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AMEREN MISSOURI SIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. CHARLES COUNTY, MISSOURI

Prepared for

Ameren
MISSOURI

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1.0 INTRODUCTION

The Sioux Energy Center (SEC) is located in northeast St. Charles County, Missouri along the Mississippi River, approximately 14 miles upstream of the confluence with the Missouri River and approximately 3 miles east of Portage de Sioux, Missouri. The SEC is located within the floodplain of the Mississippi and Missouri Rivers and has three active CCR surface impoundments within an approximate 149-acre area. The CCR surface impoundments, designated as Bottom Ash Pond (SCPA), Fly Ash Pond (SCPB) and Gypsum Pond, Cell 1 (SCPC), are used for managing coal combustion residuals (CCR). SCPA and SCPB no longer receive CCRs, have been dewatered, and are currently being closed. SCPC is currently receiving CCRs. Before closure, pooled water from SCPA and SCPB discharged through NPDES permitted outfalls into Poeling Lake. Decant water in SCPC discharges into the Recycle Pond where pumps recirculate the water back to the power plant. A map showing the location of the surface impoundments and the Recycle Pond is attached as Figure 1.

1.1 Purpose

The purpose of this report is to document evaluations and assessments completed for the Ameren Missouri Sioux Energy Center active CCR Units as required by select sections within 40 CFR Part 257, the final rule to regulate the disposal of CCR as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA). Specifically, Reitz & Jens completed assessments and evaluations as required by:

A. §257.73(c)(1), History of Construction
B. §257.73(a)(2), Periodic Hazard Potential Classification
C. §257.73(d)(1), Periodic Structural Stability Assessment
D. §257.73(e)(1), Periodic Safety Factor Assessment
E. §257.82, Hydrologic and Hydraulic Capacity Requirements, and
F. §257.83(b), Inspection Requirements for CCR Surface Impoundments

The evaluations and assessments required by §257.73(c)(1) are discussed in the body of this report. The evaluations and assessments required by the remaining applicable sections of 40 CFR Part 257 are contained in the Appendices.

2.0 SIOUX ENERGY CENTER CCR UNITS

2.1 Owner and Operator

The CCR Units at the Sioux Energy Center (SEC) are owned and operated by Ameren Missouri. The SEC plant personnel have the primary responsibility for CCR unit operation. The SEC is located at 8501 North State Route 94, West Alton, Missouri 63386. The Ameren Missouri Dam Safety Group performs CCR unit inspections and reviews all updates to the Operations and Maintenance (O&M) Manual. A copy of the most recent O&M manual is included in Appendix A. The Ameren Missouri Dam Safety Group is located at 11149 Lindberg Business Court, St. Louis, Missouri 63127.

2.2 CCR Unit Location

The CCR Units are located as identified on the most recent USGS 7.5 minute Elsah, IL topographic quadrangle map in Township 48N, and Range 6E of the 5th Principal Meridian. A partial plot of the USGS topographic quadrangle map showing the location of the SEC is attached as Figure 2.

2.3 CCR Unit Identification and Purpose

There are three surface impoundments and the Recycle Pond at the SEC. The surface impoundments are used to store CCR. The Recycle Pond collects decant water from SCPC, which is recirculated back to the power plant. Decant water has historically been discharged into Poeling Lake through Outfall #006 from the SCPB and through Outfall #002 from the SCPA; however, these ponds have been dewatered and are currently being closed. The NPDES permit number for the SCPA and SCPB outfalls is MO-0000353. The name of each unit, type of impounded CCR, and operational status are listed in Table 1. SCPA and SCPB are not regulated as dams by the Missouri Department of Natural Resources (MDNR) because the height of the perimeter dam is less than 35 feet. The SCPC was initially regulated as a dam by MDNR because of the potential for future vertical expansion. SCPC is no longer regulated by MDNR because Ameren no longer plans to stack gypsum above a height of 35 feet within the impoundment.

Table 1 – Sioux Energy Center CCR Units

CCR Unit	CCR Type	Operational Status
Bottom Ash Pond (SCPA)	Bottom and Fly Ash	**Active**
Fly Ash Pond (SCPB)	Fly Ash	**Active**
Cell 1 (SCPC)	Gypsum	**Active**

2.4 CCR Unit Watershed

The Sioux Energy Center is located along the Mississippi River, approximately 14 miles upstream of the confluence with the Missouri River. According to the current Flood Insurance Rate Map, the regulatory 100-year flood elevation at the site is about el. 437 to 438. SCPA and SCPB are mapped outside the regulatory floodway and 100-year floodplain of both rivers. SCPC is mapped within the 100-year floodplain. The Mississippi River is immediately to the north of SCPA and the Missouri River is about 1 mile to the south of the SEC. Poeling Lake, which connects to the Mississippi River, is located immediately to the west of SCPA and SCPB. Outfalls from the SCPA and SCPB discharge into Poeling Lake. The Mississippi River has a watershed area of approximately 170,000 square miles at the site and the Missouri River has a watershed area of approximately 500,000 square miles at their confluence. The Sioux Energy Center does not receive rainfall run-off from areas outside of the facility. The watershed area for the SCPA and SCPB are about 93 and 89 acres, respectively.

2.5 Geomorphology and Foundation Geology

The geology at the Sioux Energy Center consists of natural alluvium, approximately 100 to 120 feet thick, deposited by the Mississippi and Missouri Rivers and sedimentary rocks of the Paleozoic era.

The alluvium consists of four somewhat distinct, sometimes discontinuous, coarse- to fine-grained deposits. The lower unit of considerable thickness once comprised the active channel for either or both bounding rivers and are called “channel deposits”. This unit contains primarily fine to coarse sands with occasional silt interlaying and fine gravel fragments.

As river floodplains developed beyond the active channels, additional deposits of medium to fine sand occurred along the banks of the active channels. They also formed within the floodplain areas due to hydraulic variations within the active channels. They periodically diverted or retarded intermittent active channel flow and are thus termed “natural levee deposits”.

The upper or near-surface unit contains primarily silts and clays, often intermixed or interbedded with fine to medium sands. The intermediate sandy unit is typically interlayered, whereas the upper more fine-grained unit is typically interbedded. The predominate particle or grain size reflects the water velocity at the time of settling and deposition. More coarse-grained soils “settle out” at faster water velocities; the upper fine-grained materials “settle out” in a low-flow to stagnant water environment. These interlayered and interbedded deposits of varying lithologies, are more recent deposits, and are termed “floodplain deposits”. They may also contain remnants of decomposing root fibers indicating a period of exposure when surface vegetation thrived.

The upper-most alluvial unit are flood basin deposits. The typical thickness of the upper or near-surface unit is about 5 to 10 feet. This unit typically comprises very fine-grained clays with some silt intermixture.

Sedimentary bedrock lithology of the region consists of limestones, dolomites, sandstones and shales. The bedrock is of the Carboniferous Period and Mississippian System. The lowest unit is the Osagean Series, Burlington-Keokuk limestone formation, which is commonly the combination of the Burlington formation and the overlying Keokuk formation. Total thickness of the formation may range from 150 to

250 feet while consisting of a white to light buff, coarsely crystalline limestone with some chert sparsely intermixed throughout. The overlying Meramecian Series, Warsaw formation consists of fine- to coarse-crystalline limestone with chert, dolomite and shale intermixed throughout. This formation is typically 40 to 50 feet thick and is differentiated from the underlying Burlington-Keokuk limestone by the inclusion of often dark to black and sometimes fissured shale. The upper-most bedrock unit is the Meramecian Series, Salem formation with similar lithology to the underlying Warsaw formation. This formation is about 40 to 60 feet thick containing a buff limestone with dolomitic limestone, dolomite and shale.

Groundwater levels at the Sioux Energy Center closely follow the stage of the adjacent Mississippi River, and to a lesser extent the stage of the Missouri Rivers. The direction of groundwater flow is generally southward from the Mississippi River to the Missouri River.

2.6 Surveillance, Maintenance and Repair of the CCR Units

The Sioux Fly Ash and Bottom Ash Pond Embankment, and Cells 1 & 4A and Recycle Pond O&M manuals outline objectives, responsibilities, and procedures for Ameren personnel who are responsible for the management of the Sioux CCR units. The embankments of the CCR units are visually inspected weekly by Ameren plant operations staff. Ameren Missouri Dam Safety Group personnel perform annual inspections and periodic inspections or assessments with plant operations staff. In addition, the Ameren Missouri Dam Safety Group may conduct unannounced safety inspections. Descriptions of each type of inspection or assessment are included in the following sections. Checklists used during inspection of the CCR Units are included in the attached O&M manuals in Appendix A.

2.6.1 Surveillance

2.6.1.1 Weekly Inspections

Weekly inspections are conducted by plant staff or support staff familiar with the ponds/ash pond embankments. The weekly inspections consist of visually inspecting the crest and slopes of each ash pond embankment to identify new or changed conditions. Checklists are completed and are made available to the Dam Safety Group for review.

2.6.1.2 Annual Inspection

These inspections are conducted annually by the plant staff and the Ameren Missouri Dam Safety Group staff. The annual inspection is a detailed visual inspection of the ash pond embankment crest, interior and exterior slopes, downstream toe area, inlet/outlet works, and appurtenant structures.

An inspection report is to be prepared by the Ameren Missouri Dam Safety Group staff that includes a description of the observations of the visual inspection, photographs of the facilities taken during the inspection, and a written evaluation of the results. A record of maintenance activities for the ash pond embankments is also kept current by the Ameren Missouri Dam Safety Group.

2.6.1.3 Periodic Structural Stability Assessments

The Periodic Structural Stability Assessments are conducted every 5 years by the Ameren Missouri Dam Safety Group staff to document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein in general accordance with 40 CFR Part §257.73(d)(1).

Ameren Missouri Dam Safety Group staff will prepare a periodic structural stability assessment report which at a minimum will document whether the CCR unit has been designed, constructed, operated, and maintained with:

i. Stable foundations and abutments;
ii. Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;
iii. Dikes (embankments) mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;
iv. Vegetated slopes of dikes and surrounding areas not to exceed a height of 6 inches above the slope of the dike, except for slopes which have an alternate form of slope protection;
v. A single spillway or a combination of spillways designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the design flood event. The spillways must be either of non-erodible construction and designed to carry sustained flows; or earth or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected;
vi. Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure;
vii. For CCR units with downstream slopes which can be inundated by the pool level of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.

If a deficiency or a release is identified during the periodic assessment, Ameren Missouri will remedy the deficiency or release as soon as feasible and prepare documentation detailing the corrective measures taken.

2.6.1.4 Periodic Hazard Potential Classification

Ameren Missouri Dam Safety Group staff will update the hazard potential classification every 5 years in general accordance with 40 CFR Part §257.73(a)(2). Ameren Missouri Dam Safety Group staff will prepare documentation of the hazard potential classification of each CCR unit as either high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment, or a low hazard potential CCR surface impoundment, and the basis for each hazard potential classification. Ameren Missouri Dam Safety Group staff will prepare and maintain a written Emergency Action Plan if it is determined that a CCR unit is either a high hazard potential surface impoundment or a significant hazard surface impoundment.

2.6.1.5 Periodic Safety Factor Assessment

Ameren Missouri Dam Safety Group staff will conduct periodic safety factor assessments every 5 years in general accordance with 40 CFR Part §257.73(e)(1). The periodic safety factor assessments will be conducted for each CCR unit and will document whether the calculated factors of safety for each CCR unit achieve the minimum safety factors specified in §257.73(e)(1) for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments will be supported by appropriate engineering calculations.

2.6.1.6 Periodic Inflow Design Flood Control System Plan

Ameren Missouri Dam Safety Group staff will prepare an inflow design flood control system plan every 5 years in general accordance with 40 CFR Part §257.82. The plan will document how the inflow design flood control system has been designed, constructed, operated and maintained to adequately manage flow into the CCR surface impoundment during and following the peak discharge of the inflow design flood. The inflow design flood is the probable maximum flood for a high hazard potential CCR surface impoundment, the 1000-year flood for a significant hazard potential CCR surface impoundment, the 100-year flood for a low hazard potential CCR surface impoundment, and the 25-year flood for an incised surface impoundment.

2.6.1.7 Special Inspections

Special inspections are conducted when extreme events which may impact stability (seismic activity, severe flooding, etc.) occur. Special inspections are like the annual inspection but may be focused on a particular area. If conditions are discovered during a weekly or annual inspection which create concern for the SEC plant, personnel, or surrounding properties, a special inspection will be conducted. Responsibility for performance of special inspections will be evaluated based on the severity of the event and potential damage.

2.6.1.8 Unannounced Inspections

The Ameren Missouri Chief Dam Safety Engineer (CDSE) may conduct unannounced inspections at the site as deemed appropriate. The inspection may include a visual inspection of the facility, a review of the inspection documentation, and interviews with plant personnel to review their understanding of the required inspection procedures.

2.6.1.9 Inspection Findings

Observations made during the inspections are rated with a condition code as shown in the following Table 2. The timeliness of response to deficiencies observed depends on the severity of the condition.

Table 2 - Ameren Missouri Dam Safety Inspection Condition Codes

Condition Code	Description
EC	Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, emergency repairs, work stoppage, plant stoppage.
IM	Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM	Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB	Condition requires regular observation and potential future minor maintenance.
GC	Good Condition.
NO	No observation possible.
NI	Not Inspected. State reason in comment column.

2.6.2 Maintenance and Repair of the CCR Units

The O&M manual requires that timely repairs must be made after problem areas are identified. The plant engineer is to specify the work to be completed using Ameren's Work Control Process and provide direction to correct items noted in the operation and maintenance, and engineering inspections. The work request by the plant engineer will be reviewed with the Dam Safety Group to ensure proper emphasis has been placed on the request. The O&M manual specifies the minimum maintenance activities and requires that maintenance activities be documented. The O&M manual further specifies that no alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer.

3.0 SCPA (BOTTOM ASH POND)

3.1 History of Construction

SCPA was brought online in 1967. As-built drawings are presented in the O&M manual in Appendix A. The pond configuration and features are shown in Figure 1. SCPA historically received process water used to sluice bottom ash, and flow from the plant combined drained sump (CDS). Currently the SCPA is being closed and no longer receives flow from either of these sources. The southern half of SCPA is filled to capacity with a mixture of bottom and fly ash. The northern half of the pond contains bottom ash.

The perimeter embankment was originally constructed with 2 horizontal (H) to 1 vertical (V) upstream and downstream slopes and a crest elevation of approximately 443 to 445 feet. Portions of the downstream embankment slope have subsequently been flattened to 2.5H to 1V. SCPA is bound by plant fill to the east and northeast, and the embankment dam ties into the plant fill. The pond was incised to el. 400 and the excavated material was used to construct the embankment dam and for plant fill.

Prior to the completion of closure, flow from SCPA was routed through an outlet structure and discharged through a 30-inch diameter conduit that is primarily reinforced concrete pipe (RCP). The last five feet of the conduit on the downstream end was corrugated metal pipe (CMP), which was adjoined on the upstream side to 13 feet of non-reinforced concrete pipe. The remaining 88 feet of conduit was RCP. The outlet structure was reinforced concrete, with a reinforced concrete weir and steel bulkhead on the upstream side. The bulkhead had an orifice with a manually operated sluice gate. Flow to the structure was through a 24-inch diameter HDPE pipe and an opening cut in a large diameter, galvanized, corrugated steel skimmer. The steel skimmer was upstream of the bulkhead and had lost some functionality because of ponded ash. The 24-inch HDPE pipe was buoyed so that it floats and anchored so that is runs to the north side of the pond. There is a short outlet channel that is armored with riprap. The outlet channel discharges into Poeling Lake.

A summary of pertinent data for the SCPA is summarized in Table 3.

Table 3 – SCPA (Bottom Ash Pond)

CCR Unit	Maximum Pond Area (acres)	Maximum Dam Height (feet)	Minimum Crest Width (feet)	Crest Length (feet)	Upstream Slope Steepness (H:V)	Downstream Slope Steepness (H:V)
SCPA	49	27	10	6,700	2:1	2:1 & 2.5:1

3.2 Modifications to Embankment Geometry and Operation

The following section describes modifications to the embankment geometry and operation. Significant modifications are shown on Figure 1.

3.2.1 2009 Spillway Modification

The original spillway consisted of a reinforced concrete structure with a concrete weir and concrete or wooden stoplogs on the upstream side, and a corrugated steel skimmer. The as-built plans dated 2009 show that the stoplogs were removed and replaced with a steel frame (bulkhead) and manually operated stainless steel sluice gate. The gate is used to restrict flow through an orifice in the steel frame that has a width of 2.5 feet and height of 2 feet. The invert of the orifice is at el. 429 and the top of the steel frame is at el. 440. Plans showing the modifications are presented in the O&M manual presented in Appendix A.

3.2.1 2009 Riprap Armor Slopes

Riprap armor was installed on approximately 750 lineal feet of the southwest and approximately 630 feet of the north downstream slopes, and on approximately 570 lineal feet on the north upstream slope. On the downstream slope the riprap was installed from the toe to about half-way up the embankment. Riprap was large stone with a median size of approximately 18 inches.

3.2.2 2012 Stability Berm, Rock Wedge and Inverted Filter

Based on recommendations to improve the stability of the embankment, a riprap stability berm was constructed on the north side of the pond. The berm was constructed along approximately 620 lineal feet of the toe, and had a minimum width of 17 feet and thickness of 4 feet. At the same time, a rock wedge was constructed on the adjacent drainage channel slope over approximately 160 lineal feet. The rock wedge was recommended to have a maximum steepness of 2H to 1V and a minimum thickness of 3 feet.

An inverted filter was also constructed along the downstream toe at the northeast corner of the perimeter berm where seepage has been observed. The inverted filter consists of two, 2 foot layers of filter media that is armored with 4 feet of riprap. The riprap armor is keyed in 2 feet at the downstream toe. Figure 3 is a schematic of the inverted filter.

3.2.3 2012 Combined Sump Discharge

The outlet for the combined sump discharge (CDS) was moved south approximately 400 feet on the east side of the SCPA.

3.2.4 2015 Embankment Modifications and Slurry Wall Addition

The downstream slope along the southwest and south perimeter berms was flattened to a 2.5H to 1V slope and armored with riprap. Ten inches of riprap was placed from the shoulder to the downstream toe of the embankment. The riprap has a maximum size of 10 inches and a predominate size of 6 inches. A geotextile fabric was placed under the riprap along the length of the embankment slope. In addition, a ditch with 2H to 1V sideslopes was cut in the CCR on the upstream side of the embankment. Figure 4 shows a typical cross-section through the southwest and south perimeter berms.

A slurry cutoff wall was constructed through the crest of the embankment in the northeast corner of the perimeter berm. The slurry wall extends to a minimum depth of 40 feet below the embankment crest. A 3-foot thick clay cap was constructed above the slurry wall. The slurry wall extends approximately 300 lineal feet along the northeast perimeter embankment. Figure 5 shows the general location, extents and a typical cross-section through the northeast corner of the perimeter berm with the slurry wall.

3.2.5 Closure Construction (2017 to 2021)

The SCPA is being closed in two phases. Phase 1 was completed in 2019, and consisted of closure of an approximate 16-acre area on the southwest and west sides of the pond. The area was graded and capped with two feet of soil as part of closure. Portions of the Phase 1 area were subsequently developed for a new parking lot and low volume wastewater treatment facility (LVW).

Phase 2 closure was initiated in 2021 and is scheduled to be complete by the end of 2021. Phase 2 closure will include grading the remaining exposed CCR to facilitate drainage and capping the CCR with a 60 mil HDPE geomembrane and 2 feet of soil. Ditches created during closure for stormwater runoff will be lined with closure turf underlain by a geomembrane, and the existing NPDES outlet works will be removed.

3.3 Foundation and Abutment Geology

Geotechnical investigations were conducted in 2010 and 2015 along the southern, western and northern sections of the embankment dam. Geotechnical investigations were also conducted in 1963 prior to construction of the embankment. These geotechnical investigations are included in Appendix A. The typical foundation profile consists of an uppermost stratum of clay to silty clay that is firm to stiff, and approximately 7 to 15 feet thick. In the southern portion of the pond the uppermost stratum is silty sand. The clay is generally underlain by 4 to 7 feet of loose to medium-dense silty sand. Poorly graded sand is encountered generally at a depth of about 20 feet below the natural ground surface beneath the silty sand. The sand is intermittently fine to coarse and medium-dense to dense. The sand extends to bedrock, and typically becomes coarser with depth, with gravel, cobbles and boulders encountered in the deeper sands near the interface with bedrock. Near the SCPA, bedrock is encountered at a depth of about 105 to 110 feet below the original ground surface.

3.4 Embankment Material

Embankment fill generally consists of compacted layers with varying amounts of clay, silt and sand that were excavated from the incised portion of the pond. Fill material is generally soft to firm or loose to medium-dense. All or portions of the downstream slopes along the south, southwest, northwest and north embankments are armored with riprap to provide stability and erosion protection.

3.5 Operating Pool Surface Elevations

SCPA has been dewatered and is currently being closed. Stormwater falling within the footprint of the impoundment is actively managed by the closure contractor to prevent overtopping of the perimeter embankments.

3.6 CCR Unit Outlet Works

The spillway for the SCPA is a 30-inch reinforced concrete pipe (RCP). The 30-inch RCP inlet is connected to a concrete outlet structure that has a weir, steel bulkhead and large diameter, galvanized, corrugated, steel skimmer on the upstream side. Discharge from the pipe flows through a short outlet channel that is armored with riprap and into Poeling Lake. There is no emergency spillway for the SCPA. Drawings for the outlet works are presented in the O&M Manual presented in Appendix A. The spillway will be abandoned during closure construction.

Summarized in Table 4 are pertinent data for the SCPA outlet works.

Table 4 – SCPA (Bottom Ash Pond) Outlet Works

CCR Unit	Description	Type	Upstream Invert Elevation (feet)	Downstream Invert Elevation (feet)
SCPA	Spillway	30" RCP	429	422

3.7 Impounded CCR

The SCPA impounds bottom and fly ash. A survey from 2019 shows contours of the impounded ash. Table 5 summarizes the estimated volume and depth of the CCR stored in the pond.

Table 5 – SCPA (Bottom Ash Pond) CCR

CCR Unit	Est. Volume of CCR (CY)	Approximate Bottom Elev. of CCR Unit (feet)	Est. Maximum CCR Elev. (feet)	Est. Average Depth of CCR (feet)	Est. Maximum Depth of CCR (feet)
SCPA	1,680,338	400	445	30	45

The impounded bottom ash generally consists of sand to gravel sized particles. Relative density tests on the ash show the minimum density ranges from 91.3 to 95.4 pcf, and the maximum density ranges from 113.1 to 116.4 pcf. The results of relative density tests are presented in Appendix A. The impounded fly ash is assumed to be Type C. A boring was conducted on the south side of the pond in 2014 for the construction of a transmission tower inside the perimeter of the impoundment. A mixture of bottom and fly ash was encountered. The ash was very loose to medium-dense with moisture contents ranging from 41.1 to 78 percent. A log of the boring is presented in Appendix A.

3.8 Instrumentation

The SCPA has a water level staff gage. Ameren measures and records pool levels during weekly inspections.

3.9 Structural Instability

There are no records of structural instability for SCPA.

4.0 SCPB (FLY ASH POND)

4.1 History of Construction

SCPB was brought online in 1994. As-built drawings are presented in the O&M manual in Appendix A. The pond configuration and features are shown in Figure 1. The pond historically received process water used to sluice fly ash and stormwater runoff from the coal pile. The pond no longer receives process water or stormwater runoff from the coal pile. SCPB has been dewatered and is currently being closed. Flow within the SCPB was conveyed north to south through interior ditches within the ash. Decant water was ponded in the southern portion of the SCPB. The perimeter embankment was originally constructed with 3H to 1V upstream and downstream slopes and a crest elevation of approximately 441.5 to 446.4 feet. The minimum crest width is 20 feet. The pond is bound to the north and east by plant fill. The embankment section is thickened to the south by a railroad embankment, and to the west by the plant access road. The downstream slope may be as steep as 2H to 1V in locations where the embankment section is thickened by adjacent improvements. The pond was incised to a bottom elevation of approximately 422 feet and has 60-mil HDPE liner on the side slopes and 40-mil HDPE on the bottom. The water level was controlled by an upturned 18” HDPE pipe inlet. The discharge pipe was regulated by two motor operated butterfly valves. The HDPE pipe penetrates the southern half of the west perimeter embankment and discharges decant water into Poeling Lake.

A summary of pertinent data for the SCPB is summarized in Table 6.

Table 6 – SCPB (Fly Ash Pond)

CCR Unit	Maximum Pond Area (acres)	Maximum Dam Height (feet)	Minimum Crest Width (feet)	Length (feet)	Upstream Slope Steepness (H:V)	Downstream Slope Steepness (H:V)
SCPB	62	22	20	7,900	3:1	2:1 to 3:1

4.2 Modifications to Embankment Geometry and Operation

4.2.1 2010 Riprap Placement

Riprap was placed on the downstream slopes in the northwest part of the pond. The segment armored has not been thickened by adjacent improvements. The riprap was placed to help prevent future erosion from occurring on the slopes.

4.2.2 Gypsum Slurry Piping Fill

In 2010 fill was placed adjacent to the embankment near the southeast corner of the pond. The fill was placed for new piping that is used to transport gypsum slurry to SCPC. The fill is compacted fly ash with a soil cap and was placed adjacent to and on the downstream slope at a steepness of about 3H to 1V.

4.2.3 2012 Planned Solar Panel Fill Area

The area adjacent to the east perimeter berm was filled to an elevation near the top of the embankment with compacted fly ash. The area filled was approximately 17 acres and included a storm drainage system. The area was developed for potential solar power generation, but the infrastructure was never constructed. A grading plan for the fill area is presented in Figure 6.

4.2.4 Closure Construction (2020 to 2021)

Closure of SCPB was initiated in 2020 and is scheduled to be complete in 2021. Closure will include grading the exposed CCR to facilitate drainage and capping the CCR with a 60 mil HDPE geomembrane and 2 feet of soil. Ditches created during closure for stormwater runoff will be lined with closure turf underlain by a geomembrane, and the existing NPDES outlet works will be removed.

4.3 Foundation and Abutment Geology

Geotechnical investigations along the southern perimeter embankments in 2010 and borings for the original plant development in 1963 are referenced for the SCPB foundation material. The geotechnical investigations are included in Appendix A. The uppermost stratum is firm to stiff clay with a thickness of about 8 to 10 feet. The clay is underlain by silty sand and then poorly graded sand. The consistency of the silty sand and sand is medium dense and medium dense to dense, respectively. The silty sand stratum is generally 11 to 13 feet thick. The sand is fine to coarse, and intermittently silty and gravely. The sand extends to limestone bedrock, which is encountered at a depth of about 120 feet beneath the original ground surface.

4.4 Embankment Material

Embankment fill generally consists of compacted layers of clays, silts and sands that were excavated from the incised portion of the pond. Fill material is generally firm to stiff or medium dense. The upstream and downstream slopes are 3H to 1V, except where the embankment section has been widened by adjacent improvements. In the locations where the embankment has been widened the downstream slopes can vary from 2H to 1V and 3H to 1V. Borings through the embankment fill on the south side of the pond are presented in Appendix A.

4.5 Operating Pool Surface Elevations

The SCPB has been dewatered and is currently being closed. Stormwater falling within the footprint of the impoundment is actively managed by the closure contractor to prevent overtopping of the perimeter embankments.

4.6 CCR Unit Outlet Works

The spillway for the SCPB is an 18-inch HDPE pipe with an inlet upturned to an elevation of 434.5 feet. The downstream invert elevation for the discharge pipe is at elevation 430 feet. Two motor operated butterfly valves are used regulate the pool level and flow through the outlet into Poeling Lake. The outlet pipe is upturned on the downstream end and discharges onto a concrete slab. The outlet channel is armored with riprap for a short distance immediately downstream of the concrete slab. There is no emergency spillway for the SCPB. The pond has a staff gage near the inlet for the spillway. The outlet works construction drawings and alignment is shown in the O&M Manual presented in Appendix A. The spillway will be abandoned during closure construction.

Summarized in Table 7 are pertinent data for the SCPB outlet works.

Table 7 – SCPB (Fly Ash Pond) Outlet Works

CCR Unit	Description	Type	Upstream Invert Elevation (feet)	Downstream Invert Elevation (feet)
SCPB	Conduit Spillway	18” HDPE pipe	434.5	430

4.7 Impounded CCR

The SCPB impounds fly ash at the estimated volume and depth shown in Table 8.

Table 8 – SCPB (Fly Ash Pond) CCR

CCR Unit	Est. Volume of CCR (CY)	Approximate Bottom Elev. of CCR Unit (feet)	Est. Maximum CCR Elev. (feet)	Est. Average Depth of CCR (feet)	Est. Maximum Depth of CCR (feet)
SCPB	2,234,805	422	458	24	32

Particle size distribution tests on samples of fly ash show the ash consists of primarily silt sized particles, with fine to medium sand and clay sized particles. The Specific Gravity of the fly ash ranges from about 2.18 to 2.52. Laboratory compaction characteristic curves using standard effort on fly ash are presented in Appendix A. The maximum dry density ranges from 64.4 to 80.8 pcf, and the optimum moisture content ranges from 28.5 to 51.9%.

4.8 Instrumentation

The SCPB has a water level staff gage. Ameren measures and records pool levels during weekly inspections.

4.9 Structural Instability

There are no records of structural instability for SCPB.

5.0 SCPC (CELL 1)

5.1 History of Construction

The SCPC was brought online in 2010. As-built drawings are presented in the Cells 1 & 4A and Recycle Pond O&M manual in Appendix A. The SCPC configuration and features are shown in Figure 1. The Flue Gas Desulfurization (FGD) system produces gypsum as a byproduct. The FGD gypsum slurry is pumped to SCPC where it is managed for long-term or permanent storage. The SCPC does not receive any additional stormwater run-off outside its bounded area. The gypsum slurry discharges into the cell at the approximate midpoint of the east embankment. The gypsum settles out into SCPC and the decant water flows into the Recycle Pond through a set of triple box culverts. SCPC and the Recycle Pond are separated by an embankment. Triple box culverts connect SCPC with the Recycle Pond, and the culverts control the maximum normal water level in SCPC to el. 441.1. SCPC also has an emergency spillway on the west side of the impoundment. The bottom and side slopes of SCPC are lined with 80-mil HDPE liner, which was constructed over 24 inches of compacted, impervious clay. The SCPC embankment upstream and downstream slopes have a steepness of 3H to 1V and the crest elevation is approximately 446 feet. Riprap armor was placed from the downstream toe to about the mid-height of the embankment along the south and west berms in SCPC. Drawings for SCPC are shown in Appendix A.

A summary of pertinent data for SCPC is summarized in Table 9.

Table 9 - SCPC (Cell 1)

CCR Unit	Maximum Pond Area (acres)	Maximum Dam Height (feet)	Minimum Crest Width (feet)	Length (feet)	Upstream Slope Steepness (H:V)	Downstream Slope Steepness (H:V)
SCPC	37.5	24	12	5,200	3:1	3:1

5.2 Modifications to Embankment Geometry and Operation

There have been no modifications to the SCPC embankment geometry since the original construction of the impoundment in 2010.

5.3 Foundation and Abutment Geology

Geotechnical investigations in 2005 for SCPC document the impoundment foundation material and are presented in Appendix A. The uppermost stratum is generally clays and silty clays with scattered seams and layers of low plastic silt, underlain by silts. The thickness of these fine-grain deposits ranged from 0 to 24 feet, but generally between about 5 to 10 feet. Clay soils are almost all high plastic. The fine-grain soils are firm to stiff, with undrained cohesive shear strengths of 500 psf to over 2000 psf.

The upper fine-grain soils are underlain by sandy silts, silty fine sands, and fine sands, generally to a depth of 30 feet. These upper sandy soils are generally loose to medium-dense. The upper sandy soils are underlain by fine to coarse, poorly graded sands and well-graded sands, with some silty sands and gravelly sands at greater depths. Limestone bedrock is at a depth of about 115 feet. The lower sands generally ranged from medium dense to very dense, increasing in density with increasing depth.

5.4 Embankment Material

Embankment fill consists of compacted layers of clay and silt with varying amounts of sand. Fill material was compacted to an average of 100% of the maximum dry unit weight determined from the Standard Proctor Moisture-Density Test (ASTM D698). Fill placement was monitored, and moisture-density tests were obtained during construction. The upstream and downstream slopes have a steepness of 3H to 1V. Riprap armor was placed from the downstream toe to about the mid-height of the embankment along the south and west berms. The crest elevation of the embankment for SCPC is approximately elevation 446 feet.

The bottom of SCPC and the upstream slopes are covered with 2 feet of compacted clay liner that has a maximum hydraulic conductivity of $1x10^{-7}$ cm/sec. Clay for the liner was obtained on site. The compaction criteria for the clay liner were developed using the “Daniel Method.” Fill placement was monitored and moisture-density tests were obtained during construction.

5.5 Operating Pool Surface Elevations

The normal operating pool level for SCPC is elevation 441.1 feet. Assuming there is no flow from the triple box culvert spillway, the maximum surcharge pool elevation during the 100-year, 24-hour storm in SCPC is 442.5 feet. An area-capacity curve for SCPC is shown in Figure 7.

5.6 CCR Unit Outlet Works

The principal spillway for SCPC is a set of three box culverts. Each box culvert has a width of 6 feet and height of 3 feet. The flowline of the box culverts is at elevation 441 feet. The box culverts discharge into the Recycle Pond. The spillway construction drawings are presented in Appendix A.

SCPC also has a broad crested weir emergency spillway located near the northeast corner of the impoundment. The top of the spillway is lined with interlocking modular blocks. The spillway invert elevation is at 445.0 feet. At the invert elevation the spillway has a width of 12.5 feet, and the sides are tapered up to the top of the embankment elevation over 12 feet. The blocks extend 19 feet down the downstream slope, where they terminate at the top of the riprap. A typical cross-section of the emergency spillway is shown in the construction drawings presented in Appendix A.

Summarized in Table 10 are pertinent data for the SCPC outlet works.

Table 10 – SCPC (Cell 1) Outlet Works

CCR Unit	Description	Type	Upstream Invert Elevation (feet)	Downstream Invert Elevation (feet)
SCPC	Principal Spillway	Triple box culverts	441.0	441.0
SCPC	Emergency Spillway	Broad Crested Weir	445.0	NA

5.7 Impounded CCR

SCPC impounds gypsum and the estimated volume and depth are shown in Table 11. A topographic survey of the impounded ash was conducted in 2020 and is attached as Figure 8.

Table 11 – SCPC (Cell 1) CCR

CCR Unit	Est. Volume of CCR (CY)	Approximate Bottom Elev. of CCR Unit (feet)	Est. Maximum CCR Elev. (feet)	Est. Average Depth of CCR (feet)	Est. Maximum Depth of CCR (feet)
SCPC	812,617	422	445	15	21

Typical wet FGD gypsum is characterized by a moderately low hydraulic conductivity. The angle of internal friction (ϕ) for gypsum is typically assumed to be about 40 to 42 degrees.

5.8 Instrumentation

There is no staff gage in SCPC. Given the large capacity of the box culverts, the water level within the pond is nearly constant at the invert of the culverts. The water level in the Recycle Pond is continuously monitored by Plant operation personnel using level sensors installed at the east end of the Recycling Pond.

5.9 Structural Instability

There are no records of structural instability for SCPC.

6.0 PERIODIC HAZARD POTENTIAL CLASSIFICATION

40 CFR Part 257
Periodic Hazard Potential Classification Assessments for CCR Surface Impoundments
§257.83(a)(2)

The 2020 Periodic Hazard Potential Classification Assessment was conducted for active CCR surface impoundments SCPA (Bottom Ash Pond), SCPB (Fly Ash Pond) and SCPC (Cell 1) at the Sioux Energy Center. These CCR surface impoundments are low hazard potential because failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner. The hazard potential classification was completed in general accordance with Federal Guidelines for Dam Safety: Hazard Potential Classification for Dams by the Federal Emergency Management Agency (January 2004).

CCR Unit	Hazard Potential Classification
SCPA	Low
SCPB	Low
SCPC	Low

Refer to Appendix B for the 2020 Periodic Hazard Potential Classification report. The subsequent assessment of the hazard potential must be conducted within 5 years of this assessment.

Engineer's Seal

STATE OF MISSOURI
JEFF
BERTEL
NUMBER
PE-2010025265
PROFESSIONAL ENGINEER

Jeff Bertel, P.E.
License: PE-2010025265
Date: October 15, 2021

7.0 PERIODIC STRUCTURAL STABILITY ASSESSMENT

40 CFR Part 257
Periodic Structural Stability Assessment for CCR Surface Impoundments §257.73(d)(1)

The 2020 Periodic Structural Stability Assessment was conducted for the active CCR surface impoundments SCPA (Bottom Ash Pond), SCPB (Fly Ash Pond) and SCPC (Cell 1) at the Sioux Energy Center. The structural stability assessment was completed in general accordance with 40 CFR Part §257.73(d)(1). Assessment of all three CCR Units found no structural stability deficiencies, no significant issues with the current operations and maintenance, and that the design and construction are adequate, however some corrective measures were recommended.

Requirement	SCPA	SCPB	SCPC
Initial periodic assessment was completed in general accordance with the requirements of 40 CFR Part §257.73(d)(1)	Yes	Yes	Yes

Refer to Appendix C for the 2020 Periodic Structural Stability Assessment report. The subsequent Periodic Structural Stability Assessment must be conducted within 5 years of this assessment.

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JEFF
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Date: October 15, 2021

8.0 PERIODIC SAFETY FACTOR ASSESSMENT

40 CFR Part 257
Periodic Safety Factor Assessment for CCR Surface Impoundments §257.73(e)(1)

The 2020 Periodic Safety Factor Assessment was conducted for the active CCR surface impoundment SCPC at the Sioux Energy Center. The Periodic Safety Factor Assessment for SCPC shows that the critical cross section for this Unit meets or exceeds the minimum factors of safety specified in 40 CFR Part §257.73(e)(1) as summarized below. SCPA and SCPC no longer receive CCRs, have been dewatered and are currently being closed. A safety factor assessment for the closed condition of SCPA and SCPC, completed by Golder Associates found that the minimum factors of safety meet or exceed the minimum requirements.

Requirement	SCPA	SCPB	SCPC
The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.	≥1.50	≥1.50	≥1.50
The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.	≥1.40	≥1.40	≥1.40
The calculated seismic factor of safety must equal or exceed 1.00.	≥1.00	≥1.00	≥1.00
The calculated liquefaction factor of safety must equal or exceed 1.20.	≥1.20	≥1.20	≥1.20

Refer to Appendix D for the 2020 Periodic Safety Factor Assessment report. The subsequent Periodic Safety Factor Assessment must be conducted within 5 years of this assessment.

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9.0 HYDROLOGIC AND HYDRAULIC CAPACITY REQUIREMENTS

40 CFR Part 257
Hydrologic and Hydraulic Capacity Requirements for CCR Surface Impoundment §257.82

The 2020 periodic inflow design flood control system plan was completed for the active CCR surface impoundment SCPC at the Sioux Energy Center. The inflow design flood control system plan was completed in general accordance with 40 CFR Part §257(e)(1) using the 100-year design flood for low hazard potential CCR surface impoundments. SCPA and SCPB have been dewatered and are currently being closed. Closure of SCPA and SCPB was designed by Golder Associates so that water is not permanently impounded within the perimeter embankment.

Requirement	SCPA	SCPB	SCPC
The periodic inflow design flood control system plan meets the requirements of 40 CFR Part §257.82	Yes	Yes	Yes

Refer to Appendix E for the Inflow Design Flood Control System Plan report. The owner or operator must prepare periodic inflow design flood control system plans every five years, or whenever there is a change in conditions that would substantially affect the plan.

Engineer's Seal

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Date: October 15, 2021

10.0 CLOSURE

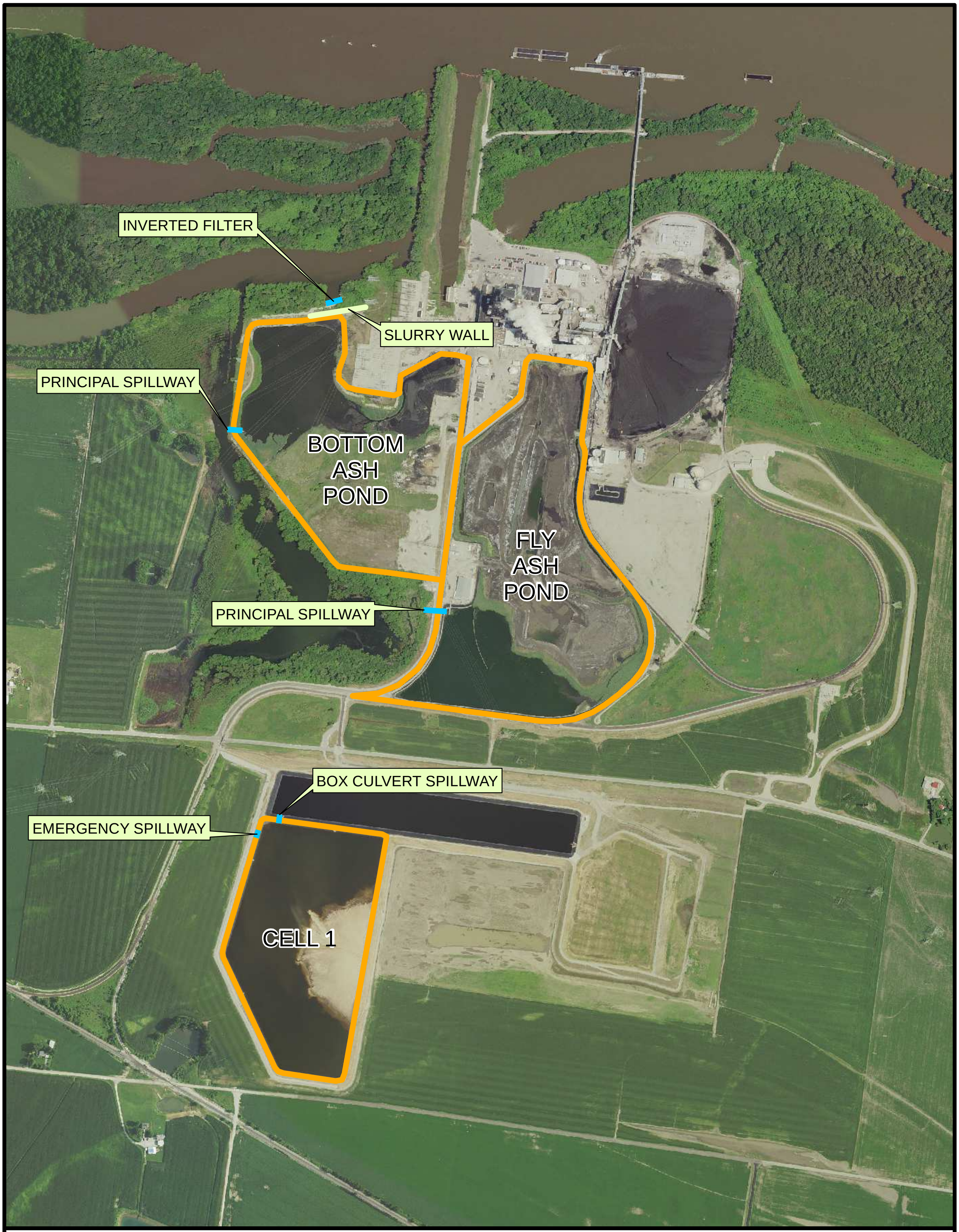
The preceding history of construction is regarded as a living document. If there is a significant change to any information or there are periodic updates, Ameren must update the relevant information and place it in the facility's operating record.

11.0 REFERENCES

Ameren Missouri. (2010). “Operation and Maintenance Manual; Sioux Flyash and Bottom Ash Pond Embankment, West Alton, Missouri, St. Charles County.” Dam Safety and Hydro Engineering, St. Louis, Missouri.

Ameren Missouri. (2015). “Operation and Maintenance Manual for Cells 1 & 4A and Recycle Pond, Sioux Energy Center Utility Waste Landfill, St. Charles County, Missouri.” Power Operations Services, St. Louis, Missouri.

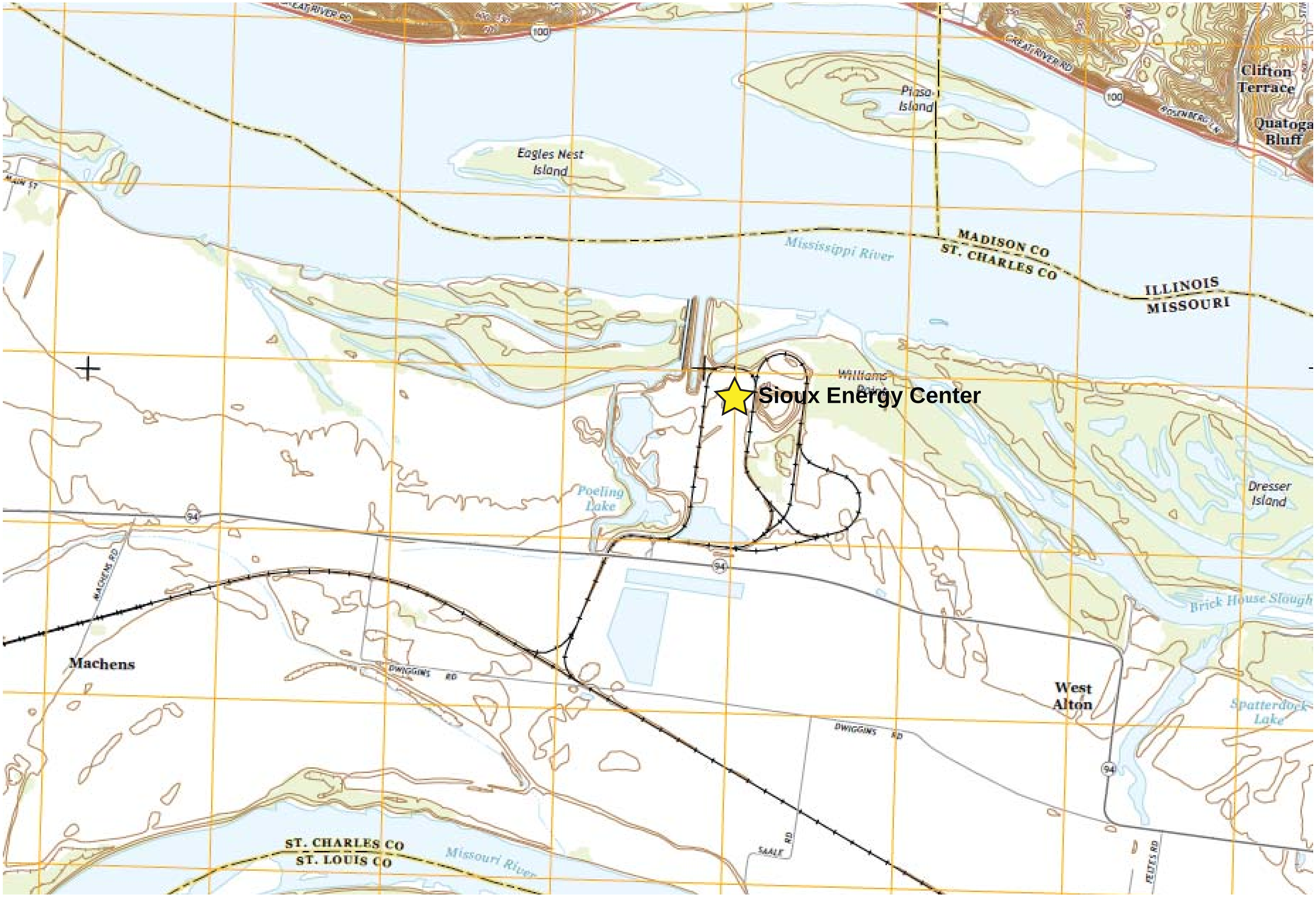
Environmental Protection Agency. (2015). “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule.” 40 CFR Parts 257 and 261., Vol. 80, No. 74.



AMEREN MISSOURI
SIOUX ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

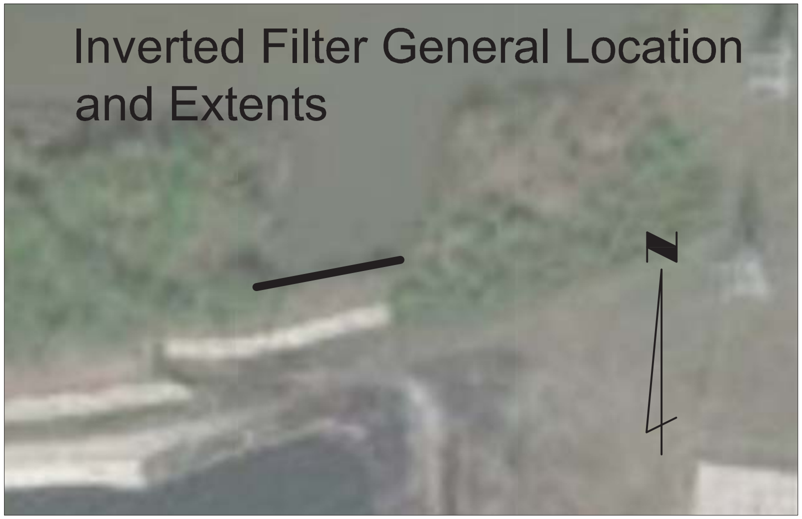
REITZ & JENS, INC.
CONSULTING ENGINEERS



Ameren Missouri
Sioux Energy Center
CCR Unit Evaluation
USGS 7.5 minute quadrangle map

REITZ & JENS, INC.

Figure 2

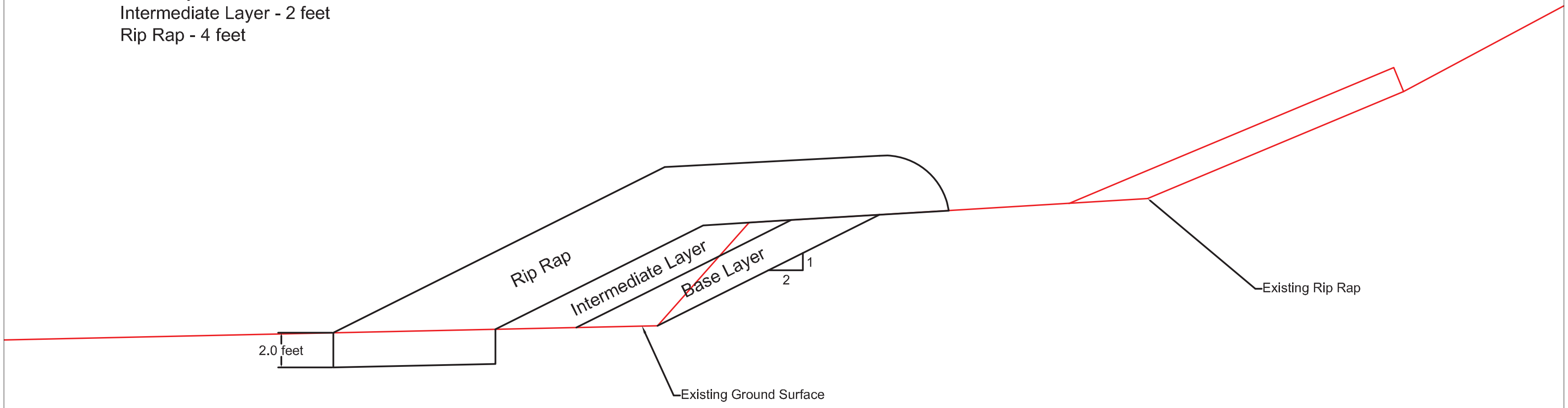


Sioux Power Station

Inverted Filter
General Location and Extents
Cross-section

Inverted Filter Cross-section

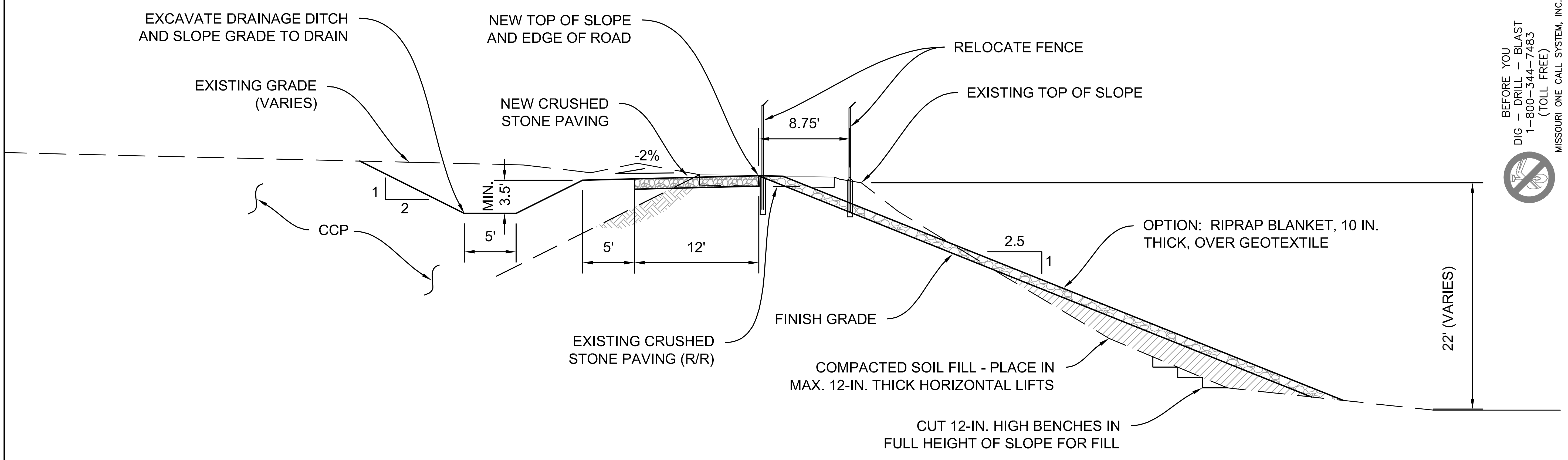
<u>Layer Thickness</u>
Base Layer - 2 feet
Intermediate Layer - 2 feet
Rip Rap - 4 feet



Dimension Shown on Sketch are Approximate

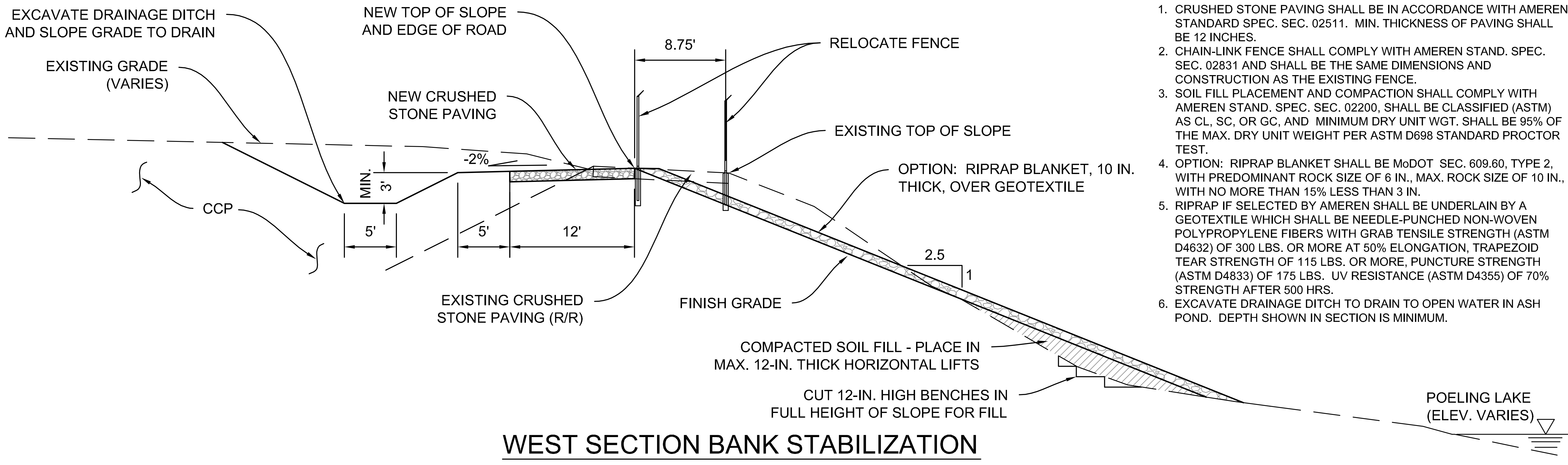
REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure 3



EAST SECTION BANK STABILIZATION

SCALE: 1 IN. = 10 FEET



WEST SECTION BANK STABILIZATION

SCALE: 1 IN. = 10 FEET

NOTES:

1. CRUSHED STONE PAVING SHALL BE IN ACCORDANCE WITH AMEREN STANDARD SPEC. SEC. 02511. MIN. THICKNESS OF PAVING SHALL BE 12 INCHES.
2. CHAIN-LINK FENCE SHALL COMPLY WITH AMEREN STAND. SPEC. SEC. 02831 AND SHALL BE THE SAME DIMENSIONS AND CONSTRUCTION AS THE EXISTING FENCE.
3. SOIL FILL PLACEMENT AND COMPACTION SHALL COMPLY WITH AMEREN STAND. SPEC. SEC. 02200, SHALL BE CLASSIFIED (ASTM) AS CL, SC, OR GC, AND MINIMUM DRY UNIT WGT. SHALL BE 95% OF THE MAX. DRY UNIT WEIGHT PER ASTM D698 STANDARD PROCTOR TEST.
4. OPTION: RIPRAP BLANKET SHALL BE MoDOT SEC. 609.60, TYPE 2, WITH PREDOMINANT ROCK SIZE OF 6 IN., MAX. ROCK SIZE OF 10 IN., WITH NO MORE THAN 15% LESS THAN 3 IN.
5. RIPRAP IF SELECTED BY AMEREN SHALL BE UNDERLAIN BY A GEOTEXTILE WHICH SHALL BE NEEDLE-PUNCHED NON-WOVEN POLYPROPYLENE FIBERS WITH GRAB TENSILE STRENGTH (ASTM D4632) OF 300 LBS. OR MORE AT 50% ELONGATION, TRAPEZOID TEAR STRENGTH OF 115 LBS. OR MORE, PUNCTURE STRENGTH (ASTM D4833) OF 175 LBS. UV RESISTANCE (ASTM D4355) OF 70% STRENGTH AFTER 500 HRS.
6. EXCAVATE DRAINAGE DITCH TO DRAIN TO OPEN WATER IN ASH POND. DEPTH SHOWN IN SECTION IS MINIMUM.

BEFORE YOU
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MISSOURI ONE CALL SYSTEM, INC.

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CONSULTING ENGINEERS
1055 Corporate Square Drive
St. Louis, Missouri 63132
314.993.4132

Designed J. Gilliam
Checked J. Bertel
Drawn J. Fouse
Issued 4/16/15

AMEREN MISSOURI
3700 S. Lindbergh Blvd.
St. Louis, Missouri 63127

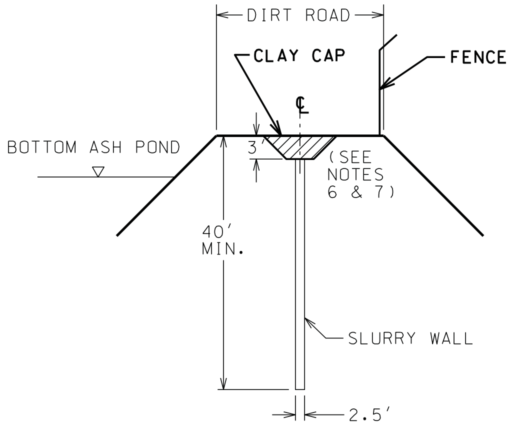
Ameren Missouri Sioux Energy Center
Bottom Ash Pond Bank Stabilization,
Southeast Section (Revised)

SHEET 1
OF 1

Figure 4

PLANT OVERVIEW

PLAN-SLURRY WALL



SECTION THRU SLURRY WALL
NOT TO SCALE

SLURRY WALL NOTES:

1. SLURRY WALL IN-PLACE/PERMANENT HYDRAULIC CONDUCTIVITY 1X10^{-7} cm/sec OR LESS.
2. TRENCH WIDTH MINIMUM 30 INCHES.
3. TRENCH DEPTH FROM SURFACE MINIMUM 40 FEET. VERIFY THAT BOTTOM OF WALL TERMINATES IN NATURAL FINE GRAINED SOIL.
4. TRENCH LENGTH MINIMUM 330 FEET, LENGTH MAY BE INCREASED BASED ON FIELD OBSERVATIONS.
5. THE APPROXIMATE ALIGNMENT OF THE SLURRY WALL BE STAKED BY AMEREN.
6. TOP OF SLURRY WALL SHALL BE WITHIN 3 FEET OF EXISTING GROUND SURFACE.
7. CONTRACTOR IS RESPONSIBLE FOR DESIGN AND INSTALLATION OF A PERMANENT CLAY CAP.

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE.THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

CONSTRUCTION

MARK UP DRAWING NO.	REV.
--------------------	---

SHEET NO. ---

SCALE
NTS

PROPERTY-
BOTTOM ASH POND
SLURRY WALL

UNIT NO.
N/A

DWG. SIZE
17 X 22

SUB CLASS
02010

SITE: SIOUX ENERGY CENTER

Ameren
MISSOURI

DRAWING NO.	REV.
SX-DWG-PROP-000009	000

SHEET NO. 001

DRAWING RECORD

REV.	DATE	PROJECT NO.	AMEREN SUPV ENGR	DRAFTING			ENGR APPROVAL		DESCRIPTION
				DRFTR	CHK'D	SUPV	AMEREN	OTHER	
000	03-17-15	-	GEISMANN	MSB	GAC	KAJ	GAC	-	FIRST ISSUE PER SX-2015-MDM-0010

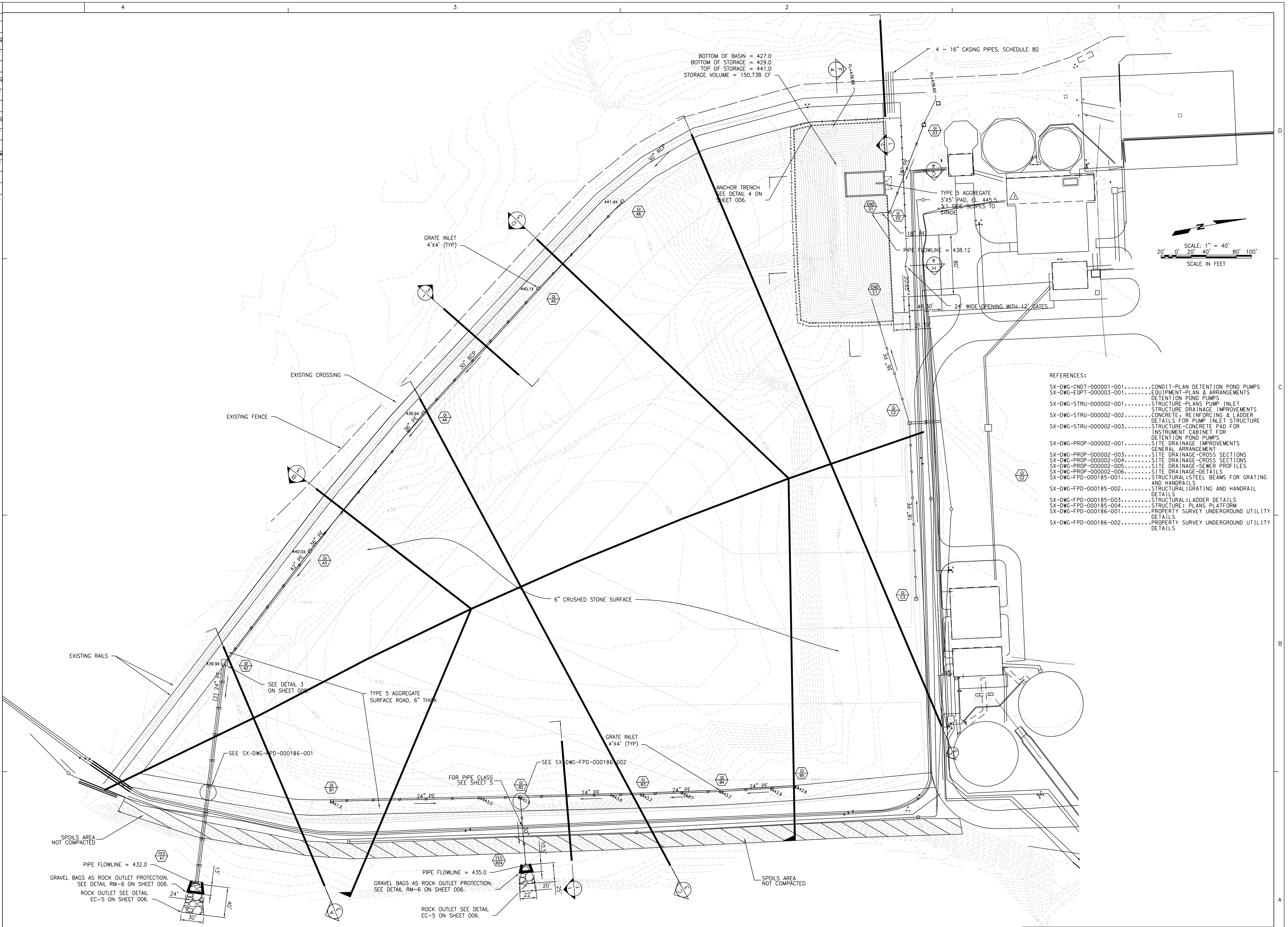
Figure 5

PRINT DIST.

REVISIONS

REV.	W.O.	
REV. 0	DATE 051211	DRAWN JSP
CHKD ART	SUPV MPS	APPD
W.O.		FILM
ISSUED > FOR BIDDING		
REV. 1	DATE 052311	DRAWN JSP
CHKD JSP	SUPV MPS	APPD
W.O.		FILM
ISSUED > FOR BIDDING		
REV. 2	DATE 062811	DRAWN DMM
CHKD ART	SUPV MPS	APPD
W.O.		FILM
ISSUED > FOR CONSTRUCTION		
REV 3	DATE 040212	DRAWN DLF
CHKD DLF	SUPV KAJ	APPD JSW
W.O. 85575		FILM

AS BUILT PER AMS, RVS'D PIPE MAT'L CHANGE.



REFERENCES:

SX-DWG-CNDT-000001-001........CONDIT-PLAN DETENTION POND PUMPS
SX-DWG-EQPT-000003-001........EQUIPMENT-PLAN & ARRANGEMENTS DETENTION POND PUMPS
SX-DWG-STRU-000002-001........STRUCTURE-PLANS PUMP INLET STRUCTURE DRAINAGE IMPROVEMENTS
SX-DWG-STRU-000002-002........CONCRETE, REINFORCING & LADDER DETAILS FOR PUMP INLET STRUCTURE
SX-DWG-STRU-000002-003........STRUCTURE-CONCRETE PAD FOR INSTRUMENT CABINET FOR DETENTION POND PUMPS
SX-DWG-PROP-000002-001........SITE DRAINAGE IMPROVEMENTS GENERAL ARRANGEMENT
SX-DWG-PROP-000002-003........SITE DRAINAGE-CROSS SECTIONS
SX-DWG-PROP-000002-004........SITE DRAINAGE-CROSS SECTIONS
SX-DWG-PROP-000002-005........SITE DRAINAGE-SEWER PROFILES
SX-DWG-PROP-000002-006........SITE DRAINAGE-DETAILS
SX-DWG-FPD-000185-001.........STRUCTURAL:STEEL BEAMS FOR GRATING AND HANDRAILS
SX-DWG-FPD-000185-002.........STRUCTURAL:GRATING AND HANDRAIL DETAILS
SX-DWG-FPD-000185-003.........STRUCTURAL:LADDER DETAILS
SX-DWG-FPD-000185-004.........STRUCTURE: PLANS PLATFORM
SX-DWG-FPD-000186-001.........PROPERTY SURVEY UNDERGROUND UTILITY DETAILS
SX-DWG-FPD-000186-002.........PROPERTY SURVEY UNDERGROUND UTILITY DETAILS

DWG NAME:
PLOTTED:
LAST:
DIMSCALE:

PLOT SCALE FACTOR 1

THE UNDERGROUND UTILITIES SHOWN HEREIN WERE PLOTTED FROM AVAILABLE INFORMATION AND DO NOT NECESSARILY REFLECT THE ACTUAL EXISTENCE, NONEXISTENCE, SIZE, TYPE, NUMBER, OR LOCATION OF THESE OR OTHER UTILITIES. THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE ACTUAL LOCATION OF ALL UNDERGROUND UTILITIES, SHOWN OR NOT SHOWN, AND SHALL LOCATE THE UTILITIES IN THE FIELD PRIOR TO ANY GRADING, EXCAVATION, OR CONSTRUCTION IMPROVEMENTS.

CDG ENGINEERS
CDG Engineers Architects Planners Inc.
11040

DRAWN
CHKD.
SUPV.
APPD.

SITE PLAN
CIVIL DRAWINGS
AMEREN MISSOURI – SIOUX
SITE DRAINAGE IMPROVEMENTS

LOCATION SIOUX PLANT
CLASS

Ameren
ST. LOUIS MISSOURI
SX-DWG-PROP-000002-002
REV. 3

37-13-070 Rev. 9-85

4
3
2
1

Figure 6

Ameren Missouri: Sioux Energy Center
SCPC (Cell 1)
AREA CAPACITY CURVES

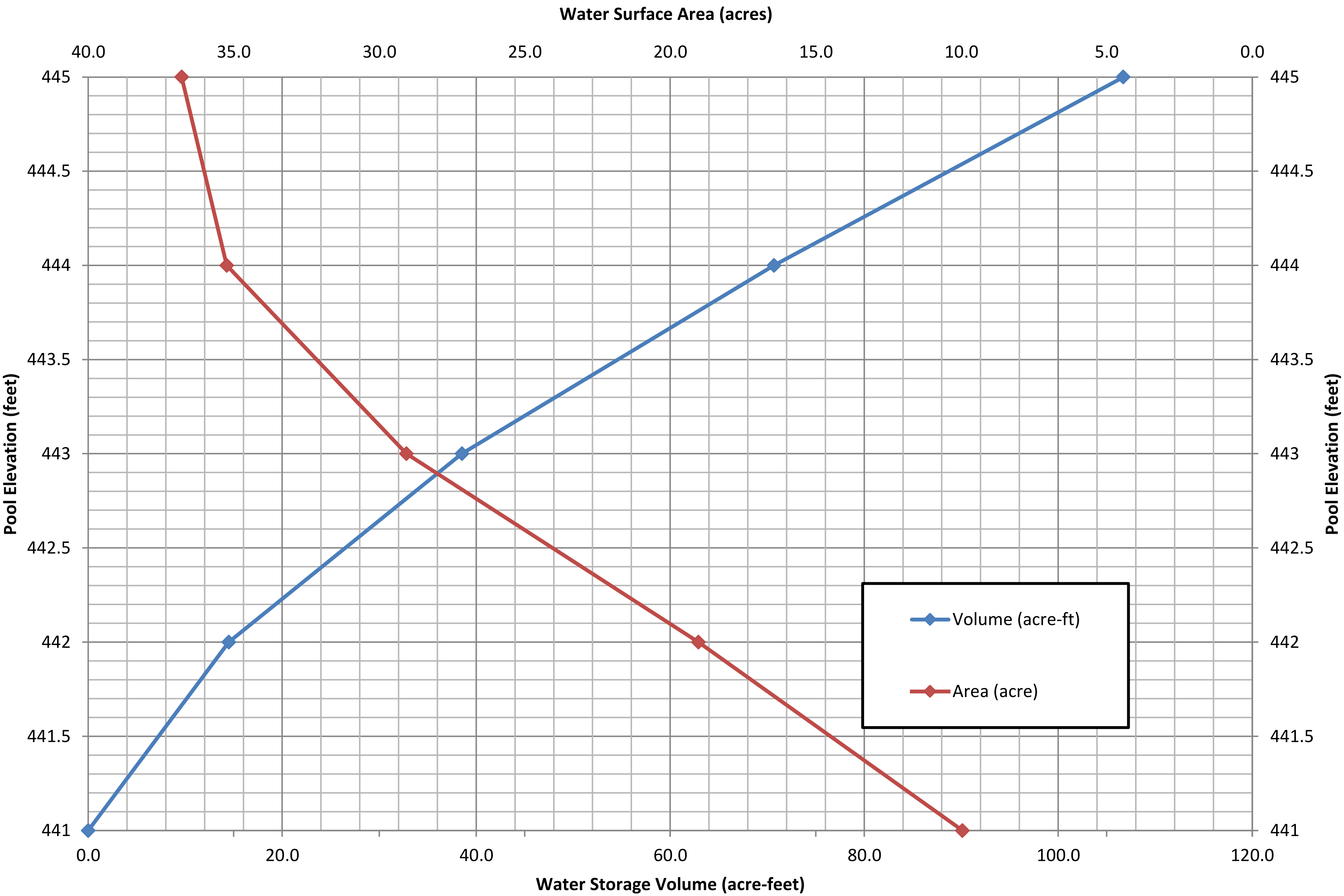
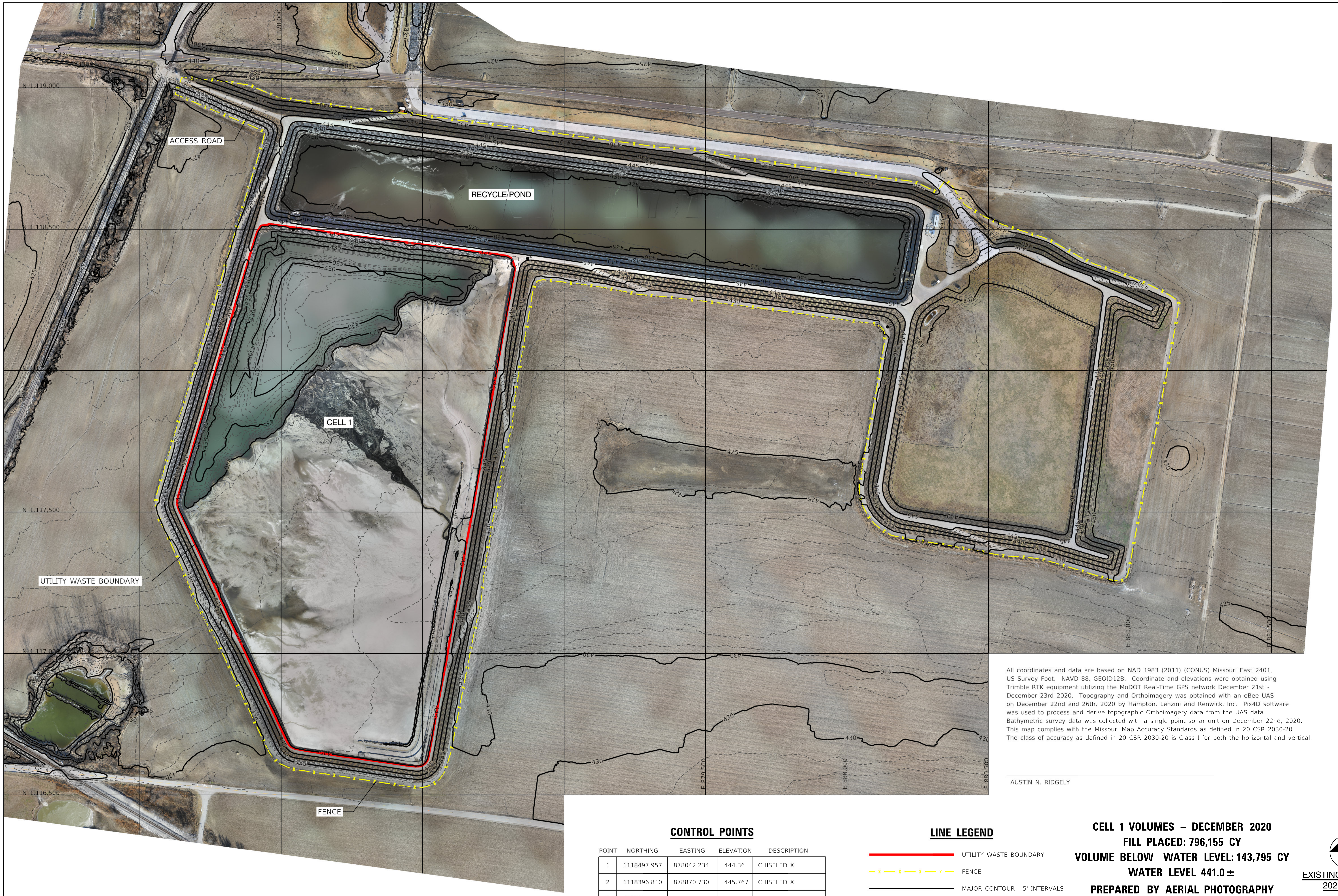


Figure 7



All coordinates and data are based on NAD 1983 (2011) (CONUS) Missouri East 2401, US Survey Foot, NAVD 88, GEOID12B. Coordinate and elevations were obtained using Trimble RTK equipment utilizing the MoDOT Real-Time GPS network December 21st - December 23rd 2020. Topography and Orthoimagery was obtained with an eBee UAS on December 22nd and 26th, 2020 by Hampton, Lenzini and Renwick, Inc. Pix4D software was used to process and derive topographic Orthoimagery data from the UAS data. Bathymetric survey data was collected with a single point sonar unit on December 22nd, 2020. This map complies with the Missouri Map Accuracy Standards as defined in 20 CSR 2030-20. The class of accuracy as defined in 20 CSR 2030-20 is Class I for both the horizontal and vertical.

AUSTIN N. RIDGELY

CONTROL POINTS

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	1118497.957	878042.234	444.36	CHISELED X
2	1118396.810	878870.730	445.767	CHISELED X
3	1118154.696	880142.569	429.909	IP SET

LINE LEGEND

🟥	UTILITY WASTE BOUNDARY
— x — x — x — x —	FENCE
———	MAJOR CONTOUR - 5' INTERVALS
- - - - - -	MINOR CONTOUR - 1' INTERVALS

CELL 1 VOLUMES – DECEMBER 2020

FILL PLACED: 796,155 CY

VOLUME BELOW WATER LEVEL: 143,795 CY

WATER LEVEL 441.0 ±

PREPARED BY AERIAL PHOTOGRAPHY

FLIGHT DATED DECEMBER 26, 2020

N

EXISTING SITE PLAN

2020-12-26

0' 75' 150' 225'

SCALE: 1"=150'

REVISIONS

NO.	DATE	DESCRIPTION	NO.	DATE	DESCRIPTION

DESIGNED: ANR
DRAWN: SMS
CHECKED: ANR
DATE: 1/22/2021

PROJECT NUMBER: 20.0653
FILE: 200653-Sioux.dgn
SCALE: 1"=150'

Hampton, Lenzini and Renwick, Inc.
Civil & Structural Engineers . Land Surveyors . Environmental Services
HLR ELGIN . SPRINGFIELD . WOODRIDGE . MT CARMEL
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184.000959 ILLINOIS PROFESSIONAL DESIGN FIRM LS / PE / SE CORPORATION

Ameren MISSOURI

Ameren Missouri

AMEREN MISSOURI ENERGY CENTER

TOPOGRAPHIC MAP

TOTAL SHEETS 1

SHEET NUMBER 1

Figure 8

APPENDIX A

SIOUX FLYASH AND BOTTOM ASH POND EMBANKMENT OPERATION AND MAINTENANCE MANUAL

OPERATION AND MAINTENANCE MANUAL FOR CELLS 1 & 4A AND RECYCLE POND

2010 DAM SAFETY REPORT BORINGS AND SOIL LABORATORY TESTS

2015 GEOTECHNICAL BORINGS AND SOIL LABORATORY TESTS

1963 ORIGINAL PLANT BORINGS

BOTTOM ASH RELATIVE DENSITY TESTS

SIOUX-ROXFORD 5: STRUCTURE 2 BORING LOG

FLY ASH PROCTOR TESTS

DETAILED SITE INVESTIGATION BORING LOCATION MAP

DETAILED SITE INVESTIGATION LOGS FOR GEOTECHNICAL BORINGS

DETAILED SITE INVESTIGATION SOIL TEST RESULTS

UTILITY WASTE LANDFILL, SHEETS 1 TO 13

OPERATION AND MAINTENANCE MANUAL

SIOUX FLYASH AND BOTTOM ASH POND EMBANKMENT
WEST ALTON, MISSOURI
ST CHARLES COUNTY

JULY19, 2010

DAM SAFETY & HYDRO ENGINEERING
3700 S. LINDBERGH BLVD
ST. LOUIS, MO 63127

OPERATION AND MAINTENANCE PLAN
SIOUX FLYASH AND BOTTOM ASH POND EMBANKMENT
WEST ALTON, MO

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OPERATION AND MAINTENANCE PLAN
RUSH ISLAND FLYASH EMBANKMENT
JEFFERSON COUNTY, MO

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SECTION 1

GENERAL

This operation and maintenance plan, (hereafter referred to as the O&M Manual), outlines objectives, proposed policies, responsibilities, and procedures for Ameren personnel who are responsible for the management of the Sioux Fly ash and Bottom ash Ponds.

REASONS FOR DEVELOPMENT AND DISSEMINATION OF THE O&M MANUAL

As an ash pond embankment owner, Ameren is responsible for the safety of the public and for maintaining the structures within the Ameren's jurisdiction for both safety and economy. The overall public interest is served by providing a document to serve as a basis for the safe and economical operation and maintenance of the ash pond embankment during both emergency and day-to-day conditions.

GENERAL RESPONSIBILITIES CONCERNING DAMS

Shift Supervisor

Contacts local agencies when emergency conditions exist at the Sioux Fly ash and Bottom ash Ponds.

Plant Engineer

Ensures operation and maintenance program is being implemented as outlined in this document. Ensures performance of weekly inspections. Performs annual assessment of the Operation and Maintenance Manual.

Chief Dam Safety Engineer

Reviews all updates to the Operation and Maintenance Manual.

Dam Safety Group

Performs annual bottom ash and fly ash pond embankment inspection with the Plant Engineer. Reviews weekly dam safety inspection reports.

SECTION 2

DEFINITIONS

Abutment - That part of the valley side or concrete walls against which the dam is constructed. Right and left abutments are those on respective sides of an observer when viewed looking downstream.

Appurtenant Works - The structures or machinery auxiliary to dams that are built to operate and maintain dams; such as outlet works, spillways, gates, valves, channels, etc.

Boil - A stream of water discharging from the ground surface downstream of the dam carrying with it a volume of soil that is distributed around the hole formed by the discharging water.

Berm - A horizontal step or bench in the sloping profile of an embankment dam.

Breach - A break, gap, or opening (failure) in a dam that releases impoundment water.

Concrete Block - An erosion protection method using interlocking concrete blocks, usually with openings that are filled with soil and grass.

Core - A zone of material of low permeability in an earthen dam.

Dam - A barrier built for impounding or diverting the flow of water.

Dike (Levee) - An embankment or structure built alongside a river to prevent high water from flooding bordering land.

Drain, Layer or Blanket - A layer of pervious material in a dam to facilitate the drainage of the embankment, including such items as a toe drain, a weep hole, and a chimney drain.

Drawdown - The resultant lowering of water surface level due to the controlled release of water from the impoundment.

Embankment - Fill material, usually earth or rock, placed with sloping sides.

Earthen Dam - Any dam constructed of excavated natural materials.

Failure - An incident resulting in the uncontrolled release of water from a dam.

Freeboard - The vertical distance between a stated water level and the top of a dam.

Gate or Valve - In general, a device in which a leaf or member is moved across the waterway to control or stop the flow.

Groin - The junction of the upstream or downstream face of the dam with the valley wall.

Maintenance - The upkeep, involving labor and materials, necessary for efficient operation of dams and their appurtenant works.

Operation - The administration, management, and performance needed to operate the dam and appurtenant works.

Operation and Maintenance Inspection - Inspections conducted by the Plant Engineer. These inspections are frequent visual inspections of the dam surface and appurtenant works.

Outlet - An opening through which water can freely discharge for a particular purpose from an impoundment.

Phreatic Surface - The upper surface of saturation in an embankment.

Piping - The progressive development of internal erosion by seepage, appearing downstream as a hole or seam, discharging water that contains soil particles.

Riprap - A layer of large stones, broken rock or precast blocks placed in a random fashion, usually on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against current, wave and ice action.

Silt/Sediment - Soil particles and debris in an impoundment.

Slump/Slide Area - A portion of earth embankment that moves downslope, sometimes suddenly, often with cracks developing.

Spillway System - A structure or structures over or through which flows are discharged. If the flow is controlled by gates, it is considered a controlled spillway. If the elevation of the spillway crest is the only control of the flows, it is considered an uncontrolled spillway.

Emergency Spillway - A spillway designed to operate very infrequently, only during exceptionally large floods, usually constructed of materials expected to erode slowly.

Principal Spillway - The main spillway that controls both normal and flood flows and is constructed of non-erodible materials.

Auxiliary Spillway - A spillway that works in conjunction with the principal spillway to control flood flows and is constructed of non-erodible materials.

Stilling Basin - A basin constructed to dissipate the energy of fast flowing water, such as from a spillway, and to protect the stream bed from erosion.

Toe of Embankment - The junction of the face of the dam with the ground surface in the floodplain upstream or downstream of the dam.

Trash Rack - A structure of metal or concrete bars located in the waterway at an intake to prevent the entry of floating or submerged debris.

SECTION 3

INFORMATION ABOUT THE EMBANKMENT

LOCATION

The Sioux Power Station is located in unincorporated St. Charles County, Missouri, within the Mississippi floodplain. The plant is northwest of the City of West Alton on the south bank of the Mississippi River in the Township 48 North, Range 6 East of the 5th Principal Meridian.

DESCRIPTION OF DAM AND APPURTENANCES

The Sioux Plant embankment is single stage industrial dams. The Bottom Ash Pond dam impounds an area of approximately 47-acres. The Fly Ash Pond dam impounds an area of approximately 60-acres. These areas were estimated from aerial photos. The length of the perimeter of the dam measured along the crest for the Bottom Ash and Fly Ash Ponds is 6,600-lineal-feet (lf) and 7,675-lf respectively.

Bottom Ash Pond

The Bottom Ash embankment was constructed in the 1960's and consists of compacted earth fill at 2 (H) to 1 (V) slopes. The Bottom Ash Pond is unlined. The elevation around the perimeter of the embankment is approximately 445-ft. At the northwest corner of the dam, the top of the embankment is lower, with the lowest elevation being approximately 443-ft. The Bottom Ash Pond dam has a height of approximately 27-ft. The dam height was calculated using the lowest elevation on the top of the embankment and the elevation of the Bottom of Poeling Lake. The elevations used in the dam height calculations were measured during a survey conducted for this project. The elevation of the Bottom of Poeling Lake is an estimate based on measurements using a floating depth finder. This measurement was taken directly downstream of the Bottom Ash Pond outfall.

Fly Ash Pond

The Fly Ash embankment was constructed in the 1990's. The upstream slopes of the Fly Ash dam are constructed of compacted earth fill at 3 horizontal (H) to 1 vertical (V) and are lined with a 60 mil high-density polyethylene liner (HDPE). The upstream slopes were constructed from the top and over the slopes of an existing railroad and roadway embankment. The existing slopes of the railroad and roadway embankments are typically 2 (H) to 1 (V) and form the downstream slopes. A short section at the northwest corner of the dam was constructed with new downstream slopes at 3 (H) to 1 (V). The Fly Ash Pond original design plans call for an approximate bottom elevation of 422-feet (ft). The elevation around the perimeter of the embankment ranges from approximately 441.5 to 446.4-ft. In the southwest corner, the top of the embankment is at its lowest with the elevation being approximately 441.5-ft. The embankment height was calculated using the lowest elevation at the top of the embankment measured during a survey conducted for this project and the lowest elevation measured at the toe of the dam.

HAZARD CLASSIFICATION

The Sioux Dam Impoundments are not currently subject to MDNR dam safety regulations. If regulations did apply, the Sioux Dams would be classified as a Class III, LOW HAZARD POTENTIAL, as defined by Missouri Department of Natural Resources (MDNR), because there are no dwellings downstream. In addition, there are no dams currently registered with MDNR directly influencing the Sioux Ash Ponds.

Per the "draft" November 2010 Dewbarry & Davis, LLC Dam Assessment Report prepared for the USEPA, both the fly and bottom ash ponds would have "significant" hazard due to the potential for untreated slurry water to enter the Mississippi River.

PURPOSE OF DAM

The embankmetn form the perimeter of two impoundments. The two impoundments are the Bottom Ash and Fly Ash Ponds. The active reservoirs are used for coal combustion (Bottom Ash and Fly Ash) sedimentation storage.

PERTINENT DATA

Pertinent data about the dam, appurtenant works, and reservoir is presented in Table 1.

TABLE 1
PROJECT DATA

Bottom Ash Pond:	
Upstream Slope	2 (H) on 1 (V)
Downstream Slope	2 (H) on 1 (V)
Elevation, Top of Embankment	445.0 to 443.0 feet
Elevation, Normal Pool	438 feet
Area	47 acres
Freeboard, Normal Pool	5.0 feet
Minimum Freeboard Requirement	2.5 feet
Liner	Not Lined
Outlet Works:	
Structure Type	24" Buoyed Skimmer,
Inlet Invert Elevation	Buoyed at the water surface
Outlet Invert Elevation	422 feet
Elevation, Max. Pool	443.0 feet

Fly Ash Pond:	
Upstream Slope	3 (H) on 1 (V)
Downstream Slope	3 (H) on 1 (V)
Elevation, Top of Embankment	441.5 to 446.4 feet
Elevation, Normal Pool	439.2 feet
Area	60 acres
Freeboard, Normal Pool	2.3 feet
Minimum Freeboard Requirement	2.0 feet
Liner	60 mil high-density polyethylene (HDPE)
Outlet Works:	
Structure Type	18" HDPE Pipe, regulated by two motor operated butterfly values
Inlet Invert Elevation	434.5 feet
Outlet Invert Elevation	430 feet
Elevation, Max. Pool	439.5 feet

SECTION 4

OPERATION ACTIVITIES

NORMAL OPERATION

Bottom Ash Pond

The normal pool elevation is 438-ft (~5.0 ft of freeboard). Water is pumped from the combined drain sump to the Bottom Ash Pond by four pumps. There are two pumps driven by 200-horsepower (hp) pump motors and two pumps driven by 60-hp pump motors. These pumps have the combined total capacity to pump an estimated 46-cubic-feet-per-second (cfs). The Bottom Ash Pond also receives flow from sluice water which is used to transport coal combustion ash.

The Bottom Ash Pond water level is controlled by an outfall that discharges to Poeling Lake. The original outfall structure consisted of a large diameter galvanized corrugated steel skimmer which is perforated or overlaps to allow water to flow into a concrete pit. A steel bulkhead and sluice gate is in place to control flow. A 30-in concrete pipe discharges water from the concrete pit to Poeling Lake. The downstream invert elevation of the pipe is 422-ft. Subsequently, due to sedimentation near the outfall structure, a 24-in pipe was installed bypassing the skimmer. The pipe runs from the concrete pit and to the north side of the pond. The pipe is buoyed to keep it near the surface and anchored to maintain its alignment.

Fly Ash Pond

The normal operating pool elevation for the Fly Ash Pond is 439.2-ft (~2.3 ft of freeboard). The Fly Ash Pond receives sluice water and does not receive any stormwater other than what directly falls on the pond.

The Fly Ash water level is regulated by an outfall that discharges to Poeling Lake. The outfall consists of one 18-inch (in) HDPE pipe which is upturned to an elevation of 434.5-ft on the upstream end. On the downstream end the invert elevation at the point of discharge is 430-ft. The downstream and upstream elevations of the outfall pipe were obtained from plans provided. Flow through this pipe and the pool elevation is regulated by two motor operated butterfly valves.

INSTRUMENTATION MONITORING DATA

The staff gage located in the Fly Ash Pond only indicates pool elevations greater than 441-ft at one-half-foot increments. Pond level at which water is expected to overtop the dam is at elevation 441.5-ft. The Bottom Ash Pond does not contain a pool elevation indicator. Pool elevations are not recorded for either pond.

TYPES OF DAM INSPECTIONS

Weekly visual inspections are conducted at the embankment by plant operations staff. The AmerenUE Dam Safety Group performs annual inspections with plant operations. Engineering inspections are performed every five years. In addition, the AmerenUE Dam Safety Group may conduct unannounced safety inspections. The following sections describe each type of inspection.

Weekly Inspection:

Weekly inspections are conducted by plant staff or support staff familiar with the pond/dam. The weekly inspection consists of visually inspecting the crest and slopes of the dam to identify any new or changed conditions. Checklists are completed and are made available to the Dam Safety Group for review. A recommended inspection checklist for the weekly inspection is included in ***Appendix A.***

Annual Inspection:

These inspections are conducted annually by the plant staff and the AmerenUE Dam Safety Group staff. The annual inspection is a detailed visual inspection of the dam crest, interior and exterior slopes, downstream toe area, inlet/outlet works, and appurtenant structures. A recommended inspection checklist for the annual inspection is included in ***Appendix A.***

Records: An inspection Report is to be prepared by the AmerenUE Dam Safety Group staff that includes a description of the observations of the visual inspection, photographs of the facilities taken during the inspection, and a written evaluation of the results. A record of activities occurring at the dam is to be kept current by the AmerenUE Dam Safety Group.

Special Inspection:

These inspections are conducted when extreme events which my impact dam stability (seismic activity, severe flooding, etc.). Special inspections are similar to the annual inspection, but may be focused on a particular area. If conditions are discovered during a weekly or annual inspection which create concern for the plant or dam safety staff, a special inspection will be conducted. Responsibility for performance of special inspections will be evaluated based on severity of the event. A recommended inspection checklist for the special inspection is included in ***Appendix A.***

Unannounced Inspections

The AmerenUE Chief Dam Safety Engineer (CDSE) may conduct unannounced inspections at the site as deemed appropriate. The inspection may include a visual inspection of the facility, a review of the inspection documentation, and interviews with plant personnel to review their understanding of the required inspection procedure.

The inspections checklists are to be completed and filed for each inspection. The checklists for each inspection are located in ***Appendix A.*** Condition codes are given to each item listed on the inspection checklist. The condition codes are defined below.

EC - Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

Examples: Whirlpools, piping situation, embankment slough extending through half crest width, sinkhole in crest

IM - Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.

Examples: Sinkhole on downstream slopes, gate of valve failure

MM - Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

Examples: Crest rutting, rodent holes and animal burrows, tree growth on embankment slope, minor downstream embankment slough

OB - Condition requires regular observation to ensure that the condition does not become worse.

Examples: Minor seepage – No evidence of material movement

GC - Good Condition.

NE - No evidence of a problem.

NI - Not Inspected. Reason should be stated in comment.

SECTION 5

MAINTENANCE ACTIVITIES

Timely repairs are a must after problem areas have been identified. The Plant Engineer is to specify the work and provide direction to correct items noted in the operation and maintenance and engineering inspections. Such items include mowing, seeding, tree and brush removal, painting, replacing riprap, repairing fences and locks, clearing debris, etc. The maintenance activities specified in the following sections are minimum requirements. Maintenance activities should be documented (Refer to Records Page 11). NOTE: NO alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer and the concurrence of the Missouri Department of Natural Resources, Water Resource Center.

Ash Pond Stacking: Ash may be temporarily stacked up to an elevation of 15 feet above the top levee elevation with the toe of the slope of the stacked ash 125 feet from the existing ash containment levee. The ash stack slope shall be a minimum 3 horizontal to 1 vertical. No perched water level above the crest of the perimeter embankment is permissible.

Debris: Remove all trash, logs and other debris that may obstruct flow from the outlet works.

Concrete Block and Rip Rap: Replace or level blocks and rip rap as needed to provide adequate protection against erosion.

Vegetation Control:

(1) A good grass cover on the embankment should be maintained by seeding, fertilizing and mulching areas that are refilled, barren, or thinly vegetated. Seeding mixtures used for maintenance reseeding shall result in cover compatible with adjacent cover.

(2) Grassed areas such as the embankment and areas beyond the embankment toe for a distance of approximately 20 feet should be mowed at least twice annually, where physically accessible.

(3) All eroded areas should be filled and compacted, reseeded, fertilized and mulched to establish a thick erosion resistant cover.

(4) All trees and brush on the dam embankment should be removed to prevent development of a root system that could provide seepage paths. Herbicides utilized for tree and brush control are discussed in Appendix C.

(5) All brush and trees should be removed to a distance of approximately 20 feet beyond the toe of the dam, where physically accessible.

Animal Damage: Rodent holes should be filled with compacted clay dirt and reseeded. If rodents become a nuisance, an effective rodent control program as approved by the Missouri Department of Natural Resources District Wildlife Biologist should be implemented.

Concrete: Spalled and cracked areas on concrete structures should be patched to guard against any further deterioration of the structure. Concrete construction joints should be filled with a suitable joint filler, such as a bituminous sealant, to protect against weathering.

Drains: All drains and weep holes should be kept open and functional by cleaning them of silt and debris.

Painting: All metal work, fencing, railing, etc. should be properly prepared and repainted as necessary to protect against rusting.

Signs: All warning signs and staff gages should be maintained (repaired, painted, or replaced) as needed.

Sedimentation: As sediment accumulates in the reservoir, less storage is available for the control of flood waters from the watershed. Efforts should be made to work with the U.S. Department of Agriculture, Natural Resources Conservation Service and the upstream land owners to minimize the sediment being transported to the reservoir. A location for the placement of the sediment removed from the reservoir (if upstream of the dam, above the top of the dam) should be determined.

SECTION 6

EMERGENCY CONDITIONS

If a condition arises where there is a possibility of dam failure, the following plan will be put into effect (Refs. Sioux EIP SX-EIP-DAMINT-16 and SX-EIP-NOTIFY-17).

(1) The pond level will be lowered by the primary spillway, and closely monitoring the area for changes in conditions. If the primary spillway should become inoperable, supplemental pumps will be used to lower the level of the pond.

(2) The following agencies would be notified by Ameren concerning the status of the dam. These agencies will inform the public as to what action would be taken. Ameren will do whatever possible to minimize damage at downstream locations.

A. St Charles County Sheriff	636-949-0809
B. St Charles County Emergency Management	636-949-3023
C. MDNR –Water Resources Center	573-751-2867
D. Army Corps of Engineers (St. Louis District)	314-331-8567
E. MDNR – Dam Safety	573-368-2175
F. Ameren Chief Dam Safety Engineer	314-210-4356

FIGURES

FIGURE 1
SIOUX PROJECT
LOCATION MAP

FIGURE 2
AERIAL VIEW
SIOUX PLANT

APPENDIX A

INSPECTION CHECKLISTS

Sioux Fly Ash Pond

Weekly Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	**Condition Code ***	**Comments**
Inlet and Outlet	**Structure / Supports**		
	Outfall Condition		
	Other		
Earth Embankment	**Vertical & Horizontal Alignment of Crest**		
	Pond Liner		
	Seepage		
	Erosion		
	Vegetation		
	Unusual Movement or Cracking		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.

MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

OB = Condition requires regular observation to ensure that the condition does not become worse.

GC = Good Codition.

NE = No evidence of a problem.

NI = Not Inspected. Reason should be stated in comment

Sioux Bottom Ash Pond

Weekly Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	**Obstruction**		
	Structure / Supports		
	Leakage		
	Outfall Condition		
	Other		
Earth Embankment	**Vertical & Horizontal Alignment of Crest**		
	Seepage		
	Erosion		
	Vegetation		
	Unusual Movement or Cracking		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.

MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

OB = Condition requires regular observation to ensure that the condition does not become worse.

GC = Good Codition.

NE = No evidence of a problem.

NI = Not Inspected. Reason should be stated in comment

Fly Ash Pond
Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	**Obstruction**		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	**Vertical & Horizontal Alignment of Crest**		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant

IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.

MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

OB = Condition requires regular observation to ensure that the condition does not become worse.

GC = Good Codition.

NE = No evidence of a problem.

NI = Not Inspected. Reason should be stated in comment

Bottom Ash Pond
Inspection Checksheet

Date	
Inspector	
Lake Level	
Temperature	
Weather	

	Item	Condition Code *	Comments
Inlet and Outlet	**Obstruction**		
	Inlet Piping Supports		
	Leakage		
	Outfall Pipe Condition		
	Outfall Valve		
	Other		
Earth Embankment	**Vertical & Horizontal Alignment of Crest**		
	Pond Liner		
	Seepage		
	Erosion		
	Fencing		
	Vegetation		
	Unusual Movement or Cracking At or Beyond Toe		
	Other		

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency
IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should
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OB = Condition requires regular observation to ensure that the condition does not become worse.
GC = Good Codition.
NE = No evidence of a problem.
NI = Not Inspected. Reason should be stated in comment

APPENDIX B

HERBICIDES

HERBICIDES

Site personnel should check with the Missouri Department of Natural Resources, Regional Fisheries Biologist and the Regional Wildlife Biologist before using any herbicide. Read the product label prior to use and follow the use directions and precautions accordingly.

On March 1, 1979 the U.S. Environmental Protection Agency (U.S.E.P.A.) halted the use of the herbicide 2, 4, 5-T in parks and recreation areas. The use of silvex (2, 4, 5-TP) around water has also been banned.

Some examples of approved herbicides are:

1)	Tordon RTU by DOW Chemical. (Can be obtained with blue dye.)
2)	WEEDONE 170 by Union Carbide
3)	WEEDONE, 2, 4-DP by Union Carbide
4)	A 1% to 2% solution of ROUNDUP
5)	Garlon by DOW Chemical
6)	Banvel by Sandoz

Your distributor may carry brand name herbicides other than those listed above. Be certain that the product does not contain the ingredients 2, 4, 5-T or 2, 4, 5-TP. An example of an unacceptable product is ESTERON 2, 4, 5 by DOW Chemical.

APPENDIX C

PROJECT DRAWINGS

PRINT DIST.

REVISIONS

REV.	E.O.
0	E956

FIRST ISSUE

8430-X-128771

NOTE: PLAN DETAIL (AUTO PLOT) FROM PHOTOGRAMMETRIC DIGITAL DATA.

CONTOURS WERE COMPILED AS DIGITAL STRING DATA DIRECTLY FROM THE STEREO PLOTTER (STRING FORMED BY X, Y, Z COORDINATES).

LEGEND

RAILROAD	▬	MANHOLE	●
PAVED ROAD	═	CATCH BASIN	○
UNPAVED ROAD	═	LOCATED OBJECT	◆
TRAIL	—	SINGLE TREE	✿
SIDEWALK	▬ ▬	TREE LINE	〰
BUILDING	□	STREAM	— · —
FOUNDATION	⌐	INDEX CONTOUR	—430—
FENCE	—x—	DEPRESSION CONTOUR	───
WALL	—	APPROXIMATE CONTOUR	- - -
SIGN	●	SPOT ELEVATION	·425.6
POLE	•		

TOPOGRAPHIC MAP

PREPARED FOR:
UNION ELECTRIC

PREPARED BY:
WALKER & ASSOCIATES
1650 HEADLAND DR.
FENTON, MO. 63026

SCALE: 1"=100' CONTOUR INT. 1' PHOTOS FLOWN 12-1-92
CONTROL DATUM: HOR. ASSUMED VER. MSL
DASHED CONTOURS MAYBE UNRELIABLE

P.OTT
NOT CHKD
SKO

PROPERTY - TOPOGRAPHIC MAP
ASH POND AREA
FROM AERIAL SURVEY 12-1-1992

LOCATION 001009

SIOUX PLANT

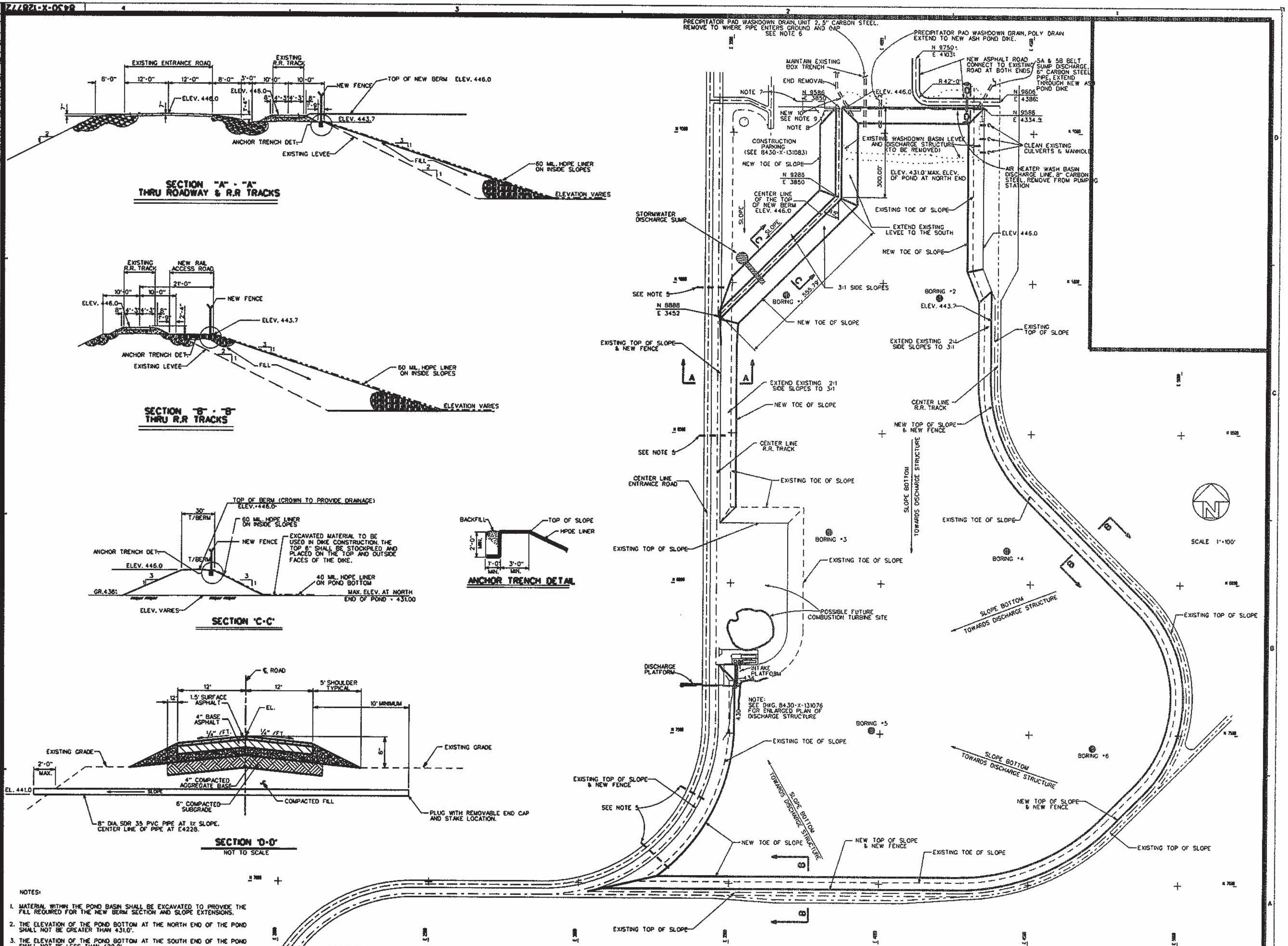
02010

UNION ELECTRIC COMPANY
ST. LOUIS, MO.

8430-X-128771

REV. 0

REVISIONS		
REV. 0	W.A. E956	
FIRST ISSUE		
REV 1	DATE 052093	DRWN MGL
CHKD NOT	SUPV SKO	APVD CWR
W.A. E956		FILM
ADD NEW ASH POND PLAT-FORMS & INFO		
REV 2	DATE 06H93	DRWN MGL
CHKD NOT	SUPV SKO	APVD CWR
W.A. E956		FILM
ADD NOTES 6-9 & MISC. PIPE MOVED INTAKE STRUCTURE 10 WEST, ADD 15' TO LENGTH OF INTAKE STRUC		



NOTES:

1. MATERIAL WITHIN THE POND BASIN SHALL BE EXCAVATED TO PROVIDE THE FILL REQUIRED FOR THE NEW BERM SECTION AND SLOPE EXTENSIONS.
2. THE ELEVATION OF THE POND BOTTOM AT THE NORTH END OF THE POND SHALL NOT BE GREATER THAN 431.0'.
3. THE ELEVATION OF THE POND BOTTOM AT THE SOUTH END OF THE POND SHALL NOT BE LESS THAN 422.0'.
4. THE POND BOTTOM SHALL BE GRADED TO A CONSTANT UNIFORM SLOPE STARTING FROM THE NORTH END AND EXTENDING SOUTH TO THE DISCHARGE STRUCTURE WITH NO MOUNDS OR DEPRESSED AREAS.
5. APPROXIMATE LOCATION OF EXISTING CULVERTS. THEY ARE TO BE PLUGGED WITH CONCRETE AND ABANDONED IN PLACE. ANY EXISTING CULVERTS NOT SHOWN ON DRAWING SHALL ALSO BE PLUGGED WITH CONCRETE AND ABANDONED IN PLACE (IN THE AREA OF THE NEW ASH POND).
6. PRECIPITATOR PAD WASHDOWN DRAIN, UNIT 1, 5" CARBON STEEL, EXTEND PIPE THROUGH NEW ASH POND DIKE. (EXTEND UNIT 1 LINE INTO POND).
7. END REMOVAL OF AIR HEATER WASH BASIN DISCHARGE LINE AND CAP LINE.
8. CAUSTIC INJECTION LINE, ¾" CARBON STEEL, REMOVE FROM AIR HEATER WASH BASIN DISCHARGE LINE TO POINT INDICATED BY NOTE 7 AND CAP LINE.
9. REMOVE EXISTING 10" SHOT PIT DISCHARGE LINE FROM WHERE THE LINE GOES UNDERGROUND AT THE AIR HEATER TO THE NEW ASH POND. INSTALL NEW 10" NASPIPE FROM END OF REMOVALS AND EXTEND INTO NEW ASH POND. INSTALL 30' NASPIPE ELBOW AND OLD PIPE CONNECTION TO REDIRECT FLOW. NEW PIPING SHALL BE BURIED. BURIED PIPING SHALL BE SLEEVED BY A 16" CARBON STEEL SCH 40 PIPE. RESTORE ASPHALT PAVING

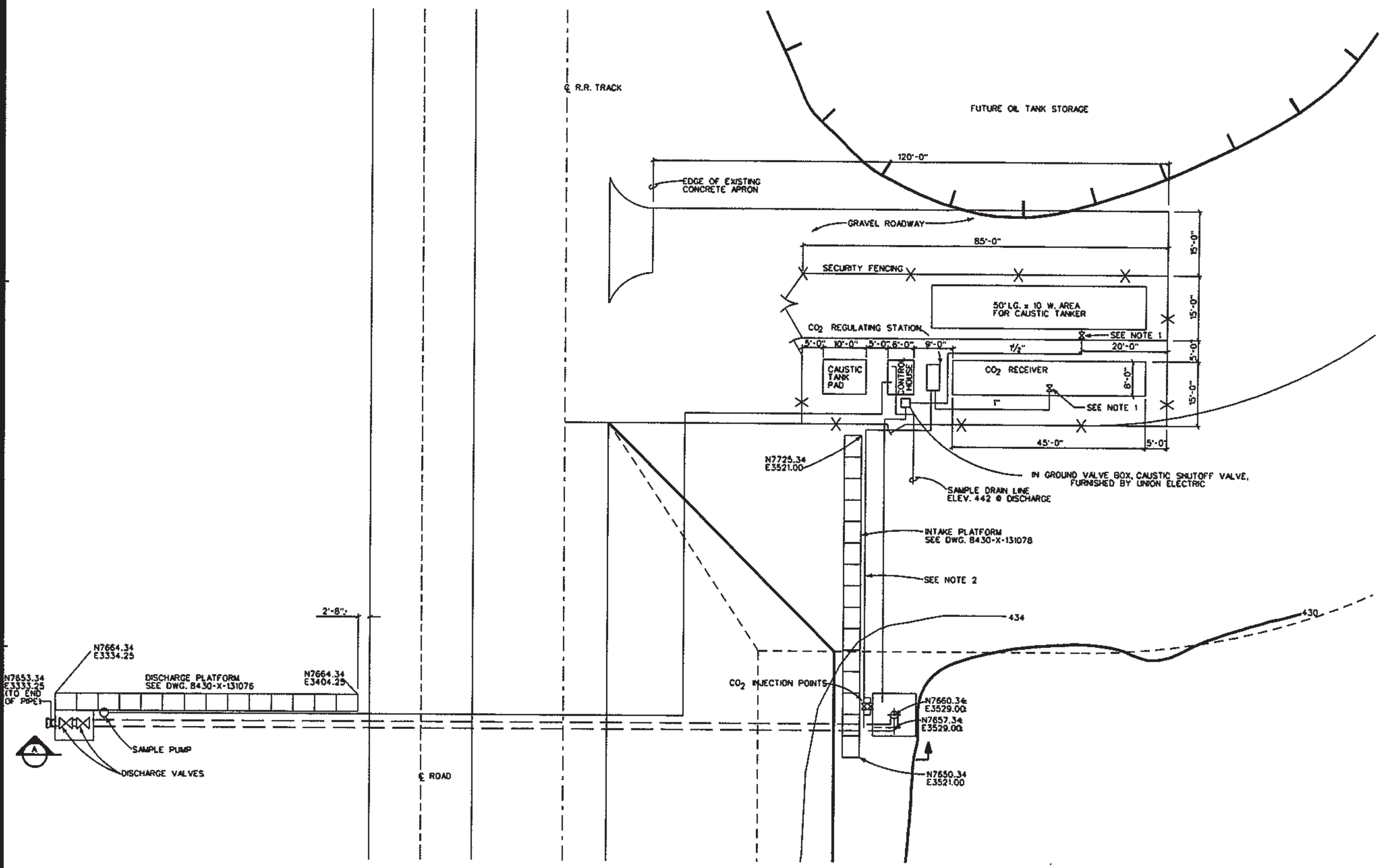
FOR EXISTING GROUND CONDITIONS SEE DRAWING 8430-X-128771

NOTICE OF LIMITED RESPONSIBILITY

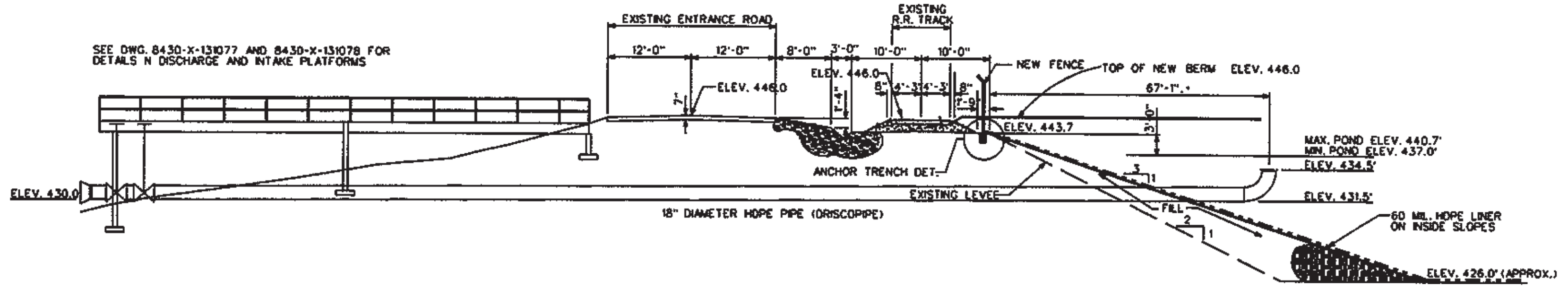
REV. 0 SEALED BY
CERT. NO. 0C25009*4
STATE OF MISSOURI

P.OTT 3-30-93	PROPERTY - PLAN NEW ASH POND	
CHKD. P.D.O.		
SUPV. SKO		
APPD. 3-30-93 C.W.REZSONYA 001009	SIOUX PLANT	02010
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8430-X-128772	REV. 2

REVISIONS		
REV. 0	W.O. E956	
FIRST ISSUE		
REV 1	DATE 0979?	DRAWN MGL
CHKD NOT	SUPV SKO	APPD CWR
W.O. J639		FILM
MOVED INTAKE PLATFORM 10' WEST, PLATFORM IS NOW 75' LONG (WAS 60' LONG)		
REV 2	DATE 0125?	DRAWN MGL
CHKD TG	SUPV SKO	APPD
W.O. 6672		FILM
ADD. COORDS. & SLIP ON BCK. WTR. VLV.		



ENLARGED PLAN
1"=10'



A SECTION

NOTES:

1. PIPING IS BURIED 1'-0" BELOW GRADE. EXTEND PIPING ABOVE GRADE AND LOCATE BALL VALVE 1'-0" ABOVE GRADE. INSTALL PIPE NIPPLE AND CAP ON UPPER VALVE THREADED CONNECTION.

2. RUN CO2 AND CAUSTIC PIPING ON INTAKE PLATFORM AT GRATING ELEVATION. LOCATE BOTH CO2 ISOLATION VALVES FOR EASY ACCESS FROM PLATFORM. EXTEND CAUSTIC LINE TO EXTEND 1'-0" INTO 18" DISCHARGE PIPE INLET.

REFERENCE DRAWINGS:

8430-X-128771-----PROPERTY-TOPOGRAPHIC MAP (EXISTING GROUND CONDITIONS)
8430-X-128772-----PROPERTY-PLAN

DO NOT SCALE DRAWING!

8430-X-131076

REV. 0 SEALED BY

MIKE LOWRY
CHKD. NOT CHKD.
SUPV. STEVE OTT

PROPERTY - ENLARGED PLAN
NEW ASH POND
DISCHARGE STRUCTURE

LOCATION 001009
SIOUX PLANT
CLASS 02010

UNION ELECTRIC COMPANY
ST. LOUIS, MO.

8430-X-131076
REV. 2

PRINT DIST.

REVISIONS

REV. 2 | E.O. E956

~~FIRST ISSUE~~

1 6-21-93 MGL

NOT CKD

E956

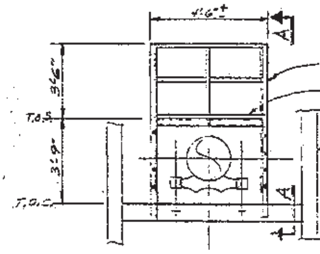
INTAKE PLATFORM WAS 60' LG., CHGD EL. OF FTGS. (PTFM. LOCATION) CHGD., ADD NOTE 2

2 1-25-94 MGL

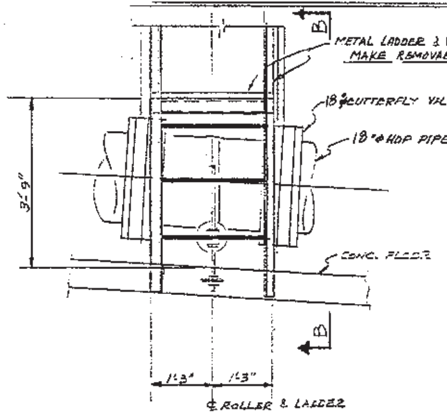
TG [illegible]

8672

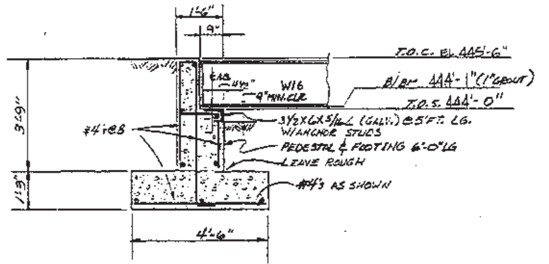
ADD. COORDS. & PLATF. GRTG.



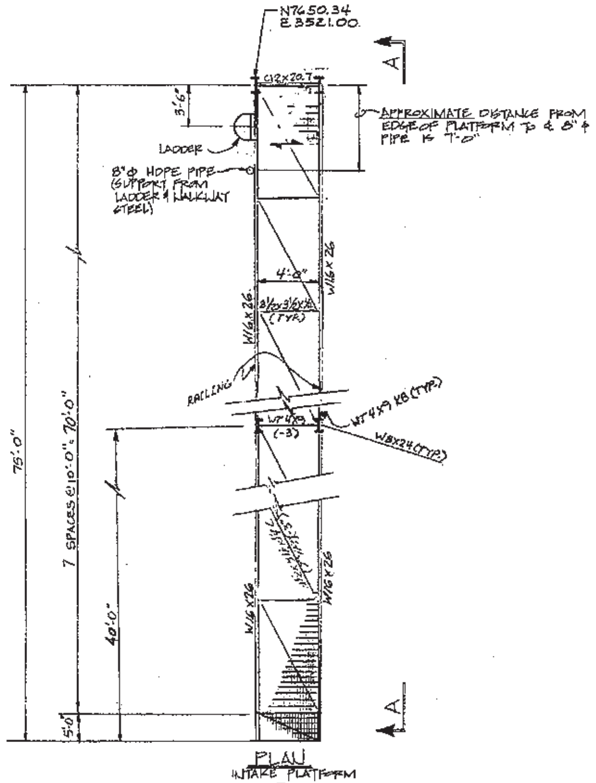
ELEV. B-B



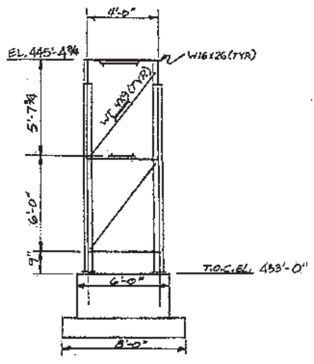
ELEVATION A-A



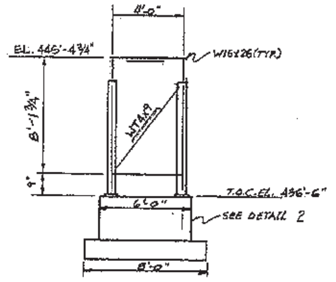
DETAIL 1
NORTH FOOTING



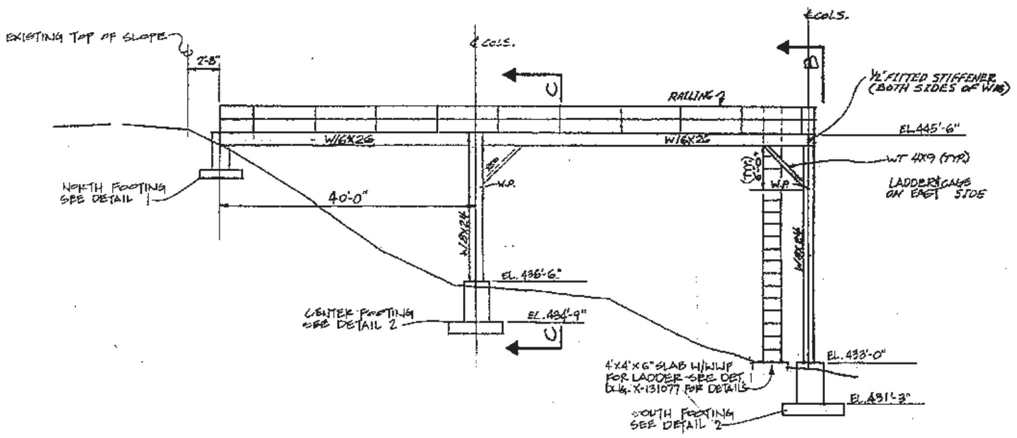
PLAN
INTAKE PLATFORM



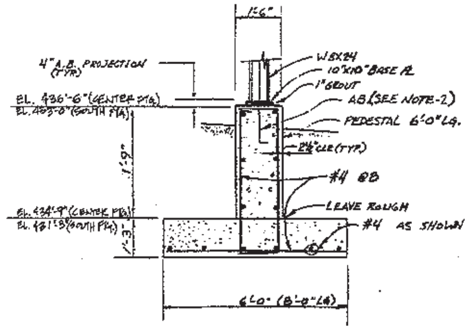
SECTION B-B



SECTION C-C



SECTION A-A



DETAIL 2
CENTER & SOUTH FOOTING

NOTES:

1. THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. NO. EC-2799.
2. ELEVATIONS GIVEN FOR CONCRETE FOOTINGS ARE ESTIMATED AND SHOULD BE VERIFIED IN THE FIELD. BEFORE ANY WORK BEGINS.

REFERENCE DRAWINGS:

8430-X-128772 ----- PROPERTY PLAN

THIS DRAWING HAS NO SCALE

8430-X-131078

STATE OF MISSOURI
CARL W. REZSONYA
NUMBER E-18282

DRAWN 5-14-93 MIKE LOWRY
CHKD. NOT CHKD.
SUPV. STEVE OTT
APPD. 5-15-93 Carl W. Rezsonya
LOCATION

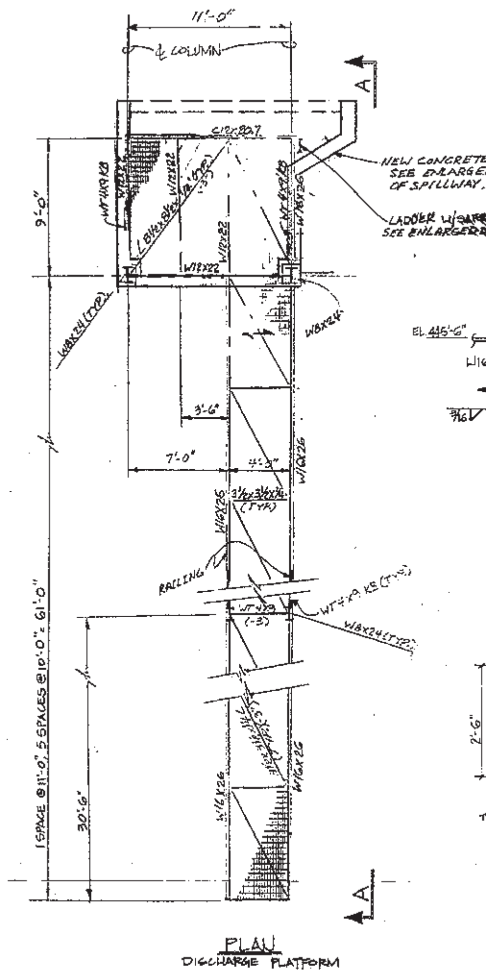
STRUCTURE-ASSEMBLY & DETAILS
NEW ASH POND
INTAKE STRUCTURE

SIOUX PLANT

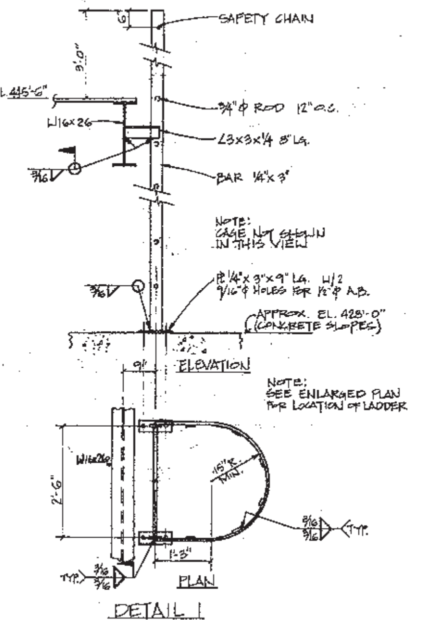
UNION ELECTRIC COMPANY
ST. LOUIS, MO.

8430-X-131078

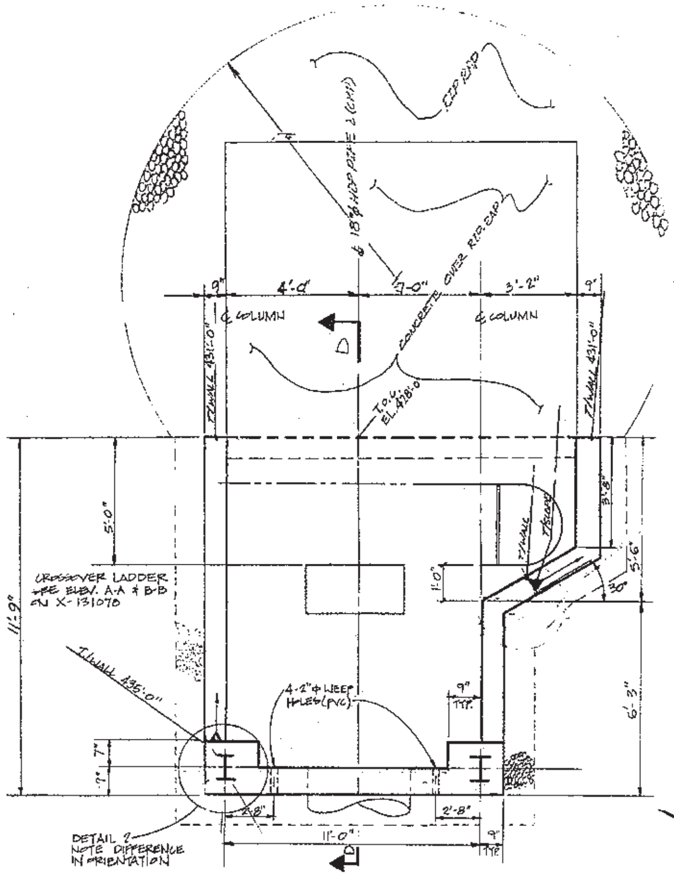
REV. 2



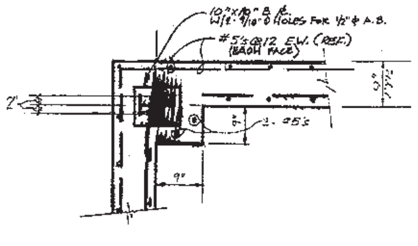
PLAN
DISCHARGE PLATFORM



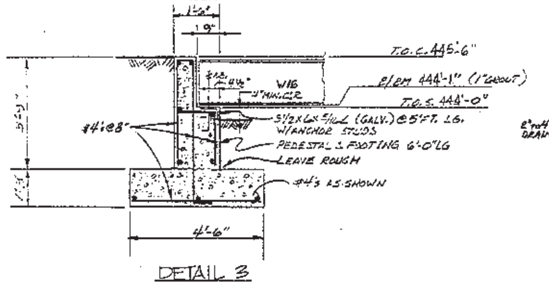
DETAIL 1
LADDER & CAGE



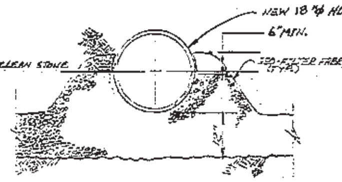
ENLARGED PLAN
CONCRETE SPILLWAY



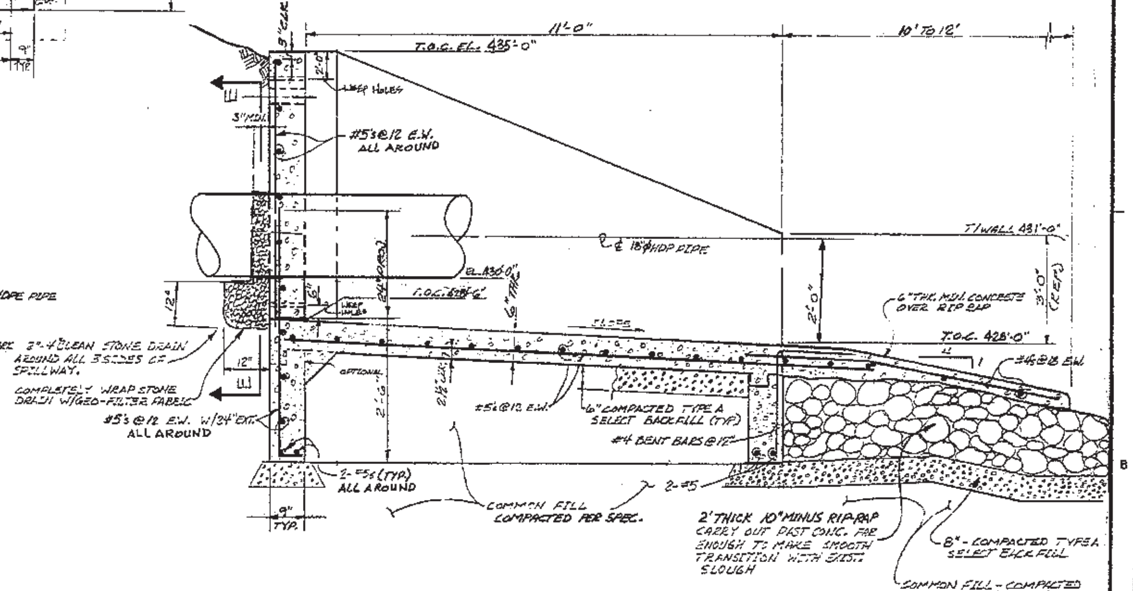
DETAIL 2
CORNER OF SPILLWAY TYPICAL @ 2 PLACES



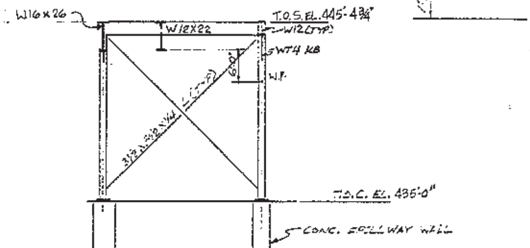
DETAIL 3
END FOOTING



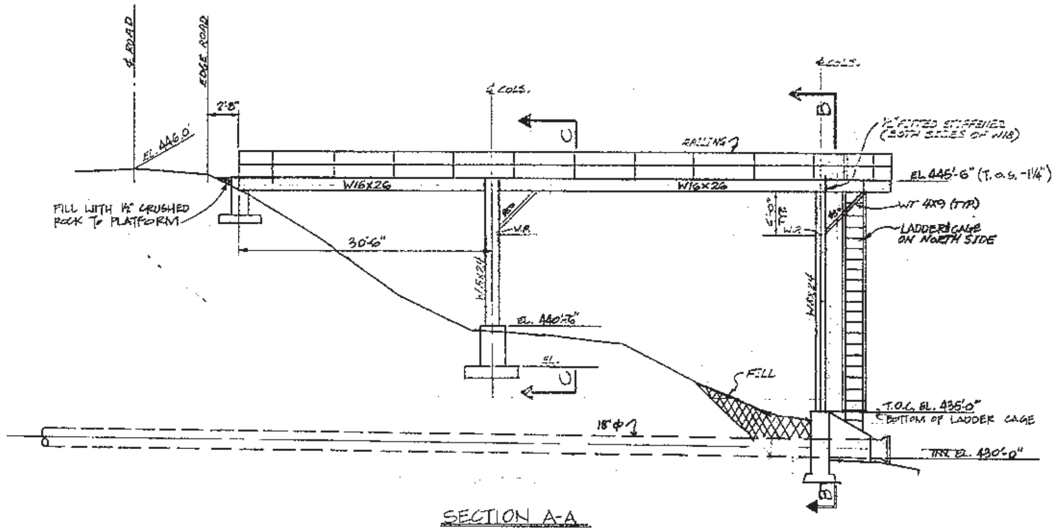
SECTION E-E



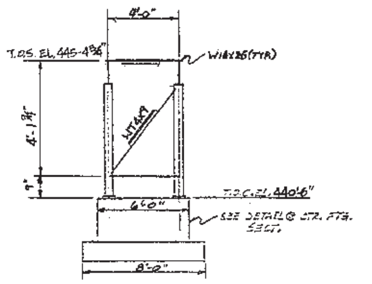
SECTION D-D



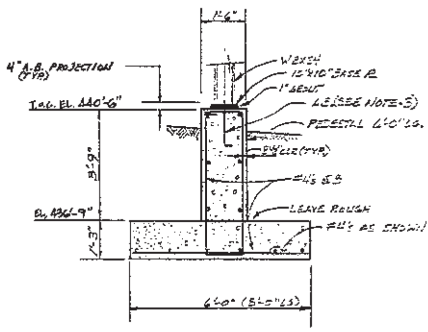
SECTION B-B



SECTION A-A



SECTION C-C



DETAIL 4
CENTER FOOTING

NOTES:
1. THIS WORK TO BE DONE IN ACCORDANCE WITH U.E. SPEC. No. EC-2799
2. ALL ANCHOR BOLTS TO BE ¾"φ x 1'-6" LG. (U.N.O.) VERTICAL LENGTH WITH 3" HOOK, GALVANIZED.

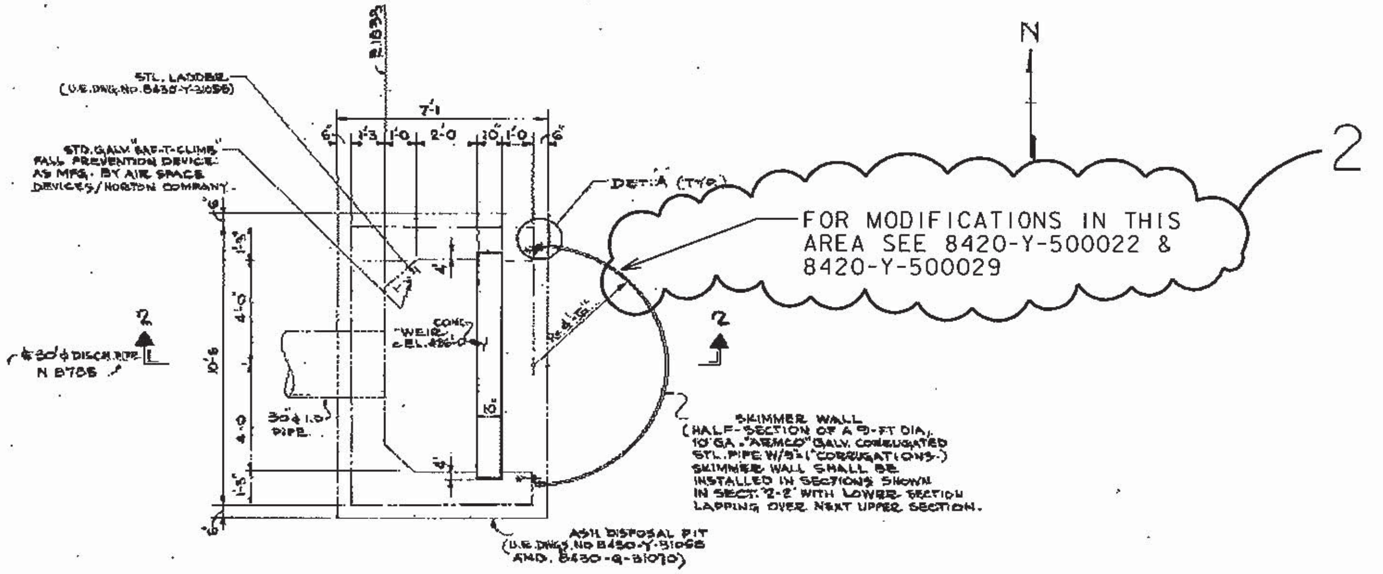
REFERENCE DRAWINGS:
8430-X-128772 - - - - - PROPERTY PLAN

THIS DRAWING HAS NO SCALE

CARL W. REZSONYA
NUMBER E-15232

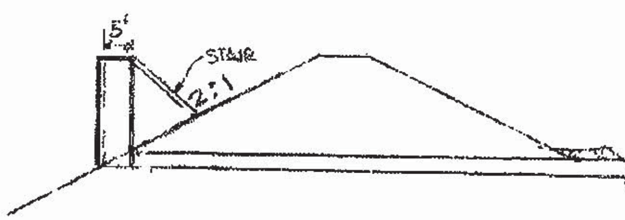
DRAWN 11 MAY 93 MIKE LOWRY	STRUCTURE -ASSEMBLY & DETAILS NEW ASH POND DISCHARGE STRUCTURE
CHKD NOT CHKD.	
SUPV STEVE OTT	
APPD. 5-27-93 Carl Rezsonya	LOCATION 00009 SIOUX PLANT CLASS 04030
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8430-X-131077 REV. 0

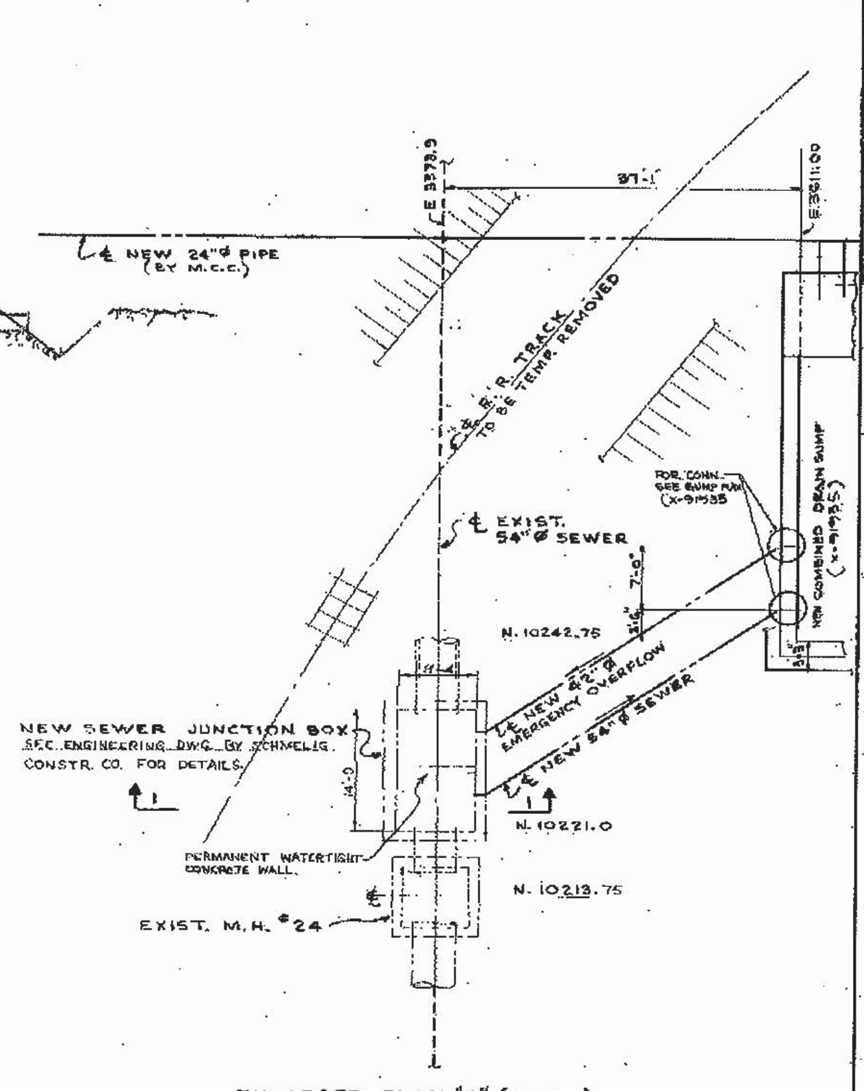
8430-X-131077



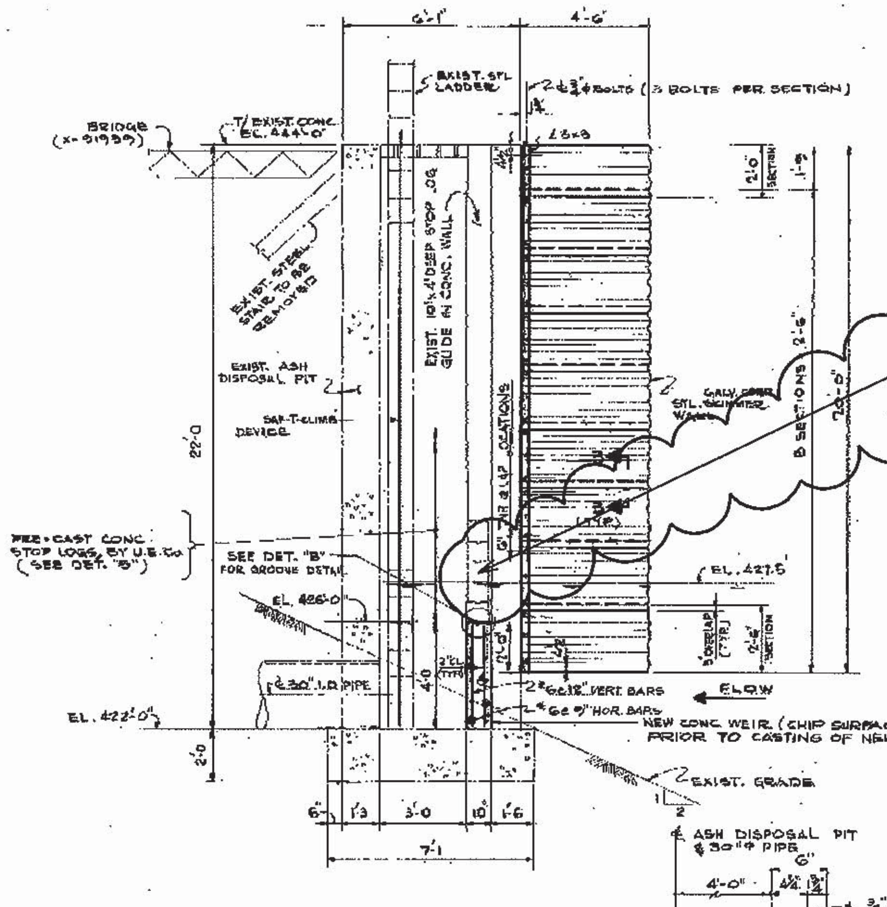
FOR MODIFICATIONS IN THIS AREA SEE 8420-Y-500022 & 8420-Y-500029

PLAN — MODIFIED ASH POND OVERFLOW (X-91934)
SCALE 3/8" = 1'-0"





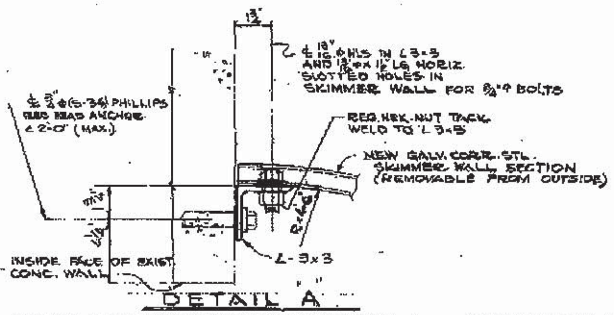
ENLARGED PLAN "C" (X-91934)
SCALE: 1/8" = 1'-0"



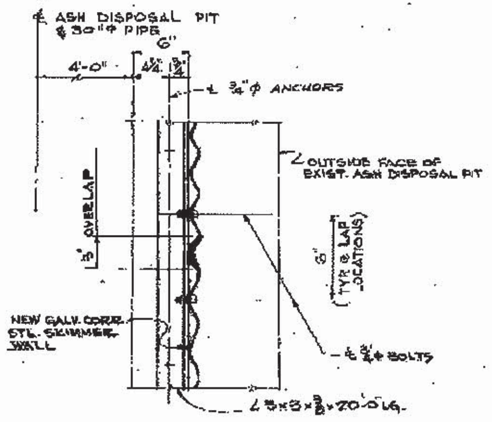
2

REMOVE EXISTING CONCRETE STOP LOGS. REPLACE WITH STRUCTURAL STEEL FRAME AND SLUICE GATE SHOWN ON DRAWING 8420-Y-500022 AND 8420-Y-500029

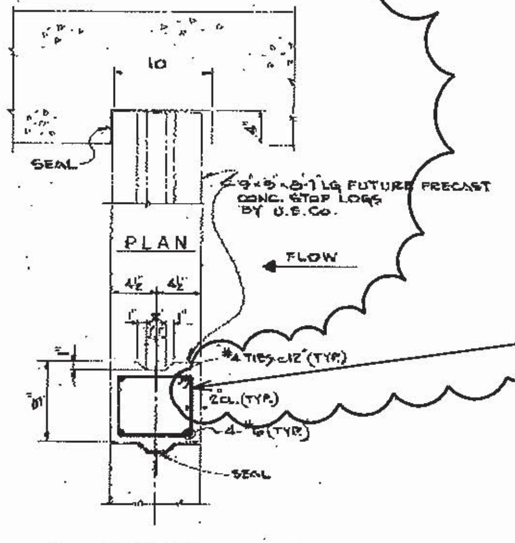
SECTION "2-2"
SCALE 3/8" = 1'-0"



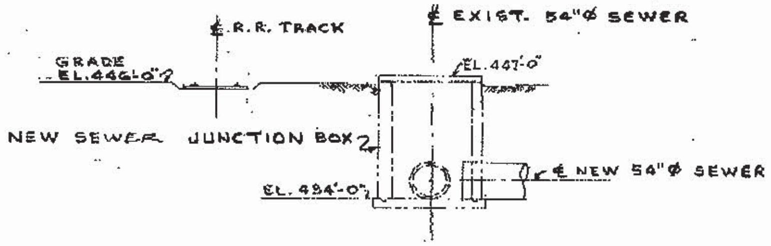
DETAIL "A"



SECTION 3-3
SCALE 1/2" = 1'-0"



DETAIL "B"
SCALE 1 1/2" = 1'-0"



SECTION 1-1
SCALE: 1/8" = 1'-0"

NOTES:

1. FOR GENERAL NOTES AND REF. DRAWINGS SEE DWG 8430-X-91934
2. DESIGN H.W. LEVEL FOR WEIR & STOP LOG DESIGN IS @ EL. 444.0'
3. ALL WORK BY STRUCTURAL/CIVIL CONSTRUCTION CONTRACTOR UNLESS OTHERWISE NOTED.

REVISIONS

C DWG. REVISED FOR BID QUOTATION. @ A-7 THRU 12 RELOCATED NEW 24"φ PIPE. APP'D: RAH 6-28-77 FILMED: 6-28-77

0 DWG. CHECKED, SIGNED, STAMPED & RELEASED FOR CONSTRUCTION. CHK'D: E.S. APP'D: RAH 7-8-77 FILMED: 7-8-77

1 C-11: REVISED ENLARGED PLAN "C" ADDED NEW SEWER JUNCTION BOX, REROUTED NEW 42"φ & 54"φ PIPES. F-11: REV. SECT. 1-1 CHK'D: S.A.K. APP'D: RAH 9-2-77 FILMED: 9-2-77

AMEREN REVISIONS

REV	DATE	DRAWN
2	051209	MSB
CHKD	SUPV	APPD
NOT		
W.O.		FILM

ADDED NOTE PER SLUICE GATE ADDITION

B RELEASED FOR CONSTRUCTION BIDS ONLY. APP'D: RAH 5-18-77 FILMED: 5-18-77 02

A RELEASED WITH STRUCTURAL SPEC'S FOR CLIENTS COMMENTS ONLY APP'D: RH/ES 6-1-77 FILMED: 6-2-77 01

STATE OF MISSOURI ROBERT L. HOBBS NUMBER E-12626 REGISTERED PROFESSIONAL ENGINEER

8430-X-91938-01

UNION ELECTRIC COMPANY
ST. LOUIS, MISSOURI
001009 SIOUX PLANT 08250
ASH POND OVERFLOW AND MISC. MODIFICATION
Designed By
FLUOR PIONEER INC.
CHICAGO, ILLINOIS 60606

DRAWN	DATE	DESIGNED	DATE	CHECKED	DATE	SCALE
R.R.		O.R.		J.R./RAH	6-1-77	AS NOTED

DESIGN GROUP LEADER	DATE	FILMED DATE	FLUOR PIONEER DWG. NO.
Ernie Strand	7-7-77		UE-SP-99-PD-8005

APPROVED
PROJECT NO. 104193 SHT.
8430-X-91938 REVISION 2

...\PROJECTS\SIOUX\STR\91938.dgn 09/17/2010 7:30:28 AM

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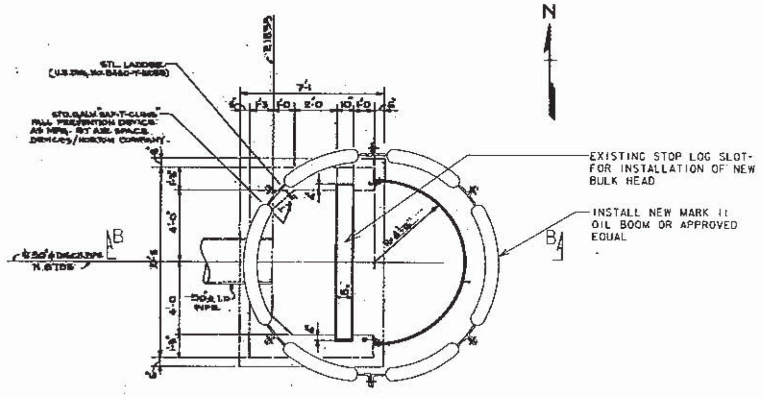
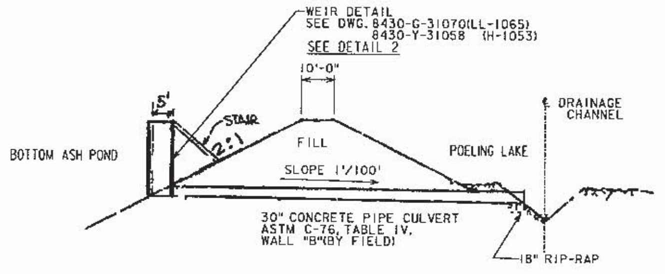
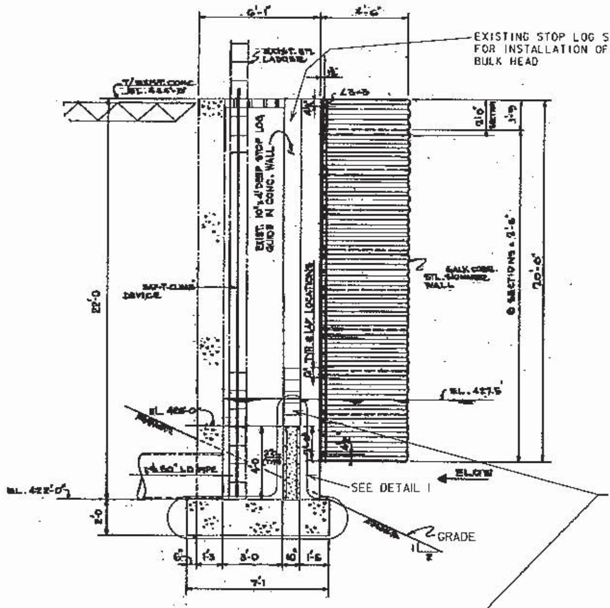
REVISIONS	
REV.	W.O.
0	
FIRST ISSUE	



DETAIL 1
PLAN-EXISTING BOTTOM ASH WATER CONTROL STRUCTURE

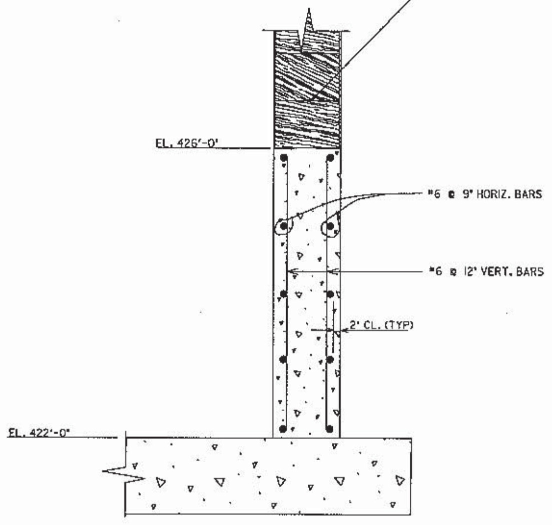


SECTION "A-A"

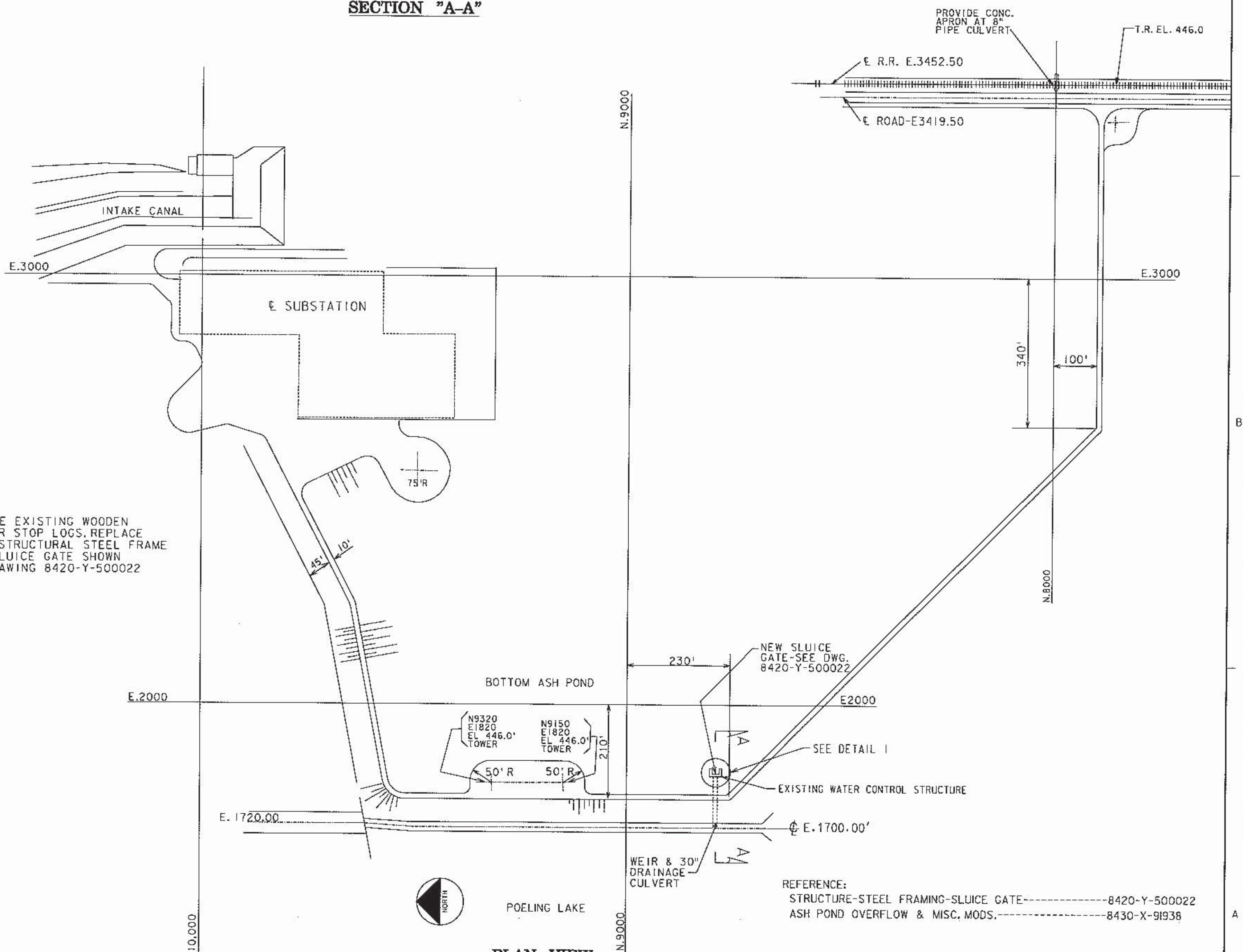


REMOVE EXISTING WOODEN TIMBER STOP LOGS. REPLACE WITH STRUCTURAL STEEL FRAME AND SLUICE GATE SHOWN ON DRAWING 8420-Y-500022

DETAIL-2
SECTION "B-B"



DETAIL 3



PLAN VIEW

REFERENCE:
STRUCTURE-STEEL FRAMING-SLUICE GATE--------------8420-Y-500022
ASH POND OVERFLOW & MISC. MODS.------------------8430-X-91938

NOTICE OF LIMITED RESPONSIBILITY

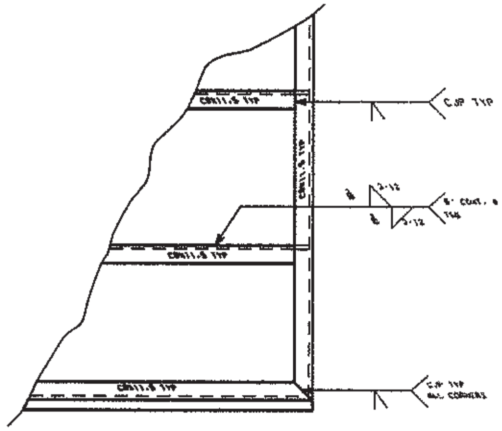
THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

PREPARED FOR AmerenUE

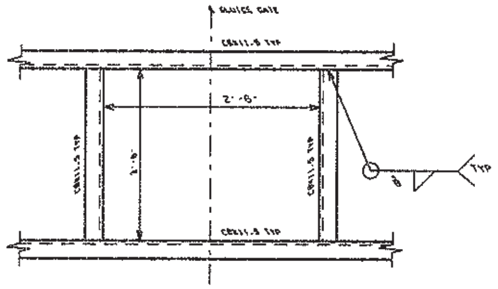
DRAWN 5-29-09 MSB	STRUCTURE-STEEL-INSTALLATION BULKHEAD/SLUICE GATE & OIL SKIMMER FOR BOTTOM ASH POND WATER CONTROL STRUCTURE	
CHKD. NOT CHK'D.		
SUPV. S.K. OTT		
APPD.	LOCATION 001009 SIOUX PLANT	CLASS 04060
Ameren ST. LOUIS, MISSOURI	8420-Y-500029	REV. 0

37-E3-118 Rev. 9-85

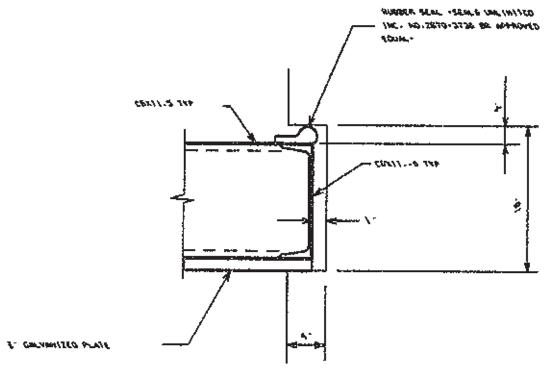
PRINT. DIST.	
REVISIONS	
REV.	W.O.
0	20315
FIRST ISSUE	



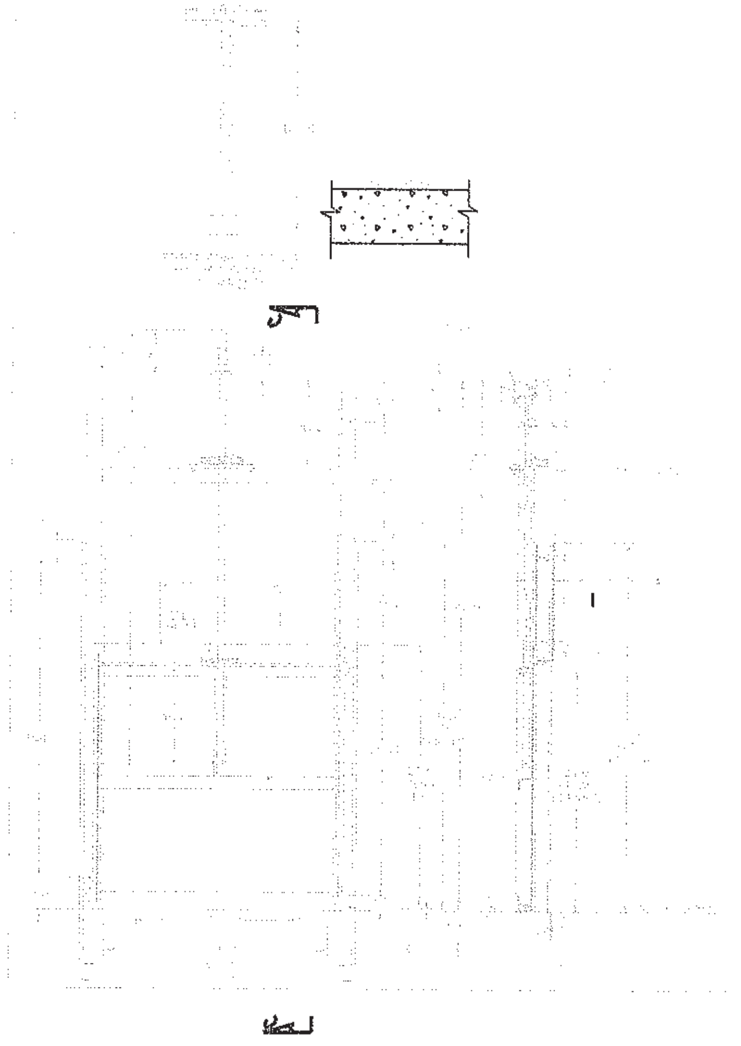
DETAIL 1



DETAIL 2



DETAIL 3

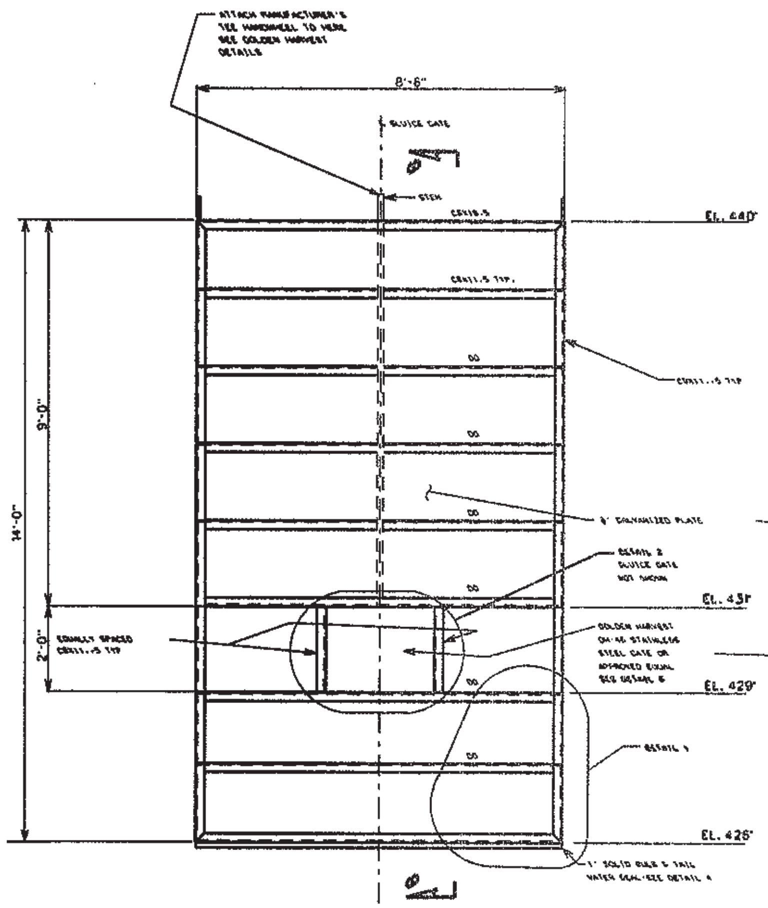


DETAIL 6

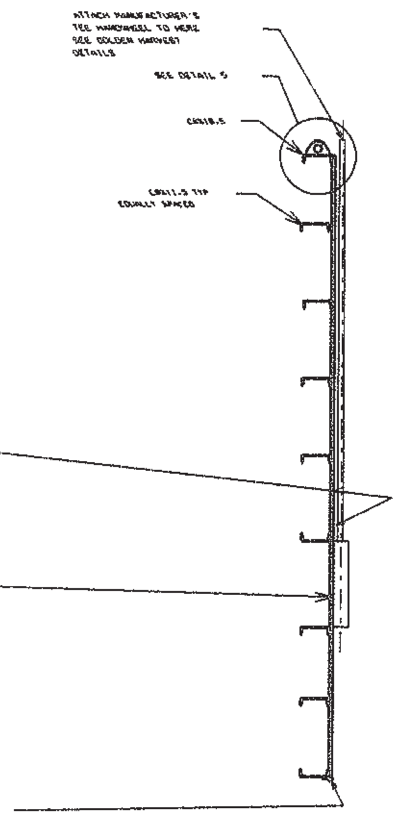
GOLDEN HARVEST GH-46 STAINLESS STEEL GATE OR APPROVED EQUAL.

SECTION "C-C"

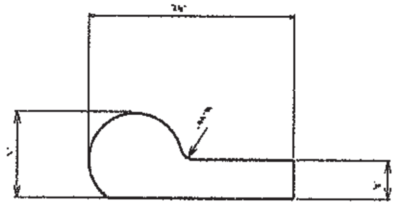
FOR SLUICE GATE



SECTION "A-A"



SECTION "B-B"

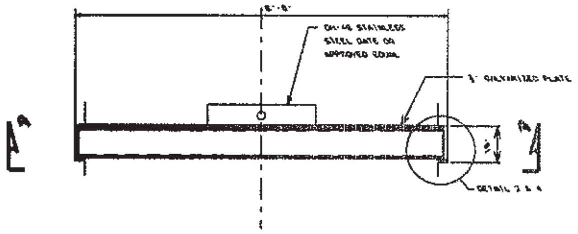


DETAIL 4

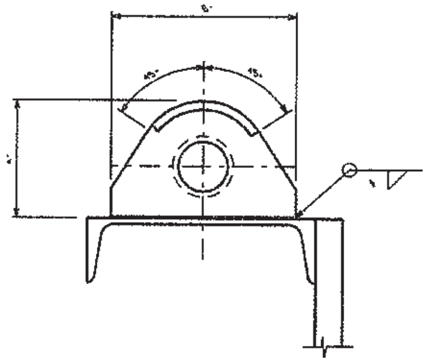
AT WATER SEAL

RUBBER SEAL -SEALS UNLIMITED INC. NO.2870-3736 OR APPROVED EQUAL-

NOTE: USE MANUFACTURER RECOMMENDED MOUNTING KIT



PLAN



DETAIL 5

NOTE: USE WINGATE CORP 5 TON LIFTING LUG OR APPROVED EQUAL.

NOTES:

1. ALL STRUCTURAL STEEL WORK SHALL BE IN ACCORDANCE WITH THE "MANUAL OF STEEL CONSTRUCTION OF THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION"-AISC-.
2. ALL STEEL SHALL CONFORM TO ASTM A6 AND SHALL BE GRADE 50 -ASTM 572 OR A992-
3. SUBMIT SHOP DRAWINGS TO ENGINEER. SHOP DRAWINGS SHALL INCLUDE COMPLETE DETAILS AND SCHEDULES FOR FABRICATION AND ASSEMBLY OF ALL COMPONENTS INCLUDING ALL SHOP AND AND FIELD CONNECTIONS. INDICATE WELDS BY STANDARD AWS A2.1 AND A2.4 SYMBOLS AND SHOW SIZE, LENGTH, AND TYPE OF WELD.
4. WELD CONSTRUCTION SHALL COMPLY WITH AWS CODE FOR PROCEDURES, APPEARANCE AND QUALITY OF WELDS, AND METHODS USED IN CORRECTING WELDING WORK.
5. ELECTRODES FOR WELD SHALL BE E70 FOR MANUAL ARC WELDING.
6. ALL STRUCTURAL MEMBERS TO BE HOT DIPPED GALVANIZED EXCEPT GATE.

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN WORK SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING HIS/HER SEAL, SIGNATURE OR INITIALS. HE/SHE DOES NOT HAVE AUTHORITY OVER THE PROJECT AS A WHOLE. THE UNDERSIGNED DISCLAIMS ANY RESPONSIBILITY FOR WORK DONE UNDER SUBSEQUENT REVISIONS AND ANY OTHER DOCUMENTS ASSOCIATED WITH THE PROJECT WHICH DO NOT BEAR HIS/HER SEAL, SIGNATURE OR INITIALS.

PREPARED FOR AmerenUE

DRAWN BY VSA	STRUCTURE-STEEL FRAMING BULKHEAD-SLUICE GATE BOTTOM ASH POND
CHK/RVR NOT CHK'D	
SUPV. S.K. OTT	
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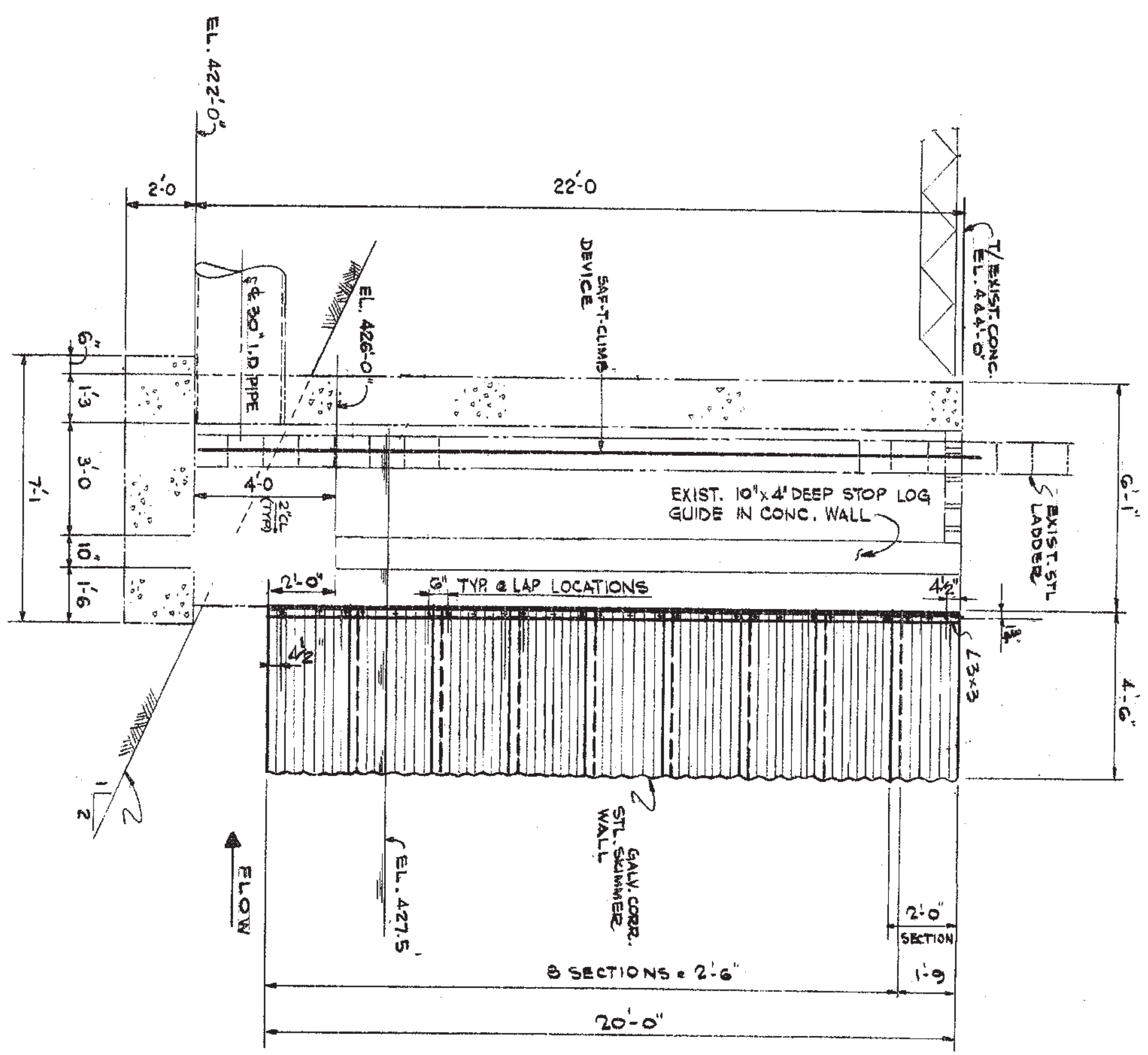

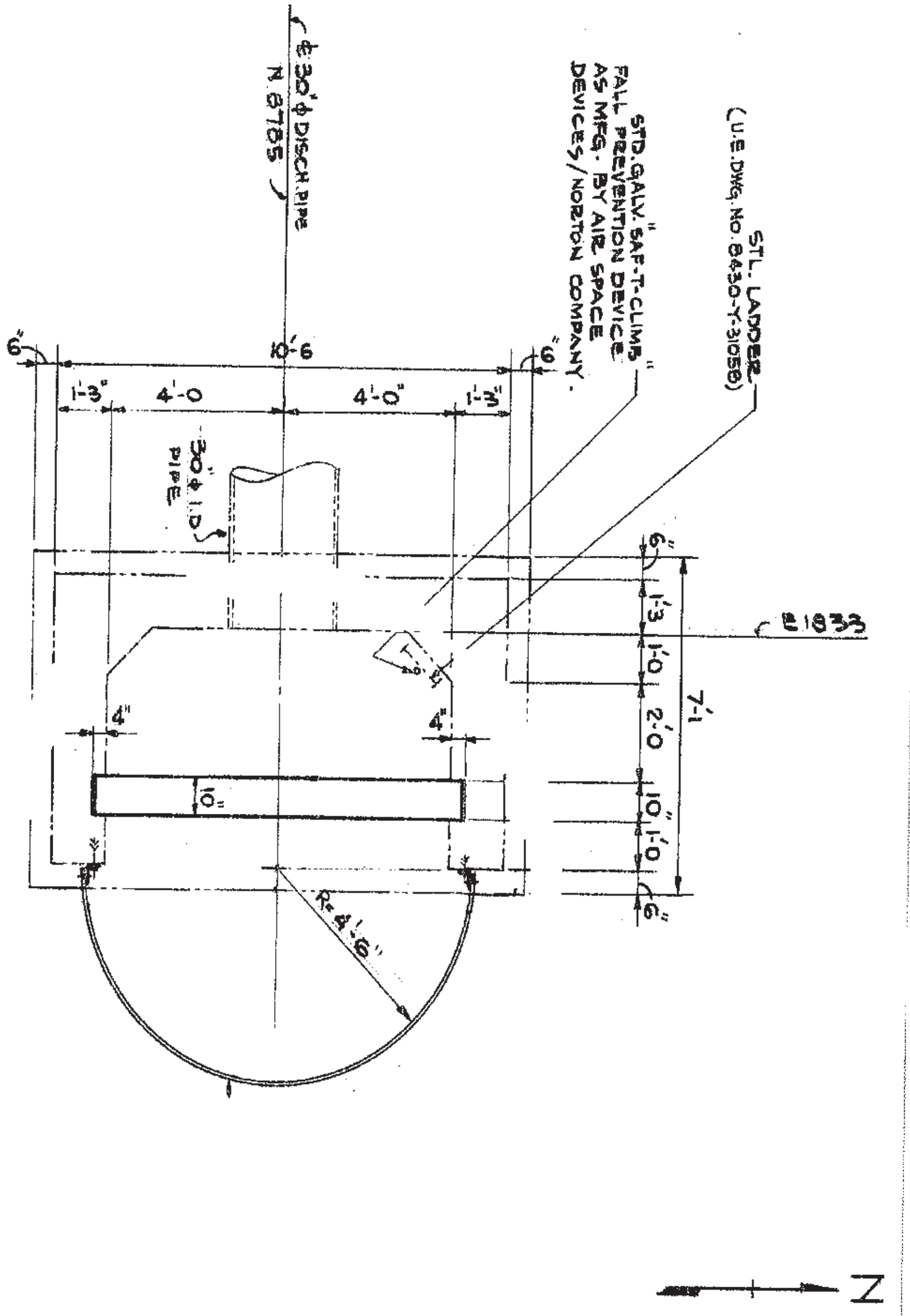

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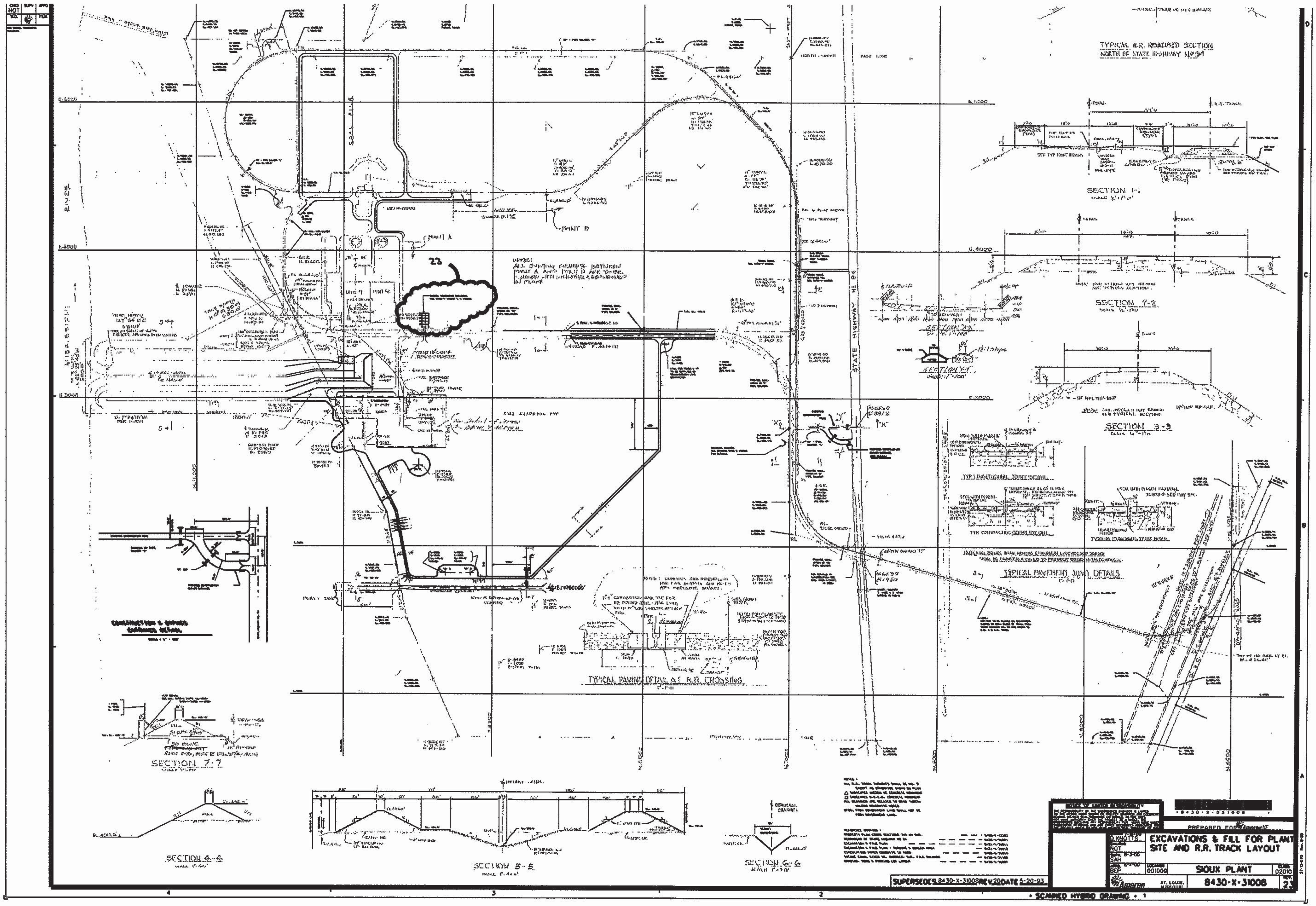

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REITZ & JENS, INC.
CONSULTING ENGINEERS

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING LAND - AIR – WATER

Project Engineering Team

Operation and Maintenance Manual for Cells 1 & 4A and Recycle Pond
Sioux Energy Center Utility Waste Landfill
St. Charles County, Missouri

Prepared for:

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MISSOURI

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April 2011 (Revised October 2015)

Ameren Missouri Sioux Energy Center Utility Waste Landfill
Cells 1 & 4A and Recycle Pond
Operation and Maintenance Manual

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ABBREVIATIONS

BFE	Base Flood Elevation, from FEMA Flood Insurance Study maps
CCPs	Coal combustion products (fly ash, bottom ash, and boiler slag)
CDSE	Ameren Missouri Chief Dam Safety Engineer
CPA	Construction Permit Application
CY	Cubic yard(s)
DRSP	MDNR Dam and Reservoir Safety Program (as in MDNR-DRSP)
DSI	Detailed Site Investigation, part of the MDNR permitting process
DSP	Ameren Missouri’s Dam Safety Program (DSP 003)
EIP	Ameren Emergency Implementing Procedures
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FS	Factor of Safety
HDPE	High density polyethylene
MDNR	Missouri Department of Natural Resources
O&M	Operation and maintenance
PSI	Preliminary Site Investigation
SCC	St. Charles County
SWMC	Soil Waste Management Code for St. Charles County
SWMP	MDNR Solid Waste Management Program (as in MDNR-SWMP)
UWL	Utility waste landfill
WFGD	Wet flue gas desulfurization
WFP	Waste Facility Plan, required by St. Charles County

Ameren Missouri Sioux Energy Center Utility Waste Landfill
Cells 1 & 4A and Recycle Pond
Operation and Maintenance Manual

1.0 INTRODUCTION

1.1 GENERAL DESCRIPTION OF UTILITY WASTE LANDFILL

The Ameren Missouri Sioux Energy Center ("Plant") Utility Waste Landfill (UWL) site is located in unincorporated St. Charles County within a tract of land totaling 398 acres, of which 183.5 acres are permitted for use as the active disposal area. The UWL site is adjacent to the Plant, located south of State Highway 94 and north of Dwiggins Road. The active disposal area will be divided into multiple disposal cells. A general plan of the UWL is shown in Figure 1. Cell 1, the Recycle Pond, and associated facilities were constructed between 2008 and 2010. Cell 4A was constructed in 2012 and 2013. A plan of Cell 1, Cell 4A and the Recycle Pond is shown in Figure 2. The remaining acreage includes area for future cells, soil-borrow areas, access roads, flood protection berms, buffer area, slurry pipes, and haul roads. Ameren leases as much of the unused acreage as possible for crop farming.

The UWL has been approved by the Missouri Department of Natural Resources (MDNR) to allow permanent disposal of both wet flue gas desulfurization (WFGD) gypsum using wet "gypsum stack" methods, and dry disposal of coal combustion products (CCPs) produced by the Sioux Energy Center. The purpose of the Cell 1 and future Cells 2 and 3 is storage of gypsum from the WFGD system. Cells 4 through 7 will store moisture-conditioned (i.e. "dry") CCPs. Only the western half of Cell 4 (Cell 4A) has been constructed. The purpose of a future individual cell may change before it is designed and constructed.

Only CCPs generated by Ameren Missouri's Sioux Energy Center will be accepted at the UWL. The total CCP volume estimated to be available at the site is 21,123,000 CY when all cells have been constructed. This equates to an estimated 20,532,000 tons of landfill capacity. Based on historical production and assumptions for future CCP generation, the calculated life expectancy of the landfill is approximately 48 years, reaching capacity in 2058.

1.2 SCOPE OF O&M MANUAL

This Operations and Maintenance (O&M) Manual is only for: Cell 1, Cell 4A, and the Recycle Pond outside the Reclaim Water Pump House and associated Electrical Equipment Building. This Manual does NOT include the operation and maintenance of the piping, mechanical or electrical systems that are located in the Plant; between the Plant and the Pump House; nor associated with the Pump House and the Electrical Building at the Recycle Pond.

Safety requirements and procedures are not included in this Manual. Ameren Missouri and Sioux Energy Center health and safety rules and procedures must be followed. In particular, working on or near the inside slopes of Cell 1 and the Recycle Pond requires special precautions, such as the use of floatation vests and a life line. The high density polyethylene (HDPE) liner is very slippery when wet.

The effective timeframe of this O&M Manual began with start-up of the WFGD system in November 2010 until Ring Drain B will be installed. Ring Drain B will be required when enough gypsum solids have accumulated in Cell 1 for continued wet stack operation, which is at about el. 441 to 443. Based on an average monthly production rate of 7,000 to 9,000 tons of gypsum, Ring Drain B will not be required until 2020 to 2021 if gypsum stacking operations are performed. Plant operational, maintenance and construction activities required for the UWL beyond the installation of Ring Drain B in Cell 1 will need to be addressed at that time.

CCPs will be placed in Cell 4A as a construction contract periodically. Therefore, the daily operational procedures for the dry cell are not included in this O&M Manual. These procedures are stated in the St. Charles County Waste Facility Plan and the Construction Permit Application (CPA).

Because the effective timeframe of this O&M Manual spans several years, modifications made to processes or associated documents may necessitate revision and modification to this O&M Manual.

1.3 AMEREN DAM SAFETY PROGRAM

This operation, maintenance and inspection program for the Sioux UWL Cell 1 and Recycle Pond shall be in compliance with the current Ameren Missouri Procedure AUE-ADM-5103, “Dam Safety Program for Ameren Missouri Non-Hydroelectric Facilities.” The Dam Safety Program does not apply to Cell 4A or the other dry CCP cells.

1.4 OVERVIEW OF UWL

The Utility Waste Landfill (UWL) is being constructed in phases (or cells) that will be designed and permitted to accept either gypsum or CCPs. The initial phase was the construction of Cell 1 and Recycle Pond, which are located within a 183.5-acre permit boundary within the 398 acre tract. The footprint of Cell 1 covers approximately 37.5 acres, and the Recycle Pond footprint is approximately 19.6 acres. Cell 1 was designed for wet gypsum stacking operation. Additional disposal capacity for both gypsum and CCPs will be created by adding additional disposal cells with prior regulatory approval. At this time, Cells 1, 2 and 3 will hold WFGD gypsum, and will total 96.9 acres. Cells 4 through 7 will hold CCPs and will total 86.6 acres. Cell 4A has been constructed with a footprint of about 15 acres. Preliminary approval for adding future cells has been obtained from both the Missouri Department of Natural Resources (MDNR) and St. Charles County. The present MDNR permit does not allow reclamation activities.

The existing topography of the site is very flat. The site is a part of the 100-year floodplain of the Mississippi and Missouri Rivers, but not in the floodway. There are two topographic ridges, each less than 3 feet high, and one shallow drainage feature that cross the site north of Dwiggins Road in a general east-west direction. The shallow drainage feature lies between the two ridges. The entire UWL site is protected from flooding on the Mississippi River by the L-15 agricultural levee system up to about el. 433, which is the 20-year flood event on the Mississippi River (i.e. on average would occur once in every 20 years). The 50-year flood event on the Mississippi River is el 435. The 100-year flood event on the Mississippi River is el. 438.7 (i.e. BFE). The railroad embankment protects the site from the 100-year flood event on the Missouri River. The site itself generally drains from northwest to southeast. The Ameren spur railroad embankment to the west as well as roads on the north and south generally block surface water from flowing onto the UWL site.

A typical cross-section of a perimeter berm for Cell 1 and the Recycle Pond is shown in Figure 3. The top of the perimeter berms is at el. 446. A cross-section of the perimeter soil berms for Cell 4A (north, west and south berms) is shown in Figure 4. A cross-section of the east temporary CCP berm of Cell 4A is also shown in Figure 4. The interior floor and side slopes of Cells 1 and 4A and the Recycle Pond are lined with HDPE liner over 24 inches of high plastic clay. The HDPE and the compacted clay are collectively referred to as the “composite liner.” The HDPE liner is held at the top of the interior slope by a 24-inch wide by 24-inch deep anchor trench. **IT IS CRITICAL THAT THE HDPE LINER IS NOT CUT, TORN OR PUNCTURED AT ANY POINT**. The HDPE liner must always be protected from damage. (The interior slope of the CCP berm does not have a HDPE liner.) The exterior of the western and southern Cell 1 and Recycle Pond perimeter berms are armored with riprap for flood protection in the remote event of a breach of the railroad embankment such as occurred in 1993.

Access to the UWL is limited to authorized Ameren personnel and contractors. Emergency vehicle access from the Sioux Energy Center to the UWL can be provided during a flood event via Highway 94 across from the Sioux Energy Center employee entrance. Access around the UWL is provided by gravel maintenance roads on the top of the perimeter berms and around the exterior toe of the perimeter berms. Another entrance was constructed to allow access via Highway 94 directly across from the Sioux Energy Center contractor’s entrance. The entrance and associated haul road allows for CCP transportation from the Energy Center to the UWL.

Cells 1 and 4A and the Recycle Pond are surrounded by a seven-foot high security fence topped with barbed wire. Locked gates are located on the north side of the UWL at the entrance roads to control access to the disposal area. Ameren Sioux Energy Center security staff is on duty 24 hours per day and will provide additional security to the UWL through routine site monitoring.

1.4.1 Cell 1

The WFGD scrubber system installed at the Sioux Energy Center will reduce sulfur dioxide (SO_2) emissions. The by-product is gypsum (as found in wallboard), which is transported to the UWL as a slurry containing about 15% to 20% solids. Gypsum stored in the Gypsum Transfer Tank at the Plant is pumped from one of two gypsum transfer pumps located in the Plant’s Gypsum Transfer Building through three underground HDPE pipelines. The piping connects the UWL system with the WFGD system at the Reclaim Water Pump House. These lines include gypsum transfer, reclaim water return, and a common spare that can be utilized for either gypsum transfer or reclaim water system. The pipelines cross under Highway 94 and enter through the north wall of the Pump House (shown in Figure 2).

The gypsum slurry is piped to Cell 1 through either one of two buried HDPE pipelines that run from the south wall of the Pump House, down the centers of the east embankment and the south embankment of the Recycle Pond, and down the center of the east embankment of Cell 1. The pipes discharge into Cell 1 at the approximate midpoint of the east embankment (Sta.

34+40) at an invert elevation of 442.67. There are 7 pairs of cleanouts in manholes – one set for each slurry pipeline – located at about 300-foot spacing (see Figure 2).

The gypsum slurry discharges into Cell 1, where the gypsum settles out and the “decant” water flows into the Recycle Pond. The water will normally flow by gravity through the triple box culverts (“Influent Structure”) near the northwest corner of Cell 1, or it may be pumped or siphoned out of Cell 1 into the Recycle Pond. The flow line of the box culverts is at about el. 441 which controls the maximum water level in Cell 1.

Cell 1 is designed with two ring drains that are a key component to the long-term stability of the UWL during gypsum stacking operations. The positions of the two ring drains are illustrated in Figure C-1 in Appendix C. These ring drains are not critical to the stability or operation of Cell 1 until gypsum stacking operations reached above about el. 451. The outer ring drain is designated “Ring Drain A” and was installed on top of the HDPE liner at the bottom of Cell 1. Four outlet drain pipes have been installed for Ring Drain A as shown in Figure 2. As the height of the gypsum stack increases, the lower gypsum is compressed, forcing the water out. Some of this water will be forced through the ring drains and up and out of the outlet pipes, which will discharge into a future perimeter ditch formed in the gypsum (see Figure C-1). The outlet pipes discharge at el. 443.0. So the height of the gypsum will have to be 3 to 5 feet above the discharge of the outlet pipes, or at about el. 446 to 448, before water will flow from the outlet pipes. Therefore, Ring Drain A and its associated outlet pipes are not expected to function during the effective timeframe of this O&M Manual. Ring Drain B is not currently installed, but is designed to be installed at approximate el. 440 when the gypsum in Cell 1 has accumulated to about el. 441 to el. 443, at which point a stable working surface can be established (see Section 1.2). Ring Drain B consists of 6-inch diameter slotted pipe enclosed by drainage gravel blanket. The gravel blanket is 12 feet wide and 18 inches thick, and is wrapped with a filter fabric. The total length of Ring Drain B is about 3600 feet.

The available volume for gypsum in Cell 1 up to el. 441 is 856,000 CY. Gypsum stacking operations will be required shortly after the gypsum fills Cell 1 up to about el. 441 to 442, which is expected to be in the 2020 to 2021 timeframe. Gypsum stacking operations are presented in Appendix C. Gypsum stacking in Cell 1 may not be allowable depending on the outcome of pending regulations. Should regulations allow stacking, the available volume of gypsum in Cell 1 is about 2.8 million CY to a maximum elevation of 485 feet. Permitting and construction of Cell 2 will need to be complete and ready for operation by the time this elevation is reached in Cell 1 and possibly sooner depending on regulations.

The sump, located at the approximate center of the north end of Cell 1, is designed to allow a submersible pump to be installed at a later date near the bottom of Cell 1 to help drain Cell 1. For example, this might be done to repair a leak in the liner.

1.4.2 Recycle Pond

The landfill is designed as a no-discharge water management system. The excess slurry water and rainfall within the perimeter berms is collected in the Recycle Pond and pumped back to the WFGD system as reclaim water. The water in the Recycle Pond normally will flow through the box culverts in the southwest corner to the east end, where two 48-inch diameter HDPE pump intakes manholes (“Effluent Structures”) are located on the bottom of the Recycle Pond. The tops of the manholes are at el. 426.5, and the bases are at el. 422. Water will flow through the tops of the manholes. If the water in the Recycle Pond is drawn down below el. 426.5 under special circumstances, then there are holes in the side of both manholes which will allow water to flow into the manholes down to el. 425.

These pump intakes are connected to 2 reclaim pumps in the Pump House through 2 double-wall HDPE intake pipes that enter the west side of the Pump House. The flowline of the intake pipes is at el. 423 at the pump intake manholes. The pipes go through the west wall of the pump house at el. 426 and el. 427 (centerline). The pump intakes and exposed piping are held in place by a gravel blanket that also protects the HDPE liner during future maintenance activities. The pump intakes have mesh screens covering their open tops that are designed to keep large objects and debris out of the reclaim pumps in the Pump House.

The water levels within the Recycle Pond are continuously monitored by the Plant operation personnel. A series of redundant level sensors are installed at the east end of the Recycle Pond to allow continuous monitoring. These sensors are housed in five 4-inch diameter HDPE pipes that are installed on top of the HDPE liner on the slope of the east embankment (see detail in Figure 2). The three long pipes house pressure transducers which are continuously read water level sensors, while the two shorter pipes house water level probes with redundancy for the “high” and “high-high” water level alarms. The HDPE pipes housing the level sensors are anchored to the HDPE liner by HDPE “anchors” boxes that are filled with gravel and are welded to the HDPE liner.

A recirculation pipe exits the west side of the Pump House, just below the top of the east embankment, and discharges into the southeast end of the Recycle Pond. The Pump House also has a sump pit to remove water that may accumulate in the Pump House. The water is returned to the Recycle Pond through a buried pipe that exits the south side of the Pump House and also discharges into the southeast corner of the Recycle Pond.

There are two (2) Emergency Spillways located in the west perimeter embankment: one for the Recycle Pond and one for Cell 1. These spillways are a regulatory requirement of the Dam Construction Permit, to provide a controlled discharge in the unlikely event that the water levels in either the Recycle Pond or Cell 1 are close to overtopping the perimeter embankments. THE EMERGENCY SPILLWAYS ARE NEVER INTENDED TO BE USED UNDER NORMAL OPERATING CONDITIONS. Discharge of water from the Recycle Pond or Cell 1 into the area outside of the perimeter embankments is not allowed under existing State and County environmental permits.

1.4.3 Cell 4A

Cell 4A is designed for the storage of CCPs from the Sioux Energy Center. As noted previously, Cell 4A is the western one-half of the whole future Cell 4, that is when the eastern Cell 4B is constructed (see Figure 1). The design capacity of Cell 4A is 990,000 CY up to el.

514 (i.e. el. 515 minus 1 foot of soil cover). Cell 4B would have to be permitted and constructed so that it is operational before the CCPs in Cell 4A reach el. 514.

The east berm of Cell 4A is a “temporary interior” berm and was constructed with compacted CCPs from the ash pond at the Sioux Energy Center. Cell 4A has a blanket leachate collection system over the bottom and interior side slopes, and under the east CCP berm. Leachate is free water that drains to the bottom of the cell, either from water squeezed out of the CCPs by compression of its own weight or precipitation percolating through the CCP fill. The blanket leachate collection system is a geo-composite that consists of an expanded HDPE mesh topped with a non-woven filter fabric. The geo-composite drains to a central north-south leachate collection pipe, which conveys the leachate to a sump located at the north berm of Cell 4A. The entire geo-composite is covered with 12 inches of clean sand, to protect the geo-composite and to act as a filter to keep fly ash out of the leachate collection system.

A submersible leachate sump pump (EPG SurePump Model WSDPTSL 15-6) is located at the bottom of the sump in an 18-inch HDPE pipe that runs up the interior slope to the leachate sump pump vault (see Figure 2). The north-south leachate collection pipe also extends up the interior slope to the vault, and has a cleanout. The leachate sump pump can be pulled up the sloping 18-inch pipe with a cable and pulley for maintenance. The controls for the leachate sump pump are located within a control panel (PG PumpMaster Series L925PT) mounted outside of the vault. The leachate sump pump is equipped with a pressure sensor and operates automatically to control the fluid pressure or “head” in the leachate collection system. Per MDNR-SWMP regulations, no more than one foot of water can remain on the HDPE liner outside of the sump area. The leachate sump pump discharges through a flexible hose, which connects inside the vault to a buried 6-inch HDPE pipe that runs along the top of the north berm over to the discharge structure in the Recycle Pond. Power to operate the leachate sump pump comes from the Reclaim Water Electric Equipment Building. The leachate pump and alarm settings are discussed later in Section 2.4.1 and in the O&M manual for the leachate pump system.

Cell 4A was initially filled with CCPs from the active Sioux ash pond north of Hwy. 94 as soon as the cell was completed and authorization was received from MDNR-SWMP and revised operating license from St. Charles County. The initial filling of Cell 4A was required to provide ballast (weight) to counter hydrostatic uplift on the bottom liner in the event of a significant flood. A plan and profile of the initial filling with CCPs is shown in Figure 9A. The top of the CCP fill has an “intermediate” soil cover because CCPs will not be placed within Cell 4A for more than 60 days, in accordance with MDNR-SWMP regulations. Precipitation that collects in Cell 4A must be pumped to the Recycle Pond, to try to minimize the volume that percolates through the CCP fill and becomes leachate that must be removed by the leachate collection system. The surface of the intermediate cover is shaped to drain to a sump located below the storm water channel at the west side of Cell 4A. An electric submersible sump pump (Zoeller Model MX292) pumps the collected storm water up to a buried discharge pipe which drains by gravity into the Recycle Pond (see Figures 2 and 9B). The storm water pump is designed to be readily relocated as CCPs are added to Cell 4A. Power for the storm water pump comes from the Reclaim Water Electric Equipment Building. The storm water pump is equipped with automatic controls and a moisture sensor indicator panel mounted on the pipe bollard with the power source (see Figure 9B). The storm water pump settings are discussed later in Section 2.4.2 and in the O&M manual for the storm water pump.

Currently, CCP ballast has been placed to elevations of 433 feet at the berms to 437 feet at the center of Cell 4A. An intermediate soil cover has been placed over the CCPs to elevations of 435 to 438 feet. The construction ramp was left in place to facilitate future CCP placement and also covered with the soil cover. When the CCPs in Cell 4A reach el. 483, then an intermediate storm water collection berm with "let-down" storm water channels will be constructed. The volume of CCPs in Cell 4A up to el. 483 is 850,000 CY.

There is one Emergency Spillway located in the west perimeter embankment to provide a controlled discharge into the Recycle Pond in the unlikely event that stormwater pump cannot maintain operations to prevent overtopping the perimeter embankments. THE EMERGENCY SPILLWAY IS NEVER INTENDED TO BE USED UNDER NORMAL OPERATING CONDITIONS. Discharge of water from Cell 4A into the area outside of the perimeter embankments is not allowed under existing State and County environmental permits.

1.5 STATE AND LOCAL PERMITS

The following State and County permits and licenses have been obtained in order to construct and operate the UWL:

1) Missouri Department of Natural Resources (MDNR) Solid Waste Disposal Area Operating Permit No. 0918301, dated July 30, 2010.

2) MDNR Solid Waste Disposal Area Construction Permit No. 0918301, dated March 28, 2008. The "Groundwater Monitoring Program" is incorporated into this Permit.

3) MDNR Dam and Reservoir Safety Council Construction Permit C-426 (MO40160), dated April 1, 2008, with a memorandum of understanding. This permit has to be renewed annually.

4) St. Charles County Solid Waste Operating License #04303, dated November 1, 2013, revised December 10, 2013. This license must be renewed annually by October 31.

5) MDNR Solid Waste Management Program Authorization to Operate (ATO) Cell 4A, dated December 6, 2013.

6) MDNR issued Water Pollution Control Construction Permit #22-7667 for the Recycle Pond on August 5, 2008.

7) Wastewater discharges from the Sioux Energy Center are authorized by NPDES Permit MO-0000353. This includes the Recycle Pond. Reissuance of this permit is currently pending with MDNR.

These permits and licenses contain specific requirements which must be followed and are provided in Appendix D for reference. The pertinent current requirements are summarized in

Section 6 and throughout this O&M Manual. However, nothing in this Manual may modify or supersede the requirements in the actual permits and licenses. The renewal or modification of these documents may impact the contents of this O&M Manual and may require revision of this Manual.

2.0 OPERATIONS

State operating permits and the St. Charles County operating license list Ameren Missouri as the operator of the UWL. This O&M Manual has been prepared based on Plant personnel conducting the day-to-day operations. Day-to-day activities of the UWL may be subcontracted to a qualified contractor in the future. If so, that may require revision to this O&M Manual, as well as notification and revision of one or more of the State permits or the County license.

2.1 PERSONNEL

When the UWL is being operated daily, that is receiving CCP from the Sioux Energy Center rather than periodically under a construction contract, then the landfill manager and at least one other employee of the landfill will be Certified Solid Waste Technicians, in accordance with the approved CPA, Section 4.8.3. The other employee who is a Certified Solid Waste Technician will be qualified to serve the role of landfill manager during the manager’s absence. However, until the UWL has daily operations, these certifications are not required. The St. Charles County Solid Waste Facility License does require that the personnel performing the weekly and special inspections must be trained to do these inspections (see Section 3.0 of Embankment Inspections).

2.2 EQUIPMENT

A preventative maintenance program will be implemented for the landfill equipment to minimize equipment failure and maximize equipment life. The landfill will have redundant pieces of equipment for use in most emergency situations. Each piece of equipment will be equipped with a fire extinguisher. See the St. Charles County Waste Facility Plan for a list of primary equipment and maintenance requirements.

2.3 ROUTINE GYPSUM MANAGEMENT

The water level in Cell 1 must be maintained at el. 441 feet from about December 1 through about March 31 each year to provide freeze protection for the clay liner until a minimum of 2 feet of gypsum can be spread on the sides of Cell 1 for freeze protection. The volume of water in Cell 1 will gradually be reduced as gypsum solids accumulate. Since the beginning of operations, gypsum slurry has been discharged into Cell 1 through the ends of the buried slurry pipes at about the middle of the east side as shown in Figure 5. The gypsum sediment is forming a “beach” below the discharges that will be above the water surface. The beach expands outward as more gypsum is pumped into Cell 1. Once the beach extends more than half way across Cell 1, as illustrated in Figure 6, flexible overland pipes will need to be installed around the perimeter of Cell 1 to continue discharging into Cell 1 at the south end. The overland pipes, as illustrated in Figure 7, should be 10-inch HDPE SDR-17. The discharge ends of the buried slurry pipes have bolted HDPE flanges to connect overland pipes. The overland pipes may be placed on the slope;

however the pipes may NOT be anchored by any means that would puncture the HDPE liner. Bags filled with gypsum or fly ash (not sand) may be placed on the slope to hold the pipes.

2.3.1 Siphoning

It will be necessary or desirable at times to lower the water level within Cell 1 to about el. 438 to optimize the distribution of the gypsum. This time is from about April 1 to the end of November. This must be done by pumping or with a siphon. A minimum head differential of 3 to 4 feet between the Cell 1 and the Recycle Pond is needed for the siphon to work. The difference in head between the cell and the pond will provide sufficient head differential to operate a siphon to lower the water level in Cell 1 below el. 441. Reclaim water will be transported from Cell 1 to the Recycle Pond either by gravity through the triple box culverts or by a siphon using an 8-inch (or larger) siphon line. The siphon line may be run through the box culvert to keep the road on the top of the embankment clear. As soon as sufficient water accumulates in the Recycle Pond, it will be pumped back to the Plant for reuse so that the water level in the Recycle Pond is maintained within the range of el. 432 to el. 435 during normal operation.

2.3.2 Berm and Rim Ditch Construction

After the discharge point is relocated as shown in Figure 7, it will become necessary to begin construction of the perimeter gypsum berm and rim ditch. The beginning of the construction is illustrated in Figures 6, 7 and 8. The water level in Cell 1 must be 3 feet or more below the working surface of the gypsum beach to support light earthmoving equipment. As discussed in the previous section, the water level may be lowered below el. 441 by pumping or siphoning during the appropriate time of the year. Once the perimeter gypsum berm and rim ditch have been constructed around the southern half of the Cell 1 (Figure 8), then the gypsum slurry will be carried in the rim ditch.

2.3.3 Gypsum Stacking Operations

When stacking will be required above the perimeter berm elevation of 441, gypsum management should follow the operational guidelines presented in Appendix C.

2.4 ROUTINE DRY CELL MANAGEMENT

CCPs will continue to be managed within the existing ash ponds at Sioux Energy Center for the foreseeable future. When necessary due to space constraints within the ash ponds, Ameren will issue a construction contract to haul stockpiled CCPs from Sioux to Cell 4A. The CCPs must be sufficiently dry to pass the Paint Filter Liquids Test (USEPA Method 9095B) prior to transportation. Basically, this requires that there is no “free water” when transporting the CCPs to Cell 4A. A characteristic of the fly ash at the Sioux is that it retains water, which does not drain out of stockpiled fly ash. The CCPs should be conditioned to a moisture content low enough to pass the Paint Filter Test and to get the fly ash sufficiently dry to transport to the cell.

The first step in adding CCPs to Cell 4A will be to remove the intermediate soil cover. The plan is for the contractor to stockpile and reuse the soil for the intermediate cover on the new CCP fill. The truck ramp constructed in Cell 4A during the initial CCP ballast placement was left in place to facilitate future CCP placement. The gravel haul road from the contractor's entrance to the main entrance of the UWL may require regular maintenance to handle the heavy truck traffic during the hauling of CCPs to Cell 4A. After completion of hauling, the haul road and any other areas along the haul route should be restored if damage, such as rutting, occurs during hauling operations.

A bulldozer, tracked loader or other suitable type of earth moving equipment will be used to spread and compact the CCPs on the working face. The slope of the working face should not be steeper than 33% and the CCPs should be compacted in lifts no greater than 2 feet in thickness and to an average dry unit weight of 68 pounds per cubic foot (pcf). Generally, the disposal cells will be filled in a total vertical lift of 8 to 10 feet in height, with the waste confined to the smallest practicable area and compacted to the smallest practicable volume. The slope of the final landfill exterior side slopes of the dry disposal area will not exceed 25% slope (4 horz. to1 vert.). The vertical lifts will be staggered to promote storm water runoff with minimal erosion and to provide easy truck access and traffic flow while maintaining an orderly sequence of fill within the active portion of the lined cell. The CCPs may require additional conditioning to obtain a moisture content ranging from 30 to 40% for optimal compaction and for dust control. The operator will add moisture to the CCPs deposited at the active working face by spraying water directly onto the waste. If necessary, moisture content will be lowered by aerating the CCPs by disking or grading the CCPs on the working face. The compaction of the CCPs must be sufficient such that construction equipment will be able to run on top of the fill during placement of the new CCPs.

Refer to the plans in the CPA and the Waste Facility Plan for details about the design of the CCP fill, perimeter storm water collection ditch, and let down structures.

2.4.1 Leachate Collection System

MDNR-SWMP regulations require that the maximum water pressure on the HDPE liner below the CCP fill shall not exceed 1 foot of water (62.4 lbs/ft^2 or 0.43 psi). Therefore, the leachate collection sump pump must be capable of removing the leachate from the sump to keep the pressure in the leachate collection blanket below the CCP fill to less than 12 inches. The pressure transducer that controls the leachate sump pump is located at the center of the end. When the leachate sump pump is set in the bottom of the 18-inch pipe, the center of the pressure transducer is 13.3 inches above the bottom of the sump and 29.6 inches below the leachate collection geo-composite at the edge of the sump. Therefore, the control on the leachate sump pump should be set to turn the pump on when the pressure reaches 41.5 inches. The pump control should be set to turn the pump off when the pressure drops to 17 inches. The controls have two alarms, which are sent to the Control Room: the pump tripped/loss of power alarm, and the high level alarm. The high level alarm is set to 54 inches to indicate an excess head of 12 inches on the HDPE liner in the vicinity of the sump. The current settings on the controls are shown in Table 1.

The control panel for the leachate collection sump pump is located next to the sump pump vault. The control panel has a pump run light, a digital pressure readout, and elapsed run time readout for the pump, and a high level light. An exterior red alarm light on top of the control panel will also turn on with the high level alarm. See the EPG Companies Operations & Maintenance Manual for more details about the leachate collection sump pump system.

Table 1 – Setting of Operating Levels on Cell 4A Leachate Collection Pump

Parameter	Meter Reading inches	Operation
Pr Hi	41.5	Turns pump on
Pr Lo	17	Turns pump off
AL Hi	54	Turns high level light on
Hy Hi	1.0	Turns high level light off when drops below AL Hi
AL H2	143	Turns pump off (Greater value indicates probable failure of level sensor)
Hy H2		Not used

The Plant receives only two alarms on the main alarm screen. The two alarms are: 1) the pump tripped/loss of power alarm, and 2) the high level alarm (AL Hi in Table 1). If the pump tripped/loss of power alarm is received, then maintenance personnel should be sent to Cell 4A to review the control panel, to investigate the cause and to determine the appropriate action. The alarm indicates one of two scenarios: 1) The pump has not been operating and water has steadily accumulated in the sump to an elevation above the high alarm setting (troubleshooting of the pump is required), or 2) The pump is running but cannot keep up with the amount of water entering the sump (no action is required as long as the pump continues to run and the water level drops below the high alarm setting). It is permissible for the leachate in the collection system to exceed 12 inches for up to several days, for example if a heavy rain has increased infiltration into the leachate collection system from ponded water on the surface. If the high level alarm stays on more than 48 hours, or if it occurs several times in a week, then Ameren Environmental Services should be notified.

2.4.2 Storm Water Pump

Storm water that collects in Cell 4A must be pumped into the Recycle Pond. The storm water channel is only an “emergency spillway” to prevent the overtopping of the perimeter berms. The storm water pump is intended to be relocated as needed during placement of CCP fill, but it must remain in the vicinity of the buried storm water discharge pipe into the Recycle Pond (see Figure 2). The pump is sized for approximately 100 GPM at a total dynamic head (TDH) of 18 feet. At that rate, the pump will require about 7-1/2 days to remove a 25-year, 1-hour rainfall in Cell 4A (2.63 inches). There may be considerable infiltration of ponded storm water into the leachate collection system during the initial years when the thickness of the CCPs is less than design. If the leachate collection sump pump runs excessively, then adding a second storm water pump should be evaluated to shorten the time required to pump out the storm water.

2.5 ROUTINE OPERATION OF THE RECYCLE POND

Reclaim water will normally discharge from Cell 1 into the Recycle Pond by gravity through the triple box culverts. A minimum elevation of 428 feet is required at all times to maintain proper ballast on the HPDE liner, with the exception of short durations for repair or maintenance of the pump intake structures. **The water level in the Recycle Pond will require a minimum**

elevation of 430 feet to provide submergence for the reclaim pump intakes. The water level in the Recycle Pond should be maintained between el. 432 and el. 435 during December 1 through about March 31 each year to provide freeze protection for the clay liner.

Special consideration of Recycle Pond management (i.e. leaving enough storage volume) should consider major boiler outages, forecasted heavy storms, or dual unit outages when the water level in the Recycle Pond is maintained above el. 435. Surge capacity is required in the Recycle Pond to accommodate all precipitation runoff from the entire area of Cell 1, Cell 4A, and the Recycle Pond. Instrumentation to continuously monitor the level of the Recycle Pond is housed in 4-inch diameter, perforated HDPE pipes. The following instrumentation set points have been established:

Table 2 – Recycle Pond Water Level Set Points

Elevation (ft)	Description	Notes
428	Low Level	Auto Stop Reclaim Water Pumps; Minimum Elevation of water
430	Low	Start Permit - Reclaim Water Pumps
432	Low Level Alarm	
435	High with Check light and Alarm	Design Storm Water Capacity
443	High Alarm	
443.5	High High Alarm	

Additional details of the operation of the UWL are presented in Section 4.0 of the CPA, and are reproduced in Appendix D of the St. Charles County Waste Facility Plan.

3.0 EMBANKMENT INSPECTIONS

This operation, maintenance and inspection program for the Sioux UWL Cell 1, Recycle Pond, and Cell 4A shall be in compliance with the current Ameren Missouri Procedure AUE-ADM-5103 “Dam Safety Program for Ameren Missouri Non-Hydroelectric Facilities” and the permits and licenses listed in Section 1.5.

Cell 1 and the Recycle Pond are listed in AUE-ADM-5103, Section 1.2.1.5 as “Gypsum Stack and Recycle Pond Dam.” Section 2.3 defines the policies, objectives and expectations of Ameren Missouri’s Dam Safety Program. Section 3.0 defines the duties and responsibilities of the Chief Dam Safety Engineer (CDSE), the Dam Safety Group Staff, and operations personnel.

Section 4.4 defines four types of dam safety inspections: routine, annual, special, and unannounced. These inspections also apply to Cell 4A. The inspections for Cells 1 and 4A and the Recycle Pond shall be: Weekly (“routine” in the AUE-ADM-5103), Special Incident, and Annual. The Dam Safety Group may still perform unannounced inspections.

All inspections (with the exception of initial emergency or urgent Special Incident inspections) must be done during daylight hours.

All inspections shall be done by qualified person or persons. The St. Charles County Solid Waste Facility License stipulates that a “qualified” person shall be trained to recognize specific signs of structural instability and other hazardous conditions by visual observation and, if applicable, to monitor instrumentation.

3.1 DESCRIPTIONS OF CERTAIN ANOMALIES

The following terms used in describing certain anomalies associated with embankment maintenance and inspection are provided as background information.

“Slough” – appears in a slope as a relatively shallow spherical depression with a mound of disturbed material at the bottom of the depression. A slough may occur anywhere on a slope. A slough in the riprap may be very difficult to see. If the soil in the slough and below the slough is dry, then the slough should be noted and repaired as soon as possible. If the soil is wet in the slough or below the slough or there is seepage from the slough, then the Dam Safety Group and the Shift Supervisor at the Plant should be notified immediately.

“Deep Slide” – is a large movement of soil that may involve one-third or more of the slope. A slide is characterized by a nearly vertical “scarp” or exposed embankment material at the top of the slide, and a large mound of disturbed soil at the base of the slide. The lateral extent of the slide may appear circular. The Dam Safety Group and the Shift Supervisor at the Plant should be notified immediately if a slide is found, particularly if water is seeping from the disturbed area.

“Surface Slide” – is a very shallow slide, where the surface sod, riprap or soil has moved down the slope. There may be visible cracking, but no depression or scarp. A shallow slide should be noted and repaired as soon as possible.

“Seepage” – may be visible water running out of the base or face of a slope or it may be evident as a very wet, spongy area of soil. Water will be draining out of the base of a slope for some time after rain or snow. This is particularly true at the base of the riprap slope because a large quantity of rain or snow is collected in the spaces between riprap stone. Seepage at the base should be watched and reported if it occurs during dry weather, or continues for several days after a rain or a week after a snow.

“Boil” – is evident as seepage from a hole in the face of a slope or several hundred feet beyond the base of a slope. At the Sioux UWL, a boil may occur beyond the crushed rock perimeter road. There may be a mound of soil around the hole of the boil. The seepage water may be clear or may be muddy. A boil should be reported immediately to the Plant Shift Supervisor and the Dam Safety Group.

“Burrow” – any damage from animal intrusions, whether rutting, digging dens or tunnels or searching for food.

“Woody Vegetation” – includes shrubs, trees, dense ground cover, or any plant with a stiff, “woody” stem. Woody vegetation may interfere with mowing of the grass cover, or hide animal burrows or erosion.

3.2 WEEKLY INSPECTIONS

The Weekly Inspection shall consist primarily of traveling the upper and lower service roads of Cells 1 and 4A and Recycle Pond embankments, to look for visible evidence of potential problems, and with stops to check certain features. The form for Weekly Inspections is in Appendix A.

1) Inspect for erosion, sloughing, sliding, boils, seepage or animal burrows, in particular after the adjacent fields have been harvested.

2) Look at the grass cover on all embankments for bare spots or woody vegetation during the appropriate seasons. Record the locations of any bare spots.

3) Record the level of the water in the Recycle Pond, Cell 1, and Cell 4A (if any). Verify the elevation of the water in the Recycle Pond corresponds to the elevation indicated scrubber system logic and operator screen. If the difference between the visual level and the level indicated by the instrumentation is more than 12 inches, then the instrumentation will need to be recalibrated. Check that the level of the Recycle Pond is between el. 430 and 443. If the water level is lower than el. 430 or higher than el. 443, immediate action is required by the Plant Shift Supervisor.

4) Inspect for water spraying or running out of the manholes for the gypsum supply pipes between the Pump House and Cell 1. If so, notify the Plant Shift Supervisor immediately.

5) Check whether the level of the water in either the Cell 1 or the Recycle Pond is less than 2 feet below the crest of the emergency spillways (el. 445). If so, notify the Plant Shift Supervisor immediately.

6) Inspect for unevenness, depressions or cracking in the top of the embankment or the box culverts. A settlement of 0.2-foot or more should be reported.

7) Inspect for holes in the perimeter security fence (including barbed wire), vandalism, and whether the main entrance gate and the emergency entrance gate are locked.

8) Check that the gypsum slurry is flowing unobstructed from the discharge pipes.

9) Estimate visually and record the vertical distance between the flowline of the discharge pipes and the sedimented gypsum. It is not necessary to measure the distance. **Do not walk out on the HDPE liner without suitable safety equipment and procedures.**

10) Inspect the transducer level housing and controls for signs of damage due to power outages, water damage, animal burrows, debris damage or other deterioration. Make certain that the HDPE anchor blocks holding the instrumentation pipes are full of gravel.

11) Check the crushed rock perimeter roads, tops of embankments and ramps for evidence of erosion or vehicle tire rutting. Record the locations of erosion or rutting.

12) Look for deterioration, unevenness or cracks in the concrete blankets around the drain outlets and the sump outlet, and for erosion around the blankets and pipes.

13) Look for signs of stress or tears in the HDPE liners above water in the Recycle Pond.

14) Look for signs of stress or tears in the HDPE liners above water in Cell 1.

15) Look for exposed HDPE liner and geo-composite in Cell 4A, and for evidence of stress or tears.

16) Inspect for deterioration, unevenness, cracking, erosion or separation of the precast concrete blocks in the Recycle Pond below the triple box culverts. Check for debris or sediment that may be blocking the culverts.

17) Inspect for deterioration, unevenness, cracking, erosion or separation of the precast concrete blocks in the southeast corner of the Recycle Pond below the discharge pipes.

18) Inspect for deterioration, unevenness, cracking, settlement, erosion or separation of the precast concrete blocks in the Recycle Pond emergency spillway. Check for animal burrows. Check for debris or sediment that may block the spillway.

19) Inspect for deterioration, unevenness, cracking, settlement, erosion or separation of the precast concrete blocks in the Cell 1 emergency spillway. Check for animal burrows beneath the blocks. Check for debris or sediment that may block the spillway.

20) Inspect the HDPE recirculation pipe for leaks, and if pipe is frozen.

21) Inspect the Pump House sump discharge pipe, and if the pipe is frozen.

22) Inspect the Storm Water Channel between Cell 4A and the Recycle Pond for displacement or cracking.

23) Inspect the Cell 4A Storm Water Pump and Discharge Pipe.

24) Inspect the Leachate Collection Sump Pump Vault for displacement or leaking leachate.

25) Inspect the controls of the Leachate Collection Sump Pump and record the number of elapsed hours of operation.

26) Check for exposed CCPs on the exterior face of the CCP berm.

The Weekly Inspection form should be completed in the field while performing the inspection. If no anomalies or problems are noted, file with the records of the UWL as noted in Section 6.0. If an anomaly or problem is noted, indicate the location(s) on the Inspection Plan and attached it to the report, and email or FAX copies to the appropriate persons listed in Section 6.1.

Schedule the maintenance of the protective grass cover on the side slopes of the embankments in accordance with the recommendations in Appendix B. Mowing should be scheduled no more than 2 weeks prior to the Annual Inspection.

3.3 SPECIAL INCIDENT INSPECTION

An inspection shall be completed immediately following any of the following special incidents:

1) Within 48 hours prior to the start-up/commissioning of gypsum production.
2) Following periods of ice on the Recycle Pond and Cell 1 occurring between December 15 through March 31 of each year; inspect for damage to HDPE liners.
3) Brush fire inside the perimeter security fence.
4) Heavy rain of more than 2 inches in 24 hours.
5) A Mississippi or Missouri River flood event that inundates the exterior slopes of the embankments.
6) An earthquake with a magnitude (Mw) of 5.0 or greater.

The Special Incident Inspection is the same as the Weekly Inspection, and may be substituted for the normal Weekly Inspection if the timing coincides. If a Special Incident Inspection occurs during non-daylight hours, the inspection must be repeated during daylight hours the following day. The Special Incident Inspection form is provided in Appendix A. The completed Special Incident Inspection form is to be emailed or faxed immediately to the appropriate persons listed in Section 6.1.

A survey (horizontal and vertical) should be done of the tops of all the berms as described in Section 6.3.2 following an earthquake with a magnitude (Mw) of 5.0 or greater.

3.4 ANNUAL INSPECTION

The Annual Inspection shall be completed by a Professional Engineer registered in Missouri with a background in civil or geotechnical engineering. It should be done with a team of 2 qualified people or more. The St. Charles County Solid Waste Facility License stipulates that a “qualified” person shall be trained to recognize specific signs of structural instability and other hazardous conditions by visual observation and, if applicable, to monitor instrumentation. The Annual Inspection shall consist of a detailed inspection of all of the embankments and appurtenances by walking both the tops and toes of the embankments. The Annual Inspection may be done in conjunction with the regular Weekly Inspection.

The registered Professional Engineer shall complete and seal the Annual Inspection report. The Annual Inspection report shall include as a minimum:

1) Completed Weekly Inspection form
2) Results of elevation survey if performed, comparing results with previous surveys

3) General assessment of the UWL and features as outlined in Section 1.4.3.

4) List of specific corrective actions and repairs, specifying the urgency of each

5) Photos of features and any items to be repaired or corrected

6) The Annual Inspection report shall be distributed to the persons and agencies listed in Section 6.0.

4.0 MAINTENANCE ACTIVITIES

Maintenance activities include procedures for routine maintenance and procedures for specific incident maintenance. Routine maintenance includes regularly scheduled activities and unscheduled activities that are to be completed, as required. A required routine maintenance procedure is groundwater sampling for chemical monitoring. Groundwater sampling is not included in the scope of this O&M Manual.

4.1 ROUTINE MAINTENANCE PROCEDURES

4.1.1 Maintain the grassy vegetation and riprap on the external slopes of the Cells 1 and 4A and the Recycle Pond perimeter embankments.

   a) If animal burrows are found, fill burrows with compacted silty clay and take measures to eliminate animals from area. A reference on repairs and preventative measures is the FEMA “Technical Manual of Dam Owners: Impacts of Animals on Earthen Dams,” FEMA 473, September 2005.

   b) Immediately repair erosion.

   c) Evidence of sloughing, sliding or seepage may be indicating a larger problem. Immediately send inspection report to the CDSE or designated Dam Safety Staff for evaluation. Repair as indicated by Dam Safety.

   d) Bare spots should be re-seeded and mulched with the appropriate native grasses seed mixture as given in Appendix B.

   e) Mow protective grass cover and treat with fertilizer or herbicide as outlined in Appendix B.

4.1.2 Maintain the unpaved on-site road system.

   a) Unpaved perimeter road system on top and bottom of the Cells 1 and 4A and Recycle Pond berms.

      i. Regrade to correct vehicle tire rutting.

      ii. Place additional gravel as necessary for all-weather travel and to fill erosion. Coarser crushed rock, such as 2-inch minus, may be used to fill deep gullies. Cap the coarse rock with 1-inch minus for a travel surface.

   b) Unpaved ramps connecting upper and lower perimeter road system.

i. Regrade to correct vehicle tire rutting and/or erosion.

ii. Place additional gravel as necessary for all-weather travel and to fill erosion. See above note about using coarser crushed rock.

4.1.3 Maintain perimeter security fencing and access gates as needed. Backfill animal burrows. Maintain all facility signs required by State and County environmental permits; clean, repair, update or replace, as necessary.

a) UWL –Solid Waste Entrance Sign (one sign satisfies both State and County requirements).

b) Recycle Pond – Wastewater Treatment Facility Sign.

4.1.4 Maintain the emergency spillways as needed to maintain discharge flowline at el. 445.0. Replace broken blocks, reset blocks and fill voids with fine gravel (“Meramec Sand”).

4.1.5 Maintain the grouted precast concrete revetment blocks below the triple box culverts and below the discharge pipes in the Recycle Pond.

a) Inspect articulated blocks on top and sides of berm for displacement or deterioration.

b) Inspect for general signs of significant or differential settlement (greater than 1 to 2 inches).

c) Place additional grout as needed to fill voids or stop settlement.

4.1.6 Maintain erosion control mats (concrete mat forms) at the ring drain pipe outlets (four) and sump pipe (one) in Cell 1.

a) Repair erosion of fly-ash on the slopes under and around the discharge pipes. Fly ash may be replaced with “sand” bags filled with fly ash or dry bags of concrete mix. DO NOT USE SANDBAGS.

b) Repair pipe movement or differential settlement as directed by the Dam Safety Staff.

c) Repair concrete erosion control mats for degradation and deterioration.

4.1.7 Whenever the water level in the Recycle Pond is lowered below the top of the intakes (Effluent Structures), inspect the pump intake manholes, cover screens and drilled holes in the sides of the intakes for clogging and debris. Inspect gravel ballast covering the pipes inside the Recycle Pond between the pump intakes and the HDPE liner penetration in the east slope for signs of movement or displacement. Maintain the inlet manhole cover screens and drilled inlet holes for the two pump intakes.

a) Clean as necessary.

b) Replace gravel ballast covering the pipes inside the Recycle Pond between the pump intakes and the HDPE liner penetration as needed.

c) Maintain the integrity of the screens on the recirculation pipe and pump house sump outlet pipe to prevent animal access to the pipe.

4.1.8 Maintain the water level transducers per the manufacturer's specifications and operations manual.

a) Reset the elevations of the transducers as needed to maintain the water level within the required limits.

b) Maintain the condition of the pipe anchors for integrity and function.

4.1.9 Maintain blind flanges on slurry pipe clean outs. The top plates of the clean outs tend to loosen in freezing weather and must be checked for leaks whenever a gypsum slurry pipeline is going to be used after a period of inactivity.

4.1.10 Replace the vent filter and water vapor trap on the Leachate Collection Sump Pump (see Bulletin 0690C of EPG Companies Operations and Maintenance Manual for Leachate Sump Pump.

4.2 SPECIAL INCIDENT MAINTENANCE PROCEDURES

Perform maintenance in response to a Special Incident Inspection due to one the following events:

4.2.1 <u>After each heavy rain event of more than 3 inches in 24 hours</u>. Arrange for timely repairs. Do not discharge any water outside of Cells 1 or 4A or the Recycle Pond unless approved by Ameren Environmental Services.

4.2.2 <u>If a flood inundates the perimeter berm exterior slopes</u>. Document and arrange to make timely repairs as necessary. Monitor, contain and test as appropriate any floodwaters accumulated on site in any depressions for appropriate management in compliance with applicable laws and regulations. Do not discharge any water from Cells 1 or 4A or the Recycle Pond unless approved by Ameren Environmental Services.

4.2.3 <u>During extended heat/drought</u>. Monitor water elevation levels in Cell 1 and the Recycle Pond to maintain a minimum water level in the Recycle Pond of el. 430 when recycle pumps are operating or el. 428 for brief periods when the pumps are not in operation.

4.2.4 <u>Vandalism, vehicle or equipment damage</u>. Systems that could be damaged include: the security fencing; access gates; roads; composite liner containment systems; slurry piping system; water recirculation piping system; riprap protection of the outer berms; the transducer level controls system; groundwater monitoring wells; and other facility appurtenances.

a) Notify the appropriate Plant personnel, Plant security authorities, and Ameren Dam Safety. Ameren Dam Safety may notify County, State and Federal agencies as necessary of the vandalism and damage.

b) Document the cause and extent of damage and arrange for timely repairs along with appropriate documentation of repairs as necessary to restore the damaged systems.

c) Develop and implement preventive measures and methods to avoid or minimize the potential for a reoccurrence of the event.

4.2.5 In preparation for use of a slurry pipe after an extended period without flow, inspect the integrity of the slurry pipe clean-out blind flange seals. Check the tightness of the bolts. Periods of freeze-thaw tend to loosen the bolts. After the pipe is on line, check the cleanout manholes for leakage. If possible, remove the lids of the manholes so that the cleanouts can be inspected for spraying or leaking for the first day shift after the pipe is on line. Place cones, orange barrels or other barricade around each open manhole for safety.

4.2.6 A seismic event of magnitude 5.0 or greater:

a) Notify the appropriate Plant personnel, Plant security authorities, local authorities, and Ameren Dam Safety. Ameren Dam Safety may notify County, State and Federal agencies as necessary of the observed damage.

b) Document the cause and extent of damage and arrange for timely repairs, along with appropriate documentation of repairs as necessary to restore the damaged systems.

c) Ameren Dam Safety will have a survey of the tops of all berms done (see Section 6.3.2).

4.2.7 Settlement of the Top of Perimeter Berms: notify Ameren Dam Safety. A survey of the top of the perimeter berm(s) may be required, and construction may be necessary to maintain the required flood level protection (el. 446).

5.0 EMERGENCY ACTION PLANS

In an emergency situation, the approved procedures outlined in Ameren Missouri's "Emergency Implementing Procedures" (EIP) must be followed. This Section provides information to supplement the EIP in the event of an emergency situation unique to the UWL, but is not a substitute for the Ameren Missouri EIP.

5.1 BREACH OF EMBANKMENT

Design features intended to prevent a breach of the embankments have been incorporated in Cell 1, Cell 4A, and the Recycle Pond. Emergency spillways located on the west embankments of both Cell 1 and the Recycle Pond are designed to accommodate discharges in an emergency situation to prevent the topping of the embankments. The spillway between Cell 4A and the

Recycle Pond is intended to convey storm water to prevent overtopping of the berms, but this is not an emergency situation that requires action. Perimeter berms are lined with clay, are vegetated and have a layer of riprap to prevent erosion damage. In the event of a breach of embankment, the appropriate officials and authorities must be notified immediately in accordance with the Ameren Missouri Sioux EIP.

5.2 DISCHARGE THROUGH EMERGENCY SPILLWAY

Discharge of water from the Recycle Pond or Cell 1 into the area outside of the embankments is not permitted. Water is never to be pumped from either the Recycle Pond or Cell 1 or Cell 4A and discharged outside of the embankments. In the event of a discharge, the appropriate officials and authorities must be notified in accordance with the Ameren Missouri EIP. In addition, the MDNR "National Pollutant Discharge Elimination System Standard Conditions" require the following reporting actions:

1) Provide MDNR with the following information in writing within five (5) days of becoming aware of such conditions:
    a) Description of the discharge and cause of noncompliance, and
    b) The period of noncompliance, including exact dates and times; or if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the discharge.
2) Twenty-four hour reporting. Ameren Missouri must report any noncompliance which may endanger health or the environment. Information shall be provided orally with 24 hours from the time that Ameren becomes aware of the circumstances. A written submission shall also be provided with five (5) days of the time that Ameren becomes aware of the circumstances. MDNR may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

5.3 FLOODING SURROUNDING EMBANKMENTS

A flood condition surrounding the UWL could impose a hydrostatic uplift pressure on the bottom of the composite liners in Cells 1 and 4A and the Recycle Pond. To maintain a factor of safety against upward displacement and rupture of the liner, **the levels of the water and gypsum slurry in the Recycle Pond and Cell 1 must always be no more than 2.5 feet below the level of the flood water surrounding the UWL.**

Should flooding in the area of the UWL occur, the appropriate officials and authorities should be notified in accordance with Ameren Missouri Sioux Energy Center EIP.

Following Cell 4A construction, approximately 196,000 cubic yards of CCP and temporary soil cover were placed to fill the cell up to el. 435 to 438 as ballast on the composite liner and for freeze protection of the underlying clay. At this elevation, the composite liner is safe from excess hydrostatic uplift for a flood event with an elevation of 441 feet. Once the CCP and temporary soil cover in Cell 4A is at or above el. 438.2, then the composite liner is safe from excess hydrostatic uplift for a flood event up to el. 445 (the elevation of the spillways).

Until the level of CCP in Cell 4A is at or above el. 438.2, water will have to be pumped into Cell 4A if a flood event is expected to exceed el. 441. Such an event will flood the fields surrounding the UWL and Hwy. 94. The following table states the water level that is required in Cell 4A for various flood levels surrounding the UWL, and the estimated volume of water that is needed in Cell 4A. This is based upon the current level of CCP and temporary soil cover.

Anticipated Flood Elev. Surrounding UWL	Required Elev. of Water in Cell 4A	Estimated Volume of Water gallons.	Estimated Duration of Pumping at 720 GPM
441 to 442	436.7	2,564,000	2.5 days
442 to 443	437.8	5,273,000	5.1 days
443 to 444	438.9	8,958,000	8.6 days
444 to 445	440.0	13,032,000	12.6 days

Two gasoline 7.1 HP engine Dayton semi-trash pumps (Model 11G236) with hoses are stored in the Sioux Energy Center storeroom dedicated for flood protection of Cell 4A. The maximum suction lift for this pump is 26 feet. The flow rate for 10 feet of head is 363 GPM. The pumps shall be positioned on the perimeter berm of Cell 4A. Water may be pumped from the Recycle Pond if the flow into the Recycle Pond is sufficient to maintain the required water level in the Pond; otherwise, water may be pumped from the flooded field surrounding Cell 4A.

If a flood exceeding el. 441 is anticipated, then the following procedures shall be followed:

1. Turn off the storm water pump and effluent pump in Cell 4A.
2. Set up the 2 designated flood pumps and begin pumping water into Cell 4A **with sufficient time to pump the minimum required volume of water prior to the anticipated flood level.** Rainfall in Cell 4A may significantly decrease the required volume of water to be pumped. Also, the storm water pump in Cell 4A may be repositioned to pump water from the Recycle Pond into Cell 4A.
3. Monitor the operation of the pumps and the water level in Cell 4A at least hourly, 24 hours a day, 7 days a week, until the required water level in Cell 4A is reached or the flood event is over.
4. All water pumped into Cell 4A must be pumped into the Recycle Pond; no water that may have been in contact with CCPs may be discharged outside of Cell 4A.

5.4 FIRE, MEDICAL OR OTHER

Fire extinguishers shall be located on all landfill equipment (not necessarily contractor’s haul trucks to and from the site). Communication equipment used at the UWL during operations will consist of two-way radios. Two-way radios will be assigned to personnel - not to equipment. This ensures all staff has communication equipment on their person at all times and provides direct access to the Sioux Energy Center Control Room. Table 3 in Section 5.5 is a list of agencies, individuals and telephone numbers for emergency contact.

5.5 CONTACTS

Table 3 – Important Contacts

Sioux Energy Center & UWL	
Operating Supervisor (including after Hours):	Ameren Missouri Sioux Energy Center
	8501 N. State Route 94
	West Alton, MO 63386
	(314) 992-6233
Sioux – Engineering	(314) 992-6207
Ameren Missouri Dam Safety Staff	
After Hours	(314) 957-3406
During Normal Hours	(314) 210-4356
Missouri Highway Patrol, Troop C	
Emergency:	9-1-1
Non-Emergency:	(314) 340-4000
St. Charles County Sheriff	
Emergency:	9-1-1
Non-Emergency:	(636) 949-3005
Alton, IL Police Department	
Emergency:	9-1-1
Non-Emergency:	(618) 463-3505
Hospital	
Emergency Room (Ambulance Service):	9-1-1
Non-Emergency:	Alton Memorial Hospital
	1 Memorial Drive
	Alton, Illinois 62002
	(618) 463-7311
West Alton Fire Department	
Emergency:	9-1-1
Non-Emergency:	(636) 899-1122
St. Charles County Government	
Department of Community Health & the Environment	9-1-1
	(636) 949-1800

6.0 PERMIT REQUIREMENTS, RECORD KEEPING AND DISTRIBUTION

6.1 INTERNAL AMEREN COMMUNICATIONS

Written reports shall be prepared to document all inspections and maintenance performed during the effective timeframe of this O&M Manual. A copy of each report must be sent to the appropriate persons listed in this Section. Ameren Dam Safety staff and the Chief Dam Safety Engineer (CDSE) are responsible for sending reports to County and State agencies as required by the various permits and licenses, except in an emergency (see Section 5.0).

The appropriate records, as dictated by the State and County, must be kept on site and available upon request to State and local officials during operating hours. Records will be stored at the Sioux Energy Center. The designated person responsible for record keeping is Brett Novotny.

Records associated with the requirements of this O&M Manual include those generated from the various inspections outlined in Section 3.0. These records must be kept together in a binder or file and stored on site. Table 4 outlines the anticipated internal distribution of inspection reports:

Table 4 – Internal Distribution of Inspection Reports

		PLANT SHIFT SUPERVISOR	PLANT OPERATIONS	PLANT ENGINEERING	DAM SAFETY GROUP	POWER OPERATIONS SERVICES	UWL File
WEEKLY INSPECTION	Emergency Condition	Call	Email	Email	Call	Email	X
	Problem or Anomaly			X	X	X	X
	No problems						X
SPECIAL INCIDENT	Emergency Condition	Call	Email	Email	Call	Email	X
	Recycle Pond Level	Call	Email			X	X
	Flooding		X	X	Email		X
	Routine			X	X	X	X
ANNUAL	Emergency Condition	Call	Email	Email	Call	Email	X
	Routine			X	X	X	X

Missouri and St. Charles County also have specific recordkeeping requirements. The St. Charles County Solid Waste Management Code (SWMC) and the Solid Waste Facility License outline record keeping requirements for St. Charles County Department of Community Health & the Environment. The recordkeeping requirements of the State and County are discussed in further detail below and in Table 5.

Table 5 – Division of Responsibility

Task	Frequency	Responsible Group	Section
MDNR-SWMP Reporting	even years by July 30, within 60 days	Environmental Services	6.4.2
MDNR dam construction permit	annual by April 1	Dam Safety	6.4
St. Charles County operating license	annual by November 1	Environmental Services	6.5
St. Charles County annual reporting	annual by November 1, within 30 days	Environmental Services	6.4.1
St. Charles County quantities of CCP received	quarterly	Environmental Services	6.5.1
Non-Compliance/Incident Reporting	verbal: within 24 hrs	Sioux Energy Center	6.3.1, 6.5.1
	written: within 15 days		
Emergency Spillway Discharge	within 5 days	Sioux Energy Center	6.3.1, 6.5.1
Flood Events	as needed	Sioux Energy Center	3.3, 6.3.1, 6.5.1
Groundwater Monitoring	quarterly	Environmental Services	6.2.1
Weekly Inspections	weekly	Sioux Energy Center	3.2
Annual Inspections	annually	Dam Safety	3.4, 6.3.1
Special Inspections	as needed	Sioux Energy Center	3.3
Inspection follow-ups	as needed	Sioux Energy Center	
Mowing	twice per year	Sioux Energy Center	Appendix B
Weed Control	twice per year	Sioux Energy Center	Appendix B
Fertilizing	as needed	Sioux Energy Center	Appendix B
Re-Seeding	as needed (September)	Sioux Energy Center	Appendix B
Record Keeping	-	Sioux Energy Center	6

6.2 MDNR SOLID WASTE CONSTRUCTION PERMIT

The UWL development process began with the MDNR with a “Request of Preliminary Site Approval” in May 2005 and later a St. Charles County Request for Zoning Special Use Permit in March 2006. Following the preliminary site approval by MDNR, a detailed site investigation (DSI) was conducted at the site and a detailed report published of the findings. St. Charles County has rezoned the site, granted a conditional use permit and approved the site development plan. An application for construction permit was filed with MDNR on February 7, 2007. The MDNR issued Construction Permit Number 0918301 for the UWL in March 28, 2008. The following Permit Conditions are taken from pages 2 through 8 of the Solid Waste Construction Permit No. O918301:

1) All reports, plans, and data required to satisfy these general conditions shall be prepared or approved by a Professional Engineer registered in the state of Missouri.

2) Written approval from MDNR Solid Waste Management Program (SWMP) must be obtained prior to making any operational or design changes that are not in the permit.

3) State and County environmental permits require detection monitoring of groundwater quality in the vicinity of the UWL on a regular schedule. Sixteen (16) groundwater monitoring wells are installed around the perimeter of the UWL for this purpose. All sixteen (16) wells are located outside of the perimeter security fencing. The approximate locations of the groundwater monitoring wells are shown in Figure 1. Detection monitoring is required at all monitoring wells. The minimum sampling frequency required by 10 CSR 80-11.010 is twice yearly during the months of May and November. Details of the groundwater detection monitoring are stated in the Solid Waste Permit (included in Appendix D) and Appendix S – Revised 9-07 of Construction Permit Application. The groundwater monitoring, sampling, testing and chemical analyses are beyond the scope of this O&M Manual and will be managed by others.

6.3 MDNR SOLID WASTE OPERATING PERMIT

The MDNR Solid Waste Disposal Area Operating Permit (No. O918301) requires that any facility design elements that need to be changed or that may affect future construction or operation activities must be submitted and approved by MDNR prior to beginning construction. Also, any design or operational changes, complete construction specifications, construction procedures, and construction grade drawings must be submitted and approved prior to implementation. Should the O&M manual be followed, additional modifications to this permit will not be required; however, this permit should be reviewed prior to any change in operations.

6.3.1 MDNR-SWMP Recordkeeping Requirements

Record- keeping requirements for MDNR are provided in 10 CSR 80-11.010(17)(C)1. Records shall be maintained at Sioux Energy Center. Records five (5) years old or older may be stored at an alternate site if approved by MDNR; such stored records must be made available at the landfill upon request of MDNR personnel. Records must cover at least the following:

1) Major operational problems, complaints or difficulties;

2) Any demonstration, certification, finding, monitoring, testing or analytical data required under sections (4) and (9) of 10 CSR 80-11.010;

3) Dust and litter control efforts;

4) Quantitative measurements of the waste handled and an estimate of the air space left at the facility (see Section 6.3.3);

5) Any cost estimates and financial assurance documentation required under 10 CSR 80-2.030(4);

6) Inspection records and training procedures as required under subsection (3)(B) of 10 CSR 80-11.010;

7) Records associated with future corrective measures as required under section (10) of 10 CSR 80-11.010 (11); and

8) A detailed report of the origin of all waste received (refer to Section 6.5.1).

6.3.2 UWL Survey Requirements

An elevation survey of the tops of the perimeter berms of both Cells 1 and 4A and the Recycle Pond shall be done in conjunction with the Annual Inspection in certain years:

1) When a survey of Cells 1 and 4A is required for the MDNR-SWMP, which is every 2 years (CSR 80-11.010 (17)(D)) to measure the remaining air space. At present, MDNR-SWMP will waive performing a survey. (A letter will be issued form MDNR-SWMP documenting this agreement.)

2) Prior to the stacking of gypsum above the top of the perimeter berm (el. 446).

3) When the level of the stacked gypsum reaches 5 feet above the perimeter berm, or el. 451.

4) When CCPs in dry cells reach 10 feet above the perimeter berm, or el. 456.

The survey should be done at approximately 100-foot centers and at appurtenances (box culverts, cleanouts, sump and outlet drains, etc.). The elevation survey shall be completed to an accuracy of 0.01 foot. Elevations shall be tied to the permanent benchmarks established for the UWL (see Sheet 2 of the record drawings). The survey shall be done by a competent survey team.

6.3.3 Biennial Airspace Estimate

Every even-numbered year after the date of the permit issuance and prior to January 31, Ameren Missouri must submit to MDNR-SWMP an estimate of the air space (i.e. CCP volume) remaining in the UWL. The required topographic survey for this estimate is presently waived (see Section 6.3.2) by MDNR-SWMP. A copy of the estimate is also to be sent to SCC (see “Waste Facility Plan for St. Charles County”, 3.36(f) in Appendix D.

6.4 MDNR DAM AND RESERVOIR SAFETY DAM CONSTRUCTION PERMIT

Neither Cell 1 nor the Recycle Pond is a regulated dam in Missouri during the period of this O&M Manual and under current Missouri regulations because they are less than 35 feet high. However, since Cell 1 and the rest of the UWL are designed to be 100 feet high to allow for future gypsum stacking operations, Cell 1 is considered a regulated dam that is under construction while in operation. The MDNR Dam & Reservoir Safety Program (DRSP) issued Construction Permit C-426 (No. MO40160), of which Cell 1 is a part. The Recycle Pond is not included in the Construction Permit except where Cell 1 and the Recycle Pond have a common embankment. Cell 4A and the future dry cells are not included in the Dam Construction Permit.

The anniversary date of the Dam Construction Permit is April 1 and is valid for one (1) year. **Ameren Missouri must submit an application letter for an extension of the Dam Construction Permit each year prior to April 1 until the construction of the UWL is finished**, that is until the entire UWL ceases to receive gypsum or CCP and is closed. When the UWL is closed, then Ameren Missouri must submit an application for a Dam Safety Permit to the MDNR-DRSP.

No changes shall be made in the construction of the dam which adversely affects the dam with regard to its integrity or to the environment, public safety, life or property. If any modifications to the plans or specifications are necessary, then the application letter for the extension must request approval of the modifications.

