver	
Fax #: 831-8208	Phone: 421-6611	Fax: 431-7171

Quanterra
Environmental Services

CONFIRMATION OF COMMUNICATION

Pursuant to our conversation today, the following is Quanterra's understanding of your instructions. We believe this ☐ is ☒ is not a contract change. An estimate of the schedule and cost impact (if any) will follow, so that change order negotiations may begin, if necessary. Meanwhile, Quanterra ☒ will ☐ will not perform according to the revised instructions, unless you instruct otherwise.

Client Name: Parsons Engineering Science	Program Name/LIMS Number: Keesler AFB
Quanterra Project Number: 059173	Contact at Laboratory: Ellen La Riviere
Date of Request: February 20, 1998	Contract/Order Number:
Date Change Order Submitted to Client: February 21, 1998	Authorized Client Representative: John Hicks

TYPE OF CHANGE:	DESCRIPTION OF MODIFICATION/CHANGE/DISCREPANCY/NOTIFICATION:
☒ Method ☐ Sample Delivery Schedule ☐ SDA Criteria ☐ Matrix ☐ QC Change ☐ Bottles Received ☐ Deliverable ☐ C of C Discrepancies ☐ PROGRAM CHANGE ☒ PROJECT CHANGE ONLY	The chain of custody received with the samples in this project requested nitrate/nitrite analyses. During telephone discussions with the client, it was determined the laboratory will analyze the samples for nitrate by Method 300.0.

Date change is to be implemented: February 20, 1998

APPROVED BY:
CLIENT REP: John R. Hicks

QUANTERRA REP: Ellen LaRiviere

Follow-up required: ☐ N/A
☒ Yes, Describe: Please sign acknowledgment and return to the laboratory.

731854.0600.2000

Post-it® Fax Note 7671	Date 2/25 # of pages 1
To Ellen LaRiviere	From John Hicks
Co./Dept. Quanterra	Co. Parsons ES
Phone # 421-6611	Phone # 831-8100
Fax # 431-7171	Fax #

Quanterra
Environmental Services

Overview

On February 21, 1998, Quanterra Incorporated; Denver Laboratory received six aqueous samples from Parsons Engineering Science, Inc.

This report presents the analytical results as well as supporting information to aid in the evaluation and interpretation of the data and is arranged in the following order:

Overview
Sample Description Information/Analytical Test Requests
Analytical Results
Quality Control Report

Aromatic Volatile Organics Data Review

Each sample was analyzed to achieve the lowest possible reporting limits within the constraints of the method. In some cases, due to interferences or analytes present at concentrations above the linear calibration range of the instrument, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilutions required. Quanterra samples 059189-0001-SA, -0004-SA and –0005-SA were analyzed at dilutions for Method 8020A due to the concentration of target compounds present in the samples

Methane Data Review

Analyses for methane by RSK-175 were performed by Quanterra's Austin laboratory.

Samples 059189-0001-SA, -0004-SA and –0005-SA were analyzed at dilutions for methane by RSK-175 due to the concentration of the target analyte present in the sample. The reporting limits have been raised relative to the dilutions required.

The percent recovery in the matrix spike duplicate, 059189-0002-SD, exceeded the upper control limit. Because the laboratory control sample (LCS) was within acceptable limits, a matrix effect is indicated, and no further action was required by the laboratory.

With the above noted exceptions, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. All laboratory quality control samples analyzed in conjunction with the samples in this project were within established control limits.

Quanterra
Environmental Services

Footnotes and Data Qualifiers

The data sheets contained in this report may contain a variety of footnotes and data qualifiers. Some footnotes are used with specific tests; for example, footnotes used with the GC/FID Petroleum Hydrocarbon methods to indicate (in the analyst's judgment) the product that appears to be present. Finally, there are a number of general qualifiers that serve to identify problems and pertinent observations made during sample analysis that may not be discussed in the Overview. These are described below:

B Compound is also detected in the blank. The indicated compound was detected in the sample as well as the method blank. Please note that the B flag is not used when the sample result is ND (Not Detected).

G Reporting limit raised due to the matrix of the sample. Indicates that reporting limits were raised due to the presence of non-target compounds or other matrix interferences. The sample may or may not have been diluted. For inorganic methods, the footnote applies only to the flagged analyte. For organic methods, the footnote pertains to all analytes determined by the method.

J Result is detected below the reporting limit or is an estimated concentration. Most commonly, a "J" value indicates that the reported result for the analyte is below the stated reporting limit and is an estimated value. "J" values are applied to organic analytes detected above the MDL but below the reporting limit and for inorganic analytes detected above the IDL but below the reporting limit. Analytes which are not detected at or below the reporting limit are reported as "ND" and do not have "J" flags. Because "J" values may represent false positive concentrations, care should be used when interpreting these data. If there is uncertainty about the quantitation of an analyte such as due to metals serial dilution failure, this footnote may also indicate that a reported result is an estimated concentration, even if it is above the reporting limit.

N Spiked sample recovery not within limits. This qualifier is applied to the parent sample when MS/MSD recoveries are not within acceptable limits.

r This footnote is analyst defined. The data sheets will list "r" footnotes with consecutive numbers. The electronic data deliverable will show "r" data qualifiers. Please see datasheet for exact definition.

Quanterra
Environmental
Services

ANALYTICAL TEST REQUESTS
for
Parsons Engineering Science

Lab ID: 059189	Group Code	Analysis Description	Custom Test?
0001 - 0005	A	Method EPA-9 RSK-175 by GC/FID	Y
		AFCEE	Y
		Aromatic VOAs by Method 8020A with MTBE & TMBs	Y
		GC Prep For Waters	N
		AFCEE	Y
		Aromatic VOAs by Method 8020A with MTBE & TMBs	Y
		AFCEE	N
		Nitrate, Ion Chromatography	N
		AFCEE	N
		Lead, Furnace AA (Totals)	N
		Prep - Total Metals, Furnace AA	N
0006	B	AFCEE	Y
		Aromatic VOAs by Method 8020A with MTBE & TMBs	Y
		GC Prep For Waters	N
		AFCEE	Y
		Aromatic VOAs by Method 8020A with MTBE & TMBs	Y

Quanterra Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MW8-4 (0.00,0.00)		
LAB ID:	059189-0001-SA		
Matrix:	GRND-H20	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 25	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	880	d	50	1.4	ug/L
Toluene	89	M	50	3.8	ug/L
Ethylbenzene	210	M	50	1.4	ug/L
Xylenes (total)	600	d	50	3.8	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	103	%	44 - 165
Fluorobenzene	82	%	44 - 165

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

LIMs Report Key

Section	Description
Cover Letter	Signature page, report narrative as applicable.
Sample Description Information	Tabulated cross-reference between the Lab ID and Client ID, including matrix, date and time sampled, and the date received for all samples in the project.
Sample Analysis Results Sheets	Lists sample results, test components, reporting limits, dates prepared and analyzed, and any data qualifiers. Pages are organized by test.
QC LOT Assignment Report	Cross-reference between lab IDs and applicable QC batches (DCS, LCS, Blank, MS/SD, DU)
Duplicate Control Sample Report	Percent recovery and RPD results, with acceptance limits, for the laboratory duplicate control samples for each test are tabulated in this report. These are measures of accuracy and precision for each test. Acceptance limits are based upon laboratory historical data.
Laboratory Control Sample Report	Percent recovery results for a single Laboratory Control Sample (if applicable) are tabulated in this report, with the applicable acceptance limits for each test.
Matrix Spike/Matrix Spike Duplicate Report	Percent recovery and RPD results for matrix-specific QC samples and acceptance limits, where applicable. This report can be used to assess matrix effects on an analysis.
Single Control Sample Report	A tabulation of the surrogate recoveries for the blank for organic analyses.
Method Blank Report	A summary of the results of the analysis of the method blank for each test.

List of Abbreviations and Terms

Abbreviation	Term	Abbreviation	Term
DCS	Duplicate Control Sample	MSD	Matrix Spike Duplicate
DU	Sample Duplicate	QC Run	Preparation Batch
EB	Equipment Blank	QC Category	LIMs QC Category
FB	Field Blank	QC Lot	DCS Batch
FD	Field Duplicate	ND	Not Detected at or above the reporting limit expressed
IDL	Instrument Detection Limit (Metals)	QC Matrix	Matrix of the laboratory control sample(s)
LCS	Laboratory Control Sample	RL	Reporting Limit
MB	Method Blank	QC	Quality Control
MDL	Method Detection Limit	SA	Sample
MS	Matrix Spike	SD	Spike Duplicate
RPD	Relative Percent Difference	TB	Trip Blank
ppm (part-per-million)	mg/L or mg/kg (usually)	ppb (part-per-billion)	ug/L or ug/kg (usually)
QUAL	Qualifier flag	DIL	Dilution Factor

Quanterra
Environmental Services

SAMPLE DESCRIPTION INFORMATION
for
Parsons Engineering Science

Lab ID	Client ID	Matrix	Sampled Date	Sampled Time	Received Date
059189-0001-SA	MW8-4 (0.00,0.00)	GRND-H20	20 FEB 98	08:15	21 FEB 98
059189-0002-SA	MW8-1 (0.00,0.00)	GRND-H20	20 FEB 98	08:30	21 FEB 98
059189-0002-MS	MW8-1 (0.00,0.00)	GRND-H20	20 FEB 98	08:30	21 FEB 98
059189-0002-SD	MW8-1 (0.00,0.00)	GRND-H20	20 FEB 98	08:30	21 FEB 98
059189-0003-SA	MWA-10B (0.00,0.00)	GRND-H20	20 FEB 98	09:15	21 FEB 98
059189-0004-SA	MW8-5 (0.00,0.00)	GRND-H20	20 FEB 98	10:20	21 FEB 98
059189-0005-SA	MW8-3 (0.00,0.00)	GRND-H20	20 FEB 98	10:20	21 FEB 98
059189-0006-FB	FIELD/TRIP BLANK (0.00,0.00)	WATER-QA	20 FEB 98	10:20	21 FEB 98

Quanterra Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MW8-4 (0.00,0.00)		
LAB ID:	059189-0001-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 25	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	880	M	50	1.4	ug/L
Toluene	93	d	50	3.8	ug/L
Ethylbenzene	220	d	50	1.4	ug/L
Xylenes (total)	600	M	50	3.8	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	96	%	44 - 165
Fluorobenzene	86	%	44 - 165

d = See Preferred Result on Other Column
M = Preferred Result

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name: Parsons Engineering Science
Client ID: MW8-1 (0.00,0.00)
LAB ID: 059189-0002-SA
Matrix: GRND-H2O Sampled: 20 FEB 98 Received: 21 FEB 98
Authorized: 21 FEB 98 Prepared: 26 FEB 98 Analyzed: 26 FEB 98
Instrument: GCPID-H Dilution: 1.0

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	ND		2.0	0.054	ug/L
Xylenes (total)	ND		2.0	0.15	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	94	%	44 - 165
Fluorobenzene	87	%	44 - 165

ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MWA-10B (0.00,0.00)		
LAB ID:	059189-0003-SA		
Matrix:	GRND-H20	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	ND		2.0	0.15	ug/L
Ethylbenzene	ND		2.0	0.054	ug/L
Xylenes (total)	ND		2.0	0.15	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	97	%	44 - 165
Fluorobenzene	94	%	44 - 165

ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MW8-5 (0.00,0.00)		
LAB ID:	059189-0004-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 50	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	1500	d	100	2.8	ug/L
Toluene	ND	M	100	7.5	ug/L
Ethylbenzene	930	M	100	2.7	ug/L
Xylenes (total)	540	d	100	7.5	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	99	%	44 - 165
Fluorobenzene	90	%	44 - 165

d = See Preferred Result on Other Column
M = Preferred Result
ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MW8-5 (0.00,0.00)		
LAB ID:	059189-0004-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 50	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	1400	M	100	2.8	ug/L
Toluene	ND	d	100	7.5	ug/L
Ethylbenzene	940	d	100	2.7	ug/L
Xylenes (total)	530	M	100	7.5	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	96	%	44 - 165
Fluorobenzene	90	%	44 - 165

d = See Preferred Result on Other Column
M = Preferred Result
ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MW8-3 (0.00,0.00)		
LAB ID:	059189-0005-SA		
Matrix:	GRND-H20	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 250	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	2500	M	500	14	ug/L
Toluene	10000	M	500	38	ug/L
Ethylbenzene	1700	M	500	14	ug/L
Xylenes (total)	8200	M	500	38	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	96	%	44 - 165
Fluorobenzene	88	%	44 - 165

M = Preferred Result

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	MW8-3 (0.00,0.00)		
LAB ID:	059189-0005-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 250	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	2600	d	500	14	ug/L
Toluene	10000	d	500	38	ug/L
Ethylbenzene	1800	d	500	14	ug/L
Xylenes (total)	8300	d	500	38	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	92	%	44 - 165
Fluorobenzene	88	%	44 - 165

d = See Preferred Result on Other Column

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

AFCEE^Aromatic VOAs by Method 8020A with MTBE & TMBs
Method 8020A

Client Name:	Parsons Engineering Science		
Client ID:	FIELD/TRIP BLANK (0.00,0.00)		
LAB ID:	059189-0006-FB		
Matrix:	WATER-QA	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: 26 FEB 98	Analyzed: 26 FEB 98
Instrument:	GCPID-H	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Benzene	ND		2.0	0.056	ug/L
Toluene	0.97	J	2.0	0.15	ug/L
Ethylbenzene	ND		2.0	0.054	ug/L
Xylenes (total)	ND		2.0	0.15	ug/L

Surrogate	Recovery		Acceptable Range
a,a,a-Trifluorotoluene	95	%	44 - 165
Fluorobenzene	85	%	44 - 165

J = Result is detected below the reporting limit or is an estimated concentration.
ND = Not Detected

Reported By: Shawn Hadley

Approved By: Audrey Cornell

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Organics by Chromatography

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059189-0001-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0001-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0002-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0002-MS	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0002-SD	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0003-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0004-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0004-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0005-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0005-SA	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0006-FB	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H
059189-0006-FB	AQUEOUS	8020-PAR-A	26 FEB 98-H	26 FEB 98-H

Quanterra
Environmental Services

LABORATORY CONTROL SAMPLE REPORT
Organics by Chromatography
Project: 059189

Category: 8020-PAR-A Method 8020A - AFCEE Aromatic Volatile Organics with MTBE
Matrix: AQUEOUS Date Analyzed: 26 FEB 98
QC Run: 26 FEB 98-H
Concentration Units: ug/L

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) LCS	Accuracy(%) Limits
Benzene	20.0	19.8	99	75-125
Toluene	20.0	19.3	96	70-125
Chlorobenzene	20.0	19.3	96	75-129
Ethylbenzene	20.0	19.0	95	71-129
Xylenes (total)	60.0	58.3	97	71-133
1,3-Dichlorobenzene	20.0	19.4	97	70-131
1,2-Dichlorobenzene	20.0	19.4	97	61-134
1,4-Dichlorobenzene	20.0	19.6	98	75-126

Surrogates	Concentration Spiked	Concentration Measured	Accuracy(%) LCS	Accuracy(%) Limits
a,a,a-Trifluorotoluene	30.0	27.6	92	44-165
Fluorobenzene	30.0	26.6	89	44-165

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

SINGLE CONTROL SAMPLE REPORT
Organics by Chromatography

Category: 8020-PAR-A
Matrix: AQUEOUS
QC Lot: 26 FEB 98-H QC Run: 26 FEB 98-H
Concentration Units: ug/L

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) SCS	Accuracy(%) Limits
a,a,a-Trifluorotoluene	30.0	28.2	94	44-165
Fluorobenzene	30.0	27.1	90	44-165

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental
Services

Quanterra Incorporated
4955 Yarrow Street
Arvada, Colorado 80002

303 421-6611 Telephone
303 431-7171 Fax

ANALYTICAL RESULTS
FOR
PARSONS ENGINEERING SCIENCE, INC.

QUANTERRA INCORPORATED, DENVER
PROJECT NUMBER 059189

MARCH 21, 1998

Written by: Ellen La Riviere
Ellen La Riviere, Program Manager

Quanterra
Environmental Services

METHOD BLANK REPORT
Organics by Chromatography
Project: 059189

Test: 8020-PAR-MDL-AP AFCEE Aromatic VOAs by Method 8020A with MTBE & TMBs
Matrix: AQUEOUS
QC Lot: 26 FEB 98-H QC Run: 26 FEB 98-H Date Analyzed: 26 FEB 98

Analyte	Result	Units	RL	MDL
Benzene	ND	ug/L	2.0	0.056
Toluene	ND	ug/L	2.0	0.15
Ethylbenzene	ND	ug/L	2.0	0.054
Xylenes (total)	ND	ug/L	2.0	0.15

Test: 8020-PAR-MDL-2-AP AFCEE Aromatic VOAs by Method 8020A with MTBE & TMBs
Matrix: AQUEOUS
QC Lot: 26 FEB 98-H QC Run: 26 FEB 98-H Date Analyzed: 26 FEB 98

Analyte	Result	Units	RL	MDL
Benzene	ND	ug/L	2.0	0.056
Toluene	ND	ug/L	2.0	0.15
Ethylbenzene	ND	ug/L	2.0	0.054
Xylenes (total)	ND	ug/L	2.0	0.15

ND = Not Detected

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Organics by Chromatography
Project: 059189

Category: 8020-PAR-A Method 8020A - AFCEE Aromatic Volatile Organics with MTBE
Matrix: AQUEOUS
Sample: 059189-0002
MS Run: 26 FEB 98-H
Units: ug/L

Analyte	Sample Result	Concentration MS Result	MSD Result	Amount Spiked MS	Amount Spiked MSD	% Recovery MS	% Recovery MSD	Recov. Accep. Limits	RPD MS-MSD	RPD Accept Limits
Benzene	ND	20.9	22.1	20.0	20.0	104	110	75-125	5.6	20
Toluene	ND	20.2	21.5	20.0	20.0	101	108	70-125	6.2	20
Chlorobenzene	ND	20.3	21.3	20.0	20.0	102	106	75-129	4.8	20
Ethylbenzene	ND	19.8	21.1	20.0	20.0	99	106	71-129	6.4	20
Xylenes (total)	ND	61.0	63.9	60.0	60.0	102	106	71-133	4.6	20
1,3-Dichlorobenzene	ND	20.4	21.2	20.0	20.0	102	106	70-131	3.8	20
1,2-Dichlorobenzene	ND	20.4	21.3	20.0	20.0	102	106	61-134	4.3	20
1,4-Dichlorobenzene	ND	20.5	21.5	20.0	20.0	102	108	75-126	4.8	20
tert-Butyl methyl ether	NA	NA	NA	20.0	20.0	NC	NC	65-138	NC	20
1,2,3-Trimethylbenzene	NA	NA	NA	20.0	20.0	NC	NC	70-130	NC	20
1,3,5-Trimethylbenzene	NA	NA	NA	20.0	20.0	NC	NC	70-130	NC	20
1,2,4-Trimethylbenzene	NA	NA	NA	20.0	20.0	NC	NC	70-130	NC	20

Surrogates		%Recovery		Rec. Accept. Limits
a,a,a-Trifluorotoluene	94.3	94.9	98.1	44-165
Fluorobenzene	87.0	87.1	91.8	44-165

NA = Not Applicable
NC = Not Calculated, calculation not applicable.
ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

AFCEE
Total Metals

Client Name: Parsons Engineering Science
Client ID: MW8-4 (0.00,0.00)
LAB ID: 059189-0001-SA
Matrix: GRND-H2O   Sampled: 20 FEB 98   Received: 21 FEB 98
Authorized: 21 FEB 98   Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	ND		1.0	0.0012	0.0050	mg/L	SW7421	24 FEB 98	25 FEB 98

ND = Not Detected

Reported By: Robin Proctor   Approved By: Jan Ecos

Quanterra
Environmental Services

AFCEE
Total Metals

Client Name:	Parsons Engineering Science
Client ID:	MW8-1 (0.00,0.00)
LAB ID:	059189-0002-SA
Matrix:	GRND-H2O
Authorized:	21 FEB 98

Sampled: 20 FEB 98 Received: 21 FEB 98
Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	ND	W	1.0	0.0012	0.0050	mg/L	SW7421	24 FEB 98	25 FEB 98

W = Post-digestion spike for furnace AA out of control limits while sample absorbance is less than 50% of spike absorbance
ND = Not Detected

Reported By: Robin Proctor Approved By: Jan Ecos

Quanterra
Environmental Services

AFCEE
Total Metals

Client Name:	Parsons Engineering Science
Client ID:	MWA-10B (0.00,0.00)
LAB ID:	059189-0003-SA
Matrix:	GRND-H2O
Authorized:	21 FEB 98

Sampled: 20 FEB 98   Received: 21 FEB 98
Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	0.0016	JW	1.0	0.0012	0.0050	mg/L	SW7421	24 FEB 98	25 FEB 98

J = Result is detected below the reporting limit or is an estimated concentration.
W = Post-digestion spike for furnace AA out of control limits while sample absorbance is less than 50% of spike absorbance

Reported By: Robin Proctor   Approved By: Jan Ecos

Quanterra
Environmental Services

AFCEE
Total Metals

Client Name:	Parsons Engineering Science		
Client ID:	MW8-5 (0.00,0.00)		
LAB ID:	059189-0004-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	ND	W	1.0	0.0012	0.0050	mg/L	SW7421	24 FEB 98	25 FEB 98

W = Post-digestion spike for furnace AA out of control limits while sample absorbance is less than 50% of spike absorbance
ND = Not Detected

Reported By: Robin Proctor

Approved By: Jan Ecos

Quanterra
Environmental Services

AFCEE
Total Metals

Client Name:	Parsons Engineering Science		
Client ID:	MW8-3 (0.00,0.00)		
LAB ID:	059189-0005-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: See Below	Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Lead	0.021		1.0	0.0012	0.0050	mg/L	SW7421	24 FEB 98	25 FEB 98

Reported By: Robin Proctor

Approved By: Jan Ecos

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Metals Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059189-0001-SA	AQUEOUS	PB-LAW-AT	24 FEB 98-K3	24 FEB 98-K3
059189-0002-SA	AQUEOUS	PB-LAW-AT	24 FEB 98-K3	24 FEB 98-K3
059189-0002-MS	AQUEOUS	PB-LAW-AT	24 FEB 98-K3	24 FEB 98-K3
059189-0002-SD	AQUEOUS	PB-LAW-AT	24 FEB 98-K3	24 FEB 98-K3
059189-0003-SA	AQUEOUS	PB-LAW-AT	24 FEB 98-K3	24 FEB 98-K3
059189-0004-SA	AQUEOUS	PB-LAW-AT	24 FEB 98-K3	24 FEB 98-K3
059189-0005-SA	AQUEOUS	PB-LAW-AT	24 FEB 98-K3	24 FEB 98-K3

Quanterra Environmental Services

DUPLICATE CONTROL SAMPLE REPORT
Metals Analysis and Preparation

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limits
Category: PB-LAW-AT Matrix: AQUEOUS QC Lot: 24 FEB 98-K3 Concentration Units: mg/L								
Lead	0.0400	0.0473	0.0473	0.0473	118	74-124	0.0	15

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental
Services

METHOD BLANK REPORT
Metals Analysis and Preparation
Project: 059189

Test: PB-AFCEE2-MDL-AT AFCEE Lead, Furnace AA (Totals)
Matrix: AQUEOUS
QC Lot: 24 FEB 98-K3 QC Run: 24 FEB 98-K3 Date Analyzed: 25 FEB 98

Analyte	Result	Units	RL	MDL
Lead	ND	mg/L	0.0050	0.0012

ND = Not Detected

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Metals Analysis and Preparation
Project: 059189

Category: PB-LAW-AT Lead, Furnace AA / Totals (England AFB)
Matrix: AQUEOUS
Sample: 059189-0002
MS Run: 24 FEB 98-K3
Units: mg/L

Analyte	Concentration: Sample Result	MS Result	MSD Result	Amount Spiked MS/MSD	%Recovery MS	%Recovery MSD	%RPD	Acceptance Limit Recov.	Acceptance Limit RPD
Lead	ND W	0.0481	0.0487	0.0400	120	122	1.2	74-124	15

W = Post-digestion spike for furnace AA out of control limits while sample absorbance is less than 50% of spike absorbance
ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra
Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: MW8-4 (0.00,0.00)
LAB ID: 059189-0001-SA
Matrix: GRND-H20 Sampled: 20 FEB 98 Received: 21 FEB 98
Authorized: 21 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Nitrate as N	ND		1.0	0.040	0.50	mg/L	9056	NA	21 FEB 98

ND = Not Detected

Reported By: Patty Jungk

Approved By: Jan Ecos

Quanterra
Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: MW8-1 (0.00,0.00)
LAB ID: 059189-0002-SA
Matrix: GRND-H2O Sampled: 20 FEB 98 Received: 21 FEB 98
Authorized: 21 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Nitrate as N	0.21	J	1.0	0.040	0.50	mg/L	9056	NA	21 FEB 98

J = Result is detected below the reporting limit or is an estimated concentration.

Reported By: Patty Jungk Approved By: Jan Ecos

Quanterra
Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: MWA-10B (0.00,0.00)
LAB ID: 059189-0003-SA
Matrix: GRND-H2O Sampled: 20 FEB 98 Received: 21 FEB 98
Authorized: 21 FEB 98 Prepared: See Below Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Nitrate as N	0.65		1.0	0.040	0.50	mg/L	9056	NA	21 FEB 98

Reported By: Patty Jungk Approved By: Jan Ecos

Quanterra
Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: MW8-5 (0.00,0.00)
LAB ID: 059189-0004-SA
Matrix: GRND-H2O   Sampled: 20 FEB 98   Received: 21 FEB 98
Authorized: 21 FEB 98   Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Nitrate as N	ND		1.0	0.040	0.50	mg/L	9056	NA	21 FEB 98

ND = Not Detected

Reported By: Patty Jungk   Approved By: Jan Ecos

Quanterra
Environmental Services

General Inorganics

Client Name: Parsons Engineering Science
Client ID: MW8-3 (0.00,0.00)
LAB ID: 059189-0005-SA
Matrix: GRND-H2O   Sampled: 20 FEB 98   Received: 21 FEB 98
Authorized: 21 FEB 98   Prepared: See Below   Analyzed: See Below

Parameter	Result	Qual	Dil	MDL	Rep Lim	Units	Method	Prepared Date	Analyzed Date
Nitrate as N	0.14	J	1.0	0.040	0.50	mg/L	9056	NA	21 FEB 98

J = Result is detected below the reporting limit or is an estimated concentration.

Reported By: Patty Jungk   Approved By: Jan Ecos

Quanterra
Environmental
Services

QC LOT ASSIGNMENT REPORT
Wet Chemistry Analysis and Preparation

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059189-0001-SA	AQUEOUS	NO3-PAR-A	21 FEB 98-S1	21 FEB 98-S1
059189-0002-SA	AQUEOUS	NO3-PAR-A	21 FEB 98-S1	21 FEB 98-S1
059189-0002-MS	AQUEOUS	NO3-PAR-A	21 FEB 98-S1	21 FEB 98-S1
059189-0002-SD	AQUEOUS	NO3-PAR-A	21 FEB 98-S1	21 FEB 98-S1
059189-0003-SA	AQUEOUS	NO3-PAR-A	21 FEB 98-S1	21 FEB 98-S1
059189-0004-SA	AQUEOUS	NO3-PAR-A	21 FEB 98-S1	21 FEB 98-S1
059189-0005-SA	AQUEOUS	NO3-PAR-A	21 FEB 98-S1	21 FEB 98-S1

Quanterra
Environmental
Services

DUPLICATE CONTROL SAMPLE REPORT
Wet Chemistry Analysis and Preparation

Analyte	Concentration Spiked	Measured DCS1	Measured DCS2	AVG	Accuracy Average(%) DCS	Accuracy Limits	Precision (RPD) DCS	Precision Limits
Category: NO3-PAR-A Matrix: AQUEOUS QC Lot: 21 FEB 98-S1 Concentration Units: mg/L								
Nitrate as N	10.0	10.4	10.5	10.5	105	90-110	0.67	20

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Wet Chemistry Analysis and Preparation
Project: 059189

Test: NO3-AF-IC-PAR-MDL-A AFCEE Nitrate, Ion Chromatography
Matrix: AQUEOUS
QC Lot: 21 FEB 98-S1 QC Run: 21 FEB 98-S1 Date Analyzed: 21 FEB 98

Analyte	Result	Units	RL	MDL
Nitrate as N	ND	mg/L	0.50	0.040

ND = Not Detected

Quanterra
Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Wet Chemistry Analysis and Preparation
Project: 059189

Category: NO3-PAR-A Nitrate as N by Ion Chromatography (Cape Canaveral)
Matrix: AQUEOUS
Sample: 059189-0002
MS Run: 21 FEB 98-S1
Units: mg/L

Analyte	Concentration: Sample Result	Concentration: MS Result	Concentration: MSD Result	Amount Spiked MS/MSD	%Recovery MS	%Recovery MSD	%RPD	Acceptance Limit Recov.	Acceptance Limit RPD
Nitrate as N	0.21 J	4.91	4.89	5.00	94	94	0.4	90-110	20

J = Result is detected below the reporting limit or is an estimated concentration.

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name:	Parsons Engineering Science		
Client ID:	MW8-4 (0.00,0.00)		
LAB ID:	059189-0001-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: N/A	Analyzed: 03 MAR 98
Instrument:	GCFID-K1A	Dilution: 100	

Parameter	Result	Qualifier	RL	MDL	Units
Methane	4700	B	50	5.2	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin   Approved By: Lynn S. Calvin

Quanterra
Environmental Services

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name: Parsons Engineering Science
Client ID: MW8-1 (0.00,0.00)
LAB ID: 059189-0002-SA
Matrix: GRND-H2O   Sampled: 20 FEB 98   Received: 21 FEB 98
Authorized: 21 FEB 98   Prepared: N/A   Analyzed: 03 MAR 98
Instrument: GCFID-K1A   Dilution: 1.0

Parameter	Result	Qualifier	RL	MDL	Units
Methane	62	B	0.50	0.052	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin   Approved By: Lynn S. Calvin

Quanterra
Environmental Services

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name:	Parsons Engineering Science		
Client ID:	MWA-10B (0.00,0.00)		
LAB ID:	059189-0003-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: N/A	Analyzed: 03 MAR 98
Instrument:	GCFID-K1A	Dilution: 1.0	

Parameter	Result	Qualifier	RL	MDL	Units
Methane	3.1	B	0.50	0.052	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin Approved By: Lynn S. Calvin

Quanterra Environmental Services

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name:	Parsons Engineering Science		
Client ID:	MW8-5 (0.00,0.00)		
LAB ID:	059189-0004-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: N/A	Analyzed: 03 MAR 98
Instrument:	GCFID-K1A	Dilution: 100	

Parameter	Result	Qualifier	RL	MDL	Units
Methane	4900	B	50	5.2	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin　　Approved By: Lynn S. Calvin

Quanterra
Environmental Services

Method EPA-9 RSK-175 by GC/FID
Method EPA-9 RSK-175

Client Name:	Parsons Engineering Science		
Client ID:	MW8-3 (0.00,0.00)		
LAB ID:	059189-0005-SA		
Matrix:	GRND-H2O	Sampled: 20 FEB 98	Received: 21 FEB 98
Authorized:	21 FEB 98	Prepared: N/A	Analyzed: 03 MAR 98
Instrument:	GCFID-K1A	Dilution: 30	

Parameter	Result	Qualifier	RL	MDL	Units
Methane	1100	B	15	1.6	ug/L

B = Compound is also detected in the blank.

Reported By: Quanterra-Austin   Approved By: Lynn S. Calvin

Quanterra
Environmental Services

QC LOT ASSIGNMENT REPORT
Subcontracted to Quanterra Lab

Laboratory Sample Number	QC Matrix	QC Category	QC Lot Number (DCS)	QC Run Number (SCS/BLANK)
059189-0001-SA	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1
059189-0002-SA	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1
059189-0002-MS	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1
059189-0002-SD	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1
059189-0003-SA	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1
059189-0004-SA	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1
059189-0005-SA	AQUEOUS	GAS-AUS-A	03 MAR 98-S1	03 MAR 98-S1

Quanterra
Environmental Services

LABORATORY CONTROL SAMPLE REPORT
Subcontracted to Quanterra Lab

Category: GAS-AUS-A
Matrix: AQUEOUS
QC Lot: 03 MAR 98-S1 QC Run: 03 MAR 98-S1
Concentration Units: ug/L

Analyte	Concentration Spiked	Concentration Measured	Accuracy(%) LCS	Accuracy(%) Limits
Methane	34.1	30.2	89	70-130
Ethane	63.9	57.0	89	70-130
Ethene	59.6	52.8	88	70-130

Calculations are performed before rounding to avoid round-off errors in calculated results.

Quanterra Environmental Services

METHOD BLANK REPORT
Subcontracted to Quanterra Lab
Project: 059189

Test: GASES-AUSTIN-MDL-A Method EPA-9 RSK-175 by GC/FID
Matrix: AQUEOUS
QC Lot: 03 MAR 98-S1 QC Run: 03 MAR 98-S1 Date Analyzed: 03 MAR 98

Analyte	Result		Units	RL	MDL
Methane	0.12	J	ug/L	0.50	0.052

J = Result is detected below the reporting limit or is an estimated concentration.

Quanterra Environmental Services

MATRIX SPIKE/MATRIX SPIKE DUPLICATE QC REPORT
Subcontracted to Quanterra Lab
Project: 059189

Category: GAS-AUS-A Gases by Method AUS GC-0019 (Quanterra-Austin)
Matrix: AQUEOUS
Sample: 059189-0002
MS Run: 03 MAR 98-S1
Units: ug/L

	Concentration			Amount Spiked		% Recovery		Recov. Accep.	RPD	RPD Accept
Analyte	Sample Result	MS Result	MSD Result	MS	MSD	MS	MSD	Limits	MS-MSD	Limits
Methane	62	101	117	33.9	34.3	115	160	70-130	14	30
Ethane	0.87	56.4	55.7	63.6	64.2	87	85	70-130	2.3	30
Ethene	ND	51.8	51.3	59.3	60.0	87	86	70-130	2.1	30

ND = Not Detected

Calculations are performed before rounding to avoid round-off errors in calculated results.

59189

CHAIN OF CUSTODY RECORD / ANALYTICAL SERVICES REQUEST

Page 1 of 1

QUANTERRA
~~Evergreen Analytical Inc.~~
~~4036 Youngfield St.~~
~~Wheat Ridge, Colorado 80033~~
~~(303) 425-6021~~
~~FAX (303) 425-6854~~
~~(800) 845-7400~~

COMPANY PARSONS E3
ADDRESS 5390 Triangle Pkwy STE 100
CITY NORCROSS STATE GA ZIP 30092
PHONE# (404) 235-2300 FAX # ____ FAX RESULTS Y / N

Sampler Name:
(signature) [signature]
(print) Brad Lewis

CLIENT CONTACT (print) Brad
CLIENT PROJ. I.D. 731654.06
EAL. QUOTE # ____ P.O.# ____
TURNAROUND REQUIRED* ☒ STD (2 wks) ☐ UST
☐ Other (Specify)* ____
*expedited turnaround subject to additional fee

Please **PRINT** all information:

	CLIENT SAMPLE IDENTIFICATION	DATE SAMPLED	TIME	No. of Containers	MATRIX: Water-Drinking/Discharge/Ground (circle)	MATRIX: Soil / Solid / Air / Gas	MATRIX: Oil / Sludge / Multi-phase	TCLP VOA/BNA/Pest/Herb/Metals (circle)	VOA 8260/624/524.2 (circle)	BNA 8270/625 (circle)	Pesticides 8080/608 (circle)	Pest/PCBs 8080/608/508 (circle)	PCB Screen	Herbicides 8150/515 (circle)	BTEX 8020/602 (circle)/MTBE (circle)	TVPH 8015mod. (Gasoline)	TEPH 8015mod. (Diesel)	Total Metals-DW / NPDES / SW846 (circle & list metals below)	Dissolved Metals - DW / SW846 (circle & list metals below)	Oil & Grease 413.1	TRPH 418.1	METHANE RSK-175	LEAD 7421	NITRATE ~~E~~ E300.0				For Laboratory use only
01	MW8-~~5~~4	2/20/98	0815	8	X										X													
02	MS/SD MW8-1		0830	24	X																							
03	MWA-10B		0915	8	X																							
04	MW8-5		1020	8	X																							
05	MW8-3		1020	8	X																							
06	FIELD/TRIP BLANK		1020	3	X																	BG						
					Sample Fraction																							Loc
	Instructions:				Container																							

For Laboratory use only:
W.O. # ____
B.O.F. # ____
C/S (O) ____/____
C/S (I) ____/____
Cooler Temp. °C 2.3
Seals Intact Y / N / NA
Samples Pres. Y / N / NA
Headspace Y / N / NA
By ____/____

MW8-1 IS MS/MSD FOR GROUND WATER

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time	Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Date/Time
[signature]	2/20/98 1200	D. Dalton	2.21.98 0825				

I8B260176

Quanterra

Chain of Custody Record

QUA-4124

Client	Project Manager	Date	Chain Of Custody Number
QES - Denver	Ellen LaRiviere	02-21-98	20147

Address	Telephone Number (Area Code)/Fax Number	Lab Number	Page
4955 Yarrow St	303-421-6611		Page 1 of 1

City	State	Zip Code	Site Contact
Arvada	CO	80002	

Project Name	Carrier/Waybill Number
Parsons / Kwolslen AFB	

Contract/Purchase Order/Quote No.

