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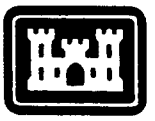
Final Report

Confirmation Study For the Former Forbes Atlas Missile Site S-5 Bushong, Kansas

Contract DACW41-87-D-0153
KC Project No. B07KS020400



US Army Corps of Engineers
Kansas City District

1991

O'BRIEN & GERE

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FINAL REPORT

CONFIRMATION STUDY
FORMER FORBES ATLAS MISSILE SITE S-5
BUSHONG, KANSAS
CONTRACT DACW41-87-D-0153

U.S. ARMY CORPS OF ENGINEERS
KANSAS CITY DISTRICT
KANSAS CITY, MISSOURI

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APRIL, 1991

TABLE OF CONTENTS

TABLE OF CONTENTS (*continued*)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

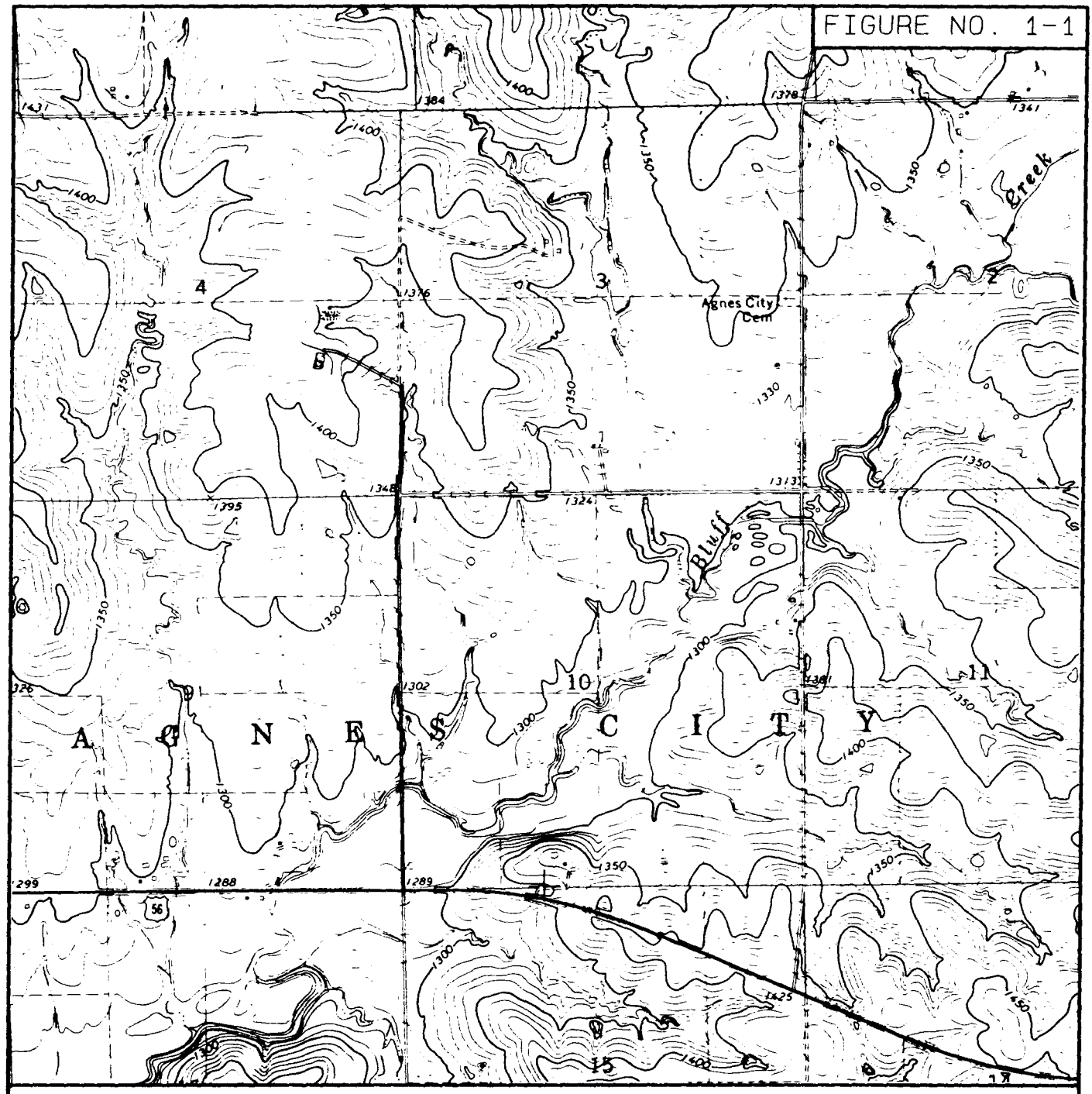
SECTION 1 - BACKGROUND

1.1 Project Background

The United States Army Corps of Engineers (USACE) contracted with O'Brien & Gere Engineers, Inc. (Contract No. DACW41-87-D-0153) to perform a Confirmation Study at the Former Forbes Atlas Missile Site S-5 in Bushong, Kansas (Figure 1-1). This report documents the investigation and evaluation performed during the Confirmation Study. The six sections of this report discuss the project and program background, site conditions, site investigation, analytical results, interpretations, and conclusions.

1.1.1 Overview of the Forbes Atlas Missile System

The Atlas Missile Program provided an important element of the United States defense system during a period of rapid evolution in intercontinental ballistic missile (ICBM) systems. However, this evolutionary period was short lived. Nine Atlas Missile facilities were assigned to the former Forbes Field Air Force Base in Topeka, Kansas. The Forbes Atlas Missile sites consisted of "coffin" type silos in which missiles were stored in the horizontal position. The horizontal missiles were hydraulically elevated to the vertical position for firing. These sites were operational from 1959 through 1965. By 1965, the Atlas Type "E" Missiles were obsolete and all remaining sites were deactivated. Records indicate that the missiles were returned to the U. S. Air Force, and the missile silo equipment was sold for salvage. During their operational period, the Atlas Missile sites may have contributed to environmental contamination from past activities such as fuel storage or maintenance.



FORMER FORBES ATLAS MISSILE SITE S-5 BUSHONG, KANSAS

TOPOGRAPHIC SITE LOCATION MAP

ADAPTED FROM U.S.G.S. (7.5 MIN)
BUSHONG QUADRANGLE
BUSHONG, KANSAS, 1971
SCALE 1"= 2,000'
CONTOUR INTERVAL 10 FEET

3068.020-03F

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1.1.2 Potential Contamination

The former Atlas Missile site activities and components which generated potential contaminants include:

- propellant storage;
- diesel fuel storage;
- hydraulic systems;
- maintenance products including petroleum, oil, lubricants, solvents, batteries, and paints;
- equipment operations;
- personnel; and,
- sanitary systems.

The propellant storage consisted of underground storage tanks (USTs) containing kerosene and liquid oxygen. Leakage of liquid oxygen would not have produced a toxic environmental condition. Due to the short operational period (less than six years), UST leakage due to deterioration during this period is unlikely. However, kerosene may have remained in the tank after the site was deactivated. Subsequent deterioration of the tank may have allowed the remaining kerosene to leak into the surrounding soil. Furthermore, spillage during tank filling, tank overfilling, and leaking piping or piping connections are other possible sources of contamination. Propellants were also stored within the missile and missile silo. Kerosene spillage within the silo would have been discharged through the silo discharge system to the silo exterior.

Diesel fuel was also stored in a UST at the missile site. Diesel fuel was supplied to the on-site generator to provide emergency power for control room and launch activities. At remote Atlas Missile sites where public electric power was not available, on-site

generators supplied normal operating power. As described in the preceding paragraph, tank leakage resulting from tank deterioration during the short operational period is unlikely; however, spillage during tank filling, tank overfilling, leaking piping or piping connections are possible sources of release. Furthermore, leakage of remaining product following site deactivation as a result of subsequent tank deterioration is another possible source of contamination.

Following the deactivation of the site, hydraulic fluid may have remained in the pressure lines, pumps, and cylinders. Subsequent deterioration of the hydraulic system may have allowed the remaining fluid to leak into the silo and, ultimately, into the environment.

The Atlas Missile sites contained hydraulic systems, pumps, generators, electronics, heating systems, ventilating systems, air conditioning, refrigeration, and other systems that required routine maintenance to maintain operational reliability. Maintenance activities included the use of solvents, petroleum, oil, and lubricants. Accidental spills of these materials may have led to environmental contamination.

Treatment of sanitary waste which was generated at the Forbes Atlas Missile Site S-5 consisted of two lagoon cells. Residual sludge which may contain elevated metals concentrations may be present on site within the former lagoon cells

The missile silo was equipped with sump pumps which removed any ground water which infiltrated into the silo. The water was apparently pumped to a drainage ditch which was located at such a distance from the silo to prevent interaction with silo backfill and the launch control center.

1.2 Program Background

The Department of Defense (DOD) conducts a number of industrial processes and manufacturing operations. In the late 1970's, the DOD became aware of the negative impacts of what were previously considered acceptable disposal practices of waste materials associated with these processes and operations. In response to that knowledge, programs were developed between 1975 and 1978 by each service division to identify and assess potential contamination on active military installations. However, only problems with active installations could be addressed because funds could not be spent on sites not owned by the DOD.

The passage of the 1984 Defense Appropriations Act (DAA) changed this situation. Specific language in the DAA directed the DOD to extend its efforts to include sites formerly used by the DOD. Additionally, the DAA broadened the definition of "hazard" to include structures and debris which were to be abandoned, or had been abandoned, upon termination of the military use of the site. The DAA directed that the Secretary of Defense assume overall management of the program to ensure consistent approach and adequate resource allocation to all projects. The Defense Environmental Restoration Account (DERA) was established to provide resources for the evaluation and characterization of potential chemical contamination at active and inactive installations. Specific areas targeted by the DAA include hazardous substances in waters, correction of other environmental damage, including unexploded materials disposal, demolition and removal of unsafe buildings and structures, and improving the DOD's hazardous waste operations.

Sites located on active DOD installations are being investigated under the Installation and Restoration Program (IRP). Investigations of sites either previously or presently owned by the DOD which are located on inactive DOD installations are conducted separately from the IRP efforts. The Atlas Missile sites are classified as non-IRP investigations. The two types of investigations consist of similar tasks, as described in the following paragraphs.

During an IRP investigation, a records search and site visit are conducted at an active installation to establish a list of potentially contaminated sites at the installation. A Hazard Ranking System (HRS) is developed to determine the order in which site investigations are to occur, based on environmental and/or public health risks. Similarly, non-IRP investigations consist of background research; however, the research is oriented to determine the ownership history of the site. Additionally, research into the demolition of structures previously used by the DOD are also conducted during a non-IRP investigation.

A Confirmation Study is performed during both types of investigations. The study consists of soil and water sampling and, in some instances, ground water monitoring well installations. The primary purposes of each study may differ, however. The purpose of a non-IRP Confirmation Study is to conduct a preliminary assessment of whether contamination exists at an inactive DOD installation and whether such contamination was caused by the DOD operations.

SECTION 2 - SITE CONDITIONS

2.1 Project Objectives

The Scope of Work (SOW) for this Confirmation Study is dated May 3, 1988. According to Item 2 of the SOW, the objective of this study is "to provide a preliminary determination of the presence or absence of chemical contamination which may have resulted from Department of Defense activities at the site". To fulfill this objective, O'Brien & Gere Engineers, Inc. (O'Brien & Gere) performed the following tasks:

- Conducted a preliminary site investigation to collect background information;
- Prepared a work plan and a safety plan;
- Installed and developed ground water monitoring wells (GMW #501 and GMW #502);
- Collected drill water samples;
- Collected and analyzed soil samples;
- Evaluated physical and chemical data;
- Prepared an engineering report including a hazard ranking system (HRS) report; and,
- Analyzed ground water samples.

The USACE performed the following tasks:

- Re-developed ground water monitoring wells;
- Collected ground water samples;
- Analyzed drill water samples.

Details of each of these tasks are presented in the following sections of this report and in the previously approved work and safety plans. This section of the report describes pertinent

background information including the results of the preliminary site investigation, site location and environmental features, land use, and a history of the property ownership.

2.2 Preliminary Site Investigation Summary

In accordance with Task No. 2 of the SOW, a preliminary site investigation was performed by Mr. David W. Cika, Mr. Gary W. Fern, P.E., Mr. A. J. Ramsey, Ms. Suzanne M. Riney, P.E., and Mr. Kurt J. Unnerstall of O'Brien & Gere in October, 1988. The following information was obtained during this investigation:

- The site is located at the SE 1/4, Sec. 4, T 16 S, R 10 E, approximately two miles west and three miles north of Bushong, Kansas in Lyon County. The site may be accessed from a north/south section road, on the east side of the site, off of Highway 56 (Figure 1-1).
- According to information obtained from USACE boring logs for the site, the surface geology at the site consists of four to nine feet of lean, fat, and organic fat clays, some very gravelly with cobbles. The bedrock material is limestone with alternating shales of the Chase and Council Grove Groups of Permian Age.
- According to information obtained from USACE boring logs for the site, shallow ground water is approximately three to ten feet below existing grade.
- Surface runoff is expected to flow from the immediate site area in a general north to northeast direction.
- The site is enclosed within a chain link security fence but the gate has been breached.

Runoff - drainage of water through surface stream

Drainage - the process of discharge of water from an area by stream, etc and removal of excess water from soil by downward flow

- The sliding steel door to the coffin silo at the end of the entrance ramp is slightly ajar and the door adjacent to the silo entrance can be opened to access the complex. Furthermore, two of the manholes are also accessible.
- Two sewage lagoons are located approximately 50 meters north of the northern fence line.
- Slab formations remain for the cooling tower, administration building and maintenance building.
- Underground structures at the site include the silo, a launch control facility and tunnel, and former water, liquid oxygen, kerosene, and diesel fuel underground storage tanks.

2.3 Site Geology and Environmental Features

Former Forbes Atlas Missile Site S-5, Bushong, Kansas, (Figure 1-1) lies within the eastern portion of the Flint Hill upland region of the Osage Plains physiographic province. In this region, bedrock is composed primarily of Permian and Pennsylvanian System sedimentary deposits. From the Flint Hills Upland region eastward in Kansas, outcropping Pennsylvanian and the overlying Permian rocks dip gently to the west and northwest with an average dip of 20 to 25 feet per mile.

Competent bedrock of the Permian System, Wolfcampian Series, Chase Group was encountered in all borings advanced with a drill rig at the site during this study. This corroborates background information supplied by the USACE indicating that limestones with alternating shales of the Chase and Council Grove Groups of the Permian Age underlie the site at depths from between four feet and nine feet below grade. The limestones and shales of the Chase Group are overlain by deposits of silty clays and clays containing weathered limestone and shale fragments and cobbles.

Information on depth to bedrock is understood to have been interpreted from pre-silo construction geotechnical boring logs for the site. The specific interpretation of the overburden/bedrock contact interface is subject to discussion since the upper weathered zones of the Permian Age formation tend to have cohesive "soil-like" properties and are penetrable with hollow-stem auger drilling methods.

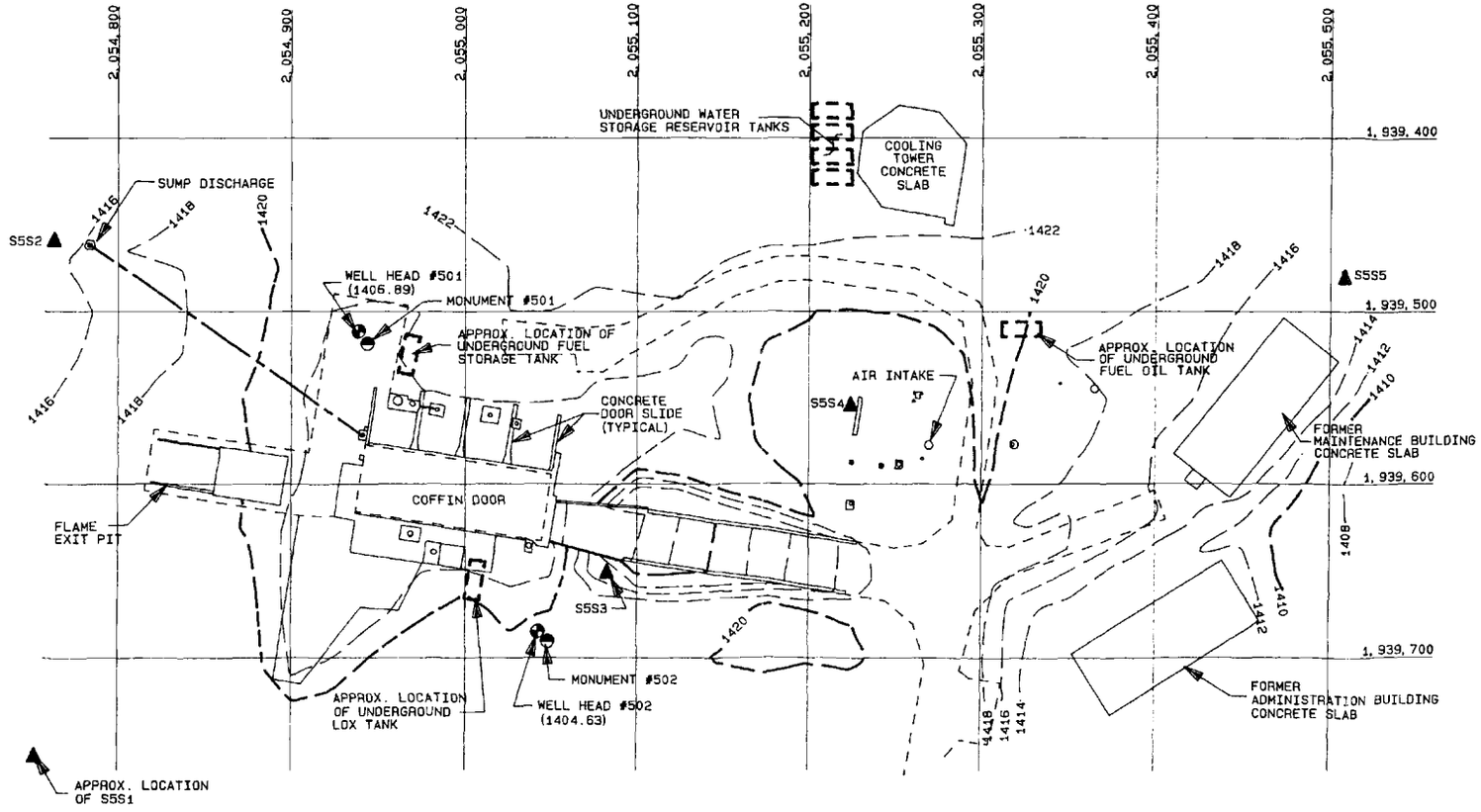
The surface soils at the site have been identified as the Labette silty clay loam and the Florence-Labette complex, according to the United States Department of Agriculture, Soil Conservation Service (SCS). The SCS has classified the Labette as a moderately sloping, well drained soil located on side slopes and the Florence-Labette complex as a gently sloping to strongly sloping, well drained soil on ridgetops and side slopes.

As part of the confirmation study, two shallow ground water monitoring wells were installed at the site under the direction of the USACE. Varying thicknesses of fill, clays, and weathered limestones and shales of the Chase Group were encountered in each of the borings. More complete and detailed sample and lithology descriptions are presented on the respective field test boring logs included as Appendix A. Well completion diagrams (Ground Water Monitoring Well Field Logs) are presented in Appendix B.

Shallow ground water in the study area investigated was initially encountered at depths from between 17.0 feet and 18.5 feet below ground surface in Permian shales of the Chase Group. USACE test boring data had placed shallow ground water at depths from between four feet and nine feet below grade. Ground water elevation data obtained from the monitoring wells is presented in Tables 3-6 and 3-7, and is represented on Figure No. 2-1.

ACHTER>USCOE>SITE.5

FIGURE NO. 2-1



NOTE:
SITE PLAN AND ELEVATIONS BASED ON TOPOGRAPHIC SURVEY PERFORMED BY FORGY SURVEYING, ON JULY 13, 1990.

LEGEND

- ▲ SHALLOW SOIL BORING LOCATION
- ◓ GROUND WATER MONITORING WELL LOCATION
- ◓ BRASS MONUMENT
- (1406.89) GROUND WATER ELEV. IN FEET AS MEASURED BY THE USACE ON OR AROUND 8/01/90.
- —1422— SURFACE ELEVATION

FORMER
FORBES ATLAS MISSILE
SITE S-5
BUSHONG, KANSAS

GROUND WATER ELEVATION MAP

SCALE: 1"=80'-0"

3068.020-04F

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The topography of the immediate site area is relatively uniform with relief generally less than 14 feet. The greatest change in elevation occurs north of the silo area where the grade drops approximately eight to ten feet. Surface drainage away from the immediate site area is generally in all directions but primarily to the east towards an intermittent tributary stream of Bluff Creek. Bluff Creek is located approximately one mile south of the site and flows along a general northeast to southwest direction.

2.4 Land Use

Land use in the immediate vicinity of the site is primarily agricultural. Specifically, the surrounding properties are used for grazing. An oil field is located approximately 2.2 miles south of the site. The estimated population within a one-mile radius of the site is approximately 8.25, based on a house count (assuming 2.75 persons per house) from the U. S. Geological Service, Bushong, Kansas 7.5 minute series topographic quadrangle map (1971). Bushong, Kansas is located approximately five miles southeast of the site. Council Groves, Kansas is located approximately 11 miles southwest of the site.

2.5 Ownership

Former Forbes Atlas Missile Site S-5, totaling 259.97 acres, was acquired by the DOD through fee, easements, and condemnation from 1959 through 1961. The former Forbes Field Air Force Base, now the Forbes Airport Authority, is located in Topeka, Kansas. Site S-5 was one of nine sites located near Topeka, Kansas which were collectively known as the Forbes Atlas Missile Complex.

The government began terminating the easements at site S-5 in 1965. In 1967, the current site, consisting of 24.55 acres, was conveyed to the City of Admire, Kansas. Flint Hills Development Corporation purchased the site on August 30, 1967 and then sold the site to Loren H. Hohman on April 6, 1983. The property was sold to George Nye, et ux, on April 6, 1983. The site is currently not being used.

SECTION 3 - SITE INVESTIGATION

3.1 Introduction

This section describes each aspect of the site investigation, including the work and safety plans; a sample numbering scheme; the soil sampling program, which includes sample locations and sampling procedures; monitoring well installations, including monitoring well locations and construction; monitoring well development; the water sampling program; and, the site survey.

3.2 Work Plan and Safety Plan

After the preliminary site investigation, the following work plan and safety plan were developed to describe planned site investigation procedures:

- Work Plan - Former Forbes Atlas Missile Site S-5 - Bushong, Kansas; and,

- Safety Plan - Former Forbes Atlas Missile Site S-5 - Bushong, Kansas.

These Plans were submitted to the Kansas City District Corps of Engineers for review and approval. Following approval, these Plans provided guidance for site investigation procedures, which began in May, 1990.

A brief outline of field techniques is presented in the following paragraphs along with field data gathered during the sampling program. A summary of the sampling program, including the sample types, the number of each sample type, the analytical parameters, and the sample containers is presented in Table 3-1. Specific details regarding field methods are presented in the previously approved work plan. A copy of the field log book is included as Appendix C of this report.

Table 3-1
Sampling Program
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Sample Matrix	Samples	Control Samples (1) QC (AE lab)	QA (USACE)	Total Samples	Analysis Parameters per Sample (2)	Sample Containers
A. Soil						
1. Geotechnical samples						
a. Field sample	4	-	-	4	Grain size distribution, moisture content, and Atterberg limits.	1-8 oz. widemouth glass
2. Analytical samples						
a. Field sample	5	-	-	5	Volatile Organics	2-4 oz. widemouth glass
b. Background sample	1	-	-	1	Polynuclear Aromatic Hydrocarbons (PAH)	1-8 oz. widemouth glass
c. Duplicate sample	-	1	1	2	Total Metals	1-8 oz. widemouth glass
B. Water						
1. Soil sampling						
a. Rinsate sample	-	1	1	2	Volatile Organics	2-40 ml. glass vials
b. Travel blank	-	1	1	2	Polynuclear Aromatic Hydrocarbons (PAH)	2-1 liter amber glass
					Total Metals	1-1000 ml. polyethelene
2. Drill water sampling						
a. Field sample	-	-	1	1	Volatile Organics	2-40 ml. glass vials
b. Travel blank	-	-	1	1	Polynuclear Aromatic Hydrocarbons (PAH)	2-1 liter amber glass
(3)					Total Metals	1-1000 ml. polyethelene
3. Ground water sampling						
a. Field sample	2	-	-	2	Volatile Organics	2-40 ml. glass vials
b. Duplicate sample	-	1	1	2	Polynuclear Aromatic Hydrocarbons (PAH)	2-1 liter amber glass
c. Rinsate sample	-	1	1	2	Total Metals	1-1000 ml. polyethelene
d. Travel blank	-	2	2	4		

Notes:

(1) QA sample containers were provided by CEMRD-ED-L.

(2) Each sample was analyzed for the parameters listed with the exception of the travel blanks. Travel blanks were analyzed for volatile organics only.

(3) The number of ground water QA samples are estimates based on the approved work plan. These samples were collected by the USACE.

3.3 Sample Numbering

Sample numbers represent the site name, sample matrix, and sample location. Soil sample numbers consist of four characters. The first two characters of each sample number represent the site name. In other words, "S5" corresponds to "Site S-5" which represents the Former Forbes Atlas Missile Site S-5. The third character of the sample number represents the sample matrix; "S" denotes a soil sample. The final numerical character in each soil sample number corresponds to the sample location number. Water sample numbers consist of six characters. The first three characters, "GMW", represent a ground water monitoring well sample. The fourth character represents the site name; "5" corresponds to "Former Forbes Atlas Missile Site S-5". The final two numerical characters in each water sample number correspond to the sample location number. Travel blank sample numbers consist of five characters. As with the soil sample numbers, the first two characters correspond to the site name. The third and fourth characters, "TB", stand for "Travel Blank". The final character in each travel blank sample number was used to differentiate between travel blank samples. During the ground water sampling expedition, the USACE collected an additional travel blank which was designated "Trip Blank". Quality Control samples are preceded by either a "D" (duplicate) or an "R" (rinsate). Quality Assurance samples are preceded by an "M" (duplicate) or an "MR" (rinsate). Table 3-2 summarizes the sample numbering scheme.

Table 3-2
Sample Numbering
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Sample Number	Sample Matrix	Description of Sample
S5S1	Soil	Soil sample number one (background sample).
S5S2	Soil	Soil sample number two.
S5S3	Soil	Soil sample number three.
S5S4	Soil	Soil sample number four.
S5S5	Soil	Soil sample number five.
S5S6	Soil	Soil sample number six.
* DS5S2	Soil	Duplicate of soil sample number two.
* RS5S2	Water	Rinsate sample for soil sample number two.
** MDS5S2	Soil	Duplicate of soil sample number two.
** MRS5S2	Water	Rinsate sample for soil sample number two.
** DW5	Water	Drill water sample.
GMW501	Water	Ground water monitoring well 501.
GMW502	Water	Ground water monitoring well 502.
* DGMW502	Water	Duplicate of ground water monitoring well 502.
* RGMW502	Water	Rinsate sample for ground water monitoring well 502.
** MDGMW502	Water	Duplicate of ground water monitoring well 502.
** MRGMW502	Water	Rinsate sample for ground water monitoring well 502.
S5TB1	Water	Travel blank number one.
S5TB2	Water	Travel blank number two.
Trip Blank	Water	Travel blank number three submitted by the USACE.

Notes:

* = Quality control sample sent to Southwest Laboratory of Oklahoma.

** = Quality Assurance sample sent to CEMRD-ED-L.

3.4 Soil Sampling Program

The soil sampling program at the Former Forbes Atlas Missile Site S-5 included samples collected for geotechnical analysis and samples collected for chemical analysis. The following paragraphs discuss the sampling procedures and locations.

3.4.1 Geotechnical Soil Sampling Procedures

Geotechnical soil sampling was performed during drilling procedures which occurred from May 22, 1990 through May 24, 1990. The boreholes for the ground water monitoring well installation were advanced with a Central Mine Equipment drilling rig (CME-55) supplied and operated by Layne-Western, Inc. Soil samples were obtained with a two-foot split spoon sampler according to ASTM D1586-84. Two samples from each boring were analyzed for grain size distribution, moisture content, and Atterberg limits.

3.4.2 Shallow Soil Sample Locations

Shallow soil samples were collected for chemical analysis in six locations at the site. Sample locations were outlined in the approved work plan for this project based on information obtained during the preliminary site investigation. Shallow soil sample locations are shown in Figures 3-1 and 3-2.

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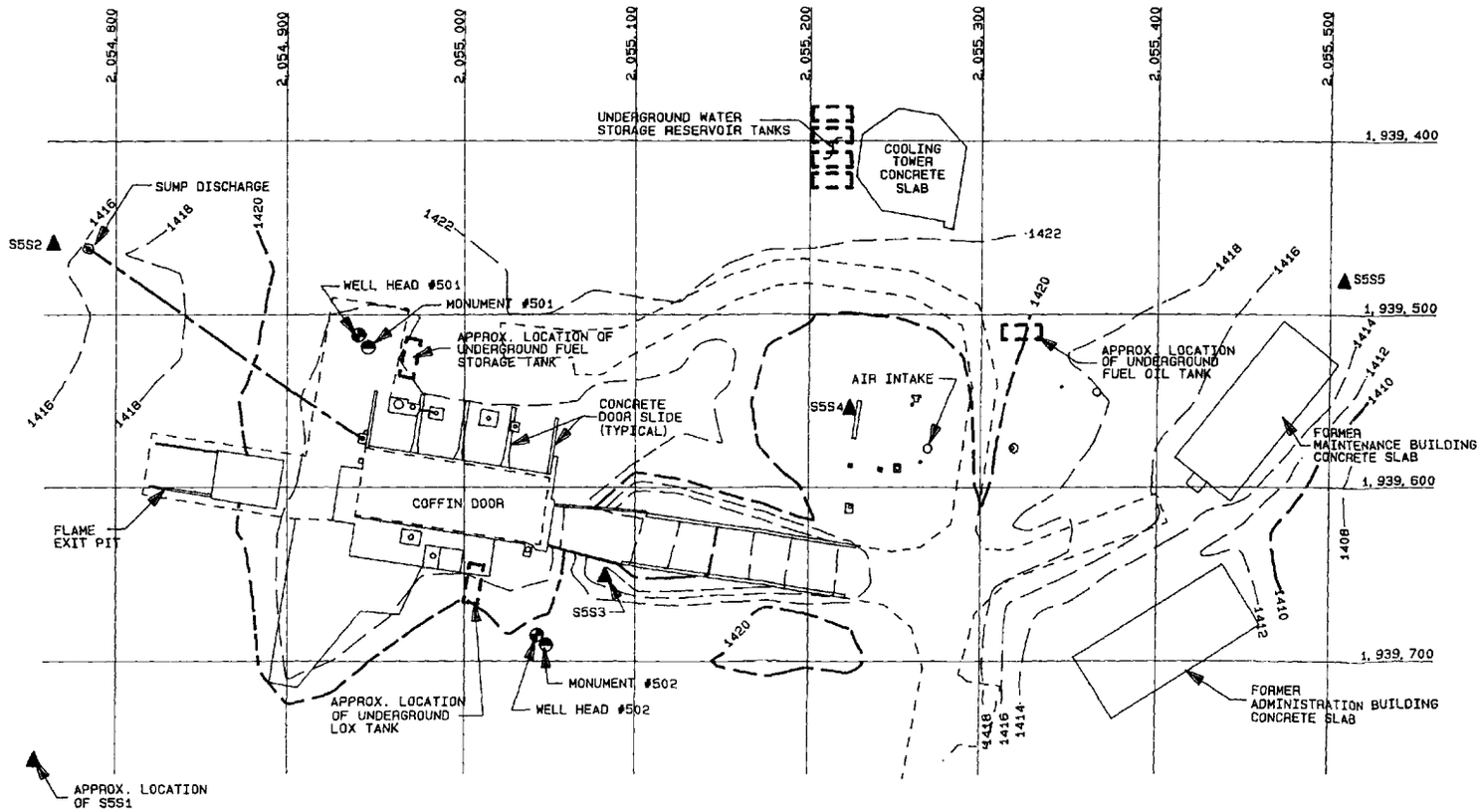
FIGURE NO. 3-1



NOTE:
SITE PLAN AND ELEVATIONS BASED ON TOPOGRAPHIC SURVEY PERFORMED BY FORGY SURVEYING, ON JULY 13, 1990.