If at any time during construction or operation, immediate alterations to the approved plans and specifications are required to adequately protect the integrity of the UWL, the environment or public health, safety or welfare, then the alterations may be started, but Ameren Missouri shall promptly notify the Chief Engineer of MDNR-DRSP of such requirements. If the alterations are to remain as permanent project features, then the plans and specifications must be revised as soon as practical and must be submitted to the Dam and Reservoir Safety Council for approval. Such alteration shall be discontinued if disapproved by the Council, upon notice of such disapproval.

The annual application letter for the extension of the Dam Construction Permit must state the progress of “construction” and that there have been no significant modifications to the approved set of plans and specifications to date, if that is true. The application letter for the annual extension must be sealed by a Professional Engineer registered in Missouri. If a topographic survey of Cell 1 has been done for the MDNR-SWMP, then include the survey in the annual application letter, but it is not required. The first change to the approved drawings will likely be when the height of the gypsum is above el. 446. See the “Memorandum of Understanding” in Appendix D.

If any modifications to the plans or specifications are necessary, then the application letter for the extension must detail the changes, the reasons for the changes and the impact on the dam safety criteria. If changes to the plans or specifications are necessary, then the changes should be submitted informally to the MDNR-DRSP prior to the anniversary date of the Construction Permit, so that the MDNR-DRSP can advise Ameren Missouri whether the changes are significant enough to require a modification to the Construction Permit.

The Construction Permit also states that, “Based upon conditions existing at the time of issuing this permit, the Downstream Environmental Zone is Class II.” The UWL is considered an “industrial water detention dam or reservoir” (10 CSR 22-2.030(3)) with a Downstream Environmental Class II (10 CSR 22-2.040). The downstream environment zone is the area downstream, which is generally to the east of the UWL, which would be inundated by a breach of the dam. Inundation is defined as water, 2 feet or more deep, over the general level of the submerged ground outside of the stream channel, which is poorly defined for the UWL. Downstream Environmental Class II is defined as containing 1 to 9 permanent dwellings, or 1 or more campgrounds with permanent water, sewer and electrical services, or 1 or more industrial buildings. If future development to the east or downstream of the UWL were to cause the Downstream Environmental Class to become Class I, then modifications would have to be made to the Dam Construction Permit and possibly to the design of the UWL. Class I is defined as 10 or more permanent dwellings or any public building.

6.5 ST. CHARLES COUNTY SOLID WASTE OPERATING LICENSE

The St. Charles County Solid Waste Operating License No. O4303 has many requirements. A copy of the license is included in Appendix D and should be read carefully. Not included in Appendix D is the "Waste Facility Plan for St. Charles County." A copy of the Waste Facility Plan (WFP) must be kept at the Plant and should be read carefully. The main points pertaining to routine operations are briefly summarized in this Section.

1) Permitted hours to receive slurry waste are 24 hours per day, 7 days per week. Routine operating hours in the UWL are 6:00 AM to 5:30 PM.

2) Permitted Maximum Tonnage is 30,000 Tons per Month

3) Maximum Permitted Traffic Volume is 1000 Vehicles per Month.

4) A complete copy of this License and incorporated documents shall be kept at the disposal site, as identified by the Division Director (License Condition 8c).

5) Solid wastes that are permitted for disposal in the UWL are fly ash, bottom ash, boiler slag, and gypsum (License Condition 8d).

6) Ameren Missouri is prohibited from placing in the landfill the following wastes (License Condition 9):

    a. Other than in Cell 1 and 4, any liquid waste material that is determined to contain free liquids as defined by Method 9095 (Paint Filter Liquids Test), as described in Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (EPA Pub. No. SW-846);

    b. Hazardous waste, as defined by State and Federal Regulations;

    c. PCB waste, as defined by State and Federal Regulations; and

    d. Waste not identified in License Condition 8(d).

7) The St. Charles County Division of Environmental Health and Protection, or an authorized representative, must be allowed to enter the facility during the permitted hours of operation, or where records must be kept under the conditions of this License, upon the presentation of credentials or other documents as may be required by law (License Condition 12). The representatives must have access to and copy at reasonable times any records that must be kept under conditions of this License. Also, they may inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this License. They may sample, photograph, or monitor at reasonable times, for the purposes of assuring License compliance or as otherwise authorized, any substances, locations, or parameters at any location subject to the License.

8) Cells 1 and 4A and the Recycle Pond shall be examined at intervals not exceeding 7 days and all instruments shall be monitored. Cells 1 and 4A and the Recycle Pond shall be inspected annually by a registered Professional Engineer to assure that the design,

operation, and maintenance of the surface impoundment is in accordance with generally accepted engineering standards and such findings has been placed in the operating record. (License Condition 12) If a potential hazardous condition develops, then Ameren shall immediately take actions to eliminate the condition and to notify potentially affected persons and State and local first responders.

The St. Charles County Solid Waste Operating License must be renewed annually for each year beginning with each anniversary date of the issuance of license (Condition 12). The requirements for the annual application for renewal and other reporting requirements are summarized in Section 6.5.2.

6.5.1 St. Charles County Recordkeeping Requirements

The recordkeeping requirements for the St. Charles County (SCC) Department of Community Health & the Environment requires Ameren Missouri to maintain the following records at the site in accordance to SCC SWMC 240.1150(36):

1) Major problems and complaints regarding operation of the UWL;
2) All environmental media sampling/testing data;
3) In the event of documented exceedance of applicable standards established by MDNR for any monitoring system;
4) Records of vector control efforts;
5) Records of dust and litter control efforts;
6) A copy of the SCC SWMC supplied by the division; and
7) Records of quantity of waste handled. Quantities are to be reported quarterly. Such records shall be made contemporaneously with the matters recorded.

In addition, all incident reports shall be maintained at Sioux Energy Center. Ameren Missouri must report any noncompliance, imminent or existing hazard from a release of waste or hazardous constituents, or from a fire or explosion at the UWL, which may endanger human health or the environments, in accordance with SCC SWMC 240.1150 and as provided in the Waste Facility Plan. Such information must be reported by telephone to (636) 949-1800 within 24 hours from the time Ameren Missouri becomes aware of the circumstances. A written report must be submitted within 15 days of the incident and shall include the following:

1) Name and title of person making report;
2) Date, time and type of incident;
3) Name and quantity of material(s) involved;
4) A complete description of the occurrence and its cause;
5) The extent of injuries, if any;

6) An assessment of actual or potential hazards to the environment and human health outside the facility, where this is applicable;

7) Estimated quantity and disposition of recovered material that resulted from the incident; and

8) Actions taken by the Plant in response to the incident.

Ameren Missouri must also maintain a complete copy of this the Solid Waste Facility License and incorporated documents, which, at a minimum, include the following documents listed in the SCC license under Condition 10:

1) Detailed Geologic and Hydrologic Site Investigation Report for AmerenUE Sioux Power Plant, Proposed Utility Waste Disposal Area St. Charles County, Missouri, 9/20/2007.

2) AmerenUE Sioux Power Plant Construction Permit Application for a Proposed Utility Waste Landfill, St. Charles County, Missouri, 9/20/2007.

3) Plan sheets numbered Sheet 1 of 33 through Sheet 33 of 33, titled, Ameren UE Sioux Power Plant Utility Waste Landfill, Construction Permit Number 0918301, St. Charles County, Missouri, Proposed Dry Disposal Area Permit Modification," dated June 2010, final revision August 2011, approved by Thomas R. Gredell, P.E., GREDELL Engineering Resources, Inc.

4) MDNR Solid Waste Disposal Area Construction Permit #0918301, dated March 28, 2008.

5) Sioux Power Plant Utility Waste Landfill, Construction Permit No. 0918301, Permit Modification – Cell 1 Ring Drains, St. Charles County, Missouri, November 2009, Revised January 2010.

6) AmerenUE Sioux Power Plant Utility Waste Landfill, Proposed Construction Permit Modification, Construction Permit Number 0918301, St. Charles County, Missouri, 6/1/2010.

7) Solid Waste Facility License, Ameren Missouri Sioux Power Plant Utility Waste Landfill, Facility NO. 04303, dated November 1, 2010.

8) AmerenUE Sioux Power Plant Utility Waste Landfill Proposed Construction Permit Modification, Construction Permit Number 0918301 revised February 2012.

9) Waste Facility Plan for St. Charles County, Sioux Energy Center UWL, Revised November 2013.

In addition, a copy of the annual renewal application, including the required report, shall be kept at Sioux Energy Center at all times.

6.5.2 St. Charles County Annual Report

The annual report must contain the information required in Section 240.820 (Ord. No 01-06§§1-8,5-30-01). Ameren Missouri must apply to renew the Solid Waste Facility License annually at least 30 days prior to each anniversary date of the initial license (November 01 of each year). The requirements for the renewal application are set forth in the schedule in subsection (2) of section 240.810 of the SCC SWMC, which are listed below. The application shall be addressed and delivered to the SCC Division Director and shall request that a renewal license be issued for a period of one (1) year.

1) Any changes in the waste facility plan which must be made to reflect actual usage or conditions.

2) Total incoming waste tonnage received.

3) Summary of all environmental monitoring data for all media compiled during the previous period with interpretation of trends using suitable modeling presentation.

4) Quantities of leachate collected, processed, treated and disposed or dissipated. (Ordinance includes landfill gases, which the UWL will have none.)

5) Equipment replaced or changed or anticipated to be replaced or changed.

6) A report describing the infrastructures which have been put in place including as-built construction plans and records.

7) If the facility is still under construction, a written report detailing conformance with the schedule contained in the Waste Facility Plan.

6.6 ST. CHARLES COUNTY WASTE FACILITY PLAN

A waste facility plan for the Sioux UWL was prepared and submitted to St. Charles County. It was approved for the Solid Waste Operating License. Most of the contents are contained in the other documents. The main points are briefly summarized in this Section.

1) Section 2.10(d): Daily cover is not required. If necessary, internal roads will be watered to minimize fugitive dust emissions.

2) Section 2.10(h)(ii): The gypsum stack will not have fire hazards, odors, litter, and decomposition gases typically associated with municipal solid waste landfills. Mosquitoes are the only possible vector anticipated. Should mosquitoes become a problem, then a mosquito eradication program will be implemented.

3) Section 2.10(h)(iv): Any areas of the side slopes that have settled, are severely eroded, or on which previously planted vegetation did not survive will be recovered, re-graded or reseeded as necessary to maintain side slope cover and integrity.

4) Section 2.14 of the Waste Facility Plan pertains to closure, which is beyond the scope of this O&M Manual.

5) Section 2.18: The Sioux Energy Center has existing Emergency Implementing Procedures (EIP) for emergencies and natural disasters which shall be followed for the Sioux Energy Center UWL.

6) Section 2.19: The Sioux Energy Center has a Safe Work Rules Handbook which covers general safety guidelines, task specific safety procedures, and Ameren's Corporate Safety & Health Policy. The Safe Work Rules Handbook shall be followed for the Sioux Energy Center UWL.

7) Section 3.25: A preventative maintenance program will be implemented for the landfill equipment. The landfill will have redundant equipment for use in most emergency situations.

8) Section 3.36 lists the documents and records that shall be kept on site.

9) Sections 3.38 and 3.39 specify the sign that shall be displayed at the entrance to the UWL.

7.0 REFERENCE DOCUMENTS

The following is a list of Ameren documents pertinent to the operation and maintenance of the UWL that are current as of May 2014. Some of these documents are subject to internal or regulatory changes over time.

1) Report "Sioux Power Plant Utility Waste Landfill, Construction Permit No. 0918301, Cell 1 Operating Permit Requirements Report, St. Charles County, Missouri," dated February 2010, Revised July 9, 2010.

2) Plan Sheets 1 through 33 titled, "Ameren UE Sioux Power Plant Utility Waste Landfill, Construction Permit Number 0918301, St. Charles County, Missouri, Proposed Dry Disposal Area Permit Modification," dated June 2010, final revision August 2011.

3) Report titled, "Ameren Missouri Sioux Power Plant Utility Waste Landfill, Proposed Construction Permit Modification, Construction Permit No. 0918301, St. Charles County, Missouri," dated June 2010, with final revision dated February 2012 and Addendum dated January 2014.

4) Ardaman & Associates, Inc. report titled, "Operation Plan, Gypsum Management Facility, Ameren Sioux Power Station," dated 2008, revised April 19, 2009.

5) Ameren Missouri Procedure AUE-ADM-5103 titled "Dam Safety Program for Ameren Missouri Non-Hydroelectric Facilities," latest revision.

6) Ameren Missouri Sioux Energy Center Emergency Implementing Procedures, latest revision.

7) Ameren Missouri Sioux Energy Center Utility Waste Landfill, Waste Facility Plan, St. Charles County, Missouri, revised November 2013 (SX-PLN-000158)

8) EPG Companies Operations and Maintenance Manual for Leachate Sump Pump (EPG Job #13-11136).

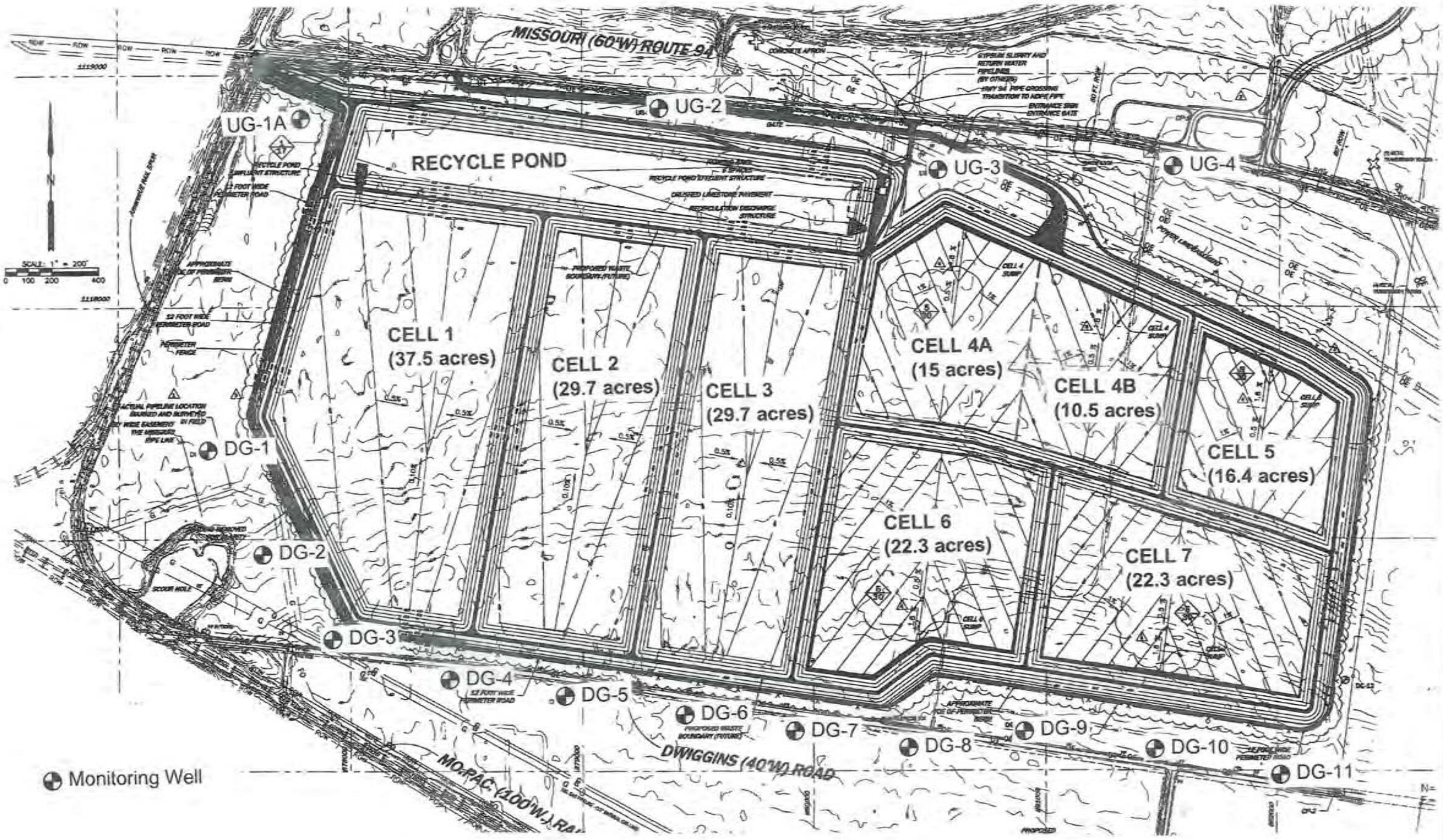
9) Zoeller Pump Company Owner's Manual for Zoeller Hazardous Environment Pumps.

10) Power Operations Safe Work Rules Handbook.

11) Design Basis Document “Sioux Common – Utility Waste Landfill” SX-DB-GPS-000004.

12) Design Change Package “Wet Flue Gas Desulfurization (WFGD) System Retrofit” SX-10-DCN-1600.

13) Design Change Package “Utility Waste Landfill – Cell 4” SX-2013-DC-0004.

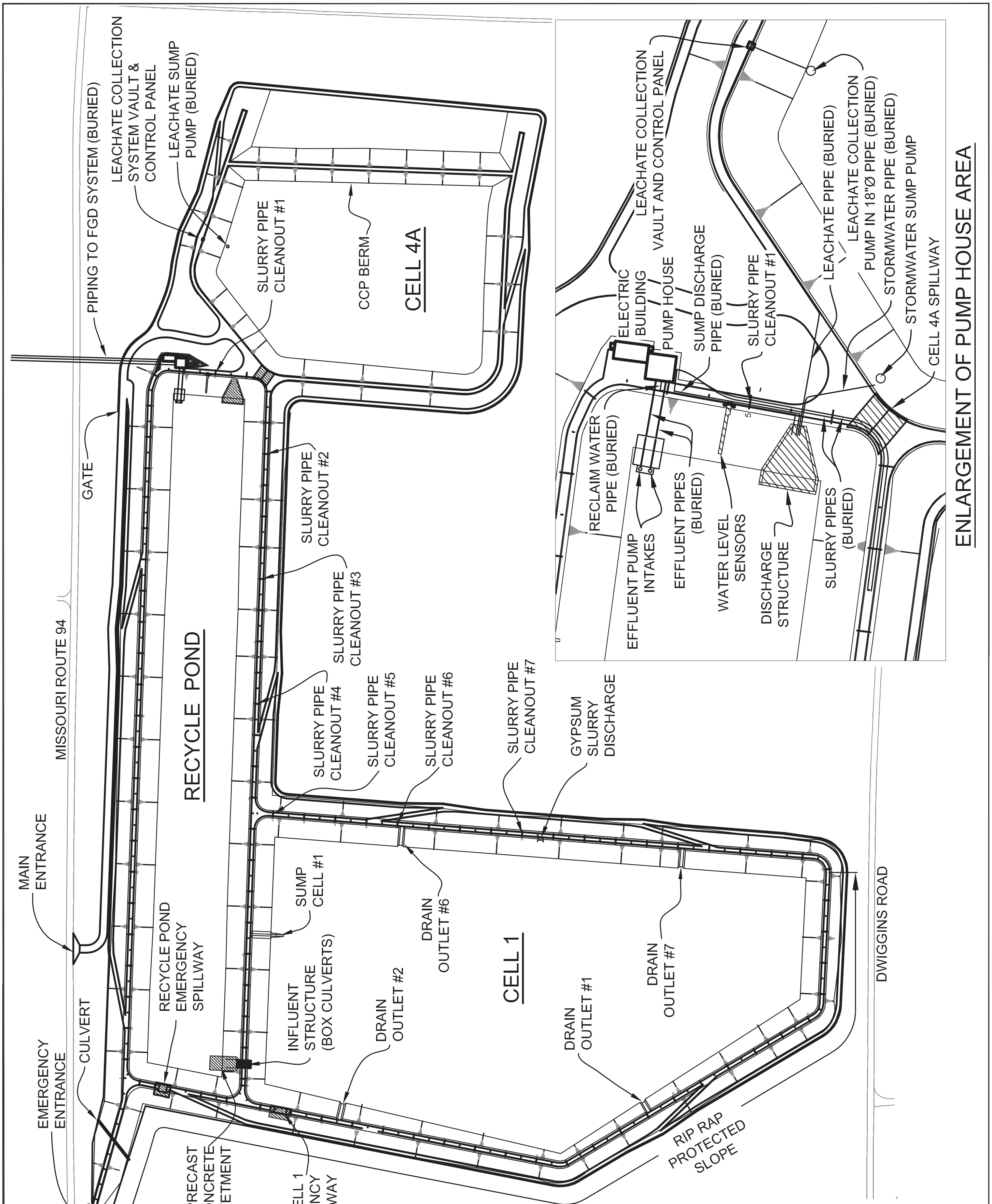


Note: reproduced from Sheet 5 of
Modified Construction Permit Application.

Reitz & Jens, Inc.

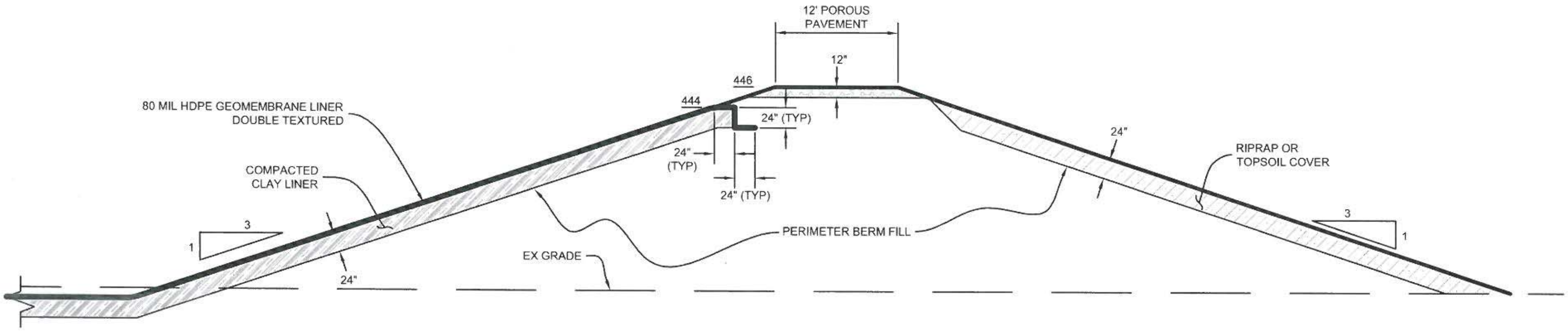
Ameren Sioux Energy Center UWL
GENERAL PLAN OF
UTILITY WASTE LANDFILL

Figure 1



SIOUX PLANT UWL O&M MANUAL
PLAN OF CELLS 1, 4A AND
RECYCLE POND

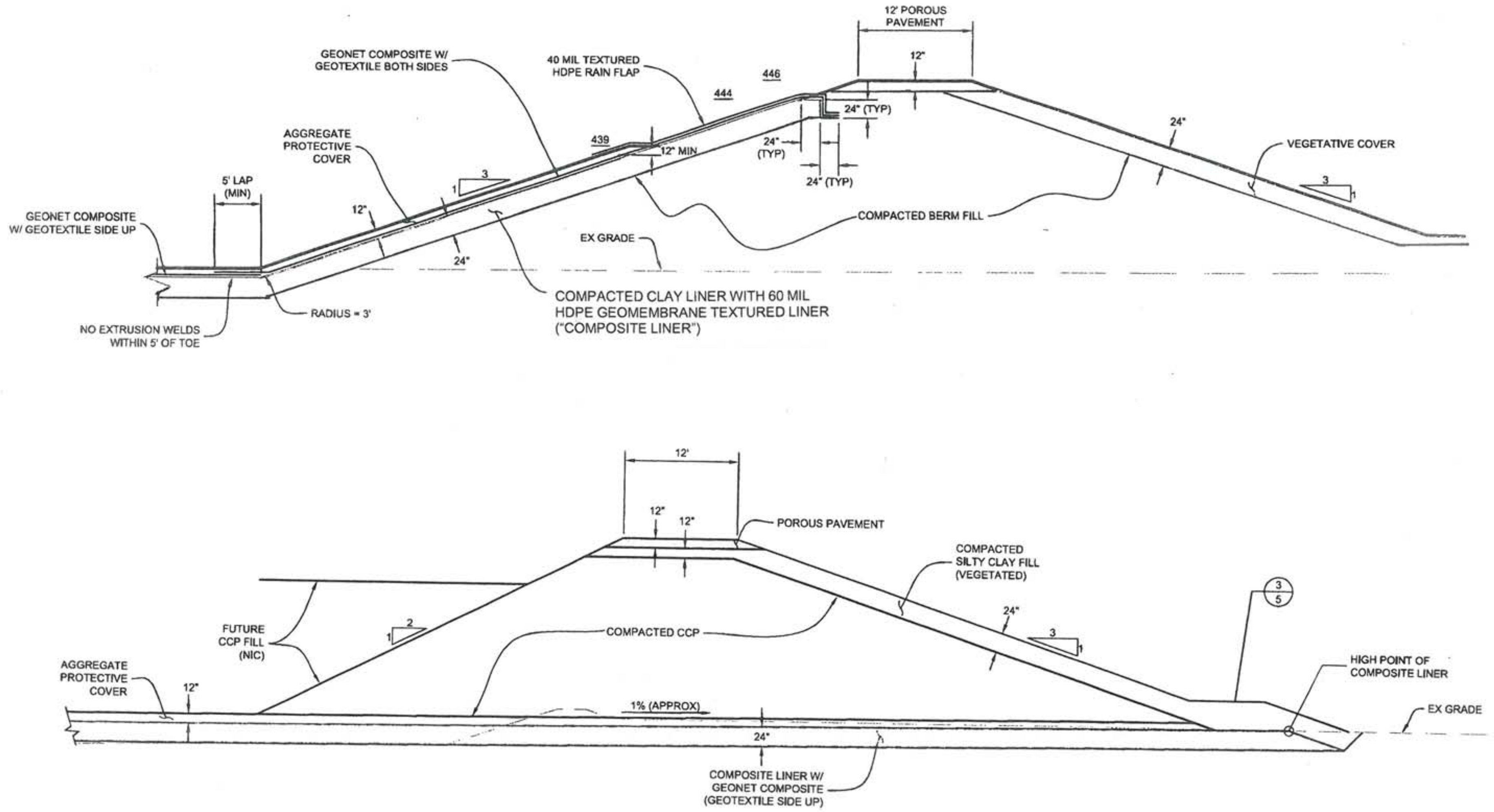
Figure 2



Ameren Sioux Energy Center UWL
TYPICAL CROSS-SECTION OF CELL 1 AND
RECYCLE POND PERIMETER BERM

REITZ & JENS, INC.

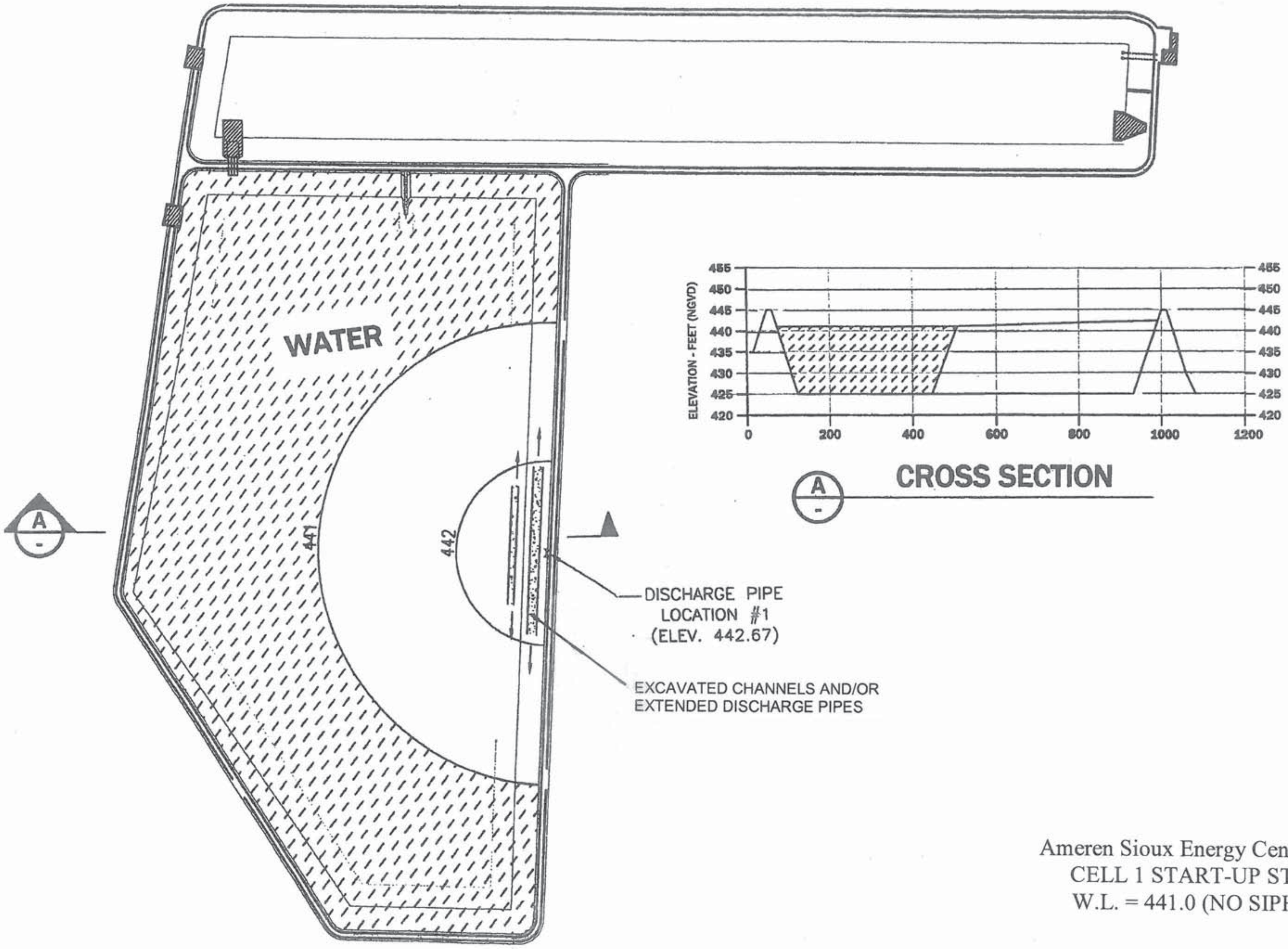
Figure 3



Ameren Sioux Energy Center UWL
TYPICAL CROSS-SECTION OF CELL 4A
SOIL PERIMETER BERM AND CCP BERM

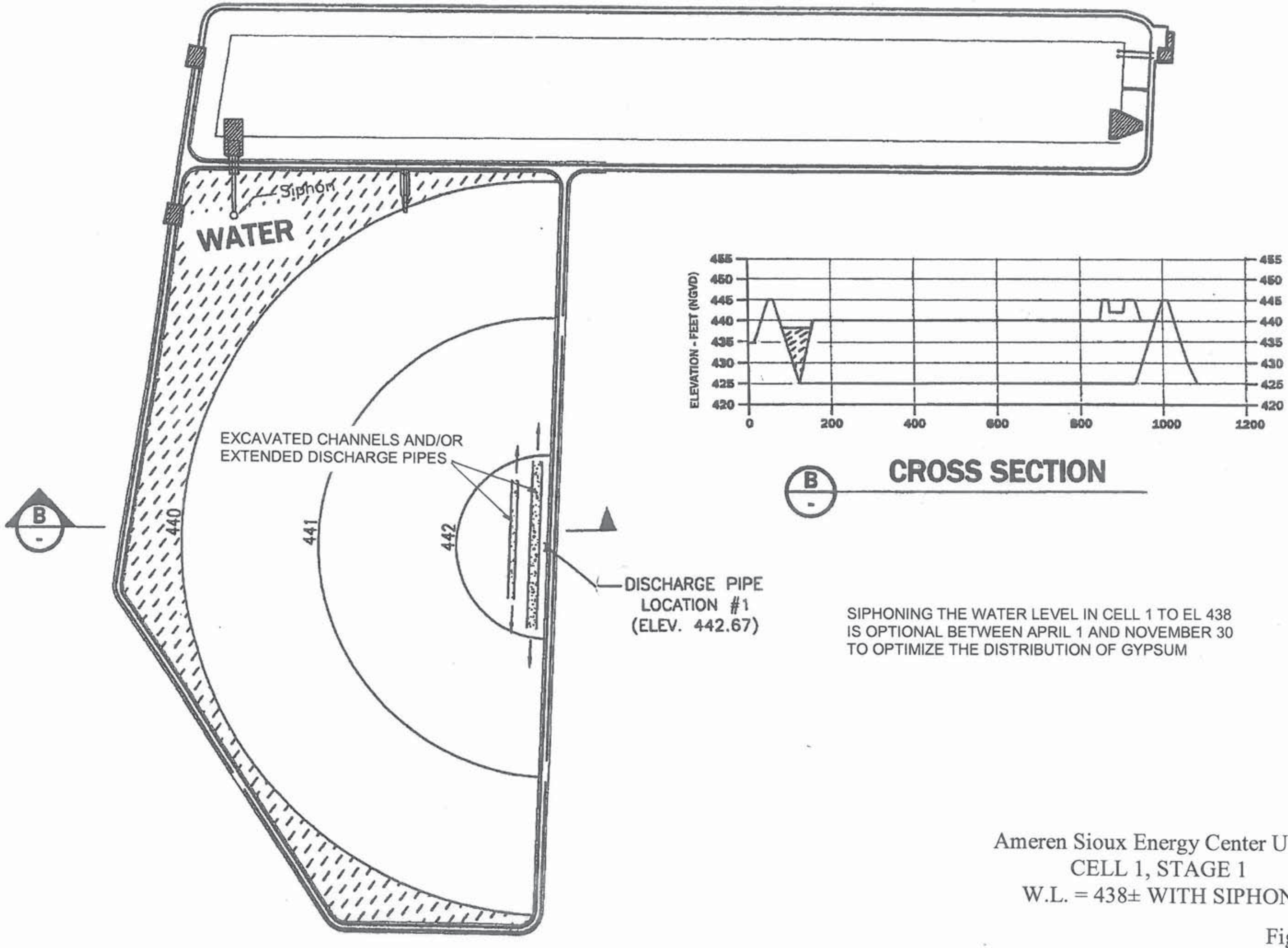
REITZ & JENS, INC.

Figure 4



Ameren Sioux Energy Center UWL
CELL 1 START-UP STAGE
W.L. = 441.0 (NO SIPHON)

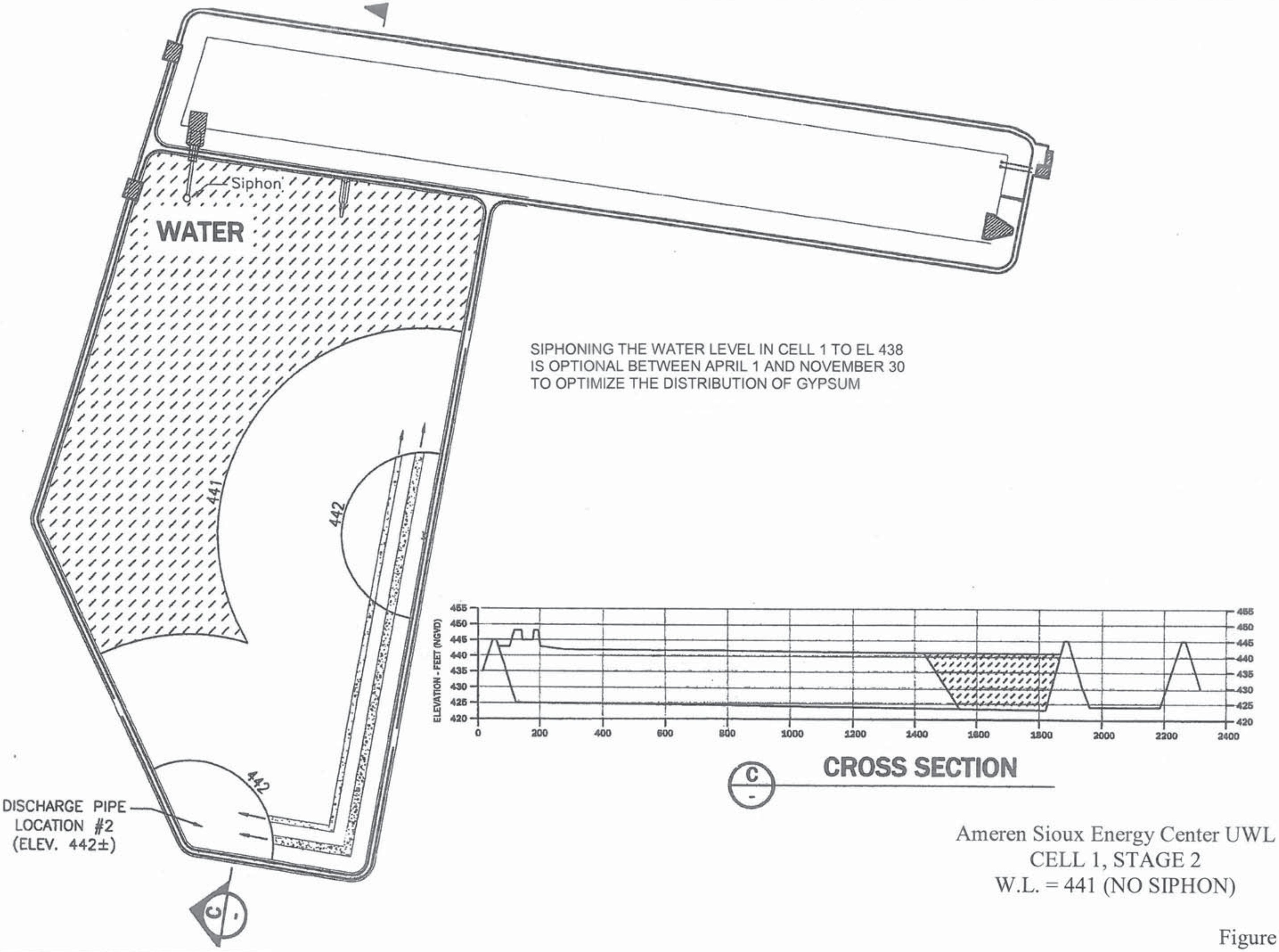
Figure 5



SIPHONING THE WATER LEVEL IN CELL 1 TO EL 438
IS OPTIONAL BETWEEN APRIL 1 AND NOVEMBER 30
TO OPTIMIZE THE DISTRIBUTION OF GYPSUM

Ameren Sioux Energy Center UWL
CELL 1, STAGE 1
W.L. = 438± WITH SIPHON

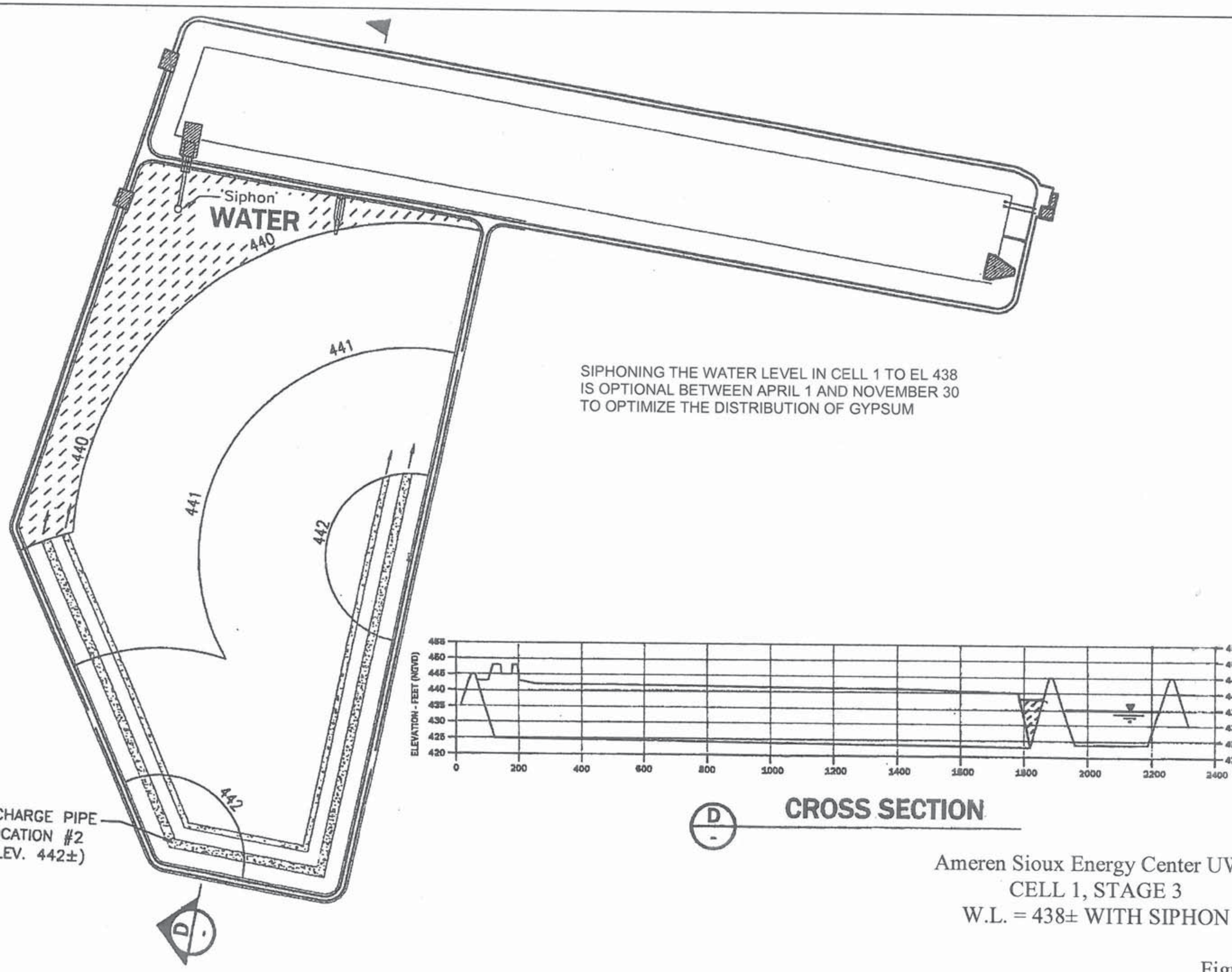
Figure 6



SIPHONING THE WATER LEVEL IN CELL 1 TO EL 438
IS OPTIONAL BETWEEN APRIL 1 AND NOVEMBER 30
TO OPTIMIZE THE DISTRIBUTION OF GYPSUM

Ameren Sioux Energy Center UWL
CELL 1, STAGE 2
W.L. = 441 (NO SIPHON)

Figure 7



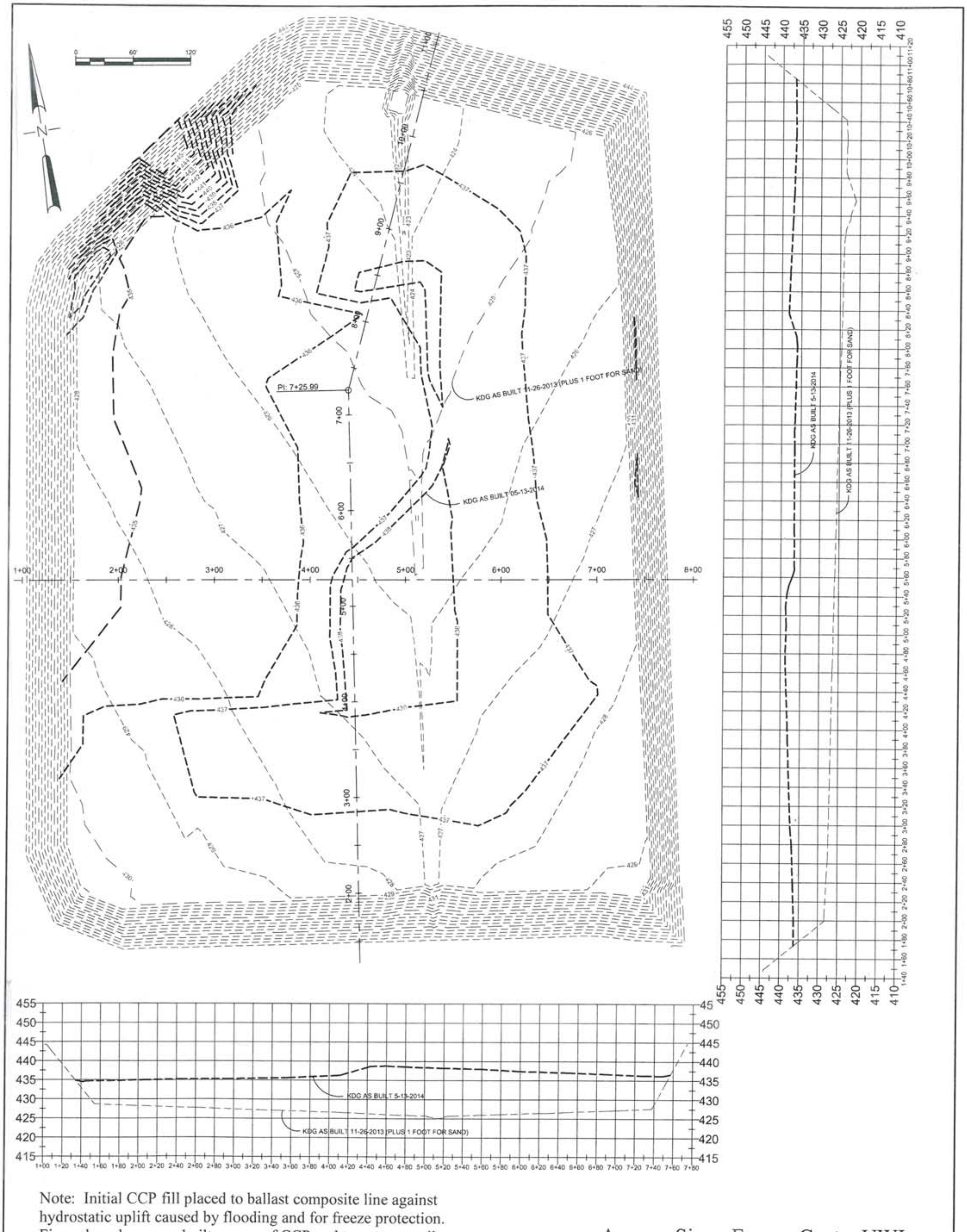
SIPHONING THE WATER LEVEL IN CELL 1 TO EL 438
IS OPTIONAL BETWEEN APRIL 1 AND NOVEMBER 30
TO OPTIMIZE THE DISTRIBUTION OF GYPSUM

D

CROSS SECTION

Ameren Sioux Energy Center UWL
CELL 1, STAGE 3
W.L. = 438± WITH SIPHON

Figure 8

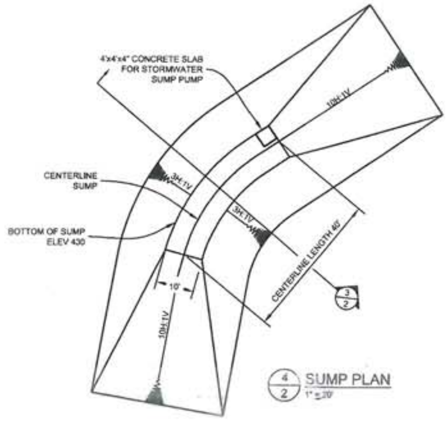


Note: Initial CCP fill placed to ballast composite line against hydrostatic uplift caused by flooding and for freeze protection. Figure based upon as-built survey of CCP and temporary soil cap by K*d*G, dated 5/13/2014.

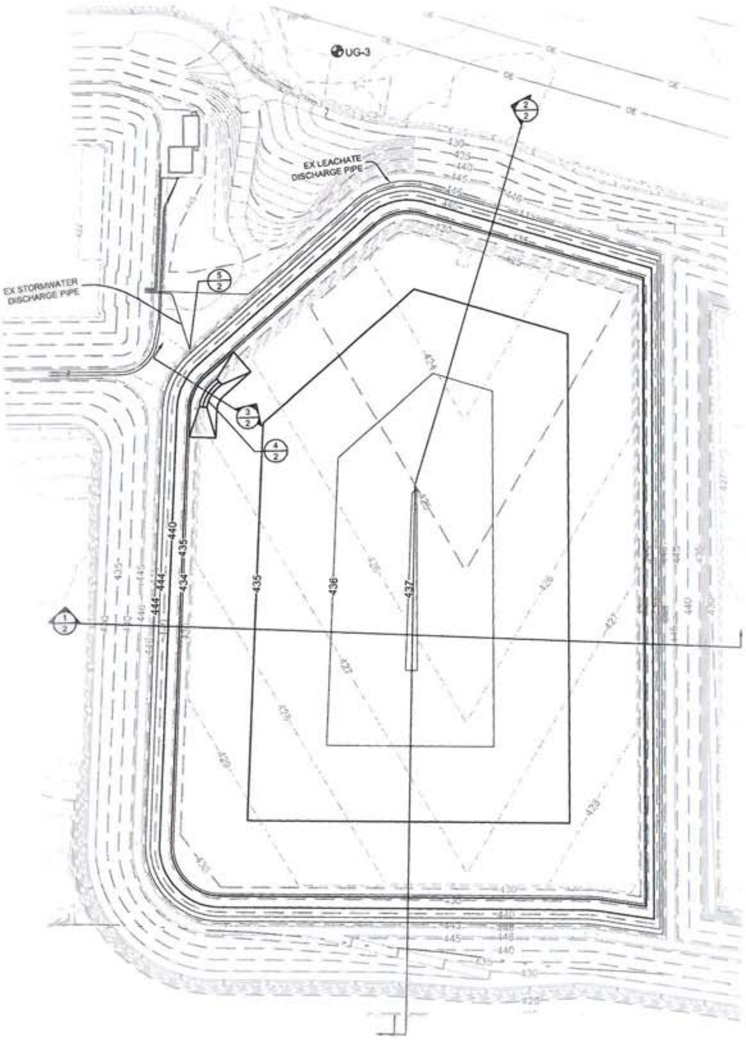
Ameren Sioux Energy Center UWL
INITIAL FILLING OF CELL 4A

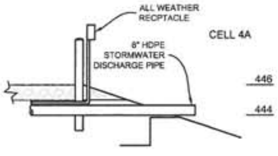
REITZ & JENS, INC.

Figure 9A

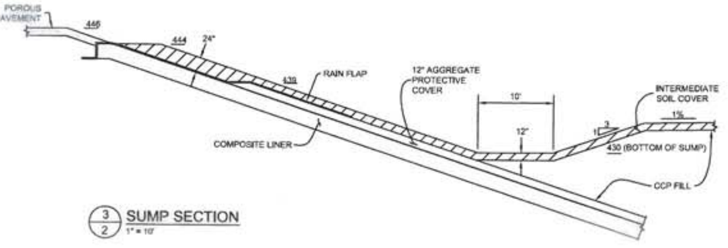


4/2 SUMP PLAN
1" = 20'





5/2 EXISTING STORMWATER DISCHARGE PIPE AND ELECTRICAL CONNECTIONS
1" = 5'



3/2 SUMP SECTION
1" = 10'

Note: reproduced from Dwg. 8430-Y-168643
"Cell 4A – Phase 3, Sheet 2 of 2, Initial CCP Fill."

Ameren Sioux Energy Center UWL
LOCATION OF STORM WATER
SUMP AND PUMP DETAILS

Figure 9B

Ameren Missouri Sioux Energy Center UWL
Cells 1 & 4A and Recycle Pond O&M Manual

APPENDIX A

INSPECTION FORMS

APPENDIX A – INSPECTION FORMS

LIST OF CONTENTS

Sioux UWL Cells 1 & 4A and Recycle Pond

WEEKLY INSPECTION REPORT

Recycle Pond Level By Visual Reading of Instrumentation Pipes	
Recycle Pond Level Reading through DCS	
Cell 1 Level	
Elapsed Hours on Cell 4A Leachate Pump	

Date & Time	
Inspector(s)	
Weather	
Temperature	

	Item	Condition Code *	Comments
RECYCLE POND	Erosion, sloughing, sliding, boils, seepage		
	Condition of grass cover, woody vegetation, burrows		
	Recycle Pond between el. 428 and 443		
	Settlement, depression or crack in embankment		
	Gravel Ballast Covering Pump Intake Pipes (when visible)		
	Damage to transducer level controls or pipes		
	Unevenness, movement of triple box culverts		
	HDPE Recirculation Pipe (leaking or frozen)		
	Pump House Sump Discharge Pipe (leaking or frozen)		
	Erosion or rutting gravel top & perimeter roads and ramps		
	HDPE Liner		
	Precast Concrete Revetment below Box Culverts		
	Precast Concrete Revetment below Discharge Pipes		
	Emergency Spillway		
	Imminent discharge thru emergency spillway		
CELL 1	Erosion, sloughing, sliding, boils, seepage		
	Condition of grass cover, woody vegetation, burrows		
	Settlement, depression or crack in embankment		
	Emergency Spillway		
	Imminent discharge thru emergency spillway		
	Gypsum slurry flowing unobstructed		
	Slurry spraying or running out of cleanouts		
	Height from discharge pipe flowline to gypsum level		Visual Estimate, inches:

Sioux UWL Cells 1 & 4A and Recycle Pond
WEEKLY INSPECTION REPORT

Date & Time	

	Item	Condition Code *	Comments
CELL 1 (cont.)	HDPE Liner		
	Erosion or rutting gravel top & perimeter roads and ramps		
	Sump Outlet & Concrete Pad		
	Drain Outlets & Concrete Pads		
	Movement of riprap		
CELL 4A	Erosion, sloughing, sliding, boils, seepage		
	Condition of grass cover, woody vegetation, burrows		
	Settlement, depression or crack in embankment		
	Storm Water Channel		
	Storm Water Pump & Discharge Pipe		
	Standing water in Cell		
	Leachate Collection Sump Pump Vault		
	Leachate Collection Pump, Controls & Discharge		
	HDPE Liner		
	Erosion or rutting gravel top & perimeter roads and ramps		
OTHER	Holes or breaks in perimeter fence, vandalism		
	Main and emergency gates locked		

Drive slowly around tops of embankments looking for visible signs of present or developing major problems. Indicate location(s) of problems or anomalies on inspection plan - sign, date and attach sheet to report.

If a problem is noted, email or FAX report to appropriate persons. If emergency condition is noted, immediately contact the Shift Operations Supervisor and Chief Dam Safety Engineer.

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.

MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

OB = Condition requires regular observation to ensure that the condition does not become worse.

GC = Good Condition.

NE = No evidence of a problem.

NI = Not Inspected. Reason should be stated in comment.

Attach Inspection Form (plan) with Additional Observations or Comments on Back

Sioux UWL Cells 1 & 4A and Recycle Pond

SPECIAL INCIDENT INSPECTION REPORT

Recycle Pond Level By Visual Reading of Instrumentation Pipes	
Recycle Pond Level Reading through DCS	
Cell 1 Level	
Elapsed Hours on Cell 4A Leachate Pump	

Date & Time	
Inspector(s)	
Weather	
Temperature	

DATE, TIME AND TYPE OF INCIDENT:

	Item	Condition Code *	Comments
RECYCLE POND	Erosion, sloughing, sliding, boils, seepage		
	Condition of grass cover, woody vegetation, burrows		
	Recycle Pond between el. 428 and 443		
	Settlement, depression or crack in embankment		
	Effluent Pump Intake Structures (when visible)		
	Gravel Ballast Covering Pump Intake Pipes (when visible)		
	Damage to transducer level controls or pipes		
	Unevenness, movement of triple box culverts		
	HDPE Recirculation Pipe (leaking or frozen)		
	Pump House Sump Discharge Pipe (leaking or frozen)		
	Erosion or rutting gravel top & perimeter roads and ramps		
	HDPE Liner		
	Precast Concrete Revetment below Box Culverts		
	Precast Concrete Revetment below Discharge Pipes		
	Emergency Spillway		
	Imminent discharge thru emergency spillway		
CELL 1	Erosion, sloughing, sliding, boils, seepage		
	Condition of grass cover, woody vegetation, burrows		
	Settlement, depression or crack in embankment		
	Emergency Spillway		
	Imminent discharge thru emergency spillway		
	Gypsum slurry flowing unobstructed		
	Slurry spraying or running out of cleanouts		

Sioux UWL Cells 1 & 4A and Recycle Pond

SPECIAL INCIDENT INSPECTION REPORT

Date	

	Item	Condition Code *	Comments
CELL 1 (cont.)	Height from discharge pipe flowline to gypsum level		Visual Estimate, inches:
	HDPE Liner		
	Erosion or rutting gravel top & perimeter roads and ramps		
	Sump Outlet & Concrete Pad		
	Drain Outlets & Concrete Pads		
	Movement of riprap		
CELL 4A	Erosion, sloughing, sliding, boils, seepage		
	Condition of grass cover, woody vegetation, burrows		
	Settlement, depression or crack in embankment		
	Storm Water Channel		
	Storm Water Pump & Discharge Pipe		
	Standing water in Cell		
	Leachate Collection Sump Pump Vault		
	Leachate Collection Pump, Controls & Discharge		
	HDPE Liner		
	Erosion or rutting gravel top & perimeter roads and ramps		
OTHER	Holes or breaks in perimeter fence, vandalism		
	Main and emergency gates locked		

Drive slowly around tops of embankments looking for visible signs of present or developing major problems. Indicate location(s) of problems or anomalies on inspection plan - sign, date and attach sheet to report.

If a problem is noted, email or FAX report to appropriate persons. If emergency condition is noted, immediately contact the Shift Operations Supervisor and Chief Dam Safety Engineer.

If an emergency situation requires an immediate Special Inspection during poor visibility (such as at night) then a second Special Inspection must be completed in daylight as soon as possible.

Condition Codes

EC = Emergency Condition. A serious dam safety condition exists that needs immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

IM = Item needing immediate maintenance to restore or ensure its safety or integrity. Remediation should be completed within 1 month.

MM = Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

OB = Condition requires regular observation to ensure that the condition does not become worse.

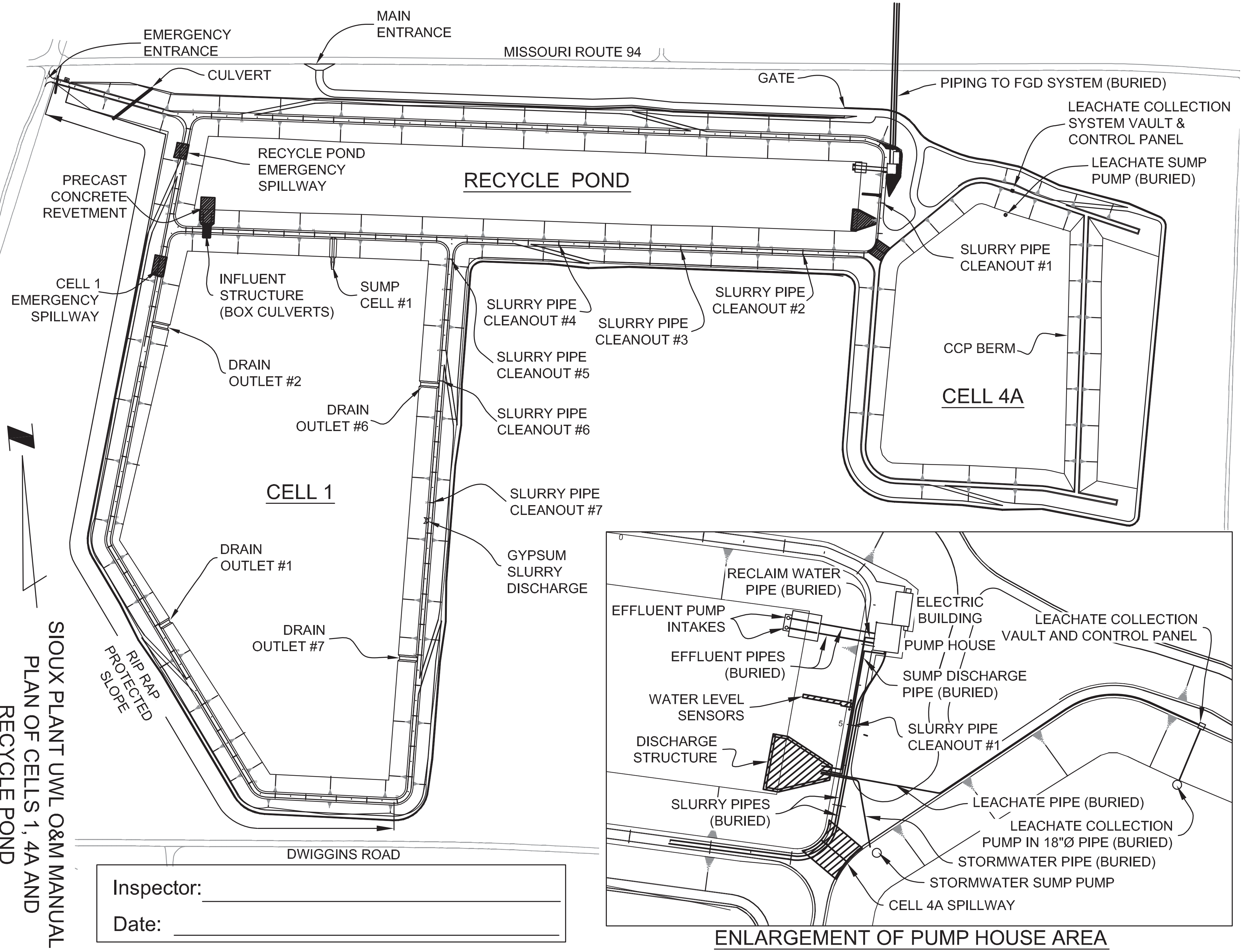
GC = Good Condition.

NE = No evidence of a problem.

NI = Not Inspected. Reason should be stated in comment.

ATTACH INSPECTION FORM (PLAN) AND **NOTE ACTIONS TAKEN ON BACK OF FORM**

SIOUX PLANT UWL O&M MANUAL PLAN OF CELLS 1, 4A AND RECYCLE POND INSPECTION FORM



Inspector: ____________________

Date: ____________________

Ameren Missouri Sioux Energy Center UWL
Cells 1 & 4A and Recycle Pond O&M Manual

APPENDIX B

MAINTENANCE OF PROTECTIVE GRASS COVER

Appendix B
MAINTENANCE OF PROTECTIVE GRASS COVER

1.0 ROUTINE MAINTENANCE

1.1 The embankment slopes were planted by broadcast seeding native grasses. The seed was a mixture of VNS annual ryegrass (temporary cover crop), Soft Red Winter wheat (temporary cover crop), 30% Canadian wild rye (native), and 30% “Cave-in-Rock” switchgrass (native). The wheat and annual rye start turning brown in June or early summer, but will reseed and begin growing again in the fall. The wild rye and switchgrass are perennial native warm season grasses that begin growing in late spring. It typically will take 2 to 3 years to establish the permanent native grass cover.

1.2 If additional wheat or rye cover is needed, it should be sown in September and will start to grow in October. If additional perennial switchgrass is needed, it should be broadcast seeded in early February or drilled by early spring so that it will grow over the summer.

1.3 The grasses should be mowed, to 6 to 8 inches high, twice per year, or a controlled burn once per year between mid-February and April 15. If a controlled burn is used, the burning should be from the top of embankment down, to have a slower and more controlled burn. A permit will be needed from St. Charles County to manage the native grasses by burning.

1.4 Riprap areas should be sprayed with an herbicide once in the spring and once in the fall of each year to eliminate the growth of woody vegetation. Embankment mowing should be supplemented by periodic use of herbicides to prevent the growth of woody plants on the embankments and within the perimeter fence of the UWL. The U.S. EPA bans the use of the herbicide 2,4,5-T in parks and recreational areas, and the use of Silvex (2,4,5-TP) around water. Herbicides shall not be used that contain 2,4,5-T or 2,4,5-TP, such as ESTERON 2,4,5 by DOW Chemical. Approved herbicides include 2,4-D or 2,4-DP, such as RTU or GARLON by DOW Chemical, WEEDONE 170 or WEEDONE 2,4-DP by Union Carbide, or a 1% to 2% solution of ROUNDUP.

1.5 Woody plants should be entirely removed from the slopes of the embankments, including the root ball. The void left from removal of the root ball should be backfilled with compacted silty clay or low plastic clay, and the disturbed area should be reseeded.

2.0 RESEEDING

2.1 PRODUCTS

2.1.1 Commercial fertilizer of 0-20-20 grade shall be provided and applied to the permanent seeding sites, so that not more than 2.0 pounds of phosphorus (P_2O_5) per 1000 sq.ft. and 2.0 pounds of potassium (K_2O) per 1000 sq.ft. are applied. The fertilizer shall be nitrogen (N) free. No nitrogen shall be applied at time of seeding. The fertilizer shall be uniform in composition, free flowing and suitable for application with available equipment. The fertilizer shall be delivered to the site in bags or other convenient containers, fully labeled or otherwise designated in accordance with the applicable State fertilizer laws, and bearing the name, trade name or trademark, and warranty of the producer.

2.1.2 Permanent seed mixture should be as follows. All grass seed will meet minimum of 98% purity and 85% germination.

Kinds of Seed	Pounds Pure Live Seed per Acre
Switchgrass (Blackwell or Cave-in-Rock) (*Panicum virgatum*)	15 lbs.
Wild Rye (*Elymus canadensis*)	15 lbs.
Annual Ryegrass (*Lolium multiflorum*)	20 lbs.
Oats or Wheat	30 lbs.
Total Pounds Pure Live Seed/Acre	80 lbs.

2.1.3 Mulch should be mature prairie hay, or if prairie hay is not available, straw of cereal grain such as oats or wheat. Materials containing objectionable weed seeds or other species detrimental to the planting should not be used.

2.2 APPLICATION - Permanent seeding sites should be tilled to an average depth of 3 to 5 inches, and fertilizer may be applied up to 10 days before seeding, or at the time of seeding, or up to 5 days after seeding. Seeding may be done by drilling or by broadcasting. Hay or straw mulch should be spread uniformly at the rate of 2 tons per acre. Mulch shall be spread by hand, blower-type mulch spreader, or other approved method. The mulch shall not be bunched or clumped. Sunlight shall not be completely excluded from penetrating to the ground surface. All areas installed with seed shall be mulched on the same day as the seeding. Mulch shall be anchored immediately following spreading with either a mechanical anchor, such as a V-type-wheel land packer or a scallop-disk land packer designed to force mulch into the soil surface, or mulch may be glued to the ground surface using biodegradable glue.

Ameren Missouri Sioux Energy Center UWL
Cells 1 & 4A and Recycle Pond O&M Manual

APPENDIX C

GYPSUM STACKING OPERATIONS

Appendix C
GYPSUM STACKING OPERATIONS

C.1 BEGINNING GYPSUM STACKING

The initial filling of Cell 1 is described in Section 2.3. Settled gypsum will gradually create a plain of material within Cell 1 that slopes gently away from the embankment (the “gypsum beach”), as shown in Figure 5. The bottom of the gypsum slurry discharge pipes is at el. 442.67. The gypsum beach cannot exceed about el. 442 without having to either change the discharge location or begin excavating the gypsum to construct the first dikes.

The concept of gypsum stacking is illustrated in Figure C-1. Two dikes will be made with gypsum from Cell 1: the exterior or outer dike, and the interior or inner dike. The channel between the perimeter berm of Cell 1 and the outer dike forms the perimeter ditch which returns water to the triple box culverts once the outer ditch is completed around all of Cell 1. The excavated channel between the outer dike and the inner dike forms the “rim ditch” which carries the gypsum slurry around the Cell 1. A cut is made through the inner dike at selected locations to distribute the gypsum slurry. The coarser gypsum particles settle in the rim ditch, where it is easier to excavate the gypsum with trackhoes to build the outer and inner dikes. The fine particles of gypsum settle in the center “sedimentation area” which is always under water.

Because the water level during the winter will be at el. 441, the gypsum beach on the eastern side of Cell 1 will reach an el. of 441 or higher during the first winter. As the water level is lowered during the spring, the beach on the east side of Cell 1 will dewater making it easier to begin construction of the inner and outer dikes in this area. Construction of the initial rim ditch will allow slurry to continue to be discharged from this location and redirect the slurry flow to the north and south along the east side of Cell 1, increasing the overall size of the beach.

After April 1 during normal operations, the water level in Cell 1 can be lowered to el. 438± to optimize the natural beach formation (Figure 6). This will continue until December 15, at which time the water level in Cell 1 will be raised to el. 441. When the gypsum beach extends more than one-half the distance across Cell 1, and while the water level is lowered to el. 438±, the ends of the slurry discharge pipes should be moved to the south end of Cell 1 (Discharge Location #2, Figure 7). HDPE pipe must be added to the ends of the gypsum slurry pipes at Location #1, and the pipe extension aligned along the inner edge of the embankment to the south end of Cell 1. The exact piping alignment and the final location of Discharge Location #2 will require field configuration.

After April 1, the water level in Cell 1 can again be lowered to el. 438± to optimize the natural beach formation (Figure 8). Construction of the initial rim ditches and exterior and interior dikes (Figures C-1 and C-2) will continue until they extend along the south perimeter of Cell 1 and halfway north on both the east and west perimeter of Cell 1. The construction of dikes and ditches is further detailed in the following section.

C.2 GYPSUM DIKES AND SEDIMENTATION POND CONSTRUCTION

Construction of the rim ditch should begin after the beach at the east and south sides of Cell 1 reach el. 441 and the water level in the south end of the impoundment is lowered to el. 438±. The rim ditch is constructed by building two elevated roads on the gypsum beach beginning at the middle of the east berm and proceeding both clockwise and counterclockwise around the perimeter of the stack as shown in Figure C-2. Access to the beach will be provided by carefully pushing fill soil or fly ash outward from the crest of the earthen perimeter berm out onto the beach. The thickness of the fill will need to be at least 18 inches thick above the HDPE liner to avoid damage to the liner and will need to be at least 36 inches thick above the gypsum beach. After the access pad has been constructed far enough out onto the beach to allow excavation of the gypsum without damaging the liner, the access road can be completed using gypsum excavated from the beach. The details of constructing the access road and establishing the rim ditch are illustrated in Figure C-2. Note that the rim ditch is advanced by pushing the windrowed gypsum off of the two roadways out onto the beach in approximately 20-ft long segments.

Gypsum excavated from the beach is expected to be soft and saturated and must be windrowed and allowed to drain before it can be spread and compacted to form the roadway. Typically, gypsum drains sufficiently in 24 hours to allow spreading and compacting. Caution should be used to prevent equipment from getting stuck in the gypsum until the specific drainage characteristics of the gypsum produced at the Plant are determined. Sufficient compaction can be achieved by tracking with a low pressure D-6 dozer. Depending on the reach of the excavator, the rim ditch can advance about 20 feet per day in each direction.

The rim ditch should be refilled each day to provide gypsum for raising the roadway as the excavator retreats from the most recently placed windrow. The height of the interior dike when the initial rim ditch is completed should be at least 3 feet above the beach. The outer slope of the outer rim ditch should be graded to a slope of 3 horz. to 1 vert. (3H:1V). The gypsum interior and exterior dikes should be initially raised in lift increments of about 1.5 to 2 feet. A minimum freeboard of 3 feet should be maintained between the slurry level in the rim ditch and the crest of the perimeter embankment. The gypsum exterior dike should always be maintained at a slightly higher elevation (1 foot minimum) than the interior dike of the rim ditch to prevent accidental overflow of gypsum slurry down the stack slope in the event the rim ditch becomes blocked.

The exterior and interior dike crests should be moved inward each lift as needed to maintain the design slope of 3H:1V. The slopes can be graded with a smooth-edged excavator bucket, e.g., a finish or cleanup bucket. Under no circumstances should the slopes of the stack be graded using a toothed excavator bucket.

At an advance rate of 20 feet per day, it will take about 2 months for the rim ditch to reach the midpoint of the impoundment as illustrated in Figure 8. During this period, the beach and the water level in the ponded area will have increased in elevation by about two feet. During this same period, a 2-ft thick gypsum protective cover should be placed on top of the HDPE liner on interior of the earthen perimeter embankment. The gypsum for the cover can be excavated from the rim ditch.
Once the rim ditch is constructed around the east, south and west perimeter of the south half of Cell 1, the rim ditch must be extended across the middle of the impoundment. While construction is

completed, gypsum will be discharged intermittently into the north compartment as shown in Figure C-3. Clarified water will continue to be discharged using the siphon from northwest corner of Cell 1 in order to maintain the water level about 9 feet below the crest of the earthen perimeter dike. It is estimated that it will take about one month to construct the divider dike across the middle of the impoundment.

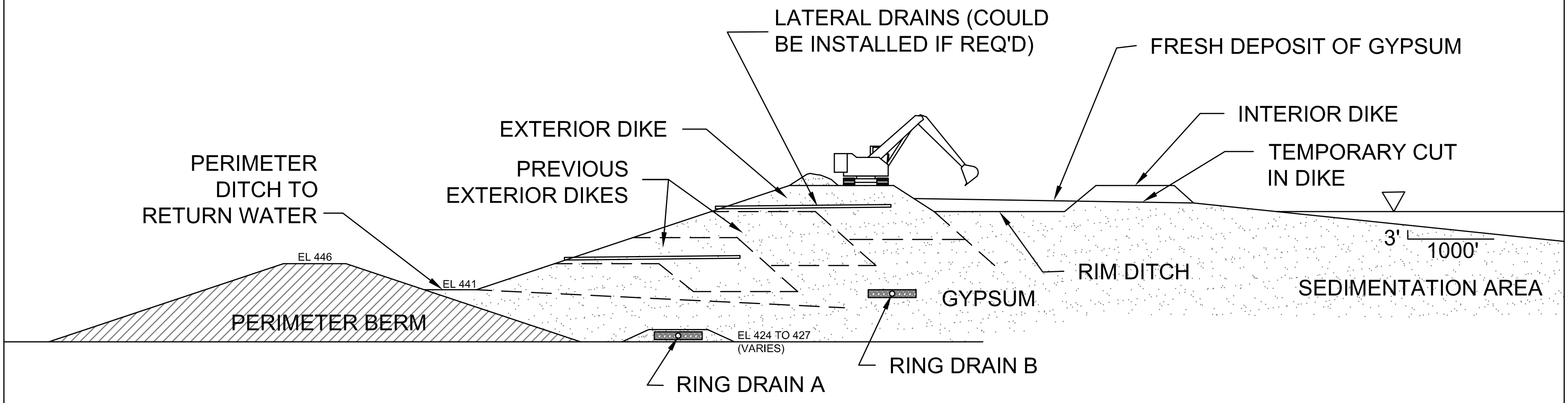
When the rim ditch around the south sedimentation pond is finished, gypsum will be introduced into the north compartment at both the southeast and southwest corners. When the rim ditch is extended into the north sedimentation pond, the rim ditch needs to be raised by discharging gypsum slurry into the sedimentation pond at both the southeast and southwest corners. Water will be decanted from the south sedimentation pond through a cut in the north inner dike near the northwest corner of the south sedimentation pond as shown in Figure C-3. The rim ditch on the east side of Cell 1 will be approximately 2 feet higher than the rim ditch on the west side of Cell 1 so that the clarified water from the south compartment can flow along the rim ditch into the north sedimentation pond as shown in Figure C-3.

At some time before the rim ditch in the north compartment reaches the location of the siphon line, the siphon line needs to be extended to the south as shown in Figure C-4. This will allow the rim ditch to be completed along the entire length of the north perimeter embankment. The 2-ft thick gypsum protective cover placed against the liner on the earthen perimeter dike of the southern compartment should also be completed during this time.

When the surface area of the water at the northwest corner of the south sedimentation pond becomes too small to effectively settle the gypsum, the cut through the inner dike at the northwest corner should be relocated to the middle of the inner dike where the bottom elevation of the rim ditch is 1.5 to 2 feet higher than at the northwest corner so that the south sedimentation pond can be raised by about 1.5 feet. The northwest corner of the south sedimentation pond, which is the lowest point in the pond before the cut is relocated, can be raised by blocking the south rim ditch as shown in Figure C-5 and directing gypsum slurry into the west part of the south sedimentation pond through a cut in the west inner dike.

Construction of the rim ditch for the north sedimentation pond will proceed as shown in Figure C-5 until the rim ditch is complete. When the rim ditch at the northwest corner of the north sedimentation pond, which is the lowest point in the entire Cell 1, reaches el. 440, an emergency decant structure should be installed near the northeast corner of the Phase I north compartment as shown in Figures C-6 and C-7.

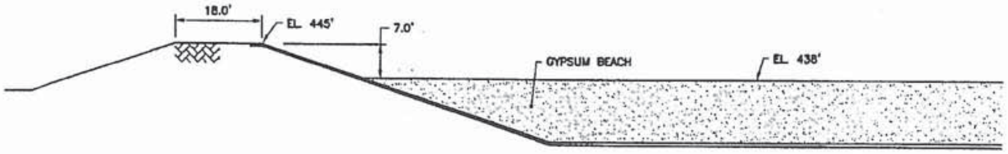
The total volume of gypsum required to completely form the inner and outer dikes of the rim ditch around the entire stack impoundment, as illustrated in Figure C-8, is estimated at approximately 96,000 cubic yards. After Cell 1 has been divided into 2 operating subcells, then construction of Ring Drain B can begin.



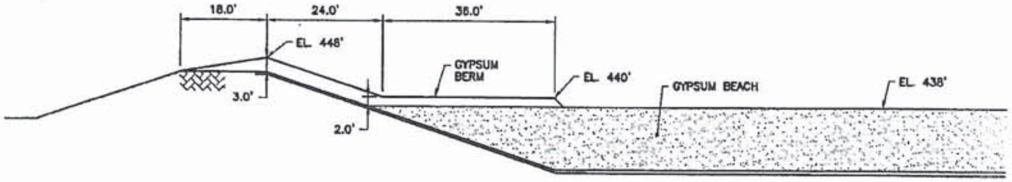
Note: after Ardaman & Associates' report
on wet gypsum stack method.

Ameren Missouri Sioux Power Plant UWL
COMPONENTS OF WET
GYPSUM STACKING OPERATION

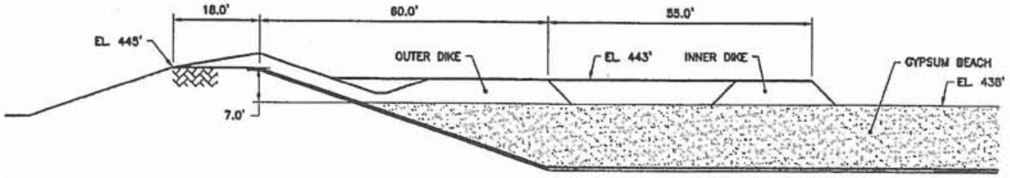
Figure C-1



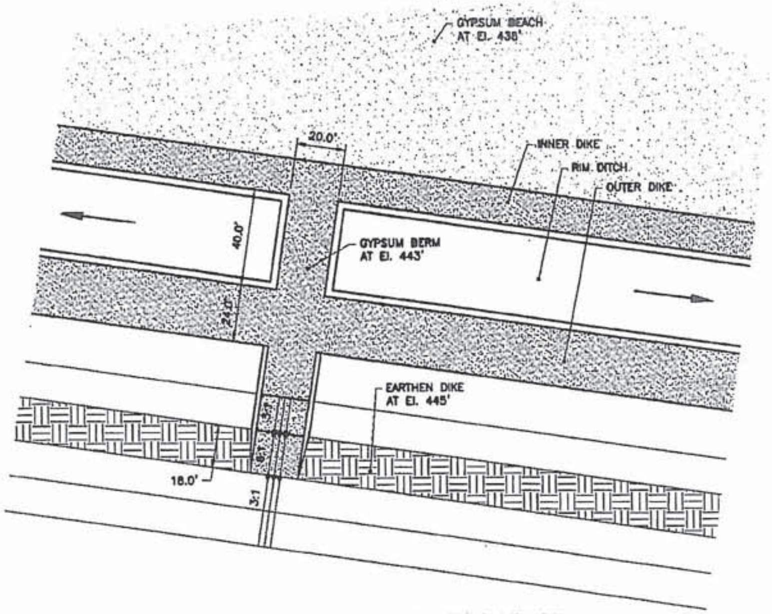
STEP 1 DISCHARGE GYPSUM TO RAISE THE GYPSUM BEACH TO 7 FEET BELOW THE CREST OF THE EARTHEN DIKE ALONG THE SOUTH WALL OF THE SETTLING COMPARTMENT



STEP 2 BUILD A 20 FOOT WIDE, 36 FOOT LONG WORK BENCH INTO THE COMPARTMENT USING FLY ASH OR GYPSUM AT THE LOCATION SHOWN IN FIGURE 2



STEP 3 CAREFULLY DIG GYPSUM FROM THE BEACH TO RAISE AND EXTEND THE WORK BENCH. EXTEND INNER AND OUTER DIKE FROM WORK BENCH AS SHOWN IN FIG 2.



PLAN VIEW OF THE INITIATION OF GYPSUM DIKE CONSTRUCTION

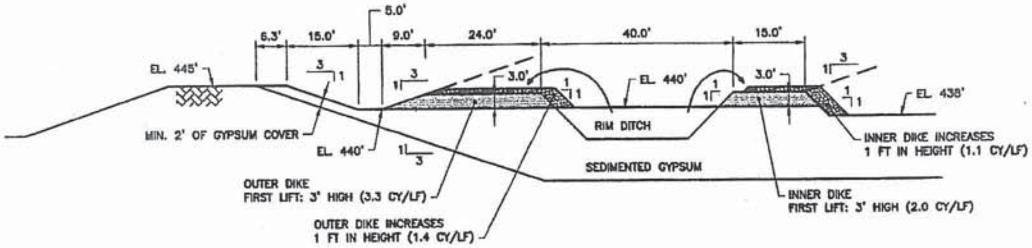
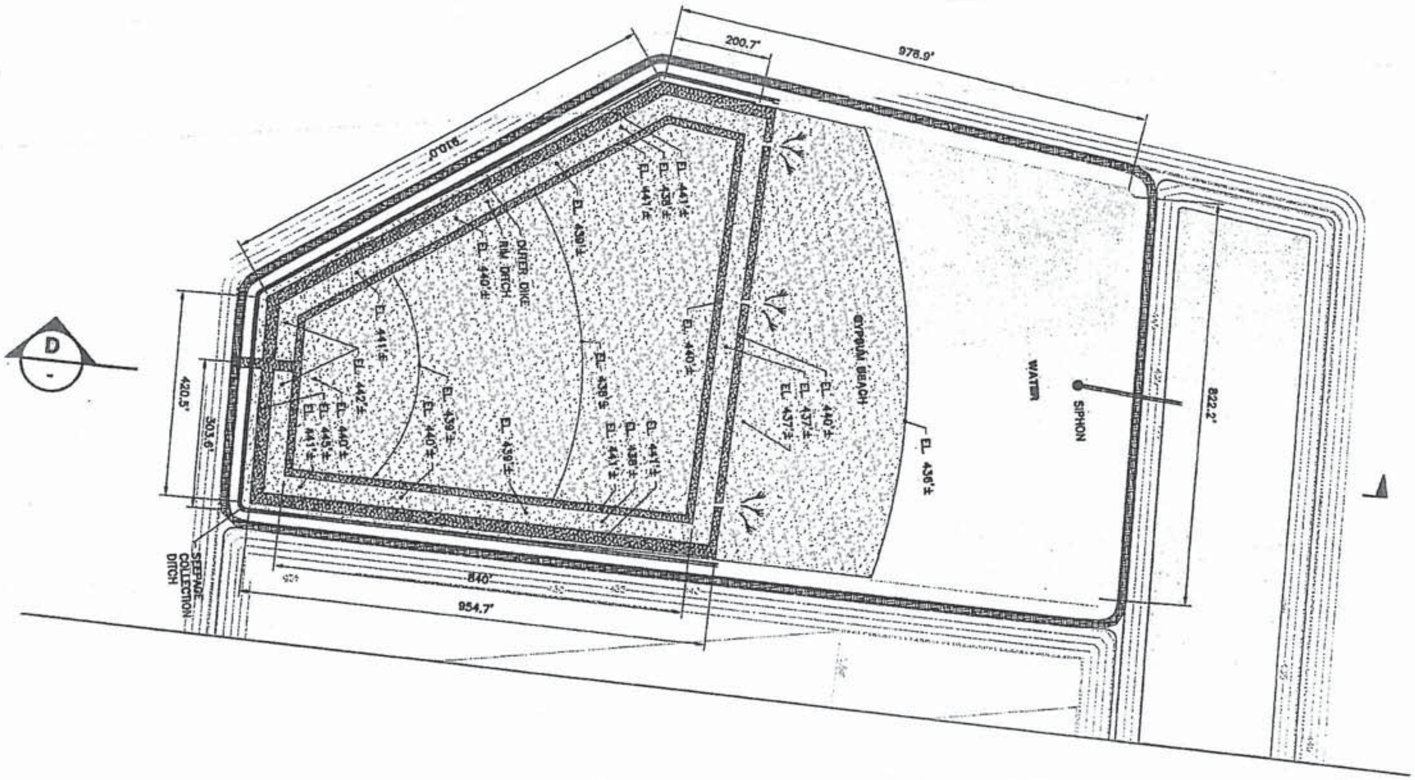


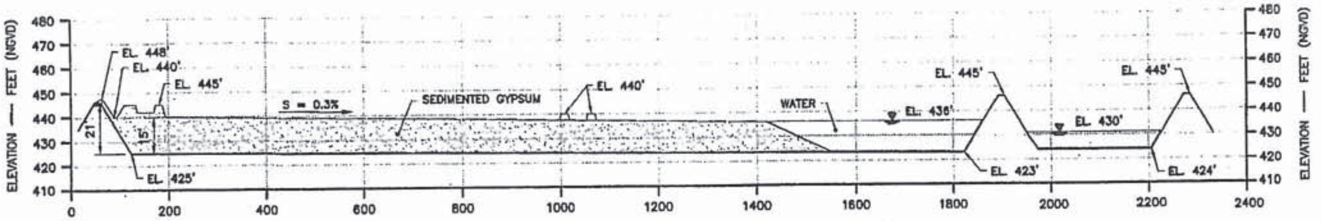
ILLUSTRATION OF INNER AND OUTER DIKE CONSTRUCTION

Sioux Plant UWL O&M Manual
CONSTRUCTION OF INNER AND
OUTER GYPSUM DIKES

Figure C-2

Note: figure based on report by
Ardaman & Associates, 2008.
(Ref. 4 in Section 1.6)





D
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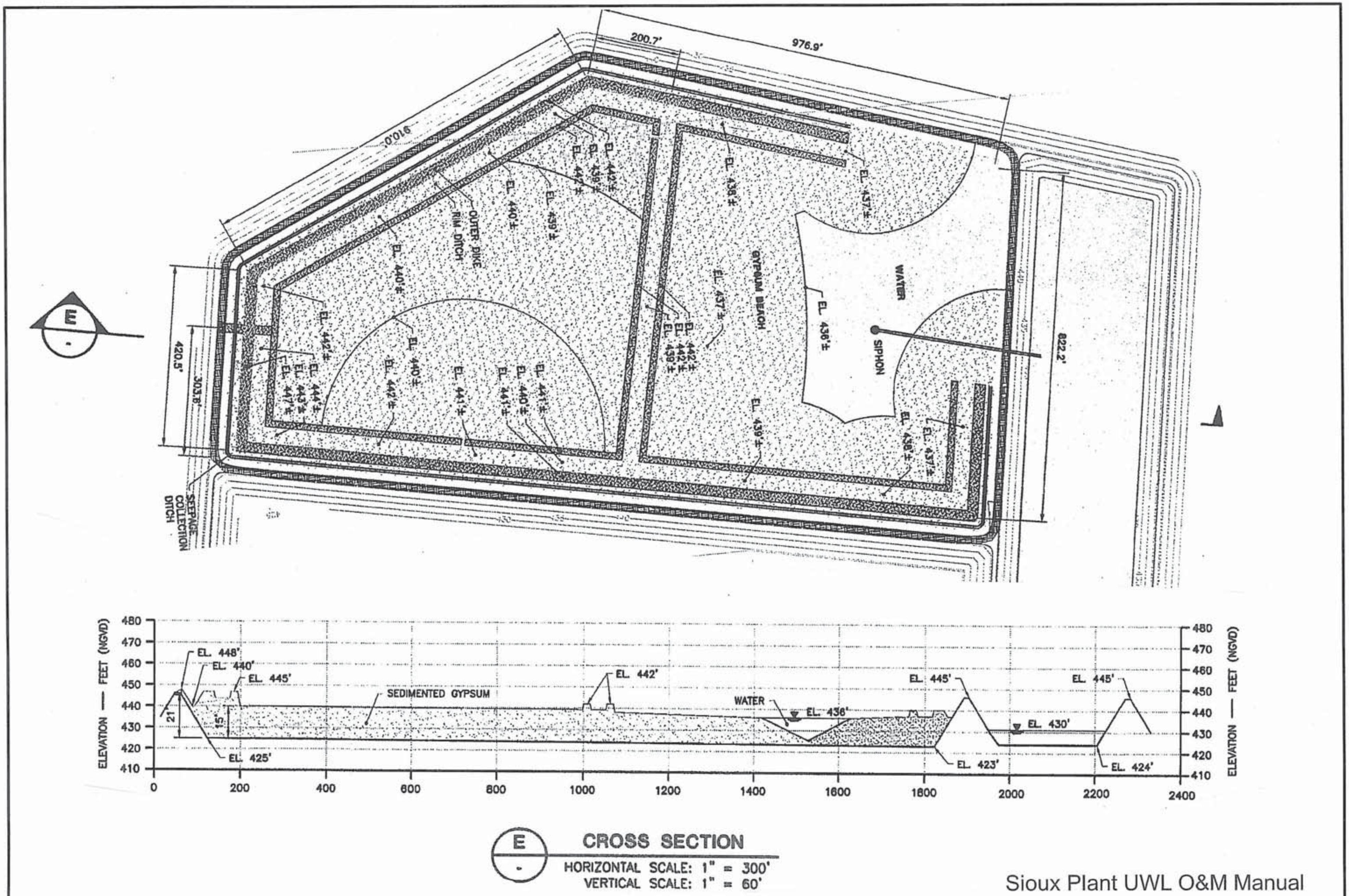
CROSS SECTION

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'

Sioux Plant UWL O&M Manual
END OF STAGE 4

Note: figure based on report by Ardaman & Associates, 2008. (Ref. 4 in Section 1.6)

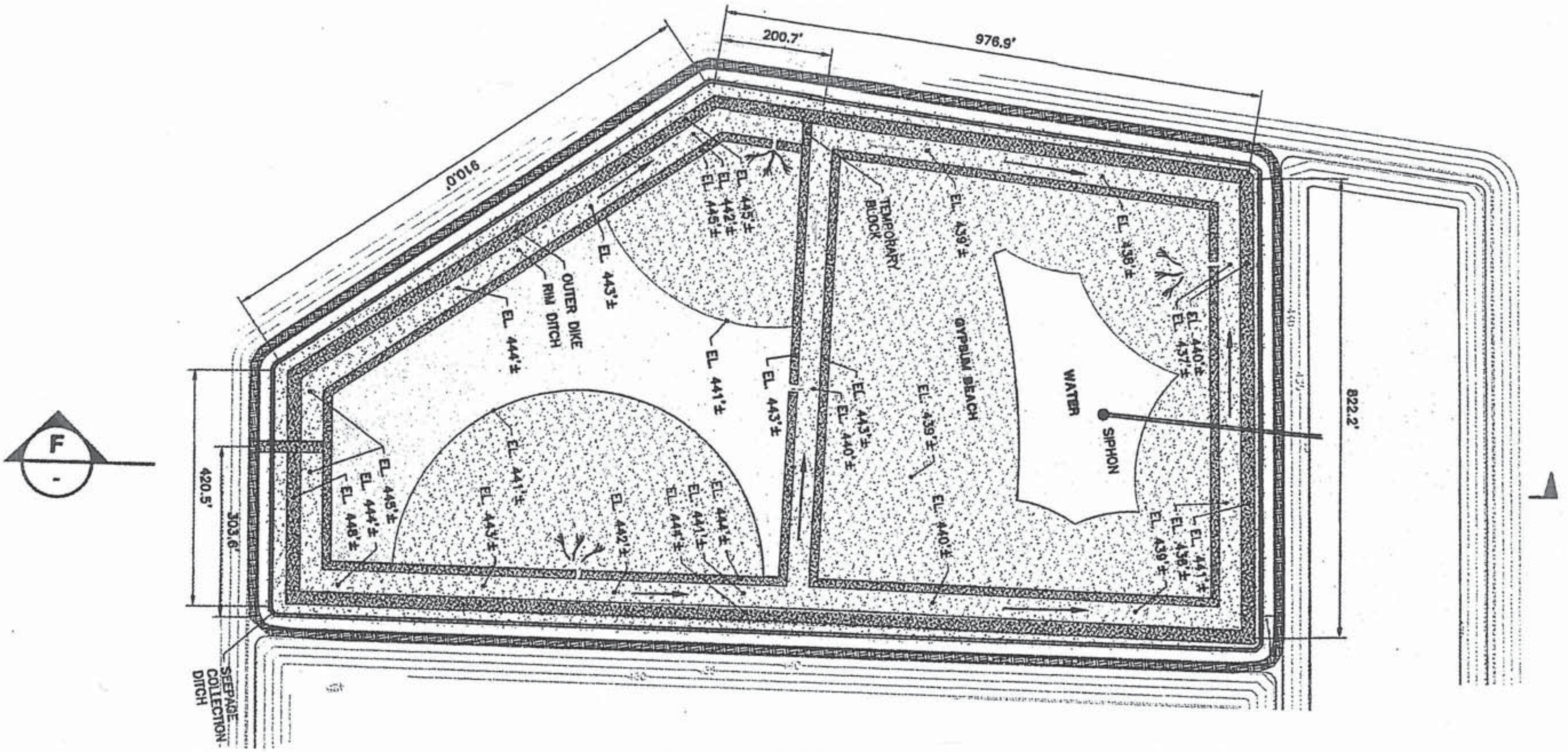
Figure C-3

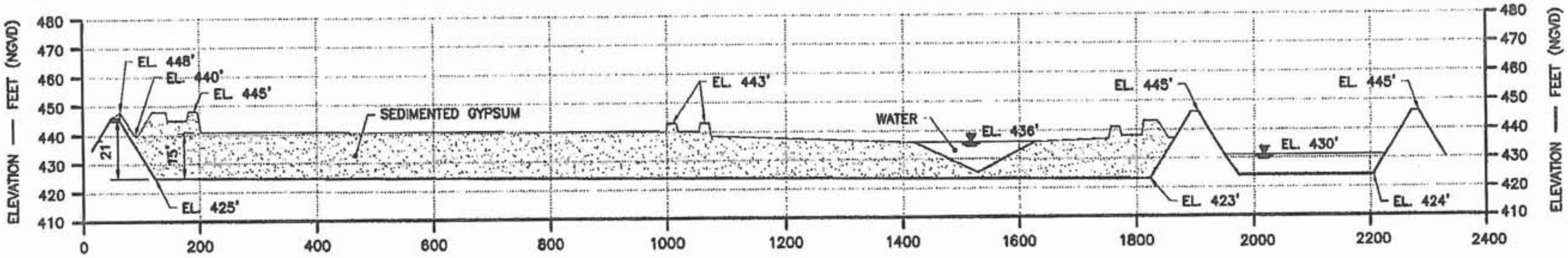


Sioux Plant UWL O&M Manual
STAGE 5

Figure C-4

Note: figure based on report by
Ardaman & Associates, 2008.
(Ref. 4 in Section 1.6)





F
-

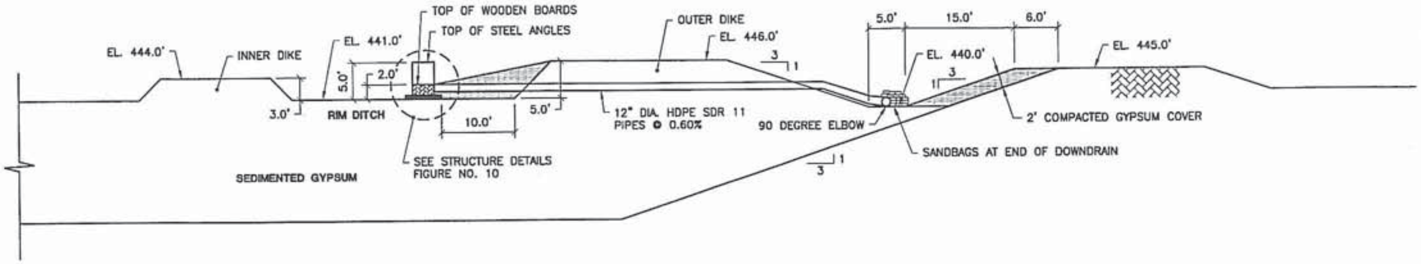
CROSS SECTION

HORIZONTAL SCALE: 1" = 300'
VERTICAL SCALE: 1" = 60'

Sioux Plant UWL O&M Manual
STAGE 6

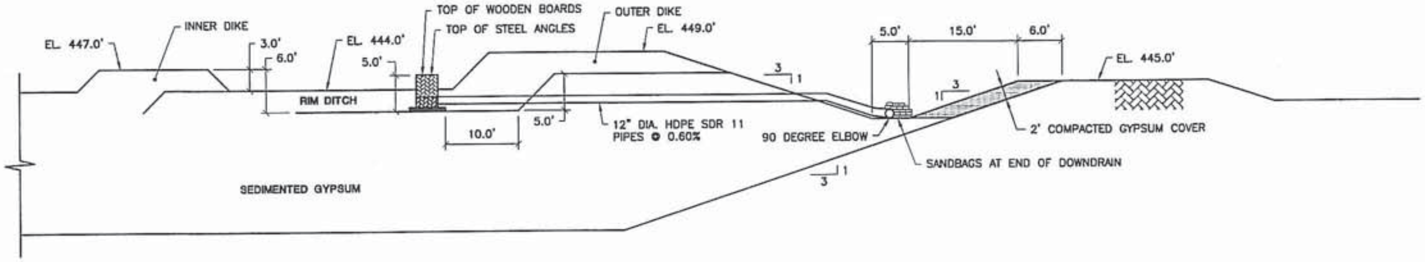
Note: figure based on report by Ardaman & Associates, 2008. (Ref. 4 in Section 1.6)

Figure C-5

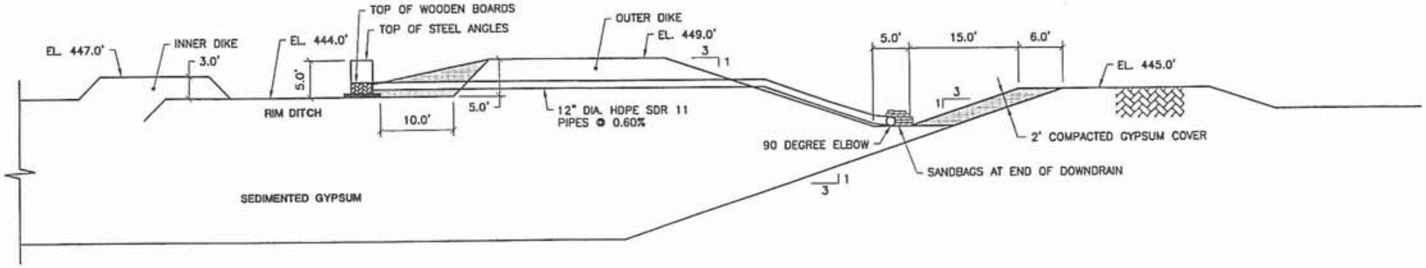


1-1
9

STEP 1 BUILD A BERM 10 FT INTO RIM DITCH TO PLACE DECANT RISER; EXCAVATE THROUGH OUTER DIKE TO BURY DECANT PIPE.



STEP 2 ADD FLASH BOARDS TO DECANT RISER TO KEEP SLURRY IN RIM DITCH 2 FT BELOW TOP OF FLASH BOARDS

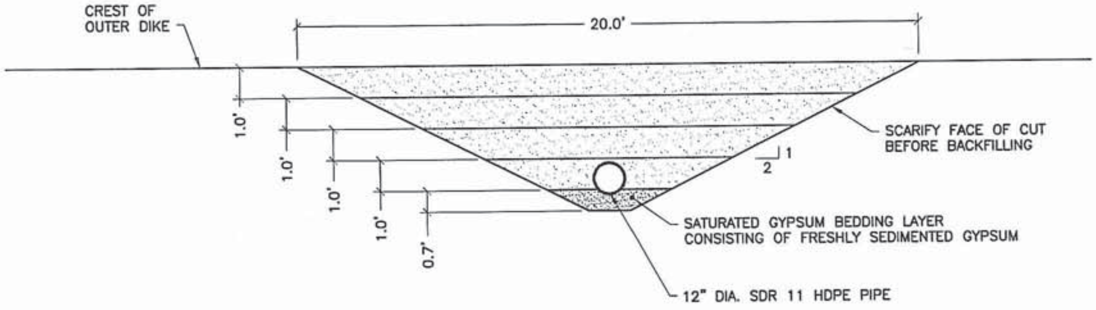


STEP 3 AFTER RIM DITCH RISES 3 FT, DIG DECANT RISER AND PIPE OUT AND REINSTALL THEM IN A NEARBY LOCATION (ABOUT 50 FT AWAY)

Note: figure based on report by
Ardaman & Associates, 2008.
(Ref. 4 in Section 1.6)

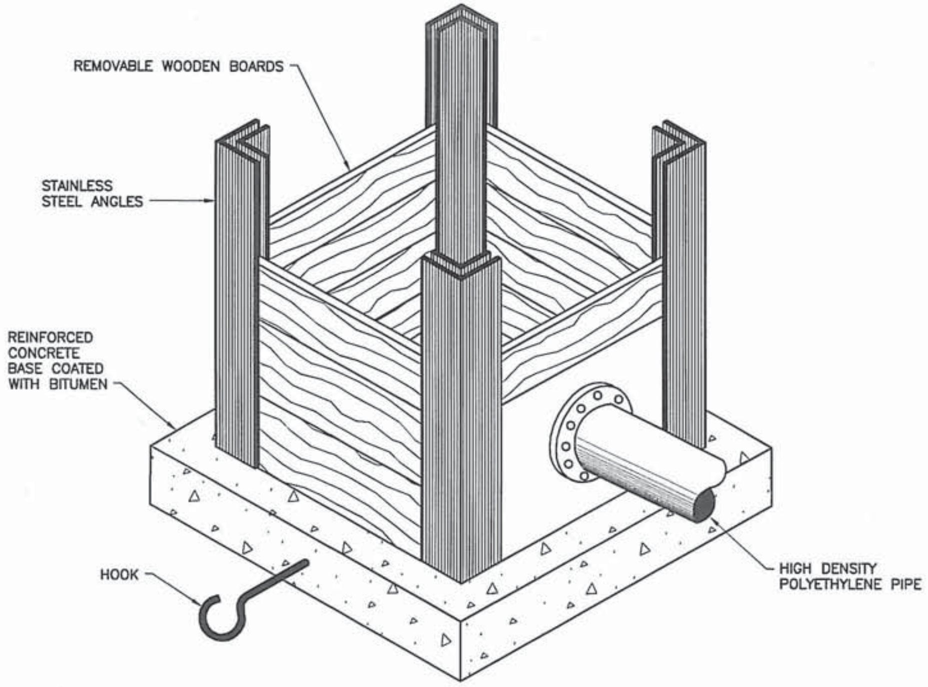
Sioux Plant UWL O&M Manual
DECANT STRUCTURE INSTALLATION

Figure C-6



AA' 10 **DECANT PIPE THROUGH OUTER DIKE**

(N.T.S.)



NOTE:
1. PLACE 8-in LIFT OF WET TO VERY WET GYPSUM AT BOTTOM OF EXCAVATION PRIOR TO INSTALLING PIPE;
2. PUSH PIPE INTO FRESHLY PLACED GYPSUM TO ENSURE INTIMITE CONTACT BETWEEN GYPSUM AND LOWER 1/3 PIPE;
3. HOLD PIPE DOWN WITH PILES OF WET GYPSUM SPACED EVENLY ALONG CENTERLINE OF PIPE;
4. PLACE AND TAMP WET TO VERY WET GYPSUM AROUND REMAINING CUT IN 12-INCH LIFTS, SCARIFYING BETWEEN LIFTS IF NECESSARY;
5. DO NOT DRIVE CONSTRUCTION EQUIPMENTS ACROSS BACKFILLED CUT OR USE THE RIM DITCH FOR AT LEAST 48 HOURS AFTER THE CUT HAS BEEN BACKFILLED;
6. BACKFILL EXCAVATION AT PREVIOUS DECANT STRUCTURE LOCATION BY TAMPING WET OR VERY WET GYPSUM IN 12-INCH LIFTS, SCARIFYING BETWEEN LIFTS AS NECESSARY;
7. PRIOR TO BACKFILLING A CUT, THE EXPOSED GYPSUM SURFACE SHALL BE SCARIFIED TO BREAK UP AND REMOVE ANY DRY OR CEMENTED SURFACE CRUST, IF PRESENT.

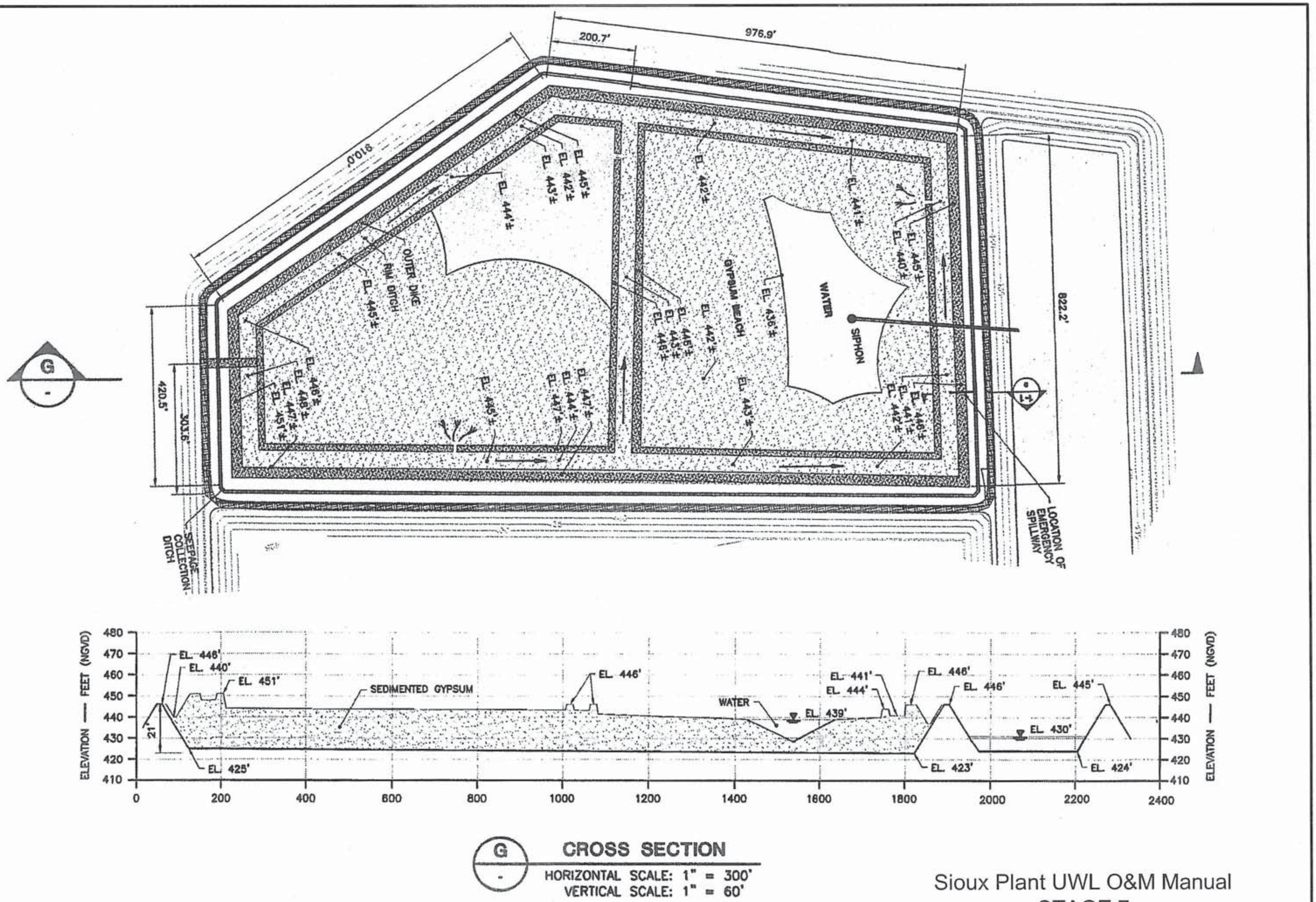
- 10 **MOVABLE OVERFLOW-TYPE DECANT STRUCTURE DETAIL**

(N.T.S.)

Note: figure based on report by
Ardaman & Associates, 2008.
(Ref. 4 in Section 1.6)

Sioux Plant UWL O&M Manual
DETAILS OF DECANT STRUCTURE

Figure C-7



Note: figure based on report by
Ardaman & Associates, 2008.
(Ref. 4 in Section 1.6)

Sioux Plant UWL O&M Manual
STAGE 7

Figure C-8

Ameren Missouri Sioux Energy Center UWL
Cells 1 & 4A and Recycle Pond O&M Manual

APPENDIX D

STATE AND LOCAL PERMITS

APPENDIX D – STATE AND LOCAL PERMITS

LIST OF CONTENTS

The following State and County permits and licenses have been obtained in order to construct and operate the UWL:

1. Missouri Department of Natural Resources (MDNR) Solid Waste Disposal Area Operating Permit No. 0918301, dated July 30, 2010.

2. MDNR Solid Waste Disposal Area Construction Permit No. 0918301, dated March 28, 2008.

3. Groundwater Monitoring Program incorporated into this Construction Permit.

4. MDNR Dam and Reservoir Safety Council Construction Permit C-426 (MO40160), dated April 1, 2008, amended April 8, 2010.

5. Letter of agreement by MDNR-DRSP, received February 16, 2011, of the Memorandum of Understanding dated August 5, 2008.

6. MDNR Dam and Reservoir Safety Council Construction Permit C-426 (MO40160), dated April 1, 2008, amended February 11, 2014.

7. St. Charles County Solid Waste Facility Operating License #04303 including Cell 4A, dated December 10, 2013.

8. St. Charles County Solid Waste Facility Operating License #04303, dated October 31, 2013.

9. MDNR Solid Waste Management Program Approval of Modified CPA, February 8, 2013.

10. MDNR Solid Waste Management Program Authorization to Operate (ATO) Cell 4A, December 6, 2013.

11. MDNR Solid Waste Management Program Approval of Initial Filling of Cell 4A with Conditions, dated April 6, 2015.

12. MDNR Solid Waste Management Program Modification of Permit No. 0918301 to incorporate the October 2015 Flood Protection Plan, dated October 28, 2015.

13. MDNR-SWMP “Biennial Airspace Estimate” Form

Missouri
Department of Natural Resources

Solid Waste Disposal Area Operating Permit

Permit Number 0918301
AmerenUE Sioux Power Plant Utility Waste Landfill
AmerenUE
St. Charles County

David J Lamb

Director, Solid Waste Management Program

Date: JUL 30 2010

STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Mark N. Templeton, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

JUL 30 2010

CERTIFIED MAIL # 7007-0710-0002-2053-9726
RETURN RECEIPT REQUESTED

Mr. Michael Menne
Ameren UE
One Ameren Plaza
1901 Choteau Avenue
St. Louis, MO 63103

RE: AmerenUE Sioux Power Plant Utility Waste Landfill, Utility Waste Disposal Area Construction Permit Number 0918301, St. Charles County

Dear Mr. Menne:

A request for an Operating Permit has been filed with the Missouri Department of Natural Resources' (Department) Solid Waste Management Program (SWMP) for AmerenUE Sioux Power Plant Utility Waste Landfill, Construction Permit Number 0918301.

Whereas, the permittee has demonstrated compliance with the requirements of 10 CSR 80-2.020(2)(B) to the Department's satisfaction; an Operating Permit is hereby granted for Cell 1, as shown on drawing 2 of the plan sheets titled "Construction of Cell 1 and Recycle Pond". This Operating Permit is hereby made an official part of Solid Waste Disposal Area Construction Permit Number 0918301.

The following documents are hereby approved and incorporated into Permit Number 0918301.

DOCUMENTS:

1. A letter dated July 15, 2010, from Mr. Paul Pike, Environmental Science Executive of Ameren Services. This document includes a response to the July 1, 2010, comment letter from the Solid Waste Management Program.

2. A letter dated May 27, 2010, to Ms. Charlene Fitch, Solid Waste Management Program, from Mr. Paul Pike, Ameren Services, and received on June 1, 2010, requesting the Operating Permit.

3. "Cell 1 Operating Permit Requirements Report", dated February 2010 and received February 26, 2010, prepared by Ben Moore, P.E. of GREDELL Engineering Resources, Inc.

4. "Cell 1 Final CQA Report", dated January 20, 2010, and received February 20, 2010, prepared by Jeffrey Fouse, P.E. of Reitz & Jens, Inc. Consulting Engineers to be included with the final CQA report prepared by Ben Moore, P.E. of GREDELL Engineering Resources, Inc. This document also includes a set of plan sheets dated May 18, 2009, revised November 2, 2009, titled "Construction of Cell 1 and Recycle Pond", prepared and stamped by Jeffrey Fouse, P.E. of Reitz & Jens, Inc. Consulting Engineers.

5. "Cell 1 HDPE Geomembrane Liner CQA Report", dated February 2010 and received February 19, 2010, prepared by Ben Moore, P.E. of GREDELL Engineering Resources, Inc.

6. "Cell 1 Clay Liner Report", dated October 21, 2009, revised December 4, 2009, and received on December 10, 2009, prepared by Jeffrey Fouse, P.E. of Reitz & Jens, Inc. Consulting Engineers to be included with the Final CQA Report prepared by Ben Moore, P.E. of GREDELL Engineering Resources, Inc.

7. "Ardaman & Associates Cell 1 Reports Volumes 1 and 2", dated October 2009 and received on November 17, 2009, prepared by Thomas Ingra, P.E. of Ardaman & Associates, Inc. and compiled by GREDELL Engineering Resources, Inc.

The following conditions are an integral part of this approval. Compliance with these conditions shall, in part, determine compliance with Permit Number 0918301.

CONDITIONS:

1. A request for Authorization to Operate must be submitted for approval at least sixty (60) days prior to moving into future cells.

2. Any facility design elements that you need to change or that may affect future construction or operation activities must be submitted and approved prior to beginning construction. Also, any design or operational changes, complete construction specifications, construction procedures, and construction grade drawings must be submitted and approved prior to implementation.

3. All silt fences must be inspected monthly or during a storm event, whichever is more frequent.

This approval is not to be construed as compliance with any existing federal or state environmental laws other than the Missouri Solid Waste Management Law; nor should this be construed as a waiver for any other regulatory requirements. This approval is not to be construed as compliance with any existing local permitting or zoning ordinances; nor does it supersede any local permitting and/or zoning requirements.

The Department reserves the right to revoke, suspend, or modify this approval and/or Permit Number 0918301 if the permit holder fails to maintain the facility in compliance with the state's Solid Waste Management Law, with the terms and conditions of the permit, or the approved engineering plans and specifications.

If you are adversely affected by this decision, you may appeal to have the matter heard by the Director of the Missouri Department of Natural Resources. To appeal, you must file a petition within thirty (30) days of the date that this decision was mailed or the date it was delivered, whatever date is earlier.

We appreciate your efforts towards environmentally sound solid waste management practices. If you have any comments or questions concerning this letter, please contact Ms. Charlene Fitch or Ms. Katherine Huxol of my staff at (573) 751-5401, or P.O. Box 176, Jefferson City, Missouri 65102-0176.

Sincerely,

SOLID WASTE MANGEMENT PROGRAM

David J. Lamb
Director

DJL:khl

c: Senator Tom Dempsey, Missouri Senate
Representative Kenny Biermann, Missouri House of Representatives
The Honorable Steve Ehlmann, County Executive, St. Charles County Government
Ben Moore, P.E., GREDELL Engineering Resources, Inc.
Mr. Mark N. Templeton, Director, Department of Natural Resources
Ms. Crystal Lovett-Tibbs, Legislative Liaison, Department of Natural Resources
Mr. Chris Nagel, Chief, Enforcement Section, Solid Waste Management Program
Mr. Rob Morrison, Chief, Permits Section, Water Protection Program
Mr. Eric Gramlich, Solid Waste Management Program
St. Louis Regional Office

Matt Blunt, Governor • Doyle Childers, Director
STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

MAR 2 8 2008

CERTIFIED MAIL #: 7007-0710-0002-2053-3168
RETURN RECEIPT REQUESTED

Mr. Paul R. Pike, Strategic Analyst
Ameren UE Sioux Utility Waste Landfill
1901 Chouteau Avenue
St. Louis, MO 63166-1419

RE: Ameren UE Sioux Power Plant Utility Waste Landfill, Solid Waste Disposal Area Construction Permit Number 0918301, St. Charles County

Dear Mr. Pike:

An application for a construction permit to construct the above-referenced solid waste disposal area was filed with the Missouri Department of Natural Resources on March 28, 2007. The application was subsequently revised in response to the Department of Natural Resources' Solid Waste Management Program's (SWMP) comments, and the revisions were submitted on September 21, 2007. The application was filed by Gredell Engineering Resources, Inc. for review and approval. The application, prepared by Thomas R. Gredell, P.E., includes engineering plans, specifications, operating procedures, and subsequent correspondence or amendments for the subject disposal area. The application was reviewed for compliance with the Missouri Solid Waste Management Law (Sections 260.200 to 260.345, RSMo), and the Missouri Solid Waste Management Regulations.

In accordance with Section 260.205.5(7), RSMo, the department hereby approves the application as provided in the enclosed "Ameren UE Sioux Power Plant Utility Waste Landfill, Solid Waste Disposal Area Construction Permit Number 0918301" issued to Ameren UE, as owner/operator, to construct a solid waste disposal area as of the date of this letter. The disposal area is located adjacent to the Ameren UE Sioux Power Plant, south of State Highway 94, approximately two miles east of the town of Portage Des Sioux, and adjoining the City of West Alton, in St. Charles County, Missouri. The general legal description is as follows: Township 48 North, Range 6 East. The Latitude is North 38 Degrees, 54 minutes, and the Longitude is West 90 degrees, 18 minutes. This permit applies only to that tract of land consisting of approximately 398 acres as described by the engineering plans, specifications, and operating procedures submitted to the department. The disposal area contains approximately 183.5 acres divided into two phases to be used for waste disposal. The remaining area is to be utilized for utility waste landfill-related design features such as borrow area, all-weather access roads, buffer zone, leachate collection and removal system, and storm water diversion structures.

The department may review this permit after the date of issuance and notify the permit holder as necessary to assure the landfill continues to comply with the currently applicable requirements and provisions of the Missouri Solid Waste Management Law and rules adopted thereunder. Approval of the application and issuance of this permit is given with the explicit understanding that the disposal area will be developed and operated in compliance with the approved plans, specifications, operating procedures, the conditions of the permit, the Missouri Solid Waste Management Regulations, and the Missouri Solid Waste Management Law. This permit is not to be construed as compliance with any existing federal or state environmental laws other than the Missouri Solid Waste Management Law; nor should this be construed as a waiver for any other regulatory requirements. This permit is not to be construed as compliance with any existing local ordinances or zoning requirements.

As the holder of this permit, you are required to comply with all applicable environmental laws and regulations enforced by the department. These environmental requirements are administered by the department's Air Pollution Control Program, Water Protection Program, Land Reclamation Program, Hazardous Waste Program and SWMP. In addition, you are required to comply with all applicable environmental laws administered by the government of St. Charles County, Missouri. Noncompliance with these environmental laws and regulations may, in certain circumstances, result in the suspension or revocation of this permit and may subject the permit holder to civil and criminal liability.

The Missouri Department of Natural Resources is committed to reducing, reusing and recycling all materials that might otherwise become waste. We believe reducing the amount of waste going into landfills has a multitude of economic as well as environmental benefits for Missouri citizens and businesses. Accordingly, we strongly encourage you to utilize and support materials recycling and reuse programs and techniques that reduce the amount of waste going into the landfill and make efficient use of our precious natural resources.

If you are aggrieved by this decision, you may be entitled to seek further administrative or judicial review pursuant to Section 260.235 or Section 536.150 of the Missouri Revised Statutes. Any appeal of the decision should be filed with the Director within 30 days of notice of the decision.

The department reserves the right to revoke, suspend, or modify Permit Number 0198301 if the permit holder fails to maintain the facility in compliance with the state's Solid Waste Management Law and regulations, the terms and conditions of the permit, and the approved engineering plans and specifications.

I appreciate your cooperation. If you have any questions, please contact Charlene Fitch, P.E., of the department's SWMP at (573) 751-5401 or P.O. Box 176, Jefferson City, Missouri 65102-0176.

Sincerely,

DIVISION OF ENVIRONMENTAL QUALITY

Daniel R Schuette

Daniel R. Schuette
Director

DRS:szl

Enclosure

c: The Honorable Tom Dempsey, Missouri Senate
The Honorable Vicki Schneider, Missouri House of Representatives
Mr. Steve Ehlmann, St. Charles County Executive
Mr. Mike Duvall, St. Charles County Government
Thomas R. Gredell, P.E., Gredell Engineering Resources, Inc.
Mr. David Berger, St. Louis-Jefferson Solid Waste Management District
Mr. James Alexander, Dam Safety Program, Division of Geology and Survey
Mr. Mike Alesandrini, Ombudsman, St. Louis Regional Office
St . Louis Regional Office

MISSOURI DEPARTMENT OF NATURAL RESOURCES
SOLID WASTE PERMIT

Ameren UE Sioux Utility Waste Landfill
Solid Waste Disposal Area Construction Permit Number 0918301
St. Charles County, Missouri

Issue Date: MAR 28 2008

FACILITY DESCRIPTION

This facility is a utility waste landfill located adjacent to the Ameren UE Sioux Power Plant, south of State Highway 94, approximately two miles east of the town of Portage Des Sioux, and adjoining the City of West Alton, in St. Charles County, Missouri. The general legal description is as follows: Township 48 North, Range 6 East. The Latitude is North 38 Degrees, 54 minutes, and the Longitude is West 90 degrees, 18 minutes. This permit applies only to that tract of land consisting of approximately 398 acres as described by the engineering plans, specifications, and operating procedures submitted to the department. The disposal area contains approximately 183.5 acres divided into two phases to be used for waste disposal. The remainder is to be utilized for utility waste landfill-related design features such as borrow area, all-weather access roads, buffer zone, leachate collection and removal system, and storm water diversion structures.

PERMIT DOCUMENTS

These documents are incorporated by this reference into Permit Number 0918301:

1. A letter dated February 6, 2007, to Mr. Jim Bell, Chief of Engineering, from Mr. Paul R. Pike, Strategic Analyst of Ameren UE, received February 8, 2007, requesting the Construction Permit.

2. Ameren UE Sioux Power Plant, Construction Permit Application for a Proposed Utility Waste Landfill, St. Charles County, Missouri, prepared by Ameren UE, first received February 8, 2007, deemed completed on March 28, 2007, last revised September 21, 2007. The Construction Permit Application form designates Ameren UE as the owner and operator of the landfill and Gredell Engineering Resources, Inc. as the engineering firm. Thomas R. Gredell, P.E., is the certifying professional engineer registered in Missouri.

3. Detailed Geologic and Hydrologic Site Investigation Report for Ameren UE Sioux Power Plant, Proposed Utility Waste Disposal Area, St. Charles County, Missouri, Volume I and II, prepared by Daniel E. Klockow, P.E., R.G., Gredell Engineering Resources, Inc., received February 8, 2007.

4. Engineering drawings numbered Sheet 1 of 22 through Sheet 22 of 22, titled, Ameren UE Sioux Power Plant, Proposed Utility Waste Landfill, St. Charles County, Missouri, September 2007, prepared by Reitz and Jens, Inc. and Gredell Engineering Resources, Inc., dated March 28, 2007, revised September 21, 2007. Thomas R. Gredell, P.E., is the certifying professional engineer registered in Missouri.

5. A letter dated September 20, 2007, to Jim Bell, Chief of Engineering, from Paul R. Pike, Strategic Analyst of Ameren UE, received September 21, 2007, in response to the SWMP's comment letter dated June 28, 2007.

6. A letter dated November 29, 2007, to Charlene Fitch, P.E., Solid Waste Management Program (SWMP), from Thomas R. Gredell, P.E., Gredell Engineering Resources, Inc., received December 3, 2007, responding to MDNR's verbal comments on October 23, 2007.

7. A letter dated February 20, 2008, to Jim Bell, SWMP, from Steven Lauer, of the St. Charles County Commission, received February 25, 2008, confirming the Ameren UE Sioux Power Plant Utility Waste Landfill is in compliance with local zoning in St. Charles County.

GENERAL CONDITIONS

The following general conditions are an integral part of Permit Number 0918301. Compliance with these general conditions shall, in part, determine compliance with the permit. All reports, plans, and data required to satisfy these general conditions shall be prepared or approved by a professional engineer registered in the state of Missouri.

1. Operation and Design

   Any change in the operation and/or design of this facility other than that which has been described in the application and approved in this permit is a modification of the permit, and prior written approval shall be obtained in advance of the permittee making that change.

2. Easement, Notice and Covenant

   The owner and the department shall execute:

   A. An easement to allow the department, its agents or its contractors, to enter the premises to complete work specified in the closure plan, monitor or maintain the site, or take remedial action during the post-closure period; and

   B. A notice and covenant indicating that the property has been permitted as a solid waste disposal area and prohibiting use of the land in any manner which interferes with the closure and post-closure plan filed with the department.

   To satisfy these requirements, the Missouri Department of Natural Resources' Solid Waste Management Program (SWMP) has prepared a standard document titled Agreement for Easement, Notice and Covenant Running with the Land. This document is available electronically for your use. At least two (2) copies of the original document shall be submitted to the department's SWMP for approval and signature within thirty (30) days of the date of this permit.

3. Borehole Abandonment

All exploratory boreholes, abandoned monitoring wells and abandoned piezometers shall be plugged in accordance with 10 CSR 23-3.110, "Permanent Abandonment of Wells" and 10 CSR 23-4.080, "Plugging of Monitoring Wells," or an alternate method approved by the department. Proof of proper abandonment of boreholes and piezometers within each cell boundary shall be submitted to the department's SWMP for approval prior to requesting an operating permit for each subsequent cell.

4. Groundwater Monitoring

A. Groundwater monitoring shall be required per the following documents, which are hereby incorporated by reference into solid waste Permit Number 0918301:

1. "Groundwater Sampling and Analysis Plan" Appendix S-REVISED 9-07, of the Construction Permit Application (including all tables, figures and appendices included in Appendix S-REVISED 9-07); and

2. The enclosed document titled GROUNDWATER MONITORING PROGRAM, Ameren UE, Permit Number 0918301 dated MAR 28 2008, which is hereby incorporated by reference into solid waste Permit Number 0918301.

B. Before an operating permit will be granted, the construction of all groundwater monitoring wells shall be approved by the department. Two (2) copies of the geologist's boring logs and as-built drawings showing the well construction for any new monitoring wells, as well as two (2) copies of plan sheets that show the as-built locations of these wells, shall be submitted to the department's SWMP.

5. Liner and Final Cover

A. All borrow material used for liner and cover construction shall be from a previously sampled and approved borrow area.

B. The top surface of each lift of the compacted clay soil liner and final cover shall be scarified prior to placement of an over-lying lift of liner soil.

C. The top surface of the final lift of the compacted clay liner shall be smooth drum rolled prior to flexible membrane liner placement to ensure intimate contact between the compacted clay liner and the flexible membrane liner.

D. The soils to be used for liner and cover construction shall be periodically tested and analyzed to ensure they meet the requirements as described in the engineering report.

The compaction of the soil liner and final cover shall be confirmed via the following Quality Assurance/Quality Control (QA/QC) procedures. All QA/QC data results shall be submitted to the department's SWMP as follows:

1. On every 5,000 cubic yards of soil to be applied, perform laboratory tests of grain size, soil classification, Atterberg limits, permeability, and density/moisture testing (Standard or Modified Proctor).

2. Whenever soil conditions change, perform laboratory analysis on at least one representative sample for every 5,000 cubic yards of material used for construction.

3. All laboratory analysis on soil shall be performed prior to initial placement of soil.

4. Nuclear gauge field density and moisture tests (ASTM D2922-81) shall be performed on each lift of the soil liner and final cover. Testing shall be performed at a maximum horizontal spacing of one hundred (100) foot centers, offset fifty (50) feet, for each lift of the liner. Any portion of the liner and final cover which fails to meet the minimum compaction specification shall be removed, recompacted and retested.

5. A moisture/density calibration adjustment shall be performed at the start of each construction phase, when the soil used for liner/cover construction changes, when you change instruments, or every 12 months, which ever occurs first. Calibration adjustment procedures are covered in Annex A1, paragraph Al.3 of ASTM D 3017-88.

6. Elevations of the bottom and top of the landfill compacted soil liner and final cover shall be checked at a maximum horizontal spacing of one hundred (100) foot centers.

E. Installation of the flexible membrane liner and cover shall be performed in accordance with the QA/QC measures specified in the approved engineering report, and with the manufacturer's recommendations.

F. Please supply the department's SWMP with QA/QC data and results on the composite liner's geosynthetic components for each phase and conduct both nondestructive and destructive testing on the geomembrane.

G. The permittee shall provide seven (7) days advance notice of the following activities to the department's SWMP:

1. Test pad construction;

2. Subgrade excavation;

3. Placement of the soil component of the liner system, including final surface preparation;

4. Placement of the geosynthetic components of the liner system; and

5. Placement of the leachate collection system and its protective layer.

6. Placement of the final cover system.

The department's SWMP reserves the right to inspect and approve or disapprove any of the above-mentioned activities during the construction of the landfill.

6. Construction Quality Assurance Plan and Test Pad

A. The department may require you to revise the Construction Quality Assurance (CQA) Plan included in Appendix P-REVISED 9-07 of the approved engineering report following completion of the test pad. All construction and testing methods determined to be necessary during test pad construction shall be incorporated into the CQA plan at that time. The department must review and approve the revised CQA plan prior to construction of the liner system for the first landfill phase or cell.

B. Determination of soil placement criteria and construction of a test pad are required for each soil type proposed for use in liner construction. The department reserves the right to require test pads for future phases.

C. In addition to the testing outlined in the approved engineering report, a minimum of five (5) uniformly spaced nuclear moisture/density tests, per ASTM D 3017 and ASTM D 2922, shall be performed on each lift of the test pad.

D. At a minimum, the following information shall be included in each test pad report.

   1. A detailed discussion explaining how each soil type was identified and characterized to determine the acceptable placement range. The discussion shall also take into account the soil testing performed during the detailed site investigation. This discussion shall include, at a minimum, a comparison of the following soil properties:

      a) Grain Size
      b) Atterbergs
      c) USCS soil classification
      d) Optimum moisture content
      e) Maximum dry density

    f) Color
    g) Texture

2. For each soil type, one plot showing the Proctor curves using symbology indicating which Proctor points passed the hydraulic conductivity criteria and which failed.

3. For each soil type, one plot showing the field moisture/density test results compared with the Proctor curves and the moisture and density pass/fail criteria.

4. A map showing soil sample locations and depths. All laboratory test reports shall be clearly correlated to sample locations.

5. A detailed discussion of the successful and unsuccessful construction techniques used, including:

    a) Methods of moisture conditioning
    b) Methods of surface preparation for each lift
    c) Depth of penetration of the compactor feet

6. A discussion of the amount of compactive effort applied to each lift of compacted soil based on the type and weight of equipment used, the number of passes, and the lift thicknesses.

7. A detailed discussion of how each soil type was identified in the field in order to correlate it to the proper soil placement range.

8. Documentation that all required calibration procedures specified by ASTM D 2922 and ASTM D 3417 (nuclear density and moisture testing) were performed before/during test pad construction.

9. A description of the methods used for subgrade preparation.

10. Copies of all field notes taken during test pad construction.

7. Operating Permit

When requesting the Operating Permit for the initial cell, three (3) copies of a written report shall be submitted containing all QA/QC data/results, as-built drawings, drawing(s) showing details of inter-phase berms, and a certification by a professional engineer who is registered in the state of Missouri stating that the landfill cell was constructed as per the department-approved engineering design plans and specifications. The certification shall be signed, or sealed, and dated by both the permittee and a professional engineer registered in the state of Missouri. The report and certification shall be approved by the department's SWMP before the Operating Permit for the initial cell will be granted.

If an application for the Operating Permit for the initial cell of the solid waste disposal area is not received by the department within sixty (60) months of issuance of the Construction Permit, the applicant, prior to submittal of an Operating Permit Application, shall hold a public awareness and community involvement session, solicit comments, and respond to the comments; submit to the department for approval any necessary changes to the design and operation of the facility so as to be in compliance with currently applicable law and rules; and submit to the department an updated violation history disclosure statement.

8. Authorization to Operate

When requesting Authorization to Operate for all subsequent cells, two (2) copies of a written report shall be submitted containing all QA/QC data/results, as-built drawings, drawing(s) showing details of inter-phase berms and the tie-in of liner elements to previously constructed phases, and a Missouri registered professional engineer's certification that each was constructed as per the department-approved engineering design plans and specifications. The certification shall be signed, or sealed, and dated by both the permittee and the Missouri registered professional engineer. The report and certification must be approved by the department's SWMP before Authorization to Operate for that cell will be issued. Additionally, the closure FAI for the subsequent cells must be submitted and approved.

9. Surface Water Control

Before an Operating Permit will be issued, the permittee shall provide correspondence to the department showing that all applicable permits and design approvals have been acquired from the Missouri Department of Natural Resources' Water Protection Program (WPP). As related to design approvals, the department's WPP may need to issue a Construction Permit for each sedimentation pond.

10. Air Pollution Control

Before an Operating Permit will be issued, the permittee shall provide correspondence to the department showing that all applicable permits and design approvals have been acquired from the Missouri Department of Natural Resources' Air Pollution Control Program.

11. Dam Safety

Before an Operating Permit will be issued, the permittee shall provide correspondence to the department showing that all applicable permits and design approvals have been acquired from the Missouri Department of Natural Resources' Water Resources Center, Dam & Reservoir Safety.

12. Statistical Evaluation of Groundwater Data

A. The department's SWMP shall be notified and allowed to review any changes in the statistical evaluation as they occur.

B. The permittee shall notify the department's SWMP of any statistical deviations in the groundwater data as they occur.

C. A minimum of four (4) rounds of groundwater monitoring data must be collected prior to filling.

D. Ameren UE has agreed to collect quarterly samples until there are 12 sets of samples.

SITE SPECIFIC CONDITIONS

A. In the future, should Ameren decide to reclaim the gypsum by-product from the permitted waste area, the department's SWMP must approve the reclamation plan prior to disturbance of the permitted area.

B. The Missouri Department of Transportation (MoDOT) must approve the design and related parameters regarding the proposed waste transport system (sluicing the waste over State Highway 94). A copy of the official MoDOT approval must be provided prior to the issuance of an operating permit.

C. A stockpiling plan for liner quality soil will be developed by the landfill construction contractor and/or geo-tech engineer. Once this plan is developed, please provide a copy to the department.

D. The wet gypsum stacking method of filling is approved; should Ameren UE wish to accept other coal combustion by-product wastes, a permit modification must be submitted.

DISPOSAL AREA DESCRIPTION

The types of waste to be accepted shall consist of coal combustion by-products including but not limited to fly ash, coal wastes, boiler slag and flue gas desulfurization wastes (gypsum).
The area fill method of utility waste landfill operation shall be utilized. The excavation depths and solid waste fill locations shall be completed as shown on the approved engineering plans and specifications. Upon completion of the disposal area, the final cover shall be graded, limed, fertilized as necessary, and seeded with grasses to control erosion. Continued maintenance of the

area shall be provided in accordance with the approved post-closure plan. All fencing, gates, equipment maintenance buildings, all-weather access roads, signs, surface-water control devices, leachate treatment facilities, operating equipment, standby equipment, and other necessary appurtenances shall be provided as per the approved plans, specifications, and operating procedures. The plans, specifications, and operating procedures described above have been examined as to engineering features of design which might affect the operation of the solid waste disposal area as a utility waste landfill.

MODIFICATION AND TERMINATION OF PERMIT

The department reserves the right to revoke, suspend, or modify Permit Number 0918301 if the permit holder fails to maintain the facility in compliance with the Missouri Solid Waste Management Law and regulations, the terms and conditions of the permit, or the approved engineering plans and specifications.

MAR 28 2008

Date of Permit

Daniel R Schuette

Daniel R. Schuette, Director
DIVISION OF ENVIRONMENTAL QUALITY

GROUNDWATER MONITORING PROGRAM
Ameren UE, Sioux Utility Waste Landfill
Permit Number 0918301
Date MAR 2 8 2008

A. INCORPORATED DOCUMENTS

The following documents are incorporated by this reference into the Groundwater Monitoring Program of Permit Number 0918301:

1. "Groundwater Sampling and Analysis Plan" Appendix S, of the Ameren UE Sioux Power Plant, Construction Permit Application, prepared by Gredell Engineering Resources, Inc., first received March 28, 2007, last revised September 21, 2007. The Construction Permit Application designates Ameren UE as the owner and operator of the landfill, and Gredell Engineering Resources, Inc., as the engineering firm. Thomas R. Gredell, P. E. is the certifying professional engineer registered in Missouri.

2. Engineering drawing Figure 2, "Monitoring Well Location Map" received September 21, 2007.

B. MONITORING WELLS

The groundwater monitoring network of the Ameren UE Sioux Utility Waste Landfill shall consist of 16 monitoring wells. This monitoring system will be used to monitor groundwater flowing beneath the landfill. UG-1, UG-2, UG-3 and UG-4 will be background (upgradient) monitoring wells. DG-1, DG-2, DG-3, DG-4, DG-5, DG-6, DG-7, DG-8, DG-9, DG-10, DG-11, and DG-12 will be compliance (downgradient) monitoring wells.

The Missouri Department of Natural Resources' Solid Waste Management Program (SWMP) and the Division of Geology and Land Survey (DGLS) shall review any changes in direction of groundwater flow from potentiometric surface maps; and as waste filling progresses in the landfill. The department's SWMP shall review all groundwater monitoring data to evaluate statistical determinations.

The existing and new (to be installed) monitoring wells listed in Table I are those for which Ameren UE Sioux Utility Waste Landfill is responsible for reporting bailing, purging, sampling, and field observations, and to provide representative sampling parameter analyses from the Sioux Utility Waste Landfill. For consistency in designations, the department's SWMP will use the monitoring point designations as shown in Table I. These designations shall appear on subsequent electronic submissions of groundwater data and groundwater monitoring reports. These monitoring designations shall be referenced in future correspondence associated with this permit.

Table I

COMPLIANCE SUBJECT TO CHANGE BY THE SWMP AND DGLS	MONITORING WELL LOCATIONS	MONITORING WELL DESIGNATIONS
Upgradient	**Monitoring well** UG-1 located at approximately N1118957, E877795.	UG-1
Upgradient	**Monitoring well** UG-2 located at approximately N1118859, E879319.	UG-2
Upgradient	**Monitoring well** UG-3 located at approximately N1118609, E880519.	UG-3
Upgradient	**Monitoring well** UG-4 located at approximately N1118616, E881530.	UG-4
Compliance	**Monitoring well** DG-1 located at approximately N1117387, E877384.	DG-1
Compliance	**Monitoring well** DG-2 located at approximately N1116940, E877618.	DG-2
Compliance	**Monitoring well** DG-3 located at approximately N1116572, E877920.	DG-3
Compliance	**Monitoring well** DG-4 located at approximately N1116403, E878421.	DG-4
Compliance	**Monitoring well** DG-5 located at approximately N1116330, E878919.	DG-5
Compliance	**Monitoring well** DG-6 located at approximately N1116257, E879418.	DG-6
Compliance	**Monitoring well** DG-7 located at approximately N1116185, E879912.	DG-7
Compliance	**Monitoring well** DG-8 located at approximately N1116114, E880398.	DG-8

COMPLIANCE SUBJECT TO CHANGE BY THE SWMP AND DGLS	MONITORING WELL LOCATIONS	MONITORING WELL DESIGNATIONS
Compliance	**Monitoring well** DG-9 located at approximately N1116162, E880902.	DG-9
Compliance	**Monitoring well** DG-10 located at approximately N1116080, E881456.	DG-10
Compliance	**Monitoring well** DG-11 located at approximately N1115995, E882006.	DG-11
Compliance	**Monitoring well** DG-12 located at approximately N1116386, E882290.	DG-12

For each monitoring event, prepurging water level elevations from all piezometers and monitoring wells shall be recorded and the data electronically submitted to the department's SWMP with the other groundwater sampling data. Piezometers within the landfill footprint shall be maintained and monitored as long as possible before landfill construction reaches their location. Piezometers within the landfill foot print shall be properly abandoned.

The department's DGLS shall be notified prior to mobilization of any drilling so that on-site technical assistance can be provided to the driller and site manager.

Any field investigations shall include a descriptive log as noted in the guidance document entitled, APPENDIX 1, GUIDANCE FOR CONDUCTING AND REPORTING DETAILED GEOLOGIC AND HYDROLOGIC INVESTIGATIONS AT A PROPOSED SOLID WASTE DISPOSAL AREA. At the time of construction of any new monitoring well, full details concerning the drilling procedures and development shall be reported to the department's SWMP and the department's DLGS before the department will grant approval for each well. The information and data submitted to the department's SWMP and the department's DGLS shall include, but not be limited to the following:

1. Depth and lithologic description of all water bearing or saturated zones encountered during drilling;

2. Descriptions of all geologic materials encountered and sampled during drilling, including: lithology, mineralogy, texture, grain-size, color, fossil occurrence, percent sample recovery, and primary/secondary porosity features;

3. Changes in porosity and degrees of saturation of all geologic materials encountered, (e.g., dry, damp, moist, wet, and/or saturated) including their associated depths from the ground surface;

4. Water level depths measured from the ground surface immediately following daily final drilling activity and measured preceding any subsequent drilling activity;

5. Complete records of drilling fluid volumes, including any lost fluid volumes and depths at which they are lost;

6. Complete records of recovered (lost) fluids prior to installation and development of well;

7. A description of all sources and chemical analyses of potable water used in drilling or boring, analyzing for the same chemical parameters as specified in the enclosed groundwater parameters to establish baseline groundwater quality;

8. Complete details or method(s) of drilling, including starting and ending times, depth and location of any drilling equipment refusals;

9. Measurements of drilling rate, including pressure gauges or weights on bit read during drilling and coring;

10. Measurements of soil sampling advance (e.g., loads on the sampling device as specified by the weight or number of blow counts to sample and/or refusal);

11. Complete details of well development, including starting and ending times;

12. Appearance of well fluids before, during, and after development;

13. Records of indicator parameters monitored throughout development;
14. Initial and final water levels immediately prior and immediately after development;
15. Initial well bore fluid volume (gallons);
16. Initial depth of well prior to development, in feet, from a specified point;
17. Total depth of well immediately after development from a specified point;
18. Total volume (gallons) evacuated during development;
19. Complete copies of all field notes;
20. Complete copies of monitoring well construction summaries having north and east location survey coordinates;
21. Complete copies of monitoring well boring logs having detailed soil and lithologic graphics/descriptions; and
22. Complete copies of the Monitoring Well Certification Record.

Existing or new wells improperly constructed, or screened to monitor improper or inadequate zones shall be abandoned as per 10 CSR 23-4.

All wells shall be constructed in accordance with Missouri Department of Natural Resources' Well Construction Codes, 10 CSR 23-1 through 6.

As per monitoring well construction standards cited above, each well borehole shall be at least four (4) inches larger than the outside diameter of the casing used.

Well construction (including locking cap security casing) shall be completed the same day the well casing is installed.

No wells shall be located in swales, drainage ditches, or any place where water can accumulate around the well.

Suggested monitoring well locations are based on hydrogeologic and topographic information, and do not take into account the location of any man-made alterations to the site. Alternate locations may be required if conflicts arise with the suggested locations.

C. SAMPLING FREQUENCY/PARAMETERS

1. Baseline and Background Sampling

Prior to filling in a phase/cell, baseline sampling shall start with at least four (4) quarters of independent samples as described in 10 CSR 80-3.010(11)(C)3 for all new monitoring wells designated in this document. A minimum of eight (8) independent samples shall be taken over the first eight (8) quarters after the date of development of any new monitoring well. Each of these baseline samples shall be analyzed for the groundwater monitoring parameters contained in the enclosed list titled Groundwater Monitoring Parameters. During baseline sampling, compliance monitoring wells shall be sampled during the first, second, third, and fourth quarters of a year for the parameters contained in the enclosed lists.

Subsequent to the first eight (8) quarters of baseline monitoring the background database for each monitoring well will be updated with detection monitoring data as described in Appendix S, "Groundwater Sampling and Analysis Plan".

2. Detection Monitoring

After the previously described eight (8) quarters of baseline sampling have been completed, all monitoring wells shall be sampled semi-annually for the parameters contained in the enclosed list entitled Groundwater Monitoring Parameters.
All sampling results shall be submitted electronically to the department's SWMP within ninety (90) days from the date the sample is obtained.

3. Assessment Monitoring

Permittee shall follow the procedures outlined in 10 CSR 80-11.010(11)(C)6 as a response to statistical analysis of significant difference in groundwater sampling results.

D. GROUNDWATER MONITORING PROGRAM

Statistical analyses of groundwater data or additional hydrogeologic characterization through subsurface sampling and testing could alter the interpretation of previous hydrogeologic investigations. Approval of this Groundwater Monitoring Program does not preclude it from any future revision.

E. INQUIRIES

All inquiries concerning these reporting procedures and/or any discussion of possible deviations from these reporting procedures shall first be directed to the department's SWMP at (573) 751-5401 for consideration by the department.

GROUNDWATER MONITORING PARAMETERS

Inorganic and Other Parameters

Arsenic (As, μg/l)
Aluminum (Al, μg/l)
Antimony (Sb, μg/l)
Barium (Ba, μg/l))
Beryllium (Be, mg/l)
Boron (B, μg/l)
Cadmium (Cd, μg/l)
Calcium (Ca, mg/l)
Chemical Oxygen Demand (COD, mg/l)
Chlorides (Cl, mg/l)
Chromium (Cr, μg/l)
Cobalt (Co, ug/l)
Copper (Cu, ug/l)
Fluoride (Fl, mg/l)
Hardness (calculated, mg/l)
Iron (Fe, μg/l)
Lead (Pb, μg/l)
Magnesium (Mg, mg/l)
Manganese (Mn, μg/l)
Mercury (Hg, μg/l)
Nickel (Ni, mg/l)
pH (s.u.)
Selenium (Se, μg/l)
Silver (Ag, μg/l)
Sodium (Na, mg/l
Specific Conductance(Conductivity at 25° C,mhos/cm)
Sulfate (SO_4, mg/l)
Thallium (Tl, μg/l)
Total Dissolved Solids (TDS, mg/l)
Total Organic Carbon (TOC, mg/l)
Total Organic Halogens (TOX, mg/l)
Zinc (Zn, μg/l)
Groundwater Elevation (This is the only parameter for a piezometer.)

ALL METALS ARE TOTAL - DO NOT FIELD FILTER SAMPLES
ALL FIELD OBSERVATIONS SHOULD BE REPORTED IN THE ELECTRONIC FORMAT DESCRIBED BY THE DEPARTMENT.

STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Mark N. Templeton, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

April 8, 2010

Ameren UE
C/O Mr. Thomas L. Hollenkamp, P.E., S.E.
P.O. Box 66149, MC F-604
St. Louis, Missouri 63166-6149

RE: Sioux Power Plant Utility Waste Landfill (MO40160) St. Charles County

Dear Mr. Hollenkamp,

In response to your request to extend the expiration date of Construction Permit C-426 for the Sioux Power Plant Utility Waste Landfill, I have amended the permit to expire on April 01, 2011 and have enclosed a copy for your use. A copy of the amended permit is also being sent to Mr. Jeff Fouse, the engineer of record.

If you have any questions, please feel free to contact me.

Sincerely,

WATER RESOURCES CENTER

Robert A. Clay, P.E.
Chief Engineer
Dam & Reservoir Safety Program

RAC/clb

enclosures

c: Reitz & Jens
C/O Mr. Jeff Fouse, P.E.
1055 Corporate Square Drive
St. Louis, Missouri 63132

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
DAM AND RESERVOIR SAFETY COUNCIL

CONSTRUCTION PERMIT

Pursuant to Chapters 236.400 through 236.500 of the Revised Statutes of Missouri and the rules established by the Dam and Reservoir Safety Council, and on the basis of statements and information contained in the permit application, letters, maps, plans, specifications and reports prepared by Jeffrey L. Fouse, E-21043, hereafter known as the permittee's engineer, for the Sioux Power Plant Utility Waste Landfill, St. Charles County, all of which are made a part hereof by reference, **PERMISSION IS HEREBY GRANTED TO** Ameren UE, hereafter known as the permittee, whose address for the purpose of notices and other communications pertaining to this permit is C/O Mr. Tom Hollenkamp, One Ameren Plaza, 1901 Chouteau Avenue, P.O. Box 66149, St. Louis, Missouri 63166, which address is subject to change by written notice from the permittee, **TO CONSTRUCT A DAM** having a maximum crest elevation of 446.0 ft. The embankment will create two impoundments, a recycle pond and a waste containment cell. Each impoundment will have an open channel principal spillway with a control elevation of 445.00 feet. The dam is located in U.S. Survey 1838, Township 48 North, Range 06 East, and assigned the identification number of MO 40160, and approximate UTM Coordinates of 4,309,475 meters North and 734,822 meters East, Zone 15. This permit is subject to the following provisions:

GENERAL PROVISIONS:

1. No liability shall be imposed upon or incurred by the State of Missouri and/or the Dam and Reservoir Safety Council, or any of their officers, agents, employees and members, officially or personally, on account of the granting hereof or on account of any damage to any person or property resulting from any act or omission of the permittee or any of its agents, employees, or contractors or closed corporations of successors or assigns relating to any matter hereunder. This permit shall not be construed as estopping or limiting any legal claim or right of action of the state against the permittee, its agents, employees or contractors for any damages or injury resulting from any such act or omission by them or for violation of or failure to comply with the provisions of the permit or applicable provisions of law.

2. The permittee shall comply with all Federal, State, and local laws and regulations, and shall obtain such other permits as may be required.

3. In all cases where the doing by the permittee of anything authorized by this permit shall involve the taking, using, or damaging of any property rights or interest of any other person or persons, or of any publicly owned lands or improvements thereon or interests therein, it is the sole responsibility of the permittee, before proceeding therewith, to obtain the written consent of all persons, agencies, or authorities concerned, and to acquire all property rights, and interests necessary therefor, including flood easements or permissions for all properties which may be inundated by the dam on a temporary or permanent basis in the upstream impoundment area below the top of dam elevation.

4. The permittee shall notify the Dam and Reservoir Safety Council in writing upon the sale or other transfer of interest in said dam or reservoir.

5. Based on conditions existing at the time of issuing this permit, the Downstream Environment Zone is Class II.

SPECIAL PROVISIONS:

1. Construction work authorized under this permit shall be completed on or before April 1, 2011, unless extended in writing by the Dam and Reservoir Safety Council or the Chief Engineer of the Dam and Reservoir Safety Program.

2. No changes shall be made in the construction of the dam which adversely affect the dam or reservoir with regard to its integrity or to the environment, public safety, life or property.

3. If the permittee finds at any time during construction or operation that, in order to adequately protect the integrity of the dam, the environment or public health, safety or welfare, immediate alterations to the approved plans and specifications are required, the alterations may be started, but the permittee shall promptly notify the Chief Engineer of such requirements. If the alterations are to remain as permanent project features, the permittee shall, as soon as practicable, revise the plans and specifications and submit the revisions to the Dam and Reservoir Safety Council for approval. Such alteration shall be discontinued if disapproved by the Council, upon notice of such disapproval.

4. The permittee shall immediately notify in writing, the Chief Engineer of any unforeseen conditions discovered during construction that may adversely affect the structural stability of the dam.

5. The permittee, in cooperation with the permittee's engineer, shall be responsible for providing adequate controls on construction activities, compliance with plans and specifications authorized herein and verification of design, construction, and operating assumptions.

6. The permittee shall, as soon as practicable following construction, cover or protect all exposed soil resulting from the construction by placing riprap, sod and/or seed on banks and slopes of said construction for the prevention of soil erosion.

7. Within two (2) weeks of completion of the work authorized under this permit, the owner shall notify the Chief Engineer in writing that construction was completed in accordance with the approved plans and specifications. As-built plans and drawings shall be submitted if significant changes were made during construction.

8. Undertaking or initiating any work or part thereof authorized herein by the permittee constitutes acceptance of the permit and all its terms and conditions.

Executed at Rolla, Missouri on this 1st day of April, 2008. Amended April 8, 2010

DAM AND RESERVOIR SAFETY COUNCIL

By: Robert A. Clay
Chief Engineer
Dam and Reservoir Safety Program

STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

Ameren Corporation
c/o Mr. Thomas L. Hollenkamp, P.E.,S.E.
One Ameren Plaza
1901 Chouteau Avenue
P.O. Box 66149, MC F-604
Saint Louis, Missouri 63166-6149

RECEIVED
FEB 16 2011

RE: Utility Waste Landfill MO40160 St. Charles County

Dear Tom:

In early December, Paul Simon and I met Matt Frerking at the Sioux Power Plant project to observe the progress of construction. One of the topics discussed is how we intend to manage the permitting for the structure. This project is projected to take up to 60 years to complete to the final configuration. Thus far, the starter dike for one of three proposed cells has been completed.

After reviewing the history of the project, I propose that we use the memorandum of understanding prepared by Ameren and submitted to us on August 5, 2008 as a guideline for amending the permit to allow future phases of construction.. This will allow us to review and approve the project at key intermediate stages of construction. I have enclosed a copy of that memorandum for your convenience. The landfill can continue to operate under the current construction permit, with extensions as needed, until the next phase of construction begins. The current construction permit will then be amended to allow additional phases. Amendments must be applied for in the same manner as the initial permit.

If you have any questions, please contact me. I can be reached at 573/368-2177 or via email at bob.clay@dnr.mo.gov.

Sincerely,
WATER RESOURCES CENTER

Robert A. Clay, P.E.
Chief Engineer
Dam and Reservoir Safety Program

RAC/rac

AmerenUE

One Ameren Plaza
1901 Chouteau Avenue
PO Box 66149, MC F-604
Saint Louis, Missouri 63166-6149

August 5, 2008

RECEIVED
AUG 12 2008 WRC

Mr. James Alexander, P.E.
Missouri Department of Natural Resources
Geological Survey and Resource Assessment Division
Dam and Reservoir Safety Program
P.O. Box 250
Rolla, Missouri 65402

RE: AmerenUE Sioux Power Plant Utility Waste Landfill
Construction Permit C-426
MO40160, St. Charles County, Missouri

Dear Mr. Alexander:

Matthew Frerking, Carl Rezsonya and I appreciated meeting with you and Robert Clay on May 7, 2008, to discuss the construction permit that was issued on April 1, 2008, for the AmerenUE Sioux Power Plant Utility Waste Landfill (UWL). Ameren requested this meeting primarily to discuss the Special Provision No. 1 which states that the construction work authorized under this permit shall be completed on or before April 1, 2009, unless extended in writing by the Dam and Reservoir Safety Council or the Chief Engineer of the Dam and Reservoir Safety Program (D&RSP). We understand that the D&RSP only issues construction permits with a duration of one year. Since the construction and operation of the UWL may take up to 60 years, it is important for Ameren to have an understanding with the D&RSP that transcends all of the people currently involved with the project, as much as possible.

Attached is a summary statement of the principle points that we discussed in our meeting on May 7. Please review this summary to be certain that it accurately states the requirements under applicable Missouri regulations and D&RSP's position regarding the ongoing construction permit process for the UWL. We appreciate your corrections or additions to this summary, if any, because we would like this statement to become a "Memorandum of Understanding" between D&RSP and Ameren of the construction permit process for the Sioux Plant UWL.

Please contact either Matthew Frerking (314) 957-3426 or me at (314) 957-3406 if you want to discuss any questions or comments that you have. Thank you, again, for your time.

Sincerely,
Matt Frerking
For
Thomas L. Hollenkamp, P.E., S.E.
Chief Dam Safety Engineer

MEMORANDUM OF UNDERSTANDING PERTAINING TO THE AMEREN UE SIOUX POWER PLANT UTILITY WASTE LANDFILL ST. CHARLES COUNTY (MO40160) JULY 2008

1. AmerenUE is constructing an Utility Waste Landfill (UWL) for the coal combustion byproducts from the Sioux Power Plant on its property south of Hwy. 94 in St. Charles County, Missouri. Construction Permit No. 0918301 was issued by the Missouri Department of Natural Resources Solid Waste Management Program (SWMP) for the UWL based on the construction permit application by AmerenUE, first received by SWMP on February 8, 2007, deemed completed on March 28, 2007, and last revised September 21, 2007.

2. Reitz & Jens, Inc. (Permittee's Engineer) submitted to Missouri Department of Natural Resources Dam & Reservoir Safety Program (D&RSP) on behalf of AmerenUE (Permittee) an engineering report and a set of preliminary drawings for the UWL. The engineering report and drawings, dated May 10, 2007, described the entire UWL project which eventually will consist of six cells and a recycle pond. The UWL will be constructed in phases. The design life of the UWL is up to 60 years. The D&RSP approved the concept of the UWL in a letter dated July 2, 2007.

3. Reitz & Jens submitted construction drawings and specifications for Cell 1 and the Recycle Pond to the D&RSP on February 14, 2008. The drawings showed the construction of the perimeter berms for Cell 1 and the Recycle Pond up to el. 446, and other appurtenances. The D&RSP issued Construction Permit No. M040160 for Cell 1 and the Recycle Pond on April 1, 2008.

4. The construction phase of the UWL will last until the UWL is closed in accordance with the requirements of the MDNR-SWMP. After the UWL is closed, Ameren will apply to the D&RSP for a dam operating permit.

5. The construction permit issued by D&RSP must be extended each year. The first extension is due before April 1, 2009. If there is no significant deviation from the latest approved construction drawings and specifications, then D&RSP only requires a letter from AmerenUE requesting the extension and a letter sealed by a registered Professional Engineer certifying that the construction to date has been in accordance with the approved construction drawings and specifications. The extension will be issued by D&RSP upon receipt of AmerenUE's request accompanied by the certification. If a survey of the completed construction is available, then D&RSP would like a copy of the survey, but it is not required.

6. When AmerenUE wants to proceed to the next phase of construction beyond the latest approved construction drawings and specifications, such as to construct the next planned cell or to raise the height of the gypsum stack, then AmerenUE will submit the revised construction drawings and specifications to D&RSP for approval prior to implementing the next phase.

7. The first significant change to the current construction drawings will be when the height of the gypsum stack in Cell 1 will rise above el. 446.

8. An engineering report will not be required if modifications to the construction drawings and specifications are within the scope of the approved engineering report for the UWL project dated May 10, 2007. The modified construction drawings will have a recent survey of the completed construction. The D&RSP will issue a modified construction permit upon approval of the modified construction documents if the modifications are within the scope of the original plans and engineering report for the overall UWL project.

Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director

DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

February 11, 2014

Ameren UE
C/O Mr. Thomas L. Hollenkamp, P.E., S.E.
P.O. Box 66149, MC F-604
St. Louis, Missouri 63166-6149

RE: Sioux Power Plant Utility Waste Landfill (MO40160) St. Charles County

Dear Mr. Hollenkamp,

In response to your request to extend the expiration date of Construction Permit C-426 for the Sioux Power Plant Utility Waste Landfill, I have amended the permit to expire on April 01, 2015 and have enclosed a copy for your use. A copy of the amended permit is also being sent to Mr. Jeff Greer, the engineer of record.

If you have any questions, please feel free to contact me.

Sincerely,

DEPARTMENT OF NATURAL RESOURCES

Robt A. Clay

Robert A. Clay, P.E.
Chief Engineer
Dam & Reservoir Safety Program

RAC/clb

enclosures

c: Mr. Jeff Greer, P.E.
3700 Lindberg Blvd.
Sunset Hills, Missouri 63127

Construction Permit C-426
Amended February 11, 2014

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
DAM AND RESERVOIR SAFETY COUNCIL

CONSTRUCTION PERMIT

Pursuant to Chapters 236.400 through 236.500 of the Revised Statutes of Missouri and the rules established by the Dam and Reservoir Safety Council, and on the basis of statements and information contained in the permit application, letters, maps, plans, specifications and reports prepared by Jeffrey L. Fouse, E-21043, hereafter known as the permittee's engineer, for the Sioux Power Plant Utility Waste Landfill, St. Charles County, all of which are made a part hereof by reference, **PERMISSION IS HEREBY GRANTED TO** Ameren UE, hereafter known as the permittee, whose address for the purpose of notices and other communications pertaining to this permit is C/O Mr. Tom Hollenkamp, One Ameren Plaza, 1901 Chouteau Avenue, P.O. Box 66149, St. Louis, Missouri 63166, which address is subject to change by written notice from the permittee, **TO CONSTRUCT A DAM** having a maximum crest elevation of 446.0 ft. The embankment will create two impoundments, a recycle pond and a waste containment cell. Each impoundment will have an open channel principal spillway with a control elevation of 445.00 feet. The dam is located in U.S. Survey 1838, Township 48 North, Range 06 East, and assigned the identification number of MO 40160, and approximate UTM Coordinates of 4,309,475 meters North and 734,822 meters East, Zone 15. This permit is subject to the following provisions:

GENERAL PROVISIONS:

1. No liability shall be imposed upon or incurred by the State of Missouri and/or the Dam and Reservoir Safety Council, or any of their officers, agents, employees and members, officially or personally, on account of the granting hereof or on account of any damage to any person or property resulting from any act or omission of the permittee or any of its agents, employees, or contractors or closed corporations of successors or assigns relating to any matter hereunder. This permit shall not be construed as estopping or limiting any legal claim or right of action of the state against the permittee, its agents, employees or contractors for any damages or injury resulting from any such act or omission by them or for violation of or failure to comply with the provisions of the permit or applicable provisions of law.

2. The permittee shall comply with all Federal, State, and local laws and regulations, and shall obtain such other permits as may be required.

3. In all cases where the doing by the permittee of anything authorized by this permit shall involve the taking, using, or damaging of any property rights or interest of any other person or persons, or of any publicly owned lands or improvements thereon or interests therein, it is the sole responsibility of the permittee, before proceeding therewith, to obtain the written consent of all persons, agencies, or authorities concerned, and to acquire all property rights, and interests necessary therefor, including flood easements or permissions for all properties which may be inundated by the dam on a temporary or permanent basis in the upstream impoundment area below the top of dam elevation.

4. The permittee shall notify the Dam and Reservoir Safety Council in writing upon the sale or other transfer of interest in said dam or reservoir.

5. Based on conditions existing at the time of issuing this permit, the Downstream Environment Zone is Class II.

SPECIAL PROVISIONS:

1. Construction work authorized under this permit shall be completed on or before April 1, 2015, unless extended in writing by the Dam and Reservoir Safety Council or the Chief Engineer of the Dam and Reservoir Safety Program.

2. No changes shall be made in the construction of the dam which adversely affect the dam or reservoir with regard to its integrity or to the environment, public safety, life or property.

3. If the permittee finds at any time during construction or operation that, in order to adequately protect the integrity of the dam, the environment or public health, safety or welfare, immediate alterations to the approved plans and specifications are required, the alterations may be started, but the permittee shall promptly notify the Chief Engineer of such requirements. If the alterations are to remain as permanent project features, the permittee shall, as soon as practicable, revise the plans and specifications and submit the revisions to the Dam and Reservoir Safety Council for approval. Such alteration shall be discontinued if disapproved by the Council, upon notice of such disapproval.

4. The permittee shall immediately notify in writing, the Chief Engineer of any unforeseen conditions discovered during construction that may adversely affect the structural stability of the dam.

5. The permittee, in cooperation with the permittee's engineer, shall be responsible for providing adequate controls on construction activities, compliance with plans and specifications authorized herein and verification of design, construction, and operating assumptions.

6. The permittee shall, as soon as practicable following construction, cover or protect all exposed soil resulting from the construction by placing riprap, sod and/or seed on banks and slopes of said construction for the prevention of soil erosion.

7. Within two (2) weeks of completion of the work authorized under this permit, the owner shall notify the Chief Engineer in writing that construction was completed in accordance with the approved plans and specifications. As-built plans and drawings shall be submitted if significant changes were made during construction.

8. Undertaking or initiating any work or part thereof authorized herein by the permittee constitutes acceptance of the permit and all its terms and conditions.

Executed at Rolla, Missouri on this 1st day of April, 2008. Amended February 11, 2014

DAM AND RESERVOIR SAFETY COUNCIL

By: Robert A. Clay
Chief Engineer
Dam and Reservoir Safety Program

ST.CHARLES COUNTY
COMMUNITY HEALTH
& THE ENVIRONMENT

Division of Environmental Health and Protection

Tuesday, December 10, 2013

Certified Mail No. 7003 2260 0005 1076 6250
RETURN RECEIPT REQUESTED

Mr. Michael Menne
Ameren Missouri
One Ameren Plaza
1901 Chouteau Avenue
St. Louis, MO 63166-6149

RE: Revised Waste Facility Plan and Operation of Cell 4A- Ameren Missouri Sioux Power Plant Utility Waste Landfill

Mr. Menne:

The St. Charles County Department of Community Health and the Environment received a request for approval of the revised Waste Facility Plan (WFP) to operate the Sioux Plant Utility Waste Landfill (UWL) dated October 14, 2013 in a letter from Mr. Paul Pike of Ameren Missouri to Mr. Ryan Tilley of St. Charles County Government.

The St. Charles County Department of Community Health and the Environment has issued a conditional Solid Waste Facility License (SWFL) for operation of Cell 1 on October 31, 2013. This conditional license did not include the operation of Cell 4A until it could subsequently be approved by the Director.

Whereas, the licensee has demonstrated compliance with the requirements and request of the Division Director and the *St. Charles County Solid Waste Management Code* (SCC SWMC) to the division's satisfaction; the November 2013 revised WFP has been approved and the Solid Waste Facility License previously issued on November 1, 2013 is hereby enacted to include disposal of SCC approved waste into the western half of Cell 4 (Cell 4A).

This approval to operate shall not be construed as compliance with any federal, state, or local law other than that of the SCC SWMC; nor shall this be construed as a waiver for any other regulatory requirement. This approval is not to be construed as compliance with any existing local ordinances other than that of SCC SWMC; nor does it supersede any local laws including permitting and/or zoning requirements.

The Division Director reserves the right to suspend, revoke, or modify the license and approval based on any of the following criteria:

1. Failure to comply with the provisions of the WFP;
2. Failure to comply with the provisions of the SCC SWMC;

3. Failure to operate the facility in a manner consistent with the public health and welfare and the health and welfare of persons operating and/or using the facility, or in a manner deemed not to be protective of the environment.

The division is committed to working together with the community as a partner to achieve excellence in environmental health and protection within St. Charles County. I appreciate the opportunity to address your questions and further this partnership.

If the Environmental Health and Protection Division can be of any more assistance, please feel free to contact me at (636) 949-7406 or via email at **rtilley@sccmo.org**.

Respectfully,

Ryan Tilley

Ryan Tilley, REHS
Director, Division of Environmental Health and Protection

Cc: Charlene Fitch, P.E., Missouri Dept. of Natural Resources

ST. CHARLES COUNTY
COMMUNITY HEALTH
& THE ENVIRONMENT

Division of Environmental Health and Protection

Thursday, October 31, 2013

Certified Mail No. 7003 2260 0005 1076 6748
RETURN RECEIPT REQUESTED

Mr. Michael Menne
Ameren Missouri
One Ameren Plaza
1901 Chouteau Avenue
St. Louis, MO 63166-6149

RE: Solid Waste Facility License Renewal- Ameren Missouri Sioux Power Plant Utility Waste Landfill

Mr. Menne:

The St. Charles County Department of Community Health and the Environment received a request that a renewal license be issued to operate the Sioux Plant Utility Waste Landfill (UWL) on October 24, 2013 in a letter from Mr. Paul Pike of Ameren Missouri to Mr. Ryan Tilley of St. Charles County Government.

Whereas, the licensee has demonstrated compliance with the requirements and request of the Division Director and the *Solid Waste Management Code of St. Charles County* (SCC SWMC) to the division's satisfaction; a renewal operating license will be granted. The renewal is hereby granted for Cell 1, as shown on drawing 7 of 22 in appendix G of the WFP for St. Charles County.

Before operation of Cell 4 and the revised WFP may be granted final approval, the division must complete the review of the WFP and allow additional time for Ameren to complete any revisions deemed necessary by the director. In addition, DNR must issue an operating permit approving Cell 4 before we will approve of the revised WFP and operation of Cell 4. In the future, applications must be delivered to the Division Director at least (30) days prior to each anniversary date as required in section 240.810 of the SCC SWMC.

The attached license includes the provisional approval to operate Cell 4 utilizing the revised WFP contingent upon their formal approval by the appropriate agencies. Any necessary exceedance of the conditional license for permitted maximum monthly tonnage or permitted monthly traffic volume will require at least seven (7) days' notice to the division.

The license issued shall be for a fixed number of years equal to the estimated operating life of the facility as contained in the approved WFP. Notwithstanding the issuance of a license for a fixed number of years, the WFP and the license must be reviewed annually subject to the provisions of Section 240.810 et seq., and the modifications requested by the operator in the annual application may include a request that the term of the license be changed.

The operating license may be suspended or revoked, following a hearing before the Division Director, based on any of the following criteria:

1. Failure to comply with the provisions of the WFP;
2. Failure to comply with the provisions of the SCC SWMC;
3. Failure to operate the facility in a manner consistent with the public health and welfare and the health and welfare of persons operating and/or using the facility, or in a manner deemed not to be protective of the environment.

The division is committed to working together with the community as a partner to achieve excellence in environmental health and protection within St. Charles County. **I appreciate the opportunity to address your questions and further this partnership.**

If the Environmental Health and Protection Division can be of any more assistance, please feel free to contact me at (636) 949-7406 or via email at rtilley@sccmo.org. If you have trouble reaching me, our office assistant Suzanne Lovasco, can be contacted at 636-949-1800.

Respectfully,

Ryan Tilley

Ryan Tilley, REHS
Director, Division of Environmental Health and Protection

cc:
The Honorable Steve Ehlmann, County Executive, St. Charles County Government SEhlmann@sccmo.org
Ms. Julie Eckstein, Director, Community Health and the Environment, St. Charles County Government JEckstein@sccmo.org
Ms. Joann Leykam, County Administrator, St. Charles County Government JLeykam@sccmo.org
Mr. Harold Ellis, County Counselor, St. Charles County Government HEllis@sccmo.org
Mr. Wayne Anthony, Director, Community Development, St. Charles County Government WAnthony@sccmo.org
Ms. Dorothy E. Franklin, Regional Director, St. Louis Regional Office, MO DNR dorothy.franklin@dnr.mo.gov
Ms. Charlene Fitch, P.E. Engineering Section Chief, SWMP, MO DNR charlene.fitch@dnr.mo.gov
Mr. Paul Pike, Environmental Science Executive, Ameren Missouri PPike@ameren.com

ST. CHARLES COUNTY
COMMUNITY HEALTH
& THE ENVIRONMENT

SOLID WASTE FACILITY LICENSE

1650 Boone's Lick Road • St. Charles, MO • 63301 • 636-949-1800 • http://health.sccmo.org/health

1. Facility Number 0 4 3 0 3 **2. State Permit No.** 0 9 1 8 3 0 1

3. Name and Street Address of Facility
AMEREN MISSOURI SIOUX POWER PLANT UTILITY WASTE LANDFILL
SOUTHSIDE OF HWY 94 NORTH, EAST OF DWIGGINS ROAD
UNINCORPORATED

4. Name and Mailing Address of Operator
MICHAEL L. MENNE, VICE-PRESIDENT, ENVIRONMENTAL SERVICES
AMEREN MISSOURI
ONE AMEREN PLAZA, 1901 CHOUTEAU AVENUE
ST. LOUIS, MO 63103

5. Name and Mailing Address of Owner
MICHAEL L. MENNE, VICE-PRESIDENT, ENVIRONMENTAL SERVICES
AMEREN MISSOURI
ONE AMEREN PLAZA, 1901 CHOUTEAU AVENUE
ST. LOUIS, MO 63103

6. Specifications:

Upon a significant change in design or operation from that described herein, this permit is subject to revocation or suspension. The attached permit findings and conditions are integral parts of this permit and supersede the conditions of any previously issued solid waste facility permit.

a. Permitted Operations:

☒ Solid Waste Disposal Site ☐ Composting Facility (Green Material)
☐ Transfer/Processing Facility (MRF) ☐ Other:

b. Permitted Hours of Operations:

Receipt of Refuse/Waste* 0 0 0 0 to 0 0 0 0 ***24 hours per day, 7 days per week**
Ancillary Operations/Facility Operating Hours 0 6 0 0 to 1 7 3 0

c. Permitted Maximum Tonnage: **30,000** Tons per month

d. Permitted Traffic Volume: **≤ 1000** Vehicles per month

e. Key Design Parameters (Detailed parameters see facility *Waste Facility Plan*):

	Total	Disposal	Transfer/Processing	Composting	Transformation
Permitted Area (in acres)	**398.04**	**183.5**	N/A	N/A	N/A
Design Capacity (cu. Yards)		**21,900,000**	N/A	N/A	N/A
Max. Elevation (Ft. MSL)		**525**			
Max. Depth (Ft. MSL)		**100**			
Estimated Closure Year		**2068**			

7. Legal Description of Facility:

The Ameren Missouri Sioux Power Plant Utility Waste Landfill (UWL) site is located south of State Highway 94, adjacent to the power plant, in unincorporated St. Charles County, in the southeastern part of Township 48 North, Range 6 East. The site is approximately two (2) miles east of the town of Portage des Sioux, and twelve (12) miles west-northwest of the confluence of the Mississippi and Missouri Rivers. The UWL is proposed within a tract of land totaling 398.04 acres, of which 183.5 acres are proposed for use as the active disposal area. The remaining acreage includes a proposed 19.6 acre wastewater recycle pond (permitted separately by the Water Pollution Control Program), soil borrow areas for soil liner and final cover as needed, access roads, flood protection berms and buffer area.

SOLID WASTE FACILITY LICENSE

Facility Number	0	4	3	0	3	State Permit No.	0	9	1	8	3	0	1

8. Findings:

a. DEFINITIONS
Unless the context otherwise requires, the words used in the License have meanings ascribed to them in Solid Waste Management Code of St. Charles County, Missouri (SCC SWMC) (Ord. No. 01-061 sections--8, 5-30-01)
b. LICENSE ACTIONS
This license is for operation(s) of Cell 1 until the Division Director authorizes it's extension to include Cell 4. This License is based upon the information submitted in the application for a solid waste facility permit and the *Waste Facility Plan for St. Charles County* , April 2010 (WFP), and as approved by the St. Charles County, Department of Community Health and the Environment, Division of Environmental Health and Protection (Division or LEA). The License may be modified by the Division for cause in accordance with SCC SWMC sections 240.750, 240.810, or if there is a change in the statutes or regulations upon which the issuance of the License is based, or if modification is otherwise necessary to protect public health and safety and safeguarding environmental health and protection. If the disposal site does not remain in compliance with the applicable statutes and regulations, this license may be revoked or suspended when written notice is given by the Division. The filing of a request by the Licensee for a License modification or termination, or a notification of planned changes or anticipated noncompliance, does not stay any License condition. The Licensee shall inform the Division of any deviation from or change in operations as presented in the WFP, which may affect the Licensee's ability to comply with applicable regulations or conditions of the License. This License may be transferred to a subsequent owner or operator only if the Division approves the transfer based on documentation of financial responsibility provided by the new owner or operator.

This license may include the operation of Cell 4 under the guidance of the revised WFP once the Division Director has agreed to extend the license to Cell 4 and once the director has approved the revised WFP. The director will not agree to such terms until DNR has completed its review and granted approval for operation.

c. AVAILABILITY OF LICENSE DOCUMENTS
The Licensee shall keep at the disposal site a complete copy of this License and incorporated documents, as identified by the Division Director.
d. SOLID WASTES PERMITTED FOR DISPOSAL

i. Industrial Wastes:	**Fly Ash & Bottom Ash**
ii. Special Wastes:	**Boiler Slag & Gypsum**

9. Prohibitions:

The Licensee is prohibited from placing in the landfill the following wastes:
i. Other than in Cell 1 and Cell 4, any liquid waste material that is determined to contain free liquids as defined by Method 9095 (Paint Filter Liquids Test), as described in *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods (EPA Pub. No. SW-846);*
ii. Hazardous waste, as defined by State and Federal Regulations;
iii. PCB waste, as defined by State and Federal Regulations; and
iv. Waste not identified in License Condition 8(d).

10. The following documents describe and/or restrict the operation of this facility:

	Date		Date
Detailed Geologic and Hydrologic Site Investigation Report for Ameren UE Sioux Power Plant, Proposed Utility Waste Disposal Area St. Charles County, Missouri (DSI)	9/20/07	AmerenUE Sioux Power Plant Utility Waste Landfill Proposed Construction Permit Modification Construction Permit Number 0918301 St. Charles County, Missouri	06/2010
AmerenUE Sioux Power Plant Construction Permit Application for a Proposed Utility Waste Landfill, St. Charles County, Missouri (CPA)	9/20/07	Missouri DNR Solid Waste Disposal Area Operating Permit Permit Number 0918301 AmerenUE Sioux Power Plant Utility Waste Landfill	07/2010
Ameren UE Sioux Power Plant, Proposed Utility Waste Landfill, St. Charles County, Missouri (Plans)	9/20/07	AmerenUE Sioux Power Plant Utility Waste Landfill Proposed Construction Permit Modification Construction Permit Number 0918301 St. Charles County, Missouri (Revised)	02/2012
Missouri DNR Solid Waste Disposal Area Construction Permit No. 0918301	3/28/08	Revised Waste Facility Plan	10/2013

SOLID WASTE FACILITY LICENSE

Facility Number	0	4	3	0	3	**State Permit No.**	0	9	1	8	3	0	1

10. The following documents describe and/or restrict the operation of this facility: (continued)

Sioux Power Plant Utility Waste Landfill Construction Permit No. 0918301, Permit Modification - Cell 1 Ring Drains	11/2009	License Renewal Application Package for Ameren Missouri Sioux Utility Waste Landfill	10/2013
Waste Facility Plan for St. Charles County	4/2010		

11. Self Monitoring:

The owner/operator shall submit the results of all self monitoring programs to the Local Enforcement Agency (LEA), St. Charles County Department of Community Health and the Environment within 30 days of the end of the reporting period (*for example, 1st quarter = January - March, the report is due by April 30, etc.. Information required on an annual basis shall be submitted with the 4th quarter monitoring report, unless otherwise stated.)*

Program	Reporting Frequency
a). The Licensee shall submit to the Division a report of the solid waste received at the site. The report must be submitted in a format approved by the Division.	**Quarterly**
b). Financial Assurance Reporting: The Licensee Shall: i. Notify the Division of any adjustments made to the estimates for the amounts of closure and post-closure care in accordance with SCC SWMC; and ii. The Licensee shall submit the closure and post-closure cost estimates adjusted for inflation.	**Annually**
c). Groundwater monitoring reports	**Quarterly**
d). The Licensee shall submit to the Division a report of the surface impoundment inspections at the site. The report must be submitted in a format approved by the Division.	**Annually**

12. Local Enforcement Agency (LEA) Conditions:

1. The operator shall comply with all Federal and State Minimum Standards for solid waste handling and disposal.

2. The Licensee shall keep at the disposal site a complete copy of this License and incorporated documents, as identified in Section 10.

3. The Licensee shall furnish to the Division, any relevant information which the Division may request in order to determine compliance with this License or to determine whether cause exists for modifying, revoking and reissuing, or terminating this License. The Licensee shall also furnish to the Division, upon request, copies of records as a requirement of this License. This shall be done in a reasonable timeframe within a mutually agreeable and negotiated deadline.

4. Licensee shall furnish to St. Charles County Government, Department of Community Development, any relevant information which the Department may request in order to determine compliance with county rules, laws, regulations and/or codes. This shall be done in a reasonable timeframe within a mutually agreeable and negotiated deadline.

5. Licensee shall not operate Cell 4 or implement the revised WFP until subsequently approved by the Division Director.

12. Local Enforcement Agency (LEA) Conditions: (continued)

6. In accordance with SCC SWMC section 240.1150, the Licensee shall report incidents to the Division as provided in the *Waste Facility Plan for St. Charles County,* April 2010 (WFP) or October 2013. In addition, the Licensee shall report any noncompliance, imminent or existing hazard from a release of waste or hazardous constituents, or from a fire or explosion at the facility, which may endanger human health or the environment. Such information shall be reported by telephone to (636) 949-1800 within twenty-four (24) hours from the time the Licensee becomes aware of the circumstances. A written report shall be submitted within fifteen (15) days of the incident and shall include the following:

    1. Name and title of person making report;
    2. Date, time, and type of incident;
    3. Name and quantity of material(s) involved;
    4. A complete description of the occurrence and its cause;
    5. The extent of injuries, if any;
    6. An assessment of actual or potential hazards to the environment and human health outside the facility, where this is applicable;
    7. Estimated quantity and disposition of recovered material that resulted from the incident; and
    8. Actions taken by the Licensee in response to the incident.

7. The Licensee shall give advance notice to the Division Director of any planned changes in the permitted facility or activity, which may result in noncompliance with License requirements.

8. The Licensee shall allow the Division of Environmental Health and Protection, or an authorized representative, upon the presentation of credentials or other documents as may be required by law to:

    1. Enter at reasonable times (any time during the permitted hours of operation found in 6b) upon the Licensee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this License; and
    2. Have access to and copy, at reasonable times, any records that must be kept under conditions of this License; and
    3. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this License; and
    4. Sample, photograph, or monitor at reasonable times, for the purposes of assuring License compliance or as otherwise authorized, any substances, locations, or parameters at any location subject to the License.

9. The Licensee shall: Follow and document a program for quality assurance and quality control for the construction of the facility.

10. The Licensee shall notify the Division in writing within sixty (60) days following the commencement of construction of a new cell.

11. The Licensee shall maintain the following records at the site in accordance to SCC SWMC section 240.1150(36):

    1. Major problems and complaints regarding operation of the landfill;
    2. All environmental media sampling/testing data;
    3. In the event of documented exceedence of applicable standards established by Missouri Department of Natural Resources for any monitoring system;
    4. Records of vector control efforts;
    5. Records of dust and litter control efforts;
    6. A copy of the SCC SWMC supplied by the division; and
    7. Records of quantity of waste handled. Such records shall be made contemporaneously with the matters recorded.

12. Despite the approval of the WFP and the issuance of a license for the construction and operation of facility, the licensee shall apply to renew such license annually for each year beginning with each anniversary date of the issuance of license. The renewal application as set forth in the schedule in subsection (2) of section 240.810 of the SCC SWMC shall be addressed and delivered to the Division Director at least thirty (30) days prior to each anniversary date of the initial license and shall contain:

    1. A request that a renewal license be issued for a period of one (1) year, and
    2. A report containing the information required in Section 240.820. (Ord. No 01-061 sections 1--8, 5-30-01)

SOLID WASTE FACILITY LICENSE

Facility Number	0	4	3	0	3	**State Permit No.**	0	9	1	8	3	0	1

12. Local Enforcement Agency (LEA) Conditions: (continued)

13. Surface Impoundment Inspection(s) Requirements:

1. All existing UWL surface impoundments shall be examined as follows:

a. At intervals not exceeding 7 days for appearances of structural weakness and other hazardous conditions;

b. At intervals not exceeding 7 days all instruments shall be monitored;

c. All inspections required by sections (1)(a) and (1)(b) above shall be performed by a qualified person as defined in (5) of this section, designated by the Licensee;

d. All existing UWL surface impoundments shall be inspected annually by a registered professional engineer to assure that the design, operation, and maintenance of the surface impoundment is in accordance with generally accepted engineering standards. The Licensee must notify the Division Director that a registered professional engineer has found that the design, operation, and maintenance of the surface impoundment is in accordance with generally accepted engineering standards and such findings has been placed in the operating record.

2. When a potentially hazardous condition develops, the Licensee shall immediately:

a. Take action to eliminate the potentially hazardous condition;

b. Notify potentially affected persons and state and local first responders;

c. Direct a qualified person to monitor all instruments and examine the structure at least once every eight hours, or more often as required by an authorized representative of the state.

3. After each inspection and instrumentation monitoring referred to in sections (1) and (2), each qualified person who conducted all or any part of the inspection or instrumentation monitoring shall promptly record the results of such inspection or instrumentation monitoring in a book which shall be available in the operation record and such qualified person shall also report the results of the inspection or monitoring to the Division Director as required in Section 11, Self Monitoring of this License. A report of each inspection and instrumentation monitoring shall also be available for public review if requested.

4. All inspection and instrumentation monitoring reports recorded in accordance with section (3) shall include a report of the action taken to abate hazardous conditions and shall be promptly signed by the person designated by the Licensee as responsible for health and safety at the UWL.

5. The qualified person or persons referred to in 12(1)(c) of this section shall be trained to recognize specific signs of structural instability and other hazardous conditions by visual observation and, if applicable, to monitor instrumentation.

6. The Licensee must record and retain at the site in an operating record, all records, reports, studies or other documentation required to demonstrate sections (1) - (5).

14. All reports, notifications, or other submissions which are required by this License shall be submitted to:

Division of Environmental Health and Protection
Department of Community Health and the Environment
St. Charles County Government
1650 Boones Lick Road
St. Charles, MO 63301

License issued: 1 1 / 0 1 / 1 3

License expires: 1 0 / 3 1 / 1 4

Signature of Approving Officer

Ryan Tilley

Ryan Tilley, REHS
Director, Division of Environmental Health and Protection

Signature of Health Officer

Julia M. Eckstein

Julie Eckstein
Director, Department of Community Health and the Environment

Public Health
Prevent. Promote. Protect.

STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

FEB 08 2013

Mr. Paul Pike
Ameren Services
One Ameren Plaza
1901 Chouteau Avenue
P.O. Box 66149
St. Louis, MO 63166-6149

RE: Ameren Missouri Sioux Power Plant Utility Waste Landfill Dry Cell Permit Modification, Permit Number 0918301, St. Charles County

Dear Mr. Pike:

This letter is in response to the report and accompanying plan sheets titled, "Ameren UE Sioux Power Plant, Utility Waste Landfill, Proposed Construction Permit Modification," dated June 2010, revised March 2011, August 2011, November 2011, and February 2012, last received February 17, 2012. This report is signed and sealed by Thomas R. Gredell, P.E. of Gredell Engineering Resources, Inc. In the report the facility is requesting to modify the Ameren Missouri Sioux Power Plant Utility Waste Landfill permit in order to implement dry disposal of CCPs in 86.6 acres (cells 4, 5, 6, and 7) of the 183.5 acre permitted landfill. The Missouri Department of Natural Resources' (Department) Solid Waste Management Program has reviewed this report and plan sheets and hereby approves this modification request.

The following condition is an integral part of this approval. Compliance with this condition shall determine compliance with Permit Number 0918301:

CONDITION:

The Split Sampling Contract is in the process of being reviewed and agreed upon and must be executed once complete.

The following documents are hereby incorporated into permit number 0918301:

DOCUMENTS:

1. A report titled, "AmerenUE Sioux Power Plant, Utility Waste Landfill, Proposed Construction Permit Modification, Construction Permit Number 0918301, St. Charles County, Missouri" dated June 2010, received June 25, 2010, signed and sealed by Thomas R. Gredell, P.E. of Gredell Engineering Resources, Inc.

2. A letter dated April 8, 2011, received April 13, 2011, written in response to the October 7, 2010, comment letter. The following were revised:

    a. Report Covers
    b. Title Page, Table of Contents, and Text
    c. CD of the report
    d. Appendix K
    e. Appendix M
    f. Appendix N
    g. Appendix O
    h. Appendix P
    i. Appendix R
    j. Appendix T
    k. Appendix AA
    l. Plan Sheets 2 through 25, 28, and 33

3. A letter dated August 24, 2011, received August 25, 2011, written in response to the June 24, 2011, comment letter. The following were revised:

    a. Report Covers
    b. Title Page, Table of Contents, and Text
    c. CD of the report
    d. Appendices Cover
    e. Appendix K
    f. Appendix M
    g. Appendix N
    h. Appendix O
    i. Appendix P
    j. Plan Sheets 1, 26, 29, 30, 31, and 32

4. A letter dated November 17, 2011, received November 18, 2011, written in response to the October 18, 2011, comment letter. The submittal includes the "Ameren Missouri Sioux Plant Dry Cell Demonstration: Base of UWL Liner in Intermittent Contact with Groundwater" report dated November 2011, received November 18, 2011, prepared by Reitz & Jens, Inc. Consulting Engineers and Gredell Engineering Resources, Inc. and signed and sealed by Thomas R. Gredell, P.E. of Gredell Engineering Resources, Inc. The following were revised with this submittal:

    a. Report Covers
    b. Title Page, Table of Contents, and Text
    c. CD of the report
    d. Appendices Cover
    e. Appendix K

    f. Appendix M
    g. Appendix O
    h. Appendix P

5. A letter dated February 17, 2012, received February 17, 2012, written in response to a January 18, 2012, e-mail. The following were revised with this submittal:

    a. Report Covers
    b. Title Page, Table of Contents, and Text (3-38, 3-39, 4-23, 4-24)
    c. CD of the report
    d. Appendices Cover
    e. Appendix P
    f. Plan Sheet 27

This approval is not to be construed as compliance with any existing federal or state laws other than the Missouri Solid Waste Management Law; nor should this be construed as a waiver for any other regulatory requirements. This approval is not to be construed as compliance with any existing local permitting or zoning ordinances; nor does it supersede any local permitting and/or zoning requirements.

The Department reserves the right to revoke, suspend, or modify this approval and/or Permit Number 0918301 after due notice, if the permit holder fails to maintain the facility in compliance with the Missouri Solid Waste Management Law and rules, the terms and conditions of the permit, and approved engineering plans and specifications.

If you have any comments or questions, please contact Ms. Katherine Huxol at (573) 526-3940 or at P.O. Box 176, Jefferson City, Missouri 65102-0176, or at katherine.huxol@dnr.mo.gov.

Sincerely,

SOLID WASTE MANAGEMENT PROGRAM

Charlene S Fitch

Charlene S. Fitch, P.E.
Chief, Engineering Section

CSF:khl

c: Thomas Gredell, P.E., Gredell Engineering Resources, Inc.
Mr. Ryan Tilley, Director, St. Charles County Government
St. Louis Regional Office

Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

www.dnr.mo.gov

DEC 06 2013

Mr. Paul Pike
Ameren Services
One Ameren Plaza
1901 Chouteau Avenue
P.O. Box 66149
St. Louis, MO 63166-6149

RE: Cell 4A Construction Quality Assurance (CQA) Report for Ameren Missouri Sioux Energy Center Utility Waste Landfill, Permit Number 0918301, St. Charles County

Dear Mr. Pike:

This letter is in response to the letter dated November 14, 2013, and received November 14, 2013, requesting approval to operate the western half of Cell 4 (Cell 4A) of the Ameren Missouri Sioux Energy Center Utility Waste Landfill. The documentation of the construction of Cell 4A was presented in the Cell 4A Construction Quality Assurance (CQA) Reports submitted in four parts in which the last report is dated November 14, 2013, and was received on November 14, 2013, and was submitted on your behalf by Reitz & Jens, Inc. Consulting Engineers. Cell 4A is approximately 15 acres and has been modified from a Gypsum landfill to implement dry disposal of coal combustion products (CCP's). The Missouri Department of Natural Resources' (Department) Solid Waste Management Program (SWMP) approved the modification from a Gypsum landfill to a dry disposal landfill on February 8, 2013, with the condition that a Split Sampling Contract be executed. A letter dated November 26, 2013, and two copies of the signed Groundwater Sampling Agreement were received December 2, 2013, to satisfy the February 8, 2013, condition.

The SWMP has reviewed these submittals. Whereas the permittee has demonstrated compliance with requirements of 10 CSR 80-2.020(4)(C) to the Department's satisfaction, the authorization to operate (ATO) is hereby granted. This ATO is hereby made an official part of Permit Number 0918301.

The following documents are hereby approved and incorporated into Permit Number 0918301:

DOCUMENTS:

1. A report titled, "Cell 4A Construction Quality Assurance (CQA) Report, Part 1 – Summary of Lab Test Data on Clay Liner," dated September 9, 2013, received September 20, 2013, signed and sealed by Jeffrey Lynn Fouse, P.E. of Reitz & Jens, Inc.

2. A report titled, "Cell 4A Construction Quality Assurance (CQA) Report, Part 2 – Perimeter Berms and Clay Liner," dated September 27, 2013, received October 1, 2013, signed and sealed by Jeffrey Lynn Fouse, P.E. of Reitz & Jens, Inc.
3. A report titled, "Cell 4A Construction Quality Assurance (CQA) Report, Part 3 – HDPE Geomembrane and Leachate Collection System," dated October 14, 2013, received October 15, 2013, signed and sealed by Jeff Bertel, P.E. of Reitz & Jens, Inc.
4. A report titled, "Cell 4A Construction Quality Assurance (CQA) Report, Part 4 – CCP Berm and Appurtenances," dated November 14, 2013, received November 14, 2013, signed and sealed by Jeff Bertel, P.E. of Reitz & Jens, Inc.
5. A letter dated November 14, 2013, received November 14, 2013, signed by Mr. Paul Pike, Environmental Science Executive of Ameren requesting authorization to operate Cell 4A of the Ameren Missouri Sioux Energy Center Utility Waste Landfill.
6. A memorandum dated November 8, 2013, received November 14, 2013, responding to comments concerning "Cell 4A Construction Quality Assurance (CQA) Report, Part 3, HDPE Geomembrane and Leachate Collection System".
7. A report dated November 27, 2013, received on December 2, 2013, titled, "Cell 4A Construction Quality Assurance (CQA) Report, Response to MDNR-SWMP Comments," signed and sealed by Jeff Bertel, P.E. of Reitz & Jens, Inc.

The following conditions are an integral part of this approval. Compliance with these conditions shall, in part, determine compliance with Permit Number 0918301:

CONDITIONS:

1. On page 18 of the Construction Quality Assurance Plan in Appendix P of the report titled, "Ameren Missouri Sioux Power Plant, Utility Waste Landfill, Proposed Construction Permit Modification" revised February 2012, approved February 8, 2013, the destructive testing specifications for the geomembrane are listed. These specifications do not match the construction specifications stated in the response to comment 17. Within 45 days of the date of this letter please evaluate the geomembrane destructive test specifications and determine if the specification used for Cell 4A is adequate and indicate what specifications will be used for future cells. We typically accept the Geosynthetic Research Institute (GRI) GM19 as the industry standard reference in geomembrane seaming. If you want to use standards that do not match these standards, you would need to provide justification.
2. Within 45 days of the date of this letter, please provide an update to the construction quality assurance plan for this facility which specifies updated compaction specifications for both the perimeter berms and the CCP berms for use in future cells.

3. Within 45 days of the date of this letter please provide evidence that the exterior of the perimeter berms for Cell 4A were constructed at a 3:1 slope.

This ATO shall not to be construed as compliance with any existing federal or state environmental laws other than the Missouri Solid Waste Law; nor should this be construed as a waiver for any other regulatory requirements. This approval is not to be construed as compliance with any existing local permitting or zoning ordinances; nor does it supersede any local permitting and/or zoning requirements.

The Department reserves the right to revoke, suspend, or modify this approval and/or Permit Number 0918301 after due notice, if the permit holder fails to maintain the facility in compliance with the Missouri Solid Waste Management Law and regulations, the terms and conditions of the permit, and approved engineering plans and specifications.

If you have any comments or questions, please contact Mr. Tom Roscetti at (573) 526-3940, or at P.O. Box 176, Jefferson City, Missouri 65102-0176.

Sincerely,

SOLID WASTE MANAGEMENT PROGRAM

Charlene S Fitch

Charlene S. Fitch, P.E.
Chief, Engineering Section

CSF:khl

c: Jeff Bertel, P.E., Reitz & Jens, Inc. Consulting Engineers
Jeffrey Fouse, P.E., Reitz & Jens, Inc. Consulting Engineers
Mr. Ryan Tilley, St. Charles County Division of Environmental Health and Protection
St. Louis Regional Office via Electronic Shared File

STATE OF MISSOURI
Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director
DEPARTMENT OF NATURAL RESOURCES
www.dnr.mo.gov

APR 06 2015

Mr. Paul Pike
Ameren Services
One Ameren Plaza
1901 Chouteau Avenue
P.O. Box 66149
St. Louis, MO 63166-6149

RE: Cell 4A Initial Ash Placement, Ameren Missouri Sioux Power Plant Utility Waste Landfill, Permit Number 0918301, St. Charles County

Dear Mr. Pike:

This letter is in response to a letter from you, dated November 21, 2014, with an attached report from Reitz and Jens, Inc. The submittal is a response to a comment letter from the Solid Waste Management Program (SWMP), dated August 4, 2014, on the initial filling of Cell 4A. The initial filling was described in a report, dated May 29, 2014, also from Reitz and Jens, Inc. Both of these documents also address slope stability using updated material properties.

Based on our review of the submitted information, the SWMP is satisfied with both the initial report and the follow-up. However, the SWMP does have concerns; please note the conditions listed below.

The following conditions are an integral part of this approval. Compliance with these conditions shall, in part, determine compliance with Permit Number 0918301.

<u>CONDITIONS:</u>

1. During the October 1, 2014, on-site meeting between representatives of Ameren, Reitz and Jens, and the SWMP, it was agreed that Ameren would provide a flooding plan for Cell 4A, which would counteract hydrostatic uplift on the landfill liner should a 100-year flood occur before additional waste is added to the cell. This was to increase the safety factor and therefore provide additional assurance that uplift could not occur. This was not included in the November 2014 response. We would expect such a plan to address, at a minimum:

    - Pump sizing and availability
    - Pumping rates necessary
    - Minimum depth of water necessary
    - The triggering event to start pumping water into the cell

    Please provide this within 120 days of the date of this letter.

2. The November 2014 Reitz and Jens report (Document 2 below) states that the coal combustion waste was placed in thick lifts because it was too wet to spread in thin lifts. If, in the future, waste is to be placed in thicker lifts than the currently approved 2 foot lifts, please submit a request to modify the permit.

The following documents were reviewed and are incorporated by reference into Permit Number 0918301.

DOCUMENTS:

1. A report titled "Cell 4A Construction Quality Assurance (CQA) Summary Report for Phase 3 – Initial Filling", dated May 29, 2014, and prepared by Reitz and Jens, Inc.
2. A letter from Mr. Paul Pike of Ameren Missouri, dated November 21, 2014, and attached report from Reitz and Jens, Inc. titled "Response to MDNR-SWMP Cell 4A Authorization to Operate Follow-up and Initial Ash Placement", and dated August 4, 2014.

This approval is not to be construed as compliance with any existing federal or state environmental laws other than the Missouri Solid Waste Management Law; nor should this be construed as a waiver for any other regulatory requirements. This approval is not to be construed as compliance with any existing local permitting or zoning ordinances; nor does it supersede any local permitting and/or zoning requirements.

The department reserves the right to revoke, suspend, or modify this approval and/or Permit Number 0918301 if the permit holder fails to maintain the facility in compliance with the Missouri Solid Waste Management Law and rules, the terms and conditions of the permit, and the approved engineering plans and specifications.

We appreciate your continued efforts toward environmentally sound solid waste management practices. Should you have any questions, please contact Thomas Roscetti, P.E. of my staff at (573) 526-3940 or P.O. Box 176, Jefferson City, MO 65102-0176.

Sincerely,

SOLID WASTE MANAGEMENT PROGRAM

Charlene S Fitch

Charlene S. Fitch, P.E.
Chief, Engineering Section

CSF:trl

c: Jeffrey Fouse, P.E., Reitz and Jens
Mr. Larry Lehman, Chief, Compliance/Enforcement Section, SWMP
St. Louis Regional Office via Electronic Shared File

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES
Jeremiah W. (Jay) Nixon, Governor • Sara Parker Pauley, Director
www.dnr.mo.gov

OCT 28 2015

Mr. Paul Pike
Ameren Services
One Ameren Plaza
1901 Chouteau Avenue
P.O. Box 66149
St. Louis, MO 63166-6149

RE: Flood Protection Plan for Cell 4A, Ameren Missouri Sioux Power Plant Utility Waste Landfill, Permit Number 0918301, St. Charles County

Dear Mr. Pike:

This letter is in response to a letter from you, dated August 3, 2015, which responds to Condition 1 of the Solid Waste Management Program (SWMP) letter of April 6, 2015, approving the information previously submitted on the initial filling of Cell 4A. Attached to your letter was a flood protection plan for Cell 4A, submitted in the form of Section 5.3 of a document titled "Cell 1 and 4A and Recycle Pond Operations & Maintenance". The flood protection plan discusses the procedures to be taken to counteract hydrostatic uplift on the landfill liner if the flood elevation is expected to be at the 100 year level. In addition, we have received a letter dated October 19, 2015, from Jeffrey Fouse, P.E. of Reitz and Jens, Inc., which discusses the moisture holding capability of the utility waste. Attached to Mr. Fouse' letter is a revised flood protection plan (revised date October 2015).

We have reviewed the documents submitted and believe they fulfill the condition of the April 6, 2015, letter. In addition, we hereby modify Permit Number 0918301 to incorporate the October 2015 flood protection plan.

If you have any questions, please contact Thomas Roscetti, P.E. of my staff at (573) 526-3940 or at P.O. Box 176, Jefferson City, MO 65102-0176.

Sincerely,

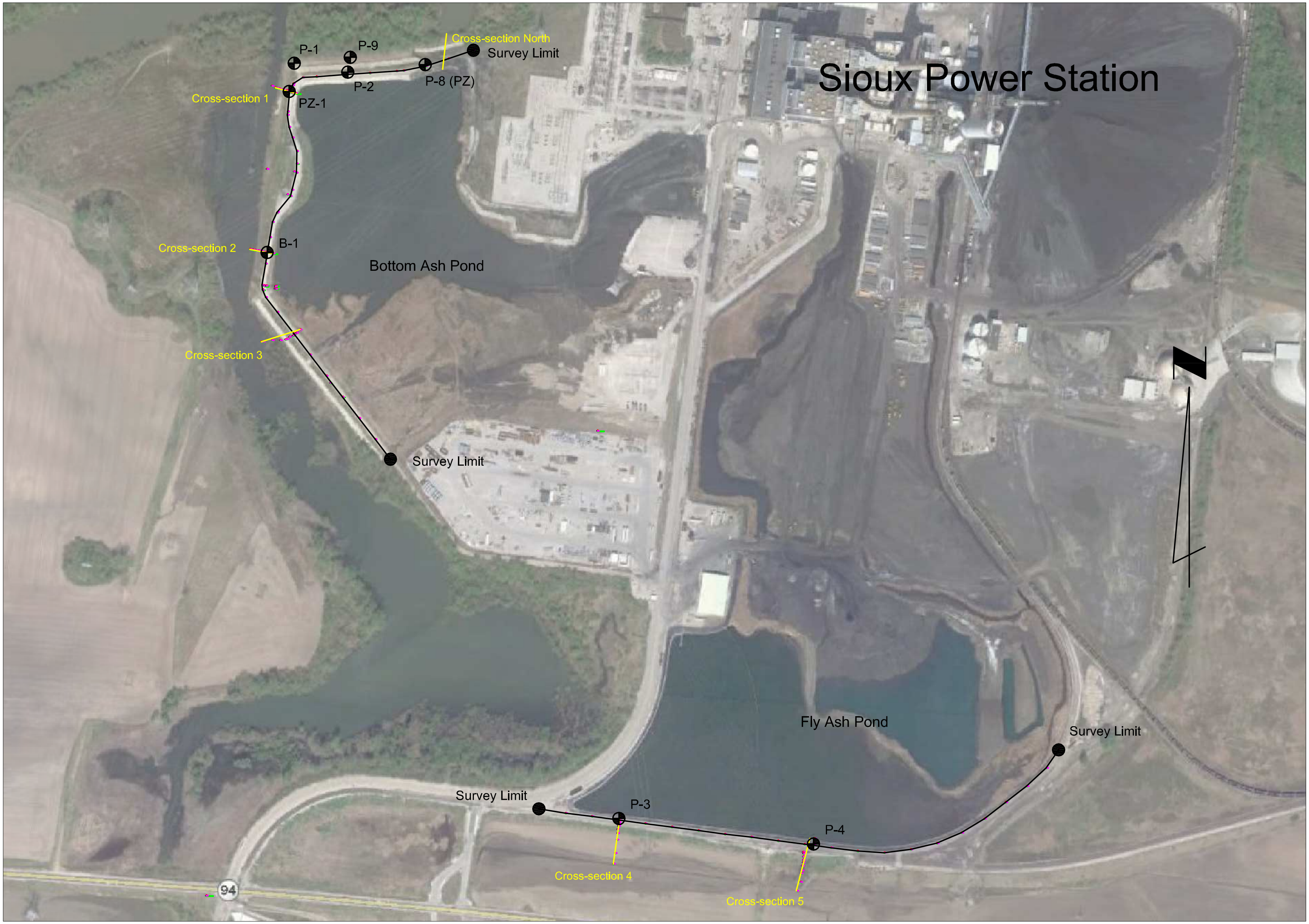
SOLID WASTE MANAGEMENT PROGRAM

Charlene S Fitch

Charlene S. Fitch, P.E.
Chief, Engineering Section

CSF:trl

c: Jeffrey Fouse, P.E., Reitz and Jens, Inc.
Mr. Larry Lehman, Chief, Compliance/Enforcement Section, SWMP
St. Louis Regional Office via Electronic Shared File



Elevation Profile Survey Limits
Locations of Cross-section and Borings

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure 1

KEY TO BORING LOGS

Symbol	Description
KEY TO SOIL SYMBOLS	
⁂	Crushed Limestone
▩	Miscellaneous FILL
▨	High plastic CLAY (CH)
░	Poorly-graded SAND (SP)
▧	Low plastic Silty CLAY (CL)
MISCELLANEOUS SYMBOLS	
▽	Water table during drilling
⌁	Boring continues
●	Moisture content (%)
▲	N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)
■	Shear strength from Pocket Penetrometer (tsf)
SOIL SAMPLERS	
◩	2-in. O.D. Split-Spoon
▯	3-in. O.D. Shelby Tube

Notes:

1. Details of the drilling and sampling program are presented in the general introduction of the report

2. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual or occur between samples.

Figure 2-0

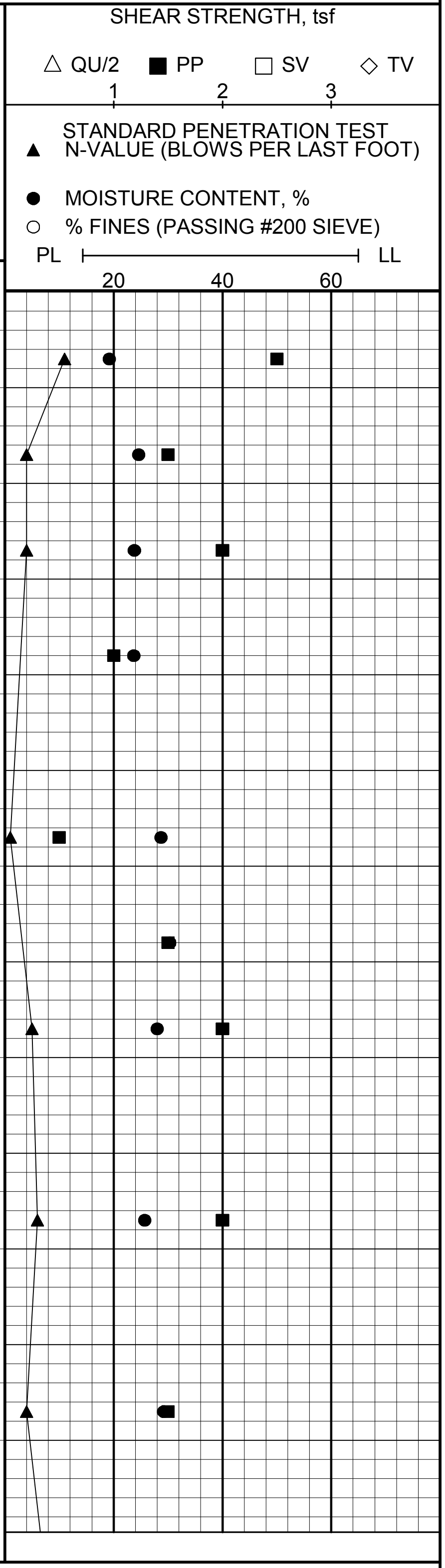
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG PZ-1

Ash Pond Stability
Sioux Power Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1121510.79 E 877737.340
ELEVATION: 443.0 DATUM: NAVD88
DATE DRILLED: 06-12-10

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0			8" CRUSHED LIMESTONE, 1/2" minus rock		
		100	FILL, consisting of compacted layers and laminations of high plastic clay, silty clay, silt, sand and mixtures of all, stiff, moist	2-5-6	19.2
	440	56	Becoming firm	2-2-2	24.6
5		44		2-2-2	23.8
	435	40		98.2	23.7
10			PZ-1, screened interval from 10'6" to 20'6"		
	430	67	Becoming very moist and very soft	0-0-1	28.7
15		83		91.3	30.3
	425	83	Becoming firm	1-2-3	28.0
20			Began mud rotary drilling at 20'		
	420	67	CLAY (CH), gray, firm, high plastic, with silty clay, trace limonite and fine roots	2-3-3	25.7
25	415	83	Without silty clay	1-2-2	29.2
30					



DRILLER: Terra Drill
METHOD: 3.75" ID HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 86.3
LOGGED BY: C. Cook

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 16 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

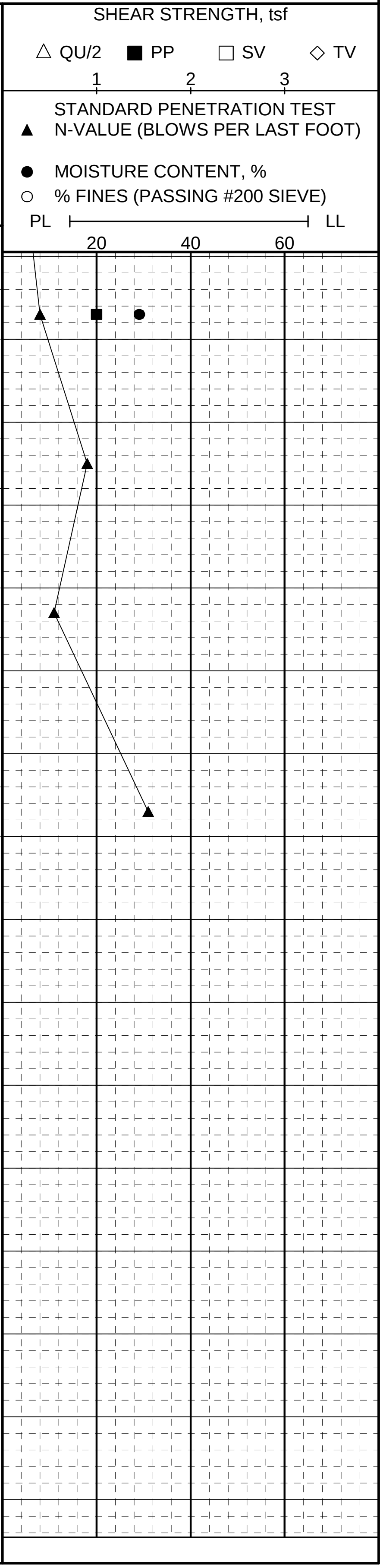
File: 2010012488

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG PZ-1

Ash Pond Stability

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	410							
					100		0-2-6	29.1
35						SAND (SP), brownish-tan, fine to medium grain, loose		
	405				67	Becoming medium dense	6-9-9	
40								
	400				94		2-5-6	
45								
	395				67	Becoming gray with fine gravel lenses	7-11-20	
50						Boring terminated at 50'-0" in sand		
	390							
55								
	385							
60								
	380							
65								
	375							
70								



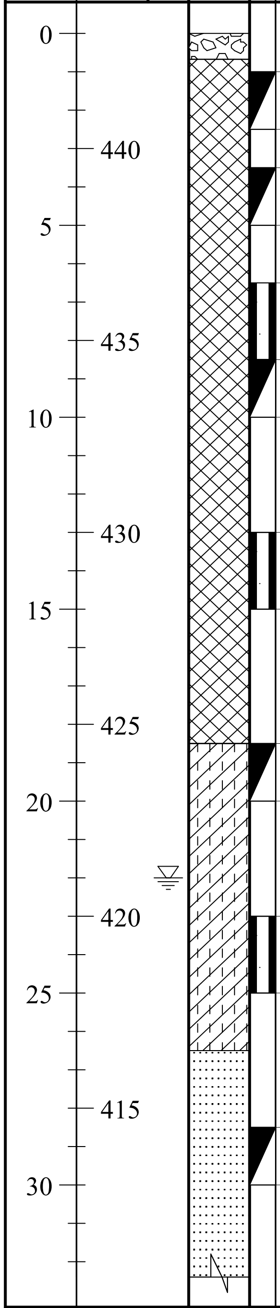
File: 2010012488

REITZ & JENS, INC.
CONSULTING ENGINEERS

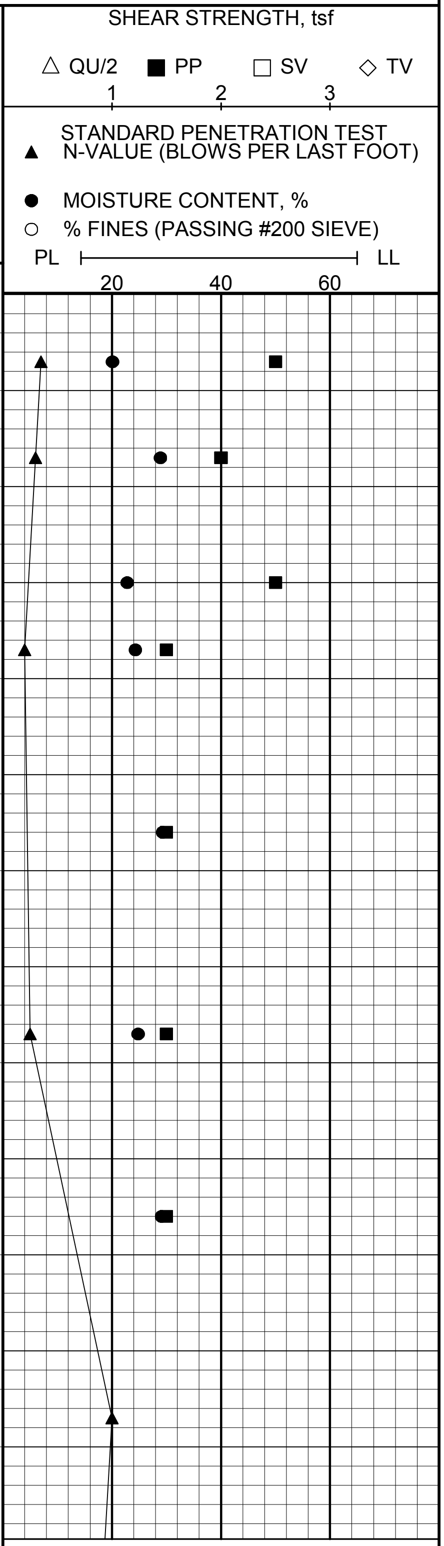
BORING LOG B-1

Ash Pond Stability
Sioux Power Plant
CLIENT: **Ameren Missouri**

LOCATION: N 1122114.98 E 877818.565
ELEVATION: 443.0 DATUM: NAVD88
DATE DRILLED: 06-12-10



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	8" CRUSHED LIMESTONE, 1/2" minus rock		
28	FILL, consisting of compacted layers and laminations of silty clay, high plastic clay, sand, silt and mixtures of all, trace lignite, stiff, moist	4-3-4	20.1
44	Becoming firm	2-2-4	28.9
67		103.6	22.8
83		2-2-2	24.3
92	Becoming very moist	87.3	29.3
83	Silty CLAY (CL), gray, firm, trace lignite and limonite	1-3-2	24.8
100		86.8	29.1
	Began mud rotary drilling at 25'		
	SAND (SP), brownish-tan, fine to medium grain, medium dense		
100		7-11-9	



DRILLER: Terra
METHOD: 4.75" HSA
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 86.3
LOGGED BY: C. Cook

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 22 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

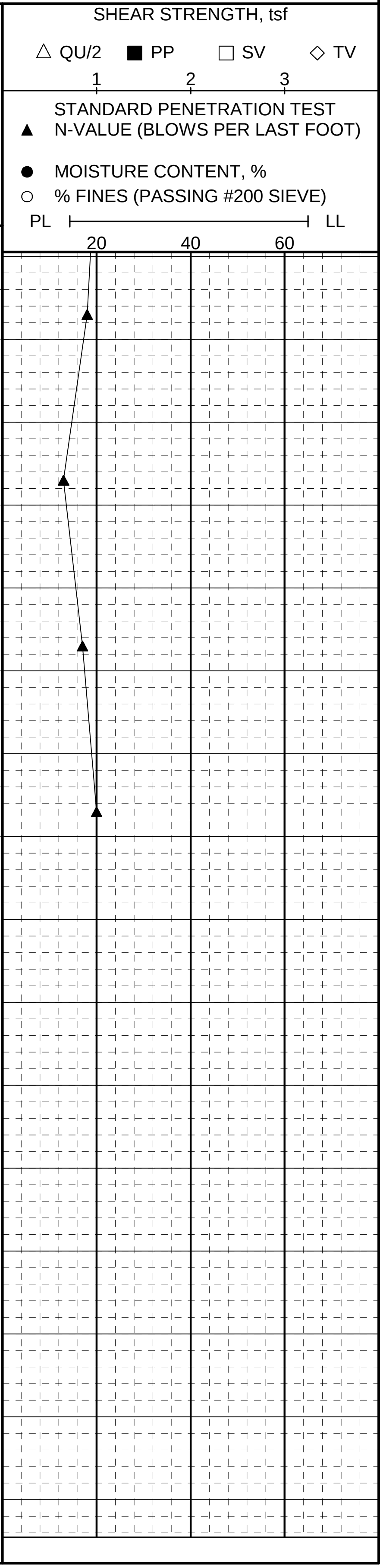
File: 2010012488

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Ash Pond Stability

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	410							
					100		7-9-9	
35								
	405							
					100	With clay laminations in sample	5-5-8	
40								
	400							
					33	Becoming fine to coarse grain	8-8-9	
45								
	395							
					100	Becoming gray	6-10-10	
50						Boring terminated at 50'-0" in sand		
	390							
55								
	385							
60								
	380							
65								
	375							
70								



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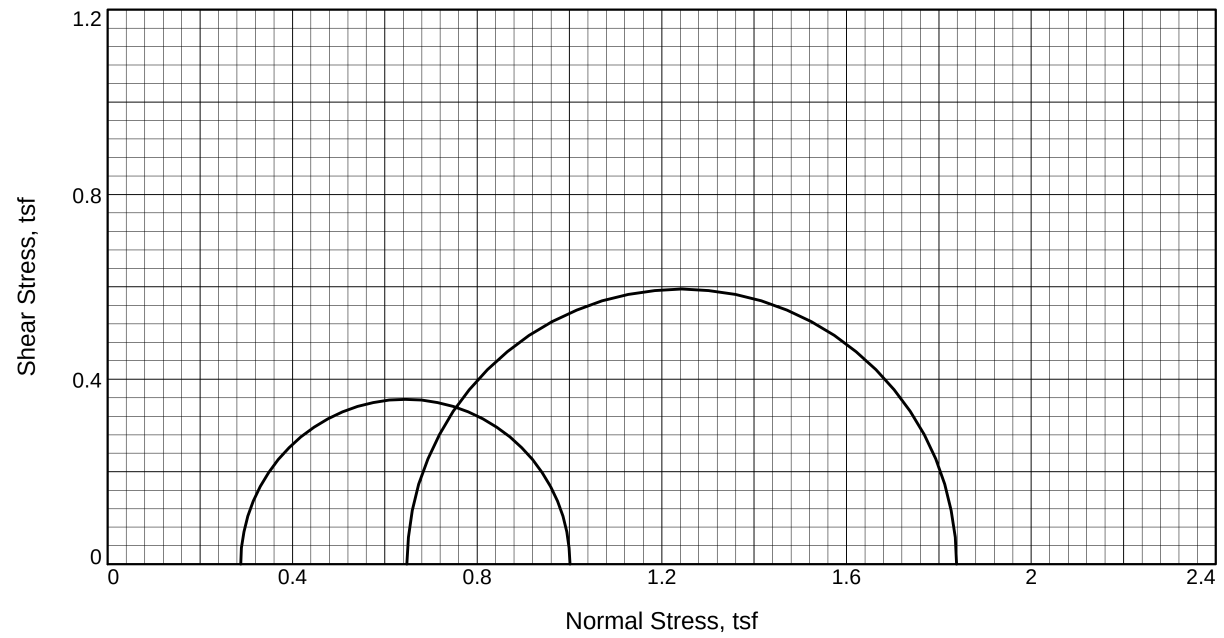
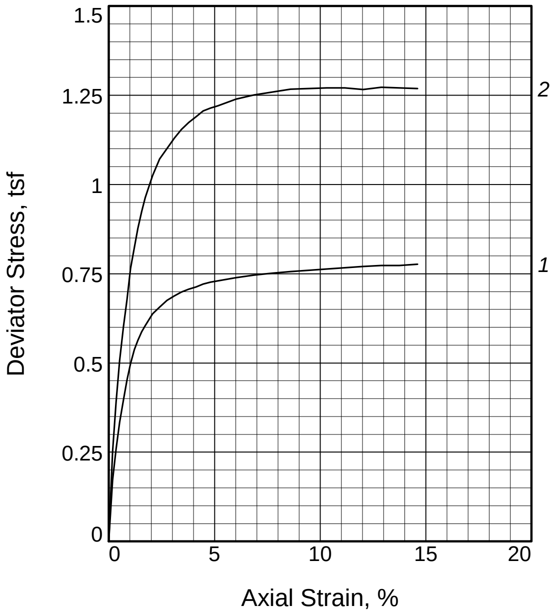




	Sample No.	1	2
Initial	Water Content,	28.8	31.7
	Dry Density, pcf	93.3	89.2
	Saturation,	97.3	97.0
	Void Ratio	0.7936	0.8765
	Diameter, in.	2.85	2.85
	Height, in.	5.82	5.82
At Test	Water Content,	28.8	31.7
	Dry Density, pcf	93.3	89.2
	Saturation,	97.3	97.0
	Void Ratio	0.7936	0.8765
	Diameter, in.	2.85	2.85
	Height, in.	5.82	5.82
	Strain rate, %/min.	0.80	0.80
	Back Pressure, tsf	0.00	0.00
	Cell Pressure, tsf	0.29	0.65
	Fail. Stress, tsf	0.71	1.19
	Ult. Stress, tsf	0.78	1.27
	σ_1 Failure, tsf	1.00	1.84
	σ_3 Failure, tsf	0.29	0.65

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: Clay, silty clay, clayey silt, and clayey sand FILL (CH-CL-SC), grey, with lignite and limonite, sand lenses and some

Assumed Specific Gravity= 2.68

Remarks:

Figure 2-3

Client: Ameren Missouri

Project: Ash Pond Stability

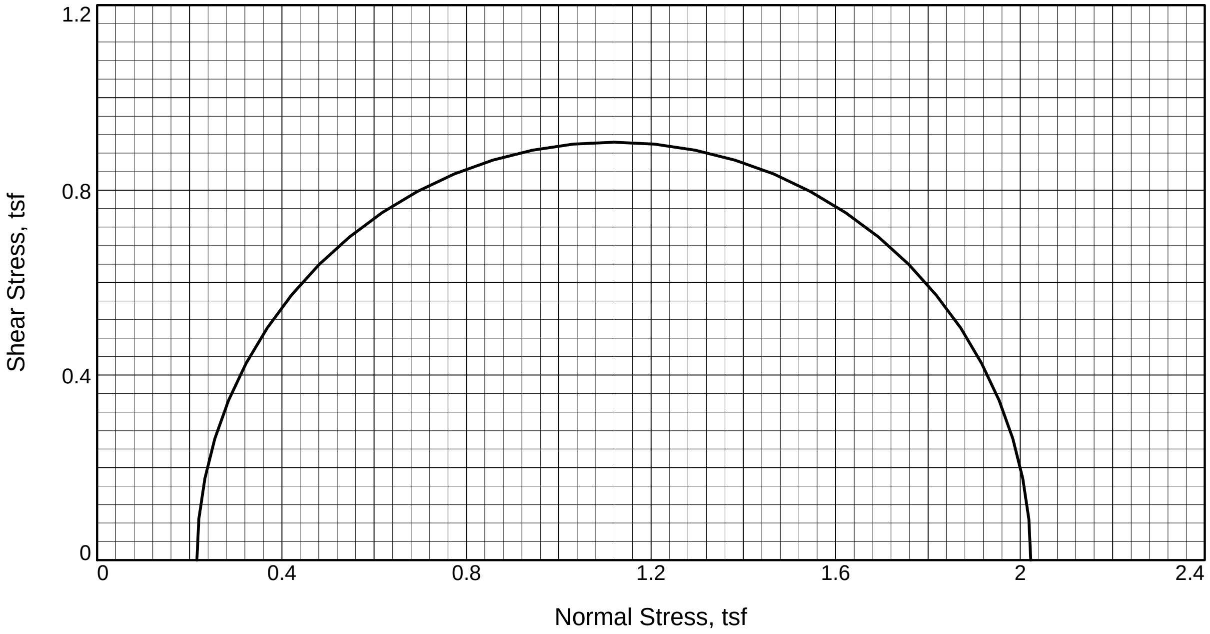
Source of Sample: PZ-1 **Depth:** 16

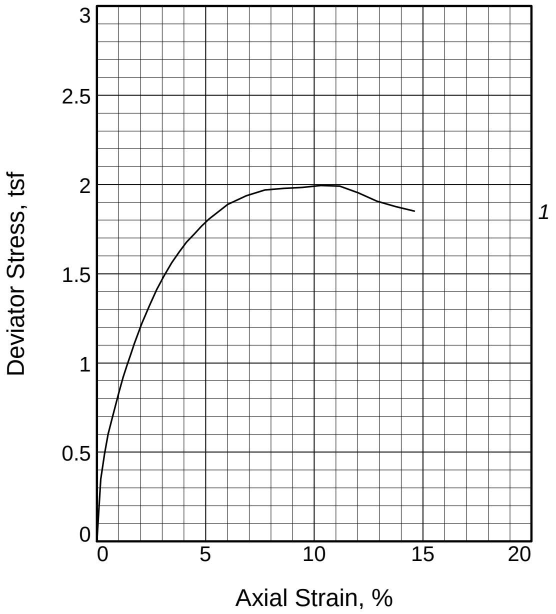
Sample Number: ST-6

Proj. No.: 2010012488 **Date:** 6/14/10

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Bertel





Sample No.		1
Initial	Water Content,	22.8
	Dry Density, pcf	103.6
	Saturation,	99.6
	Void Ratio	0.6146
	Diameter, in.	2.85
	Height, in.	5.82
At Test	Water Content,	22.8
	Dry Density, pcf	103.6
	Saturation,	99.6
	Void Ratio	0.6146
	Diameter, in.	2.85
	Height, in.	5.82
Strain rate, %/min.		0.80
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.22
Fail. Stress, tsf		1.81
Ult. Stress, tsf		2.00
σ_1 Failure, tsf		2.02
σ_3 Failure, tsf		0.22

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: Clay, silty clay, clayey silt, and sandly silty clay FILL (CH-CL-ML), grey, with lignite and limonite

Assumed Specific Gravity= 2.68

Remarks:

Figure 2-4

Client: Ameren Missouri

Project: Ash Pond Stability

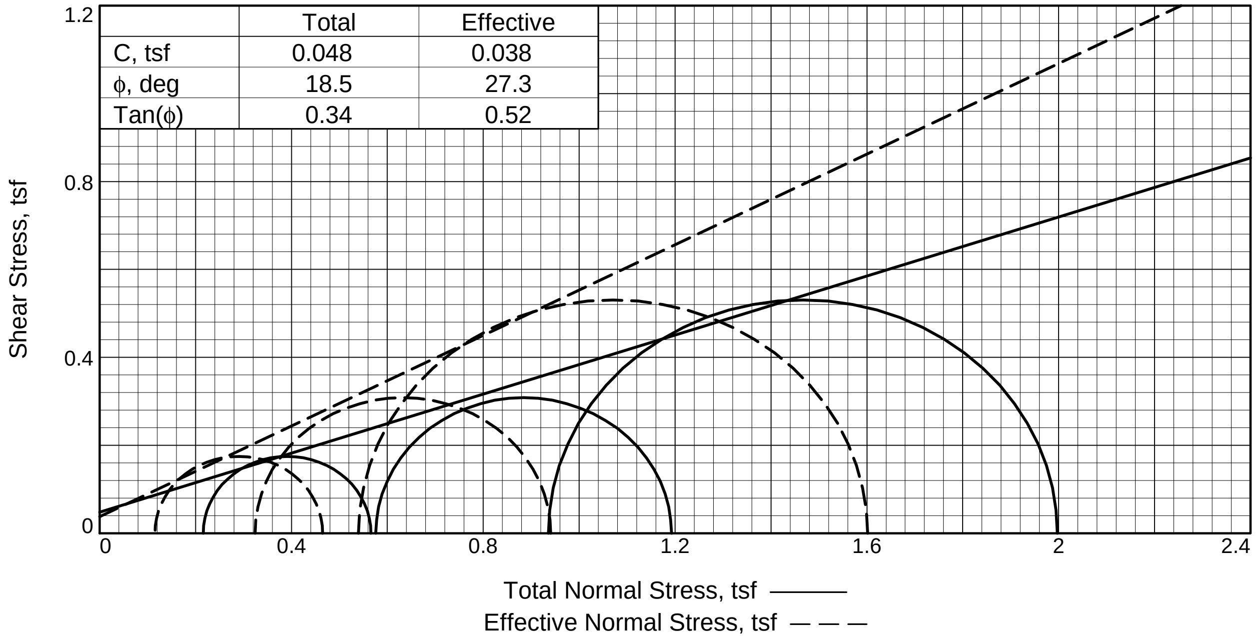
Source of Sample: B-1 **Depth:** 6.5

Sample Number: ST-3

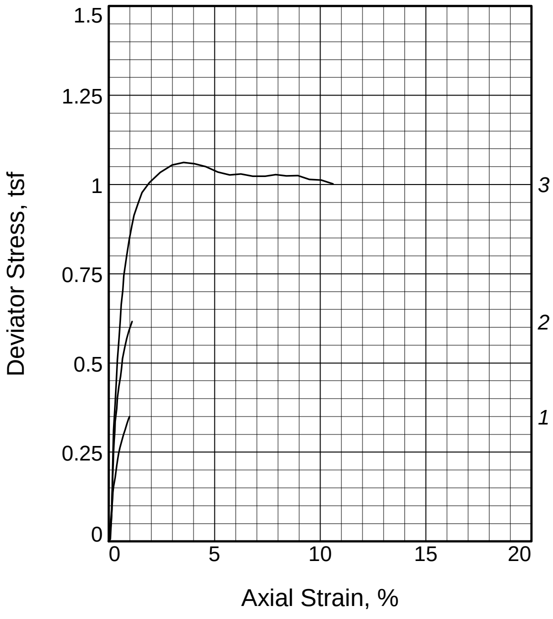
Proj. No.: 2010012488 **Date:** 6/14/10

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Bertel



	Total	Effective
C, tsf	0.048	0.038
ϕ, deg	18.5	27.3
Tan(ϕ)	0.34	0.52



	Sample No.	1	2	3
Initial	Water Content,	29.3	29.3	29.3
	Dry Density, pcf	87.3	87.3	87.3
	Saturation,	85.7	85.7	85.7
	Void Ratio	0.9163	0.9163	0.9163
	Diameter, in.	2.01	2.01	2.01
	Height, in.	4.08	4.08	4.08
At Test	Water Content,	33.1	32.2	31.7
	Dry Density, pcf	88.7	89.8	90.5
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.8868	0.8629	0.8488
	Diameter, in.	2.00	2.00	2.01
	Height, in.	4.06	4.00	3.95
	Strain rate, %/min.	0.15	0.05	0.03
	Back Pressure, tsf	3.96	4.32	4.68
	Cell Pressure, tsf	4.18	4.90	5.62
	Fail. Stress, tsf	0.35	0.62	1.06
	Total Pore Pr., tsf	4.06	4.57	5.08
	Ult. Stress, tsf	0.35	0.62	1.06
	Total Pore Pr., tsf	4.06	4.57	5.08
	$\bar{\sigma}_1$ Failure, tsf	0.47	0.94	1.60
	$\bar{\sigma}_3$ Failure, tsf	0.12	0.32	0.54

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Silty clay, clayey silt, and clay FILL, grey, with sandy silt lenses, lignite, and limonite

Assumed Specific Gravity= 2.68

Remarks:

Figure 2-5

Client: Ameren Missouri

Project: Ash Pond Stability

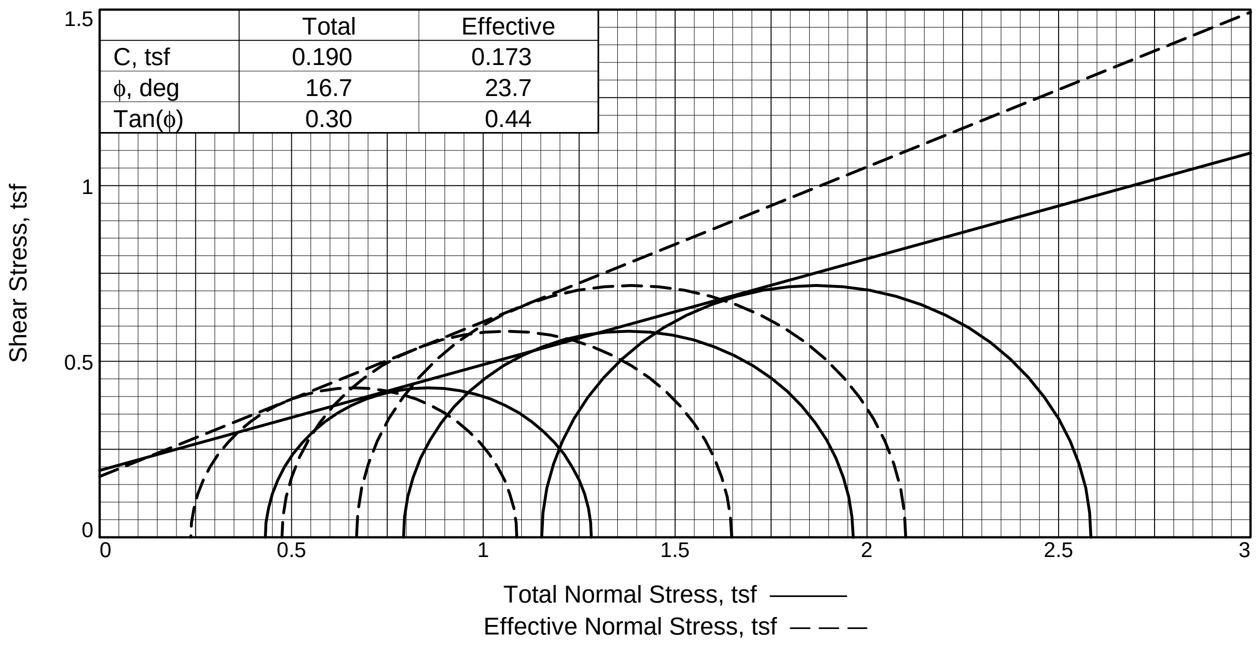
Source of Sample: B-1 **Depth:** 13

Sample Number: ST-5

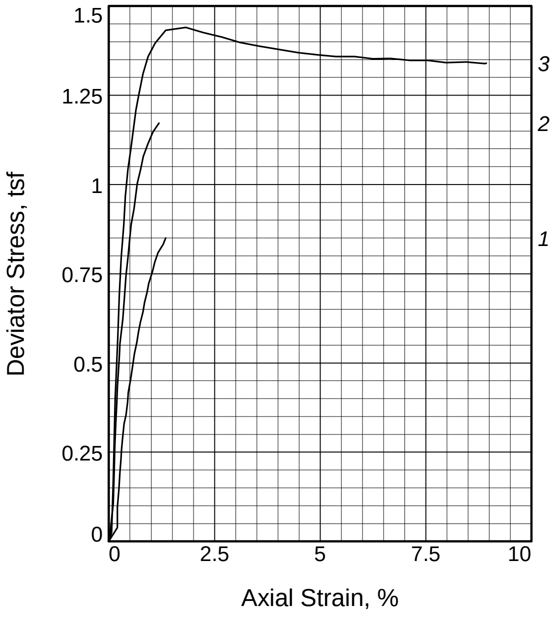
Proj. No.: 2010012488 **Date:** 6/14/2010

RJ REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Bertel



	Total	Effective
C, tsf	0.190	0.173
ϕ, deg	16.7	23.7
Tan(ϕ)	0.30	0.44



	Sample No.	1	2	3
Initial	Water Content,	29.1	29.1	29.1
	Dry Density, pcf	86.8	86.8	86.8
	Saturation,	84.2	84.2	84.2
	Void Ratio	0.9280	0.9280	0.9280
	Diameter, in.	2.02	2.02	2.02
	Height, in.	5.00	5.00	5.00
At Test	Water Content,	33.3	33.0	32.9
	Dry Density, pcf	88.4	88.7	89.0
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.8923	0.8854	0.8807
	Diameter, in.	2.01	2.02	2.03
	Height, in.	4.97	4.90	4.84
	Strain rate, %/min.	0.50	0.50	0.50
	Back Pressure, tsf	3.96	4.32	5.04
	Cell Pressure, tsf	4.39	5.11	6.19
	Fail. Stress, tsf	0.85	1.17	1.43
	Total Pore Pr., tsf	4.15	4.64	5.52
	Ult. Stress, tsf	0.85	1.17	1.43
	Total Pore Pr., tsf	4.15	4.64	5.52
	$\bar{\sigma}_1$ Failure, tsf	1.09	1.65	2.10
	$\bar{\sigma}_3$ Failure, tsf	0.24	0.48	0.67

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Silty CLAY (CL), grey-brown, with lignite and limonite

LL= 45

Assumed Specific Gravity= 2.68

Remarks:

Figure 2-6

Client: Ameren Missouri

Project: Ash Pond Stability

Source of Sample: B-1 **Depth:** 23

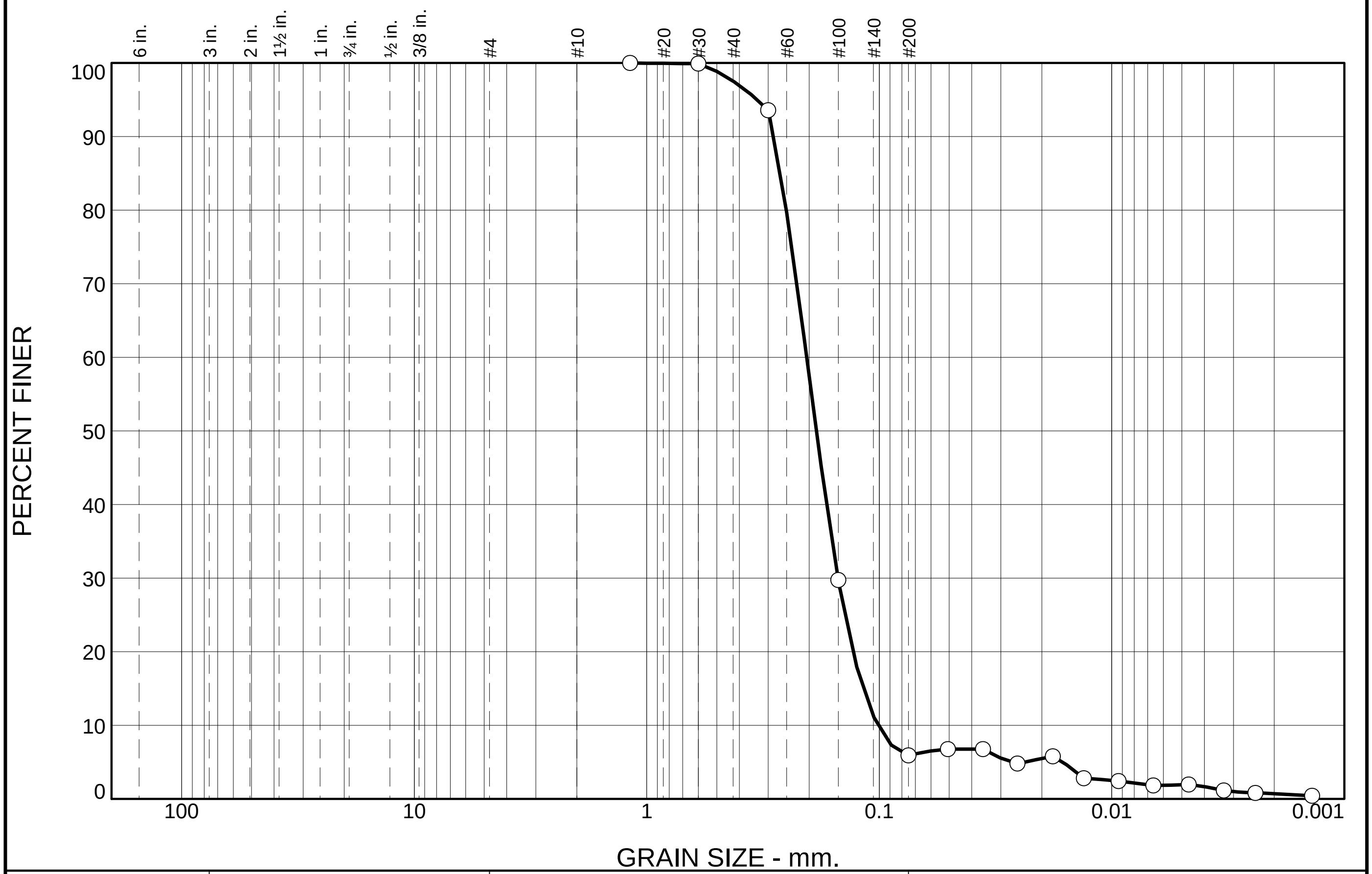
Sample Number: ST-7

Proj. No.: 2010012488 **Date:** 6-14-10

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Fouse

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	2.5	91.6	4.0	1.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#30	99.9		
#50	93.6		
#100	29.8		
#200	5.9		

* (no specification provided)

Material Description

SAND (SP), grey, fine grain, trace silt and clay, with organic material (detritus)

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.2658 D_{60}= 0.2051 D_{50}= 0.1863
D_{30}= 0.1504 D_{15}= 0.1174 D_{10}= 0.1015
C_u= 2.02 C_c= 1.09

Date Tested: 9/13-15/10 **Tested By:** J. Crose, K. Kocher

Remarks

Sample No.: Sample #1 **Source of Sample:** Sand Boil Location **Date Sampled:** 9/9/10
Location: **Elev./Depth:** Surface
Checked By: D. Eskridge **Title:** Project Manager

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Bottom Ash Pond Seepage

Project No: 2010012488 **Figure** 2-7

Particle Size Distribution Report - ASTM D422

% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.0	93.5	5.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	100.0		
#30	99.8		
#40	99.0		
#50	92.3		
#100	37.2		
#200	5.5		

* (no specification provided)

Material Description

SAND (SP), grey, fine grain, trace silt and clay, with organic material (detritus)

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.2639 D_{60}= 0.1955 D_{50}= 0.1750
D_{30}= 0.1350 D_{15}= 0.0994 D_{10}= 0.0863
C_u= 2.26 C_c= 1.08

Date Tested: 9/13/10 **Tested By:** J. Crose

Remarks

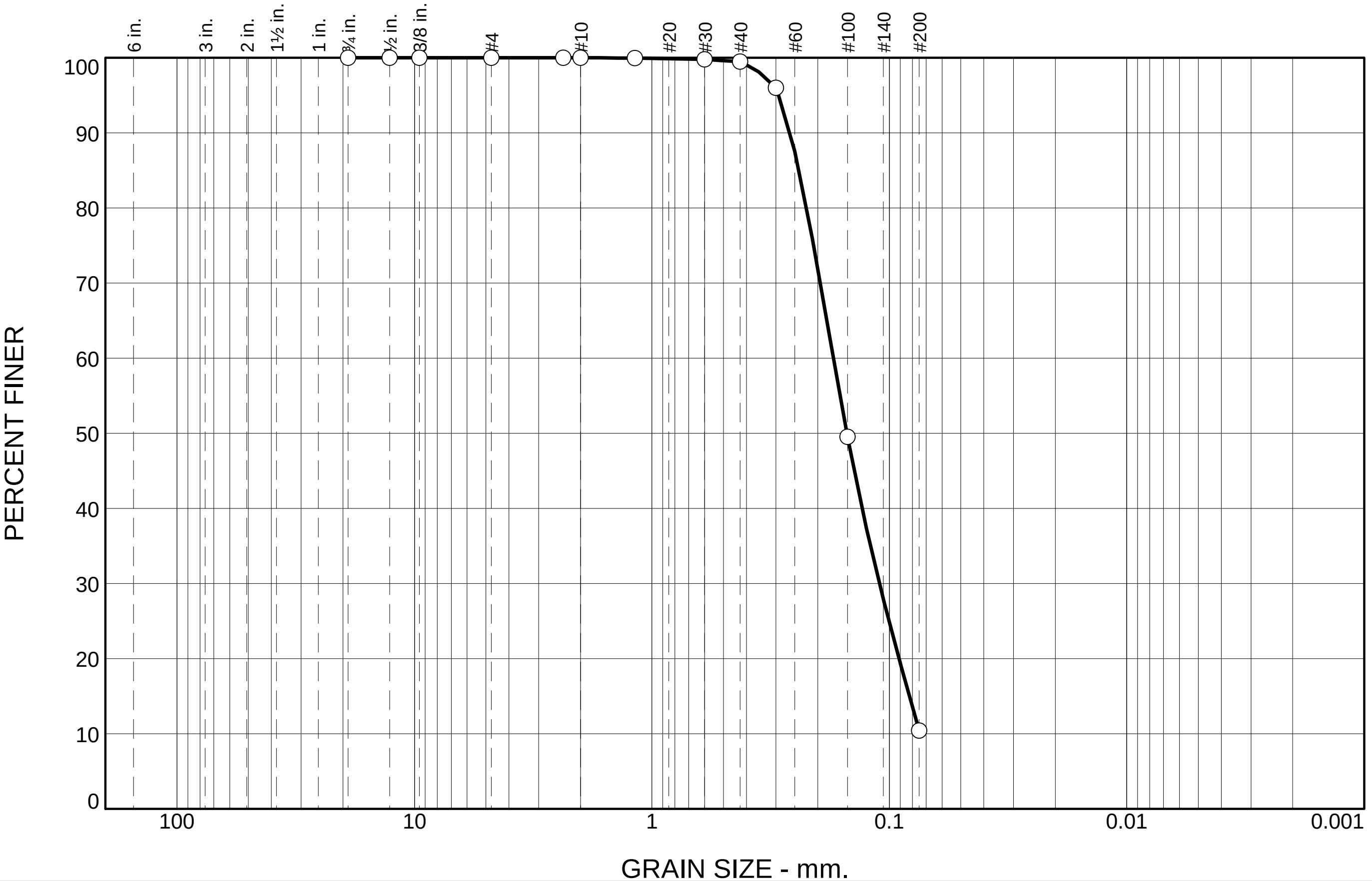
Sample No.: Sample #1 **Source of Sample:** Sand Boil Location **Date Sampled:** 9/9/10
Location: **Elev./Depth:** Surface
Checked By: D. Eskridge **Title:** Project Manager

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Bottom Ash Pond Seepage

Project No: 2010012488 **Figure** 2-8

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.5	89.1	10.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	100.0		
#10	100.0		
#16	100.0		
#30	99.8		
#40	99.5		
#50	96.0		
#100	49.6		
#200	10.4		

* (no specification provided)

Material Description

SAND (SP-SM), grey, fine grain, with silt, clay, and organic material (detritus)

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.2400 D_{60}= 0.1720 D_{50}= 0.1509
D_{30}= 0.1102 D_{15}= 0.0824 D_{10}=
C_u= C_c=

Date Tested: 9/13/10 **Tested By:** J. Crose

Remarks

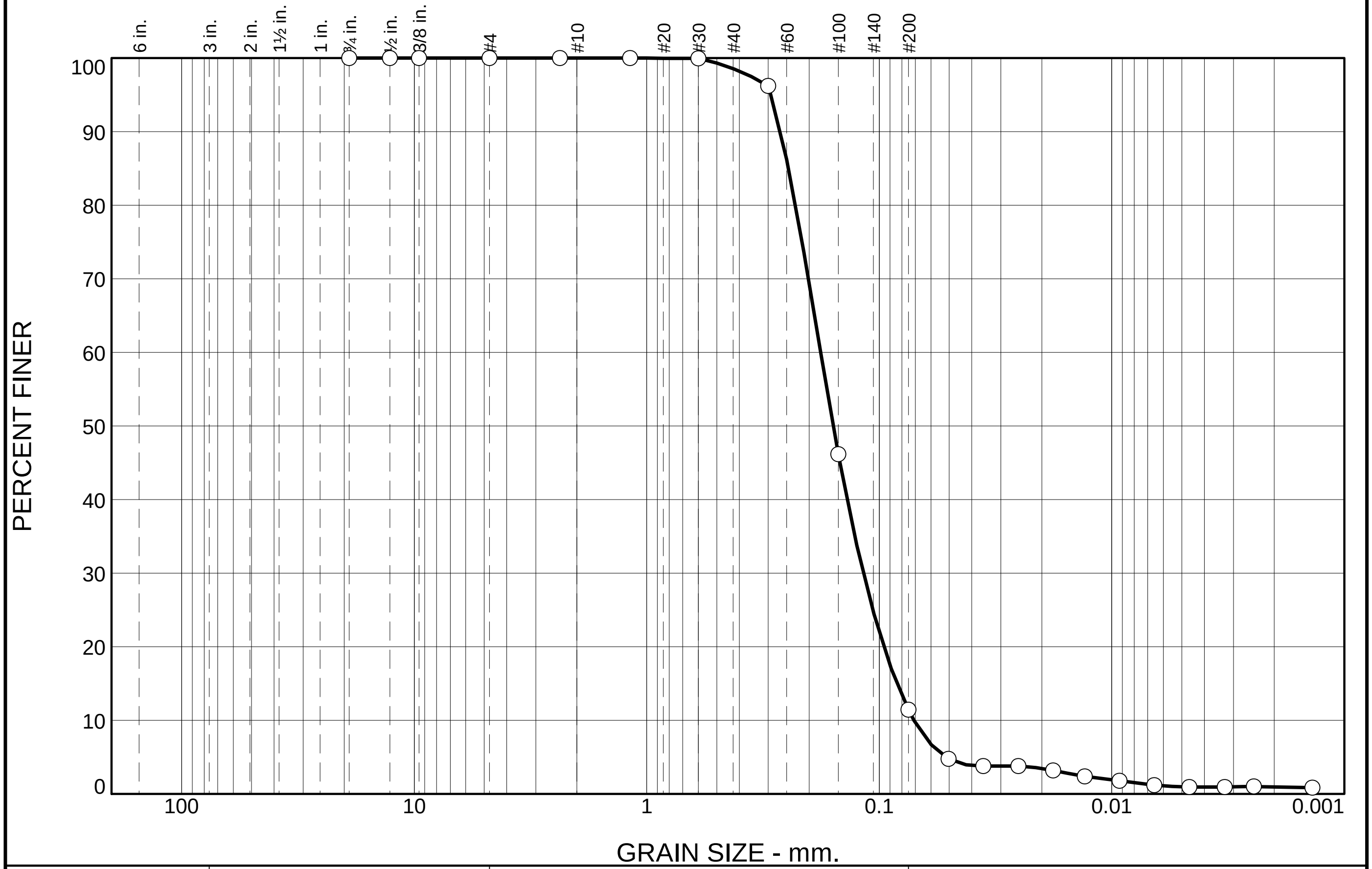
Sample No.: Sample #2 **Source of Sample:** Sand Boil Location **Date Sampled:** 9/9/10
Location: **Elev./Depth:** Surface
Checked By: D. Eskridge **Title:** Project Engineer

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren Missouri
Project: Bottom Ash Pond Seepage

Project No: 2010012488 **Figure** 2-9

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.4	87.1	10.5	1.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
1/2	100.0		
3/8	100.0		
#4	100.0		
#8	100.0		
#16	100.0		
#30	100.0		
#50	96.2		
#100	46.2		
#200	11.5		

* (no specification provided)

Material Description

SAND (SP-SM), grey, fine grain, with silt, clay, and organic material (detritus)

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.2456 D_{60}= 0.1786 D_{50}= 0.1577
D_{30}= 0.1172 D_{15}= 0.0841 D_{10}= 0.0708
C_u= 2.52 C_c= 1.09

Date Tested: 9/13-15/10 **Tested By:** J. Crose, K. Kocher

Remarks

Sample No.: Sample #2 **Source of Sample:** Sand Boil Location **Date Sampled:** 9/9/10
Location: **Elev./Depth:** Surface
Checked By: D. Eskridge **Title:** Project Manager

REITZ & JENS, INC.
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Client: Ameren Missouri
Project: Bottom Ash Pond Seepage

Project No: 2010012488 **Figure** 2-10

LEGEND

Symbol	Description
KEY TO SOIL SYMBOLS	
▨	Organic Material
▨	Clay
▨	Silty Clay to Clay
▨	Clayey Silt to Silty Clay
▨	Sandy Silt to Clayey Silt
▨	Silty Sand to Sandy Silt
▨	Sand to Silty Sand
⁘	Sand
●	Gravelly Sand to Sand

│ qc = Cone Tip Pressure, tons/sq. ft.

