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LITHOLOGIC AND STRATIGRAPHIC COMPILATION OF NEAR-SURFACE SEDIMENTS FOR THE PADUCAH GASEOUS DIFFUSION PLANT, MCCRACKEN COUNTY, KY

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ABSTRACT OF THESIS

LITHOLOGIC AND STRATIGRAPHIC COMPILATION OF NEAR-SURFACE SEDIMENTS FOR THE PADUCAH GASEOUS DIFFUSION PLANT, MCCRACKEN COUNTY, KY

The Jackson Purchase region of western Kentucky consists of Coastal Plain sediments near the northern margin of the Mississippi Embayment. Within this region is the Paducah Gaseous Diffusion Plant (PGDP), a uranium enrichment facility operated by the US Department of Energy. At PGDP, a Superfund site, soil and groundwater studies have provided subsurface lithologic data from hundreds of monitoring wells and borings. Despite preliminary efforts by various contractors, these data have not been utilized to develop detailed stratigraphic correlations of sedimentary units across the study area. In addition, sedimentary exposures along streams in the vicinity of PGDP have not been systematically described beyond the relatively simple geologic quadrangle maps published by the US Geological Survey in 1966–67. This study integrates lithologic logs, other previous site-investigation data, and outcrop mapping to provide a compilation of near-surface lithologic and stratigraphic data for the PGDP area. A database of borehole data compiled during this study has been provided to PGDP for future research and archival. Developments in understanding near-surface geology include the adoption of nomenclature used by the Illinois State Geological Survey (ISGS), which separates the “Continental Deposits” into two distinct units, the Mounds Gravel and Metropolis Formation, based on their unique depositional histories. Additionally, faulting presented on the preliminary Joppa (IL) 7.5-minute quadrangle map, but not mapped on the Joppa (KY) 7.5-minute quadrangle map, appears to have impacted deposition of post-Eocene sediments at the site. These faults are co-linear to zones of irregularity noted in the Cretaceous McNairy Formation structure elevation map created during this study, thick zones of the Mounds Gravel noted in an isopach map from this study, and contaminant plume maps created previously by contractors.

Key Words:
Geologic Mapping, Jackson Purchase, Mounds Gravel, Metropolis Formation, Paducah Gaseous Diffusion Plant

Joshua L. Sexton

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LITHOLOGIC AND STRATIGRAPHIC COMPILATION OF NEAR-SURFACE SEDIMENTS FOR THE PADUCAH GASEOUS DIFFUSION PLANT, MCCRACKEN COUNTY, KY

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in the College of Arts and Sciences at the University of Kentucky

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2006

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Chapter 1. Introduction

Location and History

The Jackson Purchase region of western Kentucky consists of Coastal Plain sediments outlined by the northern extent of the Mississippi Embayment (Figure 1.0). The Paducah Gaseous Diffusion Plant (PGDP), a uranium enrichment facility operated by the United States Department of Energy (USDOE) (CH2M Hill, 1992; Clausen et al., 1992), resides in this region, in McCracken County, Kentucky (Jacobs, 1997) (Figure 1.1).

PGDP began operation in 1952 and enriches uranium fuel for use in nuclear reactors. Fuel is formed from UF_6 gas, a mixture of uranium 235 (^{235}U) and fluorine (F) that passes through cascade diffusion process to achieve enrichment. Unfortunately, because of this processing there is now a groundwater contamination problem on and around the PGDP facility.

On May 31, 1994, PGDP was designated a Superfund site, making it a priority for cleanup among contaminated sites in the United States (Jacobs, 1997). The primary contaminants of concern at the site are trichloroethene (TCE) and technetium-99 (^{99}Tc). TCE was used as a degreasing agent and ^{99}Tc was formed at the site as a byproduct of processing nuclear fuel rods (Sweat, 2000). Neither contaminant is being used or generated at the site now due to changes in practice, but previous releases have resulted in dissolved-phase transport of both contaminants into plumes stretching beyond the borders of the facility (Sweat, 2000). This off-site contaminant migration has impacted groundwater and surface water quality. Previous monitoring has determined that plumes propagated north from the facility toward the Ohio River (Clausen et al., 1992; Jacobs, 1997).

Groundwater contamination by TCE and ^{99}Tc has resulted in monitoring and remediation by PGDP contractors under the oversight of the United States Environmental Protection Agency (USEPA). Through the 1990's, site investigations and groundwater studies have sought answers to site-specific problems in and around the facility ranging from contaminant plume projection to waste cell siting (EDGe, 1989; CH2M Hill, 1992; Clausen et al., 1992; Jacobs, 1997). These studies contain shallow lithologic data from hundreds of monitoring wells and borings. Because the data were collected for different purposes, the data do not have a consistent style or use the same nomenclature. Detailed stratigraphic correlations of sedimentary units have not previously been developed from data gathered at the site.

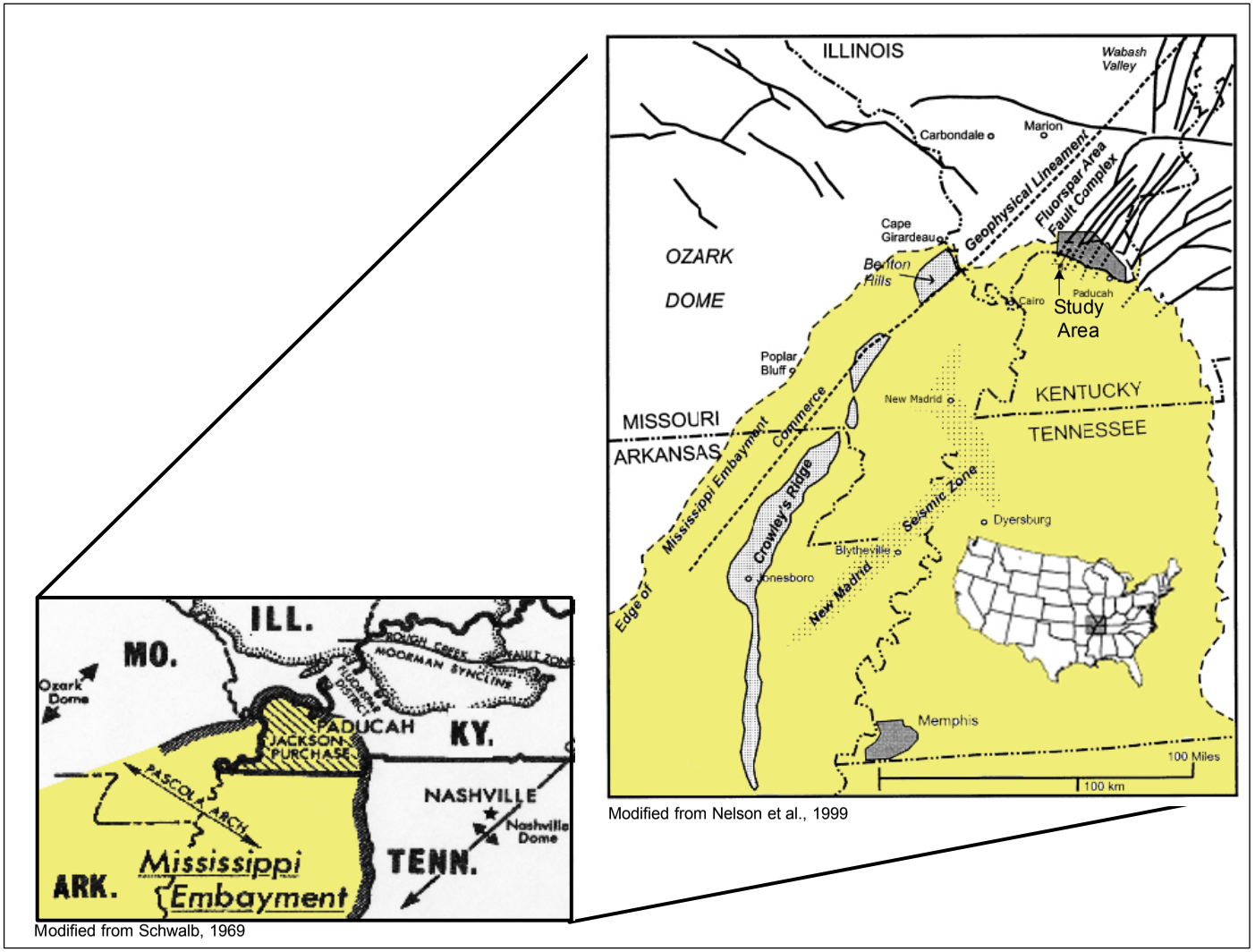


Figure 1.0: Outline of the Mississippi Embayment illustrating regional features and the study area.

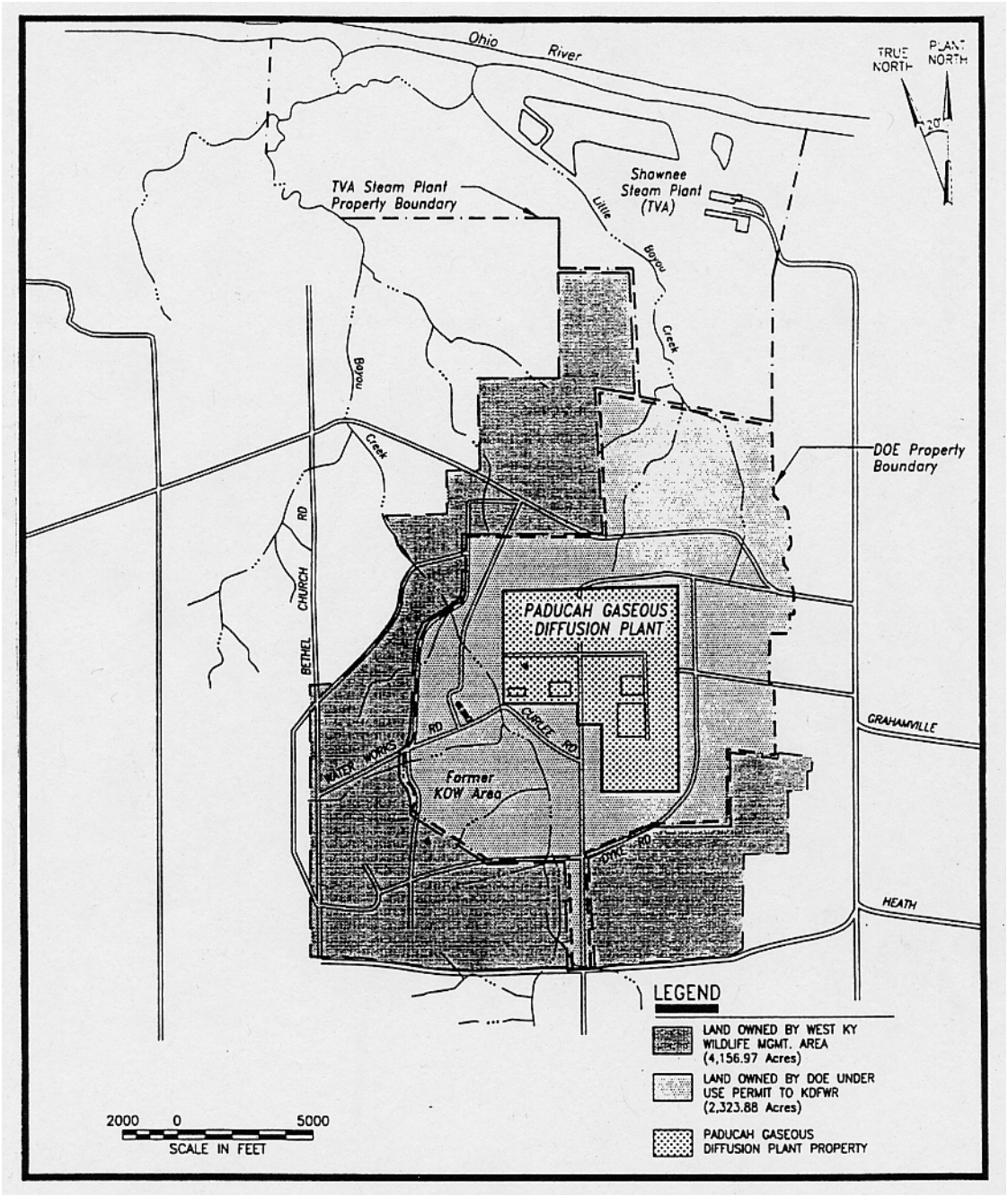


Figure 1.1: Map of study area indicating property boundaries and local roads (CDM and JEG, 1995).

Additionally, sedimentary exposures along streams in the vicinity of PGDP have not been systematically described beyond the broad, formation-scale mapping of 7.5-minute quadrangles published by the United States Geological Survey (USGS) in 1966–67.

Purpose

This project was funded under a USDOE grant through the Kentucky Research Consortium for Energy and Environment (KRCEE) with a goal of locating and compiling available data into a common database from which those data could be accessible to future researchers. The second goal of this project was to create a site-wide stratigraphic framework for the Late Tertiary through Quaternary sediments within which the Regional Gravel Aquifer (RGA) is located. The RGA is the primary pathway of lateral contaminant transport within the study area (Clausen et al., 1992; Jacobs, 1997). By understanding the extent, potential interconnection of stratigraphic units, and sedimentology of the RGA and confining units at the site, more realistic projections of groundwater flow may be possible in future research. To achieve these goals I utilized the newly created geologic database, reviewed previous studies, and conducted additional field investigations across the region.

General Geology

The geologic units in the shallow subsurface in the study area are Tertiary to Quaternary fluvial, lacustrine, and eolian sediments (Olive, 1966; Finch, 1967; Clausen et al., 1992). These sediments are associated with deposition/erosion of the Illinois Basin, Mississippi Embayment, glacial slack-water lakes, and the ancestral Tennessee River (Olive, 1966; Finch, 1967).

Stratigraphy

Mississippian limestone bedrock is unconformably overlain by Upper Cretaceous sediments in the study area (Figure 1.2) (Olive, 1980; Clausen et al., 1992; Langston and Street, 1998). The Tuscaloosa Formation is the first stratigraphic unit overlying this regional unconformity. The Tuscaloosa consists of well-graded chert gravel (rubble zone) with a sandy to clayey matrix (Jacobs, 1997). Tuscaloosa sediments, where present, are overlain by micaceous clays and interlensing fine to medium-grained sands and silts of the Upper Cretaceous McNairy Formation (Olive, 1980; Clausen et al., 1992).

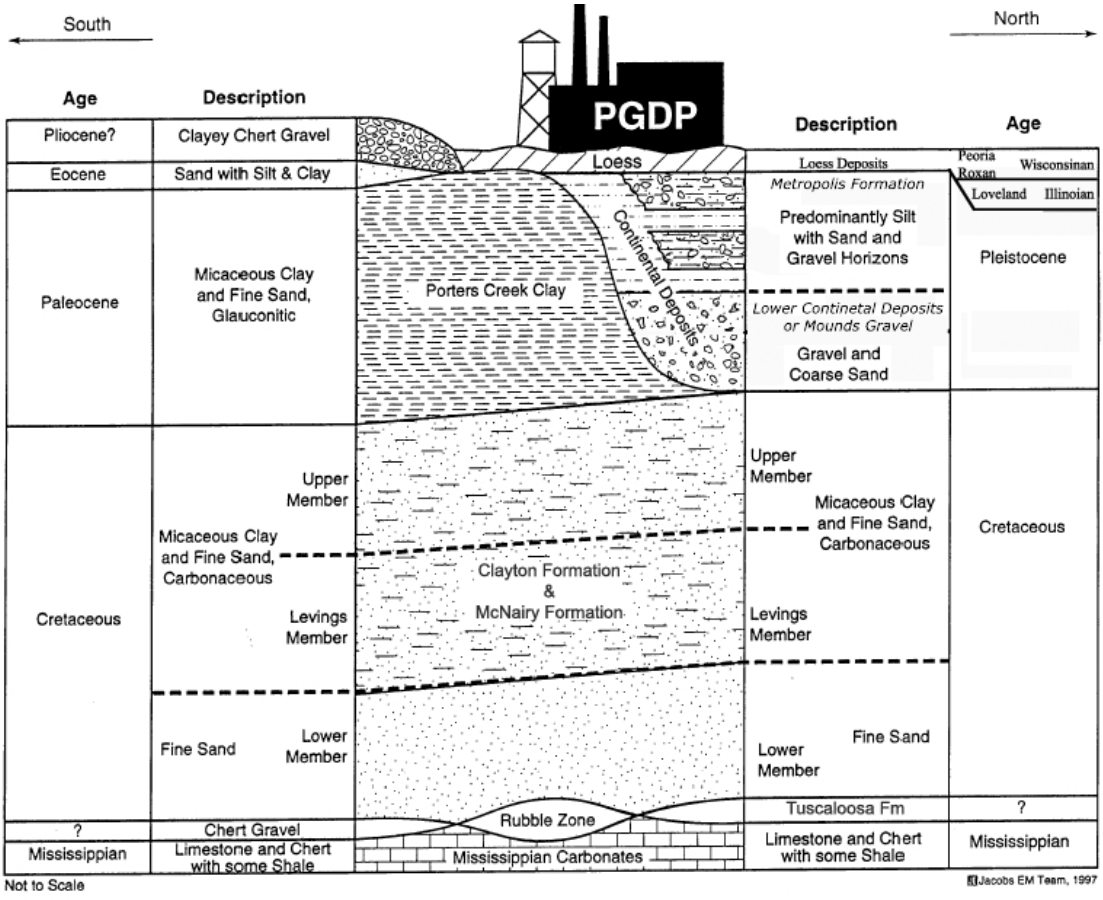


Figure 1.2: Stratigraphic column of geologic units above the Mississippian bedrock unconformity (modified from Jacobs, 1997).

The Paleocene Clayton Formation is only distinguished from the McNairy Formation in the study area by palynological evidence (Davis et al., 1973). Palynological investigations were not part of this study; therefore, I follow methods of Olive (1966) in combining the Clayton Formation into the McNairy Formation. The undifferentiated McNairy Formation unconformably overlies the Tuscaloosa Formation where present and directly overlies limestone bedrock where the Tuscaloosa Formation is absent. Subsurface investigations at the plant indicate that the McNairy Formation consists of 40 to 50 percent sand with an average thickness of 225 feet (ERCE, 1990). Davis (1996) indicates the McNairy consists of three members in the study area: an upper silt and sand member, a middle silt and clay member referred to as the Levings Member, and a lower sand member.

The McNairy contains more clay near Paducah than in the southeastern portion of the Jackson Purchase (Davis et al., 1973). Because of its clay content the unit forms a semi-confining surface underlying the RGA (Clausen et al., 1992). These Cretaceous deposits have been interpreted as deltaic in origin and center near the northeast edge of the embayment, grading to marine sands and clays to the southwest (Pryor, 1960). Reconstructions of the paleo-geography during the Cretaceous support this interpretation (Figure 1.3). The Cretaceous-Tertiary extinction event (KT boundary) occurred at the end of the Cretaceous (~65.5 Ma). This event was not described in literature reviewed during the study and no distinct indicators were noted during the study.

The Paleocene Porters Creek Clay unconformably overlays the McNairy Formation and is present to the southeast of PGDP. The Porters Creek Clay is characterized as a dark gray, slightly to very micaceous, glauconitic clay containing variable amounts of fine-grained sand with a substantial silt component (Lambert, 1966; Olive, 1966; Finch, 1967). The Porters Creek Clay (Jacobs, 1997) was interpreted by Olive (1980) to have formed during marine to fresh-water sedimentation from a sea that covered much of the embayment during this time.

Eocene sands of the Wilcox, Claiborne and Jackson Formations unconformably overlay the Porters Creek Clay and are undifferentiated in the study area. Eocene sands are generally very thin north of US Highway 60 (CH2M Hill, 1992). These sediments are actually comprised of interlensing sand- to clay-size grains and are only found in the southernmost portion of the study area (Clausen et al., 1992).

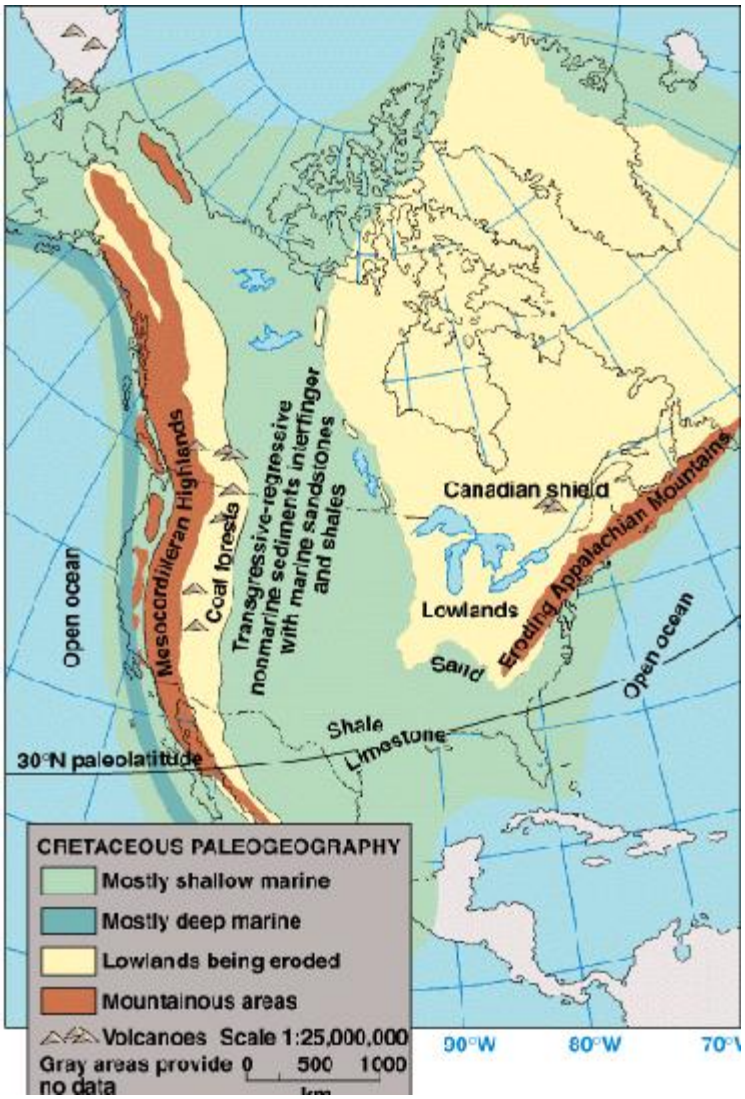


Figure 1.3: Paleogeography of North America during the Cretaceous (Levin, 2003).

As the ancestral Tennessee River became incised in the region, the Porters Creek Clay and Eocene sands were removed from a large portion of the study area, leaving a terrace to the south of Grahamville where the northernmost exposures of these units occur (Figure 1.2, 1.4). Olive (1966, 1980) labeled the sediments overlying the Cretaceous to Eocene sediments the Continental Deposits, which were further subdivided into upper and lower members by later investigators (EDGe, 1989; CH2M Hill, 1992). The Lower Continental Deposits are stratigraphically equivalent to the Mounds Gravel as designated by the Illinois State Geological Survey (ISGS) or the Lafayette Formation (Lafayette gravel) in other parts of the region (Langston and Street, 1998). For the purposes of this study the Mounds Gravel designation will be used for nomenclature, as this unit has been extensively mapped in southern Illinois. Mounds Gravel deposits unconformably overlie Paleocene and Eocene units in the southern portion of the site and the McNairy Formation north of the truncation of the Porters Creek Clay (Figure 1.4). Mounds Gravel deposits consist of reddish-orange to brown chert clasts with a glossy patina. Clasts occur within a matrix of poorly sorted sands containing lenses of clay and silt (Potter, 1955a; Potter, 1955b; Clausen et al., 1992, Nelson, 2005). The unit has been interpreted as a deposit of high-energy braided rivers (Potter, 1955a), which occupied a broad steep-sided valley formed by the ancestral Tennessee River (Nelson et al., 1999). Olive (1980) recognized four erosional surfaces, three of which have been identified as terraces at the site within the RGA (Clausen et al., 1992). Nelson et al. (2002) indicates that the lower terraces formed under the incised flat and broad deep-valley conditions proximal to the current course of the Ohio River. These lower terraces occur at a base elevation of 245 to 310 feet above mean sea level (msl) (Clausen et al., 1992).

Capping the Mounds Gravel in the study area is the Metropolis Formation (Nelson et al., 1999), also commonly referred to as the Upper Continental Deposits by PGDP contractors (Clausen et al., 1992; Jacobs, 1997) and mapped as Quaternary sands and silts by Finch (1967). The Metropolis Formation is primarily silt and sand with lesser components of clay and gravel (Nelson et al., 1999) in a massive to finely laminated matrix (Clausen et al., 1992). The average thickness of the Metropolis Formation is 15 to 55 feet at the site.

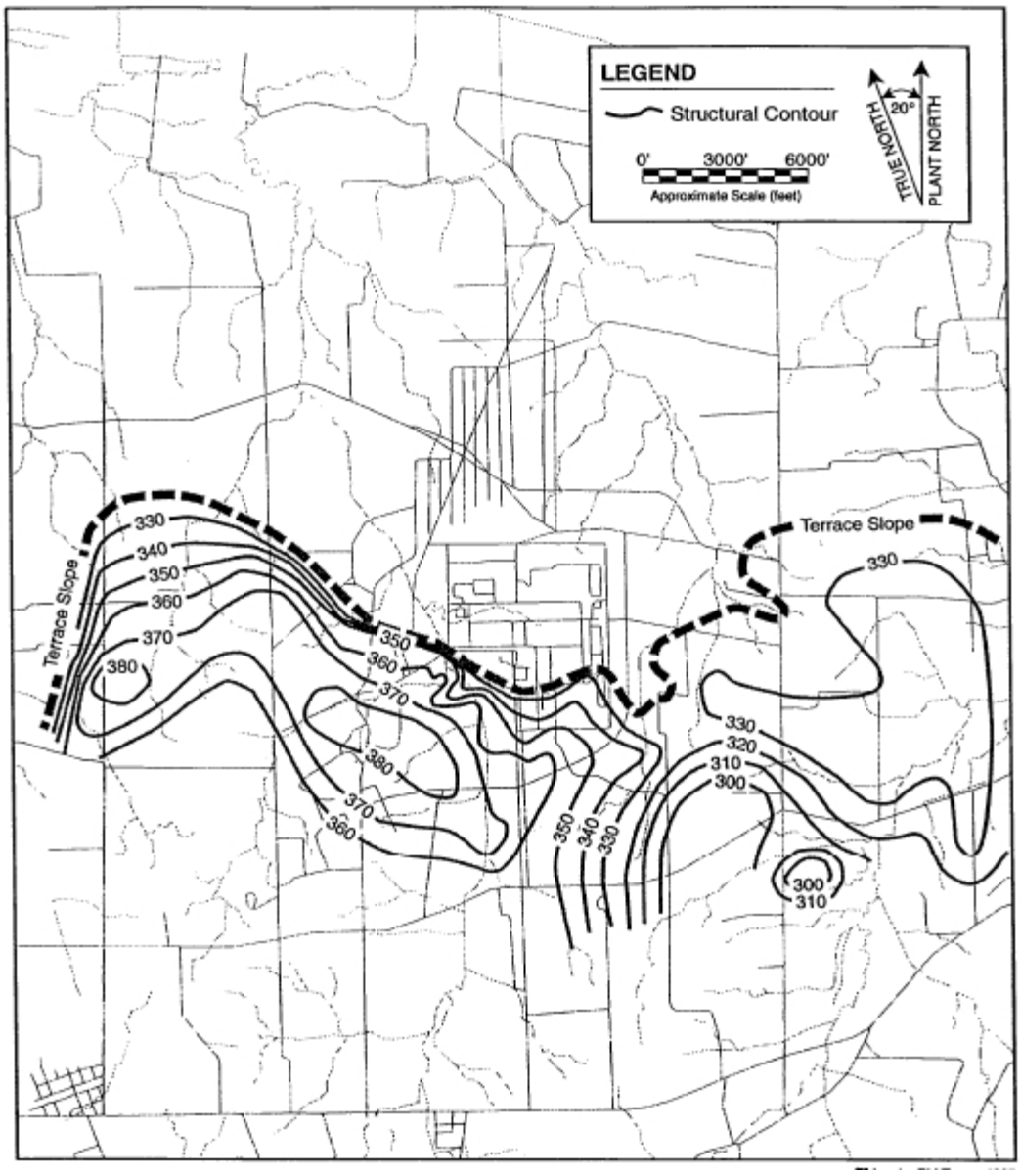


Figure 1.4: Structural elevation map of the Porters Creek Clay illustrating relief and truncation of the unit (Jacobs, 1997).

The unit is generally light gray to yellowish-brown and commonly shows evidence of cylindrical vertical burrows (Nelson et al., 1999; Nelson, 2006). Gravels in the Metropolis Formation most likely were derived from the underlying Mounds Gravel, but can be differentiated by rounding, pitting, and a complete or substantial loss of the glossy patina indicative of Mounds Gravel (Nelson et al., 1999; Nelson, 2005). The contact between Mounds Gravel and Metropolis Formation is often gradational across an interval of 3 to 15 feet (Nelson, 2005). Clausen et al. (1992) note that the Metropolis Formation may locally be laterally traceable along erosional contacts, as indicated by WLA (2005). However, Nelson (2005) states that lateral traceability cannot be expected regionally because of the small scale of bed forms (5 to 15 feet). Deposition of the Metropolis Formation is thought to have occurred early in the Pleistocene as the ancestral Tennessee River became diverted, leaving slow-moving, underfit meandering streams to flow down the ancestral Tennessee River valley (Nelson et al., 2003). These rivers were much narrower than the preceding braided streams leading to laterally heterogeneous deposits. Slow sediment aggradation in this environment led to the extensive weathering, bioturbation and soil formation seen (Nelson et al., 1999, 2002).

A series of loess deposits, averaging 5 to 25 feet in thickness, blankets the majority of the site (Finch, 1967; Clausen et al., 1992; US DOE, 1997). These deposits are fine-grained and interpreted as glacial eolian sediments, similar to the underlying Metropolis Formation (Upper Continental Deposits) (Finch, 1967). Loess deposits are separated by buried soils that indicate unconformities (Olive, 1980). Loveland, Roxana and Peoria are the principal loess units at the site (Follmer, 2005). The Loveland formed during Illinoisan glaciation and is the oldest loess unit at the site (Follmer, 2005). The Sangamon geosol caps this unit and is a useful marker bed between the Illinoisan and Wisconsin-stage loess deposits. Wisconsin-age Roxana loess lies above the Sangamon geosol and is darker brown to reddish silt that is coarser than the Loveland loess. The Peoria is very similar to the older Loveland unit. This uppermost loess has been carbon-14 (^{14}C) dated throughout the Midwest with an age of 13 to 24 thousand years before the present (ka) (Follmer, 2005). The Peoria loess is a massive yellowish silt (Follmer, 2005). The Roxana and Peoria loesses are commonly combined into an informal unit known as the Wisconsin loess where intervals are thin and stratigraphic leakage has occurred (Follmer, 2005). Reworking of deposits in the active Ohio River floodplain has left Holocene alluvium deposits in lowland areas throughout the northern sections of the study area (Finch, 1967).

Structure

The Jackson Purchase region consists of a thick package of flat-lying unlitihified sediments underlain by Mississippian bedrock, regionally dipping toward the center of the Illinois Basin (Clausen et al., 1992). Olive (1980) states that sediments overlying bedrock form an unconformity parallel to the outline of the Mississippi Embayment and dip towards the axis of the embayment. It is estimated that the McNairy and Porters Creek Clay dip 30 to 35 feet per mile towards the axis of the embayment while the younger Eocene sediments dip 25 feet per mile in the same direction (Olive, 1980).

Seismicity in the area is a function of the New Madrid Seismic Zone (NMSZ) lying to the southwest and the Fluorspar Area Fault Complex (FAFC) to the northeast (Figure 1.0). Nelson et al. (1999) postulate that these complexes formed during failed Cambrian rifting of the Reelfoot Rift, an arm of the currently active NMSZ. The Pascola Arch also developed during the Cretaceous due to activation of faults along the Reelfoot Rift. The arch formed a highland in the Jackson Purchase region (Langston and Street, 1998). Mapping in Southern Illinois has indicated displacement of Pleistocene strata along FAFC faults. Several of these faults are projected into western Kentucky (Langston and Street, 1998; Nelson et al., 1999; Woolery and Street, 2002). Faults of the FAFC in southern Illinois are dominantly high-angle normal faults striking to the northeast with fewer high-angle reverse and oblique-slip faults (Nelson et al., 1999). These faults bound narrow pull-apart grabens following the same strike (Nelson et al., 1999).

Olive (1966) mapped soft-sediment deformation in the study area within the Porters Creek Clay and other researchers have noted soft-sediment deformation in both the Porters Creek Clay (Davis, 2005; Amick, 2005) and the clay facies of Quaternary deposits (Clausen et al., 1992; WLA, 2006). Langston and Street (1998) suggest that faulting appears to have propagated from bedrock into the Mounds Gravel in the northern portion of the study area. Woolery and Street (2002) imaged near-vertical northeast-trending faults displacing Quaternary sediments within 25 feet of the ground surface using shear-wave seismic reflection methods at the site. These features support an interpretation of faulting from the FAFC of southern Illinois into western Kentucky presented by Nelson et al. (1999) and are consistent with major fault displacement of the Quaternary strata.

Chapter 2. Methods

Field Investigation

Examination of surficial geology within the study area concentrated on creeks and excavations because they provided extended sections where near-surface features could be viewed and sampled. Little Bayou Creek and Bayou Creek had the most exposures (Figure 1.1). These generally north-south oriented creeks cross the West Kentucky Wildlife Management Area (WKWMA), the PGDP site, and private properties. Descriptions of exposures in the Tennessee Valley Authority's (TVA) Shawnee Fossil Plant borrow pits and drainage ditches also provided useful information. Investigations of Newton Creek, Nasty Creek, and Metropolis Lake provided geologic information. Gravel pits shown on the Joppa and Heath 7.5-minute geologic quadrangle maps proved inaccessible during site investigations because they had been flooded or revegetated. Locations strategic to plant security or with institutional controls in place for possible health hazards remained un-surveyed.

For all exposures, strata descriptions were taken using standard methods. Clast orientations were measured where a gravel or cobble fabric was observable in outcrop. Photographs were taken for database archival and to aid in comparison of exposures. Sediments were sampled for dating at selected locations where the stratigraphic units were thought to be undisturbed and well represented. A hand-held Global Positioning System (GPS), with approximately ± 15 feet horizontal resolution, was utilized with 1:24,000-scale topographic maps to reference all locations spatially. Elevations were measured for selected bedding contacts using a Total Station electronic distance measuring device and a stadia rod equipped with a prism. Elevations of exposures used known top-of-casing elevations from the closest monitoring wells as a reference for all elevation calculations. A magnetic compass and inclinometer set at a declination of 3.5^{o} to the northwest were used to determine the strike of gravel and cobble clasts in outcrop. Soil sample collection utilized a sliding hammer adapted to a double-wall sample barrel. Samples collected with this system fed through the steel outer barrel into inner aluminum sleeves 2 inches in diameter and 6 inches in length. All aluminum sleeves were cut to length, ground, decontaminated, and stored in sealable plastic bags prior to use.

Age Dating

Because of the lateral heterogeneity of stratigraphic units and the possibility of multiple unconformities in these units, it was determined that absolute age dating should be attempted. The aim of this task was to assist in the interpretation of surficial geology by using age, along with depositional context, for comparison with mapped exposures in the area. Radiometric dating using ^{14}C is a common method for dating Quaternary deposits; however, the units of interest preserved very little organic material. Sampling was considered along Little Bayou Creek and Bayou Creek, but during the WLA (2005) site investigation, 87 (30-foot) soil cores were found to be too deficient in organic material to facilitate ^{14}C sampling. Additionally, vegetation proximal to all exposures made contamination from modern rooting likely. Another complication was that manganese (Mn) concretions in the Mounds Gravel and Metropolis Formation appeared indistinguishable from charcoal under field conditions.

Optically Stimulated Luminescence (OSL) was chosen as an alternative method for dating the carbon-deficient sediment (Foreman, 2005; Owen, 2005). The OSL technique measures the energy of photons released from sediment, in this case, quartz grains, to calculate a burial age (Aitken, 1998; Foreman, 2005). This is accomplished by stimulating the release of absorbed ionized elements like uranium (U) and thorium (Th) using light energy (Aitken, 1998). As the samples absorb light energy, ionized radiation is released as a luminescence emission (Aitken, 1998). This occurs naturally when sediments are exposed to sunlight. When these sediments are buried, they begin to retain ionized radiation from cosmic rays and other sources because there is no longer an energy source (sun or heat) to promote ionization (Aitken, 1998).

Using OSL for geochronology is accomplished by measuring the intensity of the luminescence emission and calibrating this to a dosage rate needed to release all ionized elements (Aitken, 1998). This dose rate is then divided by the estimated radioactivity that the sample received after burial to yield a luminescence age (Aitken, 1998). The following equation by Aitken (1998) illustrate these relationships:

$$\text{Age} = \text{Paleodose} / \text{Dose-rate}$$

Sample preparation occurred at the University of Cincinnati (UC) under the guidance of Dr. Lewis Owen. Samples were processed in a light-controlled laboratory using sodium-vapor lamps equipped with filters to create a yellow-orange light that would not liberate ionized radiation. Approximately 1 inch of sediment along each end of each sample tube was extruded to lower the possible light contamination incurred during

sample collection. These ends were set aside to be processed for later neutron activation analysis, which is not a light-sensitive process. Samples were then extruded into glass beakers and weighed. Next, samples were placed in a drying oven set at 50^{o}C and allowed to dry slowly for several days. Once samples were dry, they were re-weighed to calculate in-situ moisture content (Table 2.0).

Samples were sieved using a magnetic shaker and clean brass sieves with mesh sizes of 1000 μm, 500 μm, 250 μm, 180 μm, 125 μm, and 90 μm, plus the pan to isolate grain-size fractions for analysis. Sieving took approximately 1 hour for each sample. Sieves were cleaned after each run using a fine needle and soft bristle brush to remove grains lodged in the brass mesh. This process was done at a light table outside of the lab to insure all lodged grains were removed, and every attempt was made not to damage the mesh of the sieves during cleaning. Sieves were then rinsed to remove all dust particles, flushed with compressed air and placed in an oven to dry for reuse. One sample required wet-sieving because of its high fines content. This was accomplished, after the initial dry sieving attempt, using tap water and a 20-gallon container. The sieve stack was placed over the container (minus the pan) and each sieve was flushed with water and gently rubbed by hand to break up clods. Once the size fraction of interest remained, particles on that sieve were flushed with water into a glass beaker and the process was repeated for the next sieve. All materials less than 90 μm were allowed to flow into the 20-gallon container and discarded. Grain size analysis from samples can be viewed in Table 2.1.

Container ID		LM01 L	LM01 U	LM02	LM03 L	LM03 U	LM04	LM06	LM07	LM08
Weight of beaker	(g)	165.45	163.08	163.86	164.46	163.75	164.57	203.74	164.31	165.72
Weight of moist soil + beaker	(g)	388.63	354.69	384.14	387.37	314.35	389.71	370.78	291.96	336.08
Weight of dry soil + beaker	(g)	372.06	339.8	364.38	363.71	308.2	364.04	337.41	288.69	325.86
Weight of moisture	(g)	16.57	14.89	19.76	23.66	6.15	25.67	33.37	3.27	10.22
Weight of dry soil	(g)	206.61	176.72	200.52	199.25	144.45	199.47	133.67	124.38	160.14
Water content	(%)	8.02	8.43	9.85	11.87	4.26	12.87	24.96	2.63	6.38

Table 2.0: Moisture content of OSL samples collected.

ID	Weight (g) obtained above sieve (mesh in µm)							Mass pre sieving (g)	Mass post sieving (g)	% Loss
	1000	500	250	180	125	90	<90			
LM01 L	116.01	15.48	54.9	12.54	4.54	0.89	0.84	206.61	205.2	0.68%
LM01 U	0	0.17	7.34	31.31	38.92	23.62	64.28	176.72	165.64	6.27%
LM02	97.62	14.55	51.76	17.67	5.86	2.31	8.76	200.52	198.53	0.99%
LM03 L	15.35	13.99	39.61	21.01	19.32	10.94	71.28	199.25	191.5	3.89%
LM03 U	57.15	18.71	38.45	11.05	6.35	2.67	8.89	144.45	143.27	0.82%
LM04	12.72	14.13	26.48	18.42	23.07	14.19	86.77	199.47	195.78	1.85%
LM06	6.64	1.08	12.03	13.89	11.61	11.54	73.43	133.67	130.22	2.58%
LM07	87.96	14.79	12.43	2.18	0.87	0.25	0.94	124.38	119.42	3.99%
LM08	Sample had to be wet sieved							160.14	NA	NA

Table 2.1: Grain size distribution from sieve analysis of OSL samples collected.

Post-sieving removal of organic and carbonate material was accomplished by a series of acid treatments. The samples were first soaked in 30% hydrogen peroxide (H_2O_2) for approximately 96 hours to dissolve any organic material. Samples were then rinsed with de-ionized water and placed in a 10% hydrochloric acid (HCl) solution for 24 hours to remove carbonate material. Samples were rinsed again and given a 10% hydrofluoric acid (HF) treatment for 1 hour to remove feldspars and other minerals not removed during the previous treatments. After the HF treatment, samples were rinsed and allowed to sit in a 10% HCl solution for 1 hour to remove any fluorite (CaF_2) that may have precipitated during the HF treatment. Chemical treatments were finished with a triple rinse of all samples with deionized water followed by a triple rinse with acetone to accelerate sample drying. Samples were then placed in a 50^{o}C oven and allowed to dry.

Isolation of minerals was accomplished by density separation using lithium heteropolytungstate (trade name LST), a heavy liquid with a specific gravity of 2.85 g/cm^3. Four solutions of LST were prepared by dilution with deionized water to densities of 2.75, 2.62, 2.58, and 2.53 g/cm^3. These density ranges allow for the separation of heavy minerals, quartz, feldspars and clays, respectively, for each sample (Figure 2.0). Mineral separation for samples began by immersing the sample in a 2.53 g/cm^3 solution, spinning the sample in a centrifuge for 2 minutes and then decanting the liquid containing suspended grains into an appropriately labeled container. This process was repeated until separation of all four density ranges was accomplished. Density ranges of greater than 2.75 g/cm^3 and less than 2.53 g/cm^3 were discarded as heavy minerals and clays, and were not used for analysis. The 2.53 g/cm^3 - 2.58 g/cm^3 and 2.58 - 2.62 g/cm^3 density ranges corresponded to potassium feldspar and sodium feldspar, respectively, and were triple rinsed with deionized water to remove all traces of the LST solution, then triple rinsed with acetone and allowed to dry prior to storage.

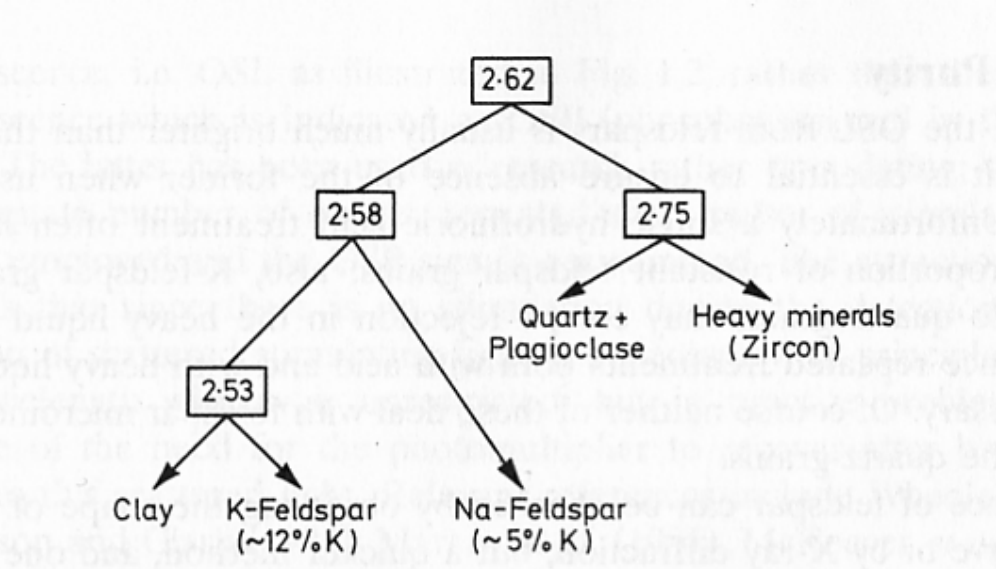


Figure 2.0: Densities of heavy liquids used for mineral separation of OSL samples (Aitken, 1998).

The quartz fraction in the density solution of 2.62 - 2.75 g/cm^3 was triple rinsed with deionized water and subjected to a series of acid treatments to remove any plagioclase minerals in the sample as well as any alpha contamination along the skin of the quartz grains (Aitken, 1998). A treatment of 49% HF was performed for one hour, followed by a 2-hour 10% HCl treatment to remove any CaF_2 precipitation from the previous action. After acid treatment, each isolated quartz sample was triple rinsed with deionized water followed by a triple rinse with acetone and allowed to dry prior to storage.

Sub-samples removed for neutron activation were placed in a 100^{o}C oven and allowed to dry. These samples were then divided and 25% (~25 grams) of each sample was ground to a powder using a mortar and pestle. Approximately 5 grams of this powder were placed in a resealable plastic bag and set aside to be sent to the USGS luminescence lab for neutron activation analysis. The remaining ground sample was placed in a resealable plastic bag as a backup. Leftover, un-ground samples were also placed in resealable plastic bags for archival. After each sample was ground, the mortar and pestle were washed with a mild detergent, rinsed with tap water, and wiped dry with a paper towel. To ensure drying, a small amount of acetone was wiped onto the mortar and pestle and was allowed to dry before preparation of the next sample began.

Analysis of the prepared samples was performed by Dr. Lewis Owen at UC using a Risø OSL-TL system. The single aliquot regenerative method was used to analyze all samples. Twenty (or greater) aliquots from each sample were analyzed by this method. Neutron activation analysis results are pending from the USGS luminescence lab in Denver, CO. Calculations will be made once neutron activation data are obtained.

Acquisition and Application of Published Data

Boring records for the PGDP were cited from published documents and logs provided by the Kentucky Division of Waste Management in hard-copy format. TVA borehole data were provided in digital and hardcopy formats. USGS borehole data for the Joppa geologic quadrangle (GQ) map were acquired from the Kentucky Geological Survey in archived microfiche format. This data were scanned into a digital image format for preservation prior to manual entry into the digital database. USGS boring data for the Heath GQ were provided by Science Applications International Corporation (SAIC) in hard-copy format.

Spatial Reference

All borehole data that were input into the database were spatially referenced in two coordinate systems: the PGDP's plant coordinate system and Universal Transverse Mercador (UTM), a projected coordinate system. A dual-coordinate system was selected to simplify future data use. For the PGDP borings, surveyed plant coordinates were referenced from the original borehole log or extracted from the report in which they were presented. Non-PGDP borings were generally presented in a projected coordinate system and were transferred into UTM coordinates. Transformation of all borehole data into a dual coordinate system was accomplished by use of the Transform Oak Ridge Coordinates (TORC) program version 2.0 provided by KRCEE.

Lithologic Data

All lithologic data entered into the database originated from published borehole logs. When possible, the original driller's/geologist's log was used for lithologic description; if unavailable, the next-published log for the boring was selected. The RockWorks^{2004} program was used to store and manage all borehole data. All pertinent information was copied directly from the boring log to create a digital copy. For consistency and simplification, the grain size of a unit is located at the front of the description column in uppercase letters, followed by a colon and the rest of the formal description (color, sorting, grain size percentages, etc.), which is presented in lower case format. Where non-continuous sampling was noted in logs, the description for the last lithology described was carried through until a change in lithology was noted usually because of sampling or a change in drilling conditions. This was easily resolved in many instances where a graphical log was presented with written descriptions. When only written descriptions were present, contacts were determined using lithologic descriptions for proximal borings. Depths for all lithologies were entered in feet and converted between metric and English units as needed.

A modified Unified Soil Classification System (USCS) was implemented to create an identifier for individual lithologic units. This identifier is a summation of formal lithologic descriptions found at set sample depths from borehole logs. Identifiers may be used in later modeling tasks for geologic interpretation or the log can be reviewed in its entirety for detailed geologic characterization. The USCS was chosen because of the geotechnical nature of most boreholes and because it was already adopted as the primary classification system on many geologic logs. This system also addressed the

non-lithified lithologies of the site as well as or better than other systems considered. Table 2.2 depicts the USCS classification system. Additional labels for classification were created for site-specific geologic characteristics. USCS and site-specific identifiers utilized are presented in Table 2.3. USCS lithologic identification is based primarily on grain size. Beyond grain size analysis, USCS classification uses the following descriptors: “well-graded”, “poorly-graded”, “low plasticity”, and “high plasticity”. Well-graded is equivalent to the geologic term poorly-sorted and poorly-graded is equivalent to well-sorted. This graded descriptor refers to the amount of variation seen on a grain size distribution plot for coarse-grained soils. Plasticity is related to the behavior of fine-grained soil at different moisture contents and is identified by conducting a liquid-limit test on the soil, commonly determined by an ASTM D-4318 test. However, for most of the geotechnical borings used in this study, the liquid limit was estimated in the field. A liquid limit exceeding 50 indicates a high plasticity soil. High plasticity soils are generally clays and are often referred to as fat or swelling clays. Low plasticity soils, those with a liquid limit below 50, include both silts and clays. These soils are often described as lean.

In instances of incomplete or inconsistent lithologic description, the following assumptions were made. If clay plasticity was not designated as “fat” or “lean”, lean was assumed due to fewer fat clays noted in the boring database. Where lithologic description for a silt lithology was not designated “fat” or “lean”, lean was assumed as silt rarely exhibits plastic properties. If sand or gravels were identified with no sorting indicated, well-graded (poorly-sorted) was assumed because of the heterogeneous nature of sediments previously noted at the site. All assumptions were also evaluated with respect to the lithology described in adjacent borings.

A sample population of 58 borings was selected from the 400 entered for site-wide cross-sections. The original logs of the 58 selected borings can be viewed in Appendix A. A sample population was created to simplify geologic cross-sections because of massive data overlap. The boreholes chosen were based on spatial distribution, detail of lithologic log, and total well depth. To verify that the selected sample population was in agreement with the total dataset, a block model of each dataset was created using RockWorks^{2004} software. The model was generated using an inverse distance algorithm with random blending and interpretation of outliers to smooth data. Slices were made through both models every 10 feet at equal elevation ranges to calculate lithologic percentages.

Coarse-Grained Soils

% -#200?	% of C.F. -#4	% -#200?			USCS Symbol	USCS Name
<50%	<50%	0-5%	c_u>6 and 1<c_c<3?	yes	SW	Well-graded sand
				no	SP	Poorly-graded sand
		5-12%	Dual classification		SP-SM	Poorly-graded sand with silt
					SP-SC	Poorly-graded sand with clay
					SW-SM	Well-graded sand with silt
					SW-SC	Well-graded sand with clay
		12-50%	PI>0.73(LL-20)%?	yes	SC	Clayey sand
				no	SM	Silty sand
	>50%	0-5%	c_u>4 and 1<c_c<3?	yes	GW	Well-graded gravel
				no	GP	Poorly-graded gravel
		5-12%	Dual classification		GP-GM	Poorly-graded gravel with silt
					GP-GC	Poorly-graded gravel with clay
					GW-GM	Well-graded gravel with silt
					GW-GC	Well-graded gravel with clay
		12-50%	PI>0.73(LL-20)%?	yes	GC	Clayey gravel
				no	GM	Silty gravel

Fine-Grained Soils

% -#200?	LL > 50%?	PI > 0.73(LL-20)%?	USGS Symbol	USCS Name
>50%	yes	yes	CH	Fat clay
		no	MH	Elastic silt
	no	yes	CL	Lean clay
		no	ML	Lean silt

Notes:
% - #200? = The precent of material passing the # 200 sieve
% - C.F. - #4 = The precent of material passing the # 4 sieve
$c_u = D_{60} / D_{10}$ $c_c = D_{30} / (D_{60} * D_{10})$; where D_{10}, D_{30}, and D_{60} correspondto 10%, 30% and 60% passing, respectively
LL= Liquid Limit: ASTM D-4318
PL= Plastic Limit: ASTM D-4318
PI = Plasticity Index = LL - PL

Table 2.2: USCS classification system (Kalinski and Supranata, 2005).

	CL	Lean clay		SM-SP	Silty sand
	CH	Fat clay		SP-SM	Poorly graded silty sand
	CM	Silty clay		SW-SM	Well-graded sand with silt
	CL-ML	Lean clay with silt		SW-SC	Well graded sand with gravel
	CH-MH	Fat clay with elastic silt		SP-SC	Poorly graded sand with clay
	CL-SM	Lean clay with silty sand		SP-GM	Poorly graded sand with silty gravel
	CS	Sandy clay		SP-ML	Poorly graded sand with silty clay
	CG	Gravelly clay		SW-CL	Poorly graded sand with clay
	ML	Silt		SP-SG	Poorly graded sand with gravel
	MC	Clayey silt		GW	Well-graded gravel
	MS	Sandy silt		GP	Poorly graded gravel
	MH	Elastic silt		GS	Sandy gravel
	SW	Well-graded sand		GC	Clayey gravel
	SP	Poorly graded sand		GM	Silty gravel
	SC	Clayey sand		RZ	Rubble zone
	SM	Silty sand		LS	Limestone
	SG	Gravelly sand		FILL	Secondary fill
	SP-CM	Poorly graded sand with silty clay		DG	Data gaps (no data)

Table 2.3: Lithologic identifiers used.

A Mann-Whitney rank sum test was performed using SigmaStat software to test for statistical differences between the models based on lithologic percentages. Comparison of six lithology types for comparable elevation ranges did not illustrate a statistical difference between the two populations. Raw data and analysis are presented in Appendix B.

Stratigraphic Data

Stratigraphic units were chosen based on borehole lithology and followed the PGDP hydro-stratigraphic unit (HU) nomenclature (Clausen et al., 1992; Jacobs, 1997). A columnar section of this nomenclature can be viewed in Figure 2.1, including the equivalent chrono-stratigraphic units described in the introduction. HU nomenclature for database archival should prove more useful to future researchers than chrono-stratigraphic nomenclature because HU nomenclature traces similar lithologic units according to physical properties. Surficial loess comprises HU-1, which was described as undifferentiated because of a lack of detail in lithologic logs. HU-2 is characterized by discontinuous sandy to pebbly lenses in a silty matrix. HU-2 was divided into HU-2A and HU-2B, where possible, as individual upward-fining intervals with a pebbly base (Davis, 2005). HU-3 is a confining layer of clay and silt with variable amounts of sand. Units HU-2 and HU-3, however, do not always appear in the sequence illustrated in Figure 2.1. In some logs the entire HU-2 or HU-3 unit is missing. In other logs these units alternate multiple times before they contact the underlying HU. HU-4 is a discontinuous, well-sorted sand directly overlying the Mounds Gravel, where the sand is present. HU-2 through HU-4 are equivalent to the Metropolis Formation. HU-5 defines the Mounds Gravel/RGA and is identified by coarse chert gravels in a silty sand matrix of similar color. HU-6 is a semi-confining surface below the RGA, generally sandy clay to fine sand, and is equivalent to the upper member of the McNairy Formation. Reworked deposits pose a unique problem to the hydro-stratigraphic nomenclature because these units can be found at the same elevation with similar lithology as in-place deposits; however, they are obviously not age-equivalent.

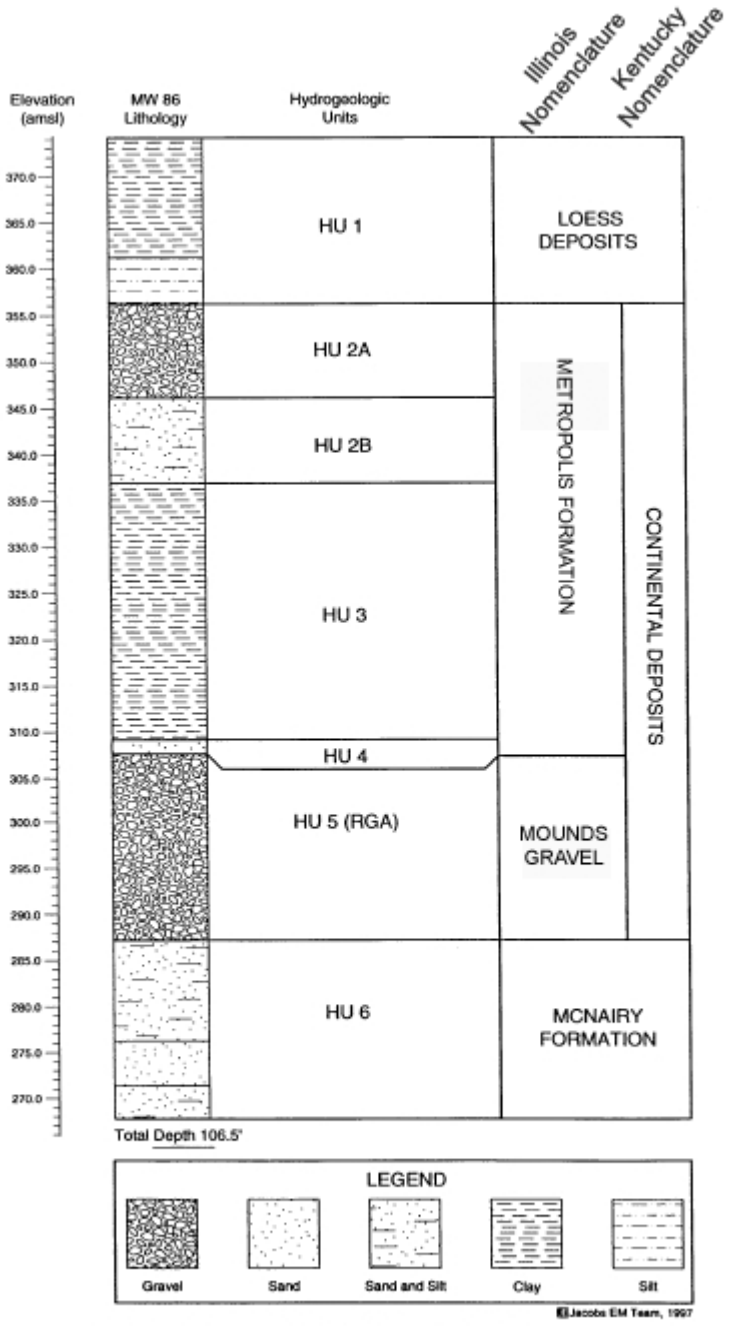


Figure 2.1: Hydrostratigraphic units used for input into the geologic database presented with the chrono-stratigraphic equivalent units (modified from Jacobs, 1997).

Reworking is most likely proximal to drainage features and in the northernmost portion of the study area within the active Ohio River floodplain, and therefore should not affect a site-wide stratigraphic model. Chrono-stratigraphic units (geologic units mapped on GQ maps) are used on all lines of cross-section, thickness and elevation maps. These units are used for all visualizations, as they are the common names referenced to the unit, which fit best into a local stratigraphic framework.

Geologic Interpretations

All interpreted stratigraphic contacts presented in cross-sections were picked by hand from strip-log profiles created using RockWorks[2004]. Stratigraphic boundaries were drawn manually on all cross-sections using Canvas 8, a 2-D vector drafting program, and scale was preserved on all lines of section. Grid models for isopach maps and structural elevation maps were created from the total available well population using a kriging point algorithm in Surfer 7 software. Color-fills, contour maps and base maps were all created using Surfer 7, and background images were added later to aid in spatial reference.

Chapter 3. Data

Original data and data from previous studies are referenced in the following section. Locations of surficial investigations are shown in Figure 3.0, a map of the site illustrating points where data were collected, including notes, measurements, photos, orientations, and sampling locations. Clast orientation data may be viewed in Figure 3.1 and raw data are presented in Table 3.0. OSL sample locations may be viewed in Figure 3.2 and field logs from sample collection are presented in Appendix C.

Surficial Information

Exposures along Bayou Creek and Little Bayou Creek offer the best insight into the near-surface geology of the study area. Previous studies indicate that near-surface sediments are dominantly Pleistocene in age (Table 3.1) (WLA, 2006). Exposures along creeks are complicated by modern fluvial processes. Erosion and deposition by modern processes include fine sediment veneers from back-flooding of the Ohio River, stream cut-and-fill structures from seasonally variable flow, and disturbances from rooting. All surface inspection points from the study area are referenced in Appendix D.

Bayou Creek

Bayou Creek flows parallel to Little Bayou Creek in the western portion of the study area until the streams converge approximately 1,100 feet from the Ohio River. Gravel deposits appear in a substantial portion of the creek exposures. Data for Bayou Creek are arranged along geologically similar stream reaches, starting at the southern (upstream) end of the stream and proceeding downstream to the Ohio River.

First Reach

Surveyed deposits along the southernmost reach, Woodville Road to Acid Road, contain upward-fining, reddish-yellow, medium to fine chert gravels in a sandy matrix atop a massive light-gray clay, with a sharp contact between the two units at ID 130 (Figure 3.3). These sediments appear to be reworked materials from the Mounds Gravel upper terrace and Metropolis Formation (Nelson, 2006). Gravel lenses average approximately 2 feet in thickness and appear throughout this reach.

Figure 3.0: Field investigation location points referenced by identifier to Appendix D.

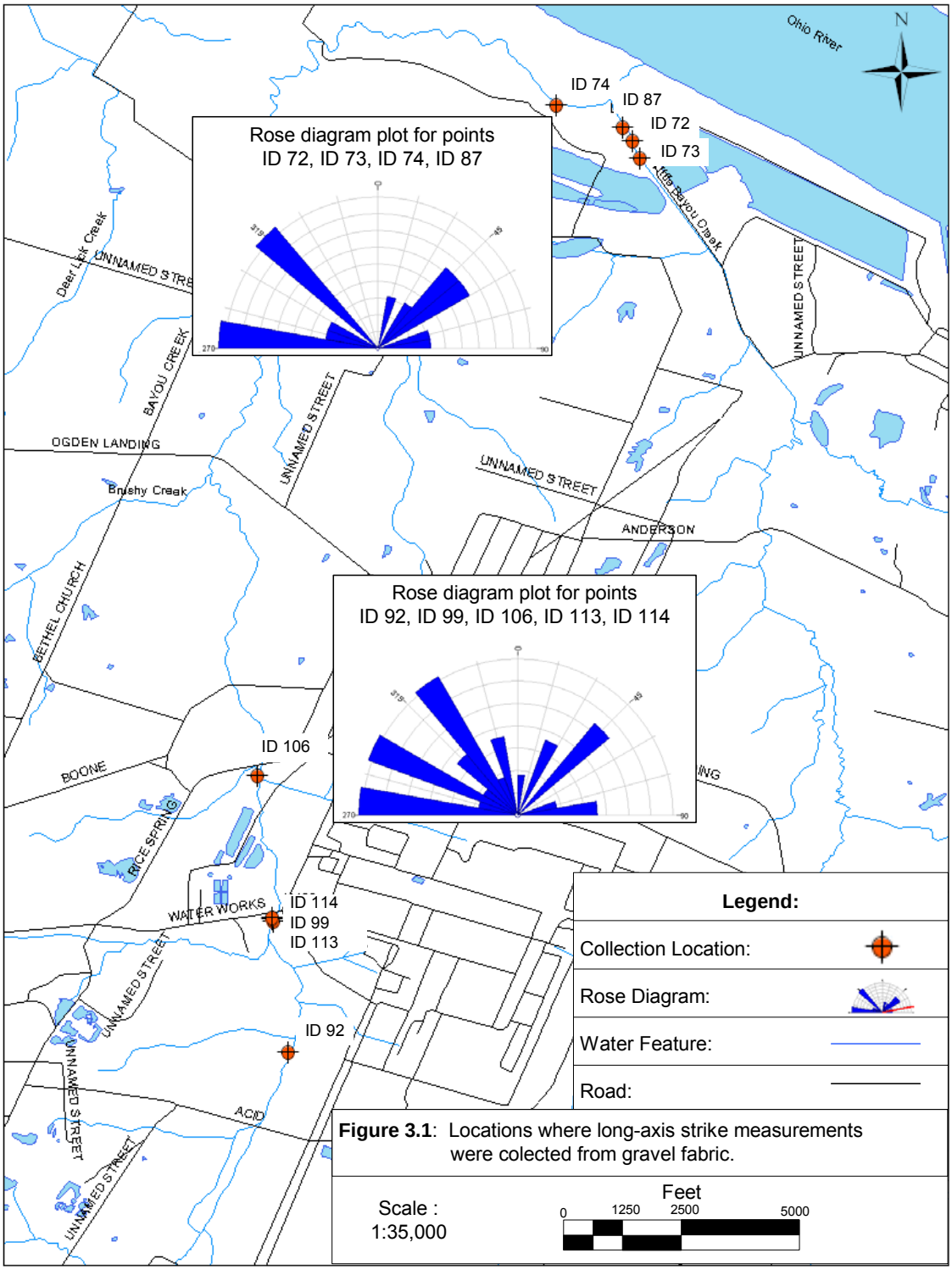


Figure 3.1: Locations where long-axis strike measurements were colected from gravel fabric.

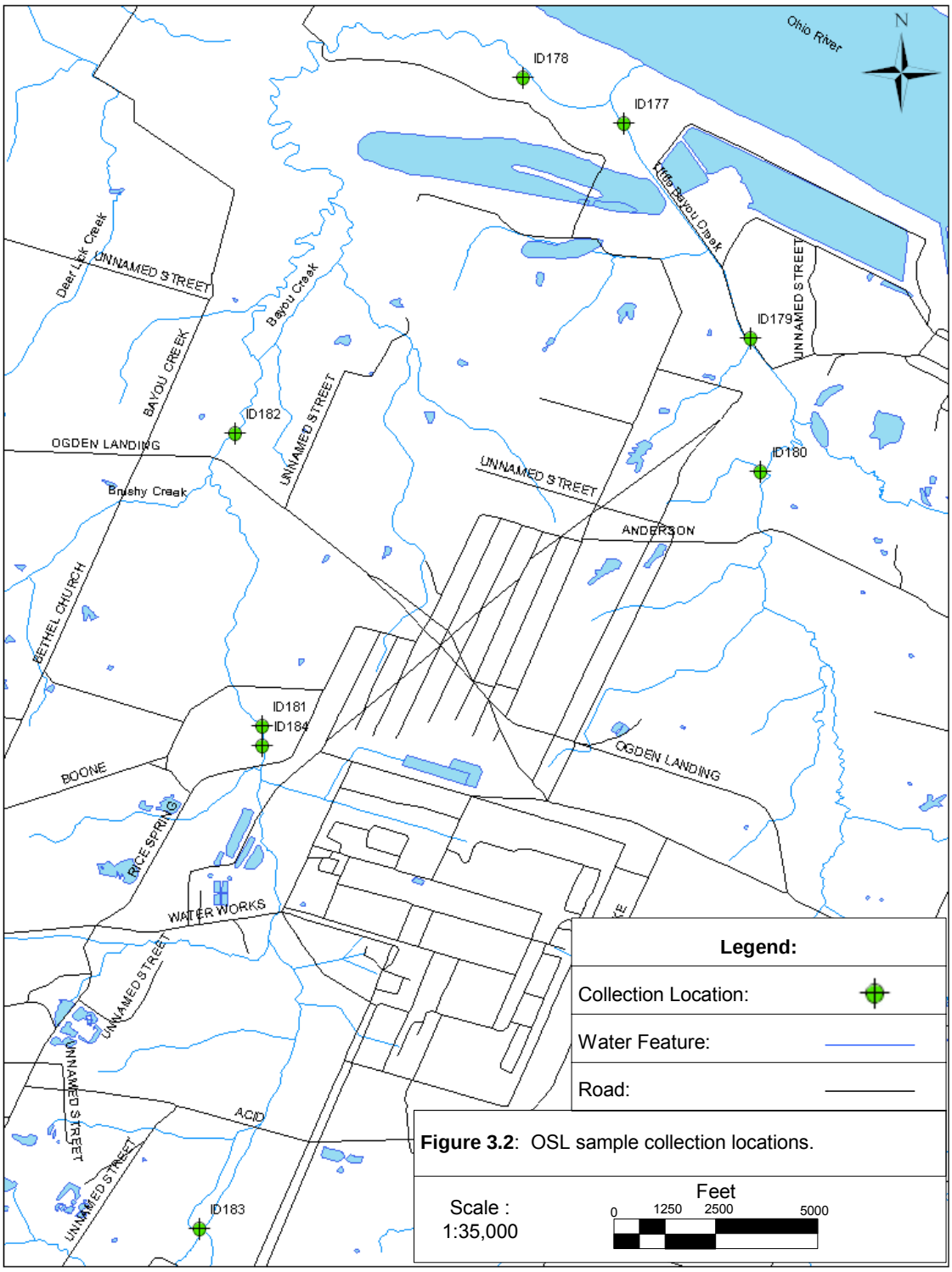


Figure 3.2: OSL sample collection locations.

ID	Northing (UTM)	Easting (UTM)	Strike (degrees)	ID	Northing (UTM)	Easting (UTM)	Strike (degrees)
ID 113	4108987	338002	294	ID 99	4108970	338005	45
ID 113	4108987	338002	320	ID 99	4108970	338005	48
ID 113	4108987	338002	265	ID 106	4110058	337930	86
ID 113	4108987	338002	286	ID 106	4110058	337930	94
ID 113	4108987	338002	20	ID 106	4110058	337930	337
ID 114	4108995	338002	311	ID 106	4110058	337930	75
ID 114	4108995	338002	327	ID 87	4114874	340224	90
ID 114	4108995	338002	291	ID 87	4114874	340224	130
ID 92	4107985	338074	99	ID 72	4114768	340278	70
ID 92	4107985	338074	128	ID 72	4114768	340278	115
ID 92	4107985	338074	161	ID 73	4114645	340323	90
ID 92	4107985	338074	166	ID 73	4114645	340323	100
ID 92	4107985	338074	208	ID 73	4114645	340323	30
ID 92	4107985	338074	98	ID 73	4114645	340323	50
ID 92	4107985	338074	9	ID 73	4114645	340323	45
ID 92	4107985	338074	97	ID 73	4114645	340323	10
ID 99	4108970	338005	328	ID 73	4114645	340323	52
ID 99	4108970	338005	295	ID 73	4114645	340323	310
ID 99	4108970	338005	312	ID 74	4115047	339825	310
ID 99	4108970	338005	42	ID 74	4115047	339825	40
ID 99	4108970	338005	328	ID 74	4115047	339825	85
ID 99	4108970	338005	296	ID 76	4115275	339619	90

Table 3.0: Raw clast orientation data collected along stream exposures.

Core Designation	Section Line	Depth (Feet)	Lab Number	Sample Material	OSL Age (ka)[4]	Unit
UKK-1-215	UKK-1A-1A'	5.8 – 6.0	UIC 1693IR[1]	Silt/Loess	16.6 ± 1.2	Upper Peoria Loess (unit 1)
UKK-1-415	UKK-1B-1B'	5.6 – 5.9	UIC 1698IR	Silt/Loess	19.3 ± 1.4	Upper Peoria Loess (unit 1)
UKK-2-344	UKK-2A-2A'	4.5 – 4.7	UIC 1695IR	Silt/Loess	23.5 ± 1.7	Upper Peoria Loess (unit 1)
UKK-2-344	UKK-2A-2A'	4.5 – 4.7	UIC 1695IRr[2] (Duplicate)	Silt/Loess	22.3 ± 1.6	Upper Peoria Loess (unit 1)
UKK-2-344	UKK-2A-2A'	4.5 – 4.7	UIC 1695IG[3] (Duplicate)	Silt/Loess	20.6 ± 1.5	Upper Peoria Loess (unit 1)
UKK-1-215	UKK-1A-1A'	8.4 – 8.7	UIC 1694IR	Silt/Loess	27.3 ± 1.9	Lower Peoria Loess (unit 2)
UKK-1-415	UKK-1B-1B'	8.1 – 8.4	UIC 1699IR	Silt/Loess	23.5 ± 1.7	Lower Peoria Loess (unit 2)
UKK-2-344	UKK-2A-2A'	7.2 – 7.4	UIC 1696IR	Silt/Loess	27.3 ± 1.9	Lower Peoria Loess (unit 2)
UKK-2-544	UKK-2B-2B'	7.5 – 7.7	UIC 1702IR	Silt/Loess	28.8 ± 2.1	Lower Peoria Loess (unit 2)
UKK-1-215	UKK-1A-1A'	10.3 – 10.5	UIC 1701IR	Silt/Loess	34.6 ± 2.5	Roxana Silt (unit 3)
UKK-1-415A	UKK-1A-1A'	9.4 – 9.6	UIC 1700IR	Silt/Loess	47.2 ± 3.5	Roxana Silt (unit 3)
UKK-2-344A	UKK-2A-2A'	10.8 – 11.0	UIC 1697IR	Silt/Loess	39.6 ± 2.8	Roxana Silt (unit 3)
UKK-2-344A	UKK-2A-2A'	10.8 – 11.0	UIC 1697IRr (Duplicate)	Silt/Loess	41.1 ± 2.9	Roxana Silt (unit 3)
UKK-2-544	UK-2B-2B'	13.1 – 13.4	*(awaiting confirmation)*	Silt/Loess	50 to 80 *(awaiting refinement)*	unnamed intermediate loess (unit 4)

Table 3.1: Ages calculated using Optically Stimulated Luminescence for near-surface sediments (WLA, 2006).

Hard, light-gray clay is present below the gravels and forms a firm bottom in the creek bed (in locations not covered by eroded gravel deposits). This clay is continuously present along the stream banks and is likely derived from the Metropolis Formation. Loess and modern soil cap the gravel deposits in this area. One OSL sample was collected from a gravel lens at ID 183 and a grain-size distribution curve for this sample is presented in Appendix E. Iron oxide precipitation appears along several sections of the creek, firmly cementing gravels in some locations and occurring as amorphous iron (III) hydroxide ($Fe(OH)_3$) in others (Figure 3.4).

Second Reach

North of Acid Road until approximately 0.9 miles downstream of Rice Spring Road gravel is continuously exposed with mean clast size increasing up to 2.5 inches along the long axis. Gravels within bank exposures south of Rice Spring Road appear to be modern reworking of the Metropolis Formation while deposits to the north are in place (Nelson, 2006). Gravel deposits along this portion of creek are as much as 300 feet in length and average approximately 3 feet in thickness. Gravels appear transitional with sandy silts in some locations upstream of Rice Spring Road. Light-gray clay crops-out below the gravel deposits in creek banks (Figure 3.5) and is also continuous along this reach with a sharp, undulating contact separating the two units. Clay deposits at various locations along this reach have been mapped as the Porters Creek Clay by Olive (1966).

One soft-sediment deformation feature was noted in a gravel deposit between Acid Road and Rice Spring Road (Figure 3.6). This feature is a thinly laminated silt that penetrates into the gravel sequence bounded above and below by silt. Silts above and below the structure exhibit horizontal lamination. The gravels penetrated show little imbrication and are dark bronze chert clasts with occasional weathered chert and quartz pebbles. The boundary separating the upper and lower gravel zones is similar to other transitional zones along this stretch. A clastic dike mapped in the lower clay deposit by Olive (1966) (near ID 112) was not found, but it was confirmed to exist by Davis (2005). Collection of 2 OSL samples was attempted at locations ID 181 and ID 184; however, cementation of the gravel deposits allowed for the recovery of the ID 184 sample only. A grain-size distribution curve generated during OSL sample preparation is presented in Appendix E. Amorphous $Fe(OH)_3$ was noted at ID 98 and intense Fe and Mn staining was noted at ID 103. Gravels exhibit a preferred median clast strike of 284^o across five locations of this reach (Figure 3.1).

Figure 3.3: Outcrop at ID 130 illustrating the sharp contact between pebble-gravel deposits and underlying clay.

Figure 3.4: Amorphous $Fe(OH)_3$ precipitating out into Bayou Creek at ID 138.

