

OB/OD 1.6 001

**DRAFT FINAL**

**TECHNICAL MEMORANDUM**

**MOBILIZATION #2 ACTIVITIES  
OPEN BURN/OPEN DETONATION AREA  
FORT RILEY, KANSAS**

**8 May 1998**

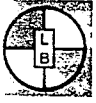
**Prepared for:**

**United States Army Engineer District, Kansas City  
CENWK-EP-EA  
601 East 12th Street  
Kansas City, Missouri 64106-2896  
Contract No. DACA41-92-D-0001**

**Prepared by:**

**Louis Berger & Associates, Inc.  
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8 May 1998

Mr. Glen Shonkwiler  
U.S. Army Engineer District, Kansas City  
Attn: CENWK-EP-EA  
601 East 12th Street  
Kansas City, Missouri 64106-2896

RE: Draft Final Technical Memorandum Mobilization #2, Open Burn/Open Detonation Area,  
Fort Riley, Kansas

Dear Glen:

Enclosed are four copies of the Draft Final Technical Memorandum for Mobilization #2 at the Open Burn/Open Detonation Area. This memo documents the installation of the piezometers.

A disk copy of this report has also been provided to Dr. Archer. In case of any discrepancy between the disk copy and hard copy, the hard copy prevails.

This document has been checked and coordinated during Berger's internal review prior to this submittal.

If you have any questions, please do not hesitate to call me, or Tom Lewis, the Site Manager, at (973) 678-1960 Extension 755.

Sincerely,

LOUIS BERGER & ASSOCIATES, INC.

Barry Millman, P.E.  
Program Manager

Enclosures (4)

copy: Directorate of Environment & Safety (5 copies)  
AFZN-ES-L (Attn: John Cook)  
Bldg 407 Pershing Court (1st Floor)  
Fort Riley, KS 66442-6016

Bob Koke (2 copies)  
Federal Facilities/Special Emphasis Section  
Superfund Division  
U.S. Environmental Protection Agency, Region VII  
726 Minnesota Avenue  
Kansas City, Kansas 66101

Randy Carlson (2 copies)  
Bureau of Environmental Remediation  
Kansas Department of Health and Environment  
Forbes Field, Building 740  
Topeka, Kansas 66620-7500

Dr. Allen Archer (2 copies plus 1 disk copy)  
Department of Geology, Thompson Hall  
Kansas State University  
Manhattan, KS 66506

LBA: Tom Lewis/Mike McCloskey  
Susan Knauf  
File (DO32/JH1124D)

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- Attachment 1 Drilling Logs
- Attachment 2 Geophysical Logs
- Attachment 3 Well Specification Forms
- Attachment 4 Well Development Forms

## Overview of Mobilization #2 Activities Open Burn/Open Detonation Area

### 1.0 Introduction

This report presents a summary of the supplemental field work conducted during Mobilization #2 performed in accordance with the "Overview of Mobilization #1 Findings and Proposed Mobilization #2 Activities" memorandum (CENWK, 1997, referred to as Tech Memo #1), dated 30 May 1997.

The objectives of the supplemental investigations are to (a) evaluate the possible source and extent of contamination, (b) evaluate whether or not any other contaminants associated with the site are co-contaminants with the chlorinated solvent, and (c) clarify the local geology and movement of water within the different formations that underlay this site. Activities performed to achieve these objectives included the installation and development of five nested piezometers; geophysical logging of the five pilot borehole, existing monitoring well OB97-05, and an outcrop; surveying of all wells, piezometers, and sampling locations for elevation and coordinates; and sampling. Additional sampling of wells, piezometers, and surface water locations was performed in September 1997. The activities performed during the June/July 1997 mobilization are described in detail in the following sections.

There were a number of deviations from the proposed activities as follows:

- Grab samples were not collected from the piezometers as planned because of the difficulties in purging the piezometers. These samples were collected during the groundwater sampling event in September 1997;
- Surface water sampling was not conducted as the flow in the streams was intermittent. Sampling locations were surveyed, however, and it was proposed to collect samples when conditions permit;
- The number of piezometers installed (26) was changed from the proposed number (28) based on a review of the drilling logs and geophysical logs; and
- The amount of coring conducted at OB97-13PZ was reduced from the proposed 25 feet to approximately 10 feet based on the materials encountered. The coring did, however, reveal the Schroyer Limestone/Havensville Shale contact, which partially fulfilled the purpose of coring. As the upper portion of the Schroyer was absent, the entire thickness could not be cored.

## 2.0 Piezometer Construction

Five nested piezometers were installed at the OB/OD Area during Mobilization #2 between 1 and 19 June 1997. Figure 1 is a site map showing all the well and piezometer locations. Figure 2 is a site map showing location of surface water sampling locations (only OB97-SW2 has been sampled through September 1997). The piezometer construction data is presented in Table 1. The survey data for the eight existing wells, the five piezometers, and other site features are presented in Table 2.

Prior to the commencement of drilling activities for the nested piezometers, the ground surface elevation of the proposed locations were surveyed. As the proposed screen intervals for piezometers OB97-10 through OB97-12 were the same, their locations were adjusted so that the ground surface elevation for each location was within 2 feet. Accurate elevation data were important prior to drilling as the limestone formations at the site are relatively flat lying, and the elevation at which these formations might be expected to be encountered was known from previous drilling and logging activities performed at the site.

Drilling was performed using an Ingersol-Rand TH 60 rig using air rotary drilling techniques. Pilot borings were advanced using a  $5\frac{7}{8}$ -inch tricone bit, allowing for accurate logging of the cuttings. The borings were then reamed with a  $9\frac{7}{8}$ -inch tricone bit. Coring was performed at one piezometer location (OB97-13PZ) from 17.4 feet below ground surface (bgs) to 26.5 feet bgs. Drilling logs for each of the piezometer borings are included in Attachment 1. Upon completion of each boring an 8-inch inner diameter polyvinyl chloride (PVC) casing was installed temporarily to prevent collapse of the sidewalls.

Upon completion of the five borings, downhole geophysical logging was performed using a gamma logging tool (Colog MGX logger with a 2375 gamma sonde). Logging of monitoring well OB97-05 and the outcrop south of Vinton School Road were also performed during this mobilization. The outcrop is located about 2,000 feet southwest of the OB/OD Area. The geophysical logs, printed at a scale of 1 inch equals 10 feet, are included as Attachment 2. The drilling logs and geophysical logs were used to select the screen intervals for each piezometer.

Each piezometer is constructed of 1-inch diameter schedule 80 PVC and the screen sections for each are approximately 1-foot long, with the exception of the piezometer OB97-09PZ screening the Florence Limestone. The screen interval for this piezometer is approximately 2 feet long. Six nested piezometers were installed at piezometer location OB97-09PZ and five nested piezometers were installed at the other four piezometer locations. Each piezometer was constructed in a similar fashion by first backfilling the boring with bentonite to a depth approximately 1.5 feet below the proposed depth of the lowest piezometer. Time delayed bentonite pel-plug was used to allow the bentonite time to fall through the water before hydrating. Where it was deemed appropriate (i.e., when the formation water was viscous or the water column large), a 2-inch tremie pipe was used to place the bentonite. The bentonite seal was allowed three hours to hydrate before the sand/filter pack and



piezometer was set. Once all the piezometers were installed, a 10-inch protective steel casing was set, weep holes drilled, and three bumper posts set. All piezometer casings at each location were cut to the same elevation and notched for identification purposes. The deepest piezometer at each location had no notches with each consecutively shallower piezometer having one more notch than the previous piezometer. An aluminum plate, stamped with screened interval and elevation information was secured to the inside of each protective casing and a brass survey monument set in the concrete pad was stamped with the piezometer identification and elevation information (ground surface and top of PVC casing). The well specification forms are provided in Attachment 3.

### 3.0 Well Development

During drilling operations at piezometer OB97-13PZ, groundwater was forced from monitoring well OB97-07, located approximately 10 feet to the west. It was therefore necessary to redevelop this well. Redevelopment took place on 17 and 18 June 1997. A bladder pump was used to surge and pump the well.

Monitoring well OB97-05 was also developed on 10 June 1997 during Mobilization #2 as it was not completed during Mobilization #1 due to heavy rains. A stainless steel bailer was used to surge and remove groundwater from this well. Well development logs are included in Attachment 4 and the results of the well development of both wells is summarized in Table 3.

### 4.0 Piezometer Purging

It was planned to remove 3 well volumes from each piezometer and to collect a grab sample. Due to the narrow diameter and depths of the piezometers, conventional pumps could not be used. On 17 June 1997, purging of the piezometers commenced at OB97-13PZ using inertial (jiggle) tubes. However, purging using this method could not be completed due to limitations of the jiggle tubes. The limitations of the jiggle tubes were the depths of the piezometers (particularly at OB97-09PZ) and the shallow head in many of the piezometers. The jiggle tubes will not lift water if there is not sufficient head in the piezometer (i.e., a water column of at least 1.5 feet). It was, therefore, decided to use air lift methods to purge the piezometers.

On 4 July 1997 the piezometers were purged using air lift methods. Before purging, a round of groundwater level measurements and photoionization detector (PID) reading were recorded. An injection tube was used to deliver air to the bottom of each piezometer, forcing water up the piezometer casing. At each piezometer cluster, the deepest piezometer was purged first. Each piezometer was purged to dryness. Purge water from OB97-09PZ and OB97-10PZ was discharged to the ground. Purge water from OB97-11PZ through OB97-13PZ was containerized in Tank C. Table 4 summarizes the total purge volume collected from each piezometer.

## 5.0 Groundwater and Surface Water Sampling

As the piezometers could not be purged with inertial tubes, grab samples were not collected from all the piezometers. Only one sample from OB97-13PZ(2) was collected from the piezometer screened in the Schroyer Limestone and analyzed for Volatile Organic Compounds (VOCs) (EPA Method 8260). The spring and dug well were also sampled. The Quality Control Summary Report (QCSR) reports the validated data.

Surface water sampling was not performed as the flow in the two streams bordering the OB/OD site had low and intermittent flow. Proposed sample locations were surveyed, however, and it was proposed to collect these samples when conditions permit.

## 6.0 Groundwater Elevation Data

Table 5 lists information collected for groundwater elevations in both the existing wells, the wells installed during Mobilization #1, and the piezometers installed during Mobilization #2 and measured in June and July 1997. It includes the total depths measured on 5 July 1997.

## 7.0 Investigation-Derived Waste

Drill cuttings generated during drilling operations were staged on plastic sheeting at each borehole and headspace screening using a PID was performed on samples from each interval encountered. All drill cutting with a PID response less than 1 ppm were spread on the ground surface near each borehole. Only drill cuttings from OB97-11PZ exhibited a PID greater than 1 ppm and so these were containerized in 55-gallon steel drums and staged on site. Cuttings from all other boreholes were spread on the ground surface following screening. A composite sample of the soil from five of the seven drums was collected on 19 June 1997 and analyzed for VOCs (EPA Method 8260).

With the exception of OB97-09PZ and OB97-10PZ, all groundwater generated during drilling activities was containerized and placed in Tank C with purge water from the previous mobilization. As OB97-09PZ is located in an upgradient location and VOCs have not been detected in the eastern portion of the site near OB97-10PZ, groundwater from these locations was not containerized. The contents of Tank C were aerated during Mobilization #2 activities and a sample of the tank contents was collected on 19 June 1997 and analyzed for VOCs (EPA Method 8260).

## 8.0 Groundwater Elevation Contours

The groundwater elevation contours for 2 September 1997 are in a westerly direction using wells and piezometers screened in the Wymore Shale/Schroyer Limestone (Figure 3), in northwest and southwest directions using the piezometers screened in the Schroyer Limestone (bottom) (Figure 4), and southern and westerly direction using the piezometers screened in the Havensville (top) (Figure 5).

There are no contours drawn for the Threemile Limestone, the Kinney Limestone, the Wymore Shale, or the Schroyer Limestone (top) as either there were insufficient elevations measured (i.e., wells were dry), the gradient was too small to infer a direction, or the wells screen different elevations as is the case for the Three Mile Limestone wells.

## 9.0 Geologic Cross-Sections

Figure 6 is a map showing the cross section cuts, which updates the cross-section shown in Tech Memo #1. Figure 7 is a cross section that overlays the drilling log information with the geophysical log information and shows the elevation of the screens in the wells and piezometers

## 10.0 References

CENWK, 1997. *Technical Memorandum, Overview of Mobilization #1 Preliminary Findings and Proposed Mobilization #2 Activities Open Burn/Open Detonation Area, Fort Riley, Kansas*, 30 May 1997.

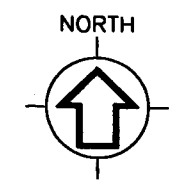
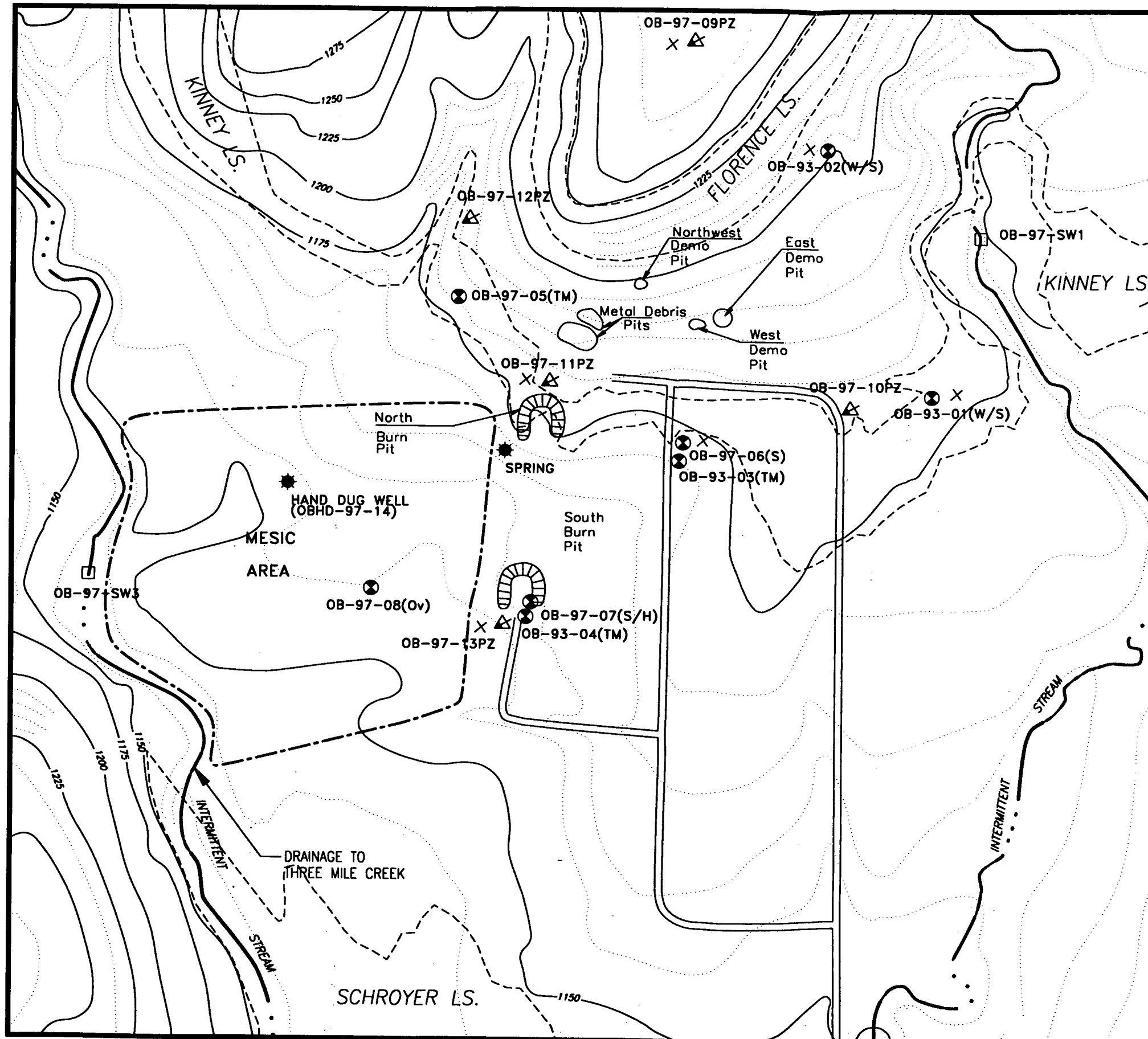
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





**FIGURES**

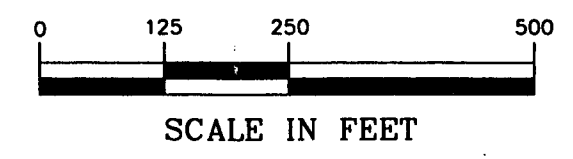
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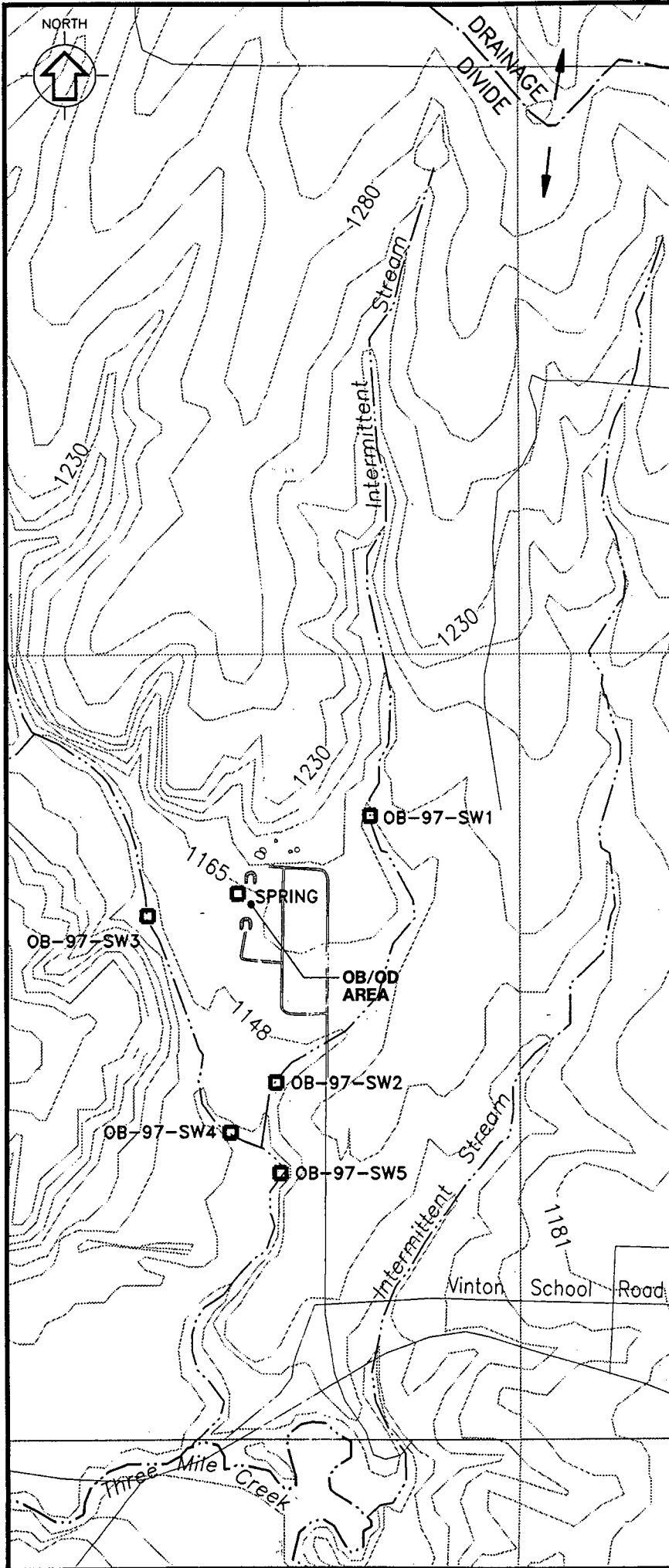
-  GROUNDWATER MONITORING WELL
-  NESTED PIEZOMETER
-  SURFACE WATER SAMPLE
-  INTERMITTENT STREAM
-  25-FOOT ELEVATION CONTOURS
-  5-FOOT ELEVATION CONTOURS
-  ROAD
-  SPRING/HAND DUG WELL
-  USGS DATA PLATFORM



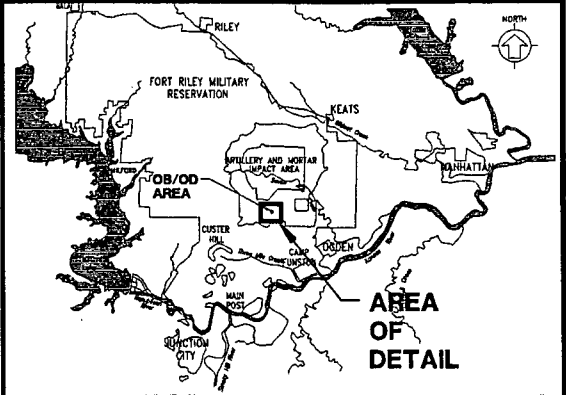
 U.S. ARMY CORPS OF ENGINEERS  
 LOUIS BERGER & ASSOCIATES, INC.  
 FORT RILEY (OB/OD Area - TM)  
**LOCATION OF WELLS,  
 NESTED PIEZOMETERS,  
 AND FEATURES**

SCALE: AS SHOWN	DATE: May 1998	<b>Figure 1</b>
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TM-ODCM/01MAY98/OB-SWSL.SCR



### KEY MAP

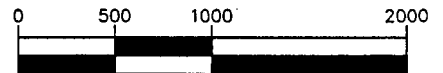


### LEGEND

- SURFACE WATER SAMPLING LOCATION
- THREE MILE CREEK
- INTERMITTENT STREAM

SOURCE:  
USGS 7.5 MIN. QUADRANGLE, FORT RILEY NE  
ELEVATIONS SHOWN IN FEET ABOVE MEAN SEA LEVEL

### GRAPHIC SCALE



( IN FEET )  
1 inch = 1000 ft.