Sample I.D. No. and Description	Date	Time	Sample Type	Total Volume	Containers Type	Containers No.	Preservative	Condition on Receipt	Analysis
59189 - 01	02-20-98	0815	Groundwater	120 mL	40 mL	3	HCl	Good 4°	8260 175
- 02	↓	0830	↓	120 mL	↓	3	↓	JM 2-25-98	↓
- 02 MS/SD	↓	0830	↓	240 mL	↓	6	↓	↓	↓
- 03	↓	0915	↓	120 mL	↓	3	↓	↓	↓
- 04	↓	1020	↓	120 mL	↓	3	↓	↓	↓
- 05	↓	1020	↓	120 mL	↓	3	↓	↓	↓

Special Instructions

Possible Hazard Identification: ☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal: ☐ Return To Client ☐ Disposal By Lab ☐ Archive For ______ Months

Turn Around Time Required: ☐ Normal ☐ Rush

QC Level: ☐ I. ☐ II. ☐ III.

Project Specific (Specify)

1. Relinquished By	Date	Time	1. Received By	Date	Time
Kristi Bixby	2-23-98	1440	[signature]	2-25-98	0939
2. Relinquished By	Date	Time	2. Received By	Date	Time
3. Relinquished By	Date	Time	3. Received By	Date	Time

Comments

DISTRIBUTION: WHITE - Stays with Sample; CANARY - Returned to Client with Report; PINK - Field Copy

Quanterra

SAMPLE CHECKLIST

Project #: 59189 Date/Time Received: 2-21-98 @0835

Company Name & Sampling Site: Parsons ES

*Cooler #(s): 1

Temperatures: 2.3

Unpacking & Labeling Check Points:

N/A	Yes	No	Check Point	Initials
	☑	☐	1. Radiation checked, record if reading > 0.5 mR/hr. (_____ mR/hr)	PBD
	☑	☐	2. Cooler seals intact.	
	☑	☐	3. Chain of custody present.	
	☐	☑	4. Bottles broken and/or are leaking, comment if yes.	
			PHOTOGRAPH BROKEN BOTTLES	
	☑	☐	5. Containers labeled, comment if no.	
	☑	☐	6. pH of all samples checked and meet requirements, note exceptions.	
	☑	☐	7. Chain of custody includes "received by" and "relinquished" by signatures, dates, and times.	
	☐	☑	8. Receipt date(s) > 48 hours past the collection date(s)? If yes, notify PA/PM.	
	☑	☐	9. Chain of custody agrees with bottle count, comment if no.	
	☑	☐	10. Chain of custody agrees with labels, comment if no.	
☐	☑	☐	11. VOA samples filled completely, comment if no.	
☐	☑	☐	12. VOA bottles preserved, check for labels.	
	☐	☑	13. Did samples require preservation with sodium thiosulfate?	
☐	☐	☑	14. If yes to #12, did the samples contain residual chlorine?	
☑	☐	☐	15. Sediment present in "D," dissolved, bottles.	
	☑	☐	16. Are analyses with short holding times requested?	
☐	☑	☐	17. Is extra sample volume provided for MS, MSD or matrix duplicates?	
	☐	☑	18. Multiphase samples present? If yes, comment below.	
	☐	☑	19. Any subsampling for volatiles? If yes, list samples.	
			PHOTOGRAPH MULTIPHASE SAMPLES	
	☑	☐	20. Clear picture taken, labeled, and stapled to project folder.	
☑	☐	☐	21. Subout COC signed and sent with samples to bottle prep?	
	☑	☐	22. Was sample labeling double checked?	PBD

Comments: Include action taken to resolve discrepancies/problems. Include a hard copy of e-mail or use extra paper if more space is needed. __________

Initials: ______

Quanterra
Environmental Services

Table Of Contents

Standard Deliverables With Supporting Documentation

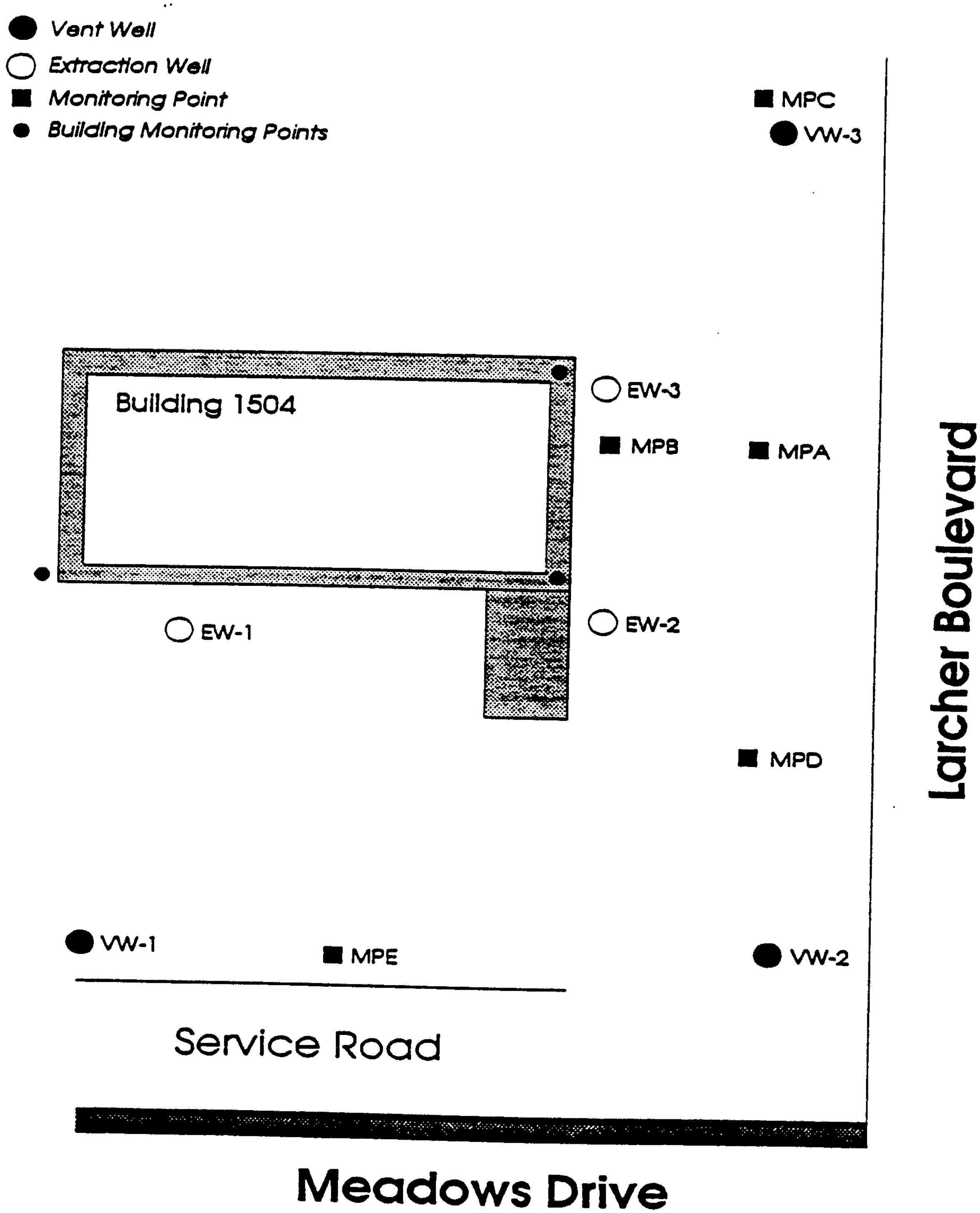
[Please Note: A one-page "Description of Supporting Documentation" is provided in the Supporting Documentation section(s).]

APPENDIX B
PERTINENT DATA FROM PREVIOUS SITE INVESTIGATIONS

SITE MAPS

BIOVENT

Figure 16.6 Schematic Diagram of AOC A, Keesler AFB Showing Injection Wells, Extraction Wells, and Monitoring Points (not ot scale)



DDC

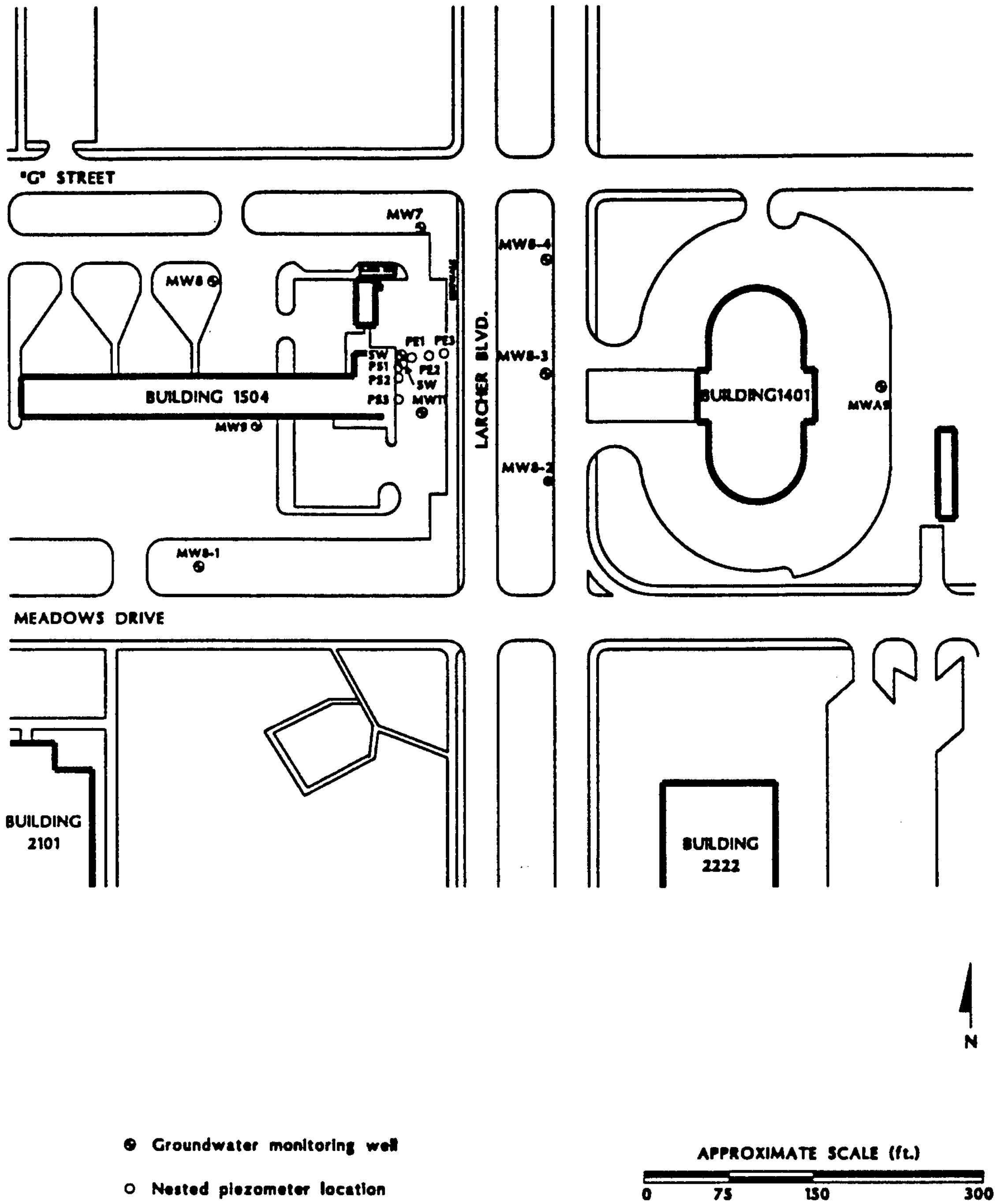


FIGURE 2: PLAN VIEW OF THE TEST SITE AT KEESLER AIR FORCE BASE (BUILDING 1504)

WB 1236-1 CAD

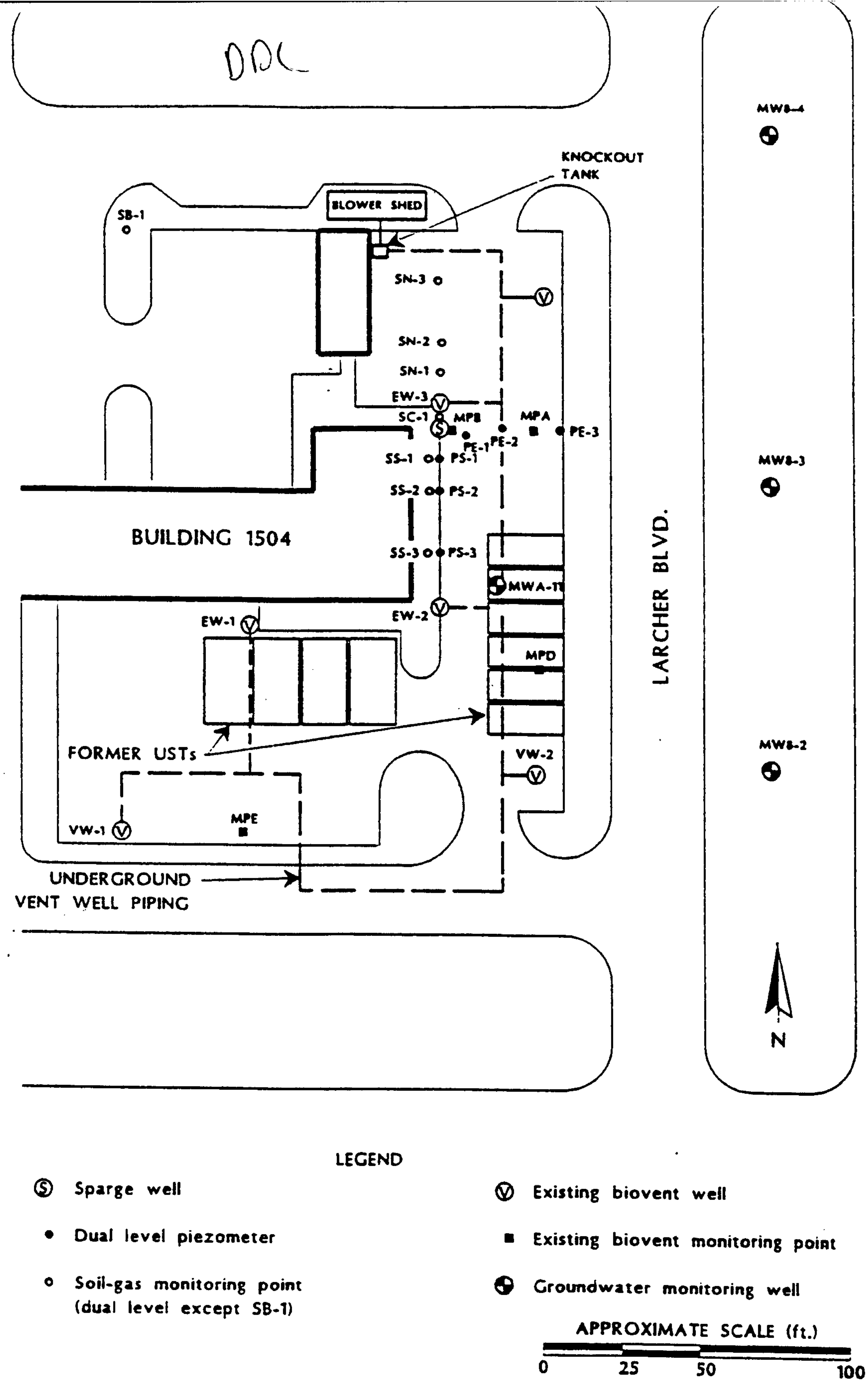
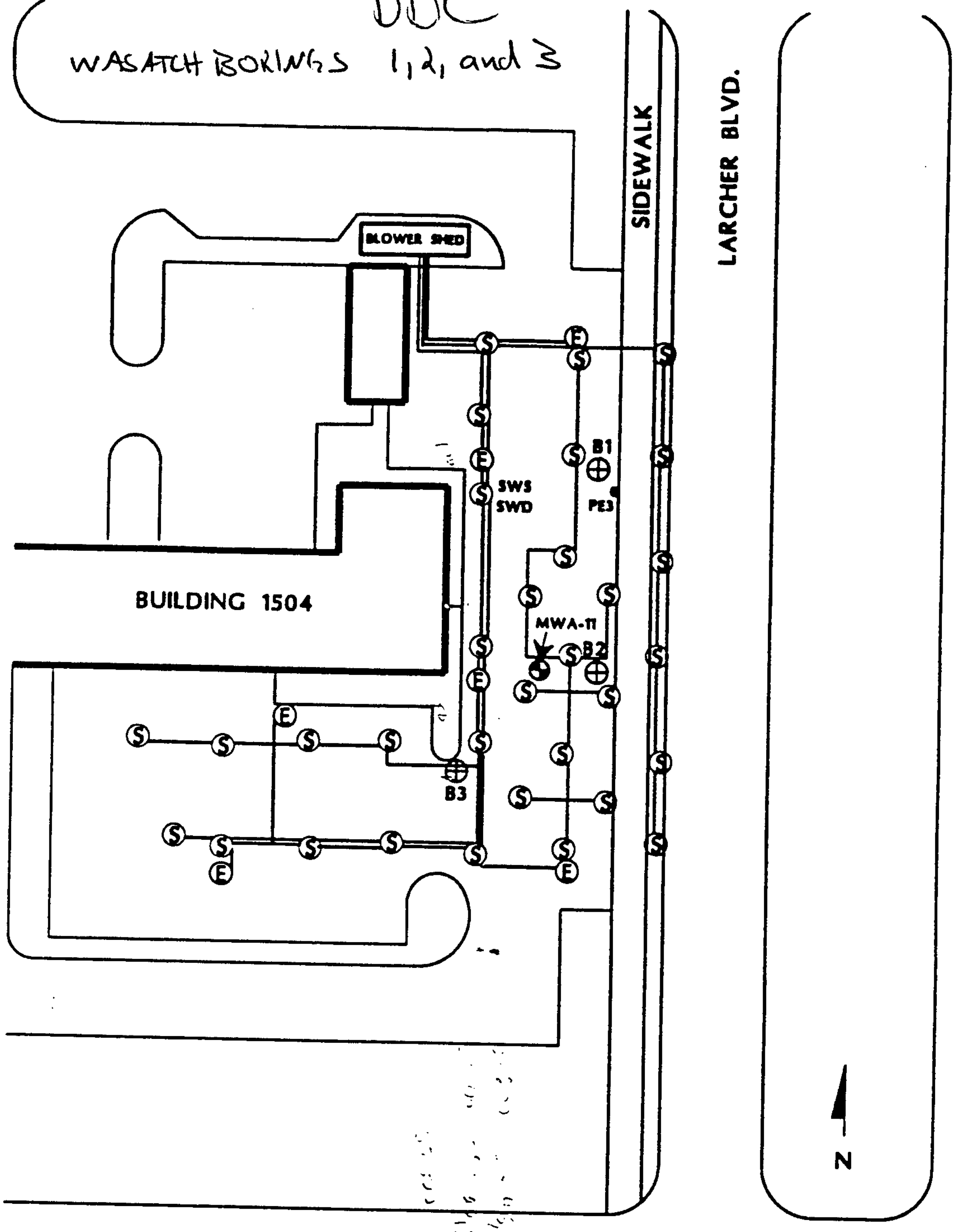


FIGURE 5: PLAN VIEW OF WELL, PIEZOMETER, AND SOIL GAS PROBE LOCATIONS

WEI 1238-1 CAD

DDC

WASATCH BORINGS 1, 2, and 3



LEGEND

Manifold location

Ⓢ DDC well location blower 1

Ⓢ DDC well location blower 2

Ⓔ Soil vapor extraction well location

⊕ Exploratory Boring Location

APPROXIMATE SCALE (ft.)

0 25 50 100

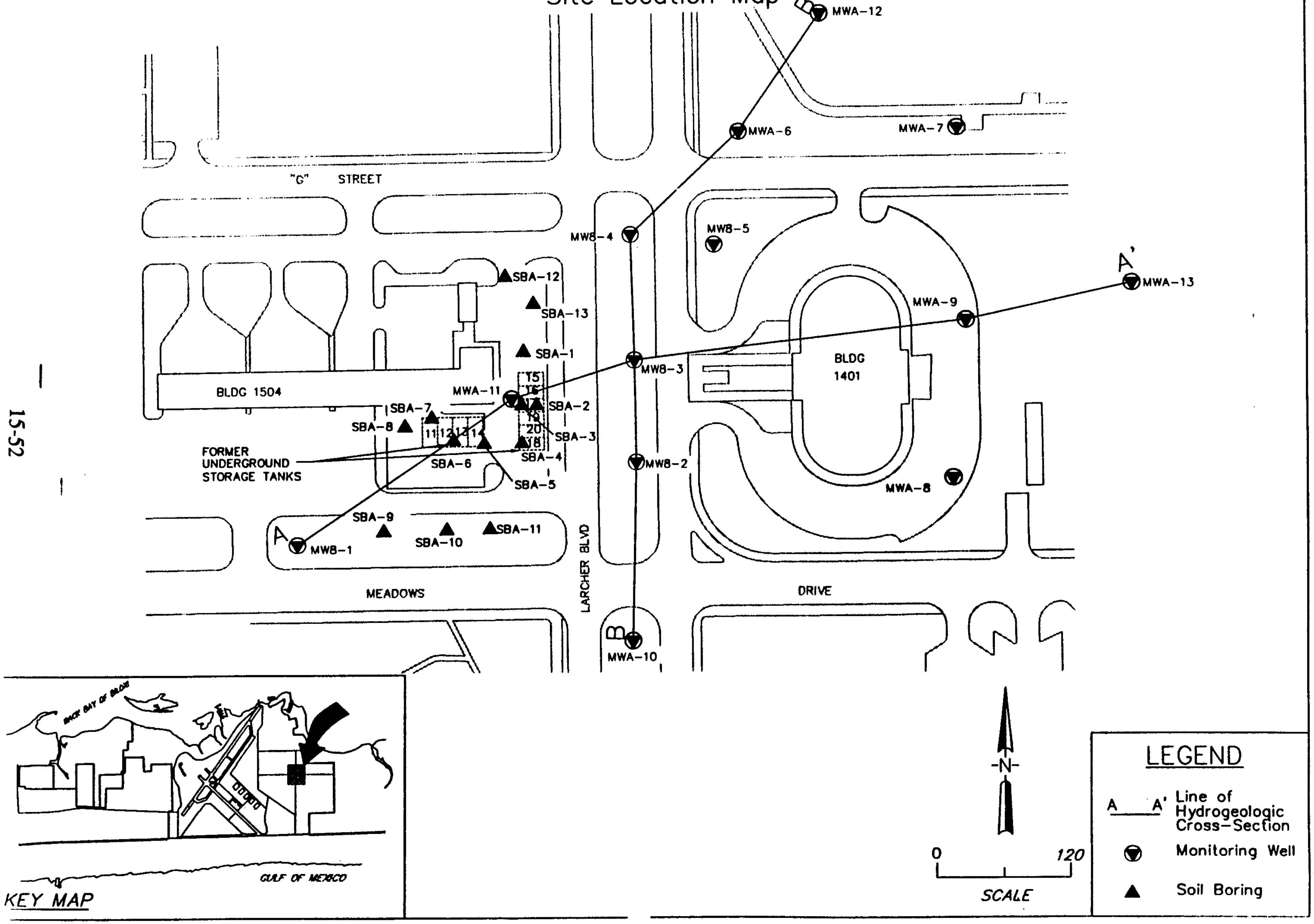
FIGURE 1: PLAN VIEW OF DDC AND SVE WELL LOCATIONS

WEI 1238-1 CAD

CROSS-SECTION

J: \AT784\CADD\ \GOOD\AOC-A, 04/29/98 at 19:13

Figure 15.1 BX Ser Station (AOC A)
Site Location Map



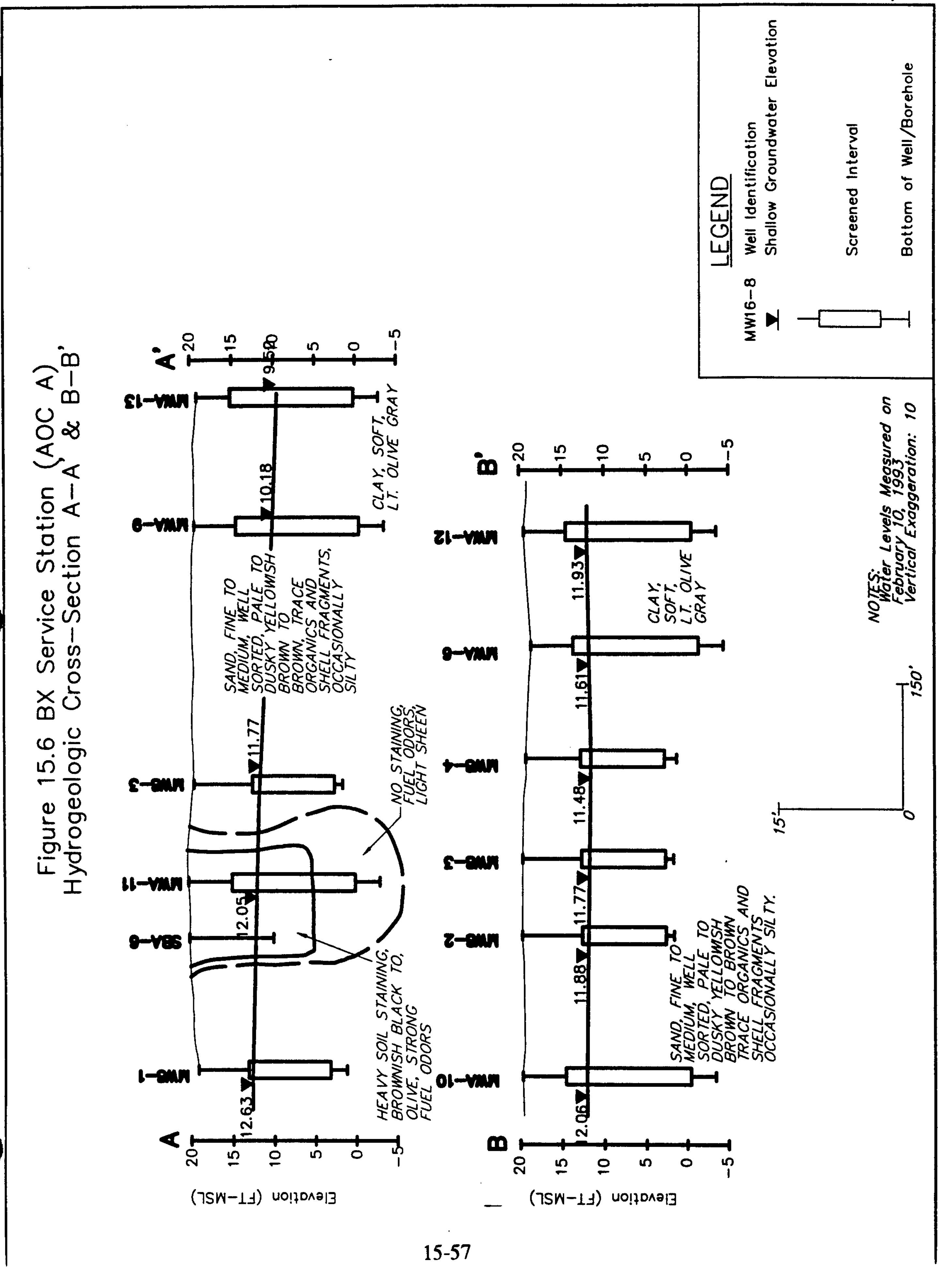


Figure 15.6 BX Service Station (AOC A)
Hydrogeologic Cross-Section A-A' & B-B'
A
A'
B
B'
Elevation (FT-MSL)
MWB-1
SBA-6
MWA-11
MWB-3
MWA-9
MWA-13
MWA-10
MWB-2
MWB-3
MWB-4
MWA-6
MWA-12
12.63
12.05
11.77
10.18
9.50
12.06
11.88
11.77
11.48
11.61
11.93
HEAVY SOIL STAINING, BROWNISH BLACK TO, OLIVE, STRONG FUEL ODORS
NO STAINING, FUEL ODORS, LIGHT SHEEN
SAND, FINE TO MEDIUM, WELL SORTED, PALE TO DUSKY YELLOWISH BROWN TO BROWN, TRACE ORGANICS AND SHELL FRAGMENTS, OCCASIONALLY SILTY
CLAY, SOFT, LT. OLIVE GRAY
SAND, FINE TO MEDIUM, WELL SORTED, PALE TO DUSKY YELLOWISH BROWN TO BROWN TRACE ORGANICS AND SHELL FRAGMENTS OCCASIONALLY SILTY.
CLAY, SOFT, LT. OLIVE GRAY
LEGEND
MW16-8 Well Identification
Shallow Groundwater Elevation
Screened Interval
Bottom of Well/Borehole
NOTES:
Water Levels Measured on February 10, 1993
Vertical Exaggeration: 10
15'
0
150'
J:\AT784\CADD\tape\GOOD\AOC-AA, 04/28/98 at 14:29

GEOLOGY/ HYDROGEOLOGY

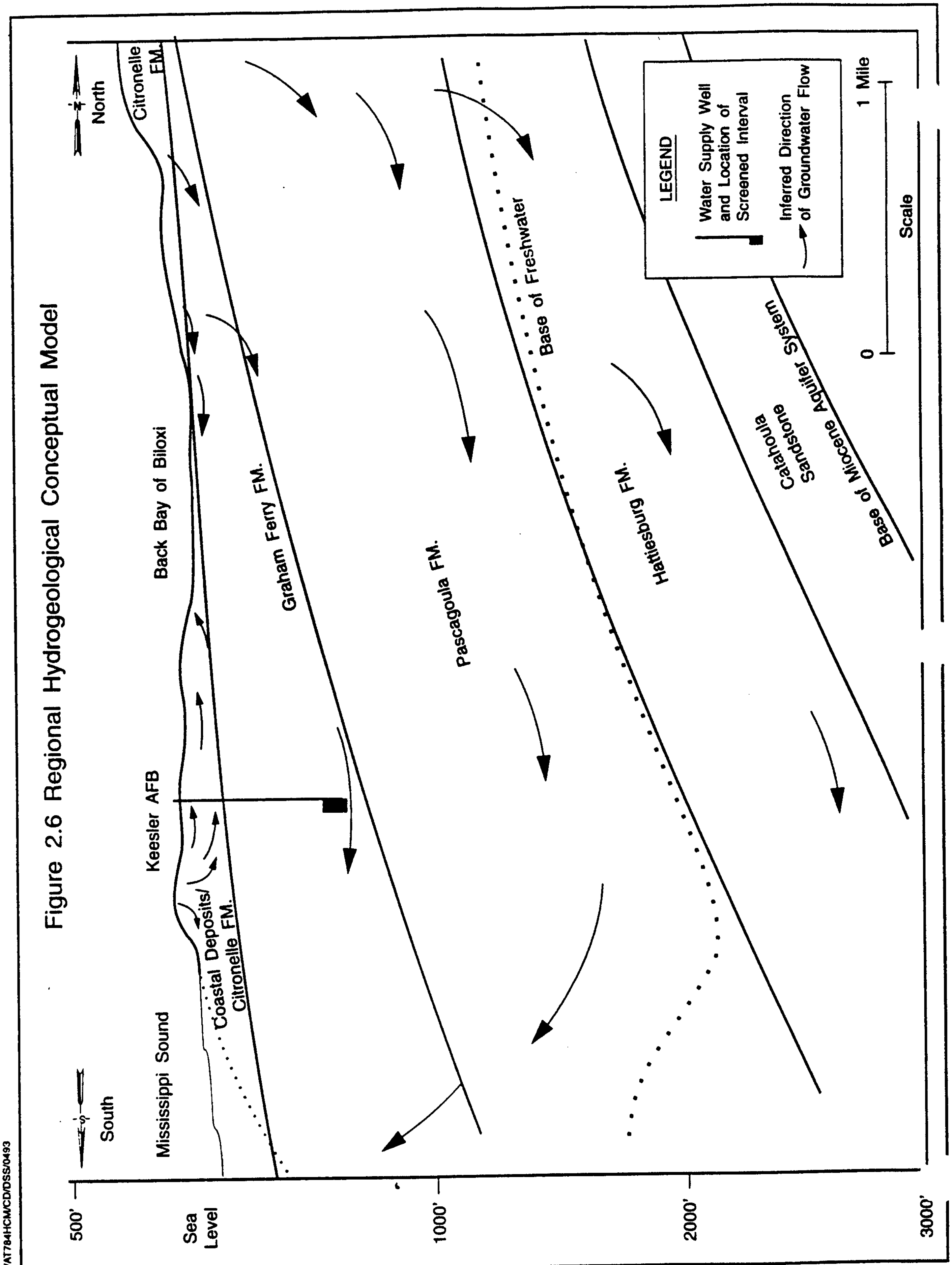
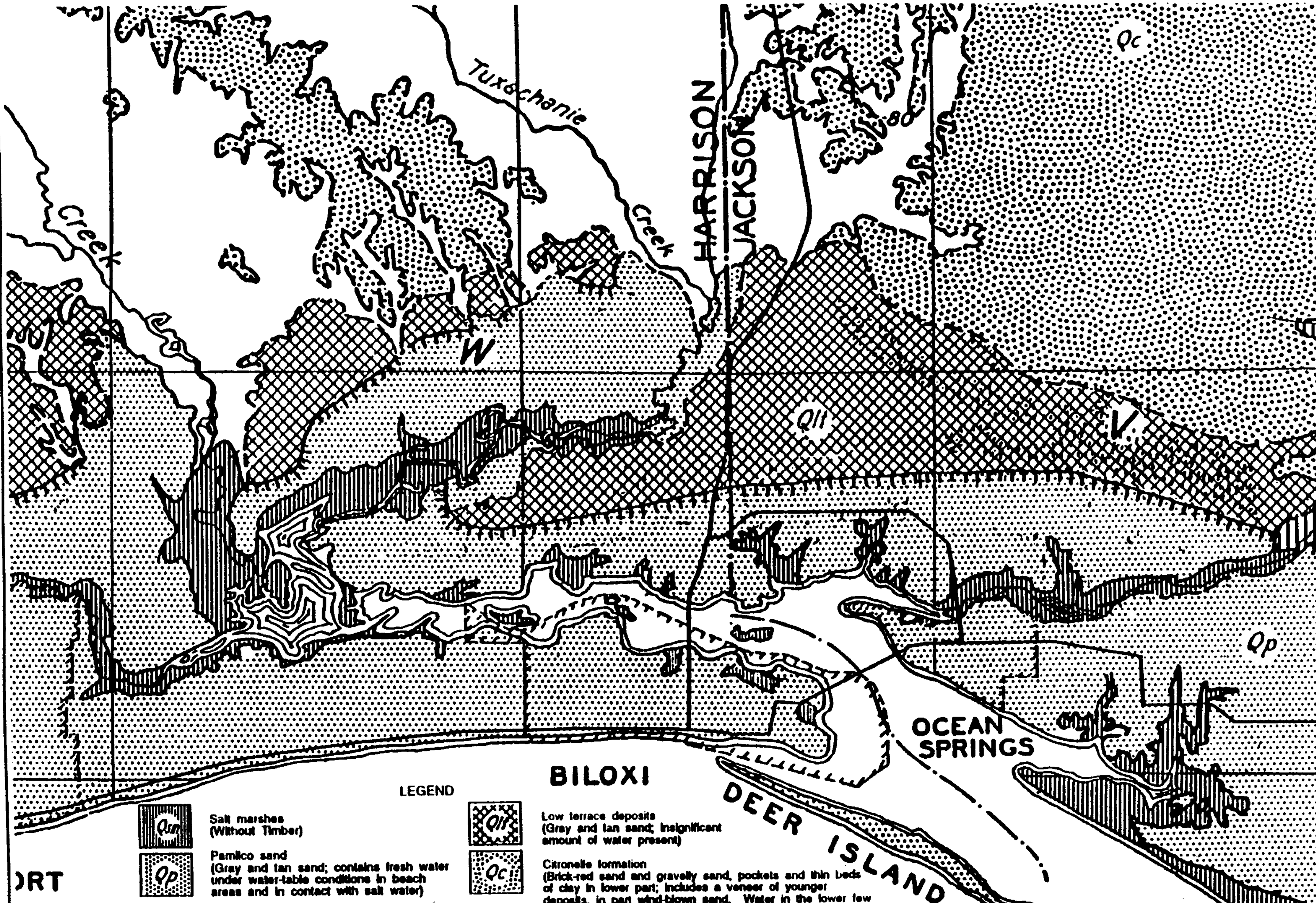


Figure 2.6 Regional Hydrogeological Conceptual Model

G/AT784HCM/CD/DSS/0493

Figure   Geologic Map of the Biloxi Area



Source: Brown, 1944

Table ~~2.3~~ 2.1 Mississippi Coastal Plain Geologic Units and Their Water-bearing Properties

System	Series	Formation	Thickness (ft)	Physical Character	Hydrology
Quaternary	Holocene	Alluvium	0 to 80	Chert and quartz gravels and sandy clays and silt; much organic debris including sawdust in and near the tidal	Contains water that is probably salty as far north as salt water penetrates up the rivers.
	Pleistocene	Coastal Deposits	1 to 75	Mostly unconsolidated gray and tan sand; locally contains pebbles of quartz and chert and, in former lagoonal areas, much clay and silt	Contain fresh water having a low dissolved-solids content. Near the coast at shallow depths, the water is subject to salt-water encroachment.
		Low Terrace Deposits	0 to 20	Sand derived from beach deposits, locally sprinkled with pebbles of quartz and brown chert	
		High Terrace Deposits	0 to 100	Sand and gravel where quartz is more abundant and chert less abundant than in the older adjacent Citronelle Formation, locally an iron-cemented conglomerate at the base	
Tertiary	Pliocene	Citronelle	0 to 100+	Brick-red sand and gravelly sand, the pebbles are mostly brown chert and milky quartz, generally cross-bedded, and, in the lower part, contain thin beds and pockets of gray clay and	Maintains high base flows of streams, and a source of recharge to the Miocene aquifer system. Supplies most rural wells in uplands.
		Graham Ferry	0 to 200	Silty clay and shale, silty sand, and gravelly sand and gravel in heterogeneous deltaic masses; various colors; generally dark, carbonaceous clay most abundant in the outcrops; marine fossil casts in the upper	Supplies 60 percent of the municipal and industrial groundwater supply. Soft sodium bicarbonate type of water, usually having a lower chloride content than the Pascagoula Formation.
	Miocene	Pascagoula	250 to 1,000	Clay and shale, blue-green, silt, sandy shale, gray and green sand, gray silty clay, and dark sandy gravel containing numerous grains and pebbles of polished black chert, of estuarine or deltaic origin, identified primarily by a	Comprises several aquifers along the coast and many sand beds of local extent. The base of fresh water is in the lower part of the formation. Where the thickness is substantial, transmissivity is high.
		Hattiesburg	850+	Gray-green and blue-green shale and clay, gray sand and silt, mostly carbonaceous and noncalcareous, of a continental origin than overlying beds	Contains supplies of fresh water in counties north of coastal area.
		Catahoula Sandstone	300+	Shale, sandy shale, sand, clay and silt, and gravelly sands containing black chert	Unused, saline water.