Figure 3.5: Sharp contact between clay and gravel deposits at ID 152.

Figure 3.6: Soft-sediment deformation feature noted downstream of Acid Road.

Third Reach

Downstream of ID 159, bank exposures are overgrown and occasionally mud-draped north of ID 174 due to agricultural land-use practices. Gravels appear in the bed of the creek along with sand bars, as opposed to the gravel-dominated bed upstream. Additionally, only fine gravels sparsely crop out along banks. Exposures along reach three are covered by modern fluvial deposits and represent reworked loess and fine-grained material from the Metropolis Formation. These materials form a surficial veneer along the creek banks. Increasing sand was noted in exposures along with active stream features. Excavation into the banks revealed a buff to tan silty sand overlying dark bluish-gray clay (Figure 3.7). These sediments are likely part of the Metropolis Formation. One OSL sample was collected from the underlying clay unit at ID 182 and sieve analysis is presented in Appendix E. Downstream of ID 175 the stream became nearly impassable because of beaver dams and deadfall. Exposures along this section of stream during the study period were overgrown, flooded and/or inaccessible until the low-water bridge just downstream of ID 63.

Fourth Reach

Downstream from the low-water bridge to ID 6, the creek takes an easterly course. Stream morphology also begins to change as the stream widens, and gravels once again are present in the stream bed. Diffuse seeps along banks emanate from gravels appearing low in the banks and often precipitate amorphous $Fe(OH)_3$. Banks are composed of an upward-fining sequence of gravel to sand to mud (ID 5). Bank sediments are poorly graded and friable with a bleached buff outer surface that is dark brown upon excavation (ID 6). The Metropolis Formation is the source of material in the creek bed and bank exposures, but most exposures appear reworked by modern processes.

Fifth Reach

ID 17 (Figure 3.8) marks the location where gravel to cobble sequences appear in outcrop. These continue, where not eroded, downstream to ID 74. These exposures exhibit a sharp, inclined upper contact that undulates on the order of 1 to 2 feet. Gravels show faint imbrication and signs of internal scour. Gravels in bank exposures are derived from the Mounds Gravel and may be in-place deposits or have undergone slight reworking by the current fluvial system.

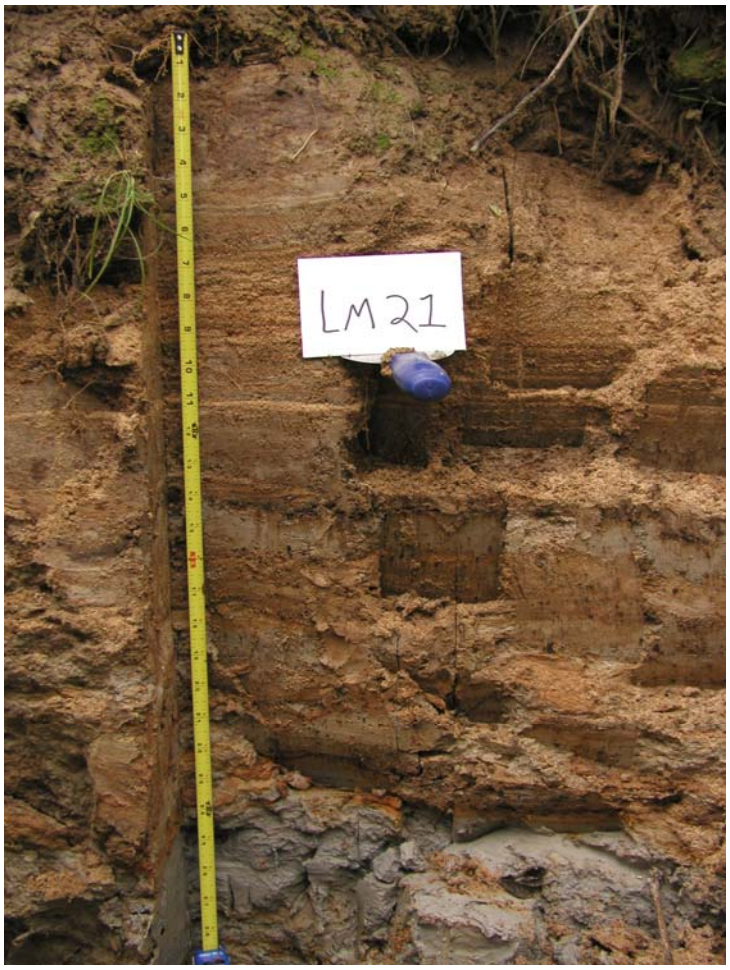


Figure 3.7: Outcrop at ID 168 illustrating facies change to silty sand overlying gray clay.

Figure 3.8: Return to well cemented coarse gravel-cobble sequences at ID 17.

These gravels are sharply overlain by a light-tan loess and modern soil cap until the gravels are completely draped downstream of ID 74 by fine sediment deposited by the backflooding of the Ohio River. Elevation of the gravel deposit at ID 17 was measured at 303 to 306 feet above mean sea level (amsl) (Figure 3.0). One OSL sample was collected at ID 178 and grain size distribution from sieve analysis is presented in Appendix #. Clast measurements collected at ID 74 and ID 76 (Figure 3.1, Table 3.1) yield a median long-axis clast strike of 86^{o}.

Little Bayou Creek

Little Bayou Creek flows along the eastern portion of the WKWMA and has undergone channelization along its northern reaches, resulting in good geologic exposures. Institutional controls for health hazards are in place along the southernmost portion of the creek, so it was not surveyed. However, a previous study by SAIC (2004) was referenced for descriptive purposes along this section of the creek. Surficial data are presented along geologically similar segments of the creek.

Sixth Reach

SAIC (2004) indicates no exposures south of the lowest portion of the terrace slope defined by Jacobs (1997) along Little Bayou Creek. Upstream of McCaw Road, clay crops out in the bank as much as 2 feet above stream level. The stream dissects into this unit (SAIC, 2004). A layer of thin massive silt (1 foot thick, immediately upstream of McCaw Road) and modern soil cap the clay (SAIC, 2004). The exposure height increases between McCaw Road and Ogden Landing Road. Massive silt (6 feet thick) appears in a 9-foot-high exposure, over the clay, with vertical to sub-vertical fractures along a 30-foot-long exposure midway along this reach. Immediately downstream a 50-foot-long exposure contains a 6.5-foot-thick layer of medium-grained, silty sand grading to massive silt, which is separated from the underlying weathered clay by a gravel-rich contact (SAIC, 2004). This sequence continues with a total height of 6 to 8 feet for approximately 200 feet along the stream (SAIC, 2004). The silt along this reach represents undifferentiated loess.

Seventh Reach

North of Ogden Landing Road to ID 34, pebble and sand lenses appear frequently in the massive silt that caps the clay unit subcropping below the stream (Figure 3.9). These lenses appear partially iron cemented and are as much as 19 feet in length with an average thickness of 1 foot. At ID 34 and progressing downstream, clasts within lens-shaped deposits increase to gravel and cobble size and appear in banks until ID 36. Sediments along reach seven are reworked material from the Metropolis Formation and loess deposits. Exposure was limited from this point downstream to Anderson Road, but cross-bedded coarse gravel bars (modern) were noted in the stream.

Eighth Reach

The largest natural outcrop of the study area is located approximately 0.3 mile downstream of Anderson Road at ID 43 (Figure 3.10). This large exposure is a model for all exposures starting at ID 42, where fine-grained silty sand is noted in the banks and continues until channelization has occurred 0.7 mile downstream. This exposure represents the upper portion of the Metropolis Formation capped by undifferentiated loess. Outcrops along this reach consist of 5- to 15-foot vertical banks of tan to white silty sand with stringers of iron cement over a creek bed of hard, mottled, light gray clay, which is covered occasionally with an eroded sandy veneer. Weakly cemented sand layers eroded from exposures occur occasionally along this reach as “flagstone” along the creek banks. One OSL sample was collected at ID 43 and a grain-size distribution curve from sieve analysis is provided in Appendix E.

Where channelization begins, the creek bed takes a new form. Increased sand in the bed is noted along this reach with seeps and boils forming along the banks and in the bed. Water temperatures from seeps and boils differ significantly from stream temperatures in summer and winter, which indicates these features to be areas of groundwater discharge (LaSage, 2004). Bank lithology, however, remains a massive silt to silty sand until ID 83.

Figure 3.9: Pebble lens downstream of Ogden Landing Road.

Figure 3.10: Large outcrop at ID 43.

Ninth Reach

Interbedded dark gray clay, orange sand and tan silt are present upon excavation of the surface veneer at ID 83 (Figure 3.11). The dark gray clay, however, only appears locally on the northeast bank, and dark gray to black clay is seen washing down the same bank in other locations. This is a modern feature, influenced by sediment delivered from the nearby TVA ashponds.

Gravel deposits crop out along both creek banks approximately 90 feet downstream of ID 84 until ID 72. Exposures along this portion of the ninth reach illustrate the Metropolis Formation / Mounds Gravel contact. This contact was confirmed by Nelson (2006) and consist of an estimated 2-foot gradational interval where preserved. The Metropolis Formation and/or Sangamon Geosol (Loveland loess unit) cap the Mounds Gravel along this reach. The Mounds Gravel deposits are iron stained, weakly to well cemented, and reddish-brown in color. Clasts have a bronze patina and are gravel- to cobble-sized. The sandy matrix of the unit retains the reddish-brown color. Elevation of the gravels at the start of the exposure is 318 feet amsl and undulates +/- 1 foot along the exposure at measured locations. In high banks (where preserved) the Metropolis Formation consists of orange and gray silty sand and weathered-brown chert gravel, with a gradational contact between the two units. In other locations, silty sand or silt loess beneath modern soil overlies the gravels, and a gradational contact separates the upper sediments from the gravel deposits. At the start of the gravel exposure a medium gray clayey silt is present below the gravels, but the clay is not visible further downstream as the gravels sub-crop below stream level (Figure 3.12). Two OSL samples were collected at ID 179; one in the gravel deposit and one in the underlying clayey silt. Sieve analyses of these samples can be viewed in Appendix E.

Figure 3.11: Interbedded silts and clays at ID 83.

Figure 3.12: Start of gravel deposit overlying gray clay.

Gravel deposits continue to be exposed from ID 72 until slightly beyond ID 77, where they become masked by silt drapes and bank erosion. The extent of exposures depends greatly upon the season and recent stage of the Ohio River. Deposits along this reach differ slightly from those downstream as cementation is mostly or completely absent and the sandy matrix of the unit is a yellowish-tan instead of the reddish-brown color of the clast. Sediments from ID 72 to ID 77 retain the bronze patina indicating Mounds Gravel, but have been reworked by modern fluvial processes. Massive silt overlies the gravel deposits and good exposures are available because of the channelization/rerouting of the creek. The overlying silt, while not indicating bedforms, does contain various leach zones and a sandy contact where it merges with the underlying gravels (Figure 3.13). This silt represents in-place undifferentiated loess. Elevation of the gravel deposits ranges from 310 to 313 feet along this reach and modern sediment drapes had to be excavated prior to measurement in some areas. Two OSL samples were collected at ID 177, one in the upper silt unit and one in the gravel unit. Sieve analyses of the samples is presented in Appendix E. A preferred fabric in clast orientation for the gravel deposits was also noted at ID 69, ID 72, and ID 73, and orientation measurements from these locations indicate a mean clast strike of 76^{o} (Figure 3.1, Table 3.0). Downstream of ID 77 to the Ohio River exposures are heavily masked by modern deposition.

OSL Data

OSL results are still pending. Neutron activation data are required for age calculations and these data have not been received from the USGS luminescence laboratory. Using a range of dose rate values recommended by Owen (2006), OSL data appear to be erroneous. Data at ID 177 do not follow the law of superposition. All aliquots sampled at ID 177 appear much younger in the lower gravel unit than in the upper silt unit. Other samples from the Metropolis Formation exhibit ages much younger than the loess ages presented in Table 3.1. These results are inconsistent with the known stratigraphy of the site.

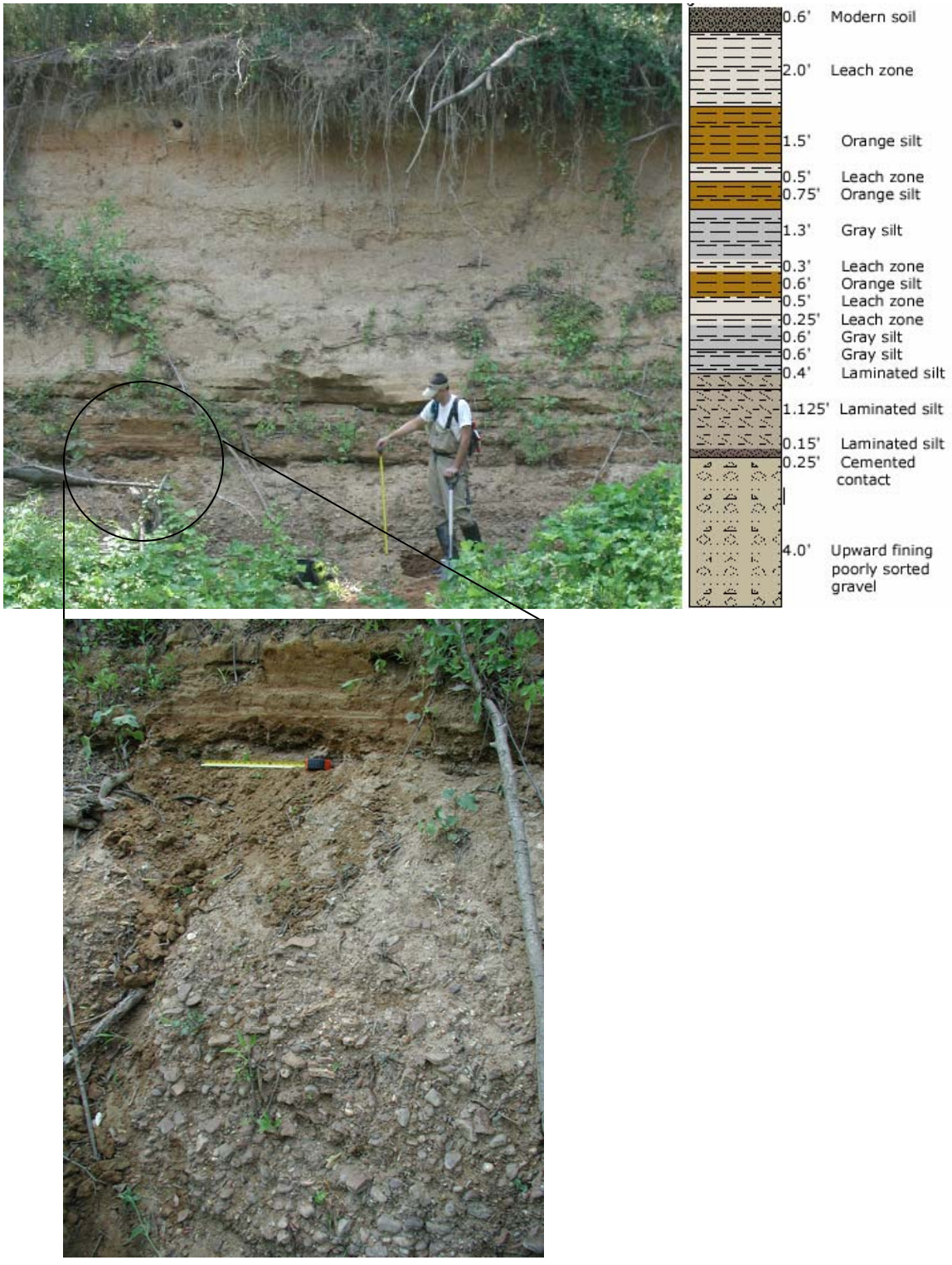


Figure 3.13: Outcrop at ID 69.

Subsurface Data

Borings conducted from previous site investigations were the primary source of subsurface data on underlying geology. Spatial distribution of selected borings (Figure 3.14) resulted in adequate resolution for site-wide geologic assessment. Surface elevation of selected borings ranged from 415 feet to 322.5 feet amsl and the deepest borings penetrated into limestone bedrock 350 feet below the surface. Boring logs from continuous sediment cores yielded the most useful information, while discrete interval sampling generally provided information on lithologic boundaries. Data quality ranged from excellent to poor and every attempt was made to confirm the accuracy of data before they were used for interpretation. In most wells deeper than 80 feet, three to four distinctive boundaries were discernable by changes in color, grain size and mineralogy.

Stratigraphic interpretations of data have been assembled from surficial and subsurface data. Subsurface data are presented in isopach maps, structural elevation maps, and cross-section profiles. Surficial data were used to aid in identification of stratigraphic units, understand the spatial distribution of lithologies, and interpret depositional environments.

Structural Elevation and Thickness

Limestone bedrock dips to the south (Figure 3.15). Six additional boreholes from outside the study area were added to increase the resolution of Figure 3.15 (Figure 3.16). A bedrock low underlying the study forms a lobe striking to the north. This low drops 63 feet across the five borings that penetrate bedrock directly underlying the site. A small structural high appears immediately south of the terrace slope and bedrock elevation varies 28 feet on opposite sides of the terrace slope. The median elevation of bedrock in Figure 3.15 is 42 feet amsl. The overlying Tuscaloosa Formation had insufficient data points to create a structural elevation map.

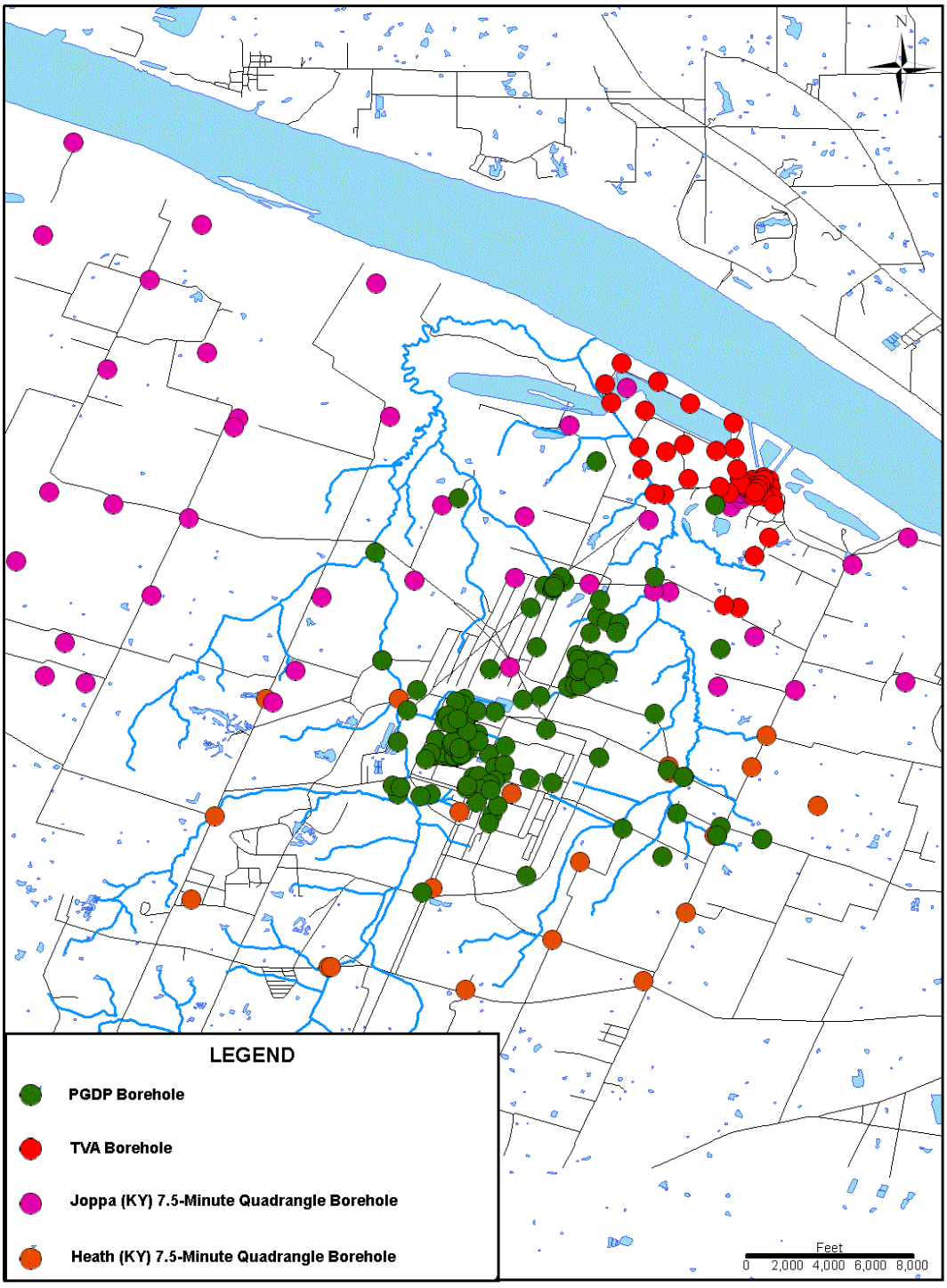


Figure 3.14: Spatial distribution across the study area.

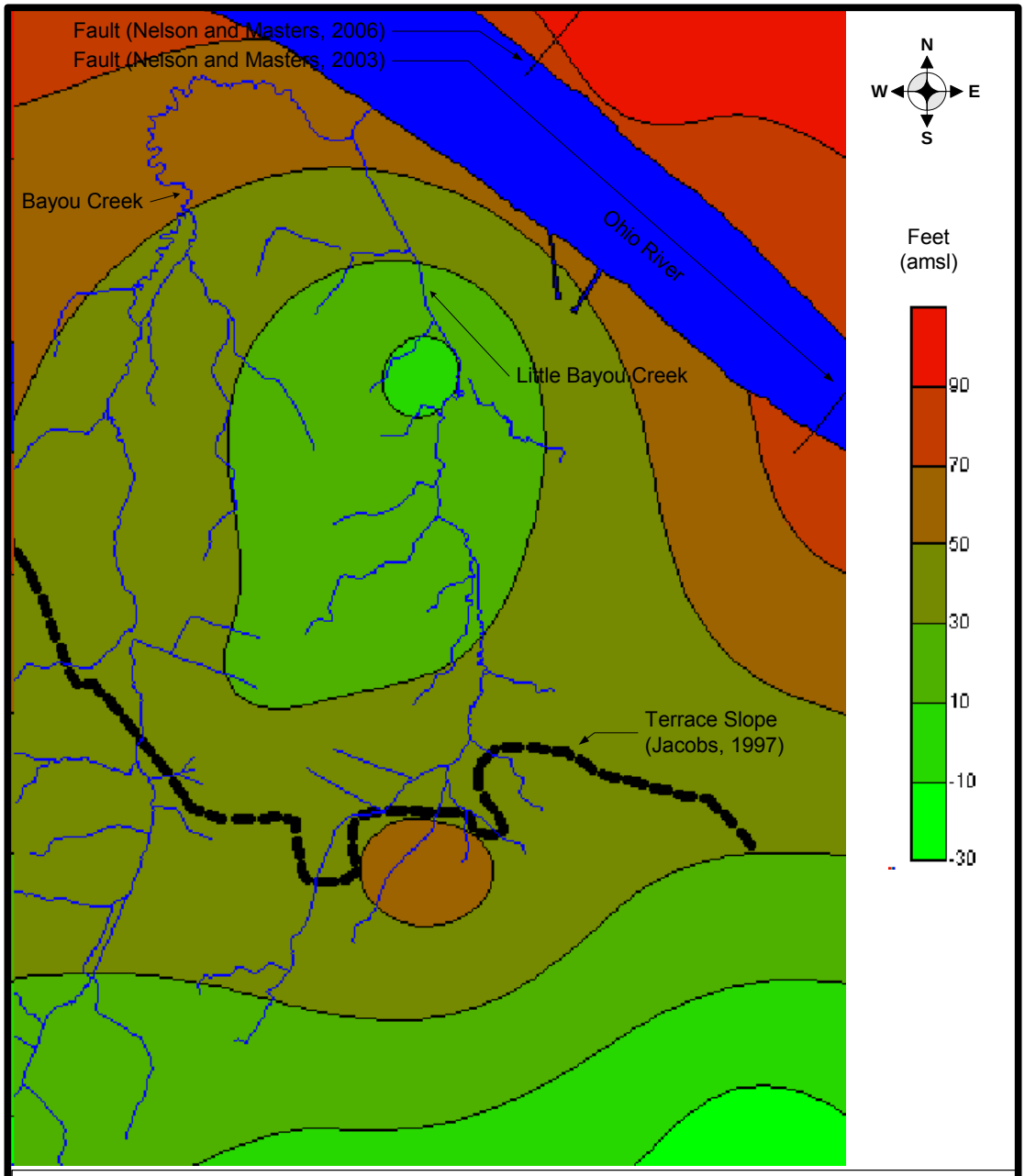


Figure 3.15: Structure coutour map of Mississippian limestone bedrock.

Notes: Contour interval 20 feet; elevations are amsl.

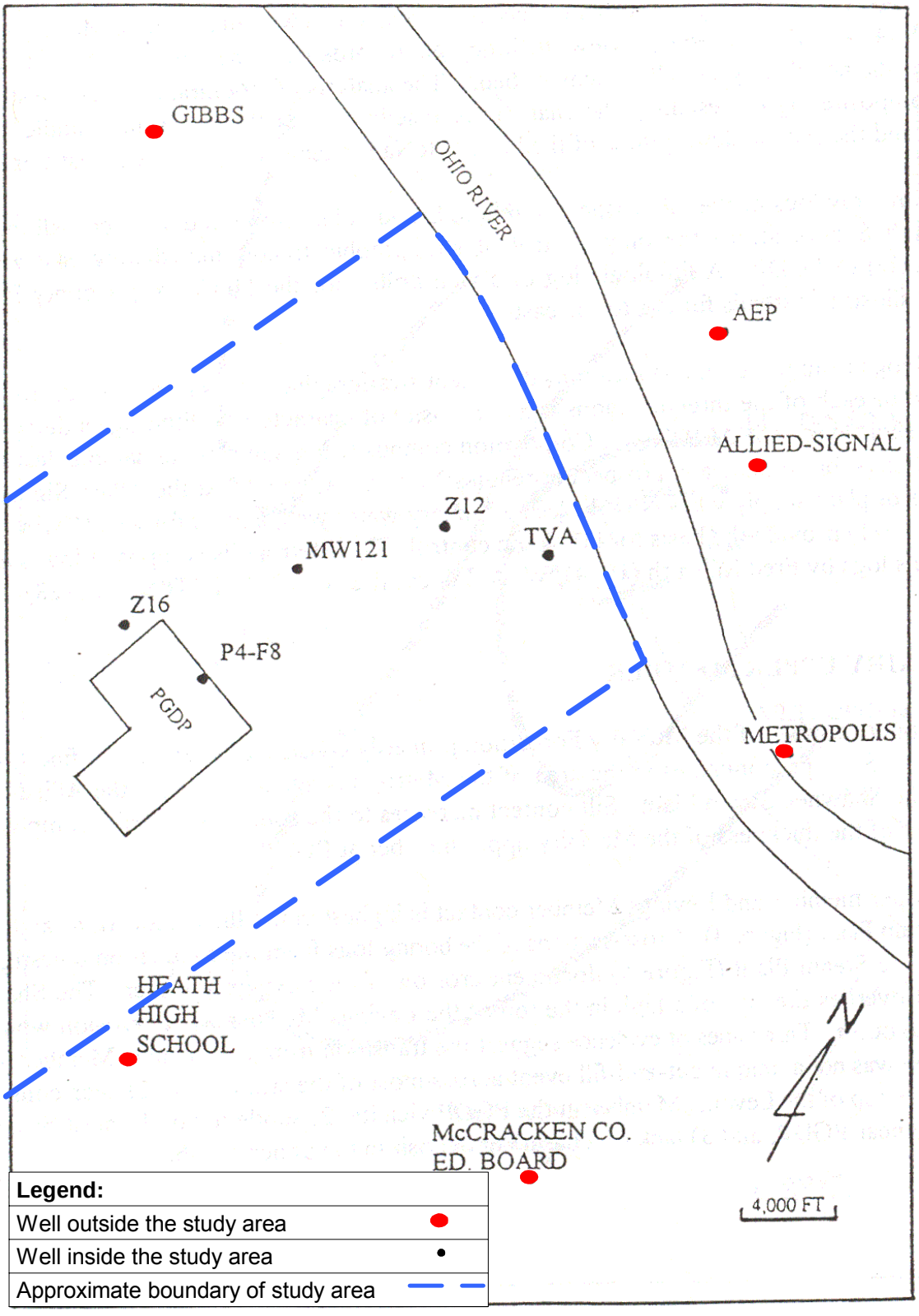


Figure 3.16: Map indicating boreholes used outside of the study area (modified from Davis, 1996).

The McNairy Formation overlies bedrock through most of the study area and exhibits a 122-foot elevation change across Figure 3.17. Most of the elevation change is in the southern portion of the study area where elevation changes abruptly from 180 to 270 feet amsl. The elevation change for the McNairy Formation appears less prominent in the southwestern portion of the study area, but this may be related to reduced well control in that region. North of the terrace slope an additional zone of irregularity is noted. This zone strikes northeast, perpendicular to the Ohio River. The Porters Creek Clay (Figure 3.18) is preserved south of the terrace slope (Jacobs, 1997) and dips to the east. The Eocene sands sparsely occur in the study area and insufficient data were present to create a structural elevation map of the unit.

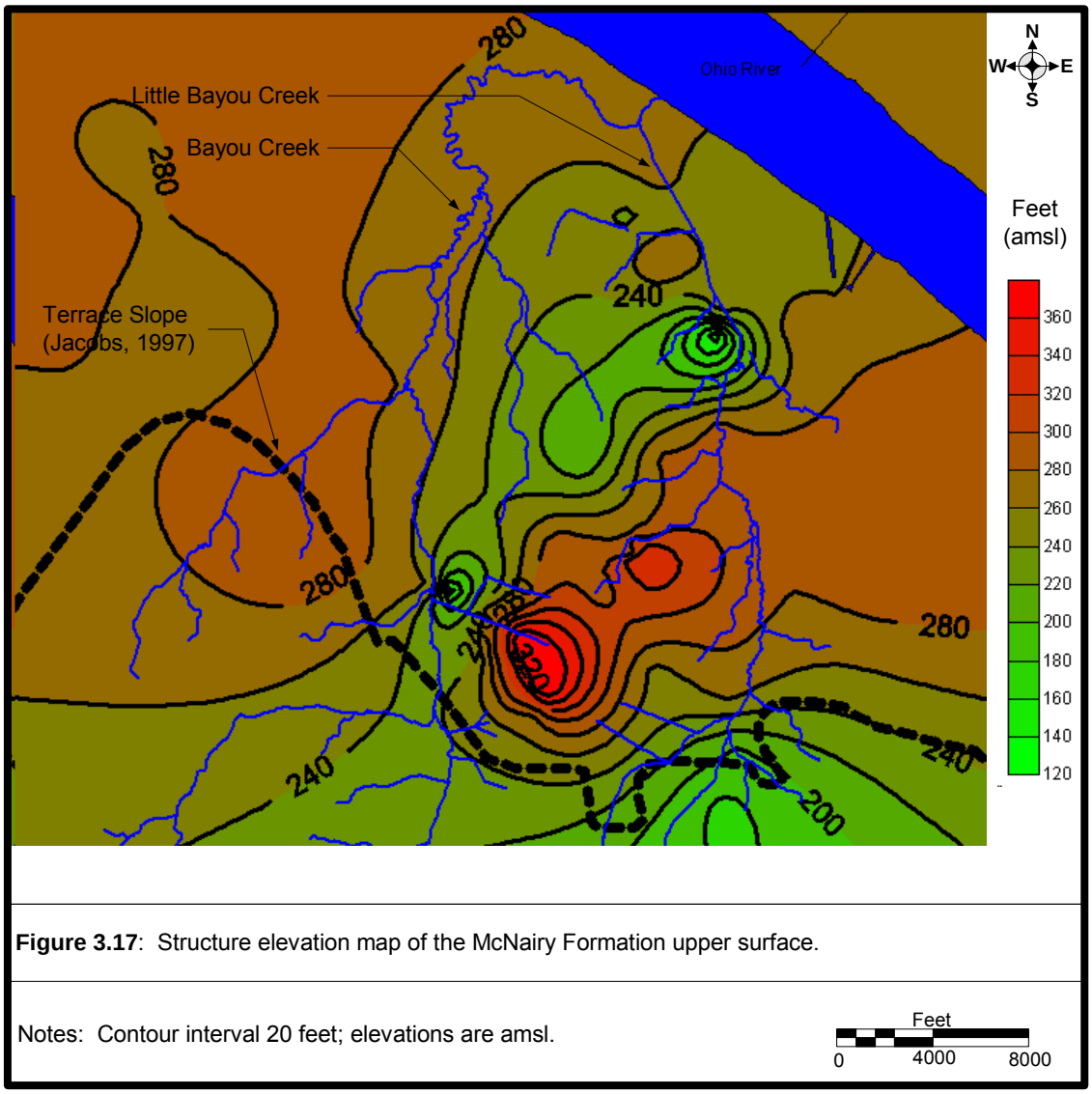


Figure 3.17: Structure elevation map of the McNairy Formation upper surface.

Notes: Contour interval 20 feet; elevations are amsl.

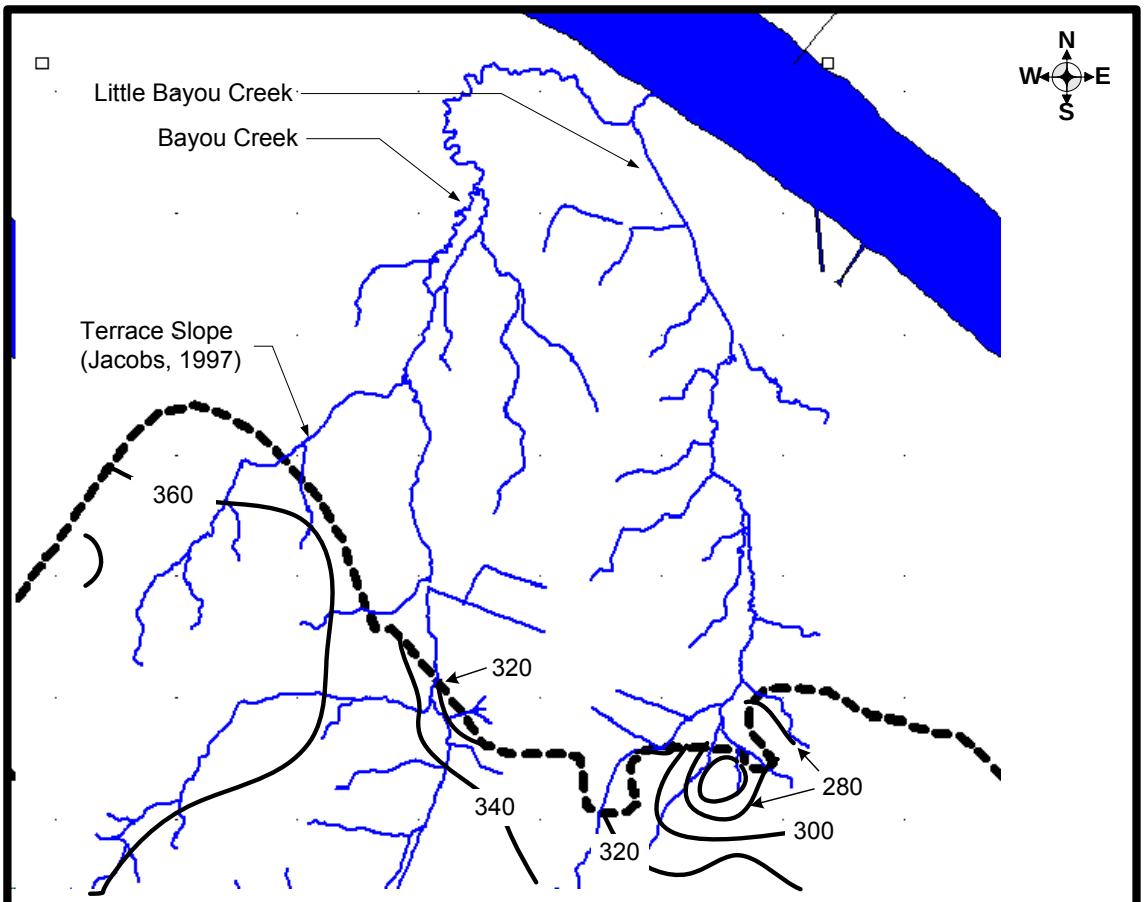


Figure 3.18: Structure elevation map of the Porters Creek Clay upper surface.

Notes: Contour interval 20 feet; elevations are amsl.

Feet
0 4000 8000

The Mounds Gravel shows a similar pattern to the McNairy Formation (Figure 3.19), with rapid elevation change in the southern portion of the study area, southward to the terrace slope (Jacobs, 1997). The highest elevation of the Mounds Gravel appears in the southwest of the study area at 412 feet amsl, and elevation decreases 147 feet to 265 feet amsl in the northern portion of the study area. The Mounds Gravel trend also is similar to the McNairy Formation trend: elevations are higher along the western border of the study area, and a similar zone of irregularity is displaced in the northeastern quadrant.

The Mounds Gravel was the deepest unit with sufficient data points to create an isopach map (Figure 3.20). Thickening of the unit occurs in two distinct locations, along a northwest trend, parallel to the terrace slope (Jacobs, 1997) and along the same anomalous northeast strike noted from the Mounds Gravel and McNairy Formation structure contour maps. The thickness of the Mounds Gravel varies from 80 to 2 feet with a mean thickness of 29 feet.

The Metropolis Formation blankets the Mounds Gravel with a gentle dip toward the Ohio River (Figure 3.21). The average elevation for the Metropolis Formation is 353 feet amsl in the study area. The elevation drops 168 feet from the terrace slope to the Ohio River floodplain. Figure 3.22, an isopach map of the Metropolis Formation, displays a median thickness of 27 feet, with thinning occurring along dip, nearing the Ohio River.

Undifferentiated surficial loess caps all formations. The loess has a median thickness of 15.5 feet (Figure 3.23), which increases in structural lows of the Metropolis Formation structure-contour map (Figure 3.21).

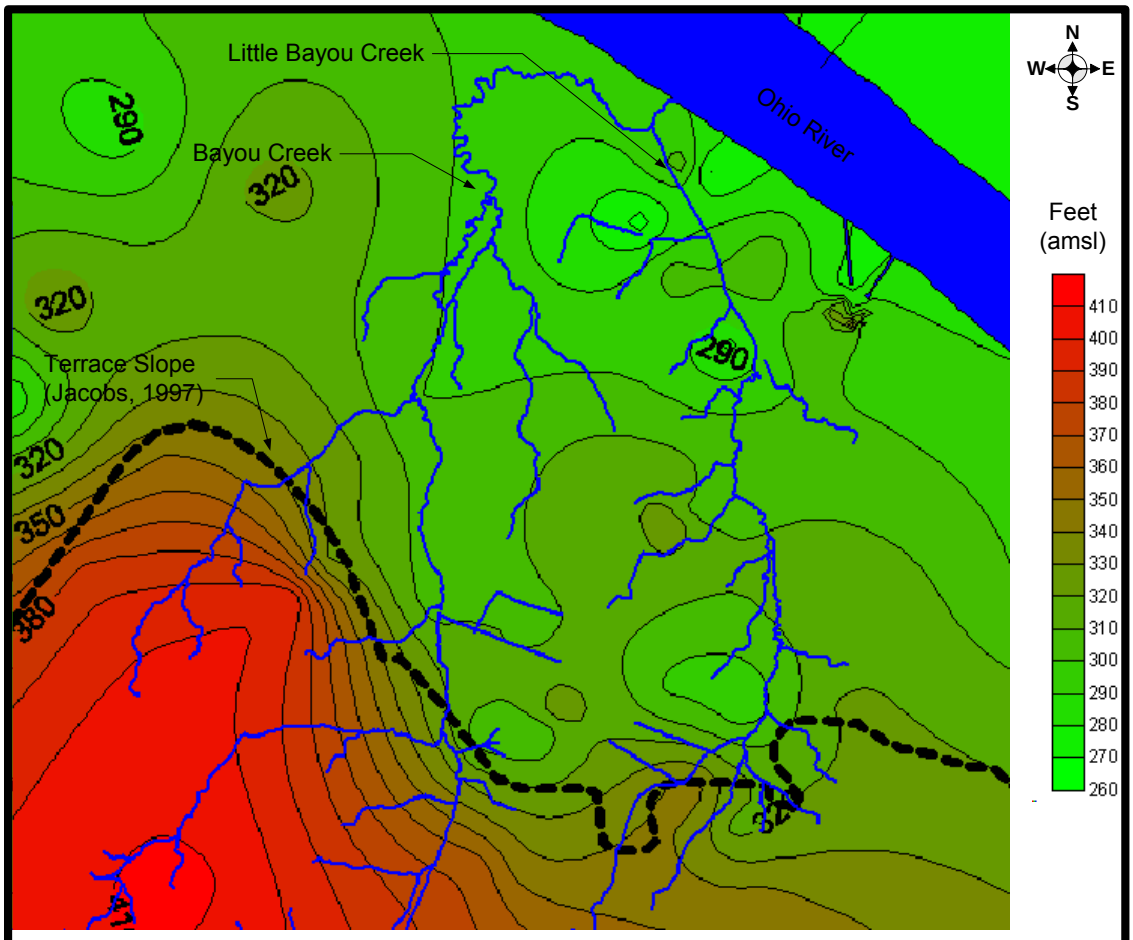


Figure 3.19: Structure elevation map of the Mounds Gravel upper surface.

Notes: Contour interval 10 feet; elevations are amsl

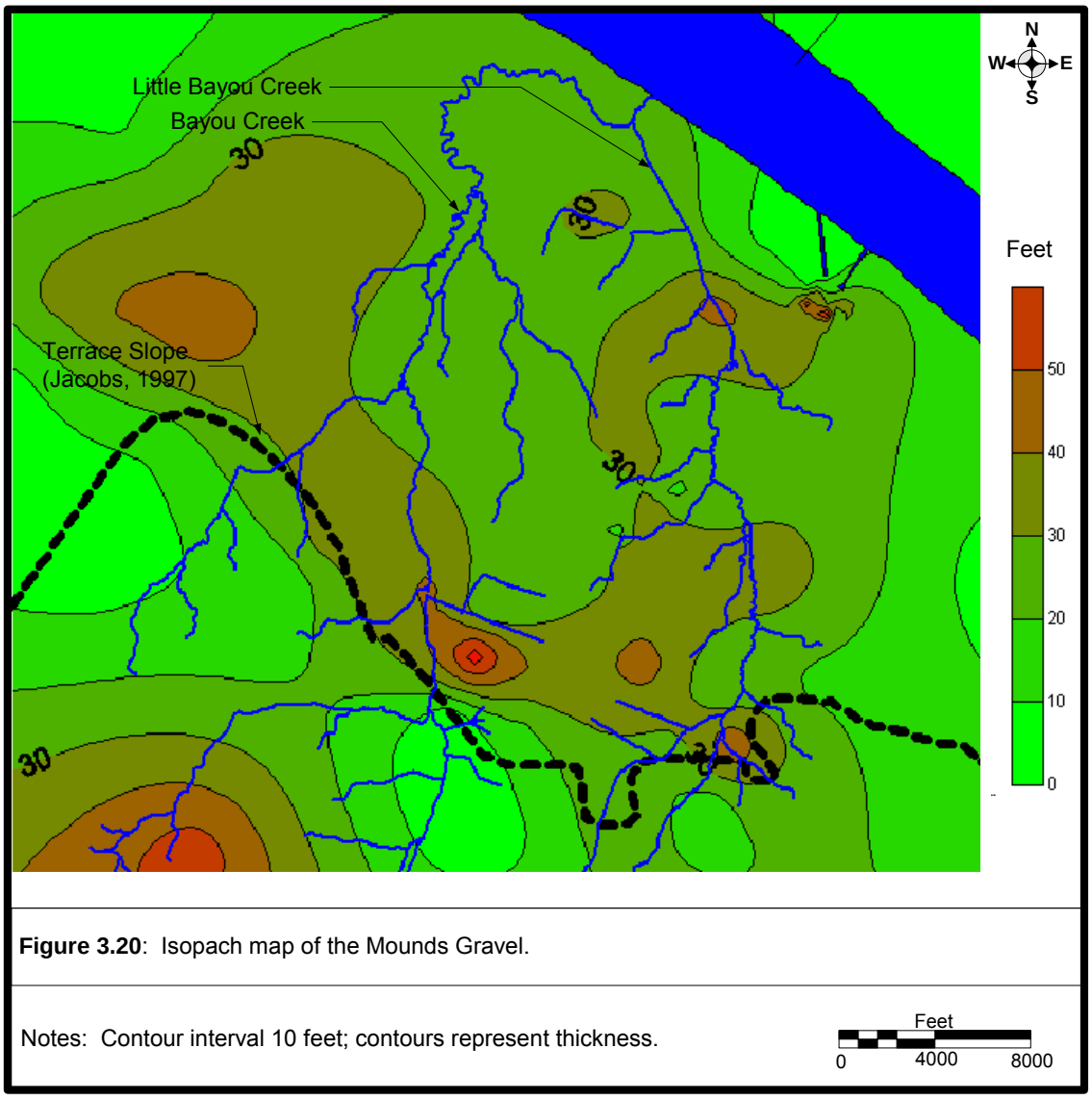


Figure 3.20: Isopach map of the Mounds Gravel.

Notes: Contour interval 10 feet; contours represent thickness.

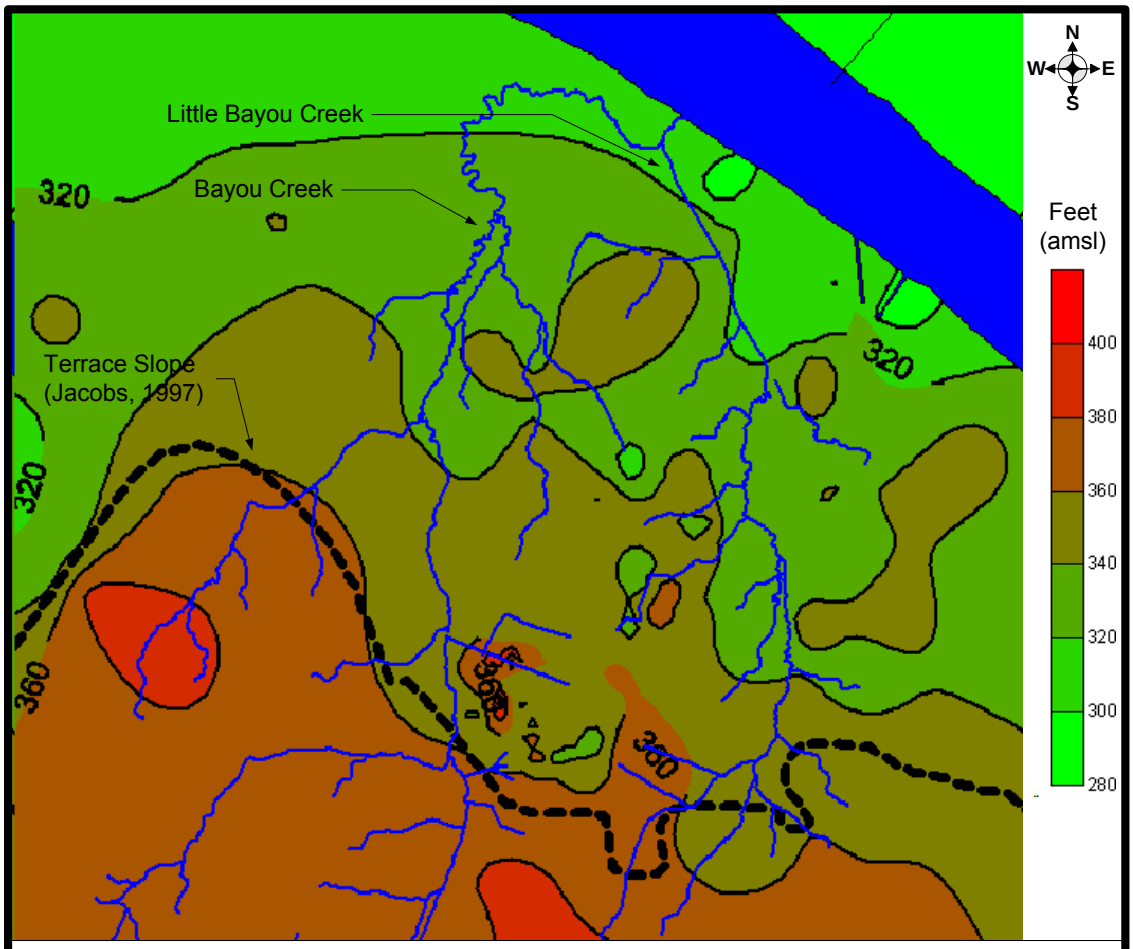


Figure 3.21: Structure elevation map of the Metropolis Formation upper surface.

Notes: Contour interval 20 feet; elevations are amsl.

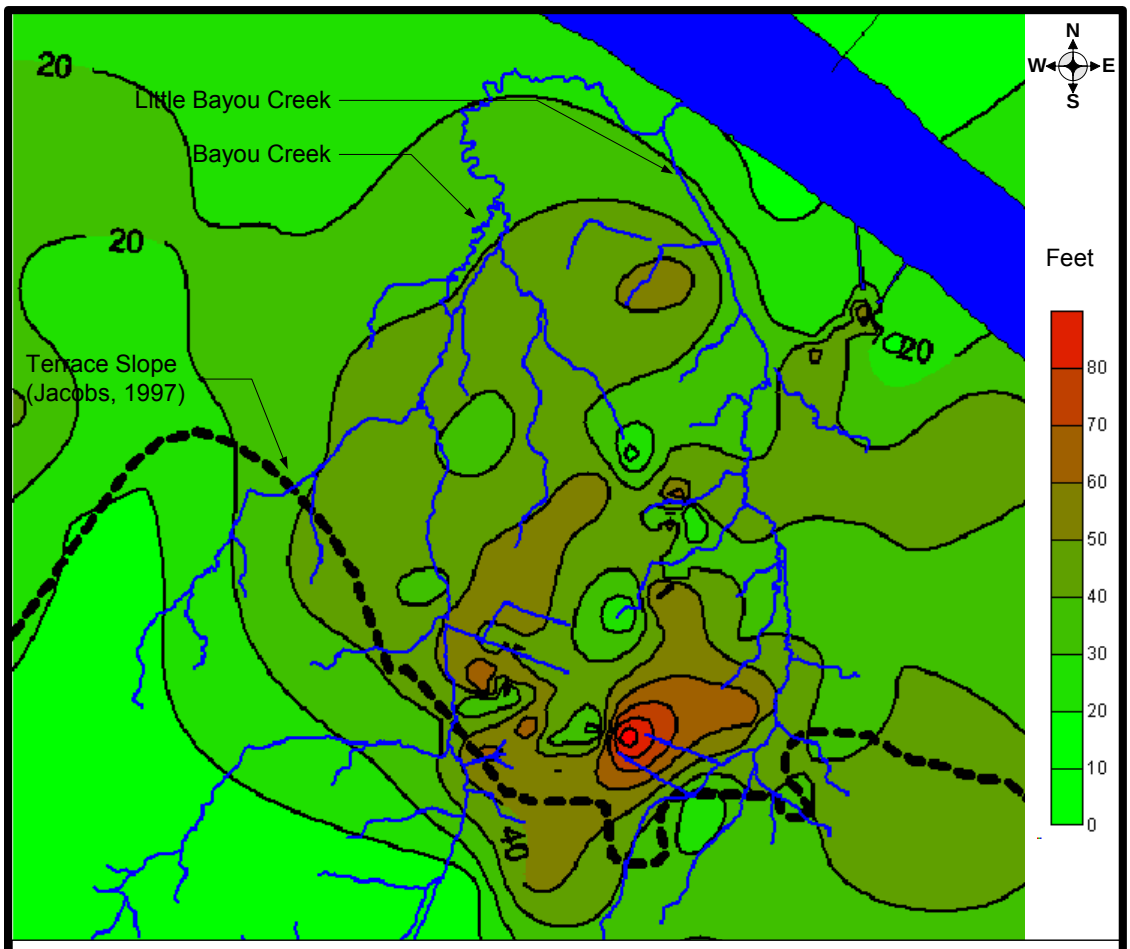


Figure 3.22: Isopach map of the Metropolis Formation.

Notes: Contour interval 10 feet; contours represent thickness.

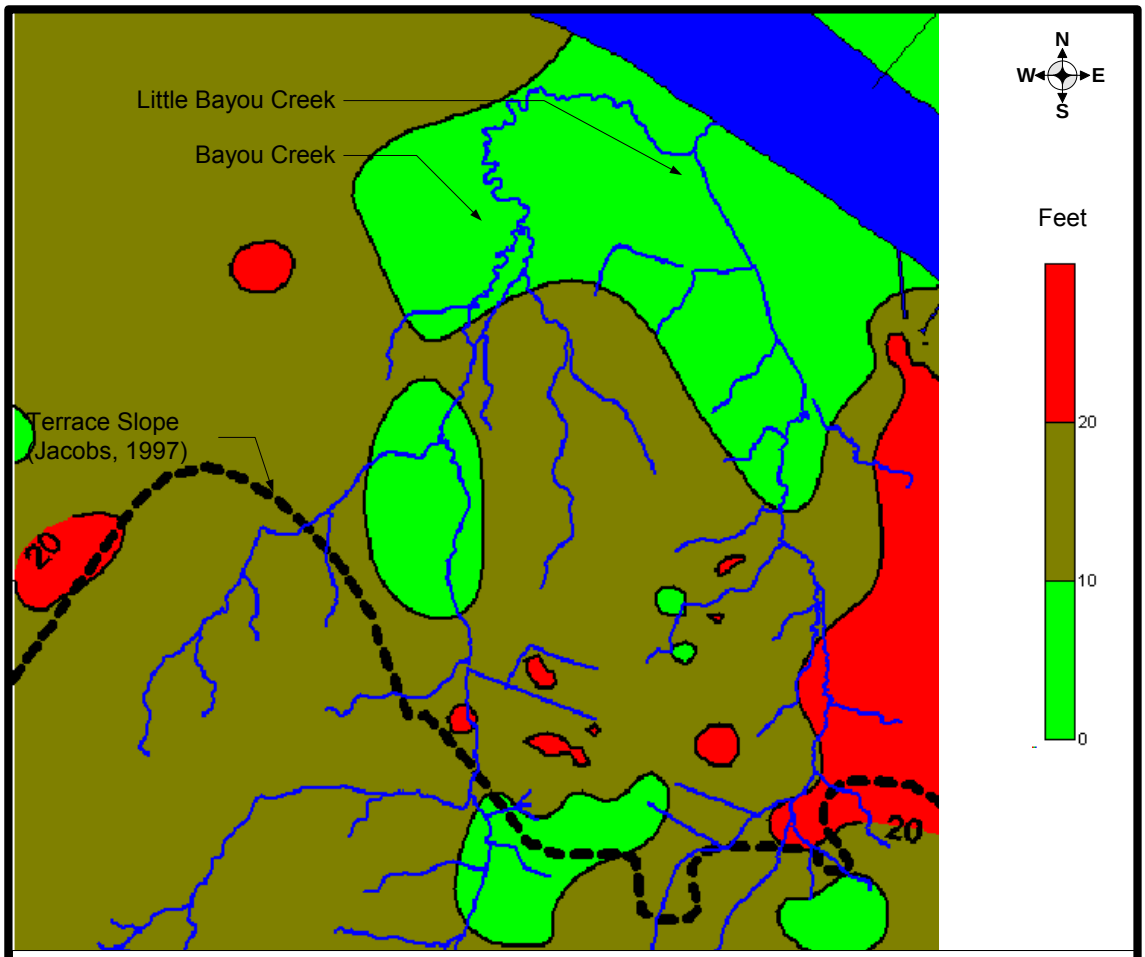


Figure 3.23: Isopach map of undifferentiated loess deposits.

Notes: Contour interval 10 feet; contours represent thickness.

Feet
0 4000 8000

Geologic Sections

The location of geologic cross-sections is presented in Figure 3.24 along with the borings used in each section. All cross-sections are presented at 50 times vertical exaggeration. Lithologic and stratigraphic identifications for all cross-sections are presented on section A-A' and are consistent through all lines of section.

South - North Sections

The westernmost profile, A-A', is presented in Figure 3.25, and clearly illustrates the truncation of Porters Creek Clay by the Mounds Gravel. The Mounds Gravel directly overlies the McNairy Formation north of the terrace face between boreholes 20 and 13 on A-A'. Profile A-A' additionally illustrates thickening of the Metropolis Formation and Mounds Gravel to the north of the terrace face.

Crossing the center of the site, profile B-B' (Figure 3.26) illustrates the same truncation of the Porters Creek Clay, but an elevated and irregular McNairy Formation appears north of the terrace face between S-18 and MW-158. This juxtaposition indicates that the Mounds Gravel has dissected into the McNairy Formation in the northern portion of the study area. The Metropolis Formation caps the Mounds Gravel and has a relatively uniform thickness compared to the Mounds Gravel.

Across the eastern portion of the study area, profile C-C' (Figure 3.27) illustrates the full stratigraphic record of the area. Eocene sands are present at the southern flank of the section between AH-203 and MW-346, and the Porters Creek Clay extends north until it is truncated at boring MW-122. Between boreholes MW-122 and MW-345 there is a significant elevation change in the top of the McNairy Formation. The formation continues at this new elevation through the rest of the section. The Mounds Gravel thickens between borings MW-346 and MW-345, filling in the terrace slope. However, the unit appears to vary in thickness as the Metropolis Formation dissects into the unit at borings MW-122 and S-15.

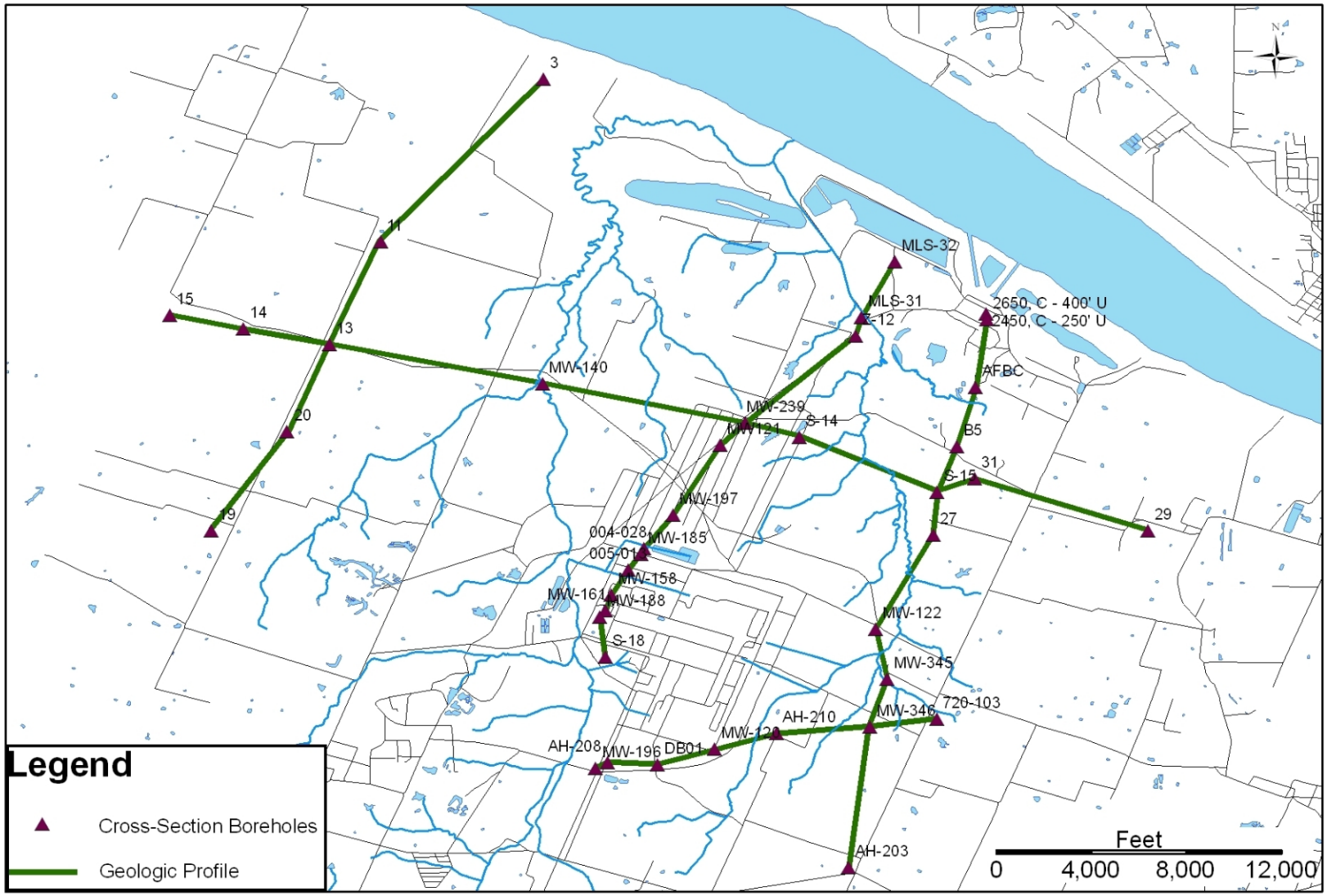


Figure 3.24: Map illustrating lines of geologic cross-sections and borings used.

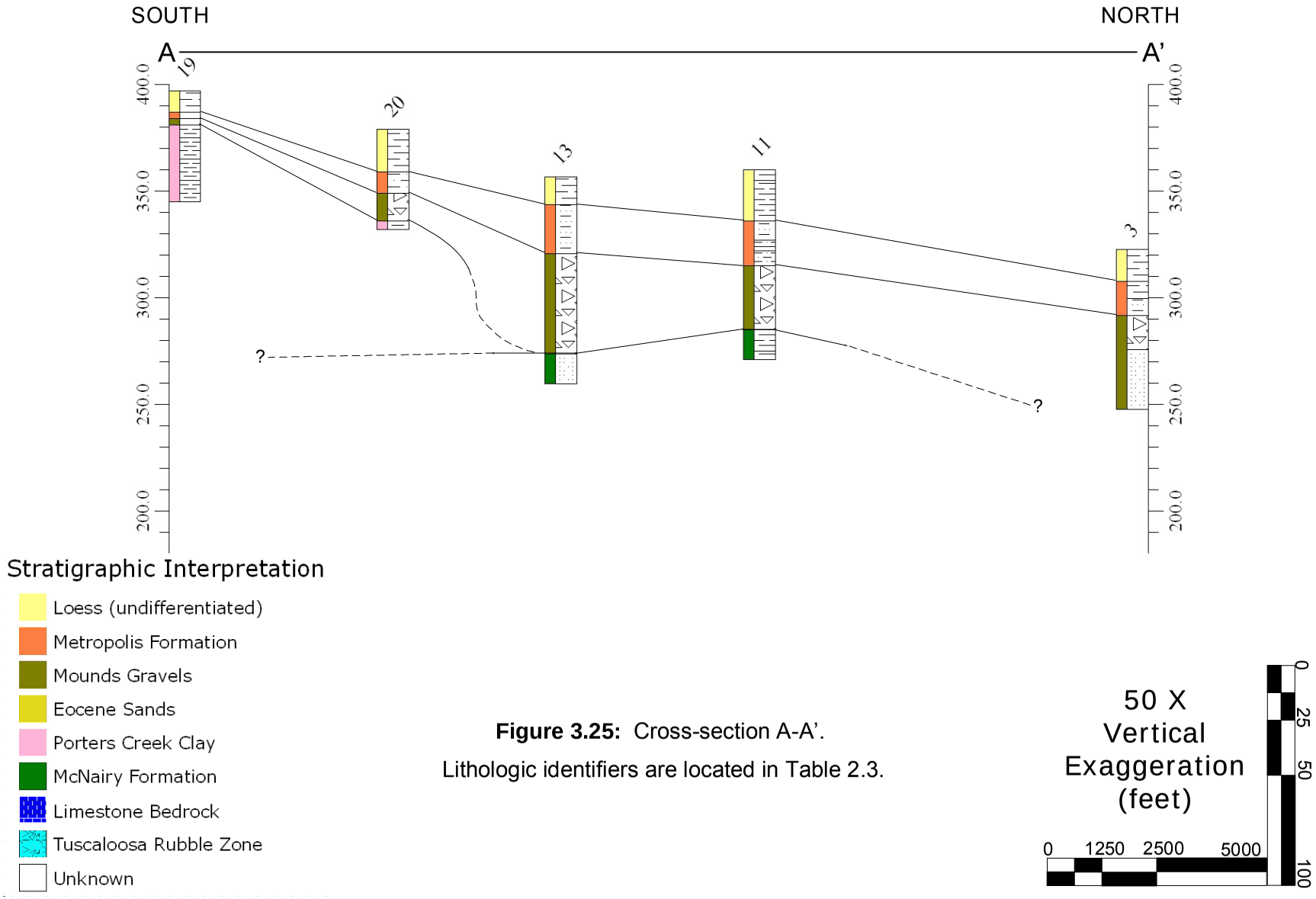


Figure 3.25: Cross-section A-A'.

Lithologic identifiers are located in Table 2.3.

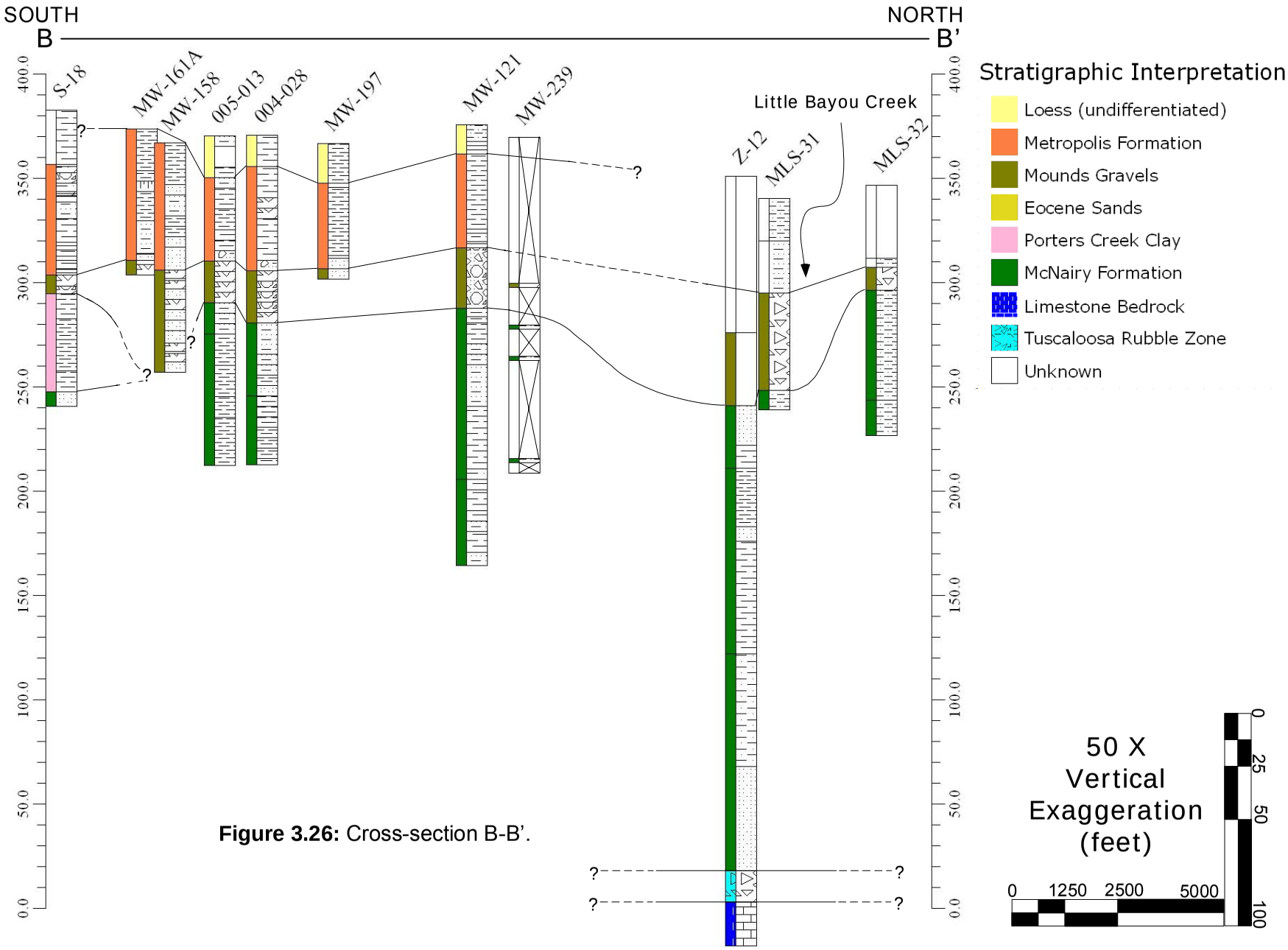


Figure 3.26: Cross-section B-B'.

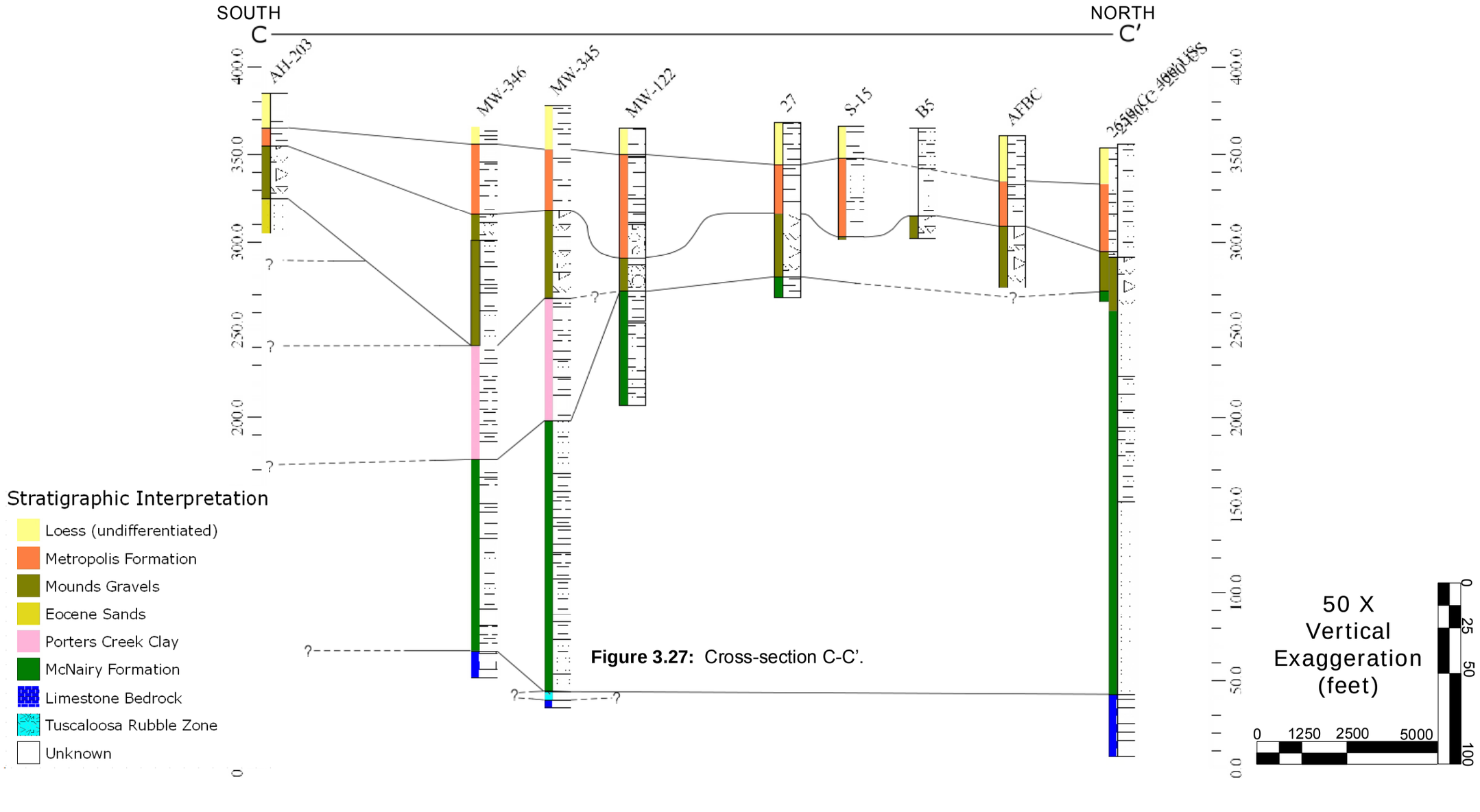


Figure 3.27: Cross-section C-C'.

West - East Sections

Sub-parallel to the Ohio River, profile D-D' (Figure 3.28) exhibits a subtle change in the McNairy Formation elevation at the western most extent of the sections; however, the elevation is consistent through the rest of the section east of boring 14. The Mounds Gravel thickness undulates throughout the section, thinning at the eastern most limit. A thick Metropolis Formation is preserved east of boring 13.

Profile E-E' (Figure 3.29) cuts across the southern portion of the study area. The Porters Creek Clay is preserved through the length of this section. The terrace face occurs east of boring AH-210, where a deep sequence of Mounds Gravel deeply incises into the Porters Creek Clay. The Mounds Gravel and Metropolis Formation thicken to the east of the section.

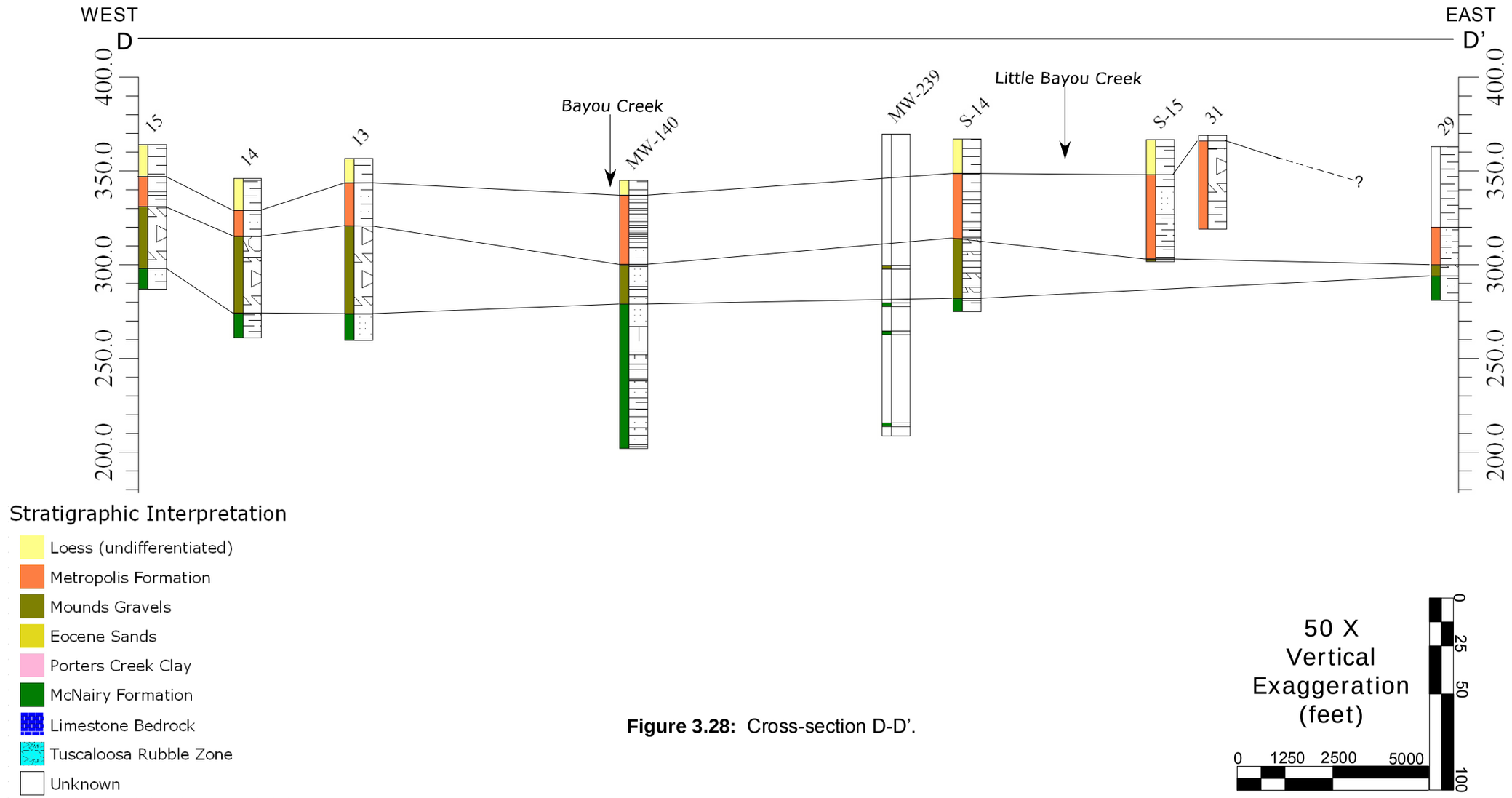


Figure 3.28: Cross-section D-D'.