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FORT RILEY MILITARY RESERVATION (OB/OD AREA-TM)

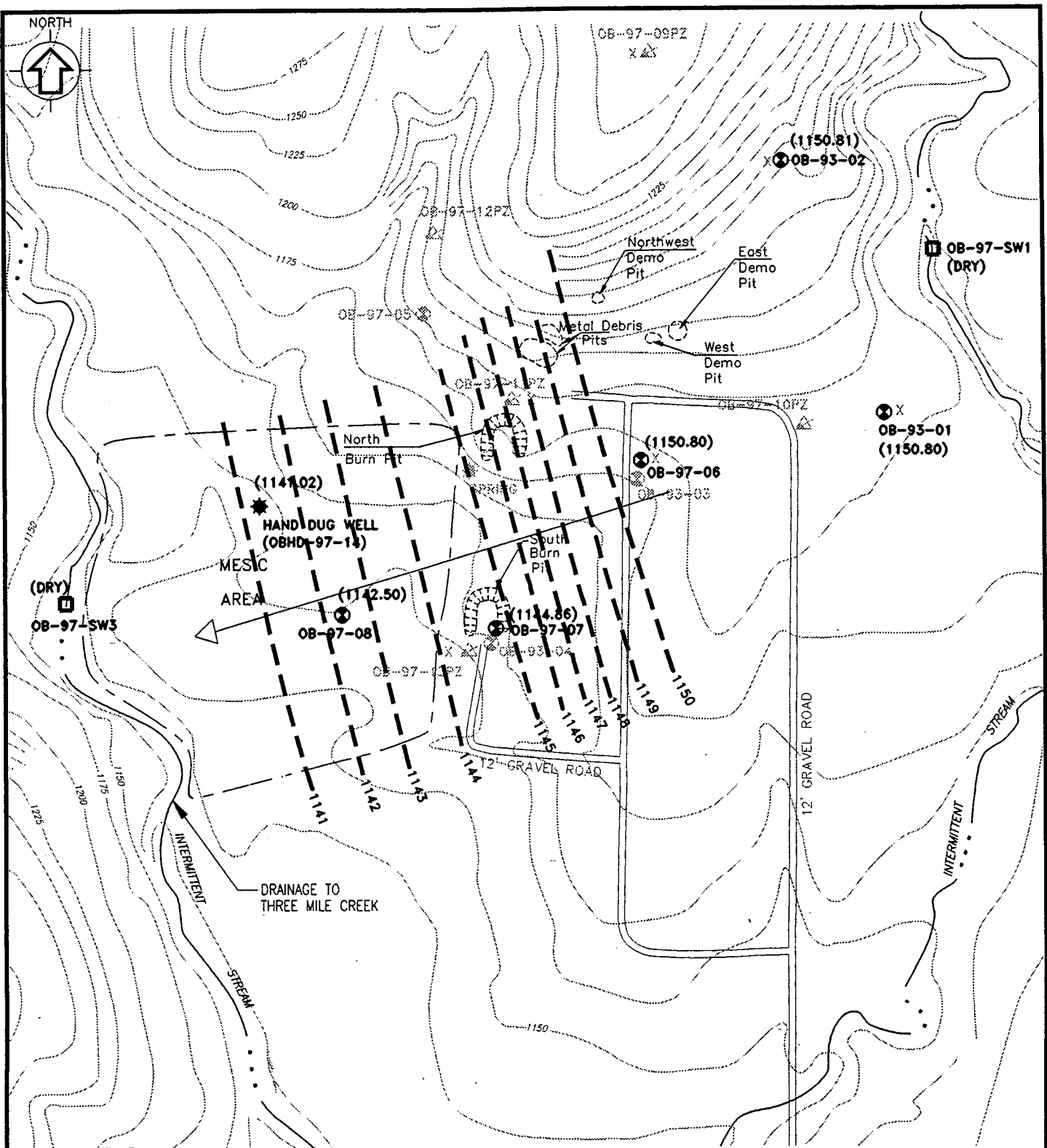
### SURFACE WATER SAMPLING LOCATIONS

SCALE:  
AS SHOWN

OB/OD TM DATE:  
MAY 1998

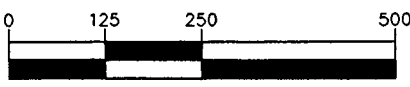
FIG. 2

NORTH



**LEGEND**

- INTERMITTENT STREAM
- GROUND SURFACE ELEVATION CONTOURS (ft msl)
- GRAVEL ROAD
- GROUNDWATER MONITORING WELL
- NESTED PIEZOMETER
- GROUNDWATER ELEVATION (ft msl)
- SURFACE WATER SAMPLING LOCATIONS
- GROUNDWATER FLOW DIRECTION
- INFERRED GROUNDWATER ELEVATION CONTOUR (ft msl)
- SPRING/HAND DUG WELL

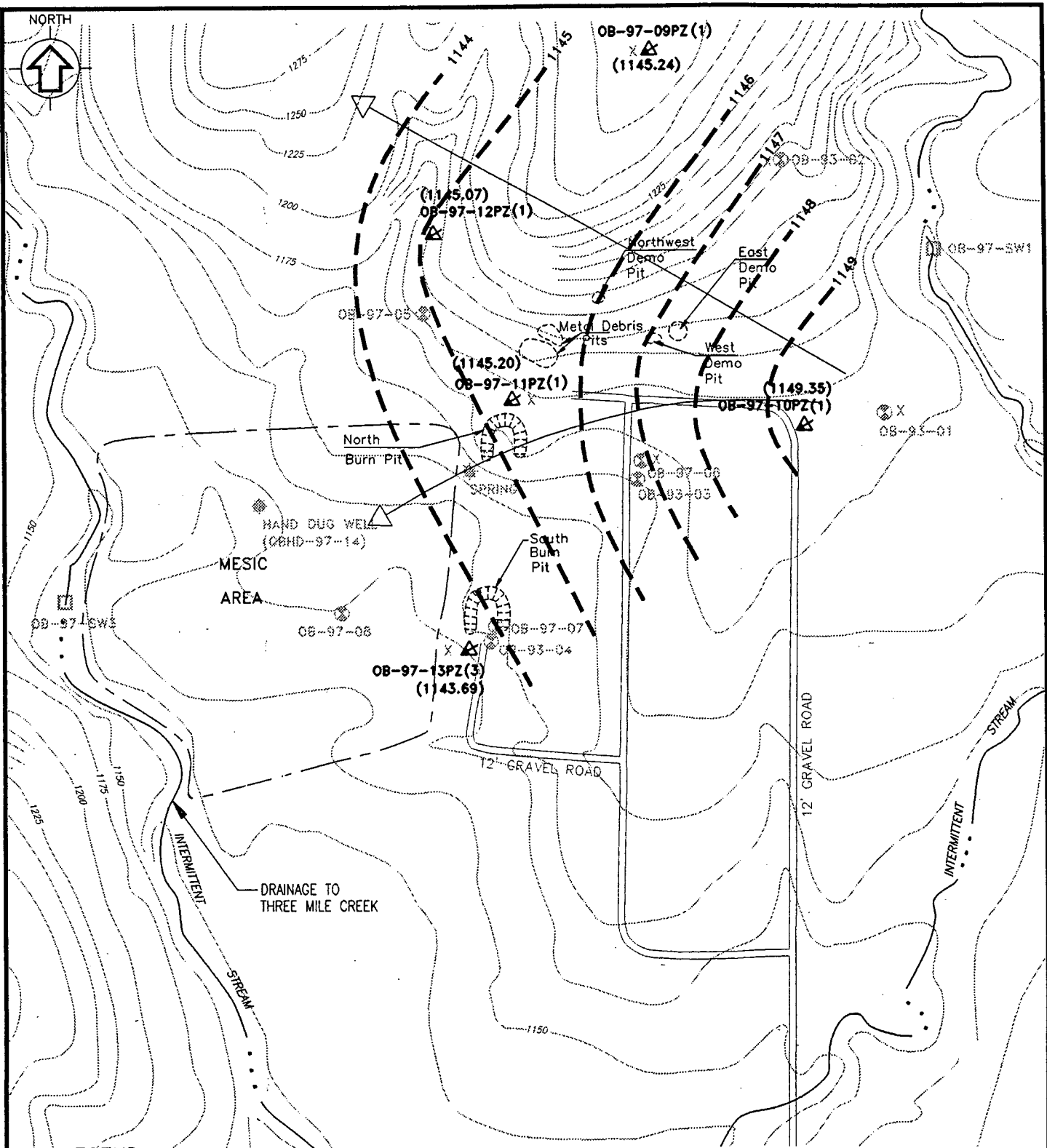


( IN FEET )  
1 inch = 250 ft.

	U.S. ARMY CORPS OF ENGINEERS
	LOUIS BERGER & ASSOCIATES, INC.
FORT RILEY MILITARY RESERVATION (OB/OD AREA TM)	
<b>GROUNDWATER ELEVATION CONTOURS</b>	
<b>WYMORE SHALE/SCHROYER LIMESTONE</b>	
<b>WELLS - 2 SEPTEMBER 1997</b>	
SCALE: AS SHOWN	OB/OD TM DATE: MAY 1998
FIG. 3	

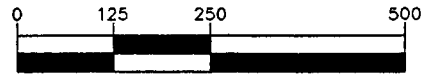
TM-OD.3/01MAY98/OB-GEC2.SCR

NORTH



**LEGEND**

- INTERMITTENT STREAM
- GROUND SURFACE ELEVATION CONTOURS (ft msl)
- GRAVEL ROAD
- GROUNDWATER MONITORING WELL
- NESTED PIEZOMETER
- (1169.49)** GROUNDWATER ELEVATION (ft msl)
- SURFACE WATER SAMPLING LOCATIONS
- GROUNDWATER FLOW DIRECTION
- INFERRED GROUNDWATER ELEVATION CONTOUR (ft msl)
- SPRING/HAND DUG WELL
- USGS DATA PLATFORM



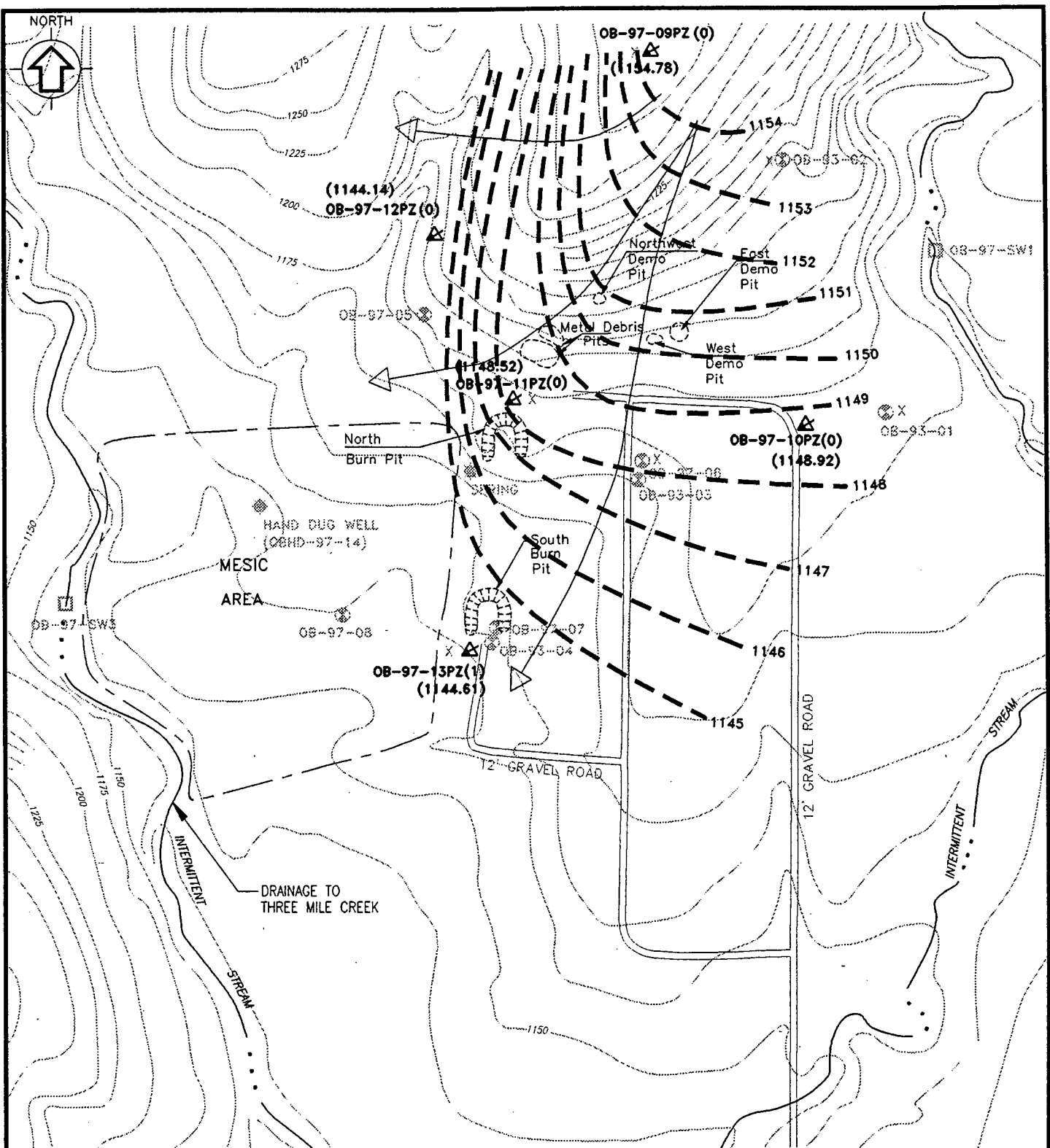
( IN FEET )  
1 inch = 250 ft.

	U.S. ARMY CORPS OF ENGINEERS
	LOUIS BERGER & ASSOCIATES, INC.
FORT RILEY MILITARY RESERVATION (OB/OD AREA TM)	
<b>GROUNDWATER ELEVATION CONTOURS</b>	
<b>SCHROYER LIMESTONE (BOTTOM) PIEZOMETERS</b>	
<b>2 SEPTEMBER 1997</b>	
SCALE: AS SHOWN	OB/OD TM DATE: MAY 1998
FIG. 4	

TM-OD5/01MAY98/OB-CEC4.SCR

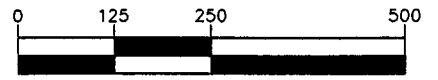


NORTH



**LEGEND**

- INTERMITTENT STREAM
- GROUND SURFACE ELEVATION CONTOURS (ft msl)
- GRAVEL ROAD
- GROUNDWATER MONITORING WELL
- NESTED PIEZOMETER
- GROUNDWATER ELEVATION (ft msl)  
(1169.49)
- SURFACE WATER SAMPLING LOCATIONS
- GROUNDWATER FLOW DIRECTION
- INFERRED GROUNDWATER ELEVATION CONTOUR (ft msl)
- SPRING/HAND DUG WELL
- USGS DATA PLATFORM



( IN FEET )  
1 inch = 250 ft.



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LOUIS BERGER & ASSOCIATES, INC.

FORT RILEY MILITARY RESERVATION (OB/OD AREA TM)

**GROUNDWATER ELEVATION CONTOURS  
HAVENSVILLE (TOP) PIEZOMETERS  
2 SEPTEMBER 1997**

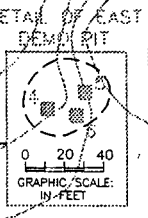
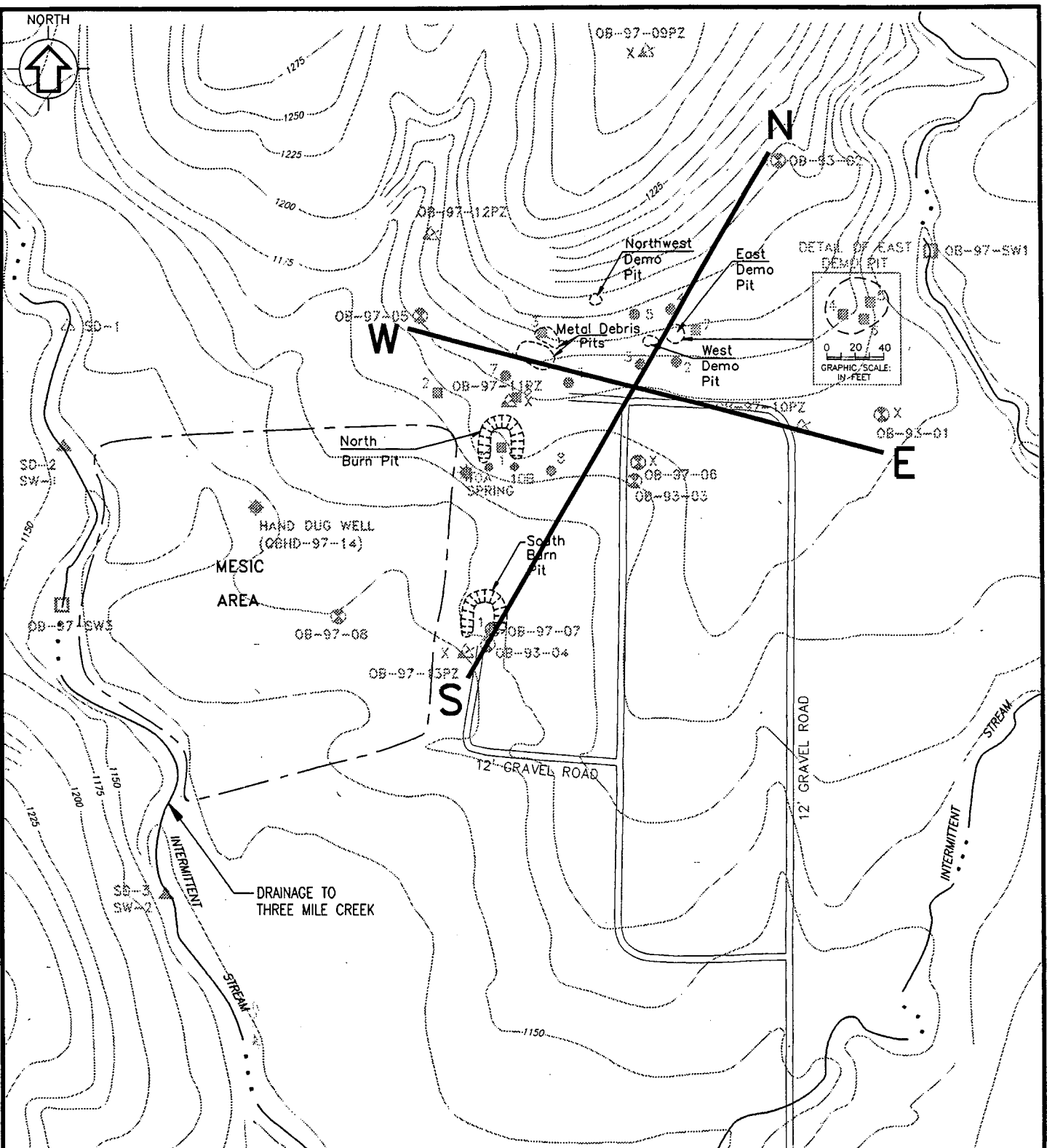
SCALE:  
AS SHOWN

OB/OD TM DATE:  
MAY 1998

FIG. 5

TM-OD6/01MAR98/OB-GEC5.SCR

NORTH



**LEGEND**

- INTERMITTENT STREAM
- GROUND SURFACE ELEVATION CONTOURS (ft msl)
- GRAVEL ROAD
- GROUNDWATER MONITORING WELL
- BORING LOCATION (SB)
- SEDIMENT & WATER SAMPLE (SD & SW)
- SURFACE SOIL SAMPLES (SS)
- SEDIMENT SAMPLES (S<sub>D</sub>)
- SPRING/HAND DUG WELL
- NESTED PIEZOMETER
- SURFACE WATER SAMPLING LOCATIONS
- CROSS SECTION LINE



( IN FEET )  
1 inch = 250 ft.



