

**LONGHORN ARMY
AMMUNITION PLANT**

KARNACK, TEXAS

**ADMINISTRATIVE
RECORD**

VOLUME 2 of 10

1997

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Prepared for:

**Department of the Army
Longhorn Army Ammunition Plant
Marshall, Texas 75671**

1998

LONGHORN ARMY AMMUNITION PLANT KARNACK, TEXAS ADMINISTRATIVE RECORD - CHRONOLOGICAL INDEX

VOLUME 2 OF 10

1997

- A. Title: Memorandum - Subject: Final Remedial Investigation Report Group 1 Sites (Sites 1, 11, 27, and XX) and Volume 2 Baseline Risk at the Longhorn Army Ammunition Plant, Karnack, Texas (w/enclosures)
- Group(s): 1
- Site(s): 1, 11, 27 and XX
- Location: Longhorn Army Ammunition Plant
- Agency: Department of The Army, Tulsa District, Corps of Engineers
- Author(s): Mr. Burl D. Ragland, Lead Project Manager, Army Team
- Recipient: Mr. David Tolbert, Project Mgr.
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- B. Title: Report - Subject: Remedial Investigation Report, Group 1 Sites, Volume I
- Group(s): 1
- Site(s): 1, 11, 27 and XX
- Location: Longhorn Army Ammunition Plant
- Agency: U.S. Army Corps of Engineers, Tulsa District
- Author(s): U.S. Army Corps of Engineers
- Recipient: Mr. David Tolbert, Project Mgr.
- Date: May 1997
- Bate Stamp: 018605-019027



DEPARTMENT OF THE ARMY

TULSA DISTRICT, CORPS OF ENGINEERS
POST OFFICE BOX 61
TULSA, OKLAHOMA 74121-0061

018604

REPLY TO
ATTENTION OF:

CESWT-PP-ME (200-1c)

30 April 1997

MEMORANDUM FOR Commander, Longhorn/Louisiana Army Ammunition
Plants, ATTN: SIOLH-OR (Mr. David Tolbert),
Post Office Box 658, Doyline, LA 71023

SUBJECT: Final Remedial Investigation Report Group 1 Sites (Sites
1, 11, 27, and XX) and Volume 2 Baseline Risk at the Longhorn
Army Ammunition Plant, Karnack, Texas

1. Please find enclosed two copies of the subject document for
your review and comments. Please submit comments by 30 May 1997.
Comments submitted before the due date will be greatly
appreciated.

2. If you have any questions, please contact Ms. Yolane
Hartsfield at 918-669-7530.

FOR THE COMMANDER:

Encls

for *Yolane Hartsfield*
BURL D. RAGLAND
Lead Project Manager
Army Team

LONGHORN ARMY AMMUNITION PLANT

018605

FINAL

**REMEDIAL INVESTIGATION REPORT
GROUP 1 SITES**

VOLUME 1

**Prepared for
Longhorn Army Ammunition Plant
Karnack, Texas**

**Prepared by
U. S. Army Corps of Engineers
Tulsa District**

May 1997

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015606

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Appendix A, Geologic Logs and Well Schematics
Appendix B, Results of Physical Tests
Appendix C, Slug Test Data
Appendix D, Groundwater Grab Sample Results

ACRONYMS AND ABBREVIATIONS USED IN THE TEXT

012611

Al	aluminum
As	arsenic
B	compound was also found in the laboratory method blank
Ba	barium
CDAP	chemical data acquisition plan
Cr	chromium
DNT	2,6-dinitrotoluene
EBA	Ebasco Services, Inc.
EPS	Environmental Protection Systems, Inc.
HPLC	high performance liquid chromatography
INF	Intermediate-Range Nuclear Force
J	value of a compound was estimated and may not be accurate
LHAAP	Longhorn Army Ammunition Plant
MS/MSD	matrix spike/matrix spike duplicate
NB	nitrobenzene
NGVD	National Geodetic Vertical Datum, 1929
Ni	nickel
NO ₂ NO ₃	nitrite/nitrate
O.D.	Outside diameter
QA/QC	quality assurance/quality control
PAH	polynuclear aromatic hydrocarbon
Pb	lead
PQL	practical quantitation limit
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	remedial investigation
Se	selenium
Sr	strontium
SVE	Sverdrup Environmental, Inc.
SVOC	semivolatile organic compound
SWD Lab	USACE Southwestern Division Laboratory
TAL	target analyte list
TCE	trichloroethylene
TNB	1,3,5-trinitrobenzene
TNT	2,4,6-trinitrotoluene
TOC	total organic carbon
TOX	total organic halogen
UCL	upper confidence limit
USACE	U. S. Army Corps of Engineers
USATHAMA	U. S. Army Toxic and Hazardous Materials Agency
UXO	unexploded ordnance
WES	Roy F. Weston, Inc.

EXECUTIVE SUMMARY

018612

This Remedial Investigation Report presents the findings of the investigations performed at four sites which have been designated as the Group 1 Sites, Longhorn Army Ammunition Plant, Karnack, Texas. Longhorn Army Ammunition Plant is located in central east Texas in the northeast corner of Harrison County, Texas. Its mission has been the production of TNT flake, pyrotechnic and illuminating ammunition, and rocket motors. Group 1 sites are identified as follows:

Site 11	Suspected TNT Burial Site
Site 1	Inert Burning Grounds
Site XX	Ground Signal Test Area
Site 27	South Test Area

This report presents results from investigations conducted during the Phase 1 study in 1993 and the Phase 2 study in 1994, by the Tulsa District Army Corps of Engineers.

The possibility of contamination at each of these sites was thoroughly investigated by taking samples of soil, groundwater, sediment, and surface water, and testing them for volatile organics, semivolatile organics, explosives, metals, common anions, pH, and conductivity. Slug tests performed in the monitoring wells at these sites show permeabilities which range from 10^{-3} to 10^{-4} cm/sec. The groundwater horizontal flow velocity varies from 0.04 feet per day to 0.26 feet per day across the sites. The plant is situated on an outcrop of the Wilcox Group, consisting of unconsolidated deposits of fine-grained sands, silts, and clays.

Sites 1, 11, XX, and 27 were extensively explored and no evidence has been found to suggest that contamination from site activities exists. Since all of these sites are related to operations with TNT, and no confirmed explosives were found, no further action is recommended at these sites.

1.0 INTRODUCTION

This Remedial Investigation (RI) Report presents the findings of the investigations performed at the Longhorn Army Ammunition Plant (LHAAP), Group 1 Sites, located in Karnack, Texas. These results include a Phase 1 study conducted in 1993 and a Phase 2 study conducted in 1994, by the Tulsa District Army Corps of Engineers for LHAAP. Prior to these studies, the U. S. Army Toxic and Hazardous Materials Agency (USATHAMA) and Morton Thiokol performed investigations.

1.1 PURPOSE

This report details the remedial investigations that were performed at the Group 1 sites in order to determine whether suspected operations at these sites have contaminated the environment, and, if present, the nature and extent of this contamination and to establish the degree of risk to human health and the environment posed by any contamination found.

1.2 SCOPE

This document is a summary of the remedial investigations and data evaluation for the Group 1 sites (11, 1, XX, and 27). Investigations were conducted at the four sites which included the following media: soil, groundwater, sediment, surface water, and soil gas. Analytical, geotechnical, and geologic information are presented from the results of these investigations.

1.3 REPORT ORGANIZATION

Section 2 discusses Longhorn Army Ammunition Plant on a facility-wide and regional basis. Topics addressed include location, history, meteorology and climate, topography, surface water, and regional geohydrology.

Section 3 discusses the type of investigations performed and the approach to evaluating the potential for contamination.

Sections 4 through 7 discuss the site geology. Materials encountered and groundwater are presented on geologic sections through each site. Monitoring wells and groundwater flow are also discussed. Chemical findings for each site are presented in Sections 8 through 11. Due to the volume of analytical data, copies of laboratory data is not included but is available for review at the Tulsa District Corps of Engineers office. Also in these sections are discussions of the sampling performed.

Section 12 contains a summary and conclusions. References are given in Section 14.

Appendix A contains soil boring logs and monitoring well installation diagrams; Appendix B, the results of the physical testing on the soil samples; Appendix C, slug test data; and Appendix D, a summary of groundwater grab sample analytical results.

Volume 2 of this report contains the Risk Assessments performed for each each of these site.

2.0 FACILITY DESCRIPTION AND BACKGROUND

018614

This section presents a physical description of Longhorn Army Ammunition Plant and a background history on the facility. Subjects addressed include location, history, meteorology and climate, topography, surface water, and regional geohydrology. These discussions are based on the Phase 1 and 2 site investigations.

2.1 LOCATION

The Longhorn Army Ammunition Plant is located in central east Texas in the northeast corner of Harrison County. The installation occupies 8,493 acres between State Highway 43 at Karnack, Texas and the western shore of Caddo Lake, as shown on Figure 2-1. The nearest major cities are Marshall, Texas, approximately 14 miles to the southwest, and Shreveport, Louisiana, approximately 40 miles to the east. State Highways 43 and 134 provide access to the installation.

LHAAP is bounded to the north and east by Caddo Lake, a large fresh water lake located on the Texas-Louisiana state line. The eastern fence of the installation is 3-1/2 miles from the State border. The small incorporated city of Uncertain and the non-incorporated community of Karnack, Texas are located immediately north and west of the installation boundary, respectively. The remaining surrounding area is sparsely populated.

2.2 HISTORY

2.2.1 Plant History

Longhorn Army Ammunition Plant is a government-owned, contractor-operated industrial facility under the jurisdiction of the U.S. Army Armament, Munitions and Chemical Command. LHAAP was established in October 1942 with the primary mission to produce 2,4,6-trinitrotoluene (TNT) flake in the Plant 1 area with Monsanto Chemical Company as the first operator of the plant. Flake production continued through World War II until August 1945 when Monsanto's role ceased and the plant went on standby status until February 1952. From 1952 until 1956, Universal Match Corporation was the operator, producing such pyrotechnic ammunition as photoflash bombs, simulators, hand signals, and 40-millimeter tracers. In November 1955, Thiokol Corporation began operation of the Plant 3 area rocket motor facility. Thiokol assumed responsibility for total operation of the plant with the departure of Universal Match Corporation in 1956. Production of rocket motors continued to be the primary mission of LHAAP until 1965, when the production of pyrotechnic and illuminating ammunition was re-established.



2-2

Because of suspected environmental concerns associated with past production operations, LHAAP was placed on the National Priorities List on 30 August 1990. On 30 December 1991, LHAAP entered into a Federal Facilities Agreement with State and Federal environmental agencies to conduct remedial investigations and to perform appropriate actions necessary for proper site remediation.

Until recently, operations consisted of compounding pyrotechnic and propellant mixtures; load, assembly and pack activities; accommodating receipt and shipment of containerized cargo; and the maintenance and/or layaway of standby facilities and equipment as they apply to mobilization planning. The installation has also been responsible for the static firing and elimination of Pershing I and II rocket motors in compliance with the Intermediate-Range Nuclear Force (INF) Treaty in effect between the United States and former Soviet Union. Currently, LHAAP maintains standby facilities as they transition from active production to a caretaker status by July 1997.

2.2.2 Group 1 Sites History and Description

The four sites addressed in this report, collectively referred to as Group 1, are situated at various locations on the LHAAP installation. The sites are listed below and their locations are shown in Figure 2-2.

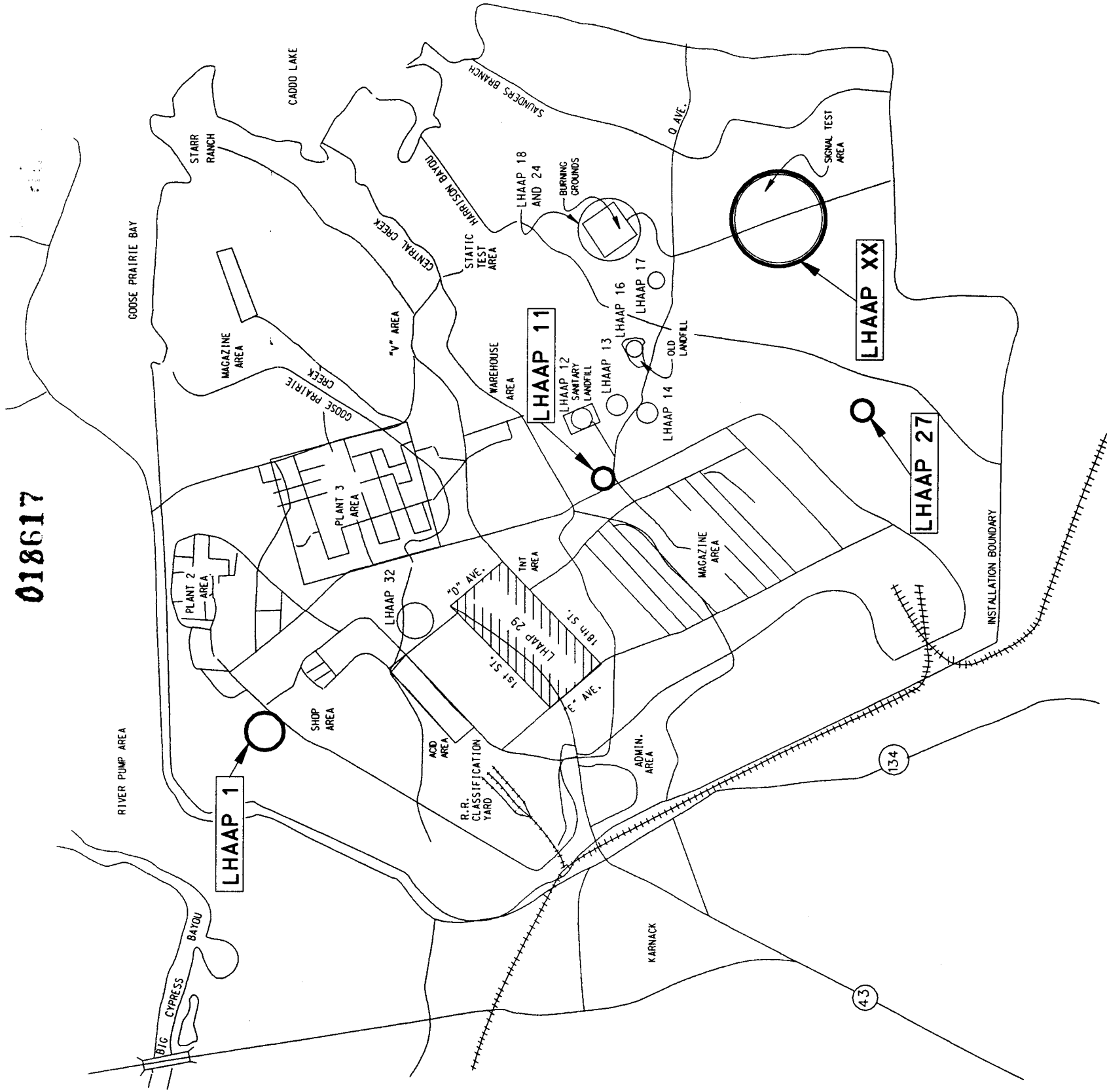
LHAAP SITE NO.	SITE NAME
11	Suspected TNT Burial Site
1	Inert Burning Grounds
XX	Ground Signal Test Area
27	South Test Area

2.2.2.1 Site 11, Suspected TNT Burial Site

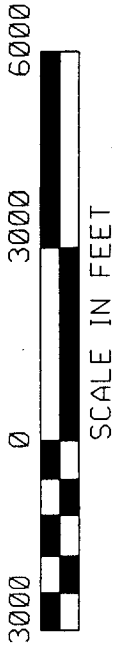
Based on information gathered by USATHAMA, during the 1940s, bulk TNT may have been disposed of near the intersection of avenues P and Q. Other than the designation of this location by USATHAMA in the early 1980s as the Suspected TNT Burial Site, there is no confirmed documentation that TNT burial occurred at this site. The 10-acre site has been inactive since its suspected use in the 1940s (USACE, 1992). The site is situated in the south central portion of LHAAP adjacent to the intersection of Avenues P & Q, as shown on Figure 2-2. A detailed map of the Suspected TNT Burial Site is shown on Figure 2-3. The site consists of a relatively flat area of cut grass immediately north of the intersection, bounded by Avenue P on the west, Avenue Q on the south, and the tree line on the north and east. Power lines parallel Avenues P & Q on two sides of the site. A large forested area extending to Central Creek is present north of the site. Surface drainage from the area flows to ditches along the eastern and western edges of the site,



018617



- SITES IN THIS INVESTIGATION
- LHAAP 11
 - LHAAP 1
 - LHAAP XX
 - LHAAP 27

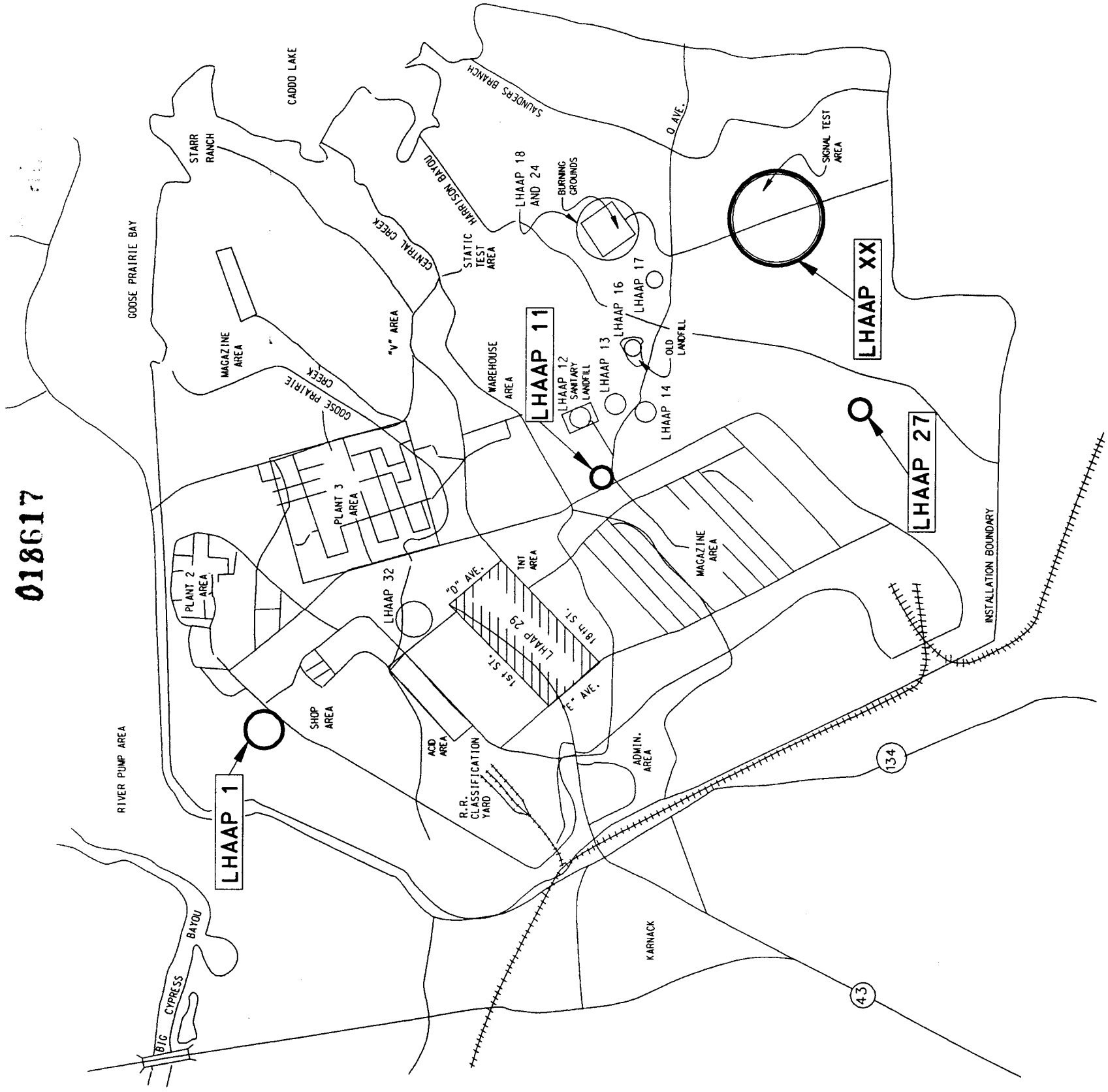


		U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
DESIGNED BY:		LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS	
DRAWN BY:		LHAAP SITE LOCATION MAP	
CHECKED BY:			
SUBMITTED BY:			
CHIEF, GEOTECH BR.		FIGURE 2-2	

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

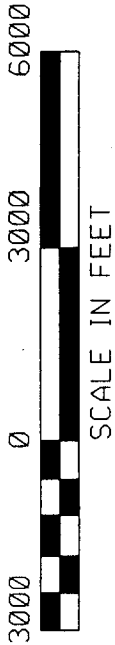


018617



SITES IN THIS INVESTIGATION

- LHAAP 11
- LHAAP 1
- LHAAP XX
- LHAAP 27



♦ THINK VALUE ENGINEERING - IT SAVES MONEY ♦	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS	
DESIGNED BY:	LHAAP SITE LOCATION MAP
DRAWN BY:	
CHECKED BY:	
SUBMITTED BY:	
CHIEF, GEOTECH BR.	

LONGHORN ARMY AMMUNITION PLANT
KARNACK, TEXAS

FIGURE 2-2

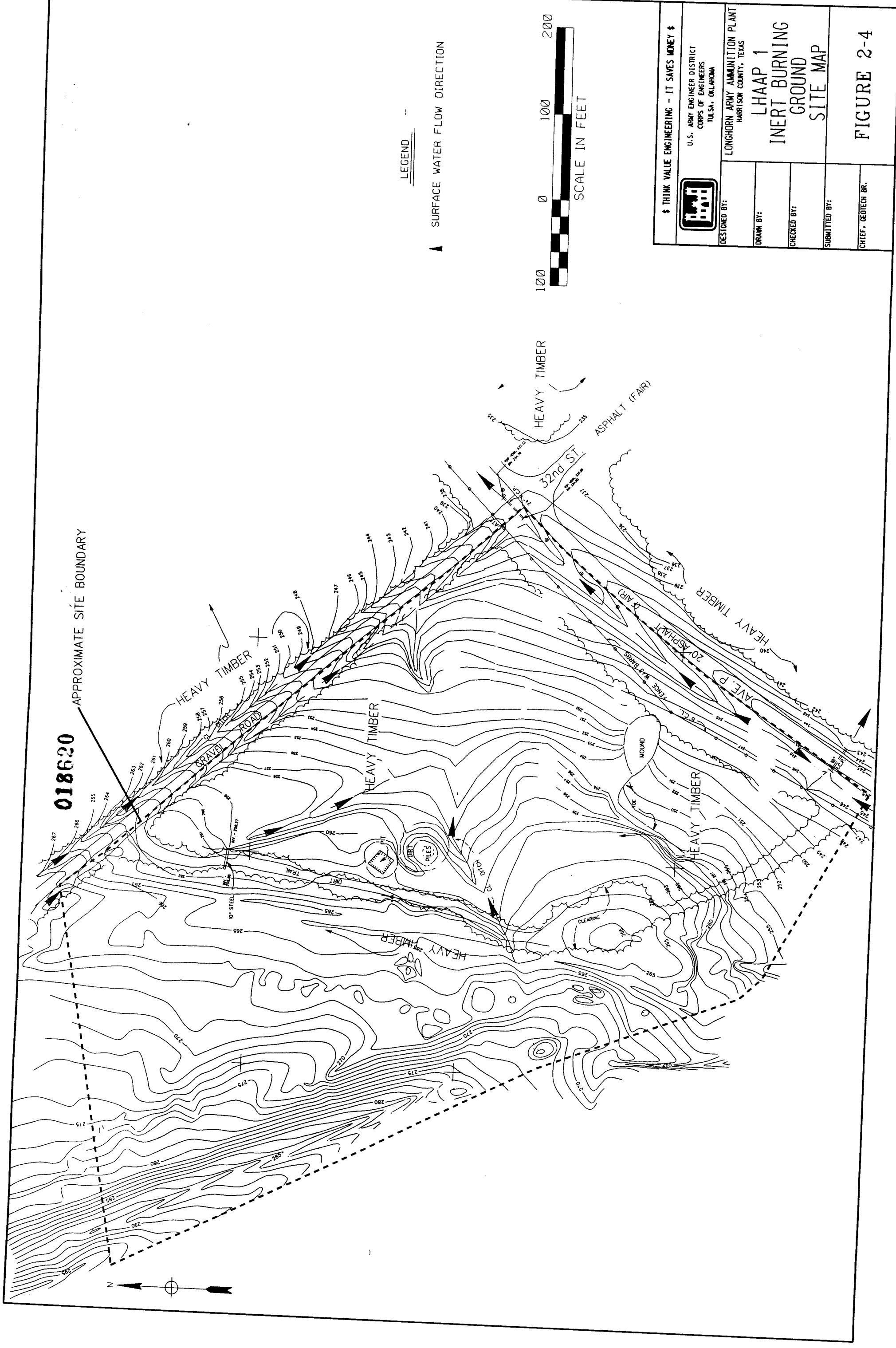
eventually draining to Central Creek. A small depression, about 100 feet wide, exists on the north side of the site. Aerial photographs do not document the presence of this apparent borrow area prior to 1963, and the area does not appear to be active in aerial photos dating back to 1985. The primary source of potential contamination at this site is buried TNT in one or more pits.

2.2.2.2 Site 1, Inert Burning Grounds

The Inert Burning Grounds were originally used during World War II by Monsanto Chemical Company for burning trash, ashes, scrap lumber, and waste from burned 2,4,6-TNT. Bulk 2,4,6-TNT may also have been burned at the site. The site was not used between August 1945 and February 1952 when LHAAP was in a standby status. Universal Match Corporation later used the site to burn wastes, including photo flash powder, for a few years during the 1950s until most burning operations were transferred to the Burning Ground No. 2/Flashing Area (Site 17) located on the installation. Intermittent, small-scale burning operations may have continued at the site into the early 1960s. It is suspected that burning operations were conducted in one or more burn pits or pans that were subsequently filled or covered. Burn residues were most likely not removed. It is also suspected that some wastes may have been dumped without burning and were subsequently covered by or mixed with fill material. The site is situated in the extreme northwestern portion of LHAAP, near the intersection of Avenue P and 32nd Street, as shown on Figure 2-2. A detailed map of the Inert Burning Grounds and surrounding area is shown as figure 2-4. Roads, fences, and limited vegetation information are shown with heavily timbered areas differentiated from lightly or non-timbered areas. The interior of the site, about 1 1/2 acres in size, is lightly timbered. Current vegetation patterns serve as only a rough indication of past disposal areas due to considerable regrowth of trees during the 25 or more years that have elapsed since the site was used for waste disposal. The area of investigation comprises about 10 acres.

2.2.2.3 Site XX, Ground Signal Test Area

The Ground Signal Test Area has been used intermittently since April 1963 for aerial and on-ground testing and destruction of a variety of devices, including red phosphorus smoke wedges, infrared flares, illuminating 60 and 81 mm mortar shells, illuminating 40 to 155 mm cartridges, button bombs, and various types of explosive simulators. Prior to the recent rocket motor burn-outs at the site for the INF Treaty, the site was used intermittently over a 20-year period for testing and burn-out of rocket motors from Nike-Hercules, Pershing, and Sargent missiles. About 1970, one of the Sargent rocket motors was inadvertently destroyed when it exploded in an excavated pit near the center of the site just west of the road crossing the site. Debris from the explosion was reportedly placed in the resulting crater and the crater was backfilled. Since late in 1988, the site has also been used for the burn-out of rocket motors in Pershing missiles destroyed in accordance with the INF Treaty between the United States and the former Soviet Union.

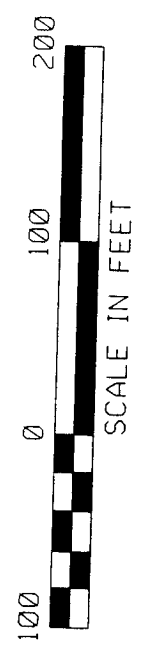


018620

APPROXIMATE SITE BOUNDARY

LEGEND

▲ SURFACE WATER FLOW DIRECTION



		\$ THINK VALUE ENGINEERING - IT SAVES MONEY \$	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA		LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS	
DESIGNED BY:		DRAWN BY:	LHAAP 1
CHECKED BY:			INERT BURNING
SUBMITTED BY:			GROUND
CHIEF, GEOTECH BR.			SITE MAP
		FIGURE 2-4	

The Ground Signal Test Area is in the southeastern portion of LHAAP, as shown on Figure 2-2. Access to the site is provided by an asphalt paved road that intersects Long Point Road just east of its intersection with Avenue Q. The access road proceeds in a general south-southeasterly direction for about 0.4 mile to the center of the site and continues for another 0.7 mile to the southern LHAAP boundary. Approximately 70 percent of the site is located within the watershed of Saunders Branch. The remaining 30 percent lies within the watershed of Harrison Bayou. Both of these streams flow into Caddo Lake. The total surface water flow distance from the site to Caddo Lake via Saunders Branch and its tributaries is about 2.0 miles and via Harrison Bayou and its tributaries is about 2.3 miles.

Surface water runoff from the Saunders Branch watershed portion of the site is collected by drainage ditches alongside the circular dirt road forming the outer margin of the site. These ditches converge to form a northeast-trending drainage way that carries the runoff to Saunders Branch. Surface water runoff from the remainder of the site is collected by drainage ditches alongside the circular road or by the drainage ways extending into the southwestern part of the site. The drainage ditches and drainage ways converge to form a drainage way that conveys the runoff onto the floodplain of Harrison Bayou.

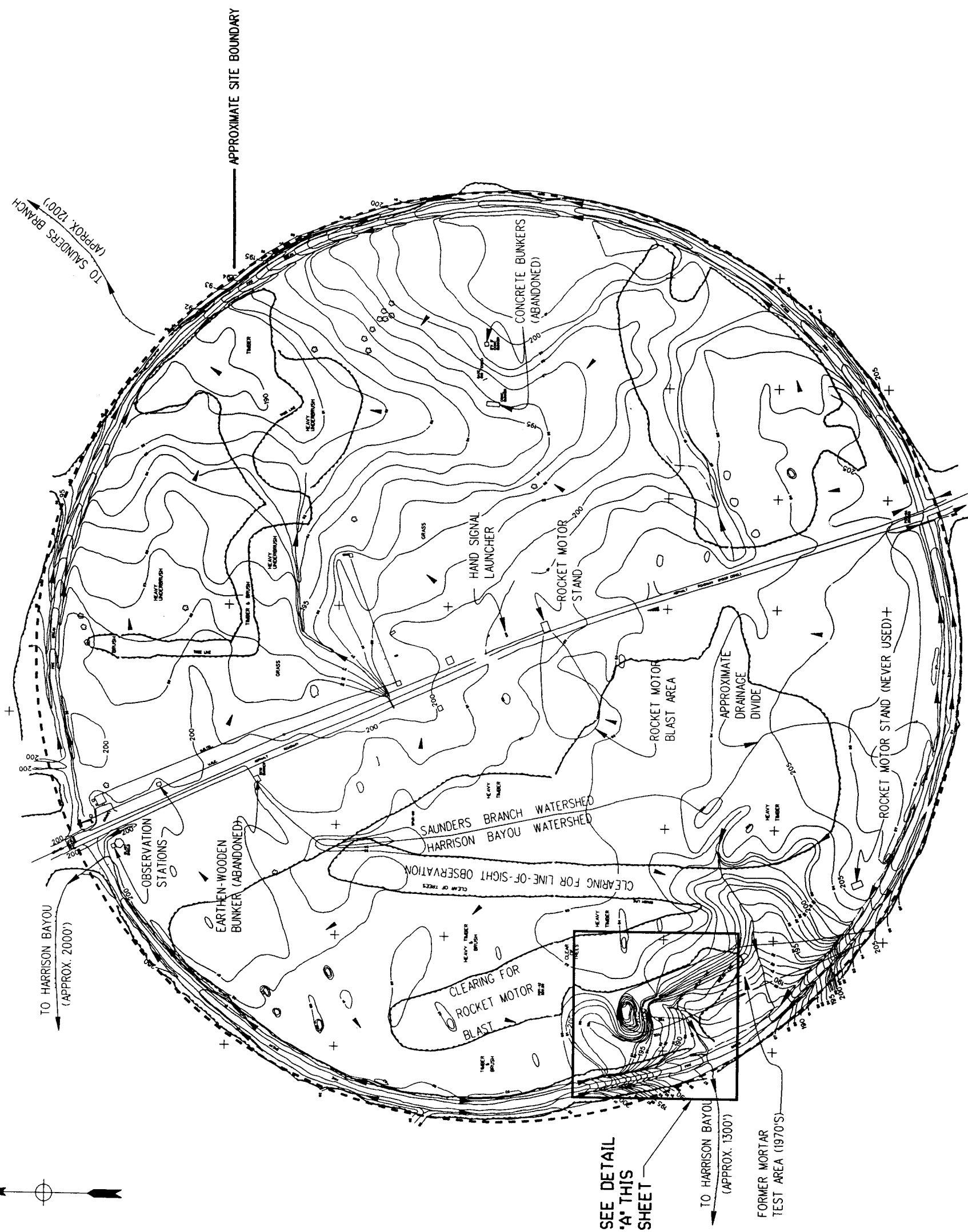
A detailed site map of the Ground Signal Test Area is provided on Figure 2-5. The map depicts detailed topography, the access road crossing the site, the circular fire lane and dirt road that form the site boundary, and limited vegetation information. The site encompasses an area of approximately 80 acres.

2.2.2.4 Site 27, South Test Area

The South Test Area was constructed in 1954 and was used by Universal Match Corporation for testing photoflash bombs that were produced at LHAAP until about 1956. The bombs were tested by exploding them in the air over an elevated, semi-elliptical earthen test pad within the floodplain of Harrison Bayou. Testing was observed and controlled from a building on a hilltop 1,000 feet west-northwest of the test pad. Bombs awaiting testing were stored in three earth-covered concrete bunkers a few hundred feet west of the observation building. A general layout of the site is shown on Figure 2-6.

During the late 1950s, illuminating (signal) devices were demilitarized within pits excavated in the vicinity of the test pad. During the early 1960s, leaking production items (possibly 3- to 4-pound canisters of white phosphorus) were demilitarized in the vicinity of the test pad. In the early 1980s, approximately 52,000 1/2- and 1-pound photoflash cartridges were demilitarized in a 500-square foot area situated about 300 feet east of the observation building and immediately north of the road extending from the observation building to the test pad. The South Test Area has apparently not been used since the early 1980s. Vegetation has encroached on many of the formerly cleared areas in the vicinity of the test pad and alongside the access road.

018622



DETAIL "A"

LEGEND

▲ SURFACE WATER FLOW DIRECTION

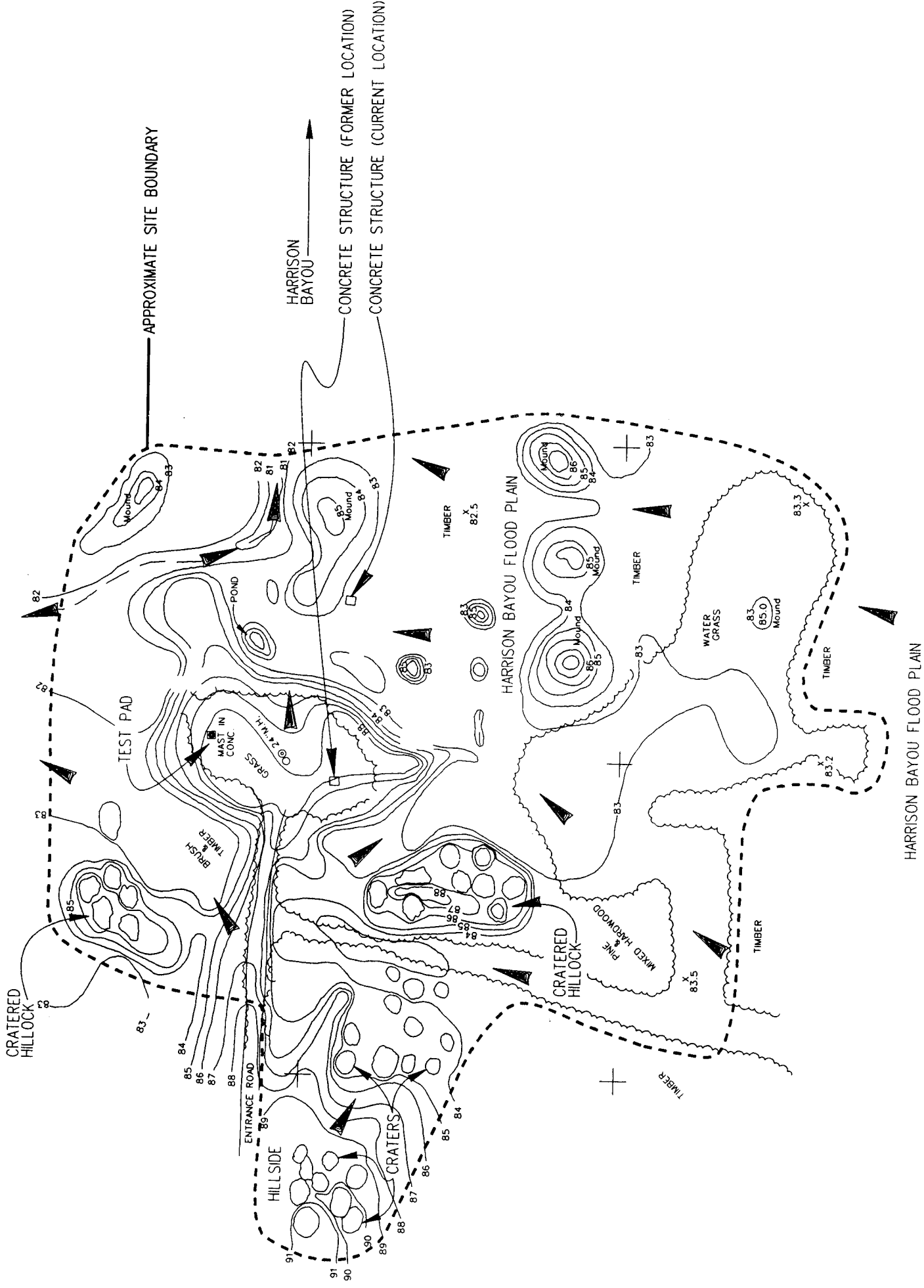


\$ THINK VALUE ENGINEERING - IT SAVES MONEY \$	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	LHAAP XX
CHECKED BY:	GROUND SIGNAL TEST AREA
SUBMITTED BY:	SITE MAP
CHIEF, GEOTECH BR.	FIGURE 2-5



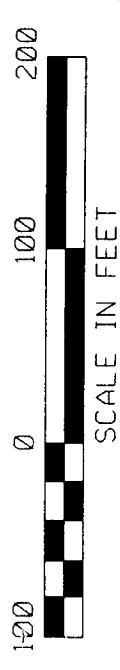
018623

HARRISON BAYOU FLOOD PLAIN



LEGEND

▲ SURFACE WATER FLOW DIRECTION



\$ THINK VALUE ENGINEERING - IT SAVES MONEY \$	
 U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	LHAAP 27
CHECKED BY:	SOUTH TEST AREA
SUBMITTED BY:	SITE MAP
CHIEF, GEOTECH BR.	FIGURE 2-6

The South Test Area is in the south central portion of LHAAP, as shown on Figure 2-2. The earthen test pad is approximately 2,000 feet southeast of Avenue P and the magazine area. The entrance to the test area is on Avenue P about 1,700 feet northeast of its intersection with Avenue E. A deteriorated asphalt and gravel road runs from the entrance to the test pad. The concrete bunkers and observation building previously described are situated alongside the road about halfway between the entrance and the test pad. A circular, 50-foot wide fire lane with a 2,000-foot diameter is centered at the test pad. The fire lane was constructed in 1954 and was apparently maintained until the early 1960s. It is now partially overgrown with brush and small trees.

A detailed current map of the test pad and contiguous areas is provided as Figure 2-6. The site boundary is based on a study of historical aerial photographs, current vegetation patterns, and field observations. The site covers an area of approximately 6.6 acres.

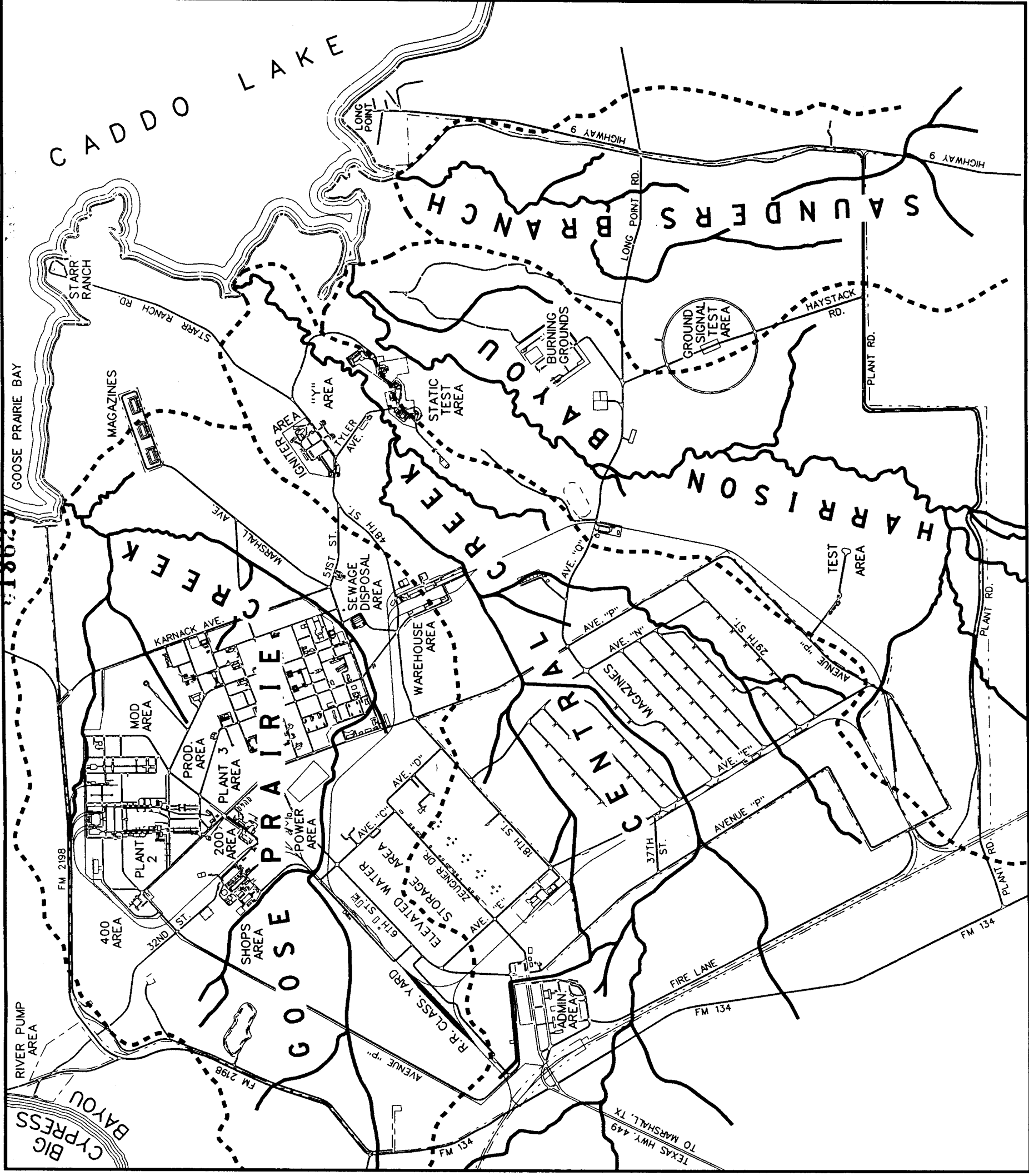
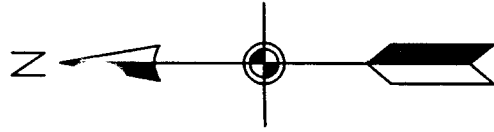
2.3 METEOROLOGY AND CLIMATE

LHAAP is located in a moist, subhumid to humid, mild climate. The average annual rainfall is 46 inches. Precipitation is fairly evenly distributed throughout the year, although summer and fall are frequently drier, and December through May are often the wettest months. Precipitation almost always occurs as rain, with snow a rare occurrence.

2.4 SURFACE FEATURES AND SURFACE HYDROLOGY

The area around LHAAP is characterized by mixed pine-hardwood forests that cover gently rolling to hilly terrain with an average slope of 3 percent towards the northeast. Most of the terrain slopes 3 percent or less, but slopes as steep as 12 percent are common in the western and northwestern portions of the installation and along the Harrison Bayou floodplain. The installation is surrounded by pine-hardwood forests and agricultural land. The northeastern border is formed by Caddo Lake and Goose Prairie Bayou. Ground surface elevations on LHAAP vary from 170 to 335 ft NGVD (National Geodetic Vertical Datum, 1929).

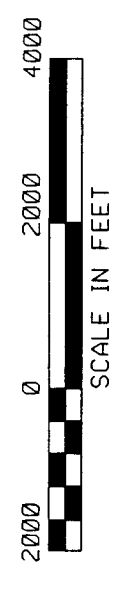
All surface water from the installation drains northeastwardly into Caddo Lake through four drainage systems that cross portions of the installation. These systems are Saunders Branch, Harrison Bayou, Central Creek, and Goose Prairie Creek. They are shown in Figure 2-7. Caddo Lake is a part of Big Cypress Bayou, into which a very small portion of the northwest corner of the installation drains. Saunders Branch of Martin's Creek flows onto LHAAP near the southeast corner of the installation and flows northward into Caddo Lake. Approximately 11 percent of the heavily wooded eastern section of the plant is drained by this system. Harrison Bayou enters LHAAP on the southern edge of the installation and carries 30 percent of the surface drainage of the plant. This bayou bisects the installation in a northeasterly direction. Central Creek enters LHAAP on its western edge just south of the town of Karnack. Approximately 29 percent of the surface drainage from the installation is carried to Caddo Lake via this drainage course. The



MAP SYMBOL LEGEND

- DRAINAGE CHANNELS
- WATERSHED BOUNDARIES

FROM HYDROGEOLOGICAL ASSESSMENT
(COE, MAY, 1995)



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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

DESIGNED BY:

DRAWN BY:

CHECKED BY:

SUBMITTED BY:

CHIEF, GEOTECH BR.

LONGHORN ARMY AMMUNITION PLANT
HARRISON COUNTY, TEXAS

LHAAP
SURFACE DRAINAGE

FIGURE 2-7

headwaters of Goose Prairie Creek are located near the northwest corner of the plant and consist of one larger creek and several smaller tributaries. Goose Prairie Creek flows along the northern edge of the installation and drains approximately 30 percent of LHAAP.

Caddo Lake is created by Caddo Dam, constructed on the Big Cypress Bayou in Caddo Parish, Louisiana. The original dam was constructed in 1914 for local navigation purposes and was reconstructed in 1971. The spillway elevation of the lake is 168.9 ft NGVD. Big Cypress Bayou resumes east of Caddo Lake and joins the Red River at Shreveport, Louisiana. The Red River flows southeast across Louisiana into the Mississippi River at Simmesport, Louisiana.

2.5 REGIONAL GEOHYDROLOGY

2.5.1 Geology

LHAAP is located on a deep inland extension of the Gulf Coastal Plain Section of the Coastal Plain Physiographic Province, commonly referred to as the Pineywoods. The area is characterized by mixed pine-hardwood forests that cover gently rolling to hilly terrain. The installation lies on the northern flank of the Sabine Uplift, which is bordered on the west by the East Texas Basin. The geology at LHAAP is summarized from the Texas Water Development Board Groundwater Report on Harrison County (1966).

LHAAP is situated on an outcrop of the Wilcox Group, which crops out over a large part of the eastern half of Harrison County. Figure 2-8 is a description of the geologic units which occur in Harrison County, and Figure 2-9 is a geologic map of a portion of Harrison County showing the Wilcox Group and overlying sediments. Figure 2-10 presents schematic geologic sections through LHAAP. The base of the Wilcox slopes westward into the East Texas syncline, and in the LHAAP vicinity, it is approximately 50 ft NGVD, making the Wilcox approximately 120 to 300 ft thick beneath the installation. The Wilcox consists mostly of fine to medium-grained sands interbedded with a considerable amount of silt and clay, and occasional seams of lignite. Although sand beds up to 50 ft thick are present locally, individual beds are generally lenticular, with lenses of clay, sand, and silt pinching out or grading into each other over very short distances, making correlation difficult. The Wilcox Group is underlain conformably by the predominantly calcareous clay of the Midway Group.

Soil types encountered in the borings drilled at LHAAP generally consist of fine-grained sands, silts, and clays in varying combinations. These occur as residual soil (developed from weather Wilcox), unweathered Wilcox materials, or alluvial deposits associated with the drainage systems crossing the installation. Residual soils typically consist of silty or sandy clay occasionally interbedded with sand strata. Alluvial soils occur as interbedded fine-grained sands, silts, and clays.

018627

GEOLOGIC UNITS OF HARRISON COUNTY, TEXAS

SYSTEM	SERIES	GROUP	UNIT	APPROX MAXIMUM THICKNESS (FEET)	CHARACTER OF ROCKS	WATER-BEARING PROPERTIES
QUATERNARY	RECENT AND PLEISTOCENE		ALLUVIUM AND TERRACE DEPOSITS	50	PREDOMINANTLY CLAY, SILT, AND FINE SAND. TERRACE MATERIAL LOCALLY FINE TO COARSE SAND.	YIELDS SMALL QUANTITIES OF WATER TO A FEW WELLS
			SPARTA SAND	25	FINE SAND AND SANDY CLAY LIMONITIC IRONSTONE SEAMS COMMON IN OUTCROP AREA	
			VECHEA GREENSAND	50	FINE TO MEDIUM SAND, GLAUCONITIC AND QUARTZITIC, LAMINAR TO CROSS-BEDDED. LIMONITIC IRONSTONE SEAMS AND CONCRETIONS COMMON IN OUTCROP AREA.	
	EOCENE	CLAIBORNE	QUEEN CITY SAND	200	VERY FINE TO MEDIUM SAND, QUARTZITIC, INTERBEDDED WITH SILT AND CLAY, LAMINAR TO CROSS-BEDDED. CONTAINS MINOR AMOUNTS OF LIGNITE. LIMONITIC IRONSTONE SEAMS COMMON IN OUTCROP AREA.	CYPRESS AQUIFER
			REKLAW FORMATION	100	CLAY AND FINE SAND, GLAUCONITIC AND QUARTZITIC, MOSTLY LAMINAR BUT LOCALLY CROSS-BEDDED. LOCALLY CONTAINS MARINE FOSSILS. LIMONITIC IRONSTONE SEAMS COMMON IN OUTCROP AREA.	
			CARRIZO SAND	100	FINE TO MEDIUM SAND INTERBEDDED WITH SILT AND CLAY. LAMINAR TO CROSS-BEDDED. LIMONITIC IRONSTONE SEAMS COMMON IN OUTCROP AREA.	
				700	FINE TO MEDIUM SAND INTERBEDDED WITH SILT AND CLAY. LAMINAR TO CROSS-BEDDED. LIMONITIC IRONSTONE SEAMS COMMON IN OUTCROP AREA.	
TERTIARY	PALEOCENE	MIDWAY		900	PREDOMINANTLY MARINE CLAY. BECOMES SILTY IN UPPER PART.	NOT KNOWN TO YIELD FRESH WATER IN HARRISON COUNTY.

SOURCE: TEXAS WATER DEVELOPMENT BOARD REPORT 27



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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

DESIGNED BY:

DRAWN BY:

CHECKED BY:

SUBMITTED BY:

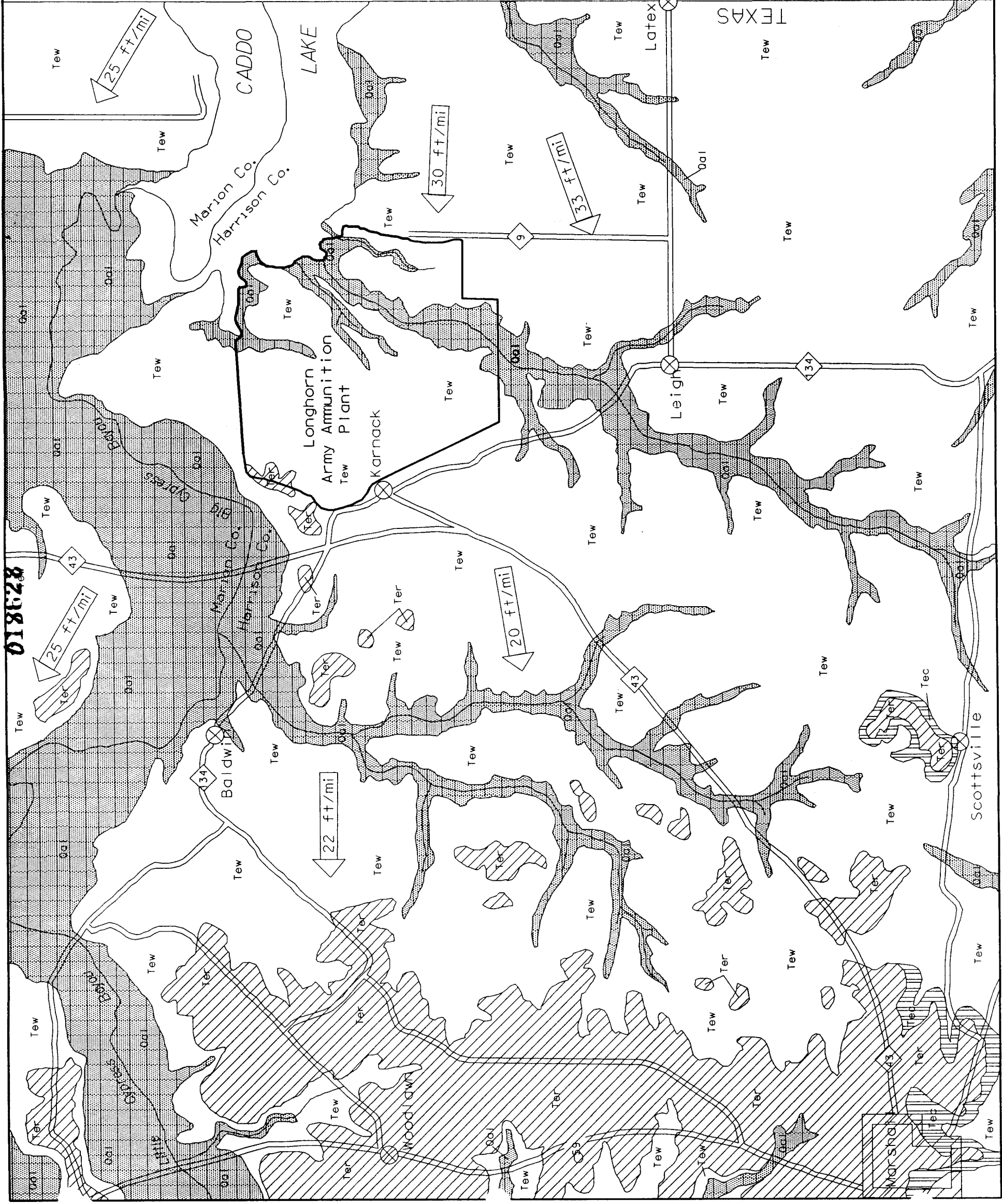
CHIEF, GEOTECH BR.

LONGHORN ARMY AMMUNITION PLANT
HARRISON COUNTY, TEXAS

LHAAP

GEOLOGIC UNITS OF
HARRISON COUNTY,
TEXAS

FIGURE 2-8



018628

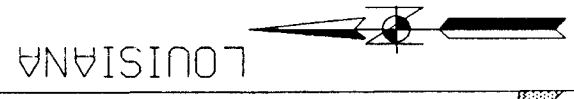
LEGEND

- Quaternary
Alluvium and low-level terrace deposits
- Tertiary, Eocene
Reklaw Formation (lower part only)
- Carrizo Sand (only in SW; pinches out to the north)
- Wilcox Group, undivided (upper and middle parts)

25 ft/mi

Direction and rate of dip of surface strata, based upon structure of marker bed at top of Navarro Group, 650-700 ft below base of Wilcox Group.

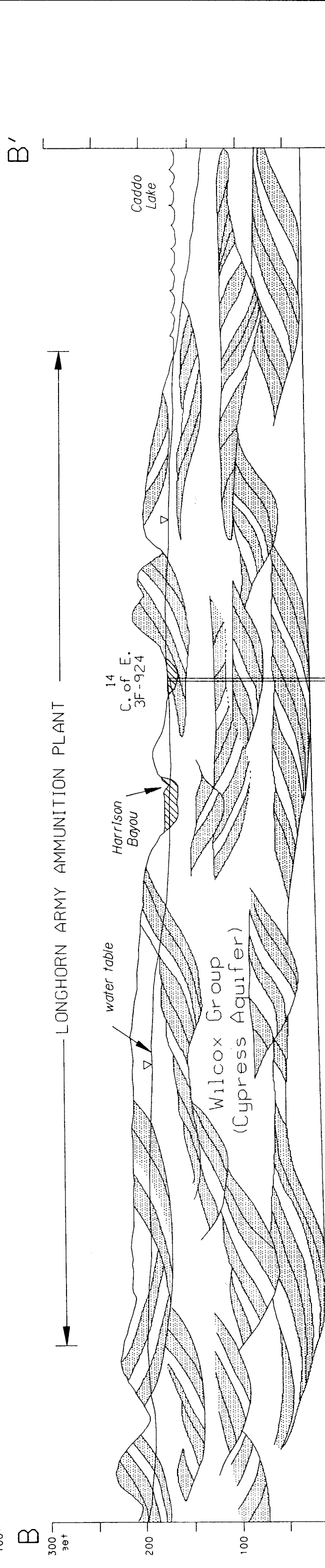
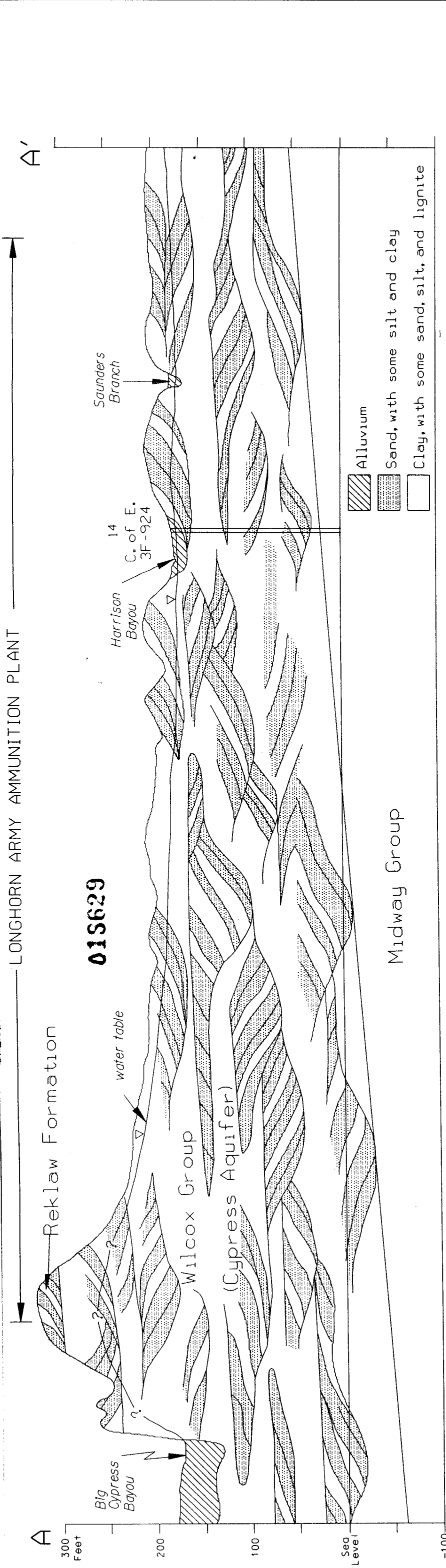
FROM HYDROGEOLOGIC ASSESSMENT (COE, MAY 1995)



	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	
CHECKED BY:	
SUBMITTED BY:	
CHIEF, GEOTECH BR.	

LHAAP
GEOLOGIC MAP OF
NORTHEASTERN
HARRISON COUNTY

FIGURE 2-9



FROM HYDROGEOLOGIC ASSESSMENT (COE, MAY 1995)

FIGURE 2-10

Midway Group

0 1000 2000 3000 4000 5000 Feet

0 1/2 1 Mile

Location Map

A B

LHAAP

C. of E. 3F-924

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	LHAAP
CHECKED BY:	SCHEMATIC GEOLOGIC SECTIONS THROUGH LHAAP
SUBMITTED BY:	FIGURE 2-10
CHIEF, GEOTECH BR.	

LONGHORN ARMY AMMUNITION PLANT

FIGURE 2-10

2.5.2 Groundwater Resources

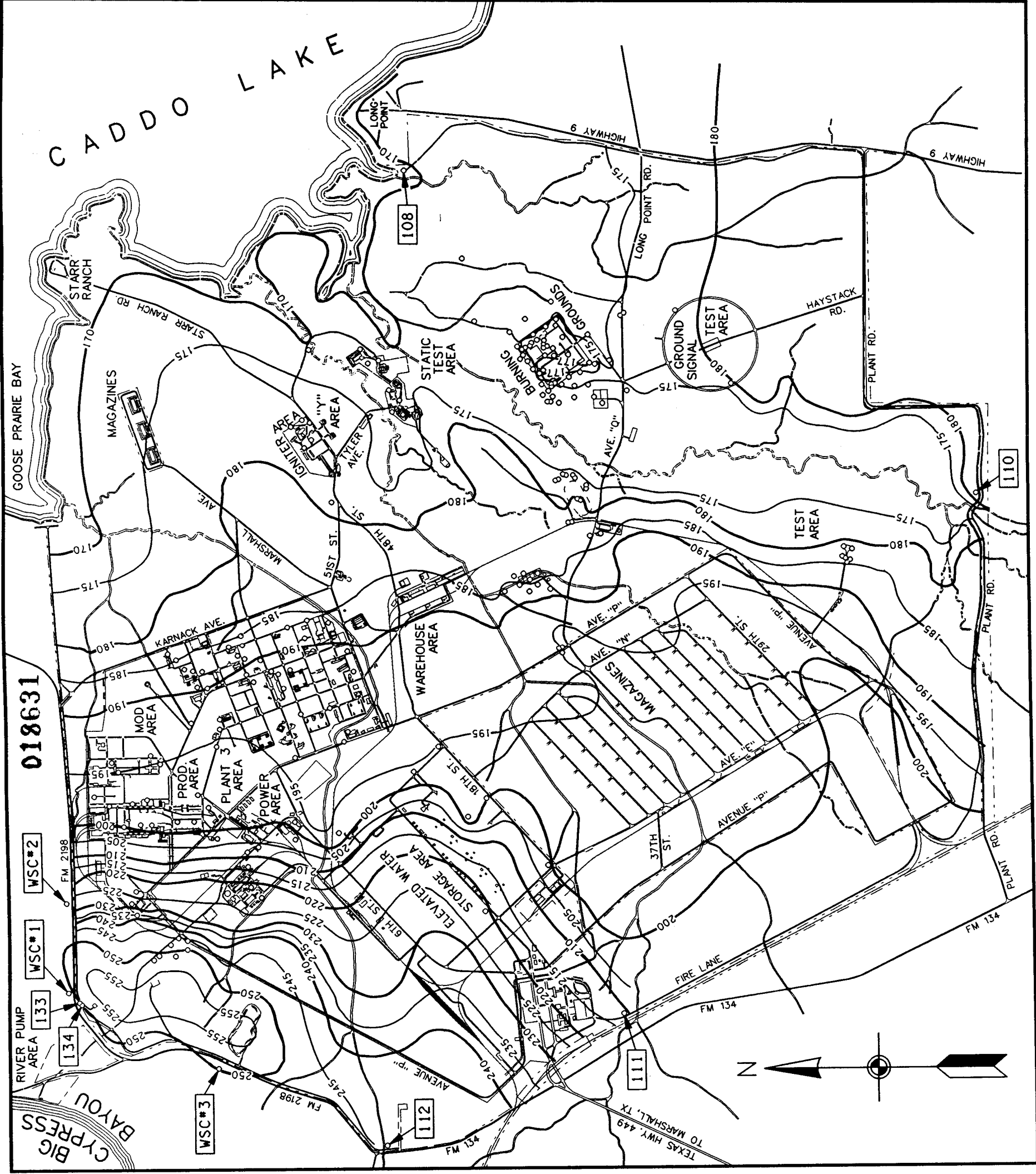
018630

The Wilcox Group was identified by the Texas Water Development Board as the basal unit of the regional Cypress aquifer, also known as the Carrizo-Wilcox aquifer. The Cypress aquifer outcrops over most of Harrison County and is comprised of, in ascending order, the Wilcox Group, the Carrizo Sand, the Reklaw Formation, and the Queen City Sand. All units are believed to be hydraulically connected. These units all dip to the northwest into the East Texas syncline.

The availability of groundwater in Harrison County is largely dependent on the hydrologic characteristics of the units comprising the Cypress aquifer. The Wilcox Group, outcropping in the area of LHAAP, yields small (less than 50 gpm) to moderate (50-500 gpm) quantities of fresh water to wells throughout the county. As the basal unit of the Cypress aquifer, the Wilcox is also considered as the base of fresh water in the area, conformably overlying the Midway Group, which does not yield usable quantities of water but tends to serve as a relatively impermeable basement to the overlying water-bearing Wilcox.

Groundwater at LHAAP is generally unconfined, whether in alluvial or Wilcox materials, and can be encountered as shallow as several feet below the ground surface. Perched and locally confined conditions frequently occur within the Wilcox due to its highly variable stratigraphy, with frequent clay lenses. Recharge is primarily by precipitation infiltration from the surface. Depth to groundwater in the Wilcox has been observed to fluctuate as much as 2-ft within a 6-month period in some areas of the installation. These fluctuations are most likely due to seasonal variations in rainfall. Figure 2-11 is a groundwater potentiometric surface map that encompasses most of LHAAP, based on monitoring wells at the facility.

There are two public water supply wells currently in use near LHAAP. One well is located in and owned by Caddo Lake State Park. It is completed to a depth of 315 ft and has been in use since 1935. The other public supply well is owned by the Karnack Water Supply Corporation and services the town of Karnack. It is located approximately 1/2 mile southeast of town. The well is 430 ft deep, and the pump is set at a depth of 200 ft. It has been in use since 1942. In addition, two public use standby wells exist near LHAAP. These wells are used by the Karnack School and the George Washington Carver School as standby wells only. The Karnack School well is 265 ft deep, and the George Washington Carver well is 105 ft deep. All other wells in the area of LHAAP are used for stock and domestic purposes. These wells are typically around 250 ft deep. At one time, there were two water supply wells at LHAAP which have been plugged and abandoned. The water supply for LHAAP is currently Big Cypress Bayou.



MAP SYMBOL LEGEND

108 ○ LONGHORN AAP PERIMETER MONITORING WELL, and WELL IDENTIFICATION (108, e.g.)

WSC#2 ○ CADDO LAKE WATER SUPPLY CORPORATION WATER-WELL, and WELL IDENTIFICATION (*2, e.g.)

○ OTHER MONITORING WELLS

WATER LEVELS TAKEN IN NOVEMBER 1994 FROM HYDROGEOLOGIC ASSESSMENT (COE, MAY 1995)



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U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

DESIGNED BY: LONGHORN ARMY AMMUNITION PLANT
HARRISON COUNTY, TEXAS

LHAAP
POTENTIOMETRIC
SURFACE

SUBMITTED BY:

FIGURE 2-11

CHIEF, GEOTECH BR.

3.0 FIELDWORK AND SAMPLING METHODS

3.1 INVESTIGATIONS

Numerous investigations were conducted at the Group 1 sites during the 1980s and early 1990s by various contractors. Environmental Protection Systems, Inc. (EPS) from Jackson, Mississippi performed the majority of these studies in order to provide USATHAMA with a base-wide contamination assessment. The Phase 1 RI efforts were conducted by Ebasco Services, Inc. from Dallas, Texas and Roy F. Weston, Inc. from Houston, Texas in 1993. The Phase 2 RI was conducted by Sverdrup Environmental, Inc. from St. Louis, Missouri in 1994. In the winter/ of 1996/1997 the Tulsa District Corps of Engineers collected surface soil samples to be used in the risk assessment portion of this report. A brief summary of past investigations at the these sites is given in Table 3-1. More detailed descriptions of these investigations and their findings are discussed for each of the four units in Sections 8 through 11.

3.1.1 UXO Clearance

The purpose of this investigation, performed for both Ebasco and Sverdrup by UXB International of Chantilly, Virginia and for Weston by EOD Technology of Oak Ridge, Tennessee, was to locate and stake out a safe path to each sampling location where no unexploded ordnance (UXO) would be found. The UXO teams used magnetometers and visual observations to locate any possible UXO at the sites.

3.1.2 Geophysical Surveys

A geophysical survey was performed at Site 11 during Phase 1 to locate buried TNT waste. A magnetic survey and induction survey were performed on the ground surface to locate any magnetic conductivity anomalies. Soil borings were completed at the locations of any such anomalies.

3.1.3 Soil Gas Surveys

GEO Environmental Testing performed an active soil gas survey, consisting of five sampling points, during Phase 2 at a portion of Site XX to confirm the presence of acetone.

3.1.4 Soil Borings

EPS took eight soil samples from four borings, all at Site 11. For Phase 1 of the Group 1 sites investigations, 171 soil samples were taken from 40 borings, and for Phase 2, 28 soil samples were taken from eight borings. Sampling methods for soil for both phases included split-barrel sampling, Shelby tube sampling, continuous tube sampling, and hand augering. Stainless steel

3-in. O.D. split-barrel samplers were driven 2-ft within hollow-stem augers to obtain soil samples for chemical analyses during the investigation. Due to inadequate recovery with the split barrel, soil samples from boring 27WW-01 were collected using 3-in. diameter Shelby tubes. A 1.0-in. O.D. continuous tube sampler was used to sample XXSB01 using the Geoprobe rig. Stainless steel hand augers were used to collect surface soil samples from 0 to 1-ft depth at sites 1 and 27. Borings ranged from 5 to 35 feet in depth. Phase 1 borings were extended several feet into

Table 3-1
Summary of Past Investigations
At Sites 11, 1, XX, 27

Site	Date	Contractor	Nature of investigation
11	1982	EPS	Soil borings and soil sampling.
11	1988	EPS	Soil borings and surface soil samples.
11	1993	Ebasco	Soil borings and sampling of surface water, sediment, groundwater, and soil. Geophysical surveys.
11	1994	Sverdrup	Soil borings and monitoring wells, and sampling of soil and groundwater.
11	1996/97	Tulsa District COE	Surface soil samples.
1	1982	EPS	Monitoring well installation and sampling. Surface soil samples.
1	1993	Ebasco	Soil borings and sampling of surface water, sediment, groundwater, and soil.
1	1993	Weston	Monitoring well installation and sampling of soil, sediment, surface water, and groundwater.
1	1994	Sverdrup	Monitoring well installation and sampling of sediment, surface water, and groundwater.
1	1996/97	Tulsa District COE	Surface soil samples.
XX	1982	EPS	Monitoring well installation and sampling of soil and groundwater.
XX	1993	Ebasco	Soil borings and sampling of surface water, sediment, groundwater, and soil.
XX	1994	Sverdrup	Soil boring and sampling of soil and groundwater. soil gas survey.
XX	1996/97	Tulsa District COE	Surface soil samples
27	1982	EPS	Monitoring well installation and sampling of groundwater and soil.
27	1993	Ebasco	Soil borings and sampling of surface water, sediment, groundwater, and soil.
27	1994	Sverdrup	Monitoring well installation and sampling of soil and groundwater.
27	1996/97	Tulsa District COE	Surface soil samples

groundwater in order to obtain groundwater grab samples. Geologic logs were produced from each boring and are given in Appendix A. Samples for both chemical and geotechnical testing were obtained every 2.5 to 5 feet. Upon collection, soil samples were immediately composited in stainless steel bowels, containerized in jars, and placed on ice for shipment to the laboratory. Samples for volatile organics analysis were taken as discrete samples with as little disturbance as possible. During Phase 1, groundwater grab samples were collected from the open boreholes, and the borings were filled with cement grout to the ground surface. A. W. Poole was the drilling subcontractor for Ebasco, Terra-Mar, Inc. of Dallas, Texas was the drilling subcontractor for Weston, and Alliance Environmental was the drilling subcontractor for Sverdrup.

3.1.5 Surface Soil Investigations

At locations where contamination on the surface was a potential concern, a soil sample of the upper 12 inches was taken with a stainless steel shovel. EPS took 3 surface soil samples at each of three of the sites and 9 surface soil samples at Site 11. Ebasco took 4 surface soil samples and Sverdrup took 3 at Site 27.

3.1.6 Groundwater Investigations

Groundwater grab samples were obtained from soil borings which were not completed as monitoring wells. Borings were allowed to remain open after drilling until they contained enough groundwater to sample. In some cases, the augers were left in place to prevent the collapse of the borehole. Groundwater grab samples were obtained with disposable teflon bailers and were generally highly turbid. These samples are not representative of the environment as would be a sample from a monitoring well, and were used in this study only as a screening technique. A total of 34 grab samples were taken in Phase 1, and one grab sample in Phase 2. Groundwater grab sample results are provided in Appendix E.

EPS installed and sampled 5 monitoring wells. For Phase 1, these wells were resampled and 5 additional wells were installed. All wells were purged of at least five casing volumes of water using either PVC bailers or submersible pumps. They were then sampled with disposable teflon bailers. Each container was filled directly from the bailer. Samples for volatile analysis were collected first. For Phase 2, one existing well was sampled and eight new wells were installed and sampled. The wells were purged prior to sampling with a stainless steel Grundfos Redi-Flo 2 electric submersible pump and sampled with a stainless steel bailer. The pump and tubing were decontaminated between uses according to the procedure given in the Chemical Data Acquisition Plan (CDAP). Wells were installed according to the approved method identified in the CDAP. In general, a silica sand filter pack was placed in the annulus around the well screen. The filter pack extended two feet above the top of the screen. A two to five foot thick bentonite seal, hydrated for 24 hours, separated the filter pack from the overlying cement bentonite seal. Wells installed by EPS were constructed with 2-inch stainless steel casing and 15-foot stainless steel

screens, wells installed by Weston were 4-inch PVC with 20-foot PVC screens, and wells installed by Sverdrup were 4-inch stainless steel with 10-foot stainless steel screens. All screens were 0.010-inch slot. Well schematics are given in Appendix B.

Rising head slug tests were conducted during Phase 2 on selected monitoring wells using PVC slugs. Changes in water levels versus time were measured using a pressure transducer and electronic datalogger. The Bouwer-Rice method was used to analyze the data, using the AQTESOLV software developed by Geraghty and Miller, Inc. Slug test data and analyses for the individual wells are given in Appendix D.

3.1.7 Surface Water and Sediment Investigations

Surface water and sediment samples were collected at each sampling location. At sites 1 and 11, there was insufficient water to take a sample at the sediment location. In these cases, the surface water sample was taken elsewhere on site. A total of 23 surface water and sediment samples were taken during Phase 1. A total of five surface water and three sediment samples were taken during Phase 2.

Surface water samples were collected directly into the sample container. For Phase 1, sediment samples were collected with spoons in clean stainless steel bowls, composited and containerized for shipment to the laboratory. Samples for volatile organics were not composited, but were collected as discrete samples with as little disturbance as possible. For Phase 2, sediment samples were collected using a hand-driven 1-ft long stainless steel split-barrel sampler. The sampler was driven 1-ft and the top 0.5-ft of recovery was used to fill sample jars. Multiple drives were required to obtain adequate material quantity in some cases. All additional sampling drives were collected within 1-ft of the original drive.

3.1.8 Surveying

The survey contractors, Hall Engineering and Surveying Company of Texarkana for Ebasco, Rose Engineering and Surveying of Houston for Weston, and Winn Environmental Services of Longview, Texas for Sverdrup, located all borings, wells, and sample locations, using benchmarks set from existing control in the area.

3.2 QUALITY ASSURANCE AND QUALITY CONTROL

Quality Assurance/Quality Control (QA/QC) activities were performed to ensure that the investigations were of the highest caliber. QA/QC procedures are described in detail in the Phase 1 and Phase 2 workplans and the respective CDAPs. QC sampling included the collection of 10% field duplicate samples, equipment rinsate blanks, trip blanks, and additional samples for matrix spike/matrix spike duplicate (MS/MSD) analyses. QC samples were tested by the same laboratory

as the field sample. QA sampling consisted of 10% field duplicates, taken at the time of the QC duplicate. QA samples were tested by a different laboratory. For both Phase 1 and Phase 2 Investigations, QA testing was performed by U. S. Army Corps of Engineers Southwestern Division Laboratory (SWD Lab) in Dallas, Texas.

Qualifiers of the data used by the laboratories include a J when matrix interferences or other problems cause the data to be suspect, and a B when the compound is also found in the laboratory method blank and is suspected of being a laboratory contaminant.

3.3 CHEMICAL AND PHYSICAL TESTING

Chemical testing for Phase 1 was performed for Ebasco by Inchcape Testing Services of Richardson, Texas (formerly NDRC) and for Weston by Gulf Coast Laboratories, University Park, Illinois and Lionville Laboratory of Lionville, Pennsylvania. Phase 2 testing was performed by PDP Analytical Services of Spring, Texas for all parameters except explosives and anions, which were tested by Inchcape. Analytical methods are given in Table 3-2.

QA samples for both phases were tested by SWD Lab and their contractors. Phase 1 data was validated by the Scientex Corporation and Weston, and Phase 2 data was validated by Sverdrup. Oversight data validation of the QA samples for both phases was performed by the Tulsa District Corp of Engineers. All of these labs are validated by the U.S. Army Corps of Engineers for the analyses performed.

Geotechnical tests on soil samples were performed by SWD Lab for Ebasco, ETL Lab in Lionville, Pennsylvania for Weston, and Winn Environmental Services of Longview, Texas for Sverdrup. Results of geotechnical tests are given in Appendix C and test methods are listed in Table 3-3.

3.4 APPROACH TO ASSESSMENT OF CONTAMINATION

In Sections 8 through 11 of this report, the analytical results of soil, sediment, surface water, and groundwater sampling will be presented. Detections of organic compounds will be used as obvious indicators that plant operations had impacted the area of investigation. Detections of inorganic compounds which appear abnormally high will be noted.

In Section 12, the Risk Assessment evaluation of each site is provided. In those evaluations, the detected concentrations will be evaluated for risk.

018637

Table 3-2
Group 1 Sites
Chemical Analytical Methods

Parameter	Ebasco/Weston	Sverdrup
Volatiles	8240	8240
Semivolatiles	8270	8270
Explosives	8330	8330
Antimony	6010	7041
Arsenic	7060	7060
Barium	6010	6010
Cadmium	6010	6010
Chromium	6010	6010
Lead	7421	7421
Mercury	7470/7471	7470/7471
Nickel	6010	6010
Selenium	7740	7740
Silver	6010	6010
Thallium	7841	7841
Nitrate/nitrite	353.3	353.3
Chloride	9052	9056/325.3
Sulfate	9038	9056/375.4
Pesticides	8080	-
Herbicides	8150	-
pH	9040/9045	-
Conductivity	9050	-
Total organic halogen	9020	-
Total organic carbon	9060	-
Total phenols	9065	-

Table 3-3
Group 1 Sites
Methods for Physical Tests

Parameter	Ebasco/Weston	Sverdrup
Moisture	D2216	D2216
Gradation	D421/422	D421/422
Atterberg limits	D4318	D4318

4.0 GEOHYDROLOGY, SITE 11

This section presents a description of physical site conditions at Site 11. Subjects addressed include geology, soils and hydrogeology. Information presented in this section is based on data obtained from the field investigations.

4.1 SUMMARY OF INVESTIGATIONS

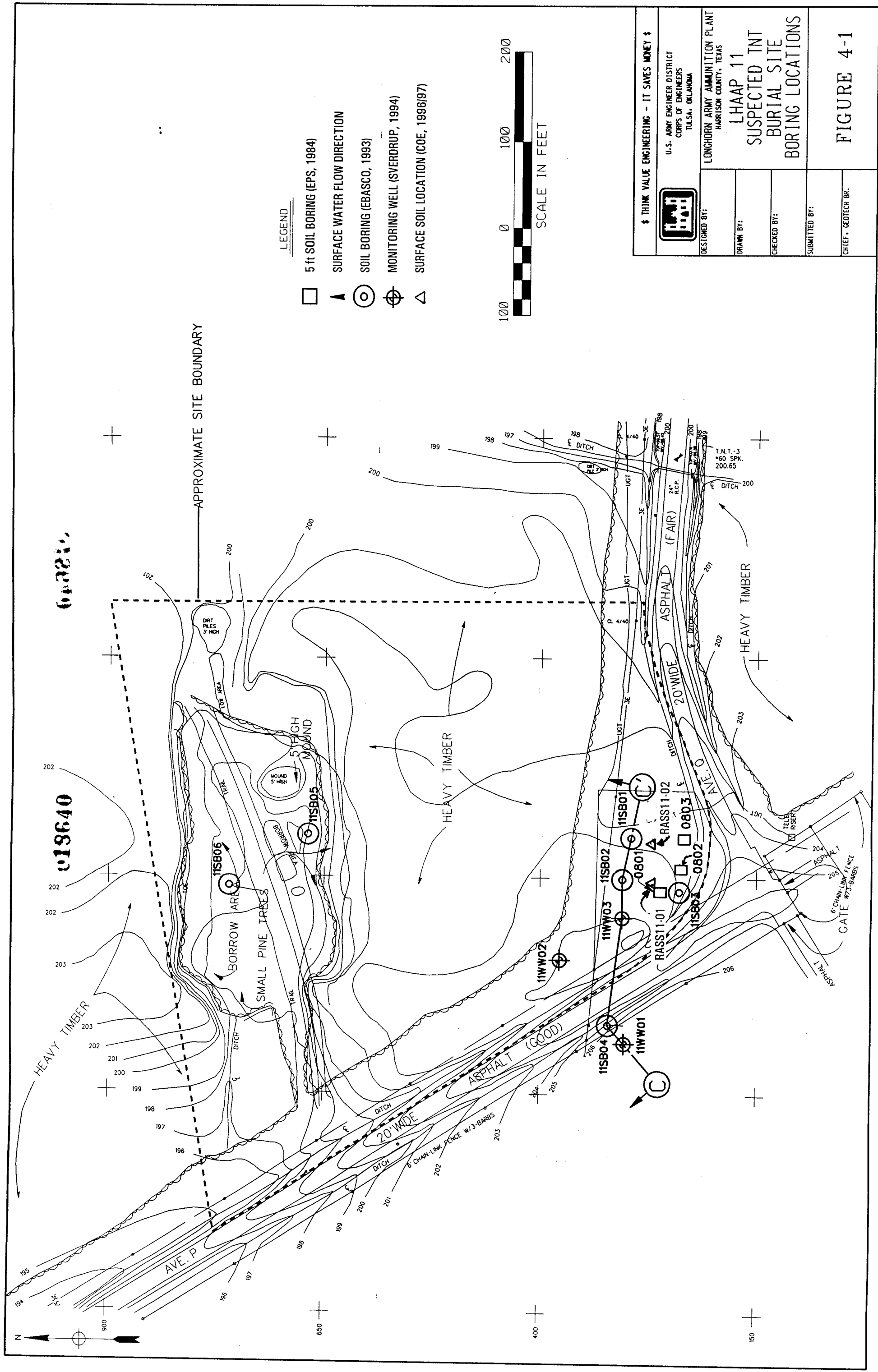
Site 11 was originally investigated by EPS for USATHAMA in 1982 (EPS, 1984). EPS drilled and sampled three 5-foot deep soil borings, 0801, 0802, and 0803, at locations shown on Figure 8-1. Samples were analyzed for explosives compounds from 0.0 to 2.5 feet and from 2.5 to 5.0 feet.

EPS performed another investigation of Site 11 for Morton Thiokol in 1988 (EPS, 1988). EPS drilled one 5-foot deep boring at the approximate location of the previously investigated shallow boring 0801. Soil samples were vertically composited from 0 to 18 inches and from 18 inches to 5 feet in this boring. Nine surface soil samples were also collected to depths of 12 inches. The samples were analyzed for explosives compounds only.

In 1993, Ebasco conducted a Phase 1 remedial investigation of Site 11 which included the collection of 20 soil samples and 6 groundwater grab samples from 6 soil borings, 2 sediment samples, and 2 surface water samples. All soil, groundwater, sediment, and surface water samples were analyzed for volatile organics, semivolatile organics, explosives, metals, and anions. The groundwater was also analyzed for TOC, TOX, and phenols. Physical tests on soil samples included moisture content, Atterberg limits, and grain size distribution. Three of the soil borings, 11SB01, 02, and 03, were located near electromagnetic anomalies found during the geophysical survey performed during this phase.

In 1994, Sverdrup conducted a Phase 2 remedial investigation at Site 11, which included the collection of 13 soil samples and 3 groundwater samples from three monitoring wells installed during that investigation. Wells 11WW01, 11WW02, and 11WW03 were screened over the intervals 14.50' to 24.50', 19.50' to 29.50', and 7.0' to 17.0', respectively. All soil and groundwater samples were analyzed for volatiles, semivolatiles, explosives, metals, and anions. Physical tests on soil samples included moisture content, Atterberg limits, and grain size distribution. Field measurements on water samples included pH, temperature, and specific conductance.

In August 1996, the Tulsa District Corps of Engineers collected two surface soil samples in support of the risk analysis to be performed at this site. These samples were analyzed for explosives and 11 metals (arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, antimony, and thallium). In February 1997, surface soil samples were taken at the same



locations with analyses performed for 12 metals (aluminum, beryllium, calcium, cobalt, copper, iron, potassium, magnesium, manganese, strontium, vanadium and zinc).

Table 4-1 summarizes the samples taken by these contractors. All of the sample and boring locations are shown on Figure 4-1.

4.2 GEOLOGY AND SOILS

Soils encountered in the borings at Site 11 consisted primarily of interbedded silty and clayey sands, and sandy silts and clays of the Wilcox Group. Boring locations are shown on the site map, Figure 4-1, and a geologic section is shown on Figure 4-2. Boring logs are given in Appendix A.