LEGEND

- ▲ SHALLOW SOIL BORING LOCATION
- ◉ GROUND WATER MONITORING WELL LOCATION
- ⊖ BRASS MONUMENT

FORMER
FORBES ATLAS MISSILE
SITE S-5
BUSHONG, KANSAS

SITE PLAN

SCALE: 1"=80'-0"

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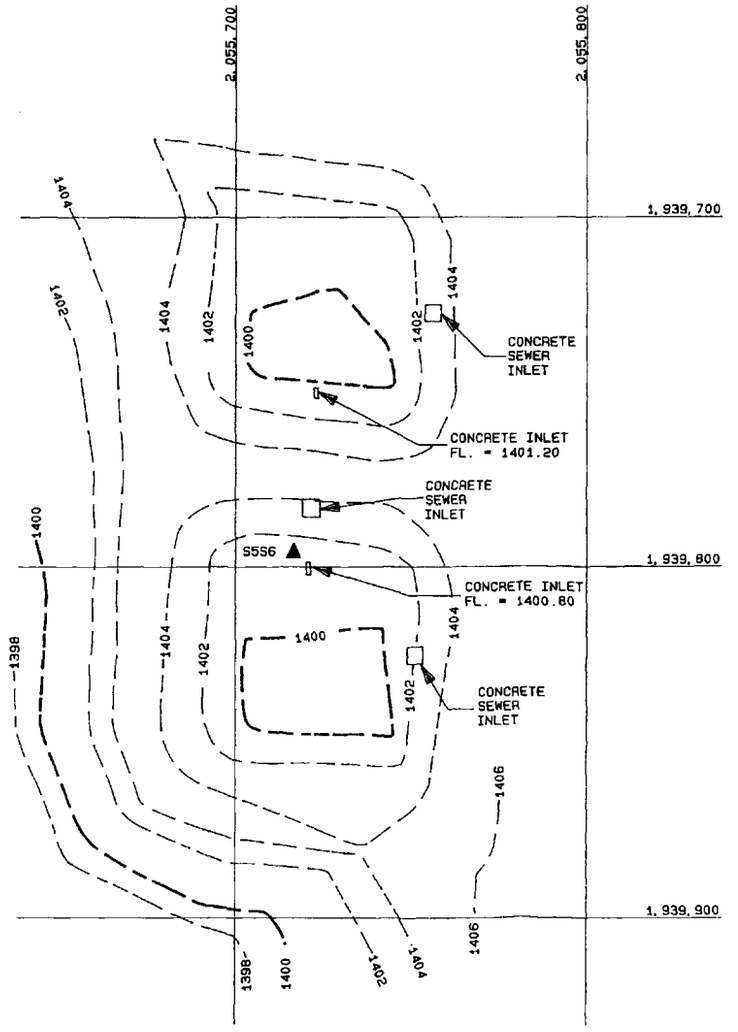
ACHTER>USCOE>SITE.5

FIGURE NO. 3-2



NOTE:
SITE PLAN AND ELEVATIONS BASED ON TOPOGRAPHIC SURVEY PERFORMED BY FORGY SURVEYING, ON JULY 13, 1990.

LEGEND

▲ SHALLOW SOIL BORING LOCATION

FORMER
FORBES ATLAS MISSILE
SITE S-5
BUSHONG, KANSAS

SITE PLAN "LAGOON CELLS"

SCALE: 1"=40'-0"

3068.020-02F

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3.4.3 Shallow Soil Sampling Procedures

Soil samples for chemical analyses were collected with a stainless steel hand auger at a depth of approximately one foot. Augering proceeded at each sampling location from the sampling depth (one foot) until sufficient soil had been collected for the required samples. The soil was emptied from the auger into a stainless steel bowl and then transferred to the sample containers. Specific sampling procedures are outlined in the previously approved work plan. Copies of Field Sampling Reports and Chain-of-Custody Records for soil samples are included as Appendix D of this report.

3.5 Monitoring Well Installation

Two shallow ground water monitoring wells (GMW #501 and GMW #502) were installed to assess specific subsurface areas at the Former Forbes Atlas Missile Site S-5. The wells were installed and completed according to the general guidelines set forth in the previously approved monitoring well installation plan which may be found in the previously approved work plan. The work plan originally outlined locations for three monitoring wells; however, during installation procedures, limestone bedrock was encountered in the location of monitoring well GMW #503. After approximately 43 hours, the borehole for GMW #503 remained dry. Therefore, an alternate location was selected for GMW #503; however, bedrock was again encountered and no shallow ground water entered the borehole. Therefore, after consultation with the USACE, the attempted installation of GMW #503 was abandoned at the direction of the USACE. The following sections briefly discuss monitoring well locations, construction, and development.

3.5.1 Monitoring Well Locations

The locations of the monitoring wells installed at the site (GMW #501 and GMW #502) are shown in Figure 3-1. Each location is discussed below:

- Monitoring Well GMW #501: Monitoring Well GMW #501 was installed west of the silo structure. The well was located to assess shallow ground water in the vicinity of the underground diesel fuel storage tank.
- Monitoring Well GMW #502: Monitoring Well GMW #502 was installed east of the silo structure to assess shallow ground water in the vicinity of the liquid oxygen tank and the area east of the silo structure.

3.5.2 Monitoring Well Construction

A CME-55 drill rig was used to advance the borings for ground water monitoring well construction. The rig was equipped with 3.75-inch inner diameter (ID), 6.5-inch outer diameter (OD) hollow stem augers. The Monitoring Well Installation Plan for Former Forbes Atlas Missile Site S-5 stated that all of the borings for the monitoring wells would be terminated after penetrating approximately 11 feet into the phreatic zone of the shallowest unconfined aquifer. In accordance with the installation plan, final penetration depths were determined in the field based on actual subsurface conditions in order to comply with conditions set forth in the SOW and in the previously approved work plan. These conditions included the prevention of possible inter-aquifer contamination. The total depths of each well are given in both the field test boring logs (Appendix A) and the ground water monitoring well field logs (Appendix B). The monitoring wells were constructed after completely drilling each borehole. The monitoring wells were constructed within each borehole with the following materials: new, commercially fabricated, threaded, "O" ring

sealed, flush joint, No. 10 machine slot (0.010 inch) 2-inch ID, Schedule 40 polyvinylchloride (PVC) screen; new, threaded, "O" ring sealed flush joint, 2-inch ID, Schedule 40 PVC solid riser pipe and cap; non-carbonate silica sand; bentonite pellets, grout mixture (cement, bentonite, and water); steel security box cover with lock; and protective steel posts. A concrete pad (three feet by three feet by four inches thick) was constructed around each well and a brass monument cap was set in the surface of each pad.

The monitoring wells were constructed from May 22, 1990 through June 7, 1990. The boring at each well was advanced with the hollow stem augers. Split spoon soil samples were collected from each borehole using a two-foot split spoon sampler according to ASTM D1586-84. The borings were advanced beyond the phreatic zone of the shallowest aquifer encountered until auger refusal was encountered at a competent layer of limestone bedrock at each boring location. Upon completion of the borings, the 2-inch PVC screens and risers were then assembled and placed inside the augers at each boring location. The sand pack and bentonite pellets were placed within the annular space between the auger casing and the PVC casing through a tremie pipe. A stainless steel centralizer was installed on the riser at each location. The augers were removed from the boreholes. At each location, the bentonite pellets were wetted every ten minutes for 30 minutes and hydration was allowed to continue for at least eight hours. A cement-bentonite grout mixture was placed on top of the bentonite seal through a tremie pipe and allowed to cure for a minimum of 48 hours before beginning well development. Finally, the well completion system, consisting of the concrete pad, steel security box cover, and steel posts, was constructed at each well location. Table 3-3 lists pertinent information on well construction details.

Table 3-3
Well Construction Data
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Well Number	Boring Depth (1) (feet)	Screened Interval (1) (feet)	Sand Pack (2) (feet)	Bentonite Seal (2) (feet)	Grout Interval (2) (feet)	Construction Date
GMW #501	24.3	13.3-23.3	14.3	2.7	7.3	05/23/90
GMW #502	21.5	10.5-20.5	12.5	2.5	6.5	05/22/90

Notes:

(1) Depth below ground surface.

(2) Length of material in well column.

Copies of the field test boring logs, ground water monitoring well field logs, and field log book are included as Appendices A, B, and C, respectively. The field log book contains records of daily activities as entered by the site geologist. The field test boring logs show relevant stratigraphic data on borings for each well and the total depth of each boring. Ground water monitoring well field logs document well construction information including quantities and types of materials used.

3.5.3 Monitoring Well Development

Development of monitoring wells GMW #501 and GMW #502 occurred from June 2, 1990 until June 7, 1990. The purpose of well development was to remove fine particles, such as silt and clay, that were introduced into the well during the drilling process, and to improve the hydraulic connection between the aquifer and the well. Each well was developed by surging with surge equipment provided by Layne Western, Inc., and by manually bailing with a stainless steel bailer. Well development data are summarized in Table 3-4.

Field measurements included the following: the depth to static water level in each well; the depth to the bottom of each well; quantity of standing water in each well (including the saturated sand pack interval); water quality data including pH, specific conductance, and temperature measurements; physical characteristics of the water in each well; development equipment; surge techniques; and, the quantity of water removed from each well. The well development data sheets (Appendix E) list measurements of water quality during different stages of well development that are used to evaluate development conditions. No significant variations in these parameters were noted during well development. The final measurements of pH, specific conductance, and temperature are presented in Table 3-5.

Table 3-4
Well Development Data
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Well Number	Method of Development (1)	Quantity of Water in Well (gallons) (2)	Quantity of Water Removed from Well (gallons)	Duration of Surging (hours)	Duration of Bailing (hours)	Turbidity	Development Dates
GMW #501	Surging, bailing	5.9	38.0	1.00	1.67	Moderate	06/02/90 - 06/07/90
GMW #502	Surging, bailing	4.9	36.0	1.00	2.15	Moderate	06/02/90 - 06/07/90

← numbers (T 3-5)

Notes:

(1) The monitoring wells were developed using two techniques:
(a) Surging with 5.0 ft. of AW drill rod attached to a surge block with neoprene seals.
(b) Bailing with a 4.0 ft. long, 1-1/2" outside diameter, bottom check ball valve discharge PVC bailer with poly rope.

(2) Quantity of water in well casing and saturated annulus.

Table 3-5
Ground Water Quality Measurements
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Well Number	pH	Specific Conductance (umhos/cm)	Temperature (C)	Date
GMW #501	7.17	610	19.0	06/07/90
GMW #502	7.01	710	18.5	06/07/90

Note:

All measurements reflect final instrument readings at the end of well development.

3.6 Water Sampling Program

The water sampling program at the Former Forbes Atlas Missile Site S-5 included samples of drill water and shallow ground water which were collected for chemical analyses. The following paragraphs discuss the sampling procedures.

3.6.1 Drill Water Sampling Procedures

Water used during drilling procedures and for decontamination of drilling equipment was obtained from the City of Bushong, Kansas. The water was sampled directly from the tank which was mobilized to the site by Layne Western Company, Inc.

3.6.2 Ground Water Sampling Procedures

The shallow ground water monitoring wells at Former Forbes Atlas Missile Site S-5 were sampled in two phases. During the first phase, O'Brien & Gere mobilized to the site on August 1, 1990. Static water level measurements in each well were made during this phase. These measurements are summarized in Table 3-6. Based on these measurements, the volume of water in each well was calculated. A volume of water equal to five times the actual volume of water in each well was removed from each well using a stainless steel bailer. Water quality measurements including pH, specific conductance, and temperature were obtained throughout the bailing procedures. These measurements are summarized in Table 3-6. After the five well volumes were removed from each well, sampling procedures were terminated. The USACE returned to the site on August 21, 1990 to perform final sampling of the wells. During this sampling expedition, the monitoring wells were re-developed with a surge block and teflon bailer. A copy of the USACE field report is

included in Appendix F. Table 3-7 summarizes the USACE well re-development data generated during the sampling expedition from August 21 through August 30, 1990. Table 3-8 summarizes the USACE ground water measurements taken during the sampling expedition.

3.7 Site Survey

Well-head casing elevations at the Former Forbes Atlas Missile Site S-5 were surveyed by Forgy Surveying in June, 1990. Top of casing well-head elevations are presented in Table 3-6 and Table 3-8. A vertical control was set by using the triangulation station (STING) brass disk located at the silo entrance. The datum benchmark elevation is 1425.59. In addition, shallow soil sample locations were identified on the survey. The site survey has been included in this report as Appendix G.

Table 3-6
Ground Water Level Summary
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Well Number	TOC (1) (feet)	Depth to Ground Water Surface (feet below TOC)	Ground Water Elevation (feet)	Date	Coordinates (2) North	East
GMW #501	1425.19	18.30	1406.89	08/01/90	2054941.77	1939515.76
GMW #502	1421.90	17.27	1404.63	08/01/90	2055046.28	1939686.34

Notes:

(1) TOC - Top of well casing elevation based on bench mark elevation at triangulation station "STING" referenced on the Site Survey in Appendix G.

(2) Coordinates based on State Plane Coordinates referenced on the Site Survey in Appendix G.

Table 3-7
USACE Well Re-development Data
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Well Number	Method of Re-development (1)	Quantity of Water in Well (gallons) (2)	Quantity of Water Removed from Well (gallons)	Duration of Surging and Bailing (hours)	Turbidity	Development Dates
GMW #501	Surging, bailing	3.0	11.0	2.25	Some	08/21/90 - 08/30/90
GMW #502	Surging, bailing	1.6	16.0	2.18	Some	08/21/90 - 08/30/90

Notes:

(1) The monitoring wells were developed using two techniques:
(a) Surging with a CME 55 drill rig with an attached two-inch diameter 15-foot surge block.
(b) Bailing with a two-inch teflon bailer and teflon line.

(2) Quantity of water in well casing and saturated annulus.

Table 3-8
USACE Ground Water Measurements
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Well Number	TOC (1) (feet)	Depth to Ground Water Surface (feet below TOC)	Ground Water Elevation (feet)	Date (2)	pH (3)	Specific Conductance (3) (umhos/cm)	Temperature (3) (C)
GMW #501	1425.19	18.60	1406.59	08/21/90	7.17	730	17
GMW #502	1421.90	17.90	1404.00	08/21/90	7.15	880	22

Notes:

(1) TOC - Top of well casing elevation based on bench mark elevation at triangulation station "STING" referenced on the Site Survey in Appendix G.

(2) Assumed date. USACE re-development and sampling efforts at Site S-5 began on 08/21/30.

(3) All measurements reflect final instrument readings at the end of re-development.

SECTION 4 - ANALYTICAL RESULTS

4.1 Geotechnical Analytical Results

During the ground water monitoring well installations, soil samples were collected for geotechnical analyses. Two samples were collected from each borehole and analyzed for grain size distribution, moisture content, and Atterberg limits. Table 4-1 summarizes the analytical results. A copy of the laboratory report is included in this report as Appendix H.

4.2 Soil Analytical Results

Shallow soil samples were collected at six locations at the Former Forbes Atlas Missile Site S-5 (Figure 3-1). Soil samples were analyzed for volatile organics, polynuclear aromatic hydrocarbons, and total metals. The analytical methods performed are listed in Table 4-2.

The results of the soil sample analyses are summarized in Table 4-3. A copy of the laboratory report is included in this report as Appendix I. Five volatile organics were detected. Acetone was detected in samples S5S3 and DS5S2. The greatest concentration of acetone, 0.010 milligrams per kilogram (mg/kg), was detected in sample DS5S2. A chloroform concentration of 0.002 mg/kg was estimated in samples S5S2, S5S3, S5S4, S5S6, DS5S2, and S5TB1 (0.002 milligrams per liter). Methylene chloride was detected in every sample. Sample DS5S2, a duplicate of sample S5S2, registered the greatest concentration of methylene chloride at 0.036 mg/kg. Sample S5S2 registered 0.033 mg/kg of methylene chloride. Toluene was detected in the rinsate sample, RS5S2, at an estimated concentration of 0.001 mg/kg. Trichloroethene (trichloroethylene) was detected in sample DS5S2 at a concentration of 0.010 mg/kg.

One semi-volatile organic, naphthalene, was detected in sample DS5S2. The estimated concentration of naphthalene was 0.071 mg/kg.

Table 4-1
Geotechnical Analytical Results
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Sample Number	Sample Interval (feet)	Percentage Sand (%)	(1) Unified Soil Classification	Moisture Content (%)	Atterberg Limits LL	PL	PI
GMW501	3.0-5.0	61	ML	27.0	48	30	18
GMW501	19.0-21.0	75	MH	19.7	58	38	20
GMW502	4.0-6.0	65	CH	27.0	51	22	29
GMW502	8.0-10.0	56	CH	16.4	36	20	16

Notes:

(1) Based on laboratory analysis and USC Plasticity Chart.

(2) LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index (PI=LL-PL)

Table 4-2
Analytical Methods for Soil Samples
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Parameter	Method (1)	Detection Limit (mg/kg) (2)
Volatile Organics	8240	0.0050-0.0100
Semi-Volatile Organics	8270	0.6600
Metals		
Arsenic	7060	2.0
Barium	6010	4.0
Cadmium	6010	1.0
Chromium	6010	1.0
Lead	6010	0.6-4.0
Mercury	7471	0.1-0.2
Selenium	7740	1.0
Silver	6010	2.0

Notes:

(1) Source: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846, Third Edition, November, 1986.

(2) Detection limits are for Southwest Laboratory of Oklahoma, Inc., for soil samples only. See Appendix A for detection limits for rinsate and travel blank samples.

Table 4-3
Summary of Positive Analytical Results
for Soil Samples
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Results in mg/kg
Sampled 05/23/90

Parameter	Sample Designation								
	S5S1	S5S2	S5S3	S5S4	S5S5	S5S6	DS5S2	RS5S2 *	S5TB1 *
Volatile Organics									
Acetone	BDL	BDL	0.002 BJ	BDL	BDL	BDL	0.010 B	BDL	BDL
Chloroform	BDL	0.002 BJ	0.002 BJ	0.002 BJ	BDL	0.002 BJ	0.002 BJ	BDL	0.002 J
Methylene Chloride	0.015 B	0.033 B	0.022 B	0.021 B	0.011 B	0.017 B	0.036 B	0.008 B	0.017 B
Toluene	BDL	BDL	BDL	BDL	BDL	BDL	BDL	0.001 J	BDL
Trichloroethene	BDL	BDL	BDL	BDL	BDL	BDL	0.010	BDL	BDL
Semi-Volatile Organics									
Naphthalene	BDL	BDL	BDL	BDL	BDL	BDL	0.071 J	BDL	NA
Metals									
Arsenic	6.7	3.6	5.3	4.9	4.7	BDL	3.2	BDL	NA
Barium	134	129	179	2180	152	76.6	155	BDL	NA
Cadmium	BDL	1.3	BDL	BDL	BDL	BDL	1.4	BDL	NA
Chromium	18.9	12.6	14.7	15.7	11.7	20.8	13.1	BDL	NA
Lead	23.0	41.6	33.0	19.8	18.8	12.0	63.8	BDL	NA

Notes:

* = Results in mg/l
BDL = Below Detection Limit
B = Analyte detected in the method blank as well as in the sample
J = Estimated value of concentration below detection limit
NA = Not Analyzed

Concentrations of five metals exceeded the detection limits. Arsenic was detected in samples S5S1, S5S2, S5S3, S5S4, S5S5, and DS5S2. The background sample, S5S1 exhibited the greatest concentration of 6.7 mg/kg. Barium was detected in all of the samples except the rinsate sample, RS5S2. A barium concentration of 2,180 mg/kg was detected in sample S5S4. Cadmium was detected in samples S5S2 and the duplicate of sample S5S2, sample DS5S2, at concentrations of 1.3 mg/kg and 1.4 mg/kg, respectively. Chromium was detected in all of the samples except the rinsate sample, RS5S2. Sample S5S6 registered the greatest concentration of chromium at 20.8 mg/kg. Lead was also detected in all of the samples except the rinsate sample RS5S2. The greatest concentration of lead, 63.8 mg/kg, was detected in sample DS5S2, the duplicate of sample S5S2. Sample S5S2 exhibited the second greatest lead concentration of 41.6 mg/kg.

4.3 Drill Water Analytical Results

Drill water samples were submitted to the USACE Missouri River Division Laboratory. The analytical results for these samples may be inserted into Appendix J of this report.

4.4 Ground Water Analytical Results

Two ground water monitoring wells were installed and sampled in accordance with the general guidelines set forth in the SOW and the previously approved work plan. Copies of the Chain-of-Custody Records for ground water samples are included as Appendix K of this report. Ground water samples were analyzed for volatile organics, semi-volatile organics, and total metals. The analytical methods performed are listed in Table 4-4.

Table 4-4
Analytical Methods for Water Samples
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Parameter	Method (1)	Detection Limit (mg/l) (2)
Volatile Organics	8240	0.0050-0.0100
Semi-Volatile Organics	8270	0.0100-0.0125
Metals		
Arsenic	7060	0.0100
Barium	6010	0.0200
Cadmium	6010	0.0050
Chromium	6010	0.0050
Lead	6010	0.0300
Mercury	7470	0.0002
Selenium	7740	0.0050
Silver	6010	0.0100

Notes:

(1) Source: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846, Third Edition, November, 1986.

(2) Detection limits are for Southwest Laboratory of Oklahoma, Inc.

The results of the ground water sample analyses are summarized in Table 4-5. Copies of the laboratory reports are included as Appendix L of this report. Five volatile organics were detected. An acetone concentration of 0.004 milligrams per liter (mg/l) was estimated in the rinsate sample, RGMW502, and the travel blank, S5TB2. A concentration of bromodichloromethane of 0.002 mg/l was estimated in the rinsate sample, RGMW502 and the sample designated "Trip Blank". Chloroform was detected in the rinsate sample RGMW502 and the sample designated "Trip Blank" at concentrations of 0.054 mg/l and 0.040 mg/l, respectively. Trans-1,2-dichloroethene was detected in samples GMW502 and DGMW502 at concentrations of 0.098 mg/l and 0.104 mg/l, respectively. Trichloroethene (trichloroethylene) was also detected in ground water samples GMW502 and DGMW502 at concentrations of 0.076 mg/l and 0.085 mg/l, respectively. A trichloroethene concentration of 0.002 mg/l was estimated in sample GMW501.

No semi-volatile organic compounds were detected in any of the ground water samples.

Three metals were detected. Barium was detected in samples GMW501, GMW502, and DGMW502, at concentrations of 0.134 mg/l, 0.234 mg/l, and 0.235 mg/l, respectively. Chromium was detected in samples GMW502 and DGMW502 at concentrations of 0.021 mg/l and 0.019 mg/l, respectively. A lead concentration of 0.045 mg/l was detected in sample GMW501.

Table 4-5
Summary of Positive Analytical Results
for Ground Water Samples
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Results in mg/l
Sampled 08/21/90 - 08/30/90

Parameter	Sample Designation					
	GMW501	GMW502	DGMW502	RGMW502	S5TB2	Trip Blank
Volatile Organics						
Acetone	BDL	BDL	BDL	0.004 J	0.004 J	BDL
Bromodichloromethane	BDL	BDL	BDL	0.002 J	BDL	0.002 J
Chloroform	BDL	BDL	BDL	0.054	BDL	0.040
Trans-1,2-Dichloroethene	BDL	0.098	0.104	BDL	BDL	BDL
Trichloroethene	0.002 J	0.076	0.085	BDL	BDL	BDL
Metals						
Barium	0.134	0.234	0.235	BDL	NA	NA
Chromium	BDL	0.021	0.019	BDL	NA	NA
Lead	0.045	BDL	BDL	BDL	NA	NA

Notes:

BDL = Below Detection Limit
J = Estimated value of concentration below detection limit
NA = Not Analyzed

4.5 Quality Assurance/Quality Control Results

Quality Assurance/Quality Control (QA/QC) procedures for this project are defined in the previously approved work plan. QA/QC procedures are established for sampling methods, testing procedures, and documentation of control and organizational responsibility. QA/QC samples were sent to both Southwest Laboratory of Oklahoma, Inc. (SWLO) and the U. S. Army Corps of Engineers Missouri River Division Laboratory (CEMRD-ED-L). The analytical results for samples sent to CEMRD-ED-L may be attached to this report as Appendix M. The remainder of this section discusses only those samples sent to SWLO.

Five types of QA/QC samples were analyzed by the laboratory for soil and water samples. These types of samples consisted of duplicate, replicate, spike, rinsate, and blank samples. In addition to these types of samples, the laboratory has established internal QA samples which are used to analyze method controls, instrument calibration, and internal QA procedures. Complete analytical results, including QA/QC results, are included in this report in Appendices I and L.

A duplicate sample is a sample which is collected at the same location as one of the field samples. A duplicate sample is submitted to the laboratory for analysis as a separate sample. The duplicate soil sample, DS5S2, was collected at the location of sample S5S2. Although acetone and trichloroethene were not detected in sample S5S2, 0.010 mg/kg of these volatile organic compounds were detected in the duplicate sample, DS5S2. A concentration of 0.002 mg/kg of chloroform was estimated for both samples S5S2 and DS5S2. Methylene chloride was detected in both samples S5S2 and DS5S2 at concentrations of 0.033 mg/kg and 0.036 mg/kg, respectively. Although naphthalene was not detected in sample S5S2, 0.071 mg/kg of naphthalene was detected in the duplicate sample DS5S2. No other semi-volatile organics were detected in either sample. Similar concentrations of metals were detected in samples S5S2 and DS5S2. Arsenic registered 3.6 mg/kg in sample S5S2 and 3.3 mg/kg in sample DS5S2. Cadmium concentrations of 1.3 mg/kg and 1.4

mg/kg were detected in samples S5S2 and DS5S2, respectively. Chromium was detected in samples S5S2 and DS5S2 at concentrations of 12.6 mg/kg and 13.1 mg/kg, respectively. The concentrations of barium and lead varied slightly more between samples S5S2 and DS5S2. Barium was detected in sample S5S2 at a concentration of 129 mg/kg whereas 155 mg/kg of barium were detected in sample DS5S2. Lead was detected in samples S5S2 and DS5S2 at concentrations of 41.6 mg/kg and 63.8 mg/kg, respectively. In general, the concentrations of each constituent in samples S5S2 and DS5S2 are of the same magnitude considering the heterogeneous nature of soils in Kansas, which may produce a wide range of analytical results.

The duplicate ground water sample, DGMW502, was collected at the same location as GMW502. Trans-1,2-dichloroethene was detected in samples GMW502 and DGMW502 at concentrations of 0.098 mg/l and 0.104 mg/l, respectively. Trichloroethene was detected in sample GMW502 at a concentration of 0.076 mg/l, and in sample DGMW502 at a concentration of 0.085 mg/l. No semi-volatile organics were detected in either sample. Barium was detected in samples GMW502 and DGMW502 at concentrations of 0.234 mg/l and 0.235 mg/l, respectively. Chromium concentrations of 0.021 mg/l and 0.019 mg/l were detected in samples GMW502 and DGMW502, respectively.

Replicate samples are portions of a single field sample which is split either upon arrival at the laboratory or just prior to analysis. These portions, in addition to the field sample, are analyzed as separate samples. The matrix spike and matrix spike duplicate are two replicate samples.

In matrix spike and matrix spike duplicate samples, known quantities of certain analytes are added to a sample prior to sample extraction and analysis. The sample is split into replicates, spiked and analyzed. The objective of spiking is to determine the extent of interference on analyte recovery and precision from one sample to the next. Percent recoveries are calculated for each analyte detected in the samples. The relative percent difference between the samples is then

calculated. These results are used to assess analytical precision. The analytical results for the matrix spike and matrix spike duplicate samples are summarized in Table 4-6.

All samples to be analyzed by the laboratory are spiked with one or more surrogate compounds prior to extraction and analysis. A surrogate compound is an organic compound which is similar to the analytes in chemical composition, extraction, and chromatography, but which is not normally found in a field sample (EPA, November, 1986). Percent recoveries are calculated for each surrogate compound in each sample. The surrogate compounds used for the volatile organics analyses were toluene-d8, bromoflourobenzene, and 1,2-dichloroethane-d4. With the exception of sample DS5S2, the percent recoveries for these compounds in all soil and ground water samples were within the advisory limits established by the EPA (EPA, November, 1986). The percent recovery for toluene-d8 was above the EPA advisory limit, and the percent recovery for bromoflourobenzene was below the EPA advisory limit in sample DS5S2. The surrogate compounds used for the semi-volatile organics analyses were nitrobenzene-d5, 2-flourobiphenyl, and terphenyl-d14. The percent recoveries for these compounds in all soil and ground water samples, except soil sample S5S4 and ground water samples GMW501 and GMW502, were within the EPA advisory limits. The percent recovery for terphenyl-d14 for sample S5S4 was above the EPA advisory limits, and the percent recoveries for 2-flourobiphenyl for samples GMW501 and GMW502 were below the EPA advisory limits. The percent recoveries for all surrogate spike samples are summarized in Table 4-7.

Table 4-6
Quality Control: Percent Recovery
for Spike Samples
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Parameter	Medium	Matrix Spike (MS) Percent Recovery	Matrix Spike Duplicate (MSD) Percent Recovery	(1) Relative Percent Difference (RPD)	(2) Laboratory Control Limits % Recovery	(2) Laboratory Control Limits RPD	(3) EPA Control Limits % Recovery	(3) EPA Control Limits RPD
Volatile Organics:								
1,1-Dichloroethene	Water	86	86	0	61-145	14	D-234	-
Trichloroethene	Water	92	92	0	71-120	14	71-157	-
Benzene	Water	92	90	2	76-127	11	37-151	-
Toluene	Water	98	96	2	76-125	13	47-150	-
Chlorobenzene	Water	98	98	0	75-130	13	37-160	-
Semivolatile Organics:								
1,4-Dichlorobenzene	Water	50	48	4	36-97	27		
N-Nitrosodi-n-propylamine	Water	52	52	0	41-116	38	D-230	-
1,2,4-Trichlorobenzene	Water	46	47	2	39-98	23	44-142	-
Acenaphthene	Water	56	53	5	46-118	19	47-145	-
2,4-Dinitrotoluene	Water	63	62	2	24-96	47	39-139	-
Pyrene	Water	67	69	3	26-127	36	52-115	-
Total Metals								
Arsenic	Soil	59	71	18	-	-	-	-
Barium	Soil	84	90	2.9	-	-	75-125	20
Cadmium	Soil	101	101	0	-	-	75-125	20
Chromium	Soil	88	100	13	-	-	75-125	20
Lead	Soil	82	86	4.3	-	-	75-125	20
Mercury	Soil	95	-	-				
Selenium	Soil	91	91	0	-	-	-	-
Silver	Soil	99	99	0	-	-	75-125	20

Notes:

(1) RPD = [|(MSD-MS)|/((MSD+MS)/2)]x100

(2) Source: Southwest Laboratory of Oklahoma, Inc.