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FORT RILEY MILITARY RESERVATION (OB/OD AREA TM)

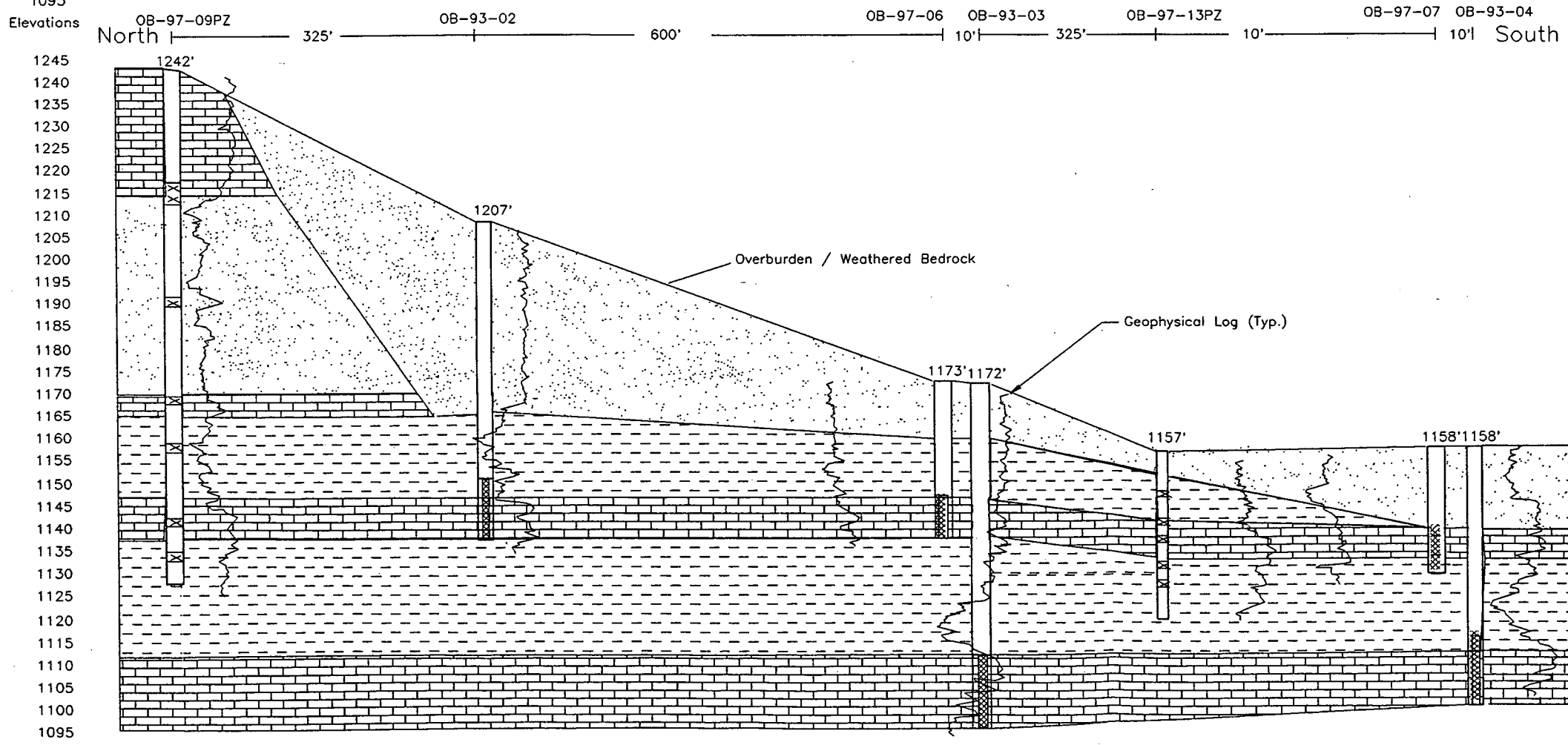
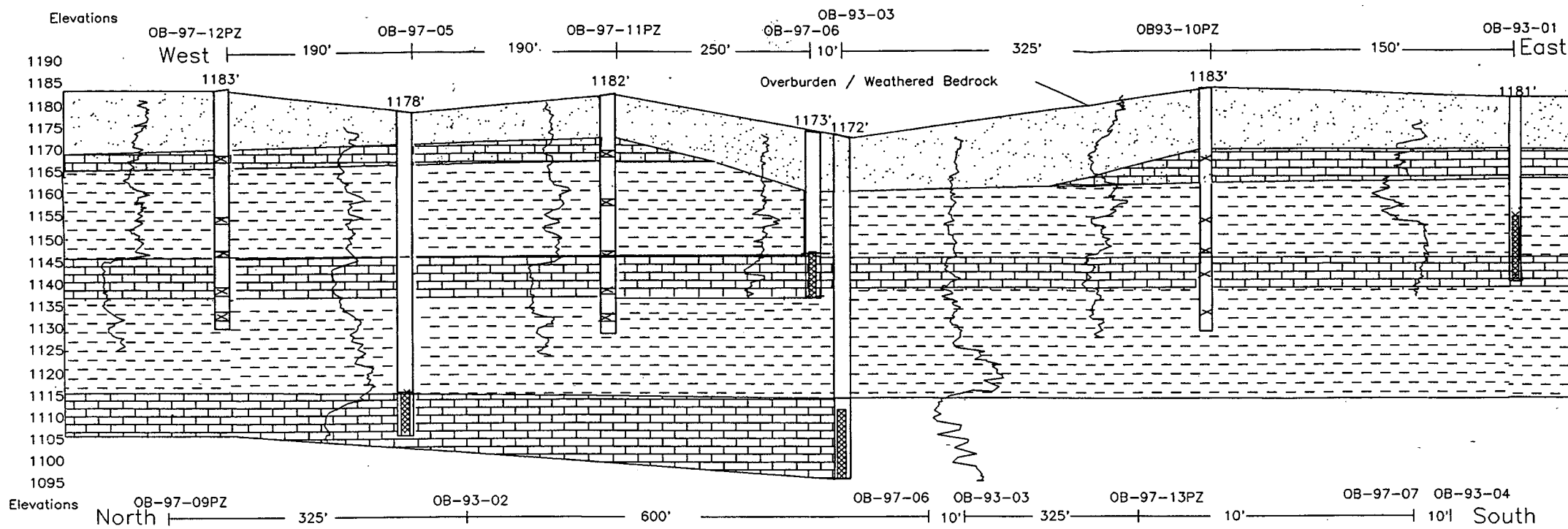
**CROSS SECTIONS LOCATION MAP**

SCALE:  
AS SHOWN

OB/OD TM DATE:  
MAY 1998

FIG. 6

TM-OD1/01MAY98/OB-SECTL.SCR



Formation / Elevation

Blue Springs Shale
Kinney Limestone
Wymore Shale
Schroyer Limestone
Havensville Shale
Three Mile Limestone
Speiser Shale

Formation / Elevation

Florence Limestone
Blue Springs Shale
Kinney Limestone
Wymore Shale
Schroyer Limestone
Havensville Shale
Three Mile Limestone
Speiser Shale

**NOTE:**  
 CROSS SECTIONS CONSTRUCTED BASED ON LITHOLOGICAL  
 AND GEOPHYSICAL LOGS.

	U.S. ARMY CORPS OF ENGINEERS
	LOUIS BERGER & ASSOCIATES, INC.
FORT RILEY MILITARY RESERVATION (OB/OD AREA TM)	
<b>GEOLOGIC CROSS SECTIONS</b>	
SCALE: N.T.S.	OB/OD TM DATE: MAY 1998
FIG. 7	

TM-GEOX/01MAY98/U4



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**TABLES**

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**Table 1 Piezometer Construction Data in Mobilization #2**

Well ID	Dates of Drilling	Surveyed Elevation -Grd (ft. amsl)	Surveyed Elevation - TOC (ft. amsl)	Total Depth (ft. bgs)	Interval Cored (ft. bgs)	Screened Interval Elevation (ft. amsl)	Formation Screened
OB-97-09PZ	6/6/97-6/7/97	1242.81	1245.70	114.5	NAp	1133.81 - 1132.81 1140.72 - 1139.81 1156.81 - 1155.81 1168.81 - 1167.81 1191.81 - 1190.81 1216.79 - 1214.81	Havensville Shale Schroyer Limestone Wymore Shale Kinney Limestone Blue Springs Shale Florence Limestone
OB-97-10PZ	6/8/97	1183.28	1185.52	58.0	NAp	1134.18 - 1133.28 1141.28 - 1140.28 1147.30 - 1146.28 1154.28 - 1153.28 1167.28 - 1166.28	Havensville Shale Schroyer Limestone (lower) Schroyer Limestone (upper) Wymore Shale Kinney Limestone
OB-97-11PZ	6/9/97	1182.21	1184.43	58.0	NAp	1132.21 - 1131.21 1138.21 - 1137.21 1146.21 - 1145.21 1153.21 - 1152.21 1169.21 - 1168.21	Havensville Shale Schroyer Limestone (lower) Schroyer Limestone (upper) Wymore Shale Kinney Limestone
OB-97-12PZ	6/5/97	1183.24	1185.65	58.0	NAp	1133.24 - 1132.24 1139.24 - 1138.24 1147.24 - 1146.24 1154.24 - 1153.24 1169.24 - 1168.24	Havensville Shale Schroyer Limestone (lower) Schroyer Limestone (upper) Wymore Shale Kinney Limestone
OB-97-13PZ	6/3/97-6/4/97	1157.92	1160.15	38.0	17.4-26.5	1127.92 - 1126.92 1131.92 - 1130.92 1136.92 - 1135.92 1141.42 - 1140.42 1146.92 - 1145.92	Havensville Shale (lower) Havensville Shale (upper) Schroyer Limestone (lower) Schroyer Limestone (upper) Overburden

Notes: NAp - Not Applicable, not cored; ft. amsl - feet above mean sea level; ft. bgs - feet below ground surface; TOC - top of casing; Grd. - ground surface

**Table 2 Survey Data**

Survey Point	Ground Elevation (ft. amsl)	Top of Casing Elevation (ft. amsl)	NAD 27 Coordinates		NAD 83 Coordinates	
			Latitude/Easting	Longitude/Northing	Latitude/Easting	Longitude/Northing
OB93-01	1182.07	1183.72	2351617.00	297014.00	1663860.43	297017.70
OB93-02	1208.44	1210.08	2351430.00	297455.00	1663673.43	297458.70
OB93-03	1172.88	1174.84	2351178.00	296891.00	1663421.43	296894.70
OB93-04	1158.32	1160.09	2350915.00	296603.00	1663158.43	296606.70
OB97-05	1178.23	1180.12	2350827.53	297143.29	1663070.96	297146.99
OB97-06	1173.36	1175.37	2351177.15	296903.05	1663420.58	296906.75
OB97-07	1158.72	1160.37	2350918.19	296614.14	1663161.62	296617.84
OB97-08	1158.25	1160.11	2350704.07	296753.03	1662947.50	296756.73
OB97-09PZ	1242.81	1245.70	2351194.18	297646.11	1663437.61	297649.81
OB97-10PZ	1183.28	1185.52	2351567.81	296982.44	1663711.24	296986.14
OB97-11PZ	1182.21	1184.43	2350973.70	296987.18	1663217.13	296990.88
OB97-12PZ	1183.24	1185.65	2350811.13	297281.66	1663054.56	297285.36
OB97-13PZ	1157.92	1160.15	2350926.34	296598.84	1663169.77	296602.54
Dug Well	NAp	1155.28	2350548.60	296813.88	1662792.03	296817.58
Spring	1162.48	1163.66	2350873.72	296885.77	1663117.15	296889.47
OB97-SW1	1168.74	1169.94	2351710.83	297304.08	1663954.26	297307.78
OB97-SW2	1132.01	1132.92	2351041.69	295273.69	1663285.12	295277.37
OB97-SW3	1145.30	1145.97	2350180.08	296664.68	1662423.51	296668.38
OB97-SW4	1130.10	1131.65	2350911.84	295132.88	1663155.27	295136.56
OB97-SW5	1128.99	1130.96	2351195.15	294895.91	1663438.58	294899.59

**Notes:**

Elevation for dug well is the top of the angle iron adjacent to well.

Elevations for the spring are ground elevation (1162.48 ft. amsl) and the top of the iron bar (1163.66 ft. amsl) placed at the head of the spring by the surveyor.

Elevations for surface water sample locations are the ground surface along the centerline of each stream and the top of the iron bar placed at each location by the surveyor.

NAp - Not Applicable; ft. amsl - feet above mean sea level; ft. bgs - feet below ground surface

**Table 3 Well Development Results for Mobilization #2**

Well ID	Development Dates (1997)	Development Volume (gal)	Measurements at End			
			Temp (°F/°C)	pH	Conductivity (μmhos/cm)	Turbidity (NTU)
OB-97-05	6/10	55	73.0/22.8	7.02	1184	22.6
OB-97-07	6/17-6/18	65	54.3/12.4	6.70	520	25.4

**Table 4 Piezometer Purging Data for Mobilization #2**

Piezometer ID	Initial Condition 4 July 1997	Volume Purged (Gals)
OB97-09PZ(0)	Water Present	1.5
OB97-09PZ(1)	Water Present	Blown dry - water not recoverable
OB97-09PZ(2)	Dry	Dry
OB97-09PZ(3)	Water Present	Blown dry - water not recoverable
OB97-09PZ(4)	Water Present	Blown dry - water not recoverable
OB97-09PZ(5)	Water Present	Blown dry - water not recoverable
OB97-10PZ(0)	Water Present	1
OB97-10PZ(1)	Water Present	3
OB97-10PZ(2)	Water Present	0.5
OB97-10PZ(3)	Water Present	3
OB97-10PZ(4)	Dry	Dry
OB97-11PZ(0)	Water Present	3
OB97-11PZ(1)	Water Present	2.5
OB97-11PZ(2)	Water Present	Blown dry - water not recoverable
OB97-11PZ(3)	Water Present	0.25
OB97-11PZ(4)	Dry	Dry
OB97-12PZ(0)	Water Present	1
OB97-12PZ(1)	Water Present	0.2
OB97-12PZ(2)	Dry	Dry
OB97-12PZ(3)	Water Present	0.6
OB97-12PZ(4)	Dry	Dry
OB97-13PZ(0)	Water Present	1.5
OB97-13PZ(1)	Water Present	Blown dry - water not recoverable
OB97-13PZ(2)	Water Present	(Was purged when sampled on 6/19/97)
OB97-13PZ(3)	Water Present	0.8
OB97-13PZ(4)	Water Present	Blown dry - water not recoverable



Table 5 Summary of Groundwater Elevation Data at Open Burn/Open Detonation Area

Well ID	Formation Screened	Top of Screen Elev. (ft. amsl)	Bottom of Screen Elev. (ft. amsl)	Ground Elevation (ft. amsl)	Measuring Point Elev. (ft. amsl)	1-Jun-97		4-Jun-97		5-Jun-97		6-Jun-97		7-Jun-97		9-Jun-97	
						Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)
OB93-01	Wymore/Schroyer	1155	1140	1182.07	1183.72	1155.41	28.31	1154.91	28.81	1154.87	28.85	1154.84	28.88	1154.59	29.13	1154.35	29.37
OB93-02	Wymore/Schroyer	1151	1136	1208.44	1210.08	1155.40	54.68	1154.89	55.19	1154.86	55.22	1154.85	55.23	1154.59	55.49	1154.34	55.74
OB93-03	Threemile Limestone	1111	1096	1172.88	1174.84	1124.03	50.81	1123.86	50.98	1123.85	50.99	1123.84	51.00	1123.79	51.05	1123.73	51.11
OB93-04	Threemile Limestone	1116	1101	1158.32	1160.09	1125.01	35.08	1124.89	35.20	1124.90	35.19	1124.88	35.21	1124.84	35.25	1124.78	35.31
OB97-05	Threemile Limestone	1115	1105	1178.23	1180.12	1124.10	56.02	1123.95	56.17	1123.96	56.16	1123.94	56.18	1123.89	56.23	1123.83	56.29
OB97-08	Schroyer Limestone	1146.5	1136.5	1173.36	1175.37	1155.39	19.98	1154.90	20.47	1154.86	20.51	1154.86	20.51	1154.59	20.78	1154.39	20.98
OB97-07	Schroyer/Havensville	1140	1130	1158.72	1160.37	1146.66	13.71	1146.93	13.44	1147.00	13.37	1147.15	13.22	1147.05	13.32	1146.77	13.60
OB97-08	Overburden	1149	1139	1158.25	1160.11	1145.94	14.17	1145.62	14.49	1145.51	14.60	1145.44	14.67	1145.28	14.83	1145.05	15.06
OB97-09PZ(0)	Havensville Shale	1133.81	1132.81	1242.81	1245.70	Wells/Piezometers Not Installed											
OB97-09PZ(1)	Schroyer Limestone	1140.72	1139.81	1242.81	1245.70												
OB97-09PZ(2)	Wymore Shale	1156.81	1155.81	1242.81	1245.70												
OB97-09PZ(3)	Kinney Limestone	1168.81	1167.81	1242.81	1245.70												
OB97-09PZ(4)	Blue Springs Shale	1191.81	1190.81	1242.81	1245.70												
OB97-09PZ(5)	Florence Limestone	1216.79	1214.81	1242.81	1245.70												
OB97-10PZ(0)	Havensville Shale	1134.18	1133.28	1183.28	1185.52												
OB97-10PZ(1)	Schroyer Limestone-bottom	1141.28	1140.28	1183.28	1185.52												
OB97-10PZ(2)	Schroyer Limestone-top	1147.30	1146.28	1183.28	1185.52												
OB97-10PZ(3)	Wymore Shale	1154.28	1153.28	1183.28	1185.52												
OB97-10PZ(4)	Kinney Limestone	1167.28	1166.28	1183.28	1185.52												
OB97-11PZ(0)	Havensville Shale	1132.21	1131.21	1182.21	1184.43												
OB97-11PZ(1)	Schroyer Limestone-bottom	1138.21	1137.21	1182.21	1184.43												
OB97-11PZ(2)	Schroyer Limestone-top	1146.21	1145.21	1182.21	1184.43												
OB97-11PZ(3)	Wymore Shale	1153.21	1152.21	1182.21	1184.43												
OB97-11PZ(4)	Kinney Limestone	1169.21	1168.21	1182.21	1184.43												
OB97-12PZ(0)	Havensville Shale	1133.24	1132.24	1183.24	1185.65												
OB97-12PZ(1)	Schroyer Limestone-bottom	1139.24	1138.24	1183.24	1185.65												
OB97-12PZ(2)	Schroyer Limestone-top	1147.24	1146.24	1183.24	1185.65												
OB97-12PZ(3)	Wymore Shale	1154.24	1153.24	1183.24	1185.65												
OB97-12PZ(4)	Kinney Limestone	1169.24	1168.24	1183.24	1185.65												
OB97-13PZ(0)	Havensville Shale-bottom	1127.92	1126.92	1157.92	1160.15												
OB97-13PZ(1)	Havensville Shale-top	1131.92	1130.92	1157.92	1160.15												
OB97-13PZ(2)	Schroyer Limestone-bottom	1136.92	1135.92	1157.92	1160.15												
OB97-13PZ(3)	Schroyer Limestone-top	1141.42	1140.42	1157.92	1160.15												
OB97-13PZ(4)	Overburden	1146.92	1145.92	1157.92	1160.15												
Dug Well	NAP	NAP	NAP	NM	1155.28	NM	NM	1144.88	10.40	1144.73	10.55	1144.63	10.65	1144.58	10.70	1144.58	10.70

DTW - Depth to Water below measuring point (ft.)

R - Rejected, based on the bottom of screen

NAP - Not Applicable

NM - Not Measured

J - Estimated value, measured within 0.1 foot of bottom of screen.

R - Rejected elevation, measured below bottom of screen.

+ - The piezometers were purged using air lift method on 4 July 1997 after the water elevations were measured, and water elevations were measured again on 5 July 1997.