Table 4-1
Site 11 - Suspected TNT Burial Site
Exploration Summary

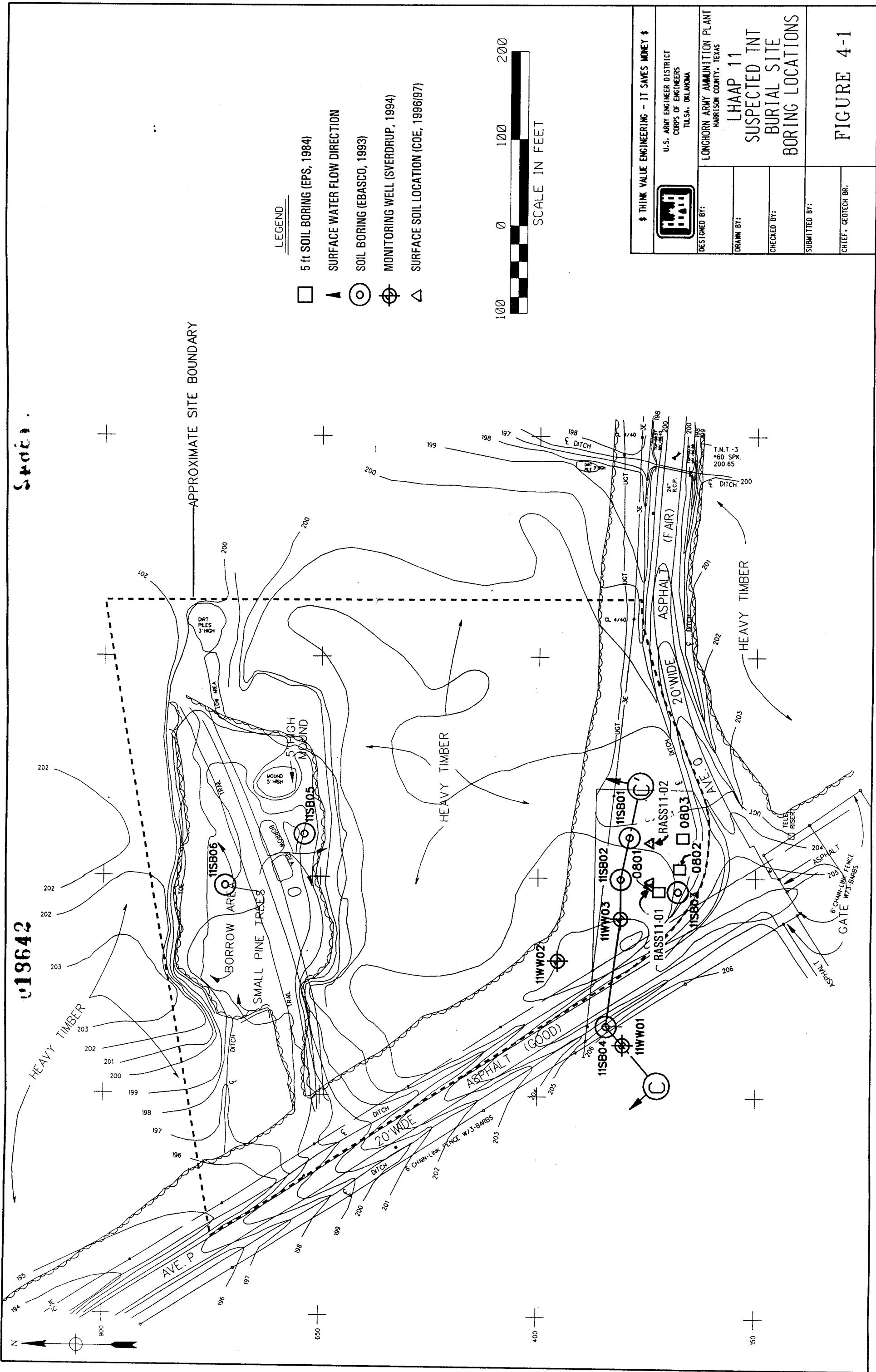
A-E	Date	Exploration	Sample ID	Number of samples
EPS	1984	3 borings	0801 to 0803	2 soil samples/boring
EPS	1988	1 boring	801	2 soil samples
EPS	1988	9 surface soil	S1 to S9	1 soil sample/site
EBA	1993	6 borings	11SB01 to 06 11GG01 to 06	20 soil samples total 1 gw grab sample/boring
EBA	1993	2 surface waters	11SW13, 11SW14	2 water samples
EBA	1993	2 sediment samples	11SD13, 11SD14	2 sediment samples
SVE	1994	3 monitoring wells	11WW01 to 11WW03	13 soil samples total 1 gw sample/well
COE	1996/97	2 surface soil samples	RASS11-01, RASS11-02	2 soil samples

EPS = Environmental Protection Systems; EBA = Ebasco Services; WES = Roy F. Weston; SVE = Sverdrup Environmental; COE = Tulsa District Corps of Engineers

Surficial soils generally consist of moist, firm, reddish brown/gray mottled, low plastic to moderately plastic, silty clay or clayey sand extending to depths of 6 to 14 ft below ground surface. Within the area of the suspected burial pit, the surficial layer has been excavated and is only 1 to 3 ft thick. Below this surficial layer is a reddish brown and gray, medium to dense silty fine sand with occasional silty clay lenses. Groundwater beneath the site was generally first encountered within this layer. Underlying the saturated silty sand was a reddish brown, firm to stiff, plastic, silty clay ranging in depth from 12.0 to 29.5 ft below ground surface.

019642

Sheet 1



LEGEND

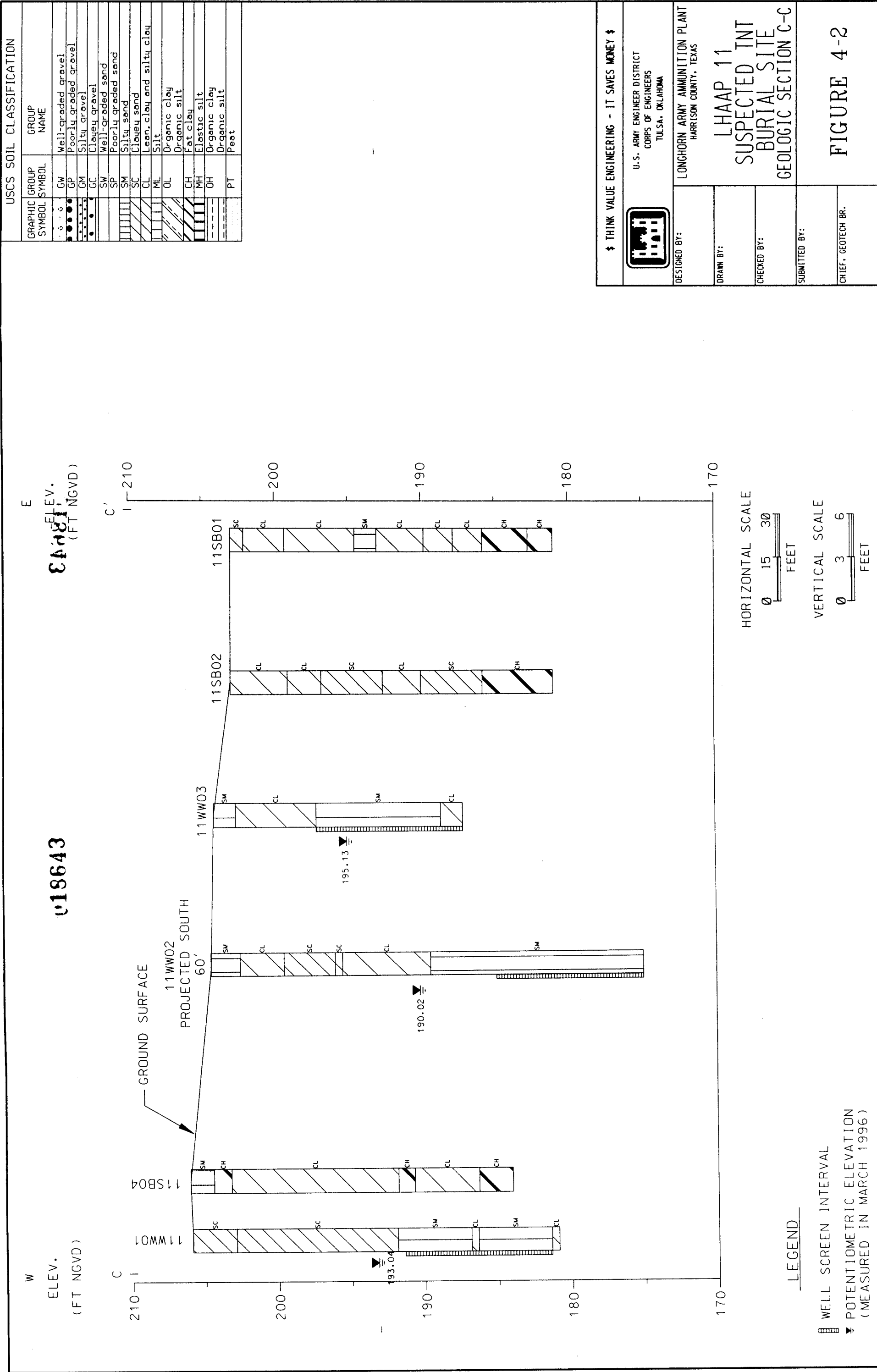
- 5 ft SOIL BORING (EPS, 1984)
- SURFACE WATER FLOW DIRECTION
- SOIL BORING (EBASCO, 1993)
- MONITORING WELL (SVERDRUP, 1994)
- SURFACE SOIL LOCATION (COE, 1996/97)



THINK VALUE ENGINEERING - IT SAVES MONEY

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
TULSA, OKLAHOMA

DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	LHAAP 11
CHECKED BY:	SUSPECTED TNT BURIAL SITE
SUBMITTED BY:	BORING LOCATIONS
CHIEF, GEOTECH BR.	FIGURE 4-1



4.3 HYDROGEOLOGY

018644

Groundwater samples were taken from 6 borings during the Phase 1 RI. Three shallow monitoring wells (11WW01, 11WW02, and 11WW03) were drilled and installed as part of Phase 2. Information obtained from the drilling of these wells was utilized to evaluate the upper most water-bearing transmissive unit underlying Site 11. Monitoring well installation diagrams are given in Appendix B.

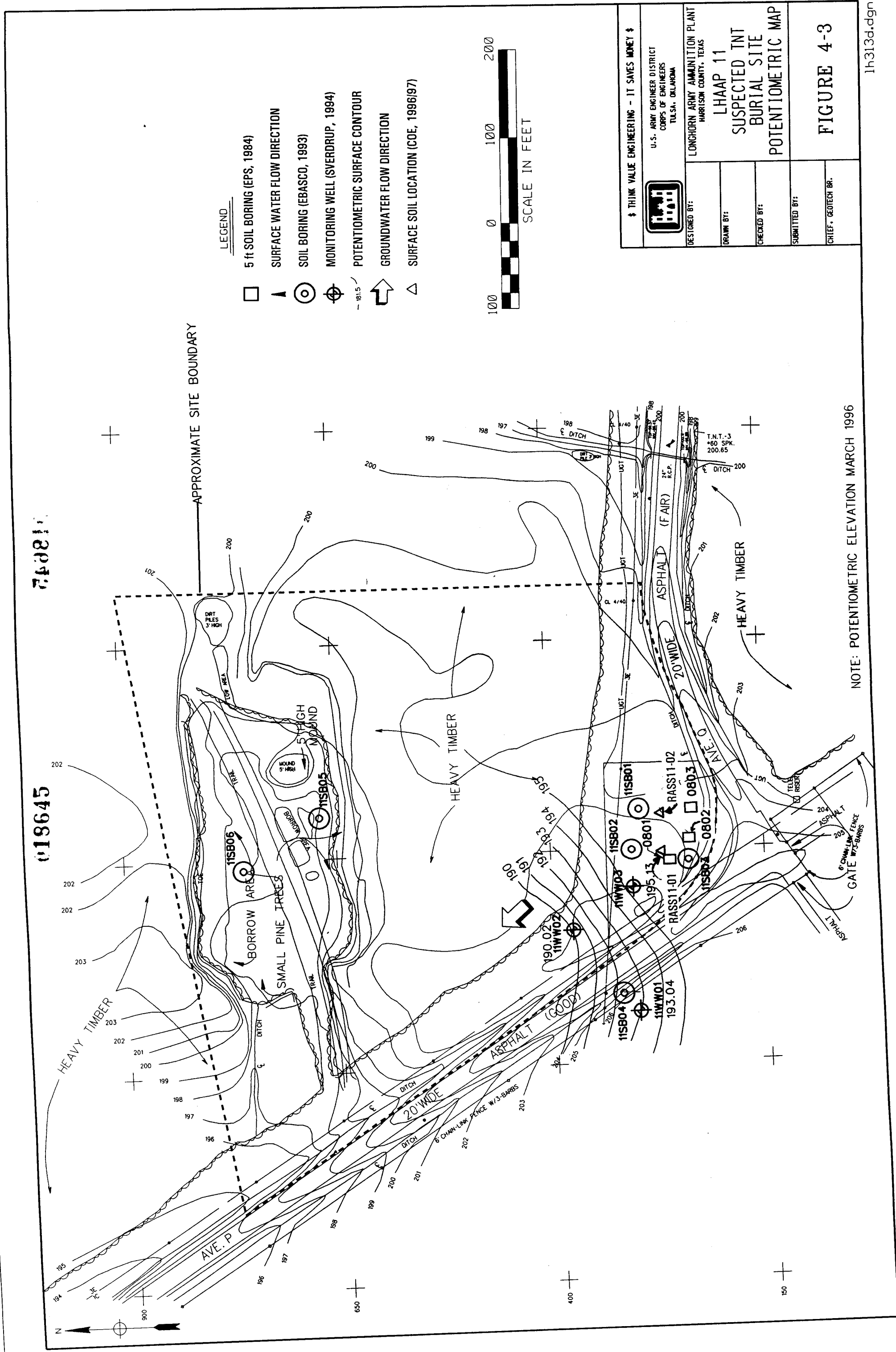
Groundwater was first encountered during drilling at depths of approximately 9 to 24 ft below ground surface. Generally groundwater was encountered within silty fine sand lenses contained within the thicker silt and clay layers. Monitoring wells were installed with their screens set across these sand lenses. Static groundwater elevations measured following monitoring well development were generally found to be higher than the elevations of saturated soils observed during drilling. At two of the three monitoring wells (11WW01 and 11WW03) a clay unit was present at the base of the water-bearing unit.

Table 4-2 contains groundwater elevations from the monitoring wells on 11 November 1994 and 12 March 1996. As can be seen from the table, the water level in the wells dropped 2 to 5 feet from the first reading to the second. Based on the 3 monitoring wells, the highest water level is from 11WW-02, which is within the site. The flow direction is northwesterly. Potentiometric contours are given on Figure 4-3. The hydraulic gradient, based on the March 1996 water levels from the wells is 0.06 ft/ft.

Table 4-2
Site 11 - Suspected TNT Burial Site
Monitoring Well and Groundwater Data

Well Number	Ground Elevation (feet)	Elevation Top of Casing (feet)	Date of Reading	Elevation of Ground Water (feet)	Date of Reading	Elevation of Ground Water (feet)
11WW01	205.90	208.59	11/94	197.76	3/96	193.04
11WW02	204.50	207.24	11/94	191.61	3/96	190.02
11WW03	204.20	206.87	11/94	199.16	3/96	195.13

Rising head slug tests were conducted on the three wells to evaluate aquifer characteristics. Results using the Bouwer-Rice unconfined method for Site 11 give the hydraulic conductivity as 1.0×10^{-3} ft/min (5.2×10^4 cm/sec). Slug test data and analyses for the individual wells are contained in Appendix D. Hydraulic conductivity values calculated from the slug tests are listed in Table 4-3.



The horizontal groundwater flow velocity at Site 11 was calculated to be 0.41 ft/day using the relationship $v = Ki/n$. This is based on the average hydraulic conductivity and groundwater gradient presented earlier and an assumed effective porosity of 20% for a silty fine sand.

Table 4-3
Site 11 - Suspected TNT Burial Site
Hydraulic Conductivity Values

WELL	K (ft/min)	K (cm/sec)
11WW01	1.0×10^{-3}	5.2×10^{-4}
11WW02	1.0×10^{-4}	5.2×10^{-5}
11WW03	2.0×10^{-3}	1.0×10^{-3}

5.0 GEOHYDROLOGY, SITE 1

This section presents a description of physical site conditions at Site 1. Subjects addressed include geology, soils and hydrogeology. Information presented in this section is based on data obtained from the field investigations.

5.1 INVESTIGATIONS

Site 1 was first investigated by EPS for USATHAMA in 1982. During this investigation, EPS installed and sampled monitoring well 104 and collected three surface soil samples at locations shown on Figure 9-1. The soil and groundwater samples were analyzed for explosive compounds, metals, and anions. Groundwater samples were also analyzed for volatile and semivolatile organic compounds.

In 1993, a two stage Phase 1 Remedial Investigation was conducted at Site 1. Stage 1 consisted of field investigations conducted by Ebasco over the south and east portions of the site. Stage 2 consisted of investigations performed by Weston over the north and west portions of the site. The area investigated by Weston was called Site 1a in the Phase 1 and Phase 2 data summaries. In this report, all data is grouped together and referred to as Site 1. Ebasco collected 41 soil samples at 5-ft depth intervals from 8 soil borings. The borings extended to depths of 10 to 30 ft. Groundwater grab samples, used for field screening, were collected from each boring. Groundwater was also sampled from existing monitoring well 104. Sediment and surface water samples were collected from 7 locations. Locations sampled by Ebasco and Weston are shown on Figure 9-1.

Weston collected 74 soil samples at 5-ft depth intervals within unsaturated soils from 9 soil borings. Five of the borings were completed as monitoring wells and groundwater samples were collected. Groundwater grab samples were collected from the four borings which were not completed as monitoring wells. Weston also resampled well 104. In addition, Weston collected 3 samples of sediment, surface water, and construction debris. Samples from the Phase 1 investigations conducted by Ebasco and Weston were analyzed for volatiles, semivolatiles, explosives, target analyte list (TAL) metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, silver, antimony, thallium, and nickel), and anions (chloride, sulfate, and nitrate/nitrite). Groundwater grab samples were analyzed for explosives, total organic carbon (TOC), total organic halogens (TOX), phenols, and anions.

In 1994, Sverdrup conducted a Phase 2 investigation of Site 1 which included the collection of 3 sediment samples, 5 surface soil samples, and 2 groundwater samples from one newly installed monitoring well and one existing well. These samples were analyzed for volatiles, semivolatiles, explosives, TAL metals, and anions. The surface soil samples were analyzed for barium, lead,

and selenium. Physical tests on soil samples included moisture content, Atterberg limits, and grain size distribution.

In August 1996, the Tulsa District Corps of Engineers collected surface soil samples from nine locations in support of the risk assessment to be performed at this site. All samples were analyzed for semi-volatile organics. Two samples (RASS01-1 and RASS01-9) were also analyzed for explosives and 11 metals (arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, antimony, and thallium). In February 1997, surface soil samples were taken at the locations, RASS01-1 and RASS01-9. Samples from both locations were analyzed for 12 metals (aluminum, beryllium, calcium, cobalt, copper, iron, potassium, magnesium, manganese, strontium, vanadium and zinc). In addition, a sample from location RASS01-1 was analyzed explosives.

Table 5-1 summarizes the samples and boring numbers taken by these contractors. All sample and boring locations are shown on Figure 5-1.

Table 5-1
Site 1 - Inert Burning Grounds
Exploration Summary

A-E	Date	Exploration	Sample ID	Number of Samples
EPS	1982	1 monitoring well	104	1 groundwater sample
EPS	1982	3 surface soil	0101 to 0103	1 soil sample/site
EBA	1993	8 borings	01SS22 to 29 01GG22 to 29	41 soil samples total 1 gw grab sample/boring
EBA	1993	1 well resampling	MW 104	1 groundwater sample
EBA	1993	7 sediment & surface water samples	01SD06 to 12 01SW06 to 12	7 sediment 7 water
WES	1993	1 well resampling	MW104	1 groundwater sample
WES	1993	9 borings with 5 made into wells	01SB01 to 04 01MW01 to 05 01GG01 to 04 01MW01 to 05	74 soil samples total 4 groundwater grabs 5 groundwater
WES	1993	3 sediment & surface water samples	01SD01 to 03 01SW01 to 03	3 sediment 3 water
SVE	1994	3 sediment samples	01SD21 to 23	3 sediment

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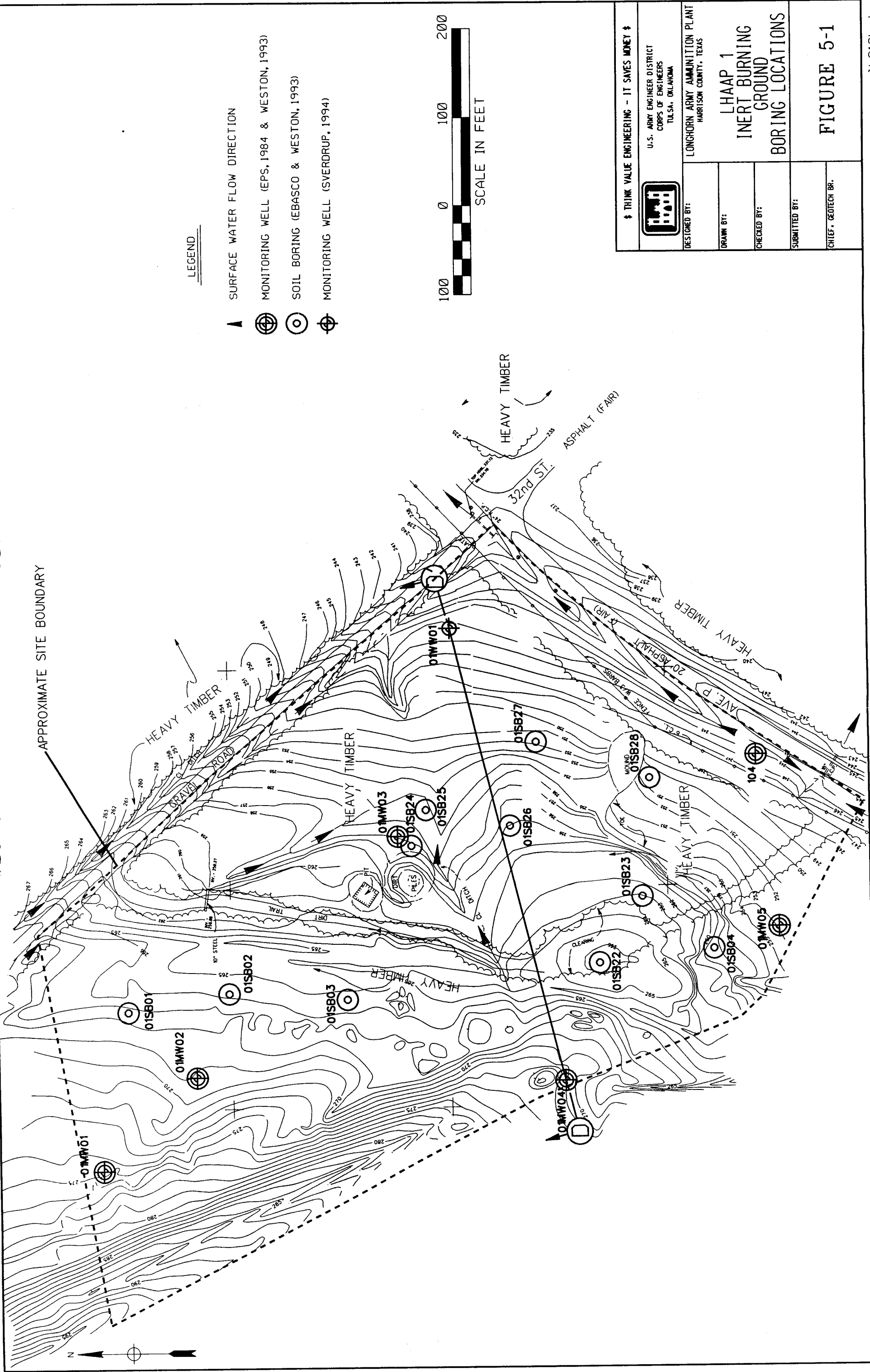


Table 5-2
Site 1- Inert Burning Ground
Monitoring Well Data

Well	Date Completed	Top Screen (feet, BGS)	Base Screen (feet, BGS)
01MW01	12/3/93	22.50	42.50
01MW02	12/5/93	20.00	40.00
01MW03	12/7/93	8.00	28.00
01MW04	12/12/93	17.50	37.50
01MW05	12/9/93	5.00	25.00
01WW01	8/24/94	7.00	17.00
104	5/19/82	10.00	25.00

Groundwater was first encountered at 01WW01 immediately below a surficial clay layer at a depth of approximately 10 ft below ground surface. The groundwater potentiometric elevation measured, following the installation and development of well 01WW01 on September 14, 1994, was 0.23 ft below ground surface. This significant difference in water levels is indicative of confined groundwater conditions. Monitoring well 01WW01 is positioned at the base of a small hill, and numerous groundwater seeps and marshy areas were noticed in this vicinity.

Table 5-3 contains groundwater levels measured on three different dates. Based on November 1994 groundwater measurements, a potentiometric surface map was compiled for the shallow water bearing transmissive unit underlying Site 1, as shown in Figure 5-3. The groundwater flow is to the east. Well 01MW01 is the most upgradient well, with a groundwater elevation of 252.31 feet. Well 01WW01, near the intersection of 32nd Street and Avenue P has the lowest groundwater elevation at 245.14 feet. Based on these potentiometric contours, a hydraulic gradient of 0.012 ft/ft was calculated.

Rising head slug tests were conducted on monitoring wells 01WW01 and 01MW04. Results of data analysis following the Bouwer-Rice method produced an average hydraulic conductivity of 2.7×10^{-3} ft/min (1.4×10^{-3} cm/sec). Specific hydraulic conductivity values per well are presented in Table 5-4. Slug test data and analyses for the individual wells are contained in Appendix C.

The horizontal groundwater flow velocity at Site 1 was calculated to be 0.23 ft/day, using the

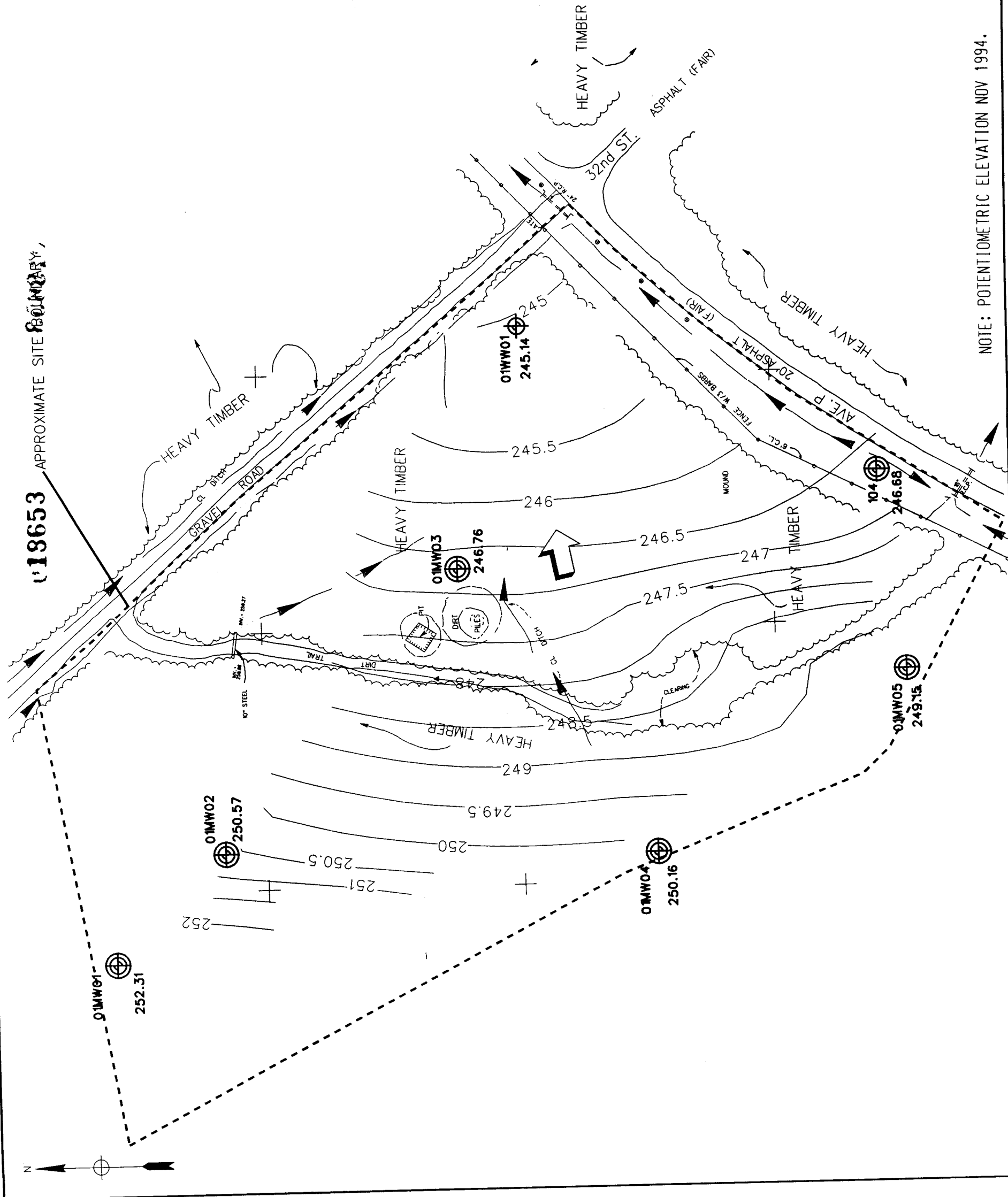
relationship $v = Ki/n$. This is based on the average hydraulic conductivity and groundwater gradient presented earlier and an assumed effective porosity of 20% for a silty fine sand.

Table 5-3
Site 1 - Inert Burning Grounds
Monitoring Well and Groundwater Elevation Data

Well Number	Ground Elevation (feet)	Elevation Top of Casing (feet)	Date of Reading	Ground Water Elevation (feet)	Date of Reading	Ground Water Elevation (feet)
104	245.37	248.06	12/93	242.87	11/94	246.68
01MW01	275.26	277.84	12/93	248.67	11/94	252.31
01MW02	270.39	273.04	12/93	246.91	11/94	250.57
01MW03	257.20	259.76	12/93	243.22	11/94	246.76
01MW04	271.25	273.95	12/93	245.85	11/94	250.16
01MW05	254.15	256.68	12/93	245.20	11/94	249.15
01WW01	245.10	247.60			11/94	245.14

Table 5-4
Site 1 - Inert Burning Grounds
Hydraulic Conductivity Values

WELL	K (ft/min)	K (cm/sec)
01WW01	2.0×10^{-3}	1.0×10^{-3}
01MW04	3.4×10^{-3}	1.7×10^{-3}



18653 APPROXIMATE SITE BOUNDARY

LEGEND

- SURFACE WATER FLOW DIRECTION
- MONITORING WELL (EPS, 1984 & WESTON, 1993)
- MONITORING WELL (SVERDRUP, 1994)
- POTENTIOMETRIC SURFACE CONTOUR
- GROUNDWATER FLOW DIRECTION



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DESIGNED BY:		DRAWN BY:	
CHECKED BY:		SUBMITTED BY:	
CHIEF, GEOTECH BR.		LHAAP 1 INERT BURNING GROUND POTENTIOMETRIC MAP	
		FIGURE 5-3	

NOTE: POTENTIOMETRIC ELEVATION NOV 1994.

6.0 GEOHYDROLOGY, SITE XX

This section presents a description of physical site conditions at Site XX. Subjects addressed include geology, soils and hydrogeology. Information presented in this section is based on data obtained from the field investigations.

6.1 SUMMARY OF INVESTIGATIONS

Site XX was investigated by EPS for USATHAMA in 1982. EPS installed and sampled monitoring wells 127 and 128 with screen settings of 10.0 to 25.0 ft and 17.5 to 32.5 ft, respectively. Groundwater samples from each well were analyzed for explosives compounds, metals, and anions. In addition, groundwater from Well 128 was analyzed for volatile and semivolatile organic compounds. EPS also collected and analyzed three shallow soil samples for explosives, metals, and anions. All sampling locations are shown on Figure 10-1.

In 1993, Ebasco Services, Inc. conducted a Phase 1 Remedial Investigation which included the collection of 7 sediment samples, 7 surface water samples, 15 soil samples from 7 borings, 2 groundwater samples from the two EPS wells, and 6 groundwater grab samples from 6 of the borings which made water.

Monitoring well groundwater, soil, surface water, and sediment samples were analyzed for volatiles, semivolatiles, explosives, metals, and anions. Groundwater grab samples were analyzed for explosives, anions, total organic halogens, total organic carbon, and phenolics. Physical tests on soil samples included moisture content, Atterberg limits, and grain size distribution.

In 1994, Sverdrup conducted a Phase 2 field investigation which included the collection of soil gas samples from 5 sampling points. One soil boring was drilled from which 3 soil samples and 1 groundwater grab sample were collected. Soil and groundwater samples were analyzed only for volatiles. Soil gas samples were analyzed for acetone, methylene chloride, and trichloroethene. Physical tests on soil samples included moisture content, Atterberg limits, and grain size distribution. Field measurements on water samples included pH, temperature, and specific conductance.

In August 1996, the Tulsa District Corps of Engineers collected surface soil samples from two locations in support of the risk analysis to be performed at this site. Both samples were analyzed for volatile organic compounds and 11 metals (arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, antimony, and thallium). In February 1997, surface soil samples were taken at the same two locations. Samples from both locations were analyzed for semi-volatile organic compounds and pesticides/PCBs. A sample from RASSXX-02 was also analyzed for 12 metals (aluminum, beryllium, calcium, cobalt, copper, iron, potassium, magnesium, manganese, strontium, vanadium and zinc).

Table 6-1 summarizes the samples and boring numbers taken by these contractors. All of the sample and boring locations are shown on Figure 6-1.

6.2 GEOLOGY AND SOILS

Soils encountered in the borings at Site XX consisted primarily of interbedded silty and clayey sands, and sandy silts and clays of the Wilcox Group. Boring locations are shown on the site map, Figure 6-1, and a geologic section is shown on Figure 6-2. Boring logs are given in Appendix A.

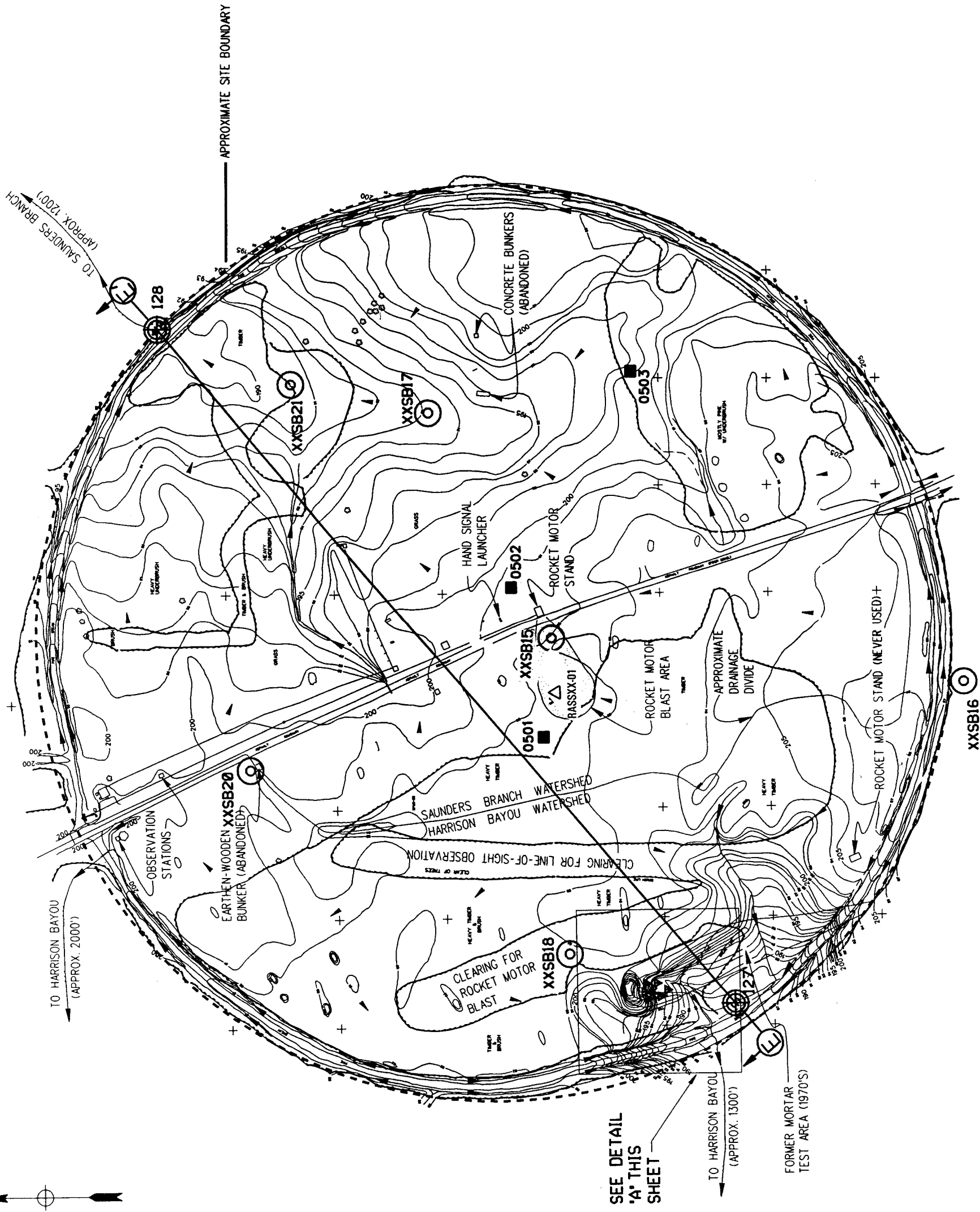
Table 6-1
Site XX - Ground Signal Test Area
Exploration Summary

A-E	Date	Exploration	Sample ID	Number of Samples
EPS	1984	3 surface soil	0501 to 0503	3 soil samples
EPS	1984	2 monitoring wells	MW127 to MW128	2 groundwater samples
EBA	1993	7 borings	XXSB15 to 21 XXGG15 to 18 XXGG20 to 21	16 soil samples total 6 groundwater grabs
EBA	1993	7 surface waters	XXSW01, XXSW15 to 20	7 water
EBA	1993	7 sediment samples	XXSW01 XXSW15 to 20	7 sediment
EBA	1993	2 well resampling	MW127 to MW128	2 groundwater samples
SVE	1994	5 soil gas sampling points	XXSG01, XXSG03 to 05, XXSG07	5 soil gas
SVE	1994	1 boring	XXSB01 XXGG01	3 soil samples 1 groundwater grab
COE	1996/97	2 surface soil samples	RASSXX-01, RASSXX-02	2 surface soil samples

EPS = Environmental Protection Systems ; EBA = Ebasco; SVE = Sverdrup; COE = Tulsa District Corps of Engineers

Surficial soils encountered generally consisted of a moderately plastic, mottled, gray and brown, silty clays and silts to depths of 5 to 9 ft. This surficial clay cap was generally not present along the northern third of the site. Below this surficial layer was a light gray and brown, moist, low plastic, clayey sand changing into a silty sand with occasional sand and clay lenses at depth. Groundwater was generally encountered within this silty sand layer at a depth of approximately 10 to 15 ft below ground surface.

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DETAIL 'A'

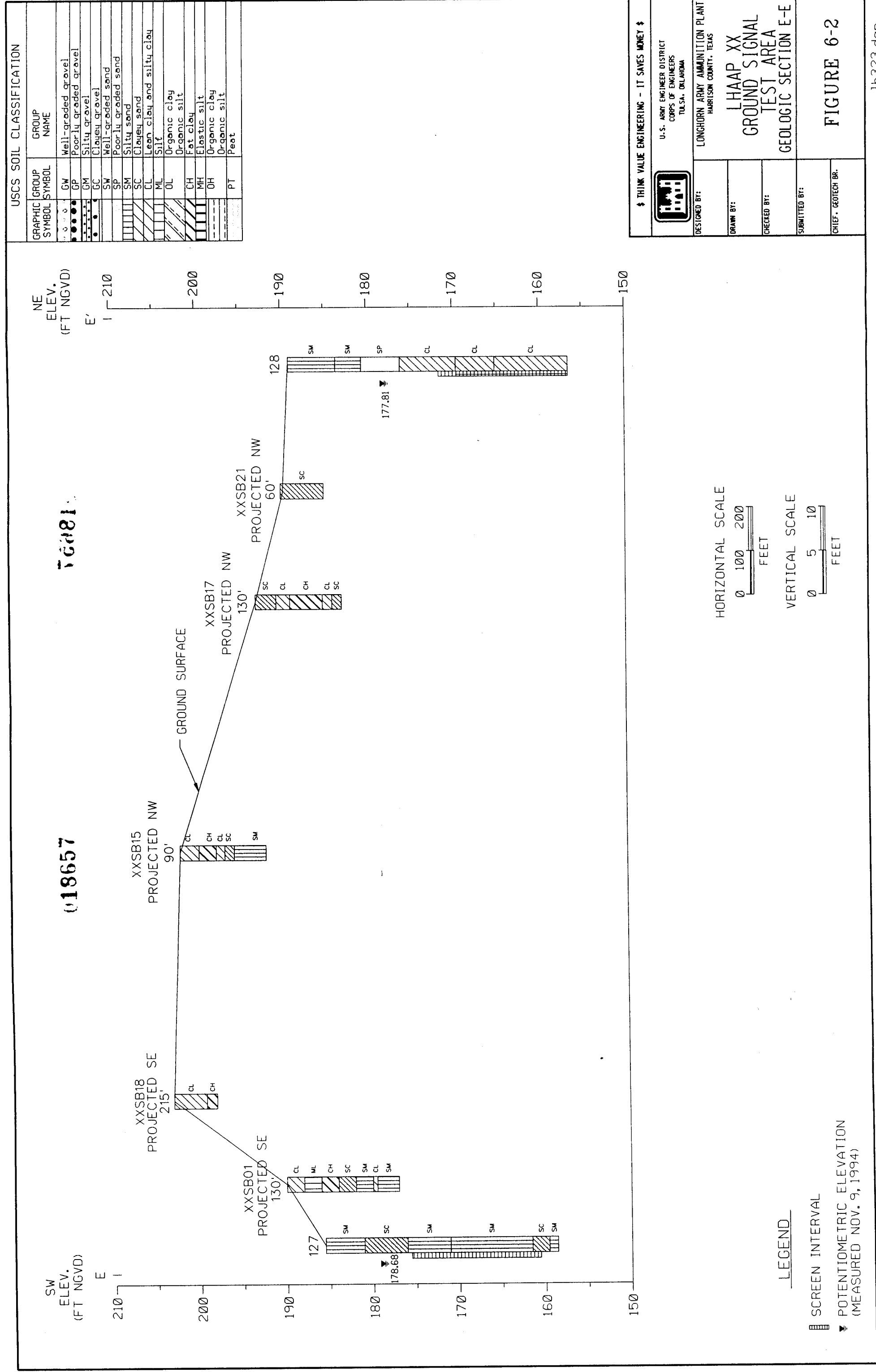
LEGEND

- SHALLOW SOIL SAMPLE (EPS, 1982)
- ▲ SURFACE WATER FLOW DIRECTION
- SOIL BORING (EBASCO, 1993)
- ⊙ MONITORING WELL (EPS, 1982)
- SOIL BORING (SVERDRUP, 1994)
- ▽ SOIL GAS SAMPLE (SVERDRUP, 1994)
- △ SURFACE SOIL SAMPLE (COE, 1996/97)



SCALE IN FEET

✦ THINK VALUE ENGINEERING - IT SAVES MONEY ✦	
	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	LHAAP XX
CHECKED BY:	GROUND SIGNAL TEST AREA
SUBMITTED BY:	BORING LOCATIONS
CHIEF, GEOTECH BR.	FIGURE 6-1



6.3 HYDROGEOLOGY

Two shallow monitoring wells, 127 and 128, were drilled and installed at Site XX by EPS in 1982. Well 127 was completed with the screened interval placed from 10.1' to 24.1' below ground surface (BGS). Well 128 was completed with the screened interval from 17.4' to 32.4' BGS. No new monitoring wells were installed at Site XX during the Phase 1 and Phase 2 field investigations, but groundwater samples were taken from 7 soil borings. Monitoring well installation diagrams are provided in Appendix A.

Groundwater was generally encountered at depths of 10 to 15 ft below ground surface, within a silty sand unit containing sand and clay lenses. The monitoring wells were installed with their screens set within this silty sand unit. Table 6-2 contains groundwater potentiometric measurements.

There is insufficient data to draw a potentiometric surface across the site. However, based on the Hydrogeological Assessment (COE, 1995a), the flow direction is to the northwest. No slug test data is available for wells at Site XX.

Table 6-2
Site XX - Ground Signal Test Area
Monitoring Well and Groundwater Data

Well	Ground Elevation (feet)	Elevation Top of Casing (feet)	Ground Water Depth (feet)	Date of Reading	Ground Water Elevation (feet)
MW127	185.9	188.43	9.77	11/94	178.68
MW128	189.2	191.77	13.95	11/94	177.8

7.0 GEOHYDROLOGY, SITE 27

This section presents a description of physical site conditions at Site 27. Subjects addressed include geology, soils and hydrogeology. Information presented in this section is based on data obtained from the field investigations.

7.1 SUMMARY OF INVESTIGATIONS

Site 27 was investigated by EPS for USATHAMA and a contamination survey report was published in June 1984 (EPS, 1984). EPS collected 3 shallow soil samples and installed and sampled monitoring wells 131 and 132. Sample locations are indicated on Figure 11-1. Soil and groundwater samples were analyzed for explosives, metals, and anions. In addition, groundwater from Well 131 was analyzed for pesticides, volatiles and semivolatiles.

During the Phase 1 RI conducted in 1993, Ebasco collected 20 soil samples from the unsaturated soils in 10 soil borings. Two of the borings were 8 feet deep and the others were 7 feet deep. Groundwater grab samples were collected in each boring. The 2 monitoring wells installed by EPS were also sampled. Ebasco collected 4 sediment and surface water samples and 4 surface soil samples. Soil, sediment, surface water, and groundwater samples were analyzed for volatiles, semivolatiles, explosives, metals, and anions.

The Phase 2 field investigation conducted by Sverdrup included the collection of 3 surface soil samples, 12 soil samples from 4 borings, and a groundwater sample from each of 4 installed monitoring wells. Surface soil samples were analyzed for chromium and mercury. Soil and groundwater samples were analyzed for explosives, metals, and anions. Physical tests on soil samples included moisture content, Atterberg limits, and grain size distribution. Field measurements on water samples included pH, temperature, and specific conductance.

In August 1996, the Tulsa District Corps of Engineers collected surface soil samples from nine locations in support of the risk analysis to be performed at this site. Samples from all nine locations were analyzed for explosives. Samples from four of these locations (RASS27-02, RASS27-04, RASS27-06 and RASS27-08) were also analyzed for 11 metals (arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, antimony, and thallium). In February 1997, surface soil samples were taken at the four locations (RASS27-02, RASS27-04, RASS27-06 and RASS27-08) and analyzed for 12 metals (aluminum, beryllium, calcium, cobalt, copper, iron, potassium, magnesium, manganese, strontium, vanadium and zinc).

Table 7-1 summarizes the samples and boring numbers taken by these contractors. All of the sample and boring locations are shown on Figure 7-1.

7.2 GEOLOGY AND SOILS

Soils encountered in the borings at Site 27 consisted primarily of interbedded silty and clayey sands, and sandy silts and clays of the Wilcox Group. Boring locations are shown on the site map, Figure 7-1, and a geologic section is shown on Figure 7-2. Boring logs are given in Appendix A.

Table 7-1
Site 27 - South Test Area
Exploration Summary

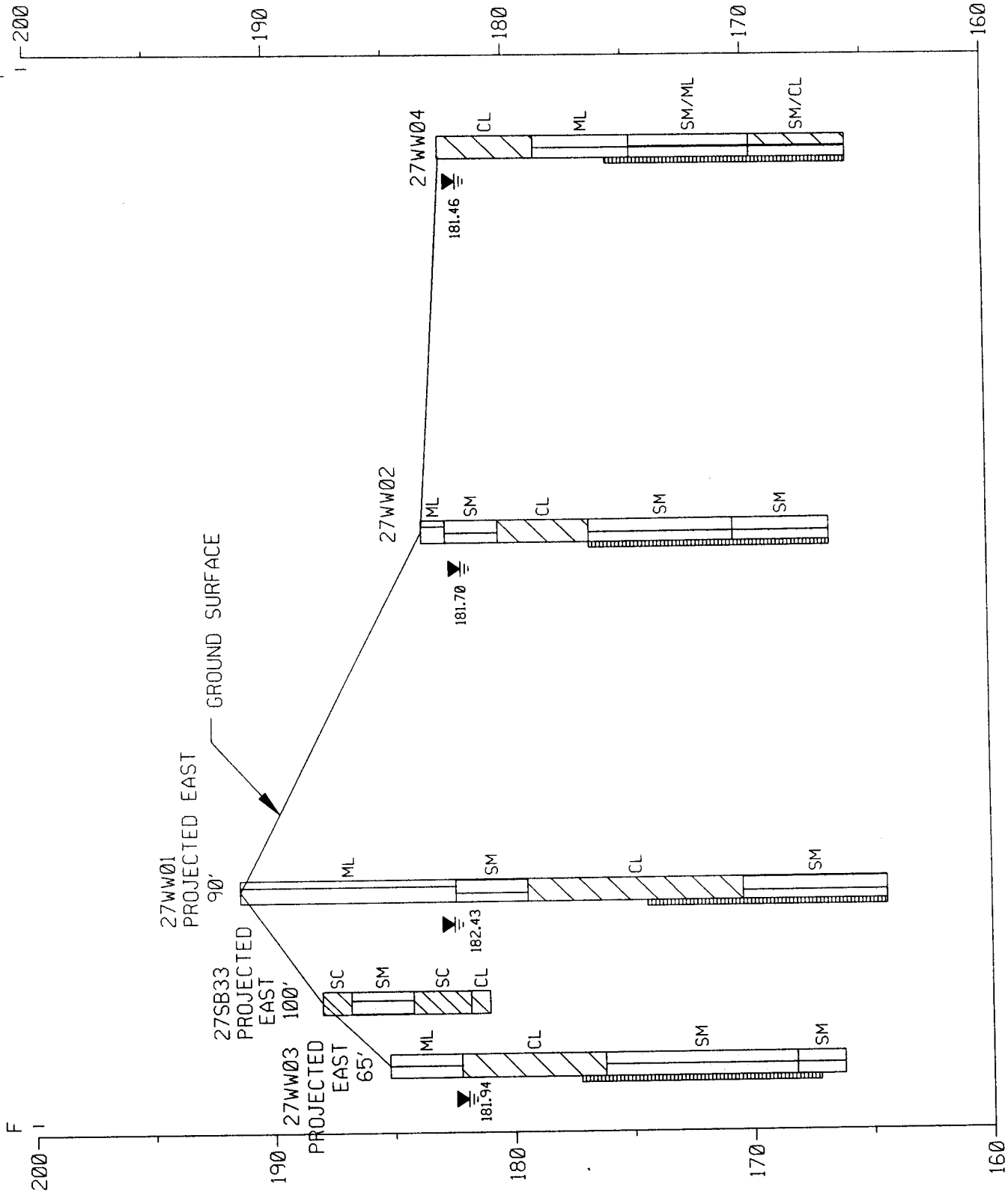
A-E	Date	Exploration	Sample ID	Number of Samples
EPS	1984	3 surface soil	0401 to 0403	3 soil samples
EPS	1984	2 monitoring wells	MW131 to MW132	2 groundwater samples
EBA	1993	10 borings	27SB30 to 39 27GG30 to 39	20 soil samples total 10 groundwater grabs
EBA	1993	4 surface waters	27SW02 to 27SW05	4 waters
EBA	1993	4 sediment samples	27SD02 to 27SD05	4 sediment
EBA	1993	2 wells resampling	MW131 to MW132	2 groundwater samples
EBA	1993	4 surface soil	27SS01 to 04	4 surface samples
SVE	1994	4 monitoring wells	27WW01 to 27WW04	12 soil samples 4 groundwater samples
SVE	1994	3 surface soil	27SS21 to 23	3 surface samples
COE	1996/97	9 surface soil	RASS27-01 to 09	9 surface soil samples

Surficial soils encountered consisted primarily of reddish brown, silts to silty sands ranging from approximately 3 to 8 ft thick which increasing sand content at depth. Underlying the surficial material was a gray, brown, firm to hard, moist, plastic, silty clay, ranging in thickness from 4 to 9 ft. Extending below this clay zone at all four of the Phase 2 monitoring well locations was a saturated reddish brown/gray mottled, medium dense to dense, silty fine sand with occasional silty clay lenses, ranging in depth from 7 to 9 ft below ground surface. Groundwater beneath the site was generally first encountered within this layer.

SW
ELEV.
(FT NGVD)

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NE
ELEV.
(FT NGVD)



LEGEND

- WELL SCREEN INTERVAL
- POTENTIOMETRIC ELEVATION
(MEASURED ON NOV. 9, 1994)

HORIZONTAL SCALE
0 15 30
FEET

VERTICAL SCALE
0 3 6
FEET

USCS SOIL CLASSIFICATION	
GRAPHIC SYMBOL	GROUP NAME
	Well-sorted gravel
	Poorly sorted gravel
	Silty gravel
	Clayey gravel
	Well-sorted sand
	Poorly sorted sand
	Silty sand
	Clayey sand
	Lean clay and silty clay
	Silt
	Organic clay
	Organic silt
	Fat clay
	Elastic silt
	Organic clay
	Organic silt
	Peat

\$ THINK VALUE ENGINEERING - IT SAVES MONEY \$	
	U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	LHAAP 27
CHECKED BY:	SOUTH TEST AREA
SUBMITTED BY:	GEOLOGIC SECTION F-F
CHIEF, GEOTECH BR.	FIGURE 7-2

7.3 HYDROGEOLOGY

Wells 131 and 132 were drilled and sampled by EPS in 1982 and resampled by Ebasco. Four additional monitoring wells, 27WW01, 27WW02, 27WW03, and 27WW04, were drilled and installed as part of the Phase 2 field investigation. Table 7-2 lists the screened depths and completion date of each monitoring well at Site 27. Information obtained from these wells along with additional information from the Phase 2 investigation and subsequent potentiometric measurement data were utilized to evaluate the upper most water bearing transmissive unit underlying Site 27. Monitoring well installation diagrams are given in Appendix A.

Table 7-2
Site 1- Inert Burning Ground
Monitoring Well Data

Well	Date Completed	Top Screen (feet, BGS)	Base Screen (feet, BGS)
131	6/8/82	8.00	23.00
132	6/9/82	9.20	24.20
27WW01	8/19/94	17.00	27.00
27WW02	8/19/94	7.00	17.00
27WW03	8/19/94	8.00	18.00
27WW04	8/24/94	7.00	17.00

Groundwater was generally encountered within a silty fine sand layer underlying surficial silt and clay layers at depths ranging from approximately 7 to 9 ft below ground surface at three of the four new monitoring well locations. This water bearing zone was encountered in monitoring well 27WW01 at a depth of approximately 21 feet below ground surface due to the well located on a structural high within Site 27 as shown in Figure 7-2. All monitoring wells were installed with their screened interval placed across this shallow water bearing silty fine sand unit. Potentiometric measurements taken following installation and development of these new wells generally corresponded with the top of the silty fine sand unit with the exception of monitoring well 27WW01 where the potentiometric surface was measured approximately 10 ft above the top of this unit. Table 7-3 contains groundwater potentiometric measurements made in monitoring wells and soil borings.

Based on these groundwater measurements, a potentiometric surface map was compiled for the shallow water bearing transmissive unit underlying Site 27 as shown in Figure 7-3. Based on

the potentiometric contours plotted, a hydraulic gradient of 0.004 ft/ft in a northerly direction was calculated. This finding shows that monitoring well 27WW04 is positioned hydraulically downgradient of the other three monitoring wells installed during the Phase 2 investigation.

Table 7-3
Site 27 - South Test Area
Monitoring Well and Groundwater Data

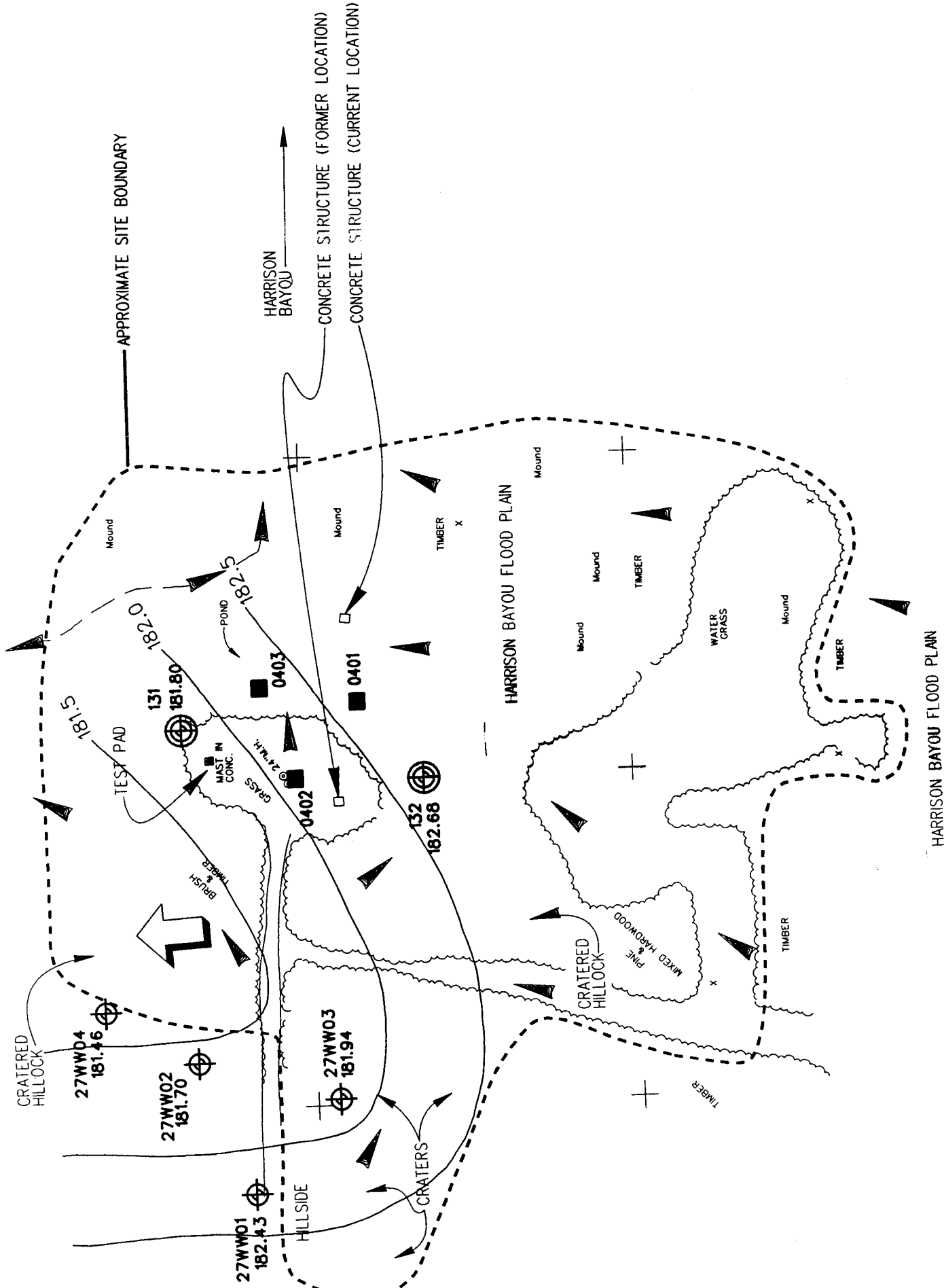
Well	Ground Elevation (feet)	Elevation Top of Casing (feet)	Date of Reading	Ground Water Elevation (feet)
131	186.31	189.02	11/94	181.80
132	185.51	188.34	11/94	182.68
27WW01	191.37	194.15	11/94	182.43
27WW02	183.57	186.37	11/94	181.70
27WW03	185.22	187.91	11/94	181.94
27WW04	182.67	185.27	11/94	181.46



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7-483

HARRISON BAYOU FLOOD PLAIN



LEGEND

- SHALLOW SOIL SAMPLE (EPS, 1982)
- SURFACE WATER FLOW DIRECTION
- MONITORING WELL (EPS, 1982)
- MONITORING WELL (SVERDRUP, 1994)
- POTENTIOMETRIC SURFACE CONTOUR
- GROUNDWATER FLOW DIRECTION



\$ THINK VALUE ENGINEERING - IT SAVES MONEY \$	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	LHAAP 27
CHECKED BY:	SOUTH TEST AREA
SUBMITTED BY:	POTENTIOMETRIC MAP
CHIEF, GEOTECH BR.	FIGURE 7-3

NOTE: POTENTIOMETRIC ELEVATION NOV. 1994

Rising head slug tests were conducted on all four Phase 2 monitoring wells using PVC slugs. Hydraulic conductivities calculated using the Bouwer-Rice method are given in Table 7-4. The average hydraulic conductivity value calculated for this shallow transmissive unit at Site 27 is 1.4×10^{-3} ft/min (7.6×10^{-4} cm/sec). Slug test data and analysis for the individual wells are given in Appendix D.

Table 7-4
Site 27 - South Test Area
Hydraulic Conductivity Values

Well	K (ft/day)	K (cm/sec)
27WW01	1.9×10^{-3}	1.0×10^{-3}
27WW02	1.0×10^{-3}	5.3×10^{-4}
27WW03	2.3×10^{-3}	1.2×10^{-3}
27WW04	5.8×10^{-4}	3.0×10^{-4}

The horizontal groundwater flow velocity at Site 27 was calculated to be 0.040 ft/day using the relationship $v = Ki/n$, using the average hydraulic conductivity and groundwater gradient and an assumed effective porosity of 20% for a silty fine sand.

8.0 CHEMICAL FINDINGS, SITE 11

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This section presents the results of field investigations at LHAAP Site 11, the Suspected TNT Burial Site. The information presented includes a summary and discussion of the chemical results of soil and water sampling at the site.

8.1 ANALYTICAL RESULTS

Data summary tables, showing detected analytes only, were prepared for each round or phase of sampling and are discussed below.

8.1.1 Soil Investigations

Initial investigations were conducted by EPS in 1984 and again in 1988. During these early focused investigations, EPS did not sample or test for any analytes other than explosives. Results of explosive analyses performed by EPS indicated minimal soil contamination (Table 8-1). The explosive, 2,4,6-TNT, was detected at 1860 ug/kg in soil sample 0801 at a depth of 2.5-5.0 ft during the 1984 sampling.

Table 8-1
Site 11 - Suspected TNT Burial Site
EPS Subsurface Soil Analytical Summary (1984 and 1988)

Parameter	Units	Sample Name / Interval							
		0801 (1984)		0801		0802		0803	
		0.0-2.5'	2.5'-5.0'	0.0-1.5'	1.5'-5.0'	0.0-2.5'	2.5'-5.0'	0.0-1.5'	1.5'-2.5'
2,4,6-TNT	ug/kg	<DL	1860	<DL	<DL	<DL	<DL	<DL	<DL
1,3,5-TNB	ug/kg	<DL	<DL	23	37	<DL	<DL	<DL	<DL

The explosive, 1,3,5-TNB, was detected in 7 of 9 surface soil samples during the 1988 sampling, ranging from 10 ug/kg to 117 ug/kg (Table 8-2). A companion boring at location 0801 which was drilled in 1988, did not detect 2,4,6-TNT and could not confirm the earlier finding.

During the Phase 1 Remedial Investigation conducted in the summer of 1993 a total of 6 soil borings were drilled and sampled by Ebasco. Three soil borings (11SB01, 02, and 03) were drilled within the boundary of the suspected burial pit and two borings (11SB05 and 06) were drilled within the borrow area to attempt to locate the disposal pit and to identify any explosives compounds in the soil and groundwater. One soil boring (11SB04) was drilled outside of the suspected waste disposal area. Analytical results of soil sampling conducted by Ebasco are shown in Table 8-3.

Table 8-2
Site 11 - Suspected TNT Burial Site
EPS Surface Soil Analytical Summary (1984 and 1988)

Parameter	Units	Sample Name								
		S1	S2	S3	S4	S5	S6	S7	S8	S9
2,4,6-TNT	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
1,3,5-TNB	ug/kg	40	<DL	22	10	97	70	117	13	<DL

Table 8-3
Site 11 - Suspected TNT Burial Site
Ebasco (1993) Subsurface Soil Analytical Summary

Parameter	Units	Boring 11SB01				Boring 11SB02			
		0-4'	5'-7'	10'-12'	15'-17'	0-4'	5'-7'	10'-12'	15'-17'
Volatile Organics	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Bis (2-ethylhexyl) phthalate	ug/kg	<DL	<DL	<DL	343	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	2J	1J	1J	4J	4J	2J	4J	<DL
Barium	mg/kg	36.9	50.4	50.7	1.5	33.5	28.2	28.8	61.6
Chromium	mg/kg	4.2	1.6	1.1	4.7	8.1	3.6	<DL	10.9
Lead	mg/kg	7J	5J	4J	10J	4J	11J	4J	4J
Mercury	mg/kg	0.02	0.02	<DL	<DL	0.02	<DL	0.02	<DL
Nickel	mg/kg	1.5	7.5	2.5	10.8	3.6	6.3	5.3	5.3
Antimony	mg/kg	<DL	<DL	3.3J	<DL	<DL	<DL	<DL	<DL
Chloride	mg/kg	<DL	44	<DL	<DL	<DL	<DL	<DL	<DL
Nitrate / Nitrite	mg/kg	<DL	<DL	<DL	0.74	0.35	<DL	<DL	0.53
Sulfate	mg/kg	640	610	860	290	240	310	<DL	540
pH	pH	6.1	6.4	7.1	7.7	6.2	6.2	6.6	6.8
Conductivity	umhos/cm	44	106	208	96	61	77	72	97

Table 8-3 (continued)
Site 11 - Suspected TNT Burial Site
Ebasco (1993) Subsurface Soil Analytical Summary

Parameter	Units	Boring 11SB03				Boring 11SB04			
		0.0'- 2.0'	5.0'- 7.0'	10.0'- 14.0'	15.0'- 17.0'	0.0'- 2.0'	5.0'- 7.0'	10.0'- 14.0'	15.0'- 17.0'
Volatile Organics	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Bis (2-ethylhexyl) phthalate	ug/kg	369	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	4J	2J	0.3	3	4	4	4J	2J
Barium	mg/kg	74.7J	33.7J	30.6J	32.4J	89.3J	44.7J	28.6	41
Chromium	mg/kg	10.5	1.1	5.3	3.8	11.9	15.8	2.9	8.2
Lead	mg/kg	6J	5J	1.6	3.0	4.6	5.2	5.4	2.5
Mercury	mg/kg	0.02	<DL	<DL	<DL	0.01	<DL	0.01	0.01
Selenium	mg/kg	2.3J	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Nickel	mg/kg	6.0	3.1	2.4	4.2	8.8	8.8	4.3	4.3
Nitrate / Nitrite	mg/kg	0.48	<DL	<DL	1.67	1.73	2.34	2.34	1.79
Sulfate	mg/kg	74	1200	170	240	100	110	80	120
pH	pH	5.7	6.2	7.0	7.3	6.1	6.2	5.9	5.9
Conductivity	umhos/cm	53	100	75	123	33	45	48	42

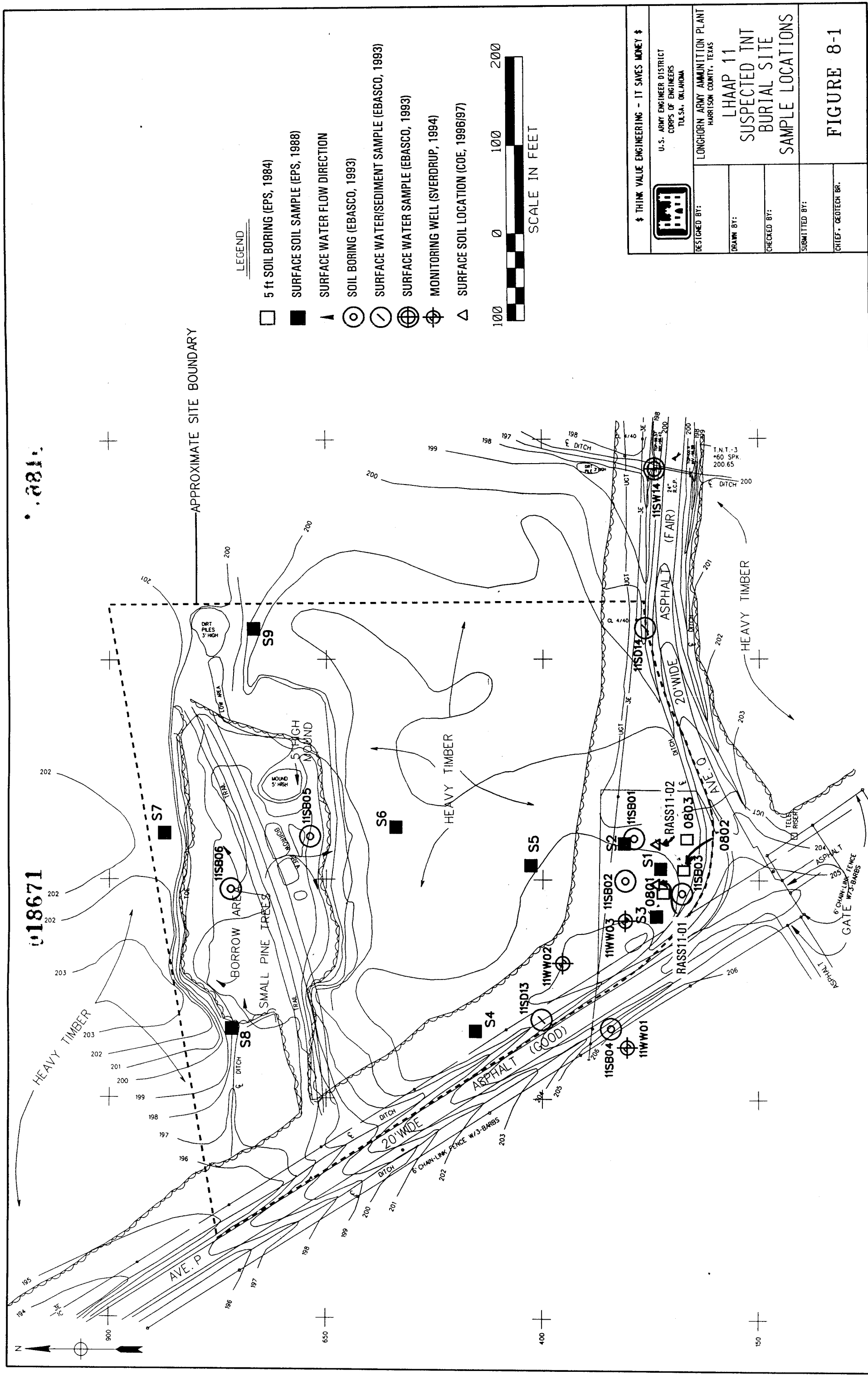
Generally, very few indications of contamination were found in the Phase 1 investigations. Based on Ebasco's findings, the presence of explosives found by EPS also could not be confirmed. With the exception of two low concentration occurrences of bis(2-ethylhexyl)phthalate, a common laboratory contaminant, explosives, volatile organic, and semi-volatile organic compounds were not detected in any of the soil samples collected during the Phase 1 investigation.

Table 8-3 (continued)
Site 11 - Suspected TNT Burial Site
Ebasco (1993) Soil Analytical Summary

Parameter	Units	Boring 11SB05		Boring 11SB06	
		0'-2'	5'-7'	0'-2'	5'-9'
Volatile Organics	ug/kg	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	3J	0.4J	3J	2J
Barium	mg/kg	25.8	19	167	54.0J
Chromium	mg/kg	5	<DL	6.9	3.8
Lead	mg/kg	4	3.1	22	4.7
Mercury	mg/kg	0.02	<DL	<DL	<DL
Nickel	mg/kg	4.3	1.4	6.9	5.7
Chloride	mg/kg	<DL	<DL	<DL	18
Nitrate / Nitrite	mg/kg	2.4	2.44	1.42	1.65
Sulfate	mg/kg	100	90	270	180
pH	pH	5.8	5.9	6.3	6.7
Conductivity	umhos/cm	40	46	50	83

Phase 2 field investigation sampling, performed by Sverdrup in 1994, consisted of drilling and sampling three monitoring wells, 11WW01, 02, and 03 (Figure 8-1). Samples for chemical analyses were collected at 5-foot intervals from the ground surface throughout the vadose zone. The borings were completed as monitoring wells with 4-in. I.D. stainless steel casing and 10-foot stainless steel screens for groundwater monitoring. Analytical results of soil sampling conducted by Sverdrup are summarized in Table 8-4.

With the exception of some common laboratory contaminants, no explosive, volatile, or semi-volatile organic compounds were detected in any of the soil samples. Methylene chloride, was detected above the PQL of 12 ug/kg in 11 of the 13 soil samples, ranging from 14 to 32 ug/kg. Acetone was found in 3 samples above the PQL of 12 ug/kg, at values of 23, 52, and 80 ug/kg. It was also found in the field blanks and is qualified with a "B". Di-n-butyl phthalate was found in 10 of the 13 samples at concentrations ranging from 440 to 755 ug/l. Di-n-butylphthalate was found in the laboratory method blanks at similar concentrations and is also qualified with a "B". The most commonly detected metals were arsenic, barium, chromium, lead, and nickel.



The highest detected metal concentrations appear to be randomly distributed at various intervals and borings. Based on the scattered occurrence of the highest metal concentrations, there is no evidence of soil contamination.

Table 8-4
Site 11 - Suspected TNT Burial Site
Soil Analytical Summary from Sverdrup (1994)

Parameter	Units	Boring 11WW01				Boring 11WW03		
		0.0'-2.0'	3.0'-5.0'	8.0'-10.0'	13.0'-15.0'	0.0'-1.0'	3.0'-5.0'	8.0'-10.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	<DL	52B	23B	<DL	<DL	<DL
Methylene chloride	ug/kg	<DL	<DL	<DL	14	17	23	27
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butyl phthalate	ug/kg	595B	483B	648B	755B	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	3.7	9.71	6.14	1.1	4.2	0.92	2.7
Barium	mg/kg	73.2	63.1	43	40.6	77.1	89.6	30.1
Chromium	mg/kg	18.5	16.5	8.6	6.5	9.9	8.6	4.8
Lead	mg/kg	7.66	12.6	14.5	7.63	7.1	4.6	4.7
Nickel	mg/kg	5.1	6.2	6.4	2.3	6.2	9.6	3.1
Chloride	mg/kg	18.6	21.6	21.5	21.6	32.9	19.8	9.7
Nitrate / Nitrite	mg/kg	16.9	18.3	13.7	15.7	17.9	12.2	18.6
Sulfate	mg/kg	0.64	0.76	0.80	1.15	0.52	0.76	0.53

In August 1996, the Tulsa District Corps of Engineers collected two surface soil samples at Site 11 to provide data to be used in the preparation of the risk assessment portion of this report. The sample locations shown on Figure 8-1. These samples were analyzed for explosives and 11 metals (arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, antimony, and thallium). In February 1997, surface soil samples were taken at the same locations with analyses performed for 12 metals (aluminum, beryllium, calcium, cobalt, copper, iron, potassium, magnesium, manganese, strontium, vanadium and zinc). Analytical results of surface soil samples collected by the Tulsa District Corps of Engineers are presented in Table 8-5.

No explosives were detected in the samples collected. Detected metal concentrations showed no indications of contamination.

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Table 8-4 (Continued)
Site 11 - Suspected TNT Burial Site
Sverdrup Subsurface Soil Analytical Summary (1994)

Parameter	Units	Boring 11WW02					
		0.0'- 1.0'	3.0'- 5.0'	8.0'- 10.0'	13.0'- 15.0'	18.0'- 20.0'	23.0'- 25.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	80B	<DL	<DL	<DL	<DL
Methylene Chloride	ug/kg	21	20	23	32	25	33
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	634B	568B	644B	440B	579B	563B
Explosive	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.5	2.4	5.9	1	3	1.6
Barium	mg/kg	116	49.2	84.5	85.5	80.4	51
Chromium	mg/kg	7.3	9.2	11.2	11	10	8.9
Lead	mg/kg	8.09	7.31	16	8.91	6.42	5.7
Nickel	mg/kg	4.4	6.4	12.8	10	15.1	9.8
Chloride	mg/kg	8.9	19.6	14.2	13.3	9.3	<DL
Nitrate / Nitrite	mg/kg	17	12.7	19.4	17.9	<DL	<DL
Sulfate	mg/kg	0.61	0.64	1.15	0.9	0.92	0.85

Table 8-5
Site 11 - Suspected TNT Burial Site
Tulsa District Corps of Engineers (1996/97)
Surface Soil Analytical Summary

Parameter	Units	RASS11-01	RASS11-02
Explosives	ug/kg	<DL	<DL
Aluminum	mg/kg	4360	3400
Antimony	mg/kg	<DL	1.1
Arsenic	mg/kg	1.15	1.58
Barium	mg/kg	57.7	41.5

Table 8-5
Site 11 - Suspected TNT Burial Site
Tulsa District Corps of Engineers (1996/97)
Surface Soil Analytical Summary

Parameter	Units	RASS11-01	RASS11-02
Beryllium	mg/kg	<DL	<DL
Cadmium	mg/kg	<DL	<DL
Calcium	mg/kg	242	403
Chromium	mg/kg	6.07	5.67
Cobalt	mg/kg	2.92	<DL
Copper	mg/kg	4.35	4.02
Iron	mg/kg	12,000	4,510
Lead	mg/kg	6.0	8
Magnesium	mg/kg	199	211
Manganese	mg/kg	234	199
Mercury	mg/kg	<DL	<DL
Nickel	mg/kg	5.74	5.43
Potassium	mg/kg	372	382
Selenium	mg/kg	<DL	<DL
Silver	mg/kg	<DL	<DL
Strontium	mg/kg	<DL	<DL
Thallium	mg/kg	<DL	<DL
Vanadium	mg/kg	32.9	11.2
Zinc	mg/kg	16.6	13.6

8.1.2 Groundwater Investigations

Initial groundwater investigations consisted of collecting groundwater grab samples from the six soil borings drilled during the Phase 1 Remedial Investigation. The purpose of collecting groundwater grab samples was to obtain preliminary field screening data of potential groundwater contaminants. The most significant finding from the analysis of the groundwater grab samples was that there were no organic or explosives compounds detected with the exception of 0.62 ug/l

of 1,3,5-TNB in boring 11SB04. A data table summarizing the results of all groundwater grab samples is shown in Appendix D.

To further investigate potential groundwater contamination with explosives in the vicinity of soil boring 11SB04, three monitoring wells, 11WW01, 11WW02, and 11WW03, were installed during the 1994 Phase 2 field investigation (Figure 8-1). One monitoring well was located one upgradient and two downgradient of boring 11SB04 to confirm the groundwater grab sample explosive result. The three installed wells were purged of a minimum of five well volumes and sampled. Results of groundwater sampling are summarized in Table 8-5.

Table 8-6
Site 11 - Suspected TNT Burial Site
Groundwater Analytical Summary (1994)

Parameter	Units	11WW01 (upgradient)	11WW02	11WW03
Volatiles	ug/l	<DL	<DL	<DL
Semivolatiles	ug/l	<DL	<DL	<DL
Explosives	ug/l	<DL	<DL	<DL
Barium	mg/l	0.032	0.139	0.3
Chromium	mg/l	<DL	0.037	0.049
Lead	mg/l	<DL	0.008	0.016
Nickel	mg/l	<DL	0.047	0.051

The only analytes detected in the three groundwater samples were the metals barium, chromium, lead, and nickel. Because no explosives were found, the indication of explosive contamination from the Phase 1 groundwater grab sample was not confirmed. Based on these results no evidence of groundwater contamination is indicated.

8.1.3 Surface Water and Sediment Investigations

Two surface water and two sediment samples were collected by Ebasco. Surface water and sediment analytical results are summarized in Table 8-6. No organic or explosives compounds were detected in any of the samples. Small concentrations of barium and lead were detected in the surface water samples. Lead ranged from 0.005 to 0.011 mg/l and barium ranged from 0.01 to 0.18 mg/l. Low concentrations of chloride (44 mg/kg), sulfate (30 mg/kg), and 6 metals were detected in the sediments. Because detected concentrations and types of metals are consistent with results from subsurface soil sampling conducted by both Ebasco and Sverdrup, no evidence for

contamination is indicated.

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Table 8-7
Site 11 - Suspected TNT Burial Site
Surface Water and Sediment Analytical Summary (1993)

Parameter	Surface Water			Sediment		
	Units	SW13	SW14	Units	SD13	SD14
Volatiles	ug/l	<DL	<DL	ug/kg	<DL	<DL
Semivolatiles	ug/l	<DL	<DL	ug/kg	<DL	<DL
Di-n-butylphthalate	ug/l	<DL	<DL	ug/kg	941B	738B
Explosives	ug/l	<DL	<DL	ug/kg	<DL	<DL
Arsenic	mg/l	<DL	<DL	mg/kg	1.5	3.9
Barium	mg/l	0.18	0.17	mg/kg	41.7	33.5
Chromium	mg/l	<DL	<DL	mg/kg	8.1	20.9
Lead	mg/l	0.011	<DL	mg/kg	13.0	4.0
Mercury	mg/l	<DL	<DL	mg/kg	0.02	0.02
Nickel	mg/l	<DL	<DL	mg/kg	2.7	3.1
Selenium	mg/l	<DL	<DL	mg/kg	0.2	0.3
Chloride	mg/l	2.6	2.6	mg/kg	44	<DL
Nitrate / Nitrite	mg/l	0.26	0.37	mg/kg	<DL	<DL
Sulfate	mg/l	3.0	<DL	mg/kg	30	30
pH	pH	<DL	<DL	pH	6.4	6.7
Conductivity	umhos/cm	<DL	<DL	umhos/cm	60	112

8.2 NATURE AND EXTENT OF CONTAMINATION

8.2.1 Explosives

Since the site is a suspected TNT burial site, the major contaminant of concern is TNT. The only TNT was found in the soil in 1982 and not confirmed four years later when the identical spot was drilled again and sampled. Soil and groundwater explorations in 1993 and 1994 also failed to find TNT. With the exception of one field screening (groundwater grab sample) result from 1993 the Phase 1 and Phase 2 explorations failed to show any explosives at the site. All monitoring wells

drilled around the groundwater grab sample location did not detect explosives.

8.2.2 Volatile and Semivolatile Organics

Other organics found include methylene chloride and bis(2ethylhexyl)phthalate at low and consistent levels, and the laboratory-qualified presence of acetone and Di-n-butylphthalate. These compounds are common laboratory contaminants, being found in glassware and tubing (the phthalate) and in laboratory atmospheres (acetone and methylene chloride). The qualified analyses were found in field and laboratory blanks. There is no indication that volatile organics or semivolatile organics are present at the site.

8.2.3 Metals and Other Inorganics

There is no evidence that the detected metals represent contamination. Anions and other parameters are typical for the environment in which they were found.

8.3 CONCLUSIONS

Because of the absence of contamination in any of the sampling media, hot spots of explosives as would be expected around a TNT burial or even moderate concentrations, the presence of the TNT burial is unconfirmed. No further action at Site 11 is recommended.

9.0 CHEMICAL FINDINGS, SITE 1

This section presents the results of field investigations at LHAAP Site 1, the Inert Burning Grounds. The information presented includes a summary and discussion of the chemical results of soil and water sampling at the site.

9.1 ANALYTICAL RESULTS

Data summary tables, showing detected analytes only, were prepared for each round or phase of sampling and are discussed below.

9.1.1 Soil Investigations

The suspected source of contamination is burned explosive waste residues and possibly bulk explosive wastes that have been covered or mixed with fill materials. Results of analyses performed on three surface (0-1') soil samples collected by EPS in 1982 indicated consistently elevated levels of lead and zinc. No explosives, volatiles, or semivolatiles were detected in these three samples. These results are provided in Table 9-1. Sampling locations are shown on Figure 9-1.

The Phase 1 investigation of Site 1 was conducted in two phases in 1993. During the first stage of the Phase 1 investigation conducted by Ebasco, 41 soil samples were collected at 5 foot depth intervals from 8 borings ranging in depth from 10 to 30 feet. These borings were spaced over the south and east portion of the site. The analytical results from Ebasco soil samples are presented in Table 9-2. The second phase of the Phase 1 investigation was conducted by Weston over the north and west portions of the site. Weston collected 74 soil samples at 5 foot depth intervals within unsaturated soils from 9 soil borings. The results from the analysis from the soil samples collected by Weston are presented in Table 9-3.

The Phase 2 investigation of Site 1 was conducted by Sverdrup in 1994 and included the collection of 5 surface soil samples. These samples were analyzed for barium, lead and selenium. The analytical results from these samples are provided in Table 9-1.

In August 1996, the Tulsa District Corps of Engineers collected surface soil samples from nine locations in support of the risk assessment to be performed at this site. All samples were analyzed for semi-volatile organics. Two samples (RASS01-1 and RASS01-9) were also analyzed for explosives and 11 metals (arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, antimony, and thallium). In February 1997, surface soil samples were taken at the locations, RASS01-1 and RASS01-9. Samples from both locations were analyzed for 12 metals (aluminum, beryllium, calcium, cobalt, copper, iron, potassium, magnesium, manganese, strontium, vanadium and zinc). In addition, a sample from location RASS01-1 was analyzed for explosives. The results of the chemical analysis of these samples are

presented in Table 9-4.

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Figure 9-1 shows the locations of the soil boring, sampling locations and monitoring wells at Site 1.

9.1.1.1 Organic Compounds

No explosives were found in any surface or subsurface soil sample. A few volatile organic compounds were detected. Toluene at 6.7 ug/kg and xylene at 30.6 ug/kg were found at 2.5 feet in 01SB26. Styrene at 6 ug/kg was found at 7.5 feet in 01SB01. Acetone, a common laboratory contaminant, was found in low levels (10 to 32 ug/kg) in 01MW01, 02, and 01SB01. Acetone was found but qualified with a J or B in several other borings. Methylene chloride was found in 2 samples from 01SB03 at 7 and 20 ug/kg and in several other borings with a B qualifier.

Semivolatile organics were detected in soil samples at this site. Two plasticizers, di-n-butyl phthalate and bis(2-ethylhexyl)phthalate, were found in many of the samples. Out of 17 borings, di-n-butyl phthalate was found in concentrations ranging from 1 to 3 times the PQL of 330 ug/kg in 6 of them. Sample 0.0 to 2.5 in 01SB29 had a concentration of 3580 ug/kg. Di-n-butyl phthalate was found but coded with a B in 8 borings and with a J in one boring. Bis(2-ethylhexyl)phthalate was found in 6 borings in concentrations ranging from just above the PQL of 330 to 1200 ug/kg. It was qualified with a J in 7 borings. Polynuclear aromatic hydrocarbons (PAHs) showed up in the uppermost sample in two soil borings (01MW03 and 01SB26), about 130 feet from each other as well as in three of the four surface soil samples collected by the Tulsa District Corps of Engineers in 1996. PAHs also appeared in a sediment sample near 32nd Street. Four PAH compounds were detected in 01MW03 at concentrations ranging from 340 to 530 mg/kg, and 8 J-qualified compounds were found in this boring as well. Eight PAH compounds were found in 01SB26 at concentrations ranging from 484 to 1620 ug/kg. These PAH compounds are typically associated with incomplete combustion and could be present as the result of fires set to clear forest undergrowth.