MONITORING WELL COMPLETION SUMMARY

TABLE 4 -8
WELL DATA SUMMARY
BX SERVICE STATION - AOC A

Well I.D.	Coordinates								
	Northing	Easting	Elevation T.O.C.	Elevation Ground	Total Depth Ft. - B.T.O.C.	Well Diameter Inch	Screen Length Feet	Groundwater Elevation Ft. NGVD	Description
MW8-1	475223.38	269678.51	19.13	19.4	16.21	2"	10	11.74	Flush mounted cover set in pad is in fair condition. Not seal around casing.
MW8-2	475531.35	269755.31	19.57	19.9	16.27	2"	10	11.98	Flush mounted cover set in pad is in fair condition. Not seal around casing.
MW8-3	475529.21	269850.93	19.65	19.9	16.04	2"	10	11.82	Flush mounted cover set in pad is in fair condition. Not seal around casing.
MW8-4	475526.16	269966.03	19.22	19.4	15.91	2"	10	11.21	Flush mounted cover set in pad in good condition. Seal around well is good.
MW8-5	475603.59	269956.32	19.68	19.8	17.27	2"	10	10.83	Flush mounted cover set in pad is in fair condition. Not seal around casing.
MWA-6	475626.61	270061.62	18.44	18.5	22.7	2"	15	11.48	Flush mounted cover, pad and seal in good condition.
MWA-7	475825.02	270065.01	18.95	19.1	21.67	2"	15	10.83	Flush mounted cover and pad is in good condition. No seal around casing.
MWA-8	475819.91	269739.92	19.23	19.2	22.02	2"	15	11.17	Flush mounted cover set in small concrete pad is in good condition.

T.O.C. = Top of Casing
B.T.O.C. = Below Top of Casing

TABLE 4-8
(Continued)
WELL DATA SUMMARY
BX SERVICE STATION - AOC A

Well I.D.	Coordinates		Elevation T.O.C.	Elevation Ground	Total Depth Ft. - B.T.O.C.	Well Diameter Inch	Screen Length Feet	Groundwater Elevation Ft. NGVD	Description
	Northing	Easting							
MWA-9	475832.07	269886.05	19.29	19.3	23.28	2"	15	10.48	Flush mounted cover set in pad is in fair condition. Not seal around casing.
MWA-10	475523.78	269593.56	19.37		22.87	2"	15	ND	Flush mounted cover set in square pad is in good condition. No seal around casing.
MWA-11	475417.45	269815.35	20.09	20.1	21.06	4"	15	11.84	Flush mounted cover set in small pad. Well is in good condition.
MWA-12	475700.63	270172.52	19.26	19.4	22.51	2"	15	12.71	Flush mounted cover and pad in good condition.
MWA-13	475982.92	269919.38	18.43	19.1	22.1	2"	15	9.37	Flush mounted cover and pad is in good condition. No seal around casing.

T.O.C. = Top of Casing
B.T.O.C. = Below Top of Casing

SOIL BORING LOGS/ MONITORING WELL CONSTRUCTION DIAGRAMS

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO
Site Keesler AFB (AOC-A)
Boring I.D. SBA-1
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 09-24-92
Date Completed 09-24-92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 10
Ground Elevation (ft) 20.03
Depth to Water (ft)
Date Measured

Project I.D. AT 784.04
Well I.D. N/A
Date Installed
Date Grouted
Casing Material
Screen Material
Casing Interval (ft)
Screened Interval (ft)
Sump Installed?
Well Depth (ft)
TOC Elevation (ft)
Water Level (ft)
Date Measured

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0		N/A	95	>1000	SILT and SAND, little pebbles, light olive gray, fine to medium, dry.	SM		
		4,11, 7,6	100	>1000	SAND, little SILT, fine to medium, firm to loose, light olive brown to olive gray, stained, wet.	SW		
5		4,1, 13,20	100	500	SAND, fine to medium, very loose to firm, very pale orange to olive gray, stained, damp.			
		10,14 22,18	100	>1000	SAND, fine to medium, firm to very firm, very pale orange to pale yellowish brown, wet.			
		2,20, 2,48	100	>100	SAND, fine to medium, very firm to dense, very pale orange, wet.			
10								
15								
20								
25								

KE30R

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO	Project I.D. AT 784.04
Site Keesler AFB (AOC-A)	Well I.D. N/A
Boring I.D. SBA-2	Date Installed
Geologist/Engineer J. Burgin	Date Grouted
Drilling Method Hollow-Stem Auger	Casing Material
Sampling Method Split-Spoon	Screen Material
Date Started 09-24-92	Casing Interval (ft)
Date Completed 09-24-92	Screened Interval (ft)
Driller Layne Environmental	Sump Installed?
Borehole Diameter (in) 8	Well Depth (ft)
Depth Drilled (ft) 10	TOC Elevation (ft)
Ground Elevation (ft) 20.0	Water Level (ft)
Depth to Water (ft)	Date Measured
Date Measured	

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	NA	NA	22.0	SAND and SILT, fine to medium, olive gray to moderate olive brown, stained, dry.	SM		
	X	NA	NA	20.0	SAND, little SILT, fine to medium, moderate yellowish brown, damp.	SW		
5	X	22,19, 14,21	100	70.0	SAND, fine to medium, firm to very firm, very pale orange to olive brown, damp to moist.			
	X	13,35 12	70	1000	As above, dense to firm, color ranges from brownish black to black, (apparent oil stains).			
	X	8,15, 22,23	80	1000	(As above), firm to very firm.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO
Site Keesler AFB (AOC-A)
Boring I.D. SBA-3
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 09-25-92
Date Completed 09-25-92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 10
Ground Elevation (ft) 20.02
Depth to Water (ft)
Date Measured

Project I.D. AT 784.04
Well I.D. N/A
Date Installed
Date Grouted
Casing Material
Screen Material
Casing Interval (ft)
Screened Interval (ft)
Sump Installed?
Well Depth (ft)
TOC Elevation (ft)
Water Level (ft)
Date Measured

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	NA	90	62.0	SAND and SHELL FRAGMENTS (fill), fine to medium, pale yellowish brown, dry.	SW		
	X	3,5, 6,7	95	150.0	SAND and FILL MATERIAL, fine to medium, SHELL FRAGMENTS, loose, very pale orange to dark brown, damp.			
5	X	8,4, 7,9	100	100	SAND, fine to coarse, moderately sorted, loose, very pale orange, little black stains, wet.	SW		
	X	NA	100	100	SAND, trace SHELL FRAGMENTS, trace PEBBLES, fine to medium, very pale orange, little black stains, wet.			
	X	4,7, 22,34	10	100	SAND, fine to medium, loose to dense, very pale orange with brownish black stains, wet.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO	Project I.D. AT 784.04
Site Keesler AFB (AOC-A)	Well I.D. N/A
Boring I.D. SBA-4	Date Installed
Geologist/Engineer J. Burgin	Date Grouted
Drilling Method Hollow-Stem Auger	Casing Material
Sampling Method Split-Spoon	Screen Material
Date Started 09-25-92	Casing Interval (ft)
Date Completed 09-25-92	Screened Interval (ft)
Driller Layne Environmental	Sump Installed?
Borehole Diameter (in) 8	Well Depth (ft)
Depth Drilled (ft) 8	TOC Elevation (ft)
Ground Elevation (ft) 20.08	Water Level (ft)
Depth to Water (ft)	Date Measured
Date Measured	

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	NA	90	0.0	SAND and SHELL FRAGMENTS (fill), fine to medium, moderately sorted, yellowish brown, damp.	SW		
	X	3,4, 7,9	95	0.0	As above, loose, some black staining, odors.			
5	X	2,4, 6,7	95	3.0	SAND, fine to medium, loose, trace SHELL FRAGMENTS, pale yellowish brown with brownish black oil stains, wet.	SW		
	X	6,8,9	100	8.0	SAND, trace SILT, trace ORGANIC MATERIAL (wood chips), loose, yellowish brown, wet.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO	Project I.D. AT 784.04
Site Keesler AFB (AOC-A)	Well I.D. N/A
Boring I.D. SBA-5	Date Installed
Geologist/Engineer J. Burgin	Date Grouted
Drilling Method Hollow-Stem Auger	Casing Material
Sampling Method Split-Spoon	Screen Material
Date Started 09-25-92	Casing Interval (ft)
Date Completed 09-25-92	Screened Interval (ft)
Driller Layne Environmental	Sump Installed?
Borehole Diameter (in) 8	Well Depth (ft)
Depth Drilled (ft) 10	TOC Elevation (ft)
Ground Elevation (ft) 20.20	Water Level (ft)
Depth to Water (ft)	Date Measured
Date Measured	

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	NA	100	20	SAND, little SILT, trace CLAY, fine to medium, pale yellowish brown with olive gray, stains, fuel odor, moist.	SW		
	X	5,5, 9,9	100	350	SAND, trace SILT, fine to medium, well sorted, loose, pale yellowish brown to olive gray, stains, fuel odor, wet.			
5	X	2,6, 13,14	100	300	SAND, trace SILT, fine to medium, compacted, loose to firm, pale yellowish brown with olive gray, wet.			
	X	15,26 38,50	100	>1000	SAND, fine to medium, well sorted, very firm to dense, very pale orange with brownish black stains, wet.			
	X	10,25 30,35	100	>1000	(As above), very firm to dense.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO
Site Keesler AFB (AOC-A)
Boring I.D. SBA-6
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 09/25/92
Date Completed 09/25/92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 10
Ground Elevation (ft) 20.22
Depth to Water (ft)
Date Measured

Project I.D. AT 784.04
Well I.D. N/A
Date Installed
Date Grouted
Casing Material
Screen Material
Casing Interval (ft)
Screened Interval (ft)
Sump Installed?
Well Depth (ft)
TOC Elevation (ft)
Water Level (ft)
Date Measured

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0		NA	90	>1000	SAND and SILT, brownish black (heavily stained), strong odors, moist.	SM		
		3,4 3,4,	90	70	SAND, little SILT, fine to medium, very loose, moderate olive brown to black, stained, odors, wet.	SW		
5		3,8, 15,22	100	>1000	SAND, fine to medium, loose to very firm, pale yellowish brown, olive gray to black stains, fuel odors, wet.			
		17,30, 50/18"	100	>1000	SAND, fine to medium, dense to very dense, very pale orange with olive gray stains, fuel odors, wet.			
		9,23, 32,38	100	>1000	(As above), very firm to dense.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO
Site Keesler AFB (AOC-A)
Boring I.D. SBA-7
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 09/25/92
Date Completed 09/25/92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 10
Ground Elevation (ft) 20.40
Depth to Water (ft)
Date Measured

Project I.D. AT 784.04
Well I.D. N/A
Date Installed
Date Grouted
Casing Material
Screen Material
Casing Interval (ft)
Screened Interval (ft)
Sump Installed?
Well Depth (ft)
TOC Elevation (ft)
Water Level (ft)
Date Measured

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	NA	90	0.0	SAND and CLAY, some SHELL FRAGMENTS, light brown, compacted, moist.	SC		
	X	2.8, 10,11	95	18.0	As above, loose to firm, pale yellowish brown to light brown with some black stains, wet.			
5	X	2.11, 18,24	95	340.0	SAND, fine to medium, firm to very firm, dark yellowish brown to olive gray, stained, fuel odors, wet.	SW		
	X	2.10, 12,12	95	100.0	SAND, little SILT, fine to medium, firm to very firm, olive brown, stained, odors, wet.			
	X	2.5, 7,14	100	410.0	SAND, fine to medium, loose to firm, pale yellowish brown to dark yellowish brown, some staining, fuel odors, wet.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO
Site Keesler AFB (AOC-A)
Boring I.D. SBA-8
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 09/25/92
Date Completed 09/25/92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 10
Ground Elevation (ft) 20.42
Depth to Water (ft)
Date Measured

Project I.D. AT 784.04
Well I.D. N/A
Date Installed
Date Grouted
Casing Material
Screen Material
Casing Interval (ft)
Screened Interval (ft)
Sump Installed?
Well Depth (ft)
TOC Elevation (ft)
Water Level (ft)
Date Measured

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	NA	100	400.	SAND and CLAY, stiff, compacted, fine to medium, mottled, moderate brown with olive gray, odors, dry.	SC		
	X	2,11 13,18	100	300	SAND, little CLAY, fine to medium, firm, moderate brown to olive gray, stains, odors, wet.	SW		
5	X	4,8, 17,24	90	140	(As above), firm to very firm.			
	X	10,17 27,25	90	70	SAND, little SILT, trace CLAY, fine to medium, firm to very firm, pale yellowish brown to olive gray, fuel odors, staining, wet.			
	X	4,8, 15,27	100	90	SAND and CLAY, fine to medium, loose to very firm, olive gray, fuel odors, staining, wet.	SC		
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO
Site Keesler AFB (AOC A)
Boring I.D. SBA-9
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 10/20/92
Date Completed 10/20/92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 10
Ground Elevation (ft) 19.67
Depth to Water (ft)
Date Measured

Project I.D. AT 784.04
Well I.D. N/A
Date Installed
Date Grouted
Casing Material
Screen Material
Casing Interval (ft)
Screened Interval (ft)
Sump Installed?
Well Depth (ft)
TOC Elevation (ft)
Water Level (ft)
Date Measured

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	N/A	N/A	2.0	SAND, little CLAY and SILT, fine to course, dark yellowish orange to light olive gray, dry.	SW		
	X	8,9, 11,13	100	4.2	SAND, fine to medium, well sorted, loose to firm, very pale orange to grayish orange, moist.			
5	X	4,12, 17,20	100	40.0	SAND, fine to medium, well sorted, firm, very pale orange to dark yellowish orange, moist.			
	X	7,9, 14,22	100	11.0	SAND, fine to medium, well sorted, firm to very firm, very pale orange, wet.			
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ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO	Project I.D. AT 784.04
Site Keesler AFB (AOC A)	Well I.D. N/A
Boring I.D. SBA-10	Date Installed
Geologist/Engineer J. Burgin	Date Grouted
Drilling Method Hollow-Stem Auger	Casing Material
Sampling Method Split-Spoon	Screen Material
Date Started 10/21/92	Casing Interval (ft)
Date Completed 10/21/92	Screened Interval (ft)
Driller Layne Environmental	Sump Installed?
Borehole Diameter (in) 8	Well Depth (ft)
Depth Drilled (ft) 10	TOC Elevation (ft)
Ground Elevation (ft) 19.71	Water Level (ft)
Depth to Water (ft)	Date Measured
Date Measured	

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	N/A	40	6.1	SAND, little CLAY and SILT, fine to coarse, dark yellowish orange to light olive gray, dry.	SW		
	X	6,16, 17,14	90	6.4	SAND, fine to medium, well sorted, firm, very pale orange to grayish orange, moist.			
5	X	5,10, 17,25	85	9.1	SAND, fine to medium, well sorted, firm to very firm, very pale orange to dark yellowish orange, moist.			
	X	11,23 34,53	100	3.8	SAND, fine to medium, well sorted, very firm to very dense, very pale orange, wet.			
	X	1,7, 12,21	100	1.6	As above, loose to very firm, grayish orange.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO	Project I.D. AT 784.04
Site Keesler AFB (AOC A)	Well I.D. N/A
Boring I.D. SBA-11	Date Installed
Geologist/Engineer J. Burgin	Date Grouted
Drilling Method Hollow-Stem Auger	Casing Material
Sampling Method Split-Spoon	Screen Material
Date Started 10/21/92	Casing Interval (ft)
Date Completed 10/21/92	Screened Interval (ft)
Driller Layne Environmental	Sump Installed?
Borehole Diameter (in) 8	Well Depth (ft)
Depth Drilled (ft) 10	TOC Elevation (ft)
Ground Elevation (ft) 19.66	Water Level (ft)
Depth to Water (ft)	Date Measured
Date Measured	

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	N/A	N/A	0	SAND and SILT, trace organics 'peat', fine to medium, well sorted, moderate yellowish brown, dry.	SM		
	X	12,18, 11,13	100	5.8	SAND, trace CLAY and SILT, fine to medium, well sorted, firm, moderate yellowish brown, light stains, moist.	SW		
5	X	13,7, 9,10	100	12.0	SAND, fine to medium, very well sorted, loose, very pale orange to pale brown, wet.			
	X	11,12, 24,34	100	7.4	SAND, fine to medium, very well sorted, firm to dense, very pale orange, wet.			
	X	8,11, 17,25	100	2.5	As above, firm to very firm.			
10					Peat	OH		
					Note: Organic 'peat' layer begins at 9.5'.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO	Project I.D. AT 784.04
Site Keesler AFB (AOC A)	Well I.D. N/A
Boring I.D. SBA-12	Date Installed
Geologist/Engineer J. Burgin	Date Grouted
Drilling Method Hollow-Stem Auger	Casing Material
Sampling Method Split-Spoon	Screen Material
Date Started 10/21/92	Casing Interval (ft)
Date Completed 10/21/92	Screened Interval (ft)
Driller Layne Environmental	Sump Installed?
Borehole Diameter (in) 8	Well Depth (ft)
Depth Drilled (ft) 10	TOC Elevation (ft)
Ground Elevation (ft) 19.72	Water Level (ft)
Depth to Water (ft)	Date Measured
Date Measured	

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	N/A	N/A	50.0	SAND little SILT, moderately sorted, yellowish brown, fuel odors, damp.	SW		
	X	5,6, 8,7	100	68.0	SAND, fine to medium, well sorted, loose, very pale orange, fuel odors, sains, wet.			
5	X	2,3, 8,14	100	>1000	SAND, fine to medium, well sorted, loose to firm, very pale orange, mottling, fuel odors, stains, wet.			
	X	6,7, 27,32	100	>1000	SAND, fine to medium, well sorted, loose to dense, very pale orange, strong fule odors, wet.			
	X	5,9, 20,28	100	38.0	As above, loose to very firm.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO	Project I.D. AT 784.04
Site Keesler AFB (AOC A)	Well I.D. N/A
Boring I.D. SBA-13	Date Installed
Geologist/Engineer J. Burgin	Date Grouted
Drilling Method Hollow-Stem Auger	Casing Material
Sampling Method Split-Spoon	Screen Material
Date Started 10/21/92	Casing Interval (ft)
Date Completed 10/21/92	Screened Interval (ft)
Driller Layne Environmental	Sump Installed?
Borehole Diameter (in) 8	Well Depth (ft)
Depth Drilled (ft) 10	TOC Elevation (ft)
Ground Elevation (ft) 19.73	Water Level (ft)
Depth to Water (ft)	Date Measured
Date Measured	

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG	WELL DIAGRAM
0	X	N/A	N/A	>1000	SAND, trace SILT, fine to medium, moderately sorted, fuel odors, damp.	SW		
	X	2,3, 6,7	100	>1000	SAND, fine to medium, very well sorted, loose, very pale orange, fuel odors, stains, wet.			
5	X	7,7, 10,14	100	72.0	As above, loose to firm.			
	X	4,23, 34,76	100	>1000	As above, very firm to very dense.			
	X	3,5, 10,16	100	>1000	As above, loose to firm, with heavy oil stains.			
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KEBOR

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

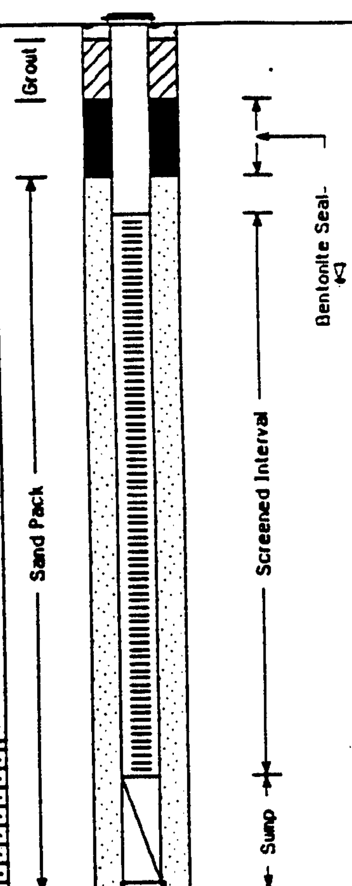
Client EMO
Site Keesler AFB (AOC A)
Boring I.D. MWA-6
Geologist/Engineer J. Burgin
Drilling Method Hollow -Stem Auger
Sampling Method Split-Spoon
Date Started 9-16-92
Date Completed 9-16-92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 23
Ground Elevation (ft) 18.57
Depth to Water (ft) 6.84
Date Measured 02-10-93

Project I.D. AT 784.04
Well I.D. MWA-6
Date Installed 9-16-92
Date Grouted 9-16-92
Casing Material 2" Sch. 40 PVC
Screen Material 2" PVC 20 Slot
Casing Interval (ft) 0 - 5
Screened Interval (ft) 5 - 20
Sump Installed? YES
Well Depth (ft) 23
TOC Elevation (ft) 18.45
Water Level (ft) 11.61
Date Measured 02-10-93

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS
0	X	N/A	90	3.8	SAND, fine to medium, and TOPSOIL (2" cap), pale yellowish brown, dry to moist.	SW
	X	N/A	90	7.2	SAND, fine to medium, well sorted, some ORGANICS, pale yellowish brown, moist.	SW
5	X	5.7, 9.10	90	2.2	SAND, fine to medium, trace ORGANICS, loose, pale yellowish brown to grayish orange, moist.	SW
	X	1.1, 6.10	90	0	SAND, fine to medium, very loose to loose, well sorted, moderate yellowish brown to moderate brown, wet.	
	X	9.13, 16.20	75	26	(Same As above) with trace ORGANICS.	
10						
15	X	8.16, 20.38	90	2.6	SAND, fine to medium, loose to dense, well sorted, moderate yellowish brown, wet.	
20	X	1.1, 2.4	100	7.6	SAND, poorly sorted, some CLAY, soft, moderate yellowish brown to light olive gray, wet.	SC
25						

GRAPHIC LOG

WELL DIAGRAM



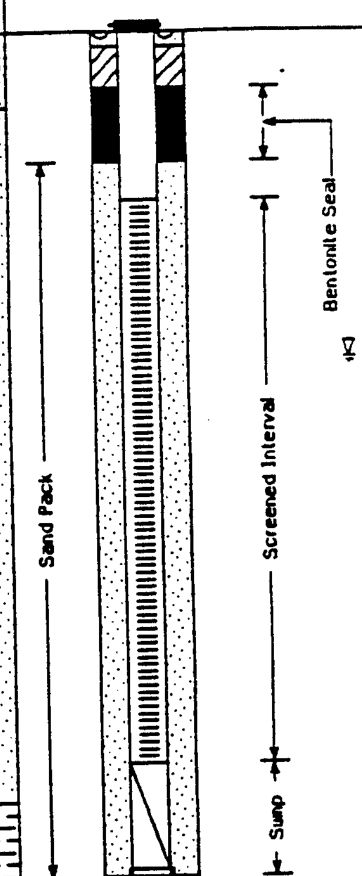
ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO
Site Keesler AFB (AOC A)
Boring I.D. MWA-7
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 9-21-92
Date Completed 9-21-92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 22.5
Ground Elevation (ft) 19.14
Depth to Water (ft) 8.78
Date Measured 02-10-93

Project I.D. AT 784.04
Well I.D. MWA-7
Date Installed 9-21-92
Date Grouted 9-22-92
Casing Material 2" Sch. 40 PVC
Screen Material 2" PVC 20 Slot
Casing Interval (ft) 0 - 4.5
Screened Interval (ft) 4.5 - 19.5
Sump Installed? YES
Well Depth (ft) 22.5
TOC Elevation (ft) 18.93
Water Level (ft) 10.15
Date Measured 02-10-93

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG
0	X	N/A	90	0.1	SAND, fine to medium, little loamy topsoil (2" cap), some SHELL FRAGMENTS, trace ORGANICS, pale yellowish orange, dry.	SW	
	X	N/A	50	0	SAND, fine to medium, trace black ORGANICS, pale yellowish orange, damp.	SW	
5	X	2.5, 8.13	70	0	SAND, loose to firm, well sorted, pale yellowish brown, moist.		
10	X	5.8, 18.28	80	0	SAND, fine to medium, loose to very firm, well sorted, dusky yellowish brown, wet.		
15	X	2.5, 13.15	90	0	SAND, fine to medium, loose to firm, well sorted, pale yellowish brown, slight sulfurous odor, wet.		
20	X	3.1, 1.2	90	0	SAND, fine to medium, well sorted, dusky yellowish brown, wet, slight odor, grades to CLAY, soft, odors, moist.	CL	
25							

WELL DIAGRAM



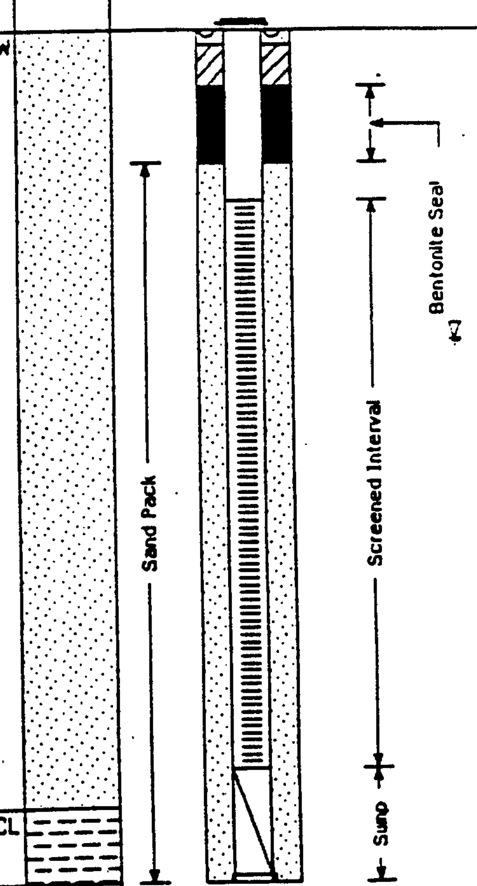
ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO
Site Keesler AFB (AOC A)
Boring I.D. MWA-8
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 9-21-92
Date Completed 9-21-92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 22.5
Ground Elevation (ft) 19.45
Depth to Water (ft) 8.24
Date Measured 02-10-93

Project I.D. AT 784.04
Well I.D. MWA-8
Date Installed 9-21-92
Date Grouted 9-21-92
Casing Material 2" Sch. 40 PVC
Screen Material 2" PVC 20 Slot
Casing Interval (ft) 0 - 4.5
Screened Interval (ft) 4.5 - 19.5
Sump Installed? YES
Well Depth (ft) 22.5
TOC Elevation (ft) 19.26
Water Level (ft) 10.98
Date Measured 02-10-93

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS
0	X	N/A	100	5.0	SAND, fine to coarse, trace SILT, pale yellowish orange to dark gray, mottled, damp.	SW
	X	5.6, 13.12	90	10.0	SAND, trace CLAY, trace SILT, trace SHELL FRAGMENTS, loose to firm, pale yellowish orange, moist.	
5	X	3.5, 3.6	5	0	(No recovery - spoon plugged with pine chunk).	
	X	6.9, 8.13	40	40.0	SAND, fine to medium, well sorted, trace ORGANICS (pine chunks), loose to firm, pale yellowish brown, strong disinfectant odor (pine), moist to wet.	
10						
15	X	8.12, 15.22	100	10	SAND, fine to medium, firm to very firm, well sorted, dusky yellowish, wet.	
20	X	5.5, 15.25	100	0	SAND, fine to medium, well sorted, dusky yellowish brown, wet, slight odor, grades to CLAY, very stiff, light olive gray, wet.	CL
25						

GRAPHIC LOG — WELL DIAGRAM



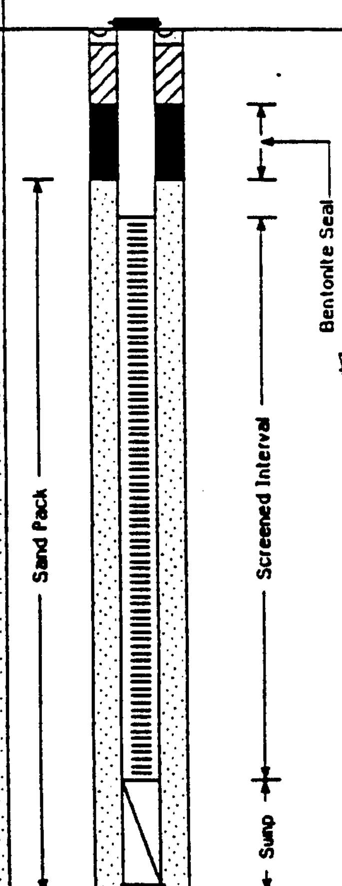
KEWRAP

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO	Project I.D. AT 784.04
Site Keesler AFB (AOC A)	Well I.D. MWA-9
Boring I.D. MWA-9	Date Installed 9-22-92
Geologist/Engineer J. Burgin	Date Grouted 9-22-92
Drilling Method Hollow-Stem Auger	Casing Material 2" Sch. 40 PVC
Sampling Method Split-Spoon	Screen Material 2" PVC 20 Slot
Date Started 9-22-92	Casing Interval (ft) 0 - 5
Date Completed 9-22-92	Screened Interval (ft) 5 - 20
Driller Layne Environmental	Sump Installed? YES
Borehole Diameter (in) 8	Well Depth (ft) 23
Depth Drilled (ft) 23	TOC Elevation (ft) 19.29
Ground Elevation (ft) 19.48	Water Level (ft) 10.18
Depth to Water (ft) 9.11	Date Measured 02-10-93
Date Measured 02-10-93	

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG
0	X	N/A	95	3.0	SAND, fine to coarse, and TOPSOIL (2" cap), little GRAVEL, pale yellowish brown, slight staining, dry to moist.	SW	
	X	1.5, 8.4	100	0.2	SAND, fine to medium, loose, moderately sorted, pale yellowish brown, wet.		
5							
10	X	3.2, 7.13	100	1.4	SAND, fine to medium, very loose to loose, well sorted, pale yellowish brown, wet.		
15	X	8.17, 19.21	100	60.0	SAND, fine to medium, firm to very firm, well sorted, dusky yellowish brown, sulfurous odors, wet.		
20	X	3.4, 3.5	100	9.0	SAND, fine to medium, very loose to loose, well sorted, dusky yellowish brown to pale yellowish brown, sulfurous odors, wet.		
25							

WELL DIAGRAM



ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

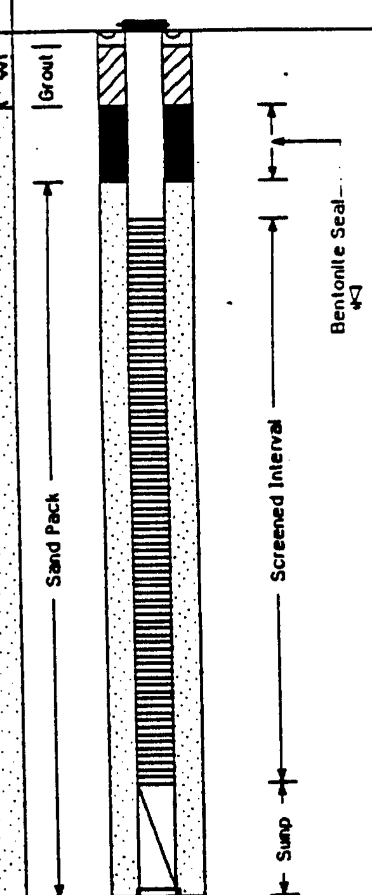
Client EMO
Site Keesler AFB (AOC A)
Boring I.D. MWA-10
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 9-22-92
Date Completed 9-22-92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 23
Ground Elevation (ft) 19.56
Depth to Water (ft) 7.31
Date Measured 02-10-93

Project I.D. AT 784.04
Well I.D. MWA-10
Date Installed 9-22-92
Date Grouted 9-22-92
Casing Material 2" Sch. 40 PVC
Screen Material 2" PVC 20 Slot
Casing Interval (ft) 0 - 5
Screened Interval (ft) 5 - 20
Sump Installed? YES
Well Depth (ft) 23
TOC Elevation (ft) 19.37
Water Level (ft) 12.06
Date Measured 02-10-93

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS
0	X	N/A	80	1.0	SAND, fine to coarse, some SHELL FRAGMENTS, trace SILT, pale yellowish brown, damp.	SW
	X	N/A	95	4.8	SAND, fine to coarse, pale yellowish brown, damp.	SW
5	X	3,4, 6,10	100	1.6	SAND, fine to medium, moderately sorted, little SHELL FRAGMENTS, loose, pale yellowish brown, wet.	
10	X	9,4, 10,18	100	1.8	SAND, fine to medium, moderately sorted, little SHELL FRAGMENTS, loose to firm, dusky yellowish brown, wet.	
15	X	1,4, 10,10	100	10.0	SAND, fine to medium, moderately sorted, little SHELL FRAGMENTS, loose, dusky yellowish brown, wet.	
	X	N/A	50	1.0	SAND, fine to medium, well sorted, trace SHELL FRAGMENTS, moderate yellowish brown, wet.	
20	X	N/A	100	0	(Same as above).	
	X	1,4, 3,2	50	0	(Same as above).	
25						