(ft. amsl) - feet above mean sea level

Table 5 Summary of Groundwater Elevation Data at Open Burn/Open Detonation Area (Continued)

Well ID	Formation Screened	Top of Screen Elev. (ft. amsl)	Bottom of Screen Elev. (ft. amsl)	Ground Elevation (ft. amsl)	Measuring Point Elev. (ft. amsl)	10-Jun-97		11-Jun-97		14-Jun-97		16-Jun-97		17-Jun-97		18-Jun-97	
						Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)
OB93-01	Wymore/Schroyer	1155	1140	1182.07	1183.72	1154.32	29.40	1154.39	29.33	1154.11	29.61	1153.85	29.87	1153.65	30.07	1153.47	30.25
OB93-02	Wymore/Schroyer	1151	1136	1208.44	1210.08	1154.33	55.75	1154.39	55.69	1154.11	55.97	1153.88	56.20	1153.70	56.38	1153.51	56.57
OB93-03	Threemile Limestone	1111	1096	1172.88	1174.84	1123.67	51.17	1123.67	51.17	1123.53	51.31	1123.46	51.38	1123.38	51.46	1123.31	51.53
OB93-04	Threemile Limestone	1116	1101	1158.32	1160.09	1124.74	35.35	1124.74	35.35	1124.62	35.47	1124.53	35.56	1124.42	35.67	1124.34	35.75
OB97-05	Threemile Limestone	1115	1105	1178.23	1180.12	1123.77	56.35	1123.78	56.34	1123.62	56.50	1123.56	56.56	1123.48	56.64	1123.40	56.72
OB97-06	Schroyer Limestone	1146.5	1136.5	1173.36	1175.37	1154.34	21.03	1154.40	20.97	1154.13	21.24	1153.87	21.50	1153.67	21.70	1153.49	21.88
OB97-07	Schroyer/Havensville	1140	1130	1158.72	1160.37	1146.76	13.61	1146.68	13.69	1146.46	13.91	1146.32	14.05	1146.25	14.12	1146.17	14.20
OB97-08	Overburden	1149	1139	1158.25	1160.11	1144.98	15.13	1144.92	15.19	1144.74	15.37	1144.53	15.58	1144.45	15.66	1144.36	15.75
OB97-09PZ(0)	Havensville Shale	1133.81	1132.81	1242.81	1245.70											1158.44	87.26
OB97-09PZ(1)	Schroyer Limestone	1140.72	1139.81	1242.81	1245.70											1146.52	99.18
OB97-09PZ(2)	Wymore Shale	1156.81	1155.81	1242.81	1245.70											1158.43	87.27
OB97-09PZ(3)	Kinney Limestone	1168.81	1167.81	1242.81	1245.70											1168.83	76.87
OB97-09PZ(4)	Blue Springs Shale	1191.81	1190.81	1242.81	1245.70											1191.96	53.74
OB97-09PZ(5)	Florence Limestone	1216.79	1214.81	1242.81	1245.70											1216.28	29.42
OB97-10PZ(0)	Havensville Shale	1134.18	1133.28	1183.28	1185.52											1138.54	46.98
OB97-10PZ(1)	Schroyer Limestone-bottom	1141.28	1140.28	1183.28	1185.52											1151.28	34.24
OB97-10PZ(2)	Schroyer Limestone-top	1147.30	1146.28	1183.28	1185.52											1153.47	32.05
OB97-10PZ(3)	Wymore Shale	1154.28	1153.28	1183.28	1185.52											1164.71	20.81
OB97-10PZ(4)	Kinney Limestone	1167.28	1166.28	1183.28	1185.52											<b>1166.24 R</b>	19.28
OB97-11PZ(0)	Havensville Shale	1132.21	1131.21	1182.21	1184.43											1154.52	29.91
OB97-11PZ(1)	Schroyer Limestone-bottom	1138.21	1137.21	1182.21	1184.43											1146.67	37.76
OB97-11PZ(2)	Schroyer Limestone-top	1146.21	1145.21	1182.21	1184.43											1146.59	37.84
OB97-11PZ(3)	Wymore Shale	1153.21	1152.21	1182.21	1184.43											1154.56	29.87
OB97-11PZ(4)	Kinney Limestone	1169.21	1168.21	1182.21	1184.43											1168.39	16.04
OB97-12PZ(0)	Havensville Shale	1133.24	1132.24	1183.24	1185.65											1147.57	38.08
OB97-12PZ(1)	Schroyer Limestone-bottom	1139.24	1138.24	1183.24	1185.65											1146.43	39.22
OB97-12PZ(2)	Schroyer Limestone-top	1147.24	1146.24	1183.24	1185.65											1146.56	39.09
OB97-12PZ(3)	Wymore Shale	1154.24	1153.24	1183.24	1185.65											1160.22	25.43
OB97-12PZ(4)	Kinney Limestone	1169.24	1168.24	1183.24	1185.65											Dry	Dry
OB97-13PZ(0)	Havensville Shale-bottom	1127.92	1126.92	1157.92	1160.15											1145.33	14.82
OB97-13PZ(1)	Havensville Shale-top	1131.92	1130.92	1157.92	1160.15											1146.20	13.95
OB97-13PZ(2)	Schroyer Limestone-bottom	1136.92	1135.92	1157.92	1160.15											1146.04	14.11
OB97-13PZ(3)	Schroyer Limestone-top	1141.42	1140.42	1157.92	1160.15											1147.19	12.96
OB97-13PZ(4)	Overburden	1148.92	1145.92	1157.92	1160.15											1149.83	10.32
Dug Well	NAP	NAP	NAP	NM	1155.28	1144.50	10.78	1144.52	10.76	1144.03	11.25	1143.83	11.45	1143.74	11.54	1143.67	11.61

DTW - Depth to Water below measuring point (ft.)

R - Rejected, based on the bottom of screen

NAP - Not Applicable

NM - Not Measured

J - Estimated value, measured within 0.1 foot of bottom of screen.

R - Rejected elevation, measured below bottom of screen.

+ - The piezometers were purged using air lift method on 4 July 1997 after the water elevations were measured, and water elevations were measured again on 5 July 1997.

(ft. amsl) - feet above mean sea level

Table 5 Summary of Groundwater Elevation Data at Open Burn/Open Detonation Area (Continued)

Well ID	Formation Screened	Top of Screen Elev. (ft. amsl)	Bottom of Screen Elev. (ft. amsl)	Ground Elevation (ft. amsl)	Measuring Point Elev. (ft. amsl)	20-Jun-97		4-Jul-97 +		5-Jul-97 +	
						Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)	Groundwater Elevation (ft. amsl)	DTW (ft.)
OB93-01	Wymore/Schroyer	1155	1140	1182.07	1183.72	1153.37	30.35	1151.95	31.77	1152.11	31.61
OB93-02	Wymore/Schroyer	1151	1136	1208.44	1210.08	1153.39	56.69	1151.96	58.12	1152.16	57.92
OB93-03	Threemile Limestone	1111	1096	1172.88	1174.84	1123.24	51.60	1122.48	52.36	1122.53	52.31
OB93-04	Threemile Limestone	1116	1101	1158.32	1160.09	1124.23	35.86	1123.17	36.92	1123.16	36.93
OB97-05	Threemile Limestone	1115	1105	1178.23	1180.12	1123.34	56.78	1122.51	57.61	1122.57	57.55
OB97-06	Schroyer Limestone	1146.5	1136.5	1173.36	1175.37	1153.38	21.99	1151.97	23.40	1152.17	23.2
OB97-07	Schroyer/Havensville	1140	1130	1158.72	1160.37	1146.03	14.34	1145.27	15.10	1145.26	15.11
OB97-08	Overburden	1149	1139	1158.25	1160.11	1144.18	15.93	1142.98	17.13	1142.92	17.19
OB97-09PZ(0)	Havensville Shale	1133.81	1132.81	1242.81	1245.70	1156.21	89.49	1155.68	90.02	1150.20	95.5
OB97-09PZ(1)	Schroyer Limestone	1140.72	1139.81	1242.81	1245.70	1146.51	99.19	1145.21	100.49	Dry	Dry
OB97-09PZ(2)	Wymore Shale	1156.81	1155.81	1242.81	1245.70	1156.21	89.49	1156.05	89.65	Dry	Dry
OB97-09PZ(3)	Kinney Limestone	1168.81	1167.81	1242.81	1245.70	1168.73	76.97	1168.58	77.12	Dry	Dry
OB97-09PZ(4)	Blue Springs Shale	1191.81	1190.81	1242.81	1245.70	1192.00	53.70	1191.93	53.77	Dry	Dry
OB97-09PZ(5)	Florence Limestone	1216.79	1214.81	1242.81	1245.70	1215.73	29.97	<b>1214.91 J</b>	30.79	Dry	Dry
OB97-10PZ(0)	Havensville Shale	1134.18	1133.28	1183.28	1185.52	1140.01	45.51	1146.31	39.21	1136.65	48.87
OB97-10PZ(1)	Schroyer Limestone-bottom	1141.28	1140.28	1183.28	1185.52	1151.18	34.34	1150.78	34.74	1150.33	35.19
OB97-10PZ(2)	Schroyer Limestone-top	1147.30	1146.28	1183.28	1185.52	1153.44	32.08	1151.99	33.53	1151.95	33.57
OB97-10PZ(3)	Wymore Shale	1154.28	1153.28	1183.28	1185.52	1164.50	21.02	1164.69	20.83	1157.52	28
OB97-10PZ(4)	Kinney Limestone	1167.28	1166.28	1183.28	1185.52	<b>1166.24 R</b>	19.28	Dry	Dry	Dry	Dry
OB97-11PZ(0)	Havensville Shale	1132.21	1131.21	1182.21	1184.43	1153.62	30.81	1152.96	31.47	1152.41	32.02
OB97-11PZ(1)	Schroyer Limestone-bottom	1138.21	1137.21	1182.21	1184.43	1146.66	37.77	1145.29	39.14	1145.70	38.73
OB97-11PZ(2)	Schroyer Limestone-top	1146.21	1145.21	1182.21	1184.43	1146.54	37.89	<b>1145.21 J</b>	39.22	1145.29	39.14
OB97-11PZ(3)	Wymore Shale	1153.21	1152.21	1182.21	1184.43	1153.59	30.84	1152.95	31.48	1152.41	32.02
OB97-11PZ(4)	Kinney Limestone	1169.21	1168.21	1182.21	1184.43	1168.39	16.04	<b>1167.76 R</b>	16.67	Dry	Dry
OB97-12PZ(0)	Havensville Shale	1133.24	1132.24	1183.24	1185.65	1136.52	49.13	1147.79	37.86	1135.29	50.36
OB97-12PZ(1)	Schroyer Limestone-bottom	1139.24	1138.24	1183.24	1185.65	1146.43	39.22	1145.12	40.53	1145.53	40.12
OB97-12PZ(2)	Schroyer Limestone-top	1147.24	1146.24	1183.24	1185.65	1146.65	39.00	<b>1146.21 R</b>	39.44	Dry	Dry
OB97-12PZ(3)	Wymore Shale	1154.24	1153.24	1183.24	1185.65	1160.11	25.54	1158.91	26.74	1158.85	26.8
OB97-12PZ(4)	Kinney Limestone	1169.24	1168.24	1183.24	1185.65	Dry	Dry	<b>1168.18 R</b>	17.47	Dry	Dry
OB97-13PZ(0)	Havensville Shale-bottom	1127.92	1126.92	1157.92	1160.15	1132.33	27.82	1132.18	27.97	1131.69	28.46
OB97-13PZ(1)	Havensville Shale-top	1131.92	1130.92	1157.92	1160.15	1145.69	14.46	1145.23	14.92	1143.91	16.24
OB97-13PZ(2)	Schroyer Limestone-bottom	1136.92	1135.92	1157.92	1160.15	1146.05	14.10	1145.30	14.85	1145.28	14.87
OB97-13PZ(3)	Schroyer Limestone-top	1141.42	1140.42	1157.92	1160.15	1141.32	18.83	1143.79	16.36	1144.24	15.91
OB97-13PZ(4)	Overburden	1146.92	1145.92	1157.92	1160.15	1147.39	12.76	1146.35	13.80	1146.60	13.55
Dug Well	NAP	NAP	NAP	NM	1155.28	1143.50	11.78	1142.40	12.88	1141.98	13.3

DTW - Depth to Water below measuring point (ft.)

R - Rejected, based on the bottom of screen

NAP - Not Applicable

NM - Not Measured

J - Estimated value, measured within 0.1 foot of bottom of screen.

R - Rejected elevation, measured below bottom of screen.

+ - The piezometers were purged using air lift method on 4 July 1997 after the water elevations were measured, and water elevations were measured again on 5 July 1997.

(ft. amsl) - feet above mean sea level

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**ATTACHMENTS**

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**ATTACHMENT 1**

**Drilling Logs**

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# HTW DRILLING LOG

HOLE NO.  
OB-97-9P2

SHEET 1  
OF 14 SHEETS

1. COMPANY NAME  
Louis Berger & Associates Inc

2. DRILLING SUBCONTRACTOR  
Layne

3. PROJECT  
OB/OD Area

4. LOCATION  
OB/OD AREA, RANGE 16  
FT. RILEY KANSAS

5. NAME OF DRILLER  
Bob Knopf

6. MANUFACTURER'S DESIGNATION OF DRILL  
TH-60 INGERSOLL-RAND AIR RIG

7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT

5 7/8" bit air rotary to 114'  
Sampling air cuttings  
ream with 9 3/8" bit to  
114.5'

8. HOLE LOCATION  
NORTH END OF OB/OD ON TOPOGRAPHIC HIGH

9. SURFACE ELEVATION  
1241.74 feet above mean sea level

10. DATE STARTED  
6-6-97

11. DATE COMPLETED  
6-7-97

12. OVERBURDEN THICKNESS  
3.5 feet

15. DEPTH GROUNDWATER ENCOUNTERED  
Moisture At 15 Ft / 26 Ft / 72 Ft / 78 Ft

13. DEPTH DRILLED INTO ROCK  
111 Feet

16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED  
96.32 Ft b.g.s / 2 days

14. TOTAL DEPTH OF HOLE  
114.5

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)  
96.33 Ft b.g.s / 6-10-97

18. GEOTECHNICAL SAMPLES  
N/A

DISTURBED

UNDISTURBED

19. TOTAL NUMBER OF CORE BOXES  
N/A

20. SAMPLES FOR CHEMICAL ANALYSIS  
N/A

VOC

METALS

OTHER (SPECIFY)

OTHER (SPECIFY)

OTHER (SPECIFY)

21. TOTAL CORE RECOVERY  
N/A %

22. DISPOSITION OF HOLE

BACKFILLED

MONITORING WELL

OTHER (SPECIFY)

Nested  
Piezometer

23. SIGNATURE OF INSPECTOR

Darryl Morgan

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1242	0	Limestone (light gray (N7)) fine crystalline, medium hard, slightly chalky, abundant chert, Dry	hny 0				Begin drilling @ 1030hrs 6-6-97 with 5 7/8" bit air rotary
1241	1						
1240	2	Shale: (pale yellow, (547/4)) fine texture, sft, calcareous, HCL reaction, 50% fines, 50% limestone and chert fragments (0.5cm to 3.0cm) Dry	0				
1239	3	Florence					
1238	4	Limestone: pale yellow (518/2) fine crystalline, sft, slightly weathered, some chert, Dry	0				torque up slow drilling
1237	5						

PROJECT

HOLE NO. OB-97-9P2  
TOTAL P. 02

# HTW DRILLING LOG

HOLE NO.  
OB-97-09PZ  
SHEET 2  
OF 14 SHEETS

PROJECT **OB/OD Area**

INSPECTOR **Darryl Morgan**

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1237	5		hn 6				
1236	6	<del>Shale: pale yellow (547/4), fine texture, calcareous, HCL reaction</del> <sup>DM</sup>	0				
1235	7	Shale: pale yellow (547/4), fine texture, calcareous, HCL reaction, 50% fines, 50% Limestone and chert fragments (0.5cm to 3.0cm) dry					Smooth drilling
1234	8	Limestone: pale yellow (548/2) fine crystalline, medium hard, slightly chalky, some chert dry	0				
1233	9						
1232	10						torque up Smooth out
1231	11		0				
1230	12	Limestone: A/A abundant chert, dry					torque up
1229	13	<del>limestone</del> <sup>DM</sup> Shale: yellow (548/6) fine texture, soft, 50% fines, 50% Limestone fragments (0.5cm to 3.0cm)					Smooth out
1228	14						

# HTW DRILLING LOG

HOLE NO.  
OB-97-09-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 3  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEO TECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1228	14	Limestone: A/A, dry	hnu				
1227	15	Strong bank 5YR 5/6, medium plasticity, medium dilatancy. EL (100% fines) dry Limestone: A/A, abundant Chert, dry	0				smooth out moisture at 15-16' torque up
1226	16		0				
1225	17						
1224	18	Limestone: A/A, abundant Chert, dry					smooth out torque up
		<del>Limestone: A/A, abundant</del> <del>Chert</del>	0				
1223	19	Limestone: olive yellow (2.5Y 6/8) fine crystalline, medium hard to soft, slightly chalky, some chert, slightly weathered, dry	0				
1222	20						
1221	21						
1220	22	Limestone: A/A, dry					
1219	23						



# HTW DRILLING LOG

HOLE NO.  
OB-97-09-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 4  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1219	23		hnu				
1218	24	Limestone: white (N81) fine crystalline, hard, dense, fossiliferous, slightly chalky, abundant chert, dry	0				Compressor on rig froze up @ 1130hrs fixed compressor resumed drilling @ 1100hrs 6-7-97
1217	25	shale: pale olive (SY 614) subplaty, firm to hard, HCL reaction, very calcaeous Limestone: A/A dry					
1216	26		0				drilling rate increased moisture at 26-29'
1215	27	shale: light greenish gray (SG711) blocky, fine texture, firm to hard, HCL reaction, very calcaeous, dry					
1214	28		0				
1213	29	Shale: dark green gray (SG411) fine texture, blocky, slight HCL reaction, slightly calcaeous,					
1212	30		0				
1211	31	shale: light greenish gray (SG4711) moist, fine texture, blocky to subplaty, firm, weak HCL reaction, slightly calcaeous					
1210	32						

# HTW DRILLING LOG

HOLE NO.  
OB-97-09-PZ

PROJECT OB/OD Area

INSPECTOR Darryl Morgan

SHEET 5  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1210	32	Shale: dark greenish gray (5G4/1) fine texture, firm to hard, non calcaceous, no reaction HCL, dry	hru 0				
1209	33						
1208	34		0				
1207	35						
1206	36		0				
1205	37	Shale: dark reddish gray (5YR4/2), fine texture, soft to firm, subplaty, weak reaction HCL, slightly calcaceous, dry					
1204	38	Shale: dark reddish brown, (5YR3/3) A/A, reaction HCL calcaceous, dry					
1203	39		0				
1202	40						
1201	41						

# HTW DRILLING LOG

HOLE NO.  
OB-97-09-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 6  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1204	41	Shale: greenish gray (566/1), fine texture, subplaty, soft, strong HCL reaction, very calcareous. dry	hnu  0				
<del>1200</del>	42	Shale: dark reddish brown (5423/3), fine texture, subblocky, strong HCL reaction, very calcareous, dry					
1198	43	Shale: light greenish gray (5647/1) A/A, dry					
1198	44		0				
1198	45						
1195	46	Shale: dark greenish gray (5644/1), fine texture, subplaty, soft, weak HCL reaction, slightly calcareous dry					
1195	47		0				
1194	48						
1193	49		0				
1192	50						

# HTW DRILLING LOG

HOLE NO.  
08-97-09 PZ

PROJECT *OB/OD Area*

INSPECTOR *Darvil Morgan*

SHEET 7  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1192	50	Limestone: light gray (N7/1) fine crystalline, medium hard, dry	hnu				Water @ 50ft 6/3/97 while returning torque up drill rate slowed
1190	51		0				
1188	52	Shale: greenish gray (56/1) fine texture, subplaty, soft, NO HCL reaction, non-calcareous dry	0				smooth out drill rate increased
1188	53						
1188	54						
1186	55		0				
1185	56	shale: very dark gray (N3/1) fine texture, platy, laminated soft, no HCL reaction, non calcareous, dry	R				
1185	57		0				
1184	58	shale: very dark gray (N1/3) fine texture, subplaty, hard, strong HCL reaction, very calcareous, dry					torque up drill rate slowed
1182	59						

# HTW DRILLING LOG

HOLE NO.  
OB-97-09-PZ

PROJECT OB/OD Area

INSPECTOR Darryl Morgan

SHEET 8  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1183	59		hnu				smooth out drill rate increase
1182	60	shale: very dark gray (N/3) fine texture, subplaty, soft, strong HCL reaction, very calcareous, dry	0				
1180	61						
1180	62			0			
1178	63						
1178	64						
1178	65	Shale: A/A, dry	0				torque up drill <sup>am</sup> rate slowed
1175	66						
1175	68						
1174	68						