9.1.1.2 Metals

Lead concentrations detected in soil samples were as high as 75 ug/kg, and tended to be highest at or near the surface. For nickel, a maximum concentration 44 ug/kg was detected with higher concentrations appearing to generally increase with depth. Barium concentrations were as high as 149 ug/kg in 01MW01. Barium shows no apparent trend with depth. A maximum concentration of 0.9 ug/kg for selenium was detected in the interval 1.4'-4.6' in 01MW02.

Table 9-1
Site 1 - Inert Burning Grounds
Surface Soil Analytical Summary from EPS (1982) and Sverdrup (1994)

Parameter	Units	EPS (0.0 to 1.0')			Sverdrup				
		0101	0102	0103	SS01	SS02	SS03	SS04	SS05
Volatiles	ug/kg	<DL	<DL	<DL	NT	NT	NT	NT	NT
Semivolatiles	ug/kg	<DL	<DL	<DL	NT	NT	NT	NT	NT
Explosives	ug/kg	<DL	<DL	<DL	NT	NT	NT	NT	NT
Aluminum	mg/kg	1361	1435	1128	NT	NT	NT	NT	NT
Barium	mg/kg	102.6	106.6	98.4	66.4	188	67	68.2	61.7
Chromium	mg/kg	11.2	12.3	14.4	NT	NT	NT	NT	NT
Lead	mg/kg	29.4	26.1	28.4	8.7	29	17	19	7.4
Nickel	mg/kg	6	5	5	NT	NT	NT	NT	NT
Manganese	mg/kg	49.8	99.4	122.1	NT	NT	NT	NT	NT
Selenium	mg/kg	NT	NT	NT	<DL	<DL	<DL	<DL	<DL
Strontium	mg/kg	10.1	9.5	9.4	NT	NT	NT	NT	NT
Copper	mg/kg	8.1	17.4	15.4	NT	NT	NT	NT	NT
Zinc	mg/kg	25.4	56.4	47.2	NT	NT	NT	NT	NT
Chloride	mg/kg	6	5	7	NT	NT	NT	NT	NT
Nitrite/Nitrate	mg/kg	<DL	<DL	8.33	NT	NT	NT	NT	NT
Sulfate	mg/kg	40.0	29.7	40.5	NT	NT	NT	NT	NT
Fluoride	mg/kg	7	8	9	NT	NT	NT	NT	NT

Table 9-2
Site 1 - Inert Burning Grounds
Ebasco Subsurface Soil Analytical Summary (1993)

Parameter	Units	Boring 01SB22					
		0.0-2.5'	2.5'-5.0'	5.0'-7.5'	10.0'-14.0'	14.0'-17.0'	20.0'-24.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	3	2	1	1	4	2
Barium	mg/kg	98.7	79	28.9	23.7	32.9	84.3
Chromium	mg/kg	12.4	7.2	10.3	53.4	10.9	7.8
Lead	mg/kg	18	4.3	3.6	4.1	5.2	7.5
Mercury	mg/kg	0.11	0.04	0.03	0.07	0.05	0.02
Nickel	mg/kg	4.2	5	2.4	4.6	5.7	16.1
Selenium	mg/kg	0.3	0.2	0.1	0.1	<DL	<DL
Nitrite/Nitrate	mg/kg	1.49	1.66	0.71	0.79	1.18	0.89
Sulfate	mg/kg	750	150	<DL	130	130	<DL
pH	pH	7.8	7.6	7.3	6.2	6.4	6.5
Conductivity	umhos	277	184	185	64	40	145

Table 9-2 (con't)
Site 1 - Inert Burning Grounds
Ebasco Subsurface Soil Analytical Summary (1993)

Parameter	Units	Boring 01SB23					
		0.0'- 2.5'	2.5'- 5.0'	5.0'- 7.5'	10.0'- 12.0'	15.0'- 19.0'	20.0'- 22.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Semi-volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butyl phthalate	ug/kg	855	<DL	<DL	<DL	<DL	<DL
Bis(2ethylhexyl) phthalate	ug/kg	396	<DL	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	5	5	2	2	1	4
Barium	mg/kg	47.3	35.4	55.9	17.3	43.9	60.4
Chromium	mg/kg	8.6	6.6	11.2	8.3	5.7	9.1
Lead	mg/kg	17	9.8	4	4.7	8	7
Mercury	mg/kg	0.07	0.09	0.02	0.02	0.08	<DL
Nickel	mg/kg	6.5	2.6	3.4	1.5	4.5	10.5
Selenium	mg/kg	0.3	0.2	0.2	0.2	0.2	0.1
Chloride	mg/kg	<DL	44	44	<DL	<DL	44
Nitrite/Nitrate	mg/kg	0.64	0.89	0.94	0.76	0.96	1.22
Sulfate	mg/kg	<DL	190	150	130	270	130
pH	pH	6.1	7.2	7.2	6.2	6.2	6.6
Conductivity	umhos	106	210	331	100	53	130

Table 9-2 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Ebasco (1993)

Parameter	Units	Boring 01SB24				Boring 01SB25			
		0.0'- 2.5'	2.5'- 5.0'	5.0'- 7.5'	10.0'- 14.0'	0.0'- 2.5'	2.5'- 5.0'	5.0'- 7.5'	10.0'- 12.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	0.2	0.2	2	3	6	4	5	4
Barium	mg/kg	55.6	59.3	32.3	30.1	60.1	23.6	58.2	60.1
Chromium	mg/kg	18.6	32.1	6.2	9.4	20.4	18	17.6	8.5
Lead	mg/kg	3	5	2	10	61	9	13	9
Mercury	mg/kg	0.08	0.06	<DL	0.03	0.06	0.04	0.03	0.02
Nickel	mg/kg	5.6	11.6	7.4	44.4	8.1	5.9	8.9	18.7
Selenium	mg/kg	0.2	0.3	<DL	0.2	0.5	0.1	0.1	<DL
Chloride	mg/kg	44	<DL	<DL	<DL	44	<DL	<DL	<DL
Nitrite/Nitrate	mg/kg	1.38	1.12	1.84	1.38	1.32	0.41	0.38	0.68
Sulfate	mg/kg	330	140	140	150	<DL	150	<DL	<DL
pH	pH	7.0	6.6	5.8	6.1	6.8	7	6.1	6.3
Conductivity	umhos	171	277	283	133	109	218	212	104

Table 9-2 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Ebasco (1993)

Parameter	Units	Boring 01SB26			
		0.0- 2.5'	2.5'- 5.0'	5.0'- 7.5'	10.0'- 12.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL
Toluene	ug/kg	<DL	6.7	<DL	<DL
Xylene	ug/kg	<DL	30.6	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	<DL	<DL	<DL	799
Phenanthrene	ug/kg	763	<DL	<DL	<DL
Fluoranthene	ug/kg	1620	<DL	<DL	<DL
Pyrene	ug/kg	1740	<DL	<DL	<DL
Benzo(a)anthracene	ug/kg	753	<DL	<DL	<DL
Benzo(b)fluoranthene	ug/kg	887	<DL	<DL	<DL
Benzo(k)fluoranthene	ug/kg	762	<DL	<DL	<DL
Benzo(a)pyrene	ug/kg	829	<DL	<DL	<DL
Ideno(a,h)anthracene	ug/kg	560	<DL	<DL	<DL
Benzo(g,h,i)perylene	ug/kg	484	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	3	4	4	3
Barium	mg/kg	59.1	39.9	52.8	55.9
Chromium	mg/kg	9	12.6	22.7	15.2
Lead	mg/kg	9	8	13	8
Mercury	mg/kg	0.01	0.06	0.04	0.04
Nickel	mg/kg	3.6	3.7	9	14.1
Selenium	mg/kg	0.2	0.4	0.4	<DL
Chloride	mg/kg	<DL	44	44	<DL
Nitrite/Nitrate	mg/kg	1.41	<DL	1.66	1.05
Sulfate	mg/kg	<DL	<DL	160	<DL
pH	pH	6.6	6.3	6.2	6
Conductivity	umhos	42	199	127	71

Table 9-2 (con't)
Site 1 - Inert Burning Grounds
Ebasco Sub Surface Soil Analytical Summary (1993)

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Parameter	Units	Boring 01SB27			Boring 01SB28		
		0.0- 2.5'	2.5'- 5.0'	5.0'- 7.5'	0.0- 2.5'	2.5'- 5.0'	5.0'- 7.5'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Di-n- butyl phthalate	ug/kg	1450	567	443	662	<DL	<DL
Bis(2-ethylhexyl) phthalate	ug/kg	<DL	<DL	<DL	955	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	6	3	4	3	4	4
Barium	mg/kg	73.9	44.7	31.7	54.8	23.9	24.7
Chromium	mg/kg	19.1	11.4	18.6	11.7	19.6	14.9
Lead	mg/kg	75	15	10	7	9	5
Mercury	mg/kg	0.08	0.05	0.02	0.06	0.03	0.03
Nickel	mg/kg	6.9	4	8.2	5	4.9	4.6
Selenium	mg/kg	0.2	0.3	0.2	0.5	0.3	<DL
Chloride	mg/kg	44	44	44	44	44	44
Nitrite/Nitrate	mg/kg	<DL	<DL	<DL	<DL	1.41	1.44
Sulfate	mg/kg	<DL	250	150	130	<DL	<DL
pH	pH	6.7	6.6	5.6	6.1	5.9	5.8
Conductivity	umhos	100	714	360	139	42	314

Table 9-2 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Ebasco (1993)

019687

Parameter	Units	Boring 01SB29						
		0.0'- 2.5'	2.5'- 5.0'	5.0'- 7.5'	10.0'- 12.0'	15.0'- 17.0'	20.0'- 23.0'	25.0'- 27.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	3580	<DL	<DL	<DL	<DL	<DL	<DL
Bis(2-ethylhexyl) phthalate	ug/kg	<DL	577	<DL	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	5	3	4	3	3	3	2
Barium	mg/kg	47.2	40.4	47.1	47.6	37.1	45.7	42.7
Chromium	mg/kg	10.7	9.6	11.9	7.3	1.7	2.2	1.7
Lead	mg/kg	8	5	9	9	8	6	7
Mercury	mg/kg	0.08	0.03	0.02	0.02	0.03	0.03	0.02
Nickel	mg/kg	5.4	7.3	11.5	12.7	6.4	10.1	10.1
Selenium	mg/kg	0.2	<DL	<DL	<DL	<DL	<DL	<DL
Chloride	mg/kg	<DL	<DL	44	<DL	<DL	44	<DL
Nitrite/Nitrate	mg/kg	<DL	0.48	0.76	1.55	1.23	<DL	<DL
pH	pH	6.0	5.6	5.8	6.2	6.5	6.7	6.8
Conductivity	umhos	49	233	67	49	52	59	43

Table 9-3
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

Parameter	Units	Well 01MW01					
		0.0'-1.0'	1.0'-3.4'	3.4'-6.0'	6.0'-7.5'	7.5'-10.8'	10.8'-13.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	10	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butyl phthalate	ug/kg	190B	180B	<DL	120B	85B	79B
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	3.2	0.057	1.7	2.3	0.9	1.7
Barium	mg/kg	83.7	97.8	99.4	149	103	113
Cadmium	mg/kg	<DL	<DL	<DL	<DL	<DL	0.88
Chromium	mg/kg	11	14.3	15.1	14.5	12.9	13.3
Lead	mg/kg	11.8	6.6	8.1	16.2	7.1	6.1
Mercury	mg/kg	<DL	0.11	<DL	<DL	<DL	<DL
Nickel	mg/kg	21.3	23.1	30.9	34.7	21.2	26.7
Selenium	mg/kg	<DL	<DL	<DL	<DL	<DL	0.19
Thallium	mg/kg	<DL	<DL	<DL	0.18	<DL	<DL
Chloride	mg/kg	100	43	11	37	<DL	130
Nitrite/Nitrate	mg/kg	<DL	<DL	<DL	<DL	1.5	<DL
Sulfate	mg/kg	56.9	59.7	149	<DL	105	112
pH	pH	4.5	5	4.8	5.2	4.3	5

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

Parameter	Units	Well 01MW01					
		15.0'- 17.5'	17.5'- 20.2'	20.2'- 22.0'	22.0'- 24.0'	25.0'- 27.0'	27.0'- 29.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	<DL	<DL	<DL	12	10
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	77B	130B	100B	73B	82B	75B
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	0.83	1.3	0.97	1.8	1.4	1.3
Barium	mg/kg	95.5	102	81.7	86.5	87.4	102
Chromium	mg/kg	12.1	10.7	13	12.9	14.4	14.5
Lead	mg/kg	7.2	9.2	18.7	7.7	10.6	9.2
Nickel	mg/kg	25.7	27.5	18.7	24.2	24	27.9
Chloride	mg/kg	40	3	79	<DL	12	55
Nitrite/Nitrate	mg/kg	<DL	<DL	<DL	1.4	<DL	<DL
Sulfate	mg/kg	47.8	100	82.6	66.5	51.6	59.4
pH	pH	5	5.6	5.4	5.3	5.2	5

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary From Weston (1993)

Parameter	Units	Well 01MW02				
		0.0'-1.4'	1.4'-4.6'	5.0'-6.8'	6.8'-9.5'	10.0'-11.5'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	9J	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	130B	92B	90B	110B	73B
Bis(2-ethylhexyl)phthalate	ug/kg	<DL	86I	120I	<DL	190I
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.9	1.8	0.93	0.72	1.9
Barium	mg/kg	33.3	48.2	64.5	55.7	83.4
Chromium	mg/kg	18.4	12.5	11.3	14.2	13.4
Lead	mg/kg	5.3	15	5.9	7	8.1
Nickel	mg/kg	6.3	5.6	12.1	12.7	20.2
Selenium	mg/kg	0.44	0.9		0.19	0.25
Nitrite/Nitrate	mg/kg	1.8	<DL	<DL	<DL	<DL
Sulfate	mg/kg	<DL	76.8	103	66.1	<DL
pH	pH	4.9	4.8	4.9	4.9	4.9

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

013691

Parameter	Units	Well 01MW02				
		12.0'-14.5'	15.0'-16.6'	17.0'-18.8'	20.0'-21.5'	22.0'-24.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	12	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	<DL	<DL	170B	39B	<DL
Bis(2-ethylhexyl)phthalate	ug/kg	150J	340	150J	88J	320J
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.2	0.88	1.3	0.65	1.3
Barium	mg/kg	82.1	110	94.4	80.5	79.8
Chromium	mg/kg	14	26.1	11.3	13.2	13.3
Lead	mg/kg	4.5	3.7	4.9	3.4	7.4
Nickel	mg/kg	18.7	21	24.1	26.1	25.4
Selenium	mg/kg	0.24	0.3	0.29	<DL	0.19
Sulfate	mg/kg	57.7	<DL	<DL	70.1	76.8
pH	pH	5	4.8	5.4	5.5	5

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

Parameter	Units	Well 01MW03				
		0.0'-1.5'	1.5'-4.4'	5.0'-6.6'	7.0'-9.4'	10.0'-11.6'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Methylene chloride	ug/kg	<DL	6B	5B	6B	5B
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	160B	93B	210B	120B	110B
Bis(2-ethylhexyl)phthalate	ug/kg	190J	220J	370	210J	120J
Phenanthrene	ug/kg	290J	<DL	<DL	<DL	<DL
Anthracene	ug/kg	56J	<DL	<DL	<DL	<DL
Fluoranthene	ug/kg	530	<DL	<DL	<DL	<DL
Pyrene	ug/kg	370	<DL	<DL	<DL	<DL
Benzo(a)anthracene	ug/kg	230J	<DL	<DL	<DL	<DL
Chrysene	ug/kg	240J	<DL	<DL	<DL	<DL
Benzo(b)fluoranthene	ug/kg	530	<DL	<DL	<DL	<DL
Benzo(k)fluoranthene	ug/kg	160J	<DL	<DL	<DL	<DL
Benzo(a)pyrene	ug/kg	340	<DL	<DL	<DL	<DL
Indeno(123-cd)pyrene	ug/kg	240J	<DL	<DL	<DL	<DL
Dibenzo(ah)anthracene	ug/kg	59J	<DL	<DL	<DL	<DL
Benzo(g,h,i)perylene	ug/kg	230J	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.6	3.3	2.4	1.9	2.9
Barium	mg/kg	65.4	67.3	69.9	68.8	70.7
Chromium	mg/kg	12.3	17.1	19.8	12.2	12.9
Lead	mg/kg	28.3	13	11.7	11.5	17.1
Mercury	mg/kg	0.091	<DL	<DL	<DL	<DL
Nickel	mg/kg	7.3	6.3	12	11.8	19
Selenium	mg/kg	0.23	0.53	0.23	0.21	0.3
Sulfate	mg/kg	71.4	71.2	<DL	71.7	56.8
pH	pH	6.6	5.1	5	5	5

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

Parameter	Units	Well 1MW04				
		0.0-1.5'	1.8'-3.8'	5.0'-6.8'	6.8'-9.0'	10.0'-11.6'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	29B	<DL	32B	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	150B	140B	160B	140B	180B
Bis(2-ethylhexyl) phthalate	ug/kg	270J	210J	<DL	1200	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.1	2.2	1.7	3.3	3.1
Barium	mg/kg	79.4	99.6	39.7	52.1	52
Chromium	mg/kg	12.3	11.2	8.2	16.4	13
Lead	mg/kg	5.5	5.5	5.7	6.6	12.5
Nickel	mg/kg	3.7	4.9	2.2	2.7	2.8
Selenium	mg/kg	<DL	<DL	0.19	0.41	0.7
Nitrate / Nitrite	mg/kg	1	<DL	1.1	<DL	<DL
Sulfate	mg/kg	99	102	75.8	70.2	50.5
pH	pH	5.9	5.1	4.9	5	7

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

Parameter	Units	01MW04				
		11.6'-14.0'	15.0'-16.7'	16.7'-19.8'	20.0'-21.5'	21.8'-24.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Acetone	ug/l	19B	11B	15B	20B	15B
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	110B	46B	210B	170B	210B
Bis(2-ethylhexyl) phthalate	ug/kg	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	2.1	0.81	0.74	0.87	0.75
Barium	mg/kg	77	105	103	125	117
Chromium	mg/kg	16.1	15.6	12.9	12.2	12.7
Lead	mg/kg	12.5	13.1	7.1	8.4	9.9
Nickel	mg/kg	13.9	27.5	21.7	26.6	25
Selenium	mg/kg	0.82	0.54	0.27	0.53	0.59
Sulfate	mg/kg	79.7	75.3	88.3	28.8	21.1
pH	pH	5.4	5.6	5.3	5.3	5.4

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

Parameter	Units	Well 01MW05				
		0.0-1.4'	1.4'-3.8'	5.0'-6.6'	6.6'-9.2'	10.0'-12.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Methylene Chloride	ug/kg	5B	5B	5B	5B	5B
Acetone	ug/kg	<DL	<DL	<DL	<DL	13B
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	110B	120B	120B	150B	140B
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.1	2.4	2.2	2	2.4
Barium	mg/kg	65.1	45.9	19.5	20.2	53.2
Chromium	mg/kg	12.8	20.7	10	11.2	10.6
Lead	mg/kg	3.7	9.2	4.7	3.9	6.4
Nickel	mg/kg	3.3	4.1	1.5	<DL	7.4
Selenium	mg/kg	<DL	0.18	0.43	0.4	0.39
Chloride	mg/kg	<DL	<DL	<DL	43	73
Sulfate	mg/kg	59.2	55	58.6	84.8	51.8
pH	pH	5.8	4.8	4.6	4.4	4.6

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

Parameter	Units	Boring 01SB01								
		0.0'- 1.4'	1.4'- 3.5'	5.0'- 6.6'	6.6'- 8.8'	10.0'- 11.5'	11.5'- 13.8'	15.0'- 16.4'	16.4'- 18.8'	20.0'- 21.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Styrene	ug/kg	<DL	<DL	<DL	6	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	20	20	13	32	29	23	27	36
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butyl phthalate	ug/kg	330	290J	300J	290J	270J	270J	360J	310J	280J
Bis(2-ethylhexyl) phthalate	ug/kg	<DL	<DL	<DL	84J	<DL	<DL	<DL	48J	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	4.5	8.8	4.0	3.8	2.6	2.3	1.7	1.5	1.4
Barium	mg/kg	32.2	35.4	65.2	62.6	54.5	74.2	77.7	100	76.9
Chromium	mg/kg	10.9	19.2	11.5	11.3	12.4	14.2	12.3	12.7	15.9
Lead	mg/kg	7.7	6.5	9.4	9.4	7.4	10.4	7.5	29.7	12.7
Nickel	mg/kg	6.7	12.6	15.5	14.5	15.8	21.7	19.4	26.5	28.4
Selenium	mg/kg	0.22	0.20	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Chloride	mg/kg	18.7	149	310	236	119	<DL	55.4	30.8	<DL
Nitrate / Nitrite	mg/kg	<DL	51.5	<DL	<DL	1.3	<DL	10.6	<DL	4.8
Sulfate	mg/kg	60.1	<DL	49.0	<DL	<DL	<DL	<DL	<DL	<DL
pH	pH	4.7	4.5	4.3	4.4	4.7	5.6	5.5	6.1	6.2

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

Parameter	Units	Boring 01SB02								
		0.0'- 1.5'	1.5'- 3.8'	5.0'- 6.5'	6.5'- 8.0'	10.0'- 11.5'	11.5'- 14.0'	15.0'- 16.5'	16.5'- 18.6'	20.0'- 21.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	<DL	11B	18B	19B	13B	19B	23B	10B
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butyl phthalate	ug/kg	98B	<DL	120B	100B	<DL	<DL	<DL	120B	110B
Bis(2ethylhexyl) phthalate	ug/kg	<DL	240J	210J	60J	100J	81J	<DL	50J	39J
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	3.4	2.6	1.8	1.4	1.2	1.7	1.5	1.6	2.3
Barium	mg/kg	42.9	49.0	62.3	74.7	85.6	76.8	94.0	107	96.7
Chromium	mg/kg	13.7	16.3	18.2	12.1	12.8	11.9	10.9	14.8	14.1
Lead	mg/kg	10.2	10.1	5.8	9.2	8.6	9.8	9.5	10.2	9.9
Nickel	mg/kg	6.0	7.9	10	15.5	17.2	14.2	20.5	20.7	18.9
Selenium	mg/kg	0.39	0.31	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Nitrate / Nitrite	mg/kg	<DL	<DL	<DL	<DL	<DL	13.4	36.6	8.3	10.8
Sulfate	mg/kg	66.5	62.9	69.8	<DL	69.4	63.4	52.4	67.5	<DL
pH	pH	4.8	5.1	4.9	5.1	5.4	5.6	5.6	4.9	5.6

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

018698

Parameter	Unit	Boring 01SB03		
		0.0-1.5'	1.5-3.5'	4.0'-5.0'
Volatiles	ug/kg	<DL	<DL	<DL
Methylene Chloride	ug/kg	7	20	<DL
Acetone	ug/kg	490B	600B	35B
Semivolatiles	ug/kg	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	110B	120B	100B
Bis(2-ethylhexyl) phthalate	ug/kg	<DL	85I	240I
Explosives	ug/kg	<DL	<DL	<DL
Arsenic	mg/kg	2.2	1.7	1.6
Barium	mg/kg	37.5	98.1	29.8
Chromium	mg/kg	13.1	12.2	7.7
Lead	mg/kg	5.4	26	6.2
Nickel	mg/kg	3.1	4.3	2.7
Selenium	mg/kg	0.17	0.2	<DL
Sulfate	mg/kg	67.6	<DL	<DL
pH	pH	5.7	5.2	5.1

Table 9-3 (con't)
Site 1 - Inert Burning Grounds
Soil Analytical Summary from Weston (1993)

018699

Parameter	Units	Boring 01SB04						
		0.0'-1.5'	1.5'-3.8'	5.0'-6.6'	6.6'-8.6'	10.0'-11.5'	11.4'-14.0'	15.0'-16.6'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	<DL	16B	<DL	22B	12B	110B
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	190B	160B	160B	170B	120B	97B	120B
Bis(2-ethylhexyl) phthalate	ug/kg	<DL	190J	500	1100	180J	400	980
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	0.59	2.0	2.7	0.84	0.43	0.84	1.9
Barium	mg/kg	32.1	43.0	21.7	51.5	28.6	63.7	56.9
Chromium	mg/kg	5.1	9.8	16.5	9.3	17.5	12.0	11.3
Lead	mg/kg	2.9	5.0	6.8	5.1	6.8	14.2	19.5
Nickel	mg/kg	<DL	<DL	<DL	1.5	<DL	4.2	7.6
Selenium	mg/kg	<DL	0.56	0.63	0.29	0.23	0.20	0.47
Nitrate / Nitrite	mg/kg	0.73	<DL	<DL	<DL	22.8	24.6	<DL
Sulfate	mg/kg	<DL	107	146	116	100	<DL	92.6
pH	pH	5.6	4.7	4.7	4.6	4.7	4.8	4.8

Table 9-4
Site 1 - Inert Burning Grounds
Tulsa District Corps of Engineers (1996/97)
Surface Soil Analytical Summary

019700

Parameter	Units	RASS01-01	RASS01-02	RASS01-03	RASS01-04	RASS01-05	RASS01-06	RASS01-07	RASS01-08	RASS01-09
Explosives	ug/kg	<DL	NT	NT	NT	NT	NT	NT	NT	<DL
Semivolatiles	mg/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Benzo(a)anthracene	mg/kg	<DL	<DL	<DL	<DL	0.530	0.533	<DL	<DL	0.391
Benzo(f)fluoranthene	mg/kg	<DL	<DL	<DL	<DL	0.456	0.878	<DL	<DL	0.416
Benzo(k)fluoranthene	mg/kg	<DL	<DL	<DL	<DL	0.372	0.65	<DL	<DL	0.701
Benzo(g,h,i)pyrene	mg/kg	<DL	<DL	<DL	<DL	<DL	0.412	<DL	<DL	0.367
Chrysene	mg/kg	<DL	<DL	<DL	<DL	<DL	0.814	<DL	<DL	0.517
Fluoranthene	mg/kg	<DL	<DL	<DL	<DL	0.449	1.74	<DL	<DL	1.19
Phenanthrene	mg/kg	<DL	<DL	<DL	<DL	<DL	0.861	<DL	<DL	0.642
Pyrene	mg/kg	<DL	<DL	<DL	<DL	<DL	1.14	<DL	<DL	0.687
Aluminum	mg/kg	3540	NT	NT	NT	NT	NT	NT	NT	6490
Antimony	mg/kg	<DL	NT	NT	NT	NT	NT	NT	NT	<DL
Arsenic	mg/kg	2.57	NT	NT	NT	NT	NT	NT	NT	2.58
Barium	mg/kg	56.1	NT	NT	NT	NT	NT	NT	NT	72.2
Beryllium	mg/kg	<DL	NT	NT	NT	NT	NT	NT	NT	<DL
Cadmium	mg/kg	<DL	NT	NT	NT	NT	NT	NT	NT	3.61
Calcium	mg/kg	242	NT	NT	NT	NT	NT	NT	NT	769
Chromium	mg/kg	16	NT	NT	NT	NT	NT	NT	NT	13.1
Cobalt	mg/kg	<DL	NT	NT	NT	NT	NT	NT	NT	3.32
Copper	mg/kg	6.39	NT	NT	NT	NT	NT	NT	NT	10.7
Iron	mg/kg	6,870	NT	NT	NT	NT	NT	NT	NT	11,900
Lead	mg/kg	17.8	NT	NT	NT	NT	NT	NT	NT	22.8
Magnesium	mg/kg	190	NT	NT	NT	NT	NT	NT	NT	396
Manganese	mg/kg	38.5	NT	NT	NT	NT	NT	NT	NT	198
Mercury	mg/kg	<DL	NT	NT	NT	NT	NT	NT	NT	<DL
Nickel	mg/kg	7.03	NT	NT	NT	NT	NT	NT	NT	6.37
Potassium	mg/kg	277	NT	NT	NT	NT	NT	NT	NT	612
Selenium	mg/kg	<DL	NT	NT	NT	NT	NT	NT	NT	<DL
Silver	mg/kg	<DL	NT	NT	NT	NT	NT	NT	NT	<DL
Strontium	mg/kg	<DL	NT	NT	NT	NT	NT	NT	NT	<DL
Thallium	mg/kg	<DL	NT	NT	NT	NT	NT	NT	NT	<DL
Vanadium	mg/kg	14.2	NT	NT	NT	NT	NT	NT	NT	17.7
Zinc	mg/kg	18.5	NT	NT	NT	NT	NT	NT	NT	22.6

9.1.1.3 Anions

018701

The anions, primarily chloride, sulfate, and nitrate, investigated at Site 1 are all naturally occurring at LHAAP. Chloride had a maximum concentration of 310 ug/kg, sulfate, 750 ug/kg, and nitrate, 51.5 ug/kg. All of the nitrate analyses were below 2 mg/kg with the exception of those in laboratory batches L022 and L040. Although it was not identified in the data validation, there may have been a laboratory problem which caused these analyses to be elevated. Several of the PQLs are elevated by a factor of 5.

9.1.2 Groundwater Investigations

Groundwater sampling included sampling both monitoring wells and open boreholes. Monitoring well 104 was installed by EPS in 1982 and has been sampled three times during the investigation of this site. Wells MW01, MW02, MW03, MW04 and MW05 were installed and sampled by Weston in 1993 during the Phase 1 investigation. During the Phase 2 investigation Sverdrup installed well 01WW01 and sampled it and well MW04. The results of all groundwater samples from monitoring wells are included in Table 9-5. The only explosive to appear was 2,6-DNT which was detected in well MW04 at 14 ug/l. It showed up as a semivolatile (PQL = 10 ug/l) in the GC/MS scan but did not appear as an explosive by HPLC (method 8330, PQL = 0.31 ug/l). Acetone (12 and 19 ug/l) and 2-butanone (11 and 18 ug/l) were both detected in wells MW02 and MW05. No high metal concentrations were detected.

9.1.3 Surface Water and Sediment Investigations

A total of 10 surface water and 13 sediment samples were collected during the RI investigations to determine the extent of contaminated sediment in the drainage pathways.

Sediment contained acetone in 01SD21 and 01SD22 at 94 and 57 ug/kg respectively, 2-butanone at 13 ug/kg in 01SW22, and methylene chloride at 13 ug/kg in 01SD01. No explosives were found in any sample, and metals and anions were low. Samples 01SD01 and 02 contained 2700 ug/kg and 2300 ug/kg of benzoic acid respectively. Sample 01SD01 was taken in triplicate, with a QC sample tested by the same lab and a QA sample tested by an independent lab, and the additional results revealed that the QC sample value was 1200J and the QA sample was below detection limits. In addition, the surrogate recoveries for the semivolatile batch were low and the re-extraction exceeded holding times, and the results should, therefore, be considered estimated. Sample 01SD09 contained minor amounts of PAHs. A sediment analytical summary is given in Table 9-6.

Surface water at Site 1 contained no organic compounds, other than 6.3 ug/l toluene from 01SW06, and trace amounts of some of the metals. Anions were low. Surface water results

are summarized in Table 9-7.

018702

Table 9-5
Site 1 - Inert Burning Grounds
Groundwater Analytical Summary

Parameter	Units	MW 01	MW 02	MW 03	MW 04	MW O4	MW 05	104	104	104	01W W01
		1993	1993	1993	1993	1994	1993	11/82	3/93	12/93	9/94
Volatiles	ug/l	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Acetone	ug/l	<DL	11B	<DL	<DL	<DL	18	<DL	<DL	<DL	<DL
2-butanone	ug/l	<DL	12	<DL	<DL	<DL	19	<DL	<DL	<DL	<DL
Semivolatiles	ug/l	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Isophoron	ug/l	<DL	<DL	<DL	1J	<DL	<DL	<DL	<DL	<DL	<DL
2,6-DNT	ug/l	<DL	<DL	<DL	14	<DL	<DL	<DL	<DL	<DL	<DL
Bis(2-ethylhexyl) phthalate	ug/l	1J	3J	<DL	5J	<DL	<DL	<DL	<DL	<DL	<DL
Explosives	ug/l	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
1,3,5-TNB	ug/l	<DL	<DL	<DL	<DL	<DL	<DL	9.74	<DL	<DL	<DL
Nitrobenzene	ug/l	<DL	<DL	<DL	<DL	<DL	<DL	1.82	<DL	<DL	<DL
Aluminum	mg/l	<DL	<DL	<DL	<DL	<DL	<DL	0.372	<DL	<DL	<DL
Arsenic	mg/l	<DL	<DL	<DL	<DL	<DL	<DL	0.021	<DL	<DL	<DL
Barium	mg/l	0.071	0.15	0.13	0.13	0.117	0.14	0.067	0.19	0.31	0.07
Cadmium	mg/l	<DL	<DL	<DL	<DL	<DL	<DL	0.001	<DL	<DL	<DL
Chromium	mg/l	<DL	0.046	<DL	<DL	0.010	<DL	0.046	<DL	0.056	<DL
Lead	mg/l	0.015	0.034	0.20	0.016	0.005	0.01	0.034	0.01	0.041	<DL
Manganese	mg/l	<DL	<DL	<DL	<DL	<DL	<DL	0.085	<DL	<DL	<DL
Strontium	mg/l	<DL	<DL	<DL	<DL	<DL	<DL	0.096	<DL	<DL	<DL
Nickel	mg/l	<DL	0.048	<DL	<DL	<DL	<DL	0.057	<DL	0.02	<DL
Chlorides	mg/l	8.6	6.8	6.8	2.7	2.1	10.9	8.0	13.3	6.0	6.4
Nitrite/Nitrate	mg/l	0.34	0.37	<DL	<DL	0.10	0.11	3.5	0.05	<DL	0.23
Sulfate	mg/l	16.5	17.3	39.8	3490	<DL	7.5	5.71	24	19.3	13.8

Table 9-6
Site 1 - Inert Burning Grounds
Sediment Analytical Summary
Collected by Ebasco (1993) and Sverdrup (1994)

18703

Parameter	Units	SD01	SD02	SD03	SD06	SD07	SD08
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	12B	20B	<DL	<DL	<DL
Methylene Chloride	ug/kg	<DL	13	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Benzoic Acid	ug/kg	2700	2300	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	110B	77B	190B	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	0.54	0.76	5.1	2.8	1.4	1.8
Barium	mg/kg	22.6	46.3	88.4	20.5	55.7	24.4
Chromium	mg/kg	4.9	<DL	21	10.1	11.9	5.7
Lead	mg/kg	4.9	5.3	13	9	8	4.2
Mercury	mg/kg	<DL	7.8	<DL	<DL	<DL	<DL
Nickel	mg/kg	1.4	<DL	6.3	1.5	3.8	2.9
Selenium	mg/kg	<DL	0.22	1.1	0.1	0.3	0.2
Chloride	mg/kg	<DL	<DL	<DL	1060	44	44
Nitrite/Nitrate	mg/kg	2.3	<DL	<DL	<DL	2.32	<DL
Sulfate	mg/kg	55.4	<DL	74.6	30	30	30
pH	pH	4.7	6	5.5	6.1	6	6.4

Table 9-6 (con't)
Site 1 - Inert Burning Grounds
Sediment Analytical Summary
Collected by Ebasco (1993) and Sverdrup (1994)

Parameter	Units	SD-09	SD-10	SD-11	SD-12	SD-21	SD-22	SD-23
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Acetone	ug/kg	<DL	<DL	<DL	<DL	94	57	<DL
2-butanone	ug/kg	<DL	<DL	<DL	<DL	<DL	13	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Phenanthrene	ug/kg	1060	<DL	<DL	<DL	<DL	<DL	<DL
Fluoranthene	ug/kg	1580	<DL	<DL	<DL	<DL	<DL	<DL
Pyrene	ug/kg	1130	<DL	<DL	<DL	<DL	<DL	<DL
Benzo(a)anthracene	ug/kg	420	<DL	<DL	<DL	<DL	<DL	<DL
Chrysene	ug/kg	550	<DL	<DL	<DL	<DL	<DL	<DL
Benzo(b)fluoranthene	ug/kg	480	<DL	<DL	<DL	<DL	<DL	<DL
Benzo(k)fluoranthene	ug/kg	390	<DL	<DL	<DL	<DL	<DL	<DL
Benzo(a)pyrene	ug/kg	390	<DL	<DL	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Antimony	mg/kg	<DL	1	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1	1.9	1.9	2.8	<DL	<DL	<DL
Barium	mg/kg	13.4	29.6	41.4	31.7	<DL	<DL	<DL
Cadmium	mg/kg	<DL	1	<DL	<DL	<DL	<DL	<DL
Chromium	mg/kg	4.4	14	9.3	12.3	<DL	<DL	<DL
Lead	mg/kg	4.9	3.6	5.9	5.6	<DL	<DL	<DL
Mercury	mg/kg	0.04	<DL	0.03	<DL	<DL	<DL	<DL
Nickel	mg/kg	1.2	2.7	3.6	2.4	<DL	<DL	<DL
Selenium	mg/kg	<DL	0.1	0.3	0.1	<DL	<DL	<DL
Silver	mg/kg	<DL	1	<DL	<DL	<DL	<DL	<DL
Chloride	mg/kg	44	44	<DL	<DL	<DL	<DL	<DL
Nitrite/Nitrate	mg/kg	2.3	2.13	2.3	<DL	0.57	0.44	0.59
Sulfate	mg/kg	30	60	<DL	<DL	<DL	<DL	<DL
pH	pH	5.2	7.9	6.4	6.3	NR	NR	NR
Conductivity	umhos	103	408	56	39	NR	NR	NR

NR = Value not reported.

Table 9-7
Site 1 - Inert Burning Grounds
Surface Water Analytical Summary (Ebasco/Weston, 1993)

018705

Parameter	Units	SW-01	SW-02	SW-03	SW-06	SW-07
Volatiles	ug/l	<DL	<DL	<DL	<DL	<DL
Acetone	ug/l	<DL	11B	<DL	<DL	<DL
Toluene	ug/l	<DL	<DL	<DL	6.3	<DL
Semivolatiles	ug/l	<DL	<DL	<DL	<DL	<DL
Bis(2ethylhexyl)phthalate	ug/l	<DL	<DL	2I	<DL	<DL
Explosives	ug/l	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/l	0.003	0.003	0.003	0.02	<DL
Barium	mg/l	0.052	0.06	0.32	0.34	0.47
Lead	mg/l	0.005	0.018	0.027	0.045	0.034
Chloride	mg/l	8	17	3.8	5.3	1.8
Nitrate / Nitrite	mg/l	<DL	<DL		0.09	0.09
Sulfate	mg/l	69.5	25	38.3	2	2
		SW-08	SW-09	SW-10	SW-11	SW-12
Volatiles	ug/l	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/l	<DL	<DL	<DL	<DL	<DL
Explosives	ug/l	<DL	<DL	<DL	<DL	<DL
Barium	mg/l	0.013	0.04	0.15	0.12	0.06
Lead	mg/l	<DL	<DL	<DL	0.014	0.022
Chloride	mg/l	7.1	6.2	9.7	<DL	<DL
Nitrate / Nitrite	mg/l	0.02	0.02	0.19	0.08	0.03
Sulfate	mg/l	35	66	90	3	2

9.2 NATURE AND EXTENT OF CONTAMINATION

018706

9.2.1 Explosives

The most significant finding is the total absence of explosives from any of the 115 samples taken at this site. The one sample of DNT as a semivolatile was not confirmed by the more accurate HPLC test (Method 8330). There is no evidence of explosives in either the soil or groundwater.

9.2.2 Volatile and Semivolatile Organics

Volatiles found included acetone and methylene chloride, which are common laboratory contaminants. The abundance of qualifiers and low levels of unqualified results is not an indicator of contamination. Styrene at 6 ug/kg is just above the PQL of 5 and was only found in one boring. Toluene and xylene were found in 01SB26 and are probably related to the PAHs found there. 2-butanone was found in low levels in a sediment sample and two groundwater samples. PAHs which were found in two borings and one sediment sample are indicators of the heavy hydrocarbons, such as compounds found in paving mixes. A piece of asphalt in these samples could have given these results. The phthalates are very common laboratory contaminants and, with the possible exception of the one isolated value of 3580 ug/kg in 01SB29, are very likely related to sample handling. There is no evidence of organic compounds which represent contamination.

9.2.3 Metals and Other Inorganics

Nickel and lead were detected with apparently elevated concentrations.

9.3 CONCLUSIONS

Based on the available information, there is no demonstrated contamination. No explosives were found. No further action is recommended.

10.0 CHEMICAL FINDINGS, SITE XX

018707

This section presents the results of field investigations at LHAAP Unit No. XX, the Ground Signal Test Area. The information presented includes a summary and discussion of the chemical results of soil and water sampling at the site.

10.1 ANALYTICAL RESULTS

Data summary tables showing detected analytes only were prepared for each round of phase of sampling and are discussed below.

10.1.1 Soil Investigations

The primary sources of potential contamination at this site are the burn residues and non-burned fragments of various pyrotechnic, illuminant and signal devices that have been tested and destroyed on the site, and the residues from burn-out of rocket motors on the site. Results of analyses performed by EPS on surface soil samples, collected in 1982, indicated lead concentrations to be consistently elevated. No explosives were detected at any sampling location. These results are shown on Table 10-1.

During the Phase 1 Remedial Investigation in 1993, Ebasco collected soil samples from four 5-ft deep soil borings, two 10-ft deep soil borings, and one 22-ft deep soil boring (Figure 10-1). Boring XXSB21 was drilled in a swale in the northeastern part of the site to identify potential contaminants in accumulated sediment. Boring XXSB20 was drilled in the northwestern part of the site near the rocket motor testing blast area to determine the nature of any airborne contamination and boring XXSB19 was drilled in the former Mortar Test Area in the southwestern part of the site to identify any residues in the soil from the past testing of illuminating mortar shells. Of the four remaining borings, XXSB15 was drilled within the rocket motor testing blast area, XXSB17 was drilled in the western part of the site, XXSB18 was drilled in the east-central part of the site, and XXSB16 was drilled near the southern boundary of the site. Results of these samples are shown in Table 10-2.

The Phase 1 RI resulted in the detection of acetone at a reported concentration of 10,300 ug/kg in one subsurface soil sample collected from the 2.5-5 ft sampling interval in soil boring XXSB19. TCE was found at a concentration of 42 ug/kg in one subsurface soil sample collected from the 5-7 ft sampling interval in boring XXSB17. Nickel and selenium concentrations in subsurface soil samples appear elevated at several depths in borings XXSB16 and XXSB19.

The Phase 2 RI in 1994 included one soil boring (XXSB01) drilled adjacent to existing boring XXSB19 to investigate the high acetone concentration from that boring (Figure 10-1). Results of chemical analyses indicated the presence of methylene chloride at 18 ug/kg at the 0-2 ft sampling

XXSD20



18708

TO SAUNDERS BRANCH
(APPROX. 1200')

TO HARRISON BAYOU
(APPROX. 2000')

OBSERVATION
STATIONS

EARTHEN-WOODEN XXSB20
BUNKER (ABANDONED)

SAUNDERS BRANCH WATERSHED
HARRISON BAYOU WATERSHED

CLEARING FOR LINE-OF-SIGHT OBSERVATION

CLEARING FOR
ROCKET MOTOR
BLAST

SEE DETAIL
'A' THIS
SHEET

TO HARRISON BAYOU
(APPROX. 1300')

FORMER MORTAR
TEST AREA (1970'S)

ROCKET MOTOR
BLAST AREA

ROCKET MOTOR STAND (NEVER USED)

WETLAND LINE
AT DISSEMINATION

ROCKET MOTOR
STAND

HAND SIGNAL
LAUNCHER

CONCRETE BUNKERS
(ABANDONED)

APPROXIMATE SITE BOUNDARY

128 XXSD18

XXSB21

XXSB17

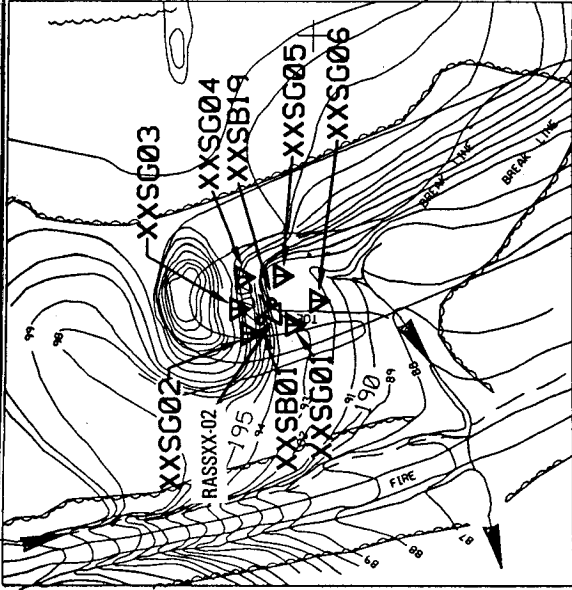
0501

XXSB15

0502

0503

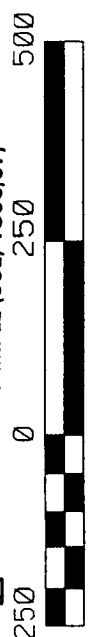
XXSB16



DETAIL "A"

LEGEND

- SHALLOW SOIL SAMPLE (EPS, 1982)
- SURFACE WATER FLOW DIRECTION
- SOIL BORING (EBASCO, 1993)
- SURFACE WATER/SEDIMENT SAMPLE (EBASCO, 1993)
- MONITORING WELL (EPS, 1982)
- SOIL BORING (SVERDRUP, 1994)
- SOIL GAS SAMPLE (SVERDRUP, 1994)
- SURFACE SOIL SAMPLE (COE, 1996/97)



SCALE IN FEET

\$ THINK VALUE ENGINEERING - IT SAVES MONEY \$	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	LHAAP XX GROUND SIGNAL TEST AREA SAMPLE LOCATIONS
CHECKED BY:	
SUBMITTED BY:	
CHIEF, GEOTECH BR.	FIGURE 10-1

interval in boring XXSB01. Neither acetone nor any other volatile organic compounds were reported. Analytical results from XXSB01 are shown in Table 10-3.

In August 1996, the Tulsa District Corps of Engineers collected surface soil samples from two locations in support of the risk analysis to be performed at this site. Both samples were analyzed for volatile organic compounds and 11 metals (arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, antimony, and thallium). In February 1997, surface soil samples were taken at the same two locations. Samples from both locations were analyzed for semi-volatile organic compounds and pesticides/PCBs. A sample from RASSXX-02 was also analyzed for 12 metals (aluminum, beryllium, calcium, cobalt, copper, iron, potassium, magnesium, manganese, strontium, vanadium and zinc). Analytical results from surface soil samples collected by the Tulsa District Corps of Engineers are presented in Table 10-4.

No explosives, pesticides, volatile organics or semivolatile organic compounds were detected. Elevated concentrations of arsenic and chromium were detected.

Table 10-1
Site XX - Ground Signal Test Area
EPS Surface Soil Analytical Summary (1982)

Parameter	Units	Sample Name/Interval		
		0501	0502	0503
		0.0-1.0'	0.0-1.0'	0.0-1.0'
Explosives	ug/kg	<DL	<DL	<DL
Nitrate	ug/kg	8.0	7.41	<DL
Sulfate	ug/kg	61.93	28.83	41.04
Chloride	ug/kg	5.0	<DL	<DL
Fluoride	ug/kg	6.0	6.0	<DL
Aluminum	ug/kg	1128.6	1105.5	3.6
Barium	ug/kg	227.8	165.8	61.0
Chromium	ug/kg	8.4	9.2	9.4
Lead	ug/kg	27.6	26.5	26.6
Manganese	ug/kg	742	499.5	140.8
Strontium	ug/kg	9.4	11.8	3.9
Copper	ug/kg	3.3	2.7	2.0
Zinc	ug/kg	6.3	10.1	11.1
Nickel	ug/kg	4.0	5.0	4.0

Table 10-2
Site XX- Ground Signal Test Area
Ebasco Subsurface Soil Analytical Summary (1993)

Parameter	Units	Boring XXSB15		Boring XXSB16			
		0.0- 2.0'	5.0- 7.0'	0.0- 3.0'	5.0- 7.0'	10.0- 14.0'	16.0- 18.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Di-n-butyl phthalate	ug/kg	517B	428B	674B	649B	753B	1310B
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	3	2	4	5	2.1	2
Barium	mg/kg	44	42	20.2	54.3	31.8	32.5
Chromium	mg/kg	4.9	<DL	6.3	8.6	8.8	14.8
Lead	mg/kg	6	4	6	11	7	9
Mercury	mg/kg	<DL	<DL	0.03	<DL	0.06	<DL
Nickel	mg/kg	2.8	2.4	2.1	11.1	13.3	27.8
Selenium	mg/kg	0.3	<DL	0.2	0.2	<DL	1.2
Thallium	mg/kg	<DL	<DL	<DL	0.2	<DL	0.2
Nitrate/Nitrite	mg/kg	0.9	6.72	5.33	2.81	<DL	5.82
Sulfate	mg/kg	990	5700	4500	5300	4600	4100
pH	pH	5.7	6.8	5.7	6.4	5.9	5.9
Conductivity	umhos/cm	44	70	38	59	27	920

018711

Table 10-2 (con't)
Site XX- Ground Signal Test Area
Ebasco Subsurface Soil Analytical Summary (1993)

Parameter	Units	Boring XXSB17		Boring SB18	Boring XXSB19	
		0.0- 2.0'	5.0- 7.0'	0.0- 2.0'	0.0- 2.5'	2.5- 5.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
TCE	ug/kg	<DL	42	<DL	<DL	<DL
Acetone	ug/kg	<DL	<DL	<DL	<DL	10300
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL
Di-n- butyl phthalate	ug/kg	1820B	1850B	<DL	1810B	1830B
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	5	2	3	3	6
Barium	mg/kg	66.7	100	28.2	37.6	26.6
Chromium	mg/kg	13.5	9.3	12.9	11.4	14.2
Lead	mg/kg	7	5	6	5	5
Mercury	mg/kg	<DL	0.06	0.03	0.03	0.04
Nickel	mg/kg	4.5	10.1	2.8	5.9	21.3
Selenium	mg/kg	0.1	<DL	0.3	0.1	<DL
Chloride	mg/kg	<DL	<DL	<DL	<DL	310
Nitrate/Nitrite	mg/kg	<DL	8.75	0.56	<DL	5.74
Sulfate	mg/kg	820	5100	150	4900	820
pH	pH	6.1	6.7	7.9	5.9	5.4
Conductivity	umhos/cm	33	50	71	195	1520

Table 10-2 (con't)
Site XX- Ground Signal Test Area
Ebasco Subsurface Soil Analytical Summary (1993)

018712

Parameter	Units	Boring XXSB20		Boring XXSB21	
		0.0-2.5'	2.5-5.0'	0.0-2.5'	2.5-5.0'
Volatiles	ug/kg	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	2080B	2790B	2270B	2390B
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	4	2	1	1.9
Barium	mg/kg	57.2	52.4	48.5	48.8
Chromium	mg/kg	15.9	9.9	5.9	7.2
Lead	mg/kg	4	5	5	6
Nickel	mg/kg	5.8	4.4	4.1	4.1
Selenium	mg/kg	0.1	<DL	<DL	<DL
Nitrate/Nitrite	mg/kg	1.5	1	1.1	1
Sulfate	mg/kg	3800	4400	500	400
pH	pH	5.9	5.4	5.9	5.7
Conductivity	umhos/cm	195	1520	36	29

Table 10-3
Site XX - Ground Signal Test Area
Sverdrup Subsurface Soil Analytical Summary (1994)

Parameter	Units	Boring XXSB01		
		0-2'	5-7'	9-10'
Volatiles	ug/kg	<DL	<DL	<DL
Methylene chloride	ug/kg	18	<DL	<DL

Table 10-4
Site XX - Ground Signal Test Area
Tulsa District Corps of Engineers (1996/97)
Surface Soil Analytical Summary

018713

Parameter	Units	RASSXX-01	RASSXX-02
Explosives	ug/kg	<DL	<DL
Pesticides	mg/kg	<DL	<DL
Volatile Organics	ug/kg	<DL	<DL
Semivolatiles	mg/kg	<DL	<DL
Aluminum	mg/kg	4670	8050
Antimony	mg/kg	<DL	<DL
Arsenic	mg/kg	32.8	4.33
Barium	mg/kg	88.1	92.2
Beryllium	mg/kg	<DL	<DL
Cadmium	mg/kg	3.63	5.42
Calcium	mg/kg	332	621
Chromium	mg/kg	28.9	14.3
Cobalt	mg/kg	3.21	<DL
Copper	mg/kg	3.70	6.21
Iron	mg/kg	6,970	13,500
Lead	mg/kg	11.0	9
Magnesium	mg/kg	243	826
Manganese	mg/kg	567	37.8
Mercury	mg/kg	<DL	<DL
Nickel	mg/kg	10.6	15
Potassium	mg/kg	281	484
Selenium	mg/kg	<DL	<DL
Silver	mg/kg	<DL	<DL
Strontium	mg/kg	<DL	18.9
Thallium	mg/kg	<DL	<DL
Vanadium	mg/kg	20.6	24.3
Zinc	mg/kg	9.17	17.6

10.1.2 Soil Gas Investigations

018714

To further investigate potential contamination with acetone and other volatile organics in the vicinity of existing boring XXSB19, an active soil gas survey consisting of 5 sampling points was conducted by Sverdrup in 1994 (Figure 10-1). Soil gas samples (XXSG01, XXSG03, XXSG04, XXSG05, and XXSG07) were collected from the sampling points and analyzed on site for acetone, methylene chloride, and TCE. The soil gas survey was performed using a Geoprobe™ sampling system to hydraulically push a sampling probe into the ground to depths of 3-5 ft and collect representative soil gas samples. Results of on-site analysis of the soil gas samples indicated no detectable concentrations of acetone, methylene chloride, or TCE.

10.1.3 Groundwater Investigations

Two monitoring wells, MW-127 and MW-128, were installed and sampled by EPS in 1982 (Figure 10-1). At the time of installation, these wells contained no volatiles, semivolatiles, or explosives, but had apparently elevated concentrations of nickel and thallium. These wells were resampled during the Phase 1 RI explorations in 1993. Again, no organics were detected in any groundwater samples. In addition, no elevated metal concentrations were reported in either MW-127 or MW-128 so the high values indicated for nickel and thallium during the 1982 sampling event were not confirmed. Analytical results for these wells are shown in Table 10-4.

Six groundwater grab samples (GG15 through GG18, and GG20 and GG21) were collected from 6 of the soil borings (XXSB15 through XXSB17 and XXSB19 through XXSB21) drilled during the Phase 1 RI. One groundwater grab sample (GG01) was obtained from soil boring XXSB01 drilled during the Phase 2 RI. The purpose of collecting groundwater grab samples was to obtain preliminary field screening data of potential groundwater contaminants. Acetone was detected at 17 ug/l in sample XXGG01. However, acetone also appeared in the travel blank at the same concentration. No other volatiles or explosives appeared in any of the grab samples. No metals analyses were performed. A data table summarizing the results of all groundwater grab samples is shown in Appendix D.

10.1.4 Surface Water and Sediment Investigations

Seven sediment samples (SD01 and SD15 through SD20) and 7 surface water samples (SW01 and SW15 through SW20) were collected during the Phase 1 RI. No volatiles, semivolatiles, or explosives were detected in any of the samples, with the exception of phthalates in 4 of the sediment samples. Metals and anions were present in low concentrations. Chemical analyses for sediment samples are shown in Table 10-5 and chemical analyses for surface water samples are shown in Table 10-6.

018715

Table 10-5
Site XX - Ground Signal Test Area
Groundwater Analytical Summary (1982 and 1993)

Parameter	Units	Well MW-127		Well MW-128	
		1982	March 1993	1982	March 1993
Volatiles	ug/l	<DL	<DL	<DL	<DL
Semivolatiles	ug/l	<DL	<DL	<DL	<DL
Explosives	ug/l	<DL	<DL	<DL	<DL
Aluminum	mg/l	0.037	<DL	0.353	<DL
Barium	mg/l	0.046	0.11	0.0515	<DL
Cadmium	mg/l	0.01	<DL	0.005	<DL
Chromium	mg/l	0.012	<DL	<DL	<DL
Lead	mg/l	<DL	0.011	<DL	0.011
Manganese	mg/l	1.86	<DL	1.086	<DL
Nickel	mg/l	0.157	0.05	0.082	<DL
Strontium	mg/l	3.36	<DL	4.12	<DL
Thallium	mg/l	0.14	<DL	0.11	<DL
Sulfate	mg/l	1622	1200	559	330
Chloride	mg/l	832	527	1000	873
Fluoride	mg/l	1	<DL	<DL	<DL

Table 10-6
Site XX - Ground Signal Test Area
Sediment Analytical Summary (1993)

018716

Parameter	Units	SD 01	SD 15	SD 16	SD 17	SD 18	SD 19	SD 20
Volatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Bis(2-ethylhexyl)phthalate	ug/kg	369	<DL	<DL	443	434	<DL	421
Di-n-butylphthalate	ug/kg	<DL	<DL	<DL	669	554	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	2.4	1	1.9	1.8	2	3.5	0.9
Barium	mg/kg	126	29.8	64.1	23.3	48.4	27.5	39.6
Chromium	mg/kg	5.5	4.1	9.8	3.5	5.8	<DL	4.4
Lead	mg/kg	9	5	7	4	6	8	6
Mercury	mg/kg	0.03	0.03	0.03	0.01	0.01	0.01	0.03
Nickel	mg/kg	14.7	3.7	5.1	2.6	3.1	3.1	4
Selenium	mg/kg	0.3	0.1	0.4	0.1	0.2	0.3	0.1
Chloride	mg/kg	<DL	44	<DL	<DL	<DL	<DL	44
Sulfate	mg/kg	30	40	230	30	30	30	40
pH	pH	7.3	5.6	6	5.7	5.8	6.3	5.8
Conductivity	umhos/cm	115	88	37	25	53	62	98

Table 10-7
Site XX - Ground Signal Test Area
Surface Water Analytical Summary (1993)

118717

Parameter	Units	SW 01	SW 15	SW 16	SW 17	SW 18	SW 19	SW 20
Volatiles	ug/l	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Semivolatiles	ug/l	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Explosives	ug/l	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Barium	mg/l	0.11	0.13	0.07	0.06	0.23	0.43	0.09
Lead	mg/l	<DL	<DL	<DL	<DL	<DL	0.006	0.011
Chloride	mg/l	28.4	31.0	2.6	2.6	2.6	2.6	9.7
Nitrate/Nitrite	mg/l	0.04	<DL	0.30	0.09	<DL	<DL	<DL
Sulfate	mg/l	32	29	2.0	5.0	<DL	<DL	4.0

10.2 NATURE AND EXTENT OF CONTAMINATION

10.2.1 Explosives

No explosives were detected in any sample collected at Site XX from any sample medium.

10.2.2 Volatile and Semivolatile Organics

Acetone was detected in two samples at Site XX. It was detected at a concentration of 10,300 ug/kg in a subsurface soil sample obtained from the 2.5 to 5.0-ft sampling interval in soil boring XXSB19, and at a concentration of 17 ug/l in groundwater grab sample XXGG01 from the soil boring adjacent to XXSB19. The water sample was accompanied by a contaminated travel blank. The blank contained acetone at 17 ug/l and indicated a problem in sampling or shipping. The acetone at these locations was thoroughly investigated by soil boring XXSB01 and 5 soil gas samples, all of which were clean. This sample of acetone must represent either a sampling or a laboratory problem. TCE was present in one isolated subsurface soil sample collected from the 5-7 ft sampling interval in soil boring XXSB17 on the eastern portion of the site and methylene chloride was detected at a concentration of 18 ug/kg in one subsurface soil sample collected between a depth of 0-2 ft in soil boring XXSB01. The only semivolatiles found were di-n-butyl phthalate and bis(2-ethylhexyl)phthalate. These common plasticizers were either qualified with a B (found in the method blanks) or were found in very low concentrations. No contamination by volatile or semivolatile organics is demonstrated.

10.2.3 Metals and Other Inorganics

118718

Limited occurrences of elevated site metals concentrations in soils were found during the field investigations. Lead was present at apparently elevated concentrations in all 3 surface soil samples collected by EPS in 1982. During subsequent Phase 1 RI sampling by Ebasco in 1993, lead was present at levels consistently below the previous sampling event in all subsurface soil samples collected at selected depths between 0 and 18 ft. In soil boring XXSB16, both nickel and selenium were present at apparently elevated levels in the subsurface soil sample obtained from a depth of 16-18 ft. Likewise, the concentration of nickel also appeared elevated at the 2.5-5 ft sampling interval in soil boring XXSB19. None of the metals concentrations in either surface or subsurface soils are excessively high and the elevated concentrations do not indicate evidence of metals contamination in soils.

High concentrations of nickel and thallium in groundwater samples collected from monitoring wells MW-127 and MW-128 in 1982 were not confirmed during the 1993 resampling. Results for these metals were either below detection limits or, in the case of nickel for MW-127, at a concentration an order of magnitude lower than the 1982 result. Thus, evidence of groundwater contamination is not supported by available data.

10.3 CONCLUSIONS

There is no demonstrated contamination found at this site and no further action at Site XX is recommended.

11.0 CHEMICAL FINDINGS, SITE 27

This section presents the results of investigations at LHAAP Site 27, the South Test Area. The information presented in section 11 includes a summary and discussion of the chemical results of soil and water sampling at the site.

11.1 ANALYTICAL RESULTS

Data summary tables showing detected analytes only, were prepared for each round or phase of sampling and are discussed below.

11.1.1 Soil Investigations

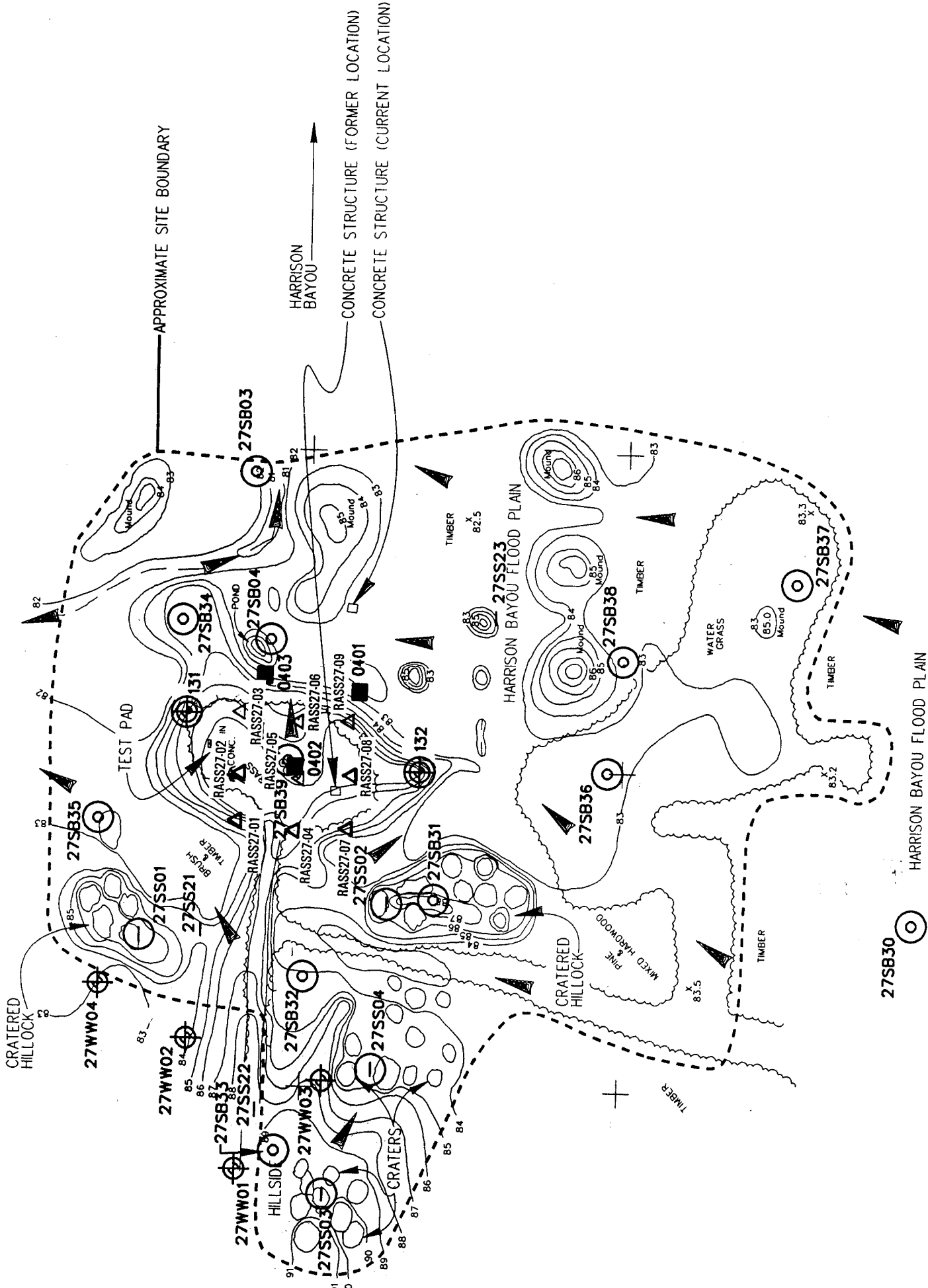
The primary sources of potential contamination of this site are the various components of the photoflash bombs, the illuminating devices, and other explosives that have been detonated and buried at the site. Figure 11-1 shows the locations of the soil borings, sampling locations and monitoring wells at Site 27. Results of analyses performed by EPS during the 1982 sampling indicated 2,4,6-TNT in the surface soil at locations 0401 and 0402 at 10,150 and 4,610 ug/kg, respectively. Lead appeared to have elevated concentrations in all three soil samples. These results are shown in Table 11-1.

During the Phase 1 remedial investigation conducted in 1993, Ebasco collected 4 surface soil samples from the 4 cratered areas west of the test pad and soil samples from 10 borings drilled southwest and west of the pad to identify contaminants from detonated explosives, including certain metals and anions.

Analytical results from the Phase 1 soil samples indicated no detectable explosives or volatile organics. Several samples had low concentrations of phthalates. Some of the samples were tested for pesticides and herbicides, with no detectable results. A summary of results of the surface soils are shown in Table 11-1 and the borings in Table 11-2.

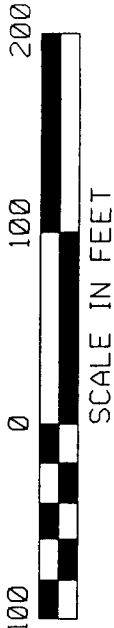
018720

HARRISON BAYOU FLOOD PLAIN



LEGEND

- SHALLOW SOIL SAMPLE (EPS, 1982)
- SURFACE WATER FLOW DIRECTION
- SOIL BORING (EBASCO, 1993)
- SURFACE SOIL SAMPLE (EBASCO, 1993) (3)
- MONITORING WELL (EPS, 1982)
- SURFACE SOIL SAMPLE (SVERDRUP, 1994) (994)
- MONITORING WELL (SVERDRUP, 1984)
- SURFACE SOIL SAMPLE (COE, 1996/97)



\$ THINK VALUE ENGINEERING - IT SAVES MONEY \$	
U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS TULSA, OKLAHOMA	
DESIGNED BY:	LONGHORN ARMY AMMUNITION PLANT HARRISON COUNTY, TEXAS
DRAWN BY:	
CHECKED BY:	
SUBMITTED BY:	
CHIEF, GEOTECH BR.	

FIGURE 11-1

Table 11-1
Site 27 - South Test Area
EPS Surface Soil Analytical Summary (1982)

018721

Parameter	Units	Sample 0401	Sample 402	Sample 403
		EPS		
Explosives	ug/kg	<DL	<DL	<DL
TNT	ug/kg	10150	4610	<DL
Aluminum	mg/kg	1100	1386	1426
Barium	mg/kg	87	136.6	57.2
Chromium	mg/kg	16.3	12.3	10.3
Lead	mg/kg	25.5	26.3	24.6
Manganese	mg/kg	90	199.2	137.5
Strontium	mg/kg	5	9	4.3
Copper	mg/kg	2.7	41.1	2.8
Zinc	mg/kg	8.1	17.4	9.2
Nickel	mg/kg	1	4	2.2
Fluoride	mg/kg	6	5	6
Nitrate/Nitrite	mg/kg	15.8	22.3	0.96
Sulfate	mg/kg	38.2	37.5	33.25

Table 11-1 (continued)
Site 27 - South Test Area
Ebasco Surface Soil Analytical Summary (1993)

018722

Parameter	Units	Sample SS01	Sample SS02	Sample SS03	Sample SS04
		Ebasco			
Volatiles	ug/kg	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	2180	<DL	2610	<DL
Bis(2-ethylhexyl) phthalate	ug/kg	360	380	360	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	0.9	0.7	0.9	0.8
Barium	mg/kg	71.7	140	168	80.1
Chromium	mg/kg	3.8	2.3	3.9	5.7
Lead	mg/kg	5	2	7	7
Mercury	mg/kg	<DL	0.02	0.02	<DL
Nickel	mg/kg	1.8	2.5	3	2.9
Selenium	mg/kg	<DL	0.2	0.2	0.3
Nitrate/Nitrite	mg/kg	2.24	2.14	2.05	<DL
Sulfate	mg/kg	40	30		80
pH	pH	5.6	6	5.6	5.2
Conductivity	umhos/cm	98	90	43	30

Table 11-2
Site 27 - South Test Area
Ebasco Soil Analytical Summary (1993)

Parameter	Units	Boring 27SB30		Boring 27SB31	
		0'-2'	5'-7'	0'-2'	5'-8'
Volatiles	ug/kg	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	443	<DL	<DL	<DL
Bis(2-ethylhexyl) phthalate	ug/kg	332	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.3	1.2	1.1	2
Barium	mg/kg	131	54.3	60.8	19.2
Chromium	mg/kg	8.2	1.6	3.4	6.9
Lead	mg/kg	9	5	6	5
Mercury	mg/kg	0.02	0.03	0.03	0.02
Nickel	mg/kg	6.1	1.9	2.6	2.4
Selenium	mg/kg	0.3	<DL	<DL	0.2
Chloride	mg/kg	576	487	44	310
Nitrate/Nitrite	mg/kg	<DL	<DL	1.05	<DL
Sulfate	mg/kg	5400	6600	300	2100
pH	pH	5.7	8.3	5.6	5.8
Conductivity	umhos/cm	2520	1850	41	525

Table 11-2 (continued)
Site 27 - South Test Area
Ebasco Soil Analytical Summary (1993)

Parameter	Units	Boring 27SB32		Boring 27SB33	
		0'-2'	5'-7'	0'-2'	5'-7'
Volatiles	ug/kg	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.4	1.8	1.7	1.3
Barium	mg/kg	47.7	42.5	58	14
Chromium	mg/kg	5.9	5.8	4.1	8.8
Lead	mg/kg	7	6	5	5
Mercury	mg/kg	0.08	0.04	0.03	0.02
Nickel	mg/kg	5.6	2.9	2.1	1.7
Selenium	mg/kg	<DL	0.2	<DL	0.3
Chloride	mg/kg	133	399	44	310
Nitrate/Nitrite	mg/kg	1.07	0.5	1.01	1.02
Sulfate	mg/kg	540	300		190
pH	pH	5.4	4.7	5.7	4.8
Conductivity	umhos	193	1680	28	390

018725

Table 11-2 (continued)
Site 27 - South Test Area
Ebasco Soil Analytical Summary (1993)

Parameter	Units	Boring 27SB34		Boring 27SB35	
		0'-3'	5'-7'	0'-2'	5'-7'
Volatiles	ug/kg	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL
Pesticides/Herbicides	ug/kg	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.1	1.7	1.1	1.1
Barium	mg/kg	38.1	9.8	33.7	26.3
Chromium	mg/kg	5.9	7.2	5.6	3.5
Lead	mg/kg	4	7	5	4
Mercury	mg/kg	0.02	<DL	0.03	<DL
Selenium	mg/kg	<DL	0.2	0.3	<DL
Nickel	mg/kg	4	3.5	1.4	1.6
Chloride	mg/kg	222	576	222	399
Nitrate/Nitrite	mg/kg	1.49	0.66	<DL	<DL
Sulfate	mg/kg	280	340	260	270
pH	pH	5.4	4.6	4.7	4.7
Conductivity	umhos/cm	1320	2280	1250	1690

Table 11-2 (continued)
Site 27 - South Test Area
Ebasco Soil Analytical Summary (1993)

Parameter	Units	Boring 27SB36		Boring 27SB37	
		0'-2'	0'-2'	0'-2'	5'-7'
Volatiles	ug/kg	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL
Pesticides/Herbicides	ug/kg	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	0.9	0.4	0.8	0.7
Barium	mg/kg	151	46.3	54.7	47.6
Chromium	mg/kg	6.8	4.3	4.2	3.2
Lead	mg/kg	7	5	5	4
Mercury	mg/kg	0.02	0.02	0.02	0.02
Nickel	mg/kg	4	3.1	3.8	2.9
Selenium	mg/kg	0.2	<DL	<DL	<DL
Chloride	mg/kg	1110	310	1290	931
Nitrate/Nitrite	mg/kg	<DL	<DL	<DL	<DL
Sulfate	mg/kg	4700	3900	5400	5800
pH	pH	8.8	9.1	8.9	9
Conductivity	umhos/cm	5260	1270	5170	3380

018727

Table 11-2 (continued)
Site 27 - South Test Area
Ebasco Soil Analytical Summary (1993)

Parameter	Units	Boring 27SB38		Boring 27SB39	
		0'-2'	5'-7'	0'-2'	5'-7'
Volatiles	ug/kg	<DL	<DL	<DL	<DL
Semivolatiles	ug/kg	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	<DL	<DL	<DL	513
Pesticides/Herbicides	ug/kg	<DL	<DL	<DL	<DL
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	0.7	0.5	2.3	0.6
Barium	mg/kg	27.3	49.4	41.8	6.1
Chromium	mg/kg	6	5.3	22.2	<DL
Lead	mg/kg	5	4	5	6
Mercury	mg/kg	0.05	<DL	0.03	<DL
Nickel	mg/kg	<DL	2.6	<DL	<DL
Selenium	mg/kg	0.2	<DL	<DL	<DL
Chloride	mg/kg	310	665	<DL	487
Nitrate/Nitrite	mg/kg	<DL	<DL	<DL	<DL
Sulfate	mg/kg	4000	5600	<DL	4900
pH	pH	7.5	8.4	6.5	6.6
Conductivity	umhos/cm	908	2590	135	226

During the Phase 2 field investigation conducted by Sverdrup in 1994, four soil borings (27WW01 through 27WW04) were drilled in the vicinity of 27SB33 and completed as monitoring wells. Three surface soil samples (27SS21, 27SS22, and 27SS23) were collected from 0.0 to 0.5 feet using a stainless steel hand auger. The three surface soil samples were analyzed for chromium and mercury.

No explosives were detected in the Phase 2 soil samples. No volatiles or semivolatiles were tested. Results of the surface soil samples are given in Table 11-3 and results of the soil borings are given in Table 11-4.

Table 11-3
Site 27 - South Test Area
Sverdrup Surface Soil Analytical Summary (1994)

Parameter	Units	Sample 27SS21	Sample 27SS22	Sample 27SS23
		Sverdrup		
Chromium	mg/kg	10.6	7.8	5.6
Mercury	mg/kg	<DL	<DL	<DL

Table 11-4
Site 27 - South Test Area
Sverdrup Soil Analytical Summary (1994)

Parameter	Units	Well 27WW01			
		0'-2'	5'-7'	10'-12'	13'-15'
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	2.5	5.2	3.2	3.4
Barium	mg/kg	1.05	86.1	23.8	72.8
Chromium	mg/kg	13.3	13.6	9	15.4
Lead	mg/kg	9	10	6.5	12.6
Nickel	mg/kg	8.4	8.3	5.2	18.6
Chloride	mg/kg	<DL	<DL	<DL	22.2
Nitrate/Nitrite	mg/kg	0.75	0.81	0.82	0.99
Sulfate	mg/kg	<DL	<DL	16.4	54.4

Table 11-4 (continued)
Site 27 - South Test Area
Sverdrup Soil Analytical Summary (1994)

Parameter	Units	Well 27WW02		Well 27WW03		
		0'-2'	5'-7'	0'-2'	3'-5'	8'-10'
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.3	1.5	1.1	1.5	2.1
Barium	mg/kg	105	148	84.6	54.3	23
Chromium	mg/kg	6.9	9.6	8.2	8.5	7.1
Lead	mg/kg	6	7.1	6.7	5.4	4.9
Nickel	mg/kg	3.3	6.6	3.8	4.7	5.1
Chloride	mg/kg	49.8	<DL	<DL	22.6	30.4
Nitrate/Nitrite	mg/kg	0.64	0.88	0.82	0.54	0.55
Sulfate	mg/kg	41.5	<DL	<DL	26.3	26.7

Table 11-4
Site 27 - South Test Area
Sverdrup Soil Analytical Summary (1994)

Parameter	Units	Well 27WW04		
		0'-2'	3'-5'	8'-10'
Explosives	ug/kg	<DL	<DL	<DL
Arsenic	mg/kg	2.3	1.8	1.1
Barium	mg/kg	104	639	65.8
Chromium	mg/kg	6.2	9.8	6
Lead	mg/kg	7.7	6.1	4.5
Nickel	mg/kg	3.9	10	9.4
Chloride	mg/kg	<DL	6322	485
Nitrate/Nitrite	mg/kg	1.6	1.9	2.6
Sulfate	mg/kg	314	498	354

In August 1996, the Tulsa District Corps of Engineers collected surface soil samples from nine locations in support of the risk analysis to be performed at this site. Samples from all nine locations were analyzed for explosives. Samples from four of these locations (RASS27-02, RASS27-04, RASS27-06 and RASS27-08) were also analyzed for 11 metals (arsenic, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, antimony, and thallium). In February 1997, surface soil samples were taken at the four locations (RASS27-02, RASS27-04, RASS27-06 and RASS27-08) and analyzed for 12 metals (aluminum, beryllium, calcium, cobalt, copper, iron, potassium, magnesium, manganese, strontium, vanadium and zinc). Analytical results from surface soil samples collected by the Tulsa District Corps of Engineers are presented in Table 11-5.

No explosives were detected in the surface soil samples collected. Metals detected at elevated levels included cadmium, copper, and zinc.

11.1.2 Groundwater Investigations

Groundwater analyses from wells 131 and 132, installed by EPS in 1982, indicated elevated concentrations of metals and anions. Both wells had apparently elevated concentrations of cadmium. Chloride was 27,850 mg/l and 10,330 mg/l respectively. No explosives were found in either well. Well 131 had no volatiles or pesticides. It contained low levels of phthalates and 24 ug/l ethylene glycol. Well 132 was not tested for organics other than explosives. These wells were resampled in March of 1993 by Ebasco. Ebasco found no volatiles, semivolatiles, or explosives. Chlorides were much lower than the previous sampling results (306 mg/l and 1700 mg/l respectively). Results from wells 131 and 132 are found in Table 11-6.

Table 11-5
Site 27 - South Test Area
Tulsa District Corps of Engineers (1996/97)
Surface Soil Analytical Summary

018731

Parameter	Units	RASS27-01	RASS27-02	RASS27-03	RASS27-04	RASS27-05	RASS27-06	RASS27-07	RASS27-08	RASS27-09
Explosives	ug/kg	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Aluminum	mg/kg	NT	10300	NT	5390	NT	4350	NT	8360	NT
Antimony	mg/kg	NT	<DL	NT	<DL	NT	<DL	NT	<DL	NT
Arsenic	mg/kg	NT	13.1	NT	6.08	NT	11.6	NT	7.81	NT
Barium	mg/kg	NT	82.6	NT	123	NT	112	NT	69.5	NT
Beryllium	mg/kg	NT	1.16	NT	<DL	NT	<DL	NT	<DL	NT
Cadmium	mg/kg	NT	21	NT	8.54	NT	14.7	NT	9.04	NT
Calcium	mg/kg	NT	554	NT	392	NT	809	NT	787	NT
Chromium	mg/kg	NT	30.9	NT	15.2	NT	36.3	NT	21.4	NT
Cobalt	mg/kg	NT	<DL	NT	<DL	NT	<DL	NT	<DL	NT
Copper	mg/kg	NT	18.70	NT	6.94	NT	7.69	NT	5.65	NT
Iron	mg/kg	NT	70,000	NT	45,400	NT	23,200	NT	21,800	NT
Lead	mg/kg	NT	17.0	NT	18.0	NT	15.0	NT	11.0	NT
Magnesium	mg/kg	NT	310	NT	187	NT	308	NT	635	NT
Manganese	mg/kg	NT	204	NT	137	NT	223	NT	135	NT
Mercury	mg/kg	NT	<DL	NT	<DL	NT	<DL	NT	<DL	NT
Nickel	mg/kg	NT	<DL	NT	2.41	NT	<DL	NT	<DL	NT
Potassium	mg/kg	NT	302	NT	150	NT	235	NT	513	NT
Selenium	mg/kg	NT	0.83	NT	0.71	NT	0.66	NT	<DL	NT
Silver	mg/kg	NT	<DL	NT	<DL	NT	<DL	NT	<DL	NT
Strontium	mg/kg	NT	<DL	NT	<DL	NT	<DL	NT	16.8	NT
Thallium	mg/kg	NT	<DL	NT	<DL	NT	<DL	NT	<DL	NT
Vanadium	mg/kg	NT	72.4	NT	50.7	NT	25.6	NT	27.5	NT
Zinc	mg/kg	NT	41.3	NT	19.6	NT	19.6	NT	22.4	NT

NT = Not tested.

Table 11-6
Site 27 - South Test Area
Groundwater Analytical Summary
EPS (1982) and Ebasco (1993)

018732

Parameter	Units	Well 131		Well 132	
		11/82	3/93	11/82	3/93
Volatiles	ug/l	<DL	<DL	NT	<DL
Semivolatiles	ug/l	<DL	<DL	NT	<DL
Di-n-butylphthalate	ug/l	52	<DL	NT	<DL
Ethylene glycol	ug/l	24	<DL	NT	<DL
Pesticides	ug/l	<DL	NT	NT	NT
Explosives	ug/l	<DL	<DL	<DL	<DL
Barium	mg/l	0.048	0.25	0.053	0.09
Chromium	mg/l	<DL	<DL	0.015	<DL
Lead	mg/l	<DL	<DL	0.016	<DL
Nickel	mg/l	0.053	<DL	0.102	<DL
Aluminum	mg/l	0.222	NT	0.232	NT
Cadmium	mg/l	0.001	<DL	0.009	<DL
Strontium	mg/l	1.34	NT	2.64	NT
Thallium	mg/l	0.08	<DL	0.1	<DL
Chloride	mg/l	27850	306	10330	1700
Fluoride	mg/l	1	NT	1	NT
Nitrate/Nitrite	mg/l	<DL	<DL	<DL	0.01
Sulfate	mg/l	216.6	121	337	780

NT = Not tested.

Table 11-7
Site 27 - South Test Area
Groundwater Analytical Summary - Sverdrup Wells (1994)

Parameters	Units	Well 27WW01	Well 27WW02	Well 27WW03	Well 27WW04
Semivolatiles	ug/l	<DL	<DL	<DL	<DL
Explosives	ug/l	<DL	<DL	<DL	<DL
Arsenic	mg/l	0.006	<DL	<DL	<DL
Barium	mg/l	0.097	0.046	0.017	0.05
Chromium	mg/l	0.053	0.026	0.01	0.025
Nickel	mg/l	0.13	0.23	0.12	0.37
Chloride	mg/l	2340	3700	2.7	2200
Nitrate/Nitrite	mg/l	0.06	0.08	1.17	0.24
Sulfate	mg/l	1250	1800	2.4	1700

Phase 1 groundwater investigations consisted of collecting groundwater grab samples from the 10 soil borings drilled. The purpose of collecting groundwater grab samples was to obtain preliminary field screening data of potential groundwater contaminants. The most significant findings from the analysis of groundwater grab samples was the detection of nitrobenzene (6.58 ug/l) and RDX (18.4 ug/l) in the sample from 27GG33, located in the cratered hillocks west of the test pad. Sample 27GG38 contained elevated nitrate at 3.31 mg/l and 27GG37 contained elevated sulfate, chloride, and nitrate. A data table summarizing the results of all groundwater grab samples is shown in Appendix D.

Based on the explosives found in grab sample 27GG33, four monitoring wells, 27WW01 through 27WW04, were installed during the Phase 2 field investigation at the locations shown on Figure 11-1. Well 27WW01 was installed approximately 10 feet from 27SB33, and wells 27WW02 and 27WW03 were installed to the east of the boring. Well 27WW04 was installed downgradient of the other three wells. The maximum screen length used was 10 ft.

The wells were purged a minimum of five well volumes and sampled once field parameters stabilized. No explosives or semivolatiles were found. Volatiles were not tested. Nickel, nitrate, and chloride were detected at elevated levels in most of the samples. Results of these analyses are given in Table 11-7.

11.1.3 Surface Water and Sediment Investigations

Four sediment and 4 surface water samples were collected during the Phase 1 remedial investigation. No explosives or volatiles were found in the sediment samples. Two of the sediments contained di-n-butylphthalate. Most samples contained low levels of metals and anions. Lead was detected in surface water sample 27SW03 at 0.015 mg/l. Barium, chloride, nitrate, and sulfate were found in low levels in these samples. No volatiles, semivolatiles, or explosives were found. Results are given in Tables 11-8 and 11-9.

No surface water or sediment samples were collected during the Phase 2 field investigation.

Table 11-8
Site 27 - South Test Area
Sediment Analytical Summary (1993)

Parameters	Units	Sample 27SD02	Sample 27SD03	Sample 27SD04	Sample 27SD05
Volatiles	ug/kg	<DL	<DL	<DL	<DL
Semi-volatiles	ug/kg	<DL	<DL	<DL	<DL
Di-n-butylphthalate	ug/kg	<DL	2170	<DL	1760
Explosives	ug/kg	<DL	<DL	<DL	<DL
Arsenic	mg/kg	1.1	0.9	1.1	0.7
Barium	mg/kg	91.8	43.5	254	39
Chromium	mg/kg	4.6	1.9	5.2	2.4
Lead	mg/kg	9	8	5	4
Mercury	mg/kg	0.03	<DL	<DL	<DL
Nickel	mg/kg	6	3	3.9	2.8
Selenium	mg/kg	<DL	0.2	<DL	<DL
Chloride	mg/kg	44	<DL	<DL	<DL
Nitrate/Nitrite	mg/kg	2.26	2.17	<DL	2.36
Sulfate	mg/kg	40	40	50	30
pH	pH	6.3	5.2	5.6	6.4
Conductivity	umhos/cm	170	51	197	123

Table 11-9
Site 27 - South Test Area
Surface Water Analytical Summary (1993)

Parameter	Units	Sample 27SW02	Sample 27SW03	Sample 27SW04	Sample 27SW05
Volatiles	ug/l	<DL	<DL	<DL	<DL
Semi-volatiles	ug/l	<DL	<DL	<DL	<DL
Explosives	ug/l	<DL	<DL	<DL	<DL
Barium	mg/l	0.11	0.29	0.11	0.12
Lead	mg/l	<DL	0.015	<DL	<DL
Chloride	mg/l	27.5	15.1	48.7	30.1
Nitrate/Nitrite	mg/l	0.29	0.33	0.28	0.2
Sulfate	mg/l	40	40	50	30

11.2 NATURE AND EXTENT OF CONTAMINATION

11.2.1 Explosives

During the Phase 1 Remedial Investigation, explosives were detected only in groundwater grab sample 27GG33. As a result, four new wells were installed in the vicinity of boring 27SB33 to further evaluate the potential for explosives contamination in the area. No explosives were detected in any of the soil or groundwater samples collected from the four new wells. The explosives found in the 1982 work by EPS have not been found in any other surface or subsurface soil samples. The presence of explosives, the most likely contaminant at the site, is not confirmed.