GRAPHIC LOG

WELL DIAGRAM



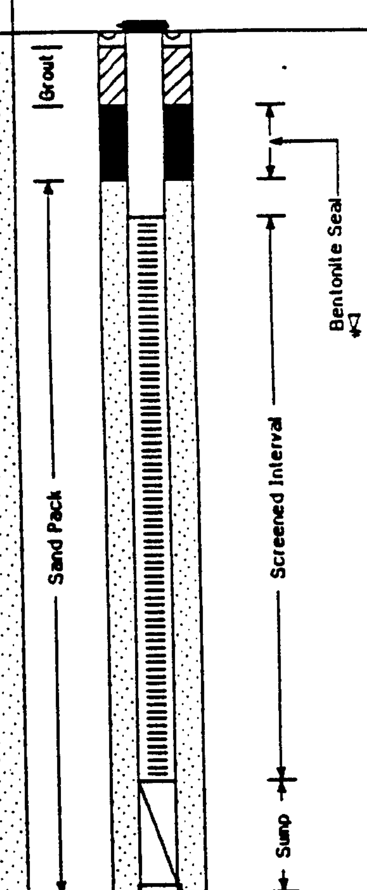
KEVRAP

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO	Project I.D. AT 784.04
Site Keesler AFB (AOC A)	Well I.D. MWA-11
Boring I.D. MWA-11	Date Installed 9-24-92
Geologist/Engineer J. Burgin	Date Grouted 9-24-92
Drilling Method Hollow-Stem Auger	Casing Material 4" Sch. 40 PVC
Sampling Method Split-Spoon	Screen Material 4" PVC 20 Slot
Date Started 9-23-92	Casing Interval (ft) 0 - 5
Date Completed 9-23-92	Screened Interval (ft) 5 - 20
Driller Layne Environmental	Sump Installed? YES
Borehole Diameter (in) 11	Well Depth (ft) 23
Depth Drilled (ft) 23	TOC Elevation (ft) 20.16
Ground Elevation (ft) 20.38	Water Level (ft) 12.05
Depth to Water (ft) 8.11	Date Measured 02-10-93
Date Measured 02-10-93	

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG
0	X	N/A	70	>1000	SAND, fine to medium, trace SHELL FRAGMENTS, trace SILT, olive gray, strong fuel odors, staining, damp.	SW	
	X	N/A	50	>1000	SAND, fine to medium, moderately sorted, olive gray, strong fuel odors, staining, damp.		
5	X	2,7, 10,10	100	>1000	SAND, fine to medium, loose, well sorted, olive gray, strong fuel odors, staining, wet.		
10	X	5,10, 25,40	100	46.0	SAND, fine to medium, well sorted, trace SILT, loose to very firm, olive gray, strong fuel odors, staining, wet.		
15	X	4,8, 12,20	60	16.0	SAND, fine to medium, moderately sorted, little SHELL FRAGMENTS, ORGANICS (peat), loose to firm, dusky yellowish brown, fuel odors, light sheen, wet.		
20	X	2,10, 12,14	80	16.0	SAND, fine to medium, moderately sorted, little SHELL FRAGMENTS, firm, dark yellowish brown to pale brown, fuel odors, light sheen, wet.		
25							

WELL DIAGRAM



KEWRAP

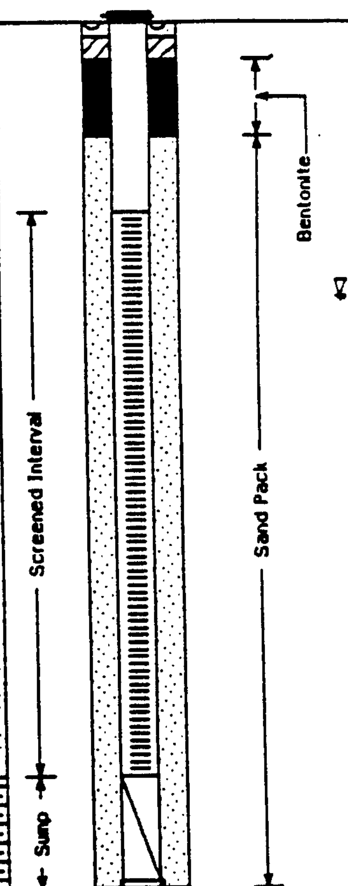
ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

Client EMO
Site Keesler AFB (AOC A)
Boring I.D. MWA-12
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 10-20-92
Date Completed 10-20-92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 23
Ground Elevation (ft) 19.43
Depth to Water (ft) 7.30
Date Measured 02-10-93

Project I.D. AT 784.04
Well I.D. MWA-12
Date Installed 10-20-92
Date Grouted 10-20-92
Casing Material 2" Sch. 40 PVC
Screen Material 2" PVC 20 Slot
Casing Interval (ft) 0 - 5
Screened Interval (ft) 5 - 20
Sump Installed? YES
Well Depth (ft) 23
TOC Elevation (ft) 19.23
Water Level (ft) 11.93
Date Measured 02-10-93

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS	GRAPHIC LOG
0		N/A	60	5.4	SAND, fine to medium, and TOPSOIL (4" cap), little SHELL FRAGMENTS, little ORGANICS (pine wood fragments), moderate yellowish brown to dark yellowish orange, moist.	SW	
		N/A	40	22.0	SAND, fine to medium, well sorted, trace ORGANICS (pine fragments), dark yellowish orange, wet.		
5		5,10, 11,10	100	8.8	SAND, fine to medium, well sorted, trace SILT, trace ORGANICS (wood, plant debris), firm, wet.		
10		6,15, 17,21	100	56.0	SAND, fine to medium, well sorted, little ORGANICS (peat), firm to very firm, moderate brown to dusky yellowish brown, wet.		
15		6,13, 17,12	100	1.9	SAND, fine to medium, firm, well sorted, moderate yellowish brown, wet.		
20		1,0, 3,3	100	6.8	SAND, fine to medium, well sorted, moderate yellowish brown, wet, grades to CLAY, soft, light olive gray, wet.	CL	
25							

WELL DIAGRAM



KEWRAP

ENGINEERING - SCIENCE
SOIL BORING LOG AND WELL CONSTRUCTION RECORD

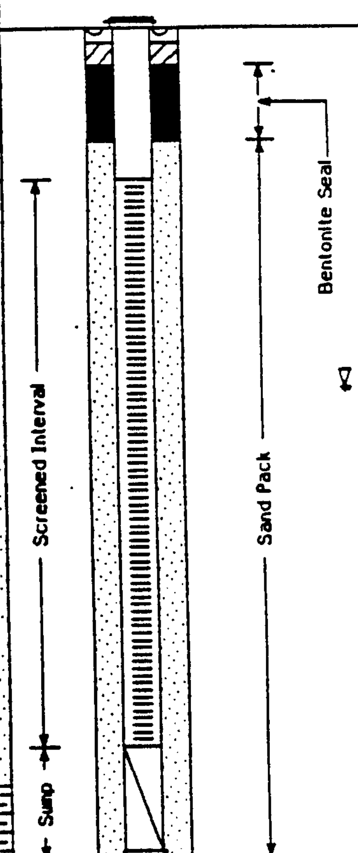
Client EMO
Site Keesler AFB (AOC A)
Boring I.D. MWA-13
Geologist/Engineer J. Burgin
Drilling Method Hollow-Stem Auger
Sampling Method Split-Spoon
Date Started 10-20-92
Date Completed 10-20-92
Driller Layne Environmental
Borehole Diameter (in) 8
Depth Drilled (ft) 22
Ground Elevation (ft) 19.17
Depth to Water (ft) 9.53
Date Measured 02-10-93

Project I.D. AT 784.04
Well I.D. MWA-13
Date Installed 10-20-92
Date Grouted 10-20-92
Casing Material 2" Sch. 40 PVC
Screen Material 2" PVC 20 Slot
Casing Interval (ft) 0 - 4
Screened Interval (ft) 4 - 19
Sump Installed? YES
Well Depth (ft) 22
TOC Elevation (ft) 19.05
Water Level (ft) 9.52
Date Measured 02-10-93

DEPTH (feet)	SAMPLE	BLOWS/6 IN	% REC.	HNu/OVA (ppm)	LITHOLOGIC DESCRIPTION	SOIL CLASS
0	X	N/A	85	0.2	SAND, fine to coarse, and SILT, some SHELL FRAGMENTS (fill material), dry.	SM
5	X	2,3, 8,9	100	2.2	SAND, fine to medium, well sorted, trace CLAY, trace ORGANICS (wood), very loose to loose, wet.	SW
10	X	23,14, 22,29	100	2.0	SAND, fine to coarse, little CLAY, trace PEBBLES, trace ORGANICS (peat), firm to very firm, dusky yellowish brown, wet.	
15	X	4,11, 17,21	100	0.2	SAND, fine to medium, firm, well sorted, little SILT, trace ORGANICS (wood, peat), brown to dusky brown, wet.	
20	X	3,1, 2,0	100	22.0	SAND, fine to medium, well sorted, moderate yellowish brown, wet, grades to CLAY, soft, light olive gray, wet.	CL
25						

GRAPHIC LOG

WELL DIAGRAM



KEWRAP

Project Name: Keesler AFB
Project Location: Biloxi, Miss.
Engineer/Geologist: DAB
Date of Boring: 12/4/87
Top of Casing: 0.24 ft BGL
Drilling Co: ERS
PID: Photoionization Detector
SS: Split-spoon

Project Number: 87256
File Number: 81
Site Number: 8
Boring Number: 8MW1
Boring Diameter: 7 in
Well Diameter: 2 in
Casing Material: Sch 40 PVC
Drill Type: Hollow Stem Auger

Sample Number	Sample Depth	PID: Back-ground ppm	PID: SS Sample ppm	N Value	Feet	Visual Classification
		0.0	0.0	43		[SM] SAND, brown yellow (10YR 6/6), silty (25%), fine-grained, loose to slightly dense, moist - organics 0.0 to 0.5 ft
					1	
177	2-4	0.0	0.0	60	2	[SW] SAND, very pale brown (10YR 7/4), slightly silty (5%), fine-grained, well sorted, moderately dense, moist
					3	
		0.0	0.0	60	4	-yellow/yellow brown (10YR 7/6 and 5/6)
					5	
178	6-8	0.0	0.0	70	6	WATER LEVEL 6.25 FT TOC 4/1/88
		0.0	0.0		7	[SP] SAND, very pale brown (10YR 7/3), medium-grained, poorly sorted, dense, wet
		0.0	0.0	93	8	-brown to dark brown (10YR 5/3.5), slightly silty, fine to medium-grained
					9	
		0.0	0.0	122	10	SAND FILTER PACK FROM 5.0 TO 18.0 FT BGL
					11	BENTONITE SEAL FROM 4.0 TO 5.0 FT BGL; GROUT FROM 0.88 TO 4.0 FT BGL
179	12-14	0.0	0.0	140	12	WELL SCREEN AND WELL POINT FROM 6.0 TO 16.5 FT BGL
					13	
					14	
					15	
					16	
					17	
					18	TOTAL DEPTH OF BORE HOLE 18.0 FT BGL

Project Name: Keesler AFB
Project Location: Biloxi, Miss.
Engineer/Geologist: DAB
Date of Boring: 12/4/87
Top of Casing: 0.26 ft BGL
Drilling Co: ERS
PID: Photoionization Detector
SS: Split-spoon

Project Number: 87256
File Number: 83
Site Number: 8
Boring Number: 8MW3
Boring Diameter: 7 in
Well Diameter: 2 in
Casing Material: Sch 40 PVC
Drill Type: Hollow Stem Auger

Sample Number	Sample Depth	PID Back-ground ppm	PID SS Sample ppm	N Value	Feet	Visual Classification
		0.0	0.0	36	1	[SM] SAND, yellow brown (10YR 5/8), silty, fine-grained, slightly dense, moist
185	2-4	0.0	0.0	31	2	-yellow (10YR 7/6)
					3	[SW] SAND, very pale brown (10YR 7/3), fine-grained, well sorted loose to slightly dense, moist
		0.0	0.0	13	4	-white with brown streaks (10YR 8/1)
					5	
186	6-8	0.0	0.0	28	6	-very pale brown (10YR 8/3)
					7	WATER LEVEL 7.64 FT TOC 4/1/88
		0.0	58.0	57	8	-pale brown (10YR 8/2.5) to white (10YR 8/1), moderately dense - PID reading peaked at 80 ppm
					9	-wet
		0.0	75.0	68	10	-brown to pale brown layers - PID peaked at 80 ppm
					11	
187	12-14	1.0	400.0	90	12	-denser - PID reading peaked at 515 ppm
					13	
					14	SAND FILTER PACK FROM 4.0 TO 18.0 FT BGL BENTONITE SEAL FROM 3.0 TO 4.0 FT BGL GROUT FROM 0.85 TO 3.0 FT BGL WELL SCREEN AND WELL POINT FROM 7.0 TO 17.5 FT BGL
					15	
					16	
					17	
					18	TOTAL DEPTH OF BORE HOLE 18.0 FT BGL

Project Name: Keesler AFB
Project Location: Biloxi, Miss.
Engineer/Geologist: DAB
Date of Boring: 12/4/87
Top of Casing: 0.22 ft BGL
Drilling Co: ERS
PID: Photoionization Detector
SS: Split-spoon

Project Number: 8725b
File Number: 92
Site Number: 9
Boring Number: 8MW2
Boring Diameter: 7 in
Well Diameter: 2 in
Casing Material: Sch 40 PVC
Drill Type: Hollow Stem Auger

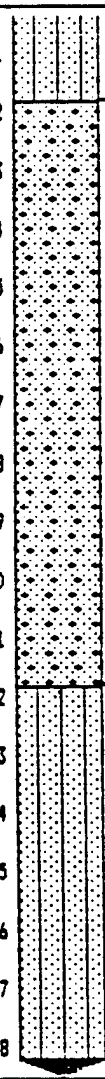
Sample Number	Sample Depth	PID: Back-ground ppm	PID: SS Sample ppm	N Value	Feet	Visual Classification
		0.0	0.0	29		[SM] SAND, light yellow brown (10YR 6/4), silty, fine-grained, with shells and pebbles, loose, moist
					1	
174	2-4	0.0	0.0	34	2	-no shells
					3	
		0.0	0.0	50	4	-brown yellow (10YR 6/8), slightly silty
					5	
175	6-8	0.0	19.0	51	6	[SW] SAND, pale yellow brown (10YR 6/3), fine-grained with some medium-sized grains, well sorted, slightly dense, moist
					7	WATER LEVEL 7.35 FT TOC 4/1/89
		0.0	20.0	50	8	-pale brown (10YR 7/4), fine-grained, moderately dense moist to wet
					9	
		0.0	50.0	80	10	-denser - PID reading peaked at 89 ppm
					11	
176	12-14	1.5	`50	79	12	-PID reading peaked at 70 ppm
					13	SAND FILTER PACK FROM 5.5 TO 18.0 FT BGL
					14	BENTONITE SEAL FROM 4.5 TO 5.5 FT BGL GROUT FROM 0.8 TO 4.5 FT BGL
					15	WELL SCREEN AND WELL POINT FROM 7.0 TO 17.5 FT BGL
					16	
					17	
					18	TOTAL DEPTH OF BORE HOLE 18.0 FT BGL

C-22

Project Name: Keesler AFB
Project Location: Biloxi, Miss.
Engineer/Geologist: DAB
Date of Boring: 12/5/87
Top of Casing: 0.18 ft BGL
Drilling Co: ERS
PID: Photoionization Detector
SS: Split-spoon

Project Number: 87256
File Number: 84
Site Number: 8
Boring Number: 8MW4
Boring Diameter: 7 in
Well Diameter: 2 in
Casing Material: Sch 40 PVC
Drill Type: Hollow Stem Auger

Sample Number	Sample Depth	PID Back-ground ppm	PID SS Sample ppm	N Value	Feet	Visual Classification
		0.0	0.0	39		[SM] SAND, brown yellow (10YR 7/7.5), silty (25%), fine-grained, loose to slightly dense, dry to moist
					1	
189	2-4	0.0	1.5	40	2	[SW] SAND, white (10YR 8/1), fine-grained, well sorted, slightly dense to moderately dense, moist
					3	
		0.0	1.0	56	4	-very pale brown (10YR 7/4) with brown streaks
					5	
190	6-8	0.0	0.0	72	6	-light brown (10YR 6/4), moderately dense to dense
					7	WATER LEVEL 7.53 FT TOC 4/1/88
		0.0	0.0	106	8	-light yellow brown (10YR 6/4), slightly silty (5-10%) fine to medium-grained, moist to wet
					9	
		0.0	0.0	94	10	
					11	
191	12-14	0.0	0.0	113	12	[SM] SAND, dark brown (10YR 3/3), silty (10-15%), fine to medium grained, dense, wet
					13	
					14	SAND FILTER PACK FROM 5.0 TO 18.0 FT BGL; BENTONITE SEAL FROM 4.0 TO 5.0 FT BGL
					15	GROUT FROM 0.79 TO 4.0 FT BGL; WELL SCREEN AND WELL POINT FROM 6.5 TO 17.0 FT BGL
					16	
					17	
					18	TOTAL DEPTH OF BORE HOLE 18.0 FT BGL



Project Name: Keesler AFB
Project Location: Biloxi, Miss.
Engineer/Geologist: DAB
Date of Boring: 12/5/87
Top of Casing: 0.12 ft BGL
Drilling Co: ERS
PID: Photoionization Detector
SS: Split-spoon

Project Number: 8725c
File Number: 85
Site Number: 8
Boring Number: 8MW5
Boring Diameter: 7 in
Well Diameter: 2 in
Casing Material: Sch 40 PVC
Drill Type: Hollow Stem Auger

Sample Number	Sample Depth	PID Back-ground ppm	PID SS Sample ppm	N Value	Feet	Visual Classification
		0.0	0.0	72		[SM] SAND, very pale light yellow brown (10YR 6/4 - 7/4), silty,
					1	(silt 25%), fine-grained, dry
193	2-4	0.0	1.5	32	2	-less dense
					3	
		0.0	0.0	39	4	[SW] SAND, light yellow brown (10YR 6/6 - 6/4), fine-grained, well sorted, slightly dense, moist
					5	
194	6-8	0.0	0.0	44	6	
					7	
		0.0	0.0	63	8	WATER LEVEL 8.05 FT TOC 4/1/88
					9	-wet
		0.0	0.0	93	10	-light gray (10YR 7/2) to pale brown (10YR 7/4), fine to medium-grained, slightly silty (10-12%), dense
					11	
195	12-14	0.0	1.0	122	12	-pale brown (10YR 5/3) to brown (10YR 6/3), medium-grained
					13	
					14	SAND FILTER PACK FROM 6.0 TO 18.0 FT BGL BENTONITE SEAL FROM 5.0 TO 6.0 FT BGL
					15	GROUT FROM 0.71 TO 5.0 FT BGL WELL SCREEN AND WELL POINT FROM 7.0 TO 17.5 FT BGL
					16	
					17	
					18	TOTAL DEPTH OF BORE HOLE 18.0 FT BGL

SOIL ANALYTICAL AND MAPS

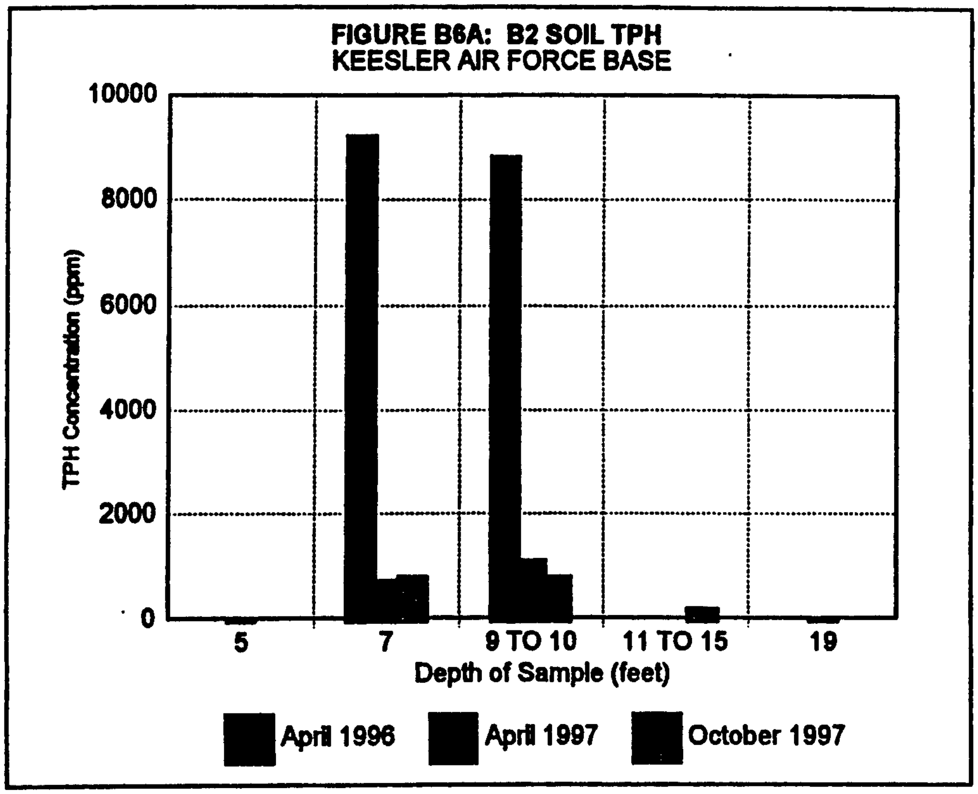


FIGURE B6A: B2 SOIL TPH
KEESLER AIR FORCE BASE
TPH Concentration (ppm)
10000
8000
6000
4000
2000
0
5
7
9 TO 10
11 TO 15
19
Depth of Sample (feet)
April 1996
April 1997
October 1997

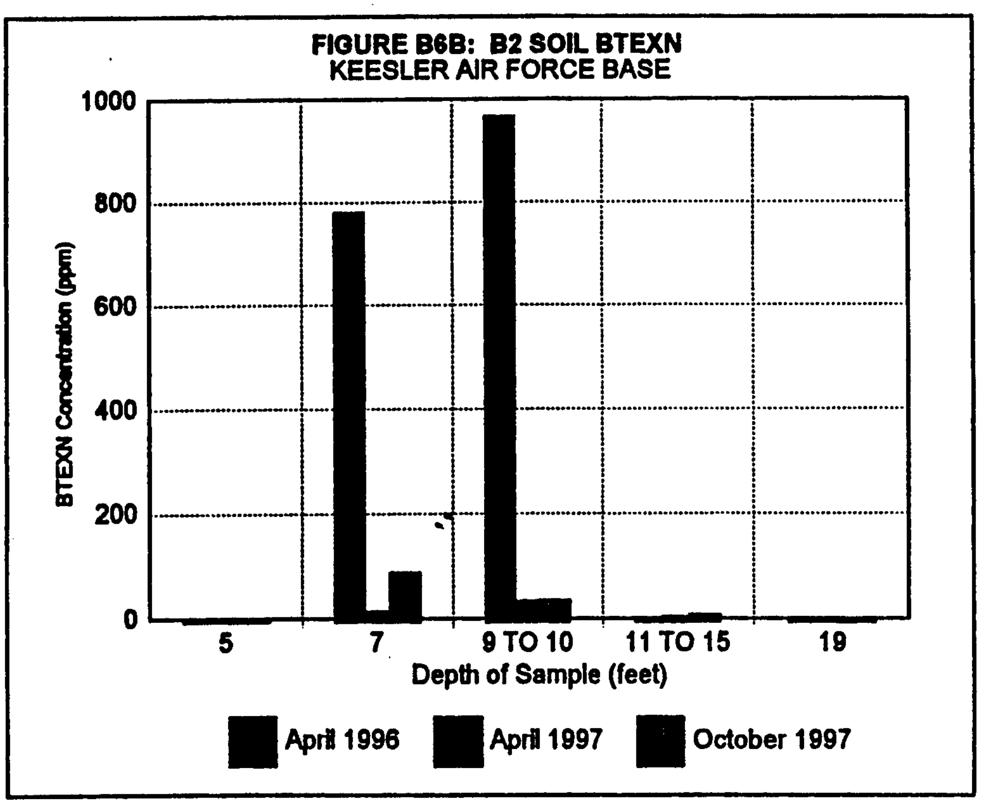


FIGURE B6B: B2 SOIL BTEXN
KEESLER AIR FORCE BASE
BTEXN Concentration (ppm)
1000
800
600
400
200
0
5
7
9 TO 10
11 TO 15
19
Depth of Sample (feet)
April 1996
April 1997
October 1997

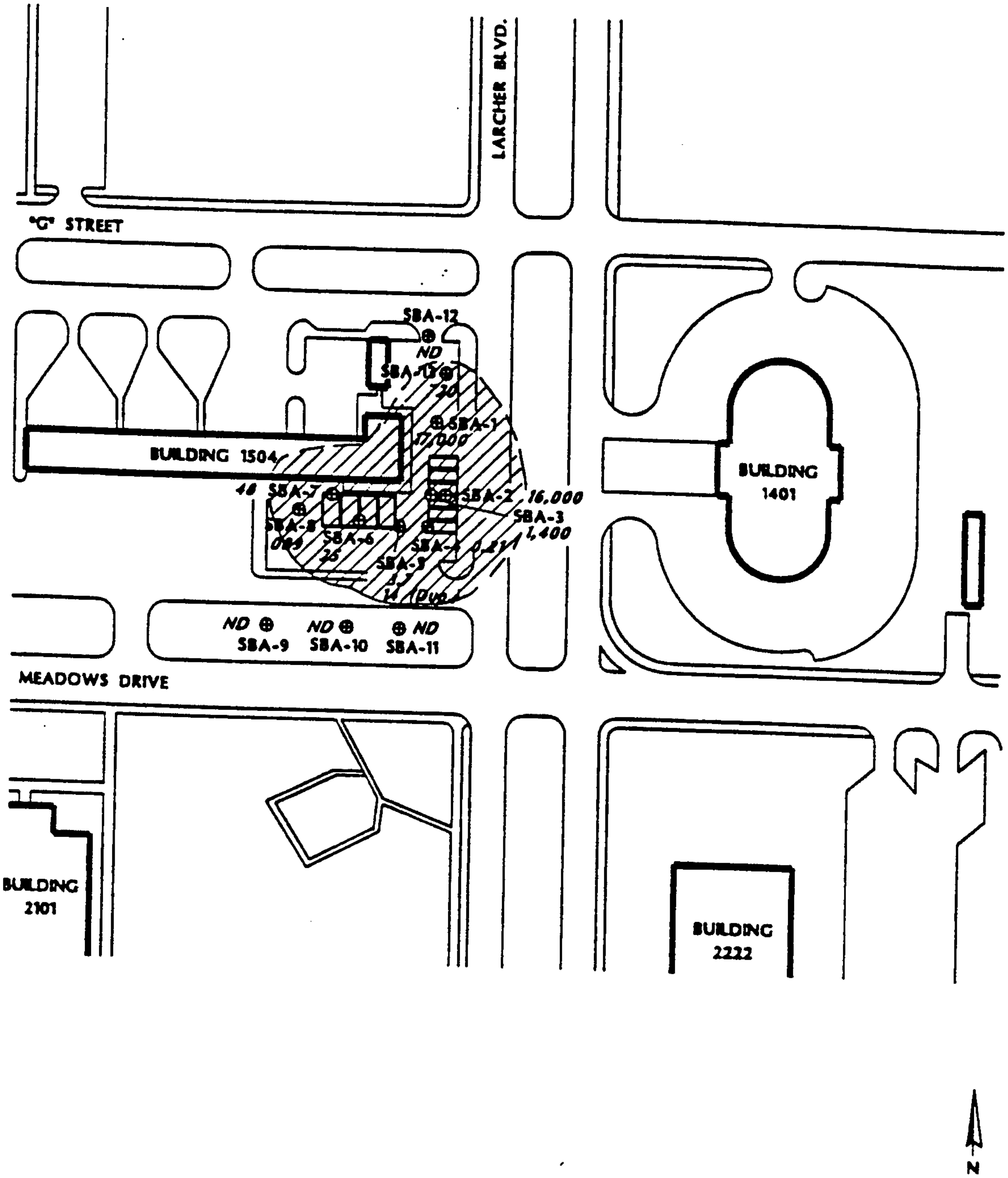
'NASATCH BORINGS 1, 2, and 3

TABLE A7: SOIL SAMPLE ANALYTICAL RESULTS
(NS indicates no sample collected from interval.)

Sample Location	Sample Depth (feet)	TPH	Benzene	Toluene	Ethyl-Benzene	Total Xylenes	Naph-thalene	Total BTEXN
Measured Concentrations (mg/kg) on 4/23/96:								
B1	5	<2.0	<0.10	<0.10	<0.10	<0.10	<0.10	0
	7	4500	0.95	13	25	210	69	317.95
	9	9900	28	180	72	360	41	681
	15	440	1.2	5.5	3.1	17	2.7	29.5
	19	35	0.18	0.46	0.19	1.3	0.12	2.25
B2	5	<2.0	<0.10	<0.10	<0.10	<0.10	<0.10	0
	7	9200	0.42	18	40	290	41	389.42
	9	8800	8.5	11	64	350	49	482.5
	13	<2.0	<0.10	<0.10	<0.10	<0.10	<0.10	0
	19	<2.0	<0.10	<0.10	<0.10	<0.10	<0.10	0
B3	5	NS	NS	NS	NS	NS	NS	0
	7	21000	91	510	160	680	92	1533
	9	1300	4.9	30	7	51	9.4	102.3
	15	<2.0	<0.10	<0.10	<0.10	<0.10	<0.10	0
	19	<2.0	<0.10	<0.10	<0.10	<0.10	<0.10	0
Measured Concentrations (mg/kg) on 4/29/97:								
B1	5	<2.0	<0.20	<0.20	<0.20	<0.20	<0.40	0
	7	400	<0.06	<0.06	<0.06	2.8	3.5	6.3
	9	160	<0.28	1.6	0.34	11	3.3	16.24
	15	4.9	0.08	0.2	0.17	0.21	0.45	1.11
	19	NS	NS	NS	NS	NS	NS	0
B2	5	0.99	<0.20	<0.20	<0.20	<0.20	<0.40	0
	7	720	<0.40	4.5	3.1	36	7.9	51.5
	9	1100	<0.30	10	4.9	96	20	130.9
	13	NS	NS	NS	NS	NS	NS	0
	19	0.91	0.03	<0.20	<0.20	<0.20	<0.40	0.03
B3	5	NS	NS	NS	NS	NS	NS	0
	7	2400	4.4	57	17	100	21	199.4
	9	13	0.06	0.48	0.08	1.7	0.65	2.97
	11	11	0.65	0.94	0.47	1.1	0.46	3.62
	19	NS	NS	NS	NS	NS	NS	0
Measured Concentrations (mg/kg) on 10/24/97:								
B1	5	NS	NS	NS	NS	NS	NS	0
	7	62	<0.10	<0.01	<0.01	<0.01	0.19	0.19
	9	6400	<0.10	29	5.7	150	51	235.7
	15	13	0.08	0.2	0.17	0.21	0.45	1.11
	19	NS	NS	NS	NS	NS	NS	0
B2	5	NS	<0.20	<0.20	<0.20	<0.20	<0.40	0
	7	800	<0.1	2	0.82	26	14	42.82
	9	790	<0.1	<0.1	0.1	8.4	8.1	16.6
	13	170	<0.1	<0.1	<0.1	1.3	1.5	2.8
	19	NS	NS	NS	NS	NS	NS	0
B3	5	NS	NS	NS	NS	NS	NS	0
	7	<2.0	<0.1	<0.1	<0.1	<0.1	<0.1	0
	10	5800	3.1	95	37	190	31	356.1
	11	13	<0.1	0.15	<0.1	0.47	0.51	1.13
	15	14	<0.1	0.68	0.13	0.83	0.26	1.9
	19	NS	NS	NS	NS	NS	NS	0

NS = Not sampled

Figure 2.8



LEGEND

⊕ Soil boring with
25 TPH concentration in mg/kg
ND = non detect

Estimated areal extent of detectable TPH concentration in soil

APPROXIMATE SCALE (ft.)
0 75 150 300

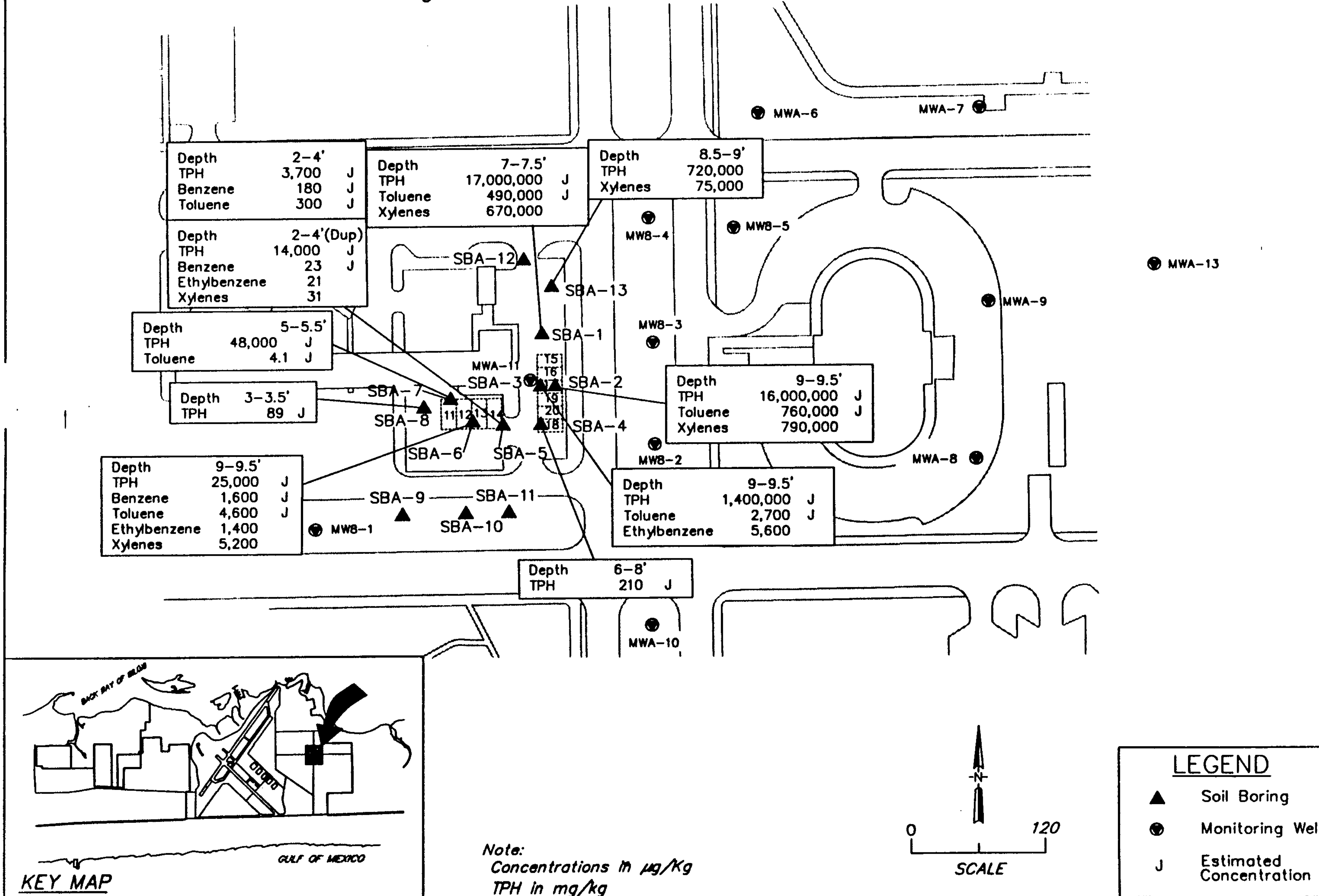
FIGURE 3: EXTENT OF DETECTABLE PETROLEUM HYDROCARBONS IN SOIL

WEI 1238-1 CAD

BASED ON 1992 DATA

J:\AT784\CADD\tape\GOOD\AOCORG, 05/22/98 at 17:46

Figure 15.5 BX Service Station (AOC A)
Organics Detected in Soils 1992



Note:
Concentrations in µg/Kg
TPH in mg/kg

Table 15.2 BX Service Station (AOC A) - Soil Test Results - BTEX and TPH

Boring ID	SBA-1		SBA-2		SBA-3		SBA-4		SBA-5		SBA-5 (a)		SBA-6		SBA-7		SBA-7	
Depth (ft)	7.0-7.5		9.0-9.5		9.0-9.5		6.0-8.0		2.0-4.0		2.0-4.0		9.0-9.5		5.0-5.5		9.0-9.5	
Date	9/24/92		9/25/92		9/25/92		9/25/92		9/25/92		9/25/92		9/25/92		9/25/92		9/25/92	
BTEX Compounds - SW8020 (µg/kg)																		
DILUTION FACTOR	1000		1000		10		1.0		1.0		5.0		5.0		1.0		1.0	
Benzene	100000	U	110000	U	600	U	1	U	180	J	23	J	1600	J	1.1	U	1.1	U
Ethyl Benzene	210000	U	220000	U	5600		2.1	U	240	U	21		1400		2.3	U	2.2	U
Toluene	490000	J	760000	J	2700	J	2.1	U	300	J	11	U	4600	J	4.1	J	2.2	U
Xylenes (total)	670000		790000		1200	U	2.1	U	240	U	31		5200		2.3	U	2.2	U
BTEX (total)	1160000		1550000		8300		- -		480		75		12800		4.1		- -	
Total Petroleum Hydrocarbons - SW8015 (µg/kg)																		
DILUTION FACTOR	5000		2000		1000		1		5		100		100		100		1	
Gasoline	17000000	J	16000000	J	1400000	J	210	J	3700	J	14000	J	25000	J	48000	J	56	U