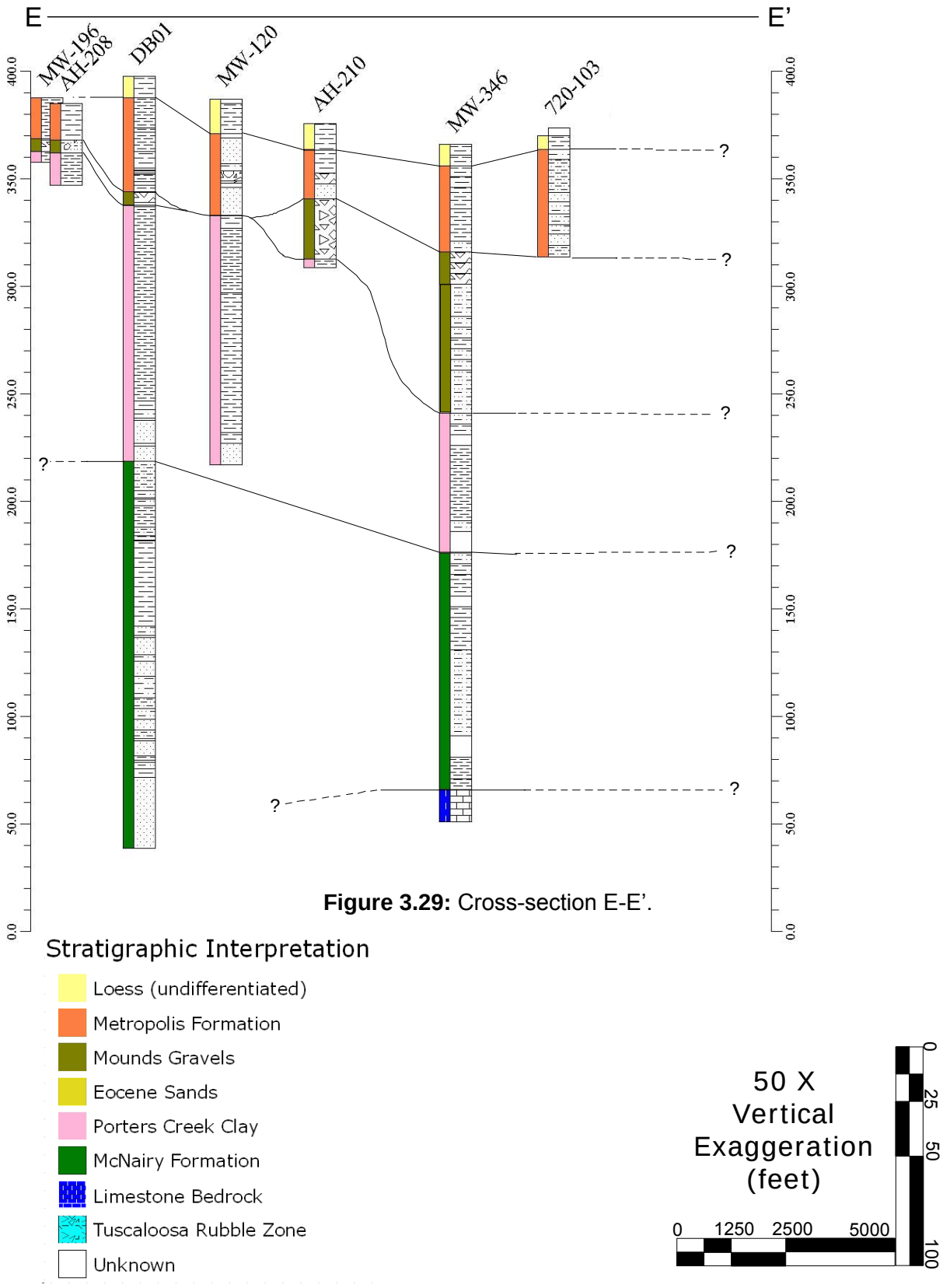


Figure 3.29: Cross-section E-E'.

Chapter 4. Discussion

Deposition and Geologic Units

Data and results of this investigation support previous interpretations of the general depositional environments discussed in the introduction. There is, however, significant influence of paleotopography and possibly tectonic structures on these environments. In the study area, the structural elevation of the McNairy Formation exhibits areas of disruption striking to the northeast, in the center of Figure 3.17. These disruptions are along the trend of faulting across the Ohio River in the Joppa (IL) and Metropolis (IL) GQ maps. Further evidence of disruption is present along profile B-B' (Figure 3.26), where the upper surface of the McNairy varies substantially in elevation between boreholes S-18 and 005-013. A similar phenomenon is present to the east along profile C-C' (Figure 3.27) between MW-346 and MW-122. This elevation change may have led to increased erosion of the Porters Creek Clay in the southeastern portion of the study area.

Scour by the ancestral Tennessee River has been interpreted as having formed the terrace slope (Jacobs, 1997). This is well represented by the steep slope of the Porters Creek Clay in Figure 1.2. The paleocurrent direction of the ancestral Tennessee River was probably similar to the orientation of the modern Ohio River. Assuming the long axis of gravel is oriented perpendicular to flow, to roll along in bedload, clast orientations can be used as crude paleocurrent indicators. Orientations of long-axis clast strikes measured from exposures along Little Bayou and Bayou Creek averaged 284^{o} in the south and 76^{o} in the north (Figure 3.1), indicating an east – west component to flow.

The ancestral Tennessee River occupied a much broader valley than the current Ohio River floodplain. The southern extent of the incised river during the Pleistocene stretched from the terrace slope (Figure 1.2) in Kentucky to the High Mounds contour on the Joppa (IL) geologic map (Nelson and Masters, 2006). These two features form a steep-sided valley created by down-cutting of the ancestral Tennessee River.

The Porters Creek Clay and Eocene sands are terminated by the terrace slope in the southern region of the study area. Truncation of the Porters Creek Clay is best illustrated on profile A-A' (Figure 3.25), but also appears on profile B-B' (Figure 3.26) where it is slightly complicated by the elevated McNairy Formation. The use of the term "Terrace Slope" may be misleading when referring to this truncated surface. While the Mounds Gravel has been deposited by the ancestral Tennessee River in terraces across the site, the feature causing truncation of the Paleocene and Eocene units is better described as an erosional scarp. This

scarp is identified from the steep surface left on the structural elevation map of the Mounds Gravel base (Figure 4.2) and along profile A-A' (Figure 3.25).

Comparison of structural elevation maps and isopach maps (Figures 3.19 to 3.23) indicates that deposition of post-Eocene units mantled the pre-Eocene topography. Structural lows in the underlying McNairy Formation (Figure 3.17) tend to be overlain by increased thicknesses in the Mounds Gravel (Figure 3.20). In some cases, increased thicknesses may be due to infilling of paleotopographic lows, while in others increased thickness may have resulted from scouring into underlying units. Scouring of the Mounds Gravel into the Porters Creek Clay is evident on profile E-E' (Figure 3.29) at borehole AH-210. Scouring of the Metropolis Formation is present along profile C-C' (Figure 3.27) at boreholes MW-122 and S-15. Evidence of such cut and fill is also present in Metropolis Formation exposures along Bayou Creek (Figure 3.5).

Diversion of the ancestral Tennessee River into Smith Gap, IL, during the mid-Pleistocene (Nelson et al., 1999) led to a significant change in regional drainage. As sluggish, underfit streams (with deposits preserved in the Metropolis Formation) overtook the previous, broad braided-stream valley filled by the Mounds Gravel, upward-fining, gravel to silt sequences developed along meandering tracks within the paleovalley (Nelson et al, 1999). Slow aggradation of sediments in this environment resulted in weak soils development locally during inter-fluvial periods of Metropolis Formation deposition.

In the study area, numerous upward-fining sequences are noted in the Metropolis Formation with great spatial variability across the site. On profiles C-C' and E-E' (Figures 3.27 and 3.29), areas of thick, upward-fining, sharp-based Metropolis Formation lie above the thin Mounds Gravel. These likely represent scours into the Mounds Gravel due to changes in the fluvial system and deposition of small channel fills.

Evidence of cut and fill is presented in Figure 3.5 and weak soil development is noted in Figure 3.7, both from Metropolis Formation exposures along Bayou Creek. No large paleochannels were noted in outcrop exposures in creeks. Lateral traceability of internal units in the Metropolis Formation (HU-2 – HU-4) is also difficult on a site-wide scale due to the nature of deposition.

Geologic Age Dating

Preliminary results of OSL analyses appear inconsistent with the stratigraphy of the site. Data do not follow the law of superposition, nor fit into the stratigraphic context of the study area presented in Figure 1.2. Recrystallization and the depletion of radionuclide concentrations can both cause a reduction in the luminescence signal. Failure of the OSL method is likely due to bioturbation and illuviation of grains, resulting in the stratigraphic "leakage" of younger grains into the horizon sampled. As infiltrating water and roots disrupted sediments, the radionuclide concentrations were likely reduced by the introduction of younger particles, resulting in age calculation errors. Zones of cementation (iron oxide) and mineralization (manganese) noted in outcrops also likely affected the luminescence signal, causing recrystallization that resulted in younger age calculations. Based on these preliminary results, it does not appear that the OSL method is effective for dating sediments in an environment that includes pronounced infiltration and bioturbation.

Site Implications

The RGA is the primary aquifer at the site, and is of concern because of contamination. Consisting of the Mounds Gravel, the RGA is a semi-confined aquifer. The Metropolis Formation contacts the upper surface of the RGA while the McNairy Formation forms the underlying confining unit in the study area. Several depositional relationships have influenced the RGA. In coarser sequences of the Metropolis Formation (HU-2A – HU-2B), higher hydraulic conductivity is likely, which would allow groundwater and possibly pollutants to preferentially flow into the RGA. Incision of the Metropolis Formation into the Mounds Gravel, resulting in thinning of the RGA, also probably altered aquifer properties. In these areas, hydraulic conductivity values of the RGA could be lower.

Understanding the distribution of the Mounds Gravel will aid in understanding contaminant transport through the RGA. As such, it is useful to view the current contaminant plumes in relation to site geology and discern possible controls that might affect pollutant migration. The units confining the Mounds Gravel consist of clay and silt, which have a drastic contrast in hydraulic conductivity compared to the Mounds Gravel (Domenico and Schwartz, 1998). This contrast limits vertical groundwater and contaminant propagation (Clausen et al., 1992; Jacobs, 1997).

Groundwater flow in the study area is to the northeast (Figure 4.0). The year 2000 TCE plume boundary map indicates two distinct lobes of contamination, both traveling to the northeast, away from the terrace slope (Figure 4.1).

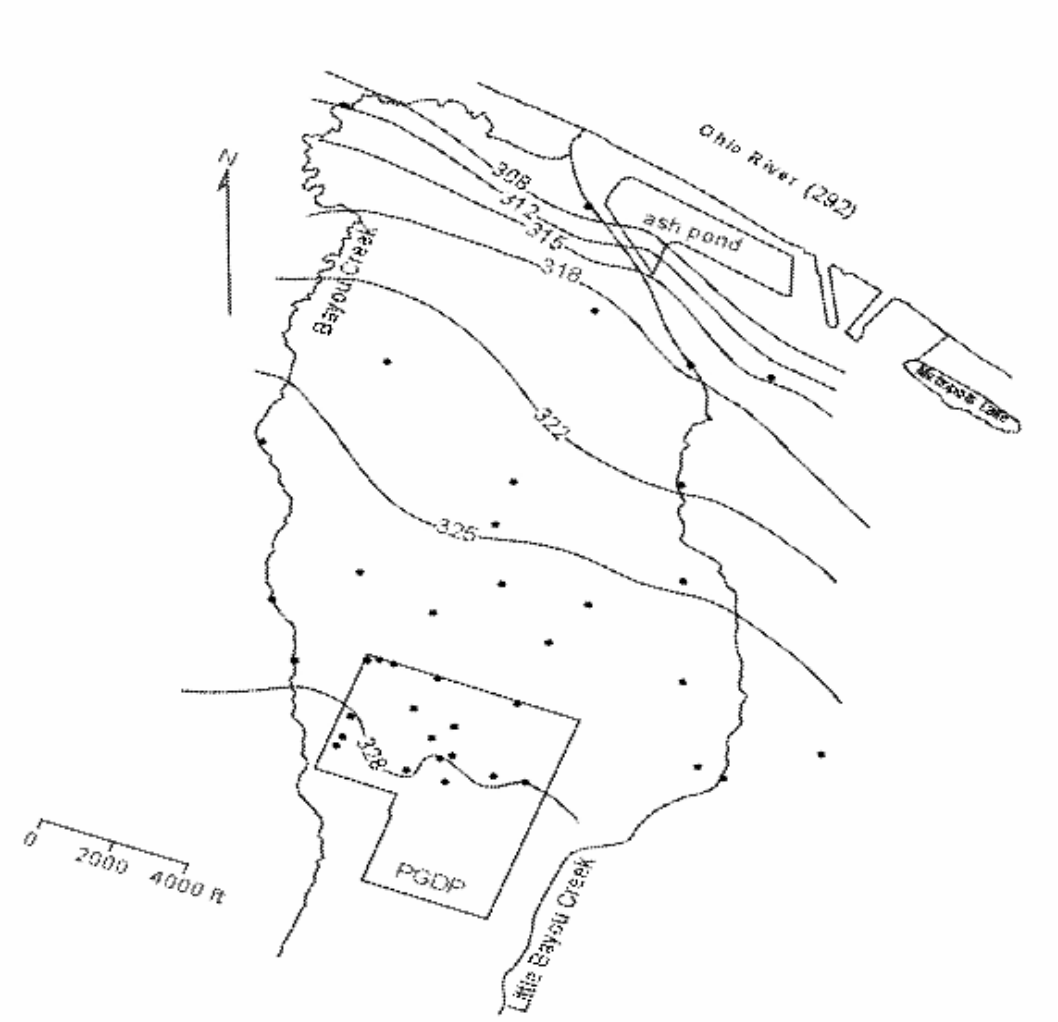


Figure 4.0: Hydraulic heads in the RGA from 1997 data, contour interval 3 feet (modified from Fryar et al., 2000).

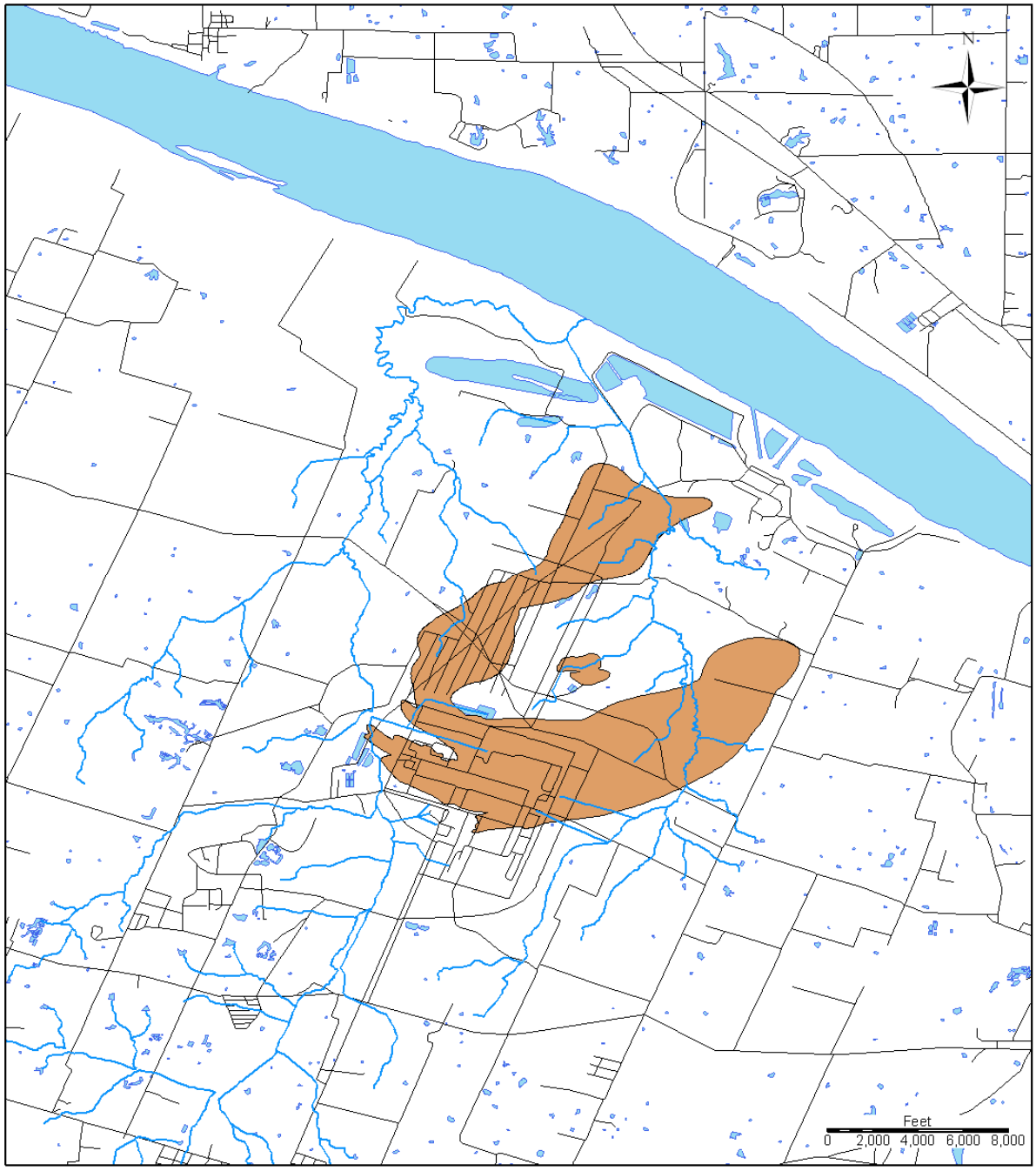


Figure 4.1: TCE plume boundary from year 2000 data.

The limit of vertical contaminant migration is the base of the Mounds Gravel (Figure 4.2). When the year 2000 TCE plume boundary map is superimposed on a structural elevation map of the base of the Mounds Gravel, a structural high corresponds to plume bifurcation (Figure 4.3). Also, when an isopach map of the Mounds Gravel (Figure 4.3) is overlain with the year 2000 TCE plume boundary map, there is a correlation between contaminant migration and Mounds Gravel thickness. As the plume crosses Little Bayou Creek in the northeast quadrant of the study area, the Metropolis Formation is thin (Figure 3.22) and the upper surface of the Mounds Gravel is mapped in outcrop downstream at ID 84 (Figure 3.0) at 318 feet amsl. Spring-water samples from this area indicate TCE concentrations greater than the maximum contaminant level set by the USEPA (Fryar et al., 2000). These contaminated discharge points indicate the connection between the RGA and surface water (Fryar et al., 2000). The interconnection of the Mounds Gravel with surface exposures was not obvious from the Joppa (KY) GQ (Finch, 1967).

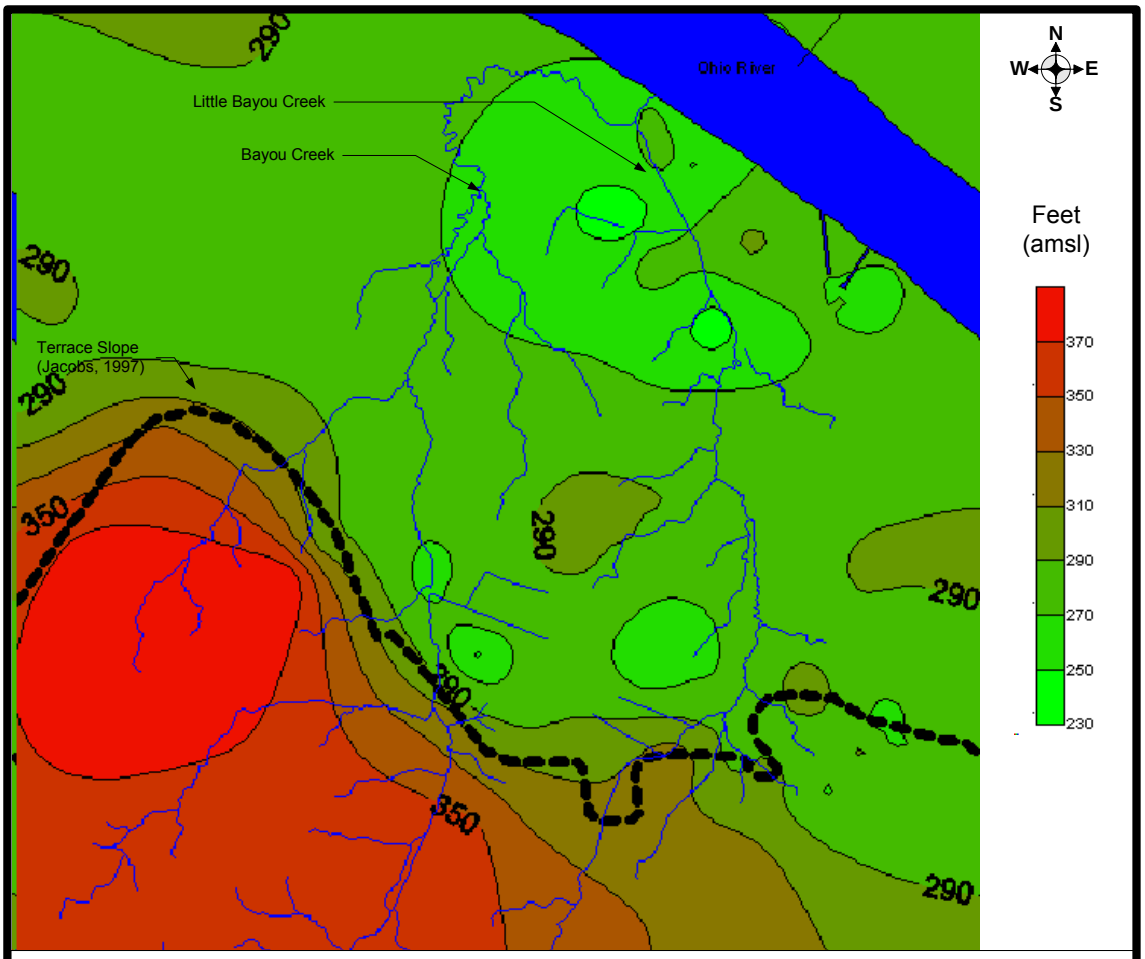


Figure 4.2: Structure elevation map of the Mounds Gravel base surface.

Notes: Contour interval 10 feet; elevations are amsl.

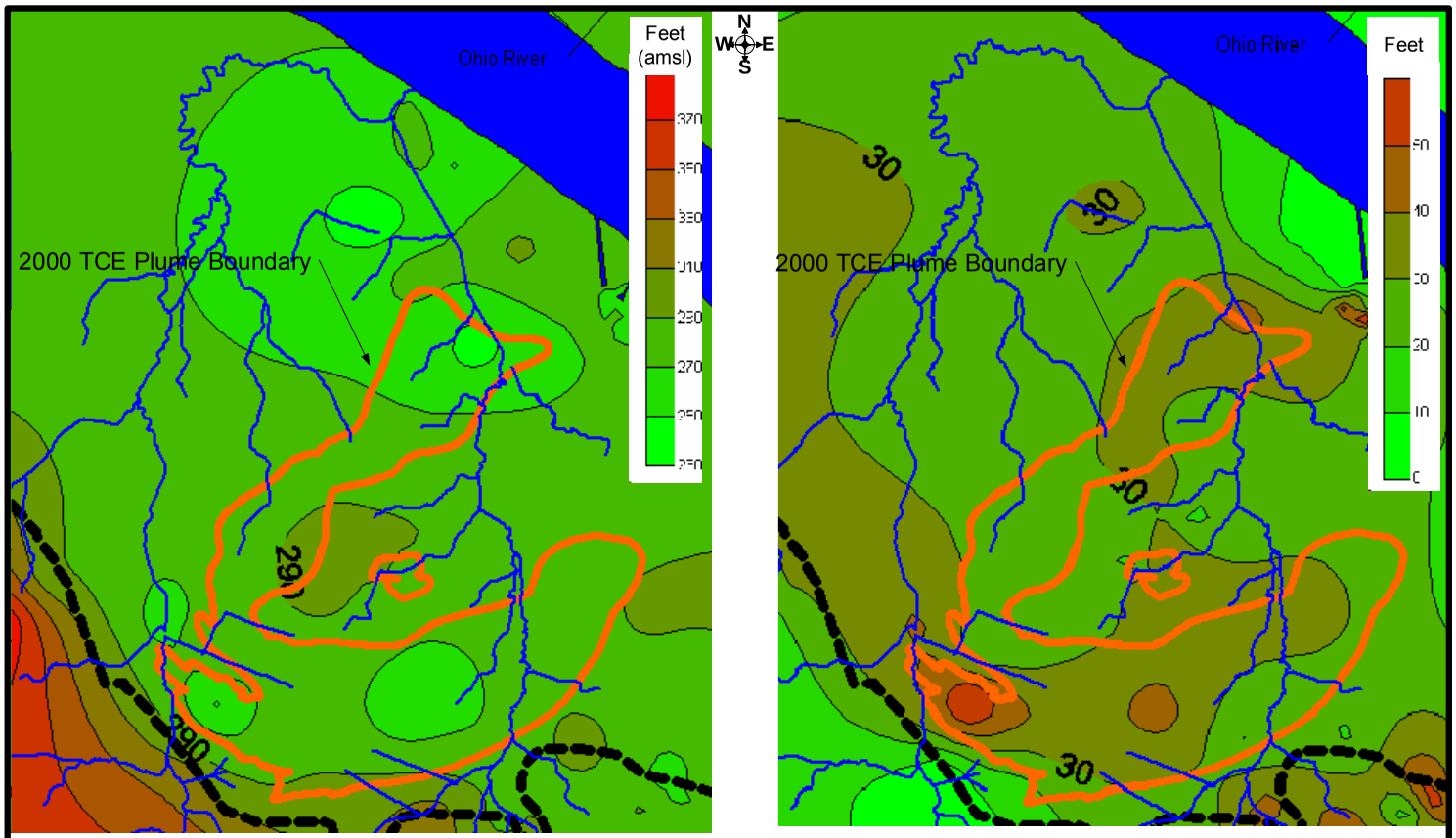


Figure 4.3: Structural elevation of Mounds Gravel base (left) and isopach of Mounds Gravel (right) draped with 2000 TCE plume boundary.

Notes: Contour interval, 20 and 10 feet, respectively.

Feet
0 4000 8000

Faults mapped by the ISGS in the Joppa (IL) and Metropolis (IL) GQ maps also postdate geologic maps of the study area in Kentucky. These faults are co-linear to the northeast – southwest oriented zones of irregularity noted on the McNairy Formation and Mounds Gravel structural elevation maps in this study (Figures 3.17 and 3.19). The timing of such faulting is hard to pinpoint. Nelson et al. (1999) indicate faulting in southern Illinois has been noted to displace the Metropolis Formation. However, the structural elevation map (Figure 3.21) and all geologic profiles (Figures 3.25 – 3.29) do not illustrate displacement of the Metropolis Formation across the river in Kentucky.

The soft-sediment deformation feature noted along Bayou Creek (Figure 3.6) is not interpreted to be a seismite. This is because the widespread occurrence of similar features has not been noted in the same unit, one of the conditions that identifies seismites (Greb and Dever, 2002). This deformation feature most likely formed during deposition as pore pressure in the fine sediment exceeded the confining pressure of the overlying gravels (Figure 3.6). Overpressurization in fluvial sediments caused by hydraulic-head differences (artesian-pressure differences), usually following flooding, can trigger fluidization and form sand dikes (Kolb, 1976; Li et al., 1996). Liquefaction of the soil probably occurred at this point, allowing the underlying fine soil to became suspended in pore fluid and injected into the unconsolidated gravels above.

Deformation features are also noted in the Porters Creek Clay. Olive (1966) mapped one clastic dike in the Heath GQ map. Amick (2005) indicated these features were commonly evident in borrow pits that had once operated in the area. Similar clastic dikes form throughout the Jackson Purchase region in the Porters Creek Clay and have been interpreted to be seismically related (Hendricks, 2000).

Faults propagating from the FAFC likely influence the erosional scarp left by the ancestral Tennessee River and Mounds Gravel deposition. This is due to the local dip to the south of the erosional scarp (Figure 1.2), correlating with both the zone of irregularity previously noted on structural elevation maps and with northeast – southwest thickening of the Mounds Gravel (Figure 3.20), all along the same strike.

Supporting this hypothesis is the undulating upper surface of the McNairy Formation noted on geologic profiles (Figures 3.26 - 3.27). In the northeastern portion of the study area, faulting mapped on the Joppa (IL) geologic map (Nelson and Masters, 2006) also correlates with contours of an erosional surface of late Cretaceous and Paleocene units mapped on the Joppa (KY) geologic map by Finch (1967) (Figure 4.4).

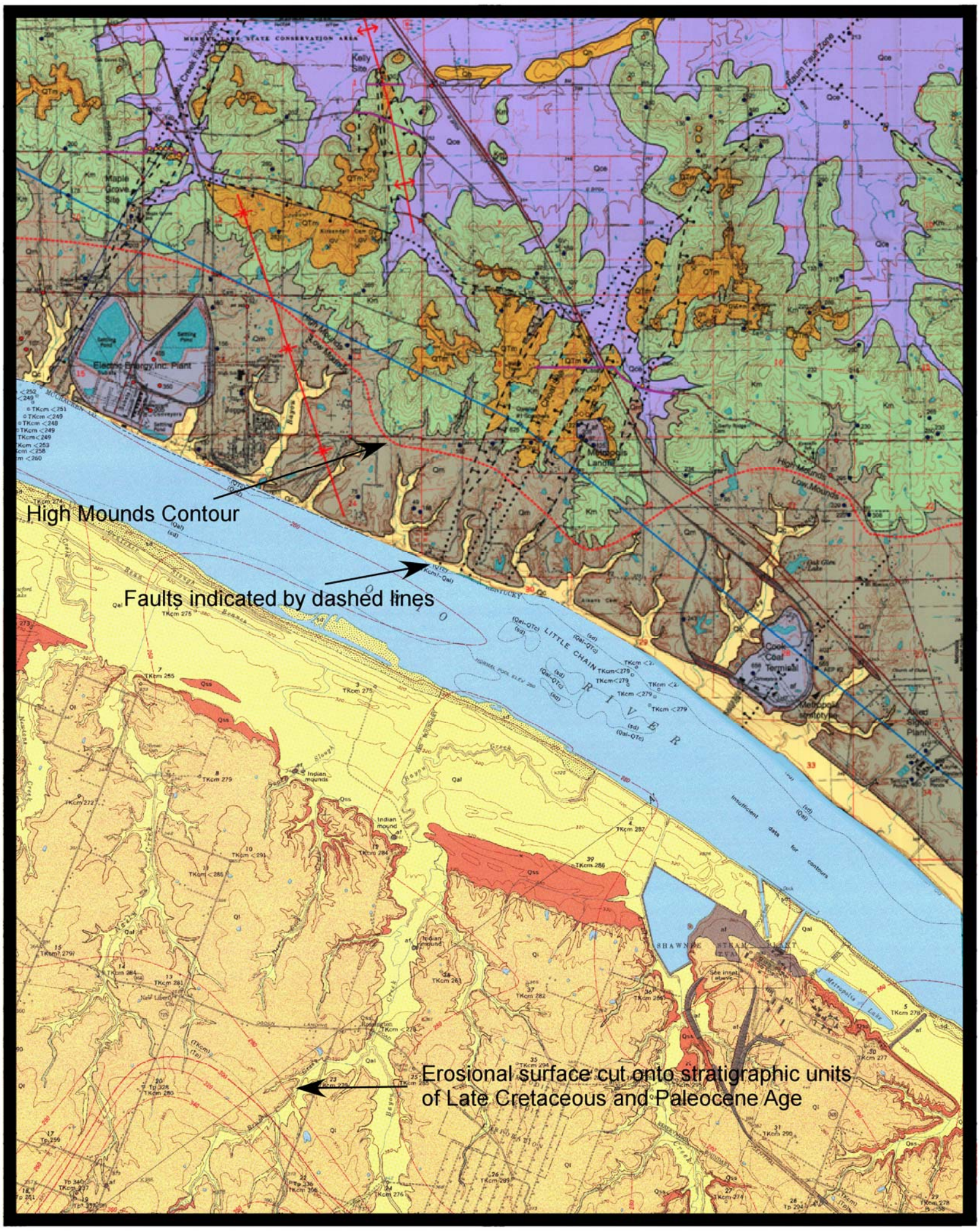


Figure 4.4: Joppa (IL) (Nelson and Masters, 2006) and Joppa (KY) (Finch, 1967) GQ maps.

Langston and Street (1998) have proposed a structural control on contaminant transport at the site. Based on a comparison of plume position, structure contour maps, and isopach maps in this study, it is likely that a combination of factors controls the RGA flow system. These factors include thickness and channel trends within the Mounds Gravel, which sometimes correspond with structural lows of the McNairy Formation paleo-topography. Along with faulting and possibly fracturing, zones of thick gravels may offer preferential pathways for groundwater / contaminant transport.

Conclusions

Near-surface sediments underlying the Paducah Gaseous Diffusion Plant and surrounding area are highly varied because of the fluvial depositional environment in which they formed. This variability manifests itself mostly in the Metropolis Formation, where underfit streams filled the broader braided-stream valley in which the Mounds Gravel was deposited. Separating the Mounds Gravel and Metropolis Formation from the previously defined Continental Deposits aids in making the distinction between the two different depositional environments and resulting deposits.

Zones of irregularity in the McNairy Formation and Mounds Gravel also complicate the near-surface geology. These zones appear to be caused by faulting from the FAFC. This faulting has affected the Mounds Gravel by limiting the deposition of the gravel from structural highs created in the McNairy Formation, by creating zones of preferential erosion in post-Miocene units, by direct uplift of stratigraphic units including the Mounds Gravel, or by a combination of all these factors.

Faulting at the site is not well understood and will require future study. At this time, spatial resolution of data in the study area is not adequate to extend faults presented on adjacent geologic maps of southern Illinois. High resolution seismic profiles along areas of irregularity noted in the structural elevation maps and geologic profiles may assist in defining faults and illustrating potential pathways for contaminant transport.

Understanding the geology of the units impacted by contamination is the key first step in predicting future contaminant transport. The lithologic and stratigraphic database provided to the PGDP for inclusion in a new data warehouse program should enable future researchers to better understand and model the hydraulic properties of the RGA.

APPENDIX A

Lithologic logs of boreholes used in geologic profiles.

All boreholes appear as they did in their respective references

Borehole Identification	Page Number	Borehole Identification	Page Number
AH-114	77	MW-197	155
AH-203	78	MW-215	159
AH-208	79	MW-217	161
AH-210	80	MW-219	163
AH-211	81	MW-239	165
AH-212	83	MW-346	174
AH-328	84	S-14	180
DB01	85	S-15	184
MW-120	97	S-18	187
MW-121	104	S-19	192
MW-122	111	3	195
MW-140	118	11	196
MW-144	124	13	197
MW-158	129	14	198
MW-161	133	15	199
MW-163	136	18	200
MW-183	140	19	201
MW-185	144	20	202
MW-188	148	27	203
MW-193	151	29	204
MW-196	155	31	205

AH-114

W 13735-S1410

S1098.8 — 302.5

Hole No. USGS 0.8 - 2.5 (114)

Heath — Quad.

McCracken — County

Kentucky Coord. S1,098,800-302,500

Discriptive location: 1 mi. N of Ky Ordinance Works

Source of Data

Date 8/11/64

Elev. of watertable 390+

Elev. of surf. 415'

Type of well B-40 Mobile Drill Auger

Elev. of Fm. Tops Tw 388 - Tp 373

Driller F. Wreck

Unit	Material	Thickness (ft.)	Depth (ft.)
	Fill - gravel	3	3
	Silt, light brown	13	16
	Gravel	11	27
	Sand	15	42
	Clay, dark gray	10	52

AH-203

E 4450-59010 (near H-024)

In Heath

203

Hole No. USGS 2.95-8.7

Logged by W. W. Olive

Quad. Heath County McCracken Kentucky Coord. 81,112,950-288,700

Discriptive Location at Heath

(urce of Data Date 8/13/64

Elev. of watertable 350'

Elev. of surf. 385' Elev. of Pm. Tops TW-325'

Type of well B-40 Mobile Drill Auger Driller F. Wrock

Unit	Material	Thickness (ft.)	Depth (ft.)
	Silt, yellowish-brown slightly sandy in part, pebbly returns from 20'	30	30
	Gravel	30	60
	Sand, yellowish-gray, fine-medium, contains lumps or thin layers of light gray clay	20	80
	TD 80'		

AH-208

W 4675 - 57650

208 7

Hole No. [illegible]
Logged by W. W. Olive

WELL LOG

Quad. Heath
Descriptive location
Source of Data
Elev. of waterTable
Elev. of surf.
Type of wall 305'

County McCracken
0.85 mi. N. Spring Bayou Creek
South entrance P&DP property
362' (very little water elev. of Fm. Tops
B-40 Mobile Drill Auger

Kentucky Coord. S1,104,900 - 293,400
Date 7/31/64
Driller [illegible]
Ft. Wash

Unit	Material	Thickness (ft.)	Depth (ft.)
	Silt, sandy and pebbly in part	17	17
	Gravel in clay matrix	6	23
	Clay, dark grey and yellowish brown in upper 13' dark gray in lower 2' - upper part is deeply weathered	15+	38

23 SL
5 GV
7 SN
28 GV
Tpc 4 CL

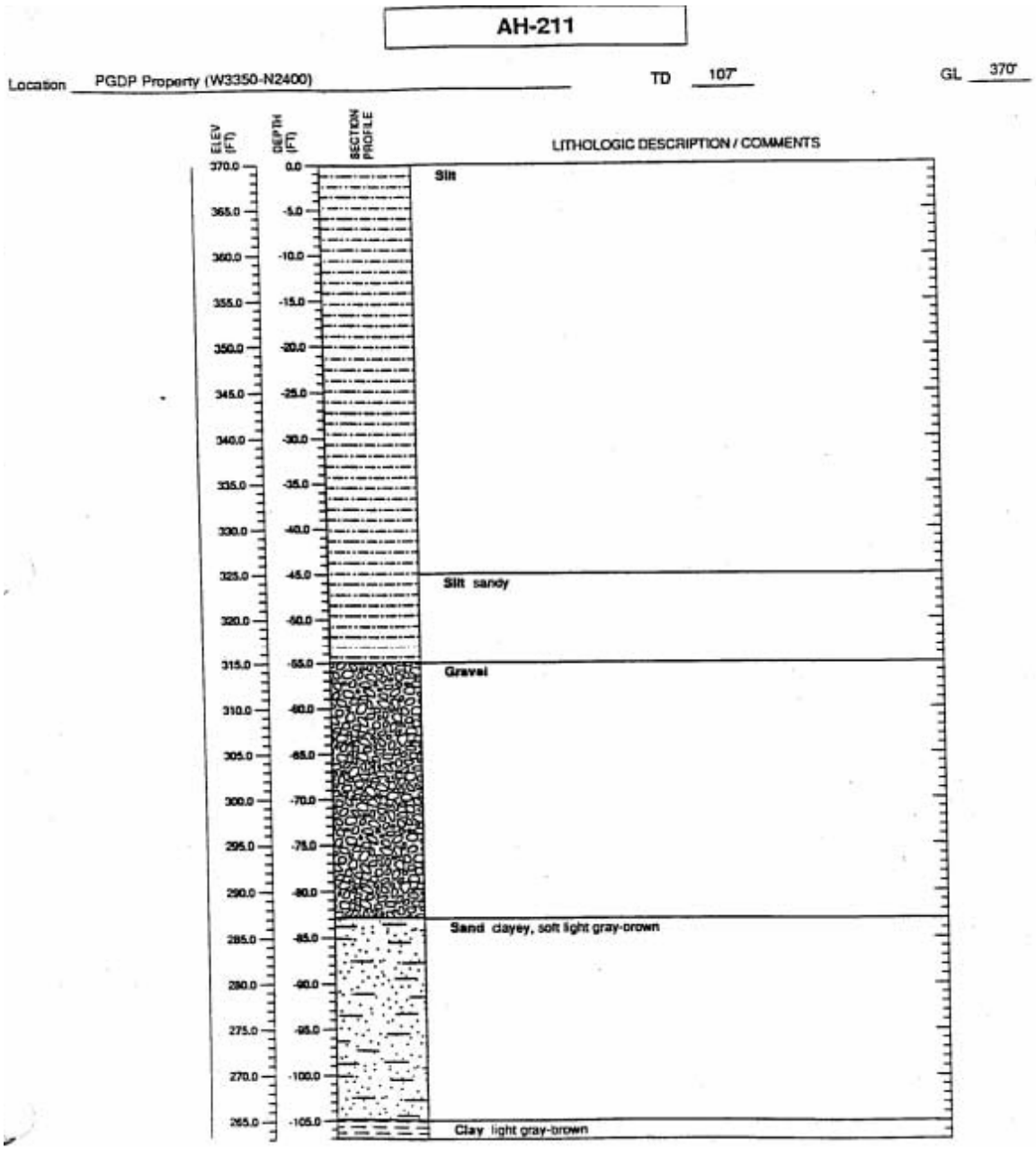
RGA Top ?
EoT -316
Tpl Top -316

AH-210
E 238-54538
210

Hole No. USGS 0.6-4.95
Logged by W. W. Olive

Quad. Heath County McCracken Kentucky Coord. 1,110,6
Discriptive location 1.2 mi. NE Heath 294,9
burce of Data Date 7/30/64
Elev. of watertable 444'
Elev. of surf. 379'
Type of well B-40 Mobile Drill Auger Elev. of Pm. Topa 316'
Driller W. Wreck

Unit	Material	Thickness (ft.)	Dep (f
	at		
	Silt, yellowish brown grading into about 12' into finely laminated sandy light gray silty for 2 or 3' and back to yellowish brown sandy silt, with scattered pebbles - laminated in part.	23	2
	Gravelly, fine	5	2
	Sand, fine grained, yellowish brown, silty-argillaceous, light gray clay streaks - laminae?	7	3
	Gravel, coarse	28	6
)	Clay, dark gray	4	6


AH-211
Location PGDP Property (W3350-N2400)
TD 107'
GL 370'
ELEV (FT)
DEPTH (FT)
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
370.0
365.0
360.0
355.0
350.0
345.0
340.0
335.0
330.0
325.0
320.0
315.0
310.0
305.0
300.0
295.0
290.0
285.0
280.0
275.0
270.0
265.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
-35.0
-40.0
-45.0
-50.0
-55.0
-60.0
-65.0
-70.0
-75.0
-80.0
-85.0
-90.0
-95.0
-100.0
-105.0
Silt
Silt sandy
Gravel
Sand clayey, soft light gray-brown
Clay light gray-brown

AH-211

W 3350 - N2400

(211) 3

Hole No. ~~HCG 6.95-2.20~~

Logged by ~~H. W. Olive~~

Quad. Heath County McCracken Geology Coord. 1,189,950

Ground Elevation Location 1000' E. Harmony Cemetery - 1.6 mi. WNW Grahamville 302,200

Type of Data 2/26/64 - Drizzly

Elevation 325?

Total Depth 370 Size of Hole (7Ikm) 287

Type of Well B-40 augered test hole Driller: F. Wreck

Material		
Silt, (easier drilling at 45°) grading downward (at 45°?) into sandy silt, non-calcareous.	55	55
Gravel	28	83
Sand, and light grayish brown clay with blebs of fine grained sand, soft.	22	105
Clay, light grayish brown with blebs fine grained sand, compact, micaceous.	2	107

AH-212

W8975-N325

212

USGS 3.9 - 2.4

1 mi. W. Olive

Quad. Heath County McCracken Kentucky Coord. 31,103,000-0.,400

Discriptive location 1.15 mi. W. Harmony Cem. - West Bank of Bayou Creek

Source of Data Date 8/11/64

Elev. of watertable

Elev. of surf. 363' = GL Elev. of Fm. Tops 273 (TKcm)

Type of well B-40 Mobile Drill Auger Driller F. Wreck

Unit	Material	Thickness (ft.)	Depth (ft.)
	Road fill and silt	8	8
	Gravel in sand matrix, reddish-brown	7	15
	Silt, yellowish-brown, slightly sandy to very sandy	19	34
	Sand, fine-medium, clayey, reddish-brown. Pulled and sampled hit at 37'	15	49
	Gravel	41	90
	Sand and clay interlain, mottled orange and light gray grading downward into dark gray	10	100

AH-328

E4894 - N3556'

328 4

USGS 8.75-0.3

Hole No.

Quad. Heath

County McCracken

Kentucky Coord. 1,115,750-300,300

Location 0.65 mi. N. Carmel Chapel on E. side Ky. 305

Date 2/27/64

Elev. 374' GL=374'

T.D. of Well 267' (TKcm) NOTE

Driller B-40 augered test hole

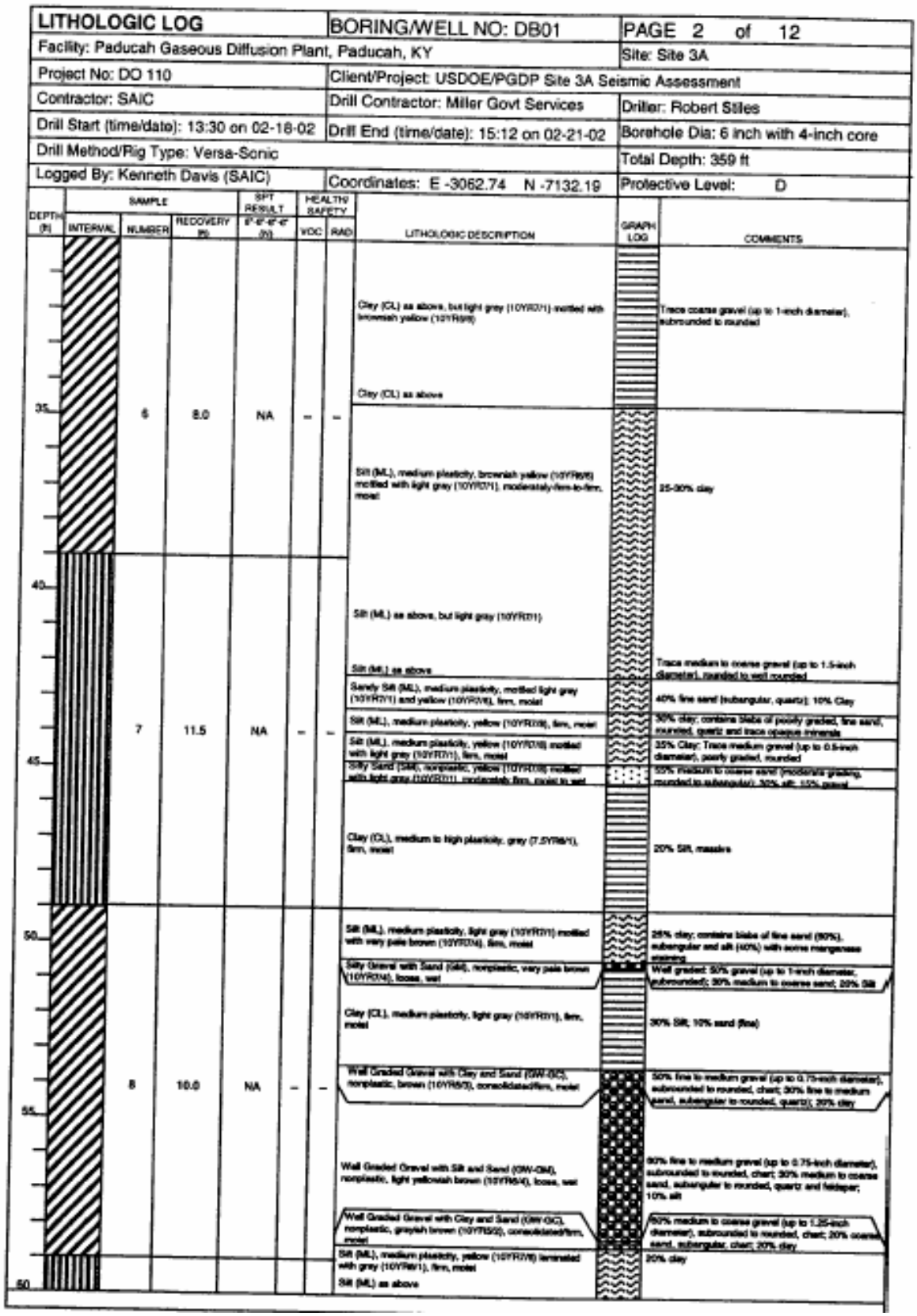
F. Wrenk

Material	Thickness (Ft.)	Depth (Ft.)
Silt, yellow-brown, thin layer gravel @ 28'	43	43
Pebbly silty yellow-brown sand with stringers of gravel	30	73
Gravel, coarse	34	107
Sand, dark gray very fine grained, argillaceous, and clayey, dark gray, sandy - no glauconite	½	107½

NOTE: 1-28-65 Tpc at 267'

LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 1 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT 6"-6"-6" (N)	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
							Gravelly, Silt (ML), brown (10YR4/3), firm, slightly moist		Ground elevation = 307.36 ft asml Roadbase, 40% Silt, 45% Gravel (1-2 inch diameter)
		1	3.7	NA	–	–	Silt (ML), medium plasticity, light brownish yellow (10YR6/4) mottled with light gray (10YR7/1), firm, moist		25-30% clay; possibly laminated
5		2	4.8	NA	–	–	Silt (ML) as above, but light brownish gray (10YR6/2) Silt (ML) as above, but pale brown (10YR6/3) mottled with light gray (10YR7/1)		
10		3	6.6	NA	–	–	Clay (CL) medium plasticity, pale brown (10YR6/3) mottled with light gray (10YR7/1), firm, moist Clay (CL) as above, but yellowish brown (10YR5/4), moderately soft grading downward to brownish yellow (10YR6/6) mottled with yellow (10YR7/6) and light gray (10YR7/1), soft		30-35% silt
15		4	6.3	NA	–	–	Clay (CL) as above, but yellow (10YR7/6) mottled with light gray (10YR7/1), firm		
20		5	11.0	NA	–	–	Clay (CL) as above, but brownish yellow (10YR6/8) mottled with light gray (10YR7/1) Clay (CL) as above		Trace medium to coarse Gravel (up to 1.5-inch diameter) from 21-24 ft bgs, rounded to subrounded, chert
25							Clay (CL), medium plasticity, light gray (10YR7/1) mottled with brownish yellow (10YR6/6), grading downward from firm to soft, moist		30-35% silt
							Clay (CL), medium plasticity, light gray (10YR7/1), firm, moist		30-35% silt Trace medium gravel (up to 0.4-inch diameter), subrounded
30									



LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 2 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT (blows/ft)	HEALTH & SAFETY VOC	HEALTH & SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
35		6	8.0	NA	–	–	Clay (CL) as above, but light gray (10YR7/1) mottled with brownish yellow (10YR6/8)		Trace coarse gravel (up to 1-inch diameter), subrounded to rounded
							Clay (CL) as above		
							Silt (ML), medium plasticity, brownish yellow (10YR6/6) mottled with light gray (10YR7/1), moderately-firm-to-firm, moist		25-30% clay
40		7	11.5	NA	–	–	Silt (ML) as above, but light gray (10YR7/1)		
							Silt (ML) as above		Trace medium to coarse gravel (up to 1.5-inch diameter), rounded to well rounded
							Sandy Silt (ML), medium plasticity, mottled light gray (10YR7/1) and yellow (10YR7/6), firm, moist		40% fine sand (subangular, quartz); 10% Clay
							Silt (ML), medium plasticity, yellow (10YR7/8), firm, moist		30% clay; contains blebs of poorly graded, fine sand, rounded, quartz and trace opaque minerals
45							Silt (ML), medium plasticity, yellow (10YR7/8) mottled with light gray (10YR7/1), firm, moist		35% Clay; Trace medium gravel (up to 0.5-inch diameter), poorly graded, rounded
							Silty Sand (SM), nonplastic, yellow (10YR7/8) mottled with light gray (10YR7/1), moderately firm, moist to wet		55% medium to coarse sand (moderate grading, rounded to subangular); 30% silt; 15% gravel
							Clay (CL), medium to high plasticity, gray (7.5YR6/1), firm, moist		20% Silt, massive
50							Silt (ML), medium plasticity, light gray (10YR7/1) mottled with very pale brown (10YR7/4), firm, moist		25% clay; contains blebs of fine sand (60%), subangular and silt (40%) with some manganese staining
							Silty Gravel with Sand (GM), nonplastic, very pale brown (10YR7/4), loose, wet		Well graded; 50% gravel (up to 1-inch diameter, subrounded); 30% medium to coarse sand; 20% Silt
							Clay (CL), medium plasticity, light gray (10YR7/1), firm, moist		30% Silt; 10% sand (fine)
55		8	10.0	NA	–	–	Well Graded Gravel with Clay and Sand (GW-GC), nonplastic, brown (10YR5/3), consolidated/firm, moist		50% fine to medium gravel (up to 0.75-inch diameter), subrounded to rounded, chert; 30% fine to medium sand, subangular to rounded, quartz); 20% clay
							Well Graded Gravel with Silt and Sand (GW-GM), nonplastic, light yellowish brown (10YR6/4), loose, wet		60% fine to medium gravel (up to 0.75-inch diameter), subrounded to rounded, chert; 30% medium to coarse sand, subangular to rounded, quartz and feldspar; 10% silt
							Well Graded Gravel with Clay and Sand (GW-GC), nonplastic, grayish brown (10YR5/2), consolidated/firm, moist		50% medium to coarse gravel (up to 1.25-inch diameter), subrounded to rounded, chert; 20% coarse sand, subangular, chert; 20% clay
60							Silt (ML), medium plasticity, yellow (10YR7/6) laminated with gray (10YR6/1), firm, moist		20% clay
							Silt (ML) as above		

LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 3 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

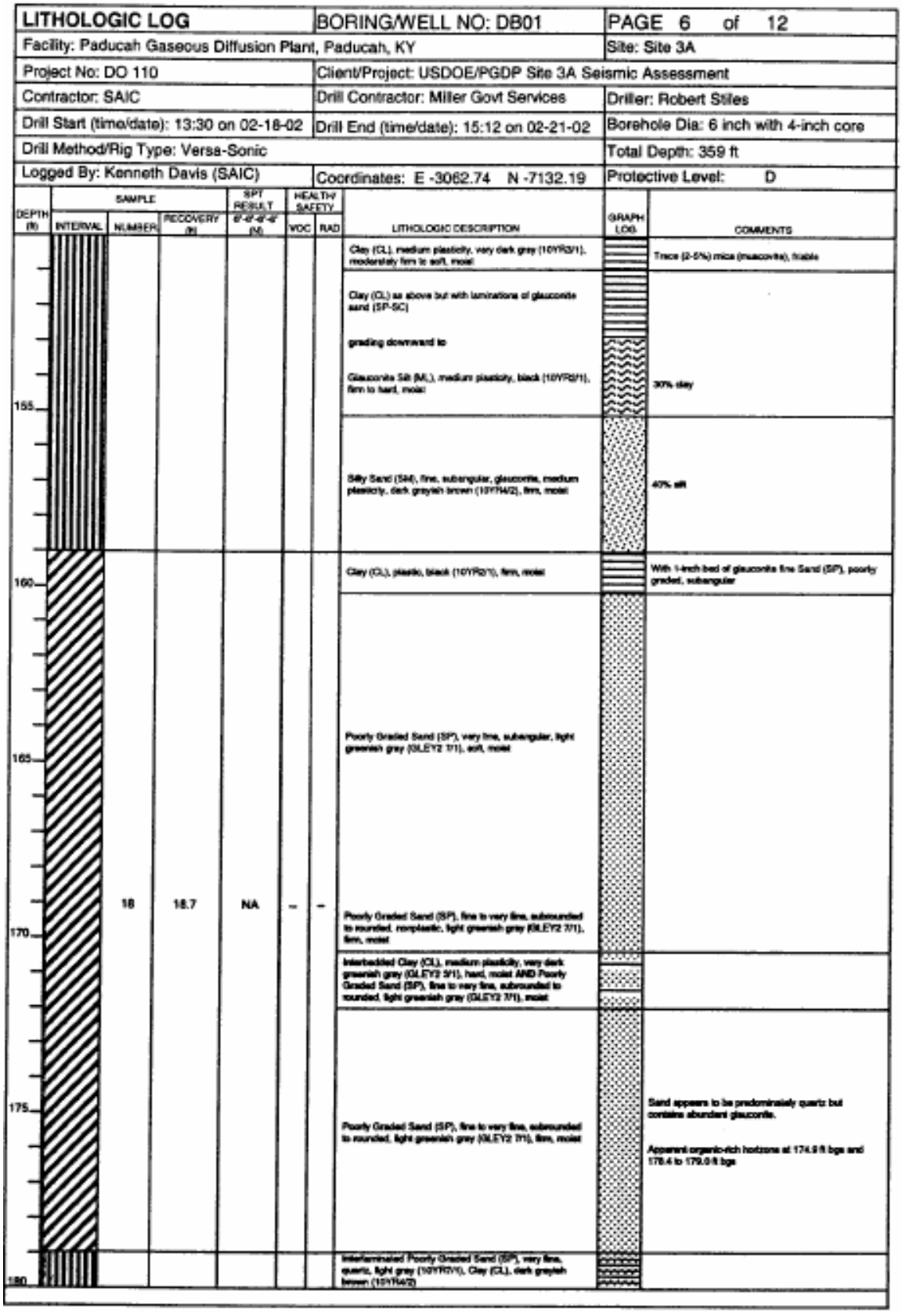
DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT 6"-6"-6"-6" (N)	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
							Silt (ML) as above		
65		9	10.0	NA	–	–	Clay (CL), low plasticity, gray (10YR8/1), hard, slightly moist Clay (CL), medium plasticity, very dark grayish brown (10YR3/2), firm, moist		
70		10	9.5	NA	–	–	Clay (CL) as above but hard, dry Clay (CL), medium plasticity, very dark grayish brown (10YR3/2), firm, moist		
80		11	8.8	NA	–	–	Clay (CL), medium plasticity, very dark gray (10YR3/1), firm to hard, slightly moist		Friable
85							Clay (CL) as above		
90									

LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 4 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT 6"-6"-6"-6" (N)	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPHIC LOG	COMMENTS
95		12	10.2	NA	–	–	Clay (CL), medium plasticity, very dark gray (10YR3/1), firm to hard, slightly moist		Breaks along horizontal laminations
100									
105		13	11.0	NA	–	–	Clay (CL) as above		Trace (2-5%) mica (muscovite)
110									
115		14	9.6	NA	–	–	Clay (CL) as above		
120							Clay (CL) as above		

LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 5 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT 6"-6"-6"-6" (N)	HEALTH & SAFETY VOC	HEALTH & SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
125		15	9.8	NA	–	–	Clay (CL), medium plasticity, very dark gray (10YR3/1), firm to hard, slightly moist		Trace (2-5%) mica (muscovite), friable
130		16	10.5	NA	–	–	Clay (CL) as above		
135							Clay (CL) as above		
140									
145		17	20.8	NA	–	–	Clay (CL) as above but moderately firm-to-soft, moist		
150									

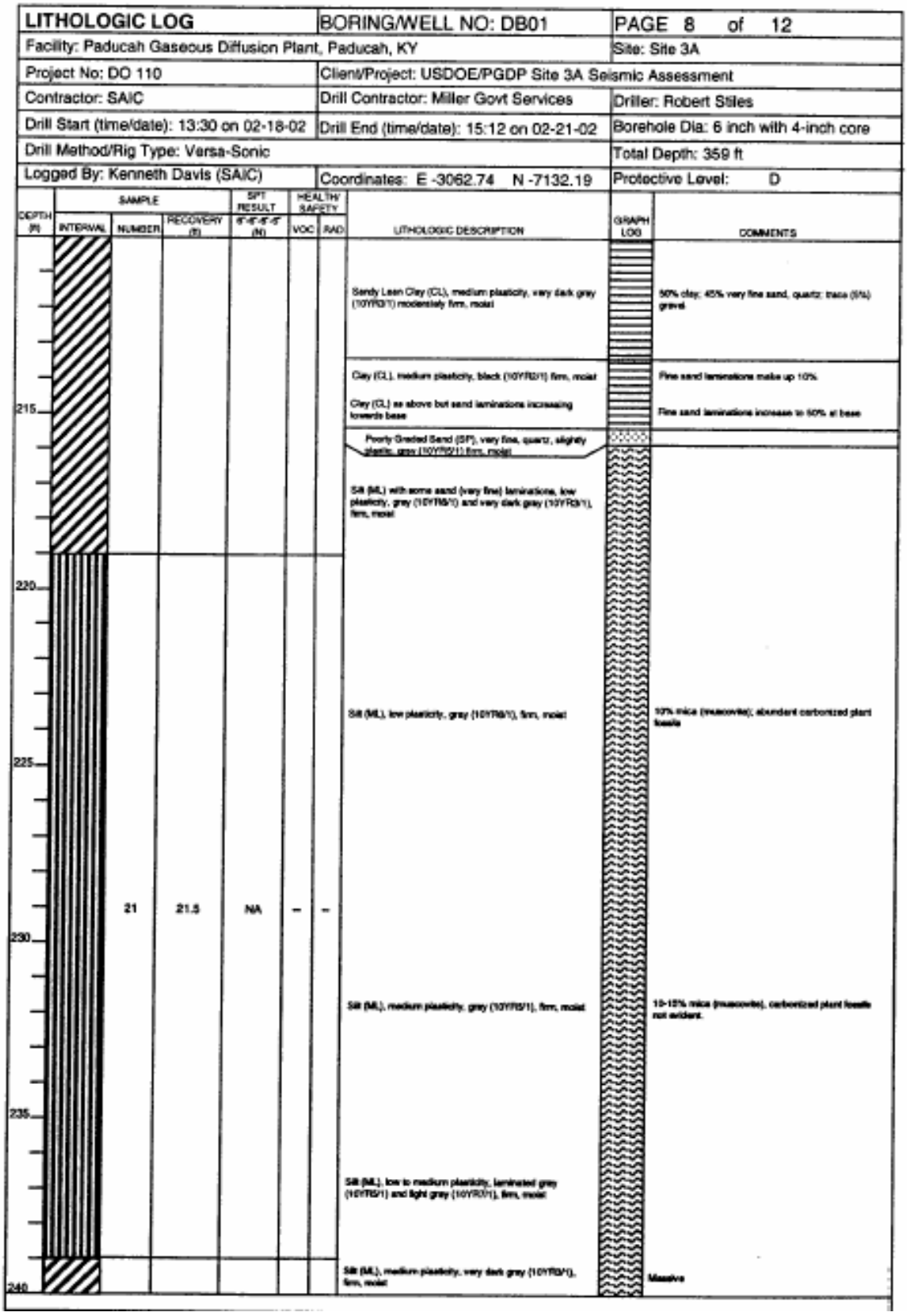


LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 6 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT 6"-6"-6"-6" (N)	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
155							Clay (CL), medium plasticity, very dark gray (10YR3/1), moderately firm to soft, moist		Trace (2-5%) mica (muscovite), friable
							Clay (CL) as above but with laminations of glauconite sand (SP-SC)		
							grading downward to		
							Glauconite Silt (ML), medium plasticity, black (10YR2/1), firm to hard, moist		30% clay
							Silty Sand (SM), fine, subangular, glauconite, medium plasticity, dark greyish brown (10YR4/2), firm, moist		40% silt
160							Clay (CL), plastic, black (10YR2/1), firm, moist		With 1-inch bed of glauconite fine Sand (SP), poorly graded, subangular
165							Poorly Graded Sand (SP), very fine, subangular, light greenish gray (GLEY2 7/1), soft, moist		
170		18	18.7	NA	–	–	Poorly Graded Sand (SP), fine to very fine, subrounded to rounded, nonplastic, light greenish gray (GLEY2 7/1), firm, moist		
							Interbedded Clay (CL), medium plasticity, very dark greenish gray (GLEY2 3/1), hard, moist AND Poorly Graded Sand (SP), fine to very fine, subrounded to rounded, light greenish gray (GLEY2 7/1), moist		
175							Poorly Graded Sand (SP), fine to very fine, subrounded to rounded, light greenish gray (GLEY2 7/1), firm, moist		Sand appears to be predominately quartz but contains abundant glauconite. Apparent organic-rich horizons at 174.9 ft bgs and 178.4 to 179.0 ft bgs
180							Interlaminated Poorly Graded Sand (SP), very fine, quartz, light gray (10YR7/1), Clay (CL), dark greyish brown (10YR4/2)		

LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 7 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT REMAT 6"-6"-6"-6" (N)	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
185							Interlaminated Clay (CL), dark grayish brown (10YR4/2) AND Poorly Graded Sand (SP), very fine, quartz, light gray (10YR7/1), medium plasticity, firm, moist		60% clay; 40% sand
							Interlaminated Clay (CL) AND Poorly Graded Sand (SP), as above		80% clay; 20% sand
190		19	23.8	NA	–	–	Interlaminated Clay (CL) AND Poorly Graded Sand (SP), as above		
195							Clayey Sand (SC), very fine to fine, poorly graded, medium plasticity, grayish brown (10YR5/2), firm, moist		20% clay
							Clay (CL), plastic, black (10YR2/1), hard, moist		
							Interlaminated Clay (CL), dark grayish brown (10YR4/2) AND Poorly Graded Sand (SP), very fine, quartz, light gray (10YR7/1), medium plasticity, firm, moist		50% clay; 50% sand
							Interlaminated Clay (CL) AND Sand (SP), as above		
200									
205							Clay (CL), plastic, black (10YR2/1), firm, moist		20% very fine sand, quartz
		20	20.5	NA	–	–	Clay (CL) as above		
210							Sandy Lean Clay (CL)		50% clay; 50% very fine sand, quartz



LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 8 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT 6"-6"-6"-6" (N)	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
215							Sandy Lean Clay (CL), medium plasticity, very dark gray (10YR3/1) moderately firm, moist		50% clay; 45% very fine sand, quartz; trace (5%) gravel
							Clay (CL), medium plasticity, black (10YR2/1) firm, moist		Fine sand laminations make up 10%
							Clay (CL) as above but sand laminations increasing towards base		Fine sand laminations increase to 50% at base
							Poorly Graded Sand (SP), very fine, quartz, slightly plastic, gray (10YR5/1) firm, moist		
220							Silt (ML) with some sand (very fine) laminations, low plasticity, gray (10YR5/1) and very dark gray (10YR3/1), firm, moist		
225							Silt (ML), low plasticity, gray (10YR5/1), firm, moist		10% mica (muscovite); abundant carbonized plant fossils
230		21	21.5	NA	–	–	Silt (ML), medium plasticity, gray (10YR5/1), firm, moist		10-15% mica (muscovite), carbonized plant fossils not evident.
235							Silt (ML), low to medium plasticity, laminated gray (10YR5/1) and light gray (10YR7/1), firm, moist		
240							Silt (ML), medium plasticity, very dark gray (10YR3/1), firm, moist		Massive

LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 9 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

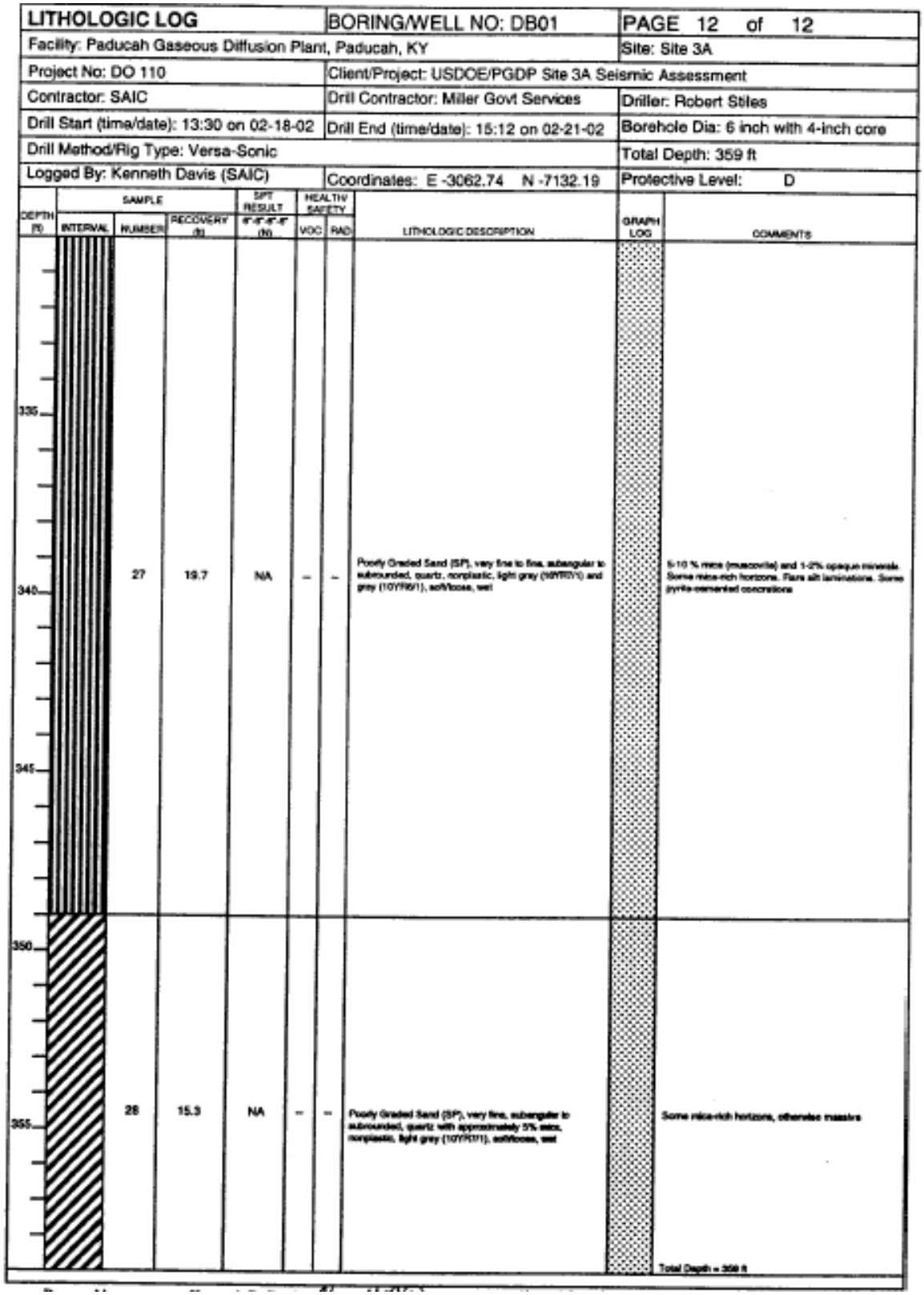
DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT 6"-6"-6" (N)	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
245		22	11.8	NA	–	–	Silt (ML), medium plasticity, very dark gray (10YR3/1), firm, moist		Massive
							Silt (ML), medium plasticity, laminated gray (10YR5/1) and light gray (10YR7/1), firm, moist		
250							Silt (ML) as above		Trace coarse gravel (up to 1.25-inch diameter), rounded
							Silt (ML) as above but moderately firm		
255									
							Silty Sand (SM), fine, rounded, poorly graded, quartz, gray (7.5YR6/1), soft, wet		30% silt
260							Silty Sand (SM) as above		
		23	10.1	NA	–	–	Laminated Clay (CL) AND Poorly Graded Sand (SP), fine, rounded, quartz, medium plasticity, gray (10YR5/1) and light gray (10YR7/1), firm, moist		70% clay; 30% sand. Note: some glauconite present
							Poorly Graded Sand (SP), subangular to subrounded, quartz, nonplastic, light gray (10YR7/1), soft, wet		
265									
270							Laminated Silt (ML) AND Poorly Graded Sand (SP), very fine, subangular, quartz, low plasticity, gray (10YR5/1) and light gray (10YR7/1), firm, moist		70% silt; 30% sand. Some glauconite present

LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 10 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT (bpf)	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
275							Laminated Silt (ML) AND Poorly Graded Sand (SP), very fine, subangular, quartz, low plasticity, gray (10YR6/1) and light gray (10YR7/1), firm, moist		70% silt; 30% sand. Some glauconite present
							Poorly Graded Sand (SP), very fine, subangular, quartz, with some clay laminations, light gray (10YR7/1) with some gray (10YR6/1), firm, wet		15-20% clay laminations
280		24	19.8	NA	--	--			
285							Laminated Silt (ML) AND Poorly Graded Sand (SP), very fine, low plasticity, black (10YR2/1) and light gray (10YR7/1), firm, moist WITH frequent Clay (CL) interbeds (2 to 6 inches thick), plastic, black (10YR2/1), firm, moist		
290							Interlaminated Clay (CL), plastic, dark gray (10YR4/1), firm, moist AND Poorly Graded Sand (SP), very fine, subangular to subrounded, quartz, nonplastic, light gray (10YR7/1), loose/soft, moist		65% clay; 35% sand
295							Poorly Graded Sand (SP), very fine to fine, subangular to subrounded, quartz, nonplastic, light gray (10YR7/1), WITH infrequent interbeds of Clay (CL), 2 to 4 inches thick, plastic, dark gray (10YR4/1); soft, wet		85% sand; 15% clay
300		25	19.8	NA	--	--	Poorly Graded Sand (SP), WITH interbeds of Clay (CL) as above		60% sand; 40% clay

LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 11 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
Drill Method/Rig Type: Versa-Sonic		Total Depth: 359 ft
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT 6"-6"-6"-6" (N)	HEALTH/SAFETY VOC	HEALTH/SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
							Poorly Graded Sand (SP), very fine to fine, subangular to subrounded, quartz, nonplastic, light gray (10YR7/1), WITH infrequent interbeds of Clay (CL), 2 to 4 inches thick, plastic, dark gray (10YR4/1), soft, wet		60% sand; 40% clay
305							Interbedded Clay (CL) (50%), in 2- to 8-inch beds, plastic, dark gray (10YR4/1), very firm, moist AND Poorly Graded Sand (SP) (40%), in 2- to 14-inch beds, very fine to fine, subangular to subrounded, nonplastic, light gray (10YR7/1), loose/soft, wet		Clay contains 10% fine sand, clay breaks with fine laminations. Some sand laminations present in clay.
							Clay (CL), plastic, dark gray (10YR4/1), very firm, moist		10% fine sand
310							Poorly Graded Sand (SP), fine, rounded to subrounded, quartz, nonplastic, light gray (10YR7/1), soft, wet		Trace (2-5%) opaque minerals. Sparse clay interbeds (up to 2 inches thick)
315							Clay (CL), plastic, dark brown (10YR3/3), firm, moist		20% fine Sand. Contains few sand laminations
							Poorly Graded Sand (SP), fine, rounded to subrounded, quartz, nonplastic, light gray (10YR7/1), soft, wet		Trace (2-5%) opaque minerals
320		26	19.2	NA	--	--	Interbedded Poorly Graded Sand (SP), fine, rounded to subrounded, quartz, nonplastic, light gray (10YR7/1), soft, wet AND Clay (CL), plastic, dark brown (10YR3/3), firm, moist		Sand contains trace (2-5%) opaque minerals. Clay contains 20% fine sand. Bedding is approximately 6 inches thick.
							Silt (ML), medium to low plasticity, dark brown (10YR3/2), firm, moist		At 323.2 ft bgs: gravel layer, subangular, up to 1.75-inch diameter, fine-grained limestone
325							Silt (ML), low plasticity, dark greyish brown (10YR4/2), soft-to-firm, moist		Trace fine sand
330							Poorly Graded Sand (SP), very fine to fine, subangular to subrounded, quartz		