11.2.2 Volatile and Semivolatile Organics

No volatiles were found in any soil or water sample. With the exception of the one sample of ethylene glycol, only low concentrations of phthalates were found. These are common plasticizers and are more likely to be indicators of laboratory contamination than site contamination, especially at these concentrations. There is no indication of volatiles or semivolatiles at the site.

11.2.3 Metals and Other Inorganics

Most metals tested show up in varying concentrations at the site. Some of these metals, especially barium, chromium, lead, and nickel appeared to have elevated concentrations in some of the samples. Even so, the number of samples with elevated levels and the concentrations of them do not indicate contamination.

11.3 CONCLUSIONS

Because of the limited numbers and low levels of explosives detections and no demonstrated contamination from other sources, no further action at Site 27 is recommended.

12.0 SUMMARY AND RECOMMENDATIONS

Group 1 sites at LHAAP were investigated in the 1980's by EPS for Morton Thiokol as a part of an investigation by USATHAMA. Phase 1 and Phase 2 remedial investigations were performed by several firms under contract to the Tulsa District Corps of Engineers in the 1990's. A summary of the results of these studies are shown tables below.

Site 11-Suspected TNT Burial Site Summary and Recommendation			
	Soil	Groundwater	Sediments/Surface Water
Explosives	TNT found in 1982, but unconfirmed in subsequent investigations.	None	None
Organics-Volatile and Semivolatile	Laboratory contaminants only.	None	None
Inorganics	No contamination indicated	No contamination indicated	No contamination indicated
Risk Assessment	No unacceptable risk		
Recommendation	No further action		

Site 1 - Inert Burning Grounds Summary and Recommendation			
	Soil	Groundwater	Sediments/Surface Water
Explosives	None	None	None
Organics-Volatile and Semivolatile	PAHs detected in several samples. A few samples contained xylene and toluene. These compounds reflective of burning activities.	Acetone and 2-butanone detected in low concentrations.	In sediments, acetone, 2-butanone, and methylene chloride detected. PAH in one sediment sample. Toluene in one surface water sample.
Inorganics	No contamination indicated	No contamination indicated	No contamination indicated
Risk Assessment	No unacceptable risk		
Recommendation	No further action		

Site XX - Ground Signal Test Area Summary and Recommendation			
	Soil	Groundwater	Sediments/Surface Water
Explosives	None	None	None
Organics-Volatile and Semivolatile	One detection each of acetone, TCE, and methylene chloride only. All unconfirmed. Also detections of laboratory contaminants.	None	None
Inorganics	No contamination indicated	No contamination indicated	No contamination indicated
Risk Assessment	No unacceptable risk		
Recommendation	No further action		

Site 27 - South Test Area Summary and Recommendation			
	Soil	Groundwater	Sediments/Surface Water
Explosives	Initial detections of TNT unconfirmed.	None	None
Organics-Volatile and Semivolatile	Laboratory contaminants only.	None	None
Inorganics	No contamination indicated	No contamination indicated	No contamination indicated
Risk Assessment	No unacceptable risk		
Recommendation	No further action		

All Group 1 sites were extensively explored. Any possible areas of contamination were thoroughly investigated and no evidence has been found to suggest that contamination from site activities exists. Since all of these sites are related to operations with TNT, and no confirmed explosives were found, no further action is recommended at these sites.

13.0 REFERENCES

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APPENDIX A

**MONITORING WELL AND SOIL
BORING SAMPLE LOGS AND
COMPLETION DIAGRAMS**

018742

Location: LHAAP-11 Suspected TNT Burial Site		Identification: 11WW01	
Date(s): 08/22/94 - 08/22/94		X Coordinate: 3034109	Y Coordinate: 380302
Consulting Firm: Sverdrup Environmental, Inc		Elevation: 205.89'	Datum: NGVD
Logged By: JBN		Total Depth: 25.00'	Measuring Point: 208.59'
Contractor: CCI/Alliance		Completed Depth: 24.50'	Static Water Level:
Drilling Method: Hollow Stem Auger		Well Casing: type: 316 S.S. dia: 4.00" fm: -2.7' to: 14.50'	
Remarks:		Screens: type: Slotted size: .010" dia: 4.00" fm: 14.50' to: 24.50'	
		Annular Fill: type: Bentonite Grout fm: .00' to: 8.00'	
		type: Secondary Sand Filter fm: 8.00' to: 8.50'	
		type: Granular Bentonite Seal fm: 8.50' to: 11.50'	
		type: Secondary Sand Filter fm: 11.50' to: 12.50'	
		type: #20-40 Silica Filter Sand fm: 12.50' to: 24.50'	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
205	0		SS-1			SC	CLAYEY SAND - Reddish brown, loose, dry, siltier at depth	19.5	17	16	MP. EL. 208.59
200	5		SS-2			SC	CLAYEY SAND - Reddish brown with little silt, firm, moist, and plastic	13.7	19	27	
195	10		ST-3					25.9	17	29	
190	15		ST-4			SM	CLAYEY SAND - Grey, little silt, fine, loose, moist	20.4	9	53	
185	20		SS-5			CL SM	SANDY CLAY - Grey, dense with a few wet zones	30	25	25	
180	25		SS-6			CL	SILTY SAND - Grey/reddish brown, mottled, dense, wet	25	16	31	
						CL	SANDY CLAY - Reddish brown, plastic, firm, moist				

Hole No. 11WWØ1

DRILLING LOG		DIVISION	INSTALLATION LHAAP	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP Group I, Phase II		10. SIZE AND TYPE OF BIT (3A HSA)		
2. LOCATION (Coordinates or Station) Site 11		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		
3. DRILLING AGENCY Alliance		12. MANUFACTURER'S DESIGNATION OF DRILL Mobil Drill B-57		
4. HOLE NO. (As shown on drawing title and file number) 11WWØ1		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		
5. NAME OF DRILLER John L		14. TOTAL NUMBER CORE BOXES		
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER		
7. THICKNESS OF OVERBURDEN		16. DATE HOLE 8-22-94		
8. DEPTH DRILLED INTO ROCK		17. ELEVATION TOP OF HOLE		
9. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BORING %		
		19. SIGNATURE OF INSPECTOR		

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ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	sm	SS-1: Reddish brown silty fine sand (sm) loose, dry, silty at depth		SS-1 100%	collect chem & Geotech sample LH11WWØ1(0-1) @ 1300
	2					
	3	cl	SS-2: Reddish brown silty clay (cl) with little fine sand, firm moist, plastic		SS-2 100%	collect chem & Geotech sample LH11WWØ1(3-5) @ 1310
	4					
	5					
	6		ST-3: Reddish brown/gray mottled silty clay with little fine sand (cl), firm, moist, plastic			
	7					
	8					
	9		ST-4: Reddish brown/gray mottled silty clay (cl) to 14 ft then gray silty fine sand, loose moist		ST-3 100%	collect chem & geotech sample LH11WWØ1(8-10) @ 1320
	10					
	11					
	12		SS-5: gray/Reddish brown mottled silty fine sand (sm) w/ gray silty clay large 0.3ft thick at ~ 14 ft, Dense, with few wet zones		ST-4 100%	collect chem & Geotech sample LH11WWØ1(13-15) @ 1330
	13					
	14	sm				
	15					
	16					
	17					
	18	cl			SS-5 80%	collect Geotech sample
	19	sm				

DRILLING LOG (Cont Sheet)		ELEVATION TOP OF HOLE		Hole No. 11W01		
PROJECT LHAAP Group I, Phase II		INSTALLATION LHAAP		SHEET OF 2 SHEETS 2		
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	21		SS-6: Gray / Reddish brown silty fine sand (sm) mottled, dense, wet to ~ 24.5 then Reddish brown silty clay, plastic firm, moist			collect grotch sample
	22					
	23					
	24				SS-6 100%	
	25	CL				
	26		TD = 25 ft			
	27					
	28					
	29					
	30					

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ATTENTION OWNER: Confidentiality
Privilege Notice on Reverse SideState of Texas
WELL REPORT MW# 11 WW01Texas Water Well Drillers Board
P.O. Box 13067
Austin, Texas 78711

1) OWNER Longhorn Army Ammunition Plant ADDRESS Karnack Tex
(Name) (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL:
County Harrison 15 miles in NE direction from Marshall Tex
(NE, SW, etc.) (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name 118745

Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):

☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):

☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):

☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored
☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:

Date Drilling:

Started 8-22 1994Completed 8-22 1994

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
<u>11"</u>	<u>Surface</u>	<u>24.5</u>

7) BOREHOLE COMPLETION:

☐ Open Hole ☐ Straight Well ☐ Underreamed
☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval ... from 11.5 ft. to 24.5 ft.

From (ft.) To (ft.) Description and color of formation material

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

From (ft.)	To (ft.)	Description and color of formation material	Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casting Screen
						From	To	
<u>0'</u>	<u>3'</u>	<u>Red & Brown Si/Fine Sand</u>						
<u>3'</u>	<u>14'</u>	<u>Reddish Brown Si Clay</u>						
<u>14'</u>	<u>19'</u>	<u>Reddish Brown Si Fi Sand w Gray Si Clay lenses</u>	<u>4</u>	<u>New</u>	<u>Stainless TriLoc</u>	<u>+3'</u>	<u>14.5</u>	<u>Riser</u>
<u>19'</u>	<u>21'</u>	<u>Reddish Brown Clay Layer between 19' and 21'</u>	<u>4</u>	<u>New</u>	<u>Stainless TriLoc Screen</u>	<u>14.5</u>	<u>24.5</u>	<u>.010</u>
<u>21'</u>	<u>24.5'</u>	<u>Gray & Reddish Brown Si FINE SAND</u>						

(Use reverse side if necessary)

13) TYPE PUMP:

☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____

Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:

Type Test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated

Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? _____ Depth of strata _____

Was a chemical analysis made? ☐ Yes ☐ No

9) CEMENTING DATA [Rule 287.44(1)]

Cemented from 0 ft. to 8.5 ft. No. of Sacks Used 2

_____ ft. to _____ ft. No. of Sacks Used _____

Method used Trimix HoscCemented by John Loden

10) SURFACE COMPLETION

☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]☒ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]☐ Pitless Adapter Used [Rule 287.44(3)(B)]☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:

Static level 6.2 ft. below land surface

Artesian flow _____ gpm.

Date 8-22-94

Date _____

12) PACKERS:

Type

Depth

BENTONITE Chips 11.5 to 8.5

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME CCI Environmental Drilling WELL DRILLER'S LICENSE NO. 3213 DMN
(Type or print)ADDRESS 2032 Karnack Houston Texas 77092
(Street or RFD) (City) (State) (Zip)by John Loden
(Licensed Well Driller)

(Signed) _____ (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

19746

Location: LHAAP-11 Suspected TNT Burial Site		Identification: 11WW02	
Date(s): 08/20/94 - 08/20/94		X Coordinate: 3034205	Y Coordinate: 380377
Consulting Firm: Sverdrup Environmental, Inc		Elevation: 204.49'	Datum: NGVD
Logged By: JBN		Total Depth: 29.50'	Measuring Point: 207.24'
Contractor: CCI/Alliance		Completed Depth: 29.50'	Static Water Level:
Drilling Method: Hollow Stem Auger		Well Casing: type: 316 S.S. dia: 4.00" fm: -2.8' to: 19.50'	
Remarks:		Screens: type: Slotted size: .010" dia: 4.00" fm: 19.50' to: 29.50'	
		Annular Fill: type: Bentonite Grout fm: .00' to: 12.00'	
		type: Secondary Sand Filter fm: 12.00' to: 12.50'	
		type: Granular Bentonite Seal fm: 12.50' to: 15.50'	
		type: Secondary Sand Filter fm: 15.50' to: 16.50'	
		type: #20-40 Silica Filter Sand fm: 16.50' to: 29.50'	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
		SS-1				SM	SILTY SAND - Reddish brown, dry, loose, grading to reddish brown silty clay, low plasticity, firm, moist	12.2	12	14	MP. EL. 207.24
		SS-2				CL					
		ST-3				SC	SILTY CLAY - Reddish brown/gray mottled with some fine sand interbedded with gray clayey fine sand lenses				
		SS-4				SC	CLAYEY SAND - Reddish brown, little to some silt, low plasticity, stiff, moist	16.3	21	46	
	10					CL		20.1	13	44	
		ST-5				SM	SILTY CLAY - Light gray with little fine sand, moist, plastic, stiff	20.9	19	19	
-190											
	20	ST-6						22.9	20	22	
		SS-7									
-180								25.1	12	20	
		SS-8						25.8	12	25	

Hole No. 11WW02

DRILLING LOG	DIVISION	INSTALLATION LHAAP
1. PROJECT LHAAP Group 1, Phase II	10. SIZE AND TYPE OF BIT	SHEET 1 OF 2 SHEETS
2. LOCATION (Coordinates or Station) Site 11 - Suspect TNT Burial Site	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
DRILLING AGENCY Alien	12. MANUFACTURER'S DESIGNATION OF DRILL Mobil Drill B-57	
3. ELEVATION (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED
	14. TOTAL NUMBER CORE BOXES	UNDISTURBED
4. NAME OF DRILLER John	15. ELEVATION GROUND WATER	
5. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	16. DATE HOLE STARTED 8-20-94	COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING	%
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR	

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ELEVATION a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	sm	SS-1: Reddish brown silty fine sand (sm), dry loose, grading to reddish brown silty clay (cc), low plastic, firm, moist.		SS-1 100%	Collect Chem & Geotech sample LH11WW02(0-2) @ 1135
	2					
	3	cc	SS-2: Reddish brown/gray mottled silty clay (cc) with some fine sand interbedded w/ gray clayey fine sand (sc) lenses		SS-2 80%	Collect Chem & QA Sample LH11WW02(3-5) (0.5 ft than in clayey sand lenses)
	4					
	5	cc	ST-3: Lt. gray silty clay with little fine sand (cc) low plastic, stiff moist		ST-3 80%	Collect Geotech sample
	6					
	7					
	8	sc	SS-4: Lt. gray silty clay w/ little fine sand (cc), moist, plastic stiff. Reddish brown clayey fine sand (sc) low plastic, stiff from ~ 8.5 to 9 ft		SS-4 100%	Collect Chem & Geotech sample LH11WW02(8-19) @ 1210
	9	cc				
	10					
	11					
	12		ST-5: Lt. gray silty clay w/ little fine sand (cc), low plastic, stiff, moist. Grading to reddish brown silty fine sand, dense, dry		ST-5 100%	Collect Chem & Geotech sample LH11WW02(15-15) @ 1220
	13					
	14					
	15	sm	ST-6: Reddish brown silty fine sand (sm/ ml) medium dense moist		ST-6 70%	Collect Chem & Geotech sample LH11WW02(18-20) @ 1245
	16					
	17					
	18					
	19					

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE

Hole No. 11WWP2

PROJECT LHAAP Group I, Phase II

INSTALLATION LHAAP

SHEET OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	21	sm	SS-7: Reddish brown silty fine sand (sm) medium dense, moist w/ few oil wet zones			
	22					
	23		SS-8: Reddish brown silty fine sand (sm) medium dense, moist with wet zones		SS-7	collect Chem & Geotech sample LHAAP-82 (23-25)
	24	▽			80%	
	25					
	26					
	27					
	28					
	29				SS-8	collect Geotech sample
	30		TD=29.5 ft		80%	
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					
	41					
	42					
	43					

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ATTENTION OWNER: Confidentiality
Privilege Notice on Reverse SideState of Texas
WELL REPORT MW # 11 WWO2Texas Water Well Drillers Board
P.O. Box 13067
Austin, Texas 78711

1) OWNER Longhorn Army Ammunition Plant ADDRESS Karnack Texas
(Name) (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL:
County HARRISON 15 miles in NE direction from MARSHALL Tex
(NE, SW, etc.) (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name 118749

Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):

☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):

☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):

☐ Drive ☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bore
☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:

Date Drilling:

Started 8-20 1994Completed 8-20 1994

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
11"	Surface	29.5

7) BOREHOLE COMPLETION:

☐ Open Hole ☐ Straight Wall ☐ Underreamed
☒ Gravel Packed ☐ Other _____If Gravel Packed give interval ... from 16.5 ft. to 29.5 ft.

From (ft.) To (ft.) Description and color of formation material

0 - 2 Reddish Brown Si Fine SA

2 - 6 Reddish Brown Si CLAY

6 - 15' Lt Gray Si CLAY

15 - 29.5 Reddish Brown Si Fi SAND
Dense & Moist w/ wet Zones

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casing Screen
			From	To	
4"	New	Stainless Tri Loc	+ 3'	19.5	Riser
4"	New	Stainless Tri Loc	19.5	29.5	.010

9) CEMENTING DATA [Rule 287.44(1)]

Cemented from 0 ft. to 13.5 ft. No. of Sacks Used 2

_____ ft. to _____ ft. No. of Sacks Used _____

Method used Trimix HoseCemented by John Loden

(Use reverse side if necessary)

13) TYPE PUMP:

☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____

Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:

Type Test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? _____ Depth of strata _____

Was a chemical analysis made? ☐ Yes ☐ No

10) SURFACE COMPLETION

☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]☒ Specified Steel Sleeve Installed [Rule 287.44(3)(A)] 8" Steel Sleeve☐ Pileless Adapter Used [Rule 287.44(3)(B)]☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:

Static level 6.2 ft. below land surface Date 8-20-94

Artesian flow _____ gpm. Date _____

12) PACKERS:

Type _____ Depth _____

Bentonite Chips 13.5 to 16.5

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME CCI Environmental Drilling
(Type or print)WELL DRILLER'S LICENSE NO. 3213 OMNADDRESS 2032 Karnbach
(Street or RFD)Houston
(City)Tex
(State)77092
(Zip)

Signed)

John Loden
(Licensed Well Driller)

Signed)

(Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

018750

Location: LHAAP-11 Suspected TNT Burial Site				Identification: 11WW03			
Date(s): 08/21/94 - 08/21/94				X Coordinate: 3034253		Y Coordinate: 380305	
Consulting Firm: Sverdrup Environmental, Inc				Elevation: 204.21'		Datum: NGVD	
Logged By: JBN				Total Depth: 17.00'		Measuring Point: 206.87'	
Contractor: CCI/Alliance				Completed Depth: 17.00'		Static Water Level:	
Drilling Method: Hollow Stem Auger				Well Casing: type: 316 S.S. dia: 4.00" fm: -2.7' to: 7.00'			
Remarks:				Screens: type: Slotted size: .010" dia: 4.00" fm: 7.00' to: 17.00'			
				Annular Fill: type: Bentonite Grout fm: .00' to: 1.50'			
				type: Secondary Sand Filter fm: 1.50' to: 2.00'			
				type: Granular Bentonite Seal fm: 2.00' to: 5.00'			
				type: Secondary Sand Filter fm: 5.00' to: 6.00'			
				type: #20-40 Silica Filter Sand fm: 6.00' to: 17.00'			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
		SS-1				SM	SILTY SAND - Reddish brown, medium dense, dry	13.9	13	21	
		SS-2				CL	SILTY CLAY - Light grey with a little fine sand, low plasticity, stiff, moist	12.6	21	16	
-200											
		SS-3				SM	SILTY SAND - Reddish brown/grey, mottled, medium dense, moist, wet at depth	20.2		34	
		SS-4									
-190		SS-5				CL	SILTY CLAY - Plastic, stiff, moist	17.5		24	
-20											
-180											

Hole No. 11WW03

DRILLING LOG		DIVISION		INSTALLATION		SHEET	
1. PROJECT		2. LOCATION (Coordinates or Station)		10. SIZE AND TYPE OF BIT		OF 1 SHEETS	
LHAAP Group I, Phase II		Site II		LHAAP			
3. DRILLING AGENCY		4. NAME OF DRILLER		11. DAYUM FOR ELEVATION SHOWN (TBM or MSL)			
Alliance							
5. ELEVATION NO. (As shown on drawing title and file number)		6. DIRECTION OF HOLE		12. MANUFACTURER'S DESIGNATION OF DRILL		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	
11WW03		☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		Mobil Drill B-57		DISTURBED	
				14. TOTAL NUMBER CORE BOXES		UNDISTURBED	
				15. ELEVATION GROUND WATER			
				16. DATE HOLE		STARTED	
				8-21-94		COMPLETED	
				17. ELEVATION TOP OF HOLE			
				18. TOTAL CORE RECOVERY FOR BORING		%	
				19. SIGNATURE OF INSPECTOR			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	1	SM	SS-1: Reddish brown clay, fine sand, (SM), medium dense, dry		SS-1	100%	Collect Chem. & Geotech sample LHAAP03(0-2) @ 0840
	2		SS-2: Reddish brown clay, fine sand (SM) to 3.5 ft then lt. gray silty clay with a little fine sand (CL) low plastic, 12 ft moist		SS-2	100%	Collect Chem & Geotech sample LHAAP03(3-5) @ 0855
	3	CL					
	4		SS-3: reddish brown/gray mottled silty fine sand, medium dense moist, wet at bottom				
	5		SS-4: gray silty fine sand (SM) medium dense, wet		SS-3	50%	Collect Chem & Geotech sample LHAAP03(8-10) @ 0905
	6	SM					
	7		SS-5: gray silty fine sand (SM) to 15.5 ft then gray silty clay (CL) plastic, still moist		SS-4	40%	Collect Geotech sample @ 0915
	8						
	9				SS-5	100%	
	10						
	11						
	12						
	13						
	14						
	15						
	16	CL					
	17		TD=17 LL				
	18						
	19						

18751

ATTENTION OWNER: Confidentiality
Privilege Notice on Reverse SideState of Texas
WELL REPORT MW# 11WW03Texas Water Well Drillers Board
P.O. Box 13067
Austin, Texas 78711

1) OWNER Loughorn Army Ammunition Plant ADDRESS Karnack Tex
(Name) (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL:
County HARRISON 15 miles in NE direction from Marshall
(NE, SW, etc.) (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:

Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name 18752
Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):

☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):

☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):

☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored
☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:

Date Drilling:

Started 8-21 1994Completed 8-21 1994

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
11"	Surface	17

7) BOREHOLE COMPLETION:

☐ Open Hole ☐ Straight Well ☐ Underreamed
☒ Gravel Packed ☐ Other _____

If Gravel Packed give interval ... from 5 ft. to 17 ft.

From (ft.)	To (ft.)	Description and color of formation material
0	3	Reddish Brown Si Fi Sa
3	7	Lt Gray Si Clay
7	15.5	Gray Si Fi Sand
15.5	17	Gray Si Clay

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., If commercial	Setting (ft.)		Gage Casting Screen
			From	To	
4"	New	Stainless Tri Loc	3	7	Riser
4"	New	Stainless Tri Loc	7	17	.010

(Use reverse side if necessary)

13) TYPE PUMP:

☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____

Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:

Type Test: ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? _____ Depth of strata _____

Was a chemical analysis made? ☐ Yes ☐ No

9) CEMENTING DATA [Rule 287.44(1)]

Cemented from 0 ft. to 2 ft. No. of Sacks Used 1

_____ ft. to _____ ft. No. of Sacks Used _____

Method used SURFACE Pour

Cemented by _____

10) SURFACE COMPLETION

And 4'x4'x6"
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)] 8" steel sleeve
☒ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]
☐ Pileless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:

Static level 8.9 ft. below land surface

Artesian flow _____ gpm.

Date 8-21-94

Date _____

12) PACKERS:

Type	Depth
Bentonite	2' to 5'

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME CCI Environmental Drilling
(Type or print)WELL DRILLER'S LICENSE NO. 3213 DMNADDRESS 2032 Karnack
(Street or RFD)Houston
(City)Tex
(State)77092
(Zip)

(Signed)

John Loebe
(Licensed Well Driller)

(Signed)

(Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

018753

Location: LHAAP-01 Inert Burning Grounds				Identification: 01WW01							
Date(s): 08/24/94 - 08/24/94				X Coordinate: 3027596		Y Coordinate: 388695					
Consulting Firm: Sverdrup Environmental, Inc				Elevation: 244.90'		Datum: NGVD					
Logged By: JBN				Total Depth: 18.00'		Measuring Point: 247.60'					
Contractor: CCI/Alliance				Completed Depth: 17.00'		Static Water Level:					
Drilling Method: Hollow Stem Auger				Well Casing: type: 316 S.S. dia: 4.00" fm: -2.7' to: 7.00'							
Remarks:				Screens: type: Slotted size: .010" dia: 4.00" fm: 7.00' to: 17.00'							
				Annular Fill:							
				type: Secondary Sand Filter fm: 1.50' to: 2.00' type: Granular Bentonite Seal fm: 2.00' to: 5.00' type: Secondary Sand Filter fm: 5.00' to: 6.00' type: #20-40 Silica Filter Sand fm: 6.00' to: 17.00' type: fm: to:							
Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
		SS-01				CL	SANDY CLAY - Reddish brown with some silt, low plasticity, soft, moist	15.3	9	21	
		SS-02				CL	SANDY CLAY - Gray/reddish brown mottled, sandy clay with little silt, plastic, firm, moist	21.1	26	14	
240		SS-03				CL	SILTY CLAYEY SAND - Reddish brown silty clay (CL) with occasional wet silty sand lenses, iron staining, soft, moist	26.1	20	18	
10		SS-04				SM	SILTY SAND - tan with occasional reddish brown, little to some clay, non to slightly plastic, wet	30.1		11	
230		SS-05						30.5	23	23	
20											
220											

ATTENTION OWNER: Confidentiality
Privilege Notice on Reverse SideState of Texas
WELL REPORT MW# 1 WW01Texas Water Well Drillers Board
P.O. Box 13067
Austin, Texas 78711

1) OWNER Loughorn Army Ammunition Plant ADDRESS Karnack Tex
(Name) (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL:
County HARRISON 15 miles in NE direction from Marshall Texas
(NE, SW, etc.) (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name 18755

Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):

☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):

☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):

☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored
☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:

Date Drilling:

Started 8-24 1994Completed 8-24 1994

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
<u>11</u>	Surface	<u>18</u>

7) BOREHOLE COMPLETION:

☐ Open Hole ☐ Straight Well ☐ Underreamed☒ Gravel Packed ☐ Other _____If Gravel Packed give interval ... from 5 ft. to 18 ft.

From (ft.) To (ft.) Description and color of formation material

0' to 7' Redish Brown silty Clay

7' to 17 Redish Brown & Gray Silty Fine Sand

17' to 18' Red & Brown Silty Clay

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casting Screen
			From	To	
<u>4"</u>	<u>New</u>	<u>Stainless Tri Loc</u>	<u>+3'</u>	<u>7</u>	<u>Riser</u>
<u>4"</u>	<u>New</u>	<u>Stainless Tri Loc</u>	<u>7</u>	<u>17</u>	<u>.010</u>

(Use reverse side if necessary)

13) TYPE PUMP:

☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____

Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:

Type Test: ☐ Pump ☐ Baller ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? _____ Depth of strata _____

Was a chemical analysis made? ☐ Yes ☐ No

9) CEMENTING DATA [Rule 287.44(1)]

Cemented from 0 ft. to 2 ft. No. of Sacks Used 1

_____ ft. to _____ ft. No. of Sacks Used _____

Method used Surface PourCemented by John Loder

10) SURFACE COMPLETION

☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]☒ Specified Steel Sleeve Installed [Rule 287.44(3)(A)]☐ Pitless Adapter Used [Rule 287.44(3)(B)]☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:

Static level +46 ft. Above land surface

Artesian flow _____ gpm.

Date 8-25-94

Date _____

12) PACKERS:

Type _____ Depth _____

Bentonite Chips 5' to 2'

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME CCI ENVIRONMENTAL
(Type or print)WELL DRILLER'S LICENSE NO. 3213 DMNADDRESS 2032 KARBACH
(Street or RFD)Houston
(City)Tex
(State)77092
(Zip)

Signed)

John Loder
(Licensed Well Driller)

(Signed)

(Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

#18756

Location: LHAAP-XX Ground Signal Test Area	Identification: XXSB01
Date(s): 08/22/94 - 08/22/94	X Coordinate: 0
Consulting Firm: Sverdrup	Y Coordinate: 0
Logged By: DS	Elevation: 190.00'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 13.00'
Remarks:	Borehole Dia.: .00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-168					[Diagonal Lines]	CL	SILTY CLAY - mottled gray and orange-brown, stiff, low sand content (top 6" sandy clay, red-orange, moderate plasticity)				
					[Vertical Lines]	ML	CLAYEY SILT - mottled gray and brown, stiff, sl. some black layers (shale?)	11.9		31	
					[Diagonal Cross-Hatch]	CH	CLAY - orange-brown w/ gray mottling, some silt, moderate plasticity				
					[Diagonal Lines]	SC	CLAYEY SAND - gray w/ some red-brown, moist, low plasticity	14		23	
					[Vertical Lines]	SM	SILTY SAND - gray and brown, w/ 2.5" gray medium grained sand layer at @9'				
-180	10				[Horizontal Lines]	CL SM	SANDY CLAY - gray and red	24.3		9	
					[Vertical Lines]		SILTY SAND - gray w/ some reddish brown, very moist				
					[Empty Box]						
					[Empty Box]						
					[Empty Box]						
					[Empty Box]						
-170	20				[Empty Box]						
					[Empty Box]						
					[Empty Box]						
					[Empty Box]						
					[Empty Box]						
-160					[Empty Box]						

Hole No. XXSB-01

18757

DRILLING LOG		DIVISION	INSTALLATION LHAAP	SHEET 1 OF 1 SHEETS
1. PROJECT LHAAP GROUP 1, PHASE 2			10. SIZE AND TYPE OF BIT 6 3/4" H&A	
2. LOCATION (Coordinates or Station) SITE XX - GROUND SIGNAL TEST AREA			11. DAYUM FOR ELEVATION SHOWN (TBM - MSL)	
3. DRILLING AGENCY ALLIANCE (MIL ENVIRONMENTAL)			12. MANUFACTURER'S DESIGNATION OF DRILL MOBIL DRILL B-47	
4. HOLE NO. (As shown on drawing title and file number) XXSB-01			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	
5. NAME OF DRILLER JOHN LOEF			14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER 11 ft.	
7. THICKNESS OF OVERBURDEN			16. DATE HOLE STARTED 8-22-94 COMPLETED 8-22-94	
8. DEPTH DRILLED INTO ROCK N/A			17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 13 FT			18. TOTAL CORE RECOVERY FOR BORING	
			19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	CL	SHADY CLAY - red, orange, moist, medium plasticity			HMM PID - 0 ppm (direct) sample taken for chemical analysis
	2	CL	SILTY CLAY - gray, w/ orange brown mottling, stiff, little sand content			
	3	ML	CLAYEY SILT - gray and brown mottled, with black veins (shale?), stiff, sl. plastic			HMM PID - 5 ppm (indirect) sample for geophysical testing
	4					
	5	CL	SILTY CLAY - orange brown w/ gray mottling, moderately plastic, stiff			HMM PID - 0 ppm (direct) sample taken for chemical w/ analysis
	6					
	7	SC	CLAYEY SAND - gray w/ red brown clay, moist, slightly plastic			sample for geophysical testing HMM PID - 25 ppm (indirect)
	8					
	9	SM	SILTY SAND - gray w/ some brown, - medium grained			sample taken (9 10") for chemical analysis HMM PID - 0 ppm (direct)
	10	CL	SANDY CLAY - gray and red			
	11	SM	SAND - gray, very moist, w/ some reddish-brown silty sand			HMM PID - 0 ppm (direct)
	12					- water samples collected for VOC analysis
	13					- hole back filled with bentonite and grout to surface.
			TD = 13 FT.			

ENG FORM 1836
MAR 71

PREVIOUS EDITIONS ARE OBSOLETE.

PROJECT LHAAP

HOLE NO.
XXSB-01

Location: LHAAP-27 South Test Area		Identification: 27WW01		18758	
Date(s): 08/19/94 - 08/19/94		X Coordinate: 3036285		Y Coordinate: 374050	
Consulting Firm: Sverdrup Environmental, Inc		Elevation: 191.37'		Datum: NGVD	
Logged By: JBN		Total Depth: 27.00'		Measuring Point: 194.15'	
Contractor: CCI/Alliance		Completed Depth: 27.00'		Static Water Level:	
Drilling Method: Hollow Stem Auger		Well Casing: type: 316 S.S. dia: 4.00" fm: -2.8' to: 17.00'			
Conductor Casing: type: size: dia: .00" fm: .00' to: .00'		Screens: type: Slotted size: .010" dia: 4.00" fm: 17.00' to: 27.00'			
Remarks:		Annular Fill: type: Bentonite Grout fm: 1.00' to: 9.50' type: Secondary Sand Filter fm: 9.50' to: 10.00' type: Granular Bentonite Seal fm: 10.00' to: 13.00' type: Secondary Sand Filter fm: 13.00' to: 14.00' type: #20-40 Silica Filter Sand fm: 14.00' to: 27.00'			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
190		SS-1				ML	CLAY - Reddish brown with sand, low plasticity, dry, hard	13.8	18	16	
		SS-2									
	10	ST-3				SM	SILTY SAND - Reddish brown/grey, mottled, moist, medium dense	15.6	11	26	
180						CL	SANDY CLAY - Brown to reddish brown interbedded with gray fine silty sand, plastic, hard, moist	24.3	28	7	
	20	ST-5				SM	SILTY SAND - Grey/dark grey mottled, wet, medium dense with occasional reddish brown silt clay lenses, silty clay increasing with depth	18.8		20	
170		SS-6						20.1	26	5	

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE

Hole No. 27WWØ1

PROJECT LHAAP, Phase II, Ground

INSTALLATION Longhorn

SHEET 1 OF 2 SHEETS

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV. e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	MC	SS-1: Reddish Brown silt (MC) low plastic, dry hard.		SS-1	LH27-WW-01(0-2) sample for chem & geotech analysis @ 1150
	2		SS-2: Reddish Brown silt (MC) low plastic dry, hard			* hard tailing
	3					
	4		ST-3: Gray / Reddish Brown mottled silty fine sand (SM), moist medium dense		SS-2	collect chem & geotech sample LH27-WW-01(5-7) @ 12:10
	5					
	6		ST-4: Brown to reddish brown silty clay (CL) interbedded w/ gray silt, sand, plastic, hard, moist			
	7					
	8					
	9	SM	ST-5: reddish brown silty clay (CL) plastic, hard moist to 21 ft then gray silt, fine sand (SM) wet		ST-3	collect chem & geotech sample LH27-WWØ1(10-12) @ 12:40
	10			100%		
	11					
	12					
	13	CL				
	14					
	15				ST-4	collect chem & geotech sample LH27WWØ1(15-17) @ 13:05
	16			100%		
	17					
	18					
	19					
	20					
	21	SM			ST-5	collect Geotech sample @ 13:20
	22			100%		
	23					

019759

DRILLING LOG (Cont Sheet)

ELEVATION TOP OF HOLE

Hole No. 27W401

PROJECT
LHAAP

INSTALLATION
Longhorn

SHEET
OF 2 SHEETS 2

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
----------------	------------	-------------	---	------------------------------	------------------------------	---

25
26
27
28
29
30

JM

SS-5: gray / Dark gray
mottled silty fine
sand (SM), wet,
medium dense with
occasional reddish
brown silt clay lenses

SS-6
100%

collect geotech
Sample @ 1410
1410

TD = 27'

13760

ATTENTION OWNER: Confidentiality
Privilege Notice on Reverse SideState of Texas
WELL REPORT MW# 27WW01Texas Water Well Drillers Board
P.O. Box 13067
Austin, Texas 78711

1) OWNER Longhorn Army Ammunition Plant ADDRESS Karnack Tex
(Name) (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL:
County Harrison 15 miles in NE direction from Marshall
(NE, SW, etc.) (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name 18761

Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):

☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):

☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):

☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bore
☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:

Date Drilling:

Started 8-18-94Completed 8-18-94

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
<u>11</u>	Surface	<u>27</u>

7) BOREHOLE COMPLETION:

☐ Open Hole ☐ Straight Well ☐ Underreamed
☒ Gravel Packed ☐ Other _____If Gravel Packed give interval ... from 14 ft. to 27 ft.

From (ft.) To (ft.) Description and color of formation material

0 4 Reddish Brown Silt dry Hard

4' 9 Reddish Brown Si Clay
w/ Si Sand Lay

9' 21 Reddish Brown Si Clay
w/ Si Fi Sand Lay (Wet)

21' 27 Gray to Dark Gray Si Fine
Sand (wet)

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Eastin. Screener
			From	To	
<u>4"</u>	<u>New</u>	<u>Stainless Tri Loc</u>	<u>+3'</u>	<u>17</u>	<u>Riser</u>
<u>4"</u>	<u>New</u>	<u>Stainless Tri Loc</u>	<u>17</u>	<u>27</u>	<u>.010</u>

9) CEMENTING DATA [Rule 287.44(1)]

Cemented from 0 ft. to 11 ft. No. of Sacks Used 2

_____ ft. to _____ ft. No. of Sacks Used _____

Method used Trimmic HoseCemented by John Loden

13) TYPE PUMP:

☐ Turbine ☐ Jet ☐ Submersible ☒ Cylinder
☐ Other _____

Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:

Type Test ☐ Pump ☐ Bailer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☒ No. If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? _____ Depth of strata _____

Was a chemical analysis made? ☐ Yes ☐ No

10) SURFACE COMPLETION

Pad 4'x4'x6"

☐ Specified Surface Slab Installed [Rule 287.44(2)(A)] 8" Steel

☒ Specified Steel Sleeve Installed [Rule 287.44(3)(A)] Sleeve

☐ Pitless Adapter Used [Rule 287.44(3)(B)]

☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:

Static level 9.2 ft. below land surface Date 8-18-94

Artesian flow _____ gpm. Date _____

12) PACKERS:

Type Bentonite Depth 11 to 14'

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmission.

COMPANY NAME CCI Environmental Drilling
(Type or print)WELL DRILLER'S LICENSE NO. 3213 OMNADDRESS 2032 Karnack
(Street or RFD)Houston
(City)Tx
(State)77092
(Zip)

(Signed)

John Loden
(Licensed Well Driller)

(Signed)

(Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

18762

Location: LHAAP-27 South Test Area				Identification: 27WW02			
Date(s): 08/19/94 - 08/19/94				X Coordinate: 3036385		Y Coordinate: 374091	
Consulting Firm: Sverdrup Environmental, Inc				Elevation: 183.57'		Datum: NGVD	
Logged By: JBN				Total Depth: 17.00'		Measuring Point: 186.37'	
Contractor: CCI/Alliance				Completed Depth: 17.00'		Static Water Level:	
Drilling Method: Hollow Stem Auger				Well Casing: type: 316 S.S. dia: 4.00" frm: -2.8' to: 7.00'			
Remarks:				Screens: type: Slotted size: .010" dia: 4.00" fm: 7.00' to: 17.00'			
				Annular Fill:			
				type: Secondary Sand Filter fm: 1.00' to: 2.00' type: Granular Bentonite Seal fm: 2.00' to: 5.00' type: Secondary Sand Filter fm: 5.00' to: 6.00' type: #20-40 Silica Filter Sand fm: 6.00' to: 17.00' type: fm: to:			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
		ST-1				ML	SILT - Light gray with little fine sand, low plasticity, moist	14.9	7	19	MP. EL. 186.37
		ST-2				CL	SILTY SAND - Reddish brown				
-180							SILTY CLAY - Grey with sand, plastic, moist, firm	20.5	21	11	
						SM	SILTY SAND - Light grey, moist				
		SS-3									
10								21.1		38	
		SS-4				SM	SILTY SAND - Light grey with occasional iron staining, wet, slightly plastic	21.6	4	38	
-170											
20											
-160											

Hole No. **A7ww02**

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1 OF 1 SHEETS	
1. PROJECT Longhorn				10. SIZE AND TYPE OF BIT LHAAP			
2. LOCATION (Coordinates or Station) Site 27				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
DRILLING AGENCY Alameda				12. MANUFACTURER'S DESIGNATION OF DRILL Mobil Drill B-57			
HOLE NO. (As shown on drawing title and file number) 27ww02				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER John				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER ~ 8.5 ft			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE STARTED 8-19-94 COMPLETED 8-19-94			
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE 17 ft				18. TOTAL CORE RECOVERY FOR BORING 1			
19. SIGNATURE OF INSPECTOR							
ELEVATION a	DEPTH (ft) b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
	1	mc	ST-1: light gray silt (MC) with little fine sand, low plastic, moist to ~1.0 ft then reddish brown silty fine sand (sm)		ST-1 100%	collect Chem 3 Geotech sample LH27-ww02(0-2) @ 08:50	
	2	sm					
	3	cl	ST-2: Reddish brown silty fine sand (sm) to ~3.2 ft then gray silty clay (CL), plastic, moist, Firm		ST-2 100%	Collect Chem 3 Geotech sample LH27-ww02(3-5) @ 9:10	
	4						
	5						
	6		SS-3: light gray silty fine sand, moist (sr) to ~8.5 ft then wet			* Pushed 2' shoring tube, fine sand, no recovery, switched to 2' solid sampler, w/ full recovery	
	7	sm					
	8						
	9		SS-4: light gray silty fine sand (sm) w/ occ. Fe. staining wet.		SS-3 100%	collect geotech sample @ 9:20	
	10						
	11						
	12						
	13						
	14				SS-4 100%	collect geotech sample @ 9:30	
	15						
	16						
	17		TD = 17 ft				
	18						
	19						

118763

ATTENTION OWNER: Confidentiality
Privilege Notice on Reverse SideState of Texas
WELL REPORT

MW# 27WW02

Please use black ink.
Texas Water Well Drillers Board
P.O. Box 13067
Austin, Texas 78711

1) OWNER Longhorn Army Ammunition Plant ADDRESS KARNACK Tex
(Name) (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL:
County HARRISON 15 miles in NE direction from MARSHALL
(NE, SW, etc.) (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:

Section No. _____ Block No. _____ Township _____ District No. _____ Survey Name _____

Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):

☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):

☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):

☐ Driven
☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored
☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:

Date Drilling:

Started 8-19 1994Completed 8-19 1994

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
<u>11</u>	Surface	<u>12</u>

7) BOREHOLE COMPLETION:

☐ Open Hole ☐ Straight Well ☐ Underreamed☒ Gravel Packed ☐ Other _____If Gravel Packed give interval ... from 5 ft. to 17 ft.

From (ft.) To (ft.) Description and color of formation material

<u>0</u>	<u>4.5</u>	<u>Reddish Brown Si Fi So</u>
		<u>Dry</u>
<u>4.5</u>	<u>9'</u>	<u>Gray & Reddish Brown</u>
		<u>Si Clay</u>
<u>9</u>	<u>17</u>	<u>Gray Si Fine Sand (wet)</u>

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casing Screen
			From	To	
<u>4</u>	<u>New</u>	<u>Stainless Tri Loc</u>	<u>+3</u>	<u>7</u>	<u>Riser</u>
<u>4</u>	<u>New</u>	<u>Stainless Tri Loc</u>	<u>7</u>	<u>17</u>	<u>.010</u>

9) CEMENTING DATA [Rule 287.44(1)] Volclay GroutCemented from 0 ft. to 2 ft. No. of Sacks Used 1Method used Surface PourCemented by John Loden

13) TYPE PUMP:

☐ Turbine ☐ Jet ☐ Submersible ☒ Cylinder

Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:

Type Test: ☐ Pump ☒ Bailer ☐ Jetted ☐ Estimated

Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? _____ Depth of strata _____

Was a chemical analysis made? ☐ Yes ☒ No10) SURFACE COMPLETION Pad 4'x4'x6"☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]☒ Specified Steel Sleeve Installed [Rule 287.44(3)(A)] 8" Steel Sleeve☐ Pileless Adapter Used [Rule 287.44(3)(B)]☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:

Static level 5.6 ft. below land surface Date 8-19-94

Artesian flow _____ gpm. Date _____

12) PACKERS:

Type Depth

Bentonite Chips 2' to 5'

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME CCI Environmental Drilling
(Type or print)WELL DRILLER'S LICENSE NO. 3213 DMNADDRESS 2032 Karnack Houston Tex 77092
(Street or RFD) (City) (State) (Zip)Signed) John Loden (Signed) _____
(Licensed Well Driller) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

1118765

Location: LHAAP-27 South Test Area				Identification: 27WW03			
Date(s): 08/19/94 - 08/19/94				X Coordinate: 3036354		Y Coordinate: 373983	
Consulting Firm: Sverdrup Environmental, Inc				Elevation: 185.22'		Datum: NGVD	
Logged By: JBN				Total Depth: 19.00'		Measuring Point: 187.91'	
Contractor: CCI/Alliance				Completed Depth: 18.00'		Static Water Level:	
Drilling Method: Hollow Stem Auger				Well Casing: type: 316 S.S. dia: 4.00" fm: -2.7' to: 8.00'			
Remarks:				Screens: type: Slotted size: .010" dia: 4.00" fm: 8.00' to: 18.00'			
				Annular Fill: type: Bentonite Grout fm: .00' to: 2.50'			
				type: Secondary Sand Filter fm: 2.50' to: 3.00'			
				type: Granular Bentonite Seal fm: 3.00' to: 6.00'			
				type: Secondary Sand Filter fm: 6.00' to: 7.00'			
				type: #20-40 Silica Filter Sand fm: 7.00' to: 18.00'			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
		SS-1				ML	SANDY SILT - Reddish brown, dry, medium density	12.4		21	
		SS-2				CL	SILTY CLAY - Light grey/grey, mottled with little fine sand, plastic, stiff, moist	15.7	15	26	
-180		ST-3				SM	SILTY SAND - Reddish brown, medium dense, wet	18.8	7	31	
-170	10	ST-4						21.6	14	9	
		ST-5				SM	SILTY SAND - Grey/dark grey, mottled with dark grey sandy clay lenses, moist, dense	25.4	22	15	
-160	20										

Hole No. 27WW03

DRILLING LOG		DIVISION		INSTALLATION		SHEET	
1. PROJECT		2. LOCATION (Coordinates or Station)		10. SIZE AND TYPE OF BIT		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY		4. NAME OF DRILLER		12. MANUFACTURER'S DESIGNATION OF DRILL		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	
5. HOLE NO. (As shown on drawing title and file number)		6. DIRECTION OF HOLE		14. TOTAL NUMBER CORE BOXES		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		8. DEPTH DRILLED INTO ROCK		16. DATE HOLE		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BORING		19. SIGNATURE OF INSPECTOR		20. DISTURBED	
21. UNDISTURBED		22. DEGREE FROM VERT.		23. STARTED		24. COMPLETED	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	1	Sm	SS-1: Reddish brown silty fine sand (sm), dry, medium density	80%	SS-1	Collect chem 3 Geotech samples LH27WW03(0-1) @ 14:15	
	2						
	3		SS-2: Reddish brown silty fine sand (sm) to 4.5' then light gray/gray mottled silty clay w/ little fine sand (cl), Plastic, stiff, moist	100%	SS-2	Collect chem. 3 Geotech sample LH27WW03(3-5) @ 14:30	
	4						
	5	CL					
	6		ST-3: gray/reddish brown silty clay w/ some fine sand (cl), Plastic, moist to 9' then reddish brown silty fine sand (sm), medium dense, wet				
	7						
	8						
	9	Sm	ST-4: gray silty fine sand (sm), medium dense moist	100%	ST-3	collect chem 3 Geotech sample LH27WW03(7-13) @ 14:50	
	10						
	11		ST-5: gray/dark gray mottled silty fine sand (sm) w/ dark gray sand, clay lenses, moist, Dense				
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ATTENTION OWNER: Confidentiality
Privilege Notice on Reverse SideState of Texas
WELL REPORTTexas Water Well Drillers Board
P.O. Box 13067
Austin, Texas 78711

MW# 27 WW 03

1) OWNER Loughorn Army Ammunition Plant ADDRESS KARNACK Tex
(Name) (Street or RFD) (City) (State) (Zip)

2) LOCATION OF WELL:
County HARRISON 15 miles in NE direction from MARSHALL
(NE, SW, etc.) (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name 18767

Distance and direction from two intersecting section or survey lines _____

☒ SEE ATTACHED MAP

3) TYPE OF WORK (Check):

☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):

☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):

☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored
☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:

Date Drilling:

 Started 8-19 1994
 Completed 8-19 1994

DIAMETER OF HOLE

Dis. (in.)	From (ft.)	To (ft.)
<u>11</u>	<u>Surface</u>	<u>20</u>

7) BOREHOLE COMPLETION:

☐ Open Hole ☐ Straight Well ☐ Underreamed
☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval ... from 6 ft. to 18 ft.

From (ft.) To (ft.) Description and color of formation material

<u>0</u>	<u>4.5</u>	<u>Reddish brown Si Fine Sand dry</u>
<u>4.5</u>	<u>9'</u>	<u>Gray Reddish brown Si Clay</u>
<u>9'</u>	<u>19</u>	<u>GRAY Si Fine Sand (Wet)</u>

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casting Screen
			From	To	
<u>4"</u>	<u>NEW</u>	<u>STAINLESS TRI-LOC</u>	<u>+2</u>	<u>8'</u>	<u>Riser</u>
<u>4"</u>	<u>NEW</u>	<u>STAINLESS TRI-LOC</u>	<u>8'</u>	<u>18</u>	<u>.010</u>

9) CEMENTING DATA [Rule 287.44(1)]

 Volclay Grount
 Cemented from 0 ft. to 3 ft. No. of Sacks Used 1

 Method used Surface Pour
 Cemented by _____

13) TYPE PUMP:

☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____

Depth to pump-bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:

 Type Test ☐ Pump ☐ Boiler ☐ Jetted ☐ Estimated
 Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? _____ Depth of strata _____

Was a chemical analysis made? ☐ Yes ☐ No

10) SURFACE COMPLETION

 Pad 4'x4'x6"
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)]
☒ Specified Steel Sleeve Installed [Rule 287.44(3)(A)] 8" Steel Sleeve
☐ Pitless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:

 Static level 5.6 ft. below land surface Date 8-19-94
 Artesian flow _____ gpm. Date _____

12) PACKERS:

 Type Depth
Bentonite Chips 3' 6"

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

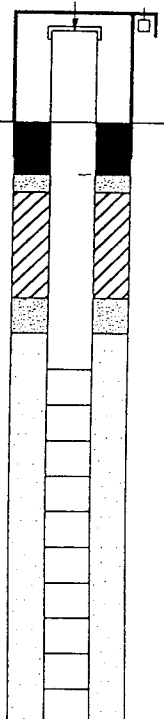
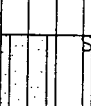
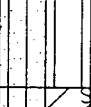
COMPANY NAME CCI Environmental Drilling WELL DRILLER'S LICENSE NO. 3213 DMN
(Type or print)ADDRESS 2032 KARNACK HOUSTON Tex 77092
(Street or RFD) (City) (State) (Zip)
 (Signed) John Lee (Registered Driller Trainee)
 (Licensed Well Driller)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

18768

Location: LHAAP-27 South Test Area		Identification: 27WW04	
Date(s): 08/24/94 - 08/24/94		X Coordinate: 3036425	Y Coordinate: 374161
Consulting Firm: Sverdrup Environmental, Inc		Elevation: 182.67'	Datum: NGVD
Logged By: JBN		Total Depth: 17.00'	Measuring Point: 185.27'
Contractor: CCI/Alliance		Completed Depth: 17.00'	Static Water Level:
Drilling Method: Hollow Stem Auger		Well Casing: type: 316 S.S. dia: 4.00" fm: -2.6' to: 7.00'	
Remarks:		Screens: type: Slotted size: .010" dia: 4.00" fm: 7.00' to: 17.00'	
		Annular Fill:	
		type: Bentonite Grout fm: .00' to: 1.50' type: Secondary Sand Filter fm: 1.50' to: 2.00' type: Granular Bentonite Seal fm: 2.00' to: 5.00' type: Secondary Sand Filter fm: 5.00' to: 6.00' type: #20-40 Silica Filter Sand fm: 6.00' to: 17.00'	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-180		SS-1				CL	SILTY CLAY - Dark gray/brown with a little fine sand, low plasticity, soft, moist				
		SS-2				ML	SILTY CLAY - Reddish brown/grey, mottled, plastic, firm, moist	21.2	16	20	
	10	SS-3				SM/ML	SILTY SAND - Grey, medium dense, wet	24.2		30	
-170		SS-4				SM/C	SILTY SAND - Reddish brown/grey, mottled with occasional clay lenses, medium dense, wet	23.3	16	17	
	20										
-160											

Hole No. 27W004

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1 OF 1 SHEETS	
1. PROJECT LHAAP Group I, Phase II				10. SIZE AND TYPE OF BIT LH240			
2. LOCATION (Coordinates or Station) Site AT				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY ICI Environmental Drilling				12. MANUFACTURER'S DESIGNATION OF DRILL Mobil Drill B-57			
4. OLE NO. (As shown on drawing title and file number) 27W004				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED UNDISTURBED			
5. NAME OF DRILLER John Li				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE STARTED 8-24-94 COMPLETED 8-24-94			
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE 17.14				18. TOTAL CORE RECOVERY FOR BORING %			
19. SIGNATURE OF INSPECTOR							

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	CL	SS-1: Dark gray/brown silty clay with a little fine sand (CL) low plastic, soft, moist		SS-1	Collect chemical sample @ 1445 and DC and QA chem sands, LH27W004(0-2)
	2				100%	
	3		SS-2: Gray / reddish brown medium to fine (CL) - (F) fine sand		SS-2	Collect chem and geotech sample @ 1455 LH27W004(3-5)
	4				100%	
	5		SS-3: Gray / reddish brown fine (SM) medium to fine sand			
	6					
	7		SS-4: gray / reddish brown medium to fine sand (SM) with fine clay lenses, medium dense, wet			
	8	-B- SM			SS-3	Collect chem & geotech sample @ 1500 LH27W004(8-10)
	9				100%	
	10					
	11					
	12					
	13					
	14				SS-4	Collect geotech sample
	15				100%	
	16					
	17					
	18		TD: 17'			
	19					

118769

ATTENTION OWNER: Confidential
Privilege Notice on Reverse Side**FILE**State of Texas
WELL REPORT

MW# 27WW04

Texas Water Well Drillers Board
P.O. Box 13067
Austin, Texas 78711

- 1) OWNER Longhorn Army Ammunition Plant ADDRESS Karnack Tex
(Name) (Street or RFD) (City) (State) (Zip)
- 2) LOCATION OF WELL:
County Harrison 15 miles in NE direction from Marshall
(NE, SW, etc.) (Town)

Driller must complete the legal description below with distance and direction from two intersecting section or survey lines, or he must locate and identify the well on an official Quarter- or Half-Scale Texas County General Highway Map and attach the map to this form.

☐ LEGAL DESCRIPTION:Section No. _____ Block No. _____ Township _____ Abstract No. _____ Survey Name 13770

Distance and direction from two intersecting section or survey lines _____

☐ SEE ATTACHED MAP

3) TYPE OF WORK (Check):

- ☒ New Well ☐ Deepening
☐ Reconditioning ☐ Plugging

4) PROPOSED USE (Check):

- ☐ Domestic ☐ Industrial ☒ Monitor ☐ Public Supply
☐ Irrigation ☐ Test Well ☐ Injection ☐ De-Watering

5) DRILLING METHOD (Check):

- ☐ Driven
☐ Mud Rotary ☐ Air Hammer ☐ Jetted ☐ Bored
☐ Air Rotary ☐ Cable Tool ☒ Other HSA

6) WELL LOG:

Date Drilling:

Started 8-24 1994
Completed 8-24 1994

DIAMETER OF HOLE

Dia. (in.)	From (ft.)	To (ft.)
<u>11</u>	Surface	<u>17</u>

7) BOREHOLE COMPLETION:

- ☐ Open Hole ☐ Straight Well ☐ Underreamed

☒ Gravel Packed ☐ Other _____
If Gravel Packed give interval ... from 5 ft. to 17 ft.

From (ft.) To (ft.) Description and color of formation material

<u>0</u>	<u>3</u>	<u>Dark Gray & Brown</u> <u>Si Clay</u>
<u>3</u>	<u>8</u>	<u>Gray Si Fine Sand</u>
<u>8</u>	<u>17</u>	<u>Gray & Reddish Brown</u> <u>Si Fine Sand (wet)</u>

8) CASING, BLANK PIPE, AND WELL SCREEN DATA:

Dia. (in.)	New or Used	Steel, Plastic, etc. Perf., Slotted, etc. Screen Mfg., if commercial	Setting (ft.)		Gage Casting Screen
			From	To	
<u>4</u>	<u>New</u>	<u>Stainless Tri Loc</u>	<u>+3</u>	<u>7</u>	<u>Riser</u>
<u>4</u>	<u>New</u>	<u>Stainless Tri Loc</u>	<u>7</u>	<u>17</u>	<u>1.010</u>

9) CEMENTING DATA [Rule 287.44(1)]

Volclay Grown
Cemented from 0 ft. to 2 ft. No. of Sacks Used 1
_____ ft. to _____ ft. No. of Sacks Used _____
Method used Surface Pour
Cemented by John Loden

13) TYPE PUMP:

- ☐ Turbine ☐ Jet ☐ Submersible ☐ Cylinder
☐ Other _____

Depth to pump bowls, cylinder, jet, etc., _____ ft.

14) WELL TESTS:

Type Test: ☐ Pump ☐ Sealer ☐ Jetted ☐ Estimated
Yield: _____ gpm with _____ ft. drawdown after _____ hrs.

15) WATER QUALITY:

Did you knowingly penetrate any strata which contained undesirable constituents?

- ☐ Yes ☒ No If yes, submit "REPORT OF UNDESIRABLE WATER"

Type of water? _____ Depth of strata _____

Was a chemical analysis made? ☐ Yes ☐ No

10) SURFACE COMPLETION

- Prod 4'x4'x6"
☐ Specified Surface Slab Installed [Rule 287.44(2)(A)] 8" Steel
☒ Specified Steel Sleeve Installed [Rule 287.44(3)(A)] Steel
☐ Pileless Adapter Used [Rule 287.44(3)(B)]
☐ Approved Alternative Procedure Used [Rule 287.71]

11) WATER LEVEL:

Static level 5.4 ft. below land surface Date 8-24-94
Artesian flow _____ gpm. Date _____

12) PACKERS:

Type Depth
Bentallite Chips 2 to 5

I hereby certify that this well was drilled by me (or under my supervision) and that each and all of the statements herein are true to the best of my knowledge and belief. I understand that failure to complete items 1 thru 15 will result in the log(s) being returned for completion and resubmittal.

COMPANY NAME CCI Environmental Drilling WELL DRILLER'S LICENSE NO. 3213 DMN
(Type or print)

RESS 2032 Karnack Houston Tex 77092
(Street or RFD) (City) (State) (Zip)

(Signed) John Loden (Signed) _____
(Licensed Well Driller) (Registered Driller Trainee)

Please attach electric log, chemical analysis, and other pertinent information, if available.

For TWC use only: Well No. _____ Located on map _____

018771

PREVIOUS INVESTIGATIONS
EBASCO, EPS, WESTON

918772

DRILLING LOG		DIVISION		INSTALLATION		Hole No. LH-11-5801	
1. PROJECT		2. LOCATION (Coordinates or Station)		10. SIZE AND TYPE OF BIT		SHEET 1 OF 2 SHEETS	
3. DRILLING AGENCY		4. HOLE NO. (As shown on drawing title and file number)		11. DAYUM FOR ELEVATION SHOWN (TBM or MSL)		12. MANUFACTURER'S DESIGNATION OF DRILL	
5. NAME OF DRILLER		6. DIRECTION OF HOLE		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		14. TOTAL NUMBER CORE BOXES	
7. THICKNESS OF OVERBURDEN		8. DEPTH DRILLED INTO ROCK		15. ELEVATION GROUND WATER		16. DATE HOLE	
9. TOTAL DEPTH OF HOLE		17. ELEVATION TOP OF HOLE		18. TOTAL CORE RECOVERY FOR BORING		19. SIGNATURE OF INSPECTOR	
LHAAP Phase I RI		LH-11-58-01		6 1/2" o.d. H.S. Auger			
AW Pool Drilling		LH-11-58-01		Ardea A.T.V.			
D. Perez		DEC. FROM VERT.		none		12	
VERTICAL		22.0'		STARTED 03/02/95		COMPLETED 03/02/95	
—		NA		94%		J. K. Callum	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
0	0	SC	SAND, clayey, brown, water saturated, w/ occasional asphalt gravel inclusions in top 2'	25%	1-8oz jar	Samples obtained via 2 3/16" i.d. stainless steel split spoon samplers	
1	1	L.C.	L.C. due to asphalt inclusions packing sampler shoe off			1-8oz soil jar filled for volatile analysis	
2	2	CL-CH	CLAY, sandy, gray mottled tan, moist	100%	4-8oz jars	surface groundwater due to recent heavy rains	
3	3		CLAY, sandy, gray mottled tan, moist	100%		1.75 pocket penetrometer (pen) HnU PID-NSR	
4	4		CLAY, sandy, gray mottled tan, moist increased sand content,	100%		4-8oz jars for various analytes (see C.O.C.) HnU PID-3 ppm	
5	5					4.5' pocket pen	
6	6	CL-SC	with sand	100%	5-8oz jars	HnU PID-NSR	
7	7					Harder drilling	
8	8		increased sand content,	100%		4.5' pocket pen	
9	9	SM-SC	SAND, silty fine, gray mottled tan, slightly clayey, moist			HnU PID-NSR	
10	10		gray, increased clay content	100%		HnU PID-NSR	
11	11		CLAY, sandy, gray, moist			2.5 pocket pen	
12	12	CL	free water observed on sampler	100%	5-8oz jars	5-8oz jars taken for various analytes	
13	13		with light brown, silty fine sand pockets ~ 2" dia,			HnU PID-NSR	
14	14	CL-CH	CLAY, gray mottled tan with silty sand in the tan element	100%		4.5' pocket pen	
15	15		increased sand content			HnU PID-NSR	
16	16	CL	CLAY, sandy, gray mottled tan, moist	100%	5-8oz jars	increased drilling rate	
17	17					HnU PID-NSR	
18	18		CLAY, gray and tan, with sand in the tan element, moist	100%		4.5' pocket pen	
19	19	CL-CH	watersaturated	100%		HnU PID-NSR	
20	20					0.0 pocket pen	

Hole No. **LH11-SB01**

DRILLING LOG		DIVISION	INSTALLATION	SHEET 2
1. PROJECT		10. SIZE AND TYPE OF BIT		
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL		
HOLE NO. (As shown on drawing title and file number)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		
4. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES		
5. DIRECTION OF HOLE		15. ELEVATION GROUND WATER		
☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		16. DATE HOLE		
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE		
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING		
9. TOTAL DEPTH OF HOLE		19. SIGNATURE OF INSPECTOR		

018773

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
20.6		CL-CH	decreased sand content			4.5' pocket pen
21		CH	CLAY, silty, sl. sandy, gray and tan, moist	100%		HNU PID-NSR: 4.5' pocket pen
22			Bottom of Boring @ 22.0'			
			(Continued from other side) Water levels: (from ground surface) 1700 hrs. on 03/02/93 ~ 21.0' 0900 hrs on 03/03/93 ~ 13.0' with ~ 5' of slough in boring 0800 hrs. on 03/04/93 ~ 12.2' 0830 hrs on 03/05/93 ~ 10.8' 1800 hrs on 03/05/93 ~ 10.4' Boring grouted to surface with cement/bentonite mix on 03/05/93			<u>Ledgend</u> HNU PID-Photo Ionization Detector NSR-No Significant Reading

118774

DRILLING LOG		DIVISION	INSTALLATION		Hole No. <u>LH11-SB02</u>	
1. PROJECT <u>LHAAP</u>			10. SIZE AND TYPE OF BIT <u>6 1/4" o.d. hollow stem auger</u>			
2. LOCATION (Coordinates or Station) <u>LH11-SB02</u>			11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY <u>A.W. Pool</u>			12. MANUFACTURER'S DESIGNATION OF DRILL <u>Ardeo A.T.V.</u>			
4. HOLE NO. (As shown on drawing title and file number) <u>LH11-SB02</u>			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED <u>NONE</u> UNDISTURBED <u>10</u>			
5. NAME OF DRILLER <u>D. Perez</u>			14. TOTAL NUMBER CORE BOXES <u>25-Box jars</u>			
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER <u>~13' b.g.s.</u>			
7. THICKNESS OF OVERBURDEN _____			16. DATE HOLE STARTED <u>03/02/93</u> COMPLETED <u>03/03/93</u>			
8. DEPTH DRILLED INTO ROCK <u>NA</u>			17. ELEVATION TOP OF HOLE _____			
9. TOTAL DEPTH OF HOLE <u>19.0'</u>			18. TOTAL CORE RECOVERY FOR BORING <u>90%</u>			
			19. SIGNATURE OF INSPECTOR <u>J.K. Callum</u>			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	SC	Sand, slightly clayey, brown, water saturated with occasional gravel fragments in upper 2"	100%		samples obtained via 2 3/4" 1.0. Stainless steel split spoon
1			CLAY, sandy, gray with tan mottling moist			HNU PID-NSR
2		CL-CH	decreased sand content			2.75 pocket pen
3				100%	4-Box jars Duplicate sample	HNU PID-NSR 1.75 pocket pen
4			CLAY, sandy, gray with tan mottling			Surface water due to recent heavy rainfall
5		CL		100%		HNU PID-NSR
6						4.5 pocket pen
7		L-C	L.C. due to sampler shoe "picking off"	25%		HNU PID-NSR
8			SAND, slightly clayey, gray			4.5+ pocket pen
9		SM-SC	increased clay content, gray with tan mottling	100%		HNU PID-NSR
10			decreased clay content			4.5+ pocket pen
11			increased clay content	100%		HNU PID-NSR
12		CL	CLAY, sandy, gray, moist			4.5+ pocket pen
13				100%	5-Box jars	5-Box jars for various analyses
14			SAND, clayey, gray and tan, water saturated			HNU PID-NSR
15		SC	increased clay content, water saturated			HNU PID-NSR
16				75%	5-Box jars	5-Box jars for various analyses
17		L-C	water saturated, atop clay layer			HNU PID-NSR
18		CH	CLAY, slightly sandy, gray and tan	100%		HNU PID-NSR
19						4.5+ pocket pen
20		N.S.	Not sampled... drilled		N.S.	

18776

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH11-S1</u>	
1. PROJECT <u>LHAAP</u>				10. SIZE AND TYPE OF BIT <u>6 1/4" o.d. hollow stem auger</u>			
2. LOCATION (Coordinates or Station) <u>LH411</u>				11. DATUM FOR ELEVATION SHOWN (FSM or MSL)			
3. DRILLING AGENCY <u>A.W. Pool</u>				12. MANUFACTURER'S DESIGNATION OF DRILL <u>Arco ATV</u>			
4. HOLE NO. (As shown on drawing title and file number) <u>LH11-SB03</u>				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED <u>None</u> UNDISTURBED <u>11</u>	
5. NAME OF DRILLER <u>D. Perez</u>				14. TOTAL NUMBER CORE BOXES <u>27-Box jars</u>		15. ELEVATION GROUND WATER <u>~15' b.g.s.</u>	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				16. DATE HOLE <u>03/05/93</u>		STARTED <u>03/03/93</u> COMPLETED <u>03/03/93</u>	
7. THICKNESS OF OVERBURDEN _____				17. ELEVATION TOP OF HOLE _____			
8. DEPTH DRILLED INTO ROCK <u>NA</u>				18. TOTAL CORE RECOVERY FOR BORING <u>95%</u>			
9. TOTAL DEPTH OF HOLE <u>22.0'</u>				19. SIGNATURE OF INSPECTOR <u>J. K. Collum</u>			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0	SM-SC	SAND, clayey brown, water saturated (due to return flow)			samples obtained via 2 5/16" i.d. stainless steel split spoon samplers	
	1		CLAY, sandy, tan mottled gray, moist	100%	5-Box jars	HnU PID-NSR 3.5 pocket pen	
	2		with occasional FeO nodular inclusions sand still present			HnU PID-NSR 1.75 pocket pen	
	3		decreasing sand content, gray mottled tan	100%		HnU PID-30 ppm 3.25 pocket pen	
	4	CL-CH				HnU PID-3.5 ppm 4.5+ pocket pen	
	5			100%		HnU PID-NSR 4.5 pocket pen	
	6				7-Box soil jars	7-Box jars taken for various analysis	
	7			50%		HnU PID-NSR 4.5 pocket pen	
	8		increased sand content, SAND, clayey, gray, moist	100%		HnU PID-NSR 4.5+ pocket pen	
	9	SM-SC				HnU PID-NSR 4.5 pocket pen	
	10			100%		HnU PID-NSR 4.25 pocket pen	
	11		CLAY, sandy, gray, moist			HnU PID-NSR	
	12	CL		100%	10-Box jars GA type	HnU PID-8.0 ppm samples taken for various analysis	
	13					HnU AD-3.0 ppm	
	14	N.S.	Not sampled... overdrilled	N.S.			
	15	CH	water saturated atop clay CLAY, slightly sandy, gray, moist with occasional black discolorations with occasional tan mottling	100%		HnU PID-NSR 1.5 pocket pen	
	16		CLAY, sandy, gray, water saturated		5-Box jars	HnU AD-NSR 1.75 pocket pen samples taken for various analysis	
	17	CL-SC	water saturated	100%		HnU PID-NSR 1.5 pocket pen	
	18		increasing sand content			HnU AD-NSR 1.25 pocket pen	
	19		water saturated atop clay	100%		HnU PID-NSR 1.5 pocket pen	
	20	CL-CH	CLAY, silty, tan with dark brown dissolution pathways			HnU PID-NSR 4.5+ pocket pen	

DRILLING LOG		DIVISION	INSTALLATION	Hole No. LH11-SB04
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 6 3/4" o.d. hollow stem auger		
2. LOCATION (Coordinates or Station) LH #11		11. DATUM FOR ELEVATION SHOWN (TBM or BSL)		
3. DRILLING AGENCY AW. Pool		12. MANUFACTURER'S DESIGNATION OF DRILL Ardeo ATV		
4. HOLE NO. (As shown on drawing title and file number) LH11-SB04		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED none UNDISTURBED 11		
5. NAME OF DRILLER D. Perez		14. TOTAL NUMBER CORE BOXES		
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER ~5' b.g.s.		
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 03/03/93 COMPLETED 03/03/93		
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE		
9. TOTAL DEPTH OF HOLE 22.0'		18. TOTAL CORE RECOVERY FOR BORING 98%		
		19. SIGNATURE OF INSPECTOR J.K. Collum		

119778

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0					
	1	SH-SC (possible fill)	SAND, silty, tan, moist	100%	5-8oz Jars	SAMPLES OBTAINED VIA 7 5/16" I.D. STAINLESS STEEL SPLIT-SPONS
	2	CH	with clay, very moist			HNU PID-NSR
	3		CLAY, sandy, tan, with occasional red Fe-Ox staining, moist			SAMPLES TAKEN FOR VARIOUS ANALYSES
	4		increasing sand			HNU PID-NSR
	5	CL	CLAY, sandy, tan, moist	100%		HNU PID-NSR
	6					1.5 pocket pen
	7					HNU PID-NSR
	8			100%		2.5 pocket pen
	9					HNU PID-NSR
	10			100%		3.0 pocket pen
	11	CL				HNU PID-NSR
	12		increased sand content	75%	5-8oz Jars	SAMPLES TAKEN FOR VARIOUS ANALYSES
	13					OVA FID-NSR
	14					3.5 pocket pen
	15			100%		OVA FID-NSR
	16					2.5 pocket pen
	17	CL	increased clay content	100%		OVA FID-NSR
	18		water saturated, increased sand content		10-8oz Jars for GC Dupe	2.25 pocket pen
	19			100%		OVA FID-NSR
	20					1.0 pocket pen
	21					OVA FID-NSR
	22					1.0 pocket pen
	23	CH	water saturated atop clay			2.75 pocket pen
	24		CLAY, gray, moist	100%		OVA FID-NSR
	25		with tan mottling			OVA FID-NSR
	26				5-8oz Jars	3.0 pocket pen
	27		CLAY, sandy, gray and tan, very moist			SAMPLES FOR VARIOUS ANALYSES
	28		decreased clay content			OVA FID-NSR
	29	CL	increased sand content	100%		
	30					2.5 pocket pen
	31					OVA FID-NSR
	32			100%		2.5 pocket pen
	33					OVA FID-NSR
	34					2.5 pocket pen
	35	CH	CLAY, silty, gray			OVA FID-NSR

113779

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH11-5804</u>	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION (Coordinates or Station)				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing title and file number) <u>LH11-5804</u>				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES		UNDISTURBED	
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE			
8. DEPTH DRILLED INTO ROCK				STARTED			
9. TOTAL DEPTH OF HOLE				COMPLETED			
17. ELEVATION TOP OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
19. SIGNATURE OF INSPECTOR				20. SIGNATURE OF DRILLER			

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
20			CLAY, silty, slightly sandy			
21		CH		100%		OVA FID-NSR 3.5 pocket pen
22			Bottom of Boring @ 22.0'			OVA FID-NSR 2.5 pocket pen
			(Continued from other side)			
			Water Levels: (From ground surface)			
			1800 hrs. on D3103/43 ~ 6.0'			
			0800 hrs. on D3104/43 ~ 4.5'			

Legend -
OVA FID - Fluorescence Ionization detector
NSR - No significant Reading

118780

DRILLING LOG		DIVISION	INSTALLATION	Hole No. <u>LH11-SB</u>
1. PROJECT <u>LHAAP</u>		10. SIZE AND TYPE OF BIT <u>6 3/4" o.d. hollow stem auger</u>		SHEET <u>1</u> OF <u>1</u> SHEET
2. LOCATION (Coordinates or Station) <u>LH11</u>		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		
3. DRILLING AGENCY <u>A.W. Pool</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>Ando A.T.V.</u>		
4. HOLE NO. (As shown on drawing title and file number) <u>LH11-SB05</u>		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN		DISTURBED <u>none</u> UNDISTURBED <u>5</u>
5. NAME OF DRILLER <u>D. Perez</u>		14. TOTAL NUMBER CORE BOXES <u>10-8oz. jars</u>		
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER <u>~4' b.g.s.</u>		
7. THICKNESS OF OVERBURDEN _____		16. DATE HOLE STARTED <u>03/04/93</u> COMPLETED <u>03/04/93</u>		
8. DEPTH DRILLED INTO ROCK <u>NA</u>		17. ELEVATION TOP OF HOLE _____		
9. TOTAL DEPTH OF HOLE <u>15.0'</u>		18. TOTAL CORE RECOVERY FOR BORING <u>84%</u>		
		19. SIGNATURE OF INSPECTOR <u>J.K. Collum</u>		

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		CLAY, sandy, gray mottled, moist			SAMPLES OBTAINED W/ 2 3/16" i.d. stainless steel split spoon
1	1	CL	increased sand content	100%	5-8oz jars	OVA FID-NSR 2.0 pocket per jar materials resistant to sampling
2	2					OVA FID-NSR
3	3		SAND, slightly clayey, gray with occ. tan mottling	100%		OVA FID-NSR 4.5 pocket per jar
4	4	SM	water saturated			OVA FID-NSR materials resistant to sampling
5	5			100%		OVA FID-NSR
6	6		Not sampled... overdrilled water saturated, decreased clay		5-8oz jars	OVA FID-NSR samples taken for various analyses (see L.O.C.)
7	7	SM		100%		OVA FID-NSR
8	8		water saturated			OVA FID-NSR
9	9	L.C.	Last Core... sample lost due to washout	20%		
10	10					
11	11					
12	12					
13	13	N.S.	Not sampled... drilled			
14	14					
15	15		Bottom of Boring @ 15.0'			
Water Levels: (From ground surface) 10700 hrs. on 03/05/93 ~ 7.7'						

Legend
 OVA FID - Fluorescence detector
 NSR - No significant response

18781

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH11-SB1</u>	
1. PROJECT <u>LHAAP</u>		2. LOCATION (Coordinate or Station) <u>LH11</u>		10. SIZE AND TYPE OF BIT <u>6 3/4" ad. hollow stem auger</u>		SHEET <u>1</u> OF <u>1</u> SHEET	
3. DRILLING AGENCY <u>A. W. Pool</u>		4. HOLE NO. (As shown on drawing title and file number) <u>LH11-SB06</u>		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		12. MANUFACTURER'S DESIGNATION OF DRILL <u>Arco A.T.V.</u>	
5. NAME OF DRILLER <u>D. Perez</u>		6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED <u>NONE</u> UNDISTURBED <u>6</u>		14. TOTAL NUMBER CORE BOXES <u>15-Box jars</u>	
7. THICKNESS OF OVERBURDEN <u>NA</u>		8. DEPTH DRILLED INTO ROCK <u>NA</u>		15. ELEVATION GROUND WATER		16. DATE HOLE STARTED <u>05/04/93</u> COMPLETED <u>02/04/93</u>	
9. TOTAL DEPTH OF HOLE <u>15.0'</u>		17. ELEVATION TOP OF HOLE		18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>		19. SIGNATURE OF INSPECTOR <u>J. H. Col l um</u>	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0	SC	SAND, clayey, gray mud tan, water saturated			Samples obtained via 2 1/16" Stainless Steel Split spoons	
	1	CL	CLAY, sandy, gray mottled tan	100%	5-Box jars	OVA FID-3 ppm Samples taken for various analytes OVA FID-NSR	
	2		increased sand content				
	3	SM	SAND, gray, tan, silty	100%		OVA FID-7 ppm (due to friction generated heat) material resistant to sampling OVA FID-NSR	
	4		4" of sandy clay @ 4.0' increased clay content	100%			
	5		SAND, clayey, gray, with occasional tan mottling			OVA FID-7 ppm (due to friction generated heat) material resistant to sampling OVA FID-NSR	
	6			100%		OVA FID-NSR	
	7	SC	increased sand content, water saturated		10-Box jars GA Dupe	Samples taken for various analytes as well as for GA duplicate OVA FID-NSR	
	8		decreased sand content	100%		OVA FID-NSR	
	9		increased clay content			OVA FID-NSR	
	10		decreased clay content	100%		OVA FID-NSR	
	11	SM	SAND, silty fine, gray, water saturated			OVA FID-NSR	
	12						
	13	N.S.	CLAY, sandy, tan Not sampled... drilled			OVA FID readings for cuttings all NSR	
	14	CL					
	15		Bottom of Boring @ 15.0'				
Water Levels: (from ground surface) 1430 hrs. on 03/04/93 ~ 9.9' 0700 hrs. on 03/05/93 ~ boring submerged under surface water							
Legend OVA FID-Fluorescence ionization detector NSR - No significant Response ppm - parts per million							

018782

11SB01

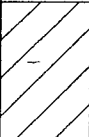
Location: LHAAP-11 Suspected TNT Burial Site					Identification: 11SB01				
Date(s): 03/02/93 - 03/02/93					X Coordinate: 3034347				
Consulting Firm: Ebasco					Y Coordinate: 380295				
Logged By:					Elevation: 203.00'				
Contractor:					Datum: MSL				
Drilling Method: Hollow Stem Auger					Total Depth: 22.00'				
Remarks:					Borehole Dia.: 8.00"				
					Static Water Level:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
200						SC	CLAYEY SAND - brown, wet, with asphalt gravel inclusions top 2"			1	
						CL	SANDY CLAY - gray mottled tan, moist				
						CL	SANDY CLAY - gray mottled tan, moist				
						CL	increased sand content from above				
10						SM	SILTY SAND - gray mottled tan, fine grained, slightly clayey, moist				
						CL	SANDY CLAY - gray w/ light brown silty fine sand pockets, moist				
190						CL	CLAY - gray mottled tan, silty sand in the tan element				
						CL	SANDY CLAY - gray mottled tan, moist				
						CH	CLAY - gray and tan, sand in the tan element, moist				
						CH	decreased sand content, plastic				
20						CH	SILTY CLAY - gray and tan, moist, slightly sandy, plastic				
180											

018783

11SB02

Location: LHAAP-11 Suspected TNT Burial Site					Identification: 11SB02				
Date(s): 03/02/93 - 03/03/93					X Coordinate: 3034299				
Consulting Firm: Ebasco					Y Coordinate: 380305				
Logged By:					Elevation: 203.00'				
Contractor:					Datum: MSL				
Drilling Method: Hollow Stem Auger					Total Depth: 22.00'				
Remarks:					Borehole Dia.: 8.00"				
					Static Water Level:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-200						CL	SANDY CLAY - gray w/ tan mottling, moist (top 2" wet, increased sand content) decreased sand content				
						CL	SANDY CLAY - gray w/ tan mottling				
						SC	SAND - gray, slightly clayey gray w/ tan mottling, increased clay content decreased clay content increased clay content				
-190						CL	SANDY CLAY - gray, moist				
						SC	CLAYEY SAND - gray and tan, wet increased clay content, wet				
						CH	CLAY - gray and tan, slightly sandy, plastic				
-180											

11SB03

118784

Location: LHAAP-11 Suspected TNT Burial Site	Identification: 11SB03
Date(s): 03/03/93 - 03/03/93	X Coordinate: 3034285
Consulting Firm: Ebasco	Y Coordinate: 380239
Logged By:	Elevation: 203.00'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 22.00'
Remarks:	Borehole Dia.: 8.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
200						CL	SANDY CLAY - tan w/ gray mottling, moist (top 0.5' wet, increased sand)				
							gray w/ tan mottling, decreased sand content				
						SC	increased sand content CLAYEY SAND - gray, moist				
10						CL	SANDY CLAY - gray, moist				
190						CH	CLAY - gray w/some black discoloration, moist, slightly sandy, plastic				
						CL	SANDY CLAY - gray, wet increased sand content				
20						CH	SILTY CLAY - tan, dark brown dissolution pathways gray, tan and light brown, plastic increased sand content				
180											

11SB04

018785

Location: LHAAP-11 Suspected TNT Burial Site						Identification: 11SB04			
Date(s): 03/03/93 - 03/03/93						X Coordinate: 3034130			
Consulting Firm: Ebasco						Y Coordinate: 380321			
Logged By:						Elevation: 206.00'			
Contractor:						Datum: MSL			
Drilling Method: Hollow Stem Auger						Total Depth: 22.00'			
Remarks:						Borehole Dia.: 8.00"			
						Static Water Level:			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						SM	SILTY SAND - tan, moist				
						CH	SANDY CLAY - tan w/ some red iron oxide staining, moist, plastic				
						CL	SANDY CLAY - tan, moist				
-200							increased sand content				
	10						increased clay content				
							increased sand content, wet				
						CH	CLAY - gray w/ tan mottling, moist, plastic				
-190						CL	SANDY CLAY - gray and tan, very moist				
							decreased clay content				
							increased clay content				
	20					CH	CLAY - gray, slightly sandy, plastic				
-180											

11SB05

018786

Location: LHAAP-11 Suspected TNT Burial Site	Identification: 11SB05
Date(s): 03/04/93 - 03/04/93	X Coordinate: 3034349
Consulting Firm: Ebasco	Y Coordinate: 380669
Logged By:	Elevation: 199.00'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 15.00'
Remarks:	Borehole Dia.: 8.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						CL SM	SANDY CLAY - gray w/ tan mottling, moist increased sand content SAND - gray w/ some tan mottling, slightly clayey wet wet, decreased clay content wet				
-190	10										
-180	20										
-170											

11SB06

018787

Location: LHAAP-11 Suspected TNT Burial Site	Identification: 11SB06
Date(s): 03/04/93 - 03/04/93	X Coordinate: 3034289
Consulting Firm: Ebasco	Y Coordinate: 380760
Logged By:	Elevation: 198.00'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 15.00'
Remarks:	Borehole Dia.: 8.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						CL	SANDY CLAY - gray w/ tan mottling (top 0.3' clayey sand, wet)				
						SM	SAND - gray				
							increased clay content				
						SC	CLAYEY SAND - gray w/ some tan mottling				
							increased sand content, wet				
190							decreased sand content				
							increased clay content				
10						SM	decreased clay content				
							SILTY SAND - gray, wet, fine grained				
						CL	SANDY CLAY - tan				
180											
20											
170											

018788

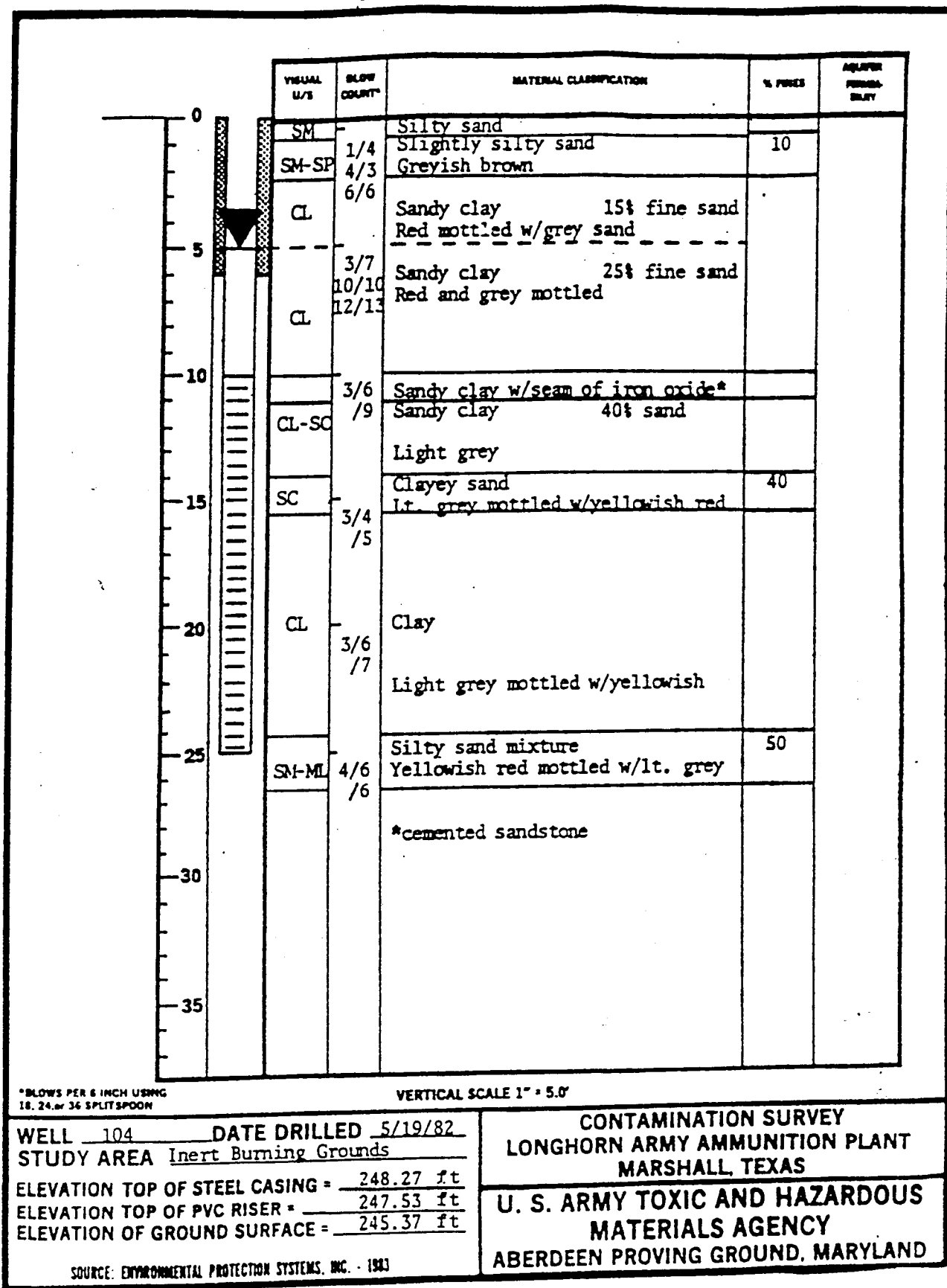
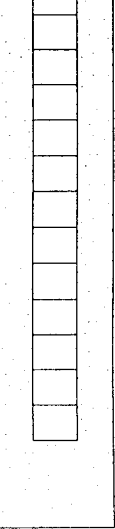