Boring ID	SBA-8		SBA-8		SBA-9		SBA-10		SBA-10 (b)		SBA-10		SBA-11		SBA-12		SBA-13	
Depth (ft)	1.0-1.5		3.0-3.5		6.0-6.5		4.5-5.0		4.5-5.0		6.0-8.0		5.0-5.5		5.0-5.5		8.5-9.0	
Date	9/25/92		9/25/92		10/20/92		10/21/92		10/21/92		10/21/92		10/21/92		10/21/92		10/21/92	
BTEX Compounds - SW8020 (µg/kg)																		
DILUTION FACTOR	1.0		1.0		100		1.0		1.0		1.0		1.0		1.0		100	
Benzene	1.1	U	1.2	U	120	U	1	U	1.1	U	1	U	1.1	U	1	U	11000	U
Ethyl Benzene	2.2	U	2.4	U	240	U	2	U	2.2	U	2.1	U	2.1	U	2	U	23000	U
Toluene	2.2	U	2.4	U	240	U	2	U	2.2	U	2.1	U	2.1	U	2	U	23000	U
Xylenes (total)	2.2	U	2.4	U	240	U	2	U	2.2	U	2.1	U	2.1	U	2	U	75000	
BTEX (total)	- -		- -		- -		- -		- -		- -		- -		- -		75000	

Total Petroleum Hydrocarbons - SW8015 (µg/kg)																	
DILUTION FACTOR	1		1		1		1		1		1		1		1		10000
Gasoline	59	U	89	J	59	U	51	U	54	U	51	U	53	U	51	U	720000

(a) - Duplicate of SBA-5
(b) - Duplicate of SBA-10

GROUNDWATER FLOW MAPS

Figure 15.7 BX Service Station (AOC A)
Groundwater Contour Map (December 1992)

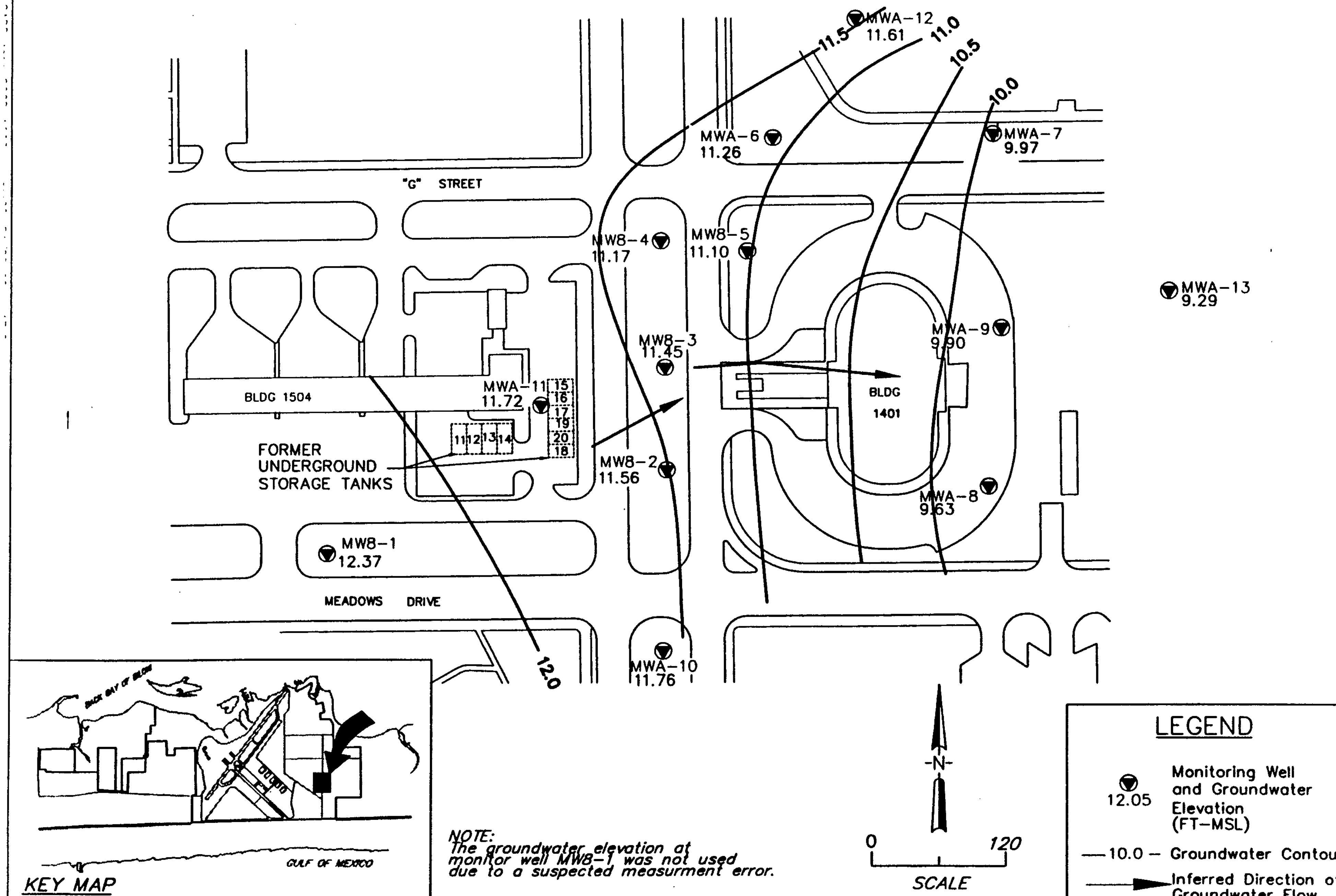
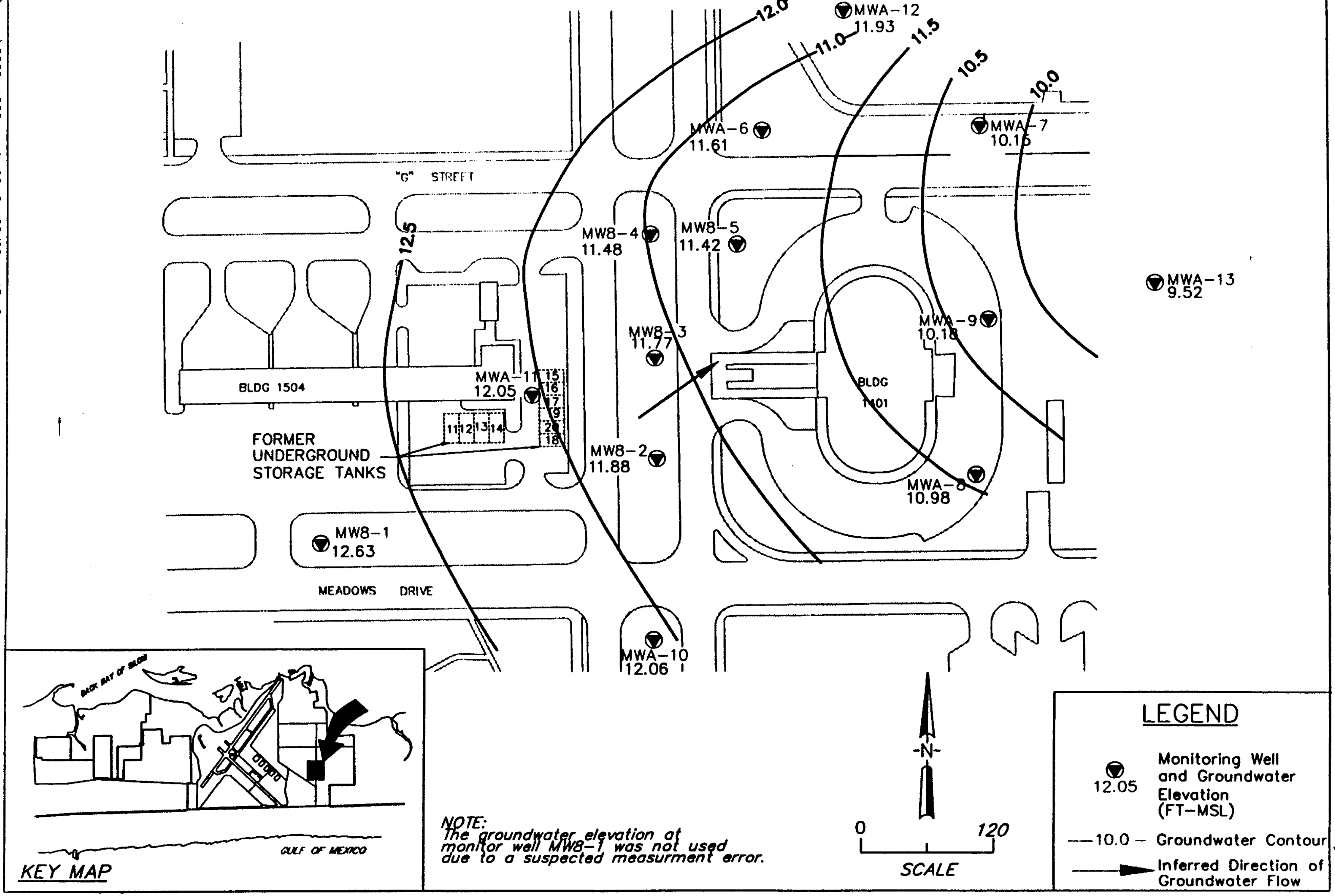
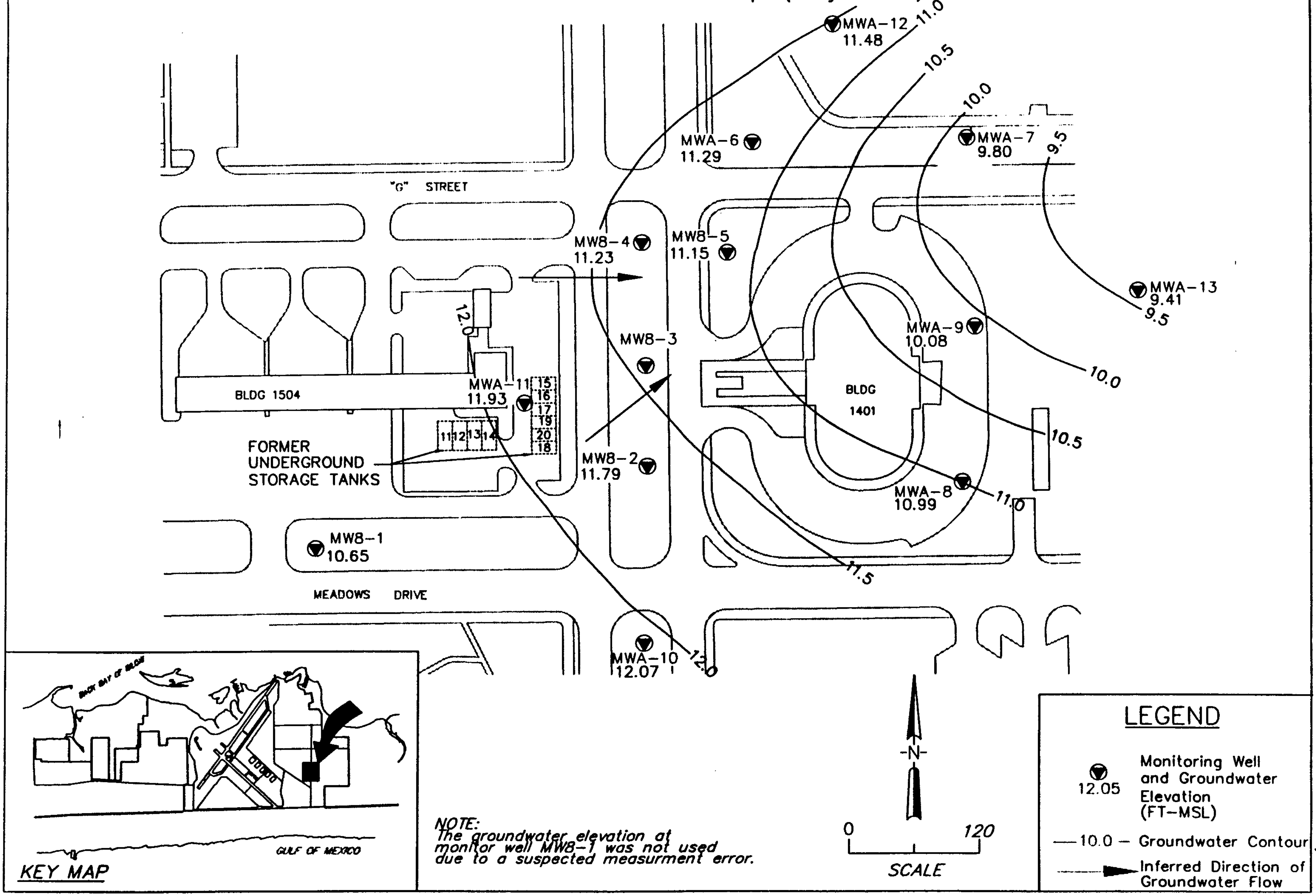


Figure 15.8 BX Service Station (AOC A)
Groundwater Contour Map (February 1993)



NOTE:
The groundwater elevation at monitor well MW8-1 was not used due to a suspected measurment error.

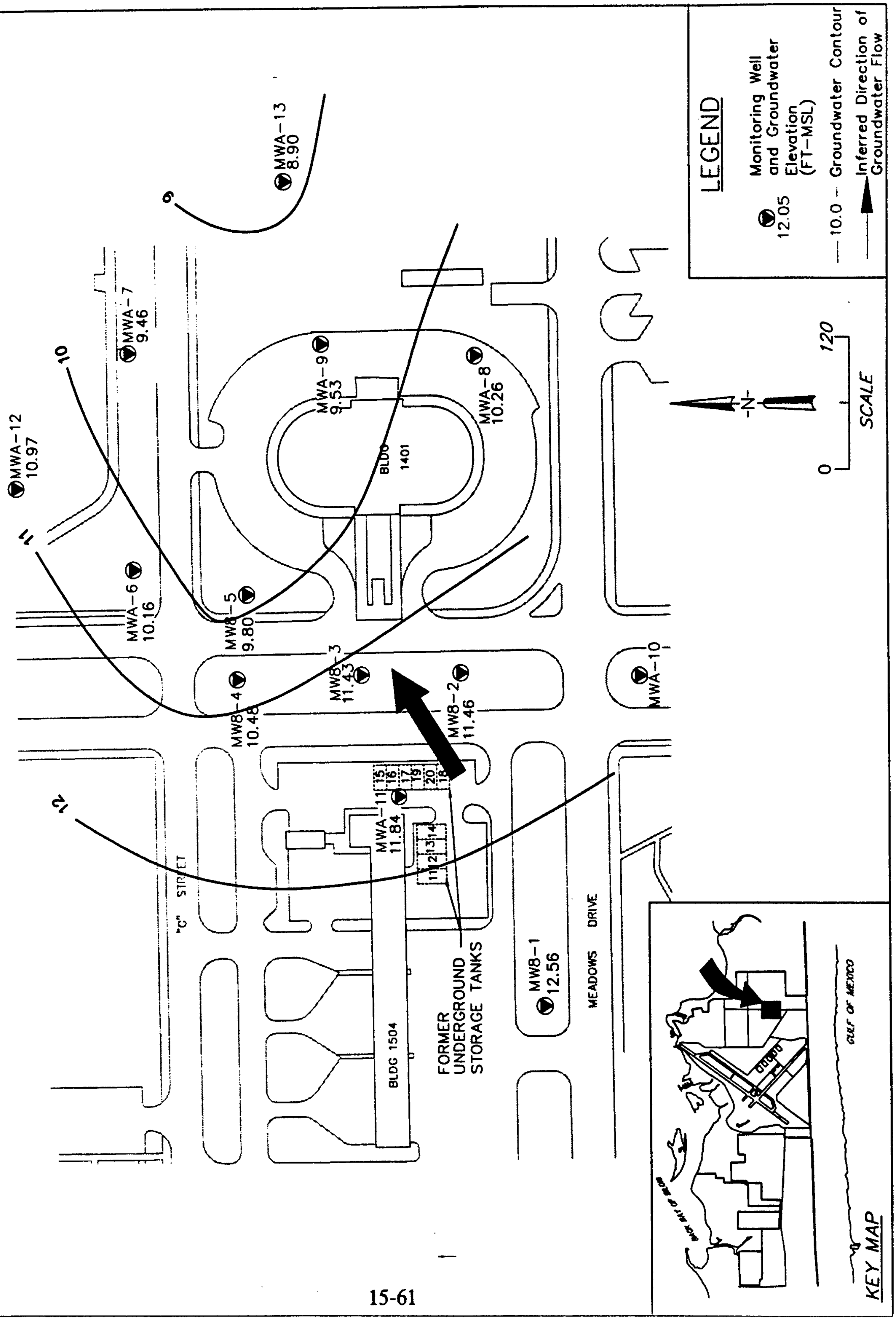
Figure 15.9 BX Service Station (AOC A) Groundwater Contour Map (May 1993)



NOTE:
The groundwater elevation at monitor well MW8-1 was not used due to a suspected measurment error.

J:\AT784\CADD\GOOD\GWCONT996, 04/23/98 at 16:52

Figure 15.10 BX Service Station (AOC A)
Groundwater Contour Map (September 1996)



GROUNDWATER ANALYTICAL AND MAPS

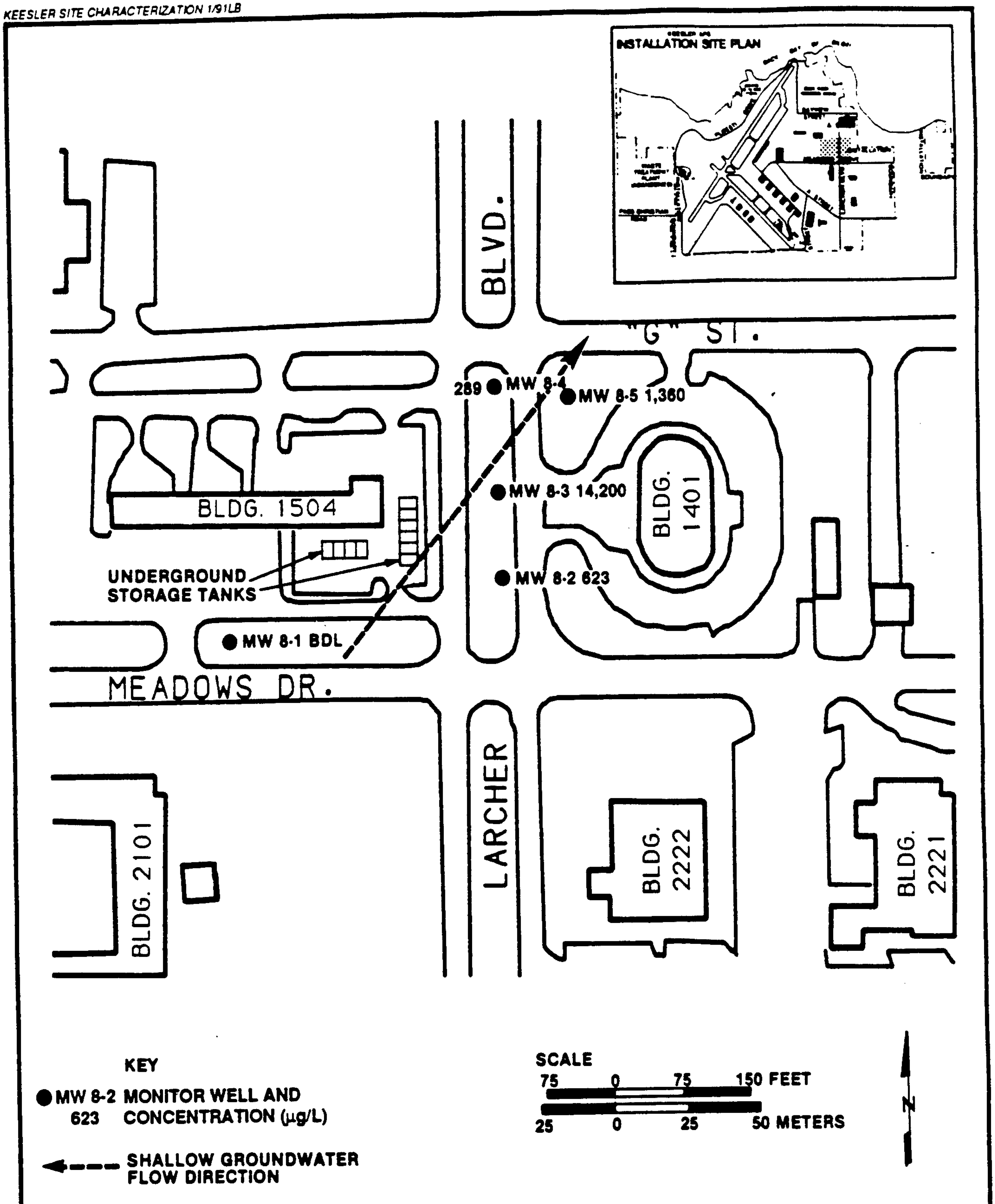


Figure 4.1-31
SITE 8 BENZENE CONCENTRATIONS IN GROUNDWATER, JANUARY 1988

SOURCE: ESE.

INSTALLATION RESTORATION PROGRAM

KEESLER AIR FORCE BASE

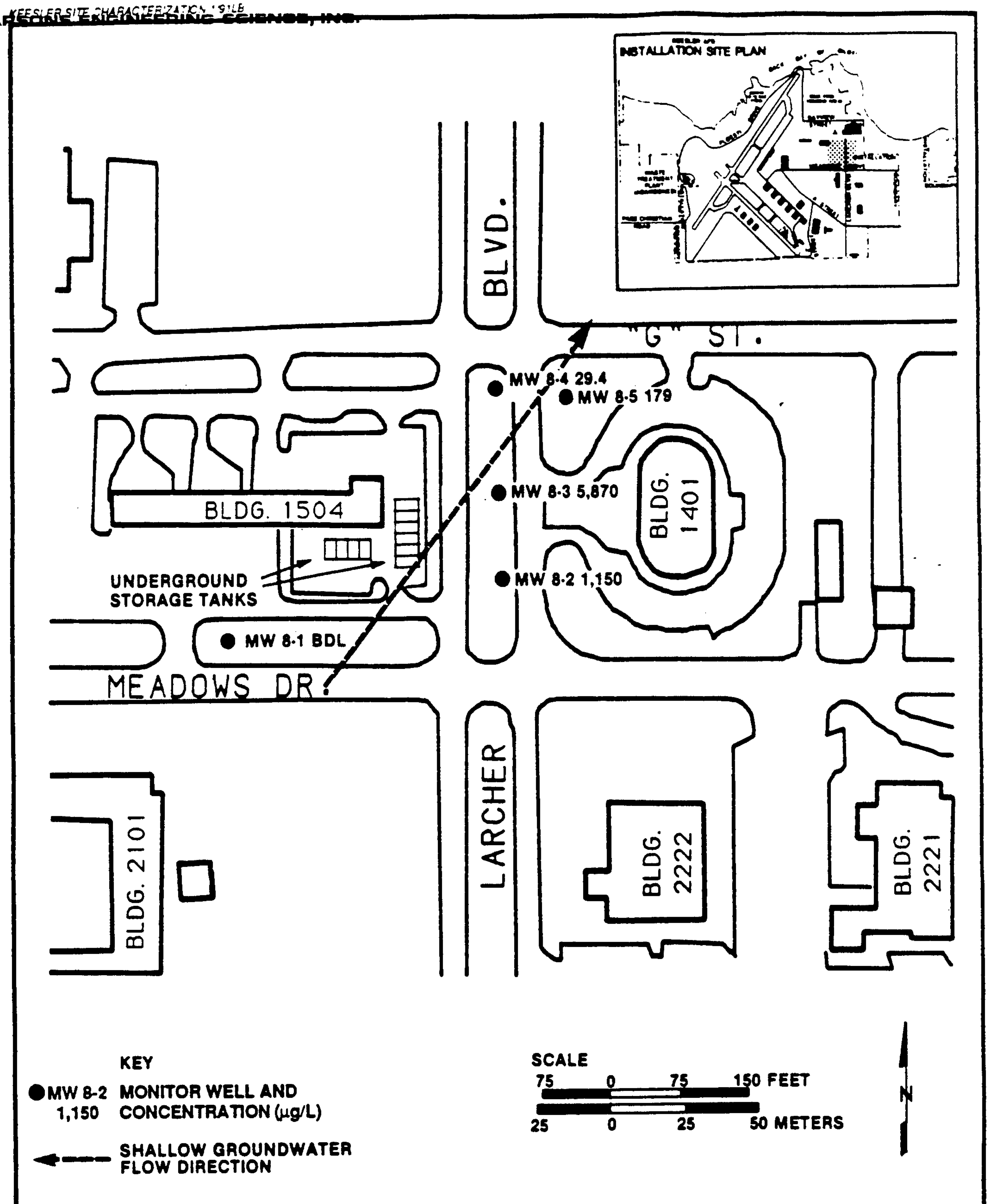


Figure 4.1-33
SITE 8 XYLENE CONCENTRATIONS IN GROUNDWATER, JANUARY 1988

SOURCE: ESE.

INSTALLATION RESTORATION PROGRAM

KEESLER AIR FORCE BASE

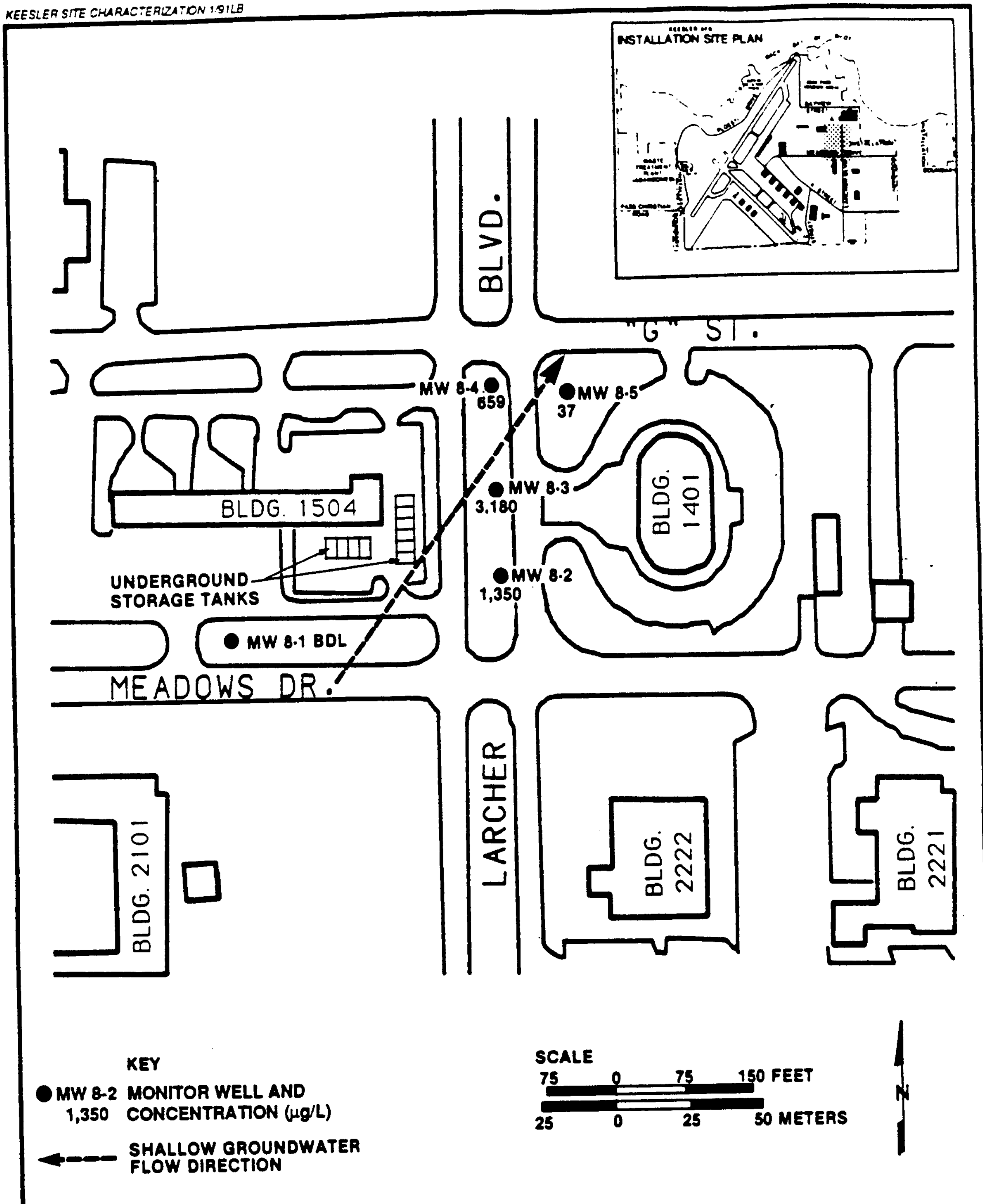


Figure 4.1-32
SITE 8 BENZENE CONCENTRATIONS IN GROUNDWATER, APRIL 1988

SOURCE: ESE.

INSTALLATION RESTORATION PROGRAM

KEESLER AIR FORCE BASE

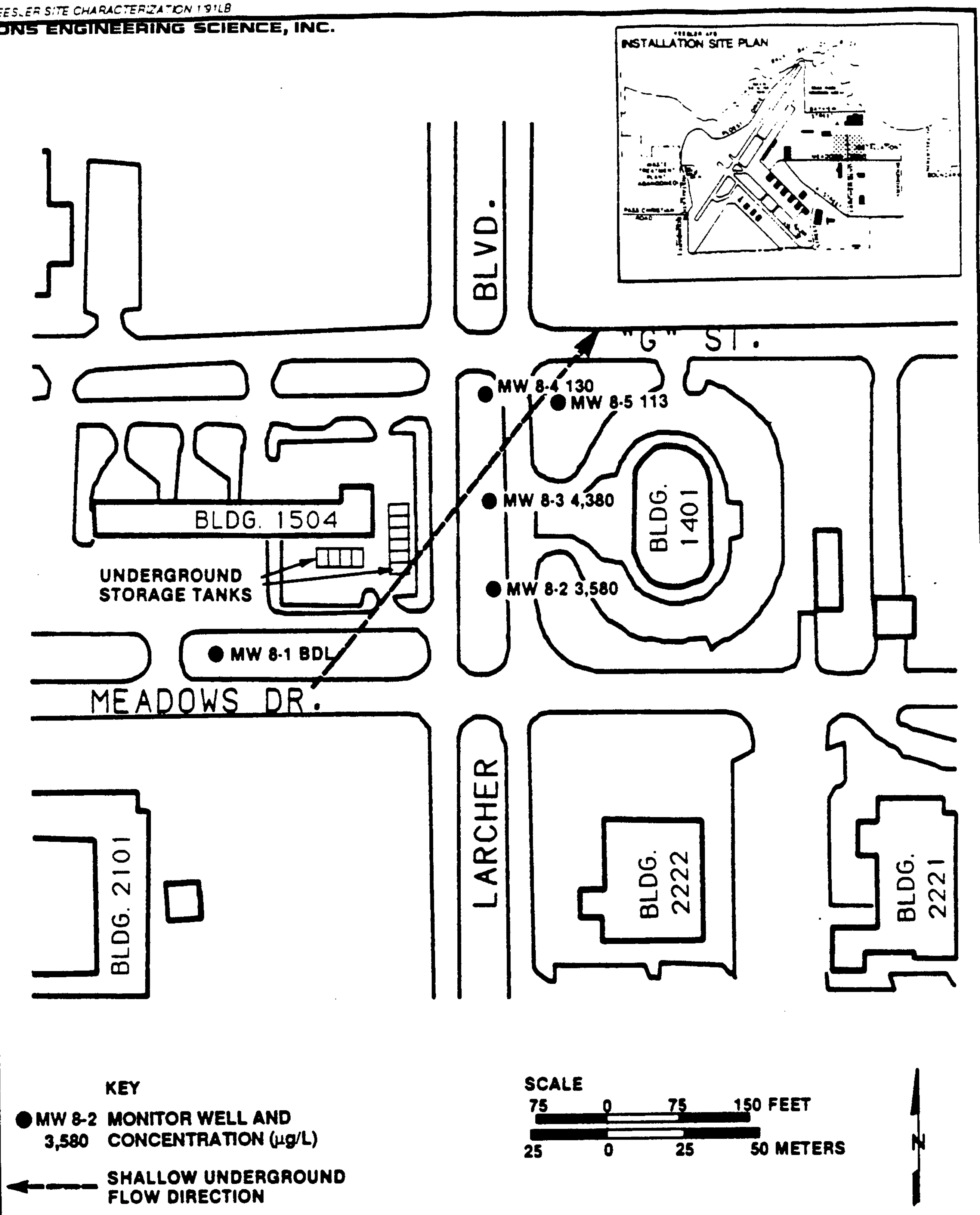


Figure 4.1-34
SITE 8 XYLENE CONCENTRATIONS
IN GROUNDWATER, APRIL 1988

SOURCE: ESE.