│ fs = Skin Friction, tons/sq. ft.

│ Rf = Friction ratio (fs/qc) in %

│ u2 = Porewater Pressure, psi

│ N60 = Calculated Equivalent N-value, blows/foot, (Standard Penetration Test)

│ Su = Calculated Undrained Shear Strength, ksf

│ Phi = Friction Angle, degrees

Notes:

1. Details of the drilling and sampling program are presented in the general introduction of the report.
2. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual.

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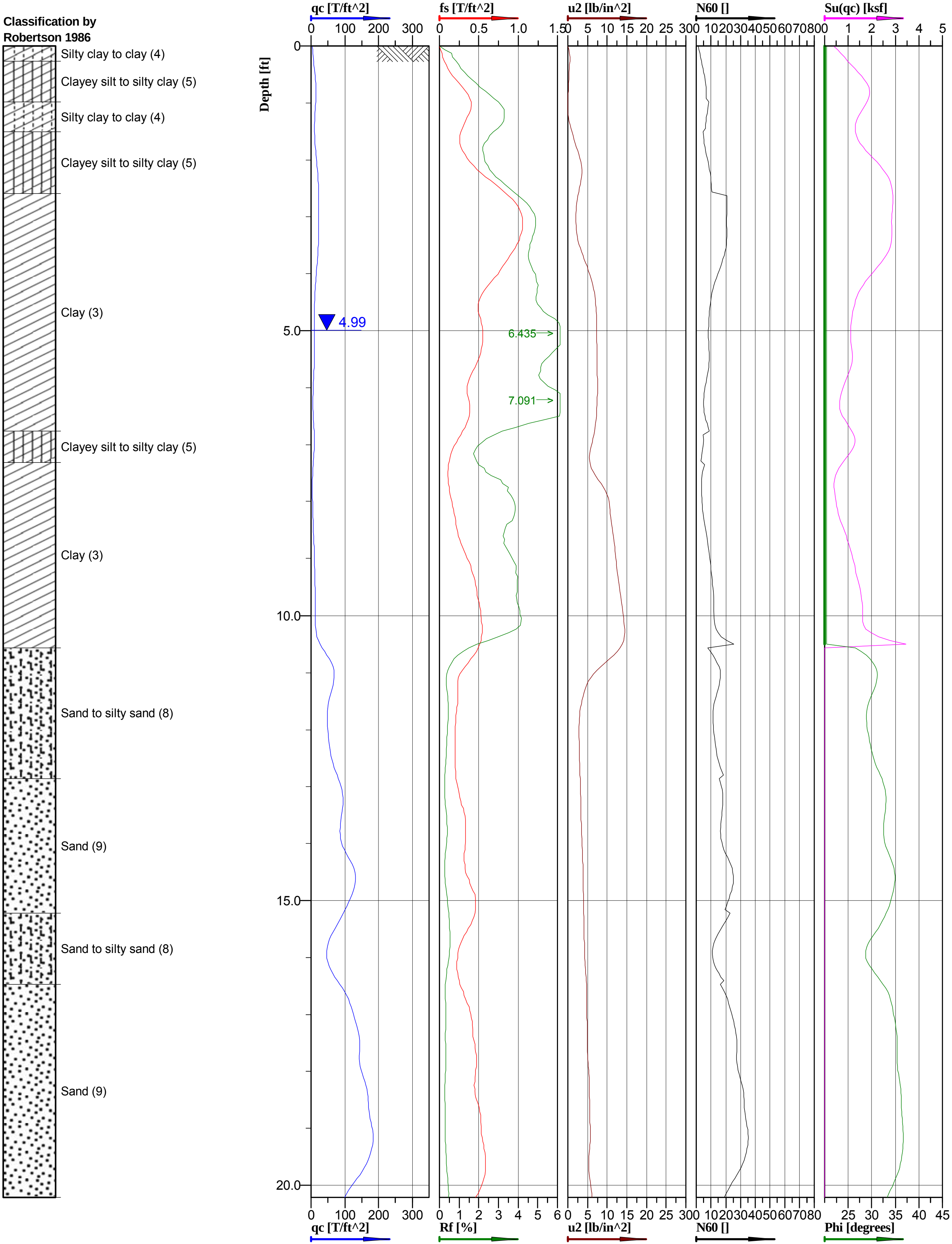
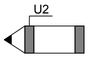
[1] Robertson et al. (1986) *Use of piezometer cone data.* Proceedings of the ASCE Specialty Conference: In Situ 86: Use of In Situ Tests in Geotechnical Engineering. ASCE 1986

[2] Lunne, T. Robertson, P.K. and Powell, J.J.M. (1997) Cone Penetration Testing in Geotechnical Practice, Published by Blackie Academic & Professional.

[3] Bowles, Joseph E. (1996) Foundation Analysis and Design. McGraw-Hill. 5th ed. Page 180.

Figure 3-0





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Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant

Position: X: 877872.87 ft, Y: 1122198.49 ft

Ground level: 425.98

Test no: P-1

Project ID: 2010012488

Client: Ameren Missouri

Date: 8/14/2010

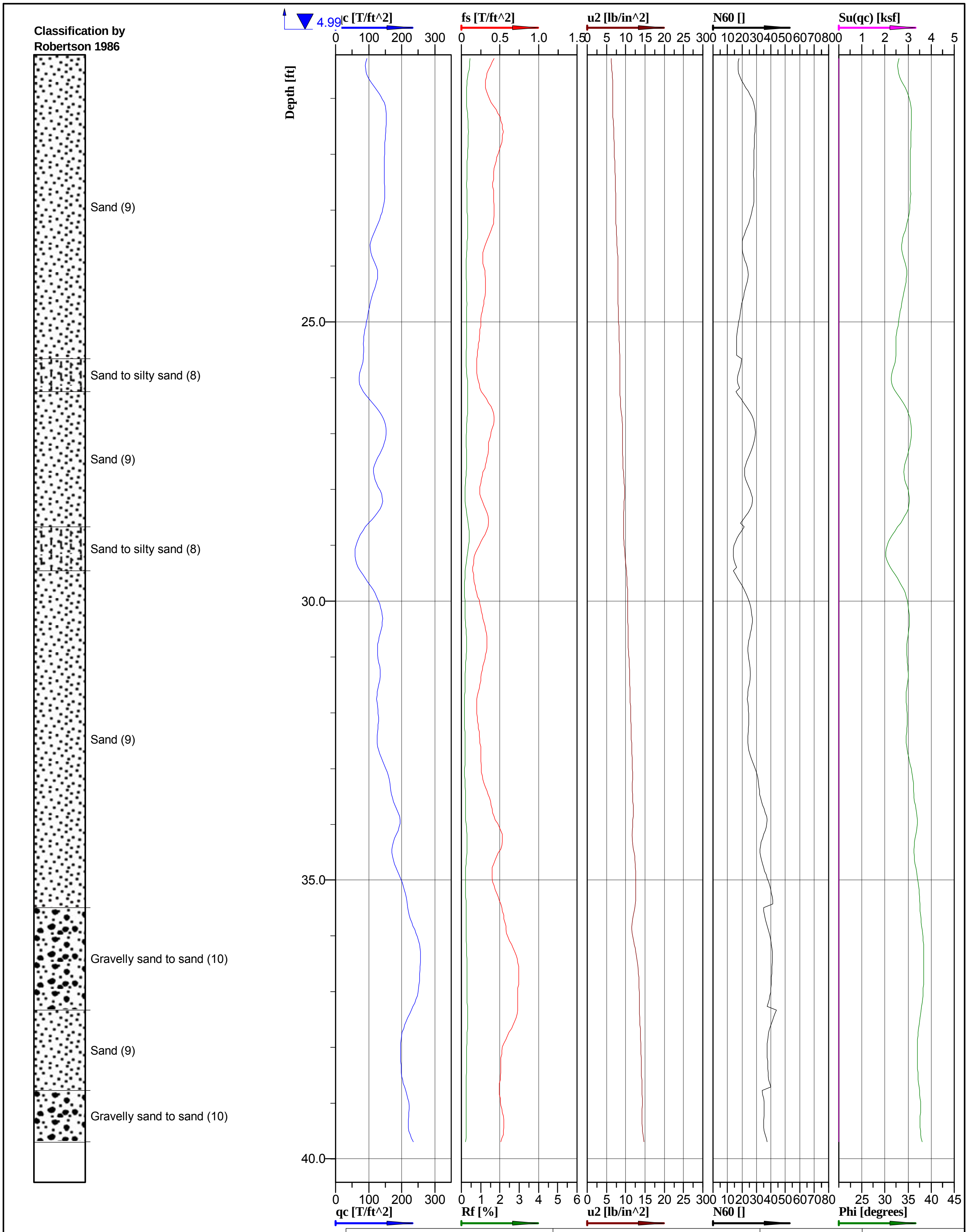
Scale: 1 : 28

Project: 2010 Ash Pond Stability Analysis

Page: 1/2

Fig: 3-1

File: p-1.cpd



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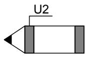
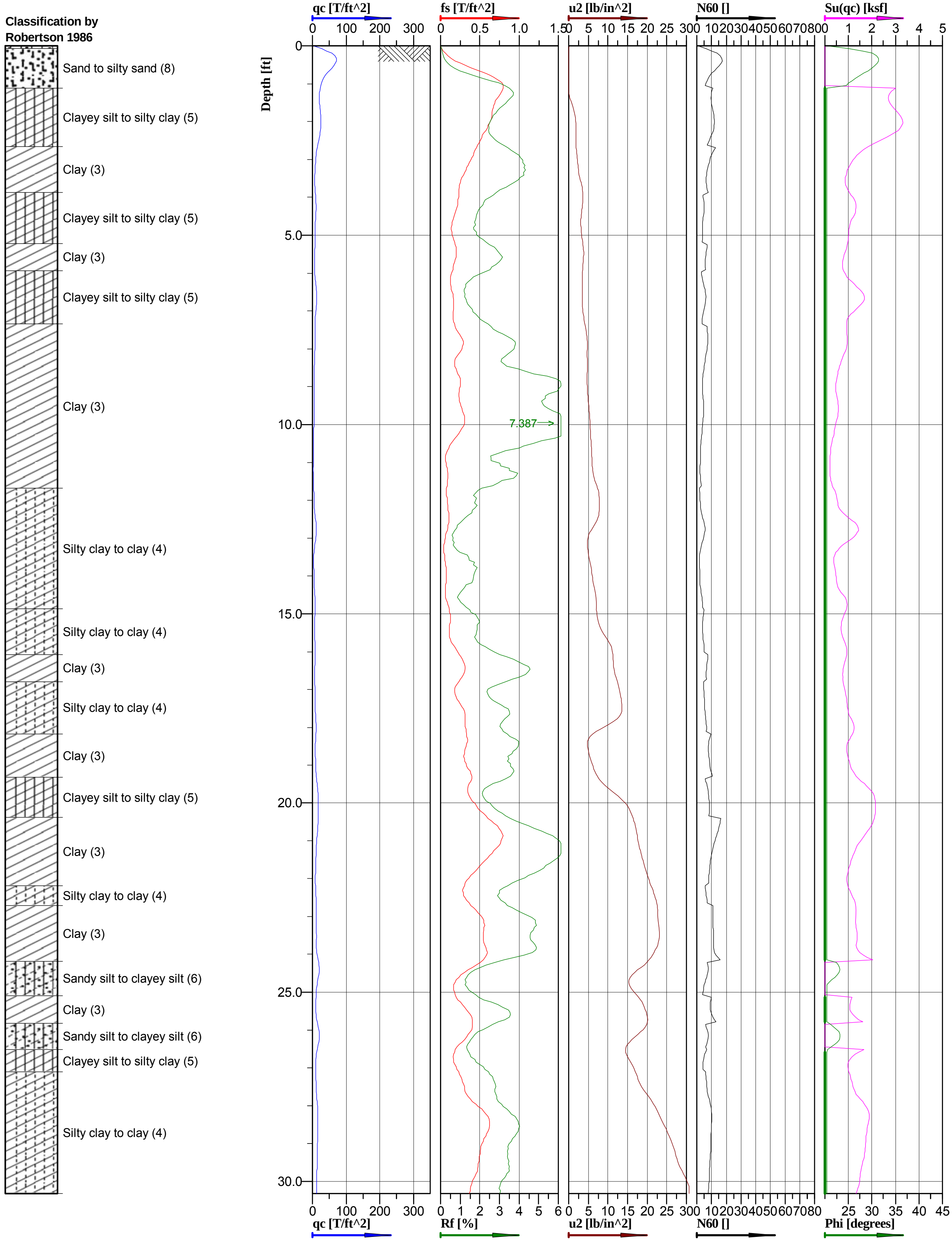
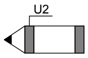


Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant	Position: X: 877872.87 ft, Y: 1122198.49 ft	Ground level: 425.98	Test no: P-1
Project ID: 2010012488	Client: Ameren Missouri	Date: 8/14/2010	Scale: 1 : 28
Project: 2010 Ash Pond Stability Analysis		Page: 2/2	Fig: 3-1
		File: p-1.cpd	

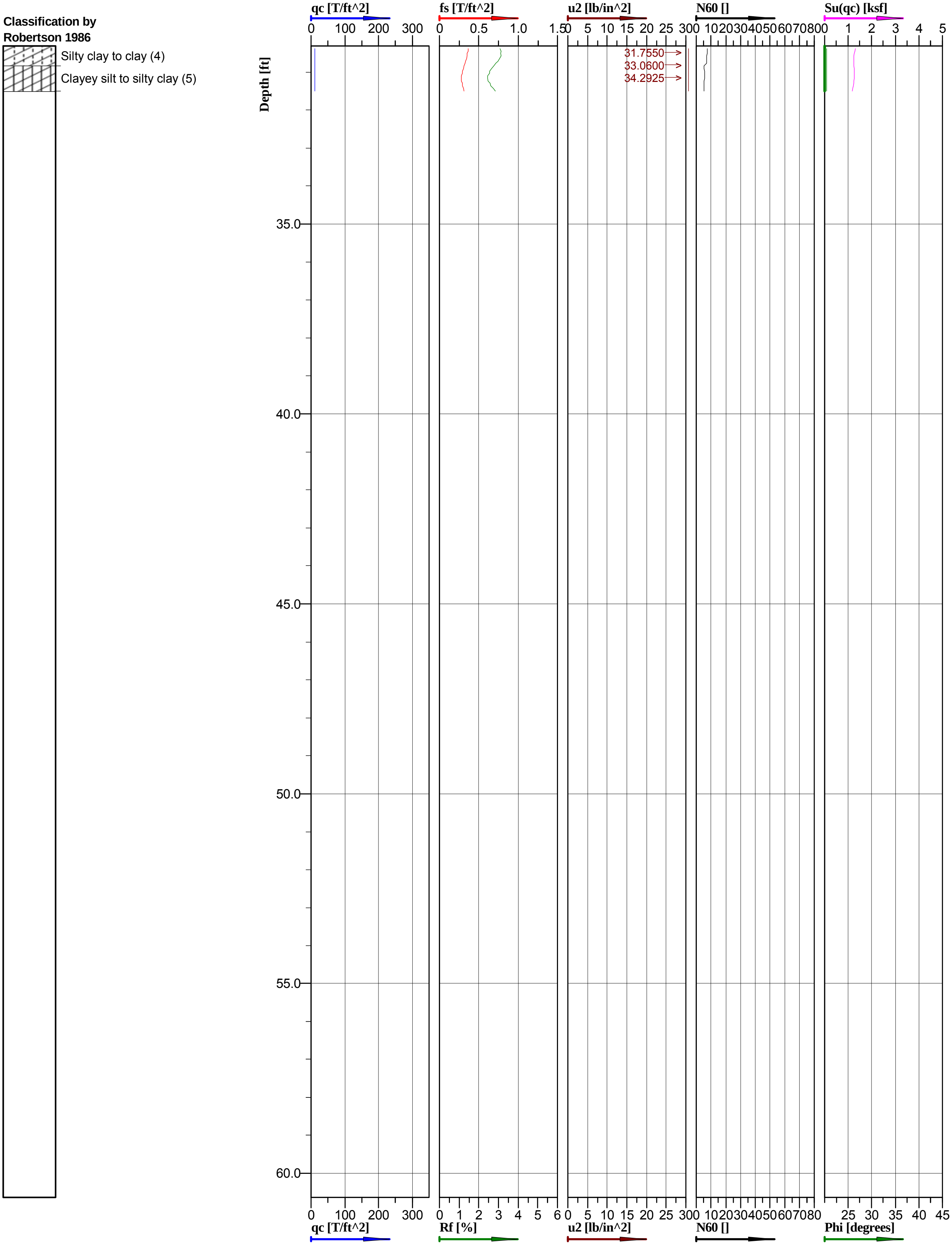


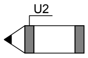


REITZ & JENS, INC.
CONSULTING ENGINEERS

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant
Position: X: 878043.41 ft, Y: 1122182.81 ft
Ground level: 443.27
Test no: P-2
Project ID: 2010012488
Client: Ameren Missouri
Date: 8/14/2010
Scale: 1 : 42
Project: Ash Pond Stability Analysis
Page: 1/2
Fig: 3-2
File: p-2.cpd





REITZ & JENS, INC.
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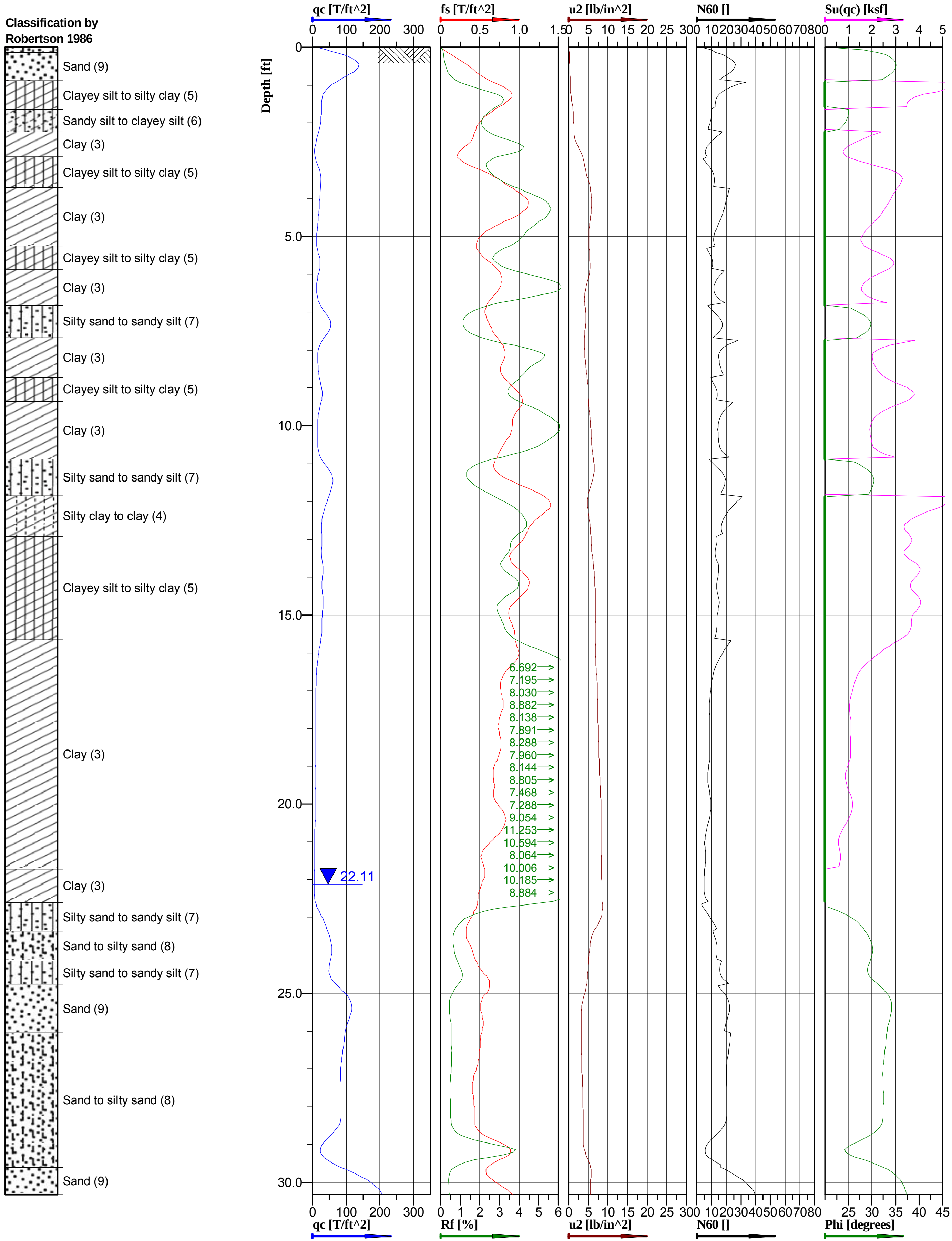
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant
Position: X: 878043.41 ft, Y: 1122182.81 ft
Ground level: 443.27
Test no: P-2
Project ID: 2010012488
Client: Ameren Missouri
Date: 8/14/2010
Scale: 1 : 42
Project: Ash Pond Stability Analysis
Page: 2/2
Fig: 3-2
File: p-2.cpd



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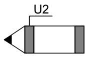
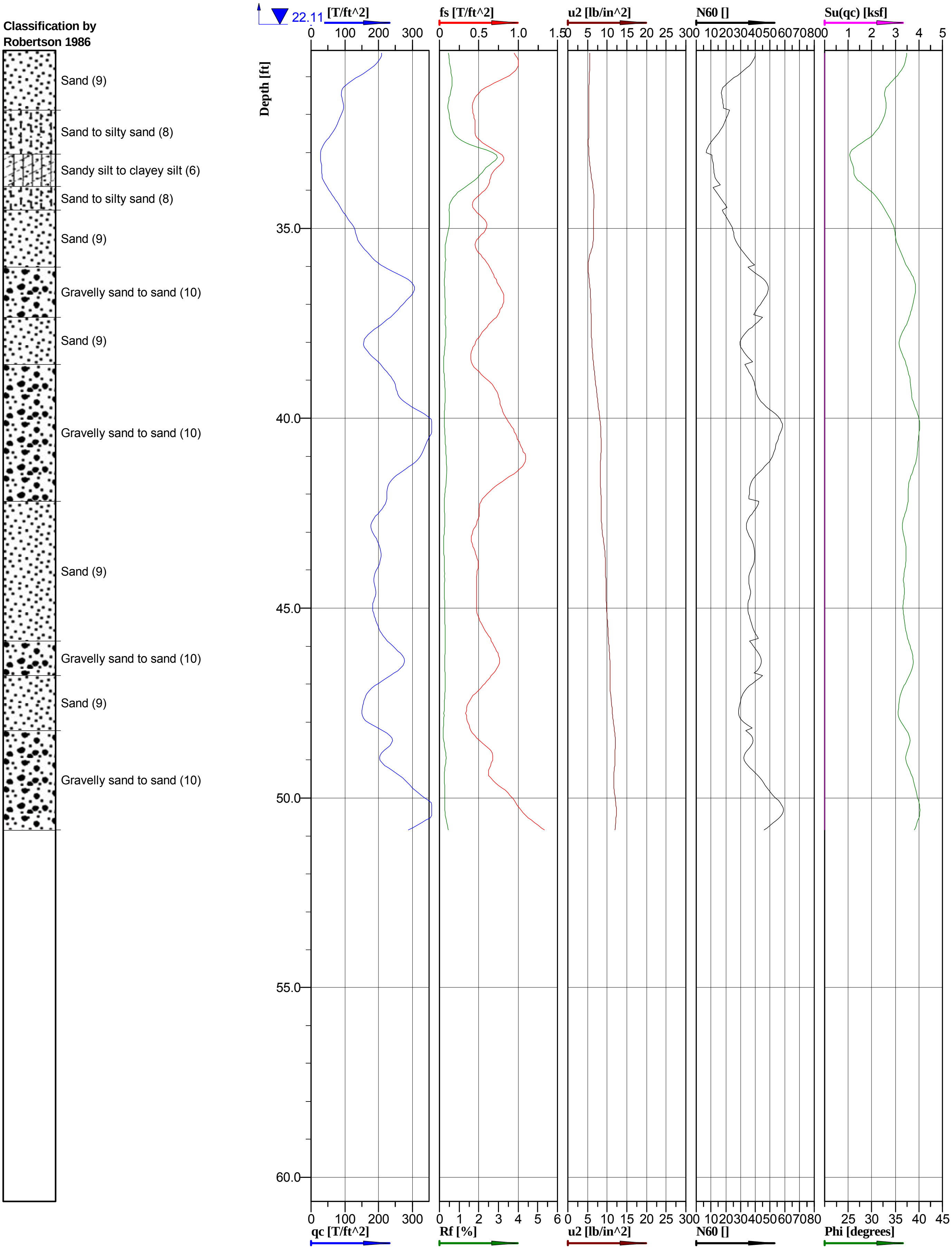
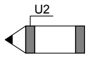
CONSULTING ENGINEERS



Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant
Position: X: 879085.63 ft, Y: 1119376.12 ft
Ground level: 441.47
Test no: P-3
Project ID: 2010012488
Client: Ameren Missouri
Date: 8/14/2010
Scale: 1 : 42
Project: 2010 Ash Pond Stability Analysis
Page: 1/2
Fig: 3-3
File: p-3.cpd





Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant
Position: X: 879085.63 ft, Y: 1119376.12 ft
Ground level: 441.47
Test no: P-3
Project ID: 2010012488
Client: Ameren Missouri
Date: 8/14/2010
Scale: 1 : 42
Project: 2010 Ash Pond Stability Analysis
Page: 2/2
Fig: 3-3
File: p-3.cpd

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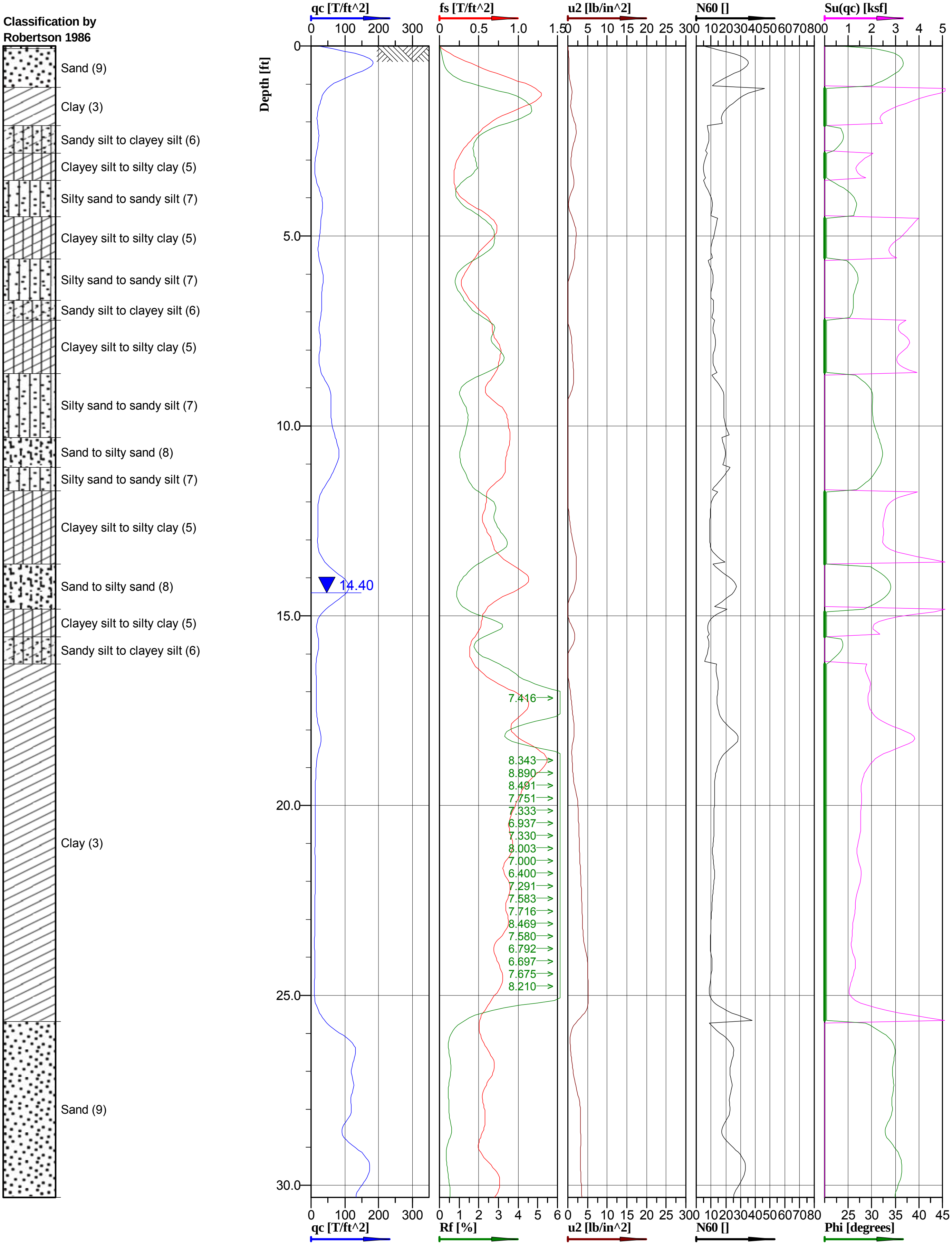
CONSULTING ENGINEERS



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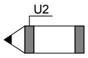
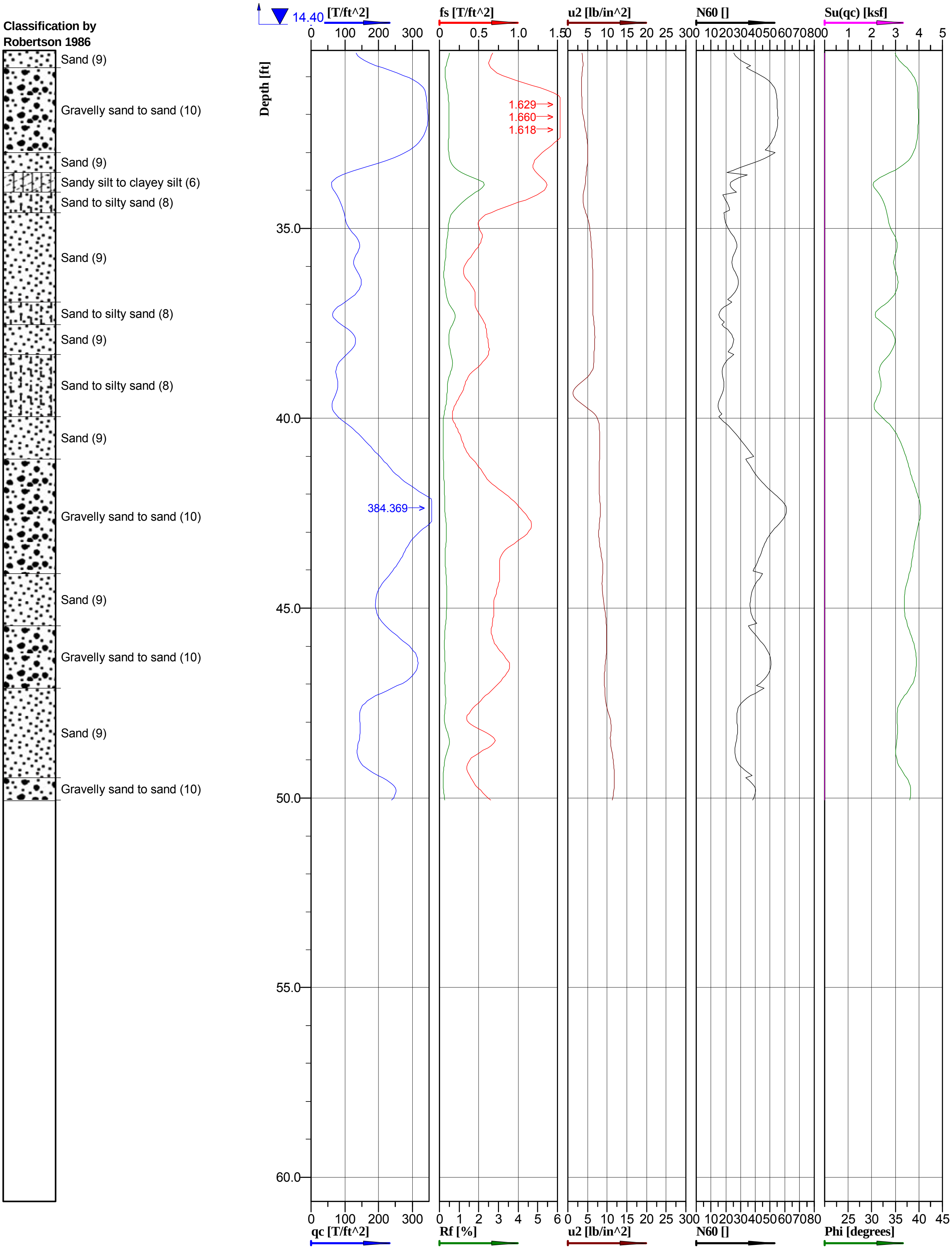


Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant	Position: X: 879812.43 ft, Y: 1119280.77 ft	Ground level: 443.08	Test no: P-4
Project ID: 2010012488	Client: Ameren Missouri	Date: 8/14/2010	Scale: 1 : 42
Project: 2010 Ash Pond Stability Analysis		Page: 1/2	Fig: 3-4
		File: p-4.cpd	



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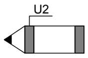
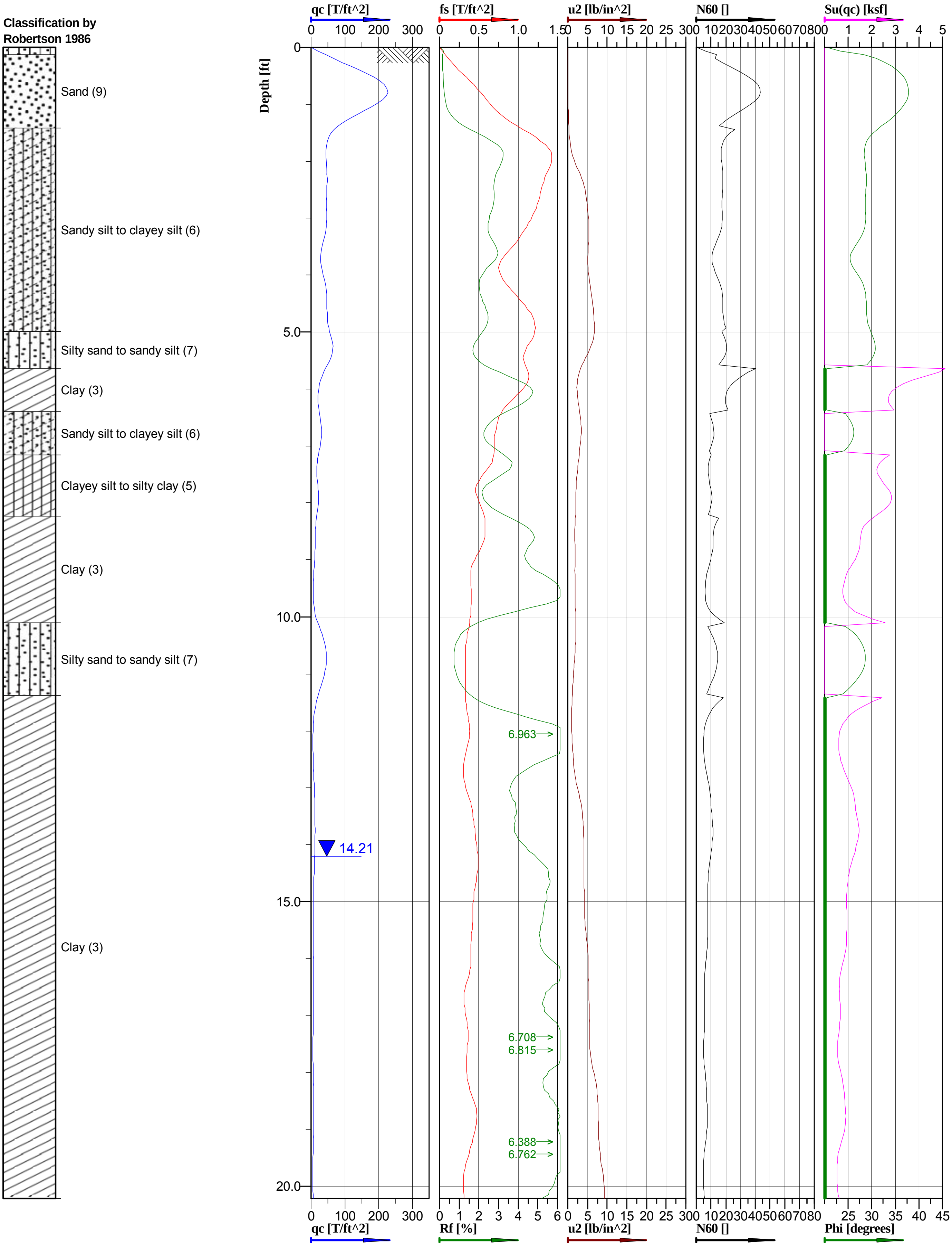
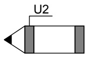


Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

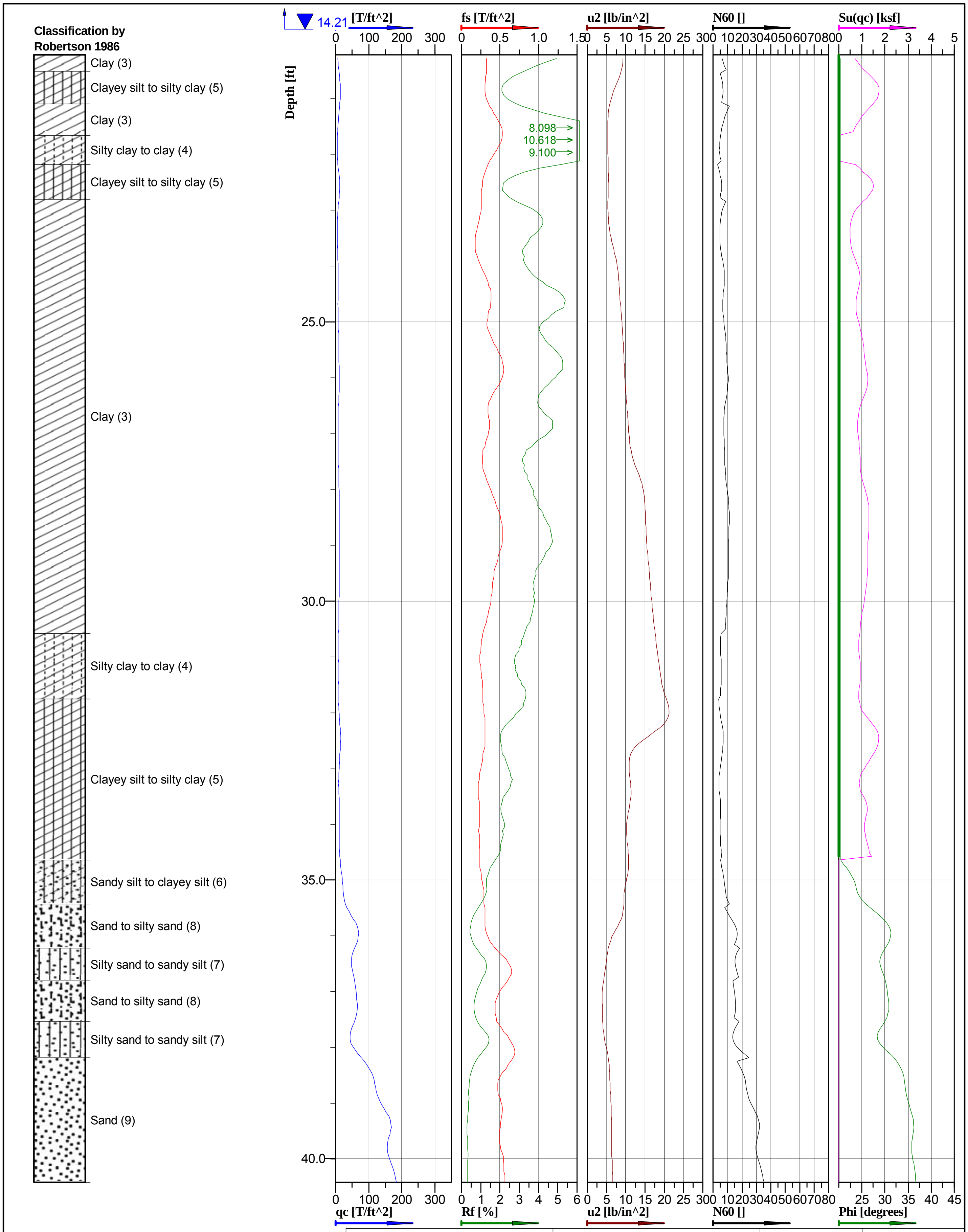
Location: Sioux Power Plant
Position: X: 879812.43 ft, Y: 1119280.77 ft
Ground level: 443.08
Test no: P-4
Project ID: 2010012488
Client: Ameren Missouri
Date: 8/14/2010
Scale: 1 : 42
Project: 2010 Ash Pond Stability Analysis
Page: 2/2
Fig: 3-4
File: p-4.cpd





Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant	Position: X: 878362.17 ft, Y: 1122193.34 ft	Ground level: 445.77	Test no: P-8
Project ID: 2010012488	Client: Ameren Missouri	Date: 8/14/2010	Scale: 1 : 28
Project: 2010 Ash Pond Stability Analysis		Page: 1/3	Fig: 3-5
		File: p-8.cpd	



Location: Sioux Power Plant	Position: X: 878362.17 ft, Y: 1122193.34 ft	Ground level: 445.77	Test no: P-8
Project ID: 2010012488	Client: Ameren Missouri	Date: 8/14/2010	Scale: 1 : 28
Project: 2010 Ash Pond Stability Analysis		Page: 2/3	Fig: 3-5
		File: p-8.cpd	

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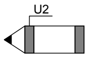
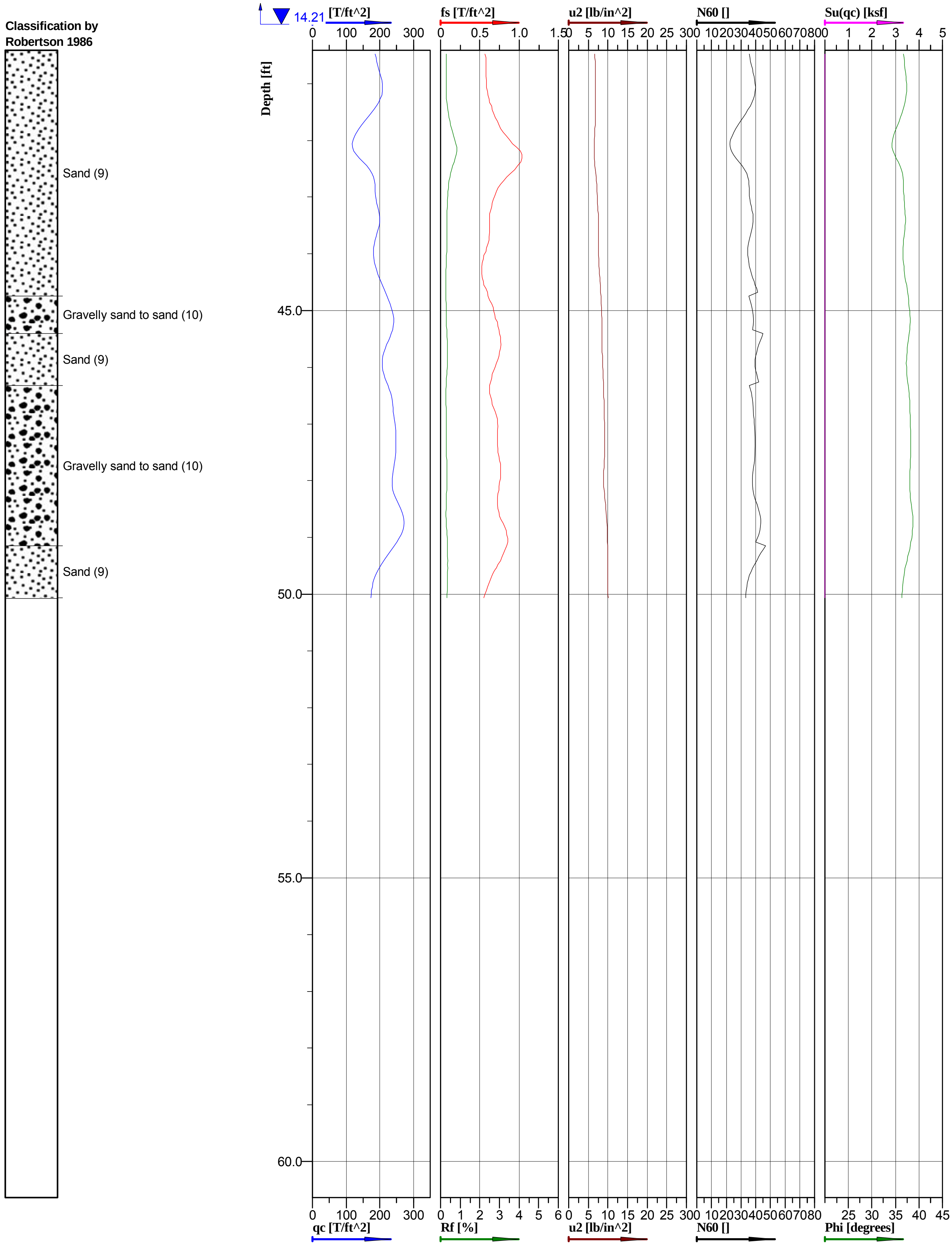
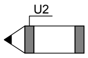


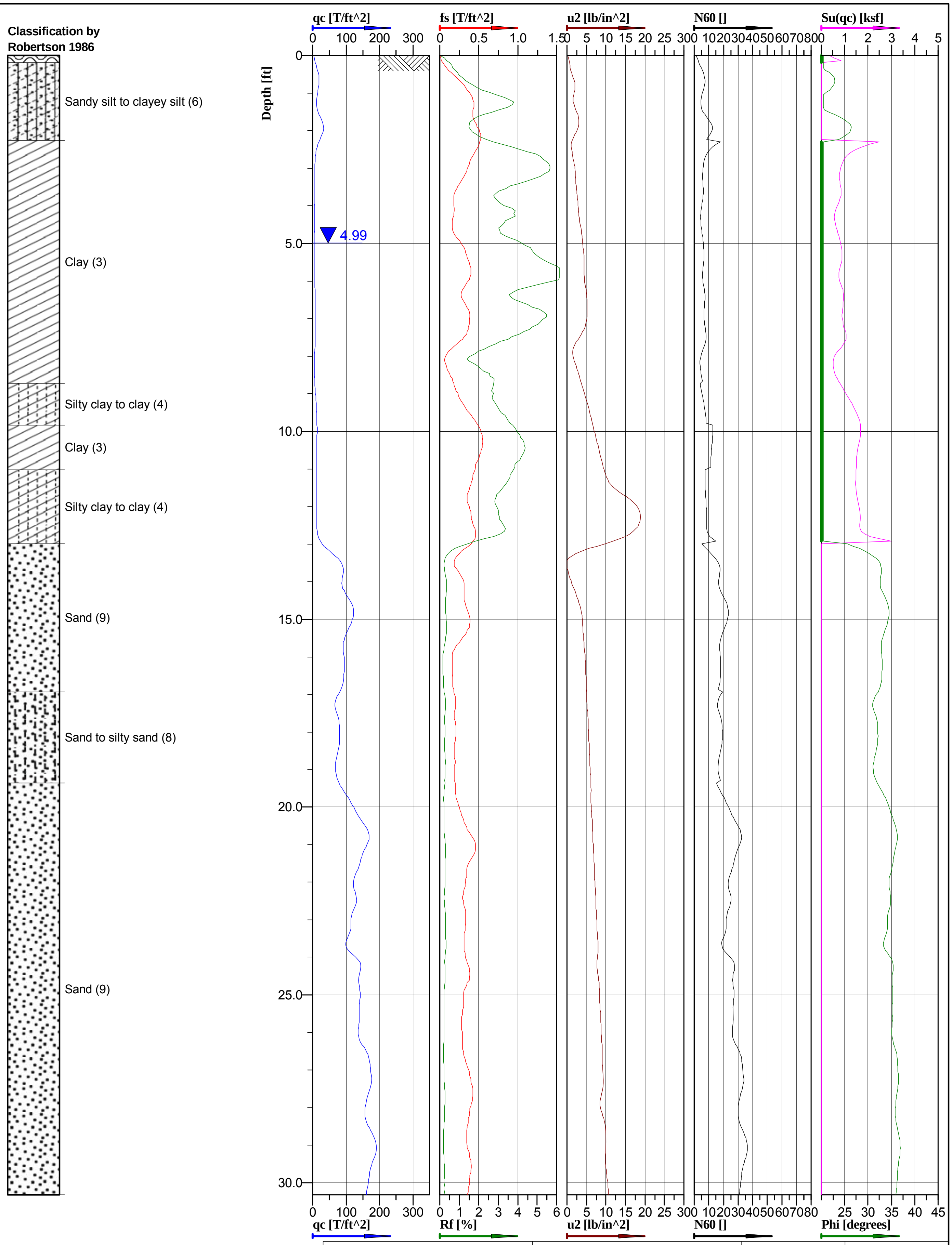
Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150





Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant
Position: X: 878362.17 ft, Y: 1122193.34 ft
Ground level: 445.77
Test no: P-8
Project ID: 2010012488
Client: Ameren Missouri
Date: 8/14/2010
Scale: 1 : 28
Project: 2010 Ash Pond Stability Analysis
Page: 3/3
Fig: 3-5
File: p-8.cpd



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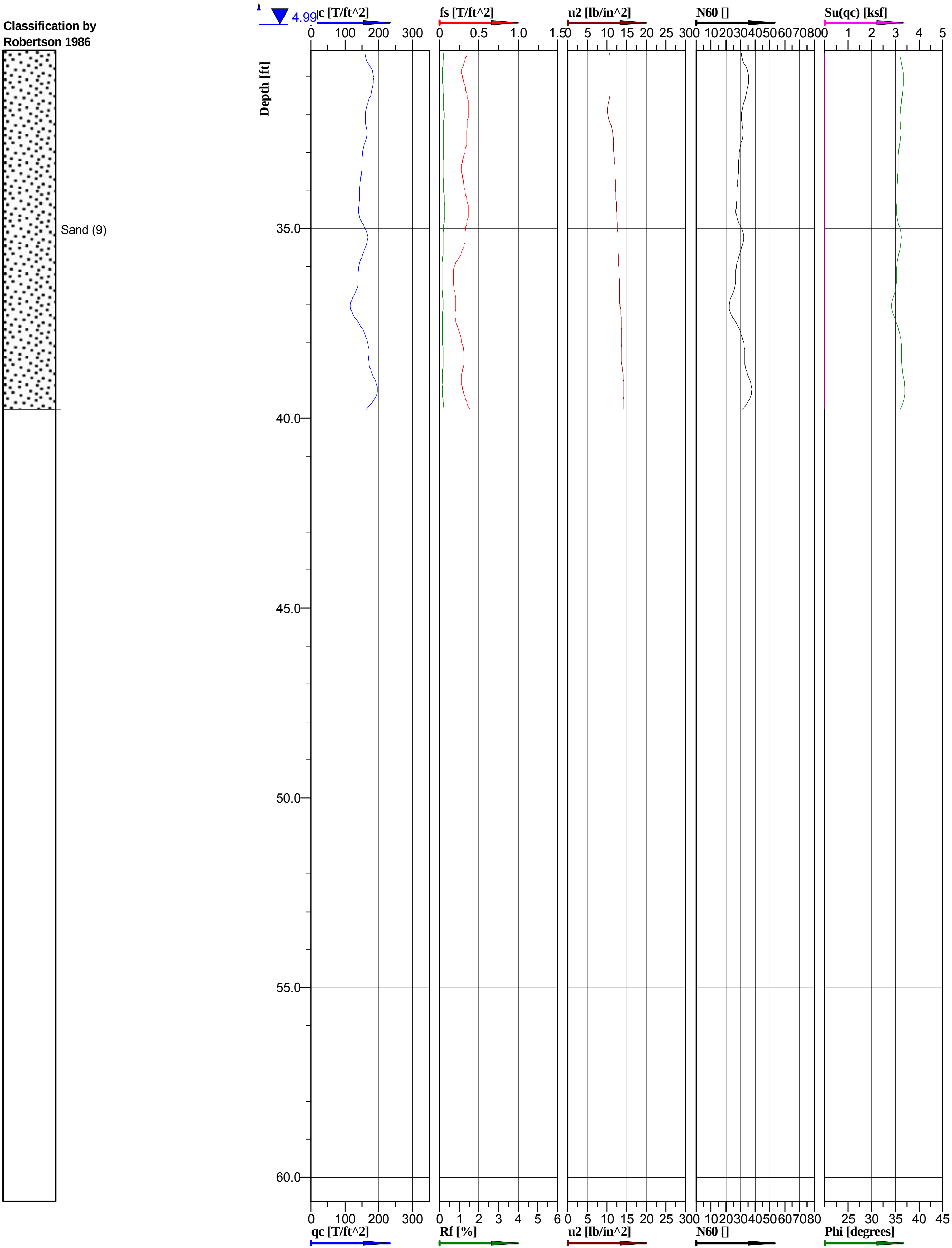
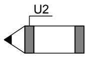
Location: Sioux Power Plant	Position: X: 878082.28 ft, Y: 1122220.67 ft	Ground level: 425.79	Test no: P-9
Project ID: 2010012488	Client: Ameren Missouri	Date: 8/14/2010	Scale: 1 : 42
Project: 2010 Ash Pond Stability Analysis		Page: 1/2	Fig: 3-6
		File: p-9.cpd	





Reitz & Jens, Inc.
Consulting Engineers

Cone No: 4274
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Sioux Power Plant	Position: X: 878082.28 ft, Y: 1122220.67 ft	Ground level: 425.79	Test no: P-9
Project ID: 2010012488	Client: Ameren Missouri	Date: 8/14/2010	Scale: 1 : 42
Project: 2010 Ash Pond Stability Analysis		Page: 2/2	Fig: 3-6
		File: p-9.cpd	

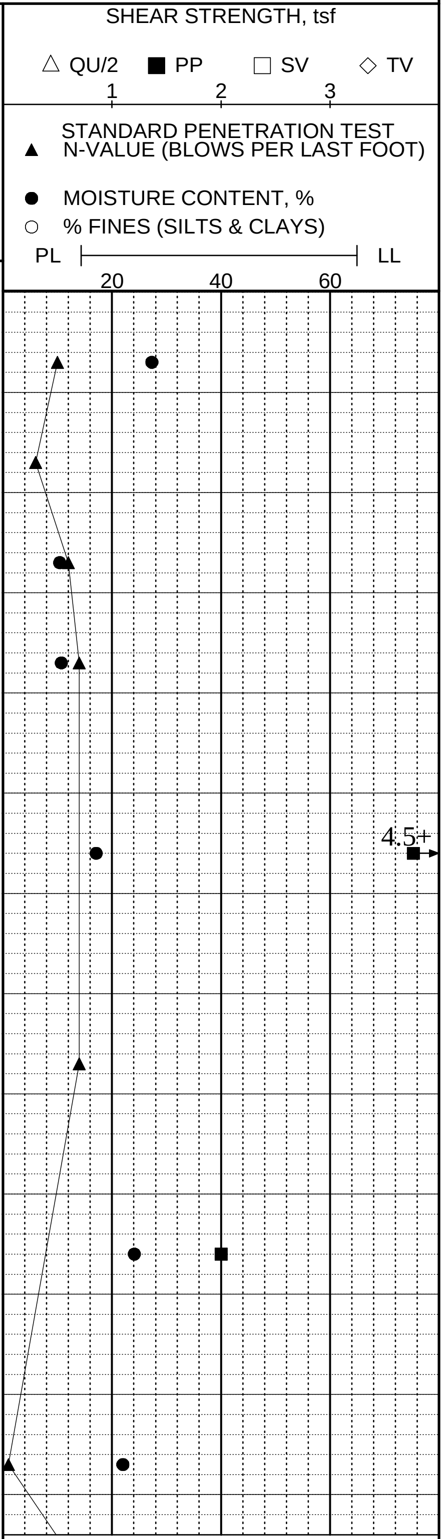
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Sioux Bottom Ash Investigation
Sioux Energy Center
CLIENT: **Ameren Missouri**

LOCATION: N E
ELEVATION: 445 DATUM:
DATE DRILLED: 04-09-15

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	445					Crushed Limestone Aggregate, 1" minus		
					44	CLAY (FILL), dark and light gray, stiff, with 1" minus crushed limestone aggregate, very moist	3-5-5	27.3
5	440				50	Becoming sandy silt, tan to brown, loose, dry	4-3-3	
					28	Becoming sandy silt, tan, medium-dense, with trace limestone fragments	3-5-7	10.4
10	435				61	Becoming brown and tan silt	6-7-7	10.7
						Slightly softer drilling at 12'		
15	430				88	Becoming clayey silt, brown, and with pockets of dark gray high plastic clay	98.6	17.1
20	425				89	Becoming tan fine sand	6-6-8	
25	420				92	Silty SAND (SM), tan to brown, very fine grain, trace clay, moist	94.0	24.1
30	415	▽			33	Measured N-value biased by borehole heave, switched to mud rotary drillin at 30'	1-0-0	22.0
						SAND (SP), brown to gray, fine to medium		



DRILLER: Midwest Drilling
METHOD: 4.25" CFA/Mud Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 75
LOGGED BY: J. Gilliam

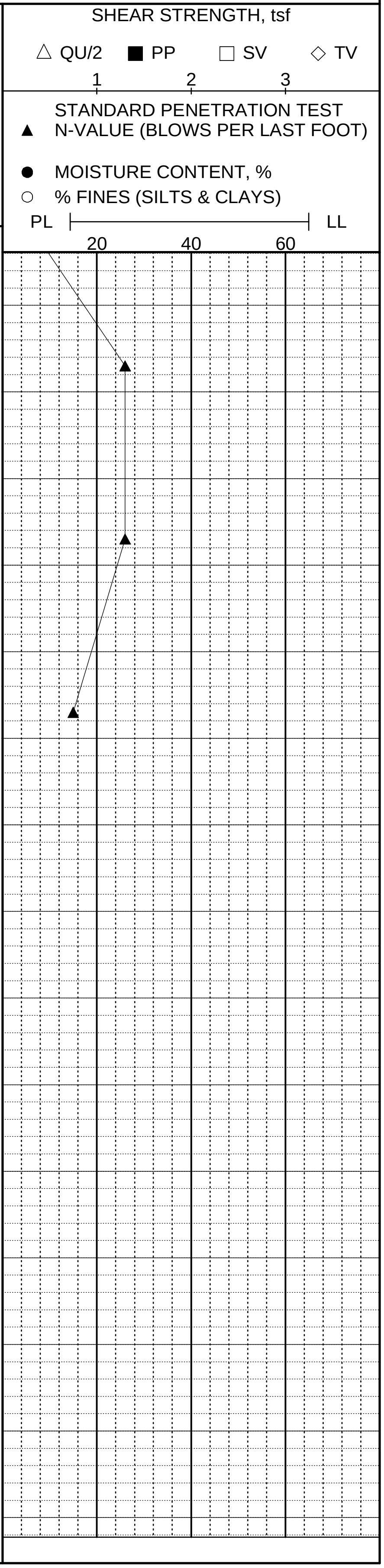
STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 29 FEET
______ BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

BORING LOG B-2

Sioux Bottom Ash Investigation

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
						grain, with trace fine gravel		
					72	Becoming dense	12-13-13	
35	410							
					78		13-14-12	
40	405							
					44	Becoming medium-dense, with trace fin gravel	7-8-7	
45	400					Boring terminated at 45'-0" in Sand.		
50	395							
55	390							
60	385							
65	380							



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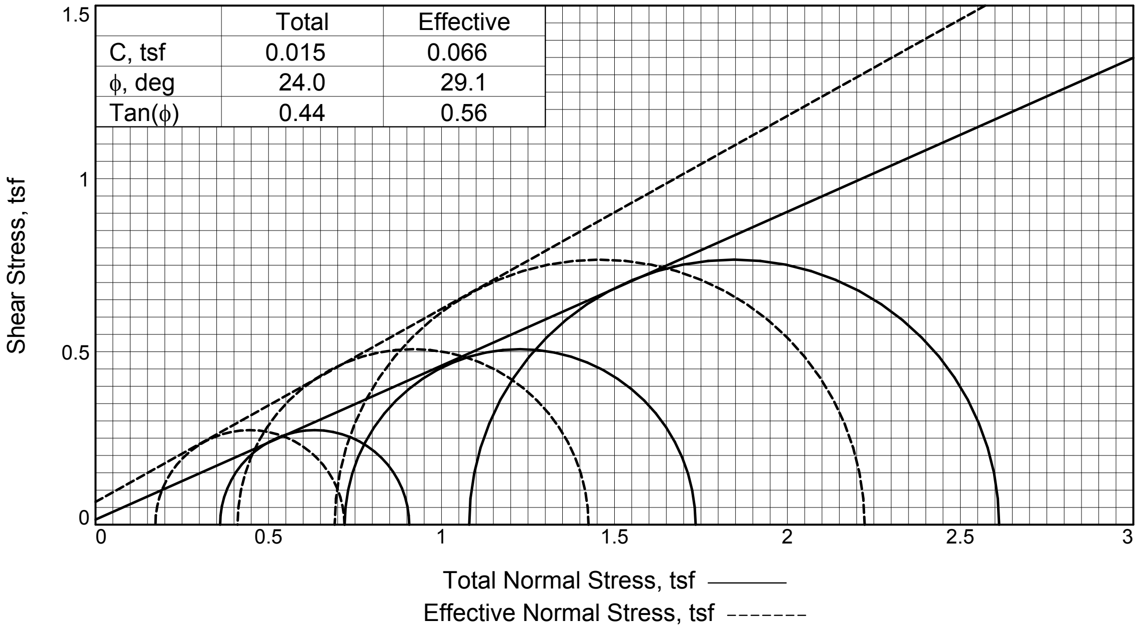
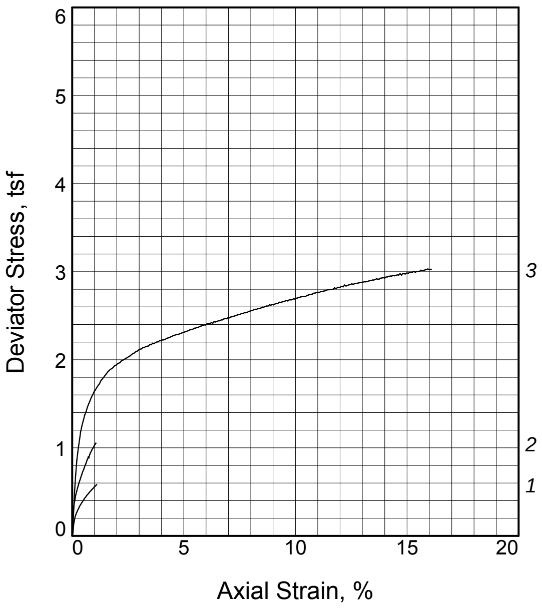


	Total	Effective
C, tsf	0.015	0.066
ϕ, deg	24.0	29.1
Tan(ϕ)	0.44	0.56



Sample No.		1	2	3
Initial	Water Content, %	17.1	17.1	17.1
	Dry Density, pcf	98.6	98.6	98.6
	Saturation, %	65.6	65.6	65.6
	Void Ratio	0.6973	0.6973	0.6973
	Diameter, in.	1.98	1.98	1.98
	Height, in.	4.49	4.49	4.49
At Test	Water Content, %	26.4	26.0	25.8
	Dry Density, pcf	97.9	98.6	99.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.7086	0.6971	0.6902
	Diameter, in.	1.98	1.99	1.99
	Height, in.	4.50	4.44	4.39
Strain rate, %/min.		0.10	0.10	0.10
Back Pressure, tsf		3.96	4.25	4.68
Cell Pressure, tsf		4.32	4.97	5.76
Fail. Stress, tsf		0.55	1.01	1.53
Total Pore Pr., tsf		4.15	4.56	5.07
Ult. Stress, tsf				
Total Pore Pr., tsf				
$\bar{\sigma}_1$ Failure, tsf		0.72	1.43	2.22
$\bar{\sigma}_3$ Failure, tsf		0.17	0.41	0.69

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Clayey SILT (CL-ML), brown, with pockets of dark grey high plastic clay

Assumed Specific Gravity= 2.68

Remarks:

Figure _______

Client: Ameren Missouri

Project: Sioux Bottom Ash Investigation

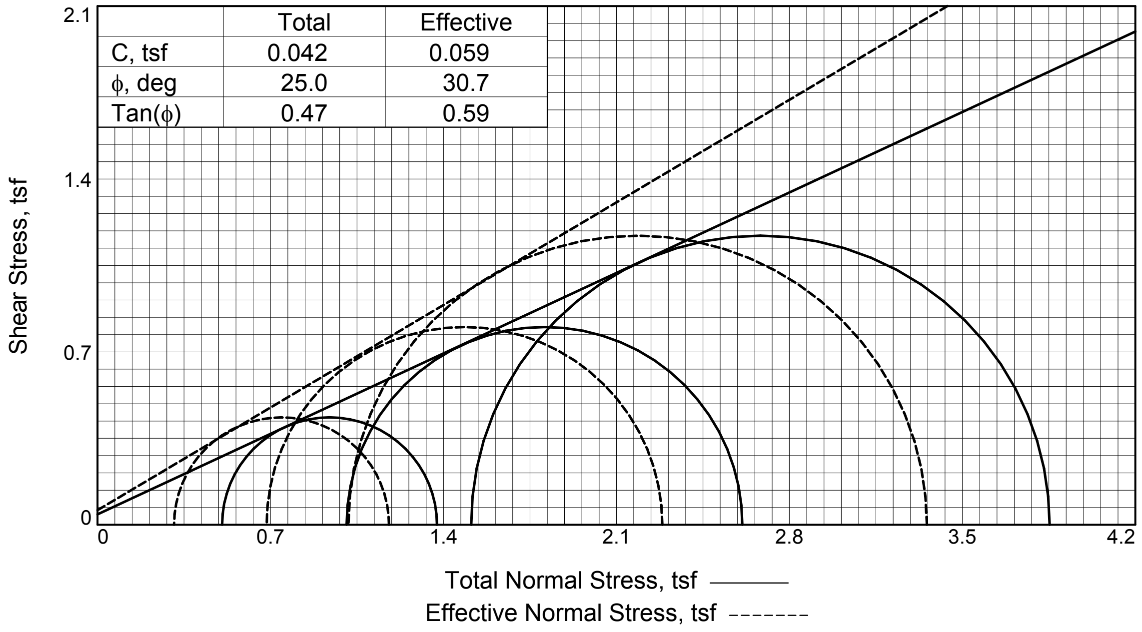
Source of Sample: B-2 **Depth:** 13

Sample Number: ST-5

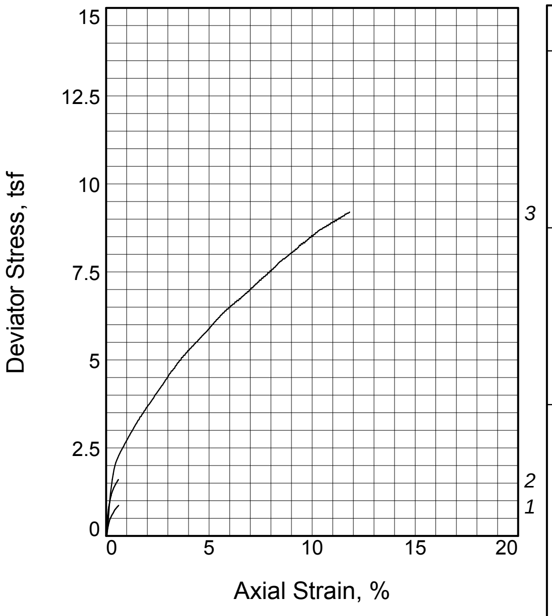
Proj. No.: 2015012432 **Date Sampled:** 4/10/15

RJ REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Bertel



	Total	Effective
C, tsf	0.042	0.059
ϕ, deg	25.0	30.7
Tan(ϕ)	0.47	0.59



	Sample No.	1	2	3
Initial	Water Content, %	24.1	24.1	24.1
	Dry Density, pcf	94.0	94.0	94.0
	Saturation, %	82.9	82.9	82.9
	Void Ratio	0.7791	0.7791	0.7791
	Diameter, in.	2.85	2.85	2.85
	Height, in.	5.82	5.82	5.82
At Test	Water Content, %	28.0	27.9	27.9
	Dry Density, pcf	95.6	95.8	95.8
	Saturation, %	100.0	100.0	100.0
	Void Ratio	0.7507	0.7471	0.7471
	Diameter, in.	2.83	2.84	2.85
	Height, in.	5.79	5.75	5.72
	Strain rate, %/min.	0.04	0.05	0.05
	Back Pressure, tsf	4.32	4.61	5.04
	Cell Pressure, tsf	4.82	5.62	6.55
	Fail. Stress, tsf	0.87	1.60	2.34
	Total Pore Pr., tsf	4.51	4.93	5.54
	Ult. Stress, tsf			
	Total Pore Pr., tsf			
	$\bar{\sigma}_1$ Failure, tsf	1.18	2.29	3.36
	$\bar{\sigma}_3$ Failure, tsf	0.31	0.68	1.02

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Silty SAND (SM), tan, very fine grained

Assumed Specific Gravity= 2.68

Remarks:

Figure ______

Client: Ameren Missouri

Project: Sioux Bottom Ash Investigation

Source of Sample: B-2 **Depth:** 23

Sample Number: ST-7

Proj. No.: 2015012432 **Date Sampled:** 4/10/15

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Bertel

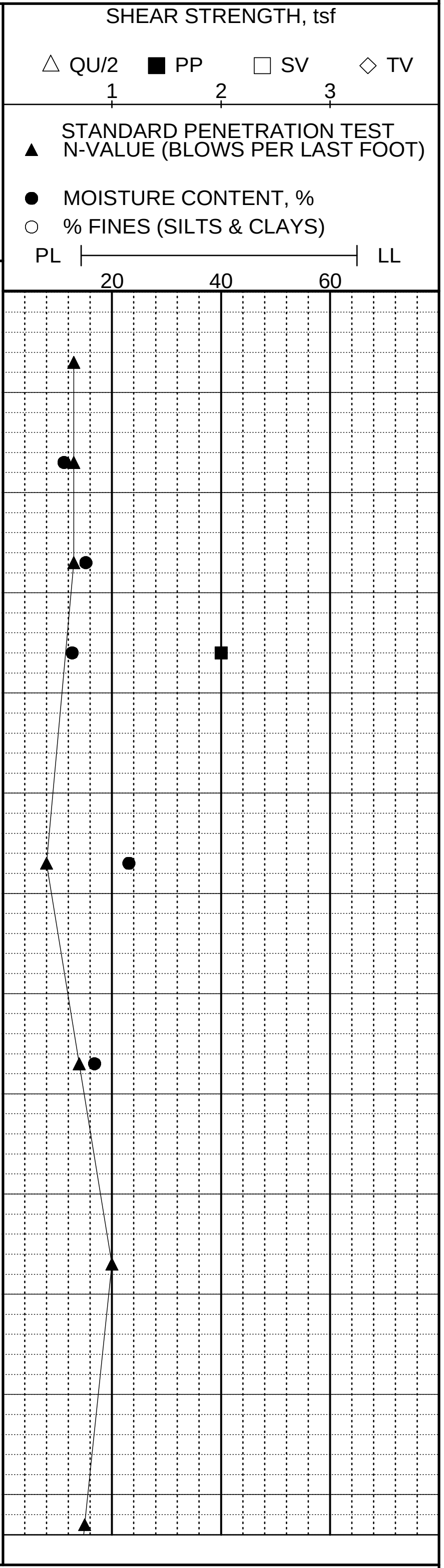
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Sioux Bottom Ash Investigation
Sioux Energy Center
CLIENT: **Ameren Missouri**

LOCATION: N E
ELEVATION: 445 DATUM:
DATE DRILLED: 04-09-15

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	445					Crushed Limestone Aggregate, 1" minus		
					83	SAND (FILL), tan, brown and gray, medium-dense, fine grain, dry	6-6-7	
					78	Becoming silty sand	7-6-7	11.2
5	440							
					50	Becoming silty sand with clayey silt lenses	5-6-7	15.2
					92	Becoming primarily fine sand with clay and silt lenses, with roots	88.5	12.7
10	435							
					78	Becoming moist, and with trace crushed limestone aggregate and brick fragments	4-4-4	23.1
15	430							
					78	Becoming silty sand and clayey silt, with trace gravel	5-6-8	16.8
20	425							
					83	Silty SAND (SM), tan, medium-dense, fine grain	8-10-10	
25	420							
		▽			67	Becoming fine to medium grain, with traces of clayey silt		
30	415					SAND (SP), tan and brown, medium-dense,		



DRILLER: Midwest Drilling
METHOD: 4.25" CFA/Mud Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 75
LOGGED BY: J. Gilliam

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 29 FEET
______ BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2015012432

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Sioux Bottom Ash Investigation

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
					78	fine to medium grain	4-6-9	
					67	Becoming tan, fine to coarse grain, and with trace fine gravel	3-4-8	
35	410							
					67	Becoming gray, and fine to medium grain	8-5-6	
40	405							
					56	Becoming fine to coarse grain, and with trace medium gravel	5-11-11	
45	400							
					50		10-8-10	
50	395					Boring terminated at 50'-0" in Sand.		
55	390							
60	385							
65	380							

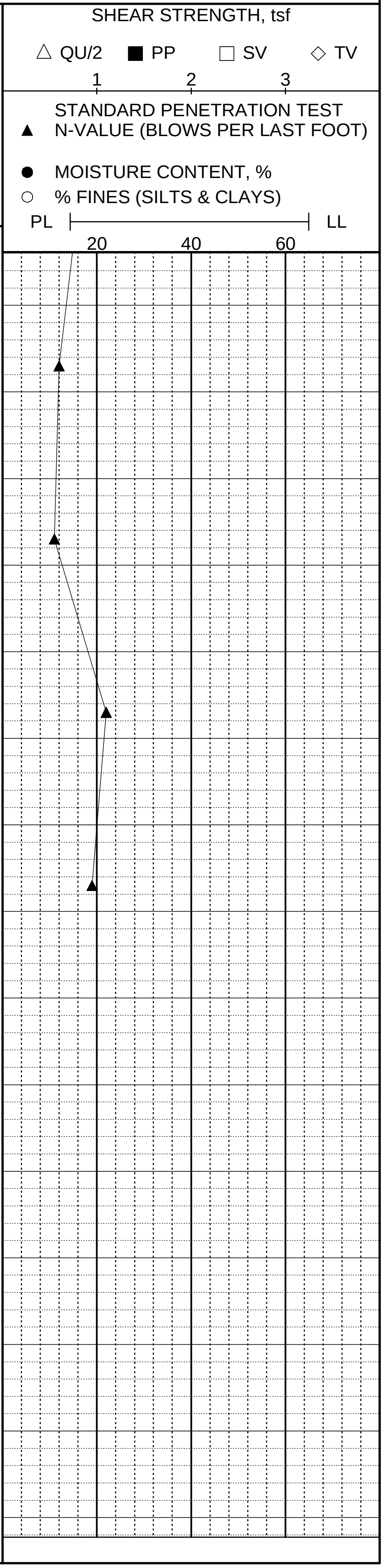


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Figure

KEY TO BORING LOGS

KEY TO SOIL SYMBOLS

Symbol	Description
⁂	Crushed Limestone
▩	Miscellaneous FILL
▥	Silty SAND (SM)
░	Poorly-graded SAND (SP)

MISCELLANEOUS SYMBOLS

▽	Water table during drilling
⌁	Boring continues
●	Moisture content (%)
▲	N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)
■	Shear strength from Pocket Penetrometer (tsf)

SOIL SAMPLERS

◪	2-in. O.D. Split-Spoon
▯	3-in. O.D. Shelby Tube

Notes:

1. The borings were drilled at the centerline of the embankment near the locations of the "east" and "west" elevation profiles surveyed by Reitz & Jens. The elevations shown on the boring logs were estimated based on existing data.

2. The borings were logged in the field by a Reitz & Jens' geotechnical engineer based upon the recovered samples, cuttings and drilling characteristics. Samples were transported to Reitz & Jens' lab for testing. Field logs were revised, if needed, based upon laboratory classification and testing.

3. Stratification lines shown on the log represent approximate soil boundaries; actual changes in strata may be gradual or occur between samples.

Figure 4

SPECIFICATIONS:

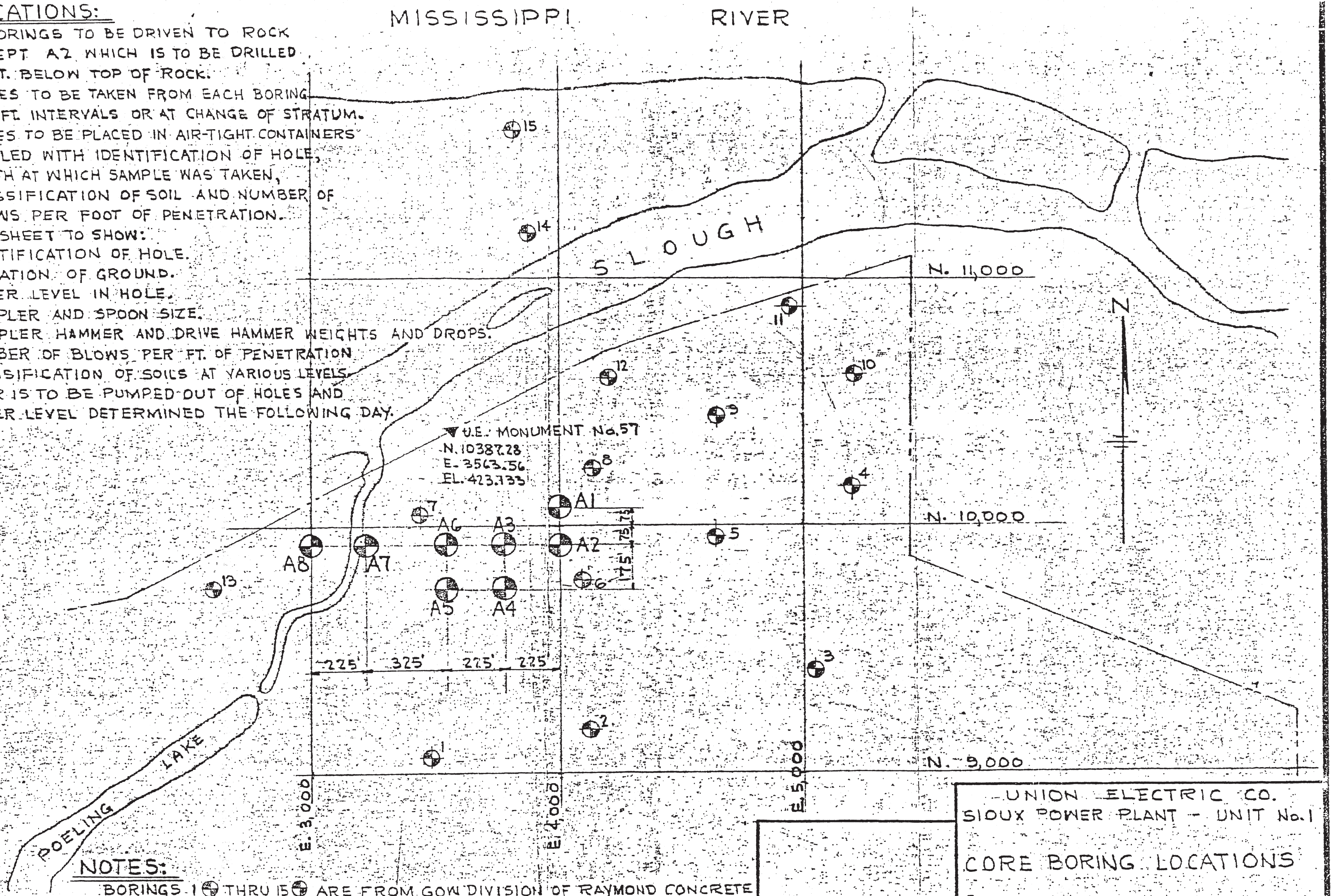
1- ALL BORINGS TO BE DRIVEN TO ROCK EXCEPT A2 WHICH IS TO BE DRILLED 40 FT. BELOW TOP OF ROCK.

2- SAMPLES TO BE TAKEN FROM EACH BORING AT 5 FT. INTERVALS OR AT CHANGE OF STRATUM.

3- SAMPLES TO BE PLACED IN AIR-TIGHT CONTAINERS LABELED WITH IDENTIFICATION OF HOLE, DEPTH AT WHICH SAMPLE WAS TAKEN, CLASSIFICATION OF SOIL AND NUMBER OF BLOWS PER FOOT OF PENETRATION.

4- DATA SHEET TO SHOW:
IDENTIFICATION OF HOLE.
ELEVATION OF GROUND.
WATER LEVEL IN HOLE.
SAMPLER AND SPOON SIZE.
SAMPLER HAMMER AND DRIVE HAMMER WEIGHTS AND DROPS.
NUMBER OF BLOWS PER FT. OF PENETRATION
CLASSIFICATION OF SOILS AT VARIOUS LEVELS.

5- WATER IS TO BE PUMPED OUT OF HOLES AND WATER LEVEL DETERMINED THE FOLLOWING DAY.



NOTES:

BORINGS 1 ⊕ THRU 15 ⊕ ARE FROM GOW DIVISION OF RAYMOND CONCRETE PILE CO. REPORT DATED APRIL 30, 1962.

BORINGS A1 ⊕ THRU A8 ⊕ ARE NEW FOR THIS REPORT.

BORINGS MAY BE RELOCATED 10 FT. IN ANY DIRECTION TO AVOID OBSTRUCTIONS.

ALL GROUND ELEVATIONS TO BE RELATED TO MONUMENT No. 57 EL. 423.133'

UNION ELECTRIC CO.
SIOUX POWER PLANT - UNIT No. 1

CORE BORING LOCATIONS

UNITED ENGINEERS & CONSTRUCTORS INC
PHILADELPHIA

CHECKED E.C.K.	INSPECTED	CORRECT ROT	APPROVED
DATE 4/17/63	ESTIMATE	ORIGINATING OFFICE	
SCALE 1"=400 FT.	ACCOUNT	9049-LL-1001A	
	ITEM		

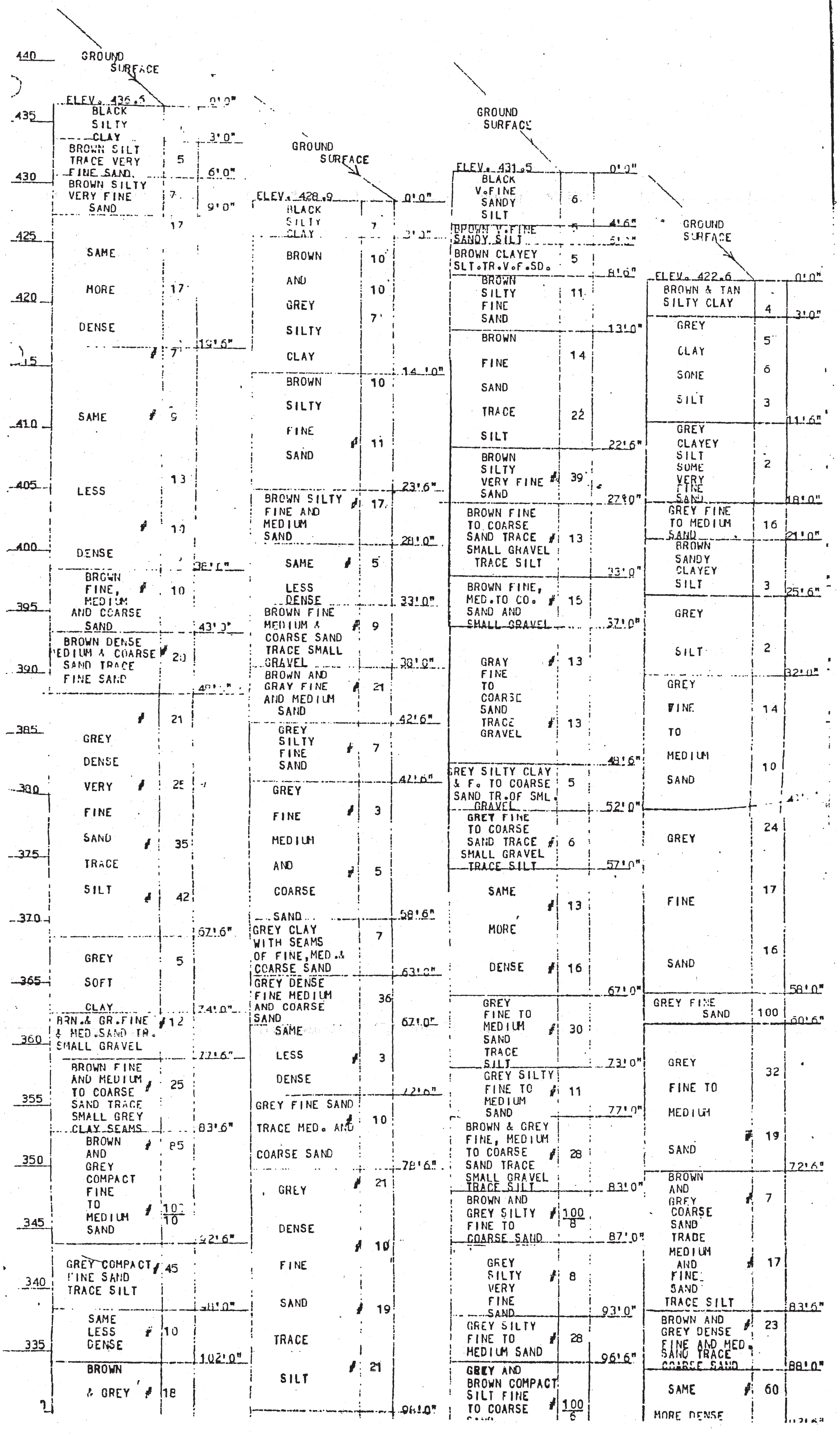
TEST BORING REPORT
RAYMOND
CONCRETE PILE COMPANY
GOW DIVISION

To UNION ELECTRIC COMPANY Date MARCH 25, 1962

Location of Borings PROPOSED SIOUX PLANT, UNION ELECTRIC COMPANY, ST. CHARLES COUNTY, MO.

All borings are plotted to a scale of 1" = 8 ft. using USGS as a fixed datum.

Boring No. 1 Boring No. 2 Boring No. 3 Boring No. 4



ELEV. 436.5

		0'0"
BLACK SILTY CLAY		3'0"
BROWN SILT TRACE VERY FINE SAND	5	6'0"
BROWN SILTY VERY FINE SAND	7	9'0"
SAME MORE DENSE	17 17	19'6"
SAME LESS DENSE	7 9 13 10	38'0"
BROWN FINE, MEDIUM AND COARSE SAND	10	43'0"
BROWN DENSE MEDIUM & COARSE SAND TRACE FINE SAND	20	48'[illegible]
GREY DENSE VERY FINE SAND TRACE SILT	21 25 35 42	67'6"
GREY SOFT CLAY	5	74'0"
BRN.& GR.FINE & MED.SAND TR. SMALL GRAVEL	12	77'6"
BROWN FINE AND MEDIUM TO COARSE SAND TRACE SMALL GREY CLAY SEAMS	25	83'6"
BROWN AND GREY COMPACT FINE TO MEDIUM SAND	85 100/10	92'6"
GREY COMPACT FINE SAND TRACE SILT	45	98'0"
SAME LESS DENSE	10	102'0"
BROWN & GREY	18	

ELEV. 428.9

		0'0"
BLACK SILTY CLAY	7	3'0"
BROWN AND GREY SILTY CLAY	10 10 7	14'0"
BROWN SILTY FINE SAND	10 11	23'6"
BROWN SILTY FINE AND MEDIUM SAND	17	28'0"
SAME LESS DENSE	5	33'0"
BROWN FINE MEDIUM & COARSE SAND TRACE SMALL GRAVEL	9	38'0"
BROWN AND GRAY FINE AND MEDIUM SAND	21	42'6"
GREY SILTY FINE SAND	7	47'6"
GREY FINE MEDIUM AND COARSE SAND	3 5	58'6"
GREY CLAY WITH SEAMS OF FINE,MED.& COARSE SAND	7	63'0"
GREY DENSE FINE MEDIUM AND COARSE SAND	36	67'0"
SAME LESS DENSE	3	72'6"
GREY FINE SAND TRACE MED. AND COARSE SAND	10	78'6"
GREY DENSE FINE SAND TRACE SILT	21 10 19 21	96'0"

ELEV. 431.5

		0'0"
BLACK V.FINE SANDY SILT	6	4'6"
BROWN V.FINE SANDY SILT	5	6'0"
BROWN CLAYEY SLT.TR.V.F.SD.	5	8'6"
BROWN SILTY FINE SAND	11	13'0"
BROWN FINE SAND TRACE SILT	14 22	22'6"
BROWN SILTY VERY FINE SAND	39	27'0"
BROWN FINE TO COARSE SAND TRACE SMALL GRAVEL TRACE SILT	13	33'0"
BROWN FINE, MED.TO CO. SAND AND SMALL GRAVEL	15	37'0"
GRAY FINE TO COARSE SAND TRACE GRAVEL	13 13	48'6"
GREY SILTY CLAY & F. TO COARSE SAND TR.OF SML. GRAVEL	5	52'0"
GREY FINE TO COARSE SAND TRACE SMALL GRAVEL TRACE SILT	6	57'0"
SAME MORE DENSE	13 16	67'0"
GREY FINE TO MEDIUM SAND TRACE SILT	30	73'0"
GREY SILTY FINE TO MEDIUM SAND	11	77'0"
BROWN & GREY FINE, MEDIUM TO COARSE SAND TRACE SMALL GRAVEL TRACE SILT	28	83'0"
BROWN AND GREY SILTY FINE TO COARSE SAND	100/8	87'0"
GREY SILTY VERY FINE SAND	8	93'0"
GREY SILTY FINE TO MEDIUM SAND	28	96'6"
GREY AND BROWN COMPACT SILT FINE TO COARSE	100/6	

ELEV. 422.6

		0'0"
BROWN & TAN SILTY CLAY	4	3'0"
GREY CLAY SOME SILT	5 6 3	11'6"
GREY CLAYEY SILT SOME VERY FINE SAND	2	18'0"
GREY FINE TO MEDIUM SAND	16	21'0"
BROWN SANDY CLAYEY SILT	3	25'6"
GREY SILT	2	32'0"
GREY FINE TO MEDIUM SAND	14 10	[illegible]
GREY FINE SAND	24 17 16	58'0"
GREY FINE SAND	100	60'6"
GREY FINE TO MEDIUM SAND	32 19	72'6"
BROWN AND GREY COARSE SAND TRADE MEDIUM AND FINE SAND TRACE SILT	7 17	83'6"
BROWN AND GREY DENSE FINE AND MED. SAND TRACE COARSE SAND	23	88'0"
SAME MORE DENSE	60	

–41?
415
410
405
400
395
390
385
380
375
370
365
360
355
350
345
340
335
325
320
315
310
305

DENSE	# 7	19'6"
SAME LESS DENSE	# 9 13 # 11	38'0"
BROWN FINE, MEDIUM AND COARSE SAND	# 10	43'0"
BROWN DENSE MEDIUM & COARSE SAND TRACE FINE SAND	# 20	[illegible]
GREY DENSE VERY FINE SAND TRACE SILT	# 21 # 25 # 35 # 42	67'6"
GREY SOFT CLAY	5	74'0"
BRN.& GR.FINE & MED.SAND TR. SMALL GRAVEL	# 12	77'6"
BROWN FINE AND MEDIUM TO COARSE SAND TRACE SMALL GREY CLAY SEAMS	# 25	83'6"
BROWN AND GREY COMPACT FINE TO MEDIUM SAND	# 85 # $\frac{100}{10}$	92'6"
GREY COMPACT FINE SAND TRACE SILT	# 45	[illegible]
SAME LESS DENSE	# 10	102'0"
BROWN & GREY FINE & MEDIUM SAND	# 18 # 8	112'0"
BROWN SILTY FINE & MEDIUM SAND	# 10	117'0"
BROWN & GREY COMPACT FINE, MEDIUM & COARSE SAND TRACE SILT, TRACE LIMESTONE FRAGMENTS	# $\frac{100}{9}$	123'8"

REFUSAL ROCK OR BOULDER ($\frac{20}{0}$)

USED 119'0" OF 2-1/2" CASING.

NOTE- SAMPLE AT90'10"- BLOWS INCREASED BY GRAVEL LODGED IN SAMPLER TIP.

3/7-12-13/62

GREY SILTY CLAY	7	14'0"
BROWN SILTY FINE SAND	10 # 11	23'6"
BROWN SILTY FINE AND MEDIUM SAND	# 17	28'0"
SAME LESS DENSE	# 5	33'0"
BROWN FINE MEDIUM & COARSE SAND TRACE SMALL GRAVEL	# 9	38'0"
BROWN AND GRAY FINE AND MEDIUM SAND	# 21	42'6"
GREY SILTY FINE SAND	# 7	47'6"
GREY FINE MEDIUM AND COARSE SAND	# 3 # 5	58'6"
GREY CLAY WITH SEAMS OF FINE,MED.& COARSE SAND	7	63'0"
GREY DENSE FINE MEDIUM AND COARSE SAND	36	67'0"
SAME LESS DENSE	# 3	72'6"
GREY FINE SAND TRACE MED. AND COARSE SAND	# 10	78'6"
GREY DENSE FINE SAND TRACE SILT	# 21 # 10 # 19 # 21	98'0"
SAME MORE DENSE	# 82	102'0"
GREY & BROWN COMPACT FINE MEDIUM & COARSE SAND TRACE SILT	# $\frac{100}{9}$	107'0"
BROWN COMPACT FINE AND MEDIUM SILTY SAND	# 105 # 100	118'5"

REFUSAL ROCK OR BOULDER $\frac{20}{0}$

USED 118'0" OF 2-1/2" CASING.

WATER LEVEL 20'0" BELOW GR. SURFACE 3 HRS. AFTER COMPL.

3/2-5-6/62

FINE SAND		13'0"
BROWN FINE SAND TRACE SILT	14 22	22'6"
BROWN SILTY VERY FINE SAND	# 39	27'0"
BROWN FINE TO COARSE SAND TRACE SMALL GRAVEL TRACE SILT	# 13	33'0"
BROWN FINE, MED.TO CO. SAND AND SMALL GRAVEL	# 15	37'0"
GRAY FINE TO COARSE SAND TRACE GRAVEL	# 13 # 13	48'6"
GREY SILTY CLAY & F. TO COARSE SAND TR.OF SML. GRAVEL	5	52'0"
GREY FINE TO COARSE SAND TRACE SMALL GRAVEL TRACE SILT	# 6	57'0"
SAME MORE DENSE	# 13 # 16	67'0"
GREY FINE TO MEDIUM SAND TRACE SILT	# 30	73'0"
GREY SILTY FINE TO MEDIUM SAND	# 11	77'0"
BROWN & GREY FINE, MEDIUM TO COARSE SAND TRACE SMALL GRAVEL TRACE SILT	# 28	83'0"
BROWN AND GREY SILTY FINE TO COARSE SAND	# $\frac{100}{8}$	87'0"
GREY SILTY VERY FINE SAND	# 8	93'0"
GREY SILTY FINE TO MEDIUM SAND	# 28	96'6"
GREY AND BROWN COMPACT SILT FINE TO COARSE SAND	# $\frac{100}{6}$	102'0"
GREY COMPACT SILTY FINE SAND	# $\frac{100}{3}$ # $\frac{100}{6}$ # $\frac{100}{8}$	117'11"

REFUSAL ROCK OR BOULDER ($\frac{25}{0}$)

USED 117'11" OF 2-1/2" CASING.

HOLE CAVED AND DRY AT 12'6" AFTER COMPLETION.

SILTY CLAY	4		3'0"
GREY CLAY SOME SILT	5 6 3		11'6"
GREY CLAYEY SILT SOME VERY FINE SAND	2		18'0"
GREY FINE TO MEDIUM SAND	16		21'0"
BROWN SANDY CLAYEY SILT	3		25'6"
GREY SILT	2		32'0"
GREY FINE TO MEDIUM SAND	14 10		[illegible]
GREY FINE SAND	24 17 16		58'0"
GREY FINE SAND	100		60'6"
GREY FINE TO MEDIUM SAND	32 # 19		72'6"
BROWN AND GREY COARSE SAND TRADE MEDIUM AND FINE SAND TRACE SILT	# 7 # 17		83'6"
BROWN AND GREY DENSE FINE AND MED. SAND TRACE COARSE SAND	# 23		88'0"
SAME MORE DENSE	# 60		92'6"
BROWN & GREY FINE & MEDIUM SAND	# 15		97'0"
BROWN AND GREY FINE, MEDIUM AND COARSE SAND TRACE SML. GRAVEL	# 15		104'0'
SAME MORE DENSE	# $\frac{100}{9}$		107'0'
GREY LIMESTONE SOME DECOMPOSED SEAMS	▨	REC. 70%	112'0'
	▨	REC. 69%	116'0'

USED 107'0" OF 2-1/2" CASING.

WATER LEVEL 2'0" BELOW GR.SURFACE 1 HR. AFTER COMPLETION.

3/2-19-22-23/62

- INDICATES WASH SAMPLE RECOVERED.

▨ - INDICATES ROCK CORING.

3/26-27-28/62

Classifications are made by visual inspection.

Water levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.

Figures in right hand column indicate number of blows required to drive 2" O.D. sampling pipe one foot, using 140 lb. weight falling 30 inches.
FIGURES IN RIGHT HAND COLUMN SHOWN AS FRACTIONS - NUMERATOR - NO. OF BLOWS

Total Footage 476'0"
Foreman A.J.HOUSE, P.HOUSE, JOHN BOWERMASTER
Job No. CB-1002-KC
Classification by FOREMEN
Sheet 2 of 5

206-1-30 PADS 7-57

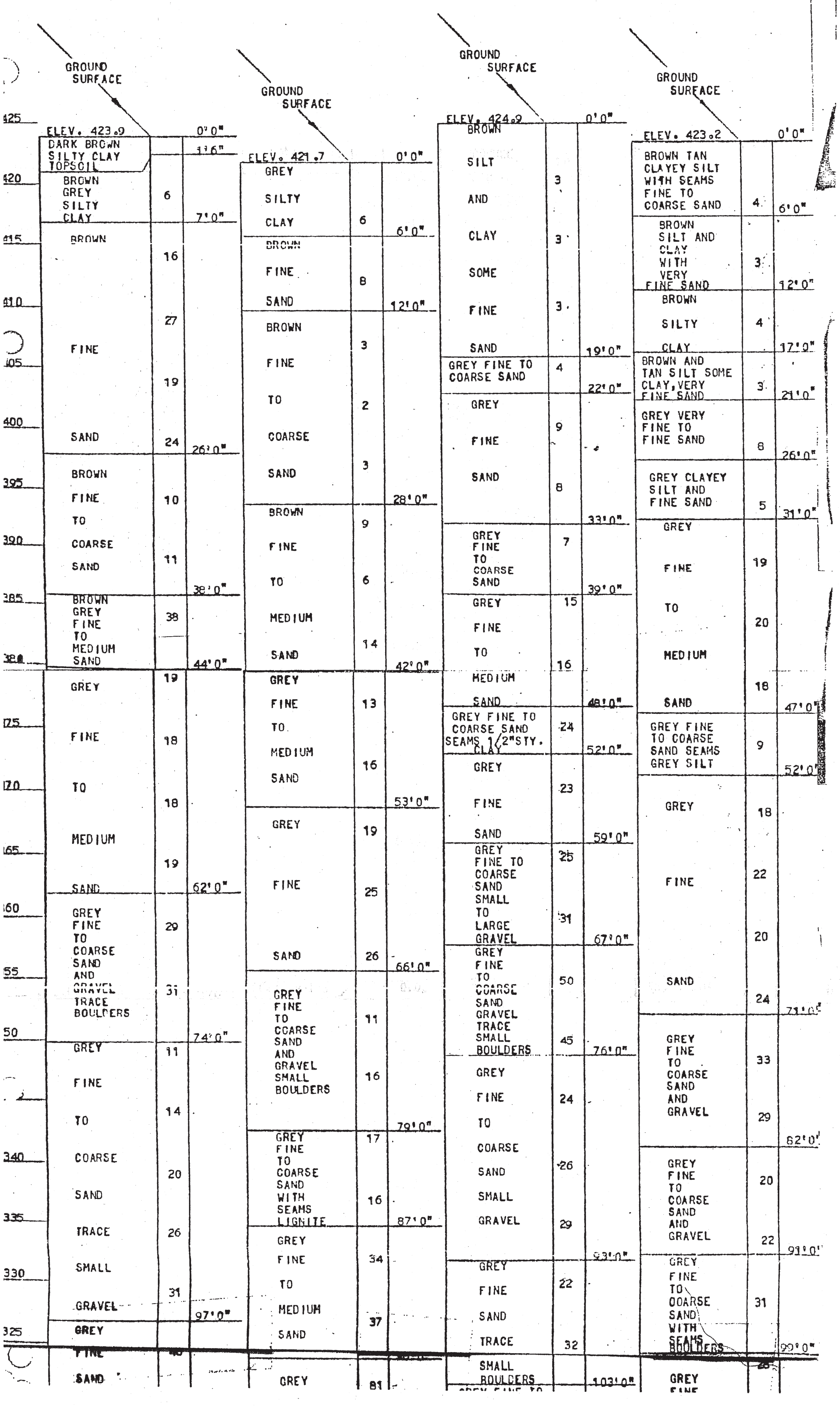
TEST BORING REPORT
RAYMOND
CONCRETE PILE COMPANY
A DIVISION OF RAYMOND INTERNATIONAL INC.

To UNITED ENGINEERS & CONSTRUCTORS INC. Date MAY 28, 1963

Location of Borings PROPOSED SIOUX PLANT - UNIT NO. 1, PORTAGE DE SIOUX, MISSOURI

All borings are plotted to a scale of 1" = 8 ft. using U. S. G. S. ELEVATIONS as a fixed datum.

Boring No. 5-A   Boring No. 6-A   Boring No. 7-A   Boring No. 8-A



Boring No. 5-A — ELEV. 423.9, 0'0"

DARK BROWN SILTY CLAY TOPSOIL		1'6"
BROWN GREY SILTY CLAY	6	7'0"
BROWN FINE SAND	16 27 19 24	26'0"
BROWN FINE TO COARSE SAND	10 11	38'0"
BROWN GREY FINE TO MEDIUM SAND	38	44'0"
GREY FINE TO MEDIUM SAND	19 18 18 19	62'0"
GREY FINE TO COARSE SAND AND GRAVEL TRACE BOULDERS	29 31	74'0"
GREY FINE TO COARSE SAND TRACE SMALL GRAVEL	11 14 20 26 31	97'0"
GREY FINE SAND	40	

Boring No. 6-A — ELEV. 421.7, 0'0"

GREY SILTY CLAY	6	6'0"
BROWN FINE SAND	8	12'0"
BROWN FINE TO COARSE SAND	3 2 3	28'0"
BROWN FINE TO MEDIUM SAND	9 6 14	42'0"
GREY FINE TO MEDIUM SAND	13 16	53'0"
GREY FINE SAND	19 25 26	66'0"
GREY FINE TO COARSE SAND AND GRAVEL SMALL BOULDERS	11 16	79'0"
GREY FINE TO COARSE SAND WITH SEAMS LIGNITE	17 16	87'0"
GREY FINE TO MEDIUM SAND	34 37	[illegible]
GREY	81	

Boring No. 7-A — ELEV. 424.9, 0'0"

BROWN SILT AND CLAY SOME FINE SAND	3 3 3	19'0"
GREY FINE TO COARSE SAND	4	22'0"
GREY FINE SAND	9 8	33'0"
GREY FINE TO COARSE SAND	7	39'0"
GREY FINE TO MEDIUM SAND	15 16	48'0"
GREY FINE TO COARSE SAND SEAMS 1/2"STY. CLAY	24	52'0"
GREY FINE SAND	23	59'0"
GREY FINE TO COARSE SAND SMALL TO LARGE GRAVEL	25 31	67'0"
GREY FINE TO COARSE SAND GRAVEL TRACE SMALL BOULDERS	50 45	76'0"
GREY FINE TO COARSE SAND SMALL GRAVEL	24 26 29	93'0"
GREY FINE SAND TRACE SMALL BOULDERS	22 32	103'0"
GREY FINE TO		

Boring No. 8-A — ELEV. 423.2, 0'0"

BROWN TAN CLAYEY SILT WITH SEAMS FINE TO COARSE SAND	4	6'0"
BROWN SILT AND CLAY WITH VERY FINE SAND	3	12'0"
BROWN SILTY CLAY	4	17'0"
BROWN AND TAN SILT SOME CLAY, VERY FINE SAND	3	21'0"
GREY VERY FINE TO FINE SAND	8	26'0"
GREY CLAYEY SILT AND FINE SAND	5	31'0"
GREY FINE TO MEDIUM SAND	19 20 18	47'0"
GREY FINE TO COARSE SAND SEAMS GREY SILT	9	52'0"
GREY FINE SAND	18 22 20 24	71'0"
GREY FINE TO COARSE SAND AND GRAVEL	33 29	82'0"
GREY FINE TO COARSE SAND AND GRAVEL	20 22	91'0"
GREY FINE TO COARSE SAND WITH SEAMS BOULDERS	31	99'0"
GREY FINE	28	

410
405
400
395
390
385
380
375
370
365
360
355
350
340
335
330
325
310

FINE SAND	27 19 24	26'0"
BROWN FINE TO COARSE SAND	10 11	38'0"
BROWN GREY FINE TO MEDIUM SAND	38	44'0"
GREY FINE TO MEDIUM SAND	19 18 18 19	62'0"
GREY FINE TO COARSE SAND AND GRAVEL TRACE BOULDERS	29 31	74'0"
GREY FINE TO COARSE SAND TRACE SMALL GRAVEL	11 14 20 26 31	97'0"
GREY FINE SAND	48	103'7"

REFUSAL ROCK OR BOULDER.

WATER ENCOUNTERED AT 7'0".

WATER LEVEL 7'0" 12 HOURS AFTER COMPLETICN WITH BORING ADVANCED TO 40'0".

WATER LEVEL 6'6" 1 1/2 HOURS AFTER COMPLETION.

WATER LEVEL 1'0" 24 HOURS AFTER COMPLETION.

BORING ADVANCED BY DRILLING MUD.

5/10/13/63

SAND	8	12'0"
BROWN FINE TO COARSE SAND	3 2 3	28'0"
BROWN FINE TO MEDIUM SAND	9 6 14	42'0"
GREY FINE TO MEDIUM SAND	13 16	53'0"
GREY FINE SAND	19 25 26	66'0"
GREY FINE TO COARSE SAND AND GRAVEL SMALL BOULDERS	11 16	79'0"
GREY FINE TO COARSE SAND WITH SEAMS LIGNITE	17 16	87'0"
GREY FINE TO MEDIUM SAND	34 37	[illegible]
GREY FINE SAND TRACE SMALL BOULDERS	81 69 20/0	107'4"

REFUSAL ROCK OR BOULDER.

BORING ADVANCED BY DRILLING MUD.

WATER ENCOUNTERED AT 5'0".

WATER LEVEL 4'10" 70 HOURS AFTER COMPLETION.

5/14/20/21/63

FINE SAND	3	19'0"
GREY FINE TO COARSE SAND	4	22'0"
GREY FINE SAND	9 8	33'0"
GREY FINE TO COARSE SAND	7	39'0"
GREY FINE TO MEDIUM SAND	15 16	48'0"
GREY FINE TO COARSE SAND SEAMS 1/2"STY. CLAY	24	52'0"
GREY FINE SAND	23	59'0"
GREY FINE TO COARSE SAND SMALL TO LARGE GRAVEL	25 31	67'0"
GREY FINE TO COARSE SAND GRAVEL TRACE SMALL BOULDERS	50 45	76'0"
GREY FINE TO COARSE SAND SMALL GRAVEL	24 26 29	93'0"
GREY FINE SAND TRACE SMALL BOULDERS	22 32	103'0"
GREY FINE TO MEDIUM SAND SOME CLAY THIN LEDGES OR BOULDERS	39	107'11"

REFUSAL ROCK OR BOULDER.

BORING ADVANCED BY DRILLING MUD.

WATER ENCOUNTERED AT 5'1".

WATER LEVEL 5'1" 1 HOUR AFTER COMPLETION.

5/21/22/63

FINE SAND		12'0"
BROWN SILTY CLAY	4	17'0"
BROWN AND TAN SILT SOME CLAY, VERY FINE SAND	3	21'0"
GREY VERY FINE TO FINE SAND	8	26'0"
GREY CLAYEY SILT AND FINE SAND	5	31'0"
GREY FINE TO MEDIUM SAND	19 20 18	47'0"
GREY FINE TO COARSE SAND SEAMS GREY SILT	9	52'0"
GREY FINE SAND	18 22 20 24	71'0"
GREY FINE TO COARSE SAND AND GRAVEL	33 29	82'0"
GREY FINE TO COARSE SAND AND GRAVEL	20 22	91'0"
GREY FINE TO OOARSE SAND WITH SEAMS BOULDERS	31	99'0"
GREY FINE TO MEDIUM SAND	28 24	109'0'
GREY FINE TO COARSE SAND, TRACE CLAY DECOMPOSED ROCK	49	111'1

REFUSAL ROCK OR BOULDER.

BORING ADVANCED BY DRILLING MUD.

WATER ENCOUNTERED AT 7'4".

WATER LEVEL 6'10" 1/2 HOUR AFTER COMPLETION.

5/23/63

Classifications are made by visual inspection.

Water levels (WL). Figure indicates time of reading (hours) after completion of boring. Water levels indicated are those observed when borings were made, or as noted. Porosity of the soil strata, variations of rainfall, site topography, etc., may cause changes in these levels.

Figures in right hand column indicate number of blows required to drive 2" O.D. sampling pipe one foot, using 140 lb. weight falling 30 inches.

Total Footage 430'8"
Foreman JOHN BOWERMASTER
Job No. CB - 1954 - KC
Classification by FOREMAN
Sheet 3 of 3

Reitz & Jens, Inc.

RELATIVE DENSITY TEST

(Minimum & Maximum Density Determinations)

Job Ameren Sioux CCP

Boring No. Bottom Ash from

Depth Surface of Stockpile

Sample No.

Mold Vol. 0.09995 (cu. ft.) (Vm)

Mold End Area 0.1961 (sq. ft.) (Am)

Lab Test by MPT Date 12/2/09

Computed by ____ Date ____

Checked by ____ Date ____

Mold No.

Mold Diam. ____ (in)

Mold Wt. ____ (lb.)

$$\text{Relative Density} = \frac{\gamma\,\text{max.}}{\gamma\,\text{field}} \cdot \frac{(\gamma\,\text{field} - \gamma\,\text{min.})}{(\gamma\,\text{max.} - \gamma\,\text{min.})} \times 100$$

MINIMUM DENSITY

Trial No.			Trial 1		Trial 2	
Weight	Tare + Soil Dry	W	17.11		17.11	
	Tare	W	7.98		7.98	
Lb.	Soil Dry	Ws	9.13		9.13	
Min. Dry Density pcf.		γd	91.3		91.3	
Min. Dry Density Average pcf						

MAXIMUM DENSITY

Method Used						
Trial No.			1		2	
Height	Initial Dial Reading	h o				
Inches	Left Dial Reading	h l	.88		.73	
	Right Dial Reading	h r	.70		.75	
	Sum	h l + h r	1.58		1.48	
	Average Dial Reading	h a		.79		.74
	Height Change	Δ h		1.29		1.24
Volume	Mold Initial Volume	V m		0.09995		0.09995
cu. ft.	Volume Change *	Δ V		0.0210807		0.0202636
	Volume of Soil	V s		0.0788693		0.0796864
Weight	Tare + Soil Dry	W	17.11		17.11	
Lb.	Tare	W m	7.98		7.98	
	Soil Dry	W s	9.13		9.13	
Max. Dry Density pcf.		γ d	116.4		114.6	
Max. Dry Density Average pcf.						

$$^{*}\Delta V = \frac{\Delta h \times A m}{12}$$

Sample Description & Remarks

Reitz & Jens, Inc.

RELATIVE DENSITY TEST

(Minimum & Maximum Density Determinations)

$$\text{Relative Density} = \frac{\gamma \text{max.} \; (\gamma \text{field} - \gamma \text{min.})}{\gamma \text{field} \; (\gamma \text{max.} - \gamma \text{min.})} \times 100$$

Job Sioux UWL Cell 4A

Boring No.

Depth

Sample No. Bottom Ash

Mold Vol. [redacted] 0.0999 (cu. ft.) (Vm)

Mold End Area 0.1961 (sq. ft.) (Am)

RJ-1

Lab Test by JRA Date 11/1/13

Computed by JDB Date 11/11/13

Checked by JDB Date 11/11/13

Mold No. RJ-1

Mold Diam. (in)

Mold Wt. 7.98 (lb.)

MINIMUM DENSITY						
Trial No.			1		2	
Weight	Tare + Soil Dry	W	17.510		17.546	
	Tare	W	7.98#		7.98#	
Lb.	Soil Dry	W s	9.53		9.566	
Min. Dry Density pcf.		γ d	95.40 pcf		95.76 pcf	
Min. Dry Density Average pcf						
MAXIMUM DENSITY						
Method Used						
Trial No.						
Height	Initial Dial Reading	h o				—
	Left Dial Reading	h l			—	
Inches	Right Dial Reading	h r			—	
	Sum	h l + h r			—	
	Average Dial Reading	h a				—
	Height Change	Δ h				0.9358 in
Volume	Mold Initial Volume	V m				0.0999
cu. ft.	Volume Change *	Δ V				0.0153
	Volume of Soil	V s				0.0846
Weight	Tare + Soil Dry	W				17.546
Lb.	Tare	W m				7.98
	Soil Dry	W s				9.566
Max. Dry Density pcf.		γ d				113.07 pcf
Max. Dry Density Average pcf.						

$$* \Delta V = \frac{\Delta h \times A m}{12}$$

drop to top plate .4159 .4349 .4240 Av. 0.4313

+ plate thick ⇒ .4960 .5210 .4969 Av 0.5045

total = 0.9358

Sample Description & Remarks

Bottom Ash

$D_f = 75\%, \gamma_f = 108.2$ PCF

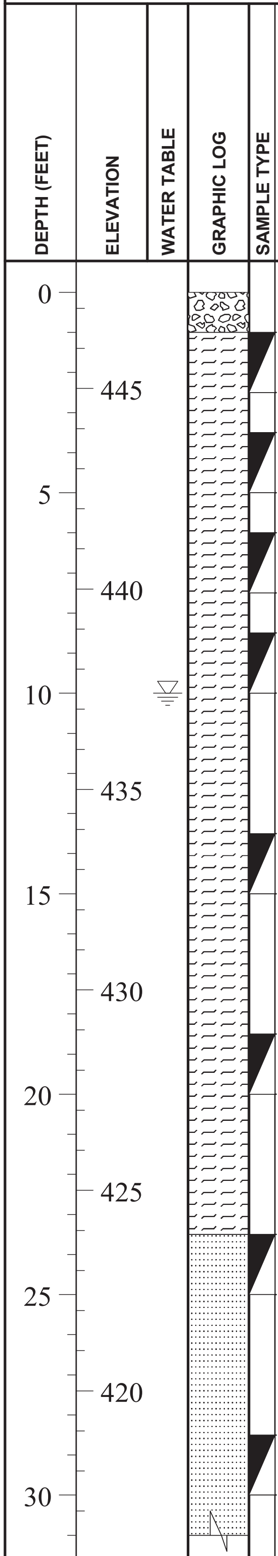
Appendix C-22

REITZ & JENS, INC.
CONSULTING ENGINEERS

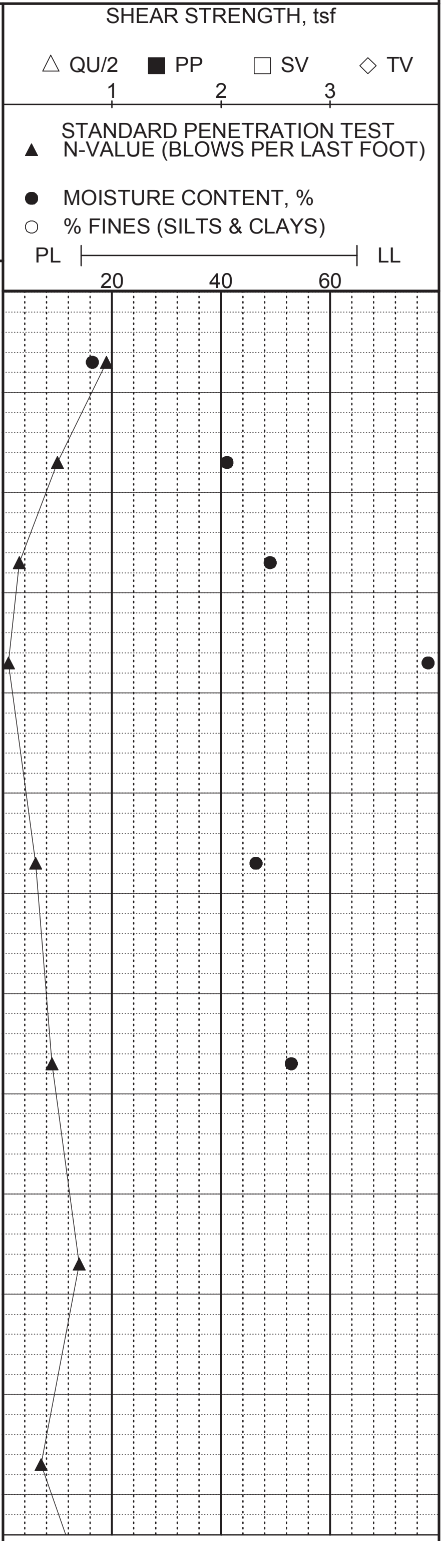
BORING LOG STR-2

Sioux-Roxford 5: Structure 2
Sioux Energy Center, West Alton, MO
CLIENT: **Ameren Services**

LOCATION: N -90.293357 E 38.910271
ELEVATION: 447.4 DATUM: Est. from LiDAR
DATE DRILLED: 07-31-14



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	Crushed AGGREGATE, limestone, 1-inch minus		
56	FLY ASH, brown and black, with trace of bottom ash, medium-dense, dry	5-9-10	16.4
100	Becoming very moist, with trace bottom ash	6-5-5	41.1
156	With layers and laminations of bottom ash, very loose, moist	0-0-3	49.0
100		2-0-1	78
100	Becoming loose, very moist Switched to mud rotaray at 15'	1-2-4	46.4
100	Becoming a mixture of fly ash and bottom ash	4-5-4	52.9
100	SAND (SP), brown and grey, fine, medium-dense	5-6-8	
67	Becoming silty, with laminations of silt, loose	2-2-5	



DRILLER: Midwest Drilling
METHOD: 4.25" CFA/Mud Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%):
LOGGED BY: C. Cook

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
U BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG STR-2

Sioux-Roxford 5: Structure 2

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	415							
					83	Becoming fine- to medium-grain, without silt, medium-dense	7-10-10	
35								
	410							
					100		12-13-13	
40								
	405							
					83	Becoming gray, fine, dense	17-21-17	
45								
	400							
					67	Becoming fine to coarse, medium-dense	9-7-8	
50						Boring terminated at 50'-0" in SAND		
	395							
55								
	390							
60								
	385							
65								
	380							

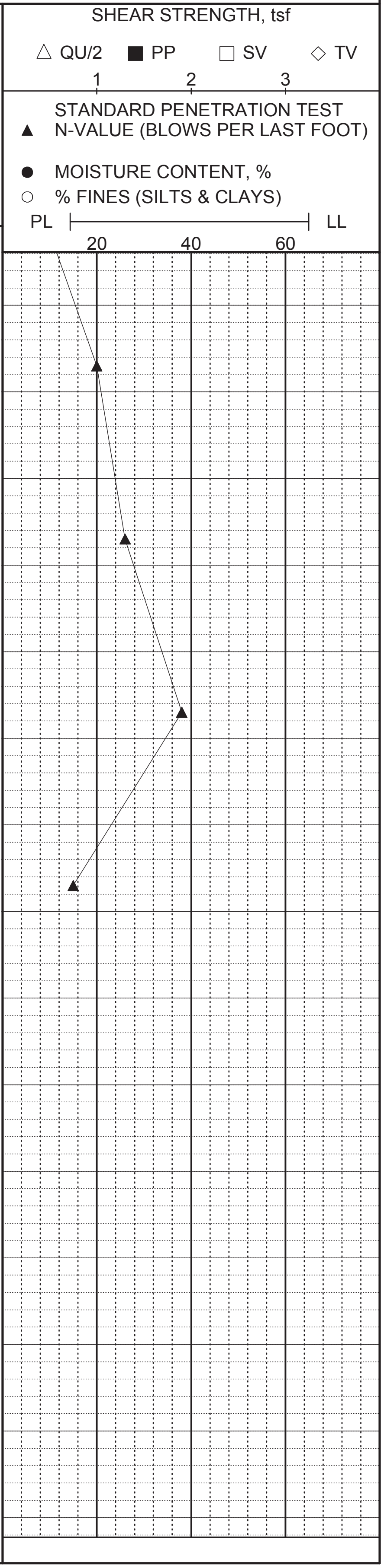


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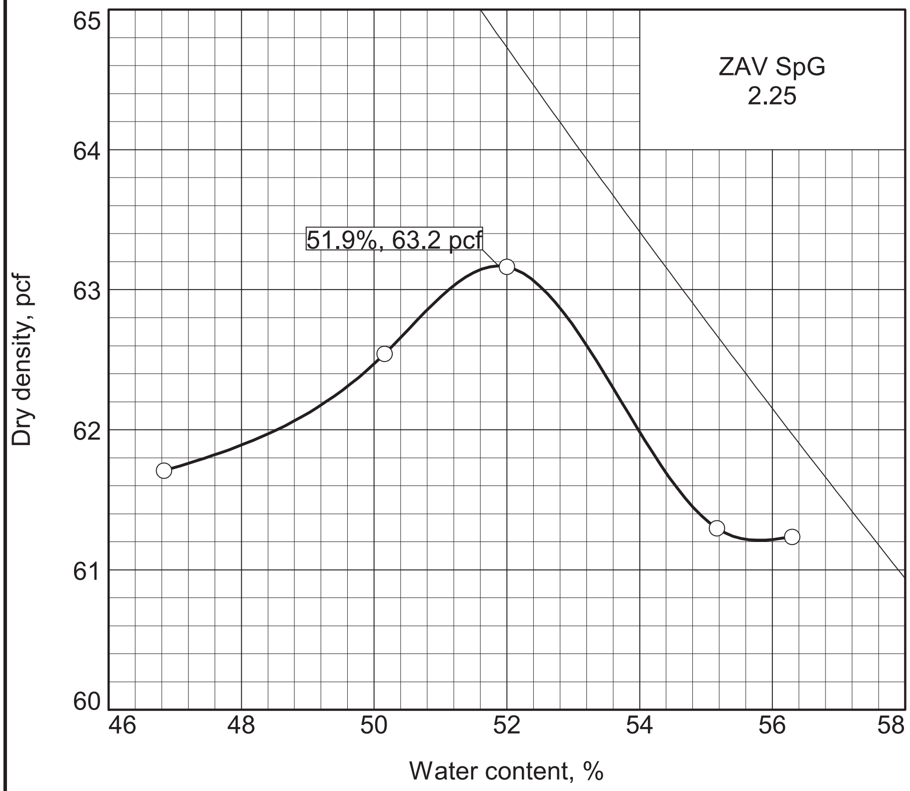
Figure 2-1 Sheet 2 of 2

COMPACTION TEST REPORT

Curve No.



Test Specification:
ASTM D 698-07 Method A Standard

Preparation Method ASTM
Hammer Wt. 5.5 lb.
Hammer Drop 12 in.
Number of Layers three
Blows per Layer 25
Mold Size 0.03333 cu. ft.
Test Performed on Material Passing #4 **Sieve**
NM **LL** **PI**
Sp.G. (ASTM D 854)
%>#4 **%<No.200**
USCS **AASHTO**
Date Sampled 10/16/13
Date Tested 10/18/13
Tested By DLB

TESTING DATA

	1	2	3	4	5	6
WM + WS	7.72	7.75	7.68	7.74	7.57	
WM	4.55	4.55	4.55	4.55	4.55	
WW + T #1	191.2	195.1	167.2	265.3	170.8	
WD + T #1	135.6	140.2	122.9	185.5	127.3	
TARE #1	34.9	35.0	34.7	43.6	34.9	
WW + T #2	270.3	227.4	156.8	259.3	165.9	
WD + T #2	190.0	164.8	116.2	181.5	124.2	
TARE #2	44.2	43.8	35.1	43.6	34.6	
MOISTURE	55.2	52.0	50.2	56.3	46.8	
DRY DENSITY	61.3	63.2	62.5	61.2	61.7	

TEST RESULTS

Maximum dry density = 63.2 pcf

Optimum moisture = 51.9 %

Material Description

Fly Ash, dark grey to black
UWL Cell 4A CCP Berm

Remarks:
Samples at 55.2% and 56.3% had free water on the surface and bottom after compaction of the lifts

Project No. 2013012477 **Client:** Ameren Missouri
Project: Sioux UWL-Cell 4 Construction CQA

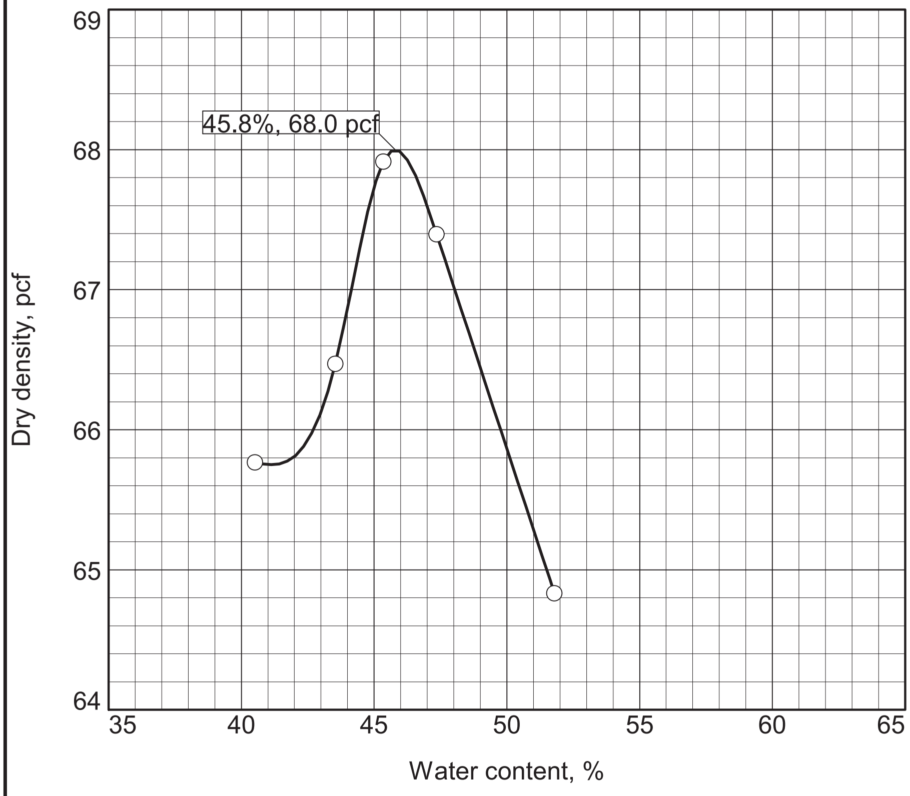
○ **Source:** Offsite Borrow **Sample No.:** 20131016 Fly Ash

REITZ & JENS, INC.
CONSULTING ENGINEERS

Checked by: K. Kocher
Title: P.E.

Figure

COMPACTION TEST REPORT



Curve No.

Test Specification:
ASTM D 698-91 Procedure B Standard

Preparation Method Standard
Hammer Wt. 5.5 lb.
Hammer Drop 12 in.
Number of Layers three
Blows per Layer 25
Mold Size 0.03333 cu. ft.
Test Performed on Material Passing 3/8 in. **Sieve**

NM ____ **LL** ____ **PI** ____
Sp.G. (ASTM D 854) ____
%>3/8 in. ____ **%<No.200** ____
USCS ____ **AASHTO** ____
Date Sampled 10/22/13
Date Tested 10/23/13
Tested By DLB

TESTING DATA

	1	2	3	4	5	6
WM + WS	7.83	7.86	7.84	7.73	7.63	
WM	4.55	4.55	4.55	4.55	4.55	
WW + T #1	309.0	204.4	304.9	278.6	280.6	
WD + T #1	217.5	150.7	223.1	206.1	212.1	
TARE #1	39.8	36.7	41.3	40.6	42.1	
WW + T #2	283.7	183.9	262.1	265.8	268.2	
WD + T #2	200.7	135.8	192.5	197.7	202.4	
TARE #2	41.3	34.6	40.2	40.5	40.8	
MOISTURE	51.8	47.4	45.3	43.5	40.5	
DRY DENSITY	64.8	67.4	67.9	66.5	65.8	

TEST RESULTS

Maximum dry density = 68.0 pcf

Optimum moisture = 45.8 %

Material Description

Fly Ash Dark grey to black

Remarks:

Project No. 2013012477 **Client:** Ameren Missouri
Project: Sioux UWL-Cell 4 Construction CQA

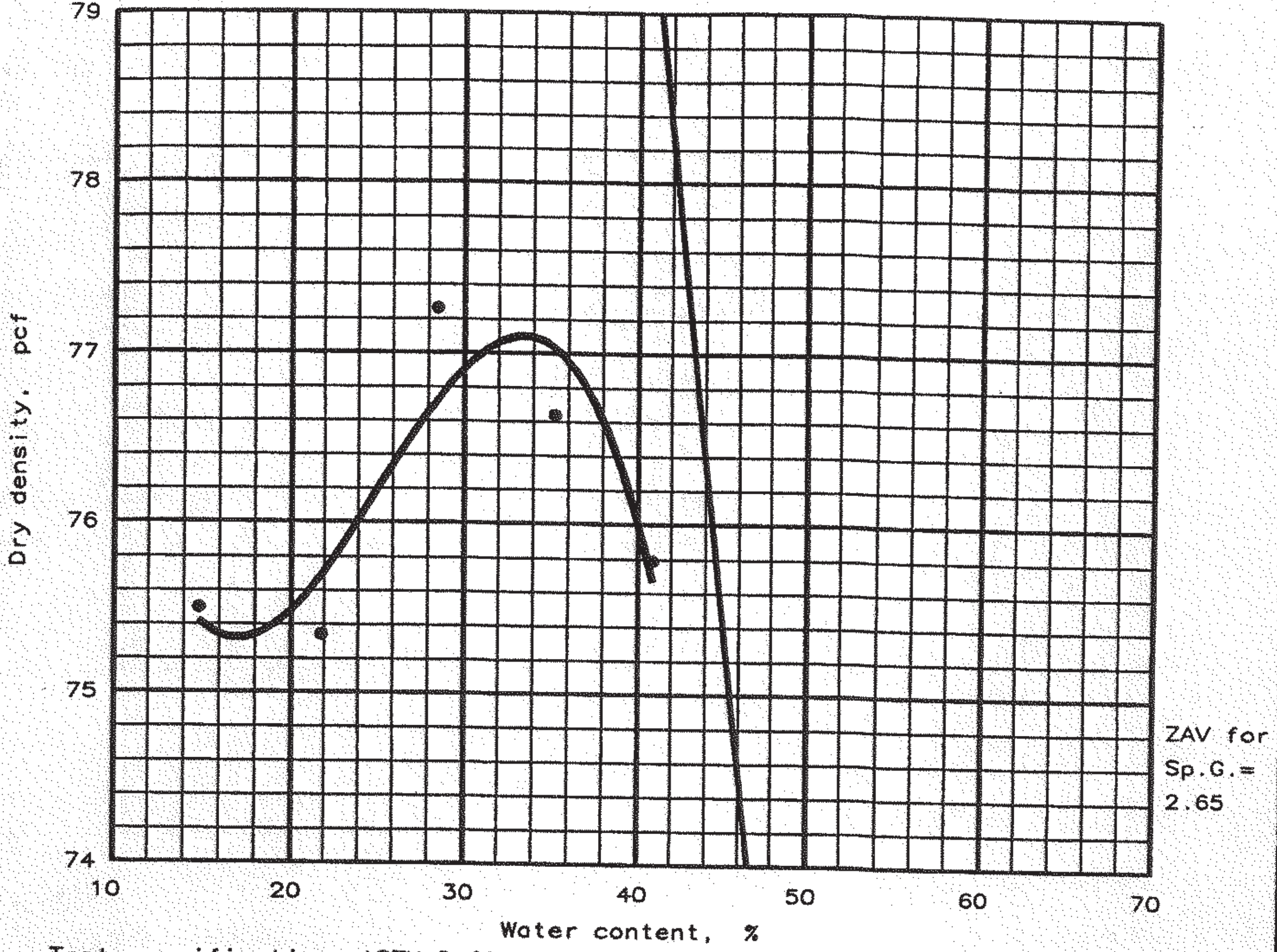
○ **Source:** Offsite Borrow **Sample No.:** 20131022 Fly Ash

REITZ & JENS, INC.
CONSULTING ENGINEERS

Checked by: JDB
Title: 10/24/13

Figure

RESULTS OF MOISTURE-DENSITY TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 77.3 pcf Optimum moisture = 28.5 %	Type F Flyash

Project No.: 2001012413

Project: Ameren Sioux Power Plant Railroad Loop

Location: Test Pits 10, 11, 12

Date: 1-22-1902

Remarks:

Combined sample

RESULTS OF MOISTURE-DENSITY TEST

REITZ & JENS, Inc.

Fig. No. B-4

RESULTS OF MOISTURE-DENSITY TEST

Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
								62 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 73.8 pcf Optimum moisture = 39.2 %	Type F Flyash

Project No.: 2001012413

Project: Ameren Sioux Power Plant Railroad Loop

Location: Test Pits 4, 5, 6

Date: 1-22-1902

Remarks:

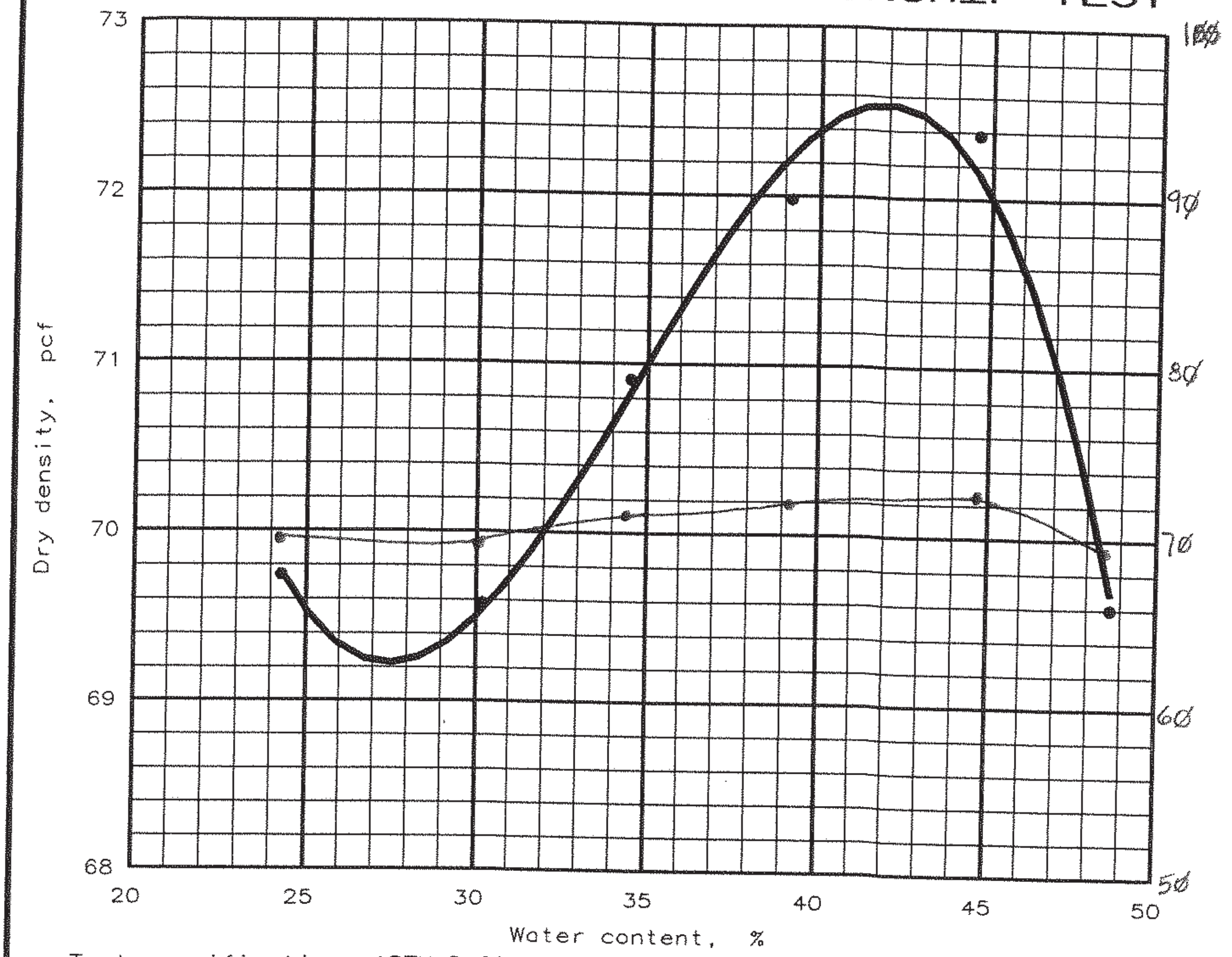
Combined sample

RESULTS OF MOISTURE-DENSITY TEST

REITZ & JENS, Inc.

Fig. No. B-3

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS

Maximum dry density = 72.5 pcf

Optimum moisture = 41.9 %

MATERIAL DESCRIPTION

Fly Ash

Sample 062402-2

Project No.: 2002012427

Project: Ameren UE Sioux Plant

Location: Ameren UE Sioux Plant Rail Loop

Sample 062402-2

Date: 07/05/2002

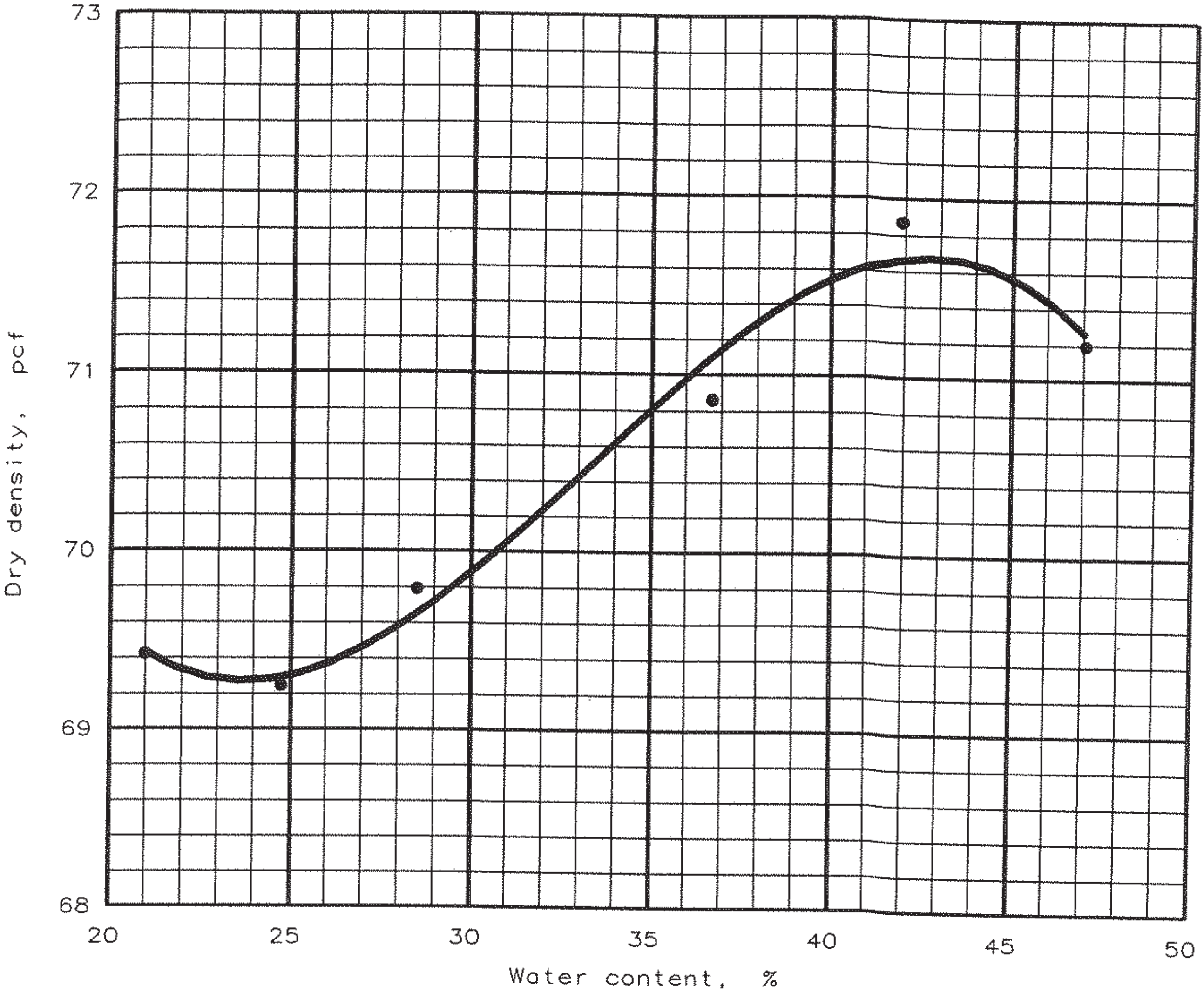
Remarks:

MOISTURE-DENSITY RELATIONSHIP TEST

REITZ & JENS, Inc.

Fig. No. ______

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 71.9 pcf Optimum moisture = 41.9 %	Fly Ash Sample 062402-1

Project No.: 2002012427

Project: Ameren UE Sioux Plant

Location: Ameren UE Sioux Plant

Rail Loop

Date: 07/05/2002

MOISTURE-DENSITY RELATIONSHIP TEST

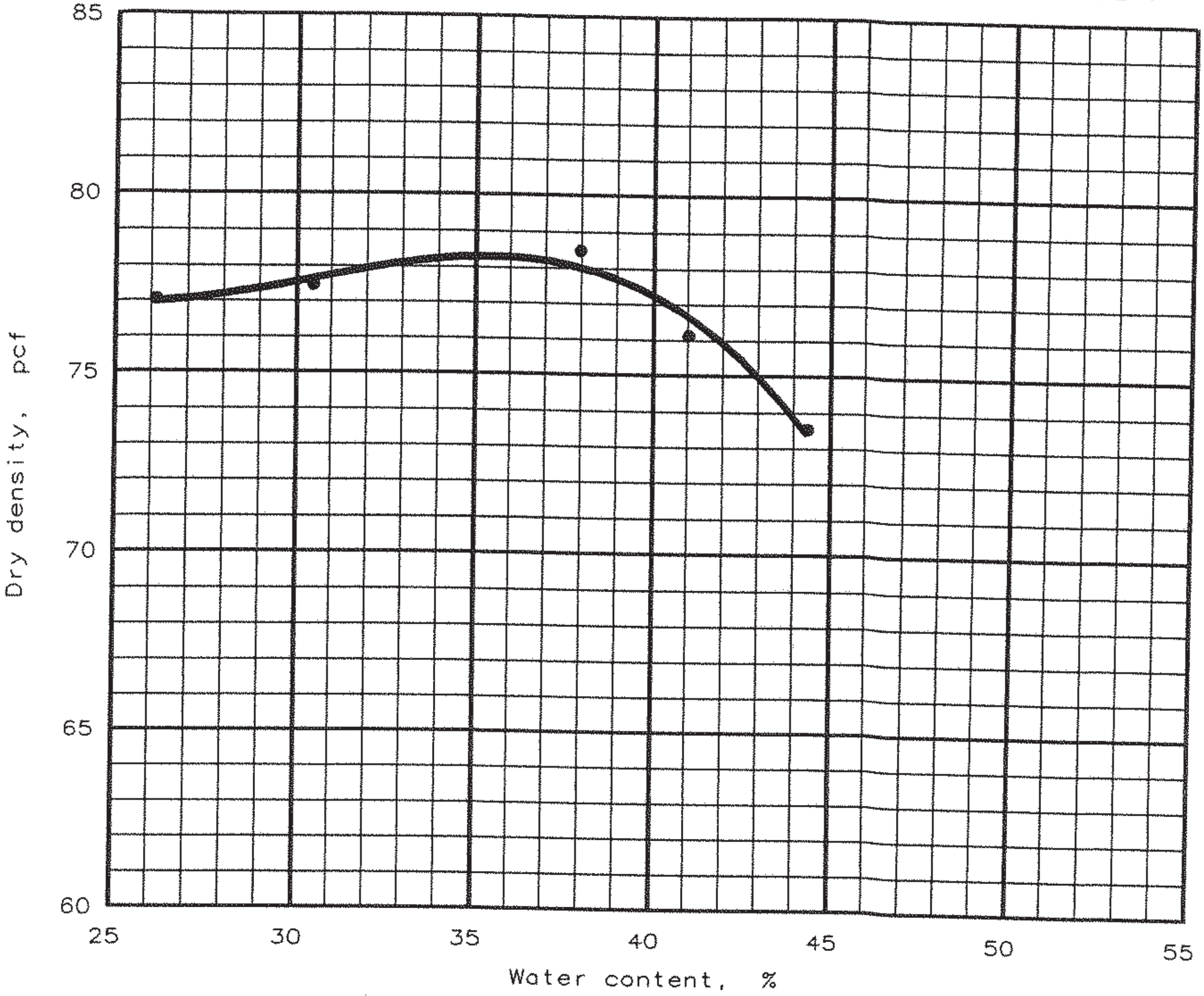
REITZ & JENS, Inc.

Remarks:

Curve #1

Fig. No.

RESULTS OF MOISTURE-DENSITY TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 78.5 pcf Optimum moisture = 38.0 %	Flyash

Project No.: 2002012427

Project: Ameren Sioux Power Plant Railroad Loop

Location: Sample 080702 #1

Date: 8-12-1902

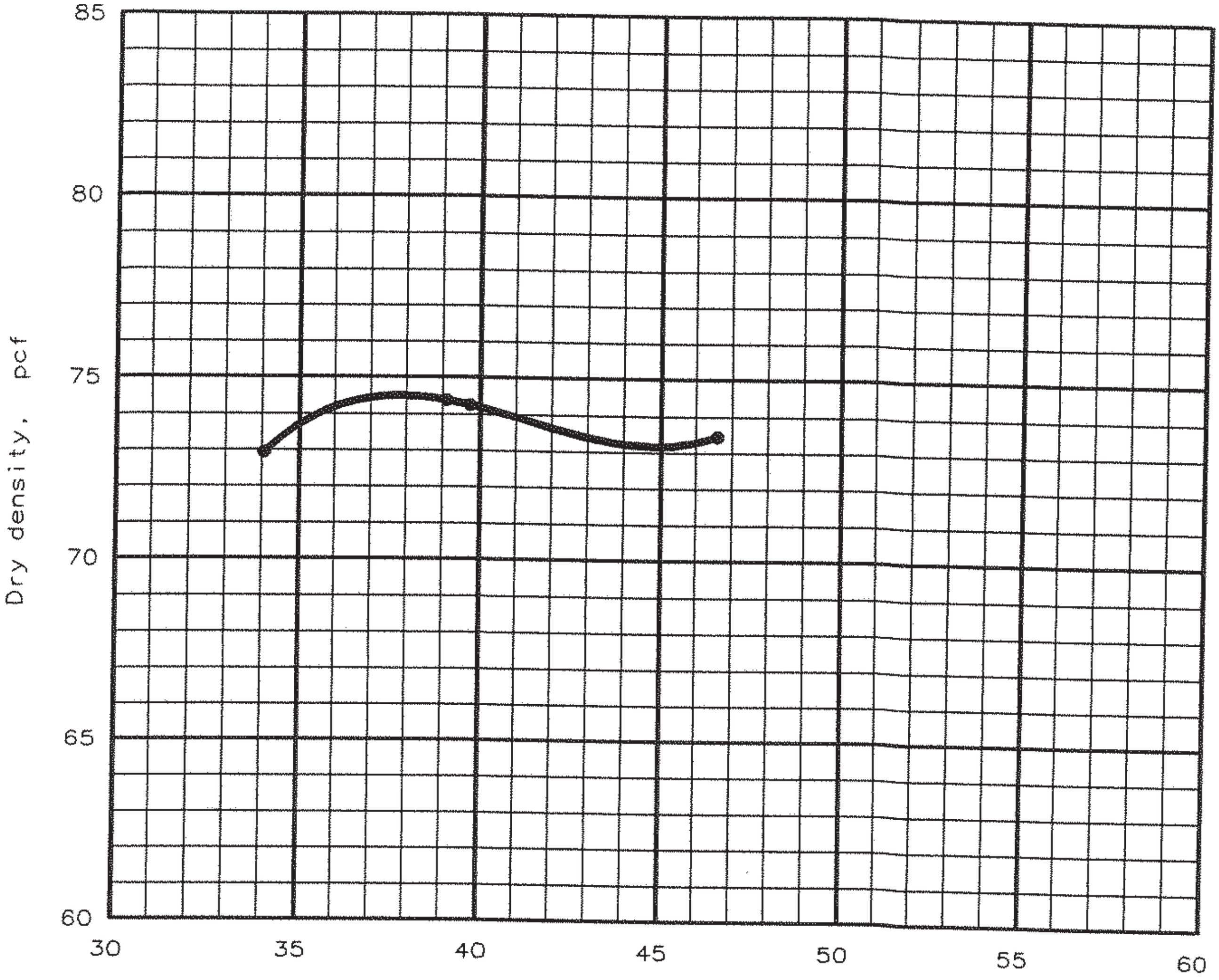
Remarks:

RESULTS OF MOISTURE-DENSITY TEST

REITZ & JENS, Inc.

Fig. No. ______

RESULTS OF MOISTURE-DENSITY TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 74.5 pcf Optimum moisture = 37.8 %	Flyash

Project No.: 2002012427

Project: Ameren Sioux Power Plant Railroad Loop

Location: Sample 080702 #2

Date: 8-12-1902

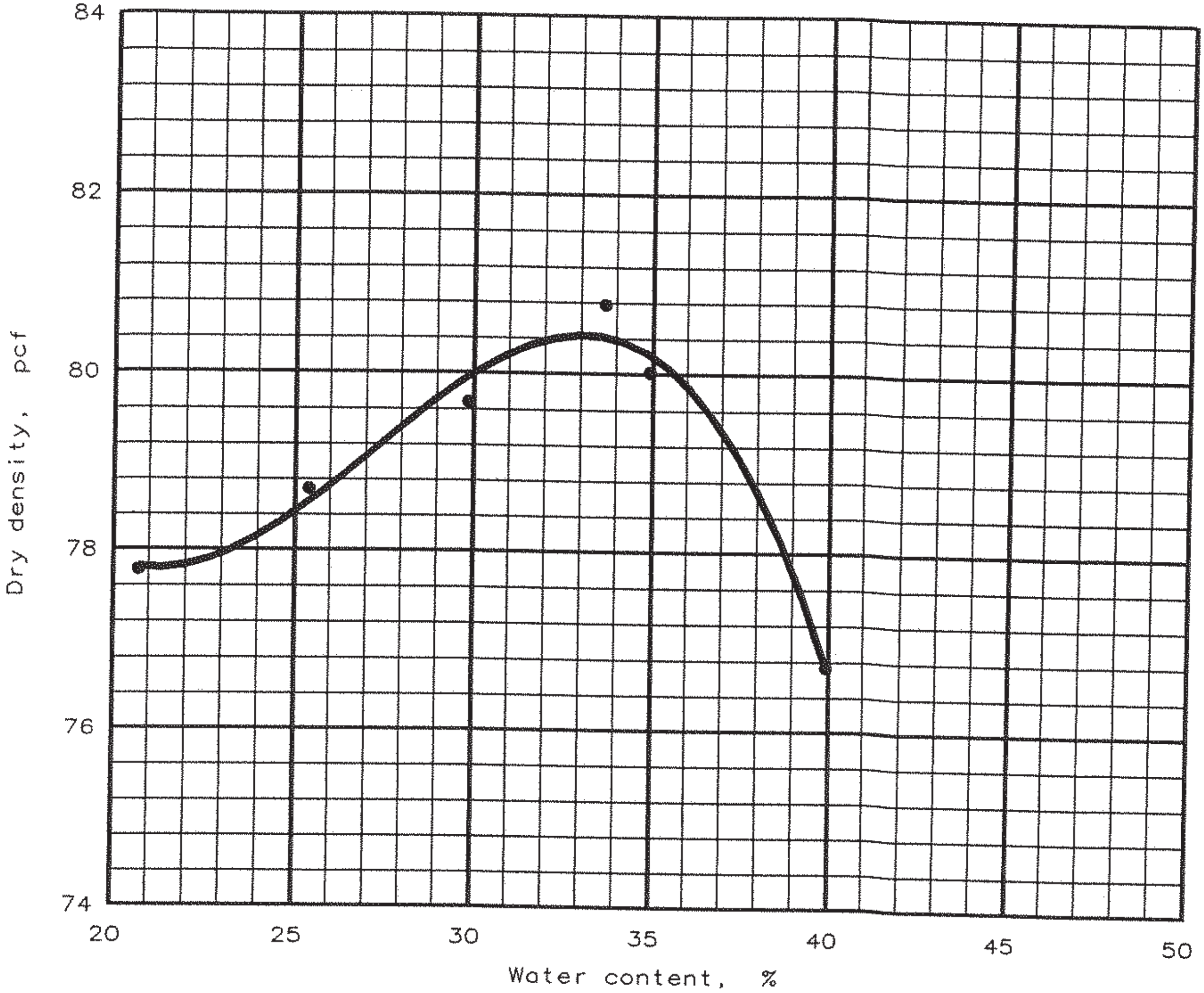
Remarks:

RESULTS OF MOISTURE-DENSITY TEST

REITZ & JENS, Inc.

Fig. No. ______

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS

Maximum dry density = 80.8 pcf

Optimum moisture = 33.7 %

MATERIAL DESCRIPTION

Fly Ash

Project No.: 2001012413

Project: Ameren Sioux Rail Loop

Location: Old Flyash Pond

Date: 8-29-2002

Remarks:

MOISTURE-DENSITY RELATIONSHIP TEST

REITZ & JENS, Inc.

Fig. No. ______

RESULTS OF MOISTURE-DENSITY TEST

Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 77.3 pcf Optimum moisture = 28.5 %	Type F Flyash

Project No.: 2001012413

Project: Ameren Sioux Power Plant Railroad Loop

Location: Test Pits 10, 11, 12

Date: 1-22-1902

Remarks:

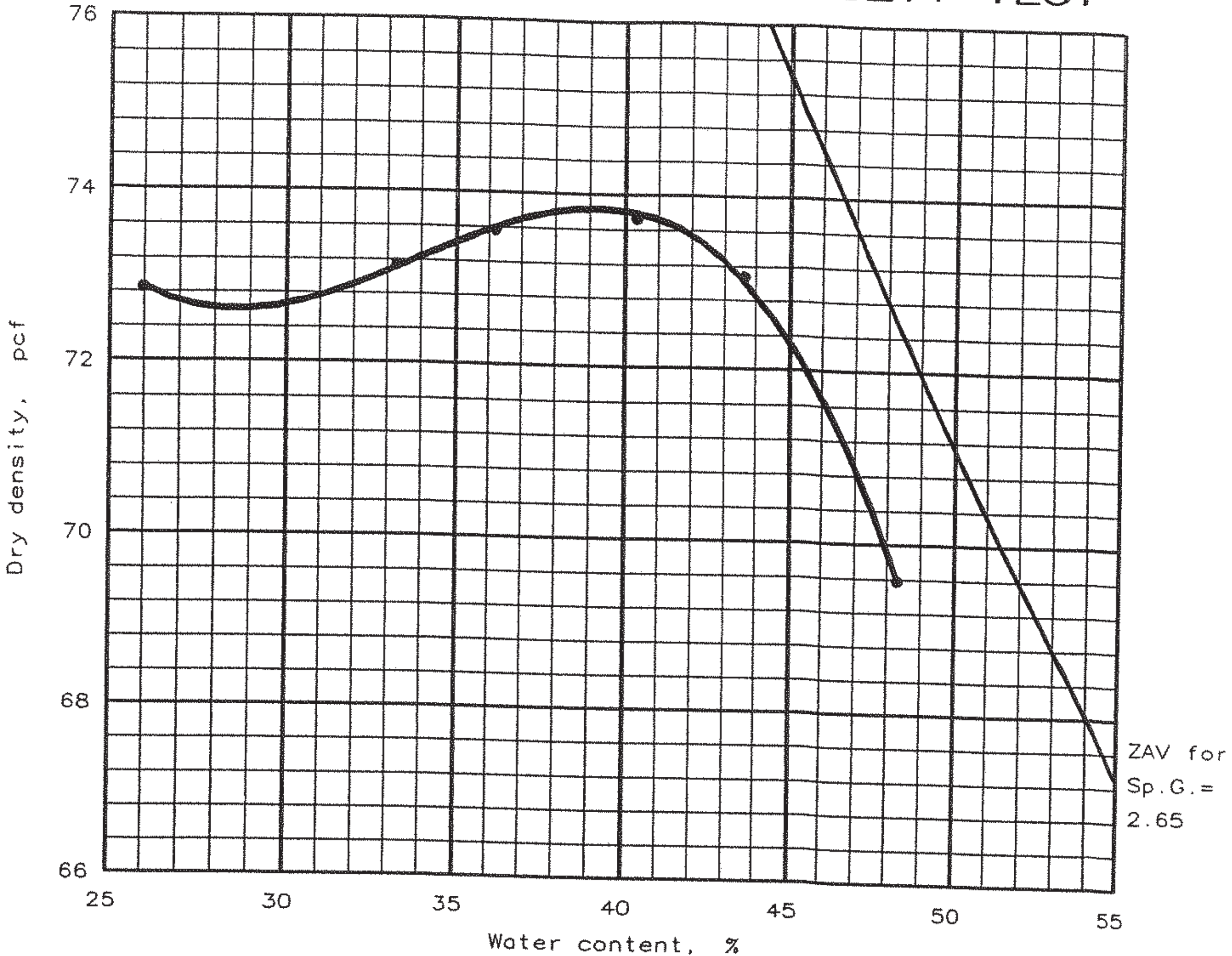
Combined sample

RESULTS OF MOISTURE-DENSITY TEST

REITZ & JENS, Inc.

Fig. No. B-4

RESULTS OF MOISTURE-DENSITY TEST



Test specification: ASTM D 698-91 Procedure A, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
								62 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 73.8 pcf Optimum moisture = 39.2 %	Type F Flyash

Project No.: 2001012413

Project: Ameren Sioux Power Plant Railroad Loop

Location: Test Pits 4, 5, 6

Date: 1-22-1902

Remarks:

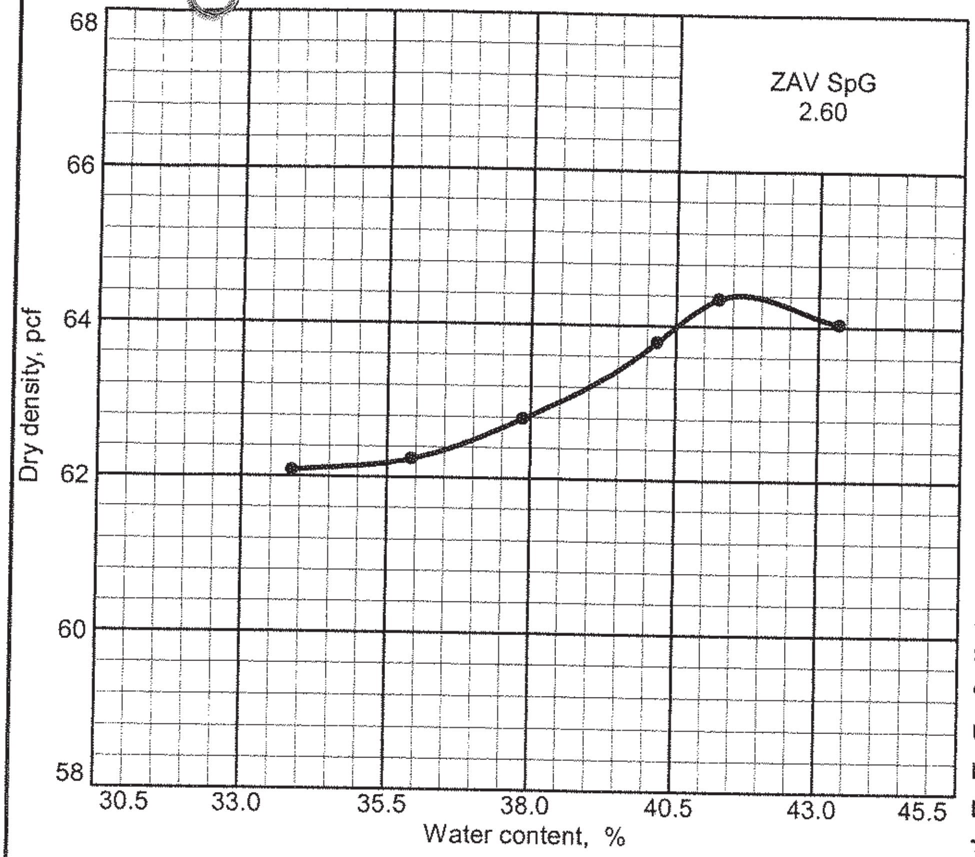
Combined sample

RESULTS OF MOISTURE-DENSITY TEST

REITZ & JENS, Inc.

Fig. No. B-3

MOISTURE-DENSITY TEST REPORT



Curve No.
2

Test Specification:
ASTM D 698-00a Method A Standard

Preparation Method
Hammer Wt. 5.5 lb.
Hammer Drop 12 in.
Number of Layers three
Blows per Layer 25
Mold Size .03333 cu.ft.
Test Performed on Material Passing No.4 **Sieve**

NM **LL** **PI**
Sp.G. (ASTM D 854) 2.60
%>No.4 **%<No.200**
USCS **AASHTO**
Date Sampled 04/29/2010
Date Tested
Tested By

TESTING DATA

	1	2	3	4	5	6
WM + WS	7.35	7.40	7.47	7.56	7.61	7.64
WM	4.58	4.58	4.58	4.58	4.58	4.58
WW + T #1	251.15	238.20	283.38	296.77	256.04	292.82
WD + T #1	196.79	186.28	216.83	223.37	190.70	216.21
TARE #1	35.84	42.20	40.84	40.83	34.49	40.13
WW + T #2	257.20	282.67	272.14	271.17	293.74	323.46
WD + T #2	201.99	218.88	207.61	203.24	220.51	238.16
TARE #2	39.44	40.79	37.41	33.99	40.50	40.80
MOISTURE	33.9	35.9	37.9	40.2	41.3	43.4
DRY DENSITY	62.1	62.2	62.8	63.8	64.4	64.0

TEST RESULTS

Maximum dry density = 64.4 pcf

Optimum moisture = 41.7 %

Material Description

Fly Ash, dark grey to black, Standard Curve #2

Project No. 2008012455 **Client:** Ameren UE
Project: Ameren - Labadie Plant UWL

● **Source:** Sioux Dry Fly Ash **Sample No.:** Sioux Fly Ash Blend2

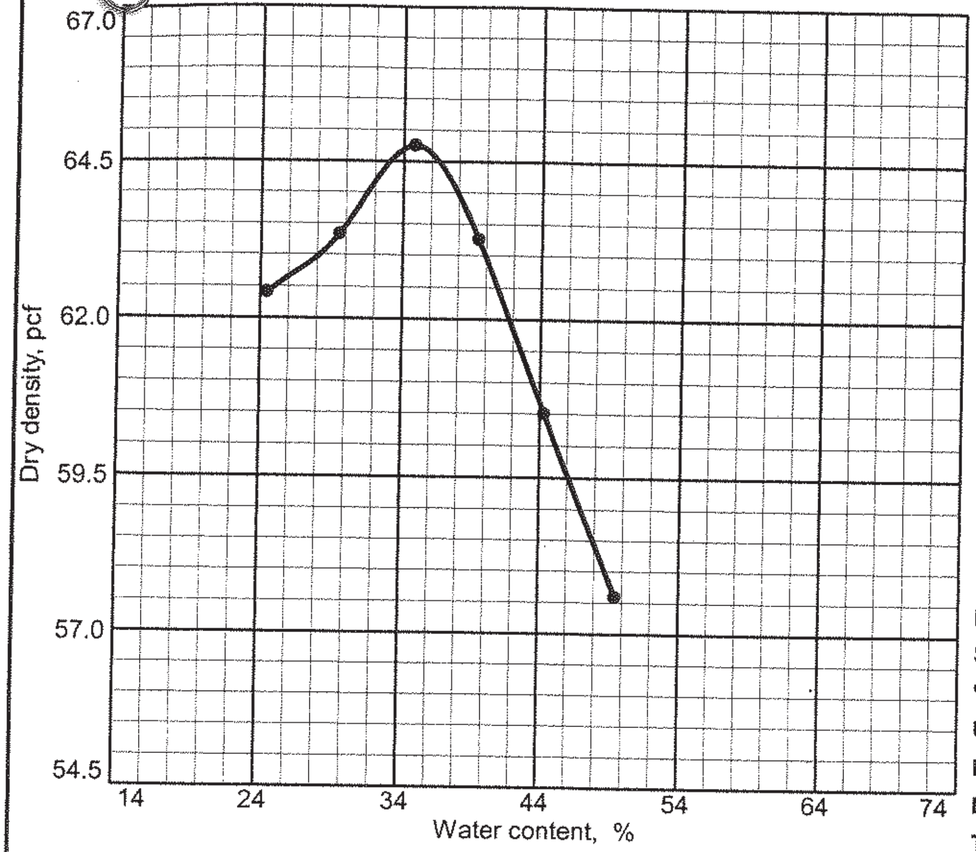
Remarks:
Standard Curve Part #2

Checked by:
Title:

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure

MOISTURE-DENSITY TEST REPORT



Curve No.
3

Test Specification:
ASTM D 698-00a Method A Standard

Preparation Method
Hammer Wt. 5.5 lb.
Hammer Drop 12 in.
Number of Layers three
Blows per Layer 25
Mold Size .03333 cu.ft.
Test Performed on Material Passing No.4 **Sieve**

NM **LL** **PI**
Sp.G. (ASTM D 854)
%>No.4 **%<No.200**
USCS **AASHTO**
Date Sampled 4/30/10
Date Tested 4/30/10
Tested By JRD

TESTING DATA

	1	2	3	4	5	6
WM + WS	7.17	7.32	7.49	7.52	7.49	7.45
WM	4.58	4.58	4.58	4.58	4.58	4.58
WW + T #1	263.72	279.35	313.59	274.51	294.27	308.01
WD + T #1	219.46	224.21	242.36	208.32	214.80	218.16
TARE #1	38.58	36.68	37.49	40.82	35.34	36.07
WW + T #2	251.38	264.26	284.78	345.95	316.98	298.33
WD + T #2	210.13	213.09	220.53	259.82	232.13	212.69
TARE #2	42.08	40.85	36.34	40.94	40.70	40.24
MOISTURE	24.5	29.6	34.8	39.4	44.3	49.5
DRY DENSITY	62.4	63.3	64.8	63.3	60.5	57.6

TEST RESULTS

Maximum dry density = 64.8 pcf

Optimum moisture = 34.8 %

Material Description

Fly Ash with ammonia, dark grey to black, Standard Curve #3. Mixed and wetted 4/30, compacted 4/30 by JRD

Remarks:

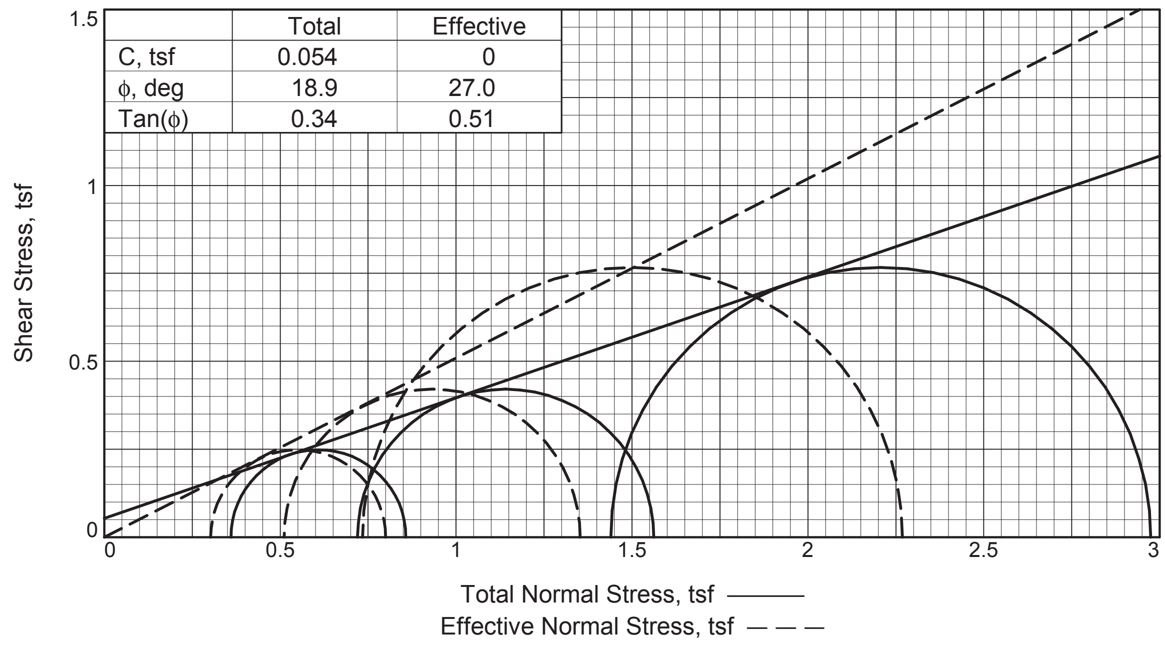
Project No. 2008012455 **Client:** Ameren UE
Project: Ameren - Labadie Plant UWL

● **Source:** Sioux Dry Fly Ash **Sample No.:** Sioux Fly Ash Blend3

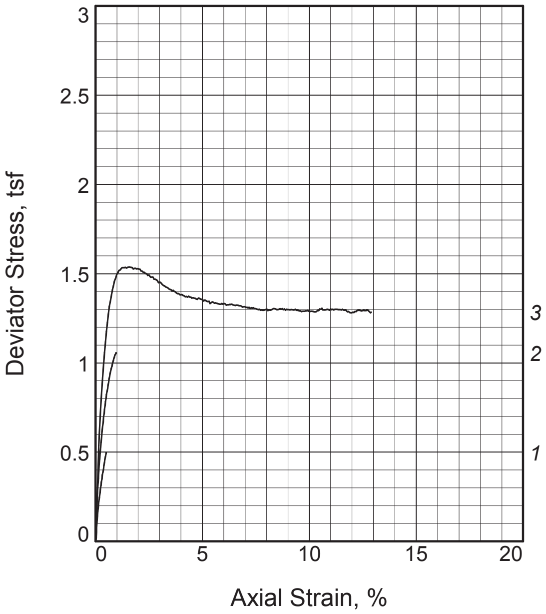
REITZ & JENS, INC.
CONSULTING ENGINEERS

Checked by:
Title:

Figure



	Total	Effective
C, tsf	0.054	0
ϕ, deg	18.9	27.0
Tan(ϕ)	0.34	0.51



	Sample No.	1	2	3
Initial	Water Content, %	55.9	55.9	55.9
	Dry Density, pcf	57.5	57.5	57.5
	Saturation, %	79.7	79.7	79.7
	Void Ratio	1.8227	1.8227	1.8227
	Diameter, in.	2.87	2.87	2.87
	Height, in.	6.00	6.00	6.00
At Test	Water Content, %	69.6	69.5	69.1
	Dry Density, pcf	57.8	57.8	58.0
	Saturation, %	100.0	100.0	100.0
	Void Ratio	1.8100	1.8058	1.7973
	Diameter, in.	2.86	2.87	2.88
	Height, in.	5.99	5.96	5.90
	Strain rate, %/min.	0.10	0.10	0.10
	Back Pressure, tsf	3.24	3.31	3.60
	Cell Pressure, tsf	3.60	4.03	5.04
	Fail. Stress, tsf	0.50	0.84	1.53
	Total Pore Pr., tsf	3.30	3.52	4.31
	Ult. Stress, tsf			
	Total Pore Pr., tsf			
	$\overline{\sigma}_1$ Failure, tsf	0.80	1.35	2.27
	$\overline{\sigma}_3$ Failure, tsf	0.30	0.51	0.73

Type of Test:
CU with Pore Pressures

Sample Type: Laboratory Compacted

Description: Sioux Ash, dark grey to black, silt to fine sand sized grains

Assumed Specific Gravity= 2.6

Remarks:

Figure 1

Client: Ameren Missouri

Project: Sioux UWL-Cell 4 Construction CQA

Source of Sample: Offsite Borrow

Sample Number: Ballast Fill Grab

Proj. No.: 2013012477 **Date Sampled:** 2/4/14

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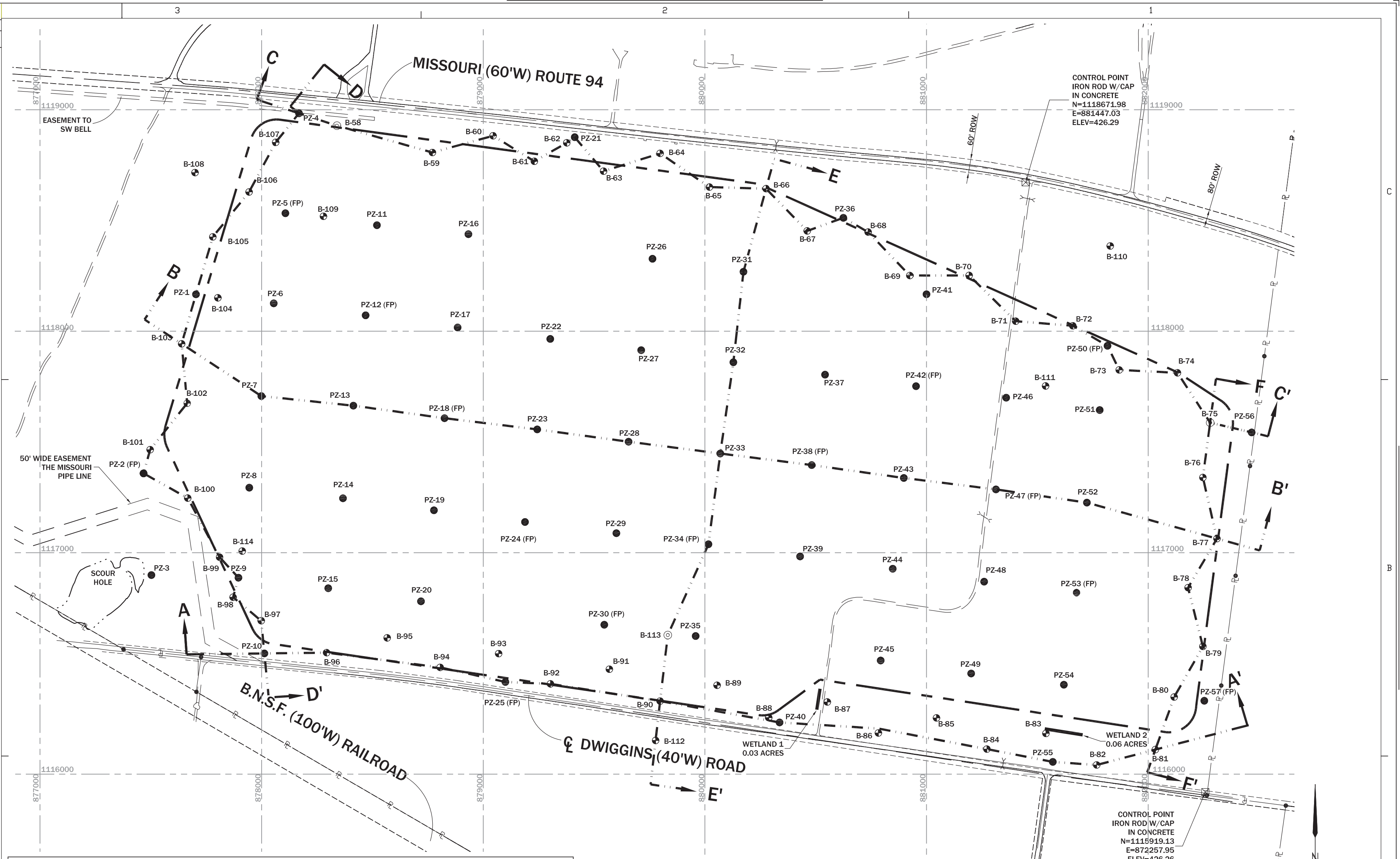
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Bertel

PRINT DIST.

REVISIONS	
REV.	W.O.



N

SCALE: 1" = 200'

0 100 200 400

LEGEND

PZ ●	PIEZOMETER BORING (57)
B ◕	TEMPORARY BORING (54)
B ◎	TEMPORARY BORING (DEEP) (3)
(FP) ●	FIELD PERMEABILITY TEST
☒	CONTROL POINT
•	℘ SURVEY POINT
✕	METAL TRANSMISSION TOWER
-○-	EXISTING POWER POLE
⟩—⟨	CULVERT
═══	PAVED ROAD
═ ═ ═ ═	ACCESS ROAD
——— ℘ ———	PROPERTY LINE (APPROX.)
——— — ———	CENTERLINE OF EXISTING ROAD
▬ ▬ ▬ ▬	PROPOSED UTILITY WASTE DISPOSAL AREA FOOTPRINT
——— G ———	EXISTING MISSOURI PIPELINE
—UT——UT—	EXISTING UNDERGROUND UTILITIES
——— FO ———	EXISTING FIBER OPTIC
—OE——OE—	EXISTING OVERHEAD ELECTRIC
▬ · · ▬ · · ▬	SECTION LINE

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PREPARED FOR AmerenUE

FIGURE 6
DETAILED SITE INVESTIGATION
PROPOSED UTILITY WASTE DISPOSAL AREA
GEOLOGIC CROSS SECTION SITE PLAN & BORING LOCATION MAP

DRAWN 080806 W.J.A. (G.E.R.)			
CHKD. A.R.C. (G.E.R.)			
SUPV. D.E.K. (G.E.R.)			
APPD. D.E.K. (G.E.R.)	LOCATION 001009	SIOUX PLANT	CLASS 02010
AmerenUE ST. LOUIS, MISSOURI	8430-Y-0168601-7		REV.

G:\CADDFiles\AMEREN-UE\SIOUX-PLANT\AM-SIOUX-DSI-SP.dwg, FIG6-BORE-LOCA, 8/7/2006 11:55:24 AM

Appendix 7

Logs for Geotechnical Borings

AMEREN UE SIOUX POWER PLANT
PROPOSED UTILITY WASTE DISPOSAL AREA
ST. CHARLES, MISSOURI

SUMMARY OF GEOTECHNICAL INVESTIGATION

1.0 INTRODUCTION

1.1 This geotechnical investigation was a component of the Detailed Site Investigation (DSI) for the proposed Utility Waste Disposal Area (UWDA) at the AmerenUE Sioux Power Plant in St. Charles County, Missouri. The purpose of this geotechnical investigation was to utilize approximately one-half of the borings required for the DSI to provide data of subsurface conditions for the subsequent geotechnical analyses and design of the UWDA.

1.2 This report describes the field investigation and laboratory testing program conducted for this geotechnical investigation, and presents the boring logs and laboratory test data in several appendices.

1.3 The geotechnical investigation was conducted in general accordance with the approved DSI Work Plan, dated June 2005, with the exceptions noted herein.

1.4 Reitz & Jens' Senior Project Manager was Jeffrey Fouse, P.E. The supervising geologist was Daniel Binz, R.G., who also supervised a portion of the piezometer borings. Jason Pruett, a Reitz & Jens' Soil Technician, directed the work in the field, and logged the borings and samples.

2.0 FIELD INVESTIGATION

2.1 Plan of Boring Locations

2.1.1 The field investigation consisted of 57 borings, B-58 through B-114. Fifty of these borings, B-58 through B-107, were located along the possible alignment of the levee that is to surround the UWDA. The borings were alternately staggered approximately 50 feet on either side of the possible centerline of the levee to provide a broader coverage, since the final centerline alignment of the levee may change through design. The 50 borings along the possible centerline of the levee (i.e. the "alignment borings") were spaced approximately 250 feet apart.

2.1.2 Seven other borings were made on the inside and outside of the proposed levee, to provide cross-sections of the subsurface conditions for stability analyses and settlement calculations. These cross-section borings are:

1) B-108 and B-109, northwest levee cross-section
2) B-110 and B-111, northeast levee cross-section
3) B-112 and B-113, south levee cross-section
4) B-114, southwest levee cross-section (utilizing piezometer boring PZ-3).

2.1.3 Reitz & Jens located and staked the borings by taping from benchmarks and the piezometer borings that had been made prior to the start of the geotechnical investigation. Boring B-110 was moved north-northeast from its planned location, to avoid the overhead high-voltage power lines. Boring B-99 was moved 25 feet northeast because old marks for a gas transmission line were only 5 feet from its planned location. The actual boring locations and ground surface elevations were surveyed by Kuhlmann Design Group (K*d*G) after the borings were completed.

2.2 Criterion for Completion Depths

2.2.1 All but three of the borings were made to a minimum depth of 30 feet, which is a minimum of 25 feet below the proposed depth of the UWDA, which is 5 feet. Three borings (B-58, B-75 and B-113) were

extended to auger refusal, primarily to obtain N-values from the Standard Penetration Test (SPT) for seismic site classification and liquefaction analyses. The shallow borings were extended beyond the minimum depth of 30 feet to a depth where the following two criteria were met: 1) the uncorrected N-value from the Standard Penetration Test (SPT) was a minimum of 12 blows/foot, and 2) the last 15 feet of soil was classified as sand or gravel (Unified Soil Classifications of SW, SP, SM, GW, GP, GP-SP). The actual depths of the shallow borings were all 31 to 31.5 feet; that is, the two criteria were met at the planned minimum depth.

2.2.2 The three deep borings were extended to drilling or sampler refusal on bedrock or boulders. Drilling refusal was defined as a penetration rate with a drill bit of less than 0.2-inches per minute for 5 minutes and with a downward pressure of at least 500 psi. Sampler refusal was defined as less than 6 inches of penetration after 50 blows with a SPT hammer. The final depths of the deep borings were: 114.15 feet in B-58, 115.5 feet in B-75, and 114.85 feet in B-113.

2.3 Drilling Procedures

2.3.1 The borings were made by Roberts Environmental Drilling, Inc. (REDI), Millstadt, Illinois, using a CME 750 drilling rig mounted on an all-terrain vehicle (ATV).

2.3.2 Borings were advanced from the ground surface to the depth of the ground water table using 4.25- inch I.D. hollow-stem augers. The actual depth of augering ranged from 8.5 feet to 13.5 feet, and averaged about 9.5 feet. The depth of the water inside the hollow-stem augers was maintained at the same depth as the surrounding ground water. Hollow-stem augers were advanced with the center plug attached to the drill rods, to prevent soil from entering the augers. After the underlying sand strata were reached below the prevailing ground water table, the borings were advanced using rotary drilling techniques with a slurry of Bentonite and soil cuttings to stabilize the hole. The slurry was recirculated, and the loss of drilling fluid was noted in the boring log. A tri-cone bit was used that had a center discharge of the drill fluid that was partially obstructed such that the soil below the bit was not disturbed.

2.3.3 Soil cuttings and material sloughed from the side of the boring were removed prior to sampling. Reitz & Jens' Soils Technician noted the length of drilling rod in the hole before it was extracted and after the sampler was set on the bottom of the boring. If the change in depth was more than 3 inches, then the sampler was removed and the hole was cleaned out.

2.4 Sampling Procedures

2.4.1 <u>From the ground surface to a depth of 10 feet</u>: The thickness of the ploughed zone with organics and root balls, etc., was noted on the boring log based upon initial auger cuttings or a shallow test pit adjacent to the boring. Samples of the subsurface soils were taken at intervals of about 2.5 feet. Samples were taken using either: 1) a hydraulically pushed, 3-in. O.D., thin-wall "Shelby tube" sampler (ASTM D1587); or 2) a 2-in. O.D., split-spoon sampler driven by manual hammer in conjunction with a Standard Penetration Test (ASTM D1586). At least one Shelby tube sample of fine-grain soils was taken in the first 10 feet of each boring. The depth of the Shelby tube sample was varied. If the uncorrected N-value from a SPT was less than 5 blows/foot and the sample was fine-grain soil, then the following sample was taken with a Shelby tube.

2.4.2 <u>From a depth of 10 feet to a depth of 50 feet</u>: Samples were taken at intervals of about 5.0 feet. Samples were obtained using a 2-in. O.D., split-spoon sampler in conjunction with a SPT. If soft, fine-grain soils were found below a depth of 10 feet, then a second Shelby tube was to be taken. This only happened in Boring B-58, in which a high plastic clay was found to a depth of 16 feet.

2.4.3 <u>From a depth of 50 feet to refusal</u>: Samples were taken at intervals of about 10.0 feet using a 2-in. O.D., split-spoon sampler in conjunction with a SPT.

2.4.4 A representative soil sample was taken from each split-spoon. If there were a change in soil type, two samples were taken. Each sample was placed in a glass jar and immediately sealed to prevent loss of moisture. Each jar was labeled with the boring number, sample number, sample depth, and the blow count for each 6-in. increment. The samples were protected against extreme temperature changes.

2.4.5 The bottom end of each Shelby tube sample was trimmed and then sealed with a tight-fitting plastic cap and duct tape. Excess fluid and loose material were removed from the upper end of the tube and the length of the sample was measured. The top end of the tube was then sealed with a tight-fitting plastic cap and duct tape. The boring number, sample number, sample depth, and recovered length were written on the outside of the tube with a permanent marker. Tube samples were maintained in a vertical position with the bottom end down at all times. Samples were protected from extreme changes in temperature or disturbance.

2.4.6 Samples were preserved and transported in general accordance with ASTM D4220 "Standard Practice for Preserving and Transporting Soil Samples." Relatively undisturbed Shelby tube samples were transported vertically in a rack to prevent disturbance. Samples were taken to Reitz & Jens' laboratory daily.
Reitz & Jens was responsible for transporting of all geotechnical samples and for maintaining records.

2.5 Field Boring Logs

2.5.1 A log of each boring was recorded by Reitz & Jens' Soils Technician in general accordance with ASTM D5434 "Field Logging of Subsurface Explorations of Soil and Rock." The field log included the following information at a minimum:

1. An accurate description of any deviation from the planned boring location.
2. Drilling method(s) used, including diameter of augers.
3. Depths of generalized soil and rock boundaries encountered, based upon drilling characteristics, samples, cuttings, color of drilling fluid, etc.
4. Depths of samples, including: type, length sampled, length recovered, hammer blows for each 6-in. interval for Standard Penetration Tests (SPT's).
5. Loss of drilling fluid, if applicable.
6. Water level readings (to 0.1 foot) when free water is first encountered, at the conclusion of drilling, and 24 hours or more after drilling.
7. Identification of the soil.
8. Pocket penetrometer readings on firm to stiff cohesive soil samples, or torvane reading on soft soil samples (Shelby-tube samples only).
9. Note the length and cause of significant delays in field operations.
10. Record the depth of material sloughed into the hole or the depth to collapse of the hole, if any.
11. Note how the boring was backfilled.

2.5.2 Soils were classified in general accordance with ASTM D2487 "Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)" and ASTM D2488 "Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Soil classifications were subsequently checked in the laboratory, and modified if necessary based on the lab classification and tests.

2.6 Backfilling of Geotechnical Borings

Borings were backfilled after the 24-hour groundwater level readings were made. Backfilling of borings was done in accordance with 10 CSR 23-6. The three deep borings were grouted with Bentonite slurry the full depth. The shallow borings were backfilled with cuttings or sand up to the bottom of the surface fine-grain stratum, if present; in which the boring was backfilled through the fine-grain stratum with Bentonite pellets up to within 2 feet of the surface, and capped with soil cuttings.

3.0 LABORATORY TESTING PROGRAM

3.1 Laboratory Procedures

3.1.1 All laboratory testing was done in general accordance with the latest applicable ASTM procedures.
The procedures contained in Reitz & Jens' Quality Manual were followed. The general procedures were:

1. All samples were logged in on Reitz & Jens' standard form for the request of laboratory soils tests, which included the boring number, sample number, sample depth interval, and sample type.

2. Jar samples from the split-spoons were classified in the lab by a different technician, geotechnical engineer or geologist than the one who performed the field classifications. A moisture content test (ASTM D2216) was performed on all fine-grained soil samples.
3. All coarse-grained samples were washed through a U.S. #200 sieve to determine the percentage of fines (ASTM D422), and the portion retained on the #200 sieve was dried, weighed, and resealed in a glass jar.

3.1.2 A copy of the field boring log and the laboratory test request form was given to the Senior Project Manager daily. The Senior Project Manager assigned laboratory tests based upon the field classifications and the anticipated geotechnical analyses required for the geotechnical design of the UWDA. The criteria for the selection of laboratory tests are described in Section 3.2.

3.1.3 Shelby tube samples were extruded immediately prior to performing the assigned tests. Each tube sample was "micro-logged." If the soil sample differed from the presumed soil classification on the field log, then the Senior Project Manager examined the soil sample and modified the test assignments accordingly. Portions of selected Shelby tube samples were saved for possible future testing. These samples were wrapped in aluminum foil, placed in plastic tubes, and the annular space was filled with paraffin wax.

3.1.4 Once all laboratory testing for given boring was complete, the laboratory classifications and test data was combined with the information in the field boring log and entered into Reitz & Jens' computer program GEOSYS. Draft logs were printed. The draft logs were reviewed by the Laboratory Manager, a licensed professional engineer, both for accuracy (i.e. correct blow counts, sample types, sample depths, recovery percentages and laboratory test results) and consistency of the information provided. The sample description on the field log, the sample description from the laboratory, and the laboratory test results were verified to be consistent in representing each sample. In certain instances, a judgment call was made to reconcile these three aspects of each sample. Unless there was strong evidence to the contrary, the stratification lines identified in the field boring log are shown on the final boring log.

3.1.5 The final boring logs were subsequently reviewed and edited, as needed, by the Senior Project Manager. The final boring logs are attached.

3.2 Criteria for Assigning Lab Tests and Results

3.2.1 The general purpose of the testing program was to obtain soil properties for the determination of: bearing capacity, short-term and long-term slope stability, seepage characteristics of the top stratum fine-grain soils and the underlying sand strata, liquefaction potential, settlement characteristics, and soil classifications for the potential use of soils for fill materials. The guidelines for assigning lab tests were:

3.2.2 Grain-size analyses (ASTM D422) were performed on selected cohesionless samples (Unified Soil Classifications of SW, SP, SM, GW, GP, GP-SP). If the percentage of fines (passing #200 U.S. sieve) was greater than 25%, then a hydrometer analysis would be performed on the fine-grain portion of the sample. A total of 186 grain-size analyses were performed. No hydrometer analyses were run. The results of the grain-size analyses were previously submitted to GREDELL Engineering.

3.2.3 Unconsolidated-undrained (U-U) triaxial shear strength tests (ASTM D2850) were performed on selected Shelby tube samples from each major cohesive soil stratum, and from borings selected from each side of the proposed levee and at each of the four cross-sections identified in the boring plan. The U-U tests were performed at the estimated confining pressure of the sample in the field conditions, to measure the *in situ* shear strength of the soil. Twenty-six U-U tests were performed. These results were previously submitted to GREDELL Engineering.

3.2.4 Series of consolidated-undrained (C-U) triaxial shear strength tests (ASTM D3080) were performed on each major cohesive soil stratum and at intervals around the proposed levee. The tests were performed with the measurement of internal pore water pressures so that the effective strength properties of the soil could be determined. Each series will have a minimum of two points, but three points if possible. Ten series of C-U tests were performed. These results were previously submitted to GREDELL Engineering.

3.2.5 Four one-dimensional consolidation tests (ASTM D2435) were performed on selected relatively undisturbed Shelby tube samples from each major cohesive soil stratum beneath the UWDA. The results of the consolidation tests were previously submitted to GREDELL Engineering.

3.2.6 Six flexible-wall hydraulic conductivity tests (ASTM D5084) were performed on selected relatively undisturbed Shelby tube samples of the upper clays. The data from these tests were previously submitted to GREDELL Engineering. The results are summarized in the following table:

Boring No.	Sample	Depth, feet	Soil Description	k, cm/sec
B-58	ST-2	4 – 6	High Plastic Clay (CH)	5.3×10^{-8}
B-70	ST-4	9 – 11	High Plastic Clay (CH)	2.6×10^{-6}
B-85	ST-2	4 – 6	High Plastic Clay (CH)	6.6×10^{-5}
B-86	ST-1	1.5 – 3.5	High Plastic Clay (CH)	5.1×10^{-9}
B-100	ST-1	1 – 3	Slightly Silty Clay (CL)	7.5×10^{-8}
B-104	ST-1	1.5 – 3.5	High Plastic Clay (CH)	4.9×10^{-8}

KEY TO BORING LOGS

KEY TO SOIL SYMBOLS

Symbol	Description
▨	Low plastic Silty CLAY (CL)
▥	Inorganic, non-plastic SILT (ML)
▨	High plastic CLAY (CH)
▨	Low plastic Silty CLAY/ Clayey SILT (CL-ML)
▥	Silty SAND or Sandy SILT (SM)
░	Poorly-graded SAND with traces of fines
░	Poorly-graded SAND (SP)
░	EXTRA: semi-random dot pattern
▤	Very Weathered LIMESTONE
▥	Low plastic Clayey SILT (ML)
▨	Low plastic CLAY (CL)
▒	Well-graded SAND with fines
▒	Well-graded SAND with no fines (SW)
▥	Clayey Sandy SILT (ML)

MISCELLANEOUS SYMBOLS

Symbol	Description
▽	Water table during drilling
▼	Delayed Reading of Water table
⌁	Boring continues
●	Moisture content (%)
▲	N-value from Standard Penetration Test, ASTM D-1586 (blows/ft)
■	Shear strength from Pocket Penetrometer (tsf)
△	Shear strength (Qu/2) from Unconfined Compression Test, ASTM D-2166 (tsf)

SOIL SAMPLERS

Symbol	Description
◪	2-in. O.D. Split-Spoon
◫	3-in. O.D. Shelby Tube

Symbol	Description
☒	Bulk sample taken from 6 in. auger

2005012477

AMEREN UE SIOUX POWER PLANT
UTILITY WASTE LANDFILL

BORING LOGS AND
RESULTS OF LABORATORY TESTS

Prepared for

Ameren

Prepared by

Reitz & Jens, Inc.
Consulting Engineers

February 22, 2006

REITZ & JENS, INC.
CONSULTING ENGINEERS

1055 corporate square drive
st. louis, missouri 63132
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www.reitzjens.com

February 22, 2006

Mr. Thomas R. Gredell, P.E.
GREDELL Engineering Resources, Inc.
1505 East High Street
Jefferson City, Missouri 65101

RE: Ameren Sioux Plant Utility Waste Landfill
Boring Logs and Results of Laboratory Tests

Dear Tom:

With this letter, we are submitting to you, and to Carl Rezsonya, the logs for the geotechnical borings for the Sioux Plant utility waste landfill – Borings B-58 through B-114. We are also submitting the results of the laboratory testing that we have performed to date: grain-size analyses, triaxial shear strength tests, and consolidation tests. We have held a number of undisturbed samples of the upper clays and silts for possible testing later. These samples have been extruded and sealed in wax.

We performed six flexible-wall hydraulic conductivity tests on selected samples. The results are:

Boring No.	Sample	Depth, feet	Soil Description	k, cm/sec
B-58	ST-2	4 – 6	High Plastic Clay (CH)	5.3 x 10^{-8}
B-70	ST-4	9 – 11	High Plastic Clay (CH)	2.6 x 10^{-6}
B-85	ST-2	4 – 6	High Plastic Clay (CH)	6.6 x 10^{-5}
B-86	ST-1	1.5 – 3.5	High Plastic Clay (CH)	5.1 x 10^{-9}
B-100	ST-1	1 – 3	Slightly Silty Clay (CL)	7.5 x 10^{-8}
B-104	ST-1	1.5 – 3.5	High Plastic Clay (CH)	4.9 x 10^{-8}

We are working on the soil profiles requested by Mike Carlson in AutoCAD, and plan to provide these AutoCAD files for Mike's review and comment within the next week.

Sincerely,
REITZ & JENS, Inc.

Jeffrey L Fouse

Jeffrey L. Fouse, P.E.
Senior Project Manager

cc; Carl Rezsonya, Ameren

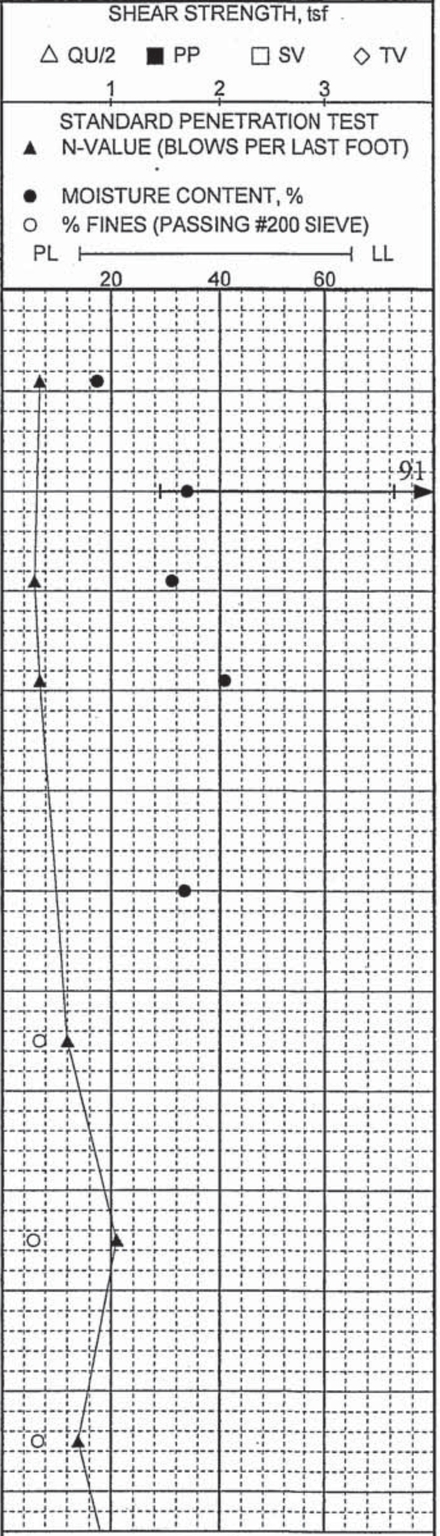
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-58

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118928 E 878340
ELEVATION: 426.8 DATUM: MSL
DATE DRILLED: 11/2/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						CLAY (CL), brown, low plastic, firm, dry, silty, with roots		
	425				39	SILT (ML), light brown, loose, dry, slightly clayey, with trace very fine sand	1-3-4	17.4
5					100	CLAY (CH), gray, high plastic, stiff, moist	85.2	34.0
	420	▼			61	Clayey SILT/Silty CLAY (CL-ML), light grayish brown, firm, with silt partings, lignite, moist	2-2-4	31.2
10					78	CLAY (CH), brown & gray, high plastic, firm, moist, very slightly silty, trace lignite	1-3-4	40.9
	415							
15		▽			21		68.3	33.5
	410					SILT (ML), brownish gray, very loose, sandy, with sand seams and lignite, wet Note: switched to mud rotary at 16.0 feet.		
					61	SAND (SP-SM), tan, fine-grain medium - dense, slightly silty, with black carbon	7-5-7	
20								
	405							
					67	Becoming grayish tan, trace carbon	6-7-14	
25								
	400							
					56		4-4-11	
30								



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

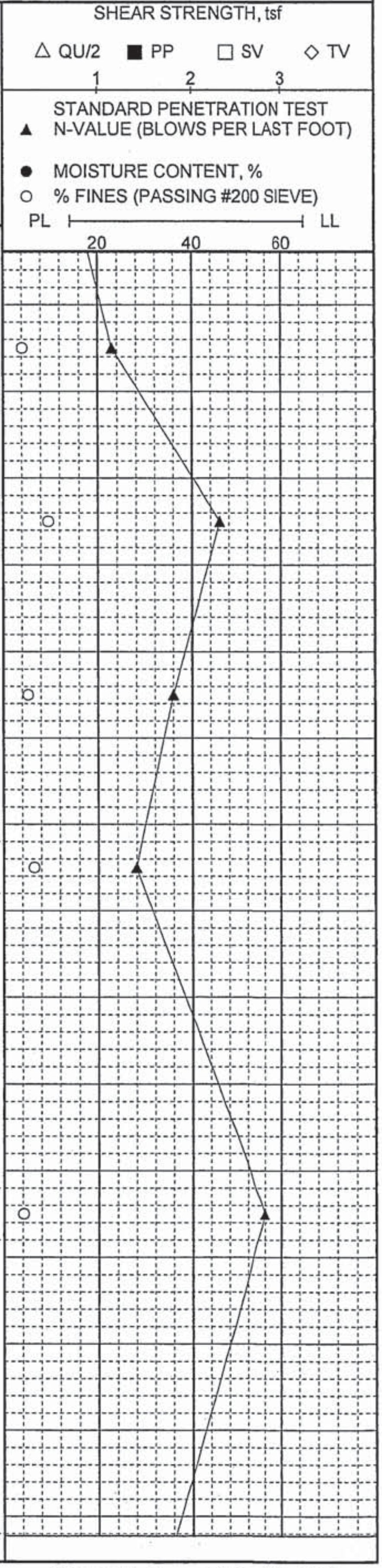
WATER LEVELS: DURING DRILLING 14.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.0 FEET AFTER 168 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2005012477

BORING LOG B-58

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	395							
					72	SAND (SP), gray, fine- to medium-grain, medium-dense	10-12-11	
35								
	390							
					72	SAND (SP-SM), grey, fine- to medium-grain, dense, slightly silty	15-22-24	
40								
	385							
					78	With lignite	13-16-20	
45								
	380							
					61	SAND (SP-SM), medium- to fine-grain, medium-dense, slighty silty, with fine gravel, high plastic clay seam	12-14-14	
50								
	375							
55								
	370							
					67	Becoming very dense	12-20-36	
60								
	365							
65								
	360							

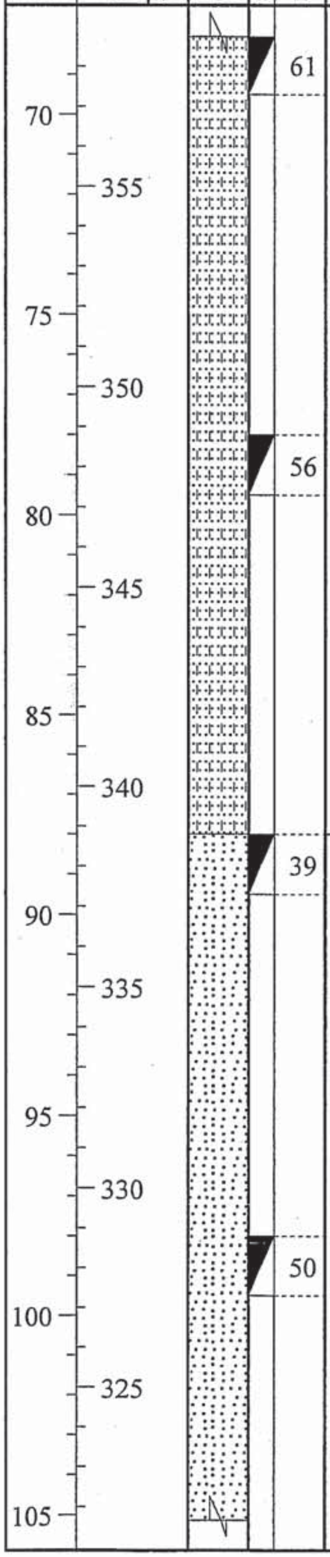


File: 2005012477

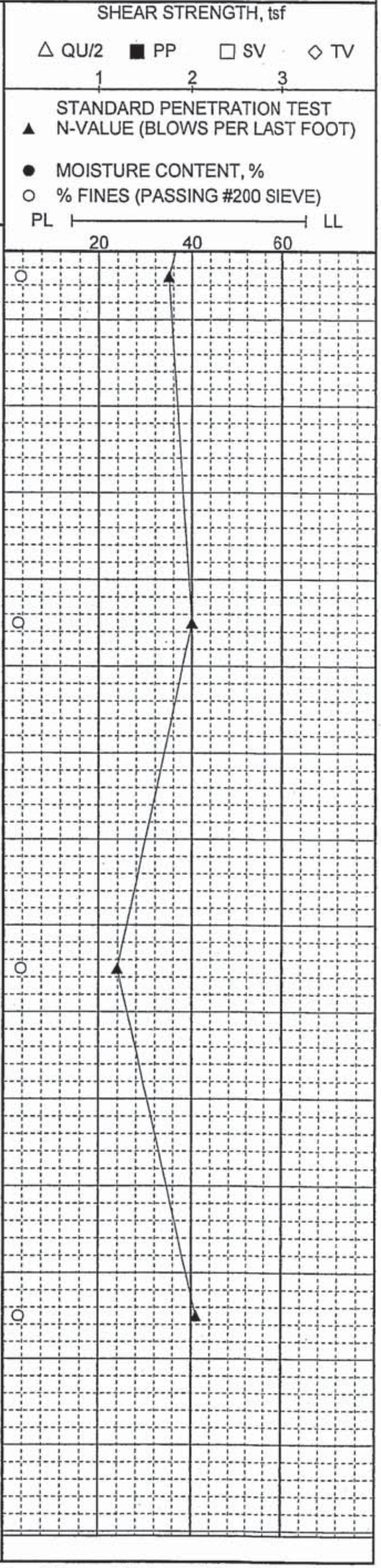
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-58

Sioux Power Plant UWLF



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
61	Becoming dense	12-17-18	
56	With 1" coal or petrified wood	11-17-23	
	Gravelly drilling at 80.5'		
39	SAND (SP) gray, medium- to coarse-grain, medium-dense, with fine to coarse gravel	19-13-11	
50	Becoming dense	19-19-22	
	Very gravelly drilling at 103.5'		

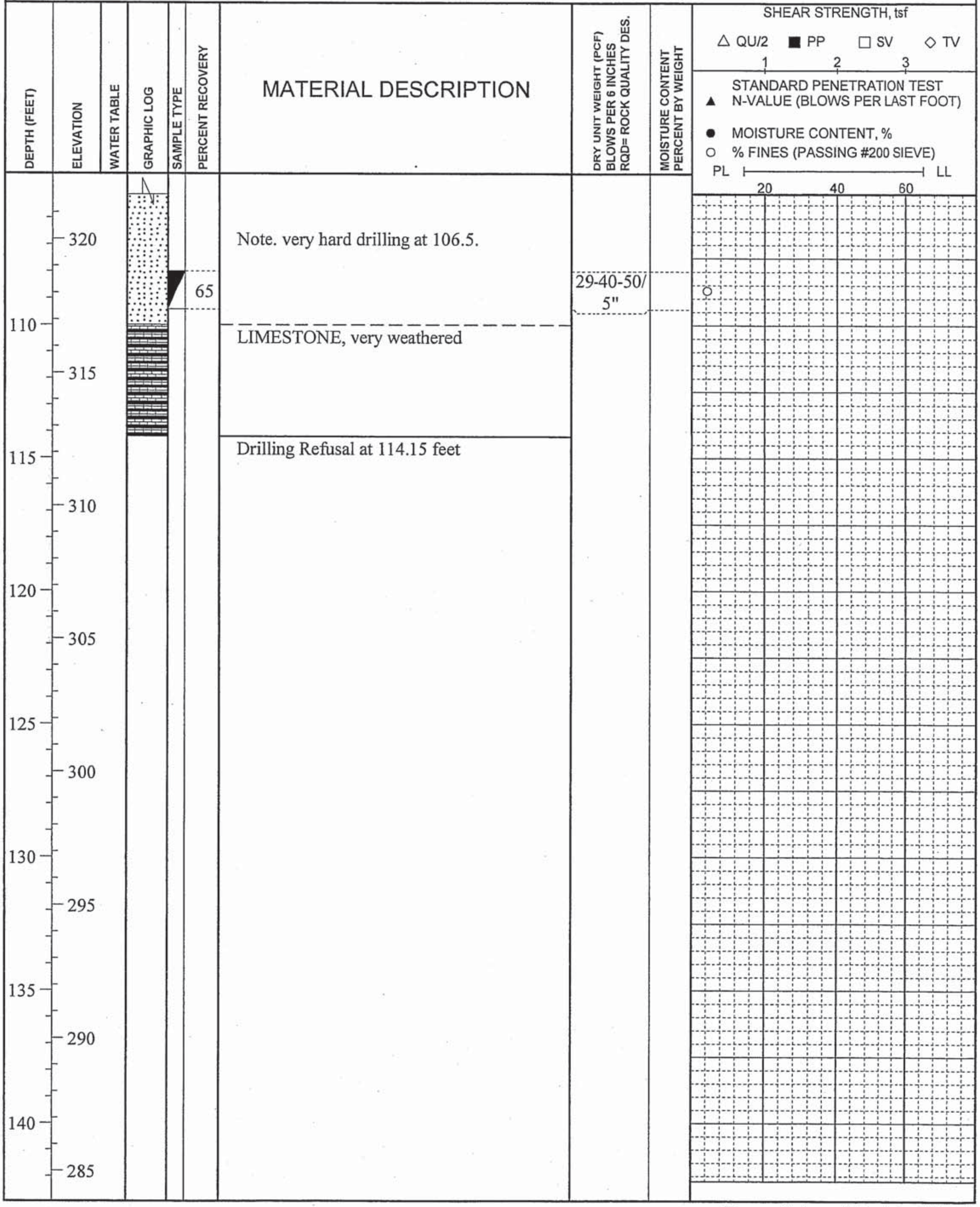


File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-58

Sioux Power Plant UWLF



DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	320					Note. very hard drilling at 106.5.		
					65		29-40-50/ 5"	
110						LIMESTONE, very weathered		
	315							
115						Drilling Refusal at 114.15 feet		
	310							
120								
	305							
125								
	300							
130								
	295							
135								
	290							
140								
	285							

Figure A-1 Sheet 4 of 4

REITZ & JENS, INC.
CONSULTING ENGINEERS

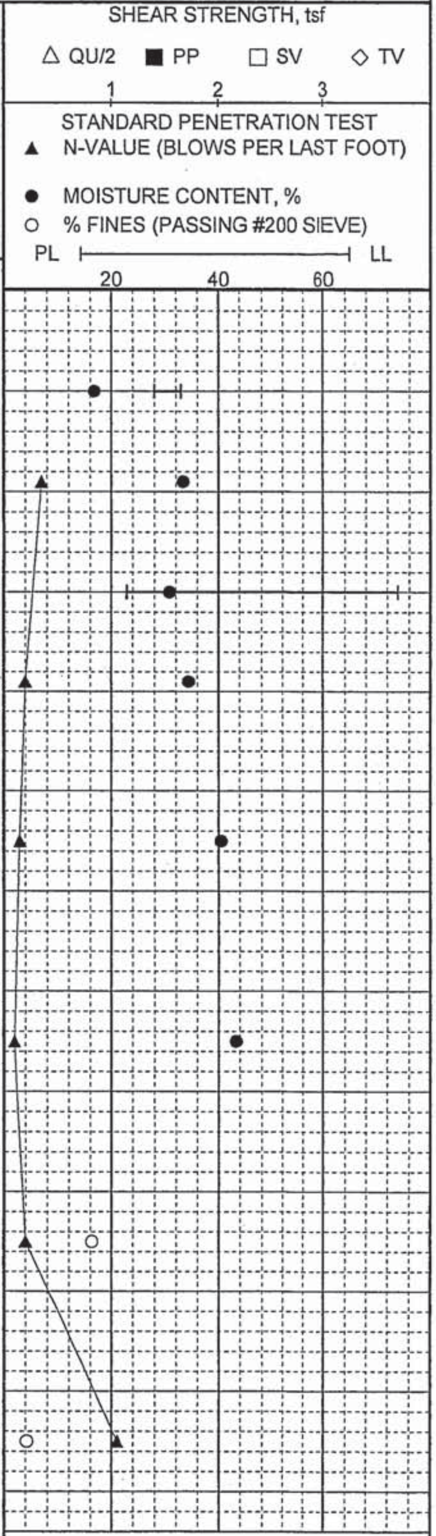
BORING LOG B-59

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118807 E 878770
ELEVATION: 427.1 DATUM: MSL
DATE DRILLED: 10/11/2005

DEPTH (FEET): 0, 5, 10, 15, 20, 25, 30
ELEVATION: 425, 420, 415, 410, 405, 400
WATER TABLE: ▽ ▼ (near elevation 420)

SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
		SILT (ML), brown, loose, dry, sandy		
		CLAY (CL), brown, low plastic, loose, silty, with tan silt seams		
▮	92	SILT (ML), brown, loose, dry, clayey traces of fine roots and fine-grain sand, with silty clay seams	82.2	16.8
◣	72		3-3-4	33.4
		CLAY (CL), brown, low plastic, firm, moist, with tan silt seams		
▮	100	CLAY (CH), dark brown and gray, high plastic, firm, moist, with lignite, limonite, silt and very fine silty sand seams	82.4	30.9
◣	89	Silty CLAY/Clayey SILT (CL-ML), brown and gray, mottled, soft, moist, with lignite Note: switched to mud rotary at 9.0 feet.	2-2-2	34.4
◣	67		1-1-2	40.5
◣	78	Becoming gray and very soft	0-1-1	43.3
◣	78	Silty SAND (SM), gray, fine-grain, very loose, slightly clayey	1-1-3	
◣	72	SAND (SP), tan and gray, fine- to coarse-grain, medium dense, with trace of fine gravel	5-9-12	



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7.0 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.0 FEET AFTER 168 HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT __ FEET

Figure A-2 Sheet 1 of 2

File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-59

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf △ QU/2 ■ PP ☐ SV ◇ TV 1 2 3 STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT) ● MOISTURE CONTENT, % ○ % FINES (PASSING #200 SIEVE) PL ⊢ ⊣ LL 20 40 60
						Boring terminated by engineer at 29.5 feet			
	395								
35									
	390								
40									
	385								
45									
	380								
50									
	375								
55									
	370								
60									
	365								
65									
	360								

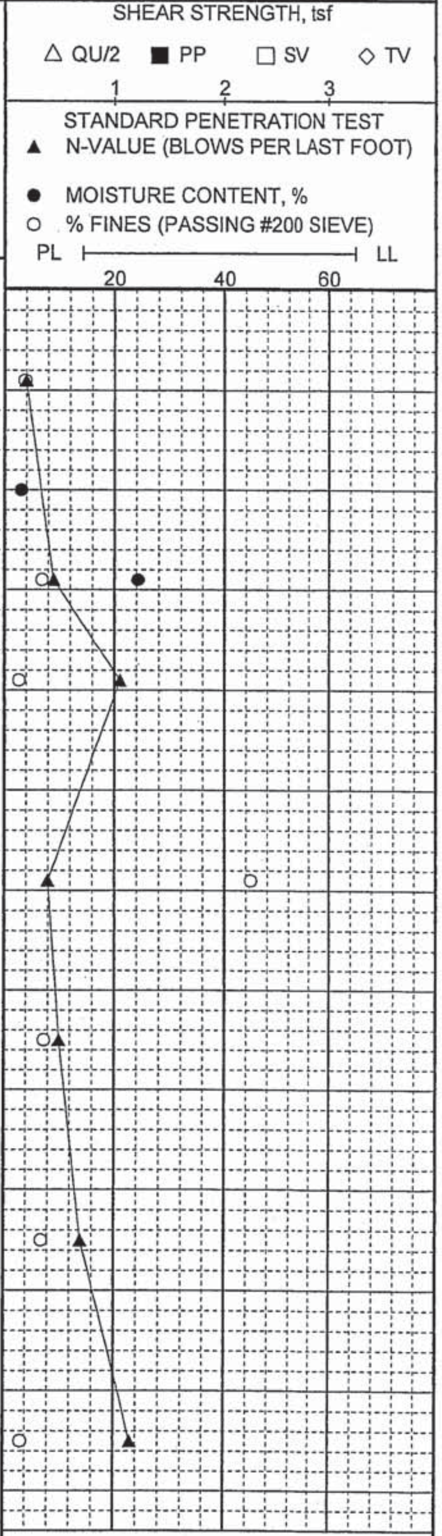
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-60

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118882 E 879044
ELEVATION: 427.9 DATUM: MSL
DATE DRILLED: 11/18/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0					SILT (ML), brown, loose, dry, sandy		
					CLAY (CL), brown, low plastic, soft, silty		
	425		◣	72	SAND (SP), light brown, fine-grain, very loose	2-2-2	
5			▯	75		91.8	3.12
	420		◣	83	SAND (SP-SM), light brown, fine grain, loose, slightly silty, with gray clayey silt/silty clay laminations, traces of limonite	5-5-4	24.3
10			◣	83	SAND (SP), tan, fine-grain, medium-dense	7-10-11	
		▼					
	415	▽					
15			◣	78	Note: switched to mud rotary at 14.0 feet. Silty SAND (SM), grayish brown, fine-grain, loose, with lignite & limonite	2-3-5	
	410		◣	33	SAND (SP-SM), grayish brown, fine-grain, medium dense, slightly silty	4-4-6	
20							
	405		◣	44	SAND (SW-SM), gray, well graded, medium-dense, slighlty silty, with trace of fine cherty gravel	3-5-9	
25							
	400		◣	56	SAND (SW), gray, well graded, medium dense, with fine gravel	7-12-11	
30					Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 14 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 11.36 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2005012477

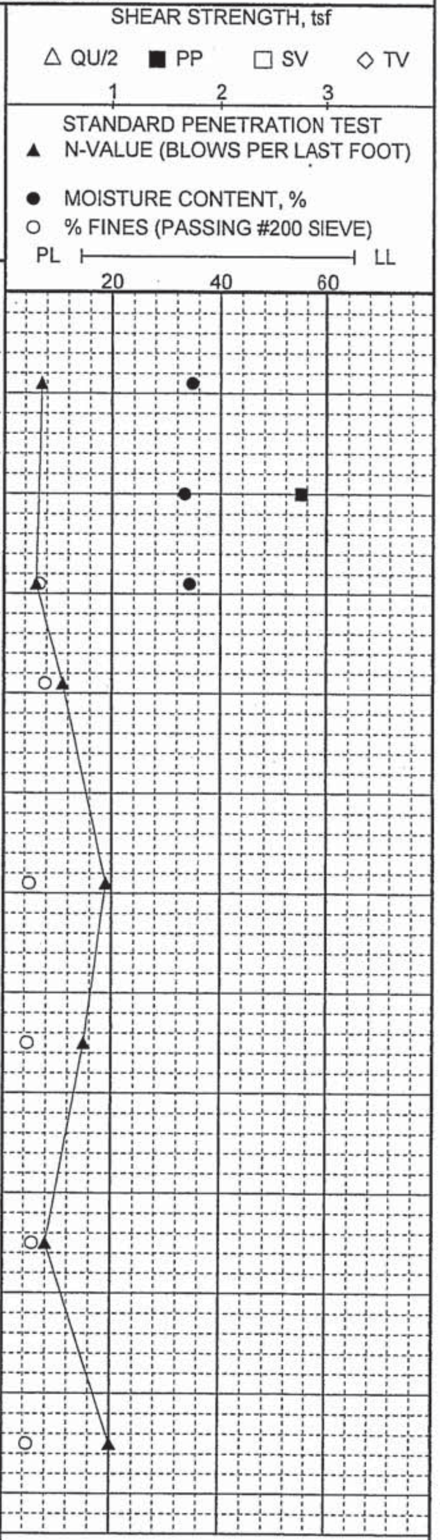
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-61

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118767 E 879230
ELEVATION: 426.3 DATUM: MSL
DATE DRILLED: 11/14/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	425					SILT (ML), brown, loose, dry, clayey, trace fine roots		
					61	CLAY (CH), brown, high plastic, firm, moist, slightly silty, with limonite	2-3-4	34.8
5					71	Becoming dark grayish brown, slick-n-sided Silty SAND (SM) gray, brown, and reddish brown, fine-grained	84.2	33.4
	420				78	SAND (SP-SM), brown, fine-grain, loose, slightly silty	3-3-3	34.3
10		▼			83	Becoming medium-dense Note: switched to mud rotary at 9.0 feet.	4-6-5	
	415	▽						
15					83	SAND (SP), brown, fine-grain, medium-dense	10-7-12	
	410				78	Becoming gray & brown, with some medium-grain sand & trace of fine gravel	7-7-8	
20	405							
					78	SAND (SP-SM), brown, fine-grain, loose	3-2-6	
25	400							
					83	SAND (SP), brown and gray, medium- to fine-grain, medium dense	8-11-9	
30						Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: D. Binz

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 12 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.6 FEET AFTER 96 HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

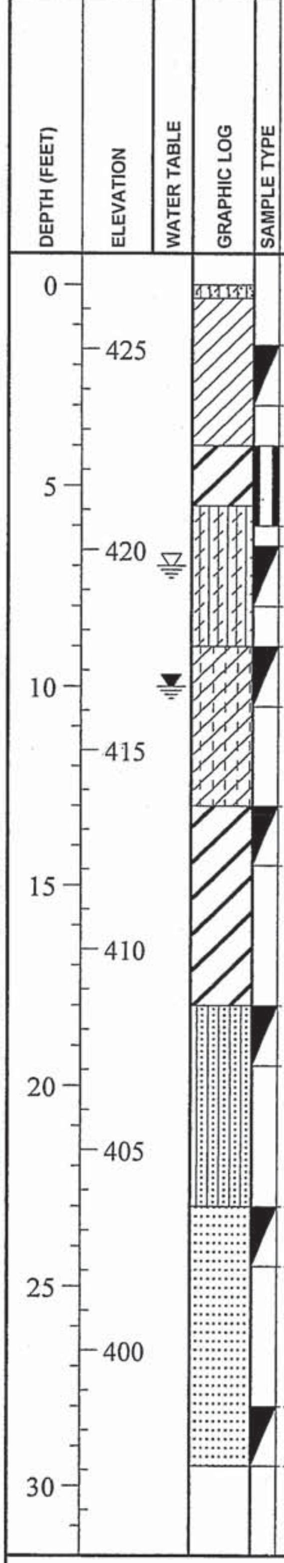
Figure A-4 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

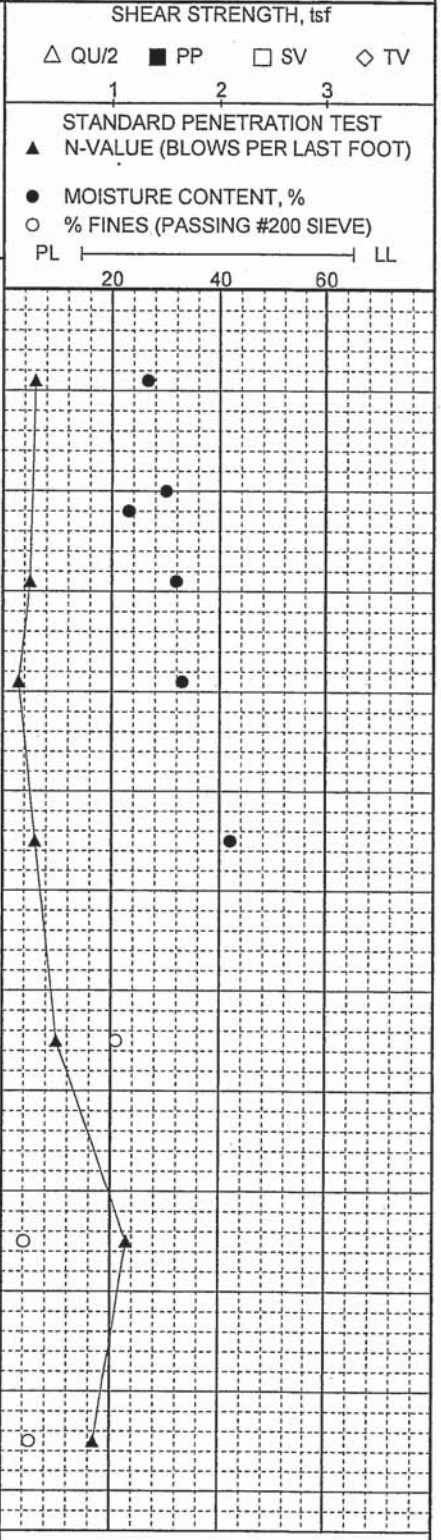
BORING LOG B-62

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118851 E 879377
ELEVATION: 426.6 DATUM: MSL
DATE DRILLED: 11/18/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, soft, dry, sandy, clayey		
61	CLAY (CL), brown, low plastic, firm, moist, slightly silty, with tannish gray silt seams	1-3-3	26.6
96	CLAY (CH), dark grayish brown, high plastic, stiff, moist, with silt lenses, and pockets of fine sandy silt	88.4 94.0	30.0 23.2
50	SILT (ML), light brown, moist, clayey, with fine-grain sand	1-2-3	31.9
61	Becoming less clayey, wet, loose, with trace of shell fragments Note: switched to mud rotary at 9.0 feet.	2-1-2	33.0
	CLAY (CL), grayish brown, low plastic, soft, moist, horzonal seams, silty, with fine sand and calcium		
100	CLAY (CH), gray, high plastic, firm, moist, with lignite & limonite	1-2-4	42.0
72	Silty SAND (SM) tan, fine- to medium-grained, medium dense, with limonite, trace clay	1-3-7	
44	SAND (SP), tan, medium- to fine-grain, medium dense, trace coase-grain, with trace of fine chert gravel	9-13-10	
61	Becoming gray & tan, with more coarse sand and clay seam	6-8-9	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 10.0 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

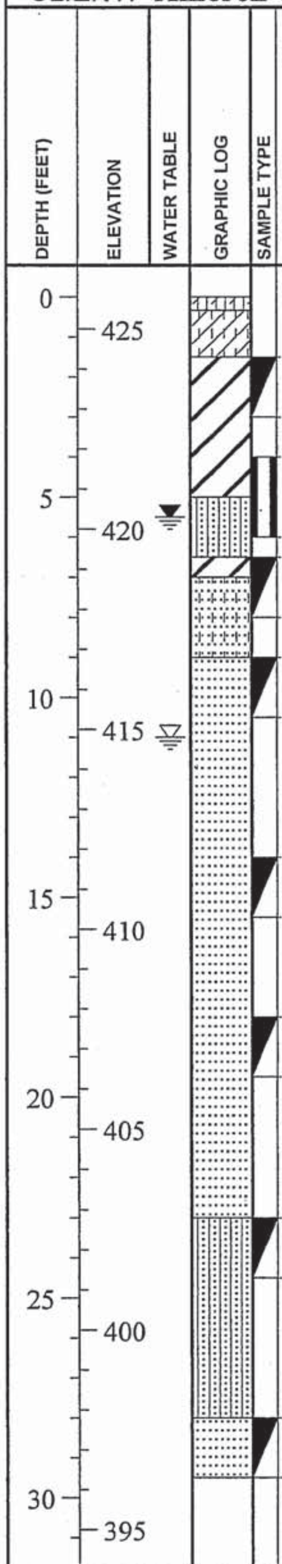
Figure A-5 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

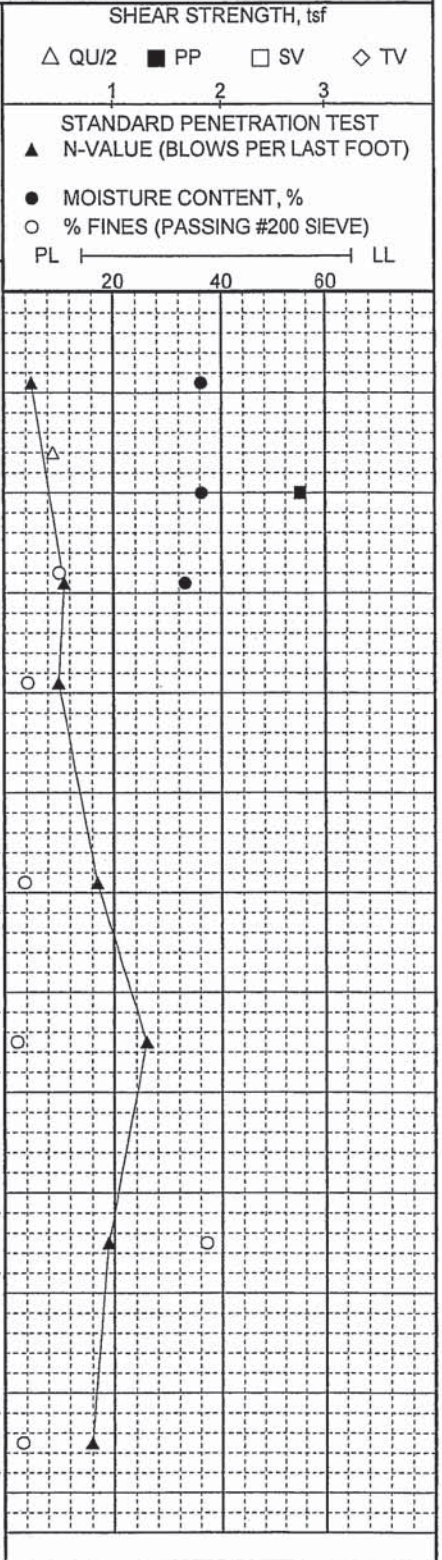
BORING LOG B-63

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118723 E 879543
ELEVATION: 425.8 DATUM: MSL
DATE DRILLED: 11/14/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, dry, clayey, trace fine roots,		
78	CLAY (CL), brown, low plastic, firm, moist, silty	2-2-3	36.2
90	CLAY (CH), brown with dark gray, high plastic, firm, moist, slightly silty, trace iron stains	82.3	36.3
	Silty SAND (SM) brown, fine-grained		
89	CLAY (CH) dark gray, high plastic, firm, moist, slightly silty, trace iron stains	2-6-5	33.2
89	SAND (SP-SM), brown, fine-grain, medium-dense, slightly silty	4-4-6	
	SAND (SP), brown, fine-grain, medium dense Note: switched to mud rotary at 9.0 feet.		
83	Becoming fine- to medium-grained	5-8-9	
61		6-11-15	
78	Silty SAND (SM) brown, fine-grain, medium-dense, with some medium-grain sand, trace lignite, shell frag.	9-9-10	
78	SAND (SP), tan, fine-grain, medium-dense, with trace medium-grain sand	6-7-9	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: D. Binz

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 11 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 5.5 FEET AFTER 96 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-6 Sheet 1 of 1

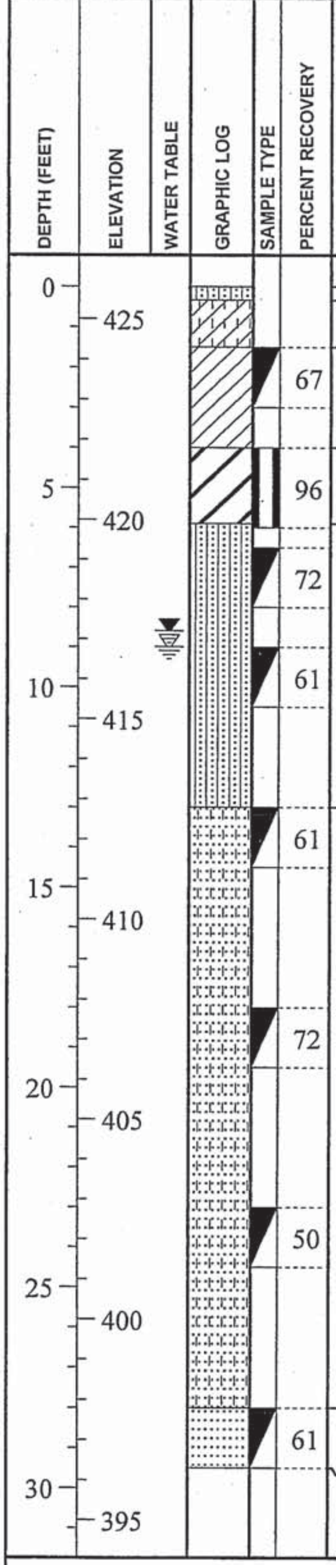
File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

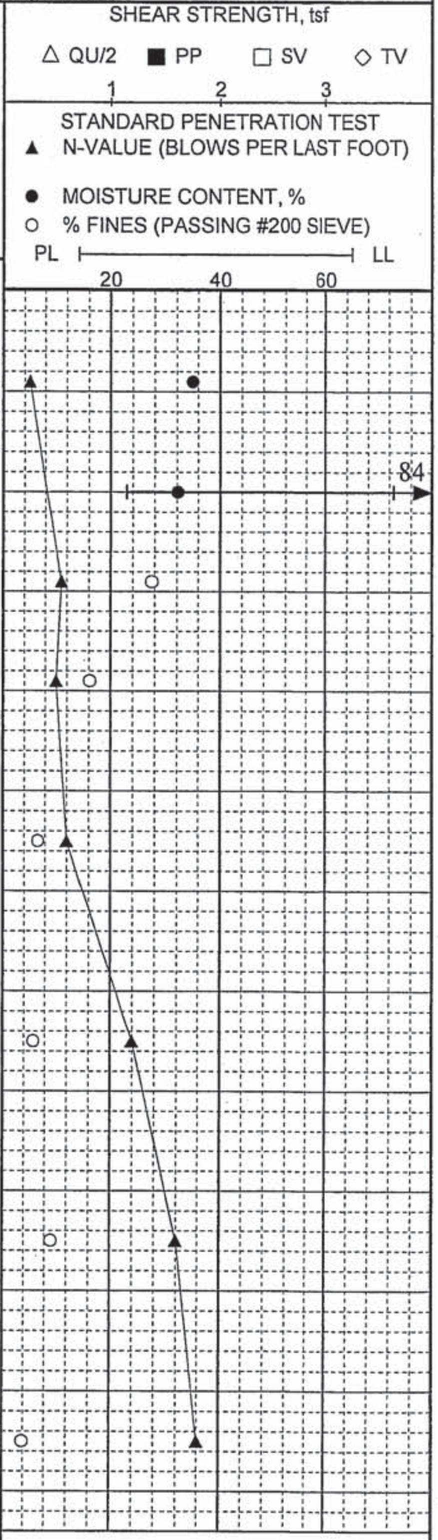
BORING LOG B-64

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118803 E 879798
ELEVATION: 425.8 DATUM: MSL
DATE DRILLED: 11/17/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, dry, very sandy		
	CLAY (CL), brown, low plastic, soft, silty		
67	CLAY (CL) brown, low plastic, firm, moist, slightly silty, with limonite	1-2-3	35.0
96	CLAY (CH), dark grayish brown, high plasic, stiff, moist, with lignite and limonite, blocky	85.4	32.2
72	Silty SAND (SM), tan, fine-grain, medium-dense	2-5-6	
61	Note: switched to mud rotary at 9.0 feet.	2-5-5	
61	SAND (SP-SM), tan, fine- to medium-grain, slightly silty	3-5-7	
72		7-14-10	
50	SAND (SP-SM), tan, fine-grain, dense, trace of medium grain, slightly silty	10-12-20	
61	SAND (SP), tan, medium-grain, dense, with trace fine gravel	8-16-20	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.6 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

Figure A-7 Sheet 1 of 1

File: 2005012477

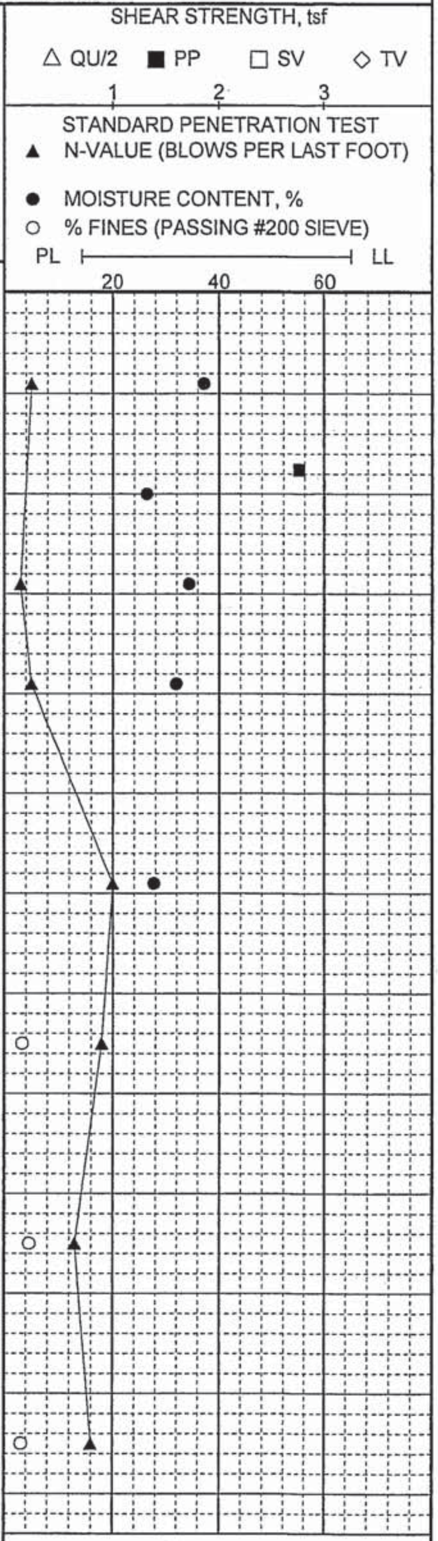
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-65

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118651 E 880020
ELEVATION: 427.0 DATUM: MSL
DATE DRILLED: 11/14/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						CLAY (CL), brown, low plastic, firm, silty, w/ roots top 4-inches		
	425				78	CLAY (CH) brown with some dark gray, high plastic, soft, moist, with traces limonite	2-2-4	37.2
5					98	SILT (ML), gray brown, very moist, very soft, clayey	86.3	26.4
	420				89		2-2-1	34.4
		▼						
10					100	Becoming sandy, soft Note: switched to mud rotary at 9.0 feet	2-3-2	32.0
	415	▽						
15					78	Becoming very sandy, without clay	5-11-9	27.7
	410							
					89	SAND (SP), brown, fine-grained, trace of medium-grain sand	8-9-9	
20								
	405							
					72		8-7-6	
25								
	400							
					78	Becoming more coarse-grained, trace of fine-gravel	6-7-9	
30						Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: D. Binz

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 13 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.72 FEET AFTER 96 HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2005012477

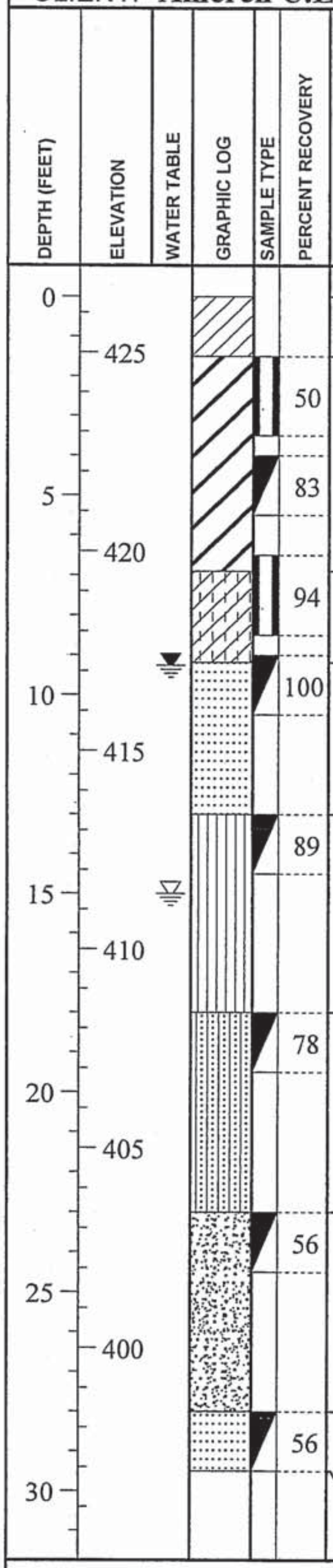
Figure A-8 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

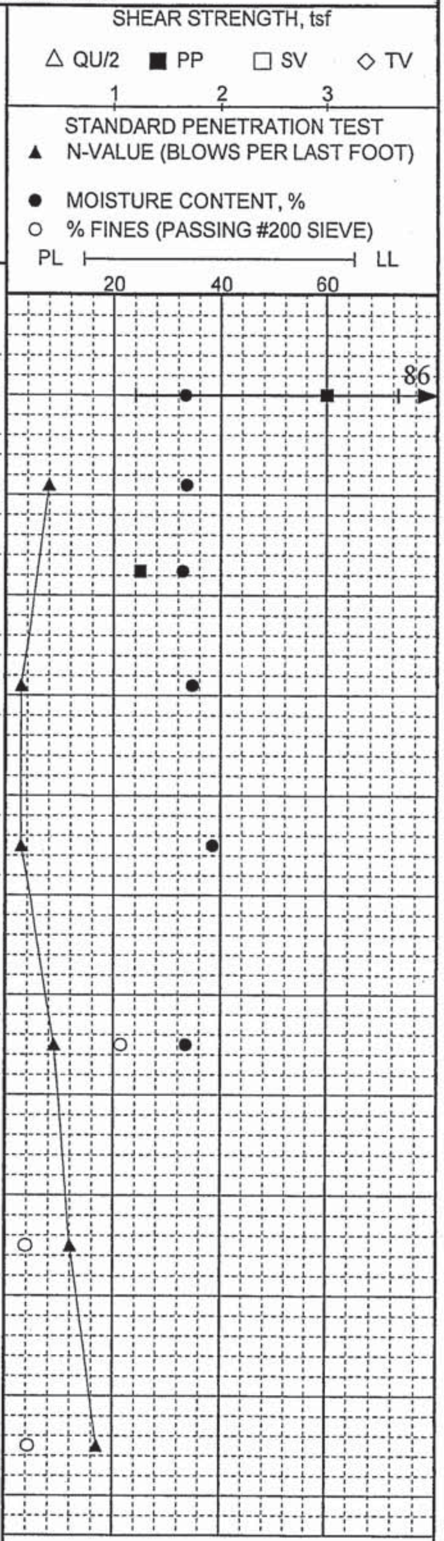
BORING LOG B-66

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118643 E 880276
ELEVATION: 426.4 DATUM: MSL
DATE DRILLED: 10/20/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	CLAY (CL), brown, low plastic, loose, dry, silty		
50	CLAY (CH), dark gray brown, high plastic, firm, moist, trace of silt	87.5	33.4
83		4-4-4	33.6
94	CLAY (CL), gray-brown, low plastic, firm, very moist, silty	87.6	32.9
	With traces of fine-grain sand		
100	SAND (SP) gray, fine-grained, moist, very loose Note: switched to mud rotary at 9.0 feet	1-1-2	34.7
89	SILT (ML) brown & gray, very loose, very moist, laminated in color, with fine-grained sand	2-1-2	38.5
78	Silty SAND (SM), dark gray and brown, fine-grain, loose, laminated in color	2-4-5	33.5
56	SAND (SW), brown, well graded, medium dense, with traces of fine gravel	3-5-7	
56	SAND (SP), gray, fine- to medium-grain, medium dense	10-10-7	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: D. Binz

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 15 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 9.26 FEET AFTER 96 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