FIGURE 3-10-3
BORING LOG AND WELL
CONSTRUCTION DETAIL FOR
MONITORING WELL NO. 104

018789

Location: LHAAP-01 Inert Burning Grounds				Identification: 01MW01			
Date(s): 12/02/93 - 12/03/93				X Coordinate: 3026981		Y Coordinate: 389100	
Consulting Firm: Weston				Elevation: 275.26'		Datum: MSL	
Logged By:				Total Depth: 45.00'		Measuring Point: 277.84'	
Contractor: Terra-Mar, Inc.				Completed Depth: 42.50'		Static Water Level:	
Drilling Method: Hollow Stem Auger				Well Casing: type: 40 PVC dia: 4.00" fm: -2.6' to: 22.50'			
Remarks:				Screens: type: Slotted size: .010" dia: 4.00" fm: 22.50' to: 42.50'			
				Annular Fill: type: Cement Grout fm: .00' to: 18.50'			
				type: Bentonite fm: 18.50' to: 20.50'			
				type: #20-40 Silica Filter Sand fm: 20.50' to: 45.00'			
				type: fm: to: to: to:			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
						SC	CLAYEY SAND - Light brown to moderate brown, organics and roots in top 2", light gray clays blebs, dry low plasticity, semi-friable, increased sand				
						SC	CLAYEY SAND - Increased sand content, moderate red-brown streaks, gray clots with black exterior, black specs				
						SM	SILTY SAND - Dark yellow orange				
						CL	SANDY CLAY - Light olive gray compacted, silty, hard, dry, very low plasticity alternating with sand fines moderate, trace sil, light brown				
						SP	SAND - Dark yellow orange friable, very low plasticity, black specs				
						CL	SANDY CLAY - Light olive gray and dark yellow orange sand, some organics, dry				
						SM	CLAYEY SILTY SAND - Dark yellow orange, black nodules, light olive gray clay blebs, becoming denser, more compact, clay moderate plasticity, moist and silty, flaky, dry, light olive gray sand fines moderate				
						SC	CLAYEY SAND - Sand fines moderate, clay matrix, dark yellow orange - moderate yellow brown, moist, low-moderate plasticity, soft, gets stiffer with increase in clay content, minor black specs				
						SC	CLAYEY SAND - 1 1/2" layer of dry, fissile clay, light brown/dark reddish brown layers, light olive gray blebs throughout				

Location: LHAAP-01 Inert Burning Grounds					Identification: 01MW01						
Date(s): 12/02/93 - 12/03/93					X Coordinate: 3026981			Y Coordinate: 389100			
Consulting Firm: Weston					Elevation: 275.26'			Datum: MSL			
Logged By:					Total Depth: 45.00'			Measuring Point: 277.84'			
Contractor: Terra-Mar, Inc.					Completed Depth: 42.50'			Static Water Level:			
Drilling Method: Hollow Stem Auger					Well Casing: type: 40 PVC dia: 4.00" fm: -2.6' to: 22.50'						
Remarks:					Screens: type: Slotted size: .010" dia: 4.00" fm: 22.50' to: 42.50'						
					Annular Fill:						
					type: Cement Grout fm: .00' to: 18.50' type: Bentonite fm: 18.50' to: 20.50' type: #20-40 Silica Filter Sand fm: 20.50' to: 45.00' type: fm: to: to: type: fm: to: to:						
Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
						SC	CLAYEY SAND - Dark yellow orange, soft, low-moderate plasticity, clay content decreases, moist, semi-friable				
-240						SC	CLAYEY SAND - Increasing wetness, few red-brown laminations and black specs, increased stiffness with depth, very low/low plasticity, bottom 2" saturated				
	40										
-230											
	50										
-220											

Hole No. LH01-5825

18791

DRILLING LOG		DIVISION		INSTALLATION		SHEET 2 OF 2 SHEETS	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION (Coordinates or Station)				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing title and file number) <u>LH-01 5825</u>				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE		STARTED COMPLETED	
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
				19. SIGNATURE OF INSPECTOR			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV- ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
			Water Levels: (from ground surface) 3/16/93 @ 1600 ~ 7.5' 3/17/93 @ 0700 ~ 6.7'			Legend HnUPd - Photoionization detector NSR - No Significant Response	

18792

Location: LHAAP-01 Inert Burning Grounds	Identification: 01SB26
Date(s): 03/16/93 - 03/17/93	X Coordinate: 3027370
Consulting Firm: Ebasco	Y Coordinate: 388629
Logged By:	Elevation: 257.00'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 20.00'
Remarks:	Borehole Dia.: 8.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						SC CH SC CL	CLAYEY SAND - tan, wet SANDY CLAY - tan, wet, plastic CLAYEY SAND - red, slightly moist, 4"-thick iron sand layer at 3.2' SANDY CLAY - red w/ gray mottling, slightly moist decreased moisture tan w/ gray mottling, moist increased moisture w/ red sand layer 2"-thick, wet w/ red iron sand and sandstone at 14.8'				

18793

Hole No. **LH01-SB26**

DRILLING LOG		DIVISION	INSTALLATION	
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 1 1/4" o.d. hollow stem auger		
2. LOCATION (Coordinates or Station) LH01		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		
3. DRILLING AGENCY AW. Pool		12. MANUFACTURER'S DESIGNATION OF DRILL Arco A.T.V.		
4. HOLE NO. (As shown on drawing title and file number) LH01-SB26		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN NONE		
5. NAME OF DRILLER D. Perez		14. TOTAL NUMBER CORE BOXES 8		
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER		
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 03/16/93 COMPLETED 03/17/93		
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE		
9. TOTAL DEPTH OF HOLE 20.0'		18. TOTAL CORE RECOVERY FOR BORING 88%		
		19. SIGNATURE OF INSPECTOR J.K. Collum		

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SC	SAND, clayey, tan, water saturated			
1		CL	CLAY, sandy, tan, wet	100%	10-Box 1013 6' dpc	Samples obtained via 2 1/2" 1/4" stainless steel splitspears
2						OVA FID-NSR 1.0 pocket pen
3		SC	SAND, clayey, red, sl. moist w/ 4" of sif. sand @ 3.2'	100%		OVA FID-NSR
4			CLAY, sandy, red mottled gray, sl. moist decreased moisture		5-Box 5082	4.5' pocket pen OVA FID-NSR material resistant to sampling
5		CL				OVA FID-NSR 4.5' pocket pen
6		CL	Lost Core	75%		OVA FID-NSR 4.5' pocket pen
7					5-Box 5013	material very resistant to sampling
8		CL		100%		4.5' pocket pen OVA FID-NSR
9						4.5' pocket pen
10		CL	Lost core ... sampler shoe packing	75%		
11		N.S.	Not Sampled ... never drilled			
12			tan, mottled gray, moist		5-Box 5013	OVA FID-NSR 3.0 pocket pen
13		CL	increased moisture	100%		OVA FID-NSR
14						OVA FID-NSR 1.5 pocket pen
15			w/ red sif. sand layers 2" thick, water saturated			OVA FID-NSR 1.25 pocket pen
16						3.0 pocket pen OVA FID-NSR
17		CL	w/ red sif. sand and Fe ore sandstone @ 14.8'	50%		
18		CL	Lost Core ... due to sampler shoe packing			
19		N.S.	Not Sampled ... drilled			
20			Bottom of Boring @ 20'			

Continued On Back

118794

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH01-SB26</u>	
1. PROJECT		10. SIZE AND TYPE OF BIT		SHEET <u>2</u>		OF <u>2</u> SHEETS	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)					
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL					
4. HOLE NO. (As shown on drawing title and file number)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED		UNDISTURBED	
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES					
6. DIRECTION OF HOLE		15. ELEVATION GROUND WATER					
☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		16. DATE HOLE		STARTED		COMPLETED	
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE					
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING					
9. TOTAL DEPTH OF HOLE		19. SIGNATURE OF INSPECTOR					
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
			Water Levels: (from ground surface) 3/17/93 @ 9:35 hrs ~ 9.1'			Legend OVA FID - Flame ionization detector NSR - No significant reading	

118795

Location: LHAAP-01 Inert Burning Grounds					Identification: 01SB27				
Date(s): 03/17/93 - 03/17/93					X Coordinate: 3027466				
Consulting Firm: Ebasco					Y Coordinate: 388598				
Logged By:					Elevation: 251.00'				
Contractor:					Datum: MSL				
Drilling Method: Hollow Stem Auger					Total Depth: 10.00'				
Remarks:					Borehole Dia.: 8.00"				
					Static Water Level:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
250						SC	Clayey Sand FILL - brown, wet tan, wet, w/ some charcoal and gravel inclusions and some charred plastic fragments				
						CL	SANDY CLAY - mottled red and gray, moist increased moisture very moist				
10											
240											
20											
230											

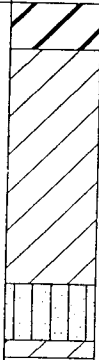
18796

DRILLING LOG		DIVISION	INSTALLATION		Hole No. <u>LH01-SB27</u>	
1. PROJECT <u>LHAAP</u>		10. SIZE AND TYPE OF BIT <u>6 3/4" o.d. full-flute auger</u>		SHEET <u>1</u> OF <u>1</u> SHEETS		
2. LOCATION (Coordinates or Station) <u>LH01</u>		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)				
3. DRILLING AGENCY <u>A.W. Pool</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>Ardeco A.T.V.</u>				
4. HOLE NO. (As shown on drawing title and file number) <u>LH01-SB27</u>		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN <u>NONE</u>		DISTURBED <u>NONE</u> UNDISTURBED <u>5</u>		
5. NAME OF DRILLER <u>D. Perez</u>		14. TOTAL NUMBER CORE BOXES				
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER				
7. THICKNESS OF OVERBURDEN <u>—</u>		16. DATE HOLE STARTED <u>03/17/93</u> COMPLETED <u>03/17/93</u>				
8. DEPTH DRILLED INTO ROCK <u>NA</u>		17. ELEVATION TOP OF HOLE				
9. TOTAL DEPTH OF HOLE <u>10.0'</u>		18. TOTAL CORE RECOVERY FOR BORING <u>88%</u>				
		19. SIGNATURE OF INSPECTOR <u>J.K. Collum</u>				
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0		SAND, clayey CLAY, sandy, brown, water saturated			
1	1		w/vertical inclusions and acc. gravel inclusions	100%	5-802 Jars	Samples obtained via 2 3/4" i.d. split spoon
2	2	SC-CL (Fill)	w/acc. charred and melted plastic fragments			OVA FID-NSR
3	3			100%	11-802 Jars	0.75 pocket pen
4	4		CLAY, sandy, mottled red and gray, moist		5-803 Jars	OVA FID-NSR
5	5	CL		65%		0.25 pocket pen
6	6	CL Lost core				OVA FID-NSR
7	7	CL		75%	5-802 Jars	OVA FID-NSR
8	8	CL Lost core				2.5 pocket pen
9	9	CL	very moist			OVA FID-NSR
10	10			100%		1.0 pocket pen
11	11		Bottom of Boring @ 10.0'			OVA FID-NSR
12	12		Water Levels (from ground surface) 3/17/93 @ 1500 ~ 2.3'			1.0 pocket pen
13	13					OVA FID-NSR
14	14					
15	15					
16	16					
17	17					
18	18					
19	19					
20	20					

Legend
OVA FID - Flame ionization detector
NSR - No Significant Response

Location: LHAAP-01 Inert Burning Grounds	Identification: 01SB28
Date(s): 03/17/93 - 03/17/93	X Coordinate: 3027423
Consulting Firm: Ebasco	Y Coordinate: 388469
Logged By:	Elevation: 251.00'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 10.00'
Remarks:	Borehole Dia.: 8.00"
	Static Water Level:

18797

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-250						CH CL SM CL	SANDY CLAY - dark tan, wet, plastic (top 0.5' clayey sand) SANDY CLAY - red, very moist red w/ gray mottling, decreased moisture gray and tan, moist SILTY SAND, gray, water saturated, fine grained, slightly clayey SANDY CLAY - mottled red and gray				
-240	10										
-230	20										

18798

DRILLING LOG		DIVISION		INSTALLATION		Hole No. LH01-SB28	
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 1 1/4" o.d. hollow stem auger		SHEET OF 1 SHEETS			
2. LOCATION (Coordinates or Station) LH01		11. DATUM FOR ELEVATION SHOWN (TBM = MSL)					
3. DRILLING AGENCY A.W. Pool		12. MANUFACTURER'S DESIGNATION OF DRILL Arco A.T.V.					
4. HOLE NO. (As shown on drawing title and file number) LH01-SB28		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED NONE		UNDISTURBED 5	
5. NAME OF DRILLER D. Perez		14. TOTAL NUMBER CORE BOXES					
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER					
7. THICKNESS OF OVERBURDEN —		16. DATE HOLE		STARTED 03/17/93		COMPLETED 03/17/93	
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE					
9. TOTAL DEPTH OF HOLE 10.0'		18. TOTAL CORE RECOVERY FOR BORING 92%					
		19. SIGNATURE OF INSPECTOR J.K. Collum					
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0	SC	SAND/clayey, dk. tan, water saturated			Samples obtained via 2 3/16" i.d. stainless steel split spoons	
	1	CL-CH	CLAY, sandy, red, v. moist	60%	5-Box Jars	OVA FID-NSR OVA FID-NSR	
	2	CL	CLAY, sandy, red, moist lost core				
	3		sl. moist, red mottled gray w/ acc. FeO nodules incl. fr. 2.4-2.6'	100%		3.0 pocket pen OVA FID-NSR	
	4				5-Box Jars	OVA FID-NSR 3.0 pocket pen	
	5	CL		100%		OVA FID-NSR 3.5 pocket pen	
	6		gray and tan, moist		5-Box Jars	OVA FID-NSR 3.5 pocket pen	
	7			100%		2.25 pocket pen OVA FID-NSR	
	8		water saturated SAND silty fine, gray, water saturated			2.25 pocket pen	
	9	SM	sl. clayey	100%			
	10	CL	CLAY, sandy, red and gray mottled			1.25 pocket pen	
	11		Bottom of Boring @ 10.0'				
	12		Water Levels (to ground surface) 3/17/93 @ 1530 hrs. ~ 7.6'				
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						

Legend
OVA FID-Flame ionization detector
NSR-No Significant Reading

Location: LHAAP-01 Inert Burning Grounds		Identification: 01SB29	
Date(s): 03/17/93 - 03/17/93		X Coordinate: 3027045	
Consulting Firm: Ebasco		Y Coordinate: 389377	
Logged By:		Elevation: 273.00'	
Contractor:		Datum: MSL	
Drilling Method: Hollow Stem Auger		Total Depth: 30.00'	
Remarks:		Borehole Dia.: 8.00"	
		Static Water Level:	

18799

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-270						CL	SANDY CLAY - red, very moist, decreased moisture after 0.5'				
						CH	CLAY - mottled gray and red, slightly moist, slightly sandy, plastic				
						CL	SANDY CLAY - gray w/ red mottling, slightly moist				
10											
-260						SM	SILTY SAND - tan, moist, slightly clayey				
											
											
											
											
											
20						SC	slightly increased moisture and clay content CLAYEY SAND - tan, moist				
											
											
-250											
											
						SM	increased sand content SILTY SAND, tan, moist, fine grained, slightly clayey, wet				

Hole No. **LH01-SB29**

DRILLING LOG		DIVISION	INSTALLATION	SHEET OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 6 1/4" hollow stem auger		
2. LOCATION (Coordinates or Station) LH01		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		
3. DRILLING AGENCY A.W. Pool		12. MANUFACTURER'S DESIGNATION OF DRILL Arco A.T.V.		
4. HOLE NO. (As shown on drawing title and file number) LH01-SB29		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED NONE UNDISTURBED 14		
5. NAME OF DRILLER D. Perez		14. TOTAL NUMBER CORE BOXES		
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER		
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 03/17/93 COMPLETED 03/17/93		
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE		
9. TOTAL DEPTH OF HOLE 30.0'		18. TOTAL CORE RECOVERY FOR BORING 100%		
		19. SIGNATURE OF INSPECTOR J.K. Collum		

18800

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0					
1	1	CL-CH	CLAY, sandy, red, v. moist decreasing moisture	100%	12-8oz jars (5-0A) (2-0D)	SAMPLES OBTAINED VIA 2" ALUMINUM SPLIT SPOONS OVA FID-NSR 0.25 pocket pen
2	2		decreased sand content			
3	3	CH	CLAY, sl. sandy, gray and red mottled, sl. moist	100%		OVA FID-NSR 3.0 pocket pen
4	4		increased sand content			
5	5		CLAY, sandy, gray mottled red, sl. moist	100%		OVA FID-NSR 2.0 pocket pen
6	6					
7	7	CL		100%	5-8oz jars	OVA FID-NSR 2.25 pocket pen
8	8					
9	9			100%		OVA FID-NSR
10	10					
11	11			100%	5-8oz jars	OVA FID-NSR 2.75 pocket pen
12	12		SAND, silty fine sl. clayey, tan, moist			OVA FID-NSR
13	13			100%		OVA FID-NSR
14	14					
15	15	SM		100%		OVA FID-NSR
16	16					
17	17			100%	5-8oz jars	OVA FID-NSR
18	18		sl. increased clay content and moisture			
19	19	SC-CL	SAND, clayey / CLAY, sandy, tan, moist	100%		OVA FID-NSR
20	20					OVA FID-NSR Continued On Back

18801

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <i>LH01-SB29</i>	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION (Coordinates or Station)				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing title and file number)				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES		UNDISTURBED	
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE		STARTED	
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE		COMPLETED	
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING		19. SIGNATURE OF INSPECTOR	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
20			<i>SAND, clayey / CLAY, sandy, tan. moist</i>			
21				100%	10-Box Jars GCDP	DVA FID - NSR
22		SC-CL				DVA FID - NSR
23				100%		DVA FID - NSR
24						DVA FID - NSR
25			<i>increased sand content</i>	100%		DVA FID - NSR
26		SM	<i>SAND, silty fine, silty clayey, tan. moist</i>		5-Box Jars	DVA FID - NSR
27			<i>water saturated</i>	100%		DVA FID - NSR
28						DVA FID - NSR
29		X	Not Sampled... drilled			
30			Bottom of Boring @ 30.0'			
			Water Levels: (from ground surface) 3/17/93 @ 1630 ~ 24.5'			

Legend
DVA FID - Flame ionization detector
NSR - No Significant Reading

013802

Location: LHAAP-01 Inert Burning Grounds						Identification: 01WW03					
Date(s): / / - 05/19/82						X Coordinate: 3027449			Y Coordinate: 388347		
Consulting Firm: EPS						Elevation: 245.37'			Datum: MSL		
Logged By:						Total Depth: 26.50'			Measuring Point: 247.53'		
Contractor:						Completed Depth: 25.00'			Static Water Level:		
Drilling Method: Hollow Stem Auger						Well Casing: type: SS dia: 2.00" fm: -2.2' to: 10.00'					
Remarks:						Screens: type: Slotted size: .010" dia: 2.00" fm: 10.00' to: 25.00'					
						Annular Fill: type: Bentonite fm: .00' to: 6.00'					
						type: #20-40 Silica Filter Sand fm: 6.00' to: 26.50'					
						type: fm: to: to:					
						type: fm: to: to:					
						type: fm: to: to:					
Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction MP. EL. 247.53
-240					[Pattern]	SM	SILTY SAND				
					[Pattern]	CL	SILTY SAND - Grayish brown, coarser grained				
					[Pattern]	CL	SANDY CLAY - Red mottled with gray sand				
					[Pattern]	CL	SANDY CLAY - Red and gray mottled				
10					[Pattern]	CL	SANDY CLAY - Seam of iron oxide				
					[Pattern]	CL	SANDY CLAY - Light gray				
-230					[Pattern]	SC	CLAYEY SAND - Light gray mottled with yellowish red				
					[Pattern]	CL	CLAY - Light gray mottled with yellow				
20					[Pattern]						
-220					[Pattern]	ML	SILTY SAND - Yellowish red mottled with light gray				

DRILLING LOG		CLIENT:		INSTALLATION		Hole No. 1118803 SHEET OF SHEETS 1 of 3	
1. PROJECT		LHAAP site 1A-RT		10. SIZE AND TYPE OF BIT		1 5/8" ID Hollow Stem Auger	
2. LOCATION		MW01		11. DATUM FOR ELEVATION SHOWN (TBM OR MSL)		MSL	
3. DRILLING AGENCY		Terra-Mar, Inc.		12. MANUFACTURER'S DESIGNATION OF DRILL		B-61	
4. HOLE NO.		MW01		13. TOTAL NO OF OVER-20 BURDEN SAMPLES TAKEN		DISTURBED X UNDISTURBED	
5. NAME OF DRILLER		M. Chism		14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE		VERTICAL X INCLINED DEG. FROM VERT.		15. ELEVATION GROUND WATER		248.67 on 12/16/93; 248.76 on 12/31/93	
7. THICKNESS OF OVERBURDEN				16. DATE HOLE		STARTED 12/02/93 COMPLETED 12/03/93	
8. DEPTH DRILLED INTO ROCK		N.A.		17. ELEVATION TOP OF HOLE		ground 275.26 ToC 277.84	
9. TOTAL DEPTH OF HOLE		45.0'		18. TOTAL CORE RECOVERY FOR BORING		90%	
				19. SIGNATURE OF INSPECTOR		David A. Dorman	
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g	
	1	SC	SAND clayey, lt. brown (54R 5/6) to mod. brown (54R 4/6), organics and roots in top 2", lt. gray clay blebs, dry, low plasticity, semi friable, increased sand content, mod. red-brown (10R 4/6) streaks, gray clay clots with black exterior, black specs	95%	5-8oz jars	Samples obtained via stainless steel Shelby tube	
	2				5-8oz jars	Samples- 8oz jars for:	
	3					VOC (later changed to 2oz jar)	
	4					SVOC	
	5						
	6			1-32oz jar	geotechnical analyses		
	7					DVM-NSR (no significant reading)	
	8	SM	SAND f-m silty, dk yellow orange (10YR 6/6)	95%	5-8oz jars	DVM-NSR	
	9	CL-SM	CLAY lt. olive gray (5Y 6/1) compacted, hard, dry, very low plasticity, alternating with SAND f-m, trace silt, lt. brown (5YR 5/6), exhibiting slight fissility		1-32oz jar	pocket penetrometer (p.p.)-0.5	
	10					p.p. 0.5	
	11	SP	SAND mostly f, dk yellow orange (10YR 6/6) friable, very low plasticity, black specs	100%	5-8oz jars	p.p. 2.0	
	12	CL-SC	CLAY lt. olive gray and SAND dk yellow orange, some organics, dry			DVM-NSR	
	13					p.p. 3-3.5	
	14	SM-CL	SAND f-m silty dk yellow orange, semi-friable, black nodules, lt. olive gray clay blebs, becoming denser, more compact	100%	5-8oz jars		
	15				1-32oz jar	p.p. 3.0-3.5	
	16				5-8oz jars		
	17						
	18						
	19						

ENG FORM 1836

PROJECT

HOLE NO.

DRILLING LOG		CLIENT:		INSTALLATION		Hole No. 13804	
1. PROJECT				10. SIZE AND TYPE OF BIT		SHEET OF SHEETS 2 of 3	
2. LOCATION				11. DATUM FOR ELEVATION SHOWN (OR)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. MW01				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE		STARTED COMPLETED	
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
				19. SIGNATURE OF INSPECTOR			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g
	20	SM-CL	CLAY mod. plasticity, moist and SILT heavy, div. lt. olive gray SANDS-M appears			
	21	SC	SAND f-m, clay matrix, dk yellow orange - mod. yellow brown (10 YR 5/4) moist, low-mod plasticity, soft gets stiffer w/increase in clay content minor black specks	100%	4-8oz jars	DVM-NSR P.P. 1.0-1.5
	22				1-2oz jar	
	23				1-32oz jar	
	24				4-8oz jars	DVM-NSR P.P. 1.0-1.5
	25				1-2oz jar	
	26		1 1/2" layer of dry, fissile clay lt. brown & dk reddish brown (10 R 3/4) layers	100%	4-8oz jars	DVM-NSR P.P. 0.75
	27				1-2oz jar	
	28		lt. olive gray clay blabs throughout		4-8oz jars	DVM-NSR
	29				1-2oz jar	
	30	SC	SAND f clayey dk yellow orange, soft, low-mod plasticity clay content decreases moist, semi friable	75%		P.P. 2.0
	31				1-32oz jar	DVM-NSR
	32					
	33				DVM-NSR P.P. 1.0-2.0	
	34					
	35		increasing wetness few red-brown laminations and black specks	70%	1-32oz jar	DVM-NSR P.P. 1.0-2.0
	36					
	37					
	38					

ENG FORM 1836

PROJECT

HOLE NO.

DRILLING LOG		CLIENT:		INSTALLATION		Hole No. 13805	
1. PROJECT				10. SIZE AND TYPE OF BIT		SHEET OF SHEETS 3 of 3	
2. LOCATION				11. DATUM FOR ELEVATION SHOWN (OR)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. MW01				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE		STARTED COMPLETED	
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
				19. SIGNATURE OF INSPECTOR			

ELEVATION a	DEPTH 38 b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g	
	39	SC	increased stiffness w/ depth very low - low plasticity	75%		OVM- NSR	
	40					1-32oz jar	OVM- NSR
	41						P.P. 1.5
	42						
	43						
	44		bottom 2" saturated			OVM- NSR	
	45		bottom of well @ 45.0'			P.P. 2.5	
			Water levels (from ground surface) 1115 on 12/03/93 ~26.5' 1541 on 12/03/93 ~28.5' 1402 on 12/16/93 26.59			H.: light dk: dark mlmed: medium f: fine V: Very Fe oxide = iron oxide mod: moderate Colors from GSA Rock Color Chart	

ENG FORM 1836

PROJECT

HOLE NO.

18806

Location: LHAAP-01 Inert Burning Grounds		Identification: 01MW02	
Date(s): 12/05/93 - 12/05/93		X Coordinate: 3027086	Y Coordinate: 388991
Consulting Firm: Weston		Elevation: 270.39'	Datum: MSL
Logged By:		Total Depth: 42.50'	Measuring Point: 273.04'
Contractor: Terra-Mar, Inc.		Completed Depth: 40.00'	Static Water Level:
Drilling Method: Hollow Stem Auger		Well Casing: type: 40 PVC dia: 4.00" fm: -2.7' to: 20.00'	
Remarks:		Screens: type: Slotted size: .010" dia: 4.00" fm: 20.00' to: 40.00'	
		Annular Fill: type: Cement Grout fm: .00' to: 15.60'	
		type: Bentonite fm: 15.60' to: 18.00'	
		type: #20-40 Silica Filter Sand fm: 18.00' to: 42.50'	
		type: fm: to:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-270						CL	SANDY CLAY - Moderate red-brown, light olive gray clay blebs throughout, organics in top 2", dry stiff, low plasticity, black nodules				
						SC	CLAYEY SAND - Red brown & dark yellow orange & gray silt layers, stiff, dry				
						CL	SANDY CLAY - Dark yellow orange and clay light olive gray, dry, low plasticity				
						SC	CLAYEY SAND - Grayish orange, dry, semi-friable, scattered light-brown clay nodules and black streaks, moist, very low plasticity				
-260	10						CLAYEY SAND - 2" medium-high plasticity, soft, light olive gray clay layer, wet, mixed with dark yellow orange				
						SC	CLAYEY SAND - Moderate red brown-moderate brown, iron oxide staining and minor cementation mixed with light olive gray clay compact, stiff				
						SP	SAND - Light brown, well sorted clay blebs, semi-friable				
-250	20					SC	CLAYEY SAND - Dark yellow orange to moderate yellow brown, semi-stiff, moist, crumbles easily, few black laminations, dark yellowish brown, clayey silty matrix, dark yellowish orange, slight increase in stiffness, moist				
						SC	CLAYEY SAND - Dark yellow-orange, wet, soft, cuts easily with knife, slight increase in moisture, clean, slight increase in stiffness, decrease in fines				

18807

Location: LHAAP-01 Inert Burning Grounds					Identification: 01MW02				
Date(s): 12/05/93 - 12/05/93					X Coordinate: 3027086		Y Coordinate: 388991		
Consulting Firm: Weston					Elevation: 270.39'		Datum: MSL		
Logged By:					Total Depth: 42.50'		Measuring Point: 273.04'		
Contractor: Terra-Mar, Inc.					Completed Depth: 40.00'		Static Water Level:		
Drilling Method: Hollow Stem Auger					Well Casing: type: 40 PVC dia: 4.00" fm: -2.7' to: 20.00'				
Remarks:					Screens: type: Slotted size: .010" dia: 4.00" fm: 20.00' to: 40.00'				
					Annular Fill:				
					type: Cement Grout fm: .00' to: 15.60' type: Bentonite fm: 15.60' to: 18.00' type: #20-40 Silica Filter Sand fm: 18.00' to: 42.50' type: fm: to: to:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-240						SC	CLAYEY SAND - Dark yellow-orange, wet, crumbles easily, soft, not very stiff black specs				
-230	40						CLAYEY SAND - Moderate yellow-brown scattered red-brown stained spots and black concretions, slight decrease in moisture and clay content, scattered dark yellow orange laminations				
-220	50										

118808

DRILLING LOG		CLIENT: Tulsa COE		INSTALLATION		Hole No. SHEET OF SHEETS 1 of 3	
1. PROJECT LHAAP Site 1A RI				10. SIZE AND TYPE OF BIT 6 5/8" ID Hollow Stem Auger			
2. LOCATION MW02				11. DATUM FOR ELEVATION SHOWN (TOMOR MSL)			
3. DRILLING AGENCY Terra-Mar, Inc.				12. MANUFACTURER'S DESIGNATION OF DRILL B-61			
4. HOLE NO. MW02				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN 19			
5. NAME OF DRILLER M. Chism				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL ☒ INCLINED ☐ DEG. FROM VERT.				15. ELEVATION GROUND WATER 246.79 on 12/5/93; 246.91 on 12/16/93			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE 12/05/93			
8. DEPTH DRILLED INTO ROCK N.A.				17. ELEVATION TOP OF HOLE 210.34 TOC 213.04			
9. TOTAL DEPTH OF HOLE 40.0'				18. TOTAL CORE RECOVERY FOR BORING ~97%			
				19. SIGNATURE OF INSPECTOR Mark A. Dorman			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR * SAMPLE NO. f	REMARKS g	
	1	CL	CLAY sandy, mod red-brown (10R 4/6), H. olive gray (5Y 6/1), clay blebs throughout, organics in top 2", dry stiff, low plasticity black nodules	100%	4-8oz jars 1-2oz jar 1-32oz jar	OVM-NSR (no significant reading) p.p. 4.5+ (pocket penetrometer = p.p.)	
	2				4-8oz jars 1-2oz jar		
	3						
	4	SC	SAND & clayey mod. red brown & dk yellow (10YR 4/6) & gray silt loam black streaks, stiff, dry			OVM-NSR p.p. 4.0	
	5						
	6	CL	CLAY sandy dk yellow orange & clay H. olive gray, dry, low plasticity		12-8oz jars 3-2oz jars 1-32oz jar	OVM-NSR	
	7						
	8			100%	4-8oz jars 1-2oz jar	p.p. = 1.0	
	9		SAND & clayey grayish orange (10YR 4/6) dry, semi-friable			OVM-NSR	
	10		Scattered H. brown (5YR 5/6) clay nodules and black streaks				
	11	SC	moist very low plasticity		4-8oz jars 1-2oz jar 1-32oz jar	p.p. = 3.0 p.p. = 3.0	
	12			100%			
	13		2" med-high plasticity, soft, H. olive gray clay layer, wet		4-8oz jars 1-2oz jar	p.p. = 1.0 OVM-NSR	
	14		mixed w/ dk yellow orange			p.p. = 1.0	
	15						
	16	SC-CL	SAND clayey fine mod red brown - mod brown (5YR 4/4), iron oxide staining and minor cementation mixed w/ H. olive gray clay compact, stiff	100%	4-8oz jars 1-2oz jar 1-32oz jar	OVM-NSR	
	17						
	18	SP	SAND f-m H. brown (5YR 5/6), well sorted, clay blebs, semi-friable		4-8oz jars 1-2oz jar	p.p. = 1.0 OVM-NSR	
	19						

ENG FORM 1836

PROJECT

HOLE NO.

DRILLING LOG		CLIENT:		INSTALLATION		Hole No. 118809 SHEET OF SHEETS 2 of 3	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION				11. DATUM FOR ELEVATION SHOWN (OR)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. MW02				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE STARTED COMPLETED			
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
				19. SIGNATURE OF INSPECTOR			

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR * SAMPLE NO. f	REMARKS g
	20	SP				
	21	SC	SAND f clayey dk. yellow orange to mod. yellow brown (104R 514), Semi-stiff moist, crumbles easily few black laminations dk yellowish brown (104R 412) clayey/silty matrix dk yellowish orange slight increase in stiffness, moist	100%	4-8oz jars	OVM- NSR P.P. = 4.5
	22				1-2oz jar	
	23				4-8oz jars	
	24				1-2oz jar	
	25					OVM- NSR
	26	SP-SC	SAND f-m (mostly f) clayey matrix, dk yellow-orange, wet, soft, cuts easily with knife, slight increase in moisture clean	77%	1-32oz jar	OVM- NSR P.P. = 1.0 P.P. = 1.5 too soft for p.p. - just squishes into sediment
	27					
	28					
	29					
	30		slight increase in stiffness			
	31	SP-SC	SAND f slightly clayey, dk yellow-orange, wet, crumbles easily, soft not very stiff black specs	100%	1-32oz jar	OVM- NSR P.P. = 1.25 P.P. = 1.25
	32					
	33					
	34					
	35		mod yellow-brown scattered red-brown stained spots and black concretions		1-32oz jar	
	36			100%		
	37		slight decrease in moisture and clay content			
	38					

ENG FORM 1836

PROJECT

HOLE NO.

118810

DRILLING LOG		CLIENT:		INSTALLATION		Hole No. SHEET OF SHEETS	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION				11. DATUM FOR ELEVATION SHOWN (OR)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. MN02				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER		16. DATE HOLE STARTED COMPLETED	
7. THICKNESS OF OVERBURDEN				17. ELEVATION TOP OF HOLE			
8. DEPTH DRILLED INTO ROCK				18. TOTAL CORE RECOVERY FOR BORING			
9. TOTAL DEPTH OF HOLE				19. SIGNATURE OF INSPECTOR			
ELEVATION a	DEPTH 38 b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR * SAMPLE NO. f	REMARKS g	
	39	SR-SC	Scattered dk yellow-orange laminations				
	40		bottom of well @ 40.0' (comp @ 42.5') water levels (from ground surface) 1055 on 12/05/93 ~23.6' 1110 on 12/05/93 ~22.7' 1359 on 12/16/93 23.48'		1-32oz jar	* Samples obtained via stainless steel Shelby tube samples - 8oz jars for SVOC, explosives, metals, anions 2 oz jar for VOC 32 oz jar for geotechnical analyses H = light dk = dark m/med = medium mod = moderate f = fine v = very Fe oxide: iron oxide Colors from GSA Rock Color Chart	

ENG FORM 1836

PROJECT

HOLE NO.

118811

Location: LHAAP-01 Inert Burning Grounds						Identification: 01AMW03					
Date(s): 12/07/93 - 12/07/93						X Coordinate: 3027359			Y Coordinate: 388758		
Consulting Firm: Weston						Elevation: 257.20'			Datum: MSL		
Logged By:						Total Depth: 30.50'			Measuring Point: 259.76'		
Contractor: Terra-Mar, Inc.						Completed Depth: 28.00'			Static Water Level:		
Drilling Method: Hollow Stem Auger						Well Casing: type: 40 PVC dia: 4.00" fm: -2.6' to: 8.00'					
Remarks:						Screens: type: Slotted size: .010" dia: 4.00" fm: 8.00' to: 28.00'					
						Annular Fill:					
						type: Cement Grout fm: .00' to: 4.00' type: Bentonite fm: 4.00' to: 6.00' type: #20-40 Silica Filter Sand fm: 6.00' to: 30.50' type: fm: to: type: fm: to:					
Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction MP. EL. 259.76
						CL	SANDY CLAY - Moist, light brown clay, low-medium plasticity, rolls slightly, dusky brown, moist silt				
						CL	SANDY SILTY CLAY - Moderate red brown to moderate brown, light olive gray silt, organics, very stiff, crumbly, dark brown lamination				
						CL	SANDY SILTY CLAY - Sand increases, very stiff, moist, still mottled color				
250						SC	CLAYEY SAND - Mottled light olive gray and light brown, wet, soft, easy to cut, crumbly black specs, light olive gray clay nodule coated in black material, elongated gray nodules gradually become layers, alternating with light brown material, low-medium plasticity				
	10					SC	CLAYEY SAND - Brownish gray, moist, compact, slight cementation, slight stiffness				
240						SC	CLAYEY SAND - Light brown, wet, crumbly, very low plasticity, black specs, 1" of real soft clay @ 21.5', clay decreases with depth				
	20					SC	CLAYEY SAND - Light olive gray, wet, soft, moderate clay, coarser sand				
						SC	CLAYEY SAND - Light brown grades into light olive gray grades into moderate yellow brown grades back to light olive gray, soft, wet, low plasticity, reddish circular staining @ 29'5"				
230											

Location: LHAAP-01 Inert Burning Grounds					Identification: 01AMW03						
Date(s): 12/07/93 - 12/07/93					X Coordinate: 3027359		Y Coordinate: 388758				
Consulting Firm: Weston					Elevation: 257.20'		Datum: MSL				
Logged By:					Total Depth: 30.50'		Measuring Point: 259.76'				
Contractor: Terra-Mar, Inc.					Completed Depth: 28.00'		Static Water Level:				
Drilling Method: Hollow Stem Auger					Well Casing: type: 40 PVC dia: 4.00" fm: -2.6' to: 8.00'						
Remarks:					Screens: type: Slotted size: .010" dia: 4.00" fm: 8.00' to: 28.00'						
					Annular Fill:						
					type: Cement Grout fm: .00' to: 4.00' type: Bentonite fm: 4.00' to: 6.00' type: #20-40 Silica Filter Sand fm: 6.00' to: 30.50' type: fm: to: to:						
Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-220	40										
-210	50										
-200											

018813

Hole No.

DRILLING LOG		CLIENT: Tulsa COE		INSTALLATION		SHEET OF SHEETS 1 of 2	
1. PROJECT LHAAP Site 1A RI				10. SIZE AND TYPE OF BIT 6.518" ID Hollow Stem Auger			
2. LOCATION MW03				11. DATUM FOR ELEVATION SHOWN (TBM OR MSL) MSL			
3. DRILLING AGENCY Terra-Mar, Inc.				12. MANUFACTURER'S DESIGNATION OF DRILL B-61			
4. HOLE NO. MW03				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN 12		DISTURBED X UNDISTURBED	
5. NAME OF DRILLER Mike Chism				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL X INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER 245.20 on 12/7/93; 243.22 on 12/10/93			
7. THICKNESS OF OVERBURDEN -				16. DATE HOLE 12/07/93 STARTED 12/07/93 COMPLETED 12/07/93			
8. DEPTH DRILLED INTO ROCK N.A.				17. ELEVATION TOP OF HOLE found 251.20 TOL 251.76			
9. TOTAL DEPTH OF HOLE 30.5'				18. TOTAL CORE RECOVERY FOR BORING 100%			
				19. SIGNATURE OF INSPECTOR David A. Dinkham			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR X SAMPLE NO. f	REMARKS g	
	1	CL	SILT sandy dusky brown (54R 4/2) (top 2")	100%	4-8oz jars	Dvm = NSR (no significant reading) p.p. = (pocket penetrometer) = 3.75 - p.p. pushes into material, but does not break or fracture it	
	2		CLAY sandy f, moist lt brown (54R 5/6) low-med plasticity rolls slightly - no worm		1-2oz jar		
	3	CL-SC	CLAY sandy f, mod- red brown (10R 4/6) to mod brown (5YR 4/4) and SILT lt. olive gray (5Y 6/1), organics	100%	4-8oz jars	Dvm = NSR p.p. + 4.5 (no fracturing)	
	4		very stiff, crumbly		1-2oz jar		
	5		dark brown organic lamination @ 4' 8" > 1 piece of black org. gravel		12-8oz jars		
	6		Sand increases - almost SAND f clayey;		3-2oz jars		
	7	SC	Very stiff	100%	1-32oz jar	p.p. + 4.5 Dvm = NSR	
	8		moist		4-8oz jars		
	9		still mottled color		1-2oz jar		
	10						
	11	SC	SAND f clayey mottled lt. olive gray rht. brown, wet, soft, lumpy to clt, crumbly black specs	100%	4-8oz jars	Dvm = NSR p.p. 1.5 p.p. = 2.0 no fracturing w/ p.p. just pushes into material	
	12		lt. olive gray clay nodule coated in black material		1-2oz jar		
	13		elongated (—) gray nodules gradually become layers, alternating w/ lt. brown material		1-32oz jar		
	14		low-med plasticity forms a ball, but does not roll well or yellow orange (6.5R 6/2)				
	15	SC	SAND f clayey brownish gray (5YR 4/1) moist, compact	100%		p.p. = too soft p.p. 3.5 Dvm = NSR	
	16		slight cementation				
	17		slight stiffness				
	18						

BNG FORM 1836

PROJECT

HOLE NO.

018814

DRILLING LOG		CLIENT:		INSTALLATION		Hole No. SHEET OF SHEETS	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION				11. DATUM FOR ELEVATION SHOWN (____ OR ____)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. MW03				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE			
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
19. SIGNATURE OF INSPECTOR				19. SIGNATURE OF INSPECTOR			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR * SAMPLE NO. f	REMARKS g	
	20	SC				P.P. 4.0	
	21	SC	SAND f-m clayey lt brown, wet, clumpy very low plasticity		1-32oz jar	Dvm = NSR	
	22		dk yellow orange black specs			P.P. 1.0	
	23		1" of real soft clay @ 21.5'	100%		P.P. 1.5 } material too soft; squishes in	
	24	SP/SC	SAND f-m trace clay lt olive gray, wet, soft			Dvm = NSR	
	25						
	26	SC	SAND f clayey lt. brown grades into lt. olive gray grades into med. yellow brown (10 YR 5/4) grades back to lt. olive gray	100%	1-32oz jar	Dvm = NSR	
	27		soft, wet, low plasticity			Dvm = NSR	
	28		@ 29' 5" reddish circular staining (Fe oxide?)		1-32oz jar		
	29						
	30		bottom well (silt trap) @ 30.5'			* Samples obtained via Stainless steel Shelby tube, w/ the exception of 24'-25'; this was obtained by split spoon	
			water levels (from ground surface)			Samples: Boz jars for: SVOC explosives anions metals	
			0945 on 12/07/93 - 11.02'			2oz jar for VOC	
			1045 on 12/07/93 - 12.0'			32oz jar for geotechnical analyses	
			1107 on 12/07/93 - 11.8'			P. fine m/mud: medium lt. light dk. dark v. very Fe oxide: iron oxide Colors, Iron Color Chart	
			1355 on 12/16/93 - 13.98'				

ENG FORM 1836

PROJECT

HOLE NO.

018815

Location: LHAAP-01 Inert Burning Grounds				Identification: 01MW04			
Date(s): 12/10/93 - 12/12/93				X Coordinate: 3027079		Y Coordinate: 388570	
Consulting Firm: Weston				Elevation: 271.25'		Datum: MSL	
Logged By:				Total Depth: 40.00'		Measuring Point: 273.95'	
Contractor: Terra-Mar, Inc.				Completed Depth: 37.50'		Static Water Level:	
Drilling Method: Hollow Stem Auger				Well Casing: type: 40 PVC dia: 4.00" fm: -2.7' to: 17.50'			
Remarks:				Screens: type: Slotted size: .010" dia: 4.00" fm: 17.50' to: 37.50'			
				Annular Fill: type: Cement Grout fm: .00' to: 14.50'			
				type: Bentonite fm: 14.50' to: 16.50'			
				type: #20-40 Silica Filter Sand fm: 16.50' to: 40.00'			
				type: fm: to:			
				type: fm: to:			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-270						SC	CLAYEY SAND - Dark yellow brown grades into pale yellow brown, soft, organics, light brown, soft, moist, scattered, light olive gray clay nodules, well sorted sand, crumbly				
						SC	CLAYEY SAND - Light olive gray, moist				
						SC	CLAYEY SAND - Dark yellow- to pale yellow-brown, black specs, coarser sand				
						CL	SANDY CLAY - Mottled light olive gray, moderate red brown, and dark yellow orange, very stiff, hard to cut, organics crumbly				
10						SC	CLAYEY SAND - Mottled light olive gray, dark yellow orange, and moderate red brown, stiff, hard to cut, many hard chunks of gravel sized dry material				
-260						SC	CLAYEY SAND - Softer, less clay, well sorted sand, no chunks, semi-friable, light brown, dry, light olive gray clay nodules				
						SC	CLAYEY SAND - Dark yellow orange, dry, slightly moist, alternating light brown and dark yellow brown, wetter, cuts easy, friable, scattered clay blebs - dark in the center, lighter on outside				
20						SC	CLAYEY SAND - Dark yellow orange, dry, slightly moist, alternating light brown and dark yellow brown, wetter, cuts easy, friable, scattered clay blebs - dark in the center, lighter on outside				
-250						SC	CLAYEY SAND - Increasing light olive gray clay - larger nodules, soft, medium plasticity, cemented hard chips and streaks, clay is low plasticity and exhibits slight fissility, wet, black specs, light olive gray and dark yellow orange				

018816

[illegible]

18817

Hole No.

DRILLING LOG		CLIENT: <u>TWISA COE</u>		INSTALLATION		SHEET OF SHEETS <u>10/3</u>	
1. PROJECT <u>LHAAP SITE 1A RI</u>		10. SIZE AND TYPE OF BIT <u>6.5" 30 Hollow Stem Auger</u>		11. DATUM FOR ELEVATION SHOWN (<u>TEM</u> OR <u>MSL</u>)		<u>MSL</u>	
2. LOCATION <u>MWD4</u>		12. MANUFACTURER'S DESIGNATION OF DRILL		<u>B-61</u>			
3. DRILLING AGENCY <u>Terra-Mar, Inc.</u>		13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		20		DISTURBED <u>X</u> UNDISTURBED	
4. HOLE NO. <u>MWD4</u>		14. TOTAL NUMBER OF CORE BOXES					
5. NAME OF DRILLER <u>M. Chism</u>		15. ELEVATION GROUND WATER <u>250.4 on 12/12/93; 245.85 on 12/14/93</u>		16. DATE HOLE		STARTED <u>12/10/93</u> COMPLETED <u>12/12/93</u>	
6. DIRECTION OF HOLE VERTICAL <u>X</u> INCLINED <u>DEG. FROM VERT.</u>		17. ELEVATION TOP OF HOLE <u>ground 271.25 TOC 273.9</u>		18. TOTAL CORE RECOVERY FOR BORING <u>78%</u>		19. SIGNATURE OF INSPECTOR <u>Shawn A. Durham</u>	
7. THICKNESS OF OVERBURDEN <u>-</u>		8. DEPTH DRILLED INTO ROCK <u>N.A.</u>		9. TOTAL DEPTH OF HOLE <u>40.0</u>			
ELEVATION a	DEPTH 0 b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR % SAMPLE NO. f	REMARKS g	
	1	SC	SAND & clayey dk yellow brown (1048 412) grades into pale yellow brown (1048 412) soft, organics	65%	4-8oz jars 1-2oz jar 1-32oz jar	P.P. = 2.0 (pocket penetrometer)	
	2		H. brown (548 516) soft, moist		4-8oz jars 1-2oz jar	P.P. = 2.5	
	3		scattered H. olive gray (54 41) clay nodules				
	4		well sorted sand crumbly				
	5						
	6	SP-SC	SAND H. olive gray + SAND & clayey H. brown + mod. red brown (1048 416), moist	100%	8-8oz jars 2-2oz jars 1-32oz jar	> 6'-7' stiff; rolls - 1/4" then cracks & falls apart	
	7	SC	same as 1-6' but more black specks		4-8oz jars 1-2oz jar	P.P. = 4.5	
	8	CL	CLAY sandy, & mottled H. olive gray, mod. red brown, mod. dk yellow orange (1048 416), very stiff, hard to cut, organics crumbly				
	9						
	10	SC	SAND & clayey mottled H. olive gray, dk yellow orange, and mod. red brown. Stiff, hard to cut. A lot of hard (Fe?) chunks of gravel sized material dry	100%	4-8oz jars 1-2oz jar 1-32oz jar	DVM: NSR (No significant reading) P.P. = 4.5	
	11		softer, less clay well sorted sand, no Fe? chunks, semi friable		4-8oz jars 1-2oz jar	DVM: NSR P.P. = 3.0 breaks sample P.P. = 3.5	
	12		H. brown, dry H. olive gray clay nodules				
	13		no worm				
	14		dk yellow orange more clay, softer dry slightly moist				
	15			100%	4-8oz jars 1-2oz jar 1-32oz jar	P.P. = ~1.5 DVM: NSR P.P. = ~1.5	
	16						
	17						
	18						
	19						

ENG FORM 1836

PROJECT

HOLE NO.

Hole No. 118818

DRILLING LOG		CLIENT:		INSTALLATION		SHEET OF SHEETS 2093	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION				11. DATUM FOR ELEVATION SHOWN (OR)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. MW04				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE STARTED COMPLETED			
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
19. SIGNATURE OF INSPECTOR							
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g	
	20		Alternating lt brown and dk yellow brown wetter, cuts easy, friable, scattered clay blebs - dark in the center, lighter on outside (gray?)	100%	4-8oz jars 1-2oz jar 1-32oz jar	OVM=NSR	
	21						
	22				4-8oz jars 1-2oz jar 1-32oz jar	OVM=NSR	
	23						
	24	(CL)	increasing H. olive gray clay - larger nodules, soft, med plasticity			P.P.=3.0	
	25	SC					
	26				1-32oz jar	OVM=NSR	
	27		cemented (Feoxide?) hard chips and streaks, clay is low plasticity and exhibits slight fissility	33%		P.P.=3.0	
	28		Wet			OVM=NSR	
	29		black specs			P.P.=2.5	
	30		H. olive gray + dk yellow orange		1-32oz jar		
	31						
	32			65%		OVM=NSR	
	33	(CH)	H. olive gray + grayish orange (w/Fe oxide) grayish red purple (SEP 412) clay streaks			P.P.=4.5?	
	34		easy to cut, squishy			too soft - no breakage	
	35	CL	clay sandy & many layers (thin) stiff brownish gray			P.P.=4.5	
	36	CL	clay trace sand & massive - clay is stiff, clay is soft. med. plasticity		1-32oz jar	OVM=NSR	
	37		lt brown + H. olive gray mottling	62%		P.P.=4.0	
	38		Sand increases; pink clay			OVM=NSR	

ENG FORM 1836

PROJECT

HOLE NO.

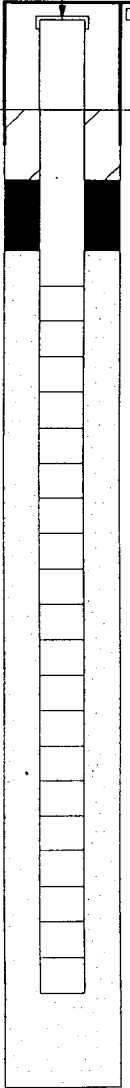
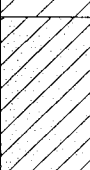
DRILLING LOG		CLIENT:		INSTALLATION		Hole No. 18819 SHEET OF SHEETS 3 of 3	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION				11. DATUM FOR ELEVATION SHOWN (OR)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. <i>MW04</i>				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER		16. DATE HOLE STARTED COMPLETED	
7. THICKNESS OF OVERBURDEN				17. ELEVATION TOP OF HOLE			
8. DEPTH DRILLED INTO ROCK				18. TOTAL CORE RECOVERY FOR BORING			
9. TOTAL DEPTH OF HOLE				19. SIGNATURE OF INSPECTOR			
ELEVATION a	DEPTH 38 b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR * SAMPLE NO. f	REMARKS g	
	39	CL	black spec clay increases, stiff shows like chert			Drm= NSR	
	40	SC-CL	SANDS + CLAY H. olive gray + H. brown crumbly		1-32oz jar	P.P. 3.5	
			bottom of well (silt trap) @ 400' Water levels (from ground surface) 1130 on 12/12/93 - 20.85' 1110 on 12/16/93 25.4			* Samples obtained via Stainless Steel Shelby tube. Samples: 4-8oz jars: SVOC metals anions explosives 1-2oz jar: VOC 1-32oz jar: geotechnical analyses H- light dk- dark mod- moderate f- fine m/med- medium v- very Fe oxide- iron oxide Colors from GSA Rock Color Chart	

ENG FORM 1836

PROJECT

HOLE NO.

Location: LHAAP-01 Inert Burning Grounds		Identification: 01AMW05	
Date(s): 12/08/93 - 12/09/93		X Coordinate: 3027252	Y Coordinate: 388323
Consulting Firm: Weston		Elevation: 254.15'	Datum: MSL
Logged By:		Total Depth: 27.50'	Measuring Point: 256.68'
Contractor: Terra-Mar, Inc.		Completed Depth: 25.00'	Static Water Level:
Drilling Method: Hollow Stem Auger		Well Casing: type: 40 PVC dia: 4.00" fm: -2.5' to: 5.00'	
Remarks:		Screens: type: Slotted size: .010" dia: 4.00" fm: 5.00' to: 25.00'	
		Annular Fill: type: Cement Grout fm: .00' to: 2.00' type: Bentonite fm: 2.00' to: 4.00' type: #20-40 Silica Filter Sand fm: 4.00' to: 27.50' type: fm: to:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
-250						SC	CLAYEY SAND - Top 3" if topsoil, dusky yellowish brown organics and roots present, moderate yellowish brown sand, very wet, soft, increases in stiffness, mottled dark yellow orange and moderate red brown, iron oxide nodules				
						CL	SANDY CLAY - Light olive gray and moderate red brown sand				
						SC	CLAYEY SAND - Light olive gray and light brown, stiff, dry, crumbly, light olive gray and dark yellow orange, gray and red patches, black streaks				
10						CL	SANDY CLAY - Light brown, light olive gray, and greenish gray, minor moderate red swirls running through, very stiff, compact, dry, some organics				
-240						SC	CLAYEY SAND - Light olive gray and light brown, wet, soft, easy to cut, scattered hard clay chips, softer with depth, wet, real soft				
20							CLAYEY SAND - Light brown, black specs, not as soft as above, wet, gooey, clay content decreases				
-230											

18821

DRILLING LOG		CLIENT	INSTALLATION	Hole No.	SHEET OF SHEETS	
1. PROJECT		Tulsa COE	10. SIZE AND TYPE OF BIT 6" ID Hollow Stem Auger			
2. LOCATION		LHAAP site 1A RI	11. DATUM FOR ELEVATION SHOWN (rem OR msl) msl			
3. DRILLING AGENCY		mw05	12. MANUFACTURER'S DESIGNATION OF DRILL B-61			
4. HOLE NO.		Terra-mar, Inc.	13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN 11 DISTURBED + UNDISTURBED			
5. NAME OF DRILLER		mw05	14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE		m. Chism	15. ELEVATION GROUND WATER 245.19 on 12/8/93; 245.20 on 12/16/93			
7. THICKNESS OF OVERBURDEN		VERTICAL ☒ INCLINED _____ DEG. FROM VERT.	16. DATE HOLE STARTED 12/08/93 COMPLETED 12/09/93			
8. DEPTH DRILLED INTO ROCK		N.A.	17. ELEVATION TOP OF HOLE ground 254.15 TOC 250.08			
9. TOTAL DEPTH OF HOLE		27.5'	18. TOTAL CORE RECOVERY FOR BORING 79.4%			
			19. SIGNATURE OF INSPECTOR <i>David A. DeWorm</i>			
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g
	1	SC	top 3" is topsoil, dusky yellowish brown (10YR2/2) organics + roots present	72%	4-8oz jars	DVM = NSR (No significant reading)
	2		SAND clayey mod. yellowish brown (10YR4/6) very wet, soft, increases in stiffness		1-2oz jar	
	3		mottled dark yellow orange (10YR4/6) + mod. red brown (10R4/6) iron oxide nodules, organics		1-32oz jar	
	4		CLAY lt. olive gray (5Y4/1) and SAND clayey mod. red brown		4-8oz jars	
	5	CL			1-2oz jar	P.P. = pocket penetrometer = 3.0
	6	SC	SAND f clayey lt. olive gray + lt. brown (5YR5/6)	73%	12-8oz jars	DVM = NSR
	7		stiff, dry, crumbly		3-2oz jar	
	8		lt. olive gray + dk. yellow orange (10YR4/6)		1-32oz jar	
	9		gray + red patches black streaks does not form worms or balls		4-8oz jars	
	10	CL		57%	1-2oz jar	P.P. = 3.0
	11		CLAY sand f lt. brown lt. olive gray, and greenish gray (5G4/1)		1-32oz jar	
	12		minor mod. red swirl running through			
	13		very stiff, compact, dry			
	14	SC	some organics (knife bent while cutting)	95%	4-8oz jars	DVM = NSR
	15		SAND f clayey lt. olive gray + lt. brown		1-2oz jars	
	16		wet, soft		1-32oz jar	
	17		easy to cut			
	18	SC	scattered hard clay chips			P.P. = 3.5
	19					

ENG FORM 1836

PROJECT

HOLE NO.

Hole No. 018822

DRILLING LOG		CLIENT:	INSTALLATION	SHEET OF SHEETS 2 of 2		
1. PROJECT			10. SIZE AND TYPE OF BIT			
2. LOCATION			11. DATUM FOR ELEVATION SHOWN (OR)			
3. DRILLING AGENCY			12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. MW05			13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		13. DISTURBED UNDISTURBED	
5. NAME OF DRILLER			14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.			15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN			16. DATE HOLE		16. STARTED COMPLETED	
8. DEPTH DRILLED INTO ROCK			17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE			18. TOTAL CORE RECOVERY FOR BORING			
9. SIGNATURE OF INSPECTOR						
ELEVATION a	DEPTH 19 b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR # SAMPLE NO. f	REMARKS g
	20	SC	Softer w/ depth			DVM = NSR
	21		wet, real soft		1-32oz jar	P.P. = 1.5
	22			100%		no breakage w/ P.P.
	23		lt. brown, black spcs, not as soft as above			DVM = 0.5 ppm
	24		wet, gooey			P.P. = 1.5
	25		clay content decreases		1-32oz jar	P.P. = 2.0
			bottom of well (silt trap) @ 27.5'			* Samples obtained via stainless steel Shelby tube
			Water levels (from ground surface)			Samples:
			1430 on 12/08/93 - 8.9' ←			4-8oz jars: SVOC anions metal explosives
			1440 on 12/08/93 - 7.7'			
			1454 on 12/08/93 - 7.0'			
			1341 on 12/16/93 - 8.95'			1- 2oz jar: VOC 1- 32oz jar: geotechnical analyses
						lt.: light dk: dark V: Very P: Fine ml med: medium mod: moderate R oxide: iron oxide Colors from GSA Rock Color Chart

ENG FORM 1836

PROJECT

HOLE NO.

18823

Location: LHAAP-01 Inert Burning Grounds	Identification: 01SB01
Date(s): 12/15/93 - 12/15/93	X Coordinate: 3027162
Consulting Firm: Weston	Y Coordinate: 389069
Logged By:	Elevation: 267.72'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 25.00'
Remarks:	Borehole Dia.: 8.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						SC	CLAYEY SAND - brown, moist, fine grained, w/ olive gray clay nodules, low plasticity, friable				
						CL	SANDY CLAY - olive gray, dry, powdery, very low plasticity, fissile				
						SC	CLAYEY SAND - light brown w/olive gray mottling, dry, fine to medium grained, pale yellow brown, minor iron oxide staining				
-260	10										
							2"-thick layer sandy light brown clay (13.5')				
							dark yellow orange, slightly moist, soft, low plasticity				
-250	20										
							increased water saturation				
-240											

118824

Hole No.

DRILLING LOG		CLIENT: TULSG COE		INSTALLATION		SHEET OF SHEETS 1 of 2	
1. PROJECT LHAAP Site 1A RT		10. SIZE AND TYPE OF BIT 6 5/8" ID Hollow Stem Auger		11. DATUM FOR ELEVATION SHOWN (TBM OR MSL) MSL			
2. LOCATION S801		12. MANUFACTURER'S DESIGNATION OF DRILL B-61		13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN 14		DISTURBED UNDISTURBED	
3. DRILLING AGENCY Terra Mar, Inc.		14. TOTAL NUMBER OF CORE BOXES		15. ELEVATION GROUND WATER 243.56 on 12/15/93			
4. HOLE NO. S801		16. DATE HOLE 12/15/93		17. ELEVATION TOP OF HOLE 267.72'		STARTED COMPLETED 12/15/93 12/15/93	
5. NAME OF DRILLER M. Chism		18. TOTAL CORE RECOVERY FOR BORING 100%		19. SIGNATURE OF INSPECTOR			
6. DIRECTION OF HOLE VERTICAL * INCLINED DEG. FROM VERT.		7. THICKNESS OF OVERBURDEN -		8. DEPTH DRILLED INTO ROCK N.A.		9. TOTAL DEPTH OF HOLE 25.0	
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g	
	1	SC to CL	SAND f. clayey lt. brown (54R 9/10) Fe oxide stains, moist, soft, olive gray (54R 4/10) clay nodules, low plasticity, friable	100%	4-8oz jars	DVM= NSR (No significant reading) P.P.= pocket penetrometer +4.5	
	2				1-2oz jar		
	3				1-32oz jar		
	4	CL	CLAY sandy lt. olive gray, dry, powdery, low plasticity, slight fissility		4-8oz jars	P.P.= +4.5	
	5				1-2oz jar	DVM= NSR	
	6	SC	SAND f-m clayey lt. brown w/ lt. olive gray mottles (some mottles surrounded by black Fe oxide? cement) dry, friable, stiff, very low plasticity, if any	100%	4-8oz jars	DVM= NSR	
	7				1-2oz jar	P.P.= +4.5	
	8				1-32oz jar	DVM= NSR	
	9						
	10						
	11		pale yellow brown (10YR 4/2) to grayish orange (10YR 7/4) minor Fe oxide staining @ 13.5', a 2" layer of clay sandy f. lt. brown	100%	4-8oz jars	DVM= NSR	
	12				1-2oz jar	P.P.= 2.0	
	13				1-32oz jar	DVM= NSR	
	14		dk yellow orange (10YR 6/4) w/ lt. brown spots (freckles) and streaks, soft, easy to cut, very low plasticity, will not roll or ball, slightly moist	100%	1-2oz jar	P.P.= 2.5	
	15					DVM= NSR	
	16					P.P.= 2.25	
	17			100%	4-8oz jars	P.P.= 2.25	
	18				1-2oz jar	DVM= NSR	
	19						

ENG FORM 1836

PROJECT

HOLE NO.

018825

Hole No.

DRILLING LOG		CLIENT:	INSTALLATION	SHEET OF SHEETS 2582		
1. PROJECT			10. SIZE AND TYPE OF BIT			
2. LOCATION			11. DATUM FOR ELEVATION SHOWN (OR)			
3. DRILLING AGENCY			12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. S801			13. TOTAL NO OF OVER- BURDEN SAMPLES TAKEN		DISTURBED	UNDISTURBED
5. NAME OF DRILLER			14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.			15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN			16. DATE HOLE		STARTED	COMPLETED
8. DEPTH DRILLED INTO ROCK			17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE			18. TOTAL CORE RECOVERY FOR BORING			
19. SIGNATURE OF INSPECTOR						
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g
	20 21 22 23 24 25	SC	increases in wetness	100%	4. 8oz jars 1. 2oz jar 1. 32oz jar	bvm: NSR P.P. = 3.0 bvm: NSR P.P. = 2.0 Samples obtained via Stainless steel Shelby tube Samples: 4. 8oz jars: SVOC anions metals explosives 1. 2oz jar VOC 1. 32oz jar geotechnical analyses H. = light dk. = dark Fe oxide = iron oxide v. = very mod. = moderate medium Colors from GSA Rock Color Chart f. = fine m. = medium
			bottom of hole @ 25'			
			Water levels (from ground surface) 0937 on 12/15/93 - 2412			

ENG FORM 1836

PROJECT

HOLE NO.

118826

Location: LHAAP-01 Inert Burning Grounds	Identification: 01SB02
Date(s): 12/14/93 - 12/14/93	X Coordinate: 3027182
Consulting Firm: Weston	Y Coordinate: 388953
Logged By:	Elevation: 265.49'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 25.00'
Remarks:	Borehole Dia.: 8.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						SC	CLAYEY SAND - mottled red and brown, fine grained, w/olive gray clay, friable, very low plasticity				
260						SC	SAND - grayish orange, w/some small gray clay nodules, soft				
10						SC	CLAYEY SAND - yellow brown, moist, fine grained, w/ friable, low plasticity clay nodules				
250							water saturated, increased clay content				
20						CL SC	CLAY - gray, fissile, compact, trace of sand CLAYEY SAND - light brown, moist, fine-grained, w/ olive gray clay, stiff, moist nodules				
240											

018827

DRILLING LOG		CLIENT: <u>TOLSA COE</u>		INSTALLATION		Hole No. <u>10827</u> SHEET OF SHEETS <u>1 of 2</u>	
1. PROJECT <u>LHAAP SITE IA RI</u>				10. SIZE AND TYPE OF BIT <u>6.5" ID Hollow Stem Auger</u>			
2. LOCATION <u>S802</u>				11. DATUM FOR ELEVATION SHOWN <u>(Tem OR MSL)</u> <u>MSL</u>			
3. DRILLING AGENCY <u>Terra-Mar, Inc.</u>				12. MANUFACTURER'S DESIGNATION OF DRILL <u>B-61</u>			
4. HOLE NO. <u>S802</u>				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN <u>14</u> DISTURBED <u>X</u> UNDISTURBED			
5. NAME OF DRILLER <u>M. Chism</u>				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL <u>X</u> INCLINED <u> </u> DEG. FROM VERT. <u> </u>				15. ELEVATION GROUND WATER <u>243.99' on 12/14/93</u>			
7. THICKNESS OF OVERBURDEN <u>—</u>				16. DATE HOLE STARTED <u>12/14/93</u> COMPLETED <u>12/14/93</u>			
8. DEPTH DRILLED INTO ROCK <u>N.A.</u>				17. ELEVATION TOP OF HOLE <u>265.49</u>			
9. TOTAL DEPTH OF HOLE <u>25.0</u>				18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>			
19. SIGNATURE OF INSPECTOR <u>Dawn A. Dorkham</u>							
ELEVATION a	DEPTH b b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR * SAMPLE NO. f	REMARKS g	
	1		SAND & clayey mottled mod. red brown (10E416) + H olive gray (54416)		4-8oz jars 1-2oz jar 1-32oz jar	P.P. = pocket penetrometer +4.5	
	2	(CL)	stiff, gets less stiff w/ depth, few organics	100%	4-8oz jars 1-2oz jar	UVM = NSR (no significant reading)	
	3	SC	few H. olive gray balls (clay) and Fe oxide chunks				
	4		crumbly, easy				
	5		some Fe oxide staining, dry sand		4-8oz jars 1-2oz jar 1-32oz jar	P.P. = 4.0	
	6		is very visible			UVM = NSR	
	7		low plasticity, slight cementation	100%	4-8oz jars 1-2oz jar	P.P. = 4.0	
	8					UVM = NSR	
	9	SC-SP	SAND & with clay grayish orange (10E714)		4-8oz jars 1-2oz jar 1-32oz jar	P.P. = 2.0	
	10		dry, friable, minor small gray clay nodules (phasing out)			UVM = NSR	
	11		soft		4-8oz jars 1-2oz jar 1-32oz jar	P.P. = 3.0	
	12		few black specs			UVM = NSR	
	13			100%	4-8oz jars 1-2oz jar	P.P. = 2.0	
	14		SAND & clayey mod. yellow brown (10E518), moist, black specs, very low plasticity, very little cement- ation/compaction			P.P. = 2.0	
	15	SC	few H. olive gray clay nodules		4-8oz jars 1-2oz jar 1-32oz jar	P.P. = 2.0	
	16					P.P. = 2.0	
	17		Wetker, easier to cut	100%	4-8oz jars 1-2oz jar	UVM = NSR	
	18		clay increases slightly w/ depth			P.P. = 2.5	
	19		Fe oxide staining				

ENG FORM 1838

PROJECT

HOLE NO.

ENG FORM 1836

PROJECT

HOLE NO.

Location: LHAAP-01 Inert Burning Grounds	Identification: 01SB03
Date(s): 12/14/93 - 12/14/93	X Coordinate: 3027174
Consulting Firm: Weston	Y Coordinate: 388818
Logged By:	Elevation: 265.51'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 5.00'
Remarks:	Borehole Dia.: 8.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-260						CL	SANDY CLAY - mottled reddish brown and olive gray, moist, medium stiffness, increasing stiffness w/ depth				
-250											
-240											

DRILLING LOG		CLIENT: Tolva COE		Hole No. 18830		
1. PROJECT		2. LOCATION		3. DRILLING AGENCY		
4. HOLE NO.		5. NAME OF DRILLER		6. DIRECTION OF HOLE		
7. THICKNESS OF OVERBURDEN		8. DEPTH DRILLED INTO ROCK		9. TOTAL DEPTH OF HOLE		
10. SIZE AND TYPE OF BIT		11. DATUM FOR ELEVATION SHOWN		12. MANUFACTURER'S DESIGNATION OF DRILL		
13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		14. TOTAL NUMBER OF CORE BOXES		15. ELEVATION GROUND WATER		
16. DATE HOLE		17. ELEVATION TOP OF HOLE		18. TOTAL CORE RECOVERY FOR BORING		
19. SIGNATURE OF INSPECTOR		20. SIGNATURE OF INSPECTOR		21. SIGNATURE OF INSPECTOR		
1. PROJECT	LHARP SITE IARI	2. LOCATION	SB03	3. DRILLING AGENCY	Terra Mar, Inc.	
4. HOLE NO.	SB03	5. NAME OF DRILLER	M. Chism	6. DIRECTION OF HOLE	VERTICAL ☒ INCLINED ☐ DEG. FROM VERT.	
7. THICKNESS OF OVERBURDEN	-	8. DEPTH DRILLED INTO ROCK	N.A.	9. TOTAL DEPTH OF HOLE	5.0	
10. SIZE AND TYPE OF BIT	6 5/8" Hollow Stem Auger	11. DATUM FOR ELEVATION SHOWN	(Term OR MSL)	12. MANUFACTURER'S DESIGNATION OF DRILL	B-61	
13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN	5	14. TOTAL NUMBER OF CORE BOXES		15. ELEVATION GROUND WATER	262.51 on 12/14/93	
16. DATE HOLE		17. ELEVATION TOP OF HOLE	265.51	18. TOTAL CORE RECOVERY FOR BORING	100%	
19. SIGNATURE OF INSPECTOR		20. SIGNATURE OF INSPECTOR		21. SIGNATURE OF INSPECTOR		
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g
	1	CL	CLAY sandy & mottled mod. red brown (10R 4/6) + H olive gray (5Y 4/1) med stiffness, moist, H olive gray is mostly in nodules stiffer w/depth	100%	4-8oz jars	Drm: NSR (no significant reading) P.P. = pocket penetrometer = 3.5 P.P. = 4.5
	2				1-2oz jar	
	3				1-32oz jar	
	4				4-8oz jars	
	5				1-2oz jar	
			bottom of hole @ 5.0'			*Samples obtained via slinker steel Shelby tube Samples: 4-8oz jars: svoc anions metals explosives 1-2oz jar: VOC 1-32oz jar: geotechnical analyses H: light dr: dark f: fine m: medium mod: moderate Colors from GSA rock color chart

ENG FORM 1836

PROJECT

HOLE NO.

Location: LHAAP-01 Inert Burning Grounds					Identification: 01SB04				
Date(s): 12/13/93 - 12/13/93					X Coordinate: 3027228				
Consulting Firm: Weston					Y Coordinate: 388398				
Logged By:					Elevation: 258.57'				
Contractor:					Datum: MSL				
Drilling Method: Hollow Stem Auger					Total Depth: 20.00'				
Remarks:					Borehole Dia.: 8.00"				
					Static Water Level:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						SC	SAND - light to yellow brown, well sorted, fine to medium grained				
						SC	w/some soft, friable clay CLAYEY SAND - dark yellow orange and reddish brown, moist				
							increasing dryness and stiffness in clay component				
-250	10										
						CL	SANDY CLAY - mottled dark yellow orange and reddish brown, moist, friable				
							decreased moisture				
						SC	CLAYEY SAND - water saturated, fine grained, well sorted, w/olive gray				
-240	20						soft stiff clay				
											
-230											

118832

DRILLING LOG		CLIENT: Tulsa COE		INSTALLATION		Hole No. SHEET OF SHEETS 1 of 2	
1. PROJECT LHAAP SIK IN RT				10. SIZE AND TYPE OF BIT 6" 10" ID Hollow Stem Auger			
2. LOCATION S804				11. DATUM FOR ELEVATION SHOWN (TBM OR MSL) msl			
3. DRILLING AGENCY Tulsa-Mor, Inc.				12. MANUFACTURER'S DESIGNATION OF DRILL 8-61			
4. HOLE NO. S804				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN 11 DISTURBED X UNDISTURBED			
5. NAME OF DRILLER M. Chism				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL + INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER 243.57 on 12/13/93			
7. THICKNESS OF OVERBURDEN -				16. DATE HOLE 12/13/93 STARTED 12/13/93 COMPLETED 12/13/93			
8. DEPTH DRILLED INTO ROCK N.A.				17. ELEVATION TOP OF HOLE 258.57'			
9. TOTAL DEPTH OF HOLE 20.0				18. TOTAL CORE RECOVERY FOR BORING 97.5%			
19. SIGNATURE OF INSPECTOR [Signature]							
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS g	
	1	SP-SC	SAND f-m, some clay lt. brown (5YR 6/4) to mod. yellow brown (10YR 5/4) very friable soft, well sorted		4-8oz jars 1-2oz jar 1-32oz jar	DVM= NSR (no significant reading) P.P.= pocket penetrometer = 0.75	
	2			100%	4-8oz jars 1-2oz jar	P.P.= 2.5 DVM= NSR	
	3		SAND f clayey dk yellow orange (10YR 6/4) + mod. red brown (10R 4/4), moist, drier w/ depth, stiffer w/ depth black specs pieces of lt. olive gray (5Y 4/1)			P.P.= 3.5	
	4						
	5						
	6	SC	very dry + crumbly; hard to cut R oxide staining, some roots	? estimate 90%	4-8oz jars 1-2oz jar 1-32oz jar	had to switch from buggy to rig- real hard to drill P.P.= 1.75	
	7			hard to get out of tube	4-8oz jars 1-2oz jar	DVM= NSR	
	8		driness makes it appear to be cemented			DVM= NSR	
	9						
	10						
	11		very dry		4-8oz jars 1-2oz jar 1-32oz jar	P.P.= 4.5 DVM= NSR	
	12			100%	4-8oz jars 1-2oz jar	P.P.= 4.5 DVM= NSR	
	13		CLAY sandy f- some mottled colors as above very dry. Black nodules scattered moist, semi-friable bands thick, some organics cannot roll into ball in warm				
	14	CL					
	15						
	16				4-8oz jars 1-2oz jar 1-32oz jar	P.P.= 4.5	
	17		slightly moist	100%		DVM= NSR	
	18	SC	SAND f clayey wetter, still pretty stiff, well sorted lt. olive gray soft.			P.P.= 1.0 breaks	
	19						

ENG FORM 1836

PROJECT

HOLE NO.

DRILLING LOG		CLIENT:		INSTALLATION		Hole No. 18833 SHEET OF SHEETS 2 of 2	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION				11. DATUM FOR ELEVATION SHOWN (OR)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. SBOA				13. TOTAL NO OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER OF CORE BOXES			
6. DIRECTION OF HOLE VERTICAL INCLINED DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE STARTED COMPLETED			
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING			
19. SIGNATURE OF INSPECTOR							
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR % SAMPLE NO. f	REMARKS g	
	20	SC	bottom of hole @ 20'			Samples collected via Stainless steel Shelby tube	
			water level (from ground level)			Samples:	
			~15' on 12/13/93 @ 1410			4-8oz jars: SVOC metal anions explosives	
						1-2oz jar: VOC	
						1-32oz jar: geochemical analyses	
						H. - light dk - dark Fe oxide: iron oxide V. - very F. - fine M. - medium mod. - moderate colors from GSA Rock Color Chart	

ENG FORM 1836

PROJECT

HOLE NO.