LITHOLOGIC LOG	BORING/WELL NO: DB01	PAGE 12 of 12
Facility: Paducah Gaseous Diffusion Plant, Paducah, KY		Site: Site 3A
Project No: DO 110	Client/Project: USDOE/PGDP Site 3A Seismic Assessment	
Contractor: SAIC	Drill Contractor: Miller Govt Services	Driller: Robert Stiles
Drill Start (time/date): 13:30 on 02-18-02	Drill End (time/date): 15:12 on 02-21-02	Borehole Dia: 6 inch with 4-inch core
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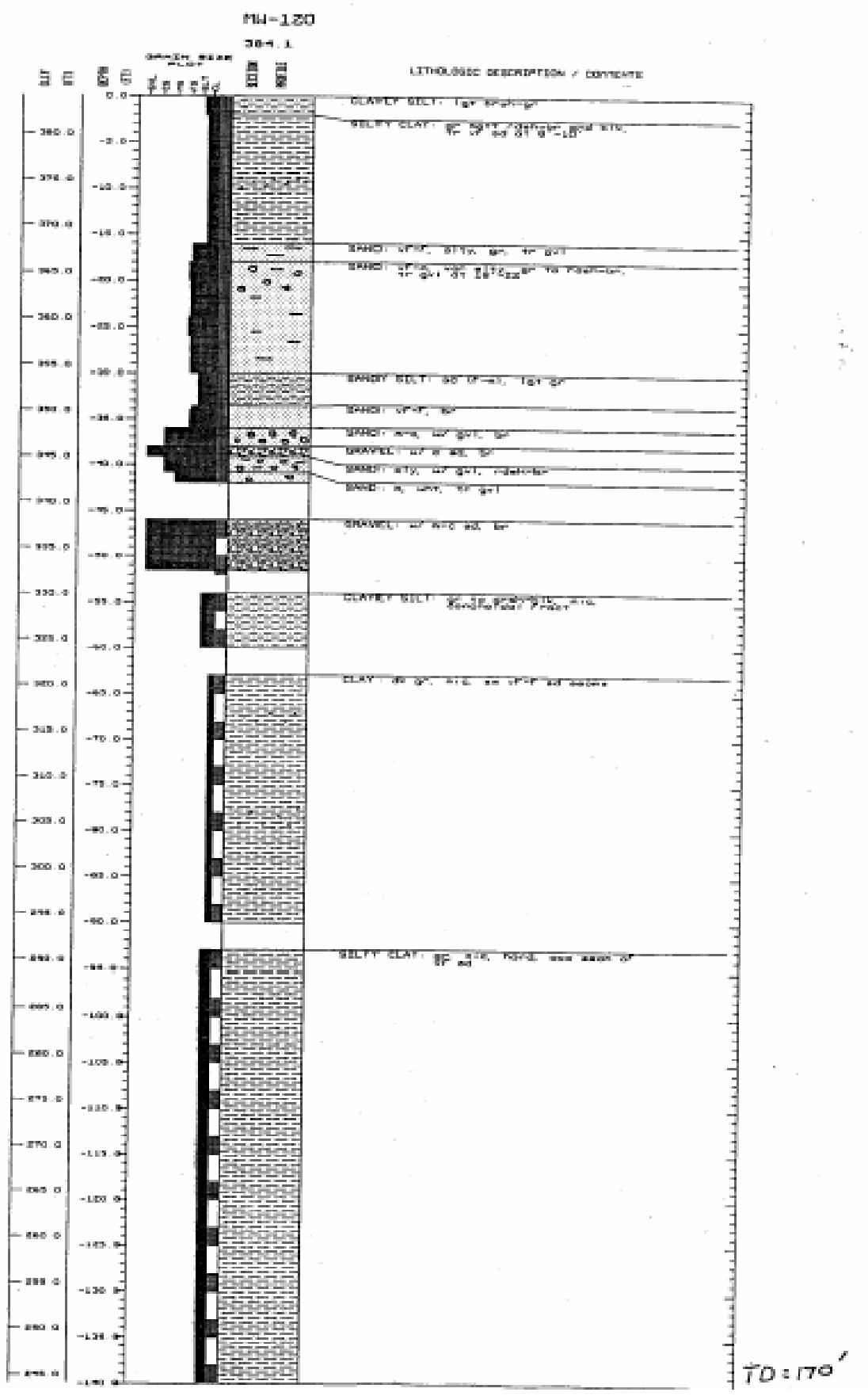
Logged By: Kenneth Davis (SAIC)	Coordinates: E -3062.74 N -7132.19	Protective Level: D

DEPTH (ft)	SAMPLE INTERVAL	SAMPLE NUMBER	SAMPLE RECOVERY (ft)	SPT RESULT 6"-6"-6" (N)	HEALTH & SAFETY VOC	HEALTH & SAFETY RAD	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
335									
340		27	19.7	NA	--	--	Poorly Graded Sand (SP), very fine to fine, subangular to subrounded, quartz, nonplastic, light gray (10YR7/1) and gray (10YR6/1), soft/loose, wet		5-10 % mica (muscovite) and 1-2% opaque minerals. Some mica-rich horizons. Rare silt laminations. Some pyrite-cemented concretions
345									
350									
355		28	15.3	NA	--	--	Poorly Graded Sand (SP), very fine, subangular to subrounded, quartz with approximately 5% micas, nonplastic, light gray (10YR7/1), soft/loose, wet		Some mica-rich horizons, otherwise massive
									Total Depth = 359 ft


MW-120
384.1
LITHOLOGIC DESCRIPTION / CONTENTS
TD = 170'

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 1 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-53 Mobile Drill, 6-inch ID Hollow Stem
WATER LEVEL AND DATE Static—26 Ft. START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0						
	0-2		1.6'	3-5-9-10 (14)	CLAYEY SILT, LIGHT BROWN-GRAY, (5 YR 6/4), DAMP, STIFF, WITH ROOT TRACES THROUGH-OUT SAMPLE	USING 140 LB. HAMMER WITH HOIST
2						
	2-4	4010	1.8'	10-20-20-25 (40)	SILTY CLAY, GRAY (N7), WITH RUST AND BLACK MOTTLING, DAMP, HARD, WITH ROOT TRACES	HEADSPACE #4010—NOT ABOVE BACKGROUND
4						
	4-6		1.8'	15-15-15-20 (30)	SAME AS ABOVE, ALSO PLASTIC	
6						TIME 15:30
	6-8		2.0'	8-10-15-15 (25)	SAME AS ABOVE, VERY STIFF	
8						
	8-10	4011	2.0'	15-15-18-19 (33)	SAME, VERY FINE SAND 0-5% VISIBLE IN SUNLIGHT	HEADSPACE #4011—NOT ABOVE BACKGROUND
10						
	10-12		2.0'	7-9-8-13 (17)	SILTY CLAY, GREENISH GRAY, (5 YR 6/4), MOIST, VERY STIFF, PLASTIC, WITH RUST MOTTLING AND BLACK ORGANIC NODULES	COLLECTED RAD SCREEN OVER FIRST FIRST 12 FT.
12						16:00
	12-14		1.5'	16-16-21-18 (37)	SILTY CLAY, GRAY, (N7), DAMP, HARD, PLASTIC, WITH RUST MOTTLING, A ONE-INCH LAYER OF ORGANIC MATERIAL IN SAMPLE	11/19/89 09:35
14						
	14-16	4012	2.0'	16-13-16-19 (29)	SAME AS ABOVE, VERY STIFF	HEADSPACE #4012—NOT ABOVE BACKGROUND
16						
	16-18		2.0'	6-11-17-26 (28)	SILTY SAND, GRAY, MEDIUM DEINSE, WITH SOME RUST MOTTLING, SAND IS FINE TO VERY FINE WITH ~ 5% PEA-SIZEID GRAVEL	INTO UPPER CONTINENTAL DEPOSITS
18						10:20
	18-20		2.0'	12-22-30-33 (52)	SAND, GRAY, (N7), MOIST, VERY DENSE, SLIGHTLY SILTY, WELL SORTED 60% VERY FINE—10% MEDIUM SANDS ~ 5% GRAVEL	
20						HEADSPACE #4013—NOT ABOVE BACKGROUND
	20-22	4013	2.0'	5-10-15-22 (25)	SAND, GRAY, (N7), MEDIUM DEN SE WITH LITTLE RUST MOTTLING, SLIGHTLY SILTY, SAND IS FINE, 5% PEA-SIZED GRAVEL	
22						
	22-23		1.0'	16-50/5	SAND AND SILT, GRAY, (N7), DAMP, VERY DENSE, FINE SAND WITH BLUE AND PINK INCLUSIONS OF SILT	RIG CHATTERING BETWEEN 22 AND 24 FT.
24						11:10
	24-26		1.5'	42-43-47-42 (90)	FINE SAND, GRAY, (N7), MOIST, VERY DENSE, SLIGHTLY SILTY, 10% SAND IS MEDIUM GRAINED, PINK SILTY INCLUSIONS	WET SPOON AT ~26 FT.
26						
	26-28	4014	2.0'	11-13-13-16 (26)	FINE SAND, BROWN, (5 YR 4/4), MOIST, MEDIUM DENSE, SLIGHTLY SILTY WITH STREAKS OF REDDISH, PLASTIC SANDY SILTS	HEADSPACE #4014—NOT ABOVE BACKGROUND WATER LEVEL AT 22 FT. AFTER SAMPLING TO 30 FT.
28						
	28-30		1.7'	9-17-28-29 (45)	FINE SAND, BROWN, (5 YR 4/4), MOIST, DENSE, WITH STREAKS OF RED AND GRAY SANDY SILTS GRADING INTO SILTY SAND	ISOLATED GRAVEL—VERY DRY AND CHALKY, VERY HARD
30						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 2 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-53 Mobile Drill, 6-inch ID Hollow Stem
WATER LEVEL AND DATE Static—16 Ft., after hitting gravels START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30						
	30-32		1.6'	13-17-17-21 (34)	SANDY SILT, LIGHT GRAY, MOIST, HARD, SAND IS FINE TO MEDIUM GRAINED (<5%)	HEADSPACE #4015—NOT ABOVE BACKGROUND
32		4015				
	32-34		2.0'	17-15-21-24 (36)	SAME AS ABOVE, WITH RED STREAKS; OVER 0.4 FT. SAND, WET, DENSE, FINE TO VERY FINE	16:10 11/19/89
34						
	34-34.5		0.4'	50/5	SAND, BROWN, (5 YR. 5/6), WET, VERY DENSE, FINE	DRILLER FELT HE WAS BANGING ON A ROCK
						LOWER CONTINENTAL DEPOSITS
36						
	36-38		1.9'	21-27-20-50 (47)	SAND AND GRAVEL, BROWN, (5 YR. 5/6), WET, DENSE, WELL SORTED SAND, MEDIUM-COARSE GRAINED WITH 20% GRAVEL TO 3/4-INCH	
38						
	38-40	4017	1.6'	42-50-5-6 (55)	GRAVEL AND SAND, BROWN, (10R 4/0), VERY DENSE, COARSE SAND WITH GRAVEL UP TO 1-INCH; OVER 0.5 FT. CLAYEY SAND AND GRAVEL, REDDISH, MEDIUM DENSE	COBBLE 3½-INCH IN DIAMETER AND ½-INCH THICK BROUGHT TO SURFACE
40						HEADSPACE #4017—NOT ABOVE BACKGROUND
	40-42		2.0	21-33-38-50/5 (71)	CLAYEY SAND AND GRAVEL (N9), AS ABOVE; OVER 1.2 FT. SAND WHITE, VERY DENSE, POORLY SORTED, MEDIUM GRAINED, WITH 5% GRAVEL TO 1/2-INCH	09:50 11/20/89
42						
						*SMOOTH DRILLING WITH SOME CHATTERING AT 42 TO 44 FT. PROBABLY IN SANDS
44						
						TRYING TO GET THROUGH RGA TODAY
46						
	46-48	4018	2.0'	19-50-41-38 (91)	GRAVEL AND SAND, BROWN, (5 YR. 4/4), VERY DENSE, GRAVEL TO 1-INCH WITH MEDIUM TO COARSE GRAINED SANDS	HEADSPACE #4018—NOT ABOVE BACKGROUND
48						
						10:40 ROUGH DRILLING! CENTER PLUG IS STUCK IN AUGERS AS SANDS ARE HEAVING
50						15:45 12/5/89
	50-52	NONE	0.4'	25-21-19-17 (40)	GRAVEL AND SAND, DENSE, WELL SORTED, 70% GRAVEL AND 30% MEDIUM TO COARSE GRAINED SAND, 1½-INCH GRAVEL STUCK IN SAMPLER-EASY DRILLING	USING ROTARY WASH DRILLING AT ~51½ FT., PROBABLY OUT OF GRAVEL
52						
54						
	54-56		2.0'	6-8-27-50 (35)	CLAYEY SILT, GRAY, (N6), DAMP, STIFF TO HARD, WITH ORANGE MOTTLING, FRACTURES EASILY	
56						HEADSPACE #4021—NOT ABOVE BACKGROUND
		4021				
58						
	58-59.5		1.4'	24-42-50/5	CLAYEY SILT, GRAYISH BLACK, (N2), HARD, MICACEOUS, FRACTURES IN CONCHOIDAL	10:00 12/6/89

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 3 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Longyear 44, Rotary Drilling With 8-inch Paddle Bit
WATER LEVEL AND DATE START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60						MOVE LONGYEAR 44 RIG ONTO SITE, SET SURFACE CASING TO 61 FT.
63	63-65		1.5'		CLAY, DARK GRAY, (N3) TO BLUISH, (5 Pb 3/2), DRY, MICACEOUS, VERY STICKY	DROVE SHELBY TUBE 1/16/90
65						
68	68-70	4022	2.0'	3-2-1-5 (3)	SAME AS ABOVE, SOFT	USING 300 LB. HAMMER ON A SAND LINE 15:15 1/16/90
70						
73	73-75	4023	1.9'	7-10-12-14 (22)	SAME AS ABOVE, VERY STIFF, WITH 2-INCH INTERVAL OF VERY FINE SAND THAT WAS DRY	08:15 1/17/90
75						SLOW DRILLING, DRILLING MUD, THICKENS EASILY AND MUST BE DILUTED ABOUT EVERY 10 FT.
78	78-80	4025 4026	1.9'	1-5-10-16 (15)	CLAY, DARK GRAY, (N3), DRY, STIFF, SLIGHTLY SILTY,STICKY, MICACEOUS	10:00
80						
83	83-85	4027	1.6'	8-10-12 (22)	SAME AS ABOVE, VERY STIFF	NO HEADSPACE ANALYSIS DONE 11:00
85						
88	88-90	4028	2.0'	2-8-12-14 (20)	SAME AS ABOVE, WITH SEVERAL VERY THIN (1/4-INCH) INTERVALS OF GRAY VERY FINE	14:00 1/17/90

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 4 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Longyear 44, Rotary Drilling With 8-inch Paddle Bit
WATER LEVEL AND DATE _____ START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90						
93	93-95	4024	1.3'	1-2-6-8 (8)	SILTY CLAY, GRAY, (N7), DRY, FIRM, SIMILAR TO ABOVE CLAY, SLIGHTLY MICACEOUS	08:10 1/18/90
95						
98	98-100	4031	1.9'	6-9-9 (18)	SAME AS ABOVE, VERY STIFF, WITH GREATER % OF MICA	11:00 WEIGHT OF RODS ALLOWING SPOON TO ONLY BE DRIVEN 18 FT.
100						
103	103-105	4032	0.9'	3-4-12-14 (16)	SAME AS ABOVE, WITH VARYING AMOUNTS OF MICA	14:15 DRILLING MUD, IS THICKENING VERY FAST, EVERY 5-10 FT.
105						
108	108-110	4033	2.0'	2-2-4-7 (6)	SAME AS ABOVE, FIRM	15:45
110						
113	113-115	4034	1.8'	4-11-16 (27)	SAME AS ABOVE, VERY STIFF	10:45 1/19/90
115						
118	118-120	4035	2.0'	8-16-18 (34)	SAME AS ABOVE, HARD	14:40

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 5 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Longyear 44, Rotary Drilling With 8-Inch Paddle Bit
WATER LEVEL AND DATE _____ START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120						
123	123-125	4036	2.0'	4-11-12 (33)	SILTY CLAY, GRAY, (N7), DRY, HARD, MICACEOUS	16:00 1/19/90
125						
128	128-130	4038	1.8'	6-7-14 (21)	SAME AS ABOVE, DRY, VERY STIFF, WITH OCCASIONAL LENSES OF VERY FINE GRAY SAND, ~1/8-INCH THICK	0:900 1/20/90
130						
133	133-135	4039	1.9'	2-3-22 (25)	SILTY CLAY, GRAY, (N7), DRY, VERY STIFF, MICACEOUS	10:15
135						
138	138-140	4040 4041	2.0'	4-9-17 (26)	SAME AS ABOVE	13:45
140						
143	143-145	4042	1.8'	5-7-13 (21)	SILTY CLAY, GRAY, (N7), STIFF TO VERY STIFF,OVER 0.5 FT. SANDY CLAY WITH 15-25% VERY FINE SAND IN THE SAME SILTY CLAY MATRIX	15:15 DRILLER NOTES CHANGE IN DRILLING BEHAVIOR
145						
148	148-	4043	1.9'	6-9-11	SILTY CLAY, GRAY, (N7), VERY STIFF, WITH VERTICAL FRACTURES (SECONDARY) WITH WHITE FILLINGS, MICACEOUS	RAD SCREENING 16:00 30 PPM ABOVE BACKGROUND

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 120 SHEET 6 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC1, Southeast Corner of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Longyear 44, Rotary Drilling With 8-inch Paddle Bit
WATER LEVEL AND DATE START 11/18/89 FINISH 1/23/90 LOGGER M. Henry

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
150						
153	153-155	4045	2.0'	1-2-6-8 (8)	SAME AS ABOVE, SLIGHTLY MOIST, FIRM, LESS MICA THAN ABOVE	11:20 1/21/90
155						DRILLER NOTES CHANGE IN RIG'S BEHAVIOR
158	158-160	4046	1.8'	6-9-9 (18)	SILTY CLAY, DARK GRAY, (N3), VERY STIFF, (NO MICA), WITH LENSES OF LIGHT GRAY-WHITE, VERY FINE, POORLY SORTED SAND; SANDS ARE MOIST	08:15 1/22/90
160						
163	163-164	4047	0.6'	50-50/2	SAND, SALT AND PEPPER COLORED, MOIST TO WET, VERY DENSE, FINE, POORLY SORTED, WITH ~5-10% GLAUCONITE	10:15
164						
168	168-169		0.6'	45-50/3	SAME AS ABOVE	13:30
169						TD OF BORING
172					FOUR WELLS SET AT THIS SITE SCREENED INTERVALS 160-170 44½-49½ 34½-39½ 20-30	

MW-121

PROJECT NUMBER	BORING NUMBER
SED28178.A	Well 121 SHEET 1 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Auger (8-inch O.D.) B-57 ATV
WATER LEVEL AND DATE START 11/14/89 FINISH 1/8/90 LOGGER J. Mitchell

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS (GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-2		1.1'	1-3-4-5 (7)	SANDY CLAY, PINK YELLOWISH BROWN, (10 YR, 6/2), DAMP, FIRM, MEDIUM TO COARSE SAND SIZE, ROOTS AT TOP	BEGIN DRILLING 11/14/89 AT 10:22
2	2-4	4050	1.5'	4-6-7-7 (13)	SAME AS ABOVE, STIFF, INCREASED SAND VERSUS CLAY, (40% SAND)	HNU = 0.0 PPM
4	4-6		1.2'	6-8-10-10 (18)	FAT CLAY WITH SAND, MODERATE YELLOWISH BROWN TO DARK YELLOWISH BROWN, (10YR 5/4), VERY STIFF, (CH)	MINOR IRON STAINING OF CLAY DRILLING RATE SMOOTH
6	6-8		1.3'	8-7-9-11 (16)	SAME AS ABOVE	
8	8-10	4051	1.7'	8-4-10-11 (19)	SILTY CLAY, DARK YELLOWISH ORANGE, (10 YR, 5/6), MOIST, VERY STIFF, TRACE SAND (10%), PLASTIC, (CH)	HNU = 0.0 PPM
10	10-12		1.7'	2-5-6-8 (11)	CLAYEY SAND, DARK YELLOWISH BROWN, (10YR, 4/2), MOIST, MEDIUM DENSE, (60%/ 50%) ORGANIC STAINING, ROOTS, TRACE SILT, (SC)	MINOR ORGANIC MATERIAL
12	12-14		1.5'	8-10-10-11 (20)	SANDY CLAY, LIGHT BROWN TO PALE YELLOWISH BROWN, (5 YR, 5/6), VERY STIFF, TRACE SILT, (CL)	
14	14-16	4052	1.2'	11-13-12-12 (25)	SILTY CLAY, LIGHT BROWN TO PALE YELLOWISH BROWN, (5 YR, 5/6) TO (10 YR, 6/2), VERY STIFF, TRACE SAND, (CL)	
16	16-18		1.9'	4-7-10-11 (17)	SAME AS ABOVE	ENDED DRILLING AT 16:40
18	18-20		1.1'	4-6-10-12 (16)	SAME AS ABOVE, INCREASING SAND CONTENT	RESUMED DRILLING 11/15/89 AT 08:19
20	20-22	4053	1.5'	5-5-7-7 (12)	SILTY CLAY, PALE YELLOWISH BROWN, (10 YR, 6/2) STIFF, TRACE MEDIUM SAND	IRON STAINING IN SANDS
22	22-24		2.0'	10-11-12-15 (23)	SAME AS ABOVE, MOIST, VERY STIFF, MORE PLIABLE	
24	24-26		1.2'	15-13-16-17 (29)	SAME AS ABOVE, VERY STIFF, NOT PLIABLE	END DRILLING AT 0:59
26	26-28	4054	2.0'	3-7-9-7 (16)	SILTY CLAY, GRAYISH ORANGE PINK TO YELLOWISH GRAY, (5 YR, 7/2), MOIST TO WET, VERY STIFF	RESUMED DRILLING 11/16/89 AT 08:14 ENCOUNTERED WATER TABLE AT 25 TO 27 FT.
28	28-30		1.0'	4-15-15-8	SAME AS ABOVE WET, HARD, TRACE SAND	

PROJECT NUMBER	BORING NUMBER
SED/88178.FI	Well 121 SHEET 2 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Auger (8-inch O.D.) B-57ATV
WATER LEVEL AND DATE START 11/14/89 FINISH 1/6/90 LOGGER J. Vilche

DEPTH IN FEET BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	30-32	4054	2.0'	3-4-7-9 (11)	SAME AS ABOVE, WET, STIFF, TOP 0.3 FT. BLACK ORGANIC STAINING	HNU = 0.0 PPM
32						UPPER CONTINENTAL DEPOSITS
	32-34		1.6'	12-14-17-17 (31)	SILTY CLAY, MODERATE REDDISH BROWN, (10 R 5/4), HARD, TRACE SAND	
34					SAME AS ABOVE, LAYERED COLOR CHANGES BETWEEN PALE YELLOWISH BROWN AND REDDISH BROWN	ISOLATED BLACK ORGANIC SEAMS
	34-36	4055	1.9'	14-15-18-18 (33)		
36	36-38		1.9'	4-8-16-22 (24)	SAME AS ABOVE, PALE YELLOWISH BROWN ABOVE REDDISH BROWN, VERY STIFF	
38	38-40		1.4'	10-25-23-27 (48)	SAME AS ABOVE, HARD, ISOLATED COBBLE	
40	40-42	4056	2.0	8-7-5-10 (12)	SAME AS ABOVE, VERY STIFF, ISOLATED COBBLE	HNU = 0.0 PPM
42		4057				
	42-44		1.5'	12-14-19-18 (33)	SAME AS ABOVE, HARD, NO COBBLE	
44	44-46		1.5'	11-15-14-14 (29)	SAME AS ABOVE, VERY STIFF, POCKETS OF LIGHT GRAY CLAY, WITH TRACE OF MEDIUM SAND	HNU = 0.0 PPM
46	46-48	4058	1.8'	6-8-12-14 (20)	SAME AS ABOVE	
48	48-50		1.7'	10-12-15-17 (27)	SAME AS ABOVE, THIN ORGANIC SEAM	
50	50-52		2.0'	6-8-9-10 (17)	CLAYEY SILT WITH SAND, REDDISH BROWN, (10R 4/6), VERY STIFF, MICACEOUS, ORGANIC SEAMS, (ML)	
52	52-54	4059	1.0'	11-14-15-15 (29)	SAND WITH SILT, REDDISH BROWN, (10R 4/6), MEDIUM DENSE, WELL GRADED, FINE TO COARSE, MICACEOUS, (80-20%) (SM)	HNU = 0.0 PPM
54	54-56		1.5'	15-22-34-23 (56)	SAME AS ABOVE, VERY DENSE, FINE TO MEDIUM SAND SIZE	ENDED DRILLING AT 10:25
56	56-58		1.9'	4-5-13-8 (18)	SANDY CLAY, REDDISH BROWN, (10R 6/4), MOIST, STIFF, PLIABLE; OVER 1.0 FT. SAND, MEDIUM DENSE, MEDIUM COARSE	RESUMED DRILLING 1/6/90 AT 08:1
58	58-60	4060	1.0'	12-20-21 (41)	SAND, REDDISH BROWN, MOIST, VERY DENSE, MICACEOUS; OVER 1.0 FT. GRAVEL	LOWER CONTINENTAL DEPOSITS

PROJECT NUMBER	BORING NUMBER
S2D28173.FI	Well 121 SHEET 3 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Pla
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Auger (8-inch O.D.) B-57ATV
WATER LEVEL AND DATE START 11/14/89 FINISH 1/6/90 LOGGER J. Mitchell

DEPTH BELOW SURFACE (Ft)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (Ft)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60						
	60-62	4060	1.8'	7-32-50/5"	SAND, REDDISH BROWN, VERY DENSE, MEDIUM COARSE; OVER 0.4 FT. GRAVEL (1/2-1/4-INCH DIAMETER), MICACEOUS, (75% SAND/25% GR)	
62						
	62-64		1.7'	14-16-18 (25)	0.95 FT. SAND, LIGHT BROWN, (5 YR. 5/6), MEDIUM DENSE, MICACEOUS; OVER GRAVEL, MODERATE BROWN, (5 YR. 4/4), SUBROUNDED	
64						
	64-66	4061	1.3'	4-12-28-50/5" (40)	SAME AS ABOVE, DENSE, GRAVEL CONTENT INCREASED VERSUS SAND, (60% GRAVEL-40% SAND)	
66						
	66-68		1.6'	15-23-24-40 (47)	SAME AS ABOVE	ENDED DRILLING AT 15:14
68						
	68-70		1.3'	11-16-23-24 (46)	SAND, DARK YELLOWISH ORANGE, (10 YR. 6/6), WET, DENSE, MEDIUM COARSE, WELL GRADED	RESUMED DRILLING 11/20/89 ?
70						
	70-72	4062	1.4'	8-19-34-39 (53)	SAME AS ABOVE, VERY WET, VERY DENSE; OVER 0.5 FT. GRAVEL (85% SAND/84% GRAVEL)	HNU = 0.0 PPM HP210 = 38 CPM
72						
	72-74		1.1'	8-17-27-26 (44)	SANDY GRAVEL, DARK YELLOWISH ORANGE, (10 YR. 6/6), DENSE, (1/8-1/2-INCH DIAMETER) (50% GRAVEL/20% SAND)	DRILLING ENDED AT 11:53
74						
	74-76		1.2'	23-19-50/5"	SAME AS ABOVE, WET, VERY DENSE, SAND CONTENT INCREASING (50% GRAVEL/50% SAND)	DRILLING BEGINNING 11/27/89 AT 07:
76						
	76-78	4064	1.1'	9-08-50/5"	SAME AS ABOVE, WET, (50% GRAVEL/20% COARSE SAND)	
78						
	78-80		2.0'	12-14-25-50/5" (39)	SAME AS ABOVE, DENSE, WITH 0.35 FT. PALE YELLOWISH BROWN, (10 YR. 6/2), CLAYEY SAND LENS AT CENTER	HNU = 0.0 PPM
80						
	80-82		1.3	14-25-38-31 (56)	SAME AS ABOVE, VERY DENSE, NO CLAYEY SAND, VERY LARGE (1HN. TO 1-IN. DIAMETER), COBBLES, GRAVEL	
82						
	82-84	4065	1.5'	11-16-38-46 (54)	0.80 FT. SAND, DARK YELLOWISH ORANGE, (10 YR. 6/6), MOIST TO WET, VERY DENSE, FINE TO MEDIUM; OVER GRAVEL, CHERT	RED STAINING IN SANDS
84						
	84-86		1.6'	8-10-27-38 (45)	SANDY GRAVEL, MODERATE YELLOWISH BROWN, (10 YR. 5/4), MOIST, DENSE, MEDIUM TO COARSE, (80% GR/20% SAND)	RED IRON STAINING
86						
	86-88		2.0'	9-12-43-30/4" (55)	SAME AS ABOVE, VERY DENSE	HNU = 0.0 PPM HP210 = 37 CPM
88		4066			CLAY, GRAYISH ORANGE PINK, (5YR. 7/2), AND SILTY SAND, LIGHT BROWN, (5YR. 5/6) TO VERY PALE ORANGE (10YR. 8/2)	200 FT. SAND AND CLAY

PROJECT NUMBER	BORING NUMBER
SEC28178.FI	Well 121 SHEET 4 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant

ELEVATION DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Hollow Stem Auger (8-inch O.D.) B-57 ATV

WATER LEVEL AND DATE START 11/14/89 FINISH 1/5/90 LOGGER J. Mitchell

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST, RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION	COMMENTS
90						
	90-92	4066	1.5'	4-1-5-9 (6)	INTERBEDDED CLAY: PALE BROWN, (5 YR. 5/2) TO GRAYISH ORANGE PINK, (5YR. 7/2); FIRM AND SANDY, LIGHT BROWN, (5 YR. 5/6) TO VERY PALE ORANGE, (10 YR. 8/2) LOOSE, MICACEOUS, BELOW GRAVEL	65% SAND/CLAY BELOW 30% GRAVEL
92						
93						AUGERED 82-95 FT. DRILLER DESCRIBES 3 FT ZONE AS CLAY UNIT
95						
	95-97		2.0'	2-4-7-10 (11)	SILTY CLAY, YELLOWISH BROWN (10YR 5/2) TO OLIVE BLACK, MOIST, STIFF, MICACEOUS, WITH INTERBEDDED CLAY AND SAND IN TOP 0.5 FT	PORTERS CREEK CLAY
97						
98		4057				
100						
	100-102		2.0'	2-5-13-19 (18)	SILTY CLAY, DUSKY YELLOWISH BROWN, (10 YR. 5/2), VERY STIFF, MICACEOUS	ENDED DRILLING AT 15:25
102						
103		4038				
105						12/1/89 RESUMED DRILLING AT 15:10
	105-107		3.0		SHELBY TUBE WAS COLLAPSED ON THE BOTTOM, COULD NOT GET TO SOIL FOR CLASSIFICATION	TOOK SHELBY TUBE SAMPLE AT 15:55 ON 12/1/89. SHELBY WAS PUSHED 2 FT., VERY HARD TO PUSH. QUIT FOR THE DAY AT 17:00
107						
	107-109	4074	1.9'	38-27-47-99 (74)	LEAN CLAY WITH SAND, DUSKY YELLOWISH BROWN, (10YR. 5/2), MOIST, HARD, MICACEOUS, 15-20% SAND, (CL)	BEGIN DRILLING AT 11:00 ON 12/13/89
109		1.9'				QUIT FOR THE DAY AT 15:30 on 12/13/89
110						RESUMED DRILLING 12/14/89 AT 13:40
	110-112		3.0'	39-37-50/5"	CLAYEY SAND, DUSKY YELLOWISH BROWN, (10 YR. 5/2), MOIST, VERY DENSE, SLIGHT PLASTICITY, 20-40% P200 SOME SMALL BLACK WOODCHIPS, (SC)	
112						
113		4075				
115						
	115-117		0.2	270/2"	POORLY GRADED SAND WITH SILT, DUSKY YELLOWISH BROWN, (10 YR. 5/2), MOIST VERY DENSE, 5-12% P200, TIP VERY TIP OF SPOON HAD LEAN CLAY, STRATIGRAPHY SEEMS TO BE ALTERNATING SAND AND CLAY, (SP-SM)	
117						
118		4078				

PROJECT NUMBER	BORING NUMBER
SED25178.FI	Well 121 SHEET 5 OF 7

SOIL BORING LOG

PROJECT: PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant

ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Mud Rotary (7⅞" Inch O.D.) Lonnyear 44

WATER LEVEL AND DATE _____ START 11/14/89 FINISH 1/6/90 LOGGER Nelson

DEPTH IN FEET (FT) BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" 6" 6" (N)	SOIL DESCRIPTION	COMMENTS
120	120-122	4079	1.0'	30-100/1"	POORLY GRADED SAND WITH SILT, LIGHT OLIVISH GRAY, (5Y 7/1), MOIST, VERY DENSE, QUARTZ SAND, VERY FINE TO FINE, 5-12% P200, (SP-SM)	RESUMED DRILLING 12/14/89 AT 13:45 SWITCHED TO 300 LB. HAM AT 120 FT.
125	125-127	4081	0.8'	54 66/6"	SAME AS ABOVE, (SP-SM)	WHILE DRILLING TO 125 FT. DRILLE INDICATED HE LOST SOME MUDDLE LOSS WAS VERY MINOR
130	130-132	4082	3.8'	30-46-24 (70)	INTERBEDDED POORLY GRADED SAND AND SANDY CLAY, POORLY GRADED SAND (80%), LIGHT GRAY, (N7), MOIST, VERY DENSE, QUARTZ SAND, FINE, 0-5% P200, (SP) SANDY CLAY (20%), DUSKY YELLOWISH BROWN (10YR 4/2) SLIGHT PLASTICITY, 20-40% SAND (CL)	QUIT FOR DAY AT 129 FT. AT 16:05 ON 12/13/89 RESUMED DRILLING AT 12:40 ON 12/18/89
135	135-137	4084	2.0'	3-6-8-10 (14)	ELASTIC SILT, DUSKY YELLOWISH BROWN (10YR 3/2), MOIST, STIFF, NON PLASTIC, VERY VERY THIN LENSES OF QUARTZ SAND THROUGHOUT SAMPLE, (ML)	QUIT FOR DAY AT 135 FT. AT 15:45 ON 12/19/89 RESUMED DRILLING AT 11:30 ON 12/20/89 QUIT FOR DAY AT 137 FT. AT 12:30 ON 12/20/89
140	140-142	4085	2.0'	10-21-33-50/3" (99)	ELASTIC SILT, OLIVE BLACK, (5Y 3/1), MOIST, VERY STIFF, SLIGHTLY PLASTIC, VERY THIN LENSES OF QUARTZ SAND THROUGH-OUT SAMPLE, (ML)	SWITCHED TO 140 LB. HAMMER AT 140 FT. RESUMED DRILLING AT 09:20 ON 12/26/89
145	145-147	4086	2.0'	23-42-50/4"	ELASTIC SILT, OLIVE BLACK, (5Y 3/1) MOIST, VERY STIFF, MODERATELY PLASTIC VERY THIN LENSES OF QUARTZ SAND MICACEOUS (ML)	SWITCHED BACK TO 300 LB. H AT 145 FT. AFTER INITIALLY DRILLI WITH 140 LB. HAMMER. FINISHED DRIVING SAMPLE WITH 300 LB.

PROJECT NUMBER	BORING NUMBER
SED28178.F5	Well 121 SHEET 6 OF 7

SOIL BORING LOG

PROJECT FGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant

ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT Mud Rotary (7¾-Inch O.D.) Longyear 44

WATER LEVEL AND DATE _____ START 11/14/89 FINISH 1/6/90 LOGGER Bringerc

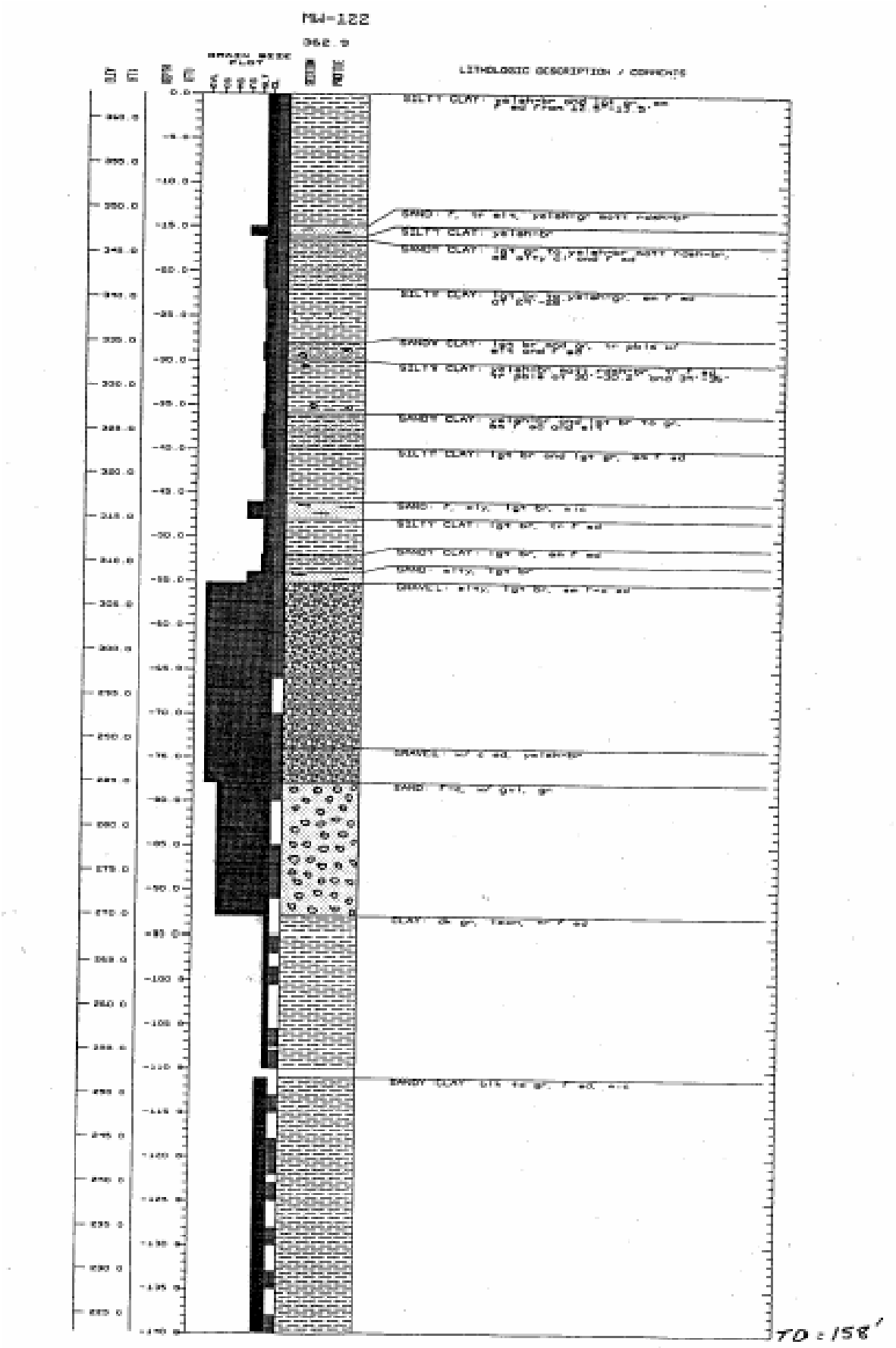
DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
152	150	4087	3.0'	5-8-12-40 (20)	PLASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, VERY STIFF, SLIGHTLY PLASTIC, STIFF, HIGHER PERCENTAGE OF THIN SAND SEAMS THAN ABOVE, MICACEOUS, (ML)	USING 300 LB. HAMMER
157	155	4088	2.0'	5-11-20-50 (29)	PLASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, HARD, SLIGHTLY PLASTIC, HIGHER PERCENTAGE OF THIN SAND SEAMS, UPPER 0.5' SATURATED, DOES NOT HAVE SAND LAMINATIONS, MICACEOUS, (ML)	END DRILLING FOR THE DAY 15:00 1/5/90 RESUME DRILLING 08:00 ON 1/8/90
162	160	4089	2.0'	WOR-4-7-15 (11)	PLASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, SLIGHTLY PLASTIC, HIGH PERCENTAGE OF THIN SAND SEAMS, MICACEOUS, (ML)	
167	165	4090	2.0'	WOR-3-9-21 (12)	INTERBEDDED PLASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, SLIGHTLY PLASTIC, MICACEOUS, (ML), AND POORLY GRADED SAND, WHITE, FINE, LAMINATIONS, 30-40% SAND, (SP)	TOP OF SAMPLE WAS WET, PROBABLY DUE TO DRILLING MUD DRILLER INDICATED A CHANGE IN DRILLING AT 167 FT
172	170	4091	2.0	2-1-5-7 (6)	CLAYEY SILT, OLIVE BLACK, (5Y 2/1), MOIST, FIRM, MODERATELY PLASTIC, (ML)	
177	175	4092	2.0'	6-12-17-18 (29)	PLASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, VERY STIFF, MODERATELY PLASTIC, MICACEOUS, THIN SEAMS OF WHITE FINE SAND, (ML)	END DRILLING FOR THE DAY 15:10 ON 1/8/90

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 121 SHEET 7 OF 7

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC2, Northwest of Plant
ELEVATION ____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Mud Rotary | 7¾-inch O.D.| Longyear 44
WATER LEVEL AND DATE ____ START 11/14/89 FINISH 11/8/90 LOGGER J. Brainard

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" 6" 6" (N)	SOIL DESCRIPTION	COMMENTS
180						USING 300 LB. HAMMER.
182	180-182	4055	2.0'	WOR-6-6-7 (13)	PLASTIC SILT, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, MODERATELY PLASTIC, THIN SEAMS OF WHITE FINE SAND, (ML)	
185	185-187	4064	2.0'	WOR-6-7-11 (18)	CLAYEY SILT, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, MODERATELY PLASTIC, THIN SEAMS OF WHITE FINE SAND AT BOTTOM OF SAMPLE, (MH)	
190	190-192	4055	2.0'	WOR-6-7-17 (12)	PLASTIC SILT AND SAND, OLIVE BLACK, (5Y 2/1), MOIST, STIFF, MODERATELY PLASTIC, LARGE NUMBER OF THIN WHITE FINE SAND SEAMS, (ML-SP)	
195	195-197	4056	2.0'	WOR-6-7-15 (12)	PLASTIC SILT, OLIVE BLACK, WET, STIFF, MODERATELY PLASTIC, FEW SEAMS OF SATURATED FINE SAND, MICACEOUS, (ML)	THE SAMPLE FROM 200 TO 202 FT IS APPARENTLY FROM 198 TO 200 FT. IN ACTUALITY.
200	200-202	4047	2.0'	3 1 3 3 (4)	PLASTIC SILT, OLIVE BLACK, (5Y 2/1), WET, SOFT, MODERATELY PLASTIC, (ML)	THE DRILLER REPORTED ROUGH DRILLING AT ABOUT 200.5 FT. THE DRILLING REPORTEDLY BECAME EASIER WITH DEPTH
205	205-206.2		1.2'	23 75 50/2"	POORLY GRADED SILTY SAND, LIGHT GRAY, (N.C), WET, VERY DENSE, VERY FINE (SP-SM)	
207						


MW-122
LITHOLOGIC DESCRIPTION / COMMENTS
TD : 158'

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 1 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant

ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering

DRILLING METHOD AND EQUIPMENT _____

WATER LEVEL AND DATE _____ START 11/18/89 FINISH 1/5/90 LOGGER MK Dwyer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-2		1.0'	2-2-3-4 (5)	SILTY CLAY, DARK YELLOWISH BROWN, (10 YR 4/2), MOIST, FIRM, HOMOGENEOUS, SLIGHTLY PLASTIC, (CL)	HNU = 0 PPM HP 260 = BACKGROUND
2	2-4	4100	1.3'	10-12-14-16 (26)	SILTY CLAY, MODERATELY YELLOWISH BROWN, (10 YR 5/4), MOIST, VERY STIFF, SOME MOTTLING, MEDIUM PLASTICITY, (CL)	SAME READINGS
4	4-6		2.0'	7-7-10-13 (17)	SILTY CLAY, PALE YELLOWISH BROWN, (10YR 6/2), MOIST, VERY STIFF, IRON RICH LAYERING, MINOR ORGANICS, LOW PLASTICITY, (CL)	
6	6-8		1.7'	8-6-10-8 (16)	SILTY CLAY, MODERATE YELLOWISH BROWN, (10YR 5/4), AND LIGHT GRAY, (N7), MOIST (7-8) TO WET (8-7), VERY STIFF, IRON RICH LAYERING, LOW PLASTICITY, (CL)	
8	8-10	4101	1.7'	7-7-10-10 (17)	SILTY CLAY, SAME AS ABOVE, HOMOGENEOUS, (9-9), IRON RICH MOTTLING, (9-10), (CL)	HNU = 0 PPM HP 260 = BACKGROUND (30 CPM)
10	10-12		1.5'	12-14-14-15 (28)	SILTY CLAY, SAME AS ABOVE, MOTTLING THROUGHOUT, (CL)	
12	12-14		1.9'	4-7-7-9 (14)	SILTY CLAY, MODERATE YELLOWISH BROWN, (10 YR 5/4), AND GRAY (N7) (13.5-14.0FT), DAMP, STIFF, IRON RICH LAYERS, 20 % FINE SAND 12.5 - 13.5 FT. (CL)	HNU = 0 PPM HP 260 = 30 CPM (BACKGROUND)
14	14-16	4102	2.0'	5-9-13-13 (22)	SILTY CLAY, MODERATE YELLOWISH BROWN, (10 YR 5/4), MOIST, VERY STIFF, HOMOGENEOUS, (CL), OVER SAND, YELLOWISH GRAY, (5Y 5/1), DRY, MEDIUM DENSITY, FINE SAND, TRACE SILT, IRON RICH MOTTLING THROUGHOUT, (SM)	
16	16-18		2.0'	8-9-9-12 (18)	SILTY CLAY, SAME AS (14-15 FT.) FROM 16-16.5FT.; OVER SANDY CLAY, YELLOWISH GRAY, (5Y 8/1), MOIST, VERY STIFF, 30% SAND, IRON RICH MOTTLING THROUGHOUT, (CL)	SAME READINGS
18	18-20		1.6'	8-11-11-12 (22)	SILTY CLAY AND SANDY CLAY, MODERATE YELLOWISH BROWN, (10YR 5/4), 18.5-18.5 FT. AND YELLOWISH GRAY, (5Y 8/1) 18.5-20 FT., MOIST, VERY STIFF, SOME IRON RICH LAYERS, LOW PLASTICITY, 25% FINE SAND, (CL)	HNU = 0 PPM HP 260 = 30 CPM (BACKGROUND)
20	20-22	4103	1.9'	9-10-12-12 (22)	SANDY CLAY, LIGHT GRAY, (N7), DAMP TO MOIST, VERY STIFF, IRON STAINED LAYERING AND INCLUSIONS, LOW PLASTICITY, (40% SAND), WITH 2-4" FINE SAND LAYERS, (CL)	
22	22-24		0.4'	6-6-11-13 (17)	SILTY CLAY, YELLOWISH GRAY, (5Y 8/1), MOIST, VERY STIFF, HOMOGENEOUS, LOW-MEDIUM PLASTICITY, (CL)	16:15 END SAMPLING
24	24-26		2.0'	6-6-8-9 (14)	SILTY CLAY, LIGHT BROWN AND GRAY, (5 YR 5/6), (N7), (15%), MOIST, STIFF, IRON STAINING AND MOTTLING THROUGHOUT, LOW PLASTICITY, SOME FINE SAND, (CL)	SAMPLE #4104 IS EQUIPMENT BLANK TAKEN ON 11/18/89
26	26-28	4105	2.0'	7-10-10-13 (20)	SILTY CLAY, LIGHT BROWN AND GRAY, (5 YR 5/6), (N7), MOIST, MEDIUM DENSITY, VERY STIFF, IRON STAINING AND MOTTLING, LOW PLASTICITY, WITH LAYERS OF WELL SORTED FINE SAND 1.2 FT. (CL)	HNU = 0 PPM HP 260 = 32 CPM (BACKGROUND)
28	28-30		1.6'	8-8-9-11	SANDY CLAY, LIGHT BROWN AND GRAY, (5YR 5/6) (N7), MOIST, VERY STIFF, IRON STAINING AND MOTTLING, TRACE SUBROUNDED PEBBLES, WITH SILT AND FINE SAND (30%), WELL GRADED, (CL)	

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 2 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-61 Hollow Stem Auger, 7-inch ID, 113/4-inch OD
WATER LEVEL AND DATE START 11/18/89 FINISH 1/5/90 LOGGER MK Dwyer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30						
	30-32		2.0'	8-7-7-9 (14)	SILTY CLAY, PALE YELLOWISH BROWN, (10YR 6/2), STIFF, IRON RICH LAYERING AND MOTTLING, TRACE SUBROUNDED PEBBLES AT 30-30.2 FT., LOW PLASTICITY, TRACE FINE SAND (10%), (CL)	HNU = 0 PPM HP 260 = 32 CPM (BACKGROUND)
32						
	32-34	4106	1.6'	6-6-8-12 (14)	SILTY CLAY, LIGHT BROWN, (5YR 5/6), AND PALE YELLOWISH BROWN, (10 YR 6/2), MOIST, STIFF, IRON RICH, MOTTLED, THIN PEBBLE LAYERS AT 34 FT., LOW PLASTICITY, SOME FINE SAND, (CL)	
34						
	34-36		1.9'	14-15-16-16 (31)	SILTY CLAY, SAME AS 30-34 FT., HARD, TRACE SUBROUNDED (1-3%) PEBBLES	
36						
	36-38		2.0'	10-7-7-9 (14)	SANDY CLAY, PALE YELLOWISH BROWN (10YR 6/2) AND LIGHT BROWN, (5YR 5/6), MOIST, STIFF, MOTTLED, LOW PLASTICITY, FINE GRAINED SAND (30%) WITH SILT, (CL)	HNU = 0 PPM HP 260 = 32 CPM (BACKGROUND)
38						
	38-40	4107	1.8'	12-12-14-16 (26)	SANDY CLAY, LIGHT BROWN, (5YR 5/6) AND LIGHT GRAY (N7), MOIST, VERY STIFF, MOTTLED, LOW PLASTICITY, WITH FINE GRAINED SAND (39-39.5 FT.), (CL)	
40						
	40-42		1.9'	13-14-14-16 (28)	SILTY CLAY, LIGHT BROWN, (5YR 5/6), AND LIGHT GRAY, (N7), MOIST, VERY STIFF, MOTTLED, LOW PLASTICITY, SOME FINE SAND, (30%), (CL)	
42						
	42-44		1.8'	8-6-6-9 (12)	CLAYEY SILT, LIGHT BROWN, STIFF, OCCASIONAL MOTTLING, (5%); OVER SILTY CLAY, (43-44 FT.), LIGHT GRAY, (N7), (CL)	HNU = 0 PPM HP 260 = BACKGROUND
44						
	44-46	4108	1.0'	7-5-9-11 (14)	SILTY CLAY, SAME AS ABOVE, 10% FINE SAND, (CL)	
46						
	46-48		1.7'	5-7-7-12 (14)	CLAYEY SAND, LIGHT BROWN, (5YR 5/6), MOIST TO WET, UNIFORM (SW-SP), STIFF, POORLY GRADED, MICACEOUS, FINE GRAINED, 20% CLAY (SC)	
48						SAMPLE #4109 EQUIPMENT BLANK ON BOWL USED TO COMPOSITE #4110
	48-50		1.8'	6-8-9-14 (17)	SILTY CLAY, LIGHT BROWN (5YR 5/6), MOIST, VERY STIFF, HOMOGENEOUS, MICACEOUS, 10 % FINE SAND, (SC)	
50						
	50-52	4110	1.0'	7-10-13-15 (23)	SILTY CLAY, SAME AS ABOVE	
52						
	52-54		1.8'	3-5-5-8 (10)	SANDY CLAY, (15% SILT), LIGHT BROWN, (5YR 5/6), MOIST TO WET, STIFF, HOMOGENEOUS, (10-30%) FINE SAND, (SC)	
54						
	54-56		1.7'	8-11-14-16 (25)	SILTY SAND, LIGHT BROWN, (5YR 5/6), MOIST TO WET, MEDIUM DENSITY, HOMOGENEOUS, (10-20%) SILT, (SM); OVER 0.3 FT. SILTY GRAVEL, MODERATE BROWN, (5 YR 4/4), (1/4-3/4 IN.) ANGULAR TO SUBANGULAR, (GM)	SAMPLE 56-58 FT: GRAVEL MOSTLY QUARTZ, 1-INCH ANGULAR, MODERATE RED, (5R 4/6), 1/4-INCH SUB-ANGULAR MODERATE RED BROWN, (10R 4/6)
56						
	56-58	4111	1.8'	16-21-24-26 (45)	SILTY GRAVEL, (40-50%) GRAVEL, LIGHT BROWN, (5YR 5/6), MOIST TO WET, DENSE, (20-40%) COARSE TO FINE SAND, (10R 4/6), (10-20%) SILT, (GM)	
58						
	58-60		1.7'	13-16-21-25	SILTY GRAVEL, SAME AS ABOVE, (GM)	
60						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 3 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant
ELEVATION ____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT 8-61 Hollow Stem Auger, 7-inch ID, 113/4-inch OD
WATER LEVEL AND DATE ____ START 11/18/89 FINISH 1/5/90 LOGGER Dwyer/Lahoud

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60						
	60-62		0.8'	8-10-19-6 (29)	SILTY GRAVEL, SAME AS ABOVE, MEDIUM DENSE, GRADING TO WELL ROUNDED, (GM)	
62	62-64	4112	1.1'	11-16-18-18 (34)	SILTY GRAVEL, SAME AS ABOVE, DENSE, (GM)	
64	64-66		0.7'	9-13-16-21 (29)	SILTY GRAVEL, SAME AS ABOVE, MEDIUM DENSE, (GM)	
66						
68						
70	70-72	4113	1.2'	13-16-18-23 (34)	SILTY GRAVEL, SAME AS ABOVE, DENSE, (GM)	
72	72-74		1.1'	8-11-13-13 (24)	SILTY GRAVEL, SAME AS ABOVE, MEDIUM DENSE, (GM)	
74	74-76	4114	1.0'	7-13-19-30 (32)	GRAVEL WITH SAND, PALE YELLOW ORANGE (10YR 8/6), TO DARK YELLOW ORANGE, (10YR 6/6), DENSE, WELL SORTED, 50-60% COARSE SAND, (GW)	
76	76-78		1.9'	9-12-21-26 (33)	GRAVEL WITH SAND, (50-60%), LOOSE, MODERATE YELLOW BROWN, (10YR 5/4), TO DARK YELLOW ORANGE, (10YR 6/6), DENSE, UP TO 1/4-INCH, POORLY SORTED, 50-60% SAND, (GW)	
78	78-80	4115	1.2'	11-14-19-21 (33)	SAND WITH GRAVEL, SAME AS ABOVE, 70% SAND, (SW); OVER 1-IN, SAND, MEDIUM GRAY, (N5), DENSE, COARSE, (SW-SP)	
80						
82						DRILLER NOTES GRAVEL WITH LARGE COBBLES
84						
86	85-87		0.7'	15-15-24-22 (39)	SAND WITH GRAVEL, AS ABOVE, 40% GRAVEL, 50-55% COARSE, POORLY SORTED SAND, 5-10% FINE SAND/SILT, (SW)	
88	87-89	4117	0.8'	12-12-25-19 (37)	SAND WITH GRAVEL, AS ABOVE, WITH 30% GRAVEL, 60% SAND, AND 10% FINE SAND, (SW)	
	89-91		0.2'	9-9-30-17	SAND WITH GRAVEL, AS ABOVE, (SW)	

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 4 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-61 Hollow Stem Auger, 7-inch ID, 113/4-inch OD
WATER LEVEL AND DATE START 11/18/89 FINISH 1/5/90 LOGGER Lahoud

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS: 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90						
91	89-91	4117	0.3'	9-9-39-12 (48)	SAND WITH GRAVEL, SAME AS ABOVE, (SW)	
92						
94						DRILLER REPORTS LITH. CHANGE NO CHATTER AND MORE PRESSURE REQUIRED-CLAY
96	95-97	4118	1.8'	20-20-28-31 (48)	LEAN CLAY, DARK GRAY, (N3), DRY, HARD, LOW PLASTIC, HOMOGENEOUS, FINE LAMINAE STRUCTURE, (CL)	
98						
100	98.5-100.5	4119	1.6'	not Hammered	LEAN CLAY, AS ABOVE , (CL)	SAMPLE TAKEN USING KELLY, NOT HAMMER
102						
104						
106	105.5-107.5	4120	2.0'	12-14-12-16 (26)	LEAN CLAY, AS ABOVE, SLIGHTLY MOIST, VERY STIFF, WITH 5% FINE SAND, SLIGHTLY PLASTIC, (CL)	
108	108-	4121	2.0'	12-18-16-14 (34)	LEAN CLAY, AS ABOVE, HARD, (CL)	
110	110					
112						WATER IN DRILL STRING SAMPLE MOIST
114	113-	4122	2.0'	10-14-11-12 (25)	SANDY CLAY, OLIVE BLACK, (5Y 2/1), 10-15% FINE SAND, DRY TO SLIGHTLY MOIST, VERY STIFF, MEDIUM PLASTIC, MICACEOUS, 10-15% FINE SAND, (CL)	
116	115					
118	118-	4123	2.0'	9-11-12-16	SANDY CLAY, AS ABOVE, WITH INTERBEDDED SAND, MEDIUM GRAY, (N5), DRY TO MOIST, FINE TO WELL SORTED, (1/16-1/2-IN. LENSES),	

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 5 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT B-61 Hollow Stem Auger, 7-inch ID, 113/4-inch OD
WATER LEVEL AND DATE _____ START 11/18/89 FINISH 1/5/90 LOGGER Lahoud

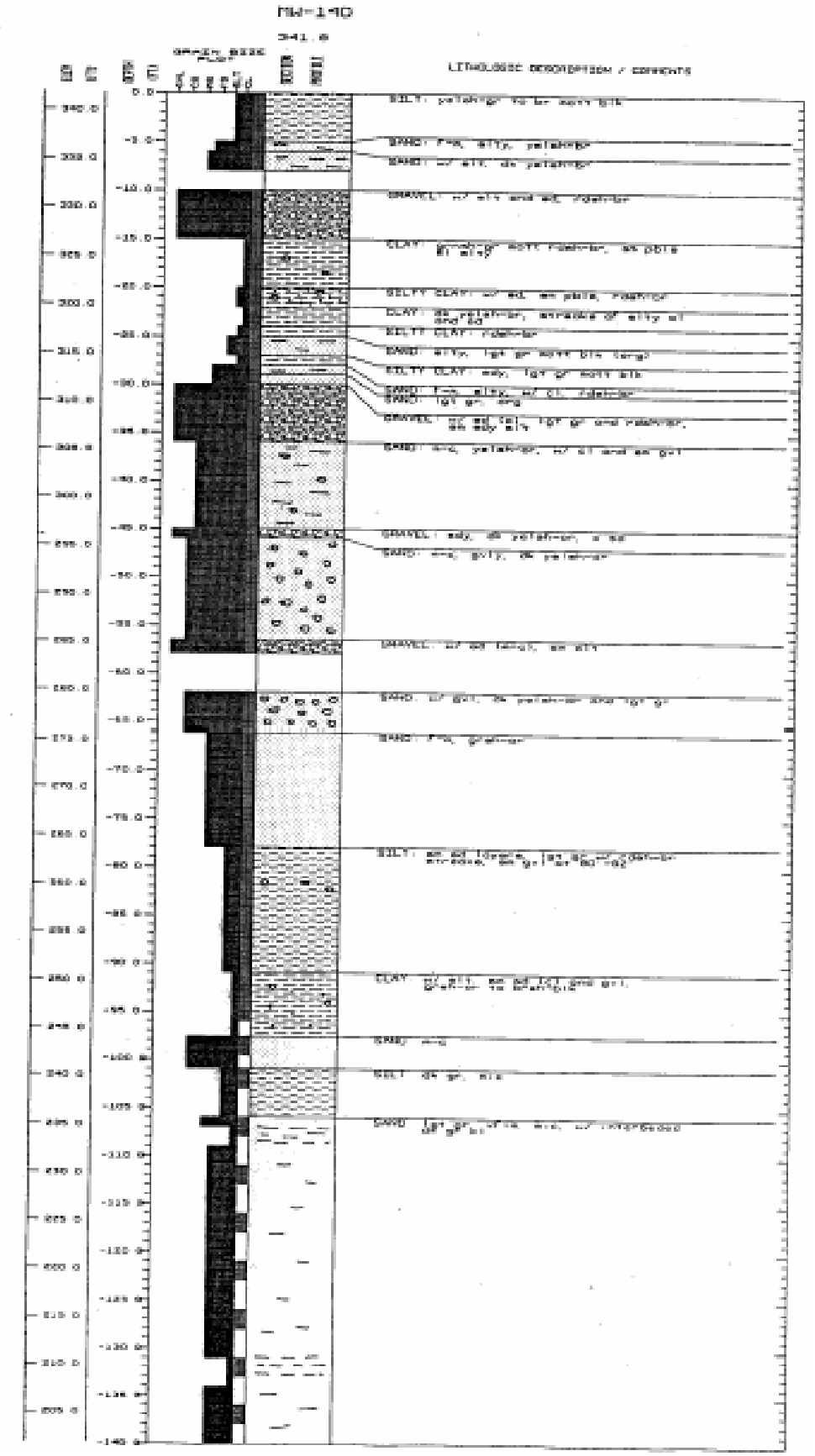
DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120	120-122	4123	2.0'	8-10-10-13 (20)	SANDY CLAY, AS ABOVE, WITH MOIST TO WET 40-50% SAND, LENSES UP TO 1-INCH, (CL)	
122						
124	123-125	4124	1.9'	9-12-16-20 (28)	SANDY CLAY, AS ABOVE, 30-40% SAND, (CL)	
126						
128	128-130	4125	2.0'	11-12-14-16 (26)	SANDY CLAY, AS ABOVE, WITH LAYERS UP TO 1-INCH, (CL)	
130						
132						
134	133-135	4126	1.7'	7-11-14-17 (25)	SANDY CLAY, AS ABOVE, (CL)	
136						
138	138-140	4127	1.9'	8-12-18-23 (30)	SANDY CLAY, AS ABOVE, MOIST, WITH 4-INCH SAND LAYER NEAR 139 FT., (CL)	
140						
142						
144	143-145	4128	1.2'	23-32 Refusal	SAND MEDIUM GRAY, (N2-N3), WET TO MOIST, VERY DENSE, MEDIUM GRAINEID, WELL SORTED, CLEAN, (SP)	REFUSAL AT 144 FT. AUGERED THERE WITH NO PROBLEM
146						
148	148-	4129	1.3'	9-14-21-33 (35)	SANDY CLAY, AS ABOVE, 138-140 FT., (CL) OVER SAND, AS ABOVE 143-145 FT., MEDIUM DENSE	

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 122 SHEET 6 OF 6

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION Well Cluster WC3, East of Plant
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT 8-61 Hollow Stem Auger, 7-inch ID, 113/4-inch OD
WATER LEVEL AND DATE START 11/18/89 FINISH 1/5/90 LOGGER Lahoud

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
150	150-152	4129	0.1'	5-5-15-15 (20)	SAND, AS ABOVE, (SP)	
152						
154	153-155	4130	2.0'	9-11-18-25 (29)	SANDY CLAY AS ABOVE, (138-140), MOIST, VERY STIFF, (CL)	
156	155-157		1.2'	7-9-12-15 (21)	SAND, AS ABOVE, (143-145), (SP); OVER SANDY CLAY, AS ABOVE, (138-140), (CL)	
158						TD OF BORING 158 FT.
160						


MW-19D
341.6
LITHOLOGIC DESCRIPTION / COMMENTS

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 1 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-2	4157	2.0'	3-3-4-5 (7)	SILT, YELLOWISH GRAY (10 YR 4/2), BROWN, MOIST, FIRM, MOTTLED (BLACK ORGANIC SPOTS), LOW PLASTICITY, (ML)	BACKGROUND= HNU=0 PPM RAD=52 CPM
2	2-4		2.0'	3-3-3-3 (6)	SILT, SAME AS ABOVE, DAMP, (ML)	HNU=0 PPM RAD=44 CPM START DRILLING 1100 HNU=0 PPM RAD=34 CPM
4	4-6		1.75'	2-2-2-2 (4)	SILT, SAME AS ABOVE, (ML), CHANGING TO SILTY SAND, YELLOWISH BROWN (10 YR 4/2), DAMP, VERY LOOSE, FINE-MEDIUM, WELL GRADED, (SM)	HNU=0 PPM RAD=46 CPM
6	6-8	4158	1.75'	2-2-2-2 (4)	POORLY GRADED SAND WITH SILT, DARK YELLOWISH BROWN (10 YR 4/2), MOIST, VERY LOOSE, MEDIUM SUBROUNDED GRAINS, MOSTLY QUARTZ, (SP-SM)	HNU=0 PPM RAD=36 CPM
8	8-10		0'		NO SAMPLE, EXTREMELY LOOSE	HNU=0 PPM RAD=38 CPM
10	10-12			3-10-20-18 (30)	WELL GRADED GRAVEL WITH SILT AND SAND, MODERATE REDDISH BROWN (10 R 4/6), WET, MEDIUM DENSE, SUBANGULAR GRAINS, (GW-GM)	HNU=0 PPM RAD=40 CPM
12	12-14	4159	2.0'	12-16-18-13 (34)	WELL GRADED GRAVEL WITH SAND, MODERATE REDDISH BROWN (10 F 4/6), STREAKS OF GRAY (N7), WET, DENSE, SUBANGULAR TO SUBROUNDED GRAINS, (GW)	HNU=0 PPM RAD=38 CPM
14	14-16		1.8'	2-3-4-9 (7)	WELL GRADED GRAVEL WITH SAND AS ABOVE, CHANGING TO FAT CLAY, GREENISH GRAY (5 GY 6/1), MOIST, STIFF, PLASTIC, (CH)	HNU=0 PPM RAD=60 CPM
16	16-18		1.8'	7-10-14-22 (24)	FAT CLAY, GREENISH GRAY (5 GY 6/1), WITH MODERATE REDDISH BROWN STREAKS, DAMP, VERY STIFF, CHANGING TO GRAVEL, (CH)	HNU=0 PPM RAD=42 CPM
18	18-20	4160	2.0'	6-12-15-14 (27)	FAT CLAY, GREENISH GRAY (5 GY 6/1), CHANGING TO SILTY CLAY (DARK YELLOWISH BROWN (10 YR 4/2), DAMP, VERY STIFF, (CL-ML)	HNU=0 PPM RAD=44 CPM
20	20-22		1.8'	5-7-10-12 (17)	SILTY CLAY WITH SAND, MODERATE REDDISH BROWN (10 YR 4/6) WITH GRAY (N7) STREAKS, DAMP, VERY STIFF, GRAINS OF DARK MINERALS, QUARTZ, SOME PEBBLES, (CL-ML)	HNU=0 PPM RAD=60 CPM
22	22-24		2.0'	5-12-13-17 (25)	FAT CLAY, DARK YELLOWISH BROWN (10 YR 4/2), MOIST, VERY STIFF, PLASTIC WITH STREAKS OF SILTY CLAY WITH SAND, LIGHT GRAY (N8), (CH)	HNU=0 PPM RAD=42 CPM
24	24-26	4161	1.75'	9-10-25-29 (35)	SILTY CLAY, MODERATE REDDISH BROWN, MOIST, STIFF, (CL-ML); CHANGING TO SILTY SAND, LIGHT GRAY (N8) MOTTLED ORGANIC STAINING (BLACK), DAMP, DENSE, IRON OXIDE, FINE, POORLY GRADED, (SW-SM)	HNU=0 PPM RAD=52 CPM
26	26-28		1.75'	5-12-11-16 (23)	SILTY SAND, SAME AS ABOVE, (SW-SM), CHANGING TO SANDY SILTY CLAY, MOTTLED AS ABOVE, DAMP, VERY STIFF, (CL-ML)	HNU=0 PPM RAD=34 CPM
28	28-30			9-22-22-25 (44)	SILTY SAND WITH CLAY, MODERATE REDDISH BROWN (10 YR 4/6) MOTTLED, MOIST, DENSE, FINE-MEDIUM, (SP-SM), CHANGING TO SAND, LIGHT GRAY (N8) MOTTLED, MOIST, IRON OXIDE, ORGANIC, (SW)	HNU=0 PPM RAD=32 CPM STOP DRILLING 1620 3/20/90
30						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 2 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30						
	30-32		1.0'	15-16-12-17 (28)	WELL GRADED GRAVEL WITH SAND, LIGHT GRAY (N7), AND MODERATE RED BROWN (10 YR 4/6) MOIST, MEDIUM DENSE, (GW), CHANGING TO SANDY SILT, LIGHT GRAY, DAMP, VERY STIFF, (ML)	RESUME DRILLING 3/21/90, 0800 HNU=0 PPM RAD=28 CPM
32	32-34	4164	2.0'	25-72-107-180 (179)	WELL GRADED GRAVEL WITH SAND, LIGHT GRAY AND MODERATE RED BROWN, MOIST, VERY DENSE, COARSE, (GW)	HNU=0 PPM RAD=34 CPM
34	34-36		1.8'	22-18-63-80 (81)	SAME AS ABOVE, (GW)	HNU=0 PPM RAD=22 CPM
36	36-38		1.2'	38-61-51-52 (112)	POORLY GRADED SAND WITH CLAY, DARK YELLOW ORANGE (10 YR 6/6), WET, VERY DENSE, MEDIUM-VERY COARSE; TOP 4": WITH VERY FINE-COARSE GRAVEL, 4-14": WITH SOME CLAY, (SP-SC)	HNU=0 PPM RAD=32 CPM
38	38-40	4165	1.8'	12-15-38-39 (53)	SAME AS ABOVE, LESS CLAY, SUBROUNDED TO SUBANGULAR, QUARTZ, TRACE MICA AND FERRO-MAGNESIUM MINERALS, (SP-SC)	0905 HNU=0 PPM RAD=20 CPM
	40-42		1.8'	15-16-26-29 (42)	SAME AS ABOVE, SOME CLAYEY SAND IN LOWER 4", (SP-SC)	0912 HNU=0 PPM RAD=40 CPM
42	42-44		1.8'	12-34-40-50 (74)	SAME AS ABOVE, BOTTOM 6": FINE-COARSE GRAVEL, (SP-SC)	0922 HNU=8 PPM RAD=40 CPM
44	44-46	4166	1.7'	19-24-32-38 (56)	TOP 12": SAME AS ABOVE; BOTTOM 5": WELL GRADED GRAVEL WITH SAND, DARK YELLOW ORANGE (10 YR 6/6), WET, VERY DENSE, VERY COARSE SAND, MOSTLY FINE-MEDIUM GRAVEL, SUBANGULAR-SUBROUNDED, (GP)	1018 HNU=0 PPM RAD=26 CPM
46	46-48		2.0'	12-27-27-29 (54)	WELL GRADED SAND, DARK YELLOWISH ORANGE (10 YR 6/6), WET, VERY DENSE, MEDIUM-COARSE, SUBANGULAR-SUBROUNDED, (SW)	1028 HNU=0 PPM RAD=20 CPM
48	48-50		2.0'	23-29-31-41 (60)	SAME AS ABOVE; BOTTOM 4" GRADED TO VERY FINE GRAVEL, (SW)	1040 HNU=0 PPM RAD=36 CPM
50	50-52	4167	2.0'	15-27-28-33 (55)	SAME AS ABOVE	1107 HNU=0 PPM RAD=28 CPM
52	52-54		2.0'	33-65-55-50 (120)	SAME AS ABOVE, TOP 12": WITH VERY FINE GRAVEL, (SW)	1115 HNU=0 PPM RAD=24 CPM
54	54-56		2.0'	26-34-41-40 (75)	SAME AS ABOVE, (SW)	HNU=0 PPM RAD=36 CPM
56	56-58	4168	1.5'	24-40-12-11 (52)	TOP 6" SAME AS ABOVE; BOTTOM 12": POORLY GRADED GRAVEL AND SAND, SAME COLOR, WET, MEDIUM-VERY COARSE SAND, SUBANGULAR-SUBROUNDED, SOME SILT, (GP)	1405 HNU=0 PPM RAD=32 CPM
58	58-60			13-16-10-11 (26)	NO RECOVERY	
60						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 3 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60	60-62		0'	13-26-65-60 (91)	NO RECOVERY	NEW LOGGER B. COCKE
62	62-64	4169	1.8'	330/6"	POORLY GRADED SAND WITH GRAVEL, DARK YELLOW ORANGE (10 YR 6/6) AND LIGHT GRAY (N8), MOIST, VERY DENSE, SUBANGULAR-SUBROUNDED, MEDIUM-ROUNDED GRAVEL, (SP)	HNU=0 PPM RAD=32 CPM * NOTE: CHANGE TO 300# HAMMER
64	64-66		2.0'	20-14-15-30 (29)	SAME AS ABOVE, DENSE, (SP)	HNU=0 PPM RAD=22 CPM STOP DRILLING 1500
66	66-68		2.0'	20-13-15-52 (28)	WELL GRADED SAND, GRAYISH ORANGE (10 YR 7/4), WET, MEDIUM DENSE, FINE-MEDIUM, SUBANGULAR, (SW)	0822 HNU=0 PPM RAD=28 CPM RESUME DRILLING 3/22/90
68	68-70	4171	2.0'	48-41-19-35 (60)	SAME AS ABOVE, BOTTOM 6", FINER SAND, (SW)	0846 HNU=0 PPM RAD=30 CPM
70	70-72			20-13-18-30 (31)	SAME AS ABOVE, (SW)	0910 HNU=0 PPM RAD=36 CPM OBTAIN SAMPLE
72	72-74		2.0'	37-47-60-50 (107)	SAME AS ABOVE, (SW)	0925 HNU=0 PPM RAD=26 CPM DRILLER CONDITION THE BOREHOLE BY RUNNING AUGER UP AND DOWN
74	74-76	4172	2.0'	20-19-16-20 (35)	SAME AS ABOVE, (SW)	1035 HNU=0 PPM RAD=32 CPM
76	76-78			4-6-7-7 (13)	SAME AS ABOVE, MEDIUM DENSE, (SW)	1410 HNU=0 PPM RAD=36 CPM NEW LOGGER B. COCKE OBTAIN SAMPLE 4172 & DUPLICATE 4173
78	78-80			2-3-5-7 (8)	ELASTIC SILT, LIGHT GRAY (N7), MOIST, FIRM, PLASTIC, STREAKS OF MODERATE REDDISH BROWN (10 R 4/6), IRON OXIDES, (MH)	1445 HNU=0 PPM RAD=46 CPM
80	80-82	4174		3-5-7-7 (12)	SAME AS ABOVE, STIFF, SMALL INTERBEDDED LAYERS OF GRAVEL, WELL-GRADED, DARK REDDISH BROWN, (MH)	1530 HNU=0 PPM RAD=50 CPM
82	82-84			4-3-3-5 (6)	SAME AS ABOVE, (MH)	1558 HNU=0 PPM RAD=
84	84-86		1.8'	3-4-5-5 (9)	SAME AS ABOVE, (MH)	0834 HNU=0 PPM RAD=44 CPM RESUME DRILLING/SAMPLING 3/25/90, 0800
86	86-88	4176	2.0'	4-4-3-5 (7)	ELASTIC SILT, SAME AS ABOVE, WITH THIN INTERBEDDED SAND WITH SILT, GRAYISH ORANGE (10 YR 7/4), MEDIUM, POORLY GRADED, WET, SUBANGULAR-ANGULAR GRAINS, <10% DARK, MINERALS, MOSTLY QUARTZ	0850 HNU=0 PPM RAD=58 CPM
88	88-90		2.0'	3-3-2-3 (5)	ELASTIC SILT, LIGHT GRAY (N7) STREAKED WITH MEDIUM GRAY (N5), MOIST, FIRM, PLASTIC, WITH INTERBEDDED SAND, GRAYISH ORANGE (10 YR 7/4) AS ABOVE, (MH)	0912 HNU=0 PPM RAD=38 CPM SAMPLE COMPOSITED 0918
90						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 4 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE _____ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