(3) Source: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846, Third Edition, November, 1986. D = Detected (D > 0).

Table 4-7
Quality Control: Percent Recovery
for Surrogate Spike Samples
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Parameter	Medium	Surrogate Spike Percent Recovery	(1) Laboratory Control Limits Percent Recovery	(2) EPA Control Limits Percent Recovery
Volatile Organics:				
Toluene-d8	Soil	97-119 *	81-117	81-117
Bromofluorobenzene	Soil	67-107 *	74-121	74-121
1,2-Dichloroethane-d4	Soil	95-105	70-121	70-121
Toluene-d8	Water	95-102	88-110	88-110
Bromofluorobenzene	Water	93-101	86-115	86-115
1,2-Dichloroethane-d4	Water	86-98	76-114	76-114
Semivolatile Organics:				
Nitrobenzene-d5	Soil	58-91	23-120	23-120
2-Fluorobiphenyl	Soil	65-101	30-115	30-115
Terphenyl-d14	Soil	73-142 *	18-137	18-137
Nitrobenzene-d5	Water	36-44	35-114	35-114
2-Fluorobiphenyl	Water	32-45 *	43-116	43-116
Terphenyl-d14	Water	60-78	33-141	33-141

Notes:

(1) Source: Southwest Laboratory of Oklahoma, Inc.

(2) Source: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA SW-846, Third Edition, November, 1986.

* = Surrogate recovery outside of QC limits.

A blank is an artificial sample which is used to monitor the introduction of artifacts into the sampling process. Travel blanks consist of analyte free, or deionized, water which is transported in sample containers to the field and then to the laboratory without being opened. In this way, travel blanks monitor sample contamination originating from sample transport, shipping and site conditions. Travel blanks were analyzed for volatile organics for soil, ground water, and drill water samples for this project. The results of these analyses are presented in Tables 4-3, 4-5, 4-6, and 4-7. A chloroform concentration of 0.002 mg/l was estimated in sample S5TB1, and a chloroform concentration of 0.040 mg/l was detected in the sample designated as "Trip Blank". Sample S5TB1 was collected during the soil sampling expedition and the sample designated as "Trip Blank" was collected during the ground water sampling expedition. During the soil sampling expedition, methylene chloride was detected in sample S5TB1 at a concentration of 0.017 mg/l. Methylene chloride was also detected in the laboratory method blank, however. A bromodichloromethane concentration of 0.002 mg/l was estimated for the sample designated "Trip Blank".

A second type of blank called an equipment blank, or rinsate sample, was also collected during the soil and ground water sampling expeditions. Rinsate samples consist of deionized water which is passed over decontaminated sampling equipment and subsequently analyzed for the same parameters as the field samples. Rinsate samples monitor sampling equipment cleanliness. The analytical results for the rinsate samples collected during the soil and ground water sampling expeditions are presented in Tables 4-3 and 4-5. Rinsate sample RS5S2 was collected prior to collecting soil sample S5S2. Methylene chloride was detected in sample RS5S2 at a concentration of 0.008 mg/l, and a concentration of 0.001 mg/l of toluene was estimated for sample RS5S2. Methylene chloride was also detected in the laboratory method blank. Rinsate sample RGMW502 was collected prior to collecting ground water sample GMW502. Concentrations of 0.004 mg/l and

0.002 mg/l of acetone and bromodichloromethane were estimated for sample RGMW502. Chloroform was detected in sample RGMW502 at a concentration of 0.054 mg/l.

SECTION 5 - INTERPRETATIONS

5.1 Summary of Analytical Data

The analytical results for this investigation are summarized in Tables 4-3, 4-5, 4-6, and 4-7. Copies of the laboratory reports for soil samples are included as Appendix I, and copies of the laboratory reports for ground water samples are included as Appendix L. Table 5-1 compares the maximum concentration of soil constituents to the concentrations observed at the background sample location. Table 5-2 compares the maximum concentrations of ground water constituents to current Federal and State regulatory criteria. Copies of the ground water regulatory criteria are included as Appendix N of this report.

Five volatile organics were detected in the soil samples. Similarly, five volatile organics were detected in the ground water samples. However, only three of these volatile organics, acetone, chloroform, and trichloroethene, were detected in both soil and ground water samples. An acetone concentration below the detection limit was estimated in soil sample S5S3. Although acetone was not detected in sample S5S2, acetone was detected in the duplicate of sample S5S2, sample DS5S2. Acetone was also detected in the laboratory method blanks associated with the soil samples. A concentration of chloroform below the detection limit was estimated in soil samples S5S2, S5S3, S5S4, S5S6, DS5S2, and the travel blank S5TB1. A chloroform concentration was also estimated in the laboratory method blanks. The travel blank associated with the soil samples was analyzed at a later date than the soil samples. The laboratory method blank on this date did not register any concentration of chloroform. Chloroform concentrations above the detection limit were detected in the ground water rinsate sample, RGMW502, and the sample collected during the ground water sampling expedition, designated "Trip Blank"; however, chloroform was not detected in the laboratory method blanks associated with the ground water samples. Trichloroethene was detected

Table 5-1
Summary of Soil Constituent Concentrations
Compared to Background Concentrations
Former Forbes Atlas Missle Site S-5
Bushong, Kansas

Parameter	Maximum Concentration Detected (mg/kg)	Location Detected	Background Concentration (mg/kg)
Volatile Organics:			
Acetone	0.010 B	DS5S2	BDL
Chloroform	0.002 BJ	*	BDL
Methylene Chloride	0.036 B	DS5S2	0.015 B
Toluene	0.001 J **	RS5S2	BDL
Trichloroethene	0.010	DS5S2	BDL
Semi-Volatile Organics:			
Naphthalene	0.071 J	DS5S2	BDL
Metals (Total):			
Arsenic	6.7	S5S1	6.7
Barium	2180	S5S4	134
Cadmium	1.4	DS5S2	BDL
Chromium	20.8	S5S6	18.9
Lead	63.8	DS5S2	23.0

Notes:

* = S5S2, S5S3, S5S4, S5S6, DS5S2, and S5TB1 levels of chloroform were estimated at 0.002 mg/kg.
** = Results in mg/l.
BDL = Below Detection Limit
B = Analyte detected in the method blank as well as in the sample.
J = Estimated value of concentration below detection limit.

Table 5-2
Summary of Ground Water Constituent Concentrations
Compared to Current Standards and Criteria
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Parameter	Maximum Concentration Detected (mg/l)	Location Detected	Regulatory Criteria Federal * (mg/l)	Regulatory Criteria State ** (mg/l)
Volatile Organics:				
Acetone	0.004 J	RGMW502, S5TB2	-	-
Bromodichloromethane	0.002 J	RGMW502, Travel Blank	0.100	0.100
Chloroform	0.054	RGMW502	0.100	0.100
Trans-1,2-Dichloroethene	0.104	DGMW502	-	0.070
Trichloroethene	0.085	DGMW502	0.005	0.005
Metals (Total):				
Barium	0.235	DGMW502	1.000	1.000
Chromium	0.021	GMW502	0.050	0.050
Lead	0.045	GMW501	0.050	0.050

Notes:

* Source: Maximum Contaminant Level (MCL) from the National Primary Drinking Water Regulations, 1985.

** Source: Kansas Department of Health and Environment, Groundwater Contaminant Target Standards, June 6, 1988.

in soil sample DS5S2, but was not detected in any of the laboratory method blanks associated with the soil samples. A concentration of trichloroethene below the detection limit was estimated in ground water sample GMW501. Trichloroethene was also detected in samples GMW502 and DGMW502, but was not detected in any of the laboratory method blanks associated with the ground water samples. Methylene chloride was detected in every soil sample collected at the site and was also detected in the laboratory method blanks. Methylene chloride was not detected in any of the ground water samples from the site. A toluene concentration below the detection limit was estimated in soil sample DS5S2, but toluene was not detected in sample S5S2, the ground water samples, or the laboratory method blanks associated with the soil and ground water samples. Although bromodichloromethane was not detected in any of the soil samples collected at the site, concentrations of bromodichloromethane below the detection limit were estimated in the ground water rinsate sample, RGMW502, and the sample designated "Trip Blank". Bromodichloromethane was not detected in the laboratory method blanks associated with the ground water samples. Trans-1,2-dichloroethene was detected in ground water sample GMW502 and the duplicate of ground water sample GMW502, sample DGMW502. Trans-1,2-dichloroethene was not detected in the soil samples from the site or the laboratory method blanks associated with the soil and ground water samples.

One semi-volatile organic compound was detected in the duplicate soil sample. Although naphthalene was not detected in sample S5S2, a naphthalene concentration below the detection limit was estimated in sample DS5S2. No semi-volatile organic compounds were detected in the ground water samples or the laboratory method blanks associated with the soil and ground water samples collected at the site.

Five metals were detected in the soil samples collected at the site. Three of these metals, barium, chromium, and lead, were also detected in the ground water samples. Barium was detected

in every soil and ground water sample collected at the site. Barium was not detected in the soil or ground water rinsate sample or the laboratory method blanks associated with the soil and ground water samples. The concentrations of barium in the soil samples ranged from 76.6 mg/kg in sample S5S6 to 2180 mg/kg in sample S5S4. Chromium was detected in every soil sample and in ground water sample GMW502 and the duplicate of sample GMW502, sample DGMW502. Chromium was not detected in the soil or ground water rinsate sample or the laboratory method blanks associated with the soil and ground water samples. Lead was detected in every soil sample and in ground water sample GMW501. Lead was not detected in the soil or ground water rinsate sample or the laboratory method blanks associated with soil and ground water samples. Arsenic was detected in every soil sample except sample S5S6. Cadmium was detected in soil sample S5S2 and the duplicate soil sample DS5S2. Neither arsenic nor cadmium was detected in either the soil rinsate sample, the ground water samples, or the laboratory method blanks associated with the soil and ground water samples.

Of the five volatile organic compounds detected in the soil samples, the maximum concentrations of acetone, chloroform, methylene chloride, and trichloroethene were detected in the duplicate soil sample, DS5S2. Chloroform was also detected at the same or lesser estimated concentration in samples S5S2, S5S3, S5S4, S5S6, S5TB1, and the laboratory method blanks. Toluene was only detected in the soil rinsate sample, RS5S2, at an estimate concentration below the detection limit. All five compounds were detected at concentrations exceeding the concentrations detected in the background sample, S5S1. The maximum concentrations of three of the five volatile organic compounds detected in the ground water samples, acetone, bromodichloromethane, and chloroform, were detected in the ground water rinsate sample, RGMW502. These concentrations are below the established Federal and State regulatory criteria. Concentrations of acetone and bromodichloromethane equivalent to the maximum concentrations

of these compounds were also detected in the travel blanks S5TB2 and "Trip Blank", respectively. The maximum concentrations of trans-1,2-dichloroethene and trichloroethene were detected in the duplicate ground water sample, DGMW502. These concentrations exceed the established Federal and/or State regulatory criteria.

The maximum concentration of naphthalene was detected in the duplicate soil sample DS5S2. Naphthalene was not detected in the background soil sample or in any ground water sample.

The maximum concentration of arsenic was detected in the background soil sample S5S1. Arsenic was not detected in any of the ground water samples. The maximum concentration of barium was detected in soil sample S5S4, and is more than 16 times greater than the concentration of barium detected in the background sample. The maximum concentrations of cadmium and lead were detected in the duplicate soil sample, DS5S2. Cadmium was not detected in the background soil sample. The maximum concentration of lead was a little less than three times greater than the background lead concentration. The maximum concentration of chromium was detected in soil sample S5S6 and was comparable to the background chromium concentration. The maximum concentrations of barium, chromium, and lead in ground water were detected in samples DGMW502, GMW502 and GMW501, respectively. All of these concentrations were below the established Federal and State regulatory criteria.

5.2 Factors Influencing Results

Acetone, chloroform, and methylene chloride were detected in soil and ground water samples and were also detected in laboratory method blanks associated with soil samples. These compounds are common laboratory artifacts used in such processes as solvent extraction. Acetone is also used as a solvent for paint and varnish and to clean and dry precision equipment.

Chloroform is used in some refrigerants and as a fumigant or an insecticide. Methylene chloride is also used in paint removers and as a degreasing agent. Although these compounds are commonly present in materials associated with maintenance activities, such as solvents, degreasers and cleaners, the presence of these compounds in the laboratory method blanks at similar concentrations suggests that the presence of these compounds in the field samples is most likely due to laboratory procedures.

Toluene was detected in the rinsate sample collected during the soil sampling expedition; however, toluene was not detected in any soil sample or travel blank associated with soil samples. Toluene is used in aviation gasoline and high-octane blending stock, and in paint solvents, lacquer thinners and diluents, detergents, and explosives. The presence of toluene in the rinsate sample but not in any of the soil samples may indicate that toluene is present in the soil but at such minute concentrations that matrix interferences prevent accurate detection of the compound. The analytical results do not suggest that the presence of toluene poses a significant environmental threat at this site. Based on the analytical results, O'Brien & Gere is unable to determine whether or not toluene exists at the site as a result of past DOD activities.

Trichloroethene was detected in soil samples at concentrations exceeding the background concentration and in ground water samples at concentrations of 0.076 mg/l and 0.085 mg/l which exceeds the Federal and State regulatory criteria of 0.005 mg/l. Trichloroethene is used primarily as a metal degreaser, a solvent for many organic compounds, as a refrigerant and heat exchange liquid, for cleaning and drying electronic parts, as a diluent in paints and adhesives, and in aerospace operations such as flushing liquid oxygen. Trichloroethene was not found in any rinsate sample, travel blank, or laboratory method blank. The presence of trichloroethene in the soil and ground water samples is most likely due to past DOD activities.

Trans-1,2-dichloroethene was detected in ground water samples at concentrations of 0.098 mg/l and 0.104 mg/l which exceeds the State regulatory criteria of 0.070 mg/l. No Federal regulatory criterion has been established for trans-1,2-dichloroethene. This compound is used as a solvent for organic materials, and in perfumes, lacquers, and thermoplastics. Trans-1,2-dichloroethene was not detected in any rinsate, travel blank, or laboratory method blank. The presence of trans-1,2-dichloroethene is most likely due to past DOD activities.

Bromodichloromethane was detected in the ground water rinsate sample and one of the travel blanks associated with the ground water samples. The concentrations of bromodichloromethane were below the established Federal and State regulatory criteria of 0.100 mg/l. The analytical results do not suggest that the presence of bromodichloromethane poses a significant environmental threat at the site.

Naphthalene was detected in the duplicate soil sample, DS5S2. Naphthalene is used as a moth repellent, fungicide, antiseptic, lubricant, preservative, cutting fluid, and emulsion breaker. Naphthalene was not detected in the soil rinsate sample, or the travel blank or laboratory method blanks associated with the soil samples. The presence of naphthalene may be due to past DOD activities.

Barium was found in soil samples greatly exceeding the background barium concentration (134 mg/kg). The greatest concentration of barium (2,180 mg/kg) was detected in sample S5S4, which was located adjacent to the former equipment hatch. Barium was detected in the ground water samples collected at the site at concentrations of 0.134 mg/l, 0.234 mg/l and 0.235 mg/l which are below established Federal and State regulatory criteria of 1.000 mg/l. Barium is used in bearings, spark-plug alloys, and as a copper deoxidizer. Other forms of barium are also used as corrosion inhibitors and paint pigments and in electronic equipment and pyrotechnics. Although all of the barium concentrations detected at the site are within the typical range of native soil

concentrations of barium (100-3,500 mg/kg) (Dragun, 1988), the presence of barium at such an elevated concentration (2,180 mg/kg) is probably the result of past DOD activities at the site.

Chromium was detected in soil and ground water samples collected at the site. The greatest concentration of chromium was detected in sample S5S6, which was collected from one of the lagoon cells where metals concentrations were potentially elevated due to sanitary waste. However, this concentration, 20.8 mg/kg, is comparable to the background concentration, 18.9 mg/kg in sample S5S1. These concentrations are within the typical range of native soil concentrations of chromium (5.0-3,000 mg/kg) (Dragun, 1988). The chromium concentrations found in the ground water samples are below the Federal and State regulatory criteria. Chromium is used as an alloying and plating element, as a coating on automotive and equipment appurtenances, and in inorganic pigments. The presence of chromium at the site is most likely not a result of past DOD activities at the site.

Lead was detected in soil and ground water samples. The greatest concentration of lead detected in the soil samples (63.8 mg/kg) is approximately three times greater than the background lead concentration (23.0 mg/kg). However, all of the lead concentrations detected at the site are within the typical range of native soil concentrations of lead (2.0-200 mg/kg) (Dragun, 1988). The lead concentration of 0.045 mg/l in ground water is below the Federal and State regulatory criteria of 0.050 mg/l. Lead is used in batteries, ammunition, solder and foil, and as a gasoline additive and cable covering. Lead concentrations in the soil may be present as a result of past DOD activities at the site.

Arsenic and cadmium were detected in the soil samples collected at the site. The highest concentration of arsenic was detected in the background sample. Arsenic is used as an alloying additive for metals and in electronic devices. Only slightly elevated concentrations of cadmium were detected in the soil samples. Cadmium is used in metal coatings, fire-protection systems, batteries,

power transmission wire, television phosphors, pigments, fungicides, and selenium rectifiers. The arsenic concentrations detected at the site are within the typical range of native soil concentrations (1.0-40 mg/kg) (Dragun, 1988). Therefore, the presence of arsenic is most likely not a result of past DOD operations at the site. Although the cadmium concentrations detected in the soil samples are within the typical range of native soil concentrations of cadmium (0.01-7.0 mg/kg) (Dragun, 1988), cadmium was not detected in the background sample. Cadmium concentrations in the soil may be due to past DOD activities.

SECTION 6 - CONCLUSIONS

6.1 Conclusions

The purpose of this investigation was to assess whether or not contamination exists at the Former Forbes Atlas Missile Site S-5 in Bushong, Kansas as a result of past DOD activities at the site. Evaluation of the analytical results from sampling at the site suggests the following conclusions:

- The volatile organic compound trichloroethene was detected in soil samples at concentrations exceeding the background concentration and the volatile organic compounds trichloroethene and trans-1,2-dichloroethene were detected in ground water samples at concentrations exceeding the Federal and State regulatory criteria. The presence of trichloroethene in the soil samples and trichloroethene and trans-1,2-dichloroethene in the ground water samples is most likely due to past DOD activities at the site.

- The heavy metal barium was found in soil samples at concentrations greatly exceeding the background barium concentration. Barium was detected in the ground water samples collected at the site at concentrations below established Federal and State regulatory criteria. Although some metals naturally occur at high levels in Kansas soils, the presence of barium at such an elevated concentration is probably the result of past DOD activities at the site.

- The volatile organic compound toluene was detected in the rinsate sample collected during the soil sampling expedition; however, toluene was not detected in any soil sample or travel blank associated with soil samples. The presence of toluene in the rinsate sample but not in any of the soil samples may indicate that toluene is present

in the soil but at such minute concentrations that matrix interferences prevent accurate detection of the compound. The analytical results do not suggest that the presence of toluene poses a significant environmental threat at this site.

- The volatile organic compound bromodichloromethane was detected in the ground water rinsate sample and one of the travel blanks associated with the ground water samples at an estimated concentration of 0.002 mg/l. This concentration of bromodichloromethane is below the established Federal and State regulatory criteria of 0.100 mg/l. The analytical results do not suggest that the presence of bromodichloromethane poses a significant environmental threat at this site.
- The semi-volatile organic compound naphthalene was detected in the duplicate soil sample, DS5S2. Naphthalene was not detected in the soil rinsate sample or the travel blank or laboratory method blanks associated with the soil samples. The presence of naphthalene may be due to past DOD activities at the site.
- The heavy metals chromium and lead were detected in soil and ground water samples collected at the site. The greatest concentration of chromium is comparable to the background chromium concentration. The greatest concentration of lead is approximately three times the background concentration of lead. The chromium (0.019 mg/l and 0.021 mg/l) and lead (0.045 mg/l) concentrations found in the ground water samples are below the Federal and State regulatory criteria which are 0.050 mg/l for both chromium and lead. The presence of chromium at the site is most likely not a result of past DOD operations at the site; however, lead concentrations in the soil may be due to past DOD activities at the site.

- Slightly elevated concentrations of the heavy metal cadmium were detected in the soil samples. Cadmium concentrations in the soil may be due to past DOD activities at the site.
- Arsenic was detected in the soil samples collected at the site. The highest concentration of arsenic was detected in the background sample. Most likely, the presence of arsenic may be attributed to native soil characteristics and is not a result of past DOD activities at the site.
- The volatile organic compounds acetone, chloroform, and methylene chloride were detected in soil samples collected at the site. Acetone and chloroform were also detected in ground water samples. These compounds are most likely present due to laboratory procedures.

References

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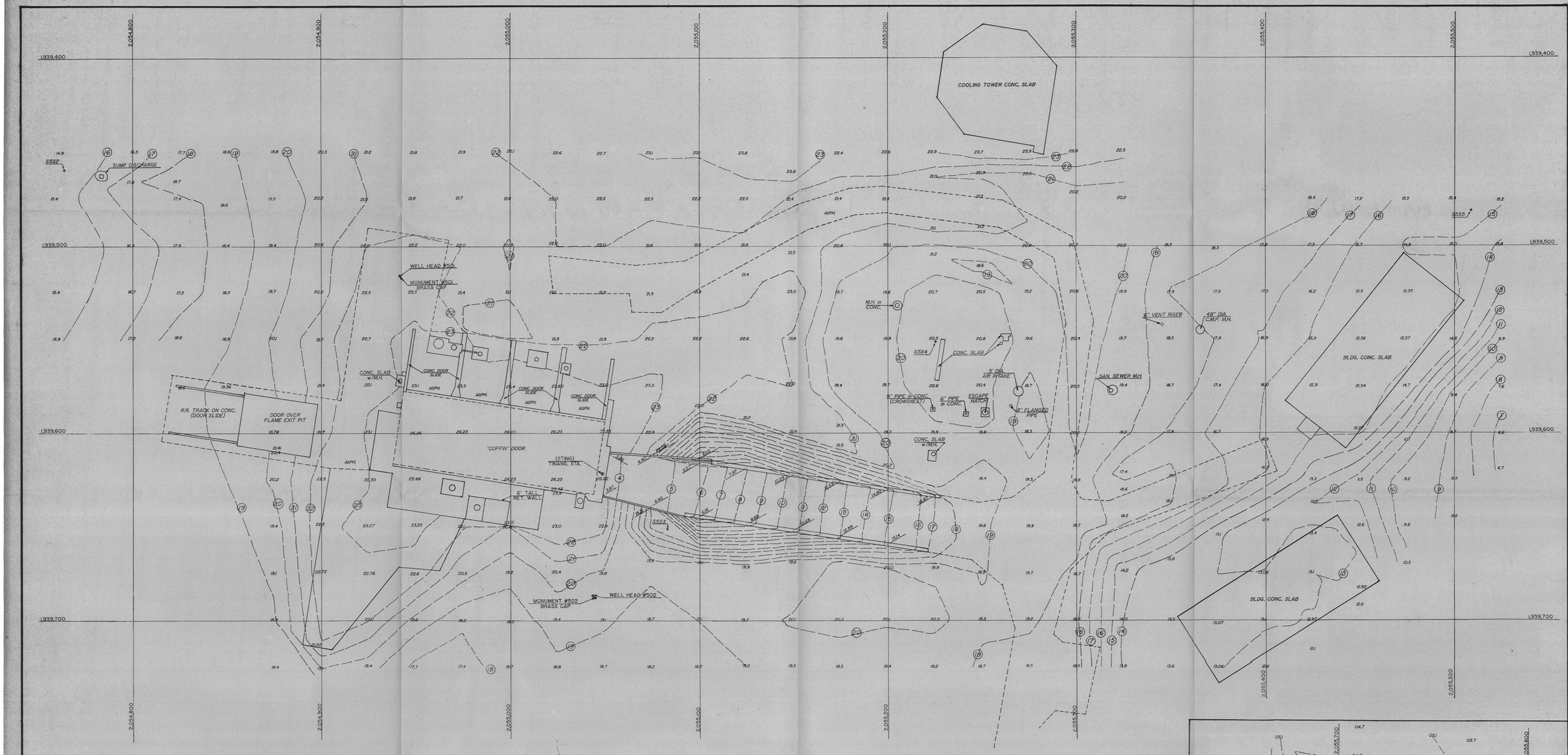


DESCRIPTION		COORDINATES NORTH	COORDINATES EAST	ELEVATION
WELL HEAD	#501	2054941.77	1939515.76	1425.19
	#502	2055046.28	1939686.34	1421.90
MONUMENT	#501	2054942.45	1939516.61	1422.76
	#502	2055047.10	1939687.03	1419.705
SOIL BORING	S552	2054763.5	1939459.6	1414.8
	S553	2055083.6	1939650.9	1411.3
	S554	2055225.7	1939551.2	1420.9
	S555	2055508.5	1939481.2	1415.0
	S556	2055715.6	1939793.4	1400

NOTES:

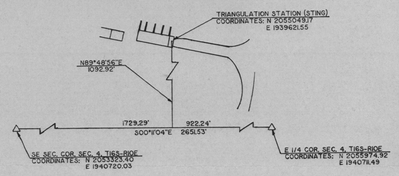
1. GRID COORDINATES ARE ESTABLISHED FROM STATE PLANE COORDINATES. THIS IS BASED ON TRIANGULATION STATION (STING). BRASS DISK PARTIALLY OBLITERATED BUT STILL EVIDENT. N=2055049.71 E=1939625.50. REFERENCE AZIMUTH TRIANGULATION STATION (KNOB) 337°18'26".
2. DATUM BENCHMARK ELEVATION 1425.59, TRIANGULATION STATION (STING).

LEGEND

- MONUMENT (brass disk)
- MONITORING WELL
- SOIL BORING
- (17) CONTOUR ELEVATION = 1417.0
- 13.6 SPOT ELEVATION

Scale: 1" = 20'

20 10 0 20

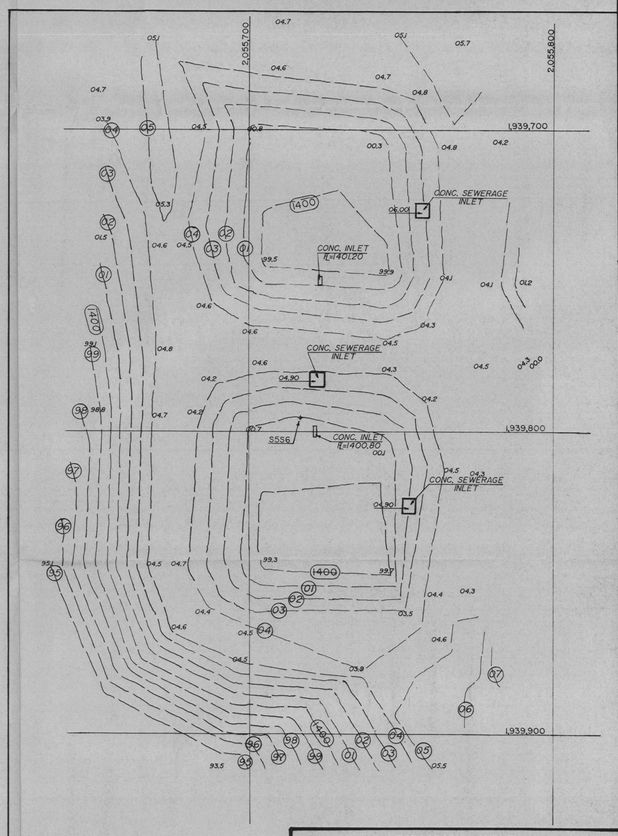


STATE OF KANSAS)
COUNTY OF LYON)

I, Galen L. Forgy, registered and authorized to practice Land Surveying in the aforesaid County and State, do hereby certify that the measurements and elevations shown hereon are true and accurate to the best of my knowledge and belief.