18834

Location: LHAAP-01 Inert Burning Grounds				Identification: 01SB22			
Date(s): 03/15/93 - 03/15/93				X Coordinate: 3027213			
Consulting Firm: Ebasco				Y Coordinate: 388529			
Logged By:				Elevation: 266.00'			
Contractor:				Datum: MSL			
Drilling Method: Hollow Stem Auger				Total Depth: 30.00'			
Remarks:				Borehole Dia.: 8.00"			
				Static Water Level:			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						CL	SANDY CLAY - mottled tan and gray, moist (top 0.4' clayey sand)				
						SC	CLAYEY SAND - mottled tan and gray				
						CL	SANDY CLAY - tan				
260											
	10						increased sand content				
							iron sandstone layer (16.0' - 16.2')				
250						CH	SILTY CLAY - gray, slightly sandy, plastic				
	20						tan and gray, increased sand content				
						CL	SANDY CLAY - gray				
240											

Hole No. **LHDI-SB22**

18835

DRILLING LOG		DIVISION		INSTALLATION		SHEET	
1. PROJECT		2. LOCATION (Coordinates, or Station)		10. SIZE AND TYPE OF BIT		11. DATUM FOR ELEVATION SHOWN (BSM or MSL)	
3. DRILLING AGENCY		4. HOLE NO. (As shown on drawing title and file number)		12. MANUFACTURER'S DESIGNATION OF DRILL		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	
5. NAME OF DRILLER		6. DIRECTION OF HOLE		14. TOTAL NUMBER CORE BOXES		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		8. DEPTH DRILLED INTO ROCK		16. DATE HOLE		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE		18. TOTAL CORE RECOVERY FOR BORING		19. SIGNATURE OF INSPECTOR		20. REMARKS	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0	SC	SAND, clayey, lt. tan	100%	10-Box Jars	Samples obtained via 2 5/16" stainless steel split spoon	
	1	CL	CLAY, sandy, mottled tan and gray, moist			HnU PID-NSR	
	2		increased sand content			HnU PID-NSR	
	3	SC-CL	SAND, clayey / CLAY, sandy, mottled tan and gray	75%		HnU PID-NSR	
	4	SC-CL	Lost Core		2-Box Jars	HnU PID-NSR	
	5		CLAY, sandy, tan	100%		HnU PID-NSR	
	6				5-Box Jars	HnU PID-NSR	
	7			100%		HnU PID-NSR	
	8					HnU PID-NSR	
	9			100%		HnU PID-NSR	
	10					HnU PID-NSR	
	11	CL		100%		HnU PID-NSR	
	12				5-Box Jars	HnU PID-NSR	
	13			100%		HnU PID-NSR	
	14		increased sand content			HnU PID-NSR	
	15			100%		HnU PID-NSR	
	16		with Fe sandstone layer from 16-16.2'		5-Box Jars	HnU PID-NSR	
	17			100%		HnU PID-NSR	
	18	CL	Not sampled, overdrilled CLAY, silty, sh. sandy, gray			HnU PID-NSR	
	19	CH		100%		HnU DID-NSR	
	20					HnU PID-NSR	

Hole No. 4401-SB22

18836

DRILLING LOG		DIVISION		INSTALLATION		SHEET <u>2</u> OF <u>2</u> SHEETS	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION (Coordinates or Station)				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing title and file number) <u>4401-SB22</u>				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES		UNDISTURBED	
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER		16. DATE HOLE	
7. THICKNESS OF OVERBURDEN				17. ELEVATION TOP OF HOLE		STARTED	
8. DEPTH DRILLED INTO ROCK				18. TOTAL CORE RECOVERY FOR BORING		COMPLETED	
9. TOTAL DEPTH OF HOLE				19. SIGNATURE OF INSPECTOR			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
20			CLAY, silty, gray	100%		H ₂ O PID-NSR	
21		CH					
22		N S	Not Sampled... overdrill	N S		12-802 jars, 98 and ASD dup	
23		CH	increased sand content, tan and gray				
24		CL	CLAY, sandy, gray	100%		H ₂ O PID-NSR	
25							
26							
27		N S	Not sampled... drilled	N S			
28							
29							
30			Bottom of Boring @ 30'				
Water Levels: (from ground surface) 3/15/93 @ 1600 hrs ~16.7' 3/17/93 @ 0700 hrs ~13.7'				Legend H ₂ O PID-Photovionization detector NSR- No Significant Reading			

Location: LHAAP-01 Inert Burning Grounds		Identification: 01SB23	
Date(s): 03/15/93 - 03/15/93		X Coordinate: 3027288	
Consulting Firm: Ebasco		Y Coordinate: 388479	
Logged By:		Elevation: 263.00'	
Contractor:		Datum: MSL	
Drilling Method: Hollow Stem Auger		Total Depth: 30.00'	
Remarks:		Borehole Dia.: 8.00"	
		Static Water Level:	
		18837	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-260						CL	Sandy Clay FILL - gray and tan				
						SM	Clayey sand from 1.2' to 1.6'				
							Silty Sand FILL - tan, fine grained, charcoal and glass debris (to 3')				
							wet				
						CH	CLAY - tan, slightly sandy				
10						CL	SANDY CLAY - tan and gray				
-250							wet, decreased sand content				
							increased sand content				
						CH	SILTY CLAY - gray, moist, slightly sandy				
							wet				
20						SC	SANDY CLAY - gray				
-240											

Hole No. **LH01-SB23**

18838

DRILLING LOG		DIVISION		INSTALLATION		SHEET 1 OF 2 SHEETS	
1. PROJECT LHAAP				10. SIZE AND TYPE OF BIT 6 1/4" o.d. hollow stem auger			
2. LOCATION (Coordinates or Section) LH #DI				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY A.W. Pool				12. MANUFACTURER'S DESIGNATION OF DRILL Arco A.T.V.			
4. HOLE NO. (As shown on drawing title and file number) LH01-SB23				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN NONE		14. TOTAL NUMBER CORE BOXES 11	
5. NAME OF DRILLER D. Perez				15. ELEVATION GROUND WATER			
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				16. DATE HOLE STARTED 03/15/93		17. ELEVATION TOP OF HOLE COMPLETED 03/15/93	
7. THICKNESS OF OVERBURDEN —				18. TOTAL CORE RECOVERY FOR BORING 100%			
8. DEPTH DRILLED INTO ROCK NA				19. SIGNATURE OF INSPECTOR J.K. Collum			
9. TOTAL DEPTH OF HOLE 30.0'							
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
1	0	CL (Fill)	CLAY, sandy, gray and tan	100%	5-8oz Jars	Samples obtained via 2 5/16" id stainless steel split spoons	
2	1		clayey sand from 1.2-1.6'			HnU PID-NSR	
3	2		SAND, silty fine, tan with charcoal and glass debris to 3.0'	100%		HnU PID-NSR	
4	3				5-8oz Jars	HnU PID-NSR	
5	4	SM (Fill)		100%		HnU PID-NSR	
6	5		water saturated		5-8oz Jars	HnU PID-NSR	
7	6		CLAY, silty, sandy, tan	100%		HnU PID-NSR 2.5 pocket pen	
8	7	CL-CH				HnU PID-NSR	
9	8					HnU PID-NSR	
10	9		CLAY, sandy, tan and gray	100%		HnU PID-NSR 1.75 pocket pen	
11	10		water saturated, decreased sand content			HnU PID-NSR	
12	11			100%	5-8oz Jars	HnU PID-NSR 2.75 pocket pen	
13	12	CL	increased sand content			HnU PID-NSR	
14	13			100%		HnU PID-NSR	
15	14					HnU PID-NSR	
16	15			100%		HnU PID-NSR	
17	16		CLAY, silty, sandy, gray moist			HnU PID-NSR 3.0 pocket pen	
18	17			100%	10-8oz Jars (3 duplicate)	HnU PID-NSR	
19	18	CH				HnU PID-NSR	
20	19			100%		HnU PID-NSR	
	20					(Continued on Back)	

Hole No. **LH01-SB23**

18839

DRILLING LOG		DIVISION		INSTALLATION		SHEET 2 OF 2 SHEETS	
1. PROJECT				10. SIZE AND TYPE OF BIT			
2. LOCATION (Coordinates or Station)				11. DATUM FOR ELEVATION SHOWN (YSM ~ MSL)			
DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing title and file number) LH01-SB23				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN				16. DATE HOLE STARTED COMPLETED			
8. DEPTH DRILLED INTO ROCK				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE				18. TOTAL CORE RECOVERY FOR BORING %			
				19. SIGNATURE OF INSPECTOR			
ELEVATION •	DEPTH 20'	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY •	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g	
	20'		CLAY, silty, sl. Sandy, gray, moist			H ₂ O PID-NSR	
	21'	CH	water saturated	100%	5-B ₂₃ jars	H ₂ O PID-NSR	
	22'						
	23'		CLAY, sandy, gray				
	24'						
	25'						
	26'	N. S.	Not sampled...drilled	N. S.			
	27'						
	28'						
	29'						
	30'		Bottom of Boring @ 30.0'				
			Water Levels: (from ground surface) 3/16/93 @ 1500hrs ~ water @ ground surface 3/17/93 @ 0700hrs ~ 1.5'			Legend H ₂ O PID - Radioisotope detector NSR - No Significant Reading	

Location: LHAAP-01 Inert Burning Grounds		Identification: 01SB24	
Date(s): 03/16/93 - 03/16/93		X Coordinate: 3027348	
Consulting Firm: Ebasco		Y Coordinate: 388742	
Logged By:		Elevation: 257.00'	
Contractor:		Datum: MSL	
Drilling Method: Hollow Stem Auger		Total Depth: 20.00'	
Remarks:		Borehole Dia.: 8.00"	
		Static Water Level:	
		018840	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						CL	SANDY CLAY - tan, very moist (top 0.75' clayey sand, wet) decreased moisture				
						CH	CLAY - mottled tan and red, slightly moist, slightly sandy, some gravel inclusions, plastic				
-250						CL	SANDY CLAY - mottled red and tan some black discoloration				
10						SC	CLAYEY SAND - red w/ gray mottling, very moist, slightly clayey wet (11.0') wet (13.8')				
-240						CL	SANDY CLAY - tan				
20											
-230											

18841

Hole No. **LH01-5824**

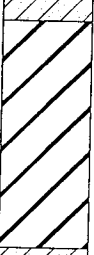
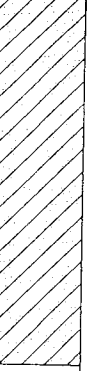
DRILLING LOG		DIVISION	INSTALLATION	SHEET 1 OF 2 SHEETS
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 6 1/4" o.d. hollow stem auger		
2. LOCATION (Coordinates or Station) LH01-5824		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		
3. DRILLING AGENCY A.W. Pool		12. MANUFACTURER'S DESIGNATION OF DRILL Ardeco A.T.V.		
4. HOLE NO. (As shown on drawing title and file number) LH01-5824		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN NONE		UNDISTURBED 7
5. NAME OF DRILLER D. Perez		14. TOTAL NUMBER CORE BOXES		
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER		
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 03/16/93 COMPLETED 03/16/93		
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE		
9. TOTAL DEPTH OF HOLE 20.0'		18. TOTAL CORE RECOVERY FOR BORING 89%		
		19. SIGNATURE OF INSPECTOR J.K. Collum		

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SC	SAND, clayey, tan, wet			Samples obtained via 2 3/16" stainless steel split spoons
1	1	CL	CLAY, sandy, tan, v. moist	100%	5-Box Jars	OVA FID-NSR 0.0 pocket pen
2	2		decreased moisture			OVA FID-4 ppm 1.5 pocket pen
3	3		CLAY, s. sandy, mottled tan and red, sl. moist, and occ. gray inclusions	100%		OVA FID-1 ppm 2.5 pocket pen
4	4	CL-CH			5-Box Jars	OVA FID-NSR 2.25 pocket pen
5	5			100%		OVA FID-NSR 3.0 pocket pen
6	6		CLAY, sandy, red and tan mottled		5-Box Jars	OVA FID-NSR 3.0 pocket pen
7	7		with occasional black discoloration.	100%		OVA FID-NSR 1.5 pocket pen
8	8	CL				OVA FID-NSR 1.75 pocket pen
9	9			100%		1.25 pocket pen
10	10		red silt, sand @ 9.6'			OVA FID-NSR 1.25 pocket pen
11	11	SC	SAND, sl. clayey, tan, mottled gray, very moist			OVA FID-NSR
12	12	SC	water saturated @ 11.4'	75%		OVA FID-NSR
13	13	SC	Lost Core		12-Box Jars OVA FID-NSR	OVA FID-NSR
14	14	SC		100%		OVA FID-NSR
15	15		water saturated @ 13.8'			OVA FID-NSR
16	16		CLAY, sandy, tan			
17	17		u. s. Not sampled but drilled	N.S.		
18	18					
19	19					
20	20		Bottom of Boring @ 20.0'			

Continued On Back

018843

Location: LHAAP-01 Inert Burning Grounds				Identification: 01SB25			
Date(s): 03/16/93 - 03/16/93				X Coordinate: 3027389			
Consulting Firm: Ebasco				Y Coordinate: 388725			
Logged By:				Elevation: 255.00'			
Contractor:				Datum: MSL			
Drilling Method: Hollow Stem Auger				Total Depth: 20.00'			
Remarks:				Borehole Dia.: 8.00"			
				Static Water Level:			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-250						SC CH	Clayey Sand FILL - wet, some charcoal and glass fragments SANDY CLAY - tan, moist mottled red and tan				
						SC CL	CLAYEY SAND - gray and tannish red, moist SANDY CLAY - reddish tan and gray				
10						SC	with gray silty clay (9.2' - 9.6') SAND - reddish tan w/ gray mottling, slightly clayey				
-240											
20											
-230											

Hole No. **LH01-SB25**

DRILLING LOG		DIVISION	INSTALLATION
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 6 1/4" hollow stem auger	
2. LOCATION (Coordinate or Station) LH01		11. DAYUM FOR ELEVATION SHOWN (TBM or MSL)	
DRILLING AGENCY A.W. Pool		12. MANUFACTURER'S DESIGNATION OF DRILL Arco A.T.V.	
HOLE NO. (As shown on drawing title and file number) LH01-SB25		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED: NONE UNDISTURBED: 7	
3. NAME OF DRILLER D. Perez		14. TOTAL NUMBER CORE BOXES	
4. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED: 03/16/93 COMPLETED: 03/16/93	
8. DEPTH DRILLED INTO ROCK NA		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE 20.0'		18. TOTAL CORE RECOVERY FOR BORING 100%	
		19. SIGNATURE OF INSPECTOR J.K. Callum	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	(SC Fill)	SAND, clayey, w/ charcoal & conc. glass fragments, wet			Samples obtained via 2 1/2" split spoon
1	1		CLAY, sandy, tan, moist	100%	5-B02 Jars	OVA FID - 2 ppm
2	2		red and tan mottled			1.5 pocket pen
3	3			100%		OVA FID - NSR
4	4	CL-CH			5-B02 Jars	2.25 pocket pen
5	5			100%		OVA FID - NSR
6	6				5-B02 Jars	2.5 pocket pen
7	7			100%		OVA FID - NSR
8	8	SC	SAND, clayey, gray and tan-red moist			OVA FID - NSR
9	9	CL	CLAY, sandy, reddish-tan and gray with gray silty clay from 9.2-9.6'	100%		OVA FID - NSR
10	10		SAND, silty clayey, reddish-tan mottled gray			1.5 pocket pen
11	11		water saturated @ 11.0'	100%	5-B02 Jars	1.75 pocket pen
12	12	SC				OVA FID - NSR
13	13			100%		OVA FID - NSR
14	14					OVA FID - NSR
15	15					
16	16					
17	17	NS	Not sampled... drilled		NS	
18	18					
19	19					
20	20		Bottom of Boring @ 20.0'			

18844

18845

Location: LHAAP-XX Ground Signal Test Area						Identification: XXWW04					
Date(s): / / - 07/09/82						X Coordinate: 3040200			Y Coordinate: 376690		
Consulting Firm: EPS						Elevation: 185.58'			Datum: MSL		
Logged By:						Total Depth: 27.00'			Measuring Point: 188.45'		
Contractor:						Completed Depth: 25.00'			Static Water Level:		
Drilling Method: Hollow Stem Auger						Well Casing: type: SS dia: 2.00" fm: -2.9' to: 10.00'					
Remarks:						Screens: type: Slotted size: .010" dia: 2.00" fm: 10.00' to: 25.00'					
						Annular Fill: type: Bentonite fm: .00' to: 5.00'					
						type: #20-40 Silica Filter Sand fm: 5.00' to: 27.00'					
						type: fm: to: to:					
						type: fm: to: to:					
Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction MP. EL. 188.45
						SM	SILTY SAND - Light yellowish brown and yellowish brown				
-180						SC	CLAYEY SAND - Light brownish gray mottled with yellowish brown				
10						SM	SILTY SAND - Clayey, light brownish gray with less mottling of yellowish brown				
-170						SM	SILTY SAND - Light brownish gray to light brownish gray mottled with yellowish brown				
20						SC	CLAYEY SAND Seam - silty				
-160						SM	SILTY SAND - Light gray				

18846

Location: LHAAP-XX Ground Signal Test Area				Identification: XXWW05			
Date(s): / / - 07/09/82				X Coordinate: 3041759		Y Coordinate: 378004	
Consulting Firm: EPS				Elevation: 189.05'		Datum: MSL	
Logged By:				Total Depth: 32.50'		Measuring Point: 191.73'	
Contractor:				Completed Depth: 32.50'		Static Water Level:	
Drilling Method: Hollow Stem Auger				Well Casing:			
Conductor Casing:				type: SS			
type: size: dia: .00" fm: .00' to: .00'				dia: 2.00" fm: -2.7' to: 17.50'			
Remarks:				Screens:			
				type: Slotted size: .010" dia: 2.00" fm: 17.50' to: 32.50'			
				Annular Fill:			
				type: Cement Grout fm: .00' to: 6.00'			
				type: Bentonite fm: 6.00' to: 11.00'			
				type: #20-40 Silica Filter Sand fm: 11.00' to: 32.50'			
				type: fm: to:			
				type: fm: to:			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
						SM	SILTY SAND - Light olive gray mottled with dark yellowish brown				
						SM	SILTY SAND - Clayey, grayish brown with yellowish brown				
-180	10					SP	SAND - Light gray				
						CL	SILTY CLAYEY SAND - Light gray and brownish yellow				
-170	20					CL	SILTY SANDY CLAY				
						CL	SILTY SANDY CLAY - Black with seams of yellow				
-160											

18847

Location: LHAAP-XX Ground Signal Test Area					Identification: XXWW05				
Date(s): / / - 07/09/82					X Coordinate: 3041759		Y Coordinate: 378004		
Consulting Firm: EPS					Elevation: 189.05'		Datum: MSL		
Logged By:					Total Depth: 32.50'		Measuring Point: 191.73'		
Contractor:					Completed Depth: 32.50'		Static Water Level:		
Drilling Method: Hollow Stem Auger					Well Casing:				
Conductor Casing: type: size: dia: .00" fm: .00' to: .00'					type: SS dia: 2.00" fm: -2.7' to: 17.50'				
					Screens:				
					type: Slotted size: .010" dia: 2.00" fm: 17.50' to: 32.50'				
Remarks:					Annular Fill:				
					type: Cement Grout fm: .00' to: 6.00'				
					type: Bentonite fm: 6.00' to: 11.00'				
					type: #20-40 Silica Filter Sand fm: 11.00' to: 32.50'				
					type: fm: to:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
150	40										
140	50										
130											

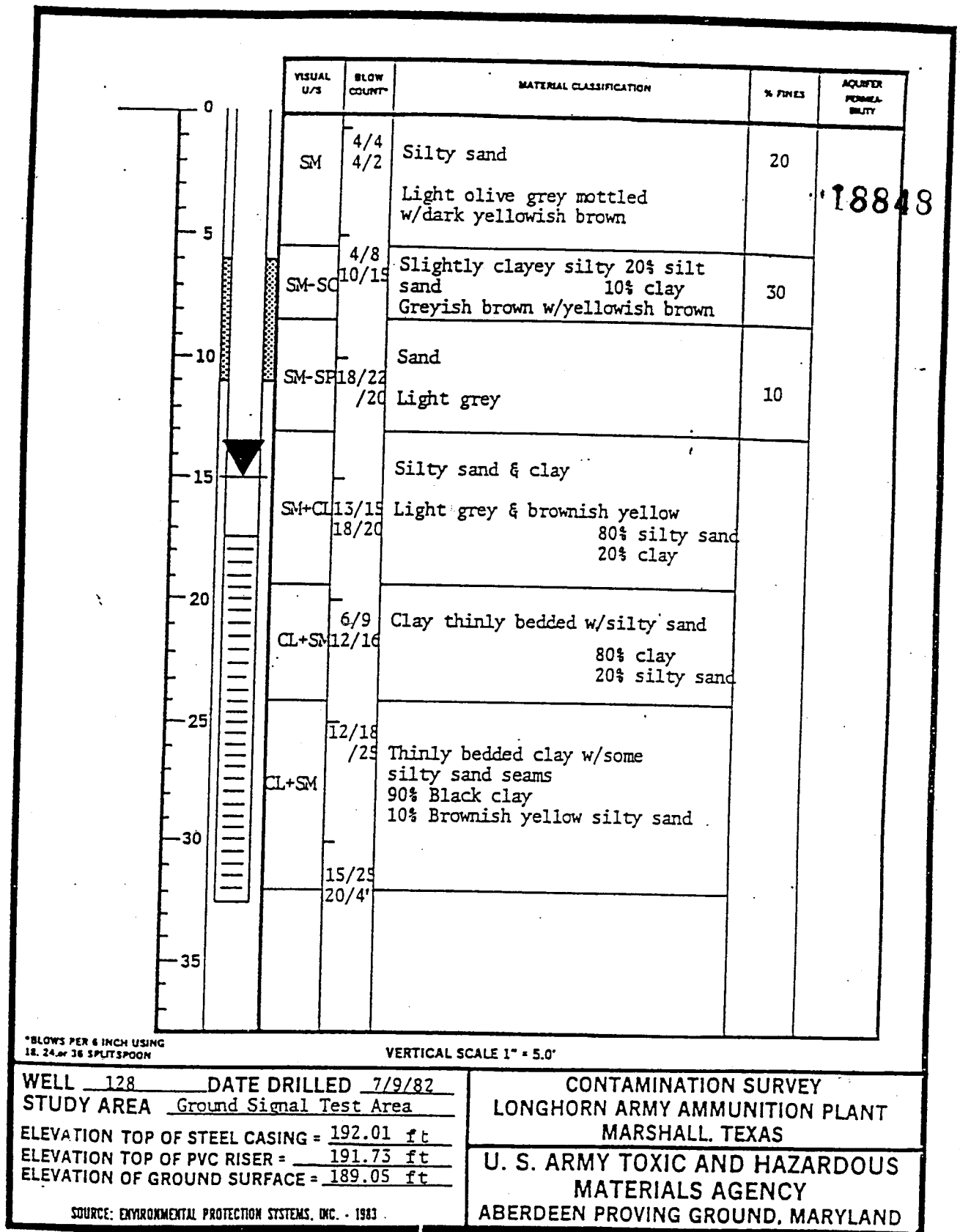


FIGURE 3-II-4
BORING LOG AND WELL
CONSTRUCTION DETAIL FOR
MONITORING WELL NO. 128

018849

Location: LHAAP-XX Ground Signal Test Area

Identification: XXSB15

Date(s): 03/09/93 - 03/09/93

X Coordinate: 3041044

Consulting Firm: Ebasco

Y Coordinate: 377101

Logged By:

Elevation: 202.00'

Contractor:

Datum: MSL

Drilling Method: Hollow Stem Auger

Total Depth: 10.00'

Remarks:

Borehole Dia.: 8.00"

Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
200						CL	SANDY CLAY - tan, wet (top 0.5' clayey sand)				
						CH	CLAY - gray w/ tan mottling, wet, slightly sandy, plastic				
						CL	SANDY CLAY - gray w/ some tan mottling, moist				
						SC	CLAYEY SAND - gray w/ some tan mottling				
						SM	increased sand content SILTY SAND - gray w/ tan mottling, wet, fine grained, slightly clayey wet				
10											
190											
20											
180											

18850

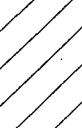
DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LHXY-SB15</u>	
1. PROJECT <u>LHAAP</u>		10. SIZE AND TYPE OF BIT <u>6 3/4" hollow stem auger</u>		SHEET <u>7</u>		OF / SHEETS	
2. LOCATION (Coordinates or Station) <u>LHXX</u>		11. DAYUM FOR ELEVATION SHOWN (TBM or MSL)					
3. DRILLING AGENCY <u>A.W. Pool</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>Ardeo A.T.V.</u>					
4. HOLE NO. (As shown on drawing title and file number) <u>LHXX-SB15</u>		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED <u>None</u>		UNDISTURBED <u>5</u>	
5. NAME OF DRILLER <u>D. Perez</u>		14. TOTAL NUMBER CORE BOXES					
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER <u>~1.0' b.g.s.</u>					
7. THICKNESS OF OVERBURDEN <u>NA</u>		16. DATE HOLE STARTED <u>03/09/93</u> COMPLETED <u>03/09/93</u>					
8. DEPTH DRILLED INTO ROCK <u>NA</u>		17. ELEVATION TOP OF HOLE					
9. TOTAL DEPTH OF HOLE <u>10.0'</u>		18. TOTAL CORE RECOVERY FOR BORING <u>87%</u>					
		19. SIGNATURE OF INSPECTOR <u>J.K. Collum</u>					

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
0	0	SC	SAND, clayey, tan, wet			
1	1	CL	CLAY, sandy, tan, water saturated	100%	5-Box Jars	Samples obtained via 2 3/4" stainless steel split spoon HnU PID-NSR 0.0 pocket pen HnU PID-NSR 0.0 pocket pen
2	2					
3	3	CH	CLAY, silty, sandy, gray and tan mottled, very wet	80%		HnU PID-NSR 1.25 pocket pen HnU PID-NSR 1.25 pocket pen
4	4	CH	Last core			
5	5	CL	CLAY, sandy, gray w/ occ. tan mottling, moist	100%		HnU PID-NSR + 5" pocket pen
6	6	SC	SAND, clayey, gray w/ occ. tan mottling, increased sand content		5-Box Jars	HnU PID-NSR + 5" pocket pen
7	7	SM-SC	SAND, silty fine, silty clayey, gray mottled tan, water saturated	75%		HnU PID-NSR
8	8	CL	Last Core water saturated			HnU PID-NSR
9	9	SM-SC		100%		HnU PID-NSR
10	10		Bottom of Boring @ 10.0'			HnU PID-NSR
11	11					
12	12		Water Levels: (from ground surface) 3/9/93 @ 1130 hrs ~1.0'			
13	13					
14	14					
15	15					
16	16					
17	17					
18	18					
19	19					
20	20					

Legend
HnU PID - Arduization detector
NSR - No Significant Response

018851

Location: LHAAP-XX Ground Signal Test Area	Identification: XXSB16
Date(s): 03/09/93 - 03/09/93	X Coordinate: 3040928
Consulting Firm: Ebasco	Y Coordinate: 376153
Logged By:	Elevation: 208.00'
Contractor:	Datum: MSL
Drilling Method: Hollow Stem Auger	Total Depth: 22.00'
Remarks:	Borehole Dia.: 8.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
			1			CL	SANDY CLAY - tan, wet (top 0.3' dk brown clayey sand) gray w/ tan mottling, wet				
						CH	CLAY - gray w/ tan mottling, moist, slightly sandy, plastic				
						CL	SANDY CLAY - gray w/tan mottling, moist decreased moisture, increased sand content				
-200	10					SC	CLAYEY SAND - gray w/ tan clay layering LIGNITE - dry, friable				
						CL	CLAY - dark gray to black, lignitic, no visible sand non-friable				
-190							SHALE - slightly sandy w/ lignitic banding LIGNITE - dry, friable				
	20					CH	SILTY CLAY - dark gray, free water on sampler slightly sandy, plastic				
-180											

18852

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LHXX-5816</u>	
1. PROJECT <u>LHAA</u>		10. SIZE AND TYPE OF BIT <u>6 1/4" o.d. hollow stem auger</u>		SHEET OF 2 SHEETS			
2. LOCATION (Coordinates or Station) <u>LHXX</u>		11. DATUM FOR ELEVATION SHOWN (BSN - MSL)					
3. DRILLING AGENCY <u>A.W. Pool</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>Arco A.T.V.</u>					
4. HOLE NO. (As shown on drawing title and file number) <u>LHXX-5816</u>		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN <u>NONE</u>		DISTURBED <u>11</u>		UNDISTURBED	
5. NAME OF DRILLER <u>D. Perez</u>		14. TOTAL NUMBER CORE BOXES					
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER					
7. THICKNESS OF OVERBURDEN <u>NA</u>		16. DATE HOLE <u>03/09/93</u>		STARTED <u>03/09/93</u>		COMPLETED <u>03/09/93</u>	
8. DEPTH DRILLED INTO ROCK <u>NA</u>		17. ELEVATION TOP OF HOLE					
9. TOTAL DEPTH OF HOLE <u>27.0'</u>		18. TOTAL CORE RECOVERY FOR BORING <u>86%</u>					
		19. SIGNATURE OF INSPECTOR <u>J.K. Collum</u>					

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SC	SAND, clayey, dk. brown, wet			
		CL	CLAY, sandy, tan, wet			
1		L	Lost Core	30%		Samples obtained via 2 3/16" i.d. stainless steel samplers HNU PID-NSR 0.0 pocket pen
2			gray and tan mottled water saturated with Fe-Ox nodular inclusions to 2.5'		5-802 Jars	0.5 pocket pen HNU PID-NSR
3		CL		100%		HNU PID-NSR 0.25 pocket pen
4			CLAY, silty, sandy, gray and tan mottled, moist			2.0 pocket pen HNU PID-NSR
5		CH		100%		2.25 pocket pen HNU PID-NSR
6			CLAY, sandy, gray and tan mottled, moist		5-803 Jars	HNU PID-NSR 2.5 pocket pen
7				100%		HNU PID-NSR 2.0 pocket pen
8						HNU PID-NSR 3.0 pocket pen
9		CL		100%		HNU PID-NSR 3.0 pocket pen
10			increasing sand content, silty moist			HNU PID-NSR 2.75 pocket pen
11				100%		HNU PID-NSR 2.5 pocket pen
12					12-802 Jars For QA and MSD dupes	HNU PID-NSR 2.75 pocket pen
13		CL-SC	CLAY, sandy / SAND, clayey, tan clay with gray silty sand layers ~1/8" clay 2-3", silty moist	100%		HNU PID-NSR 4.5 pocket pen
14		LIG.	LIGNITE, dry, friable			HNU PID-NSR friable
15			CLAY, lignitic, no visible sand, friable, dark gray-black	100%		HNU PID-NSR 4.5+, friable, pocket pen
16		CL	non friable			material resistant to sampling of just sampler advance at depth
17			SHALE, silty sandy with lignite banding, friable	100%	5-802 Jars	HNU PID-NSR 4.5 pocket pen
18		SHALE				HNU PID-NSR friable
19		L	Lignite. Lost Core due to sampler shoe packing	15%		
20			CLAY, silty, dark gray, free water on sampler			

Continued on Back

18853

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LHXY-SB16</u>	
1. PROJECT				10. SIZE AND TYPE OF BIT		SHEET <u>2</u> OF 2 SHEETS	
2. LOCATION (Coordinates or Station)				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY				12. MANUFACTURER'S DESIGNATION OF DRILL			
4. HOLE NO. (As shown on drawing title and file number)		<u>LHXY-SB16</u>		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		DISTURBED UNDISTURBED	
5. NAME OF DRILLER				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE				15. ELEVATION GROUND WATER			
☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				16. DATE HOLE		STARTED COMPLETED	
7. THICKNESS OF OVERBURDEN				17. ELEVATION TOP OF HOLE			
8. DEPTH DRILLED INTO ROCK				18. TOTAL CORE RECOVERY FOR BORING		%	
9. TOTAL DEPTH OF HOLE				19. SIGNATURE OF INSPECTOR			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	20'		CLAY, silty, dark gray, free water on sample				
	21'	CH	sl. sandy	100%		4.5' pocket am	
	22'		Bottom of Boring @ 22.0'			4.5' pocket pm	
			Water Levels: (from ground surface) 3/9/93 @ 1400 hrs. ~ 1.0'			<u>Legend</u> HnU PID - Photoionization detector MSR - No Significant Reading	

018854

Location: LHAAP-XX Ground Signal Test Area

Identification: XXSB17

Date(s): 03/09/93 - 03/09/93

X Coordinate: 3041568

Consulting Firm: Ebasco

Y Coordinate: 377380

Logged By:

Elevation: 193.00'

Contractor:

Datum: MSL

Drilling Method: Hollow Stem Auger

Total Depth: 10.00'

Remarks:

Borehole Dia.: 8.00"

Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-190						SC	CLAYEY SAND - tan, wet, contains 6" of fine silty sand water saturated, increased clay content				
						CL	SANDY CLAY - gray w/ tan mottling, wet				
						CH	CLAY - gray w/ tan mottling, wet, slightly sandy, plastic				
						CL	SANDY CLAY - gray w/ tan mottling				
10						SC	CLAYEY SAND - gray w/ tan mottling				
-180											
20											
-170											

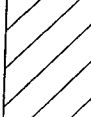
DRILLING LOG		DIVISION	INSTALLATION	11010 NO. LHXX-SB17
1. PROJECT LHAAP		10. SIZE AND TYPE OF BIT 6 1/4" hollow stem auger		
2. LOCATION (Coordinates or Station) LHXX		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		
3. DRILLING AGENCY A.W. Pool		12. MANUFACTURER'S DESIGNATION OF DRILL Ardeco A.T.V.		
HOLE NO. (As shown on drawing title and file number) LHXX-SB17		13. TOTAL NO. OF OVER- BURDEN SAMPLES TAKEN		
5. NAME OF DRILLER D. Perez		14. TOTAL NUMBER CORE BOXES		
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER		
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED 03/09/93 COMPLETED 03/09/93		
8. DEPTH DRILLED INTO ROCK NONE		17. ELEVATION TOP OF HOLE		
9. TOTAL DEPTH OF HOLE 10.0'		18. TOTAL CORE RECOVERY FOR BORING 91%		
		19. SIGNATURE OF INSPECTOR J.K. Collum		

18855

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0					
	1	SC	SAND, clayey, tan, water saturated, with 6" tan silty fine sand @ 0.8'	100%	5-802 Jars	Samples obtained via 2 3/16" Stanley steel split spoon samplers HNU PID-NSR 0.0 pocket pen HNU PID-NSR
	2		increased clay content, water saturated			
	3	CL	CLAY, sandy, gray and tan mottled, water saturated	100%		HNU PID-NSR 0.0 pocket pen
	4					HNU PID-NSR 0.25 pocket pen
	5	CH	CLAY, silty sandy, gray mottled tan, wet	80%		HNU PID-NSR 2.5 pocket pen
	6	CH	Last Core		5-802 Jars	HNU PID-NSR 2.5 pocket pen
	7	CH		100%		3.75 pocket pen HNU PID-NSR
	8	CL	CLAY, sandy, gray and tan mottled			4.0 pocket pen HNU PID-NSR
	9	SC	SAND, clayey, gray and tan mottled	75%		HNU PID-NSR 3.75 pocket pen
	10	CH	Last Core			
	11		Bottom of Boring @ 10.0'			
	12		Water Levels (from ground surface) 3/9/93 @ 1500 hrs ~ 1.0' Note: subsequent to sampling boring inundated and submerged by surface water			Legend HNU PID - Protonization detector NSR - No Significant Reading

18856

Location: LHAAP-XX Ground Signal Test Area		Identification: XXSB18	
Date(s): 03/10/93 - 03/10/93		X Coordinate: 3040317	
Consulting Firm: Ebasco		Y Coordinate: 377070	
Logged By:		Elevation: 203.00'	
Contractor:		Datum: MSL	
Drilling Method: Hand Auger		Total Depth: 5.00'	
Remarks:		Borehole Dia.: 2.75"	
		Static Water Level:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-200						CL	SANDY CLAY - tan w/ gray mottling, wet, (top 0.5' clayey sand) decreased sand content				
						CH	SILTY CLAY - tan w/ gray mottling, plastic				
10											
-190											
20											
-180											

DRILLING LOG		DIVISION		INSTALLATION		Hole No. LHXX-SB18	
1. PROJECT LHAAP		2. LOCATION (Coordinate or Station) LHXX		10. SIZE AND TYPE OF BIT 2 3/4" stainless steel hand auger		SHEET 1 OF 1 SHEETS	
3. DRILLING AGENCY EBASCO Personnel		HOLE NO. (As shown on drawing title and file number) LHXX-SB18		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL		12. MANUFACTURER'S DESIGNATION OF DRILL forestry Supply stainless steel hand auger	
5. NAME OF DRILLER		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN 5		14. TOTAL NUMBER CORE BOXES		15. ELEVATION GROUND WATER	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		16. DATE HOLE STARTED 03/10/93 COMPLETED 03/10/93		17. ELEVATION TOP OF HOLE		18. TOTAL CORE RECOVERY FOR BORING 100%	
7. THICKNESS OF OVERBURDEN		19. SIGNATURE OF INSPECTOR J.K. Collum		19. SIGNATURE OF INSPECTOR			
8. DEPTH DRILLED INTO ROCK NA		9. TOTAL DEPTH OF HOLE 5.0'					
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0	SC	SAND, clayey, tan, water saturated	100%	5-8a2	HNU PID-NSR	
	1		CLAY, sandy, tan mottled gray, water saturated	100%			
	2	CL	increased sand content	100%		HNU PID-NSR	
	3		decreased sand content	100%			
	4	CH	CLAY, silty, tan and gray mottled	100%		2.5 pocket pen HNU AD-NSR	
	5		Bottom of Boring @ 5.0'			Note: boring advanced with aid of stainless steel hand operated bucket	
Water Levels: (from ground surface) 3/10/93 @ 1500 hrs ~ 0.5'							
Legend HNU PID - Photoionization detector NSR - No Significant Response							

18857

19858

Location: LHAAP-XX Ground Signal Test Area					Identification: XXSB19				
Date(s): 03/09/93 - 03/09/93					X Coordinate: 3040236				
Consulting Firm: Ebasco					Y Coordinate: 376885				
Logged By:					Elevation: 190.00'				
Contractor:					Datum: MSL				
Drilling Method: Hand Auger					Total Depth: 5.00'				
Remarks:					Borehole Dia.: 2.75"				
					Static Water Level:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
190						CL	SANDY CLAY - red w/gray mottling, very moist (top 0.3' clayey sand, wet) increased sand content				
180	10										
170	20										
160											

18859

DRILLING LOG

PROJECT: LHAAP

LOCATION: LHX

DRILLING AGENCY: EBASCO PERSONELL

HOLE NO. (As shown on drawing title and file number): LHX-SB7 (interior area)

NAME OF DRILLER: J.K. Callum

DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.

THICKNESS OF OVERBURDEN: _____

DEPTH DRILLED INTO ROCK: NA

TOTAL DEPTH OF HOLE: 5.0'

INSTALLATION: _____

SIZE AND TYPE OF BIT: 2 3/4" o.d. hollow stem auger

DATUM FOR ELEVATION SHOWN (TBM or MSL): _____

MANUFACTURER'S DESIGNATION OF DRILL: stainless steel hand auger

TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: 6

TOTAL NUMBER CORE BOXES: NONE

ELEVATION GROUND WATER: _____

DATE HOLE STARTED: 03/09/93 COMPLETED: 03/09/93

ELEVATION TOP OF HOLE: _____

TOTAL CORE RECOVERY FOR BORING: 100%

SIGNATURE OF INSPECTOR: _____

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0	SC	SAND, clayey, red, wet	100%		
	1		CLAY, sandy, red, very moist red and gray mottled	100%	5-Box Jars	Samples obtained via 2 3/4" o.d. stainless steel split spoons. HnU PID - 2.0 ppm / no detectable odor
	2		increased sand content	100%		HnU PID - NSR
	3	CL		100%		HnU PID - NSR
	4			100%	5-Box Jars	HnU PID - NSR
	5		Bottom of Boring @ 5.0'	100%		
			Water Levels: (from ground surface) no water encountered			

Legend
HnU PID - Photobionitration detector
NSR - No significant reading

19860

Location: LHAAP-XX Ground Signal Test Area	Identification: XXSB20
Date(s): 03/10/93 - 03/10/93	X Coordinate: 3040744
Consulting Firm: Ebasco	Y Coordinate: 377799
Logged By:	Elevation: 200.00'
Contractor:	Datum: MSL
Drilling Method: Hand Auger	Total Depth: 5.00'
Remarks:	Borehole Dia.: 2.75"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
200						CL	SANDY CLAY - gray w/ tan mottling (top 0.3' clayey sand, wet)				
						SC	CLAYEY SAND - gray w/ tan mottling				
						CH	CLAY - gray w/ tan mottling, slightly sandy, plastic				
190	10										
180	20										
170											

Hole No. **LHXX-SB20**

13861

DRILLING LOG		DIVISION		INSTALLATION		SHEET / SHEETS	
1. PROJECT LHAAP				10. SIZE AND TYPE OF BIT 2 1/4" o.d. hand auger			
2. LOCATION (Coordinate or Station) LHXX				11. DATUM FOR ELEVATION SHOWN (FSM or MSL)			
3. DRILLING AGENCY Hand Augered by UXB INC.				12. MANUFACTURER'S DESIGNATION OF DRILL Forestry supply hand auger - stainless			
4. HOLE NO. (As shown on drawing title and file number) LHXX-SB20				13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN 5		DISTURBED UNDISTURBED none	
5. NAME OF DRILLER UXB				14. TOTAL NUMBER CORE BOXES			
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER			
7. THICKNESS OF OVERBURDEN NA				16. DATE HOLE 03/10/93		STARTED COMPLETED 03/10/93	
8. DEPTH DRILLED INTO ROCK NA				17. ELEVATION TOP OF HOLE			
9. TOTAL DEPTH OF HOLE 5.0'				18. TOTAL CORE RECOVERY FOR BORING 100%		3	
				19. SIGNATURE OF INSPECTOR J.K. Collum			
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
0		SC	SAND, clayey, tan, water saturated	100%			
1		CL	CLAY, sandy, gray and tan mottled	100%	5-8oz Jars	H ₂ O PID-NSR	
2		SC	SAND, clayey, gray and tan mottled	100%			
3			CLAY, s. sandy, gray and tan mottled	100%			
4		CH		100%	5-8oz Jars	2.25 pocket pen H ₂ O PID-NSR	
5			Bottom of Boring @ 5.0'	100%			
			Water Levels: (below ground surface) 3/10/93 @ 1300 ~ 1.5'				
<u>Legend</u> H₂O PID - Photoionization plate for NSR - No Significant Reading							

13862

Location: LHAAP-XX Ground Signal Test Area		Identification: XXSB21	
Date(s): 03/10/93 - 03/10/93		X Coordinate: 3041633	
Consulting Firm: Ebasco		Y Coordinate: 377697	
Logged By:		Elevation: 190.00'	
Contractor:		Datum: MSL	
Drilling Method: Hand Auger		Total Depth: 5.00'	
Remarks:		Borehole Dia.: 3.50"	
		Static Water Level:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
190	0					SC	CLAYEY SAND - gray and tan, wet increased sand content				
180	10										
170	20										
160											

18863

DRILLING LOG		DIVISION		INSTALLATION		Hole No. LHXX-SB21	
1. PROJECT		2. LOCATION (Coordinates or Station)		10. SIZE AND TYPE OF BIT		SHEET / OF SHEETS	
LHAAP		LHXX		3 1/2" o.d. hand auger			
3. DRILLING AGENCY		4. HOLE NO. (As shown on drawing title and file number)		12. MANUFACTURER'S DESIGNATION OF DRILL		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
UXB, Inc.		LHXX-SB21		Forestry Supply stainless steel hand auger			
5. NAME OF DRILLER		6. DIRECTION OF HOLE		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		14. TOTAL NUMBER CORE BOXES	
UXB		☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		5		NONE	
7. THICKNESS OF OVERBURDEN		8. DEPTH DRILLED INTO ROCK		16. DATE HOLE		15. ELEVATION GROUND WATER	
		NA		STARTED 03/10/93 COMPLETED 03/10/93			
9. TOTAL DEPTH OF HOLE		17. ELEVATION TOP OF HOLE		18. TOTAL CORE RECOVERY FOR BORING		19. SIGNATURE OF INSPECTOR	
5.0'				100%		J.K. Collum	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
0	0		SAND, clayey, gray and tan. Water saturated throughout boring	100%		HnU PID-NSR 0.0 pocket pen	
1				100%	10-Box Jars GC Dupe		
2		SC	increased sand content with numerous FeO ₂ nodular inclusions	100%		HnU PID-NSR 0.0 pocket pen	
3				100%	12-Box Jars GA and MSD dupe	HnU PID-NSR 0.0 pocket pen	
4				100%			
5			Bottom of Boring @ 5.0'				
			Water Levels (below ground surface) 3/10/93 @ 1230 water @ ground surface boring later inundated and submerged under surface water	Legend: HnU PID-Photoluminescence detector NSR- No Significant response			

18864

Location: LHAAP-27 South Test Area		Identification: 27WW06	
Date(s): / / - 06/09/82		X Coordinate: 3036598	Y Coordinate: 373910
Consulting Firm: EPS		Elevation: 185.51'	Datum: MSL
Logged By:		Total Depth: 26.00'	Measuring Point: 188.01'
Contractor:		Completed Depth: 24.00'	Static Water Level:
Drilling Method: Hollow Stem Auger		Well Casing: type: SS dia: 2.00" fm: -2.5' to: 9.00'	
Remarks:		Screens: type: Slotted size: .010" dia: 2.00" fm: 9.00' to: 24.00'	
		Annular Fill: type: Bentonite fm: .00' to: 3.00'	
		type: #20-40 Silica Filter Sand fm: 3.00' to: 26.00'	
		type: fm: to:	
		type: fm: to:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
						SP SM	SAND - Red, slightly silty, coarse grained SILTY SAND - Light brown, fine grained				
-180						SM SM	SILTY SAND - Brown with iron stain SILTY SAND - Olive with some iron stain mottling				
10											
-170							SILTY SAND - Olive mottled with strong brown				
20											
-160						SM CL	SILTY SAND - with clay seams SILTY SANDY CLAY				

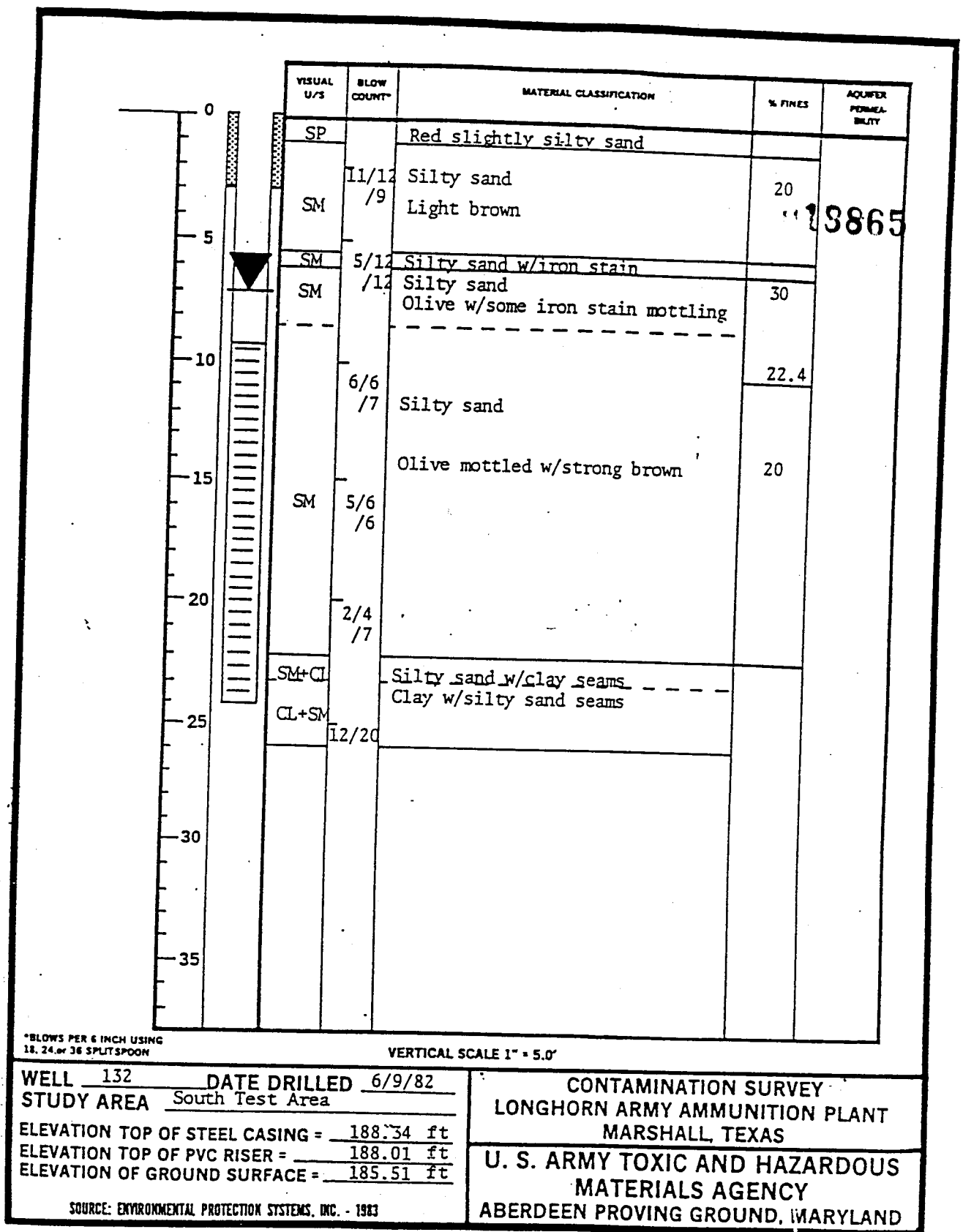
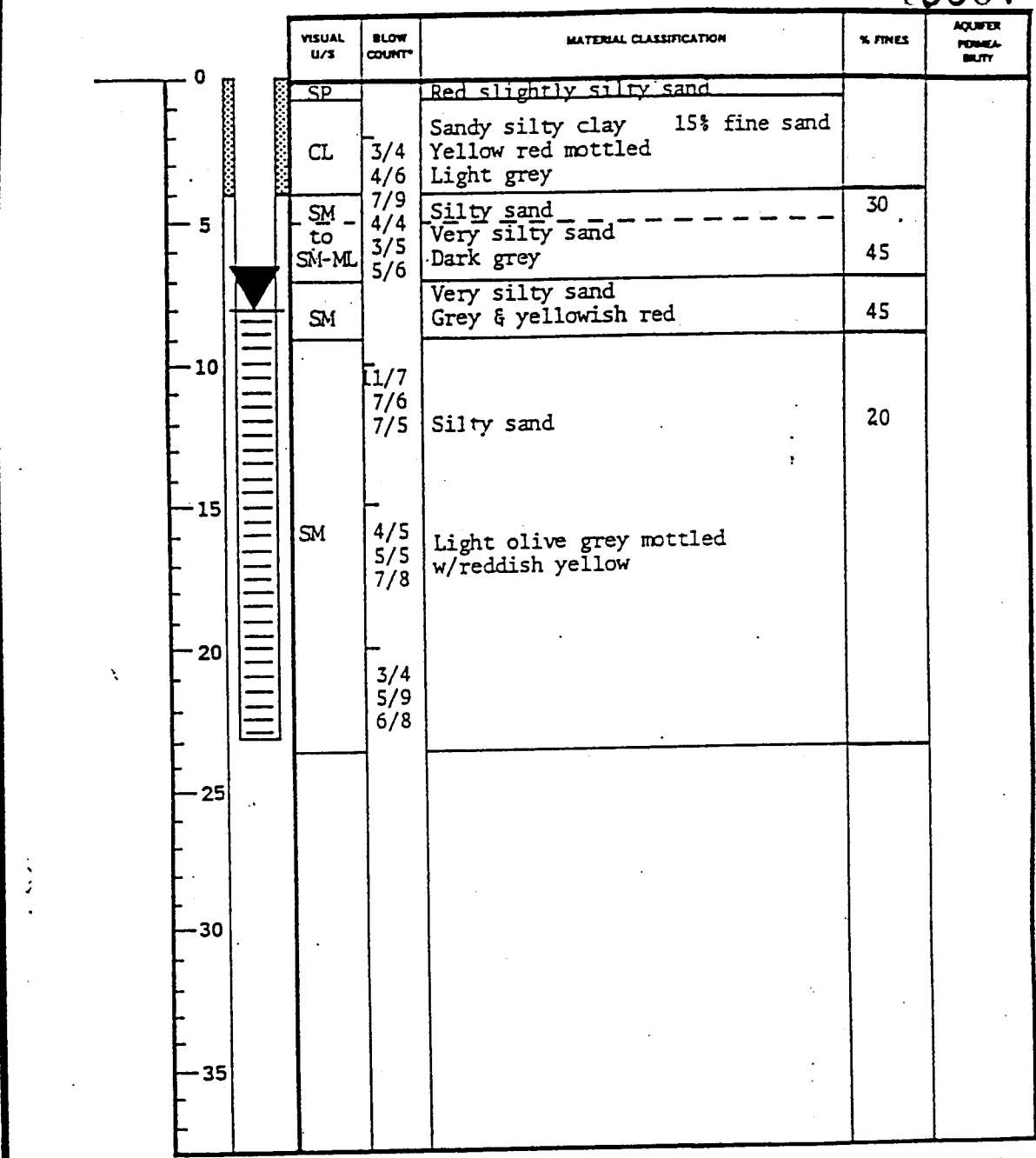


FIGURE 3-12-4
BORING LOG AND WELL
CONSTRUCTION DETAIL FOR
MONITORING WELL NO. 132

Location: LHAAP-27 South Test Area		Identification: 27WW07		18866	
Date(s): / / - 06/08/82		X Coordinate: 3036641		Y Coordinate: 374095	
Consulting Firm: EPS		Elevation: 186.31'		Datum: MSL	
Logged By:		Total Depth: 23.50'		Measuring Point: 188.87'	
Contractor:		Completed Depth: 23.00'		Static Water Level:	
Drilling Method: Hollow Stem Auger		Well Casing: type: SS dia: 2.00" fm: -2.6' to: 8.00'			
Remarks:		Screens: type: Slotted size: .010" dia: 2.00" fm: 8.00' to: 23.00'			
		Annular Fill: type: Bentonite fm: .00' to: 4.00'			
		type: #20-40 Silica Filter Sand fm: 4.00' to: 23.50'			
		type: fm: to:			
		type: fm: to:			

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Well Construction
						SP	SAND - Red, slightly silty, coarser grained				
						CL	SANDY SILTY CLAY - Yellow red mottled, light gray				
						SM	SILTY SAND - Dark gray				
						SM	SILTY SAND - Gray and yellowish red				
						SM	SILTY SAND - Light olive gray mottled with reddish yellow				
-180											
	10										
-170											
	20										
-160											

18867



*BLOWS PER 6 INCH USING 14, 24, or 36 SPLIT SPOON

VERTICAL SCALE 1" = 5.0'

WELL 131 DATE DRILLED 6/8/82
 STUDY AREA South Test Area
 ELEVATION TOP OF STEEL CASING = 189.16 ft
 ELEVATION TOP OF PVC RISER = 188.87 ft
 ELEVATION OF GROUND SURFACE = 186.31 ft

SOURCE: ENVIRONMENTAL PROTECTION SYSTEMS, INC. - 1983

CONTAMINATION SURVEY
 LONGHORN ARMY AMMUNITION PLANT
 MARSHALL, TEXAS
 U. S. ARMY TOXIC AND HAZARDOUS
 MATERIALS AGENCY
 ABERDEEN PROVING GROUND, MARYLAND

FIGURE 3-12-3
 BORING LOG AND WELL
 CONSTRUCTION DETAIL FOR
 MONITORING WELL NO. 131

018868

Location: LHAAP-27 South Test Area					Identification: 27SB30				
Date(s): 03/20/93 - 03/20/93					X Coordinate: 3036485				
Consulting Firm: Ebasco					Y Coordinate: 373520				
Logged By:					Elevation: 184.00'				
Contractor:					Datum: MSL				
Drilling Method: Hand Auger					Total Depth: 7.00'				
Remarks:					Borehole Dia.: 3.00"				
					Static Water Level:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
180						CH	SILTY CLAY - gray, wet, plastic (lower 0.5' less plastic)				
						CH	SANDY-CLAY - gray, wet, less sandy after 1.5' plastic				
						CL	gray w/ tan mottling				
						CL	SANDY CLAY - mottled tan and gray, wet				
						SM	increased sand content				
						SM	CLAYEY SAND - gray w/ tan mottling				
10											
170											
20											
160											

13869

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH27-56</u>	
1. PROJECT		2. LOCATION (Coordinates or Station)		10. SIZE AND TYPE OF BIT		SHEET / SHEET:	
<u>LHAAP</u>		<u>LH27</u>		<u>3" o.d. hand auger bit</u>			
3. DRILLING AGENCY		4. HOLE NO. (As shown on drawing title and file number)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		12. MANUFACTURER'S DESIGNATION OF DRILL	
<u>Hand Augered by EBASCO</u>		<u>LH27-5B30</u>				<u>stainless steel hand auger</u>	
5. NAME OF DRILLER		6. DIRECTION OF HOLE		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		14. TOTAL NUMBER CORE BOXES	
<u>EBASCO Personnel</u>		☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		<u>7</u>		<u>NONE</u>	
7. THICKNESS OF OVERBURDEN		8. DEPTH DRILLED INTO ROCK		15. ELEVATION GROUND WATER		16. DATE HOLE	
<u>NA</u>		<u>7.0'</u>				<u>STARTED 03/20/93 COMPLETED 03/20/93</u>	
9. TOTAL DEPTH OF HOLE		17. ELEVATION TOP OF HOLE		18. TOTAL CORE RECOVERY FOR BORING		19. SIGNATURE OF INSPECTOR	
<u>7.0'</u>				<u>100%</u>		<u>J.K. Collum</u>	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0	CH	CLAY, silty, water saturated, gray	100%		OVA FID - NSR	
	1	CL	CLAY, sandy, gray, wet		5-802 J875	OVA FID - 5-10 ppm (methane fluctuations)	
	2		CLAY, silty, st. sandy, gray	100%			
	3		gray mottled tan	100%		OVA FID - NSR	
	4	CL-CH		100%		OVA FID - NSR	
	5		CLAY, sandy, gray and tan mottled, wet	100%		OVA FID - NSR	
	6	CL	increased sand content	100%	5-803 J875	OVA FID - NSR	
	7	SM	SAND, clayey, gray mottled tan	100%		OVA FID - NSR	
			Bottom of Boring @ 7.0'				
			Water Levels (from ground surface) 3/20/93 @ 1100 ~ 2.0'				
						Legend OVA FID - Flamm. ionization detector NSR - No Significant Reading	

018870

Location: LHAAP-27 South Test Area					Identification: 27SB31				
Date(s): 03/18/93 - 03/18/93					X Coordinate: 3036497				
Consulting Firm: Ebasco					Y Coordinate: 373897				
Logged By:					Elevation: 188.00'				
Contractor:					Datum: MSL				
Drilling Method: Hand Auger					Total Depth: 8.00'				
Remarks:					Borehole Dia.: 3.00"				
					Static Water Level:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						SM	Sand FILL - brown to dark tan, slightly clayey wet				
						CL	SANDY CLAY - mottled tan and gray, moist				
						SC	SAND - mottled gray and tan, moist, slightly clayey				
-180	10										
-170	20										
-160											

018871

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH27-SB31</u>	
1. PROJECT <u>LHAAP</u>		10. SIZE AND TYPE OF BIT <u>3" o.d. stainless steel hand auger</u>		SHEET <u>1</u> OF <u>1</u> SHEETS			
2. LOCATION (Coordinates or Station) <u>LH 27</u>		11. DATUM FOR ELEVATION SHOWN (BSM or MSL)					
3. DRILLING AGENCY <u>EBASCO</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>Forrestry Supply stainless steel hand auger</u>					
HOLE NO. (As shown on drawing title and file number) <u>LH27-SB31</u>		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN <u>8</u>		DISTURBED <u>1</u> UNDISTURBED <u>NONE</u>			
5. NAME OF DRILLER <u>EBASCO Personnel</u>		14. TOTAL NUMBER CORE BOXES					
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER					
7. THICKNESS OF OVERBURDEN <u>—</u>		16. DATE HOLE STARTED <u>03/18/93</u> COMPLETED <u>03/18/93</u>					
8. DEPTH DRILLED INTO ROCK <u>NA</u>		17. ELEVATION TOP OF HOLE					
9. TOTAL DEPTH OF HOLE <u>8.0'</u>		18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>					
		19. SIGNATURE OF INSPECTOR <u>J.H. Collum</u>					
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0		SAND, sil. sl. clayey, brown-dk tan	100%	5-Bol jars	OVA FID - NSR	
	1		wet	100%		OVA FID - NSR	
	2		water saturated	100%		OVA FID - NSR	
	3	SM (probable fill)		100%		OVA FID - NSR	
	4			100%		OVA FID - NSR	
	5			100%		OVA FID - NSR	
	6	CL	CLAY, sandy, gray and tan mottled, moist	100%		OVA FID - NSR	
	7	SC	SAND, sl. clayey, gray and tan, moist	100%	12-Bol jars (5-GA) (2-MSD)	OVA FID - NSR	
	8			100%		OVA FID - NSR	
			Bottom of Boring @ 8.0'				
			Water Levels: (from ground surface) 3/18/93 @ 1830 ~ 4.5'				
<u>Legend</u> OVA FID - Flame ionization detector NSR - No Significant Reading							

18872

Location: LHAAP-27 South Test Area		Identification: 27SB32	
Date(s): 03/18/93 - 03/18/93		X Coordinate: 3036435	
Consulting Firm: Ebasco		Y Coordinate: 373999	
Logged By:		Elevation: 184.00'	
Contractor:		Datum: MSL	
Drilling Method: Hand Auger		Total Depth: 7.00'	
Remarks:		Borehole Dia.: 3.00"	
		Static Water Level:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-180						SC	CLAYEY SAND - dark tan, wet				
						CL	SANDY CLAY, dark tan w/ gray mottling, wet				
						CL	SANDY CLAY, gray with tan mottling, wet				
							increased clay content after 3.5'				
						SC	CLAYEY SAND - mottled tan and gray, wet				
							increased sand content				
-170											
-20											
-160											

18873

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH27-5832</u>	
1. PROJECT <u>LHAAP</u>		10. SIZE AND TYPE OF BIT <u>3" o.d. stainless auger bucket</u>		SHEET OF / SHEETS			
2. LOCATION (Coordinate or Station) <u>LH27</u>		11. DATUM FOR ELEVATION SHOWN (TBM or BSL)					
3. DRILLING AGENCY <u>FBASCO</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>stainless steel hand auger</u>					
HOLE NO. (As shown on drawing title and file number) <u>LH27-5832</u>		13. TOTAL NO. OF OVER- BURDEN SAMPLES TAKEN		DISTURBED <u>7</u>		UNDISTURBED <u>none</u>	
5. NAME OF DRILLER <u>FBASCO Personnel</u>		14. TOTAL NUMBER CORE BOXES					
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER					
7. THICKNESS OF OVERBURDEN <u>NA</u>		16. DATE HOLE		STARTED <u>03/18/02</u>		COMPLETED <u>03/18/02</u>	
8. DEPTH DRILLED INTO ROCK <u>NA</u>		17. ELEVATION TOP OF HOLE					
9. TOTAL DEPTH OF HOLE <u>7.0'</u>		18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>					
		19. SIGNATURE OF INSPECTOR <u>J.M. Collum</u>					

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOV- ERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	0					
	1	SC	SAND, clayey, dk. tan, water saturated	100%	5-Box Jars	OVA FID-NSR groundwater entering boring
	2	SC-CL	SAND, clayey, CLAY, sandy, dk. tan mottled gray, wet	100%		OVA FID-NSR
	3		CLAY, sandy, wet, gray mottled tan	100%		OVA FID-NSR
	4	CL	sl. increased clay content water saturated	100%		OVA FID-NSR
	5			100%		OVA FID-NSR
	6	SC-CL	SAND, clayey, CLAY, sandy, gray and tan mottled, water saturated increased sand content	100%	5-Box Jars	OVA FID-NSR
	7			100%		OVA FID-NSR
			Bottom of Boring @ 7.0'			
			Water Levels: (from ground surface) 3/18/93 @ 1830 ~ 0.5'			

Legend
OVA FID - Flame ionization detector
NSR - No Significant Reading

18874

Location: LHAAP-27 South Test Area					Identification: 27SB33				
Date(s): 03/19/93 - 03/19/93					X Coordinate: 3036300				
Consulting Firm: Ebasco					Y Coordinate: 374019				
Logged By:					Elevation: 188.00'				
Contractor:					Datum: MSL				
Drilling Method: Hand Auger					Total Depth: 7.00'				
Remarks:					Borehole Dia.: 3.00"				
					Static Water Level:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-180	10					SC	CLAYEY SAND - dark tan, very moist, decreased clay content after 0.5'				
						SM					
						SC	CLAYEY SAND - tan w/gray mottling, wet				
						CL	SANDY CLAY - tan and gray, very moist				
-170	20										
-160											

18875

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH27-SB33</u>	
1. PROJECT <u>LHAAP</u>		10. SIZE AND TYPE OF BIT <u>3" o.d. hand auger bucket</u>		SHEET OF <u>1</u> SHEETS			
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)					
3. DRILLING AGENCY <u>EBASCO</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>Shrink's steel hand auger</u>					
HOLE NO. (As shown on drawing title and file number) <u>LH27-SB33</u>		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN <u>7</u>		DISTURBED ☐ UNDISTURBED ☒		none	
5. NAME OF DRILLER <u>EBASCO Personnel</u>		14. TOTAL NUMBER CORE BOXES					
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER					
7. THICKNESS OF OVERBURDEN		16. DATE HOLE STARTED <u>03/19/93</u> COMPLETED <u>03/19/93</u>					
8. DEPTH DRILLED INTO ROCK <u>NA</u>		17. ELEVATION TOP OF HOLE					
9. TOTAL DEPTH OF HOLE <u>7.0'</u>		18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>					
		19. SIGNATURE OF INSPECTOR <u>J.K. Collum</u>					

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	1	SC	SAND, clayey, dk. tan, v. moist decreased clay content	100%	5-Box Jars	OVA FID - NSR
	2		SAND, sil. sl. clayey, moist, dk. tan dark tan and gray	100%		OVA FID - NSR
	3	SM	wet @ 2.8'	100%		OVA FID - NSR
	4			100%		OVA FID - NSR
	5	SC	SAND, clayey, tan mottled gray, wet water saturated	100%		OVA FID - NSR
	6			100%	5-Box Jars	OVA FID - NSR
	7	CL	CLAY, sandy, tan and gray, v. moist	100%		OVA FID - NSR
Bottom of Boring @ 7.0'						
Water Levels (from ground surface) 3/19/93 @ 1030 ~ 2.8'						

Legend
OVA FID - Flame ionization detector
NSR - No Significant Reading

18876

Location: LHAAP-27 South Test Area		Identification: 27SB34	
Date(s): 03/19/93 - 03/19/93		X Coordinate: 3036714	
Consulting Firm: Ebasco		Y Coordinate: 374100	
Logged By:		Elevation: 185.00'	
Contractor:		Datum: MSL	
Drilling Method: Hand Auger		Total Depth: 7.00'	
Remarks:		Borehole Dia.: 3.00"	
		Static Water Level:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						SC	CLAYEY SAND - tan, very moist				
						CL	SANDY CLAY - tan and gray, moist				
						SM	SILTY SAND - gray and tan, wet, fine grained, slightly clayey				
-180											
10											
-170											
20											
-160											

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH27-SB34</u>	
1. PROJECT <u>LHAAP</u>		10. SIZE AND TYPE OF BIT <u>3" od. hand auger bucket</u>		SHEET <u>1</u>		OF <u>1</u> SHEETS	
2. LOCATION (Coordinate or Station) <u>LH27</u>		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)					
3. DRILLING AGENCY <u>EBASCO</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>stainless steel hand auger</u>					
HOLE NO. (As shown on drawing title and file number) <u>LH27-SB34</u>		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN <u>7</u>		DISTURBED <u>none</u>		UNDISTURBED <u>none</u>	
5. NAME OF DRILLER <u>EBASCO Personnel</u>		14. TOTAL NUMBER CORE BOXES					
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEC. FROM VERT.		15. ELEVATION GROUND WATER					
7. THICKNESS OF OVERBURDEN <u>—</u>		16. DATE HOLE <u>03/19/93</u>		STARTED <u>03/19/93</u>		COMPLETED <u>03/19/93</u>	
8. DEPTH DRILLED INTO ROCK <u>NA</u>		17. ELEVATION TOP OF HOLE					
9. TOTAL DEPTH OF HOLE <u>7.0'</u>		18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>		2			
		19. SIGNATURE OF INSPECTOR <u>J. K. Collum</u>					
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0						
	1	SC	SAND, silty clayey, tan, v. moist	100%		OVA FID-NSR	
	2			100%	10-8oz Jars (GC Dups)	OVA FID-NSR	
	3		CLAY, sandy, moist, tan and gray	100%		OVA FID-NSR	
	4	CL		100%		OVA FID-NSR	
	5			100%		OVA FID-NSR	
	6			100%		OVA FID-NSR	
	6	SM	SAND, silty fine, silty clayey, wet, gray and tan	100%	5-8oz Jars	OVA FID-NSR	
	7			100%		OVA FID-NSR	
			Bottom of Boring @ 7.0'				
			Water Levels: From ground surface 3/19/93 @ 1400 ~ 3.5'				
<u>Legend</u> OVA FID-NSR NSR - No Significant Response							

18877

18878

Location: LHAAP-27 South Test Area		Identification: 27SB35	
Date(s): 03/19/93 - 03/19/93		X Coordinate: 3036556	
Consulting Firm: Ebasco		Y Coordinate: 374163	
Logged By:		Elevation: 182.00'	
Contractor:		Datum: MSL	
Drilling Method: Hand Auger		Total Depth: 7.00'	
Remarks:		Borehole Dia.: 3.00"	
		Static Water Level:	

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-180						SC	CLAYEY SAND - gray w/ tan mottling, wet				
						CL	SANDY CLAY - gray and tan, wet				
						CH	CLAY - tan w/ gray mottling, very moist, plastic				
						SC	increased sand content				
						SM	CLAYEY SAND - gray w/ tan mottling				
							SAND - mottled tan and gray, wet, slightly clayey				
10											
-170											
20											
-160											

18879

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH27-5B35</u>	
1. PROJECT <u>LHAAP</u>		10. SIZE AND TYPE OF BIT <u>3" o.d. hand auger bucket</u>		SHEET OF <u>1</u> SHEETS			
2. LOCATION (Coordinate or Station) <u>LH27</u>		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)					
3. DRILLING AGENCY <u>EBASCO</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>stainless steel hand auger</u>					
4. HOLE NO. (As shown on drawing title and file number) <u>LH27-5B35</u>		13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN <u>7</u>		DISTURBED <u>none</u>		UNDISTURBED	
5. NAME OF DRILLER <u>EBASCO Personnel</u>		14. TOTAL NUMBER CORE BOXES					
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		15. ELEVATION GROUND WATER					
7. THICKNESS OF OVERBURDEN		16. DATE HOLE		STARTED <u>03/19/93</u>		COMPLETED <u>03/19/93</u>	
8. DEPTH DRILLED INTO ROCK <u>NA</u>		17. ELEVATION TOP OF HOLE					
9. TOTAL DEPTH OF HOLE <u>7.0'</u>		18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>					
		19. SIGNATURE OF INSPECTOR <u>J. K. Collum</u>					
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0						
	1	SC	SAND, clayey, water saturated, gray mottled tan	100%	5-Bge Jars	water standing in boring ~2" b.g.s. OVA FID-NSR	
	2	LL	CLAY, sandy, water saturated, gray and tan	100%		OVA FID-NSR	
	3	LL-LH	CLAY, st. sandy, v. moist, tan mottled gray	100%		OVA FID-NSR	
	4		increased sand content	100%		OVA FID-NSR	
	5	SC-LL	SAND, clayey / CLAY, sandy, gray mottled tan	100%		OVA FID-NSR	
	6	SM	SAND, st. clayey, water saturated, tan and gray mottled	100%	5-Bge Jars	OVA FID-NSR	
	7			100%		OVA FID-NSR	
			Bottom of Boring @ 7.0'				
			Water Levels (from ground surface) 3/19/93 @ 1600 hrs. ~ 0.1'				
<u>Legend</u> OVA FID - Flame ionization detector NSR - No Significant Response							

Location: LHAAP-27 South Test Area

Date(s): 03/19/93 - 03/19/93

Consulting Firm: Ebasco

Logged By:

Contractor:

Drilling Method: Hand Auger

Remarks:

Identification: 27SB36

X Coordinate: 3036600

Y Coordinate: 373762

Elevation: 183.00'

Datum: MSL

Total Depth: 7.00'

Borehole Dia.: 3.00"

Static Water Level:

18880

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-180						CL	SANDY CLAY - gray w/ tan mottling, wet, plastic (top 0.5' silty clay)				
						SM	increased sand content SAND - gray, wet, slightly clayey				
						CL	SANDY CLAY - gray w/ tan mottling, moist				
10											
-170											
20											
-160											

13881

DRILLING LOG		DIVISION	INSTALLATION		Hole No. <u>LH27-5836</u>
1. PROJECT <u>LHAAP</u>			10. SIZE AND TYPE OF BIT <u>3" od. hand auger bucket</u>		
2. LOCATION (Coordinates or Station)			11. DATUM FOR ELEVATION SHOWN (TBM or BSL)		
3. DRILLING AGENCY <u>EBASCO</u>			12. MANUFACTURER'S DESIGNATION OF DRILL <u>stainless steel hand auger</u>		
4. HOLE NO. (As shown on drawing title and file number) <u>LH27-5836</u>			13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN DISTURBED <u>7</u> UNDISTURBED <u>NONE</u>		
5. NAME OF DRILLER <u>EBASCO Personell</u>			14. TOTAL NUMBER CORE BOXES		
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.			15. ELEVATION GROUND WATER		
7. THICKNESS OF OVERBURDEN			16. DATE HOLE STARTED <u>03/19/93</u> COMPLETED <u>03/19/93</u>		
8. DEPTH DRILLED INTO ROCK <u>NA</u>			17. ELEVATION TOP OF HOLE		
9. TOTAL DEPTH OF HOLE <u>7.0'</u>			18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>		
			19. SIGNATURE OF INSPECTOR <u>J.K. Collam</u>		

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	0	CH	CLAY, silty, gray, water saturated			
	1		CLAY, sandy, gray mottled tan, wet sl. sandy		5-8oz. Jars	OVA FID - NSR
	2	CL-CH	increased sand content			OVA FID - NSR
	3		with sand and numerous Fe-Ox nodules inclusions to 4.0'	100%		OVA FID - NSR
	4	SM	SAND, sl. clayey, gray, wet			OVA FID - NSR
	5		CLAY, sandy, gray mottled tan, moist			OVA FID - NSR
	6	CL			12-8oz. Jars D&MJD dupc	OVA FID - NSR
	7		Bottom of Boring @ 7.0'			OVA FID - NSR
			Water Levels: (from ground surface) 03/20/93 @ 0900 ~ 0.5'			

Legend
OVA FID - Flame ionization detector
NSR - No Significant Response

013882

Location: LHAAP-27 South Test Area					Identification: 27SB37				
Date(s): 03/20/93 - 03/20/93					X Coordinate: 3036751				
Consulting Firm: Ebasco					Y Coordinate: 373616				
Logged By:					Elevation: 183.00'				
Contractor:					Datum: MSL				
Drilling Method: Hand Auger					Total Depth: 7.00'				
Remarks:					Borehole Dia.: 3.00"				
					Static Water Level:				

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
-180						CL	SANDY CLAY - mottled gray and tan, wet (top 0.4' silty clay, wet)				
						CL	mottled tan and gray, increased sand content				
						CL	SANDY CLAY - gray and tan mottled, moist				
						SC	SAND - mottled gray and tan, wet, slightly clayey				
						CL	SANDY CLAY - mottled gray and tan, wet				
10											
-170											
20											
-160											

18883

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH29-8</u>	
1. PROJECT <u>LHAAP</u>		10. SIZE AND TYPE OF BIT <u>3" 100' hand auger</u>		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)		SHEET <u>1</u> OF <u>1</u> SHEET	
2. LOCATION (Coordinates or Station)		12. MANUFACTURER'S DESIGNATION OF DRILL <u>stainless steel hand auger</u>		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN <u>7</u>		UNDISTURBED <u>NONE</u>	
3. DRILLING AGENCY <u>EBASCO</u>		14. TOTAL NUMBER CORE BOXES		15. ELEVATION GROUND WATER			
4. HOLE NO. (As shown on drawing title and file number) <u>LH27-SB37</u>		16. DATE HOLE <u>STARTED 03/20/93</u>		COMPLETED <u>03/20/93</u>			
5. NAME OF DRILLER <u>EBASCO Personnel</u>		17. ELEVATION TOP OF HOLE		18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>		19. SIGNATURE OF INSPECTOR <u>J. K. Collins</u>	
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		7. THICKNESS OF OVERBURDEN _____		8. DEPTH DRILLED INTO ROCK <u>N/A</u>		9. TOTAL DEPTH OF HOLE <u>7.0'</u>	
ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)	
	0	CH	CLAY, silty, sl. sandy, gray, wet			water entering boring from 6" to 8"	
	1		CLAY, sandy w. silt, gray and tan, wet dark tan w/ loc. Fe2O3 nodular incl. to 2.0'		5-8-93	OVA FID-NSR	
	2	CL-CH				OVA FID-NSR	
	3		tan. increased sand content gray and tan mottled	100%		OVA FID-NSR	
	4	CL	CLAY, sandy, gray and tan mottled, moist			OVA FID-Sppm	
	5	SM-SC	SAND, sl. clayey, gray and tan mottled, wet			OVA FID-NSR	
	6	CL	CLAY, sandy, gray and tan mottled, wet		5-8-93 JORS	OVA FID-NSR	
	7		Bottom of Boring @ 7.0'				
	8		Water Levels: (From ground surface) 3/20/93 @ 1330 ~ 1.4'				

Legend
OVA FID - Flame ionization detect
NSR - No Significant Reading

018884

Location: LHAAP-27 South Test Area	Identification: 27SB38
Date(s): 03/20/93 - 03/20/93	X Coordinate: 3036688
Consulting Firm: Ebasco	Y Coordinate: 373752
Logged By:	Elevation: 184.00'
Contractor:	Datum: MSL
Drilling Method: Hand Auger	Total Depth: 6.80'
Remarks:	Borehole Dia.: 3.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
180						SC	CLAYEY SAND, mottled tan and gray, wet tan w/ many iron nodular inclusions				
170						CL	SANDY CLAY - light brown and tan, wet (top 0.8' clayey sand, wet) tan, mottled w/ iron nodular inclusions to 3.6' increased sand content				
20											
160											

018885

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH29-SB3</u>	
1. PROJECT <u>LHAAP</u>		2. LOCATION (Coordinates or Station) <u>LH27</u>		10. SIZE AND TYPE OF BIT <u>3" o.d. hand auger bucket</u>		SHEET <u>7</u> OF <u>7</u> SHEETS	
3. DRILLING AGENCY <u>EBASCO</u>		4. HOLE NO. (As shown on drawing title and file number) <u>LH27-SB38</u>		11. DATUM FOR ELEVATION SHOWN (TBM or MSL) <u>0</u>		12. MANUFACTURER'S DESIGNATION OF DRILL <u>stainless steel hand auger</u>	
5. NAME OF DRILLER <u>EBASCO Personnel</u>		6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN <u>7</u>		14. TOTAL NUMBER CORE BOXES <u>NONE</u>	
7. THICKNESS OF OVERBURDEN <u>—</u>		8. DEPTH DRILLED INTO ROCK <u>NA</u>		15. ELEVATION GROUND WATER		16. DATE HOLE STARTED <u>03/20/93</u> COMPLETED <u>03/20/93</u>	
9. TOTAL DEPTH OF HOLE <u>6.8'</u>		17. ELEVATION TOP OF HOLE		18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>		19. SIGNATURE OF INSPECTOR <u>J.K. Collum</u>	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
	1	SC	SAND, silty clay, 11. brown and tan, wet		5-8oz JAGS	OVA FID-NSR
	2		CLAY, sandy, 11. brown and tan, wet			OVA FID-NSR
	3	CL	tan, mottled w/ FeO ₂ nodular inclusions to 3.6'	100%		OVA FID-NSR
	4		increased sand content			OVA FID-NSR
	5		SAND, clayey / CLAY, sandy, tan and gray mottled, wet			OVA FID-NSR
	6	CL-SC	tan, w/ numerous FeO ₂ nodular incl.		5-8oz JAGS	OVA FID-NSR
	7		Bottom of Boring @ 6.8' upon auger refusal			material resistant to sampling
			Water Levels: (from ground surface) 3/20/93 @ 1430 ~ 0.1'			

Legend
OVA FID-Flame ionization detector
NSR- No Significant Response

018886

Location: LHAAP-27 South Test Area	Identification: 27SB39
Date(s): 03/20/93 - 03/20/93	X Coordinate: 3036605
Consulting Firm: Ebasco	Y Coordinate: 374014
Logged By:	Elevation: 188.00'
Contractor:	Datum: MSL
Drilling Method: Hand Auger	Total Depth: 7.00'
Remarks:	Borehole Dia.: 3.00"
	Static Water Level:

Elevation (ft)	Depth (ft)	Sample Interval	Sample No.	Water Level	Graphic Log	USCS Code	Material Description	Moisture Content (%)	Plasticity Index (%)	Percent Sand (% > 0.075mm)	Notes
						SM	Sand FILL - black, water saturated (to 0.3') tan, very moist, slightly clayey				
						CL	SILTY CLAY - gray w/ tan mottling, moist, slightly sandy				
						CH	SAND - gray w/ tan mottling, slightly clayey				
						SM					
						CL					
						CL	SANDY CLAY TO CLAYEY SAND - tan, water saturated				
						CH	SILTY CLAY - gray, moist, slightly sandy				
-180	10										
-170	20										
-160											

18887

DRILLING LOG		DIVISION		INSTALLATION		Hole No. <u>LH27-SB39</u>	
1. PROJECT <u>LHAAP</u>				10. SIZE AND TYPE OF BIT <u>3" o.d. hand auger bucket</u>			
2. LOCATION (Coordinates or Station)				11. DATUM FOR ELEVATION SHOWN (TBM or MSL)			
3. DRILLING AGENCY <u>EBASCO</u>				12. MANUFACTURER'S DESIGNATION OF DRILL <u>stainless steel hand auger</u>			
4. HOLE NO. (As shown on drawing title and file number) <u>LH27-SB39</u>				13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	
5. NAME OF DRILLER <u>EBASCO Personnel</u>				14. TOTAL NUMBER CORE BOXES		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.				15. ELEVATION GROUND WATER		15. ELEVATION GROUND WATER	
7. THICKNESS OF OVERBURDEN				16. DATE HOLE <u>03/20/93</u>		16. DATE HOLE <u>03/20/93</u>	
8. DEPTH DRILLED INTO ROCK <u>NA</u>				17. ELEVATION TOP OF HOLE		17. ELEVATION TOP OF HOLE	
9. TOTAL DEPTH OF HOLE <u>7.0'</u>				18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>		18. TOTAL CORE RECOVERY FOR BORING <u>100%</u>	
				19. SIGNATURE OF INSPECTOR <u>J.K. Collum</u>		19. SIGNATURE OF INSPECTOR <u>J.K. Collum</u>	

ELEVATION	DEPTH	LEGEND	CLASSIFICATION OF MATERIALS (Description)	% CORE RECOVERY	BOX OR SAMPLE NO.	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant)
	1	(F:1) SM-SC (F:1) CL	Black, water saturated SAND, silty clayey, tan, v. moist, w/loc. wet		10-8oz jars	OVA FID-NSR
	2	CL	CLAY, sandy, gray mottled tan		SC-Dupe	OVA FID-NSR
	3	CH	CLAY, silty, sl. sandy, gray mottled tan			OVA FID-NSR
	4	SM-SC	SAND, si. f. sl. clayey, gray mottled tan	100%		OVA FID-NSR
	5	CL-SC	CLAY, sandy, SAND, clayey, tan, water saturated			OVA FID-NSR
	6	CH	CLAY, silty, sl. sandy, gray, moist		5-8oz jars	OVA FID-NSR
	7		Bottom of Boring @ 7.0'			
			Water Levels (from ground surface) 3/20/93 @ 16.15 ~ 3.5'			

Legend
OVA FID - Flame ionization detector
NSR - No Significant Reading

18888

APPENDIX B

SOIL PHYSICAL TEST RESULTS

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS				
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW01-2003	PROJECT ANALYST
JOB NUMBER	9312G038	ETL SAMPLE NUMBER	003	QA/QC ANALYST
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED
				12/30/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	100.0
#50	0.300	99.8
#100	0.150	66.1
#200	0.075	34.3
HYDROMETER	0.0456	30.3
	0.0327	27.9
	0.0234	25.5
	0.0167	24.3
	0.0124	20.7
	0.0088	20.7
	0.0063	18.3
	0.0045	15.9
	0.0032	13.5
	0.0023	12.3
	0.0013	9.9
	0.0009	8.9

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.136
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
22.2

SAMPLE DESCRIPTION
light brown clayey SAND with 34% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
36.8	20.5	16.3

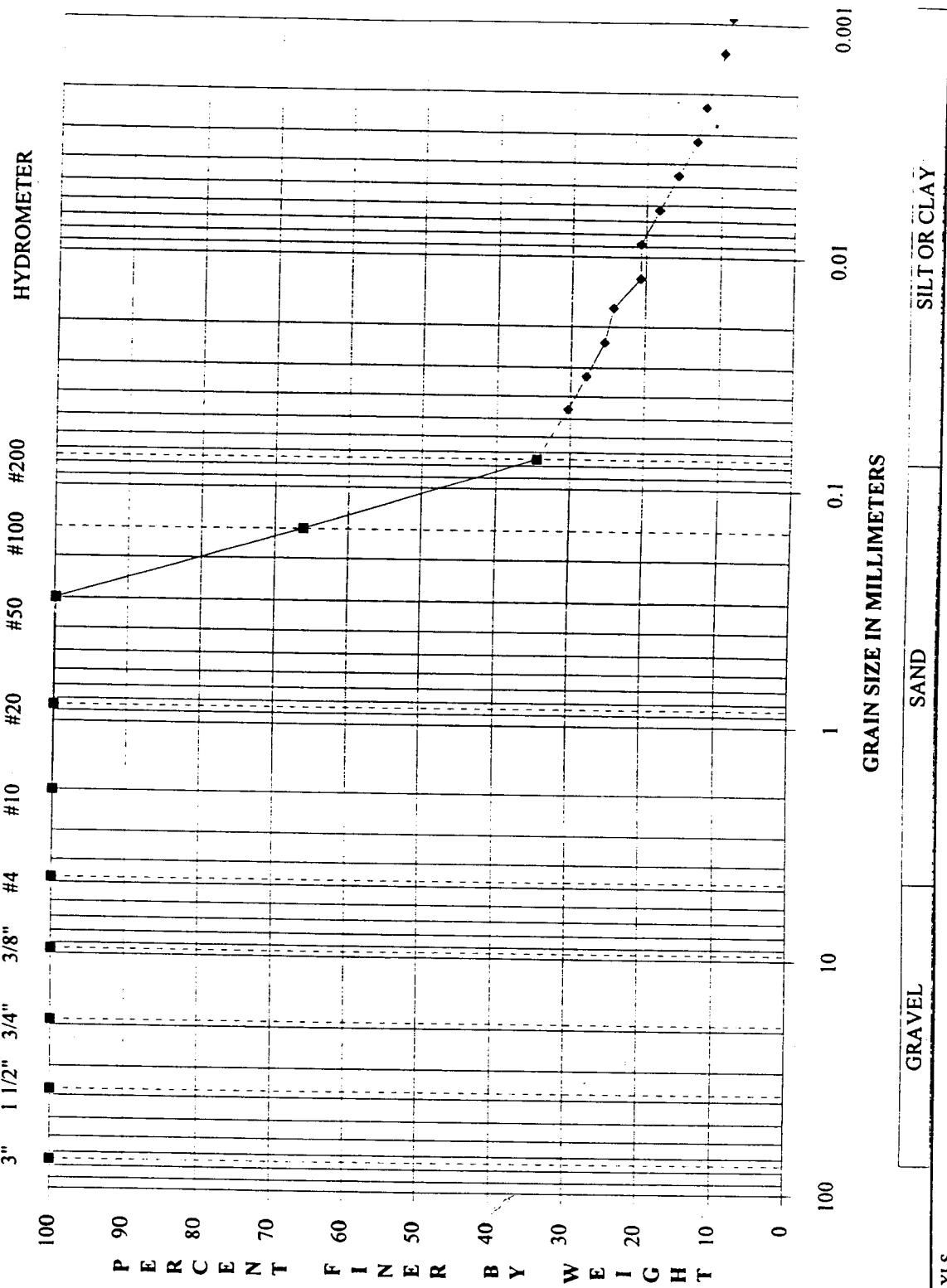
NOTES

NA=NOT APPLICABLE

018889

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW01-2003, ETL SAMPLE 9312G038-003
U.S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW01-2005	PROJECT ANALYST	WB
JOB NUMBER	9312G038	ETL SAMPLE NUMBER	006	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/30/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.3
#20	0.850	97.5
#50	0.300	95.7
#100	0.150	81.8
#200	0.075	65.9
HYDROMETER	0.0381	57.6
	0.0272	56.4
	0.0205	47.6
	0.0150	42.7
	0.0112	38.9
	0.0082	33.9
	0.0059	30.2
	0.0043	26.4
	0.0031	21.5
	0.0023	16.5
	0.0013	11.7
	0.0010	9.0

EFFECTIVE SIZES	
% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
28.7

SAMPLE DESCRIPTION
light gray CLAY of low plasticity with 34% sand
Unified Soil Classification System (USCS) Group Symbol
CL

INDEX PROPERTIES % moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
40.0	19.1	20.9

NOTES

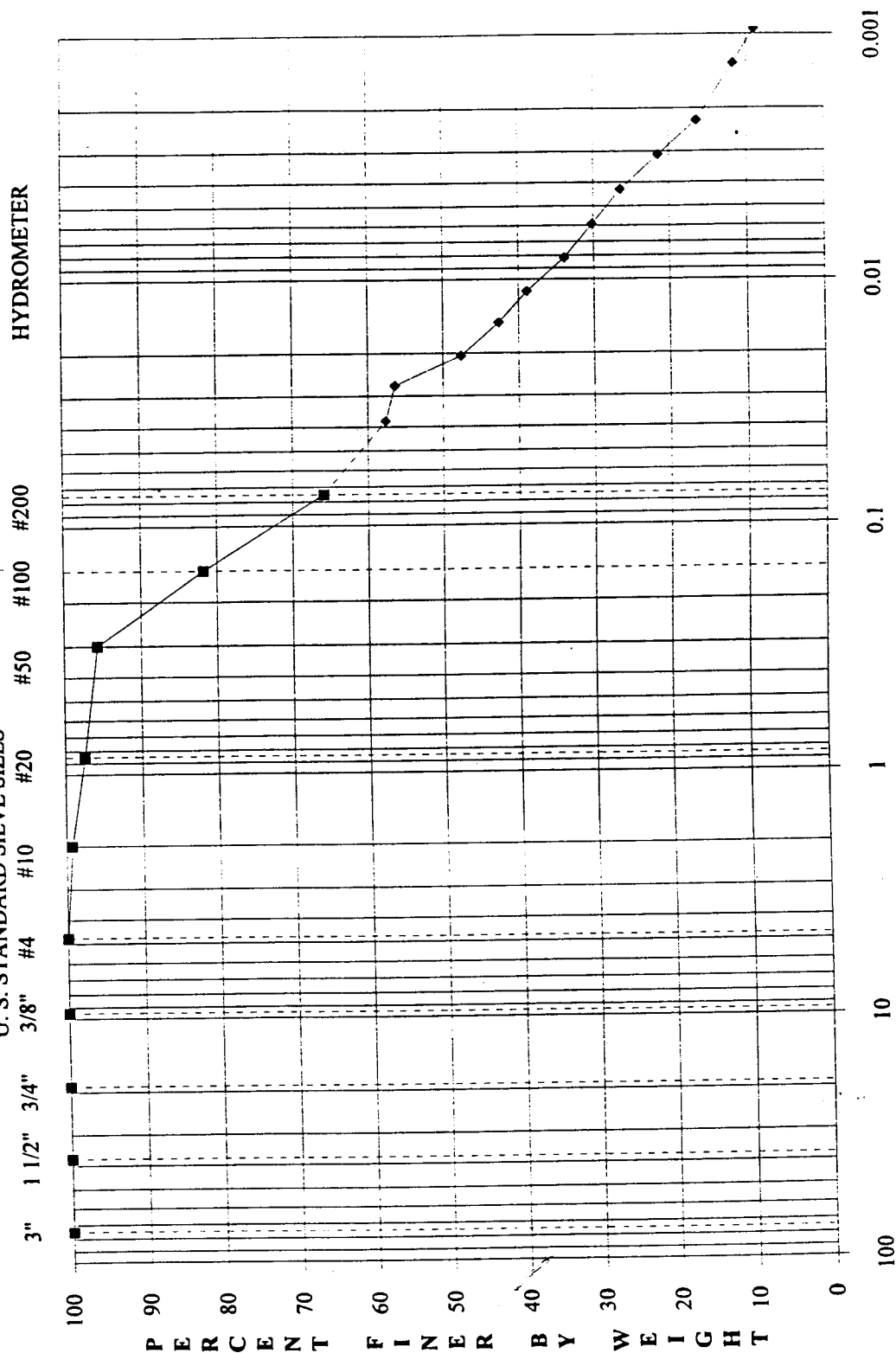
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PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW01-2005, ETL SAMPLE 9312G038-006

U.S. STANDARD SIEVE SIZES

HYDROMETER



SILT OR CLAY

SAND

GRAVEL

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW01-2007	PROJECT ANALYST	WB
JOB NUMBER	9312G038	ETL SAMPLE NUMBER	008	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/30/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	100.0
#50	0.300	99.9
#100	0.150	72.4
#200	0.075	36.8
HYDROMETER	0.0446	34.0
	0.0322	30.4
	0.0231	28.0
	0.0166	25.6
	0.0121	25.6
	0.0087	22.0
	0.0063	19.5
	0.0045	17.1
	0.0032	14.7
	0.0023	12.3
	0.0013	11.1
	0.0009	8.9

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.124
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
24.8