# HTW DRILLING LOG

HOLE NO.  
OB-97-09-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 9  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1172	68		hnu				
1173	69	Shale: A/A	0				
1172	70		0				added non-chloride water @ 70' while running 70'-114.5' all 400 gals. added was recovered.
1170	71						
1170	72	<del>Kinney</del> Limestone: pale yellow (S47B), fine crystalline, medium hard, slightly weathered, some chert, moist	0				+ torque up drill rate slowed
1168	73						
1168	74						
1167	75	Wet @ 75	0				
1165	76	Wymore shale: gray (N51), fine texture, platy, soft, strong HCL reaction, calcareous					
1165	77						

# HTW DRILLING LOG

HOLE NO.  
08-97-09-PZ

PROJECT **OB/OD Area**

INSPECTOR **Darryl Morgan**

SHEET **10**  
OF **14** SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1165	78		hnu 0				
1164	78	shale: A/A, wet zone  dry					
1163	79		0				
1162	80						
1161	81	shale: gray(N/S), fine texture, platy, firm, strong HCL reaction, calcaeous, wet zone	0				
1160	82	shale: light greenish gray (SG 7/1) fine texture, blocky, firm, strong HCL reaction, calcaeous, dry					
1159	83		0				
1158	84						
1157	85						
1156	86	shale: A/A, dry					

# HTW DRILLING LOG

HOLE NO.  
OB-97-09PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 11  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1156	86	shale A/A, dry	hnu				
			0				
1155	87						
1153	88						
1153	89		0				
1152	89 <sup>DR</sup> 90	shale: A/A, moist zone					
1150	90 <sup>DR</sup> 91						
1130	92 <sup>DR</sup> 92						
1148	92		0				
1148	93 <sup>DR</sup> 93						
1147	94 <sup>DR</sup> 94	shale: greenish gray (SBC 5/D)					



# HTW DRILLING LOG

HOLE NO.  
OB-97-09-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 12  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1147	94	blocky, fine texture soft, slight HCL reaction, wet zone	hard				
1146	95		0				
1145	96						DM torque up
		Schrover					
1144	97	Limestone: pale yellow (2.54 7/16), fine crystalline, medium hard, weathered wet.	0				torque up drill rate slowed
1143	98						
1142	99	Shale: gray (NS/D) fine texture subplaty, firm, strong HCL reaction, calcareous	0				smooth out
1141	100	Limestone: light gray (N7/D) fine crystalline, hard, dense, wet					torque up drill rate slowed
1140	101	Limestone: gray (NS/D) fine crystalline, hard, dense, abundant chert, wet					
1138	102						
1139	102						

# HTW DRILLING LOG

HOLE NO.  
OB-97-09PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 13  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1138	<del>102</del> 103		hnu				
1137	104 <del>105</del>		0				
1136	105 <del>106</del>	Havensville shale: dark gray (N41), fine texture, subplaty, soft, calcite, strong HCL reaction, calcareous, dry	0				
1135	106 <del>107</del>						
1134	107 <del>108</del>		0				torque up
1133	108 <del>109</del>	shale: A/A, dry					
1132	109 <del>110</del>						DM ended drilling @ 1228 hrs 6-7-97
1131	110	shale: dark gray (N41) fine texture, subplaty soft to firm, strong HCL reaction, calcareous, dry	0				
1130	111 <del>112</del>						
1129	112 <del>113</del>						

# HTW DRILLING LOG

HOLE NO.  
OB-97-09P2

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 14  
OF 14 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1128	112	shale: A/A, dry					Set 8" ID temporary casing to 114.5'  reamed hole with 9 7/8" bit to 114.5' finished reaming @ 1130 6-8-97 ended drilling @ 1235 hrs 6-9-97
128	113						
	114	TD 114					

# HTW DRILLING LOG

HOLE NO.  
OB-97-10PZ

SHEET 1  
OF 7 SHEETS

1. COMPANY NAME  
Louis Berger & Associates

2. DRILLING SUBCONTRACTOR  
Layne

3. PROJECT  
OB/OD Area

4. LOCATION  
OB/OD Area Range 16-Ft RILEY

5. NAME OF DRILLER  
Bob Knopf

6. MANUFACTURER'S DESIGNATION OF DRILL  
TH-60 INGERSOLL-RAND AIR RIG

7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT  
air rotary 5 7/8" bit + to  
5R/1 cased from air  
cuttings  
ream hole with 9 7/8"  
bit

8. HOLE LOCATION  
APPROX. 100 FT WEST OF OB93-01

9. SURFACE ELEVATION  
1183.01 feet mean sea level

10. DATE STARTED  
6-8-97

11. DATE COMPLETED  
6-8-97

12. OVERBURDEN THICKNESS  
20 feet (Residual soil)

15. DEPTH GROUNDWATER ENCOUNTERED  
19.5 feet

13. DEPTH DRILLED INTO ROCK  
38 feet

16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED  
27.94/6-10-97

14. TOTAL DEPTH OF HOLE  
58 feet

17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)  
29.91/6-11-97

18. GEOTECHNICAL SAMPLES  
N/A

DISTURBED  
UNDISTURBED

19. TOTAL NUMBER OF CORE BOXES  
N/A

20. SAMPLES FOR CHEMICAL ANALYSIS  
N/A

VOC METALS OTHER (SPECIFY) OTHER (SPECIFY) OTHER (SPECIFY)

21. TOTAL CORE RECOVERY  
N/A %

22. DISPOSITION OF HOLE

BACKFILLED MONITORING WELL OTHER (SPECIFY)  
5 NESTED PIEZOMETERS

23. SIGNATURE OF INSPECTOR  
Darryl Morgan

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1183		Very dark brown (10YR 2/2) medium plasticity, medium dilatancy, Limestone and chert fragments (0.5cm to 4.0 cm) CL, moist (50% fines, 50% gravel) - Blue Springs SHALE	hny				roots drilling commenced @ 1443 hrs 6-8-97 with 5 7/8" bit, air rotary
1182	1		0				Ream w/ 9 7/8" bit, air rotary @ 1420 6-9-97
1181	2		0				Finish reaming @ 1640 6-9-97 and set 58.25 Ft temporary 8" PVC casing.
1180	3						
1179	4	dark grayish brown (2.5Y 4/2) medium plasticity, medium dilatancy, trace limestone fragments, 95% fines 5% fragments, CL	0				
1178	5						

# HTW DRILLING LOG

HOLE NO.  
08-97-10PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET  
OF 2 SHEETS 7

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1178	5		anu 0				
1177	6	Brown (10YR 4/3) medium plasticity, medium dilatancy 100% fines, non calcareous no reaction HCL, CL, moist					
1176	7		0				
1175	8	dark reddish brown (5YR 3/3) medium plasticity medium dilatancy, 100% fines non calcareous, no reaction HCL, CL, moist					
1174	9		0				
1173	10	dusky red (2.5YR 3/4) medium plasticity, medium dilatancy, 100% fines, non calcareous, no reaction HCL, CL, moist					
1172	11		0				
1171	12						
1170	13						
1169	14	A/A with limestone and chert					

# HTW DRILLING LOG

HOLE NO.  
08-97-10PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 3  
OF 7 SHEETS 7

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1169	14	fragments 90% fines, 10% fragments, moist	hnu  0				
1168	15						
1167	16	Dusky red (2.5YR 3/4) medium dilatancy, medium plasticity, 75% fines, 20% Limestone and chert fragments					
1166	17	5% sand, CL, (Limestone and chert 0.7 to 2cm), moist  KINSEY LIMESTONE	0				
1165	18						
1164	19						
1163	20	Yellow (10YR 8/4) sand, fine unconsolidated, non calcareous subrounded to rounded, wet Shale, pale yellow (5Y 7/3) fine texture, firm, blocky, strong reaction HCL, very calcareous, moist	0				
1162	21	WHIMORE SHALE	0				
1161	22						
1160	23						

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# HTW DRILLING LOG

HOLE NO.  
OB-97-10PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 4  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1160	23		HAU 0				
1159	24	Shale: light greenish gray (5BG 7/11), fine texture, blocky, Soft, noncalcaeous, no reaction HCL, dry, 100%					
1158	25		0				
1157	26	Shale: greenish gray (5BG 6/1) fine texture, sub- platy, firm, strong reaction HCL, 100% fines, dry					
1156	27		0				
1155	28	Shale: dusky red (2.5YR 4/3) fine texture, sub-blocky, moderately firm, calcaeous, Strong reaction HCL, 100% fines, dry					
1154	29						
1153	30	<del>Shale: dusky red (2.5YR 4/3)</del> Shale: light greenish gray, (5BG 7/11) fine texture, blocky, firm, Very calcaeous, strong HCL reaction, 100% fines					
1152	31						
1151	32						



# HTW DRILLING LOG

HOLE NO.  
OB-97-10PZ  
SHEET 5  
OF 7 SHEETS

PROJECT OB/OD Area

INSPECTOR Darryl Morgan

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1151	32	Shale: weak red (10R4/4) fine texture, blocky, soft, no reaction HCL, 100% fines, dry	hnu 0				
1150	33						
1149	34	Shale: bluish gray (5B6/1) fine texture, sub platy, soft, very strong reaction HCL, 100% fines, dry	0				
1148	35		0				
1147	36	A/A					
1146	37						
		Schroyer LIMESTONE					
1145	38	Limestone: greenish gray (5G46/1) fine crystalline, medium hard, wet to saturated, weathered	0				torque up
1144	39		0				
1143	40	Limestone: white (N8/) fine to microcrystalline, hard, dense, wet to saturated					
1142	41						

# HTW DRILLING LOG

HOLE NO.  
OB-97-10PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 6  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1142	41		hru				
1141	42	Limestone: dark gray (N41) fine crystalline, hard, dense saturated, abundant chert	0				
1140	43						
1139	44	A/A with white (W81) limestone, saturated	0				
1138	45						
		<u>Havensville SHALE</u>					
1137	46	Shale: gray (N57), fine texture, platy, moderately firm, strong HCL reaction, calcareous, 100% fines, dry	0				
1136	47						
1135	48						
	49	Shale: A/A, dry	0				
1134	49						
1133	50						

# HTW DRILLING LOG

HOLE NO.  
OB-97-10PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 7  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1133	50		hnu 0				
1132	51	shale: A/A, dry					torque up
1131	52		0				
1130	53	shale: gray (NS/), fine texture, platy, moderate firm, strong reaction HCL, calcareous, some gypsum, 100% fines, dry					
1129	54						
1128	55	Limestone: gray (NS/), fine crystalline, hard, dense, very argillaceous, dry	0				torque up
1127	56						
1126	57		0				
1125	58	shale: black (NS/), fine texture, platy, Sdt, 100% fines, slight reaction HCL dry					TD 58' @ 1600 hrs 6-8-97
1124	59						

# HTW DRILLING LOG

HOLE NO.  
OB-97-11-PZ

1. COMPANY NAME <b>Louis Berger &amp; Associates</b>		2. DRILLING SUBCONTRACTOR <b>Layne</b>		SHEET 1 OF 7 SHEETS			
3. PROJECT <b>OB/OD Area</b>			4. LOCATION <b>OB/OD Range 16 Ft RILEY</b>				
5. NAME OF DRILLER <b>Bob Knopf</b>			6. MANUFACTURER'S DESIGNATION OF DRILL <b>TH-60 INGERSOLL-RAND AIR RIG</b>				
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT		air rotary 5 7/8" bit + 58'		8. HOLE LOCATION <b>IMMEDIATELY NORTH OF NORTH BURN PIT</b>			
		logged boring from air casing		9. SURFACE ELEVATION <b>1182.14 feet mean sea level</b>			
		ream hole with 9 7/8" bit		10. DATE STARTED <b>6-9-97</b>		11. DATE COMPLETED <b>6-9-97</b>	
				12. OVERBURDEN THICKNESS <b>12 Feet (RESIDUAL SOIL)</b>			
13. DEPTH DRILLED INTO ROCK <b>4.6 Feet</b>			15. DEPTH GROUNDWATER ENCOUNTERED <b>14.5 Feet</b>				
14. TOTAL DEPTH OF HOLE <b>58 Feet</b>			17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) <b>33.48/6-11-97 35/6-14-97</b>				
18. GEOTECHNICAL SAMPLES <b>N/A</b>		DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES <b>N/A</b>			
20. SAMPLES FOR CHEMICAL ANALYSIS <b>N/A</b>		VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)		
						21. TOTAL CORE RECOVERY <b>N/A %</b>	
22. DISPOSITION OF HOLE		BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR <b>Darryl Morgan</b>		

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1182		Very dark gray (10YR 3/1) medium plasticity, medium dilatancy, 50% fines 50% Limestone gravel (0.5cm to 3.6m)	hru				Begin drilling with 5 7/8" bit air rotary @ 0740hrs 6-9-97
1181	1	moist, CL, no HCL reaction Blue Springs SHALE	0				Ream w/ 9 7/8" bit, air rotary @ 0950 6-9-97
1180	2	grayish brown (10YR 5/2) medium plasticity, medium dilatancy, 50% fines, 50% Limestone gravel (0.5cm to 3.5cm) CL, moist, no HCL reaction	0				Finish reaming @ 1145 6-9-97 & set 58.25' temporary 8" PVC casing
1179	3						
1178	4	Yellowish brown (10YR 5/6) medium plasticity, medium dilatancy, 80% fines, 20% Limestone gravel (1.0cm to 4.0cm) CL, moist, calcareous	0				
1177	5						

# HTW DRILLING LOG

HOLE NO.  
OB-97-11-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 2  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1177	5	Slight HCL reaction	hnu				
1176	6		0				
1175	7						
1174	8	Yellowish brown (10YR 5/6) medium plasticity, medium dilatancy, 100% fines, Slight HCL reaction, Calcareous, CL moist	0				
1173	9						
1172	10	Pale olive (5Y 6/4) medium plasticity, medium dilatancy, 100% fines, Slight HCL reaction, calcareous, CL, dry	0				
1171	11						
1170	12	shale: Pale olive, (5Y 6/4) fine texture, blocky, soft, Strong HCL reaction, very Calcareous, dry	0				
1169	13	Dm <del>limestone</del> Kinney					
1168	14	Limestone: pale olive (5Y 6/3) fine to medium crystalline, hard, dense, some chert, dry					

# HTW DRILLING LOG

HOLE NO.  
OB-97-11-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 3  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1168	14	Limestone: A/A, wet	hnu 0				
1167	15						
1166	16	Limestone: A/A, wet					
1165	17		0				
1164	18	Wymore Shale: Light olive gray (5Y6/2) fine texture, sub platy, soft, slight HCL reaction, calcaeous, some Fe stain, dry	0				
1163	19						
1162	20	Shale: gray (N5/1) fine texture, blocky, firm, strong HCL reaction, calcaeous, dry	0				
1161	21						
1160	22	shale: greenish gray (5GY5/1) fine texture, blocky, firm, strong HCL reaction, Calcaeous dry					
1159	23						

# HTW DRILLING LOG

HOLE NO.  
08-97-11-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 4  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1159	23		hnu				
1158	24	shale: A/A, dry	0				
1157	25						
1156	26	shale A/A, dry	0				torque up
1155	27						
1154	28	shale: dark reddish gray (2.5YR 4/1) fine texture, blocky, firm, HCL reaction dry	0				
1153	29						
1152	30	shale: grayish green (5GY 6/1) fine texture, blocky, firm, HCL reaction, dry	0				
1151	31						
1150	32	shale dark reddish gray	↓				

# HTW DRILLING LOG

HOLE NO.  
OB-97-11-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 5  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1150	32	(54R 4/2) fine texture, blocky, firm, NO HCL reaction, dry	hnu 0				
1149	33						
1148	34	Shale: dark greenish gray (564/1) fine texture, platy soft, strong HCL reaction, calcareous, slightly moist	0				
1147	35						
1146	36	Shale: light greenish gray (567/1) fine texture, blocky, moderately firm, weak HCL reaction, slight calcareous, dry	0				
1145	37	Limestone: pale yellow (2.54 7/4), fine crystalline, soft weathered, moist	Schroyer				torque up
1144	38	Limestone: A/A wet	0				
1143	39						
1142	40	Limestone: light gray (2.54 7/2) fine to micro crystalline, hard, dense, abundant chert, saturated	0				
1141	41						



# HTW DRILLING LOG

HOLE NO.  
OB-97-11-PZ

PROJECT OB/OD Area

INSPECTOR Darryl Morgan

SHEET 6  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1141	41		hru				
1140	42	Limestone: light gray (2.547/2) fine to micro crystalline, hard, dense, with cobite, abundant chert, saturated	0				torque up drilling slowed
1139	43		0				
1138	44	Limestone: A/A saturated	0				
1137	45						
1136	46	Limestone: A/A no chert saturated					
		<u>Haversville</u>					
1135	47	Shale: dark gray (N47) fine texture, platy, soft, weak HCL reaction, slightly calcareous, moist	0				smooth out
1134	48						
1133	49						
1132	50	Shale: A/A, no HCL reaction, dry					

# HTW DRILLING LOG

HOLE NO.  
OB-97-11-PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 7  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1137	50		hnu 0				torque up smooth out
1131	51						
1130	52	shale: gray (N6/1) fine texture, blocky, firm to hard, strong HCL reaction, very calcaeous, dry	0				
1129	53						
1128	54	shale: gray (N6/1) fine texture, blocky, firm, moderate HCL reaction, calcaeous, moist					torque up for 4" possible Limestone Lense smooth out
1127	55						
1126	56	shale: gray (N6/1) fine texture, blocky, firm to hard, strong HCL reaction very calcaeous					torque up moist
1125	57		0				set 8" ID temporary casing to 58'
1124	58	shale: very dark gray (N3/1) fine texture, platy, soft, very weak HCL reaction, dry					smooth out Total Depth 58'
							finish drilling @ 0802 hrs 6-9-97

# HTW DRILLING LOG

HOLE NO.  
08-97-12PZ

1. COMPANY NAME <i>Louis Berger &amp; Associates</i>		2. DRILLING SUBCONTRACTOR <i>LAVNE</i>		SHEET 1 OF 7 SHEETS	
3. PROJECT <i>OB/OD Area</i>			4. LOCATION <i>OB/OD Area Range 16 Ft RILEY</i>		
5. NAME OF DRILLER <i>Bob Knopf</i>			6. MANUFACTURER'S DESIGNATION OF DRILL <i>TH-60 INGERSOLL-RAND AIR RIG</i>		
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT		air rotary 5 7/8" bit to 58'		8. HOLE LOCATION <i>~150 FEET NORTH OF 0897-05</i>	
		Logged hole from air cuttings		9. SURFACE ELEVATION <i>1183.07</i>	
		ream hole with 9 7/8" bit		10. DATE STARTED <i>6-5-97</i>	
				11. DATE COMPLETED <i>6-5-97</i>	
12. OVERBURDEN THICKNESS <i>14 Feet (residual soil)</i>			15. DEPTH GROUNDWATER ENCOUNTERED <i>20 Feet</i>		
13. DEPTH DRILLED INTO ROCK <i>44 Feet</i>			16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED <i>37.10 Feet / 6-9-97</i>		
14. TOTAL DEPTH OF HOLE <i>58'</i>			17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) <i>37.10 Feet / 6-10-97 &amp; 36-38 Feet / 6-11-97</i>		
18. GEOTECHNICAL SAMPLES <i>N/A</i>		DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES <i>N/A</i>	
20. SAMPLES FOR CHEMICAL ANALYSIS <i>N/A</i>		VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)
22. DISPOSITION OF HOLE		BACKFILLED	MONITORING WELL	OTHER (SPECIFY) <i>used piezometer</i>	23. SIGNATURE OF INSPECTOR <i>Darryl Morgan</i>

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1185		<i>Black (2.54 2.5/1) moist medium plasticity, medium dilatancy, CL - loam 100% fines</i>	<i>huv</i> <i>0</i>				<i>Drilling with 5 7/8" bit 6-5-97 12 1/2 hrs air rotary</i>
1182	1						
1181	2	<i>Blue SPRINGS SHALE very dark grayish brown (104R3/2) moist, medium plasticity, medium dilatancy, CL, 100% fines</i>					
1180	3						
1179	4		<i>0</i>				
1178	5						

# HTW DRILLING LOG

HOLE NO.  
OB-97-12PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 2  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1178			nd				
1177	6	Very dark grayish brown, (10 YR 3/2) dry, medium plasticity, medium dilatancy CL, 90% fines, 10% Limestone fragments (0.5cm to 1cm)	0				
1176	7						
1175	8		0				
1174	9	Dusky Red (2.5 YR 3/2) moist, medium plasticity, medium dilatancy, CL 60% fines, 40% Limestone and chert fragments (0.5cm to 2cm)	0				
1173	10						
1172	11						
1171	12						
1170	13		0				
1169	14	<u>KINNEY LIMESTONE</u> Pale olive (5Y 6/6) dry					