Galen L. Forgy — SURVEYOR — July 13, 1990 — DATE

GALEN L. FORGY REGISTERED LS-584 KANSAS LAND SURVEYOR



TOPOGRAPHIC SURVEY of FORBES ATLAS MISSLE SITE, S-5 located in SE 1/4 SEC. 4, T16S-R10E LYON CO., KANSAS

FORGY SURVEYING

SALINA 421 NORTH OHIO 913-827-9770 KANSAS

Appendices

APPENDIX A

FIELD TEST BORING LOGS

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

BORING NO. GMW#501 sheet 1 of 2

WATER ENTERS: at 18.5' while drilling

PROJECT LOCATION: Former Forbes Atlas Missile Site-5 Bushong, KS

CLIENT: USACE

SAMPLER
TYPE: ASTM D 1586-84 split spoon
HAMMER: 140lbs.
FALL: 30"

FILE NO: 3068.020

BORING CO: Layne Western RIG: CME-55

OBG GEOLOGIST: Dave Cika

BORING LOCATION: West of silo
GROUND ELEVATION: TOC:
DATES STARTED: 5-23-90 ENDED: 5-23-90

DEPTH Feet	SS SAMPLE NO.	DEPTH (Feet)	BLOWS 6"	PEN/ REC.	SAMPLE DESCRIPTION HSA 3 3/4" I.D. 5 1/2" O.D.	STRATUM CHANGE	HNU
0					Fill - 3" Asphalt over 6" crushed rock base	Fill	
1	#1	1.0-3.0	4	2.0/1.2	Fill - Dark brown silty clay with some crushed rock and asphalt - moist		0
2			7				
			17		Dark brown silty clay with some chert and limestone fragments - moist	CL	
3	#2	3.0-5.0	19	2.0/0.1			0
4			6				
			8		Rock content increasing		
5			13				
	#3	5.0-7.0	18	2.0/1.5	Yellow-brown and tan moderately to completely weathered limestone, broken and fractured with some silty clay seams and layers - damp to moist	CL & (LS)	0
6			17				
			4				
7			14				
			28		White to light gray limestone, moderately weathered, fractured, Hard drilling, fine xln - damp	(LS)	
8							
9	#4	8.5-10.5	>30	0.5/0.4	Medium brown to tan silty clay and clay with abundant weathered limestone fragments - moist	CL & (LS)	0
10							
					White to light gray slightly to moderately weathered limestone, fine to micro xln Difficult drilling	(LS)	
11							
12							
					Light brown and tan weathered calcareous shale, occ black mottling and some rust colored staining, layered and horizontal bedded - damp to moist	(SH)	
13	#5	12.5-14.5	>30	0.5/0.5			0
14							
15							

REMARKS:

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

BORING NO. GMW#501 Sheet 2 of 2

PROJECT LOCATION: Former Forbes Atlas Missile Site-5 Bushong, KS
CLIENT: USACE

SAMPLER
TYPE: ASTM D 1586-84 split spoon
HAMMER: 140 lbs.
FALL: 30"

WATER ENTERS: at 18.5' while drilling

FILE NO: 3068.020

BORING CO: Layne Western RIG: CME-55

OBG GEOLOGIST: Dave Cika

BORING LOCATION: West of silo
GROUND ELEVATION: TOC:
DATES STARTED: 5-23-90 ENDED: 5-23-90

DEPTH Feet	SS SAMPLE NO.	SS SAMPLE DEPTH (Feet)	BLOWS 6"	PEN/REC.	SAMPLE DESCRIPTION HSA - 3 3/4" I.D. 6 1/2" O.D.	STRATUM CHANGE	HNU
15	#6	15.0 - 17.0	8	2.0/1.1	Medium to light brown and tan clay-shale and shale, slightly calcareous, layered, slightly fissile - damp	(SH)	0
			18				
16			21				
			26				
17					Some with occassional very thin limestone beds (argillaceous limestone) water enters at 18.5' while drilling in shale		
18							
19	#7	19.0 - 21.0	21	1.3/0.9	Medium brown and tan to black (mottled) shale and clay shale fossiliferous, calcareous, layered, [illegible] some rust colored streaks - moist		0
			29				
20			730				
21							
22					Medium brown and tan to black and gray (mottled) shale (occas clay shale) highly calcareous - moist		
23							
						(LS)	
24					Argillaceous limestone		
25					T.D. - 24.3' Auger refusal on competent limestone		
					- Set 10.0' of 2-inch I.D., Sch. 40 PVC, #10 machine slot well screen at 23.3' - Riser casing from 13.3' to approx. 2.8' above grade.		
26					- stainless steel centralizer at 5.0'		
					- Silica sand pack from 24.3' to 10.0'		
27					- Bentonite pellet seal from 10.0' to 7.3'		
					- Grout from 7.3' to approx 1.0' below grade (Type I portland cement and approx. 3% bentonite powder)		
28					- Bentonite seal hydration time - greater than 8 hours		
29							
30							

REMARKS:

- Grout seal curing time - greater than 48 hours
- Final stick up ≈ 2.8'

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

BORING NO. GMW#502 Sheet 1 of 2

PROJECT LOCATION: Former Forbes Atlas Missle Site-5 Bushong, KS

CLIENT: USACE

SAMPLER
TYPE: ASTM D 1586-84 split spoon
HAMMER: 140lbs.
FALL: 30"

WATER ENTERS: at 17.0' below grade while drilling

FILE NO: 3068.020

BORING CO: Layne-Western RIG: CME-55

OBG GEOLOGIST: Dave Cika

BORING LOCATION: East of Silo
GROUND ELEVATION: TOC:
DATES STARTED: 5-22-90 ENDED: 5-23-90

DEPTH Feet	SAMPLE NO.	SAMPLE DEPTH (Feet)	BLOWS 6"	PEN/ REC.	SAMPLE DESCRIPTION HSA 3 3/4" I.D. 6 1/2" O.D.	STRATUM CHANGE	HNU
0					Fill-Large limestone boulder overlying Dark brown silty clay with some limestone fragments - moist	Fill	
1							
2	#1	2.0-4.0	4	2.0/0.9	Dark brown silty clay, some limestone fragments, trace sand - moist		0
3			6		Trace roots		
4			8		Apparent end of fill at 4.0'		
			8				
	#2	4.0-6.0	2	2.0/1.1	Dark brown silty clay with abundant moderately to severely weathered limestone fragments, trace roots - moist	CL (LS)	0
5			4				
			2				
6			5		obstruction at 5.0' while augering		0
	#3	6.0-8.0	10	1.2/0.7	Abundant limestone and chert fragments white to light gray and tan severely	(LS)	
			22				
7			>30		weathered to completely weathered limestone, some clay seams (v. thin) - moist		
					Becoming competent at 7.75'		
8	#4	8.0-10.0	29	.6/0.2	Slightly to moderately weathered at 8.0'		0
			730				
9					Light brown and tan calcareous clay-shale layered and somewhat fissile, some block mottling and rust colored staining - damp to moist	(SH)	
10	#5	10.0-12.0	11	1.6/1.0			0
			28				
11			730				
					Moisture content increasing		
12					Light brown and tan clay-shale, calcareous, fossiliferous - moist		
					Layered and weathered		
13							
14							
15							

REMARKS: 2ND borehole drilled on site

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

BORING NO. GMW #502 Sheet 2 of 2

PROJECT LOCATION: Former Forbes Atlas Missle site-5 Bushong, KS

CLIENT: USACE

SAMPLER
TYPE: ASTM D 1586-84 split spoon
HAMMER: 140 lbs.
FALL: 30"

WATER ENTERS: at 17.0' below grade while drilling

FILE NO: 3068.020

BORING CO: Layne-Western RIG: CME-55

OBG GEOLOGIST: Dave Cika

BORING LOCATION: East of silo
GROUND ELEVATION: TOC:
DATES STARTED: 5-22-90 ENDED: 5-23-90

DEPTH	SS SAMPLE NO.	SS SAMPLE DEPTH (Feet)	BLOWS 6"	PEN/REC.	SAMPLE DESCRIPTION HSA 3¾" I.D. 6½" O.D.	STRATUM CHANGE	HNU
15	#6	15.0-17.0	18	1.75/.3	Light brown and tan clay shale, calcareous, some grading to weathered limestone, occ rust colored streaks- damp to moist	(SH)	0
16			25				
			>30				
17					water enters at 17.0' in layered shale? Becoming less weathered with depth		
18					Hard medium to dark gray calcareous shale, layered, fissile, increasingly weathered along horizontal layers-moist		
19							
20					Difficult augering and sampling below 16'		
	#7	20.0-22.0	750	0.5/0.1			0
21					White to light gray dense fine xln limestone (argillaceous)	(LS)	
22					T.D.-21.5' Auger refusal in competent limestone (argillaceous)		
23					- Set 10.0' of 2-inch I.D., Sch. 40 PVC, #10 machine slot well screen at 20.5'- Riser casing from 10.5' to approx. 2.5' above grade		
24					- stainless steel centralizer at 5'		
25					- Silica sand pack from 21.5' to 9.0'		
					- Bentonite pellet seal from 9.0' to 6.5'		
26					- Grout seal from 6.5' to approx 1.0' below grade (Type I portland) cement and approx 3% bentonite powder)		
27					- Bentonite pellet seal hydration time - greater than 8 hours		
28					- Grout seal curing time - greater than 48 hours		
29					- Final stick up ≈ 2.5'		

REMARKS:

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

BORING NO. GMW#503 Sht 1 of

PROJECT LOCATION: Former Forbes Atlas Missle site - 5 Bushong, KS

CLIENT: USACE

SAMPLER
TYPE: ASTM D 1586-84 split spoon
HAMMER: 140lbs
FALL: 30"

WATER ENTERS: Dry at 15.5' at auger refusal, Dry after 48 hours

FILE NO: 3068.020

BORING CO: Layne-Western RIG: CME-55

OBG GEOLOGIST: Dave Cika

BORING LOCATION: North of silo
GROUND ELEVATION: TOC:
DATES STARTED: 5-22-90 ENDED: 5-22-90

DEPTH Feet	SS SAMPLE NO.	DEPTH (Feet)	BLOWS 6"	PEN/ REC.	SAMPLE DESCRIPTION HSA: 3 3/4" I.D. 6 1/2" O.D.	STRATUM CHANGE	HNU
0	#1	0.0-2.0	4	2.0/1.5	Fill - Dark brown silty clay with some crushed rock and concrete fragments - moist	Fill	0
			6				
1			5				
			7		Fill - Dark brown silty clay, trace crushed rock sand, and roots - moist		0
2	#2	2.0-4.0	4	1.5/1.4			
			6				
3			>30		Sampler refusal at 3.5' - Difficult augering from 3.5' to 4.0' - End of fill at 3.5'		
4	#3	4.0-6.0	10	1.0/1.5	Weathered and broken chert mixed with medium brown silty clay, some sand - moist	Chert and clay (CL)	0
			>30				
5							
					Medium brown to dark silty clay, abundant chert fragments, some fine to coarse sand - moist to wet	CL	
6	#4	6.0-8.0	5	2.0/.6			0
			7		Medium to light brown clay	CH	
7			13				
			17				
8	#5	8.0-10.0	10	1.0/.8	Medium to light brown clay, trace severely to completely weathered limestone fragments - damp		0
			>30				
9							
						(LS) & (SH)	
10	#6	10.0-12.0	7	2.0/1.5	Light to medium gray moderately to severely weathered limestone, fine xln, fractured, broken as fragments, some as clays and clay-shales - damp to moist		0
			14				
11			24				
			21				
12	#7	12.0-14.0	10	1.5/1.5	Light to medium gray, tan, and yellow-brown weathered limestone occ grading to light brown and gray calcareous shale		0
			20				
13			>30				
14	#8	14.0-16.0	10	1.5/1.1	Medium brown and gray calcareous and clayey shale some black staining and rust	(SH)	0
			19				
15							

REMARKS: ① 1ST borehole drilled on site
② No Ground Water encountered - Dry hole
③ Backfilled with cuttings

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

BORING NO. GMW #503 Sheet 2 of 2

PROJECT LOCATION: Former Forbes Atlas Missile Site-5 Bushong, KS

CLIENT: USACE

SAMPLER
TYPE: ASTM D 1586-84 split spoon
HAMMER: 140 lbs.
FALL: 30"

WATER ENTERS: Dry at completion
Dry after 48 hours

FILE NO: 3068.020

BORING CO: Layne-Western RIG: CME-65

OBG GEOLOGIST: Dave Cika

BORING LOCATION: North of Silo
GROUND ELEVATION: TOC:
DATES STARTED: 5-22-90 ENDED: 5-22-90

DEPTH Feet	SS SAMPLE NO.	SS SAMPLE DEPTH (feet)	BLOWS 6"	PEN/ REC.	SAMPLE DESCRIPTION	STRATUM CHANGE	HNU
					HSA 3 3/4" I.D. 6 1/2" O.D.		
15			730		Colored staining, fossiliferous - damp to moist	(SH)	
16					T.D. - 15.5'	(LS)	O
					Sampler refusal at 15.5' on apparent limestone		
17					Auger refusal at 15.5' on apparent limestone		
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

REMARKS: ① No Ground Water encountered
② Dry after 48 hours

O'BRIEN & GERE ENGINEERS, INC.

TEST BORING LOG

BORING NO. GMW#503 sheet 1 of 1

PROJECT LOCATION: Former Forbes Atlas Missile Site-5 Bushong, KS
CLIENT: USACE

SAMPLER
TYPE: ASTM-1586-84 split spoon
HAMMER: 140lbs.
FALL: 30"

WATER ENTERS: Dry at completion
Dry after 48 hours

FILE NO: 3068.020

BORING CO: Layne-Western RIG: CME-55
OBG GEOLOGIST: Dave Cika

BORING LOCATION: North of silo - North of GMW#503
GROUND ELEVATION: TOC:
DATES STARTED: 5-24-90 ENDED: 5-24-90

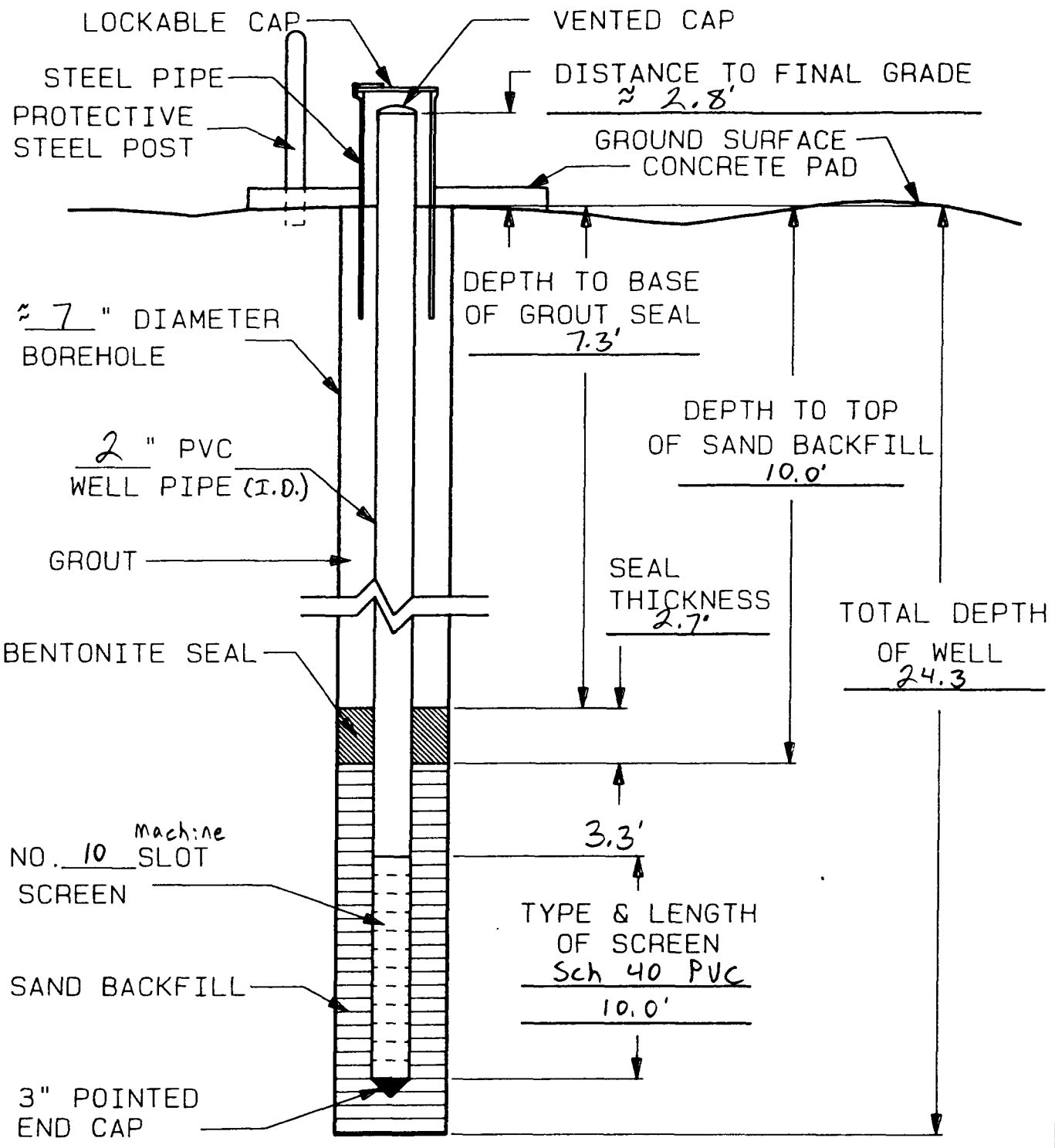
DEPTH Feet	SS SAMPLE NO.	SS SAMPLE DEPTH (feet)	BLOWS 6"	PEN/REC.	SAMPLE DESCRIPTION HSA 3¾" I.D. 6½" O.D.	STRATUM CHANGE	HNU
0	#1	0.0-2.0	2	2.0/1.0	6" topsoil over dark brown silty clay, trace fine sand and rock fragments - moist	OL	0
1			3			CL	
			5				
2			7				0
	#2	2.0-4.0	5	2.0/1.0	Dark brown slightly silty clay, trace to some sand and rock fragments - moist		
3			7				
			8		Becoming medium brown		
4			18				0
	#3	4.0-6.0	3	2.0/16"	Medium brown slightly silty clay with abundant limestone and chert fragments,		
5			7		some fine sand moist		
			7				
6			6				
	#4	6.0-8.0	4	2.0/19"	Rock content increasing		0
7			9			CL & (LS)	
			19		Medium to light brown silty clay mixed with severely to completely weathered limestone fragments - moist		
8			25				
	#5	8.0-10.0	50	3"/2"			0
9					Auger refusal on limestone at 8.8'		
					T.D. 8.8'		
10							
11							
12							
13							
14							
15							

REMARKS: ① Dry upon completion
② No Ground water encountered
③ Dry after 48 hours

APPENDIX B

GROUND WATER MONITORING WELL FIELD LOGS

GMW # 501



FINAL WATER LEVEL: 14.90 FEET BELOW TOP OF CASING.

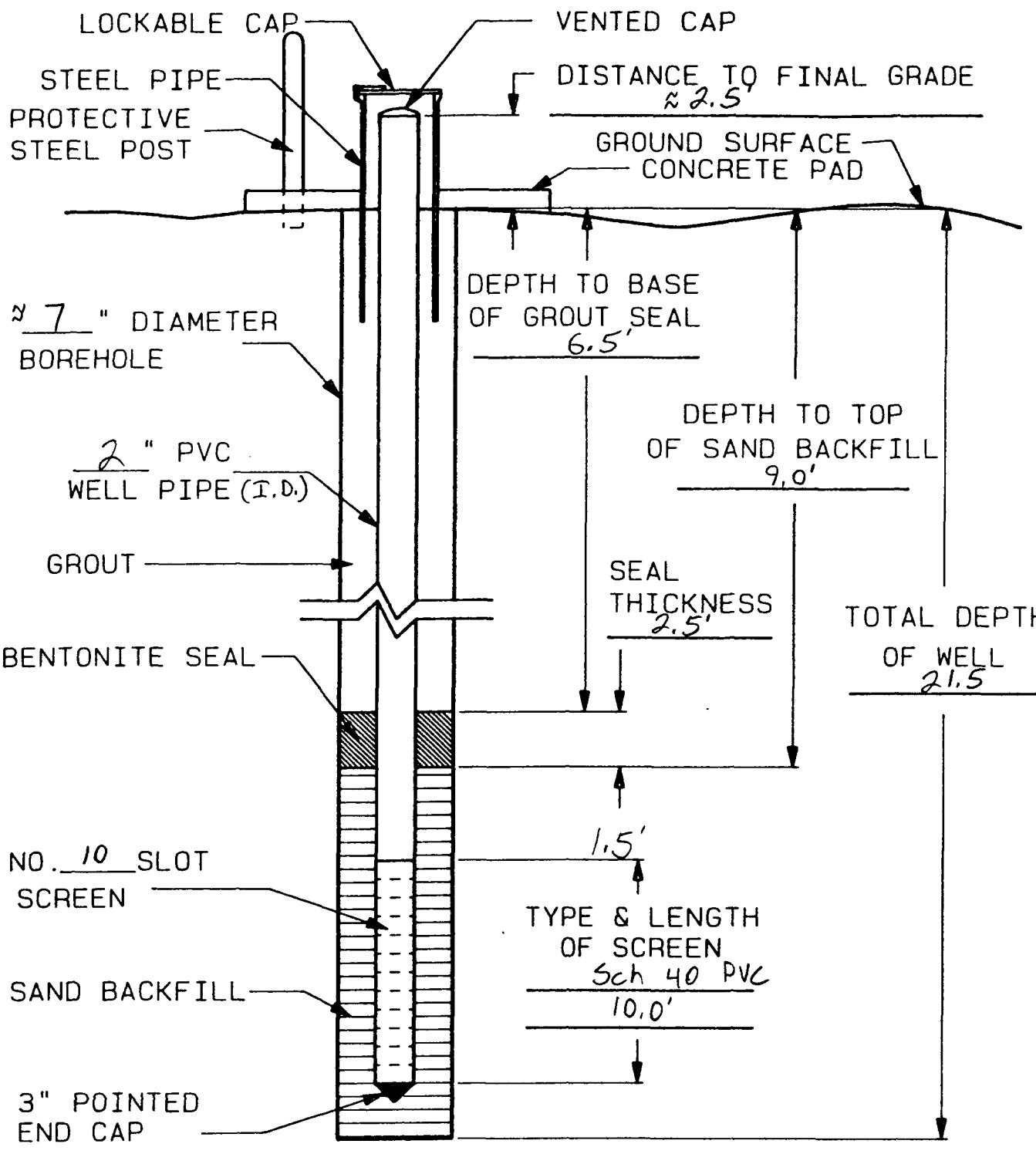
INSPECTED BY: Dave Cika DATE: 5-23-90

GROUND WATER MONITORING WELL FIELD LOG

3068.017.4F

ENGINEERS, INC.

GMW #502



FINAL WATER LEVEL: 15.13 FEET BELOW TOP OF CASING.

INSPECTED BY: Dave Cika DATE: 5-22-90

GROUND WATER MONITORING WELL FIELD LOG

3068.017.4F

GREINER ENGINEERS, INC.

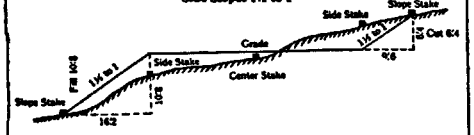
APPENDIX C

FIELD LOG BOOK

DISTANCES FROM SIDE STAKES FOR CROSS-SECTIONING

Roadway of any Width

Side Slopes 1½ to 1



In the figure above. Opposite 6 under "Cut or Fill" and under .4 read 9.6 the distance from the side stake to the slope stake at right. Opposite 10 under "Cut or Fill" and under .2 read 16.2, the distance from the side stake to the slope stake at the left.

Cut or Fill	0	.1	.2	.3	.4	.5	.6	.7	.8	.9	Cut or Fill
	Distance out from Side or Shoulder Stake										
0	0.0	0.2	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	0
1	1.5	1.7	1.8	2.0	2.1	2.3	2.4	2.6	2.7	2.9	1
2	3.0	3.2	3.3	3.5	3.6	3.8	3.9	4.1	4.2	4.4	2
3	4.5	4.7	4.8	5.0	5.1	5.3	5.4	5.6	5.7	5.9	3
4	6.0	6.2	6.3	6.5	6.6	6.8	6.9	7.1	7.2	7.4	4
5	7.5	7.7	7.8	8.0	8.1	8.3	8.4	8.6	8.7	8.9	5
6	9.0	9.2	9.3	9.5	9.6	9.8	9.9	10.1	10.2	10.4	6
7	10.5	10.7	10.8	11.0	11.1	11.3	11.4	11.6	11.7	11.9	7
8	12.0	12.2	12.3	12.5	12.6	12.8	12.9	13.1	13.2	13.4	8
9	13.5	13.7	13.8	14.0	14.1	14.3	14.4	14.6	14.7	14.9	9
10	15.0	15.2	15.3	15.5	15.6	15.8	15.9	16.1	16.2	16.4	10
11	16.5	16.7	16.8	17.0	17.1	17.3	17.4	17.6	17.7	17.9	11
12	18.0	18.2	18.3	18.5	18.6	18.8	18.9	19.1	19.2	19.4	12
13	19.5	19.7	19.8	20.0	20.1	20.3	20.4	20.6	20.7	20.9	13
14	21.0	21.2	21.3	21.5	21.6	21.8	21.9	22.1	22.2	22.4	14
15	22.5	22.7	22.8	23.0	23.1	23.3	23.4	23.6	23.7	23.9	15
16	24.0	24.2	24.3	24.5	24.6	24.8	24.9	25.1	25.2	25.4	16
17	25.5	25.7	25.8	26.0	26.1	26.3	26.4	26.6	26.7	26.9	17
18	27.0	27.2	27.3	27.5	27.6	27.8	27.9	28.1	28.2	28.4	18
19	28.5	28.7	28.8	29.0	29.1	29.3	29.4	29.6	29.7	29.9	19
20	30.0	30.2	30.3	30.5	30.6	30.8	30.9	31.1	31.2	31.4	20
21	31.5	31.7	31.8	32.0	32.1	32.3	32.4	32.6	32.7	32.9	21
22	33.0	33.2	33.3	33.5	33.6	33.8	33.9	34.1	34.2	34.4	22
23	34.5	34.7	34.8	35.0	35.1	35.3	35.4	35.6	35.7	35.9	23
24	36.0	36.2	36.3	36.5	36.6	36.8	36.9	37.1	37.2	37.4	24
25	37.5	37.7	37.8	38.0	38.1	38.3	38.4	38.6	38.7	38.9	25
26	39.0	39.2	39.3	39.5	39.6	39.8	39.9	40.1	40.2	40.4	26
27	40.5	40.7	40.8	41.0	41.1	41.3	41.4	41.6	41.7	41.9	27
28	42.0	42.2	42.3	42.5	42.6	42.8	42.9	43.1	43.2	43.4	28
29	43.5	43.7	43.8	44.0	44.1	44.3	44.4	44.6	44.7	44.9	29
30	45.0	45.2	45.3	45.5	45.6	45.8	45.9	46.1	46.2	46.4	30
31	46.5	46.7	46.8	47.0	47.1	47.3	47.4	47.6	47.7	47.9	31
32	48.0	48.2	48.3	48.5	48.6	48.8	48.9	49.1	49.2	49.4	32
33	49.5	49.7	49.8	50.0	50.1	50.3	50.4	50.6	50.7	50.9	33
34	51.0	51.2	51.3	51.5	51.6	51.8	51.9	52.1	52.2	52.4	34
35	52.5	52.7	52.8	53.0	53.1	53.3	53.4	53.6	53.7	53.9	35
36	54.0	54.2	54.3	54.5	54.6	54.8	54.9	55.1	55.2	55.4	36
37	55.5	55.7	55.8	56.0	56.1	56.3	56.4	56.6	56.7	56.9	37
38	57.0	57.2	57.3	57.5	57.6	57.8	57.9	58.1	58.2	58.4	38
39	58.5	58.7	58.8	59.0	59.1	59.3	59.4	59.6	59.7	59.9	39
40	60.0	60.2	60.3	60.5	60.6	60.8	60.9	61.1	61.2	61.4	40

EUGENE DIETZGEN CO.

Property of O'Brien & Gere Engineers

Address 5000 Cedar Plaza Parkway Suite 400

Phone (314) 842-1555
FAX (314) 842-3264

This Field Book contains special paper which is impregnated with resin to make it substantially stronger as well as water resistant. Your field notes will come out sharp and clear even when the page is wet.

MADE IN U.S.A.

INDEX PAGE

JOB NO.	PROJECT	PAGE NUMBER
3068.020	S-S	

1. 3.

5-22-90
PC 70°F

A.J. Ramsey
Julie Jennings
Dave Cika
} on site 9:15 AM

Layne/Rusty Bowles already on site
Weston/Buck Blank

Bill Ferguson (USACE) onsite at 10:20 AM (reading H&S Plan)

H&S Meeting at 9:45 AM with OBG and Layne Crew every body signed H&S forms

10:45 AM Layne set on silo. Ramp to Decon Rig and tools

11 AM calibrated HNU and prepared exclusion Zone (156 ppm at 9.8 on span)

3

ged

1.

United Telephone
Come by at 11:05AM
"No cable in area"
UTS to check at
Section road and Hwy 56
for cable

Equipment mobilized to site

1 - support truck & trailer (H2O tank)
1 - truck mounted CME-55

11:13am backed up on #503

Set up final exclusion zone
took picture
drilling with conv. hollow stem
3¼" I.D. 6½" O.D augers
at 11:49am

		Body Temp °C	Pulse
11:36	Rusty	36.6	92
	Buck	36.	92
	Dave	36.5	87

At depth of 12 feet at 12:45 PM

Bill observing outside of exclusion zone during GMW #503

Auger refusal at 13.0'

Left exclusion zone after picking up augers off bottom

		Body Temp °C	Pulse
1:21PM	Rusty	36.	96
	Buck	36.	92
	Dave	36.	87

1:26PM Lunch

2:15PM Drilling augers into borehole for GMW #503

Set 10.0' of #10 slot screen & 5' of riser in augers augered to open hole & set pipe. Will wait on water level

covered riser and borehole with 5-gallon bucket (inverted) at 2:30pm

Sheriff - Wayne Lee
Lyon Co came by
at 2:35pm

Start Decon of equip
at 3:05pm

3:36pm Set up on GMW #502

3:52pm

	pulse	temp°c
Dave	96	37.0
Rusty	100	36.9
Buck	90	36.3

BEGAN DRILLING @ 3:55

Melt F(x) on FEED LEVER 4.15.4 05

Left 20' of augers in hole for GMW #502 - waiting 24 hour water level. Borehole dry prior to departure from site at 5:20pm

Layne-Western took all equipment trucks and trailer off site for security reasons

6:30 stopped to inspect pump house on Section Road into site

5-23-90

Arrived on site at 8:AM
Cloudy, overcast, windy

GMW #503 – Dry
GMW #502 – Top H_2O 18.41 Top Auger
T.D. hole 20.8
Top H_2O 17.15 from grade

Pulled augers (20 ft.)
Bottom 1.5' visibly wet

Attempt to drill to 25
T.D. #502 -21.5'

#502 - Set 10' of #10 screen at 20.5'
sandpacked with 2" PVC Tremie
to 9', bentonite pellets to 6.5

Centralizer at 5.0' below grade

8 hour hydration time starts

10:47 AM 5-23-90
Final stickup

Lunch at Noon – Phone calls in Council Grove

Returned to site 1:PM to meet crew.

Set up exclusion zone around GMW #501 at 1:30 PM

2:PM	Pulse	Temp °C
Rusty	89	36.4
Buck	90	37.
Dave	100	37.4

Prepare to drill GMW #501 at 2:PM

3:18 PM Still Drilling #501

3:53 PM T.D. – 23.3'
Bottom of Spoon wet

4:19 PM pulled augers #501

Set 10.0' of #10 slot screen at 23.3' below grade at 4:37 PM

Top of Sand - 10.0'
Top of Bent. - 7.3'
Centralizer at 5.0'

8 hour hydration time on seal starts at 4:52 PM 5-23-90

5-24-90 Cloudy-cool ?
68°F
on site at 9:AM

Water Levels (B-ox)
GMW # 502 15.37 — D. 3.4
GMW # 501 20.01 T. 5.35

GMW #503 Dry
(Borehole)
Grouted #501 & 502 pavement patch at pos's
Left site at 10:10 AM
to call Corps (Jim Driel and Jim Johnson)

Also called office (Soil's Used me)

Decision to drill North #503 in attempt to find ground water North of 1st attempt

Returned to site at 1:00

Lunch 12 to 1 PM

Departed site at 1:15pm for Topeka to pick up HNU meter

3:02 PM Returned to site to commence Borehole for new #503

3:10pm set exclusion zone around New #503

3:20pm commence drilling NEW #503A

Relocated #503A Dry upon completion - Auger refusal at 8.8' on Bedrock

Set temporary screen and riser

5:45PM Departed site

5-25-90

Arrived on-site at 8:30 AM Sunny and warm - clear

Water levels

GMW #501 16.48' (BTOC)
GMW #502 15.02' (BTOC)
GMW #503 (Borehole)
GMW #504 (Borehole)

- Drummed all waste generated and sealed drums
- Water levels
- Still need to set brass markers, finish top the pads + drain away from covers, weep holes, paint poles and covers, develop wells

Departed site 9:15AM

5-2-90 onsite 8:AM
Sunny, strong wind cool
De-on surge roads, lines
Block

Water Level Prior to Dev.

GMW #501 - 14.83' (BTOC)
Total Depth - 25.53' (")

Development with 25' of
Decontaminated AW Drill Rod
with Neoprene seals

Commence Development
at 8:30 AM

Raised and lowered over entire
saturated interval for
1 hour
Cease surging at 9:30 AM

Water level at 9:AM

GMW # 502 14.59' (BTOC)
Total Depth 23.45 "

Calibrated pH meter
and Conductivity meter

9:25 Decon 2-4' PVC
Bailers ≥ DI and methanol

4' long PVC Bailers for Dev.
bottom check-ball valve
1½" O.D.