INSTALLATION
RESTORATION PROGRAM

KEESLER AIR FORCE BASE

Table 4.1-10a. Parameters Detected in Groundwater at Site 8. Rounds one and two. (Page 1 of 2)

SAMPLE ID'S / PARAMETERS / UNITS	METHOD	DETECTION LIMIT	MW8-1		MW8-2		MW8-3		MW8-4		MW8-5		MWR-2	MWR-1
			K8GW22 AK8W 1	K8GW22 AK8W2 1	K8GW23 AK8W 2	K8GW23 AK8W2 2	K8GW24 AK8W 3	K8GW24 AK8W2 3	K8GW25 AK8W 4	K8GW25 AK8W2 4	K8GW26 AK8W 5	K8GW26 AK8W2 5	K8GWDUP AK8W 20	K8GWDUP AK8W2 6
DATE / TIME			01/13/88 10:00	04/26/88 11:45	01/13/88 14:20	04/26/88 13:45	01/14/88 11:00	04/26/88 16:20	01/14/88 09:00	04/26/88 15:45	01/13/88 11:20	04/26/88 15:00	01/13/88 14:20	04/26/88 11:45
WATER TEMP C	EPA 170.1	N/A	22.0	23.5	22.6	24.0	22.1	24.6	21.9	25.0	22.1	23.7	22.6	23.5
PH,FIELD STD UNITS	EPA 150.1	N/A	507	5.10	6.00	5.70	6.30	5.90	6.20	5.90	5.20	5.00	6.00	5.10
SP.COND.,FIELD@25C UMHOS/CM	EPA 120.1	N/A	217	188	245	374	414	354	453	461	129	224	245	188
CHLORIDE MG/L	STD METH A429	0.500	9.542	11.96	9.434	13.96	12.16	9.608	32.71	17.16	12.32	11.14	10.18	12.08
SULFATE MG/L	STD METH A429	0.500	35.59	34.31	11.44	12.50	2.589	7.031	6.641	31.25	25.26	46.76	[illegible]	35.43
ALKALINITY,T. MG/L-CACO3	STD METH A403	5.0	30.0	41.4	68.0	178	169	160	192	218	12.5	21.0	[illegible]	40.4
HYDROCARBONS,PETRO MG/L	EPA 418.1	0.2	--	--	1.5	4.1	4.1	1.6	--	--	--	--	1.2	--
RESIDUE,DISS MG/L	EPA 160.1	5	118	144	108	248	262	208	306	304	72	126	[illegible]	130
MERCURY,TOTAL MG/L	EPA 245.1	0.0002	0.0003	--	0.0002	0.0004	--	--	--	--	--	--		--
ARSENIC,TOTAL MG/L	EPA 206.2	0.0034	0.0060	--	0.0050	--	0.0090	0.0050	0.0050	--	--	--		--
LEAD,TOTAL MG/L	EPA 239.2	0.0024	0.0210	0.0070	0.0240	0.0200	0.0270	0.0450	0.0210	0.0090	0.0160	0.0140	0.0120	0.0090
SELENIUM,TOTAL MG/L	EPA 270.2	0.0040	--	--	--	--	--	--	0.0050	--	--	--	--	--
THALLIUM,TOTAL MG/L	EPA 279.2	0.002	0.002	--	--	--	0.002	--	--	--	--	--	--	--
ALUMINUM,TOTAL MG/L	EPA 200.7	0.0300	15.9	27.1	10.6	3.70	30.8	14.9	24.8	11.6	14.6	19.7	11.6	8.01
ANTIMONY,TOTAL MG/L	EPA 200.7	0.0210	--	--	--	--	0.0414	--	--	--	--	--	--	--
BARIUM,TOTAL MG/L	EPA 200.7	0.0003	0.0691	0.208	0.0408	0.139	0.0558	0.161	0.0404	0.157	0.0451	0.178	0.0399	0.0545
BORON,TOTAL MG/L	EPA 200.7	0.0100	0.160	0.0847	0.313	0.344	0.0438	0.245	0.0418	0.171	0.651	0.181	0.820	0.0955
CALCIUM,TOTAL MG/L	EPA 200.7	0.0088	10.3	30.1	26.6	82.9	58.8	62.9	60.6	96.0	5.16	31.0	25.5	21.6
CHROMIUM,TOTAL MG/L	EPA 200.7	0.0033	0.0112	0.0252	--	0.0049	0.0251	0.0140	0.0258	0.0069	0.0132	0.0274	0.0093	
COBALT,TOTAL MG/L	EPA 200.7	0.0038	0.0110	--	--	--	--	--	0.0110	--	0.0141	--		
COPPER,TOTAL MG/L	EPA 200.7	0.0028	0.0118	0.0604	--	0.242	0.0068	0.101	0.0176	0.0784	0.0069	0.0497	0.0055	
IRON,TOTAL MG/L	EPA 200.7	0.0260	5.68	6.10	8.88	4.34	12.0	6.15	10.0	3.89	8.45	7.41	9.81	0.955
MAGNESIUM,TOTAL MG/L	EPA 200.7	0.0096	1.75	2.55	2.16	3.39	4.14	3.27	3.58	3.04	1.52	1.85	2.08	1.91
MANGANESE,TOTAL MG/L	EPA 200.7	0.0004	0.0073	0.0217	0.0124	0.0183	0.0320	0.0149	0.0680	0.0624	0.0289	0.0294	0.0126	0.0042

Table 4.1-10a. Parameters Detected in Groundwater at Site 8. Rounds one and two. (Page 2 of 2)

SAMPLE ID'S / PARAMETERS / UNITS	METHOD	DETECTION LIMIT	MW8-1		MW8-2		MW8-3		MW8-4		MW8-5		MW8-[illegible]	MW8-1
			K8GW22 AK8W 1	K8GW22 AK8W2 1	K8GW23 AK8W 2	K8GW23 AK8W2 2	K8GW24 AK8W 3	K8GW24 AK8W2 3	K8GW25 AK8W 4	K8GW25 AK8W2 4	K8GW26 AK8W 5	K8GW26 AK8W2 5	K8GWDUP AK8W [illegible]	K8GWDUP AK8W2 6
DATE / TIME			01/13/88 10:00	04/26/88 11:45	01/13/88 14:20	04/26/88 13:45	01/14/88 11:00	04/26/88 16:20	01/14/88 09:00	04/26/88 15:45	01/13/88 11:20	04/26/88 15:00	01/13/88 14:20	04/26/88 11:45
MOLYBDENUM, TOTAL MG/L	EPA 200.7	0.0039	--	--	--	--	0.0062	--	--	--	--	--		--
NICKEL, TOTAL MG/L	EPA 200.7	0.0086	--	0.0170	--	--	--	--	--	--	0.0387	0.0170		--
POTASSIUM, TOTAL MG/L	EPA 200.7	0.103	2.63	3.19	0.622	1.34	1.09	0.890	2.18	1.32	0.962	2.27	1.04	2.76
SILVER, TOTAL MG/L	EPA 200.7	0.0036	--	--	--	0.0243	0.0226	0.0080	--	0.0054	--	--	--	--
SODIUM, TOTAL MG/L	EPA 200.7	0.350	13.1	11.9	8.23	8.43	11.7	10.3	29.0	17.7	14.3	13.7	9.41	12.4
VANADIUM, TOTAL MG/L	EPA 200.7	0.0036	0.0286	0.0277	0.0244	0.0047	0.0605	0.0159	0.0375	0.0166	0.0245	0.0156	[illegible]	0.0056
ZINC, TOTAL MG/L	EPA 200.7	0.0018	0.0187	0.127	0.0130	0.112	0.0240	0.0973	0.0247	0.105	0.0075	0.117	[illegible]	0.0042
SILICON, TOTAL MG/L	EPA 200.7	0.05	8.7	17.4	12.1	2.4	17.4	5.9	11.1	3.0	4.9	8.7	[illegible]	3.8
BENZENE UG/L	SW5030/ SW8020	0.15	--	--	623	1350	14200	3180	289	659	1360	37.0	[illegible]	--
CHLOROBENZENE UG/L	SW5030/ SW8020	0.340	--	--	--	--	--	--	--	--	--	--	[illegible]	--
1,4-DICHLOROBENZENE UG/L	SW5030/ SW8020	0.450	--	--	ND	--	ND	--	ND	--	ND	--	ND	--
ETHYLBENZENE UG/L	SW5030/ SW8020	0.46	--	--	360	880	1240	766	94.7	89.2	40.9	31.8	231	--
TOLUENE UG/L	SW5030/ SW8020	0.25	--	--	2280	7080	15800	5870	2.21	16.4	8.54	2.43	1680	--
XYLENES, TOTAL UG/L	SW5030/ SW8020	0.85	--	--	1150	3580	5870	4380	29.4	130	179	113	885	--

N/A - Not applicable.
ND - Analyte was not detected by confirmatory analysis.
-- - Indicates the reported value was less than the instrument detection limit.

Source: ESE, 1988

Table 4.1-10b. Parameters Detected in Groundwater at Site 8. Round three. (Page 1 of 2)

SAMPLE ID'S PARAMETERS UNITS	METHOD	DETECTION LIMIT	MW8-1 KBGW22 AKE2W8 1	MW8-2 KBGW23 AKE2W8 2	MW8-3 KBGW24 AKE2W8 3	MW8-4 KBGW25 AKE2W8 4	MW8-5 KBGW26 AKE2W8 5
DATE TIME			10/30/89 09:05	10/30/89 09:30	10/30/89 09:45	10/30/89 10:15	10/30/89 10:45
WATER TEMP C	EPA 170.1	N/A	28.0	27.5	27.1	28.7	26.6
SP.COND.,FIELD@25C UMHOS/CM	EPA 150.1	N/A	253	255	225	301	125
PH,FIELD STD UNITS	EPA 120.1	N/A	4.60	5.00	5.00	5.30	3.70
ALUMINUM,TOTAL MG/L	SW3005/ SW6010	0.0275	3.30	4.43	3.50	14.0	3.95
ALUMINUM,DISS MG/L	SW3005/ SW6010	0.0275	0.0658	0.0322	--	0.0554	0.0490
BARIUM,TOTAL MG/L	SW3005/ SW6010	0.0011	0.0522	0.0305	0.0211	0.0341	0.0378
BARIUM,DISS MG/L	SW3005/ SW6010	0.0011	0.0455	0.0264	0.0165	0.0139	0.0324
CALCIUM,TOTAL MG/L	SW3005/ SW6010	0.0141	22.8	45.6	38.7	46.0	5.59
CALCIUM,DISS. MG/L	SW3005/ SW6010	0.0141	21.7	43.8	37.9	38.1	4.99
CHROMIUM,TOTAL MG/L	SW3005/ SW6010	0.0071	--	--	0.0118	0.0200	0.0107
COPPER,TOTAL MG/L	SW3005/ SW6010	0.0036	--	--	0.0110	0.0063	--
IRON,TOTAL MG/L	SW3005/ SW6010	0.0190	0.804	1.94	6.82	5.95	1.66
IRON,DISS MG/L	SW3005/ SW6010	0.0190	0.204	0.845	3.72	0.0722	0.789
MAGNESIUM,TOTAL MG/L	SW3005/ SW6010	0.033	2.42	2.66	2.43	2.67	1.42
MAGNESIUM,DISS MG/L	SW3005/ SW6010	0.033	2.32	2.54	2.38	2.15	1.31
MANGANESE,TOTAL MG/L	SW3005/ SW6010	0.0010	0.0015	0.0050	0.0096	0.0217	0.0134
MANGANESE,DISS MG/L	SW3005/ SW6010	0.0010	--	0.0028	0.0067	0.0103	0.0106
MOLYBDENUM,TOTAL MG/L	SW3005/ SW6010	0.0058	--	--	0.0312	--	0.0062
POTASSIUM,TOTAL MG/L	SW3005/ SW6010	0.563	2.65	1.50	--	1.21	1.09
POTASSIUM,DISS MG/L	SW3005/ SW6010	0.563	2.75	1.30	0.851	1.24	0.789
SODIUM,TOTAL MG/L	SW3005/ SW6010	0.133	14.8	5.45	11.4	15.2	11.4
SODIUM,DISS. MG/L	SW3005/ SW6010	0.133	15.6	5.73	10.9	13.4	10.5
VANADIUM,TOTAL MG/L	SW3005/ SW6010	0.0060	--	--		0.0109	
ZINC,TOTAL MG/L	SW3005/ SW6010	0.0042	0.0136	0.0302	0.0240	0.0176	0.0228

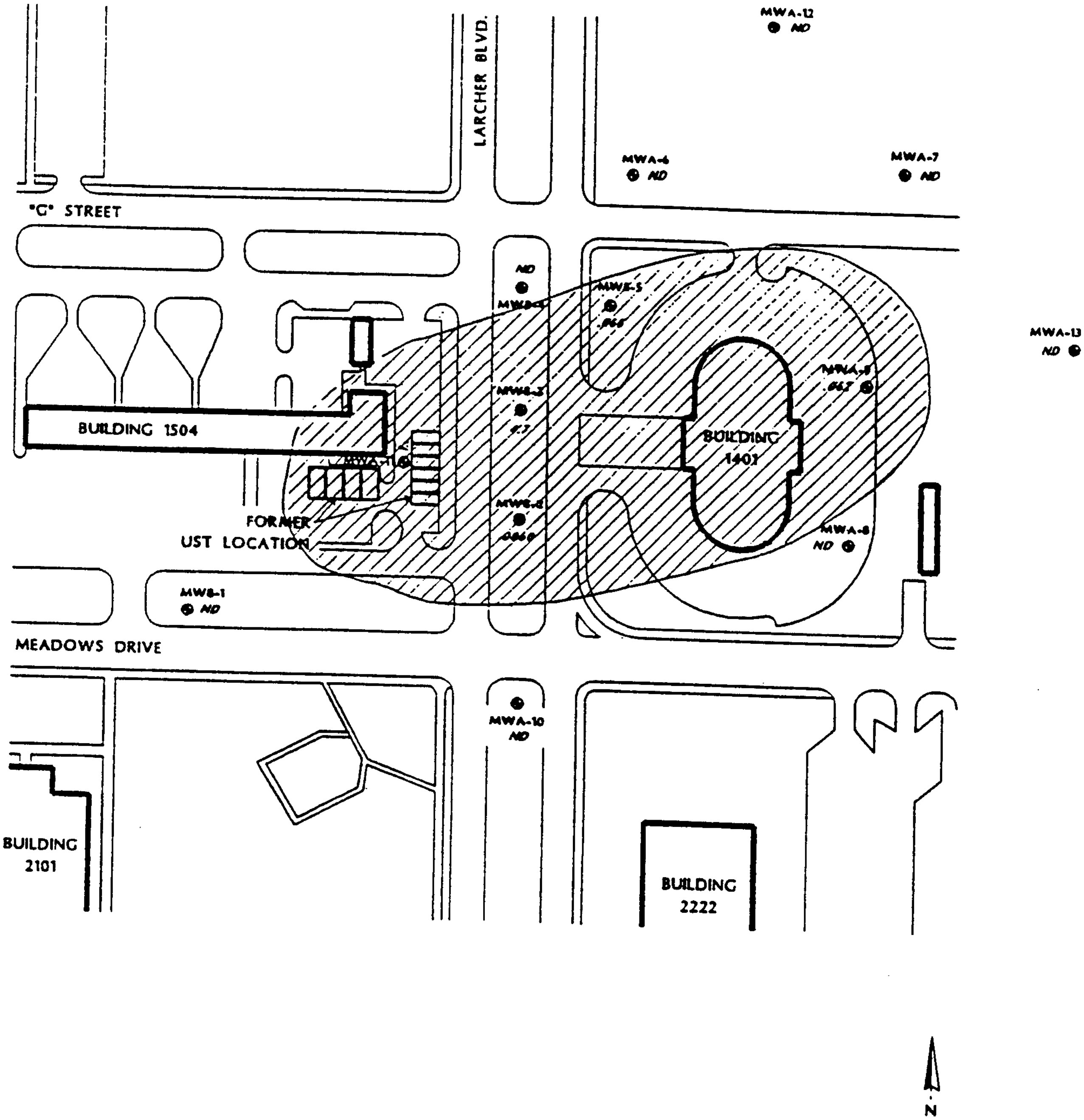
Table 4.1-10b. Parameters Detected in Groundwater at Site 8. Round three. (Page 2 of 2)

SAMPLE ID'S PARAMETERS UNITS	METHOD	DETECTION LIMIT	MW8-1 K8GW22 AKE2W8 1	MW8-2 K8GW23 AKE2W8 2	MW8-3 K8GW24 AKE2W8 3	MW8-4 K8GW25 AKE2W8 4	MW8-5 K8GW26 AKE2W8 5
DATE TIME			10/30/89 09:05	10/30/89 09:30	10/30/89 09:45	10/30/89 10:15	10/30/89 10:45
ZINC,DISS MG/L	SW3005/ SW6010	0.0042	0.0501	0.0416	0.0323	0.0557	0.0273
ARSENIC,TOTAL MG/L	SW7060	0.0023	--	0.0032	0.0076	0.0101	--
ARSENIC,DISS MG/L	SW7060	0.0023	--	--	0.0055	0.0044	--
LEAD,TOTAL MG/L	SW3005+/ SW7421	0.0014	0.0099	0.0241	0.0234	0.0435	0.0529
LEAD,DISS MG/L	SW3005+/ SW7421	0.0014	0.0022	0.0041	0.0036	--	0.0014
MERCURY,TOTAL MG/L	SW7470	0.0002	--	--	0.0002	--	--

N/A - Not applicable.
\+ - Modify digestion to be 7ml of nitric acid.
-- - Indicates the reported value was less than the instrument detection limit.

Source: ESE, 1989

Figure 2.10



LEGEND

Groundwater monitoring well with .0860 TPH concentration in mg/L
ND = non detect

Estimated areal extent of detectable TPH concentration in groundwater

APPROXIMATE SCALE (ft.)
0 75 150 300

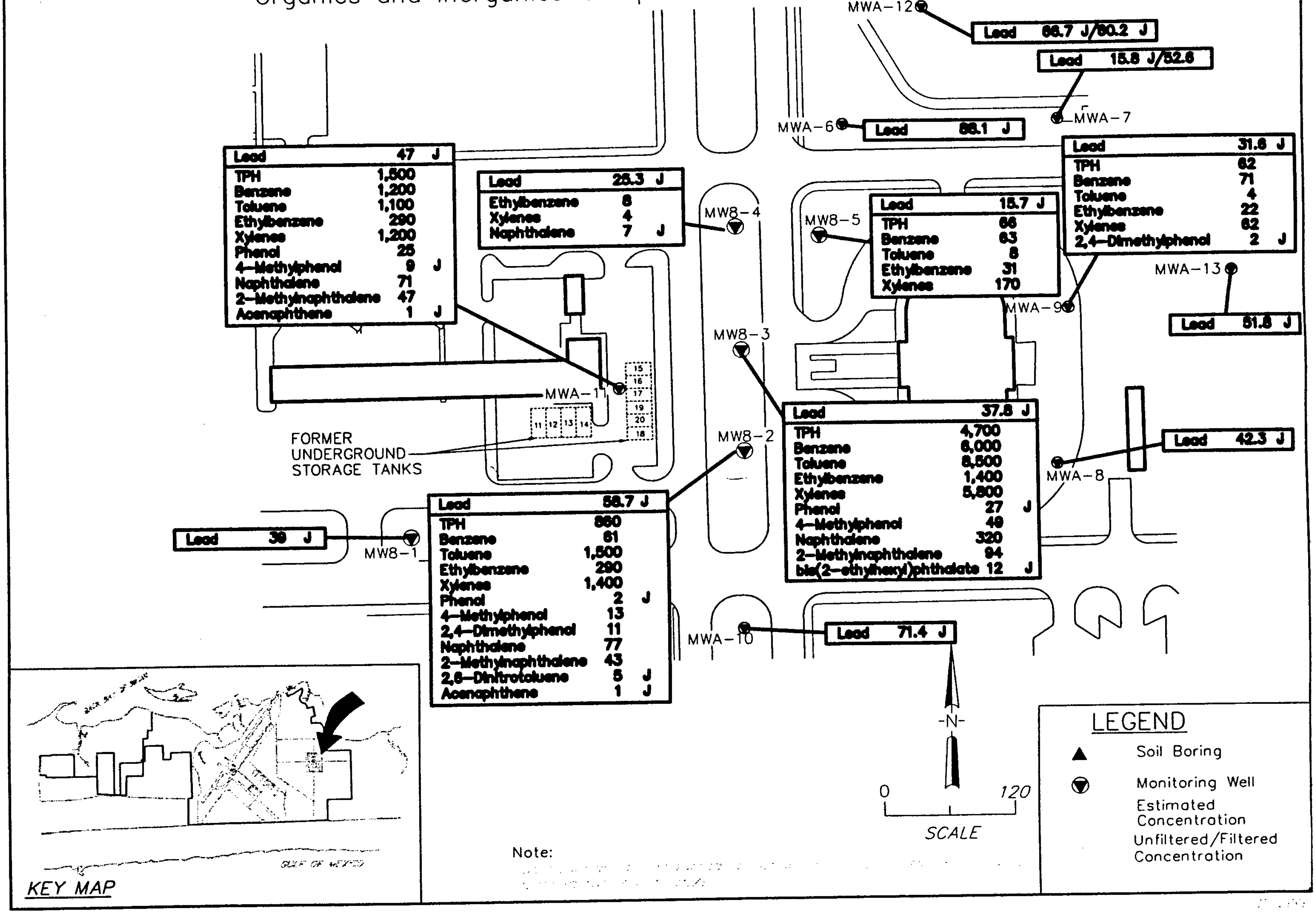
FIGURE 4: EXTENT OF DETECTABLE PETROLEUM HYDROCARBONS IN GROUNDWATER

WEI 1238-1 CAD

BASED ON 1992 DATA

3.9

Figure ~~15.10~~ BX Service Station (AOC A)
Organics and Inorganics Compounds Detected in Groundwater



J:\AT784\AOCGW, 07/07/93 at 17:47

TABLE 4: RESULTS OF GROUNDWATER CHEMICAL ANALYSIS (mg/L)

Sample Location	Date	Elapsed Time (days)	TPH	Benzene	Toluene	Ethyl-benzene	Total Xylene	Naphtha-lene
SW-S	05/09/96	0	<0.020	0.005	0.005	<0.002	0.002	<0.004
	06/14/96	36	<0.050	<0.005	<0.005	<0.005	<0.005	<0.010
	07/11/96	63	1.0	0.11	0.21	0.040	0.085	0.018
	08/14/96	97	1.3	0.15	0.37	0.077	0.16	0.033
	09/18/96	132	<0.020	<0.002	<0.002	<0.002	<0.002	<0.004
	11/25/96	200	0.73	0.12	0.23	0.07	0.1	0.016
	01/15/97	251	1.7	0.096	0.3	0.083	0.2	0.38
	04/30/97	356	1.1	0.083	0.21	0.063	0.14	0.039
SW-D	05/09/96	0	<0.020	<0.002	<0.002	<0.002	<0.002	<0.004
	06/14/96	36	2.4	0.51	0.71	0.14	0.42	0.048
	07/11/96	63	4.6	0.19	0.49	0.090	0.43	0.065
	08/14/96	97	2.1	0.074	0.19	0.072	0.13	0.088
	09/18/96	132	1.1	0.14	0.31	0.054	0.12	0.032
	11/25/96	200	9.8	0.28	0.45	0.35	0.68	0.25
	01/15/97	251	5.3	0.44	1.1	0.25	0.65	0.23
	04/30/97	356	1.1	0.04	0.087	0.055	0.069	0.063
PE3-S	05/09/96	0	96	1.7	2.9	0.86	2.0	0.15
	06/14/96	36	42	7.7	8.7	1.3	3.4	0.25
	07/11/96	63	210	10	9.5	1.5	5.0	0.88
	08/14/96	97	79	14	13	1.1	2.6	0.5
	09/18/96	132	47	9.5	12	1.3	3.2	0.49
	11/25/96	200	47	13	11	1.7	3.6	0.42
	01/15/97	251	47	8.5	9.7	1.3	3.3	0.48
	04/30/97	356	28	5	5.8	1.1	2.5	0.51
MW-11	05/09/96	0	6.9	0.8	0.12	0.26	0.91	0.050
	06/14/96	36	52	<0.005	0.012	1.3	3.6	1.1
	07/11/96	63	49	<0.005	0.013	0.91	1.5	0.52
	08/14/96	97	26	<0.005	<0.005	0.66	1.6	0.72
	09/18/96	132	36	0.42	0.35	0.63	0.75	0.39
	11/25/96	200	34	6.7	4	0.74	1.5	0.4
	01/15/97	251	19	3.7	2.4	0.42	0.48	0.26
	04/30/97	356	18	0.05	0.28	0.37	0.62	0.51
MW8-3	05/09/96	0	32	1.4	6.0	1.2	5.4	0.31
	06/14/96	36	3.8	0.068	0.41	0.094	0.48	0.067
	07/11/96	63	7.0	0.12	0.59	0.13	0.83	0.11
	08/14/96	97	11	0.084	1.8	0.40	2.9	0.11
	09/18/96	132	66	3.2	14	1.9	9.6	0.97
	11/25/96	200	61	4.8	16	2.5	9.8	0.75
	01/15/97	251	28	0.99	5.3	1.1	3.7	0.46
	04/30/97	356	17	0.74	4.2	1.7	2.4	0.41
MW8-4	05/09/96	0	8.6	1.9	0.080	0.29	0.29	0.24
	06/14/96	36	7.7	0.62	0.038	0.14	0.20	0.29
	07/11/96	63	2.7	0.27	<0.005	0.036	0.048	0.13
	08/14/96	97	0.98	0.37	<0.010	0.042	0.028	0.10
	09/18/96	132	3.3	0.89	<0.010	0.23	0.055	0.12
	11/25/96	200	4.8	1.2	<0.010	0.32	0.23	0.1
	01/15/97	251	5.2	1.3	<0.05	0.32	0.22	0.15
	04/30/97	356	4.9	2.3	0.24	0.3	0.35	0.33

Table 15.3 BX Service Station (AOC A) Groundwater Test Results - Volatile Organics

Well ID	MW8-1	MW8-2	MW8-3	MW8-4	MW8-5	MW14 (a)	MWA-6
Date	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92
Volatile Organic Compounds -- SW8240 (µg/L)							
DILUTION FACTOR	1.0	50	500	1.0	5.0	5.0	1.0
Chloromethane	2 U	100 U	1000 U	2 U	10 U	10 U	2 U
Bromomethane	2 U	100 U	1000 U	2 U	10 U	10 U	2 U
Vinyl Chloride	2 U	100 U	1000 U	2 U	10 U	10 U	2 U
Chloroethane	2 U	100 U	1000 U	2 U	10 U	10 U	2 U
Methylene Chloride	1 U	50 U	500 U	1 U	5 U	5 U	1 U
Acetone	10 U	500 U	5000 U	10 U	50 U	50 U	10 U
Carbon Disulfide	2 U	100 U	1000 U	2 U	10 U	10 U	2 U
1,1-Dichloroethene	1 U	50 U	500 U	1 U	5 U	5 U	1 U
1,1-Dichloroethane	1 U	50 U	500 U	1 U	5 U	5 U	1 U
cis-1,2-Dichloroethene	1 U	50 U	500 U	1 U	5 U	5 U	1 U
trans-1,2-Dichloroethene	1 U	50 U	500 U	1 U	5 U	5 U	1 U
1,2-Dichloroethene(total)	1 U	50 U	500 U	1 U	5 U	5 U	1 U
Chloroform	1 U	50 U	500 U	1 U	5 U	5 U	1 U
1,2-Dichloroethane	1 U	50 U	500 U	1 U	5 U	5 U	1 U
2-Butanone	10 U	500 U	5000 U	10 U	50 U	50 U	10 U
1,1,1-Trichloroethane	1 U	50 U	500 U	1 U	5 U	5 U	1 U
Carbon Tetrachloride	1 U	50 U	500 U	1 U	5 U	5 U	1 U
Vinyl Acetate	10 U	500 U	5000 U	10 U	50 U	50 U	10 U
Bromodichloromethane	1 U	50 U	500 U	1 U	5 U	5 U	1 U
1,2-Dichloropropane	1 U	50 U	500 U	1 U	5 U	5 U	1 U
cis-1,3-Dichloropropene	1 U	50 U	500 U	1 U	5 U	5 U	1 U
Trichloroethene	1 U	50 U	500 U	1 U	5 U	5 U	1 U
Benzene	1 U	**61**	**6000**	1 U	**63**	**59**	1 U
Dibromochloromethane	1 U	50 U	500 U	1 U	5 U	5 U	1 U
1,1,2-Trichloroethane	1 U	50 U	500 U	1 U	5 U	5 U	1 U
trans-1,3-Dichloropropene	1 U	50 U	500 U	1 U	5 U	5 U	1 U
Bromoform	1 U	50 U	500 U	1 U	5 U	5 U	1 U
2-Hexanone	10 U	500 U	5000 U	10 U	50 U	50 U	10 U
4-Methyl-2-pentanone	10 U	500 U	5000 U	10 U	50 U	50 U	10 U
Tetrachloroethene	1 U	50 U	500 U	1 U	5 U	5 U	1 U
1,1,2,2-Tetrachloroethane	1 U	50 U	500 U	1 U	5 U	5 U	1 U

Table 15.3 BX Service Station (AOC A) Groundwater Test Results - Volatile Organics

Toluene	1 U	1500	8500	1 U	8	8	1 U
Chlorobenzene	1 U	50 U	500 U	1 U	5 U	5 U	1 U
Ethylbenzene	1 U	290	1400	8	31	30	1 U
Styrene	1 U	50 U	500 U	1 U	5 U	5 U	1 U
Total Xylenes	1 U	1400	5800	4	170	150	1 U

Well ID	MWA-7	MWA-8	MWA-9	MWA-10	MWA-11	MWA-12	MWA-13
Date	11/18/92	11/18/92	11/18/92	11/19/92	11/20/92	11/20/92	11/20/92
Volatile Organic Compounds -- SW8240 (µg/L)							
DILUTION FACTOR	1.0	1.0	2.0	1.0	50	1.0	1.0
Chloromethane	2 U	2 U	4 U	2 U	100 U	2 U	2 U
Bromomethane	2 U	2 U	4 U	2 U	100 U	2 U	2 U
Vinyl Chloride	2 U	2 U	4 U	2 U	100 U	2 U	2 U
Chloroethane	2 U	2 U	4 U	2 U	100 U	2 U	2 U
Methylene Chloride	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Acetone	10 U	10 U	20 U	10 U	500 U	10 U	10 U
Carbon Disulfide	2 U	2 U	4 U	2 U	100 U	2 U	2 U
1,1-Dichloroethene	1 U	1 U	2 U	1 U	50 U	1 U	1 U
1,1-Dichloroethane	1 U	1 U	2 U	1 U	50 U	1 U	1 U
cis-1,2-Dichloroethene	1 U	1 U	2 U	1 U	50 U	1 U	1 U
trans-1,2-Dichloroethene	1 U	1 U	2 U	1 U	50 U	1 U	1 U
1,2-Dichloroethene(total)	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Chloroform	1 U	1 U	2 U	1 U	50 U	1 U	1 U
1,2-Dichloroethane	1 U	1 U	2 U	1 U	50 U	1 U	1 U
2-Butanone	10 U	10 U	20 U	10 U	500 U	10 U	10 U
1,1,1-Trichloroethane	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Carbon Tetrachloride	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Vinyl Acetate	10 U	10 U	20 U	10 U	500 U	10 U	10 U
Bromodichloromethane	1 U	1 U	2 U	1 U	50 U	1 U	1 U
1,2-Dichloropropane	1 U	1 U	2 U	1 U	50 U	1 U	1 U
cis-1,3-Dichloropropene	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Trichloroethene	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Benzene	1 U	1 U	71	1 U	1200	1 U	1 U
Dibromochloromethane	1 U	1 U	2 U	1 U	50 U	1 U	1 U
1,1,2-Trichloroethane	1 U	1 U	2 U	1 U	50 U	1 U	1 U

Table 15.3 BX Service Station (AOC A) Groundwater Test Results - Volatile Organics

trans-1,3-Dichloropropene	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Bromoform	1 U	10 U	2 U	1 U	50 U	1 U	1 U
2-Hexanone	10 U	10 U	20 U	10 U	500 U	10 U	10 U
4-Methyl-2-pentanone	10 U	1 U	20 U	10 U	500 U	10 U	10 U
Tetrachloroethene	1 U	1 U	2 U	1 U	50 U	1 U	1 U
1,1,2,2-Tetrachloroethane	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Toluene	1 U	1 U	**4**	1 U	**1100**	1 U	1 U
Chlorobenzene	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Ethylbenzene	1 U	1 U	**22**	1 U	**290**	1 U	1 U
Styrene	1 U	1 U	2 U	1 U	50 U	1 U	1 U
Total Xylenes	1 U	1 U	**62**	1 U	**1200**	1 U	1 U

(a) -- Duplicate of MW8-5

Table 15.4 BX Service Station (AOC A) Groundwater Test Results - Semivolatile Organics

Well ID	MW8-1	MW8-2	MW8-3	MW8-4	MW8-5	MW14 (a)	MWA-6
Date	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92
Semivolatile Organic Compounds -- SW8270 (µg/L)							
DILUTION FACTOR	1.0	1.0	4.0	1.0	1.0	1.0	1.0
N-Nitroso-Dimethylamine	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Phenol	10 U	2 J	27 J	10 U	10 U	10 U	10 U
bis(2-Choroethyl)ether	10 U	10 U	40 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	40 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Benzyl alcohol	10 U	10 U	40 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	40 U	10 U	10 U	10 U	10 U
bis(2-chloroisopropyl)ether	10 U	10 U	40 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	13	49	10 U	10 U	10 U	10 U
N-Nitroso-Di-n-propylamine	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	40 U	10 U	10 U	10 U	10 U
2-Nitrophenol	10 U	10 U	40 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	11	40 U	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	40 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Benzoic Acid	25 U	25 U	100 U	25 U	25 U	25 U	25 U
1,2,4-Trichlorobenzene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Napthalene	10 U	77	320	7 J	10 U	10 U	10 U
4-Chloroaniline	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	40 U	10 U	10 U	10 U	10 U
2-Methylnapthalene	10 U	43	94	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	40 U	10 U	10 U	10 U	10 U

Table 15.4 (Cont'd) BX Service Station (AOC A) Groundwater Test Results - Semivolatile Organics

2,4,6-Trichlorophenol	10 U	10 U	40 U	10 U	10 U	10 U	10 U
2,4,5-Trichlorophenol	25 U	25 U	100 U	25 U	25 U	25 U	25 U
2-Chloronapthalene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
2-Nitroaniline	25 U	25 U	100 U	25 U	25 U	25 U	25 U
Dimethylphthalate	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	5 J	40 U	10 U	10 U	10 U	10 U

Well ID	**MW8-1**	**MW8-2**	**MW8-3**	**MW8-4**	**MW8-5**	**MW14 (a)**	**MWA-6**
Date	**11/19/92**	**11/19/92**	**11/19/92**	**11/19/92**	**11/19/92**	**11/19/92**	**11/19/92**
Semivolatile Organic Compounds -- SW8270 (µg/L)							
DILUTION FACTOR	1.0	1.0	4.0	1.0	1.0	1.0	1.0
3-Nitroaniline	25 U	25 U	100 U	25 U	25 U	25 U	25 U
Acenaphthene	10 U	1 J	40 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	100 U	25 U	25 U	25 U	25 U
Dibenzofuran	10 U	10 U	40 U	10 U	10 U	10 U	10 U
4-Nitrophenol	25 U	25 U	100 U	25 U	25 U	25 U	25 U
2,4-Dinitrotoluene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	40 U	10 U	10 U	10 U	10 U
4-Chlorophenyl-phenylether	10 U	10 U	40 U	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	100 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-methylphenol	25 U	25 U	100 U	25 U	25 U	25 U	25 U
N-Nitrosodiphenylamine	10 U	10 U	40 U	10 U	10 U	10 U	10 U
4-Bromophenyl-phenylether	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	100 U	25 U	25 U	25 U	25 U
Phenanthrene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Fluoranthene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	40 U	10 U	10 U	10 U	10 U

Table 15.4 (Cont'd) BX Service Station (AOC A) Groundwater Test Results - Semivolatile Organics

Butylbenzylphthalate	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	20 U	20 U	80 U	20 U	20 U	20 U	20 U
Chrysene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
bis(2-ethylhexyl)phthalate	3 U	2 U	12 J	5 U	3 U	8 U	5 U
Di-n-octylphthalate	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	40 U	10 U	10 U	10 U	10 U
Well ID	**MWA-7**	**MWA-8**	**MWA-9**	**MWA-10**	**MWA-11**	**MWA-12**	**MWA-13**
Date	**11/18/92**	**11/18/92**	**11/18/92**	**11/19/92**	**11/20/92**	**11/20/92**	**11/20/92**
Semivolatile Organic Compounds -- SW8270 (µg/L)							
DILUTION FACTOR	1.0	1.0	1.0	1.0	1.0	1.0	1.0
N-Nitroso-Dimethylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Phenol	10 U	10 U	10 U	10 U	25	10 U	10 U
bis(2-Choroethyl)ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,3-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,4-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzyl alcohol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
1,2-Dichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-chloroisopropyl)ether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Methylphenol	10 U	10 U	10 U	10 U	9 J	10 U	10 U
N-Nitroso-Di-n-propylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Nitrobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Isophorone	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Table 15.4 (Cont'd) BX Service Station (AOC A) Groundwater Test Results - Semivolatile Organics

2-Nitrophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dimethylphenol	10 U	10 U	2 J	10 U	10 U	10 U	10 U
bis(2-Chloroethoxy)methane	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzoic Acid	25 U	25 U	25 U	25 U	25 U	25 U	25 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Napthalene	10 U	10 U	10 U	10 U	71	10 U	10 U
4-Chloroaniline	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnapthalene	10 U	10 U	10 U	10 U	47	10 U	10 U
Hexachlorocyclopentadiene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4,6-Trichlorophenol	10 U	10 U	10 U	10 U	10 U	10 U	25 U
2,4,5-Trichlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	10 U
2-Chloronapthalene	10 U	10 U	10 U	10 U	10 U	10 U	25 U
2-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	10 U
Dimethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Acenaphthylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,6-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Well ID	**MWA-7**	**MWA-8**	**MWA-9**	**MWA-10**	**MWA-11**	**MWA-12**	**MWA-13**
Date	**11/18/92**	**11/18/92**	**11/18/92**	**11/19/92**	**11/20/92**	**11/20/92**	**11/20/92**
Semivolatile Organic Compounds -- SW8270 (µg/L)							
DILUTION FACTOR	1.0	1.0	1.0	1.0	1.0	1.0	1.0
3-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Acenaphthene	10 U	10 U	10 U	10 U	1 J	10 U	10 U
2,4-Dinitrophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Dibenzofuran	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitrophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2,4-Dinitrotoluene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluorene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Diethylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Table 15.4 (Cont'd) BX Service Station (AOC A) Groundwater Test Results - Semivolatile Organics