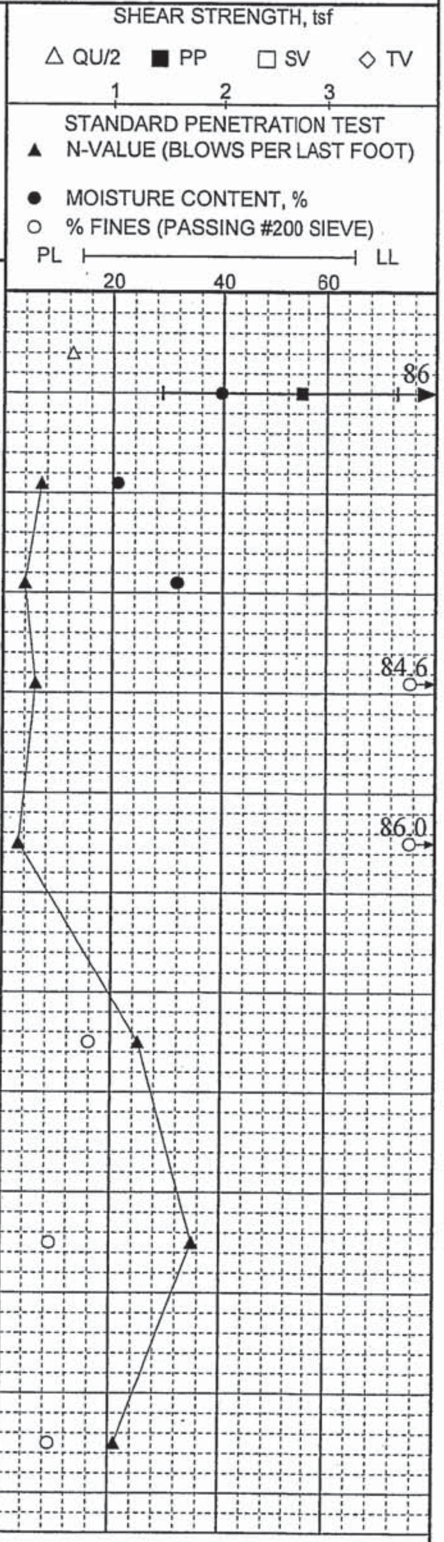
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-67

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118453 E 880461
ELEVATION: 427.8 DATUM: MSL
DATE DRILLED: 11/17/05

DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				CLAY (CL), brown, low plastic, very soft, silty, with roots in the top 4-inches		
	425		58	CLAY (CH) brown and gray, high plastic, moist, stiff, slightly silty	80.1	39.7
				Becoming less plastic, with more silt		
5			67	SILT (ML), tan, loose, with fine-grain sand	3-4-3	20.9
		▼				
	420	▽	56	SILT (ML), brown, moist, soft, clayey	1-2-2	31.8
10			78	With fine sand Note: switched to mud rotary at 9.0 feet	2-2-4	
	415		72		1-1-2	
15						
	410		67	Silty SAND (SM), brown, fine-grain, medium dense	4-15-10	
20						
	405		67	SAND (SP-SM), brown, medium- to fine-grain, dense, slightly silty	13-16-19	
25						
	400		44	With traces of fine gravel	8-11-10	
30				Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 6.0 FEET AFTER 24 HOURS
AT ______ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

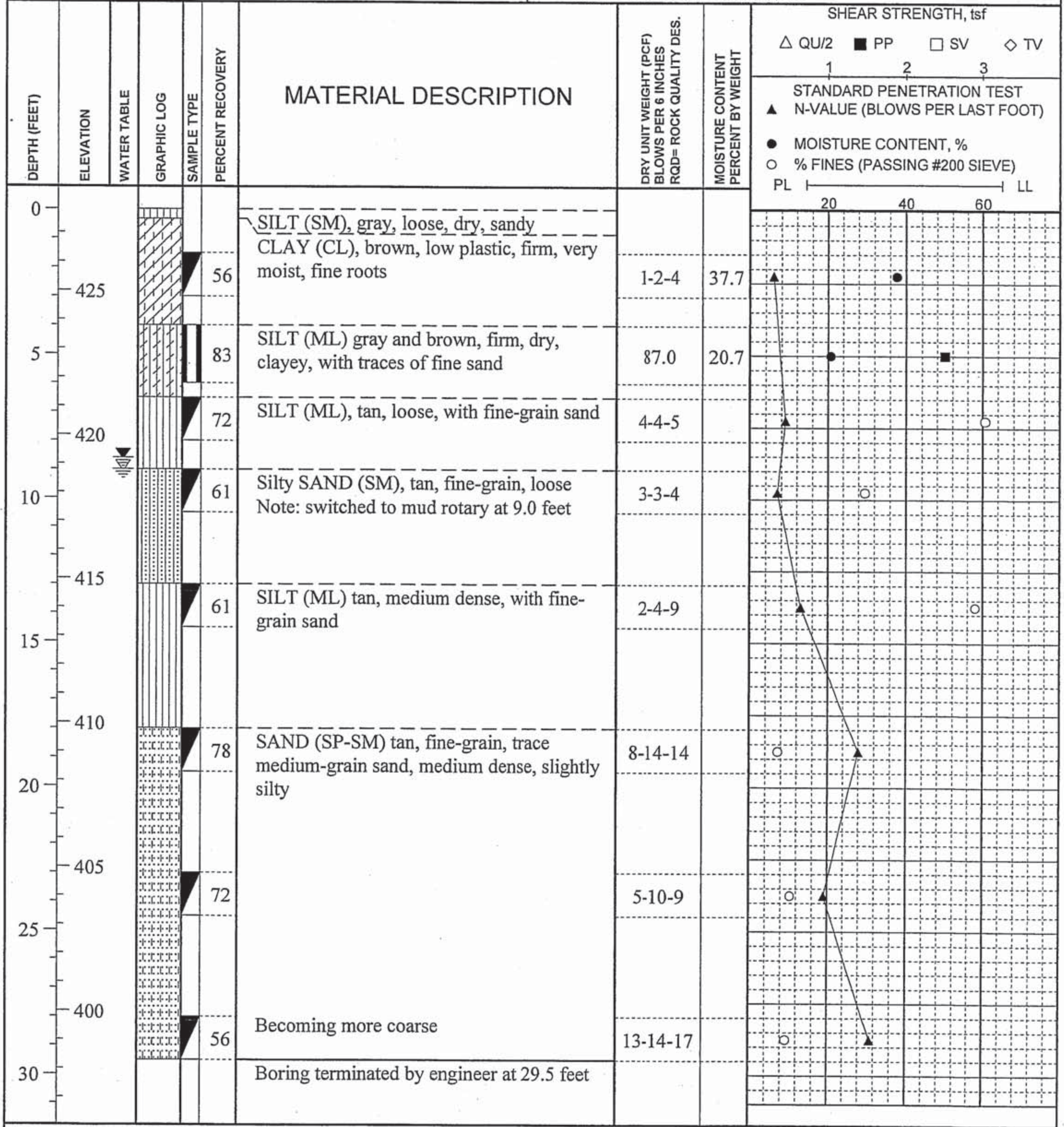
Figure A-10 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-68

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118448 E 880736
ELEVATION: 427.8 DATUM: MSL
DATE DRILLED: 11/17/05



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (SM), gray, loose, dry, sandy		
56	CLAY (CL), brown, low plastic, firm, very moist, fine roots	1-2-4	37.7
83	SILT (ML) gray and brown, firm, dry, clayey, with traces of fine sand	87.0	20.7
72	SILT (ML), tan, loose, with fine-grain sand	4-4-5	
61	Silty SAND (SM), tan, fine-grain, loose Note: switched to mud rotary at 9.0 feet	3-3-4	
61	SILT (ML) tan, medium dense, with fine-grain sand	2-4-9	
78	SAND (SP-SM) tan, fine-grain, trace medium-grain sand, medium dense, slightly silty	8-14-14	
72		5-10-9	
56	Becoming more coarse	13-14-17	
	Boring terminated by engineer at 29.5 feet		

DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.6 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

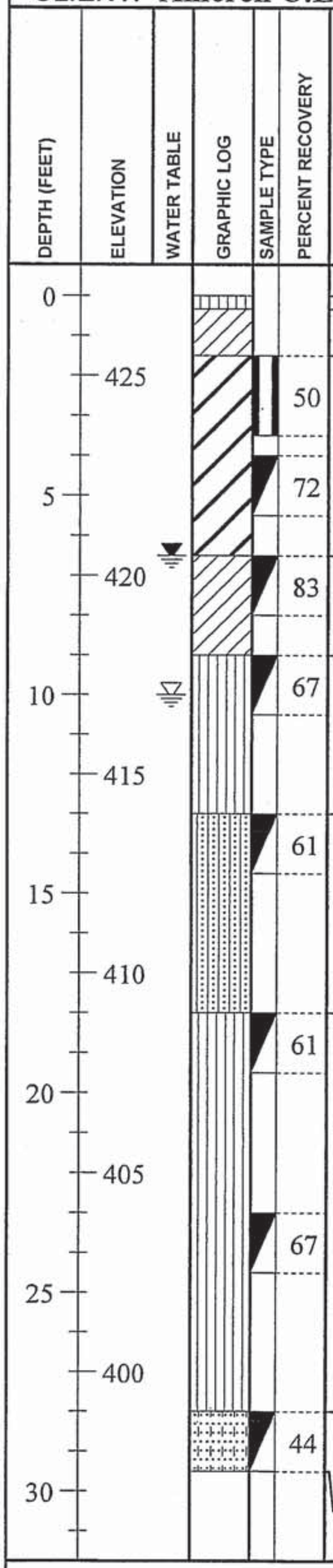
Figure A-11 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

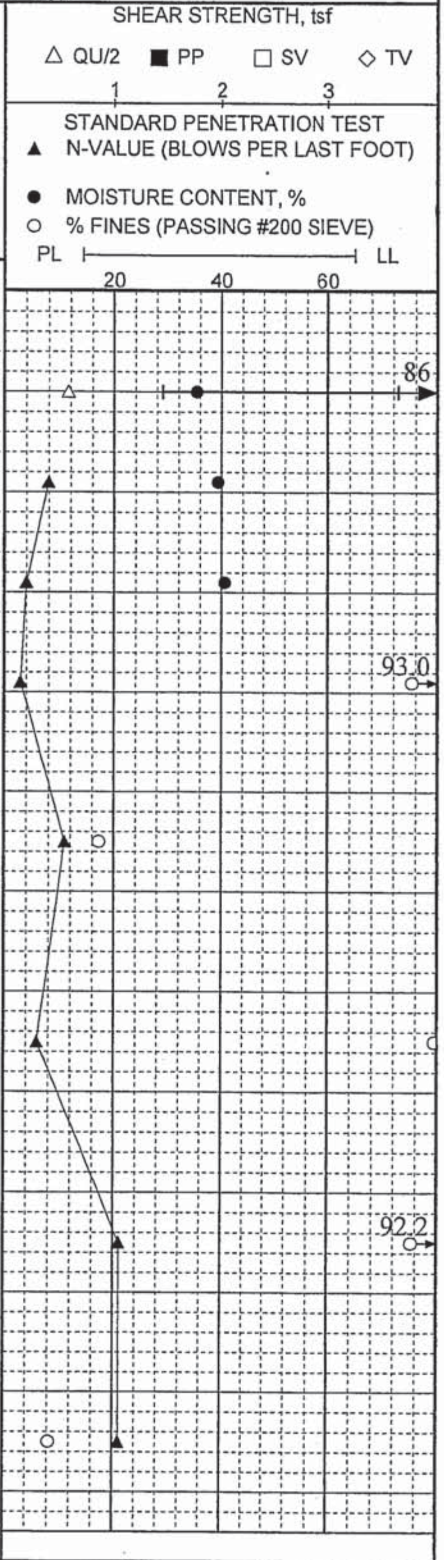
BORING LOG B-69

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118251 E 880924
ELEVATION: 427.0 DATUM: MSL
DATE DRILLED: 11/17/05



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), gray, with fine-grain sand		
	CLAY (CL), brown, low plastic, slightly silty		
50	CLAY (CH), gray-brown, high plastic, moist, stiff, slightly silty	84.4	35.4
72	Becoming more silty and less plastic	2-3-5	39.4
83	CLAY (CL), brown, low plastic, soft, very moist, with trace of limonite	1-2-2	40.6
67	SILT (ML), tan and gray, very loose, with traces of fine-grain sand Note: switched to mud rotary at 9.0 feet	2-1-2	
61	Silty SAND (SM), tan, fine-grain, medium dense	5-6-5	
61	SILT (ML), tan and gray, loose, with fine-grain sand	1-3-3	
67	Becoming dense, with trace of fine-grain sand	2-10-11	
44	SAND (SP-SM) gray, fine-grain, dense, with trace medium-grain sand, trace of coase-grain sand and fine-grain gravel	7-8-13	



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 6.5 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

Figure A-12 Sheet 1 of 2

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-69

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
						Boring terminated by engineer at 29.5 feet		
	395							
35								
	390							
40								
	385							
45								
	380							
50								
	375							
55								
	370							
60								
	365							
65								
	360							

SHEAR STRENGTH, tsf

△ QU/2 ■ PP ☐ SV ◇ TV

1 2 3

▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (PASSING #200 SIEVE)

PL ⊢——⊣ LL

20 40 60

File: 2005012477

Figure A-12 Sheet 2 of 2

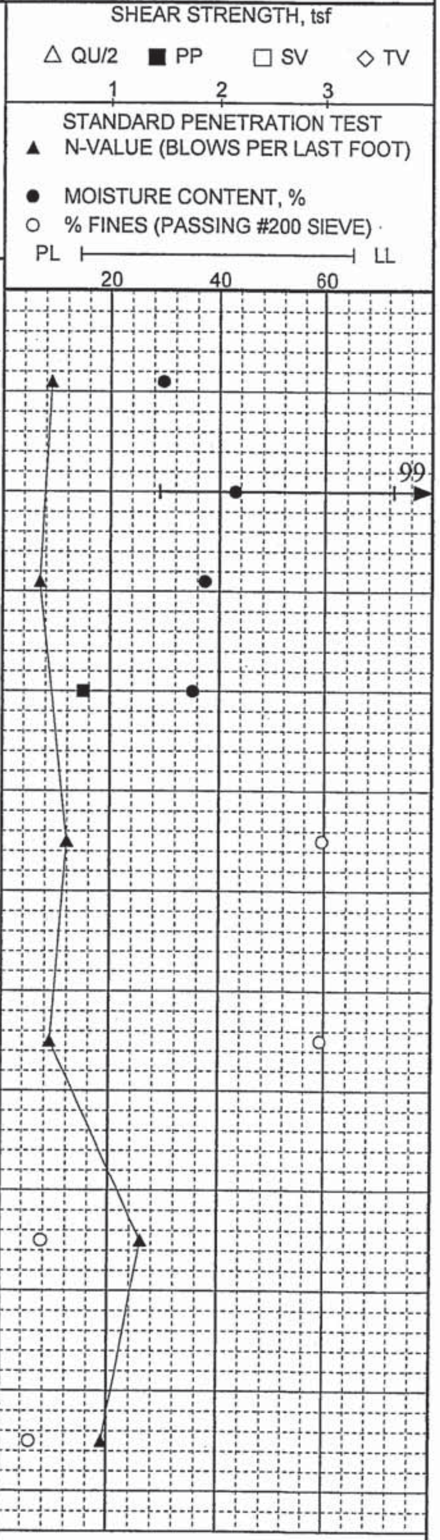
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-70

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118252 E 881192
ELEVATION: 426.8 DATUM: MSL
DATE DRILLED: 11/17/05

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						CLAY (CL), brown, low plastic, silty		
	425				78	CLAY (CL) brown, low plastic, stiff, moist, traces of limonite	2-4-5	29.7
5					79	CLAY (CH), gray-brown, high plastic, stiff, moist, slightly silty, trace of limonite	77.3	43.0
	420	▼			78		1-3-4	37.4
10					83	Note: switched to mud rotary at 9.0 feet	84.4	35.2
		▽				SILT (ML), gray, with fine-grain sand, medium dense		
	415							
					78		3-4-8	
15								
	410							
					61	Becoming loose	3-3-6	
20								
	405							
					61	SAND (SP-SM), tan, medium- to fine-grain, slightly silty, medium dense	9-11-15	
25								
	400							
					50	SAND (SW-SM), tan, well graded, medium dense, slightly silty, trace of fine gravel	10-9-10	
30						Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 11 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 7.5 FEET AFTER 24 HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-13 Sheet 1 of 1

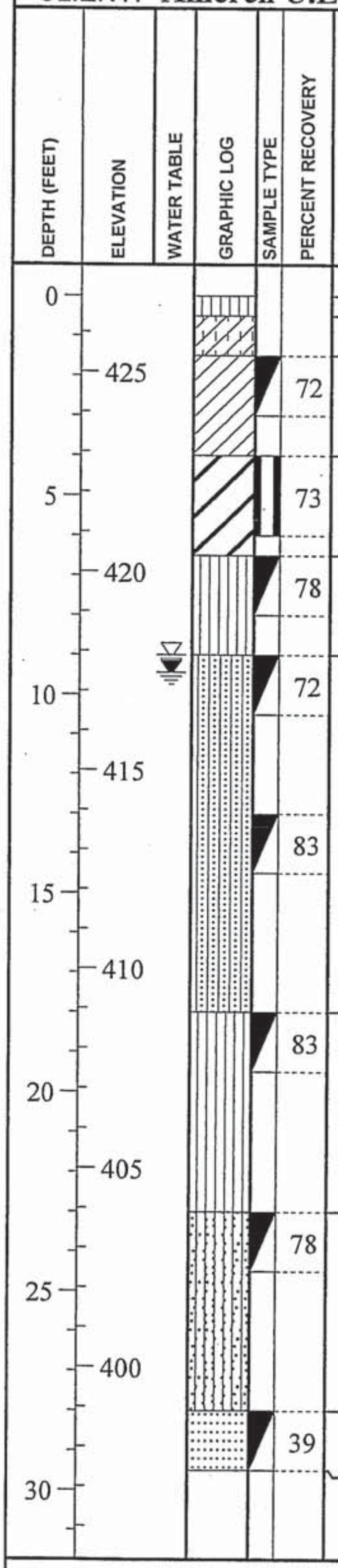
File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

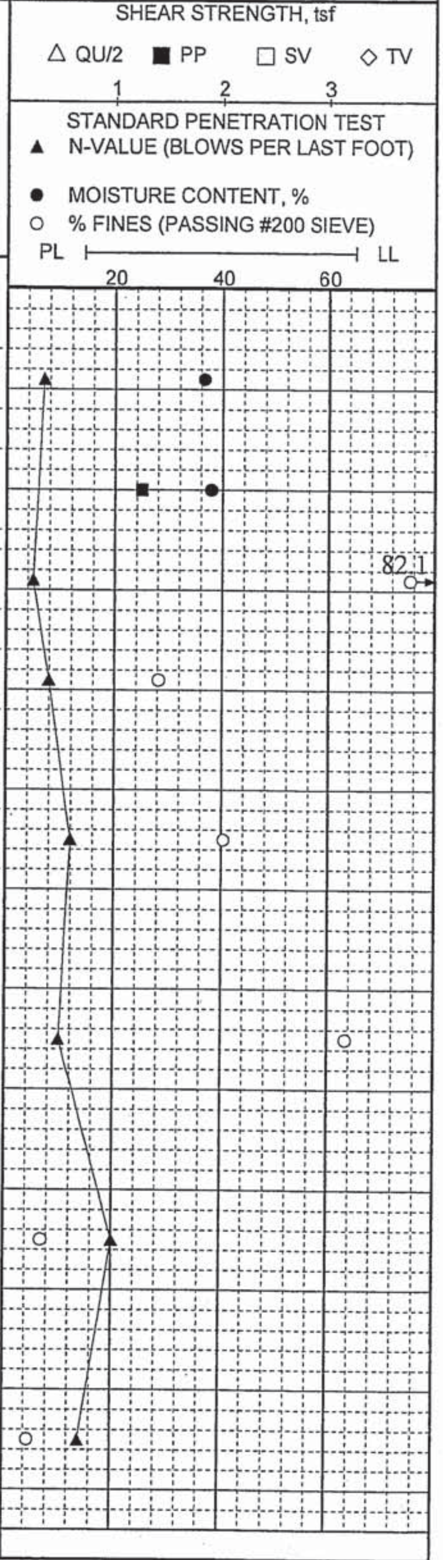
BORING LOG B-71

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118045 E 881402
ELEVATION: 426.9 DATUM: MSL
DATE DRILLED: 10/14/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, slightly clayey, trace fine roots, dry		
72	CLAY (CL), brown, low plastic, silty, trace fine roots	2-2-5	36.6
	CLAY (CL), brownish gray, low plastic, firm, very moist		
73	CLAY (CH), gray and brown, high plastic, stiff, moist, with traces of limonite	80.6	37.9
78	SILT (ML), brown, loose, with clay balls, and fine-grain sand	2-2-3	
72	Silty SAND (SM), brown, fine-grain, loose, saturated Note: switched to mud rotary at 9.0 feet	4-4-4	
83	Becoming medium dense	4-6-6	
83	SILT (ML), brown, medium dense, with fine sand	2-5-5	
78	SAND (SP-SM), gray, fine-grain, medium dense, slightly silty	6-9-11	
39	SAND (SP), gray, medium- to fine-grain, medium dense	9-7-7	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 9.44 FEET AFTER 48 HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-14 Sheet 1 of 1

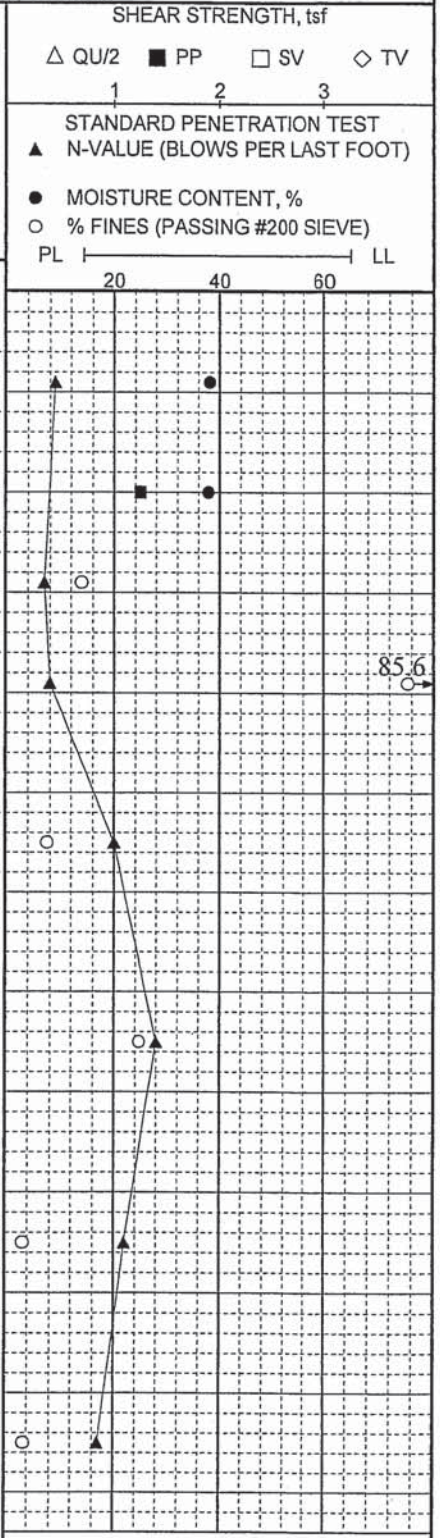
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-72

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118024 E 881660
ELEVATION: 427.3 DATUM: MSL
DATE DRILLED: 10/14/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						SILT (ML), gray, sandy, clayey, loose, dry		
						CLAY (CL), brown, low plastic, silty		
	425				72	CLAY (CL), brown & gray, low plastic stiff, with lignite and limonite, traces of roots	2-4-5	38.2
5					100	CLAY (CH), grayish brown, high plastic, firm, moist, traces of lignite and limonite	80.9	37.9
	420	▼			61	Silty SAND (SM), tan, fine-grain, loose	1-3-4	
10		▽			72	SILT (ML), tan, loose, with fine-grain sand Note: switched to mud rotary at 9.0 feet	4-4-4	
	415							
					72	SAND (SP-SM), tan, fine-grain, medium dense, slightly silty	8-10-10	
15								
	410							
					78	Silty SAND (SM), brown, fine-grain, medium dense	9-12-16	
20								
	405							
					50	SAND (SP), brown, medium- to fine-grain, medium dense, traces of coarse-grain sand	5-11-11	
25								
	400							
					39	SAND (SP), brown, coarse-, medium-, and fine-grain, medium dense, traces of fine gravel	6-7-10	
30								



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 7.0 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2005012477

Figure A-15 Sheet 1 of 2

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-72

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf △ QU/2 ■ PP ☐ SV ◇ TV 1 2 3 ▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT) ● MOISTURE CONTENT, % ○ % FINES (PASSING #200 SIEVE) PL ├──┤ LL 20 40 60
	395					Boring terminated by engineer at 29.5 feet			
35									
	390								
40									
	385								
45									
	380								
50									
	375								
55									
	370								
60									
	365								
65									
	360								

Figure A-15 Sheet 2 of 2

File: 2005012477

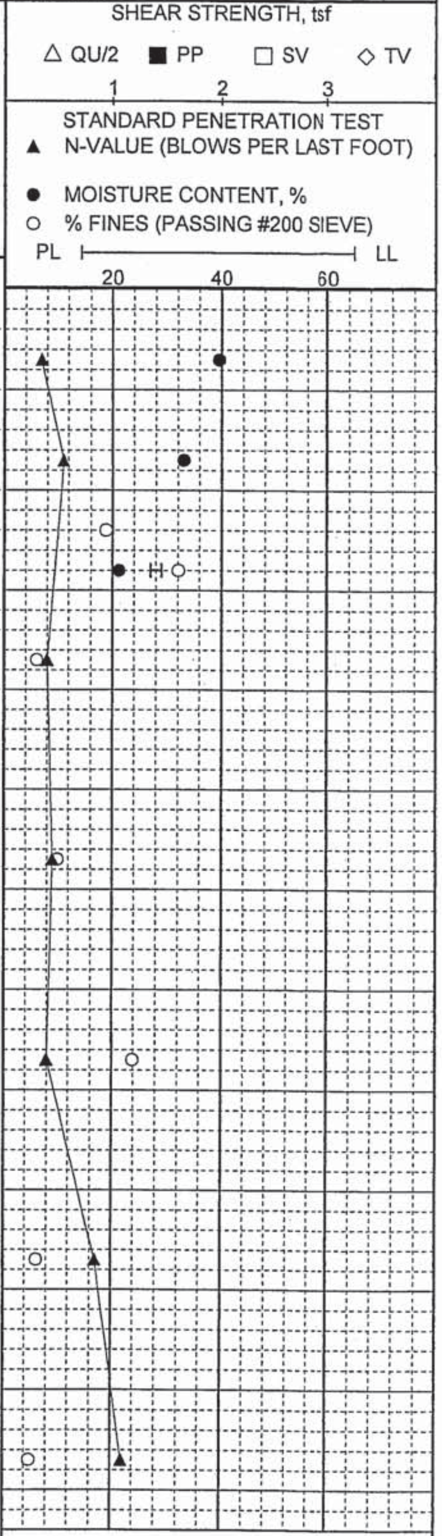
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-73

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117825 E 881869
ELEVATION: 427.4 DATUM: MSL
DATE DRILLED: 10/18/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						CLAY (CL), brown, low plastic, silty		
					61	CLAY (CH), dark gray brown, high plastic, firm, moist	2-2-5	39.6
	425							
					94	Becoming blocky, with traces of lignite and limonite	2-4-7	33.1
5								
					100	Silty SAND (SM), tan, fine grain, dry	83.3	21.2
	420							
		▼						
					72	SAND (SP-SM), tan, fine-grain, loose, slightly silty Note: switched to mud rotary at 8.5 feet	4-4-4	
10								
	415							
		▽						
					61		7-5-4	
15								
	410							
					56	Silty SAND (SM), tan, fine-grain, loose	2-4-4	
20								
	405							
					50	SAND (SP-SM), tan, medium- to fine-grain, medium dense, slighly silty	7-7-10	
25								
	400							
					56	SAND (SP), tan, medium- to fine-grain, medium dense	7-10-12	
30								
						Boring terminated by engineer at 30.0 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 13.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.57 FEET AFTER 48 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2005012477

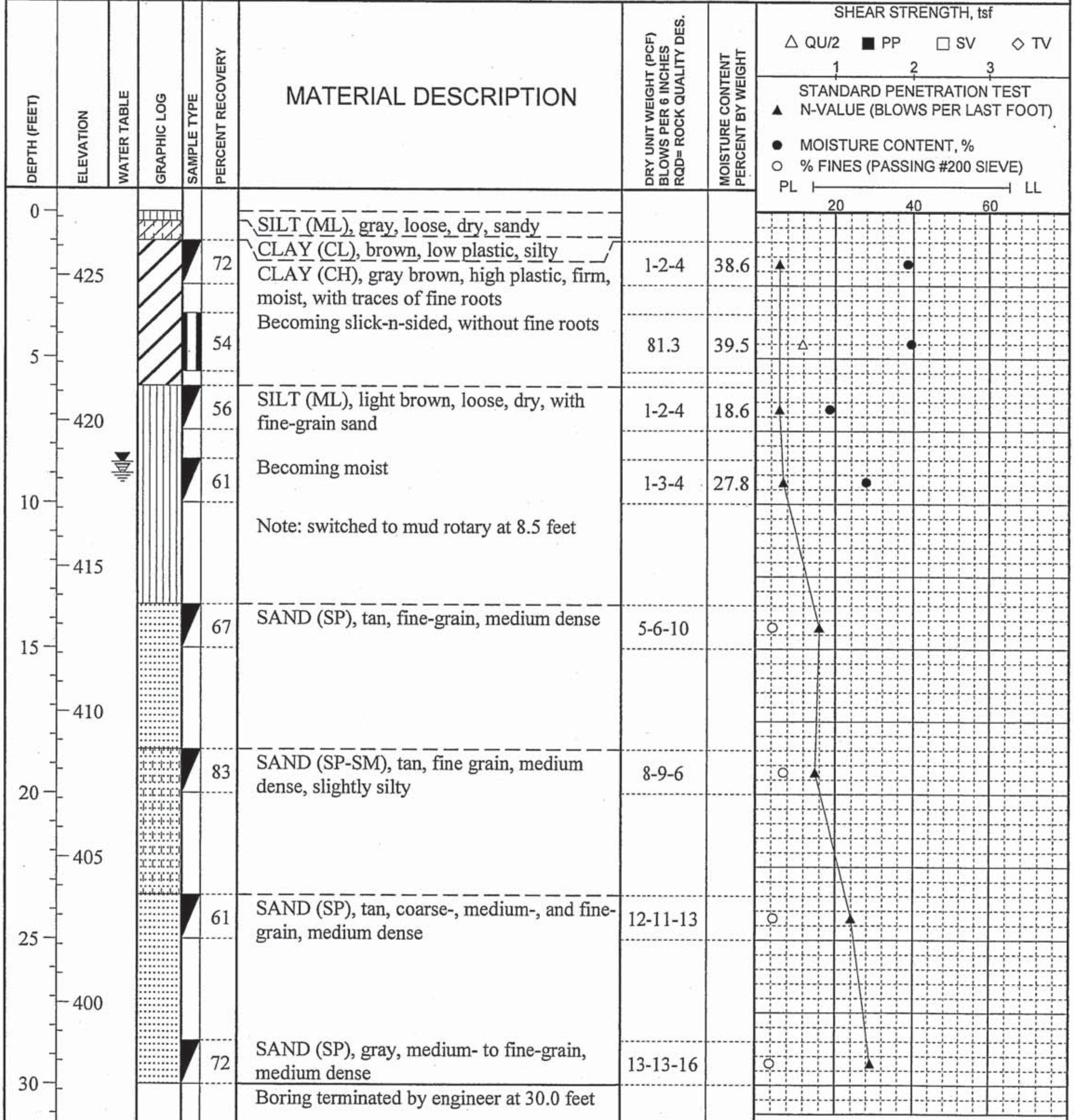
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-74

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117812 E 882132
ELEVATION: 427.2 DATUM: MSL
DATE DRILLED: 10/18/2005

PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), gray, loose, dry, sandy		
	CLAY (CL), brown, low plastic, silty		
72	CLAY (CH), gray brown, high plastic, firm, moist, with traces of fine roots	1-2-4	38.6
54	Becoming slick-n-sided, without fine roots	81.3	39.5
56	SILT (ML), light brown, loose, dry, with fine-grain sand	1-2-4	18.6
61	Becoming moist	1-3-4	27.8
	Note: switched to mud rotary at 8.5 feet		
67	SAND (SP), tan, fine-grain, medium dense	5-6-10	
83	SAND (SP-SM), tan, fine grain, medium dense, slightly silty	8-9-6	
61	SAND (SP), tan, coarse-, medium-, and fine-grain, medium dense	12-11-13	
72	SAND (SP), gray, medium- to fine-grain, medium dense	13-13-16	
	Boring terminated by engineer at 30.0 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.62 FEET AFTER 48 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-17 Sheet 1 of 1

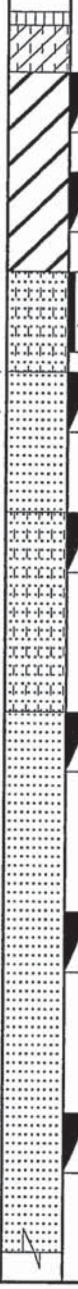
File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

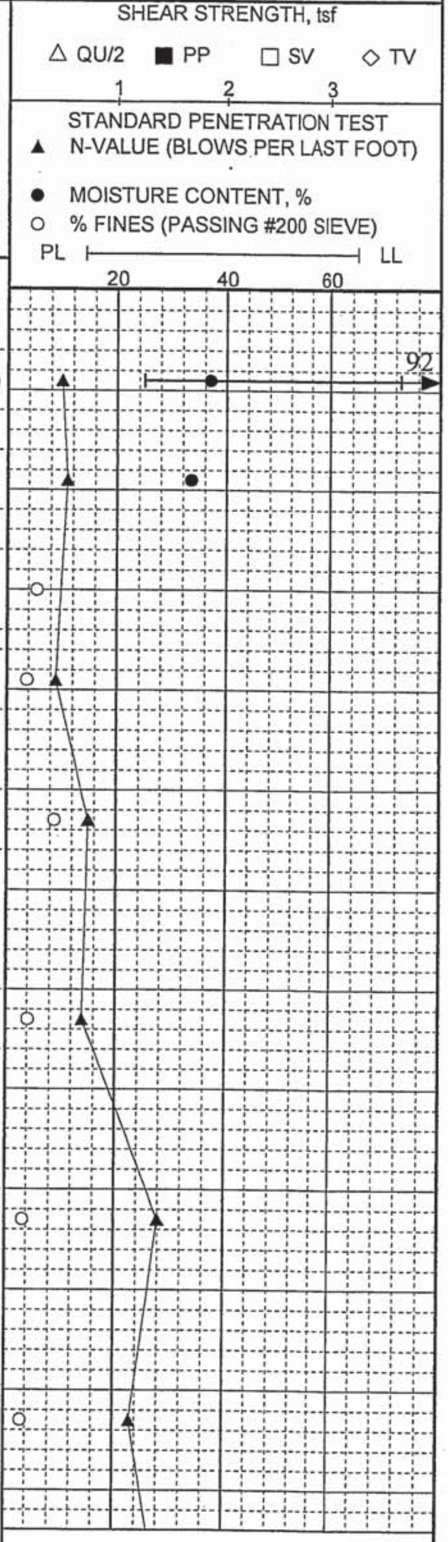
BORING LOG B-75

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117587 E 882280
ELEVATION: 427.1 DATUM: MSL
DATE DRILLED: 10/19/2005



DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				SILT (ML), brown, sandy		
				CLAY (CL), brown, low plastic, silty		
	425		56	CLAY (CH), dark grayish brown, high plastic, stiff, moist, with lignite, limonite, and trace fine roots	2-4-6	37.0
5			83	Without roots	4-5-6	33.5
	420		96	SAND (SP-SM), tan, fine-grain, slightly silty		
10		▼ ▽	78	SAND (SP), tan, fine-grain, loose Note: switched to mud rotary at 9.0 feet	3-4-5	
	415		61	SAND (SP-SM), brown and tan, fine-grain, medium dense, slightly silty	4-6-9	
15						
	410		67	SAND (SP), tan, fine-grain, medium dense	8-7-7	
20						
	405		61	Becoming medium- to fine-grain	9-12-16	
25						
	400		56	Becoming gray	6-10-13	
30						



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

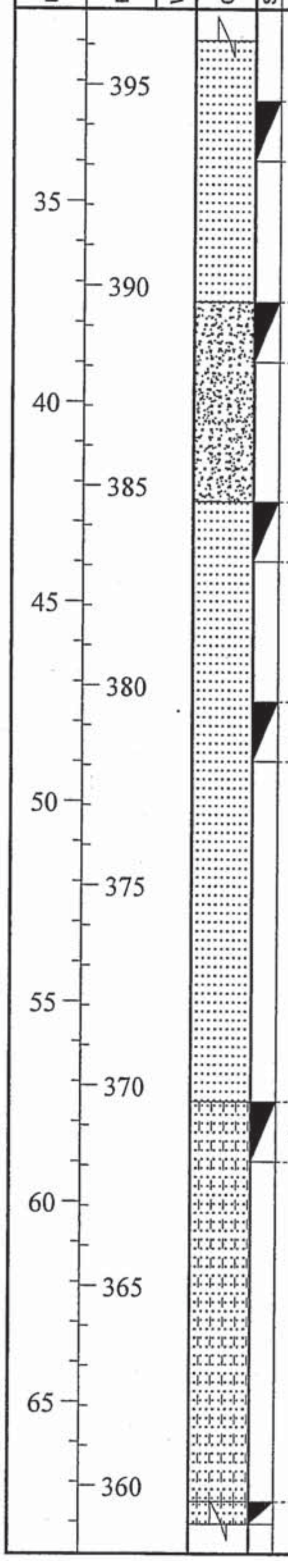
STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 9 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

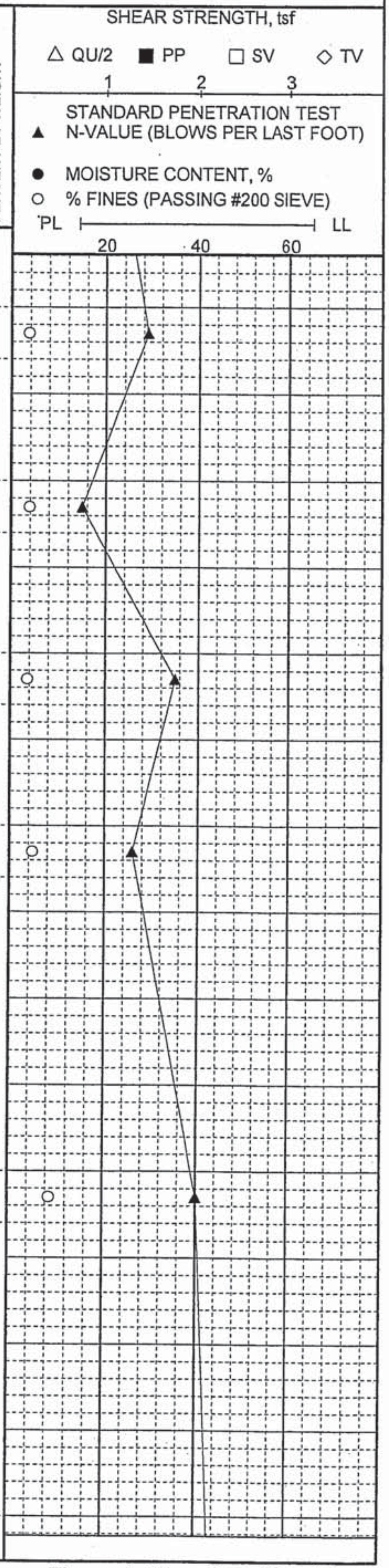
Figure A-18 Sheet 1 of 4

BORING LOG B-75

Sioux Power Plant UWLF



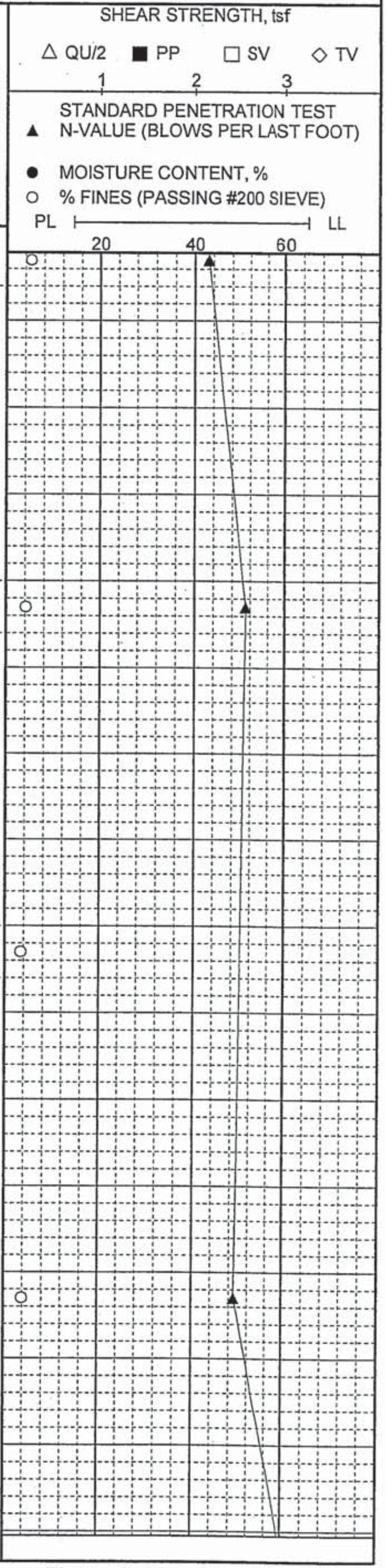
SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
◣	44		6-14-15	
◣	39	SAND (SW), gray, well graded, medium dense, trace of fine and coarse gravel	3-5-10	
◣	61	SAND (SP), tan, fine- to medium-grain, dense	12-13-22	
◣	56	Becoming medium dense	10-11-15	
◣	61	SAND (SP-SM), grey, fine-grain, dense, slightly silty, pieces of wood	7-17-23	
		Gravelly drilling at 61.5' to 62.5'		
◣				



BORING LOG B-75

Sioux Power Plant UWLF

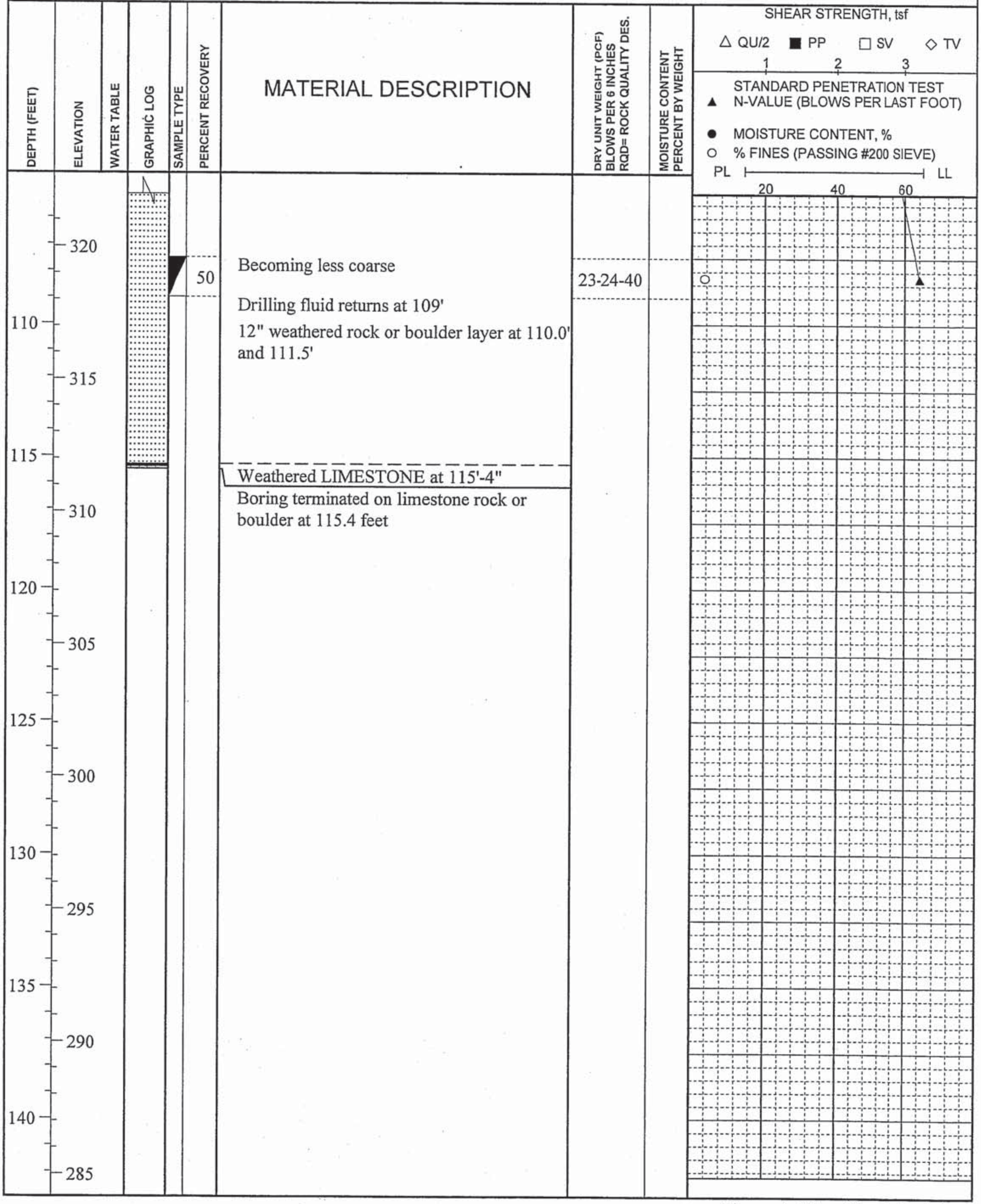
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
					50	SAND (SP-SM), gray, medium- to fine-grain, dense, slightly silty	12-19-24	
70								
	355							
75								
	350							
					72	SAND (SP), gray, medium- to fine-grain, very dense	11-15-36	
						Stiff drilling from 79.0' to 83.0' and below 84.0'		
80								
	345							
85								
	340							
					50	With trace of coarse-grain sand	12-17-18	
90								
						Gravely layers from 91.0' to 97.0' Loosing drilling fluid at 93.0'		
	335							
95								
	330							
					50	Becoming more coarse	19-24-25	
100								
	325							
105								



REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-75

Sioux Power Plant UWLF



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
50	Becoming less coarse	23-24-40	
	Drilling fluid returns at 109' 12" weathered rock or boulder layer at 110.0' and 111.5'		
	Weathered LIMESTONE at 115'-4" Boring terminated on limestone rock or boulder at 115.4 feet		

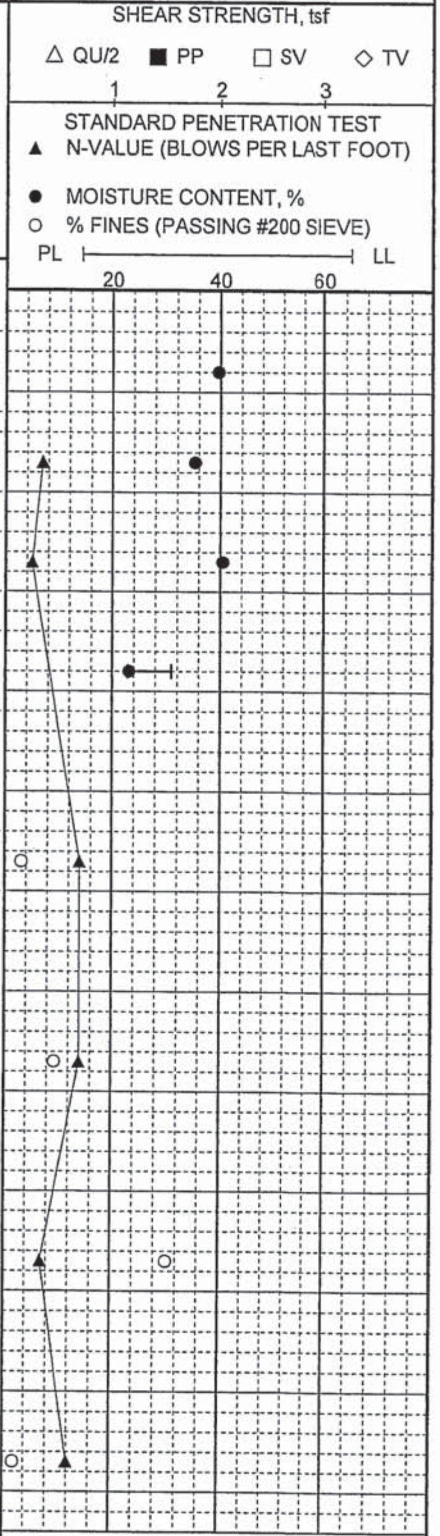
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-76

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117339 E 882247
ELEVATION: 427.5 DATUM: MSL
DATE DRILLED: 10/18/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0					SILT (ML), gray, loose, dry, with fine grain sand		
	425			92	CLAY (CL), brown, low plastic, silty	79.5	39.7
5				72	CLAY (CH), dark browninsh gray, high plastic, moist, firm, blocky, slightly silty	2-3-4	35.3
	420	▼		78	With traces of lignite	1-2-3	40.5
10		▽		79	Silty SAND (SM), tan, fine-grained, dry	76.7	23.2
					Note: switched to mud rotary at 8.5 feet		
15	415			78	SAND (SP), tan, fine-grain, medium dense	5-6-8	
20	410			83	SAND (SP-SM), tan, fine-grain, medium dense slightly silty	4-6-8	
25	405			83	Silty SAND (SM), gray, fine-grain, loose	4-4-3	
30	400			56	SAND (SP), gray, medium- to fine-grain, medium-dense	4-5-7	
					Boring terminated by engineer at 30.0 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 6.96 FEET AFTER 48 HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-19 Sheet 1 of 1

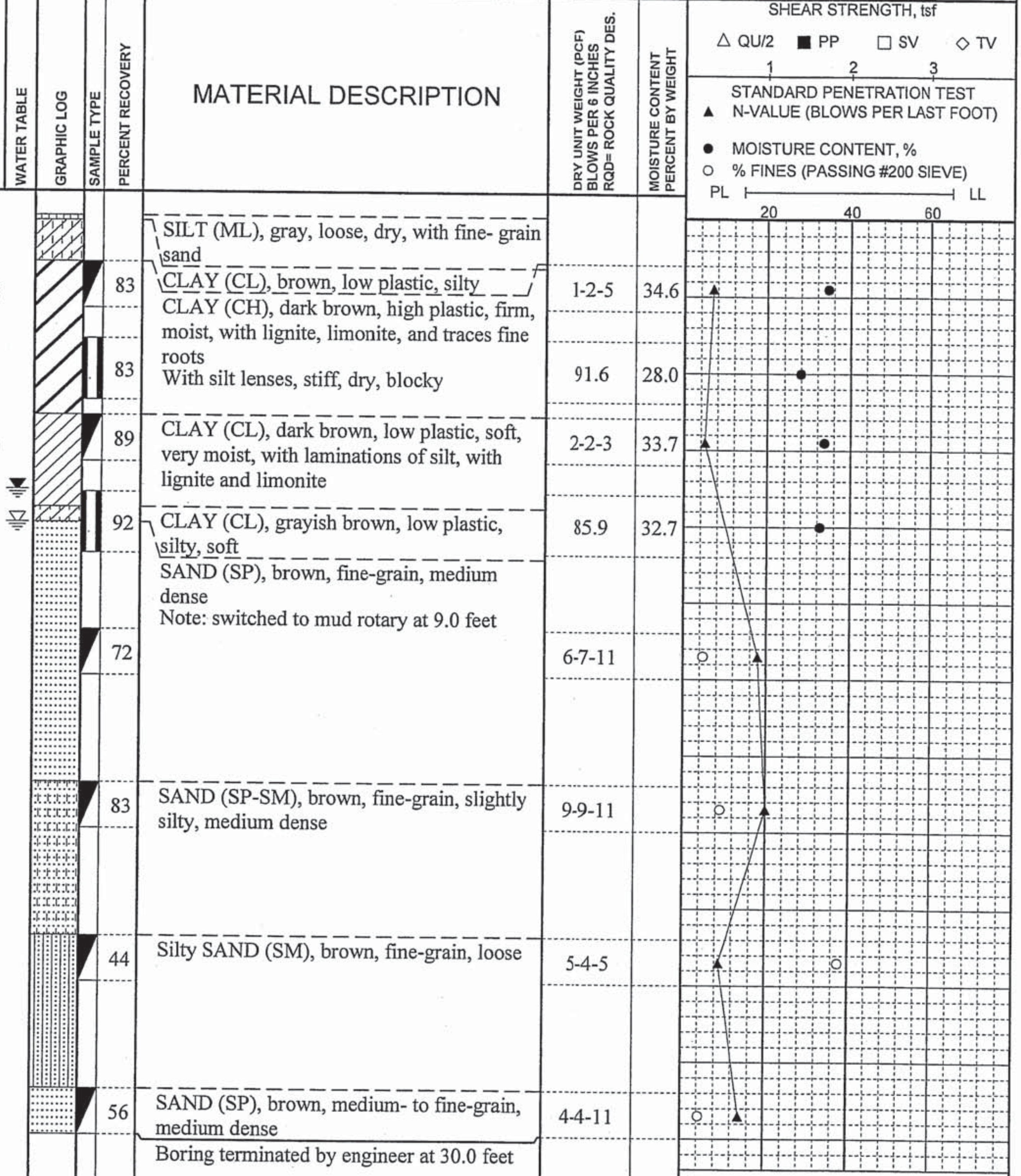
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-77

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117063 E 882310
ELEVATION: 427.5 DATUM: MSL
DATE DRILLED: 10/20/2005

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0			SILT (ML), gray, loose, dry, with fine- grain sand		
	425	83	CLAY (CL), brown, low plastic, silty	1-2-5	34.6
			CLAY (CH), dark brown, high plastic, firm, moist, with lignite, limonite, and traces fine roots		
5		83	With silt lenses, stiff, dry, blocky	91.6	28.0
	420	89	CLAY (CL), dark brown, low plastic, soft, very moist, with laminations of silt, with lignite and limonite	2-2-3	33.7
10		92	CLAY (CL), grayish brown, low plastic, silty, soft	85.9	32.7
	415		SAND (SP), brown, fine-grain, medium dense Note: switched to mud rotary at 9.0 feet		
15		72		6-7-11	
	410				
20		83	SAND (SP-SM), brown, fine-grain, slightly silty, medium dense	9-9-11	
	405				
25		44	Silty SAND (SM), brown, fine-grain, loose	5-4-5	
	400				
30		56	SAND (SP), brown, medium- to fine-grain, medium dense	4-4-11	
			Boring terminated by engineer at 30.0 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.92 FEET AFTER 264 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2005012477

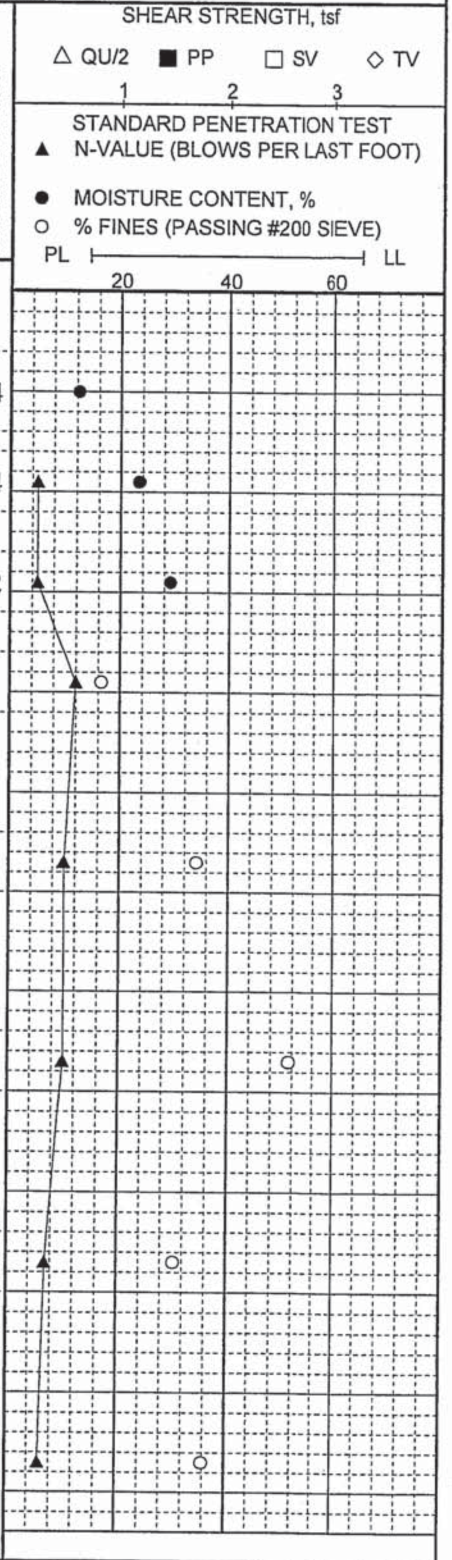
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-78

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116842 E 882180
ELEVATION: 427.2 DATUM: MSL
DATE DRILLED: 10/20/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0					SILT (ML), gray, loose, dry, sandy		
	425		▮	83	CLAY (CL), light brown, low plastic, silty, dry, with fine-grain sand	85.0	12.4
5			◣	78	SILT (ML), brown, loose, dry, with fine-grain sand	2-2-3	23.4
		∇					
	420		◣	94		2-3-2	29.2
		▼					
10			◣	72	Silty SAND (SM), brown, medium dense Note: switched to mud rotary at 9.0 feet	3-6-6	
	415						
15			◣	67		3-7-3	
	410						
20			◣	83	SILT (ML), brownish gray, medium dense, with fine-grain sand	2-4-6	
	405						
25			◣	61	Silty SAND (SM), brownish gray, loose	1-3-4	
	400						
30			◣	56		3-3-3	
					Boring terminated by engineer at 30.0 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ____
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 6 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.01 FEET AFTER 264 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

Figure A-21 Sheet 1 of 1

File: 2005012477

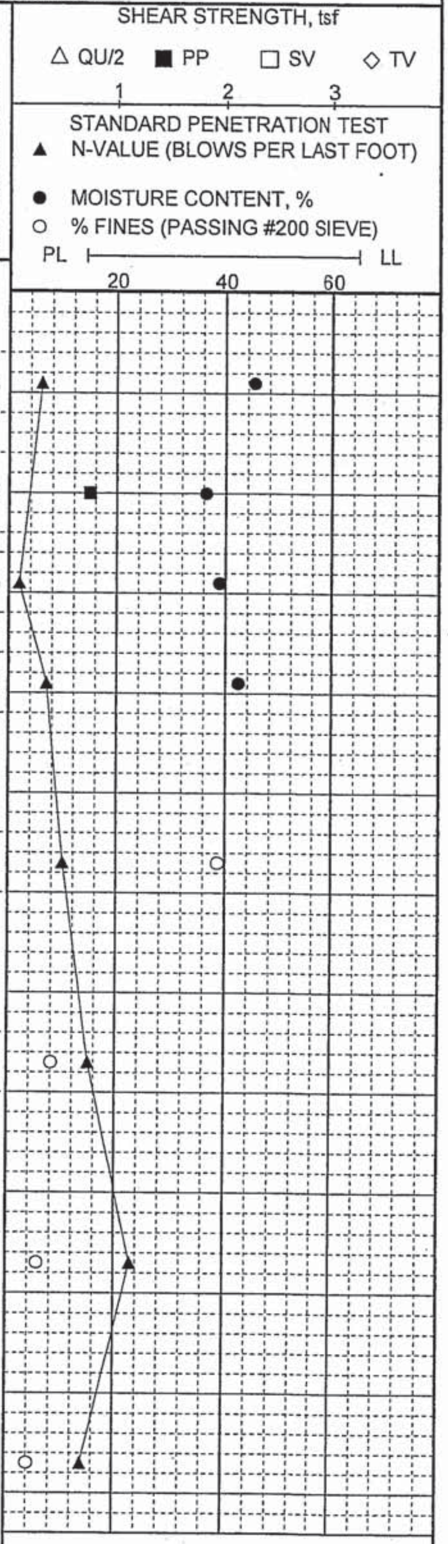
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-79

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116576 E 882247
ELEVATION: 424.9 DATUM: MSL
DATE DRILLED: 10/20/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						SILT (SM), gray, loose, dry, sandy		
						CLAY (CL), brown, low plastic, silty		
					67	CLAY (CH), dark brown, high plastic, firm, moist, with lignite, limonite, and small roots	1-2-4	45.3
5	420				92	CLAY (CL), dark grayish brown, low plastic, silty, very soft, moist, with lignite and limonite	83.5	36.5
		▽			100	Becoming more silty	1-1-1	39.0
10	415				83	Becoming firm, less silty	1-2-5	42.4
		▼				Note: switched to mud rotary at 9.0 feet		
					72	Silty SAND (SM), brown, fine-grain, medium dense	4-5-5	
15	410							
20	405				67	SAND (SP-SM), grayish brown, fine-grain, medium dense, slightly silty	7-6-9	
25	400				56	Becoming medium- to fine-grain sand	12-10-13	
30	395				39	SAND (SP), brown, medium- to fine-grain, medium dense, trace of coarse-grain sand	8-7-7	
						Boring terminated by engineer at 30.0 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 10.89 FEET AFTER 264 HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

File: 2005012477

Figure A-22 Sheet 1 of 1

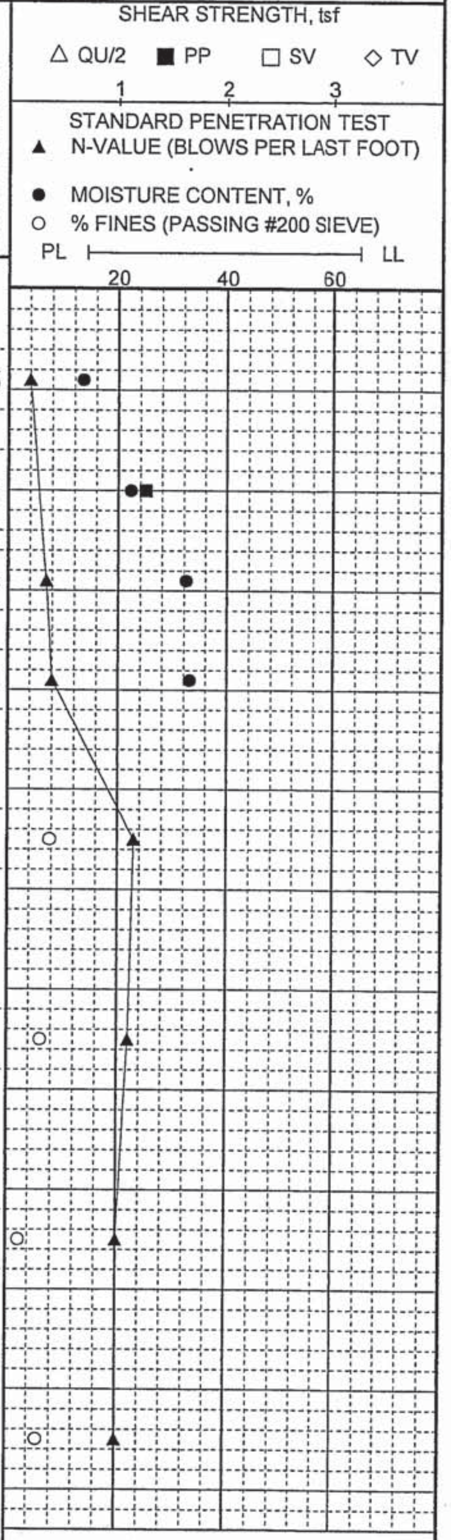
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-80

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116348 E 882117
ELEVATION: 429.6 DATUM: MSL
DATE DRILLED: 11/10/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						SILT (ML), brown, loose, dry, with fine-grain sand		
					78		2-2-2	13.6
5	425				100	Silty SAND (SM), brown, fine-grain, dry	84.5	22.3
					78	SILT (ML), tan, loose, saturated, slightly clayey, with fine-grain sand	2-3-4	32.4
		▼						
10	420				72	With trace of limonite	1-3-5	33.1
						Note: switched to mud rotary at 9.0 feet		
					67	SAND (SP-SM), tan, fine-grain, medium dense, slightly silty	9-12-11	
15	415							
					72		5-8-14	
20	410							
					39	Sand (SP), medium- to fine-grain, medium dense, trace of coarse-grain sand and fine gravel	10-10-10	
25	405							
					56	SAND (SP-SM), gray, medium- to fine-grain, medium dense, slightly silty	5-10-10	
30	400					Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.78 FEET AFTER 192 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-23 Sheet 1 of 1

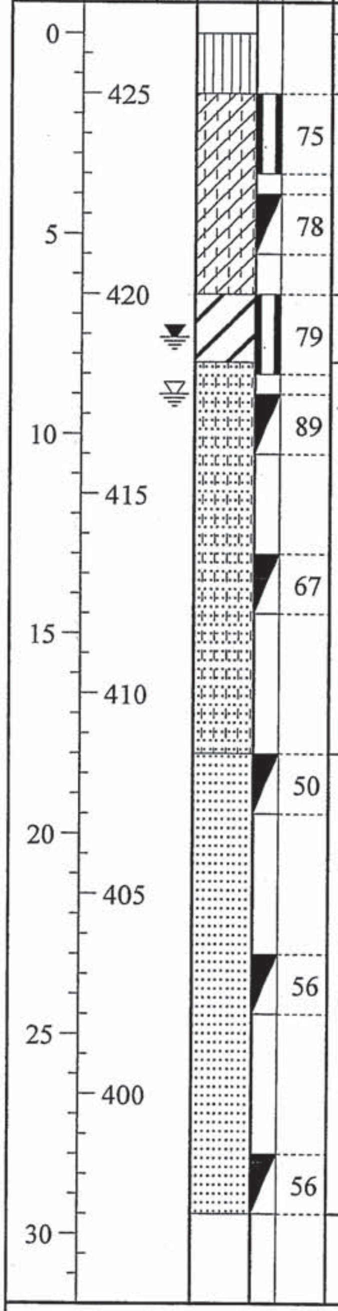
File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

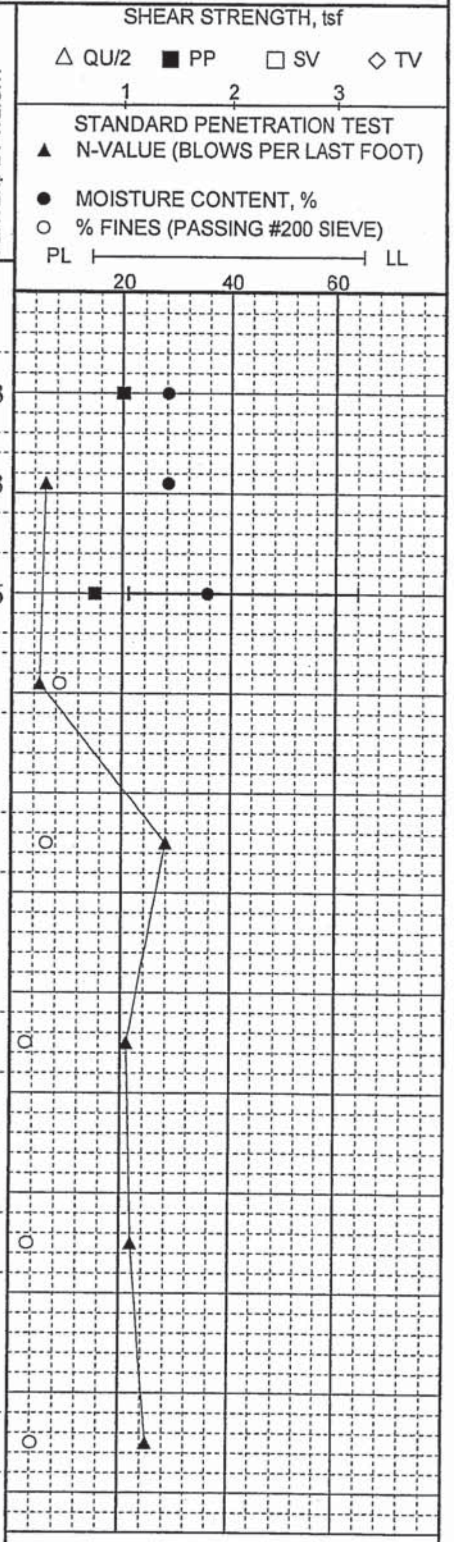
BORING LOG B-81

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116111 E 882032
ELEVATION: 426.5 DATUM: MSL
DATE DRILLED: 11/11/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), gray, loose, dry, sandy, with roots		
75	CLAY (CL), dark brownish gray, low plastic, moist, silty, with traces fine sand and limonite	92.1	28.3
78	Becoming tan and less silty	2-3-3	28.3
79	CLAY (CH), dark brownish gray, high plastic, moist, with silty clay laminations, trace of shells	86.8	35.6
89	SAND (SP-SM), tan, fine-grain, loose, slightly silty Note: switched to mud rotary at 9.0 feet	2-2-3	
67	With trace of medium-grain sand and medium dense	6-12-16	
50	SAND (SP), tan, medium- to fine-grain, medium dense, trace of coarse-grain sand 6" stiff gravel or cobble layer	6-11-10	
56	Without coarse-grain sand	8-9-13	
56		12-14-11	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 7.57 FEET AFTER 192 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2005012477

Figure A-24 Sheet 1 of 1

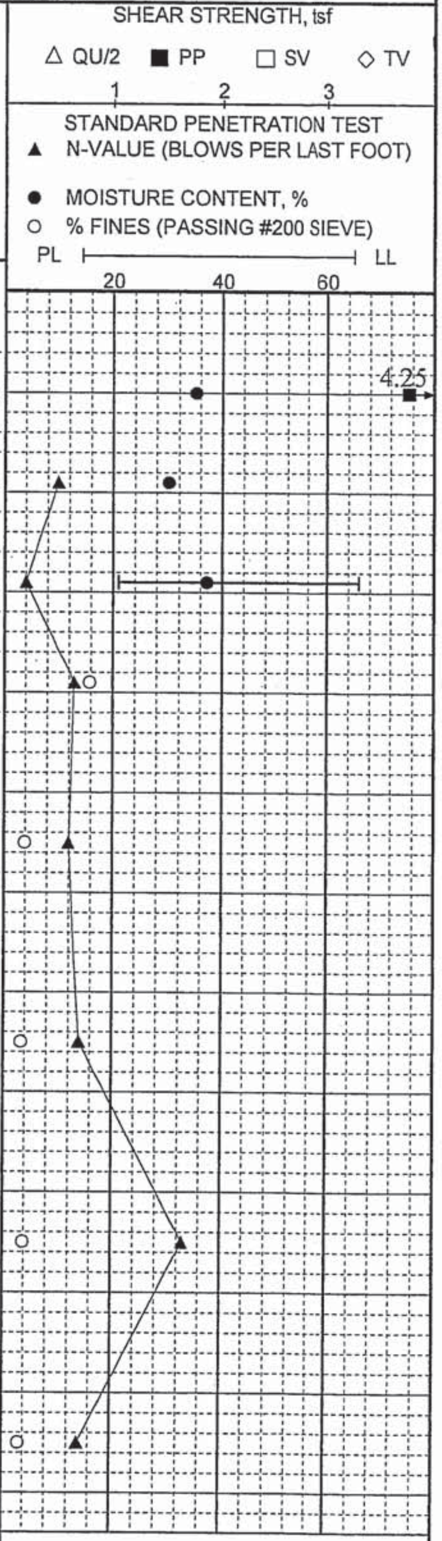
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-82

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116041 E 881768
ELEVATION: 425.1 DATUM: MSL
DATE DRILLED: 11/9/2005

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	425		SILT (ML), gray, loose, dry, sandy		
			CLAY (CL), brown, low plastic, silty		
		75	CLAY (CH), dark brownish gray, high plastic, moist, stiff, with decaying vegitation, lignite, and limonite	86.3	35.2
5	420	61	Same without decaying vegitation	4-5-5	30.2
		78	Becoming soft with fine roots	1-2-2	37.2
10	415	56	Silty SAND (SM), tan, medium- to fine-grain, medium dense Note: switched to mud rotary at 9.0 feet	5-6-7	
		56	SAND (SP) tan, medium- to fine-grain, medium dense	7-6-6	
15	410				
		56	Becoming more coarse-grained, with traces of fine gravel	5-5-9	
20	405				
		50	SAND (SP), tan, fine-grain, dense, trace of medium-grain sand	8-14-19	
25	400				
		61	SAND (SW), well graded, medium dense	5-6-8	
30	395		Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9.0 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.72 FEET AFTER 192 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

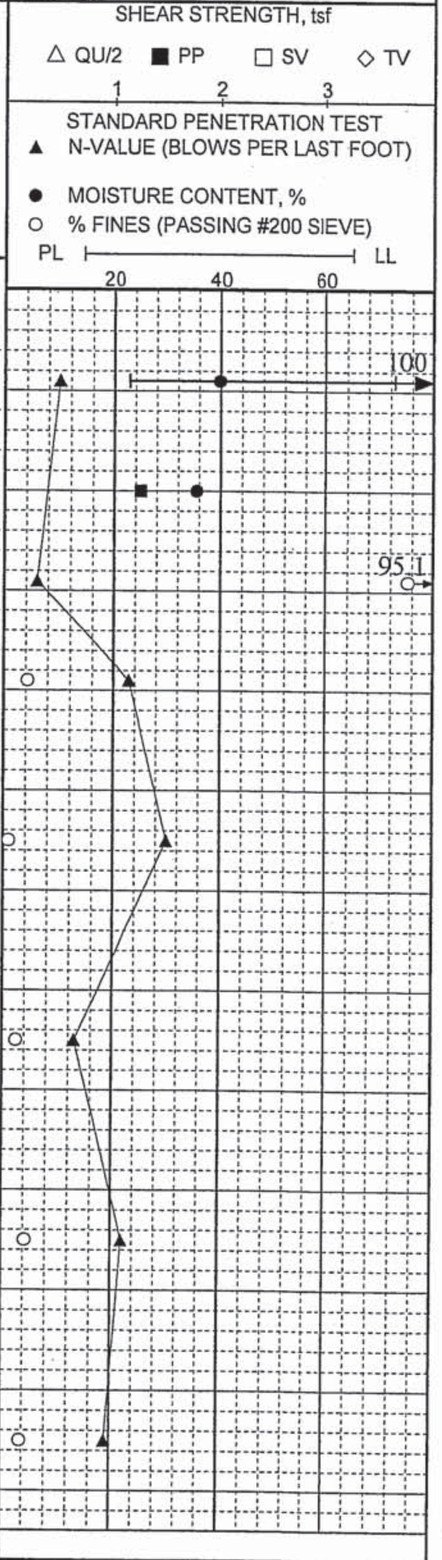
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-83

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116184 E 881538
ELEVATION: 425.9 DATUM: MSL
DATE DRILLED: 11/9/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	425			SILT (ML), gray, loose, dry, with sand, trace fine roots		
			67	CLAY (CL), brown and gray, low plastic, silty	2-4-6	39.9
				CLAY (CH), gray, high plastic, stiff, moist with traces of limonite		
5	420		100	Becoming slightly silty, blocky, and slick-n-sided	84.8	35.6
		▽	89	SILT (ML), tan, loose, with fine-grain sand	2-3-3	
10	415		67	SAND (SP), tan, fine-grain, medium dense, trace of medium-grain sand Note: switched to mud rotary at 9.0 feet	4-10-13	
			56	Becoming medium- to fine-grain sand	7-13-17	
15	410					
			50	With traces of fine gravel	5-6-7	
20	405					
			50	SAND (SP), gray and tan, coarse-, medium-, and fine-grain, medium dense, trace of fine gravel	6-9-13	
25	400					
			56	SAND (SW), gray, well graded, medium dense, with traces of fine gravel	4-9-10	
30	395			Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-26 Sheet 1 of 1

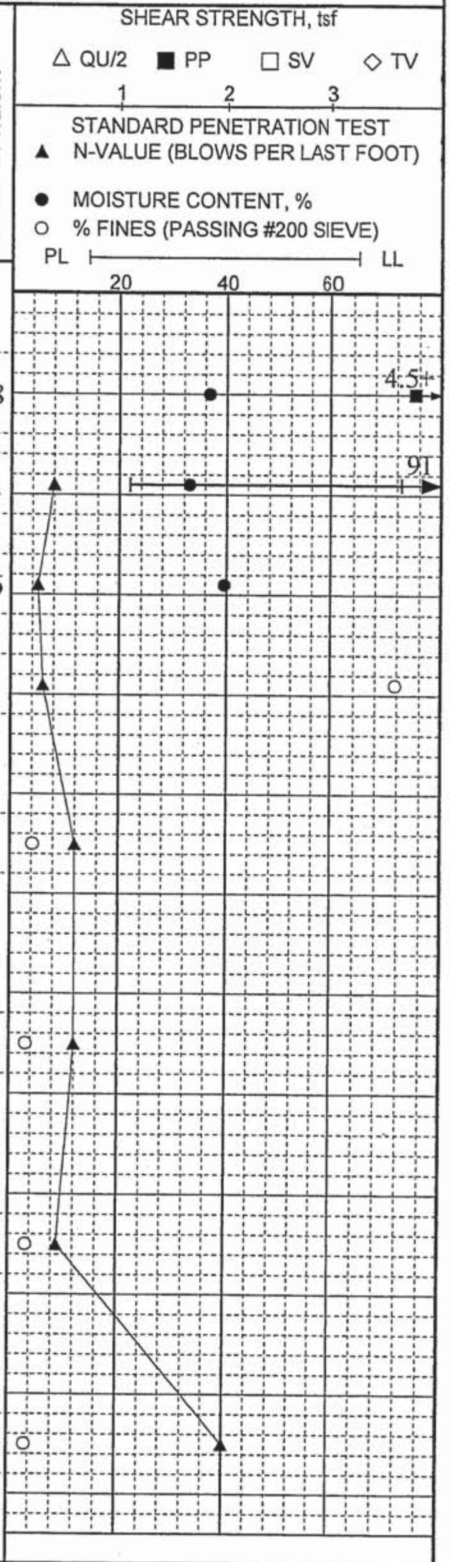
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-84

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116113 E 881272
ELEVATION: 425.4 DATUM: MSL
DATE DRILLED: 11/9/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	425				SILT (ML), gray, loose, dry, sandy, trace fine roots		
				67	CLAY (CH), gray-brown, high plastic, stiff, moist, with lignite and limonite, decomposing organics	84.3	36.8
5	420			61	Becoming firm without decaying organics	4-4-4	33.1
		▼		100		2-2-3	39.6
10	415	▽		89	SILT (ML), brown, loose, with fine-grain sand and clay balls Note: switched to mud rotary at 9.0 feet	2-2-4	
				61	SAND (SP), tan, medium- to fine-grain, medium dense	5-7-5	
15	410						
				61	With coarse-grain sand and fine gravel	5-7-5	
20	405						
				50	Becoming less coarse and loose	4-5-4	
25	400						
				61	Becoming dense	9-19-21	
					Boring terminated by engineer at 29.5 feet		
30	395						



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ____
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.3 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

Figure A-27 Sheet 1 of 1

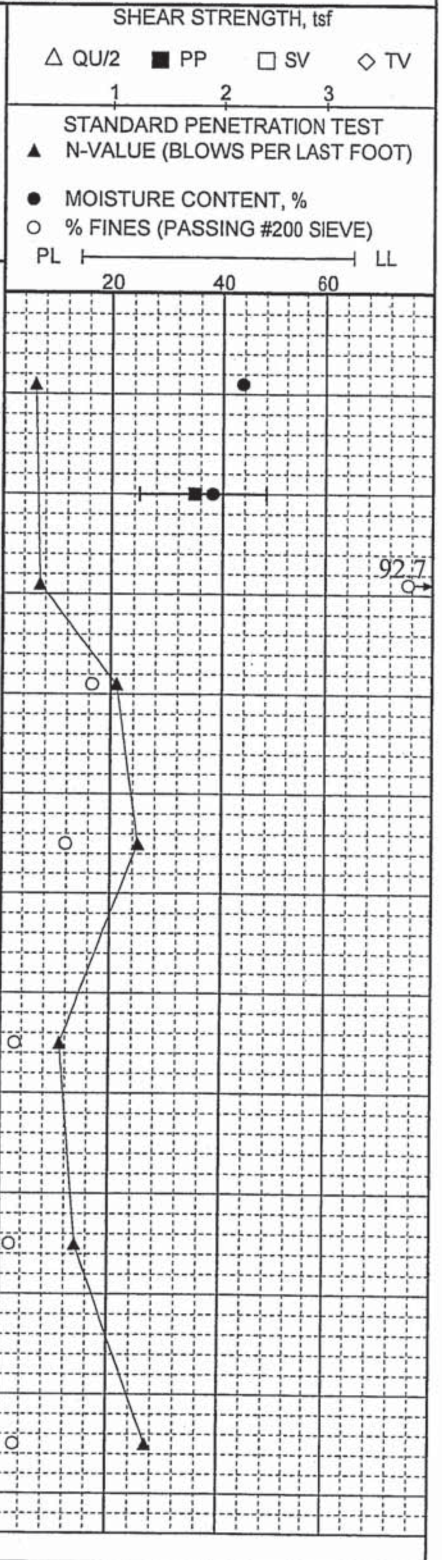
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-85

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116254 E 881045
ELEVATION: 426.0 DATUM: MSL
DATE DRILLED: 11/8/2005

PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, dry, sandy, with roots		
61	CLAY (CL), brown, low plastic, very moist, with trace of lignite	1-3-3	43.7
100	Becoming slick-n-sided, more silty near bottom of tube	79.3	38.2
67	SILT (ML), tan, loose, with fine-grain sand	4-4-3	
56	Silty SAND (SM), brown, fine-grain, medium dense Note: switched to mud rotary at 9.0 feet	8-11-10	
67	SAND (SP-SM), tan, medium- to fine-grain, medium dense, slightly silty with trace coarse-grain sand and fine gravel	9-13-12	
56	SAND (SP) tan, medium- to fine-grain, medium dense, with fine gravel	6-5-6	
50		6-5-9	
44		7-10-17	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ______ FEET AFTER ____ HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

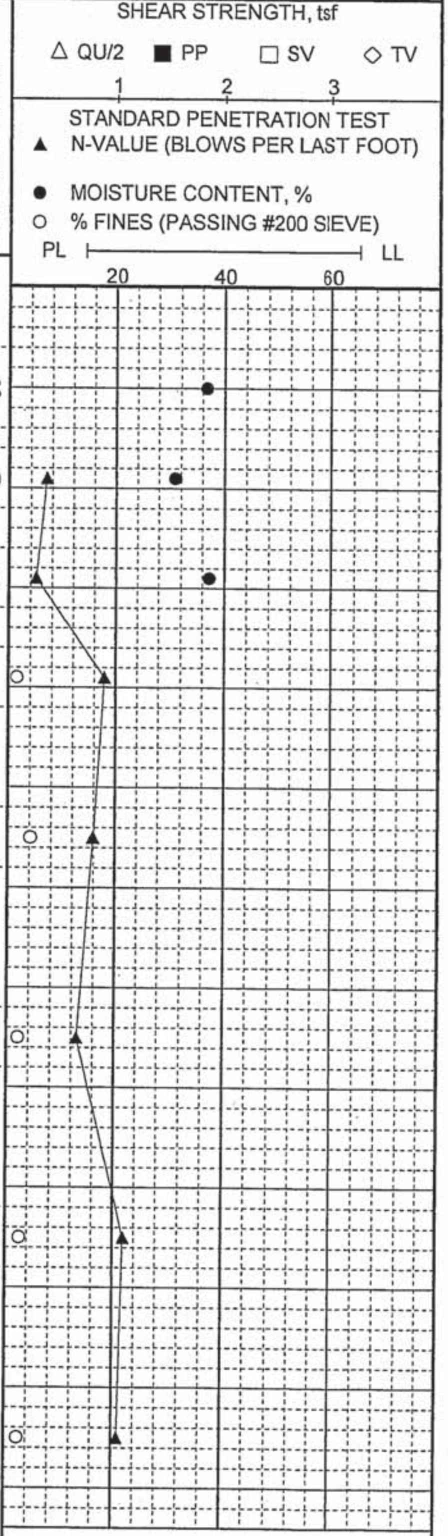
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-86

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116186 E 880783
ELEVATION: 426.1 DATUM: MSL
DATE DRILLED: 11/8/2005

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	425		SILT (ML), tan, loose, dry, sandy, with roots		
		75	CLAY (CH), brownish gray, high plastic, firm, moist, trace of lignite and laminations of silty clay	79.9	36.8
5	420	72	CLAY (CL), gray-tan, low plastic, firm, very moist	3-3-4	31.0
		89		1-2-3	37.3
10	415	56	SAND (SP), tan, fine-grain, medium dense, dry Note: switched to mud rotary at 9.0 feet	6-8-10	
		50	Becoming medium- to fine-grain sand	7-7-9	
15	410				
		39	With trace fine gravel	6-7-6	
20	405				
		50	Becoming more coarse, with fine gravel	6-11-11	
25	400				
		44		11-12-9	
30			Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 13 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.0 FEET AFTER 48 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-29 Sheet 1 of 1

File: 2005012477

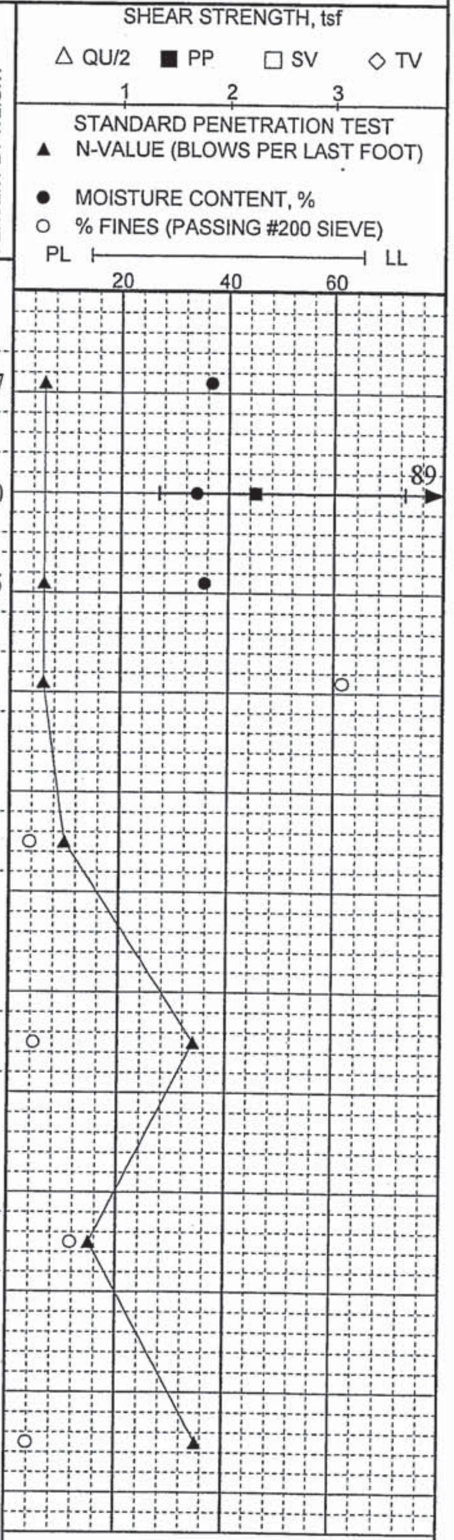
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-87

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116326 E 880552
ELEVATION: 426.4 DATUM: MSL
DATE DRILLED: 11/8/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						SILT (ML), brown and gray, loose, sandy		
	425					CLAY (CL), brown and gray, low plastic, silty		
					67	CLAY (CL), gray, low plastic, firm, very moist, trace fine roots and limonite	2-3-3	36.7
5					100	CLAY (CH), gray-brown and brown, high plastic, moist, stiff, blocky, slick-n-sided, traces of lignite and limonite	83.8	34.0
	420	▽			83	With laminations of silty clay	2-3-3	35.5
						SILT (ML), tan, loose, with fine-grain sand		
		▼						
10					56		5-2-4	
	415					Note: switched to mud rotary at 9.0 feet		
					56	SAND (SP), tan, medium- to fine-grain, loose, trace of coarse-grain sand	9-5-5	
15								
	410							
					56	With trace fine gravel, dense	9-15-19	
20								
	405							
					56	SAND (SP-SM), tan, medium- to fine-grain, medium dense, slightly silty, traces of coarse-grain sand and fine gravel	6-7-8	
25								
	400							
					28	SAND (SP), tan, medium- to fine-grain, dense	11-15-20	
30						Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 9.4 FEET AFTER 48 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

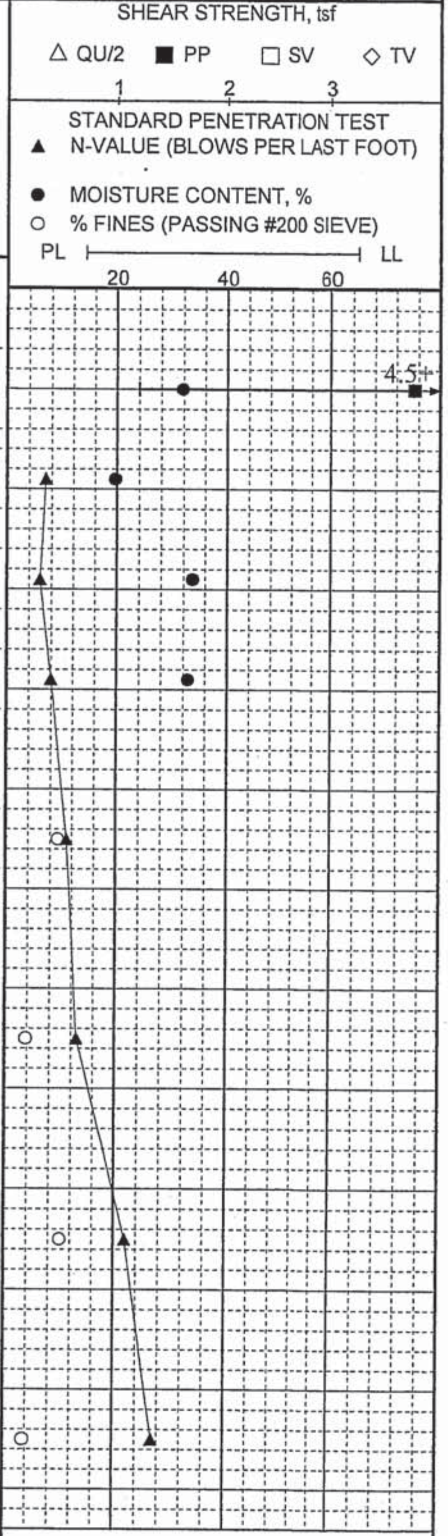
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-88

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116255 E 880287
ELEVATION: 427.8 DATUM: MSL
DATE DRILLED: 11/8/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				SILT (ML),brown, loose, dry, slightly clayey, with roots and fine sand		
	425		67	CLAY (CH), dark grayish brown, high plastic, moist, stiff, lamination and pockets of sandy silt	88.4	31.9
5			72	SILT (ML), tan, loose, dry, with fine-grain sand	3-4-3	19.7
		▼ ▽				
	420		72	Becoming less sandy, with clay and traces of limonite, very moist	1-2-4	33.7
10			83		3-1-7	32.9
				Note: switched to mud rotary at 9.0 feet		
	415		78	SAND (SP-SM), grayish tan, fine-grain, medium dense, slightly silty	6-6-5	
15						
	410		39	SAND (SP), tan, medium- to fine-grain, medium dense, trace of coarse-grain sand and fine to coarse gravel	6-7-6	
20						
	405		50	SAND (SP-SM), tan, medium- to fine-grain, medium dense, slightly silty, with coarse gravel	6-8-14	
25						
	400		56	SAND (SP), grayish tan, coarse- to medium-grain, medium dense, with fine and coarse gravel	7-9-18	
30						



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 6.4 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2005012477

Figure A-31 Sheet 1 of 2

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-88

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf △ QU/2 ■ PP ☐ SV ◇ TV 1 2 3 ▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT) ● MOISTURE CONTENT, % ○ % FINES (PASSING #200 SIEVE) PL ├──┤ LL 20 40 60
35 40 45 50 55 60 65	395 390 385 380 375 370 365 360					Boring terminated by engineer at 29.5 feet			

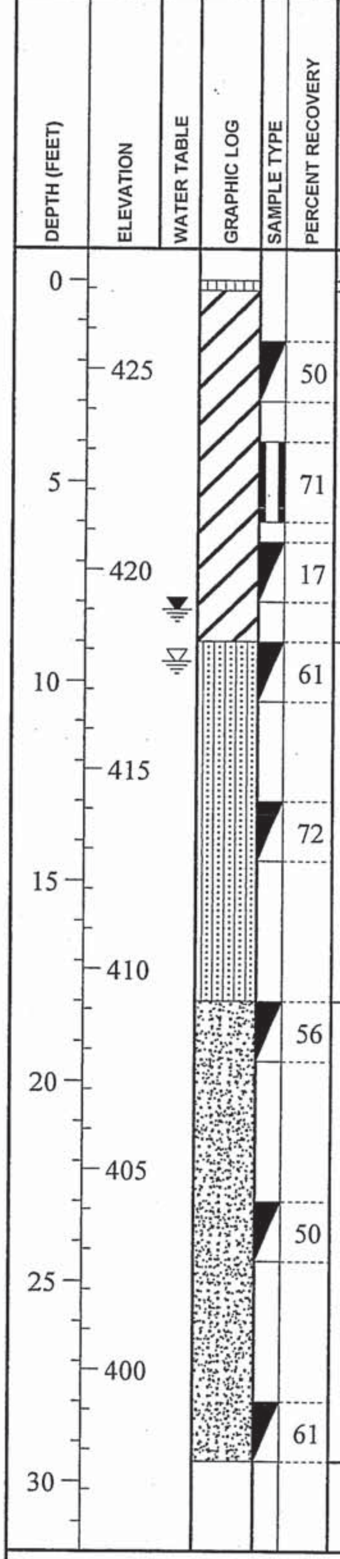
File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

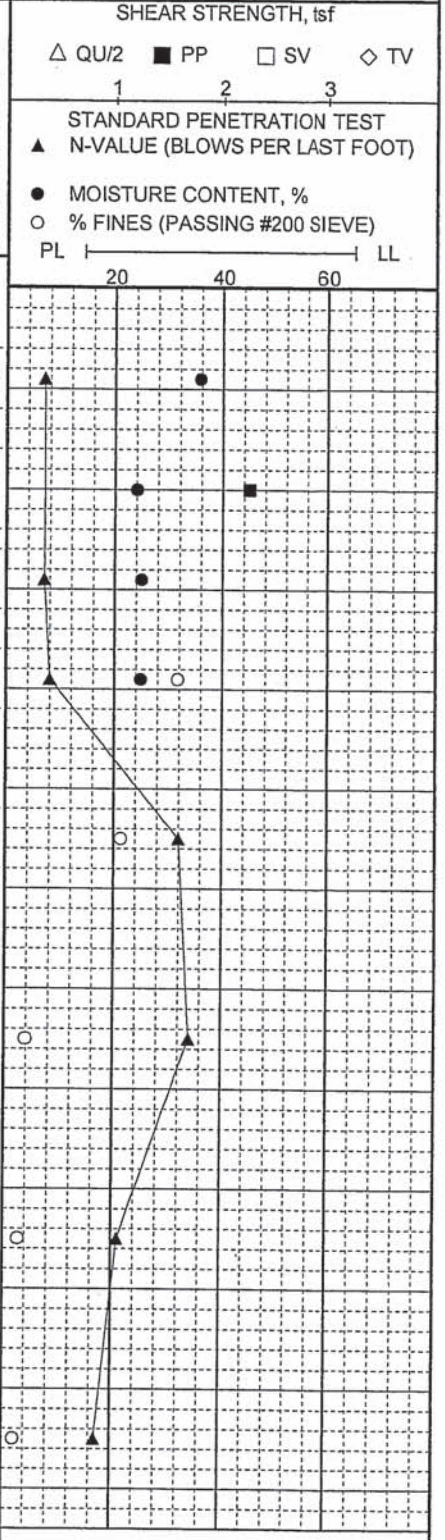
BORING LOG B-89

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116401 E 880055
ELEVATION: 427.2 DATUM: MSL
DATE DRILLED: 11/8/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, sandy		
50	CLAY (CH), grayish brown, high plastic, firm, moist	2-2-5	35.7
71	Becoming slick-n-sided, blocky, with 3" to 4" layers of sandy silt throughout	87.1	24.1
17		2-4-3	25.0
61	Silty SAND (SM), gray, fine-grain, loose Note: switched to mud rotary at 9.0 feet	3-4-4	24.9
72	With trace medium-grain sand	5-11-21	
56	SAND (SW), brown and gray, well graded, dense, with fine gravel and traces of coarse gravel	9-15-19	
50	Becoming medium dense	6-10-11	
61		5-8-12	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.2 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2005012477

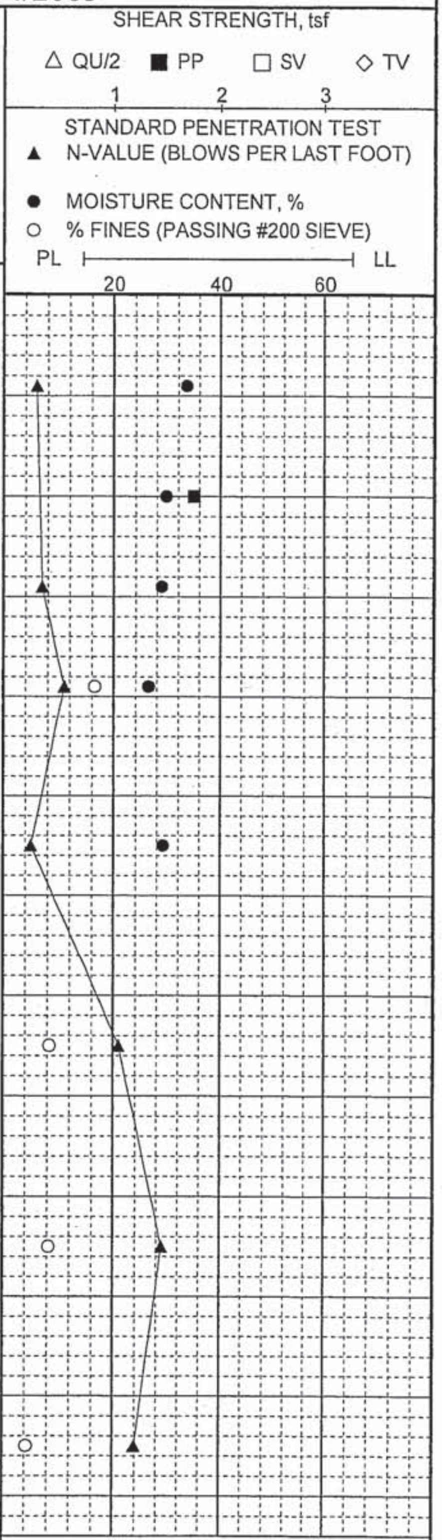
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-90

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116330 E 879798
ELEVATION: 427.7 DATUM: MSL
DATE DRILLED: 11/4/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						SILT (ML), gray, loose, sandy		
	425				44	CLAY (CH), dark brown, high plastic, firm, moist, laminations of silt	3-3-3	33.6
5					88		83.3	29.8
	420	▼			61	SILT (ML), tannish gray, loose, moist, with fine sand Becoming clayey	4-4-3	28.9
10					61	Silty SAND (SM), tan and brown, fine-grain, medium dense Note: switched to mud rotary at 9.0 feet	3-7-4	26.5
15	415				89	SILT (ML), brown to dark gray, loose, with fine-grain sand and traces of clay	1-2-3	29.2
20	410				56	SAND (SP-SM) tan, fine-grain, medium dense, slightly silty	5-10-11	
25	405				56	With trace of medium-grain sand and fine gravel	6-11-18	
	400				56	SAND (SP), tan, medium- to fine-grain, medium dense, trace of coarse-grain sand	9-12-12	
30						Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 7.8 FEET AFTER 148 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2005012477

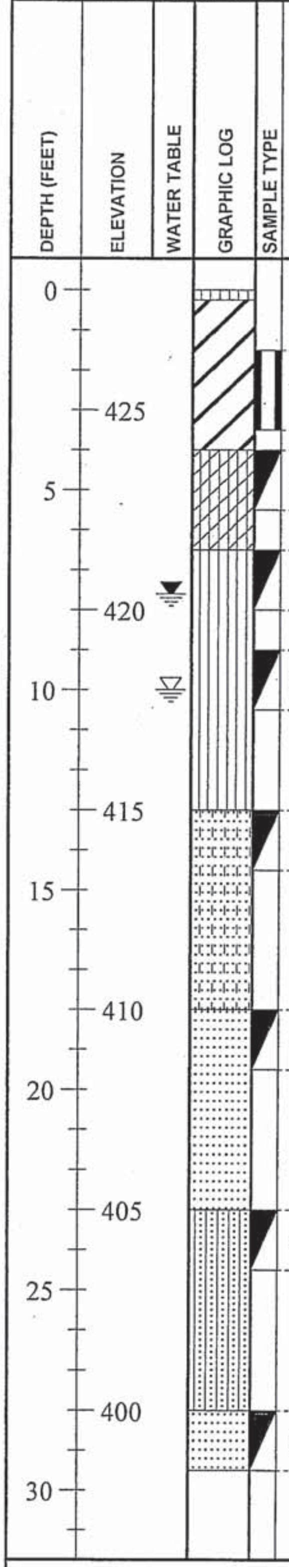
Figure A-33 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

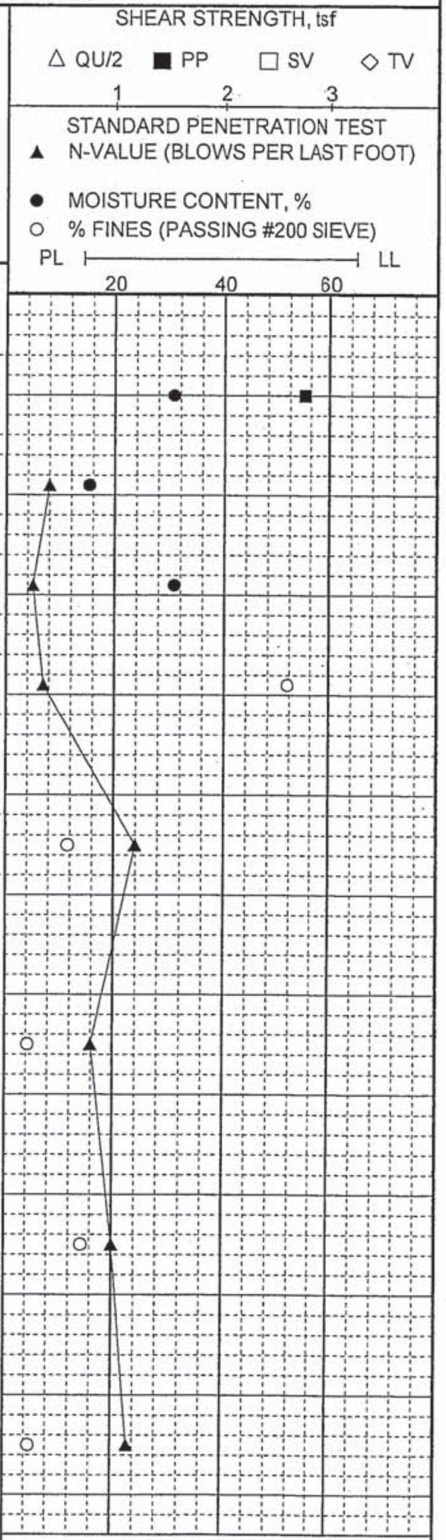
BORING LOG B-91

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116474 E 879569
ELEVATION: 428.0 DATUM: MSL
DATE DRILLED: 11/9/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, dry, sandy		
100	CLAY (CH), dark grayish brown, high plastic, firm, moist, with lignite and limonite Becoming silty with depth	87.2	30.8
67	Silty CLAY / Clayey SILT, brown and tan, firm, dry, highly laminated	3-4-4	15.4
78	SILT (ML), gray and tan, loose, moist, slightly clayey, with traces of limonite	2-2-3	30.9
67	Becoming more sandy Note: switched to mud rotary at 9.0 feet	2-3-4	
67	SAND (SP-SM), tan, fine-grain, medium dense, slightly silty	5-10-14	
44	SAND (SP), tan, coarse-, medium-, and fine-grain, medium dense, traces of fine gravel	8-8-8	
39	Silty SAND (SM), gray, medium- to fine-grain, medium dense, with trace of coarse gravel	5-8-12	
39	SAND (SP), gray, medium- to fine-grain, medium dense	10-12-11	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 7.6 FEET AFTER 144 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-34 Sheet 1 of 1

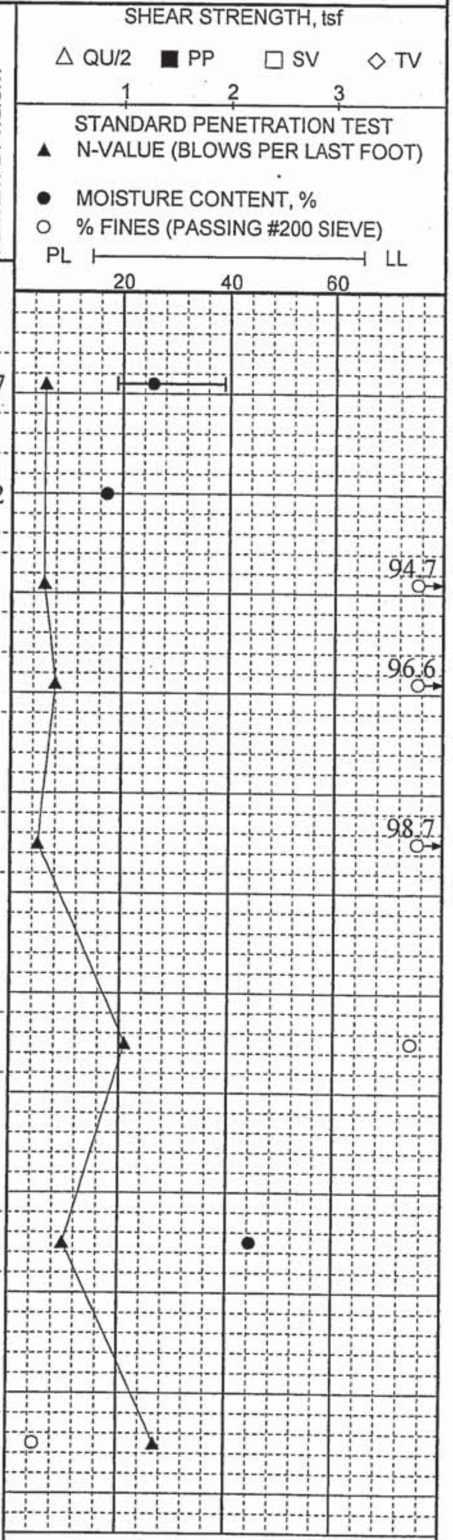
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-92

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116407 E 879303
ELEVATION: 428.6 DATUM: MSL
DATE DRILLED: 11/10/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0					SILT (ML), brown, loose, sandy		
	425		◢	50	CLAY (CL), brown and gray, low plastic, firm, moist, silty Becoming more silty near bottom of sample	1-3-3	25.7
5			▮	75	SILT (ML), tan, loose, dry, with fine-grain sand	81.3	17.2
	420	▼	◢	72		1-3-3	
10		▽	◢	78	Note: switched to mud rotary at 9.0 feet	3-3-5	
15	415		◢	89	Becoming gray, with traces of clay	1-2-3	
20	410		◢	56	Becoming medium dense, more sandy	5-10-11	
25	405		◢	89	CLAY (CL), blue-gray, low plastic, stiff, very moist, with traces of silt and seams of fine-grain sand and silt	6-4-6	44.4
	400		◢	78	SAND (SP), tan, fine-grain, medium dense	6-12-15	
30					Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 7.4 FEET AFTER 144 HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-35 Sheet 1 of 1

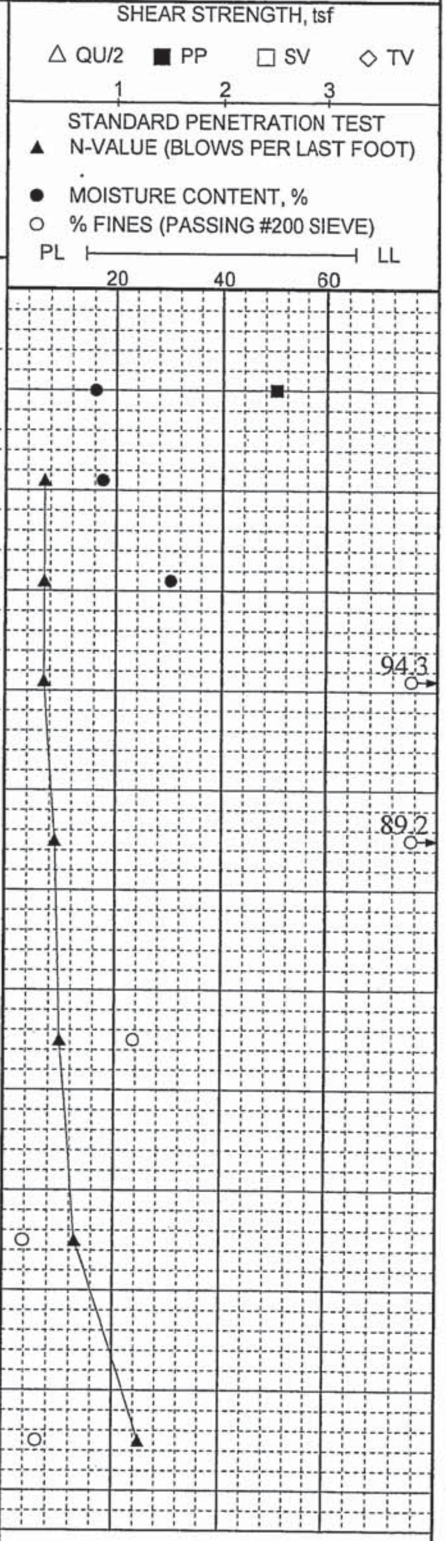
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-93

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116544 E 879069
ELEVATION: 429.0 DATUM: MSL
DATE DRILLED: 11/11/2005

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0			SILT (ML), brown, loose, dry, sandy		
			CLAY (CL), dark brown, low plastic, slightly silty		
	425	92	SILT (ML), tan, loose, dry, slightly clayey, with fine-grain sand	78.4	16.2
5		56	With traces of limonite	3-3-4	17.5
		67	Becoming very moist	3-2-5	30.3
10	420	67		2-3-4	
			Note: switched to mud rotary at 9.0 feet		
15	415	78	With clay balls	3-4-5	
20	410	56	Silty SAND (SM), tan, medium- to fine-grain, loose	1-2-8	
25	405	44	SAND (SW), well graded, medium dense, with fine gravel	6-4-9	
30	400	56	SAND (SP-SM), tan, fine-grain, medium dense, slightly silty, with traces of coarse- and medium-grain sand, traces of coarse and	17-18-17	



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.84 FEET AFTER 144 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

BORING LOG B-93

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
						fine gravel		
						Boring terminated by engineer at 29.5 feet		
	395							
35								
	390							
40								
	385							
45								
	380							
50								
	375							
55								
	370							
60								
	365							
65								

SHEAR STRENGTH, tsf

△ QU/2 ■ PP ☐ SV ◇ TV

1 2 3

▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (PASSING #200 SIEVE)

PL ⊢—⊣ LL

20 40 60

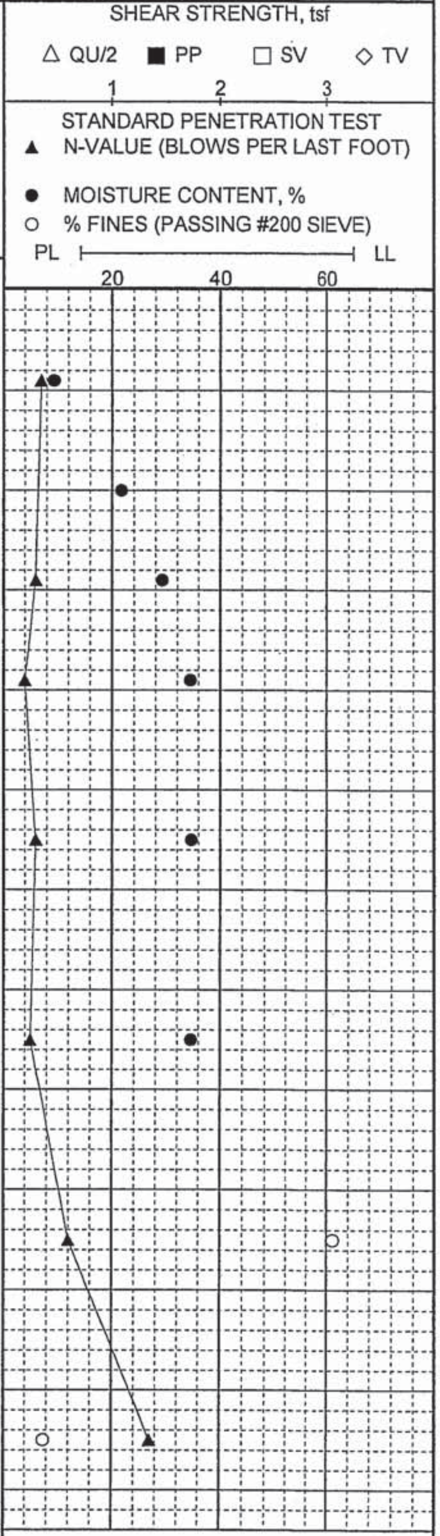
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-94

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116482 E 878805
ELEVATION: 429.6 DATUM: MSL
DATE DRILLED: 11/11/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT.
0						SILT (ML), gray, loose, dry, with fine-grain sand		
					72	With fine roots	4-3-4	9.4
5	425				96	Becoming moist and slightly clayey	83.4	21.7
		▼			56		2-3-3	29.3
10	420	▽			67	Becoming very moist	3-2-2	34.5
						Note: switched to mud rotary at 9.0 feet		
					78	With trace of lignite	1-2-4	34.7
15	415							
					56	Becoming brown and gray	1-3-2	34.6
20	410							
					28	Becoming more sandy and medium dense	7-8-4	
25	405							
					78	SAND (SW-SM), gray, well graded, medium dense, slightly silty	6-12-15	
						Boring terminated by engineer at 29.5 feet		
30	400							



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ____
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 7.58 FEET AFTER 144 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

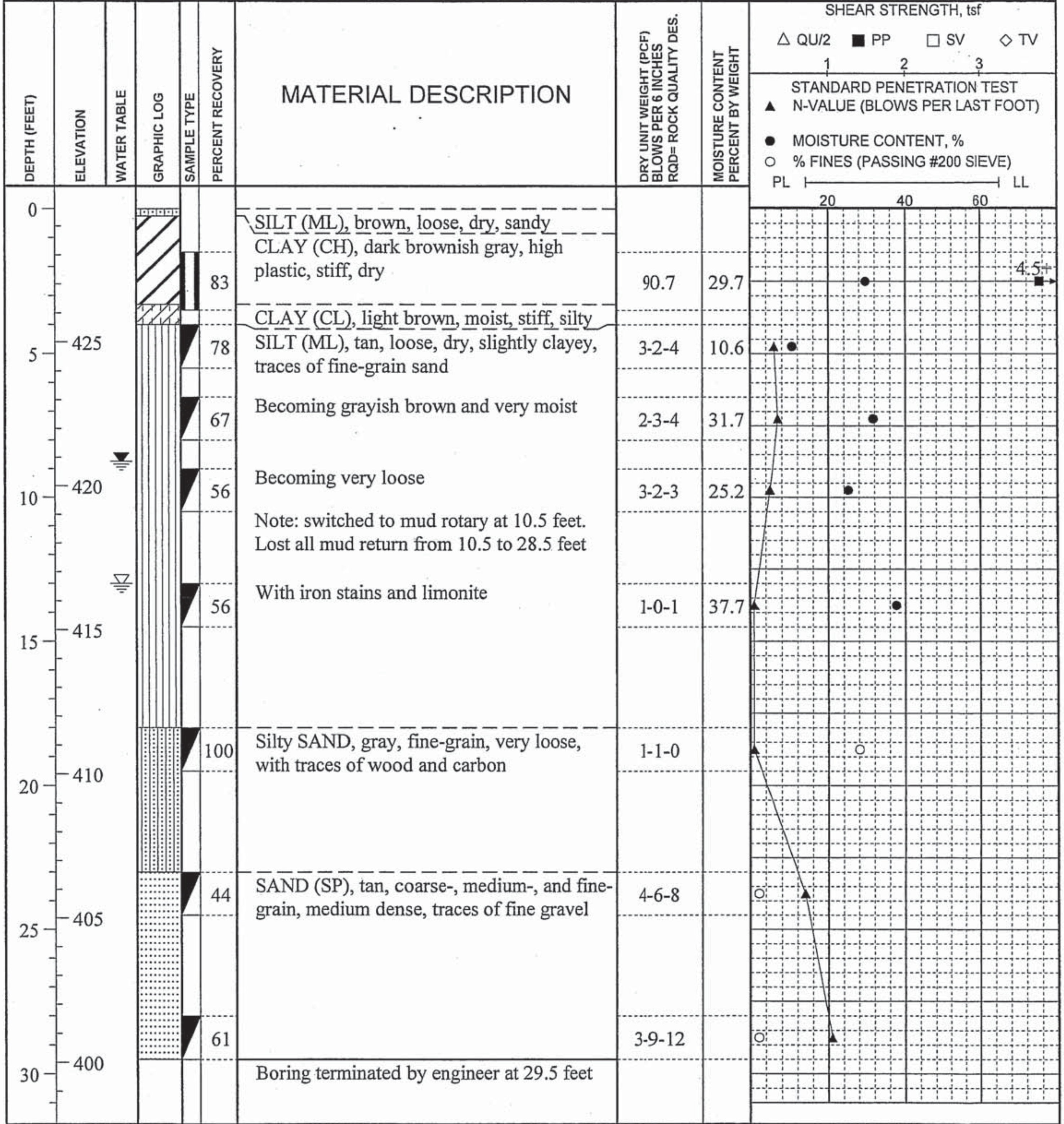
File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-95

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116615 E 878566
ELEVATION: 429.6 DATUM: MSL
DATE DRILLED: 11/11/2005



MATERIAL DESCRIPTION	PERCENT RECOVERY	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
SILT (ML), brown, loose, dry, sandy			
CLAY (CH), dark brownish gray, high plastic, stiff, dry	83	90.7	29.7
CLAY (CL), light brown, moist, stiff, silty			
SILT (ML), tan, loose, dry, slightly clayey, traces of fine-grain sand	78	3-2-4	10.6
Becoming grayish brown and very moist	67	2-3-4	31.7
Becoming very loose	56	3-2-3	25.2
Note: switched to mud rotary at 10.5 feet. Lost all mud return from 10.5 to 28.5 feet			
With iron stains and limonite	56	1-0-1	37.7
Silty SAND, gray, fine-grain, very loose, with traces of wood and carbon	100	1-1-0	
SAND (SP), tan, coarse-, medium-, and fine-grain, medium dense, traces of fine gravel	44	4-6-8	
	61	3-9-12	
Boring terminated by engineer at 29.5 feet			

DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 13 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.74 FEET AFTER 144 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2005012477

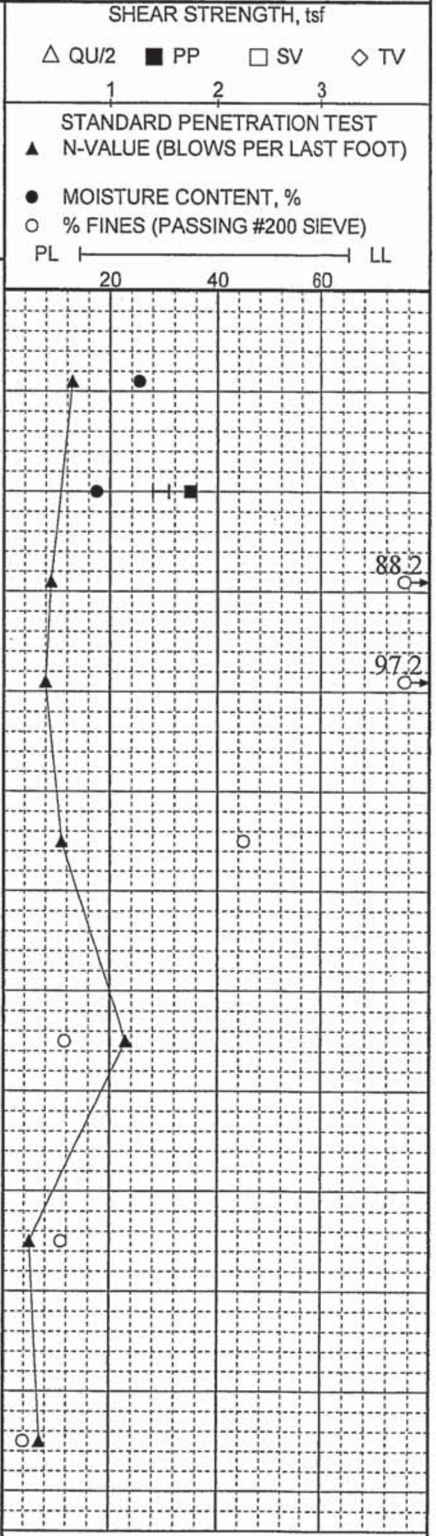
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-96

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116548 E 878293
ELEVATION: 430.1 DATUM: MSL
DATE DRILLED: 11/11/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	430				SILT (ML), gray, loose, dry, with roots		
				72	CLAY (CL), brown, low plastic, stiff, moist, with traces of fine-grain sand and silt	3-5-8	25.5
5	425			96	SILT (ML), light grayish tan, dry, loose, traces of clay and fine-grain sand, laminated	80.1	17.5
		▼		67		2-4-5	
10	420	∇		72	Becoming more clayey, traces of limonite Note: switched to mud rotary at 9.0 feet	2-3-5	
				56	Silty SAND (SM), grayish tan, fine-grain, medium dense	5-6-5	
15	415						
				72	SAND (SP-SM), grayish tan, fine-grain, medium dense, slightly silty	8-11-12	
20	410						
				67		2-2-3	
25	405						
				44	SAND (SW), gray, well graded, loose, with trace of fine gravel	3-3-4	
30	400				Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.01 FEET AFTER 144 HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

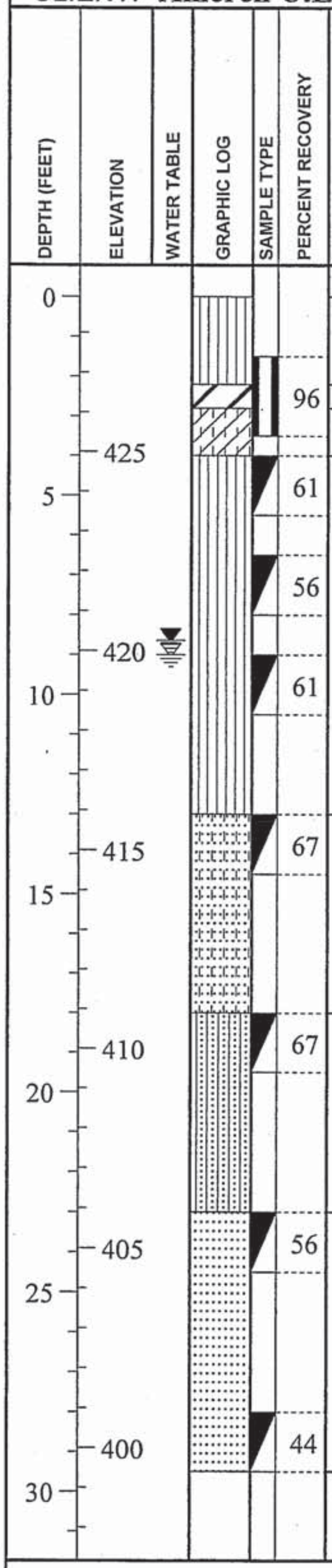
File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

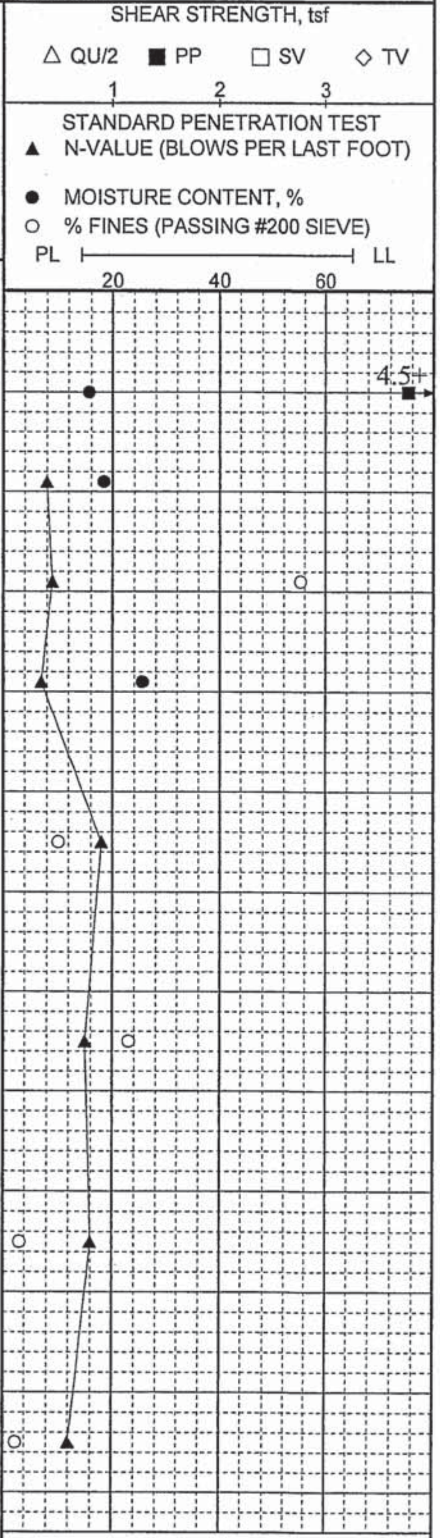
BORING LOG B-97

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116693 E 877998
ELEVATION: 428.9 DATUM: MSL
DATE DRILLED: 11/11/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, dry, with fine-grain sand Becoming grayish brown		
96	CLAY (CH), dark brownish gray, high plastic, firm, dry	95.9	15.7
61	CLAY (CL), tannish brown, firm, moist, slightly silty, trace fine-grain sand and fine roots	3-4-4	18.4
56	SILT (ML), tan, loose, dry, slightly clayey Becoming very sandy	2-4-5	
61	Becoming more clayey and moist Note: switched to mud rotary at 9.0 feet	3-3-4	25.5
67	SAND (SP-SM), tan, medium- to fine-grain, medium dense, slightly silty	6-8-10	
67	Silty SAND (SM), grayish tan, fine-grain, medium dense, trace of fine gravel	3-7-8	
56	SAND (SP), gray, medium- to fine-grain, medium dense	5-7-9	
44	With traces of fine gravel	6-6-6	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

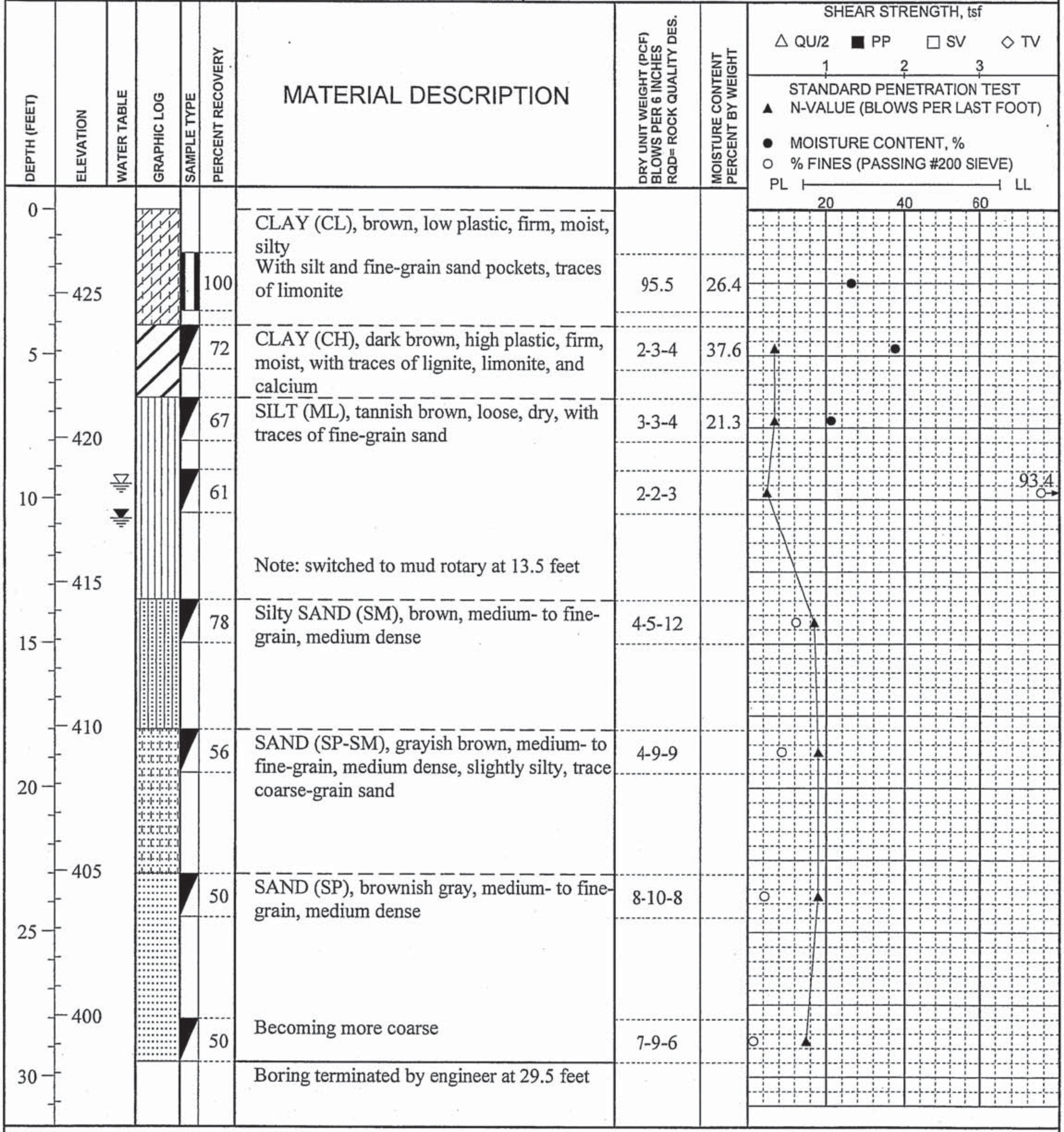
WATER LEVELS: DURING DRILLING 9 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.64 FEET AFTER 144 HOURS
AT ___ FEET AFTER ___ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-98

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116799 E 877871
ELEVATION: 427.9 DATUM: MSL
DATE DRILLED: 10/11/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	CLAY (CL), brown, low plastic, firm, moist, silty		
100	With silt and fine-grain sand pockets, traces of limonite	95.5	26.4
72	CLAY (CH), dark brown, high plastic, firm, moist, with traces of lignite, limonite, and calcium	2-3-4	37.6
67	SILT (ML), tannish brown, loose, dry, with traces of fine-grain sand	3-3-4	21.3
61		2-2-3	
	Note: switched to mud rotary at 13.5 feet		
78	Silty SAND (SM), brown, medium- to fine-grain, medium dense	4-5-12	
56	SAND (SP-SM), grayish brown, medium- to fine-grain, medium dense, slightly silty, trace coarse-grain sand	4-9-9	
50	SAND (SP), brownish gray, medium- to fine-grain, medium dense	8-10-8	
50	Becoming more coarse	7-9-6	
	Boring terminated by engineer at 29.5 feet		

DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 10.7 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

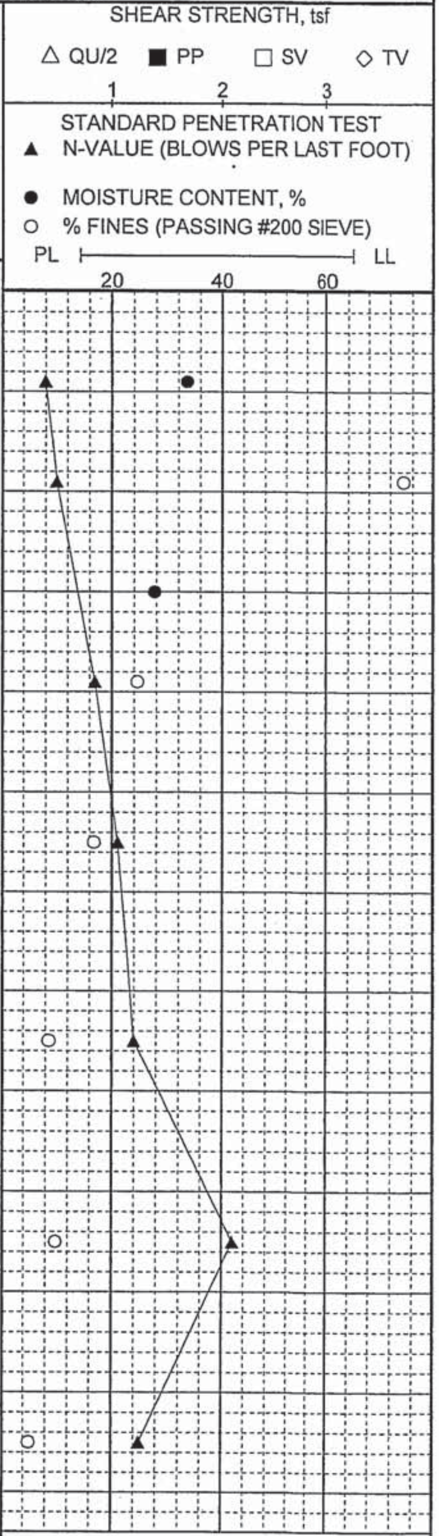
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-99

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116979 E 877810
ELEVATION: 428.2 DATUM: MSL
DATE DRILLED: 10/12/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						CLAY (CL), brown, low plastic, silty, with roots		
					72	CLAY (CH), dark brown, high plastic firm, moist, with fine sandy silt laminations, lignite, fine roots	3-2-6	33.6
	425							
5					78	SILT (ML), light tannish brown, medium dense, with fine grain sand	3-5-5	
					100	Becoming slightly clayey, with 3" layer of silty clay	93.6	27.7
	420	▼						
10					72	Silty SAND (SM), light brown, fine-grain, medium dense Note: switched to mud rotary at 9.0 feet	3-7-10	
	415	▽						
					50		8-10-11	
15								
	410							
					56	SAND (SP-SM), brown, fine-grain, medium dense, slightly silty, trace of medium grain sand	9-10-14	
20								
	405							
					83	With trace of fine gravel	8-18-24	
25								
	400							
					72	Becoming more coarse, with traces of decomposing wood	9-11-14	
30						Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 13.0 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.91 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-42 Sheet 1 of 1

File: 2005012477

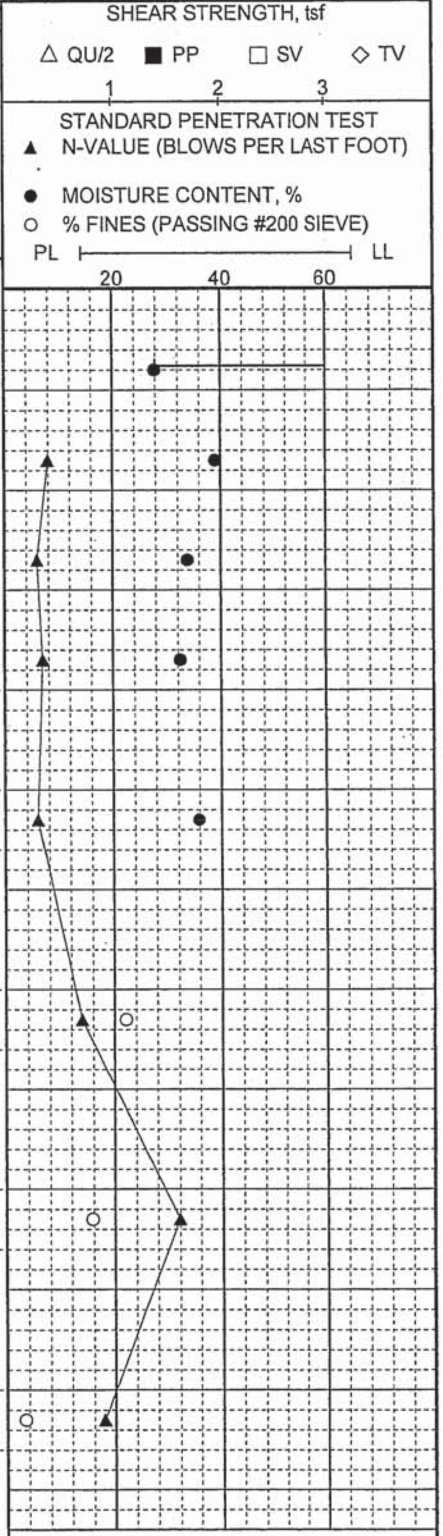
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-100

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117246 E 877666
ELEVATION: 427.3 DATUM: MSL
DATE DRILLED: 10/12/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				SILT (ML), brown, loose, dry, sandy		
				CLAY (CL), brown, moist, silty		
	425		96	CLAY (CH), brown, moist, firm, with traces of shells	92.4	27.9
5			78	Becoming more gray, with lignite and limonite	3-3-5	39.0
	420	∇	78	CLAY (CL), brownish gray, low plastic, firm, moist, silty, with laminations of silt and fine-grain sand	1-2-4	33.8
10		▼	89	SILT (ML), dark brownish gray, loose, very moist, with fine-grain sand in horizonal layers Note: switched to mud rotary at 8.5 feet	3-3-4	32.4
	415		72		2-2-4	35.8
15						
	410		61	Sitly SAND (SM), dark grayish brown, fine-grain, medium dense	6-7-7	
20						
	405		78	Becoming more coarse	10-15-17	
25						
	400		56	SAND (SP), dark grayish brown, coarse-, medium-, and fine-grain, medium dense, with traces of fine gravel	10-9-9	
30				Boring terminated by engineer at 29.0 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ____
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 6.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 9.29 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

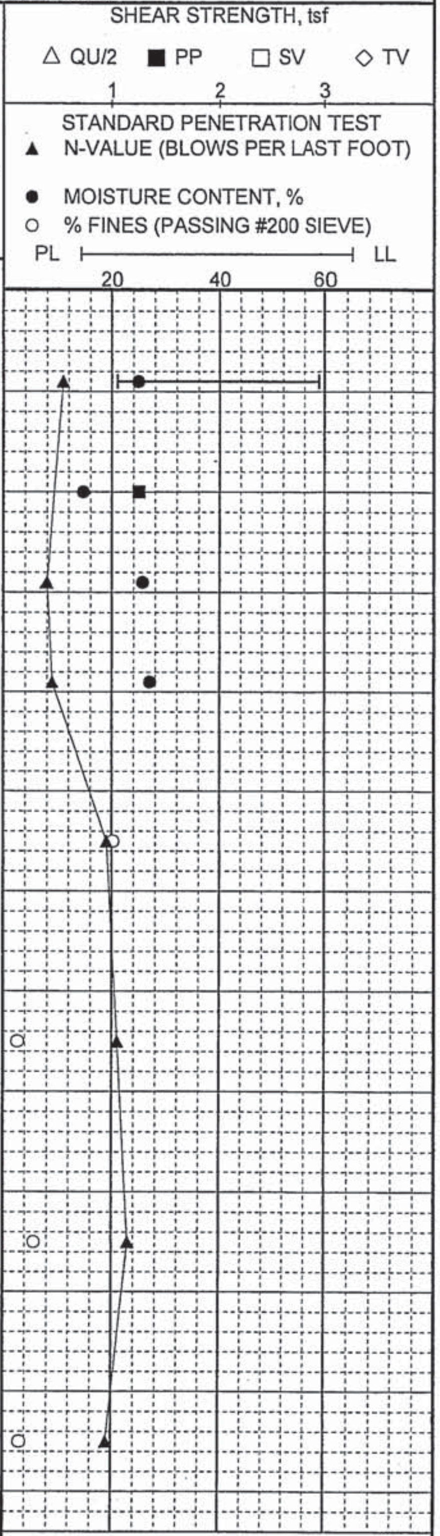
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-101

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117465 E 877497
ELEVATION: 428.7 DATUM: MSL
DATE DRILLED: 10/12/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				CLAY (CH), dark brown, high plastic, stiff, dry, with lignite and roots		
			83	With layer of silty clay	3-4-7	24.9
	425					
5			92	Becoming very stiff	92.0	14.7
				SILT (ML), light brown, dry, slightly clayey, with fine-grain sand		
			89	Becoming firm, moist, with laminations of silty clay	3-4-4	25.7
	420	▼ ▽				
10			83	Becoming stiff	3-5-4	27.0
				Note: switched to mud rotary at 9.0 feet		
	415		44	Silty SAND (SM), brown, medium- to fine-grain, medium dense	5-8-11	
15						
	410		50	SAND (SP), brown, medium- to fine-grain, medium dense	11-12-9	
20						
	405		56	SAND (SP-SM), brown, medium- to fine-grain, medium dense, slightly silty	10-11-12	
25						
	400		44	SAND (SP), brown, medium- to fine-grain, medium dense, with traces of coarse-grain sand	9-11-8	
30						



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 9.23 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

BORING LOG B-101

Sioux Power Plant UWLF

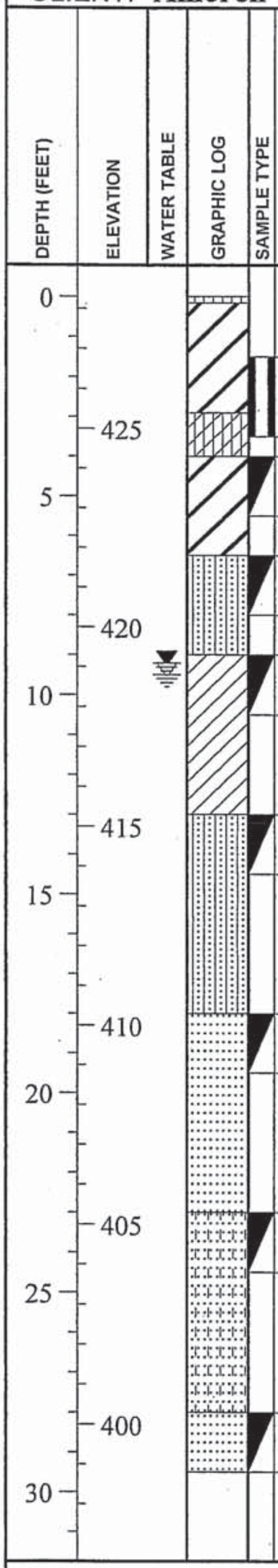
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf △ QU/2 ■ PP ☐ SV ◇ TV 1 2 3 ▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT) ● MOISTURE CONTENT, % ○ % FINES (PASSING #200 SIEVE) PL ├──┤ LL 20 40 60
						Boring terminated by engineer at 29.5 feet			
	395								
35									
	390								
40									
	385								
45									
	380								
50									
	375								
55									
	370								
60									
	365								
65									

REITZ & JENS, INC.
CONSULTING ENGINEERS

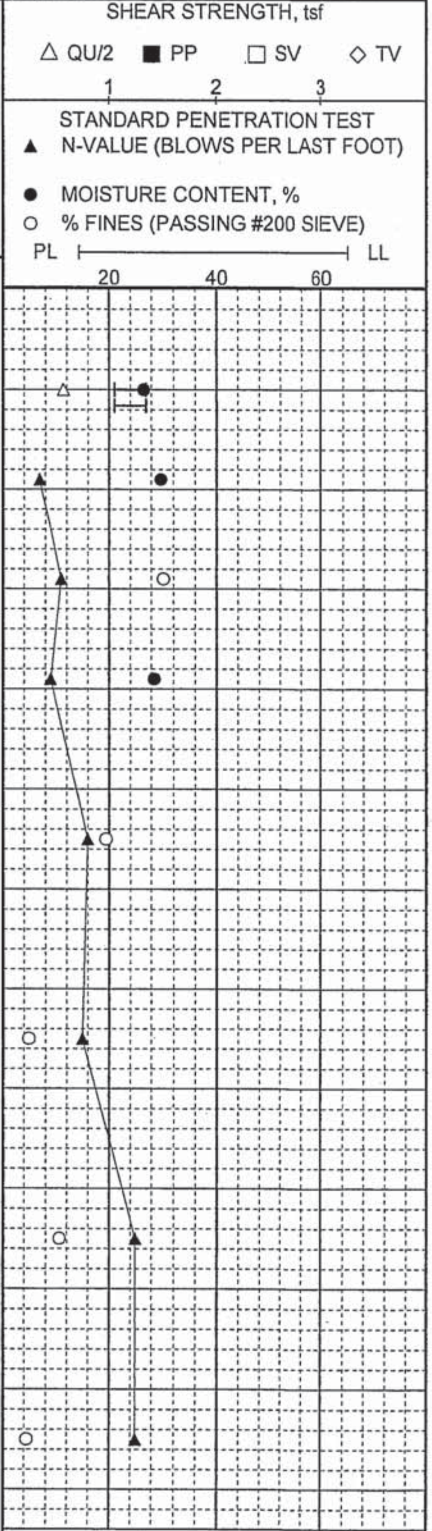
BORING LOG B-102

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117675 E 877664
ELEVATION: 428.3 DATUM: MSL
DATE DRILLED: 10/12/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, dry		
79	CLAY (CH), dark brown, high plastic, moist, with roots	92.4	26.6
	Sitly CLAY / Clayey SILT (CL-ML), dark brown, stiff, moist, with silt laminations		
78	CLAY (CH), dark brown, high plastic, moist, with traces of lignite and limonite, seam of silty clay	3-3-4	29.8
56	Silty SAND (SM), tannish brown, fine-grain, medium dense, dry	2-3-8	
72	CLAY (CL), dark brown, low plastic, stiff, moist, with lignite and limonite, 1" fine-grain sands seam Note: switched to mud rotary at 9.0 feet	1-5-4	28.5
72	Silty SAND (SP), brown, fine-grain, medium dense, with traces of medium-grain sand	6-7-9	
78	SAND (SP), brown, medium- to fine-grain, medium dense, traces of decomposed wood	3-7-8	
89	SAND (SP-SM), brown, fine-grain, medium dense, slightly silty	6-10-15	
50	SAND (SP), brown, medium- to fine-grain, medium dense, with trace of coarse-grain sand	14-12-13	



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 9.21 FEET AFTER 48 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-102

Sioux Power Plant UWLF

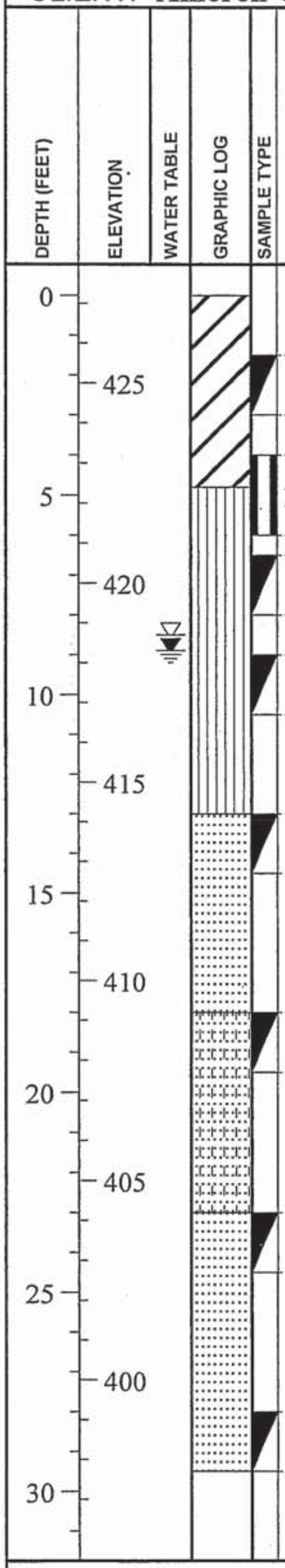
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf △ QU/2 ■ PP □ SV ◇ TV 1 2 3 STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT) ● MOISTURE CONTENT, % ○ % FINES (PASSING #200 SIEVE) PL ├──┤ LL 20 40 60
						Boring terminated by engineer at 29.5 feet			
	395								
35									
	390								
40									
	385								
45									
	380								
50									
	375								
55									
	370								
60									
	365								
65									

REITZ & JENS, INC.
CONSULTING ENGINEERS

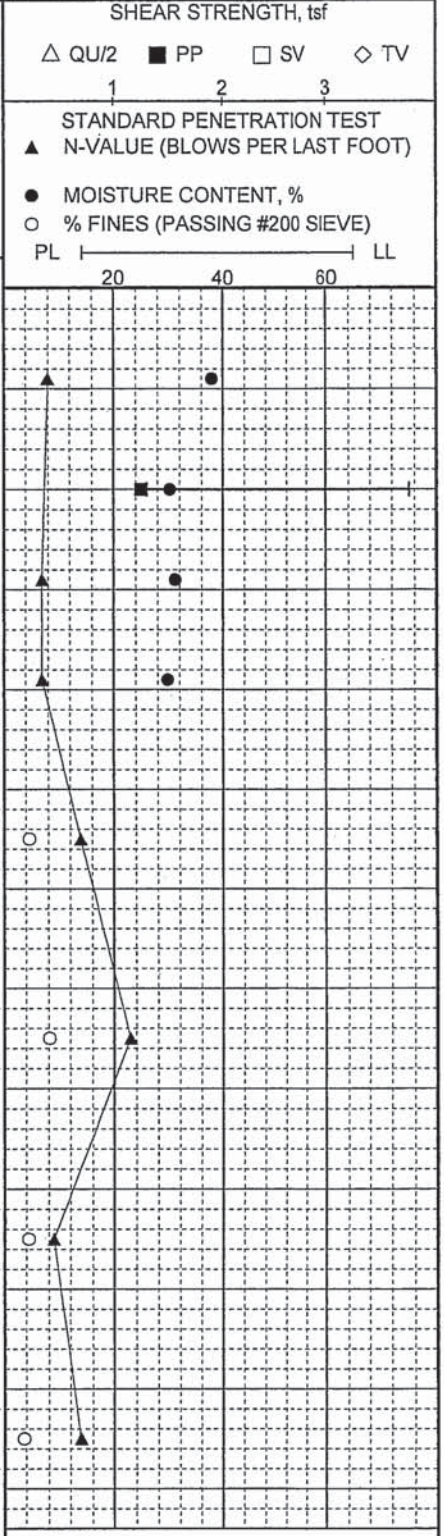
BORING LOG B-103

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117943 E 877639
ELEVATION: 427.2 DATUM: MSL
DATE DRILLED: 10/12/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
67	CLAY (CH), dark brown, high plastic, moist, firm, with traces of silty and fine-grain sand, roots With liginite and limonite	2-3-5	37.9
100	Becoming stiff, with silty clay seams SILT (ML), light brown, medium dense, moist, with traces of clay and fine-grain sand	85.3	30.2
89	Becoming more clayey and layered, loose	2-3-4	31.2
72	Becoming very sandy Note: switched to mud rotary at 9.0 feet	1-3-4	29.8
56	SAND (SP), brown, fine-grain, medium dense	6-6-8	
78	SAND (SP-SM), brown, fine-grain, medium dense, slightly silty	8-10-13	
56	SAND (SP), brown, coarse-, medium-, and fine-grain, loose	4-5-4	
39	Becoming gray in color	9-7-7	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 8.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.89 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

Figure A-46 Sheet 1 of 1

REITZ & JENS, INC.
CONSULTING ENGINEERS

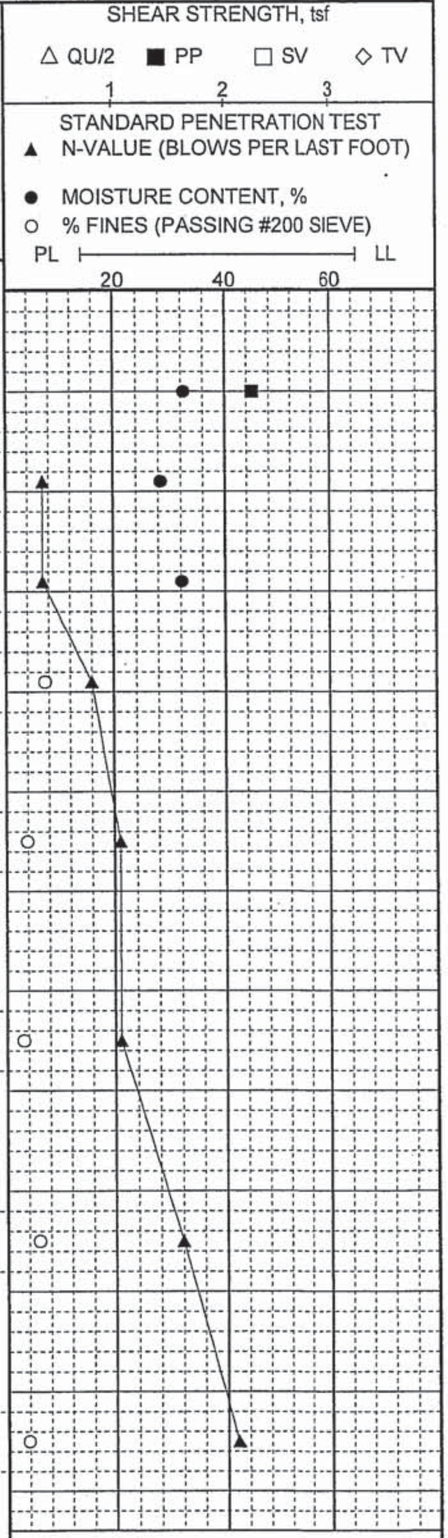
BORING LOG B-104

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118151 E 877802
ELEVATION: 427.1 DATUM: MSL
DATE DRILLED: 10/132005

DEPTH (FEET): 0, 5, 10, 15, 20, 25, 30
ELEVATION: 425, 420, 415, 410, 405, 400

PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, dry		
75	CLAY (CH), dark brown, high plastic, moist, stiff With thin silty clay seams	86.9	32.6
78	SILT (ML), tannish brown, moist, loose, with traces of clay and fine-grain sand With clayey silt lenses and seams	3-3-4	28.4
83	Becoming more gray, with clayey lenses and seams, traces of lignite and limonite	4-4-3	32.2
72	SAND (SP-SM), tan, fine-grain, medium dense, slightly silty Note: switched to mud rotary at 9.0 feet	5-7-9	
67	SAND (SP), tan, fine- to medium-grain, medium dense	7-9-12	
67		5-7-14	
56	SAND (SP-SM), tan, fine- to medium-grain, dense, slightly silty	9-16-16	
39	SAND (SP), tan, fine- to medium-grain, dense	12-17-25	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 13.6 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.52 FEET AFTER 24 HOURS
AT _____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-47 Sheet 1 of 1

File: 2005012477

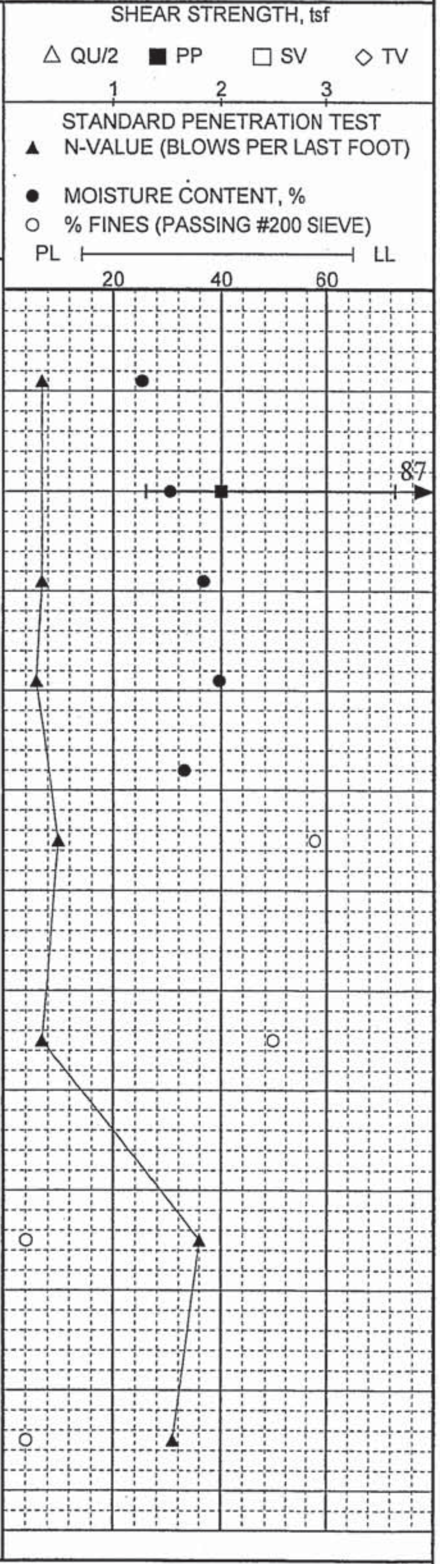
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-105

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118426 E 877780
ELEVATION: 427.1 DATUM: MSL
DATE DRILLED: 10/13/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				SILT (ML), brown, moist, loose, slightly clayey		
	425		50		4-3-4	25.3
5			92	CLAY (CH), gray and brown, high plastic, very stiff, moist, traces of sandy silt pockets, blocky, mottled, slick-n- sided, trace fine roots and lignite	90.6	30.5
	420		83		2-3-4	36.7
10			83	SILT (ML), brown and gray, firm, very moist, clayey,	2-2-4	39.7
		▼				
	415		63	Becoming stiff, with lignite, with traces of fine-grain sand and limonite	85.9	33.1
			78	SILT (ML), brown, loose, with fine-grain sand Note: switched to mud rotary at 13.0 feet	2-6-4	
15						
	410		94	Silty SAND (SM), dark gray, fine-grain, loose	4-3-4	
20						
	405		72	SAND (SP), brownish gray, fine-grain, dense	11-15-21	
25						
	400		39	Becoming more medium-grain sand	16-15-16	
30				Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 11 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 10.87 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

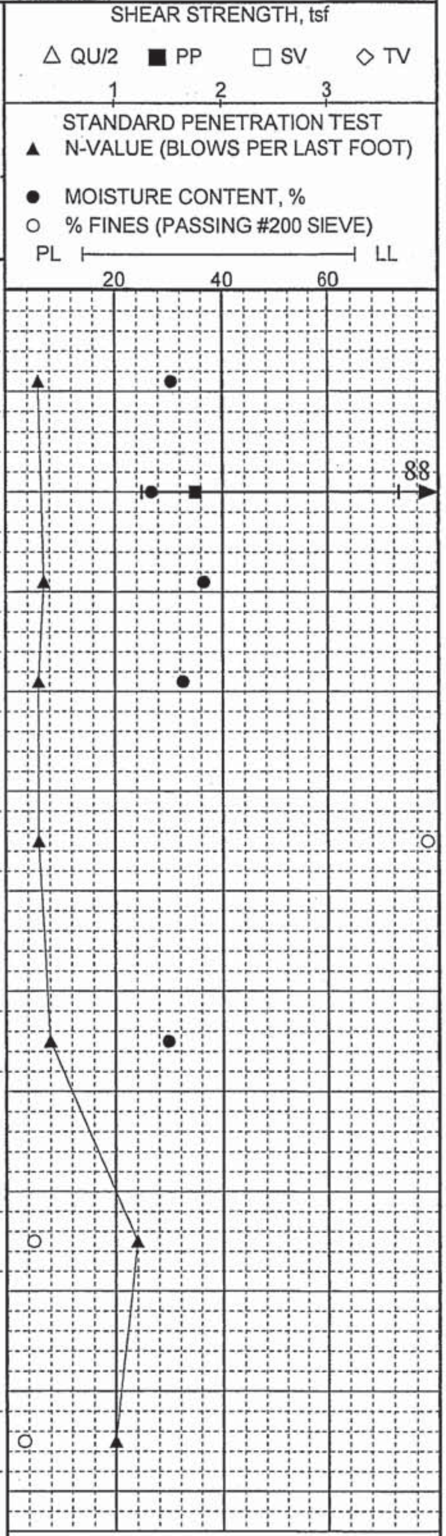
File: 2005012477

BORING LOG B-106

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118629 E 877943
ELEVATION: 427.1 DATUM: MSL
DATE DRILLED: 10/13/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						SILT (ML), tan, loose, dry		
	425				56	CLAY (CH), brown, high plastic, firm, dry, with seams of silt and fine-grain sand	1-2-4	30.4
5					96	Becoming very stiff, with silt pockets, traces of shells, lignite and limonite	94.9	26.8
	420				83	Becomin firm, moist	3-3-4	36.5
		▼						
10		▽			89	SILT (ML), brown and gray, loose, very moist, slightly clayey, with traces of fine-grain sand and fine roots Note: switched to mud rotary at 9.0 feet	1-3-3	32.6
	415				78	Without fine roots	2-3-3	
15								
	410				67	Becoming dark gray	2-3-5	29.8
20								
	405				44	SAND (SP-SM), grayish brown, medium- to fine-grain, medium dense, slightly silty	11-12-12	
25								
	400				39	SAND (SP), grayish brown, medium- to fine-grain, medium dense, with traces of coarse-grain sand, fine and coarse gravel	12-9-11	
30								



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 10 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.31 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-106

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	395					Boring terminated by engineer at 29.5 feet		
35								
	390							
40								
	385							
45								
	380							
50								
	375							
55								
	370							
60								
	365							
65								
	360							

SHEAR STRENGTH, tsf

△ QU/2 ■ PP ☐ SV ◇ TV

1 2 3

▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (PASSING #200 SIEVE)

PL ├────┤ LL

20 40 60

File: 2005012477

Figure A-49 Sheet 2 of 2

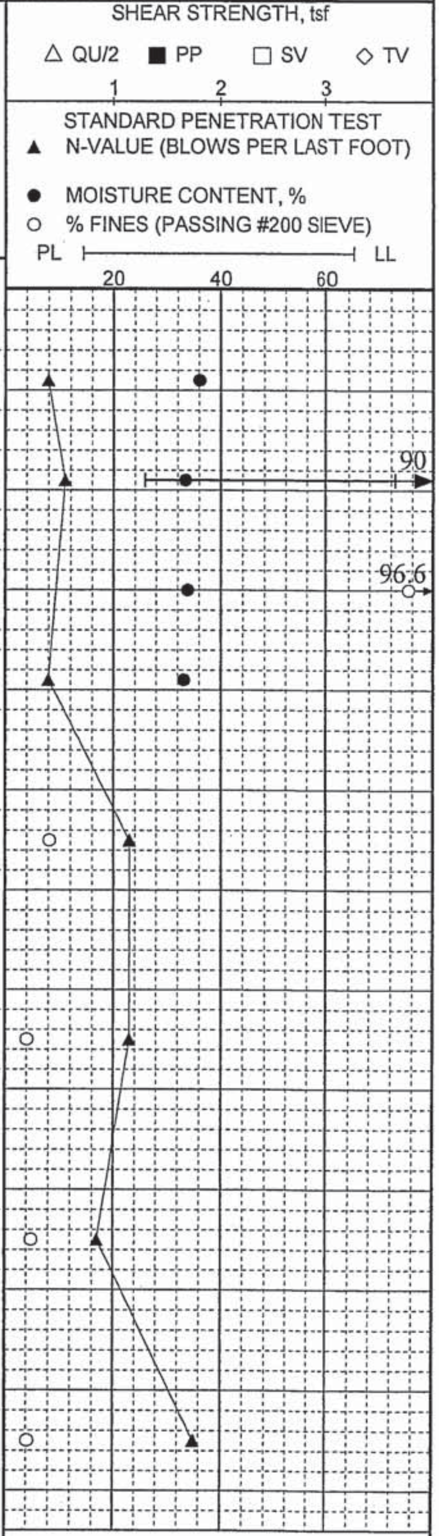
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-107

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118853 E 878063
ELEVATION: 426.7 DATUM: MSL
DATE DRILLED: 10/13/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						SILT (ML), brown, loose, sandy		
	425					CLAY (CH), dark brownish gray, high plastic, firm, moist, with traces of lignite, limonite, and shells		
					61		2-3-5	36.1
5					56	Becoming stiff, with seam of sandy silt	2-5-6	33.5
	420				100	SILT (ML), dark brownish gray, very moist, loose, with seam of silty clay	83.3	33.9
						Note: sample liquified during extraction from tube		
10					67	With seams of clay and fine-grain sand, traces of lignite, limonite, and shells	3-4-4	33.2
	415					Note: switched to mud rotary at 9.0 feet		
					67	SAND (SP-SM), grayish brown, fine-grain, medium dense, slightly silty	10-11-12	
15								
	410							
					67	SAND (SP), brown, medium- to fine-grain, medium dense	10-9-14	
20								
	405							
					44	With trace of coarse-grain sand	9-7-10	
25								
	400							
					72	Becoming fine-grain sand	12-16-19	
30						Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 8 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.66 FEET AFTER 24 HOURS
AT _____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

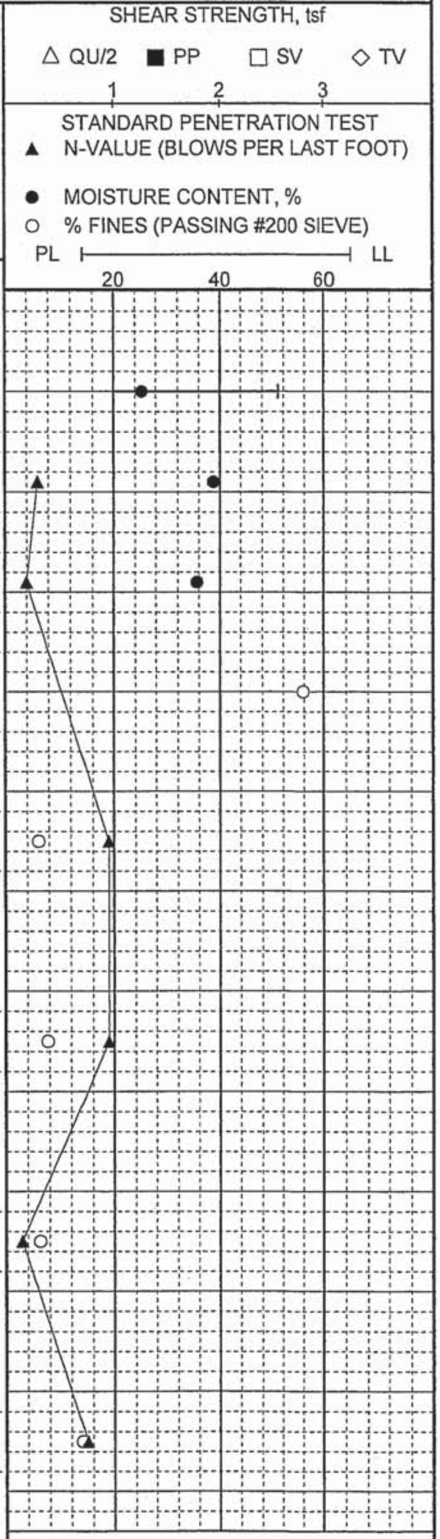
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-108

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118716 E 877699
ELEVATION: 425.6 DATUM: MSL
DATE DRILLED: 10/13/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	425			SILT (ML), light brown, loose, dry, sandy		
			73	CLAY (CH), dark gray, high plastic, firm, dry, with lignite, limonite, and decaying organics, seams of silt and fine sand	98.2	25.3
5	420		83	Becoming mottled, moist	2-3-3	38.8
		▽ ▼	56	SILT (ML), dark brown, very moist, very loose, with fine-grain sand and traces of lignite	1-2-2	35.7
10	415		0	Becoming very sandy Note: pushed spoon for sample recovery Note: switched to mud rotary at 9.0 feet		
			72	SAND (SP-SM), brown, fine-grain, medium dense, slightly silty	10-10-9	
15	410					
			44	Becoming medium- to fine-grain sand	8-9-10	
20	405					
			44	Becoming more coarse, loose, with 1.25" gray clay seam	6-2-1	
25	400			Gravelly drilling at 26.5'		
			56	Silty SAND (SM), brown, medium- to fine-grain, medium dense	5-6-9	
30	395			Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 6.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.24 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

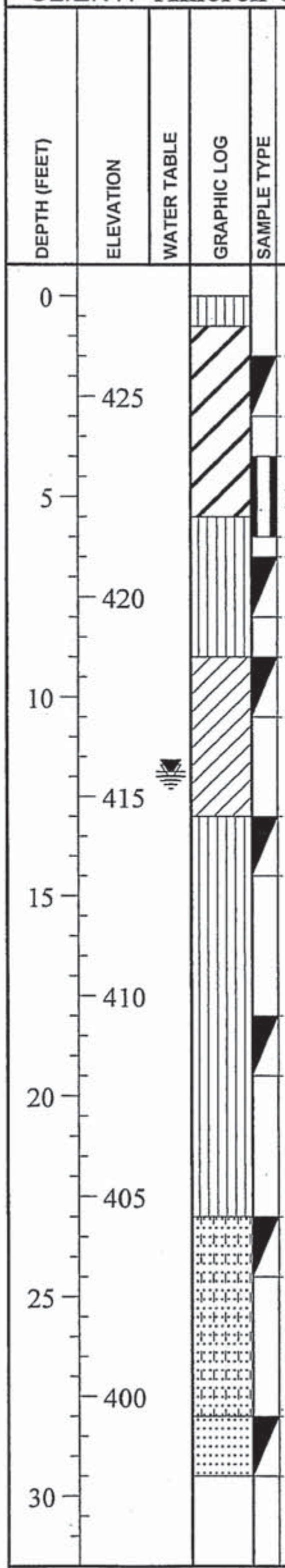
File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

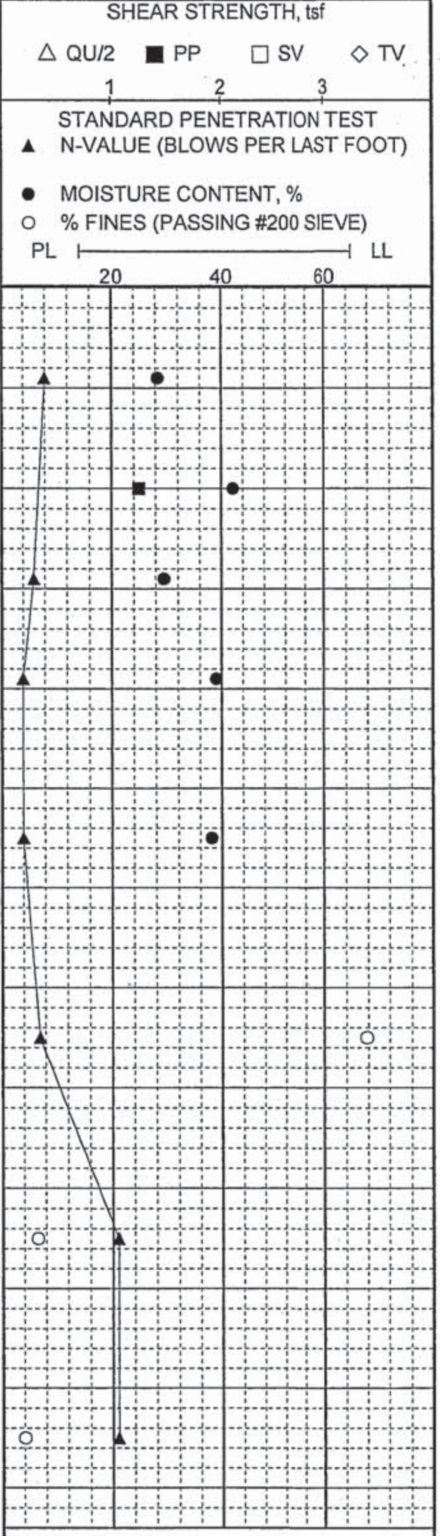
BORING LOG B-109

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118519 E 878279
ELEVATION: 427.5 DATUM: MSL
DATE DRILLED: 10/13/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, dry		
56	CLAY (CH), dark brown, high plastic, firm, dry, with lignite and limonite With silty sand seams	5-3-5	28.4
100	Becoming, moist, with 3" layer of decomposed organics	80.7	42.2
78	SILT (ML), dark brown and gray, very moist, loose, slightly clayey, with fine-grain sand, lignite and limonite	2-2-4	29.5
78	CLAY (CL), dark brown, low plastic, soft, very moist, with traces of limonite	1-2-2	39.0
83	SILT (ML), dark brown, very loose, very moist, with fine-grain sand Note: switched to mud rotary at 13.0 feet	1-2-2	38.1
78	Becoming very sandy	2-3-4	
72	SAND (SP-SM), grayish brown, medium- to fine-grain, medium dense, slightly silty	9-9-12	
72	SAND (SP), brown, coarse- to medium-grain, medium dense, with traces of fine-grain sand	9-9-12	



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 12 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 11.87 FEET AFTER 24 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

Figure A-52 Sheet 1 of 2

File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-109

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf △ QU/2 ■ PP □ SV ◇ TV 1 2 3 STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT) ● MOISTURE CONTENT, % ○ % FINES (PASSING #200 SIEVE) PL ├──┤ LL 20 40 60
35 40 45 50 55 60 65	395 390 385 380 375 370 365 360					Boring terminated by engineer at 29.5 feet			

File: 2005012477

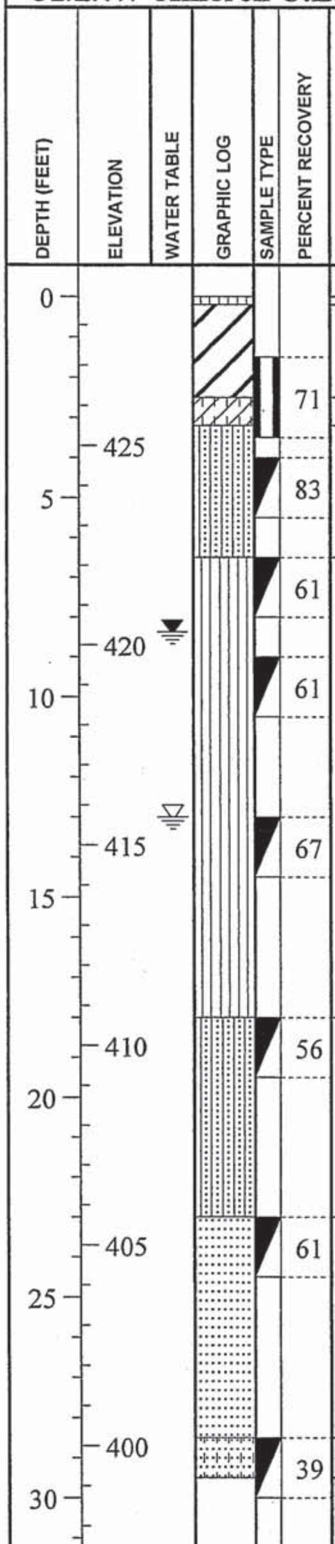
Figure A-52 Sheet 2 of 2

REITZ & JENS, INC.
CONSULTING ENGINEERS

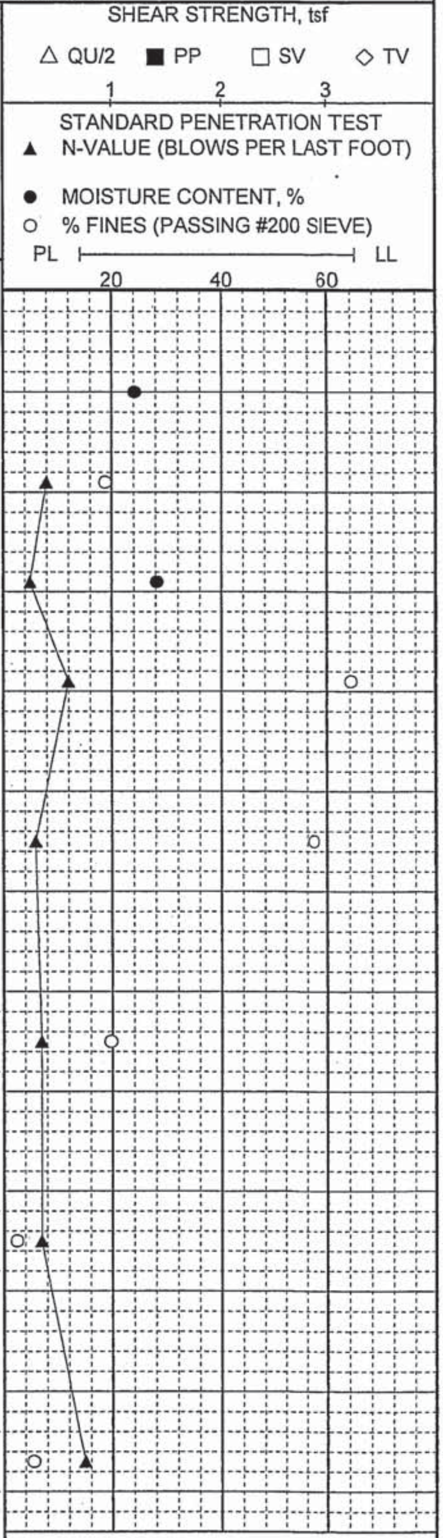
BORING LOG B-110

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1118385 E 881829
ELEVATION: 428.7 DATUM: MSL
DATE DRILLED: 10/14/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), brown, loose, dry		
	CLAY (CH), gray-brown, high plastic, stiff, dry		
71	CLAY (CL), gray-brown, low plastic, silty	93.4	24.2
	Silty SAND (SM), tan, fine-grain, loose		
83		2-4-4	
61	SILT (ML), brown and gray, loose, moist	1-2-3	28.2
61	Becoming very sandy, with traces of clay	2-5-7	
67	Very sandy Note: switched to mud rotary at 13.0 feet	1-2-4	
56	Silty SAND (SM), brown, medium- to fine-grain, loose Gravelly drilling at 20.0'	3-3-4	
61	SAND (SP), brown, medium- to fine-grain, loose	1-3-4	
39	SAND (SP-SM), gray, medium- to fine-grain, medium dense, slightly silty, trace of coarse-grain sand	7-10-5	



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 13 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.37 FEET AFTER 48 HOURS
AT ______ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

BORING LOG B-110

Sioux Power Plant UWLF

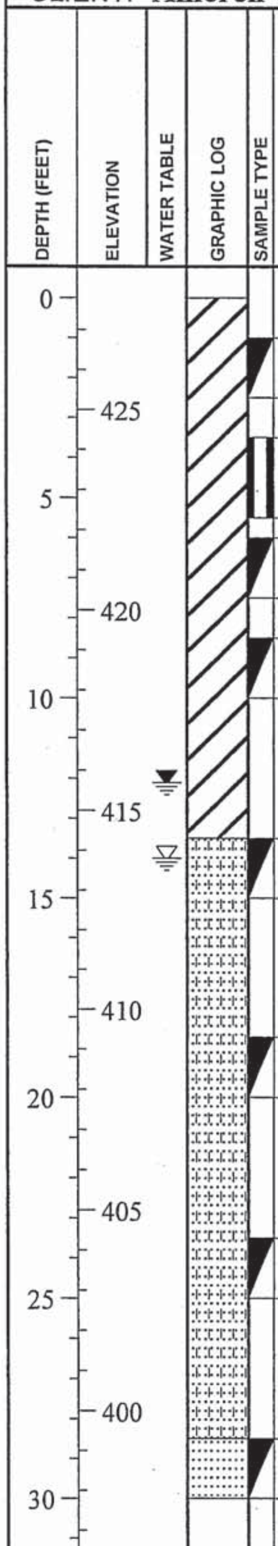
DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT	SHEAR STRENGTH, tsf △ QU/2 ■ PP ☐ SV ◇ TV 1 2 3 STANDARD PENETRATION TEST ▲ N-VALUE (BLOWS PER LAST FOOT) ● MOISTURE CONTENT, % ○ % FINES (PASSING #200 SIEVE) PL ⊢ ⊣ LL 20 40 60
						Boring terminated by engineer at 29.5 feet			
	395								
35									
	390								
40									
	385								
45									
	380								
50									
	375								
55									
	370								
60									
	365								
65									

REITZ & JENS, INC.
CONSULTING ENGINEERS

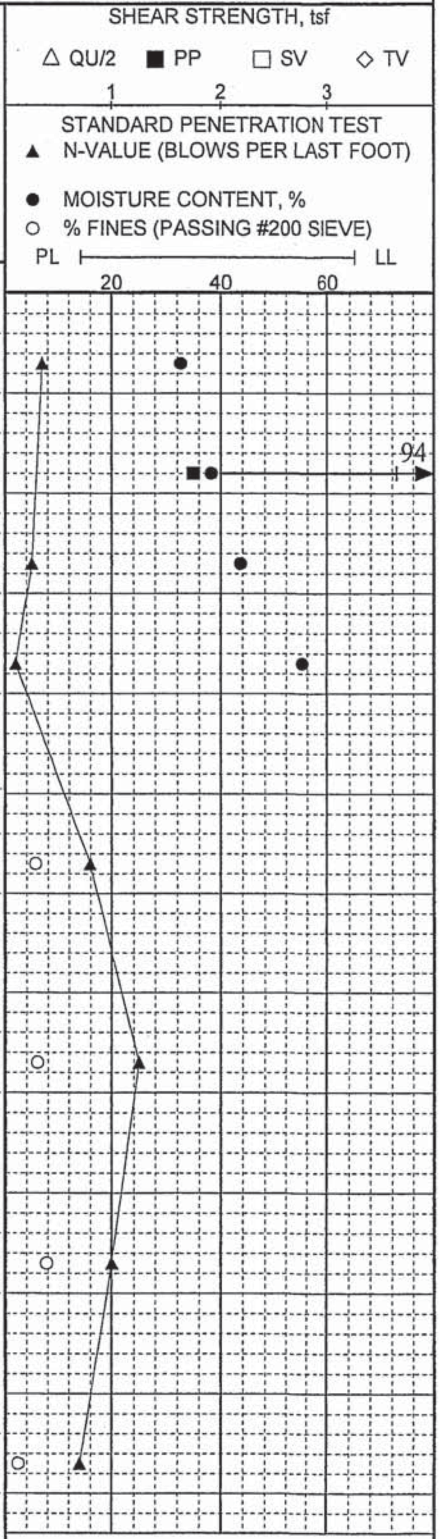
BORING LOG B-111

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117753 E 881537
ELEVATION: 427.8 DATUM: MSL
DATE DRILLED: 10/18/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	CLAY (CH), dark brown-gray, high plastic, moist, firm		
50	Becoming blocky	2-3-4	32.7
92	Becoming stiff, with lignite and limonite, slick-n-sided	77.7	38.3
83		1-2-3	43.6
61	Becoming very soft, very moist	1-1-1	55.1
72	SAND (SP-SM), tan, medium- to fine-grain, medium dense, slightly silty Note: switched to mud rotary at 13.5 feet	2-7-9	
56	With only traces of medium-grain sand	6-13-12	
61		11-15-12	
39	SAND (SP), gray, fine-grain, medium dense	9-7-7	
	Boring terminated by engineer at 30.0 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 14 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 12.11 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS

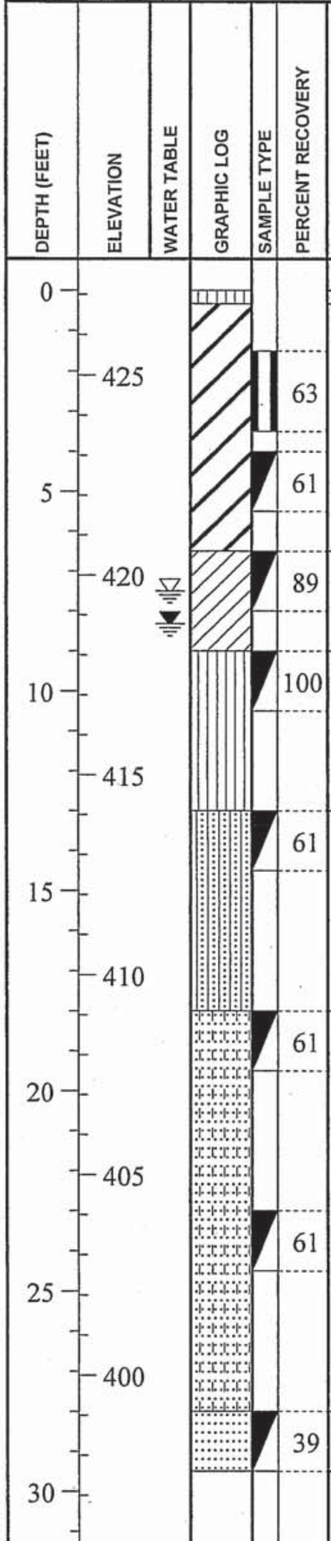
PIEZOMETER: INSTALLED AT ___ FEET

REITZ & JENS, INC.
CONSULTING ENGINEERS

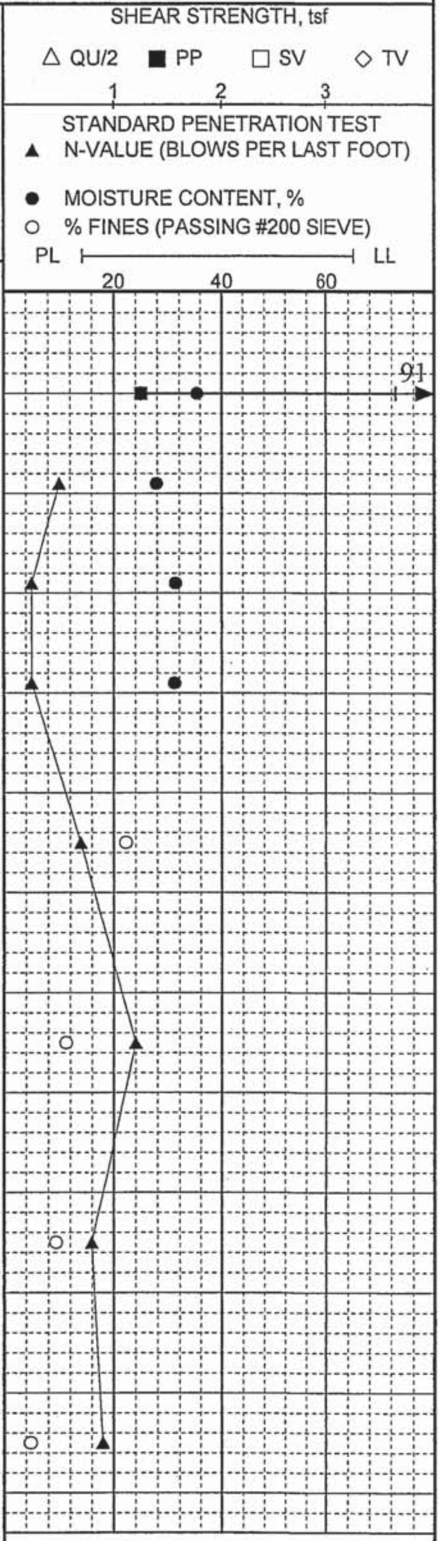
BORING LOG B-112

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116152 E 879777
ELEVATION: 427.1 DATUM: MSL
DATE DRILLED: 11/4/2005



PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	SILT (ML), gray, loose, dry, trace fine roots		
63	CLAY (CH), dark brown, high plastic, moist With lignite, traces of limonite, sandy silt pockets	84.9	35.4
61	Becoming stiff, dry, laminations of sandy silt	4-5-5	27.9
89	CLAY (CL), dark brown, low plastic, firm, moist, lignite and limonite, with thin layers of clayey silt and sandy silt	2-2-3	31.4
100	SILT (ML), dark brown, loose, very moist, with fine-grain sand Note: switched to mud rotary at 9.0 feet	2-3-2	31.2
61	Silty SAND (SM), brown, fine-grain, medium dense, wet	5-6-8	
61	SAND (SP-SM), brown, fine-grain, medium dense, slightly silty	7-9-15	
61		9-7-9	
39	SAND (SP), brown, medium- to fine-grain, medium dense, traces of decomposed wood	9-7-11	
	Boring terminated by engineer at 29.5 feet		



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.32 FEET AFTER 144 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT __ FEET

Figure A-55 Sheet 1 of 1

File: 2005012477

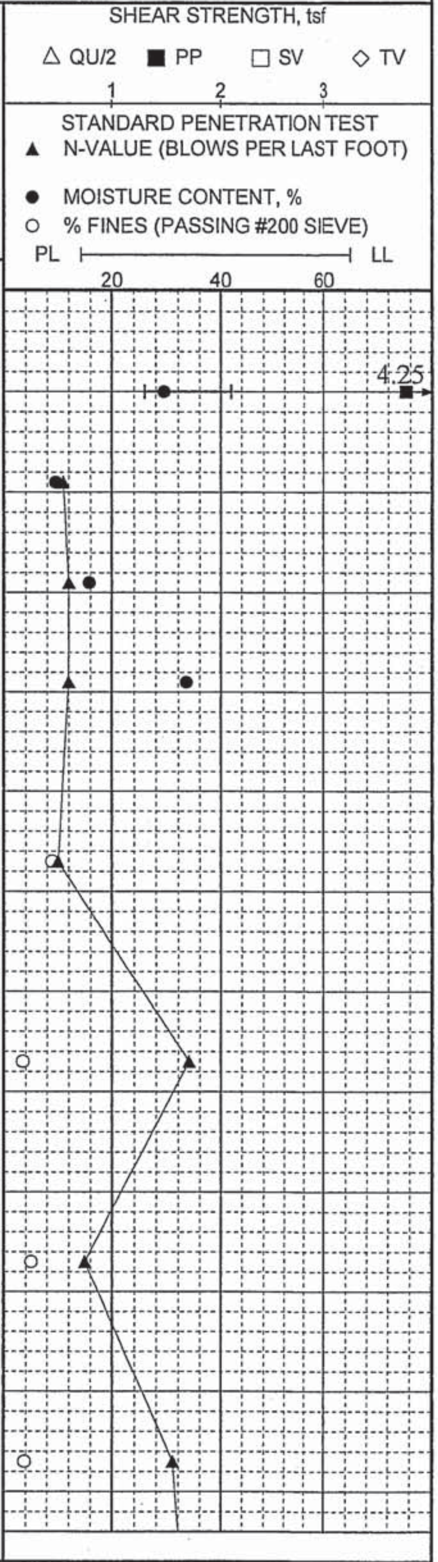
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-113

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1116628 E 879832
ELEVATION: 428.5 DATUM: MSL
DATE DRILLED: 11/1/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						CLAY (CH), dark grayish brown, high plastic, moist, stiff		
	425				79	CLAY (CL), brownish gray, low plastic, firm, moist, silty, with traces fine-grain sand	90.8	29.5
5					39	SILT (ML), grayish tan, dry, medium dense, with fine-grain sand Becoming slightly clayey	6-7-6	9.6
	420				33		6-4-8	15.8
10		∇			78	CLAY (CL), brown and gray, low plastic, moist, stiff, silty, traces of lignite and limonite, trace of fine-grain sand Note: switched to mud rotary at 9.0 feet	6-4-8	33.5
15	415				61	SAND (SP-SM), brown, fine-grain, loose, slightly silty, traces of medium-grain sand	6-5-5	
20	410				56	SAND (SP), tan, medium- to fine-grain, dense, with traces of coarse-grain sand and fine gravel	12-18-16	
25	405				44	SAND (SW-SM), tan, well graded, medium dense, slightly silty, with fine and coarse gravel	7-6-9	
30	400				50	SAND (SP), tan, medium- to fine-grain, dense, with coarse-grain sand and fine gravel	10-11-20	



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%): ______
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 9.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT _____ FEET AFTER ____ HOURS
AT _____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File: 2005012477

Figure A-56 Sheet 1 of 4

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-113

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	395				56		17-16-18	
35								
	390				78	SAND (SP-SM), brown, medium- to fine-grain, dense, slightly silty	11-14-20	
40								
	385				78	SAND (SP), gray, medium- to fine-grain, medium dense, with trace of coarse-grain sand	21-14-11	
45								
	380				72	Becoming more coarse, with traces of fine gravel, very dense	19-24-28	
50								
	375							
55								
	370				56	Same	20-22-34	
60								
	365							
65								

SHEAR STRENGTH, tsf

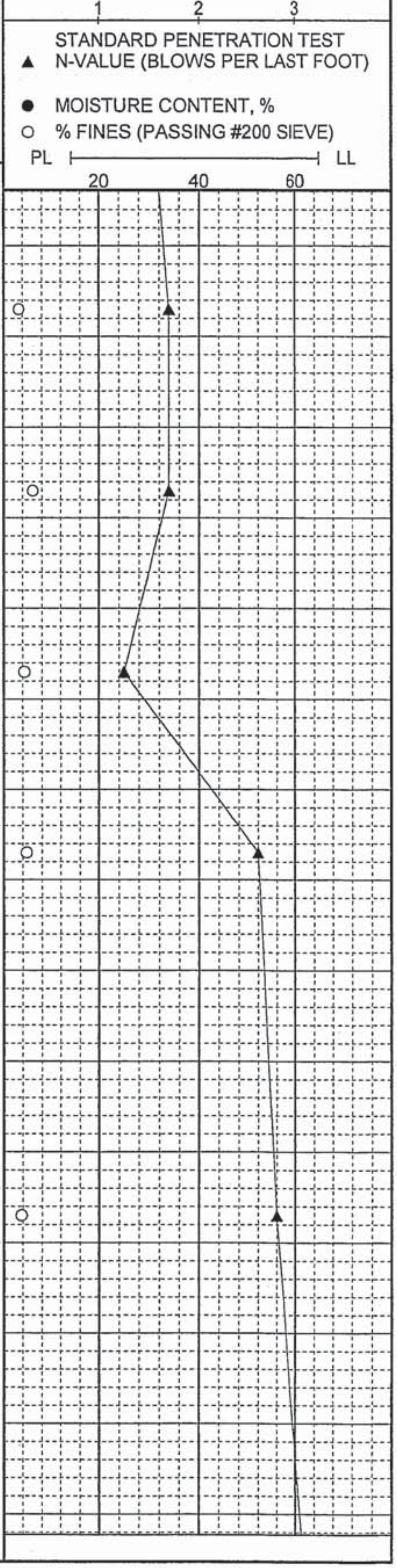
△ QU/2 ■ PP □ SV ◇ TV

▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (PASSING #200 SIEVE)

PL ⊢—⊣ LL



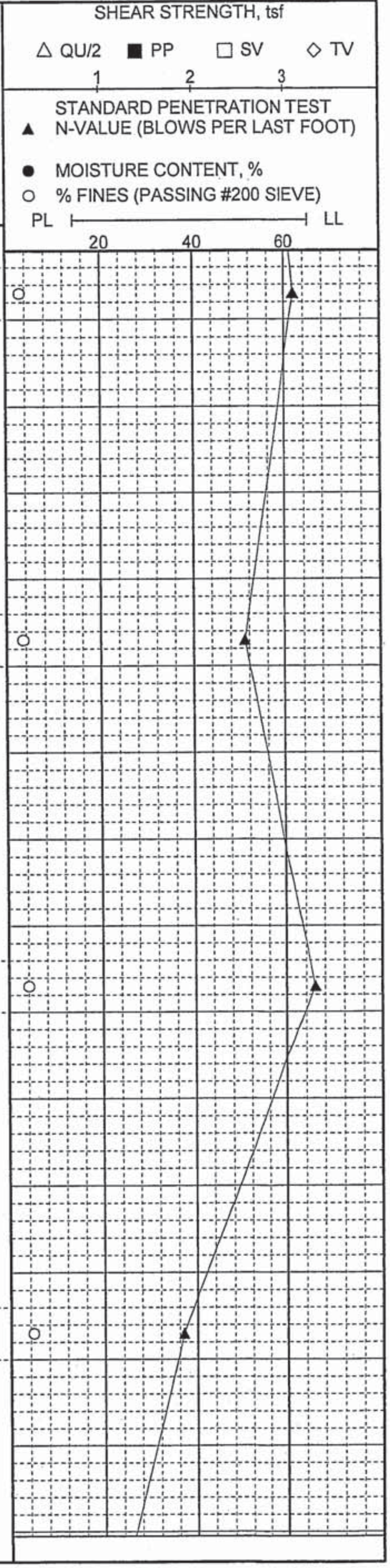
File: 2005012477

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-113

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
	360				56	Becoming tan	15-25-37	
70						Gravelly drilling at 72.0'		
75	355							
80	350				61	With traces of coarse-grain sand and fine gravel	22-23-28	
85	345							
90	340				56	With coarse-grain sand and fine gravel	30-31-35	
95	335							
100	330				44	SAND (SW), tan, well graded, dense, with fine gravel and traces of coarse gravel	23-20-17	
105	325							



REITZ & JENS, INC.
CONSULTING ENGINEERS

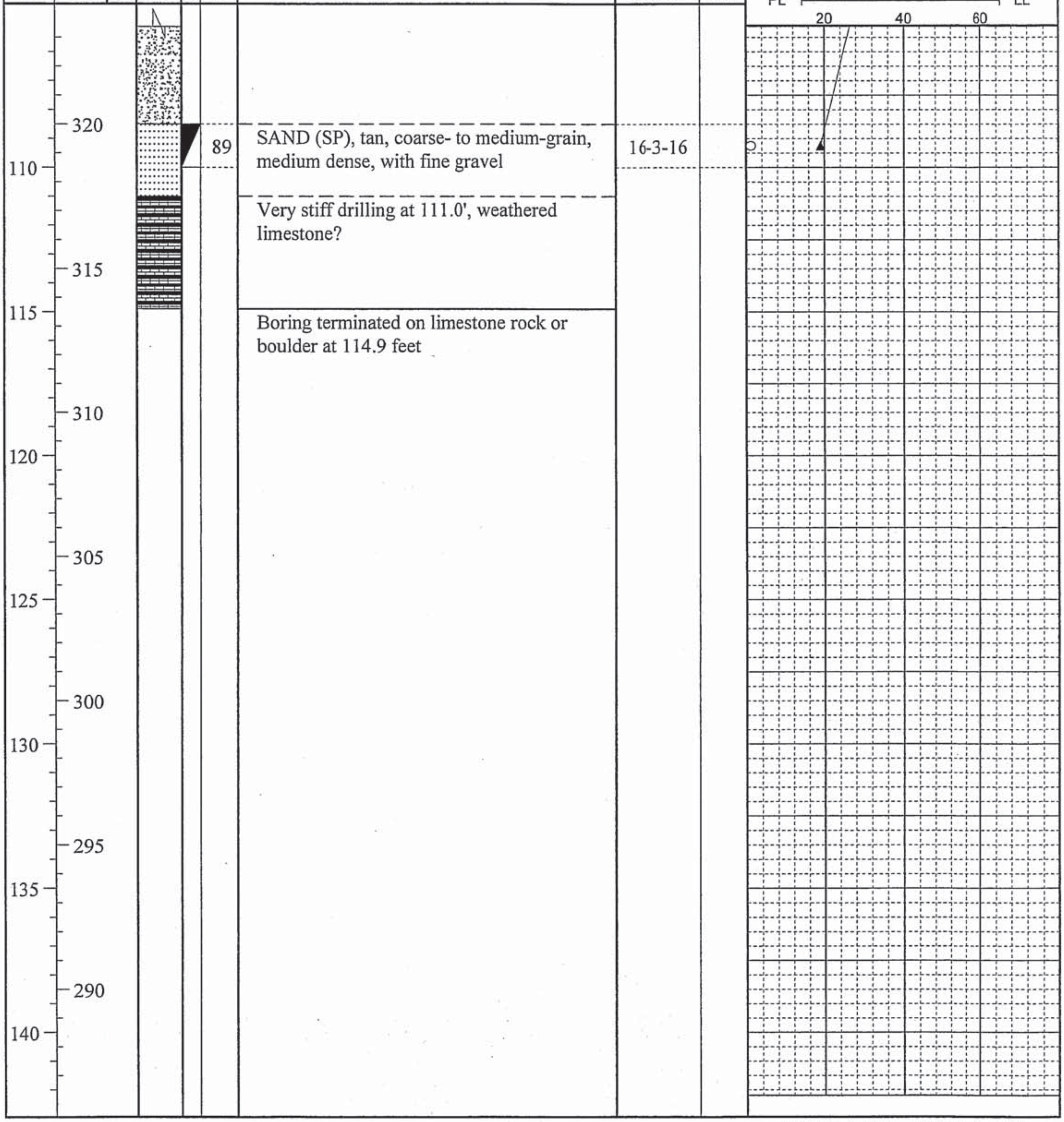
BORING LOG B-113

Sioux Power Plant UWLF

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL ├──┤ LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
					89	SAND (SP), tan, coarse- to medium-grain, medium dense, with fine gravel	16-3-16	
						Very stiff drilling at 111.0', weathered limestone?		
						Boring terminated on limestone rock or boulder at 114.9 feet		



File: 2005012477

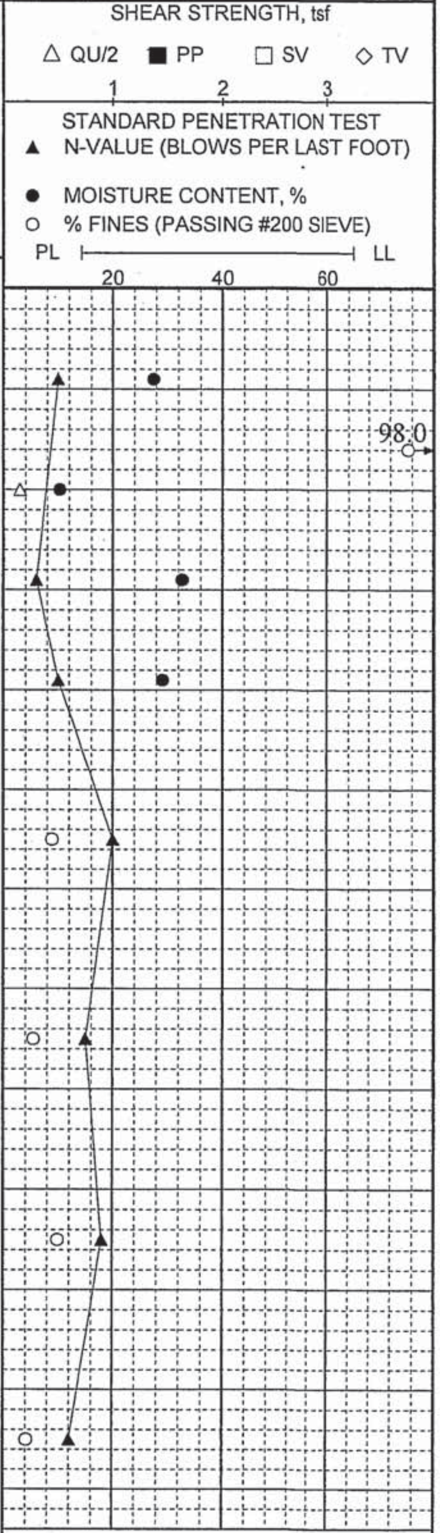
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-114

Sioux Power Plant UWLF
St. Charles County, Missouri
CLIENT: **Ameren U.E.**

LOCATION: N 1117007 E 877912
ELEVATION: 429.3 DATUM: MSL
DATE DRILLED: 10/12/2005

DEPTH (FEET)	ELEVATION	WATER TABLE	SAMPLE TYPE / PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0				SILT (ML), brown and gray, loose, dry, with fine-grain sand		
			72	CLAY (CH), dark brown, high plastic, stiff, dry With limonite, and seam of silty sand	3-3-7	27.5
5	425		100	SILT (ML), tan, firm, dry	81.7	10.3
		▽	78	Beoming clayey, with lenses of silty sand and silty clay, traces of lignite, limonite, and shells, very moist	4-3-3	32.7
10	420	▼	56	Becoming dark brownish gray Note: switched to mud rotary at 9.0 feet	3-4-6	29.1
15	415		56	SAND (SP-SM), brown, fine-grain, medium dense, slightly silty	4-7-13	
20	410		78		6-7-8	
25	405		89		6-7-11	
30	400		56	SAND (SP), brown, medium-grain, medium dense, with traces of coarse- and fine grain sand	3-4-8	



DRILLER: R.E.D.I.
METHOD: HSA & Mud Rotary
TYPE OF SPT HAMMER: Safety
HAMMER EFFICIENCY (%):
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 7 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT 8.63 FEET AFTER 48 HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

Figure A-56 Sheet 1 of 2

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-114

Sioux Power Plant UWLF

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
						Boring terminated by engineer at 29.5 feet		
	395							
35								
	390							
40								
	385							
45								
	380							
50								
	375							
55								
	370							
60								
	365							
65								

SHEAR STRENGTH, tsf

△ QU/2 ■ PP ☐ SV ◇ TV

1 2 3

▲ STANDARD PENETRATION TEST N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %

○ % FINES (PASSING #200 SIEVE)

PL ⊢—⊣ LL

20 40 60

File: 2005012477

Figure A-56 Sheet 2 of 2

Appendix 8

Soil Test Results

REITZ & JENS, INC.
CONSULTING ENGINEERS

1055 corporate square drive
st. louis, mo 63132
phone: 314.993.4132
fax: 314.993.4177
www.reitzjens.com

TO: Mike Carlson, R.G.
Gredell Engineering Resources, Inc.
1505 East High Street
Jefferson City, Missouri 65101-4826

DATE: October 18, 2005
RE: Ameren UE Sioux Plant UWLF

We are transmitting ☑ herewith ☐ under separate cover via First Class Mail
the following items:

☐ Approved Invoice/Estimate
☐ Boring Logs
☐ Bound Report
☐ Prints
☐ Change Order
☑ Test Summaries
☐ Computations
☐ Specifications
☐ Contract Documents
☐ Field Report
☐ Reproducible Drawings

Quantity	Date	Description or Title
1 set	10/18/2004	Grain Size Distribution Reports (28 sheets)

These items are transmitted for:

☑ For your use
☐ For review & comment
☐ For approval
☐ For your distribution
☐ Approved as submitted
☑ In accord with your request
☐ Returned for corrections
☐ Returned after loan to us
☐ Please return ________ copies
☐ Approved as noted

Remarks: ____________________

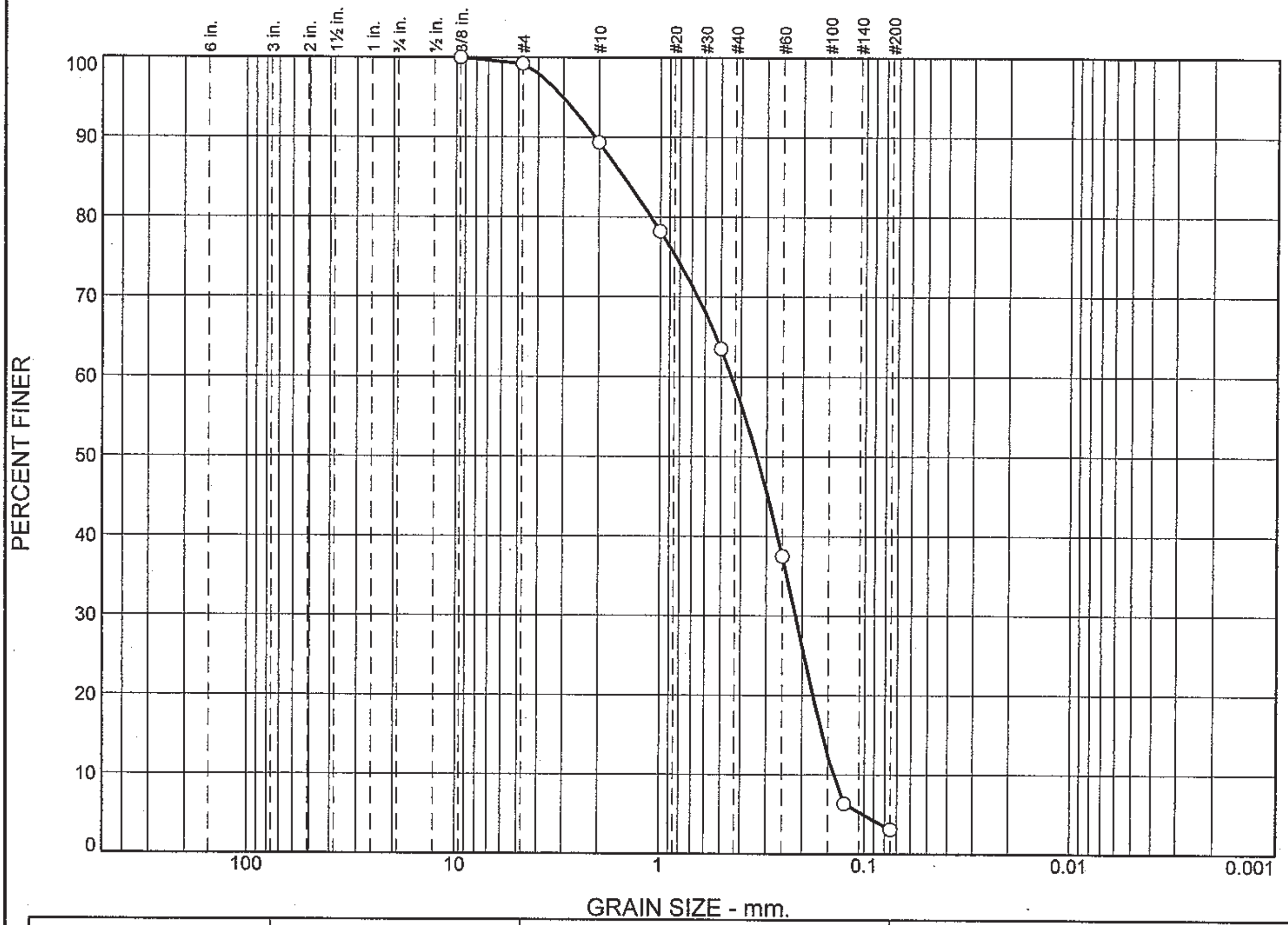
Copies to:

Sincerely,

Jeffrey L. Fouse, P.E.
Senior Project Manager

P:\Amerenue\2005012477\doc\LOT Gredell.doc

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.8	9.9	30.6	55.6	3.1	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.5131	0.4435	0.3326	0.2158	0.1597	0.1411	0.74	3.14

Material Description	USCS	AASHTO
○ SAND, fine to medium with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

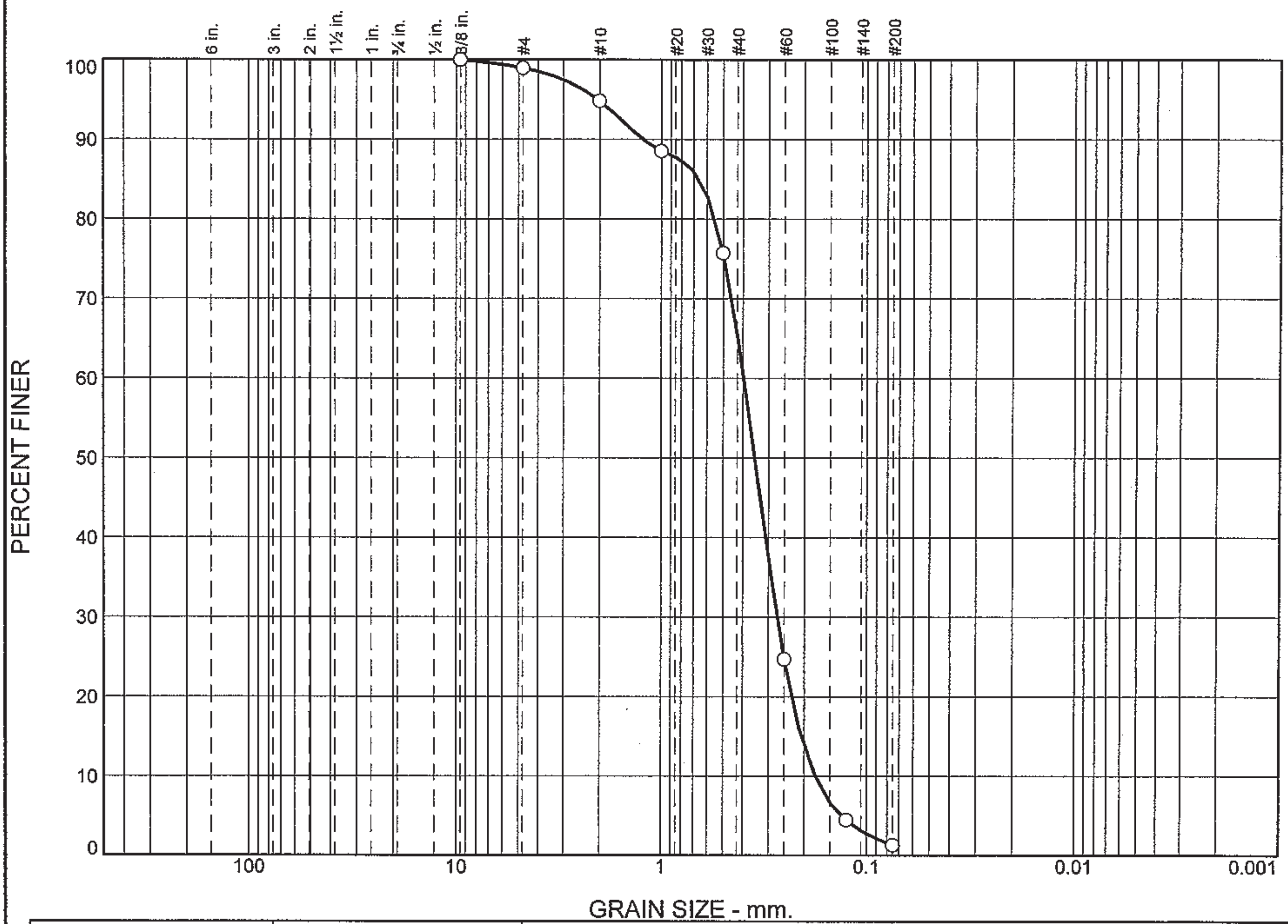
○ **Source of Sample:** B-2 **Depth:** 20

Remarks:

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.0	4.2	29.4	64.1	1.3	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.6580	0.3955	0.3492	0.2708	0.2059	0.1764	1.05	2.24

Material Description	USCS	AASHTO
○ SAND (SP), fine to medium with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

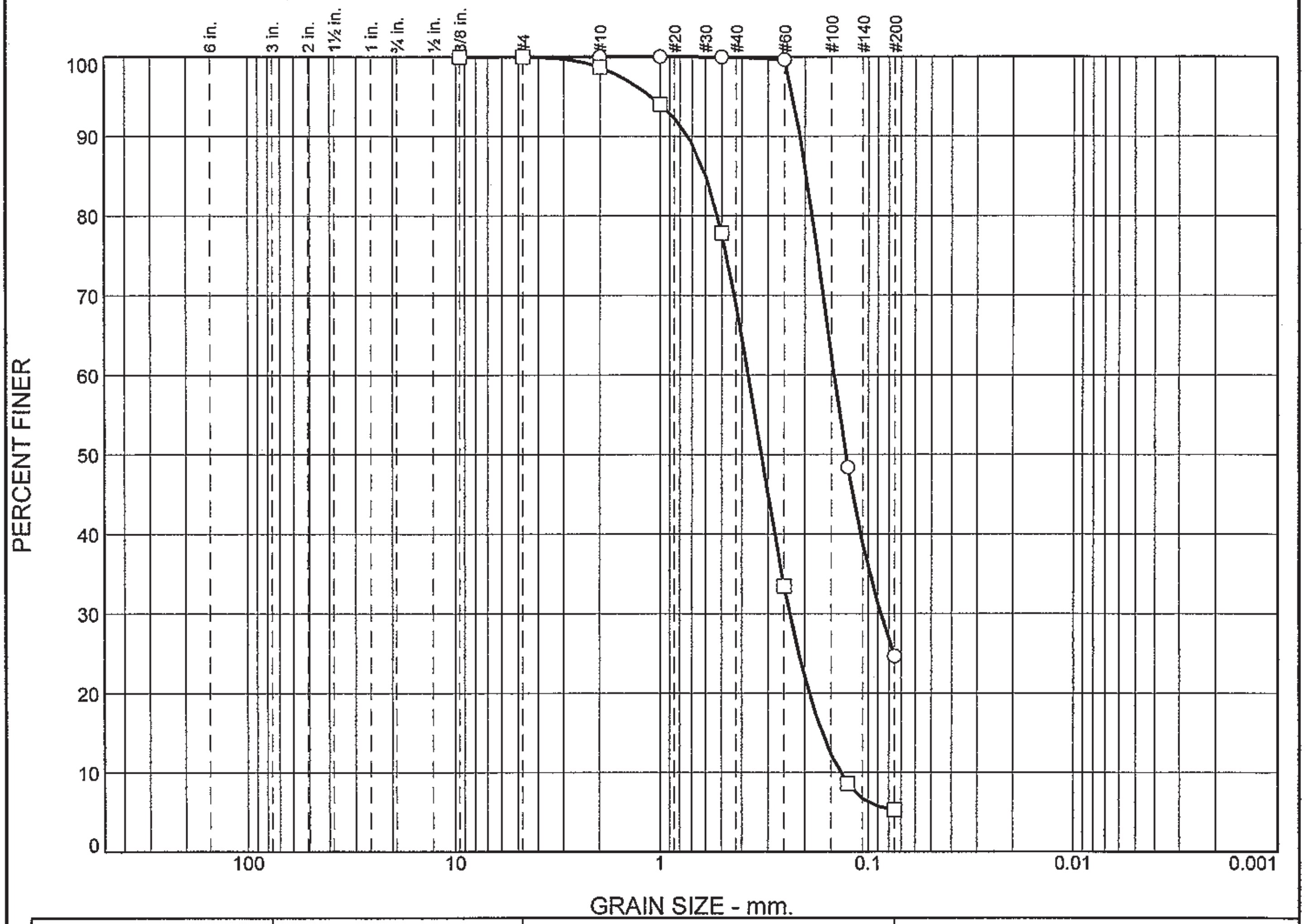
○ **Source of Sample:** B-3 **Depth:** 25

REITZ & JENS, INC.
CONSULTING ENGINEERS

Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.1	75.2	24.7	
□	0.0	0.0	0.0	1.3	30.0	63.5	5.2	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1970	0.1457	0.1280	0.0869				
□			0.5996	0.3718	0.3217	0.2352	0.1653	0.1357	1.10	2.74

Material Description	USCS	AASHTO
○ Silty SAND, fine	SM	
□ SAND, fine to medium	SP-SM	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

Sioux Power Plant UWLF

○ **Source of Sample:** B-5 **Depth:** 15

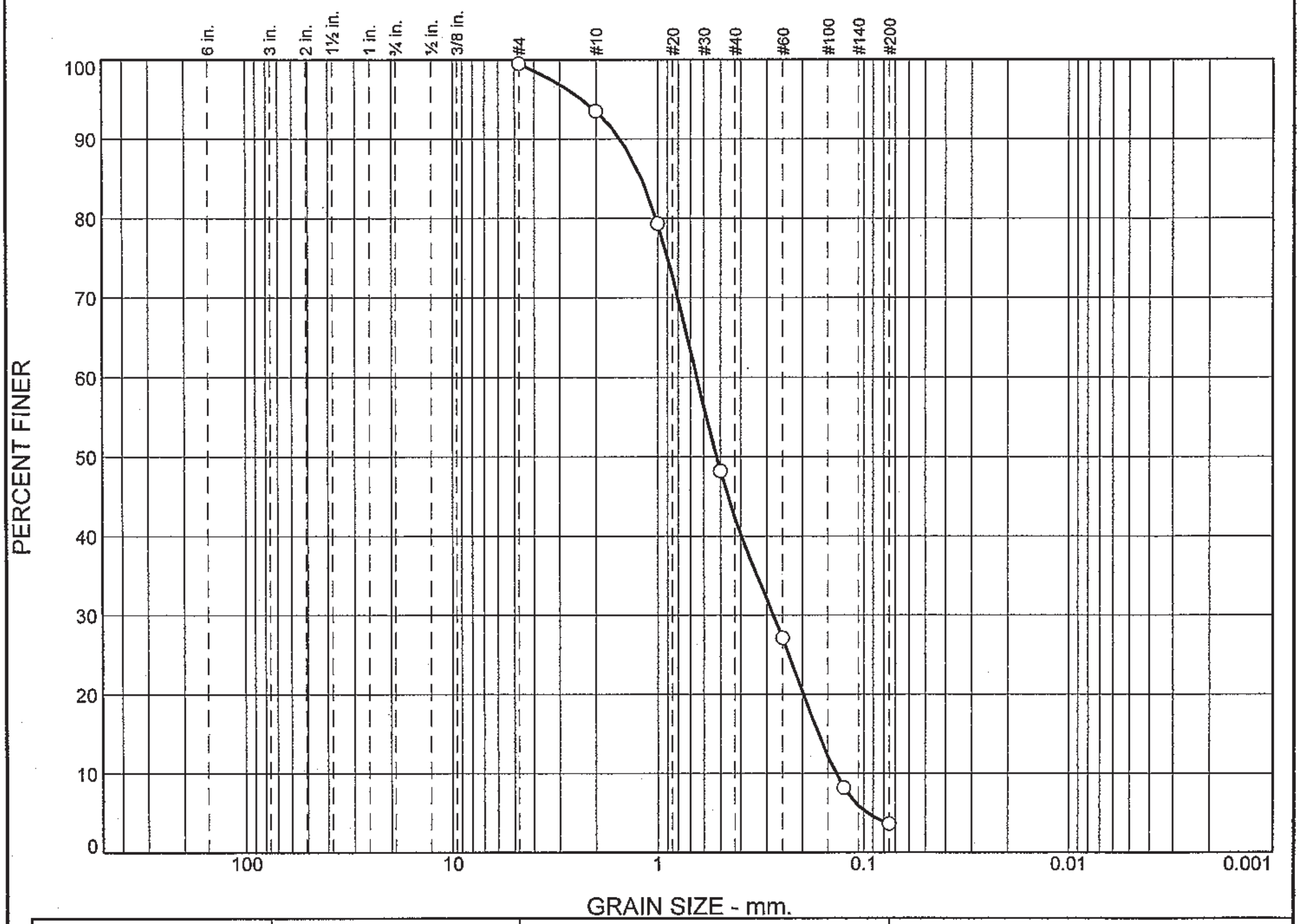
□ **Source of Sample:** B-5 **Depth:** 25

REITZ & JENS, INC.
CONSULTING ENGINEERS

Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				6.0	51.2	38.7	3.6	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.2016	0.6500	0.5226	0.2772	0.1670	0.1372	0.86	4.74

Material Description	USCS	AASHTO
○ SAND, fine to medium with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

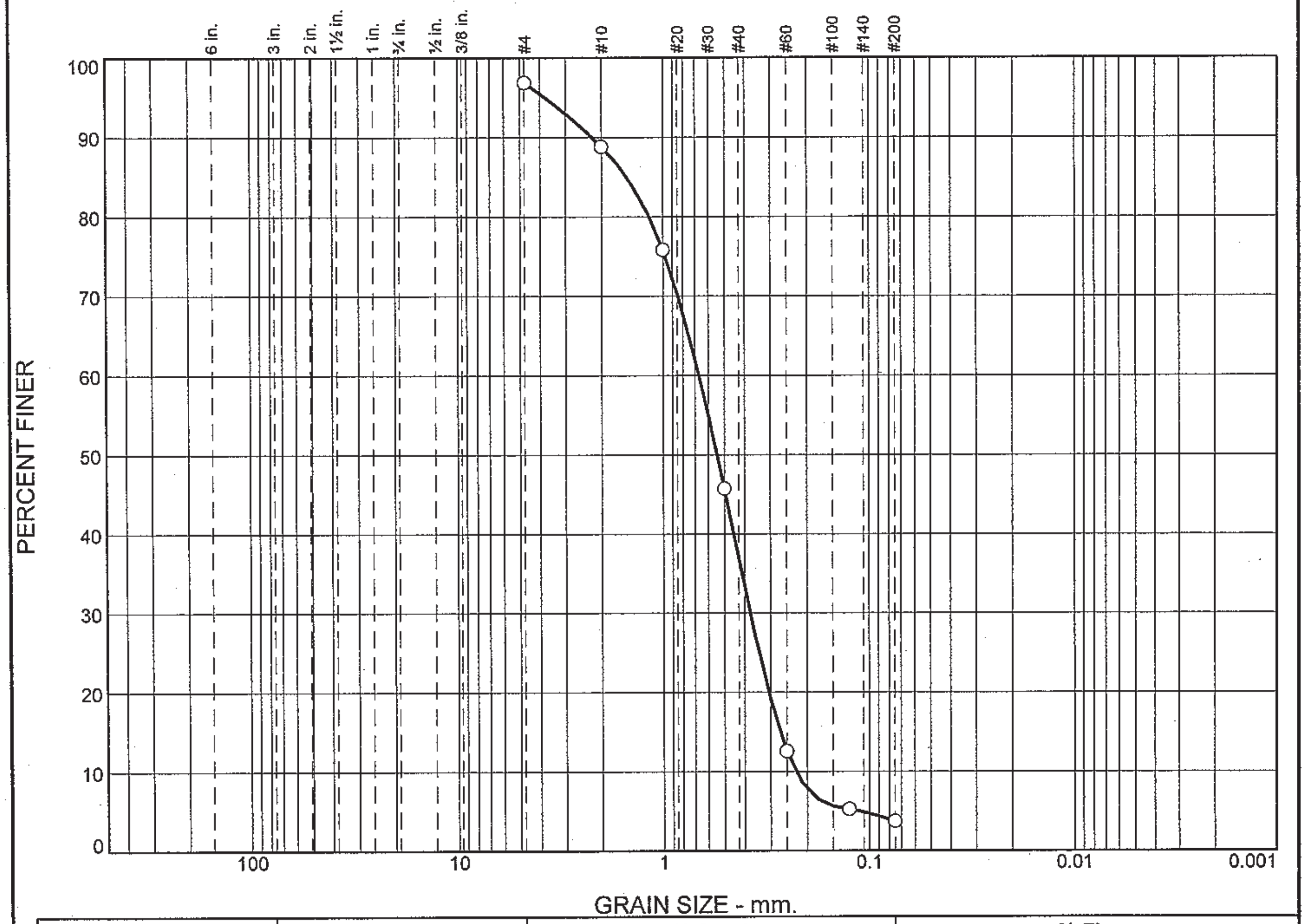
○ **Source of Sample:** B-7 **Depth:** 25

REITZ & JENS, INC.
CONSULTING ENGINEERS

Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				8.1	51.9	33.2	3.7	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.5069	0.6657	0.5428	0.3741	0.2694	0.2267	0.93	2.94

Material Description	USCS	AASHTO
○ SAND, fine to medium with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-9 **Depth:** 20

Remarks:

REITZ & JENS, INC.
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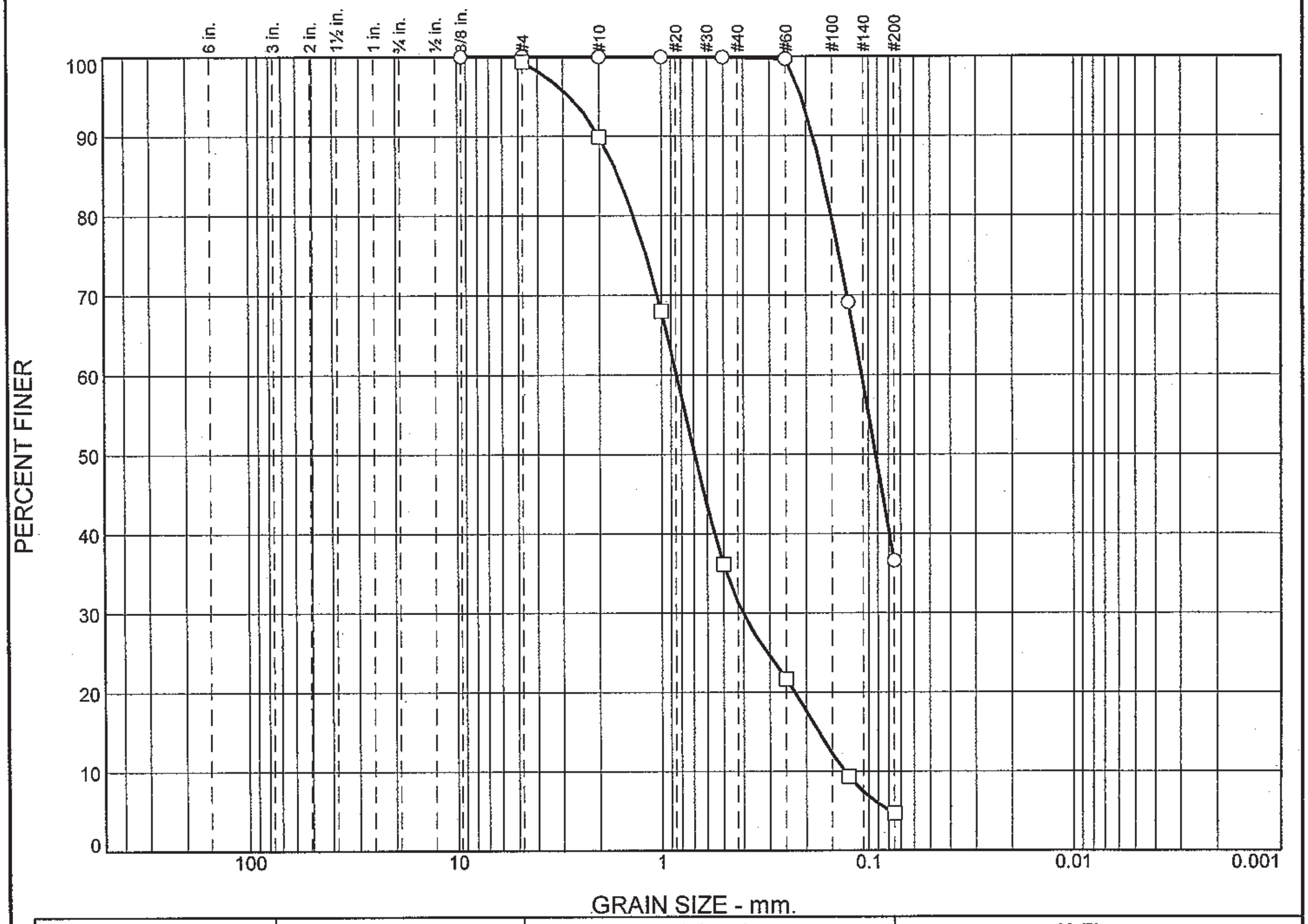
Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.2	63.2	36.6	
□				9.5	58.6	26.7	4.6	

╳	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1664	0.1078	0.0921					
□			1.6204	0.8442	0.6898	0.4028	0.1748	0.1312	1.47	6.44

Material Description	USCS	AASHTO
○ Silty SAND, very fine	SM	
□ SAND, well graded	SW	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-12 **Depth:** 10
□ **Source of Sample:** B-12 **Depth:** 20

REITZ & JENS, INC.
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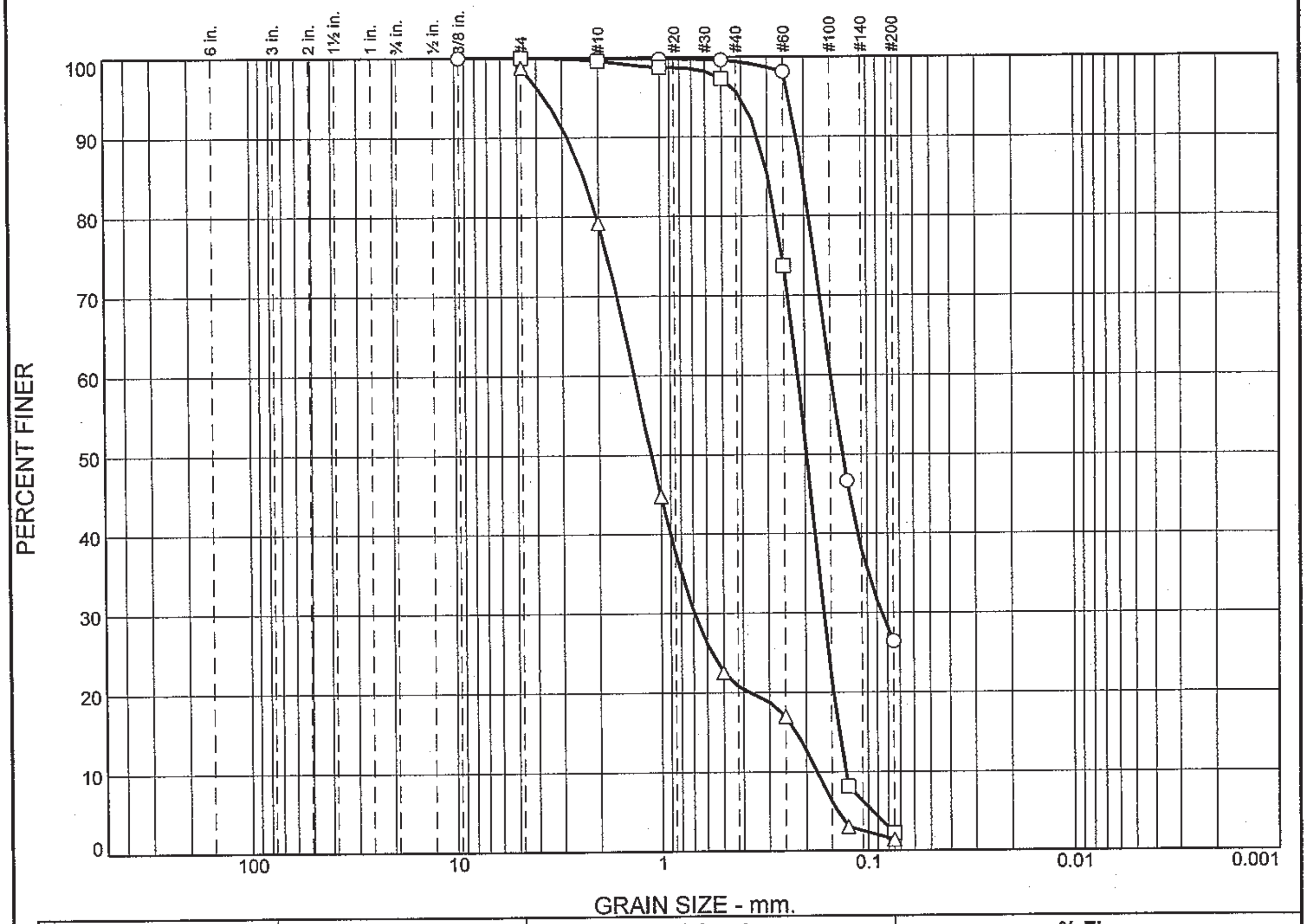
Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.5	73.0	26.4	
□	0.0	0.0	0.0	0.4	3.9	93.5	2.2	
△				19.6	58.4	19.4	1.4	

╳	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2020	0.1494	0.1313	0.0852				
□			0.2968	0.2155	0.1960	0.1626	0.1382	0.1289	0.95	1.67
△			2.3552	1.3455	1.1116	0.6894	0.2230	0.1777	1.99	7.57

Material Description	USCS	AASHTO
○ Silty SAND, very fine	SM	
□ SAND, uniform, fine	SP	
△ SAND, coarse, well graded	SW	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-14 **Depth:** 10

□ **Source of Sample:** B-14 **Depth:** 20

△ **Source of Sample:** B-14 **Depth:** 25

REITZ & JENS, INC.
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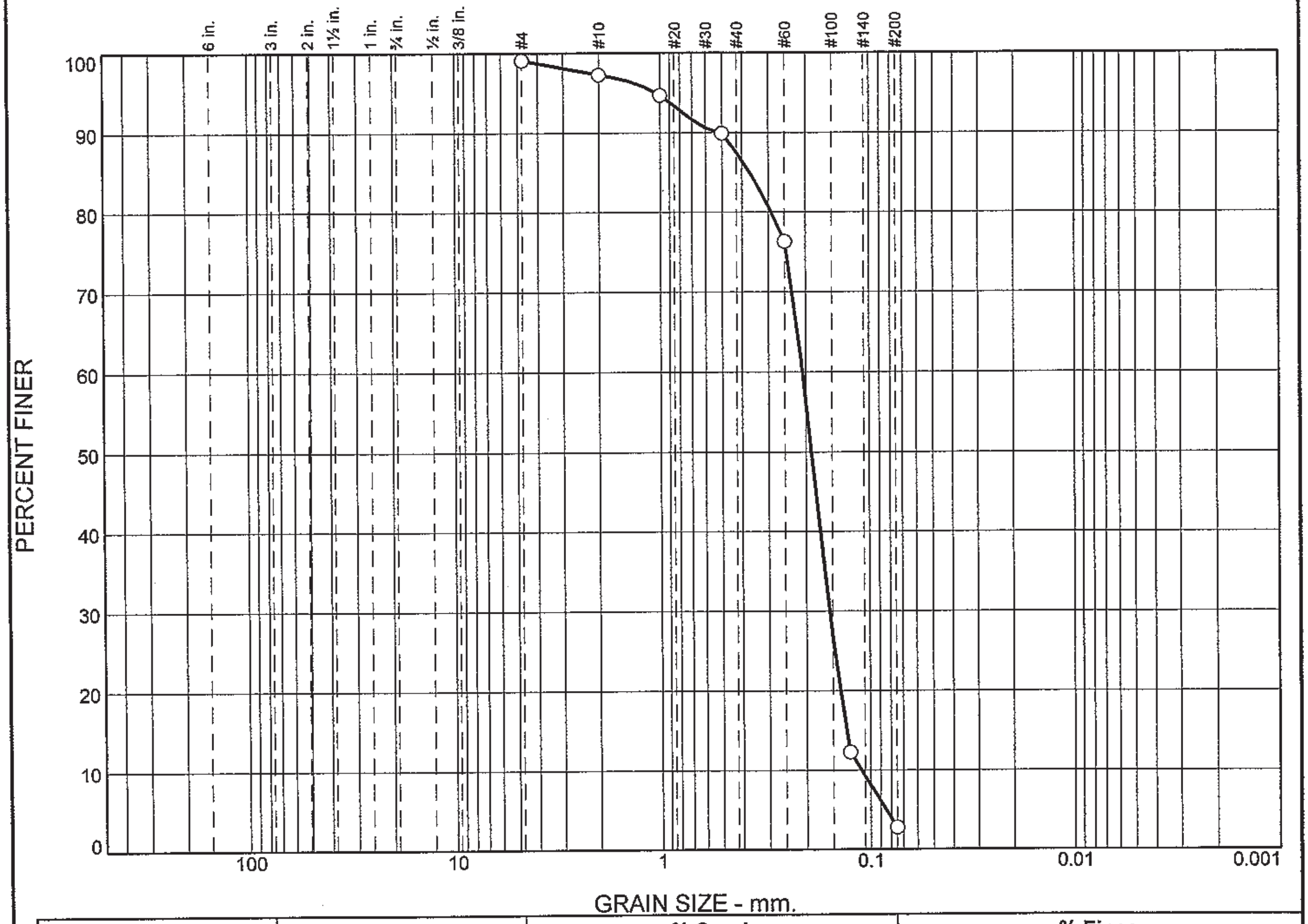
Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				1.8	9.8	84.8	2.7	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.3681	0.2068	0.1877	0.1549	0.1303	0.1107	1.05	1.87

Material Description	USCS	AASHTO
○ SAND, fine	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

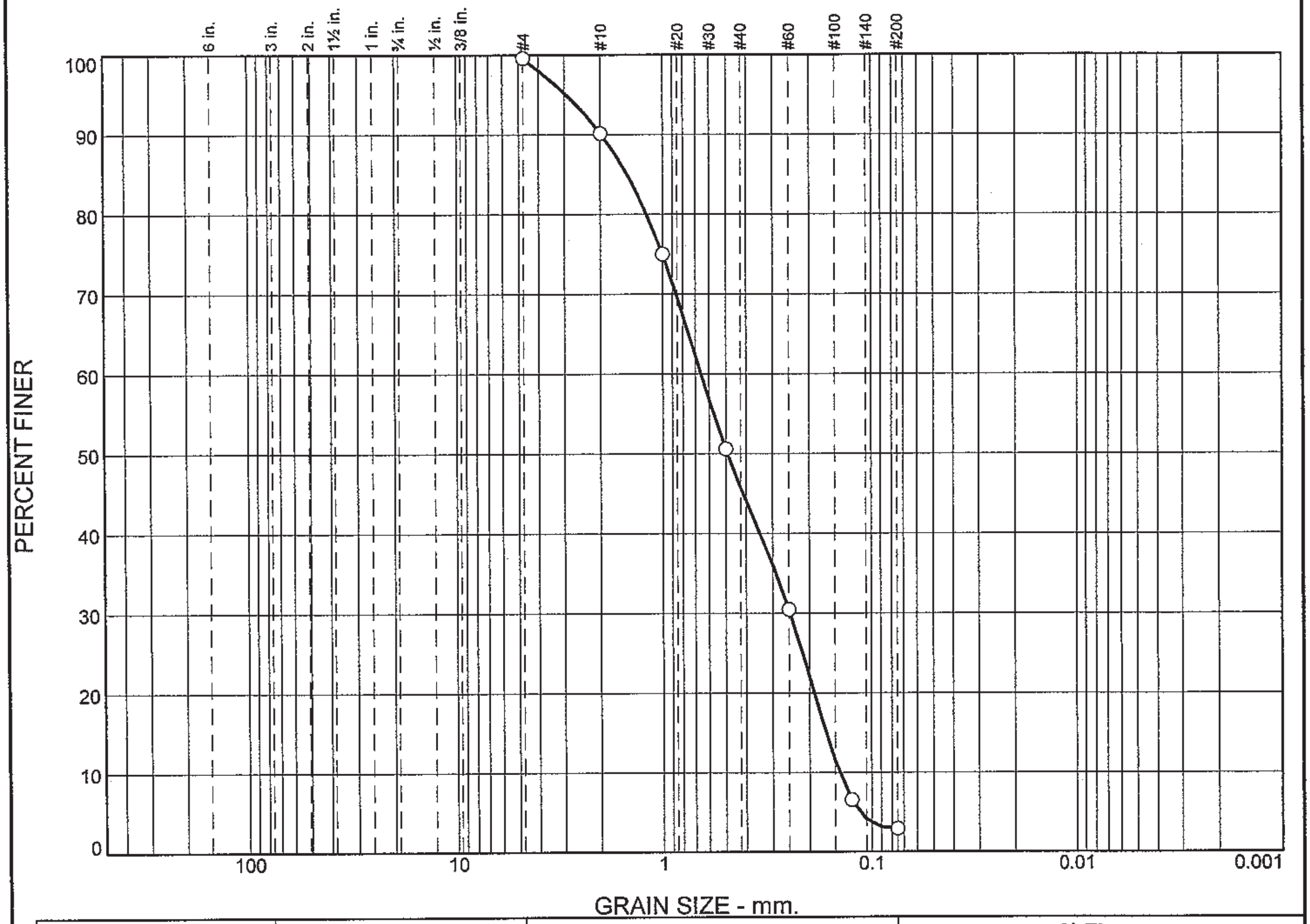
○ **Source of Sample:** B-16 **Depth:** 25

REITZ & JENS, INC.
CONSULTING ENGINEERS

Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				9.5	44.4	42.8	2.9	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.4844	0.6551	0.4912	0.2467	0.1661	0.1431	0.65	4.58

Material Description	USCS	AASHTO
○ SAND, fine to medium with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-18 **Depth:** 20

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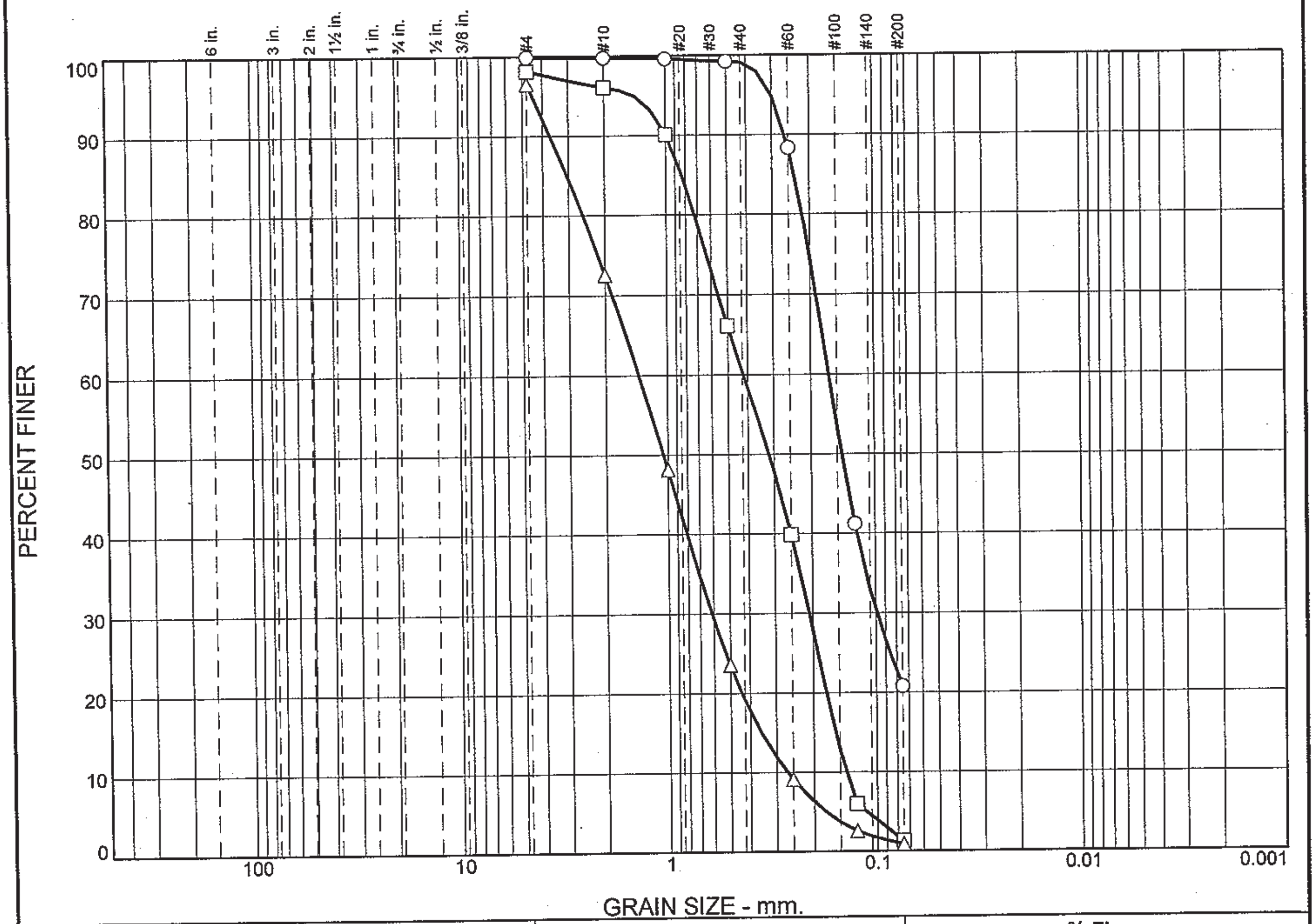
Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				0.1	0.7	78.3	20.8	
□				2.1	35.6	59.1	1.3	
△				23.9	53.5	18.2	0.9	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2347	0.1639	0.1430	0.0988				
□			0.8327	0.4196	0.3165	0.2074	0.1568	0.1403	0.73	2.99
△			3.0618	1.3787	1.0502	0.6123	0.3537	0.2662	1.02	5.18

Material Description	USCS	AASHTO
○ Silty SAND, fine, uniform	SM	
□ SAND, fine to medium	SP	
△ SAND, medium to coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-19 **Depth:** 15