# HTW DRILLING LOG

HOLE NO.  
08-97-12PZ

PROJECT OB/OD Area

INSPECTOR Darryl Morgan

SHEET 3  
OF 7 SHEETS

ELEV. <small>a</small>	DEPTH <small>b</small>	DESCRIPTION OF MATERIALS <small>c</small>	FIELD SCREENING RESULTS <small>d</small>	GEOTECH SAMPLE OR CORE BOX NO. <small>e</small>	ANALYTICAL SAMPLE NO. <small>f</small>	BLOW COUNTS <small>g</small>	REMARKS <small>h</small>
1169	14	fine texture, soft, calcareous HCL reaction, 100% fines	hnu 0				
1168	15						
1167	16						
1166	17						
1165	18	<u>WYMORE SHALE</u> gray (NS/) dry, fine texture blocky, soft to firm, weak HCL reaction, 100% fines, dry					
1164	19						
1163	20	pale green (5G 7/2) moist, fine texture, soft HCL reaction, 100% fines,					
1162	21						
1161	22						
1160	23						

# HTW DRILLING LOG

HOLE NO.  
OB-97-12 PZ  
SHEET 4  
OF 7 SHEETS

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1150	23		hnu 0				
1159	24						
1158	25	Shale: dark gray (4/N4/) dry fine texture, blocky, firm, HCL reaction, calcareous, 100% fines, dry	0				
1157	26						
1156	27		0				
1155	28						
		A/A					
1154	29						
1153	30		0				
1152	31	Limestone: (N7/) light gray, fine crystalline, weathered, firm, moist	0				torque up
1151	32						

# HTW DRILLING LOG

HOLE NO.  
OB-97-12PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 5  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1151	32	Shale: light gray (7N7/), fine texture, firm, blocky 100% fines	hnu 0				
1156	33						
1149	34		0				
1148	35						
1147	36	Schroyer Limestone: light gray (7/N7/), wet, fine crystalline, hard, dense,					drilling slowed
1146	37						
1145	38	A/A: saturated @ 38'	0				
1144	39						
1143	40		0				
1142	41	Limestone: very dark gray, (N3/) fine to micro crystalline, hard, dense, abundant chert					Torque up drilling slowed

# HTW DRILLING LOG

HOLE NO.  
OB-97-12PZ

PROJECT  
OB/OD Area

INSPECTOR  
Darryl Morgan

SHEET 6  
OF 7 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1142	41	Saturated	hnu 0				
1141	42						
1140	43	Limestone: (N/7/) Light gray, fine to microcrystalline hard, dense, some gypsum saturated	0				
1139	44						
1138	45	Havensville	0				
1137	46	Shale: very dark gray (N/3) fine texture, blocky, firm, calcareous, HCL reaction. dry					drilling smooth out
1136	47		0				
1135	48						
1134	49		0				
1133	50	Limestone: Very dark gray					torque up



# HTW DRILLING LOG

HOLE NO.  
OB-97-12-PZ  
SHEET 7  
OF 7 SHEETS

PROJECT OB/OD Area

INSPECTOR Darryl Morgan

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1133	50	fine crystalline, hard, dense, argillaceous, moist	hnu 0				
1132	51						
1131	52	Shale: very dark gray (N/3) fine texture, blocky, firm, calcaeous, HCL reaction dry	0				drilling smooth out
1130	53						
1129	54		0				
1128	55						
1127	56	Limestone: very dark gray (N/3), fine crystalline, hard, dense, argillaceous, moist Shale: very dark gray (N/3) fine texture, blocky, firm, calcaeous, HCL reaction dry	0				Torque up drilling smooth out
1126	57		0				ream hole with 9 7/8" bit to 58' Starod 1400 hrs ended @ 1620 hrs set 8" ID PVC temporary casing to 58' ended 1715 hrs end drilling @ 1390 hrs 6-5-97
1125	58	Total Depth					while reaming sticking in hole 31 to 25'

# HTW DRILLING LOG

HOLE NO.  
OB-97-13PZ

1. COMPANY NAME <i>Louis Berger &amp; Associates</i>		2. DRILLING SUBCONTRACTOR <i>Layne</i>		SHEET 1 OF 5 SHEETS	
3. PROJECT <i>OB/OD Area</i>			4. LOCATION <i>00-97-13PZ, OB/OD Area Range 16</i>		
5. NAME OF DRILLER <i>Bob Knopf</i>			6. MANUFACTURER'S DESIGNATION OF DRILL <i>TH-60 INGERSOLL-RAND AIR RIG</i>		
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT		air rotary 5 3/8" bit to 28.4'		8. HOLE LOCATION <i>ADJACENT TO 0893-04 &amp; 0897-07</i>	
		logged from air cuttings		9. SURFACE ELEVATION <i>1157.69 feet mean sea level</i>	
		ream hole with 9 3/8" bit		10. DATE STARTED <i>6-3-97</i>	
		core from 17.4' to 26.5'		11. DATE COMPLETED <i>6-4-97</i>	
		<i>air rotary 5 3/8" bit DM</i>			
12. OVERBURDEN THICKNESS <i>17.5 Feet (RESIDUAL SOIL)</i>			15. DEPTH GROUNDWATER ENCOUNTERED <i>13 Feet</i>		
13. DEPTH DRILLED INTO ROCK <i>20.5 Feet</i>			16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED <i>37.38 Feet / 6-7-97</i>		
14. TOTAL DEPTH OF HOLE <i>38'</i>			17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY) <i>37.57 / 6-9-97 37.51 / 6-10-97</i>		
18. GEOTECHNICAL SAMPLES <i>N/A</i>		DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES <i>1</i>	
20. SAMPLES FOR CHEMICAL ANALYSIS <i>N/A</i>		VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)
					21. TOTAL CORE RECOVERY <i>50%</i>
22. DISPOSITION OF HOLE		BACKFILLED	MONITORING WELL	23. SIGNATURE OF INSPECTOR <i>Darryl Morgan</i>	
				<i>Nested Piezometer</i>	

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1158	1	0.0 - 4.8' very dark grayish brown (10 YR 3/2) (100% fine) (moist) medium plasticity, medium dilatancy. CL	hnu 0				1130 hrs 6/3/97 Begin drilling w/ 5 3/8" bit air rotary
<i>DM</i> 1159 1157							
<i>DM</i> 1160 1156	2						
<i>DM</i> 1161 1155	3						
<i>DM</i> 1162 1154	4						
<i>DM</i> 1153 1153	5	<i>Wymore Shale</i> <del>Blue Shale</del> 4.8 - 6.5 continued on next page					

# HTW DRILLING LOG

HOLE NO.  
OB-97-13PZ

PROJECT **OB/OD Area**

INSPECTOR **Darryl Morgan**

SHEET OF 2 SHEETS **5**

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1152 <del>1164</del>	6	4.8-6.3 dusky red (2.5YR 3/3) (100% fine) dry, medium plasticity, medium dilatancy, CL	1.0		17.5		
1151 <del>1165</del>	7	6.5-72.0 light greenish gray (5G47/2) 85% fines 15% fine gravel Limestone (weathered) angular (0.5cm to 1cm) Dusky red (2.5YR 3/2) 85% fines, dry, medium plasticity, medium dilatancy, CL					
1150 <del>1168</del>	8						
1149 <del>1169</del>	9						
1148 <del>1170</del>	10						
1147 <del>1171</del>	11						
1146 <del>1172</del>	12	120-160 dark reddish gray (2.5YR 4/4) 85% fines 15% fine to coarse gravel (Limestone weathered) CL medium plasticity, medium dilatancy, fragments angular (0.5 to 2.0 cm)					
1145 <del>1173</del>	13						wet @ 13.0' Hand auger @ 13.5' @ 1215 hrs
1144 <del>1174</del>	14	Saturated @ 14.0'					saturated @ 14.0'

# HTW DRILLING LOG

HOLE NO.  
**OB-97-13PZ**

PROJECT  
**OB/OD Area**

INSPECTOR  
**Darryl Morgan**

SHEET  
OF 3 SHEETS **5**

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
1143 <del>1175</del> DM	15		hnu 0				
1142 <del>1176</del> DM	16						
1141 DM <del>1177</del>	17	Dark reddish gray (2.54R414) 75% fines 25% (fine to coarse gravel - Limestone) medium dilancy, medium plasticity - Cl fragments - angular (0.5cm to 2.0 cm)	0				Ream hole with 5 7/8" bit set temporary 4" PVC casing to 17' Hand auger refusal @ 17.4' @ 12.45 hrs
1140 DM <del>1178</del>	18	Schroyer Limestone Light gray (2.54712) fine crystalline, hard, dense, argillaceous, cherty, Very fossiliferous @ 18' (shell fragments)		begin run #1 @ 14.05 hrs @ 17.4'			coring begin @ 14.05 - 39.7 @ 17.4'; 1 7/8" Core barrel rubble zone encounter @ 18.5' communication between OB-97- 13PZ and OB-97- 07 air forcing water out of OB-97-07 casing
1139 DM <del>1179</del>	19	A/A Vuggy zone @ 18.5' to 19.0'	0	RQD = 8%			
1138 DM <del>1180</del>	20			DM recovery 2.4' end run #2 @ 14.25 hrs begin run #3 @ 14.50 hrs @ 22.2'			
1137 DM <del>1181</del>	21						
1136 DM <del>1182</del>	22			recovery 2.4' end run #3 @ 14.25 hrs begin run #4 @ 14.55 @ 22.2' RQD = 42%			
1135 DM <del>1183</del>	23	54 T/B (pale yellow) fine crystalline, hard, dense, gypsum nodules	0				

# HTW DRILLING LOG

HOLE NO.  
OB-97-13PZ

PROJECT: OB/OD Area

INSPECTOR: Darryl Morgan

SHEET 4  
OF 5 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
	23		hau 0	recovery 0.9 end run #2 23.46/1505			
1134	24	Havensville Shale Very dark gray (N31) dry,		begin run #3 @ 1630 hrs @ 23.4'			Lost 1.5' of core at top Core damaged lost core retrieved core ream hole with 5 7/8" bit set temporary casing to 26.5'
1133	25						
1132	26		0	recovery 1.5 end run #3 @ 1655 hrs			
1131	27	Shale: dark gray (4N41) fine texture, blocky, firm, calcareous		begin run #4 @ 1130 hrs 6-4/97 end run 1140 No recovery stop casing			ream hole with 9 7/8" bit, logged hole from cuttings from 26.5'
1130	28						
1129	29		0				
1128	30	Shale: A/A					
1127	31						
1126	32		0				

# HTW DRILLING LOG

HOLE NO.  
AR-97-18PZ  
SHEET 5  
OF 5 SHEETS

PROJECT OB/OD Area

INSPECTOR Darryl Morgan

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h
			hnu				
1125	33		0				
1124	34		0				
1123	35	Shale: dark gray (4/1N4/) fine texture, blocky, soft-firm, slightly calcareous	/				
1122	36		0				
1121	37						
1120	38	Total Depth	0				Set temporary 3" ID casing to 38' (170 blows) + finished remaining 445 hrs 6-4-97

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**ATTACHMENT 2**  
**Geophysical Logs**

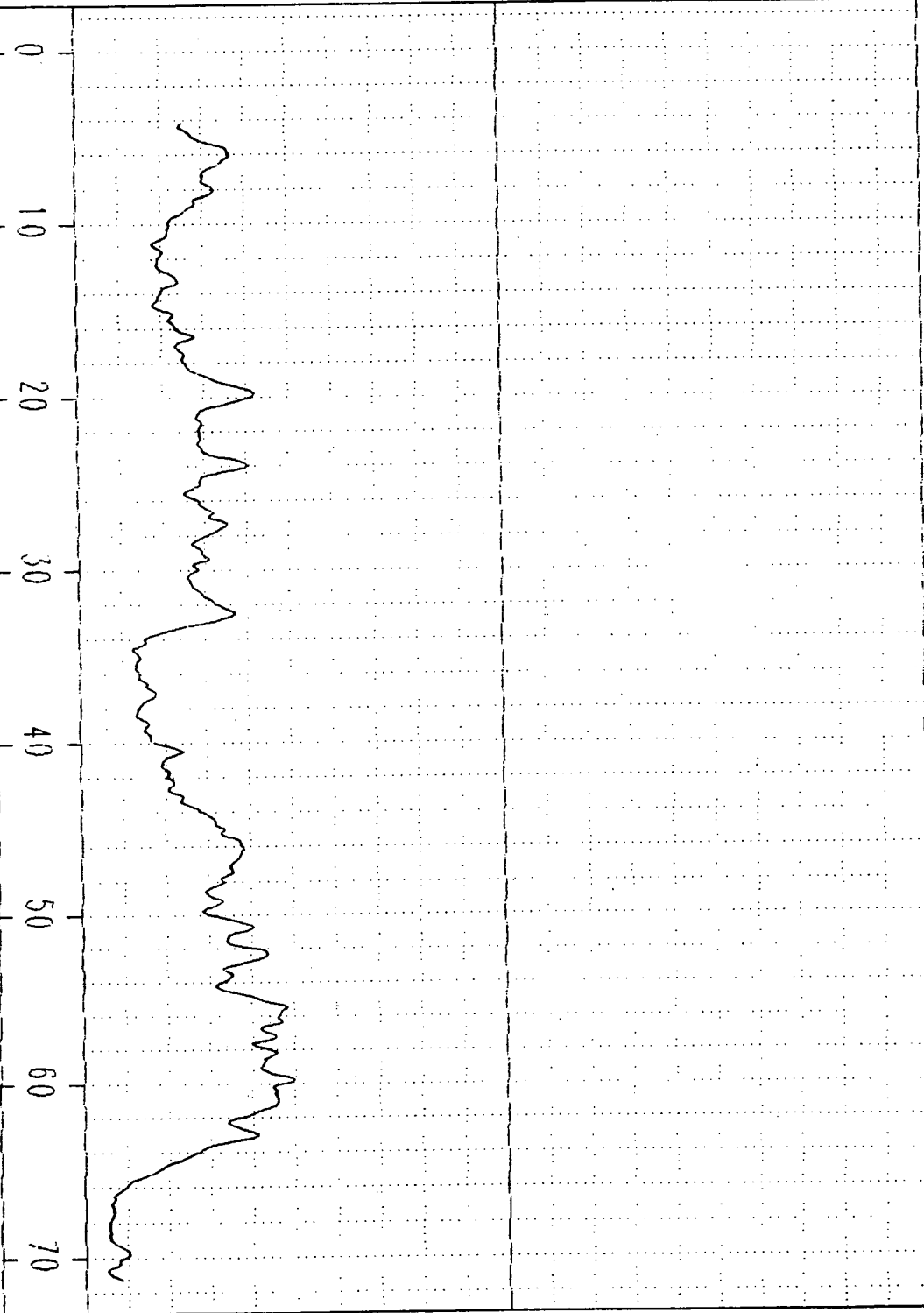
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OB9705

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← 0 NGamma CPS 500 →

(A:\OB9705.XD0)

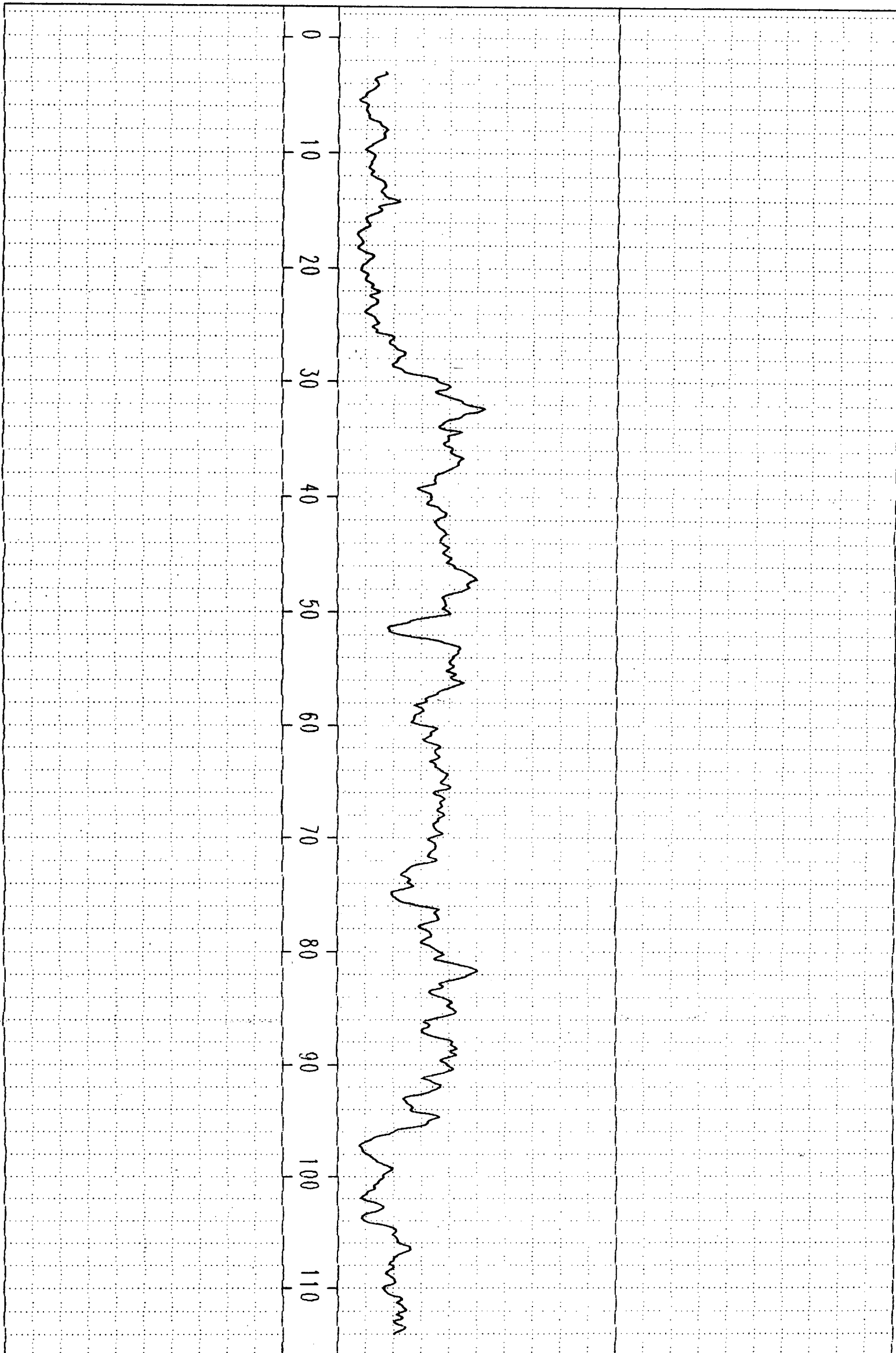
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OB9709PZ