4-Chlorophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-methylphenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
N-Nitrosodiphenylamine	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Bromophenyl-phenylether	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pentachlorophenol	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Phenanthrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Di-n-butylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Butylbenzylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3,3'-Dichlorobenzidine	20 U	20 U	20 U	20 U	20 U	20 U	20 U
Chrysene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
bis(2-ethylhexyl)phthalate	1 U	2 U	1 U	10 U	10 U	10 U	10 U
Di-n-octylphthalate	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	10 U	10 U	10 U	10 U	10 U	10 U	10 U

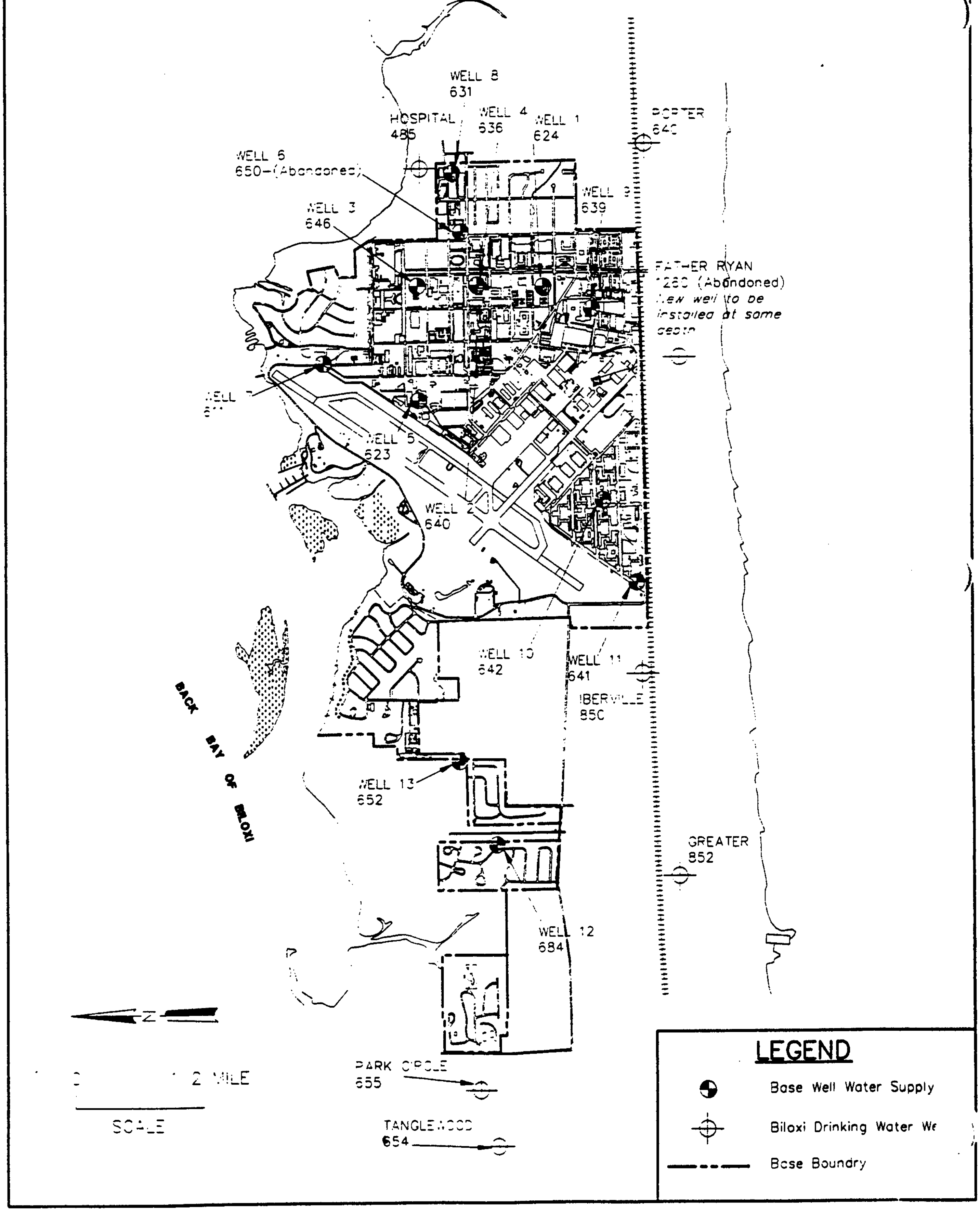
(a) -- Duplicate of MW8-5

Table 15.5 BX Service Station (AOC A) Groundwater Test Results - TPH and Lead

Well ID	MW8-1		MW8-2		MW8-3		MW8-4		MW8-5	
	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
Date	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92	11/19/92
Total Petroleum Hydrocarbons -- SW8015 (µg/L)										
DILUTION FACTOR	1.0		1.0		5.0		1.0		1.0	
Gasoline	50 U		860		4700		50 U		66	
Lead (µg/L)	39 J	2.4 U	58.7 J	14.2 U	37.8 J	13.3 U	25.3 J	1.2 U	15.7 J	1 UJ
Well ID	**MW14 (a)**		**MWA-6**		**MWA-7**		**MWA-8**		**MWA-9**	
	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered
Date	11/19/92	11/19/92	11/19/92	11/19/92	11/18/92	11/18/92	11/18/92	11/18/92	11/18/92	11/18/92
Total Petroleum Hydrocarbons -- SW8015 (µg/L)										
DILUTION FACTOR	1.0		1.0		1.0		1.0		1.0	
Gasoline	75		50 U		50 U		50 U		62	
Lead (µg/L)	16.9 J	5.5 J	88.1 J	5.8 U	15.8 J	52.6	42.3 J	1 U	31.6 J	1 U
Well ID	**MWA-10**		**MWA-11**		**MWA-12**		**MWA-13**			
	Total	Filtered	Total	Filtered	Total	Filtered	Total	Filtered		
Date	11/19/92	11/19/92	11/20/92	11/20/92	11/20/92	11/20/92	11/20/92	11/20/92		
Total Petroleum Hydrocarbons -- SW8015 (µg/L)										
DILUTION FACTOR	1.0		1.0		1.0		1.0			
Gasoline	50 U		1500		50 U		50 U			
Lead (µg/L)	71.4 J	2.7 U	47 J	20.2 U	66.7 J	60.2 J	51.8 J	2.3 U		

GENERAL BASE INFORMATION

Figure 2.8 Keesler AFB and Adjacent City of Biloxi Water Supply Wells



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APPENDIX C
FIELD FORMS FROM FEBRUARY 1998 FIELD EFFORT

BORING NO.: SBA-14 CONTRACTOR: PARSONS DATE SPUD: 2/17/98
CLIENT: AFCEE RIG TYPE: GEOPROBE DATE CMPL.:
JOB NO.: 731854.06 DRLG METHOD: DIRECT PUSH ELEVATION:
LOCATION: KEESLER AFB BORING DIA.: 2" TEMP: 55°
GEOLOGIST: B. LEWIS DRLG FLUID: WEATHER: SUNNY
COMENTS: DRILL HOLE NEXT TO ORIGINAL BORING TO GET 9-11' INTERVAL

Elev (ft)	Depth (ft)	Pro-file	USCS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1	1040		0-2 SAND, with trace clay+silt, brown to yellow, moist, loose				2'	0.0			
	5	1048		2-4 SAND, tan to lt yellow, moist, loose				4'	0.0			
	10	1110		4-6 SAND, dk brown moist, loose				6'	0.0			
		1115		6-8 SAND lt brown moist to wet, loose				8'	0.9			
	15			8-10 NA (NO RECOVERY)								
		1700		~~8-10~~ 9-11 SAND, dk brown, loose, wet, odor				10	109			
		1130		10-12 SAND, dk brown, loose wet odor				12'	126			
	20											
		1145		12-14 SAA				14'	185			
		1200		14-16 SAA				16'	67			
	25			16-18 NOT SAMPLED								
		1210		18-20 SAA				20'	45			
	30	1230		23-25 CLAY BLUE grey wet loose no odor				23-25'	0.0			
	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

ENGINEERING-SCIENCE, INC.

BORING NO.: SBA-15 CONTRACTOR: Parsons DATE SPUD: 2/18/98
CLIENT: AFCEE RIG TYPE: Geoprobe DATE CMPL.:
JOB NO.: 731854.06 DRLG METHOD: Direct Push ELEVATION:
LOCATION: BX Service Station BORING DIA.: 2" TEMP: 40°
GEOLOGIST: B Lewis DRLG FLUID: — WEATHER: sunny
COMENTS:

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1											
			0705	4' SAND, mod sorted, grey to lt brown, loose moist				4'	0.0			
	5											
			0710	6' SAA								
			0716	8' SAND, well sorted, brown to dk brown, loose wet				8'	0.0			
	10											
			0720	10' SAA								
	15		0722	12' SAA				12'	0.0			
			0730	14' SAA								
	20											
	25											
	30											
	35											

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

Water level drilled

ENGINEERING-SCIENCE, INC.

BORING NO.:	SBA-16	CONTRACTOR:	PARSONS	DATE SPUD:	2/18/98
CLIENT:	AFCEE	RIG TYPE:	GEOPROBE	DATE CMPL.:	2/18/98
JOB NO.:	731854.06	DRLG METHOD:	DIRECT PUSH	ELEVATION:	
LOCATION:	BX SERVICE STATION	BORING DIA.:	2"	TEMP:	55°F
GEOLOGIST:	B LEWIS	DRLG FLUID:	—	WEATHER:	SUNNY
COMENTS:					

Elev (ft)	Depth (ft)	Profile	USCS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1			2' SAND, with fines, dk brown, loose, moist								
	5			4' SAND, well sorted offwhite, loose, moist								
	10			6' SAA								
				8' SAND, mod-well sorted brown, loose, very moist								
	15		0830	10' SAA								
			0840	12' SAA								
	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

ENGINEERING-SCIENCE, INC.

BORING NO.:	DA-17	CONTRACTOR:	PARSONS	DATE SPUD:	2/18/98
CLIENT:	AFCEE	RIG TYPE:	GEOPROBE	DATE CMPL.:	2/18/98
JOB NO.:	731854.06	DRLG METHOD:	DIRECT PUSH	ELEVATION:	
LOCATION:	BX SERVICE ST	BORING DIA.:	2	TEMP:	60°
GEOLOGIST:	B. LEWIS	DRLG FLUID:		WEATHER:	SUNNY
COMENTS:					

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1		0920	2' SAND mod sorted grey loose moist				2'	0.0			
			0925	4' SAA				4'	34			
	5											
			0930	6' SAA				6'	15			
			0935	8' SAA except very moist w/ gasoline odor				8'	~~306~~	409		
	10											
			0940	10' SAND well sorted, dk brown wet, odor, loose				10'	584			
	15											
			0945	12' SAA				12'	263			
	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

ENGINEERING-SCIENCE, INC.

BORING NO.:	JBA-18	CONTRACTOR:	PArsons	DATE SPUD:	2/18/98
CLIENT:	AFCEE	RIG TYPE:	GEOPROBE	DATE CMPL.:	2/18/98
JOB NO.:	731854.06	DRLG METHOD:	DirectPush	ELEVATION:	
LOCATION:	BX Service Statio	BORING DIA.:	2"	TEMP:	60°F
GEOLOGIST:	B Leus	DRLG FLUID:		WEATHER:	SUNNY
COMENTS:					

Elev (ft)	Depth (ft)	Pro-file	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1	1015	2'	SAND, mal sorted, tan to brown, loose, moist				2	0.0			
	5	1018	4'	SAA				4	0.0			
		1022	6'	SAND, well sorted, lt tan to white, loose moist				6	0.0			
	10											
		1025	8'	SAND, well sorted dark brown, loose, wet, gasoline odor				8	580			
	15											
		1030	10'	SAA				10	0.0			
	20	1035	12'	SAA				12	0.0			
	25											
	30											
	35											

NOTES

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GS — Ground Surface
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NS — Not Sampled
SAA — Same As Above

SAMPLE TYPE

D — DRIVE
C — CORE
G — GRAB

▼ Water level drilled

ENGINEERING-SCIENCE, INC.

BORING NO.: ~~SA~~ SBA-19 CONTRACTOR: PARSONS DATE SPUD: 2/18/98
CLIENT: AFCEE RIG TYPE: GEOPROBE DATE CMPL.: 2/18/98
JOB NO.: 731854.06 DRLG METHOD: DIRECT PUSH ELEVATION:
LOCATION: BX SERVICE STATION BORING DIA.: 2 TEMP: 60°
GEOLOGIST: B LEWIS DRLG FLUID: WEATHER: SUNNY
COMENTS:

Elev (ft)	Depth (ft)	Profile	USCS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1		1305	2' SAND poorly sorted w/ fines, dk brown loose, moist				2	0.0			
	5							4	0.0			
			1308	4' SAND well sorted brown, moist, loose				6	0.0			
	10		1310	6' SAA except dk brown								
			1315	8' SAA except wet				8	0.0			
			1318	10' SAND, well sorted loose, grey-brown, wet hydrocarbon odor				10	~~252~~ 292			
	15											
			1320	12' SAA				12	145			
	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

ENGINEERING-SCIENCE, INC.

BORING NO.: SBA-20 CONTRACTOR: PARSONS DATE SPUD: 2/18/98
CLIENT: AFCEE RIG TYPE: GEOPROBE DATE CMPL.: 2/18/98
JOB NO.: 731854.06 DRLG METHOD: DIRECT PUSH ELEVATION:
LOCATION: KEESLER AFB BORING DIA.: 2 TEMP: 60°
GEOLOGIST: B LEWIS DRLG FLUID: WEATHER: SUNNY
COMENTS:

Elev (ft)	Depth (ft)	Profile	US CS	Geologic Description	Sample No.	Sample Depth (ft)	Sample Type	Penet Res	PID(ppm)	TLV(ppm)	TOTAL BTEX(ppm)	TPH (ppm)
	1		1340	2' SAND, poorly sorted, dk brown, loose, moist				2'	0.0			
	5							4'	0.0			
			1342	4' SAND, well sorted white to tan, loose, moist								
	10							6	0.0			
			1345	6' SAND, mod sorted, dk brown, loose very moist to wet								
	15											
			1350	8' SAA, wet w/ hydrocarbon ~~ordo~~ odor				8'	315			
	20		1353	10' SAA				10'	~~157~~	285		
			1355	12' SAA				12'	147			
	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

ENGINEERING-SCIENCE, INC.

MONITORING WELL INSTALLATION RECORD (SBA-14)

JOB NAME RBIC STREAMLINED KEESLER AFB BX SERVICE STATION WELL NUMBER MW A-14

JOB NUMBER 731854.06 INSTALLATION DATE 2/17/98 LOCATION MEDIAN AT CARLGAR

DATUM ELEVATION ____ GROUND SURFACE ELEVATION ____

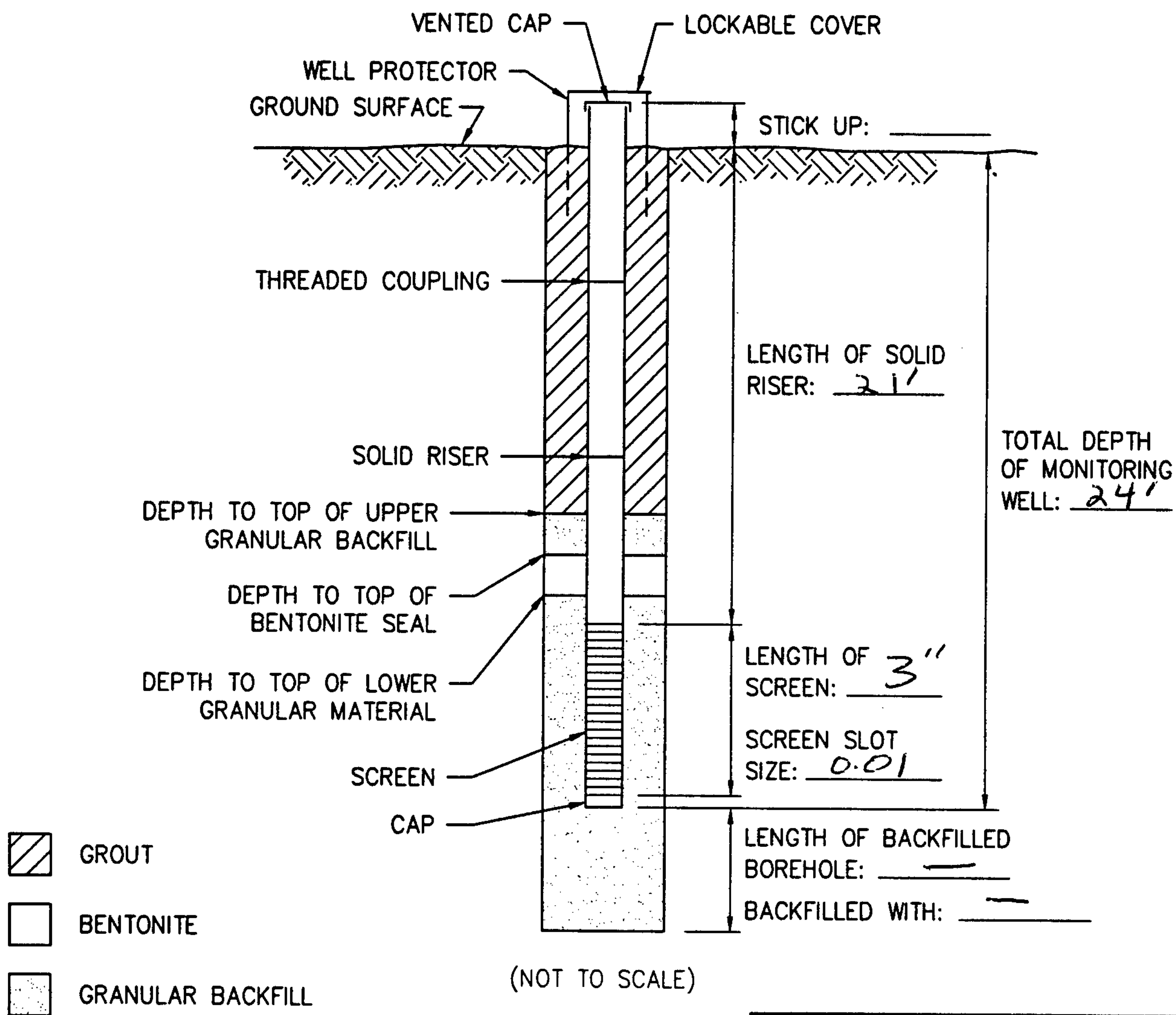
DATUM FOR WATER LEVEL MEASUREMENT ____

SCREEN DIAMETER & MATERIAL 1/2" PVC SCH 80 SLOT SIZE 0.010

RISER DIAMETER & MATERIAL 1/2" PVC SCH 80 BOREHOLE DIAMETER 2"

GRANULAR BACKFILL MATERIAL SILICA SAND/BENTONITE CRUMBLES ES REPRESENTATIVE B LEWIS

DRILLING METHOD GEOPROBE DRILLING CONTRACTOR PARSONS



(NOT TO SCALE)

STABILIZED WATER LEVEL ____ FEET BELOW DATUM.
MEASURED ON ____

MONITORING WELL INSTALLATION RECORD

ENGINEERING-SCIENCE, INC.

94DN0199, 03/01/94 at 10:22

MONITORING WELL INSTALLATION RECORD (SBA-15)

JOB NAME STREAMLINED RBIC KEESLER WELL NUMBER MWA-103

JOB NUMBER 731854.06 INSTALLATION DATE 2/18/98 LOCATION BX SERVICE STATION

DATUM ELEVATION ______ GROUND SURFACE ELEVATION ______

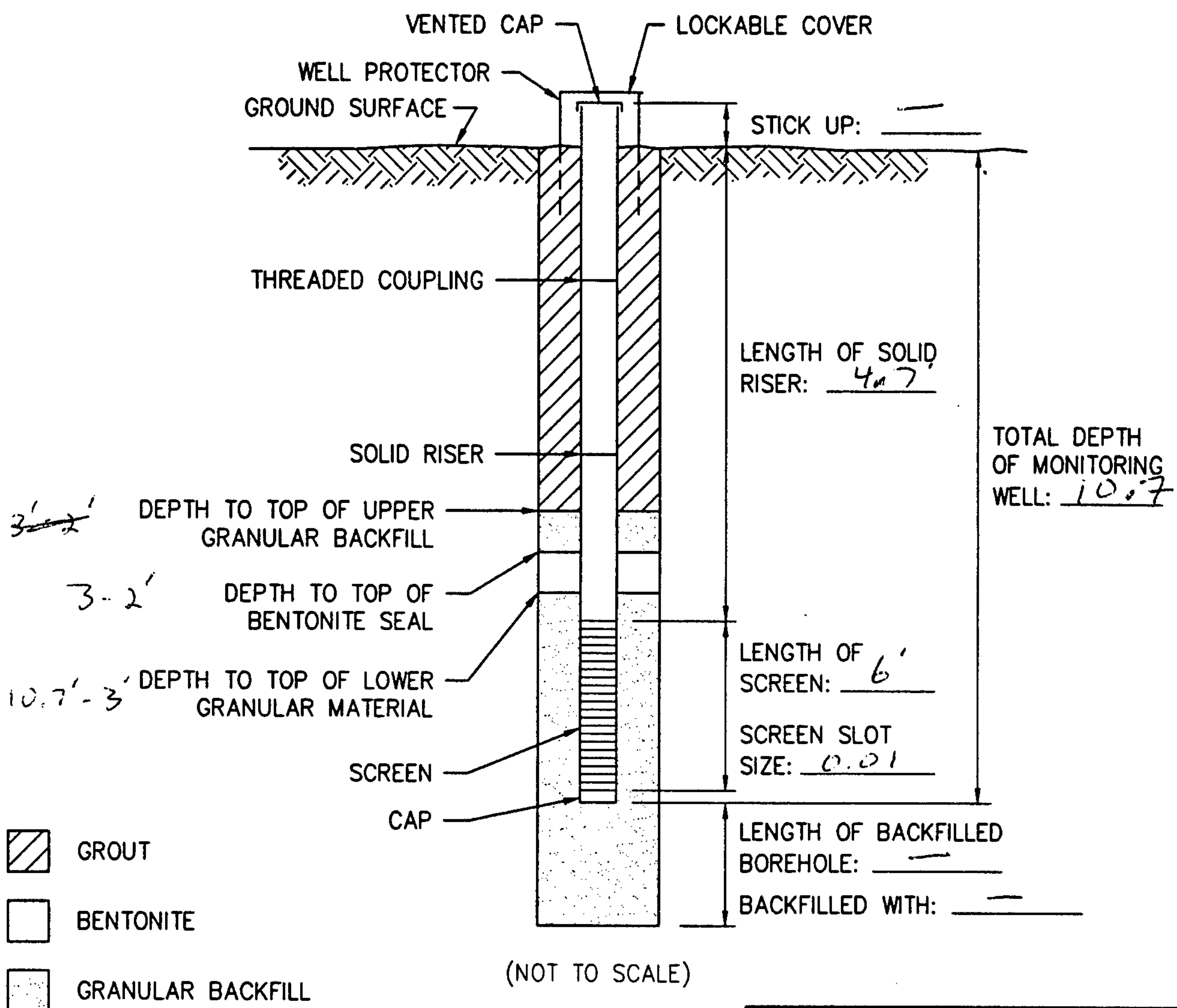
DATUM FOR WATER LEVEL MEASUREMENT ______

SCREEN DIAMETER & MATERIAL 1½" PVC SCH 80 SLOT SIZE 0.01

RISER DIAMETER & MATERIAL 1½" PVC SCH 80 BOREHOLE DIAMETER 2

GRANULAR BACKFILL MATERIAL SILICA SAND ES REPRESENTATIVE R. LEWIS

DRILLING METHOD DIRECT PUSH DRILLING CONTRACTOR ______



(NOT TO SCALE)

STABILIZED WATER LEVEL ______ FEET BELOW DATUM.

MEASURED ON ______

MONITORING WELL INSTALLATION RECORD

ENGINEERING-SCIENCE, INC.

94DN0199, 03/01/94 at 10:22

MONITORING WELL DEVELOPMENT RECORD

Job Number: 730308.03000
Location PNM - Person Gen. Station
Well Identification MWA-10B

Job Name: AFCEE-RNA
by G.A.K. Date: 2-20-98
Measurement Datum

Pre-Development Information

Time (Start): 0845

Water Level:

Total Depth of Well:

Water Characteristics

Color Dark Brown Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material No
pH 6.95 Temperature (°C) 18.7
Specific Conductance (~~µS/cm~~) 450 umhos
Dissolved Oxygen (mg/L) 1.71
Redox (mV) -133.0

Interim Water Characteristics

Gallons Removed	1.5	2.0	3.0
pH	6.75	6.72	6.71
Temperature (°C)	19.3	19.3	19.3
Specific Conductance(µS/cm)	425 umhos	415	415
Dissolved Oxygen (mg/L)	1.36	1.45	1.54
Redox (mV)	-121.3	-130.4	-123.5

Post-Development Information

Time (Finish): 0907

Water Level:

Total Depth of Well:

Approximate Volume Removed: 3.5 gallons

Water Characteristics

Color clear Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material No
pH 6.70 Temperature (°C) 19.3
Specific Conductance (~~µS/cm~~) 412 umhos
Dissolved Oxygen (mg/L) 1.56
Redox (mV) -127.4

Comments:

I:\forms\develop.doc

MONITORING WELL DEVELOPMENT RECORD

Job Number: 730308.03000
Location PNM - Person Gen. Station
Well Identification MWA-14

Job Name: AFCEE-RNA
by E.A.K. Date: 2-19-98
Measurement Datum

Pre-Development Information

Time (Start): 1415

Water Level:

Total Depth of Well:

Water Characteristics

Color Dark brown Clear Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material No
pH 5.54 Temperature (°C) 22.8°C
Specific Conductance (~~µS/cm~~) 75 µmhos
Dissolved Oxygen (mg/L) 0.36
Redox (mV) 218.9

Interim Water Characteristics

Gallons Removed 3.5

pH 5.71

Temperature (°C) 23.3

Specific Conductance(~~µS/cm~~) 80 µmhos

Dissolved Oxygen (mg/L) 0.18

Redox (mV) -246.7

Post-Development Information

Time (Finish): 1445

Water Level:

Total Depth of Well:

Approximate Volume Removed: 5 gallons

Water Characteristics

Color Dark brown ~~Clear~~ Cloudy
Odor: None Weak Moderate Strong
Any Films or Immiscible Material No
pH 5.62 Temperature (°C) 23.4
Specific Conductance (~~µS/cm~~) 75 µmhos
Dissolved Oxygen (mg/L) 0.18
Redox (mV) -238.5

Comments:

GROUNDWATER SAMPLING RECORD

Sampling Location ____________
Sampling Dates 2-20-98

GROUND WATER SAMPLING RECORD - MONITORING WELL MW 8-1
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: ____________, 1998 ________ a.m./p.m.
SAMPLE COLLECTED BY: of Parsons ES
WEATHER: Sunny ≈ 55 °F
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 ____________ 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. MW 8-1 (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:

DIRECT INSTRUMENT READINGS

Time	0750	0756	0803	0810	0815	0822	Measured With
Temp (°C)	19.6	20.3	20.3	20.3	20.4	20.4	
pH	5.64	5.70	5.79	5.87	5.87	5.88	
Cond (µS/cm)	195	189	197	207	214	219	
Do (mg/L)	0.70	0.44	0.37	0.35	0.34	0.33	
Redox (mv)	-36.0	-120	-177	-182	-180	-184	
gallons purged	Init	1.0	2.0	3.0	4.0	5.0	

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments:

7 [ ] SAMPLE CONTAINERS (material, number, size):

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method Containers:
Method Containers:

[ ] Preservatives added:
Method Containers:

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:

GROUNDWATER SAMPLING RECORD

Sampling Location ______________
Sampling Dates ______________

GROUND WATER SAMPLING RECORD - MONITORING WELL MW 8-3 (number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 2-20-98, 1998 1020 a.m./p.m.
SAMPLE COLLECTED BY: E. A. K of Parsons ES
WEATHER: ______________
DATUM FOR WATER DEPTH MEASUREMENT (Describe): ______________

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 Isopropyl & DI
Items Cleaned (List): ______________

2 [ ] PRODUCT DEPTH ______________ FT. BELOW DATUM
Measured with: ______________

WATER DEPTH ______________ FT. BELOW DATUM
Measured with: Solinst W.L.I.

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: cloudy
Odor: moderate
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. mw8-3 (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:

DIRECT INSTRUMENT READINGS

Time	0956	1003	1007	1012	1017		Measured With
Temp (°C)	20.4	20.3	20.3	20.3	20.2		YSI 55
pH	6.30	6.28	6.27	6.27	6.26		Orion 250A
Cond (~~µS/cm~~) umhos	465	460	455	450	450		YSI 33
Do (mg/L)	0.93	0.38	0.39	0.30	0.26		YSI 55
Redox (mv)	-263.0	-270.6	-235.6	-279.6	-259.6		Orion 250A
gallons purged	init.	1.0	2.0	3.0	4.0		← gallons

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments:

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 40 mL VOA, 1 750mL poly, 1 1000 mL poly

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method Containers:
Method Containers:

[ ] Preservatives added:
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 ______________
Sampling Dates ______________

GROUND WATER SAMPLING RECORD - MONITORING WELL MW8-4
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 2-20, 1998 0815 a.m./p.m.
SAMPLE COLLECTED BY: E. A. K. of Parsons ES
WEATHER: Sunny 50°
DATUM FOR WATER DEPTH MEASUREMENT (Describe): ______________

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 Isopropyl, DI
Items Cleaned (List): ______________

2 [ ] PRODUCT DEPTH ______________ FT. BELOW DATUM
Measured with: ______________

WATER DEPTH ______________ FT. BELOW DATUM
Measured with: Solinst W.L.I.

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: clear
Odor: none
Other Comments: ______________

4 [ ] WELL EVACUATION:
Method: ______________
Volume Removed: ______________
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: slight
Other comments: ______________

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Groundwater Sampling Record

Monitoring Well No. MW8-4 (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:

DIRECT INSTRUMENT READINGS

Time	0715	0726	0735	0747	0800	0813	Measured With
Temp (°C)	19.3	20.1	20.3	20.2	20.3	20.4	YSI 55
pH	6.15	6.14	6.14	6.15	6.16	6.17	Orion 250A
Cond (~~µS/cm~~) umhos	280	300	305	320	320	325	YSI 33
Do (mg/L)	0.70	0.35	0.28	0.36	0.34	0.04	YSI 55
Redox (mv)	-219.0	-267.8	-273.5	-275.5	-279.8	-280.0	Orion 250
gallons purged	init.	1.0	2.5	5.0	7.5	10.0	← gallons

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments:

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 40mL VOA, 1 750mL poly, 1 1000mL poly.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method ______ Containers: ______
Method ______ Containers: ______

[ ] Preservatives added:
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 ______
Sampling Dates 2-20-98

GROUND WATER SAMPLING RECORD - MONITORING WELL MW 8-5
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 2-20-98, 1998 1020 a.m./p.m.
SAMPLE COLLECTED BY: ______ of Parsons ES
WEATHER: Sunny ≈ 60°F
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 ______ 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. MW8-5 (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:

DIRECT INSTRUMENT READINGS

Time	0952	0954	~~1059~~	1004	1008	1019	Measured With
Temp (°C)	22.6	22.9	23.0	23.0	23.0	23.0	
pH	5.20	5.22	5.30	5.39	5.45	5.51	
Cond (μS/cm)	80	76	76	83	91	98	
Do (mg/L)	0.50	0.22	0.18	0.17	0.17	0.16	
Redox (mv)	-206	-216	-218	-223	-229	-232	
gallons purged	Init	≈1	2	3	4	5	

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments:

7 [ ] SAMPLE CONTAINERS (material, number, size):

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method ______ Containers: ______

Method ______ Containers: ______

[ ] Preservatives added:

Method ______ Containers: ______

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled

[ ] Container Lids Taped

[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:

GROUNDWATER SAMPLING RECORD

Sampling Location ____________
Sampling Dates 2-19-98

GROUND WATER SAMPLING RECORD - MONITORING WELL MW A-6
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 2-19-98, 1998 ________ a.m./p.m.
SAMPLE COLLECTED BY: of Parsons ES
WEATHER: Cloudy ≈ 65°F
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 ____________ 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. MWA-6 (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:

DIRECT INSTRUMENT READINGS

Time	1425	1433	1444	1454	1500	1505	Measured With
Temp (°C)	20.3	20.1	19.9	19.9	20.0	19.9	
pH	5.67	5.65	5.70	5.71	5.72	5.71	
Cond (μS/cm)	231	215	198	192	191	189	
Do (mg/L)	0.78	0.42	0.34	0.30	0.32	0.30	
Redox (mv)	-126	-130	-134	-134	-134	-134	
gallons purged	Init.	1.5	3.0	4.5	6.0	7.0	

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments: ______

7 [ ] SAMPLE CONTAINERS (material, number, size): ______

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method ______ Containers: ______
Method ______ Containers: ______

[ ] Preservatives added:
Method ______ Containers: ______

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled

[ ] Container Lids Taped

[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS: ______

GROUNDWATER SAMPLING RECORD

Sampling Location ____________
Sampling Dates 2-19-98

GROUND WATER SAMPLING RECORD - MONITORING WELL MW A-9
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: Feb 19, 1998 ________ a.m./p.m.
SAMPLE COLLECTED BY: of Parsons ES
WEATHER: Cloudy ≈ 60°F
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 ____________ 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. MWA-9 (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:

DIRECT INSTRUMENT READINGS

Time		6.22					Measured With
Temp (°C)	22.6	22.4	22.1	22.1	22.1	22.0	
pH	5.85	~~7.12~~	6.20	6.18	6.18	6.17	
Cond (µS/cm)	~~0.226~~	221	213	206	201	200	
Do (mg/L)	0.37	0.22	0.35	0.38	0.41	0.41	
Redox (mv)	~~0.2~~	-110	-175	-190	-197	-204	
gallons purged	Init	1.5	3.0	4.5	5.5	7.0	

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments: 1st redox reading invalid - short in cable

7 [ ] SAMPLE CONTAINERS (material, number, size):

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method ____ Containers: ____
Method ____ Containers: ____

[ ] Preservatives added:
Method ____ Containers: ____

9 [ ] CONTAINER HANDLING:

[ ] Container Sides Labeled
[ ] Container Lids Taped
[ ] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:

GROUNDWATER SAMPLING RECORD

Sampling Location ______________
Sampling Dates ______________

GROUND WATER SAMPLING RECORD - MONITORING WELL MWA-10B
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 2-20-98, 1998 0915 a.m./p.m.
SAMPLE COLLECTED BY: of Parsons ES
WEATHER: Sunny, 55°, slight NE breeze
DATUM FOR WATER DEPTH MEASUREMENT (Describe): ______________

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 DI + isopropyl
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. 10B (Cont'd)

5 [ ] SAMPLE EXTRACTION METHOD:

[ ] Bailer made of:
[ ] Pump, type:_
[ ] Other, describe:

Sample obtained is [X] GRAB; [ ] COMPOSITE SAMPLE

6 [ ] ON-SITE MEASUREMENTS:

DIRECT INSTRUMENT READINGS

Time	0907	0909	0911	0913	0915		Measured With
Temp (°C)	19.3	19.3	19.4	19.4	19.3		
pH	6.69	6.69	6.68	6.68	6.68		
umhos Cond (~~µS/cm~~)	410	410	408	405	405		
Do (mg/L)	1.54	1.54	1.54	1.51	1.48		
Redox (mv)	-135.6	-133.7	-133.4	-128.8	-136.5		
gallons purged	init.	.25	.50	.75	1.00		← gallons

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments:

7 [ ] SAMPLE CONTAINERS (material, number, size): 6-40mL VOA, 1 750mL poly, 1 1,000mL poly.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method ____ Containers: ____
Method ____ Containers: ____

[ ] Preservatives added:
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 ______________
Sampling Dates ______________

GROUND WATER SAMPLING RECORD - MONITORING WELL MWA-11
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 2 - 19, 1998 0940 a.m./p.m.
SAMPLE COLLECTED BY: of Parsons ES
WEATHER: Sunny, 50° F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): ______________

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 DI water
Items Cleaned (List): ______________

2 [ ] PRODUCT DEPTH ______________ FT. BELOW DATUM
Measured with: ______________

WATER DEPTH ______________ FT. BELOW DATUM
Measured with: Solinst Wat. Lev. Ind.