Cease surging # 501
at 9:30 AM

Decon surge equipment
with steam and DI 9:30
(All on plastic)
set up to surge # 502
at 9:45 AM

Commence surging #502
at 9:50 AM

Commence Bailing #501
at 9:55 AM
Gray-brown color and turbid
GMW # 501 went dry after
~ 3.5 gallons

Total of 5 gallons from #501
at 10:11 AM (stop

Drill weep holes and
paint posts

Cease surging #502
at 10:55 AM

Commence bailing #502 at 11:20 AM

Calib pH & Cond meters

#502 nearly dry after bailing ~3 gallons

Total - 5 gallons from #502 at 11:49 AM
closed well to paint post marker

6-3-90 Returned to site

Arrived on site at 8:40 AM
Sunny, 78°F, Windy

Commence bailing #502 at 9:45 AM

Almost dry at 10:AM after Bailing ~4 gallons

Bailed additional 1 gallon by 10:30 AM

Total gallons to date for Dec. 10 gallons

W.L. at 10:30 after well was bailed effectively Dry 21.4' (BTOC)

Start bailing #501 again at 11:AM > bailed til 11:25 AM removed an additional 0.5 gallon #501 went essentially dry

Total Development H_2O
from #501 at 11:05 AM
10 gallons

Water level #502
at 10:30 AM 21.4'
at 11. AM 20.25'

Water level #501
at 11:05 -23.6'
at 11:35 22.22

Left site at 11:45 AM
Will wait for wells
to reach near static levels
before continuing Development

DARK
Returned to site at 9:50 PM
W.L. #502 15.38

Bailed out 4 gallons
Total #502 14 gallons
10:12 PM
W.L. #501 - 16.07 - 10:17 PM
Bailed out 4 gallons
from #501
Total #501 14 gallons

10:30 PM cease

Departed site at 10:40 PM

6/4/90
Returned to site
at 7:20 PM
start 7:25PM
Bailed ~5 gallons from
GMW #502 cease 7:40PM
Total from #502
~19 gallons

Slow infiltration

start #501 7:55
Bailed ~5 gallons from
GMW #501 cease at 8:14
Total from #501
~19 gallons

Both wells - slow yield
approx 5 gallons / 8 hours

Departed site

6/5/90
Dark and cool

Returned to site at
4:30 AM
4:35AM Bailed ~5 gallons
from #502 in 10

4:59AM Bailed approx ~5 gallons
from #501

5:10 AM
Totals so far from #501
and #502

#501 → 24 gallons
#502 → 24 gallons

Returned to site
at 5:10pm

commence bailing #502

Bailed additional 4 gallons
pH = 7.1 Cond. = 660 T° = 18°C
cease bailing at 5:15PM

Sub Total #502 - 28 gallons

Commence bailing #501

pH=7.2 cond.= 660 T°=19°C

Removed 5 gallons

Total #501 - 29 gallon

Departed site at 5:45PM

5-6-96

Arrived on site at [illegible] PM

Water #502 14.[illegible]4' at 5:[illegible] PM

Commence bailing #502
at 5:41 PM

pH=7.1 Cond.= 60 T = 18°C

Cease bailing #502 [illegible]
5:50PM

Water still moderately [illegible]
Murky - green-[illegible] [illegible]
odor.

Well went almost dry at
5:56 after bailing [illegible] gallons

#502 { Total Development to date (5:59PM)
22.5 gallons
[illegible]
1 hour 59 minutes of bailing

Commence bailing at 6:[illegible] M
Cease at 6:[illegible] M
Removed additional [illegible]

6:26 PM Prepare to Bail #501
Commence bailing #501 at 6:30 pm
pH = 7.1 Cond. = 570 T° = 18°C
cease bailing of #50 at 6:45 PM

501 — Total Development of #501 to date
1 hour 30 minutes Bailing
1 hour surging
34 gallons

Pulled forms from Pads

Departed site at 7:15

6-7-90 — cloudy to sunny humid 80°F

Arrived on site at 1:25PM

Noticed that chain on locking mechanism on gate was loose from post - Not known if this was like this earlier

W.L. #502 - 15.12' at 1:30PM

Commence Bailing at 1:36PM

Bailed ~35 gallons
Well went dry
Cease Bailing #502 at 1:45PM

pH - 7.0 S.U.
Cond - 720 umhos/cm
Temp - 18.5°C
Color - clear initially to mod. cloudy brown-gray

Total Development #502
36 gallons
1 1/2 hour surging
2 hours 9 minutes of active bailing

WL. #501 - 15.73' at 2:02 PM

Commence Bailing #501 at 2:08 PM

Bailed out ~4 gallons
Well went nearly dry

Cease Bailing at 2:18 PM

pH - 7.2
Cond - 600
temp - 19°C

Clear initially turning to
Cloudy brown-gray

Total Development #501
1 hour 40 minutes of
active bailing
1 hour surging
38 gallons removed

Departed site at
2:31 PM after saying
goodbye to Bill

8/01/90 SUNNY 65° = 27

8:00 am ARRIVED ON-SITE

JULIE JENNINGS > O'BRIEN & GERE
SHAWN SOCK

BILL FERGUSON - USACE

8:15 am CALIBRATED EQUIPMENT
SET UP DE-CON STATION
PREPARED SAMPLING (X-MAS
CLEANED EQUIPMENT
measured well depth (DIA) 12.5'

8:30 am BEGAN BAILING

INITIAL MEASUREMENTS
pH 6.92
COND 520
TEMP 34°C
(clear no turbidity)

2nd MEASUREMENTS
pH 6.98
COND 580
TEMP 37°C
(very lt. tan) some turbidity

9:20 - ended bailing
- total 3 gal collected

- CLEANED EQUIPMENT

9:30 - MOVED TO GMW #502
FOUND WELL OPEN

BROKE DOWN DE-CON STATION

10:00 DEPARTED SITE

10:15 CALLED OFFICE

BILL SAID DOL STONE SAID DO SAMPLE GMW #502

11:00 RETURNED TO SITE #502
Collected Equipment
Set up D.Con
Resurveyed Sample location
Cleaned Equipment
Measured Well depth (BTW 17.22')

11:15 - Began Bailing

Initial Measurements
pH 6.9
Cond. 65c
Temp. 22 C
(Clear no turbidity)

2nd Measurements
pH 7.10
Cond. 65c
Temp. 22°C
(Almost clear only little turb

12:15 ended bailing
3 gallons removed
- slight turbidity
- Decon
- Broke down station

12:30 departed

- Photographed new drainage entryway, gate

30

8/02 Cloudy

7:30 am Arrived on site
set up de-con station
and boiling station
Calibrated equipment

8:00 am began boiling #502

@ 4.5 gal. pH ~~6.99~~ 6.58
cond. 570
Temp 17°C (light brown moderate turb.)

@ 6.0 gal pH 7.16
cond. 590
Temp. 17°C (pewter color moderately heavy turb.)

8:30 finish boiling
De-con
8:45 move to #502
Set up boiling station

31

9:00 : Begin boiling #502

@ 4.0 gallons
pH 6.58
cond. 670
Temp 17°C (brown cloudy mod. turb. silty)

@ 5.0 gallons pH 7.96
Cond. 695
Temp 17.5°C (grey-green heavy turb.)

7:20 finish boiling
De-con,
break down boiling & de-con
stations

9:40 depart site for Council Grove

Note: Bill borrowed a lock for GMW # 502.

8-02

10:00 planned office - Council / Graves
- informed Suzanne of situation: wells were still cloudy - not allowed to sample - awaiting reply from KDHE re: soil piles
- After conference call w/ USACE, Suzanne called to say we should spread soil if able and return to St. Louis
- Chuck Linn of KDHE out of office til 1:00pm

11:30 took Council groups

1:00 phoned Charles Linn - KDHE
- left message to have him call
- phone tag for 1½ hrs.

2:30 - finally caught up to Charles Linn said ok to spread dirt.
- Prepared papers to follow.

6:30pm Returned to site to spread soil and remove trash.

7:30pm Departed site

APPENDIX D

FIELD SAMPLING REPORTS AND CHAIN-OF-CUSTODY RECORDS FOR SOIL SAMPLES

FIELD SAMPLING REPORT

SAMPLE INFORMATION SAMPLE I.D. NO.: SSTB1

MATERIAL: WATER x SOIL ___ SLUDGE ___ OTHER ___
TYPE: GRAB x COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN x

CONTAINER		NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
TYPE	VOLUME			
glass vial	40ml	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) N/A

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION WEATHER Sunny AIR TEMP. 80°F

SAMPLES SHIPPED TO: SWLO
SPECIAL HANDLING: —
MODE OF SHIPMENT: Fed-Ex

QA/QC

SAMPLES COLLECTED BY: AJR OBSERVED BY: JBJ
DISCREPENCIES: —

FIELD SAMPLING REPORT

SAMPLE INFORMATION SAMPLE I.D. NO.: SS1

MATERIAL: WATER ___ SOIL X SLUDGE ___ OTHER ___

TYPE: GRAB X COMPOSITE ___ OTHER ___

HAZARDOUS: YES ___ NO ___ UNKNOWN X

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
w.m. glass	4 oz	2	4°C	
wm glass	8 oz	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) NA

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION WEATHER SUNNY AIR TEMP. 80°F

SAMPLES SHIPPED TO: SWLO

SPECIAL HANDLING: ___

MODE OF SHIPMENT: FED-EX

QA/QC

SAMPLES COLLECTED BY: AJR OBSERVED BY: JBJ

DISCREPENCIES: -

FIELD SAMPLING REPORT

SAMPLE INFORMATION | SAMPLE I.D. NO.: 5552

MATERIAL: WATER ___ SOIL X SLUDGE ___ OTHER ___
TYPE: GRAB X COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN X

CONTAINER		NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
TYPE	VOLUME			
wm glass	4oz	2	4°C	
wm glass	8oz	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) NA

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION | WEATHER Sunny AIR TEMP. 80°F

SAMPLES SHIPPED TO: SWLD
SPECIAL HANDLING: —
MODE OF SHIPMENT: FED EX

QA/QC

SAMPLES COLLECTED BY: JBJ OBSERVED BY: AJR
DISCREPENCIES: ___

FIELD SAMPLING REPORT

SAMPLE INFORMATION | SAMPLE I.D. NO.: DS552

MATERIAL: WATER ___ SOIL X SLUDGE ___ OTHER ___
TYPE: GRAB X COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN X

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
wm glass	4 oz	2	4°C	
wm glass	8 oz	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) N/A

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION | WEATHER Sunny AIR TEMP. 80°F

SAMPLES SHIPPED TO: SWLO
SPECIAL HANDLING: -
MODE OF SHIPMENT: Fed-Ex

QA/QC

SAMPLES COLLECTED BY: JBJ OBSERVED BY: AJR
DISCREPENCIES: —

FIELD SAMPLING REPORT

SAMPLE INFORMATION SAMPLE I.D. NO.: S553

MATERIAL: WATER ___ SOIL x SLUDGE ___ OTHER ___

TYPE: GRAB x COMPOSITE ___ OTHER ___

HAZARDOUS: YES ___ NO ___ UNKNOWN x

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
wm glass	4oz	2	4°C	
wm glass	8oz	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) N/A

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION WEATHER Sunny AIR TEMP. 80°F

SAMPLES SHIPPED TO: SWLO

SPECIAL HANDLING: -

MODE OF SHIPMENT: FED-EX

QA/QC

SAMPLES COLLECTED BY: AJR OBSERVED BY: JBJ

DISCREPENCIES: -

FIELD SAMPLING REPORT

SAMPLE INFORMATION | SAMPLE I.D. NO.: SS54

MATERIAL: WATER ___ SOIL X SLUDGE ___ OTHER ___
TYPE: GRAB X COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN X

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
wm glass	4 oz	2	4°C	
wm glass	8 oz	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) NA

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION | WEATHER Sunny AIR TEMP. 80°F

SAMPLES SHIPPED TO: SWLO
SPECIAL HANDLING: —
MODE OF SHIPMENT: FED-EX

QA/QC

SAMPLES COLLECTED BY: AJR OBSERVED BY: JBJ
DISCREPENCIES: —

FIELD SAMPLING REPORT

SAMPLE INFORMATION | SAMPLE I.D. NO.: S555

MATERIAL: WATER ___ SOIL X SLUDGE ___ OTHER ___
TYPE: GRAB ___ X COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN X

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
wm glass	4 oz	2	4°C	
wm glass	8 oz	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) NA

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION | WEATHER Sunny AIR TEMP. 80°F

SAMPLES SHIPPED TO: SWLO
SPECIAL HANDLING: —
MODE OF SHIPMENT: Fed-Ex

QA/QC

SAMPLES COLLECTED BY: JBV OBSERVED BY: AJR
DISCREPENCIES: —

FIELD SAMPLING REPORT

SAMPLE INFORMATION SAMPLE I.D. NO.: 5556

MATERIAL: WATER ___ SOIL x SLUDGE ___ OTHER ___
TYPE: GRAB x COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN x

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
wm glass	4 oz	2	4°C	
wm glass	8 oz	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) NA

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION WEATHER Sunny AIR TEMP. 80°F

SAMPLES SHIPPED TO: SWLO
SPECIAL HANDLING: -
MODE OF SHIPMENT: Fed-Ex

QA/QC

SAMPLES COLLECTED BY: AJR OBSERVED BY: VBJ
DISCREPENCIES: -

FIELD SAMPLING REPORT

SAMPLE INFORMATION SAMPLE I.D. NO.: MSSTB1

MATERIAL: WATER x SOIL ___ SLUDGE ___ OTHER ___
TYPE: GRAB x COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN x

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
glass vial	40ml	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) N/A

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION WEATHER SUNNY AIR TEMP. 80°F

SAMPLES SHIPPED TO: CENRD-ED-C
SPECIAL HANDLING: -
MODE OF SHIPMENT: FED-EX

QA/QC

SAMPLES COLLECTED BY: AJR OBSERVED BY: JBJ
DISCREPENCIES: -

FIELD SAMPLING REPORT

SAMPLE INFORMATION | SAMPLE I.D. NO.: DWS

MATERIAL: WATER X SOIL ___ SLUDGE ___ OTHER ___
TYPE: GRAB X COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN X

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
Plastic	1000 ml	1	HNO_3 / 4°C	
amber glass	1 l	2	4°C	
glass vial	40 ml	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) N/A

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS
pH - Metals		2.04	

COMMENTS: (CALIBRATIONS)

GENERAL INFORMATION | WEATHER Sunny AIR TEMP. 80°F

SAMPLES SHIPPED TO: CEMRD-ED-L
SPECIAL HANDLING: -
MODE OF SHIPMENT: Fed-Ex

QA/QC

SAMPLES COLLECTED BY: JBJ OBSERVED BY: AJR
DISCREPENCIES: —

FIELD SAMPLING REPORT

SAMPLE INFORMATION | SAMPLE I.D. NO.: MR5552

MATERIAL: WATER X SOIL ___ SLUDGE ___ OTHER ___
TYPE: GRAB X COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN X

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
Plastic	1000 ml	1	HNO_3 / 4°C	
amber glass	1 l	2	4°C	
glass vial	40 ml	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) N/A

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS
pH - Metals		1.97	

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION | WEATHER Sunny AIR TEMP. 80°F

SAMPLES SHIPPED TO: USACE - MRD
SPECIAL HANDLING: —
MODE OF SHIPMENT: Fed-Ex

QA/QC

SAMPLES COLLECTED BY: AJR OBSERVED BY: JBJ
DISCREPENCIES: —

FIELD SAMPLING REPORT

SAMPLE INFORMATION SAMPLE I.D. NO.: MSSS2

MATERIAL: WATER ___ SOIL X SLUDGE ___ OTHER ___
TYPE: GRAB X COMPOSITE ___ OTHER ___
HAZARDOUS: YES ___ NO ___ UNKNOWN X

CONTAINER TYPE	CONTAINER VOLUME	NUMBER	PRESERVATIVE/ PREPARATION	COMMENTS
wm glass	4 oz	2	4°C	
wm glass	8 oz.	2	4°C	

COMMENTS: (WELL PURGING VOLUME; ODOR; ETC.) NA

FIELD MEASUREMENTS

PARAMETER	EQUIPTMENT I.D.	RESULTS	COMMENTS

COMMENTS: (CALIBRATIONS) ___

GENERAL INFORMATION WEATHER SUNNY AIR TEMP. 80°F

SAMPLES SHIPPED TO: CENTRAL EDL
SPECIAL HANDLING: -
MODE OF SHIPMENT: FED-EX

QA/QC

SAMPLES COLLECTED BY: JBJ OBSERVED BY: AJR
DISCREPENCIES: ___

FIELD - JULIE B. JENNINGS
OFFICE - SUZANNE M. RINEY
5000 CEDAR PLAZA PKWY
STE. 211
ST. LOUIS, MO 63128
(314) 842-4550

O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY: FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B. Jennings / Harold Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	SAMPLE TYPE: Water Grab	SAMPLE TYPE: Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
5551		5/23/90	8:30am		X			2-4 oz.	VOA (8240)
								1-8 oz	PAH (8270)
								1-8 oz.	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7740) Se
5552		5/23/90	9:00am		X			2-4 oz.	VOA (8240)
								1-8 oz	PAH (8270)
								1-8 oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se

Relinquished by: (Signature) Julie B. Jennings / Harold Ramsey	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature) — Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:		

FIELD - JULIE B. JENNINGS
OFFICE - SUSANNE M. RINEY
5000 CEDAR PLAZA PKWY
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ST. LOUIS, MO 63128
(314) 842-4550

O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY: FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B Jennings / Harold J Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	SAMPLE TYPE: Water Grab	SAMPLE TYPE: Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
5553		5/23/90	9:30am		X			2-4oz	VOA (8240)
								1-8oz	PAH (8270)
								1-8oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se
5554		5/23/90	10:00am		X			2-4oz	VOA (8240)
								1-8oz	PAH (8270)
								1-8oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se

Relinquished by: (Signature) Julie B Jennings / Harold J Ramsey	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature) / Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:		

O'Brien & Gere Engineers, Inc.
Building Technologies Division

O'BRIEN & GERE

FIELD - JULIE B. JENNINGS
OFFICE - SUSANNE M. RINEY
5000 CEDAR PLAZA PKWY
STE. 211
ST. LOUIS, MO 63128
(314) 842-4550

CHAIN OF CUSTODY RECORD

3068.020

SURVEY: FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B Jennings / Harold J Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	Water Grab	Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
5555		5/23/90	10:30am		X			2-4oz	VOA (8240)
								1-8oz	PAH (8270)
								1-8oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se
5556		5/23/90	11:00am		X			2-4oz	VOA (8240)
								1-8oz	PAH (8270)
								1-8oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se

Relinquished by: (Signature) Julie B Jennings / Harold J Ramsey	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature) / Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:		

FIELD - JULIE B. JENNINGS
OFFICE - SUZANNE M. RINEY
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O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY: FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B. Jennings / Harold J. Rawson

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	SAMPLE TYPE: Water Grab	SAMPLE TYPE: Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
DS5S2		5/23/90	9:00am		X			2-40z.	VOA (8240)
								1-8oz.	PAH (8270)
								1-8oz.	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7040) As (7470) Hg (7741) Se
RS5S2		5/23/90	9:00am		X			2-40ml	VOA (8240)
								2-1l	PAH (8270)
								1-1000ml	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7040) As (7470) Hg (7741) Se

Relinquished by: (Signature) Julie B. Jennings / Harold J. Rawson	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature) / Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:		

O'Brien & Gere Engineers, Inc.
Business Park Systems Division

FIELD - JULIE B. JENNINGS
OFFICE - SUSANNE M. RINEY
5000 CEDAR PLAZA PKWY
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O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B. Jennings / Harold J. Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	Water Grab	Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
55TB1		5/23/90	8:00am		X			2-40ml	PAH (8270)

Relinquished by: (Signature) Julie B. Jennings / Harold J. Ramsey — Received by: (Signature) — Date/Time

Relinquished by: (Signature) — Received by: (Signature) — Date/Time

Relinquished by: (Signature) — Received by: (Signature) — Date/Time

Relinquished by: (Signature) — Received by Mobile Laboratory for field analysis: (Signature) — Date/Time

Dispatched by: (Signature) — Date/Time — Received for Laboratory by: — Date/Time

Method of Shipment:

FIELD - JULIE B. JENNINGS
OFFICE - SUZANNE M. RINEY
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O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HULTON, KANSAS

SAMPLERS: (Signature) Julie B. Jennings / Harold J. Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	Water Grab	Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
1,55 TB1		5/23/90	8:00am		x			2-40ml	VOA (8240)
DW5		5/23/90	8:00am		x			2-40ml	VOA (8240)
								2-1l	PAH (8270)
								1-1000ml	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se

Relinquished by: (Signature) Julie B. Jennings / Harold J. Ramsey	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature) — Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:		

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O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY: FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B. Jennings / Harold J. Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	Water Grab	Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSES REQUIRED
MS552		5/23/90	9:00am		X			2-40z.	VOA (8240)
								1-8oz.	PAH (8270)
								1-8oz.	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7040) Hg (7741) Se
MRS552		5/23/90	9:00am		X			2-40ml	VOA (8240)
								2-1l	PAH (8270)
								1-1000ml	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7040) Hg (7741) Se

Relinquished by: (Signature) Julie B. Jennings / Harold J. Ramsey	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature) — Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:		

O'Brien & Gere Engineers, Inc.
O'Brien & Gere Building, Butler Road, Syracuse, New York

APPENDIX E

WELL DEVELOPMENT DATA

O'BRIEN & GERE

O'BRIEN & GERE ENGINEERS, INC. JOB NAME Former Forbes Atlas Missile Site-5 Bushong, KS JOB NO. 3068.020

BY Dave CiKa DATE 6-2-90 SHEET 1 OF 2

WELL DEVELOPMENT DATA

1. Well No. GMW # 501
2. Date of Installation 5-23-90
3. Dates of Development 6-2-90 thru 6-7-90
4. Static Water Level: Before Dev. 14.83 (BTOC) Ft.; 24 Hours After _____ Ft.
5. Quantity of Water Loss During Drilling, If Used N/A Gal.
6. Quantity of Standing Water in Well and Annulus Before Dev. 5.9 Gal.

	Start	During		End
7. Specific Conductance (unhos/cm)	640	660	600	610
Temperature (°C)	17.5°C	19°C	19°C	19°C
PH (s.u.)	7.04 (No odor)	7.2	7.2	7.17

8. Depth from Top of Well Casing to Bottom of Well 25.53 Ft.
9. Screen Length 10.0' Ft.
10. Depth to Top of Sediment: Before Dev. 25.53 Ft.; After Dev. 25.53 Ft.
11. Physical Character of Water: Initially - medium brown-gray, moderate heavy turbidity
12. Type and Size of Well Development Equipment: 5' of AW drill rod attached to surge block with neoprene seals - 4' long, 1½" O.D., bottom check ball valve discharge PVC bailer ≈ Poly Rope
13. Description of Surge Technique, If Used: Raised and lowered surge block over entire saturated interval for 1hour
14. Height of Well Casing Above Ground Surface: ~2.5 Ft.
15. Total Quantity of Water Removed: 38 Gal. as of 6-7-90
16. 1-Pint Water Sample Collected: _____ (Time)

* Development Conditions:

(1) Well Water is Reasonably Clear

(2) Sediment Thickness < 5% of Screen Length

(3) Removal of 5 Well Volumes, Including Saturated Filter Annulus

(4) Stabilization of Specific Conductance and Water Temperature

17. After Final Development of the well, water from each well will be placed into the 1 liter clear glass container and photographed as a 35 mm. color slide to be submitted as part of the well log.
18. QA/QC: Development Performed by: Layne Western / O'Brien and Gere

Site Manager: Dave CiKa

O'BRIEN & GERE

O'BRIEN & GERE ENGINEERS, INC. JOB NAME Former Forbes Atlas Missile Site-5 Bushong, KS JOB NO. 3060.020

BY Dave Cika DATE 6-2-90 SHEET 2 OF 2

WELL DEVELOPMENT DATA

1. Well No. GMW #502
2. Date of Installation 5-23-90
3. Dates of Development 6-2-90 thru 6-7-90
4. Static Water Level: Before Dev. 14.59 (BTOC) Ft.; 24 Hours After _____ Ft.
5. Quantity of Water Loss During Drilling, If Used N/A Gal.
6. Quantity of Standing Water in Well and Annulus Before Dev. 4.9 Gal.

	Start	During		End
7. Specific Conductance (umhos/cm)	590	660	720	710
Temperature (C)	18.5°C	18°C	19.5°C	18.5°C
PH (s.u.)	6.77	7.10	7.02	7.01

8. Depth from Top of Well Casing to Bottom of Well 23.45 Ft.
9. Screen Length 10.0 Ft.
10. Depth to Top of Sediment: Before Dev. 23.45 Ft.; After Dev. 23.45 Ft.
11. Physical Character of Water: Initially - Medium gray-brown, moderately heavy turbidity
During -
12. Type and Size of Well Development Equipment: 5' of AW drill rod attached to surge block with neoprene seals - 4' long, 1½" O.D., bottom check ball valve discharge PVC bailer & Poly Rope
13. Description of Surge Technique, If Used: Raised and lowered surge block over entire saturated interval for 1 hour.
14. Height of Well Casing Above Ground Surface: ~2.5 Ft.
15. Total Quantity of Water Removed: 36 Gal.
16. 1-Pint Water Sample Collected: _____ (Time)

* Development Conditions:

(1) Well Water is Reasonably Clear

(2) Sediment Thickness < 5% of Screen Length

(3) Removal of 5 Well Volumes, Including Saturated Filter Annulus

(4) Stabilization of Specific Conductance and Water Temperature

17. After Final Development of the well, water from each well will be placed into the 1 liter clear glass container and photographed as a 35 mm. color slide to be submitted as part of the well log.
18. QA/QC: Development Performed by: Layne-Western / O'Brien and Gere

Site Manager: Dave Cika

APPENDIX F

USACE FIELD REPORT

DEPARTMENT OF THE ARMY
KANSAS CITY DISTRICT, CORPS OF ENGINEERS
700 FEDERAL BUILDING
KANSAS CITY, MISSOURI 64106-2896

RECEIVED
FEB 13 1991
O'Brien & Gere Engineers, Inc.
St. Louis, MO

REPLY TO
ATTENTION OF:

February 1, 1991

Toxic and Hazardous
Waste Management Branch

Mr. Gary Fern
O'Brien and Gere
5000 Cedar Plaza Parkway
Suite 211
St. Louis, Missouri 63128

Dear Mr. Fern:

As you requested, we are submitting details of the work performed by the Kansas City District, Corps of Engineers drill crew at Forbes Atlas Missile Sites 5 and 9.

If you have any questions, please contact, Mr. Jim Johnson, of my staff, at 816-426-2619.

Sincerely,

Frank S. Bader
Chief, Toxic and Hazardous
Waste Management Branch

Enclosure

FORBES ATLAS MISSILE SITES 5 AND 9
IN BUSHONG AND HOLTON, KANSAS

1. The purpose of the Kansas City District Corps of Engineers drill crew was to develop, purge and sample the seven monitoring wells at Bushong and Holton, Kansas.

2. Development was performed using a CME 55 drill rig with an attached two-inch diameter 15-foot surge block. Surging consisted of working the screened interval for approximately 20 minutes each cycle. Surging alternated with bailing of approximately 5 gallons of water or until the well was dry. The bailer was a 2-inch teflon with teflon line.

3. After mechanical development, a bladder pump was used to purge and sample the wells. The bladder pump was not used on the Bushong monitoring wells due to the small quantity of water in the wells. A bailer was used to sample the Bushong wells. Prior to sampling, temperature, pH and conductivity were monitored until stabilized (see enclosure 3.1).

4. The Holton wells were developed and sampled between 15 and 20 August 1990. Following are the details of development time, quantity and quality of water removal from the wells.

4.1 Well GMW-901 was surged and bailed dry removing between 2 and 5 gallons of water each cycle to equal 14 gallons. After four hours using a bladder pump, another 14 gallons were removed for a total of 28 gallons. Surging and bailing continued for 85 minutes, as a result clear water samples were collected for laboratory analysis.

4.2 GMW-902 surge cycles 20 minutes in length alternated with removal of 10 gallons of water. The well was not bailed dry during development or sampling. A total of 30 gallons were bailed and 15 additional gallons were removed with a bladder pump after 1.5 hours. Development continued for 158 minutes, clear samples were then collected for analysis.

4.3 The surge block was unable to be lowered into GMW-903 due to the misalignment of the well.

4.4 Development of GMW-904 alternated surging for 20 minutes with bailing the well dry for a total of 54 minutes and removal of 12 gallons of water. After 9 hours, another 20 gallons of water were removed with a bladder pump. Samples taken for chemical analysis were slightly merky.

5. The Bushong monitoring wells were developed with a surge block and bailer. The wells were developed and sampled between 21 and 30 August 1990.

5.1 GMW-501 was developed for 135 minutes and approximately 11 gallons of water were bailed before sampling. GMW-502 was surged and bailed for 131 minutes, and 16 gallons were removed prior to sampling.

5.2 Water samples from both monitoring wells were clear with a slight cloudiness after the second or third bail.

6.0 Decontamination consisted of washing the bailer, surge block and electronic water level indicator with an Alconox solution. Equipment was then thoroughly rinsed with distilled water.

7.0 Water samples for chemical analysis were bottled in containers provided by O'Brien and Gere, and preserved as the work plan designated. The sample coolers were sent by Federal Express to the appropriate laboratories.

	WATER LEVEL PRIOR TO DEVELOPMENT	TIME	SPECIFIC CONDUCTIVITY	TEMPERATURE °C	pH
GMW-901	3.8'				
		1845	840	28°	7.21
		1915	850	28°	6.97
		1955	860	26°	7.04
GMW-902	10.9'				
		1230	970	25°	6.47
		1245	970	23°	6.47
		1300	990	24°	6.47
GMW-904	11.9'				
		1405	810	30°	7.64
		1430	810	29°	7.49
		1500	810	26°	7.85
GMW-501	18.6'				
		0809	730	17°	7.17
GMW-502	17.9'				
		1025	900	19°	7.09
		1513	880	22°	7.15
	(from top of casing)				

APPENDIX G

SITE SURVEY

APPENDIX H

GEOTECHNICAL ANALYTICAL RESULTS

1982 Innerbelt Business Center Drive • St. Louis, Missouri 63114 • 314-427-7775 • Fax 314-427-6828

Geotechnical and Environmental Consultants

August 20, 1990

O'Brien & Gere Engineers, Inc.
5000 Cedar Plaza Parkway, Suite 211
St. Louis, Missouri 63128

Attn: Mr. A. J. Ramsey

Re: Laboratory Test Results
Forbes Atlas Missile Sites
Bushong and Holton, Kansas

Gentlemen:

Submitted herewith are the laboratory test results for a moisture content (ASTM D 2216), an Atterberg limit (ASTM D 4318) and a gradation analysis (ASTM D 422) conducted on each sample provided by you. The results are shown in Figures 1 through 6.

If you have any questions, please call.