□ **Source of Sample:** B-19 **Depth:** 20

△ **Source of Sample:** B-19 **Depth:** 25

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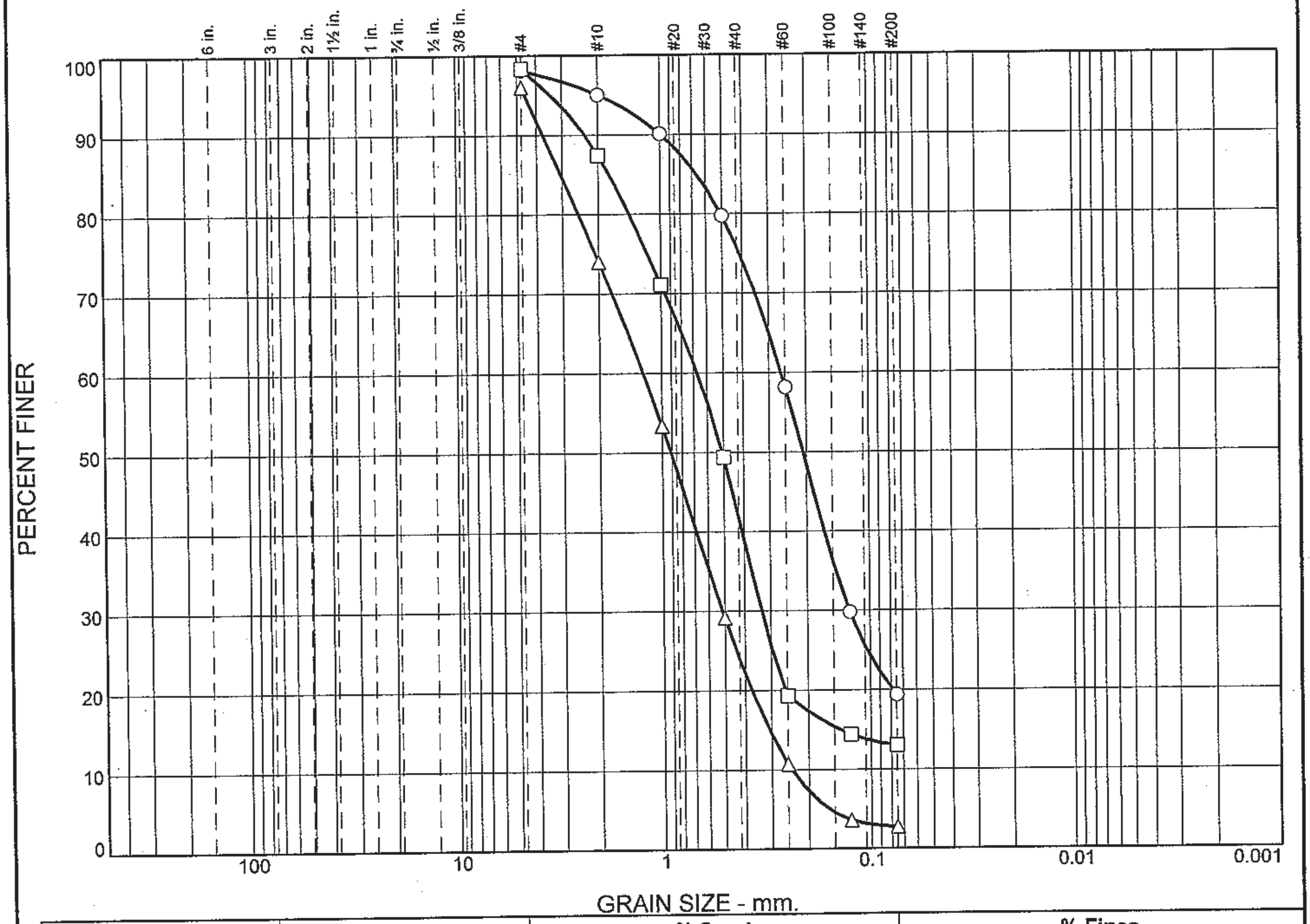
Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				3.1	19.1	56.5	19.4	
□				10.9	45.5	28.9	13.0	
△				22.0	50.1	21.2	2.7	

	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.6632	0.2617	0.2068	0.1258				
□			1.7714	0.6686	0.5073	0.3316	0.1403			
△			3.0529	1.2300	0.9068	0.5134	0.3066	0.2405	0.89	5.11

Material Description	USCS	AASHTO
○ Silty SAND, fine to medium	SM	
□ SAND, medium to coarse, with fines	SP-SM	
△ SAND, medium to coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-20 **Depth:** 15

□ **Source of Sample:** B-20 **Depth:** 20

△ **Source of Sample:** B-20 **Depth:** 25

Remarks:

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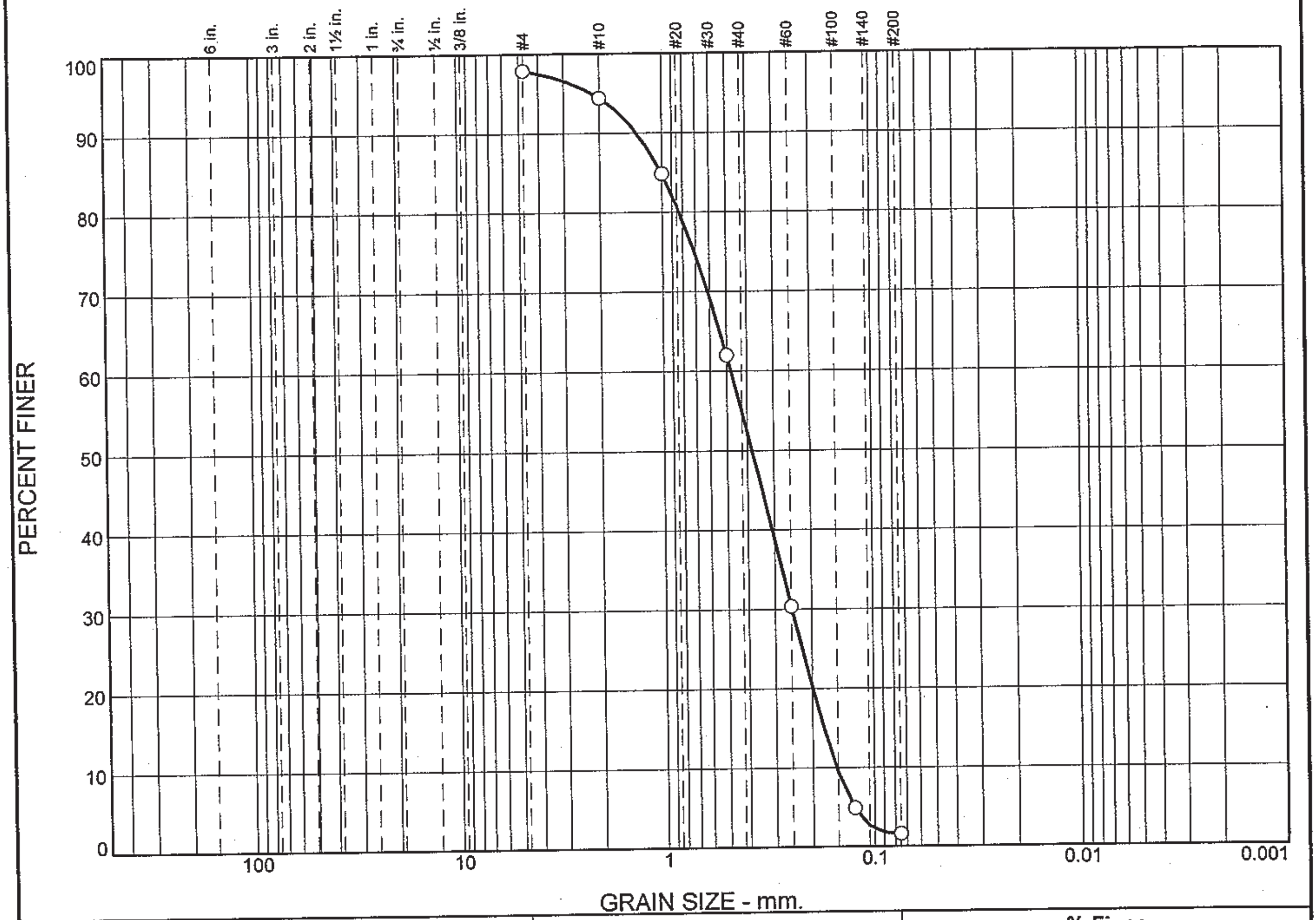
Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				3.5	39.4	53.4	1.6	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.0073	0.4768	0.3803	0.2480	0.1758	0.1526	0.85	3.12

Material Description	USCS	AASHTO
○ SAND, fine to medium,.with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-21 **Depth:** 25

Remarks:

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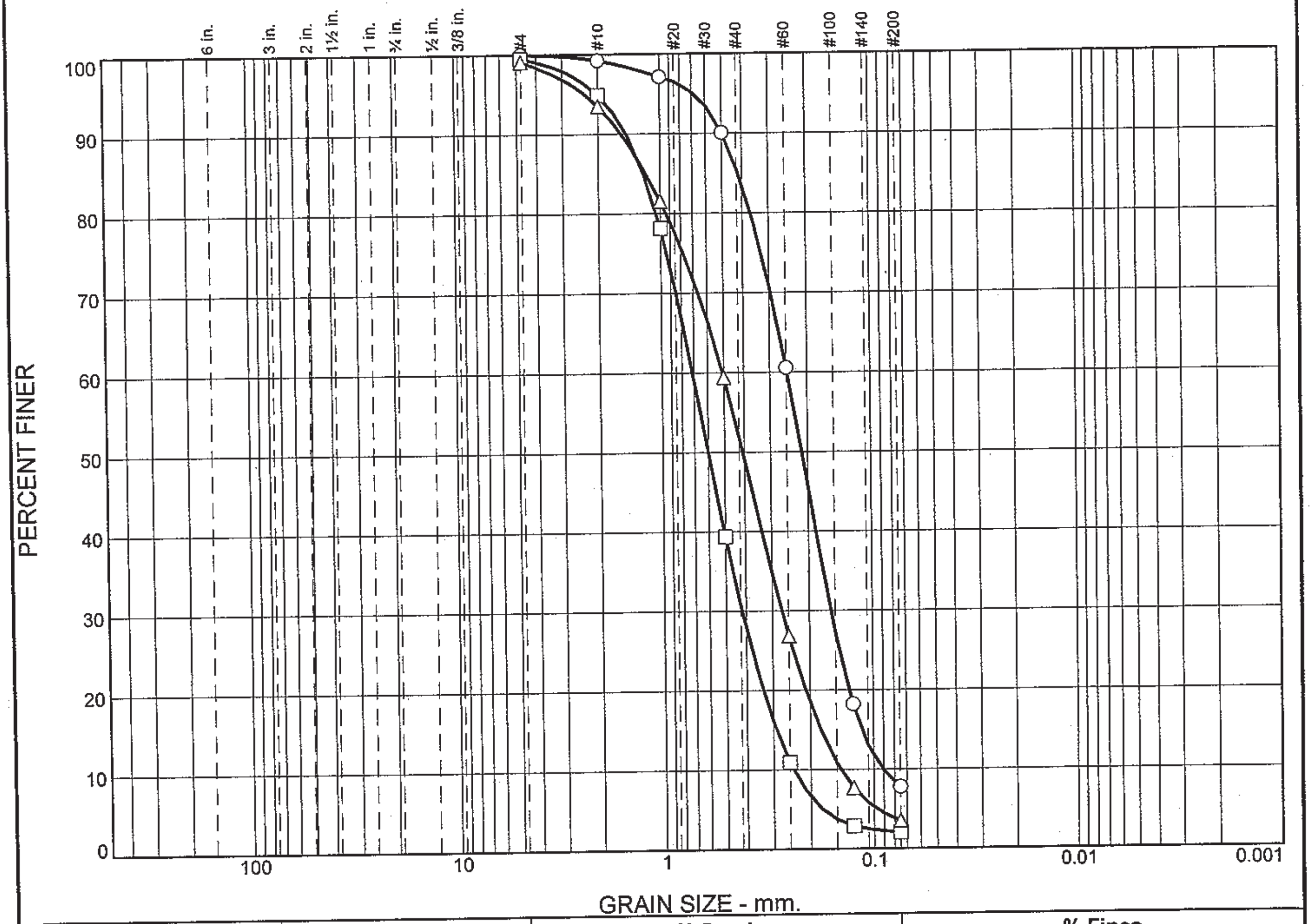
Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.8	13.6	77.8	7.8	
□				4.7	64.0	28.8	2.0	
△				5.6	41.5	48.5	3.5	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4179	0.2477	0.2126	0.1570	0.1141	0.0906	1.10	2.74
□			1.2043	0.7093	0.6002	0.4181	0.2889	0.2407	1.02	2.95
△			1.1721	0.5071	0.4078	0.2693	0.1777	0.1437	0.99	3.53

Material Description	USCS	AASHTO
○ SAND, fine to medium	SP	
□ SAND, fine to medium, with coarse	SP	
△ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-24 **Depth:** 15

□ **Source of Sample:** B-24 **Depth:** 20

△ **Source of Sample:** B-24 **Depth:** 25

Remarks:

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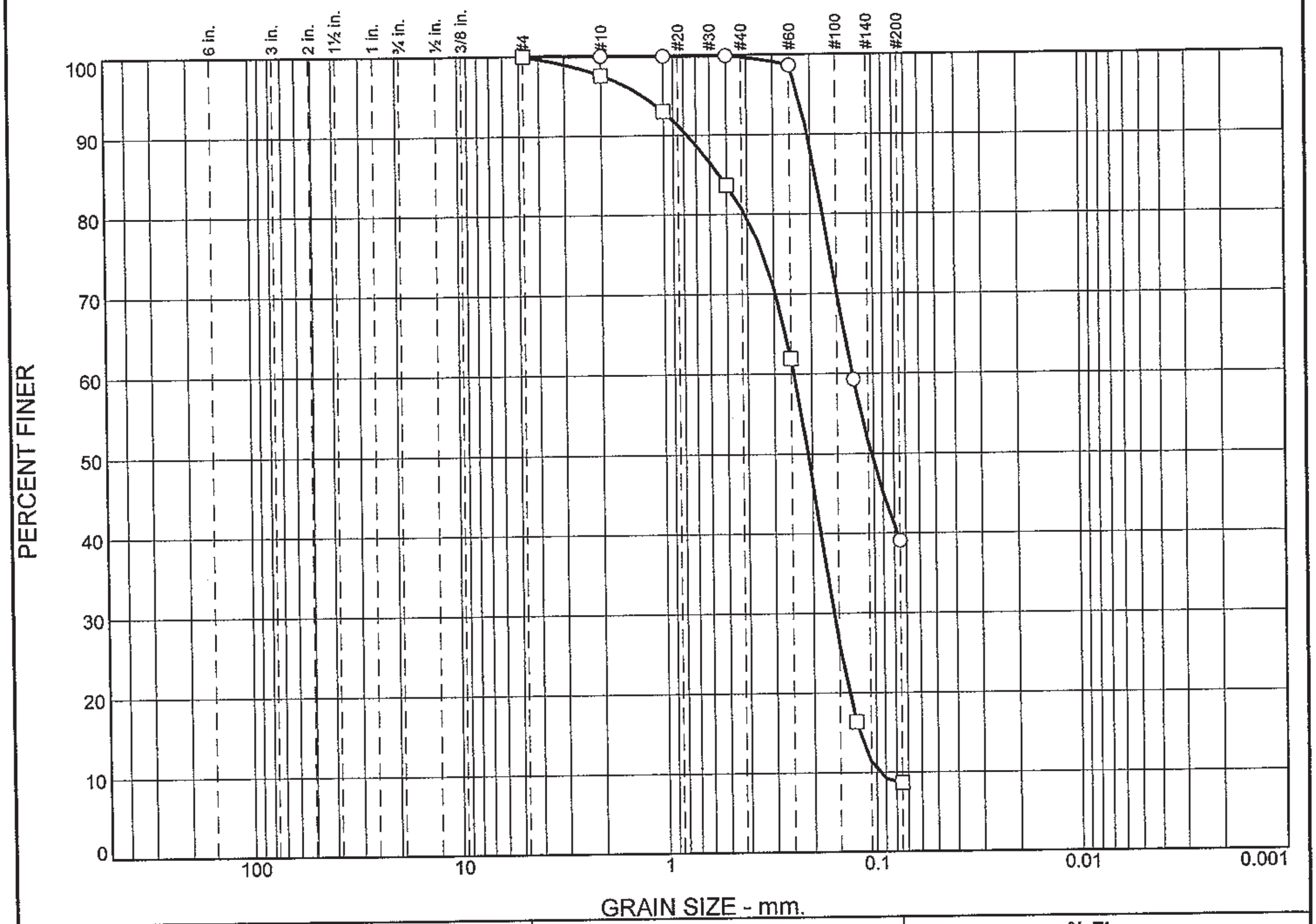
Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.3	60.6	39.1	
□	0.0	0.0	0.0	2.5	16.8	72.0	8.7	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.1889	0.1267	0.1025					
□			0.5435	0.2423	0.2089	0.1587	0.1208	0.0976	1.07	2.48

Material Description	USCS	AASHTO
○ Silty SAND, fine, uniform	SM	
□ Silty SAND, fine to medium	SP-SM	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-25 **Depth:** 20

□ **Source of Sample:** B-25 **Depth:** 25

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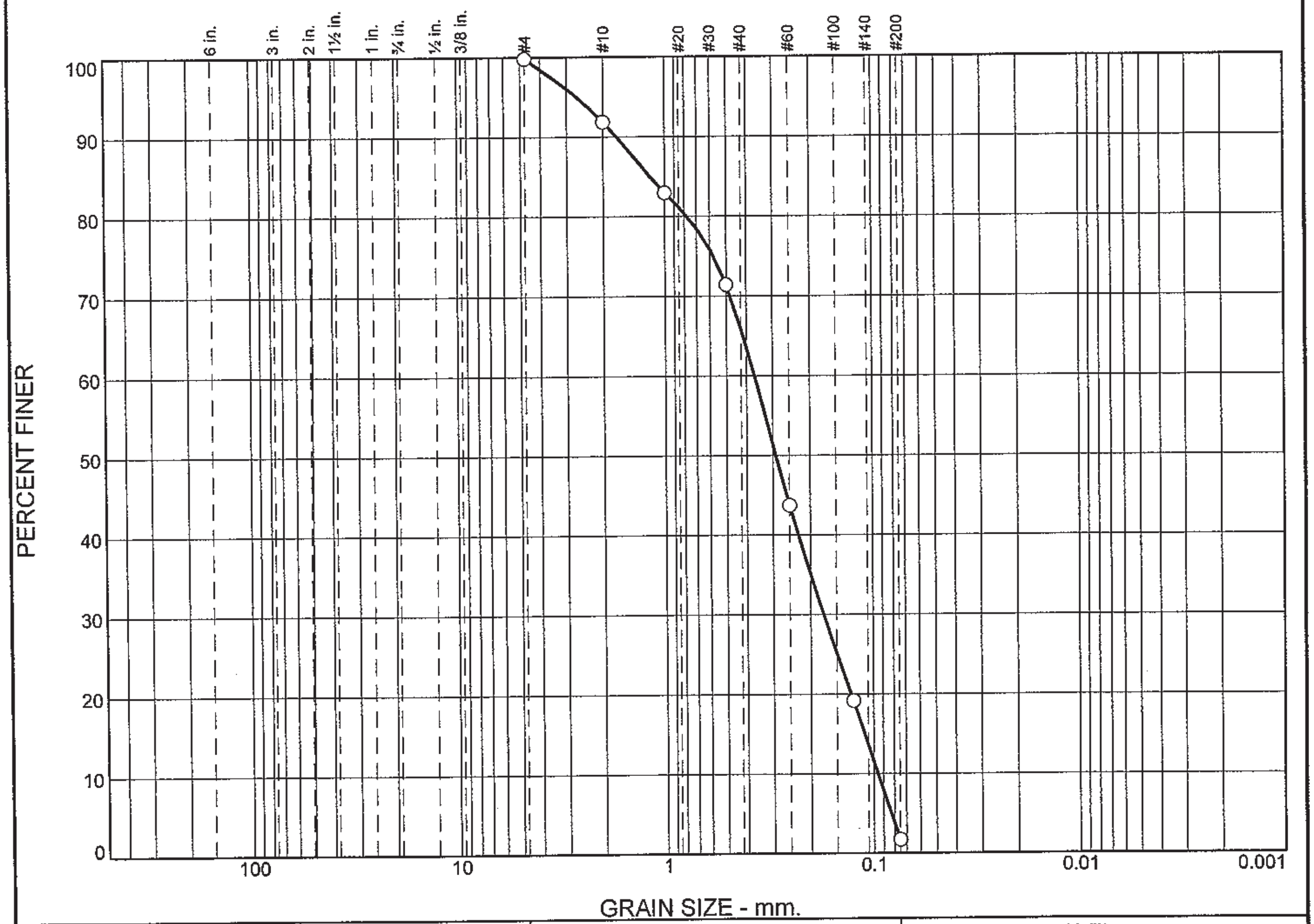
Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				8.0	25.8	64.3	1.7	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.1795	0.3657	0.2901	0.1728	0.1105	0.0954	0.86	3.83

Material Description	USCS	AASHTO
○ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-27 **Depth:** 25

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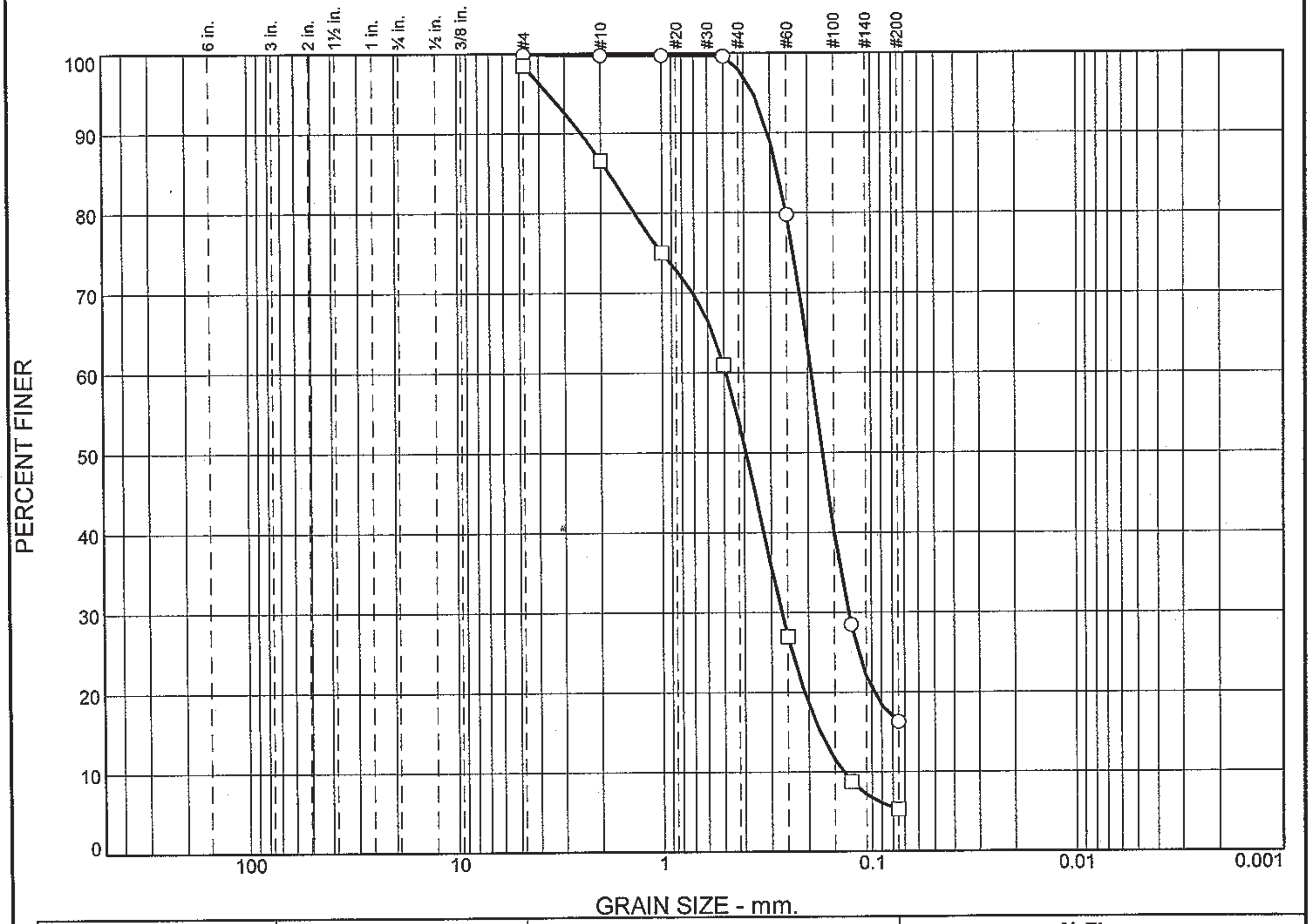
Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				0.1	1.8	81.7	16.3	
□				12.0	32.5	48.7	5.3	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2743	0.1920	0.1701	0.1286				
□			1.8231	0.4875	0.3922	0.2668	0.1762	0.1373	1.06	3.55

Material Description	USCS	AASHTO
○ Silty SAND, fine, uniform	SM	
□ SAND, fine to medium, with coarse	SP-SM	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-29 **Depth:** 15

□ **Source of Sample:** B-29 **Depth:** 20

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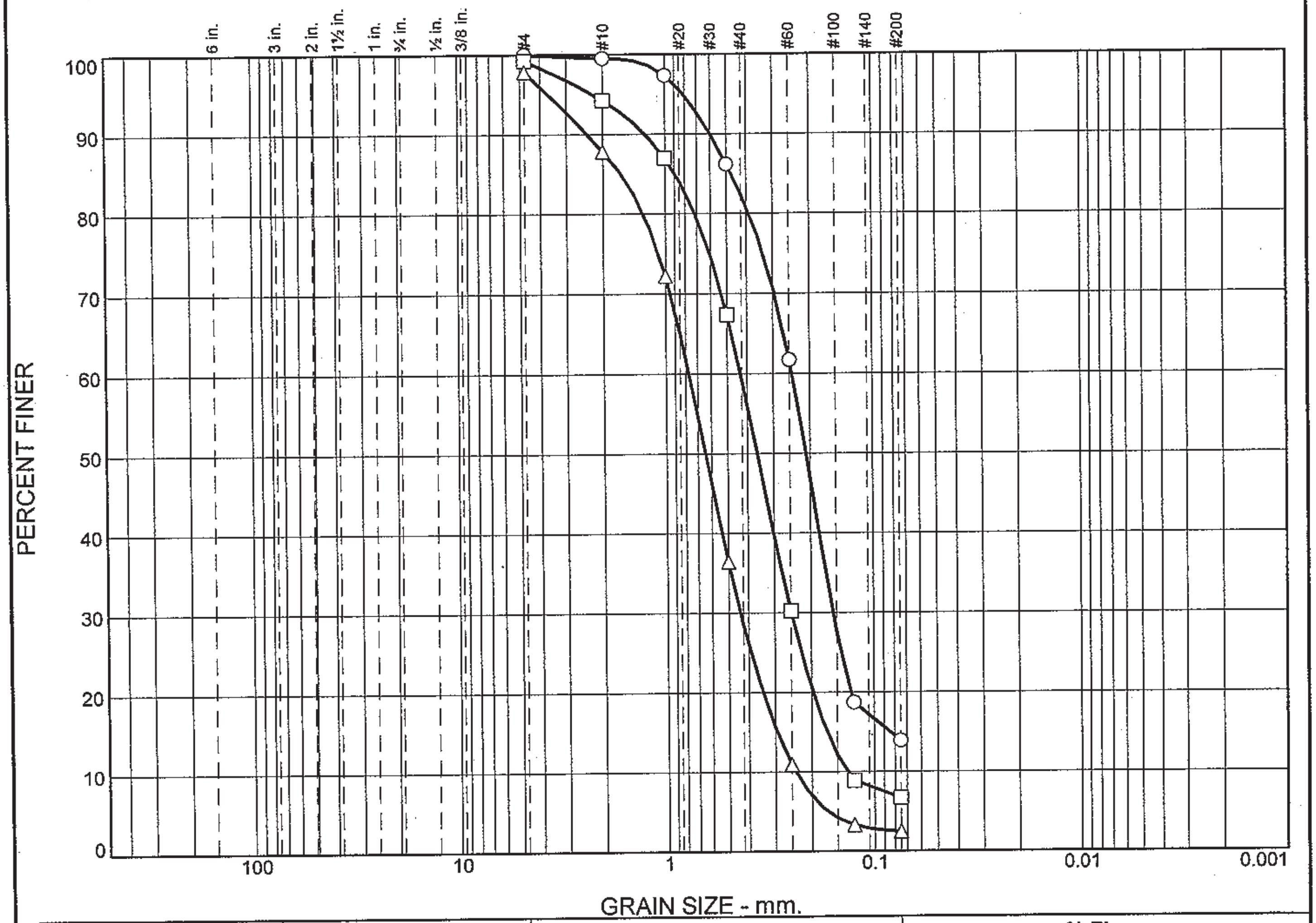
Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.5	17.1	68.5	13.9	
□				5.0	34.9	52.6	6.7	
△				10.1	59.1	26.3	2.4	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4739	0.2430	0.2088	0.1560	0.0843			
□			0.8944	0.4305	0.3592	0.2489	0.1683	0.1348	1.07	3.19
△			1.6415	0.7714	0.6425	0.4377	0.2932	0.2397	1.04	3.22

Material Description	USCS	AASHTO
○ Silty SAND, fine to medium	SM	
□ SAND, fine to medium, with coarse, and fines	SP-SM	
△ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-30 **Depth:** 15

□ **Source of Sample:** B-30 **Depth:** 20

△ **Source of Sample:** B-30 **Depth:** 25

Remarks:

REITZ & JENS, INC.
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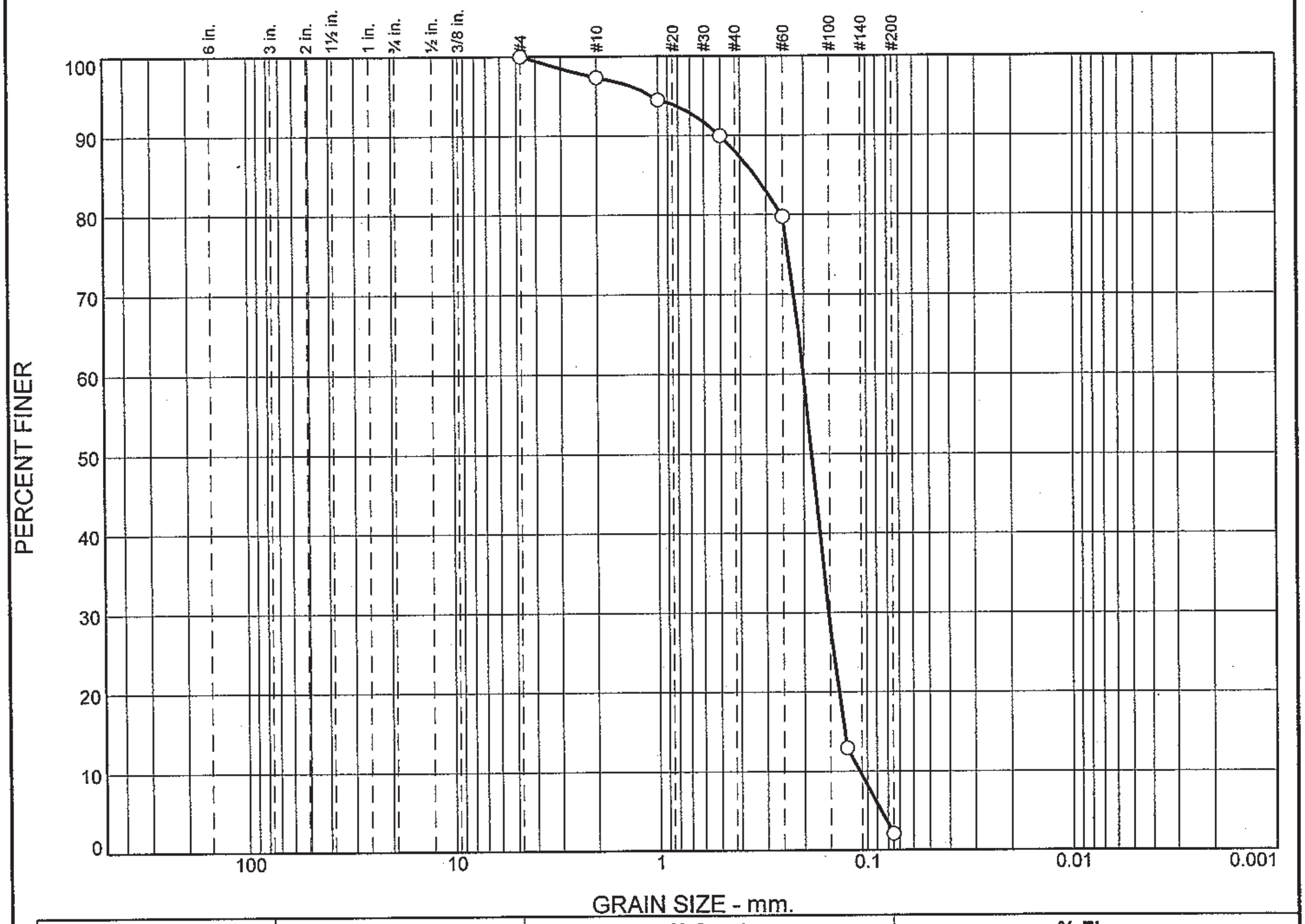
Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	2.7	9.2	86.0	2.1	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.3403	0.2006	0.1830	0.1523	0.1288	0.1089	1.06	1.84

Material Description	USCS	AASHTO
○ SAND, fine, uniform	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-31 **Depth:** 25

Remarks:

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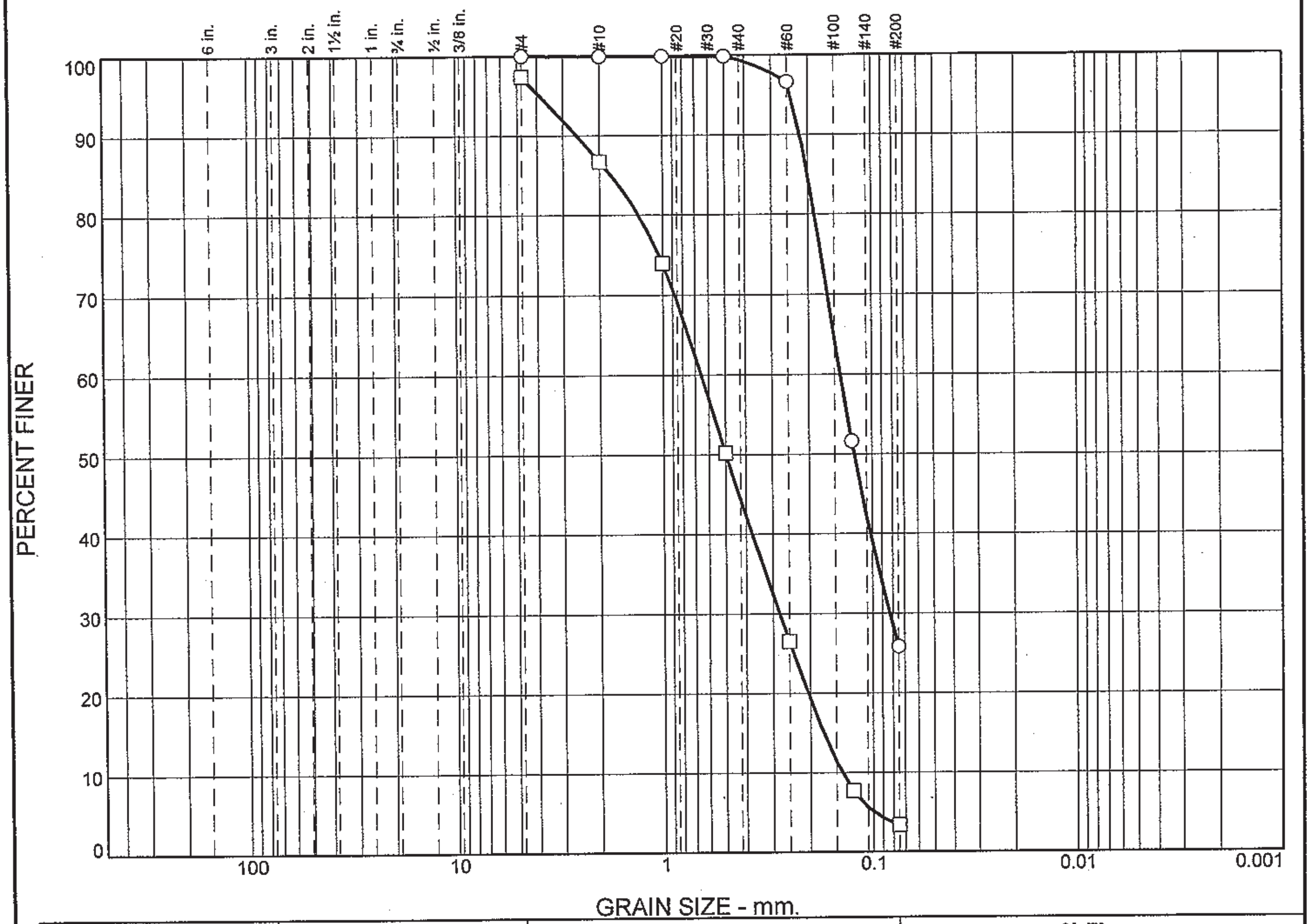
Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.5	73.6	25.8	
□				10.7	42.3	41.0	3.4	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2003	0.1412	0.1218	0.0825				
□			1.7686	0.6527	0.4972	0.2780	0.1727	0.1413	0.84	4.62

Material Description	USCS	AASHTO
○ Silty SAND, fine, uniform	SM	
□ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-34 **Depth:** 10
□ **Source of Sample:** B-34 **Depth:** 20

Remarks:

REITZ & JENS, INC.
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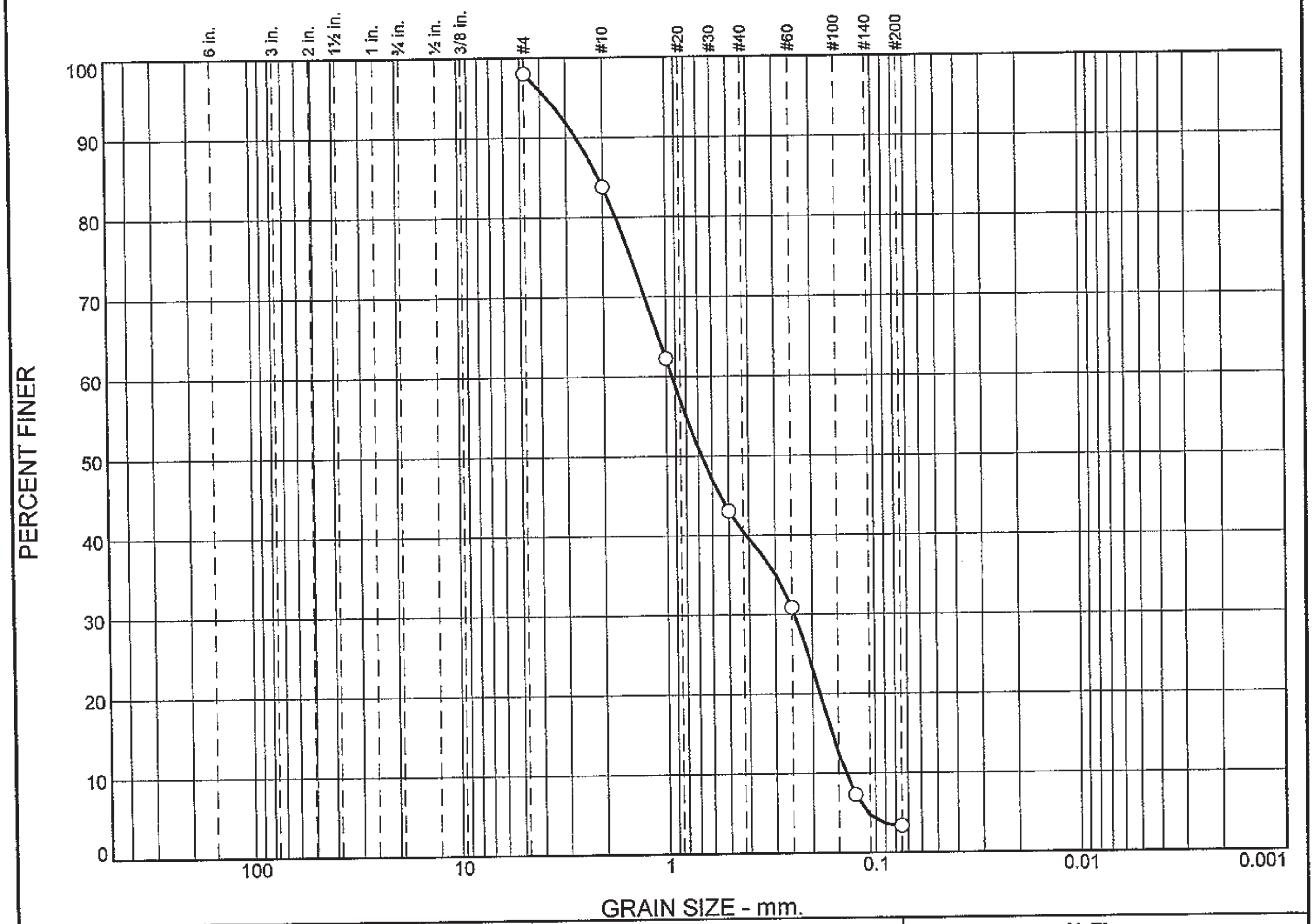
Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				14.2	43.4	37.0	3.4	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			2.1004	0.9344	0.6733	0.2428	0.1610	0.1386	0.46	6.74

Material Description	USCS	AASHTO
○ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-38 **Depth:** 20

Remarks:

REITZ & JENS, INC.
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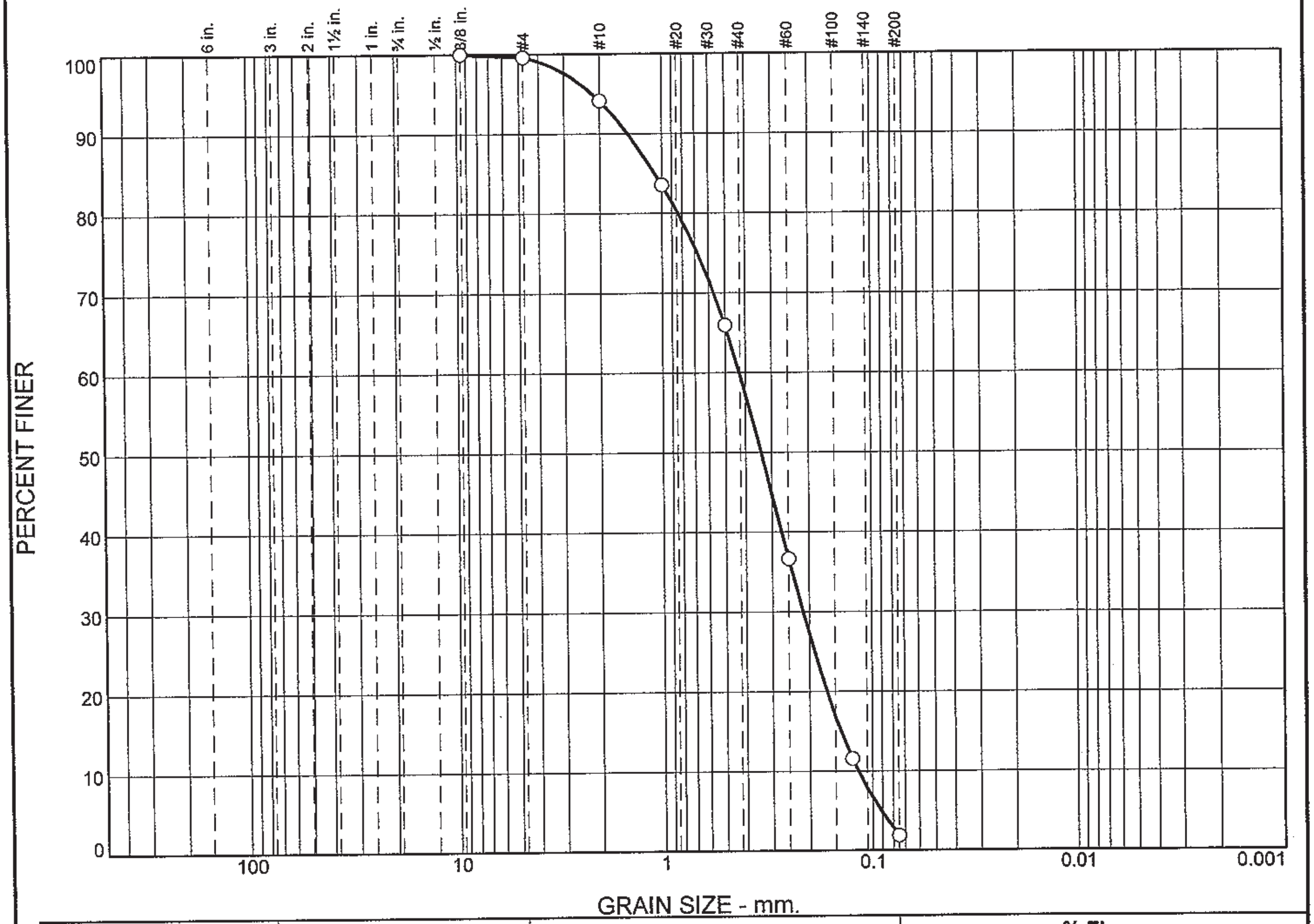
Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.4	5.5	34.3	58.0	1.8	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.0819	0.4272	0.3376	0.2139	0.1415	0.1174	0.91	3.64

Material Description	USCS	AASHTO
○ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-40 **Depth:** 25

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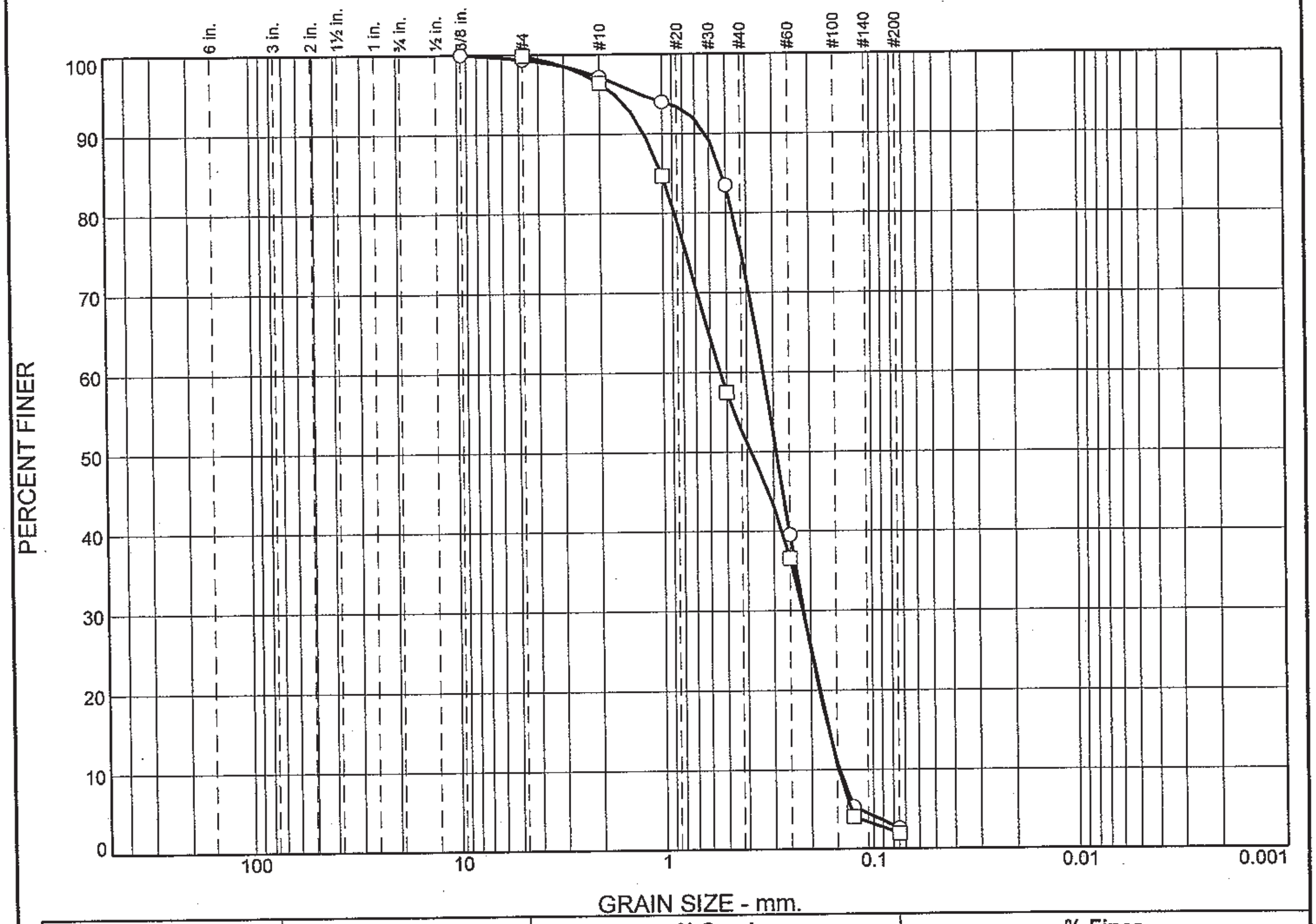
Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.6	2.2	21.7	72.9	2.6	
□				3.4	43.8	50.7	1.9	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.5198	0.3339	0.2900	0.2164	0.1650	0.1464	0.96	2.28
□			1.0100	0.5372	0.3842	0.2178	0.1642	0.1478	0.60	3.64

Material Description	USCS	AASHTO
○ SAND, fine, with medium, little coarse	SP	
□ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

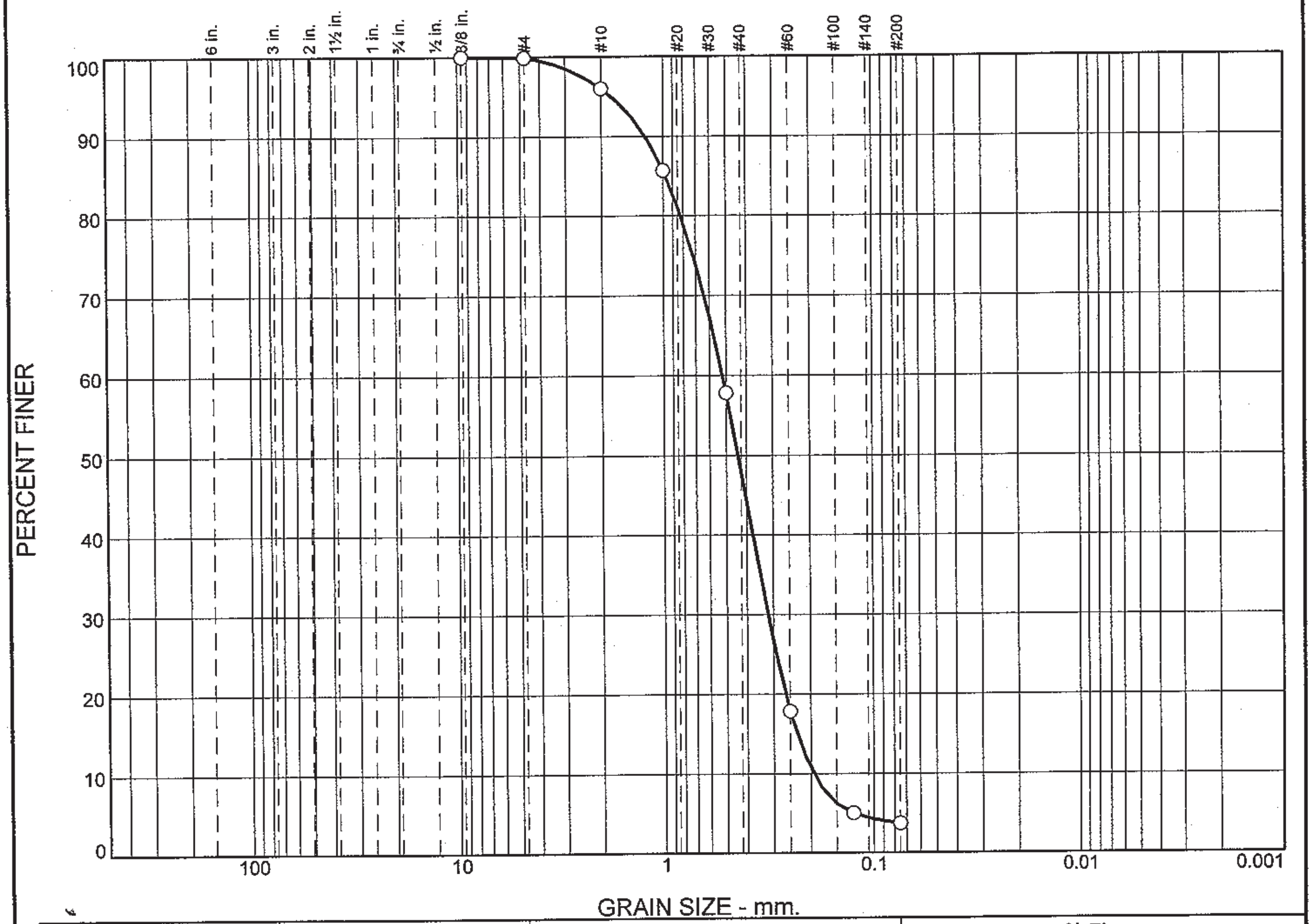
○ **Source of Sample:** B-42 **Depth:** 15
□ **Source of Sample:** B-42 **Depth:** 20

REITZ & JENS, INC.
CONSULTING ENGINEERS

Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.1	3.9	47.9	44.4	3.7	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.9739	0.5201	0.4385	0.3172	0.2321	0.1942	1.00	2.68

Material Description	USCS	AASHTO
○ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

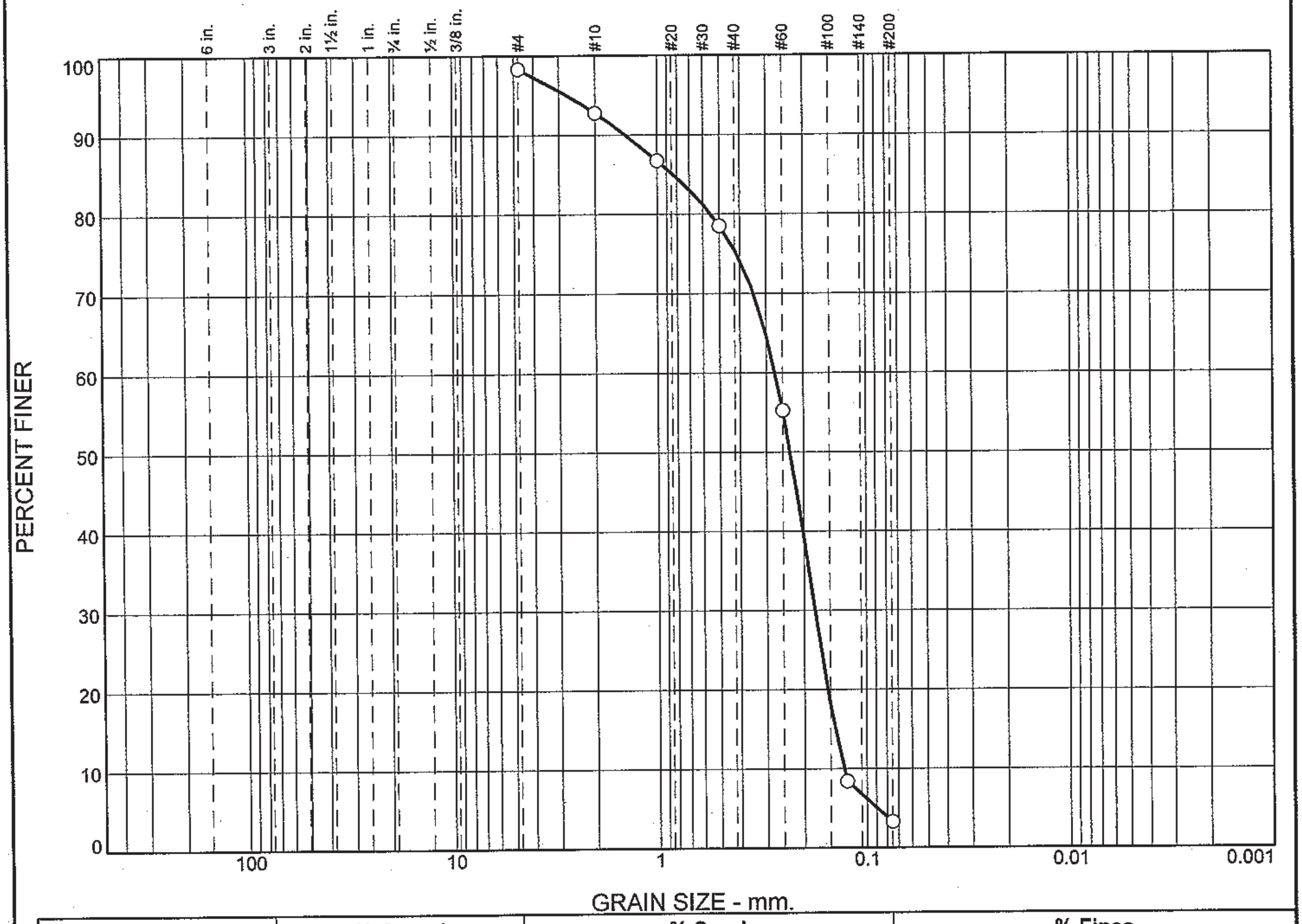
○ **Source of Sample:** B-44 **Depth:** 25

Remarks:

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				5.5	17.3	72.2	3.3	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.8377	0.2717	0.2309	0.1770	0.1425	0.1297	0.89	2.09

Material Description	USCS	AASHTO
○ SAND, fine, with medium, some coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

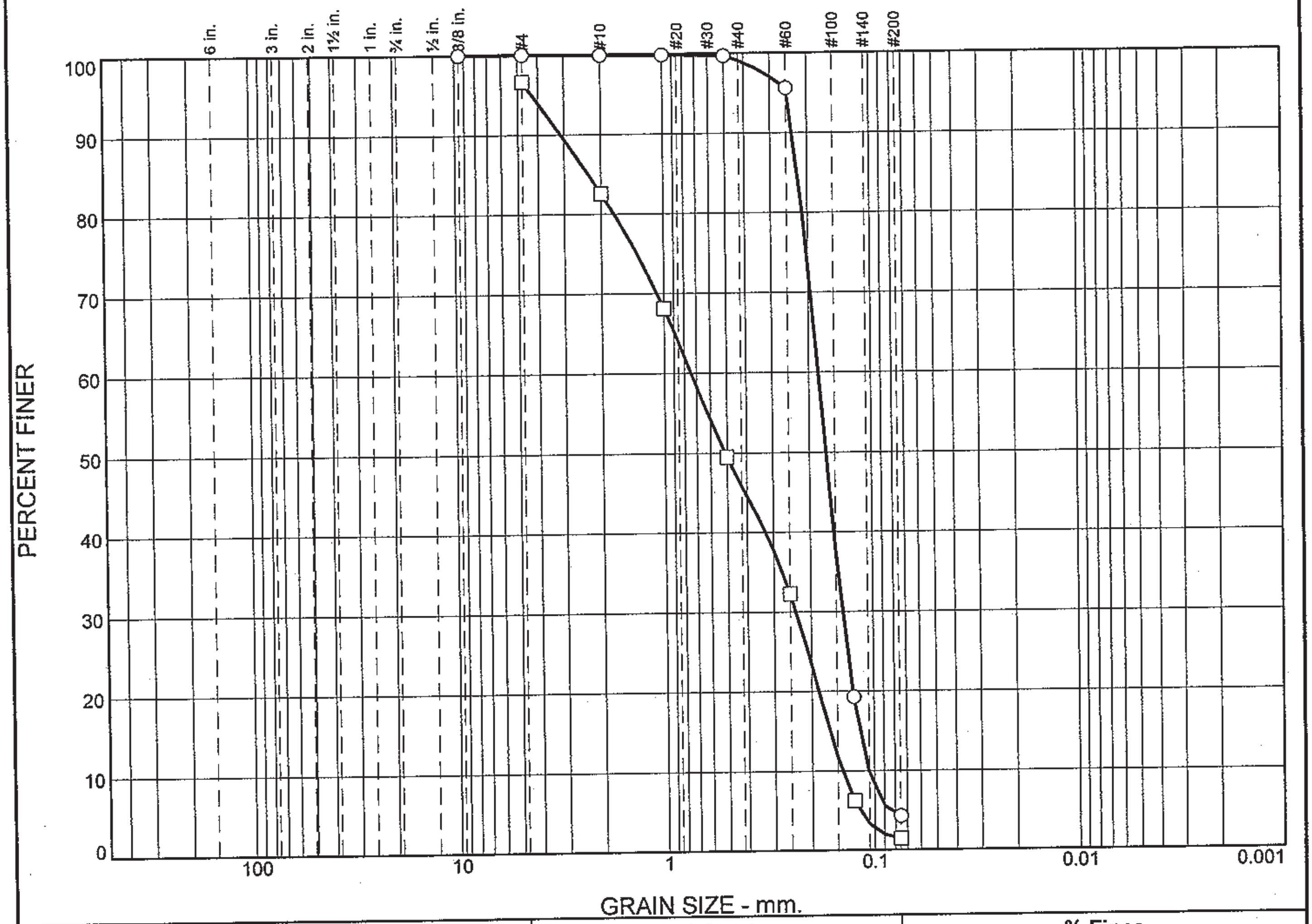
○ **Source of Sample:** B-47 **Depth:** 20

REITZ & JENS, INC.
CONSULTING ENGINEERS

Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	0.8	94.8	4.3	
□				14.0	36.8	44.4	1.4	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.2216	0.1794	0.1658	0.1401	0.1177	0.1066	1.03	1.68
□			2.3039	0.7417	0.5111	0.2351	0.1631	0.1424	0.52	5.21

Material Description	USCS	AASHTO
○ SAND, fine, uniform	SP	
□ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.
Project: Sioux Power Plant UWLF

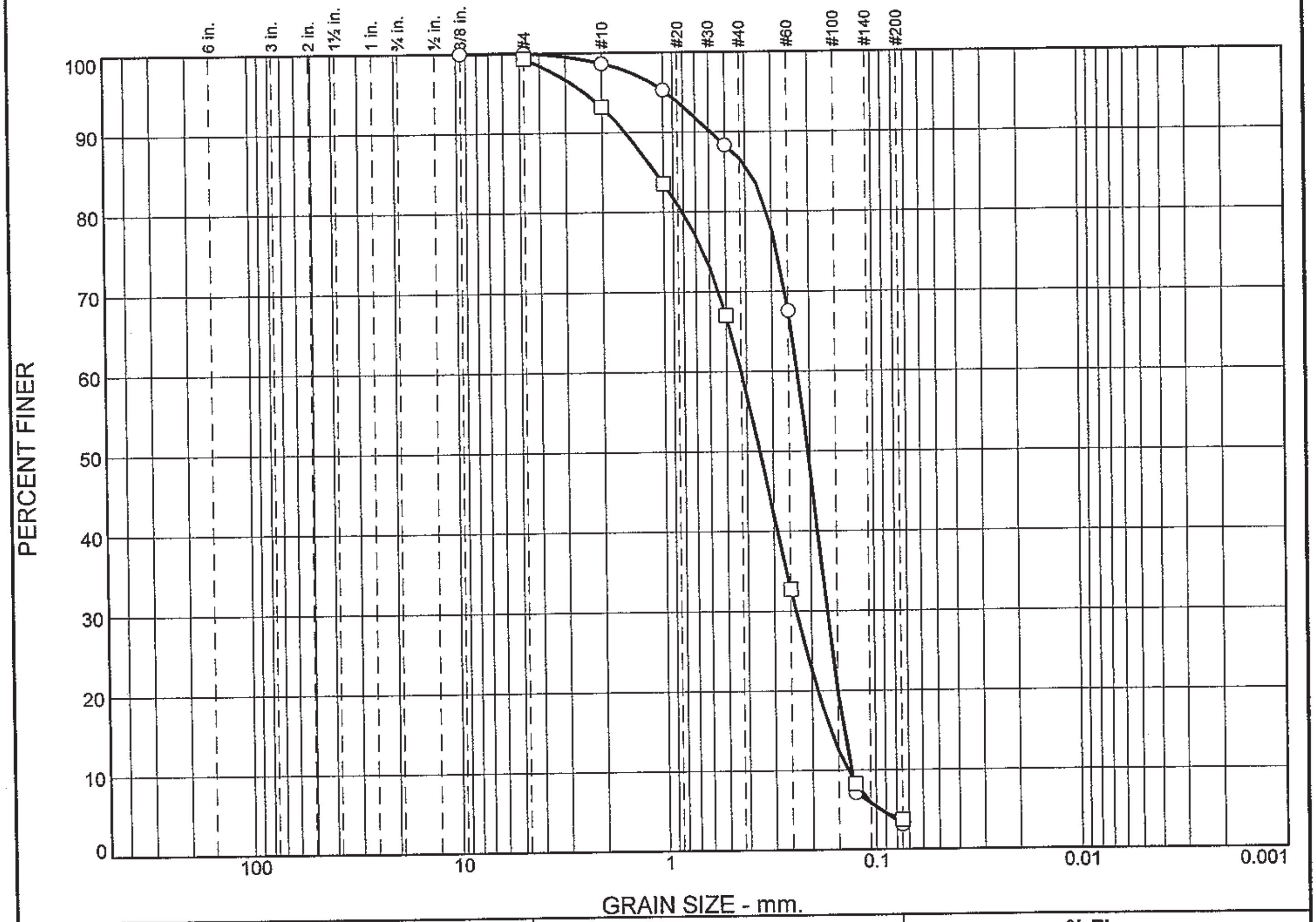
○ **Source of Sample:** B-50 **Depth:** 15
□ **Source of Sample:** B-50 **Depth:** 25

REITZ & JENS, INC.
CONSULTING ENGINEERS

Remarks:

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	1.3	12.1	83.5	3.1	
□				6.2	33.2	56.3	3.7	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.3809	0.2276	0.2045	0.1673	0.1412	0.1315	0.94	1.73
□			1.0962	0.4250	0.3483	0.2363	0.1628	0.1361	0.97	3.12

Material Description	USCS	AASHTO
○ SAND, fine, with medium, little coarse	SP	
□ SAND, fine to medium, with coarse	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-53 **Depth:** 15

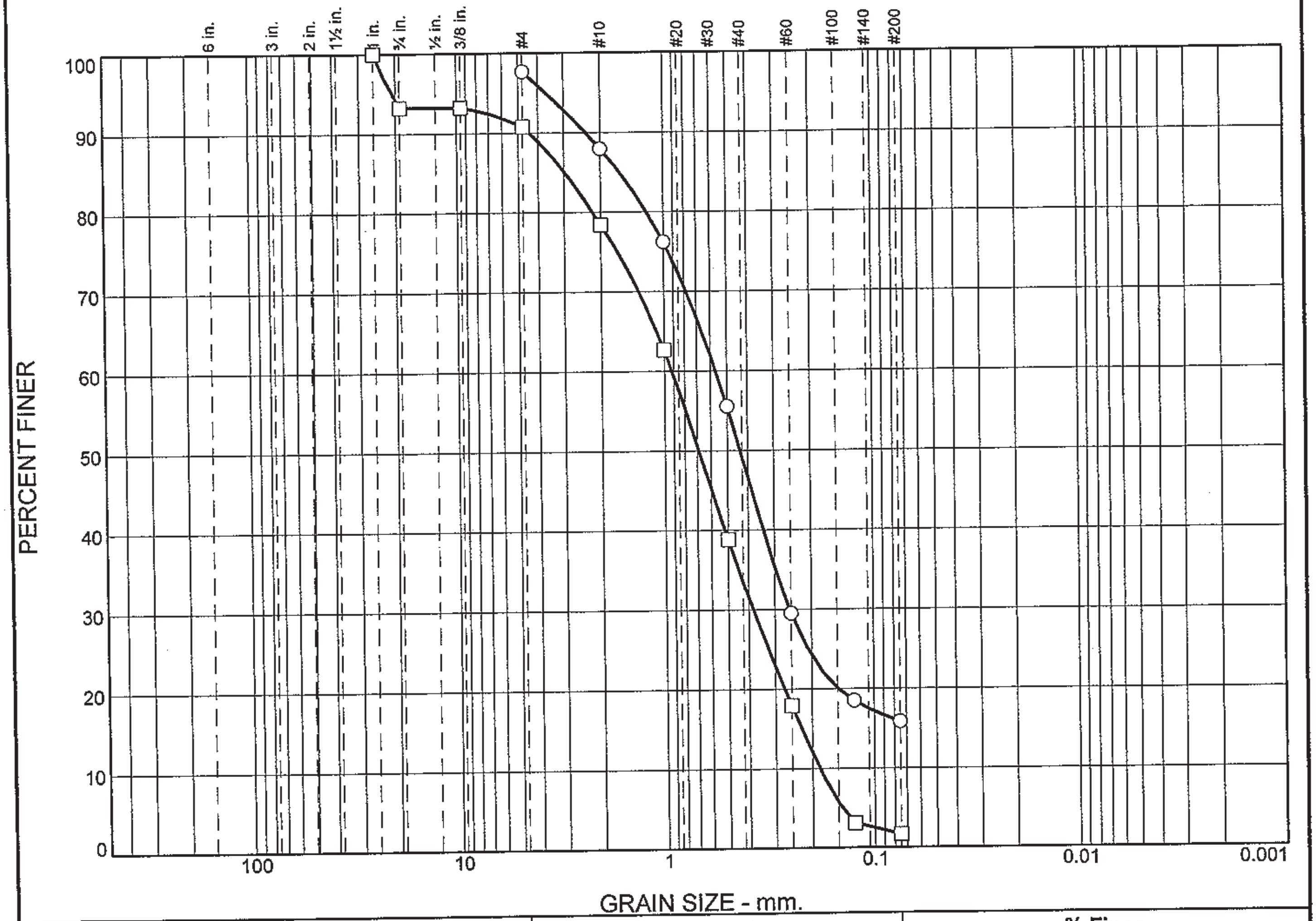
□ **Source of Sample:** B-53 **Depth:** 25

Remarks:

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○				9.8	38.7	33.4	15.8	
□	0.0	6.8	2.5	12.3	44.9	31.9	1.6	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			1.6193	0.5656	0.4339	0.2541				
□			2.9763	0.9167	0.6851	0.3804	0.2246	0.1843	0.86	4.97

Material Description	USCS	AASHTO
○ SAND, fine to medium, with coarse sand and fines	SM	
□ SAND, fine to medium, with coarse sand and some gravel	SP	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-55 **Depth:** 15

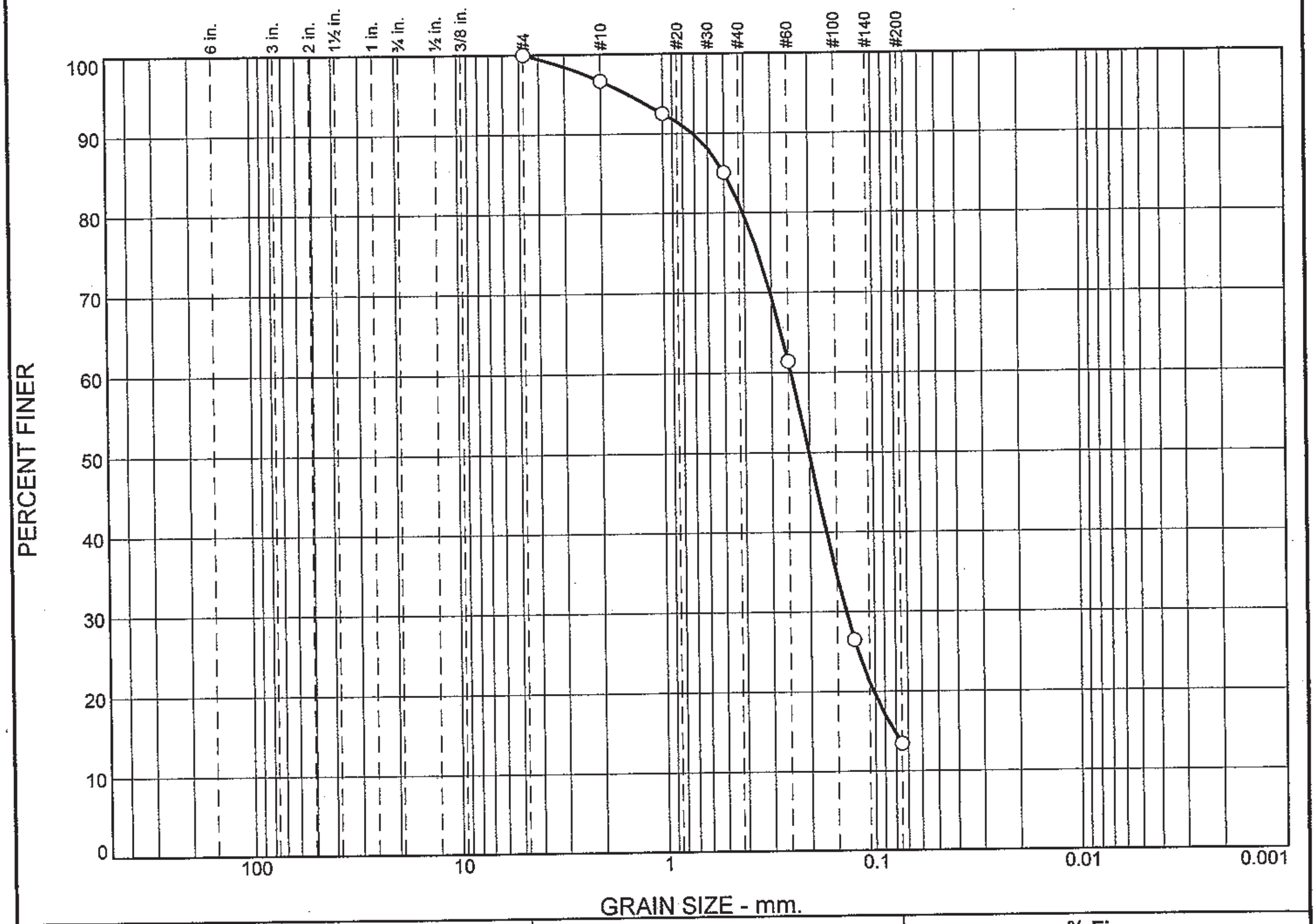
□ **Source of Sample:** B-55 **Depth:** 20

Remarks:

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure

Particle Size Distribution Report - ASTM D422



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	3.3	15.4	67.9	13.4	

☒	LL	PL	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
○			0.4985	0.2430	0.2010	0.1361	0.0813			

Material Description	USCS	AASHTO
○ SAND, fine with medium, some coarse, and fines	SM	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

○ **Source of Sample:** B-57 **Depth:** 20

Remarks:

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure

2005012477

AMEREN UE SIOUX POWER PLANT UTILITY WASTE LANDFILL

BORING LOGS AND RESULTS OF LABORATORY TESTS

Prepared for

Ameren

Prepared by

REITZ & JENS, INC.
CONSULTING ENGINEERS

February 22, 2006

REITZ & JENS, INC.
CONSULTING ENGINEERS

1055 corporate square drive
st. louis, missouri 63132
phone: 314.993.4132
fax: 314.993.4177
www.reitzjens.com

February 22, 2006

Mr. Thomas R. Gredell, P.E.
GREDELL Engineering Resources, Inc.
1505 East High Street
Jefferson City, Missouri 65101

RE: Ameren Sioux Plant Utility Waste Landfill
Boring Logs and Results of Laboratory Tests

Dear Tom:

With this letter, we are submitting to you, and to Carl Rezsonya, the logs for the geotechnical borings for the Sioux Plant utility waste landfill – Borings B-58 through B-114. We are also submitting the results of the laboratory testing that we have performed to date: grain-size analyses, triaxial shear strength tests, and consolidation tests. We have held a number of undisturbed samples of the upper clays and silts for possible testing later. These samples have been extruded and sealed in wax.

We performed six flexible-wall hydraulic conductivity tests on selected samples. The results are:

Boring No.	Sample	Depth, feet	Soil Description	k, cm/sec
B-58	ST-2	4 – 6	High Plastic Clay (CH)	5.3×10^{-8}
B-70	ST-4	9 – 11	High Plastic Clay (CH)	2.6×10^{-6}
B-85	ST-2	4 – 6	High Plastic Clay (CH)	6.6×10^{-5}
B-86	ST-1	1.5 – 3.5	High Plastic Clay (CH)	5.1×10^{-9}
B-100	ST-1	1 – 3	Slightly Silty Clay (CL)	7.5×10^{-8}
B-104	ST-1	1.5 – 3.5	High Plastic Clay (CH)	4.9×10^{-8}

We are working on the soil profiles requested by Mike Carlson in AutoCAD, and plan to provide these AutoCAD files for Mike's review and comment within the next week.

Sincerely,
REITZ & JENS, Inc.

Jeffrey L Fouse

Jeffrey L. Fouse, P.E.
Senior Project Manager

cc; Carl Rezsonya, Ameren

2005012477

AMEREN UE SIOUX POWER PLANT
UTILITY WASTE LANDFILL

BORING LOGS AND
RESULTS OF LABORATORY TESTS

Prepared for

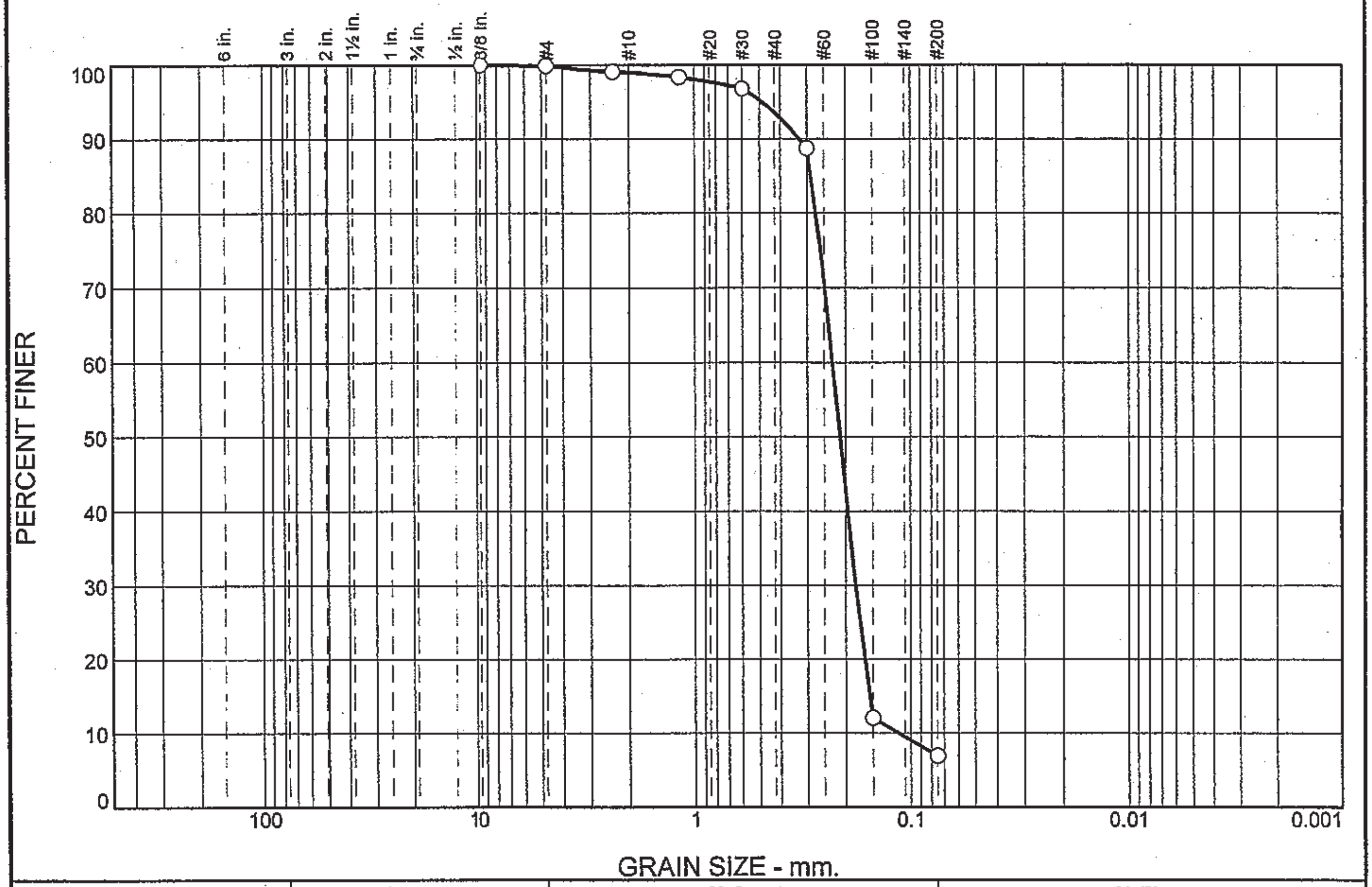
Ameren

Prepared by

REITZ & JENS, INC.
CONSULTING ENGINEERS

February 22, 2006

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.9	5.4	86.7	6.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#8	99.1		
#16	98.4		
#30	96.8		
#50	88.7		
#100	12.1		
#200	6.9		

* (no specification provided)

Material Description

SAND (SP-SM), tan, fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2866 D_{60}= 0.2285 D_{50}= 0.2112
D_{30}= 0.1798 D_{15}= 0.1554 D_{10}= 0.1133
C_u= 2.02 C_c= 1.25

Date Tested: 1/11/06 **Tested By:** J. Crose

Remarks

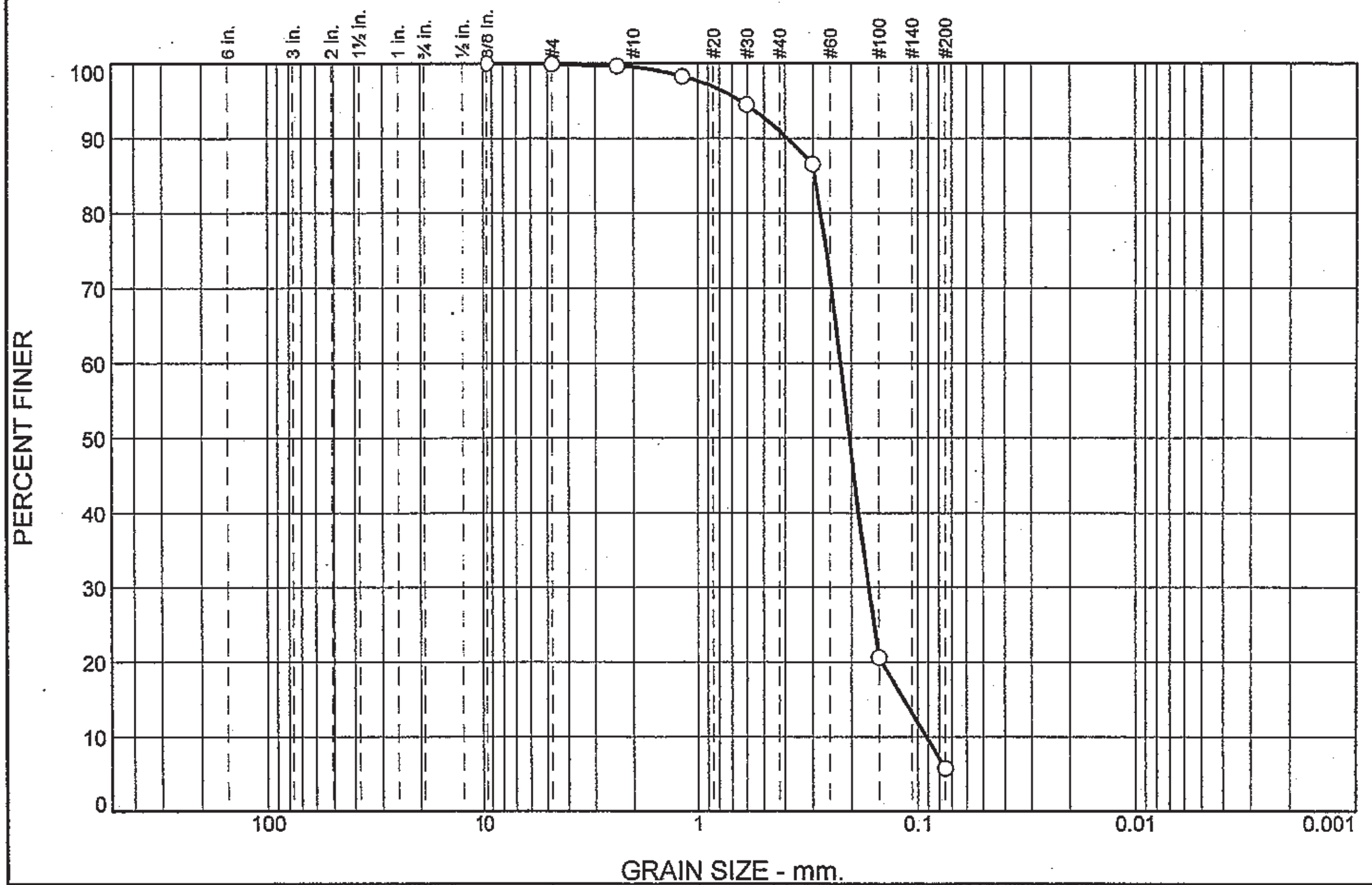
Sample No.: S-6 **Source of Sample:** B-58 **Date Sampled:**
Location: **Elev./Depth:** 18.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-1

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.3	8.5	85.3	5.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#8	99.7		
#16	98.3		
#30	94.5		
#50	86.6		
#100	20.6		
#200	5.8		

* (no specification provided)

Material Description

Sand (SP-SM), tan, fine-grained, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2930 D_{60}= 0.2233 D_{50}= 0.2037
D_{30}= 0.1678 D_{15}= 0.1154 D_{10}= 0.0914
C_u= 2.44 C_c= 1.38

Date Tested: 1/11/06 **Tested By:** J. Crose

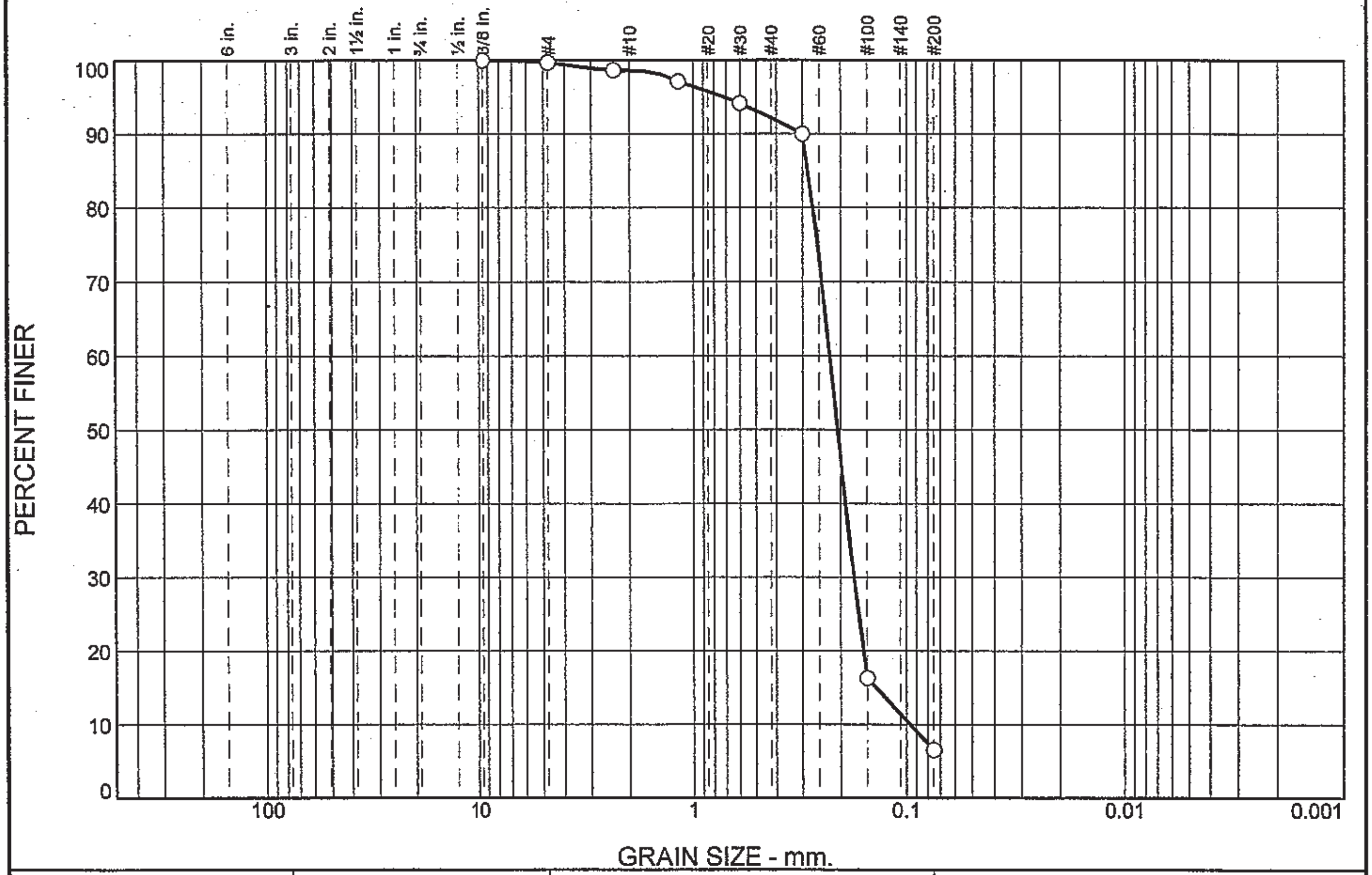
Remarks

Sample No.: S-7 **Source of Sample:** B-58 **Date Sampled:**
Location: **Elev./Depth:** 23.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-2

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	1.1	6.4	85.6	6.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.7		
#8	98.7		
#16	97.1		
#30	94.1		
#50	90.0		
#100	16.3		
#200	6.6		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2812 D_{60}= 0.2227 D_{50}= 0.2053
D_{30}= 0.1733 D_{15}= 0.1367 D_{10}= 0.0958
C_u= 2.32 C_c= 1.41

Date Tested: 1/11/06 **Tested By:** J. Crose

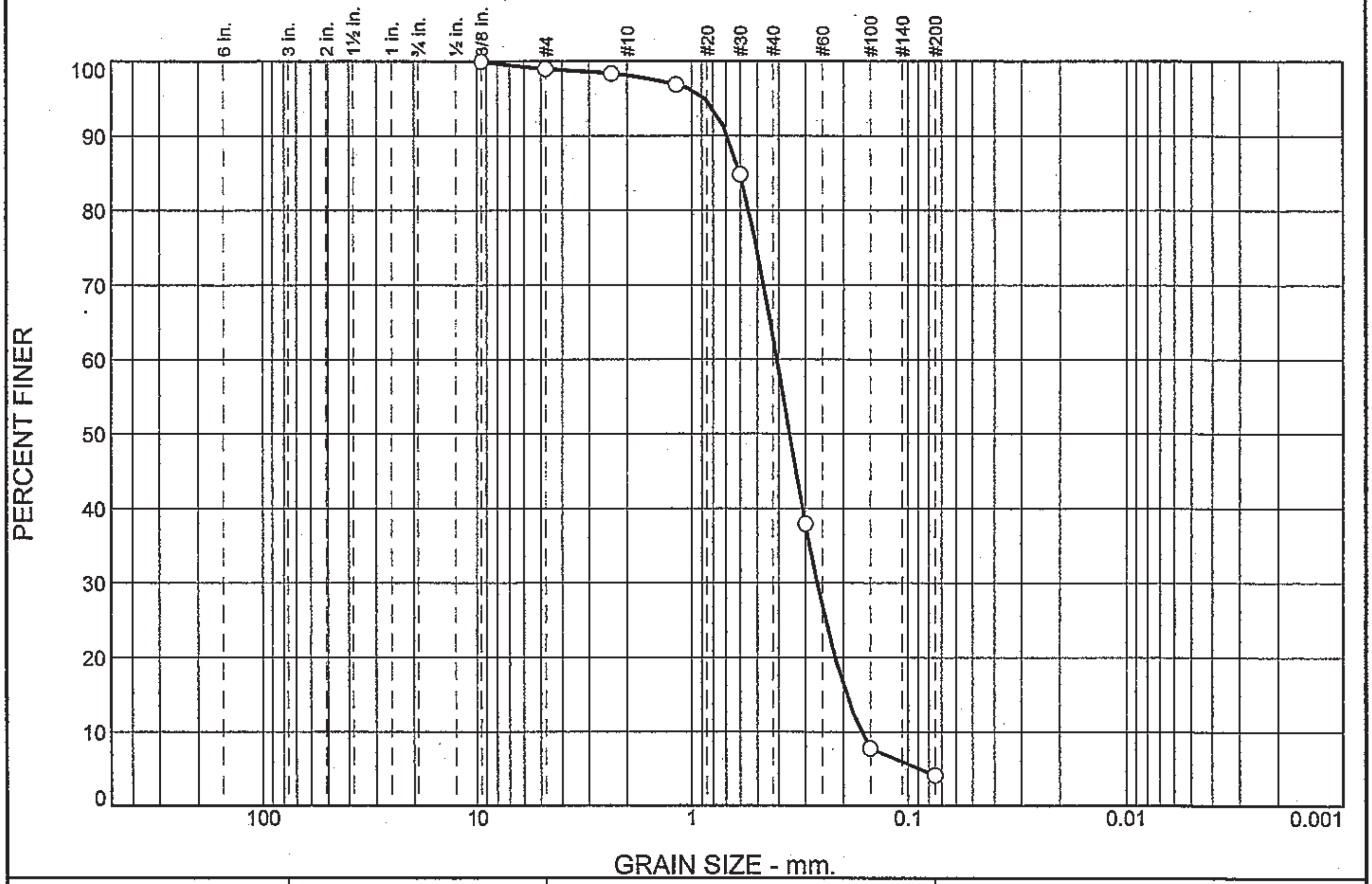
Remarks

Sample No.: S-8 **Source of Sample:** B-58 **Date Sampled:**
Location: **Elev./Depth:** 28.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-3

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.0	0.9	34.8	59.2	4.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.0		
#8	98.4		
#16	96.9		
#30	84.9		
#50	37.9		
#100	7.8		
#200	4.1		

* (no specification provided)

Material Description

SAND (SP), gray, fine- to medium-grained

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.6019 D_{60}= 0.4065 D_{50}= 0.3555
D_{30}= 0.2642 D_{15}= 0.1928 D_{10}= 0.1648
C_u= 2.47 C_c= 1.04

Date Tested: 1/12/06 **Tested By:** J. Crose

Remarks

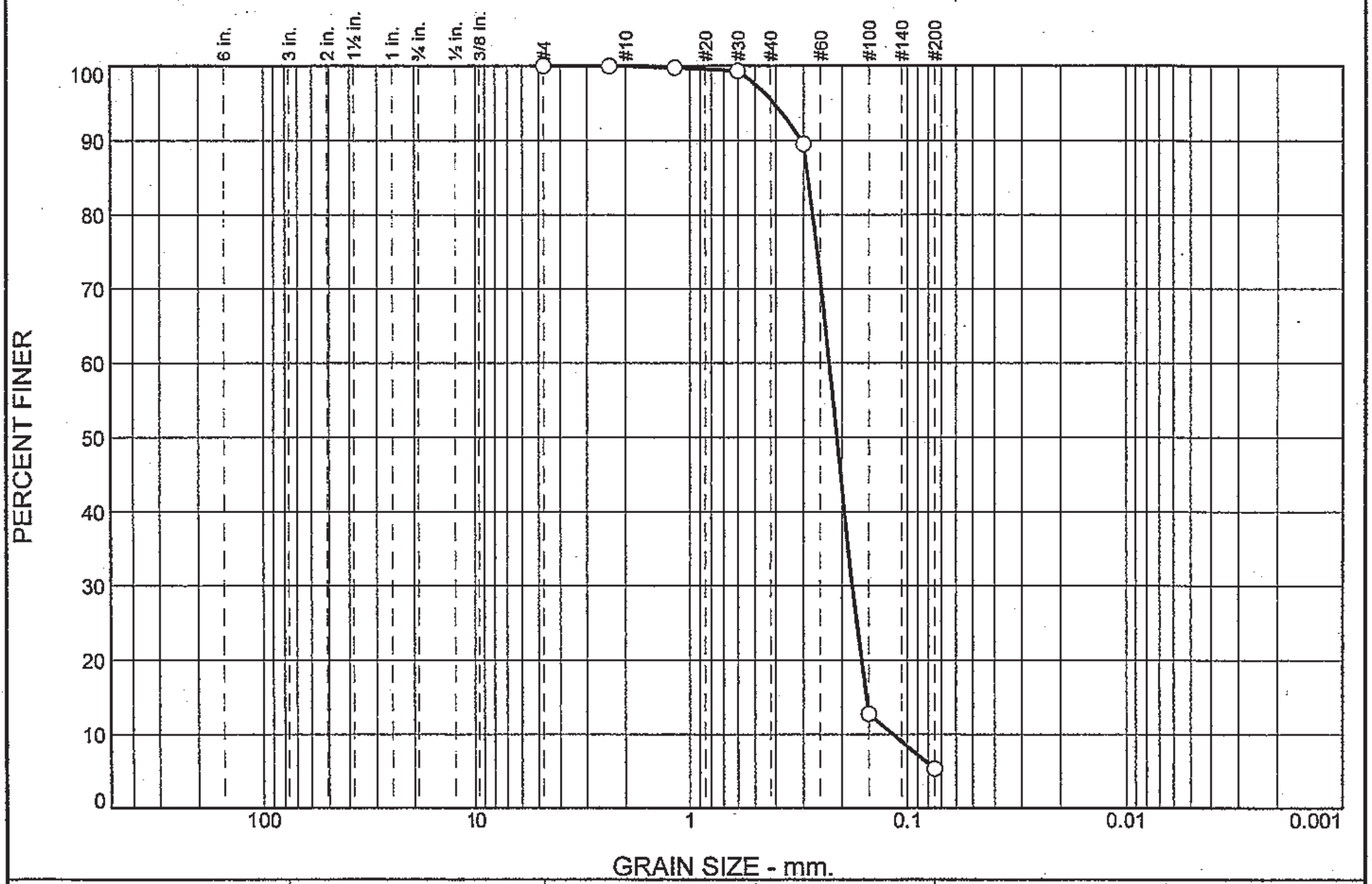
Sample No.: S-9 **Source of Sample:** B-58 **Date Sampled:**
Location: **Elev./Depth:** 33
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-4

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	4.4	90.3	5.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.8		
#30	99.3		
#50	89.6		
#100	12.8		
#200	5.3		

* (no specification provided)

Material Description

SAND (SP-SM) fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2842 D_{60}= 0.2272 D_{50}= 0.2100

D_{30}= 0.1786 D_{15}= 0.1542 D_{10}= 0.1159

C_u= 1.96 C_c= 1.21

Date Tested: 1/12/06 **Tested By:** J. Crose

Remarks

Sample No.: S-11 **Source of Sample:** B-58 **Date Sampled:**

Location: **Elev./Depth:** 43

Checked By: K. Kocher **Title:** P.E.

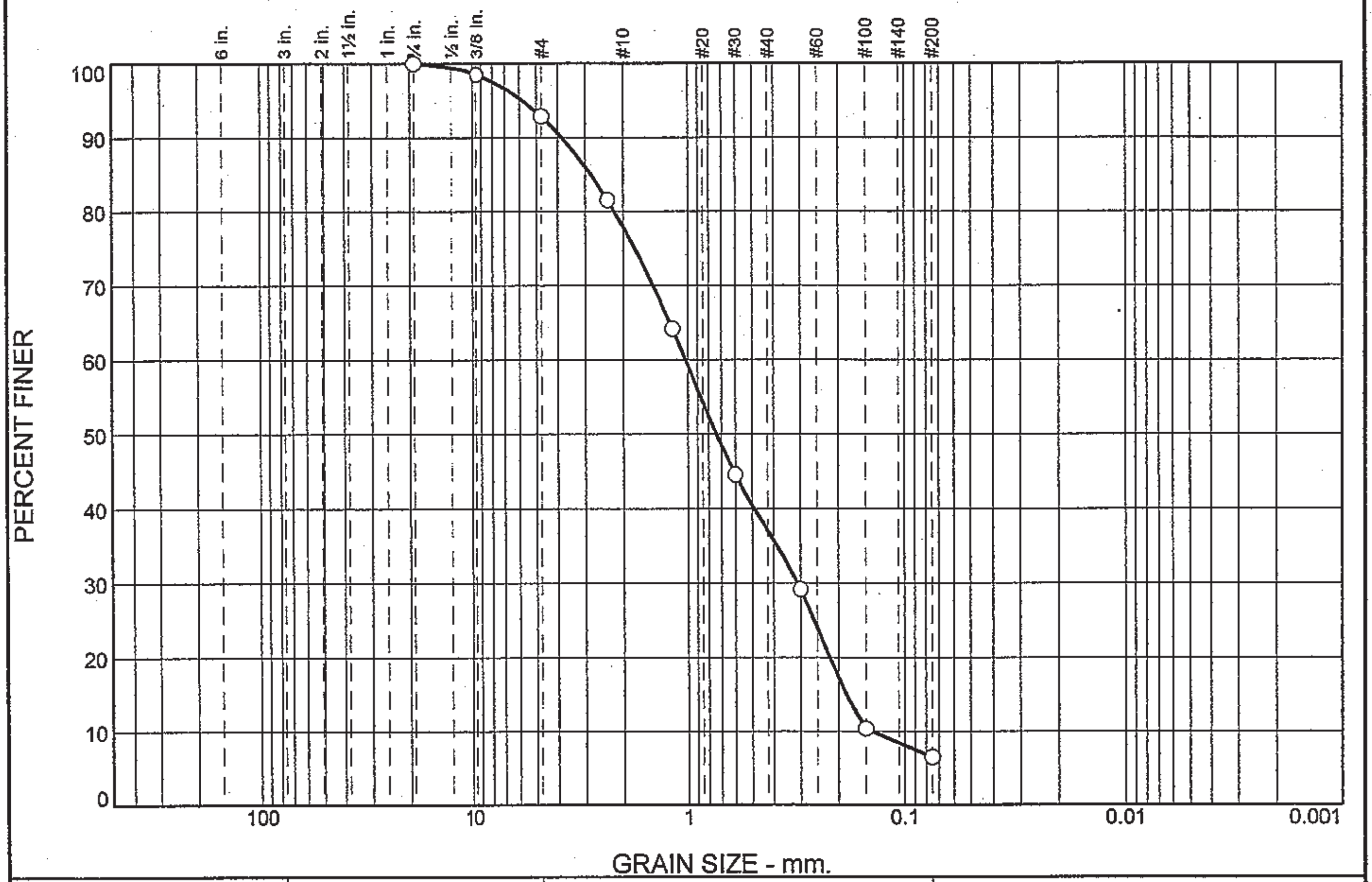
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-5

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.1	15.0	40.8	30.6	6.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	98.5		
#4	92.9		
#8	81.5		
#16	64.2		
#30	44.6		
#50	29.2		
#100	10.4		
#200	6.5		

* (no specification provided)

Material Description

SAND (SP-SM), coarse- to fine-grain, slightly silty, traces fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 2.8173 D_{60}= 1.0267 D_{50}= 0.7352
D_{30}= 0.3099 D_{15}= 0.1837 D_{10}= 0.1401
C_u= 7.33 C_c= 0.67

Date Tested: 1/12/06 **Tested By:** J. Crose

Remarks

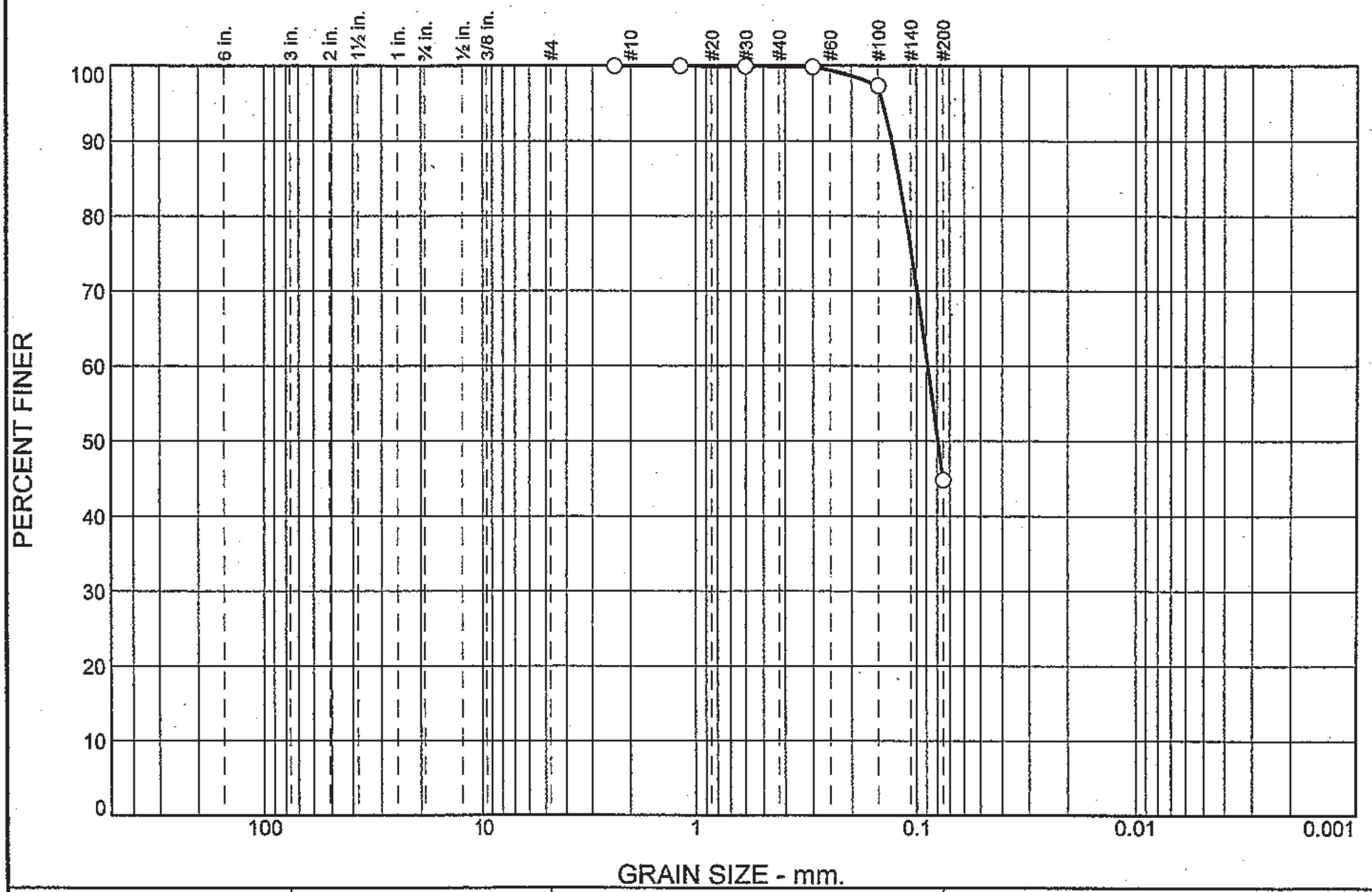
Sample No.: S-12 **Source of Sample:** B-58 **Date Sampled:**
Location: **Elev./Depth:** 48
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-6

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
				0.1	55.0	44.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	100.0		
#30	99.9		
#50	99.8		
#100	97.4		
#200	44.9		

* (no specification provided)

Material Description

SAND (SM), fine-grain, with silt

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1194 D_{60}= 0.0881 D_{50}= 0.0792

D_{30}= D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

Sample No.: S-5 **Source of Sample:** B-60 **Date Sampled:**

Location: **Elev./Depth:** 14

Checked By: K. Kocher **Title:** P.E.

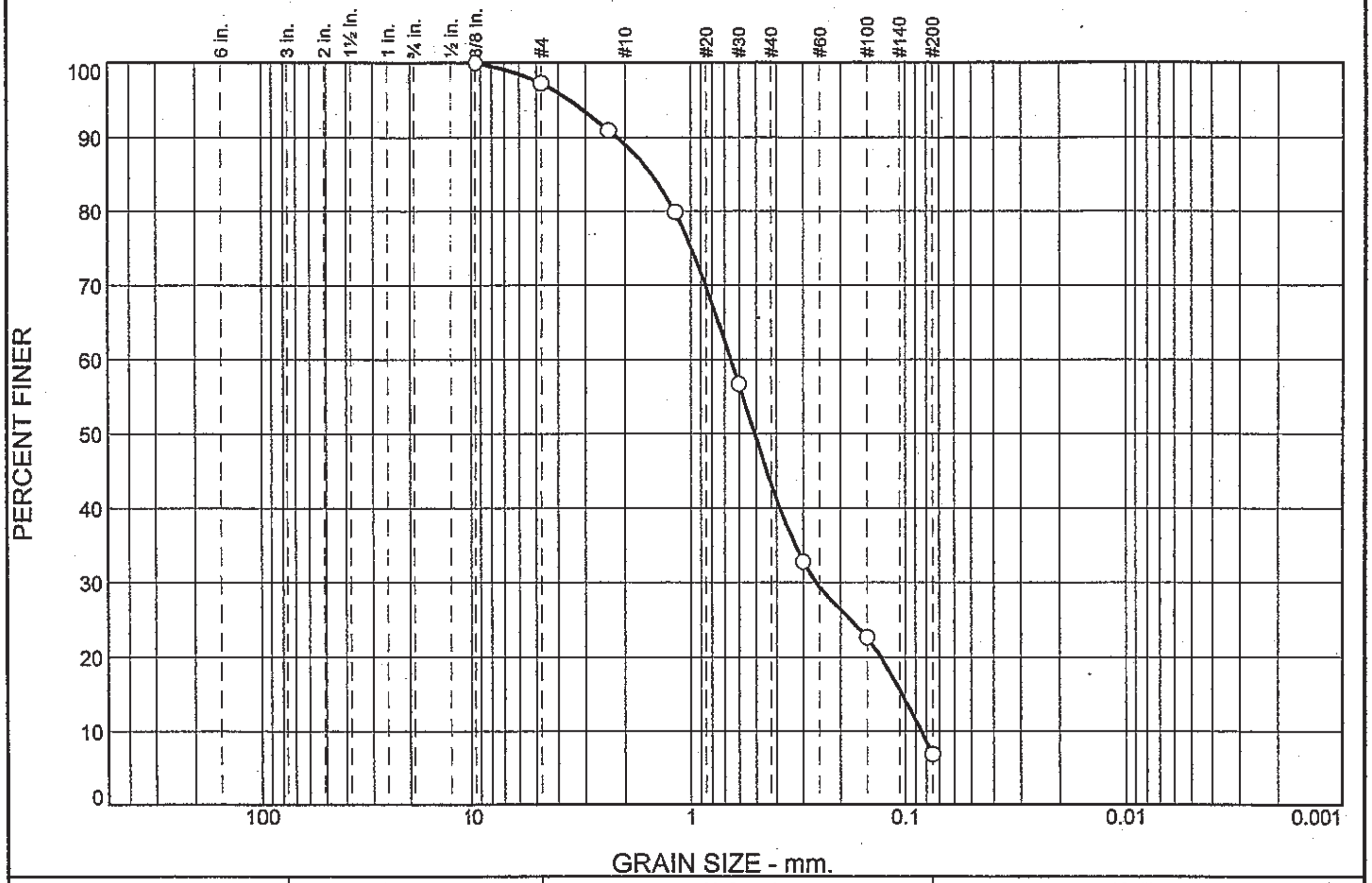
RJ REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-7

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.7	8.2	45.7	36.5	6.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	97.3		
#8	91.0		
#16	79.9		
#30	56.7		
#50	32.8		
#100	22.6		
#200	6.9		

* (no specification provided)

Material Description

SAND (SW-SM), well graded, slightly silty, trace fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW-SM AASHTO=

Coefficients

D_{85}= 1.5045 D_{60}= 0.6521 D_{50}= 0.5061
D_{30}= 0.2608 D_{15}= 0.1031 D_{10}= 0.0845
C_u= 7.72 C_c= 1.23

Date Tested: 1/17/06 **Tested By:** J. Crose

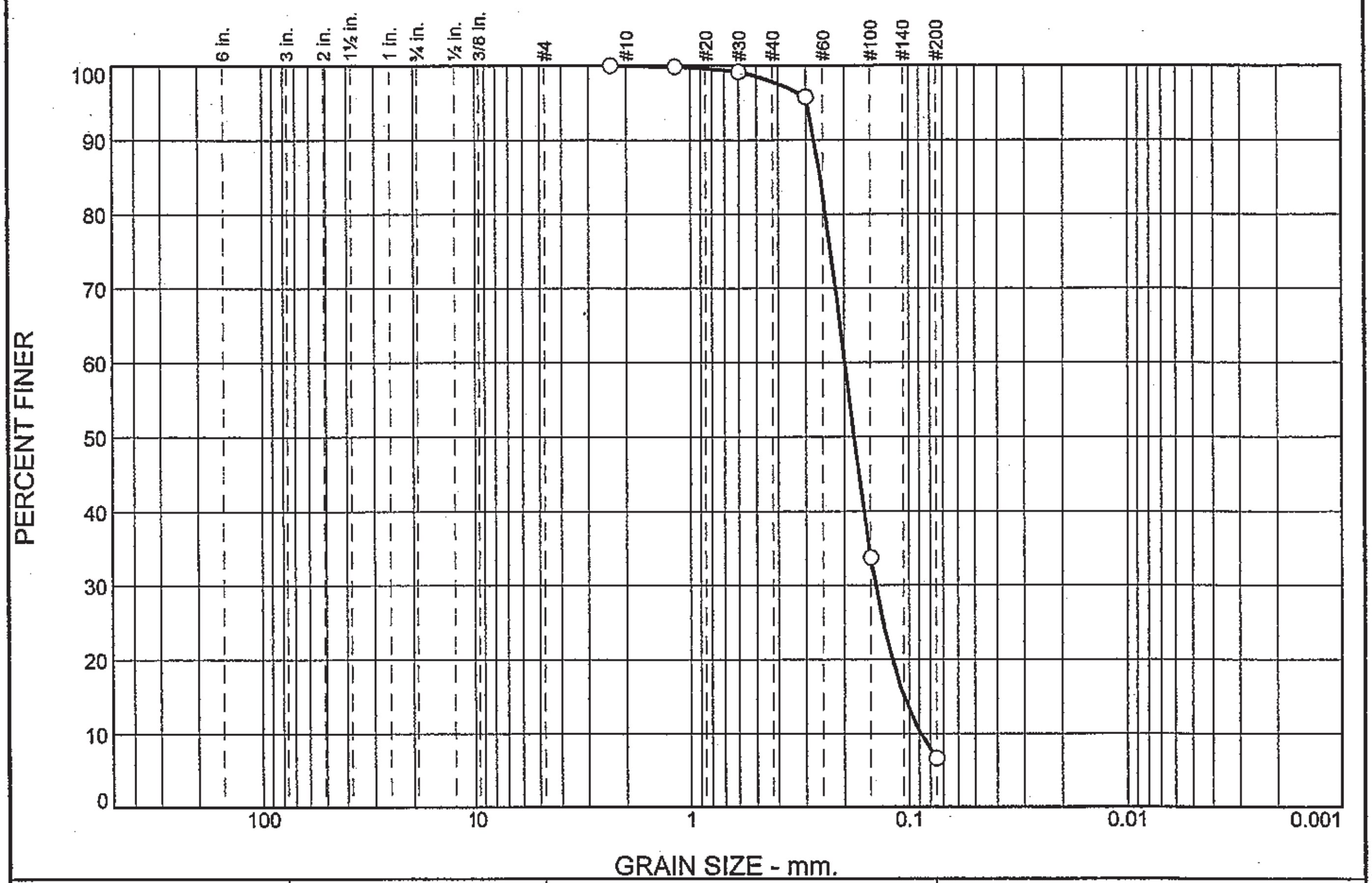
Remarks

Sample No.: S-7 **Source of Sample:** B-60 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-8

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	2.1	91.3	6.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.2		
#50	95.8		
#100	33.8		
#200	6.6		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2570 D_{60}= 0.1983 D_{50}= 0.1796
D_{30}= 0.1426 D_{15}= 0.1057 D_{10}= 0.0883
C_u= 2.24 C_c= 1.16

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

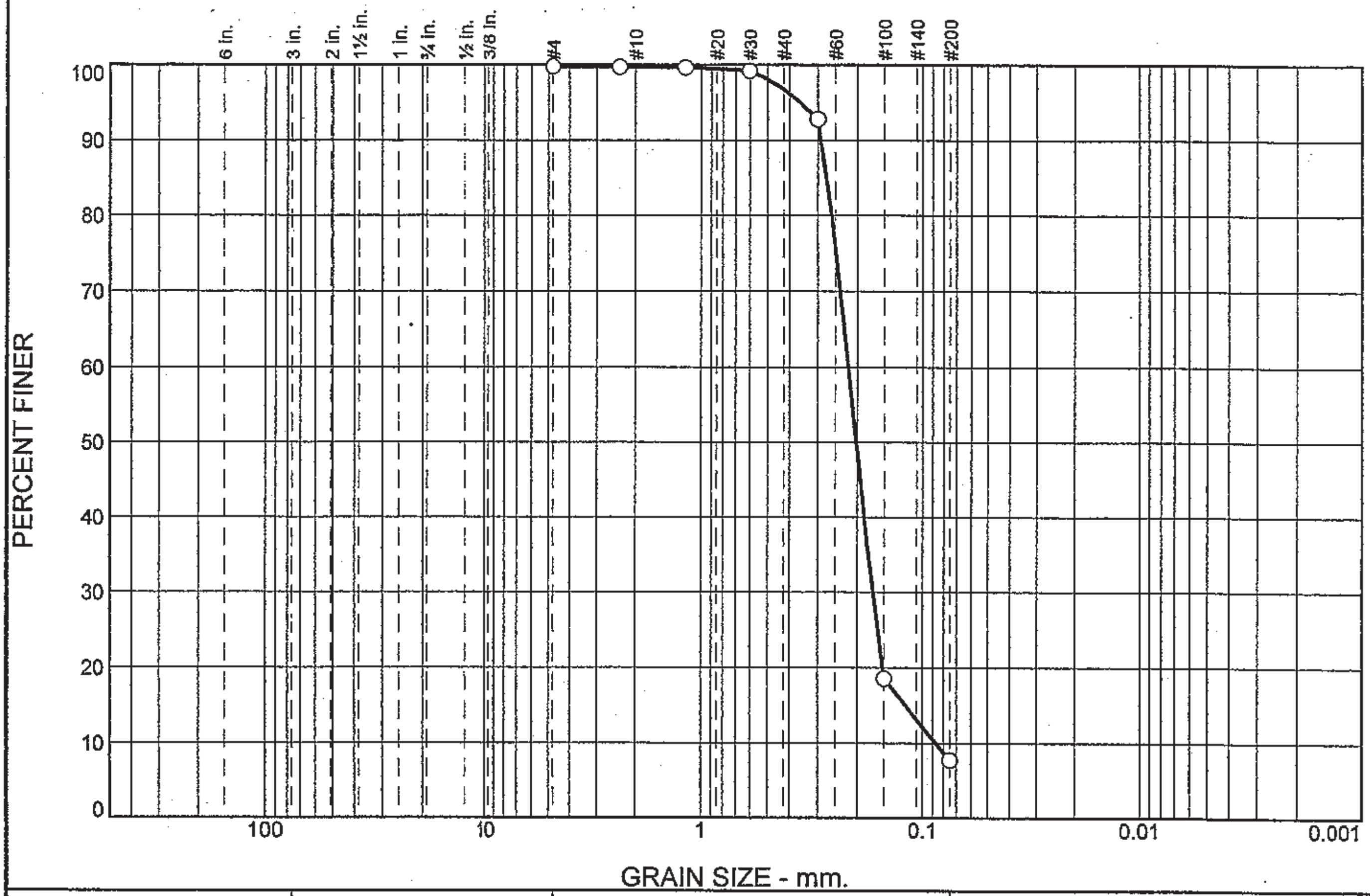
Sample No.: S-3 **Source of Sample:** B-61 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-9

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
			0.1	2.9	89.1	7.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	99.8		
#8	99.7		
#16	99.6		
#30	99.2		
#50	92.8		
#100	18.6		
#200	7.7		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2731 D_{60}= 0.2185 D_{50}= 0.2014
D_{30}= 0.1696 D_{15}= 0.1194 D_{10}= 0.0867
C_u= 2.52 C_c= 1.52

Date Tested: 1/16/06 **Tested By:** J. Crose

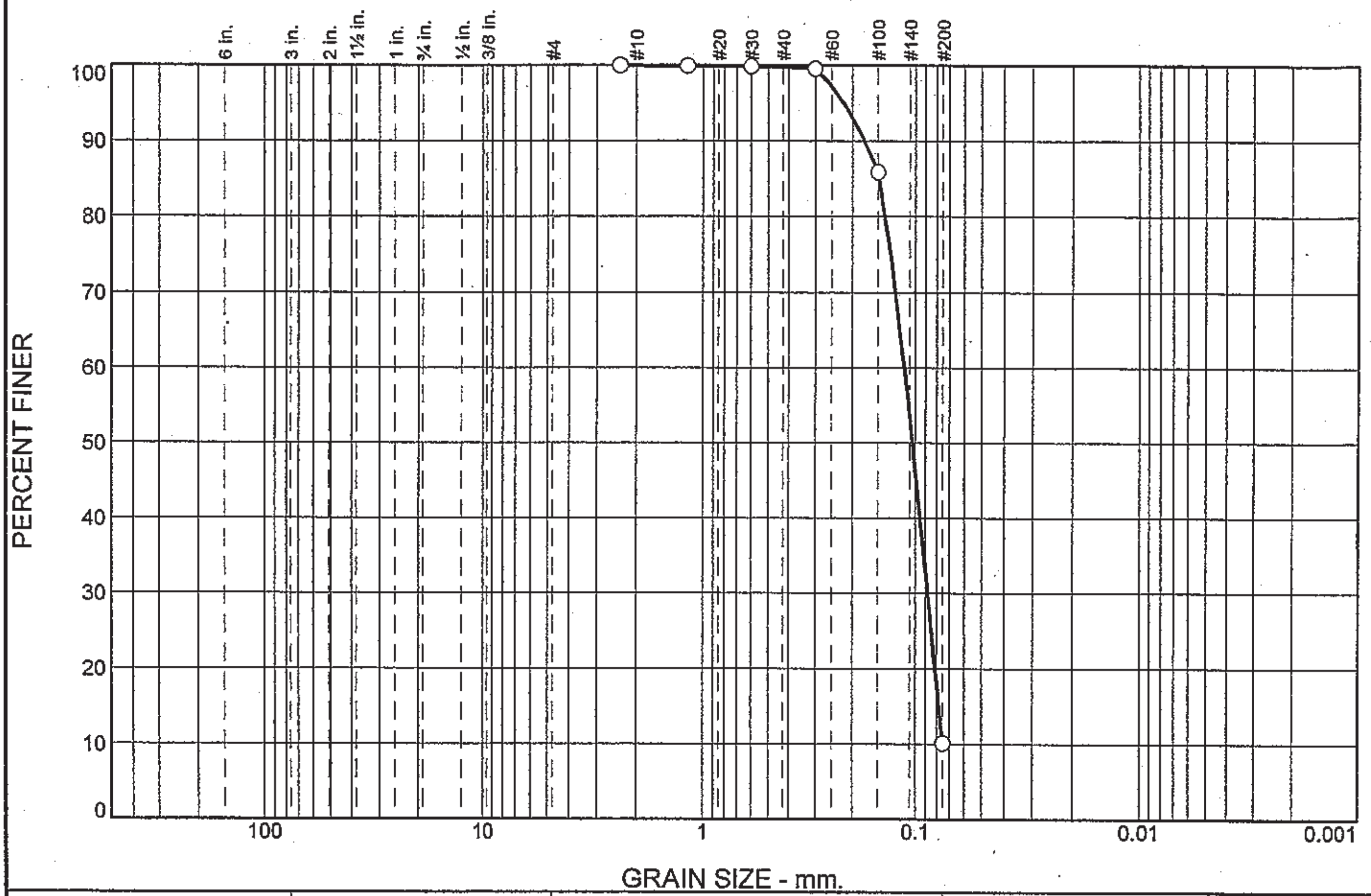
Remarks

Sample No.: S-4 **Source of Sample:** B-61 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-10

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	89.7	10.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.9		
#50	99.6		
#100	85.9		
#200	10.1		

* (no specification provided)

Material Description

SAND (SP-SM), fine grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.1480 D_{60}= 0.1120 D_{50}= 0.1026
D_{30}= 0.0873 D_{15}= 0.0778 D_{10}=
C_u= C_c=

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

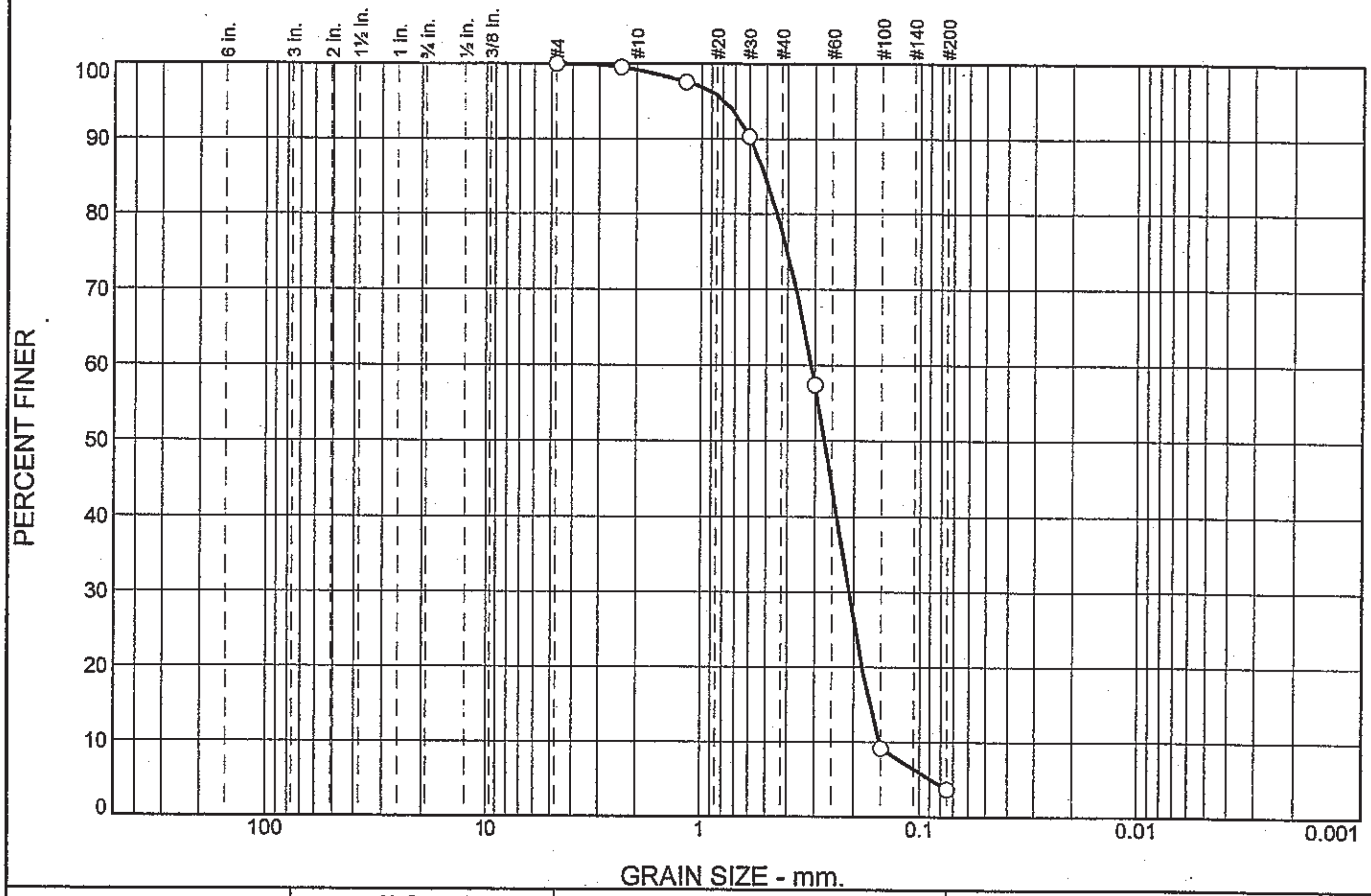
Sample No.: S-2 **Source of Sample:** B-63 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-11

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.8	21.3	74.2	3.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.5		
#16	97.6		
#30	90.3		
#50	57.4		
#100	9.1		
#200	3.7		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.5038 D_{60}= 0.3114 D_{50}= 0.2714
D_{30}= 0.2098 D_{15}= 0.1684 D_{10}= 0.1530
C_u= 2.04 C_c= 0.92

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

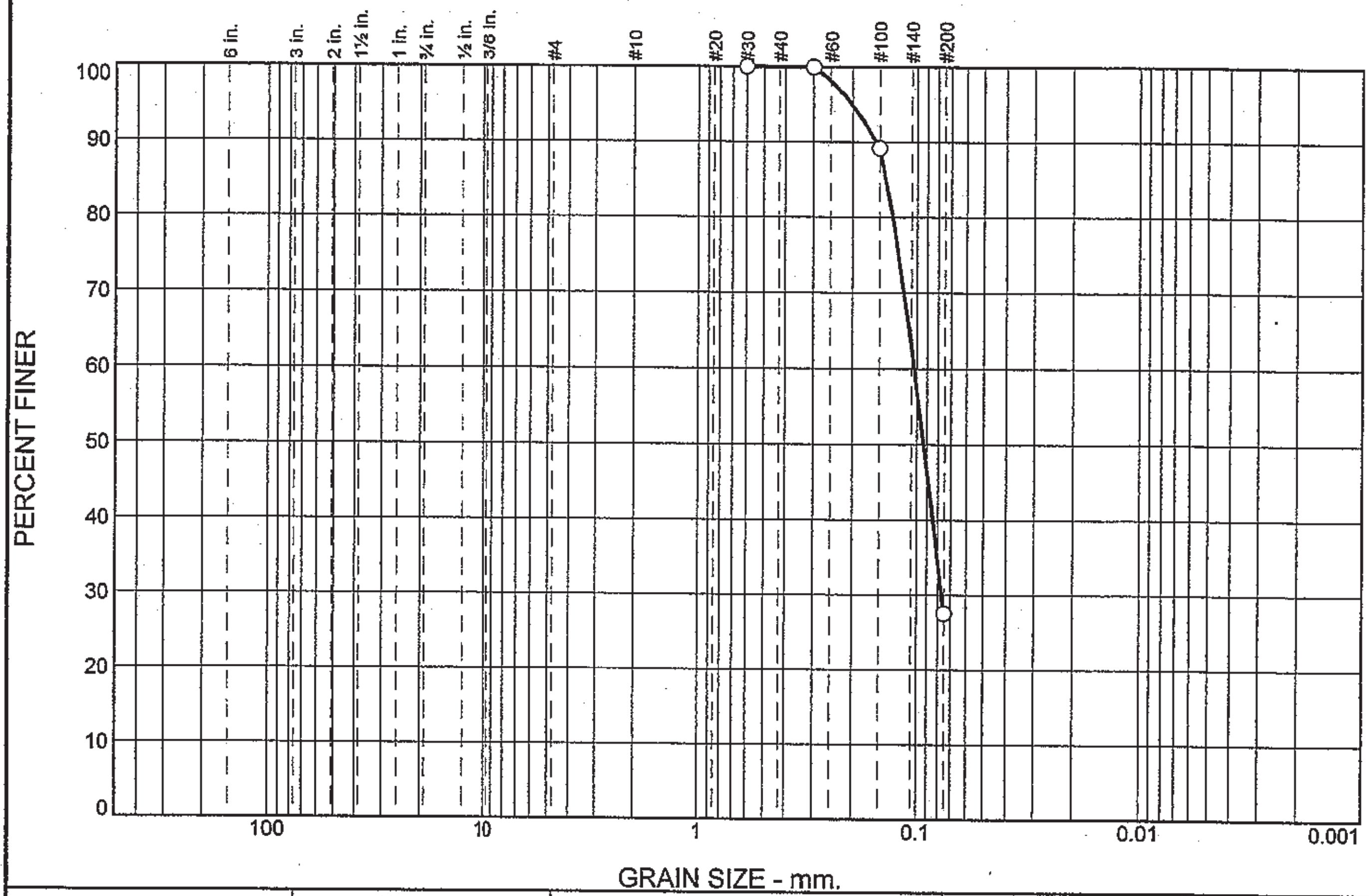
Sample No.: S-4 **Source of Sample:** B-63 **Date Sampled:**
Location: **Elev./Depth:** 14
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-12

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	72.5	27.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#50	100.0		
#100	89.2		
#200	27.5		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grained

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1394 D_{60}= 0.1026 D_{50}= 0.0927

D_{30}= 0.0767 D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/09/06 **Tested By:** RTH/JLC

Remarks

Sample No.: S-3 **Source of Sample:** B-64 **Date Sampled:**

Location: **Elev./Depth:** 6.5

Checked By: J. Fouse **Title:** P.E.

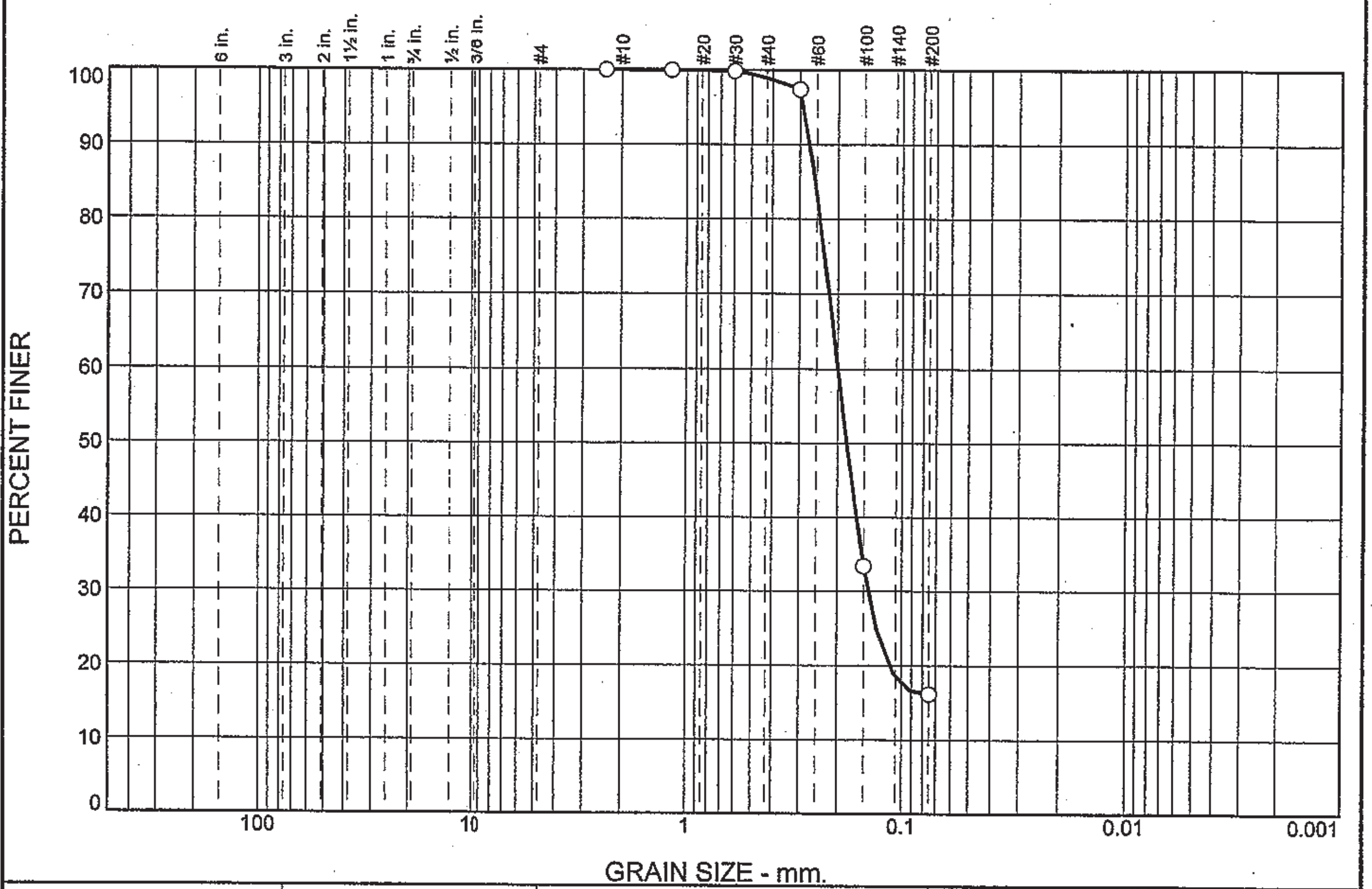
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-13

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.1	82.7	16.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	100.0		
#30	99.8		
#50	97.4		
#100	33.4		
#200	16.2		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.2543 D_{60}= 0.1988 D_{50}= 0.1806

D_{30}= 0.1427 D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/09/06 **Tested By:** RTH/JLC

Remarks

Sample No.: S-4 **Source of Sample:** B-64 **Date Sampled:**

Location: **Elev./Depth:** 9

Checked By: J. Fouse **Title:** P.E.

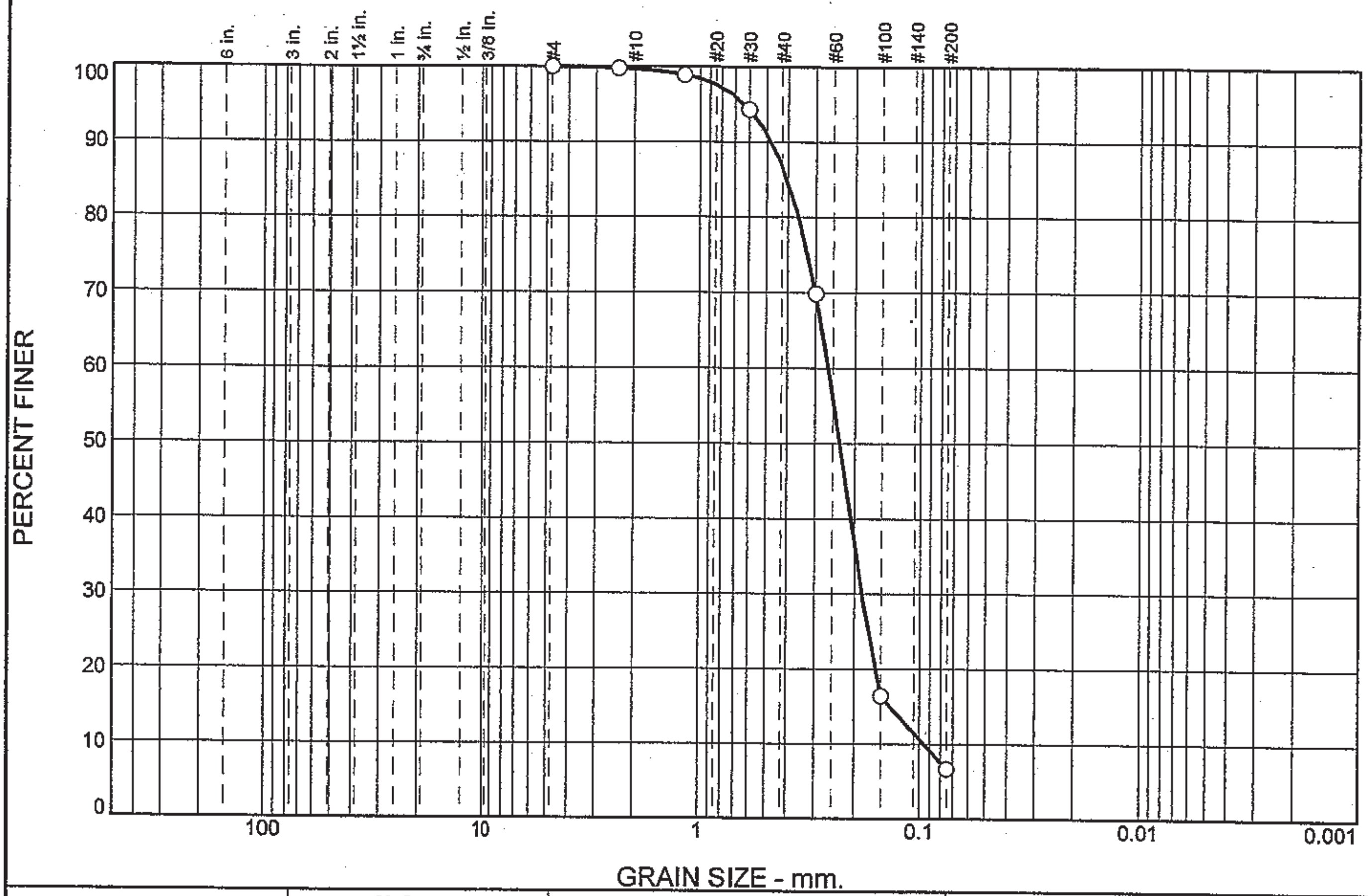
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-14

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	12.9	80.2	6.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.8		
#16	98.9		
#30	94.3		
#50	69.9		
#100	16.4		
#200	6.6		

* (no specification provided)

Material Description

SAND (SP-SM), fine grain, trace of medium-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.4032 D_{60}= 0.2628 D_{50}= 0.2332
D_{30}= 0.1838 D_{15}= 0.1358 D_{10}= 0.0952
C_u= 2.76 C_c= 1.35

Date Tested: 1/09/06 **Tested By:** RTH/JLC

Remarks

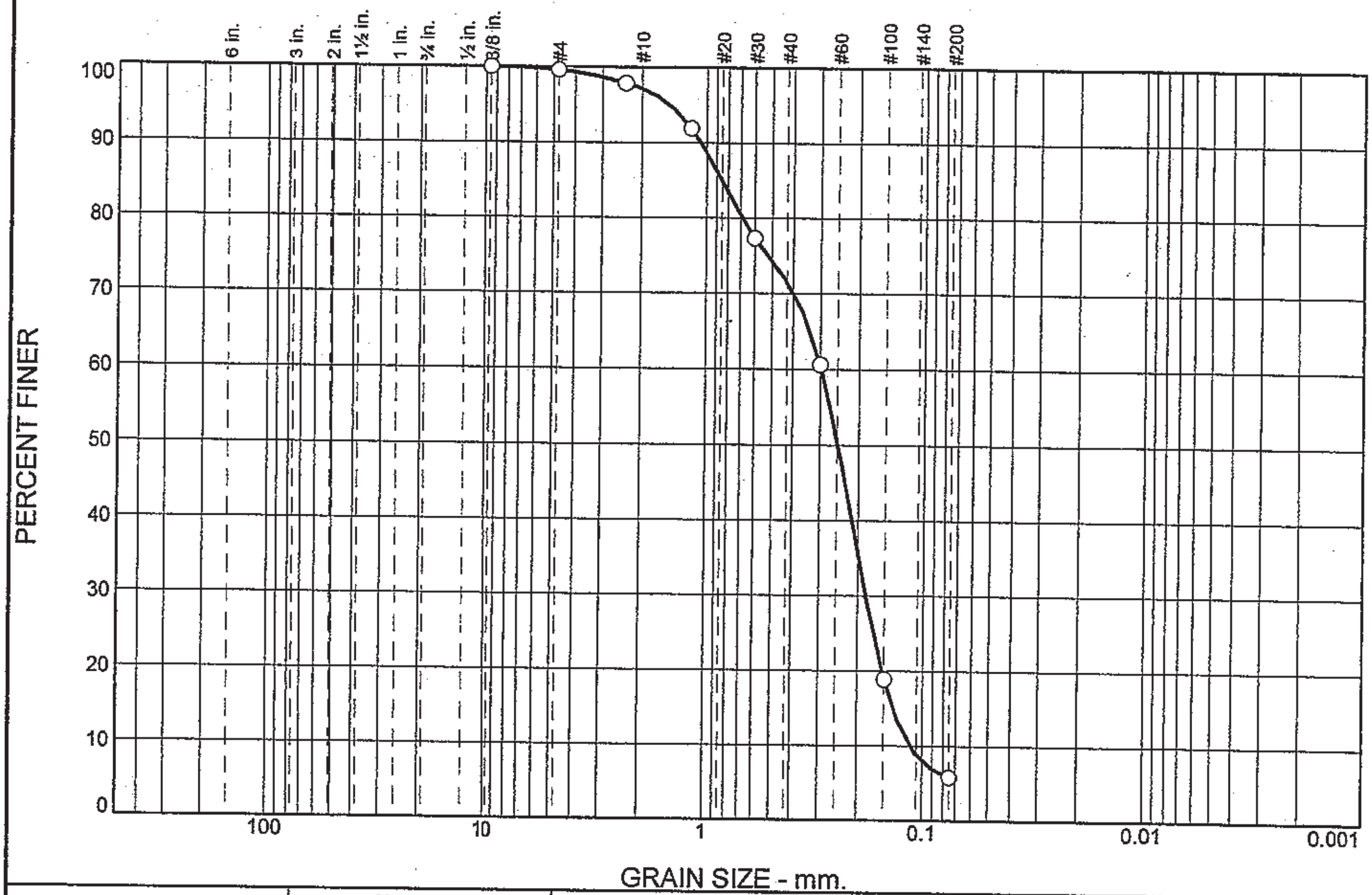
Sample No.: S-5 **Source of Sample:** B-64 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-15

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	2.4	25.7	65.7	5.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.6		
#8	97.9		
#16	91.9		
#30	77.3		
#50	60.6		
#100	18.9		
#200	5.8		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silt

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.8523 D_{60}= 0.2961 D_{50}= 0.2482
D_{30}= 0.1830 D_{15}= 0.1364 D_{10}= 0.1136
C_u= 2.61 C_c= 1.00

Date Tested: 1/09/06 **Tested By:** RTH/JLC

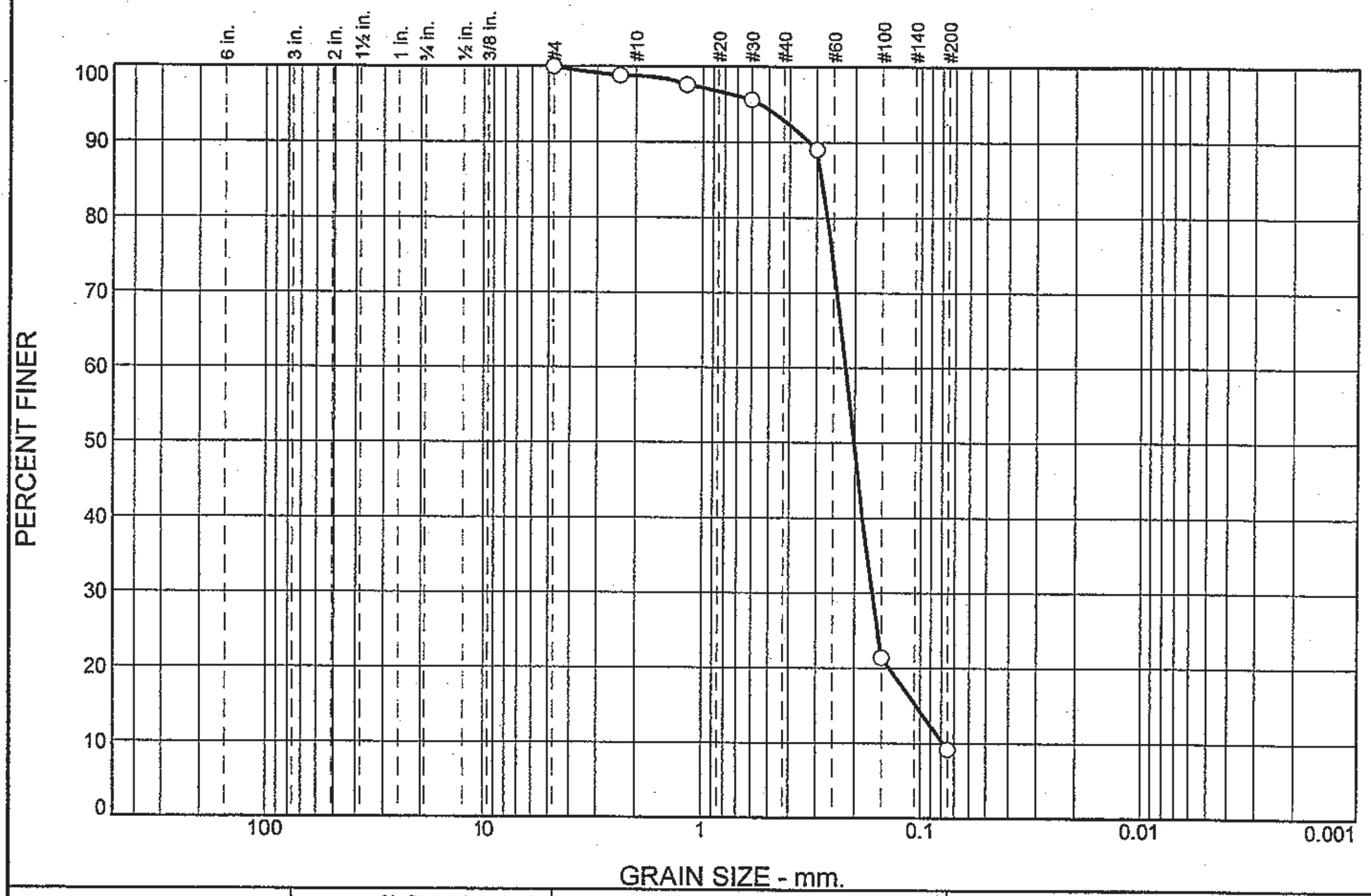
Remarks

Sample No.: S-6 **Source of Sample:** B-64 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-16

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.3	5.8	83.7	9.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	98.8		
#16	97.6		
#30	95.6		
#50	89.0		
#100	21.4		
#200	9.2		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2836 D_{60}= 0.2199 D_{50}= 0.2011
D_{30}= 0.1662 D_{15}= 0.1043 D_{10}= 0.0785
C_u= 2.80 C_c= 1.60

Date Tested: 1/09/06 **Tested By:** RTH/JLC

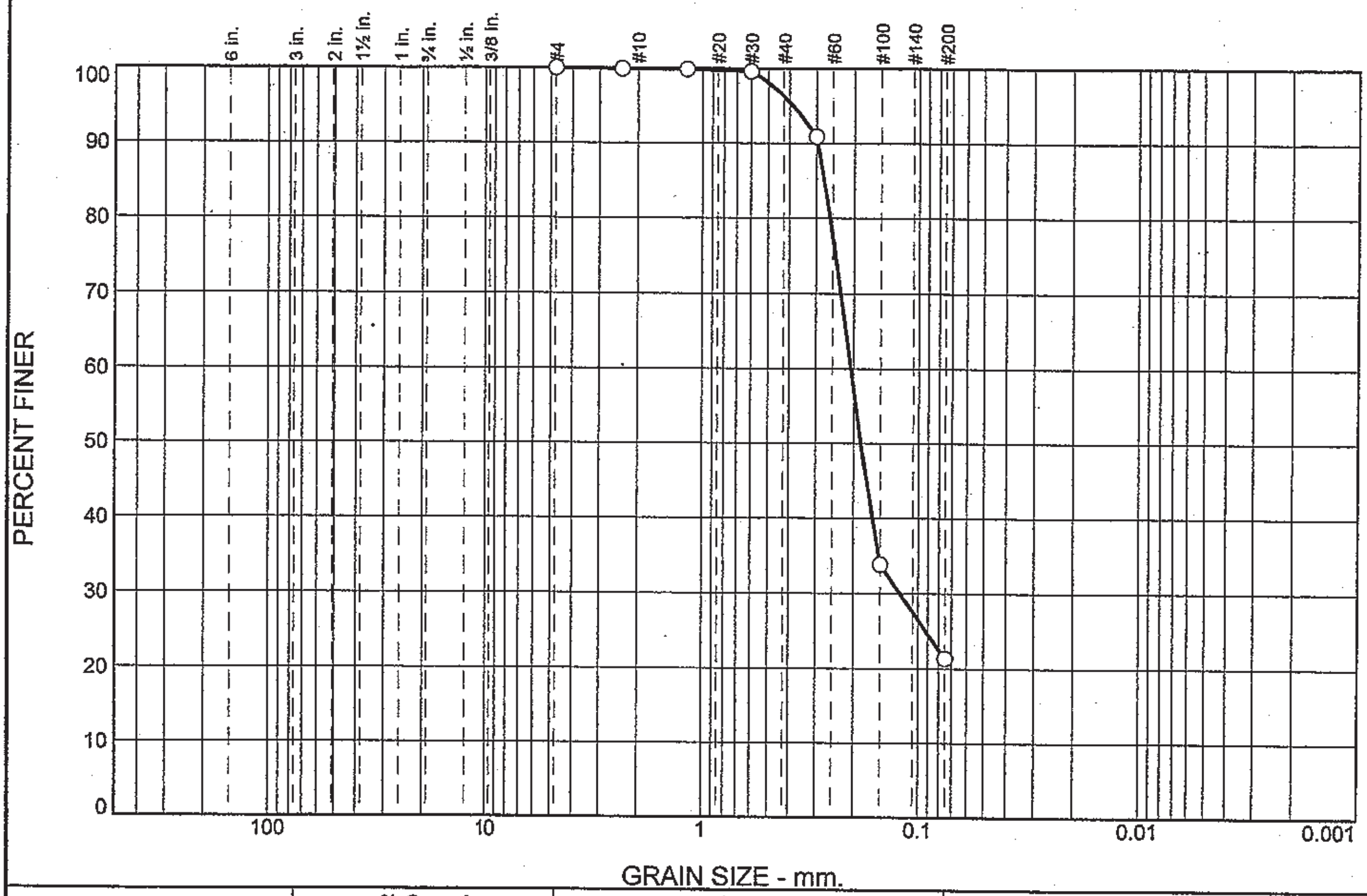
Remarks

Sample No.: S-7 **Source of Sample:** B-64 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-17

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	3.5	75.0	21.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.9		
#30	99.6		
#50	90.9		
#100	33.9		
#200	21.4		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.2741 D_{60}= 0.2058 D_{50}= 0.1846
D_{30}= 0.1211 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/10/06 **Tested By:** RTH/JLC

Remarks

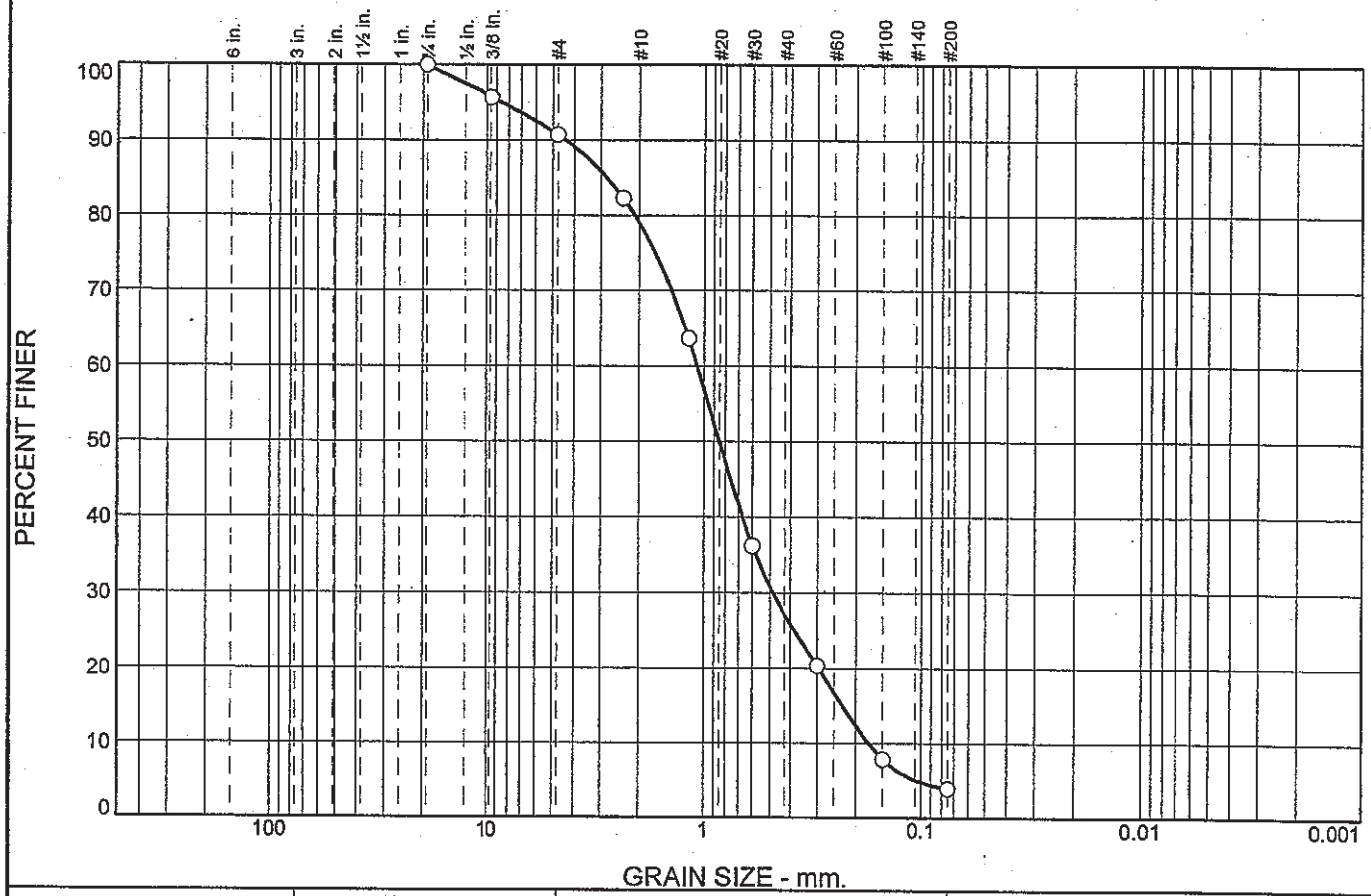
Sample No.: S-4 **Source of Sample:** B-66 **Date Sampled:**
Location: **Elev./Depth:** 18.0
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-18

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.3	11.6	52.0	23.2	3.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	95.7		
#4	90.7		
#8	82.3		
#16	63.7		
#30	36.2		
#50	20.3		
#100	7.8		
#200	3.9		

* (no specification provided)

Material Description

SAND (SW), well graded, trace of fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW AASHTO=

Coefficients

D_{85}= 2.7912 D_{60}= 1.0758 D_{50}= 0.8505

D_{30}= 0.4835 D_{15}= 0.2293 D_{10}= 0.1744

C_u= 6.17 C_c= 1.25

Date Tested: 1/10/06 **Tested By:** RTH/JLC

Remarks

Sample No.: S-5 **Source of Sample:** B-66 **Date Sampled:**

Location: **Elev./Depth:** 23.0

Checked By: J. Fouse **Title:** P.E.

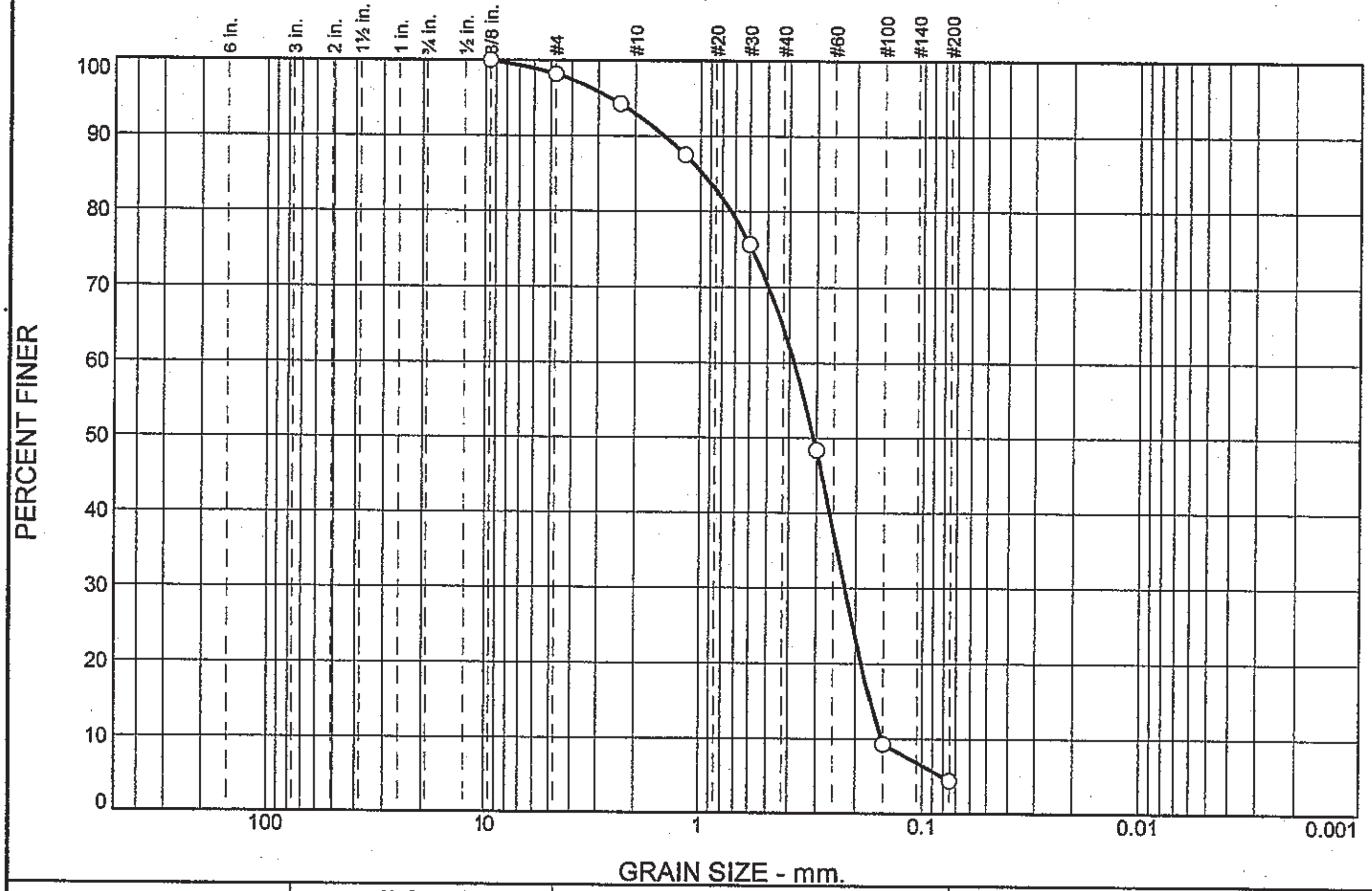
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-19

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.8	5.3	28.1	60.4	4.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	98.2		
#8	94.3		
#16	87.5		
#30	75.7		
#50	48.4		
#100	9.3		
#200	4.4		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.9757 D_{60}= 0.3781 D_{50}= 0.3087
D_{30}= 0.2227 D_{15}= 0.1715 D_{10}= 0.1529
C_u= 2.47 C_c= 0.86

Date Tested: 1/10/06 **Tested By:** RTH/ JLC

Remarks

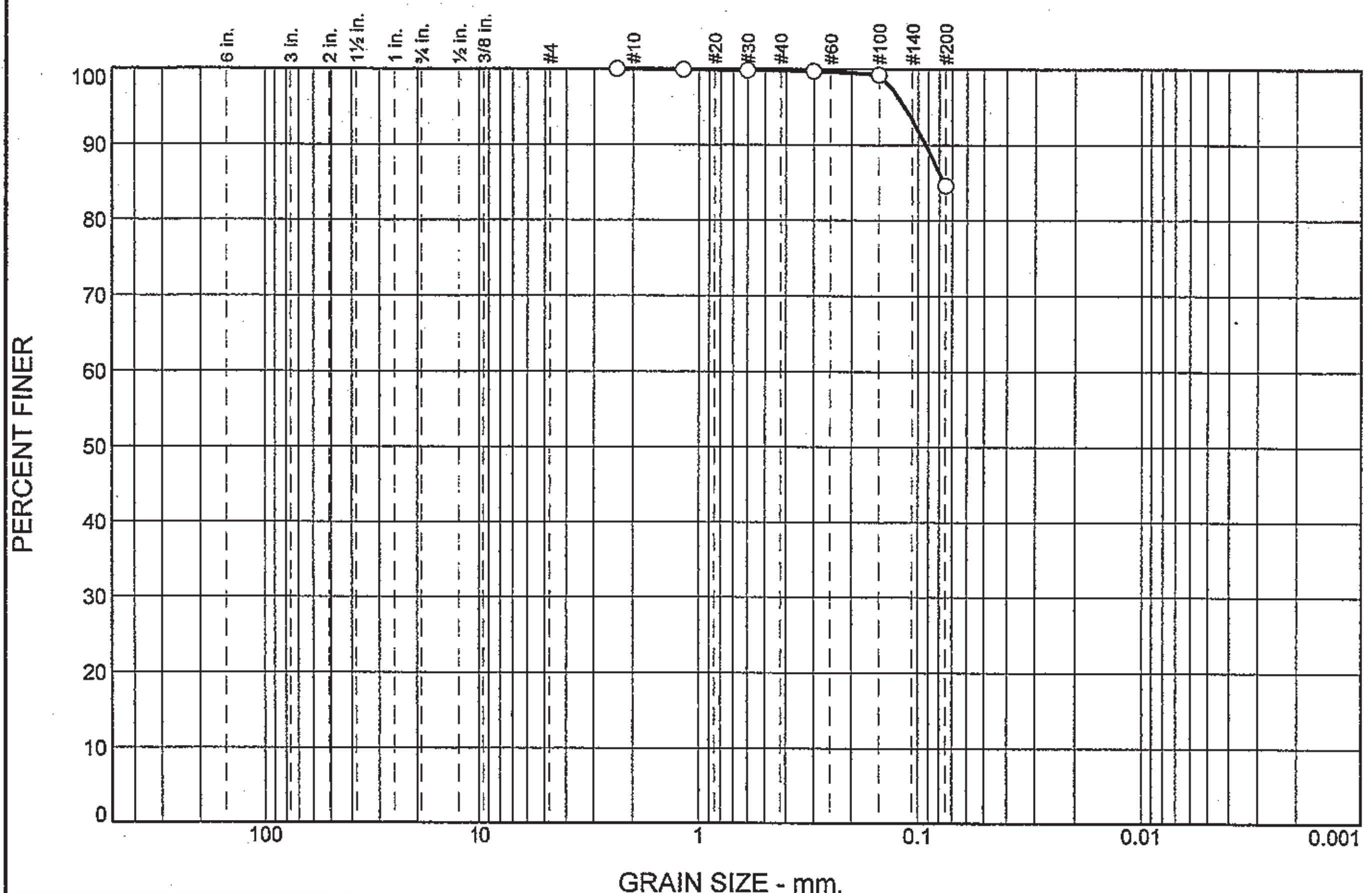
Sample No.: S-6 **Source of Sample:** B-66 **Date Sampled:**
Location: **Elev./Depth:** 28.0
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-20

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	15.2	84.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.8		
#50	99.8		
#100	99.3		
#200	84.6		

* (no specification provided)

Material Description

SILT (ML), with fine sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.0760 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/10/06 **Tested By:** RTH/JLC

Remarks

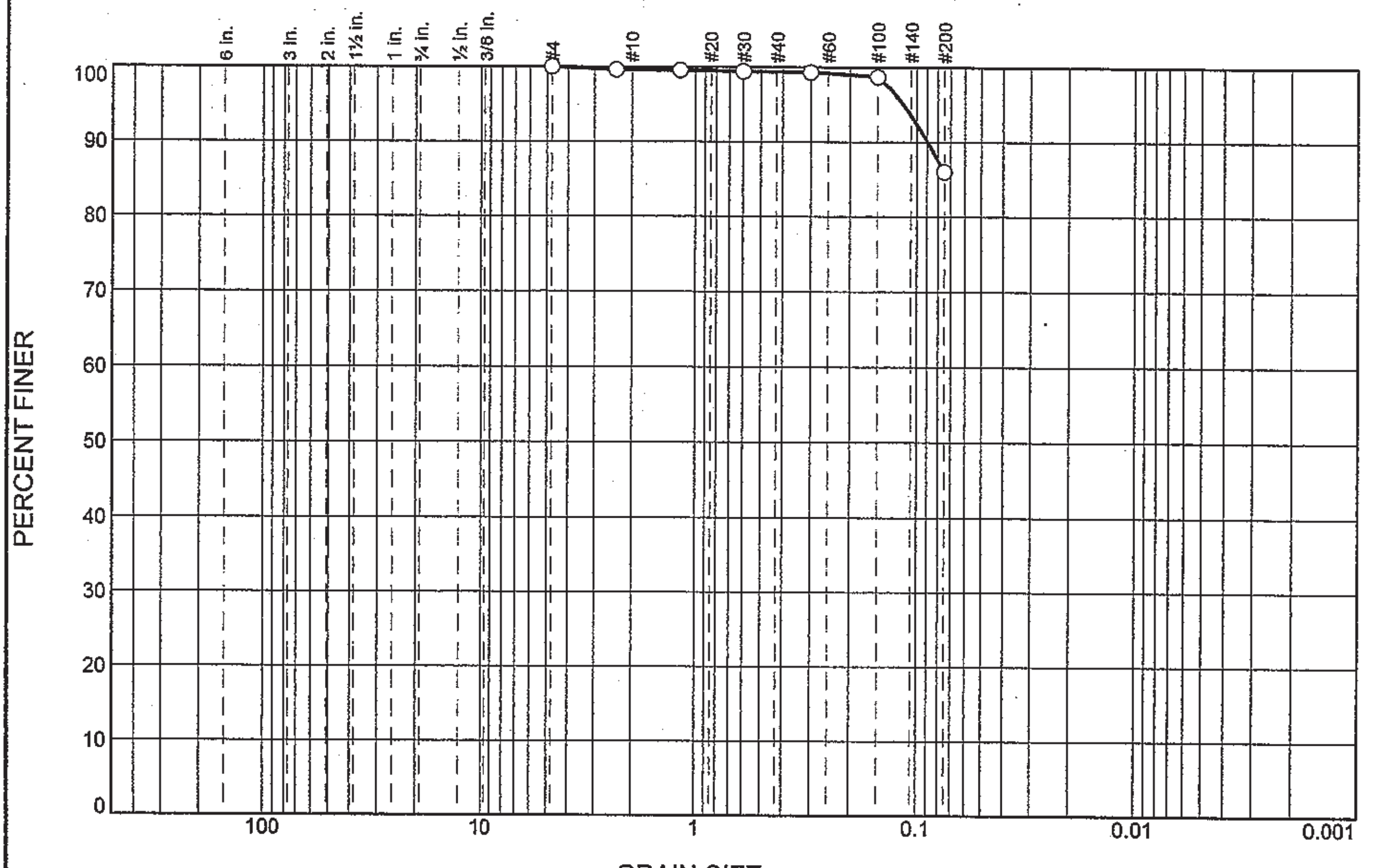
Sample No.: SS-4 **Source of Sample:** B-67 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-21

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	0.3	13.4	86.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.7		
#16	99.6		
#30	99.5		
#50	99.3		
#100	98.8		
#200	86.0		

* (no specification provided)

Material Description

SILT (ML), with fine sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/10/06 **Tested By:** RTH/JJP

Remarks

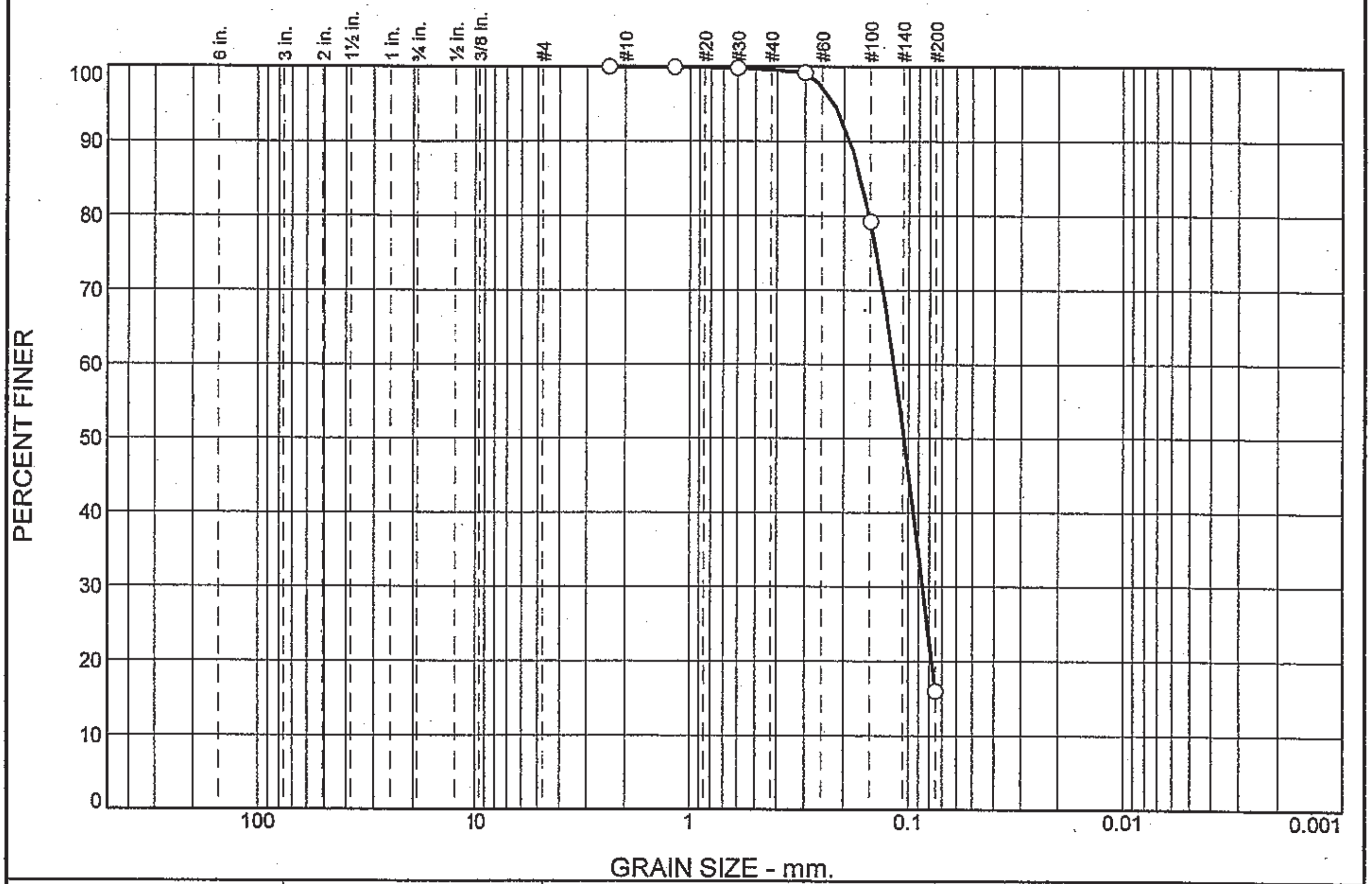
Sample No.: SS-5 **Source of Sample:** B-67 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-22

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.4	83.6	16.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.8		
#50	99.2		
#100	79.3		
#200	16.0		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grained

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1663 D_{60}= 0.1164 D_{50}= 0.1045
D_{30}= 0.0857 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/10/06 **Tested By:** RTH/JLC

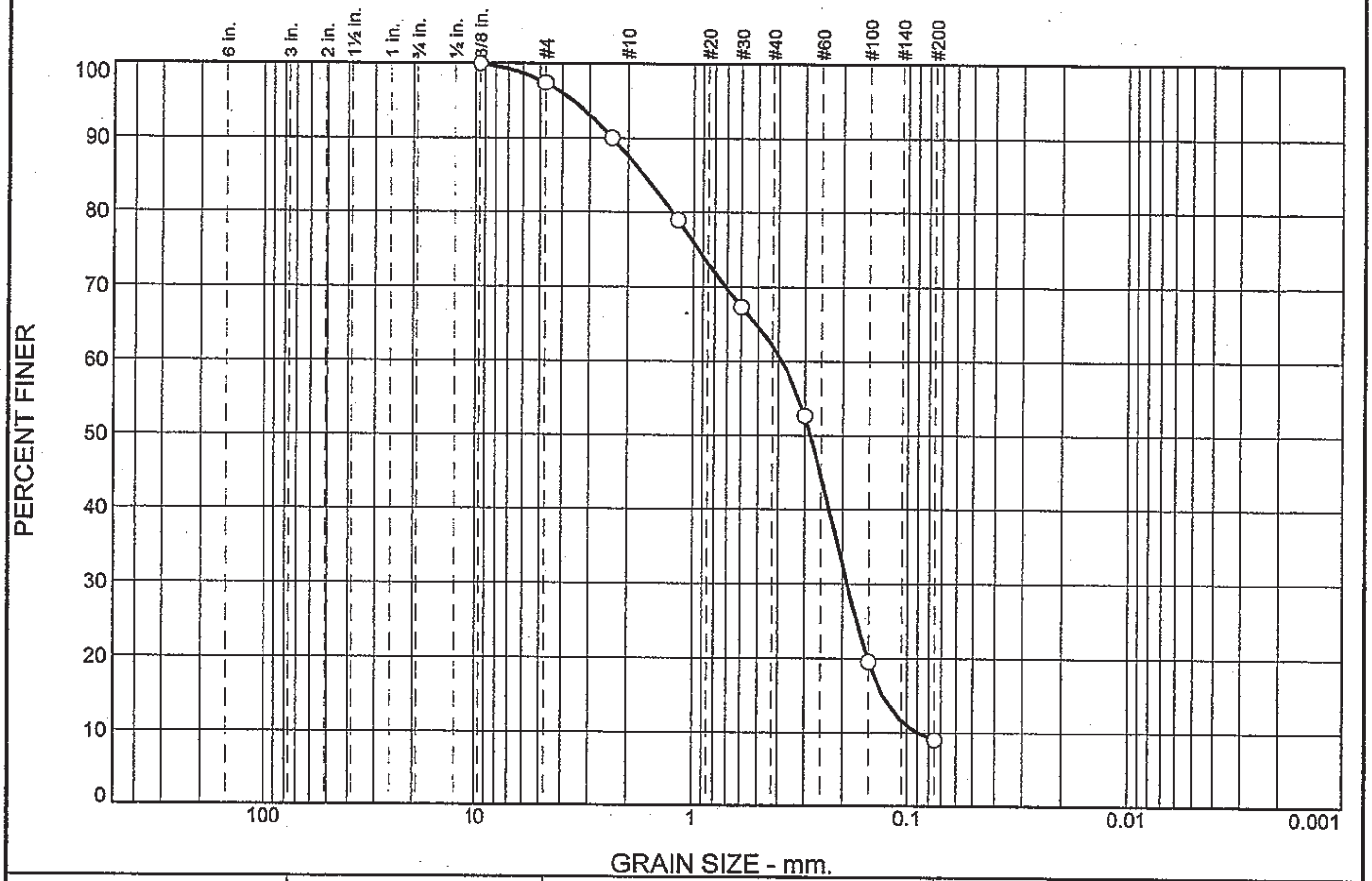
Remarks

Sample No.: SS-6 **Source of Sample:** B-67 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-23

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.5	9.9	25.5	53.1	9.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	97.5		
#8	90.0		
#16	79.0		
#30	67.3		
#50	52.6		
#100	19.6		
#200	9.0		

* (no specification provided)

Material Description

SAND (SP-SM) medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 1.6851 D_{60}= 0.3830 D_{50}= 0.2815
D_{30}= 0.1895 D_{15}= 0.1287 D_{10}= 0.0899
C_u= 4.26 C_c= 1.04

Date Tested: 1/10/06 **Tested By:** RTH/JLC

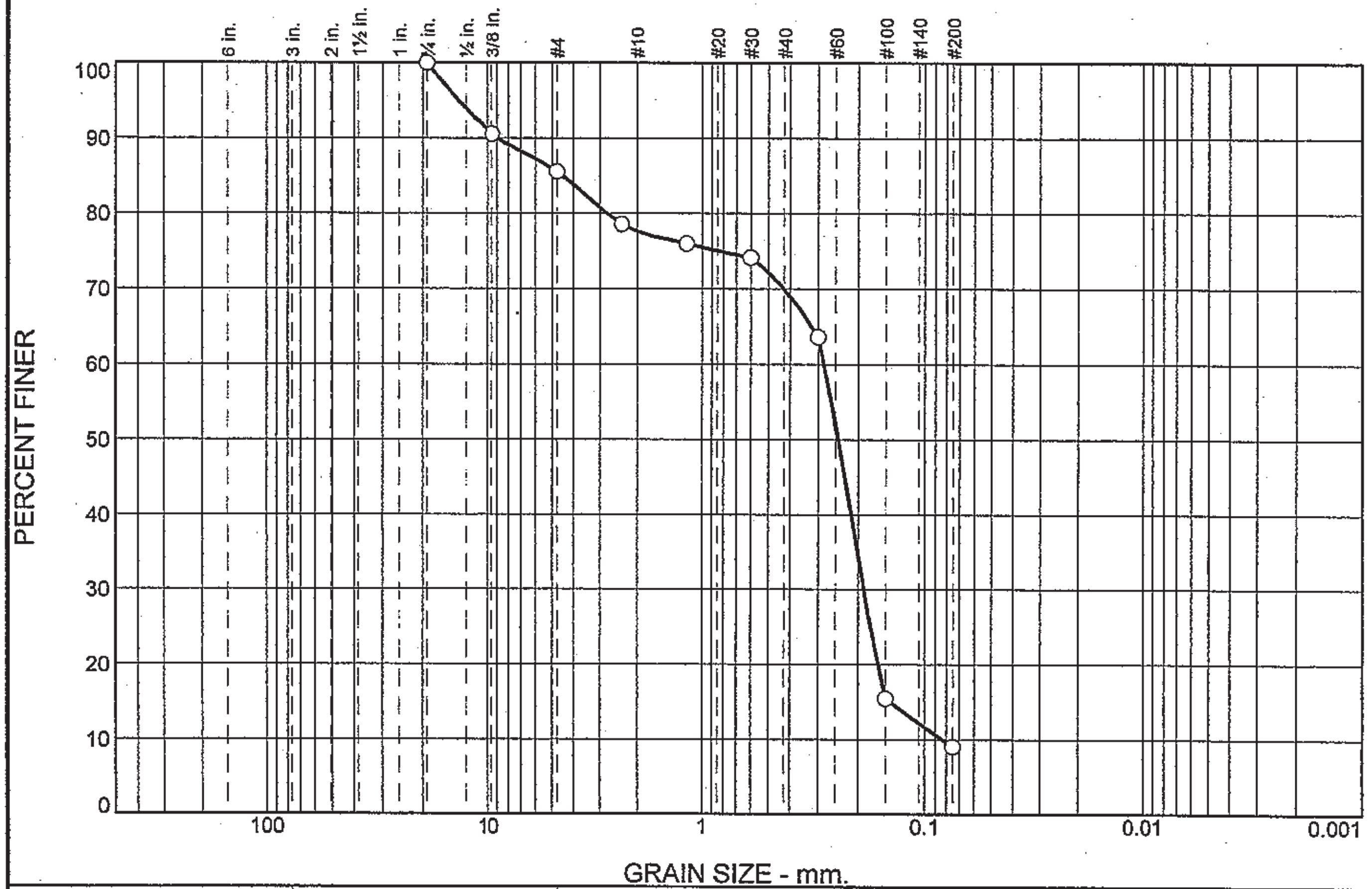
Remarks

Sample No.: SS-7 **Source of Sample:** B-67 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-24

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.4	8.0	7.6	61.0	9.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	90.6		
#4	85.6		
#8	78.6		
#16	76.0		
#30	74.2		
#50	63.6		
#100	15.4		
#200	9.0		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grained, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SW AASHTO=

Coefficients

D_{85}= 4.4588 D_{60}= 0.2814 D_{50}= 0.2433

D_{30}= 0.1882 D_{15}= 0.1431 D_{10}= 0.0833

C_u= 3.38 C_c= 1.51

Date Tested: 1/10/06 **Tested By:** RTH/JLC

Remarks

Sample No.: S-8 **Source of Sample:** B-67 **Date Sampled:**

Location: **Elev./Depth:** 28

Checked By: J. Fouse **Title:** P.E.

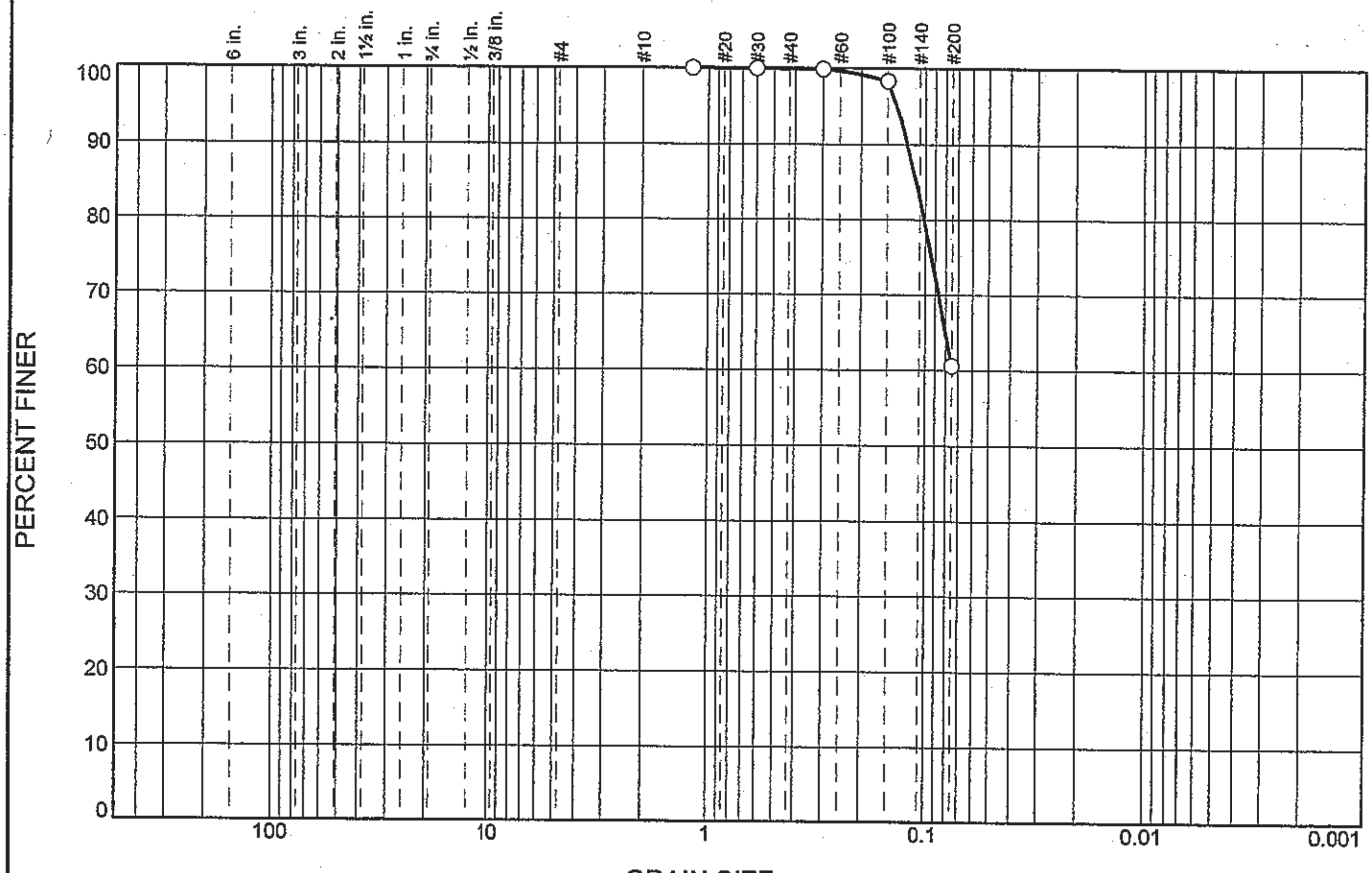
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-25

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	39.3	60.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#30	100.0		
#50	99.9		
#100	98.3		
#200	60.6		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.1097 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/10/06 **Tested By:** RTH/JLC

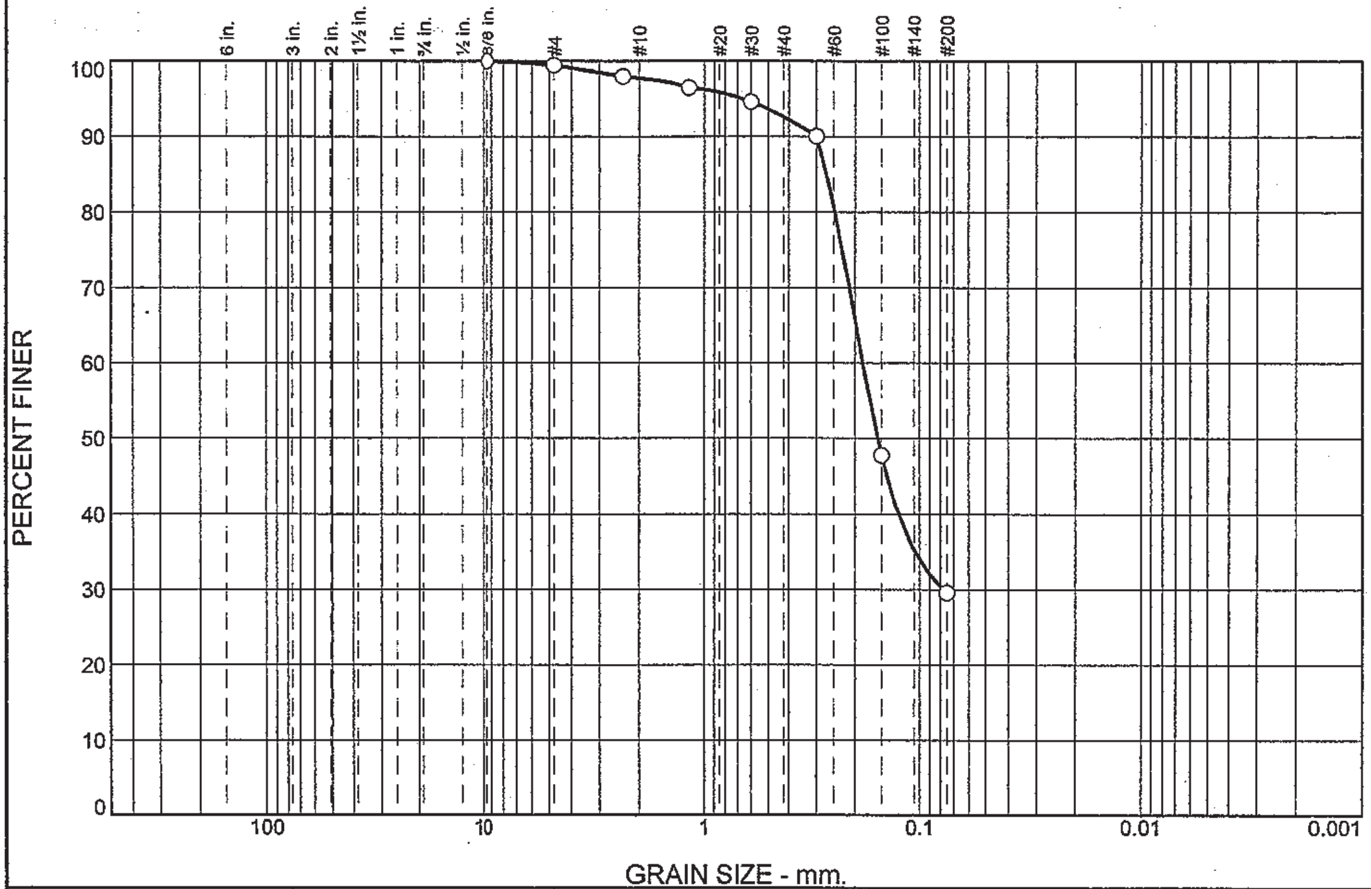
Remarks

Sample No.: S-3 **Source of Sample:** B-68 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-26

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.6	1.7	5.0	63.1	29.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.4		
#8	98.0		
#16	96.5		
#30	94.6		
#50	90.0		
#100	47.8		
#200	29.6		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grained

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.2689 D_{60}= 0.1831 D_{50}= 0.1563
D_{30}= 0.0773 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/10/06 **Tested By:** RTH/JLC

Remarks

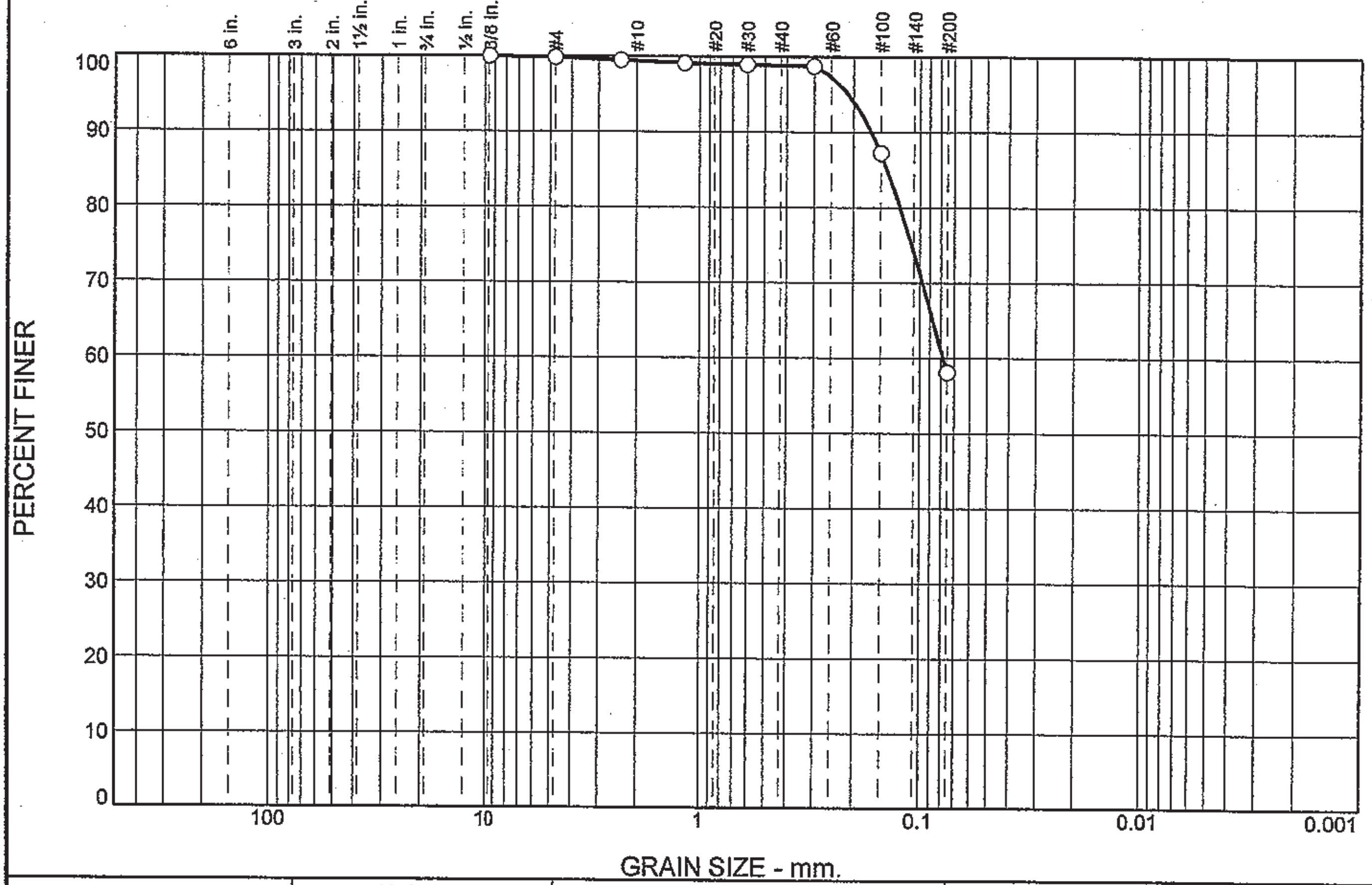
Sample No.: S-4 **Source of Sample:** B-68 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-27

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.4	0.5	40.8	58.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.8		
#8	99.5		
#16	99.1		
#30	98.9		
#50	98.8		
#100	87.3		
#200	58.1		

* (no specification provided)

Material Description

SILT (ML), with fine grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.1399 D_{60}= 0.0780 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/10/06 **Tested By:** RTH/JLC

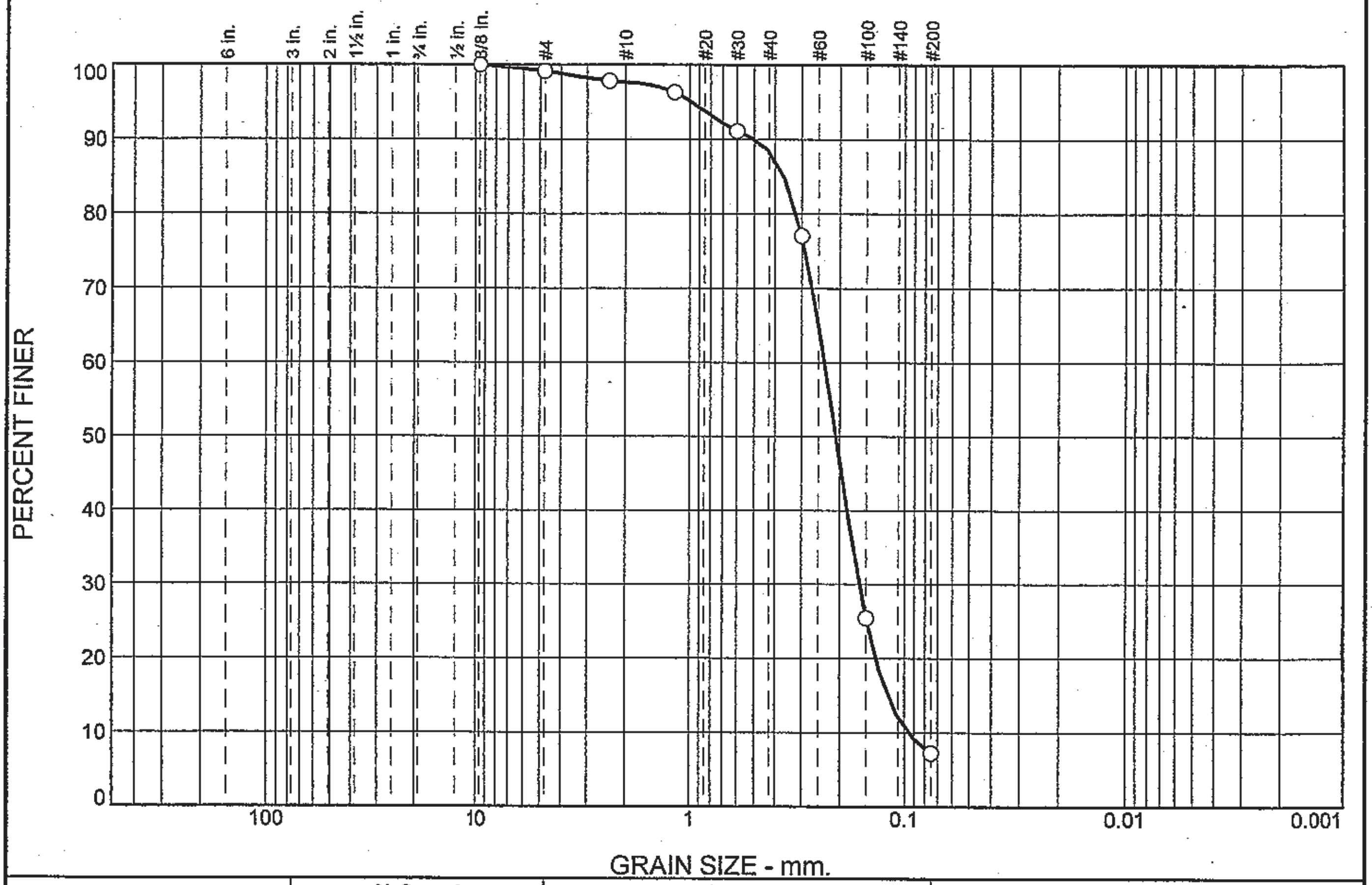
Remarks

Sample No.: S-5 **Source of Sample:** B-68 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-28

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.8	1.5	9.3	81.2	7.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.2		
#8	97.8		
#16	96.3		
#30	91.1		
#50	77.1		
#100	25.5		
#200	7.2		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.3636 D_{60}= 0.2347 D_{50}= 0.2079
D_{30}= 0.1610 D_{15}= 0.1187 D_{10}= 0.0953
C_u= 2.46 C_c= 1.16

Date Tested: 1/10/06 **Tested By:** RTH/JLC

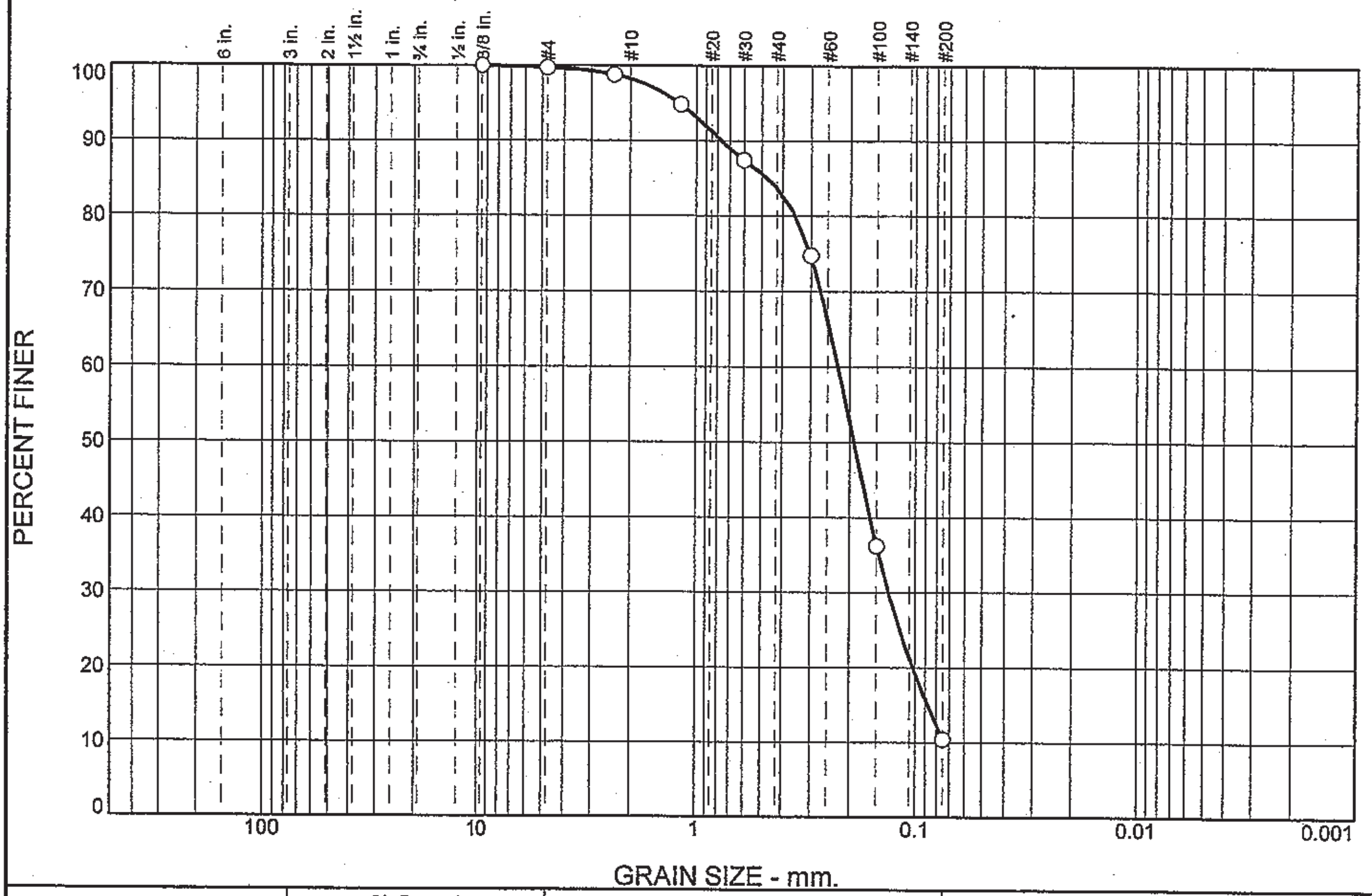
Remarks

Sample No.: S-6 **Source of Sample:** B-68 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: J. Fouse **Title:** P.E.

Reitz & Jens, Inc.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-29

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	1.4	14.6	73.3	10.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.7		
#8	98.8		
#16	94.9		
#30	87.4		
#50	74.8		
#100	36.2		
#200	10.4		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, trace medium-grain, slightly silty,

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.4685 D_{60}= 0.2247 D_{50}= 0.1905

D_{30}= 0.1320 D_{15}= 0.0874 D_{10}=

C_u= C_c=

Date Tested: 1/10/06 **Tested By:** RTH/JLC

Remarks

Sample No.: S-7 **Source of Sample:** B-68 **Date Sampled:**

Location: **Elev./Depth:** 23

Checked By: J. Fouse **Title:** P.E.

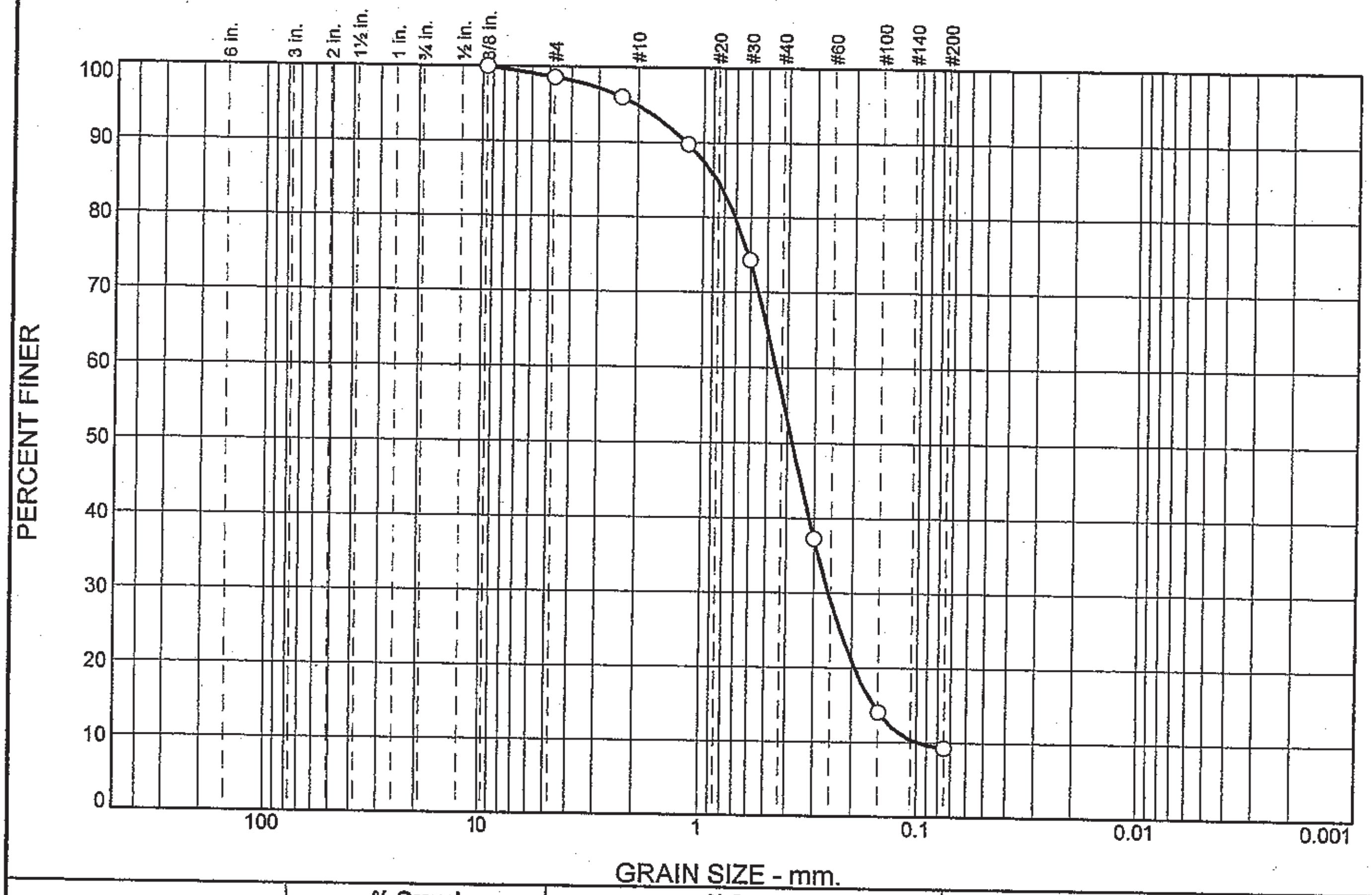
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-30

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.4	3.6	38.4	47.3	9.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	98.6		
#8	96.1		
#16	89.8		
#30	74.3		
#50	37.2		
#100	14.1		
#200	9.3		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.8618 D_{60}= 0.4509 D_{50}= 0.3786
D_{30}= 0.2567 D_{15}= 0.1577 D_{10}= 0.0990
C_u= 4.55 C_c= 1.48

Date Tested: 1/10/06 **Tested By:** RTH/JLC

Remarks

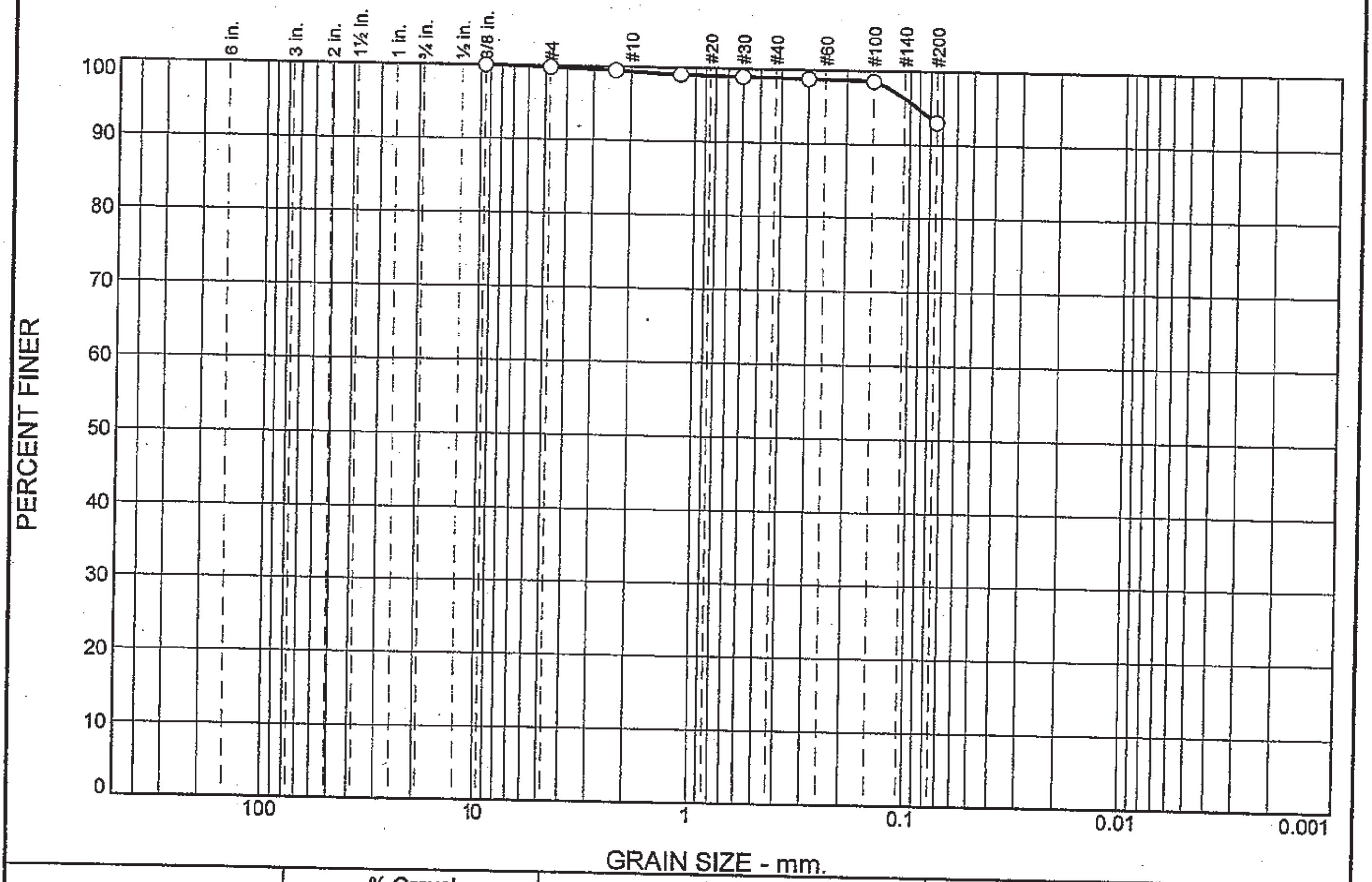
Sample No.: S-8 **Source of Sample:** B-68 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-31

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.4	0.5	5.9	93.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.8		
#8	99.5		
#16	99.1		
#30	98.9		
#50	98.8		
#100	98.6		
#200	93.0		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL=
LL=
PI=

Classification

USCS= ML
AASHTO=

Coefficients

D_{85}=
D_{60}=
D_{50}=
D_{30}=
D_{15}=
D_{10}=
C_u=
C_c=

Date Tested: 1/10/06 **Tested By:** RTH/JLC

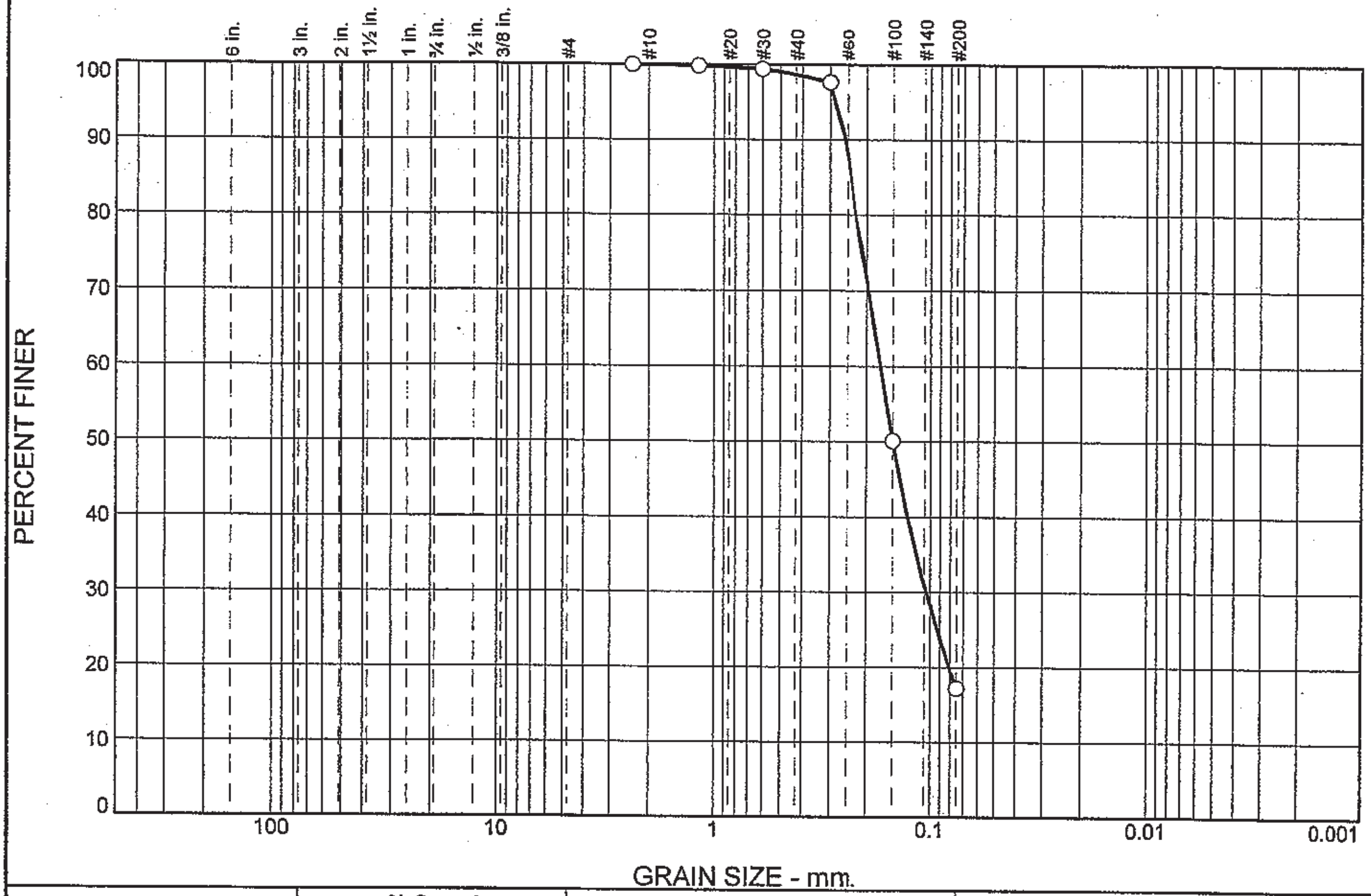
Remarks

Sample No.: SS-4 **Source of Sample:** B-69
Location:
Checked By: J. Fouse
Title: P.E.
Date Sampled:
Elev./Depth: 9

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477
Figure B1-32

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.3	81.5	17.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.8		
#30	99.4		
#50	97.7		
#100	50.1		
#200	17.2		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.2385 D_{60}= 0.1718 D_{50}= 0.1498
D_{30}= 0.1039 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/09/06 **Tested By:** RTH/JLC

Remarks

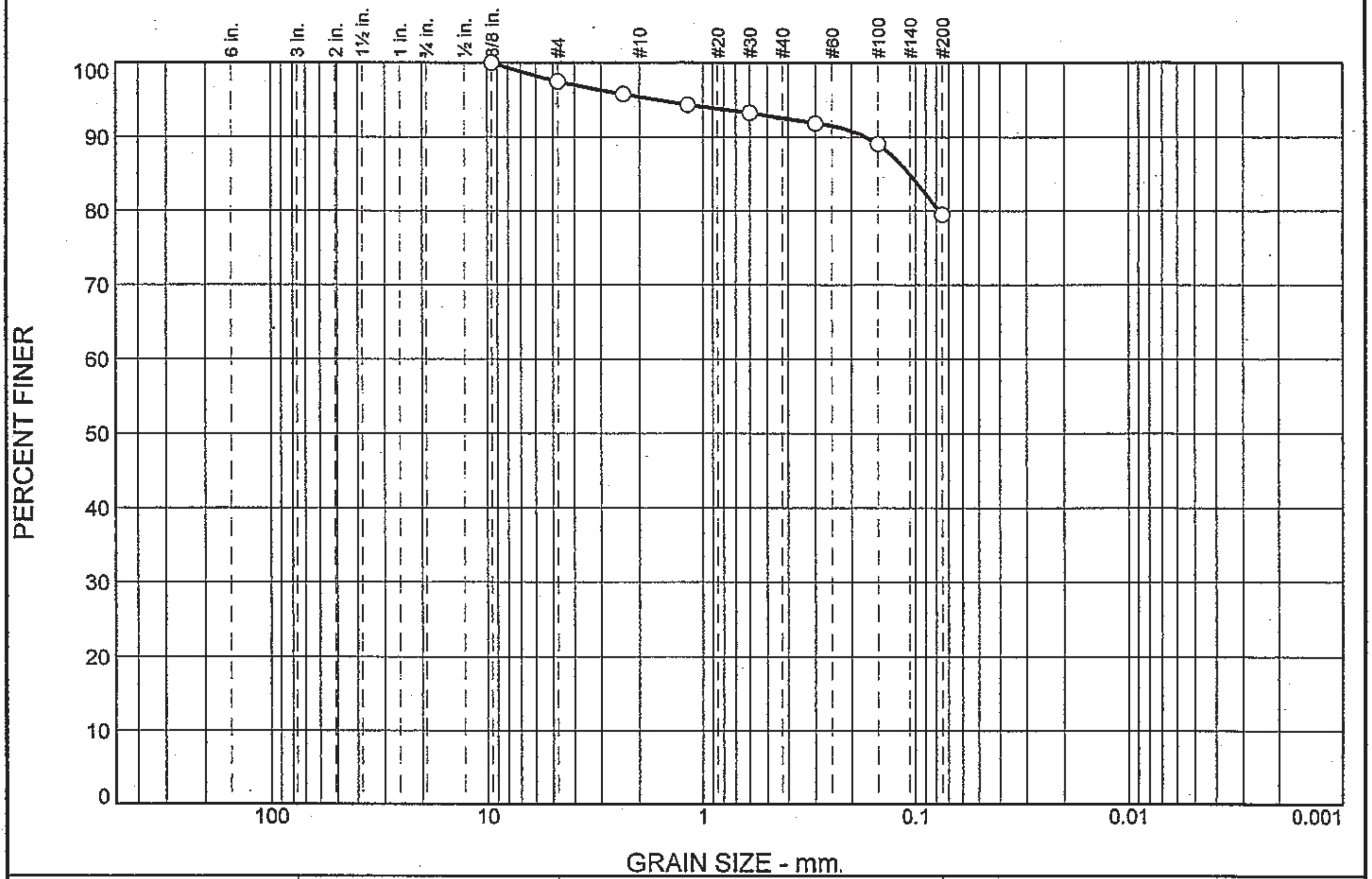
Sample No.: SS-5 **Source of Sample:** B-69 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-33

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.5	2.1	2.8	13.1	79.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	97.5		
#8	95.8		
#16	94.3		
#30	93.3		
#50	91.9		
#100	89.1		
#200	79.5		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.1063 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/09/06 **Tested By:** RTH/JLC

Remarks

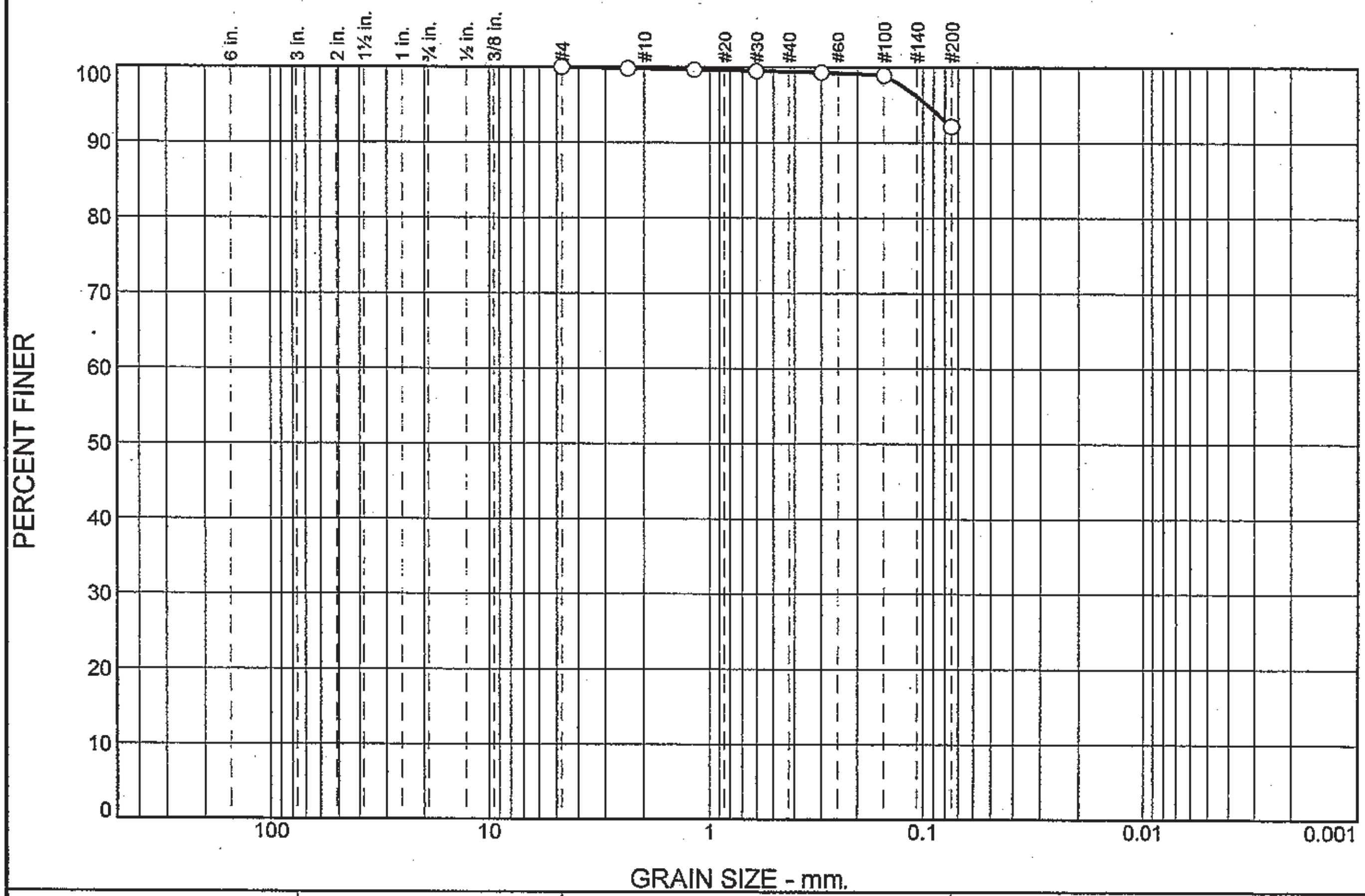
Sample No.: SS-6 **Source of Sample:** B-69 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-34

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	0.4	7.2	92.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.8		
#16	99.7		
#30	99.5		
#50	99.3		
#100	98.9		
#200	92.2		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/09/06 **Tested By:** RTH/JLC

Remarks

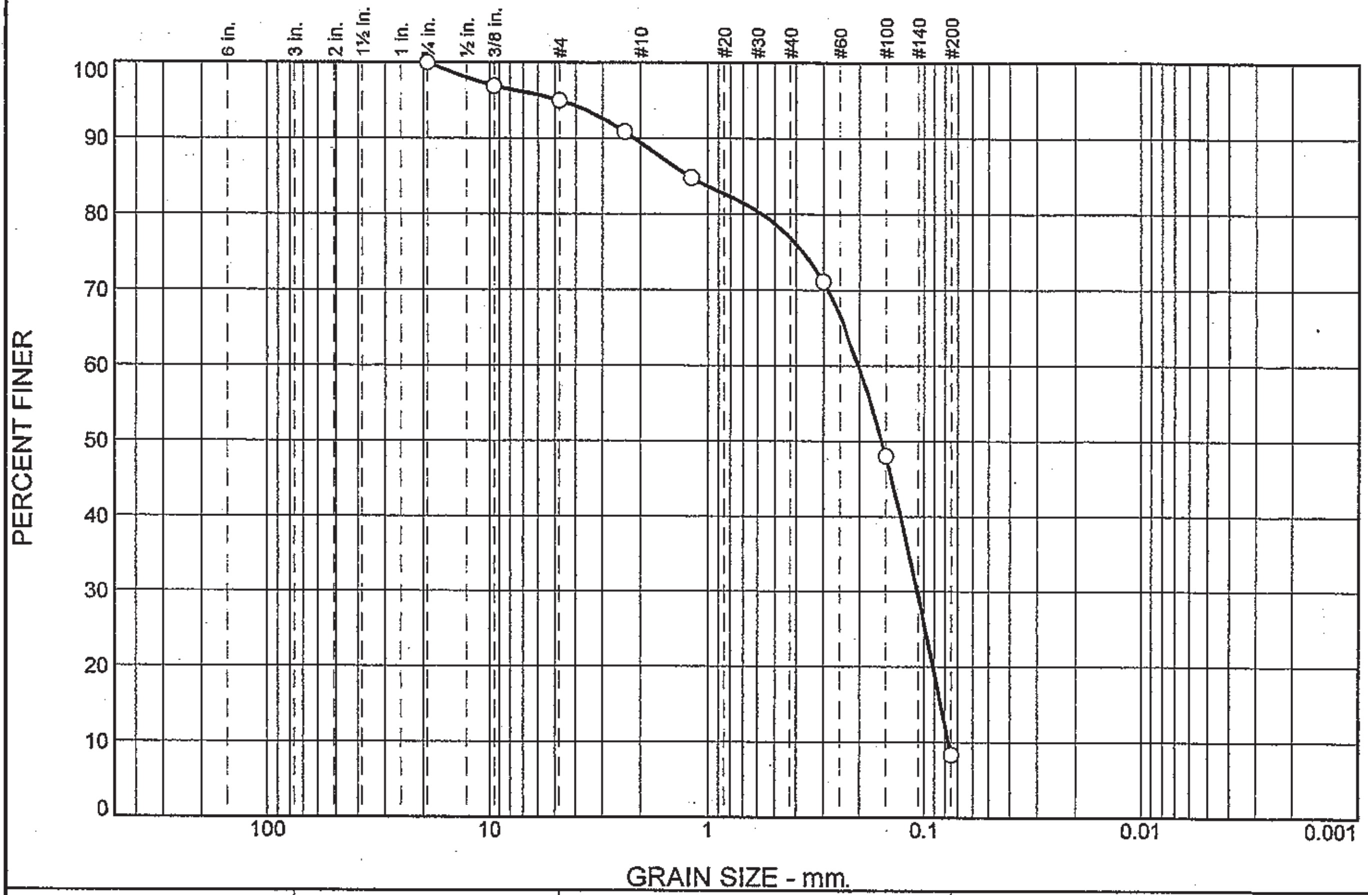
Sample No.: SS-7 **Source of Sample:** B-69 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-35

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.0	5.6	12.4	68.7	8.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	96.9		
#4	95.0		
#8	90.9		
#16	84.8		
#50	71.1		
#100	48.0		
#200	8.3		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, trace of medium-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 1.2139 D_{60}= 0.2011 D_{50}= 0.1565
D_{30}= 0.1069 D_{15}= 0.0835 D_{10}= 0.0770
C_u= 2.61 C_c= 0.74

Date Tested: 1/09/06 **Tested By:** RTH/JLC

Remarks

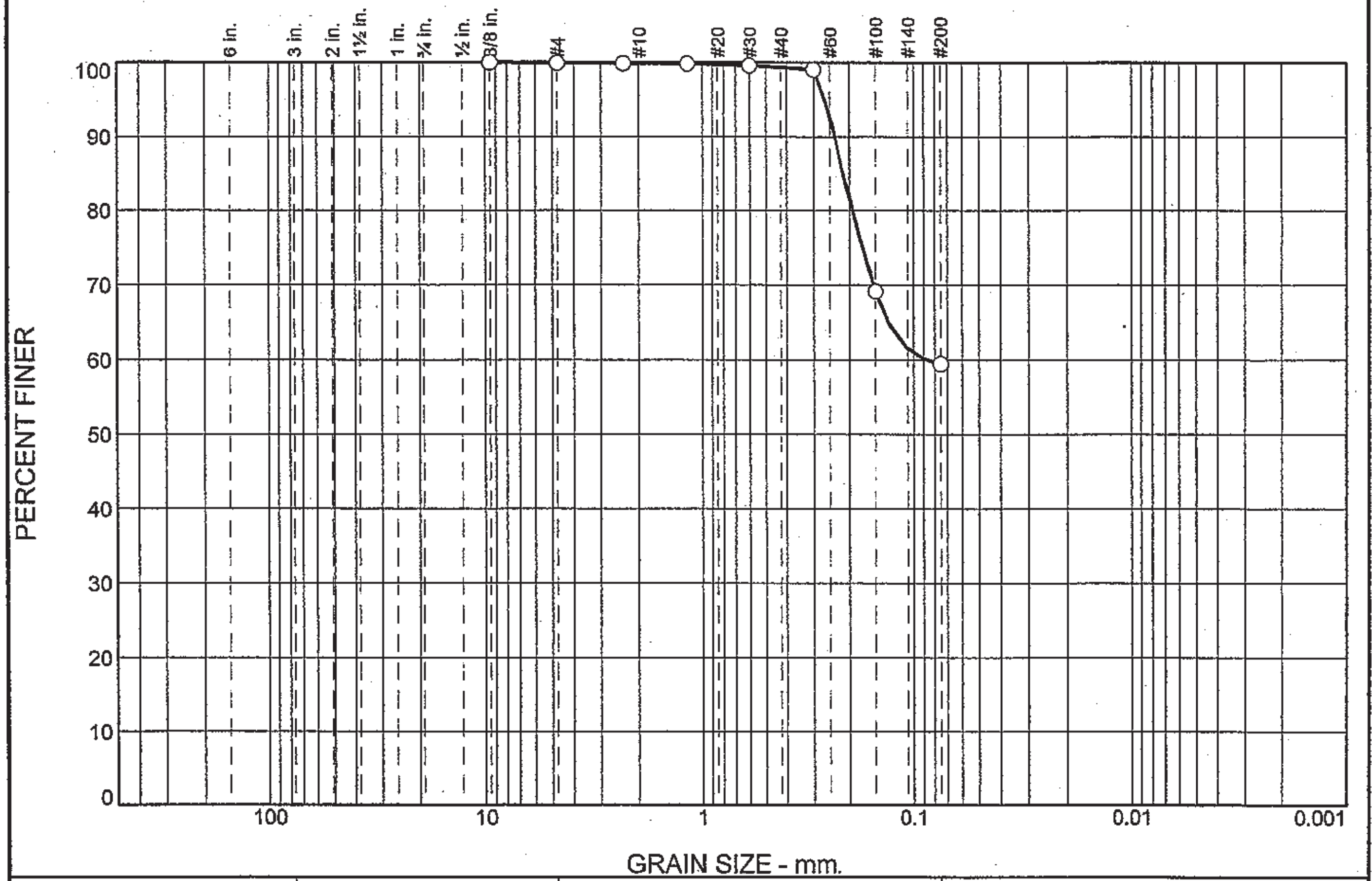
Sample No.: S-8 **Source of Sample:** B-69 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-36

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.0	0.5	39.9	59.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#8	99.9		
#16	99.8		
#30	99.6		
#50	99.1		
#100	69.2		
#200	59.5		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.2121 D_{60}= 0.0866 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/09/06 **Tested By:** RTH/JLC

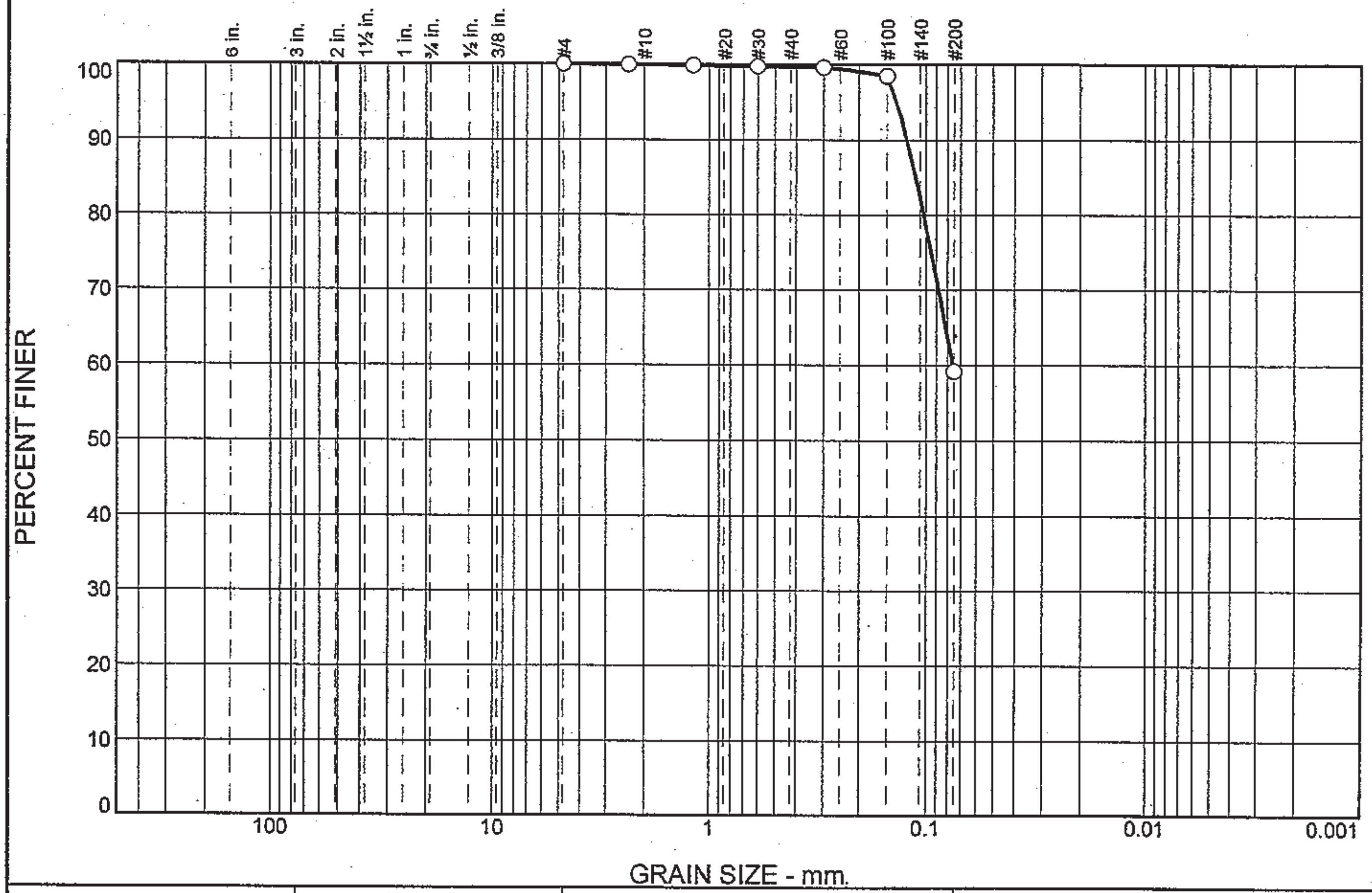
Remarks

Sample No.: S-5 **Source of Sample:** B-70 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-37

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	40.5	59.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.9		
#30	99.7		
#50	99.6		
#100	98.5		
#200	59.2		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.1104 D_{60}= 0.0759 D_{50}=

D_{30}= D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/09/06 **Tested By:** RTH/JLC

Remarks

Sample No.: S-6 **Source of Sample:** B-70 **Date Sampled:**

Location: **Elev./Depth:** 18

Checked By: J. Fouse **Title:** P.E.

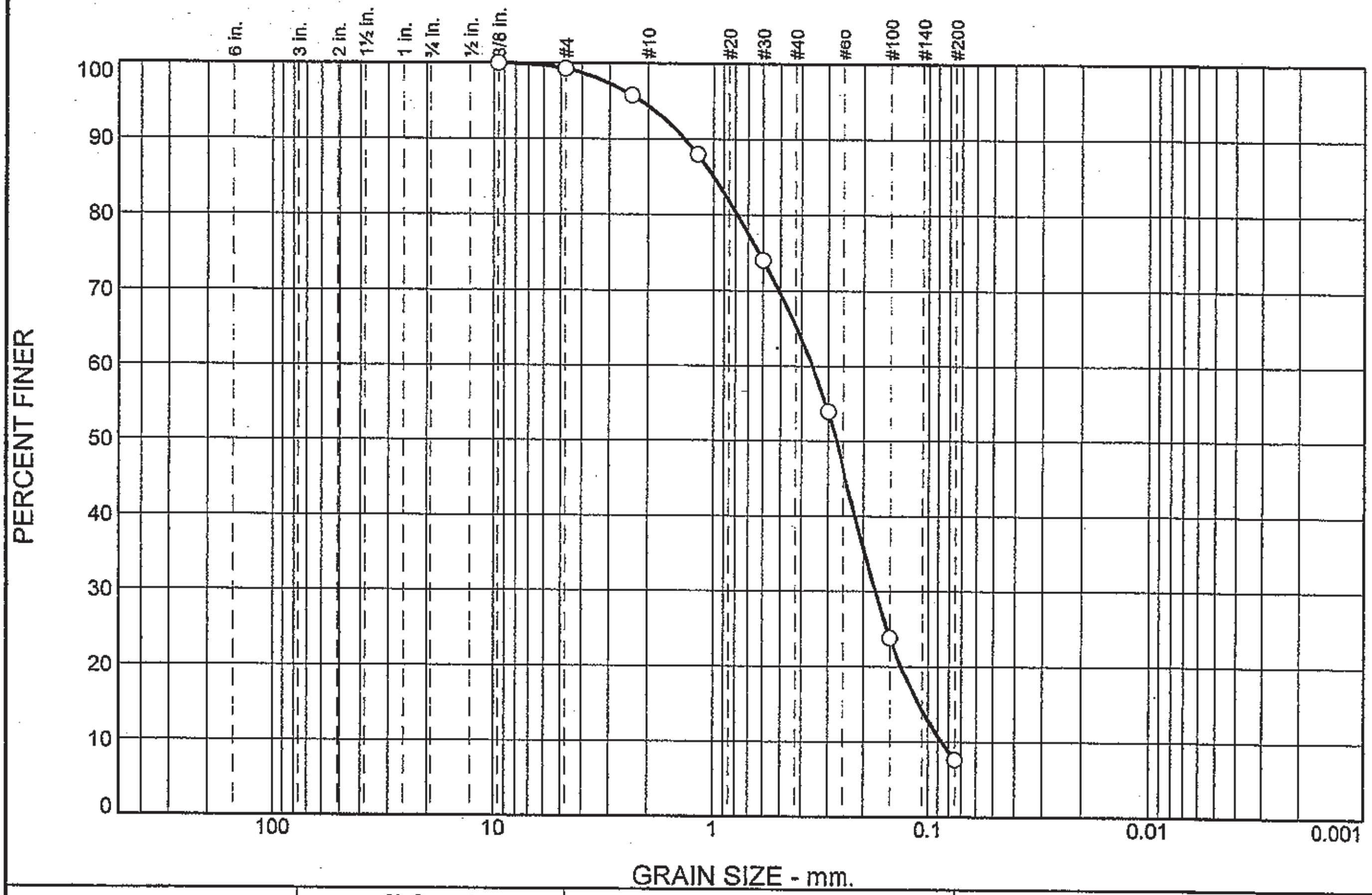
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-38

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	4.9	28.9	57.9	7.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.3		
#8	95.8		
#16	88.0		
#30	74.1		
#50	54.0		
#100	23.9		
#200	7.6		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.9963 D_{60}= 0.3547 D_{50}= 0.2727
D_{30}= 0.1752 D_{15}= 0.1104 D_{10}= 0.0861
C_u= 4.12 C_c= 1.00

Date Tested: 1/09/06 **Tested By:** RTH/JLC

Remarks

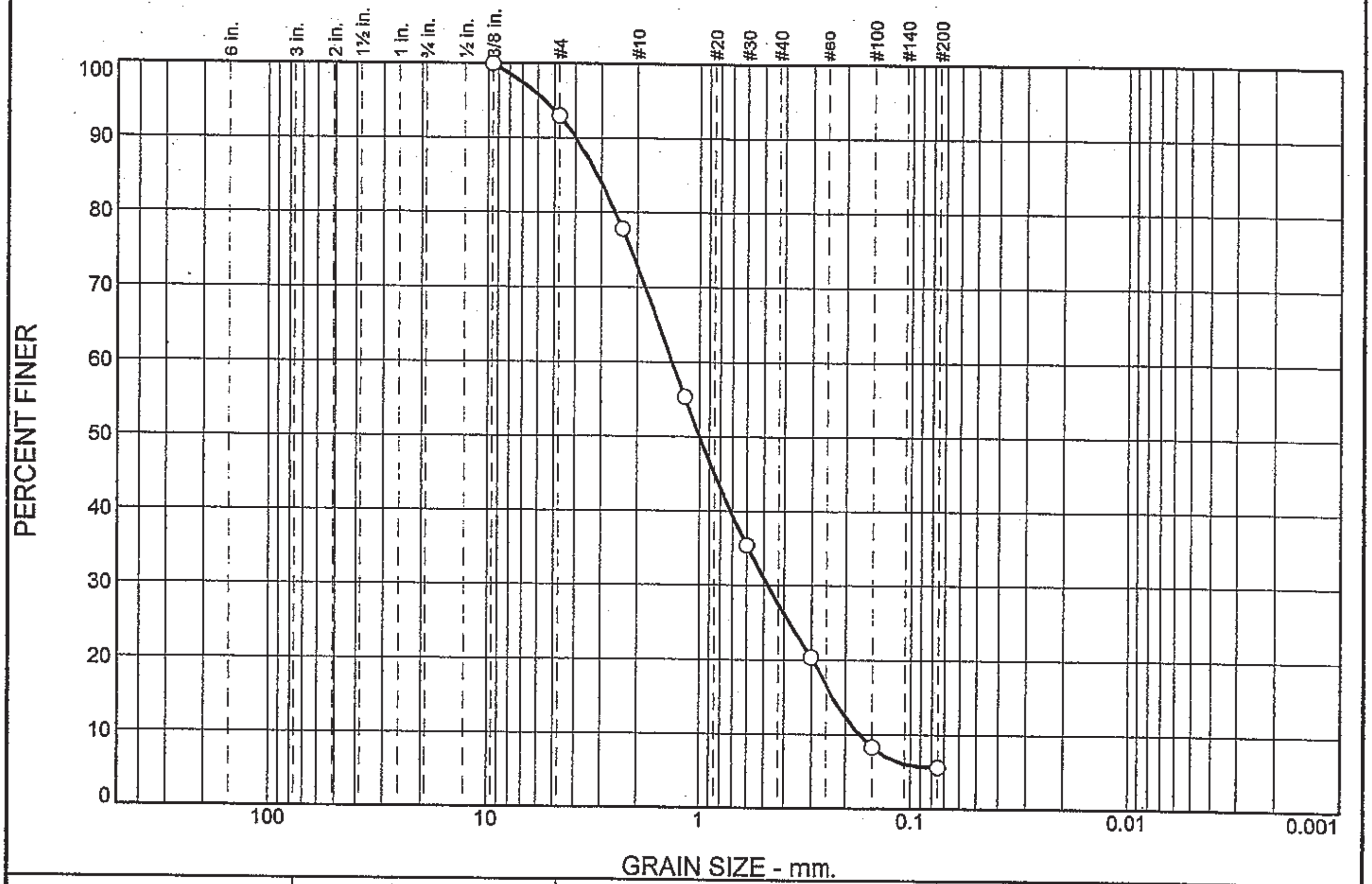
Sample No.: S-7 **Source of Sample:** B-70 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-39

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.0	20.2	45.3	21.9	5.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	93.0		
#8	77.8		
#16	55.4		
#30	35.4		
#50	20.4		
#100	8.3		
#200	5.6		

* (no specification provided)

Material Description

SAND (SW-SM), well graded, slightly silty, trace of fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW-SM AASHTO=

Coefficients

D_{85}= 3.1172 D_{60}= 1.3552 D_{50}= 0.9988
D_{30}= 0.4765 D_{15}= 0.2297 D_{10}= 0.1719
C_u= 7.88 C_c= 0.97

Date Tested: 1/09/06 **Tested By:** RTH/JLC

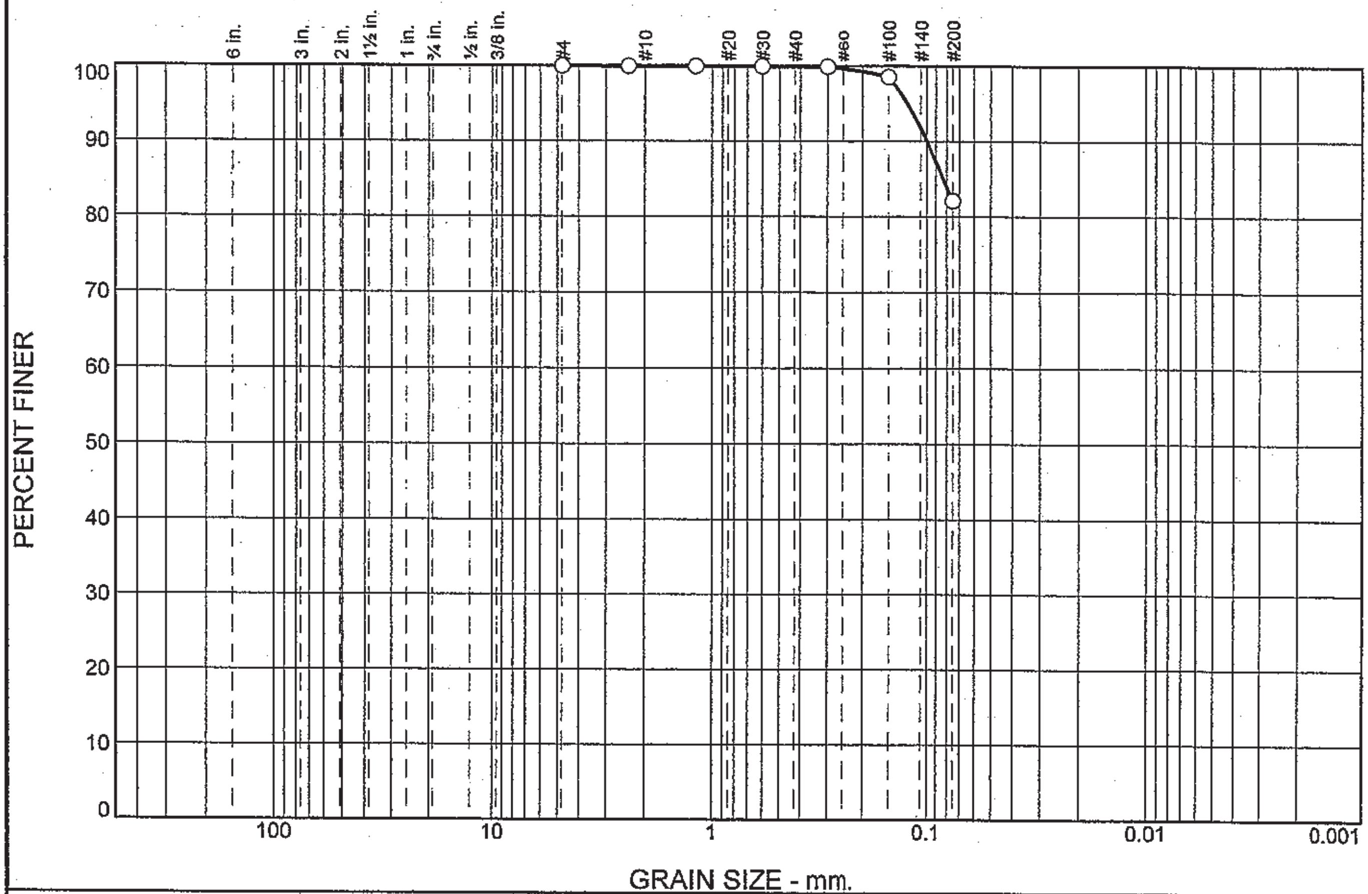
Remarks

Sample No.: S-8 **Source of Sample:** B-70 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-40

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	17.8	82.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	100.0		
#30	100.0		
#50	99.9		
#100	98.6		
#200	82.1		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.0828 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/23/06 **Tested By:** JJP

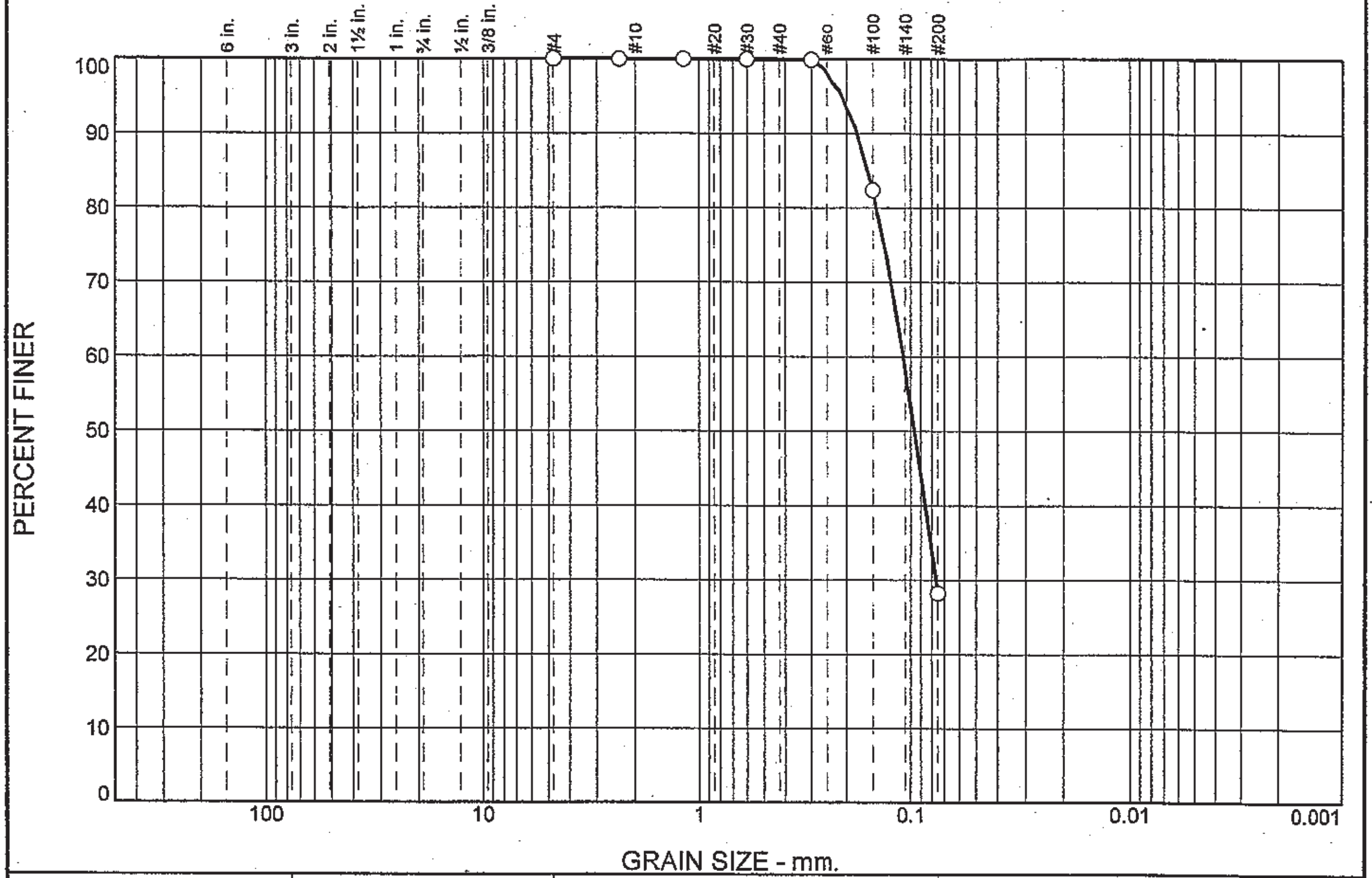
Remarks

Sample No.: S-3 **Source of Sample:** B-71 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-41

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	71.8	28.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	100.0		
#30	100.0		
#50	99.9		
#100	82.4		
#200	28.2		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1578 D_{60}= 0.1080 D_{50}= 0.0958
D_{30}= 0.0765 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/23/06 **Tested By:** JJP

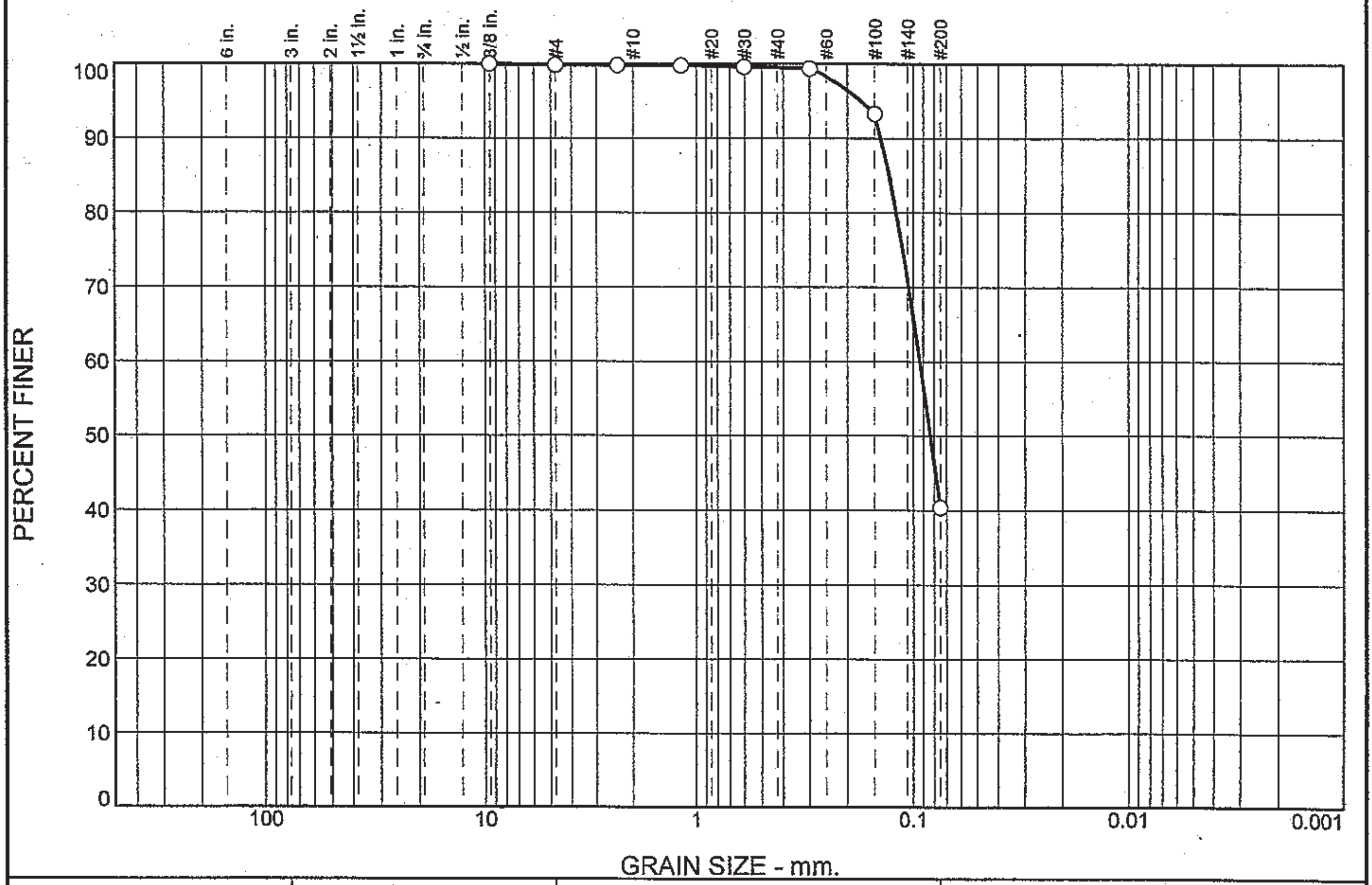
Remarks

Sample No.: S-4 **Source of Sample:** B-71 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-42

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.1	0.3	59.1	40.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#8	99.8		
#16	99.8		
#30	99.6		
#50	99.4		
#100	93.3		
#200	40.4		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1281 D_{60}= 0.0928 D_{50}= 0.0831

D_{30}= D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/23/06 **Tested By:** RTH/JJP

Remarks

Sample No.: S-5 **Source of Sample:** B-71 **Date Sampled:**

Location: **Elev./Depth:** 13

Checked By: J. Fouse **Title:** P.E.