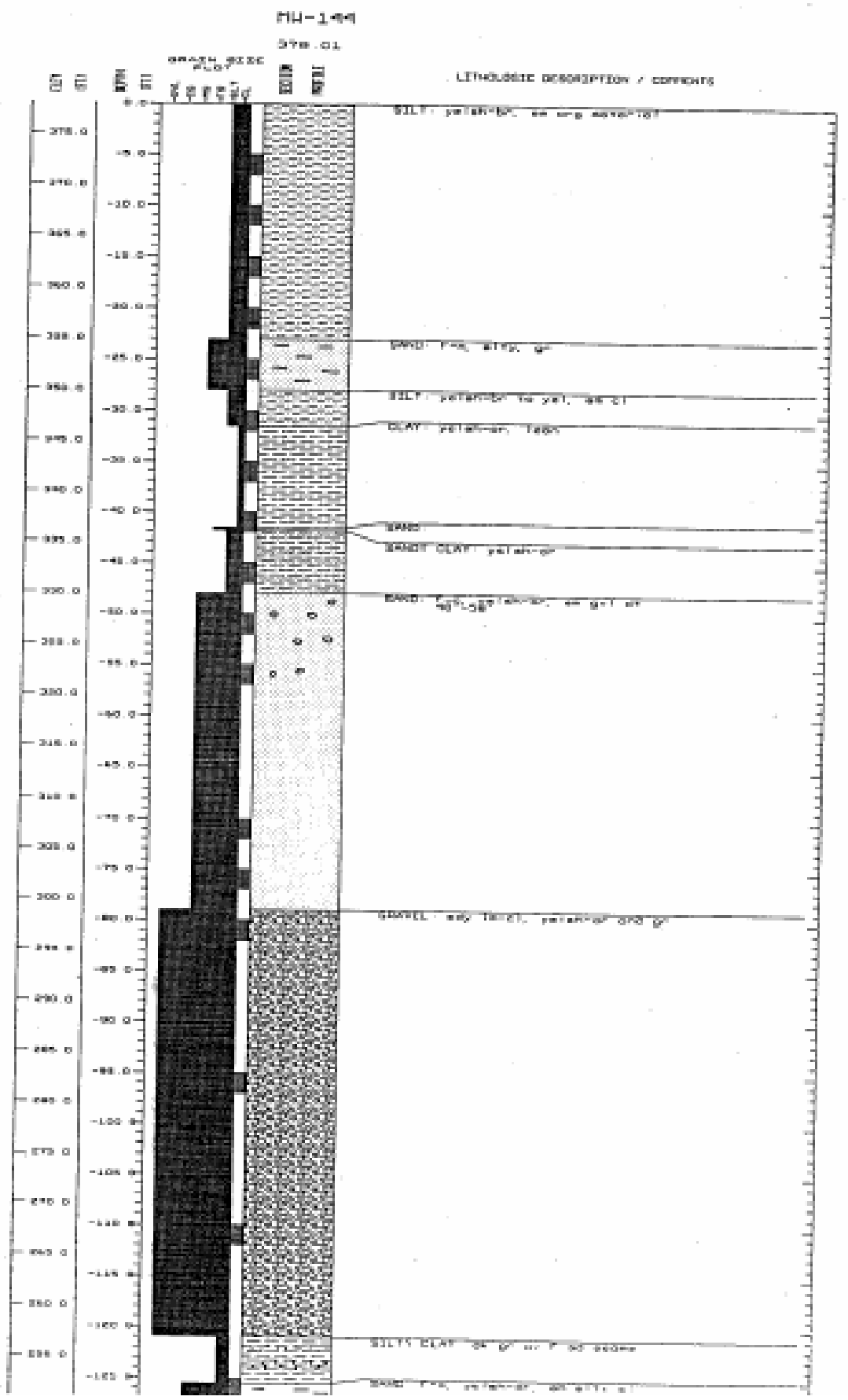
DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
92	90-92	4177	2.0'	4-4-8-10 (12)	SAME AS ABOVE, CHANGING TO FAT CLAY WITH SILT, MEDIUM GRAY (N5), MOIST, STIFF, INTERBEDDED COARSE SAND AND GRAVEL, GRAYISH ORANGE, (CH-MH)	1020 HNU=0 PPM RAD=36 CPM
94	92-94		1.9'	4-4-5-4 (9)	FAT CLAY WITH SILT, SAME AS ABOVE, (CH-MH), CHANGING TO FAT CLAY, BROWNISH BLACK (5 YR 2/1), MOIST, STIFF, (CH)	1035 HNU=0 PPM RAD=34 CPM
96	94-96			4-4-5-6 (9)	SAME AS ABOVE, (CH)	1103 HNU=0 PPM RAD= STOP DRILLING 1145, SAMPLE COMPOSITED 1110
98	96-97.6					CASING SET @ 97' RESUMED SAMPLING 4/5/90, 1010 HNU=0 PPM RAD=136 CPM
	97.6-99.6	4178	2.0'	N/A	WELL GRADED SAND, MEDIUM-COARSE, CHERTY, (SW)	SAMPLE 4178=SHELBY TUBE SAMPLE
102	99.6-101					
	101-103	4179		5-7-10-11 (17)	ELASTIC SILT, MEDIUM DARK GRAY (N4), DAMP, MICACEOUS, VERY STIFF, (MH)	1050 HNU=0 PPM RAD=40 CPM 300# HAMMER
104	103-106					
106	106-108	4180		8-20-17-28 (37)	WELL GRADED SAND, LIGHT GRAY (N7), MOIST, DENSE, FINE-MEDIUM, SUBANGULAR, <5% DARK MINERALS, <1% MICACEOUS; (SW); CHANGING TO FAT CLAY, BROWNISH BLACK (5 YR 2/1), DAMP, HARD, (CH)	1405 HNU=0 PPM RAD=32 CPM
108	108-111					
110						
112	111-113	4181	1.75'	8-18-12-29 (30)	WELL GRADED SAND, LIGHT GRAY (N7) TO MEDIUM GRAY (N6), MOIST, MEDIUM DENSE, VERY FINE-MEDIUM, <5%, DARK RED, 5-10% MICA, SUBANGULAR, (SW)	1450 HNU=0 PPM RAD=48 CPM
114	113-116					
116						
	116-118	4182	2.0'	3-7-8-16 (15)	SILTY SAND, LIGHT TO MEDIUM GRAY (N7-N4), MOIST TO DAMP, MEDIUM DENSE, FINE TO MEDIUM, MANY THIN LAYERS, 15-40% SILT, 5-10% MICA, (SM)	1530 HNU=0 PPM RAD=28 CPM
120						

PROJECT NUMBER	BORING NUMBER
SED28178.FS	Well 140 SHEET 5 OF 5

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-4; NW of Plant, Big Bayou Cr. at Ogden Landing Rd
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Hollow Stem Augers/Split Spoon Sampler
WATER LEVEL AND DATE _____ START 3/20/90 FINISH 4/6/90 LOGGER B. Cocke

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120						
122	121-123	4183	2.0'	17-8-10-17 (18)	SILTY SAND, SAME AS ABOVE, 10-25% SILT (SM); CHANGING TO WELL GRADED SAND WITH SILT, LIGHT GRAY (N7), MOIST, MEDIUM DENSE, VERY FINE TO MEDIUM, MICACEOUS, 5% SILT, (SW-SM)	HNU=0 PPM RAD=40 CPM STOPPED DRILLING 1620
124						
126	126-128	4185	1.5'	8-21-18-20 (39)	POORLY GRADED SAND, MEDIUM LIGHT GRAY (N6), MOIST-WET, DENSE, FINE, 3% DARK MINERALS, 3% MICA, (SP)	RESUMED SAMPLING 4/6/90, 0830, 300# HAMMER HNU=0 PPM RAD=39 CPM 0900
128						
130						
132	131-133	4186	1.75'	8-17-35-96 (52)	SAME AS ABOVE, FINE-MEDIUM, (SP); CHANGING TO FAT CLAY, VERY HARD, MICACEOUS, BROWNISH BLACK @ 133.5', (CH)	1020 HNU=0 PPM RAD=
134						
136	136-138	4187	2.0'	10-9-15-16 (24)	POORLY GRADED SAND, SAME AS ABOVE, MEDIUM DENSE, CONTAINS TWO 4" SEAMS OF FAT CLAY AS ABOVE, (SP)	1100 HNU=0 PPM RAD=40 CPM
138						
140						
142	141-143	4188		4-10-21-23 (31)	FAT CLAY, BROWNISH BLACK (5 YR 2/1), MOIST, VERY STIFF, MICACEOUS, (CH); CHANGING TO POORLY GRADED SAND, SAME AS ABOVE, (SP)	1535 HNU=0 PPM RAD=48 CPM STOPPED DRILLING 1535 TD OF BORING 143'


MW-144
378.01
LITHOLOGIC DESCRIPTION / COMMENTS

PROJECT NUMBER	BORING NUMBER
SE028178.FI	Well 144 SHEET 1 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-9; Dyke Rd, NE of Plant
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Mobile B-57 ATV; using 4" ID HSA
WATER LEVEL AND DATE ~72', 3/23/90 START 3/23/90 FINISH 3/25/90 LOGGER A. Bryda

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0						AIR MONITORING : HNU, EXPLOS. & RAD GM TUBE DETECTOR, AM (HNU, EXP, RAD) NOTE: USING A 140# HAMMER. FILL MATERIAL FOR DRILLING PAD IS ~25' THICK. ALL DEPTHS FROM THIS GROUND SURFACE
5	5-7	S1	1.5'	3-3-6-6 (9)	SILT, (SOME CLAY), PALE YELLOWISH ORANGE TO PALE YELLOW BROWN (10 YR 8/6 TO 10 YR 6/2), DRY, FIRM TO STIFF, SOME ROOTLETS, (ML)	AM (0,0,31) RAD COUNTS/MIN TIME 0740
10	10-12	S2	1.5'	3-4-5-6 (9)	SAME AS ABOVE, MOIST, (ML)	AM(0,0,36) TIME 0805
15	15-17	S3	2.0'	3-4-5-6 (9)	SAME AS ABOVE, SOME BLACK ORGANIC ROOTLETS, (ML)	DRILLER CONDITNS THE BOREHOLE BY RUNNING THE AUGERS UP AND DOWN AM(0,0,29) TIME 0815
20	20-22	S4	2.0'	4-5-8-10 (13)	SAME AS ABOVE, DAMP, STIFF, (ML)	AM(0,0,42) TIME 0835
25	25-27	S5	1.8'	8-8-14-11 (22)	WELL GRADED SAND WITH SILT, LIGHT OLIVE GRAY (5 Y 6/1), MOIST, MEDIUM DENSE, FINE TO MEDIUM, SUBROUNDED TO SUBANGULAR, SLIGHTLY COARSER IN BOTTOM 4" OF SPOON, (SW-SM)	AM(0,0,30) TIME 0850
30						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 144 SHEET 2 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-9; Dyke Rd, NE of Plant
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Mobile B-57 ATV; using 4" ID HSA
WATER LEVEL AND DATE ~72', 3/23/90 START 3/23/90 FINISH 3/25/90 LOGGER A. Bryda

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	30-32	S6	2.0'	6-6-8-9 (14)	TOP 18": SILT, (SOME CLAY), PALE YELLOW, COARSE TO PALE YELLOW BROWN (10 YR 8/6 TO 10 YR 6/2), DRY, STIFF, VERY SIMILAR TO S1-S4, (ML); BOTTOM 6": LEAN CLAY, SAME COLOR AS TOP, DAMP, FIRM, (CL)	DRILLER SLOWING DOWN TO PREVENT RUNNING SANDS FROM GOING UP THE AUGER AM(0,0,35) TIME 0907
35	35-37	S7	2.0'	4-5-7-9 (12)	LEAN CLAY, DARK YELLOW ORANGE (10 YR 6/6) DRY, STIFF, (CL)	AM(0,0,34) TIME 1015
	40-42	S8	2.0'	11-12-13-13 (25)	SAME AS ABOVE, WITH 4" SAND SEAM FROM 18-22", (CL)	AM(0,0,41) TIME 1050
45	45-47	S9	2.0'	5-5-9-13 (14)	SANDY LEAN CLAY, DARK YELLOW ORANGE (10 YR 6/6), MOIST, STIFF, (CL)	AM(0,0,36) TIME 1115
50	50-52	S10	2.0'	12-15-12-13 (27)	CLAYEY SAND WITH GRAVEL, DARK YELLOW ORANGE TO PALE YELLOW ORANGE (10 YR 6/6 TO 10 YR 8/6) MOIST, MEDIUM DENSE, FINE TO MEDIUM, SUBANGULAR TO ROUNDED, SEVERAL THIN GRAVEL SEAMS THROUGHOUT, (SC)	AM(0,0,48) TIME 1345
55	55-57	S11	2.0'	5-6-8-12 (14)	SAME AS ABOVE WITH SLIGHTLY HIGHER CLAY CONTENT, (SC)	AM(0,0,45) TIME 1410
60						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 144 SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-9; Dyke Rd, NE of Plant
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Mobile B-57 ATV; using 4" ID HSA
WATER LEVEL AND DATE ~72', 3/23/90 START 3/23/90 FINISH 3/25/90 LOGGER A. Bryda

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
70	70-72	S14	1.7'	3-4-6-7 (10)	CLAYEY SAND, LIGHT GRAY (N7), MOIST, LOOSE TO MEDIUM, DENSE, FINE-MEDIUM, SUBANGULAR TO SUBROUNDED, (SC)	AM(0,0,25) TIME 1600
75	75-77	S15	2.0'	11-13-20-35 (33)	CLAYEY SAND, LIGHT GRAY (N7) WET, DENSE, FINE-COARSE, ROUNDED TO SUBANGULAR, BLACK SPECS, POSSIBLE FERROMAGNESIUM MINERALS, (SC)	AM(0,0,50) TIME 1625 RAN OUT OF AUGERS WATER LEVELS READ WET RODS ~72
80	80-82	S16	1.0'	39-45-81-110 (126)	POORLY GRADED SAND WITH GRAVEL, LIGHT GRAY AND GRAYISH BLACK (N7 AND N3) TO DARK YELLOWISH ORANGE (10 YR 6/6), WET, VERY DENSE; TOP 4": (N7 TO N3); BOTTOM 6" (10 YR 6/6), COARSE-VERY COARSE, SOME GRAVEL, (SP)	BEGIN DRILLING 3/25/90 1100 ~7 RUNUP IN AUGERS, USED RODS TO CLEAN OUT AUGERS AM(0,0,30)
85	85-87				NO SAMPLE TAKEN	TIME 1150 TIME 1405 AM(0,0), NO RAD NO CUTTING COMING OUT OF THE BOREHOLE
90						
95	95-97	S17	0.5'	22-39-50 (89)	POORLY GRADED GRAVEL WITH SAND, GRAYISH ORANGE (10 YR 7/4), WET, VERY DENSE, MEDIUM-VERY COARSE SAND, GRAVEL UP TO 3/4" DIAMETER; ANGULAR-SUBROUNDED, (GP-GM)	TIME 1445 AM(0,20,36) 18" SPLIT SPOON OBTAINED
100						

PROJECT NUMBER	BORING NUMBER
SED28178.FI	Well 144 SHEET 4 OF 4

SOIL BORING LOG

PROJECT PGDP Phase I Site Investigation LOCATION WC-9; Dyke Rd, NE of Plant
ELEVATION _____ DRILLING CONTRACTOR Geotek Engineering
DRILLING METHOD AND EQUIPMENT Mobile B-57 ATV; using 4" ID HSA
WATER LEVEL AND DATE ~72', 3/23/90 START 3/23/90 FINISH 3/25/90 LOGGER A. Bryda

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
100						AM(5,0) TIME 1515 HNU HIT AT BOREHOLE, NMOT THE THE
105						AM(0,0) TIME 1535
110	110-112	S1B	0.8'	42-30-30-64 (60)	POORLY GRADED GRAVEL WITH SAND AND CLAY, GRAYISH YELLOW ORANGE (10 Y R 7/4), WET, VERY DENSE, SIMILAR TO ABOVE, GRAVEL IS MORE ANGULAR AND BLOCKY, (GP-GM)	AM(5,20,30) TIME 1610
115						AM(0,0) TIME 1650 RIG CHATTER--HARDER DRILLING
120						AM (3,0) TIME 1700 AT 121': ? DRILLING ACTION. POSSIBLY IN THE CLAY
125	125-127	S1B	2.0'	15-34-72-104 (106)	0-6" SILTY CLAY, MEDIUM DARK GRAY (N5), MOIST, HARD, LENTICULAR WITH SEVERAL, VERY FINE SAND SEAMS, [CL-ML]; 6-24": POORLY GRADED SAND WITH SILTY CLAY, PALE YELLOWISH ORANGE (10 YR 8/6), MOIST, VERY DENSE, FINE TO MEDIUM, SEVERAL THIN CLAY SEAMS, (SP-SC)	AM (0,0) PRIOR TO PUTTING RODS DOWN HOLE TIME 1710
130						TD OF BORING 127'

PROJECT NUMBER	BORING NUMBER
DRO 30888.FI	MW-158 SHEET 1 OF 4

SOIL BORING LOG

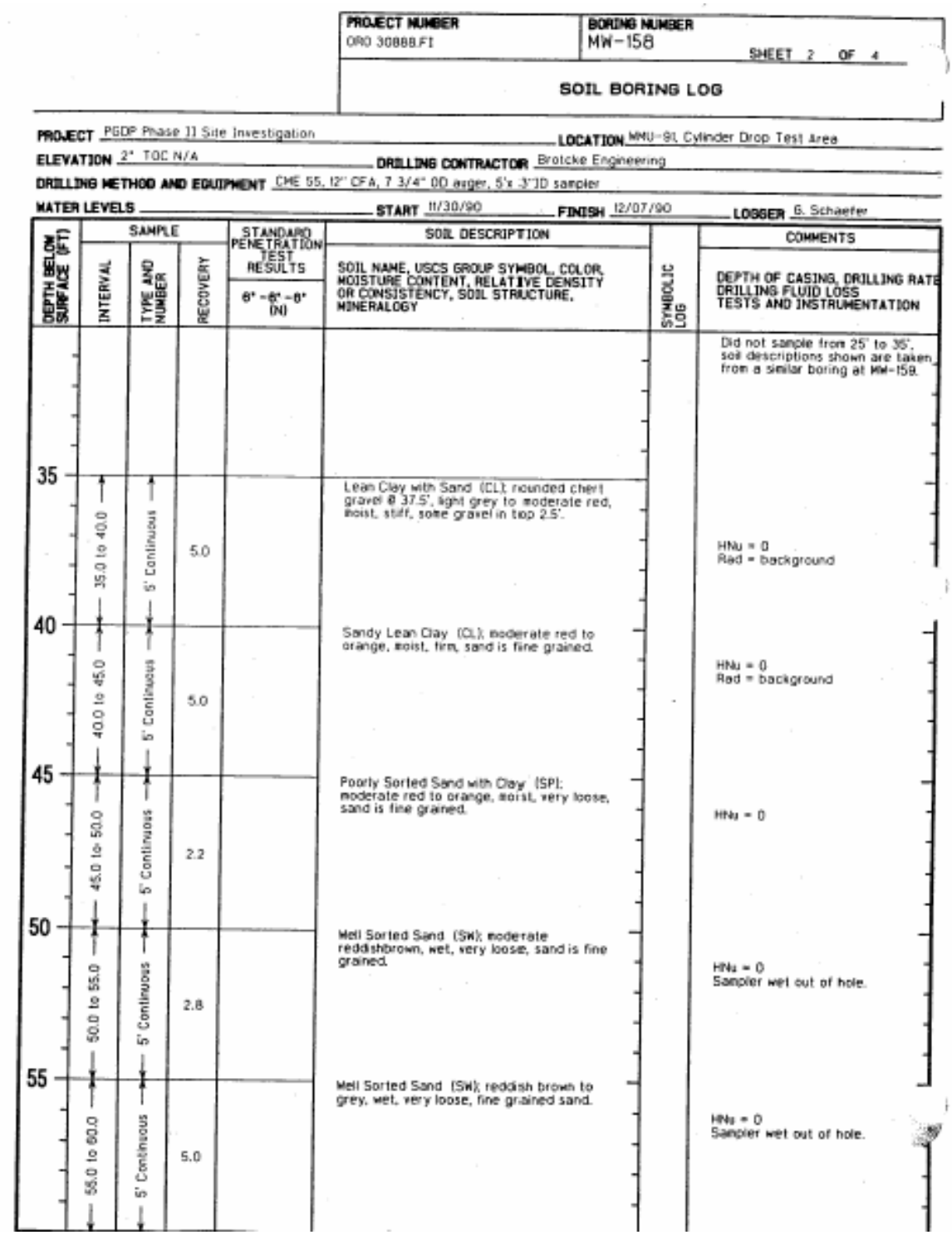
PROJECT PGDP Phase II Site Investigation LOCATION NMU-9R, Cylinder Drop Test Area

ELEVATION 2" TOC N/A DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"OD sampler

WATER LEVELS START 11/30/90 FINISH 12/07/90 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
5	0.0 to 20.0	5' Continuous			From 0 ft. to 20 ft., see boring log for MW-159		Background HNu = 0 Rad Background is high due to proximity of U-cylinders
10							Did not sample from 0' to 20', soil descriptions shown are taken from a similar boring at MW-159.
15							
20	20.0 to 25.0	5' Continuous	2.3		Sand with Gravel (SM); light brown, moist, course grained sand, subangular gravel (15-25%) chert pebbles are present throughout the interval.		HNu = 0 Sampled from 20' to 25' due to low recovery in similar boring at MW-159.
25					From 25 ft. to 35 ft. see boring log for MW-159		



PROJECT NUMBER	BORING NUMBER
ORD 30888.FI	MW-158 SHEET 2 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation — LOCATION MMU-91, Cylinder Drop Test Area

ELEVATION 2" TOC N/A — DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS — START 11/30/90 — FINISH 12/07/90 — LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
							Did not sample from 25' to 35', soil descriptions shown are taken from a similar boring at MW-159.
35	35.0 to 40.0	5' Continuous	5.0		Lean Clay with Sand (CL); rounded chert gravel @ 37.5', light grey to moderate red, moist, stiff, some gravel in top 2.5'.		HNu = 0 Rad = background
40	40.0 to 45.0	5' Continuous	5.0		Sandy Lean Clay (CL); moderate red to orange, moist, firm, sand is fine grained.		HNu = 0 Rad = background
45	45.0 to 50.0	5' Continuous	2.2		Poorly Sorted Sand with Clay (SP); moderate red to orange, moist, very loose, sand is fine grained.		HNu = 0
50	50.0 to 55.0	5' Continuous	2.8		Well Sorted Sand (SW); moderate reddishbrown, wet, very loose, sand is fine grained.		HNu = 0 Sampler wet out of hole.
55	55.0 to 60.0	5' Continuous	5.0		Well Sorted Sand (SW); reddish brown to grey, wet, very loose, fine grained sand.		HNu = 0 Sampler wet out of hole.

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-156 SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION NMU-9t, Cylinder Drop Test Area

ELEVATION 2" TOC N/A DRILLING CONTRACTOR Bratcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 11/30/90 FINISH 12/07/90 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
65	60.0 to 65.0	5' Continuous	3.0		TOP 1': Same as above. Well Graded Gravel with Sand (GW); light brown to orange, wet, very loose, sands are fine, gravel is rounded.		HNu = 0 Sampler wet out of hole.
70	65.0 to 70.0	5' Continuous	1.5		TOP 1': Sand Well Graded (SW); moderate red to orange, wet. 0.5': Well Graded Gravel (GW); chert, well rounded, moderate red to light brown, very loose.		HNu = 0 Sample wet out of hole; augers were temporarily locked during drilling.
75	70.0 to 75.0	5' Continuous	3.9		Well Sorted Sand with Gravel (SW); gravel approx. 35%, chert, rounded, coarse grained to fine sands, light brown to light orange, wet very loose.		HNu = 0 Sampler wet out of hole.
80	75.0 to 80.0	5' Continuous	0.6		Well Sorted Gravel with Sand (GW); large chert pieces, well rounded, light brown to orange, wet, loose, coarse grained sand.		HNu = 0 3 in. dia. chert cobble stuck in bottom of sampler.
85	80.0 to 85.0	5' Continuous	1.5		Well Sorted Sand with Gravel (SW); light brown to orange, wet, loose, well rounded gravel, sand was coarse to fine grained.		HNu = 0 Sampler wet out of hole.
	85.0 to 90.0	5' Continuous	1.4		Well Sorted Sand with Gravel (SW); same as above; bottom 7 in. is a well graded gravel with sand (GW).		HNu = 0 Sampler wet out of hole.

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-158 SHEET 4 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION KMU-9L Cylinder Drop Test Area

ELEVATION 2" TOC N/A DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 11/30/90 FINISH 12/07/90 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
95	90.0 to 95.0	5' Continuous	1.4		Well Sorted Sand with Gravel (SW); same as above; bottom 0.5' is a well graded gravel with sand (GW); gravels are well rounded, sand is coarse to fine, slight amount of clay present.		HNu = 0 Sampler wet out of hole.
100	95.0 to 100.0	5' Continuous	1.1		Well Graded Sand with Gravel (SW); bottom 3 in. is Well Braded Gravel with Sand (GW); light brown to light orange, wet, well rounded gravel, fine to coarse grained sand, very loose.		HNu = 0 Sampler wet out of hole. Size of chert increasing towards bottom end of sampler.
105	100.0 to 105.0	5' Continuous	1.7		Well Graded Sand with Gravel (SW); bottom 10 in. is a Poorly Graded Gravel (GP); light brown to light orange, wet, well rounded gravel, smaller diameter than above, coarse grained sand.		HNu = 0 Sampler wet out of hole. Chert gravel up to 2.5 in. found in end of sampler.
110	105.0 to 110.0	5' Continuous	5.0		TOP 3.9': Well Graded Sand with Gravel (SW); same as above except sands are fine grained. Bottom 1.1': Well Sorted Sand (SW); highly stratified, color varies with layers - white, light brown, to orange, wet, loose, very fine grained. Total Depth = 110.0 feet		HNu= 0 Sampler wet out of hole.

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-161 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-1, North of Oil Landfarm

ELEVATION 2' TOC N/A DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5's 3"OD sampler

WATER LEVELS START 11/29/90 FINISH 11/30/90 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0.0 to 5.0	5' Continuous Core	2.4		Top 1': LEAN CLAY WITH SAND (CL); moderate reddish brown, moist, some gravel. Bottom 1.4': Lean Clay (CL); brown, moist, low plasticity, 0.25' sand seam w/ gravel.		Background: HNu=0, Rad=38cpm HNu = 0, Rad = background
5	5.0 to 10.0	5' Continuous	4.4		LEAN CLAY (CL); brown, moist, low plasticity, some mottling.		HNU = 0, Rad = background
10	10.0 to 15.0	5' Continuous	5.0		LEAN CLAY (CL); same as above except for black mottling that appears to be organic. End 0.6': Sand (SP); reddish brown, wet.		HNu = 0, Rad = background
15	15.0 to 20.0	5' Continuous	3.85		Top 0.3': LEAN CLAY WITH SAND (CL); reddish brown, wet. Middle 1.8': Lean Clay (CL); gray, wet. Bottom 1.75': Lean Clay (CL); grey, wet, with gravel grading to sand.		HNu = 0, Rad = background
20	20.0 to 25.0	5' Continuous	0		See borehole log for MW-162		Cobble in tip of sampler.
25	25.0 to 30.0	5' Continuous	3.1		FAT CLAY (CH); few to little gravel, moderately reddish brown, moist.		HNu = 0, Rad = background

PROJECT NUMBER	BORING NUMBER
ORO 30888.FI	MW-161 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION HMU-1, North of Oil Landfarm

ELEVATION 2" TOC N/A DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 11/29/90 FINISH 11/30/90 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6" -6" -6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
35	30.0 to 35.0	5' Continuous 13006	5.0		LEAN CLAY (CL); moderate reddish brown with gray mottling, moist.		HNu = 1.0 ppm, Rad = background
	35.0 to 40.0	5' Continuous	3.7		Top 2.6': LEAN CLAY (CL); few sand, moderately reddish brown, moist. Bottom 1.1': LEAN CLAY (CL); yellowish brown, moist.		HNu = 1.0 ppm, Rad = background
40	40.0 to 44.0	5' Continuous	3.8		Top 1.4': LEAN CLAY WITH SAND (CL); gray, moist. Bottom 2.4': CLAYEY SAND (SC); moderately reddish brown with gray clay mottling, moist.		HNu = 0, Rad = background
					CLAYEY SAND (SC); moderately reddish brown with slight mottling.		HNu = 0, Rad = background
45	45.0 to 50.0	5' Continuous 13007			CLAYEY SAND (SC); same as above except gray mottling has changed to a continuous vertical member 0.5 in. x 1 in. in cross section, wet.		HNu = 5 ppm, Rad = background
50	50.0 to 55.0	5' Continuous 13008			Top 0.6': CLAYEY SAND WITH GRAVEL (SC); moderately reddish brown wet. Bottom 3.6': Sand (SP); moderately reddish brown, moist.		HNu = 10 ppm, Rad = background
55	55.0 to 60.0	5' Continuous			Top 2.2': CLAYEY SAND (SC); moderately reddish brown with gray mottling, wet. Bottom 0.4': Sand with Gravel (SM); reddish brown, wet.		HNu = 5 ppm, Rad = background Cobble in the auger

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-161 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, North of Oil Landfarm

ELEVATION 2" TOC N/A **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5's 3"ID sampler

WATER LEVELS **START** 11/29/90 **FINISH** 11/30/90 **LOGGER** D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
65	60.0 to 65.0	5' Continuous	0.8		SAND (SP): medium grained, moderately reddish brown, wet. Bottom 0.3': Gravel with Sand (GW); sand is coarse grained, moderately reddish brown, wet.		HNu = 0, Rad = background
	65.0 to 71.0	5' Continuous	0		No recovery.		HNu = 0, Rad = background. Driller notes that poor recovery is due to gravel falling out of the auger.
70					No recovery. 1 piece of chert (approx. 1/2 dia.) in the end of the sampler. Total Depth = 70.0 feet		

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-163 SHEET 1 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION East Plant Area, near Bldg. C-746-G

ELEVATION 2" TOC 386.14 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5's 3"ID sampler

WATER LEVELS START 12/11/90 FINISH 12/14/90 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION (SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY)	SYMBOLIC LOG	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION)
	0.0 to 5.0	5' Continuous	1.5		Top 1': Clayey Gravel (GC); gray, moist. Bottom 0.5': Silt (ML); gray, some organics and some large gravel, moist.		Background: HNu=0 ppm RAD=33 cpm
5	5.0 to 10.0	5' Continuous 13008	5.0		Top 2.2': Silt (ML); gray, moist. Bottom 2.8': Lean Clay (CL); moderate yellowish brown with gray mottling, some organics, moist.		HNu=0 RAD=background HNu=0 RAD=background
10	10.0 to 15.0	5' Continuous	5.0		Lean Clay (CL); Same as above.		HNu=0 RAD=background
15	15.0 to 20.0	5' Continuous	0		No Recovery.		Sample catcher in backwards.
20	20.0 to 25.0	5' Continuous	5.0		Lean Clay (CL); yellowish brown with gray mottling, moist.		HNu=0 RAD=background
25	25.0 to 30.0	5' Continuous	5.0		Top 0.5': Lean Clay (CL); Same as above. Next 0.6': Poorly Graded Sand (SP); reddish brown, moist, medium grained. Bottom 3.9': Lean Clay (CL); gray moist.		

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-163 SHEET 2 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION East Plant Area, near Bldg. C-746-G

ELEVATION 2" TOC 388.14 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5's 3"ID sampler

WATER LEVELS START 12/11/90 FINISH 12/14/90 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
35	30.0 to 35.0	5' Continuous	3.9		Lean Clay (CL); with trace gravel, reddish brown, moist, gravel is rounded, gray mottling. Bottom 1.6': Lean Clay (CL); with gravel, moderately reddish brown, moist, gray mottling.		HNu=0 RAD=background
40	35.0 to 40.0	5' Continuous (3010)	3.8		Well Graded Gravel with Sand (GW); reddish brown, moist. Next 0.9': Poorly Graded Sand (SP); reddish brown, moist, fine grained. Bottom 2.5': Lean Clay (CL); yellowish brown with reddish brown mottling, moist.		HNu=0 RAD=background
45	40 to 45	5' Continuous	4.3		Poorly Graded Sand (SP); gray, moist, fine grained with trace coarse grains; 1.4' from top of sample there is a 0.3' seam of coarse grains.		HNu=0 RAD=background
50	45 to 50	5' Continuous	2.4		Top 1.2': Poorly Graded Sand (SP); with trace gravel, gray, moist, fine grained. Bottom 0.4': Lean Clay (CL); with some sand, moderate reddish brown, gray mottling, moist.		HNu=0 RAD=background
55	50 to 55	5' Continuous (3011)	5.0		Top 1.2': Lean Clay (CL); with trace sand, reddish brown, gray mottling, moist. Bottom 3.8': Lean Clay (CL); reddish brown, gray mottling, moist, very stiff.		HNu=0 RAD=background
	55 to 60	5' Continuous	2.5		Lean Clay (CL); gray with reddish brown mottling, very stiff, moist.		HNu=0 RAD=background 2.5' Slough.

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-163 SHEET 3 OF 4

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION East Plant Area, near Bldg. C-746-G

ELEVATION 2" TOC 386.14 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 12/11/90 FINISH 12/14/90 LOGGER D. Geshwender

DEPTH (BELOW SURFACE (FT))	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION (SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY)	SYMBOLIC LOG	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION)
65	60 to 65	5' Continuous	3.5		Top 0.2': Poorly Graded Sand (SP); gray, moist, medium grain size. Middle 1.75': Poorly Graded Sand (SP); reddish brown, fine grained, moist. Bottom 1.55': Poorly Graded Sand (SP); gray with reddish brown mottling, moist, coarse grained.		HNu=0 RAD=background
70	65 to 70	5' Continuous	1.3		Poorly Graded Sand (SP); moderately yellowish brown, wet, coarse grained.		HNu=0 RAD=background
75	70 to 75	5' Continuous	3.25		Top 2.25': Clayey Sand (SC); gray, moist, medium grained. Bottom 1.0': Poorly Graded Sand (SP); gray, wet, coarse grained.		HNu=0 RAD=background
80	75 to 80	5' Continuous	3.2		Poorly Graded Sand (SP); same as above except medium grained.		HNu=0 RAD=background
85	80 to 85	5' Continuous	3.5		Poorly Graded Sand (SP); same as above except coarse grained.		HNu=0 RAD=background
	85 to 90	5' Continuous	3.0		Poorly Graded Sand (SP); same as above except with some gravels.		HNu=0 RAD=background

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-163 SHEET 4 OF 4

SOIL BORING LOG

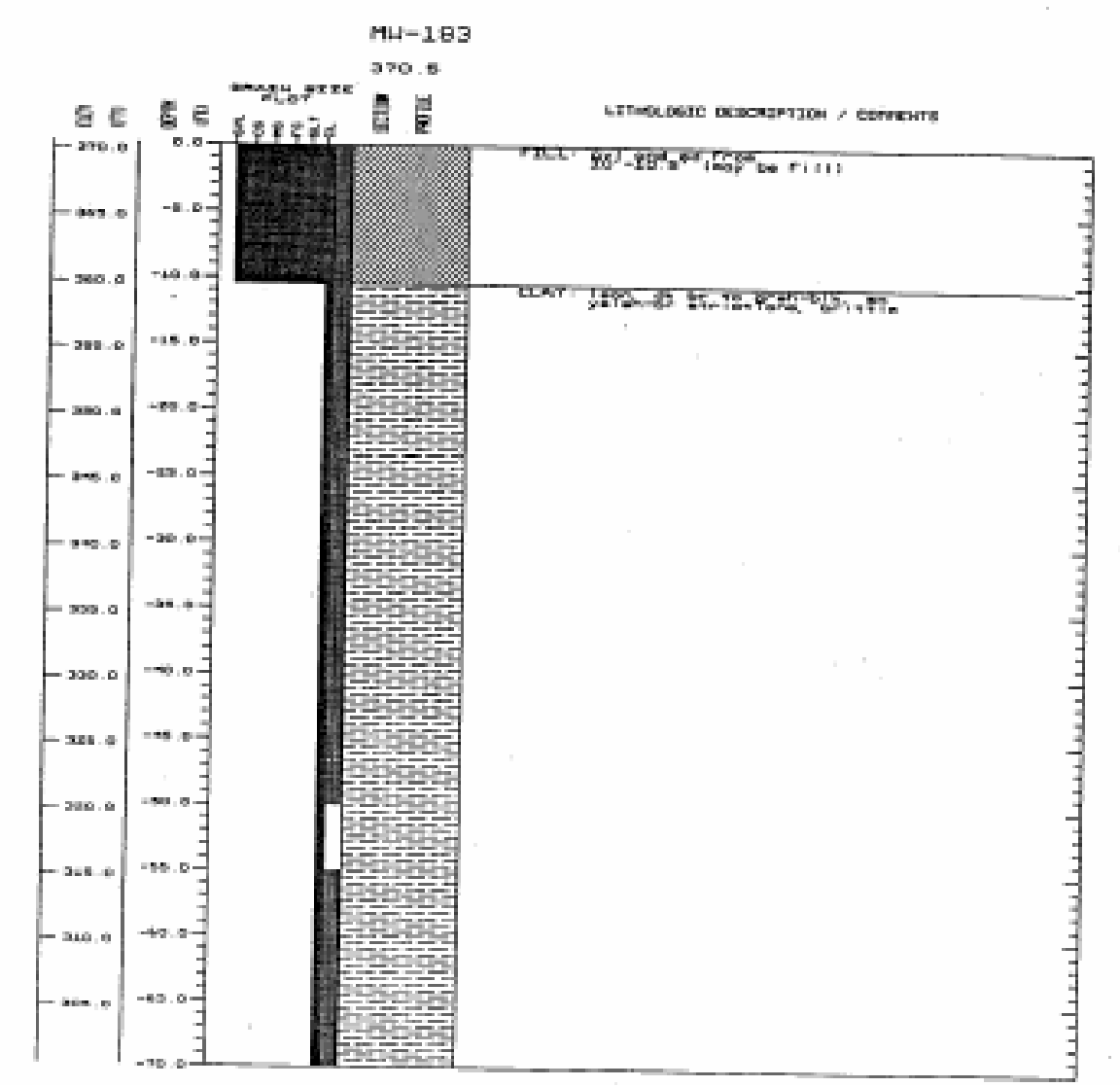
PROJECT PGDP Phase II Site Investigation LOCATION East Plant Area, near Bldg. C-746-G

ELEVATION 2" TOC 386.14 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5's 3"ID sampler

WATER LEVELS START 12/11/90 FINISH 12/14/90 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	90 to 95	5' Continuous	5.0		Poorly Graded Sand (SP); same as above except no gravel.		HNu=0 RAD=background Driller indicates hitting gravel.
95							
	95 to 100	5' Continuous	2.0		Top 1.4': Poorly Graded Sand (SP); same as above. Bottom 0.6': Well Graded Gravel (GW); with sand, yellowish brown, moist, sand is coarse grained.		
100					Total Depth = 100.0 feet		


MW-183
370.8
LITHOLOGIC DESCRIPTION / COMMENTS

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-183 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-8, Sanitary Landfill

ELEVATION _____ DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5's 3"ID sampler

WATER LEVELS _____ START 11/24/90 FINISH 01/28/91 LOGGER G. Schaeferer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0.0 to 5.0	5' Continuous	1.4		0.4': Fill Material 1.0': Lean Clay (CL): dark brown, moist, very stiff, some plant roots and gravel.		Background: HNu=0 Rad=21 cpm PP = pocket penetrometer HNu=0, Rad=29cpm, pp=3.25Kg/cm2 for CL.
5	5.0 to 10.0	5' Continuous	0.4		Fill Material: pieces of wood, black, moist.		HNu=0, Rad=35cpm, pp=N/A; low recovery due to wood chips stuck in end.
10	10.0 to 15.0	5' Continuous 13061	2.9		Top 0.5': Well Graded Gravel with Sand (GW): light brown, wet, loose, coarse sand, some wood chips. Bottom 2.4': Lean Clay (CL): dark brown, moist, stiff.		HNu=0, Rad=31cpm, pp=2.0Kg/cm2 for CL. Bottom of sampler wet out of hole.
15	15.0 to 20.0	5' Continuous 13062	5.0		Lean Clay (CL): same as above.		HNu=0, Rad=34cpm, pp=2.0Kg/cm2 for CL. Sampler wet out of hole. Took two samples: 13062 and 13063
20	20.0 to 25.0	5' Continuous	5.0		Lean Clay (CL): same as above.		HNu=0, Rad=29cpm, pp=2.0Kg/cm2.
25	25.0 to 30.0	5' Continuous	3.5		Lean Clay (CL): same as above except for dark yellowish orange striations, very stiff.		HNu=0, Rad=27cpm, pp=3.5Kg/cm2. Sampler wet out of hole.

PROJECT NUMBER	BORING NUMBER
ORD 30888.F1	MW-183 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-8, Sanitary Landfill

ELEVATION ____ DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS ____ START 11/24/90 FINISH 01/29/91 LOGGER G. Schaeferer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
35	30.0 to 35.0	5' Continuous	5.0		Lean Clay (CL): light gray with light orange layering, moist, brittle, very stiff, fairly blocky.		HNu=0, Rad=32cpm, pp=3.75Kg/cm2. Sampler wet out of hole.
40	35.0 to 40.0	5' Continuous	4.2		Lean Clay (CL): same as above.		HNu=0, Rad=30cpm, pp=3.75Kg/cm2. Sampler wet out of hole.
45	40.0 to 45.0	5' Continuous	5.0		Lean Clay (CL): grayish black, moist, hard, fissured.		HNu=0, Rad=38cpm, pp=4.5Kg/cm2. Sampler wet out of hole.
50	45.0 to 50.0	5' Continuous	5.0		Lean Clay (CL): same as above except highly fissured and brittle, micaceous		HNu=0, Rad=38cpm, pp=4.5Kg/cm2. Sampler wet out of hole.
55	50.0 to 55.0	5' Continuous	5.0		Lean Clay (CL): same as above except dry.		HNu=0, Rad=45cpm, pp=4.5Kg/cm2.
	55.0 to 60.0	5' Continuous	5.0		Lean Clay (CL): same as above		HNu=0, Rad=41cpm, pp=4.5Kg/cm2.

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-183 SHEET 3 OF 3

SOIL BORING LOG

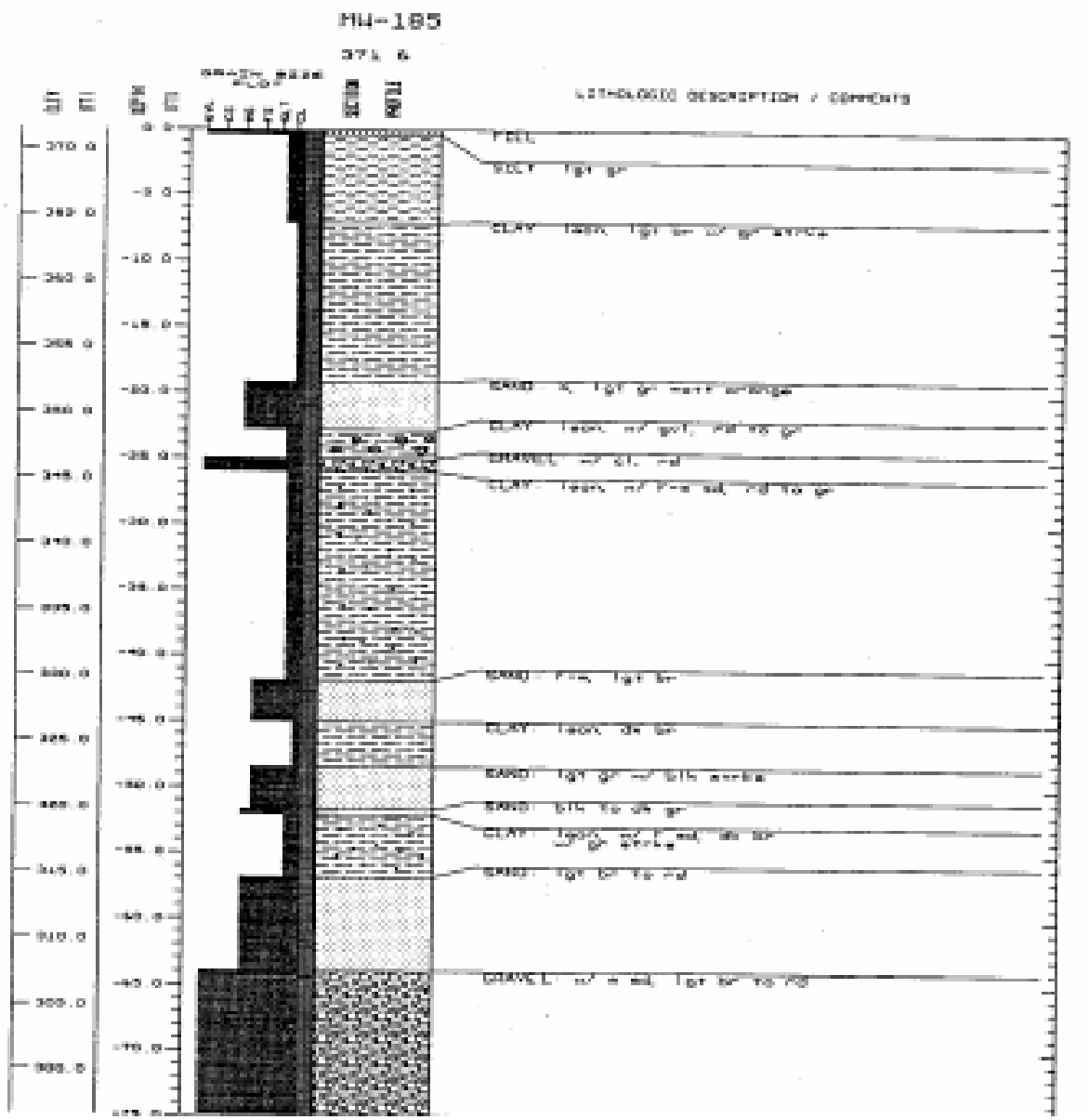
PROJECT PSDP Phase II Site Investigation LOCATION WMU-8, Sanitary Landfill

ELEVATION _____ DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5's 3"OD sampler

WATER LEVELS _____ START 11/24/90 FINISH 01/28/91 LOGGER G. Schaeferer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60.0 to 65.0	5' Continuous	5.0		Lean Clay (CL); grayish black, dry, hard, highly fissured, micaceous.		HNu=0, Rad=32cpm, pp=4.0Kg/cm2. Sampler wet out of hole.
65	65.0 to 70.0	5' Continuous	5.0		Lean Clay (CL); same as above.		HNu=0, Rad=35cpm, pp=4.25Kg/cm2.
70					Total Depth = 70.0 feet		


MW-185
LITHOLOGIC DESCRIPTION / COMMENTS

PROJECT NUMBER	BORING NUMBER
ORD 30888.F1	MW-185 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-7 Burial Ground

ELEVATION 2" TOC 373.64 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/17/91 FINISH 01/23/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0 to 5	5' Continuous	1.3		Top 0.4': Gravel fill material SILT (ML), light gray, moist, firm		Background: HNu=0 Rad=29 cpm PP = pocket penetrometer
							HNu= 0 ppm Rad= 38 cpm PP = 1.75 kg/sq. cm. Rod chatter
5	5 to 10	5' Continuous 13040	4.3		Top 2.1': SILT (ML), Same as above Bottom 2.2': LEAN CLAY (CL), light brown with gray streaking, moist, very stiff		HNu= 0 ppm Rad= 30 cpm PP = 2.25 kg/sq. cm.
10	10 to 15	5' Continuous	4.7		LEAN CLAY (CL), Same as above		HNu= 0 ppm Rad= 40 cpm PP = 2.25 kg/sq. cm.
15	15 to 20	5' Continuous 13041	4.7		Top 4.2': LEAN CLAY (CL), Same as above Bottom 0.5': WELL GRADED SAND (SW), light gray, orange mottling, wet, loose, medium grained sand		HNu= 0 ppm Rad= 30 cpm PP = 2.25 kg/sq. cm. for CL
20	20 to 25	5' Continuous	4.8		Top 2.8': WELL GRADED SAND (SW), Same as above Bottom 2': LEAN CLAY WITH GRAVEL (CL), moderate red to gray, moist, very stiff, rounded gravel		HNu= 0 ppm Rad= 33 cpm PP = 3.1 kg/sq. cm.
25	25 to 30	5' Continuous	5.0		Top 1.0': WELL SORTED GRAVEL WITH CLAY (GW), moderate red, moist, stiff, well rounded gravel Bottom 4.0': LEAN CLAY WITH SAND (CL), moderate red to gray, moist, hard		HNu= 0 ppm Rad= 43 cpm PP = 4.50 kg/sq. cm.

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-185 SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-7 Burial Ground

ELEVATION 2' TOC 373.64 ft MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 10" CFA, 7 3/4" OD auger, 5's 3"ID sampler

WATER LEVELS START 01/17/91 FINISH 01/23/91 LOGGER G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
35	30 to 35	5' Continuous	4.9		LEAN CLAY WITH SAND (CL), moderate red to grey, moist, hard, medium to fine grained sand		HNu= 0 ppm Rad= 30 cpm PP = 4.5 kg/sq. cm.
	35 to 40	5' Continuous (3042)	4.8		LEAN CLAY WITH SAND, (CL) Same as above		HNu= 0 ppm Rad= 29 cpm PP = 4.25 kg/sq. cm.
40	40 to 45	5' Continuous	3.0		Top 1.9': LEAN CLAY WITH SAND (CL), Same as above, except very stiff Bottom 1.1': WELL GRADED SAND (SW), light brown, moist, loose, fine to medium grained sand		HNu= 0 ppm Rad= 41 cpm PP = 3.0 kg/sq. cm.
45	45 to 50	5' Continuous	5.0		Top 3.5': LEAN CLAY (CL), dark brown, moist, very stiff Bottom 1.5': WELL SORTED SAND WITH CLAY (SW-SC), light gray with black streaking, moist, soft		HNu= 0 ppm Rad= 38 cpm PP = 3.5 kg/sq. cm. for CL PP = 0.5 kg/sq. cm. for SW-SC
50	50 to 55	5' Continuous	4.8		Top 1.7': WELL SORTED SAND WITH CLAY (SW-SC), Same as above Middle 0.4': WELL GRADED SAND (SW), black to dark gray, moist, loose Bottom 2.7': LEAN CLAY WITH SAND (CL), dark brown with gray streaks, moist, very stiff, fine grained sands		HNu= 0 ppm Rad= 37 cpm PP = 2.5 kg/sq. cm. for CL
55	55 to 60	5' Continuous	3.8		Top 1.9': LEAN CLAY WITH SAND (CL), Same as above, except firm Bottom 1.9': WELL SORTED SAND (SW), light brown to moderate red, wet, very loose		HNu= 0 ppm Rad= 34 cpm PP = 0.75 kg/sq. cm. for CL

PROJECT NUMBER	BORING NUMBER
ORO 30888.F1	MW-185 SHEET 3 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation **LOCATION** MMU-7 Burial Ground

ELEVATION 2" TOC 373.64 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 55, 12" CFA, 7 3/4" OD auger, 5's 3"ID sampler

WATER LEVELS **START** 01/17/91 **FINISH** 01/23/91 **LOGGER** G. Schaefer

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
65	60 to 65	5' Continuous	5.0		Top 4.0': WELL GRADED SAND (SW), light brown, wet, very loose Bottom 1.0': WELL GRADED SAND WITH GRAVEL (GW), light brown to moderate red, wet, loose, well rounded gravel, medium grained sands		HNu= 0 ppm Rad= 38 cpm PP = N/A Sampler wet out of hole
70	65 to 70	5' Continuous	1.4		WELL GRADED GRAVEL WITH SAND (GW), Same as above, except larger chert pieces (approx. 2 in. diameter maximum)		HNu= 0 ppm Rad= 38 cpm P.P.= N/A Sampler wet out of hole
75	70 to 75	5' Continuous	2.0		WELL GRADED GRAVEL WITH SAND (GW) Same as above		HNU= 0 ppm Rad= 38 cpm PP = N/A Sampler wet out of hole
					Total Depth = 75.0 feet		

PROJECT NUMBER	BORING NUMBER
ORD 30888.F1	MW-188 SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION WMU-L SW of Oil Landfarm

ELEVATION 2" TOC 374.24 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/22/91 FINISH 01/23/91 LOGGER B. Souza

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
					WELL GRADED GRAVEL (FILL)		
	0 to 5	5' Continuous	1.5		LEAN CLAY (CL), dark yellowish orange 10YR 6/6, moist		PP = pocket penetrometer HNu= 0 ppm Rad= 50 cpm PP = 2.0 to 2.5 kg/sq. cm.
5	5 to 10	5' Continuous 13047 & 13048	4.7		LEAN CLAY (CL), light olive gray 5Y 6/1, moist		HNu= 0 ppm Rad= 65 cpm PP = 0 to 2 kg/sq. cm. Took two samples: 13047 and 13048
10	10 to 15	5' Continuous	3.9		SANDY LEAN CLAY (CL), moderate yellowish brown 10YR 5/4, fine sand		HNU= 0 ppm Rad= 80 cpm PP = 1 to 2.7 kg/sq. cm.
15	15 to 20	5' Continuous 13049	3.5		SANDY LEAN CLAY (CL), same as above		HNu= 0 ppm Rad= 45 cpm PP = 1 to 1.9 kg/sq. cm.
20	20 to 25	5' Continuous	4.0		SANDY LEAN CLAY (CL), light brown 5 YR 5/6, moist, fine sand, medium gravel		HNu= 0 ppm Rad= 50 cpm PP = 1.7 to 3.0 kg/sq. cm.
25	25 to 30	5' Continuous	4.5		SANDY LEAN CLAY (CL), same as above		HNu= 0 ppm Rad= 60 cpm PP = 2.0 to 2.5 kg/sq. cm.

PROJECT NUMBER	BORING NUMBER
ORO 30888.F)	MW-188 SHEET 2 OF 3

SOIL BORING LOG

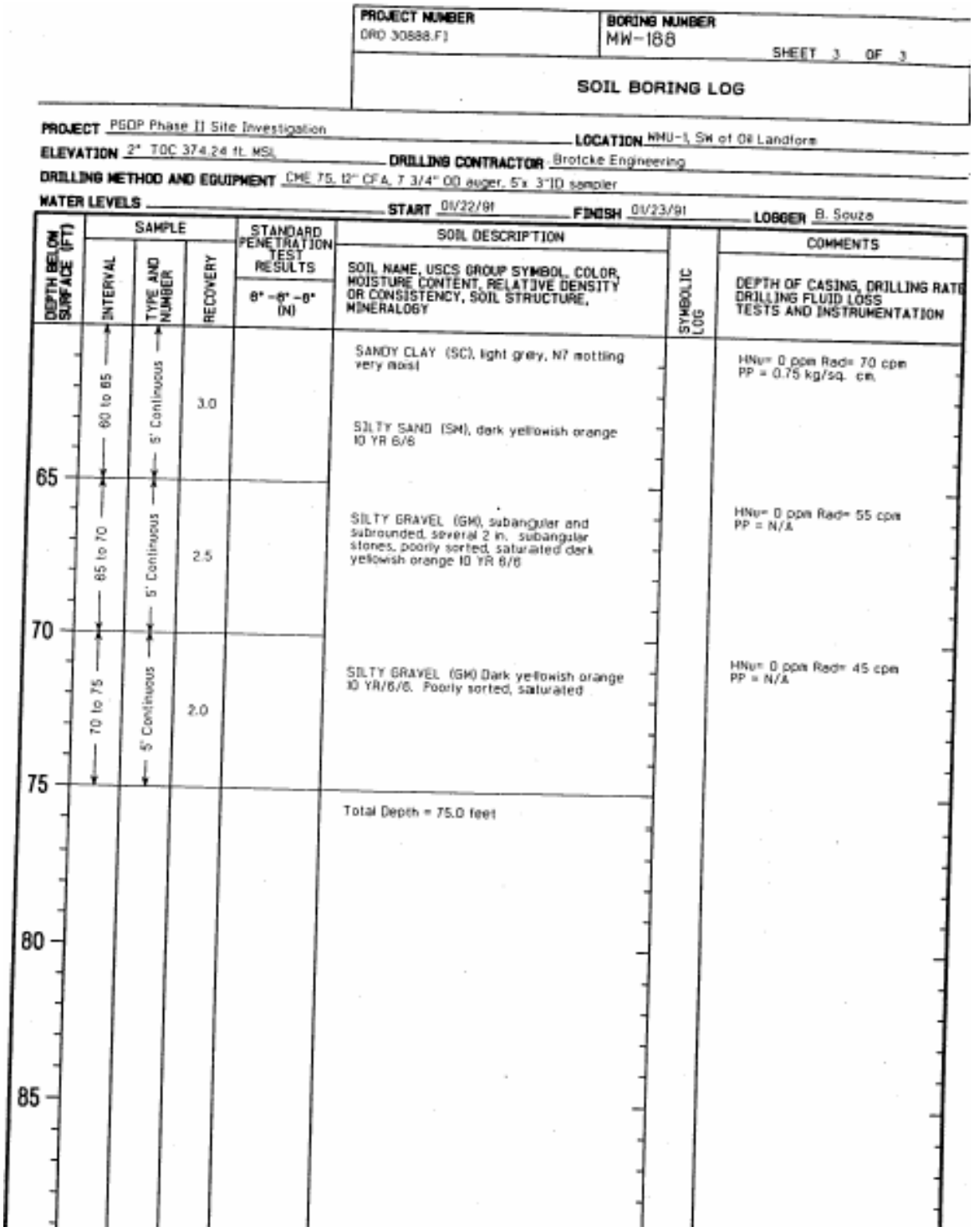
PROJECT PGDP Phase II Site Investigation **LOCATION** WMU-1, SW of Oil Landfarm

ELEVATION 2" TOC 374.24 ft. MSL **DRILLING CONTRACTOR** Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS **START** 01/22/91 **FINISH** 01/23/91 **LOGGER** B. Souza

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
35	30 to 35	5' Continuous	4.5		LEAN CLAY (CL), light brown 5YR 5/6, moist, fine sand		HNu= 0 ppm Rad= 65 cpm PP = 1 to 2.5 kg/sq. cm.
					SANDY LEAN CLAY (CL), dark yellowish orange 10 YR 6/6		
40	35 to 40	5' Continuous	5.0		LEAN CLAY (CL), dark yellowish brown 10 YR 6/6 mottling with bluish grey 5B 7/1		HNu= 0 ppm Rad= 50 cpm PP = 1 to 2.5 kg/sq. cm.
	40 to 45	5' Continuous	1.5		LEAN CLAY WITH SAND LENSE (CL), light brown 5 YR 5/6 mottling		HNu= 0.5 ppm Rad= 60 cpm
45	45 to 50	5' Continuous	5.0		SANDY CLAY (SC), moderately reddish brown 10YR 4/6 mottling with light gray sand 6N 6		HNu= 1.0 ppm Rad= 65 cpm PP = 2.0 kg/sq. cm.
50	50 to 55	5' Continuous	4.5		SANDY CLAY (SC), light brown 5 YR 5/6, slightly moist, mottling from 50 to 53 feet.		HNu= 0 ppm Rad= 60 cpm PP = 1.0 kg/sq. cm.
55	55 to 60	5' Continuous	5.0		SANDY CLAY (CL), with numerous sand lenses and fractures, light grey N7		HNu= 0 ppm Rad= 70 cpm PP = 2.75 kg/sq. cm.



PROJECT NUMBER	BORING NUMBER
ORD 30888.F1	MW-188 SHEET 3 OF 3

SOIL BORING LOG

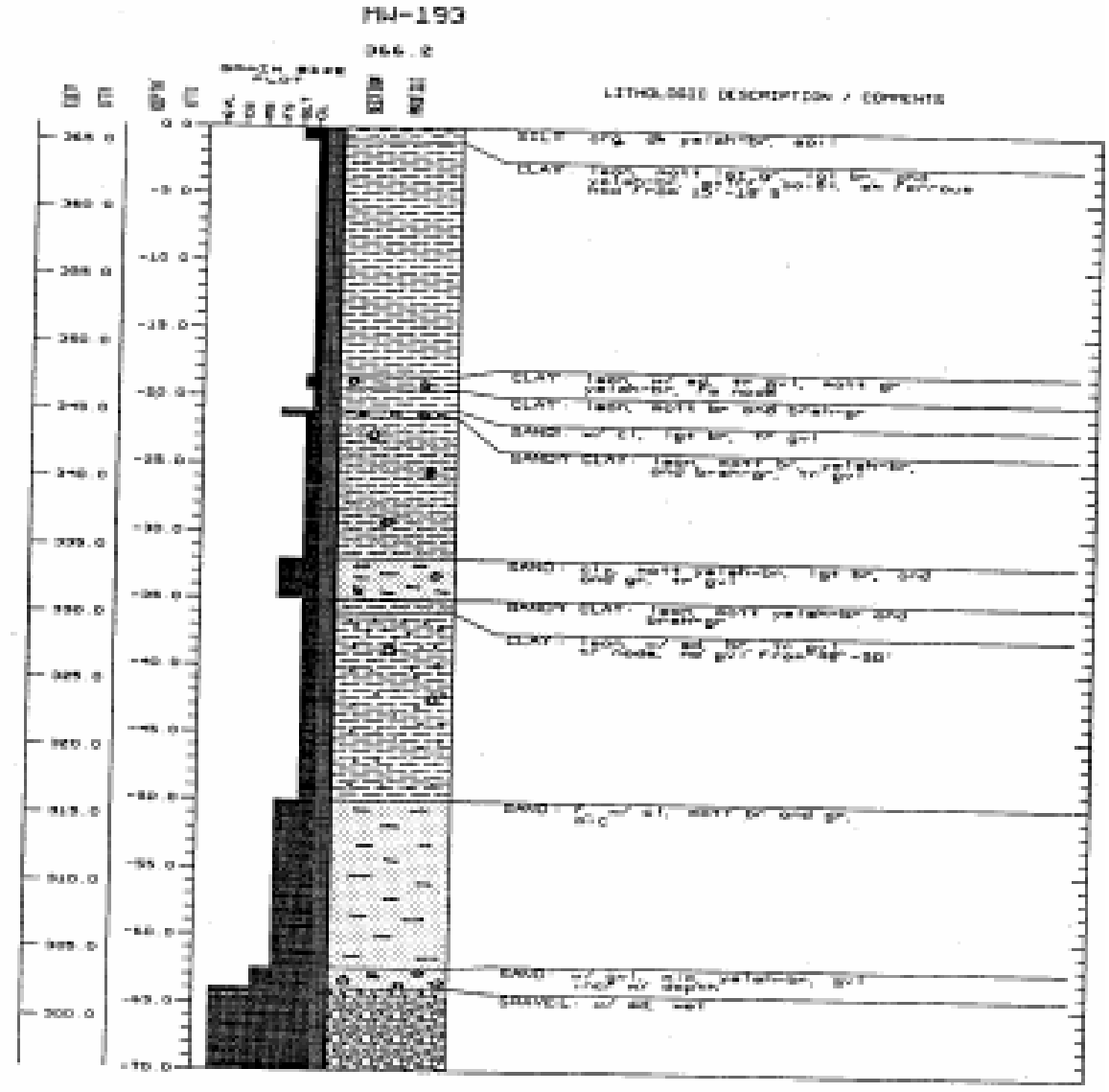
PROJECT PGDP Phase II Site Investigation LOCATION NMU-1, SW of Oil Landfarm

ELEVATION 2" TOC 374.24 ft. MSL DRILLING CONTRACTOR Brotcke Engineering

DRILLING METHOD AND EQUIPMENT CME 75, 12" CFA, 7 3/4" OD auger, 5'x 3"ID sampler

WATER LEVELS START 01/22/91 FINISH 01/23/91 LOGGER B. Souza

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
65	60 to 65	5' Continuous	3.0		SANDY CLAY (SC), light grey, N7 mottling very moist SILTY SAND (SM), dark yellowish orange 10 YR 6/6		HNu= 0 ppm Rad= 70 cpm PP = 0.75 kg/sq. cm
70	65 to 70	5' Continuous	2.5		SILTY GRAVEL (GM), subangular and subrounded, several 2 in. subangular stones, poorly sorted, saturated dark yellowish orange 10 YR 6/6		HNu= 0 ppm Rad= 55 cpm PP = N/A
75	70 to 75	5' Continuous	2.0		SILTY GRAVEL (GM) Dark yellowish orange 10 YR/6/6. Poorly sorted, saturated		HNu= 0 ppm Rad= 45 cpm PP = N/A
					Total Depth = 75.0 feet		
80							
85							


MW-193
366.2
LITHOLOGIC DESCRIPTION / COMMENTS

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW193	SHEET 1 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION Ogden Lndg. Road at Power Lines

ELEVATION 366.24 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 4/26/91 09:03 FINISH 4/26/91 12:23 LOGGER C. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION (SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL)	SYMBOLIC LOG	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION)
0	0-5	5' Continuous	4.5	N/A	ORGANIC SOIL (OL/OH), dark yellowish brown (10 YR 4/2), moist, firm, crumbles, fine grained		Bkgd: HNu =0 ppm; Rad =21 cpm
					LEAN CLAY (CL), mottled moderate yellowish brown (10 YR 5/4) and light gray (N7), moist, hard, crumbles		HNu = 0 ppm Rad = 52 cpm Pocket Pen (P.P.) = 1.0-74.5 kg/cm^2
5					LEAN CLAY (CL), mottled moderate yellowish brown (10 YR 5/4), light brown (5 YR 5/6), and light gray (N7), stiff to very stiff, moist, slightly plastic, oxidation and moisture in with depth		
	5-10	5' Continuous	5.0	N/A			HNu = 0 ppm Rad = 44 cpm P.P. = 1.0-3.25+ kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above, except with heavy oxidation 2'-2.5'		HNu = 0 ppm Rad = 65 cpm P.P. = 1.25-74.5 kg/cm2
15	15-20	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above, except with trace ferrous nodules		HNu = 0 ppm Rad = 28 cpm P.P. = 2.5-3.75 kg/cm^2
					LEAN CLAY W/SAND (CL), 3.5-4.5', trace gravel and ferrous nodules, same color, very stiff, moist		
20					LEAN CLAY (CL), mottled light brown (5 YR 5/6), mod. brown (5 YR 4/4) and light brown gray (5 YR 6/2), moist, stiff to very stiff, crumbles		
	20-25	5' Continuous	5.0	N/A	WELL GRADED SAND W/CLAY (SW-SC), light brown (5 YR 5/6), moist, trace chert gravel, 4" below		HNu = 0 ppm Rad = 62 cpm P.P. = 2.0-3.0 kg/cm2
25					SANDY LEAN CLAY (CL), mottled light brown (5 YR 5/6), moderate yellowish brown (10 YR 5/4) and light brown gray (5 YR 6/1), moist, stiff, crumbles, trace chert gravel, some oxidation staining		
	25-30	5' Continuous	5.0	N/A			HNu = 0 ppm Rad = 43 cpm P.P. = 1.25-1.75 kg/cm2
30							

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW193	SHEET 2 OF 3

SOIL BORING LOG

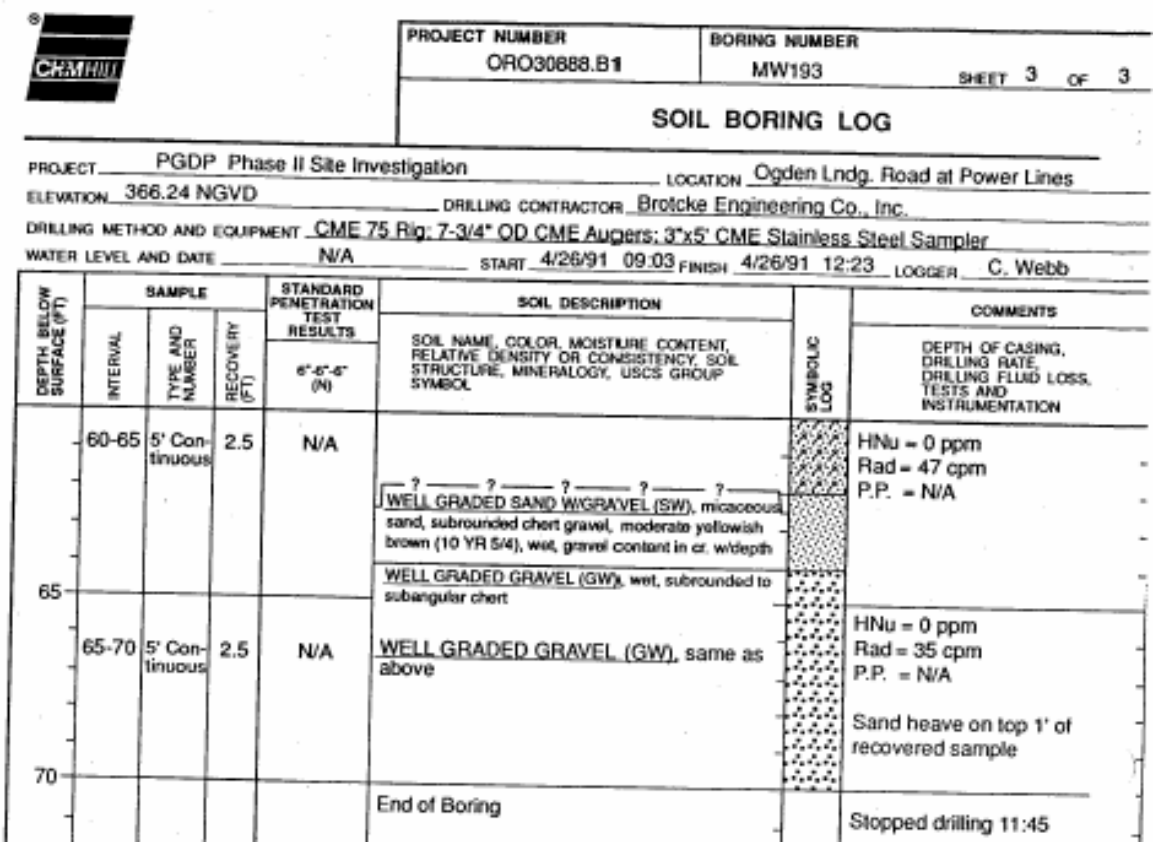
PROJECT PGDP Phase II Site Investigation LOCATION Ogden Lndg. Road at Power Lines

ELEVATION 366.24 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 4/26/91 09:03 FINISH 4/26/91 12:23 LOGGER C. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30-35	5' Continuous	5.0	N/A	SANDY LEAN CLAY (CL), mottled pale yellowish brown (10 YR 6/2) and light brown (5 YR 5/6) and light brown gray (5 YR 6/1), moist, stiff to very stiff, crumbles CLAYEY SAND (SC), mottled pale yellowish brown, light brown, and medium gray, moist, trace gravel and oxidized streaking		HNu = 0 ppm Rad = 44 cpm P.P. = 1.0-3.25 kg/cm^2 09:40 Stopped drilling to decon samplers
35	35-40	5' Continuous	5.0	N/A	SANDY LEAN CLAY (CL), mottled pale yellowish brown (10 YR 6/2) and light brown (5 YR 5/6) and light brownish gray (5 YR 6/1), wet from D.N. H_2O, very stiff to hard LEAN CLAY W/SAND (CL), moderate brown (5 YR 4/4), moist, very stiff, trace subrounded chert gravel		10:49 Resumed drilling HNu = 0 ppm Rad = 40 cpm P.P. = 2.0->4.5 kg/cm^2
40	40-45	5' Continuous	4.5	N/A	LEAN CLAY W/ SAND (CL), same as above, except mottled with light brown oxidation streaking and trace nodules		HNu = 0 ppm Rad = 48 cpm P.P. = 2.25-4.0 kg/cm^2
45	45-50	5' Continuous	5.0	N/A	LEAN CLAY W/ SAND (CL), same as above, darker oxidation LEAN CLAY W/SAND (CL), mottled moderate brown (5 YR 4/4) and light gray (N7), light gray is plastic, moist, very stiff to hard		HNu = 0 ppm Rad = 36 cpm P.P. = 1.75->4.5 kg/cm^2
50	50-55	5' Continuous	5.0	N/A	POORLY GRADED SAND W/ CLAY (SP-SC), mottled moderate brown (5 YR 4/4), and light gray (N7), gray is plastic, top 2" wet, rest is moist, very stiff, micaceous fine sand.		HNu = 0 ppm Rad = 50 cpm P.P. = 2.0-2.5 kg/cm2 Driller reports water in hole
55	55-60	5' Continuous	3.0	N/A	POORLY GRADED SAND W/ CLAY (SP-SC), same as above, no gray POORLY GRADED SAND W/CLAY (SP-SC), micaceous, light gray (N7), wet.		HNu = 0 ppm Rad = 42 cpm P.P. = 1.0-1.75 kg/cm2



PROJECT NUMBER: ORO30888.B1 | BORING NUMBER: MW193 | SHEET 3 OF 3

SOIL BORING LOG

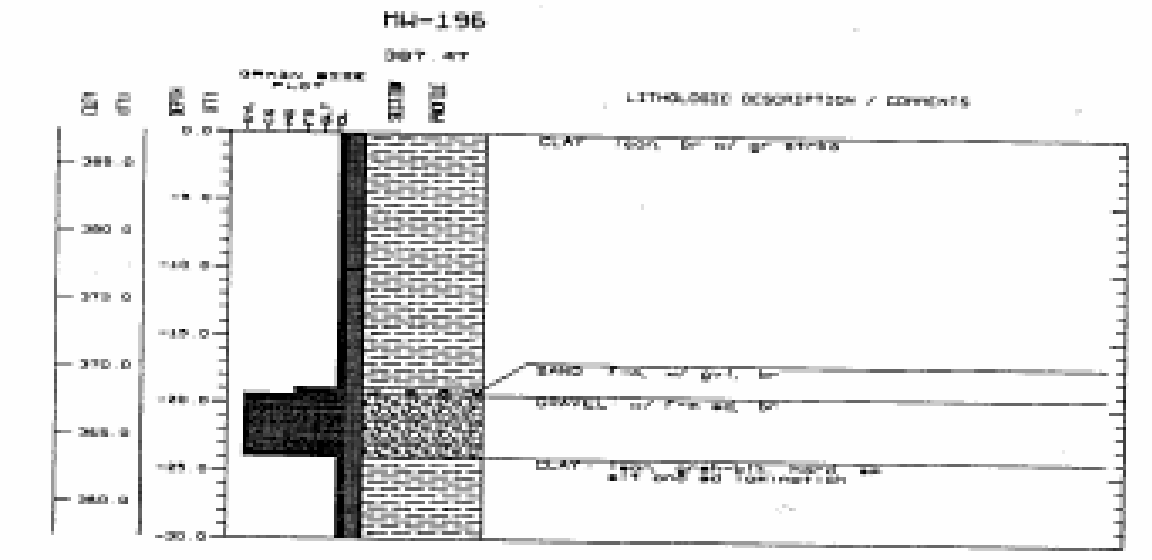
PROJECT: PGDP Phase II Site Investigation — LOCATION: Ogden Lndg. Road at Power Lines