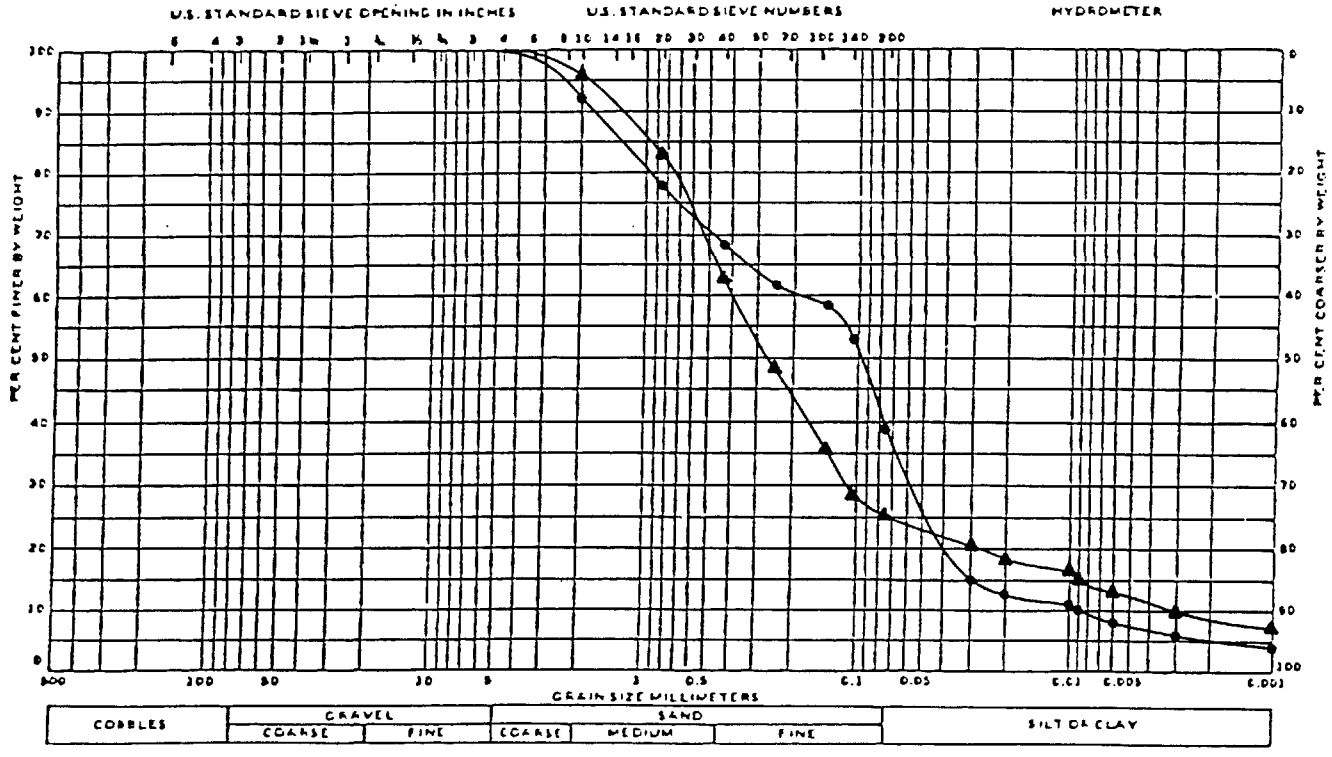
Very truly yours,
MIDWEST TESTING, INC.

Jacqueline R. Griggs
Supervisor, Field and Laboratory Services

JRG/

90634

GRADATION CURVES



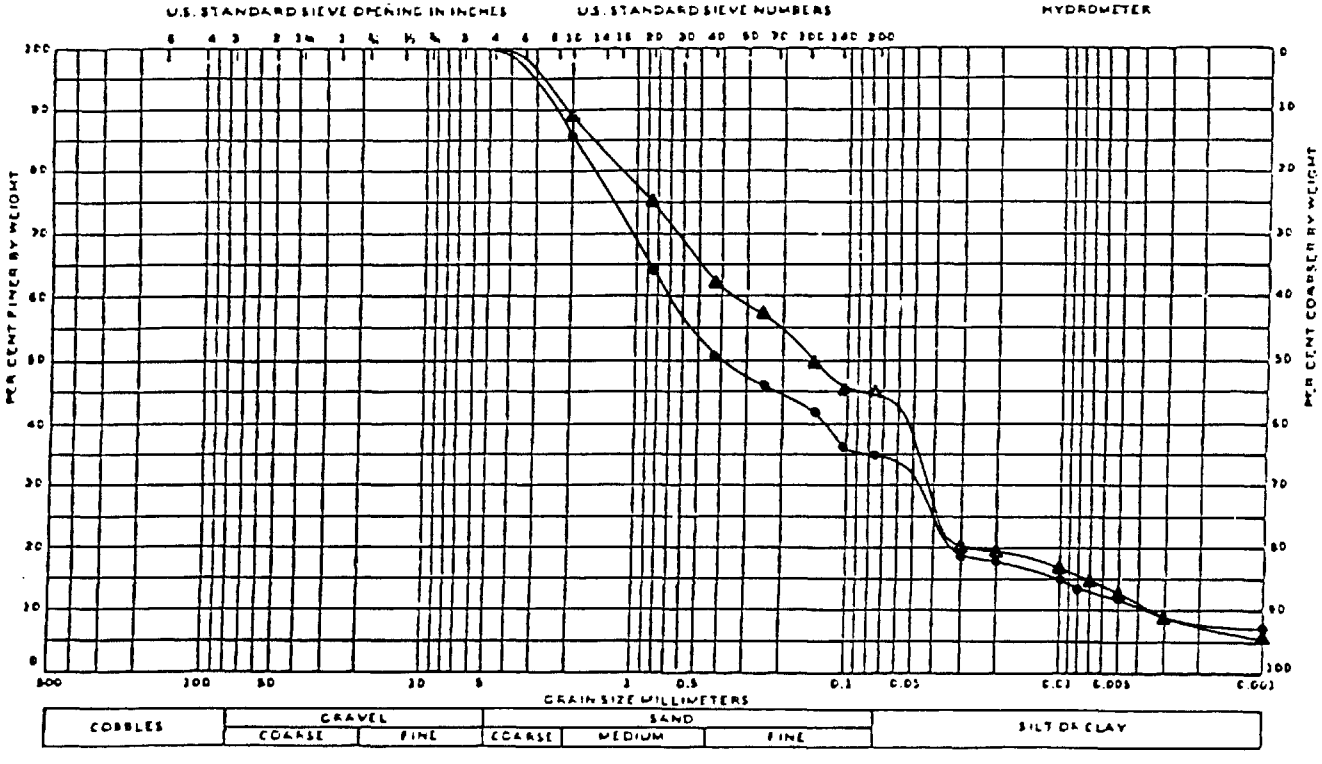
Curve	Sample No.	Depth, ft.	Description	Moisture Content, %	Liquid Limit	Plastic Limit
●	501	3 - 5	Gray Silt (ML)	27.0	48	30
▲	501	19 - 21	Gray Clayey Silt (MH)	19.7	58	38

GRADATION CURVES
Forbes Atlas Missile Site
Bushong, Kansas

Figure 1

90634

GRADATION CURVES

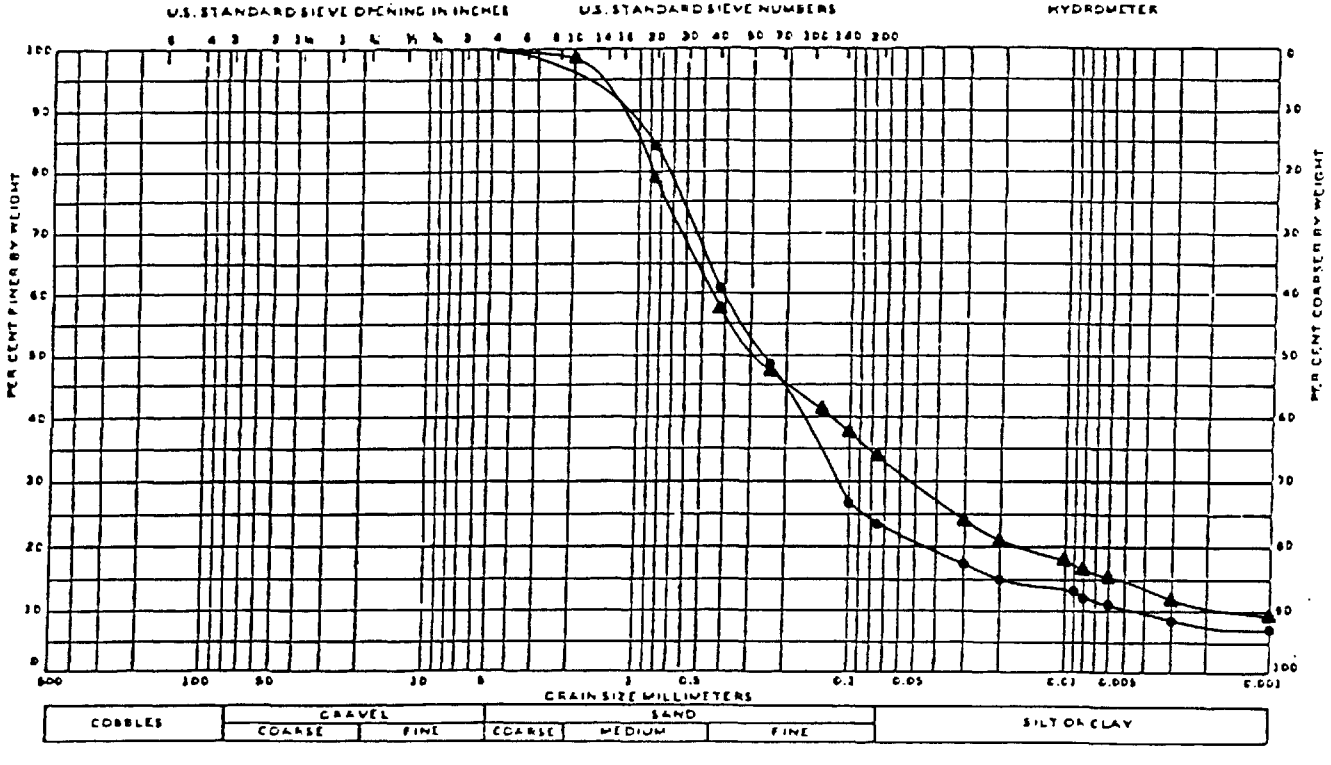


Curve	Sample No.	Depth, ft.	Description	Moisture Content, %	Liquid Limit	Plastic Limit
●	502	4 - 6	Brown Clay (CH)	27.0	51	22
▲	502	8 - 10	Brown Silty Clay (CH)	16.4	36	20

GRADATION CURVES
Forbes Atlas Missile Site
Bushong, Kansas

Figure 2

GRADATION CURVES

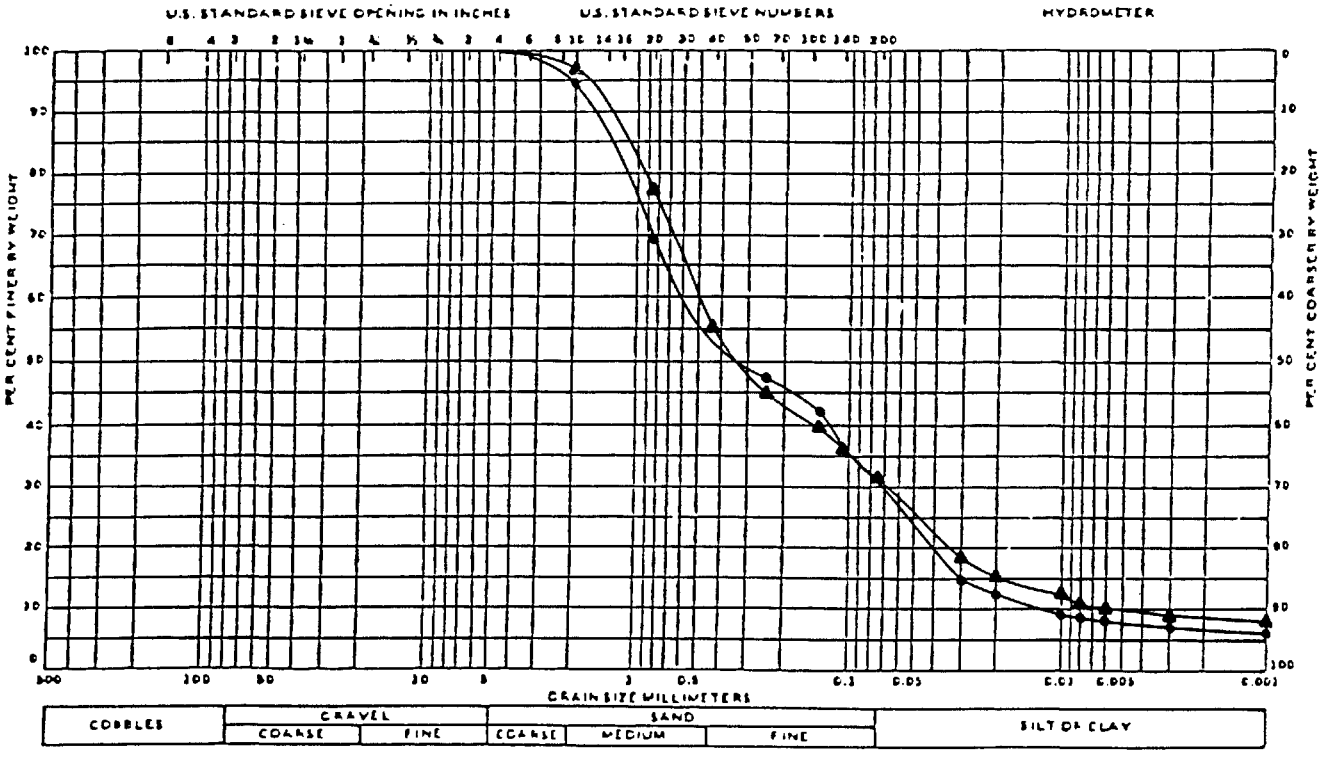


Curve	Sample No.	Depth, ft.	Description	Moisture Content, %	Liquid Limit	Plastic Limit
●	901	8 - 10	Brown Silty Clay (CL)	20.7	44	25
▲	901	23 - 25	Gray Silty Clay (CL)	17.9	32	18

GRADATION CURVES
Forbes Atlas Missile Site
Holton, Kansas

Figure 3

GRADATION CURVES



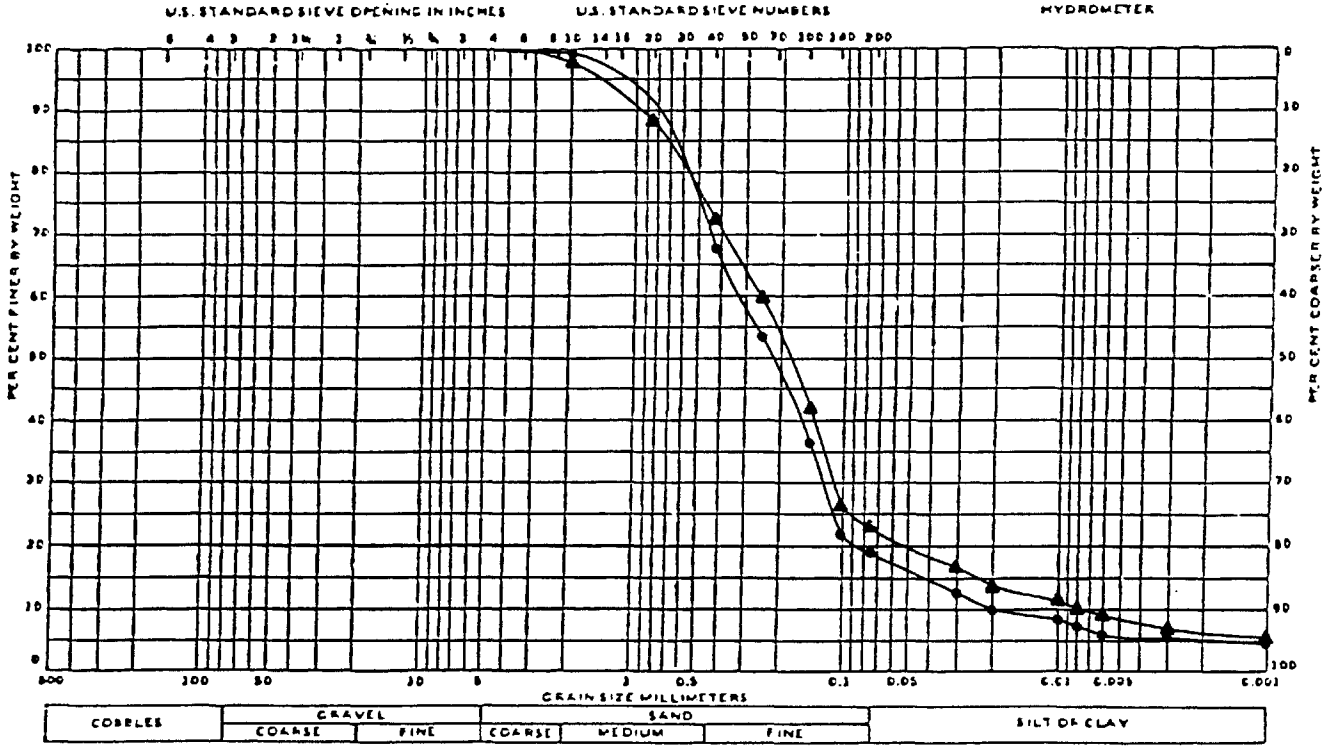
Curve	Sample No.	Depth, ft.	Description	Moisture Content, %	Liquid Limit	Plastic Limit
●	902	10 - 12	Brown Silty Clay (CL)	24.8	46	25
▲	902	16 - 18	Brown Silty Clay (CL)	20.2	42	22

GRADATION CURVES
Forbes Atlas Missile Site
Holton, Kansas

Figure 4

90634

GRADATION CURVES

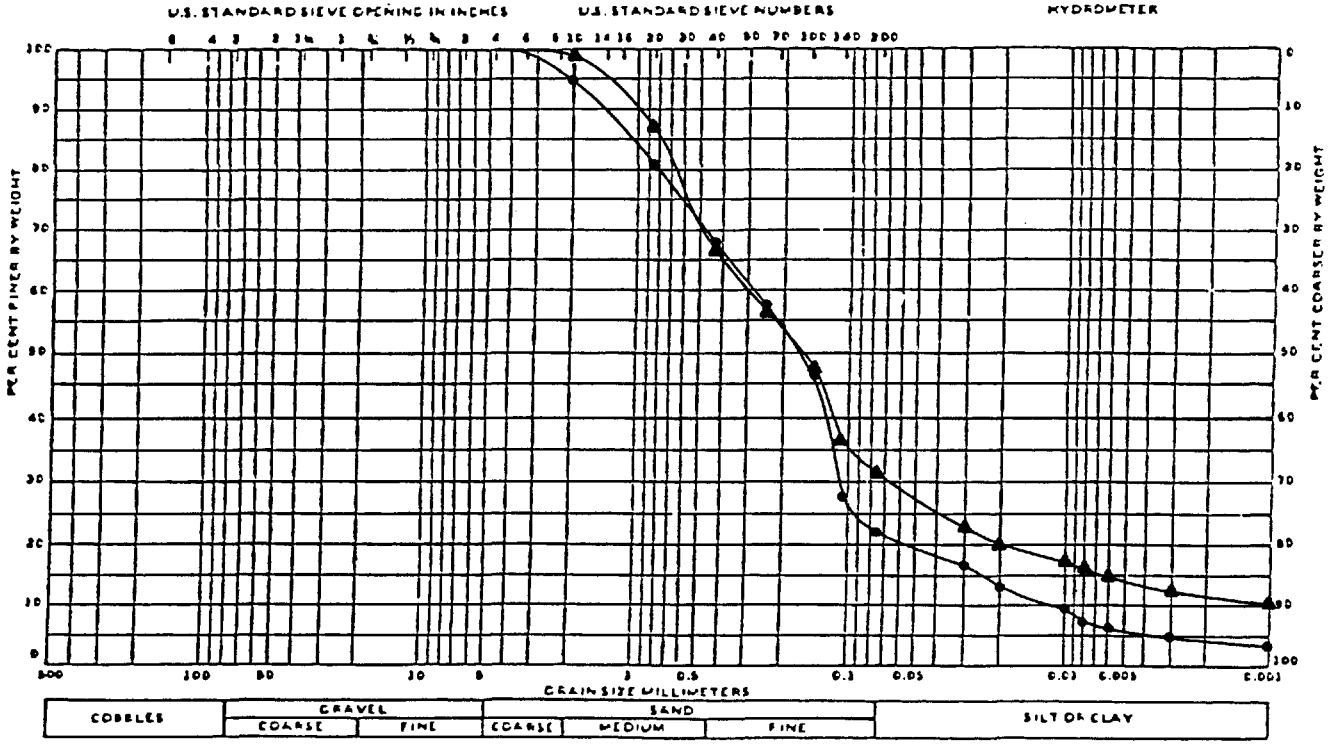


Curve	Sample No.	Depth, ft.	Description	Moisture Content, %	Liquid Limit	Plastic Limit
●	903	18 - 20	Brown Silty Clay (CL)	21.3	43	21
▲	903	27 - 29	Brown Silty Clay (CL)	18.6	27	18

GRADATION CURVES
Forbes Atlas Missile Site
Holton, Kansas

Figure 5

GRADATION CURVES



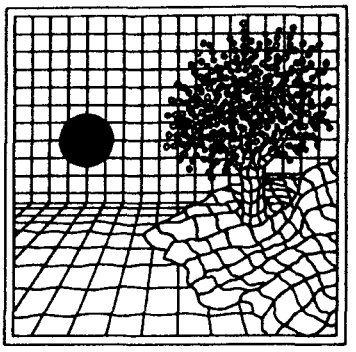
Curve	Sample No.	Depth, ft.	Description	Moisture Content, %	Liquid Limit	Plastic Limit
●	904	13 - 15	Brown Silty Clay (CL)	25.2	32	22
▲	904	18 - 20	Gray Silty Clay (CL)	16.2	39	21

GRADATION CURVES
Forbes Atlas Missile Site
Holton, Kansas

Figure 6

APPENDIX I

ANALYTICAL RESULTS FOR FIELD AND QUALITY CONTROL SOIL SAMPLES



SOUTHWEST LABORATORY OF OKLAHOMA, INC.

June 20, 1990

Julie Jennings
O'BRIEN & GERE
5000 Cedar Plaza Parkway, Suite 211
St. Louis, Missouri 63128

Project: Former Fobes Atlas Missile Sites

Dear Ms. Jennings:

Enclosed are the analytical results for your samples received in our laboratory on May 24, 1990, for the above captioned project.

If, in your review, you should have any questions or require additional information, please call.

Sincerely,

K. M. Bagawandoss Ph. D.
Project Manager

KMB/jal

Enclosures

1700 WEST ALBANY, SUITE C • BROKEN ARROW, OK 74012
(918) 251-2858 • FAX (918) 251-2599

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.01MT

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.01
DATE SUBMITTED: 05-24-90
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5S1

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL METALS					
ARSENIC	2.0	mg/Kg	6.7	05-31-90	SW 7060
BARIUM	4.0	mg/Kg	134	06-05-90	SW 6010
CADMIUM	1.0	mg/Kg	ND	06-05-90	SW 6010
CHROMIUM	1.0	mg/Kg	18.9	06-05-90	SW 6010
LEAD	4.0	mg/Kg	23.0	06-05-90	SW 6010
MERCURY	0.1	mg/Kg	ND	06-11-90	SW 7471
SELENIUM	1.0	mg/Kg	ND	06-01-90	SW 7740
SILVER	2.0	mg/Kg	ND	06-05-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = EPA METHODOLOGY, "#SW846", THIRD EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.03V

DATE: 06-19-90

SAMPLE MATRIX: SOIL
SWLO # 2669.03
DATE SUBMITTED: 05-24-90
DATE ANALYZED : 05-29-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5S3

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	22	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	2	BJ	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	2	BJ	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(81-117) 107% BROMOFLUOROBENZENE(74-121) 82% 1,2-DICHLOROETHANE-d4(70-121) 102%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.03PN

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.03
DATE SUBMITTED: 05-24-90
DATE EXTRACTED: 05-29-90
DATE ANALYZED : 06-05-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: S5S3

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	660	ND
2-METHYLNAPHTHALENE	660	ND
2-CHLORONAPHTHALENE	660	ND
[illegible]ENAPHTHYLENE	660	ND
[illegible]ENAPHTHENE	660	ND
FLUORENE	660	ND
PHENANTHRENE	660	ND
ANTHRACENE	660	ND
FLUORANTHENE	660	ND
PYRENE	660	ND
BENZO(A)ANTHRACENE	660	ND
CHRYSENE	660	ND
BENZO(B)FLUORANTHENE	660	ND
BENZO(K)FLUORANTHENE	660	ND
BENZO(A)PYRENE	660	ND
INDENO(1,2,3-CD)PYRENE	660	ND
DIBENZ(A,H)ANTHRACENE	660	ND
BENZO(G,H,I)PERYLENE	660	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (23-120) 78% 2-FLUOROBIPHENYL (30-115) 84% TERPHENYL-d14 (18-137) 124%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.04MT

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.04
DATE SUBMITTED: 05-24-90
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5S4

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL METALS					
ARSENIC	2.0	mg/Kg	4.9	05-31-90	SW 7060
BARIUM	4.0	mg/Kg	2180	06-05-90	SW 6010
CADMIUM	1.0	mg/Kg	ND	06-05-90	SW 6010
CHROMIUM	1.0	mg/Kg	15.7	06-05-90	SW 6010
LEAD	4.0	mg/Kg	19.8	06-05-90	SW 6010
MERCURY	0.1	mg/Kg	ND	06-11-90	SW 7471
SELENIUM	1.0	mg/Kg	ND	06-01-90	SW 7740
SILVER	2.0	mg/Kg	ND	06-05-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = EPA METHODOLOGY, "#SW846", THIRD EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.04V

DATE: 06-19-90

SAMPLE MATRIX: SOIL
SWLO # 2669.04
DATE SUBMITTED: 05-24-90
DATE ANALYZED : 05-29-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5S4

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
'NYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
,LOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	21	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND		1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	2	BJ	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(81-117) 103% BROMOFLUOROBENZENE(74-121) 82% 1,2-DICHLOROETHANE-d4(70-121) 105%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.04PN

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.04
DATE SUBMITTED: 05-24-90
DATE EXTRACTED: 05-29-90
DATE ANALYZED : 06-05-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: S5S4

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	660	ND
2-METHYLNAPHTHALENE	660	ND
2-CHLORONAPHTHALENE	660	ND
ACENAPHTHYLENE	660	ND
ACENAPHTHENE	660	ND
FLUORENE	660	ND
PHENANTHRENE	660	ND
ANTHRACENE	660	ND
FLUORANTHENE	660	ND
PYRENE	660	ND
BENZO(A)ANTHRACENE	660	ND
CHRYSENE	660	ND
BENZO(B)FLUORANTHENE	660	ND
BENZO(K)FLUORANTHENE	660	ND
BENZO(A)PYRENE	660	ND
INDENO(1,2,3-CD)PYRENE	660	ND
DIBENZ(A,H)ANTHRACENE	660	ND
BENZO(G,H,I)PERYLENE	660	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (23-120) 81% 2-FLUOROBIPHENYL (30-115) 99% TERPHENYL-d14 (18-137) 142%*

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.05MT

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.05
DATE SUBMITTED: 05-24-90
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5S5

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL METALS					
ARSENIC	2.0	mg/Kg	4.7	05-31-90	SW 7060
BARIUM	4.0	mg/Kg	152	06-05-90	SW 6010
CADMIUM	1.0	mg/Kg	ND	06-05-90	SW 6010
CHROMIUM	1.0	mg/Kg	11.7	06-05-90	SW 6010
LEAD	4.0	mg/Kg	18.8	06-05-90	SW 6010
MERCURY	0.1	mg/Kg	ND	06-11-90	SW 7471
SELENIUM	1.0	mg/Kg	ND	06-01-90	SW 7740
SILVER	2.0	mg/Kg	ND	06-05-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = EPA METHODOLOGY, "#SW846", THIRD EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.05V

DATE: 06-19-90

SAMPLE MATRIX: SOIL
SWLO # 2669.05
DATE SUBMITTED: 05-24-90
DATE ANALYZED : 05-31-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5S5

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	11	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND		1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	ND		2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(81-117) 113% BROMOFLUOROBENZENE(74-121) 80% 1,2-DICHLOROETHANE-d4(70-121) 102%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.05PN

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.05
DATE SUBMITTED: 05-24-90
DATE EXTRACTED: 05-29-90
DATE ANALYZED : 06-05-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: S5S5

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	660	ND
2-METHYLNAPHTHALENE	660	ND
2-CHLORONAPHTHALENE	660	ND
ACENAPHTHYLENE	660	ND
ACENAPHTHENE	660	ND
FLUORENE	660	ND
PHENANTHRENE	660	ND
ANTHRACENE	660	ND
FLUORANTHENE	660	ND
PYRENE	660	ND
BENZO(A)ANTHRACENE	660	ND
CHRYSENE	660	ND
BENZO(B)FLUORANTHENE	660	ND
BENZO(K)FLUORANTHENE	660	ND
BENZO(A)PYRENE	660	ND
INDENO(1,2,3-CD)PYRENE	660	ND
DIBENZ(A,H)ANTHRACENE	660	ND
BENZO(G,H,I)PERYLENE	660	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (23-120) 62% 2-FLUOROBIPHENYL (30-115) 82% TERPHENYL-d14 (18-137) 105%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.06MT

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.06
DATE SUBMITTED: 05-24-90
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5S6

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL METALS					
ARSENIC	2.0	mg/Kg	ND	05-31-90	SW 7060
BARIUM	4.0	mg/Kg	76.6	06-05-90	SW 6010
CADMIUM	1.0	mg/Kg	ND	06-05-90	SW 6010
CHROMIUM	1.0	mg/Kg	20.8	06-05-90	SW 6010
' EAD	4.0	mg/Kg	12.0	06-05-90	SW 6010
ERCURY	0.1	mg/Kg	ND	06-11-90	SW 7471
SELENIUM	1.0	mg/Kg	ND	06-01-90	SW 7740
SILVER	2.0	mg/Kg	ND	06-05-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = EPA METHODOLOGY, "#SW846", THIRD EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.06V

DATE: 06-19-90

SAMPLE MATRIX: SOIL
SWLO # 2669.06
DATE SUBMITTED: 05-24-90
DATE ANALYZED : 05-29-90
METHOD REFERENCE: SW846-8240, EPA METHOD0 3..
PROJECT: FORMER FORBES ATLAS ... ..E SITES
SAMPLE ID: S5S6

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
HLOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	17	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND		1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	2	BJ	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(81-117) 104% BROMOFLUOROBENZENE(74-121) 80% 1,2-DICHLOROETHANE-d4(70-121) 95%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.06PN

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.06
DATE SUBMITTED: 05-24-90
DATE EXTRACTED: 05-29-90
DATE ANALYZED : 06-07-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: S5S6

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	660	ND
2-METHYLNAPHTHALENE	660	ND
2-CHLORONAPHTHALENE	660	ND
ACENAPHTHYLENE	660	ND
NAPHTHENE	660	ND
FLUORENE	660	ND
PHENANTHRENE	660	ND
ANTHRACENE	660	ND
FLUORANTHENE	660	ND
PYRENE	660	ND
BENZO(A)ANTHRACENE	660	ND
CHRYSENE	660	ND
BENZO(B)FLUORANTHENE	660	ND
BENZO(K)FLUORANTHENE	660	ND
BENZO(A)PYRENE	660	ND
INDENO(1,2,3-CD)PYRENE	660	ND
DIBENZ(A,H)ANTHRACENE	660	ND
BENZO(G,H,I)PERYLENE	660	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (23-120) 59% 2-FLUOROBIPHENYL (30-115) 65% TERPHENYL-d14 (18-137) 73%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.07V

DATE: 06-19-90

SAMPLE MATRIX: SOIL
SWLO # 2669.07
DATE SUBMITTED: 05-24-90
DATE ANALYZED : 05-29-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: DS5S2

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND		TRICHLOROETHENE	5	10
METHYLENE CHLORIDE	5	36	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	10	B	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	2	BJ	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(81-117) 119%* BROMOFLUOROBENZENE(74-121) 67%* 1,2-DICHLOROETHANE-d4(70-121) 97%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.07PN

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.07
DATE SUBMITTED: 05-24-90
DATE EXTRACTED: 05-29-90
DATE ANALYZED : 06-07-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: DS5S2

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	660	71 J
2-METHYLNAPHTHALENE	660	ND
2-CHLORONAPHTHALENE	660	ND
ACENAPHTHYLENE	660	ND
ACENAPHTHENE	660	ND
FLUORENE	660	ND
PHENANTHRENE	660	ND
ANTHRACENE	660	ND
FLUORANTHENE	660	ND
PYRENE	660	ND
BENZO(A)ANTHRACENE	660	ND
CHRYSENE	660	ND
BENZO(B)FLUORANTHENE	660	ND
BENZO(K)FLUORANTHENE	660	ND
BENZO(A)PYRENE	660	ND
INDENO(1,2,3-CD)PYRENE	660	ND
DIBENZ(A,H)ANTHRACENE	660	ND
BENZO(G,H,I)PERYLENE	660	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (23-120) 88% 2-FLUOROBIPHENYL (30-115) 96% TERPHENYL-d14 (18-137) 136%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.08MT

DATE: 06-20-90

SAMPLE MATRIX: WATER
SWLO # 2669.08
DATE SUBMITTED: 05-24-90
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: RS5S2

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL METALS					
ARSENIC	10.0	ug/L	ND	05-31-90	EPA 206.2
BARIUM	20.0	ug/L	ND	06-05-90	EPA 200.7
CADMIUM	5.0	ug/L	ND	06-05-90	EPA 200.7
CHROMIUM	5.0	ug/L	ND	06-05-90	EPA 200.7
LEAD	3.0	ug/L	ND	06-01-90	EPA 239.2
MERCURY	0.2	ug/L	ND	06-05-90	EPA 245.1
SELENIUM	5.0	ug/L	ND	06-01-90	EPA 270.2
SILVER	10.0	ug/L	ND	06-05-90	EPA 200.7

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
EPA = #EPA600/4-79-020, MARCH 1985

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.08V

DATE: 06-20-90

SAMPLE MATRIX: WATER
SWLO # 2669.08
DATE SUBMITTED: 05-24-90
DATE ANALYZED : 05-25-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: RS5S2

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
"INYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
ILOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	8 B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	1 J
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 97% BROMOFLUOROBENZENE(86-115) 107% 1,2-DICHLOROETHANE-d4(76-114) 95%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
" = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.08PN

DATE: 06-20-90

SAMPLE MATRIX: WATER
SWLO # 2669.08
DATE SUBMITTED: 05-24-90
DATE EXTRACTED: 05-31-90
DATE ANALYZED : 06-06-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: RS5S2

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	10	ND
2-METHYLNAPHTHALENE	10	ND
2-CHLORONAPHTHALENE	10	ND
ACENAPHTHYLENE	10	ND
ACENAPHTHENE	10	ND
FLUORENE	10	ND
PHENANTHRENE	10	ND
ANTHRACENE	10	ND
FLUORANTHENE	10	ND
PYRENE	10	ND
BENZO(A)ANTHRACENE	10	ND
CHRYSENE	10	ND
BENZO(B)FLUORANTHENE	10	ND
BENZO(K)FLUORANTHENE	10	ND
BENZO(A)PYRENE	10	ND
INDENO(1,2,3-CD)PYRENE	10	ND
DIBENZ(A,H)ANTHRACENE	10	ND
BENZO(G,H,I)PERYLENE	10	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (35-114) 86% 2-FLUOROBIPHENYL (43-116) 75% TERPHENYL-d14 (33-141) 131%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.09V

DATE: 06-20-90

SAMPLE MATRIX: WATER
SWLO # 2669.09
DATE SUBMITTED: 05-24-90
DATE ANALYZED : 06-01-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5TB1

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
"TNYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
,LOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	17	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND		1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	2	J	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 108% BROMOFLUOROBENZENE(86-115) 110% 1,2-DICHLOROETHANE-d4(76-114) 106%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

FIELD - JULIE B. JENNINGS
OFFICE - SUSANNE M. RINEY
5000 CEDAR PLAZA PKWY
STE. 211
ST. LOUIS, MO 63128
(314) 842-4550

O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY: FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B. Jennings / Harold Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	Water Grab	Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
5551		5/23/90	8:30am		X			2-4 oz.	VOA (8240)
								1-8 oz	PAH (8270)
								1-8 oz.	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se
5552		5/23/90	9:00am		X			2-4 oz.	VOA (8240)
								1-8 oz	PAH (8270)
								1-8 oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se

Relinquished by: (Signature) Julie B. Jennings / Harold Ramsey	Received by: (Signature)	Date/Time 5/24/90 0830
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature)	Date/Time	Received for Laboratory by: Date/Time
Method of Shipment:		

O'Brien & Gere Engineers, Inc.
O'Brien & Gere Business Data Systems, Inc.