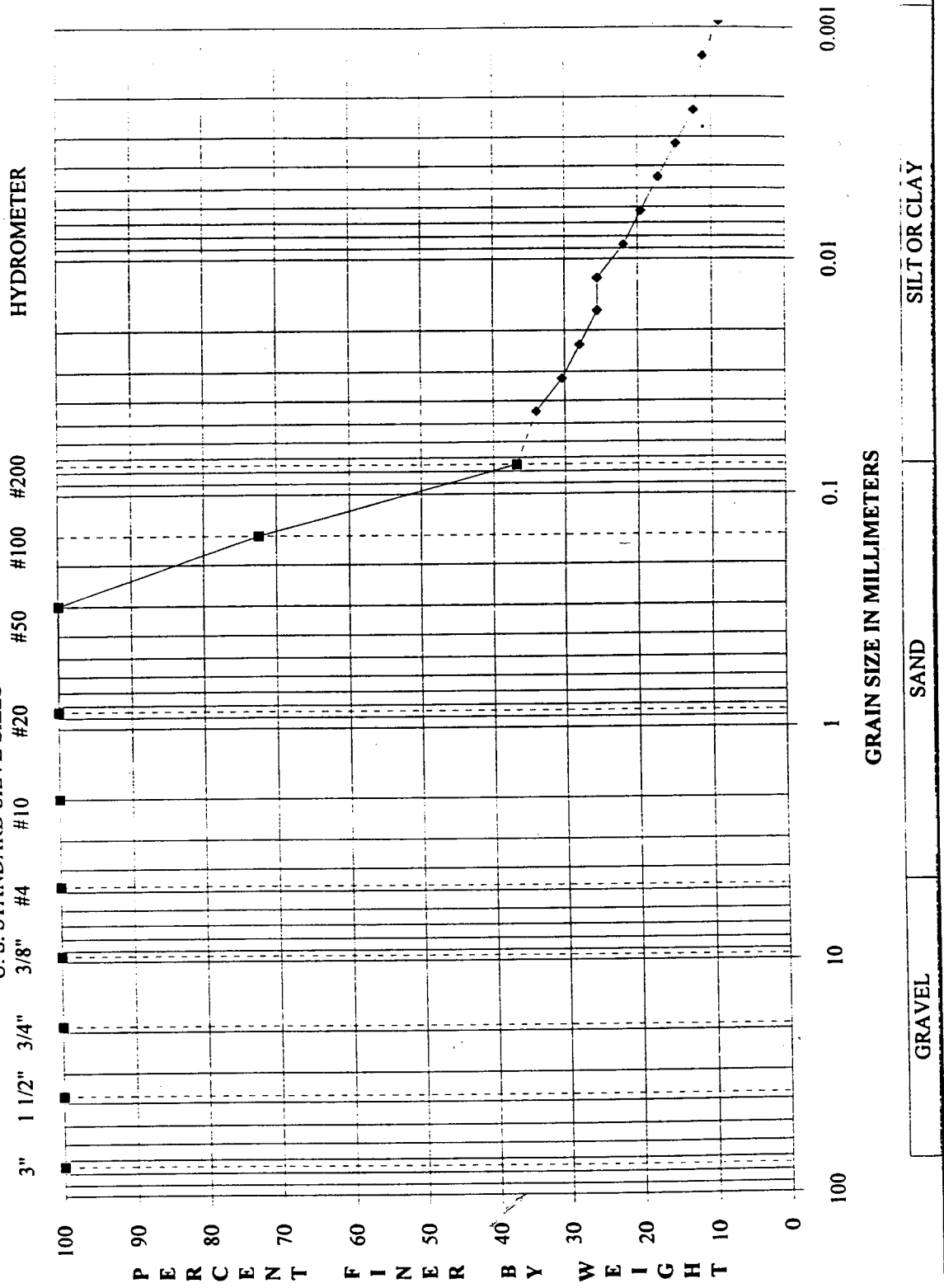
SAMPLE DESCRIPTION
light brown clayey SAND with 37% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
37.4	20.6	16.8

NOTES
NA=NOT APPLICABLE

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW01-2007, ETL SAMPLE 9312G038-008
 U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW01-2009	PROJECT ANALYST	WB
JOB NUMBER	9312G038	ETL SAMPLE NUMBER	010	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/30/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	99.9
#50	0.300	99.8
#100	0.150	64.5
#200	0.075	40.3
HYDROMETER	0.0446	35.6
	0.0322	31.8
	0.0231	29.3
	0.0166	26.8
	0.0122	25.5
	0.0087	23.0
	0.0063	20.4
	0.0045	17.9
	0.0032	15.4
	0.0023	15.4
	0.0013	11.6
	0.0009	9.3

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.136
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
27.4

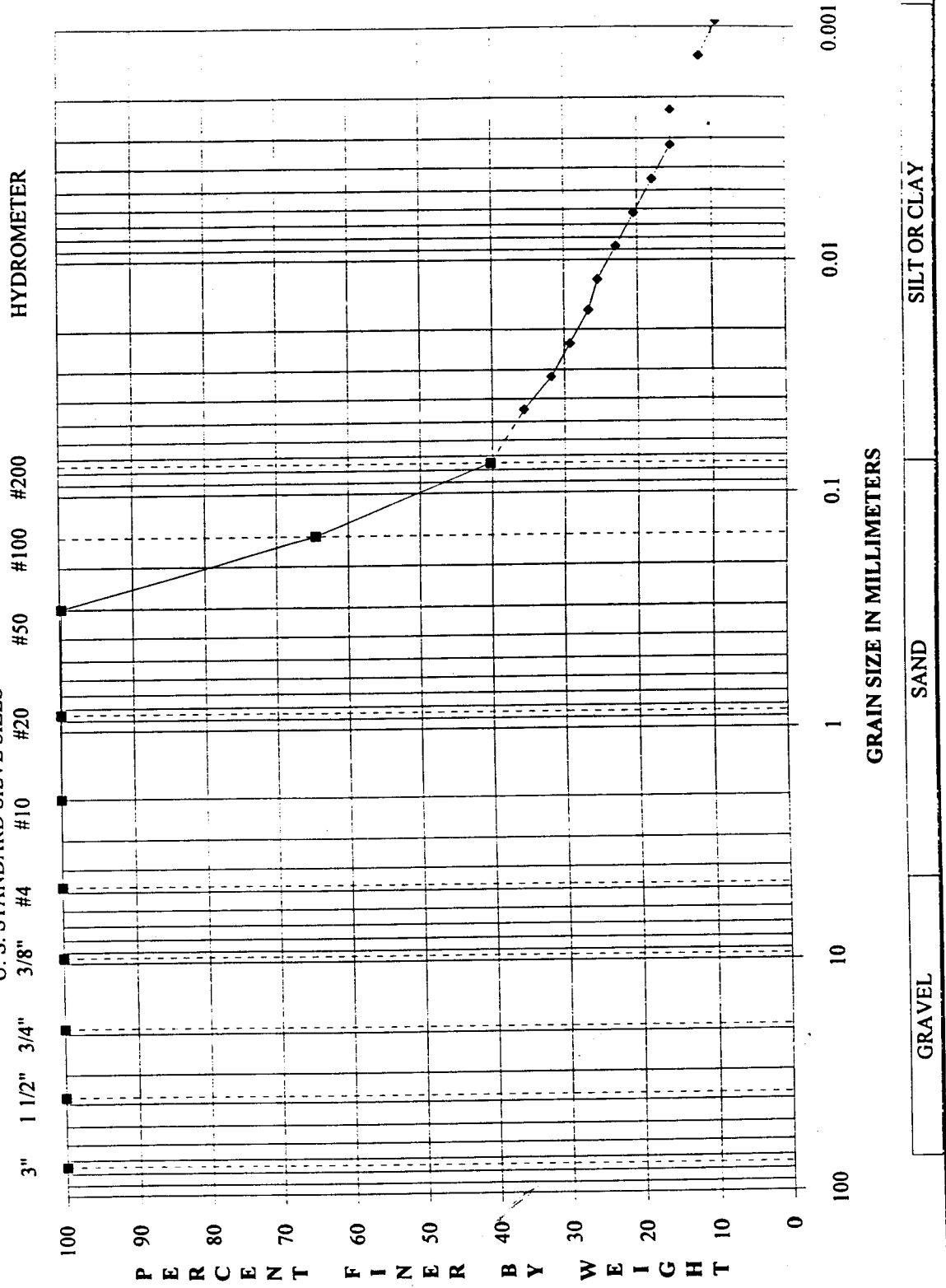
SAMPLE DESCRIPTION
light brown clayey SAND with 40% fines of low plasticity
Unified Soil Classification System (USCS) Group Symbol SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
36.2	18.1	18.1

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW01-2009, ETL SAMPLE 9312G038-010
 U.S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW01-2011	PROJECT ANALYST	WB
JOB NUMBER	9312G038	ETL SAMPLE NUMBER	012	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/30/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.8
#20	0.850	99.7
#50	0.300	99.5
#100	0.150	60.4
#200	0.075	34.1
HYDROMETER	0.0449	32.4
	0.0329	26.4
	0.0236	24.0
	0.0169	21.7
	0.0125	19.3
	0.0090	16.9
	0.0064	14.5
	0.0046	13.3
	0.0033	11.0
	0.0023	8.6
	0.0014	7.4
	0.0010	5.2

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.149
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

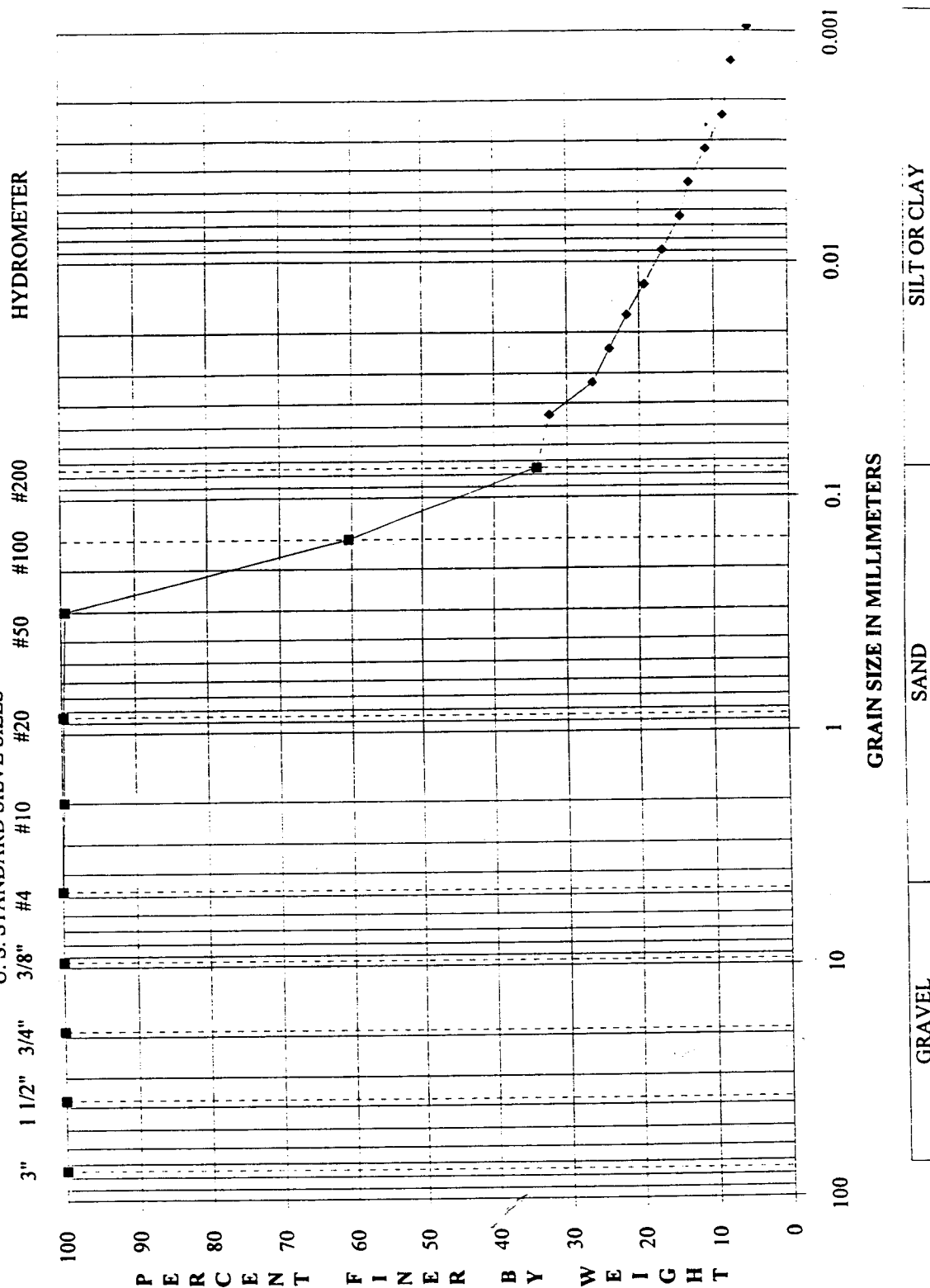
NATURAL MOISTURE CONTENT, % dry basis
28.6

SAMPLE DESCRIPTION
light brown silty SAND with 34% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SM

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
32.1	29.9	2.2

NOTES
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW01-2011, ETL SAMPLE 9312G038-012
 U.S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW01-2013	PROJECT ANALYST	WB
JOB NUMBER	9312G038	ETL SAMPLE NUMBER	014	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/30/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	99.9
#50	0.300	98.9
#100	0.150	63.0
#200	0.075	32.0
HYDROMETER	0.0475	24.2
	0.0340	21.7
	0.0242	20.5
	0.0171	20.5
	0.0127	17.9
	0.0091	15.4
	0.0064	14.1
	0.0046	11.6
	0.0033	10.4
	0.0023	9.1
	0.0014	7.8
	0.0010	5.6

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.143
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

SAMPLE DESCRIPTION
light brown clayey SAND with 32% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

NATURAL MOISTURE CONTENT, % dry basis
26.8

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
33.0	20.3	12.7

NOTES

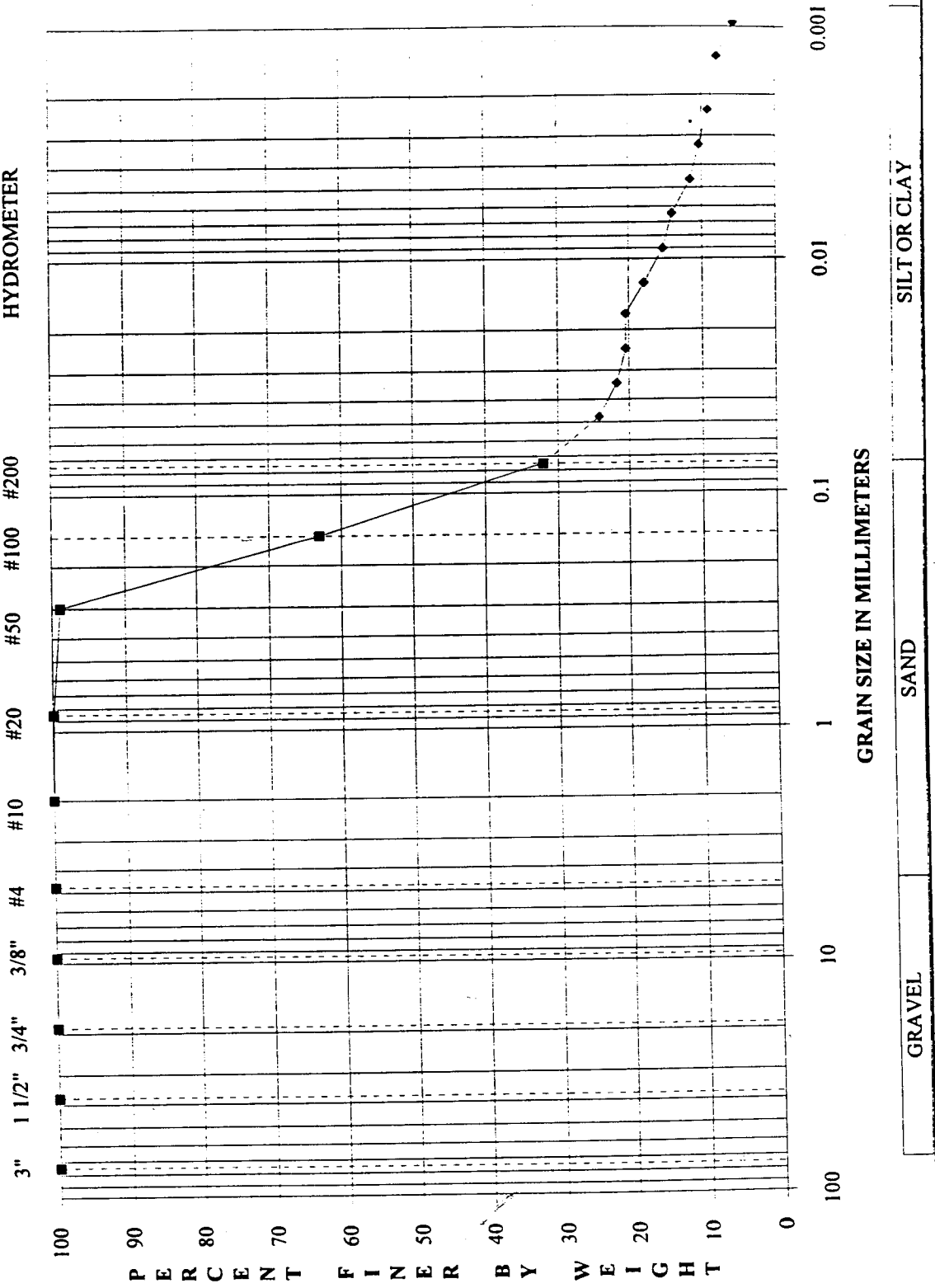
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW01-2013, ETL SAMPLE 9312G038-014

U. S. STANDARD SIEVE SIZES

HYDROMETER



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018901

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW01-2014	PROJECT ANALYST	WB
JOB NUMBER	9312G038	ETL SAMPLE NUMBER	015	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/30/93

PARTICLE SIZE DISTRIBUTION			
U. S. Standard Sieve Size	Diameter mm	% Finer	
3"	75.00	100.0	
1 1/2"	37.50	100.0	
3/4"	19.00	100.0	
3/8"	9.500	100.0	
#4	4.750	100.0	
#10	2.000	100.0	
#20	0.850	100.0	
#50	0.300	99.3	
#100	0.150	39.1	
#200	0.075	24.7	
HYDROMETER	0.0481	21.5	
	0.0345	19.0	
	0.0245	17.7	
	0.0174	16.5	
	0.0129	14.0	
	0.0092	11.5	
	0.0066	10.2	
	0.0047	9.0	
	0.0033	7.7	
	0.0024	6.5	
	0.0014	5.5	
	0.0010	5.2	

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.202
30	0.103
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
26.1

SAMPLE DESCRIPTION
light brown clayey SAND with 25% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

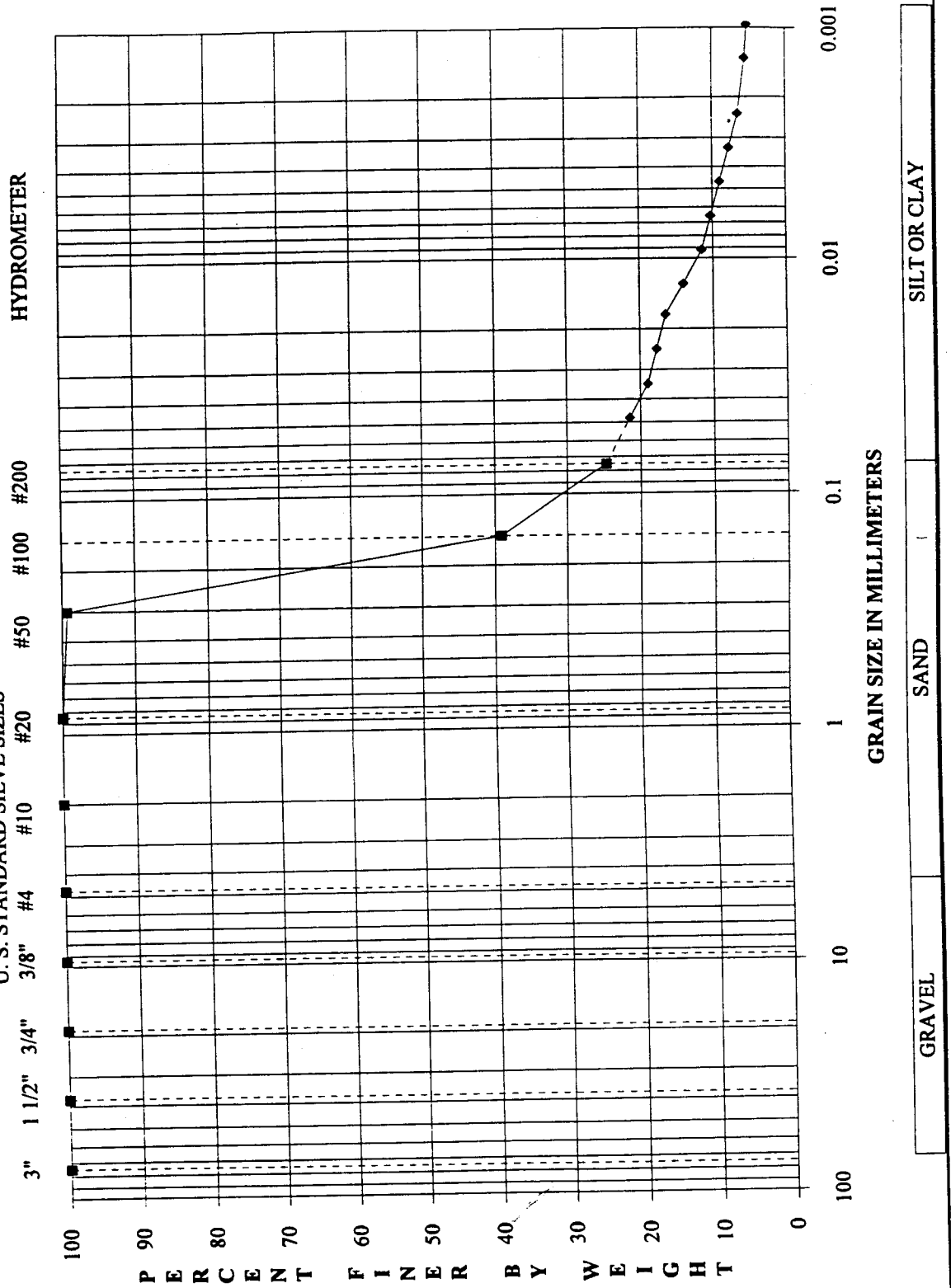
INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
29.8	21.8	8.0

NOTES

NA=NOT APPLICABLE

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW01-2014, ETL SAMPLE 9312G038-015
 U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW01-2015	PROJECT ANALYST	WB
JOB NUMBER	9312G038	ETL SAMPLE NUMBER	016	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/30/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	100.0
#50	0.300	99.8
#100	0.150	41.6
#200	0.075	25.1
HYDROMETER	0.0472	24.8
	0.0340	21.1
	0.0242	19.9
	0.0173	17.4
	0.0128	15.0
	0.0092	12.5
	0.0065	11.3
	0.0047	8.8
	0.0033	7.6
	0.0024	6.4
	0.0014	5.4
	0.0010	3.9

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.197
30	0.097
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
30.6

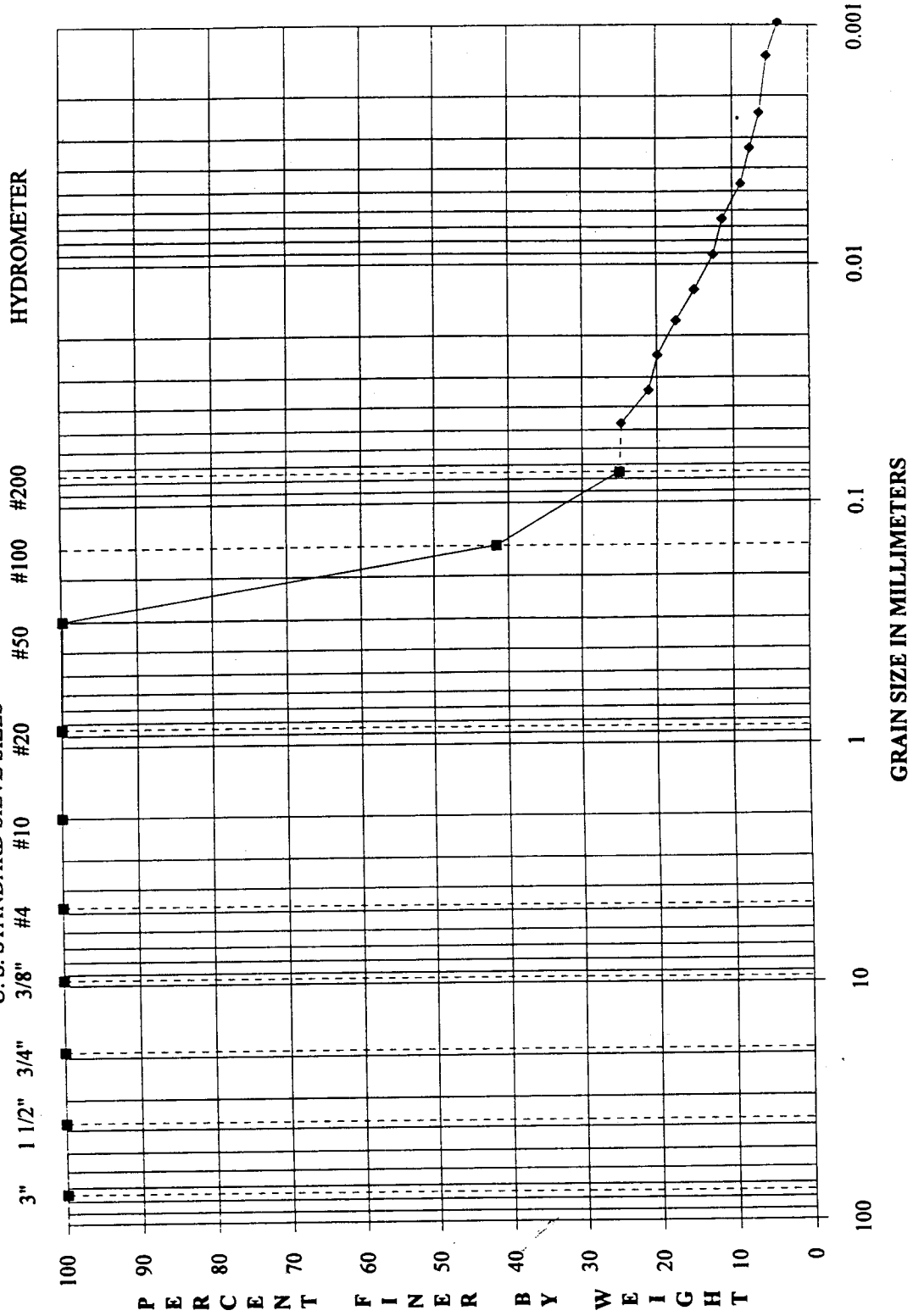
SAMPLE DESCRIPTION
light brown silty SAND with 25% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SM

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
29.8	27.4	2.4

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW01-2015, ETL SAMPLE 9312G038-016
 U. S. STANDARD SIEVE SIZES
 HYDROMETER



GRAVEL SAND SILT OR CLAY

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW02-2001	PROJECT ANALYST	WB
JOB NUMBER	9312G058	ETL SAMPLE NUMBER	001	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/31/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	94.9
#10	2.000	90.1
#20	0.850	87.2
#50	0.300	84.4
#100	0.150	75.8
#200	0.075	52.6
HYDROMETER	0.0422	41.5
	0.0303	39.1
	0.0219	35.6
	0.0156	34.4
	0.0115	33.2
	0.0083	30.9
	0.0059	29.7
	0.0042	27.3
	0.0030	26.2
	0.0021	25.0
	0.0012	22.9
	0.0009	21.4

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.099
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

SAMPLE DESCRIPTION
orange brown CLAY of low plasticity with 5% gravel and 42% sand
Unified Soil Classification System (USCS)
Group Symbol
CL

NATURAL MOISTURE CONTENT, % dry basis
19.8

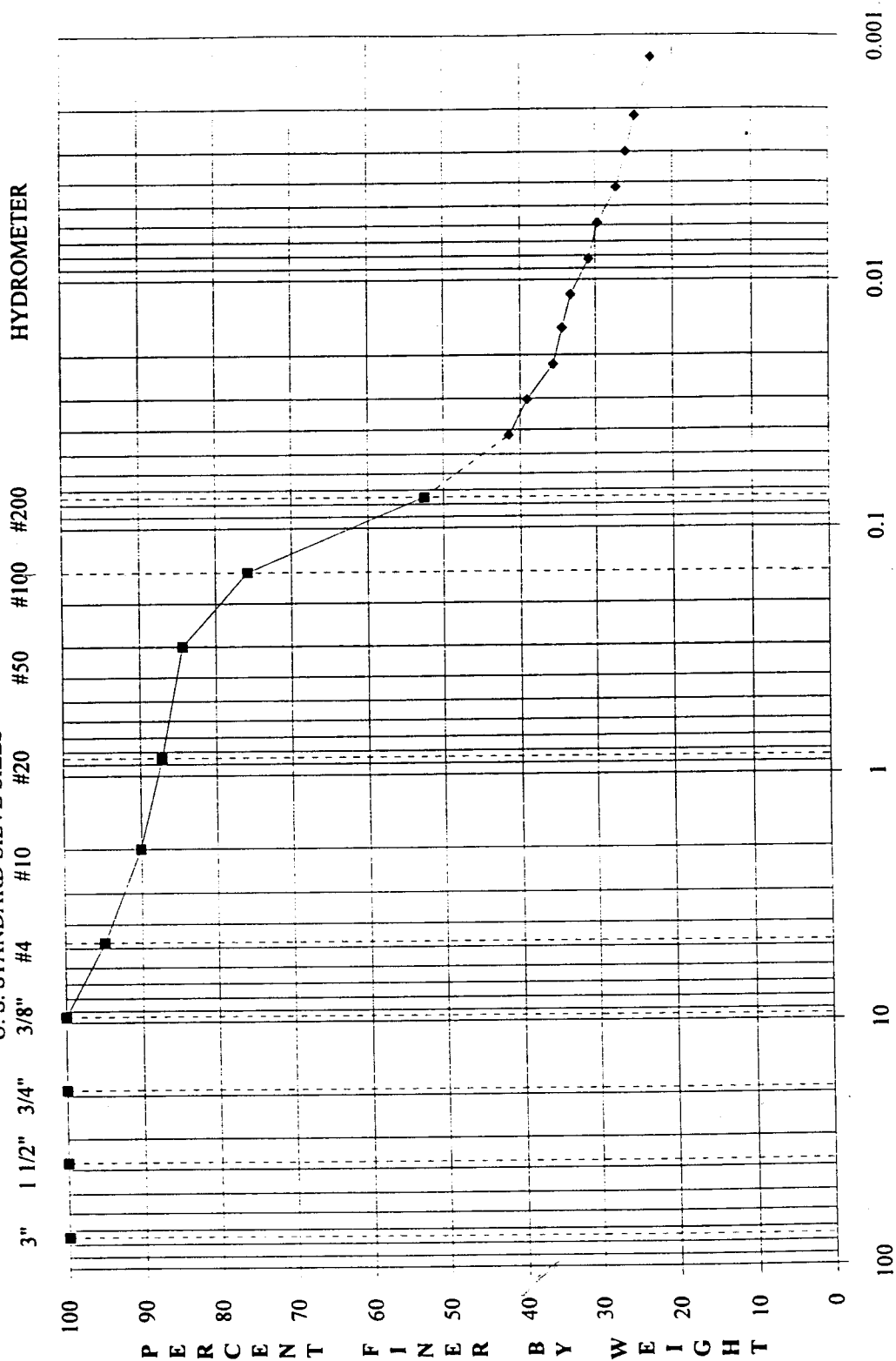
INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
47.4	20.5	26.9

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW02-2001, ETL SAMPLE 9312G058-001

U.S. STANDARD SIEVE SIZES



GRAIN SIZE IN MILLIMETERS

SILT OR CLAY

SAND

GRAVEL

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW02-2003	PROJECT ANALYST	WB
JOB NUMBER	9312G058	ETL SAMPLE NUMBER	003	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/31/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.9
#20	0.850	99.5
#50	0.300	98.8
#100	0.150	90.6
#200	0.075	74.8
HYDROMETER	0.0384	57.5
	0.0275	56.2
	0.0205	48.6
	0.0150	43.5
	0.0112	39.7
	0.0081	37.1
	0.0058	33.3
	0.0042	29.5
	0.0031	24.4
	0.0022	21.9
	0.0013	17.0
	0.0009	15.5

EFFECTIVE SIZES	
% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
28.9

SAMPLE DESCRIPTION
gray CLAY of high plasticity with 25% sand
Unified Soil Classification System (USCS) Group Symbol CH

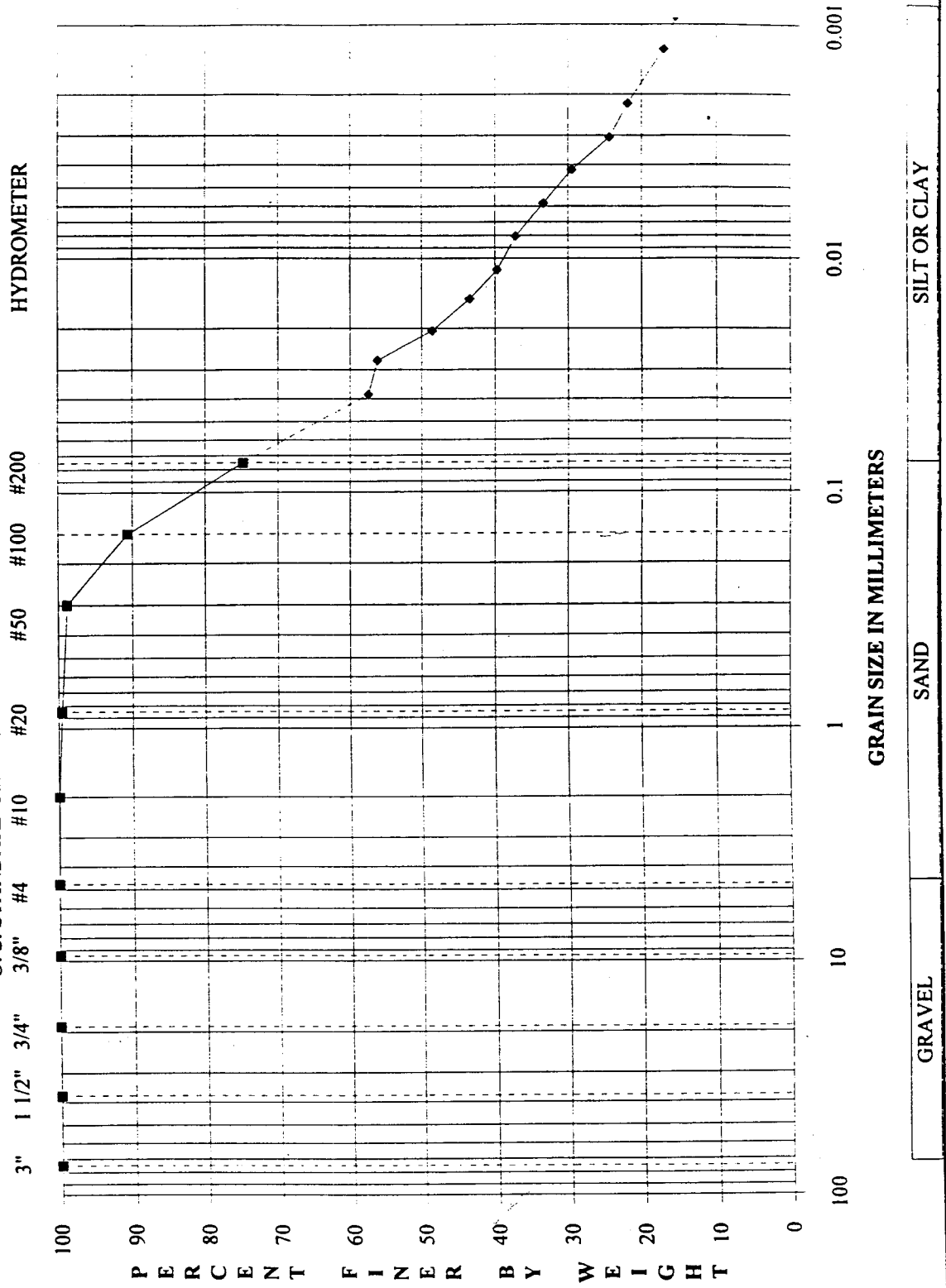
INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
55.9	22.0	33.9

NOTES
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW02-2003, ETL SAMPLE 9312G058-003

U.S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018909

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW02-2005	PROJECT ANALYST	WB
JOB NUMBER	9312G058	ETL SAMPLE NUMBER	006	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/31/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	99.9
#50	0.300	99.3
#100	0.150	87.6
#200	0.075	73.5
HYDROMETER	0.0364	63.1
	0.0261	61.9
	0.0186	60.6
	0.0139	54.3
	0.0108	45.5
	0.0080	39.2
	0.0058	34.2
	0.0042	29.2
	0.0031	24.2
	0.0022	21.6
	0.0013	15.6
	0.0009	12.8

EFFECTIVE SIZES	
% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
30.1

SAMPLE DESCRIPTION
light gray CLAY of low plasticity with 26% sand
Unified Soil Classification System (USCS) Group Symbol CL

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
47.3	21.1	26.2

NOTES
NA=NOT APPLICABLE

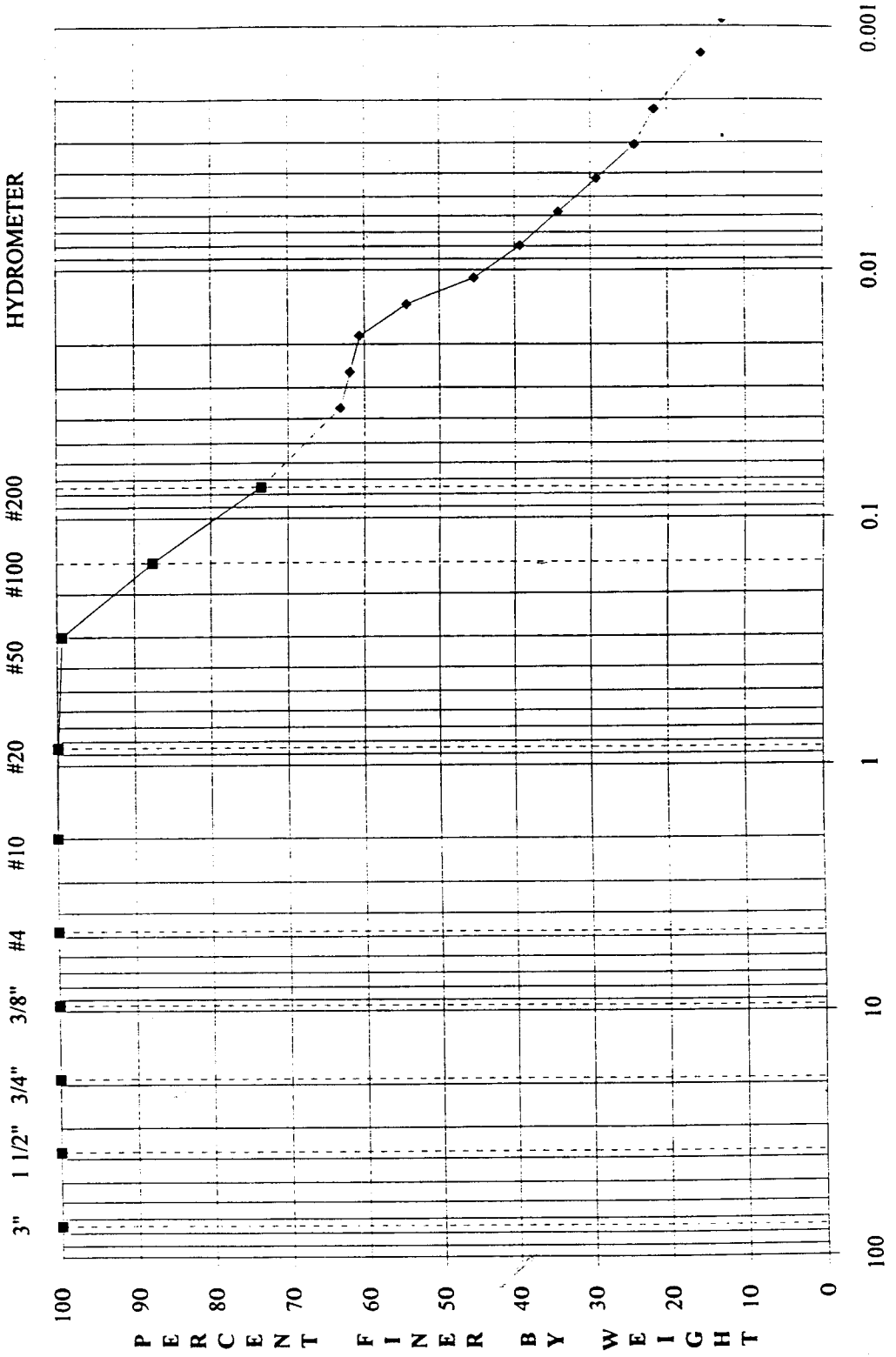
ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW02-2005, ETL SAMPLE 9312G058-006

U.S. STANDARD SIEVE SIZES

HYDROMETER



GRAVEL SAND SILT OR CLAY

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018911

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW02-2007	PROJECT ANALYST	WB
JOB NUMBER	9312G058	ETL SAMPLE NUMBER	008	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/31/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	98.2
#10	2.000	97.7
#20	0.850	96.6
#50	0.300	95.8
#100	0.150	93.2
#200	0.075	81.9
HYDROMETER	0.0348	67.0
	0.0252	64.5
	0.0196	53.4
	0.0145	47.2
	0.0110	42.3
	0.0079	39.8
	0.0058	33.6
	0.0042	28.7
	0.0031	23.7
	0.0022	21.3
	0.0013	14.1
	0.0009	11.4

EFFECTIVE SIZES	
% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
31.0

SAMPLE DESCRIPTION
light gray CLAY of high plasticity with 2% gravel and 16% sand
Unified Soil Classification System (USCS)
Group Symbol
CH

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
53.0	23.7	29.3

NOTES

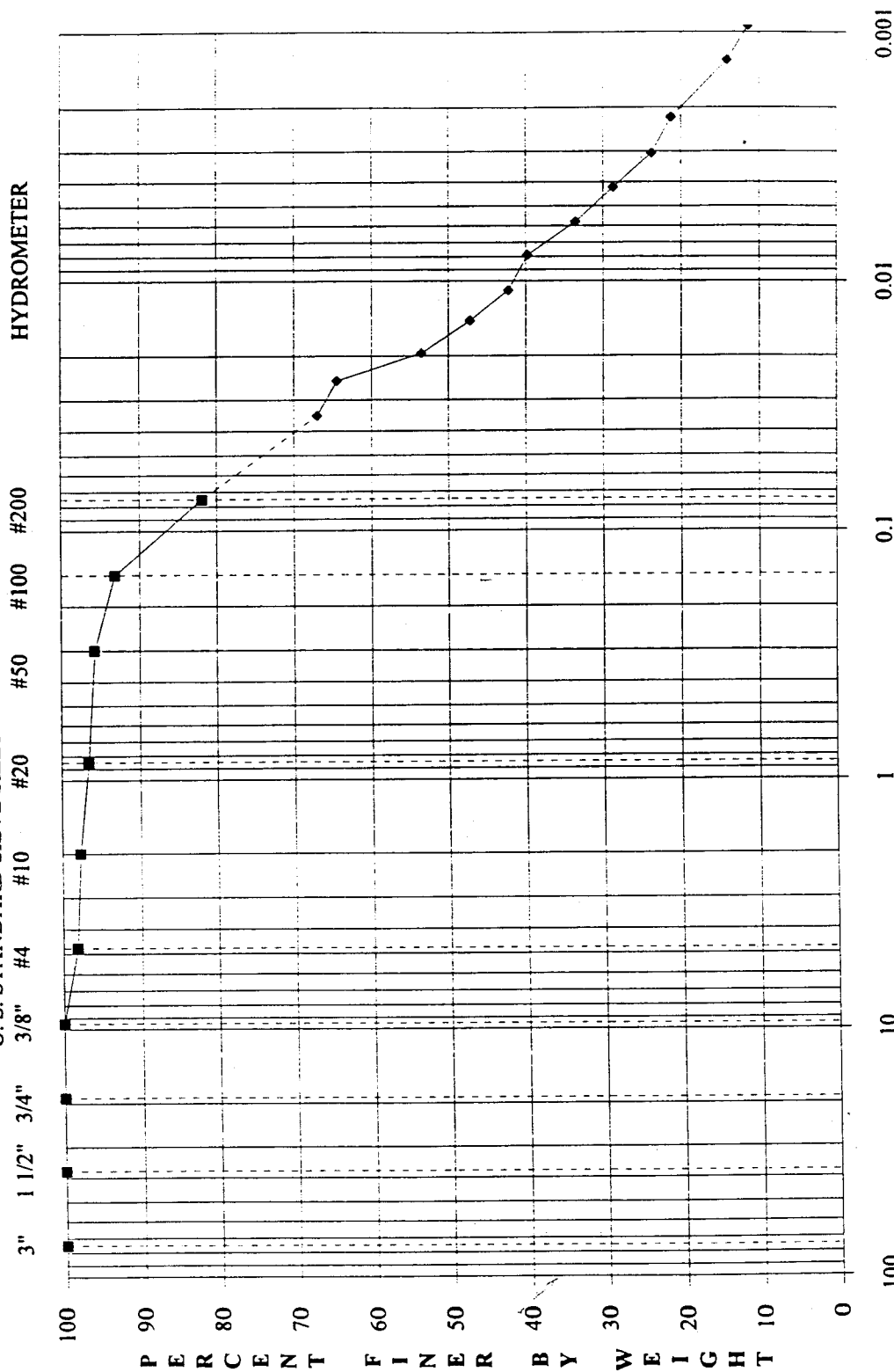
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW02-2007, ETL SAMPLE 9312G058-008

U. S. STANDARD SIEVE SIZES

HYDROMETER



GRAIN SIZE IN MILLIMETERS

GRAVEL

SAND

SILT OR CLAY

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW02-2009	PROJECT ANALYST	WB
JOB NUMBER	9312G058	ETL SAMPLE NUMBER	010	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/31/93

PARTICLE SIZE DISTRIBUTION			
U. S. Standard Sieve Size	Diameter mm	% Finer	
3"	75.00	100.0	
1 1/2"	37.50	100.0	
3/4"	19.00	100.0	
3/8"	9.500	100.0	
#4	4.750	100.0	
#10	2.000	100.0	
#20	0.850	100.0	
#50	0.300	99.8	
#100	0.150	45.1	
#200	0.075	31.6	
HYDROMETER	0.0465	25.9	
	0.0331	24.7	
	0.0237	22.4	
	0.0169	21.2	
	0.0125	18.9	
	0.0090	15.4	
	0.0064	14.2	
	0.0046	11.9	
	0.0033	10.7	
	0.0023	8.4	
	0.0013	7.5	
	0.0010	7.2	

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.191
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
27.6

SAMPLE DESCRIPTION
light brown clayey SAND with 32% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
36.8	21.2	15.5

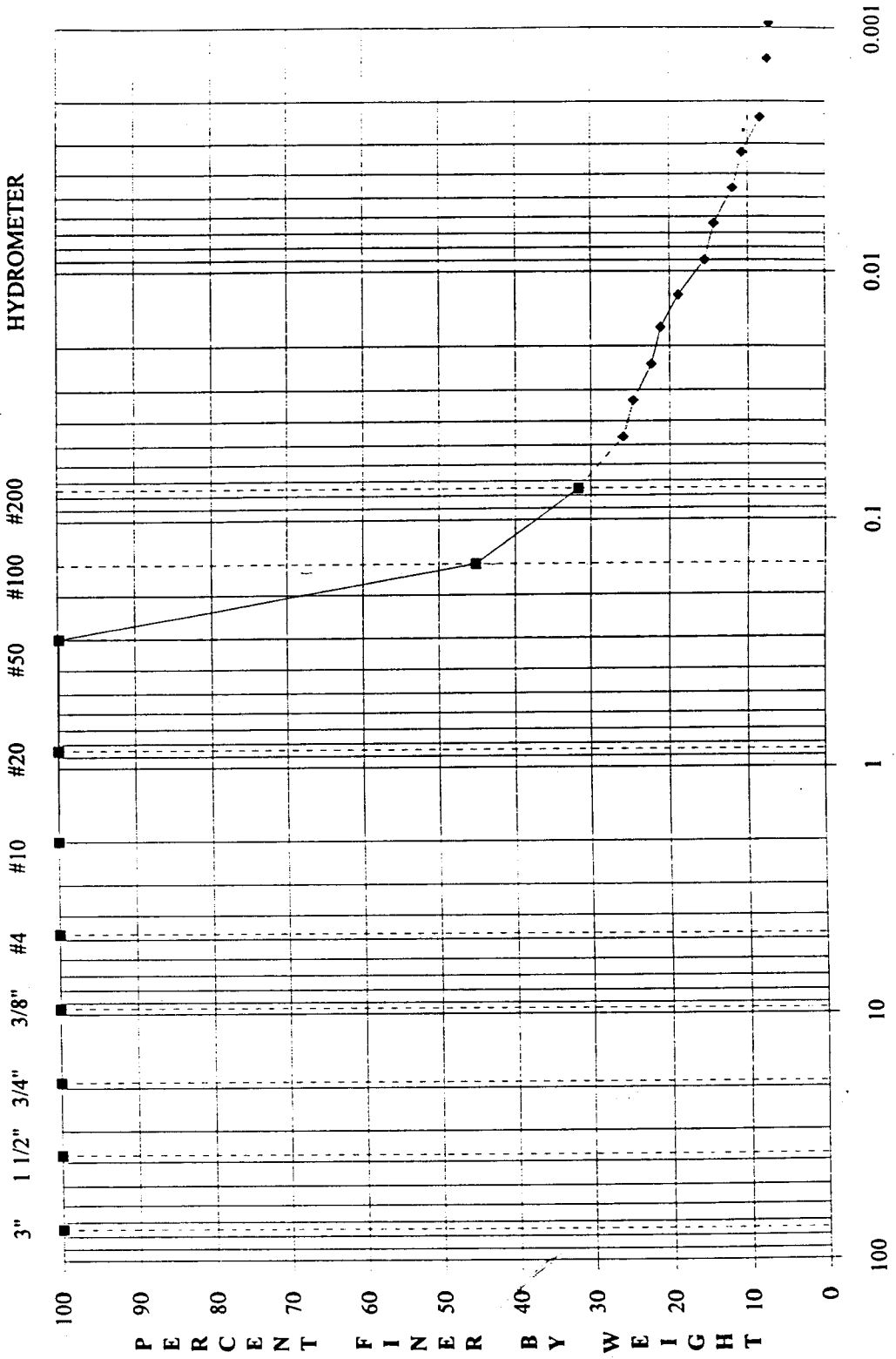
NOTES
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW02-2009, ETL SAMPLE 9312G058-010

U.S. STANDARD SIEVE SIZES

HYDROMETER



SILT OR CLAY

SAND

GRAVEL

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018915

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW02-2011	PROJECT ANALYST	WB
JOB NUMBER	9312G058	ETL SAMPLE NUMBER	012	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/31/93

PARTICLE SIZE DISTRIBUTION			
U. S. Standard Sieve Size	Diameter mm	% Finer	
3"	75.00	100.0	
1 1/2"	37.50	100.0	
3/4"	19.00	100.0	
3/8"	9.500	100.0	
#4	4.750	100.0	
#10	2.000	100.0	
#20	0.850	99.9	
#50	0.300	99.6	
#100	0.150	34.1	
#200	0.075	26.1	
HYDROMETER	0.0475	21.9	
	0.0342	18.5	
	0.0244	17.3	
	0.0173	16.2	
	0.0127	15.1	
	0.0091	12.8	
	0.0065	10.5	
	0.0046	9.4	
	0.0033	7.1	
	0.0024	5.9	
	0.0014	5.0	
	0.0010	4.8	

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.209
30	0.112
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

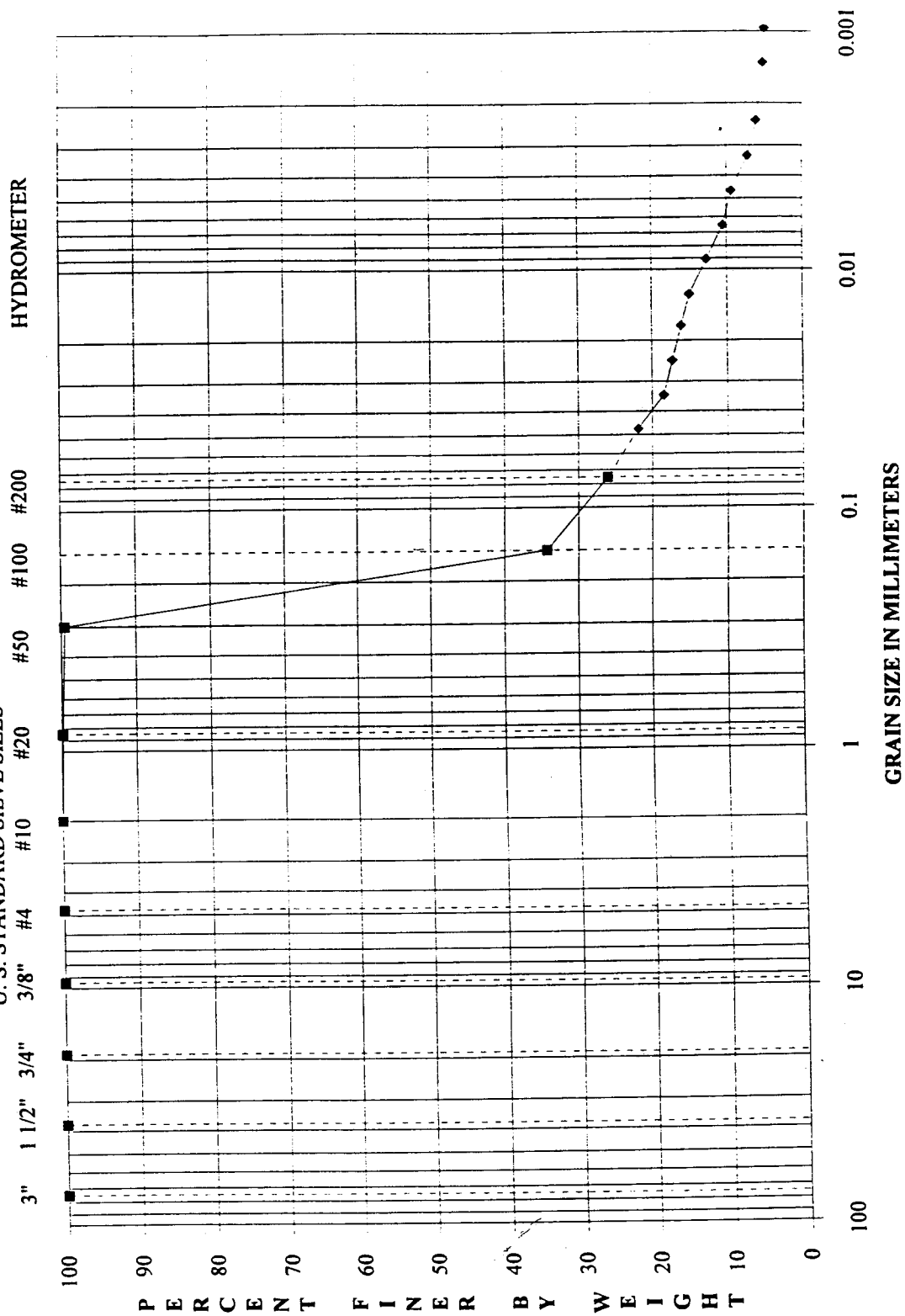
NATURAL MOISTURE CONTENT, % dry basis
28.2

SAMPLE DESCRIPTION
light brown clayey SAND with 26% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
31.0	21.1	9.9

NOTES
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW02-2011, ETL SAMPLE 9312G058-012
 U.S. STANDARD SIEVE SIZES



GRAVEL SAND SILT OR CLAY

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

18917

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW02-2012	PROJECT ANALYST	WB
JOB NUMBER	9312G058	ETL SAMPLE NUMBER	1013	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/31/93

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	100.0
#50	0.300	99.7
#100	0.150	39.9
#200	0.075	27.4
HYDROMETER	0.0475	22.6
	0.0338	21.4
	0.0241	20.3
	0.0172	17.9
	0.0127	15.5
	0.0091	14.4
	0.0065	10.8
	0.0046	9.7
	0.0033	7.3
	0.0024	4.9
	0.0014	4.0
	0.0010	3.8

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.201
30	0.091
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
26.3

SAMPLE DESCRIPTION
light brown clayey SAND with 27% fines of low plasticity
Unified Soil Classification System (USCS) Group Symbol SC

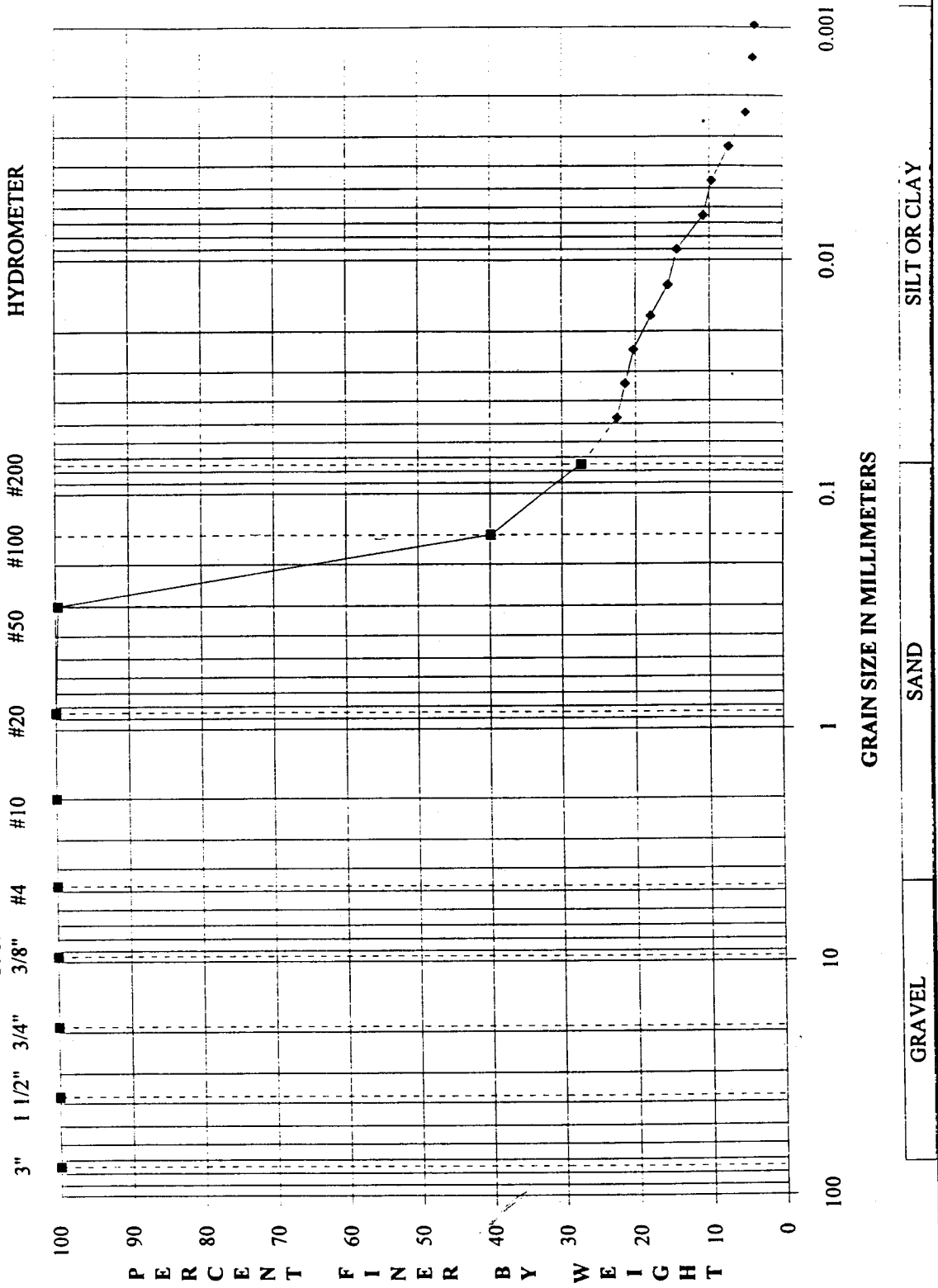
INDEX PROPERTIES % moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
29.4	20.8	8.6

NOTES
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW02-2012, ETL SAMPLE 9312G058-013

U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW02-2013	PROJECT ANALYST	WB
JOB NUMBER	9312G058	ETL SAMPLE NUMBER	014	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/31/93

PARTICLE SIZE DISTRIBUTION			
U. S. Standard Sieve Size	Diameter mm	% Finer	
3"	75.00	100.0	
1 1/2"	37.50	100.0	
3/4"	19.00	100.0	
3/8"	9.500	100.0	
#4	4.750	100.0	
#10	2.000	100.0	
#20	0.850	99.9	
#50	0.300	99.0	
#100	0.150	37.5	
#200	0.075	24.2	
HYDROMETER	0.0484	19.0	
	0.0345	17.8	
	0.0247	15.5	
	0.0176	14.3	
	0.0129	13.1	
	0.0092	12.0	
	0.0065	10.8	
	0.0046	9.6	
	0.0033	7.3	
	0.0024	6.1	
	0.0014	5.2	
	0.0010	4.9	

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.205
30	0.108
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
30.9

SAMPLE DESCRIPTION
light brown clayey SAND with 24% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
31.8	20.5	11.3

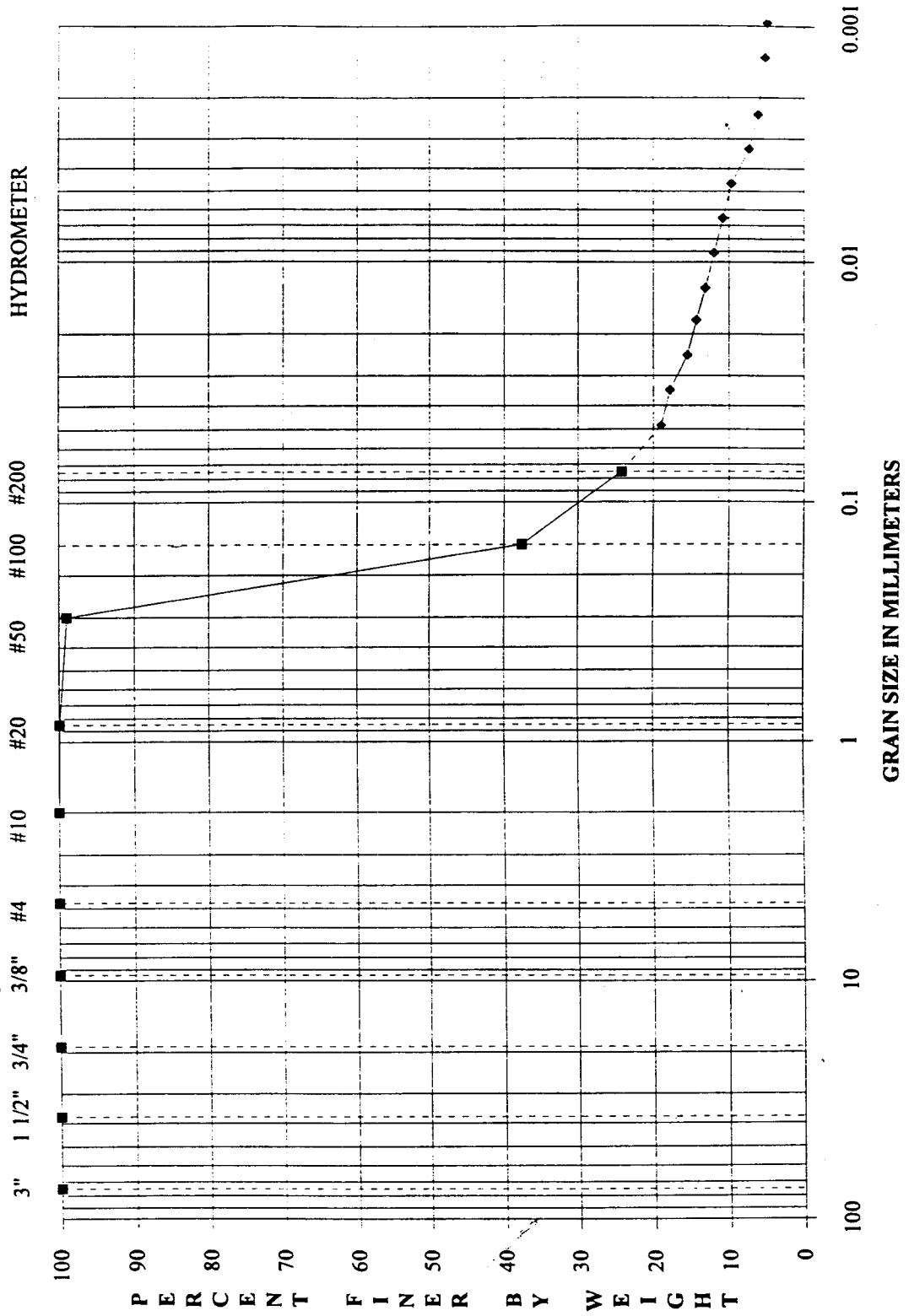
NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW02-2013, ETL SAMPLE 9312G058-014

U. S. STANDARD SIEVE SIZES



GRAVEL SAND SILT OR CLAY

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW02-2014	PROJECT ANALYST	WB
JOB NUMBER	9312G058	ETL SAMPLE NUMBER	015	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/08/93	DATE COMPLETED	12/31/93

PARTICLE SIZE DISTRIBUTION			
U. S. Standard Sieve Size	Diameter mm	% Finer	
3"	75.00	100.0	
1 1/2"	37.50	100.0	
3/4"	19.00	100.0	
3/8"	9.500	100.0	
#4	4.750	100.0	
#10	2.000	100.0	
#20	0.850	99.9	
#50	0.300	99.6	
#100	0.150	46.0	
#200	0.075	28.1	
HYDROMETER	0.0478	22.2	
	0.0340	20.9	
	0.0242	19.7	
	0.0172	18.5	
	0.0127	17.3	
	0.0091	14.9	
	0.0065	12.4	
	0.0046	11.2	
	0.0033	10.0	
	0.0023	7.5	
	0.0013	6.6	
	0.0010	6.3	

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.189
30	0.083
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
29.3

SAMPLE DESCRIPTION
light brown clayey SAND with 28% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
30.9	19.7	11.2

NOTES
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW02-2014, ETL SAMPLE 9312G058-015

U. S. STANDARD SIEVE SIZES

HYDROMETER

#200

#100

#50

#20

#10

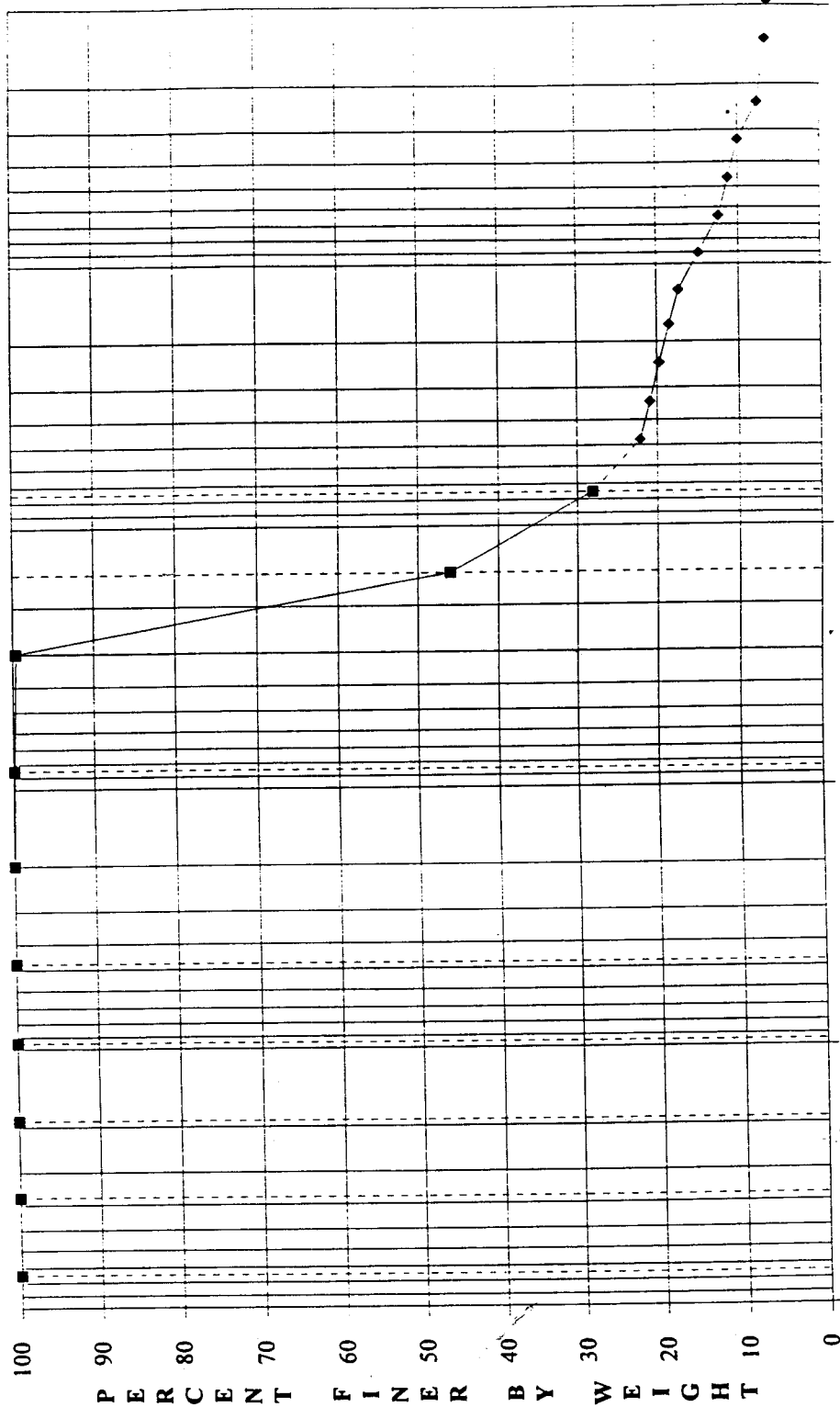
#4

3/8"

3/4"

1 1/2"

3"



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW03-2001	PROJECT ANALYST	WB
JOB NUMBER	9312G082	ETL SAMPLE NUMBER	1001	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/09/93	DATE COMPLETED	01/05/94

PARTICLE SIZE DISTRIBUTION			
U. S. Standard Sieve Size	Diameter mm	% Finer	
3"	75.00	100.0	
1 1/2"	37.50	100.0	
3/4"	19.00	100.0	
3/8"	9.500	100.0	
#4	4.750	99.4	
#10	2.000	99.4	
#20	0.850	99.1	
#50	0.300	98.7	
#100	0.150	84.9	
#200	0.075	58.6	
HYDROMETER	0.0395	52.3	
	0.0292	46.0	
	0.0213	41.0	
	0.0155	37.2	
	0.0115	34.6	
	0.0082	32.1	
	0.0059	29.6	
	0.0042	28.3	
	0.0030	27.1	
	0.0021	25.8	
	0.0012	25.5	
	0.0009	23.0	

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.079
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
16.5

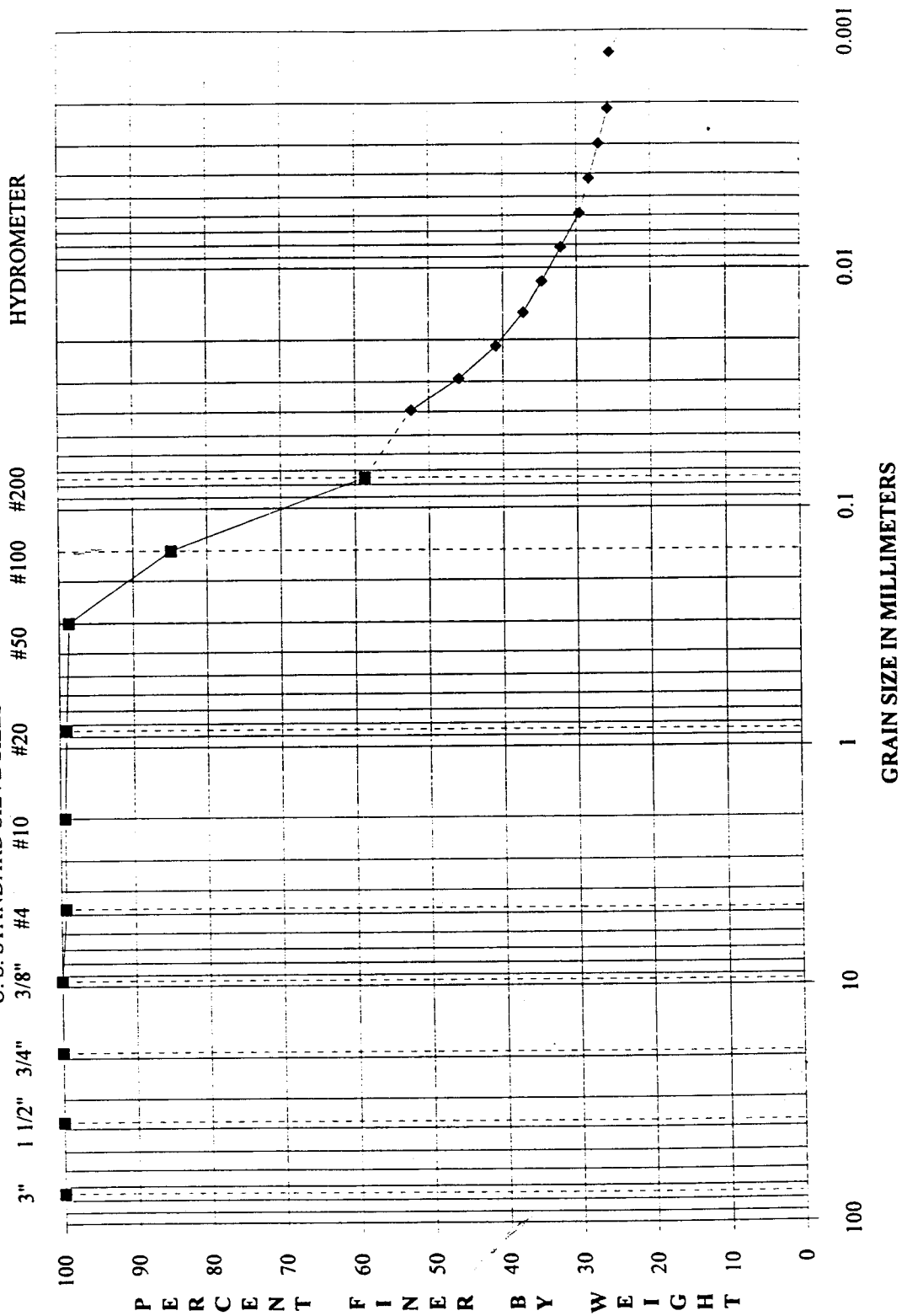
SAMPLE DESCRIPTION
orange CLAY of low plasticity with 41% sand
Unified Soil Classification System (USCS)
Group Symbol
CL

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
31.7	14.3	17.4

NOTES
NA=NOT APPLICABLE

**PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW03-2001, ETL SAMPLE 9312G082-001**

U.S. STANDARD SIEVE SIZES



GRAVEL SAND SILT OR CLAY

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW03-2003	PROJECT ANALYST	WB
JOB NUMBER	9312G082	ETL SAMPLE NUMBER	003	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/09/93	DATE COMPLETED	01/05/94

PARTICLE SIZE DISTRIBUTION			
U. S. Standard Sieve Size	Diameter mm	% Finer	
3"	75.00	100.0	
1 1/2"	37.50	100.0	
3/4"	19.00	100.0	
3/8"	9.500	100.0	
#4	4.750	99.5	
#10	2.000	99.5	
#20	0.850	99.5	
#50	0.300	99.3	
#100	0.150	80.3	
#200	0.075	61.3	
HYDROMETER	0.0394	53.8	
	0.0281	52.5	
	0.0202	49.9	
	0.0146	47.3	
	0.0108	44.7	
	0.0078	42.1	
	0.0056	39.5	
	0.0040	36.9	
	0.0029	33.0	
	0.0021	31.7	
	0.0012	28.9	
	0.0009	26.3	

EFFECTIVE SIZES	
% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

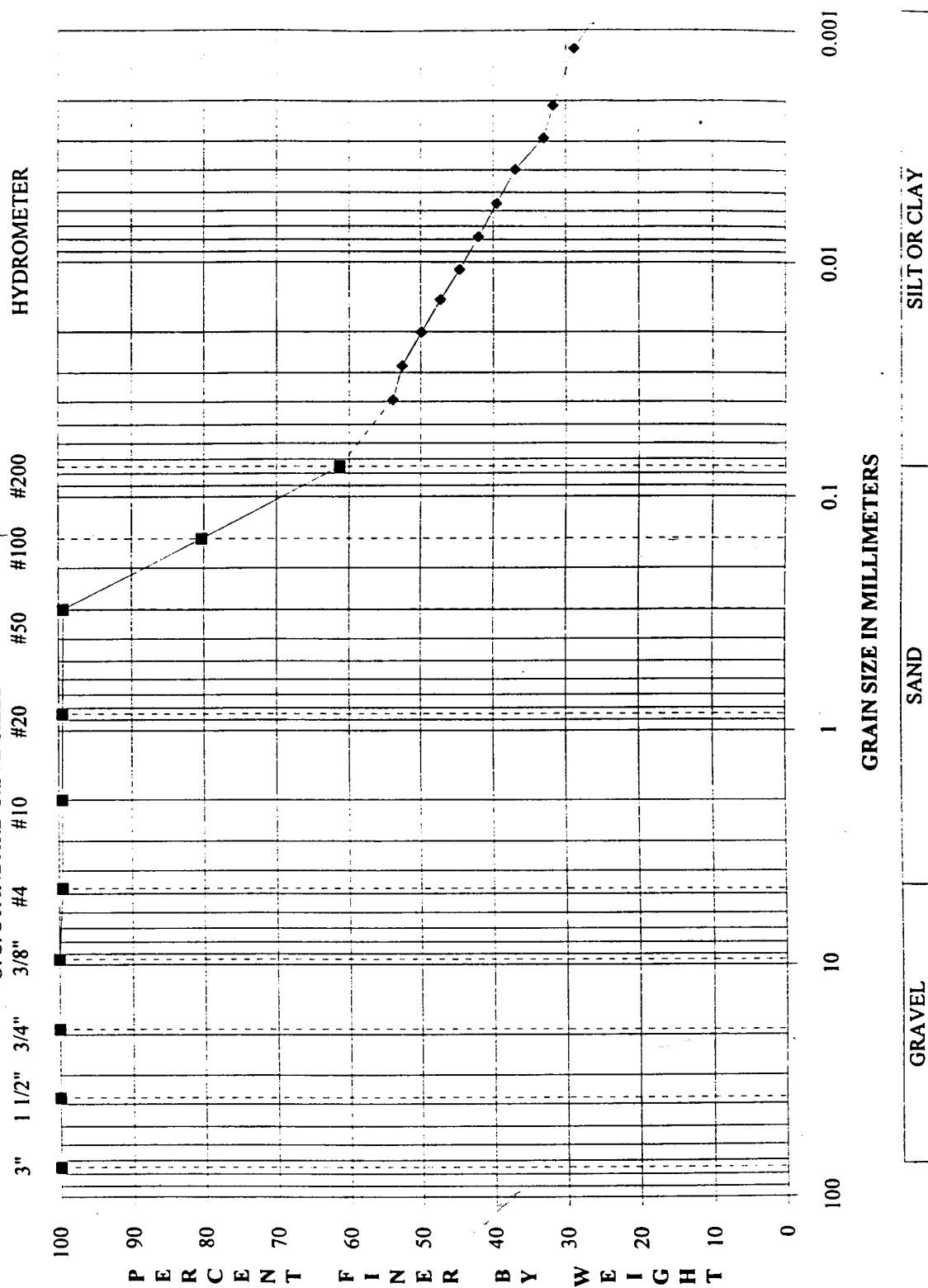
NATURAL MOISTURE CONTENT, % dry basis	
23.4	

SAMPLE DESCRIPTION	
orange CLAY of low plasticity with 38% sand	
Unified Soil Classification System (USCS)	
Group Symbol	
CL	

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
47.1	23.9	23.2

NOTES	
NA=NOT APPLICABLE	

PROJECT SAMPLE LH01A-MW03-2003, ETL SAMPLE 9312G082-003
U.S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

18927

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW03-2005	PROJECT ANALYST	WB
JOB NUMBER	9312G082	ETL SAMPLE NUMBER	1006	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/09/93	DATE COMPLETED	01/05/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	99.9
#50	0.300	99.6
#100	0.150	67.8
#200	0.075	45.4
HYDROMETER	0.0423	42.6
	0.0304	40.0
	0.0220	36.2
	0.0158	33.7
	0.0117	31.1
	0.0085	27.3
	0.0061	24.7
	0.0043	22.2
	0.0031	19.6
	0.0022	18.4
	0.0013	16.8
	0.0009	15.6

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.124
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis	
35.2	

SAMPLE DESCRIPTION
brown clayey SAND with 45% fines of low plasticity
Unified Soil Classification System (USCS) Group Symbol SC

INDEX PROPERTIES % moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
42.5	24.3	18.2

NOTES
NA=NOT APPLICABLE

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018928

GEOTECHNICAL TESTING DATA AND RESULTS				
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW03-2006	PROJECT ANALYST
JOB NUMBER	9312G082	ETL SAMPLE NUMBER	007	QA/QC ANALYST
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/09/93	DATE COMPLETED
				01/05/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	97.1
#10	2.000	95.8
#20	0.850	95.2
#50	0.300	94.4
#100	0.150	66.2
#200	0.075	40.4
HYDROMETER	0.0436	35.4
	0.0313	33.0
	0.0223	31.8
	0.0162	27.0
	0.0120	24.6
	0.0086	22.2
	0.0062	19.8
	0.0044	17.4
	0.0032	14.9
	0.0022	13.7
	0.0013	13.5
	0.0009	11.1

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.132
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
28.3

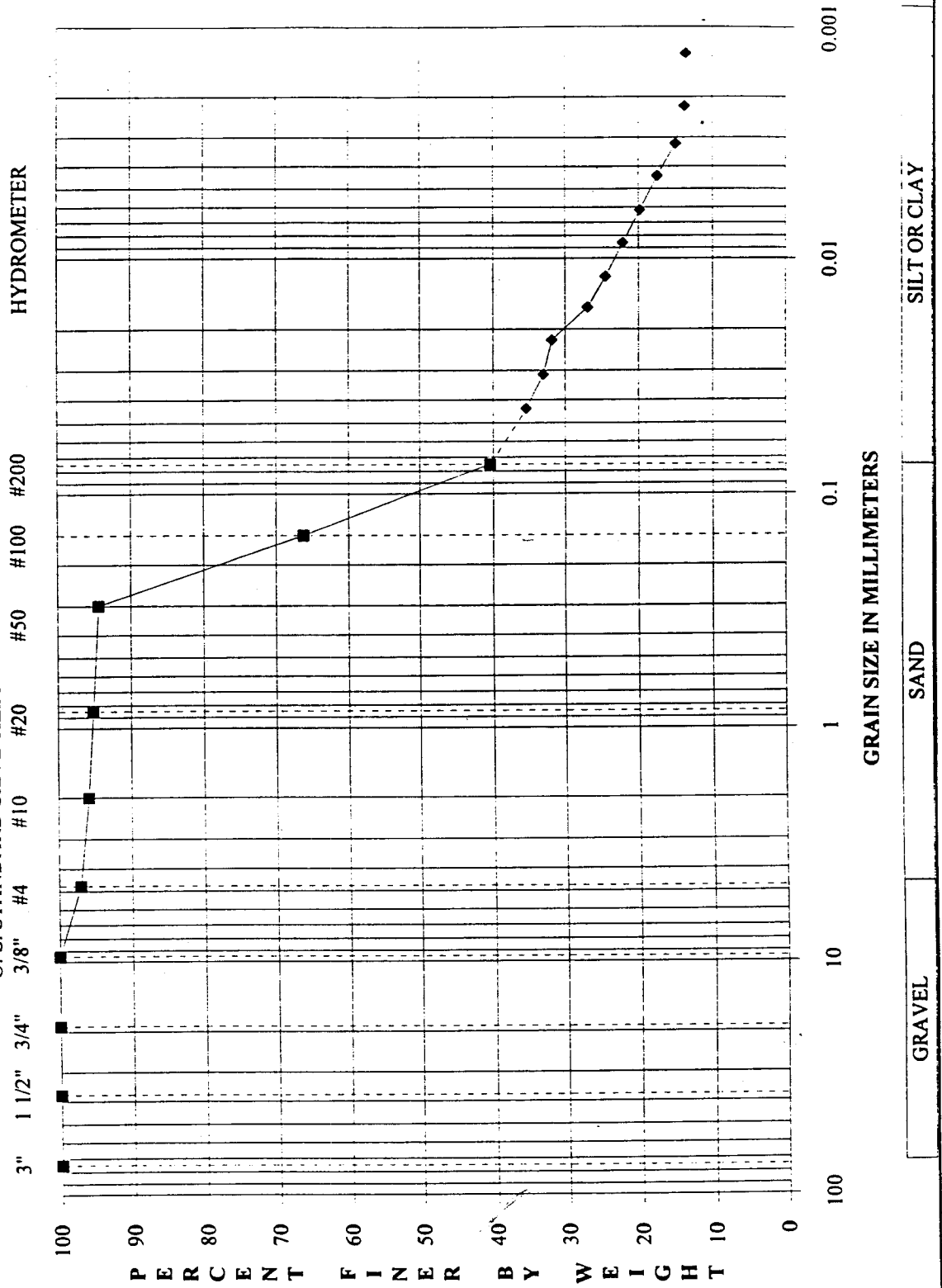
SAMPLE DESCRIPTION
orange clayey SAND with 3% gravel and 40% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
39.8	23.6	16.2

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW03-2006, ETL SAMPLE 9312G082-007
 U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS				
PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW03-2007	PROJECT ANALYST
JOB NUMBER	9312G082	ETL SAMPLE NUMBER	008	QA/QC ANALYST
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/09/93	DATE COMPLETED
				01/05/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	99.9
#50	0.300	96.9
#100	0.150	43.7
#200	0.075	35.2
HYDROMETER	0.0436	30.2
	0.0313	28.1
	0.0226	25.0
	0.0163	21.9
	0.0122	17.8
	0.0087	16.8
	0.0062	14.8
	0.0045	11.7
	0.0032	10.7
	0.0023	8.6
	0.0013	8.4
	0.0010	6.4

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.196
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
35.3

SAMPLE DESCRIPTION
orange clayey SAND with 35% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