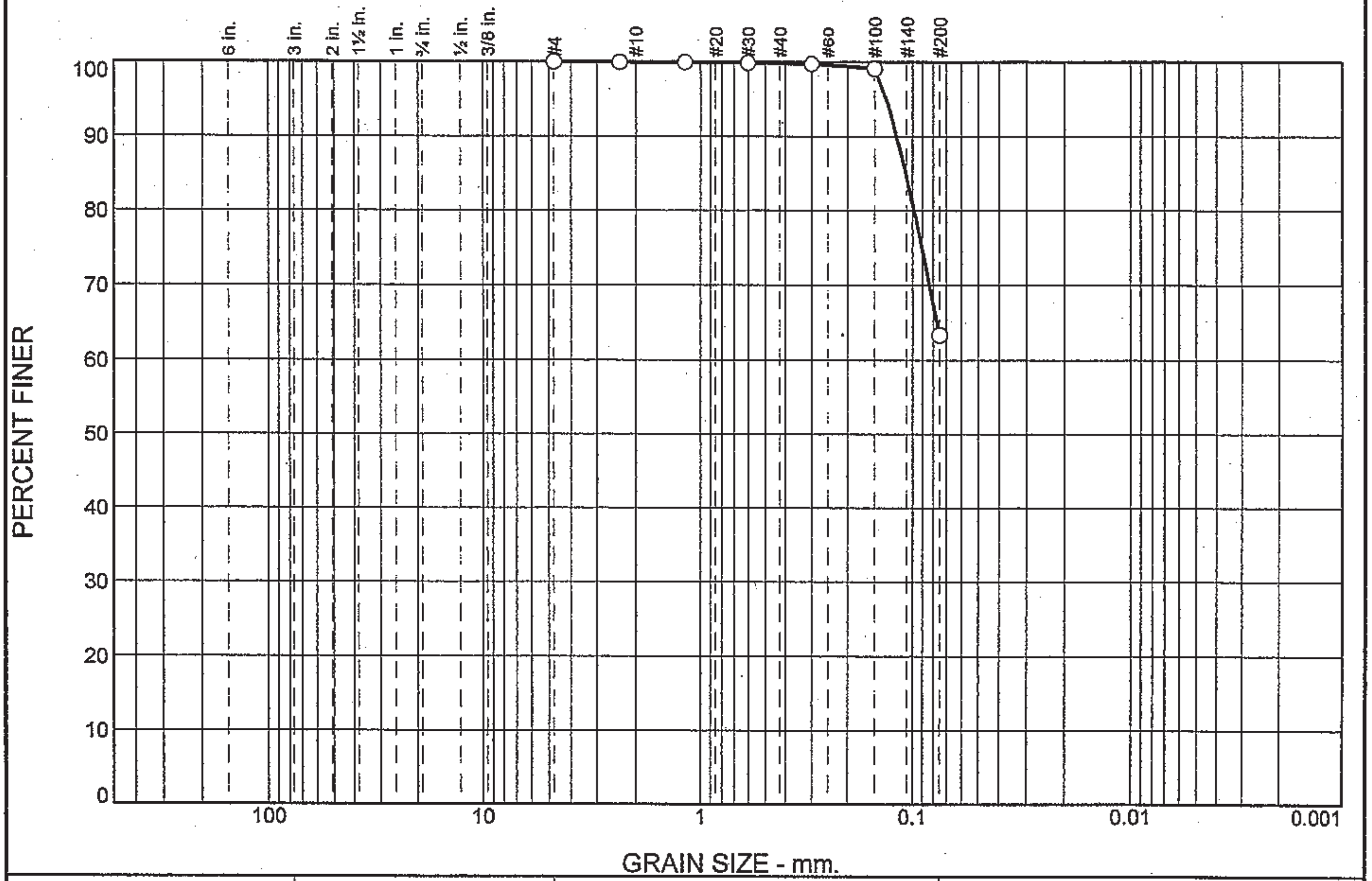
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-43

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	36.4	63.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	100.0		
#30	99.9		
#50	99.8		
#100	99.1		
#200	63.4		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.1066 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/23/06 **Tested By:** RTH/JJP

Remarks

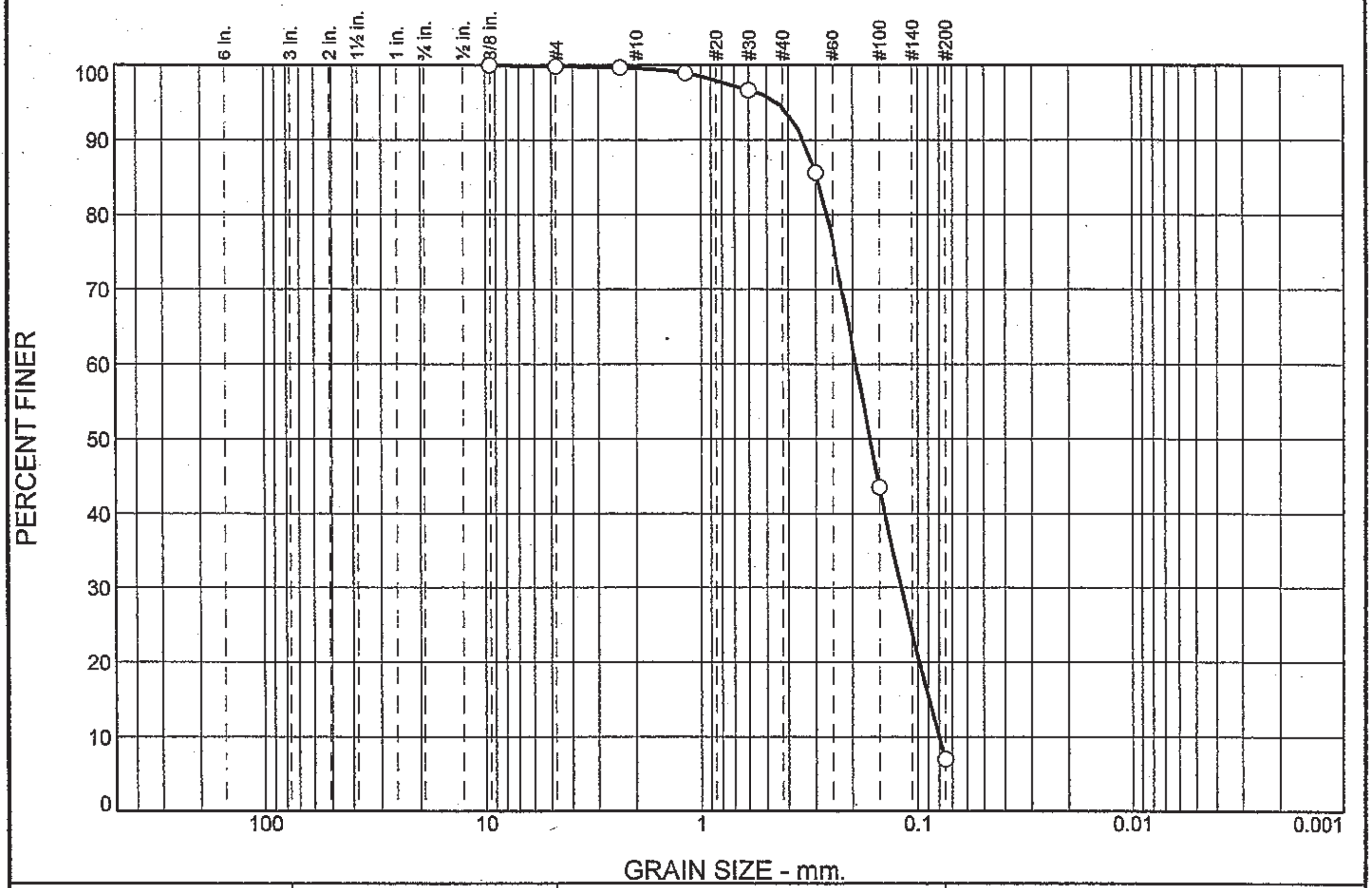
Sample No.: S-6 **Source of Sample:** B-71 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-44

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.3	5.2	87.4	7.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#8	99.7		
#16	98.9		
#30	96.7		
#50	85.7		
#100	43.6		
#200	7.0		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2953 D_{60}= 0.1923 D_{50}= 0.1657
D_{30}= 0.1189 D_{15}= 0.0886 D_{10}= 0.0799
C_u= 2.41 C_c= 0.92

Date Tested: 1/23/06 **Tested By:** RTH/JJP

Remarks

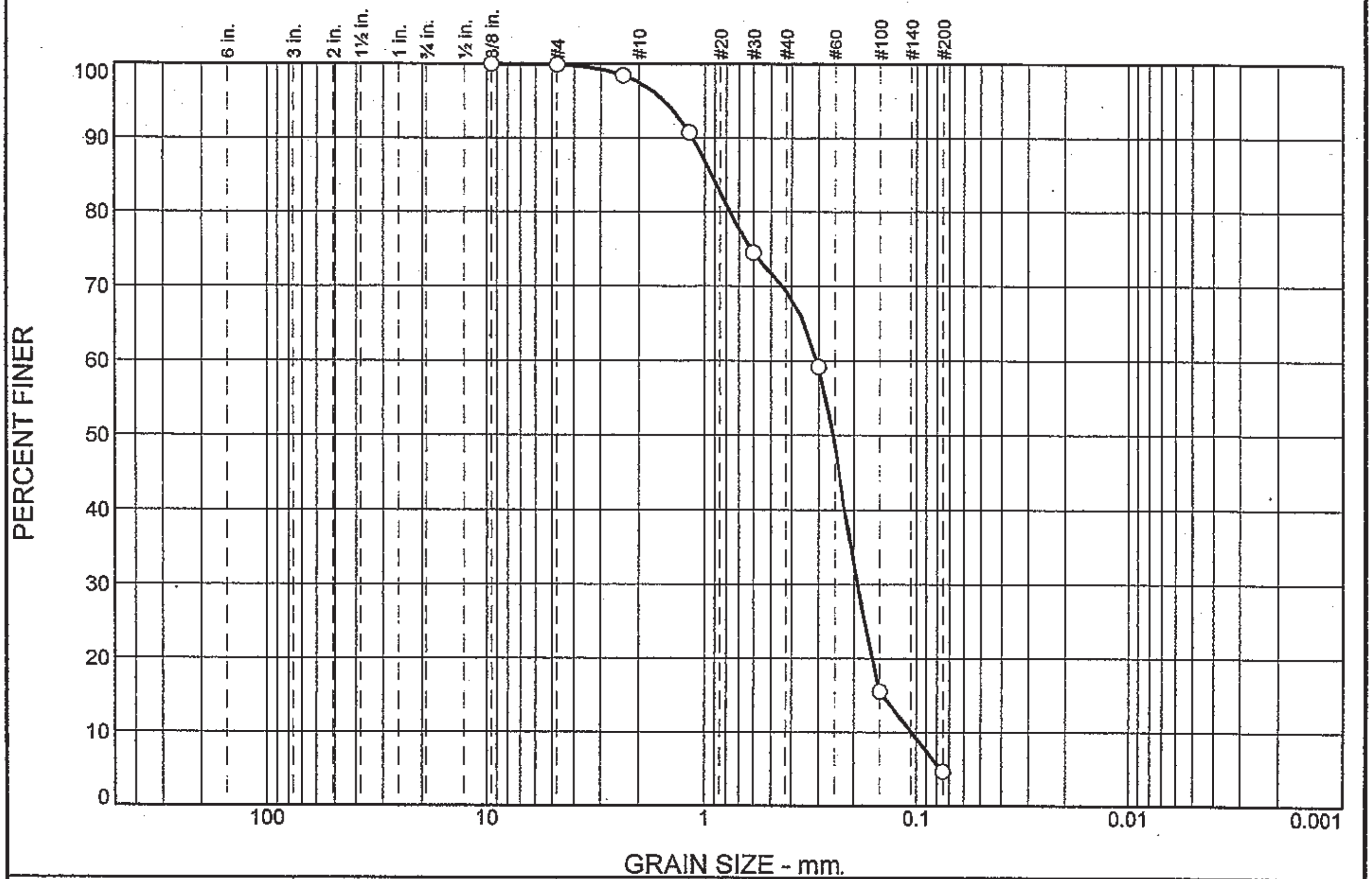
Sample No.: S-7 **Source of Sample:** B-71 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-45

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	2.4	28.0	64.8	4.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#8	98.5		
#16	90.8		
#30	74.5		
#50	59.2		
#100	15.5		
#200	4.7		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.9296 D_{60}= 0.3054 D_{50}= 0.2553
D_{30}= 0.1911 D_{15}= 0.1451 D_{10}= 0.1054
C_u= 2.90 C_c= 1.13

Date Tested: 01/25/06 **Tested By:** J. Crose

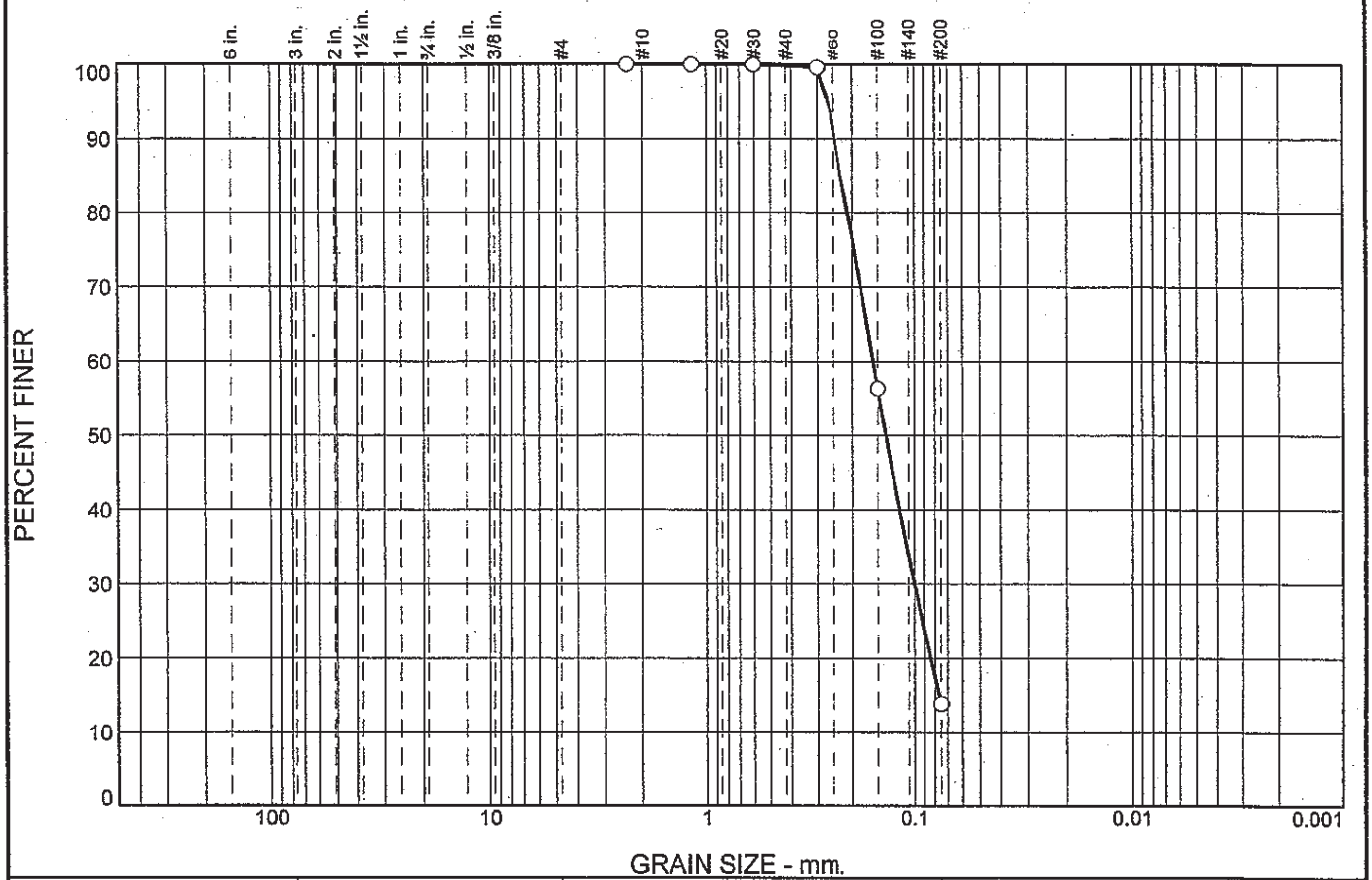
Remarks

Sample No.: S-8 **Source of Sample:** B-71 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-46

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	85.9	13.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	100.0		
#30	100.0		
#50	99.6		
#100	56.3		
#200	13.9		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.2240 D_{60}= 0.1579 D_{50}= 0.1369
D_{30}= 0.0994 D_{15}= 0.0765 D_{10}=
C_u= C_c=

Date Tested: **Tested By:** RTH

Remarks

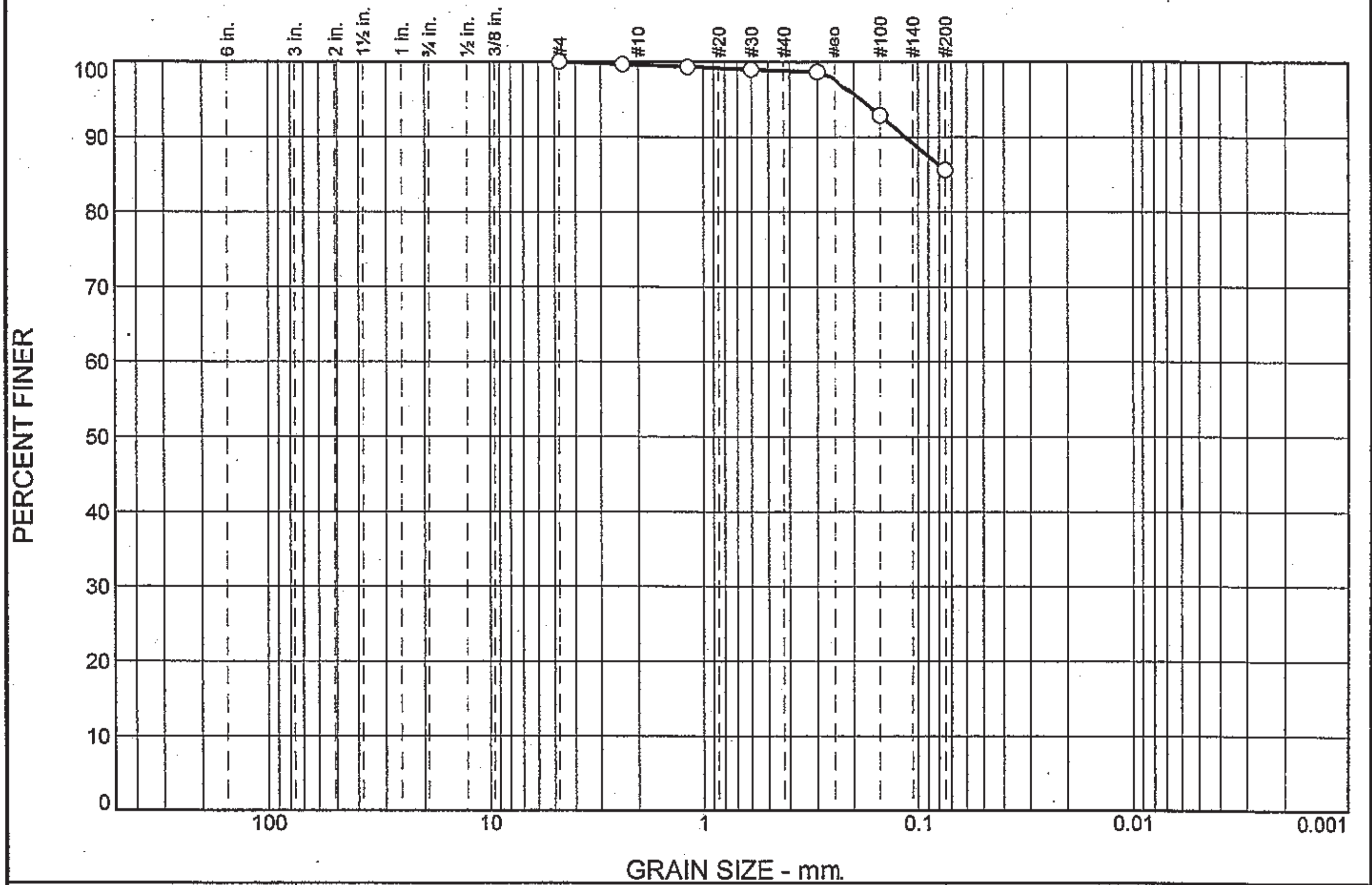
Sample No.: S-3 **Source of Sample:** B-72 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-47

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	0.8	13.2	85.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.7		
#16	99.3		
#30	99.0		
#50	98.7		
#100	92.9		
#200	85.6		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: **Tested By:** RTH

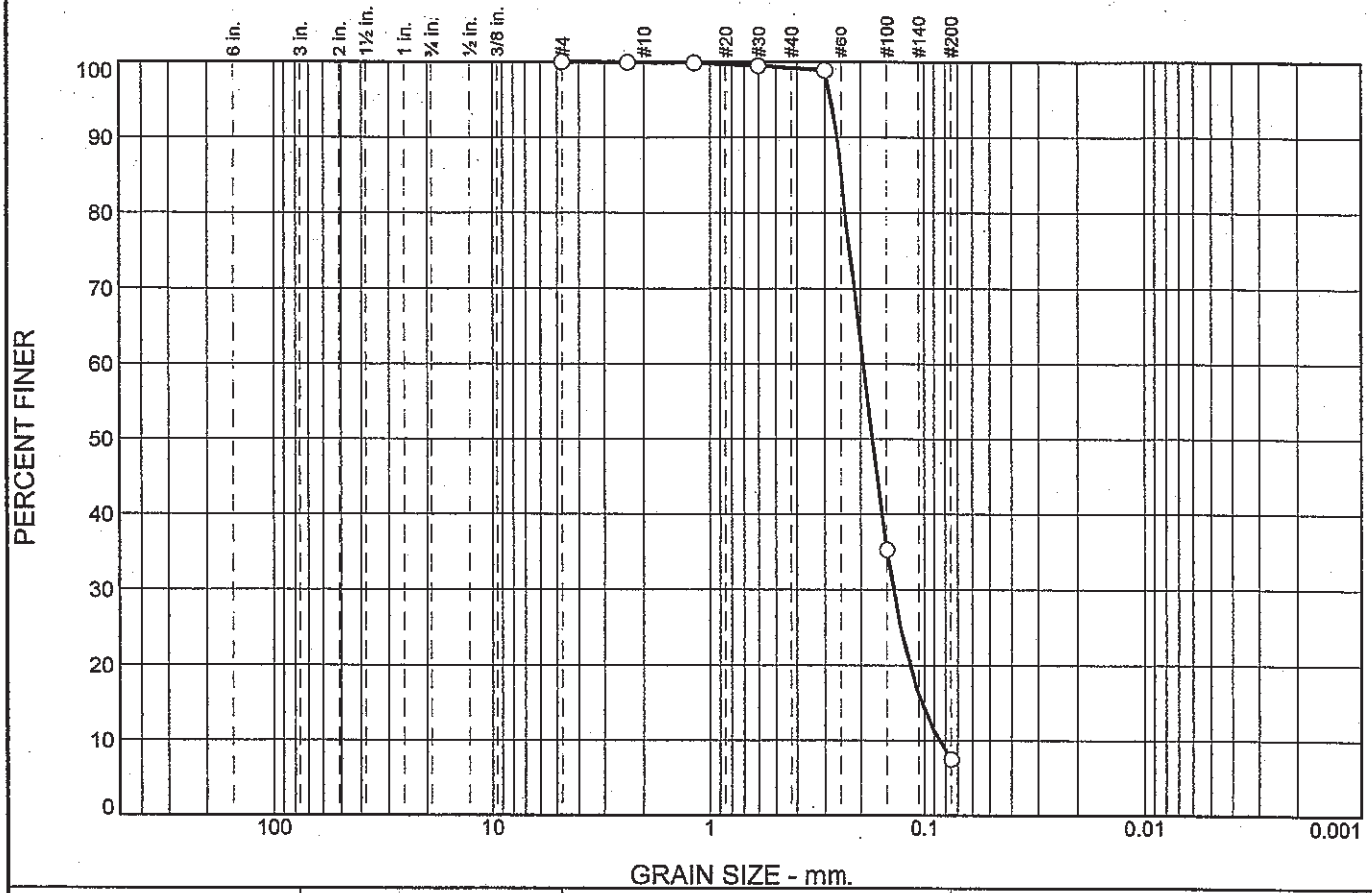
Remarks

Sample No.: S-4 **Source of Sample:** B-72 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-48

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.8	91.7	7.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.9		
#30	99.5		
#50	98.9		
#100	35.3		
#200	7.5		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2482 D_{60}= 0.1938 D_{50}= 0.1760

D_{30}= 0.1398 D_{15}= 0.1027 D_{10}= 0.0849

C_u= 2.28 C_c= 1.19

Date Tested: **Tested By:** RTH

Remarks

Sample No.: S-5 **Source of Sample:** B-72 **Date Sampled:**

Location: **Elev./Depth:** 13

Checked By: K. Kocher **Title:** P.E.

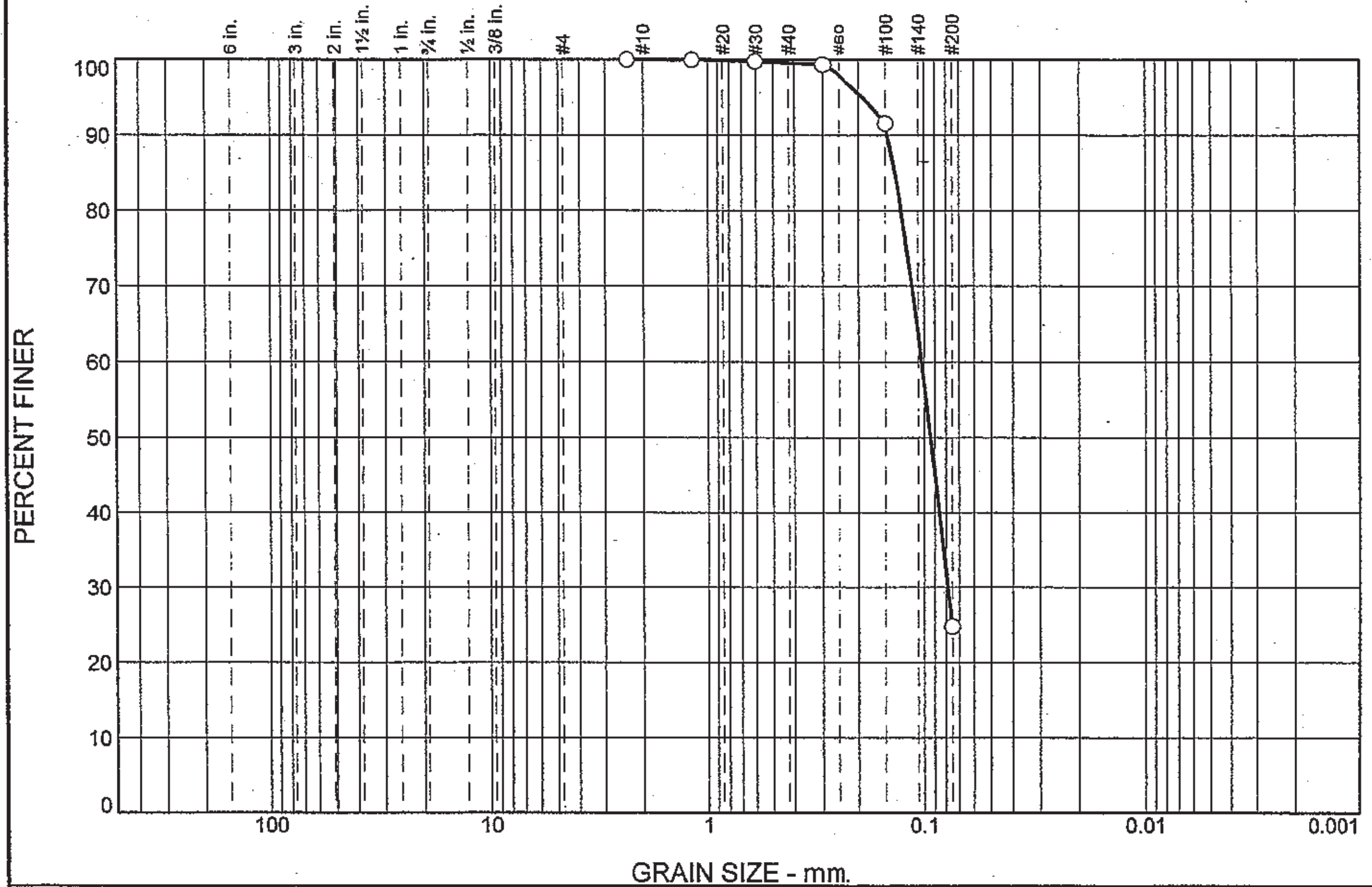
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-49

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.4	74.8	24.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	100.0		
#30	99.8		
#50	99.4		
#100	91.6		
#200	24.8		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1349 D_{60}= 0.1022 D_{50}= 0.0932
D_{30}= 0.0784 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/12/06 **Tested By:** J. Crose

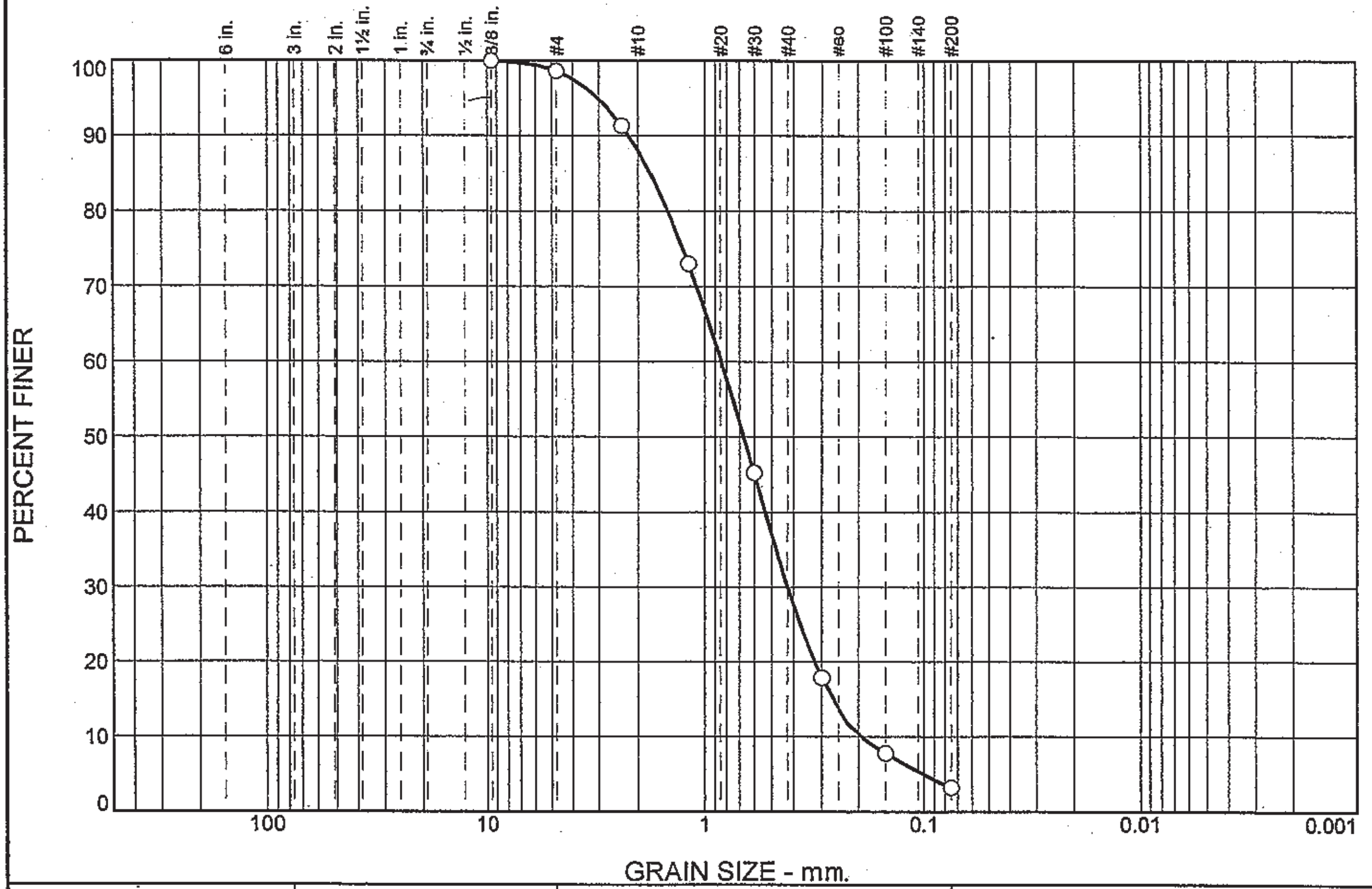
Remarks

Sample No.: S-6 **Source of Sample:** B-72 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-50

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.3	10.6	58.0	26.9	3.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	98.7		
#8	91.3		
#16	73.0		
#30	45.2		
#50	17.9		
#100	7.8		
#200	3.2		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.7562 D_{60}= 0.8424 D_{50}= 0.6678
D_{30}= 0.4237 D_{15}= 0.2667 D_{10}= 0.1935
C_u= 4.35 C_c= 1.10

Date Tested: 1/12/06 **Tested By:** J. Crose

Remarks

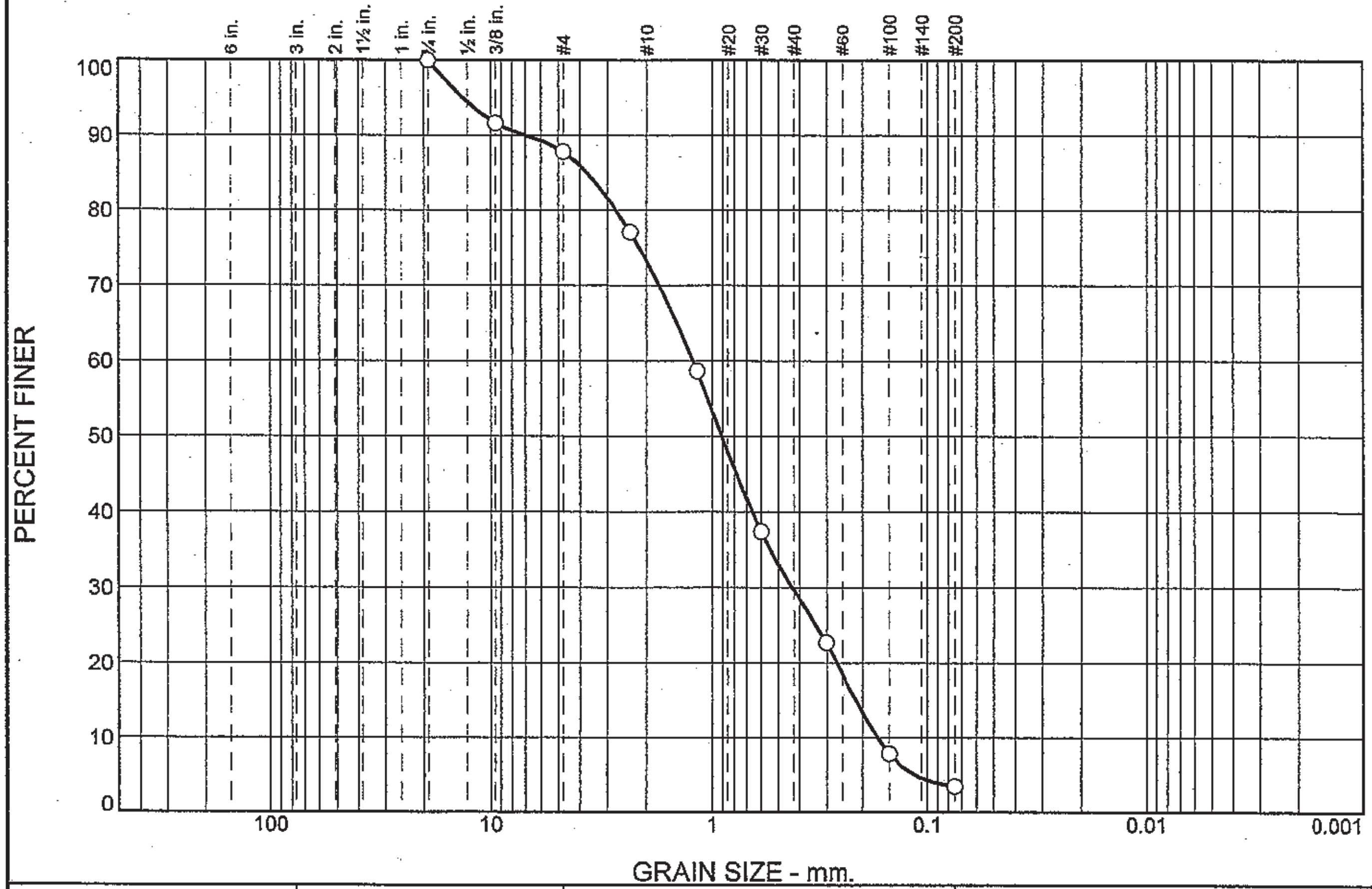
Sample No.: S-7 **Source of Sample:** B-72 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** P.E.

Reitz & Jens, Inc.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-51

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.2	14.5	43.6	26.3	3.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	91.6		
#4	87.8		
#8	77.1		
#16	58.7		
#30	37.4		
#50	22.7		
#100	7.9		
#200	3.4		

* (no specification provided)

Material Description

SAND (SP), coarse-, medium-, and fine-grain, with fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 3.6825 D_{60}= 1.2311 D_{50}= 0.9059
D_{30}= 0.4315 D_{15}= 0.2147 D_{10}= 0.1700
C_u= 7.24 C_c= 0.89

Date Tested: 1/12/06 **Tested By:** J. Crose

Remarks

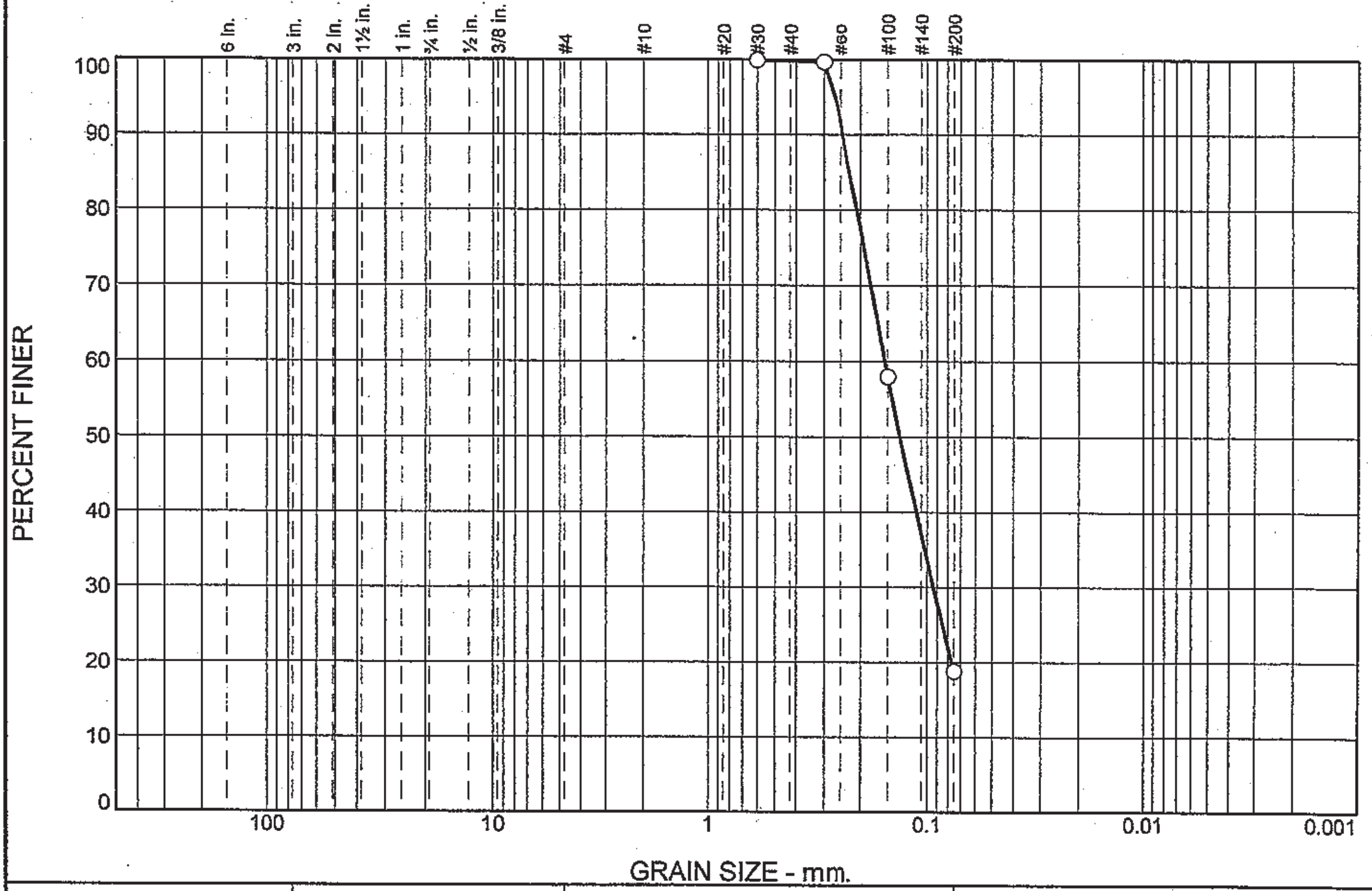
Sample No.: S-8 **Source of Sample:** B-72 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-52

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
					81.0	18.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#50	99.7		
#100	58.0		
#200	18.8		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= 27 LL= 29 PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.2231 D_{60}= 0.1546 D_{50}= 0.1324
D_{30}= 0.0930 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 12/05 **Tested By:** RTH

Remarks

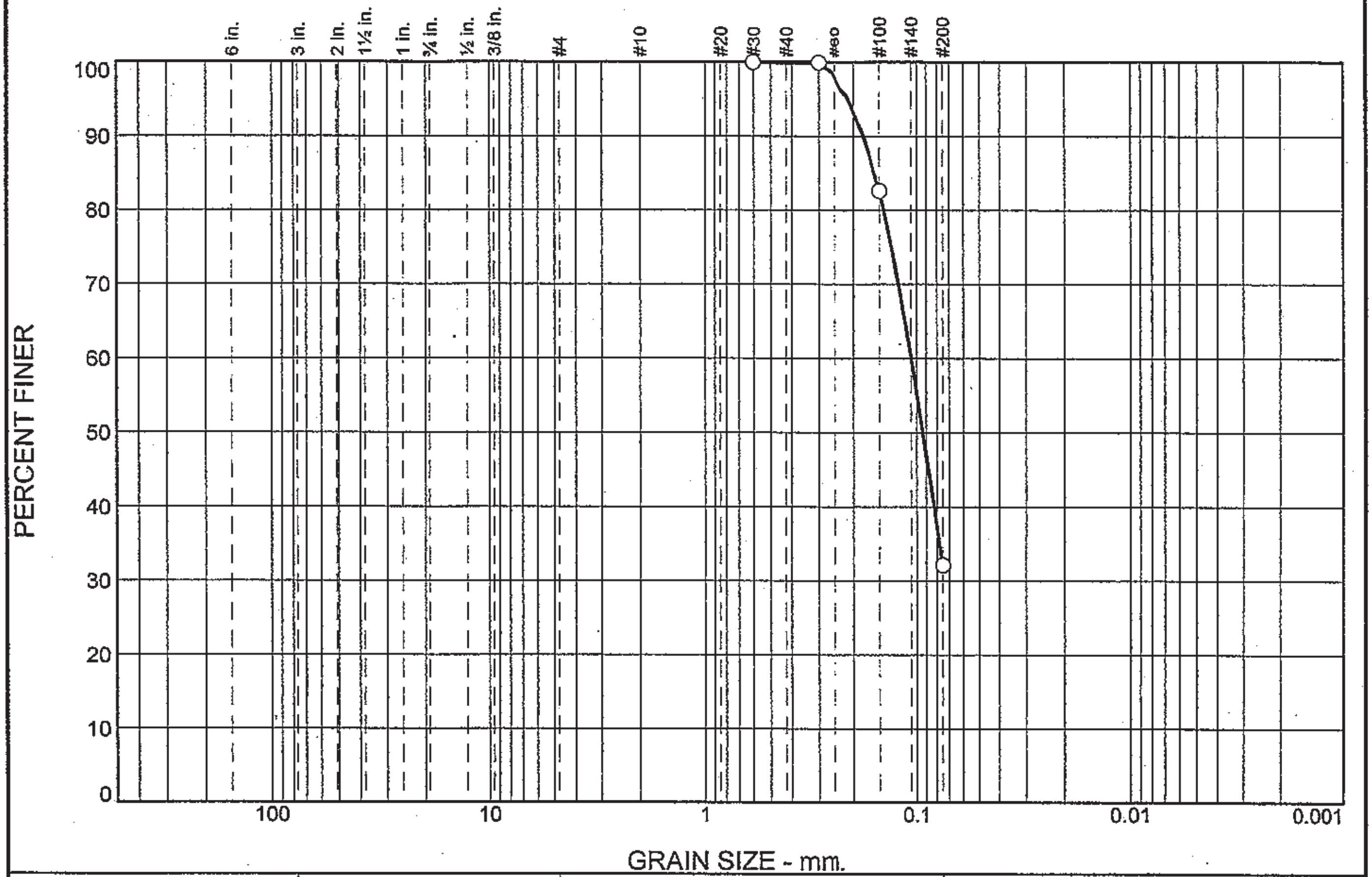
Sample No.: ST-3 **Source of Sample:** B-73 **Date Sampled:**
Location: **Elev./Depth:** 6
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-53

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
					67.8	32.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#50	99.9		
#100	82.7		
#200	32.1		

* (no specification provided)

Material Description

Silty SAND (SM) fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1574 D_{60}= 0.1056 D_{50}= 0.0930
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 12/05 **Tested By:** RTH

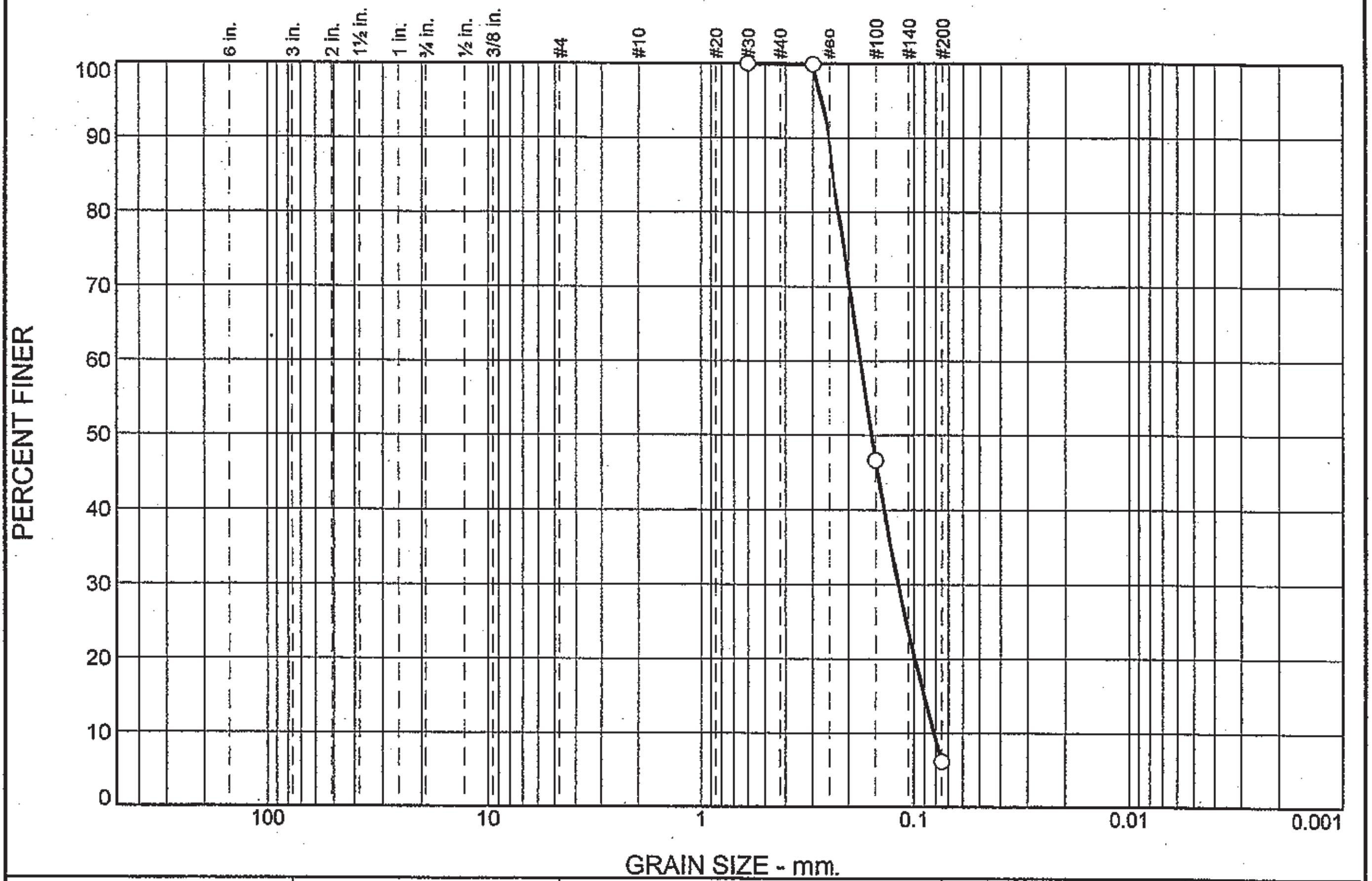
Remarks

Sample No.: **Source of Sample:** B-73 **Date Sampled:**
Location: **Elev./Depth:** 7
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-54

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	93.9	6.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#30	100.0		
#50	99.9		
#100	46.7		
#200	6.1		

* (no specification provided)

Material Description

SAND (SP-SM), fine grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2360 D_{60}= 0.1759 D_{50}= 0.1564
D_{30}= 0.1179 D_{15}= 0.0898 D_{10}= 0.0812
C_u= 2.17 C_c= 0.97

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

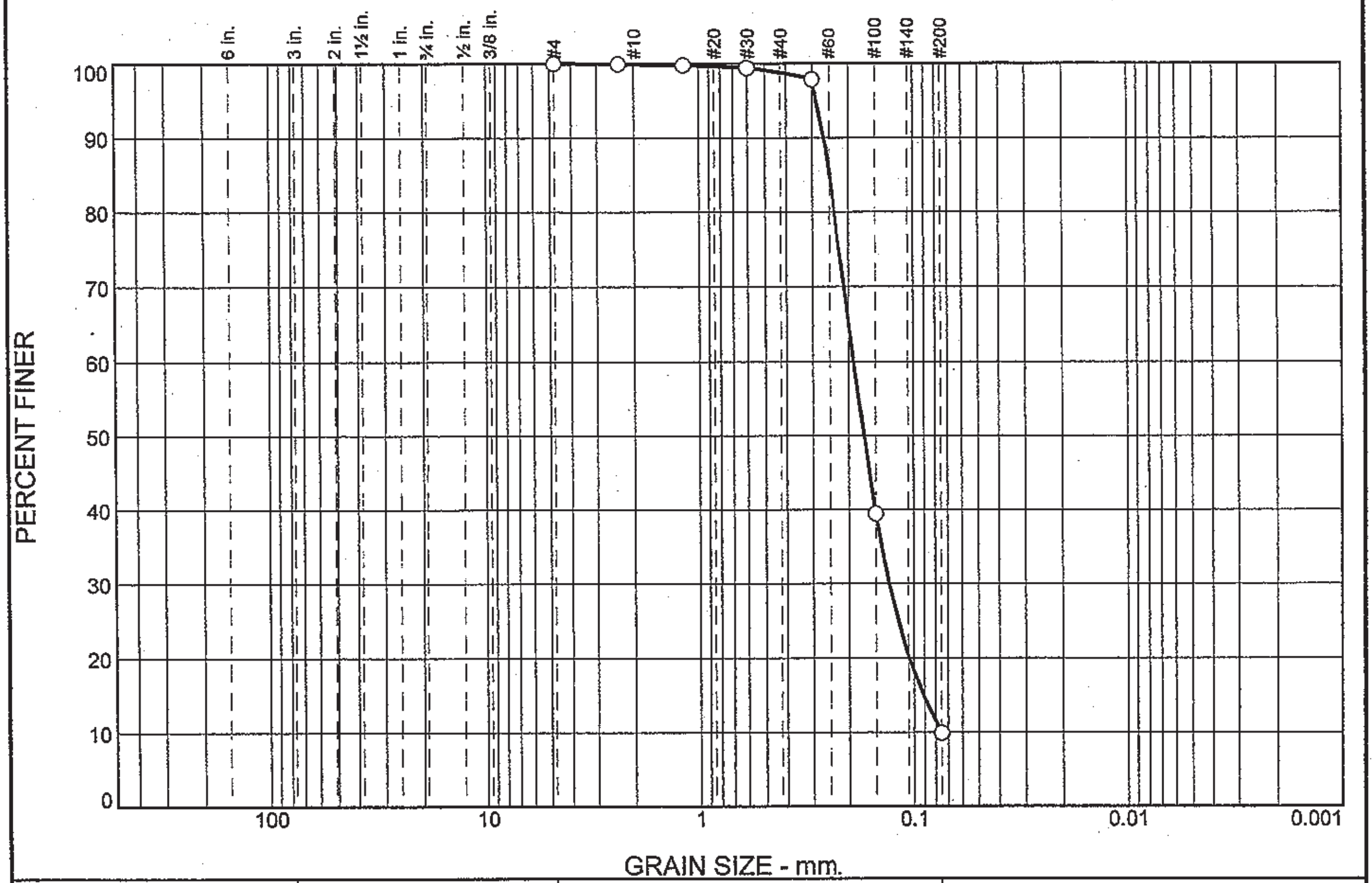
Sample No.: S-4 **Source of Sample:** B-73 **Date Sampled:**
Location: **Elev./Depth:** 8.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-55

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.1	88.9	9.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.8		
#30	99.4		
#50	97.9		
#100	39.5		
#200	9.9		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2476 D_{60}= 0.1890 D_{50}= 0.1700
D_{30}= 0.1303 D_{15}= 0.0907 D_{10}= 0.0753
C_u= 2.51 C_c= 1.19

Date Tested: 1/13/06 **Tested By:** J. Crose

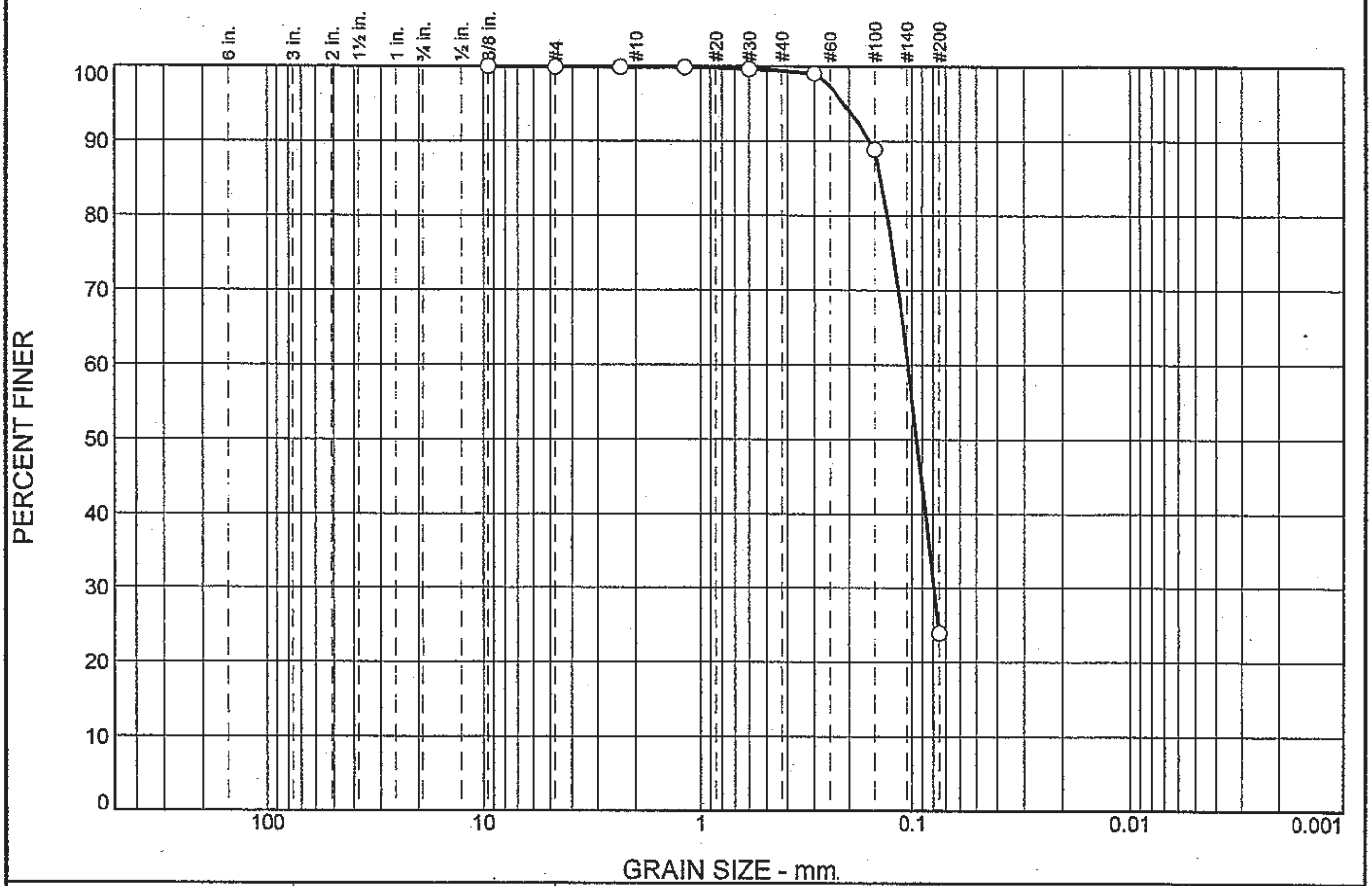
Remarks

Sample No.: S-5 **Source of Sample:** B-73 **Date Sampled:**
Location: **Elev./Depth:** 13.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-56

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.0	0.5	75.5	23.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#8	99.9		
#16	99.9		
#30	99.7		
#50	99.1		
#100	88.9		
#200	23.9		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1404 D_{60}= 0.1043 D_{50}= 0.0947

D_{30}= 0.0791 D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

Sample No.: S-6 **Source of Sample:** B-73 **Date Sampled:**

Location: **Elev./Depth:** 18.5

Checked By: K. Kocher **Title:** P.E.

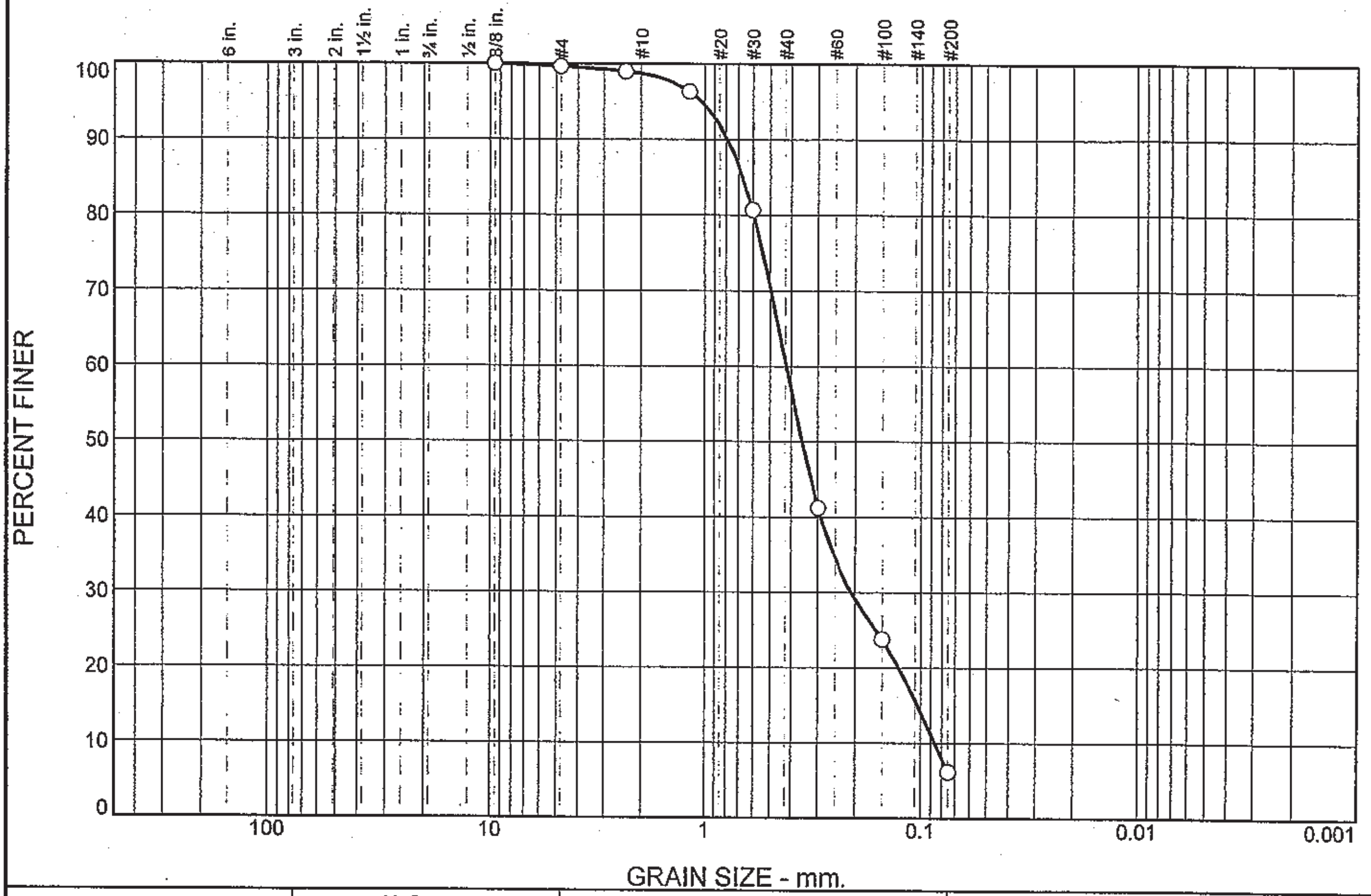
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-57

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	0.9	37.9	54.7	6.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.7		
#8	99.0		
#16	96.4		
#30	80.7		
#50	41.2		
#100	23.8		
#200	6.2		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.6650 D_{60}= 0.4187 D_{50}= 0.3551
D_{30}= 0.2091 D_{15}= 0.1031 D_{10}= 0.0859
C_u= 4.87 C_c= 1.21

Date Tested: 1/17/06 **Tested By:** J. Crose

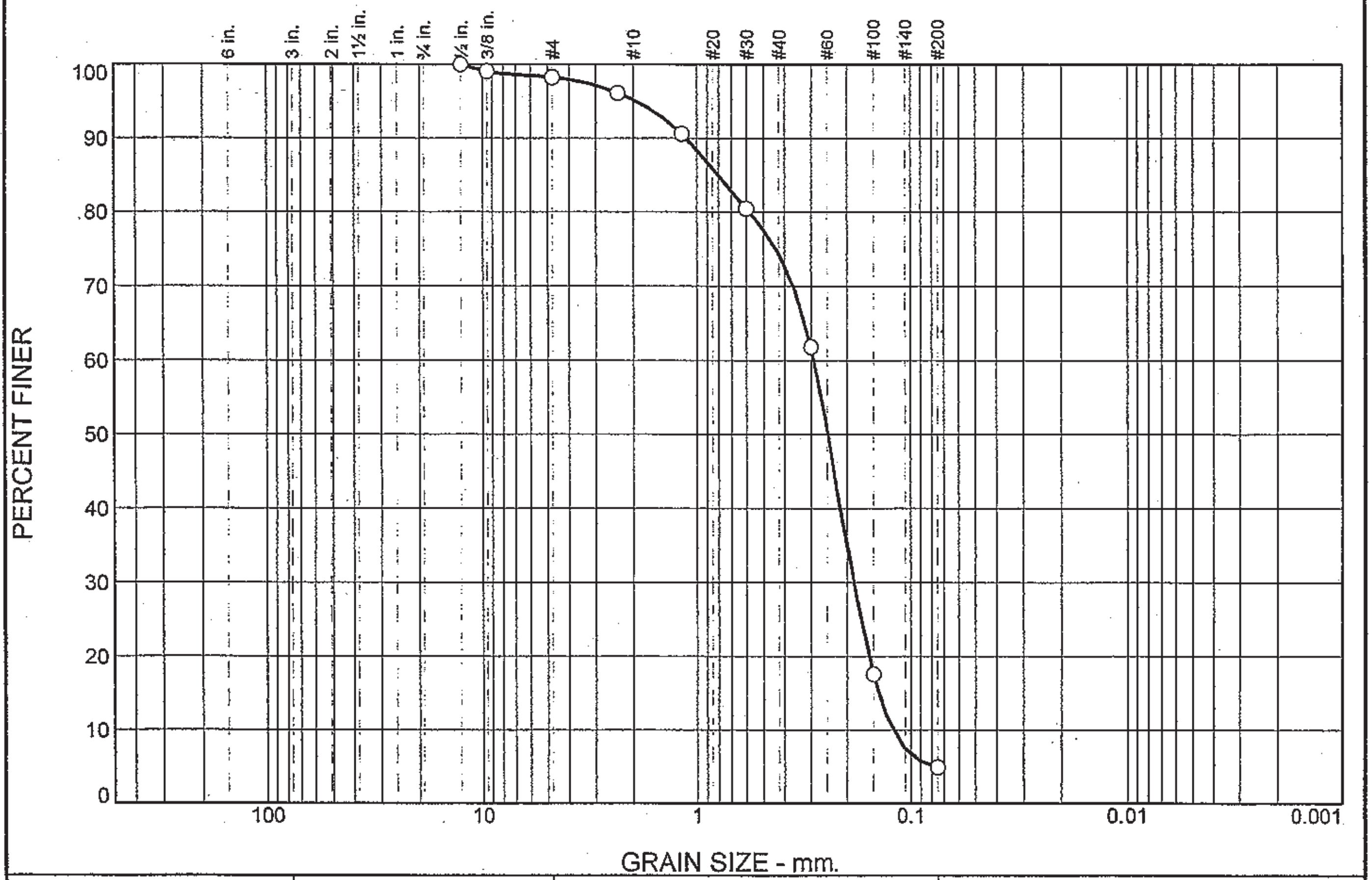
Remarks

Sample No.: S-7 **Source of Sample:** B-73 **Date Sampled:**
Location: **Elev./Depth:** 23.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-58

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	3.1	20.8	69.5	4.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
3/8	99.1		
#4	98.3		
#8	96.2		
#16	90.6		
#30	80.4		
#50	61.8		
#100	17.6		
#200	4.9		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.8013 D_{60}= 0.2902 D_{50}= 0.2473
D_{30}= 0.1855 D_{15}= 0.1415 D_{10}= 0.1211
C_u= 2.40 C_c= 0.98

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

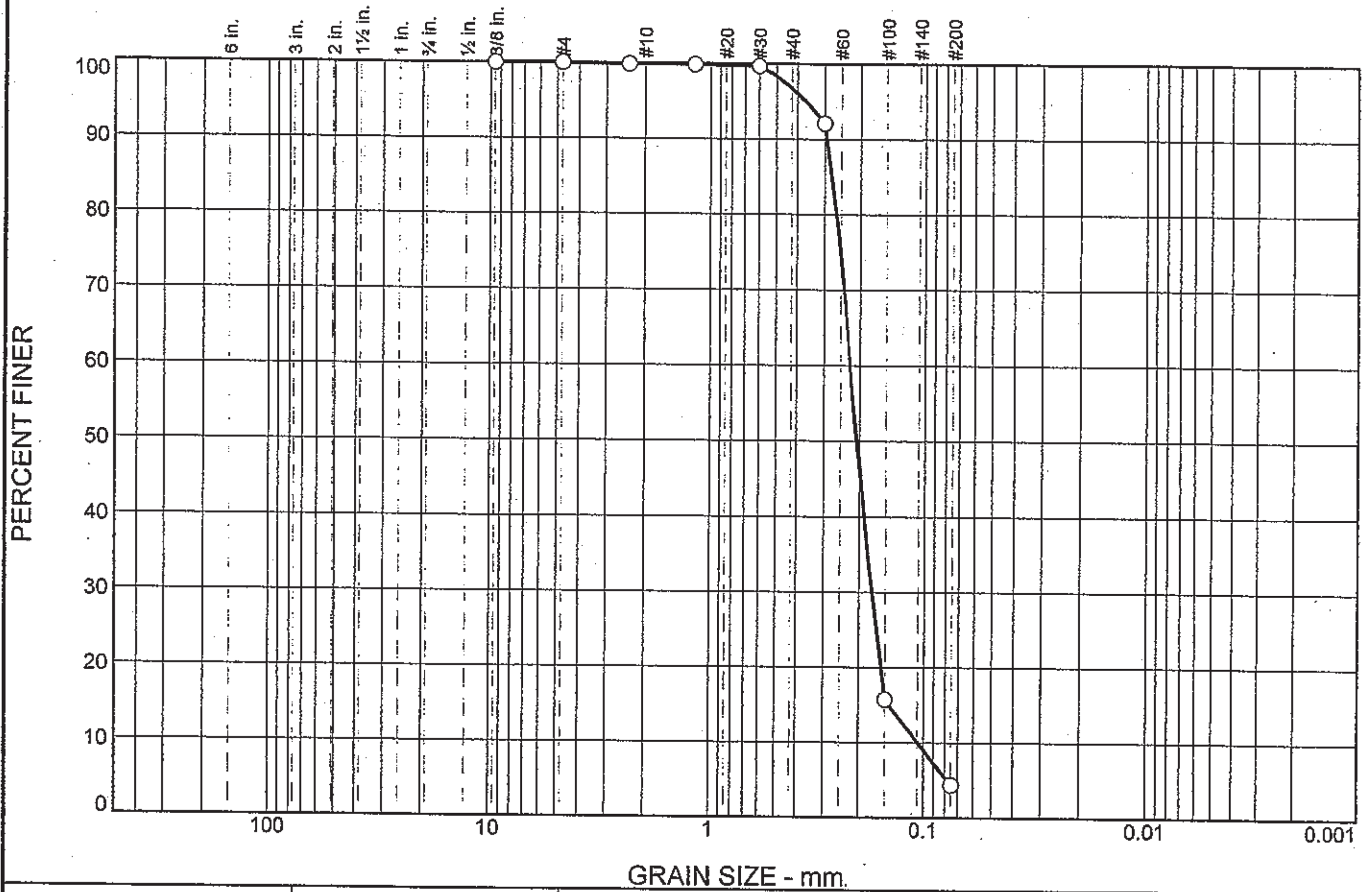
Sample No.: S-8 **Source of Sample:** B-73 **Date Sampled:**
Location: **Elev./Depth:** 28.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-59

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	3.0	92.6	4.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	100.0		
#8	99.9		
#16	99.9		
#30	99.7		
#50	92.1		
#100	15.7		
#200	4.3		

* (no specification provided)

Material Description

SAND (SP), fine grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.2759 D_{60}= 0.2215 D_{50}= 0.2047
D_{30}= 0.1736 D_{15}= 0.1435 D_{10}= 0.1059
C_u= 2.09 C_c= 1.28

Date Tested: 1/17/06 **Tested By:** J. Crose

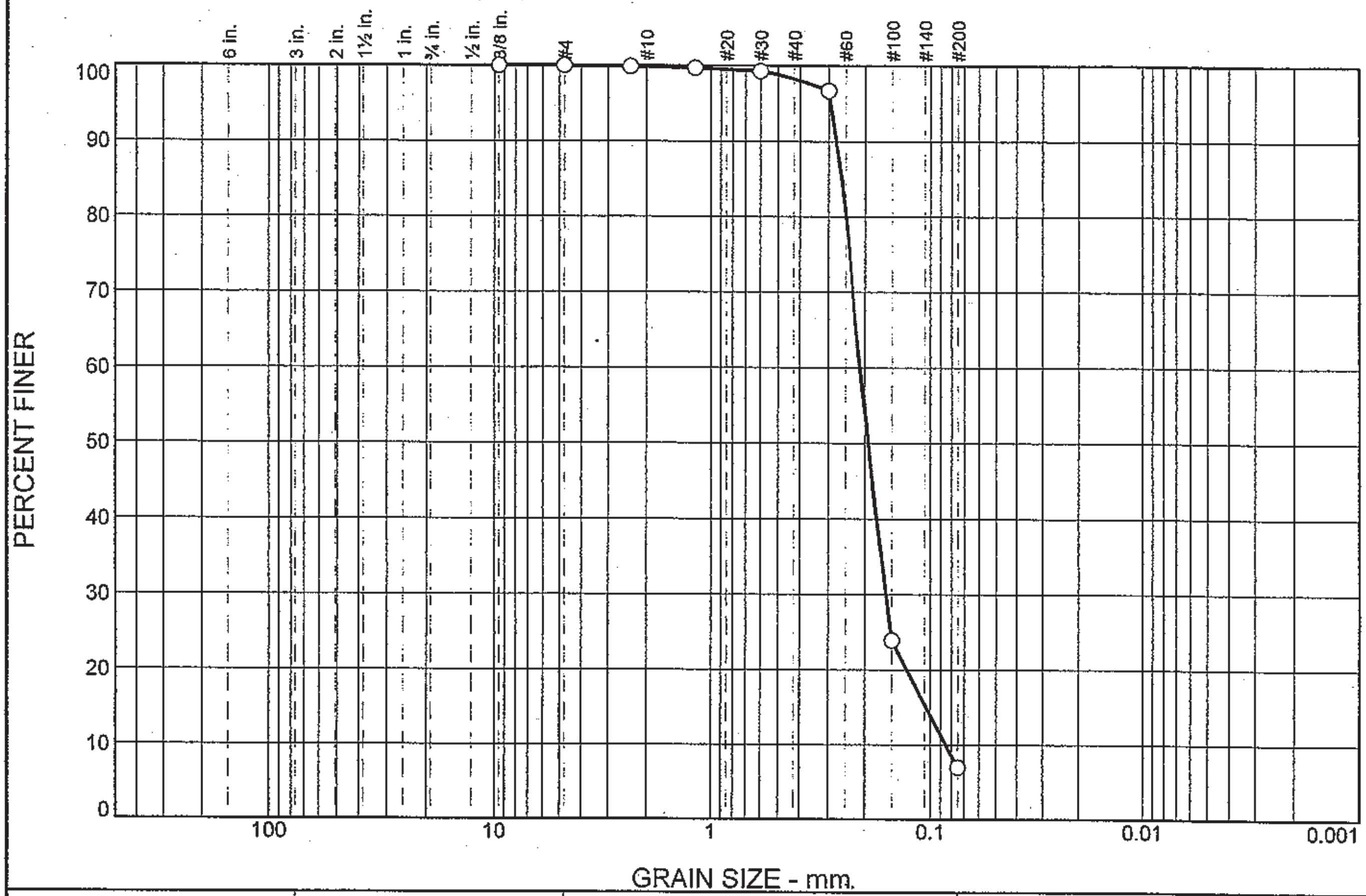
Remarks

Sample No.: S-5 **Source of Sample:** B-74 **Date Sampled:**
Location: **Elev./Depth:** 13.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-60

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.6	91.3	7.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	100.0		
#8	99.9		
#16	99.7		
#30	99.3		
#50	96.7		
#100	23.9		
#200	7.0		

* (no specification provided)

Material Description

Sand (SP-SM), fine grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2604 D_{60}= 0.2089 D_{50}= 0.1923
D_{30}= 0.1605 D_{15}= 0.1042 D_{10}= 0.0849
C_u= 2.46 C_c= 1.45

Date Tested: 1/17/06 **Tested By:** J. Crose

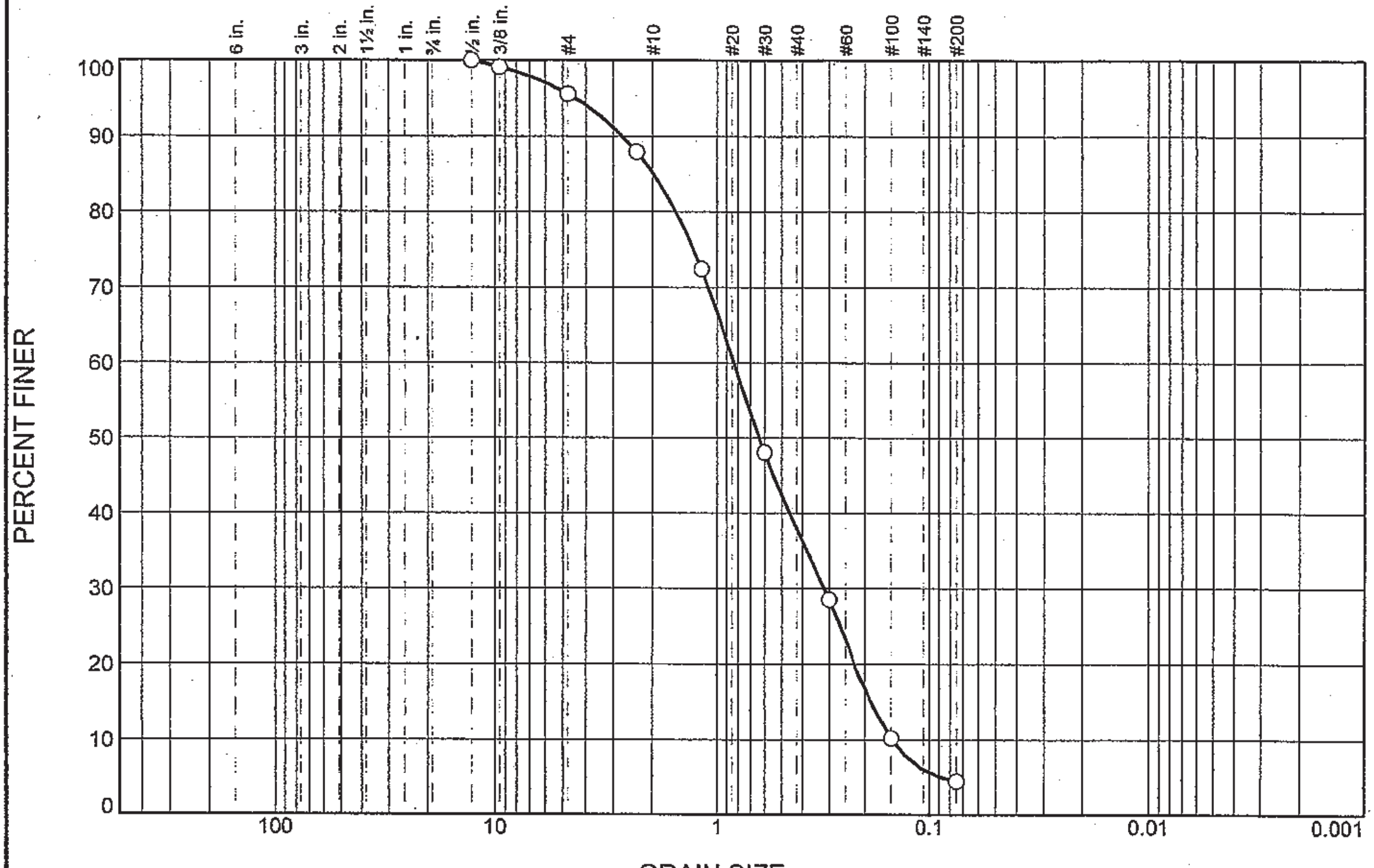
Remarks

Sample No.: S-6 **Source of Sample:** B-74 **Date Sampled:**
Location: **Elev./Depth:** 18.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-61

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.4	10.4	47.3	33.4	4.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
3/8	99.1		
#4	95.6		
#8	87.9		
#16	72.4		
#30	48.1		
#50	28.5		
#100	10.2		
#200	4.5		

* (no specification provided)

Material Description

SAND (SP), coarse-, medium-, and fine grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.9779 D_{60}= 0.8323 D_{50}= 0.6342
D_{30}= 0.3162 D_{15}= 0.1863 D_{10}= 0.1484
C_u= 5.61 C_c= 0.81

Date Tested: 1/17/06 **Tested By:** J. Crose

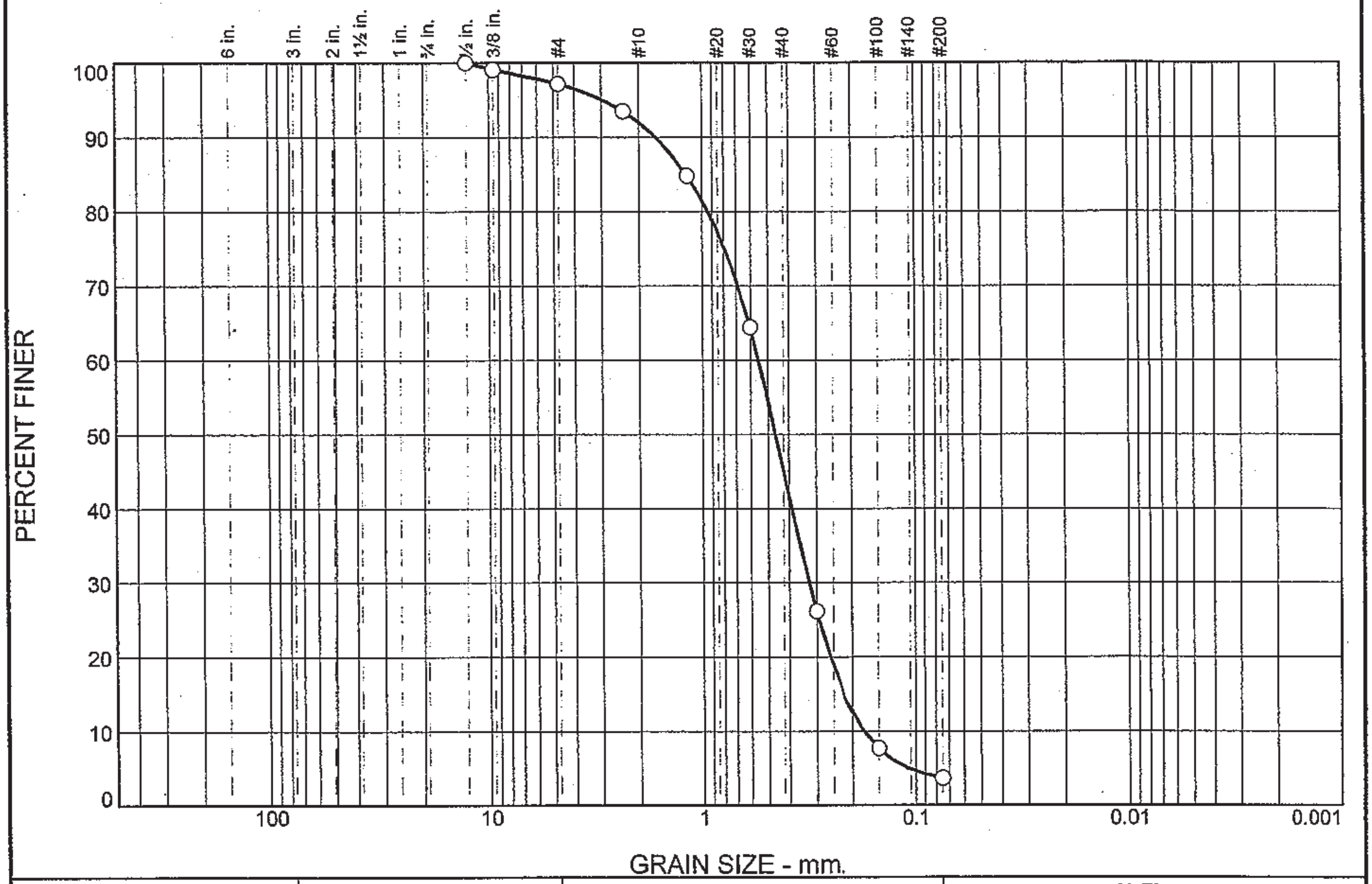
Remarks

Sample No.: S-7 **Source of Sample:** B-74 **Date Sampled:**
Location: **Elev./Depth:** 23.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-62

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.9	5.1	46.7	41.6	3.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
3/8	99.1		
#4	97.1		
#8	93.5		
#16	84.8		
#30	64.4		
#50	26.1		
#100	7.7		
#200	3.7		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.1901 D_{60}= 0.5497 D_{50}= 0.4605
D_{30}= 0.3246 D_{15}= 0.2209 D_{10}= 0.1758
C_u= 3.13 C_c= 1.09

Date Tested: 1/17/06 **Tested By:** J. Crose

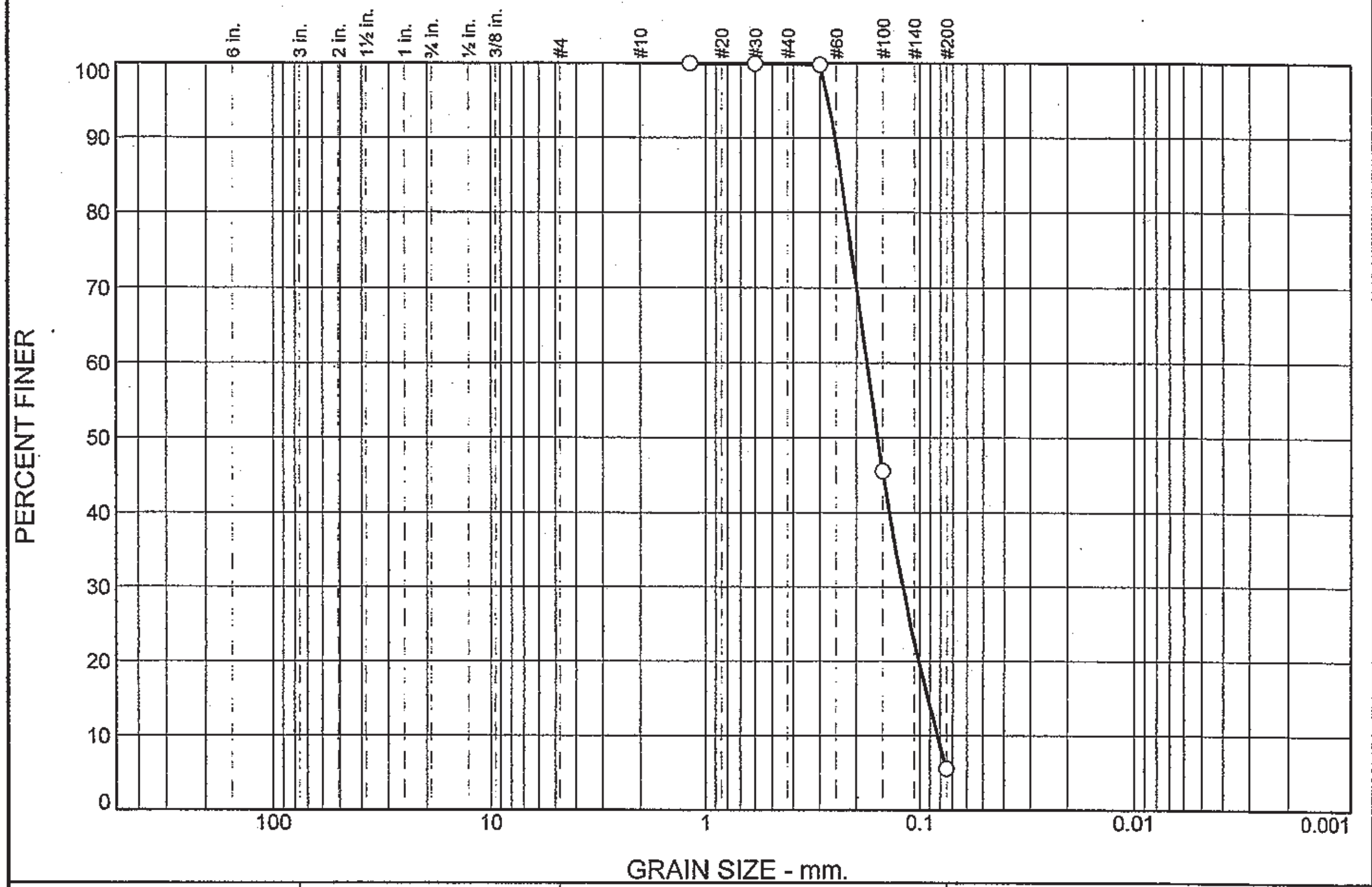
Remarks

Sample No.: S-8 **Source of Sample:** B-74 **Date Sampled:**
Location: **Elev./Depth:** 28.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-63

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
					94.4	5.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#30	100.0		
#50	99.8		
#100	45.5		
#200	5.5		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2364 D_{60}= 0.1775 D_{50}= 0.1584
D_{30}= 0.1203 D_{15}= 0.0915 D_{10}= 0.0825
C_u= 2.15 C_c= 0.99

Date Tested: 12/05 **Tested By:** RTH

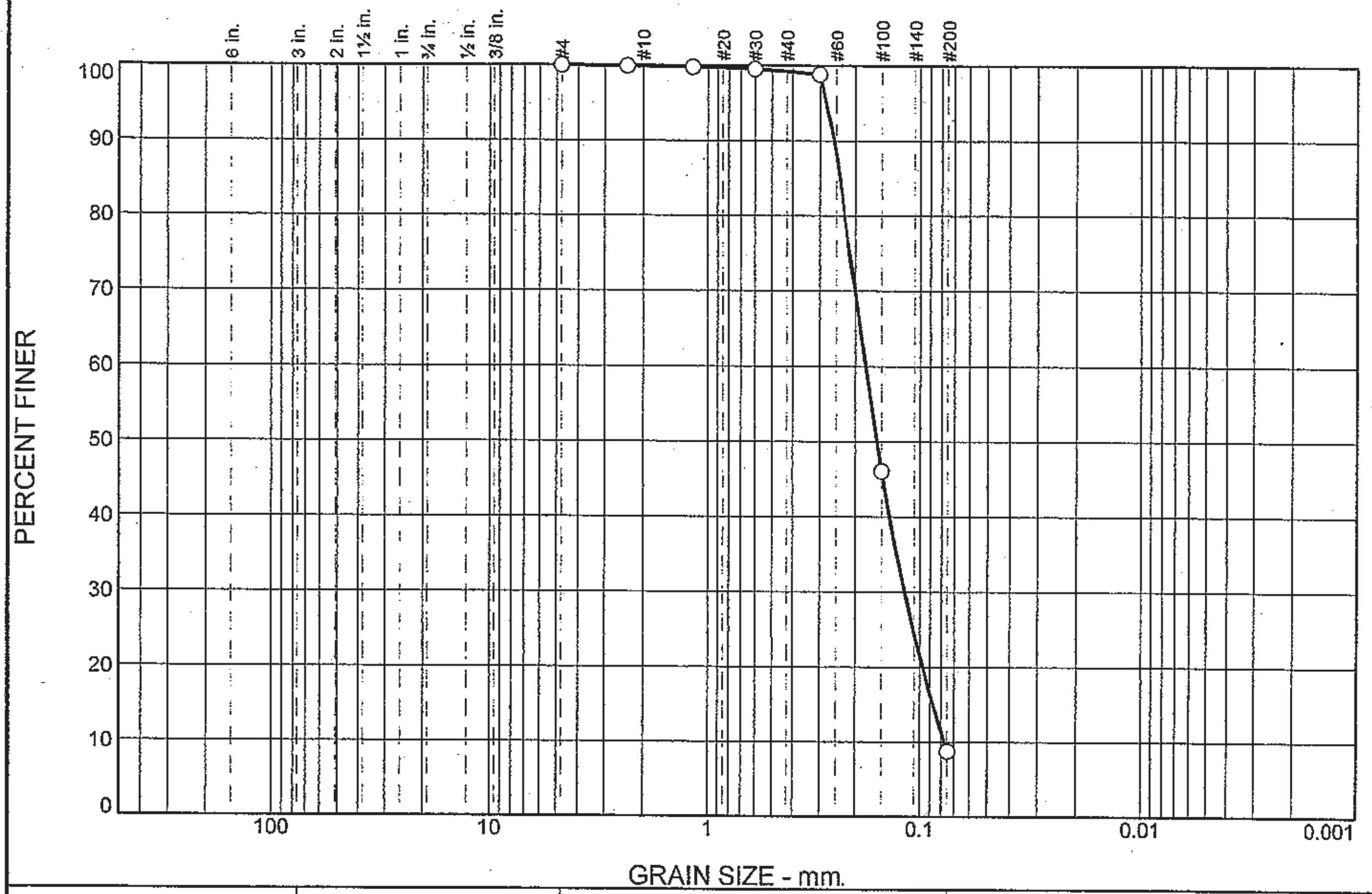
Remarks

Sample No.: ST-3 **Source of Sample:** B-75 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-64

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.6	90.5	8.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.8		
#30	99.5		
#50	98.9		
#100	46.0		
#200	8.8		

* (no specification provided)

Material Description

SAND (SP- SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= Sp-SM AASHTO=

Coefficients

D_{85}= 0.2385 D_{60}= 0.1775 D_{50}= 0.1577

D_{30}= 0.1176 D_{15}= 0.0867 D_{10}= 0.0772

C_u= 2.30 C_c= 1.01

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

Sample No.: S-5 **Source of Sample:** B-75 **Date Sampled:**

Location: **Elev./Depth:** 12.5

Checked By: K. Kocher **Title:** P.E.

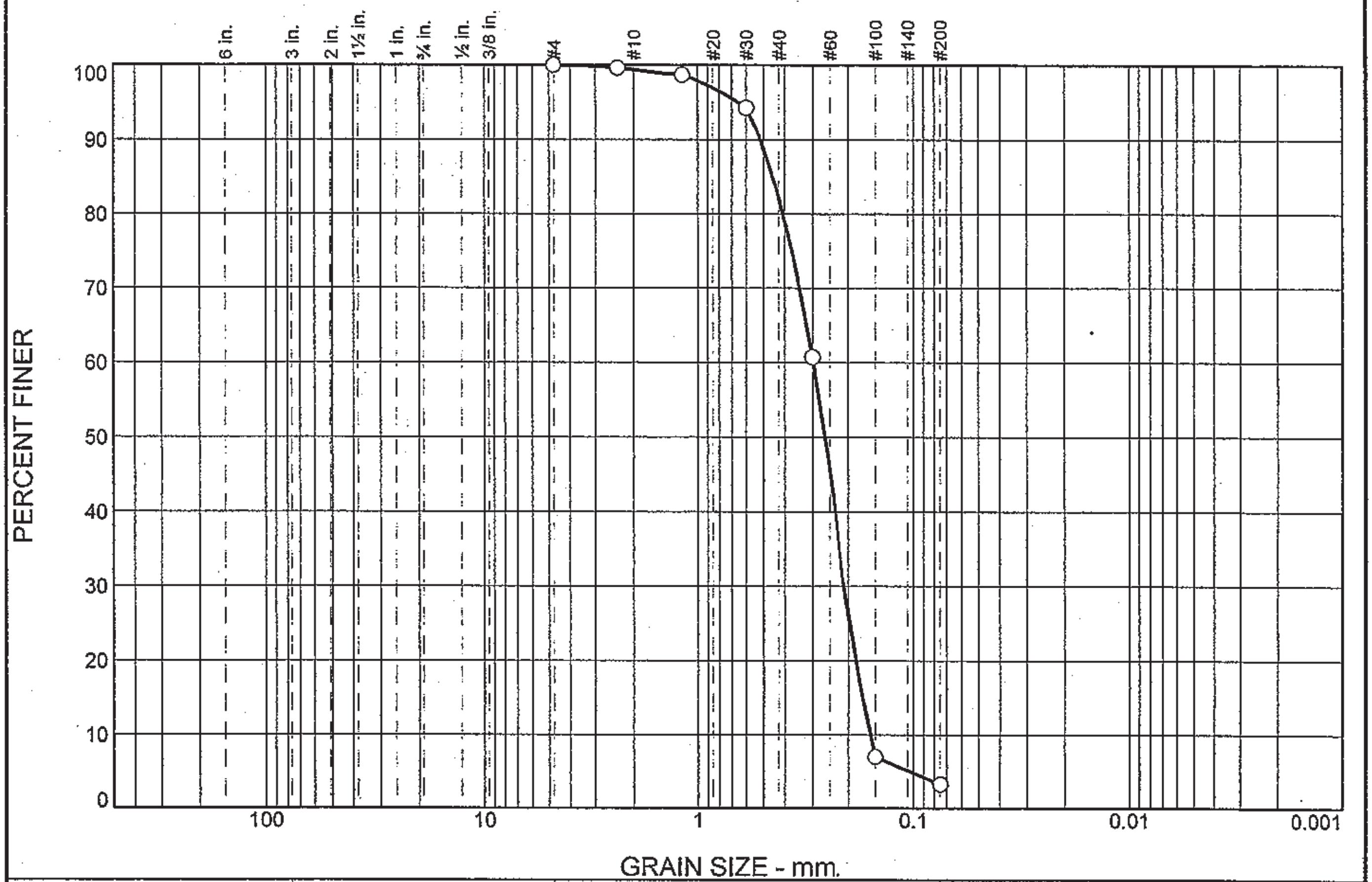
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-65

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.6	17.0	79.1	3.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.6		
#16	98.7		
#30	94.3		
#50	60.7		
#100	7.0		
#200	3.3		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.4499 D_{60}= 0.2973 D_{50}= 0.2633
D_{30}= 0.2091 D_{15}= 0.1722 D_{10}= 0.1589
C_u= 1.87 C_c= 0.93

Date Tested: 1/16/06 **Tested By:** J. Crose

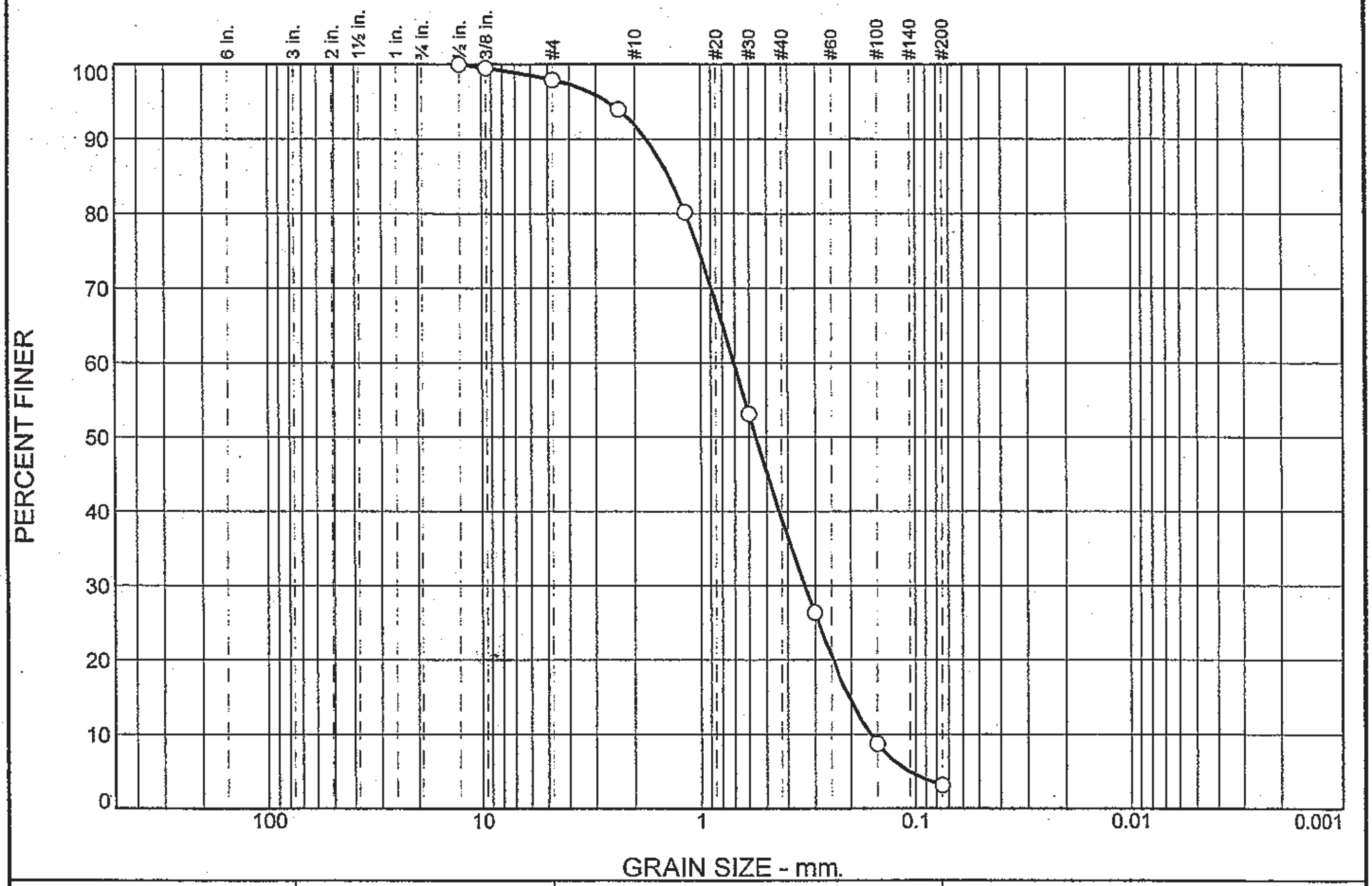
Remarks

Sample No.: S-7 **Source of Sample:** B-75 **Date Sampled:**
Location: **Elev./Depth:** 22.5
Checked By: K.Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-66

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.1	6.0	52.9	35.9	3.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
3/8	99.5		
#4	97.9		
#8	94.0		
#16	80.2		
#30	53.1		
#50	26.4		
#100	8.7		
#200	3.1		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.3955 D_{60}= 0.7033 D_{50}= 0.5572
D_{30}= 0.3335 D_{15}= 0.2039 D_{10}= 0.1618
C_u= 4.35 C_c= 0.98

Date Tested: 1/16/06 **Tested By:** J. Crose

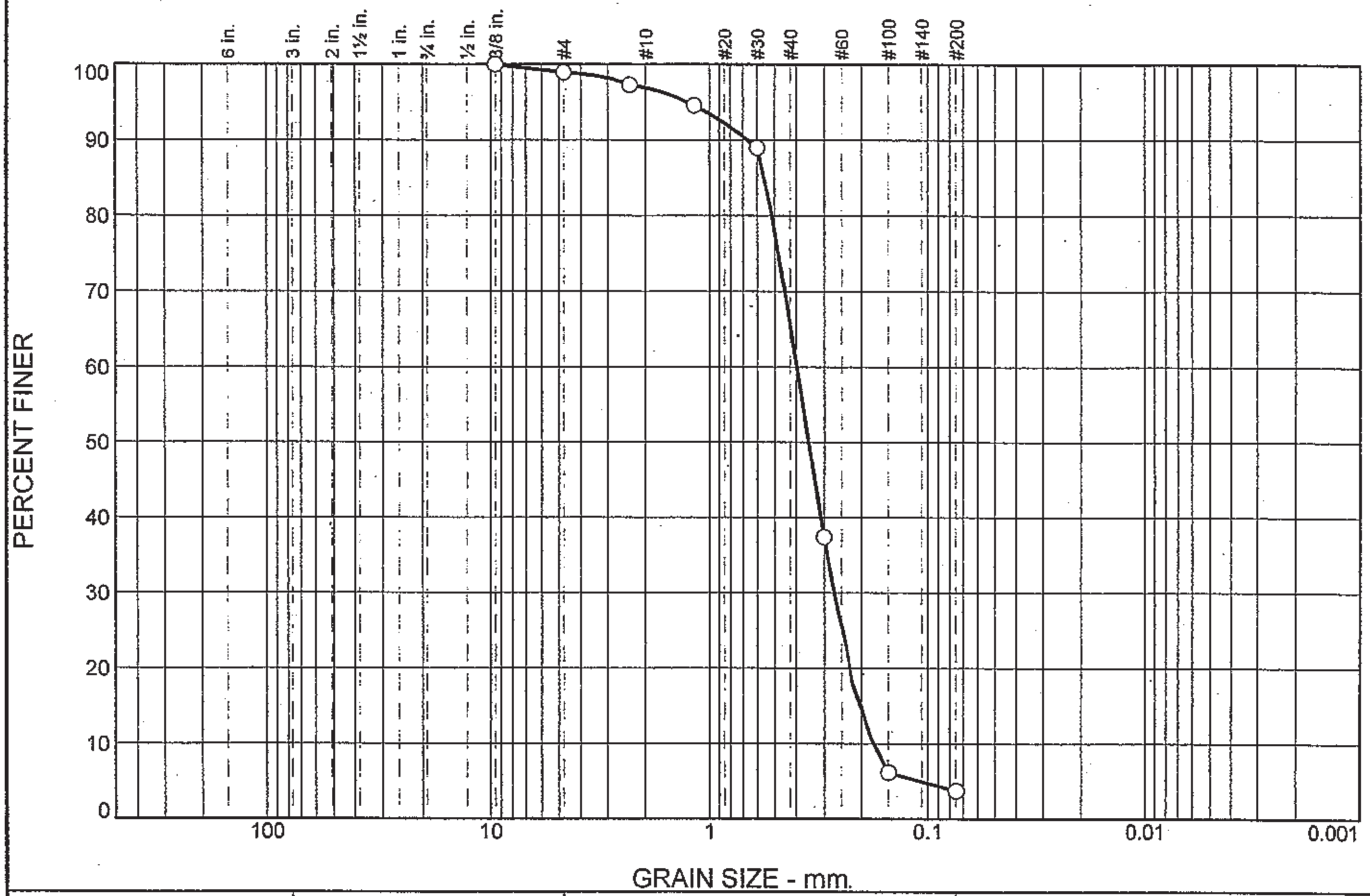
Remarks

Sample No.: S-8 **Source of Sample:** B-75 **Date Sampled:**
Location: **Elev./Depth:** 27.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-67

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.0	2.1	31.0	62.2	3.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.0		
#8	97.3		
#16	94.6		
#30	89.0		
#50	37.4		
#100	6.2		
#200	3.7		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.5545 D_{60}= 0.3958 D_{50}= 0.3516
D_{30}= 0.2695 D_{15}= 0.2023 D_{10}= 0.1755
C_u= 2.25 C_c= 1.05

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

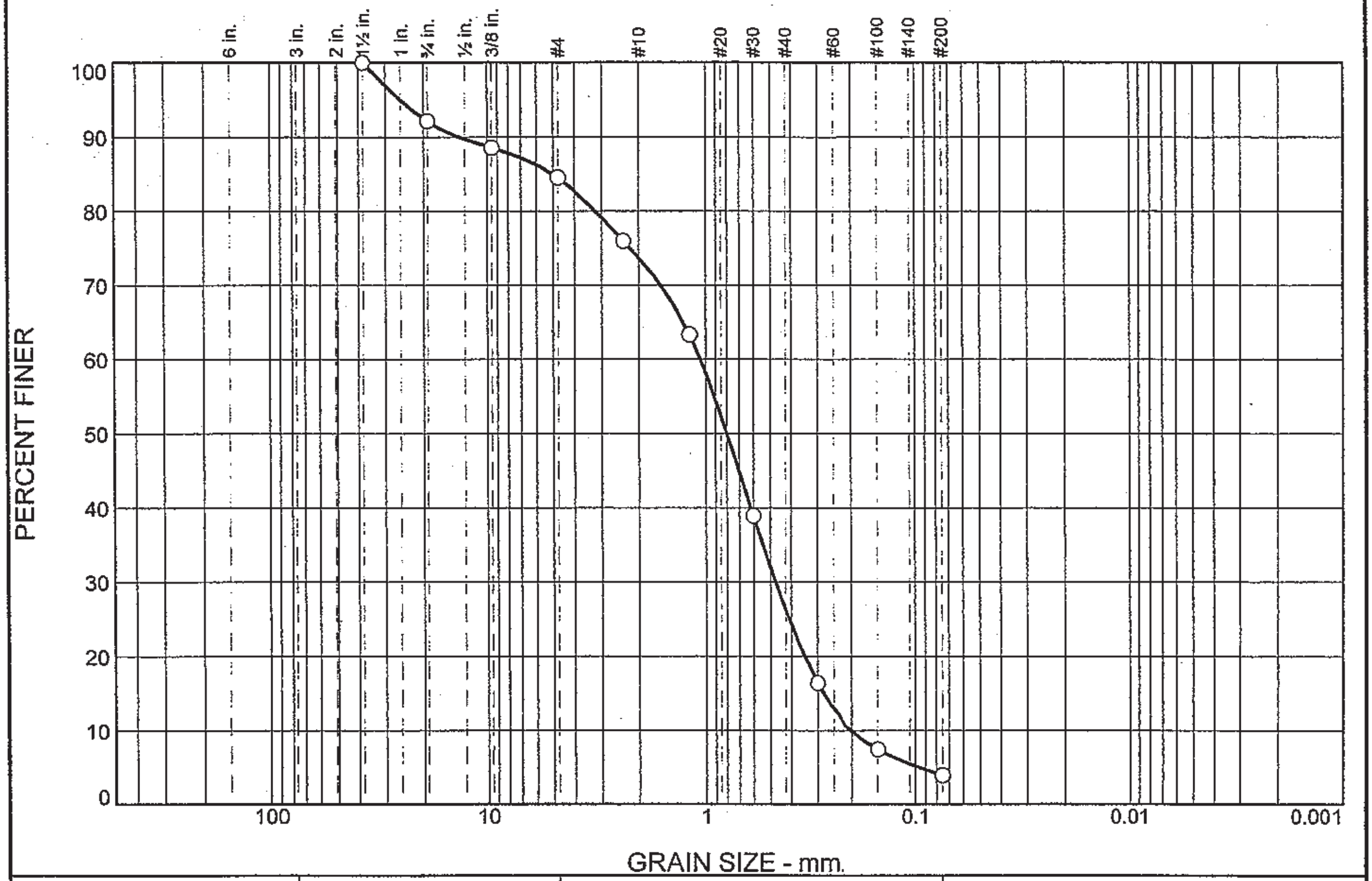
Sample No.: S-9 **Source of Sample:** B-75 **Date Sampled:**
Location: **Elev./Depth:** 32.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-68

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.8	7.7	10.8	47.4	22.4	3.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
3/4	92.2		
3/8	88.6		
#4	84.5		
#8	76.0		
#16	63.3		
#30	38.9		
#50	16.4		
#100	7.4		
#200	3.9		

* (no specification provided)

Material Description

SAND (SW), well graded, with traces of fine and coarse gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW AASHTO=

Coefficients

D_{85}= 5.0173 D_{60}= 1.0564 D_{50}= 0.7970
D_{30}= 0.4725 D_{15}= 0.2806 D_{10}= 0.2020
C_u= 5.23 C_c= 1.05

Date Tested: 1/16/06 **Tested By:** J. Crose

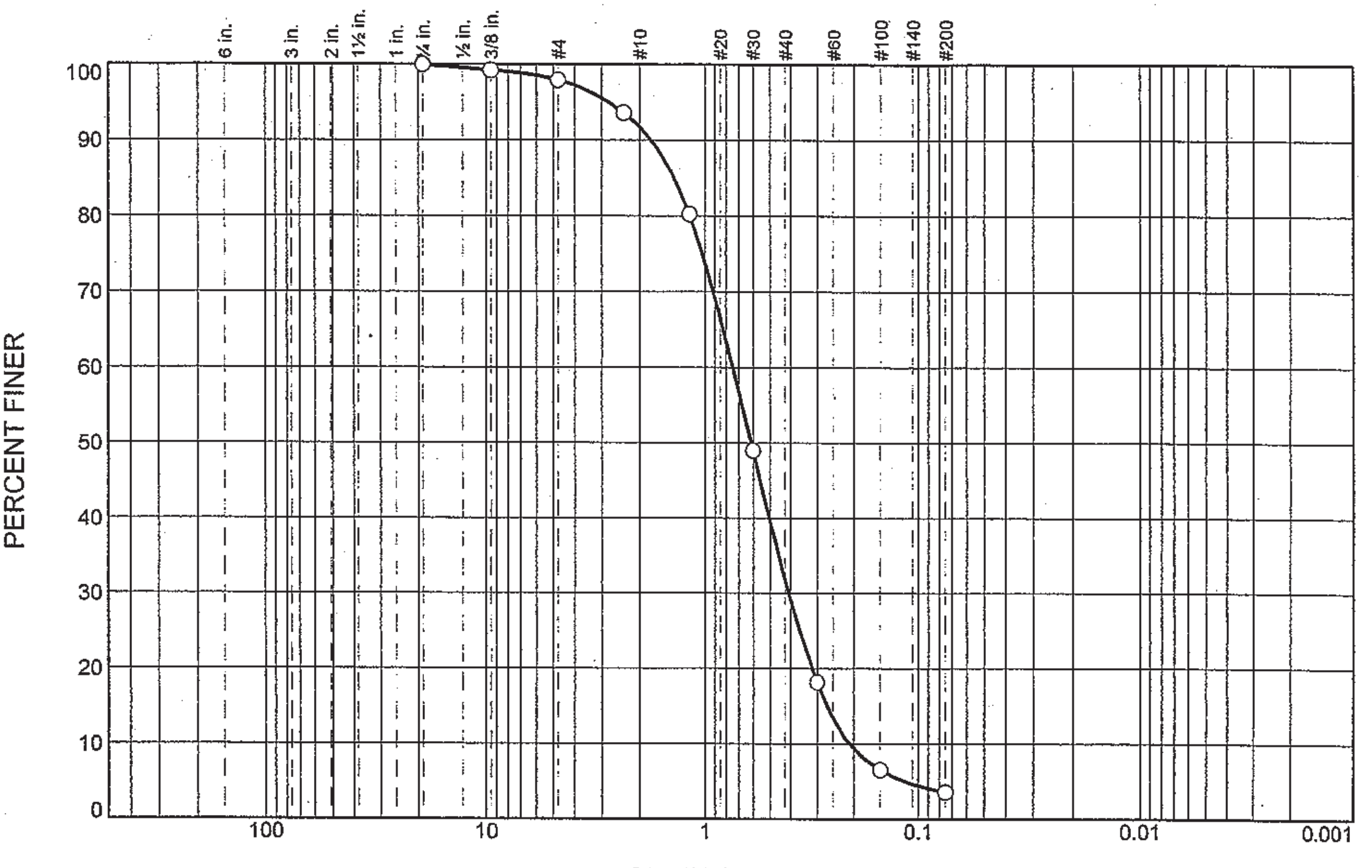
Remarks

Sample No.: S-10 **Source of Sample:** B-75 **Date Sampled:**
Location: **Elev./Depth:** 37.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-69

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.1	6.1	59.9	28.3	3.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.2		
#4	97.9		
#8	93.6		
#16	80.3		
#30	49.0		
#50	18.2		
#100	6.5		
#200	3.6		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.3854 D_{60}= 0.7429 D_{50}= 0.6118
D_{30}= 0.4079 D_{15}= 0.2682 D_{10}= 0.2083
C_u= 3.57 C_c= 1.08

Date Tested: 1/16/06 **Tested By:** J. Crose

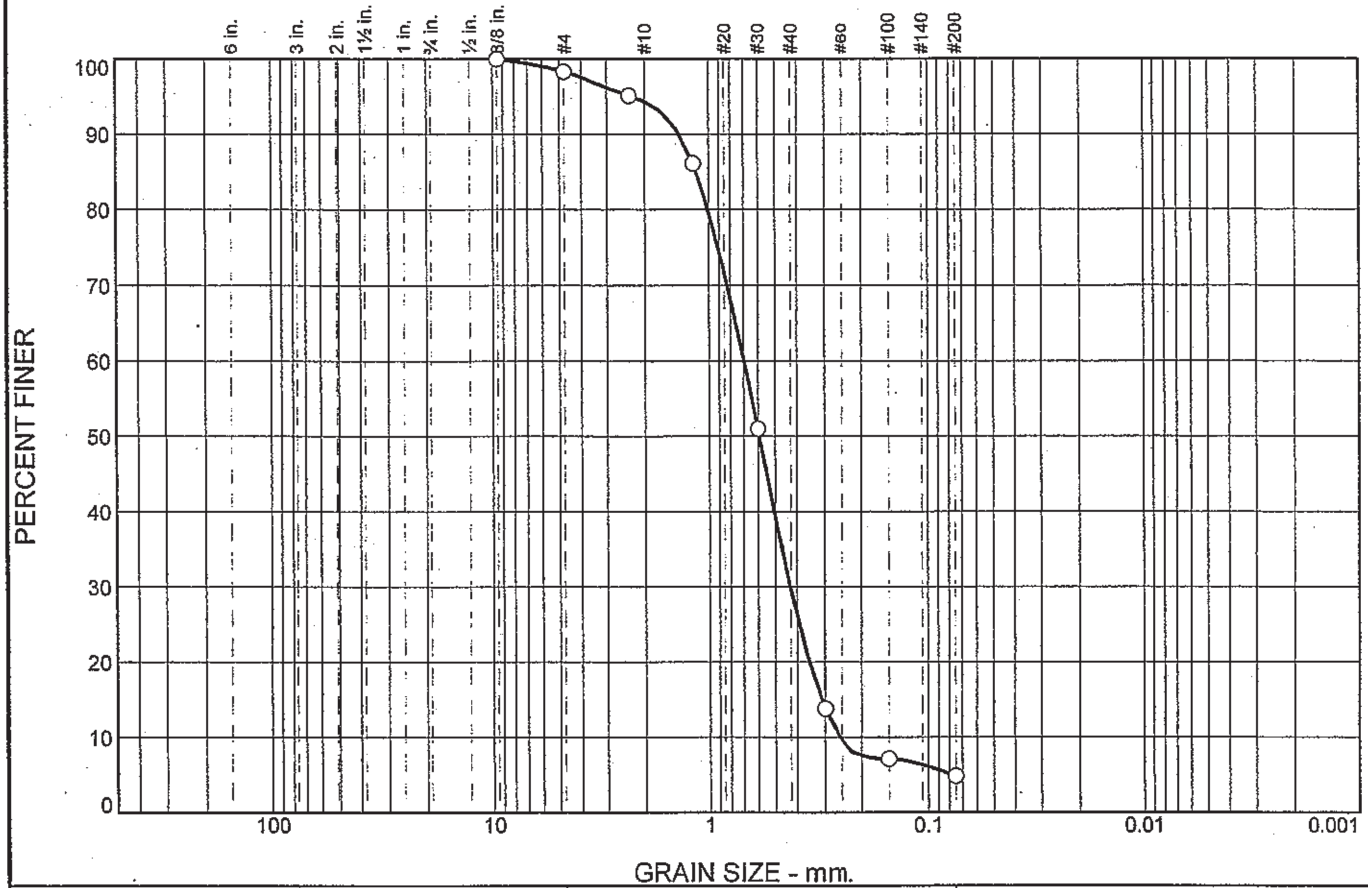
Remarks

Sample No.: S-11 **Source of Sample:** B-75 **Date Sampled:**
Location: **Elev./Depth:** 42.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-70

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	3.9	64.7	24.9	4.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	98.3		
#8	95.1		
#16	86.1		
#30	51.0		
#50	13.8		
#100	7.1		
#200	4.8		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.1417 D_{60}= 0.6931 D_{50}= 0.5905
D_{30}= 0.4270 D_{15}= 0.3112 D_{10}= 0.2568
C_u= 2.70 C_c= 1.02

Date Tested: 1/16/06 **Tested By:** J. Crose

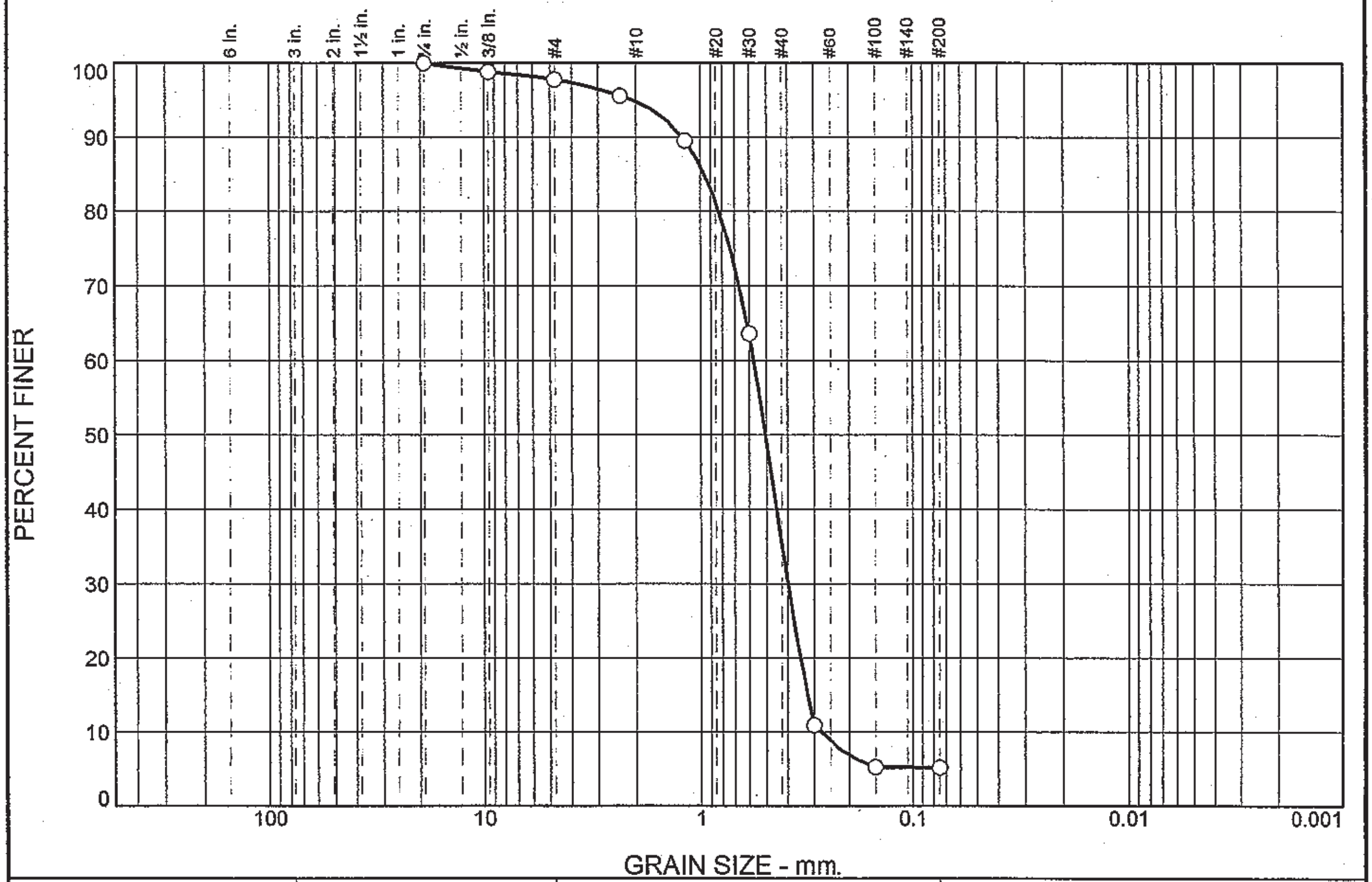
Remarks

Sample No.: S-12 **Source of Sample:** B-75 **Date Sampled:**
Location: **Elev./Depth:** 47.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-71

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.2	3.0	59.3	30.3	5.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	98.8		
#4	97.8		
#8	95.6		
#16	89.5		
#30	63.6		
#50	10.9		
#100	5.2		
#200	5.2		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.9556 D_{60}= 0.5707 D_{50}= 0.5036
D_{30}= 0.3980 D_{15}= 0.3238 D_{10}= 0.2784
C_u= 2.05 C_c= 1.00

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

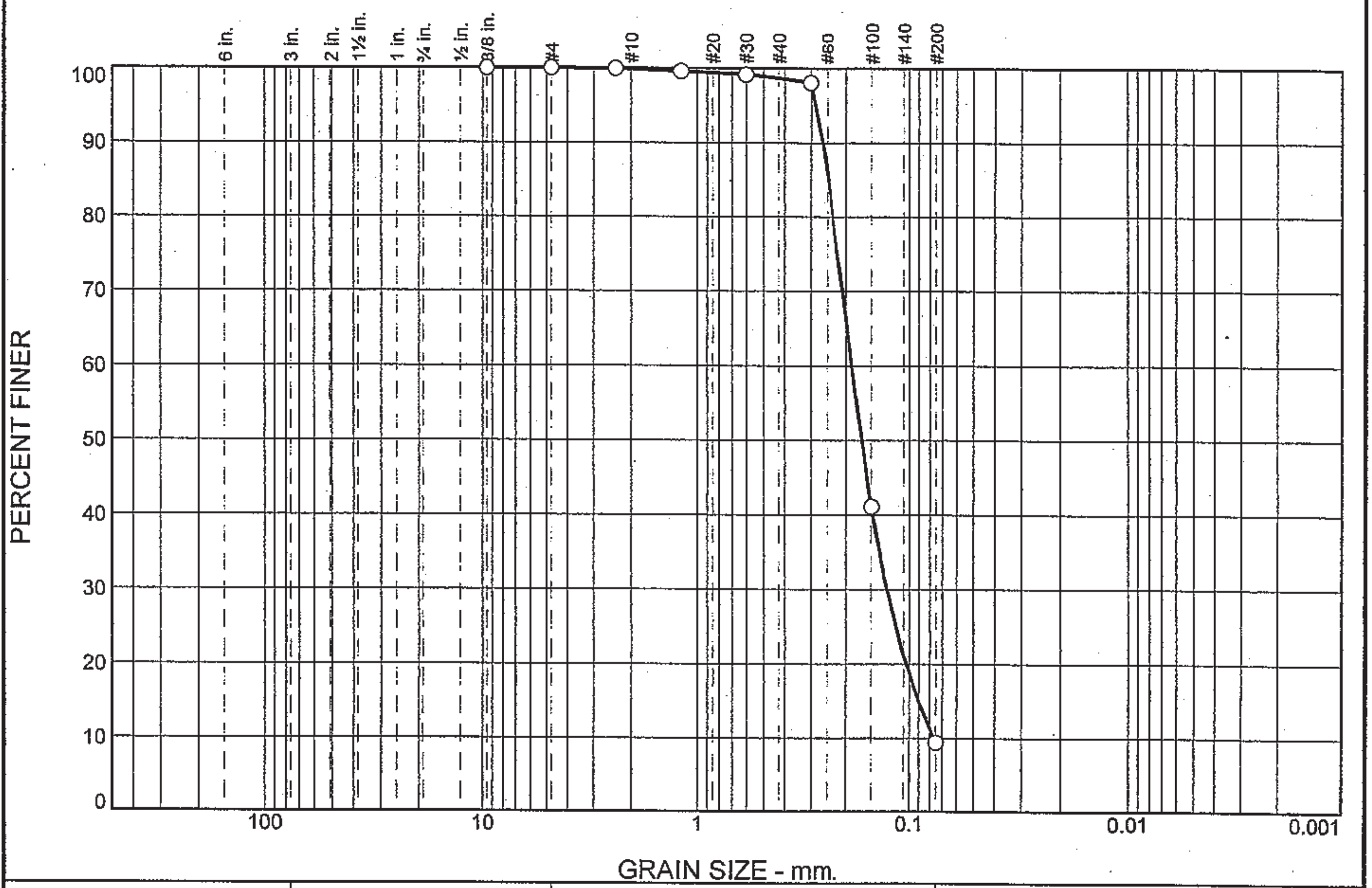
Sample No.: S-14 **Source of Sample:** B-75 **Date Sampled:**
Location: **Elev./Depth:** 67.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-72

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.2	89.3	9.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	100.0		
#8	100.0		
#16	99.6		
#30	99.1		
#50	98.1		
#100	41.1		
#200	9.4		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2454 D_{60}= 0.1862 D_{50}= 0.1670
D_{30}= 0.1270 D_{15}= 0.0898 D_{10}= 0.0765
C_u= 2.43 C_c= 1.13

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

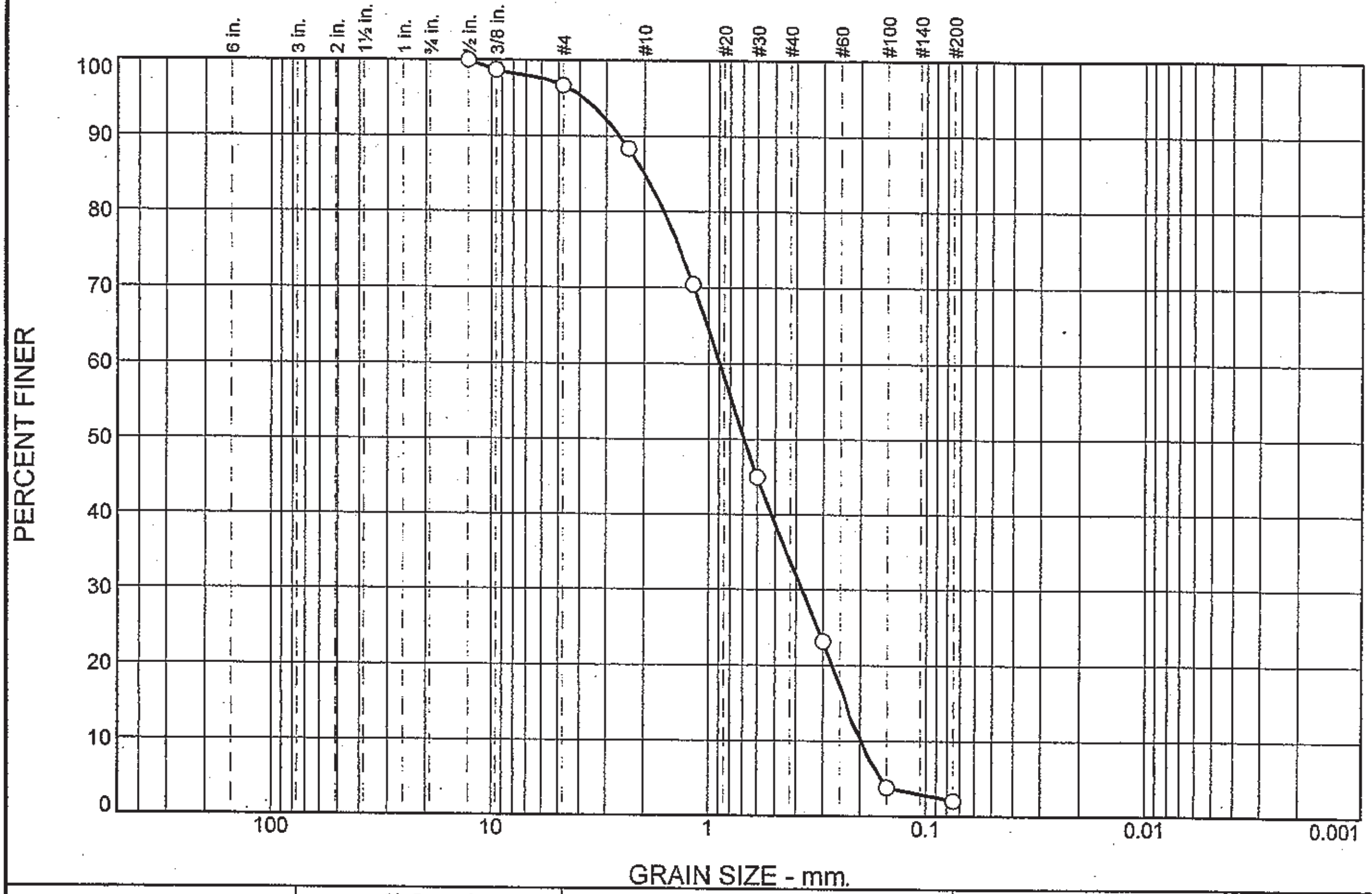
Sample No.: S-6 **Source of Sample:** B-76 **Date Sampled:**
Location: **Elev./Depth:** 18.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-73

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.3	11.7	51.2	31.8	2.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
3/8	98.7		
#4	96.7		
#8	88.3		
#16	70.4		
#30	45.0		
#50	23.2		
#100	3.8		
#200	2.0		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, traces of coarse-grain

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS= SP **AASHTO=**

Coefficients

D_{85}= 1.9992 D_{60}= 0.8900 D_{50}= 0.6878
D_{30}= 0.3744 D_{15}= 0.2327 D_{10}= 0.1972
C_u= 4.51 C_c= 0.80

Date Tested: 1/17/06 **Tested By:** J. Crose

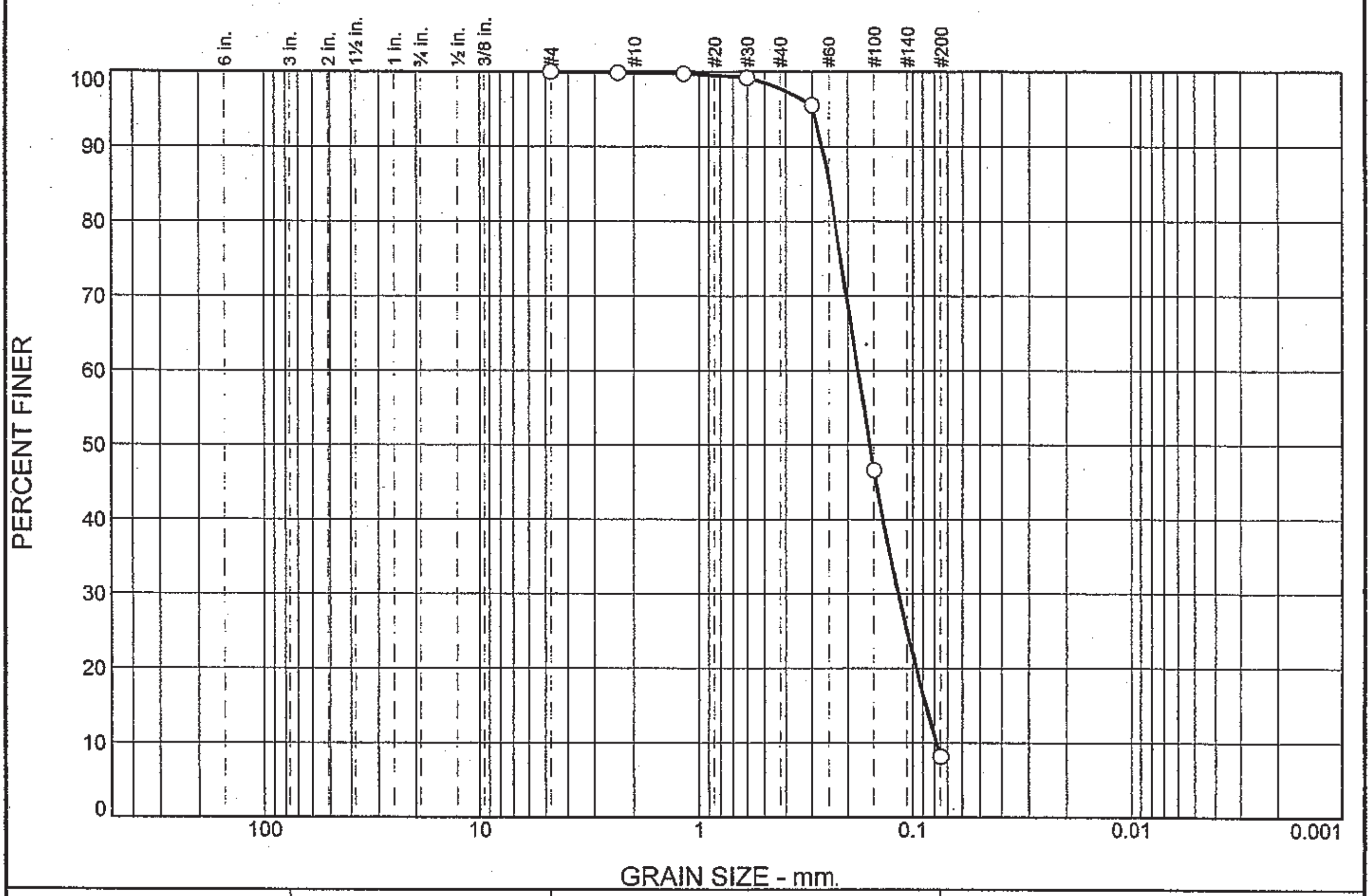
Remarks

Sample No.: S-8 **Source of Sample:** B-76 **Date Sampled:**
Location: **Elev./Depth:** 28.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-74

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	2.1	89.7	8.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.8		
#30	99.2		
#50	95.5		
#100	46.6		
#200	8.1		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2472 D_{60}= 0.1783 D_{50}= 0.1570
D_{30}= 0.1159 D_{15}= 0.0867 D_{10}= 0.0781
C_u= 2.28 C_c= 0.97

Date Tested: 1/11/06 **Tested By:** J. Crose

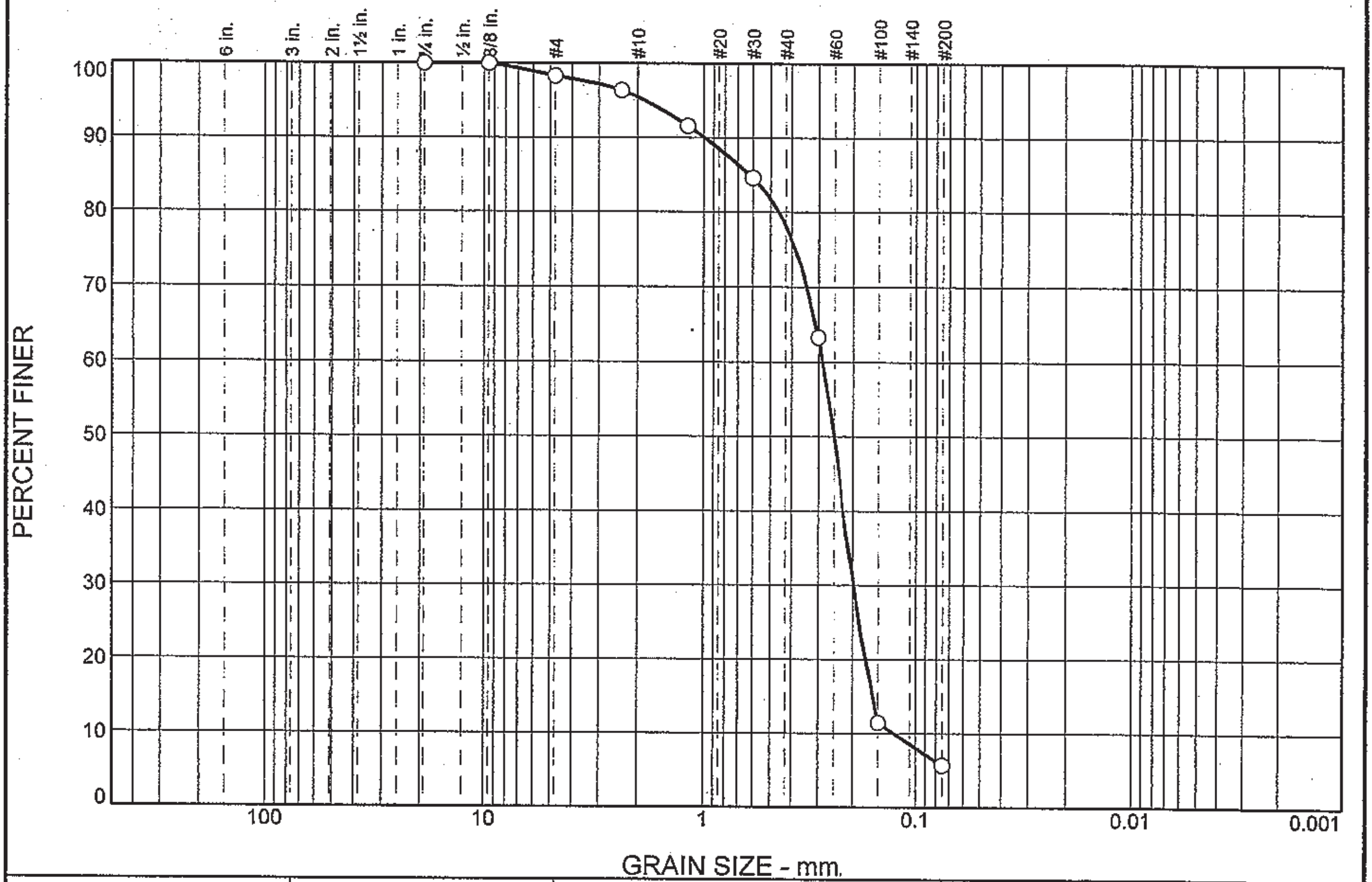
Remarks

Sample No.: S-6 **Source of Sample:** B-79 **Date Sampled:**
Location: **Elev./Depth:** 18.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-75

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	2.8	17.1	72.7	5.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	100.0		
#4	98.3		
#8	96.4		
#16	91.6		
#30	84.6		
#50	63.3		
#100	11.5		
#200	5.7		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.6213 D_{60}= 0.2854 D_{50}= 0.2503
D_{30}= 0.1969 D_{15}= 0.1600 D_{10}= 0.1260
C_u= 2.27 C_c= 1.08

Date Tested: 1/11/06 **Tested By:** J. Crose

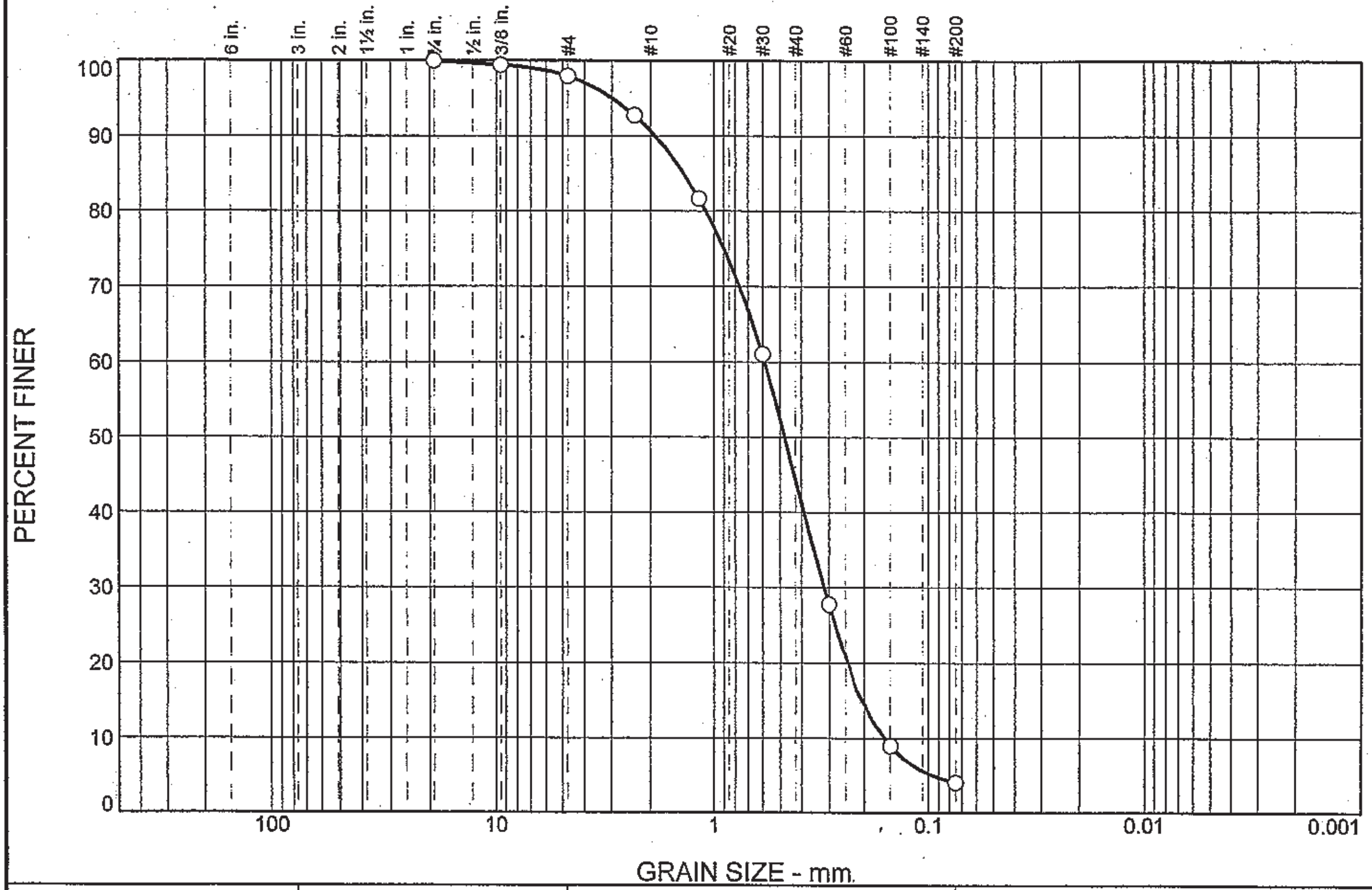
Remarks

Sample No.: S-7 **Source of Sample:** B-79 **Date Sampled:**
Location: **Elev./Depth:** 23.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-76

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.0	7.3	46.3	40.3	4.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.4		
#4	98.0		
#8	92.8		
#16	81.7		
#30	61.1		
#50	27.7		
#100	9.0		
#200	4.1		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, trace of coarse-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.3929 D_{60}= 0.5854 D_{50}= 0.4745
D_{30}= 0.3161 D_{15}= 0.2045 D_{10}= 0.1604
C_u= 3.65 C_c= 1.06

Date Tested: 1/11/06 **Tested By:** J. Crose

Remarks

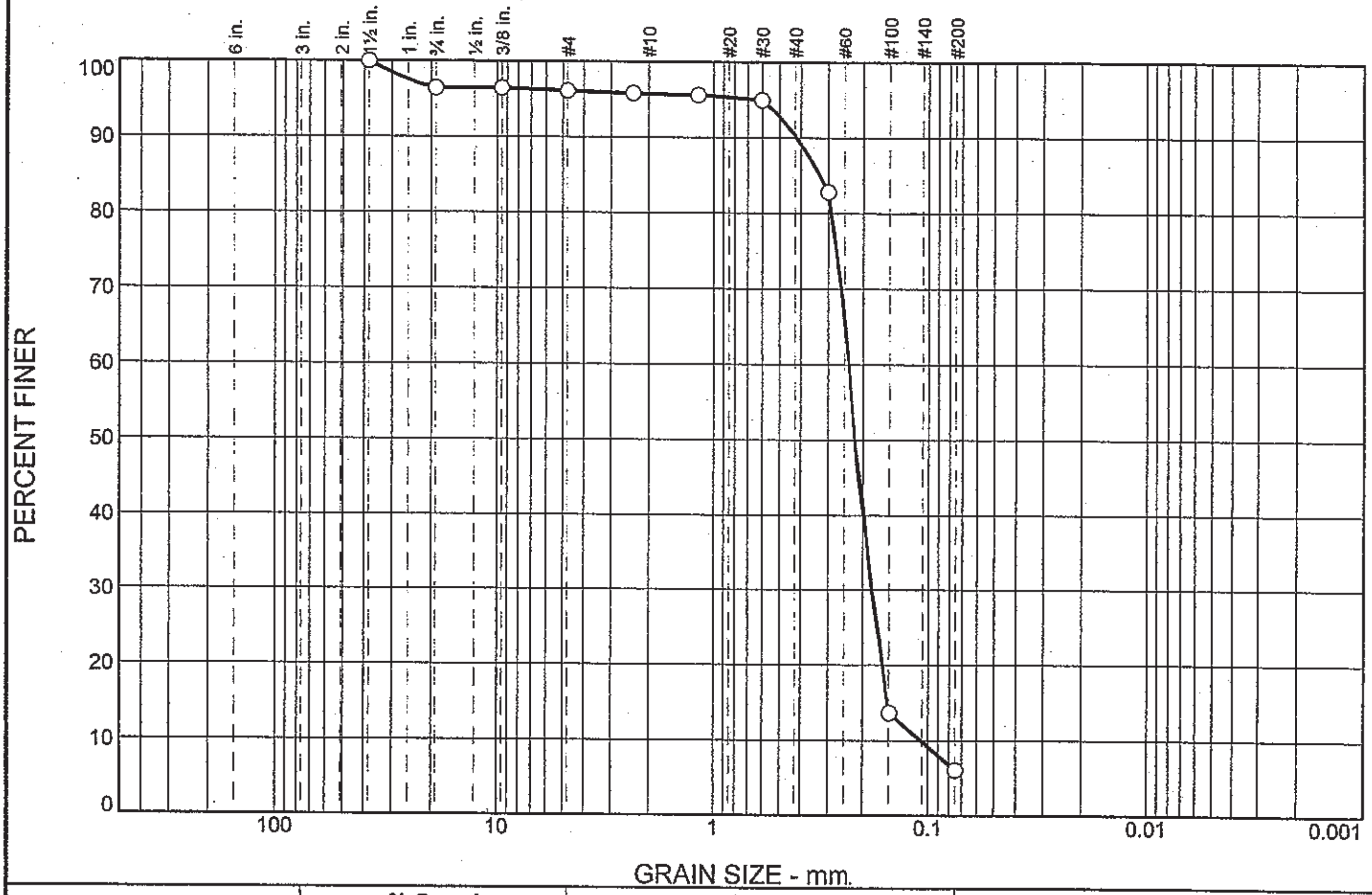
Sample No.: S-8 **Source of Sample:** B-79 **Date Sampled:**
Location: **Elev./Depth:** 28.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-77

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.6	0.3	0.4	5.3	84.3	6.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
3/4	96.4		
3/8	96.4		
#4	96.1		
#8	95.8		
#16	95.6		
#30	94.9		
#50	82.8		
#100	13.7		
#200	6.1		

* (no specification provided)

Material Description

SAND (SP-SM) fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.3277 D_{60}= 0.2357 D_{50}= 0.2157
D_{30}= 0.1802 D_{15}= 0.1528 D_{10}= 0.1074
C_u= 2.20 C_c= 1.28

Date Tested: 1/17/06 **Tested By:** J. Crose

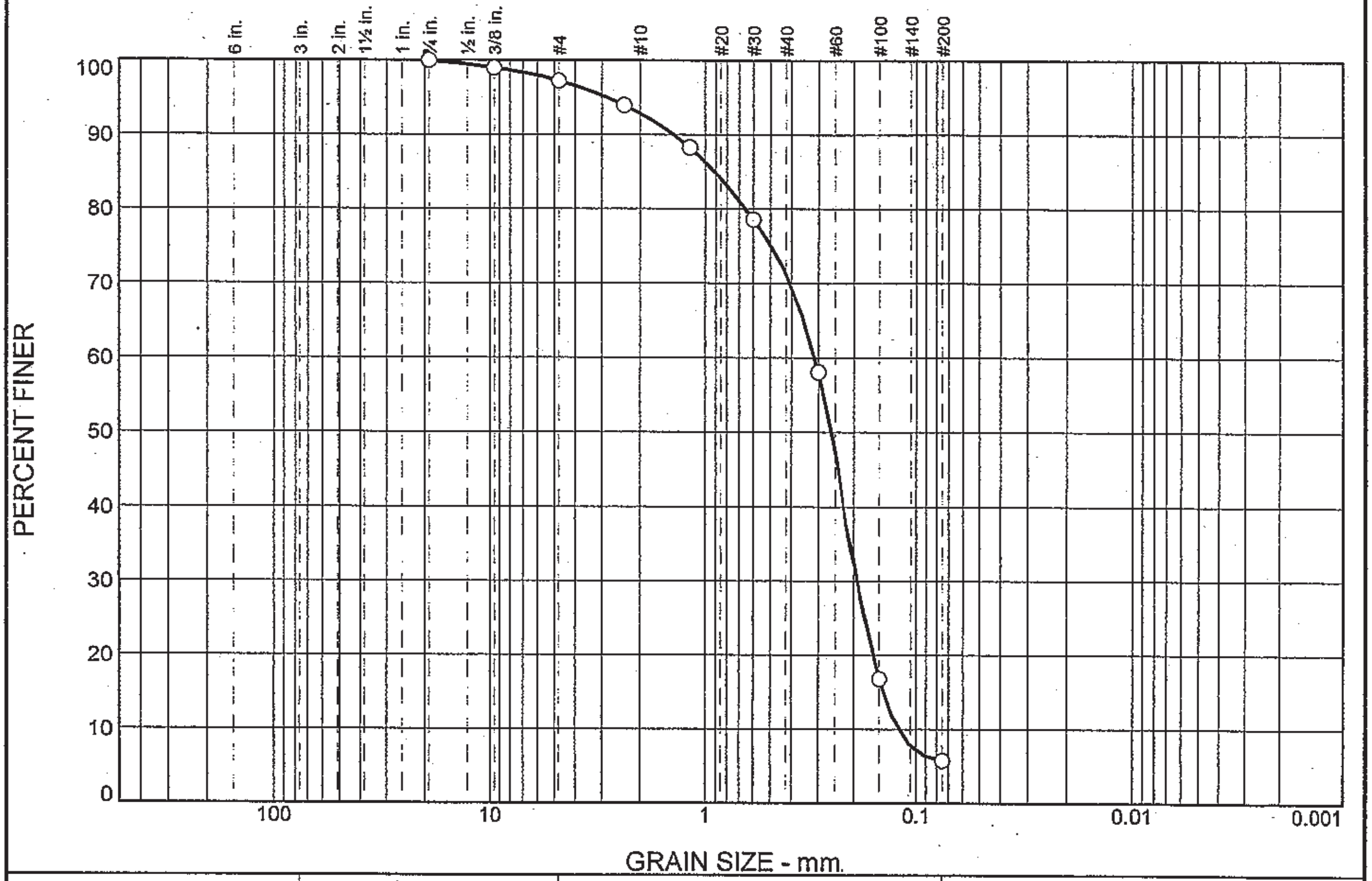
Remarks

Sample No.: S-6 **Source of Sample:** B-80 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-78

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.7	4.4	21.5	65.7	5.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.0		
#4	97.3		
#8	94.0		
#16	88.2		
#30	78.6		
#50	58.1		
#100	16.8		
#200	5.7		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.9087 D_{60}= 0.3118 D_{50}= 0.2606
D_{30}= 0.1912 D_{15}= 0.1435 D_{10}= 0.1211
C_u= 2.57 C_c= 0.97

Date Tested: 1/17/06 **Tested By:** J. Crose

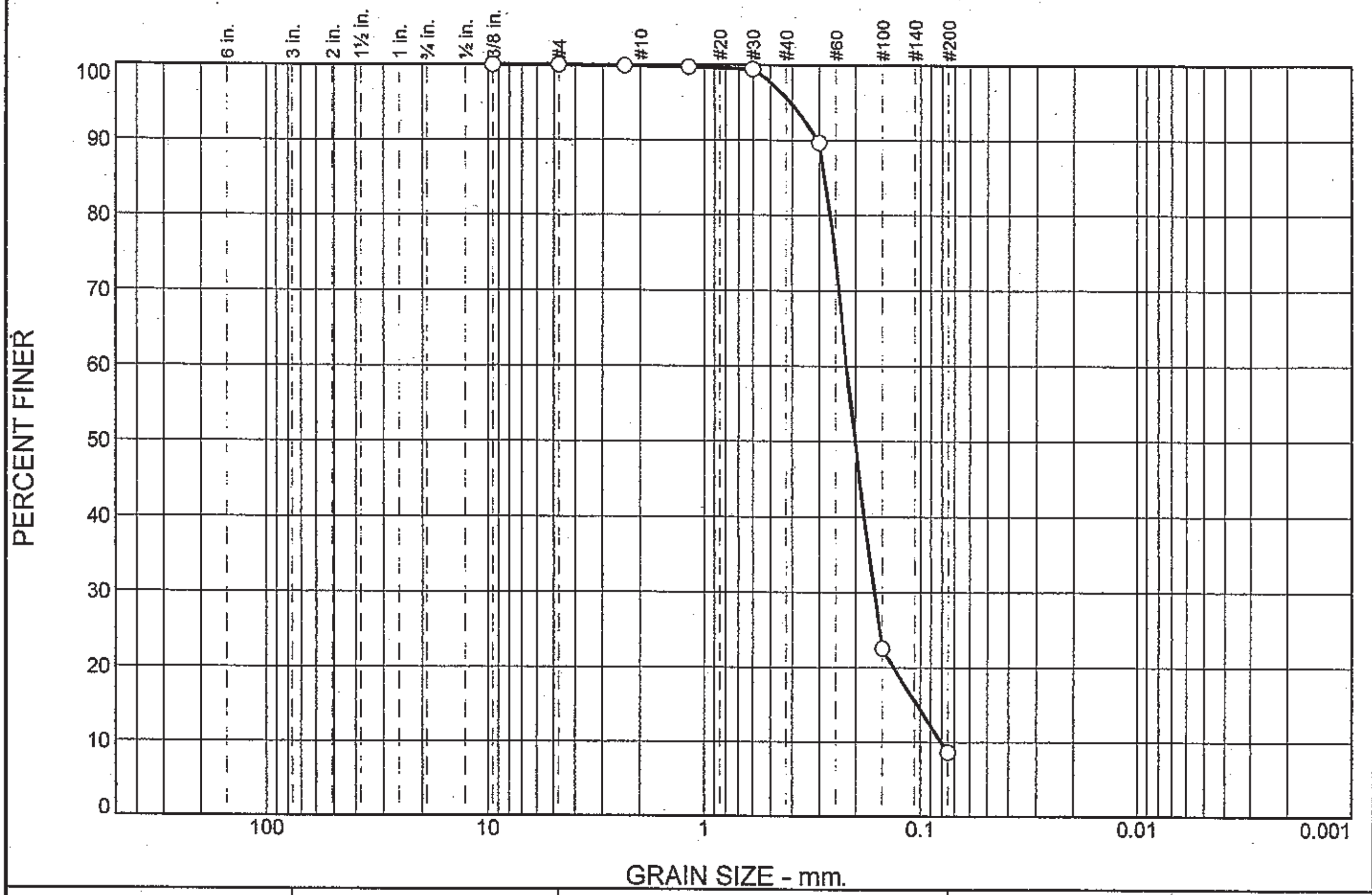
Remarks

Sample No.: S-8 **Source of Sample:** B-80 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-79

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	4.1	87.2	8.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	100.0		
#8	99.9		
#16	99.8		
#30	99.4		
#50	89.7		
#100	22.6		
#200	8.6		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2815 D_{60}= 0.2187 D_{50}= 0.1997
D_{30}= 0.1643 D_{15}= 0.1030 D_{10}= 0.0803
C_u= 2.72 C_c= 1.54

Date Tested: 11/7/06 **Tested By:** J. Crose

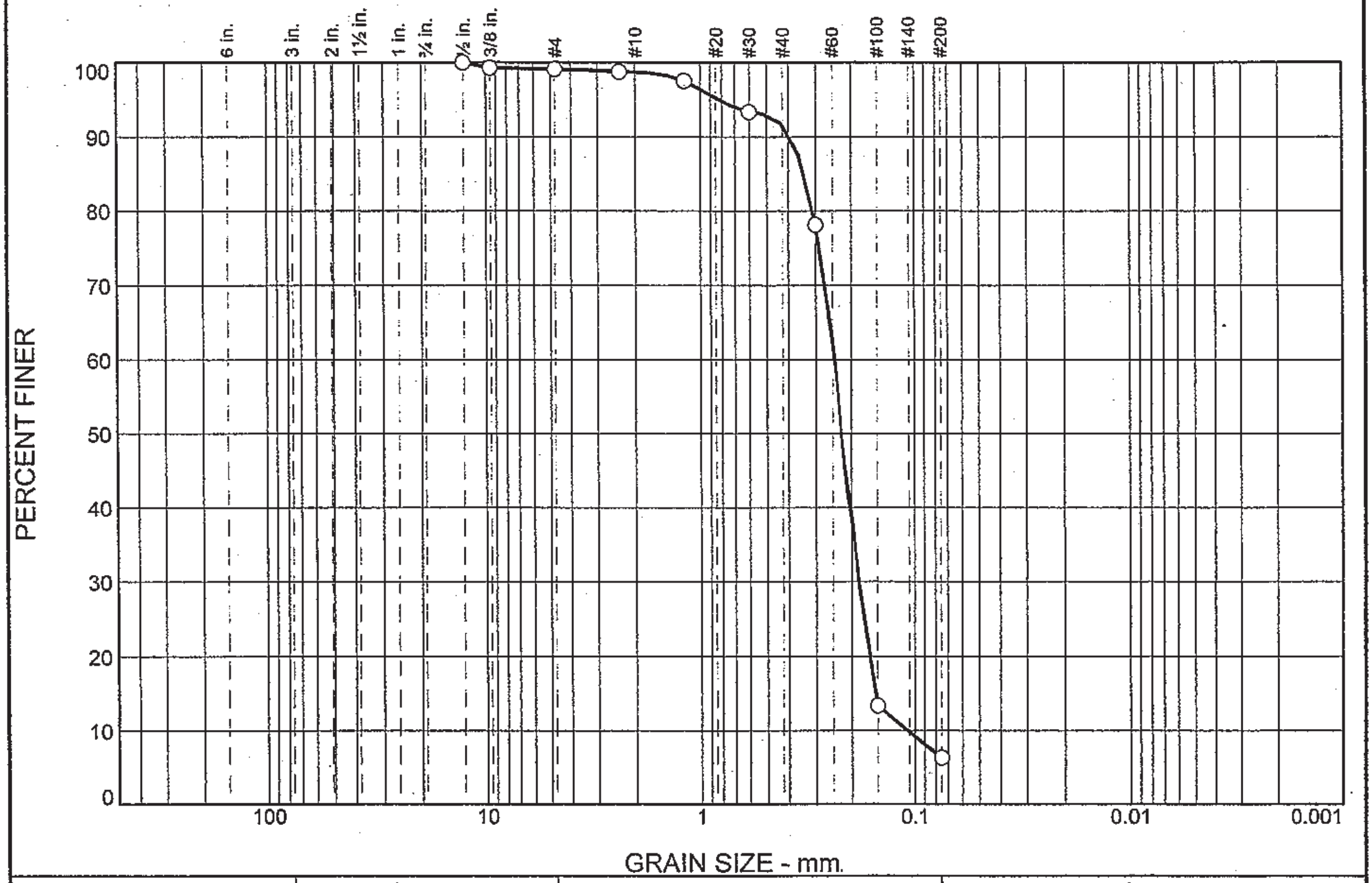
Remarks

Sample No.: S-4 **Source of Sample:** B-81 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-80

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.9	0.4	7.1	85.3	6.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
3/8	99.3		
#4	99.1		
#8	98.8		
#16	97.5		
#30	93.4		
#50	78.1		
#100	13.4		
#200	6.3		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.3380 D_{60}= 0.2441 D_{50}= 0.2217
D_{30}= 0.1831 D_{15}= 0.1537 D_{10}= 0.1079
C_u= 2.26 C_c= 1.27

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

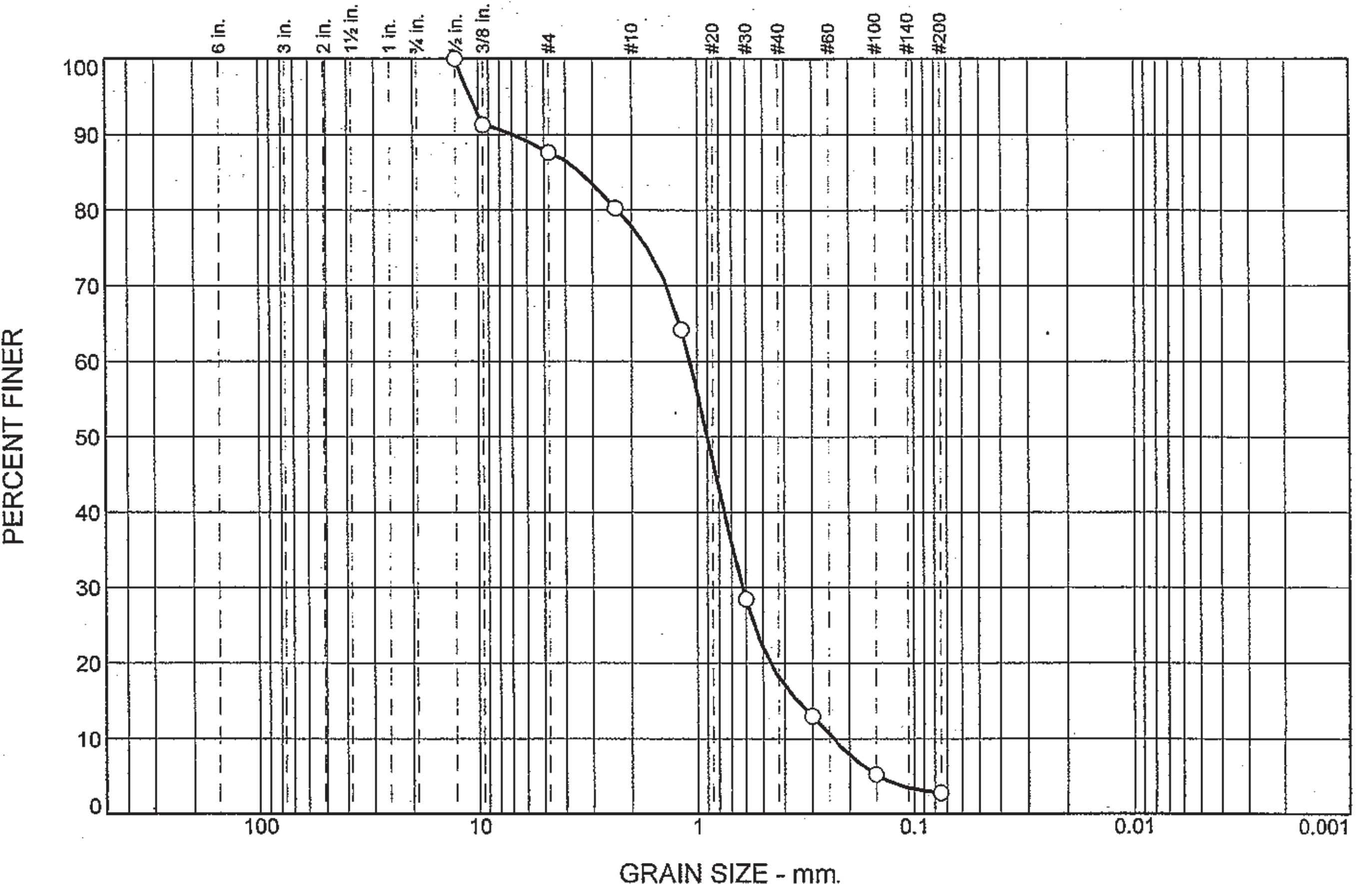
Sample No.: S-5 **Source of Sample:** B-81 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-81

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.4	9.7	59.8	15.3	2.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
3/8	91.3		
#4	87.6		
#8	80.3		
#16	64.2		
#30	28.5		
#50	13.0		
#100	5.2		
#200	2.8		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, traces of coarse-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 3.3833 D_{60}= 1.0789 D_{50}= 0.8976
D_{30}= 0.6214 D_{15}= 0.3507 D_{10}= 0.2372
C_u= 4.55 C_c= 1.51

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

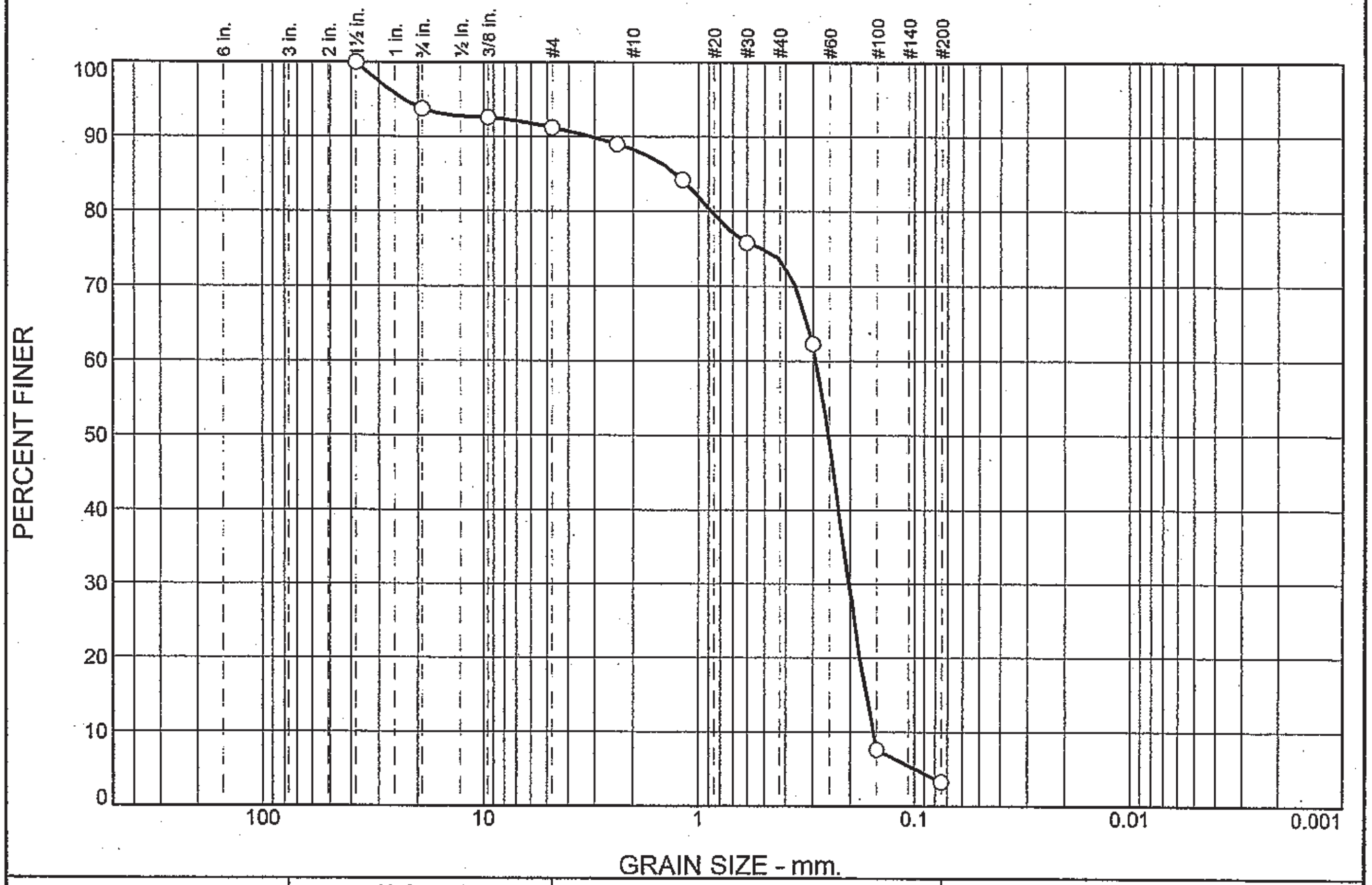
Sample No.: S-6 **Source of Sample:** B-81 **Date Sampled:**
Location: **Elev./Depth:** 18.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-82

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.2	2.6	2.9	14.7	70.3	3.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
3/4	93.8		
3/8	92.5		
#4	91.2		
#8	89.0		
#16	84.2		
#30	75.8		
#50	62.3		
#100	7.6		
#200	3.3		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.2690 D_{60}= 0.2892 D_{50}= 0.2531
D_{30}= 0.2018 D_{15}= 0.1684 D_{10}= 0.1564
C_u= 1.85 C_c= 0.90

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

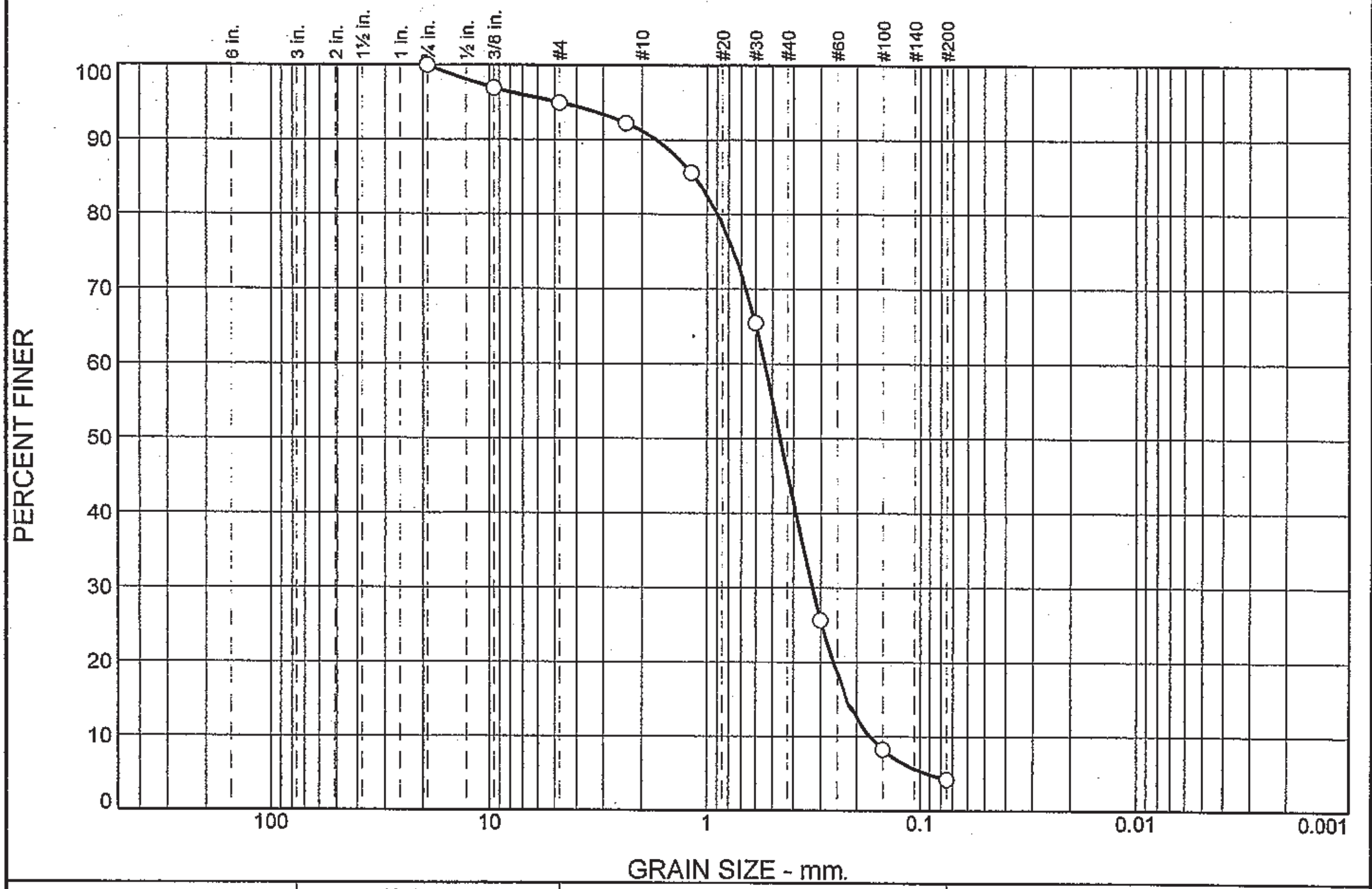
Sample No.: S-7 **Source of Sample:** B-81 **Date Sampled:**
Location: **Elev./Depth:** 23.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-83

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.0	3.8	45.7	41.3	4.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	97.0		
#4	95.0		
#8	92.2		
#16	85.6		
#30	65.5		
#50	25.7		
#100	8.2		
#200	4.2		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS= SP **AASHTO=**

Coefficients

D_{85}= 1.1381 D_{60}= 0.5409 D_{50}= 0.4572

D_{30}= 0.3270 D_{15}= 0.2226 D_{10}= 0.1728

C_u= 3.13 C_c= 1.14

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

Sample No.: S-8 **Source of Sample:** B-81 **Date Sampled:**

Location: **Elev./Depth:** 28

Checked By: K. Kocher **Title:** P.E.

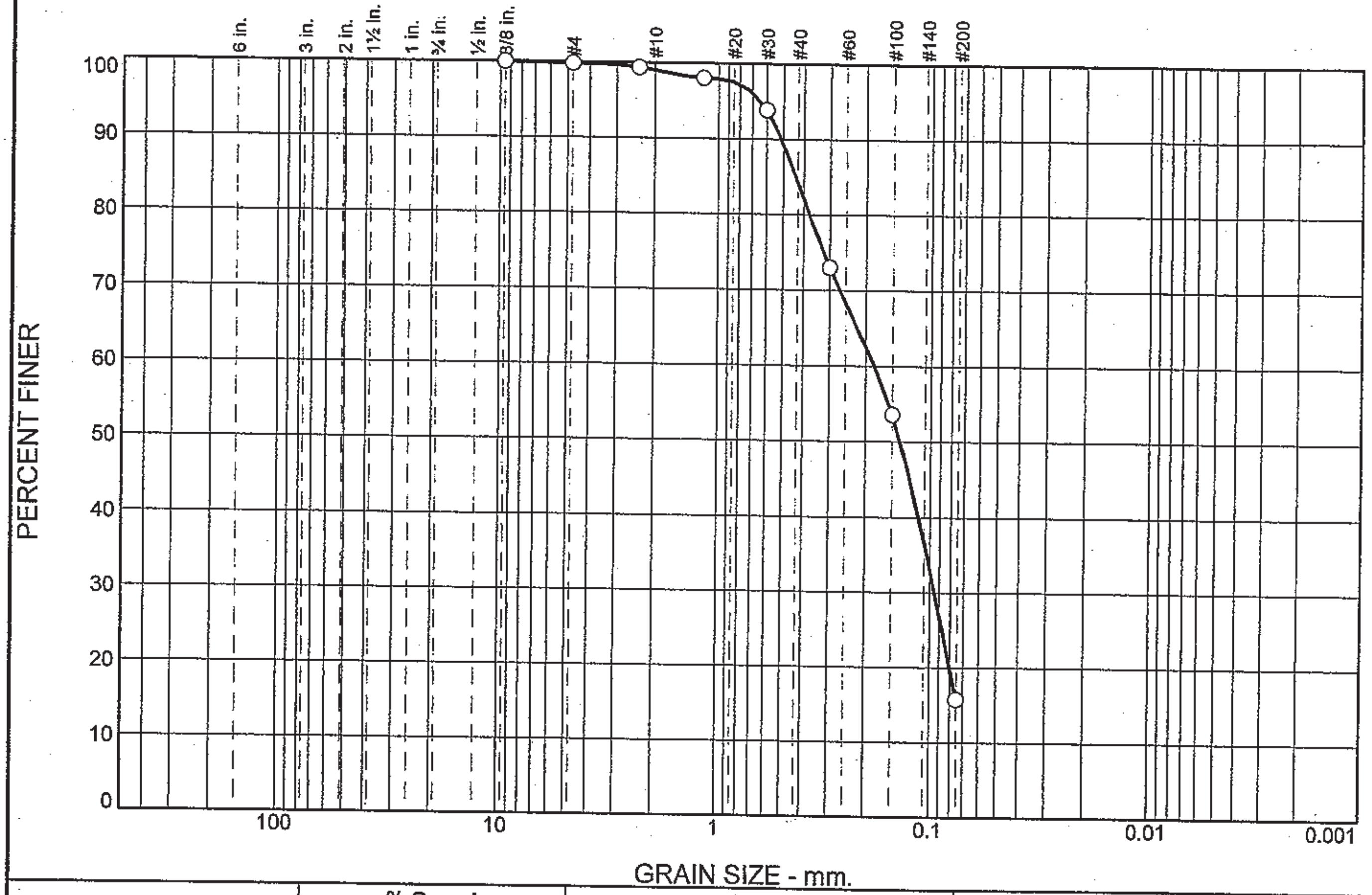
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-84

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	0.8	14.7	68.5	15.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.8		
#8	99.4		
#16	98.0		
#30	93.9		
#50	73.0		
#100	53.6		
#200	15.8		

* (no specification provided)

Material Description

Silty SAND (SM), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.4340 D_{60}= 0.1813 D_{50}= 0.1376
D_{30}= 0.0945 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

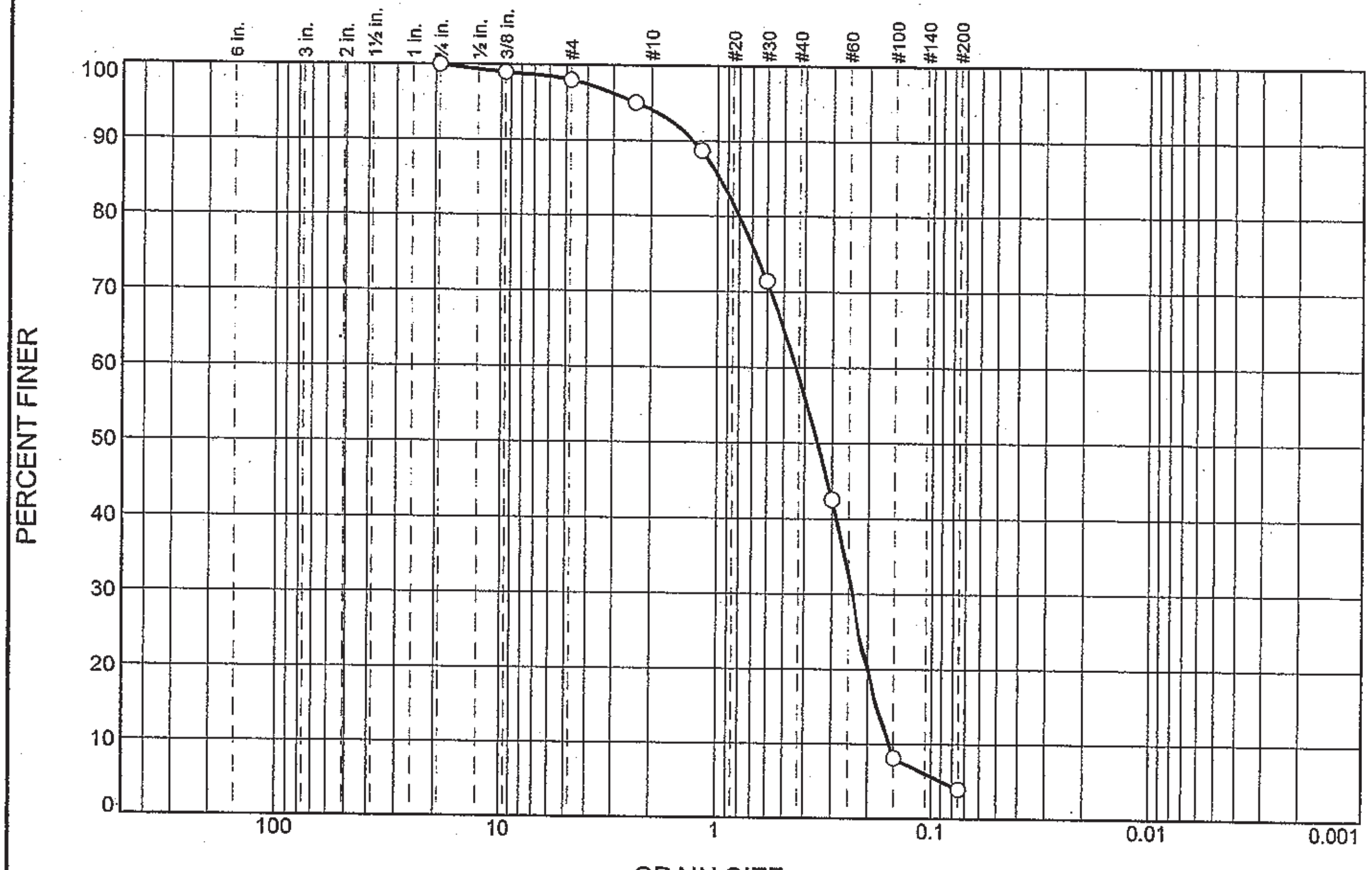
Sample No.: S-4 **Source of Sample:** B-82 **Date Sampled:**
Location: **Elev./Depth:** 9.0
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-85

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.0	3.9	35.3	54.9	3.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.0		
#4	98.0		
#8	95.0		
#16	88.7		
#30	71.4		
#50	42.6		
#100	8.1		
#200	3.9		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.9735 D_{60}= 0.4380 D_{50}= 0.3481
D_{30}= 0.2391 D_{15}= 0.1795 D_{10}= 0.1589
C_u= 2.76 C_c= 0.82

Date Tested: 1/06/06 **Tested By:** RTH/JLC

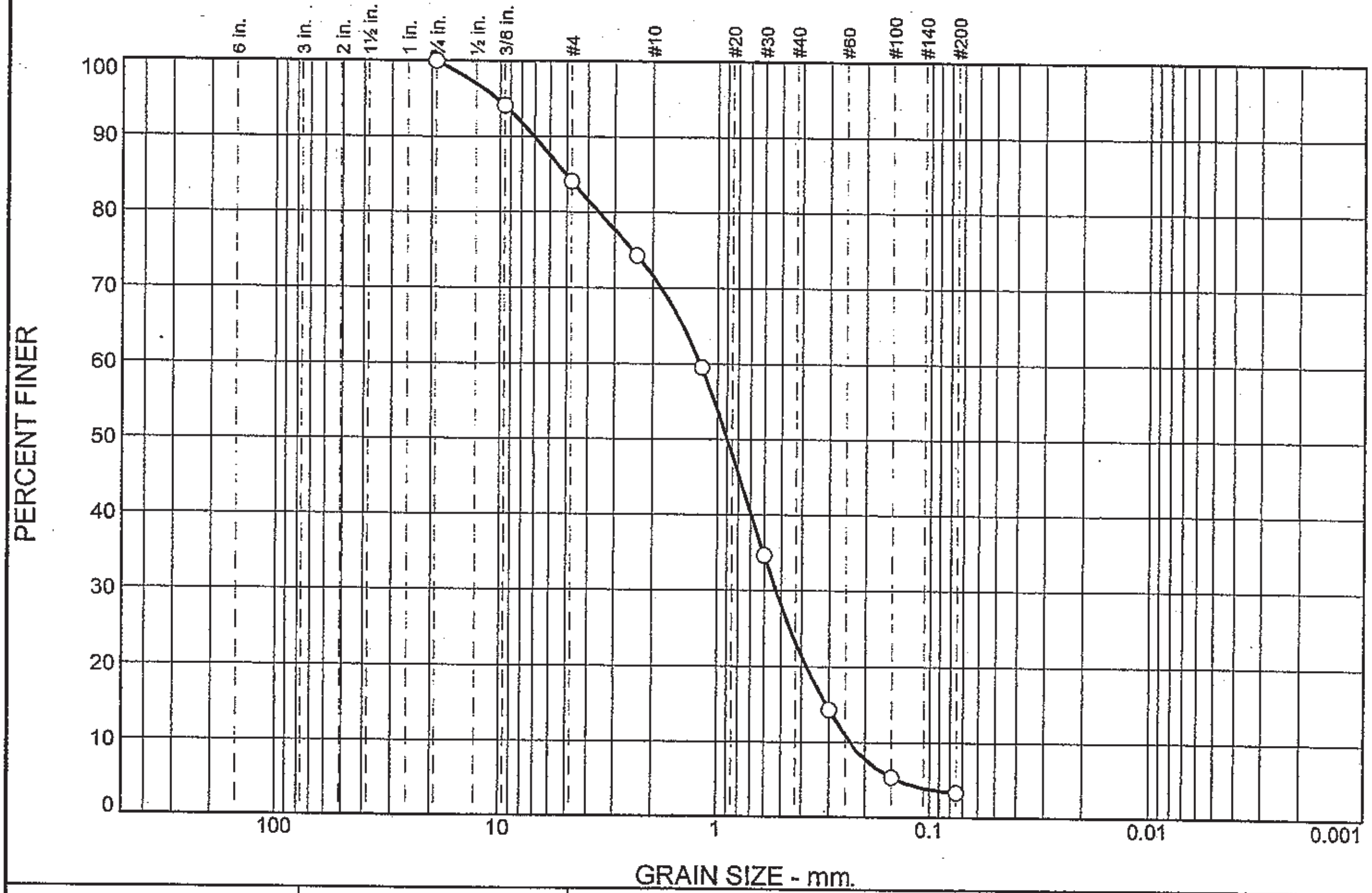
Remarks

Sample No.: S-5 **Source of Sample:** B-82 **Date Sampled:**
Location: **Elev./Depth:** 13.0
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-86

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	15.9	12.4	48.5	19.9	3.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	94.1		
#4	84.1		
#8	74.3		
#16	59.5		
#30	34.7		
#50	14.3		
#100	5.3		
#200	3.3		

* (no specification provided)

Material Description

SAND (SP), coarse-, medium-, and fine-grain, traces of fine-gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 5.0644 D_{60}= 1.1986 D_{50}= 0.8963
D_{30}= 0.5262 D_{15}= 0.3099 D_{10}= 0.2357
C_u= 5.08 C_c= 0.98

Date Tested: 1/06/06 **Tested By:** RTH/JLC

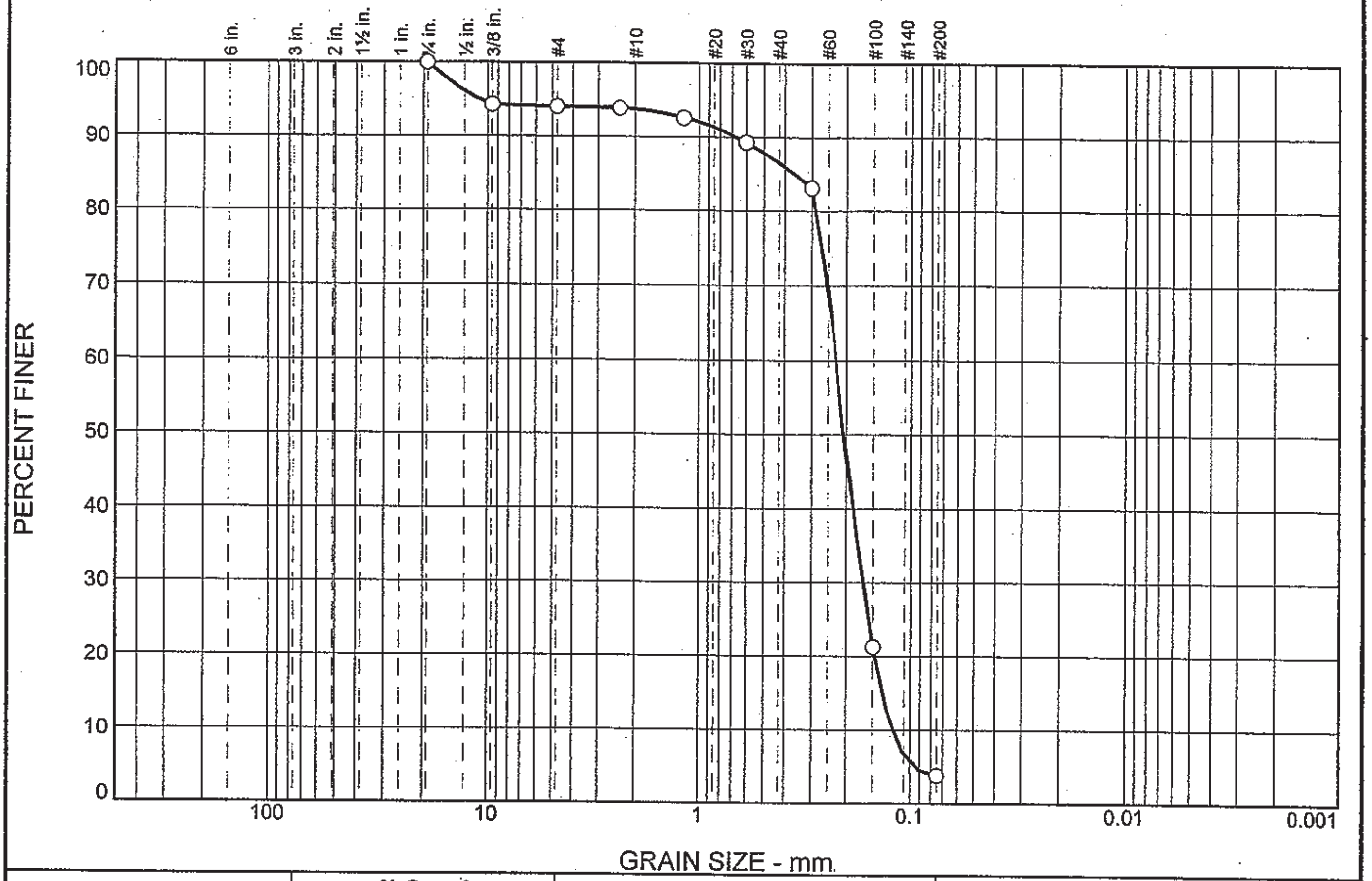
Remarks

Sample No.: S-6 **Source of Sample:** B-82 **Date Sampled:**
Location: **Elev./Depth:** 18.0
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-87

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.0	0.2	7.2	82.8	3.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	94.3		
#4	94.0		
#8	93.9		
#16	92.6		
#30	89.3		
#50	83.1		
#100	21.3		
#200	3.8		

* (no specification provided)

Material Description

SAND (SP), fine-grain, trace of medium-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.3585 D_{60}= 0.2265 D_{50}= 0.2052
D_{30}= 0.1672 D_{15}= 0.1354 D_{10}= 0.1206
C_u= 1.88 C_c= 1.02

Date Tested: 1/06/06 **Tested By:** RTH/JLC

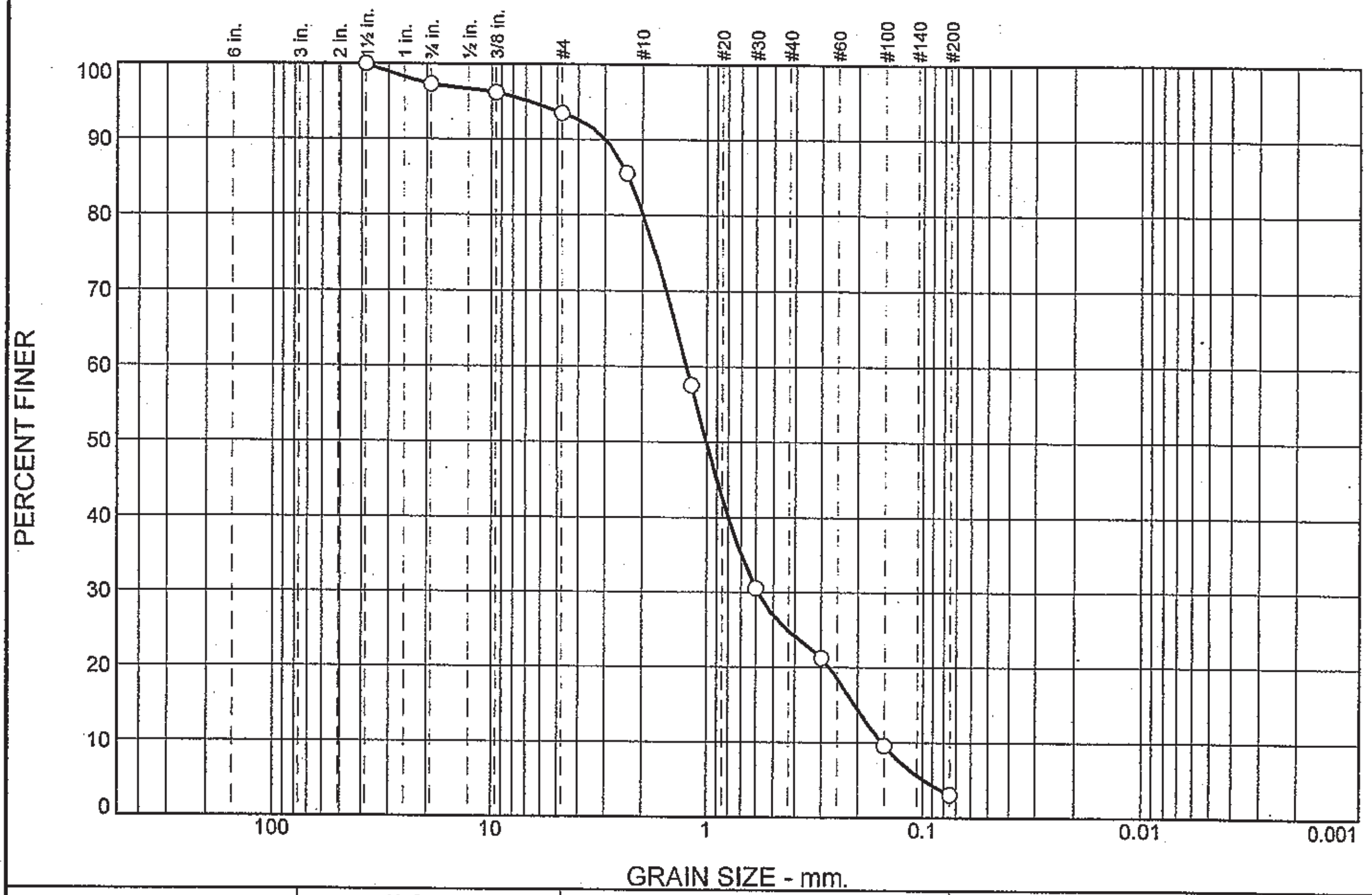
Remarks

Sample No.: S-7 **Source of Sample:** B-82 **Date Sampled:**
Location: **Elev./Depth:** 23.0
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-88

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.7	3.8	13.1	55.5	21.8	3.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	97.3		
3/8	96.2		
#4	93.5		
#8	85.5		
#16	57.6		
#30	30.6		
#50	21.2		
#100	9.6		
#200	3.1		

* (no specification provided)

Material Description

SAND (SW), well graded

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW AASHTO=

Coefficients

D_{85}= 2.3144 D_{60}= 1.2422 D_{50}= 1.0044
D_{30}= 0.5861 D_{15}= 0.2055 D_{10}= 0.1543
C_u= 8.05 C_c= 1.79

Date Tested: 1/06/06 **Tested By:** RTH/JLC

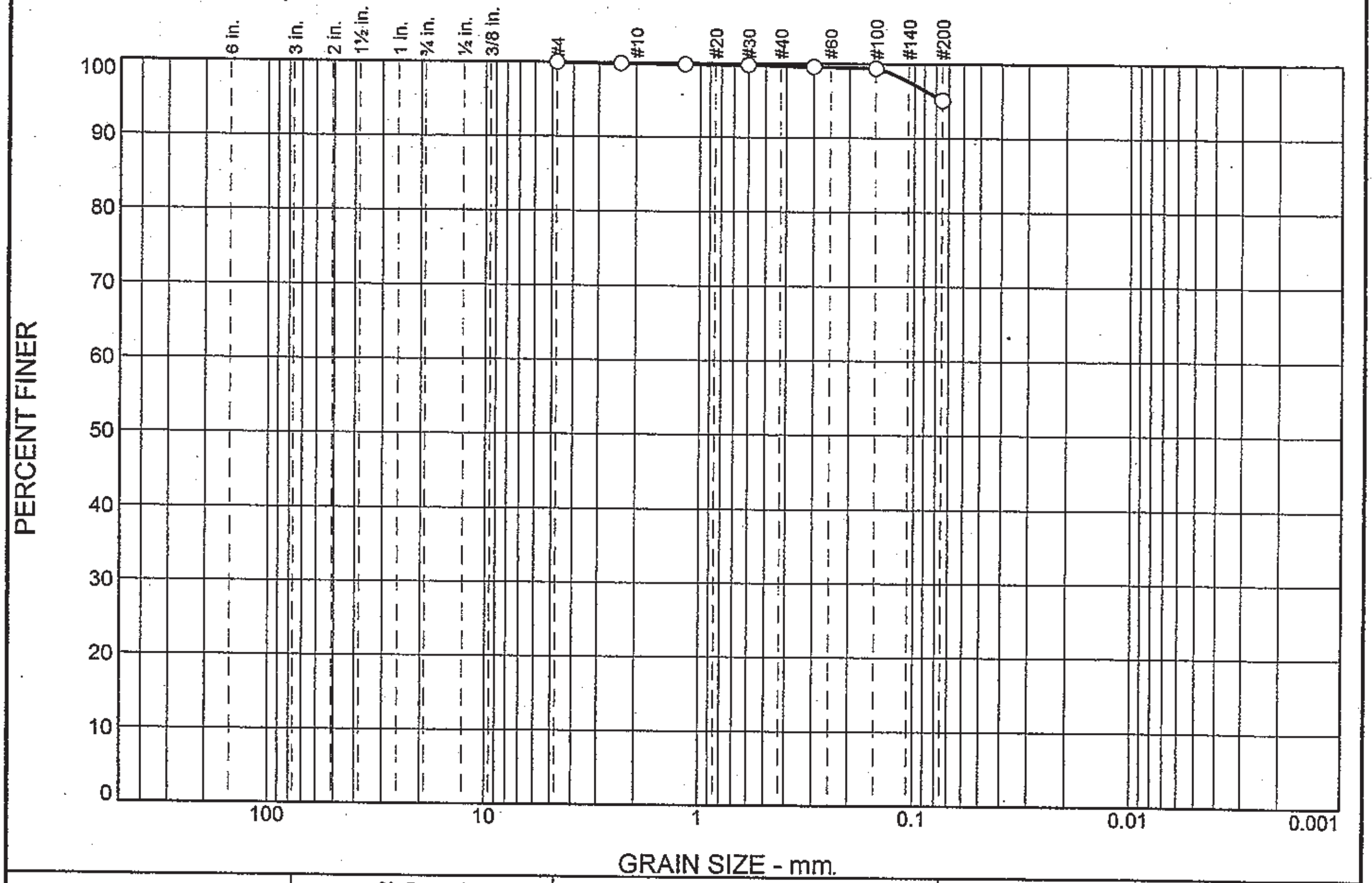
Remarks

Sample No.: S-8 **Source of Sample:** B-82 **Date Sampled:**
Location: **Elev./Depth:** 28.0
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-89

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.2	4.6	95.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.8		
#30	99.8		
#50	99.6		
#100	99.4		
#200	95.1		

* (no specification provided)

Material Description

SILT (ML), with fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/05/06 **Tested By:** RTH/JLC

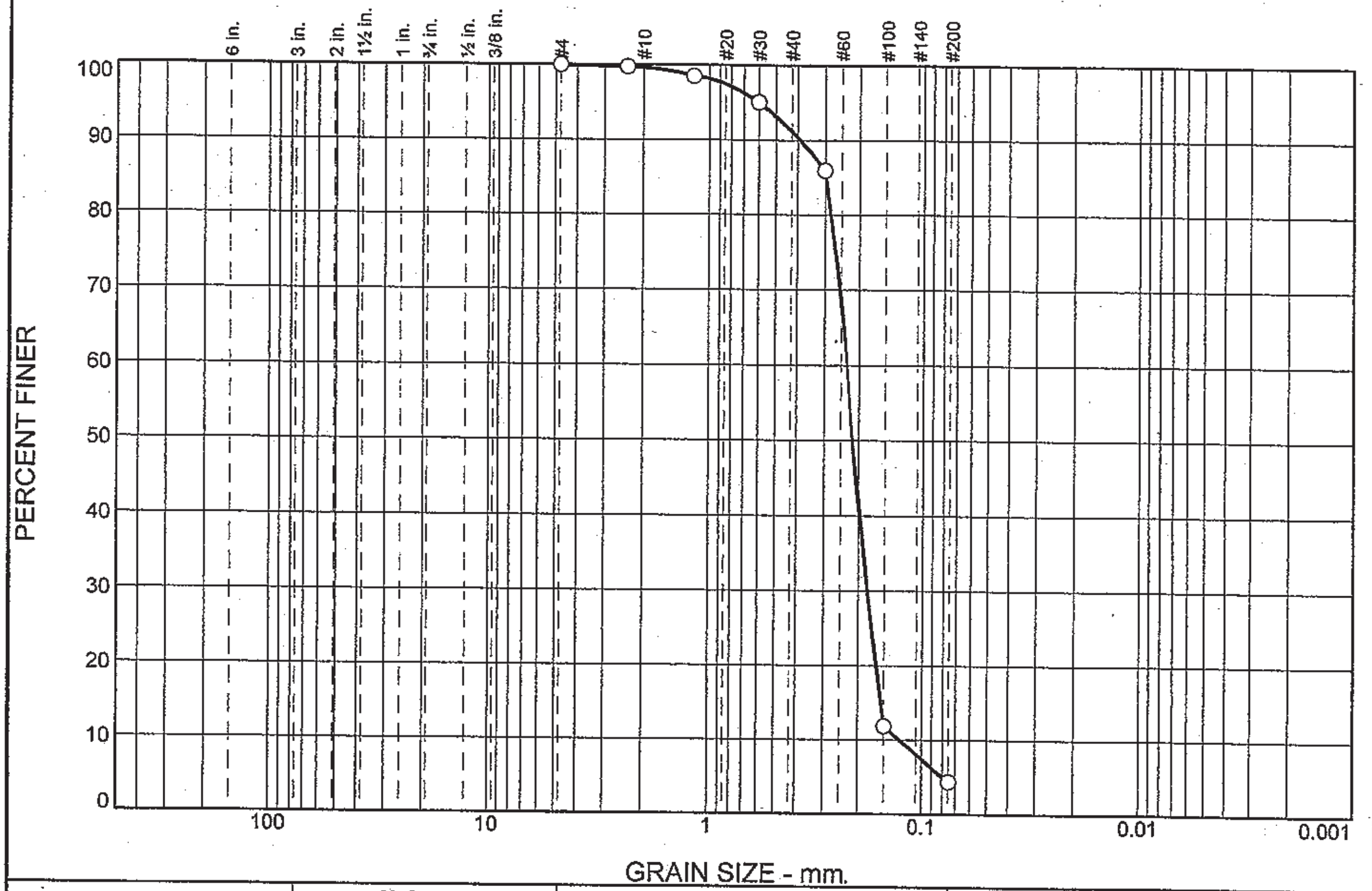
Remarks

Sample No.: S-3 **Source of Sample:** B-83 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-90

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	8.5	86.9	4.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.7		
#16	98.5		
#30	95.1		
#50	85.9		
#100	11.8		
#200	4.3		

* (no specification provided)

Material Description

SAND (SP), fine-grain, trace of medium-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.2963 D_{60}= 0.2319 D_{50}= 0.2136
D_{30}= 0.1809 D_{15}= 0.1560 D_{10}= 0.1265
C_u= 1.83 C_c= 1.12

Date Tested: 1/05/06 **Tested By:** RTH/JLC

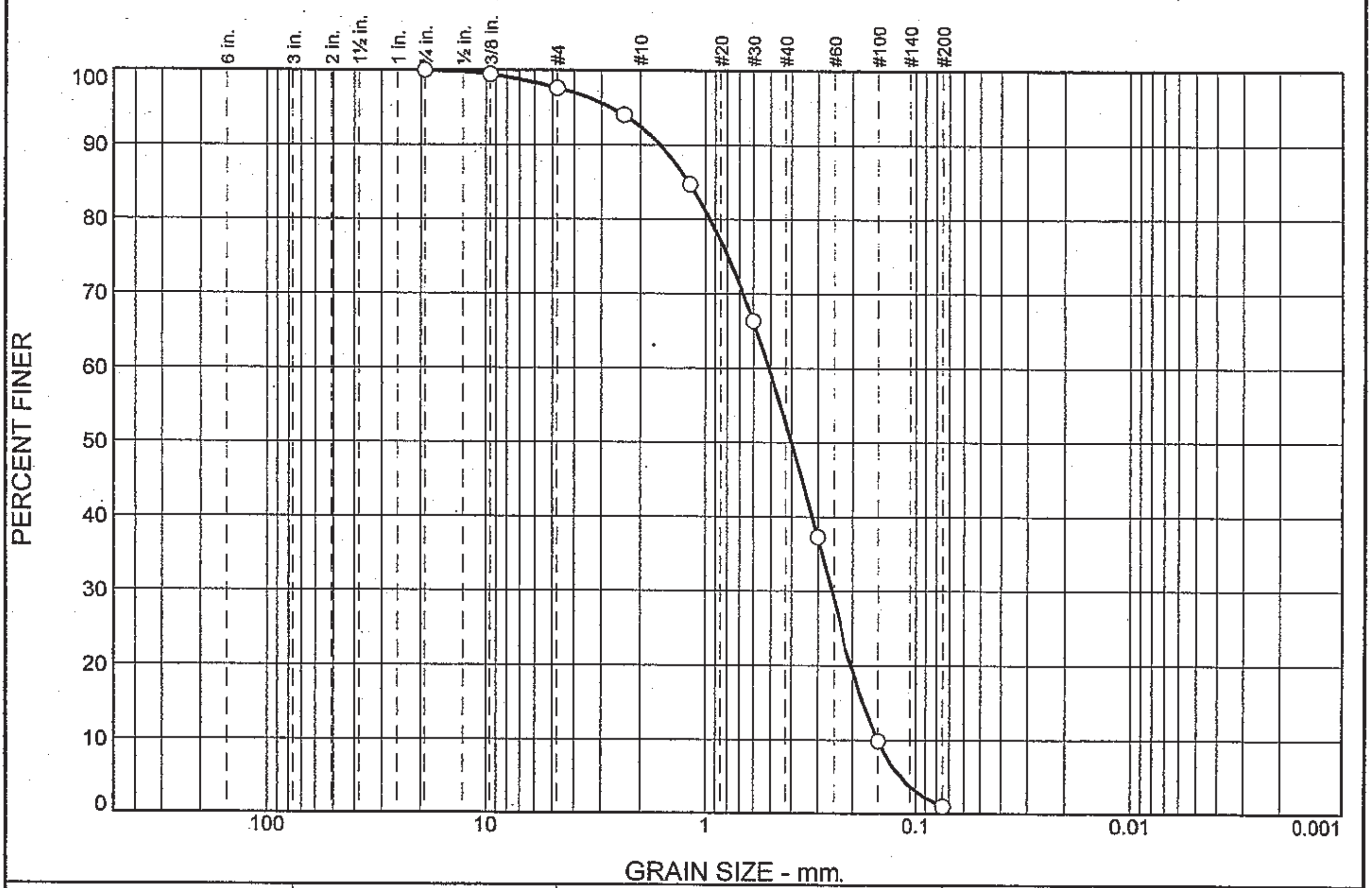
Remarks

Sample No.: S-4 **Source of Sample:** B-83 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-91

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.4	5.1	39.7	51.8	1.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.5		
#4	97.6		
#8	94.0		
#16	84.8		
#30	66.4		
#50	37.3		
#100	9.9		
#200	1.0		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.1951 D_{60}= 0.5066 D_{50}= 0.3985
D_{30}= 0.2557 D_{15}= 0.1773 D_{10}= 0.1508
C_u= 3.36 C_c= 0.86

Date Tested: 1/05/06 **Tested By:** RTH/JLC

Remarks

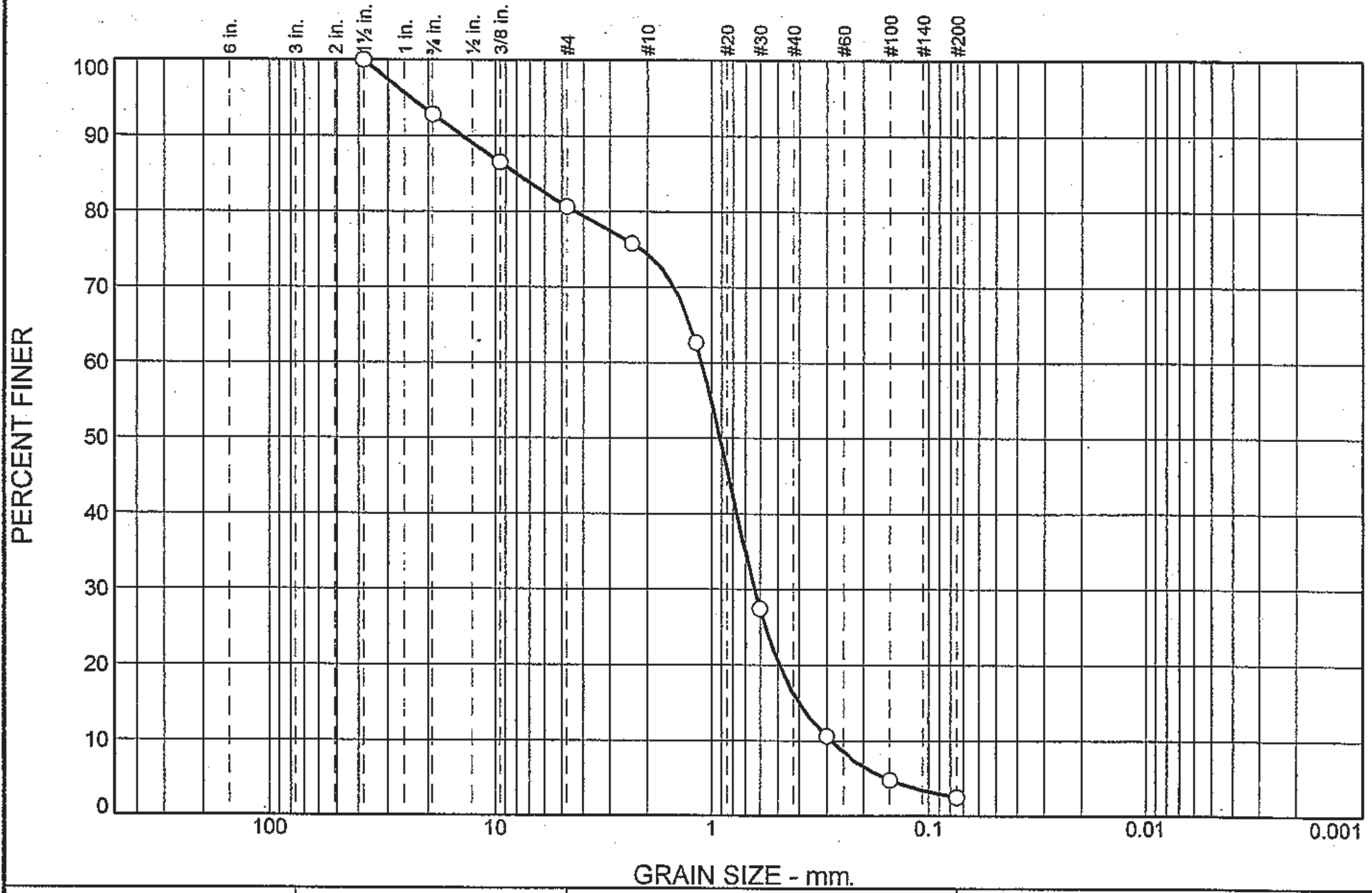
Sample No.: S-5 **Source of Sample:** B-83 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-92

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.2	12.1	6.3	58.1	13.8	2.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	92.8		
3/8	86.6		
#4	80.7		
#8	75.8		
#16	62.7		
#30	27.5		
#50	10.6		
#100	4.8		
#200	2.5		

* (no specification provided)

Material Description

Sand (SP), medium- to fine-grain, traces of fine-gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SO AASHTO=

Coefficients

D_{85}= 7.9889 D_{60}= 1.1090 D_{50}= 0.9131

D_{30}= 0.6339 D_{15}= 0.3999 D_{10}= 0.2851

C_u= 3.89 C_c= 1.27

Date Tested: 1/05/06 **Tested By:** RTH/JLC

Remarks

Sample No.: S-6 **Source of Sample:** B-83 **Date Sampled:**

Location: **Elev./Depth:** 18

Checked By: J. Fouse **Title:** P.E.

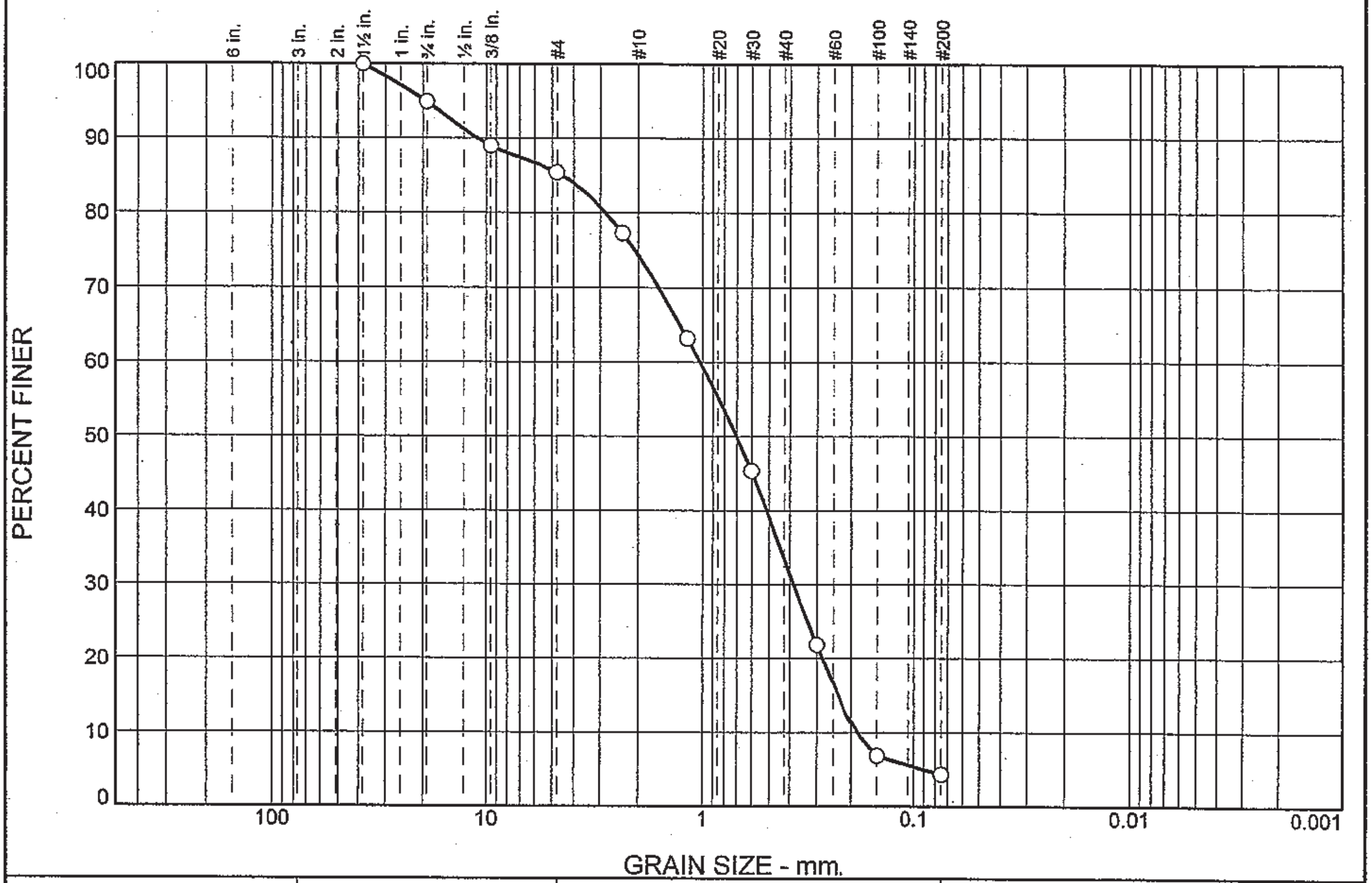
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-93

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.1	9.5	11.0	40.8	29.3	4.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	94.9		
3/8	89.0		
#4	85.4		
#8	77.3		
#16	63.2		
#30	45.4		
#50	21.8		
#100	6.8		
#200	4.3		

* (no specification provided)

Material Description

SAND (SP), coarse-, medium-, and fine-grain, trace of fine-gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 4.4914 D_{60}= 1.0290 D_{50}= 0.6997
D_{30}= 0.3838 D_{15}= 0.2351 D_{10}= 0.1863
C_u= 5.52 C_c= 0.77

Date Tested: 1/05/06 **Tested By:** RTH/JJP

Remarks

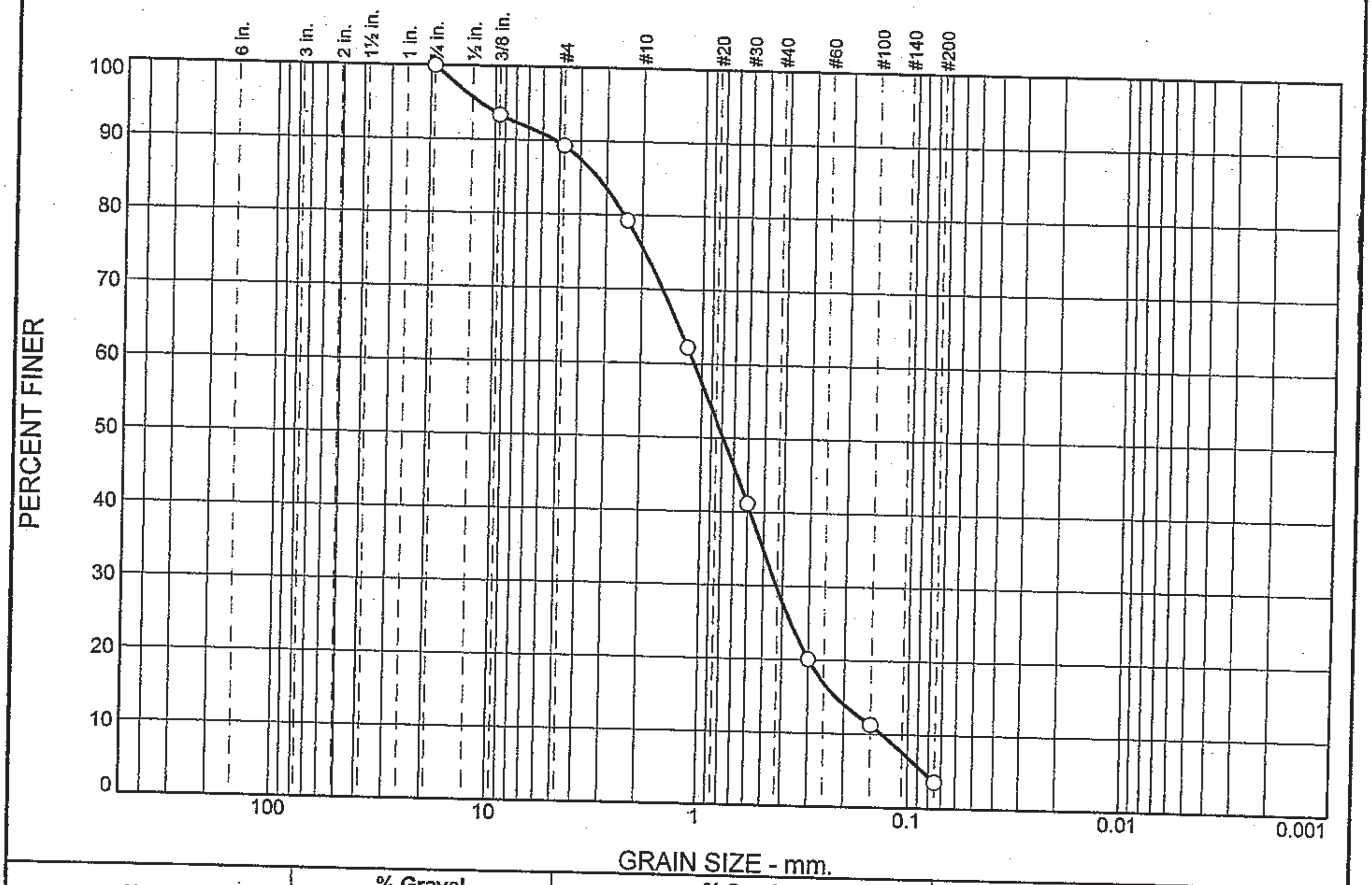
Sample No.: S-7 **Source of Sample:** B-83 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-94

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	10.7	13.5	46.2	26.0	3.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	93.4		
#4	89.3		
#8	79.3		
#16	62.2		
#30	41.1		
#50	20.1		
#100	11.2		
#200	3.6		

* (no specification provided)

Material Description

SAND (SW), well graded, with fine-gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW AASHTO=

Coefficients

D_{85}= 3.2805 D_{60}= 1.0927 D_{50}= 0.7867
D_{30}= 0.4299 D_{15}= 0.2190 D_{10}= 0.1323
C_u= 8.26 C_c= 1.28

Date Tested: 1/05/06 **Tested By:** JRD/JLC

Remarks

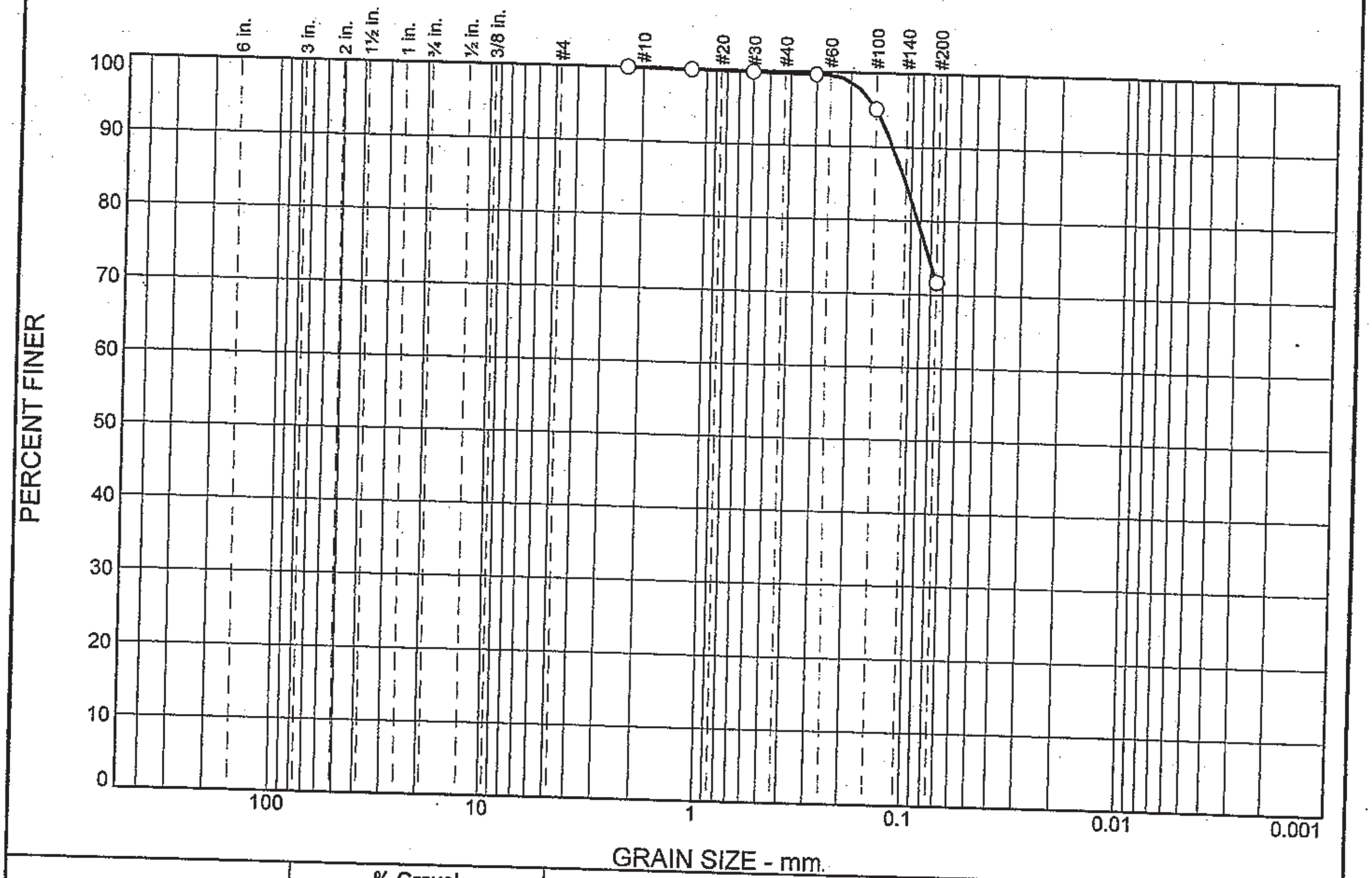
Sample No.: S-8 **Source of Sample:** B-83 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-95

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	28.1	71.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.8		
#50	99.7		
#100	95.1		
#200	71.7		

* (no specification provided)

Material Description

SILT (ML), with fine sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.1056 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/05/06 **Tested By:** JJP/RTH

Remarks

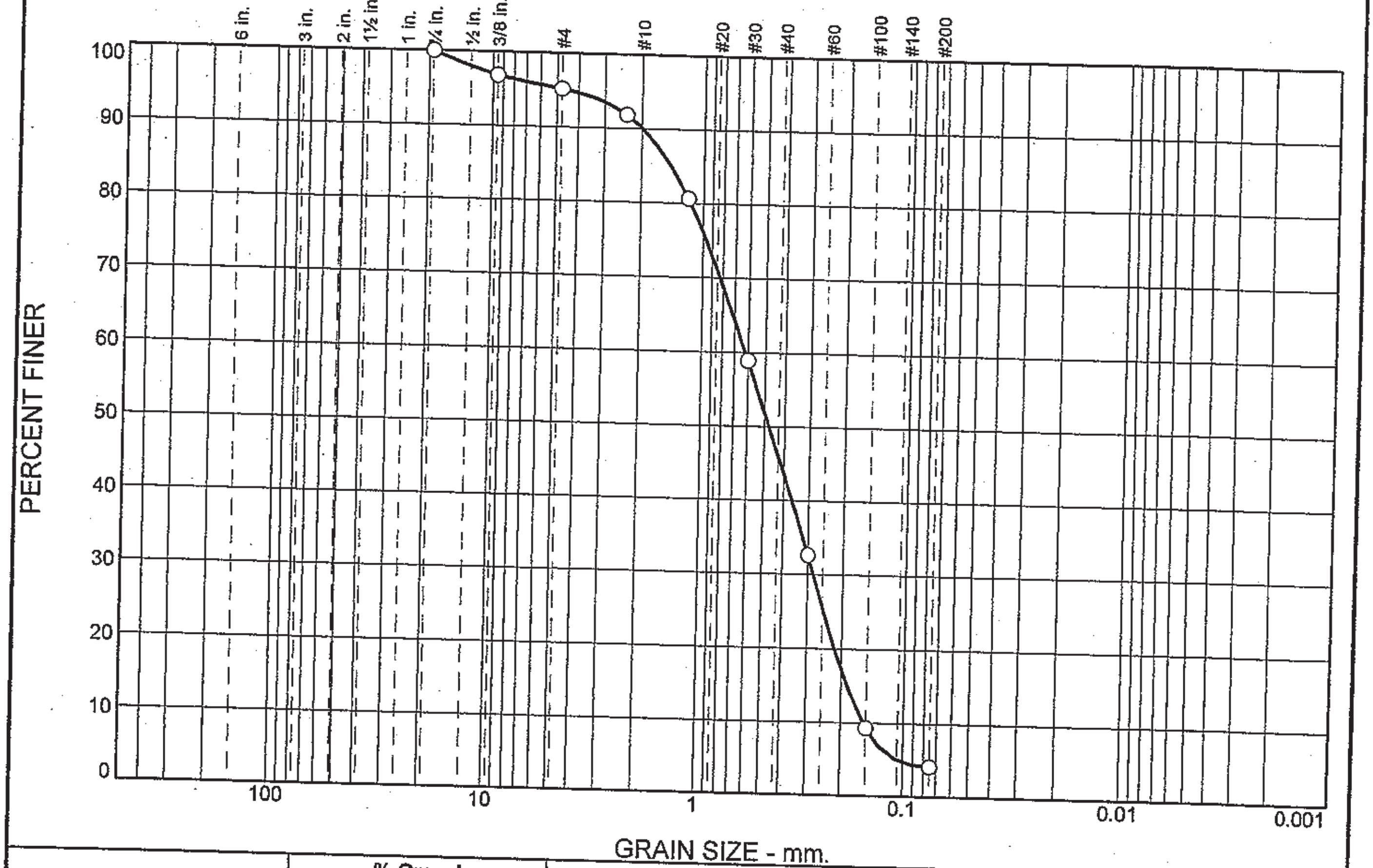
Sample No.: S-4 **Source of Sample:** B-84 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-96

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.8	5.1	44.0	41.9	4.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	96.9		
#4	95.2		
#8	91.8		
#16	80.7		
#30	58.9		
#50	32.6		
#100	9.3		
#200	4.2		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.4367 D_{60}= 0.6182 D_{50}= 0.4714
D_{30}= 0.2806 D_{15}= 0.1863 D_{10}= 0.1550
C_u= 3.99 C_c= 0.82

Date Tested: 1/05/06 **Tested By:** RTH/JJP

Remarks

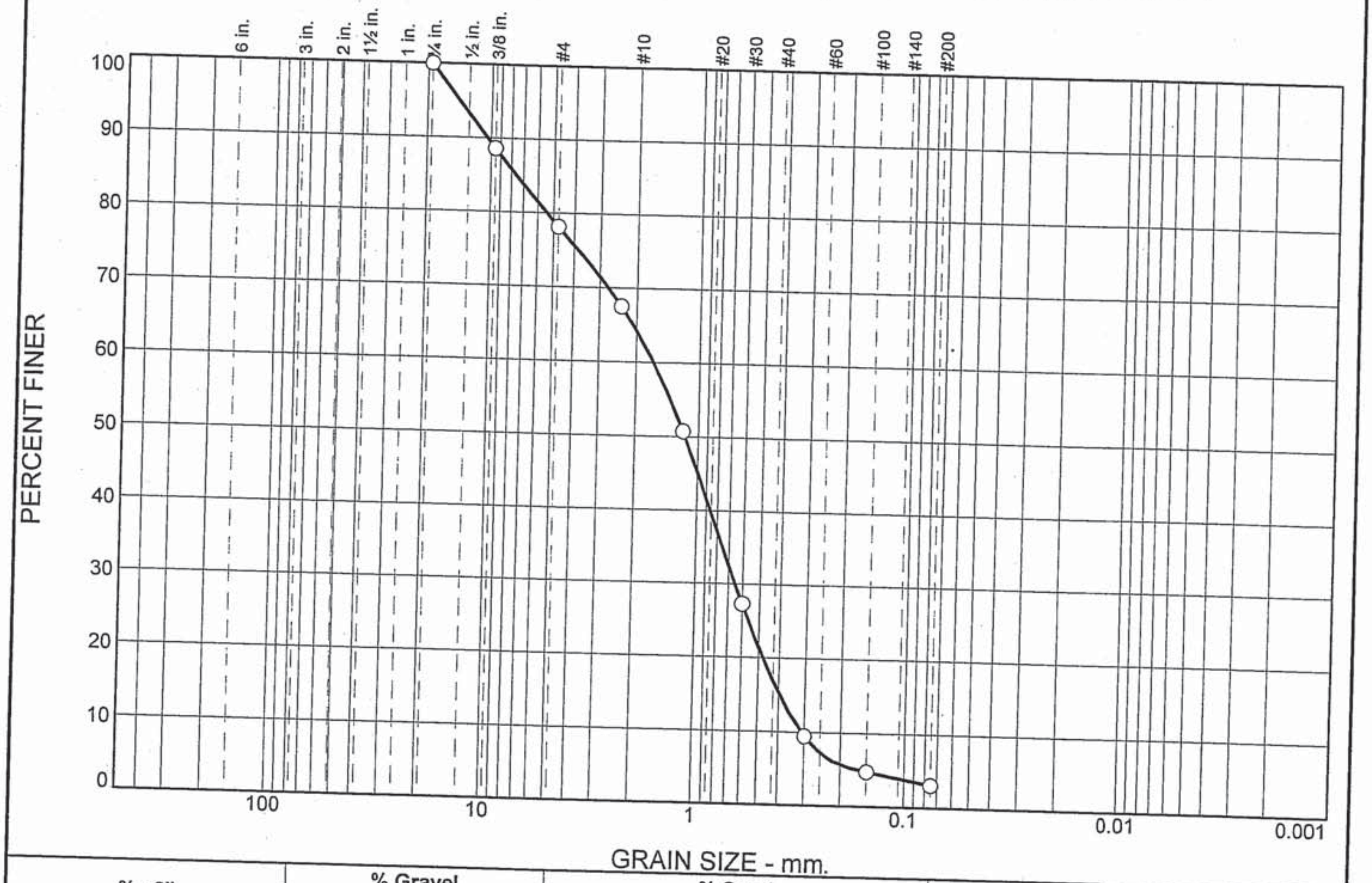
Sample No.: S-5 **Source of Sample:** B-84 **Date Sampled:**
Location:
Elev./Depth: 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-97

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	21.9	13.8	47.5	13.7	3.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	88.6		
#4	78.1		
#8	67.5		
#16	50.7		
#30	27.3		
#50	9.4		
#100	4.8		
#200	3.1		

* (no specification provided)

Material Description

SAND (SP), medium-grain, with traces of coarse- and fine-grain, with fine-gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 7.5591 D_{60}= 1.6529 D_{50}= 1.1527
D_{30}= 0.6495 D_{15}= 0.3959 D_{10}= 0.3109
C_u= 5.32 C_c= 0.82

Date Tested: 1/05/06 **Tested By:** RTH/JJP

Remarks

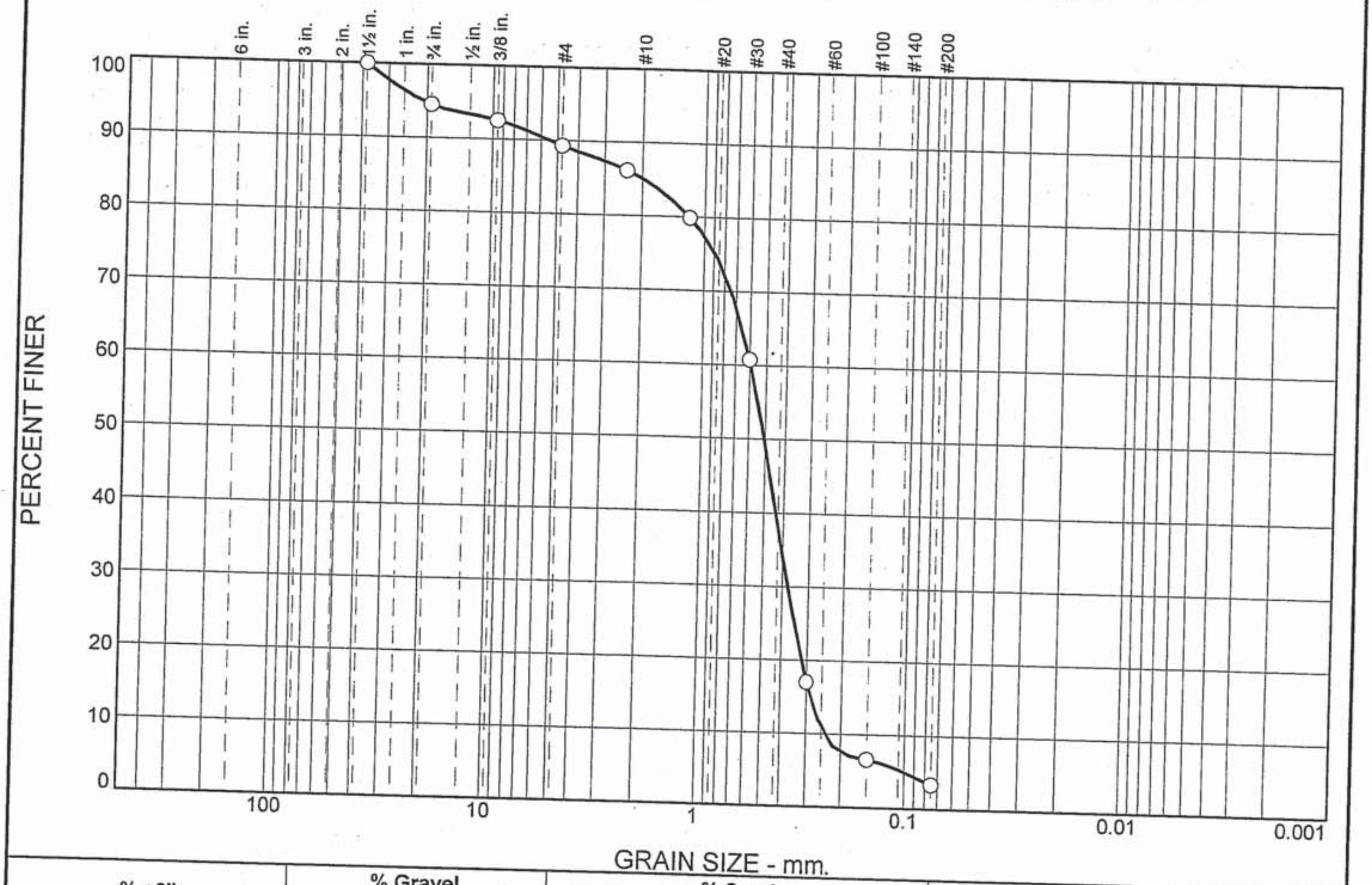
Sample No.: S-6 **Source of Sample:** B-84 **Date Sampled:**
Location:
Elev./Depth: 18
Checked By: J. Fouse
Title: P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-98

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	5.4	5.3	4.2	46.9	34.9	3.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	94.6		
3/8	92.6		
#4	89.3		
#8	86.1		
#16	79.9		
#30	60.7		
#50	17.0		
#100	6.6		
#200	3.3		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS= SP **AASHTO=**

Coefficients

D_{85}= 1.9781 D_{60}= 0.5919 D_{50}= 0.5037

D_{30}= 0.3771 D_{15}= 0.2858 D_{10}= 0.2402

C_u= 2.46 C_c= 1.00

Date Tested: 1/05/06 **Tested By:** RTH/JJP

Remarks

Sample No.: S-7 **Source of Sample:** B-84 **Date Sampled:**

Location:

Checked By: J. Fouse **Title:** P.E. **Elev./Depth:** 23

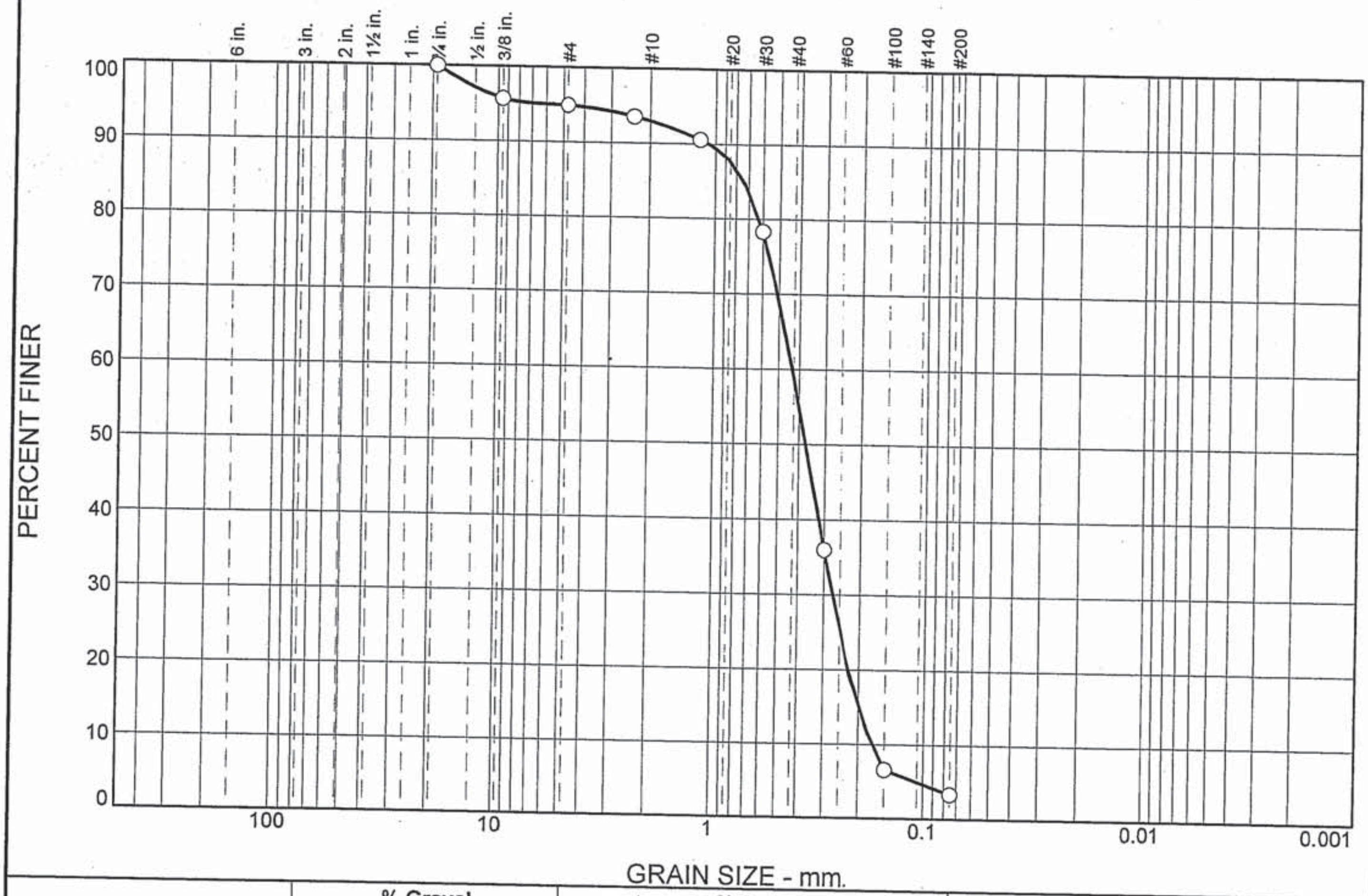
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-99

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.1	1.9	34.0	55.7	3.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	95.7		
#4	94.9		
#8	93.5		
#16	90.6		
#30	78.3		
#50	36.0		
#100	6.6		
#200	3.3		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.7365 D_{60}= 0.4317 D_{50}= 0.3715

D_{30}= 0.2712 D_{15}= 0.1985 D_{10}= 0.1717

C_u= 2.51 C_c= 0.99

Date Tested: 1/05/06 **Tested By:** RTH/JJP

Remarks

Sample No.: S-8 **Source of Sample:** B-84 **Date Sampled:**

Location: **Elev./Depth:** 28

Checked By: J. Fouse **Title:** P.E.