FIELD - JULIE B. JENNINGS
OFFICE - SUZANNE M. RINEY
5000 CEDAR PLAZA PKW
STE. 211
ST. LOUIS, MO 63128
(314) 842-4550

O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY: FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B. Jennings / Harold J. Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	SAMPLE TYPE: Water Grab	SAMPLE TYPE: Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
DS552		5/23/90	9:00am		X			2-4oz.	VOA (8240)
								1-8oz.	PAH (8270)
								1-8oz.	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se
RS552		5/23/90	9:00am		X			2-40ml	VOA (8240)
	1 40ml Voa Vial Broken in Shipment.							2-1l	PAH (8270)
								1-1000ml	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se

Relinquished by: (Signature) Julie B. Jennings / Harold J. Ramsey	Received by: (Signature) Vicki Ho Lo	Date/Time 5/24/90 0830
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature) — Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:		

OFFICE - SUSANNE M. RINEY
5000 CEDAR PLAZA PKWY
STE. 211
ST. LOUIS, MO 63128
(314) 842-4550

O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY: FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B. Cummings / Harold J. Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	SAMPLE TYPE: Water Grab	SAMPLE TYPE: Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
5553		5/23/90	9:30am		X			2-4oz	VOA (8240)
								1-8oz	PAH (8270)
								1-8oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se
5554		5/23/90	10:00am		X			2-4oz	VOA (8240)
								1-8oz	PAH (8270)
								1-8oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se

Relinquished by: (Signature) Julie B. Cummings / Harold J. Ramsey	Received by: (Signature) Vicki Hall	Date/Time 5/24/90 1330
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time
Dispatched by: (Signature) — Date/Time	Received for Laboratory by:	Date/Time
Method of Shipment:		

O'Brien & Gere Engineers, Inc.
Building Solutions Worldwide

O'BRIEN & GERE

FIELD - JULIE B. JENNINGS

OFFICE - SUZANNE M. RINEY
5000 CEDAR PLAZA PKWY
STE. 211
ST. LOUIS, MO 63128
(314) 842-4550

CHAIN OF CUSTODY RECORD

3068.020

SURVEY FORMER FORBES ATLAS MISSILE SITES 55 : 59 BUSHONG : HOLTON, KANSAS

SAMPLERS: (Signature) Julie B. Jennings / Harold J. Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE Water Comp.	Grab	Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
5555		5/23/90	10:30am		x			2-4oz	VOA (8240)
								1-8oz	PAH (8270)
								1-8oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se
5556		5/23/90	11:00am		x			2-4oz	VOA (8240)
								1-8oz	PAH (8270)
								1-8oz	Total Metals (6010) Ba, Cd, Cr, Pb, Ag (7060) As (7470) Hg (7741) Se

Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Julie B. Jennings / Harold J. Ramsey	[illegible]	5/24/90 0830
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by: (Signature)	Date/Time
Relinquished by: (Signature)	Received by Mobile Laboratory for field analysis: (Signature)	Date/Time

Dispatched by: (Signature)	Date/Time	Received for Laboratory by:	Date/Time

Method of Shipment:

FIELD - JULIE B. JENNINGS
OFFICE - SUSANNE M. RINEY
5000 CEDAR PLAZA PKWY
STE. 211
ST. LOUIS, MO 63128
(314) 842-4550

O'BRIEN & GERE

CHAIN OF CUSTODY RECORD

3068.020

SURVEY FORMER FORBES ATLAS MISSILE SITES 55 & 59 BUSHONG & HOLTON, KANSAS

SAMPLERS: (Signature) Julie B. Jennings / Harold J. Ramsey

STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water Comp.	Water Grab	Air	SEQ. NO.	NO. OF CONTAINERS	ANALYSIS REQUIRED
55TB1		5/23/90	8:00am		X			2-40ml	PAH (8270)
									↓
									RUN VOA'S ASPER
									AS RAMSEY

Relinquished by: (Signature) Julie B. Jennings / Harold J. Ramsey — Received by: (Signature) — Date/Time 5/24/90 0830

Relinquished by: (Signature) — Received by: (Signature) — Date/Time

Relinquished by: (Signature) — Received by: (Signature) — Date/Time

Relinquished by: (Signature) — Received by Mobile Laboratory for field analysis: (Signature) — Date/Time

Dispatched by: (Signature) — Date/Time — Received for Laboratory by: — Date/Time

Method of Shipment:

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ANALYTICAL REPORT

O'BRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY
ST. LOUIS, MO 63128

REPORT: G2824

REPORT DATE: 06/18/90

SWLO IDENTIFICATION

SAMPLE NO.: 2669.01 - 2669.09
DATE RECEIVED: 05/24/90

QA/QC

DESCRIPTION	PARAMETER	RESULTS	
METHOD BLANK 05/31/90	ARSENIC	<10.0	ug/L
METHOD BLANK 05/31/90	ARSENIC	<10.0	ug/L
METHOD BLANK 06/01/90	BARIUM	<4.0	mg/Kg
METHOD BLANK 06/01/90	BARIUM	<20.0	ug/L
METHOD BLANK 06/01/90	CADMIUM	<1.0	mg/Kg
METHOD BLANK 06/01/90	CADMIUM	<5.0	ug/L
METHOD BLANK 06/01/90	CHROMIUM	<1.0	mg/Kg
METHOD BLANK 06/01/90	CHROMIUM	<5.0	ug/L
METHOD BLANK 06/01/90	LEAD	<3.0	ug/L
METHOD BLANK 06/01/90	LEAD	<4.0	mg/Kg
METHOD BLANK 06/01/90	LEAD	<20.0	ug/L
METHOD BLANK 06/11/90	MERCURY	<0.20	ug/L
METHOD BLANK 05/31/90	SELENIUM	<5.0	ug/L
METHOD BLANK 06/01/90	SELENIUM	<5.0	ug/L
METHOD BLANK 06/01/90	SILVER	<2.0	mg/Kg
METHOD BLANK 06/01/90	SILVER	<10.0	ug/L
BLANK SPIKE 05/31/90	ARSENIC	84%	RECOVERY
BLANK SPIKE 05/31/90	ARSENIC	101%	RECOVERY
BLANK SPIKE 06/01/90	BARIUM	91%	RECOVERY
BLANK SPIKE 06/01/90	BARIUM	97%	RECOVERY
BLANK SPIKE 06/01/90	CADMIUM	94%	RECOVERY
BLANK SPIKE 06/01/90	CADMIUM	104%	RECOVERY
BLANK SPIKE 06/01/90	CHROMIUM	98%	RECOVERY
BLANK SPIKE 06/01/90	CHROMIUM	101%	RECOVERY
BLANK SPIKE 06/01/90	LEAD	91%	RECOVERY
BLANK SPIKE 06/01/90	LEAD	101%	RECOVERY
BLANK SPIKE 06/01/90	LEAD	100%	RECOVERY
BLANK SPIKE 06/11/90	MERCURY	104%	RECOVERY
BLANK SPIKE 05/31/90	SELENIUM	105%	RECOVERY
BLANK SPIKE 06/01/90	SELENIUM	101%	RECOVERY
BLANK SPIKE 06/01/90	SILVER	88%	RECOVERY
BLANK SPIKE 06/01/90	SILVER	99%	RECOVERY

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

ANALYTICAL REPORT

O'BRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY
ST. LOUIS, MO 63128

REPORT: G2824.2

REPORT DATE: 06/18/90

SWLO IDENTIFICATION

SAMPLE NO.: 2669.01 - 2669.09
DATE RECEIVED: 05/24/90

QA/QC

DESCRIPTION	PARAMETER	RESULTS	
MATRIX SPIKE S5S1	ARSENIC	59%	RECOVERY
DUPLICATE S5S1	ARSENIC	18%	RPD
MATRIX SPIKE S5S1	BARIUM	84%	RECOVERY
DUPLICATE S5S1	BARIUM	6.5%	RPD
MATRIX SPIKE S8S1	CADMIUM	101%	RECOVERY
DUPLICATE S8S1	CADMIUM	0%	RPD
MATRIX SPIKE S8S1	CHROMIUM	88%	RECOVERY
DUPLICATE S8S1	CHROMIUM	13%	RPD
MATRIX SPIKE S8S1	LEAD	82%	RECOVERY
DUPLICATE S8S1	LEAD	4.3%	RPD
MATRIX SPIKE S8S1	MERCURY	95%	RECOVERY
MATRIX SPIKE S8S1	SELENIUM	91%	RECOVERY
DUPLICATE S9S1	SELENIUM	0%	RPD
MATRIX SPIKE S8S1	SILVER	99%	RECOVERY
DUPLICATE S8S1	SILVER	0%	RPD

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: G2824.3

DATE: 06-20-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE ANALYZED : 05-25-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE		ND
VINYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	3	J	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND		1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	1	J	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 93% BROMOFLUOROBENZENE(86-115) 96% 1,2-DICHLOROETHANE-d4(76-114) 89%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: G2824.4

DATE: 06-19-90

SAMPLE MATRIX: SOIL
SWLO # METHOD BLANK
DATE ANALYZED : 05-29-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	12		DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	3	J	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	2	J	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(81-117) 98% BROMOFLUOROBENZENE(74-121) 95% 1,2-DICHLOROETHANE-d4(70-121) 102%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: G2824.5

DATE: 06-19-90

SAMPLE MATRIX: SOIL
SWLO # METHOD BLANK
DATE ANALYZED : 05-31-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
'HLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	5	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(81-117) 101% BROMOFLUOROBENZENE(74-121) 94% 1,2-DICHLOROETHANE-d4(70-121) 99%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: G2824.6

DATE: 06-20-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE ANALYZED : 06-01-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
'ILOROETHANE	10	ND	TRICHLOROETHENE	5	ND
_THYLENE CHLORIDE	5	3 J	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 103% BROMOFLUOROBENZENE(86-115) 96% 1,2-DICHLOROETHANE-d4(76-114) 99%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: G2824.7

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # METHOD BLANK
DATE EXTRACTED: 05-29-90
DATE ANALYZED : 06-06-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	660	ND
2-METHYLNAPHTHALENE	660	ND
2-CHLORONAPHTHALENE	660	ND
ACENAPHTHYLENE	660	ND
ACENAPHTHENE	660	ND
FLUORENE	660	ND
PHENANTHRENE	660	ND
ANTHRACENE	660	ND
FLUORANTHENE	660	ND
PYRENE	660	ND
BENZO(A)ANTHRACENE	660	ND
CHRYSENE	660	ND
BENZO(B)FLUORANTHENE	660	ND
BENZO(K)FLUORANTHENE	660	ND
BENZO(A)PYRENE	660	ND
INDENO(1,2,3-CD)PYRENE	660	ND
DIBENZ(A,H)ANTHRACENE	660	ND
BENZO(G,H,I)PERYLENE	660	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (23-120) 89% 2-FLUOROBIPHENYL (30-115) 94% TERPHENYL-d14 (18-137) 114%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: G2824.8

DATE: 06-20-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE EXTRACTED: 05-31-90
DATE ANALYZED : 06-07-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	10	ND
2-METHYLNAPHTHALENE	10	ND
2-CHLORONAPHTHALENE	10	ND
ACENAPHTHYLENE	10	ND
ENAPHTHENE	10	ND
JORENE	10	ND
PHENANTHRENE	10	ND
ANTHRACENE	10	ND
FLUORANTHENE	10	ND
PYRENE	10	ND
BENZO(A)ANTHRACENE	10	ND
CHRYSENE	10	ND
BENZO(B)FLUORANTHENE	10	ND
BENZO(K)FLUORANTHENE	10	ND
BENZO(A)PYRENE	10	ND
INDENO(1,2,3-CD)PYRENE	10	ND
DIBENZ(A,H)ANTHRACENE	10	ND
BENZO(G,H,I)PERYLENE	10	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (35-114) 75% 2-FLUOROBIPHENYL (43-116) 73% TERPHENYL-d14 (33-141) 85%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

APPENDIX J

ANALYTICAL RESULTS FOR DRILL WATER SAMPLES

APPENDIX K

CHAIN-OF-CUSTODY RECORDS FOR GROUND WATER SAMPLES

U.S. ARMY CORPS OF ENGINEERS Wichita

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME	
	Forbes Atlas Missile Site-5	Bushong, KS

SAMPLERS: (Signature)
Julia Klein

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	PAH 1L Amber glass	VOA 40ml Vial					REMARKS
Gmw502	8-29-90	15:10		X	Gmw 502	1	X						
Gmw502	8-30-90	10:21		X	Gmw 502	1	X						
Gmw502	8-29-90	15:10		X	DGmw 502	1	X						
Gmw502	8-30-90	10:21		X	DGmw 502	1	X						
Gmw501	8-29-90	13:55		X	Gmw 501	1	X						
Gmw501	8-30-90	08:02		X	Gmw 501	1	X						
[illegible]	8-29-90			X	Trip Blank	2		X					

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Julia Klein	8-30-90 11:05				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	
		[illegible]	8/31/90 0830	Preserved to 4°C.	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

No. 2366 KCD

U.S. ARMY CORPS OF ENGINEERS

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
	FORBES ATLAS MISSILE SITE -5 BUSHONG, KS

SAMPLERS: *(Signature)* [signature]

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	VOA - 2-40 ml vials	METALS - 1000 ml polyethylene	PAH's as per Julie...				REMARKS
Gmw502	8-23-90	07:53		X	Gmw-502	2	X						
Gmw502	8-23-90	07:53		X	DGmw502	2	X						
Gmw501	8-23-90	08:23		X	Gmw501	2	X						
Gmw501	8-23-90	08:29		X	Gmw501	1		X					Preserved to pH2 w/nitric acid.
Gmw502	8-23-90	10:16		X	Gmw502	1		X					Preserved to pH2 w/nitric acid.
Gmw501	8-23-90	10:10		X	DGmw502	1		X					Preserved to pH2 w/nitric acid.
Gmw502	8-23-90	09:36		X	RGmw502	2	X						Rinsate
Gmw502	8-23-90	09:48		X	RGmw502	1			X				"
Gmw502	8-23-90	09:49		X	RGmw502	1			X				"
Gmw502	8-23-90	09:52		X	RGmw502	1		X					Preserved to pH2 w/nitric acid. "
				X	5STB2	2	X						Trip Blank
													– note: these are [illegible] PAH's
													as per Julie Jennings (O'Briene & Dees)

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
[signature]	8-23-90 11:50				
Relinquished by: *(Signature)*	**Date / Time**	**Received by:** *(Signature)*	**Relinquished by:** *(Signature)*	**Date / Time**	**Received by:** *(Signature)*

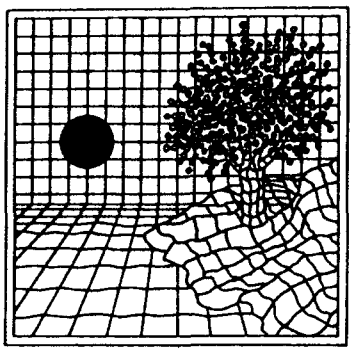
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks
		Bethany A Wolters	8/24/90 0830	All preserved to 4°C w/ ice

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

№ 2281 KCD

APPENDIX L

ANALYTICAL RESULTS FOR FIELD AND QUALITY CONTROL GROUND WATER SAMPLES



SOUTHWEST LABORATORY OF OKLAHOMA, INC.

September 25, 1990

Julie Jennings
O'BRIEN & GERE ENGINEERS, INC.
5000 Cedar Plaza Parkway, Suite 211
St. Louis, Missouri 63128

Project: Forbes Atlas Missile Site #5

Dear Ms. Jennings:

Enclosed are the analytical results for your samples received in our laboratory on August 24, 1990, for the above captioned project.

If, in your review, you should have any questions or require additional information, please call.

Sincerely,

9/25/90

K. M. Bagawandoss, Ph. D.
Asst. Program Manager, Organics

KMB/jal

Enclosures

1700 WEST ALBANY, SUITE C • BROKEN ARROW, OK 74012
(918) 251-2858 • FAX (918) 251-2599

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3543.01V

DATE: 09-19-90

SAMPLE MATRIX: WATER
SWLO # 3543.01
DATE SUBMITTED: 08-24-90
DATE ANALYZED : 08-30-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 9, HOLTON, KS.
SAMPLE ID: GMW-502

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
~HLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
~ROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	76
METHYLENE CHLORIDE	5	ND	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	98	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 101% BROMOFLUOROBENZENE(86-115) 95% 1,2-DICHLOROETHANE-d4(76-114) 90%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
~ = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3543.02V

DATE: 09-19-90

SAMPLE MATRIX: WATER
SWLO # 3543.02
DATE SUBMITTED: 08-24-90
DATE ANALYZED : 08-30-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 9, HOLTON, KS.
SAMPLE ID: DGMW-502

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	85
METHYLENE CHLORIDE	5	ND	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	104	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 102% BROMOFLUOROBENZENE(86-115) 101% 1,2-DICHLOROETHANE-d4(76-114) 87%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
' = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3543.03V

DATE: 09-19-90

SAMPLE MATRIX: WATER
SWLO # 3543.03
DATE SUBMITTED: 08-24-90
DATE ANALYZED : 08-30-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 9, HOLTON, KS.
SAMPLE ID: GMW-501

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	2 J
METHYLENE CHLORIDE	5	ND	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 97% BROMOFLUOROBENZENE(86-115) 95% 1,2-DICHLOROETHANE-d4(76-114) 86%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
, = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. ALBANY SUITE C BROKEN ARROW, OK 74012 918 251-2858

Client Name: O'BRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY
SUITE 211
ST. LOUIS, MO 63128

Client ID: GMW-501 **Project ID:** FORBES ATLAS MIS. #5

SWLO ID: 3543.04 **Report:** 3543.04

Collected: 8/23/90 **Report Date:** 09/19/90 **Page:** 1
Received: 08/24/90 **Last Modified:** **Matrix:** Water

TEST	DATE EXTRACTED	DETECTION LIMIT	UNITS	RESULTS	DATE ANALYZED	METHOD REFERENCE
		*** METALS ***				
ARSENIC		10.00	ug/l	ND	09/13/90	SW 7060
BARIUM		20.0	ug/l	134	09/12/90	SW 6010
CADMIUM		5.0	ug/l	ND	09/12/90	SW 6010
CHROMIUM		5.0	ug/l	ND	09/12/90	SW 6010
LEAD		30	ug/l	44.6	09/12/90	SW 6010
MERCURY		0.2	ug/l	ND	09/04/90	SW 7470
SELENIUM		5.0	ug/l	ND	09/18/90	SW 7740
SILVER		10	ug/l	ND	09/12/90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
I = UNABLE TO QUANTITATE DUE TO MATRIX INTERFERENCE
NA = NOT APPLICABLE
ethodology: SM = STANDARD METHODS, 16th EDITION, 1985
EPA = #EPA600/4-79-020, MARCH 1985

* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS
D = SURROGATES DILUTED OUT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION

SW = EPA METHODOLOGY, "#SW846", THIRD EDITION, NOVEMBER 1986

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. ALBANY SUITE C BROKEN ARROW, OK 74012 918 251-2858

Client Name: O'BRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY
SUITE 211
ST. LOUIS, MO 63128

Client ID: GMW-502 **Project ID:** FORBES ATLAS MIS. #5

SWLO ID: 3543.05 **Report:** 3543.05

Collected: 8/23/90 **Report Date:** 09/19/90 **Page:** 1
Received: 08/24/90 **Last Modified:** **Matrix:** Water

TEST	DATE EXTRACTED	DETECTION LIMIT	UNITS	RESULTS	DATE ANALYZED	METHOD REFERENCE
		*** METALS ***				
ARSENIC		10.00	ug/l	ND	09/13/90	SW 7060
BARIUM		20.0	ug/l	234	09/12/90	SW 6010
CADMIUM		5.0	ug/l	ND	09/12/90	SW 6010
CHROMIUM		5.0	ug/l	20.8	09/12/90	SW 6010
LEAD		30	ug/l	ND	09/12/90	SW 6010
MERCURY		0.2	ug/l	ND	09/04/90	SW 7470
SELENIUM		5.0	ug/l	ND	09/18/90	SW 7740
SILVER		10	ug/l	ND	09/12/90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
I = UNABLE TO QUANTITATE DUE TO MATRIX INTERFERENCE
"A = NOT APPLICABLE
ethodology: SM = STANDARD METHODS, 16th EDITION, 1985
EPA = #EPA600/4-79-020, MARCH 1985

* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS
D = SURROGATES DILUTED OUT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION

SW = EPA METHODOLOGY, "#SW846", THIRD EDITION, NOVEMBER 1986

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. ALBANY SUITE C BROKEN ARROW, OK 74012 918 251-2858

Client Name: O'BRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY
SUITE 211
ST. LOUIS, MO 63128

Client ID: DGMW-502 **Project ID:** FORBES ATLAS MIS. #5

SWLO ID: 3543.06 **Report:** 3543.06

Collected: 8/23/90 **Report Date:** 09/19/90 **Page:** 1
Received: 08/24/90 **Last Modified:** **Matrix:** Water

TEST	DATE EXTRACTED	DETECTION LIMIT	UNITS	RESULTS	DATE ANALYZED	METHOD REFERENCE
		*** METALS ***				
ARSENIC		10.00	ug/l	ND	09/13/90	SW 7060
BARIUM		20.0	ug/l	235	09/12/90	SW 6010
CADMIUM		5.0	ug/l	ND	09/12/90	SW 6010
CHROMIUM		5.0	ug/l	18.8	09/12/90	SW 6010
LEAD		30	ug/l	ND	09/12/90	SW 6010
MERCURY		0.2	ug/l	ND	09/04/90	SW 7470
SELENIUM		5.0	ug/l	ND	09/18/90	SW 7740
SILVER		10	ug/l	ND	09/12/90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
I = UNABLE TO QUANTITATE DUE TO MATRIX INTERFERENCE
"A = NOT APPLICABLE
thodology: SM = STANDARD METHODS, 16th EDITION, 1985
EPA = #EPA600/4-79-020, MARCH 1985

* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS
D = SURROGATES DILUTED OUT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION

SW = EPA METHODOLOGY, "#SW846", THIRD EDITION, NOVEMBER 1986

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3543.07V

DATE: 09-19-90

SAMPLE MATRIX: WATER
SWLO # 3543.07
DATE SUBMITTED: 08-24-90
DATE ANALYZED : 08-30-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 9, HOLTON, KS.
SAMPLE ID: RGMW-502

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	ND	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	4 J	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	54	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	2 J	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 95% BROMOFLUOROBENZENE(86-115) 93% 1,2-DICHLOROETHANE-d4(76-114) 98%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3543.08PN

DATE: 09-25-90

SAMPLE MATRIX: WATER
SWLO # 3543.08
DATE SUBMITTED: 08-24-90
DATE EXTRACTED: 08-27-90
DATE ANALYZED : 09-21-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE #5
SAMPLE ID: RGMW-502

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	12.5	ND
^-METHYLNAPHTHALENE	12.5	ND
CHLORONAPHTHALENE	12.5	ND
ACENAPHTHYLENE	12.5	ND
ACENAPHTHENE	12.5	ND
FLUORENE	12.5	ND
PHENANTHRENE	12.5	ND
ANTHRACENE	12.5	ND
FLUORANTHENE	12.5	ND
PYRENE	12.5	ND
BENZO(A)ANTHRACENE	12.5	ND
CHRYSENE	12.5	ND
BENZO(B)FLUORANTHENE	12.5	ND
BENZO(K)FLUORANTHENE	12.5	ND
BENZO(A)PYRENE	12.5	ND
INDENO(1,2,3-CD)PYRENE	12.5	ND
DIBENZ(A,H)ANTHRACENE	12.5	ND
BENZO(G,H,I)PERYLENE	12.5	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (35-114) 44% 2-FLUOROBIPHENYL (43-116) 45% TERPHENYL-d14 (33-141) 78%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. ALBANY SUITE C BROKEN ARROW, OK 74012 918 251-2858

Client Name: O'BRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY
SUITE 211
ST. LOUIS, MO 63128

Client ID: RGMW-502 **Project ID:** FORBES ATLAS MIS. #5

SWLO ID: 3543.09 **Report:** 3543.09

Collected: 8/23/90 **Report Date:** 09/19/90 **Page:** 1
Received: 08/24/90 **Last Modified:** **Matrix:** Water

TEST	DATE EXTRACTED	DETECTION LIMIT	UNITS	RESULTS	DATE ANALYZED	METHOD REFERENCE
		*** METALS ***				
ARSENIC		10.00	ug/l	ND	09/13/90	SW 7060
BARIUM		20.0	ug/l	ND	09/12/90	SW 6010
CADMIUM		5.0	ug/l	ND	09/12/90	SW 6010
CHROMIUM		5.0	ug/l	ND	09/12/90	SW 6010
LEAD		30	ug/l	ND	09/12/90	SW 6010
MERCURY		0.2	ug/l	ND	09/04/90	SW 7470
SELENIUM		5.0	ug/l	ND	09/18/90	SW 7740
SILVER		10	ug/l	ND	09/12/90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
I = UNABLE TO QUANTITATE DUE TO MATRIX INTERFERENCE
NA = NOT APPLICABLE
Methodology: SM = STANDARD METHODS, 16th EDITION, 1985
EPA = #EPA600/4-79-020, MARCH 1985

* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS
D = SURROGATES DILUTED OUT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION

SW = EPA METHODOLOGY, "#SW846", THIRD EDITION, NOVEMBER 1986

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3543.10V

DATE: 09-19-90

SAMPLE MATRIX: WATER
SWLO # 3543.10
DATE SUBMITTED: 08-24-90
DATE ANALYZED : 08-30-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 9, HOLTON, KS.
SAMPLE ID: S5TB2 TRIP BLK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	ND	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	4 J	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 94% BROMOFLUOROBENZENE(86-115) 87% 1,2-DICHLOROETHANE-d4(76-114) 92%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

U.S. ARMY CORPS OF ENGINEERS

CHAIN OF C ODY RECORD

PROJ. NO.	PROJECT NAME	NO. OF CONTAINERS	2-VOA - 40 ml vials	1-METALS - 1000 ml polyethylene	PAH's as 3rd	REMARKS
	FORBES ATLAS MISSILE SITE-5 BUSHONG, KS					

SAMPLERS: *(Signature)* Julia Larsen

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	2-VOA - 40 ml vials	1-METALS - 1000 ml polyethylene	PAH's as 3rd	REMARKS
Gmw502	8-23-90	07:53		X	GMW-502	2	X			
Gmw502	8-23-90	07:53		X	DGMW 502	2	X			
Gmw 501	8-23-90	08:23		X	GMW501	2	X			
Gmw501	8-23-90	08:29		X	GMW501	1		X		Preserved to pH2 w/nitric acid.
Gmw502	8-23-90	10:16		X	GMW 502	1		X		Preserved to pH2 w/nitric acid.
Gmw501	8-23-90	10:10		X	DGmw 502	1		X		Preserved to pH2 w/nitric acid.
Gmw502	8-23-90	09:36		X	RGMW 502	2	X			Rinsate
Gmw502	8-23-90	09:48		X	RGMW 502	1			X	"
Gmw502	8-23-90	09:49		X	RGmw 502	1			X	"
Gmw 502	8-23-90	09:52		X	RGMW 502	1		X		Preserved to pH2 w/nitric acid. "
				X	55TB2	2	X			Trip Blank
										note: these are for PAHs
										as per Julie Seymour (O'Brien & Dore)