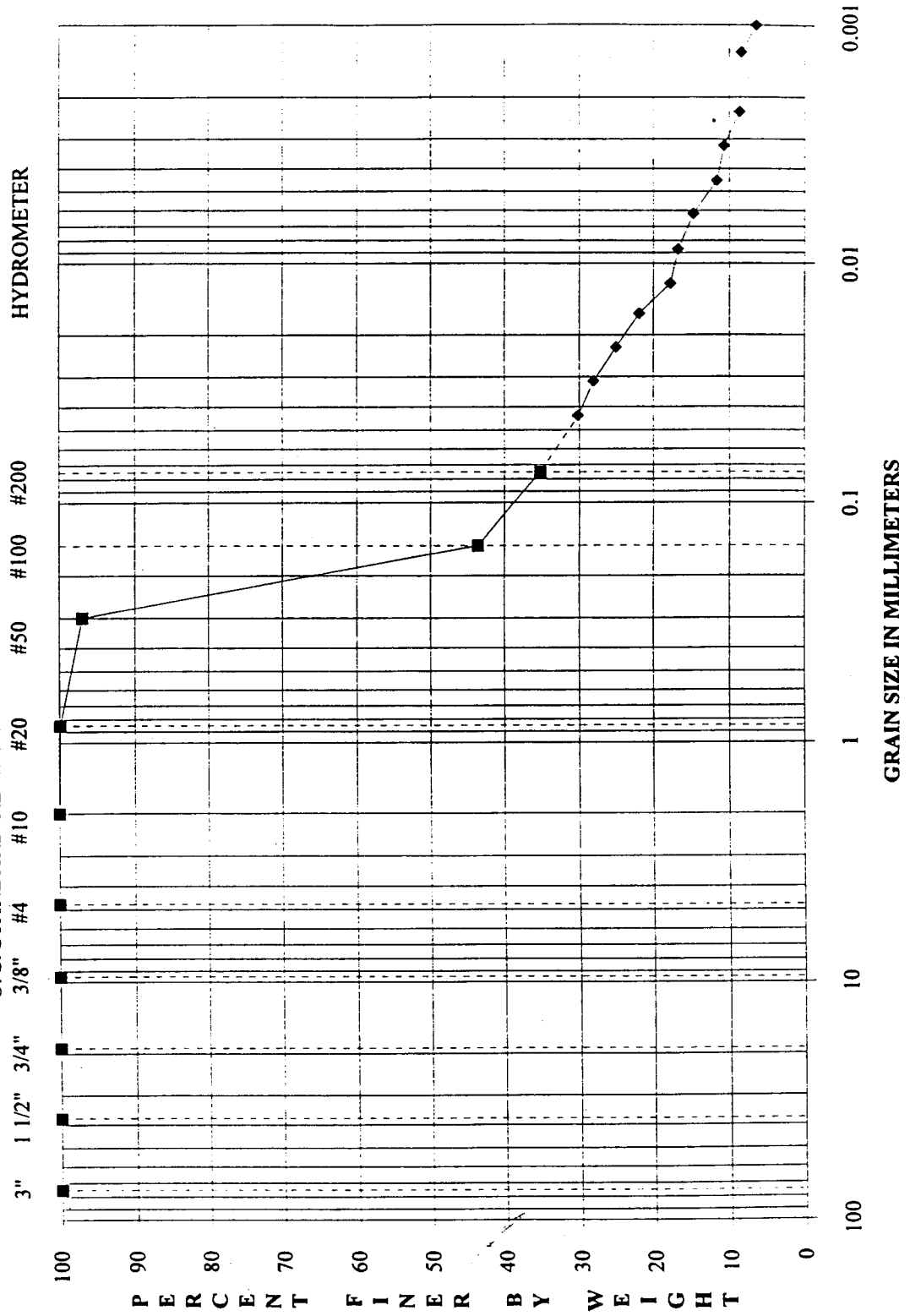
INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
31.5	20.3	11.2

NOTES
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW03-2007, ETL SAMPLE 9312G082-008

U.S. STANDARD SIEVE SIZES



SILT OR CLAY

SAND

GRAVEL

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

18932

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW03-2008	PROJECT ANALYST	WB
JOB NUMBER	9312G082	ETL SAMPLE NUMBER	009	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/09/93	DATE COMPLETED	01/06/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	100.0
#50	0.300	93.2
#100	0.150	39.0
#200	0.075	32.6
HYDROMETER	0.0452	30.8
	0.0324	28.5
	0.0233	26.1
	0.0167	23.8
	0.0123	21.4
	0.0088	19.1
	0.0063	16.7
	0.0046	13.2
	0.0032	12.0
	0.0024	9.4
	0.0014	7.3
	0.0010	6.1

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.208
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
26.3

SAMPLE DESCRIPTION
light gray clayey SAND with 33% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
26.3	18.0	8.3

NOTES

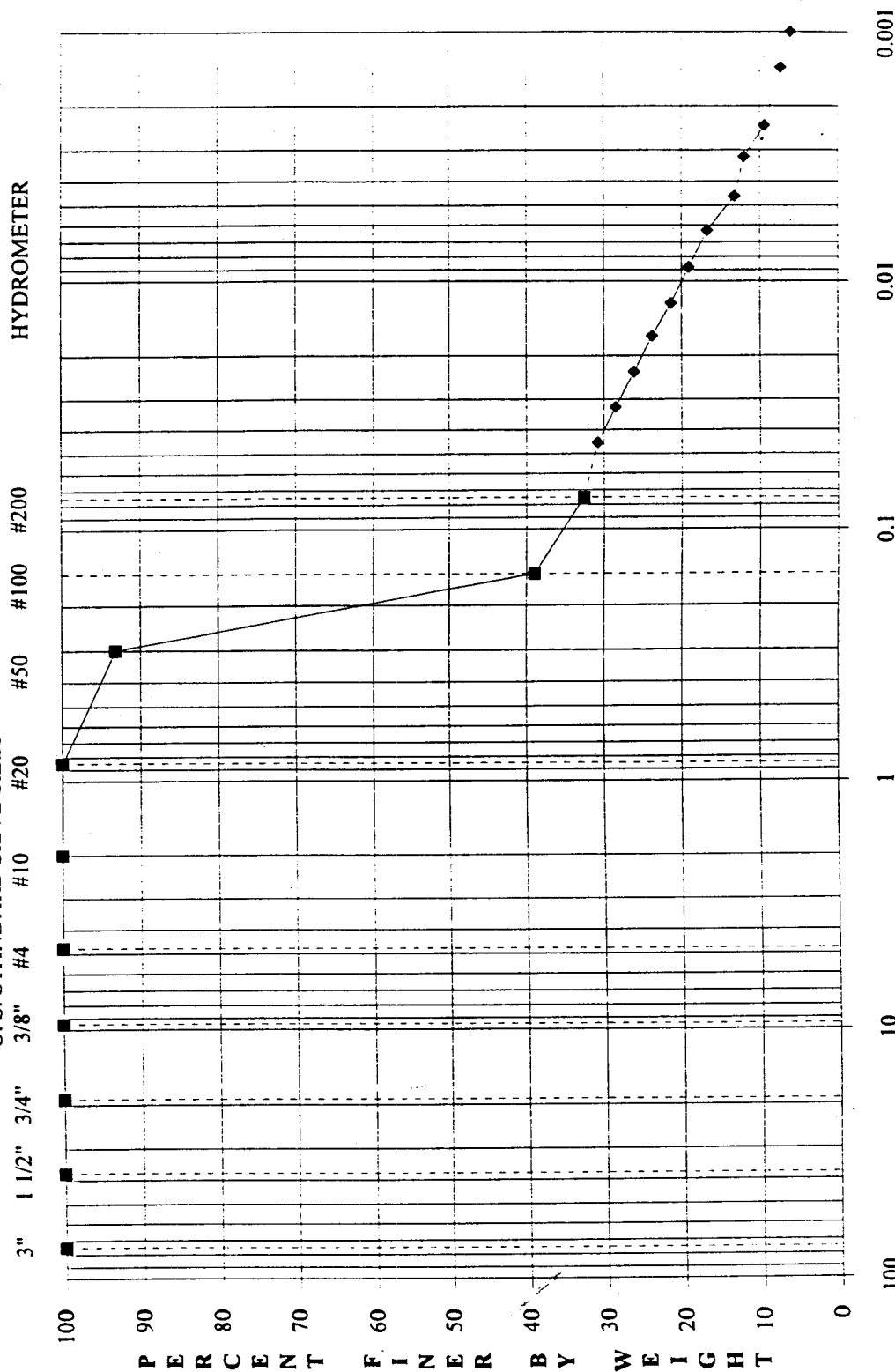
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PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW03-2008, ETL SAMPLE 9312G082-009

U. S. STANDARD SIEVE SIZES

HYDROMETER



GRAIN SIZE IN MILLIMETERS

SILT OR CLAY

SAND

GRAVEL

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	USA COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW03-2009	PROJECT ANALYST	WB
JOB NUMBER	9312G082	ETL SAMPLE NUMBER	010	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/09/93	DATE COMPLETED	01/06/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.6
#20	0.850	98.9
#50	0.300	93.9
#100	0.150	57.4
#200	0.075	48.6
HYDROMETER	0.0411	42.8
	0.0303	37.2
	0.0218	35.0
	0.0158	31.6
	0.0117	29.4
	0.0084	27.1
	0.0061	22.7
	0.0043	21.5
	0.0031	18.2
	0.0023	16.8
	0.0013	12.6
	0.0009	10.3

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.161
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
33.7

SAMPLE DESCRIPTION
light gray clayey SAND with 49% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

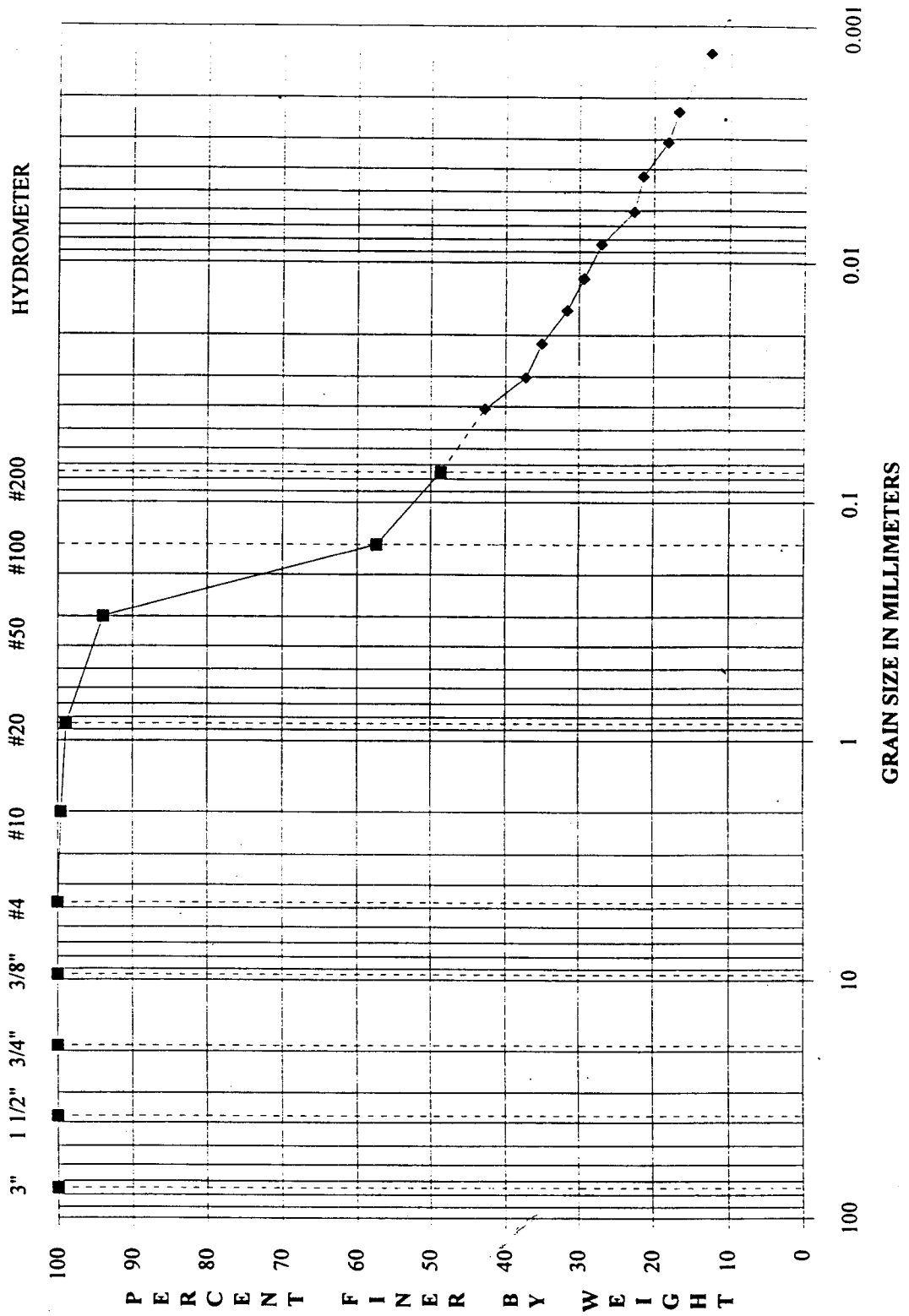
INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
30.4	18.8	11.6

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW03-2009, ETL SAMPLE 9312G082-010

U. S. STANDARD SIEVE SIZES



GRAVEL SAND SILT OR CLAY

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	Tulsa COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW05-2001	PROJECT ANALYST	WB
JOB NUMBER	9312L932	ETL SAMPLE NUMBER	001	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/20/93	DATE COMPLETED	01/07/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.7
#20	0.850	99.0
#50	0.300	97.8
#100	0.150	74.1
#200	0.075	38.4
HYDROMETER	0.0472	25.1
	0.0349	16.4
	0.0250	13.9
	0.0180	10.2
	0.0133	7.7
	0.0096	2.7
	0.0068	2.7
	0.0048	1.5
	0.0034	1.5
	0.0024	0.2
	0.0014	0.2
	0.0010	0.2

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.120
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
15.8

SAMPLE DESCRIPTION
light gray silty SAND with 38% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SM

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
16.7	16.7	0.0

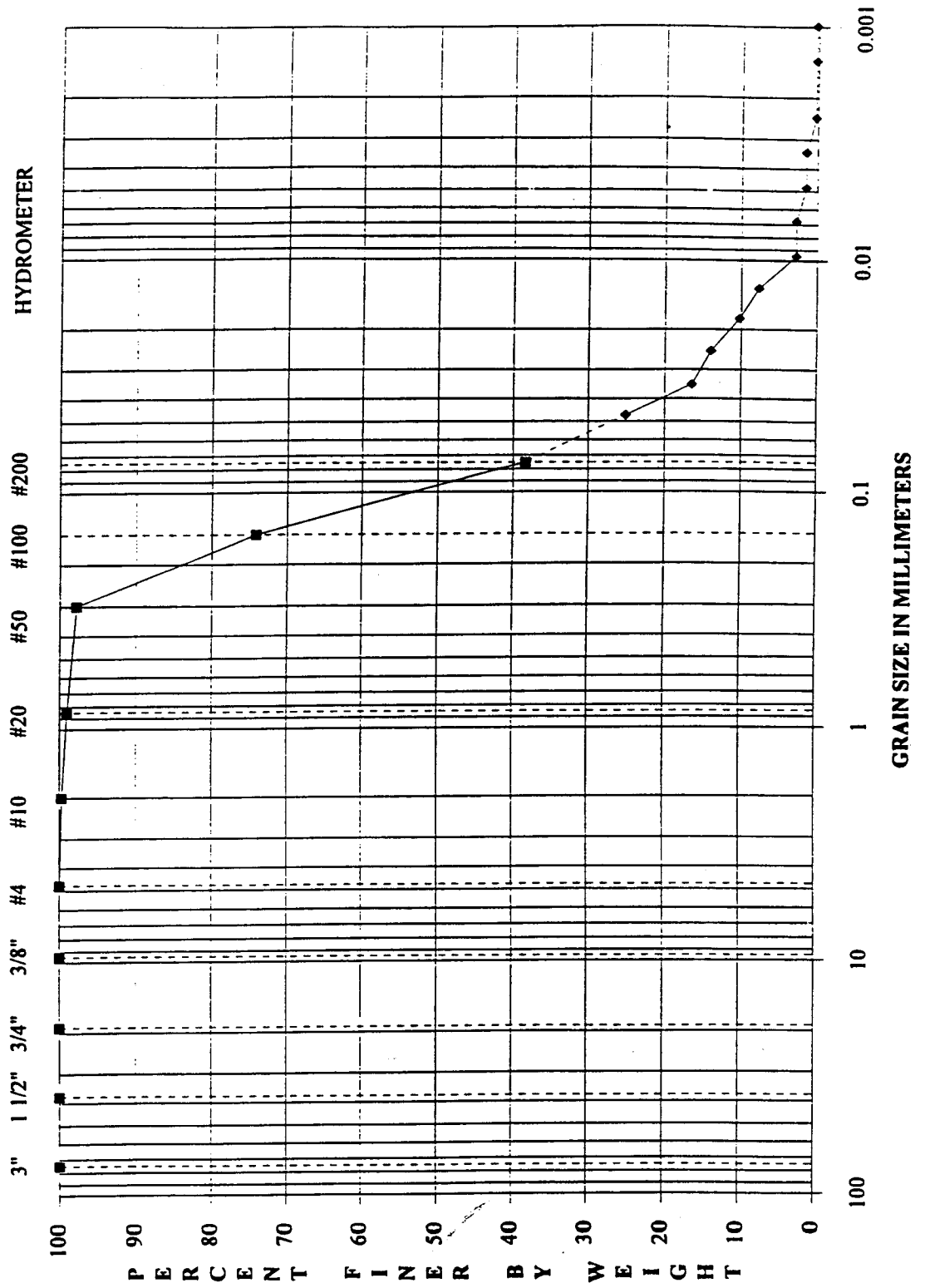
NOTES

NA=NOT APPLICABLE

GSC1.XLS

18936

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW05-2001, ETL SAMPLE 9312L932-001
U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

18938

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	Tulsa COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW05-2003	PROJECT ANALYST	WB
JOB NUMBER	9312L932	ETL SAMPLE NUMBER	003	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/20/93	DATE COMPLETED	01/06/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	100.0
#50	0.300	99.3
#100	0.150	80.1
#200	0.075	56.8
HYDROMETER	0.0411	46.1
	0.0301	41.3
	0.0219	36.5
	0.0159	32.8
	0.0118	30.4
	0.0085	26.8
	0.0061	24.4
	0.0044	22.0
	0.0031	20.8
	0.0022	19.3
	0.0013	17.1
	0.0009	15.9

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.085
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
18.9

SAMPLE DESCRIPTION
orange brown CLAY of low plasticity with 43% sand
Unified Soil Classification System (USCS)
Group Symbol
CL

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
24.6	16.7	7.9

NOTES

NA=NOT APPLICABLE

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

18939

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW05-2005	PROJECT ANALYST	WB
JOB NUMBER	9312L932	ETL SAMPLE NUMBER	006	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/20/93	DATE COMPLETED	01/07/94

PARTICLE SIZE DISTRIBUTION

U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.5
#20	0.850	99.3
#50	0.300	98.8
#100	0.150	76.6
#200	0.075	63.2
HYDROMETER	0.0400	48.1
	0.0285	47.0
	0.0204	45.8
	0.0145	44.6
	0.0108	42.3
	0.0077	41.1
	0.0055	38.8
	0.0039	37.6
	0.0028	36.5
	0.0020	35.3
	0.0012	32.9
	0.0008	31.8

EFFECTIVE SIZES

% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis

21.7

SAMPLE DESCRIPTION

orange brown CLAY of low plasticity with 37% sand

Unified Soil Classification System (USCS)

Group Symbol

CL

INDEX PROPERTIES

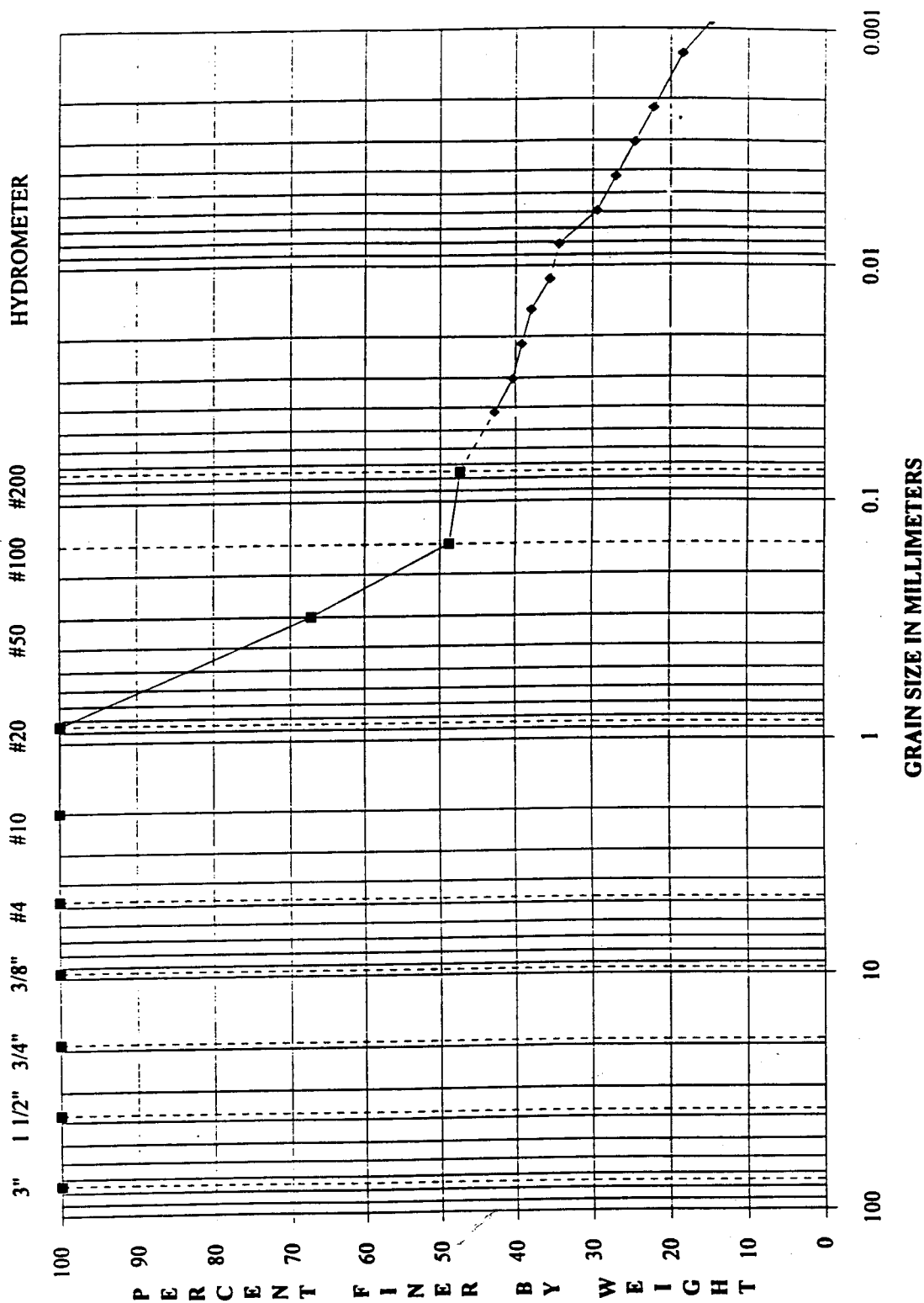
% moisture dry basis

Liquid Limit	Plastic Limit	Plasticity Index
49.5	16.7	32.8

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW05-2007, ETL SAMPLE 9312L932-007
U.S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018941

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	Tulsa COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW05-2008	PROJECT ANALYST	WB
JOB NUMBER	9312L932	ETL SAMPLE NUMBER	008	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/20/93	DATE COMPLETED	01/07/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.9
#20	0.850	99.9
#50	0.300	99.7
#100	0.150	52.0
#200	0.075	39.1
HYDROMETER	0.0446	36.1
	0.0320	33.5
	0.0229	30.9
	0.0163	29.7
	0.0121	27.1
	0.0087	23.3
	0.0063	19.4
	0.0045	16.9
	0.0032	14.3
	0.0023	11.8
	0.0013	9.2
	0.0010	6.6

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.175
30	NA
10	NA
Uniformity Coefficient	Gradation
NA	NA

SAMPLE DESCRIPTION
light gray brown clayey SAND with 39% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

NATURAL MOISTURE CONTENT, % dry basis
32.0

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
29.3	16.7	12.6

NOTES

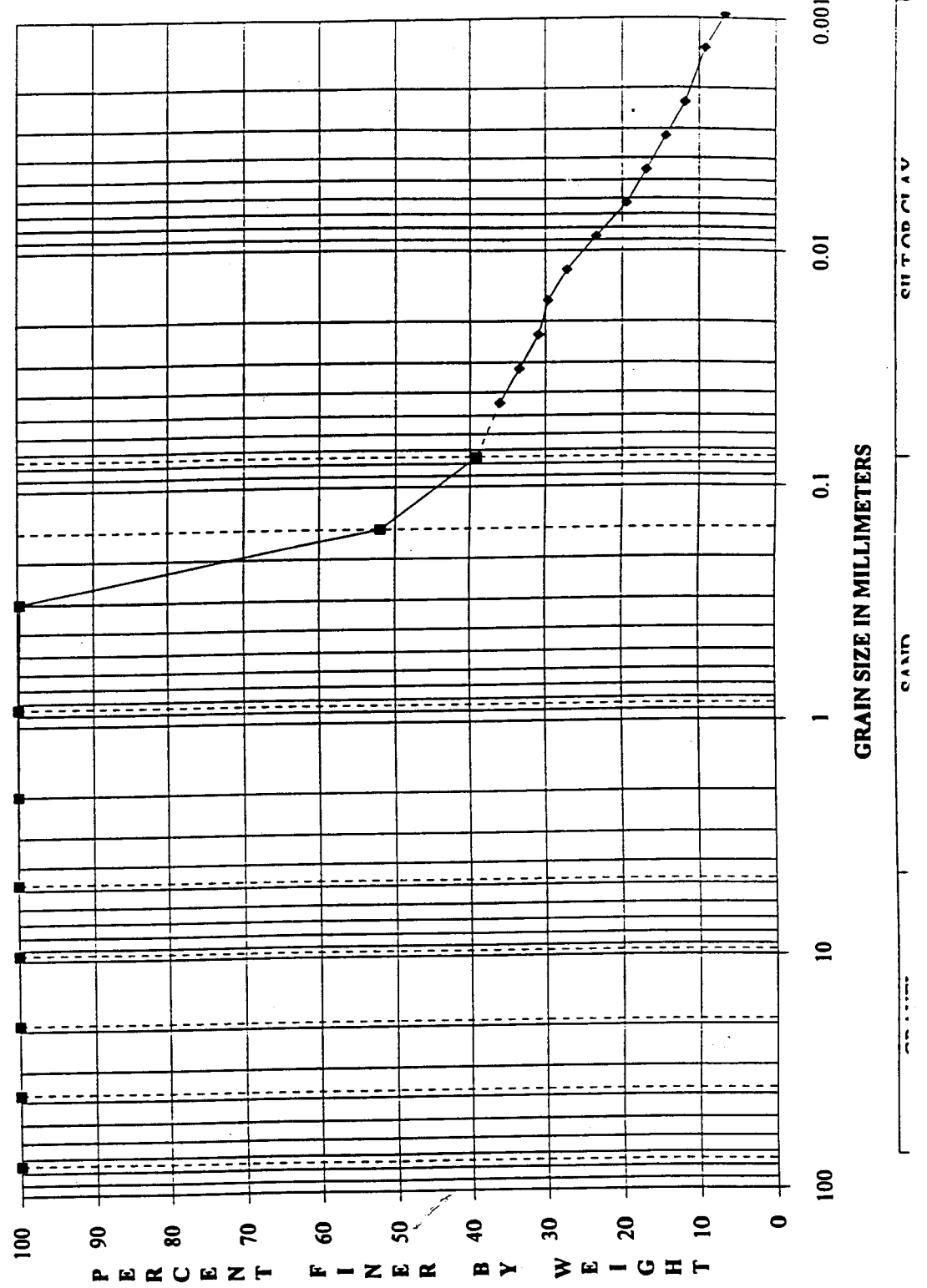
NA=NOT APPLICABLE

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

**PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW05-2008, ETL SAMPLE 9312L932-008**

U.S. STANDARD SIEVE SIZES

HYDROMETER



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

13943

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	Tulsa COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW05-2009	PROJECT ANALYST	WB
JOB NUMBER	9312L932	ETL SAMPLE NUMBER	009	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/20/93	DATE COMPLETED	01/07/94

PARTICLE SIZE DISTRIBUTION			
U. S. Standard Sieve Size	Diameter mm	% Finer	
3"	75.00	100.0	
1 1/2"	37.50	100.0	
3/4"	19.00	100.0	
3/8"	9.500	100.0	
#4	4.750	100.0	
#10	2.000	100.0	
#20	0.850	100.0	
#50	0.300	98.6	
#100	0.150	59.3	
#200	0.075	48.3	
HYDROMETER	0.0425	41.6	
	0.0303	40.4	
	0.0218	38.0	
	0.0155	36.7	
	0.0114	35.5	
	0.0081	34.3	
	0.0060	28.2	
	0.0042	27.0	
	0.0031	23.4	
	0.0022	19.7	
	0.0013	17.3	
	0.0009	14.8	

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.153
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

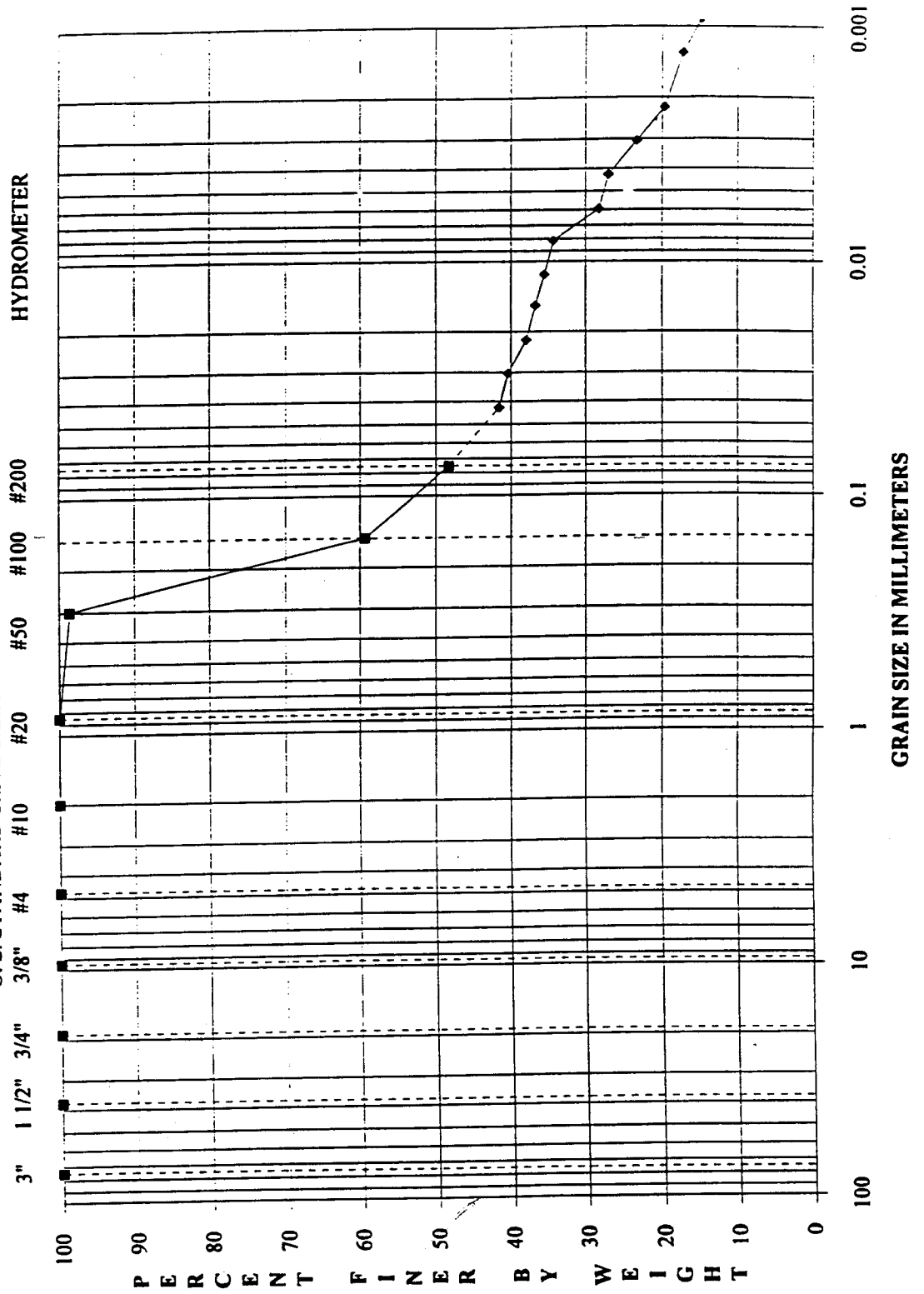
SAMPLE DESCRIPTION	
light gray brown clayey SAND with 48% fines of low plasticity	
Unified Soil Classification System (USCS)	
Group Symbol	SC

NATURAL MOISTURE CONTENT, % dry basis	
26.4	

INDEX PROPERTIES % moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
33.0	16.7	16.3

NOTES
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-MW05-2009, ETL SAMPLE 9312L932-009
U.S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB01-2001	PROJECT ANALYST	WB
JOB NUMBER	9312L040	ETL SAMPLE NUMBER	001	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/12/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.3
#20	0.850	98.9
#50	0.300	98.2
#100	0.150	91.3
#200	0.075	76.2
HYDROMETER	0.0381	58.3
	0.0280	53.2
	0.0200	52.0
	0.0148	45.7
	0.0110	43.1
	0.0078	41.9
	0.0056	39.4
	0.0041	35.6
	0.0029	33.1
	0.0021	30.5
	0.0012	28.0
	0.0009	20.4

EFFECTIVE SIZES	
% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

SAMPLE DESCRIPTION
orange brown CLAY of low plasticity with 24% sand
Unified Soil Classification System (USCS) Group Symbol
CL

NATURAL MOISTURE CONTENT, % dry basis
33.5

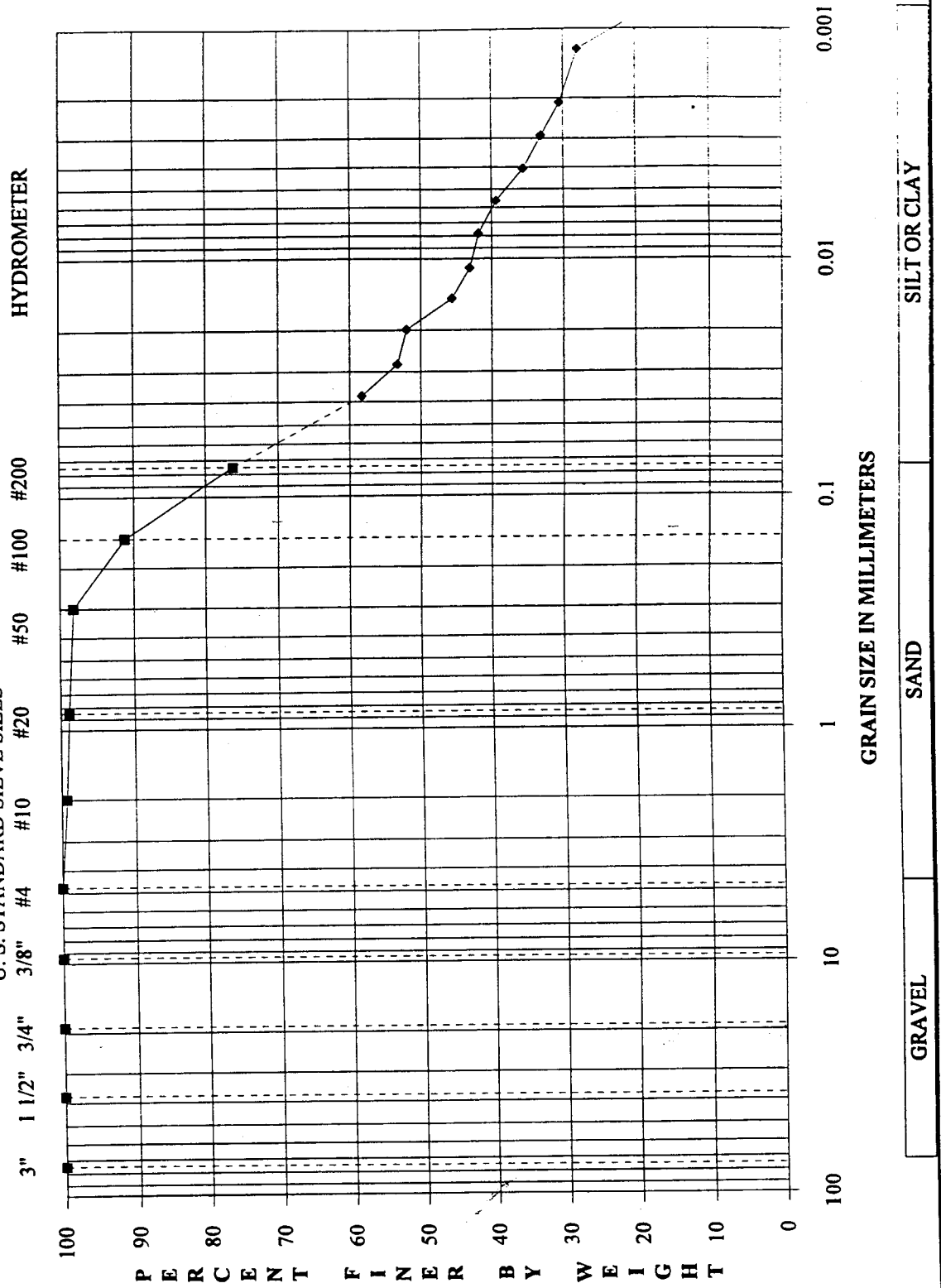
INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
47.3	20.4	26.9

NOTES

NA=NOT APPLICABLE

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-SB01-2001, ETL SAMPLE 9312L040-001
U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018947

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB01-2003	PROJECT ANALYST	WB
JOB NUMBER	9312L040	ETL SAMPLE NUMBER	003	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/12/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.9
#20	0.850	99.7
#50	0.300	99.4
#100	0.150	84.0
#200	0.075	71.2
HYDROMETER	0.0372	61.5
	0.0272	57.7
	0.0200	52.6
	0.0145	48.8
	0.0109	44.9
	0.0079	41.1
	0.0058	36.0
	0.0042	30.9
	0.0030	27.1
	0.0022	24.5
	0.0013	18.1
	0.0009	15.6

EFFECTIVE SIZES	
% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

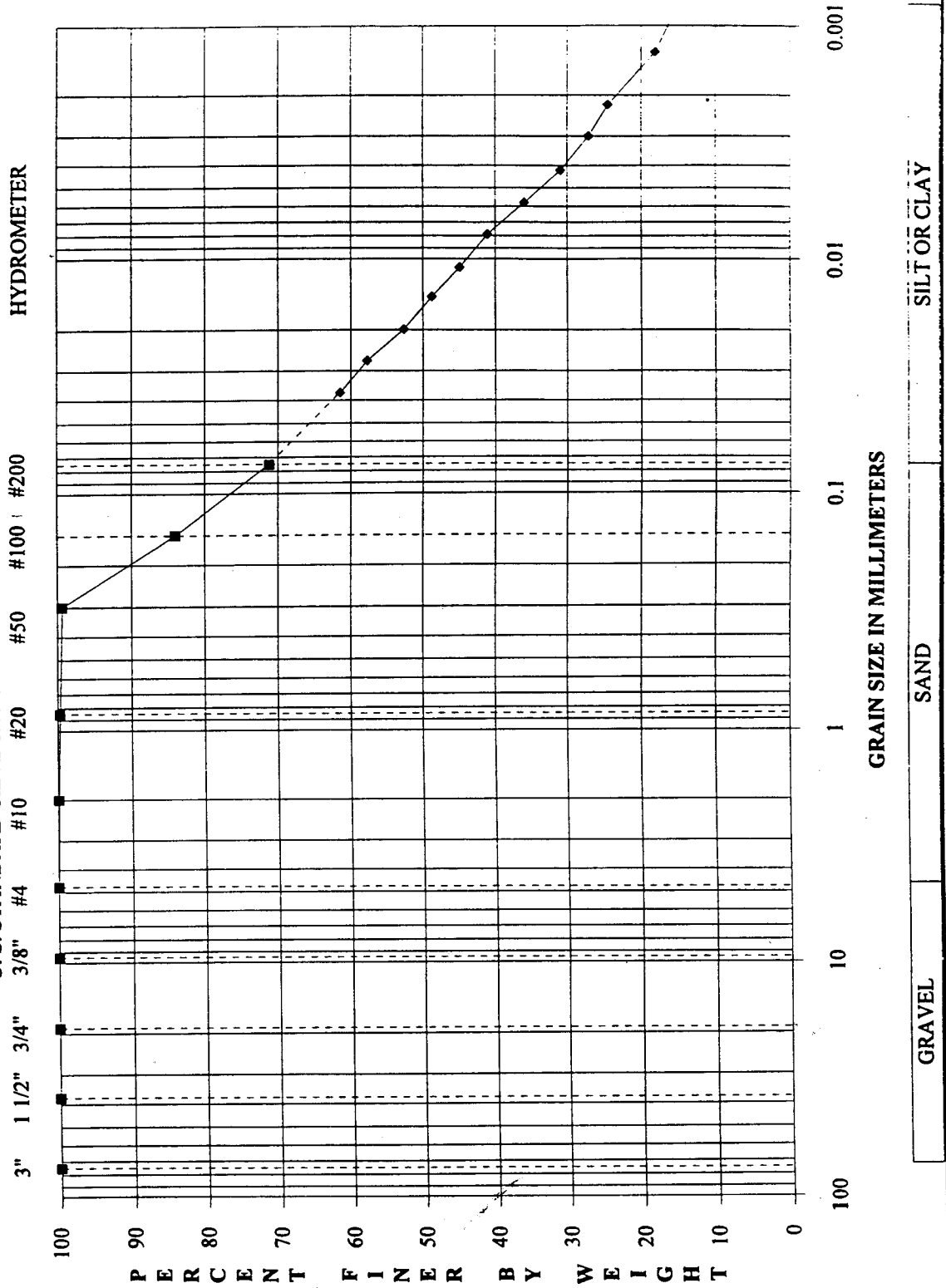
NATURAL MOISTURE CONTENT, % dry basis
24.8

SAMPLE DESCRIPTION
orange brown CLAY of low plasticity with 29% sand
Unified Soil Classification System (USCS) Group Symbol CL

INDEX PROPERTIES % moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
43.9	20.3	23.6

NOTES
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-SB01-2003, ETL SAMPLE 9312L040-003
U.S. STANDARD SIEVE SIZES
HYDROMETER



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB01-2005	PROJECT ANALYST	WB
JOB NUMBER	9312L040	ETL SAMPLE NUMBER	005	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/12/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	95.7
#20	0.850	94.3
#50	0.300	93.5
#100	0.150	77.2
#200	0.075	70.1
HYDROMETER	0.0449	34.3
	0.0322	31.7
	0.0231	29.2
	0.0164	28.0
	0.0122	25.4
	0.0087	22.9
	0.0062	20.4
	0.0045	17.9
	0.0032	15.4
	0.0023	12.9
	0.0013	9.1
	0.0010	6.6

EFFECTIVE SIZES	
% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
23.5

SAMPLE DESCRIPTION
brown CLAY of low plasticity with 30% sand
Unified Soil Classification System (USCS)
Group Symbol
CL

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
43.1	22.3	20.8

NOTES

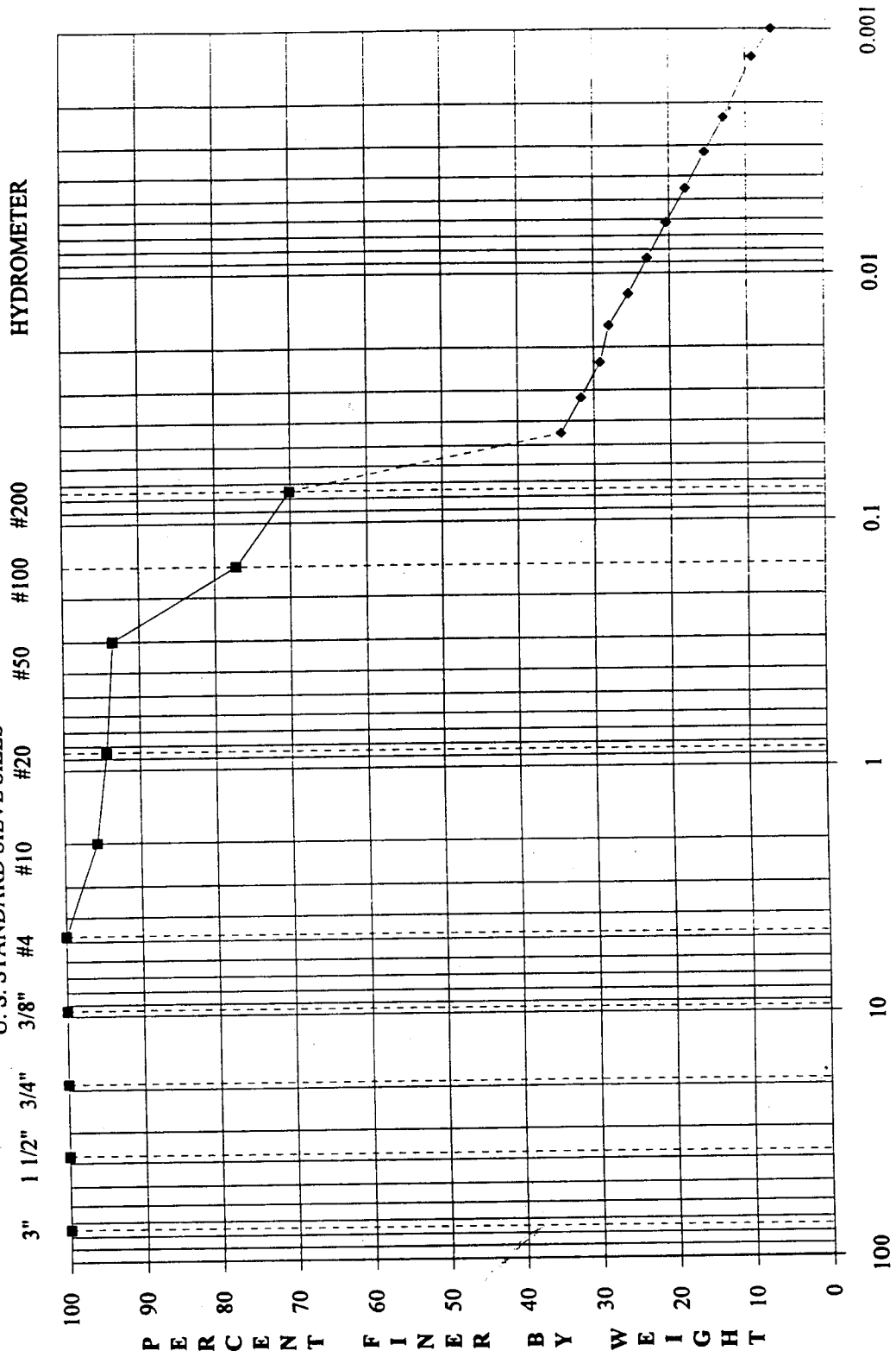
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-SB01-2005, ETL SAMPLE 9312L040-005

U. S. STANDARD SIEVE SIZES

HYDROMETER



GRAIN SIZE IN MILLIMETERS

GRAVEL SAND SILT OR CLAY

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB01-2007	PROJECT ANALYST	WB
JOB NUMBER	93121040	ETL SAMPLE NUMBER	007	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/12/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	100.0
#50	0.300	99.8
#100	0.150	62.9
#200	0.075	37.2
HYDROMETER	0.0452	32.2
	0.0324	29.7
	0.0233	27.3
	0.0167	24.8
	0.0123	23.6
	0.0087	22.3
	0.0063	18.7
	0.0045	16.2
	0.0032	13.8
	0.0023	12.5
	0.0013	10.1
	0.0010	7.6

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.142
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
24.8

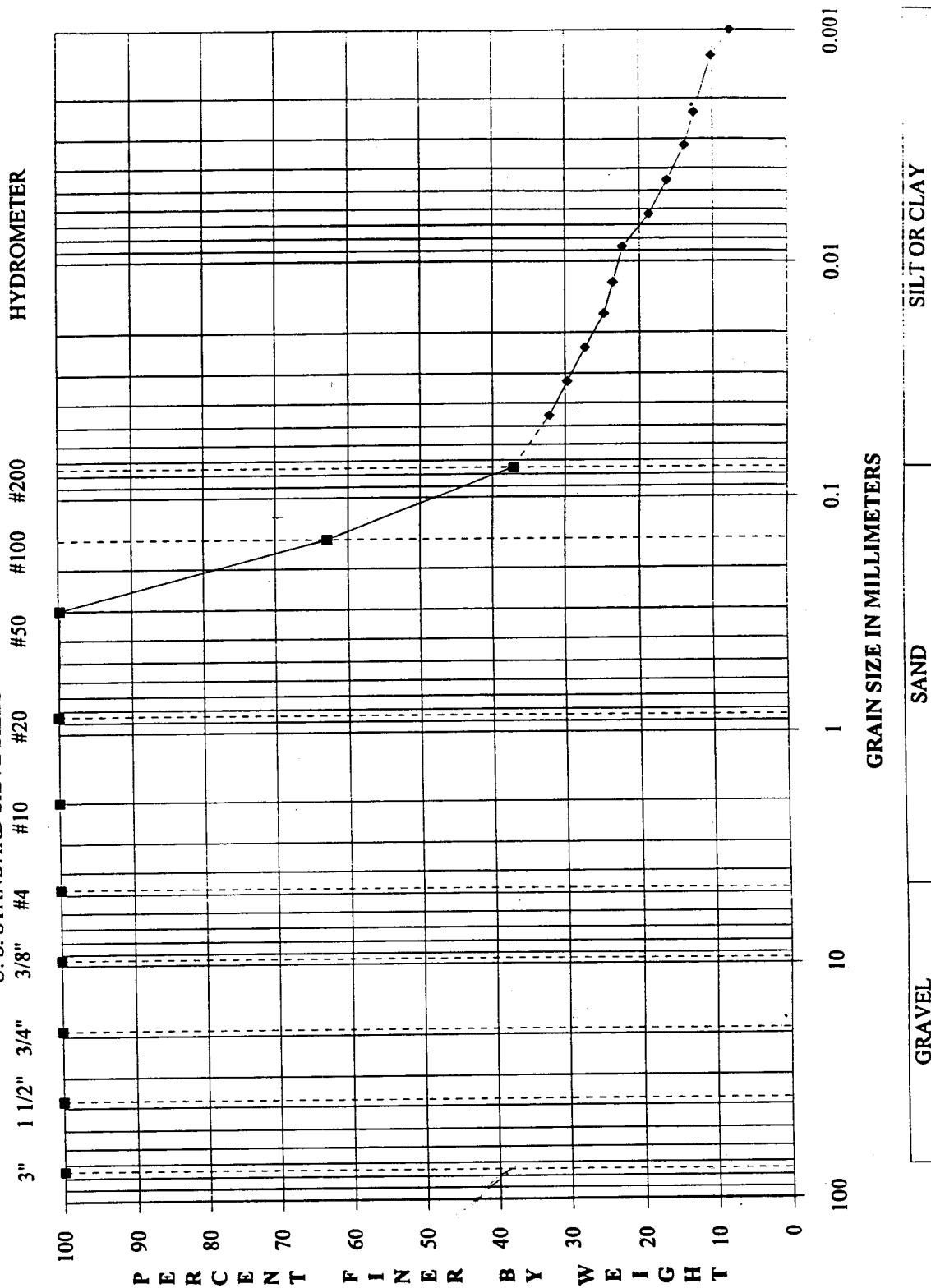
SAMPLE DESCRIPTION
light brown clayey SAND with 37% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
40.3	20.1	20.2

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-SB01-2007, ETL SAMPLE 9312L040-007
 U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB01-2009	PROJECT ANALYST	WB
JOB NUMBER	9312L040	ETL SAMPLE NUMBER	009	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/12/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	100.0
#50	0.300	99.7
#100	0.150	42.8
#200	0.075	28.0
HYDROMETER	0.0475	24.2
	0.0338	22.9
	0.0242	20.4
	0.0173	17.9
	0.0128	15.3
	0.0091	15.3
	0.0065	12.8
	0.0046	11.6
	0.0033	9.1
	0.0023	9.1
	0.0014	6.5
	0.0010	4.0

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.195
30	0.085
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
25.1

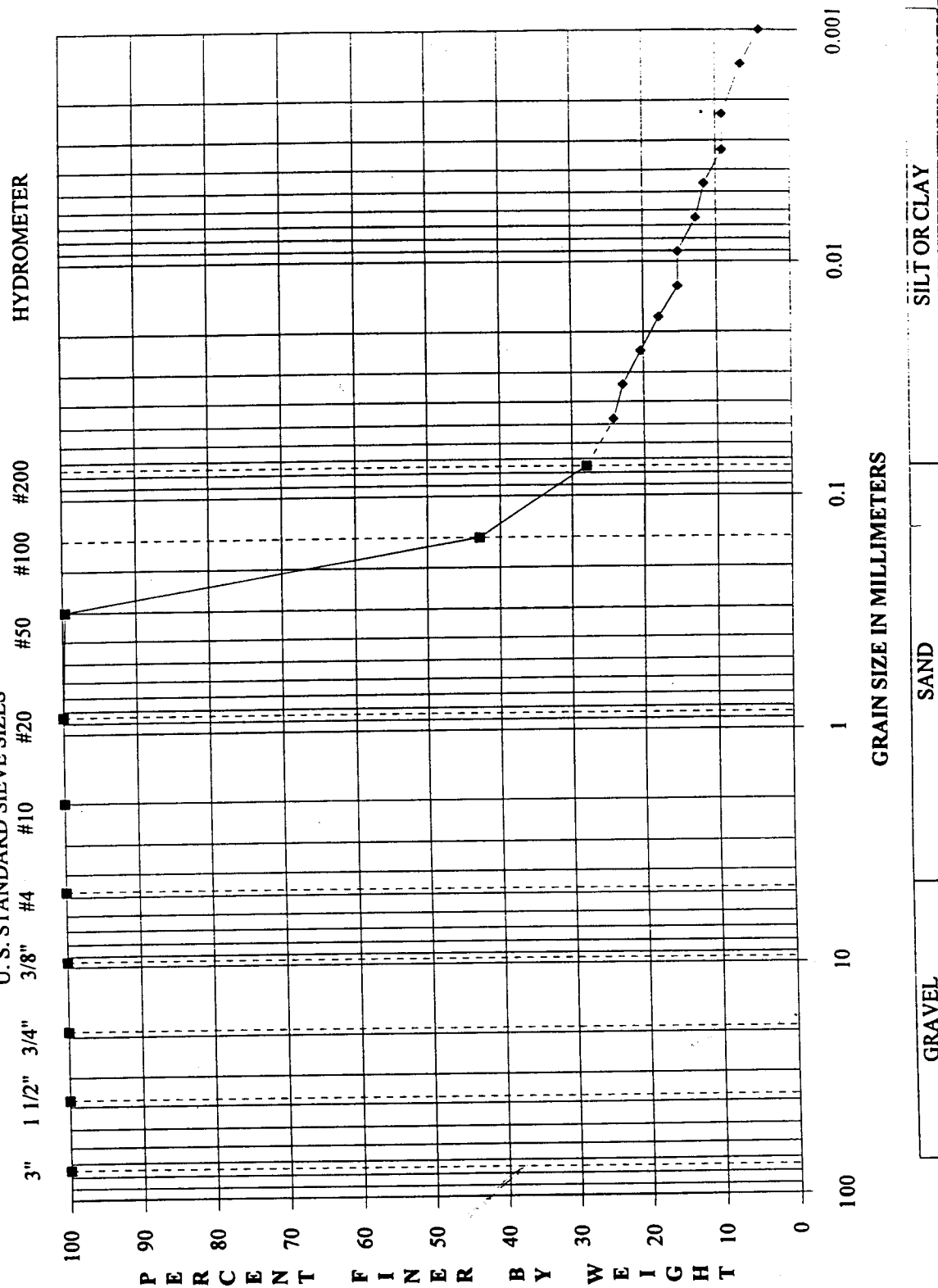
SAMPLE DESCRIPTION
light brown clayey SAND with 28% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
46.0	21.3	24.7

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-SB01-2009, ETL SAMPLE 9312L040-009
U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB02-2001	PROJECT ANALYST	WB
JOB NUMBER	9312L022	ETL SAMPLE NUMBER	004	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/09/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.2
#20	0.850	98.8
#50	0.300	98.4
#100	0.150	92.0
#200	0.075	74.1
HYDROMETER	0.0418	45.5
	0.0301	43.0
	0.0214	41.8
	0.0155	38.0
	0.0114	36.7
	0.0082	34.2
	0.0058	33.0
	0.0042	31.7
	0.0030	29.2
	0.0021	29.2
	0.0012	27.9
	0.0009	26.7

EFFECTIVE SIZES	
% Finer	Diameter mm
60	NA
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
25.3

SAMPLE DESCRIPTION
orange-red CLAY of high plasticity with 26% sand
Unified Soil Classification System (USCS) Group Symbol CH

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
62.7	23.8	38.9

NOTES

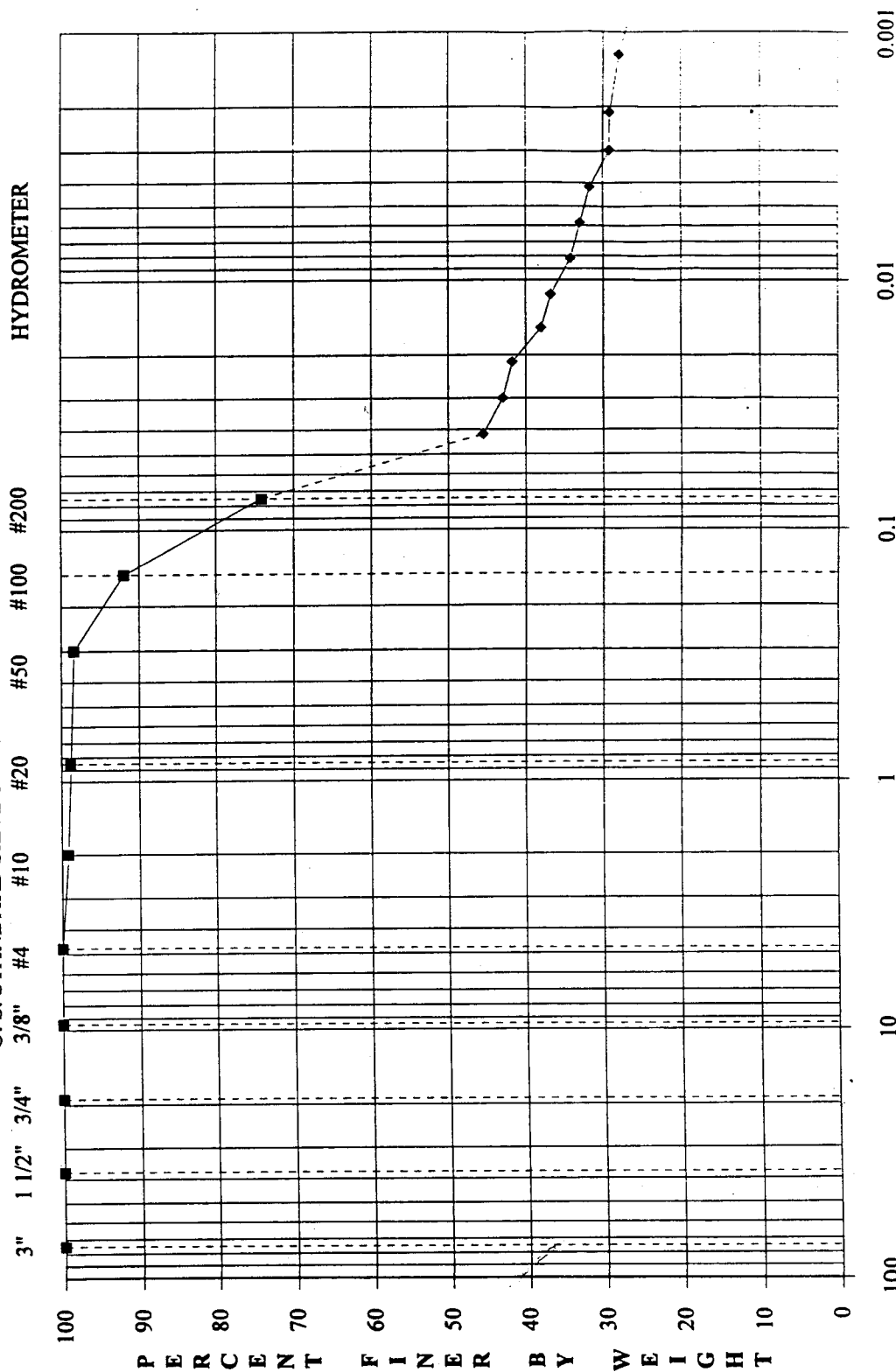
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-SB02-2001, ETL SAMPLE 9312L022-004

U. S. STANDARD SIEVE SIZES

HYDROMETER



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018957

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB02-2003	PROJECT ANALYST	WB
JOB NUMBER	9312L022	ETL SAMPLE NUMBER	006	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/09/94

PARTICLE SIZE DISTRIBUTION			
U. S. Standard Sieve Size	Diameter mm	% Finer	
3"	75.00	100.0	
1 1/2"	37.50	100.0	
3/4"	19.00	100.0	
3/8"	9.500	100.0	
#4	4.750	100.0	
#10	2.000	100.0	
#20	0.850	99.8	
#50	0.300	98.8	
#100	0.150	61.6	
#200	0.075	52.9	
HYDROMETER	0.0429	42.4	
	0.0310	38.6	
	0.0226	33.5	
	0.0162	30.9	
	0.0119	29.6	
	0.0086	27.1	
	0.0062	23.3	
	0.0044	19.4	
	0.0032	16.9	
	0.0023	16.9	
	0.0013	15.6	
	0.0009	14.3	

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.136
30	NA
10	NA
Uniformity Coefficient	Gradation
NA	NA

SAMPLE DESCRIPTION
light orange-brown CLAY of low plasticity with 47% sand
Unified Soil Classification System (USCS)
Group Symbol
CL

NATURAL MOISTURE CONTENT, % dry basis
26.0

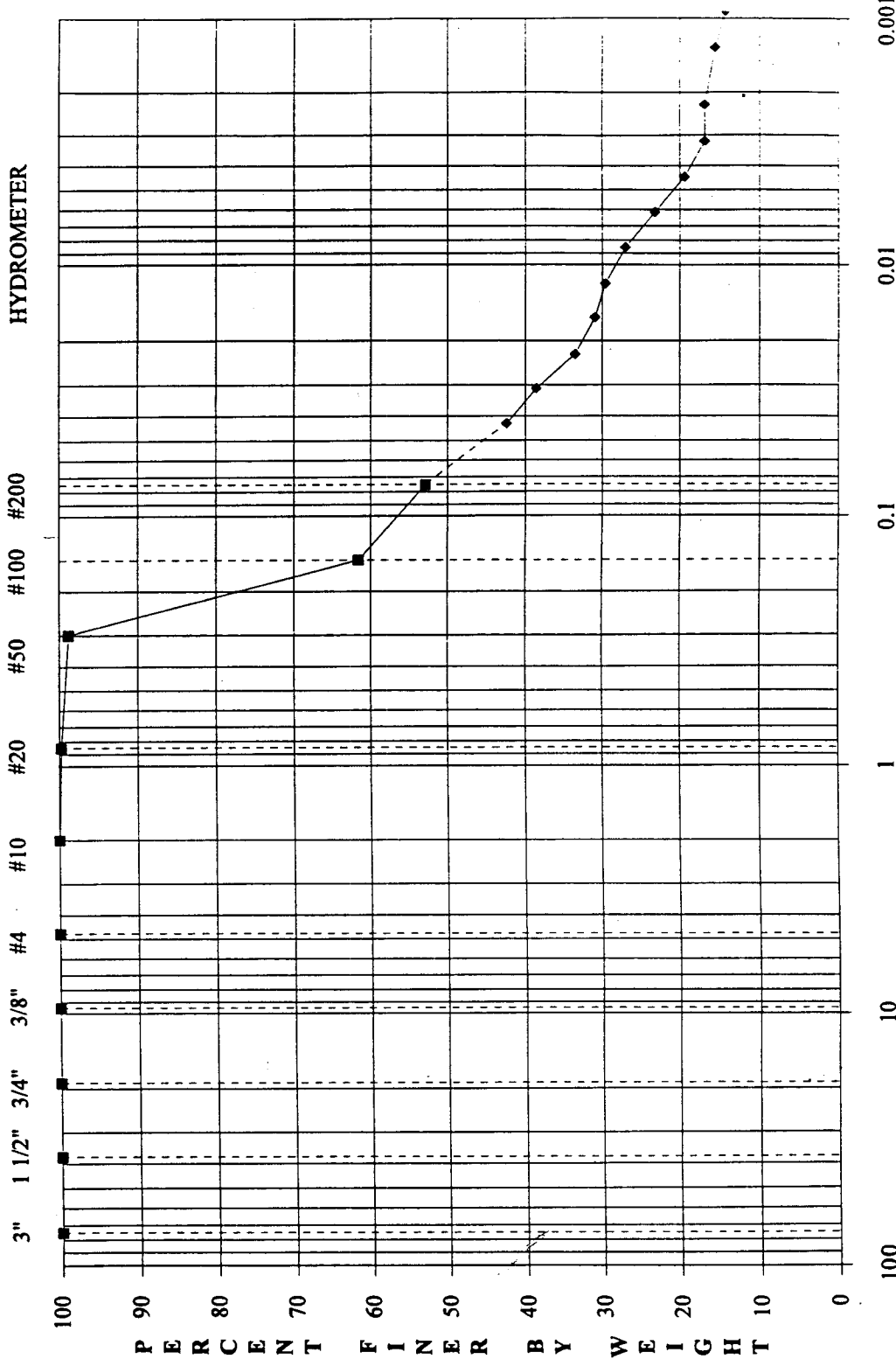
INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
39.4	22.4	17.0

NOTES
NA=NOT APPLICABLE

**PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-SB02-2003, ETL SAMPLE 9312L022-006**

U.S. STANDARD SIEVE SIZES

HYDROMETER



GRAIN SIZE IN MILLIMETERS

SILT OR CLAY

SAND

GRAVEL

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

18959

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB02-2005	PROJECT ANALYST	WB
JOB NUMBER	9312L022	ETL SAMPLE NUMBER	008	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/08/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	100.0
#50	0.300	99.8
#100	0.150	66.9
#200	0.075	38.1
HYDROMETER	0.0452	33.2
	0.0327	29.4
	0.0234	26.9
	0.0169	23.1
	0.0124	21.8
	0.0088	20.5
	0.0064	16.7
	0.0046	14.2
	0.0033	11.7
	0.0023	9.1
	0.0014	6.6
	0.0010	5.3

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.132
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
24.1

SAMPLE DESCRIPTION
light brown clayey SAND with 38% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
37.4	22.8	14.6

NOTES

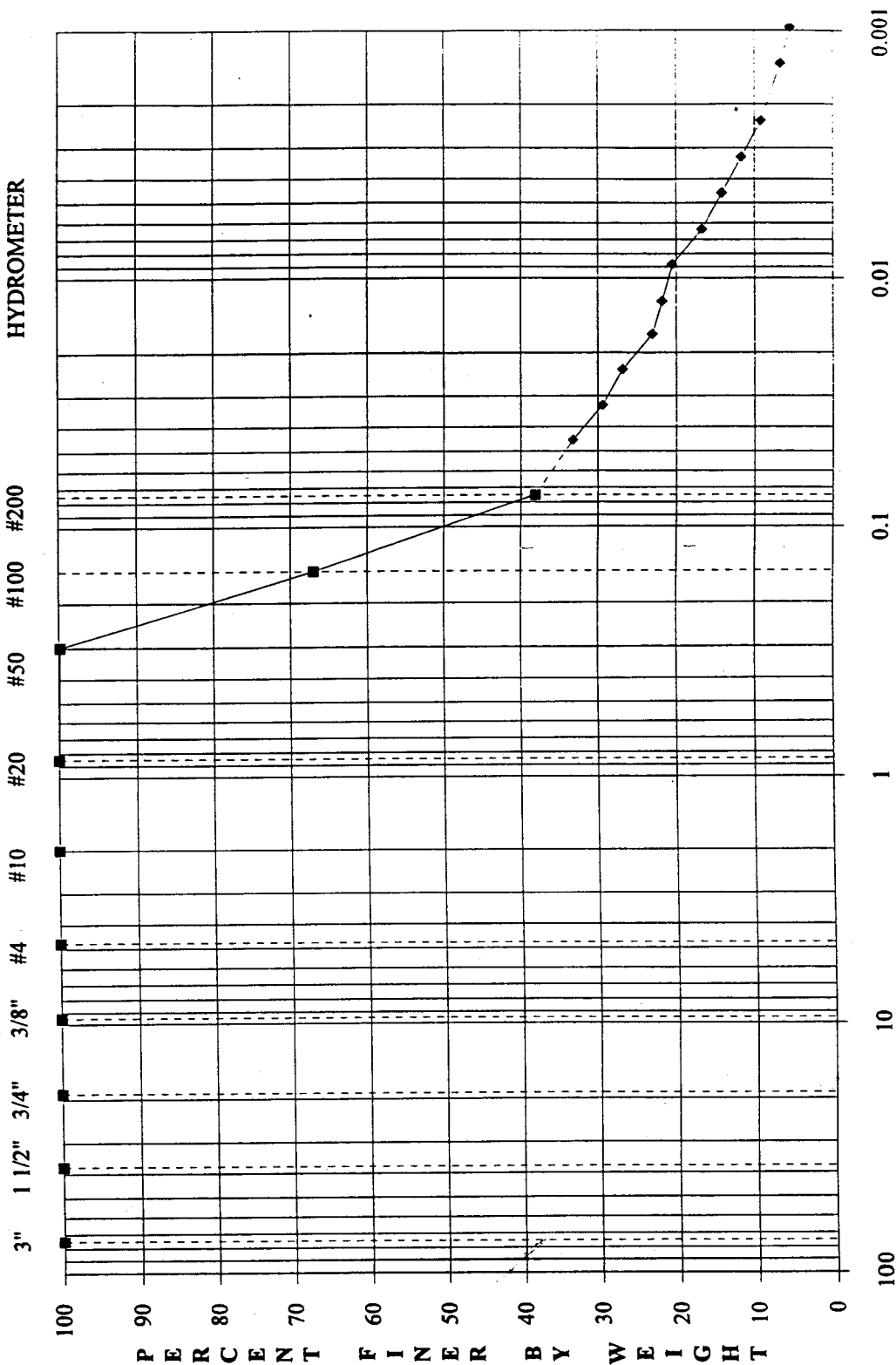
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-SB02-2005, ETL SAMPLE 9312L022-008

U. S. STANDARD SIEVE SIZES

HYDROMETER



GRAVEL SAND SILT OR CLAY

GRAVEL

SAND

SILT OR CLAY

18960

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB02-2007	PROJECT ANALYST	WB
JOB NUMBER	9312L022	ETL SAMPLE NUMBER	010	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/08/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	99.9
#50	0.300	99.6
#100	0.150	67.9
#200	0.075	38.5
HYDROMETER	0.0446	36.4
	0.0322	32.5
	0.0231	29.9
	0.0166	27.3
	0.0123	24.8
	0.0088	22.2
	0.0063	18.3
	0.0045	15.7
	0.0032	13.2
	0.0023	10.6
	0.0014	8.0
	0.0010	6.7

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.130
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
32.9

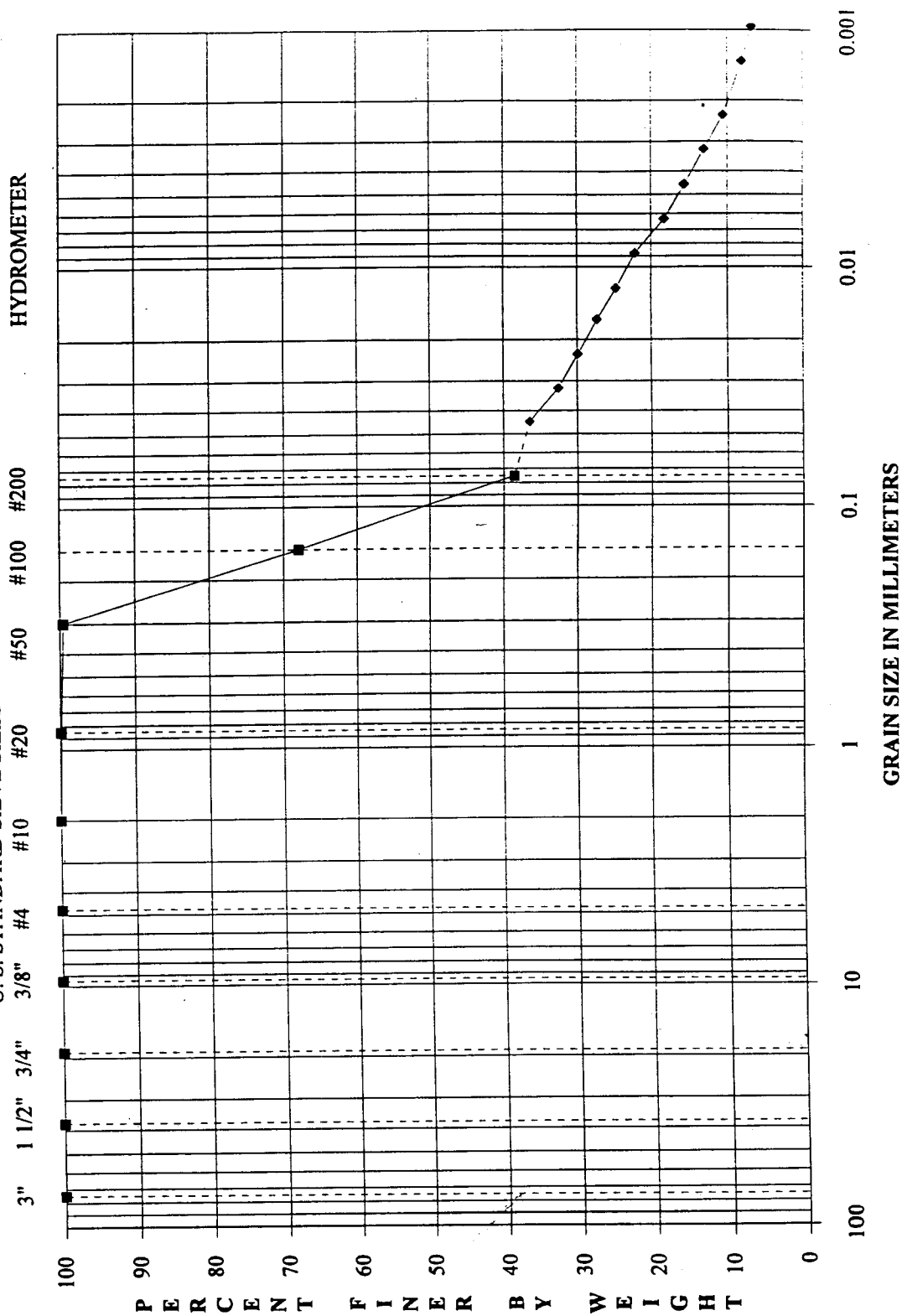
SAMPLE DESCRIPTION
light brown clayey SAND with 38% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
35.9	23.3	12.6

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-SB02-2007, ETL SAMPLE 9312L022-010
 U. S. STANDARD SIEVE SIZES



SILT OR CLAY

SAND

GRAVEL

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SW02-2009	PROJECT ANALYST	WB
JOB NUMBER	9312L022	ETL SAMPLE NUMBER	012	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/09/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	98.7
#4	4.750	95.9
#10	2.000	95.9
#20	0.850	95.8
#50	0.300	95.4
#100	0.150	48.5
#200	0.075	32.5
HYDROMETER	0.0469	25.6
	0.0338	22.0
	0.0242	19.6
	0.0172	18.4
	0.0127	16.0
	0.0091	14.8
	0.0065	12.3
	0.0046	9.9
	0.0033	8.7
	0.0023	7.5
	0.0014	6.3
	0.0010	5.1

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.187
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis	27.6
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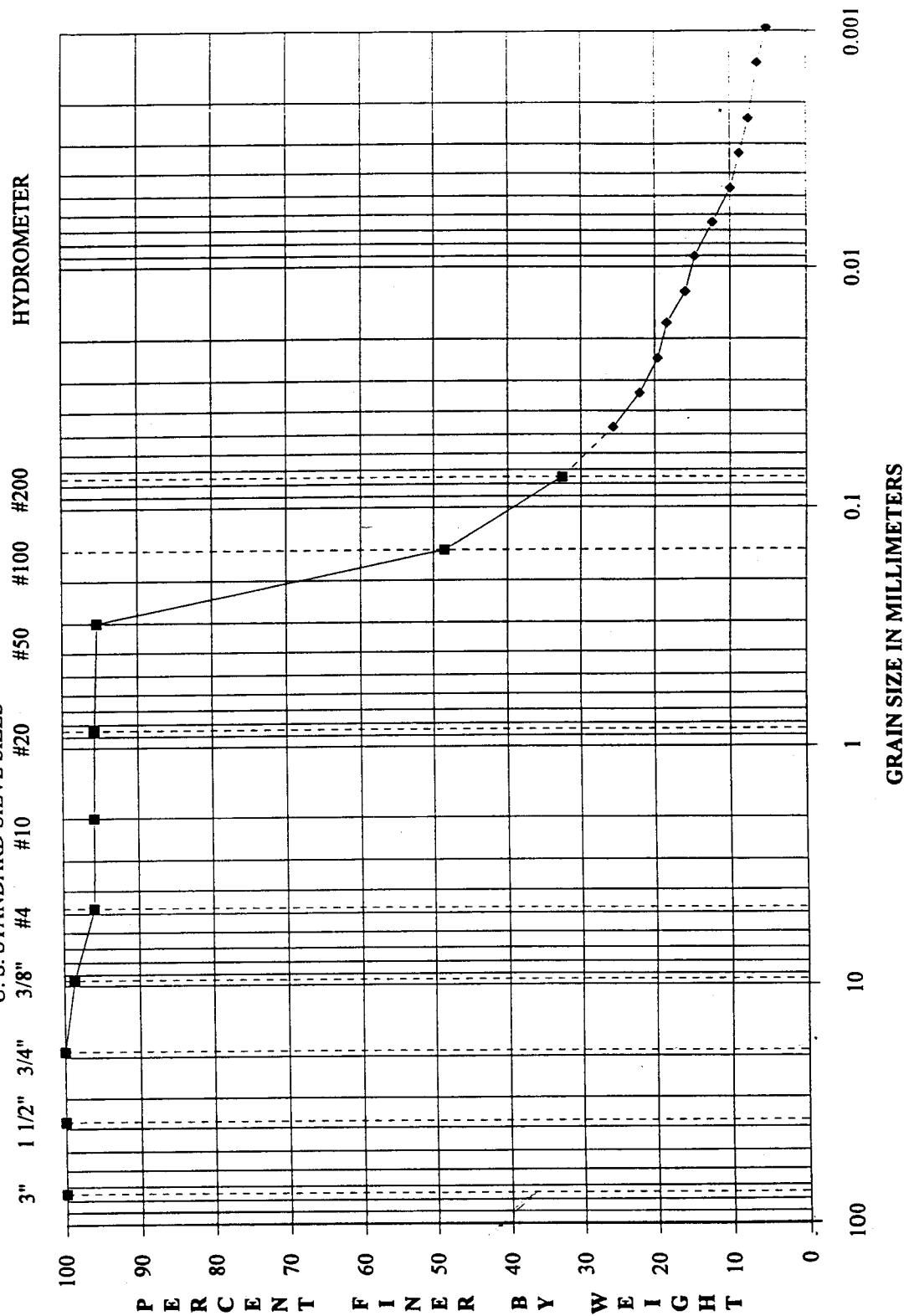
SAMPLE DESCRIPTION	light orange clayey SAND with 4% gravel and 32% fines of low plasticity
Unified Soil Classification System (USCS) Group Symbol	SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
35.9	22.4	13.5

NOTES

NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR
PROJECT SAMPLE LH01A-SW02-2009, ETL SAMPLE 9312L022-012
 U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018965

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB03-2001	PROJECT ANALYST	WB
JOB NUMBER	9312L022	ETL SAMPLE NUMBER	001	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/09/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.7
#20	0.850	99.6
#50	0.300	99.1
#100	0.150	73.3
#200	0.075	45.8
HYDROMETER	0.0456	32.4
	0.0324	31.1
	0.0233	28.5
	0.0166	27.2
	0.0122	25.9
	0.0087	24.7
	0.0062	23.4
	0.0044	22.1
	0.0031	20.8
	0.0022	19.5
	0.0013	18.2
	0.0009	18.2

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.114
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
15.6

SAMPLE DESCRIPTION
orange brown clayey SAND with 46% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol
SC

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
28.5	17.1	11.4

NOTES

NA=NOT APPLICABLE

18966

ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

018967

GEOTECHNICAL TESTING DATA AND RESULTS					
PROJECT	Tulsa COE-Longhorn	PROJECT SAMPLE I.D.	LH01A-SB03-2003	PROJECT ANALYST	WB
JOB NUMBER	9312L022	ETL SAMPLE NUMBER	003	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001-0040-00	DATE RECEIVED	12/20/93	DATE COMPLETED	01/09/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	100.0
#20	0.850	99.8
#50	0.300	99.2
#100	0.150	80.2
#200	0.075	50.6
HYDROMETER	0.0422	42.9
	0.0308	38.0
	0.0219	36.8
	0.0159	33.2
	0.0117	31.9
	0.0084	29.5
	0.0060	28.3
	0.0042	27.1
	0.0030	24.6
	0.0022	23.4
	0.0013	22.2
	0.0009	22.2

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.099
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
15.8

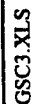
SAMPLE DESCRIPTION
light orange CLAY of low plasticity with 49% sand
Unified Soil Classification System (USCS)
Group Symbol
CL

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
32.6	16.8	15.8

NOTES
NA=NOT APPLICABLE

18968

PROJECT SAMPLE LH01A-SB03-2003, ETL SAMPLE 9312L022-003
U. S. STANDARD SIEVE SIZES



ROY F. WESTON, INC. ENVIRONMENTAL TECHNOLOGY LABORATORY

GEOTECHNICAL TESTING DATA AND RESULTS

PROJECT	Tulsa COE Longhorn	PROJECT SAMPLE I.D.	LH01A-MW04-2001	PROJECT ANALYST	WB
JOB NUMBER	9312L990	ETL SAMPLE NUMBER	001	QA/QC ANALYST	RWF
W. O. NUMBER	03886-087-001	DATE RECEIVED	12/20/93	DATE COMPLETED	01/07/94

PARTICLE SIZE DISTRIBUTION		
U. S. Standard Sieve Size	Diameter mm	% Finer
3"	75.00	100.0
1 1/2"	37.50	100.0
3/4"	19.00	100.0
3/8"	9.500	100.0
#4	4.750	100.0
#10	2.000	99.9
#20	0.850	99.8
#50	0.300	99.2
#100	0.150	78.3
#200	0.075	41.1
HYDROMETER	0.0429	38.4
	0.0315	32.6
	0.0234	24.5
	0.0169	21.0
	0.0125	18.7
	0.0090	15.3
	0.0064	12.9
	0.0046	10.6
	0.0033	10.6
	0.0023	9.5
	0.0013	8.3
	0.0010	7.2

EFFECTIVE SIZES	
% Finer	Diameter mm
60	0.113
30	NA
10	NA
Uniformity Coefficient	Gradation Coefficient
NA	NA

NATURAL MOISTURE CONTENT, % dry basis
11.7

SAMPLE DESCRIPTION
brown silty SAND with 41% fines of low plasticity
Unified Soil Classification System (USCS)
Group Symbol SM

INDEX PROPERTIES		
% moisture dry basis		
Liquid Limit	Plastic Limit	Plasticity Index
14.9	14.9	0.0

NOTES

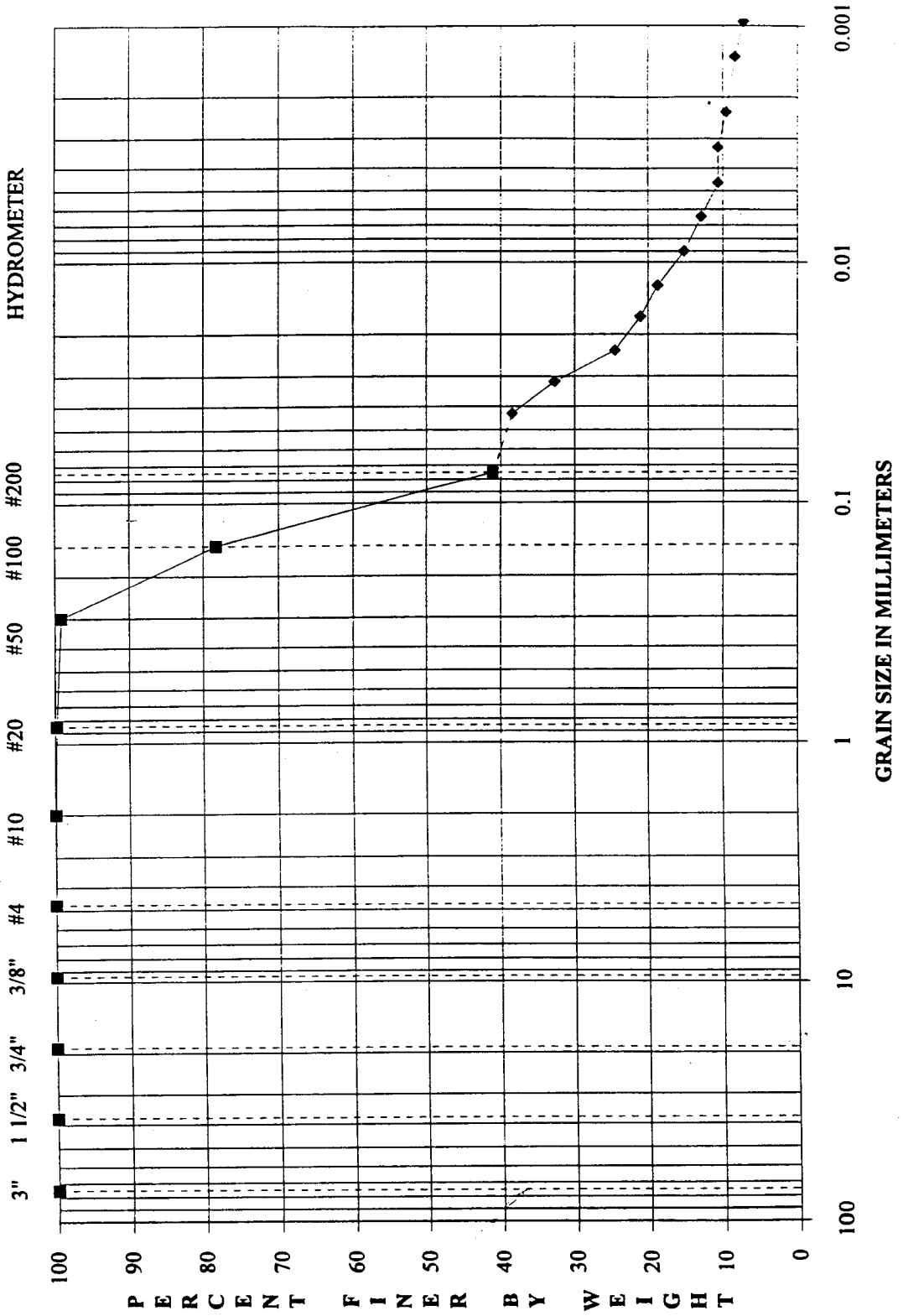
NA=NOT APPLICABLE

PARTICLE-SIZE DISTRIBUTION CURVE FOR

PROJECT SAMPLE LH01A-MW04-2001, ETL SAMPLE 9312L990-001

U.S. STANDARD SIEVE SIZES

HYDROMETER



SILT OR CLAY

SAND

GRAVEL