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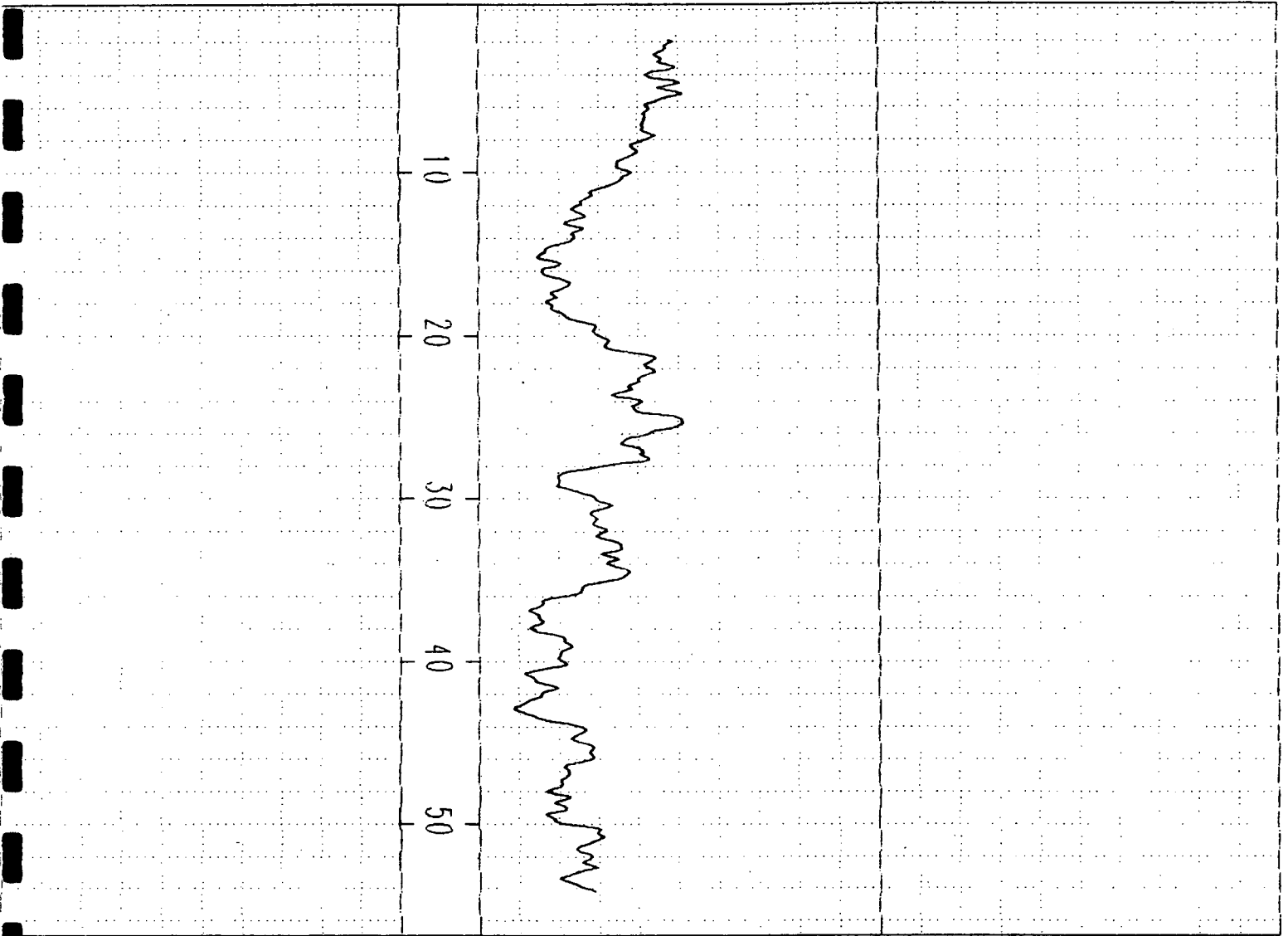
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OB9710PZ

← 0 NGamma CPS 500 →



← 0 NGamma CPS 500 →

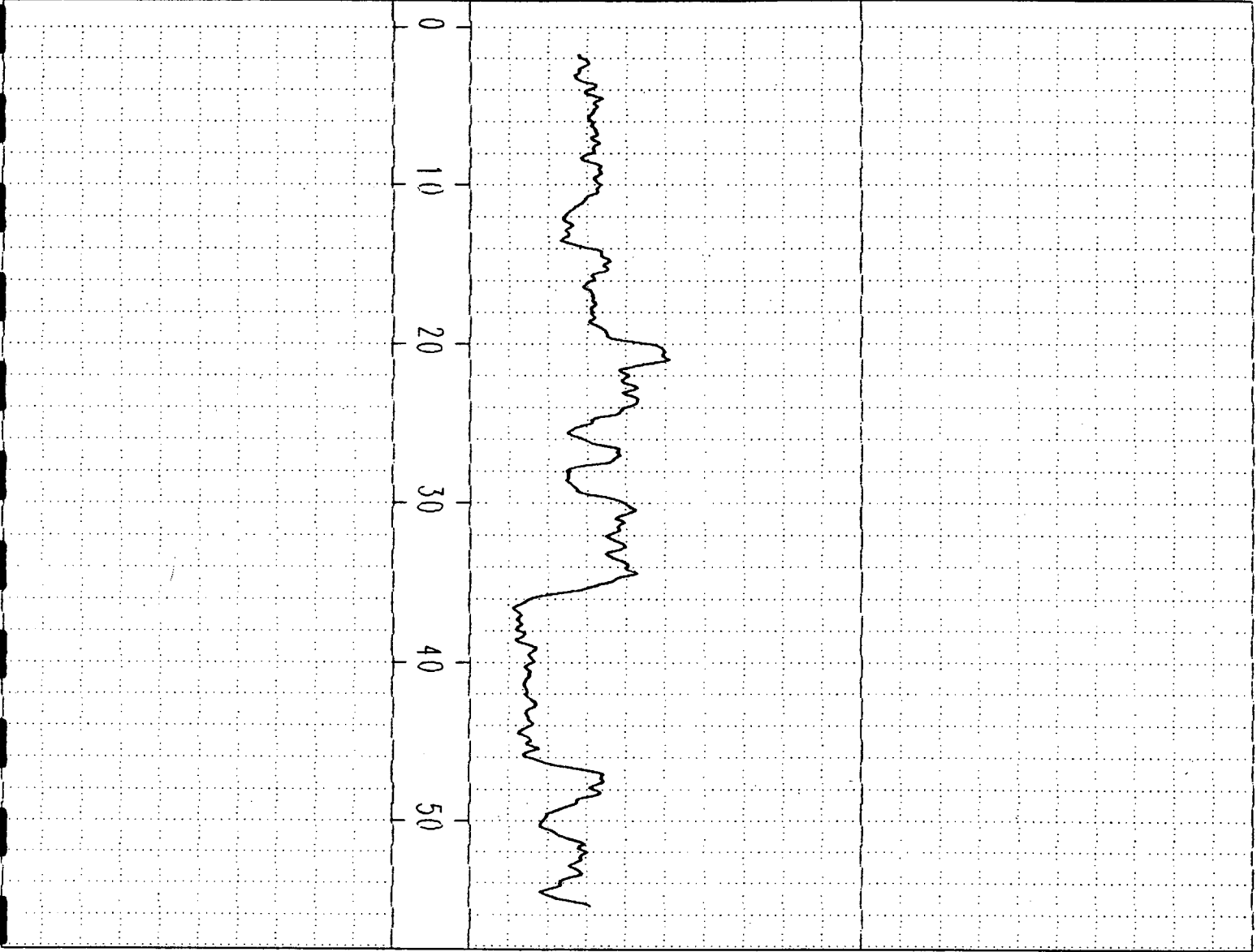
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OB9710PZ

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ob9711pz

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(A:\RILEY\OB9711PZ.XC0)

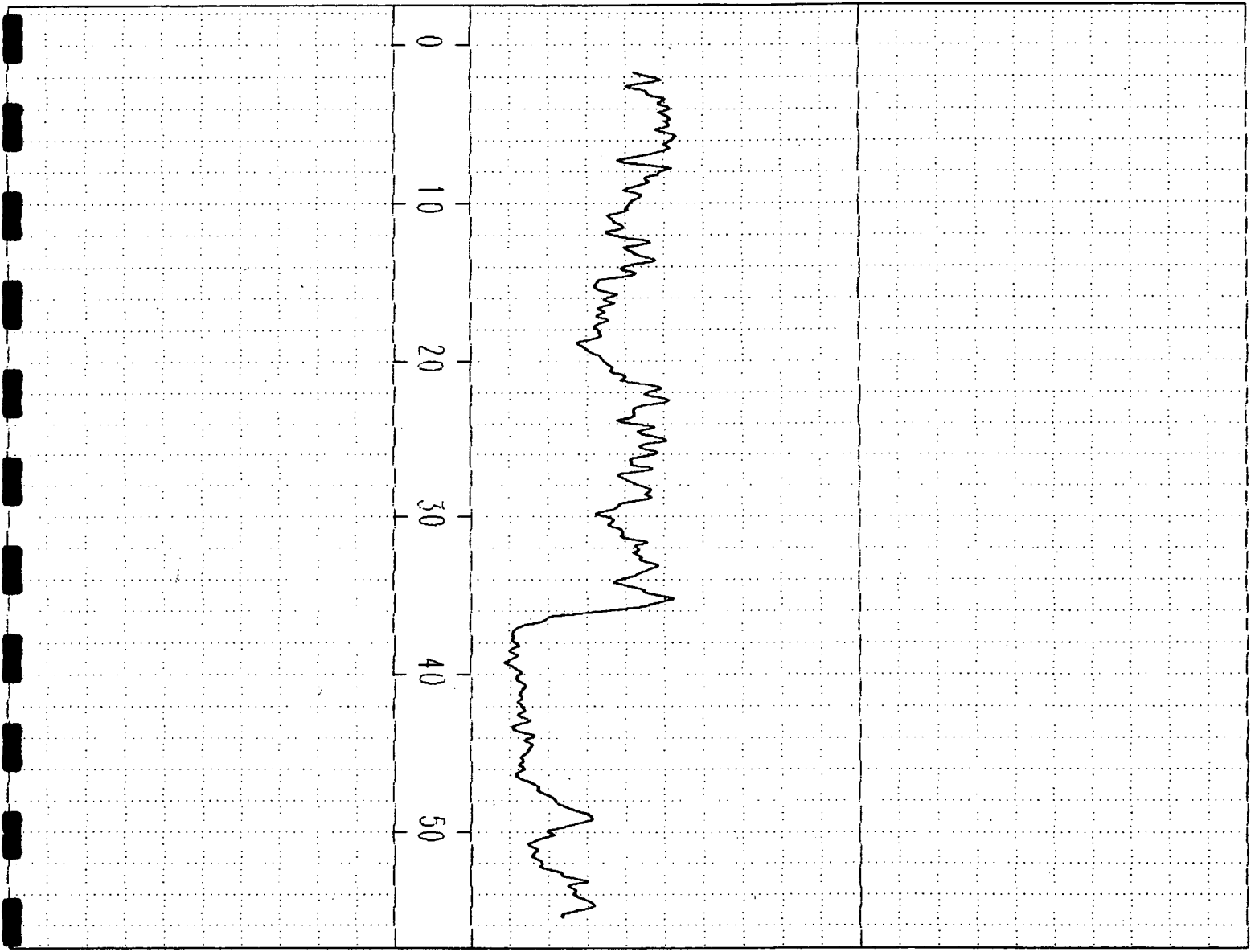
ob9711pz

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OB971 2PZ

← 0 NGamma CPS → 500



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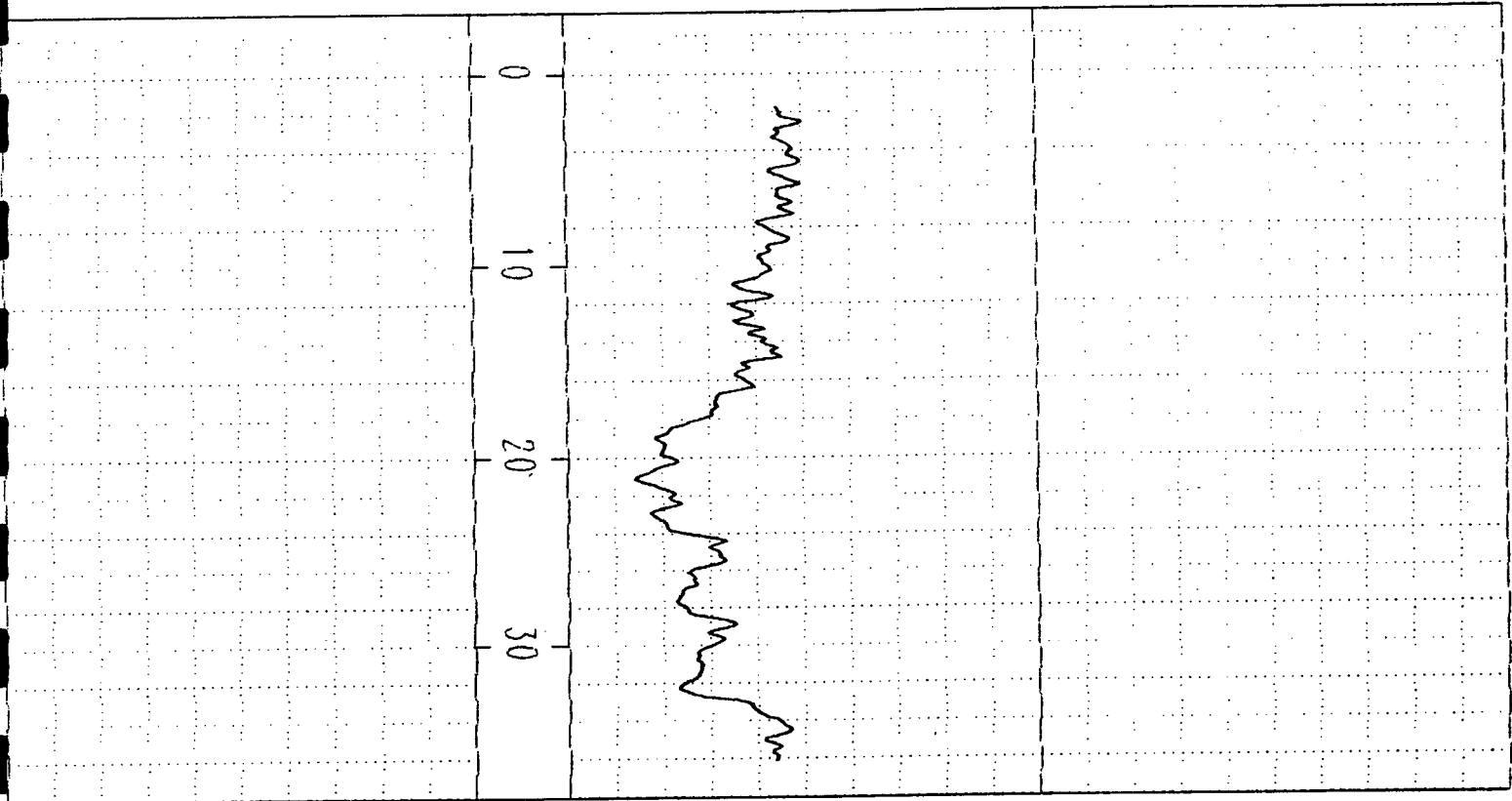
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OB971 3PZ

← 0 NGamma CPS → 500



← 0 NGamma CPS → 500

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OB971 3PZ

(C:\TEMP\OUTCROP1.AA1)

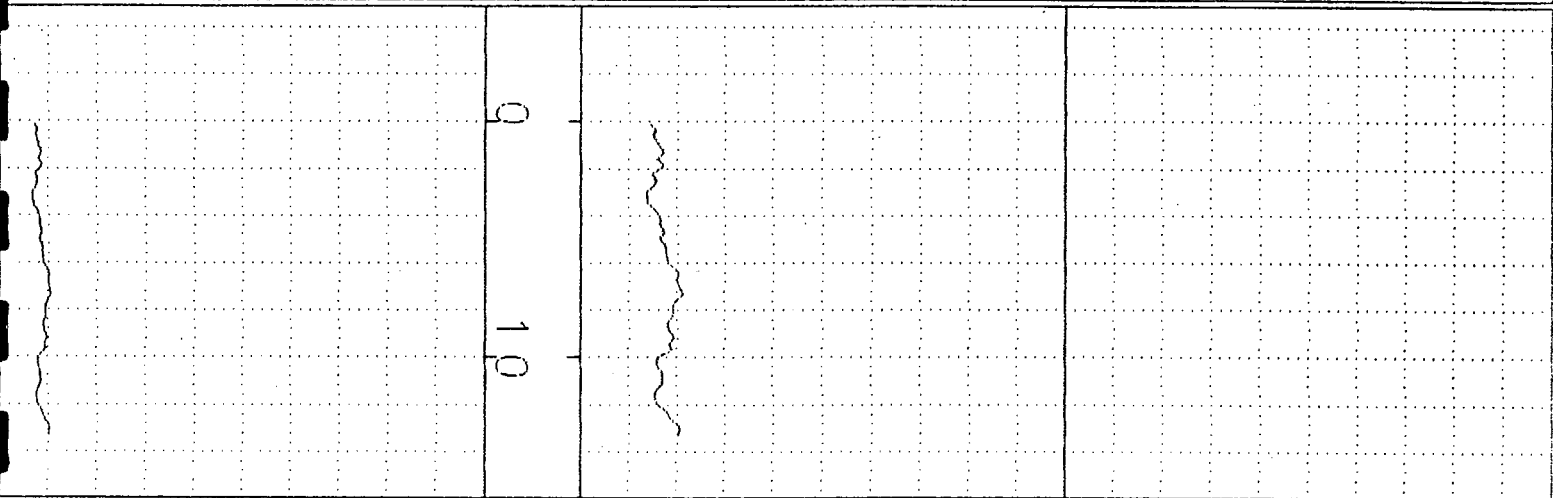
Outcrop 1

NGamma  
CPS

500

NGamDTC  
CPSdte

500



NGamma  
CPS

500

NGamDTC  
CPSdte

500

(C:\TEMP\OUTCROP1.AA1)

Outcrop 1

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**ATTACHMENT 3**  
**Well Specification Forms**

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WELL SPECIFICATION FORM

CLIENT: U.S. ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT

JOB NUMBER: JH-1124D

WELL OWNER: FORT RILEY - DES

ADDRESS: BUILDING 407 MAIN POST

CITY, STATE, ZIP CODE: FORT RILEY, KANSAS 66442-6016

PHONE: (913) 239-3343

WELL NUMBER OR OTHER IDENTIFICATION: 0B97-09PZ [0-5] NEST OF 6 Piezometers

WELL INSTALLATION DATE: START 6/6/97 : FINISH 6/17/97

GEOLOGIST SUPERVISING INSTALLATION: DANIEL KEOHANE / DARRYL MORGAN

GROUND SURFACE ELEVATION (FT): 1242.81 (SURVEYOR'S DISC)

TOP OF CASING ELEVATION (FT): 1245.06<sup>70</sup> (TOP PVC CASING)

WELL STICK-UP (FT): 2.893.25 FEET

TOTAL BORING DEPTH (FT): 114 FEET (b.g.s.)

BORING DIAMETER (IN): 9 7/8 - INCH

TOTAL DEPTH OF OUTER CASING (FT): 114 FEET (TEMPORARY)

OUTER CASING MATERIAL: SCHEDULE 80 PVC

OUTER CASING DIAMETER (IN): 8 - INCH

TOTAL DEPTH OF INNER CASING (FT. EXCLUDING SCREEN): 109 102.09 87 74 51 260 (b.g.s.)

INNER CASING MATERIAL: SCHEDULE 80 PVC

INNER CASING DIAMETER (IN): 1 INCH

TOTAL LENGTH OF WELL SCREEN (FT): 1 0.91 1 1 1 2

WELL SCREEN MATERIAL: SCHEDULE 80 PVC

WELL SCREEN DIAMETER (FT): 1 INCH

SCREEN SLOT SIZE (IN): All 0.020 INCH



WELL SPECIFICATION FORM (Cont'd)

WELL NUMBER: OB97-09 P2

BACKFILL MATERIAL AROUND SCREEN: COARSE SAND

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW TO \_\_\_\_\_

SEAL MATERIAL ABOVE SCREEN: BENTONITE (PEL PLUG OR CHIPS)

DEPTH RANGE OF SEAL (FT): SEE TABLE BELOW TO \_\_\_\_\_

BACKFILL MATERIAL AROUND CASING: ~~SEE TABLE BELOW~~ BENTONITE

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW.

DESCRIPTION OF TOP SEAL: BENTONITE TO GROUND SURFACE; PLACED AFTER STEEL PROTECTIVE CASING SET.

DESCRIPTION OF WELL COVER: 10-INCH DIAMETER STEEL PROTECTIVE CASING

OTHER ADDITIONAL INFORMATION: TOP OF P2'S NOTCHED: THE DEEPEST (HAVENSVILLE) HAS 0 NOTCHES; THE NUMBER OF NOTCHES INCREASES WITH DECREASING DEPTH B.G.S.