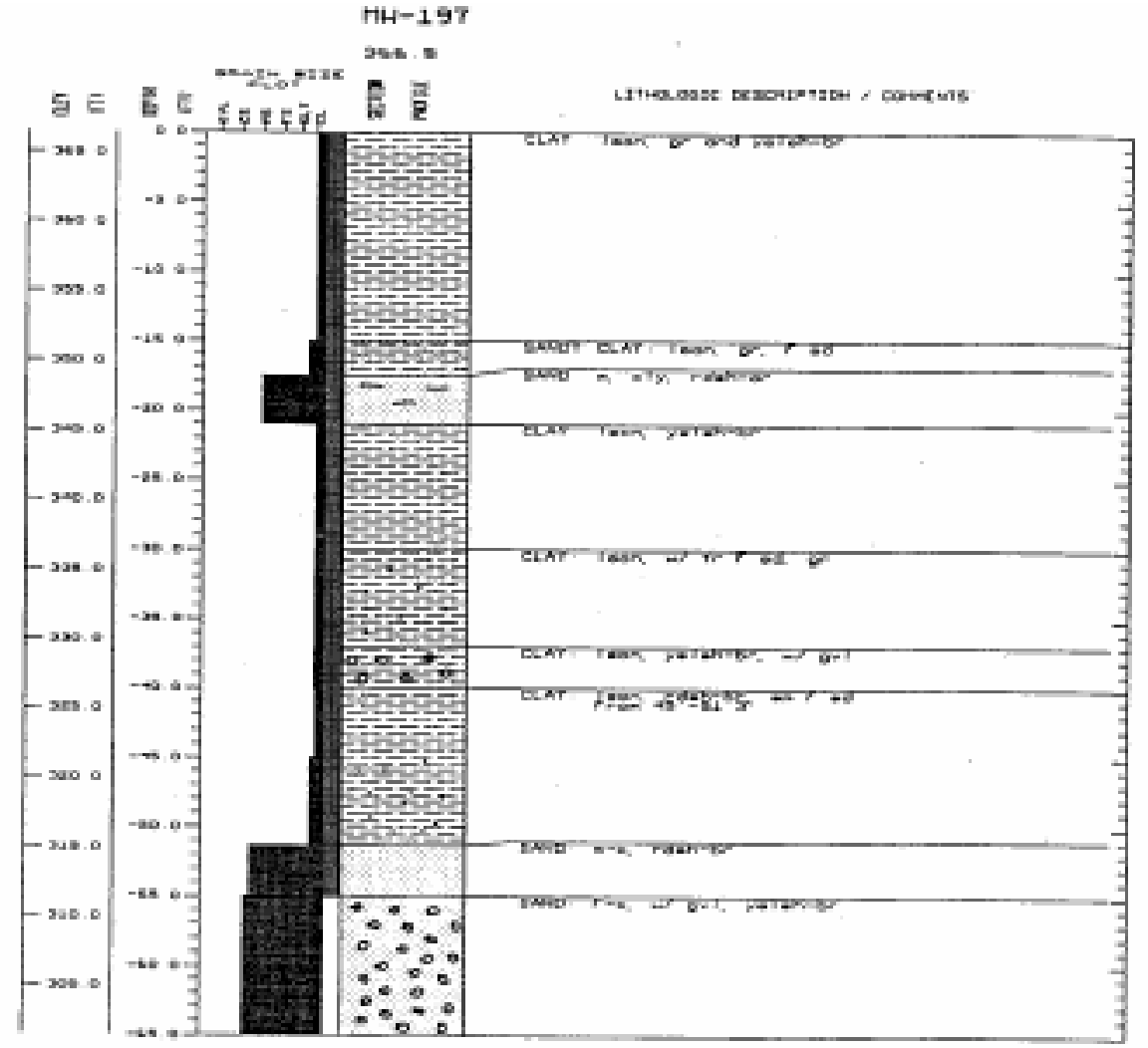
ELEVATION: 366.24 NGVD — DRILLING CONTRACTOR: Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT: CME 75 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE: N/A — START: 4/26/91 09:03 — FINISH: 4/26/91 12:23 — LOGGER: C. Webb

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS: 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	2.5	N/A	? ? ? ? ? WELL GRADED SAND W/GRAVEL (SW), micaceous sand, subrounded chert gravel, moderate yellowish brown (10 YR 5/4), wet, gravel content in cr. w/depth		HNu = 0 ppm Rad = 47 cpm P.P. = N/A
65					WELL GRADED GRAVEL (GW), wet, subrounded to subangular chert		
	65-70	5' Continuous	2.5	N/A	WELL GRADED GRAVEL (GW), same as above		HNu = 0 ppm Rad = 35 cpm P.P. = N/A Sand heave on top 1' of recovered sample
70					End of Boring		Stopped drilling 11:45


MW-19S
LITHOLOGIC DESCRIPTION / COMMENTS


MW-19T
LITHOLOGIC DESCRIPTION / COMMENTS

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET	OF
ORO30888.B1	MW197	1	3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION M6 Road North of Plant

ELEVATION 366.54 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig: 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/19/91 FINISH 3/21/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	0-5	5' Continuous	3.1	N/A	LEAN CLAY (CL), medium gray (N5), moist, very stiff		Bkgd: HNu=0 ppm; Rad=30 cpm HNu = 0 ppm Rad = 30 cpm Pocket Pen (P.P.) = 2.5 kg/cm^2
5	5-10	5' Continuous	5.0	N/A	LEAN CLAY (CL), medium dark gray (N4) with mottling, moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = 3.0 kg/cm^2
10	10-15	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above except medium gray (N5) to pale yellowish brown (10 YR 4/6)		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm2
15	15-20	5' Continuous	3.5	N/A	Top 2.5' : SANDY LEAN CLAY (CL), medium gray (N5), moist, very stiff, sand - fine grained Bot. 1.0' : CLAYEY SAND (SC), moderate reddish orange (10 R 6/6), moist, firm, sand - medium grained		HNu = 0 ppm Rad = 30 cpm P.P. = 3.5 kg/cm^2 (top) P.P. = 1.0 kg/cm^2 (bottom)
20	20-25	5' Continuous	5.0	N/A	Top 1.0' : CLAYEY SAND (SC), same as above Bot. 4.0' : LEAN CLAY (CL), pale yellowish brown (10 YR 4/6), moist, very stiff		HNu = 0 ppm Rad = 30 cpm P.P. = .25 kg/cm^2 (top) P.P. = 4.0 kg/cm^2 (bottom)
25	25-30	5' Continuous	5.0	N/A	LEAN CLAY (CL), same as above		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm2
30							

CH2MHILL

PROJECT NUMBER	BORING NUMBER	
ORO30888.B1	MW197	SHEET 2 OF 3

SOIL BORING LOG

PROJECT PGDP Phase II Site Investigation LOCATION M6 Road North of Plant

ELEVATION 366.54 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

DRILLING METHOD AND EQUIPMENT CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

WATER LEVEL AND DATE N/A START 3/19/91 FINISH 3/21/91 LOGGER D. Geshwender

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS: 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
35	30-35	5' Continuous	5.0	N/A	LEAN CLAY (CL) with trace sand, medium gray (N5) with mottling, moist, very stiff, sand is fine grained		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2
40	35-40	5' Continuous	5.0	N/A	Top 2.0' : LEAN CLAY (CL), same as above Bot. 3.0' : LEAN CLAY (CL), yellowish brown with mottling, moist, hard, with large (.15') gravel		HNu = 0 ppm Rad = 30 cpm P.P. = 4.0 kg/cm^2 (top) P.P. = >4.5 kg/cm^2 (bottom)
45	40-45	5' Continuous	3.5	N/A	LEAN CLAY (CL), moderate reddish brown (10 R 4/6), with mottling, moist, hard		HNu = 0 ppm Rad = 30 cpm P.P. = >4.5 kg/cm2
50	45-50	5' Continuous	5.0	N/A	LEAN CLAY (CL), moderate reddish brown (10 R 4/6) with mottling, moist, very stiff, with fine sand and mica flakes		HNu = 0 ppm Rad = 30 cpm P.P. = 2.5 kg/cm^2
55	50-55	5' Continuous	2.8	N/A	Top 1.3' : LEAN CLAY (CL), same as above Bot. 1.5' : POORLY GRADED SAND (SP), moderate reddish brown (10 R 4/6), wet, sand is medium to coarse grained		HNu = 0 ppm Rad = 30 cpm P.P. = N/A
60	55-60	5' Continuous	1.4	N/A	WELL GRADED SAND W/GRAVEL (SW), wet, sand is fine to coarse grained, gravel is subangular to angular		HNu = 0 ppm Rad = 30 cpm P.P. = N/A

CH2MHILL

PROJECT NUMBER	BORING NUMBER	SHEET	OF
ORO30888.B1	MW197	3	3

SOIL BORING LOG

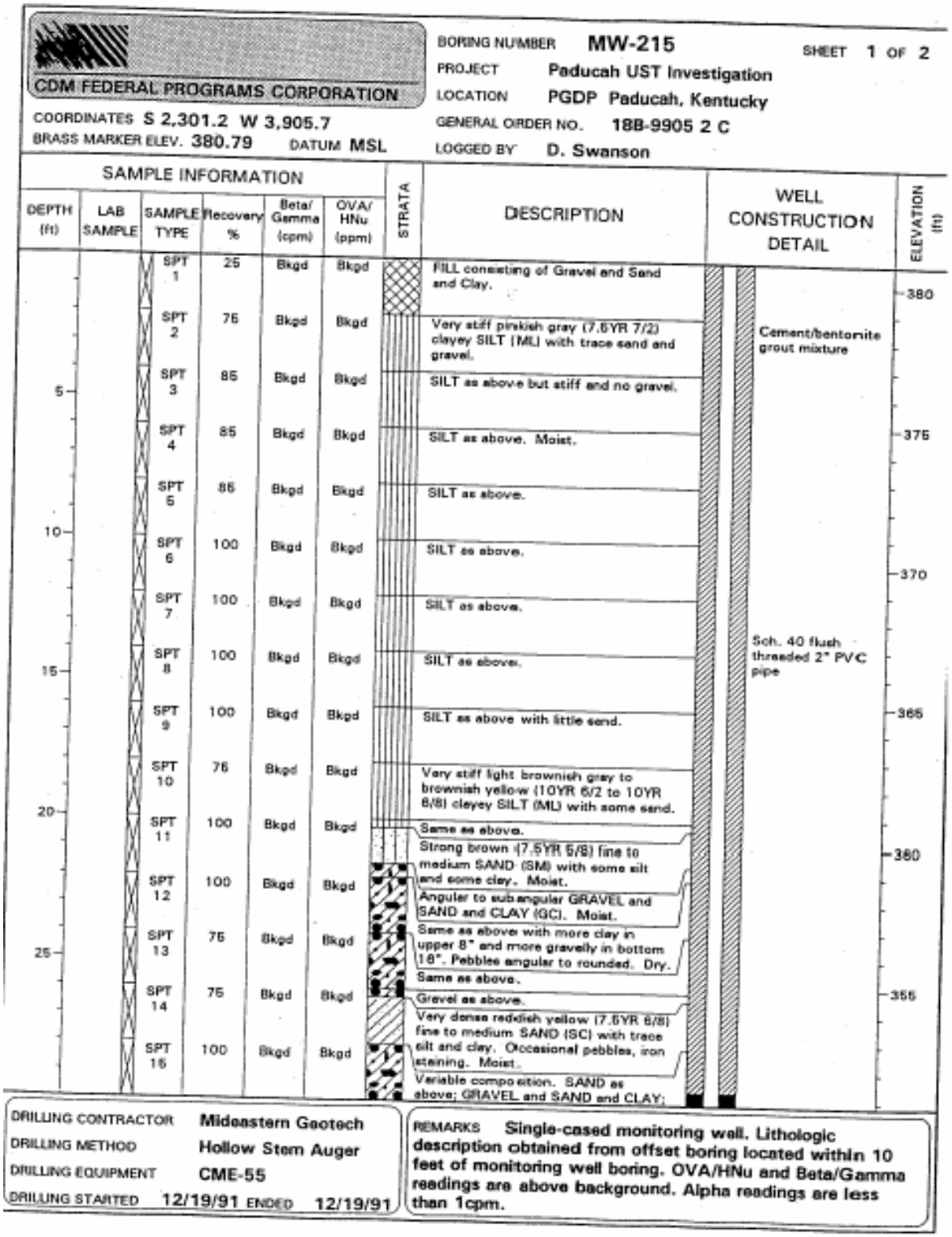
PROJECT PGDP Phase II Site Investigation LOCATION M6 Road North of Plant

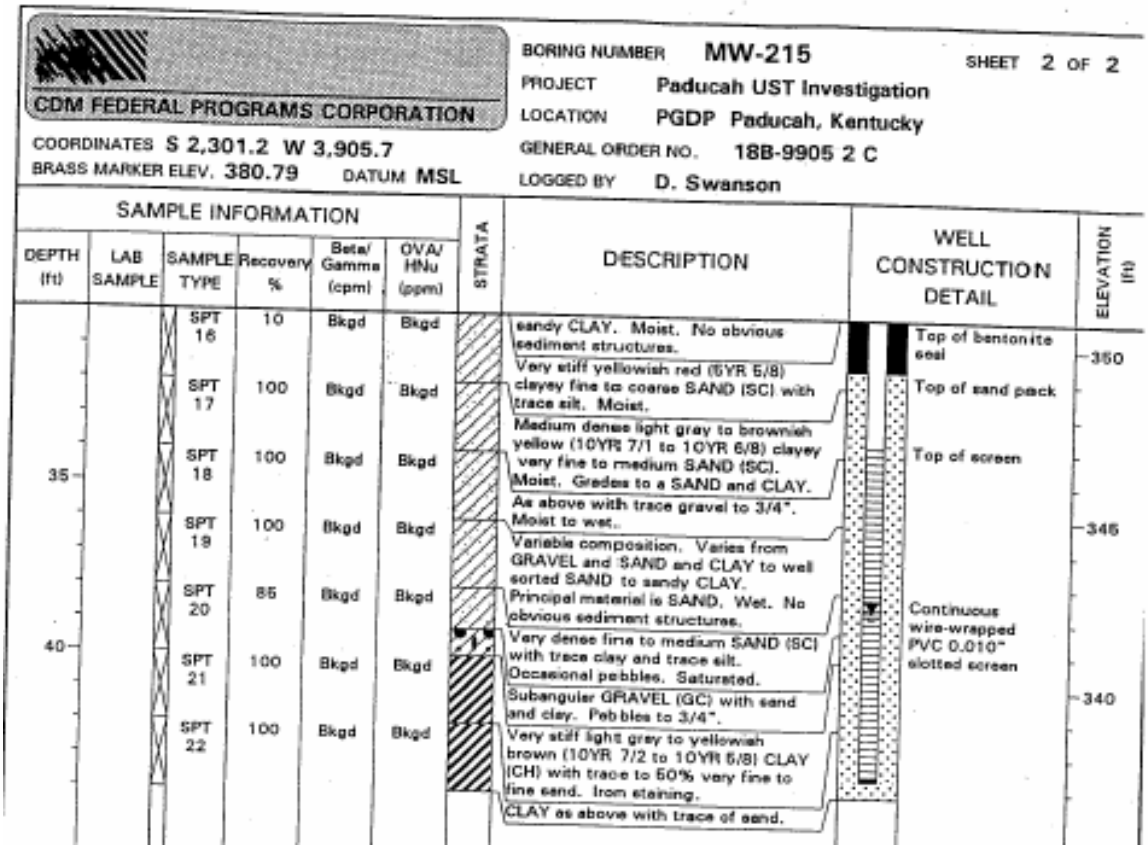
ELEVATION 366.54 NGVD DRILLING CONTRACTOR Brotcke Engineering Co., Inc.

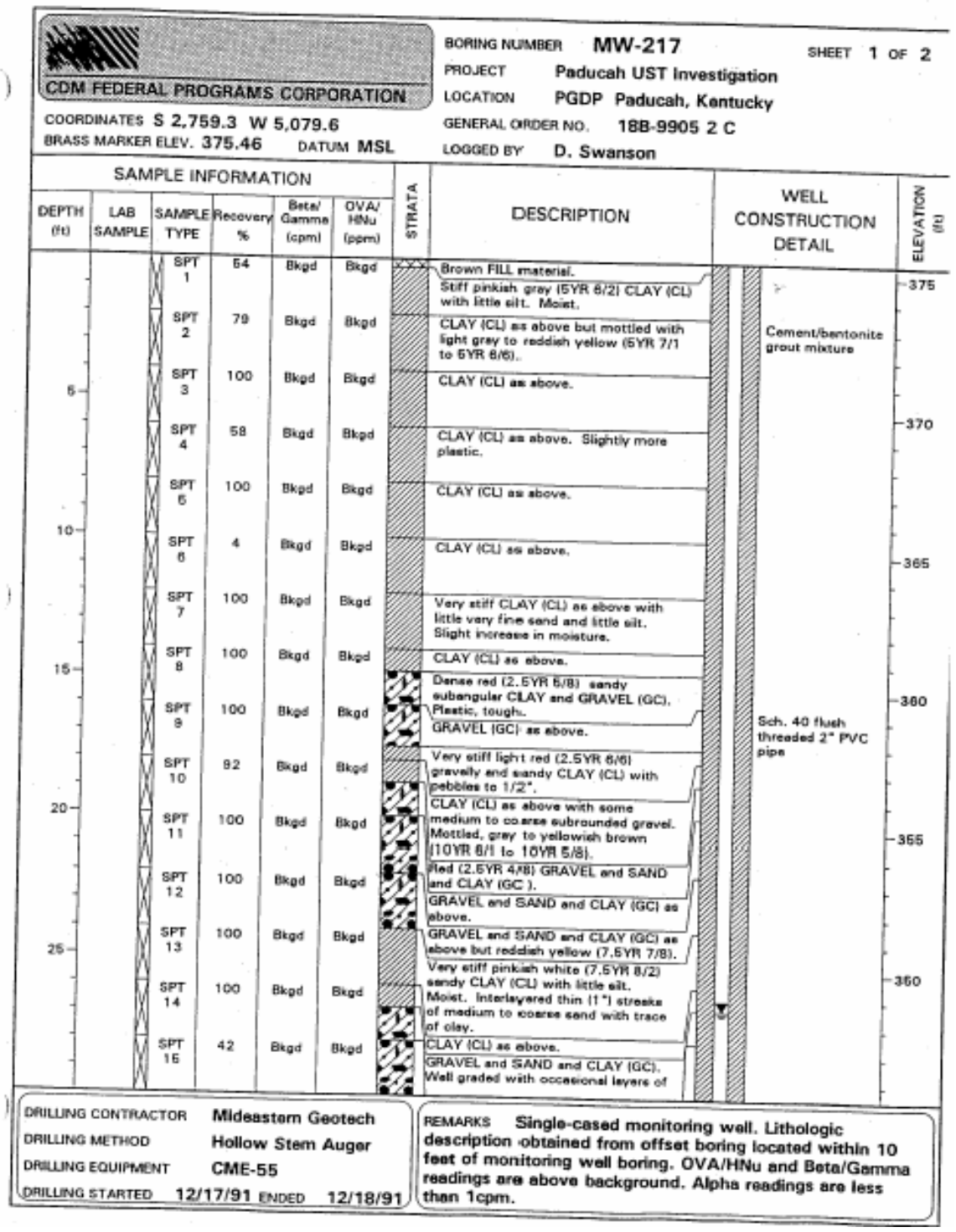
DRILLING METHOD AND EQUIPMENT CME 55 Rig; 7-3/4" OD CME Augers; 3"x5' CME Stainless Steel Sampler

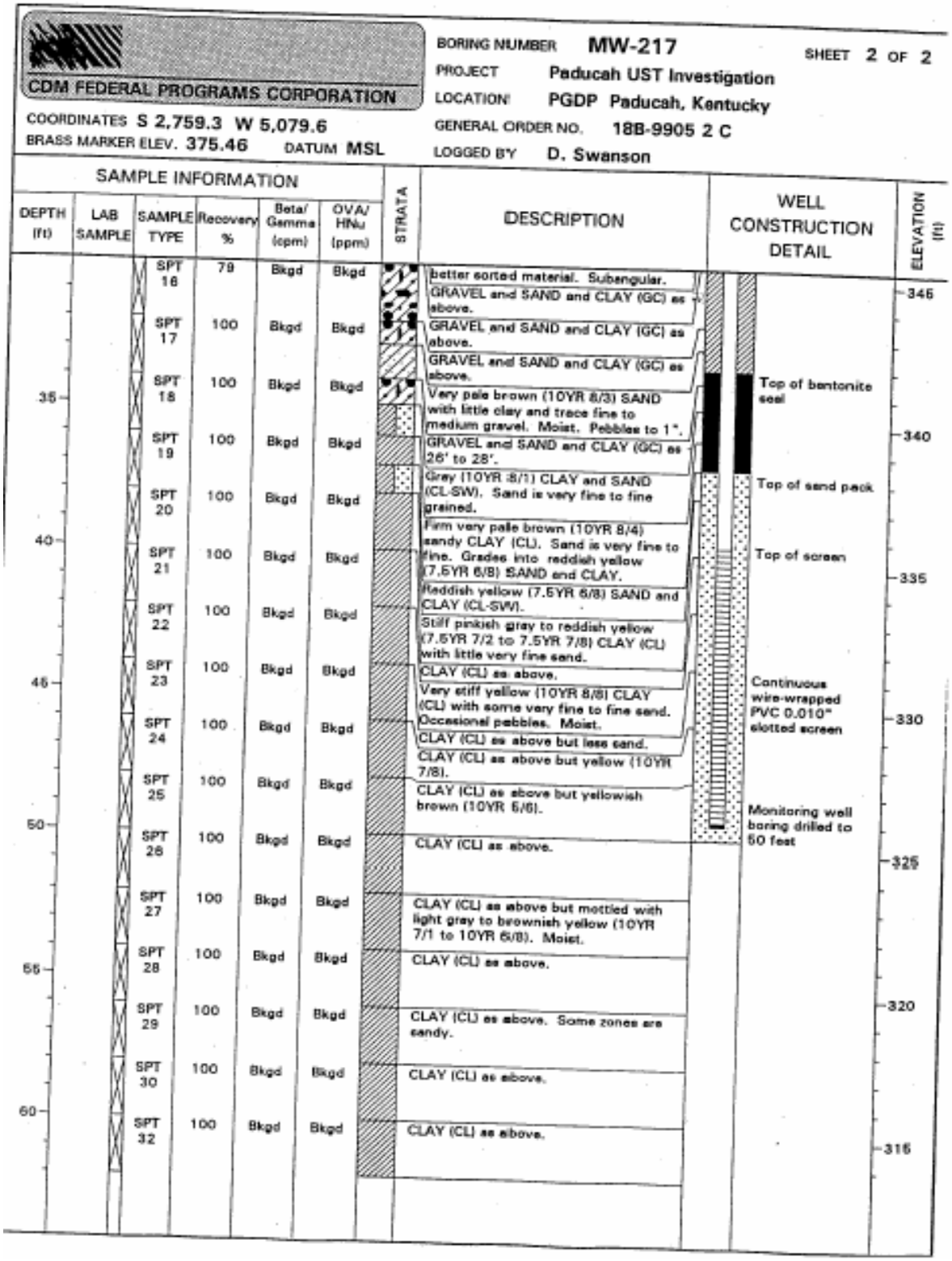
WATER LEVEL AND DATE N/A START 3/19/91 FINISH 3/21/91 LOGGER D. Geshwender

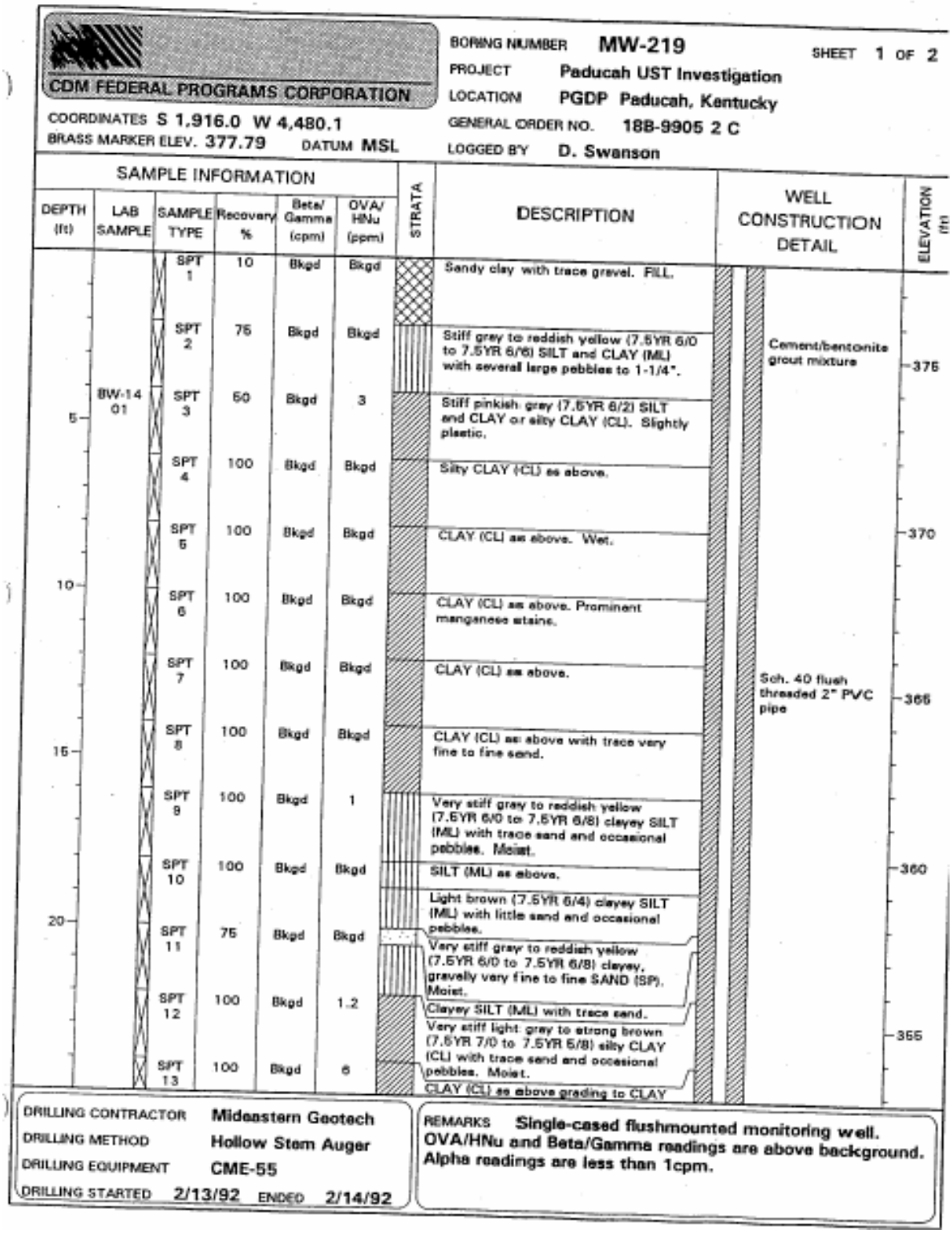
DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60-65	5' Continuous	0.0	N/A	No Recovery		
65				N/A	End of Boring		


CDM FEDERAL PROGRAMS CORPORATION
BORING NUMBER MW-215
SHEET 1 OF 2
PROJECT Paducah UST Investigation
LOCATION PGDP Paducah, Kentucky
COORDINATES S 2,301.2 W 3,905.7
GENERAL ORDER NO. 188-9905 2 C
BRASS MARKER ELEV. 380.79 DATUM MSL
LOGGED BY D. Swanson
SAMPLE INFORMATION
DEPTH (ft)
LAB SAMPLE
SAMPLE TYPE
Recovery %
Beta/ Gamma (cpm)
OVA/ HNu (ppm)
STRATA
DESCRIPTION
WELL CONSTRUCTION DETAIL
ELEVATION (ft)
SPT 1 25 Bkgd Bkgd
FILL consisting of Gravel and Sand and Clay.
SPT 2 75 Bkgd Bkgd
Very stiff pinkish gray (7.5YR 7/2) clayey SILT (ML) with trace sand and gravel.
SPT 3 85 Bkgd Bkgd
SILT as above but stiff and no gravel.
SPT 4 85 Bkgd Bkgd
SILT as above. Moist.
SPT 5 85 Bkgd Bkgd
SILT as above.
SPT 6 100 Bkgd Bkgd
SILT as above.
SPT 7 100 Bkgd Bkgd
SILT as above.
SPT 8 100 Bkgd Bkgd
SILT as above.
SPT 9 100 Bkgd Bkgd
SILT as above with little sand.
SPT 10 75 Bkgd Bkgd
Very stiff light brownish gray to brownish yellow (10YR 6/2 to 10YR 6/8) clayey SILT (ML) with some sand.
SPT 11 100 Bkgd Bkgd
Same as above.
Strong brown (7.5YR 5/8) fine to medium SAND (SM) with some silt and some clay. Moist.
SPT 12 100 Bkgd Bkgd
Angular to subangular GRAVEL and SAND and CLAY (GC). Moist.
SPT 13 75 Bkgd Bkgd
Same as above with more clay in upper 8" and more gravelly in bottom 16". Pebbles angular to rounded. Dry.
Same as above.
SPT 14 75 Bkgd Bkgd
Gravel as above.
Very dense reddish yellow (7.5YR 6/8) fine to medium SAND (SC) with trace silt and clay. Occasional pebbles, iron staining. Moist.
SPT 15 100 Bkgd Bkgd
Variable composition. SAND as above; GRAVEL and SAND and CLAY;
Cement/bentonite grout mixture
Sch. 40 flush threaded 2" PVC pipe
380
375
370
365
360
355
5
10
15
20
25
DRILLING CONTRACTOR Mideastern Geotech
DRILLING METHOD Hollow Stem Auger
DRILLING EQUIPMENT CME-55
DRILLING STARTED 12/19/91 ENDED 12/19/91
REMARKS Single-cased monitoring well. Lithologic description obtained from offset boring located within 10 feet of monitoring well boring. OVA/HNu and Beta/Gamma readings are above background. Alpha readings are less than 1cpm.


CDM FEDERAL PROGRAMS CORPORATION
BORING NUMBER MW-215
SHEET 2 OF 2
PROJECT Paducah UST Investigation
LOCATION PGDP Paducah, Kentucky
COORDINATES S 2,301.2 W 3,905.7
GENERAL ORDER NO. 18B-9905 2 C
BRASS MARKER ELEV. 380.79 DATUM MSL
LOGGED BY D. Swanson
SAMPLE INFORMATION
DEPTH (ft)
LAB SAMPLE
SAMPLE TYPE
Recovery %
Beta/ Gamma (cpm)
OVA/ HNu (ppm)
STRATA
DESCRIPTION
WELL CONSTRUCTION DETAIL
ELEVATION (ft)
SPT 16
SPT 17
SPT 18
SPT 19
SPT 20
SPT 21
SPT 22
10
100
100
100
85
100
100
Bkgd
sandy CLAY. Moist. No obvious sediment structures.
Very stiff yellowish red (5YR 5/8) clayey fine to coarse SAND (SC) with trace silt. Moist.
Medium dense light gray to brownish yellow (10YR 7/1 to 10YR 6/8) clayey very fine to medium SAND (SC). Moist. Grades to a SAND and CLAY.
As above with trace gravel to 3/4". Moist to wet.
Variable composition. Varies from GRAVEL and SAND and CLAY to well sorted SAND to sandy CLAY. Principal material is SAND. Wet. No obvious sediment structures.
Very dense fine to medium SAND (SC) with trace clay and trace silt. Occasional pebbles. Saturated.
Subangular GRAVEL (GC) with sand and clay. Pebbles to 3/4".
Very stiff light gray to yellowish brown (10YR 7/2 to 10YR 6/8) CLAY (CH) with trace to 50% very fine to fine sand. Iron staining.
CLAY as above with trace of sand.
Top of bentonite seal
Top of sand pack
Top of screen
Continuous wire-wrapped PVC 0.010" slotted screen
35
40
350
345
340


CDM FEDERAL PROGRAMS CORPORATION
BORING NUMBER MW-217
SHEET 1 OF 2
PROJECT Paducah UST Investigation
LOCATION PGDP Paducah, Kentucky
GENERAL ORDER NO. 18B-9905 2 C
LOGGED BY D. Swanson
COORDINATES S 2,759.3 W 5,079.6
BRASS MARKER ELEV. 375.46 DATUM MSL
SAMPLE INFORMATION
DEPTH (ft)
LAB SAMPLE
SAMPLE TYPE
Recovery %
Beta/ Gamma (cpm)
OVA/ HNu (ppm)
STRATA
DESCRIPTION
WELL CONSTRUCTION DETAIL
ELEVATION (ft)
SPT 1 54 Bkgd Bkgd
Brown FILL material.
Stiff pinkish gray (5YR 8/2) CLAY (CL) with little silt. Moist.
SPT 2 79 Bkgd Bkgd
CLAY (CL) as above but mottled with light grey to reddish yellow (5YR 7/1 to 5YR 8/6).
SPT 3 100 Bkgd Bkgd
CLAY (CL) as above.
SPT 4 58 Bkgd Bkgd
CLAY (CL) as above. Slightly more plastic.
SPT 5 100 Bkgd Bkgd
CLAY (CL) as above.
SPT 6 4 Bkgd Bkgd
CLAY (CL) as above.
SPT 7 100 Bkgd Bkgd
Very stiff CLAY (CL) as above with little very fine sand and little silt. Slight increase in moisture.
SPT 8 100 Bkgd Bkgd
CLAY (CL) as above.
Dense red (2.5YR 5/8) sandy subangular CLAY and GRAVEL (GC). Plastic, tough.
SPT 9 100 Bkgd Bkgd
GRAVEL (GC) as above.
SPT 10 92 Bkgd Bkgd
Very stiff light red (2.5YR 6/6) gravelly and sandy CLAY (CL) with pebbles to 1/2".
SPT 11 100 Bkgd Bkgd
CLAY (CL) as above with some medium to coarse subrounded gravel. Mottled, gray to yellowish brown (10YR 6/1 to 10YR 5/8).
SPT 12 100 Bkgd Bkgd
Red (2.5YR 4/8) GRAVEL and SAND and CLAY (GC).
GRAVEL and SAND and CLAY (GC) as above.
SPT 13 100 Bkgd Bkgd
GRAVEL and SAND and CLAY (GC) as above but reddish yellow (7.5YR 7/8).
SPT 14 100 Bkgd Bkgd
Very stiff pinkish white (7.5YR 8/2) sandy CLAY (CL) with little silt. Moist. Interlayered thin (1 ") streaks of medium to coarse sand with trace of clay.
SPT 15 42 Bkgd Bkgd
CLAY (CL) as above.
GRAVEL and SAND and CLAY (GC). Well graded with occasional layers of
Cement/bentonite grout mixture
Sch. 40 flush threaded 2" PVC pipe
375
370
365
360
355
350
5
10
15
20
25
DRILLING CONTRACTOR Mideastern Geotech
DRILLING METHOD Hollow Stem Auger
DRILLING EQUIPMENT CME-55
DRILLING STARTED 12/17/91 ENDED 12/18/91
REMARKS Single-cased monitoring well. Lithologic description obtained from offset boring located within 10 feet of monitoring well boring. OVA/HNu and Beta/Gamma readings are above background. Alpha readings are less than 1cpm.


CDM FEDERAL PROGRAMS CORPORATION
BORING NUMBER MW-217
SHEET 2 OF 2
PROJECT Paducah UST Investigation
LOCATION PGDP Paducah, Kentucky
COORDINATES S 2,759.3 W 5,079.6
GENERAL ORDER NO. 18B-9905 2 C
BRASS MARKER ELEV. 375.46 DATUM MSL
LOGGED BY D. Swanson
SAMPLE INFORMATION
DEPTH (ft)
LAB SAMPLE
SAMPLE TYPE
Recovery %
Beta/ Gamma (cpm)
OVA/ HNu (ppm)
STRATA
DESCRIPTION
WELL CONSTRUCTION DETAIL
ELEVATION (ft)
SPT 16
SPT 17
SPT 18
SPT 19
SPT 20
SPT 21
SPT 22
SPT 23
SPT 24
SPT 25
SPT 26
SPT 27
SPT 28
SPT 29
SPT 30
SPT 32
79
100
Bkgd
better sorted material. Subangular.
GRAVEL and SAND and CLAY (GC) as above.
GRAVEL and SAND and CLAY (GC) as above.
GRAVEL and SAND and CLAY (GC) as above.
Very pale brown (10YR 8/3) SAND with little clay and trace fine to medium gravel. Moist. Pebbles to 1".
GRAVEL and SAND and CLAY (GC) as 26' to 28'.
Gray (10YR 8/1) CLAY and SAND (CL-SW). Sand is very fine to fine grained.
Firm very pale brown (10YR 8/4) sandy CLAY (CL). Sand is very fine to fine. Grades into reddish yellow (7.5YR 6/8) SAND and CLAY.
Reddish yellow (7.5YR 6/8) SAND and CLAY (CL-SW).
Stiff pinkish gray to reddish yellow (7.5YR 7/2 to 7.5YR 7/8) CLAY (CL) with little very fine sand.
CLAY (CL) as above.
Very stiff yellow (10YR 8/8) CLAY (CL) with some very fine to fine sand. Occasional pebbles. Moist.
CLAY (CL) as above but less sand.
CLAY (CL) as above but yellow (10YR 7/8).
CLAY (CL) as above but yellowish brown (10YR 5/6).
CLAY (CL) as above.
CLAY (CL) as above but mottled with light gray to brownish yellow (10YR 7/1 to 10YR 6/8). Moist.
CLAY (CL) as above.
CLAY (CL) as above. Some zones are sandy.
CLAY (CL) as above.
CLAY (CL) as above.
Top of bentonite seal
Top of sand pack
Top of screen
Continuous wire-wrapped PVC 0.010" slotted screen
Monitoring well boring drilled to 60 feet
35
40
45
50
55
60
345
340
335
330
325
320
315



CDM FEDERAL PROGRAMS CORPORATION

BORING NUMBER **MW-219** SHEET 1 OF 2

PROJECT **Paducah UST Investigation**

LOCATION **PGDP Paducah, Kentucky**

COORDINATES **S 1,916.0 W 4,480.1**

BRASS MARKER ELEV. **377.79** DATUM **MSL**

GENERAL ORDER NO. **18B-9905 2 C**

LOGGED BY **D. Swanson**

DEPTH (ft)	LAB SAMPLE	SAMPLE TYPE	Recovery %	Beta/ Gamma (cpm)	OVA/ HNu (ppm)	STRATA	DESCRIPTION	WELL CONSTRUCTION DETAIL	ELEVATION (ft)
		SPT 1	10	Bkgd	Bkgd		Sandy clay with trace gravel. FILL.		
		SPT 2	75	Bkgd	Bkgd		Stiff grey to reddish yellow (7.5YR 6/0 to 7.5YR 6/6) SILT and CLAY (ML) with several large pebbles to 1-1/4".	Cement/bentonite grout mixture	375
5	BW-14 01	SPT 3	50	Bkgd	3		Stiff pinkish gray (7.5YR 6/2) SILT and CLAY or silty CLAY (CL). Slightly plastic.		
		SPT 4	100	Bkgd	Bkgd		Silty CLAY (CL) as above.		
		SPT 5	100	Bkgd	Bkgd		CLAY (CL) as above. Wet.		370
10		SPT 6	100	Bkgd	Bkgd		CLAY (CL) as above. Prominent manganese stains.		
		SPT 7	100	Bkgd	Bkgd		CLAY (CL) as above.	Sch. 40 flush threaded 2" PVC pipe	366
15		SPT 8	100	Bkgd	Bkgd		CLAY (CL) as above with trace very fine to fine sand.		
		SPT 9	100	Bkgd	1		Very stiff gray to reddish yellow (7.5YR 6/0 to 7.5YR 6/8) clayey SILT (ML) with trace sand and occasional pebbles. Moist.		
		SPT 10	100	Bkgd	Bkgd		SILT (ML) as above.		360
20		SPT 11	75	Bkgd	Bkgd		Light brown (7.5YR 6/4) clayey SILT (ML) with little sand and occasional pebbles.		
		SPT 12	100	Bkgd	1.2		Very stiff gray to reddish yellow (7.5YR 6/0 to 7.5YR 6/8) clayey, gravelly very fine to fine SAND (SP). Moist.		
		SPT 13	100	Bkgd	6		Clayey SILT (ML) with trace sand.		355
							Very stiff light gray to strong brown (7.5YR 7/0 to 7.5YR 5/8) silty CLAY (CL) with trace sand and occasional pebbles. Moist.		
							CLAY (CL) as above grading to CLAY		

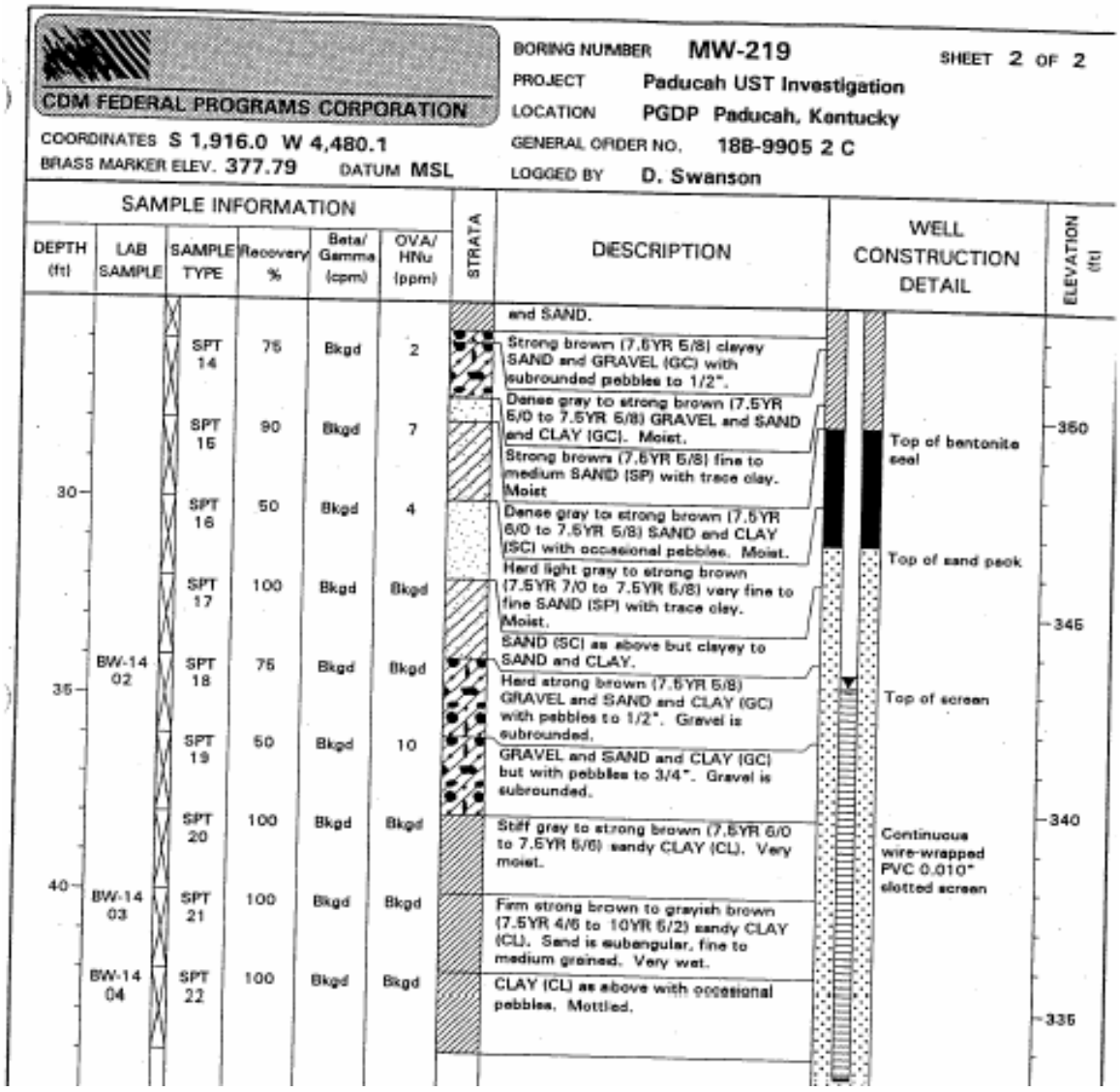
DRILLING CONTRACTOR **Mideastern Geotech**

DRILLING METHOD **Hollow Stem Auger**

DRILLING EQUIPMENT **CME-55**

DRILLING STARTED **2/13/92** ENDED **2/14/92**

REMARKS **Single-cased flushmounted monitoring well. OVA/HNu and Beta/Gamma readings are above background. Alpha readings are less than 1cpm.**



CDM FEDERAL PROGRAMS CORPORATION

BORING NUMBER MW-219 SHEET 2 OF 2
PROJECT Paducah UST Investigation
LOCATION PGDP Paducah, Kentucky
GENERAL ORDER NO. 188-9905 2 C
LOGGED BY D. Swanson

COORDINATES S 1,916.0 W 4,480.1
BRASS MARKER ELEV. 377.79 DATUM MSL

DEPTH (ft)	LAB SAMPLE	SAMPLE TYPE	Recovery %	Beta/ Gamma (cpm)	OVA/ HNu (ppm)	STRATA	DESCRIPTION	WELL CONSTRUCTION DETAIL	ELEVATION (ft)
							and SAND.		
		SPT 14	75	Bkgd	2		Strong brown (7.5YR 5/8) clayey SAND and GRAVEL (GC) with subrounded pebbles to 1/2".		
		SPT 15	90	Bkgd	7		Dense gray to strong brown (7.5YR 6/0 to 7.5YR 5/8) GRAVEL and SAND and CLAY (GC). Moist.	Top of bentonite seal	350
30		SPT 16	50	Bkgd	4		Strong browns (7.5YR 5/8) fine to medium SAND (SP) with trace clay. Moist		
		SPT 17	100	Bkgd	Bkgd		Dense gray to strong brown (7.5YR 6/0 to 7.5YR 5/8) SAND and CLAY (SC) with occasional pebbles. Moist.	Top of sand pack	
	BW-14 02	SPT 18	75	Bkgd	Bkgd		Hard light gray to strong brown (7.5YR 7/0 to 7.5YR 5/8) very fine to fine SAND (SP) with trace clay. Moist.		345
35		SPT 19	50	Bkgd	10		SAND (SC) as above but clayey to SAND and CLAY.	Top of screen	
		SPT 20	100	Bkgd	Bkgd		Hard strong brown (7.5YR 5/8) GRAVEL and SAND and CLAY (GC) with pebbles to 1/2". Gravel is subrounded.		
							GRAVEL and SAND and CLAY (GC) but with pebbles to 3/4". Gravel is subrounded.		340
40	BW-14 03	SPT 21	100	Bkgd	Bkgd		Stiff gray to strong brown (7.5YR 6/0 to 7.5YR 5/6) sandy CLAY (CL). Very moist.	Continuous wire-wrapped PVC 0.010" slotted screen	
	BW-14 04	SPT 22	100	Bkgd	Bkgd		Firm strong brown to grayish brown (7.5YR 4/6 to 10YR 5/2) sandy CLAY (CL). Sand is subangular, fine to medium grained. Very wet.		
							CLAY (CL) as above with occasional pebbles. Mottled.		335

R&R INTERNATIONAL MONITORING WELL LOG

Page 1 of 9

Monitoring Well No.:	239	Date Started: Sept. 16, 1994	Logged By: GLB, LJS, BLY
Client:	MK-Ferguson of Oak Ridge Company		Drilling Co.: Pennsylvania Drilling
R&R Project No.:	302122	Date Completed: Sept. 29, 1994	Driller: D. Newman
MK-F Project No.:	5014/2005	Location/Coordinates:	
Drilling Method:	6.25" ID and 10.25" ID HSA/WL-SC		
Final Elevation:		Sampling Method:	Split-spoon\Shelby tube
Riser: Type -	Stainless Steel	Diameter - 2.0"	Length - 146.88'
Screen: Type -	PP Stainless Steel	Diameter - 2.0"	Length - 10.00'
Total Depth:	157.00' (161.00')	Top Sand Pack: 132.00'	Top of Seal: 129.00'
Water Level at Completion:	45.21'		Slot - " 0.010"
State of Kentucky Permit Number:	8000-4537	8.00" Carbon Steel Isolation Casing -	110.00'

Depth (in feet)	B C	Sample No. Interval	PID/ RAD	Rec (In feet)	Lithology Description	Grain Size G S St C	Graphic Boring
1					Drilled blind to 70.0'		
2					See Soil Borings 28 and 31 for complete comparative lithology		
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							

R&R INTERNATIONAL MONITORING WELL LOG

Page 2 of 9

Monitoring Well No.: 239
Client: MK-Ferguson of Oak Ridge Company
R&R Project No.: 302122
MK-F Project No.: 5014/2005
Date Started: Sept. 16, 1994
Date Completed: Sept. 29, 1994
Location/Coordinates:
Logged By: GLB, LJS, BLY
Drilling Co.: Pennsylvania Drilling
Driller: D. Newman

Depth (in feet)	B C	Sample No. Interval	PID/ RAD	Rec (In feet)	Lithology Description	Grain Size G S St C	Graphic Boring
16					Drilled blind to 70.0'		
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
32							
33							

R&R INTERNATIONAL MONITORING WELL LOG

Monitoring Well No.:	239	**Date Started:** Sept. 16, 1994	**Logged By:** GLB, LJS, BLY
Client:	MK-Ferguson of Oak Ridge Company		**Drilling Co.:** Pennsylvania Drilling
R&R Project No.:	302122	**Date Completed:** Sept. 29, 1994	**Driller:** D. Newman
MK-F Project No.:	5014/2005	**Location/Coordinates:**	

Depth (in feet)	B C	Sample No. Interval	PID/ RAD	Rec (In feet)	Lithology Description	Grain Size G S St C	Graphic Boring
34					Drilled blind to 70.0'		
35							
36							
37							
38							
39							
40							
41							
42							
43							
44							
45							
46							
47							
48							
49							
50							
51							

R&R INTERNATIONAL MONITORING WELL LOG

Monitoring Well No.: 239
Client: MK-Ferguson of Oak Ridge Company
R&R Project No.: 302122
MK-F Project No.: 5014/2005

Date Started: Sept. 16, 1994
Date Completed: Sept. 29, 1994
Location/Coordinates:

Logged By: GLB, LJS, BLY
Drilling Co.: Pennsylvania Drilling
Driller: D. Newman

Depth (in feet)	B C	Sample No. Interval	PID/ RAD	Rec (In feet)	Lithology Description	Grain Size G S St C	Graphic Boring
52					Drilled blind to 70.0'		
53							
54							
55							
56							
57							
58							
59							
60							
61							
62							
63							
64							
65							
66							
67							
68							
69							

R&R INTERNATIONAL MONITORING WELL LOG

Monitoring Well No.: 239
Client: MK-Ferguson of Oak Ridge Company
R&R Project No.: 302122
MK-F Project No.: 5014/2005

Date Started: Sept. 16, 1994
Date Completed: Sept. 29, 1994
Location/Coordinates:

Logged By: GLB, LJS, BLY
Drilling Co.: Pennsylvania Drilling
Driller: D. Newman

Depth (in feet)	B C	Sample No. Interval	PID/ RAD	Rec (In feet)	Lithology Description	Grain Size G S St C	Graphic Boring
70							
71		1 (70 - 72)	0 100	1.6'	GRAVEL (95%) subangular with trace sand (5%); medium to coarse grained; subangular; medium orangish brown (10 YR 5/8)		
72							
73							
74							
75							
76							
77							
78							
79							
80							
81							
82							
83							
84							
85							
86							
87							

R&R INTERNATIONAL MONITORING WELL LOG

Monitoring Well No.: 239
Client: MK-Ferguson of Oak Ridge Company
R&R Project No.: 302122
MK-F Project No.: 5014/2005
Date Started: Sept. 16, 1994
Date Completed: Sept. 29, 1994
Location/Coordinates:
Logged By: GLB, LJS, BLY
Drilling Co.: Pennsylvania Drilling
Driller: D. Newman

Depth (in feet)	B C	Sample No. Interval	PID/ RAD	Rec (In feet)	Lithology Description	Grain Size G S St C	Graphic Boring
88							
89							
90							
91	17	2	0	1.6'	CLAY (55%) with some sand (25%) and little silt (20%); mottled medium grey (7.5 YR 6/2) and orangish brown (10 YR 6/8); moist; very hard		
92	42 50/2	(90 - 92)	BKG				
93							
94							
95							
96							
97							
98							
99							
100							
101							
102							
103							
104							
105							
106	7	3	0	1.5'	CLAY (60%) with little sand and silt (20% each); fine grained, subrounded; mottled light brown		

R&R INTERNATIONAL MONITORING WELL LOG

Monitoring Well No.: 239
Client: MK-Ferguson of Oak Ridge Company
R&R Project No.: 302122
MK-F Project No.: 5014/2005
Date Started: Sept. 16, 1994
Date Completed: Sept. 29, 1994
Location/Coordinates:
Logged By: GLB, LJS, BLY
Drilling Co.: Pennsylvania Drilling
Driller: D. Newman

Depth (in feet)	B C	Sample No. Interval	PID/ RAD	Rec (In feet)	Lithology Description	Grain Size G S St C	Graphic Boring
107	12 15	(105 - 107)	120		(7.5 YR 5/2) and medium orangish brown (10 YR 6/8); damp; stiff		
108							
109							
110							
111							
112							
113							
114							
115							
116							
117							
118							
119							
120							
121							
122							
123							
124							
125		4		Shelby			

R&R INTERNATIONAL MONITORING WELL LOG

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Monitoring Well No.:	239	**Date Started:** Sept. 16, 1994	**Logged By:** GLB, LJS, BLY
Client:	MK-Ferguson of Oak Ridge Company		**Drilling Co.:** Pennsylvania Drilling
R&R Project No.:	302122	**Date Completed:** Sept. 29, 1994	**Driller:** D. Newman
MK-F Project No.:	5014/2005	**Location/Coordinates:**	

Depth (in feet)	B C	Sample No. Interval	PID/ RAD	Rec (In feet)	Lithology Description	Grain Size G S St C	Graphic Boring
126		(124 - 126)		Tube			
127							
128							
129							
130							
131							
132							
133							
134							
135							
136							
137							
138							
139							
140							
141							
142							
143							
144							

R&R INTERNATIONAL MONITORING WELL LOG

Monitoring Well No.: 239
Client: MK-Ferguson of Oak Ridge Company
R&R Project No.: 302122
MK-F Project No.: 5014/2005
Date Started: Sept. 16, 1994
Date Completed: Sept. 29, 1994
Location/Coordinates:
Logged By: GLB, LJS, BLY
Drilling Co.: Pennsylvania Drilling
Driller: D. Newman

Depth (in feet)	B C	Sample No. Interval	PID/ RAD	Rec (In feet)	Lithology Description	Grain Size G S St C	Graphic Boring
145							
146							
147							
148							
149							
150							
151	7	5 (150 - 152)	0 BKG	0.2	rock in base of spoon SAND (85%) with little silt (15%); subrounded; well sorted; micaceous		
152	8 50/3						
153							
154							
155	12	6 (154 - 156	0 BKG	1.6'	SAND and CLAY (40% each) with little silt (20%); sand with silts are interbedded with clays; moist; damp.		
156	32 50/4						
157							
158							
159							
160							
161							
162		Base of boring at 161.0'					
163		NOTE: Depth of interior well base verified during development; as of 12/13/94 to be 156.88' below T.O.C.					

TN & ASSOCIATES, INC.
WAGs 3/8/28/DG RI
LITHOLOGIC LOG

Project No.: 1999aa

Task No.

LITHOLOGIC LOG | Boring/Well No.: RZ3-MW34L

Facility: Paducah Gaseous Diffusion Plant | Site: DATA GAPS

Client: Bechtel Jacobs Company LLC

Contractor: TN & Associates | Drill Contractor: Miller Drilling | Driller: G. MARKHAM

Start Time/Date: 1054 / 6/30/99 | End Time/Date: 1320 / 7/15/99 | Borehole Dia(s):

Drill Method/Rig Type: BAKER RIG | Total Depth: 318 FT

Logged By: D SCHMOKER | Coordinates: | Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	Field Measurements Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
0								
5	(1)		5	BKG	0	SILTY CLAY, OLIVE 10YR 5/3, MOIST		t = 1104
10	(2)		5	BKG	0	SILTY CLAY, GRAYISH BROWN (10YR 5/2) NON PLASTIC, SOFT		t = 1107
15	(3)		5	BKG	0	SILT + CLAY, LT YELLOWISH-BROWN 10 YR 6/4		t = 1114
20	(4)		5	BKG	0	CLAYEY SILT, LT YELLOWISH-BROWN (10YR 6/4) W/ GRAVEL - SUBANG		t = 1120
25	(5)		5	BGK	0	SILTY CLAY, BROWNISH-YELLOW (10YR 6/6), TRACE FINE SAND, SUBAN		t = 1456
30	(6)		5	BGK	0	A/A		t = 1502
35	(7)		5	BGK	0	A/A WITHOUT SAND		t = 1514
40	(8)		5	BGK	0	A/A		t = 1525
45	(9)		5	BGK	0	A/A		t = 1729
50	(10)		5	BGK	0	SILTY SAND, LT-YELLOWISH BROWN 10 YR 6/4) FINE-GRAINED SUBANG		t = 1727
55	(11)		5	BGK	0	SAND + GRAVEL (10YR 5/3) - SUBANG TO SUBROUND		t = 1729
60	(12)		5	BGK	0	A/A WITH GRAVEL UP TO 47 cm		t = 1730

TN & ASSOCIATES, INC.
WAGs 3/6/28/DG RI
LITHOLOGIC LOG

Project No.: 1999ax

Task No.

LITHOLOGIC LOG | Boring/Well No.: RF3-MW34

Facility: Paducah Gaseous Diffusion Plant | Site: DATA GAPS

Client: Bechtel Jacobs Company LLC

Contractor: TN & Associates | Drill Contractor: Miller Drilling | Driller: G. MAYFIELD

Start Time/Date: 1054 6/30/99 | End Time/Date: 1320/ 7/15/99 | Borehole Dia(s):

Drill Method/Rig Type: BAKER 11 | Total Depth: 318 FT

Logged By: D SCHMOKER | Coordinates: | Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	Field Measurements Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
60								
65	13		5	BKG	0	GRAVEL, YELLOW-BROWN (10YR 5/4) TO YSCM SUBANG TO SUBROUND		t = 1247
70	14		5	BKG	0	SILTY SAND + GRAVEL YELLOW-BROWN (10YR 5/4) FINE TO MED SAND, GRAVEL TO 3 CM, SUBANG-SUBRD		t = 1257
75	15		5	BKG	0	A/A		t = 1252
80	16		5	BKG	0	A/A		t = 1257
85	17		5	BKG	0	SILTY SAND, YELLOW BROWN (10YR 5/6) FINE TO MEDIUM, SUBANG TO SUBRD		t = 0900
90	18		5	BKG	0	SILTY SAND + GRAVEL YELLOW BROWN (10YR 5/6) SAND/GRAVEL AVE TO MED SUBANG TO SUBROUND		t = 0905
95	19		5	BKG	0	SILTY CLAY W/SAND + GRAVEL, TRACE-30% FINE TO MED, SUBANG TO SUBROUND (10YR 5/6)		t = 0910
100	20		5	BKG	0	SILTY SAND W/CLAY MED TO COARSE GRN TRACE FINE GRAVEL		t = 0920
105	21		5	BKG	0	SILTY SAND, YELLOW BROWN (10YR 5/6) FINE GRAINED		t = 1143
110	22		5	BKG	0	A/A OUT BROWN (10YR 5/3)		t = 1146
115	23		5	BKG	0	A/A		t = 1149
	24		5	BKG	0	A/A		t = 1153

TN & ASSOCIATES, INC.
WAGs 3/8/28/DG RI
LITHOLOGIC LOG

Project No.: 1999ar

Task No.

PAGE 3 of 6

LITHOLOGIC LOG	Boring/Well No.: R23-MW346		
Facility: Paducah Gaseous Diffusion Plant			Site: DATA GAPS
Client: Bechtel Jacobs Company LLC			
Contractor: TN & Associates	Drill Contractor: Miller Drilling		Driller: G. MARKHAM
Start Time/Date: 1054 1/30/99	End Time/Date: 1320/ 7/15/99		Borehole Dia(s):
Drill Method/Rig Type: BAKER RIG			Total Depth: 315 FT
Logged By: D SCHWAR	Coordinates:		Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	Field Measurements Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
120								
125	25		5	BKG	0	A/A		t = 1100
130	26		5	BKG	0	CLAYEY SAND, DARK-GRAY (2.5Y 3/1) FINE GRAIN SAND		t = 1705
135	27		5	BKG	0	SILTY CLAY - VERY DARK GRAY		t = 1725
140			0			NO RETURN		
145	28		5	BKG	0	CLAY, DARK GRAY (10YR 3/1), TRACE FINE SAND		t = 0954
150	29		5	BKG	0	A/A		t = 0857
155	30		5	BKG	0	A/A		t = 0940
160	31		5	BKG	0	A/A		t = 1004
165	32		5	BKG	0	A/A		t = 1009
170	33		5	BKG	0	A/A		t = 1013
175	34		5	BKG	0	A/A		t = 1015
180	35		5	BKG	0	CLAYEY SAND, DARK (10YR 3/1) FINE-GRAINED, MICA		t = 1137

TN & ASSOCIATES, INC.
WAGs 3/8/28/DG RI
LITHOLOGIC LOG

Project No.: 19990c

Task No.

PAGE 4 of 6

LITHOLOGIC LOG | Boring/Well No.: RZ3-MW34

Facility: Paducah Gaseous Diffusion Plant | Site: DATA GAPS

Client: Bechtel Jacobs Company LLC

Contractor: TN & Associates | Drill Contractor: Miller Drilling | Driller: G. MANKEMAR

Start Time/Date: 1054 / 6/30/99 | End Time/Date: 1320 / 7/15/99 | Borehole Dia(s):

Drill Method/Rig Type: BAKER RIG | Total Depth: 318 FT

Logged By: D SCHMOSAR | Coordinates: | Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	Field Measurements Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
190								
195	36		0			NO RECOVERY		
190	37		0			NO RECOVERY		
195	38		5	BKG	0	CLAYEY SAND, DARK GRAY, CARBONACEOUS DEBRIS, FINE GRAINED		t = 1141
200	39		5	BKG	0	SILTY SAND, DARK GRAY (10YR 3/1) FINE GRAINED FT ACE/MICA		t = 1324
205	40		5	BKG	0	A/A WITH CARBONACEOUS DEBRIS		t = 1325
210	41		5	BKG	0	A/A		t = 1326
215	42		0			NO RECOVERY		
220	43		5	BKG	0	SILTY SAND, DARK GRAY (10YR 3/1)		t = 1507
225	44		5	BKG	0	A/A W/ TRACE PYRITE NODULES		t = 1509
230	45		5	BKG	0	A/A		t = 1510
235	46		5	BKG	0	A/A		t = 1511
240	47		5	BKG	0	A/A W/ NO PYRITE		t = 1632

TN & ASSOCIATES, INC.
WAGs 3/8/28/DG RI
LITHOLOGIC LOG

Project No.: 1999ac

Task No.

PAGE 5 of 6

LITHOLOGIC LOG | Boring/Well No.: R23-MW34

Facility: Paducah Gaseous Diffusion Plant | Site: DATA GAPS

Client: Bechtel Jacobs Company LLC

Contractor: TN & Associates | Drill Contractor: Miller Drilling | Driller: G. MARKHAM

Start Time/Date: 1054 6/30/97 | End Time/Date: 1320/ 7/15/97 | Borehole Dia(s):

Drill Method/Rig Type: BAKER RIG | Total Depth: 316 FT

Logged By: D Schmoyer | Coordinates: | Protection Level: D

Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	Field Measurements Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
240								
245	48		5	BKG	0	A/A		t=1633
250	49		5	BKG	0	A/A		t=1635
255	50		5	BKG	0	A/A		t=1636
260	51		5	BKG	0	A/A		t=1732
265	52		5	BKG	0	A/A		t=1733
270	53		5	BKG	0	A/A		t=1734
275	54		5	BKG	0	A/A		t=1735
280	55		0			NO RECOVERY		
285	56		0			NO RECOVERY		
290	57		5	BKG	0	CLAY, DARK GREY (10YR 3/1) MED PLASTICITY		t=0952
295	58		5	BKG	0	A/A		t=0955
300	59		5	BKG	0	A/A HIGH PLASTICITY		t=2057

TN & ASSOCIATES, INC.
WAGs 3/8/28/DG RI
LITHOLOGIC LOG

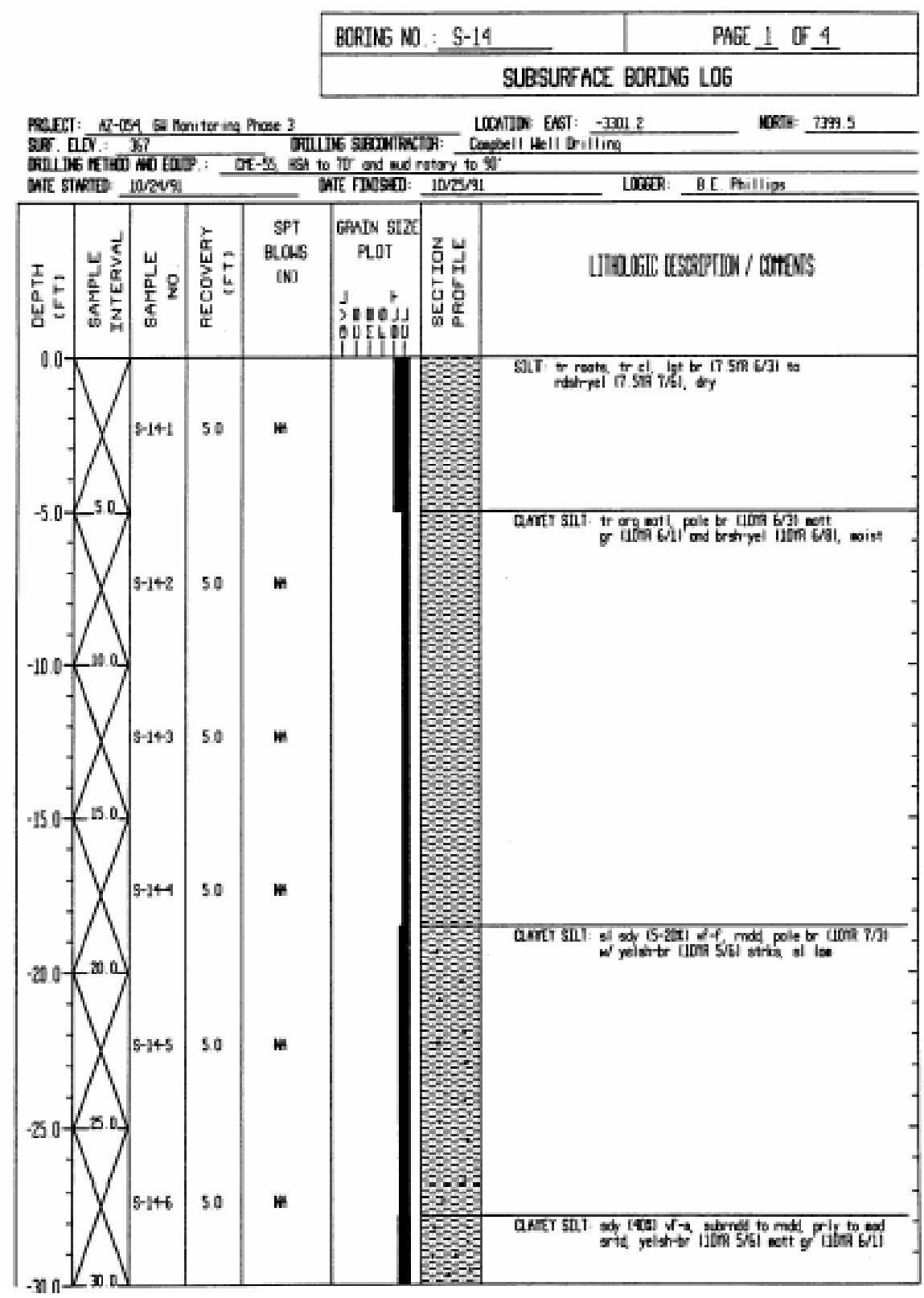
Project No.: 1999ar

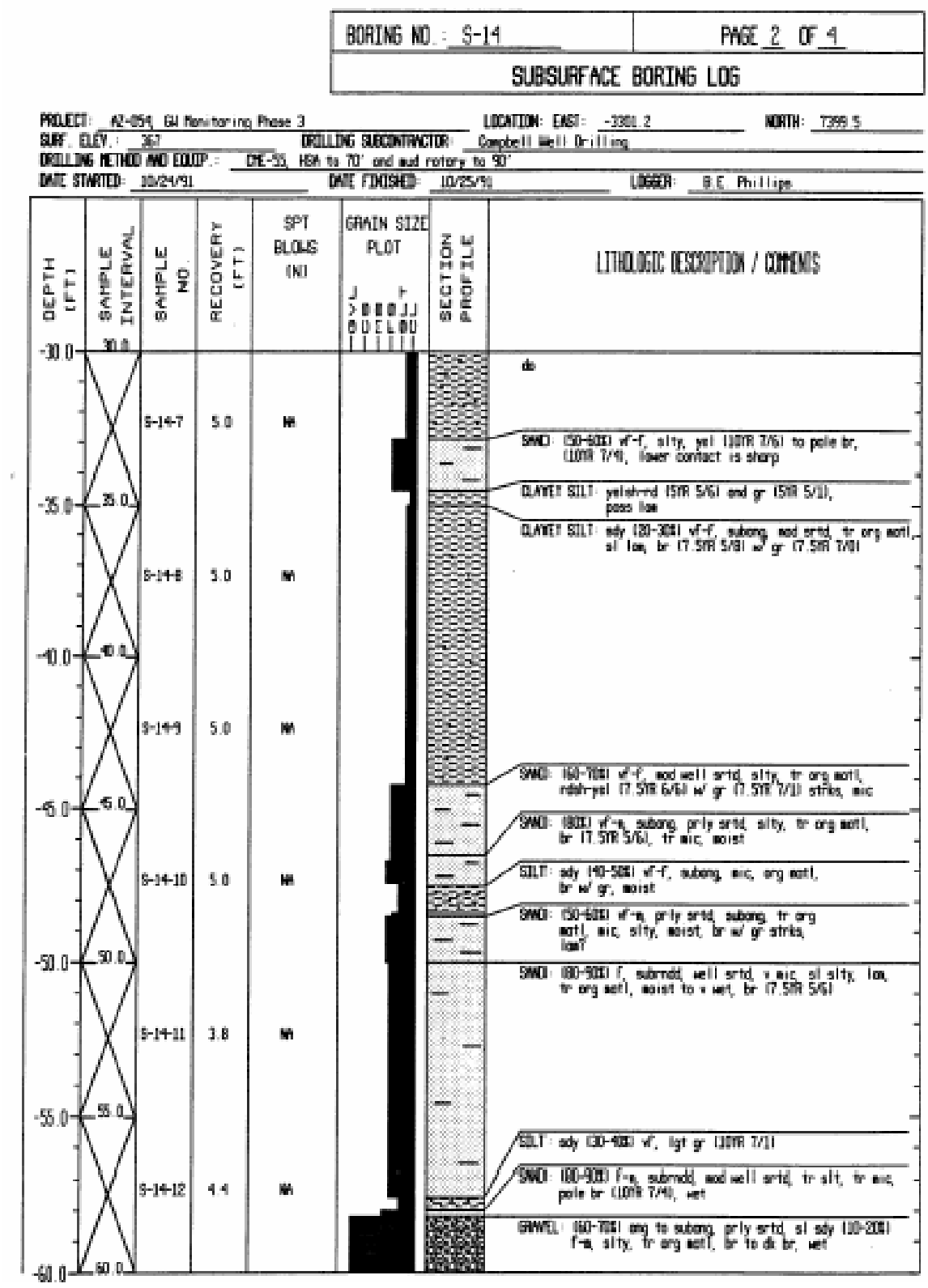
Task No.