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Julia Larsen	8-23-90 11:50				
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	
		Bethany A Wolters	8/24/90 0830	All preserved to 4°C w/ ice	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

N° 2281 KCD

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

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ANALYTICAL REPORT

O'BRIEN & GERE ENGINEERS, INC.
5000 Cedar Plaza Parkway
Suite 211
St. Louis, Missouri 63128

REPORT: 3543-1

REPORT DATE: 09/18/90

SWLO IDENTIFICATION

SAMPLE NO.: 3543.01 - 3543.04
DATE RECEIVED: 08/24/90

QA/QC

DESCRIPTION		PARAMETER	RESULTS	
METHOD BLANK	09/13/90	ARSENIC	<10	ug/L
METHOD BLANK	09/11/90	BARIUM	<20	ug/L
METHOD BLANK	09/11/90	CADMIUM	<5	ug/L
METHOD BLANK	09/11/90	CHROMIUM	<5	ug/L
METHOD BLANK	09/11/90	LEAD	<30	ug/L
METHOD BLANK	09/04/90	MERCURY	<0.2	ug/L
METHOD BLANK	09/17/90	SELENIUM	<5	ug/L
METHOD BLANK	09/11/90	SILVER	<10	ug/L
BLANK SPIKE	09/13/90	ARSENIC	108%	RECOVERY
BLANK SPIKE	09/11/90	BARIUM	101%	RECOVERY
BLANK SPIKE	09/11/90	CADMIUM	107%	RECOVERY
BLANK SPIKE	09/11/90	CHROMIUM	104%	RECOVERY
BLANK SPIKE	09/11/90	LEAD	99%	RECOVERY
BLANK SPIKE	09/17/90	SELENIUM	116%	RECOVERY
BLANK SPIKE	09/11/90	SILVER	90%	RECOVERY

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3543a

DATE: 09-19-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE ANALYZED : 08-29-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 9, HOLTON, KS.
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
ROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
INYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	9	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 97% BROMOFLUOROBENZENE(86-115) 88% 1,2-DICHLOROETHANE-d4(76-114) 94%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
. = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3543b

DATE: 09-19-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE ANALYZED : 08-30-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 9, HOLTON, KS.
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	6	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 92% BROMOFLUOROBENZENE(86-115) 92% 1,2-DICHLOROETHANE-d4(76-114) 91%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
= SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3543c

DATE: 09-25-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE EXTRACTED: 08-27-90
DATE ANALYZED : 09-21-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE #5
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	10	ND
2-METHYLNAPHTHALENE	10	ND
[illegible]CHLORONAPHTHALENE	10	ND
[illegible]NAPHTHYLENE	10	ND
ACENAPHTHENE	10	ND
FLUORENE	10	ND
PHENANTHRENE	10	ND
ANTHRACENE	10	ND
FLUORANTHENE	10	ND
PYRENE	10	ND
BENZO(A)ANTHRACENE	10	ND
CHRYSENE	10	ND
BENZO(B)FLUORANTHENE	10	ND
BENZO(K)FLUORANTHENE	10	ND
BENZO(A)PYRENE	10	ND
INDENO(1,2,3-CD)PYRENE	10	ND
DIBENZ(A,H)ANTHRACENE	10	ND
BENZO(G,H,I)PERYLENE	10	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (35-114) 52% 2-FLUOROBIPHENYL (43-116) 52% TERPHENYL-d14 (33-141) 89%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858 • FAX: 918-251-2599

CLIENT: OBRIEN & GERE ENGINEERING
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MO 63128

REPORT: 3490

DATE: 01-18-91

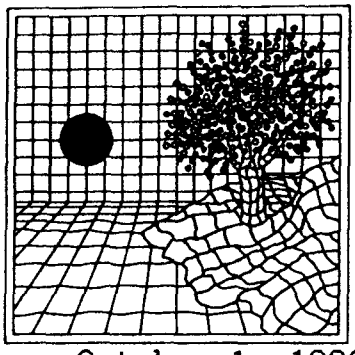
SAMPLE MATRIX: WATER
SWLO # 3490.08 (MS/MSD)
DATE ANALYZED : 08-21-90
METHOD REFERENCE: SW846-8240

WATER VOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

COMPOUND	SPIKE ADDED (ug/l)	SAMPLE CONCENTRATION (ug/l)	MS CONCENTRATION (ug/l)	MS PERCENT RECOVERY	QC LIMITS RECOVERY
1,1-DICHLOROETHENE	50	0	43	86	61 - 145
TRICHLOROETHENE	50	2	46	92	71 - 120
BENZENE	50	0	46	92	76 - 127
TOLUENE	50	0	49	98	76 - 125
CHLOROBENZENE	50	0	49	98	75 - 130

COMPOUND	SPIKE ADDED (ug/l)	MSD CONCENTRATION (ug/l)	MSD PERCENT RECOVERY	PERCENT RPD	QC RPD	LIMITS REC.
1,1-DICHLOROETHENE	50	43	86	0	14	61 - 145
TRICHLOROETHENE	50	46	92	0	14	71 - 120
BENZENE	50	45	90	2	11	76 - 127
TOLUENE	50	48	96	2	13	76 - 125
CHLOROBENZENE	50	49	98	0	13	75 - 130

*VALUES OUTSIDE OF QC LIMITS



SOUTHWEST LABORATORY OF OKLAHOMA, INC.

October 1, 1990

Julie Jennings
O'BRIEN & GERE ENGINEERS, INC.
5000 Cedar Plaza Parkway, Suite 211
St. Louis, Missouri 63128

Project: Forbes Atlas Missile Site - 5, Bushong, Kansas

Dear Ms. Jennings:

Enclosed are the analytical results for your samples received in our laboratory on August 31, 1990, for the above captioned project.

If, in your review, you should have any questions or require additional information, please call.

Sincerely,

10/1/90

K. M. Bagawandoss, Ph. D.
Asst. Program Manager, Organics

KMB/jal

Enclosures

1700 WEST ALBANY, SUITE C • BROKEN ARROW, OK 74012
(918) 251-2858 • FAX (918) 251-2599

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany . Suite "C" . Broken Arrow, Oklahoma 74012 . 918-251-2858 . FAX: 918-251-2599

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3606.01PN

DATE: 10-01-90

SAMPLE MATRIX: WATER
SWLO # 3606.01
DATE SUBMITTED: 08-31-90
DATE EXTRACTED: 09-01-90
DATE ANALYZED : 09-25-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 5, BUSHONG, KANSAS
SAMPLE ID: GMW502

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	12.5	ND
METHYLNAPHTHALENE	12.5	ND
CHLORONAPHTHALENE	12.5	ND
ACENAPHTHYLENE	12.5	ND
ACENAPHTHENE	12.5	ND
FLUORENE	12.5	ND
PHENANTHRENE	12.5	ND
ANTHRACENE	12.5	ND
FLUORANTHENE	12.5	ND
PYRENE	12.5	ND
BENZO(A)ANTHRACENE	12.5	ND
CHRYSENE	12.5	ND
BENZO(B)FLUORANTHENE	12.5	ND
BENZO(K)FLUORANTHENE	12.5	ND
BENZO(A)PYRENE	12.5	ND
INDENO(1,2,3-CD)PYRENE	12.5	ND
DIBENZ(A,H)ANTHRACENE	12.5	ND
BENZO(G,H,I)PERYLENE	12.5	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (35-114) 42% 2-FLUOROBIPHENYL (43-116) 41%* TERPHENYL-d14 (33-141) 61%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany . Suite "C" . Broken Arrow, Oklahoma 74012 . 918-251-2858 . FAX: 918-251-2599

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3606.04PN

DATE: 10-01-90

SAMPLE MATRIX: WATER
SWLO # 3606.04
DATE SUBMITTED: 08-31-90
DATE EXTRACTED: 09-01-90
DATE ANALYZED : 09-25-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 5, BUSHONG, KANSAS
SAMPLE ID: GMW501

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	12.5	ND
2-METHYLNAPHTHALENE	12.5	ND
CHLORONAPHTHALENE	12.5	ND
ACENAPHTHYLENE	12.5	ND
ACENAPHTHENE	12.5	ND
FLUORENE	12.5	ND
PHENANTHRENE	12.5	ND
ANTHRACENE	12.5	ND
FLUORANTHENE	12.5	ND
PYRENE	12.5	ND
BENZO(A)ANTHRACENE	12.5	ND
CHRYSENE	12.5	ND
BENZO(B)FLUORANTHENE	12.5	ND
BENZO(K)FLUORANTHENE	12.5	ND
BENZO(A)PYRENE	12.5	ND
INDENO(1,2,3-CD)PYRENE	12.5	ND
DIBENZ(A,H)ANTHRACENE	12.5	ND
BENZO(G,H,I)PERYLENE	12.5	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (35-114) 36% 2-FLUOROBIPHENYL (43-116) 32%* TERPHENYL-d14 (33-141) 60%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany . Suite "C" . Broken Arrow, Oklahoma 74012 . 918-251-2858 . FAX: 918-251-2599

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3606.05V

DATE: 09-17-90

SAMPLE MATRIX: WATER
SWLO # 3606.05
DATE SUBMITTED: 08-31-90
DATE ANALYZED : 09-08-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 5, BUSHONG, KANSAS
SAMPLE ID: TRIP BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
ILOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	ND	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	40	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	2 J	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 109% BROMOFLUOROBENZENE(86-115) 107% 1,2-DICHLOROETHANE-d4(76-114) 99%

"ND" = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

U.S. ARMY CORPS OF ENGINEERS Omaha

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME	NO. OF CONTAINERS	PAH Liter amber glass	VOA 40ml vial	REMARKS
	Burlington, KS Forbes Atlas Missile Site-5				

SAMPLERS: (Signature) Julia Klein

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	PAH Liter amber glass	VOA 40ml vial	REMARKS
Gmw502	8-29-90	15:10		X	Gmw 502	1	X		
Gmw502	8 30 90	10:21		X	Gmw 502	1	X		
Gmw502	8-29-90	15:10		X	DGmw 502	1	X		
Gmw502	8 30 90	10:21		X	DGmw 502	1	X		
Gmw501	8-29-90	13:55		X	Gmw 501	1	X		
Gmw501	8 30 90	08:07		X	Gmw 501	1	X		
~~Gmw~~	8-29-90			X	Trip Blank	2		X	

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Julia Klein	8-30-90 11:05				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	
		Barbara J. Smith	8/31/90 0830	Preserved to 4°C.	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

№ 2366 KCD

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany . Suite "C" . Broken Arrow, Oklahoma 74012 . 918-251-2858 . FAX: 918-251-2599

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3606a

DATE: 10-01-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE EXTRACTED: 09-01-90
DATE ANALYZED : 09-28-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 5, BUSHONG, KANSAS
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	10	ND
2-METHYLNAPHTHALENE	10	ND
CHLORONAPHTHALENE	10	ND
ACENAPHTHYLENE	10	ND
ACENAPHTHENE	10	ND
FLUORENE	10	ND
PHENANTHRENE	10	ND
ANTHRACENE	10	ND
FLUORANTHENE	10	ND
PYRENE	10	ND
BENZO(A)ANTHRACENE	10	ND
CHRYSENE	10	ND
BENZO(B)FLUORANTHENE	10	ND
BENZO(K)FLUORANTHENE	10	ND
BENZO(A)PYRENE	10	ND
INDENO(1,2,3-CD)PYRENE	10	ND
DIBENZ(A,H)ANTHRACENE	10	ND
BENZO(G,H,I)PERYLENE	10	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (35-114) 52% 2-FLUOROBIPHENYL (43-116) 55% TERPHENYL-d14 (33-141) 66%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany . Suite "C" . Broken Arrow, Oklahoma 74012 . 918-251-2858 . FAX: 918-251-2599

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 3606b

DATE: 09-17-90

SAMPLE MATRIX: WATER
SWLO # METHOD BLANK
DATE ANALYZED : 09-08-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORBES ATLAS MISSILE SITE - 5, BUSHONG, KANSAS
SAMPLE ID: METHOD BLANK

RESULTS REPORTED IN ug/L OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS	VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND	1,1,2,2-TETRACHLOROETHANE	5	ND
ROMOMETHANE	10	ND	1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND	TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND	TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	ND	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND	1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND	BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND	CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND	2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND	BROMOFORM	5	ND
CHLOROFORM	5	ND	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND	4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND	TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND	TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND	CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND	ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND	STYRENE	5	ND
			TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(88-110) 91% BROMOFLUOROBENZENE(86-115) 89% 1,2-DICHLOROETHANE-d4(76-114) 90%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
= ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.
1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858 • FAX: 918-251-2599

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MO 63128

REPORT: 3606c

DATE: 01-18-91

SAMPLE MATRIX: WATER
SWLO # 3606.02/3606.03 (MS/MSD)
DATE SUBMITTED: 08-31-90
DATE EXTRACTED: 09-01-90
DATE ANALYZED : 09-25-90
METHOD REFERENCE: SW846-8270
PROJECT: FORBES ATLAS MISSILE SITE - 5, BUSHONG, KANSAS
SAMPLE ID: GMW502

WATER SEMIVOLATILE MATRIX SPIKE/MATRIX SPIKE DUPLICATE RECOVERY

COMPOUND	SPIKE ADDED (ug/l)	SAMPLE CONCENTRATION (ug/l)	MS CONCENTRATION (ug/l)	MS PERCENT RECOVERY	QC LIMITS RECOVERY
PHENOL	200	0	-	-	12 - 89
2-CHLOROPHENOL	200	0	-	-	27 - 123
1,4-DICHLOROBENZENE	100	0	50	50	36 - 97
N-NITROSO-di-n-PROPYLAMINE	100	0	52	52	41 - 116
1,2,4-TRICHLOROBENZENE	100	0	46	46	39 - 98
4-CHLORO-3-METHYLPHENOL	200	0	-	-	23 - 97
ACENAPHTHENE	100	0	56	56	46 - 118
4-NITROPHENOL	200	0	-	-	10 - 80
2,4-DINITROTOLUENE	100	0	63	63	24 - 96
PENTACHLOROPHENOL	200	0	-	-	9 - 103
PYRENE	100	0	67	67	26 - 127

COMPOUND	SPIKE ADDED (ug/l)	MSD CONCENTRATION (ug/l)	MSD PERCENT RECOVERY	PERCENT RPD	QC LIMITS RPD	QC LIMITS RECOVERY
PHENOL	200	-	-	-	35	12 - 89
2-CHLOROPHENOL	200	-	-	-	50	27 - 123
1,4-DICHLOROBENZENE	100	48	48	4	27	36 - 97
N-NITROSO-di-n-PROPYLAMINE	100	52	52	0	38	41 - 116
1,2,4-TRICHLOROBENZENE	100	47	47	2	23	39 - 98
4-CHLORO-3-METHYLPHENOL	200	-	-	-	33	23 - 97
ACENAPHTHENE	100	53	53	5	19	46 - 118
4-NITROPHENOL	200	-	-	-	50	10 - 80
2,4-DINITROTOLUENE	100	62	62	2	47	24 - 96
PENTACHLOROPHENOL	200	-	-	-	47	9 - 103
PYRENE	100	69	69	3	36	26 - 127

VALUES OUTSIDE OF QC LIMITS

APPENDIX M

ANALYTICAL RESULTS FOR QUALITY ASSURANCE SAMPLES

APPENDIX N

GROUND WATER REGULATORY CRITERIA

Table N-1
Current Promulgated Ground Water Regulations,
Standards and Criteria:
Volatile Organics
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Volatile Organics	CAS Number	Regulations, Standards and Criteria (ug/l) MCL *	RMCL **	KAL ***
acrolein	107-02-8	---	---	320
acrylonitrile	107-13-1	---	---	3.8
benzene	71-43-2	5	---	5
bis(chloromethyl)ether	542-88-1	---	---	3.8E-06
bromodichloromethane	75-27-4	---	---	100
bromomethane	74-83-9	---	---	0.19
chlorobenzene	108-90-7	---	---	60
chloroethane	75-00-3	---	---	37
chloroethyl vinyl ether, 2-	110-75-8	---	---	---
chloromethane (methyl chloride)	74-87-3	---	---	0.19
dibromochloromethane	124-48-1	---	---	100
dichlorodiflouromethane	75-71-8	---	---	5600
dichloroethane, 1,1-	75-34-3	---	---	5
dichloroethane, 1,2-	107-06-2	5	---	5
dichloroethylene, 1,1-	75-35-4	7	---	7
dichloroethylene, cis 1,2-	540-59-0	---	---	70
dichloroethylyne, trans 1,2-	540-59-0	---	---	70
dichloromethane (methylene chloride)	75-09-2	---	---	50
dichloropropane, 1,2-	78-87-5	---	---	6
dichloropropene, cis 1,3-	542-75-6	---	---	2
dichloropropene, trans 1,3-	542-75-6	---	---	2
ethylbenzene	100-41-4	---	---	680
hexane, n-	110-54-3	---	---	14000
methyl ethyl ketone	78-93-3	---	---	170
tetrachloroethane, 1,1,2,2-	79-34-5	---	---	1.7
tetrachloroethylene	127-18-4	---	---	7
tetrachloromethane	56-23-5	---	---	5
toluene	108-88-3	---	---	2000
tribromomethane (bromoform)	75-25-2	---	---	100
trichloroethane, 1,1,1-	71-55-6	200	---	200
trichloroethane, 1,1,2-	79-00-5	---	---	6.1
trichloroethylene	79-01-6	5	---	5
trichloroflouromethane	75-69-4	---	---	8000
trichloromethane (chloroform)	67-66-3	---	---	100
vinyl chloride	75-01-4	2	---	2
xylene, o-, m-, p-	1330-20-7	---	---	440
TVOC (Total Volatile Organics)	---	---	---	100

Notes:

* MCL = Maximum Contaminant Level
** RMCL = Recommended Maximum Contaminant Level
*** KAL = Kansas Action Level

Table N-2
Current Promulgated Ground Water Regulations,
Standards and Criteria:
Base Neutral Compounds
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Base Neutral Compounds	CAS Number	Regulations, Standards and Criteria (ug/l) MCL *	RMCL **	KAL ***
acenaphthylene	208-96-8	---	---	0.029
anthracene	120-12-7	---	---	0.029
benzidene	98-87-5	---	---	0.0015
benzo[a]anthracene	56-55-3	---	---	0.029
benzo[a]pyrene	50-32-8	---	---	0.03
benzo[b]flouranthene	205-99-2	---	---	0.029
benzo[g,h,i]perylene	191-24-2	---	---	0.029
benzo[k]flouranthene	207-08-9	---	---	0.029
bis(2-chlorethoxy)methane	111-91-1	---	---	10
bis(2-chloroethyl)ther	111-44-4	---	---	4.2
bis(2-chloroisopropyl)ether	108-60-1	---	---	34.7
bis(2-ethylexyl)phthalate	117-81-7	---	---	4200
bromophenyl phenyl ether, 4-	101-55-3	---	---	10
butyl benzyl phthalate	85-68-7	---	---	10
chloronaphthalene, 2-	91-58-7	---	---	10
chlorophenyl phenyl ether, 4-	7005-72-3	---	---	10
chrysene	218-01-9	---	---	0.029
dibenz[a,h]anthracene	53-70-3	---	---	0.029
dichlorobenzene, 1,2- (o-)	95-50-1	---	---	620
dichlorobenzene, 1,3- (m-)	541-73-1	---	---	620
dichlorobenzene, 1,4- (p-)	106-46-7	---	---	75
dichlorobenzidine, 3,3'	91-94-1	---	---	0.21
diethylphthalate	84-66-2	---	---	350000
dimethylphthalate	131-11-3	---	---	313000
dinitrotoluene, 2,4-	121-14-2	---	---	1.1
dinitrotoluene, 2,6-	121-14-2	---	---	0.04
diphenylhydrazine, 1,2-	122-66-7	---	---	0.45
di-n-butyl phthalate	84-74-2	---	---	770
di-n-octyl phthalate	117-84-0	---	---	10
flouranthene	206-44-0	---	---	0.029
flourene	86-73-7	---	---	0.029
hexachlorobenzene	118-74-1	---	---	0.02
hexachlorobutadiene	87-68-3	---	---	4.5
hexachlorocylopentadiene	77-47-4	---	---	206
hexachloroethane	67-72-1	---	---	1.9
indeno[1,2,3-c,d]pyrene	193-39-5	---	---	0.029
isophorone	78-59-1	---	---	5200
naphthalene	91-20-3	---	---	143
nitrobenzene	98-95-3	---	---	5
n-nitrosodimethylamine	62-75-9	---	---	0.0014
n-nitrosodiphenylamine	86-30-6	---	---	71
n-nitrosodi-n-propylamine	621-64-7	---	---	10
phenanthrene	85-01-8	---	---	0.029
pyrene	129-00-0	---	---	0.029
styrene	100-42-5	---	---	0.14
trichlorobenzene, 1,2,4-	120-82-1	---	---	13
TBN (Total Base Neutrals noted)	---	---	---	10

Notes:

* MCL = Maximum Contaminant Level
** RMCL = Recommended Maximum Contaminant Level
*** KAL = Kansas Action Level

Table N-3
Current Promulgated Ground Water Regulations,
Standards and Criteria:
Acid Extractables
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Acid Extractables	CAS Number	Regulations, Standards and Criteria (ug/l) MCL *	RMCL **	KAL ***
chloro-m-cresol, 4-	59-50-7	---	---	3000
clhorophenol, o-	95-57-8	---	---	0.1
clhorophenol, p-	106-48-9	---	---	0.3
dichlorophenol, 2,4-	120-83-2	---	---	700
dichlorophenol, 2,6-	87-65-0	---	---	0.2
dichlorophenol, 3,4-	95-77-2	---	---	0.3
dimethyl phenol, 2,4-	105-67-9	---	---	400
dinitro-o-cresol, 4,6-	534-52-1	---	---	13.4
dinitrophenol, 2,4-	51-28-5	---	---	110
nitrophenol, 2-	88-75-5	---	---	290
nitrophenol, 4-	100-2-7	---	---	290
pentachlorophenol	87-86-5	---	---	220
phenol	108-95-2	---	---	300
tetrachlorophenol, 2,3,4,5-	1901-51-3	---	---	40
tetrachlorophenol, 2,3,4,6-	58-90-2	---	---	263
tetrachlorophenol, 2,3,5,6-	935-95-5	---	---	40
trichlorophenol, 2,3,4-	---	---	---	40
trichlorophenol, 2,4,5-	95-95-4	---	---	1
trichlorophenol, 2,4,6-	88-06-2	---	---	17
trichlorophenol, 3,4,5-	609-19-8	---	---	40

Notes:

* MCL = Maximum Contaminant Level
** RMCL = Recommended Maximum Contaminant Level
*** KAL = Kansas Action Level

Table N-4
Current Promulgated Ground Water Regulations,
Standards and Criteria:
Metals
Former Forbes Atlas Missile Site S-5
Bushong, Kansas

Metals	CAS Number	Regulations, Standards and Criteria (ug/l) MCL *	RMCL **	KAL ***
arsenic	7440-38-2	50	---	50
barium	7440-39-3	1000	---	1000
cadmium	7440-43-9	10	---	5
chromium	7440-47-3	50	---	50
iron	7439-89-6	---	300	300
lead	7439-92-1	50	---	50
manganese	7439-96-5	---	50	50
mercury	7439-97-6	2	---	2
selenium	7782-49-2	10	---	45
silver	7440-22-4	50	---	50
zinc	7440-66-6	---	5000	5000

Notes:

* MCL = Maximum Contaminant Level
** RMCL = Recommended Maximum Contaminant Level
*** KAL = Kansas Action Level

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.01V

DATE: 06-19-90

SAMPLE MATRIX: SOIL
SWLO # 2669.01
DATE SUBMITTED: 05-24-90
DATE ANALYZED : 05-31-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5S1

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
''INYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
ALOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	15	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND		1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	ND		2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(81-117) 117% BROMOFLUOROBENZENE(74-121) 77% 1,2-DICHLOROETHANE-d4(70-121) 99%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
' = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.01PN

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.01
DATE SUBMITTED: 05-24-90
DATE EXTRACTED: 05-29-90
DATE ANALYZED : 06-06-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: S5S1

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	660	ND
2-METHYLNAPHTHALENE	660	ND
2-CHLORONAPHTHALENE	660	ND
ACENAPHTHYLENE	660	ND
ACENAPHTHENE	660	ND
FLUORENE	660	ND
PHENANTHRENE	660	ND
ANTHRACENE	660	ND
FLUORANTHENE	660	ND
PYRENE	660	ND
BENZO(A)ANTHRACENE	660	ND
CHRYSENE	660	ND
BENZO(B)FLUORANTHENE	660	ND
BENZO(K)FLUORANTHENE	660	ND
BENZO(A)PYRENE	660	ND
INDENO(1,2,3-CD)PYRENE	660	ND
DIBENZ(A,H)ANTHRACENE	660	ND
BENZO(G,H,I)PERYLENE	660	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (23-120) 79% 2-FLUOROBIPHENYL (30-115) 89% TERPHENYL-d14 (18-137) 108%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.02MT

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.02
DATE SUBMITTED: 05-24-90
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: SSS2

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL METALS					
ARSENIC	2.0	mg/Kg	3.6	05-31-90	SW 7060
BARIUM	4.0	mg/Kg	129	06-05-90	SW 6010
CADMIUM	1.0	mg/Kg	1.3	06-05-90	SW 6010
CHROMIUM	1.0	mg/Kg	12.6	06-05-90	SW 6010
EAD	4.0	mg/Kg	41.6	06-05-90	SW 6010
ERCURY	0.1	mg/Kg	ND	06-11-90	SW 7471
SELENIUM	1.0	mg/Kg	ND	06-01-90	SW 7740
SILVER	2.0	mg/Kg	ND	06-05-90	SW 6010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = EPA METHODOLOGY, "#SW846", THIRD EDITION

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany . Suite "C" . Broken Arrow, Oklahoma 74012 . 918-251-2858

CLIENT: O'BRIEN & GERE
5000 CEDAR PLAZA PKWY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.02V

DATE: 06-19-90

SAMPLE MATRIX: SOIL
SWLO # 2669.02
DATE SUBMITTED: 05-24-90
DATE ANALYZED : 05-29-90
METHOD REFERENCE: SW846-8240, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S5S2

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

VOLATILES	DET. LIMIT	RESULTS		VOLATILES	DET. LIMIT	RESULTS
CHLOROMETHANE	10	ND		1,1,2,2-TETRACHLOROETHANE	5	ND
BROMOMETHANE	10	ND		1,2-DICHLOROPROPANE	5	ND
VINYL CHLORIDE	10	ND		TRANS-1,3-DICHLOROPROPENE	5	ND
CHLOROETHANE	10	ND		TRICHLOROETHENE	5	ND
METHYLENE CHLORIDE	5	33	B	DIBROMOCHLOROMETHANE	5	ND
ACETONE	10	ND		1,1,2-TRICHLOROETHANE	5	ND
CARBON DISULFIDE	5	ND		BENZENE	5	ND
1,1-DICHLOROETHENE	5	ND		CIS-1,3-DICHLOROPROPENE	5	ND
1,1-DICHLOROETHANE	5	ND		2-CHLOROETHYLVINYLETHER	10	ND
TRANS-1,2-DICHLOROETHENE	5	ND		BROMOFORM	5	ND
CHLOROFORM	5	2	BJ	2-HEXANONE	10	ND
1,2-DICHLOROETHANE	5	ND		4-METHYL-2-PENTANONE	10	ND
2-BUTANONE	10	ND		TETRACHLOROETHENE	5	ND
1,1,1-TRICHLOROETHANE	5	ND		TOLUENE	5	ND
CARBON TETRACHLORIDE	5	ND		CHLOROBENZENE	5	ND
VINYL ACETATE	10	ND		ETHYLBENZENE	5	ND
BROMODICHLOROMETHANE	5	ND		STYRENE	5	ND
				TOTAL XYLENES	5	ND

QA/QC SURROGATE RECOVERIES

TOLUENE-d8(81-117) 112% BROMOFLUOROBENZENE(74-121) 82% 1,2-DICHLOROETHANE-d4(70-121) 97%

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.02PN

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.02
DATE SUBMITTED: 05-24-90
DATE EXTRACTED: 05-29-90
DATE ANALYZED : 06-06-90
METHOD REFERENCE: SW846-8270, EPA METHODOLOGY
PROJECT: FORMER FORBES ATLAS MISSLE SITES
SAMPLE ID: S5S2

RESULTS REPORTED IN ug/Kg OR Parts Per Billion (PPB)

POLYNUCLEAR AROMATIC HYDROCARBONS	DETECTION LIMIT	RESULTS
NAPHTHALENE	660	ND
2-METHYLNAPHTHALENE	660	ND
2-CHLORONAPHTHALENE	660	ND
[illegible]NAPHTHYLENE	660	ND
[illegible]NAPHTHENE	660	ND
FLUORENE	660	ND
PHENANTHRENE	660	ND
ANTHRACENE	660	ND
FLUORANTHENE	660	ND
PYRENE	660	ND
BENZO(A)ANTHRACENE	660	ND
CHRYSENE	660	ND
BENZO(B)FLUORANTHENE	660	ND
BENZO(K)FLUORANTHENE	660	ND
BENZO(A)PYRENE	660	ND
INDENO(1,2,3-CD)PYRENE	660	ND
DIBENZ(A,H)ANTHRACENE	660	ND
BENZO(G,H,I)PERYLENE	660	ND

QA/QC SURROGATE RECOVERIES

NITROBENZENE-d5 (23-120) 91% 2-FLUOROBIPHENYL (30-115) 101% TERPHENYL-d14 (18-137) 137%

ND = NONE DETECTED ABOVE QUANTITATION LIMIT
J = ESTIMATED VALUE: CONCENTRATION BELOW LIMIT OF QUANTITATION
B = ANALYTE DETECTED IN BLANK AS WELL AS SAMPLE
* = SURROGATE RECOVERY OUTSIDE OF QC LIMITS

SOUTHWEST LABORATORY OF OKLAHOMA, INC.

1700 W. Albany • Suite "C" • Broken Arrow, Oklahoma 74012 • 918-251-2858

CLIENT: OBRIEN & GERE ENGINEERS, INC.
5000 CEDAR PLAZA PARKWAY, SUITE 211
ST. LOUIS, MISSOURI 63128
ATTN: JULIE JENNINGS

REPORT: 2669.03MT

DATE: 06-20-90

SAMPLE MATRIX: SOIL
SWLO # 2669.03
DATE SUBMITTED: 05-24-90
PROJECT: FORMER FORBES ATLAS MISSILE SITES
SAMPLE ID: S553

PARAMETER	DET. LIMIT	UNIT	RESULTS	DATE ANALYZED	METHOD REFERENCE
TOTAL METALS					
ARSENIC	2.0	mg/Kg	5.3	05-31-90	SW ⁻060
BARIUM	4.0	mg/Kg	179	06-05-90	SW ɛ010
CADMIUM	1.0	mg/Kg	ND	06-05-90	SW ɔ010
CHROMIUM	1.0	mg/Kg	14.7	06-05-90	SW ɛ010
LEAD	4.0	mg/Kg	33.0	06-05-90	SW ɛ010
MERCURY	0.1	mg/Kg	ND	06-11-90	SW ⁻471
SELENIUM	1.0	mg/Kg	ND	05-31-90	SW ⁻740
SILVER	2.0	mg/Kg	ND	06-05-90	SW ɛ010

ND = NOT DETECTED ABOVE QUANTITATION LIMIT
SW = EPA METHODOLOGY, "#SW846", THIRD EDITION