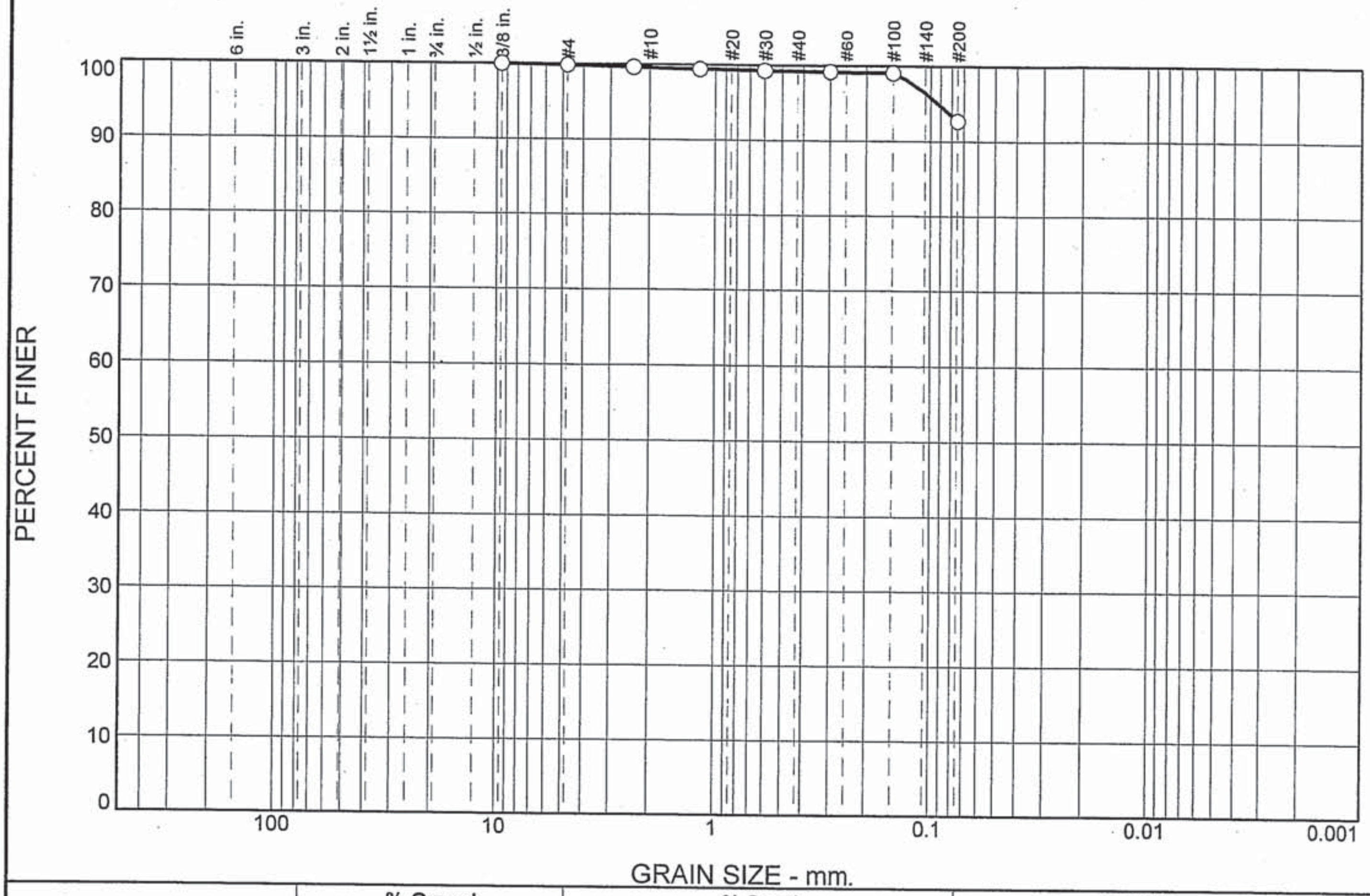
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-100

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.3	0.4	6.5	92.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#8	99.6		
#16	99.4		
#30	99.3		
#50	99.2		
#100	99.1		
#200	92.7		

* (no specification provided)

Material Description

SILT (ML), with fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/18/06 **Tested By:** JJP

Remarks

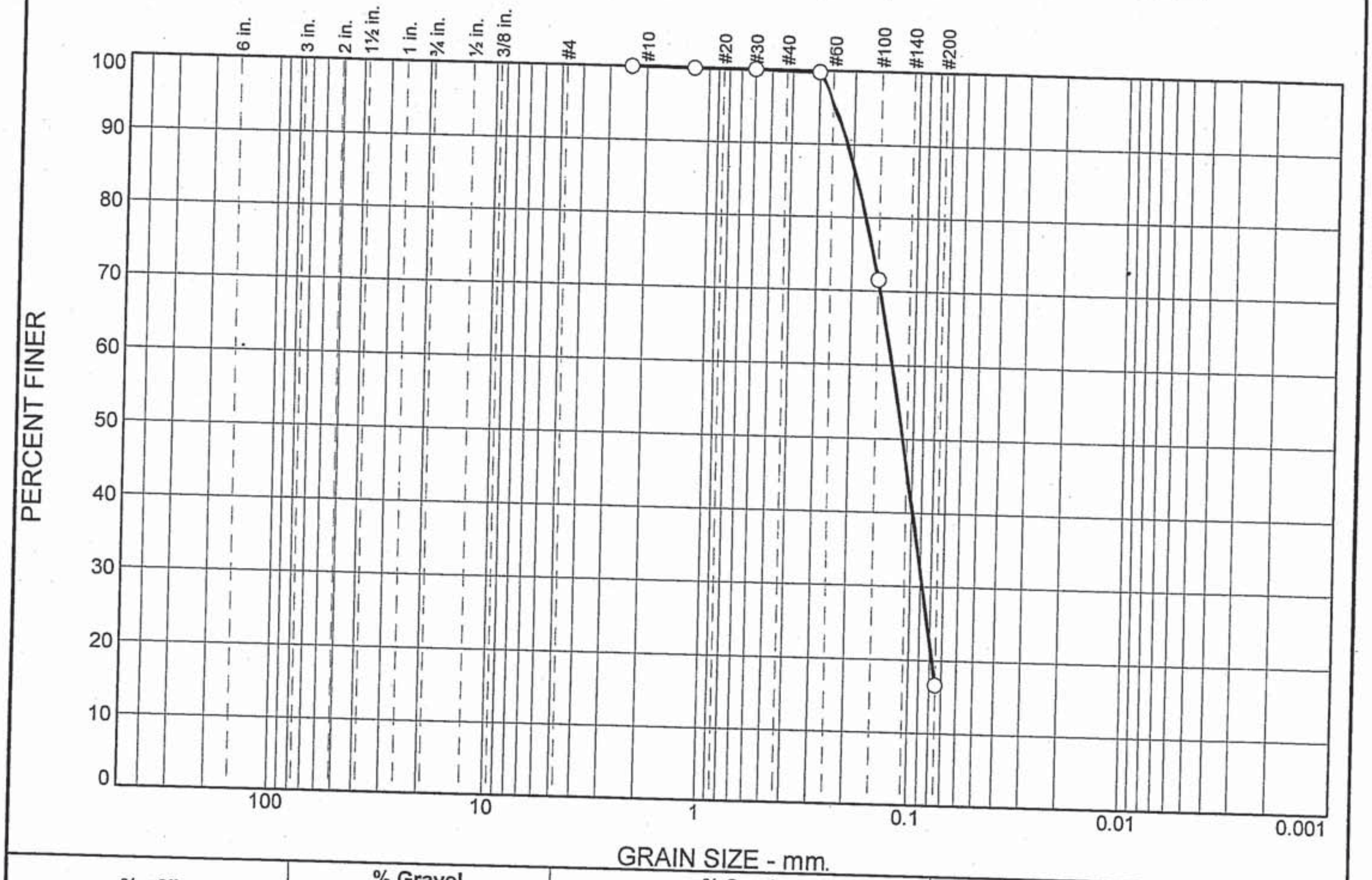
Sample No.: S-3 **Source of Sample:** B-85 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-101

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	83.3	16.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	100.0		
#30	100.0		
#50	99.8		
#100	71.6		
#200	16.6		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1902 D_{60}= 0.1270 D_{50}= 0.1115
D_{30}= 0.0876 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/18/06 **Tested By:** JJP

Remarks

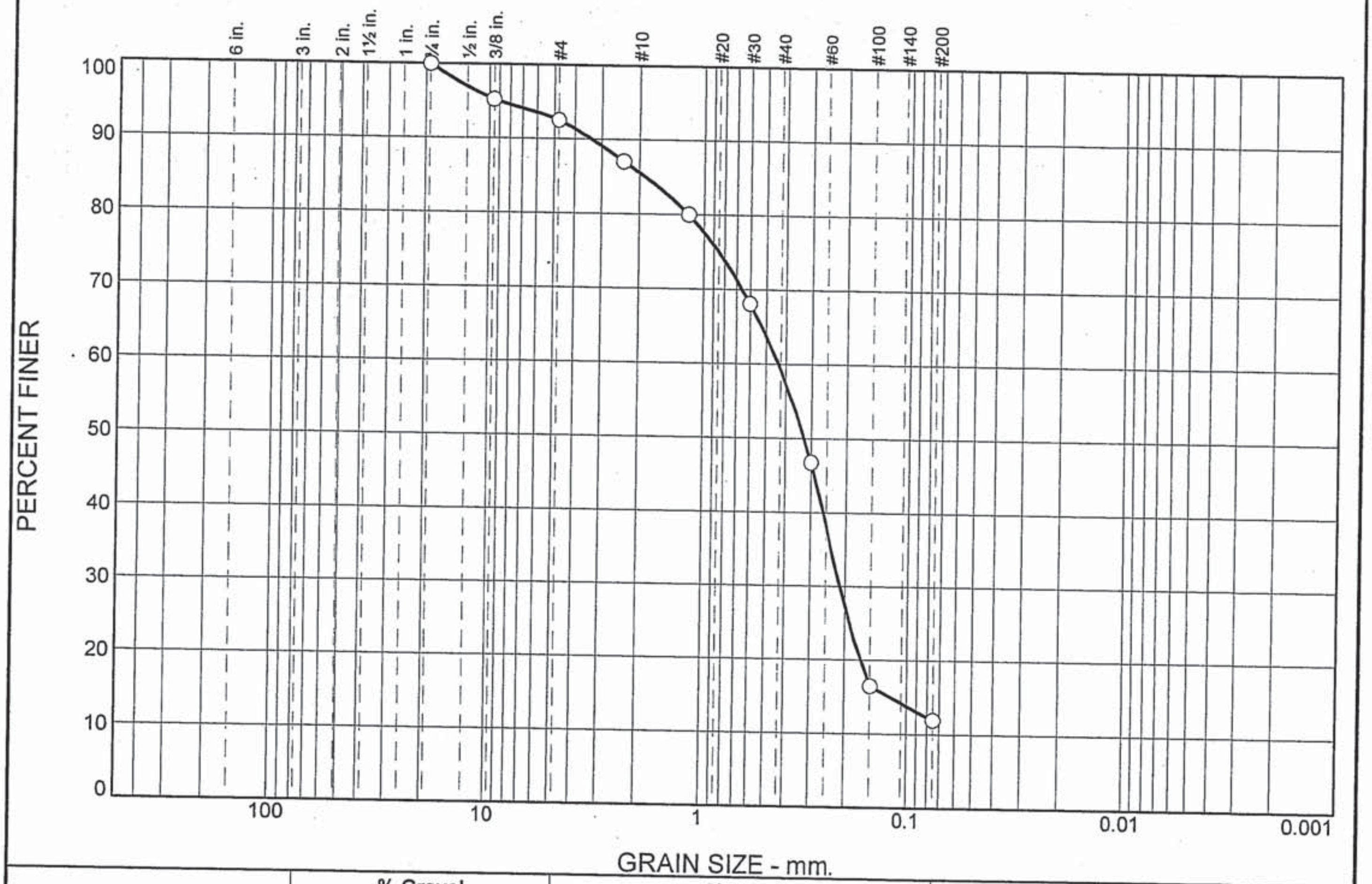
Sample No.: S-4 **Source of Sample:** B-85 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-102

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	7.5	7.0	26.2	47.4	11.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	95.2		
#4	92.5		
#8	87.0		
#16	80.0		
#30	68.1		
#50	46.8		
#100	16.5		
#200	11.9		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty, with traces of coarse-grain sand and fine-gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 1.8838 D_{60}= 0.4349 D_{50}= 0.3242

D_{30}= 0.2109 D_{15}= 0.1200 D_{10}=

C_u= C_c=

Date Tested: 1/18/06 **Tested By:** JJP

Remarks

Sample No.: S-5 **Source of Sample:** B-85 **Date Sampled:**

Location: **Elev./Depth:** 13

Checked By: J. Fouse **Title:** P.E.

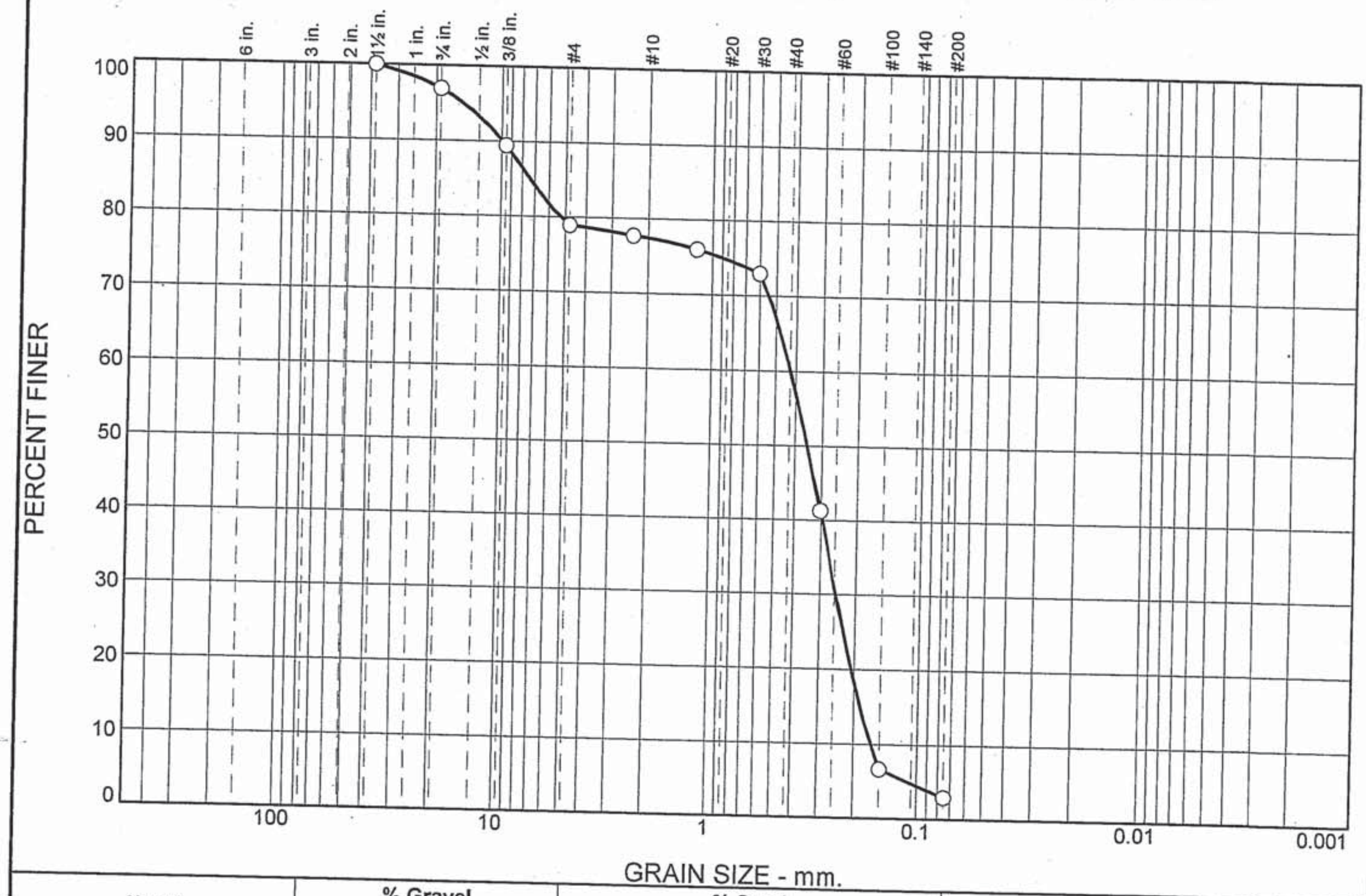
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-103

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.1	18.0	1.5	17.1	57.4	2.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	96.9		
3/8	89.5		
#4	78.9		
#8	77.7		
#16	76.0		
#30	72.9		
#50	41.3		
#100	6.7		
#200	2.9		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, with fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 7.3169 D_{60}= 0.4223 D_{50}= 0.3490
D_{30}= 0.2478 D_{15}= 0.1869 D_{10}= 0.1659
C_u= 2.55 C_c= 0.88

Date Tested: 1/18/06 **Tested By:** JJP

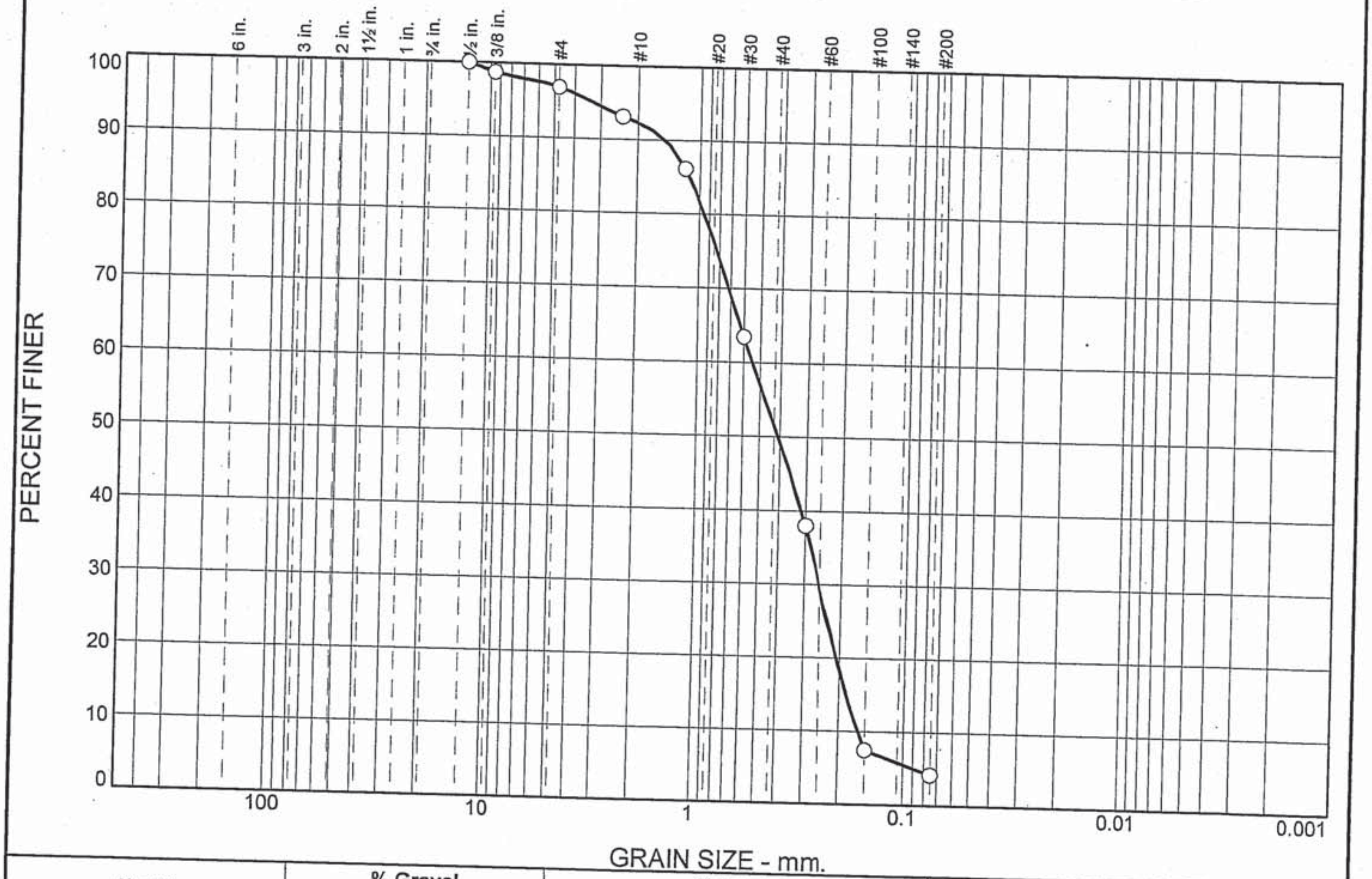
Remarks

Sample No.: S-8 **Source of Sample:** B-85 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-104

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.1	4.6	40.8	47.3	4.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
3/8	98.7		
#4	96.9		
#8	93.1		
#16	86.1		
#30	63.4		
#50	38.0		
#100	7.4		
#200	4.2		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.1259 D_{60}= 0.5443 D_{50}= 0.4068

D_{30}= 0.2538 D_{15}= 0.1855 D_{10}= 0.1631

C_u= 3.34 C_c= 0.73

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

Sample No.: S-5 **Source of Sample:** B-86 **Date Sampled:**

Location: **Elev./Depth:** 13

Checked By: K. Kocher **Title:** P.E.

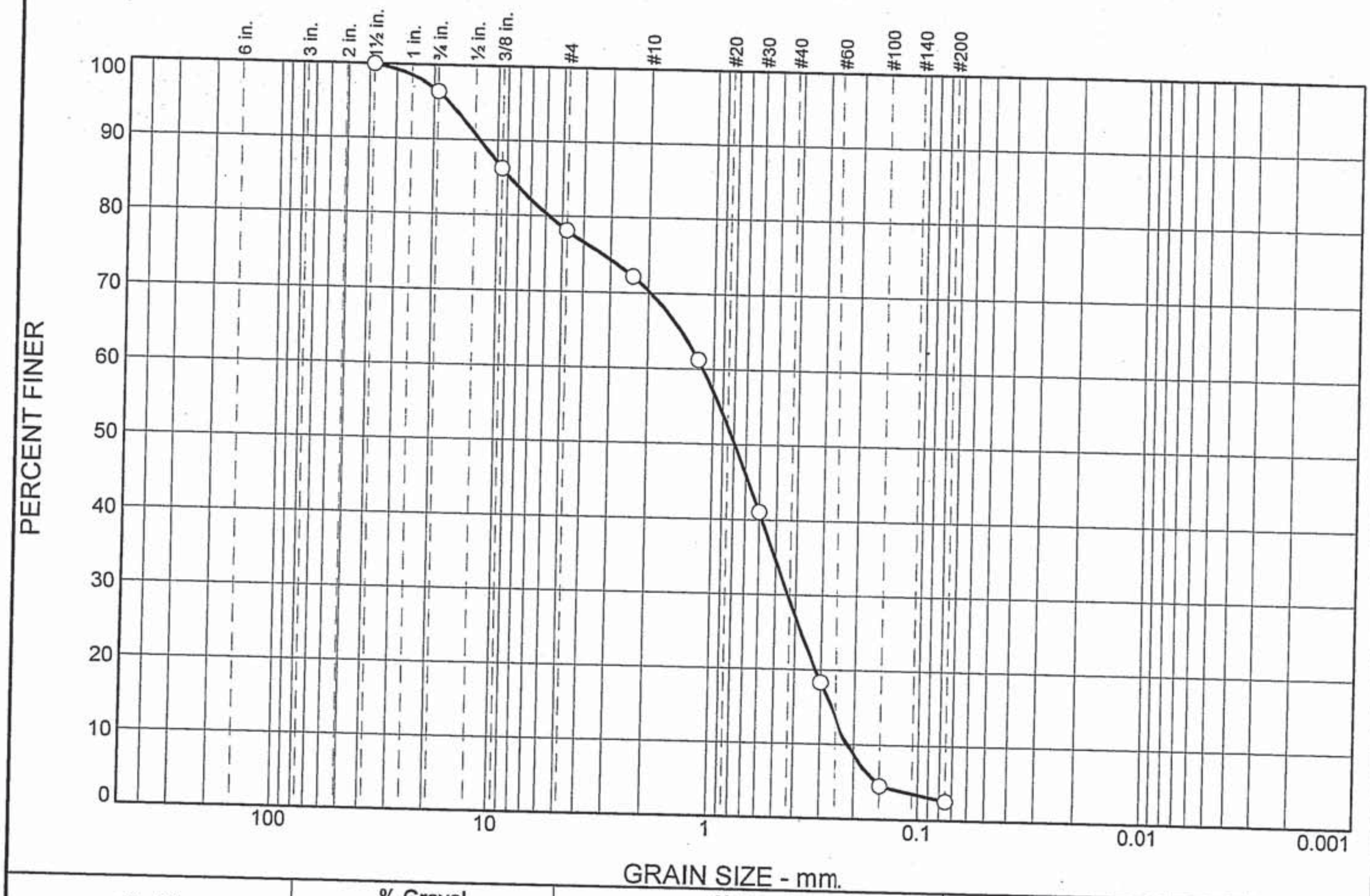
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-105

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.6	18.3	7.8	41.0	26.7	2.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
3/4	96.4		
3/8	86.2		
#4	78.1		
#8	72.2		
#16	61.2		
#30	41.1		
#50	18.3		
#100	4.5		
#200	2.6		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, trace of coarse-grain sand, with fine gravel

Atterberg Limits (ASTM D 4318)

PL=
LL=
PI=

Classification

USCS=
AASHTO=

Coefficients

D_{85}= 8.7464
D_{60}= 1.1212
D_{50}= 0.7873
D_{30}= 0.4343
D_{15}= 0.2657
D_{10}= 0.2143
C_u= 5.23
C_c= 0.79

Date Tested: 1/16/06 **Tested By:** jcrose

Remarks

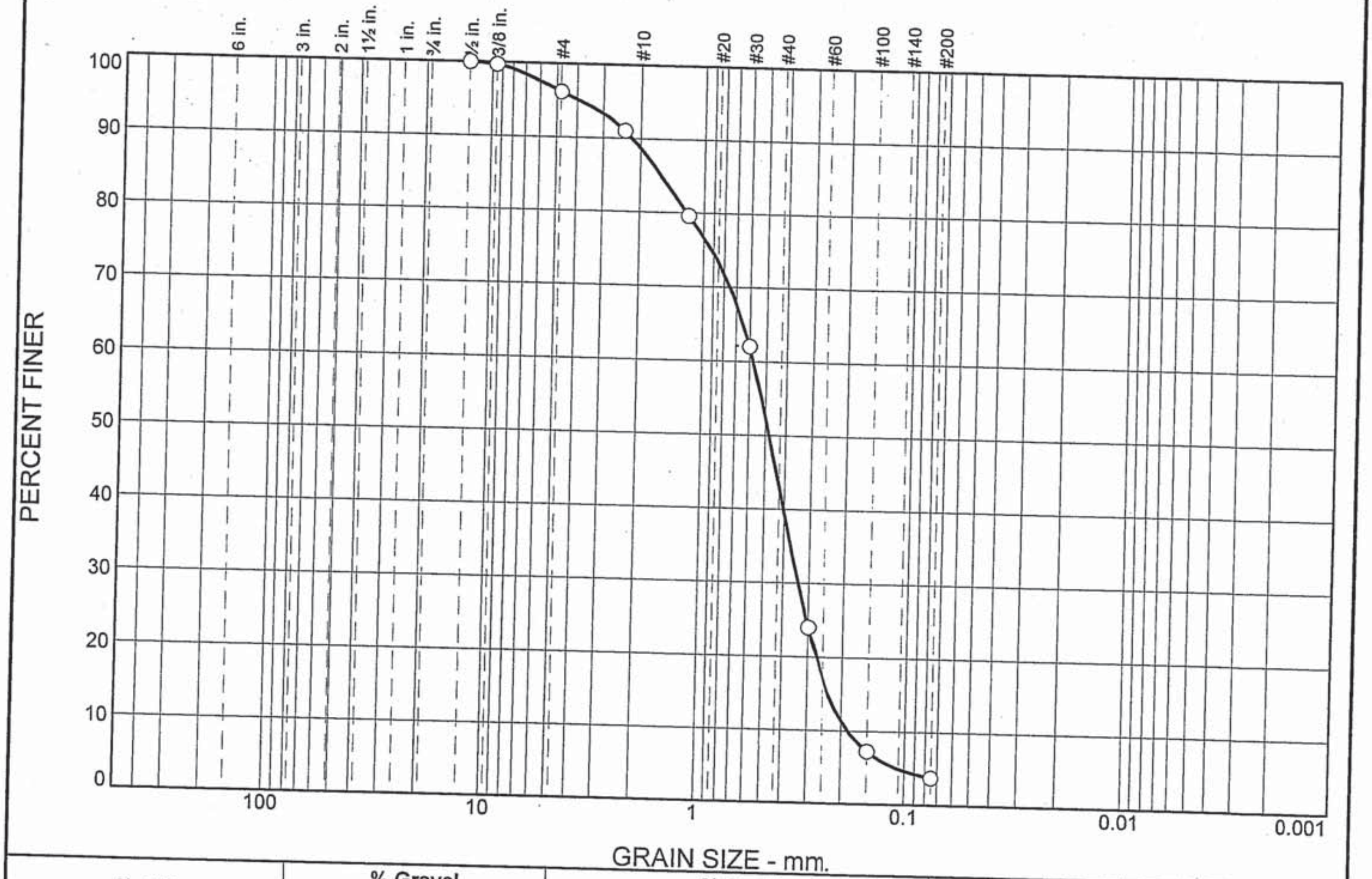
Sample No.: S-7 **Source of Sample:** B-86
Location:
Date Sampled:
Checked By:
Elev./Depth: 23
Title:

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477

Figure B1-106

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.8	7.5	45.5	39.5	3.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5	100.0		
3/8	99.7		
#4	96.2		
#8	91.0		
#16	79.6		
#30	62.0		
#50	24.0		
#100	7.2		
#200	3.7		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.5944 D_{60}= 0.5743 D_{50}= 0.4768
D_{30}= 0.3383 D_{15}= 0.2344 D_{10}= 0.1865
C_u= 3.08 C_c= 1.07

Date Tested: 1/16/06 **Tested By:** J. Crose

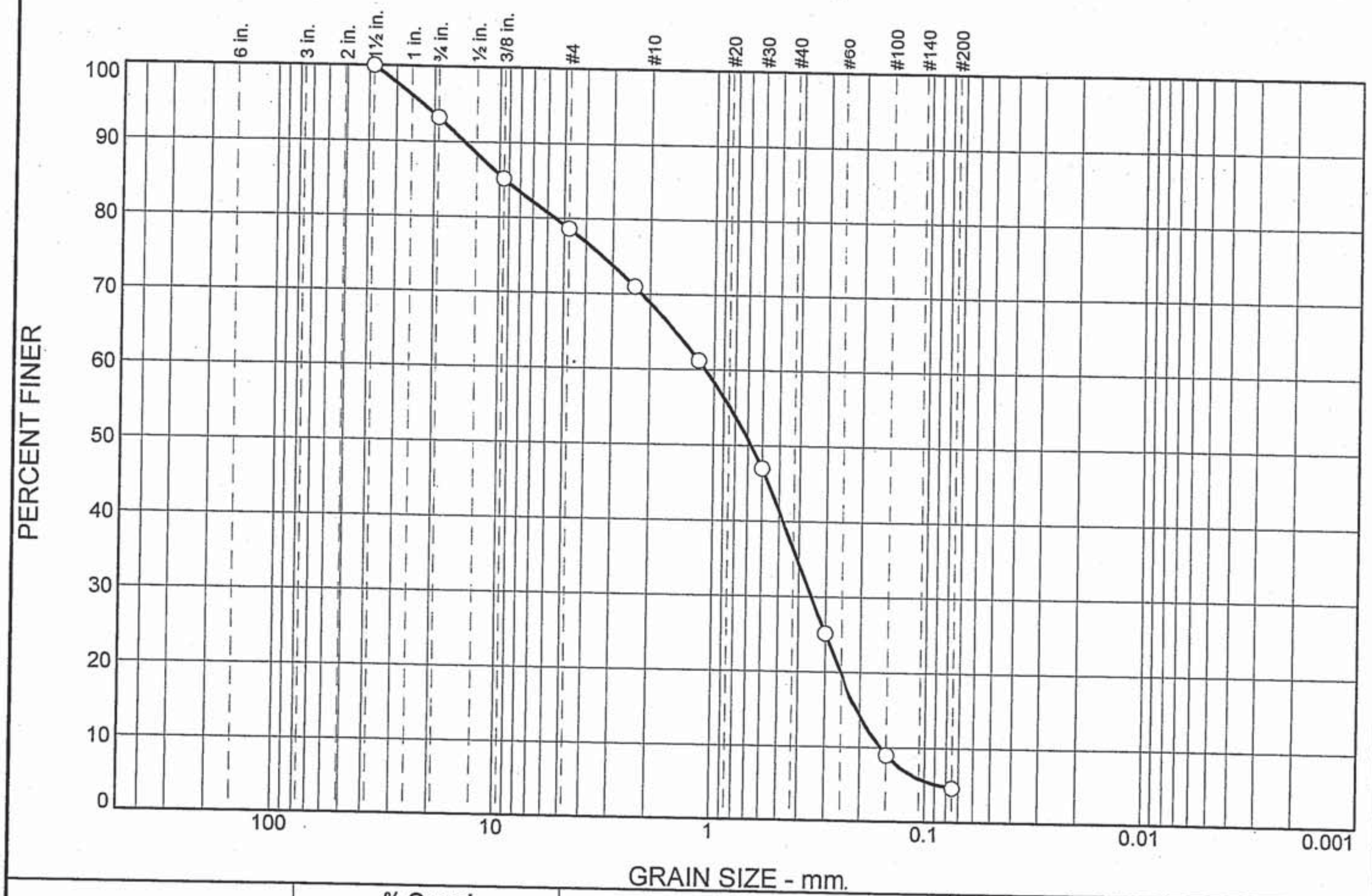
Remarks

Sample No.: S-5 **Source of Sample:** B-87 **Date Sampled:**
Location:
Checked By: K. Kocher **Title:** P.E. **Elev./Depth:** 13

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-107

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	6.8	14.6	9.7	32.5	31.8	4.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
3/4	93.2		
3/8	85.2		
#4	78.6		
#8	71.0		
#16	61.2		
#30	47.0		
#50	25.1		
#100	9.0		
#200	4.6		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, with trace of coarse-grain sand, with traces of fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 9.3614 D_{60}= 1.0981 D_{50}= 0.6731
D_{30}= 0.3500 D_{15}= 0.2072 D_{10}= 0.1609
C_u= 6.83 C_c= 0.69

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

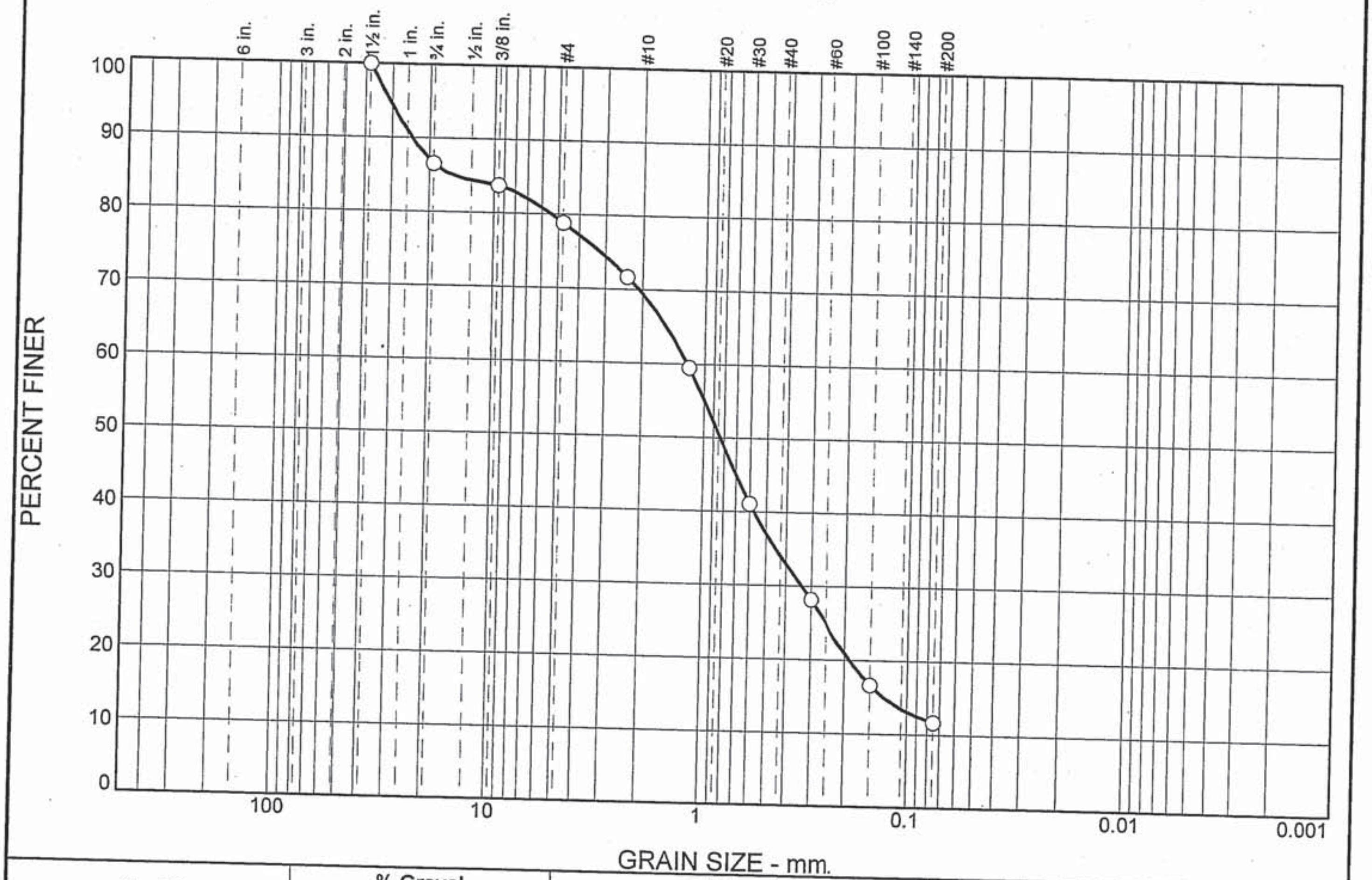
Sample No.: S-6 **Source of Sample:** B-87 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-108

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	13.5	7.7	9.3	35.4	22.5	11.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
3/4	86.5		
3/8	83.7		
#4	78.8		
#8	71.7		
#16	59.5		
#30	41.0		
#50	28.2		
#100	16.6		
#200	11.6		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty, with traces of coarse-grain sand and fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 15.5454 D_{60}= 1.2049 D_{50}= 0.8351
D_{30}= 0.3343 D_{15}= 0.1291 D_{10}=
C_u= C_c=

Date Tested: 1/16/06 **Tested By:** J. Crose

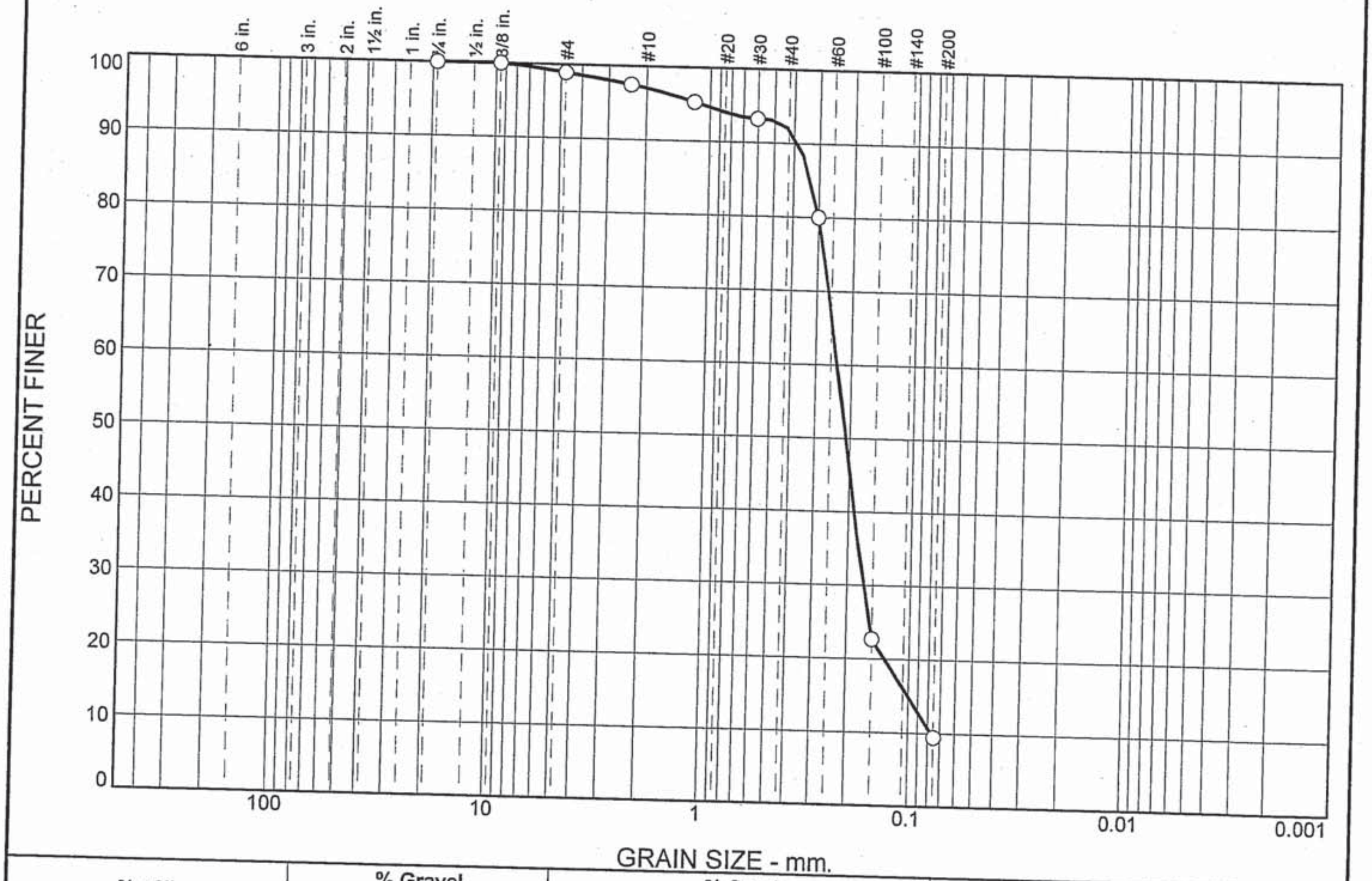
Remarks

Sample No.: S-7 **Source of Sample:** B-87
Location:
Checked By: K. Kocher **Title:** P.E.
Date Sampled:
Elev./Depth: 23

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-109

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.1	1.9	5.1	82.5	9.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	100.0		
#4	98.9		
#8	97.5		
#16	95.3		
#30	93.2		
#50	80.0		
#100	22.7		
#200	9.4		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.3299 D_{60}= 0.2326 D_{50}= 0.2089

D_{30}= 0.1664 D_{15}= 0.1003 D_{10}= 0.0773

C_u= 3.01 C_c= 1.54

Date Tested: 1/16/06 **Tested By:** J.Crose

Remarks

Sample No.: S-5 **Source of Sample:** B-88 **Date Sampled:**

Location: **Elev./Depth:** 13

Checked By: K. Kocher **Title:** P.E.

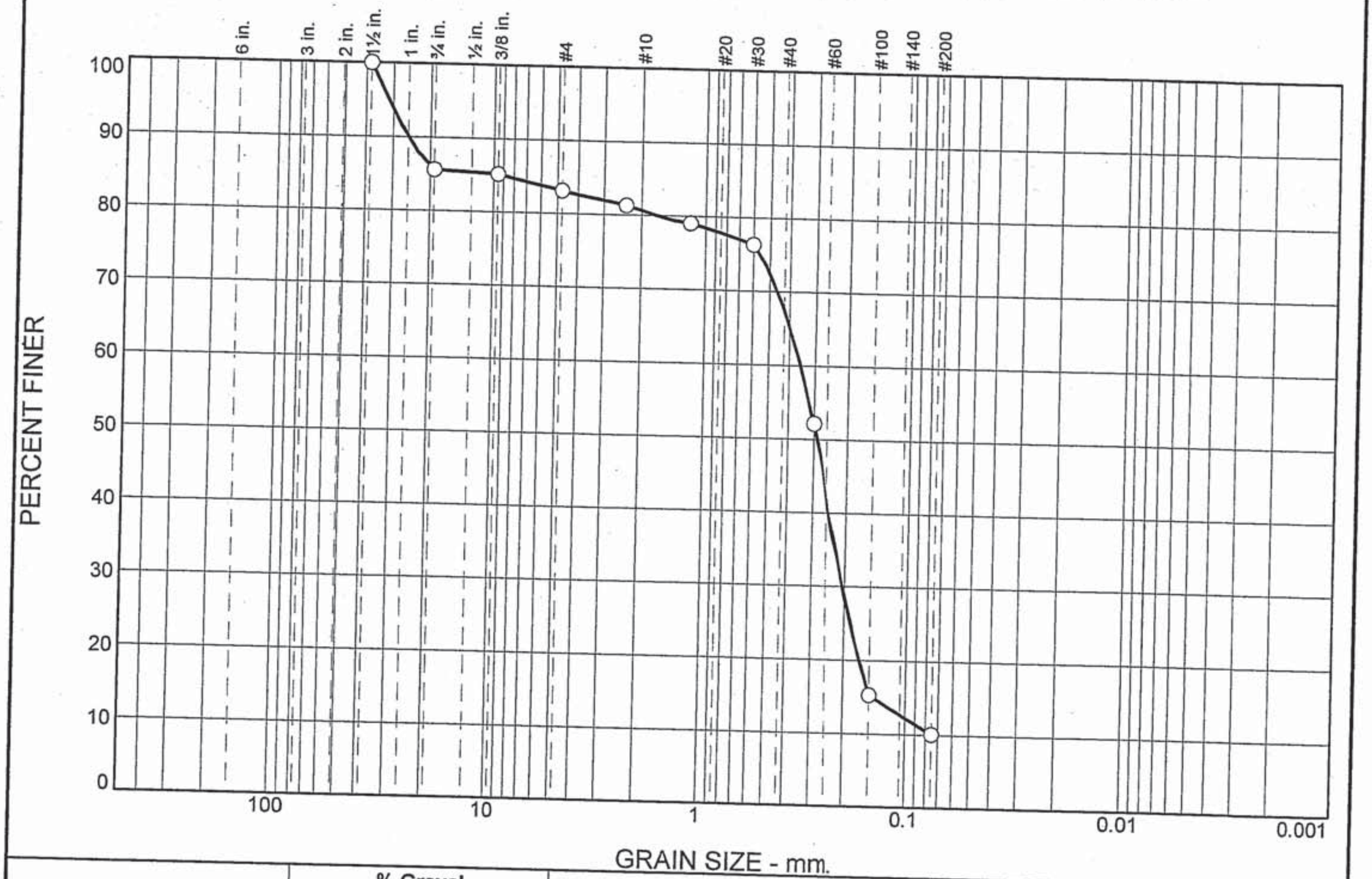
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-110

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.4	2.5	2.4	13.1	57.5	10.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
3/4	85.6		
3/8	85.2		
#4	83.1		
#8	81.3		
#16	79.1		
#30	76.3		
#50	52.1		
#100	15.3		
#200	10.1		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty, with coarse gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 9.0018 D_{60}= 0.3516 D_{50}= 0.2885
D_{30}= 0.2050 D_{15}= 0.1439 D_{10}=
C_u= C_c=

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

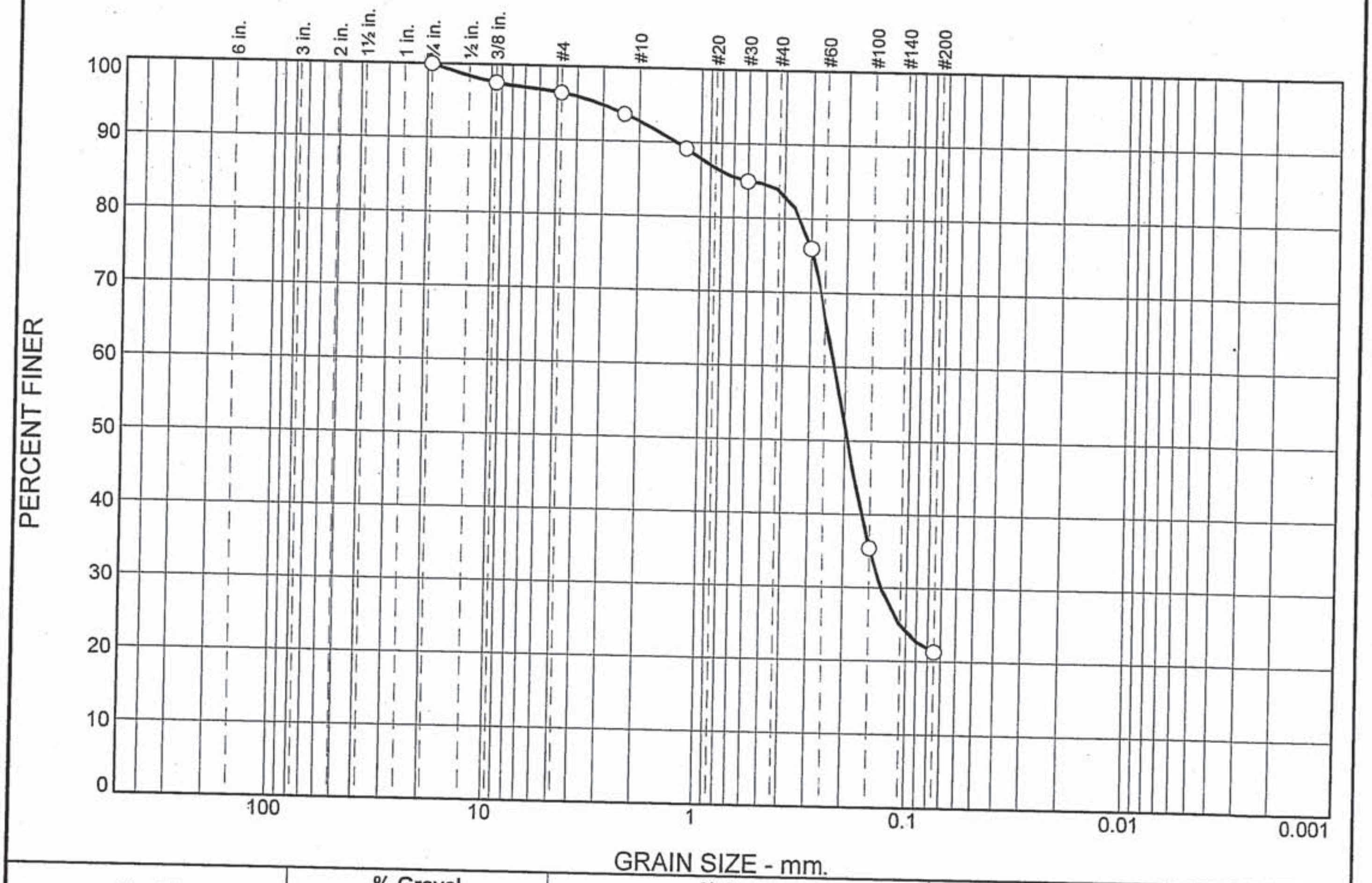
Sample No.: S-7 **Source of Sample:** B-88 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-111

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.6	3.7	8.9	62.5	21.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
3/8	97.5		
#4	96.4		
#8	93.7		
#16	89.1		
#30	84.9		
#50	76.0		
#100	35.4		
#200	21.3		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain, with traces of medium-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.6217 D_{60}= 0.2249 D_{50}= 0.1930
D_{30}= 0.1310 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/16/06 **Tested By:** J. Crose

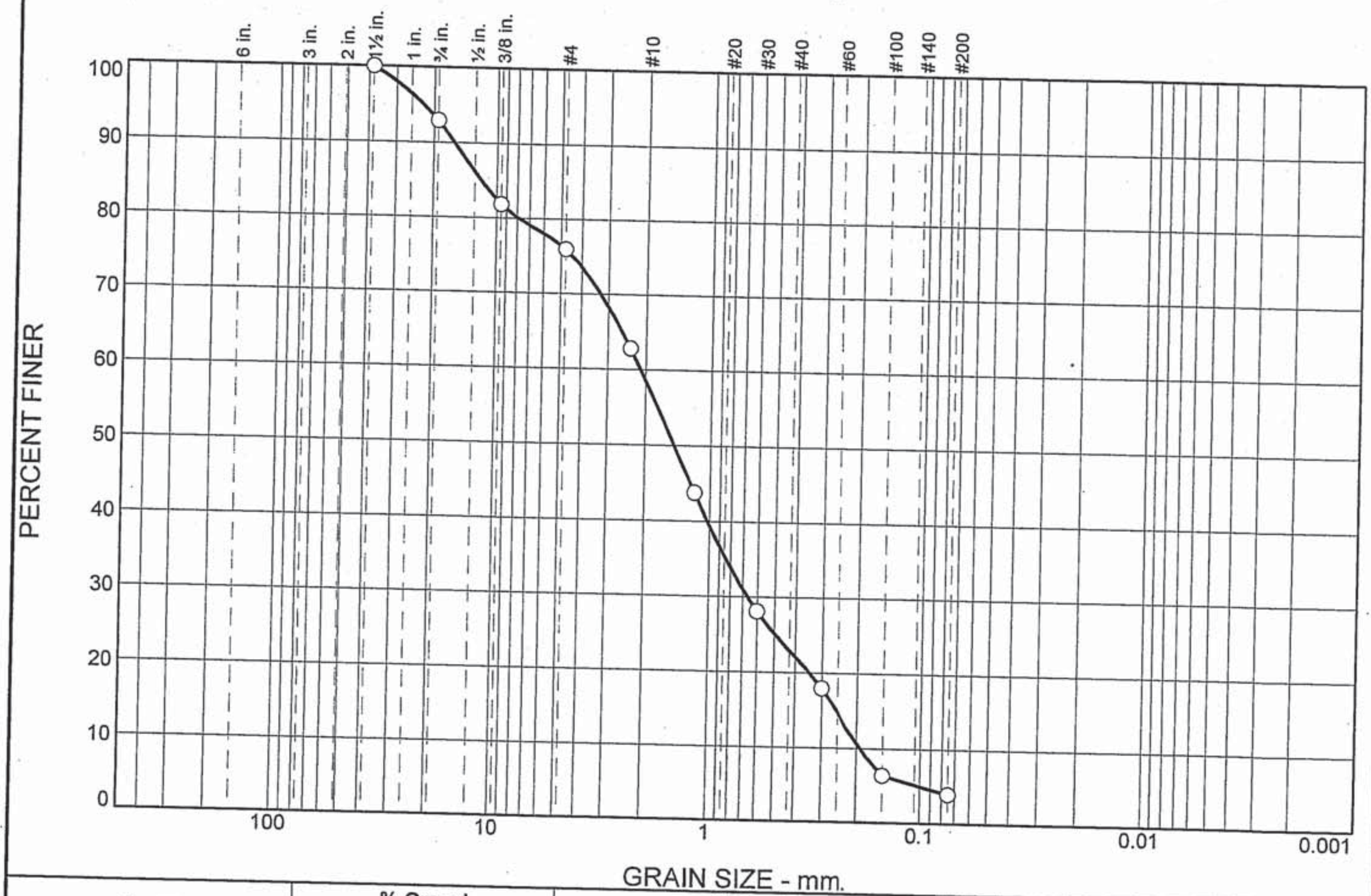
Remarks

Sample No.: S-5 **Source of Sample:** B-89 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-112

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.1	16.9	17.5	35.5	19.1	3.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
3/4	92.9		
3/8	81.9		
#4	76.0		
#8	62.8		
#16	43.8		
#30	28.1		
#50	18.0		
#100	6.4		
#200	3.9		

* (no specification provided)

Material Description

SAND (SW), well graded, with fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW AASHTO=

Coefficients

D_{85}= 11.8609 D_{60}= 2.1185 D_{50}= 1.4748
D_{30}= 0.6642 D_{15}= 0.2533 D_{10}= 0.1926
C_u= 11.00 C_c= 1.08

Date Tested: 1/16/06 **Tested By:** J Crose

Remarks

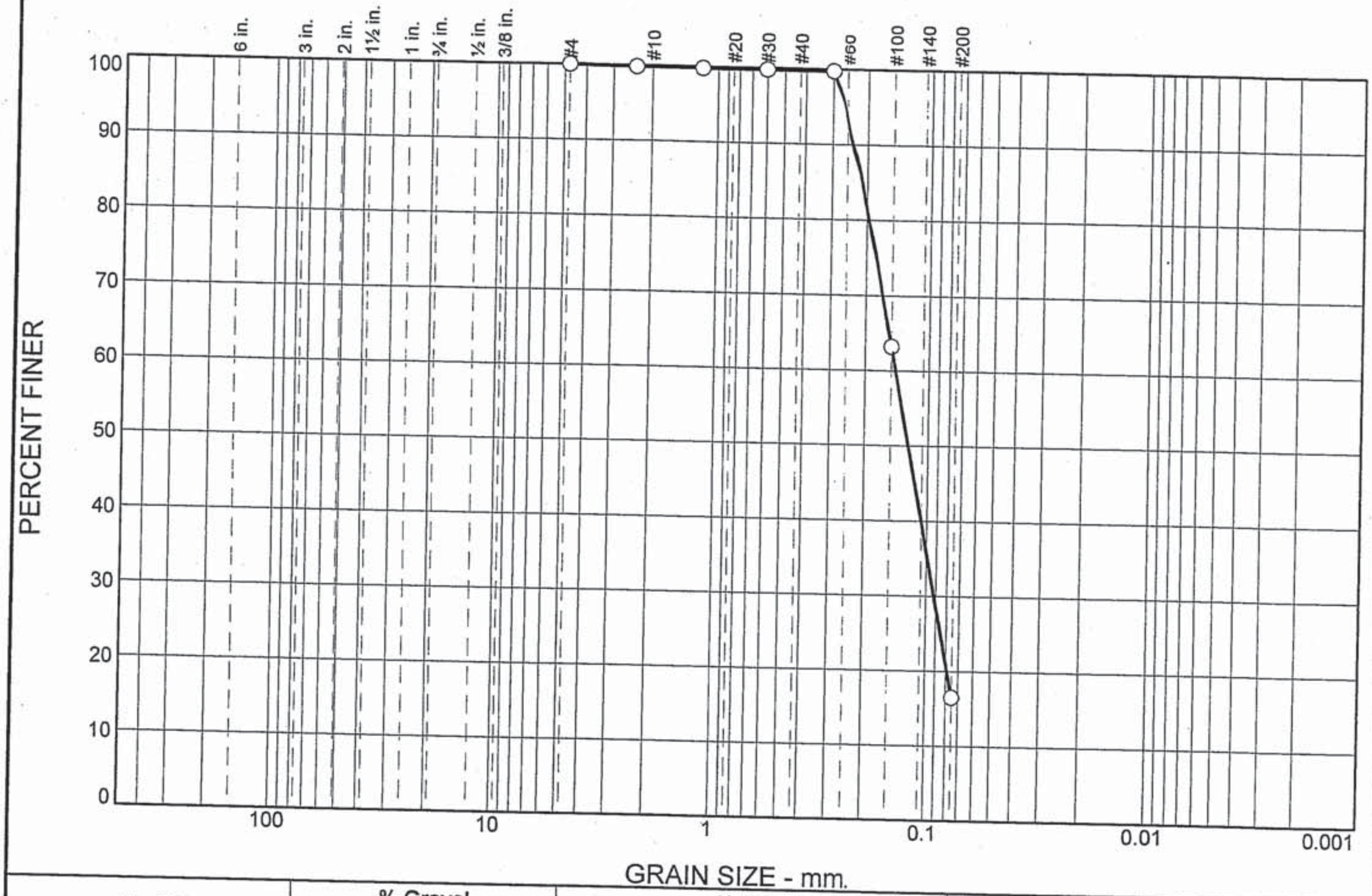
Sample No.: S-6 **Source of Sample:** B-89 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-113

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	0.0	83.3	16.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.8		
#30	99.8		
#50	99.8		
#100	63.2		
#200	16.5		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.2114 D_{60}= 0.1430 D_{50}= 0.1232

D_{30}= 0.0916 D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/23/06 **Tested By:** JJP

Remarks

Sample No.: S-4 **Source of Sample:** B-90

Location:

Date Sampled:

Elev./Depth: 9

Checked By: J. Fouse **Title:** P.E.

Reitz & Jens, Inc.
Consulting Engineers

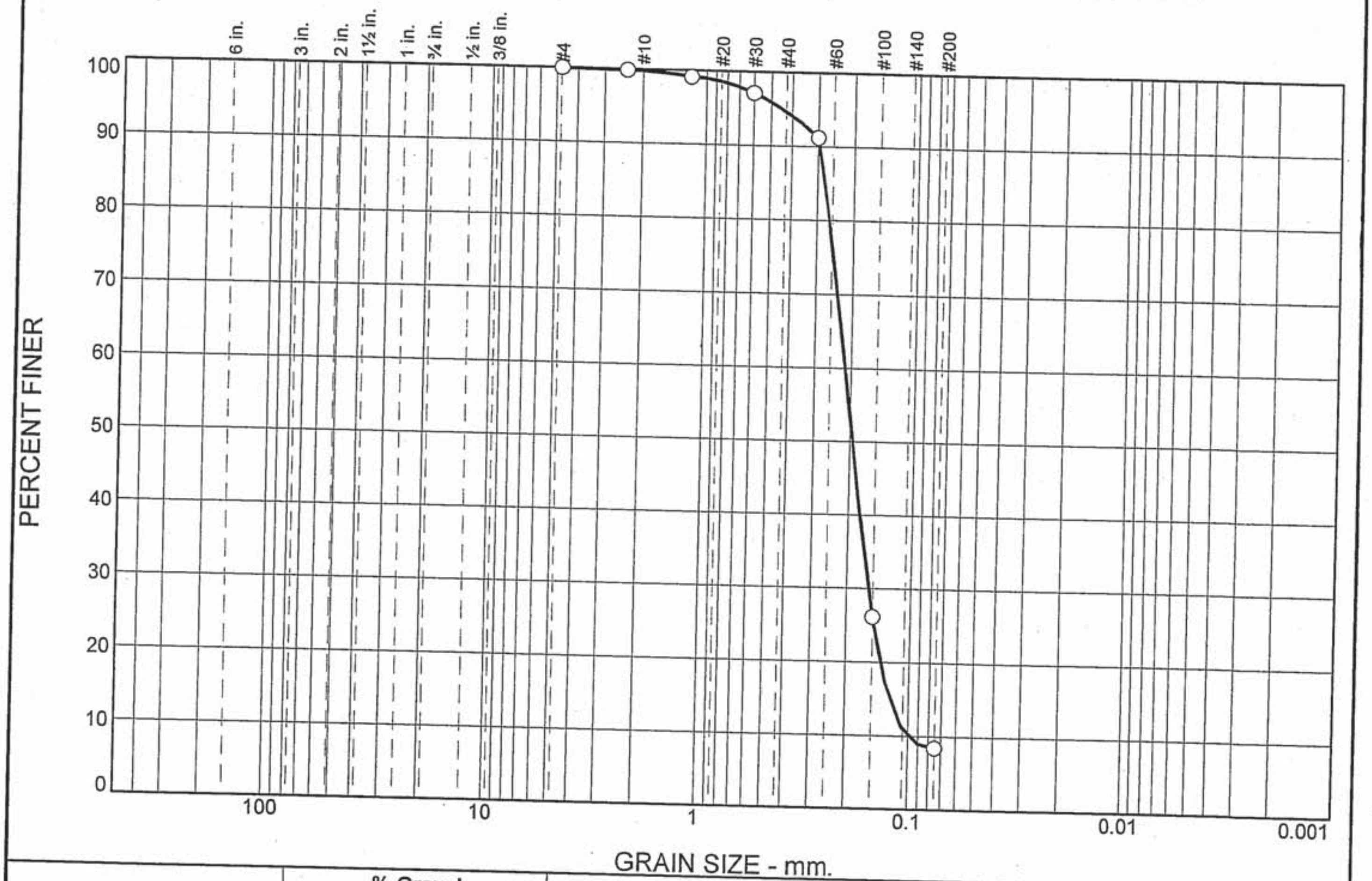
Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477

Figure B1-114

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	5.1	86.3	8.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.1		
#30	97.1		
#50	91.2		
#100	26.1		
#200	8.4		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2747 D_{60}= 0.2123 D_{50}= 0.1934
D_{30}= 0.1575 D_{15}= 0.1225 D_{10}= 0.1002
C_u= 2.12 C_c= 1.17

Date Tested: 1/23/06 **Tested By:** JJP

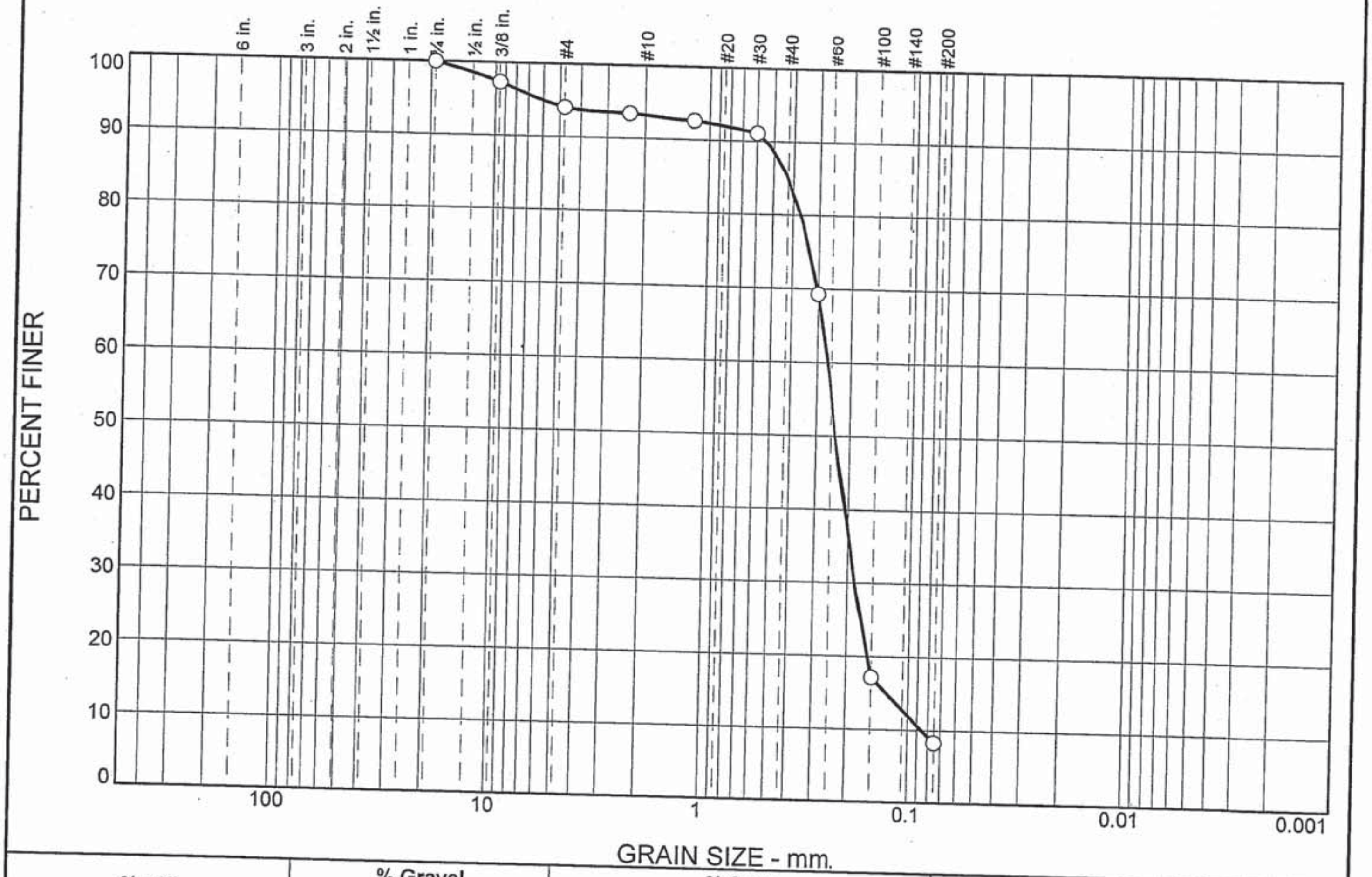
Remarks

Sample No.: S-6 **Source of Sample:** B-90 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-115

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.0	0.8	8.1	76.8	8.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
3/8	97.3		
#4	94.0		
#8	93.4		
#16	92.6		
#30	91.1		
#50	69.3		
#100	17.1		
#200	8.3		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty, trace medium-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP- SM AASHTO=

Coefficients

D_{85}= 0.4239 D_{60}= 0.2638 D_{50}= 0.2332
D_{30}= 0.1827 D_{15}= 0.1269 D_{10}= 0.0859
C_u= 3.07 C_c= 1.47

Date Tested: 1/16/06 **Tested By:** J. Crose

Remarks

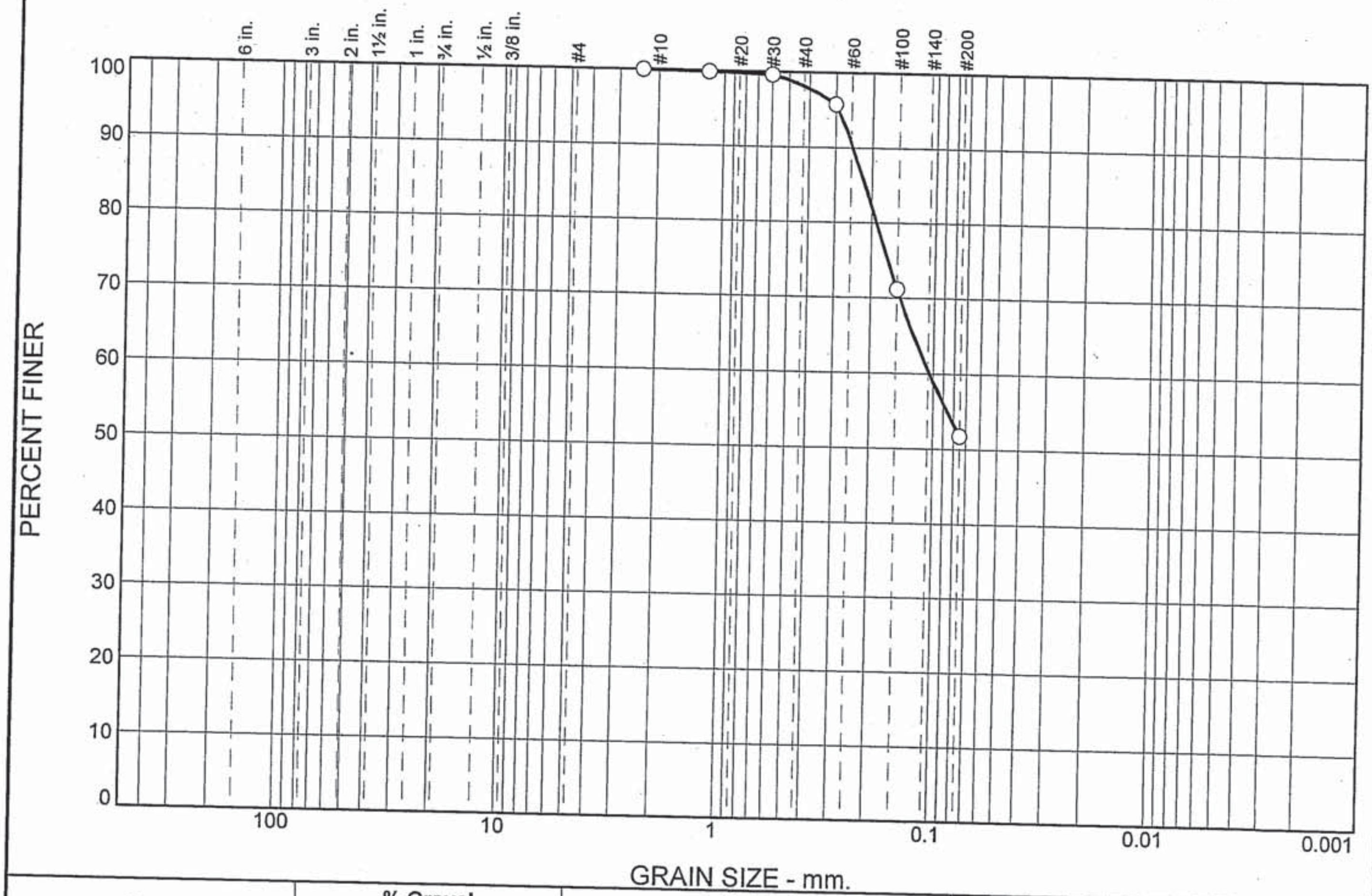
Sample No.: S-7 **Source of Sample:** B-90 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-116

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.8	46.5	51.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.6		
#50	95.8		
#100	71.1		
#200	51.7		

* (no specification provided)

Material Description

SILT (ML), with fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.2139 D_{60}= 0.1046 D_{50}=

D_{30}= D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

Sample No.: S-4 **Source of Sample:** B-91 **Date Sampled:**

Location: **Elev./Depth:** 9

Checked By: J. Fouse **Title:** P.E.

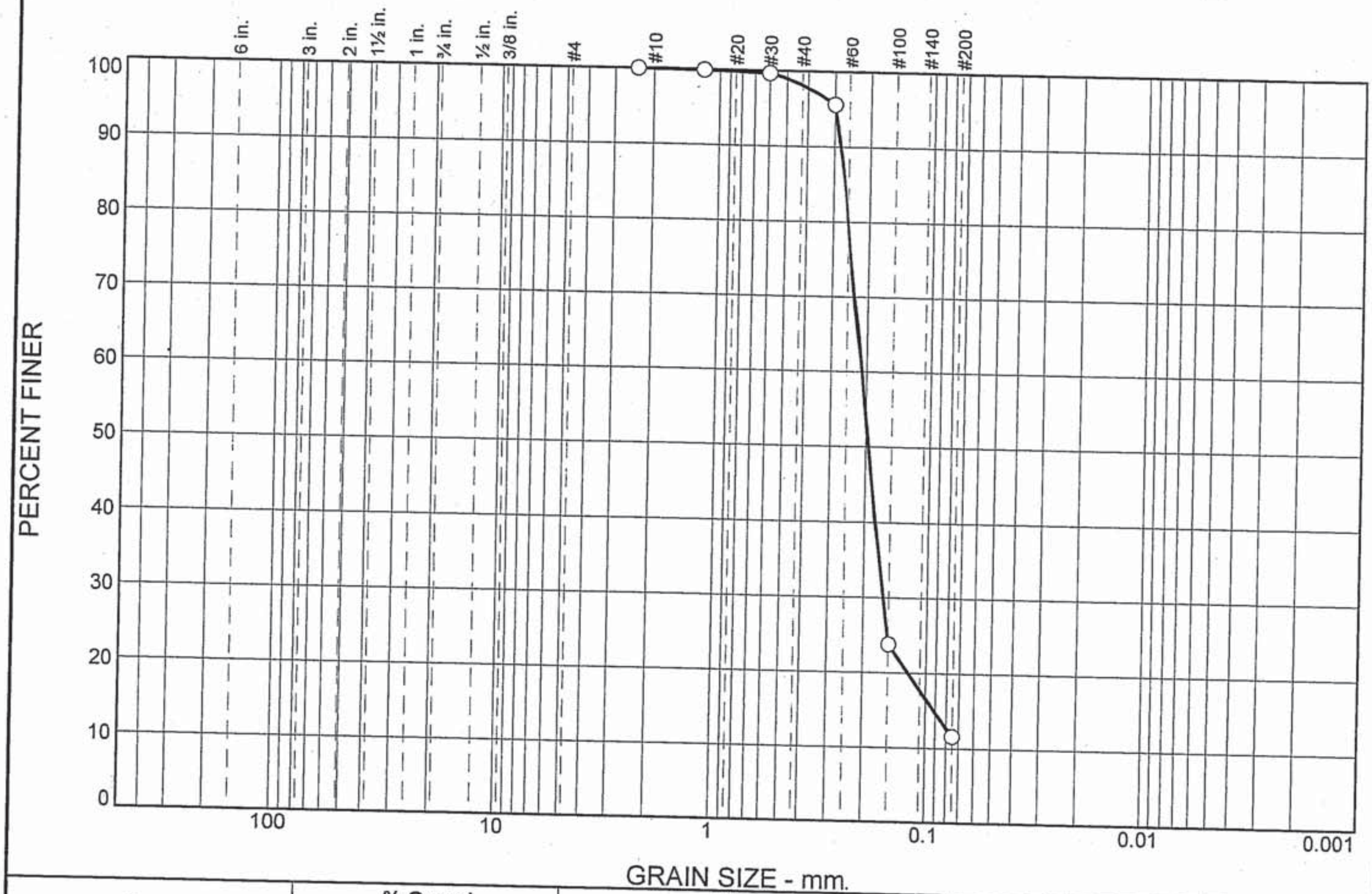
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-117

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.9	86.5	11.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.7		
#50	95.6		
#100	23.8		
#200	11.6		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2637 D_{60}= 0.2109 D_{50}= 0.1939
D_{30}= 0.1612 D_{15}= 0.0910 D_{10}=
C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

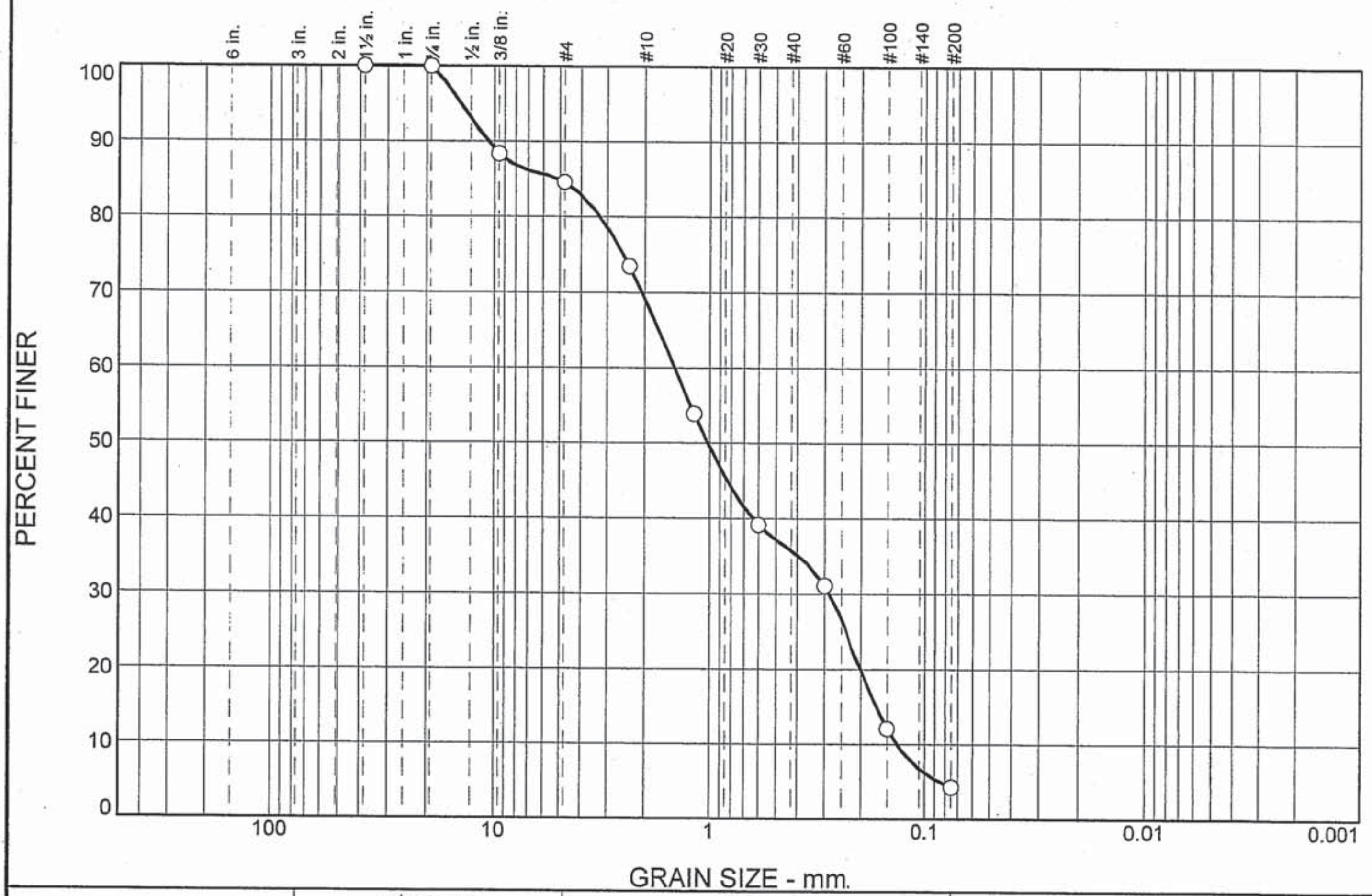
Remarks

Sample No.: S-5 **Source of Sample:** B-91 **Date Sampled:**
Location:
Elev./Depth: 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-118

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	15.4	15.4	33.4	31.5	4.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	100.0		
3/8	88.3		
#4	84.6		
#8	73.5		
#16	53.9		
#30	39.1		
#50	31.1		
#100	12.1		
#200	4.3		

* (no specification provided)

Material Description

SAND (SP), coarse-, medium-, and fine-grained, with fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 5.1075 D_{60}= 1.4559 D_{50}= 1.0226
D_{30}= 0.2850 D_{15}= 0.1685 D_{10}= 0.1353
C_u= 10.76 C_c= 0.41

Date Tested: 1/06/06 **Tested By:** RTH/JJP

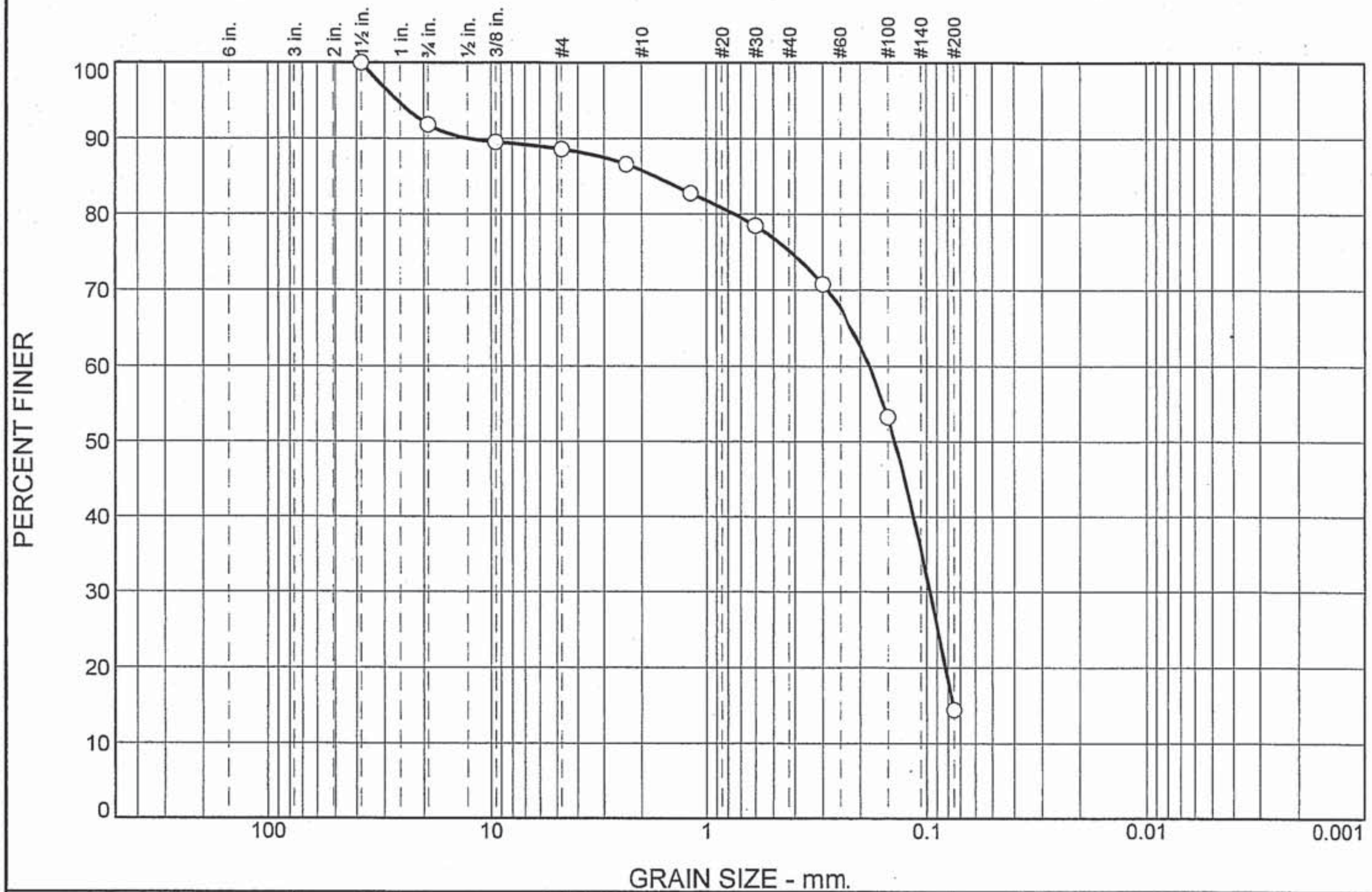
Remarks

Sample No.: S-6 **Source of Sample:** B-91 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-119

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.2	3.2	2.8	10.5	60.9	14.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	91.8		
3/8	89.5		
#4	88.6		
#8	86.6		
#16	82.8		
#30	78.5		
#50	70.8		
#100	53.3		
#200	14.4		

* (no specification provided)

Material Description

Silty SAND (SM), medium- to fine-grain, trace of coarse gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 1.7257 D_{60}= 0.1811 D_{50}= 0.1392
D_{30}= 0.0963 D_{15}= 0.0757 D_{10}=
C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

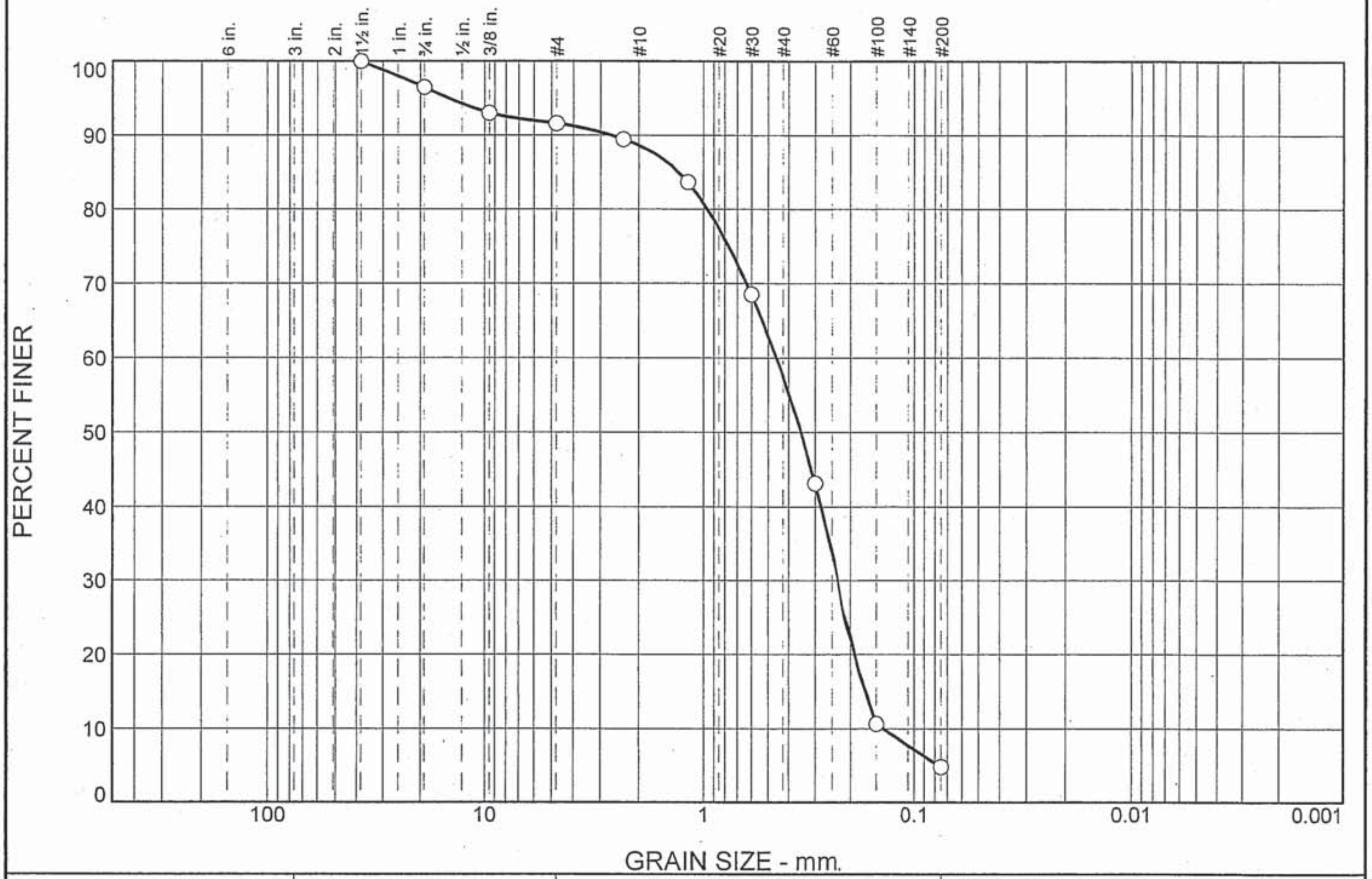
Sample No.: S-7 **Source of Sample:** B-91 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-120

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.5	4.9	2.9	31.1	52.8	4.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	96.5		
3/8	93.0		
#4	91.6		
#8	89.5		
#16	83.7		
#30	68.5		
#50	43.2		
#100	10.6		
#200	4.8		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.3022 D_{60}= 0.4554 D_{50}= 0.3494
D_{30}= 0.2321 D_{15}= 0.1697 D_{10}= 0.1391
C_u= 3.27 C_c= 0.85

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

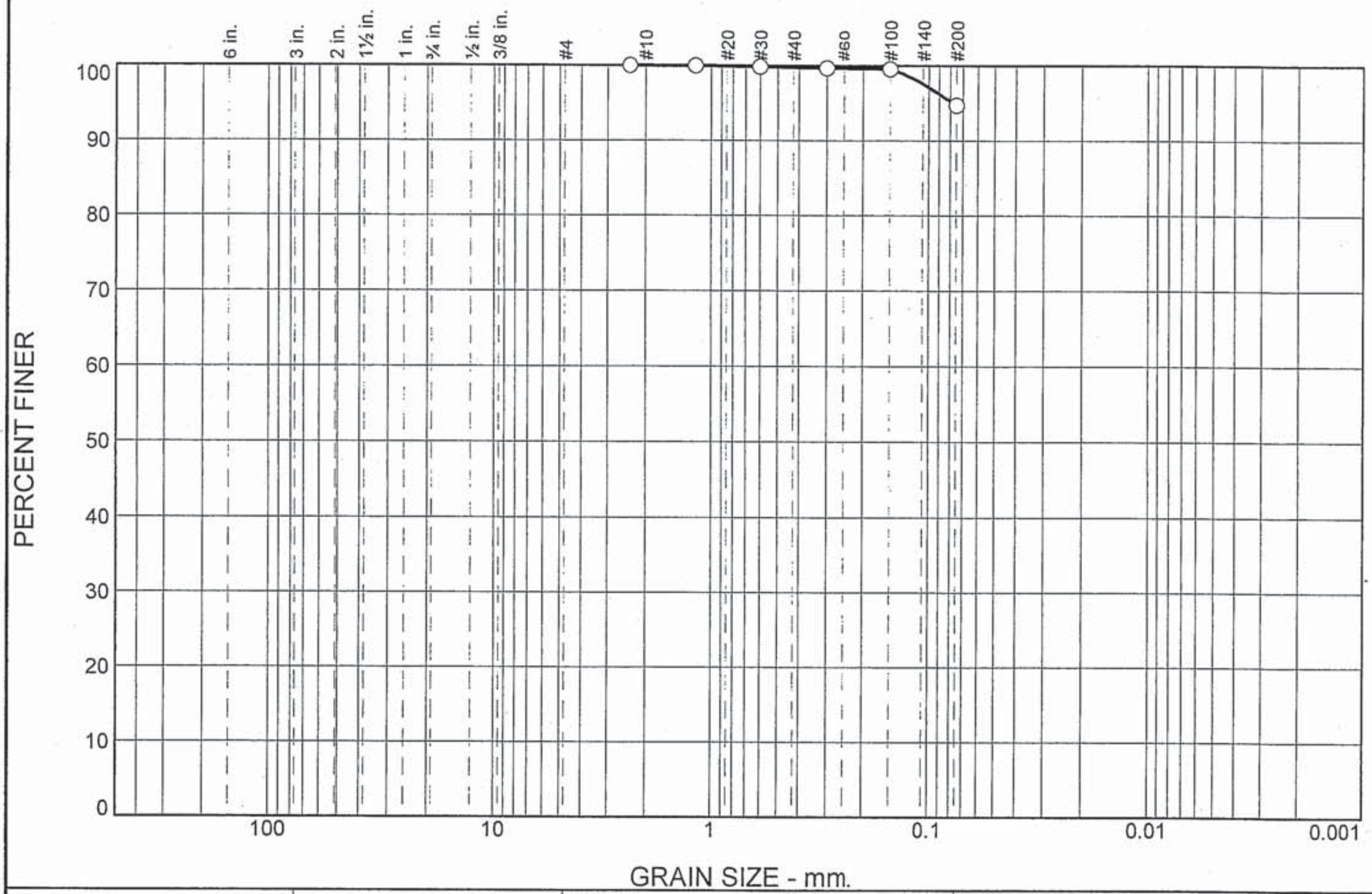
Sample No.: S-8 **Source of Sample:** B-91 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-121

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.2	5.1	94.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	100.0		
#30	99.8		
#50	99.7		
#100	99.5		
#200	94.7		

* (no specification provided)

Material Description

SILT (ML), with trace fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

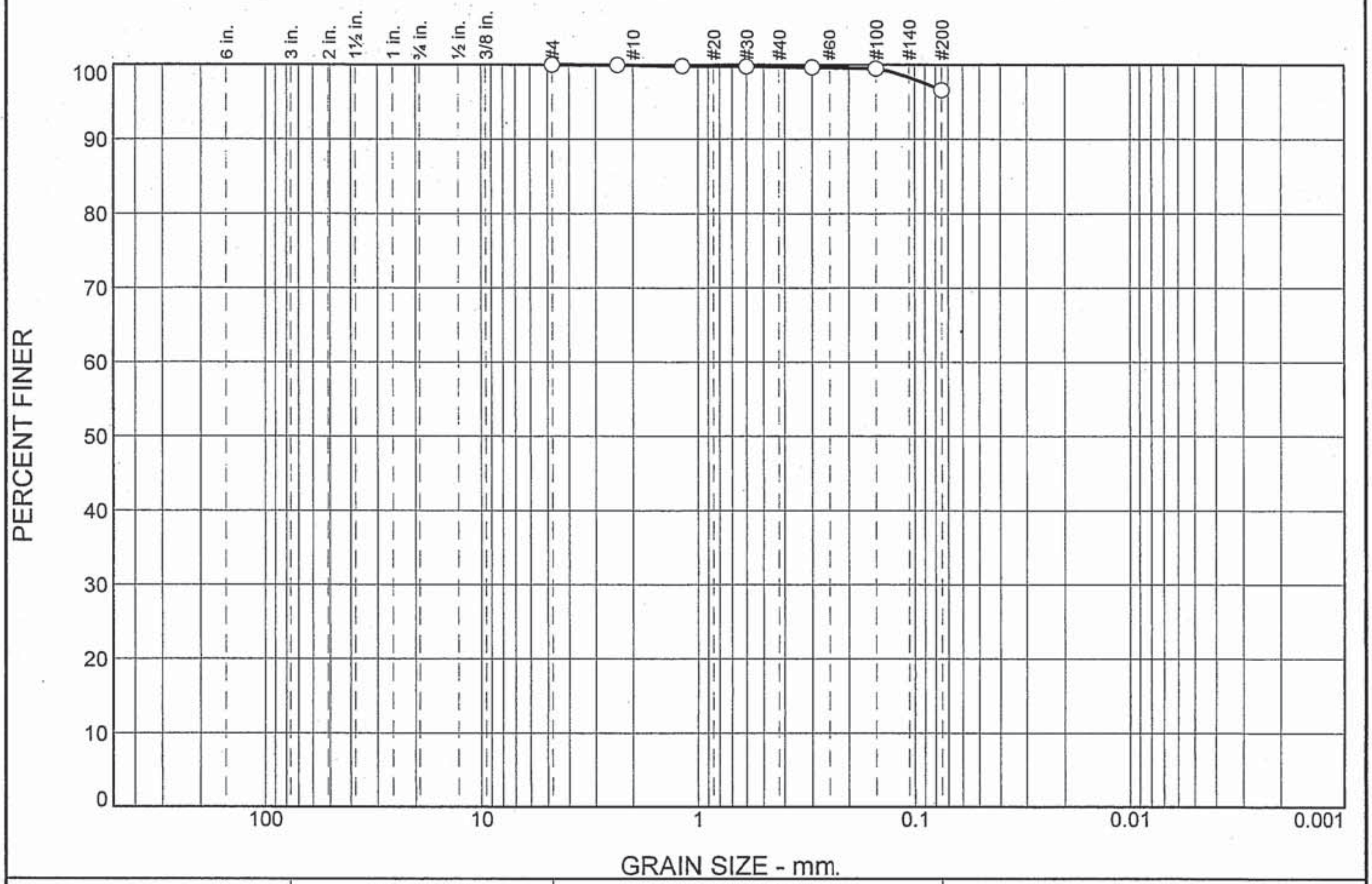
Remarks

Sample No.: S-3 **Source of Sample:** B-92 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-122

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.2	3.1	96.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.8		
#30	99.8		
#50	99.7		
#100	99.5		
#200	96.6		

* (no specification provided)

Material Description

SILT (ML)

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

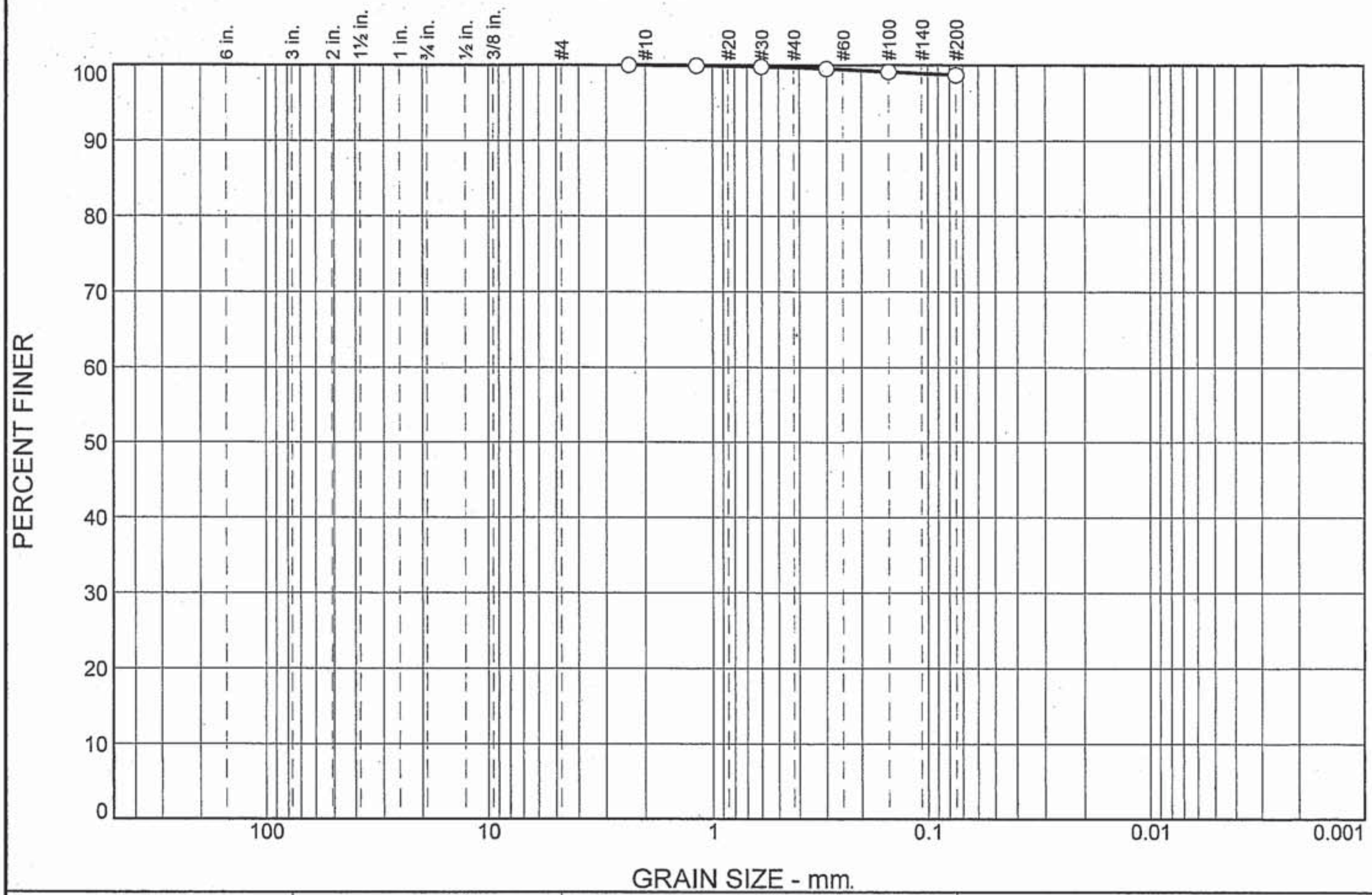
Sample No.: S-4 **Source of Sample:** B-92 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-123

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	1.0	98.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.8		
#50	99.6		
#100	99.1		
#200	98.7		

* (no specification provided)

Material Description

SILT (ML)

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

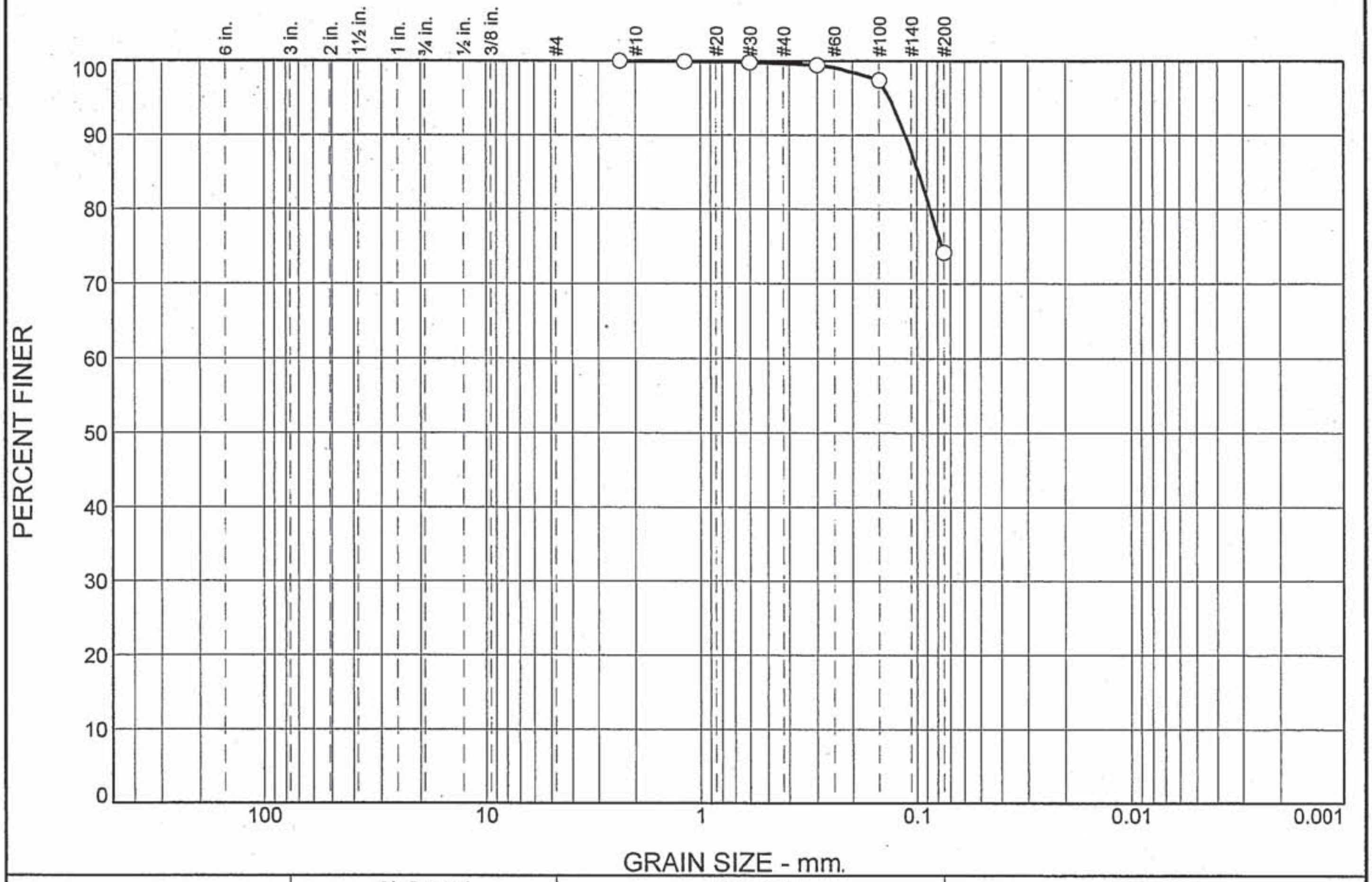
Remarks

Sample No.: S-5 **Source of Sample:** B-92 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-124

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	25.5	74.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.8		
#50	99.5		
#100	97.4		
#200	74.2		

* (no specification provided)

Material Description

SILT (ML), with fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.0981 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

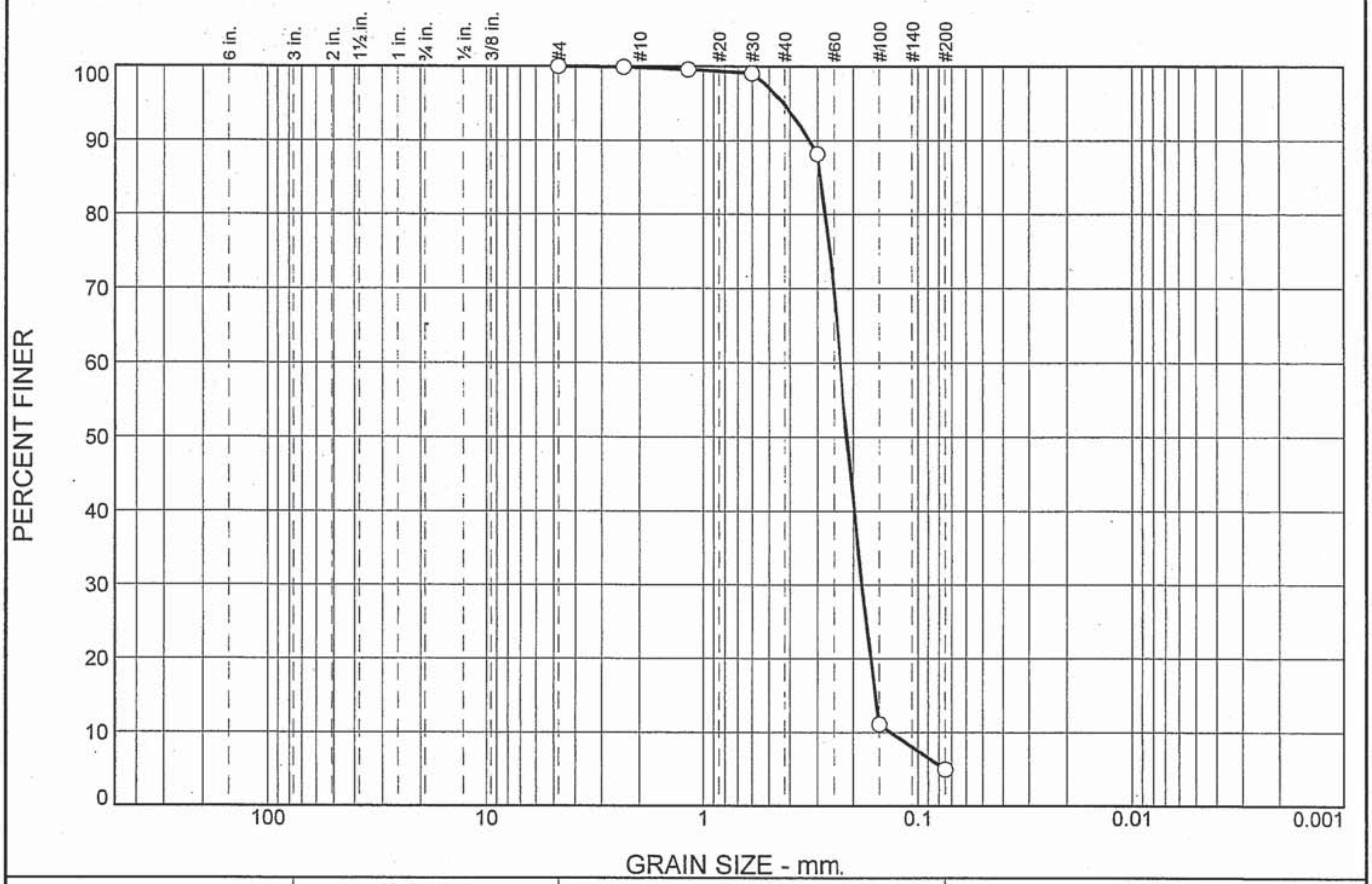
Sample No.: S-6 **Source of Sample:** B-92 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-125

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	4.8	90.1	4.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.6		
#30	99.1		
#50	88.1		
#100	11.1		
#200	4.9		

* (no specification provided)

Material Description

SAND (SP), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.2889 D_{60}= 0.2303 D_{50}= 0.2129
D_{30}= 0.1813 D_{15}= 0.1572 D_{10}= 0.1325
C_u= 1.74 C_c= 1.08

Date Tested: 1/06/06 **Tested By:** RTH/JLC

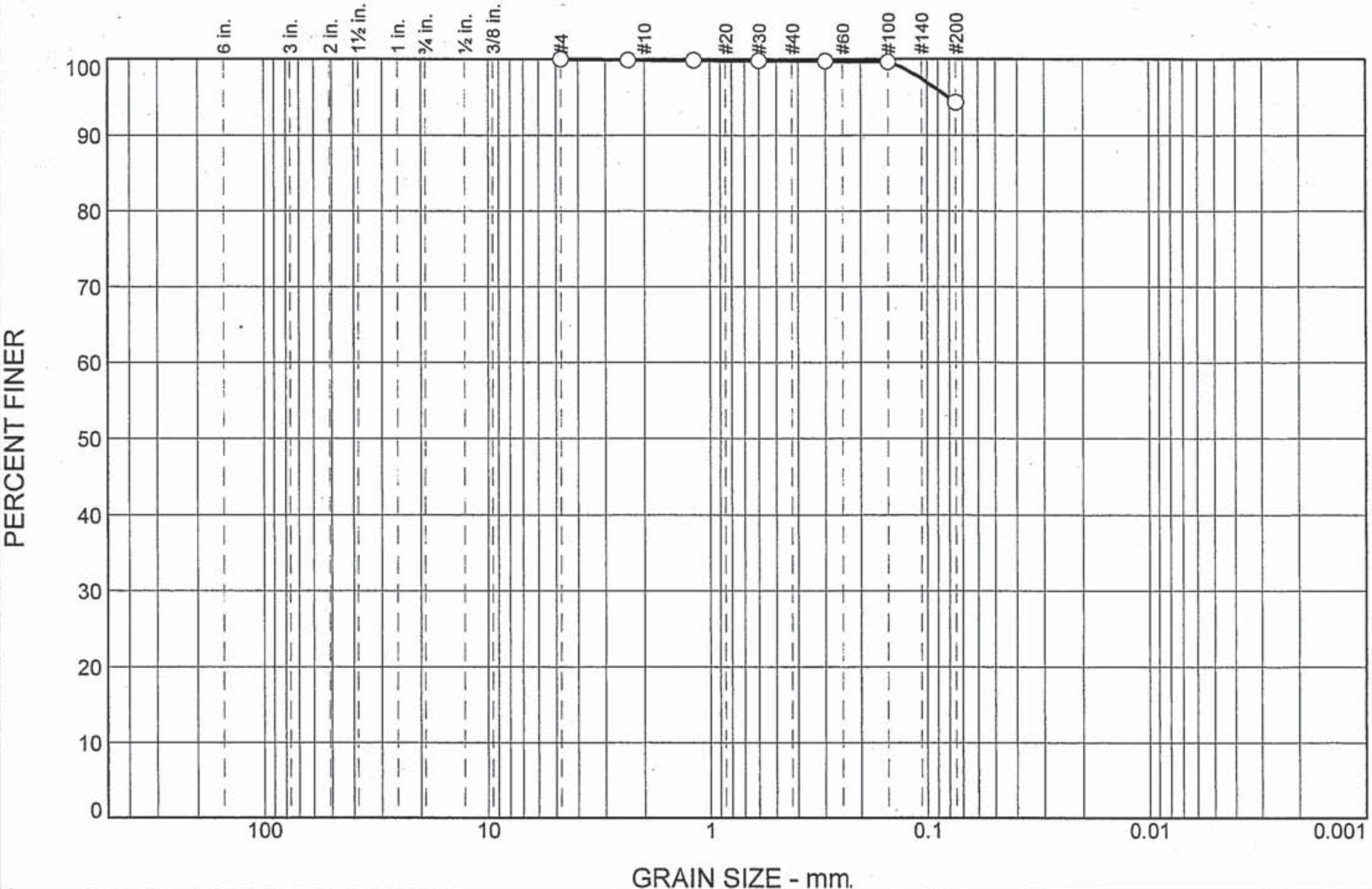
Remarks

Sample No.: S-8 **Source of Sample:** B-92 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-126

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.1	5.5	94.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.8		
#30	99.8		
#50	99.7		
#100	99.6		
#200	94.3		

* (no specification provided)

Material Description

SILT (ML), with trace fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

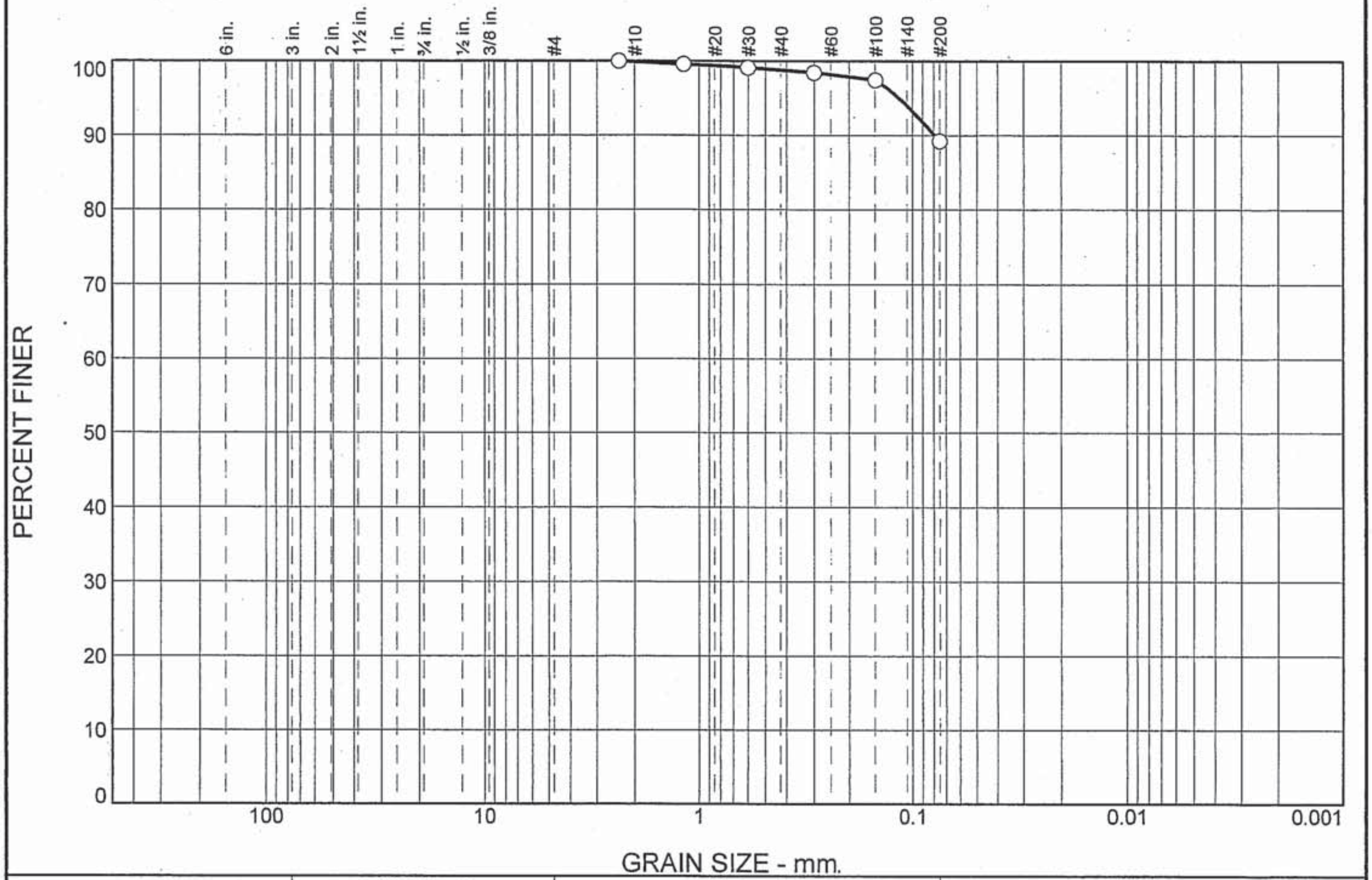
Sample No.: S-4 **Source of Sample:** B-93 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-127

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	1.1	9.6	89.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.6		
#30	99.1		
#50	98.5		
#100	97.5		
#200	89.2		

* (no specification provided)

Material Description

SILT (ML), with traces fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

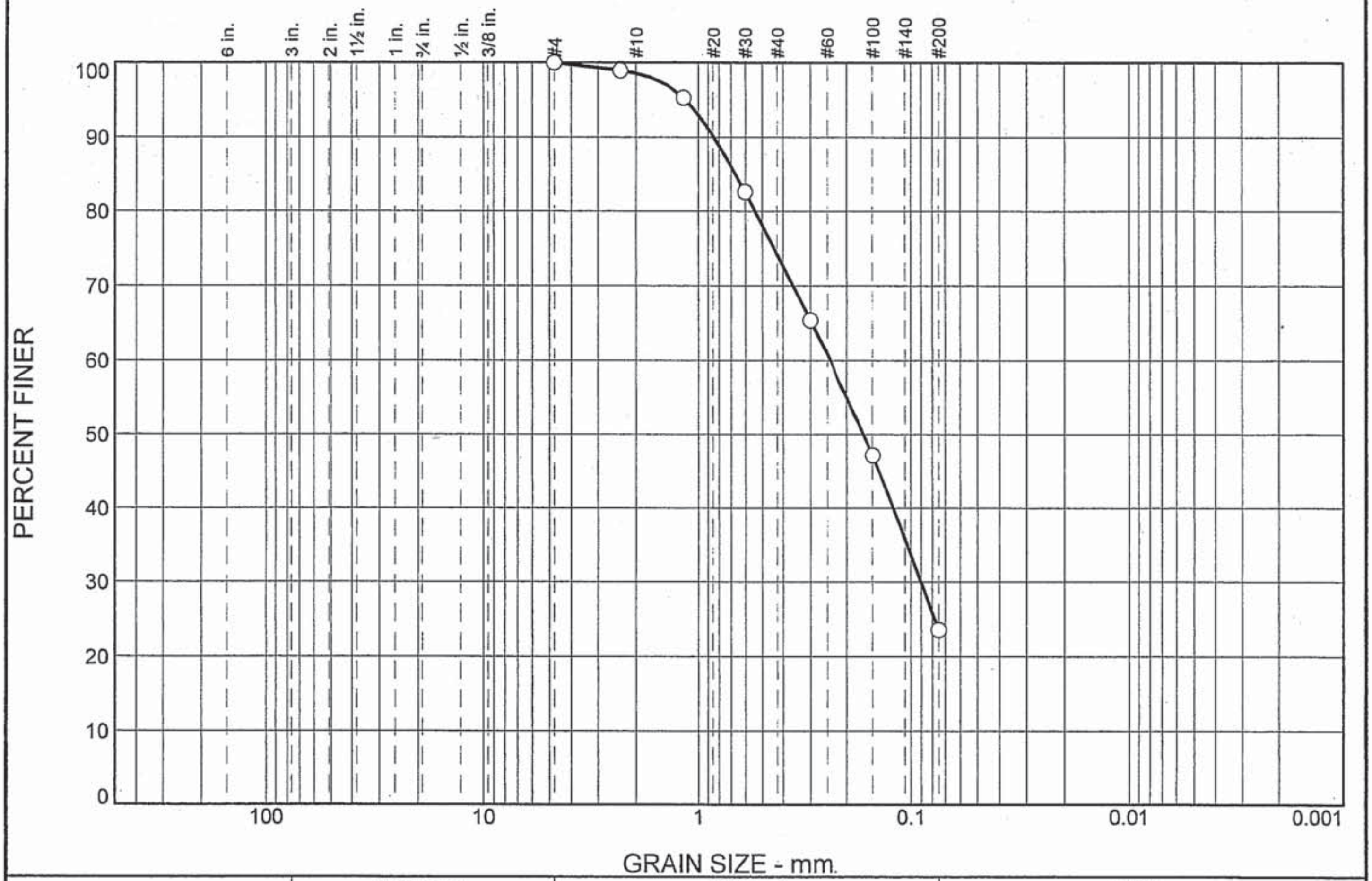
Remarks

Sample No.: S-5 **Source of Sample:** B-93 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-128

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.4	24.4	50.6	23.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	98.9		
#16	95.3		
#30	82.6		
#50	65.4		
#100	47.1		
#200	23.6		

* (no specification provided)

Material Description

Silty SAND (SM), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.6652 D_{60}= 0.2415 D_{50}= 0.1655

D_{30}= 0.0897 D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

Sample No.: S-6 **Source of Sample:** B-93 **Date Sampled:**

Location: **Elev./Depth:** 18

Checked By: J. Fouse **Title:** P.E.

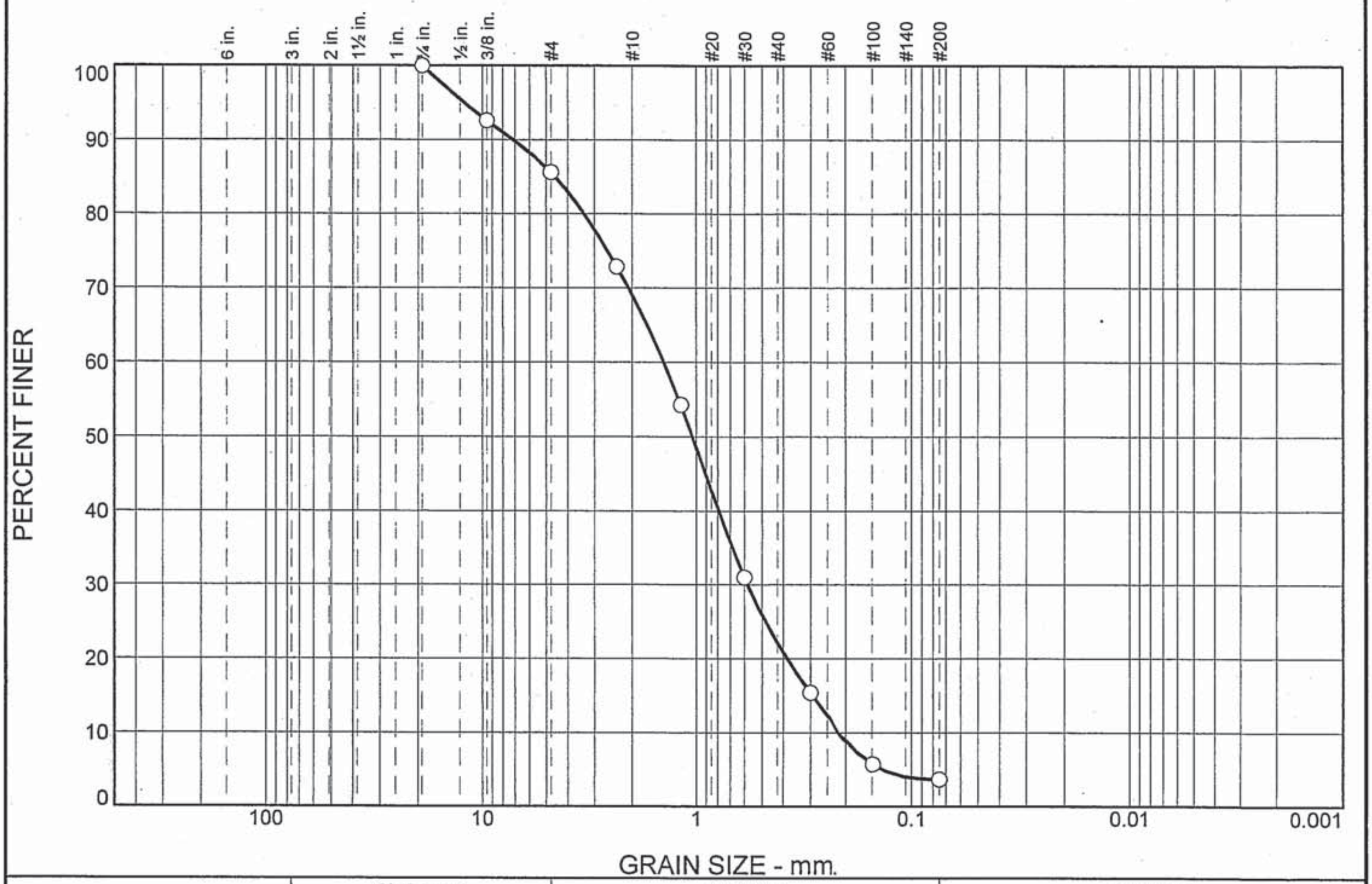
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-129

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	14.4	16.6	46.8	18.5	3.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	92.6		
#4	85.6		
#8	72.9		
#16	54.3		
#30	31.0		
#50	15.4		
#100	5.7		
#200	3.7		

* (no specification provided)

Material Description

SAND (SW), well graded, with fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW AASHTO=

Coefficients

D_{85}= 4.5414 D_{60}= 1.4197 D_{50}= 1.0409
D_{30}= 0.5801 D_{15}= 0.2934 D_{10}= 0.2161
C_u= 6.57 C_c= 1.10

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

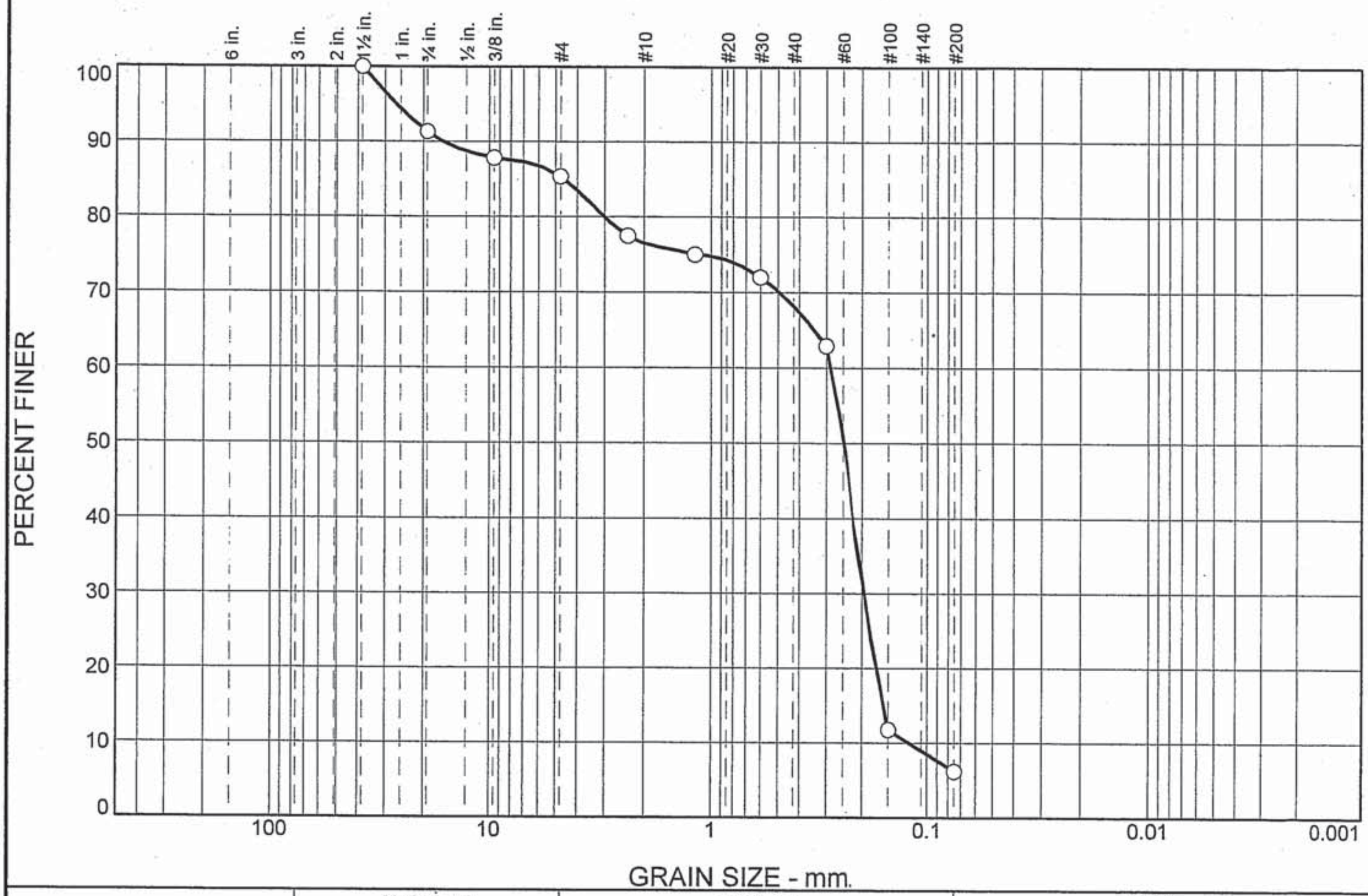
Sample No.: S-7 **Source of Sample:** B-93 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-130

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.7	6.0	8.8	8.3	62.0	6.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	91.3		
3/8	87.8		
#4	85.3		
#8	77.5		
#16	75.0		
#30	72.0		
#50	62.9		
#100	11.7		
#200	6.2		

* (no specification provided)

Material Description

SAND (SP-SM), fine grain, slightly silty, with traces of coarse- and medium-grain sand and coarse and fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 4.5708 D_{60}= 0.2852 D_{50}= 0.2476
D_{30}= 0.1946 D_{15}= 0.1589 D_{10}= 0.1206
C_u= 2.36 C_c= 1.10

Date Tested: 1/06/06 **Tested By:** RTH/JLC

Remarks

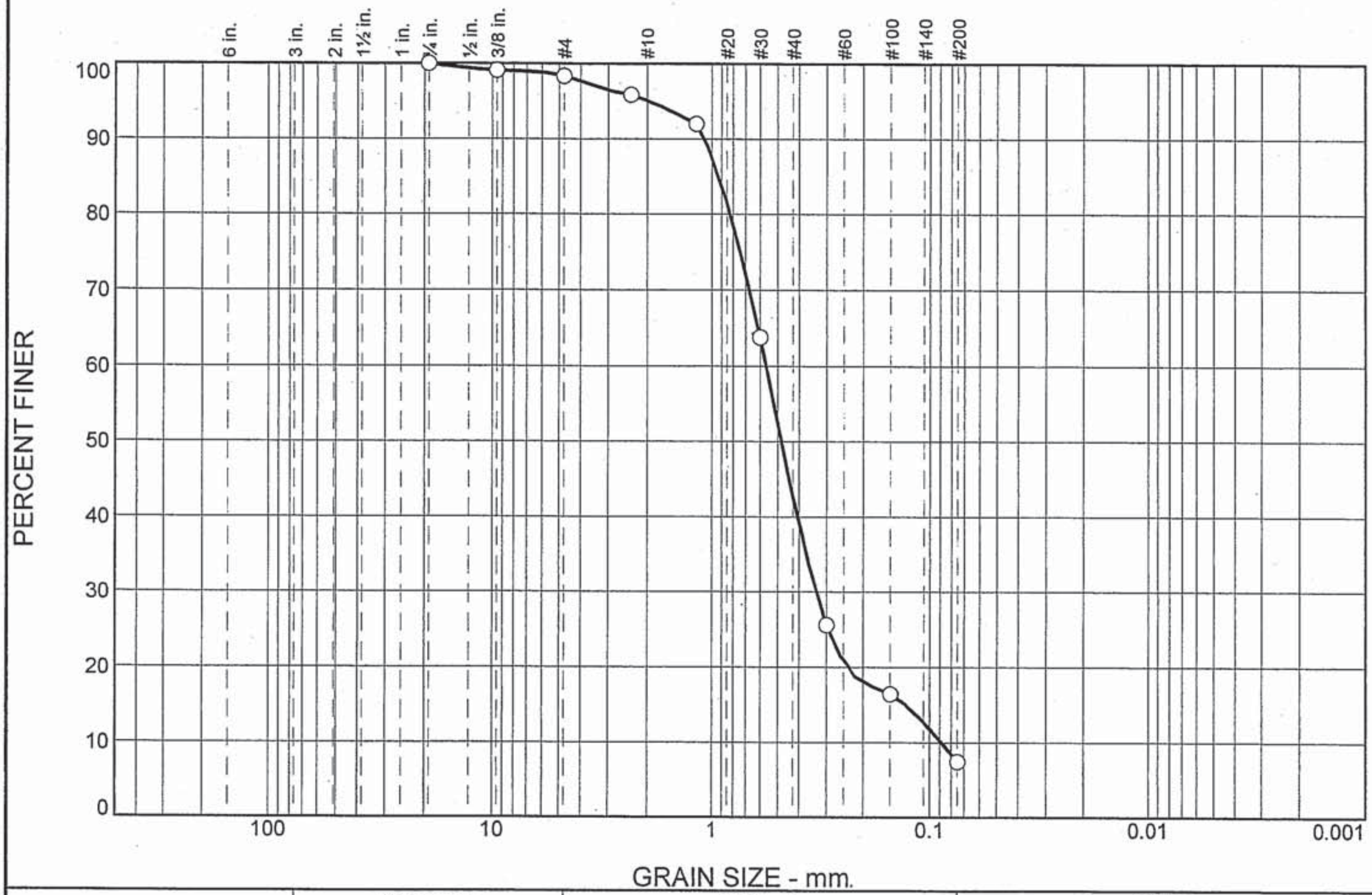
Sample No.: S-8 **Source of Sample:** B-93 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-131

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.6	3.3	52.4	35.3	7.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.1		
#4	98.4		
#8	95.9		
#16	92.0		
#30	63.8		
#50	25.6		
#100	16.4		
#200	7.4		

* (no specification provided)

Material Description

SAND (SW-SM), well graded, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW-SM AASHTO=

Coefficients

D_{85}= 0.9277 D_{60}= 0.5632 D_{50}= 0.4790
D_{30}= 0.3348 D_{15}= 0.1278 D_{10}= 0.0882
C_u= 6.38 C_c= 2.26

Date Tested: 1/13/06 **Tested By:** J. Crose

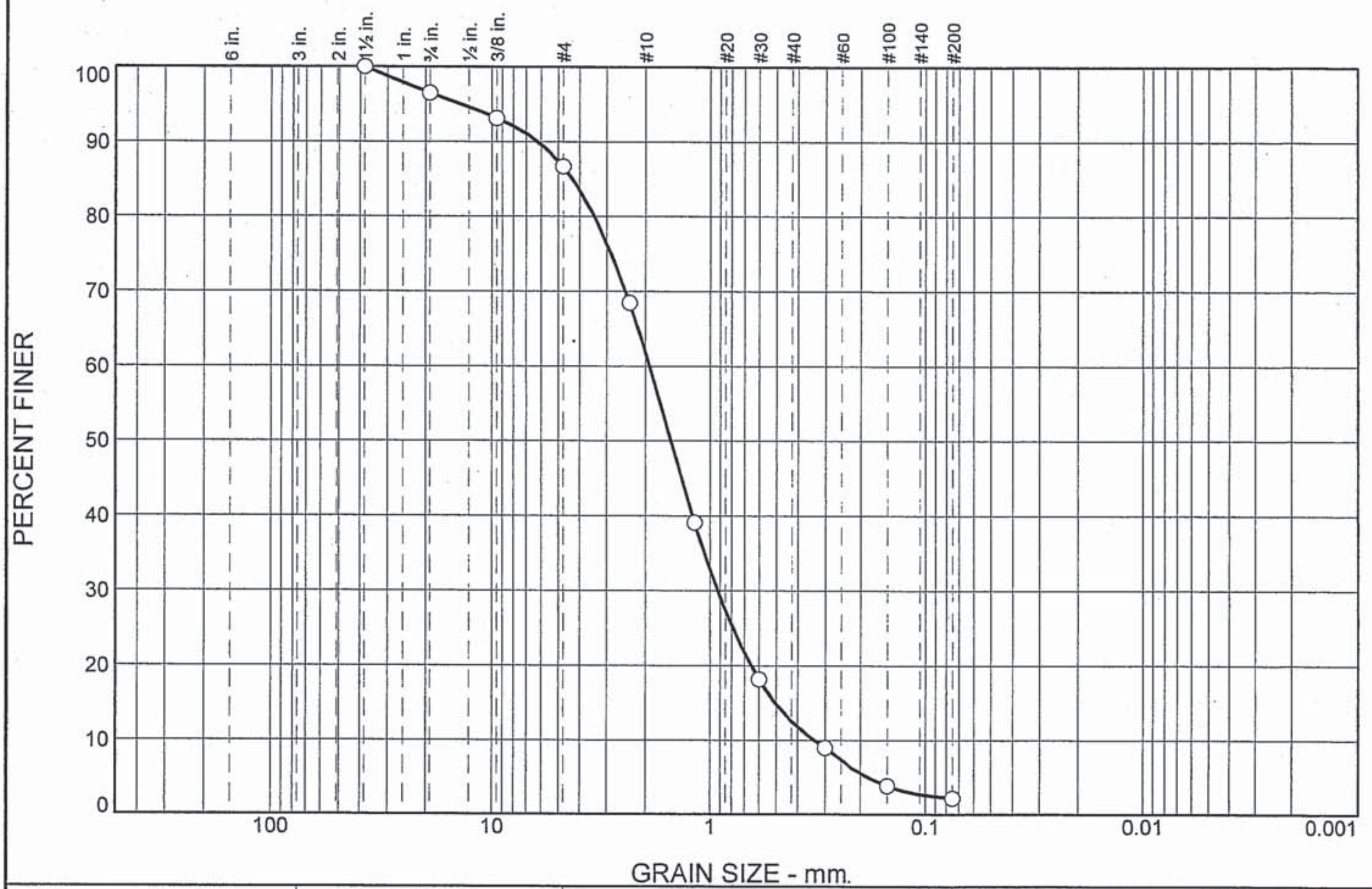
Remarks

Sample No.: S-8 **Source of Sample:** B-94 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-132

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.5	9.8	24.8	49.4	10.3	2.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	96.5		
3/8	93.2		
#4	86.7		
#8	68.5		
#16	39.1		
#30	18.1		
#50	8.9		
#100	3.8		
#200	2.2		

* (no specification provided)

Material Description

SAND (SP), coarse-, medium-, and fine grain, traces of fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 4.3117 D_{60}= 1.9126 D_{50}= 1.5221
D_{30}= 0.9233 D_{15}= 0.5055 D_{10}= 0.3361
C_u= 5.69 C_c= 1.33

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

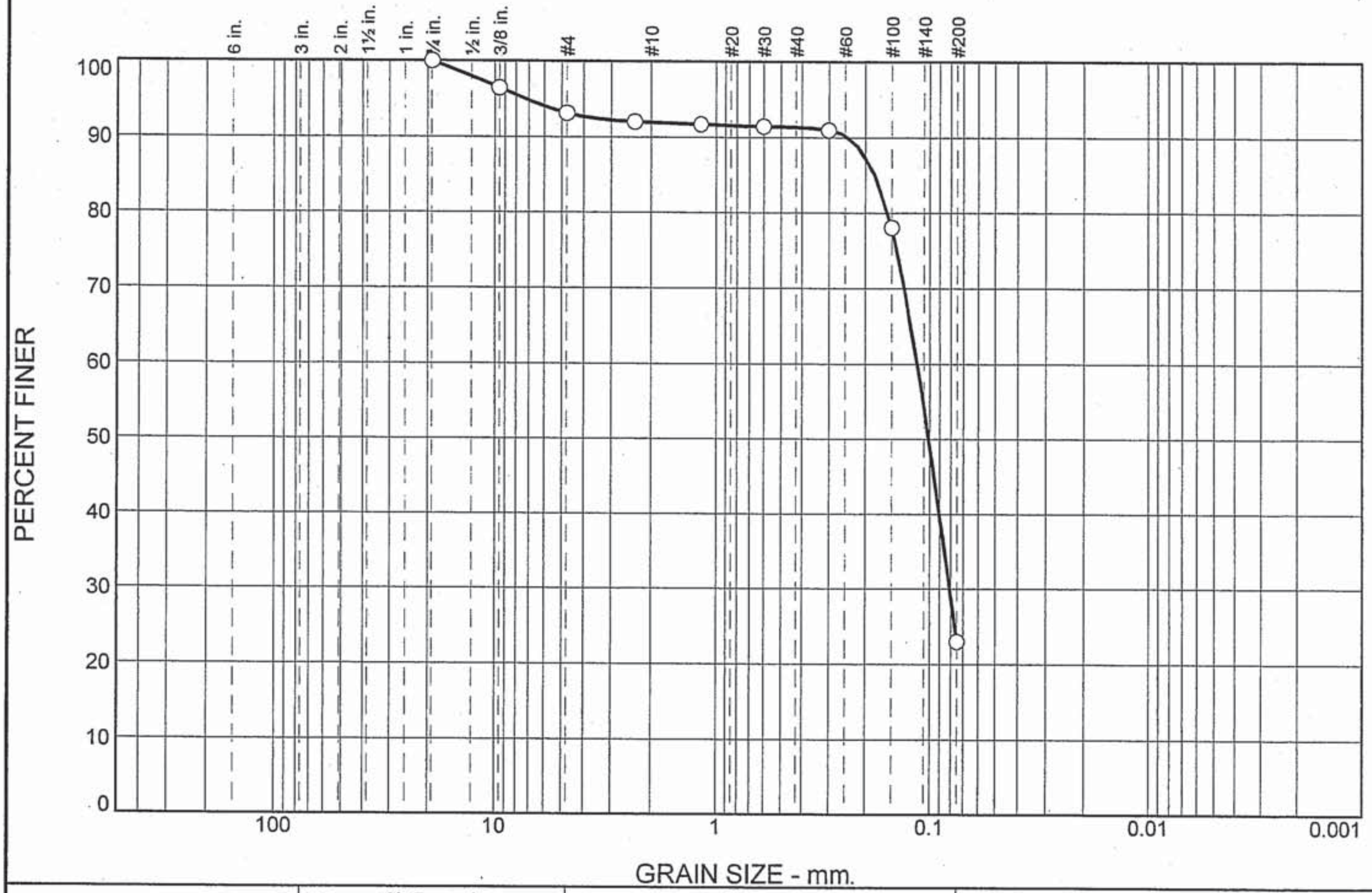
Sample No.: S-7 **Source of Sample:** B-95 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-133

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.9	1.1	0.6	68.4	23.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
3/8	96.5		
#4	93.1		
#8	92.0		
#16	91.7		
#30	91.4		
#50	91.0		
#100	78.0		
#200	23.0		

* (no specification provided)

Material Description

Silty SAND (SM), fine grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.1795 D_{60}= 0.1137 D_{50}= 0.1007
D_{30}= 0.0808 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

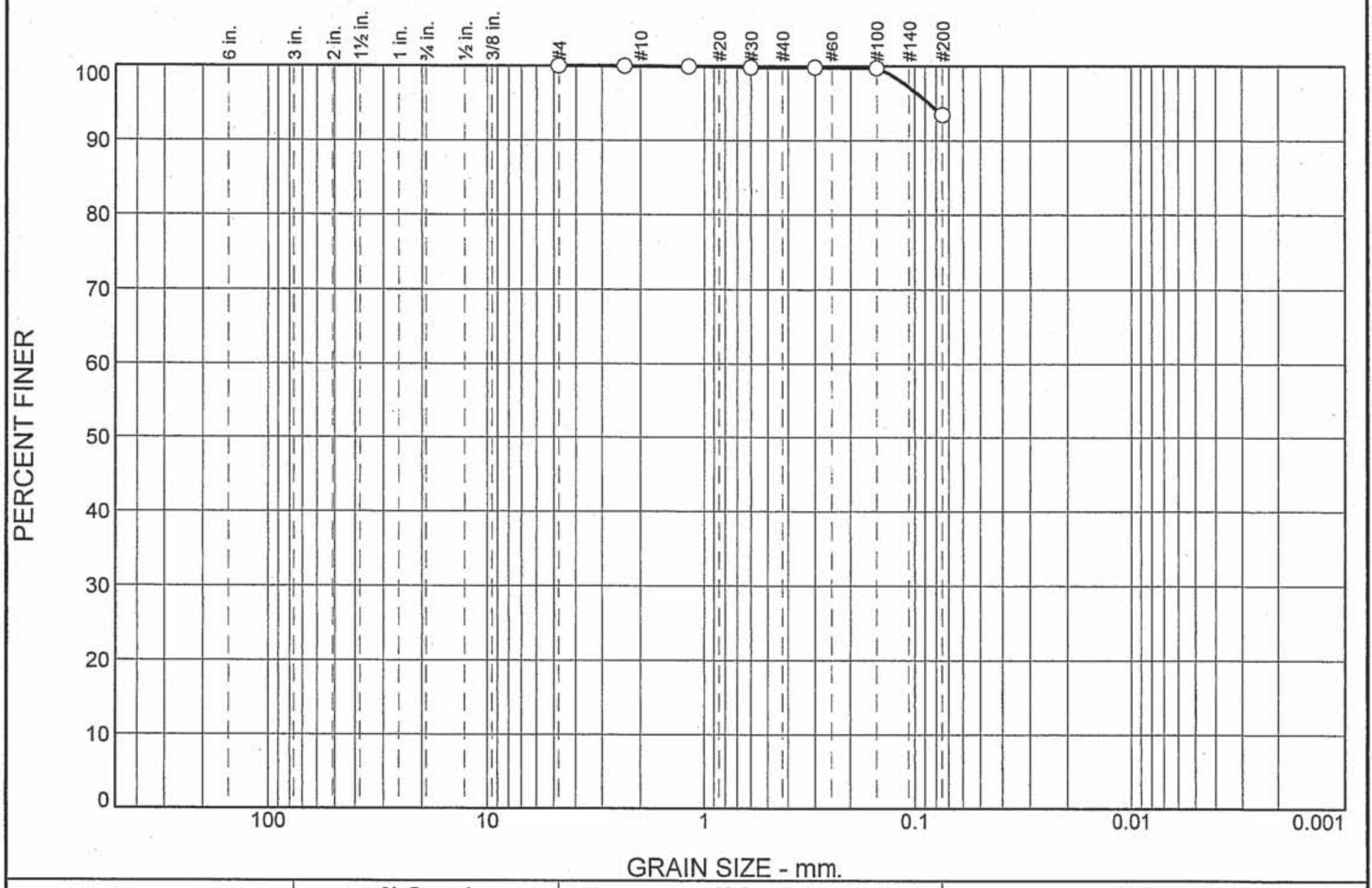
Sample No.: S-6 **Source of Sample:** B-97 **Date Sampled:**
Location: **Elev./Depth:** 18
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-134

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	6.5	93.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.9		
#30	99.9		
#50	99.8		
#100	99.7		
#200	93.4		

* (no specification provided)

Material Description

SILT (ML), with trace fine sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 01/25/06 **Tested By:** J. Crose

Remarks

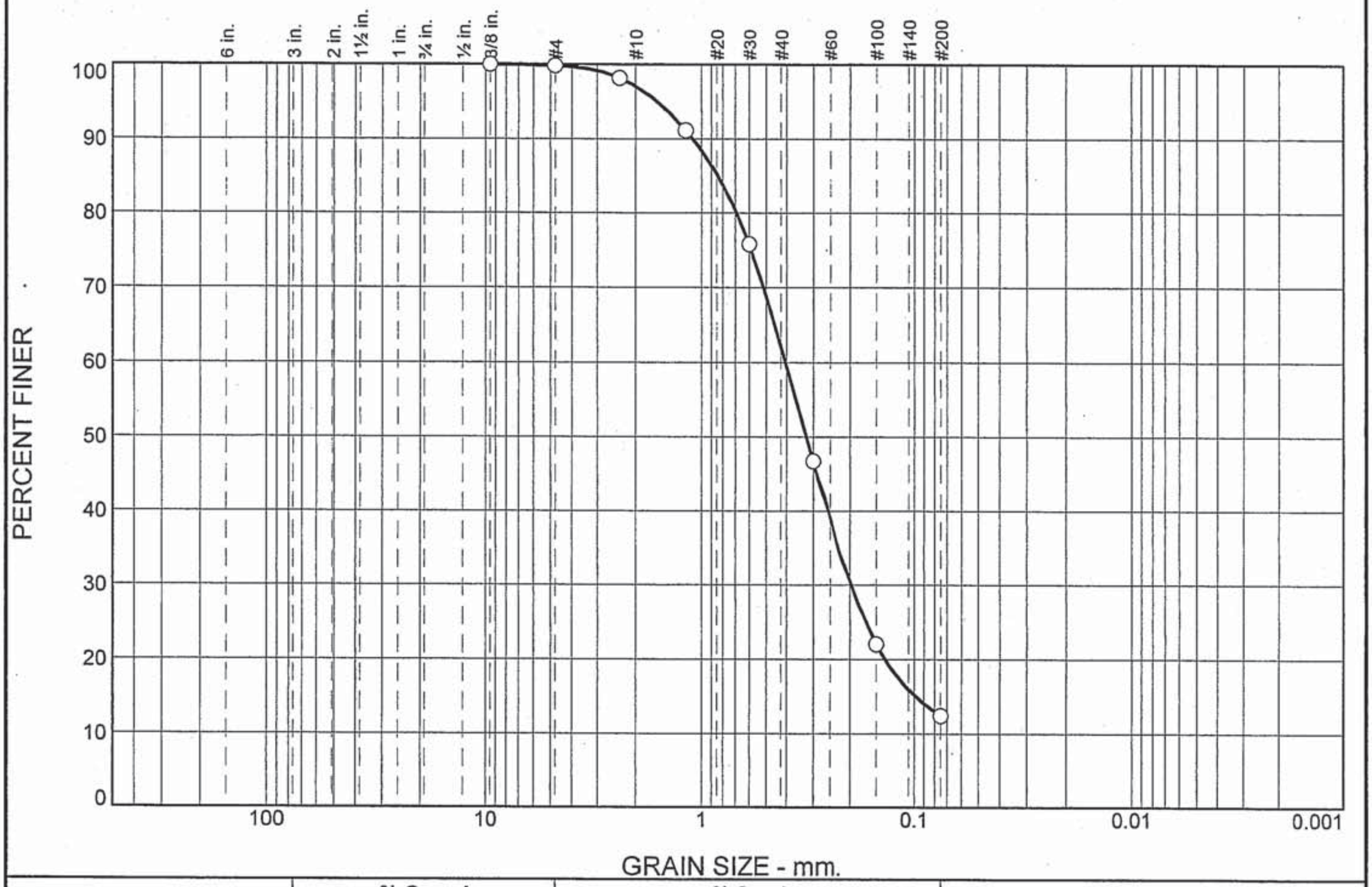
Sample No.: S-4 **Source of Sample:** B-98 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-135

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.2	2.7	34.9	49.8	12.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.8		
#8	98.2		
#16	91.2		
#30	75.8		
#50	46.7		
#100	22.1		
#200	12.4		

* (no specification provided)

Material Description

Silty SAND (SM), medium- to fine grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.8378 D_{60}= 0.4040 D_{50}= 0.3230
D_{30}= 0.1966 D_{15}= 0.0981 D_{10}=
C_u= C_c=

Date Tested: 01/25/06 **Tested By:** J. Crose

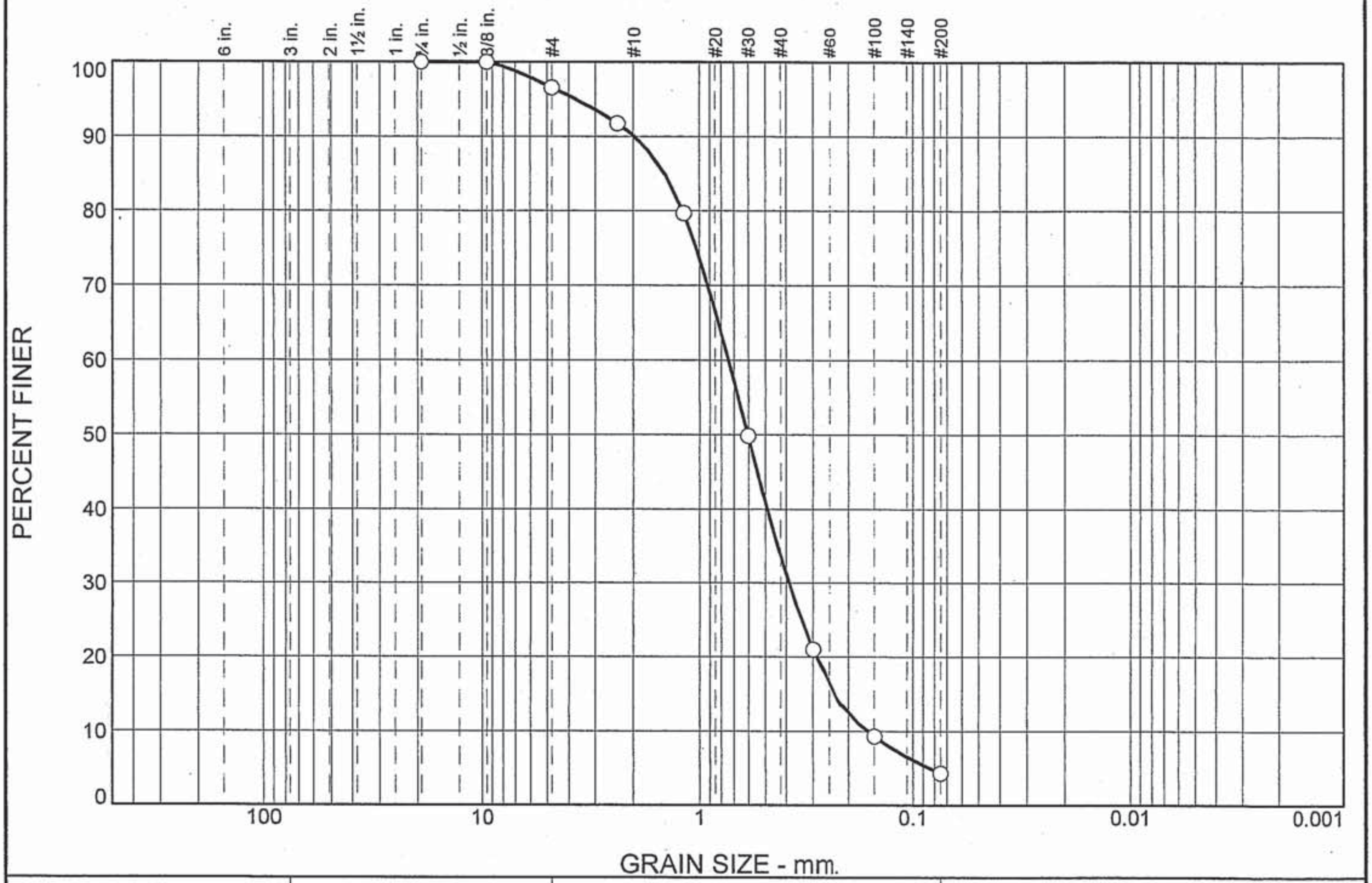
Remarks

Sample No.: S-5 **Source of Sample:** B-98 **Date Sampled:**
Location: **Elev./Depth:** 13.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-136

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.4	6.5	56.3	29.5	4.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	100.0		
#4	96.6		
#8	91.7		
#16	79.7		
#30	49.8		
#50	21.0		
#100	9.3		
#200	4.3		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, trace of coarse-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.4429 D_{60}= 0.7381 D_{50}= 0.6021
D_{30}= 0.3879 D_{15}= 0.2329 D_{10}= 0.1617
C_u= 4.57 C_c= 1.26

Date Tested: 01/25/06 **Tested By:** J. Crose

Remarks

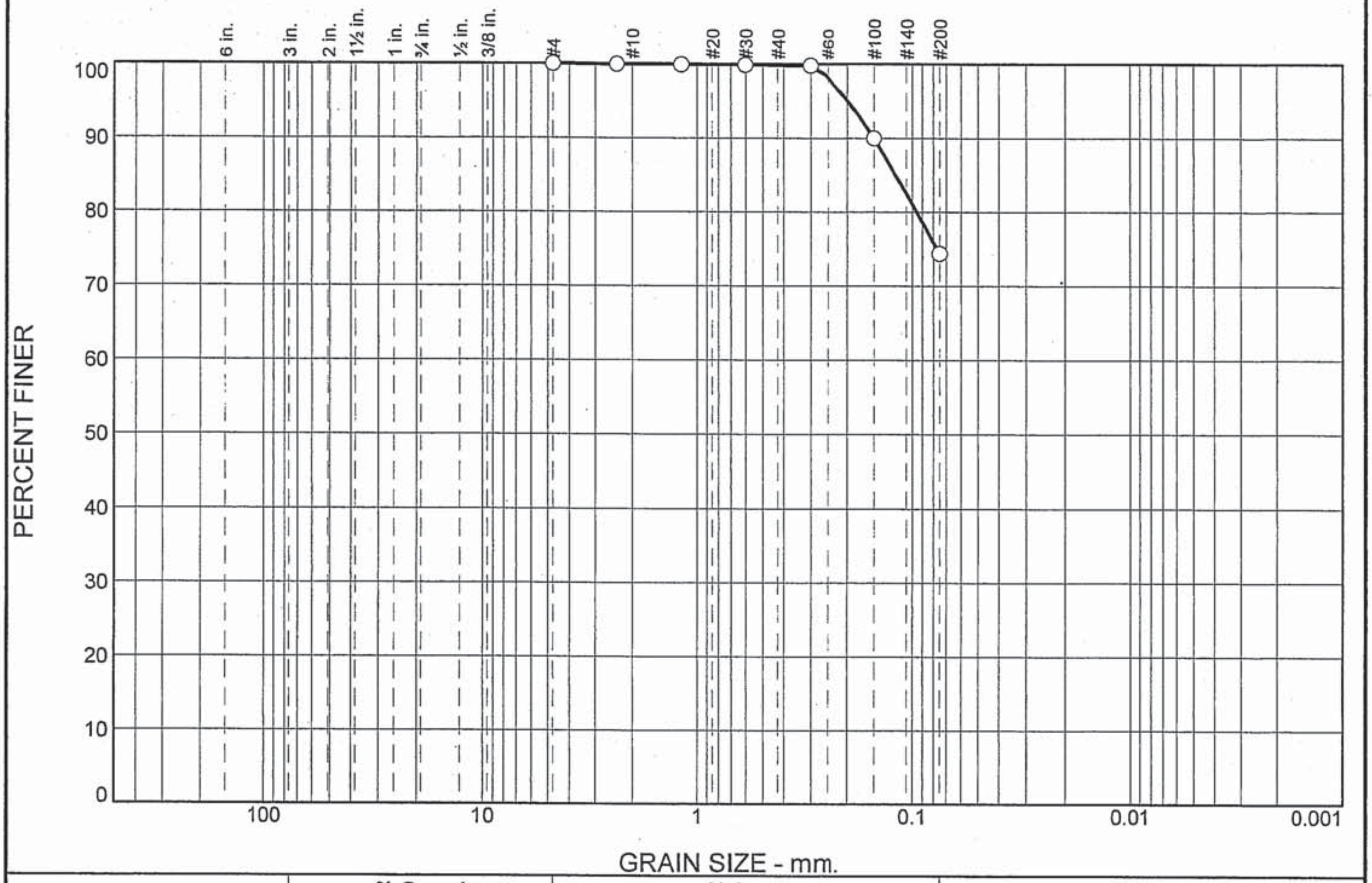
Sample No.: S-7 **Source of Sample:** B-98 **Date Sampled:**
Location: **Elev./Depth:** 23.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-137

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.1	25.5	74.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.9		
#30	99.9		
#50	99.8		
#100	90.0		
#200	74.4		

* (no specification provided)

Material Description

SILT (ML), with fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.1185 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

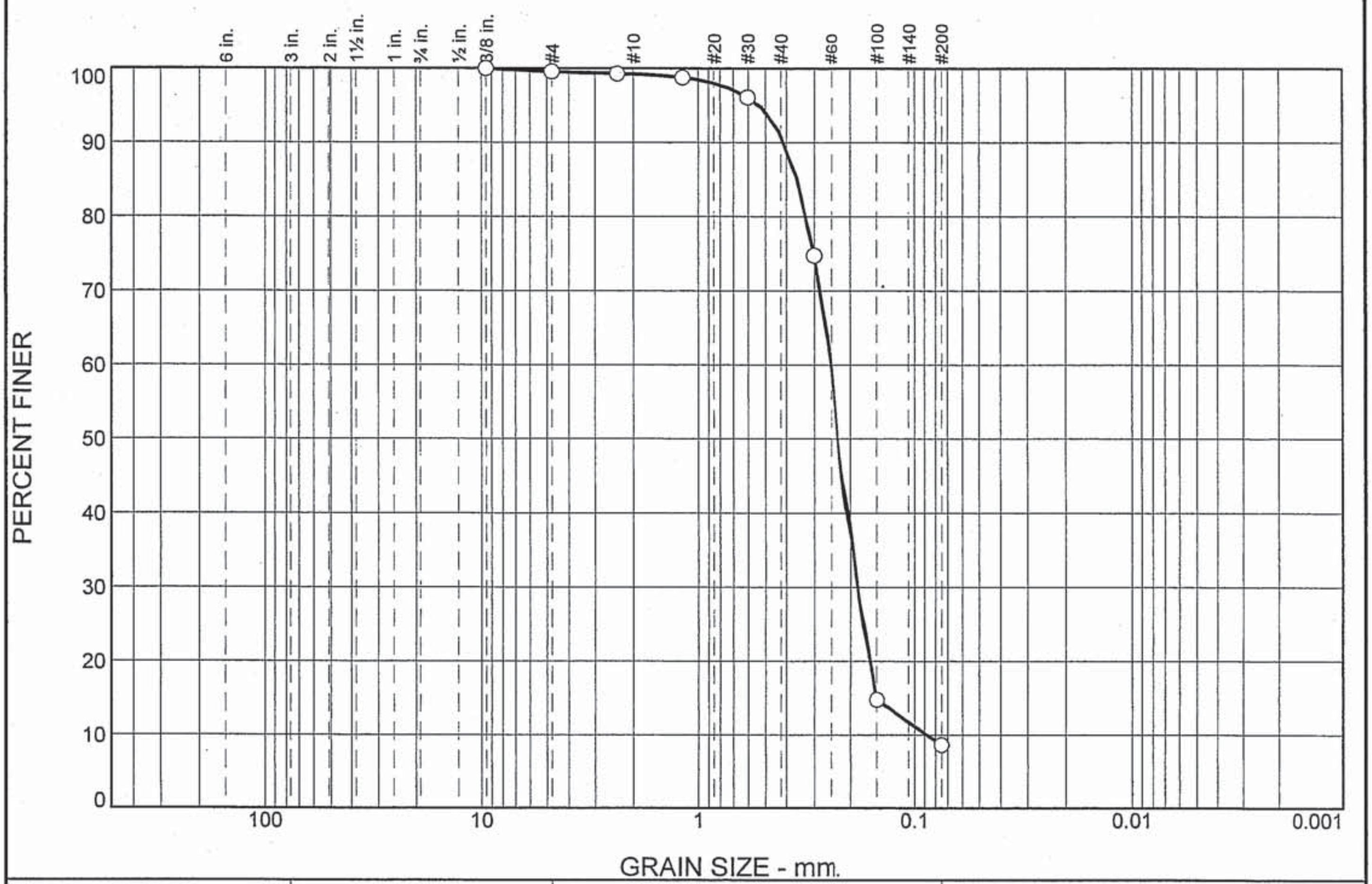
Sample No.: S-2 **Source of Sample:** B-99 **Date Sampled:**
Location: **Elev./Depth:** 4.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-138

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	0.4	8.2	82.4	8.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.6		
#8	99.3		
#16	98.8		
#30	96.1		
#50	74.8		
#100	14.8		
#200	8.6		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty, with trace of medium-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.3579 D_{60}= 0.2515 D_{50}= 0.2266
D_{30}= 0.1837 D_{15}= 0.1506 D_{10}= 0.0876
C_u= 2.87 C_c= 1.53

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

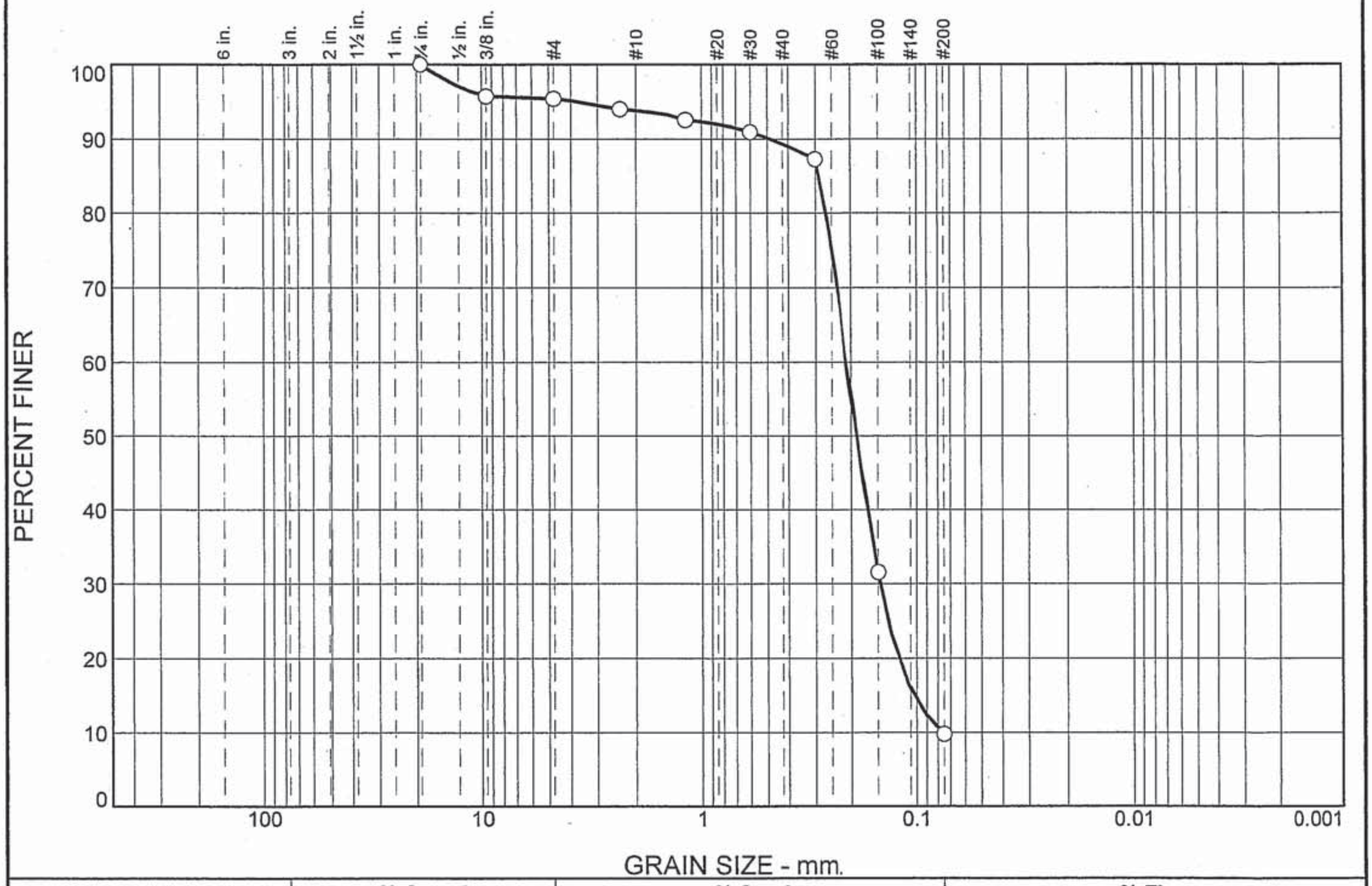
Sample No.: S-6 **Source of Sample:** B-99 **Date Sampled:**
Location: **Elev./Depth:** 18.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-139

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.6	1.6	4.4	79.6	9.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	95.8		
#4	95.4		
#8	94.0		
#16	92.6		
#30	90.9		
#50	87.3		
#100	31.6		
#200	9.8		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2876 D_{60}= 0.2097 D_{50}= 0.1880
D_{30}= 0.1465 D_{15}= 0.1025 D_{10}= 0.0762
C_u= 2.75 C_c= 1.34

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

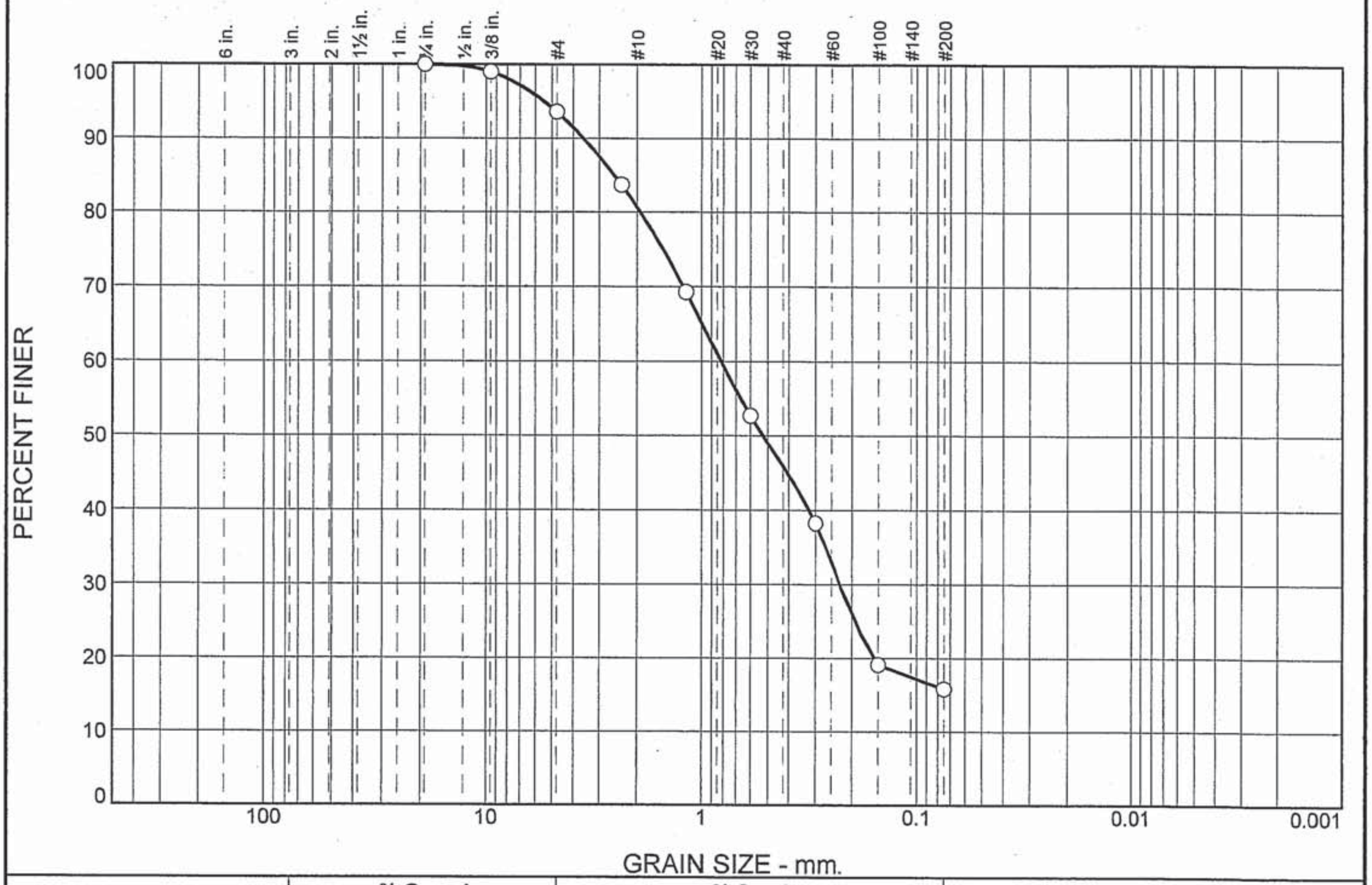
Sample No.: S-7 **Source of Sample:** B-99 **Date Sampled:**
Location: **Elev./Depth:** 23.0
Checked By: K. Kocher **Title:** P.E.

Reitz & Jens, Inc.
Consulting Engineers

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-140

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.4	12.9	34.8	30.1	15.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.0		
#4	93.6		
#8	83.7		
#16	69.3		
#30	52.7		
#50	38.2		
#100	19.1		
#200	15.8		

* (no specification provided)

Material Description

Silty SAND (SM), coarse-, medium-, and fine-grain, trace fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 2.5526 D_{60}= 0.8168 D_{50}= 0.5256
D_{30}= 0.2268 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/18/06 **Tested By:** JJP

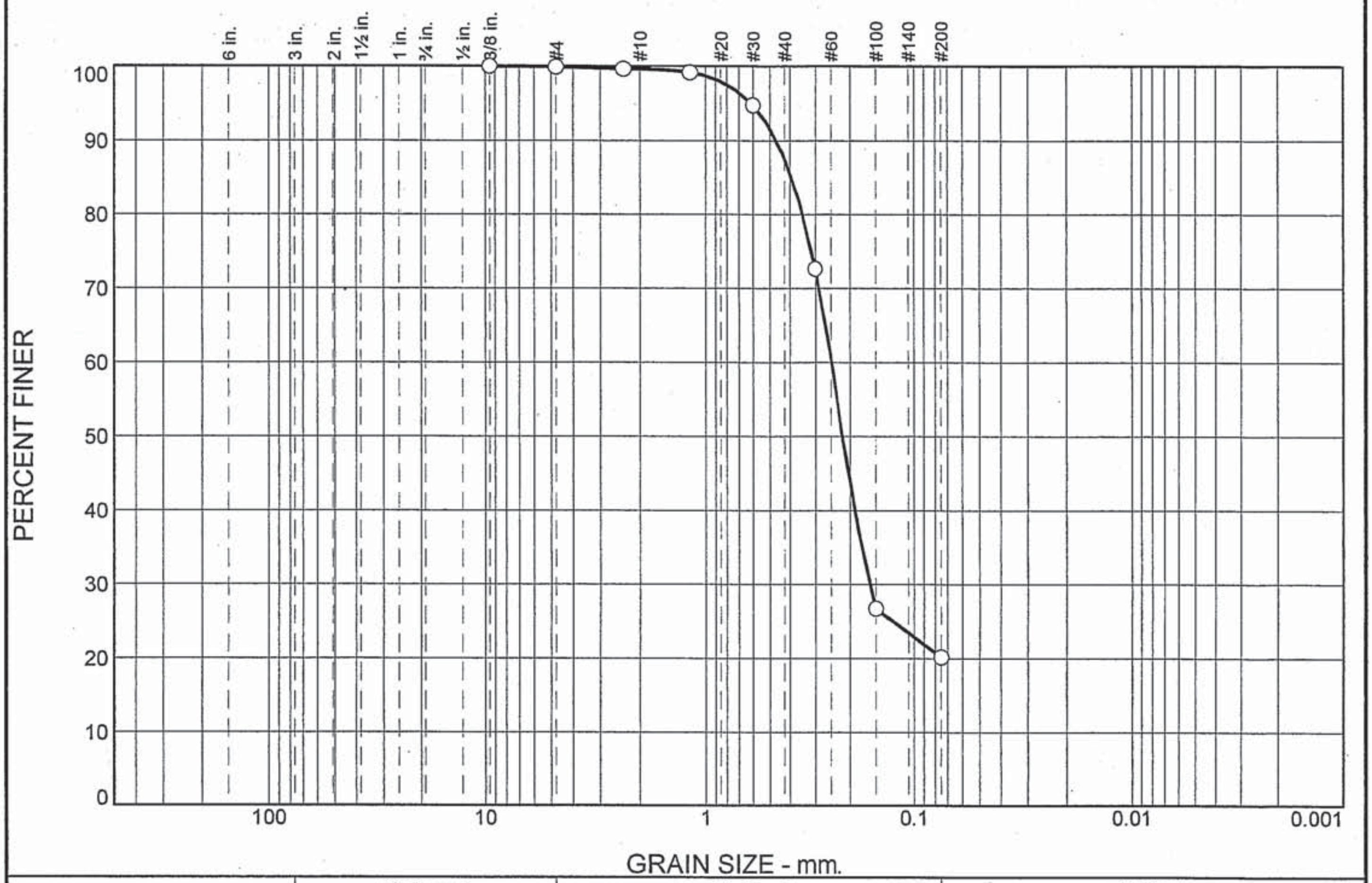
Remarks

Sample No.: S-7 **Source of Sample:** B-100 **Date Sampled:**
Location: **Elev./Depth:** 22.5
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-141

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.1	0.3	11.9	67.5	20.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.9		
#8	99.6		
#16	99.1		
#30	94.8		
#50	72.6		
#100	26.7		
#200	20.2		

* (no specification provided)

Material Description

Silty SAND (SM), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.3910 D_{60}= 0.2484 D_{50}= 0.2169

D_{30}= 0.1604 D_{15}= D_{10}=

C_u= C_c=

Date Tested: 1/18/06 **Tested By:** JJP

Remarks

Sample No.: S-5 **Source of Sample:** B-101 **Date Sampled:**

Location: **Elev./Depth:** 13

Checked By: J. Fouse **Title:** P.E.

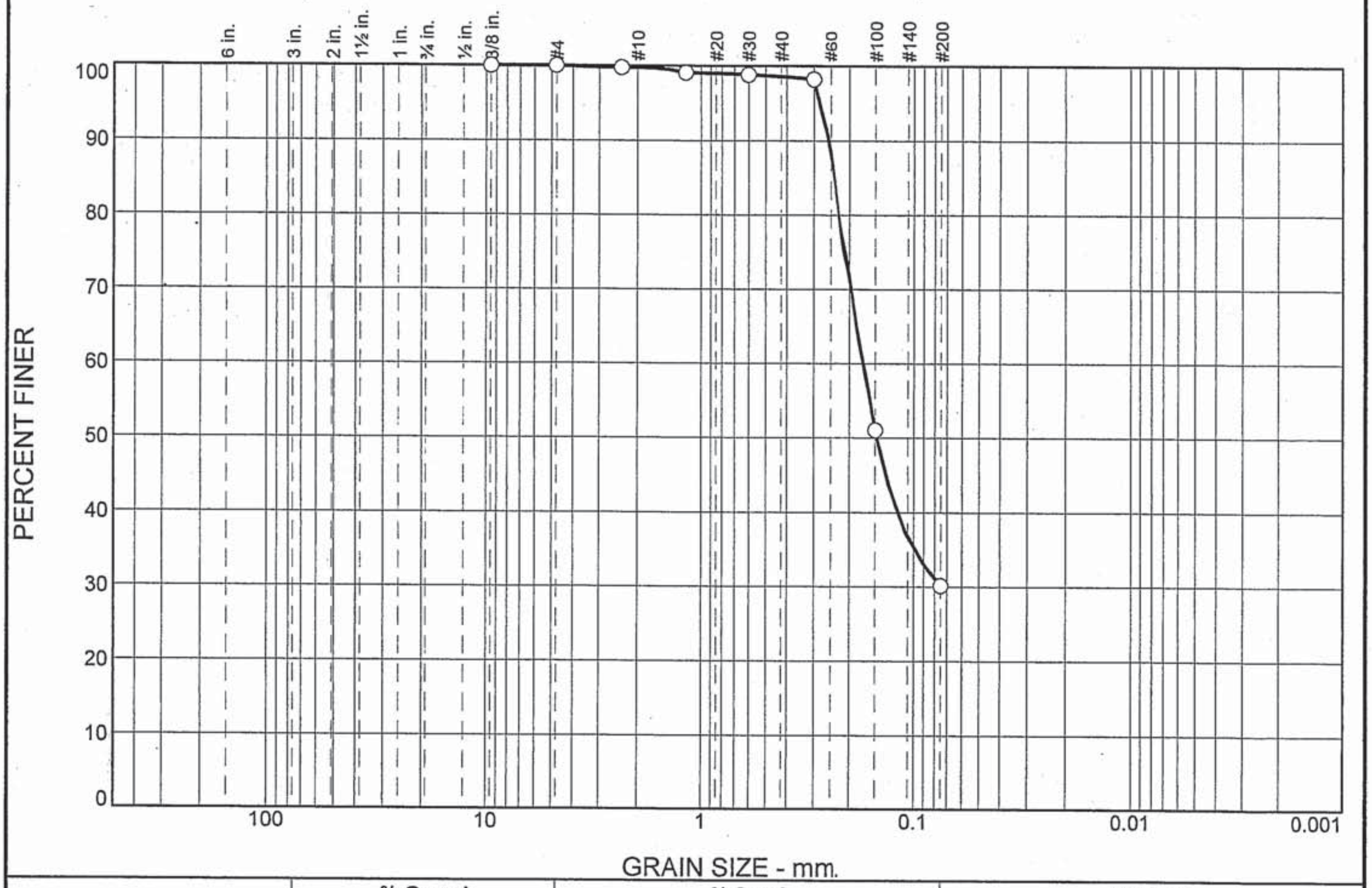
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-142

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.3	1.1	68.4	30.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	100.0		
#8	99.7		
#16	99.1		
#30	98.8		
#50	98.2		
#100	51.0		
#200	30.2		

* (no specification provided)

Material Description

Silty SAND (SM), fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.2379 D_{60}= 0.1714 D_{50}= 0.1474
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/12/06 **Tested By:** J. Crose

Remarks

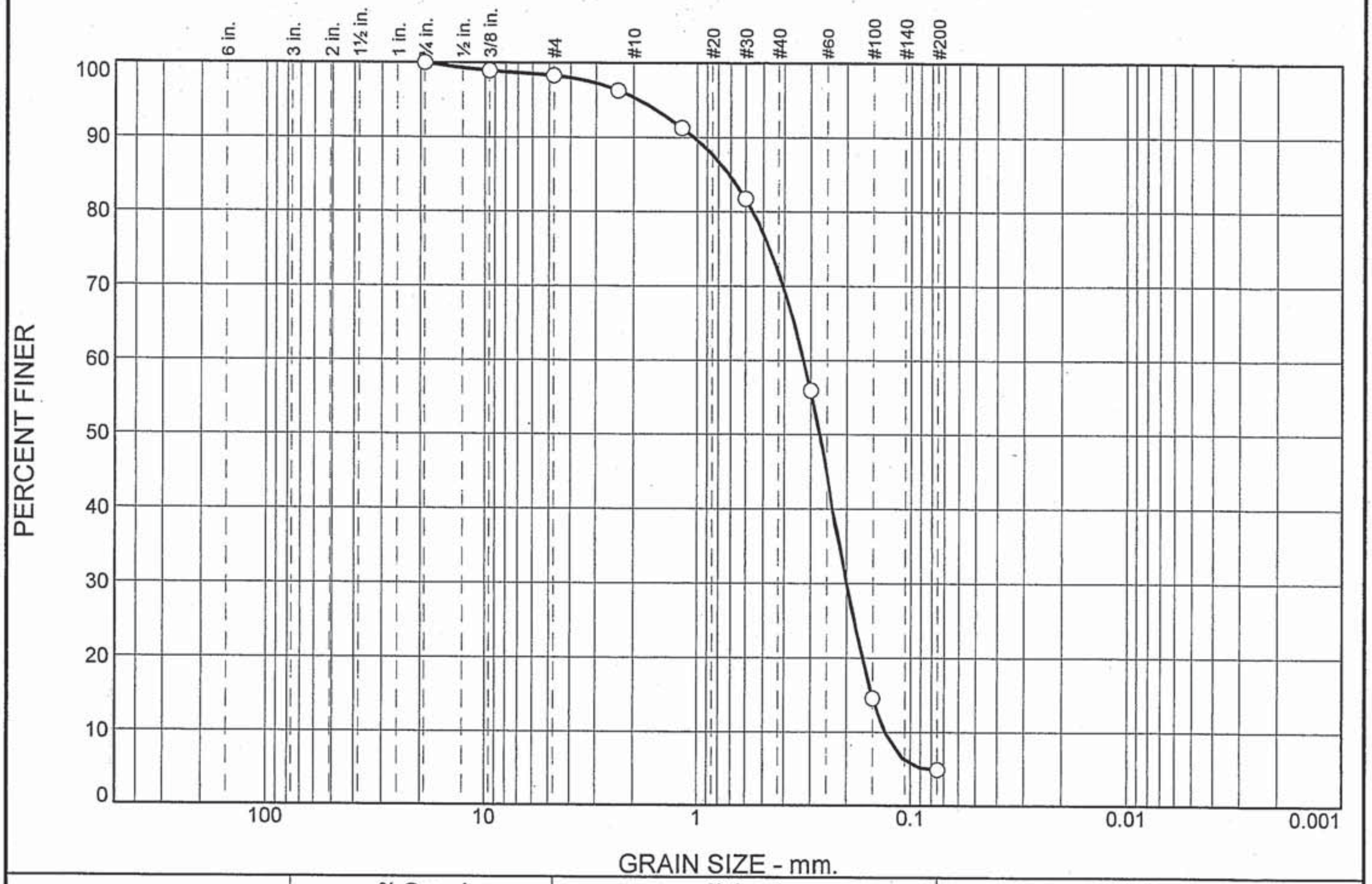
Sample No.: S-3 **Source of Sample:** B-102 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-143

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.7	2.9	23.4	67.1	4.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	98.9		
#4	98.3		
#8	96.3		
#16	91.3		
#30	81.8		
#50	55.9		
#100	14.5		
#200	4.9		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.7089 D_{60}= 0.3231 D_{50}= 0.2717
D_{30}= 0.1998 D_{15}= 0.1517 D_{10}= 0.1310
C_u= 2.47 C_c= 0.94

Date Tested: 1/12/06 **Tested By:** J. Crose

Remarks

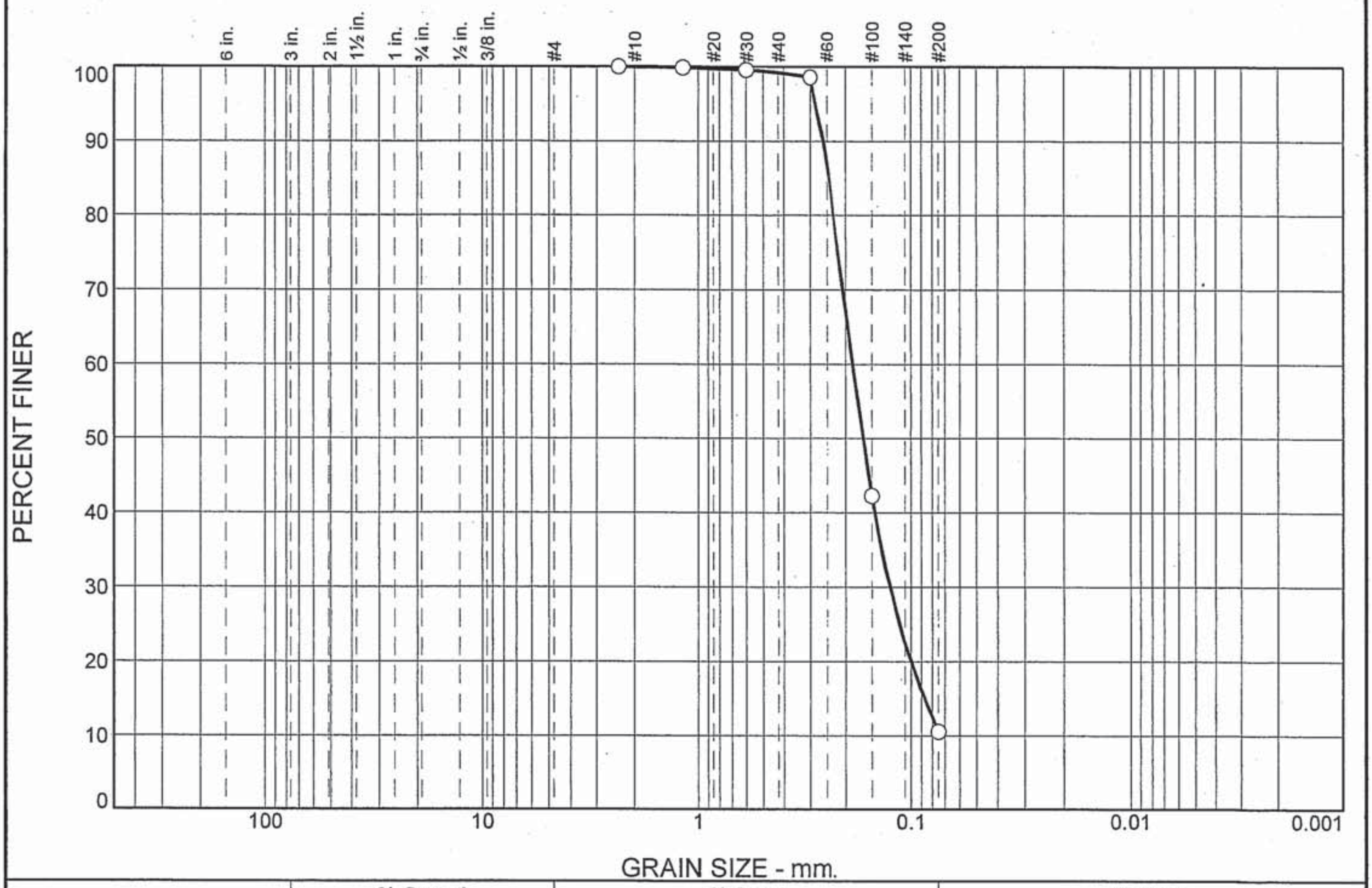
Sample No.: S-6 **Source of Sample:** B-102 **Date Sampled:**
Location: **Elev./Depth:** 18.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-144

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.8	88.6	10.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	99.9		
#30	99.6		
#50	98.6		
#100	42.2		
#200	10.6		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2433 D_{60}= 0.1843 D_{50}= 0.1649
D_{30}= 0.1242 D_{15}= 0.0865 D_{10}=
C_u= C_c=

Date Tested: 1/12/06 **Tested By:** J. Crose

Remarks

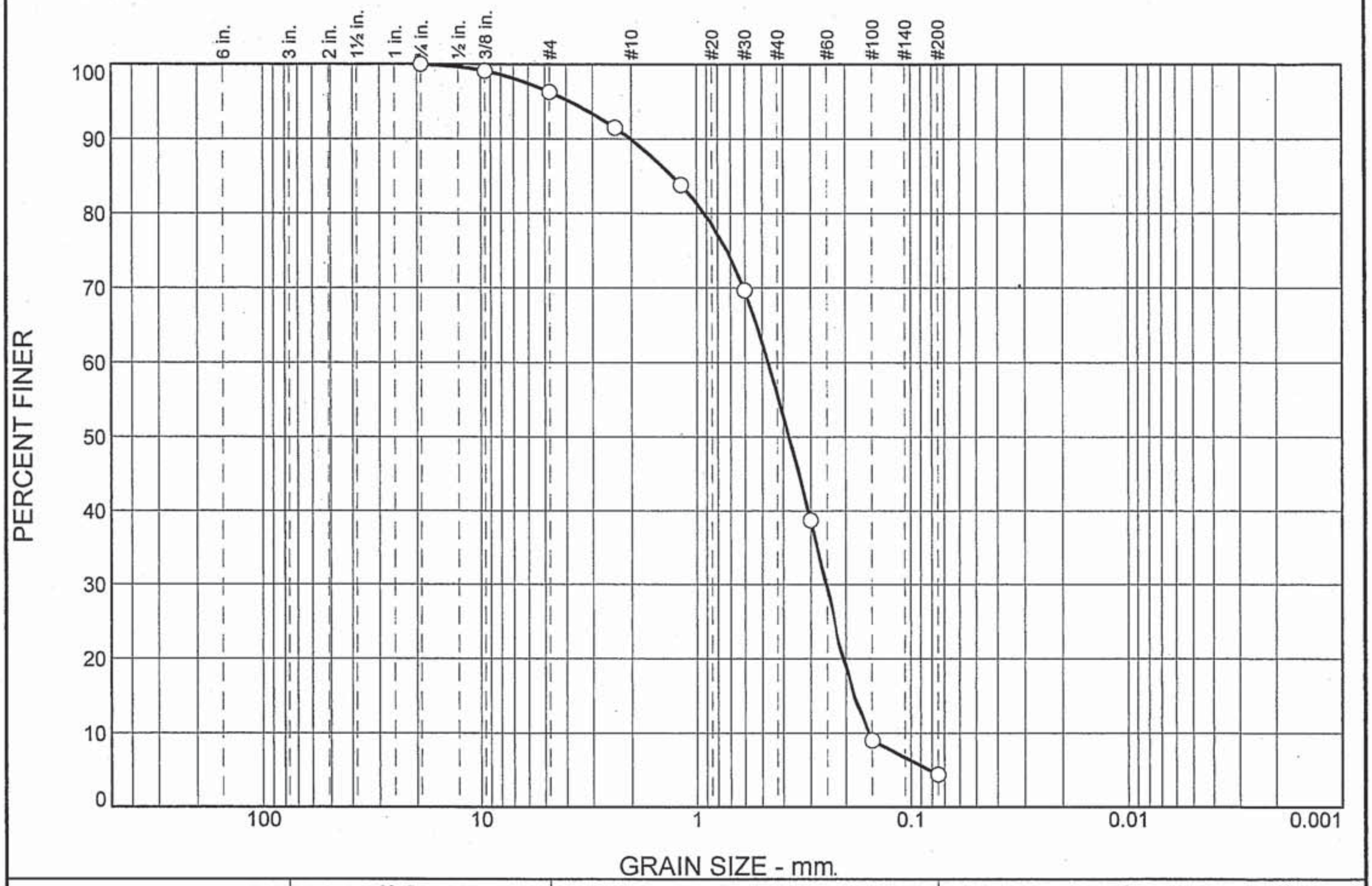
Sample No.: S-7 **Source of Sample:** B-102 **Date Sampled:**
Location: **Elev./Depth:** 23.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-145

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.7	6.3	34.2	51.4	4.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.1		
#4	96.3		
#8	91.5		
#16	83.8		
#30	69.7		
#50	38.7		
#100	9.0		
#200	4.4		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, trace of coarse-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.2914 D_{60}= 0.4665 D_{50}= 0.3757
D_{30}= 0.2528 D_{15}= 0.1812 D_{10}= 0.1558
C_u= 2.99 C_c= 0.88

Date Tested: 1/12/06 **Tested By:** J. Crose

Remarks

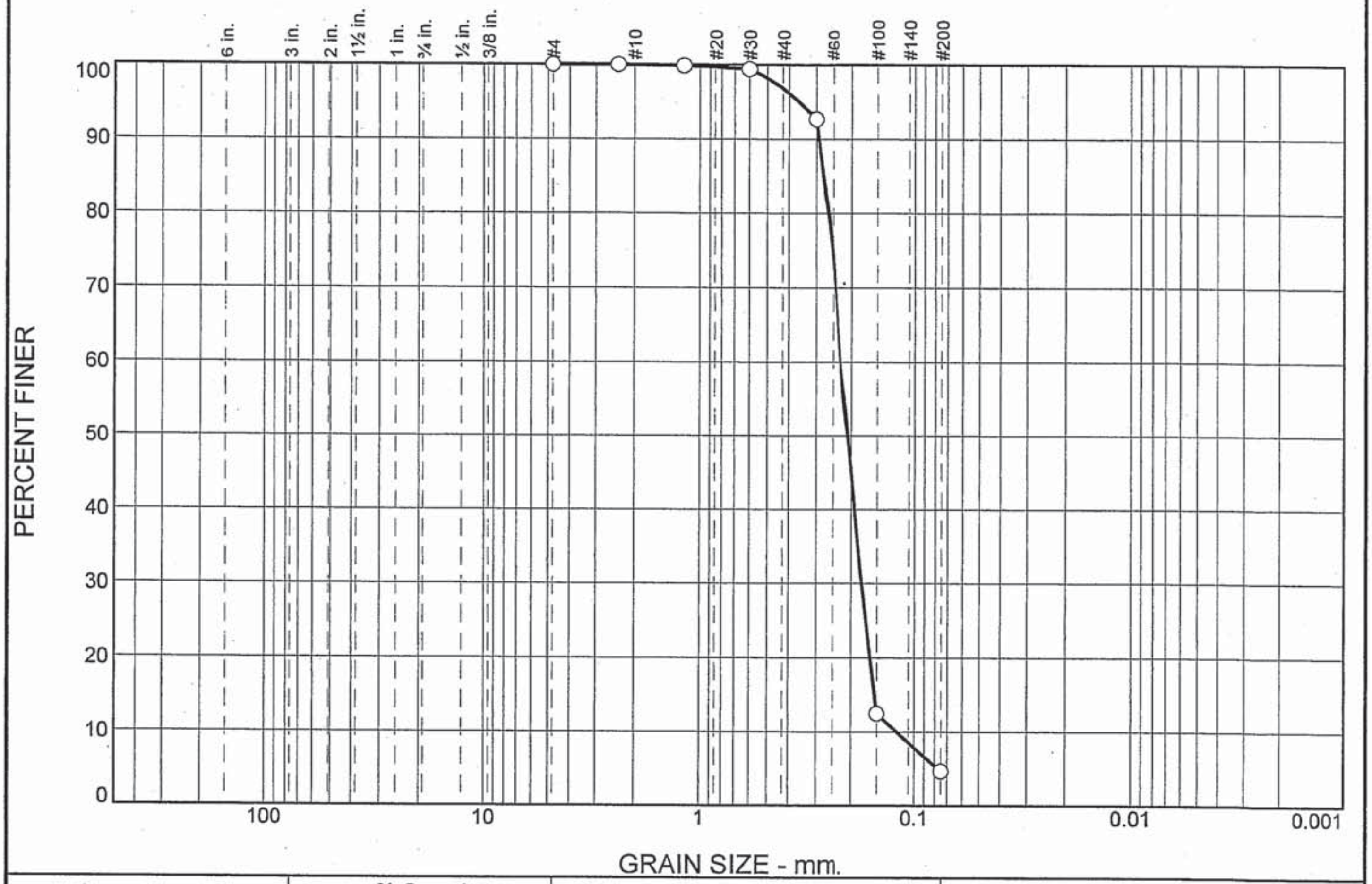
Sample No.: S-8 **Source of Sample:** B-102 **Date Sampled:**
Location: **Elev./Depth:** 28.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-146

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	3.2	92.2	4.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.9		
#30	99.4		
#50	92.7		
#100	12.5		
#200	4.6		

* (no specification provided)

Material Description

SAND (SP), fine-grained

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.2753 D_{60}= 0.2235 D_{50}= 0.2074
D_{30}= 0.1776 D_{15}= 0.1545 D_{10}= 0.1207
C_u= 1.85 C_c= 1.17

Date Tested: 1/12/06 **Tested By:** J. Crose

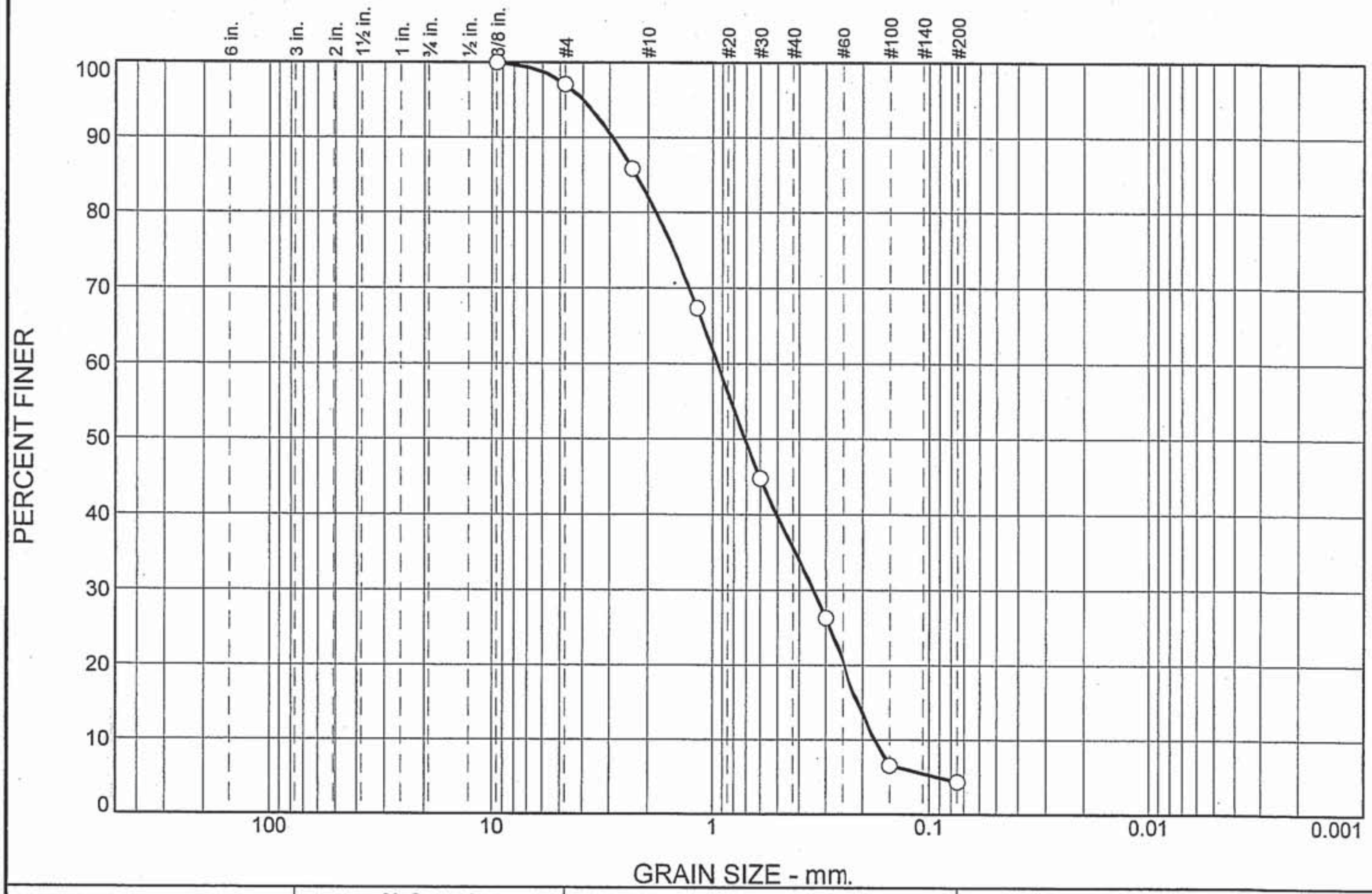
Remarks

Sample No.: S-5 **Source of Sample:** B-103 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-147

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.9	15.0	46.5	31.2	4.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	97.1		
#8	85.8		
#16	67.4		
#30	44.8		
#50	26.3		
#100	6.5		
#200	4.4		

* (no specification provided)

Material Description

SAND (SP), coarse-, medium-, and fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 2.2722 D_{60}= 0.9481 D_{50}= 0.7078
D_{30}= 0.3419 D_{15}= 0.2097 D_{10}= 0.1759
C_u= 5.39 C_c= 0.70

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

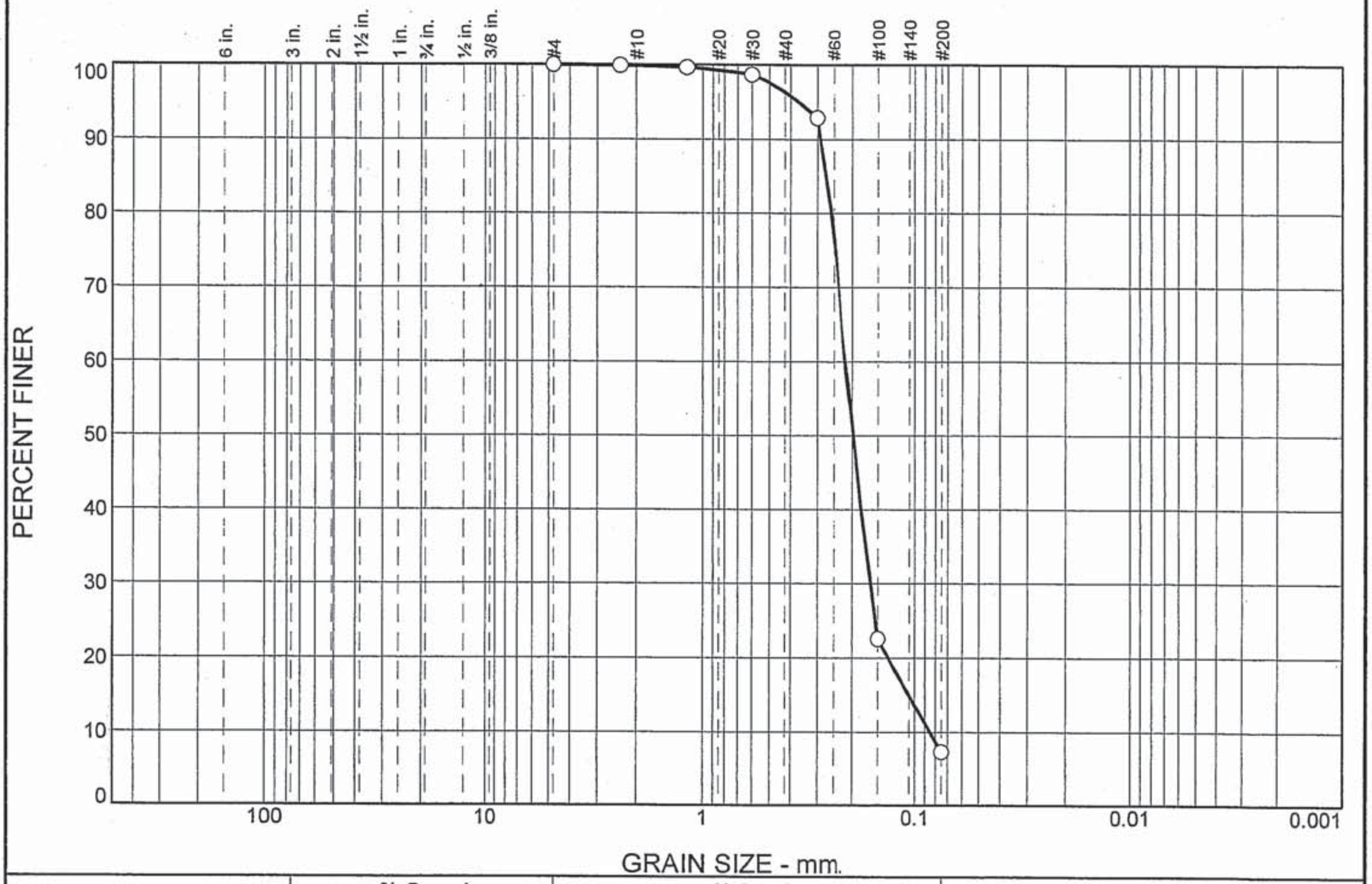
Sample No.: S-7 **Source of Sample:** B-103 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-148

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	3.5	89.1	7.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.7		
#30	98.7		
#50	92.9		
#100	22.6		
#200	7.3		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slighty silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2712 D_{60}= 0.2144 D_{50}= 0.1967
D_{30}= 0.1634 D_{15}= 0.1064 D_{10}= 0.0848
C_u= 2.53 C_c= 1.47

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

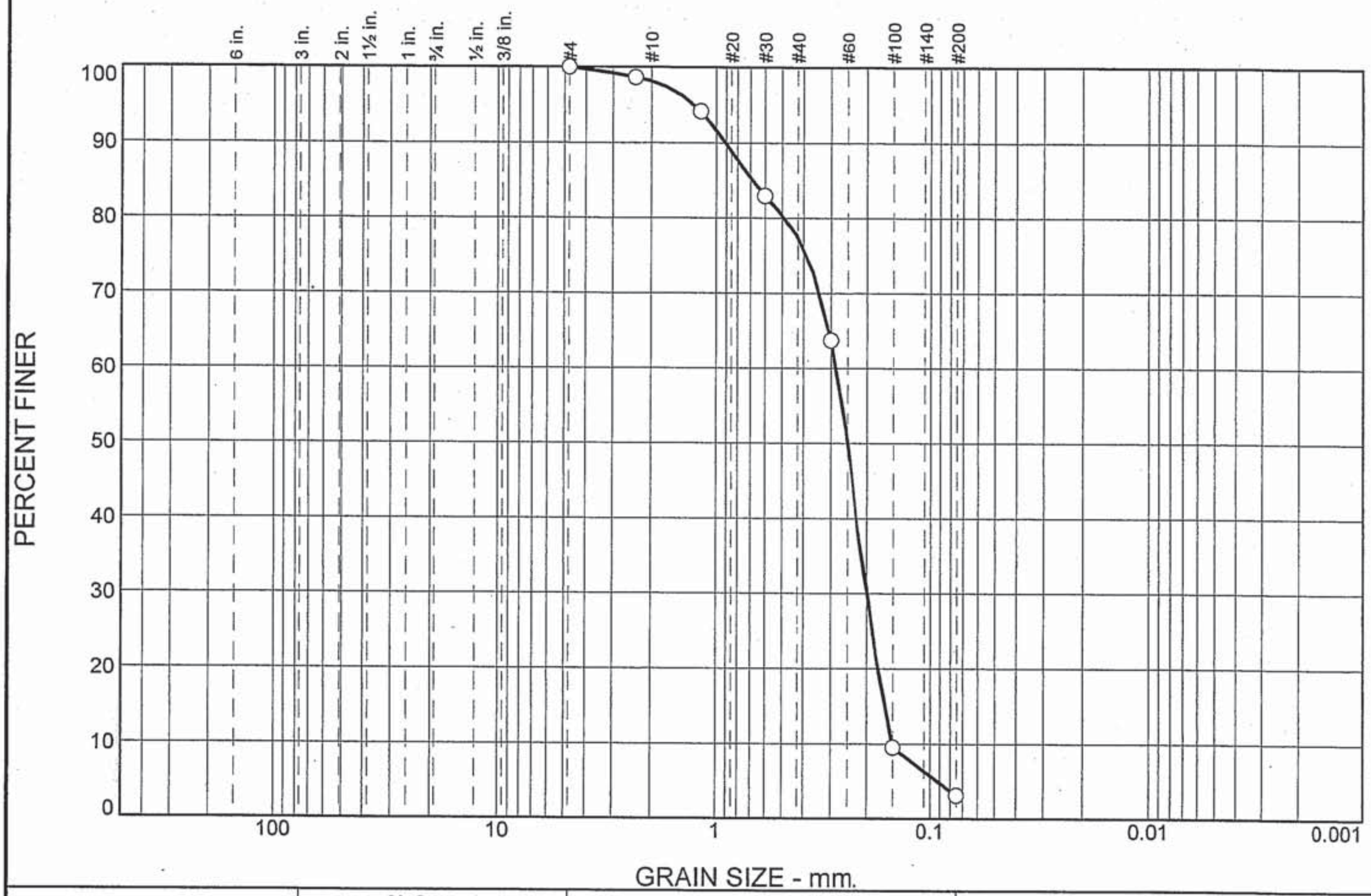
Sample No.: S-4 **Source of Sample:** B-104 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-149

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	1.8	20.6	74.5	3.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	98.7		
#16	94.2		
#30	83.0		
#50	63.7		
#100	9.5		
#200	3.1		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.6829 D_{60}= 0.2838 D_{50}= 0.2496
D_{30}= 0.1985 D_{15}= 0.1641 D_{10}= 0.1513
C_u= 1.88 C_c= 0.92

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

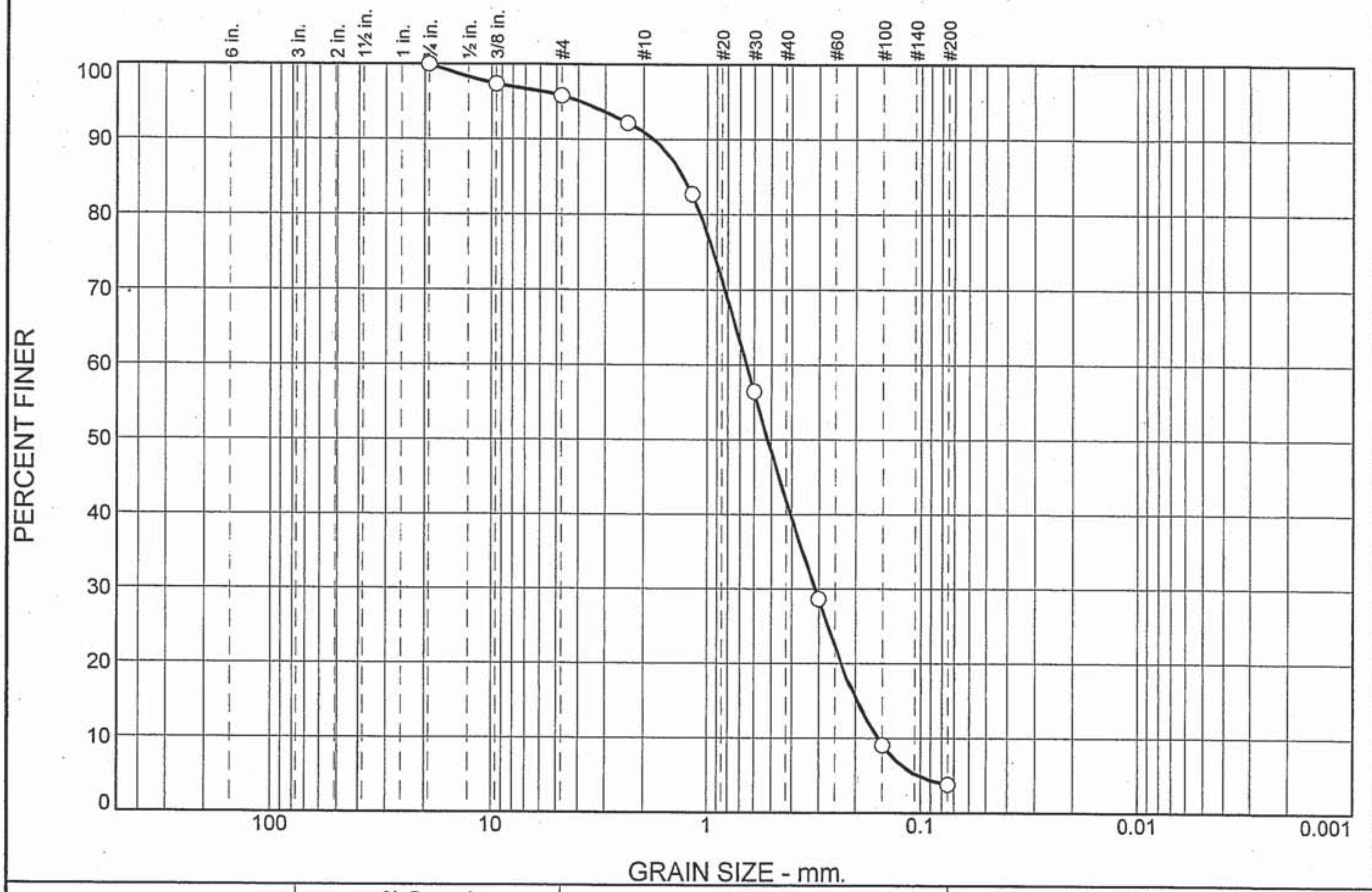
Sample No.: S-6 **Source of Sample:** B-104 **Date Sampled:**
Location: **Elev./Depth:** 18.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-150

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.2	4.8	49.0	38.2	3.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	97.4		
#4	95.8		
#8	92.2		
#16	82.7		
#30	56.4		
#50	28.7		
#100	9.0		
#200	3.8		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.2953 D_{60}= 0.6511 D_{50}= 0.5163
D_{30}= 0.3113 D_{15}= 0.1960 D_{10}= 0.1580
C_u= 4.12 C_c= 0.94

Date Tested: 1/13/06 **Tested By:** J. Crose

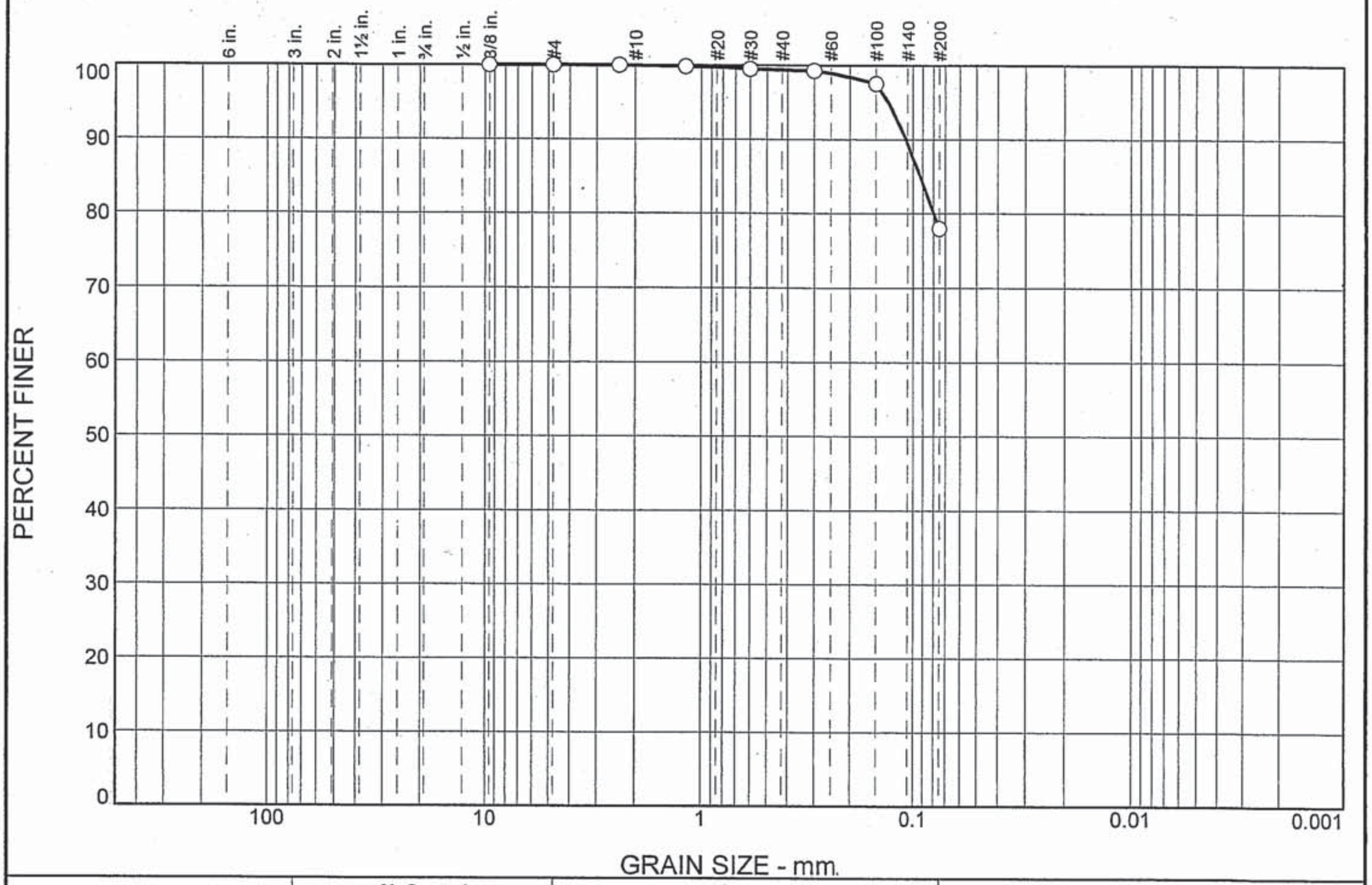
Remarks

Sample No.: S-8 **Source of Sample:** B-104 **Date Sampled:**
Location: **Elev./Depth:** 28.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-151

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	21.4	78.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	100.0		
#8	100.0		
#16	99.8		
#30	99.5		
#50	99.3		
#100	97.5		
#200	78.0		

* (no specification provided)

Material Description

SILT (ML), with fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.0920 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 01/25/06 **Tested By:** J. Crose

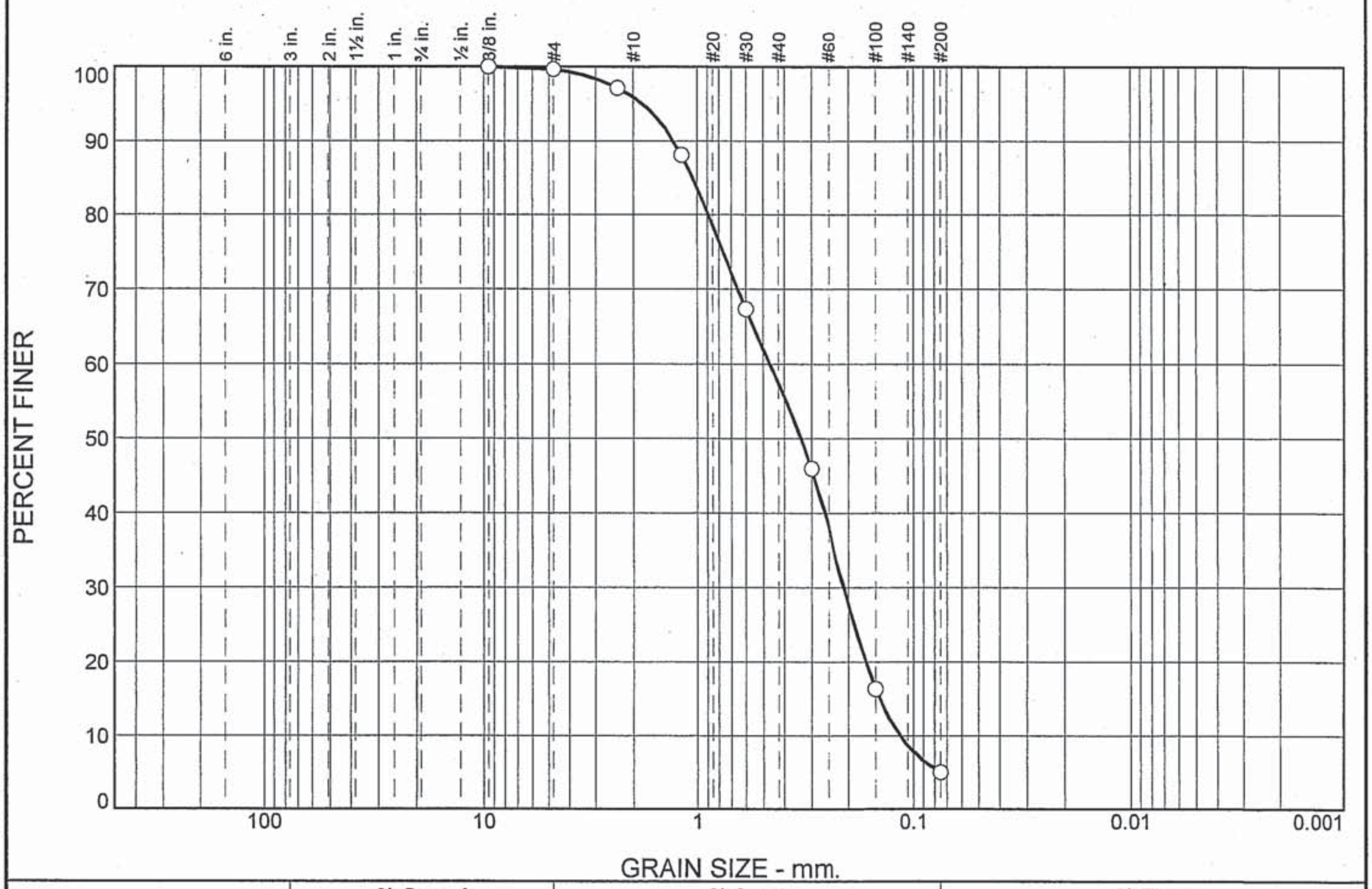
Remarks

Sample No.: S-5 **Source of Sample:** B-106 **Date Sampled:**
Location: **Elev./Depth:** 13
Checked By: K.Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-152

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	3.7	38.5	52.5	5.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.7		
#8	97.1		
#16	88.1		
#30	67.3		
#50	45.9		
#100	16.3		
#200	5.0		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 1.0475 D_{60}= 0.4648 D_{50}= 0.3347
D_{30}= 0.2098 D_{15}= 0.1437 D_{10}= 0.1160
C_u= 4.01 C_c= 0.82

Date Tested: 01/25/06 **Tested By:** J. Crose

Remarks

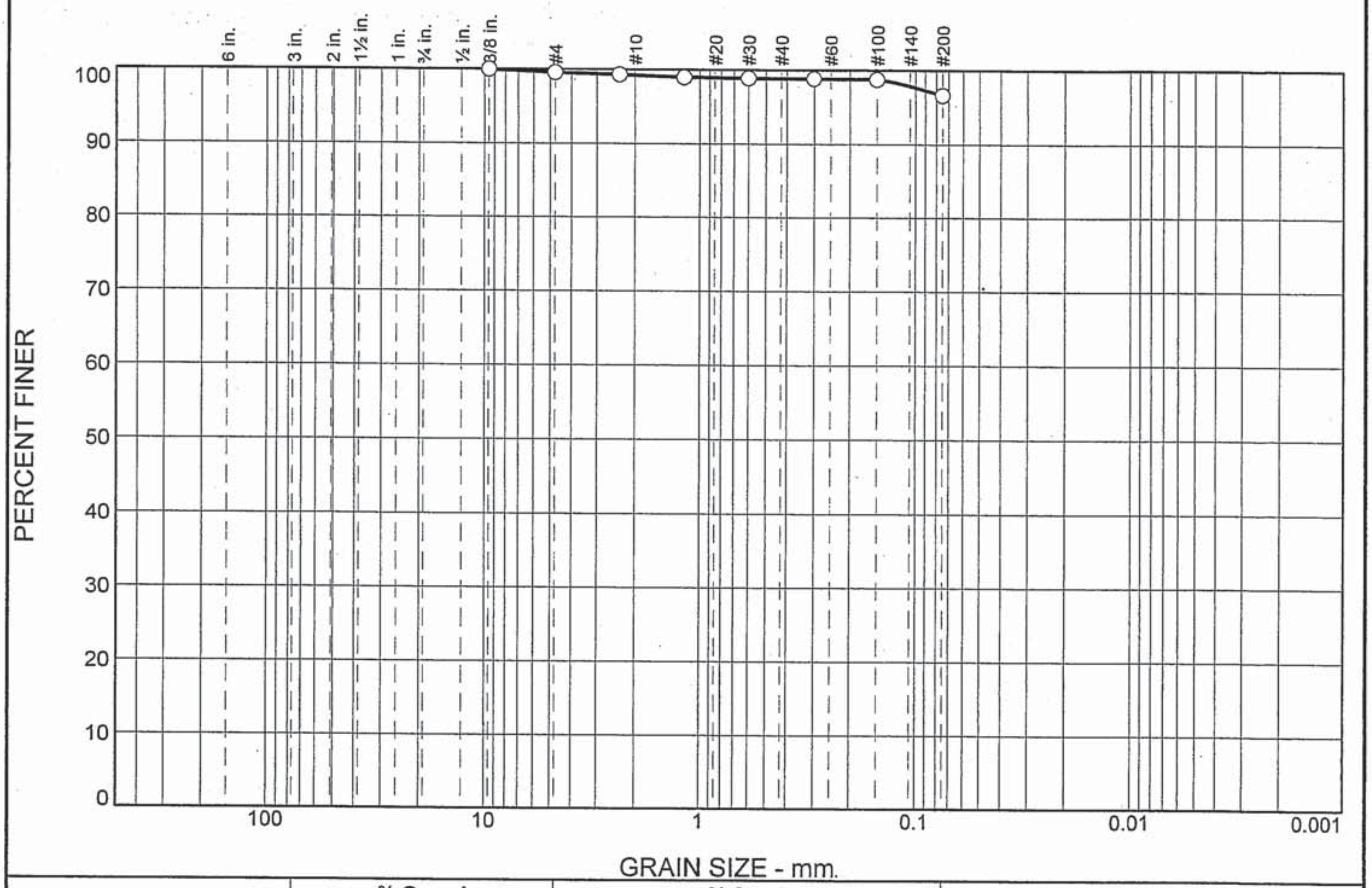
Sample No.: S-7 **Source of Sample:** B-106 **Date Sampled:**
Location: **Elev./Depth:** 23
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-153

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.4	0.4	0.3	2.3	96.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.6		
#8	99.3		
#16	99.0		
#30	98.9		
#50	98.8		
#100	98.8		
#200	96.6		

* (no specification provided)

Material Description

SILT (ML)

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/20/06 **Tested By:** J. Crose

Remarks

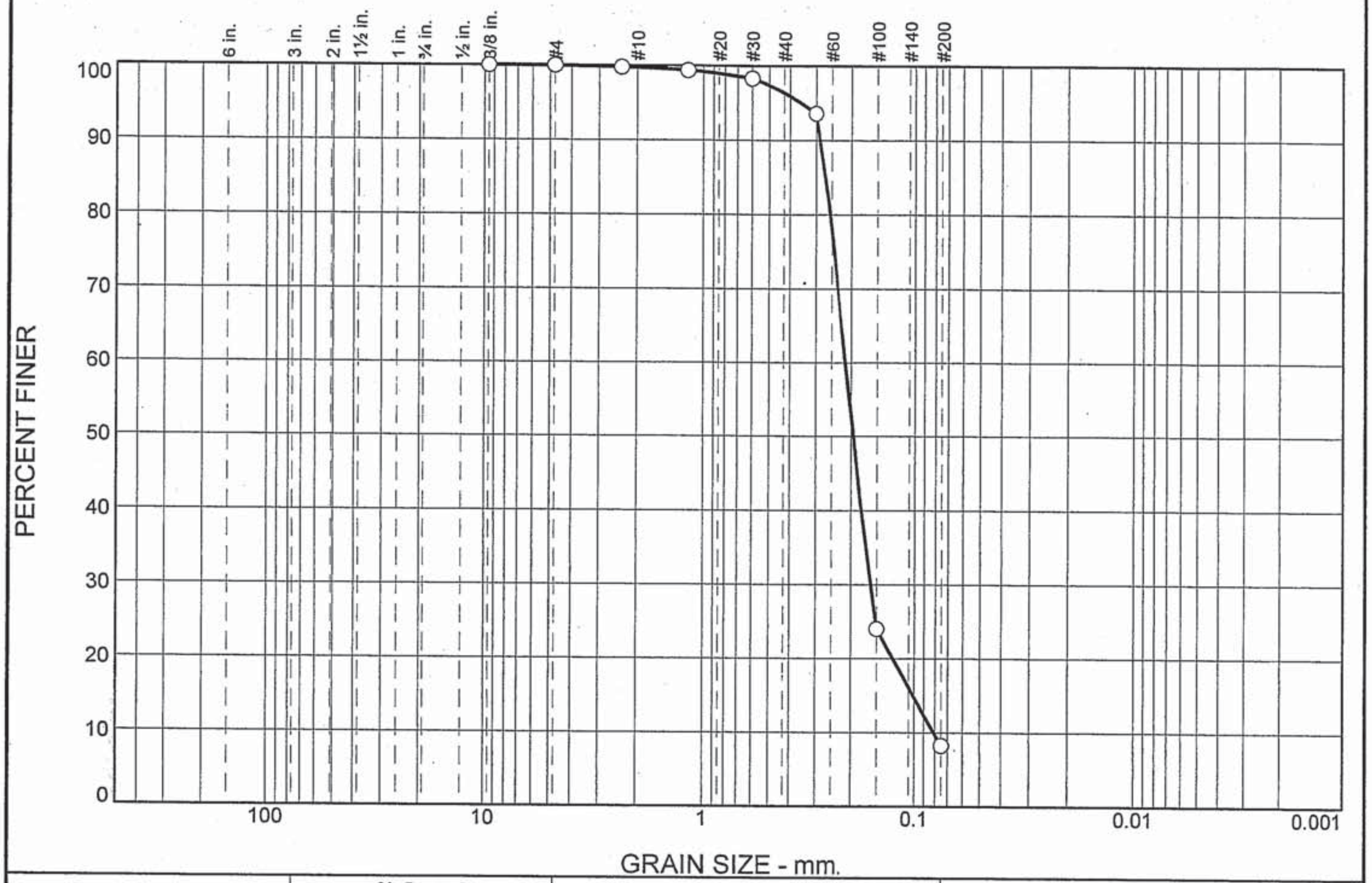
Sample No.: ST-3 **Source of Sample:** B-107 **Date Sampled:**
Location: **Elev./Depth:** 6.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-154

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.2	3.4	88.2	8.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	100.0		
#8	99.8		
#16	99.4		
#30	98.3		
#50	93.6		
#100	24.0		
#200	8.2		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2685 D_{60}= 0.2121 D_{50}= 0.1945
D_{30}= 0.1609 D_{15}= 0.1010 D_{10}= 0.0811
C_u= 2.62 C_c= 1.51

Date Tested: 01/25/06 **Tested By:** J. Crose

Remarks

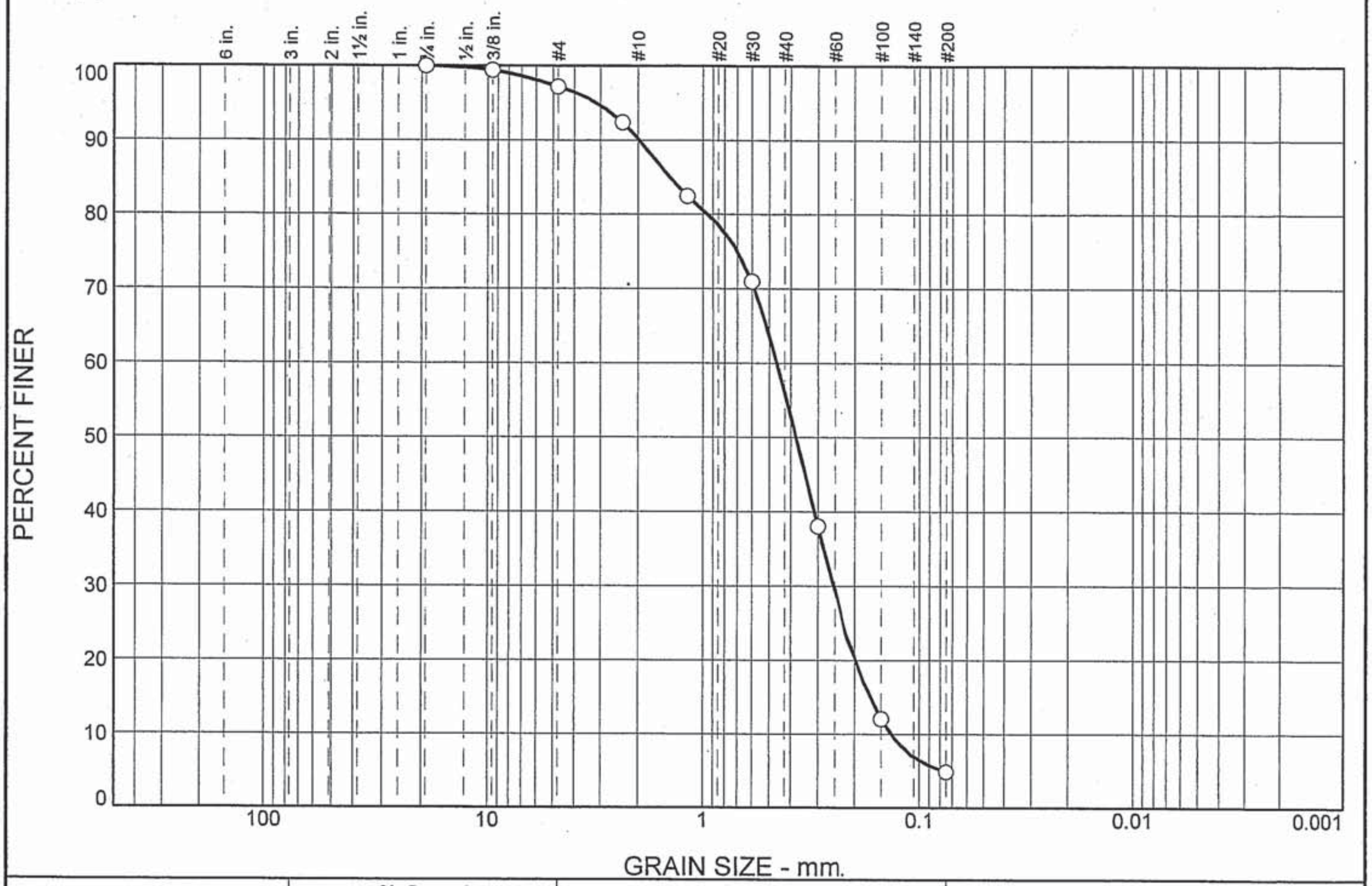
Sample No.: S-5 **Source of Sample:** B-107 **Date Sampled:**
Location: **Elev./Depth:** 13.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-155

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.8	7.0	34.1	51.2	4.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
3/8	99.4		
#4	97.2		
#8	92.4		
#16	82.4		
#30	71.0		
#50	38.0		
#100	12.0		
#200	4.9		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grained, trace of coarse-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.4209 D_{60}= 0.4597 D_{50}= 0.3776
D_{30}= 0.2533 D_{15}= 0.1687 D_{10}= 0.1353
C_u= 3.40 C_c= 1.03

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

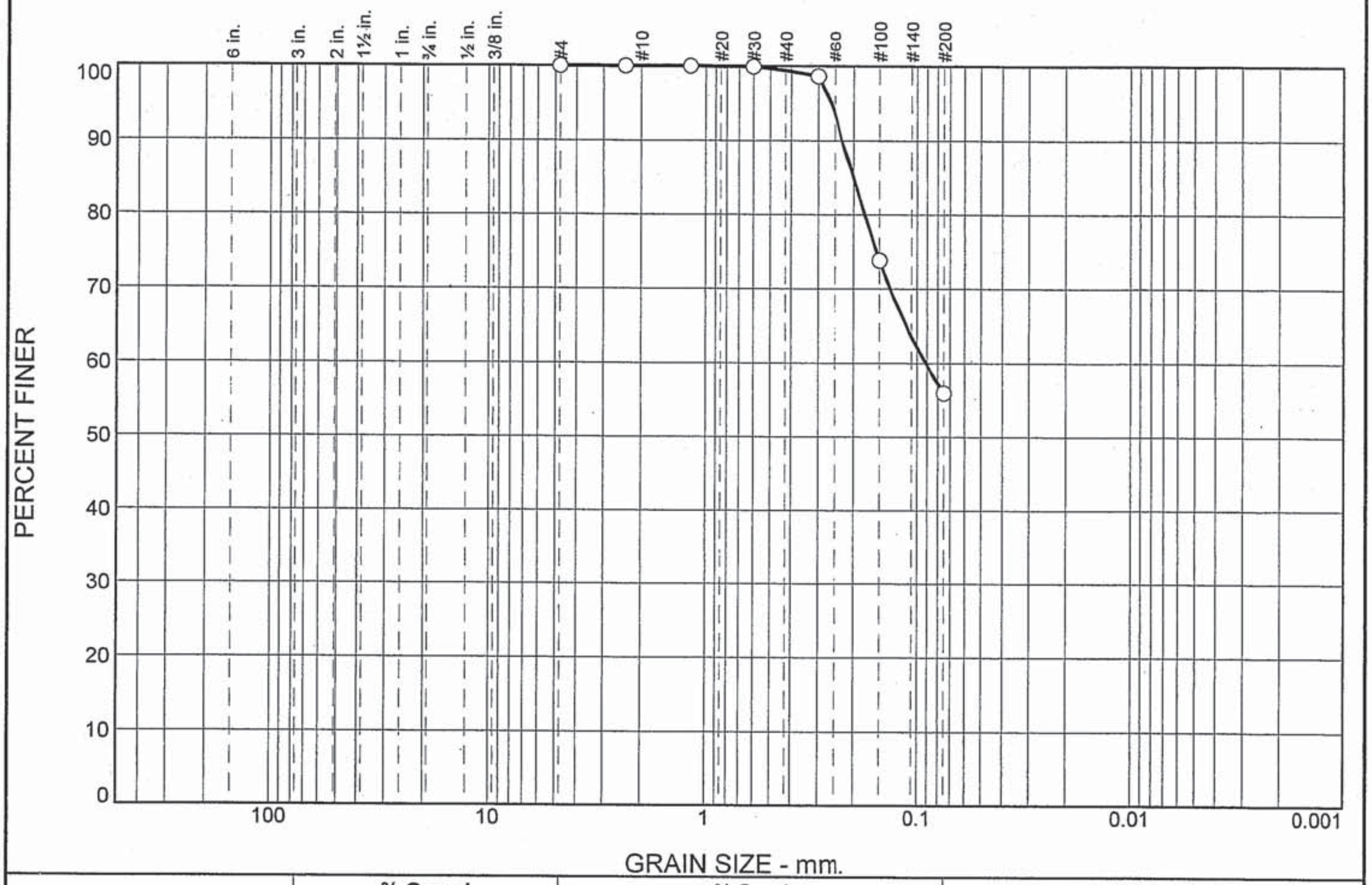
Sample No.: S-7 **Source of Sample:** B-107 **Date Sampled:**
Location: **Elev./Depth:** 23.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-156

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.6	43.5	55.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	100.0		
#30	99.9		
#50	98.6		
#100	73.8		
#200	55.9		

* (no specification provided)

Material Description

SILT (ML), with fine-grained sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.1988 D_{60}= 0.0909 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

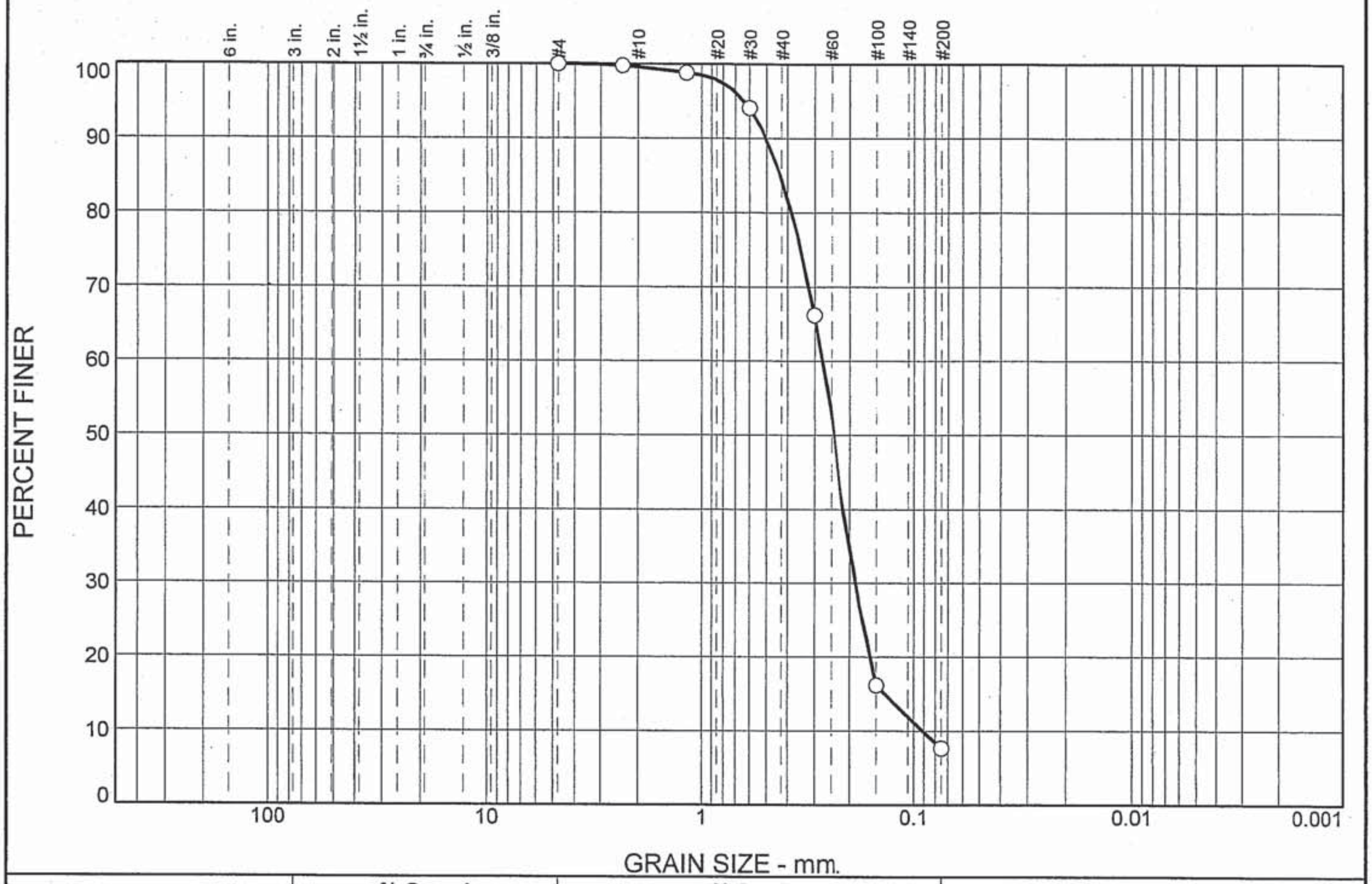
Sample No.: ST-4 **Source of Sample:** B-108 **Date Sampled:**
Location: **Elev./Depth:** 9
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-157

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	15.0	76.9	7.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.8		
#16	98.8		
#30	94.1		
#50	66.2		
#100	16.1		
#200	7.7		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.4300 D_{60}= 0.2751 D_{50}= 0.2420
D_{30}= 0.1876 D_{15}= 0.1366 D_{10}= 0.0908
C_u= 3.03 C_c= 1.41

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

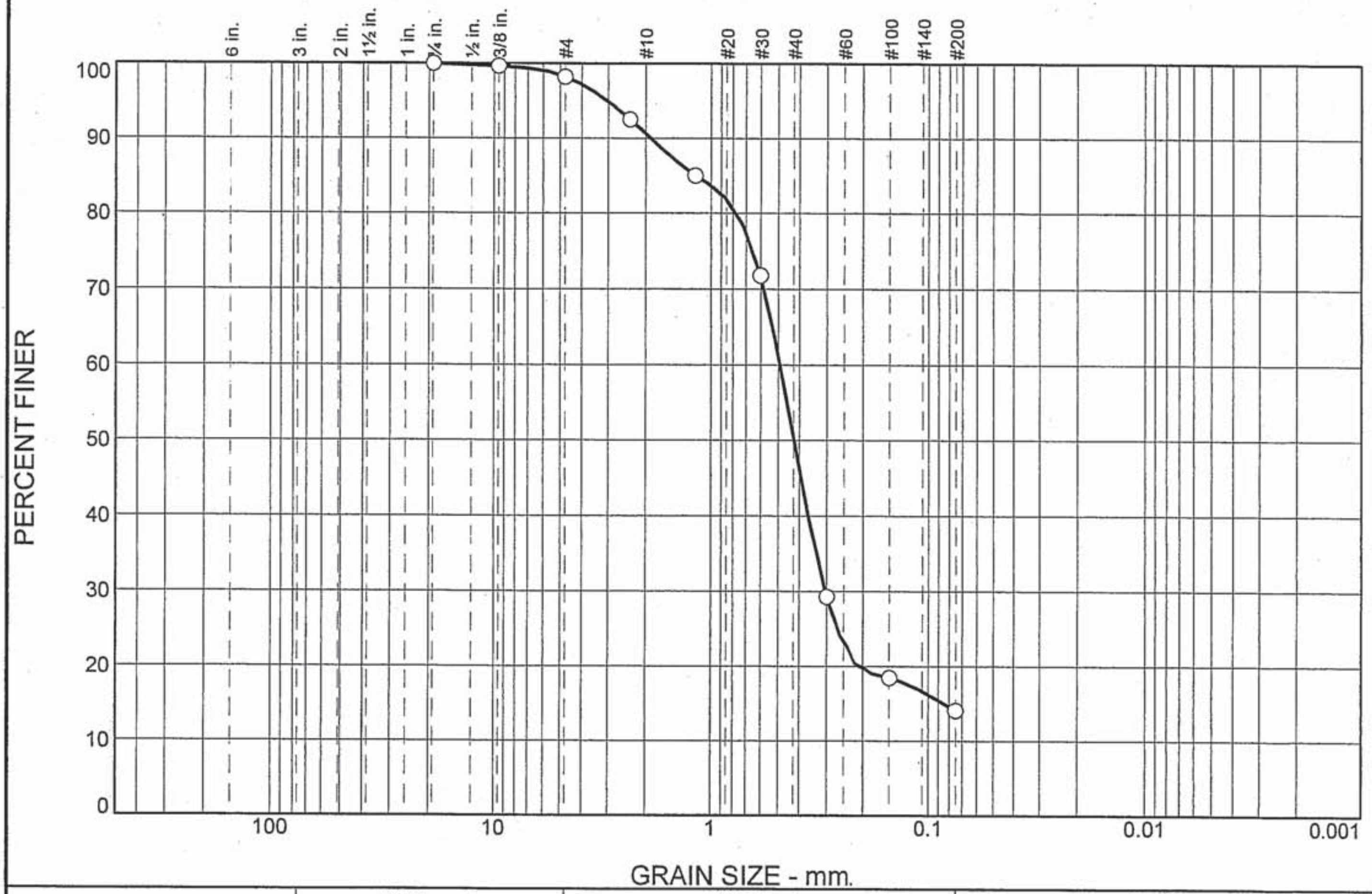
Sample No.: S-6 **Source of Sample:** B-108 **Date Sampled:**
Location: **Elev./Depth:** 18.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-158

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.8	7.6	40.1	36.4	14.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
3/8	99.7		
#4	98.2		
#8	92.5		
#16	85.0		
#30	71.8		
#50	29.3		
#100	18.4		
#200	14.1		

* (no specification provided)

Material Description

Silty SAND (SM), medium- to fine-grained, trace of coarse-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 1.1774 D_{60}= 0.4889 D_{50}= 0.4220
D_{30}= 0.3047 D_{15}= 0.0845 D_{10}=
C_u= C_c=

Date Tested: 1/17/06 **Tested By:** J. Crose

Remarks

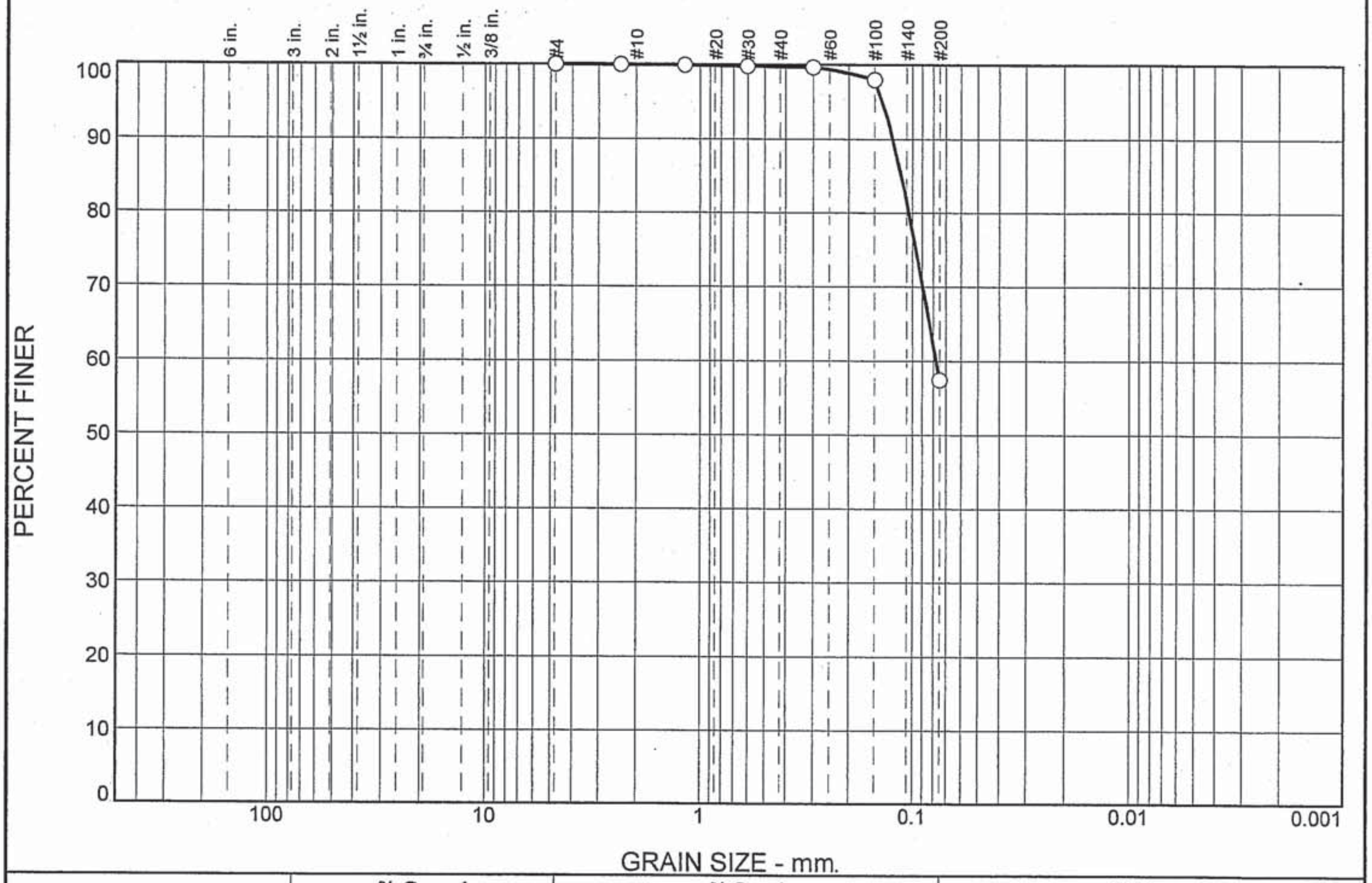
Sample No.: S-8 **Source of Sample:** B-108 **Date Sampled:**
Location: **Elev./Depth:** 28.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-159

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.3	42.3	57.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.9		
#30	99.8		
#50	99.7		
#100	98.0		
#200	57.4		

* (no specification provided)

Material Description

SILT (ML), with fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.1122 D_{60}= 0.0777 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 01/25/06 **Tested By:** J. Crose

Remarks

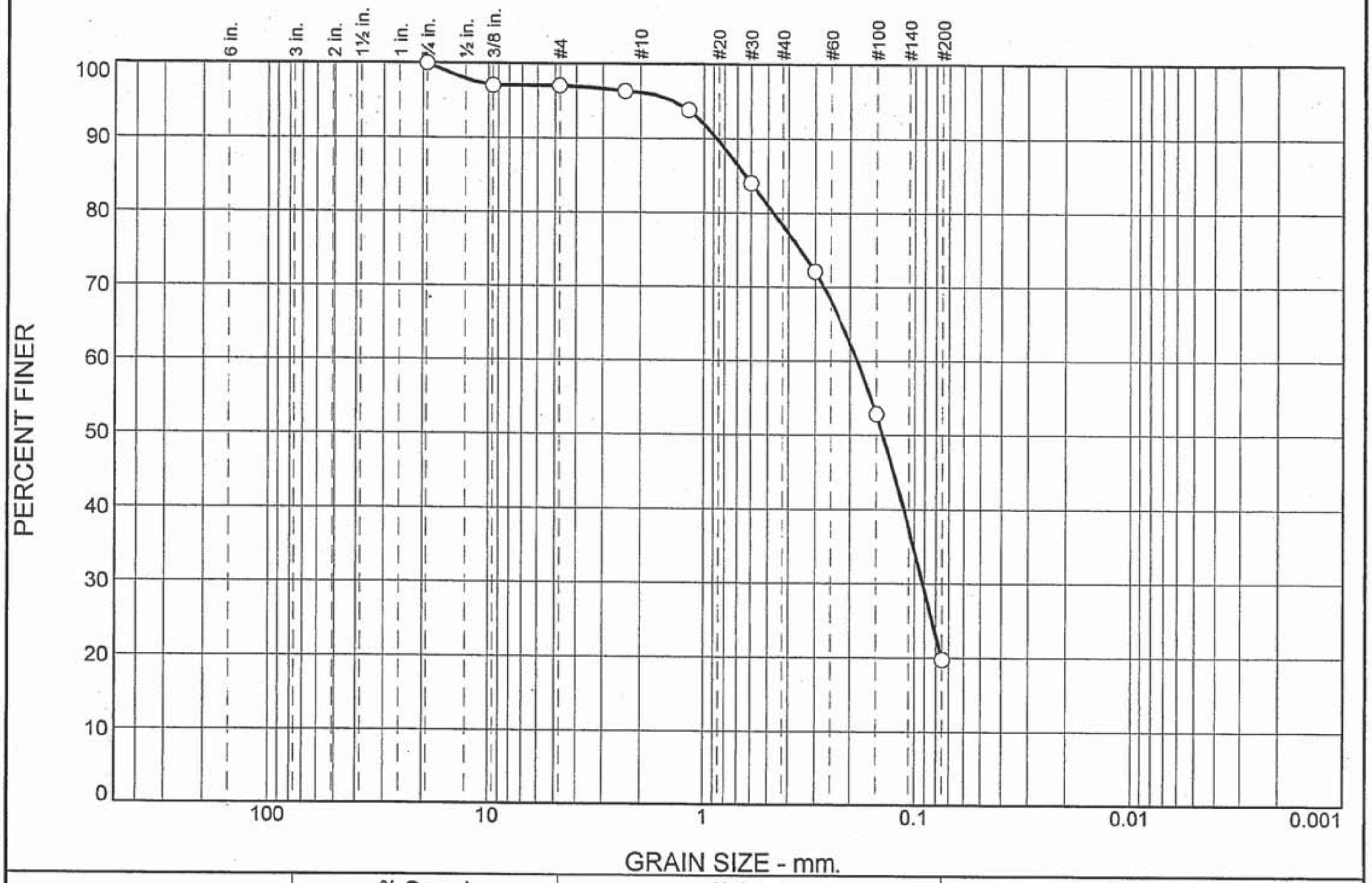
Sample No.: S-5 **Source of Sample:** B-110 **Date Sampled:**
Location: **Elev./Depth:** 13.0
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-160

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.0	0.9	17.7	58.7	19.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	97.0		
#4	97.0		
#8	96.3		
#16	93.8		
#30	84.0		
#50	72.1		
#100	52.8		
#200	19.7		

* (no specification provided)

Material Description

Silty SAND (SM), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SM AASHTO=

Coefficients

D_{85}= 0.6359 D_{60}= 0.1844 D_{50}= 0.1397
D_{30}= 0.0914 D_{15}= D_{10}=
C_u= C_c=

Date Tested: 01/25/06 **Tested By:** J. Crose

Remarks

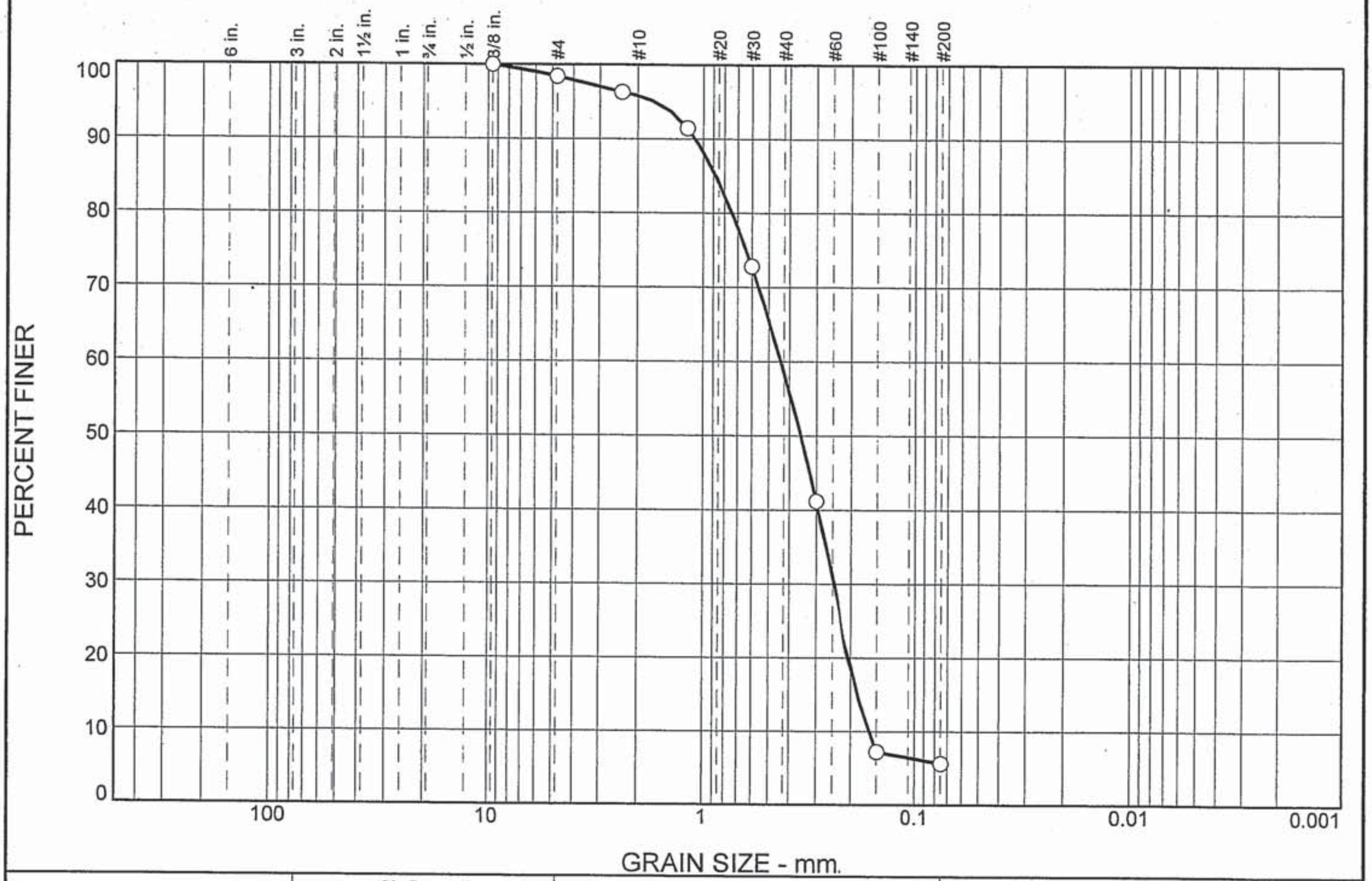
Sample No.: S-6 **Source of Sample:** B-110 **Date Sampled:**
Location: **Elev./Depth:** 18.0
Checked By: K. Kocher **Title:** P.E.