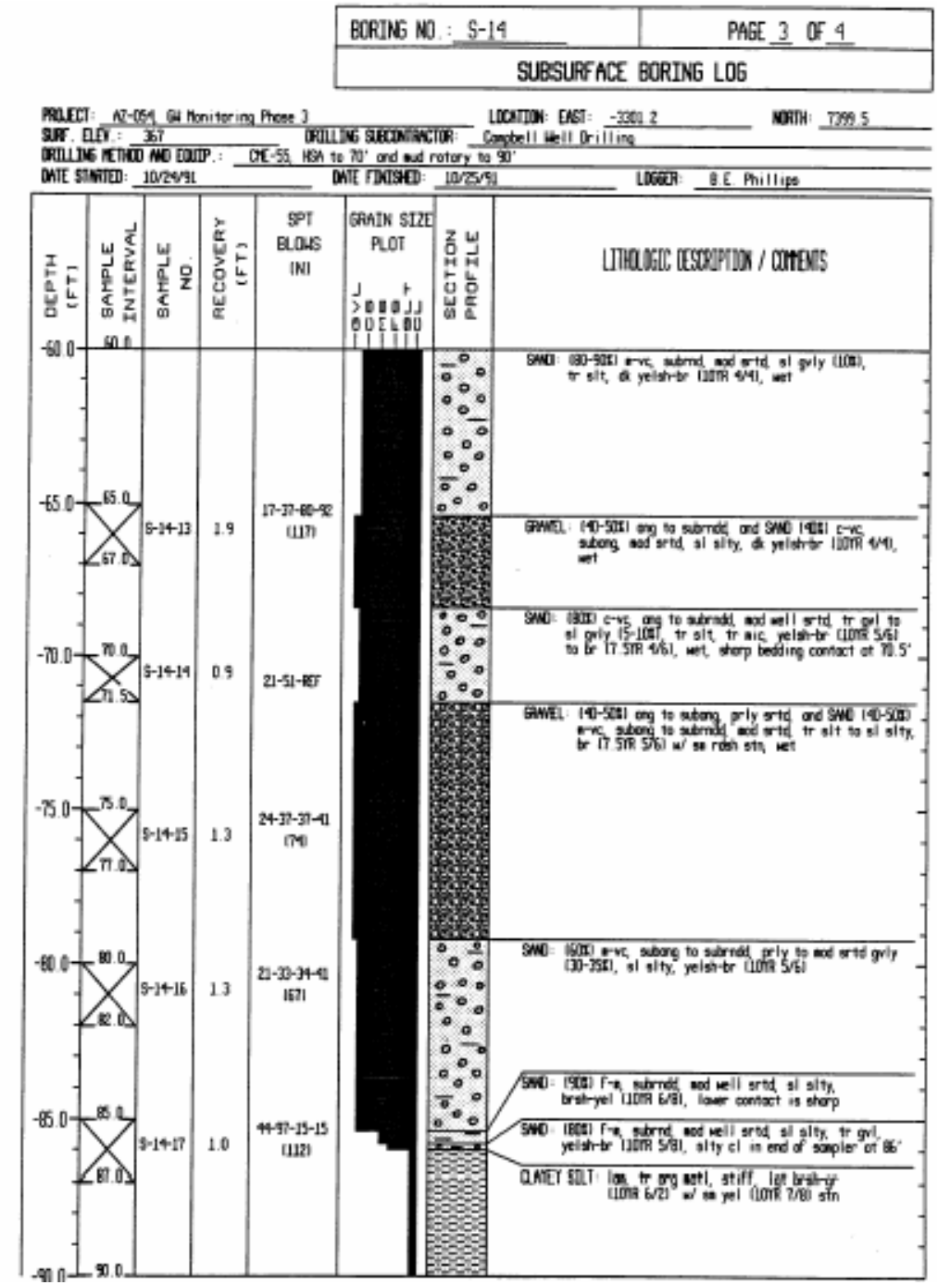
PAGE 6 of 6

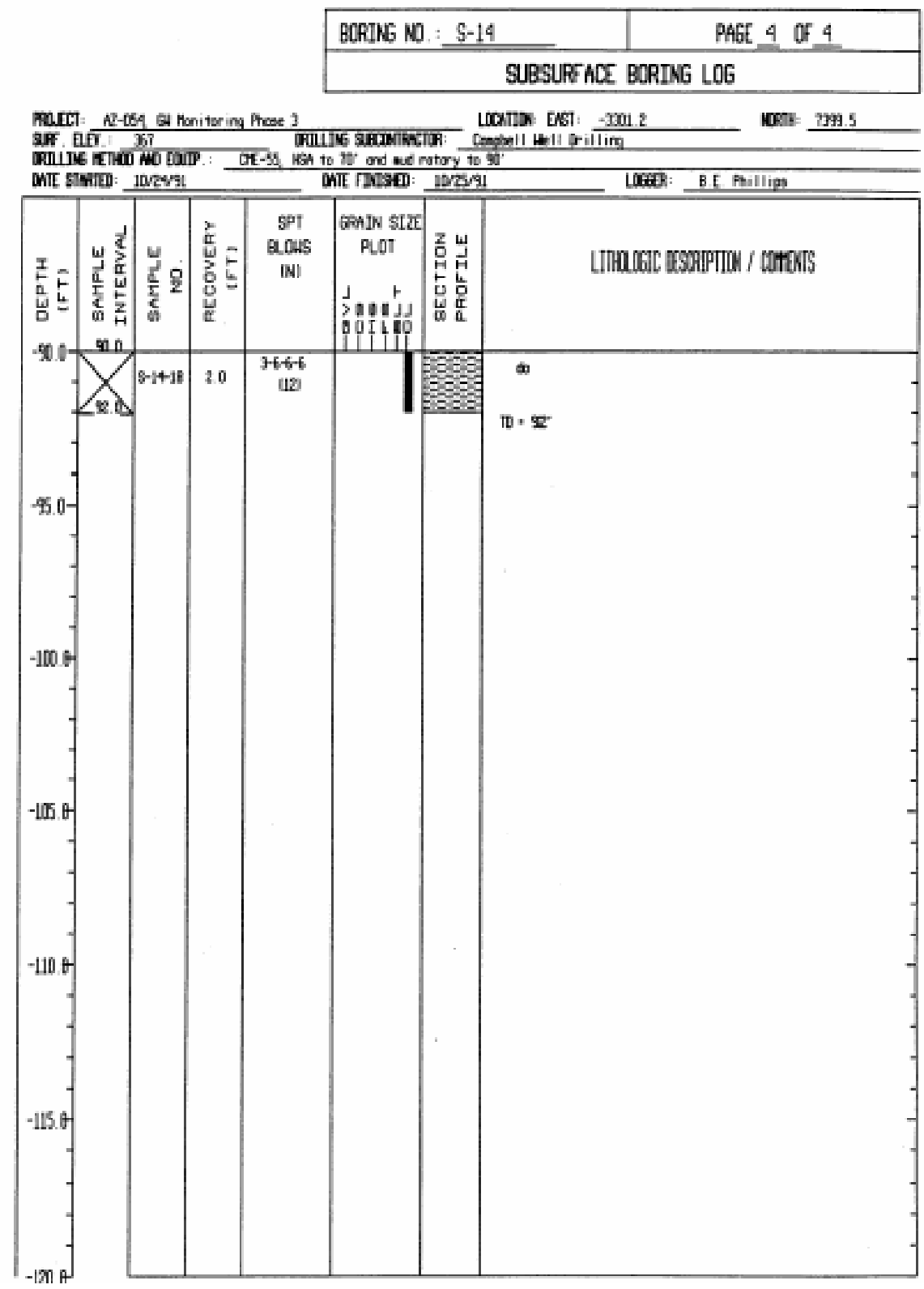
LITHOLOGIC LOG	Boring/Well No.: R23-MW346
Facility: Paducah Gaseous Diffusion Plant	Site: DATA GAPS
Client: Bechtel Jacobs Company LLC	
Contractor: TN & Associates	Drill Contractor: Miller Drilling
Start Time/Date: 1054 6/30/97	End Time/Date: 1320 / 7/15/97
Drill Method/Rig Type: BAKER RIG	Total Depth: 315 FT
Logged By: D SCHWARZ	Coordinates:
	Driller: G. MARCEAU
	Borehole Dia(s):
	Protection Level: D

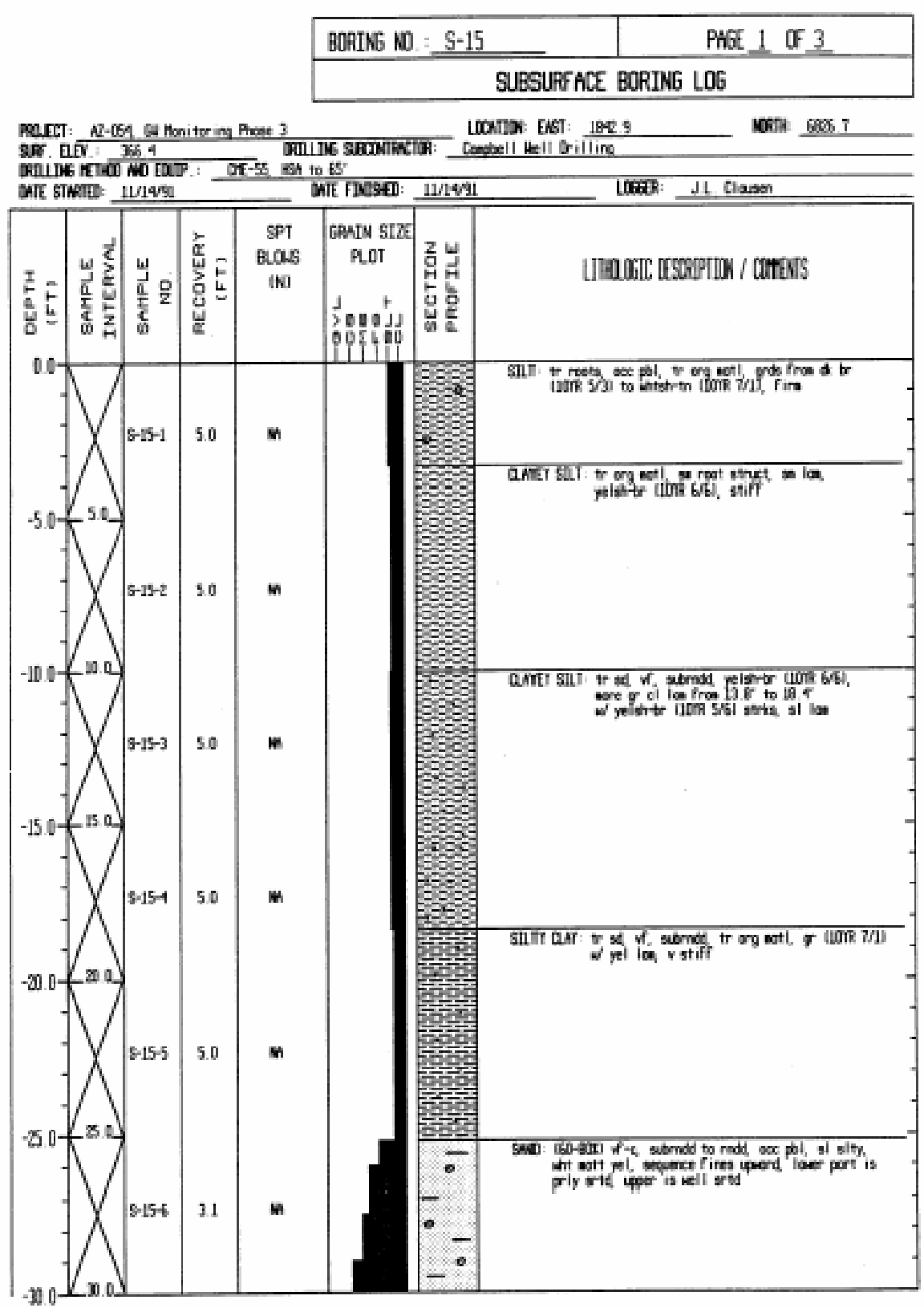
Depth (ft)	SAMPLE Interval	Number	Recovery (ft)	Field Measurements Beta/Gamma (cpm)	VOC's (ppm)	LITHOLOGIC DESCRIPTION	GRAPH LOG	COMMENTS
300								
305	(60)		5	BKG	0	LIMESTONE, FINE CRYSTALLINE, LT TO MED GRAY		t = 1102
310	(62)		5	BKG	0	A/A		t = 1112
315	(62)		5	BKG	0	A/A		t = 1245

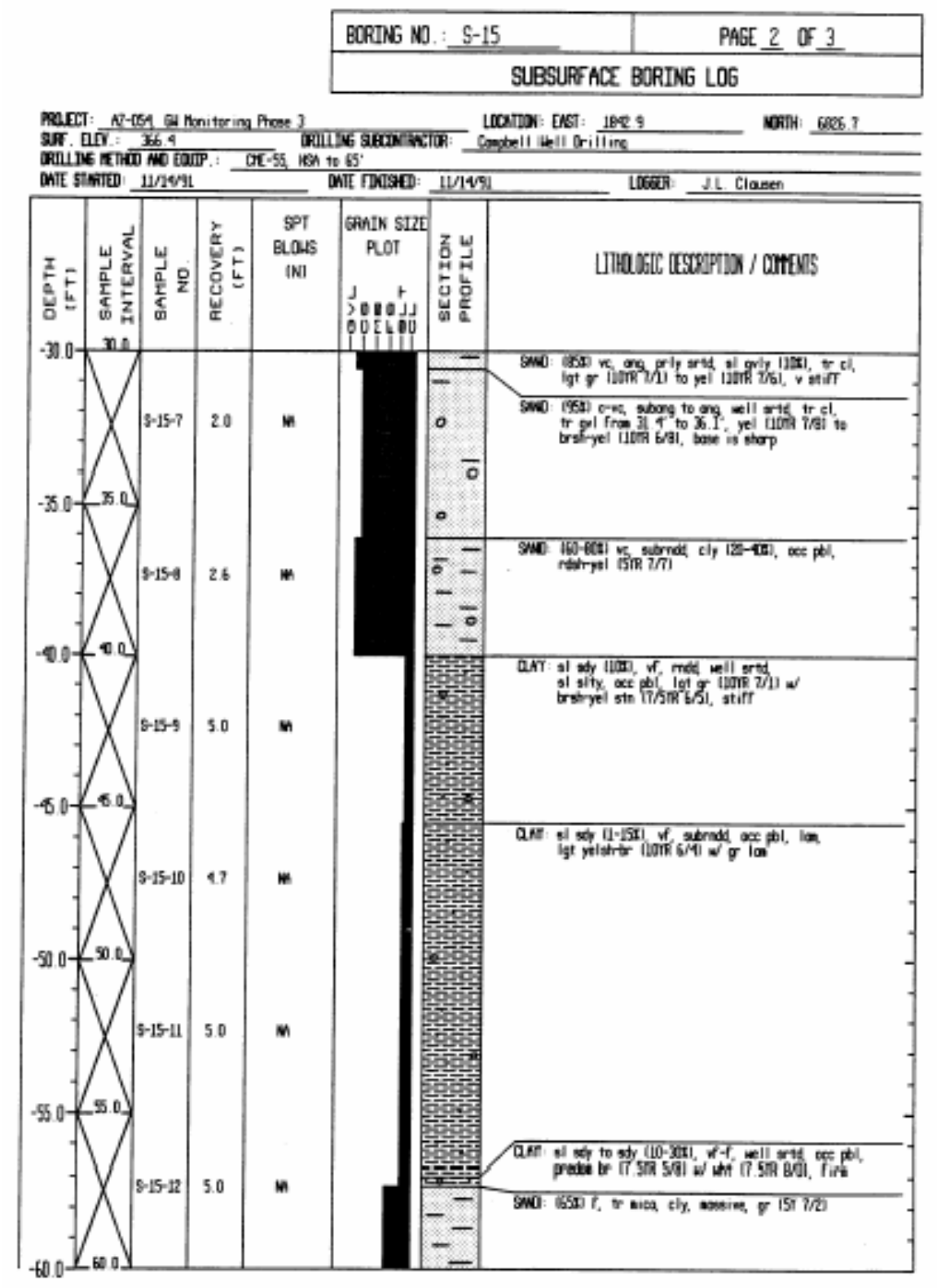

BORING NO.: S-14
PAGE 1 OF 4
SUBSURFACE BORING LOG
PROJECT: AZ-054, SW Monitoring Phase 2
LOCATION: EAST: -3301.2
NORTH: 7399.5
SURF. ELEV.: 367
DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA to TD and mud rotary to 90'
DATE STARTED: 10/24/91
DATE FINISHED: 10/25/91
LOGGER: B.E. Phillips
DEPTH (FT)
SAMPLE INTERVAL
SAMPLE NO.
RECOVERY (FT)
SPT BLOWS (N)
GRAIN SIZE PLOT
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
-30.0
5.0
10.0
15.0
20.0
25.0
30.0
S-14-1
S-14-2
S-14-3
S-14-4
S-14-5
S-14-6
5.0
NR
SILT: tr roots, tr cl, lgt br (7.5YR 6/3) to rdsh-yel (7.5YR 7/6), dry
CLAYEY SILT: tr org matl, pale br (10YR 6/3) matt gr (10YR 6/1) and brsh-yel (10YR 6/8), moist
CLAYEY SILT: sl sdy (5-20%) vf-f, rnded, pale br (10YR 7/3) w/ yelsh-br (10YR 5/6) strks, sl lse
CLAYEY SILT: sdy (40%) vf-s, submtld to rnded, pr'ly to mod srtd, yelsh-br (10YR 5/6) matt gr (10YR 6/1)


BORING NO.: S-14
PAGE 2 OF 4
SUBSURFACE BORING LOG
PROJECT: A2-054, GW Monitoring Phase 3
LOCATION: EAST: -3301.2
NORTH: 7399.5
SURF. ELEV.: 367
DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA to 70' and mud rotary to 90'
DATE STARTED: 10/24/91
DATE FINISHED: 10/25/91
LOGGER: B.E. Phillips
DEPTH (FT)
SAMPLE INTERVAL
SAMPLE NO.
RECOVERY (FT)
SPT BLOWS (N)
GRAIN SIZE PLOT
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
-30.0
30.0
S-14-7
5.0
NR
-35.0
35.0
S-14-8
5.0
NR
-40.0
40.0
S-14-9
5.0
NR
-45.0
45.0
S-14-10
5.0
NR
-50.0
50.0
S-14-11
3.8
NR
-55.0
55.0
S-14-12
4.4
NR
-60.0
60.0
do
SAND: (50-60%) vf-f, silty, yel (10YR 7/6) to pale br, (10YR 7/4), lower contact is sharp
CLAYEY SILT: yelsh-red (5YR 5/6) and gr (5YR 5/1), poss lam
CLAYEY SILT: sdy (20-30%) vf-f, subang, mod srtd, tr org matl, sl lam, br (7.5YR 5/8) w/ gr (7.5YR 7/0)
SAND: (60-70%) vf-f, mod well srtd, silty, tr org matl, redsh-yel (7.5YR 6/6) w/ gr (7.5YR 7/0) strks, mic
SAND: (80%) vf-s, subang, prly srtd, silty, tr org matl, br (7.5YR 5/6), tr mic, moist
SILT: sdy (40-50%) vf-f, subang, mic, org matl, br w/ gr, moist
SAND: (50-60%) vf-s, prly srtd, subang, tr org matl, mic, silty, moist, br w/ gr strks, lam?
SAND: (80-90%) f, submdd, well srtd, v mic, sl silty, lam, tr org matl, moist to v wet, br (7.5YR 5/6)
SILT: sdy (30-40%) vf, lgt gr (10YR 7/1)
SAND: (80-90%) f-s, submdd, mod well srtd, tr slt, tr mic, pale br (10YR 7/4), wet
GRAVEL: (60-70%) ang to subang, prly srtd, sl sdy (10-20%) f-s, silty, tr org matl, br to dk br, wet


BORING NO.: S-14
PAGE 3 OF 4
SUBSURFACE BORING LOG
PROJECT: AZ-05(1) GW Monitoring Phase 3
LOCATION: EAST: -3301.2
NORTH: 7399.5
SURF. ELEV.: 367
DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA to 70' and mud rotary to 90'
DATE STARTED: 10/24/91
DATE FINISHED: 10/25/91
LOGGER: B.E. Phillips
DEPTH (FT)
SAMPLE INTERVAL
SAMPLE NO.
RECOVERY (FT)
SPT BLOWS (N)
GRAIN SIZE PLOT
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
-60.0
60.0
-65.0
65.0
67.0
S-14-13
1.9
17-27-60-92 (117)
-70.0
70.0
71.5
S-14-14
0.9
21-51-REF
-75.0
75.0
77.0
S-14-15
1.3
24-37-37-41 (74)
-80.0
80.0
82.0
S-14-16
1.3
21-33-34-41 (67)
-85.0
85.0
87.0
S-14-17
1.0
44-97-15-15 (112)
-90.0
90.0
SAND: (80-90%) a-vc, subrnd, mod srtd, sl gvly (10%), tr slt, dk yelsh-br (10YR 4/4), wet
GRAVEL: (40-50%) ang to subrnd, and SAND (40%) c-vc, subang, mod srtd, sl silty, dk yelsh-br (10YR 4/4), wet
SAND: (80%) c-vc, ang to subrnd, mod well srtd, tr gvl to sl gvly (5-10%), tr slt, tr alc, yelsh-br (10YR 5/6) to br (7.5YR 4/6), wet, sharp bedding contact at 70.5'
GRAVEL: (40-50%) ang to subang, prly srtd, and SAND (40-50%) a-vc, subang to subrnd, mod srtd, tr slt to sl silty, br (7.5YR 5/6) w/ se rdsh stn, wet
SAND: (60%) a-vc, subang to subrnd, prly to mod srtd gvly (30-35%), sl silty, yelsh-br (10YR 5/6)
SAND: (90%) f-m, subrnd, mod well srtd, sl silty, brsh-yel (10YR 6/8), lower contact is sharp
SAND: (80%) f-m, subrnd, mod well srtd, sl silty, tr gvl, yelsh-br (10YR 5/8), silty cl in end of sampler at 86'
CLAYEY SILT: los, tr org matl, stiff, lgt brsh-gy (10YR 6/2) w/ ss yel (10YR 7/8) stn


BORING NO.: S-14
PAGE 4 OF 4
SUBSURFACE BORING LOG
PROJECT: A2-054 GA Monitoring Phase 3
LOCATION: EAST: -3301.2
NORTH: 7399.5
SURF. ELEV.: 367
DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA to 70' and mud rotary to 90'
DATE STARTED: 10/24/91
DATE FINISHED: 10/25/91
LOGGER: B.E. Phillips
DEPTH (FT)
SAMPLE INTERVAL
SAMPLE NO.
RECOVERY (FT)
SPT BLOWS (N)
GRAIN SIZE PLOT
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
-90.0
90.0
92.0
S-14-18
2.0
3-6-6-6
(12)
do
TD = 92'
-95.0
-100.0
-105.0
-110.0
-115.0
-120.0


BORING NO.: S-15
PAGE 1 OF 3
SUBSURFACE BORING LOG
PROJECT: A2-054 GW Monitoring Phase 3
LOCATION: EAST: 1842.9
NORTH: 6826.7
SURF. ELEV.: 366.4
DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA to 65'
DATE STARTED: 11/14/91
DATE FINISHED: 11/14/91
LOGGER: J.L. Clausen
DEPTH (FT)
SAMPLE INTERVAL
SAMPLE NO.
RECOVERY (FT)
SPT BLOWS (N)
GRAIN SIZE PLOT
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
0.0
S-15-1
5.0
NA
SILT: tr roots, occ pbl, tr org matl, grds from dk br (10YR 3/3) to whtsh-tn (10YR 7/1), firm
-5.0
5.0
CLAYEY SILT: tr org matl, sm root struct, sm loss, yelsh-br (10YR 6/6), stiff
S-15-2
5.0
NA
-10.0
10.0
CLAYEY SILT: tr sd, vf, submdd, yelsh-br (10YR 6/6), morc gr cl los from 13.8' to 18.4' w/ yelsh-br (10YR 5/6) strks, sl los
S-15-3
5.0
NA
-15.0
15.0
S-15-4
5.0
NA
SILTY CLAY: tr sd, vf, submdd, tr org matl, gr (10YR 7/1) w/ yel los, v stiff
-20.0
20.0
S-15-5
5.0
NA
-25.0
25.0
SAND: (SO-BOX) vf-c, submdd to rndd, occ pbl, sl silty, wht matl yel, sequence fines upward, lower part is poly srtd, upper is well srtd
S-15-6
3.1
NA
-30.0
30.0



BORING NO.: S-15 PAGE 2 OF 3

SUBSURFACE BORING LOG

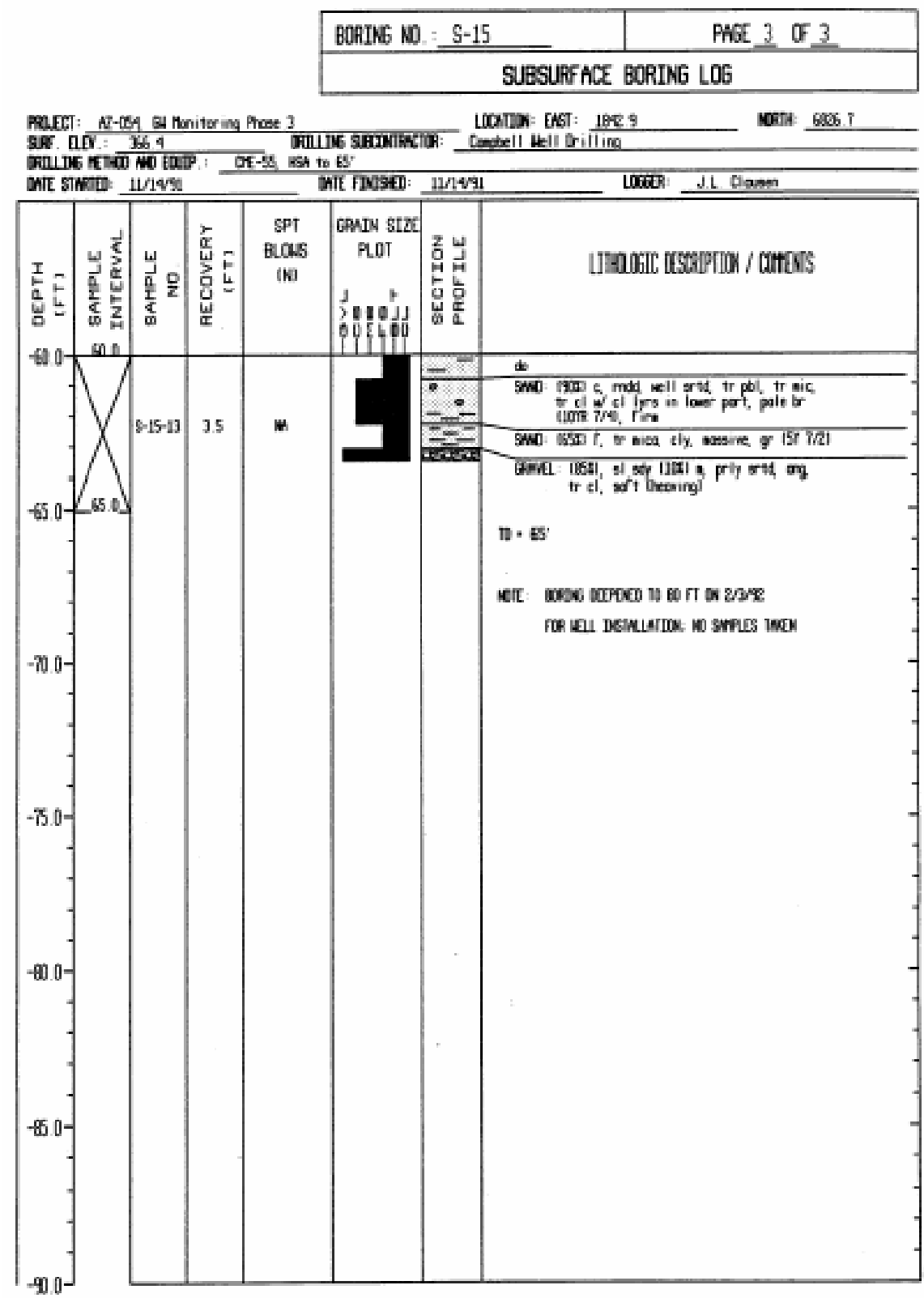
PROJECT: A7-054 GW Monitoring Phase 3 LOCATION: EAST: 1892.9 NORTH: 6826.7

SURF. ELEV.: 366.9 DRILLING SUBCONTRACTOR: Campbell Well Drilling

DRILLING METHOD AND EQUIP.: CME-55, HSA to 65'

DATE STARTED: 11/14/91 DATE FINISHED: 11/14/91 LOGGER: J.L. Clausen

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)	GRAIN SIZE PLOT	SECTION PROFILE	LITHOLOGIC DESCRIPTION / COMMENTS
-30.0	30.0						SAND: (85%) vc, ang, prly srtd, sl cnly (10%), tr cl, lgt gr (10YR 7/1) to yel (10YR 7/6), v stiff
		S-15-7	2.0	NA			SAND: (95%) c-vc, subang to ang, well srtd, tr cl, tr gvl from 31.9' to 36.1', yel (10YR 7/8) to brsh-yel (10YR 6/8), base is sharp
-35.0	35.0						
		S-15-8	2.6	NA			SAND: (60-80%) vc, subrndd, cly (20-40%), occ pbl, rdsh-yel (5YR 7/7)
-40.0	40.0						
		S-15-9	5.0	NA			CLAY: sl sdy (10%), vf, rndd, well srtd, sl silty, occ pbl, lgt gr (10YR 7/1) w/ brsh-yel stn (7.5YR 6/6), stiff
-45.0	45.0						
		S-15-10	4.7	NA			CLAY: sl sdy (1-15%), vf, subrndd, occ pbl, lam, lgt yelsh-br (10YR 6/4) w/ gr lam
-50.0	50.0						
		S-15-11	5.0	NA			
-55.0	55.0						
		S-15-12	5.0	NA			CLAY: sl sdy to sdy (10-30%), vf-f, well srtd, occ pbl, predom br (7.5YR 5/8) w/ wht (7.5YR 8/0), firm
-60.0	60.0						SAND: (65%) f, tr mica, cly, massive, gr (5Y 7/2)



BORING NO.: S-15 | PAGE 3 OF 3

SUBSURFACE BORING LOG

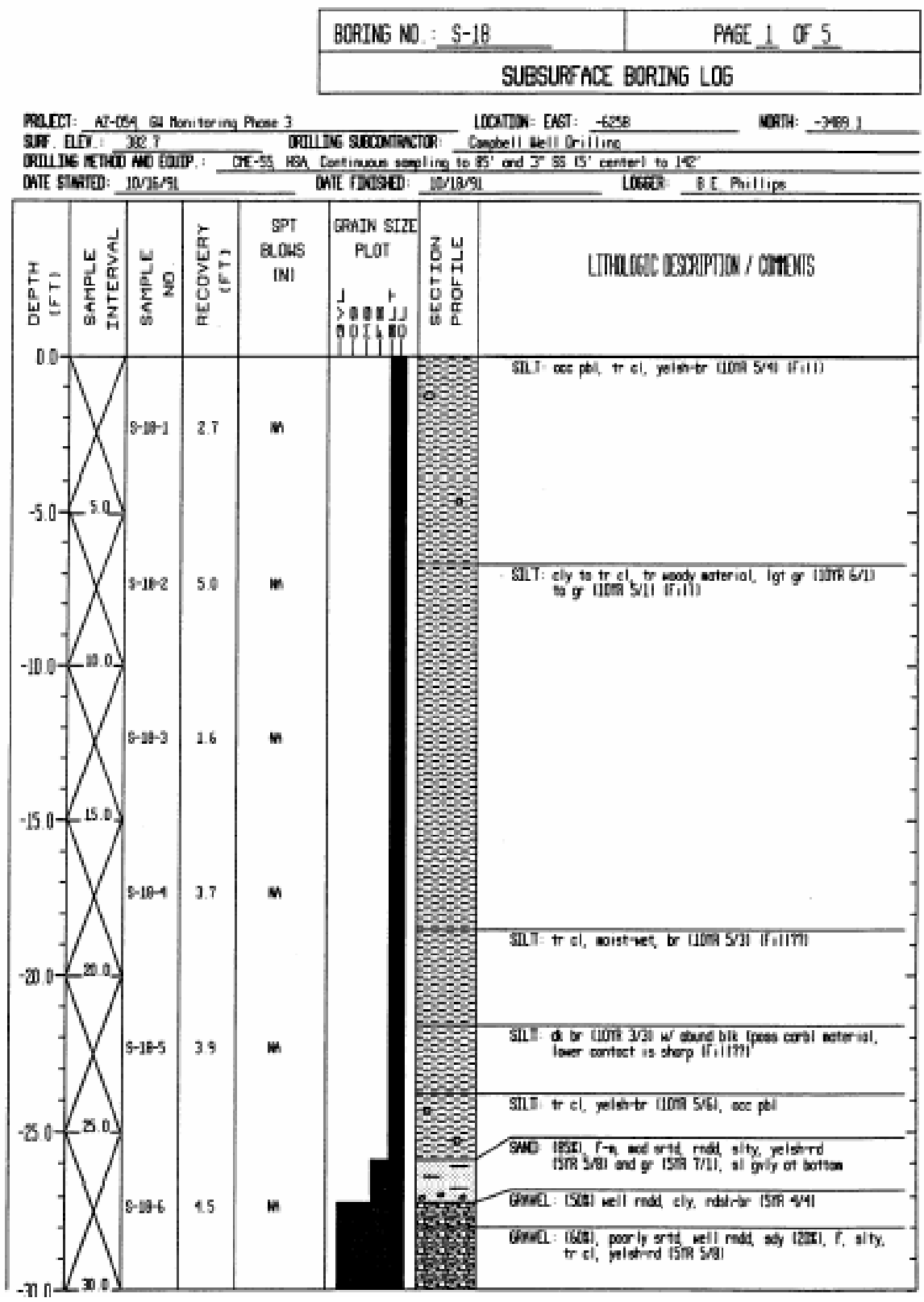
PROJECT: AZ-054 GW Monitoring Phase 3 | LOCATION: EAST: 1842.9 | NORTH: 6826.7

SURF. ELEV.: 366.9 | DRILLING SUBCONTRACTOR: Campbell Well Drilling

DRILLING METHOD AND EQUIP.: CME-55, HSA to 65'

DATE STARTED: 11/14/91 | DATE FINISHED: 11/14/91 | LOGGER: J.L. Clausen

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO	RECOVERY (FT)	SPT BLOWS (N)	GRAIN SIZE PLOT	SECTION PROFILE	LITHOLOGIC DESCRIPTION / COMMENTS
-60.0	60.0	S-15-03	3.5	NA			do SAND: (POOR) c, mdd, well srtd, tr pbl, tr mic, tr cl w/ cl lyrs in lower part, pale br (10YR 7/4), f lns SAND: (GOOD) f, tr mica, cly, massive, gr (5Y 7/2) GRAVEL: (DSA), sl sdy (10A) a, prly srtd, ang, tr cl, sat'd (heaving)
-65.0	65.0						TD = 65' NOTE: BORING DEEPENED TO 80 FT ON 2/3/92 FOR WELL INSTALLATION: NO SAMPLES TAKEN
-70.0							
-75.0							
-80.0							
-85.0							
-90.0							



BORING NO.: S-18 | PAGE 1 OF 5

SUBSURFACE BORING LOG

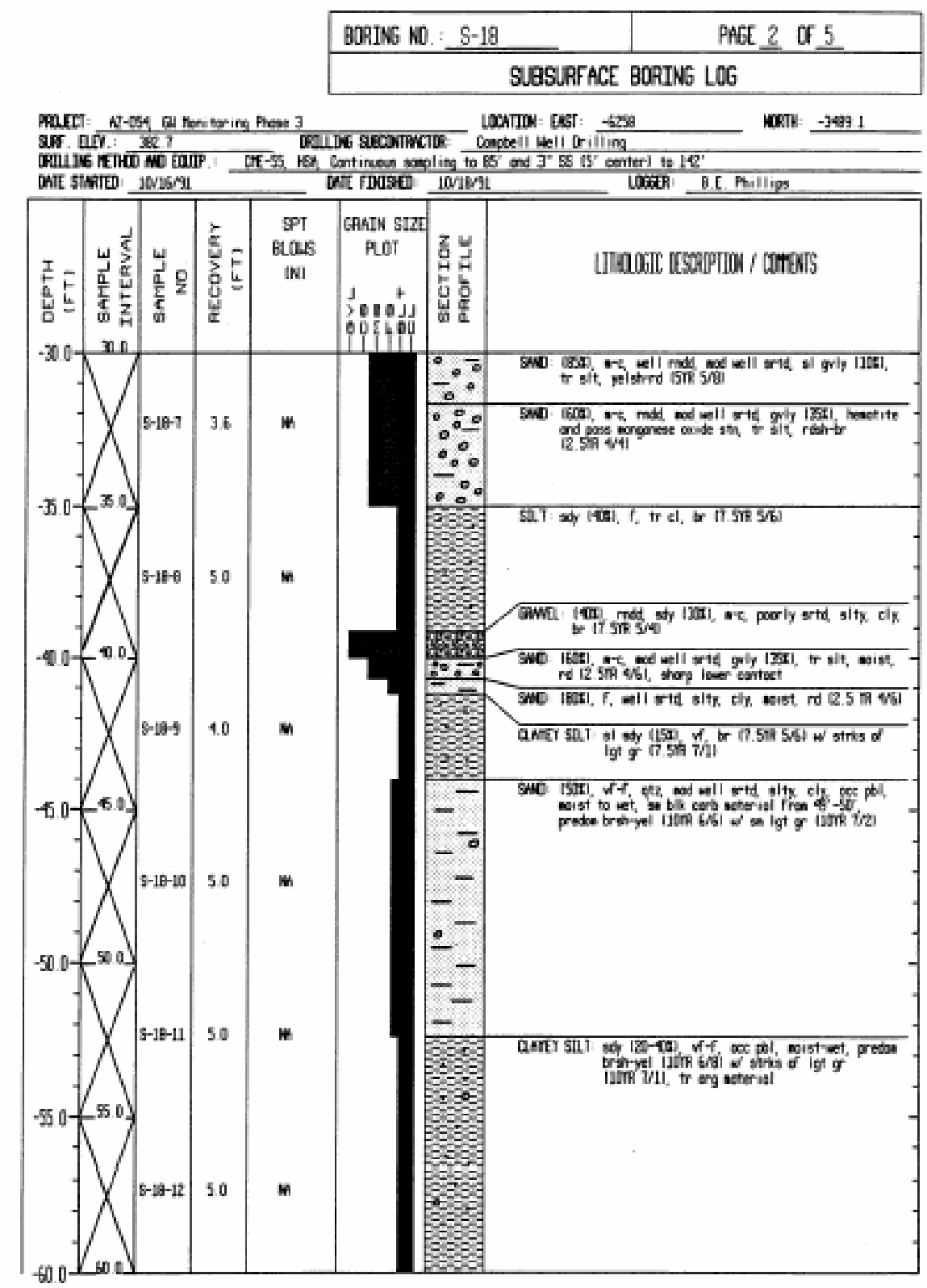
PROJECT: AT-054, GW Monitoring Phase 3 | LOCATION: EAST: -6258 | NORTH: -3488.1

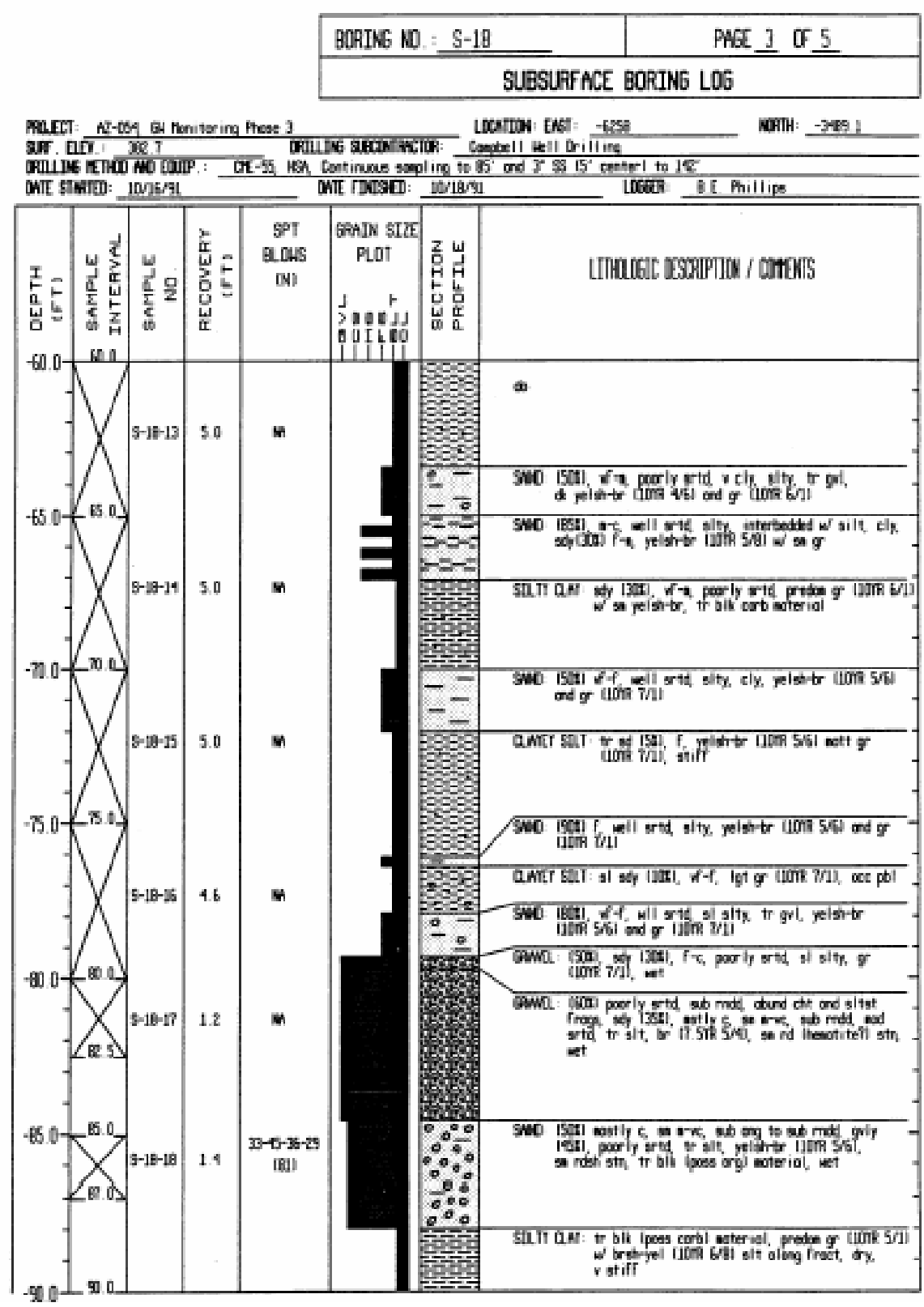
SURF. ELEV.: 302.7 | DRILLING SUBCONTRACTOR: Campbell Well Drilling

DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 85' and 3" SS (5' centers) to 140'

DATE STARTED: 10/16/91 | DATE FINISHED: 10/18/91 | LOGGER: B.E. Phillips

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)	GRAIN SIZE PLOT	SECTION PROFILE	LITHOLOGIC DESCRIPTION / COMMENTS
0.0							SILT: occ pbl, tr cl, yelsh-br (10YR 5/4) (FILL)
		S-18-1	2.7	WH			
-5.0	5.0						
		S-18-2	5.0	WH			SILT: cly to tr cl, tr woody material, lgt gr (10YR 6/1) to gr (10YR 5/1) (FILL)
-10.0	10.0						
		S-18-3	1.6	WH			
-15.0	15.0						
		S-18-4	3.7	WH			SILT: tr cl, moist-wet, br (10YR 5/3) (FILL?)
-20.0	20.0						
		S-18-5	3.9	WH			SILT: dk br (10YR 3/3) w/ abund blk (peas coal) material, lower contact is sharp (FILL?)
							SILT: tr cl, yelsh-br (10YR 5/6), occ pbl
-25.0	25.0						SAND: (SP-SM), f-m, wod srtd, rnd-sbl, silty, yelsh-rd (5YR 5/8) and gr (5YR 7/1), sl gvly at bottom
		S-18-6	4.5	WH			GRAVEL: (SW), well rnd-sbl, cly, rdsh-br (5YR 4/4)
-31.0	30.0						GRAVEL: (GW), poorly srtd, well rnd-sbl, sdy (SW), f, silty, tr cl, yelsh-rd (5YR 5/8)


BORING NO.: S-18
PAGE 2 OF 5
SUBSURFACE BORING LOG
PROJECT: AT-054, GW Monitoring Phase 3
LOCATION: EAST: -6258
NORTH: -3489.1
SURF. ELEV.: 382.7
DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 65' and 3" SS (5' centers to 140'
DATE STARTED: 10/16/91
DATE FINISHED: 10/18/91
LOGGER: B.E. Phillips
DEPTH (FT)
SAMPLE INTERVAL
SAMPLE NO.
RECOVERY (FT)
SPT BLOWS (N)
GRAIN SIZE PLOT
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
-30.0
30.0
S-18-7
3.6
NA
SAND: (SW), a-c, well rndd, mod well srtd, sl gvly (10%), tr silt, yelsh-rrd (5YR 5/8)
SAND: (SC), a-c, rndd, mod well srtd, gvly (25%), hematite and poss manganese oxide stn, tr silt, rdsh-br (2.5YR 4/4)
-35.0
35.0
SILT: sdy (40%), f, tr cl, br (7.5YR 5/6)
S-18-8
5.0
NA
GRAVEL: (40%), rndd, sdy (30%), a-c, poorly srtd, silty, cly, br (7.5YR 5/4)
-40.0
40.0
SAND: (SC), a-c, mod well srtd, gvly (25%), tr silt, moist, rd (2.5YR 4/6), sharp lower contact
SAND: (SW), f, well srtd, silty, cly, moist, rd (2.5 YR 4/6)
S-18-9
4.0
NA
CLAYEY SILT: sl sdy (15%), vf, br (7.5YR 5/6) w/ strks of lgt gr (7.5YR 7/1)
-45.0
45.0
SAND: (SC), vf-f, qtz, mod well srtd, silty, cly, occ pbl, moist to wet, sm blk carb material from 48'-50', predom brsh-yel (10YR 6/6) w/ sm lgt gr (10YR 7/2)
S-18-10
5.0
NA
-50.0
50.0
S-18-11
5.0
NA
CLAYEY SILT: sdy (20-40%), vf-f, occ pbl, moist-wet, predom brsh-yel (10YR 6/8) w/ strks of lgt gr (10YR 7/1), tr org material
-55.0
55.0
S-18-12
5.0
NA
-60.0
60.0


BORING NO.: S-18
PAGE 3 OF 5
SUBSURFACE BORING LOG
PROJECT: AZ-054 GW Monitoring Phase 3
LOCATION: EAST: -6258
NORTH: -2489.1
SURF. ELEV.: 382.7
DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 85' and 3" SS 15' center1 to 145'
DATE STARTED: 10/16/91
DATE FINISHED: 10/18/91
LOGGER: B.E. Phillips
DEPTH (FT)
SAMPLE INTERVAL
SAMPLE NO.
RECOVERY (FT)
SPT BLOWS (N)
GRAIN SIZE PLOT
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
-60.0
60.0
S-18-13
5.0
NA
clo
SAND (SW) vf-m, poorly srtd, v cly, silty, tr gvl, dk yelsh-br (10YR 4/6) and gr (10YR 6/1)
-65.0
65.0
SAND (SP) m-c, well srtd, silty, interbedded w/ silt, cly, sdy (SM) f-m, yelsh-br (10YR 5/8) w/ sm gr
S-18-14
5.0
NA
SILTY CLAY: sdy (SM), vf-m, poorly srtd, predom gr (10YR 6/1) w/ sm yelsh-br, tr blk carb material
-70.0
70.0
SAND (SW) vf-f, well srtd, silty, cly, yelsh-br (10YR 5/6) and gr (10YR 7/1)
S-18-15
5.0
NA
CLAYEY SILT: tr sd (SM), f, yelsh-br (10YR 5/6) mott gr (10YR 7/1), stiff
-75.0
75.0
SAND (SW) f, well srtd, silty, yelsh-br (10YR 5/6) and gr (10YR 7/1)
CLAYEY SILT: sl sdy (SM), vf-f, lgt gr (10YR 7/1), occ pbl
S-18-16
4.6
NA
SAND (SM), vf-f, wll srtd, sl silty, tr gvl, yelsh-br (10YR 5/6) and gr (10YR 7/1)
-80.0
80.0
GRAVEL (SW) sdy (SM), f-c, poorly srtd, sl silty, gr (10YR 7/1), wet
GRAVEL (GW) poorly srtd, sub rndd, abund clst and silstst frags, sdy (SM), mstly c, sm m-vc, sub rndd, mod srtd, tr silt, br (7.5YR 5/4), sm rd lithomarkell stn, wet
S-18-17
1.2
NA
82.5
-85.0
85.0
S-18-18
1.4
33-45-36-25 (81)
87.0
SAND (SW) mostly c, sm m-vc, sub ang to sub rndd, qvly (MSH), poorly srtd, tr silt, yelsh-br (10YR 5/6), sm rdsh stn, tr blk (poss org) material, wet
SILTY CLAY: tr blk (poss carbl material, predom gr (10YR 5/1) w/ brsh-yel (10YR 6/8) silt along fract, dry, v stiff
-90.0
90.0

BORING NO.: S-18 | PAGE 1 OF 5

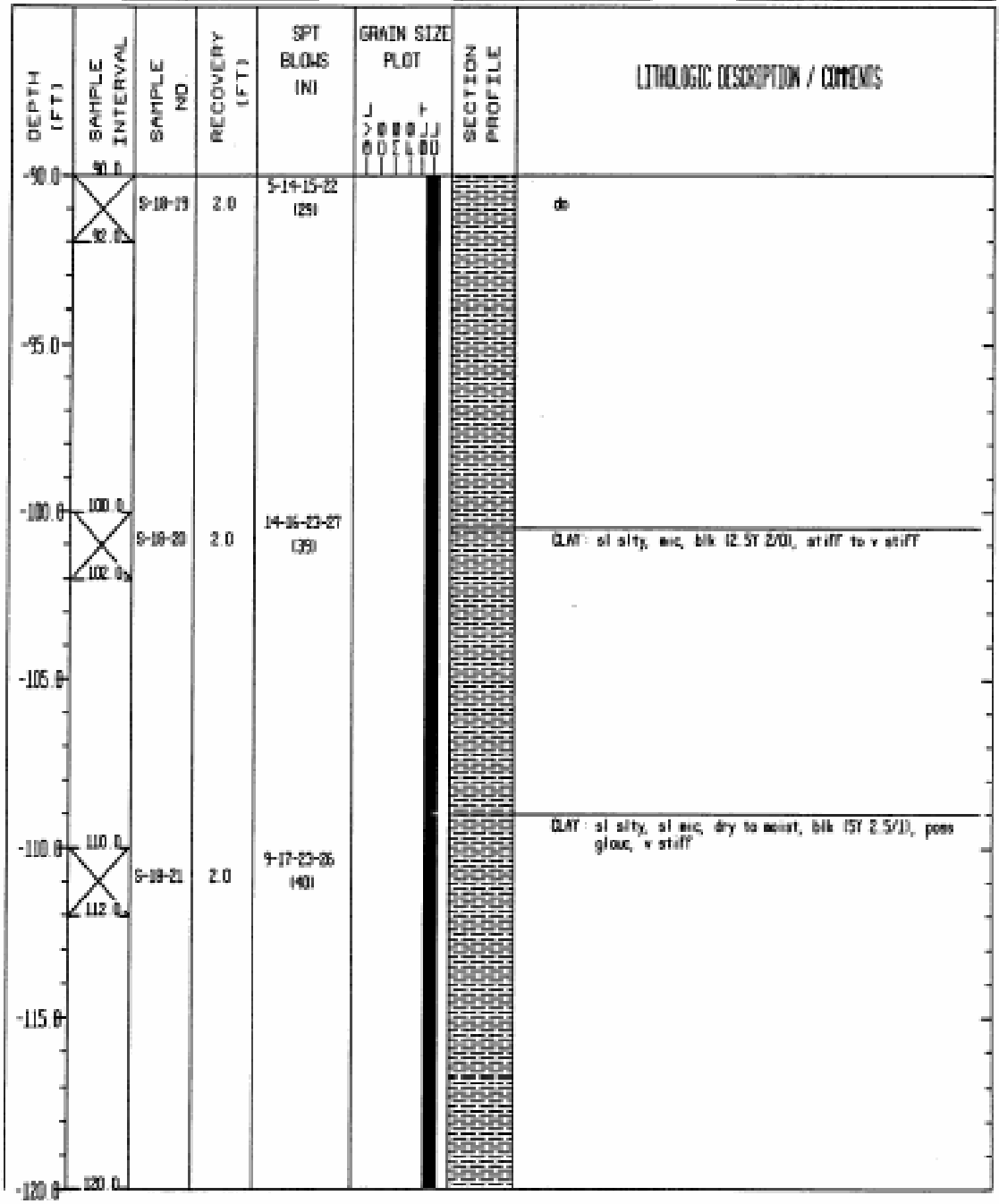
SUBSURFACE BORING LOG

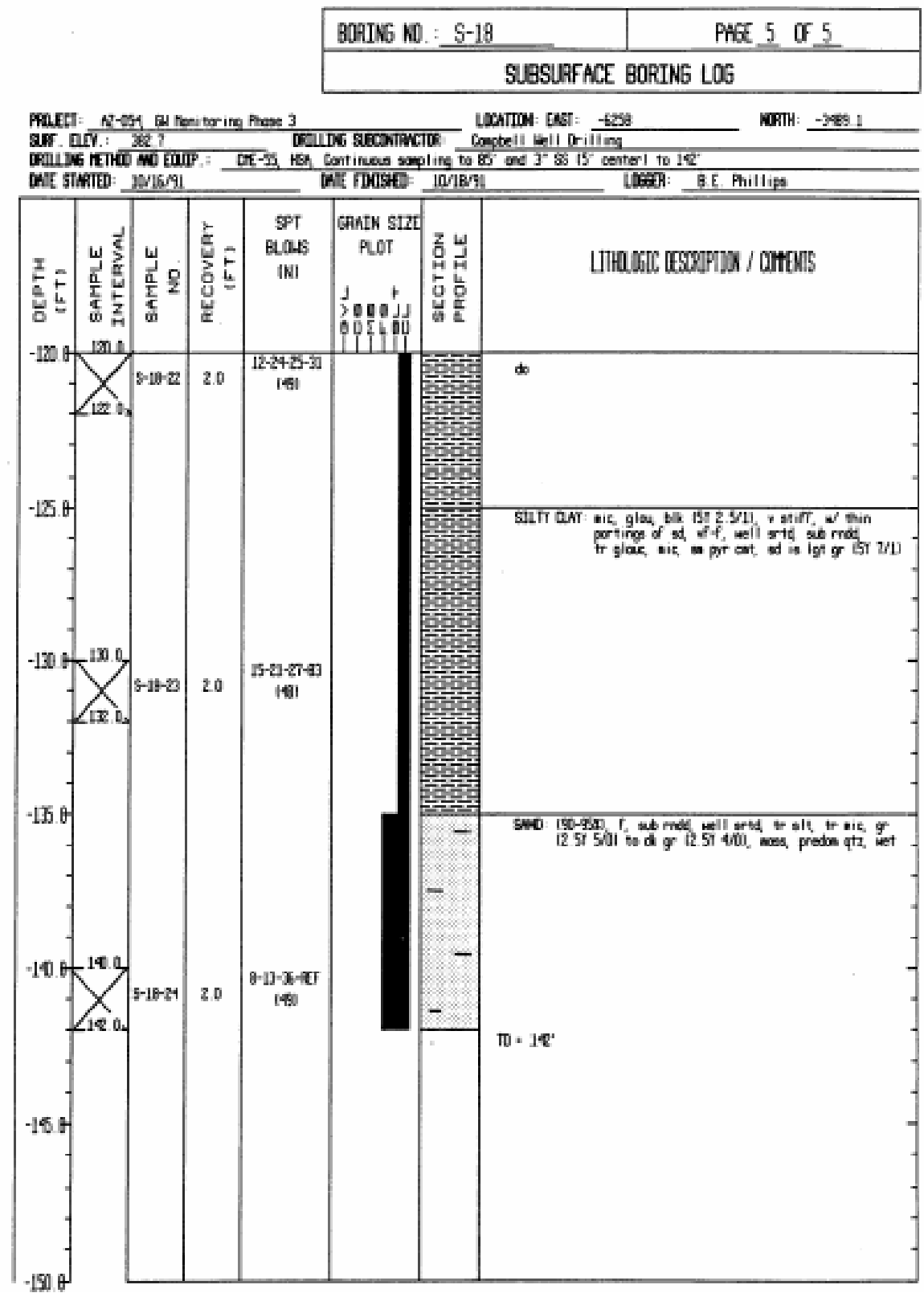
PROJECT: AF-054, GW Monitoring Phase 3 LOCATION: EAST: -6258 NORTH: -2489.1

SURF. ELEV.: 382.7 DRILLING SUBCONTRACTOR: Campbell Well Drilling

DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 85' and 3" SS (5' center) to 142'

DATE STARTED: 10/16/91 DATE FINISHED: 10/18/91 LOGGER: B.E. Phillips




BORING NO.: S-18
PAGE 5 OF 5
SUBSURFACE BORING LOG
PROJECT: AZ-054, GM Monitoring Phase 3
LOCATION: EAST: -6258
NORTH: -7489.1
SURF. ELEV.: 382 ?
DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-75, HSA, Continuous sampling to 85' and 3" SS 15' centerl to 142'
DATE STARTED: 10/16/91
DATE FINISHED: 10/18/91
LOGGER: B.E. Phillips
DEPTH (FT)
SAMPLE INTERVAL
SAMPLE NO.
RECOVERY (FT)
SPT BLOWS (N)
GRAIN SIZE PLOT
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
-120.0
120.0
122.0
S-18-22
2.0
12-24-25-31 (49)
do
-125.0
SILTY CLAY: mic, glau, blk (5Y 2.5/1), v stiff, w/ thin partings of sd, vf-f, well srtd, sub rndd, tr gluac, mic, sm pyr cmt, sd is lgt gr (5Y 7/1)
-130.0
130.0
132.0
S-18-23
2.0
25-23-27-83 (49)
-135.0
SAND: (SP-SM), f, sub rndd, well srtd, tr silt, tr mic, gr (2.5Y 5/0) to dk gr (2.5Y 4/0), mass, predom qtz, wet
-140.0
140.0
142.0
S-18-24
2.0
8-13-36-HET (49)
TD = 142'
-145.0
-150.0

BORING NO.: S-19 | PAGE 1 OF 3

SUBSURFACE BORING LOG

PROJECT: AT-054, GW Monitoring Phase 3 | LOCATION: EAST: -4596.8 | NORTH: -3698.5

SURF. ELEV.: 371.4 | DRILLING SUBCONTRACTOR: Campbell Well Drilling

DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 65'

DATE STARTED: 10/22/91 | DATE FINISHED: 10/22/91 | LOGGER: B.E. Phillips

DEPTH (FT)	SAMPLE INTERVAL	SAMPLE NO.	RECOVERY (FT)	SPT BLOWS (N)	GRAIN SIZE PLOT	SECTION PROFILE	LITHOLOGIC DESCRIPTION / COMMENTS
0.0							SILT: occ pbl, tr cl, tr vf-f sd (5%), roots, pale br (10YR 6/3) to lgt br (10YR 7/3)
		S-19-1	4.3	NA			
-5.0	5.0						
		S-19-2	3.5	NA			SAND: (80%) a-c, rndd to subrndd, mod well srtd, sl silty, sl gvly (15%), f ine lam, br (7.5YR 5/4)
							GRAVEL: (60%) subang, sdy (30%), a-c, subrndd, mod srtd, sl silty, reddish-br (2.5YR 4/4)
-10.0	10.0						SAND: (60-70%) f-m, subrndd, mod well srtd, silty, sl cl, occ pbl, pale br (10YR 7/4)
		S-19-3	3.5	NA			SAND: (80%), a-c, subrndd, mod well srtd, sl gvly (15%), rndd, tr silt, wet, br
							CLAY: sl silty, lgt gr (7.5YR 7/1)
-15.0	15.0						GRAVEL: (50-60%), poorly srtd, sdy (30-40%), c, mod srtd, sl silty, br (7.5YR 5/8)
		S-19-4	3.5	NA			CLAYEY SILT: tr sd to sdy (up to 40%), f-m, rndd, sl lam, yelsh-br and gr
-20.0	20.0						
		S-19-5	5.0	NA			
-25.0	25.0						SAND: (50-60%) a, subrndd, well srtd, silty, occ pbl, lgt yelsh-br (10YR 6/4), wet
							SAND: (70-80%) f-m, mod well srtd, tr gvl, silty, br (7.5YR 5/4), base is cly and contains 40% gvl
		S-19-6	4.7	NA			
-30.0	30.0						SILTY CLAY: sdy (25-30%) vf-f, gr (7.5YR 7/1) and br (7.5YR 4/4)

BORING NO.: S-19	PAGE 2 OF 3

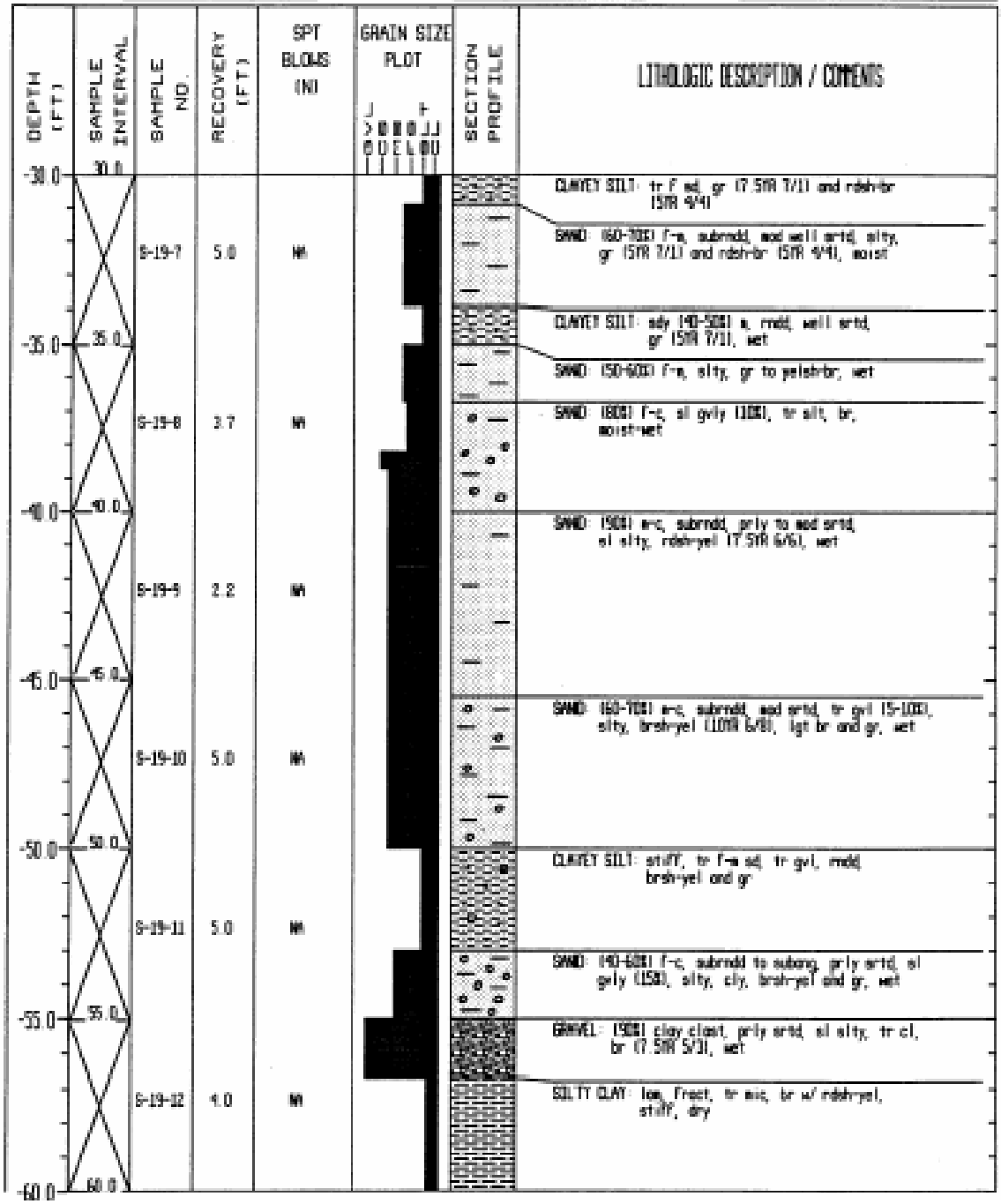
SUBSURFACE BORING LOG

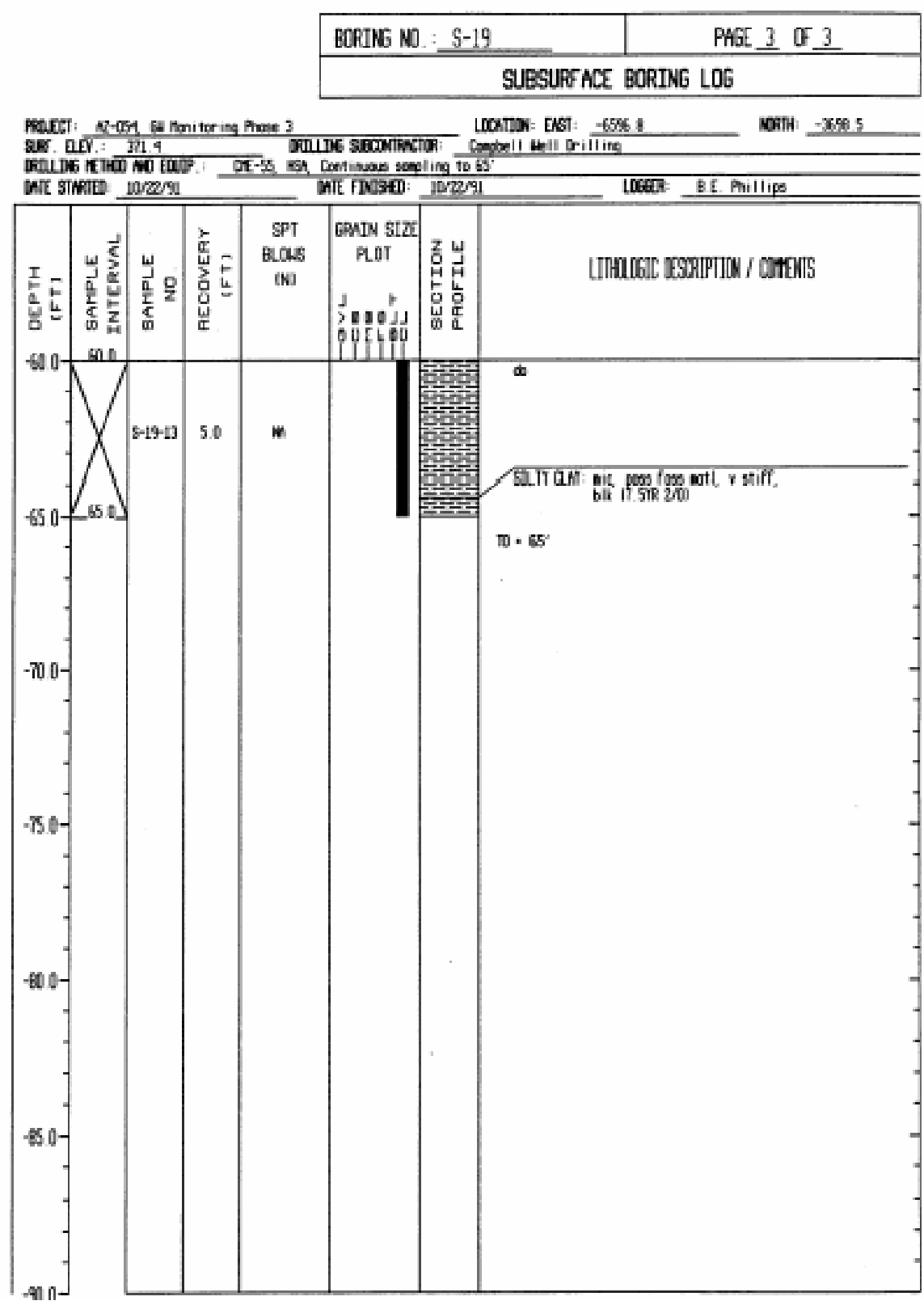
PROJECT: A2-054, GW Monitoring Phase 3 LOCATION: EAST: -1596.8 NORTH: -3698.5

SURF. ELEV.: 371.4 DRILLING SUBCONTRACTOR: Campbell Well Drilling

DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 65'

DATE STARTED: 10/22/91 DATE FINISHED: 10/22/91 LOGGER: B.E. Phillips




BORING NO.: S-19
PAGE 3 OF 3
SUBSURFACE BORING LOG
PROJECT: AZ-054, Bil Monitoring Phase 3
LOCATION: EAST: -6596.8
NORTH: -3698.5
SURF. ELEV.: 371.9
DRILLING SUBCONTRACTOR: Campbell Well Drilling
DRILLING METHOD AND EQUIP.: CME-55, HSA, Continuous sampling to 65'
DATE STARTED: 10/22/91
DATE FINISHED: 10/22/91
LOGGER: B.E. Phillips
DEPTH (FT)
SAMPLE INTERVAL
SAMPLE NO.
RECOVERY (FT)
SPT BLOWS (N)
GRAIN SIZE PLOT
SECTION PROFILE
LITHOLOGIC DESCRIPTION / COMMENTS
-60.0
60.0
S-19-13
5.0
WH
db
SILTY CLAY: blk, poss fass matl, v stiff, blk 17.5YR 2/0
65.0
TD = 65'
-65.0
-70.0
-75.0
-80.0
-85.0
-90.0

3-6 W. I. Finch 3

Joppa McCracken S1090.3-304.6

12/8/64

387

augered test hole

Driller F. Wreck

		Thickness (ft.)	Depth (ft.)
QL	Silt, gray upper 3' or 4', brown, yellowish-brown clayey, abundant silt-size black opaque mineral, damp, very sparse fine quartz at 12'	15	15
372	Silt, yellowish-brown, clayey, very sparse small (1/4") pebbles and granules of chert 15'-17'. Grades into sand.	8	23
Fine Facies	Silty and clayey sand, yellowish-brown, fine to medium-grained quartz and sparse chert, very sparse chert (1/4") pebbles, abundant silt-size black opaque mineral. Damp.	8	31
357	Gravel, heavy, drilled like clay 37-47. Pulled. Reddish-brown pebbles up to 1"	6	37
QTc	Sand, reddish-brown, poorly sorted very fine quartz and chert sand, sparse chert granules, clayey and silty, damp. Sampled 37-47. Water at 65. Gravel at 75'.	38	75

(over)

Phillips

11

Hole No. [illegible]
Logged by A. Hanson

WELL LOG

[illegible] Jones [illegible] McCracken [illegible] 31093.2-316.9

[illegible]

[illegible] Date 4-27-65

[illegible] LSD 347' Elev. of [illegible]

[illegible] well Depth 89' Driller [illegible]

Elev.	Material	Thickness (ft.)	Depth
	Silty clay, yellow gray	5	5
323	Silty clay, brown	19	24
	Fine sand, orange to brown; some clay	9	33
	Sandy clay, yellow-brown	3	36
	Clay, light gray	2	38
302	Clay, light gray with some layers of orange clayey medium sand	7	45
272	Gravel	30	75
	Silty clay purple-gray, micaceous	10	85
	Silty clay, light gray, micaceous	4	89

Loess - QTg (fine) 323'
QTg (fine) - QTg 302'
QTg - Kn 272'

13

Order No. J-14
Logged by W. I. Finch

WELL LOG

Joyce County McCracken Kentucky Geol. SE004.9-323.15

Date 3-18-65

330' Elev. of Rm. Tape Datum

	Material	Thickness (ft.)	Depth (ft.)
	Silt, yellowish-brown, clayey, abundant black opaques	13	13
Fine-grained	Clayey and silty sand, very fine quartz, and sparse chert, yellowish-brown to orange-brown, sparse coarse muscovite 25-30 Pebbly 30'-30'.	23	36
	Gravel	47	83
255-78cm	Sand, light-gray to yellowish-white very fine quartz	14	97

Potter

A. Hansen 14

WELL LOG

[illegible] Jepsen County Kentucky Const. 01096.1-[illegible]

[illegible]

[illegible] Date 3-22-65

[illegible] LSD 353'

[illegible] Depth 85' Elev. of Fm. Tops

[illegible] Driller

Unit	Material	Thickness (ft.)	Depth (ft.)
	Fill	1	1
336 ---	Silty clay, brownish yellow	16	17
Fn	Very fine sand, orange-brown, some silt and clay	14	31
322 ---	Gravel and sand	11	42
	Gravel	30	72
281 --- Tkm	Clay, dark gray #1 at 82'	13	85

Loess - QTg (fine) 336'
QTg (fine) - QTg 322'
QTg - Km 281'

15

Hole No. [illegible]

Work [illegible]

Logged by H. L. Finch

Sheet [illegible]

County McCracken

Kentucky Quad. [illegible]

Descriptive location

Source of Data

Date 6/1/[illegible]

Elev. of Pm. Type

Elev. of surf. 3[illegible]'

Type of well augered test hole

Driller F. Brock

Unit	Material	Thickness (ft.)	Depth (ft.)
[illegible]	Silt, yellowish-brown, clayey, abundant black opaques [illegible]	25	25
[illegible]	Sandy clayey silt, yellowish-brown, very fine quartz gradational contact with loess	2	27
[illegible]	Sand, clayey, light-gray, light yellow, fine quartz and chert, wo[illegible] well-sorted	6	33
[illegible]	Gravel, light gray sand matrix like above to 42', pebbles generally 1/2 - 1 1/2" maximum. Sampled 37-42 wet. Water at 45? Drilled at 77'. Gravel below 45 yellowish-brown	33	66
[illegible]	Sand, silty and clayey, very fine quartz, micaceous, abundant dark opaque minerals. Sampled	11	77

(over for lithologic study)

mottled 18

WELL LOG

File No. J-10
Logged by W.I. Finch

Joppa | County McCracken | Kentucky Coord. S1098.1-316.5

Date

Elev. of sur. 353'

Elev. of Fm. Tops

Driller

	Material	Thickness (ft.)	Depth (ft.)
	Silt, yellowish-brown, clayey, abundant black opaques. grades into Sampled 0-7,7-12,12-17,17-22,22-27,27-32	20	20
333	Silt, yellowish-brown, clayey, sparse fine quartz and chert grains, chert granule at 22'	14	34
319	Gravel, thin zones 34-37 Good gravel at 37. very heavy gravel below 40. Hit water at 40'. Cemented zone 61-61. st. Drill 6" pulled. Abandoned		61.5
	TKm		

02019

WELL LOG

Hole No. J-27
Logged by W. I. Finch

Quad. Joppa
County McCracken
Kentucky Coord. S1099.0-303.1
Descriptive location
Source of Data
Date 8-4-65
Elev. of watertable
Elev. of surf. 397'
Elev. of Rm. Tops
Type of well augered test hole
Driller F. Wreck

Unit	Material	Thickness (ft.)	Depth (ft.)
Ql	Silt, pale grayish-brown, clayey, damp, abundant black, opaques	10	10?
384	Silt, yellowish-brown, sandy. Fine to granules of quartz and sparse chert, damp., micaceous	3?	13
381 Qc	Gravel	3	16
Tp	Clay, light-gray, bright red vuggy blebs of altered? glauconite?, sampled. Dry Pulled at 22'. Sparse coarse quartz grains, few white chert 1/4" pebbles=contaminants? iron-stained clay grains and granules	6	22
	Clay, light-gray, day, crumbly, brown grains of altered? glauconite, brown angular clay grains and granules	10	32
	(over)		

Clay, light-gray, dry crumbly. Same as 22-32 — 10 — 42
"do" 32-42 quartz grains fairly abundant — 10 — 52

Pulled at 22, 32, 42, and 52. Water seepes into hole, probably for gravel 13-16.

Hole No. J-3 20
Logged by M. I. Finch

WELL LOG

Quad. Joppa County McCracken Kentucky Coord. 81099.95-304.5
Discriptive location
Source of Data Date 12/8/64
Elev. of watertable
Elev. of surf. 379' Elev. of Pa. Tops
Type of well augered test hole Driller F. Wreck

Unit	Material	Thickness (ft.)	Depth (ft.)
Ql	Silt, yellowish-brown, clayey, dry. no sand. very sparse sand at 20'	20	20
359			
329-349	Sandy, red very silty, very fine to fine quartz and chert, very sparse medium-grained mica flakes	10	30
QTc	Gravel, red, brown, coarse, up to 2 1/2" across. Water at 40'.	13	43
336			
Tp	Clay, dark-gray Sampled.	4	47

Plotted

Hole no. 27
Logged by A. Hansen

WELL LOG

Joppa

Location: Corr. S1105.9-312.1

4/20/65

LSD 351'
Depth 100'

	Material		
327 - 91	Silty clay, yellow brown	24	24
	Silt and very fine sand, yellow brown	6	30
Fn	Clayey silt, Gray	5	35
	Clayey silt, orange to dark brown	10	45
299	Clayey silt, trace medium sand, orange	7	52
	Gravel	36	88
263			
1 TKcm	Clayey silt, micaceous, white, yellow and red #1 at 96-98	12	100
	Loess - QTq (fine) 327'		
	QTq(fin.)-WTg 299'		
	QTg- Km 263'		

Logged by

Joppa County Kentucky Coast S1108.5-308.6

Descriptive location

Source of Data Date 3-22-65

Elev. of watertable LSD 363'

Elev. of surf. Depth 82' Elev. of Pm. Tops

Type of well Driller

Unit	Material	Thickness (ft.)	Depth (ft.)
---	Silty clay, yellow-brown	43	43
	Clayey very fine sand orange	20	63
	Gravel 2" cemented gravel at 69'	6	69
1	Silty fine sand, light gray, some clay #1 at 75'	13	82
	Loess - QTg (fine) 320'		
	QTg (fine) - Qtg 300		
	QTg - Km 294		

Plotted 31

Hole No. [illegible]

Logged by Groundwater - Hannan

Quad. Joppa

County MCCracken

Kentucky Coord. S1110.8-315.8

Descriptive location

Source of Data

Date 5-4-65

Elev. of watertable

Elev. of surf. LSD 321'

Elev. of Fm. Tops

Type of well Depth 50' augered test hole

Driller E. Wreck

Unit	Material	Thickness (ft.)	Depth (ft.)
Qal	Soil	3	3
314 ---	Clayey silt, brown	4	7
QTg	Gravel	28	35
286 ----			
TKcm 1	Silty clay, light gray to purple, micaceous, a few layers of orange medium sand #1 from 47'-48'	15	50
	Qal - QTg 314'		
	QTg- Km 286'		

APPENDIX B

Test for significant statistical difference between the selected borehole population used in geologic profiles and the total borehole dataset compiled for this study.