INTERVAL SCREENED	DEPTH RANGE OF BACKFILL (Ft. bgs)	DEPTH RANGE OF SEAL	INTERVAL SCREENED (Ft. bgs) APPROX
HAVENSVILLE	111.95 - 108.15	108.15 - 104.1	109 - 110
SCHROYER	104.1 - 100.93	100.93 - 89.29	102.09 - 103
WYMORE	89.29 - 85.96	85.96 - 76.10	86 - 87
KINNEY	76.10 - 72.69	72.69 - 53.78	74 - 75
BLUE SPRINGS	53.76 - 49.90	49.90 - 29.58	51 - 52
FLORENCE	29.58 - 25.00	25.00 - 4.01	28.0 - 26.02

WELL SPECIFICATION FORM

CLIENT: U.S. ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT

JOB NUMBER: JH-1124D

WELL OWNER: FORT RILEY - DEED

ADDRESS: BUILDING 407 MAIN POST

CITY, STATE, ZIP CODE: FORT RILEY, KANSAS 66442-6016

PHONE: (913) 239-3343

WELL NUMBER OR OTHER IDENTIFICATION: 0B97-10 PZ [0-4] NEST OF 5 PIEZOMETERS

WELL INSTALLATION DATE: \_\_\_\_\_

GEOLOGIST SUPERVISING INSTALLATION: DANIEL KEOHANE / DARRYL MORGAN

GROUND SURFACE ELEVATION (FT): 1183.28 (SURVEYOR'S DISC)

TOP OF CASING ELEVATION (FT): 1185.52 (TOP PVC CASING)

WELL STICK-UP (FT): 2.24 FEET

TOTAL BORING DEPTH (FT): 58 FEET

BORING DIAMETER (IN): 9 7/8 - INCHES

TOTAL DEPTH OF OUTER CASING (FT): 58 FEET (TEMPORARY)

OUTER CASING MATERIAL: SCHEDULE 80 PVC

OUTER CASING DIAMETER (IN): 8 - INCH

TOTAL DEPTH OF INNER CASING (FT. EXCLUDING SCREEN): 49.1 42.0' 35.98' 29.0' 16.01'

INNER CASING MATERIAL: SCHEDULE 80 PVC

INNER CASING DIAMETER (IN): 1 - INCH

TOTAL LENGTH OF WELL SCREEN (FT): 0.9' 1.0' 1.02' 0.9' 0.89

WELL SCREEN MATERIAL: SCHEDULE 80 PVC

WELL SCREEN DIAMETER (FT): 1 - INCH

SCREEN SLOT SIZE (IN): 0.020 - INCH

WELL SPECIFICATION FORM (Cont'd)

WELL NUMBER: OB97-10P2

BACKFILL MATERIAL AROUND SCREEN: COARSE SAND

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW TO

SEAL MATERIAL ABOVE SCREEN: BENTONITE (PEL PLUG OR CHIPS)

DEPTH RANGE OF SEAL (FT): SEE TABLE BELOW TO

BACKFILL MATERIAL AROUND CASING: BENTONITE

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW

DESCRIPTION OF TOP SEAL: BENTONITE TO GROUND SURFACE; PLACED AFTER PROTECTIVE CASING SET

DESCRIPTION OF WELL COVER: 10-INCH DIAMETER STEEL PROTECTIVE CASING

OTHER ADDITIONAL INFORMATION: INTERVAL SCREENED IS IDENTIFIED BY NUMBER OF NOTCHES - NUMBER OF NOTCHES INCREASE WITH DECREASING DEPTH SCREENED

FORMATION	DEPTH RANGE OF BACKFILL (FT bgs)	DEPTH RANGE OF SEAL (FT bgs)	SCREENED INTERVAL (FT bgs - approx)
HAVENSVILLE	52.2 - 48.5	48.5 - 44.15	49.1 - 50
LOWER SCHROYER	44.15 - 41.0	41.0 - 38.0	42 - 43
UPPER SCHROYER	38.8 - 35.01	35.01 - 31.1/30.9	35.98 - 37
WYMORE	30.9 - 26.9	26.9 - 18.5	29 - 30
KINNEY	18.5 - 15.0	15.0 - 4.0	16 - 17

WELL SPECIFICATION FORM

CLIENT: US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT

JOB NUMBER: JH-1124 D

WELL OWNER: FORT RILEY - DEB

ADDRESS: BUILDING 407 MAIN POST

CITY, STATE, ZIP CODE: FORT RILEY, KANSAS 66442-6016

PHONE: (913) 239-3343

WELL NUMBER OR OTHER IDENTIFICATION: OB97-11PZ [0-4] NEST OF 5 PIEZOMETERS

WELL INSTALLATION DATE: \_\_\_\_\_

GEOLOGIST SUPERVISING INSTALLATION: DANIEL KEOHANE / DARRYL MORGAN

GROUND SURFACE ELEVATION (FT): 1182.21 (SURVEYOR'S DISC)

TOP OF CASING ELEVATION (FT): 1184.43 (TOP PVC CASING)

WELL STICK-UP (FT): 2.22 FEET

TOTAL BORING DEPTH (FT): 58 FEET

BORING DIAMETER (IN): 9 7/8 - INCH

TOTAL DEPTH OF OUTER CASING (FT): 58.25 FEET (TEMPORARY)

OUTER CASING MATERIAL: SCHEDULE 80 PVC

OUTER CASING DIAMETER (IN): 8 - INCH

TOTAL DEPTH OF INNER CASING (FT. EXCLUDING SCREEN): -bgs to 1<sup>st</sup> slot - 50.02' 44.01' 36.0' 29.0' 13.0'

INNER CASING MATERIAL: SCHEDULE 80 PVC

INNER CASING DIAMETER (IN): 4 INCH

TOTAL LENGTH OF WELL SCREEN (FT): -1<sup>st</sup> - last slot - 0.88' 0.89' 0.9' 0.9' 0.9'

WELL SCREEN MATERIAL: SCHEDULE 80 PVC

WELL SCREEN DIAMETER (FT): 4 INCH

SCREEN SLOT SIZE (IN): 0.020 INCH

WELL SPECIFICATION FORM (Cont'd)

WELL NUMBER: OB97-11 PZ

BACKFILL MATERIAL AROUND SCREEN: COARSE SAND

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW TO \_\_\_\_\_

SEAL MATERIAL ABOVE SCREEN: BENTONITE (PEL PLUG OR CHIPS)

DEPTH RANGE OF SEAL (FT): SEE TABLE BELOW TO \_\_\_\_\_

BACKFILL MATERIAL AROUND CASING: BENTONITE

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW

DESCRIPTION OF TOP SEAL: BENTONITE TO GROUND SURFACE; PLACED AFTER PROTECTIVE CASING SET

DESCRIPTION OF WELL COVER: 10-INCH DIAMETER STEEL PROTECTIVE CASING

OTHER ADDITIONAL INFORMATION: INTERVAL SCREENED IS IDENTIFIED BY NUMBER OF NOTCHES - NUMBER OF NOTCHES INCREASE WITH DECREASING DEPTH SCREENED

FORMATION SCREENED	DEPTH RANGE OF BACKFILL (FT. bgs)	DEPTH RANGE OF SEAL (FT bgs)	INTERVAL SCREENED (FT bgs)
HAVENSVILLE	<del>49</del> 53.1 - 49.0	49.0 - 46.2	50 - 51
LOWER SCHROYER	46.2 - 42.9	42.9 - 38.3/38.1	44 - 45
UPPER SCHROYER	38.1 - 35.0	35.0 - 31.0/30.9	<del>29 - 30</del> 36 - 37
WYMORE	30.9 - 27.9	27.9 - 15.3	29 - 30
KINNEY	15.3 - 12.0	12.0 - 4.0	13 - 14

WELL SPECIFICATION FORM

CLIENT: U.S. ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT

JOB NUMBER: JH-1124 D

WELL OWNER: FORT RILEY - DEE

ADDRESS: BUILDING 407 MAIN POST

CITY, STATE, ZIP CODE: FORT RILEY, KANSAS 66442-6016

PHONE: (913) 239-3343

WELL NUMBER OR OTHER IDENTIFICATION: 0B97-12 PZ (0-4) NEST OF 5 PIEZOMETERS

WELL INSTALLATION DATE: \_\_\_\_\_

GEOLOGIST SUPERVISING INSTALLATION: DANIEL KEOHANE / DARRYL MORGAN

GROUND SURFACE ELEVATION (FT): 1183.24 (SURVEYORS DISC)

TOP OF CASING ELEVATION (FT): 1185.65 (TOP PVC CASING)

WELL STICK-UP (FT): 2.41 FEET

TOTAL BORING DEPTH (FT): 58 FEET

BORING DIAMETER (IN): 9 7/8 - INCH

TOTAL DEPTH OF OUTER CASING (FT): 58.3 (TEMPORARY)

OUTER CASING MATERIAL: SCHEDULE 80 PVC

OUTER CASING DIAMETER (IN): 8 - INCH

TOTAL DEPTH OF INNER CASING (FT. EXCLUDING SCREEN): b.g.s to 1<sup>st</sup> slot 49.99 44.0 35.99 29.0' 14.0'

INNER CASING MATERIAL: SCHEDULE 80 PVC

INNER CASING DIAMETER (IN): 4 INCH

TOTAL LENGTH OF WELL SCREEN (FT): [1<sup>st</sup> last slot] 0.9' 0.9' 0.9' 0.9' 0.9'

WELL SCREEN MATERIAL: SCHEDULE 80 PVC

WELL SCREEN DIAMETER (FT): 1 - INCH

SCREEN SLOT SIZE (IN): 0.020 INCH

WELL SPECIFICATION FORM (Cont'd)

WELL NUMBER: OB97-12 PZ

BACKFILL MATERIAL AROUND SCREEN: COARSE SAND (10-20)

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW TO \_\_\_\_\_

SEAL MATERIAL ABOVE SCREEN: BENTONITE (PEL PLUG & CHIPS)

DEPTH RANGE OF SEAL (FT): SEE TABLE BELOW TO \_\_\_\_\_

BACKFILL MATERIAL AROUND CASING: BENTONITE

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW

DESCRIPTION OF TOP SEAL: BENTONITE TO GROUND SURFACE; PLACED AFTER PROTECTIVE CASING SET

DESCRIPTION OF WELL COVER: 10-INCH DIAMETER STEEL PROTECTIVE CASING.

OTHER ADDITIONAL INFORMATION: INTERVAL SCREENED IS IDENTIFIED BY NUMBER OF NOTCHES - NUMBER OF NOTCHES INCREASE WITH DECREASING DEPTH SCREENED.

FORMATION SCREENED	DEPTH RANGE OF BACKFILL (FT b.g.s)	DEPTH RANGE OF SEAL (FT b.g.s)	INTERVAL SCREENED (FT b.g.s) APPROX
HAVENSVILLE	53.5 - 49.0	49.0 - 46.4' / 46.3	50 - 51
LOWER SCHROYER	46.3 - 43.0	43.0 - 38.5' / 38.45'	44 - 45
UPPER SCHROYER	38.45 - 35.0	35.0 - 31.3' / 31.2'	36 - 37
WYMORE	31.2' - 27.9	27.9 - 16.5' / 16.3'	29 - 30
KINNEY	16.3' - 12.8'	12.8 - 4.0	14 - 15

WELL SPECIFICATION FORM

CLIENT: US ARMY CORPS OF ENGINEERS - KANSAS CITY DISTRICT

JOB NUMBER: JH-1124 D

WELL OWNER: FORT RILEY - DEH

ADDRESS: BUILDING 407 MAIN POST

CITY, STATE, ZIP CODE: FORT RILEY, KANSAS 66442-6016

PHONE: (913) 239-3343

WELL NUMBER OR OTHER IDENTIFICATION: OB97-13P2 (0-4) NEST OF 5 PIEZOMETERS

WELL INSTALLATION DATE: \_\_\_\_\_

GEOLOGIST SUPERVISING INSTALLATION: DANIEL KECHANE / DARRYL MORGAN

GROUND SURFACE ELEVATION (FT): 1157.92 (SURVEYORS DISC)

TOP OF CASING ELEVATION (FT): 1160.15 (TOP PVC CASING)

WELL STICK-UP (FT): 2.23 FEET

TOTAL BORING DEPTH (FT): ~~37.8 FEET (TEMPORARY)~~ 38 FEET

BORING DIAMETER (IN): 9 7/8 INCH

TOTAL DEPTH OF OUTER CASING (FT): 37.8 FEET (TEMPORARY)

OUTER CASING MATERIAL: SCHEDULE 80 PVC

OUTER CASING DIAMETER (IN): 8 - INCH

TOTAL DEPTH OF INNER CASING (FT. EXCLUDING SCREEN): begs to 1<sup>st</sup> slot - 30' 25.99' 20.99' 16.5' 10.99'

INNER CASING MATERIAL: SCHEDULE 80 PVC

INNER CASING DIAMETER (IN): 1 - INCH

TOTAL LENGTH OF WELL SCREEN (FT): 1<sup>st</sup> - last slot = 0.91' 0.91' 0.91' 0.9' 0.91'

WELL SCREEN MATERIAL: SCHEDULE 80 PVC

WELL SCREEN DIAMETER (FT): 1 - INCH

SCREEN SLOT SIZE (IN): 0.020 INCH



WELL SPECIFICATION FORM (Cont'd)

WELL NUMBER: OB97-13P2

BACKFILL MATERIAL AROUND SCREEN: COARSE SAND (10-20)

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW TO \_\_\_\_\_

SEAL MATERIAL ABOVE SCREEN: BENTONITE (PEL PLUG OR CHIPS)

DEPTH RANGE OF SEAL (FT): SEE TABLE BELOW TO \_\_\_\_\_

BACKFILL MATERIAL AROUND CASING: BENTONITE

DEPTH RANGE OF BACKFILL (FT): SEE TABLE BELOW

DESCRIPTION OF TOP SEAL: BENTONITE TO GROUND SURFACE: PLACED AFTER PROTECTIVE CASING SET

DESCRIPTION OF WELL COVER: 10-INCH DIAMETER STEEL PROTECTIVE CASING

OTHER ADDITIONAL INFORMATION: INTERVAL SCREENED IS IDENTIFIED BY NUMBER OF NOTCHES - NUMBER OF NOTCHES INCREASE WITH DECREASING DEPTH SCREENED

FORMATION	DEPTH RANGE OF BACKFILL (FT b.g.s)	DEPTH RANGE OF SEAL (FT b.g.s)	INTERVAL SCREENED (FT b.g.s) APPROX
LOWER HAVENSVILLE	32.0 - 29.5	29.5 - 27.7	30-31
UPPER HAVENSVILLE	27.7 - 25.0	25.0 - 23.2/23.1	26-27
LOWER SCHROYER	23.1 - 20.0	20.0 - 18.1/17.9	21-22
UPPER SCHROYER	17.9 - 15.5	15.5 - 13.3/13.1	16.5-17.5
OVERBURDEN	13.1 - 9.8	9.8 - 4.0	11-12

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**ATTACHMENT 4**  
**Well Development Forms**

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WELL DEVELOPMENT RECORD

CLIENT: ARMY CORP OF ENGINEERS-KANSAS CITY JOB NO: JG-1270

FIELD PERSONNEL: Darryl Morgan SHEET: 1 OF: 1

1. WELL NO.: 0B-97-05
2. DATE OF INSTALLATION: 3-29-97
3. DATE OF DEVELOPMENT: 6-10-97
4. STATIC WATER LEVEL: BEFORE DEVELOPMENT 56.35 FT. 24 HOURS AFTER 10.30 <sup>56.34</sup> FT.
5. QUANTITY OF WATER LOSS DURING DRILLING, IF USED 0.0 GAL.
6. QUANTITY OF STANDING WATER IN WELL AND ANNULUS BEFORE DEVELOPMENT 18.30 GAL.

	START	DURING	END
7. PHYSICAL APPEARANCE	<u>Gray</u>	<u>lt gray</u>	<u>clear</u>
SPECIFIC CONDUCTANCE (umhos/cm)	<u>1248</u>	<u>1194</u>	<u>1151</u>
TEMPERATURE (°C)	<u>76.8°F (24.9)</u>	<u>75.9°F (24.4)</u>	<u>75.3°F (24.0)</u>
pH (s.u.)	<u>7.41</u>	<u>7.00</u>	<u>7.02</u>

8. DEPTH FROM TOP OF WELL CASING TO BOTTOM OF WELL 73.0 FT.
9. SCREEN LENGTH 10 FT.
10. DEPTH TO TOP OF SEDIMENT: BEFORE DEVELOPMENT 72.94 FT. AFTER DEVELOPMENT 72.98 FT.
11. TYPE AND SIZE OF WELL DEVELOPMENT EQUIPMENT: stainless steel bailer

12. DESCRIPTION OF SURGE TECHNIQUE, IF USED: Surge with stainless steel bailer

13. HEIGHT OF WELL CASING ABOVE GROUND SURFACE: 1.89 FT.
14. QUANTITY OF WATER REMOVED 55.0 GAL. TIME OF REMOVAL 4 hrs 50 min HR./MIN.
15. TURBIDITY IN NEPHELOMETRIC UNITS 22.6 NTUs

WELL DEVELOPMENT RECORD

CLIENT: US Army Corps of Engineers JOB NO: JH1124D

FIELD PERSONNEL: David Stein SHEET: 1 OF: 1

1. WELL NO.: OB-97-07

2. DATE OF INSTALLATION: 3-23-97

3. DATE OF DEVELOPMENT: 3-27-97

4. STATIC WATER LEVEL: BEFORE DEVELOPMENT 15.5' FT. 24 HOURS AFTER 17.91' FT.

*immediately after development*

5. QUANTITY OF WATER LOSS DURING DRILLING, IF USED — GAL.

6. QUANTITY OF STANDING WATER IN WELL AND ANNULUS BEFORE DEVELOPMENT 41.78 GAL.

Total removed (gallons) 58 62 190 200 268 410 470 —

	START		DURING				END	
7. PHYSICAL APPEARANCE <u>NTU</u>	<u>105.3</u>	<u>102.3</u>	<u>69.9</u>	<u>59.9</u>	<u>67.1</u>	<u>69.8</u>	<u>45.9</u>	<u>10.8</u>
SPECIFIC CONDUCTANCE (umhos/cm)	<u>960</u>	<u>670</u>	<u>1040</u>	<u>680</u>	<u>740</u>	<u>640</u>	<u>650</u>	<u>690</u>
TEMPERATURE (°F)	<u>57.0</u>	<u>55.9</u>	<u>70.5</u>	<u>63.1</u>	<u>63.3</u>	<u>61.5</u>	<u>63.2</u>	<u>62.0</u>
pH (s.u.)	<u>8.17</u>	<u>8.28</u>	<u>8.06</u>	<u>8.13</u>	<u>8.06</u>	<u>8.16</u>	<u>8.30</u>	<u>9.88</u>

8. DEPTH FROM TOP OF WELL CASING TO BOTTOM OF WELL 32 FT.

9. SCREEN LENGTH 9.5' FT.

10. DEPTH TO TOP OF SEDIMENT: BEFORE DEVELOPMENT \_\_\_\_\_ FT. AFTER DEVELOPMENT \_\_\_\_\_ FT.

11. TYPE AND SIZE OF WELL DEVELOPMENT EQUIPMENT: \_\_\_\_\_

Layne 2" Submersible Pump

12. DESCRIPTION OF SURGE TECHNIQUE, IF USED: Surge and pump.

13. HEIGHT OF WELL CASING ABOVE GROUND SURFACE: 1.78' FT.

14. QUANTITY OF WATER REMOVED 470 GAL. TIME OF REMOVAL 6/05 HR./MIN.

15. TURBIDITY IN NEPHELOMETRIC UNITS 10.8 NTUs

WELL DEVELOPMENT RECORD

CLIENT: Army Corp of Engineers - KANSAS JOB NO: JG-1170

FIELD PERSONNEL: DAN KEOHANE CITY CITY SHEET: 1 OF: 1

1. WELL NO.: OB97-07

2. DATE OF INSTALLATION: 3-23-97

3. DATE OF DEVELOPMENT: 6-17-97 - Redevelopment & 6-18-97

4. STATIC WATER LEVEL: BEFORE DEVELOPMENT 14.12 FT. 24 HOURS AFTER 14.34 FT.

5. QUANTITY OF WATER LOSS DURING DRILLING, IF USED N/A GAL.

6. QUANTITY OF STANDING WATER IN WELL AND ANNULUS BEFORE DEVELOPMENT 11 GAL.

	<u>START</u>	<u>DURING</u>	<u>END</u>	
7. PHYSICAL APPEARANCE	<u>Turbid</u>	<u>156</u>	<u>58.1</u>	<u>25.4</u>
SPECIFIC CONDUCTANCE (umhos/cm)	<u>785</u>	<u>791</u>	<u>580</u>	<u>520</u>
TEMPERATURE (°C)	<u>80°F (26.6)</u>	<u>82°F (27.8)</u>	<u>12.2°C</u>	<u>53.4°F</u>
pH (s.u.)	<u>7.42</u>	<u>7.41</u>	<u>6.71</u>	<u>6.70</u>

8. DEPTH FROM TOP OF WELL CASING TO BOTTOM OF WELL 28.3 FT.

9. SCREEN LENGTH 10 FT.

10. DEPTH TO TOP OF SEDIMENT: BEFORE DEVELOPMENT 28.3 FT. AFTER DEVELOPMENT 28.4 FT.

11. TYPE AND SIZE OF WELL DEVELOPMENT EQUIPMENT: 2-inch Stainless Steel  
bailer & 2-inch PVC bladder Pump.

12. DESCRIPTION OF SURGE TECHNIQUE, IF USED: 2-inch stainless steel  
bailer.

13. HEIGHT OF WELL CASING ABOVE GROUND SURFACE: 1.65 FT.

14. QUANTITY OF WATER REMOVED 65 GAL. TIME OF REMOVAL 4 hr/20 min HR./MIN.

15. TURBIDITY IN NEPHELOMETRIC UNITS 25.4 NTUs