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: 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: ______________

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Groundwater Sampling Record

Monitoring Well No. MWA-11 (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:

DIRECT INSTRUMENT READINGS

Time	0830	0839	0850	0902	0915	0930	Measured With
Temp (°C)	19.8	22.4	22.8	22.6	22.5	22.7	YSI Model 55
pH	6.31	6.37	6.36	6.34	6.31	6.31	Orion 250A
umhos → Cond ~~(µS/cm)~~	220	190	175	175	180	180	YSI model 33
Do (mg/L)	12.7%	7.7%	5.2%	0.34	0.31	0.24	YSI Model 55
Redox (mv)	122.5	-225.4	-270.4	-265.0	-300.4	-264.9	Orion 250A
gallons purged	init.	1 gal.	2.5	5.0	7.5	10.0	

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments:

7 [ ] SAMPLE CONTAINERS (material, number, size): 6 40 mL VOA's, 1 poly 750 mL, 1 poly 1,000 mL

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method Containers:

Method Containers:

[ ] Preservatives added:

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 ______________
Sampling Dates ______________

GROUND WATER SAMPLING RECORD - MONITORING WELL MWA-13
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 2-19-98, 1998 1146 a.m./p.m.
SAMPLE COLLECTED BY: G.A.K. of Parsons ES
WEATHER: Cloudy, 60° F
DATUM FOR WATER DEPTH MEASUREMENT (Describe): ______________

MONITORING WELL CONDITION:

[ ] LOCKED: [X] UNLOCKED
WELL NUMBER (IS - IS NOT) APPARENT
STEEL CASING CONDITION IS: Good
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 [X] EQUIPMENT CLEANED BEFORE USE WITH DI water
Items Cleaned (List): All meter probes

2 [ ] PRODUCT DEPTH ______________ FT. BELOW DATUM
Measured with: ______________

WATER DEPTH ______________ FT. BELOW DATUM
Measured with: Solinst W.L.I.

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: cloudy
Odor: slight
Other Comments: ______________

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: 6 gallons
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: ______________
Other comments: ______________

Groundwater Sampling Record

Monitoring Well No. MWA-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:

DIRECT INSTRUMENT READINGS

Time	1110	1118	1128	1133	1139	1145	Measured With
Temp (°C)	20.5	20.6	20.3	20.2	20.2	20.2	YSI DO model 55
pH	6.05	6.04	6.03	6.03	6.03	6.01	Orion 250A
umhos → Cond (~~µS/cm~~)	210	245	225	220	215	210	YSI Model 33
Do (mg/L)	0.77	0.47	0.35	0.40	0.41	0.29	YSI model 55
Redox (mv)	-308.8	-239.7	-172.2	-172.0	-171.0	-172.9	Orion 250A
gallons purged	init	1 gal.	2.5 gal	3.5	5.0	6.0	

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments:

7 [ ] SAMPLE CONTAINERS (material, number, size): ~~2~~ 3 40mL VOA,

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method ______ Containers: ______
Method ______ Containers: ______
[ ] Preservatives added:
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 ______________
Sampling Dates ______________

GROUND WATER SAMPLING RECORD - MONITORING WELL MWA-14
(number)

REASON FOR SAMPLING: [X] Regular Sampling; [ ] Special Sampling;
DATE AND TIME OF SAMPLING: 2-19-98, 1998 1505 ~~a.m./p.m.~~
SAMPLE COLLECTED BY: E. A. K, of Parsons ES
WEATHER: P. Cloudy, 60°
DATUM FOR WATER DEPTH MEASUREMENT (Describe): __________

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 DI water
Items Cleaned (List): __________

2 [ ] PRODUCT DEPTH __________ FT. BELOW DATUM
Measured with: __________

WATER DEPTH __________ FT. BELOW DATUM
Measured with: Solinst Water Lev. Ind.

3 [ ] WATER-CONDITION BEFORE WELL EVACUATION (Describe):
Appearance: Dark brown
Odor: moderate
Other Comments: __________

4 [ ] WELL EVACUATION:
Method: Peristaltic pump
Volume Removed: __________
Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors: slight - moderate
Other comments: __________

Groundwater Sampling Record

Monitoring Well No. MWA-14 (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:

DIRECT INSTRUMENT READINGS

Time	1448	1452	1455	1458	1501		Measured With
Temp (°C)	23.2	23.3	23.3	23.4	23.4		
pH	5.59	5.58	5.57	5.56	5.56		
umhos → Cond (~~µS/cm~~)	75	75	72	70	70		
Do (mg/L)	0.20	0.19	0.26	0.20	0.20		
Redox (mv)	-243.5	-219.3	-238.8	-243.8	-244.0		
gallons purged	init.	0.5	1.0	1.5	2.0		← gallons

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Nitrate			
(4) Nitrite			
(5) Manganese			
(6) Ferrous Iron			
(7) Total Iron			
(8) Alkalinity			
(9) Carbon Dioxide			
(10) Chloride			

Additional Comments:

7 [ ] SAMPLE CONTAINERS (material, number, size): 3 40 mL VOA's.

8 [ ] ON-SITE SAMPLE TREATMENT:

[ ] Filtration: Method ___ Containers: ___

Method ___ Containers: ___

[ ] Preservatives added:

Method ___ Containers: ___

9 [ ] CONTAINER HANDLING:

[X] Container Sides Labeled

[ ] Container Lids Taped

[X] Containers Placed in Ice Chest

10 [ ] OTHER COMMENTS:

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE	2/20/98	TIME SAMPLED	0830
		TIME ANALYSIS START	0905
SAMPLE I.D.	MW 8-1	TIME ANALYSIS END	0924

FILTERED (circle) YES NO

COLOR / ODOR: CLEAR / SULFUR ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0.09	0.09	mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	0.0	mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	17.00	17.00	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.235	0.235	mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0 digits
BGR	73 digits
	73 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 73

CHEMetrics Color Tests:

Ammonia 0.6 ppm

Technician: BL

[a/] Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

[b/] Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

7D

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE	2/20/98	TIME SAMPLED	0830
		TIME ANALYSIS START	0908
SAMPLE I.D.	MW8-1 DUP	TIME ANALYSIS END	0924

FILTERED (circle) YES NO

COLOR / ODOR: CLEAR / SULFUR ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0.09	0.09	mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	0.0	mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	1~~7~~	16.91	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.225	0.225	mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0 digits
BGR	74 digits
	74 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 74

CHEMetrics Color Tests:

Ammonia 0.6 ppm

Technician: BL

a/ Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

b/ Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE: 2/20/98
TIME SAMPLED: 1020
TIME ANALYSIS START: 1115
TIME ANALYSIS END: 1138
SAMPLE I.D.: MW8-3

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	1.11	1.11	mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	0.0	mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	4.79	4.79	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	5	0.228		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 100 — Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0 digits
BGR	228 digits
	228 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 228

CHEMetrics Color Tests:

Ammonia: 2 ppm

Technician: BL

a/ Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

b/ Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE: 2/20/98

TIME SAMPLED: 0815
TIME ANALYSIS START: 0828
TIME ANALYSIS END: 0951

SAMPLE I.D.: MW8-4

FILTERED (circle): YES NO

COLOR / ODOR: CLEAN / ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0.05	0.05	mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	0.0	mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	2.11	2.11	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	25	0.065		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity — Sample Size = 100 — Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0 digits
BGR	164 digits
	164 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 164

CHEMetrics Color Tests:

Ammonia: 3 ppm

Technician: BL

a/ Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

b/ Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE	2/20/98	TIME SAMPLED	1020
		TIME ANALYSIS START	1055
SAMPLE I.D.	MW8-5	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	0.33	0.33	mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	0.0	mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	3.8	3.8	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	25	.112		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0	digits
BGR	32	digits
	32	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 32

(1.0 X 32)

CHEMetrics Color Tests:

Ammonia 2 ppm

Technician: BL

a/ Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

b/ Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE 2/19/98

SAMPLE I.D. MWA-6

TIME SAMPLED 1505
TIME ANALYSIS START 1520
TIME ANALYSIS END 1545

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	1.46	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	30.11	mg/L	DI or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.118	mg/L	DI
					mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0 digits
BGR	30 digits
	30 total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 30

CHEMetrics Color Tests:

Ammonia 0.8 ppm

Technician: BL

a/ Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

b/ Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE	2/1 8 9/98	TIME SAMPLED	1150
		TIME ANALYSIS START	1227
SAMPLE I.D.	MWA-9	TIME ANALYSIS END	1245

FILTERED (circle) YES NO

COLOR / ODOR: CLEAR / SULFUR ODOR

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration		Blank[a/,b/]
Ferrous	50.01.1	0 - 5.10 mg/L	1	0.23	0.23	mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	0.0	mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	13.66	13.66	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.590	0.590	mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100

Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0	digits
BGR	72	digits
	72	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 72

CHEMetrics Color Tests:

Ammonia 0.4 ppm

Technician: DL

a/ Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

b/ Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE: 2/20/98
TIME SAMPLED: 0915
TIME ANALYSIS START: 0950
TIME ANALYSIS END: 1017
SAMPLE I.D.: MWA-10B

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	4.14	4.14	mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	0.0	mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	7.38	7.38	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.027	0.027	mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0	digits
BGR	207	digits
	207	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 207

CHEMetrics Color Tests:

Ammonia 0.8 ppm

Technician: BL

[a] Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

[b] Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE: 2/19/98
TIME SAMPLED: 0940
TIME ANALYSIS START: 1020
TIME ANALYSIS END: 1105

SAMPLE I.D.: MWA-11

FILTERED (circle): YES NO

COLOR / ODOR: PALE YELLOW / 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	0.47	0.47	mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	0.0	mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	38.5	38.5	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	5	0.405		mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0	digits
BGR	52	digits
	52	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 52

CHEMetrics Color Tests:

Ammonia 2 ppm

Technician: BL

[a/] Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

[b/] Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE	2/19/98	TIME SAMPLED	1146
		TIME ANALYSIS START	1205
SAMPLE I.D.	MW A-13	TIME ANALYSIS END	1224

FILTERED (circle) YES NO

COLOR / ODOR: CLEAR slt 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	1.50	1.50	mg/L	sample
						mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L	1	0.0	0.0	mg/L	sample
						mg/L	sample
Sulfate	45.000	0 - 100 mg/L	1	27.64	27.64	mg/L	DI or 50mg/L
						mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L	1	0.066	0.066	mg/L	DI
						mg/L	DI

HACH Titrations:

Alkalinity Sample Size = 100 Titrate with 1.6 N H_2SO_4

Phenolphthalein Alkalinity	0	digits
BGR	78	digits
	78	total digits

Digit Multiplier X Total Digits = Total Alkalinity (mg/L) = 78

CHEMetrics Color Tests:

Ammonia 0.4 ppm

Technician: BL

a/ Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

b/ Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

ON-SITE MEASUREMENTS
HACH AND CHEMetrics ANALYSES
Keesler AFB, BX Service Station, AOC-A (ST-06)

SAMPLE DATE: 2/19/98

TIME SAMPLED: 1505
TIME ANALYSIS START:
TIME ANALYSIS END:

SAMPLE I.D.: MWA-14

FILTERED (circle): YES NO

COLOR / ODOR: TOO DARK (SEDIMENT OR NATURAL COLOR) TO SAMPLED - FILTERED (REPEATEDLY

HACH DR/700 Measurements:

Analyte	Program	Range	Dilution	Reading	Concentration	Blank[a,b]
Ferrous	50.01.1	0 - 5.10 mg/L			mg/L	sample
					mg/L	sample
Manganese	52.13.1	0 - 20.0 mg/L			mg/L	sample
					mg/L	sample
Sulfate	45.000	0 - 100 mg/L			mg/L	DI or 50mg/L
					mg/L	DI or 50mg/L
Sulfide	61.12.1	0 - 0.600 mg/L			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) = ______

CHEMetrics Color Tests:

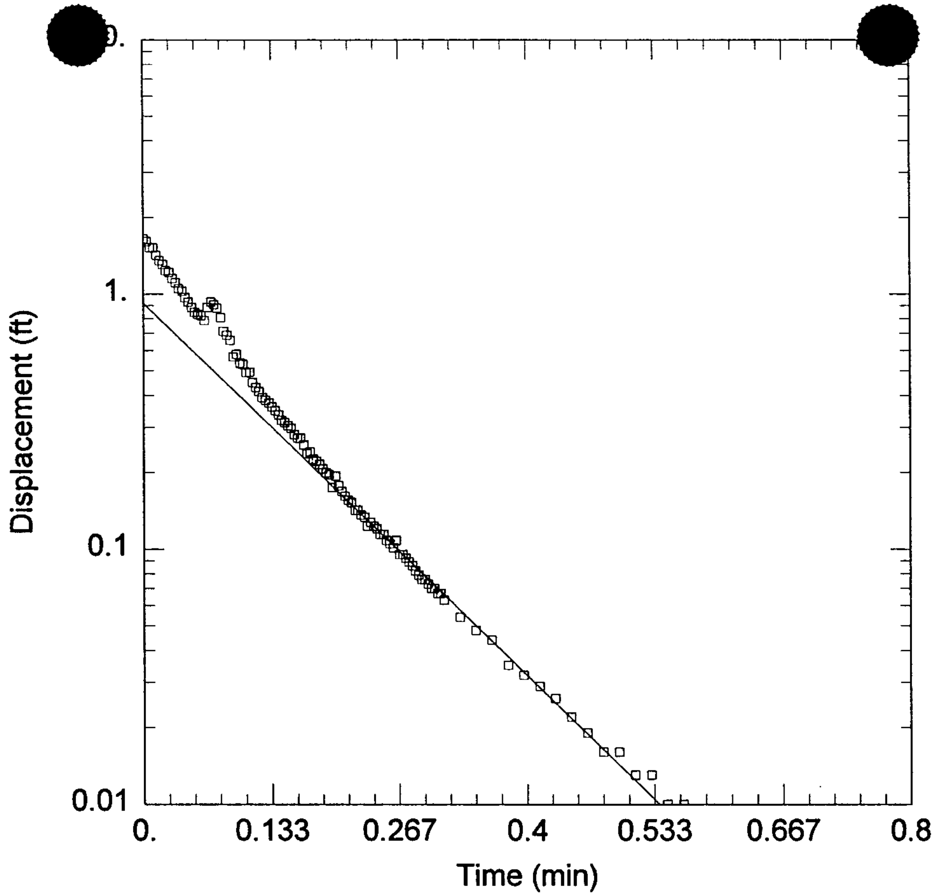
Ammonia ______ ppm

Technician: ______________________

[a] Sulfate, and sulfide blanks contain respective reagents;
Ferrous iron and manganese blanks are without reagents.

[b] Ferrous, and manganese blanks should be diluted accordingly if samples are diluted.

APPENDIX D
AQUIFER SLUG TEST INPUT AND OUTPUT



MW8-3 WITHDRAWAL

Data Set: I:\KEE-AOCA\SLUGTEST\MW8-3WB.AQT
Date: 08/21/98 Time: 12:24:24

PROJECT INFORMATION

Company: Parsons Engineering Science
Client: AFCEE
Project: 731854.06
Test Location: Keesler AFB, BX Ser Sta
Test Well: MW8-3
Test Date: 2/18/98

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 29.04 ft/day
y0 = 0.9132 ft

AQUIFER DATA

Saturated Thickness: 17.1 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 1.643 ft
Casing Radius: 0.08333 ft
Screen Length: 10. ft
Water Column Height: 8.14 ft
Wellbore Radius: 0.3333 ft
Gravel Pack Porosity: 0.15

Data Set: I:\KEE-AOCA\SLUGTEST\MW8-3WB.AQT
Title: MW8-3 WITHDRAWAL
Date: 08/21/98
Time: 12:24:34

PROJECT INFORMATION

Company: Parsons Engineering Science
Client: AFCEE
Project: 731854.06
Location: Keesler AFB, BX Ser Sta
Test Date: 2/18/98
Test Well: MW8-3

AQUIFER DATA

Saturated Thickness: 17.1 ft
Anisotropy Ratio (Kz/Kr): 1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: MW8-3

X Location: 0 ft
Y Location: 0 ft

Observation Data

Time (min)	Displacement (ft)
0.	1.643
0.0033	1.606
0.0066	1.52
0.01	1.517
0.0133	1.419
0.0166	1.35
0.02	1.305
0.0233	1.236
0.0266	1.214
0.03	1.151
0.0333	1.109
0.0366	1.049
0.04	1.024
0.0433	0.967
0.0466	0.929
0.05	0.885
0.0533	0.847
0.0566	0.831
0.06	0.822
0.0633	0.787
0.0666	0.885

0.07	0.929
0.0733	0.907
0.0766	0.879
0.08	0.806
0.0833	0.714
0.0866	0.689
0.09	0.658
0.0933	0.566
0.0966	0.579
0.1	0.534
0.1033	0.528
0.1066	0.49
0.11	0.493
0.1133	0.449
0.1166	0.43
0.12	0.414
0.1233	0.392
0.1266	0.383
0.13	0.373
0.1333	0.36
0.1366	0.348
0.14	0.335
0.1433	0.319
0.1466	0.313
0.15	0.304
0.1533	0.297
0.1566	0.281
0.16	0.272
0.1633	0.272
0.1666	0.256
0.17	0.237
0.1733	0.24
0.1766	0.225
0.18	0.221
0.1833	0.215
0.1866	0.206
0.19	0.199
0.1933	0.196
0.1966	0.174
0.2	0.193
0.2033	0.177
0.2066	0.168
0.21	0.161
0.2133	0.155
0.2166	0.152
0.22	0.142
0.2233	0.142
0.2266	0.136
0.23	0.133
0.2333	0.123
0.2366	0.127

0.24	0.123
0.2433	0.12
0.2466	0.114
0.25	0.114
0.2533	0.108
0.2566	0.105
0.26	0.101
0.2633	0.108
0.2666	0.095
0.27	0.095
0.2733	0.092
0.2766	0.089
0.28	0.086
0.2833	0.082
0.2866	0.079
0.29	0.076
0.2933	0.076
0.2966	0.073
0.3	0.07
0.3033	0.07
0.3066	0.067
0.31	0.067
0.3133	0.063
0.33	0.054
0.3466	0.048
0.3633	0.044
0.38	0.035
0.3966	0.032
0.4133	0.029
0.43	0.026
0.4466	0.022
0.4633	0.019
0.48	0.016
0.4966	0.016
0.5133	0.013
0.53	0.013
0.5466	0.01
0.5633	0.01
0.58	0.007
0.5966	0.007
0.6133	0.007
0.63	0.007
0.6466	0.007
0.6633	0.003
0.68	0.003
0.6966	0.003
0.7133	0.003
0.73	0.003
0.7466	0.003
0.7633	0.003
0.78	0.003

0.7966	0.

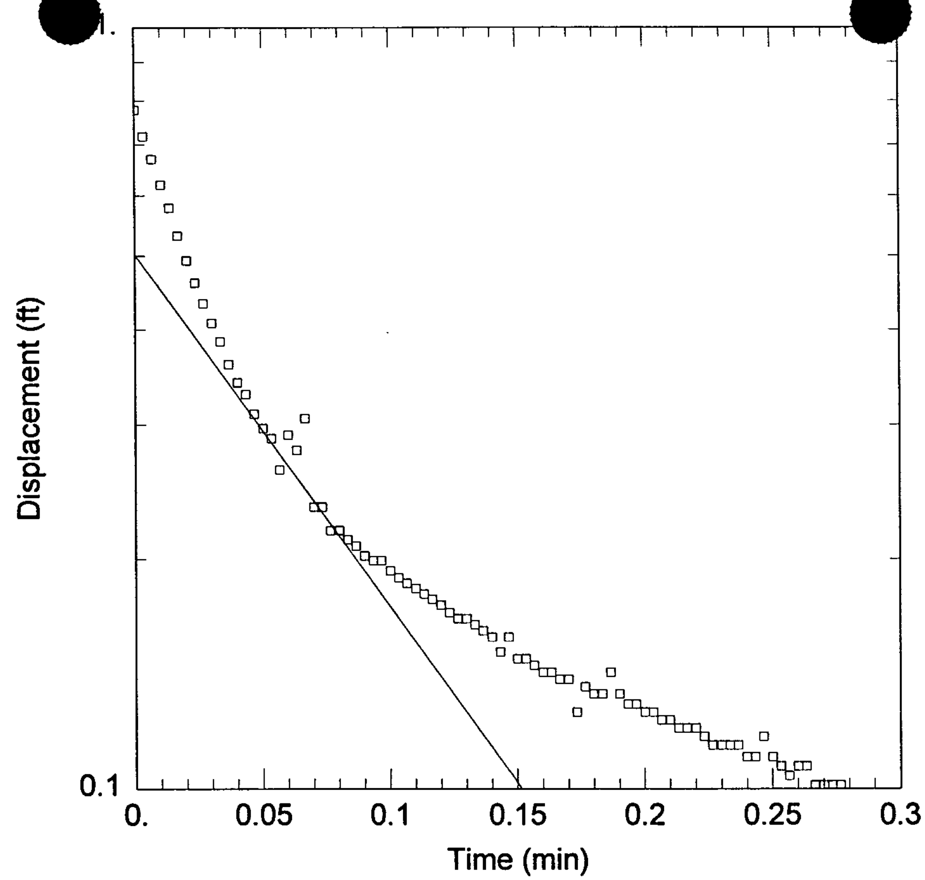
SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	29.04	ft/day
y0	0.9132	ft



MWA-9 WITHDRAWAL

Data Set: I:\KEE-AOCA\SLUGTEST\MWA-9WB.AQT
Date: 08/21/98 Time: 12:24:13

PROJECT INFORMATION

Company: Parsons Engineering Science
Client: AFCEE
Project: 731854.06
Test Location: Keesler AFB, BX Ser Sta
Test Well: MWA-9
Test Date: 2/18/98

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 44.85 ft/day
y0 = 0.5012 ft

AQUIFER DATA

Saturated Thickness: 15.88 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.778 ft
Casing Radius: 0.08333 ft
Screen Length: 15. ft
Water Column Height: 14.16 ft
Wellbore Radius: 0.3333 ft
Gravel Pack Porosity: 0.25

Data Set: I:\KEE-AOCA\SLUGTEST\MWA-9WB.AQT
Title: MWA-9 WITHDRAWAL
Date: 08/21/98
Time: 12:23:37

PROJECT INFORMATION

Company: Parsons Engineering Science
Client: AFCEE
Project: 731854.06
Location: Keesler AFB, BX Ser Sta
Test Date: 2/18/98
Test Well: MWA-9

AQUIFER DATA

Saturated Thickness: 15.88 ft
Anisotropy Ratio (Kz/Kr): 1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: MWA-9

X Location: 0 ft
Y Location: 0 ft

Observation Data

Time (min)	Displacement (ft)
0.	0.778
0.0033	0.718
0.0066	0.67
0.01	0.62
0.0133	0.578
0.0166	0.531
0.02	0.493
0.0233	0.461
0.0266	0.433
0.03	0.408
0.0333	0.386
0.0366	0.36
0.04	0.341
0.0433	0.329
0.0466	0.31
0.05	0.297
0.0533	0.288
0.0566	0.262
0.06	0.291
0.0633	0.278
0.0666	0.306

0.07	0.234
0.0733	0.234
0.0766	0.218
0.08	0.218
0.0833	0.212
0.0866	0.208
0.09	0.202
0.0933	0.199
0.0966	0.199
0.1	0.193
0.1033	0.189
0.1066	0.186
0.11	0.183
0.1133	0.18
0.1166	0.177
0.12	0.174
0.1233	0.17
0.1266	0.167
0.13	0.167
0.1333	0.164
0.1366	0.161
0.14	0.158
0.1433	0.151
0.1466	0.158
0.15	0.148
0.1533	0.148
0.1566	0.145
0.16	0.142
0.1633	0.142
0.1666	0.139
0.17	0.139
0.1733	0.126
0.1766	0.136
0.18	0.133
0.1833	0.133
0.1866	0.142
0.19	0.133
0.1933	0.129
0.1966	0.129
0.2	0.126
0.2033	0.126
0.2066	0.123
0.21	0.123
0.2133	0.12
0.2166	0.12
0.22	0.12
0.2233	0.117
0.2266	0.114
0.23	0.114
0.2333	0.114
0.2366	0.114

0.24	0.11
0.2433	0.11
0.2466	0.117
0.25	0.11
0.2533	0.107
0.2566	0.104
0.26	0.107
0.2633	0.107
0.2666	0.101
0.27	0.101
0.2733	0.101
0.2766	0.101
0.28	0.098
0.2833	0.098
0.2866	0.095
0.29	0.095
0.2933	0.095
0.2966	0.091
0.3	0.091

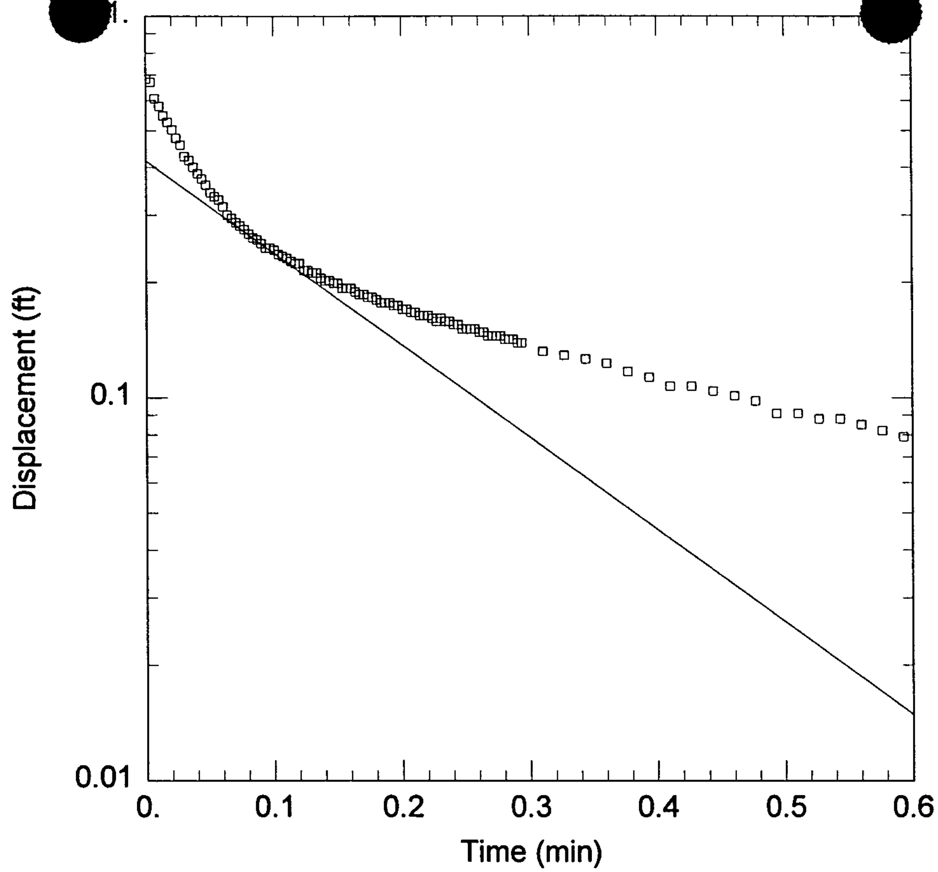
SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	44.85	ft/day
y0	0.5012	ft



MWA-11 WITHDRAWAL

Data Set: I:\KEE-AOCA\SLUGTEST\MWA-11WB.AQT
Date: 08/21/98 Time: 12:25:12

PROJECT INFORMATION

Company: Parsons Engineering Science
Client: AFCEE
Project: 731854.06
Test Location: Keesler AFB, BX Ser Sta
Test Well: MWA-11
Test Date: 2/19/98

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 45.26 ft/day
y0 = 0.4146 ft

AQUIFER DATA

Saturated Thickness: 17.19 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Initial Displacement: 0.683 ft
Casing Radius: 0.1667 ft
Screen Length: 15. ft
Water Column Height: 13.25 ft
Wellbore Radius: 0.4583 ft
Gravel Pack Porosity: 0.25

Data Set: I:\KEE-AOCA\SLUGTEST\MWA-11WB.AQT
Title: MWA-11 WITHDRAWAL
Date: 08/21/98
Time: 12:24:56

PROJECT INFORMATION

Company: Parsons Engineering Science
Client: AFCEE
Project: 731854.06
Location: Keesler AFB, BX Ser Sta
Test Date: 2/19/98
Test Well: MWA-11

AQUIFER DATA

Saturated Thickness: 17.19 ft
Anisotropy Ratio (Kz/Kr): 1

OBSERVATION WELL DATA

Number of observation wells: 1

Observation Well No. 1: MWA-11

X Location: 0 ft
Y Location: 0 ft

Observation Data

Time (min)	Displacement (ft)
0.	0.683
0.0033	0.67
0.0066	0.607
0.01	0.579
0.0133	0.547
0.0166	0.525
0.02	0.503
0.0233	0.477
0.0266	0.458
0.03	0.427
0.0333	0.417
0.0366	0.401
0.04	0.386
0.0433	0.373
0.0466	0.36
0.05	0.344
0.0533	0.335
0.0566	0.329
0.06	0.316
0.0633	0.3
0.0666	0.294

0.07	0.287
0.0733	0.281
0.0766	0.275
0.08	0.268
0.0833	0.262
0.0866	0.259
0.09	0.253
0.0933	0.246
0.0966	0.246
0.1	0.243
0.1033	0.237
0.1066	0.234
0.11	0.231
0.1133	0.227
0.1166	0.224
0.12	0.224
0.1233	0.215
0.1266	0.215
0.13	0.212
0.1333	0.212
0.1366	0.205
0.14	0.202
0.1433	0.202
0.1466	0.199
0.15	0.199
0.1533	0.193
0.1566	0.193
0.16	0.193
0.1633	0.189
0.1666	0.186
0.17	0.186
0.1733	0.183
0.1766	0.183
0.18	0.18
0.1833	0.177
0.1866	0.177
0.19	0.177
0.1933	0.174
0.1966	0.174
0.2	0.17
0.2033	0.17
0.2066	0.167
0.21	0.167
0.2133	0.164
0.2166	0.164
0.22	0.164
0.2233	0.161
0.2266	0.158
0.23	0.161
0.2333	0.158
0.2366	0.158

0.24	0.155
0.2433	0.155
0.2466	0.151
0.25	0.151
0.2533	0.151
0.2566	0.151
0.26	0.148
0.2633	0.148
0.2666	0.145
0.27	0.145
0.2733	0.145
0.2766	0.145
0.28	0.142
0.2833	0.142
0.2866	0.142
0.29	0.139
0.2933	0.139
0.31	0.132
0.3266	0.129
0.3433	0.126
0.36	0.123
0.3766	0.117
0.3933	0.113
0.41	0.107
0.4266	0.107
0.4433	0.104
0.46	0.101
0.4766	0.098
0.4933	0.091
0.51	0.091
0.5266	0.088
0.5433	0.088
0.56	0.085
0.5766	0.082
0.5933	0.079

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

VISUAL ESTIMATION RESULTS

Estimated Parameters

Parameter	Estimate	
K	45.26	ft/day
y0	0.4146	ft

APPENDIX E
USEPA IEUBK MODEL INPUT AND OUTPUT

LEAD MODEL Version 0.99d

AIR CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
Indoor AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 21.00 ug Pb/L
WATER Consumption: DEFAULT

SOIL & DUST:
Soil: constant conc.
Dust: Multiple Source Analysis

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	8.7	16.1
1-2	8.7	16.1
2-3	8.7	16.1
3-4	8.7	16.1
4-5	8.7	16.1
5-6	8.7	16.1
6-7	8.7	16.1

Additional Dust Sources: None DEFAULT
Soil contribution conversion factor: 0.70
Air contribution conversion factor: 100.0

PAINT Intake: 0.00 ug Pb/day DEFAULT

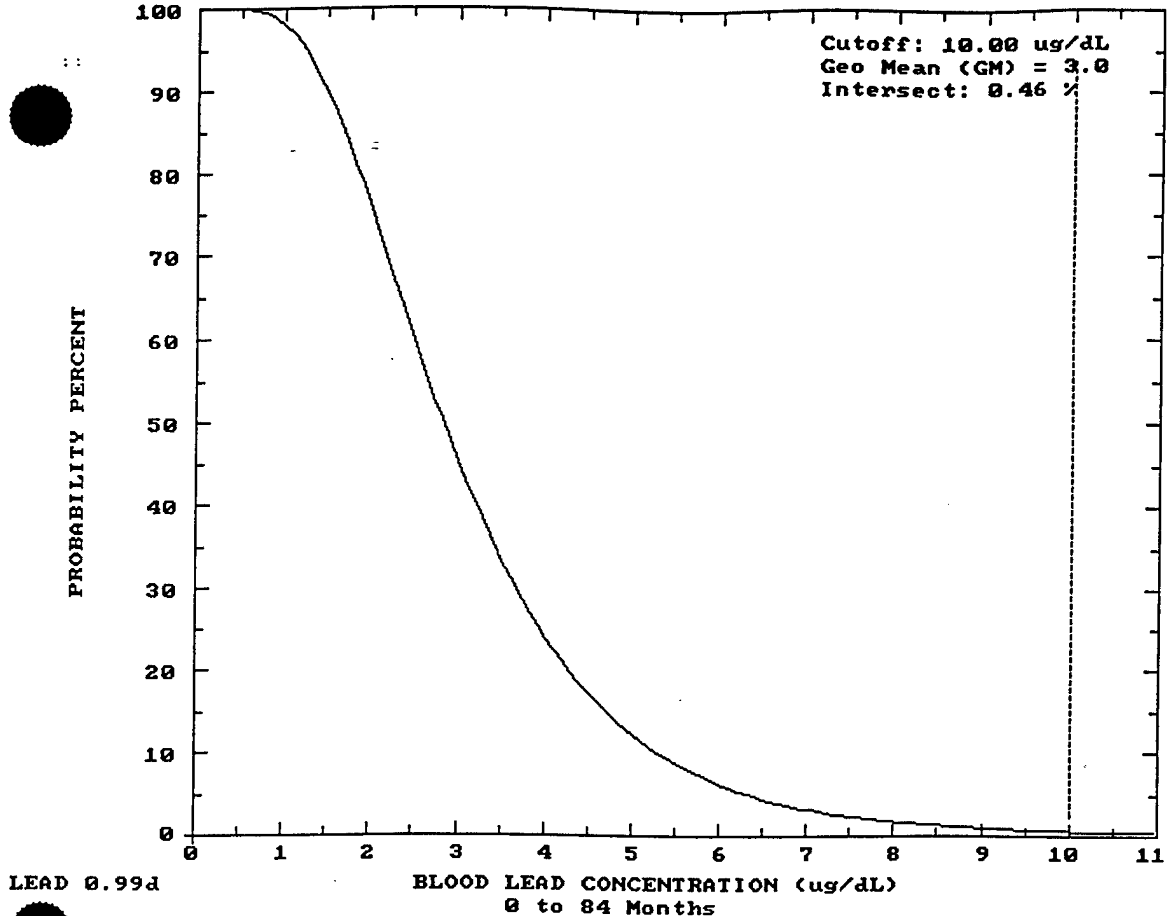
MATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	2.7	4.93	0.31
1-2:	3.3	8.10	0.48
2-3:	3.2	8.71	0.48
3-4:	3.1	8.77	0.49
4-5:	2.9	8.80	0.37
5-6:	2.8	9.28	0.33
6-7:	2.7	9.69	0.31

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	2.61	1.99	0.00	0.02

1-2:	2.69	4.89	0.00	0.03
2-3:	3.04	5.12	0.00	0.06
3-4:	2.95	5.27	0.00	0.07
4-5:	2.86	5.51	0.00	0.07
5-6:	3.03	5.82	0.00	0.09
6-7:	3.35	5.94	0.00	0.09


Cutoff: 10.00 ug/dL
Geo Mean (GM) = 3.0
Intersect: 0.46 %
PROBABILITY PERCENT
100
90
80
70
60
50
40
30
20
10
0
0
1
2
3
4
5
6
7
8
9
10
11
LEAD 0.99d
BLOOD LEAD CONCENTRATION (ug/dL)
0 to 84 Months