Midpoint Depth	CLAY -x	CM to MC -x	Silt -x	MS to SM -x	Sand -x	Sand to Gravel -x	Gravel -x
405.00	0.00	0.00	0.23	0.23	0.00	0.23	0.32
395.00	0.04	0.02	0.22	0.22	0.02	0.20	0.24
385.00	0.04	0.07	0.21	0.21	0.04	0.17	0.17
375.00	0.08	0.12	0.17	0.24	0.03	0.14	0.14
365.00	0.14	0.19	0.09	0.27	0.01	0.08	0.08
355.00	0.08	0.25	0.04	0.32	0.01	0.07	0.03
345.00	0.04	0.22	0.05	0.38	0.01	0.12	0.05
335.00	0.06	0.16	0.06	0.36	0.01	0.13	0.06
325.00	0.08	0.19	0.05	0.38	0.01	0.12	0.05
315.00	0.06	0.20	0.07	0.29	0.03	0.09	0.09
305.00	0.04	0.08	0.05	0.45	0.02	0.19	0.08
295.00	0.04	0.06	0.06	0.43	0.03	0.19	0.09
285.00	0.06	0.09	0.09	0.31	0.03	0.14	0.15
275.00	0.10	0.14	0.10	0.25	0.09	0.09	0.11
265.00	0.12	0.19	0.14	0.11	0.17	0.01	0.02
255.00	0.04	0.28	0.16	0.10	0.16	0.00	0.00
245.00	0.04	0.29	0.14	0.12	0.16	0.00	0.00
235.00	0.20	0.22	0.07	0.20	0.10	0.00	0.00
225.00	0.22	0.12	0.08	0.27	0.02	0.08	0.08
215.00	0.08	0.12	0.11	0.23	0.15	0.11	0.11
205.00	0.14	0.15	0.00	0.17	0.38	0.00	0.00

Midpoint Depth	CLAY - all	CM to MC - all	Silt - all	MS to SM - all	Sand - all	Sand to Gravel - all	Gravel - all
405.00	0.00	0.00	0.08	0.44	0.00	0.24	0.10
395.00	0.00	0.00	0.08	0.44	0.00	0.24	0.10
385.00	0.06	0.16	0.16	0.19	0.04	0.12	0.13
375.00	0.06	0.16	0.16	0.19	0.04	0.12	0.13
365.00	0.06	0.21	0.15	0.13	0.09	0.06	0.06
355.00	0.06	0.21	0.15	0.13	0.09	0.06	0.06
345.00	0.14	0.17	0.08	0.14	0.06	0.03	0.07
335.00	0.14	0.17	0.08	0.14	0.06	0.03	0.07
325.00	0.10	0.19	0.04	0.32	0.02	0.11	0.07
315.00	0.10	0.19	0.04	0.32	0.02	0.11	0.07
305.00	0.02	0.17	0.04	0.35	0.03	0.14	0.04
295.00	0.02	0.17	0.04	0.35	0.03	0.14	0.04
285.00	0.04	0.32	0.04	0.23	0.03	0.06	0.05
275.00	0.04	0.32	0.04	0.23	0.03	0.06	0.05
265.00	0.28	0.10	0.05	0.26	0.04	0.05	0.02
255.00	0.28	0.10	0.05	0.26	0.04	0.05	0.02
245.00	0.10	0.22	0.02	0.13	0.25	0.01	0.01
235.00	0.10	0.22	0.02	0.13	0.25	0.01	0.01
225.00	0.02	0.18	0.13	0.20	0.00	0.13	0.13
215.00	0.02	0.18	0.13	0.20	0.00	0.13	0.13
205.00	0.10	0.03	0.00	0.42	0.09	0.16	0.00

Notes: x = boreholes selected for use in geologic profiles
all = total borehole dataset compiled for this study

Tables above were used for statistical comparison of grain-size percentage along 10-foot intervals. Gaps in data, unknown data, and grain sizes not listed above were left out of analysis, therefore percentages may not equal 100%.

Mann-Whitney Rank Sum Test Tuesday, June 13, 2006, 4:37:58 PM

Data source: Data 1 in Notebook 1

Normality Test: Failed (P = 0.002)

Group	N	Missing	Median	25%	75%
CLAY -x-section	21	0	0.0600	0.0400	0.105
CLAY - all	21	0	0.0600	0.0200	0.1000

T = 464.500 n(small)= 21 n(big)= 21 (P = 0.753)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.753)

Mann-Whitney Rank Sum Test Tuesday, June 13, 2006, 4:38:57 PM

Data source: Data 1 in Notebook 1

Normality Test: Passed (P > 0.050)

Equal Variance Test: Passed (P = 0.587)

Group	N	Missing	Median	25%	75%
CM to MC -x-section	21	0	0.150	0.0875	0.205
CM to MC - all	21	0	0.170	0.145	0.210

T = 427.000 n(small)= 21 n(big)= 21 (P = 0.546)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.546)

Mann-Whitney Rank Sum Test Tuesday, June 13, 2006, 4:40:00 PM

Data source: Data 1 in Notebook 1

Normality Test: Failed (P = 0.007)

Group	N	Missing	Median	25%	75%
Silt -x-section	21	0	0.0900	0.0575	0.145
Silt - all	21	0	0.0500	0.0400	0.130

T = 522.500 n(small)= 21 n(big)= 21 (P = 0.076)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.076)

Mann-Whitney Rank Sum Test Tuesday, June 13, 2006, 4:40:49 PM

Data source: Data 1 in Notebook 1

Normality Test: Passed (P > 0.050)

Equal Variance Test: Passed (P = 0.653)

Group	N	Missing	Median	25%	75%
MS to SM -x-section	21	0	0.250	0.207	0.330
MS to SM - all	21	0	0.230	0.140	0.328

T = 477.000 n(small)= 21 n(big)= 21 (P = 0.529)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.529)

Mann-Whitney Rank Sum Test Tuesday, June 13, 2006, 4:41:12 PM

Data source: Data 1 in Notebook 1

Normality Test: Failed (P = <0.001)

Group	N	Missing	Median	25%	75%
Sand -x-section	21	0	0.0300	0.01000	0.113
Sand - all	21	0	0.0400	0.0200	0.0675

T = 445.500 n(small)= 21 n(big)= 21 (P = 0.890)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.890)

Mann-Whitney Rank Sum Test Tuesday, June 13, 2006, 4:41:41 PM

Data source: Data 1 in Notebook 1

Normality Test: Passed (P > 0.050)

Equal Variance Test: Passed (P = 0.703)

Group	N	Missing	Median	25%	75%
Sand to Gravel -x-section	21	0	0.110	0.0550	0.148
Sand to Gravel - all	21	0	0.110	0.0500	0.133

T = 463.000 n(small)= 21 n(big)= 21 (P = 0.782)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.782)

Mann-Whitney Rank Sum Test Tuesday, June 13, 2006, 4:42:20 PM

Data source: Data 1 in Notebook 1

Normality Test: Failed (P = 0.010)

Group	N	Missing	Median	25%	75%
Gravel -x-section	21	0	0.0800	0.0275	0.118
Gravel - all	21	0	0.0600	0.0350	0.1000

T = 482.000 n(small)= 21 n(big)= 21 (P = 0.450)

The difference in the median values between the two groups is not great enough to exclude the possibility that the difference is due to random sampling variability; there is not a statistically significant difference (P = 0.450)

APPENDIX C

Optically Stimulated Luminescence sampling logs.

Map ID	Date of Collection	Log Label	UTM Northing	UTM Easting	Notes
177	12/18/2005	LM01	4114910	340229	Upper and Lower Samples
178	12/18/2005	LM02	4115264	339629	Single Sample
179	12/18/2005	LM03	4113292	340966	Upper and Lower Samples
180	12/18/2005	LM04	4112286	341006	Single Sample
181	12/18/2005	LM05	4110438	337965	Failed Sampling Attempt
182	12/18/2005	LM06	4112632	337847	Single Sample
183	12/19/2005	LM07	4106678	337515	Single Sample
184	12/19/2005	LM08	4110296	337968	Single Sample

Luminescence Sampling Log

Josh Sexton
University of Kentucky
101 Slone Bld.
Lexington, KY 40506-0053

Phone: 540-818-2789
Fax: 859-323-1938
Email: jlsexton@uky.edu

Location: LM #1 (Lower)

Sample #: " " 4114910, 340229

Date & Time: 12/19/05 10:00 am

Moisture Content: moist

	From Surface	Depth Sampled into Outcrop
Burial Depth (ft):	17'	60" + 6" pilot hole

Notes:

Formation: mounds

Estimated Age Range: Pleistocene

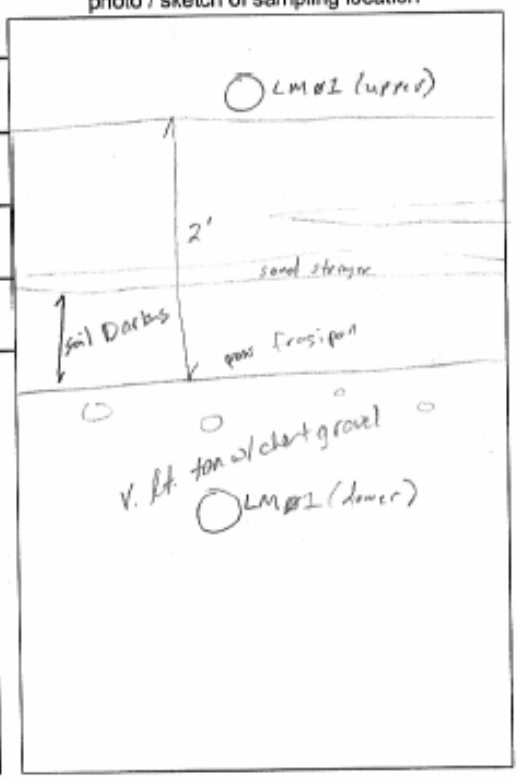
Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:

Gravelly sand
moderately graded to ~2in. long axis

photo / sketch of sampling location



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Location: LM01 (UPPER) 4114910, 340229

Sample #: " "

Date & Time: 12/19/05 9:45

Moisture Content: Dry

	From Surface	Depth Sampled into Outcrop
Burial Depth (ft):	~14'	20" oc / 6" Pilot hole

Notes:

Formation: Loess

Estimated Age Range: ?

Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:
Some fine Qtz sand in Sill, massive

photo / sketch of sampling location

Luminescence Sampling Log

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Phone: 540-818-2789
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Email: jlsexton@uky.edu

Location: LM02 4115264, 339629

Sample #: " "

Date & Time: 12/19/05 11:15 am

Moisture Content: Saturated

From Surface	Depth Sampled into Outcrop
Burial Depth (ft): 11 1/2'	13" + 10" Pilot hole

Notes:

Formation: Mounds

Estimated Age Range: Pleistocene

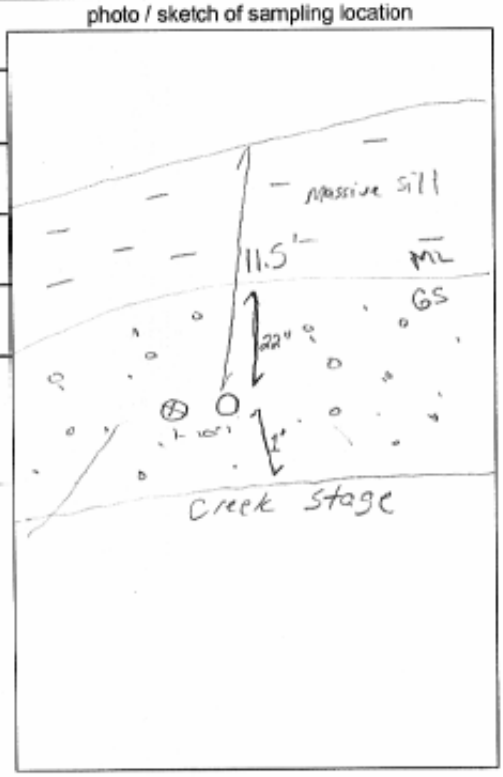
Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:
3 adjacent samples tried, failed due to cobble size too large.

long axis, gravel, coarser material than LM02 material
↳ 3"+

photo / sketch of sampling location



Luminescence Sampling Log

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Phone: 540-818-2789
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Email: jlsexton@uky.edu

Location: LM03 (Lower) 4113292, 340916E

Sample #: " "

Date & Time: 12/19/05 1300

Moisture Content: Slightly moist

	From Surface	Depth Sampled into Outcrop
Burial Depth (ft):	100"	27"

Notes:

Formation: ?

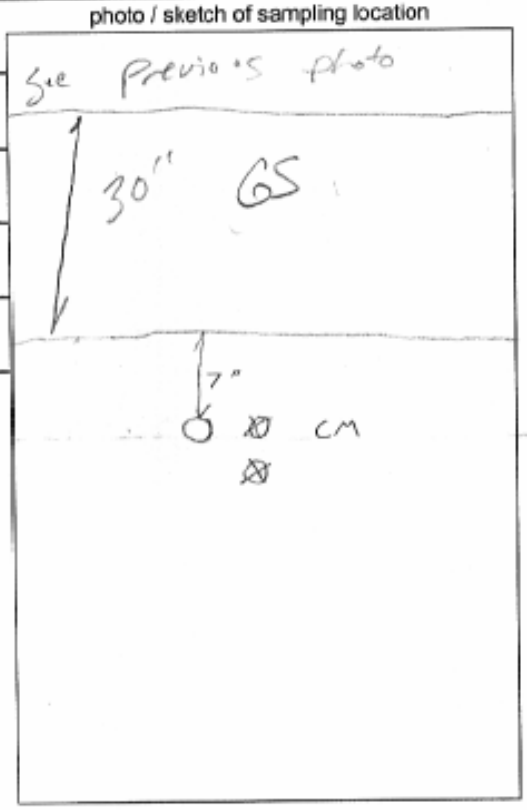
Estimated Age Range: ?

Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:
- 2 other samples attempted with pilot boring, samples not retrievable
- sample taken from clean face, therefore, shoe light contamination

photo / sketch of sampling location



Luminescence Sampling Log

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Email: jlsexton@uky.edu

Location: LM03 (upper) 4113292, 3409666

Sample #: " "

Date & Time: 12/19/05

Moisture Content: Dry

	From Surface	Depth Sampled into Outcrop
Burial Depth (ft):	80"	12" pilot hole +

Notes:

Formation: Mannis

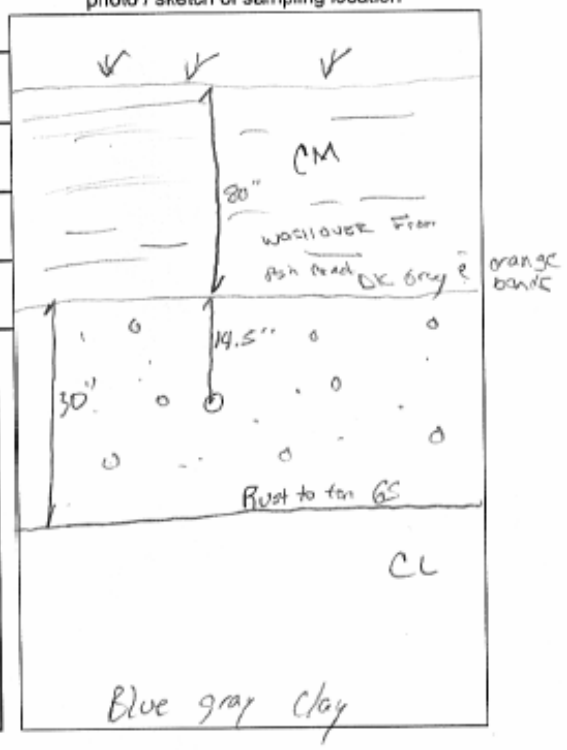
Estimated Age Range:

Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:
Lots of Fe in Sample,
Coarse grained gravel

photo / sketch of sampling location



Luminescence Sampling Log

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Phone: 540-818-2789
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Location: LM04 4112286, 341006

Sample #: " "

Date & Time: 12/19/05

Moisture Content: Slightly moist to moist

	From Surface	Depth Sampled into Outcrop
Burial Depth (ft):	13'	16"

Notes:

Formation: ML

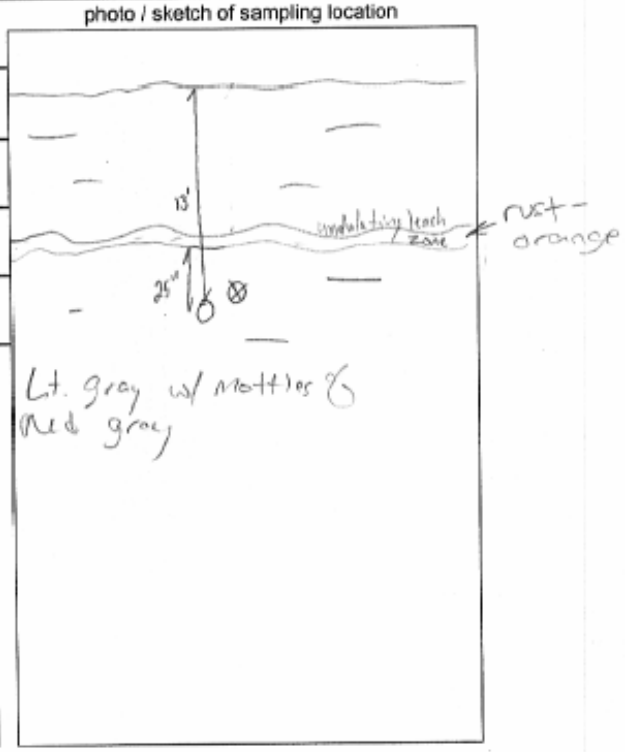
Estimated Age Range: ?

Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:
10" pilot hole, unable to retrieve sample

photo / sketch of sampling location



Luminescence Sampling Log

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Phone: 540-818-2789
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Email: jlsexton@uky.edu

Location: LM05 411∅438, 3379∅5

Sample #: " "

Date & Time: 12/19/05

Moisture Content: Dry

	From Surface	Depth Sampled into Outcrop
Burial Depth (ft):	9'	10"

Notes:

Formation:

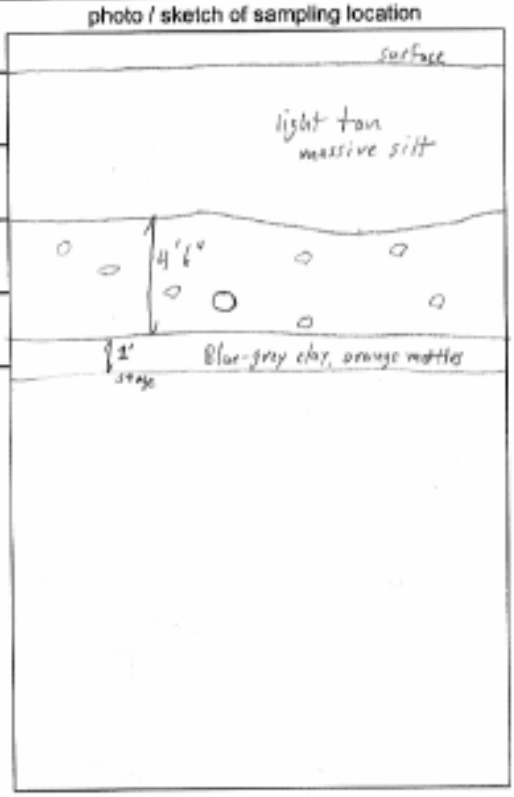
Estimated Age Range:

Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:

photo / sketch of sampling location



Luminescence Sampling Log

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Phone: 540-818-2789
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Location: LM06 4112632, 337847

Sample #: " "

Date & Time: 12/19/05

Moisture Content: Saturated

	From Surface	Depth Sampled into Outcrop
Burial Depth (ft):		12"

Notes:

Formation:

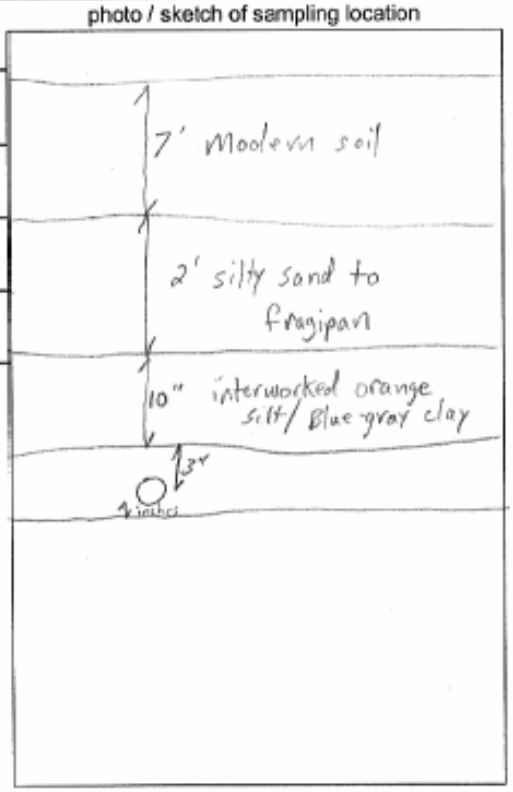
Estimated Age Range:

Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:
hole flooded as sample was retrieved, sample saturated

photo / sketch of sampling location



Luminescence Sampling Log

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Location: LM07 41Ø6678, 337515

Sample #: " "

Date & Time: 12/20/05

Moisture Content: Dry

	From Surface	Depth Sampled into Outcrop
Burial Depth (ft):	6'	20"

Notes:

Formation: Upper Terrace

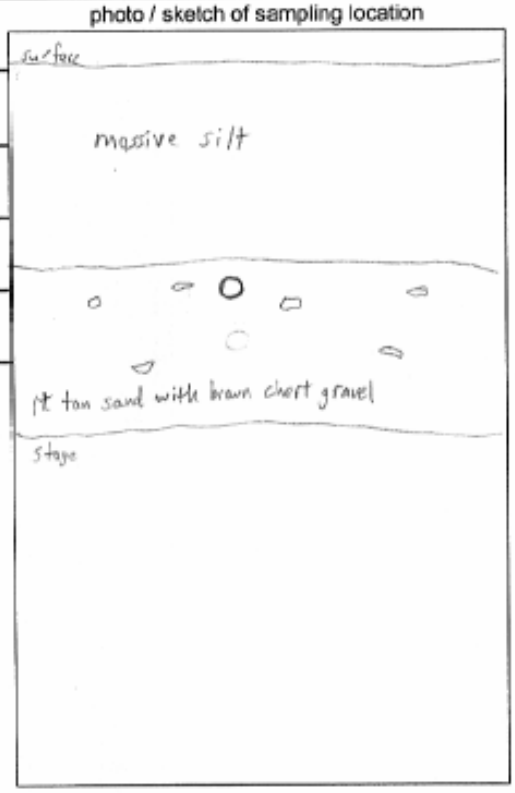
Estimated Age Range: Pleistocene

Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:
Drove sample parallel to face and dug out.

photo / sketch of sampling location



Luminescence Sampling Log

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Email: jlsexton@uky.edu

Location: LM08 4111296, 337968

Sample #: " "

Date & Time: 12/20/05

Moisture Content: Dry

	From Surface	Depth Sampled into Outcrop
Burial Depth (ft):		18"

Notes:

Formation: HU-3

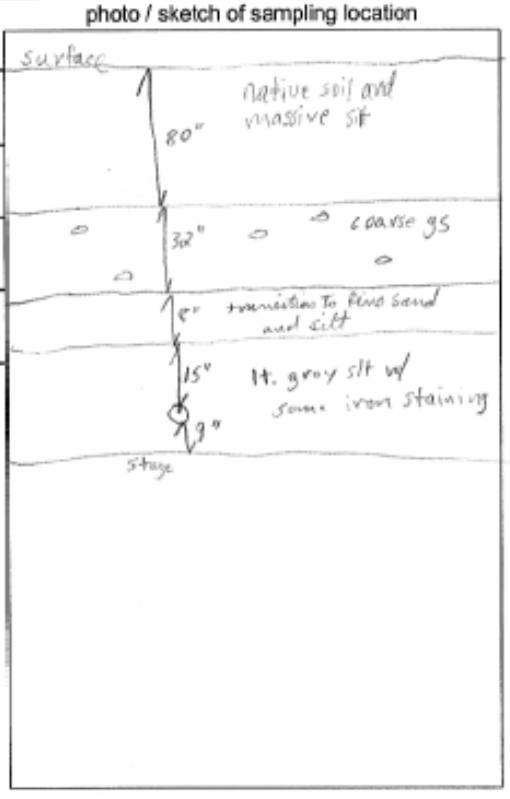
Estimated Age Range:

Stratigraphic Formation:

Anticipated Age (range):

Additional Notes:
Sample is a very firm light gray silt
Sample driven parallel to face
and dug out, very difficult
to drive in sample

photo / sketch of sampling location



APPENDIX D

Notes on the surficial geology of Bayou Creek and Little Bayou Creek.

Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
1	7/12/04	LM03	4115682	338544	Bend w/ coarse gravel (Lower Cont.?) no evidence in cut bank
2	7/12/04	LM04	4115613	338727	Gravel lining creek bed ~3' below surface
3	7/12/04	LM05	4115605	338799	Riffle, gravel bed in bank (Lower Cont.?) (pic 30yds below waypoint)
4	7/12/04	LM06	4115603	338859	Gravel lag deposit at stream level
5	7/12/04	LM07	4115596	338928	Exposed upper fining sequence gravel - sand - mud
6	7/12/04	LM08	4115645	339128	Muddy sand in bank outcrop / friable / poorly graded / buff color on outer surface / dk brown on inside
7	7/12/04	LM09	4115587	339152	Stiff gray clay / oxidized on surface / inside beds ???? sand bar
8	7/12/04	LM10	4115625	339220	Sandy riffles in stream bed
9	7/12/04	LM11	4115552	339380	Sand bar
10	7/12/04	LM12	4115519	339437	Sandy beneath oxidized layer of very dark gray clay, sand on bar with high enough mud contact to exhibit polygonal desiccation (mud) cracks
11	7/12/04	LM13	4115452	339406	Gravel stream bed
12	7/12/04	LM14	4115478	339489	Dissemination of gravel sequence
13	7/12/04	LM15	4115375	339584	Gravel stream bed / rather deep channelized section
14	7/12/04	LM16	4115305	339465	Diffused seeps on south bank (16.7 C / 121.7 us)
15	7/12/04	LM17	4115291	339448	Gravel seep on south bank, ~1' above water level / (16.4 C / 171.4 us)
16	7/12/04	LM18	4115245	339522	Gravel bar / pic
17	7/12/04	LM19	4115262	339608	Gravel to cobble sequence w/ fine grained matrix / long axis < 10cm / weakly cemented with iron oxide
18	7/12/04	LM20	4115252	339619	Sandy bars with mud cracks

Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
20	7/12/04	LM22	4115139	339729	3 pictures
21	7/12/04	LM23	4115085	339764	Gravel in lower sequence probably covered with mud / 1 picture
22	7/12/04	LM24	4115041	339807	Tributary on south bank, origin from a diffuse set of seeps (333 us/20.5C @ road) (322 us/ 19.4C @ stream)
23	7/12/04	LM25	4115130	339886	Boil (325us / 16.2C)
24	7/12/04	LM26	4115125	340015	Lots of fines covering in place stratigraphy
25	7/12/04	LM27	4115057	340102	Uniform U-shaped channel / lots of Ohio River mud
63	7/14/04	LM65	4115338	338299	Shallow, irregular, firm clay btm. sculpted by current
64	7/14/04	LM66	4115145	338117	Gravel base and bars
65	7/14/04	LM67	4115067	338130	Picture
66	7/14/04	LM68	4114950	338101	Gravel base and bars to this point
67	7/14/04	LM69	4114878	338153	Intermittent gravel and pools
74	8/17/04	LM80	4115047	339825	Gravel deposit w/ clast orientation strike: 310, 40-80, indicates some bedding
75	8/17/04	LM81	4115252	339670	Gravel deposit, ~1-1.5' above stream stage, exposed 50-60' along bank, overlain by 6-8' of sandy silt overgrown by modern vegetation
76	8/17/04	LM82	4115275	339619	Gravel deposit, (LM19) inclined sharp upper contact undulating w/ 1-2' of relief, (bar w/ internal scours), faintly imbricated, dominant strike 90, dip 125, 10-100, stream strike 40
88	6/10/05	LM06	4107617	337866	Gravel in outcrop, ~ 16" to contact above stream, upward fining chert cobbles

Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
89	6/10/05	LM07	4107687	337963	Pic of gravel lag, stringer, above contact, silty clay w/ interbedded sand below lag, massive silt off-white to tan above lag, contact grades coarser; contact about 32" above stage
90	6/10/05	LM08	4107789	338011	Cross channel?
91	6/10/05	LM09	4107798	337996	Lag w/ interbedding
92	6/10/05	LM10	4107985	338074	Contact about 4' above stage; clast orientation taken
93	6/10/05	LM11	4108268	338156	Good cutbank for sampling, fining upward, finer gravel, worked w/ silt, overlaid by massive silt
94	6/10/05	LM12	4108324	338149	Inter-worked sediments, 4 pics
95	6/10/05	LM13	4108631	338116	Gravel appears in lags (thick) or undulating, confluence of major tributary before wooden bridge
96	6/10/05	LM14	4108673	338068	Wooden RR bridge
97	6/10/05	LM15	4108721	338031	Pipe leaking water
98	6/10/05	LM16	4108844	337968	Ferric plume, some hard mottled clay in stream base, MW-344 at edge of stream, need to find well log (well elev. 366.14' mls)
99	6/10/05	LM17	4108970	338005	Gravel lag above firm silty clay, coarse gravel, clast orientation taken
100	6/10/05	LM18	4109133	338038	Gravel just after bridge still appearing in lag along bank, much lower however, still w/ a gravel stream base
101	6/10/05	LM19	4109345	338025	Gravel outcrop, black oxide stringer along the bank, undulating, but mostly continuous elevation
102	6/10/05	LM20	4109593	337957	Bank w/ black oxide stringer
103	6/10/05	LM21	4109618	337953	Start of lots of black oxide staining in bank w/ red staining further below
104	6/10/05	LM22	4109764	337933	Lag contact

Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
105	6/10/05	LM23	4109962	337929	Gravel contact w/ silt above, worked grey clay between contact below, lt. grey clay below 2nd lag to stream bed, stream bed hard clay
106	6/10/05	LM24	4110058	337930	Contact, 2 photos, clast orientation taken
107	7/4/05	LM01	4207702	675603	Start of mottled clay in creek bed and bank under gravels (east bank)
108	7/4/05	LM02	4108977	337983	End of mottled clay, banks eroding
109	7/4/05	LM03	4108840	337965	Start of hard clay in creek bed again
110	7/4/05	LM04	4108779	337995	End of mottled clay in creek bed, covered bed by flat gravel scour, concurrent w/ linear feature causing an elevation change/ripple
111	7/4/05	LM05	4108707	338022	Mottled clay in deep hole in stream
112	7/4/05	LM06	4108701	338027	Could not find clastic dike in creek
113	7/4/05	LM07	4108987	338002	Gravels in outcrop subrounded, stream bearing 27^{o}, Clast strike 294, 320, 265, 286, 20
114	7/4/05	LM08	4108995	338002	Clast strike 311, 327, 291
115	7/4/05	LM09	4112156	337169	Brushy creek stream is dry, bed load of fine subangular gravel, banks appear to be loess and modern soil.
116	7/4/05	LM10	4106380	337243	Start near SR 725 Bridge, Loess banks, well graded gravel bed load
117	7/4/05	LM11	4106383	337319	Gravels in bank, light hard mottled clay below, sharp gravel contact w/ loess, light gray clay interlensing w/ gravels
118	7/4/05	LM12	4106401	337353	More chert gravels in bank, inter-lensed w/ lt gray clay, just before old bridge

Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
119	7/4/05	LM13	4106432	337361	Large gravel bar after bridge, fine gravel appears in bank above lt gray clay
120	7/4/05	LM14	4106480	337416	Lt clay, hard in creek bed, gravels in bank appear to fine upward, top of gravel bed undulates, largest clast ~ 2", mean clast size 1.25"
121	7/4/05	LM15	4106493	337417	Gravel continues in banks, no longer clay base, now fine sand and gravel scour
123	7/4/05	LM17	4106519	337445	Picture w/ pen for scale showing upward fining w/ clay inter-layered
124	7/4/05	LM18	4106533	337468	Sandy to hard clay transition in creek bed
125	7/4/05	LM19	4106570	337482	Fine gravel cropping out in bank, less clay in stream bed
126	7/4/05	LM20	4106606	337499	Gravel still cropping out in bank, soft gravel stream bed
127	7/4/05	LM21	4106612	337492	Transition to hard clay stream bed
128	7/4/05	LM22	4106652	337503	Clay appears to be cementing gravel slightly above creek stage, buff-tan to off-white in color
129	7/4/05	LM23	4106650	337499	Massive silt over generally upward fining medium to fine gravel, over lt gray clay (pic)
130	7/4/05	LM24	4106674	337524	Measured Section; massive silt over ~ 25" upward fining sandy gravel bed; transitions to lt gray clay.
131	7/4/05	LM25	4106706	337534	Continued gravel bed exposure
132	7/4/05	LM26	4106715	337549	Outcrop exposure w/ shovel for scale, large gravel bar opposite bank
133	7/4/05	LM27	4106801	337606	Fewer fine gravels in bank and bed, hard clay below thin gravel lenses, lots of gravel deposits in stream beds

Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
135	7/4/05	LM29	4106850	337605	Pic of gravel bed w/ shovel for scale above mottled hard clay steam bed
136	7/4/05	LM30	4106870	337618	Pic of thin gravel bed w/ clay below, clay now appears higher in bank (section)
137	7/4/05	LM31	4106922	337647	Fine gravel now lower in section (creek level)
138	7/4/05	LM32	4106958	337662	Iron oxide discharge into stream (pic)
140	7/4/05	LM34	4107035	337708	Stream banks have flattened out, crossed over WKWMA horse trail, lots of gravel bars, don't appear in banks
141	7/4/05	LM35	4107083	337714	Fine gravels appear again in banks, coarse in bed load
142	7/4/05	LM36	4107102	337714	Hard cemented black gravel chunk (paver), continued gravel in banks, small area of orange (iron oxide) in stream bed
144	7/4/05	LM38	4107255	337805	Stream was straight and overgrown since last point, but now gravel appears in the banks and bars appear opposite cut banks
145	7/4/05	LM39	4107290	337812	More iron oxides in creek
146	7/4/05	LM40	4106712	337535	Gravels cropping out in bank
147	7/4/05	LM41	4106669	337496	Cemented gravel lenses "pavers"
148	10/21/05	LM01	4110266	338002	Gravel in bank, ~2' thick, large gravel bar upstream of bridge
149	10/21/05	LM02	4110252	337979	Gravel in bank continuous from LM01, some mang. staining @ creek level, Buff to orange-brown, 2.5" to pebble size clast
150	10/21/05	LM03	4110231	337959	Possible channel deposit, mixed gravel/sand at base, migrating to sand, migrating to 17" of upward fining gravel max clast size 1.5", covered by soil.

Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
151	10/21/05	LM04	4110281	337946	Measured Section 42", see photo
152	10/21/05	LM05	4110365	337966	Med. to fine gravel over lt. gray clay, mang. staining at bed contact, clay pinches out
153	10/21/05	LM06	4110430	337966	M-C 3.5' thick gravel over lt gray clay
154	10/21/05	LM07	4110584	337850	Same gravel over clay, clay is hard and extends to stream bed
155	10/21/05	LM08	4110668	337826	Fine sand deposit in stream bed
156	10/21/05	LM09	4110828	337781	Gravel outcrop above clay, no re good outcrop from LM05 to BoBo Rd. to LM09
157	10/21/05	LM10	4110994	337774	~10' cutbank, lt. tan loess over M-C gravel over gray silt in stream bed
158	10/21/05	LM11	4111179	337802	Thick clay below gravel in stream bed, clay > 4' thick
159	10/21/05	LM12	4111251	337813	Cemented gravel in place in stream above clay? pic start of increased vegetation, hard to see geology
160	10/21/05	LM13	4111536	33790	F gravel cropping out in bank, covered by overlying soil eroding off bank, steep to vertical banks ~8' high, Loess
161	10/21/05	LM14	4112189	337811	Large gravel bar, cutbank of modern soil over hard clay in creek, not much to see, spare gravel in bank, good in bed load, next to farm fields causing mud/silt drapes over outcrop
162	10/21/05	LM15	4112209	337786	Gravels in bank covered by mud drape, more sand appearing in bars/bed load, gradual decrease in gravel since entering private property, fairly continuous gravel bars or possible beds in creek?
163	10/21/05	LM16	4112242	337734	Gravel bar or bed?

Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
164	10/21/05	LM17	4112262	337664	Large gravel bar, small tributary nearby, mud banks
165	10/21/05	LM18	4112439	337699	Pebbles to fine gravels ~ 4' above stream, ~1' thick, looks different than upstream outcrops, but could be due to mud drape, just upstream of Ogden Landing Rd. bridge
166	10/21/05	LM19	4112539	337753	Large sand bar after bridge, some gravel in opposite bank, a lot less gravel in bed load.
167	10/21/05	LM20	4112640	337826	Small gravel bar
168	10/21/05	LM21	4112662	337820	Measured section including blue-gray clay, see pic / section
169	10/21/05	LM22	4112800	337881	Gravel bars before and between riprap flood control structures
170	10/21/05	LM23	4113088	338021	Blue-gray mud in creek, standing on sand next to field drainage ditch
171	10/21/05	LM24	4113123	337997	Small gravel / sand bar
172	10/21/05	LM25	4113157	337974	Small gravel / sand bar / Fe oxide deposits, several deep pools in this stretch of creek
174	10/21/05	LM27	4113546	337996	Blue-gray clay in bank, see pic / section
175	10/21/05	LM28	4113803	338183	Very little gravel after deep pools, now mostly sand bars and sand in bed load
176	10/21/05	LM29	4108148	336758	Creek very deep, and snaggy due to beaver dams and downed trees from LM28 to low water bridge

Little Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
27	7/13/04	LM29	4109477	341383	Sandy stream bed, shoaling behind dead fall / banks clay
28	7/13/04	LM30	4109516	341428	Small gravel bar, cemented grains with Fe-Manganese? / clay banks
29	7/13/04	LM31	4109589	341441	Pebble lens (picture)
30	7/13/04	LM32	4109810	341421	3 pebble banding pictures of upper continental
31	7/13/04	LM33	4109868	341429	Pebble lens (picture)
32	7/13/04	LM34	4109969	341438	Pebble lense(17'L, 1'Max H)
33	7/13/04	LM35	4110092	341459	Pebble lens (19'L, ?H)
34	7/13/04	LM36	4110342	341413	Gravel lags exposed on both sides of the creek, <1' thick
35	7/13/04	LM37	4110982	341293	Gravel appears to have coarsened to cobble size, lags are frequent but appear discontinuous
36	7/13/04	LM38	4111018	341303	Coarse sand bars and gravel lags in stream bed
37	7/13/04	LM39	4111254	341038	Coarse gravel bar
38	7/13/04	LM40	4111291	340995	NS diversion ditch???
41	7/13/04	LM43	4111885	340966	Lots of debris in water causing pooling >4'
42	7/13/04	LM44	4112139	340997	Fine grained sand
43	7/13/04	LM45	4112287	341022	Large cut bank w/ white silty sand, Cut bank mostly composed of clay, weakly Fe cemented sand "flag stones" in creek bed
44	7/13/04	LM46	4113251	340959	WB 1.5
45	7/13/04	LM47	4113295	340911	Lower Cont. Deposit
46	7/13/04	LM48	4113482	340857	Lower Cont. Deposit thickened to ~3' above stream level
47	7/13/04	LM49	4113581	340828	Seep (317us / 15.7 C)
48	7/13/04	LM50	4113677	340825	Fe cemented material no longer present in stream bed
49	7/13/04	LM51	4113832	340801	Visual contact of LC/UC ~1' above stream level
50	7/13/04	LM52	4114034	340637	(131us / 16.6C)

Little Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
51	7/13/04	LM53	4114126	340597	(149us / 15.8C)
53	7/13/04	LM55	4114218	340549	Last visual west bank seep
54	7/13/04	LM56	4114261	340528	Ash pond seep, east bank (1110us / 16.2 C)
55	7/13/04	LM57	4114279	340519	Ash pond seep, east bank (1314us / 16.4 C) / west bank seep (250us / 18C)
56	7/13/04	LM58	4114565	340376	LC reappears on east bank, east bank boil (325us / 16.2C)
57	7/13/04	LM59	4114564	340362	East bank seep (328us / 16.4C)
58	7/13/04	LM60	4114567	340354	East bank seep (327us / 16.3C)
59	7/13/04	LM61	4114580	340347	West bank seep (186us / 16.6C)
60	7/13/04	LM62	4114774	340237	LC crops out on both banks
61	7/13/04	LM63	4115076	340204	Confluence of Bayou / Little Bayou
69	8/17/04	LM71	4114874	340224	Gravel deposit in cut bank, showing some preferred clast orientation (strike long axis 90-130; dip 350-40), Gross upward fining sequence evident in "cycles", clast up to 4.5" long axis, chert gravel
70	8/17/04	LM76	4114821	340225	(near LM62) thinner gray soil layer than LM71, similar leach horizon, can't see contact w/ gravel due to erosion
71	8/17/04	LM77	4114771	340243	Gravel deposit @~ the same height as LM71, covered by soil and silt, ~ 8' above stream level

Little Bayou Creek Field Notes used in Site Maps					
ID	Date	Label	Waypoint (UTM)		Notes concerning waypoint
			Northing	Easting	
72	8/17/04	LM78	4114768	340278	Chert gravel deposit, similar size range to other deposits, ~ 5-6' above stream stage, Long axis orientation, Strike 90, 30-50, 45, 10, 52, 310; Dip 29, Upward fining sequence w/ irregular but sharp contact w/ overlying silts
73	8/17/04	LM79	4114645	340323	Gravel layer, scoured upper contact ~5' above stream stage, upward fining sequence, w/ sharp irregular upper contact w/ overlying silts, clast orientation strike: 90,100,30-50,45,10,52,310; dip: 29 (modern stream strike 329), this gravel layer seems to be supporting the modern stream terrace, defining a fairly consistent break in slope
82	8/18/04	LM88	4113262	340948	Gray clay above gravel?
83	6/8/05	LM01	4113241	340964	Dark gray clay washing into creek (from ash pond?)
84	6/8/05	LM02	4113262	340963	Areas appear to contain organic material, but appears modern
85	6/8/05	LM03	4113381	340879	Sampled
86	6/8/05	LM04	4113391	340879	Sampled / hand augered / photo
87	6/8/05	LM05	4114870	340231	Attempted sampling location on LBC near confluence. (Pit 3X5X4'), 2 hand auger samples taken. 1 at contact ~ 15" into back of pit and 1 ~5" deep in contact 20" below contact

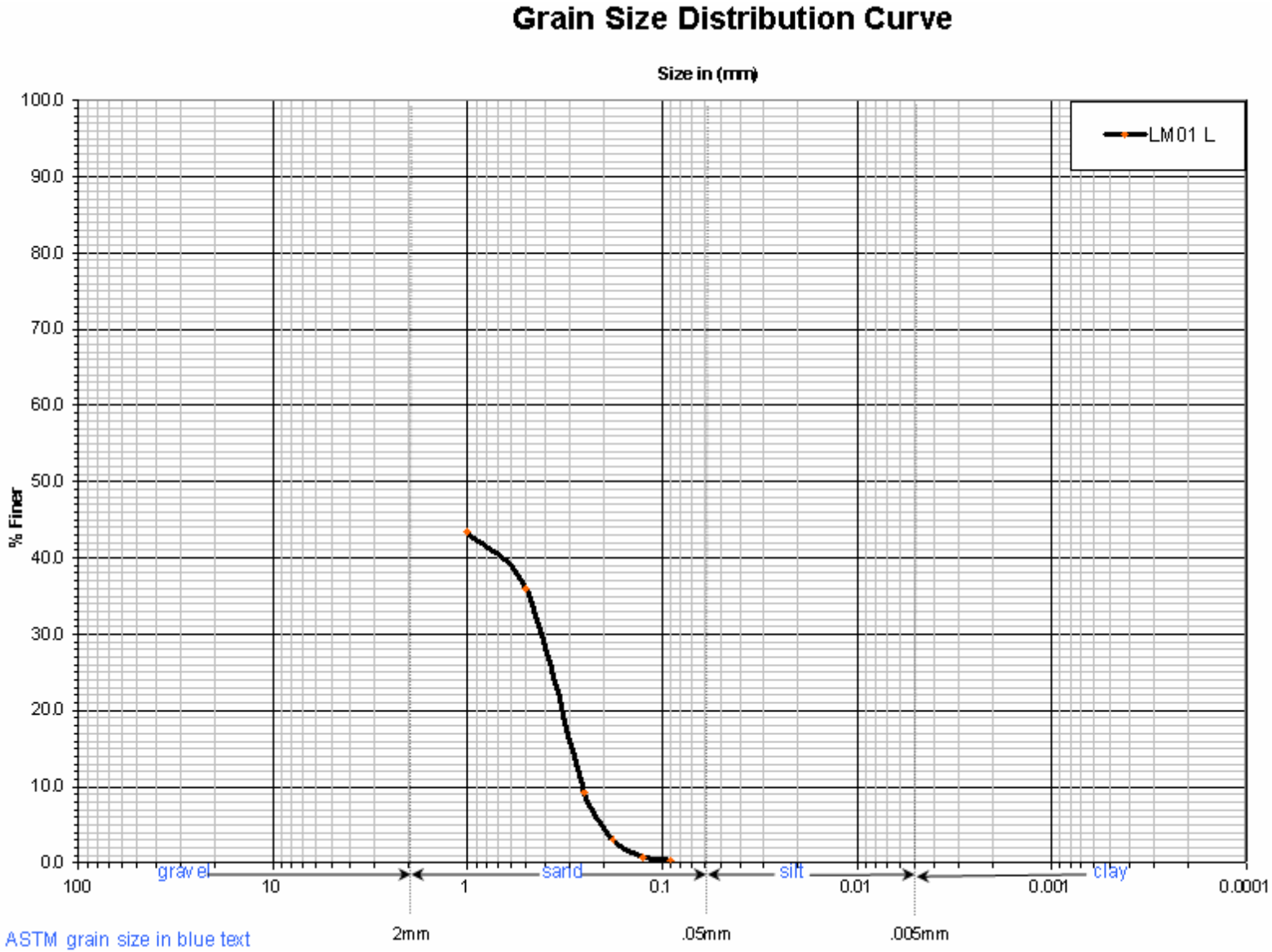
APPENDIX E

Grain-size distribution curves from

Optically Stimulated Luminescence sample preparation.

Grain-size distribution data from OSL sample preparation.

Map ID	Graph Label	Weight (g) obtained above sieve (mesh in µm)							Mass pre sieving (g)	Mass post sieving (g)	% Loss
		1000	500	250	180	125	90	<90			
177	LM01 L	116.01	15.48	54.9	12.54	4.54	0.89	0.84	206.61	205.2	0.68%
177	LM01 U	0	0.17	7.34	31.31	38.92	23.62	64.28	176.72	165.64	6.27%
178	LM02	97.62	14.55	51.76	17.67	5.86	2.31	8.76	200.52	198.53	0.99%
179	LM03 L	15.35	13.99	39.61	21.01	19.32	10.94	71.28	199.25	191.5	3.89%
179	LM03 U	57.15	18.71	38.45	11.05	6.35	2.67	8.89	144.45	143.27	0.82%
180	LM04	12.72	14.13	26.48	18.42	23.07	14.19	86.77	199.47	195.78	1.85%
182	LM06	6.64	1.08	12.03	13.89	11.61	11.54	73.43	133.67	130.22	2.58%
183	LM07	87.96	14.79	12.43	2.18	0.87	0.25	0.94	124.38	119.42	3.99%
184	LM08	sample had to be wet sieved							160.14	NA	NA


Grain Size Distribution Curve
Size in (mm)
% Finer
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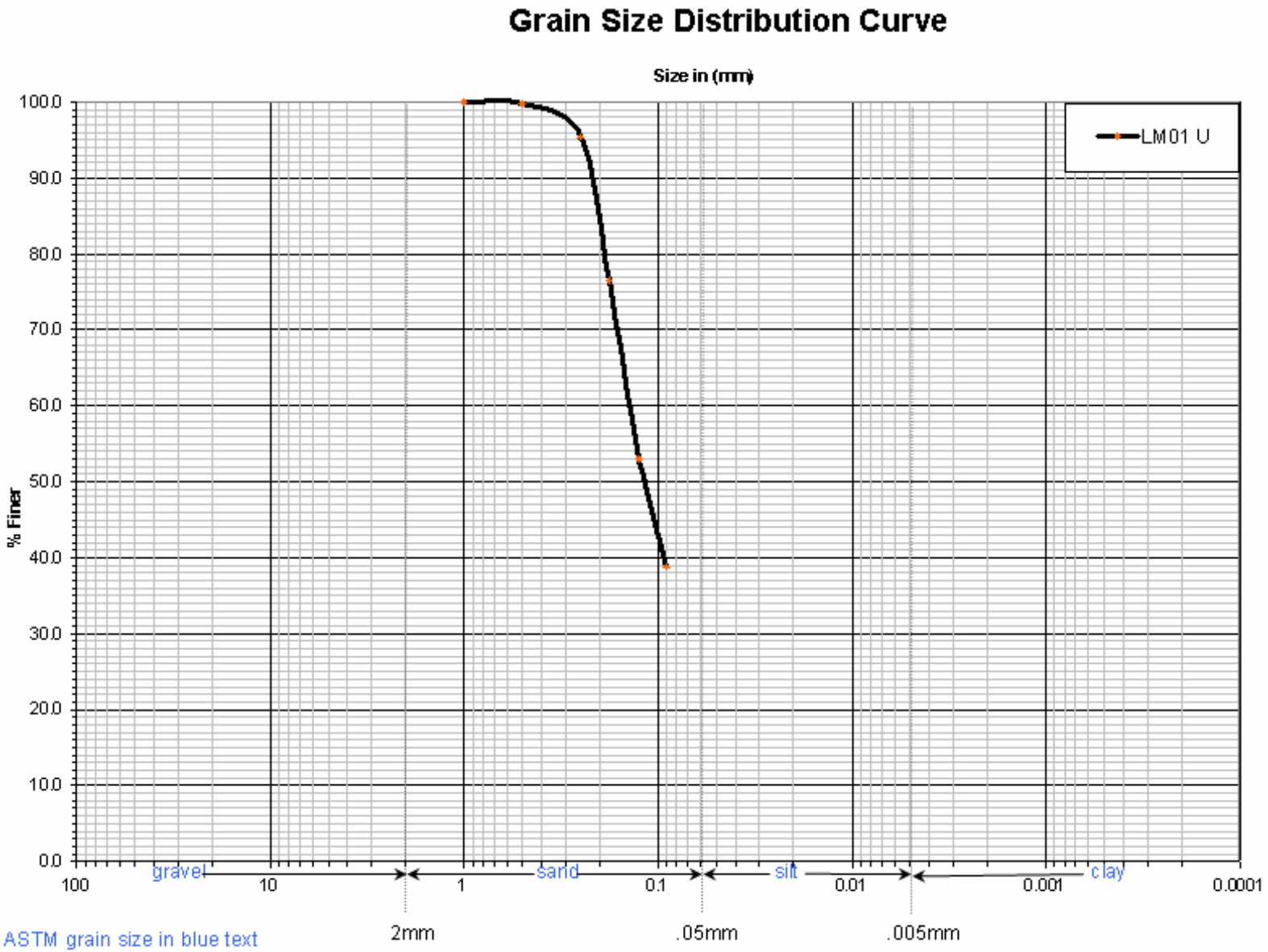
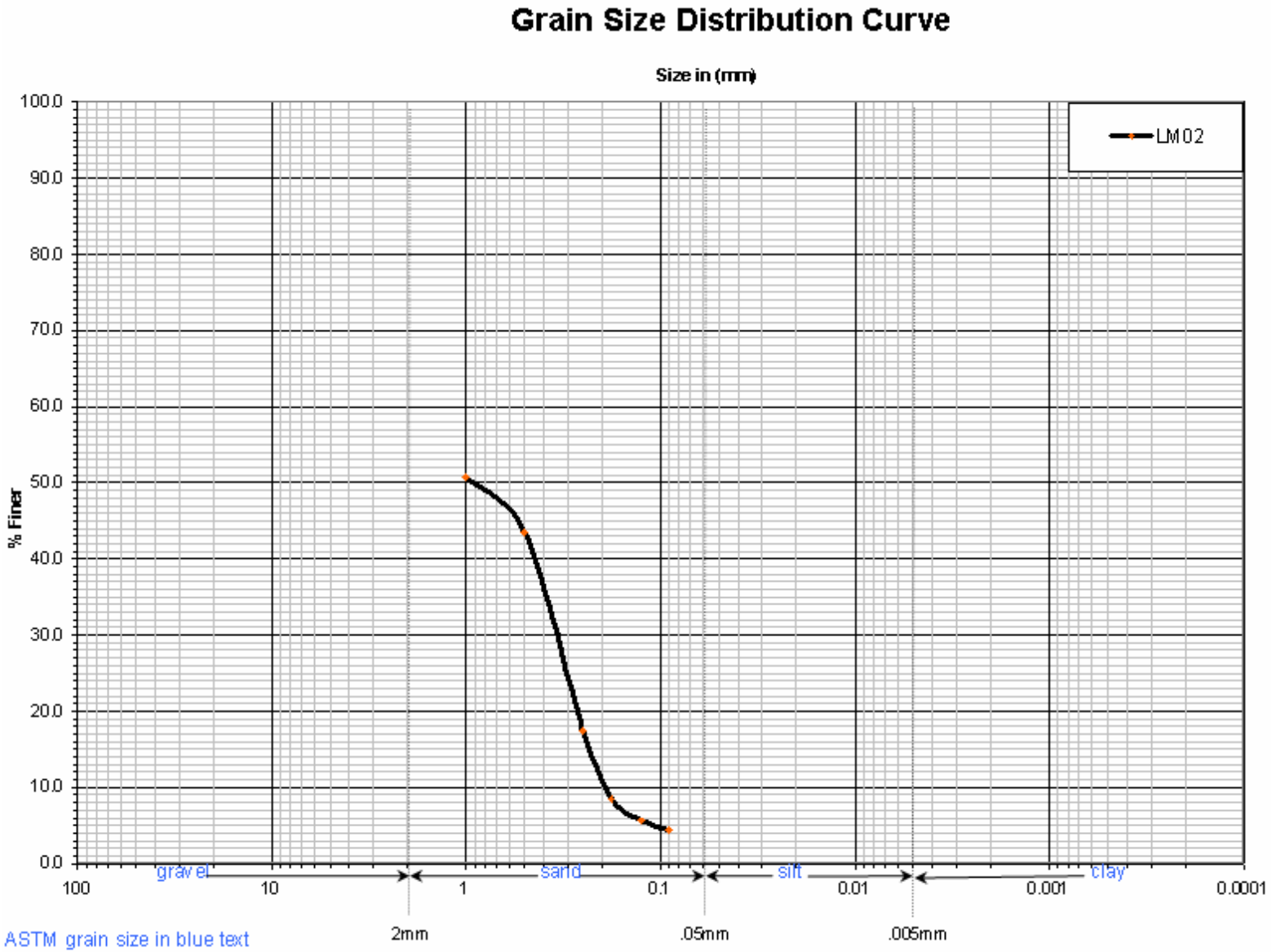
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
LM01 L
100
10
1
0.1
0.01
0.001
0.0001
gravel
sand
silt
clay
2mm
.05mm
.005mm
ASTM grain size in blue text


Grain Size Distribution Curve
Size in (mm)
% Finer
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
LM01 U
100
10
1
0.1
0.01
0.001
0.0001
gravel
sand
silt
clay
2mm
.05mm
.005mm
ASTM grain size in blue text


Grain Size Distribution Curve
Size in (mm)
% Finer
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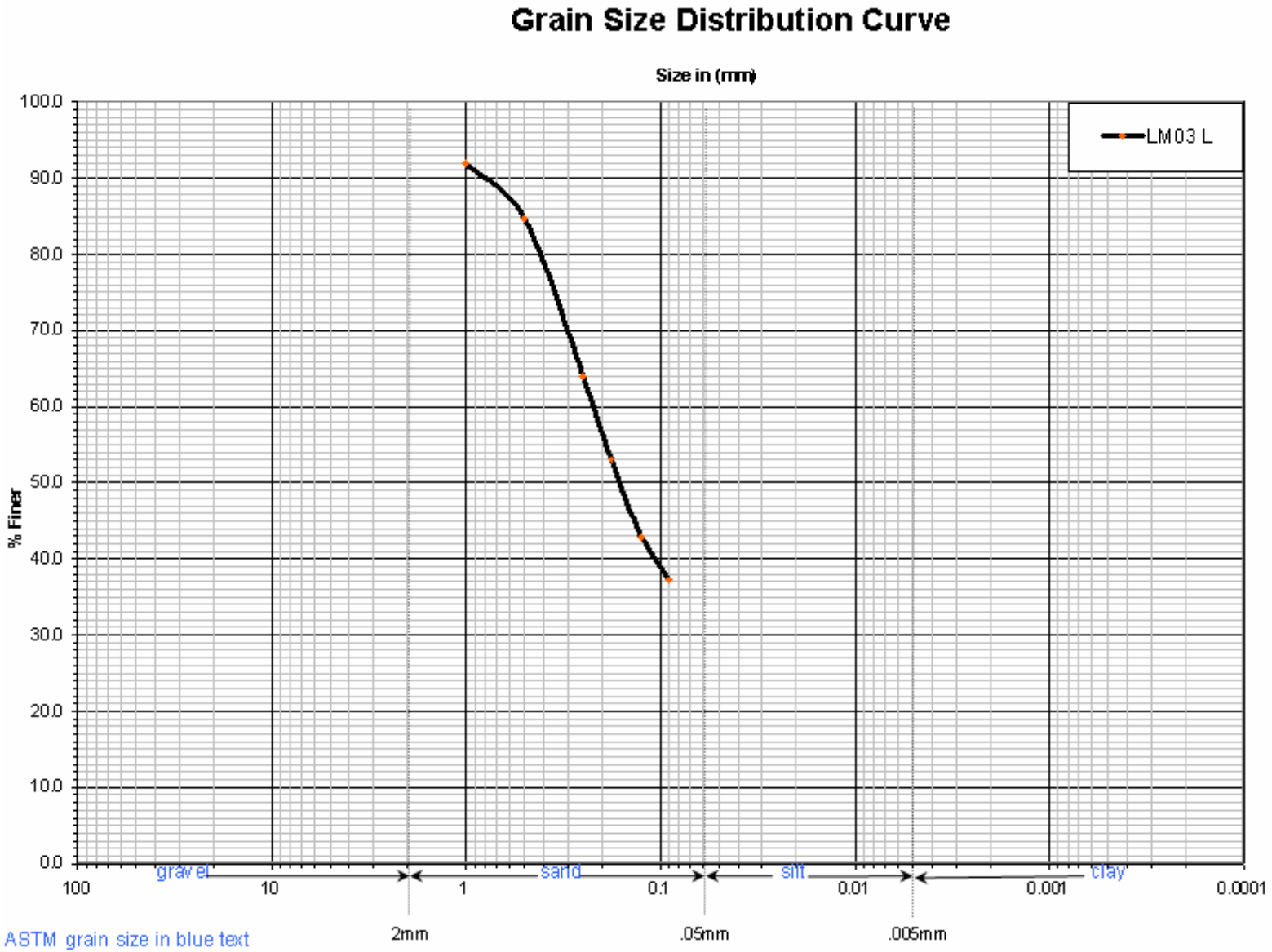
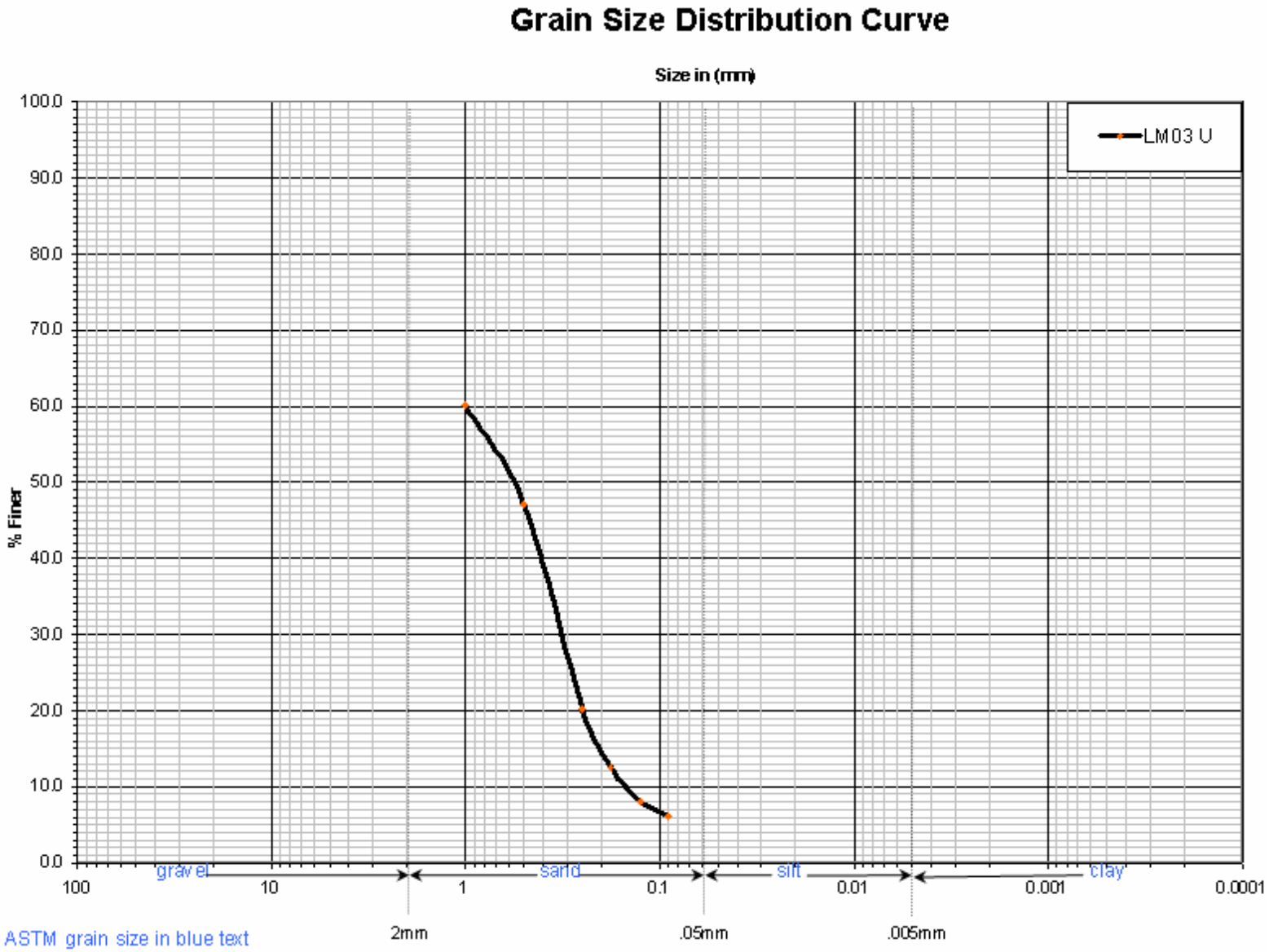
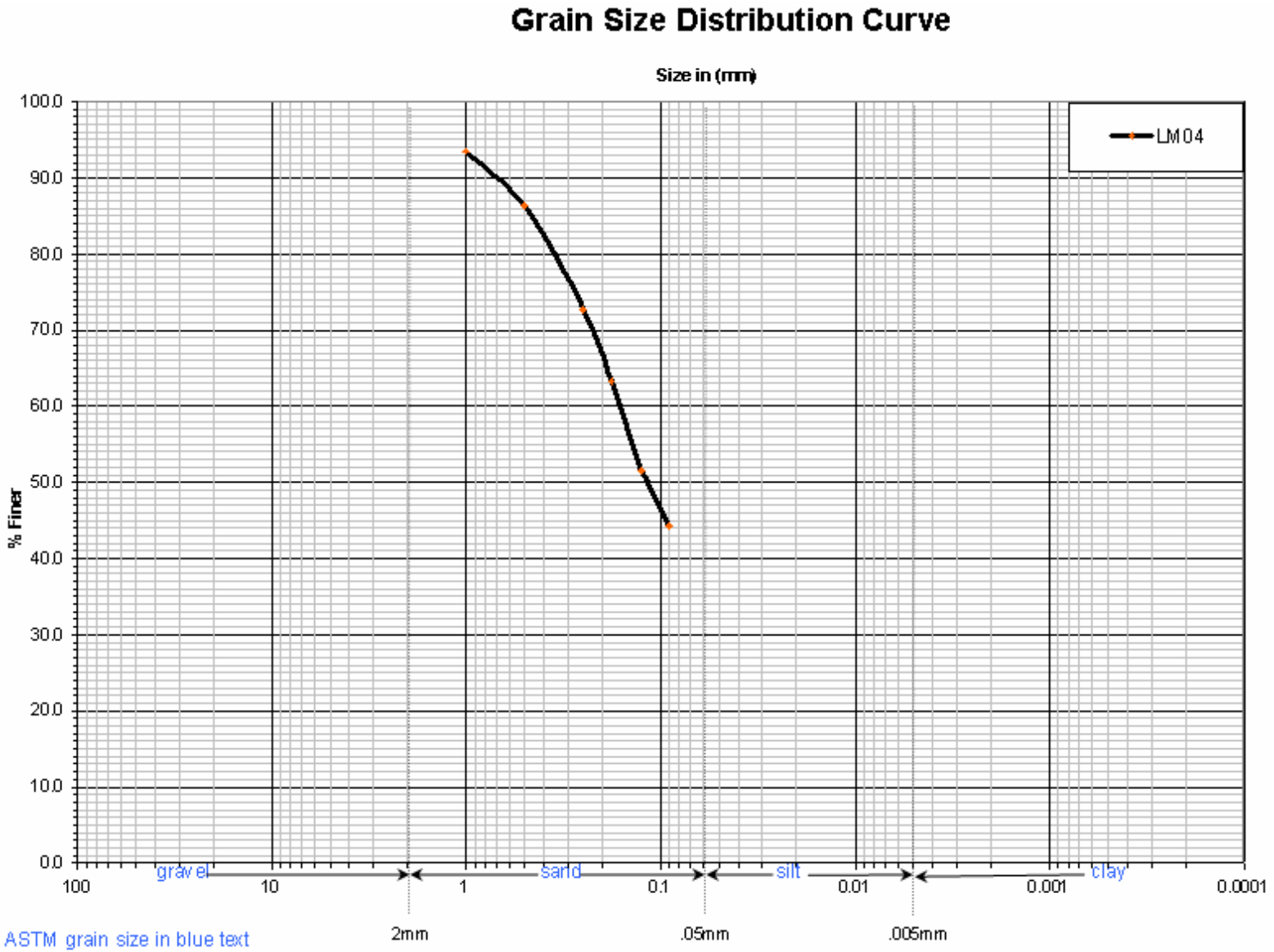
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
LM02
gravel
sand
silt
clay
100
10
1
0.1
0.01
0.001
0.0001
2mm
.05mm
.005mm
ASTM grain size in blue text


Grain Size Distribution Curve
Size in (mm)
% Finer
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
LM03 L
gravel
sand
silt
clay
100
10
1
0.1
0.01
0.001
0.0001
2mm
.05mm
.005mm
ASTM grain size in blue text


Grain Size Distribution Curve
Size in (mm)
% Finer
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
LM03 U
gravel
sand
silt
clay
100
10
1
0.1
0.01
0.001
0.0001
2mm
.05mm
.005mm
ASTM grain size in blue text


Grain Size Distribution Curve
Size in (mm)
% Finer
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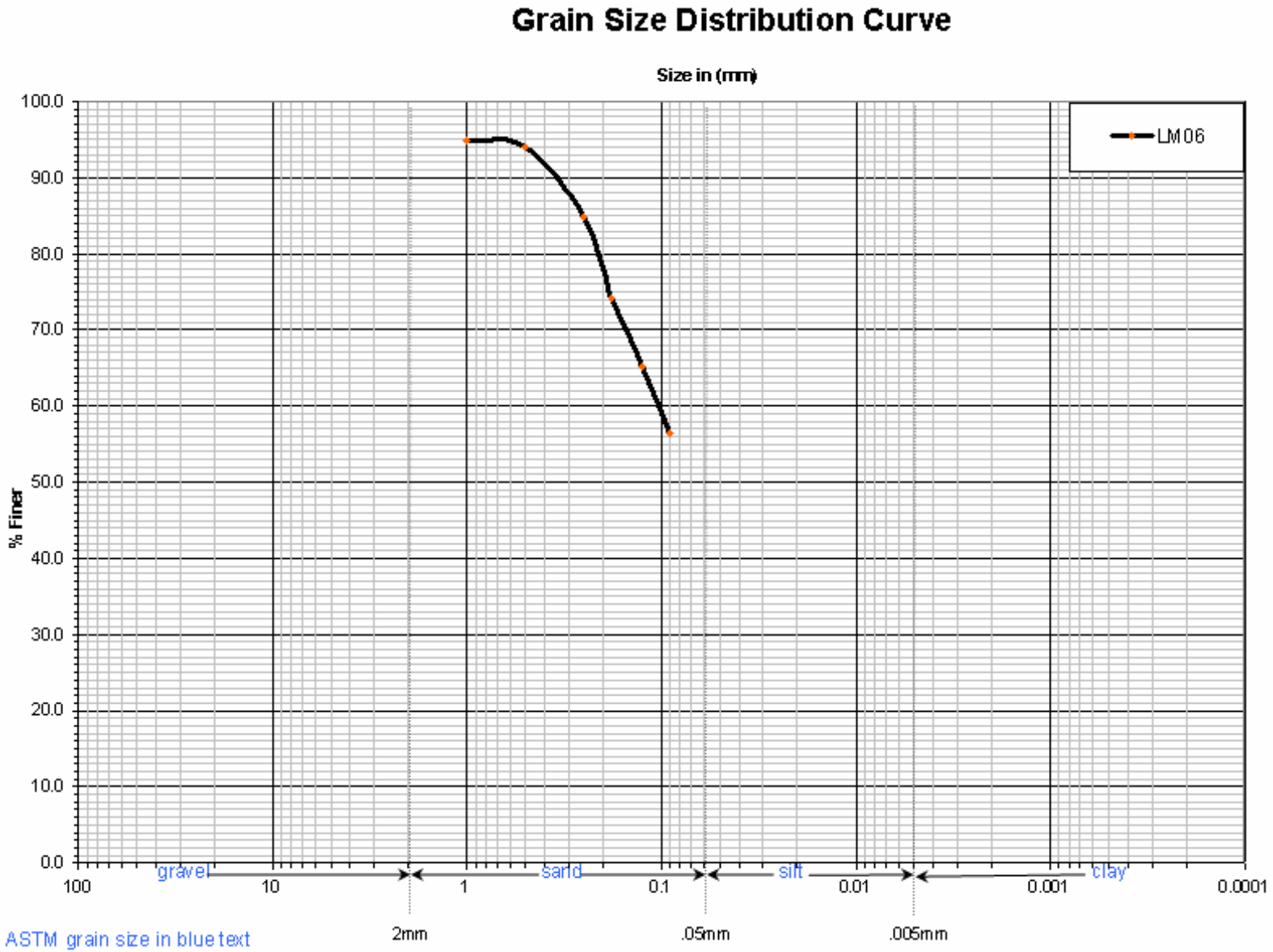
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
LM04
100
10
1
0.1
0.01
0.001
0.0001
gravel
sand
silt
clay
2mm
.05mm
.005mm
ASTM grain size in blue text


Grain Size Distribution Curve
Size in (mm)
% Finer
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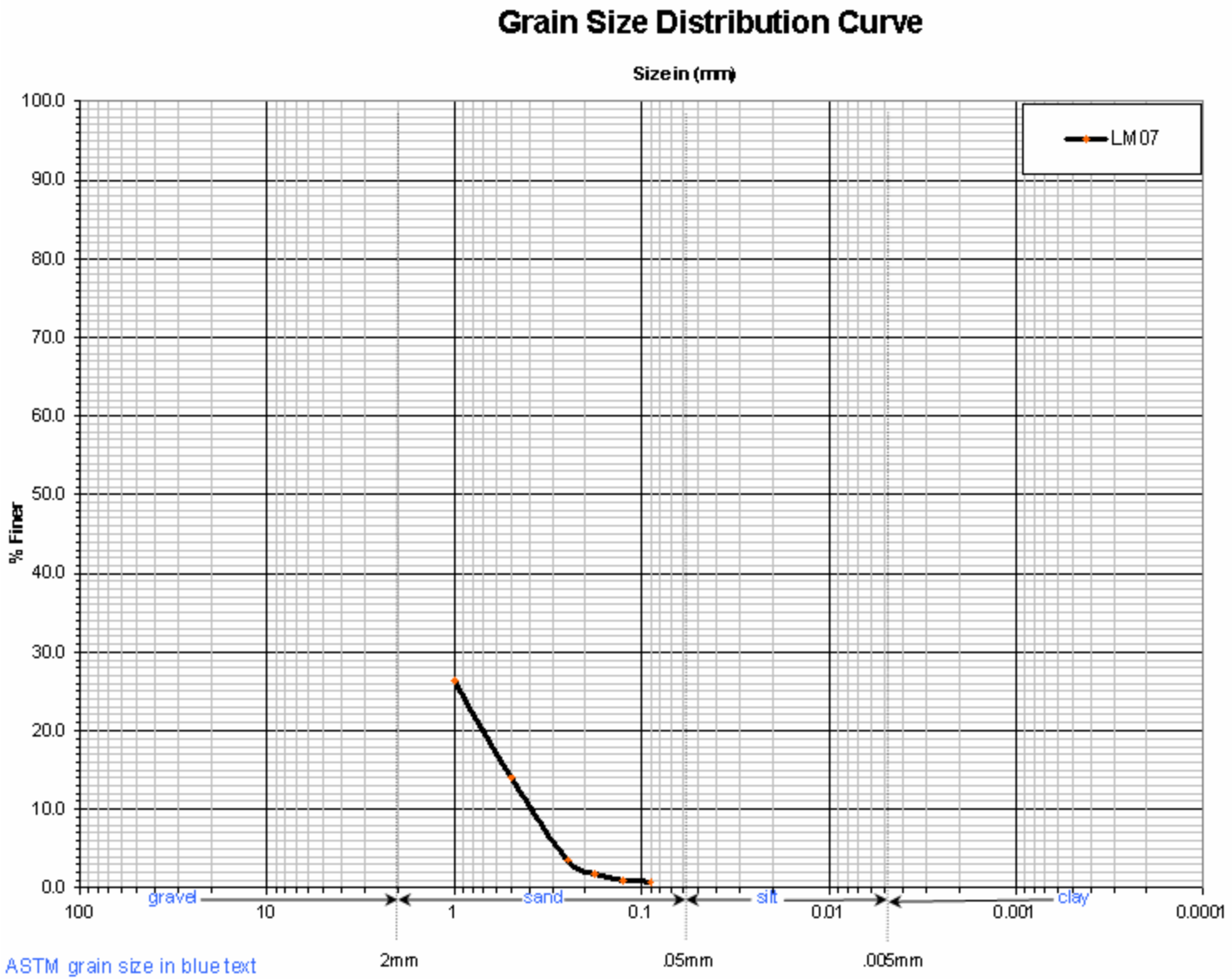
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
LM06
100
10
1
0.1
0.01
0.001
0.0001
gravel
sand
silt
clay
2mm
.05mm
.005mm
ASTM grain size in blue text


Grain Size Distribution Curve
Size in (mm)
% Finer
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90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
LM07
100
10
1
0.1
0.01
0.001
0.0001
gravel
sand
silt
clay
2mm
.05mm
.005mm
ASTM grain size in blue text

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2003 – Present	Geologist / Field Coordinator / Consultant J. L. Sexton and Son

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