Reitz & Jens, Inc.
Consulting Engineers

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-161

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	1.6	2.6	37.2	52.9	5.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	98.4		
#8	96.3		
#16	91.4		
#30	72.8		
#50	41.2		
#100	7.2		
#200	5.7		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.8755 D_{60}= 0.4381 D_{50}= 0.3548
D_{30}= 0.2461 D_{15}= 0.1849 D_{10}= 0.1637
C_u= 2.68 C_c= 0.84

Date Tested: 1/13/06 **Tested By:** J. Crose

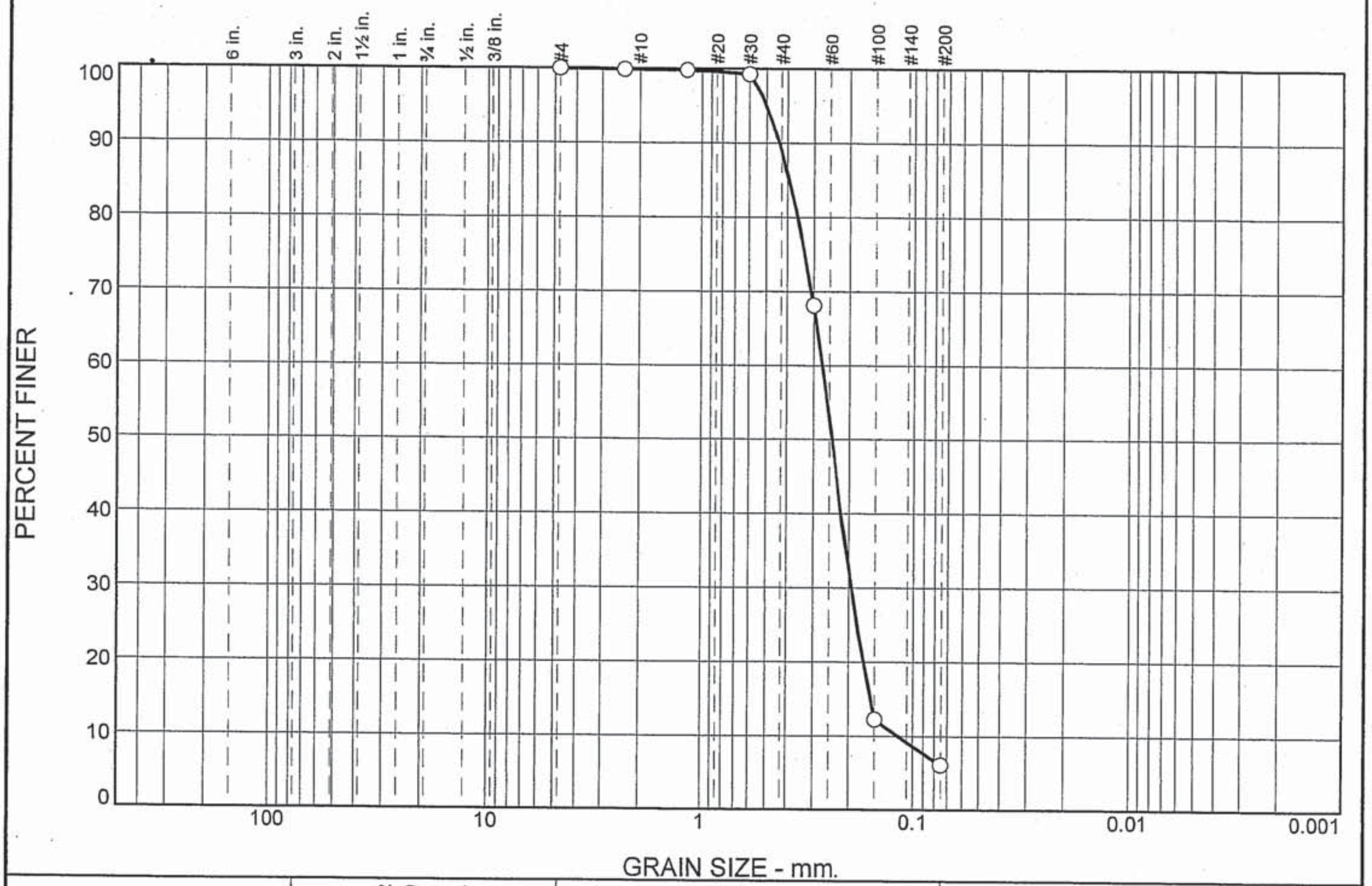
Remarks

Sample No.: S-5 **Source of Sample:** B-111 **Date Sampled:**
Location: **Elev./Depth:** 13.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-162

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	10.7	83.1	6.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.8		
#30	99.3		
#50	68.1		
#100	12.2		
#200	6.1		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty, with traces of medium-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.3897 D_{60}= 0.2717 D_{50}= 0.2427
D_{30}= 0.1938 D_{15}= 0.1577 D_{10}= 0.1165
C_u= 2.33 C_c= 1.19

Date Tested: 1/13/06 **Tested By:** J. Crose

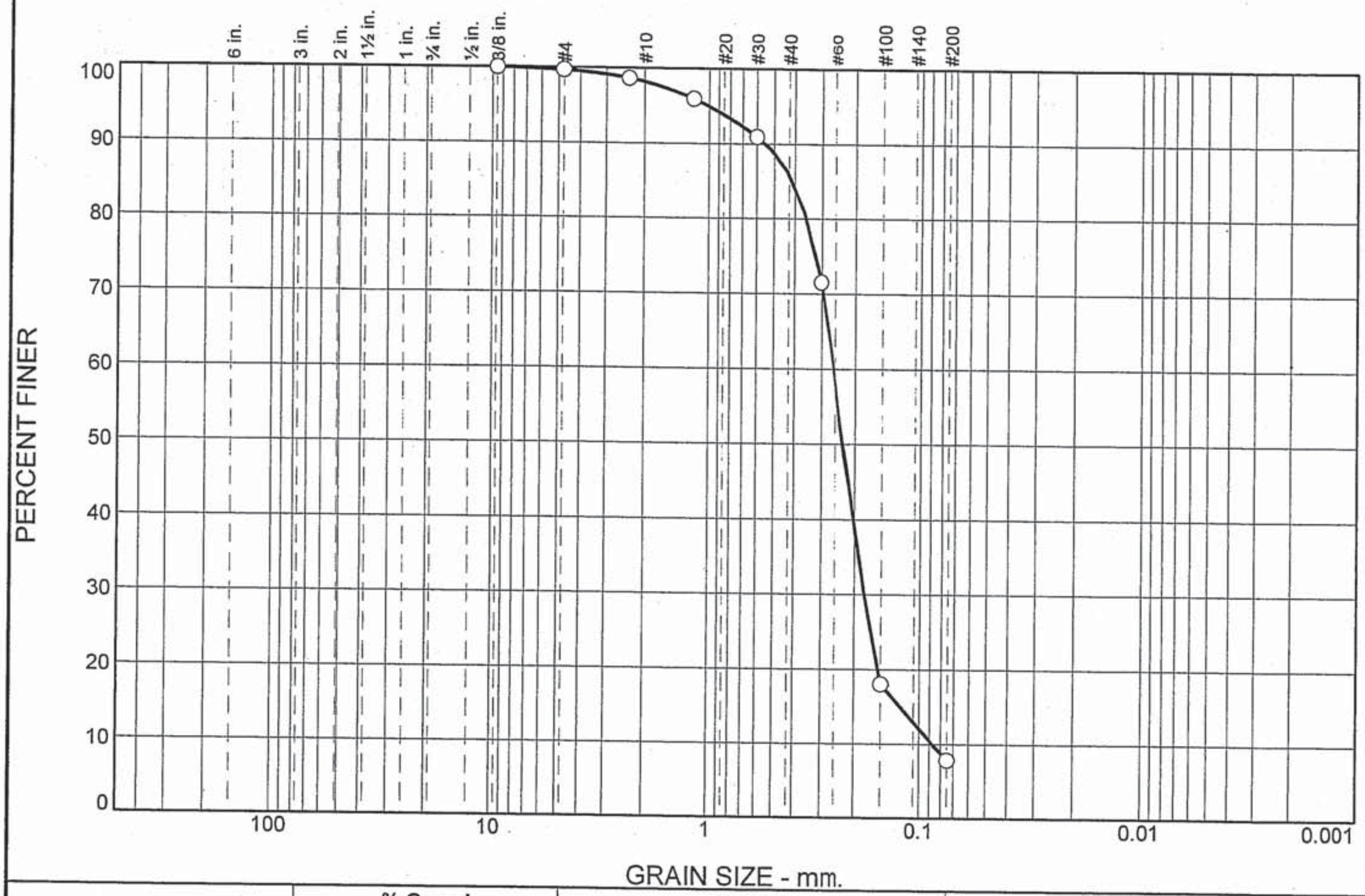
Remarks

Sample No.: S-6 **Source of Sample:** B-111 **Date Sampled:**
Location: **Elev./Depth:** 18.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-163

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	1.5	12.3	78.1	7.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.7		
#8	98.7		
#16	96.0		
#30	90.9		
#50	71.5		
#100	18.0		
#200	7.8		

* (no specification provided)

Material Description

SAND (SP-SM), medium- to fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.4099 D_{60}= 0.2560 D_{50}= 0.2272
D_{30}= 0.1792 D_{15}= 0.1221 D_{10}= 0.0869
C_u= 2.94 C_c= 1.44

Date Tested: 1/13/06 **Tested By:** J. Crose

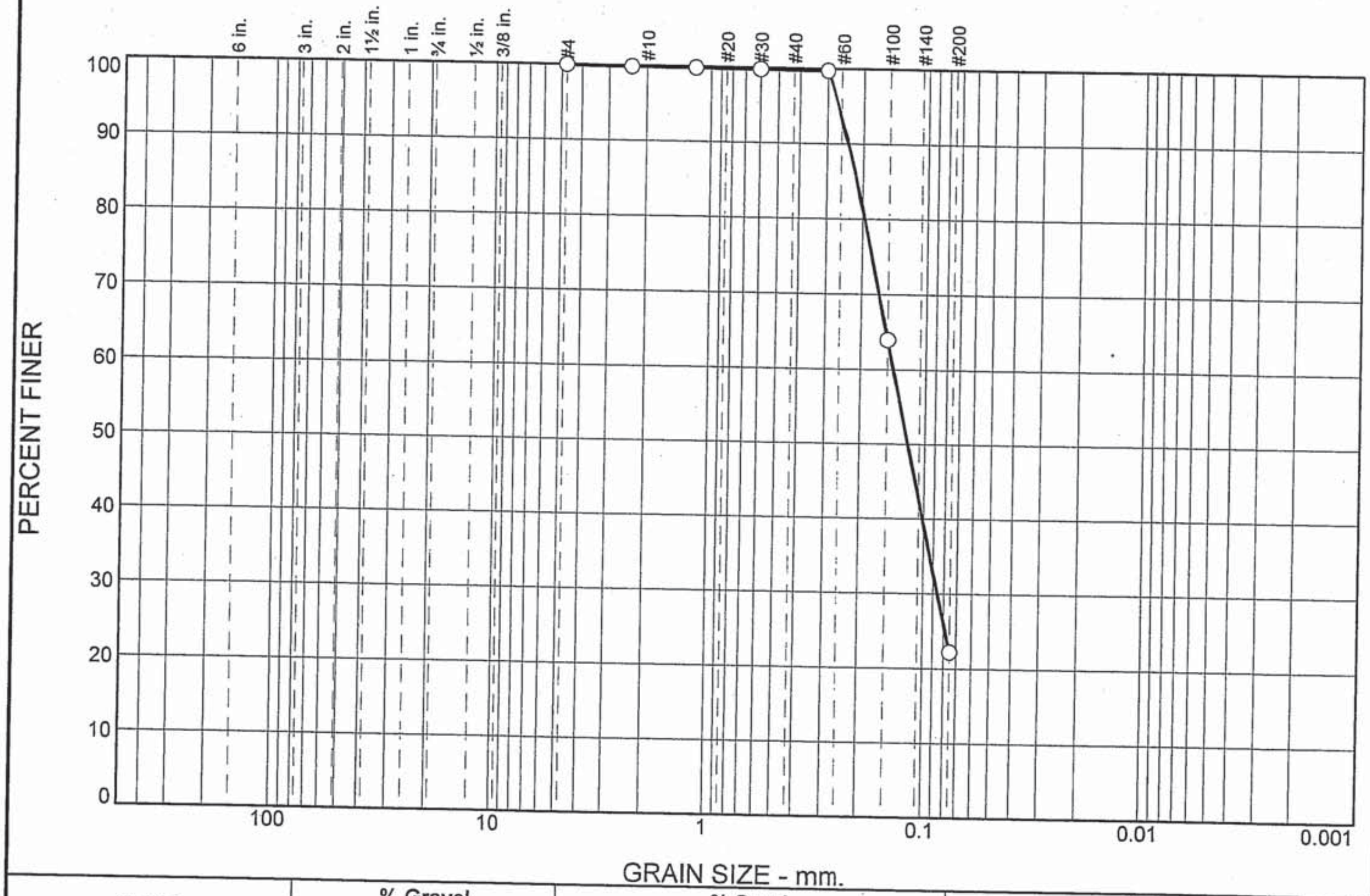
Remarks

Sample No.: S-7 **Source of Sample:** B-111 **Date Sampled:**
Location: **Elev./Depth:** 23.5
Checked By: k. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-164

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	0.1	77.6	22.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.9		
#16	99.8		
#30	99.8		
#50	99.8		
#100	64.0		
#200	22.2		

* (no specification provided)

Material Description

Silty SAND (SM) fine-grain

Atterberg Limits (ASTM D 4318)

PL=
LL=
PI=

Classification

USCS= SM
AASHTO=

Coefficients

D_{85}= 0.2114
D_{60}= 0.1408
D_{50}= 0.1197
D_{30}= 0.0856
D_{15}=
D_{10}=
C_u=
C_c=

Date Tested: 1/23/06 **Tested By:** J. Pruett

Remarks

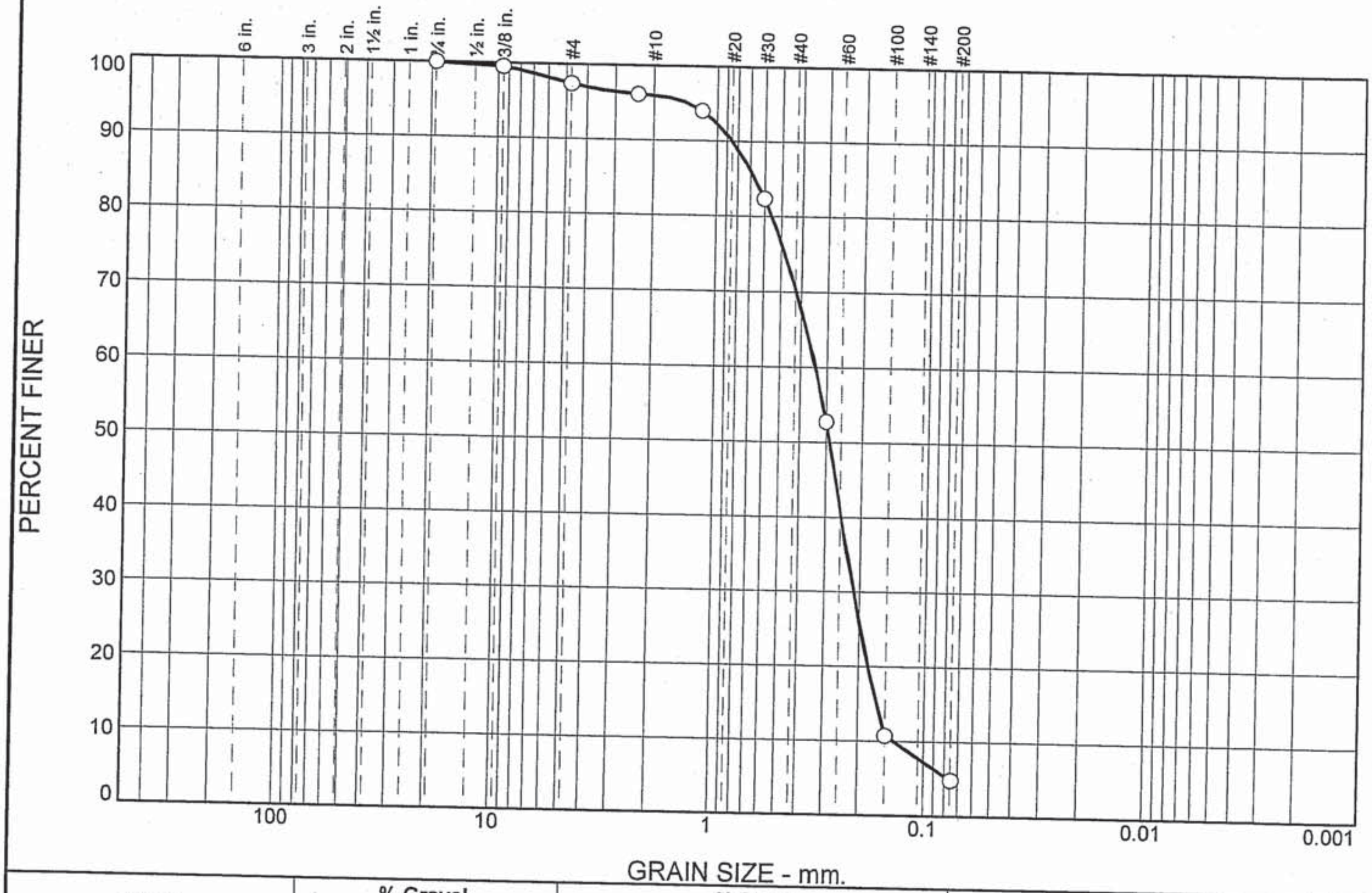
Sample No.: S-5 **Source of Sample:** B-112
Location:
Checked By: K. Kocher
Title: P.E.
Date Sampled:
Elev./Depth: 13

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477
Figure B1-165

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.6	1.4	25.5	65.7	4.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.5		
#4	97.4		
#8	96.1		
#16	94.0		
#30	82.3		
#50	52.7		
#100	10.7		
#200	4.8		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.6648 D_{60}= 0.3406 D_{50}= 0.2871
D_{30}= 0.2130 D_{15}= 0.1654 D_{10}= 0.1378
C_u= 2.47 C_c= 0.97

Date Tested: 1/23/06 **Tested By:** JJP

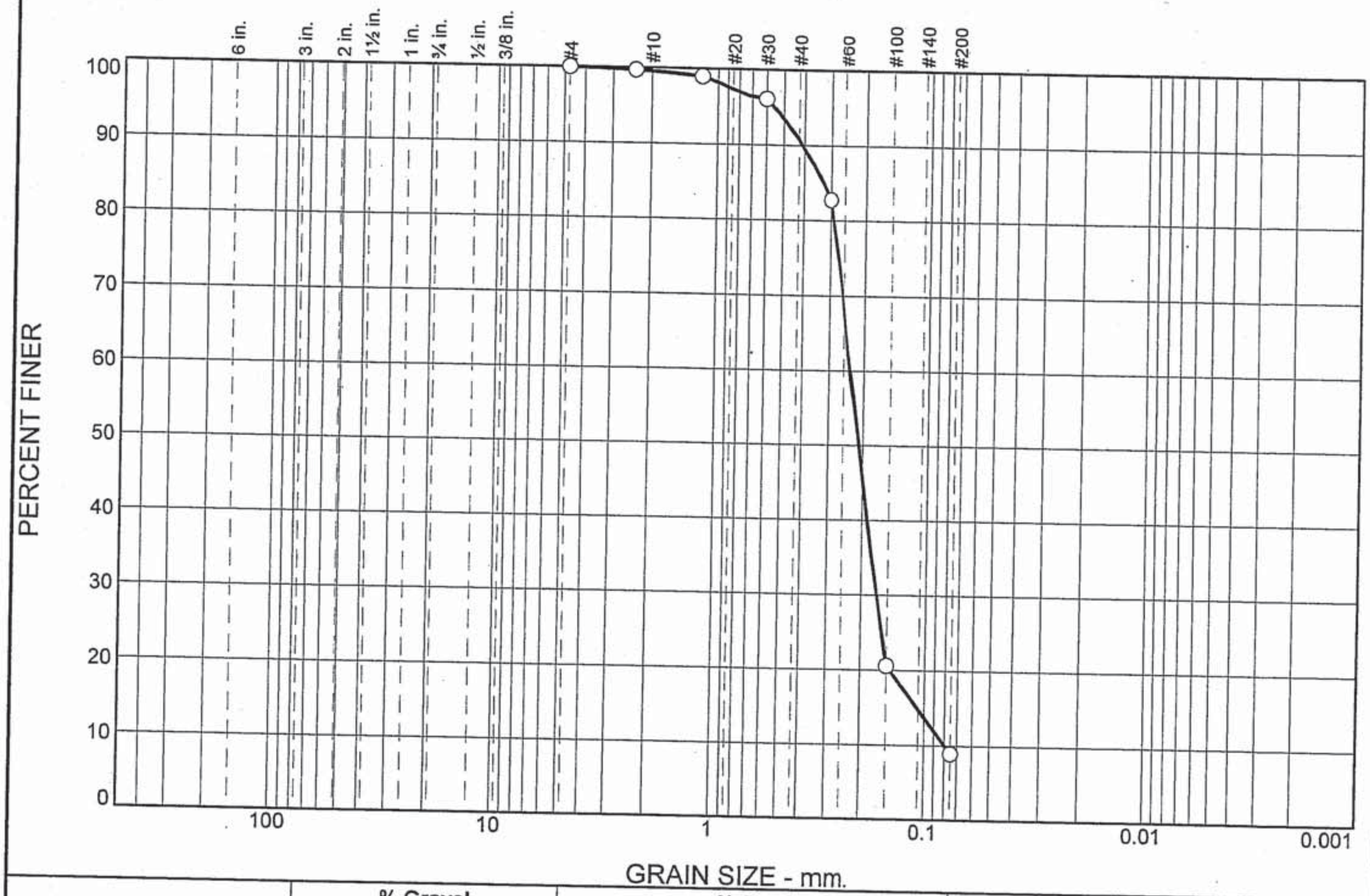
Remarks

Sample No.: S-8 **Source of Sample:** B-112 **Date Sampled:**
Location: **Elev./Depth:** 28
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-166

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.4	8.8	81.9	8.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	99.7		
#16	99.0		
#30	96.1		
#50	82.8		
#100	20.6		
#200	8.9		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty, with traces of medium-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.3266 D_{60}= 0.2302 D_{50}= 0.2086
D_{30}= 0.1695 D_{15}= 0.1075 D_{10}= 0.0800
C_u= 2.88 C_c= 1.56

Date Tested: 1/11/06 **Tested By:** J. Crose

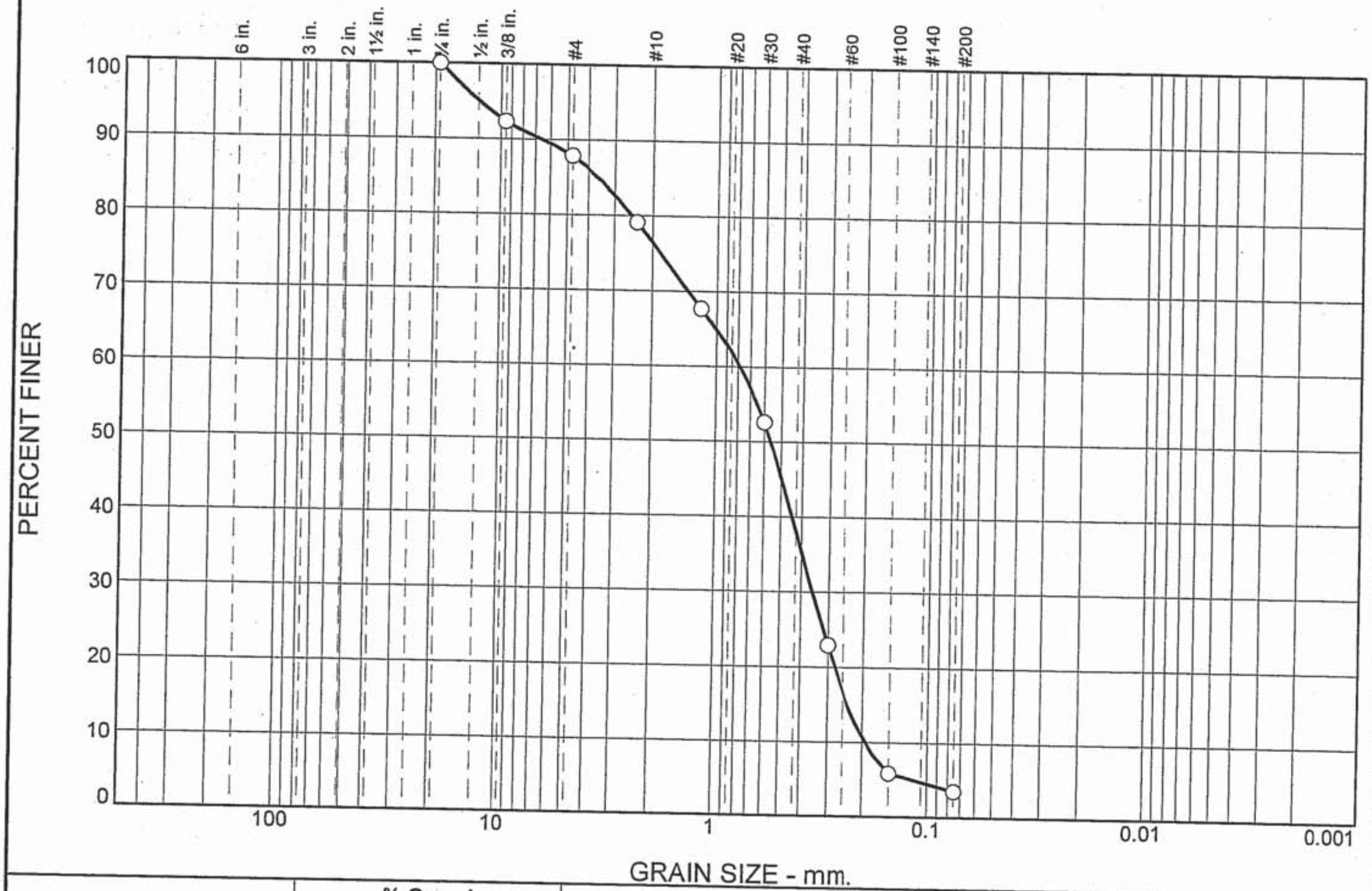
Remarks

Sample No.: S-5 **Source of Sample:** B-113 **Date Sampled:**
Location:
Elev./Depth: 13.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-167

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.1	11.4	38.3	34.7	3.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	92.3		
#4	87.9		
#8	79.1		
#16	67.7		
#30	52.6		
#50	22.9		
#100	5.9		
#200	3.5		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, with coarse- grain sand and fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 3.5884 D_{60}= 0.7780 D_{50}= 0.5587
D_{30}= 0.3548 D_{15}= 0.2375 D_{10}= 0.1942
C_u= 4.01 C_c= 0.83

Date Tested: 1/11/06 **Tested By:** J. Crose

Remarks

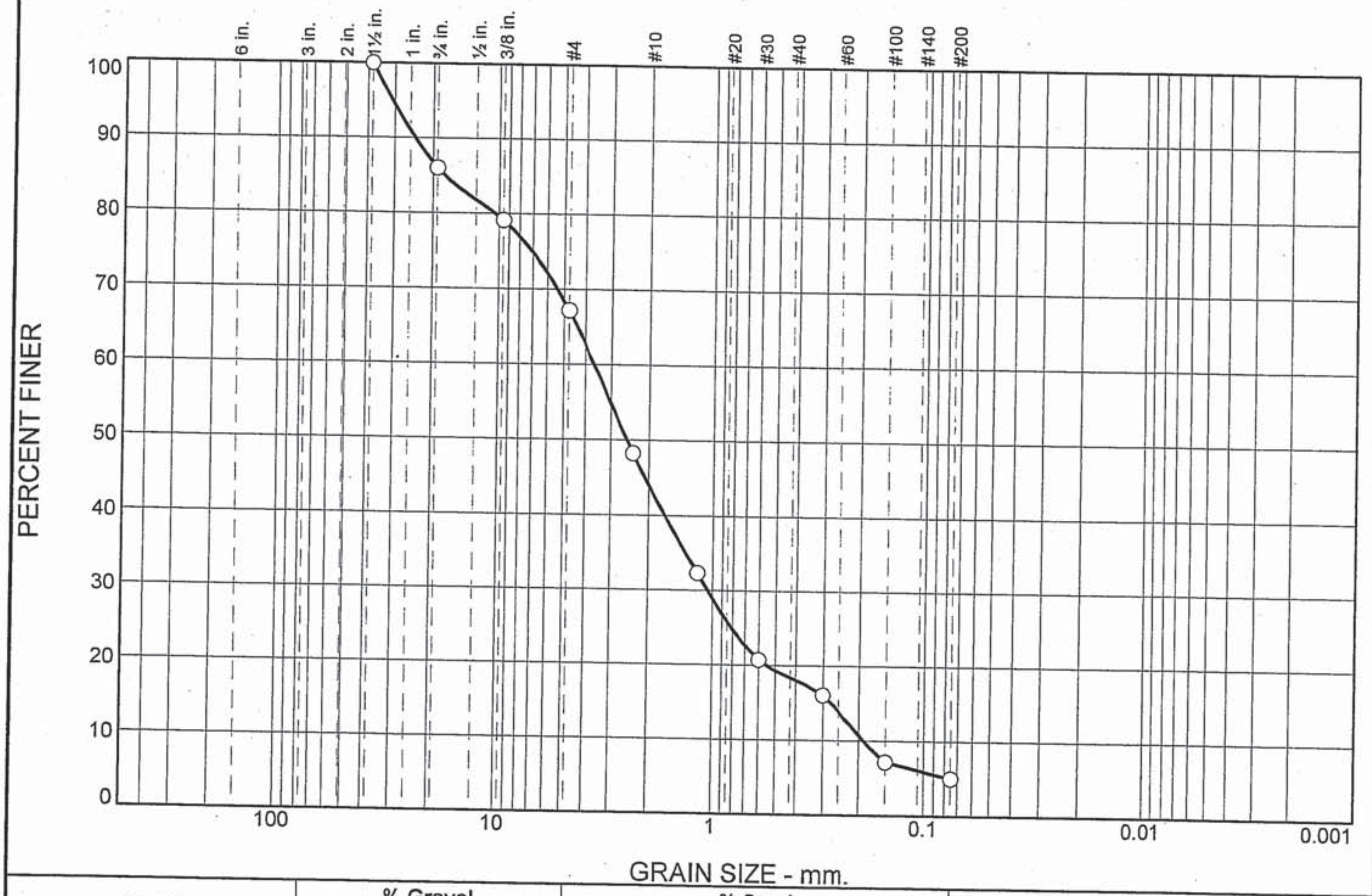
Sample No.: S-6 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 18.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-168

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	14.0	18.8	23.2	25.6	13.4	5.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	86.0		
3/8	79.1		
#4	67.2		
#8	48.2		
#16	32.3		
#30	20.7		
#50	16.0		
#100	7.1		
#200	5.0		

* (no specification provided)

Material Description

SAND (SW-SM), well graded, slightly silty, with fine and coarse gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW-SM AASHTO=

Coefficients

D_{85}= 17.6811 D_{60}= 3.6076 D_{50}= 2.5216
D_{30}= 1.0551 D_{15}= 0.2727 D_{10}= 0.1902
C_u= 18.97 C_c= 1.62

Date Tested: 1/11/06 **Tested By:** J. Crose

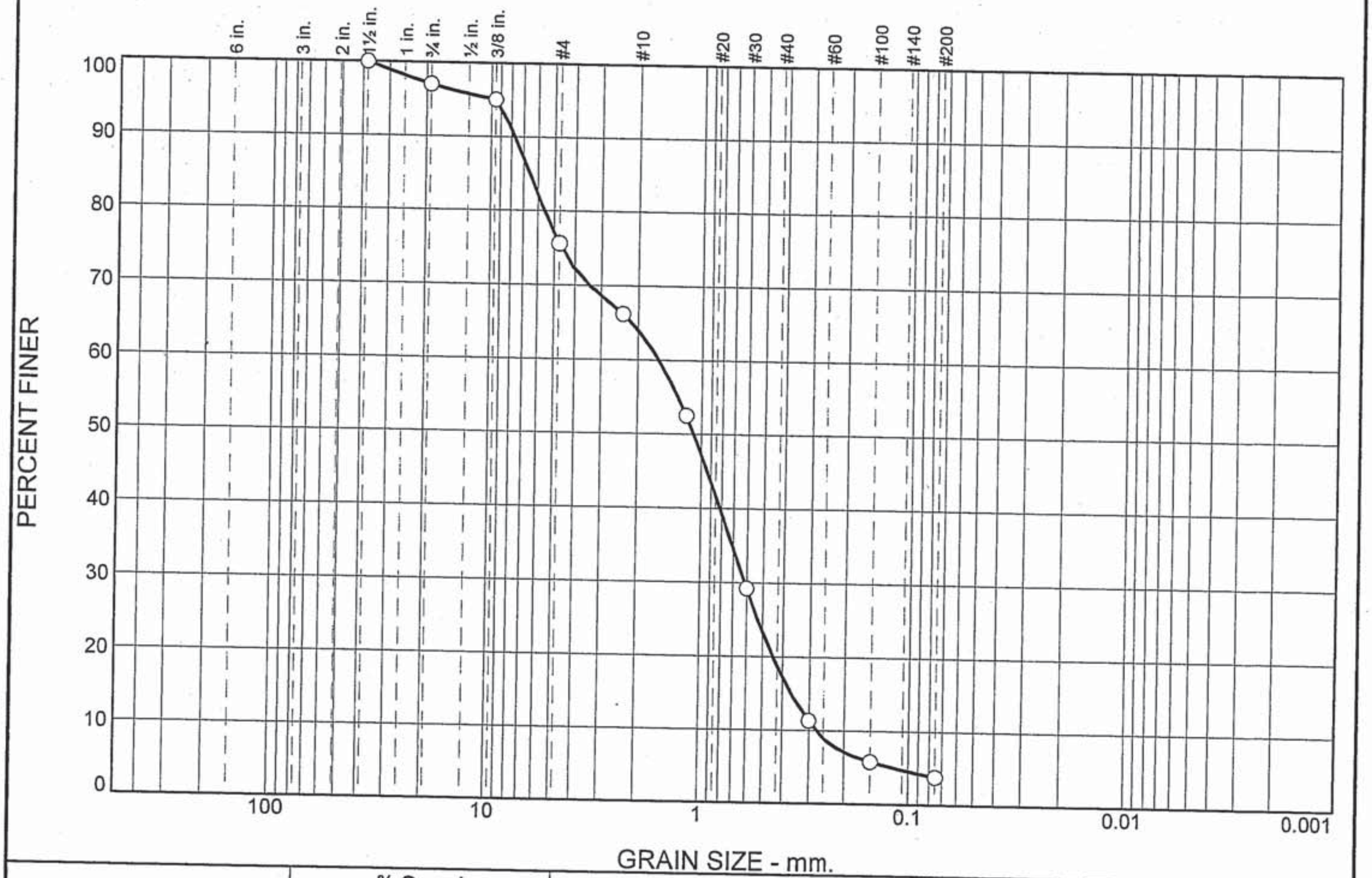
Remarks

Sample No.: S-7 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 23.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-169

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	2.9	21.5	11.6	45.2	15.0	3.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	97.1		
3/8	95.1		
#4	75.6		
#8	66.2		
#16	52.5		
#30	29.2		
#50	11.3		
#100	5.8		
#200	3.8		

* (no specification provided)

Material Description

SAND (SP), medium-grain, with coarse- and fine-grain sand, with coarse and fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 6.5396 D_{60}= 1.5968 D_{50}= 1.0866
D_{30}= 0.6136 D_{15}= 0.3642 D_{10}= 0.2745
C_u= 5.82 C_c= 0.86

Date Tested: 1/11/06 **Tested By:** J. Crose

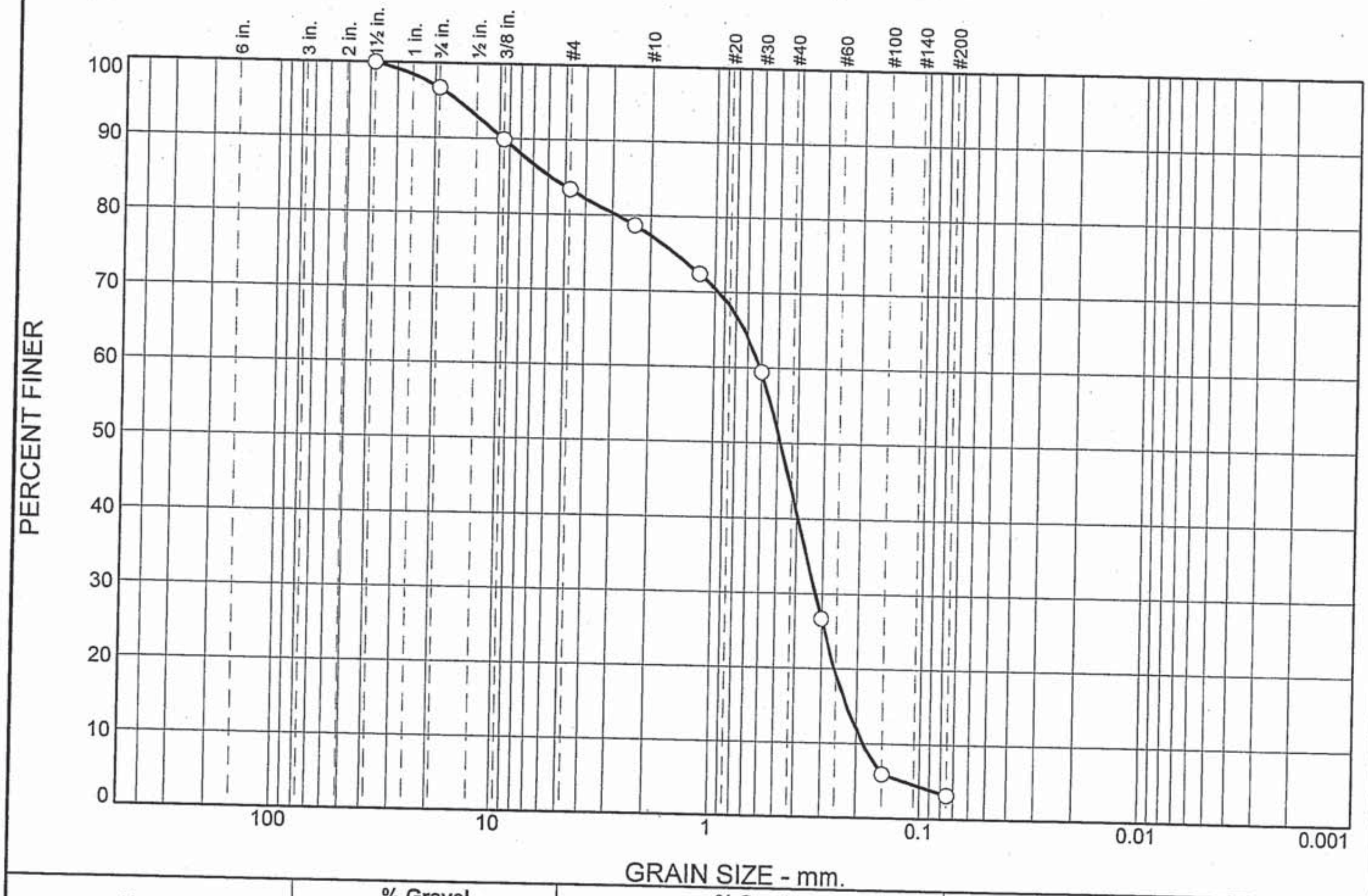
Remarks

Sample No.: S-8 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 28.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-170

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.3	13.3	6.0	33.4	40.8	3.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	96.7		
3/8	89.9		
#4	83.4		
#8	78.7		
#16	72.4		
#30	59.4		
#50	26.7		
#100	5.9		
#200	3.2		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, with trace of coarse-grain sand, with fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 5.8035 D_{60}= 0.6099 D_{50}= 0.4803
D_{30}= 0.3222 D_{15}= 0.2218 D_{10}= 0.1855
C_u= 3.29 C_c= 0.92

Date Tested: 1/11/06 **Tested By:** J. Crose

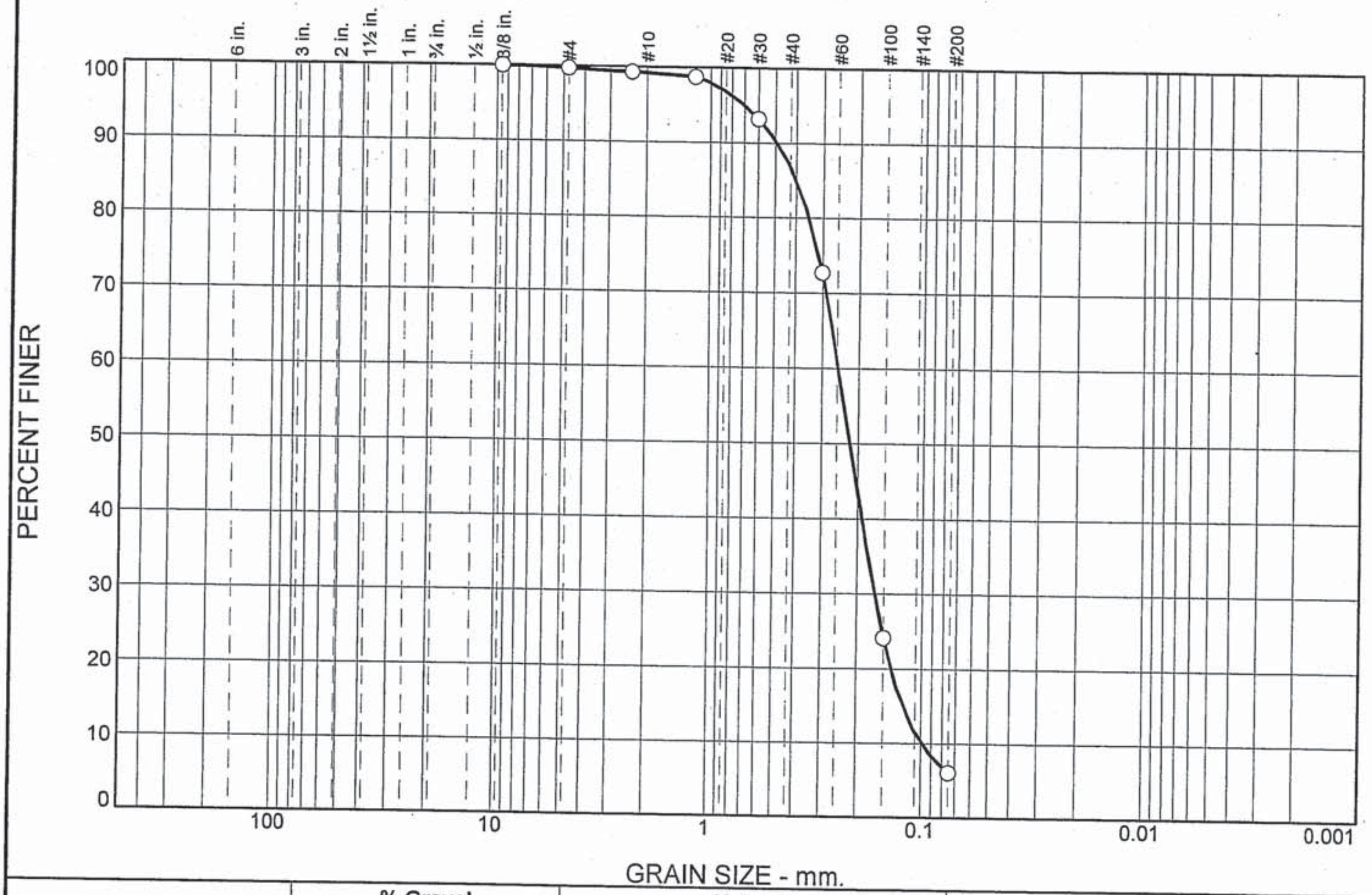
Remarks

Sample No.: S-9 **Source of Sample:** B-113 **Date Sampled:**
Location:
Elev./Depth: 33.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-171

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.3	0.5	12.3	80.8	6.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	99.7		
#8	99.4		
#16	98.7		
#30	93.2		
#50	72.7		
#100	24.1		
#200	6.1		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty, with traces of medium-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.3978 D_{60}= 0.2479 D_{50}= 0.2173
D_{30}= 0.1654 D_{15}= 0.1213 D_{10}= 0.0993
C_u= 2.50 C_c= 1.11

Date Tested: 1/11/06 **Tested By:** J. Crose

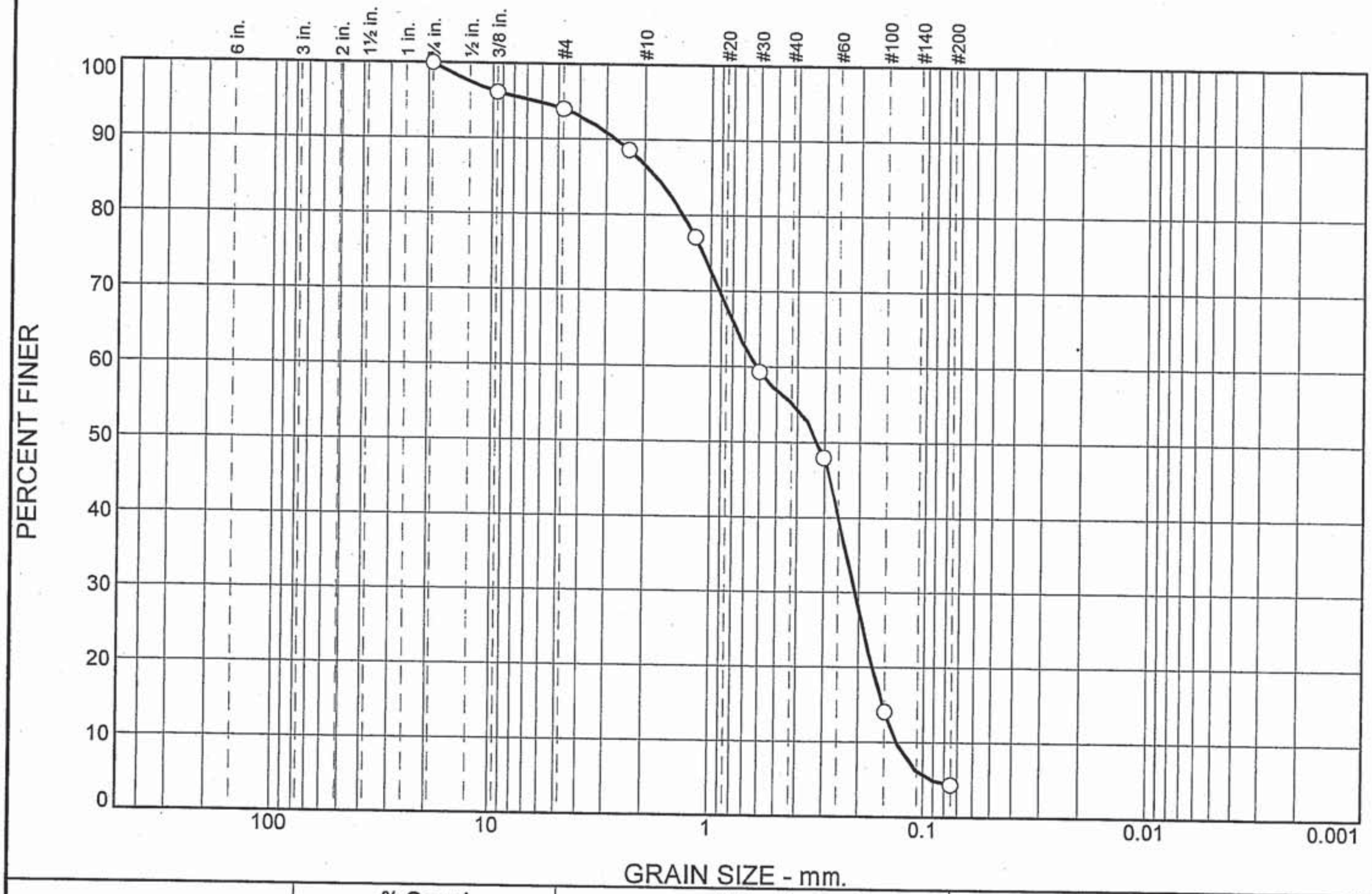
Remarks

Sample No.: S-10 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 38.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-172

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.0	7.3	31.5	50.9	4.3	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	96.1		
#4	94.0		
#8	88.6		
#16	77.1		
#30	59.3		
#50	48.0		
#100	14.0		
#200	4.3		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, trace of coarse-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 1.7702 D_{60}= 0.6236 D_{50}= 0.3197
D_{30}= 0.2074 D_{15}= 0.1537 D_{10}= 0.1320
C_u= 4.72 C_c= 0.52

Date Tested: 1/11/06 **Tested By:** J. Crose

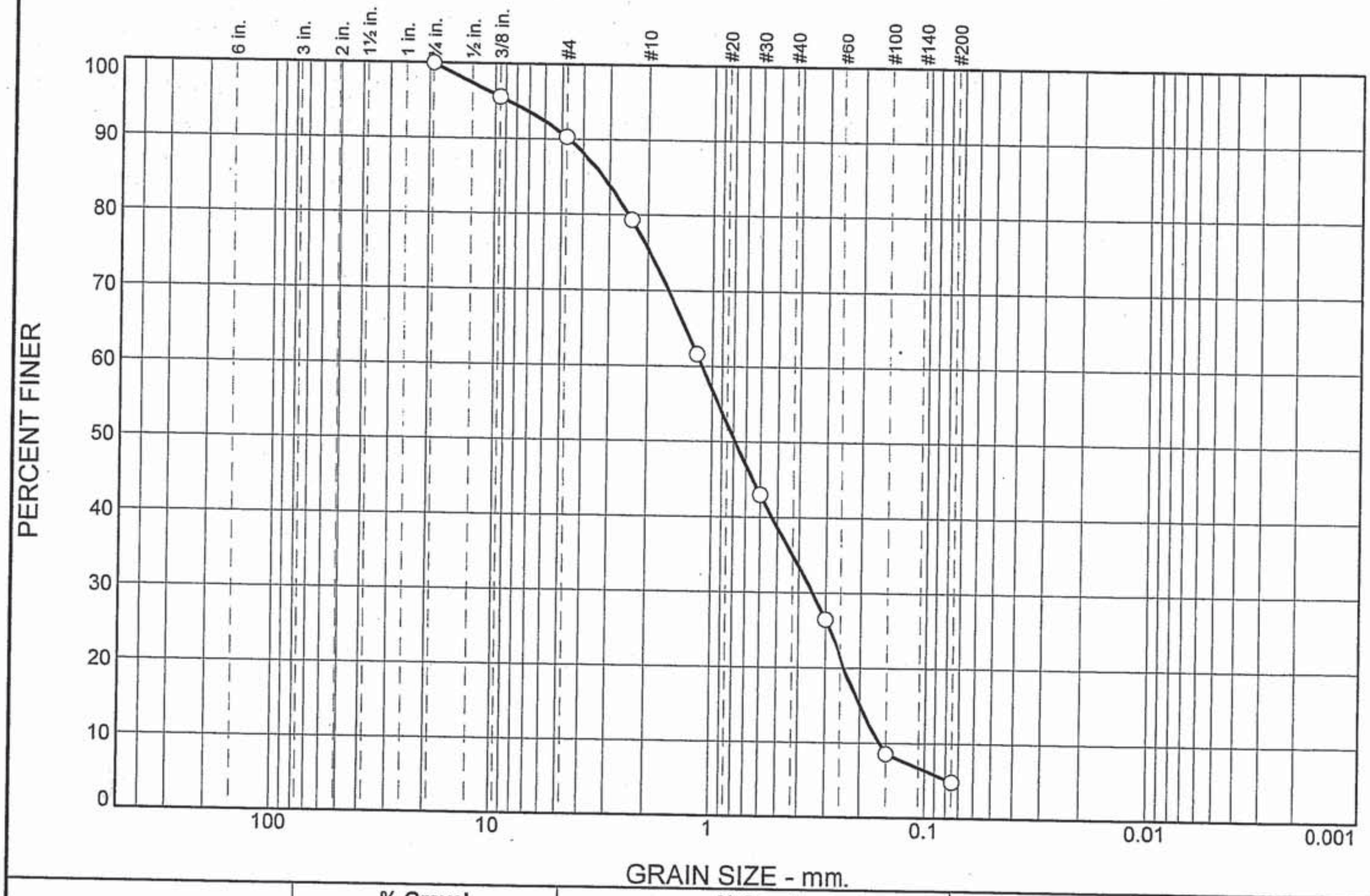
Remarks

Sample No.: S-11 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 43.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-173

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	9.7	14.7	40.6	30.2	4.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	95.6		
#4	90.3		
#8	79.3		
#16	61.6		
#30	43.0		
#50	26.5		
#100	8.5		
#200	4.8		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, with coarse- grain sand, traces of fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 3.2002 D_{60}= 1.1150 D_{50}= 0.7834
D_{30}= 0.3440 D_{15}= 0.1998 D_{10}= 0.1622
C_u= 6.88 C_c= 0.65

Date Tested: 1/11/06 **Tested By:** J. Crose

Remarks

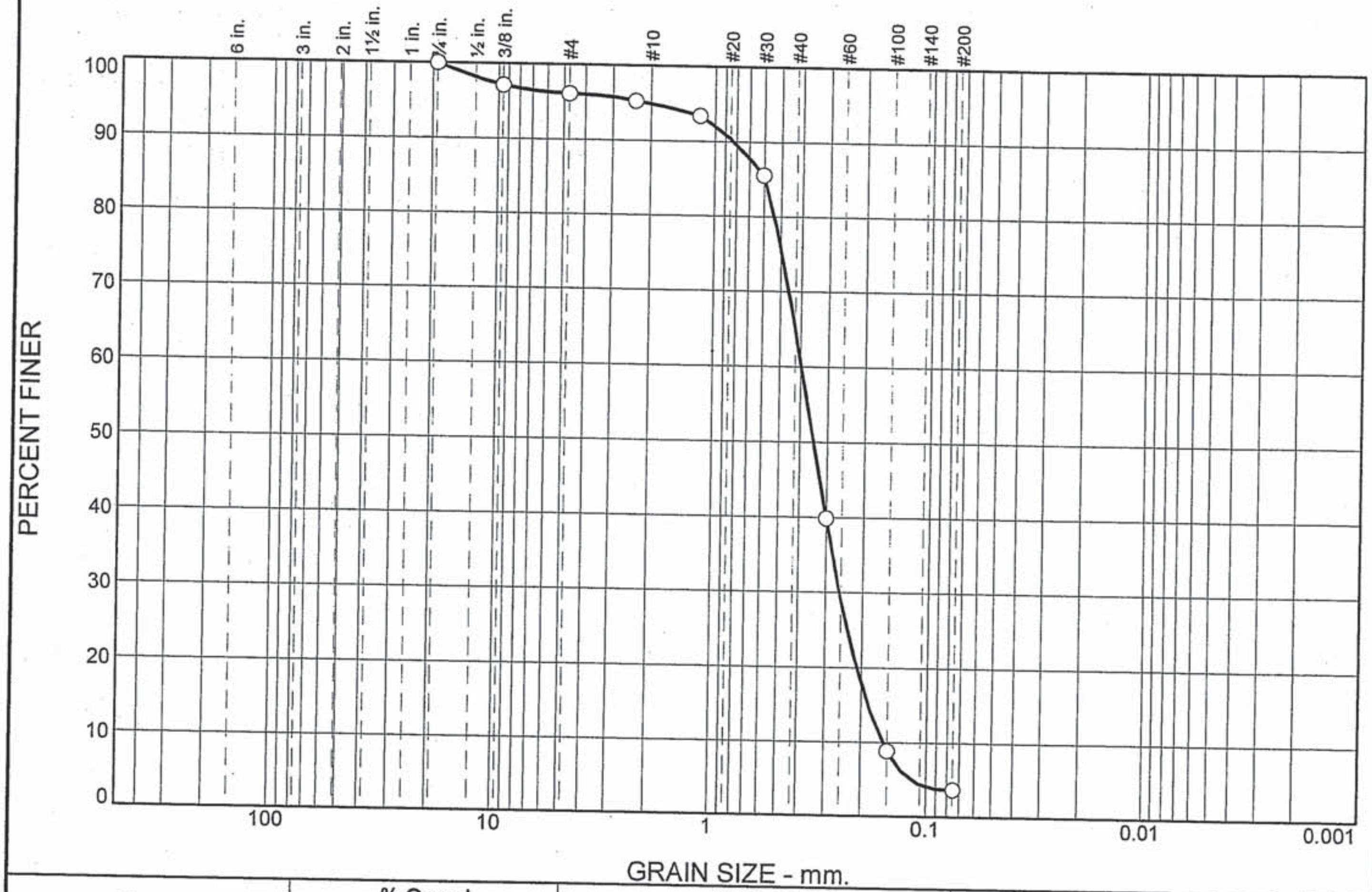
Sample No.: S-12 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 48.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-174

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.9	1.2	29.8	61.4	3.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	97.2		
#4	96.1		
#8	95.3		
#16	93.4		
#30	85.5		
#50	39.9		
#100	8.8		
#200	3.7		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.5923 D_{60}= 0.3964 D_{50}= 0.3462
D_{30}= 0.2559 D_{15}= 0.1852 D_{10}= 0.1574
C_u= 2.52 C_c= 1.05

Date Tested: 1/11/06 **Tested By:** J. Crose

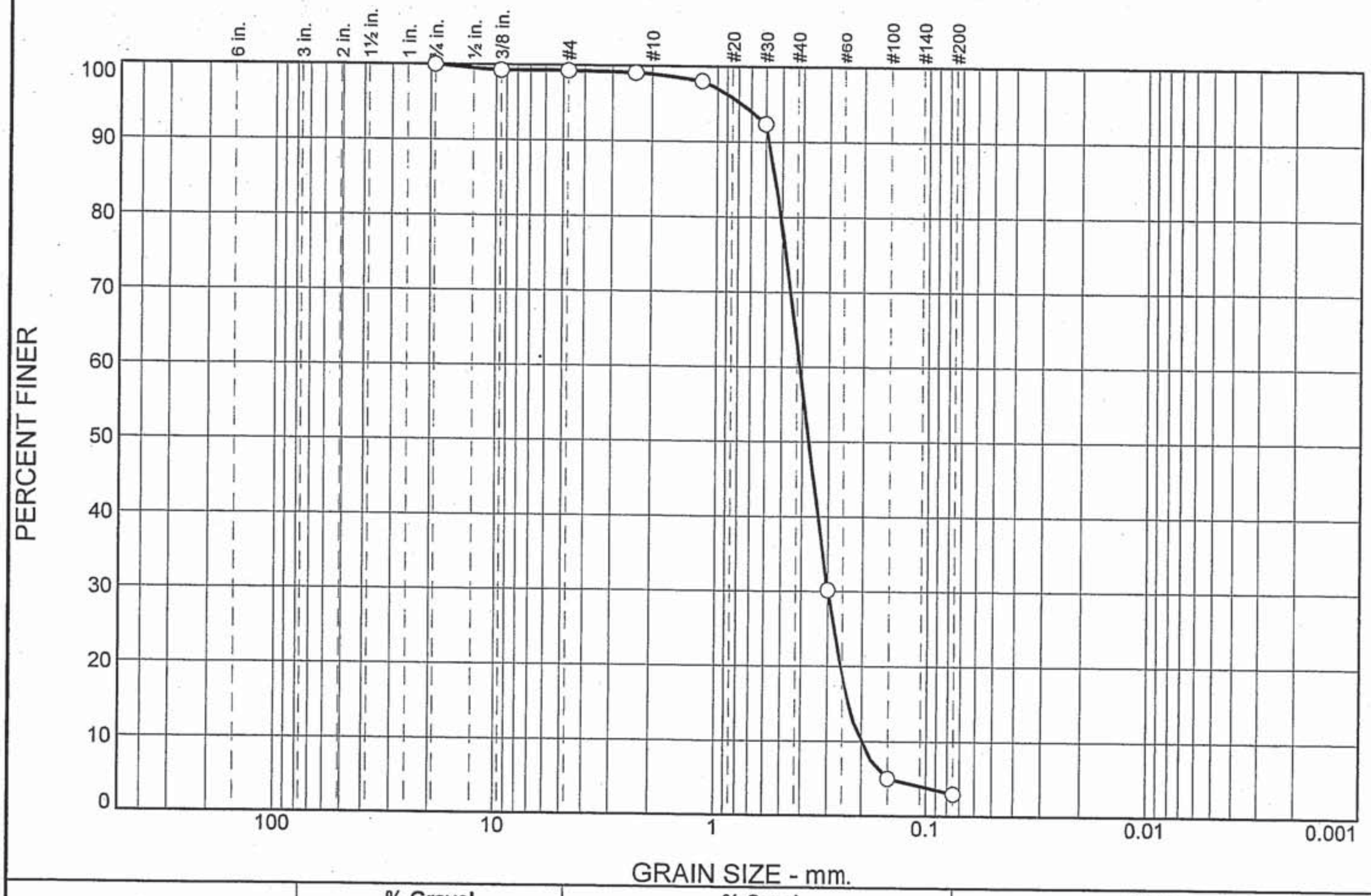
Remarks

Sample No.: S-13 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 58.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-175

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.4	35.5	60.4	3.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	99.3		
#4	99.3		
#8	99.1		
#16	98.0		
#30	92.4		
#50	30.2		
#100	5.1		
#200	3.0		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 0.5374 D_{60}= 0.4109 D_{50}= 0.3724
D_{30}= 0.2993 D_{15}= 0.2318 D_{10}= 0.2002
C_u= 2.05 C_c= 1.09

Date Tested: 1/11/06 **Tested By:** J. Crose

Remarks

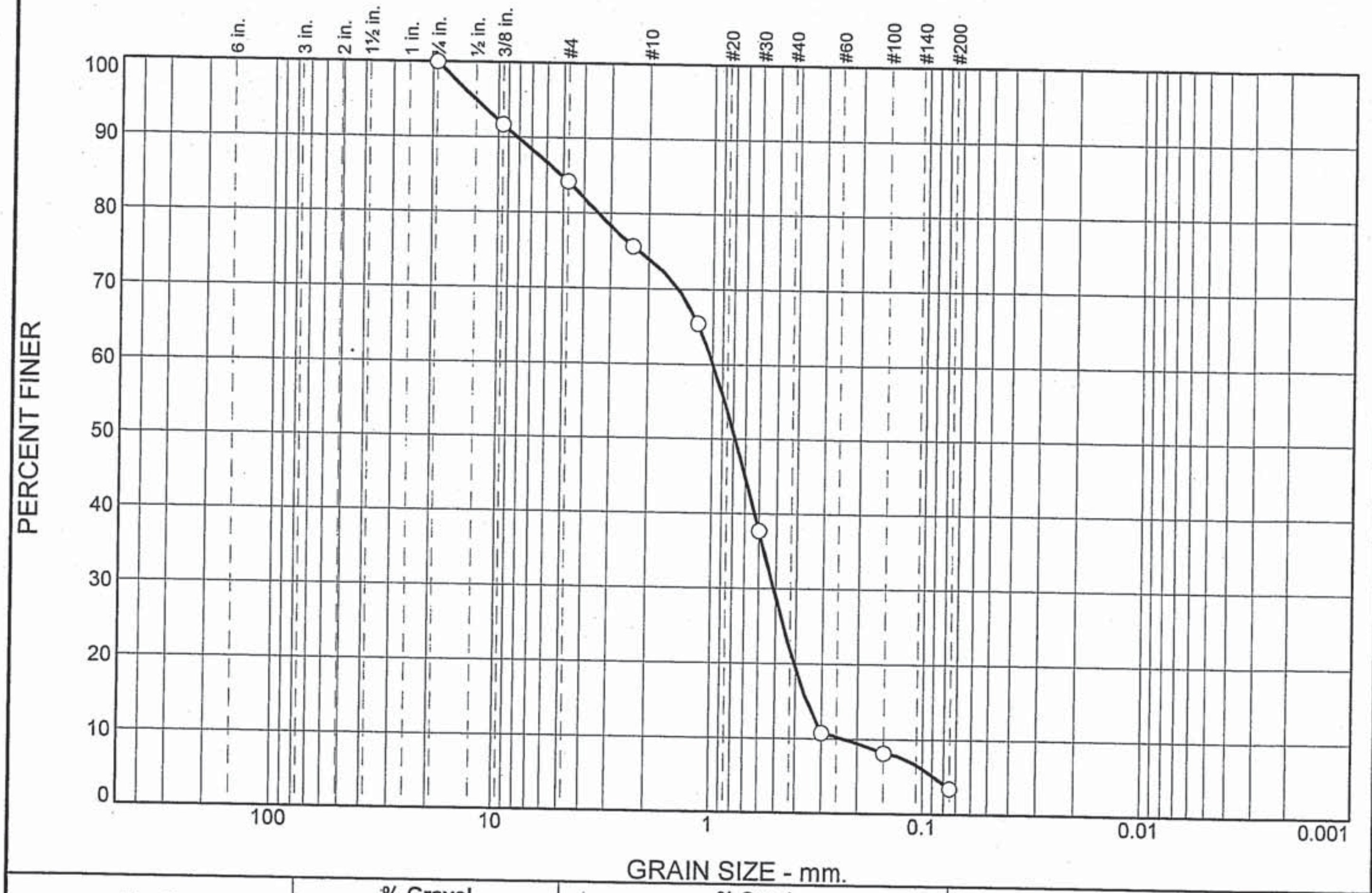
Sample No.: S-14 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 68.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-176

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	15.9	10.1	52.2	18.4	3.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	91.6		
#4	84.1		
#8	75.6		
#16	65.5		
#30	37.7		
#50	10.7		
#100	8.1		
#200	3.4		

* (no specification provided)

Material Description

SAND (SP), medium- to fine-grain, traces of coarse-grain sand, with fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 5.1110 D_{60}= 0.9950 D_{50}= 0.7796
D_{30}= 0.5106 D_{15}= 0.3532 D_{10}= 0.2325
C_u= 4.28 C_c= 1.13

Date Tested: 1/11/06 **Tested By:** J. Crose

Remarks

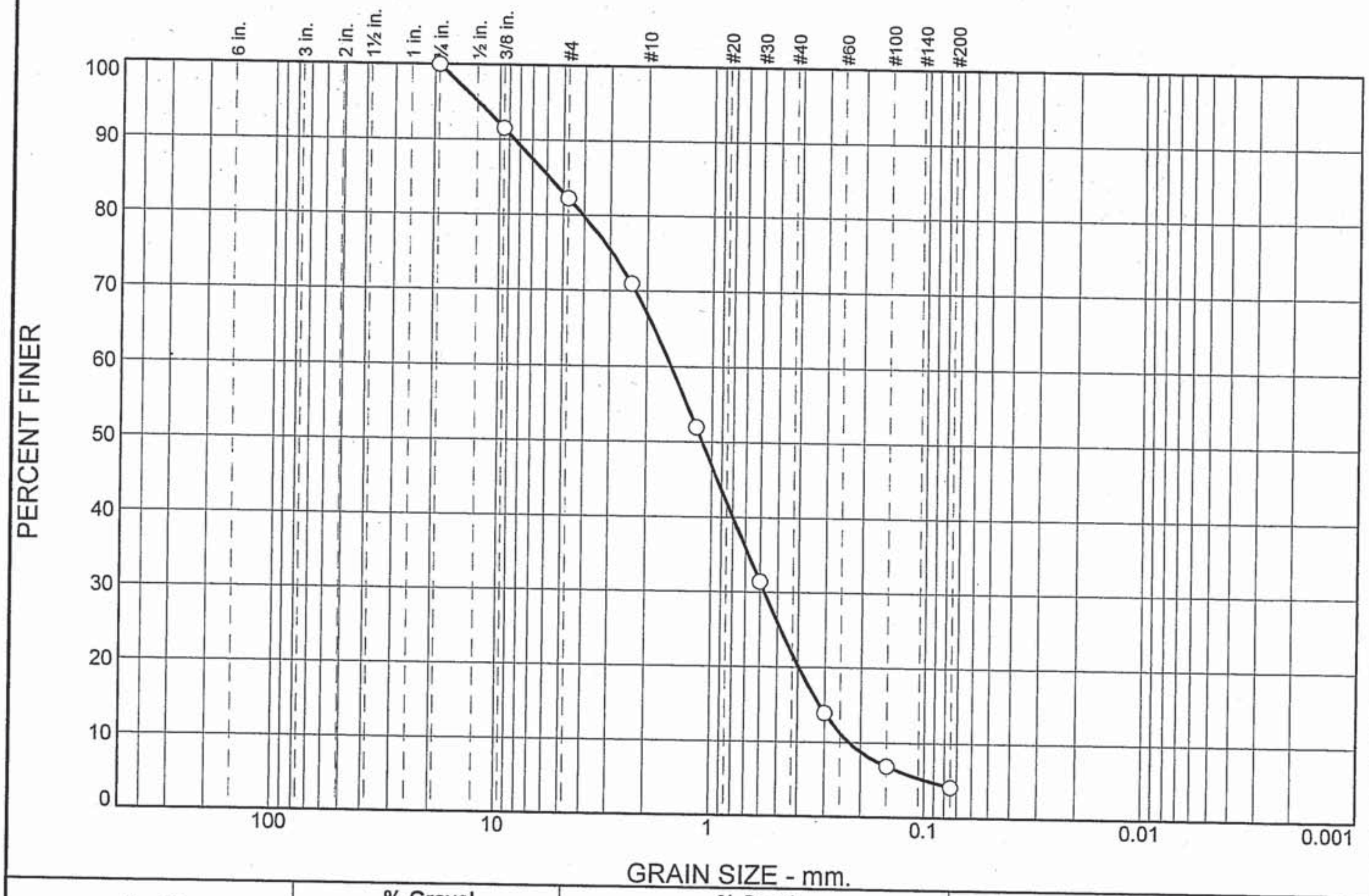
Sample No.: S-15 **Source of Sample:** B-113 **Date Sampled:**
Location:
Elev./Depth: 78.5
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-177

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	17.8	15.1	45.4	17.6	4.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	91.5		
#4	82.2		
#8	70.9		
#16	52.0		
#30	31.4		
#50	13.9		
#100	6.8		
#200	4.1		

* (no specification provided)

Material Description

SAND (SP), coarse-, medium-, and fine-grain, with fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 5.8312 D_{60}= 1.5440 D_{50}= 1.1067

D_{30}= 0.5718 D_{15}= 0.3179 D_{10}= 0.2276

C_u= 6.78 C_c= 0.93

Date Tested: 1/11/06 **Tested By:** J. Crose

Remarks

Sample No.: S-16 **Source of Sample:** B-113 **Date Sampled:**

Location: **Elev./Depth:** 88.5

Checked By: K. Kocher **Title:** P.E.

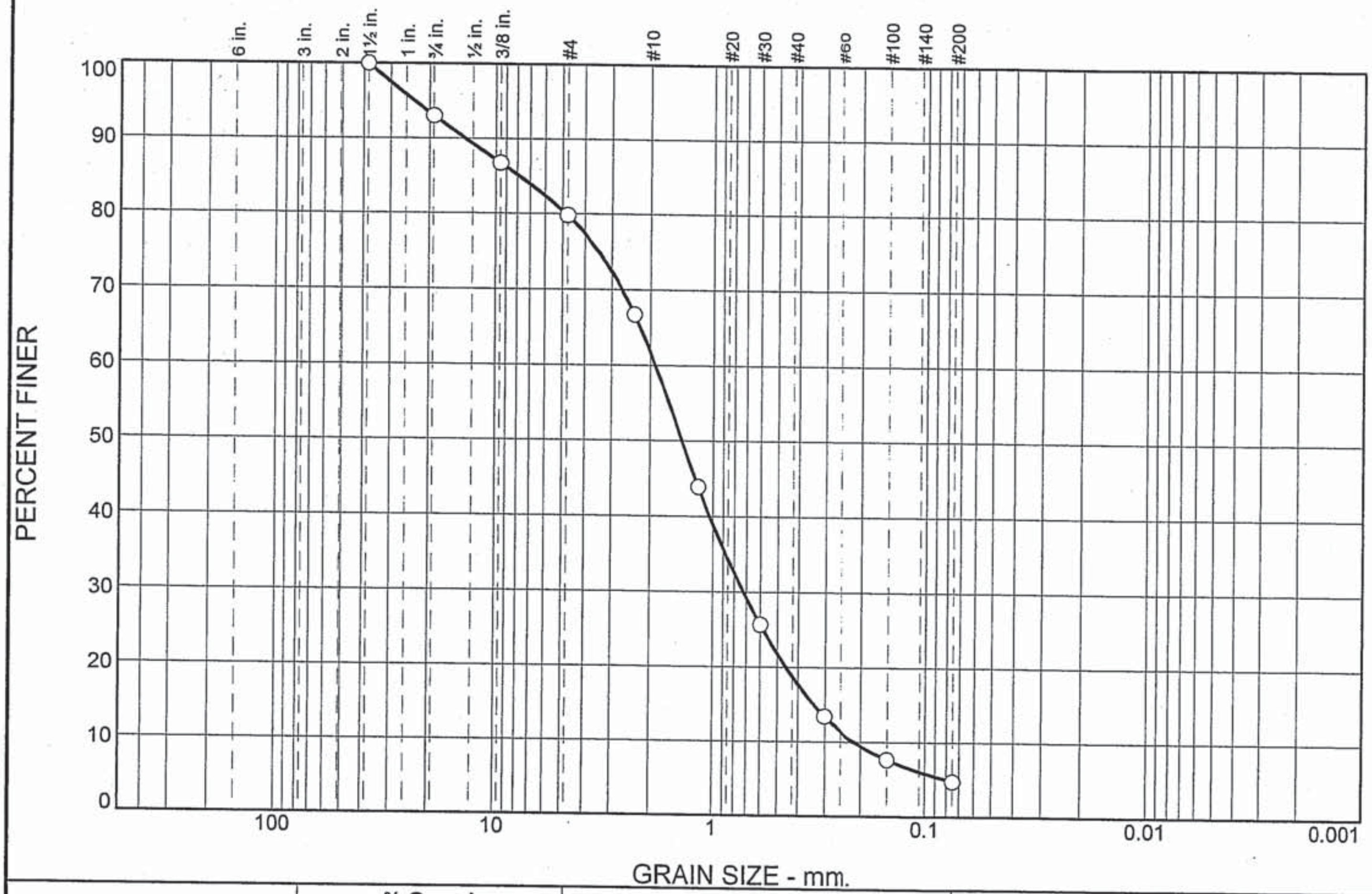
REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-178

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.0	13.2	18.0	43.1	14.0	4.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1 1/2	100.0		
3/4	93.0		
3/8	86.8		
#4	79.8		
#8	66.7		
#16	43.9		
#30	25.7		
#50	13.4		
#100	7.6		
#200	4.7		

* (no specification provided)

Material Description

SAND (SW), well graded, with fine gravel, traces of coarse gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SW AASHTO=

Coefficients

D_{85}= 7.8061 D_{60}= 1.8924 D_{50}= 1.4138
D_{30}= 0.7218 D_{15}= 0.3381 D_{10}= 0.2155
C_u= 8.78 C_c= 1.28

Date Tested: 1/10/06 **Tested By:** RTH/JLC

Remarks

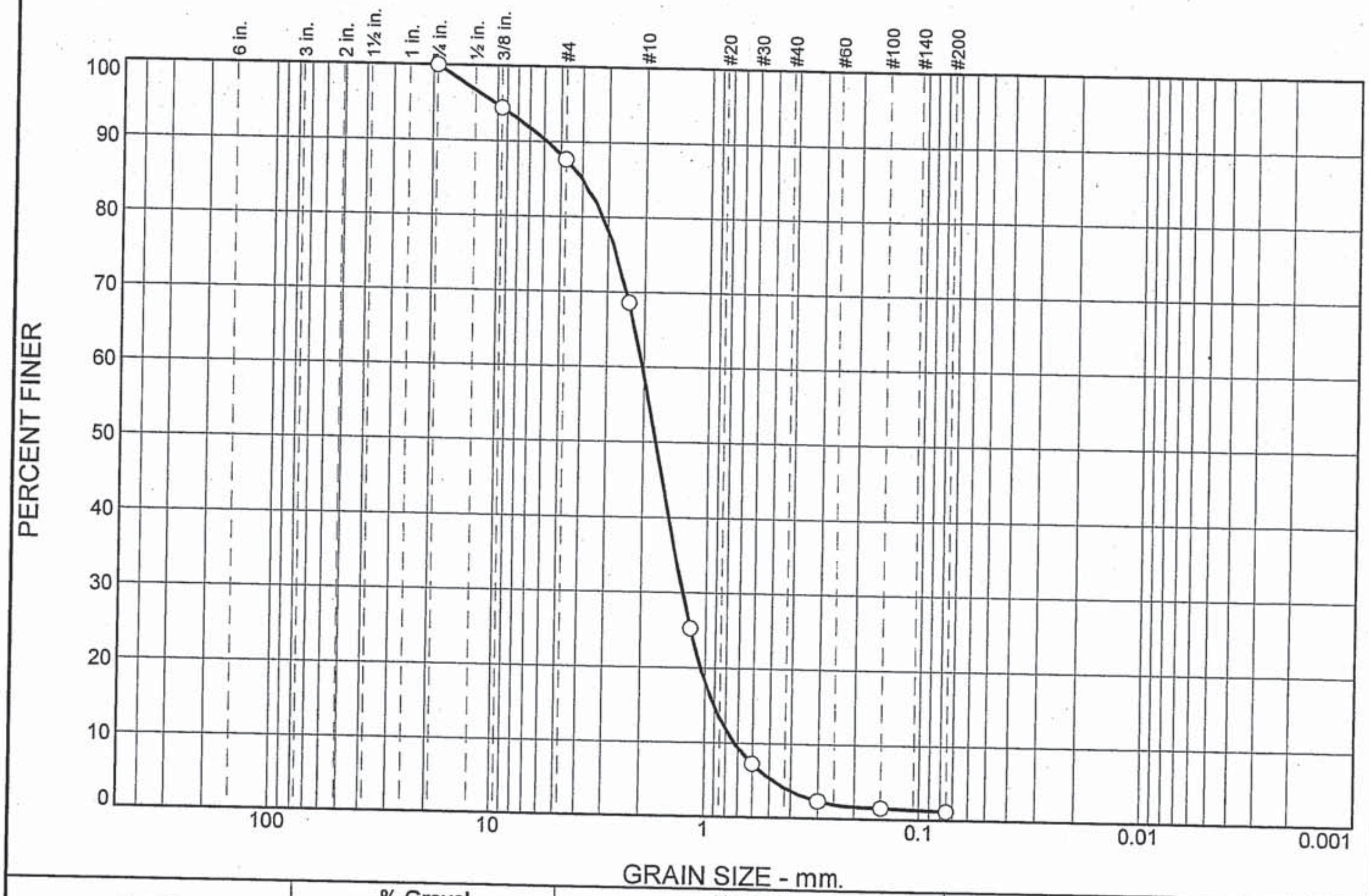
Sample No.: S-17 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 98.5
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-179

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	12.3	28.8	54.8	2.9	1.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	94.4		
#4	87.7		
#8	68.6		
#16	25.2		
#30	7.3		
#50	2.4		
#100	1.5		
#200	1.2		

* (no specification provided)

Material Description

SAND (SP), coarse- to medium-grain, with fine gravel

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 3.9625 D_{60}= 2.0335 D_{50}= 1.7475
D_{30}= 1.2871 D_{15}= 0.9089 D_{10}= 0.7287
C_u= 2.79 C_c= 1.12

Date Tested: 1/10/06 **Tested By:** RTH/JLC

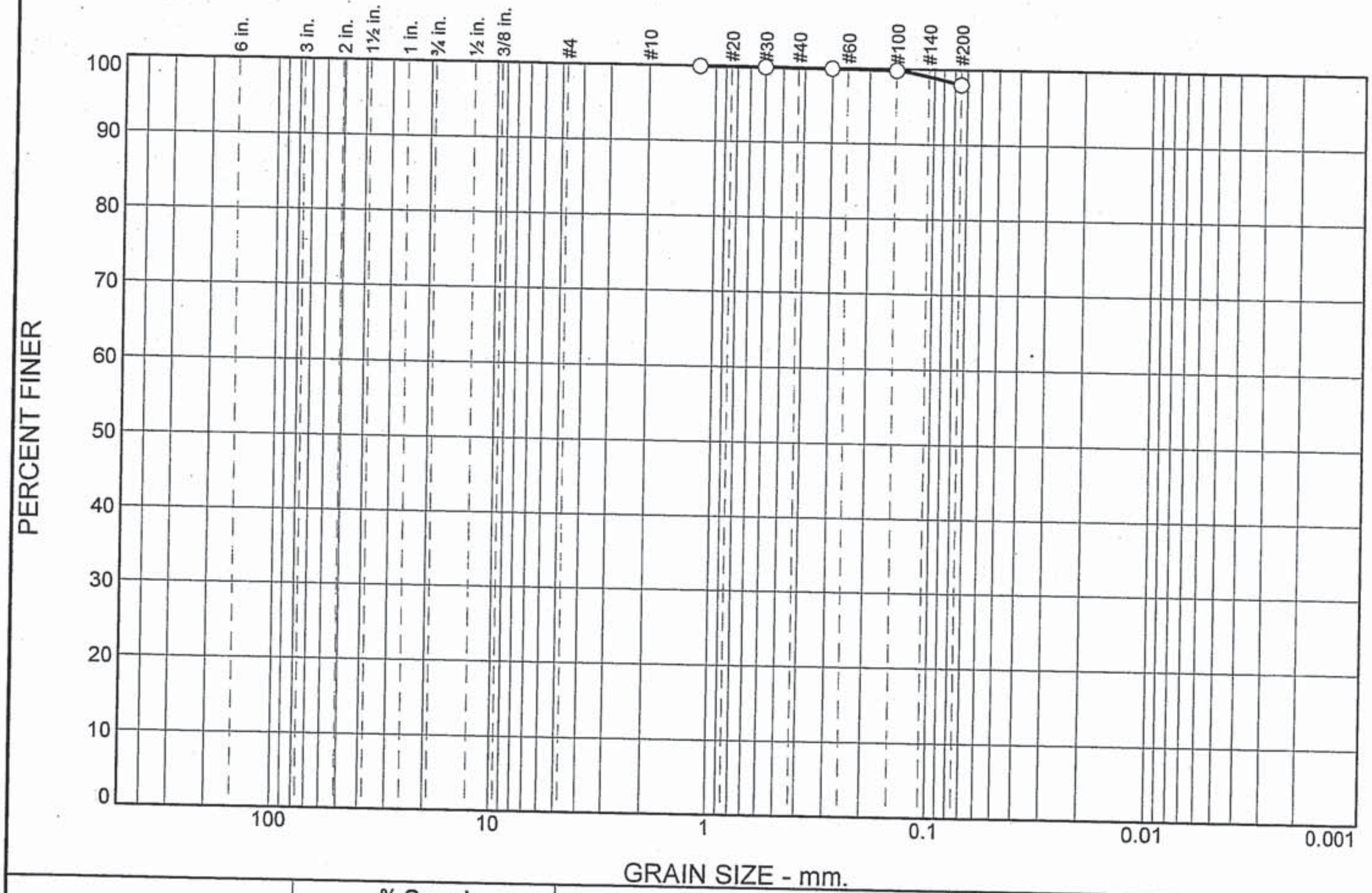
Remarks

Sample No.: S-18 **Source of Sample:** B-113 **Date Sampled:**
Location: **Elev./Depth:** 108.5
Checked By: J. Fouse **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-180

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
					1.9	98.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#16	100.0		
#30	100.0		
#50	99.9		
#100	99.8		
#200	98.0		

* (no specification provided)

Material Description

SILT (ML)

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/20/06 **Tested By:** J. Crose

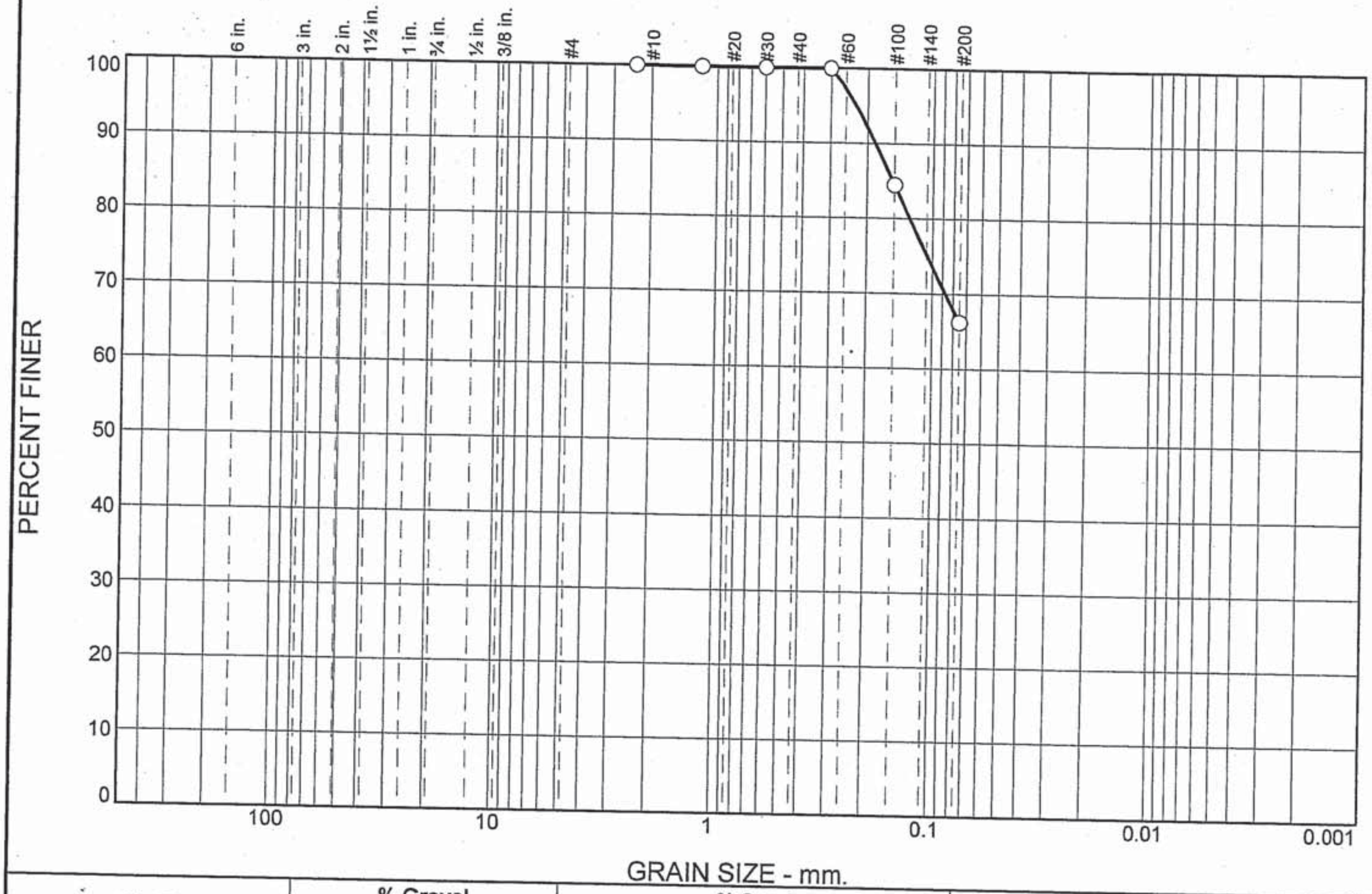
Remarks

Sample No.: ST-2 **Source of Sample:** B-114 **Date Sampled:**
Location: **Elev./Depth:** 4
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477 **Figure** B1-181

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
				0.0	33.8	66.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#8	100.0		
#16	100.0		
#30	100.0		
#50	100.0		
#100	84.5		
#200	66.2		

* (no specification provided)

Material Description

SILT (ML), with fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= ML AASHTO=

Coefficients

D_{85}= 0.1530 D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Date Tested: 1/20/06 **Tested By:** J. Crose

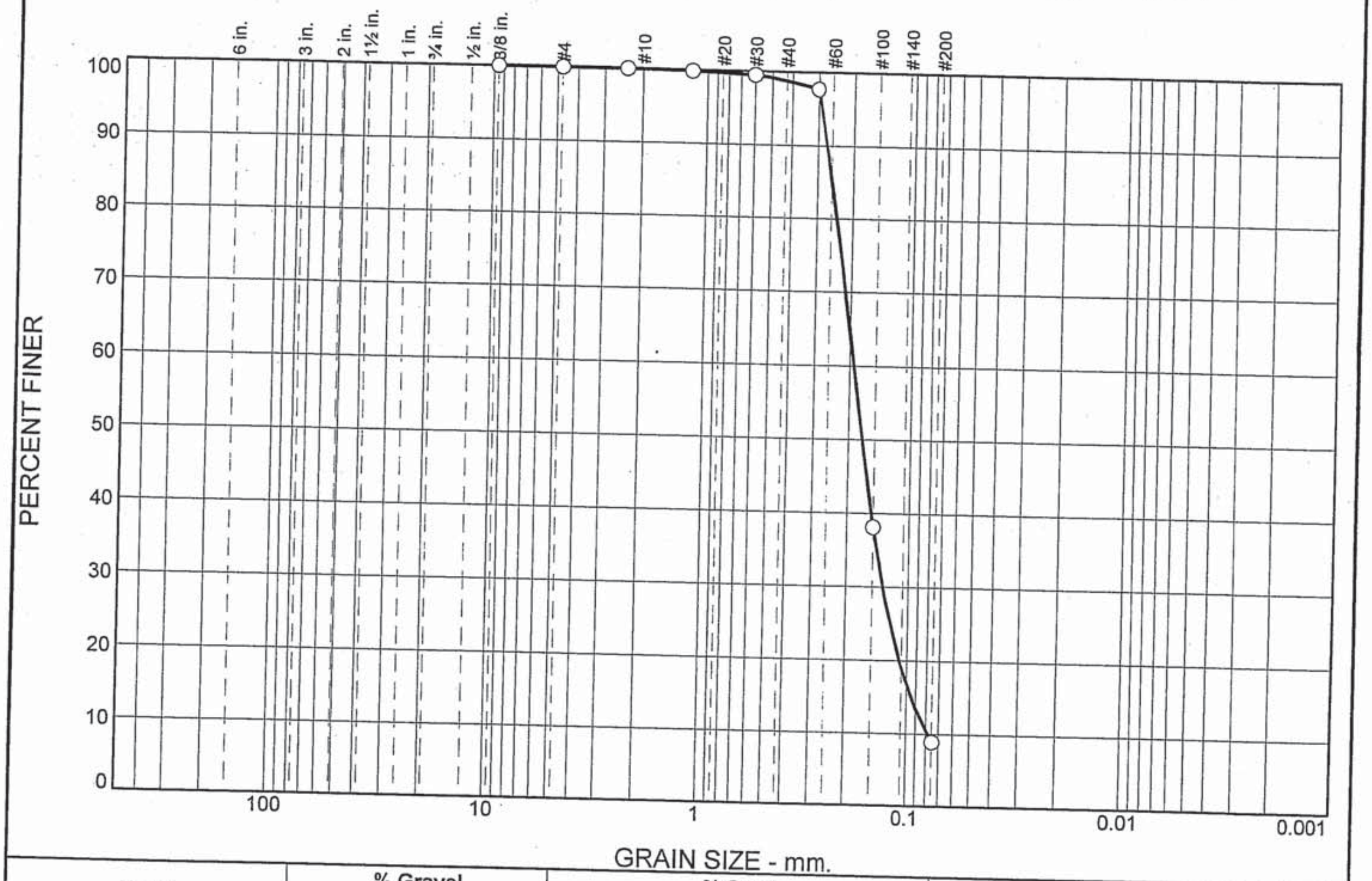
Remarks

Sample No.:
Location:
Source of Sample: B-114
Date Sampled:
Elev./Depth: 5
Checked By: K. Kocher
Title: P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477
Figure B1-182

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	1.2	89.9	8.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/8	100.0		
#4	100.0		
#8	100.0		
#16	99.8		
#30	99.5		
#50	97.7		
#100	38.1		
#200	8.9		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SW AASHTO=

Coefficients

D_{85}= 0.2490 D_{60}= 0.1910 D_{50}= 0.1721
D_{30}= 0.1334 D_{15}= 0.0945 D_{10}= 0.0785
C_u= 2.43 C_c= 1.19

Date Tested: 01/25/06 **Tested By:** J. Crose

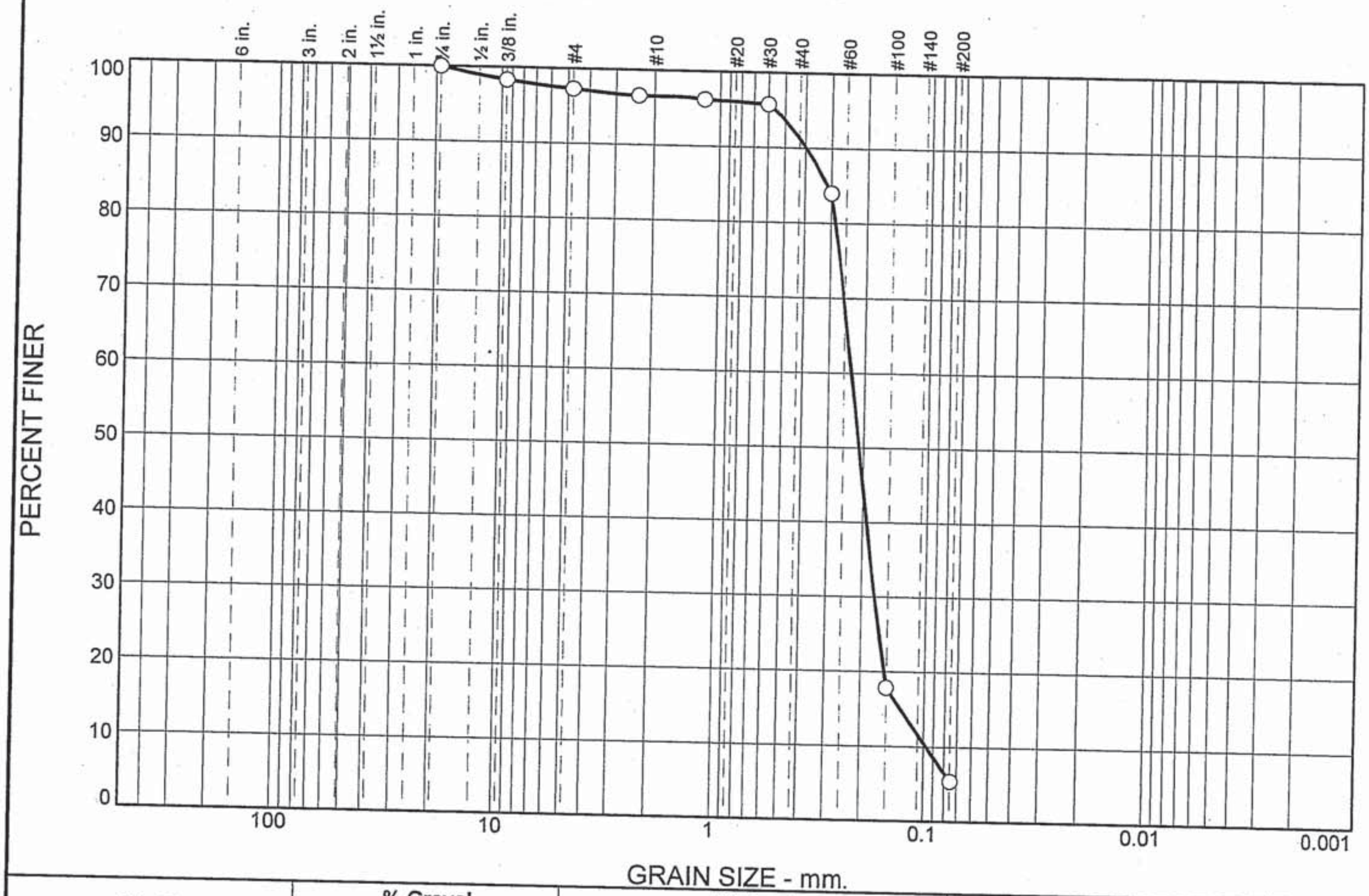
Remarks

Sample No.: S-5 **Source of Sample:** B-114
Location:
Checked By: K. Kocher
Title: P.E.
Date Sampled:
Elev./Depth: 13

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF
Project No: 2005012477
Figure B1-183

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.7	0.8	5.2	85.9	5.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	98.3		
#4	97.3		
#8	96.5		
#16	96.2		
#30	95.8		
#50	84.0		
#100	17.8		
#200	5.4		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= AASHTO=

Coefficients

D_{85}= 0.3126 D_{60}= 0.2304 D_{50}= 0.2100
D_{30}= 0.1734 D_{15}= 0.1283 D_{10}= 0.0971
C_u= 2.37 C_c= 1.34

Date Tested: 01/25/06 **Tested By:** J. Crose

Remarks

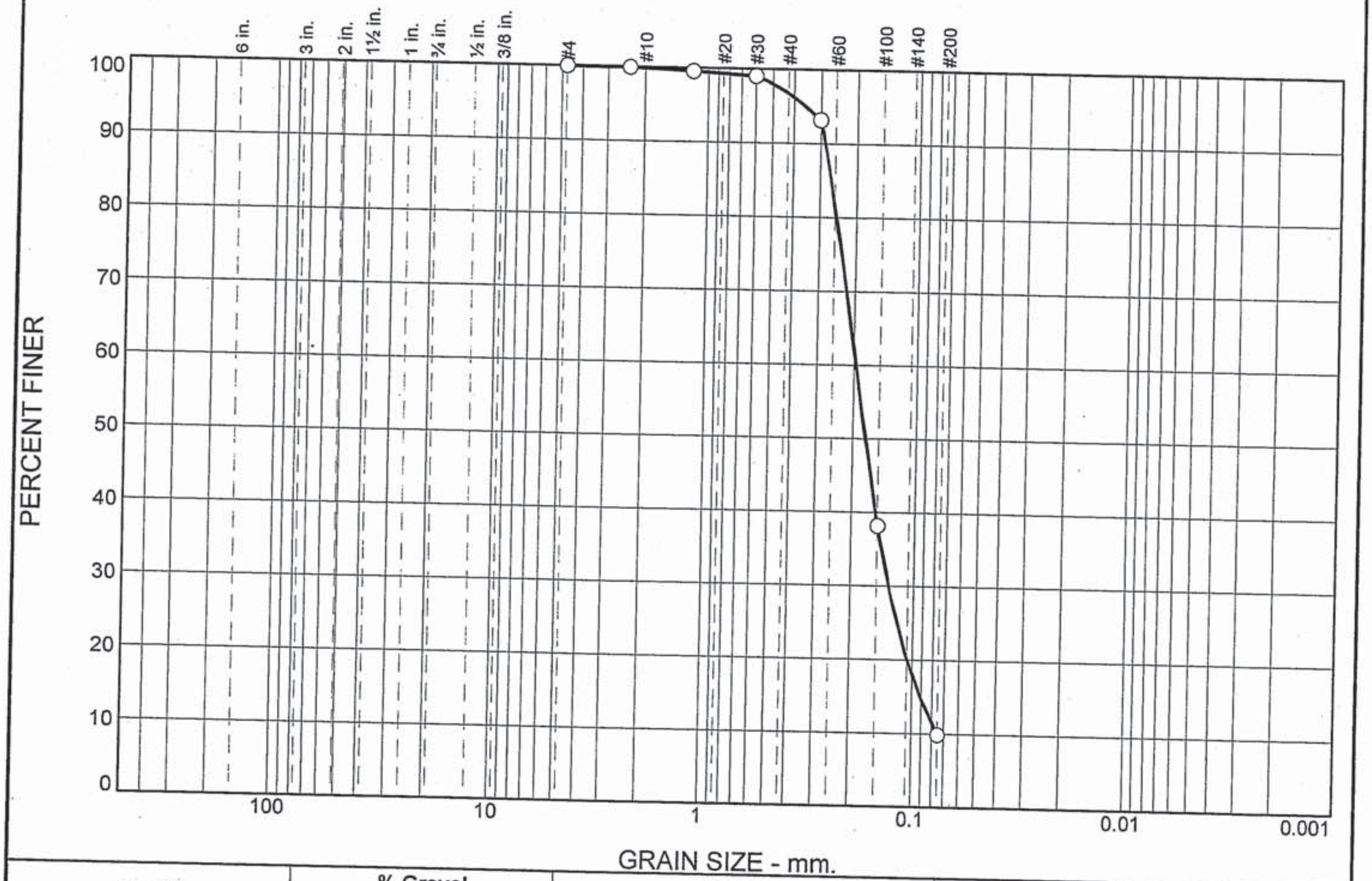
Sample No.: S-6 **Source of Sample:** B-114 **Date Sampled:**
Location:
Elev./Depth: 18
Checked By: K. Kocher
Title: P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-184

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.1	3.1	86.9	9.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#8	100.0		
#16	99.6		
#30	99.0		
#50	93.2		
#100	38.2		
#200	9.9		

* (no specification provided)

Material Description

SAND (SP-SM), fine-grain, slightly silty

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP-SM AASHTO=

Coefficients

D_{85}= 0.2624 D_{60}= 0.1949 D_{50}= 0.1741
D_{30}= 0.1318 D_{15}= 0.0909 D_{10}= 0.0754
C_u= 2.58 C_c= 1.18

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

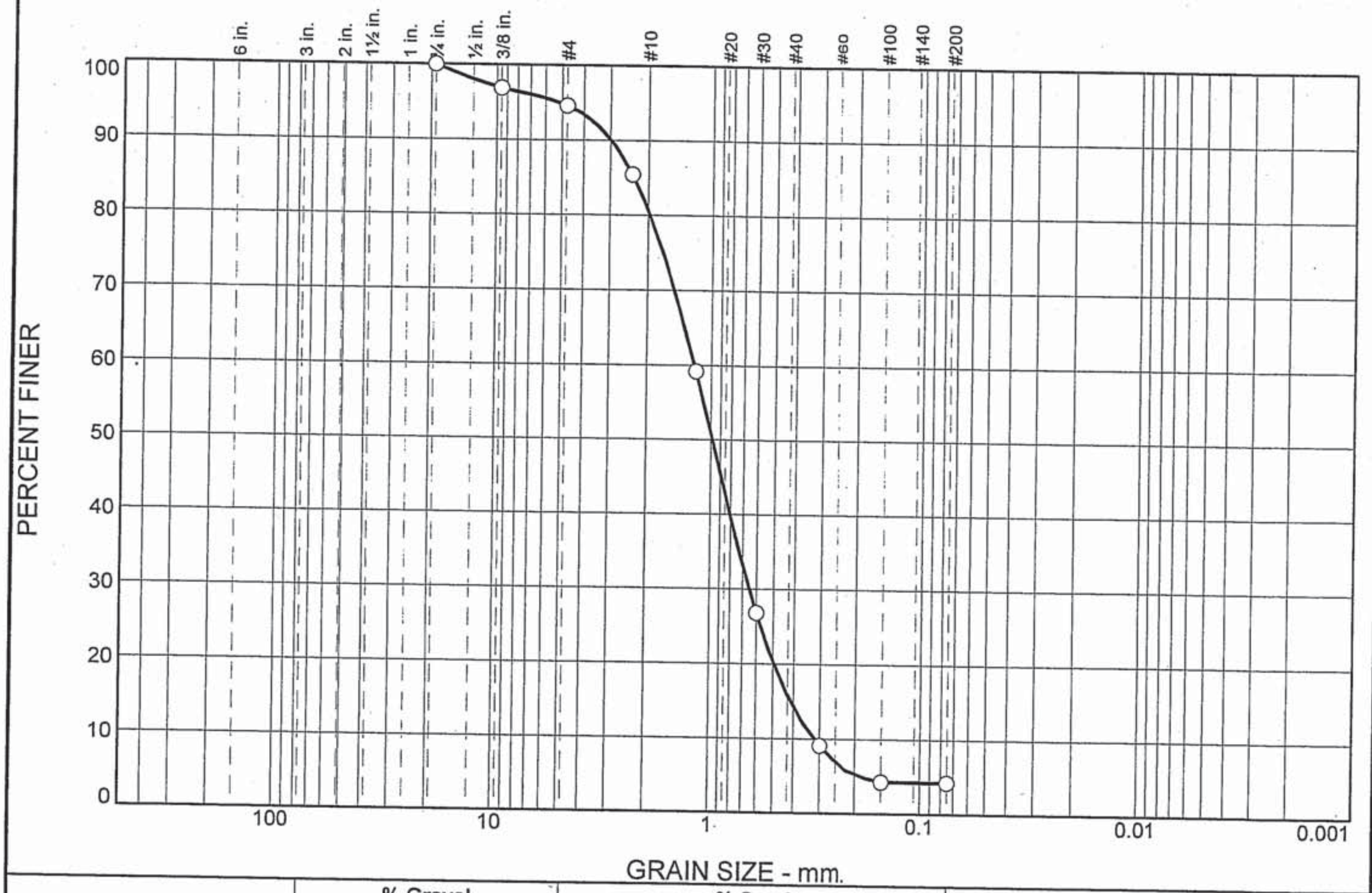
Sample No.: S-7 **Source of Sample:** B-114 **Date Sampled:**
Location:
Elev./Depth: 23
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

Client: Ameren U.E.
Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-185

Particle Size Distribution Report - ASTM D422



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	5.4	13.9	64.9	11.6	4.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3/4	100.0		
3/8	96.9		
#4	94.6		
#8	85.4		
#16	59.2		
#30	26.8		
#50	9.1		
#100	4.3		
#200	4.2		

* (no specification provided)

Material Description

SAND (SP), medium-grain, with coarse-grain and fine-grain sand

Atterberg Limits (ASTM D 4318)

PL= LL= PI=

Classification

USCS= SP AASHTO=

Coefficients

D_{85}= 2.3207 D_{60}= 1.2003 D_{50}= 0.9809

D_{30}= 0.6481 D_{15}= 0.4119 D_{10}= 0.3192

C_u= 3.76 C_c= 1.10

Date Tested: 1/13/06 **Tested By:** J. Crose

Remarks

Sample No.: S-8 **Source of Sample:** B-114 **Date Sampled:**

Location: **Elev./Depth:** 28

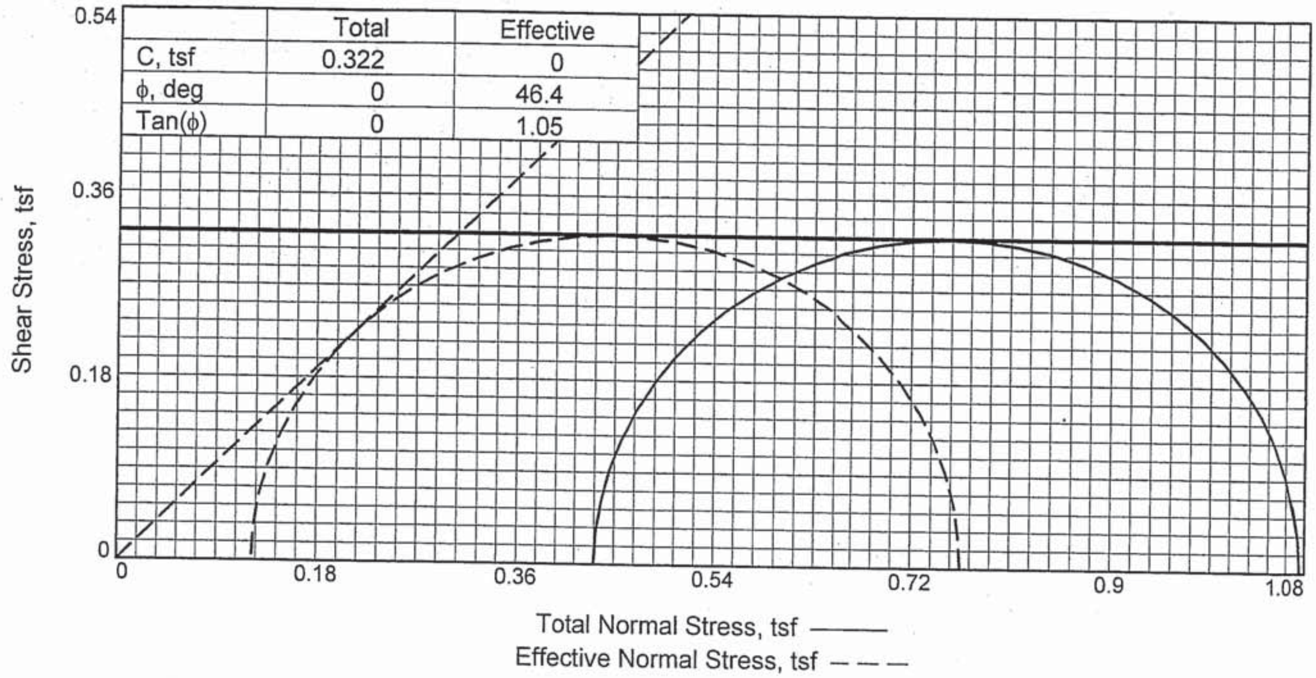
Checked By: K. Kocher **Title:** P.E.

REITZ & JENS, INC.
CONSULTING ENGINEERS

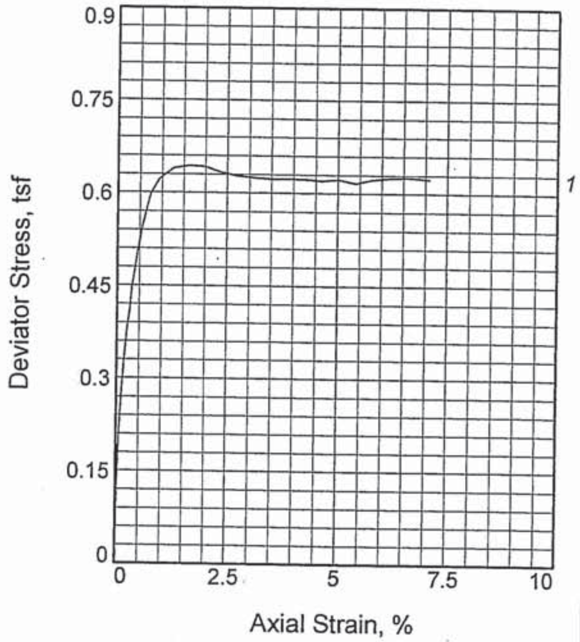
Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Project No: 2005012477 **Figure** B1-186



	Total	Effective
C, tsf	0.322	0
ϕ, deg	0	46.4
Tan(ϕ)	0	1.05



Sample No.		1
Initial	Water Content,	30.9
	Dry Density, pcf	82.4
	Saturation,	80.4
	Void Ratio	1.0299
	Diameter, in.	2.86
	Height, in.	5.82
At Test	Water Content,	37.8
	Dry Density, pcf	83.1
	Saturation,	100.0
	Void Ratio	1.0142
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		0.02
Eff. Cell Pressure, tsf		0.43
Fail. Stress, tsf		0.64
Total Pore Pr., tsf		4.99
Strain, %		1.6
Ult. Stress, tsf		0.64
Total Pore Pr., tsf		4.99
Strain, %		1.6
$\overline{\sigma}_1$ Failure, tsf		0.77
$\overline{\sigma}_3$ Failure, tsf		0.12

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: CLAY (CH), dark brown & gray, high plastic, traces of lignite and limonite, with

LL= 74 **PL=** 23 **PI=** 51

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-1

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

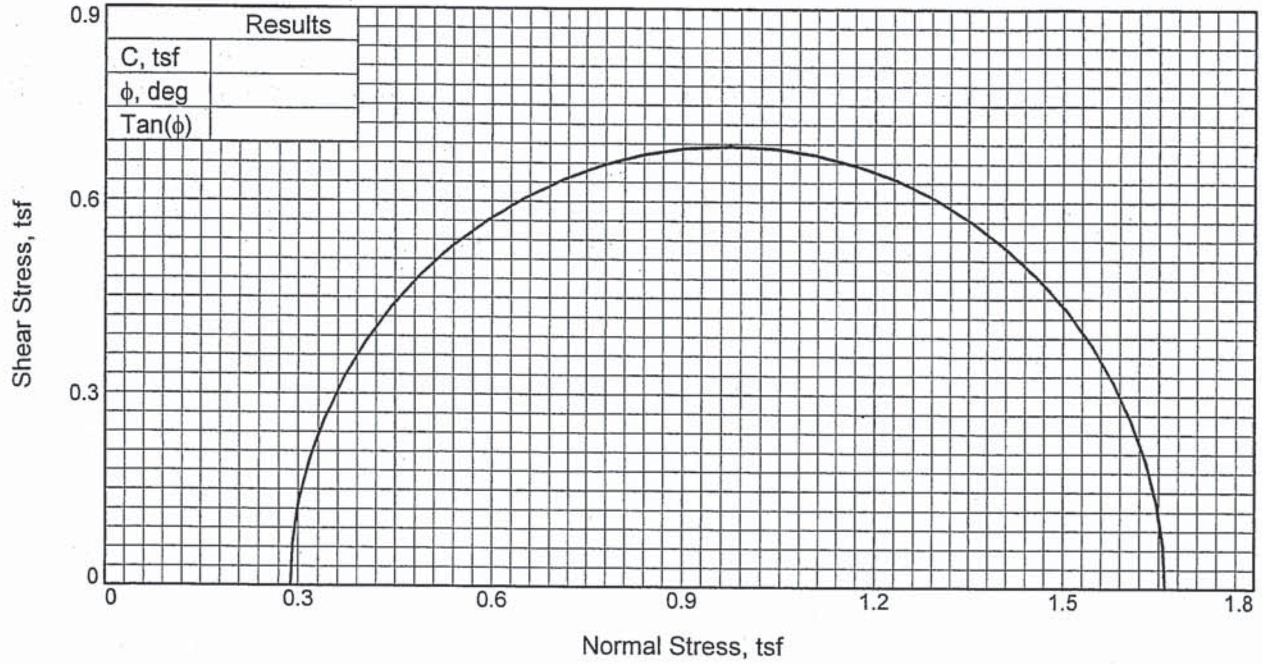
Source of Sample: B-59 **Depth:** 6.5

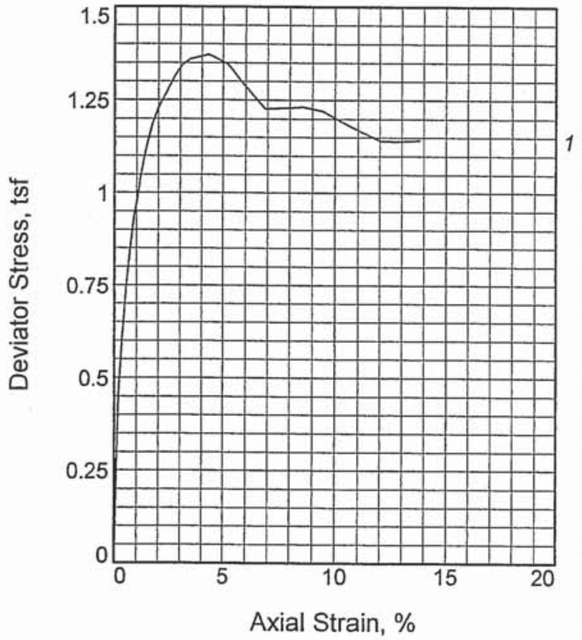
Sample Number: ST-3

Proj. No.: 2005012477 **Date:** 10/11/2005

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Fouse





	Sample No.	1
Initial	Water Content,	33.4
	Dry Density, pcf	84.2
	Saturation,	90.5
	Void Ratio	0.9873
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	33.4
	Dry Density, pcf	84.2
	Saturation,	90.5
	Void Ratio	0.9873
	Diameter, in.	2.85
	Height, in.	5.80
	Strain rate, %/min.	1.43
	Back Pressure, tsf	0.00
	Cell Pressure, tsf	0.29
	Fail. Stress, tsf	1.37
	Ult. Stress, tsf	
	σ_1 Failure, tsf	1.66
	σ_3 Failure, tsf	0.29

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark greyish brown, high plastic , with traces of silt, limonite and lignite. (slick-n-sided)

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-2

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

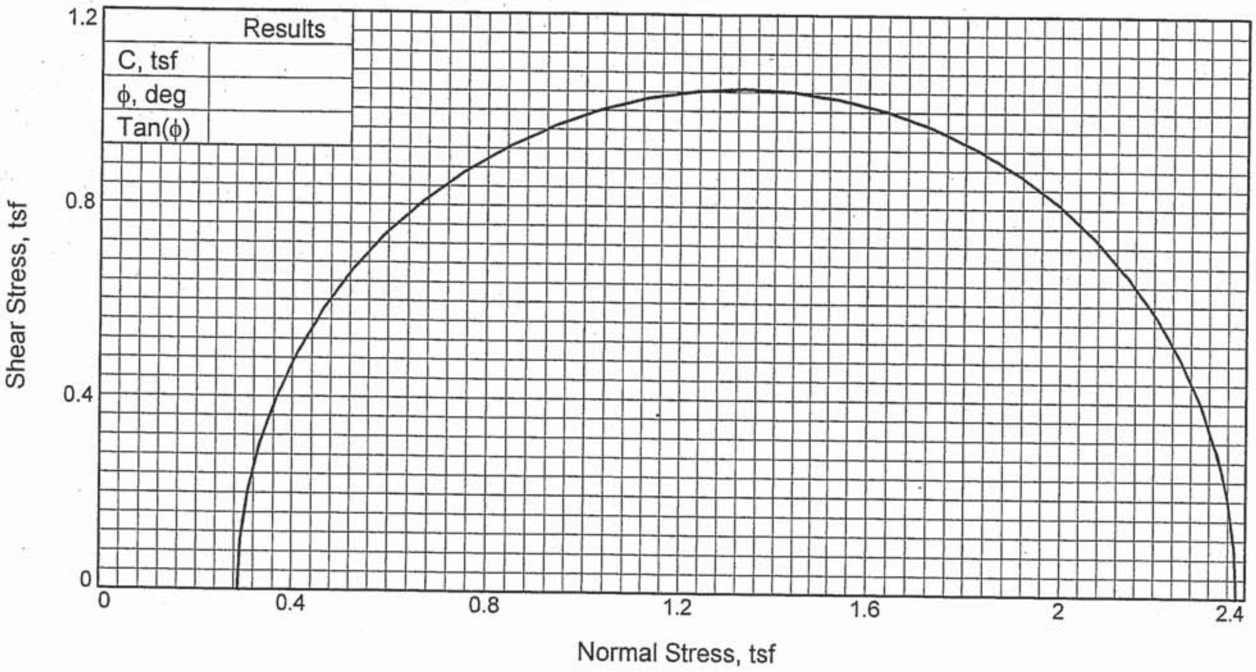
Source of Sample: B-61 **Depth:** 4

Sample Number: ST-1

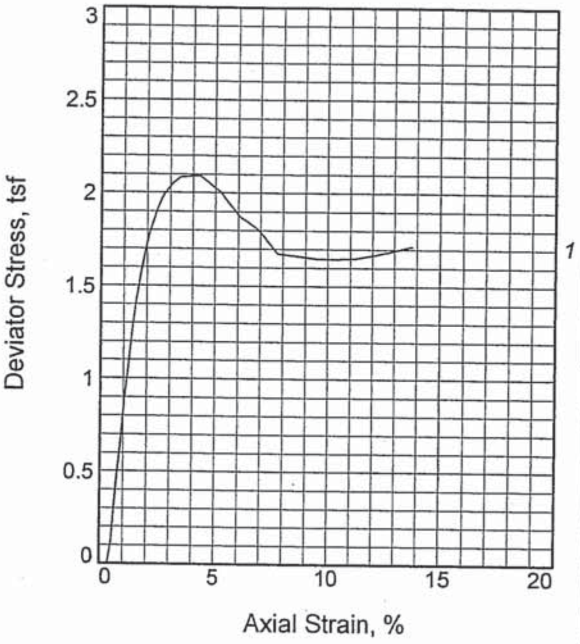
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: Jim David **Checked By:** Kyle Kocher



Results	
C, tsf	
ϕ, deg	
Tan(ϕ)	



	Sample No.	1
Initial	Water Content,	30.0
	Dry Density, pcf	88.4
	Saturation,	90.2
	Void Ratio	0.8921
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	30.0
	Dry Density, pcf	88.4
	Saturation,	90.2
	Void Ratio	0.8921
	Diameter, in.	2.85
	Height, in.	5.80
	Strain rate, %/min.	1.43
	Back Pressure, tsf	0.00
	Cell Pressure, tsf	0.29
	Fail. Stress, tsf	2.09
	Ult. Stress, tsf	
	σ_1 Failure, tsf	2.38
	σ_3 Failure, tsf	0.29

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark greyish brown, w/ brown silt lenses

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-3

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

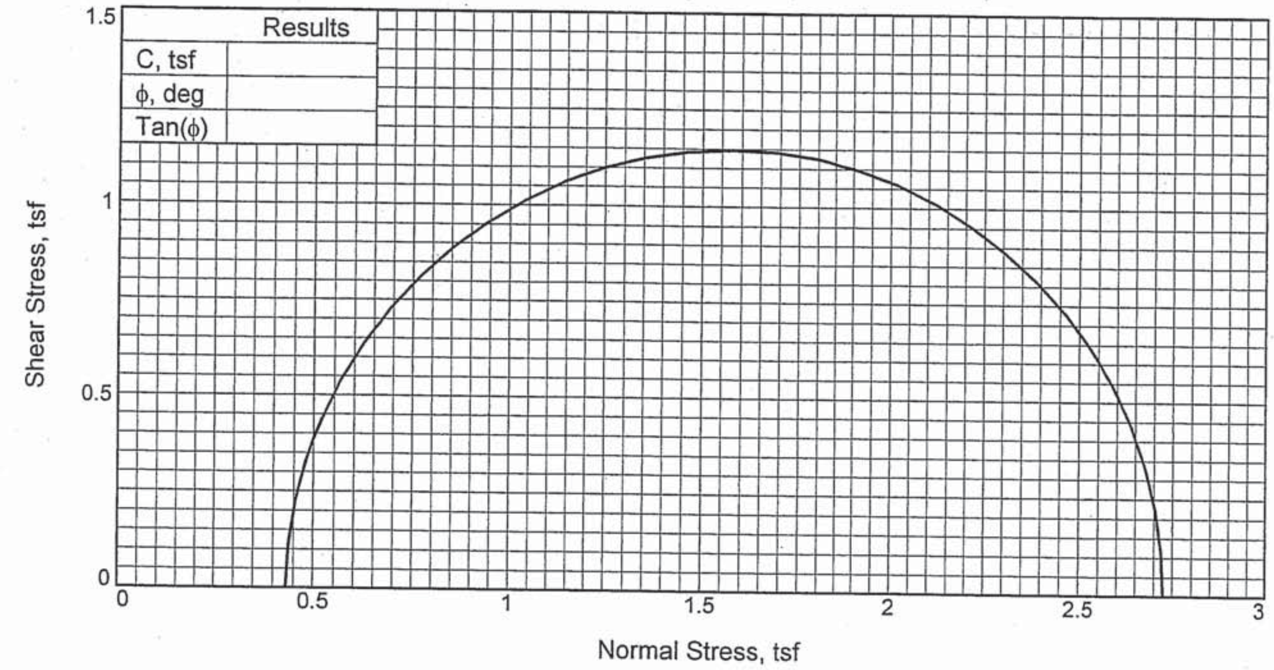
Source of Sample: B-62 **Depth:** 4

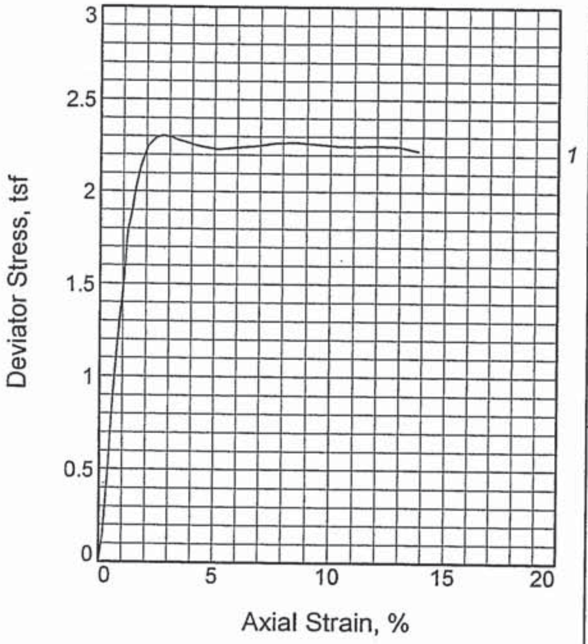
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: Jason Pruett **Checked By:** Kyle Kocher





Sample No.		1
Initial	Water Content,	32.2
	Dry Density, pcf	85.4
	Saturation,	90.1
	Void Ratio	0.9588
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	32.2
	Dry Density, pcf	85.4
	Saturation,	90.1
	Void Ratio	0.9588
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.43
Fail. Stress, tsf		2.29
Ult. Stress, tsf		2.29
σ_1 Failure, tsf		2.73
σ_3 Failure, tsf		0.43

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark greyish brown, with taces of lignite

LL= 84 **PL=** 23 **PI=** 61

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-4

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

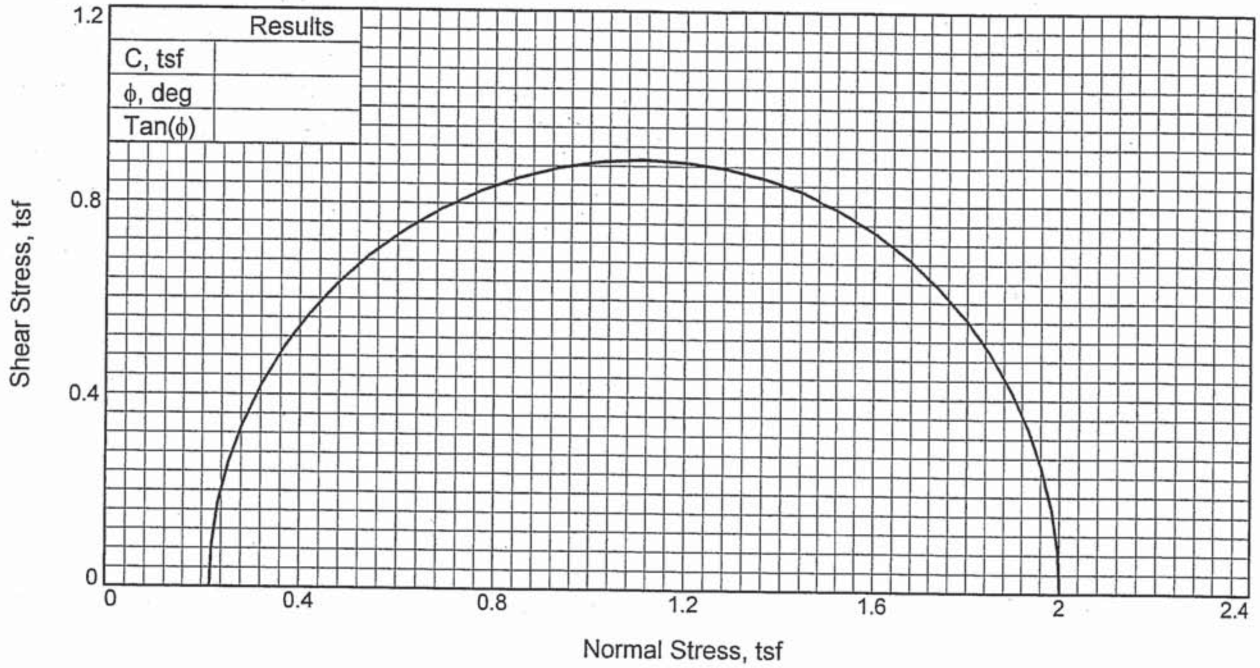
Source of Sample: B-64 **Depth:** 4

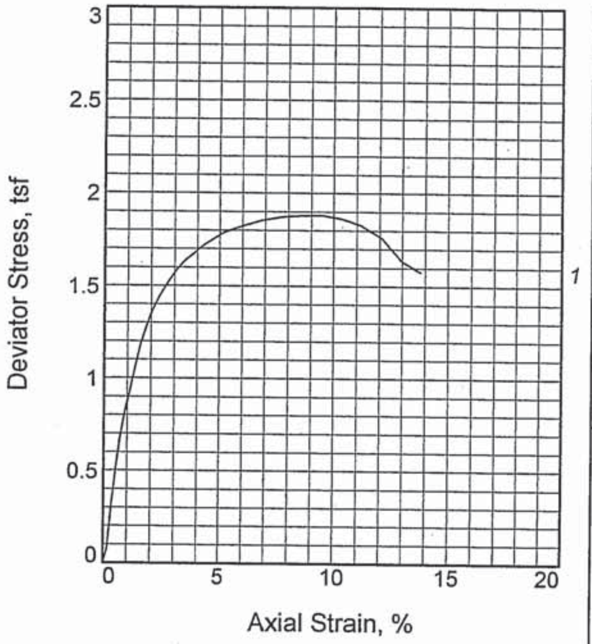
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: Jim David **Checked By:** Kyle Kocher





Sample No.		1
Initial	Water Content,	33.4
	Dry Density, pcf	87.5
	Saturation,	98.2
	Void Ratio	0.9128
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	33.4
	Dry Density, pcf	87.5
	Saturation,	98.2
	Void Ratio	0.9128
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.22
Fail. Stress, tsf		1.79
Ult. Stress, tsf		1.88
σ_1 Failure, tsf		2.00
σ_3 Failure, tsf		0.22

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark gray, high plastic

LL= 86 **PL=** 25 **PI=** 61

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-5

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

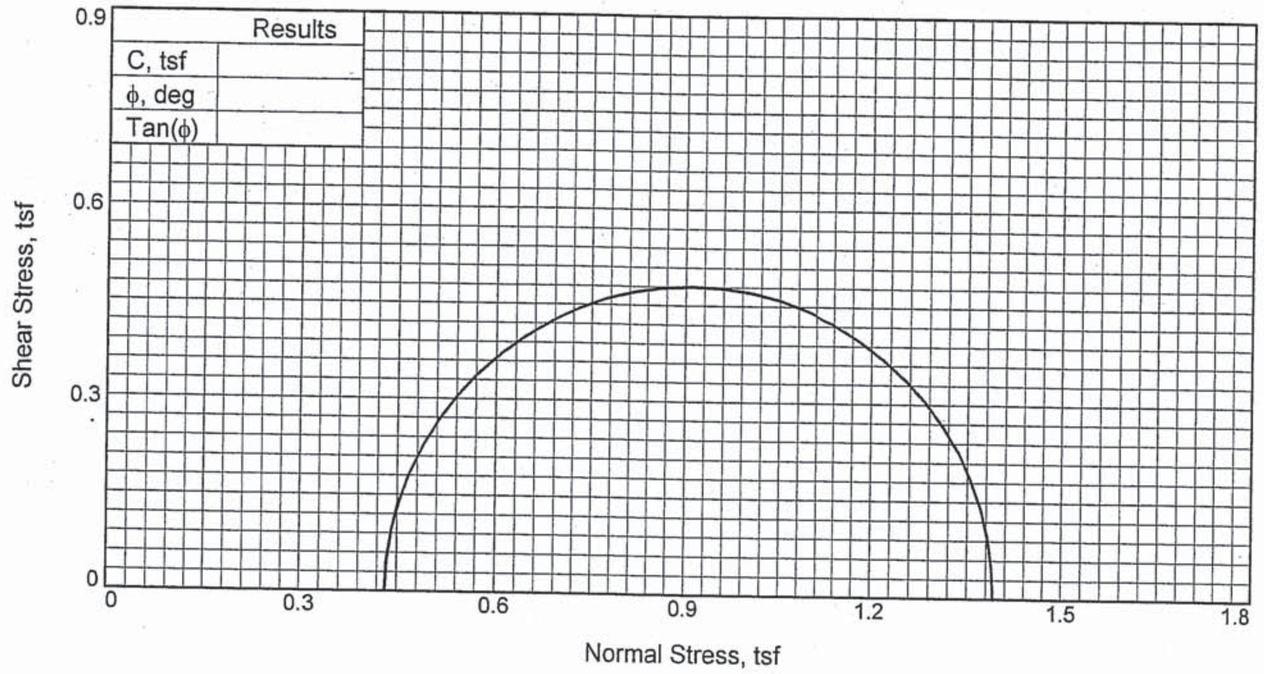
Source of Sample: B-66 **Depth:** 1.5

Sample Number: ST-1

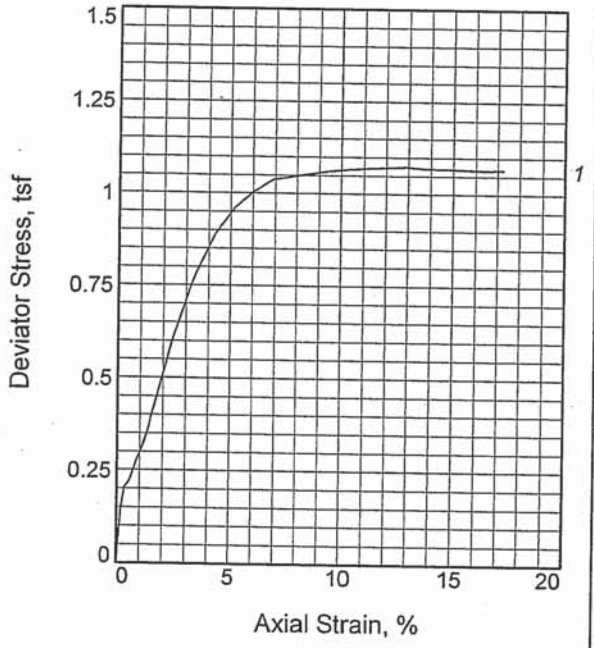
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: Jim David **Checked By:** Kyle Kocher



Results	
C, tsf	
φ, deg	
Tan(φ)	



Sample No.		1
Initial	Water Content,	32.9
	Dry Density, pcf	87.6
	Saturation,	96.8
	Void Ratio	0.9100
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	32.9
	Dry Density, pcf	87.6
	Saturation,	96.8
	Void Ratio	0.9100
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.43
Fail. Stress, tsf		0.96
Ult. Stress, tsf		1.07
σ_1 Failure, tsf		1.39
σ_3 Failure, tsf		0.43

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CL), greyish brown, silty

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-6

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

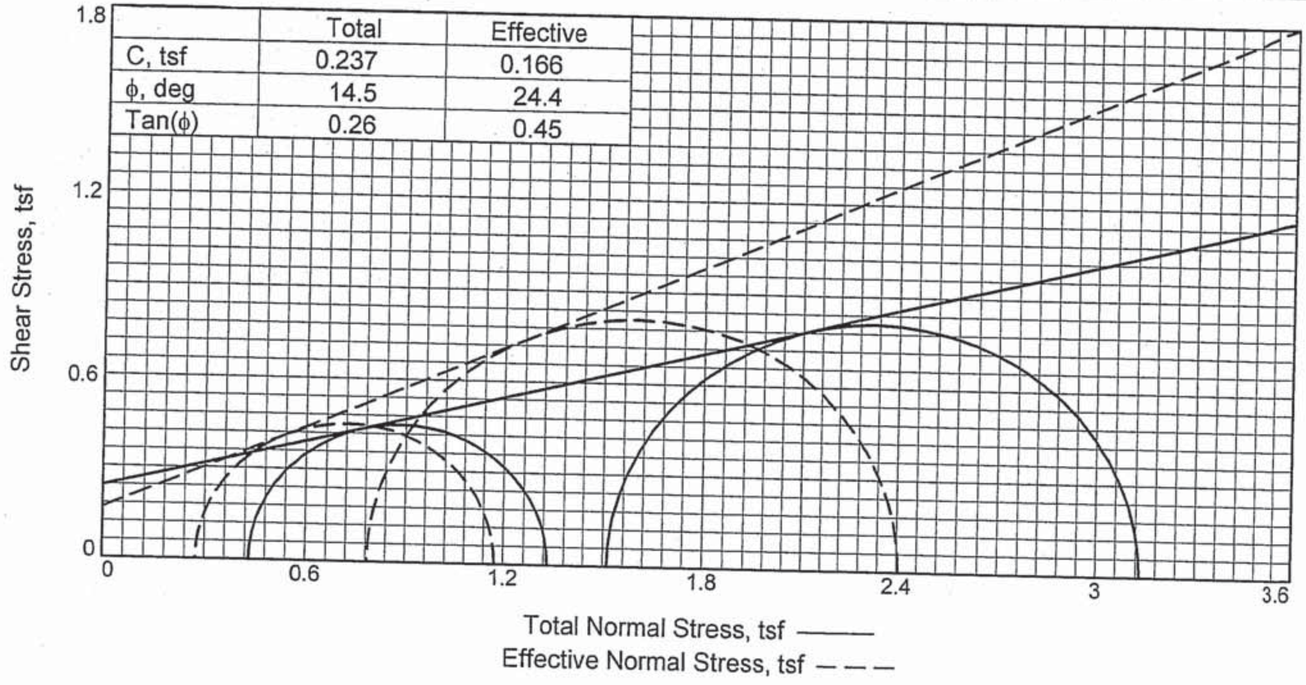
Source of Sample: B-66 **Depth:** 6.5

Sample Number: ST-2

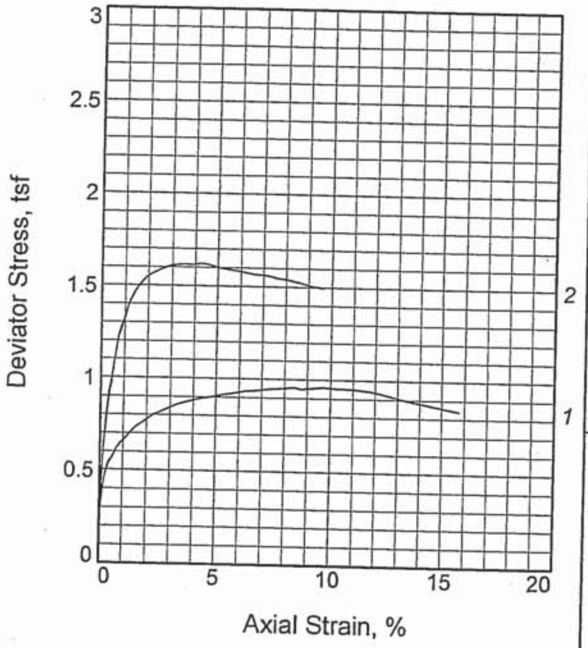
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: Jim David **Checked By:** Kyle Kocher



	Total	Effective
C, tsf	0.237	0.166
ϕ, deg	14.5	24.4
Tan(ϕ)	0.26	0.45



	Sample No.	1	2
Initial	Water Content,	40.7	45.2
	Dry Density, pcf	79.0	75.6
	Saturation,	97.4	99.9
	Void Ratio	1.1188	1.2127
	Diameter, in.	1.99	1.99
	Height, in.	4.13	4.27
At Test	Water Content,	41.3	41.3
	Dry Density, pcf	79.4	79.4
	Saturation,	100.0	100.0
	Void Ratio	1.1081	1.1067
	Diameter, in.	1.99	1.96
	Height, in.	4.12	4.20
	Strain rate, %/min.	0.10	0.05
	Eff. Cell Pressure, tsf	0.43	1.51
	Fail. Stress, tsf	0.90	1.62
	Total Pore Pr., tsf	4.84	5.41
	Strain, %	4.8	4.3
	Ult. Stress, tsf	0.96	1.62
	Total Pore Pr., tsf	4.76	5.41
	Strain, %	9.7	4.3
	$\overline{\sigma}_1$ Failure, tsf	1.17	2.41
	$\overline{\sigma}_3$ Failure, tsf	0.27	0.78

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: CLAY (CH), gray-brown, high plastic, very slightly silty, trace limonite

LL= 99 **PL=** 29 **PI=** 70

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-7

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

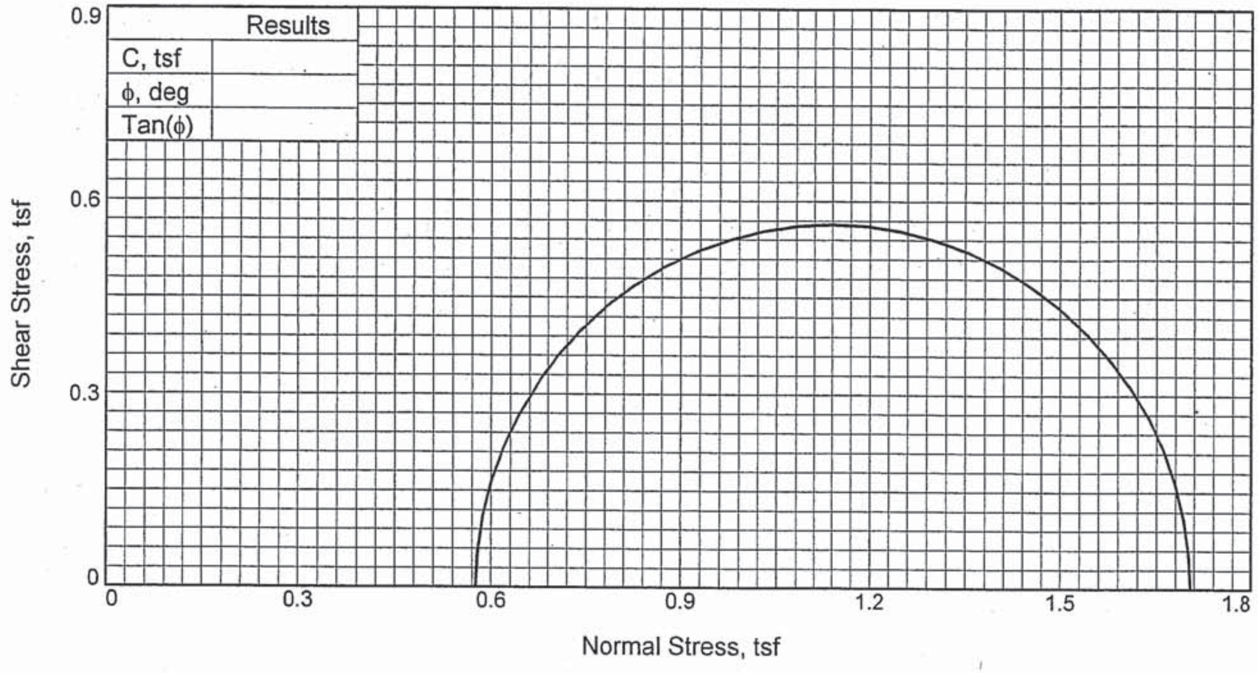
Source of Sample: B-70 **Depth:** 4

Sample Number: ST-2

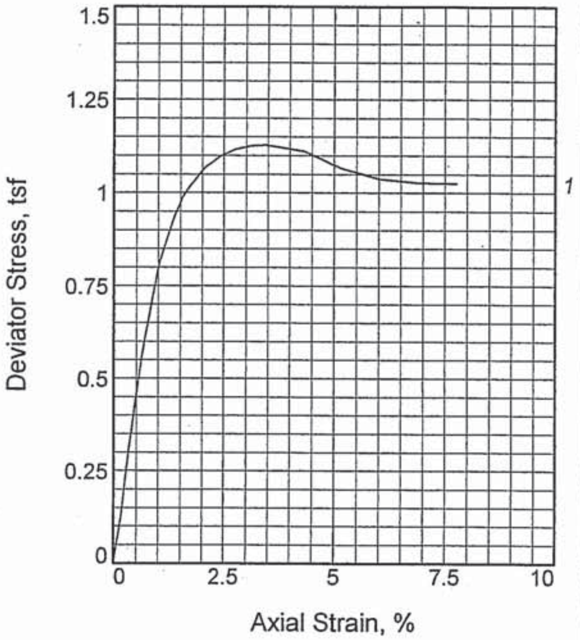
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Fouse



Results	
C, tsf	
ϕ, deg	
Tan(ϕ)	



Sample No.		1
Initial	Water Content,	35.2
	Dry Density, pcf	84.4
	Saturation,	95.9
	Void Ratio	0.9833
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	35.2
	Dry Density, pcf	84.4
	Saturation,	95.9
	Void Ratio	0.9833
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.58
Fail. Stress, tsf		1.13
Ult. Stress, tsf		1.13
σ_1 Failure, tsf		1.70
σ_3 Failure, tsf		0.58

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), gray-brown, high plastic, with lignite and limonite, traces of roots

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-8

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

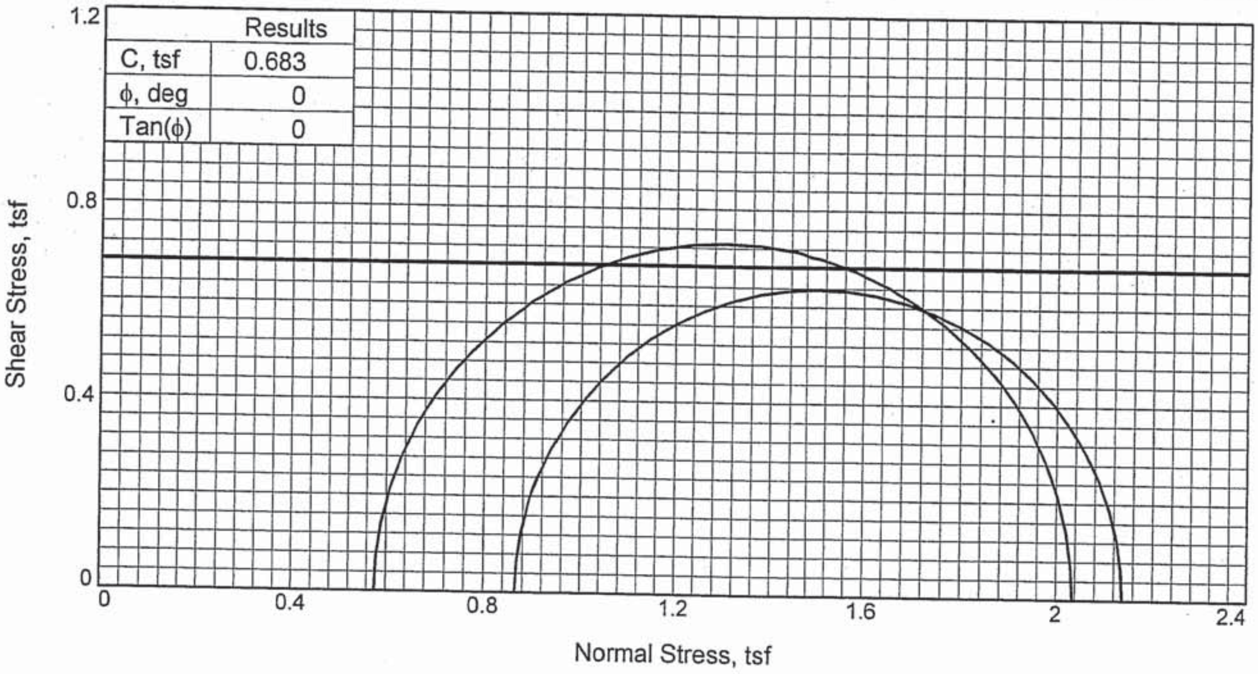
Source of Sample: B-70 **Depth:** 9

Sample Number: ST-4

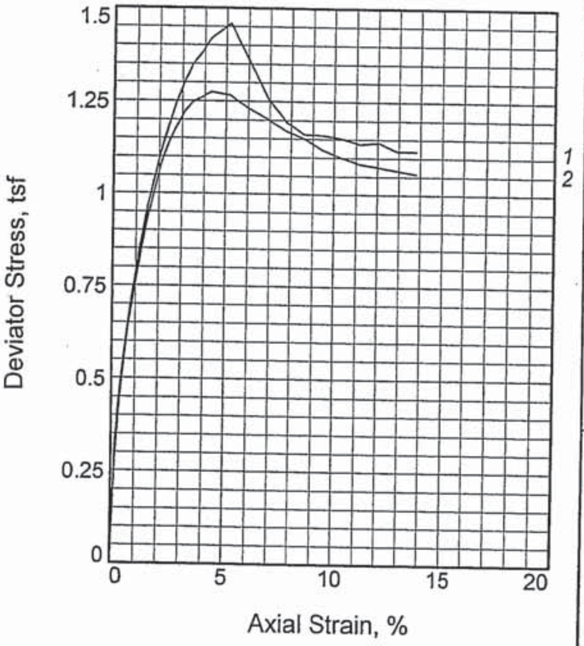
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: Jim David **Checked By:** Kyle Kocher



	Results
C, tsf	0.683
φ, deg	0
Tan(φ)	0



	Sample No.	1	2
Initial	Water Content,	34.7	41.1
	Dry Density, pcf	82.2	79.0
	Saturation,	89.7	98.4
	Void Ratio	1.0357	1.1190
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
At Test	Water Content,	34.7	41.1
	Dry Density, pcf	82.2	79.0
	Saturation,	89.7	98.4
	Void Ratio	1.0357	1.1190
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
	Strain rate, %/min.	1.43	1.43
	Back Pressure, tsf	0.00	0.00
	Cell Pressure, tsf	0.58	0.86
	Fail. Stress, tsf	1.46	1.27
	Ult. Stress, tsf	1.46	
	σ_1 Failure, tsf	2.03	2.14
	σ_3 Failure, tsf	0.58	0.86

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), gray and brown, high plastic, mottled, with traces of lignite and limonite

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-9

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

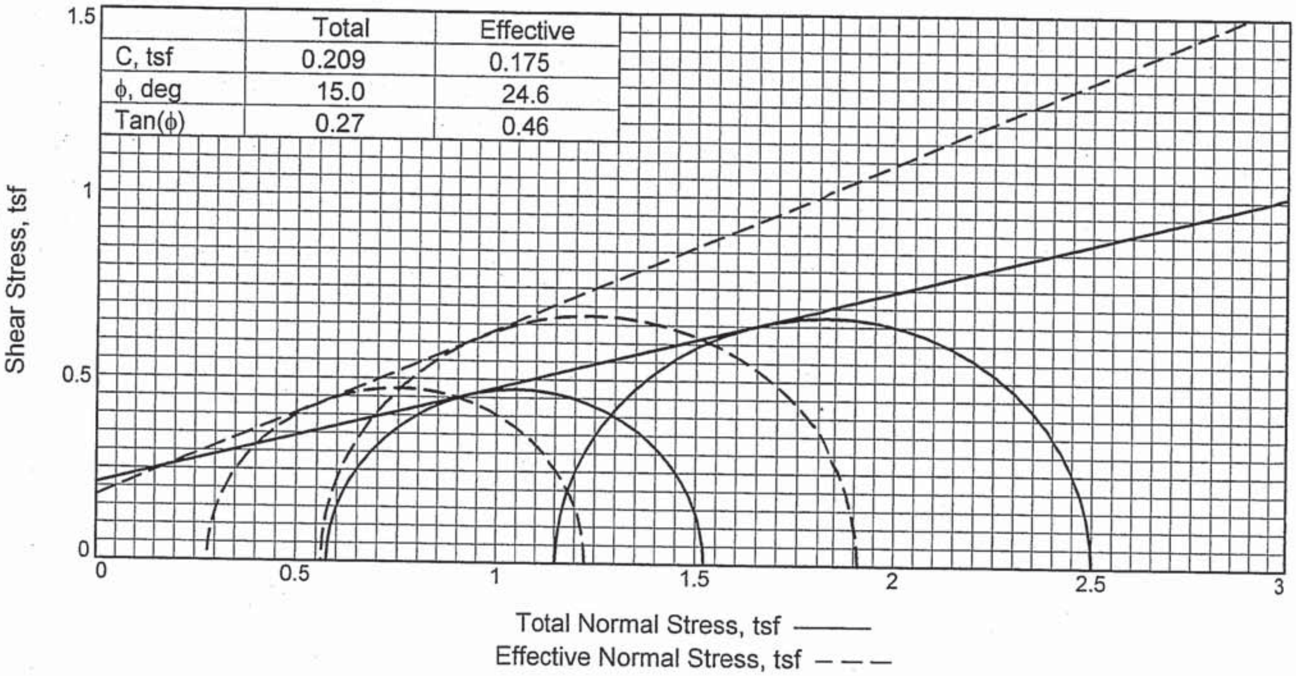
Source of Sample: B-71 **Depth:** 4

Sample Number: ST-2

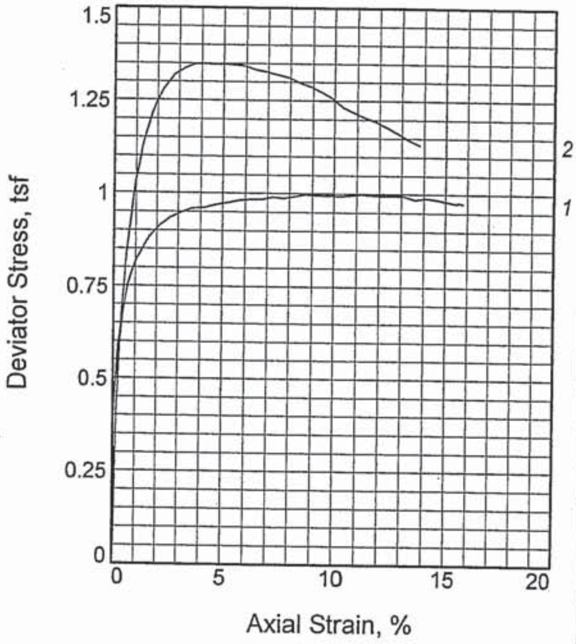
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: Jim David **Checked By:** Kyle Kocher



	Total	Effective
C, tsf	0.209	0.175
ϕ, deg	15.0	24.6
Tan(ϕ)	0.27	0.46



Sample No.		1	2
Initial	Water Content,	37.1	38.6
	Dry Density, pcf	81.1	80.6
	Saturation,	93.6	96.2
	Void Ratio	1.0623	1.0765
	Diameter, in.	1.98	1.99
	Height, in.	4.25	4.37
At Test	Water Content,	39.9	39.4
	Dry Density, pcf	80.8	81.4
	Saturation,	100.0	100.0
	Void Ratio	1.0696	1.0566
	Diameter, in.	1.98	1.99
	Height, in.	4.26	4.36
Strain rate, %/min.		0.15	0.05
Eff. Cell Pressure, tsf		0.58	1.15
Fail. Stress, tsf		0.95	1.35
Total Pore Pr., tsf		4.98	5.27
Strain, %		3.1	3.7
Ult. Stress, tsf		1.00	1.35
Total Pore Pr., tsf		4.87	5.27
Strain, %		11.2	3.7
$\overline{\sigma}_1$ Failure, tsf		1.23	1.91
$\overline{\sigma}_3$ Failure, tsf		0.28	0.56

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: CLAY (CH), grey and brown, high plastic, blocky, trace pockets of silty fine sand, trace calcium nodules, trace of lignite and

Assumed Specific Gravity= 2.68

Remarks:

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Source of Sample: B-72 **Depth:** 4

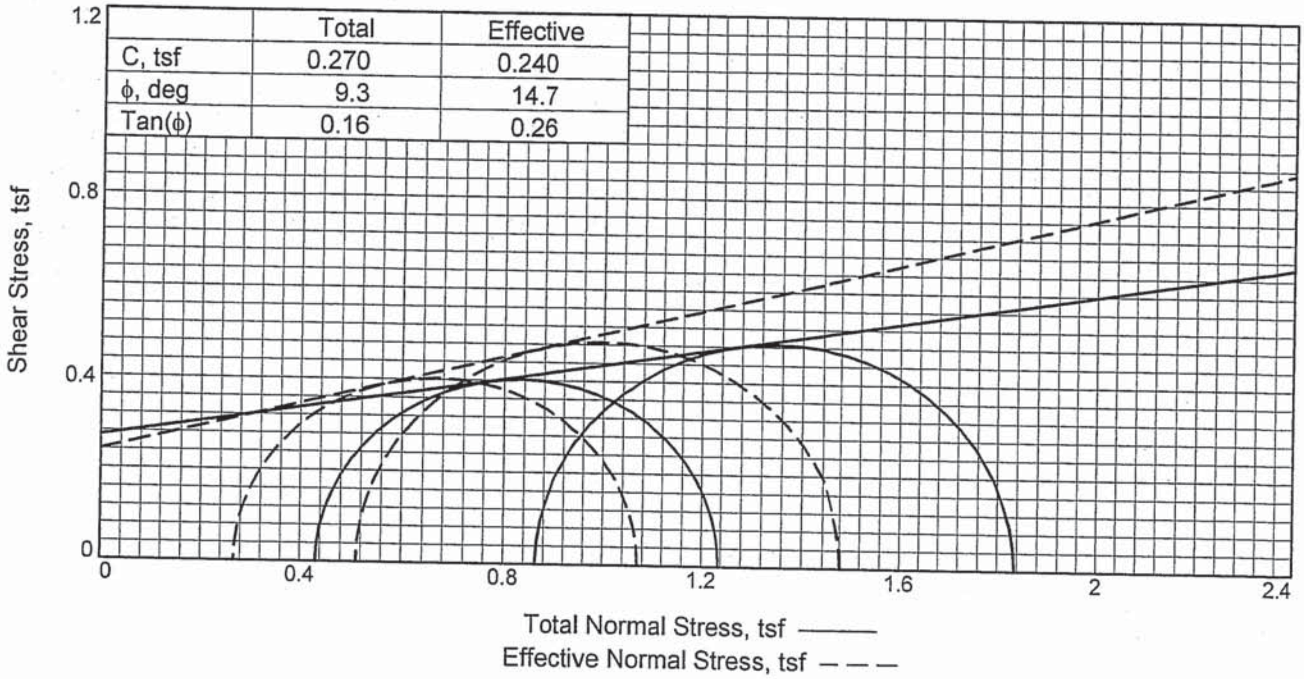
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

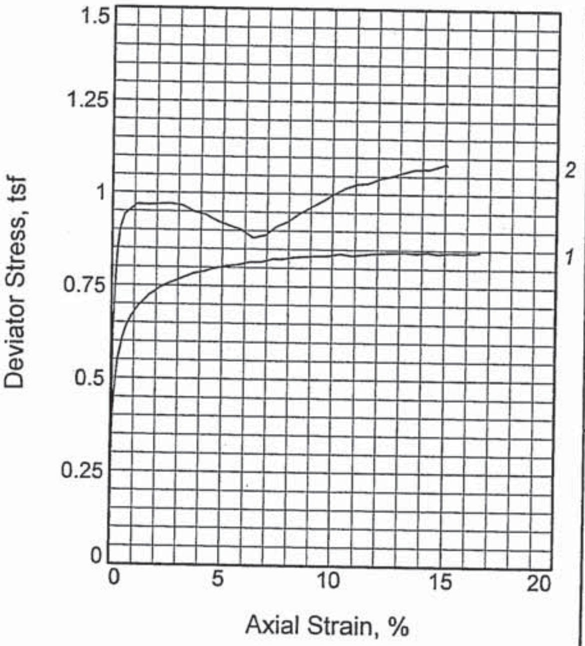
REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure B2-10

Tested By: K. Kocher **Checked By:** J. Fouse



	Total	Effective
C, tsf	0.270	0.240
ϕ, deg	9.3	14.7
Tan(ϕ)	0.16	0.26



	Sample No.	1	2
Initial	Water Content,	39.7	39.6
	Dry Density, pcf	77.6	81.4
	Saturation,	91.8	100.5
	Void Ratio	1.1572	1.0558
	Diameter, in.	2.02	2.00
	Height, in.	4.25	4.01
At Test	Water Content,	42.8	39.3
	Dry Density, pcf	77.9	81.5
	Saturation,	100.0	100.0
	Void Ratio	1.1465	1.0528
	Diameter, in.	2.02	2.00
	Height, in.	4.24	4.01
	Strain rate, %/min.	0.10	0.10
	Eff. Cell Pressure, tsf	0.43	0.86
	Fail. Stress, tsf	0.80	0.97
	Total Pore Pr., tsf	4.85	5.03
	Strain, %	5.2	2.6
	Ult. Stress, tsf	0.84	1.08
	Total Pore Pr., tsf	4.74	4.87
	Strain, %	14.2	15.1
	$\overline{\sigma}_1$ Failure, tsf	1.07	1.48
	$\overline{\sigma}_3$ Failure, tsf	0.27	0.51

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: CLAY (CH), brownish gray, high plastic, blocky

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-11

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

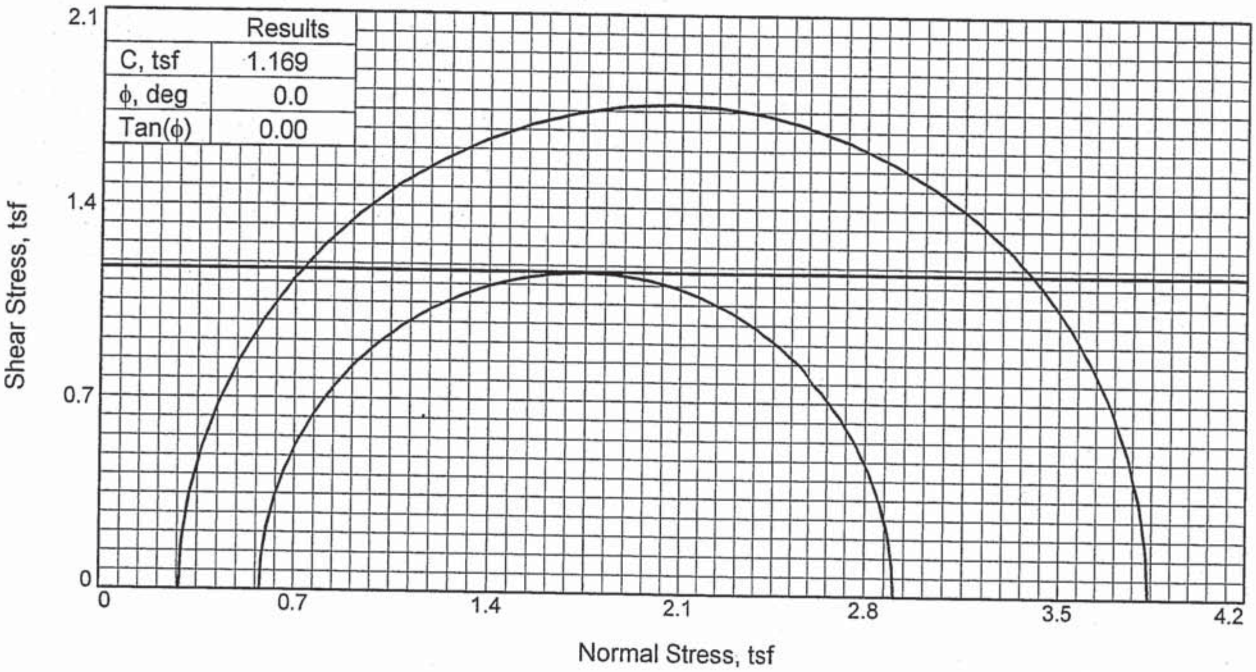
Source of Sample: B-76 **Depth:** 1.0

Sample Number: ST-1

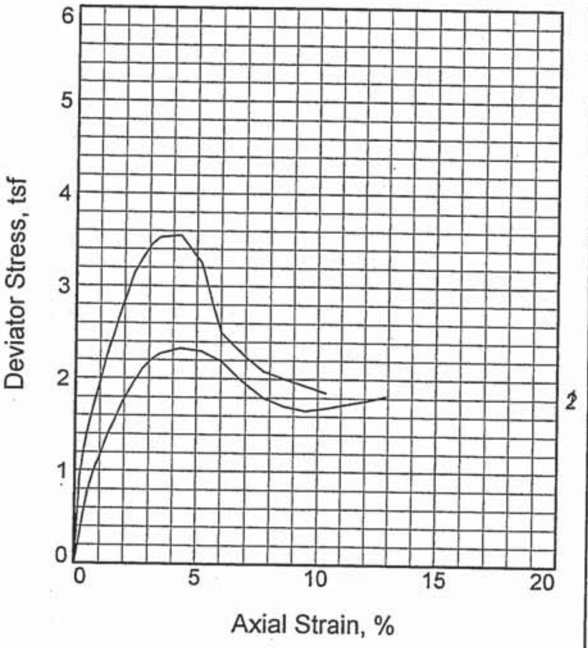
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher, J. David **Checked By:** J. Fouse



	Results
C, tsf	1.169
ϕ, deg	0.0
Tan(ϕ)	0.00



	Sample No.	1	2
Initial	Water Content,	23.7	32.3
	Dry Density, pcf	95.7	87.4
	Saturation,	85.0	94.5
	Void Ratio	0.7474	0.9145
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
At Test	Water Content,	27.9	34.1
	Dry Density, pcf	95.7	87.4
	Saturation,	100.0	100.0
	Void Ratio	0.7474	0.9145
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
	Strain rate, %/min.	1.43	1.43
	Back Pressure, tsf	0.00	0.00
	Cell Pressure, tsf	0.29	0.58
	Fail. Stress, tsf	3.55	2.33
	Ult. Stress, tsf	3.55	2.33
	σ_1 Failure, tsf	3.84	2.90
	σ_3 Failure, tsf	0.29	0.58

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark grayish brown and gray, high plastic, with lignite, limonite, silt lenses and small roots

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-12

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

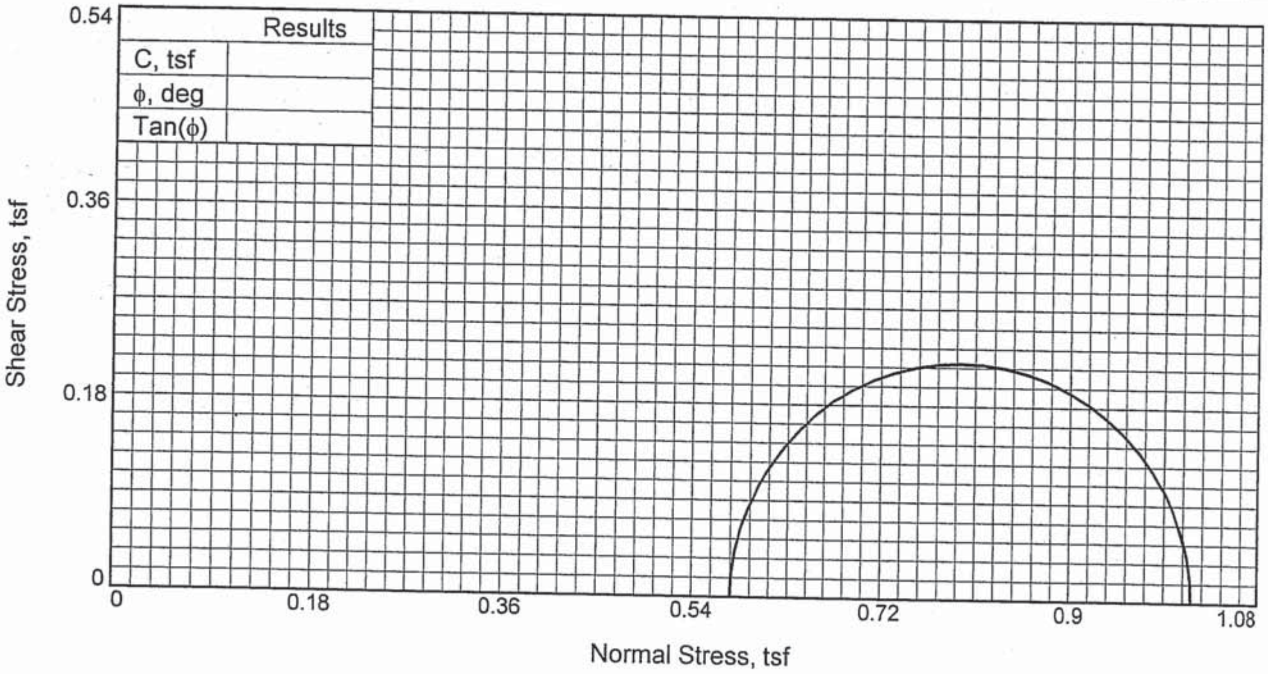
Source of Sample: B-77 **Depth:** 4.0

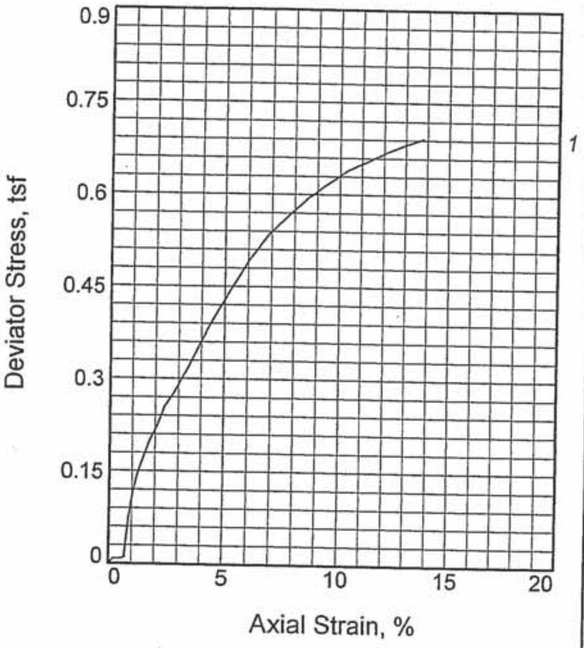
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: J. David **Checked By:** K. Kocher





Sample No.		1
Initial	Water Content,	32.7
	Dry Density, pcf	85.9
	Saturation,	92.5
	Void Ratio	0.9471
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	35.3
	Dry Density, pcf	85.9
	Saturation,	100.0
	Void Ratio	0.9471
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.58
Fail. Stress, tsf		0.44
Ult. Stress, tsf		0.69
σ_1 Failure, tsf		1.02
σ_3 Failure, tsf		0.58

Type of Test:
Unconsolidated Undrained
Sample Type: Shelby Tube
Description: Silty CLAY/clayey SILT (CL-ML), gray-brown

Assumed Specific Gravity= 2.68
Remarks:

Figure B2-13

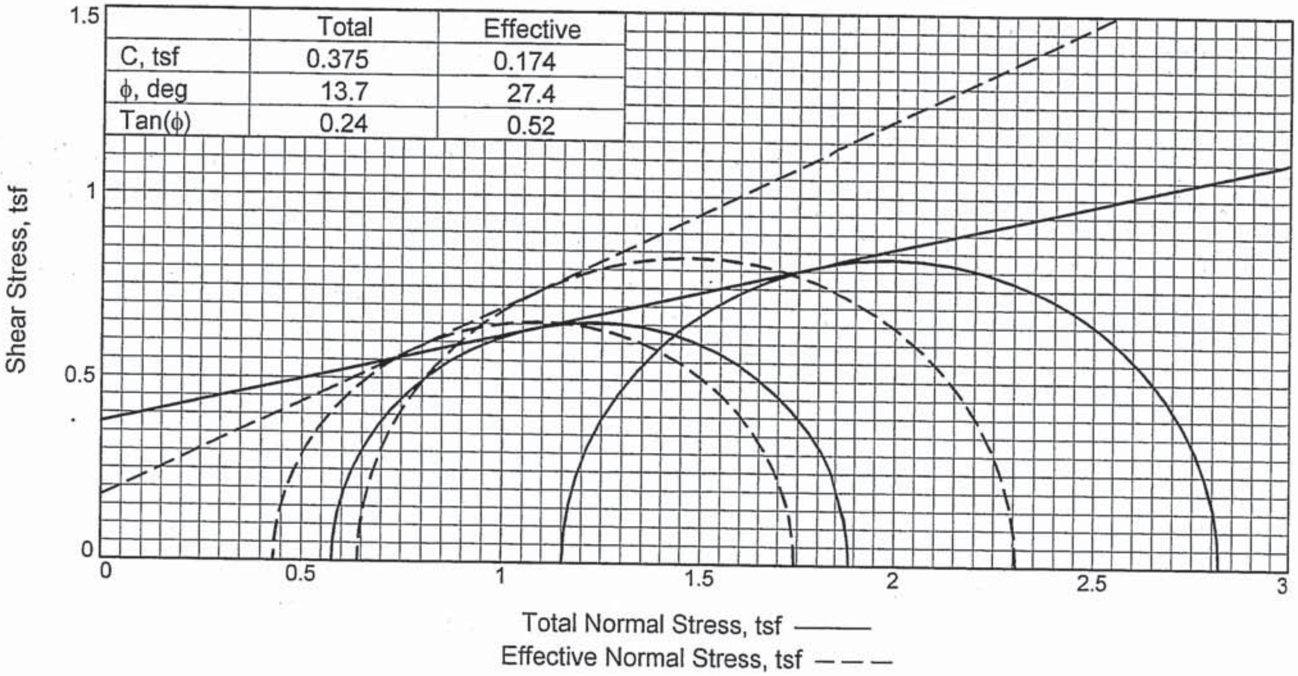
Client: Ameren U.E.

Project: Sioux Power Plant UWLF

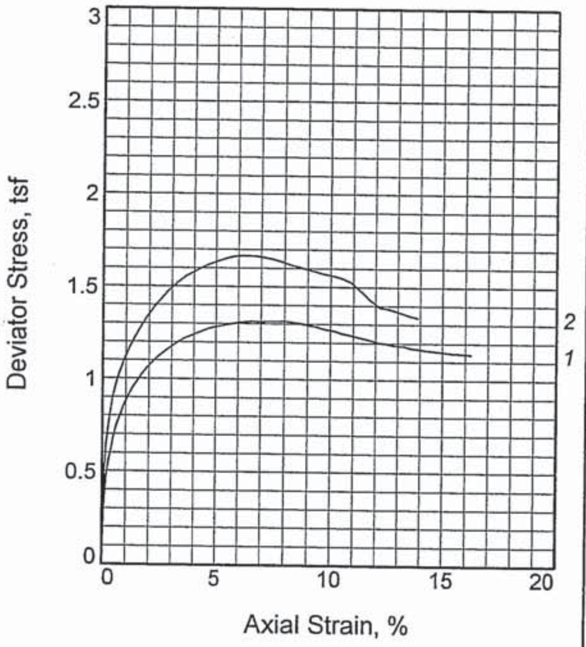
Source of Sample: B-77 **Depth:** 9
Sample Number: ST-4
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: J. David **Checked By:** K. Kocher



	Total	Effective
C, tsf	0.375	0.174
ϕ, deg	13.7	27.4
Tan(ϕ)	0.24	0.52



Sample No.		1	2
Initial	Water Content,	36.4	34.8
	Dry Density, pcf	86.4	87.2
	Saturation,	104.2	101.6
	Void Ratio	0.9361	0.9191
	Diameter, in.	2.85	2.84
	Height, in.	5.80	5.33
At Test	Water Content,	34.9	31.4
	Dry Density, pcf	86.5	90.9
	Saturation,	100.0	100.0
	Void Ratio	0.9351	0.8410
	Diameter, in.	2.85	2.80
	Height, in.	5.80	5.26
Strain rate, %/min.		0.05	0.04
Eff. Cell Pressure, tsf		0.58	1.15
Fail. Stress, tsf		1.31	1.67
Total Pore Pr., tsf		4.82	5.19
Strain, %		6.6	6.2
Ult. Stress, tsf		1.31	1.67
Total Pore Pr., tsf		4.82	5.19
Strain, %		6.6	6.2
$\overline{\sigma}_1$ Failure, tsf		1.74	2.31
$\overline{\sigma}_3$ Failure, tsf		0.43	0.64

Type of Test:
CU with Pore Pressures
Sample Type: Shelby Tube
Description: CLAY (CH), gray and brown, high plastic, with seams and pockets of gray silt and
LL= 64 **PL=** 21 **PI=** 43
Assumed Specific Gravity= 2.68
Remarks:

Figure B2-14

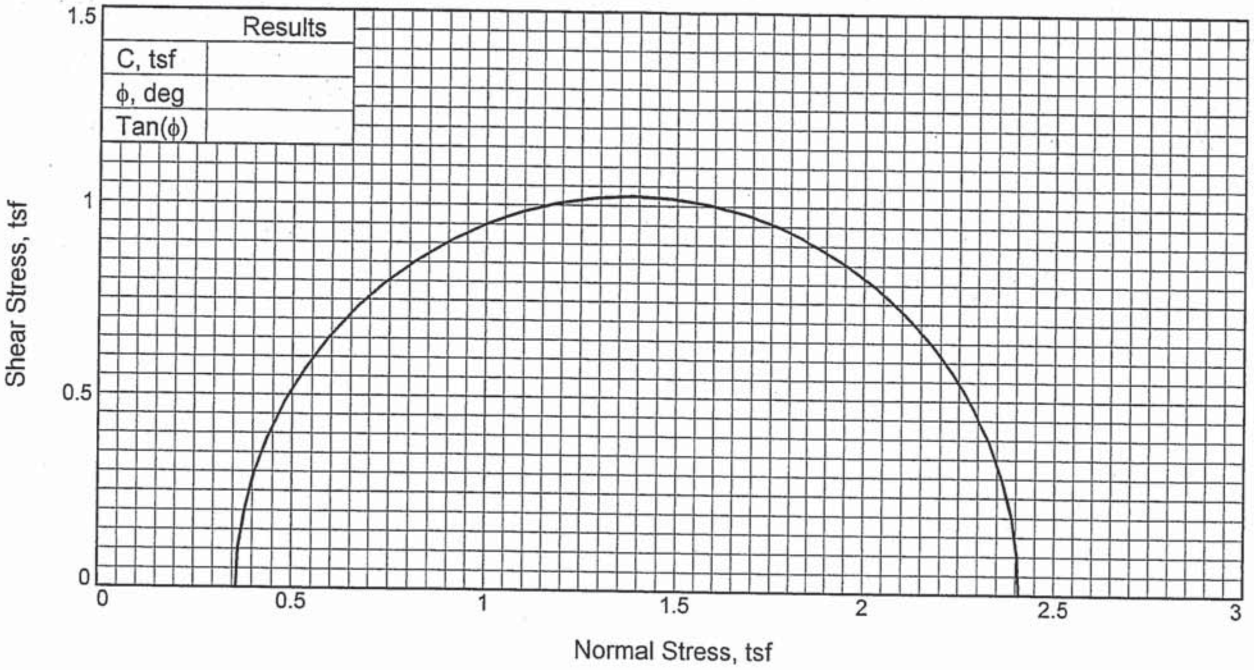
Client: Ameren U.E.

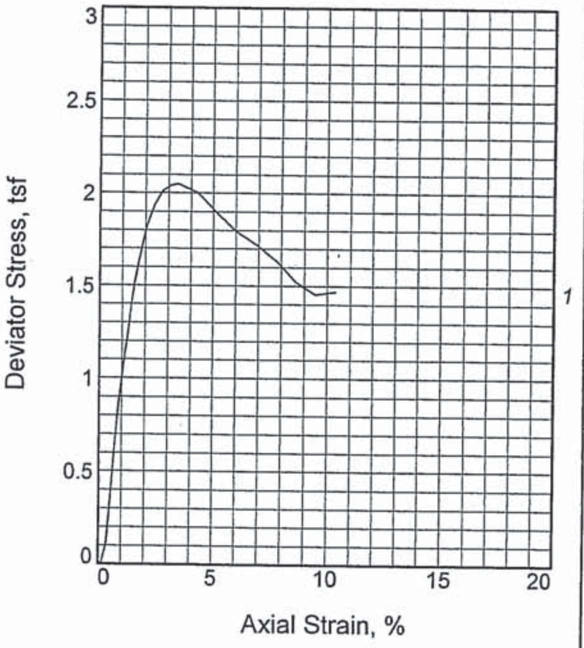
Project: Sioux Power Plant UWLF

Source of Sample: B-81 **Depth:** 6.5
Sample Number: ST-3
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher, J. David **Checked By:** J. Fouse





	Sample No.	1
Initial	Water Content,	35.3
	Dry Density, pcf	86.3
	Saturation,	100.8
	Void Ratio	0.9393
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	35.1
	Dry Density, pcf	86.3
	Saturation,	100.0
	Void Ratio	0.9393
	Diameter, in.	2.85
	Height, in.	5.80
	Strain rate, %/min.	1.43
	Back Pressure, tsf	0.00
	Cell Pressure, tsf	0.36
	Fail. Stress, tsf	2.05
	Ult. Stress, tsf	2.05
	σ_1 Failure, tsf	2.41
	σ_3 Failure, tsf	0.36

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark brownish gray, with traces of lignite, limonite, and small roots

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-15

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

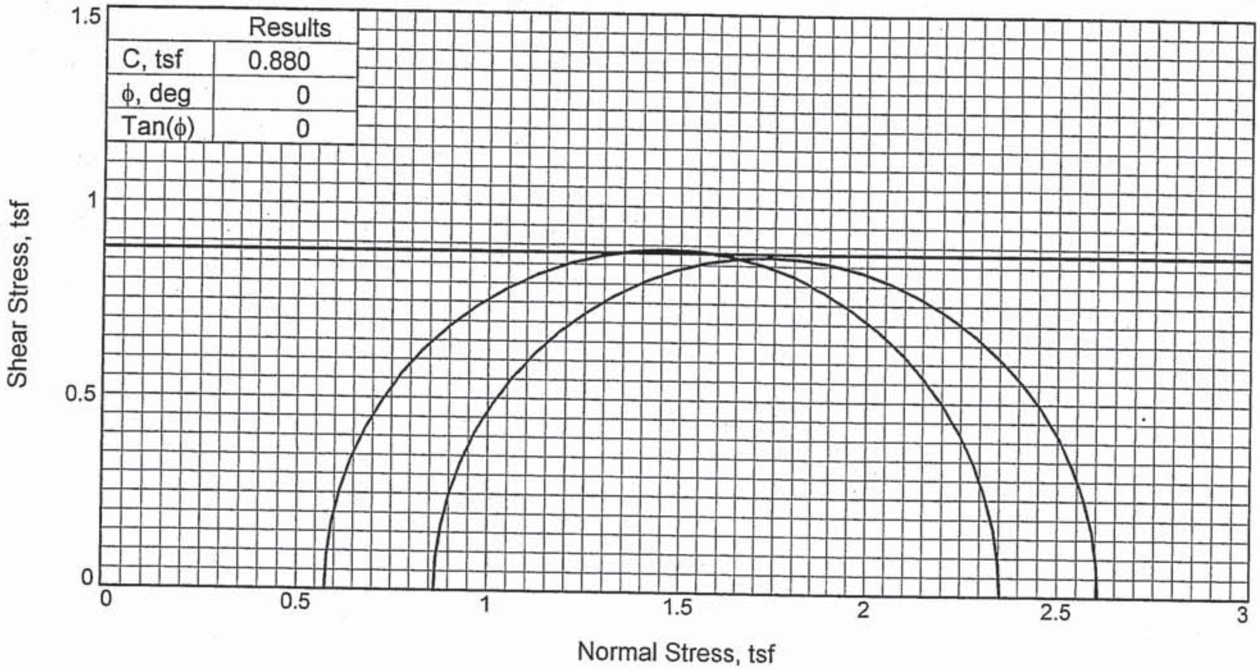
Source of Sample: B-82 **Depth:** 1.5

Sample Number: ST-1

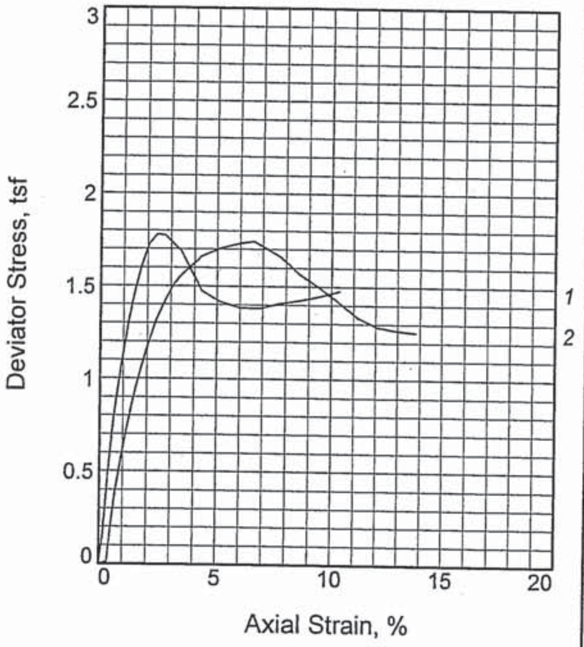
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: R. Healey **Checked By:** K. Kocher



	Results
C, tsf	0.880
ϕ, deg	0
Tan(ϕ)	0



	Sample No.	1	2
Initial	Water Content,	33.1	37.9
	Dry Density, pcf	86.9	82.9
	Saturation,	95.8	99.8
	Void Ratio	0.9256	1.0188
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
At Test	Water Content,	34.5	38.0
	Dry Density, pcf	86.9	82.9
	Saturation,	100.0	100.0
	Void Ratio	0.9256	1.0188
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
	Strain rate, %/min.	1.43	1.43
	Back Pressure, tsf	0.00	0.00
	Cell Pressure, tsf	0.58	0.86
	Fail. Stress, tsf	1.78	1.74
	Ult. Stress, tsf	1.78	1.74
	σ_1 Failure, tsf	2.35	2.61
	σ_3 Failure, tsf	0.58	0.86

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), gray-brown, very slightly silty, with traces of lignite and limonite, blocky (slick-n-sided)

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-16

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

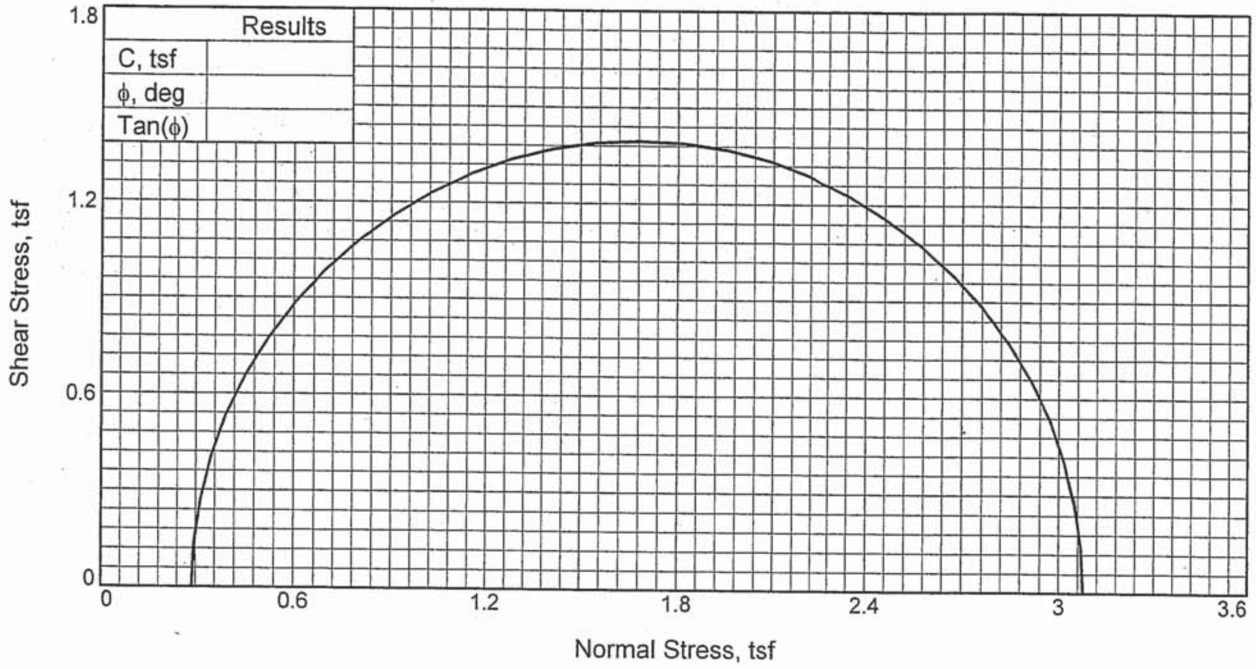
Source of Sample: B-83 **Depth:** 4

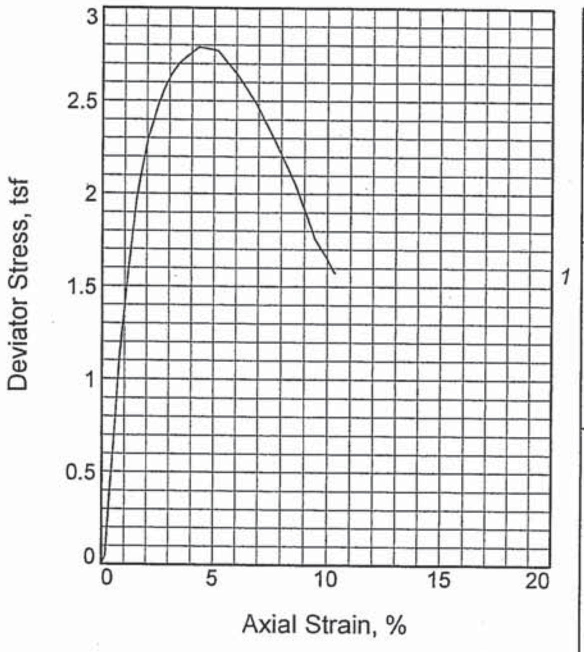
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: J. David **Checked By:** K. Kocher





Sample No.		1
Initial	Water Content,	36.8
	Dry Density, pcf	84.4
	Saturation,	100.2
	Void Ratio	0.9831
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	36.8
	Dry Density, pcf	84.4
	Saturation,	100.2
	Void Ratio	0.9831
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.29
Fail. Stress, tsf		2.79
Ult. Stress, tsf		2.79
σ_1 Failure, tsf		3.08
σ_3 Failure, tsf		0.29

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark brown and gray, mottled, with lignite and limonite

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-17

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

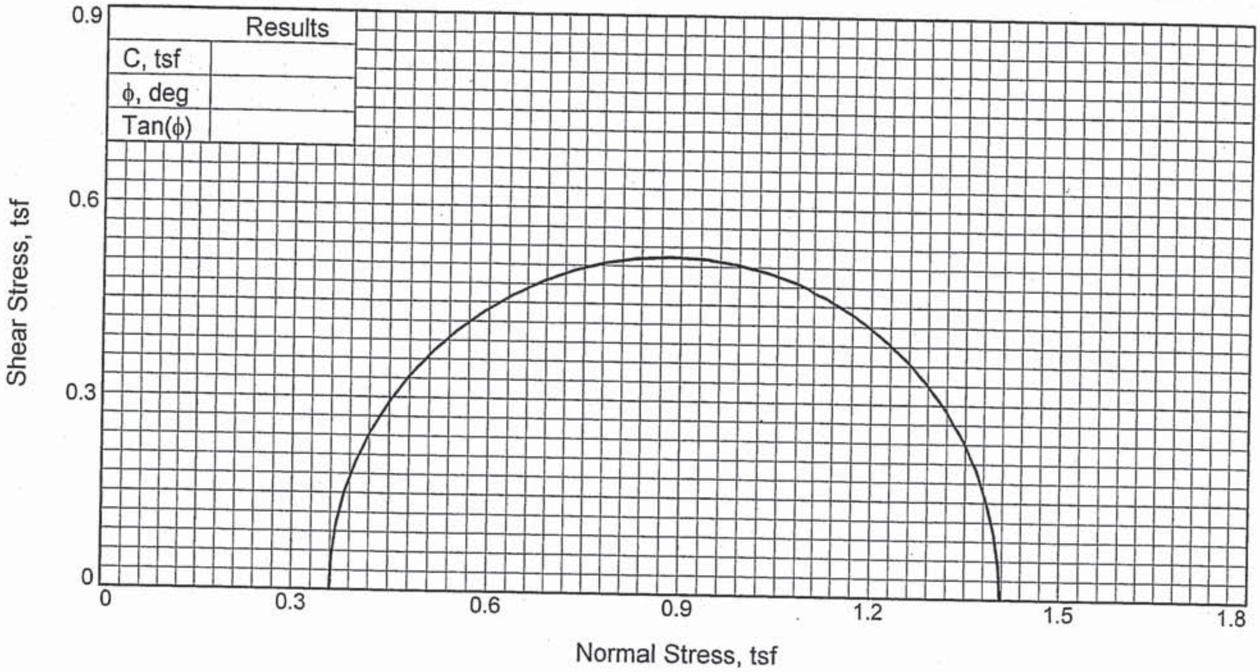
Source of Sample: B-84 **Depth:** 1.5

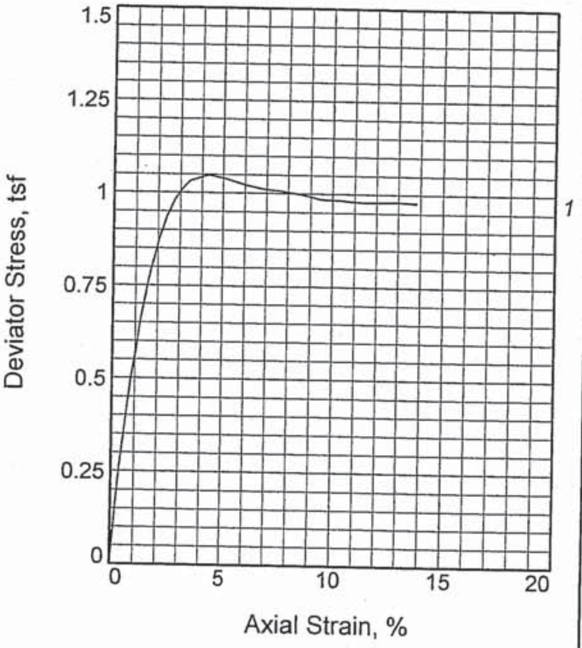
Sample Number: ST-1

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: R. Healey **Checked By:** K. Kocher





	Sample No.	1
Initial	Water Content,	40.6
	Dry Density, pcf	79.5
	Saturation,	98.6
	Void Ratio	1.1037
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	40.6
	Dry Density, pcf	79.5
	Saturation,	98.6
	Void Ratio	1.1037
	Diameter, in.	2.85
	Height, in.	5.80
	Strain rate, %/min.	1.43
	Back Pressure, tsf	0.00
	Cell Pressure, tsf	0.36
	Fail. Stress, tsf	1.05
	Ult. Stress, tsf	1.05
	σ_1 Failure, tsf	1.41
	σ_3 Failure, tsf	0.36

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CL), grayish brown, with traces of lignite and limonite (slick-n-sided)

LL= 48 **PL=** 25 **PI=** 23

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-18

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

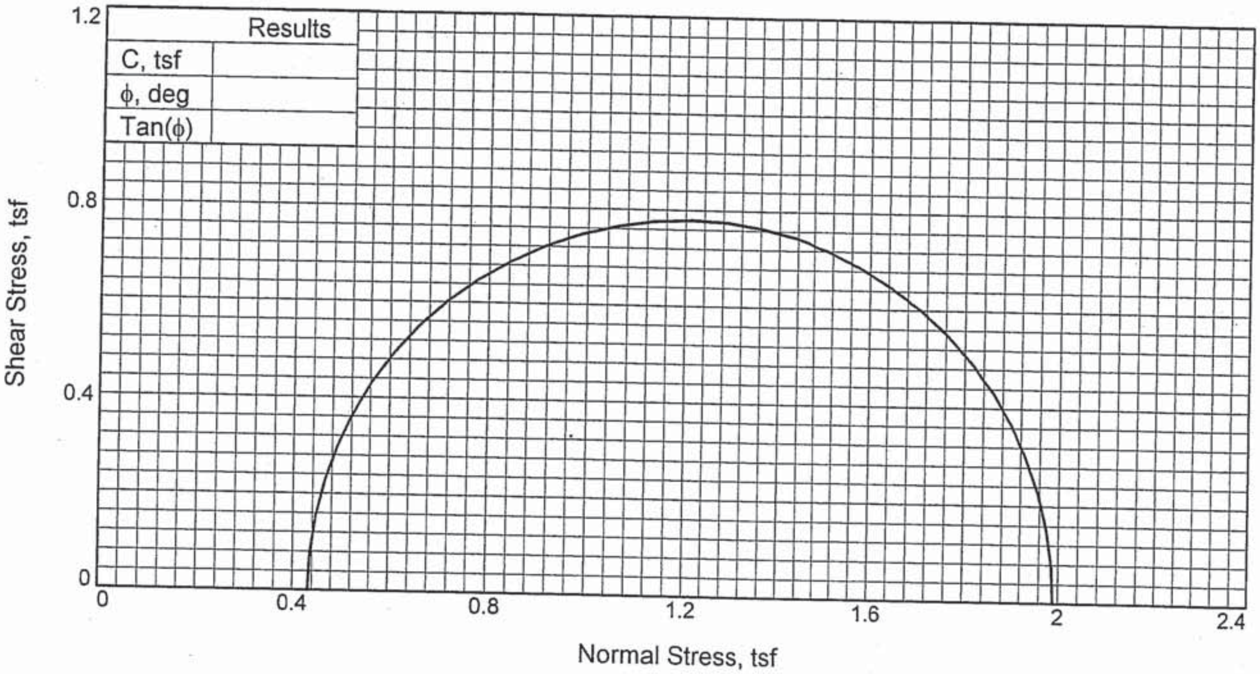
Source of Sample: B-85 **Depth:** 4

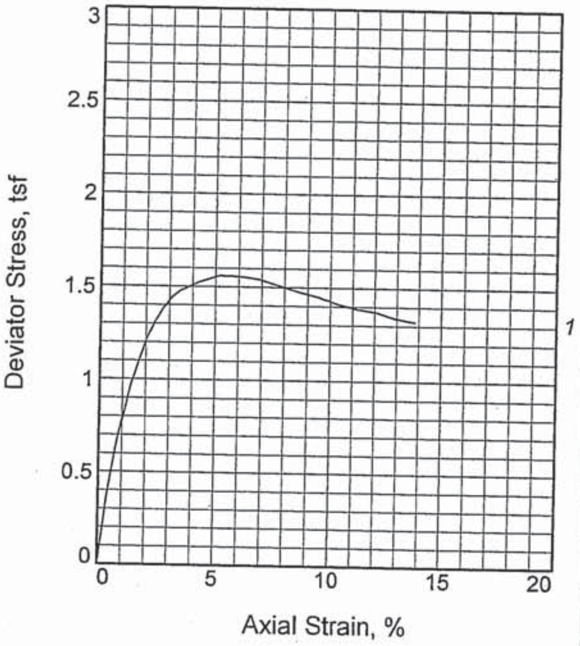
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: J. David **Checked By:** K. Kocher





Sample No.		1
Initial	Water Content,	36.1
	Dry Density, pcf	84.7
	Saturation,	99.1
	Void Ratio	0.9754
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	36.1
	Dry Density, pcf	84.7
	Saturation,	99.1
	Void Ratio	0.9754
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.43
Fail. Stress, tsf		1.56
Ult. Stress, tsf		1.56
σ_1 Failure, tsf		1.99
σ_3 Failure, tsf		0.43

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), gray-brown and brown, with traces of lignite and limonite

LL= 89 **PL=** 27 **PI=** 62

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-19

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

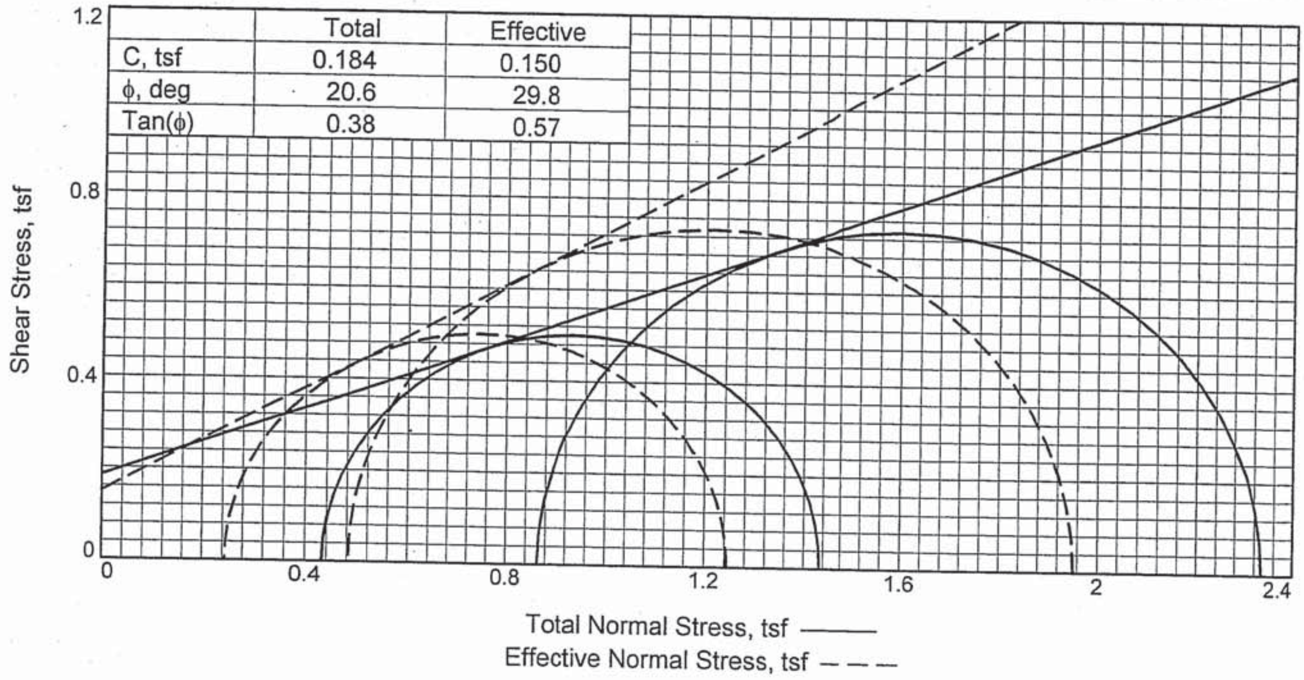
Source of Sample: B-87 **Depth:** 4

Sample Number: ST-2

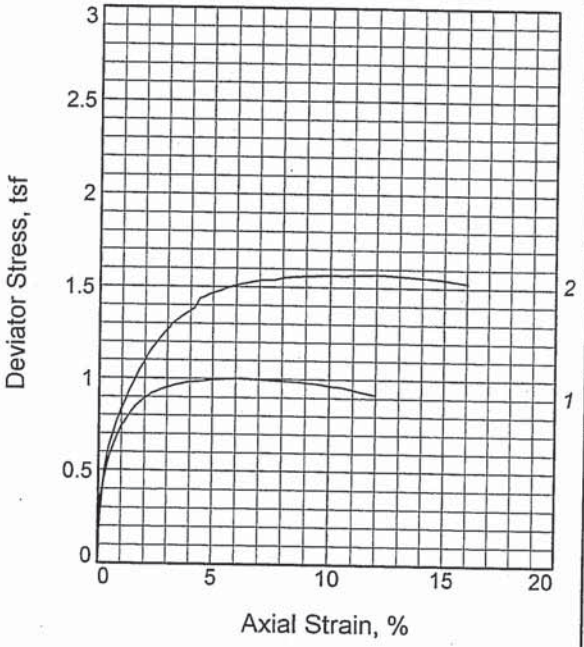
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: J. David **Checked By:** K. Kocher



	Total	Effective
C, tsf	0.184	0.150
ϕ, deg	20.6	29.8
Tan(ϕ)	0.38	0.57



Sample No.		1	2
Initial	Water Content,	33.2	30.5
	Dry Density, pcf	87.0	89.8
	Saturation,	96.4	94.7
	Void Ratio	0.9236	0.8637
	Diameter, in.	1.89	2.01
	Height, in.	3.97	4.01
At Test	Water Content,	35.4	34.0
	Dry Density, pcf	85.8	87.6
	Saturation,	100.0	100.0
	Void Ratio	0.9499	0.9100
	Diameter, in.	1.90	2.03
	Height, in.	3.99	4.04
Strain rate, %/min.		0.11	0.10
Eff. Cell Pressure, tsf		0.43	0.86
Fail. Stress, tsf		1.00	1.47
Total Pore Pr., tsf		4.87	5.06
Strain, %		5.6	5.2
Ult. Stress, tsf		1.00	1.57
Total Pore Pr., tsf		4.87	4.84
Strain, %		5.6	12.3
$\overline{\sigma}_1$ Failure, tsf		1.25	1.95
$\overline{\sigma}_3$ Failure, tsf		0.24	0.48

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: CLAY (CH), dark grayish brown, high plastic, with small pockets of very fine

LL= 75 **PL=** 51 **PI=** 24

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-20

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

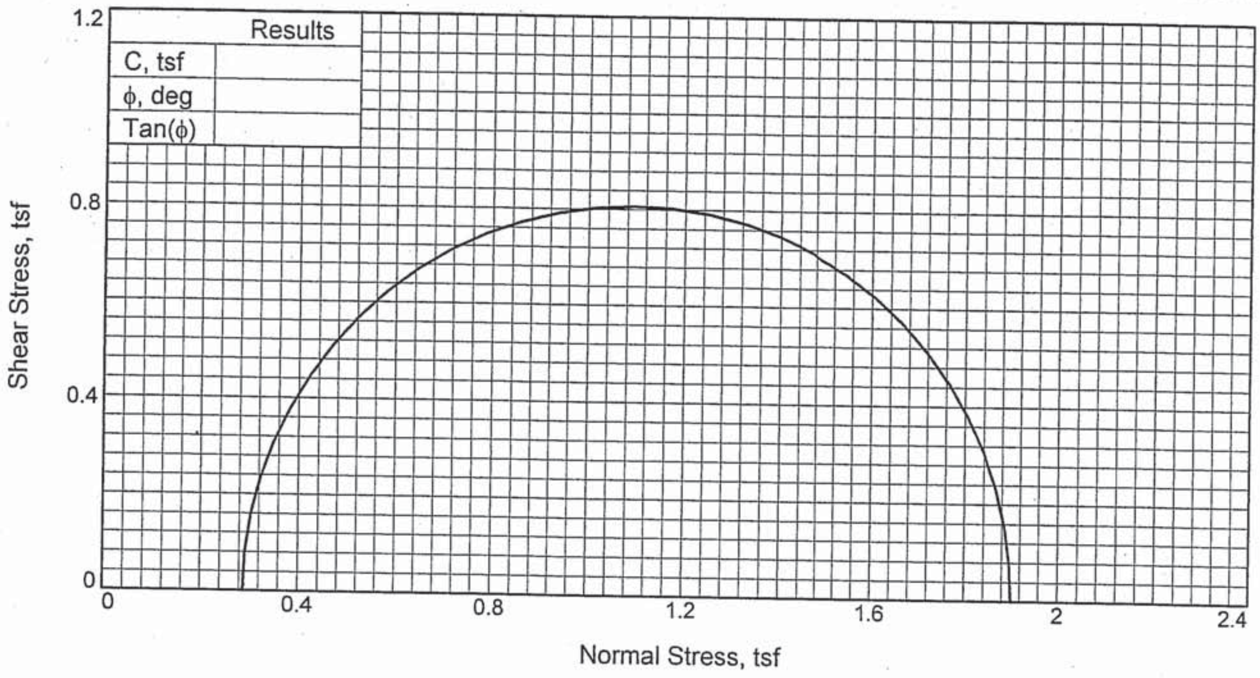
Source of Sample: B-88 **Depth:** 1.5

Sample Number: ST-1

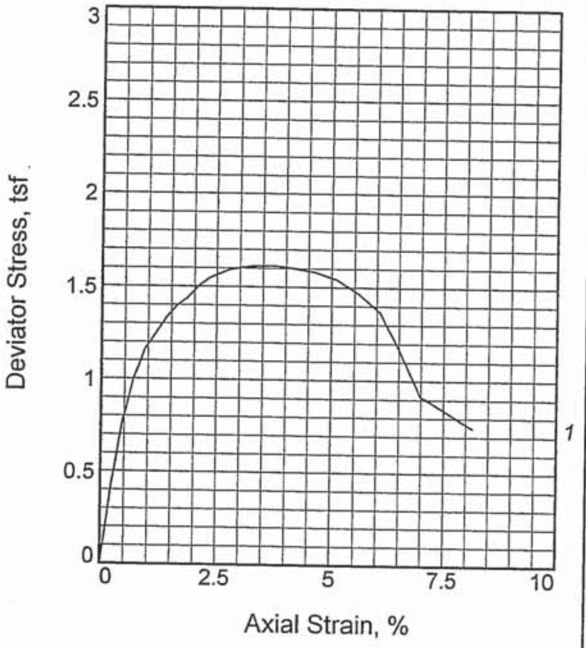
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Fouse



Results	
C, tsf	
ϕ, deg	
Tan(ϕ)	



Sample No.		1
Initial	Water Content,	36.4
	Dry Density, pcf	81.4
	Saturation,	92.5
	Void Ratio	1.0550
	Diameter, in.	2.00
	Height, in.	4.29
At Test	Water Content,	36.4
	Dry Density, pcf	81.4
	Saturation,	92.5
	Void Ratio	1.0550
	Diameter, in.	2.00
	Height, in.	4.29
Strain rate, %/min.		1.35
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.29
Fail. Stress, tsf		1.61
Ult. Stress, tsf		1.61
σ_1 Failure, tsf		1.90
σ_3 Failure, tsf		0.29

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CL), grayish brown, with limonite and calcium deposits

Assumed Specific Gravity= 2.68

Remarks:

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Source of Sample: B-90 **Depth:** 4

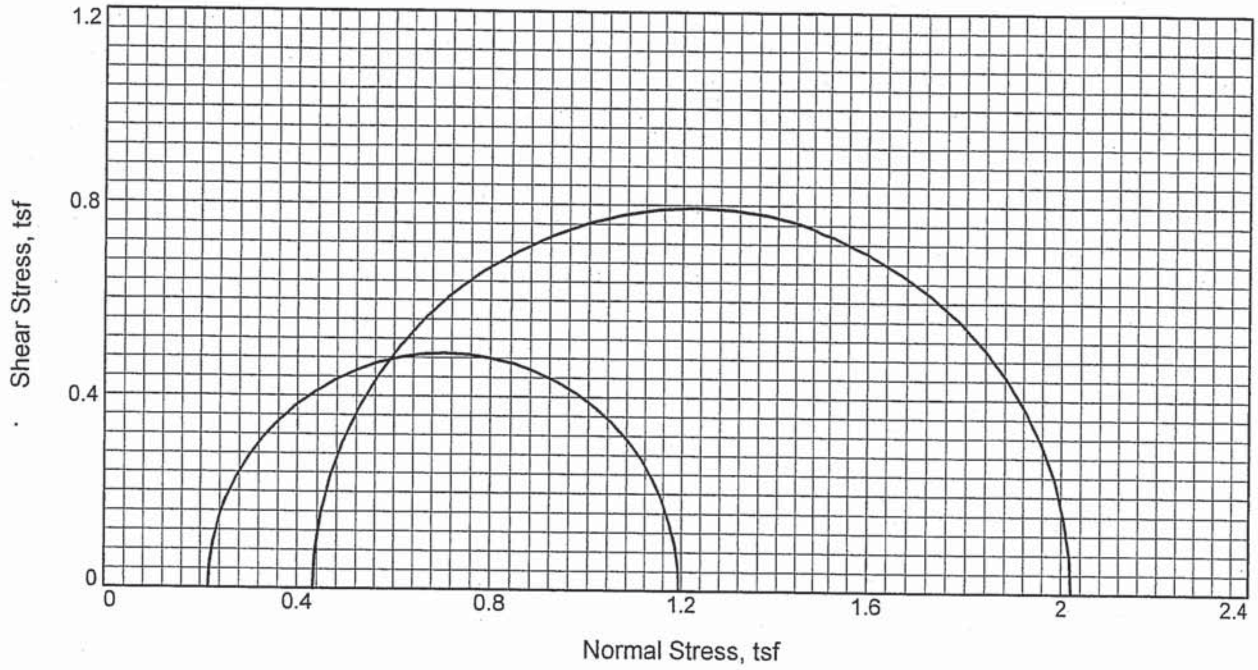
Sample Number: ST-2

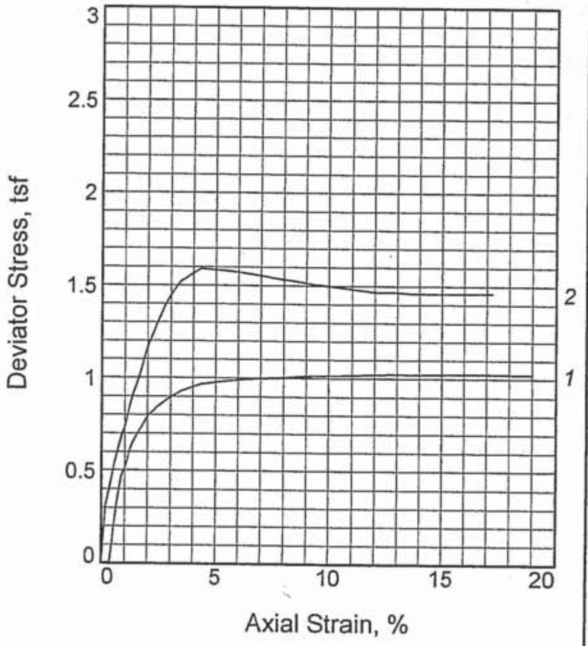
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure B2-21

Tested By: J. David **Checked By:** K. Kocher





	Sample No.	1	2
Initial	Water Content,	32.7	28.4
	Dry Density, pcf	83.8	90.9
	Saturation,	88.0	90.5
	Void Ratio	0.9967	0.8413
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
At Test	Water Content,	32.7	28.4
	Dry Density, pcf	83.8	90.9
	Saturation,	88.0	90.5
	Void Ratio	0.9967	0.8413
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
Strain rate, %/min.		1.43	1.43
Back Pressure, tsf		0.00	0.00
Cell Pressure, tsf		0.22	0.43
Fail. Stress, tsf		0.98	1.59
Ult. Stress, tsf		1.03	1.59
σ_1 Failure, tsf		1.19	2.02
σ_3 Failure, tsf		0.22	0.43

Type of Test:
Unconsolidated Undrained
Sample Type: Shelby Tube
Description: CLAY (CH), dark grayish brown, with traces of lignite and limonite

Assumed Specific Gravity= 2.68
Remarks:

Client: Ameren U.E.

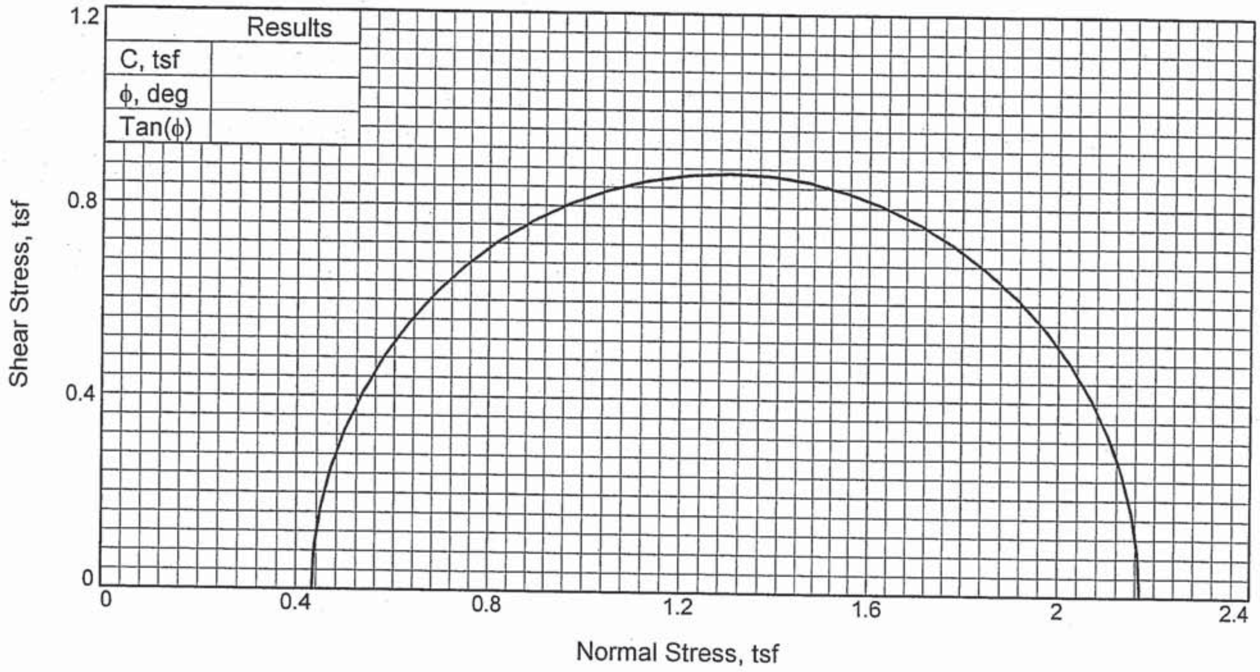
Project: Sioux Power Plant UWLF

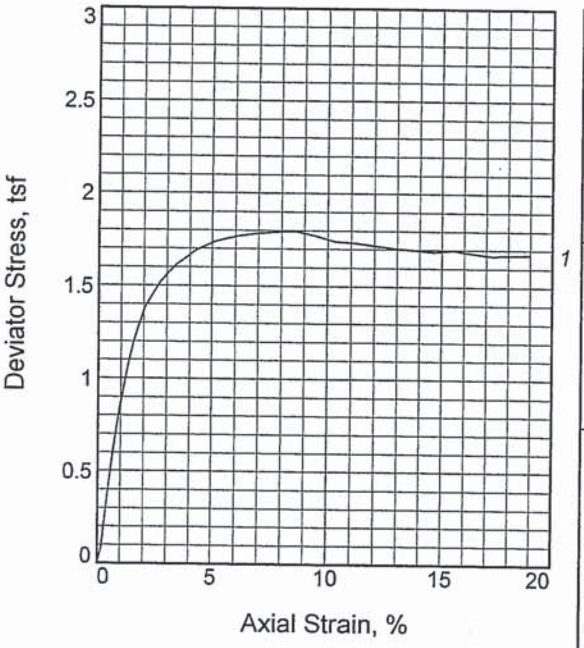
Source of Sample: B-91 **Depth:** 1.5
Sample Number: ST-1
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure B2-22

Tested By: R. Healey **Checked By:** K. Kocher





Sample No.		1
Initial	Water Content,	17.2
	Dry Density, pcf	80.3
	Saturation,	42.4
	Void Ratio	1.0831
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	17.2
	Dry Density, pcf	80.3
	Saturation,	42.4
	Void Ratio	1.0831
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.43
Fail. Stress, tsf		1.74
Ult. Stress, tsf		1.80
σ_1 Failure, tsf		2.17
σ_3 Failure, tsf		0.43

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: SILT (ML), light grayish tan, soft, fragile, horizonal laminations

LL= 31 **PL=** 28 **PI=** 3

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-23

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

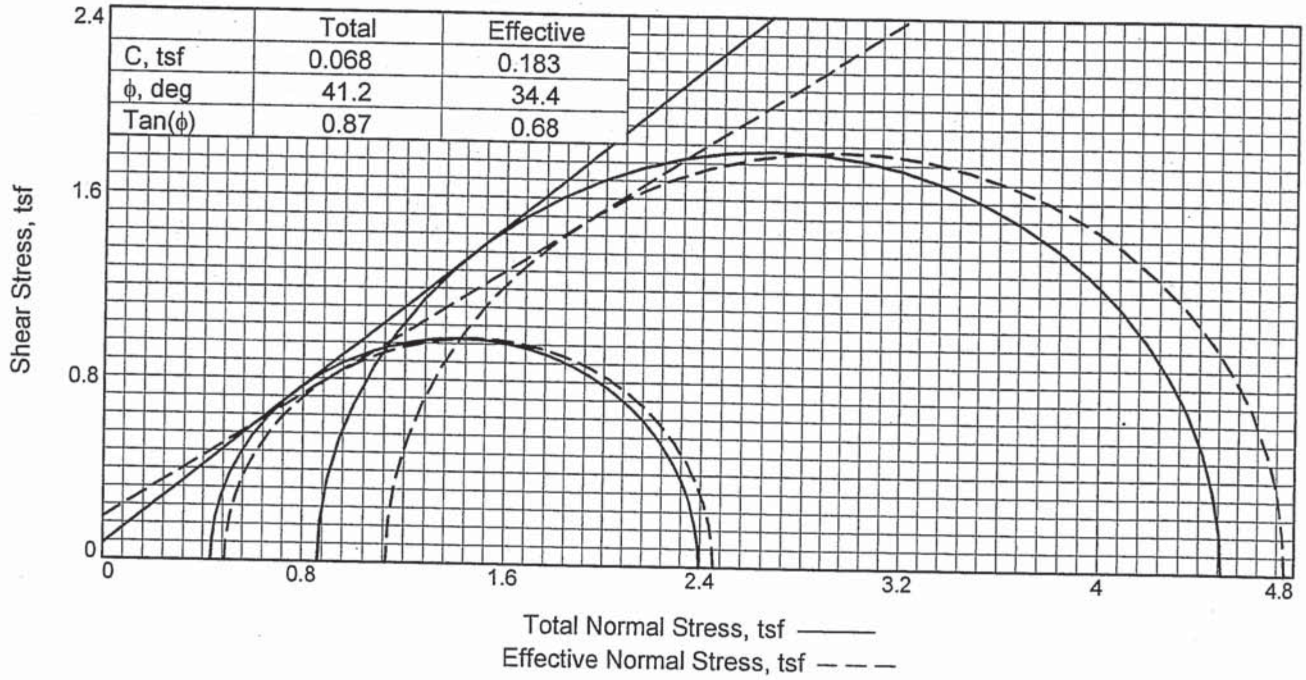
Source of Sample: B-96 **Depth:** 4

Sample Number: ST-2

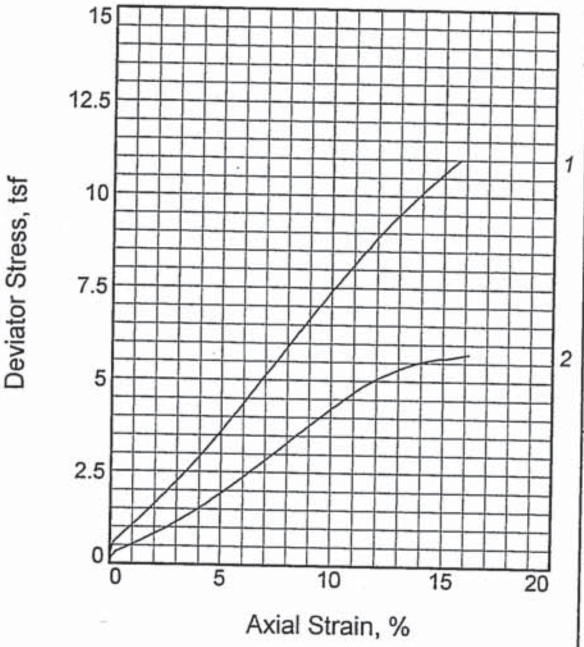
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: R. Healey **Checked By:** K. Kocher



	Total	Effective
C, tsf	0.068	0.183
ϕ, deg	41.2	34.4
Tan(ϕ)	0.87	0.68



Sample No.		1	2
Initial	Water Content,	25.7	29.8
	Dry Density, pcf	91.5	88.0
	Saturation,	83.1	88.6
	Void Ratio	0.8276	0.9011
	Diameter, in.	2.01	2.00
	Height, in.	4.15	4.28
At Test	Water Content,	31.2	33.6
	Dry Density, pcf	91.1	88.0
	Saturation,	100.0	100.0
	Void Ratio	0.8369	0.9011
	Diameter, in.	2.01	2.00
	Height, in.	4.16	4.28
Strain rate, %/min.		0.04	0.50
Back Pressure, tsf		4.32	4.68
Cell Pressure, tsf		5.18	5.11
Fail. Stress, tsf		3.63	1.96
Total Pore Pr., tsf		4.05	4.62
Ult. Stress, tsf		10.99	5.74
Total Pore Pr., tsf		1.52	3.20
$\overline{\sigma}_1$ Failure, tsf		4.76	2.45
$\overline{\sigma}_3$ Failure, tsf		1.13	0.49

Type of Test:
CU with Pore Pressures

Sample Type: Sheby Tube

Description: SILT / Silty SAND (ML-SP), light brown

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-24

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

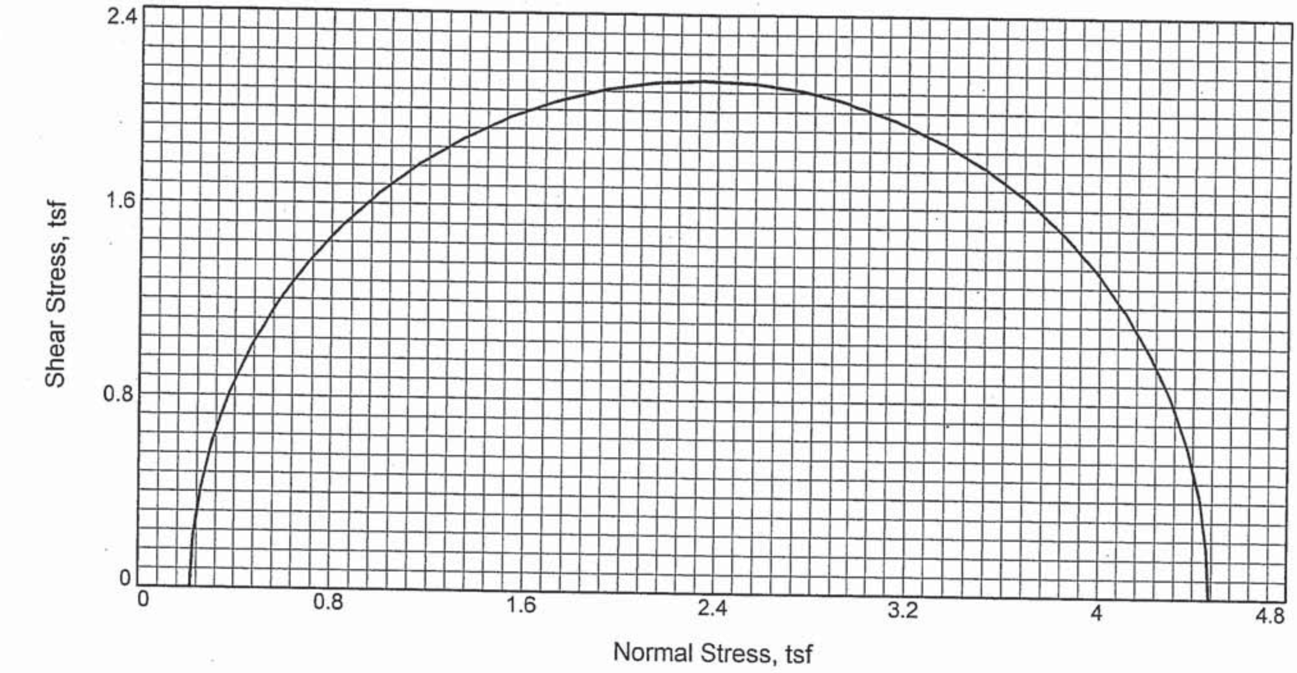
Source of Sample: B-99 **Depth:** 6.5

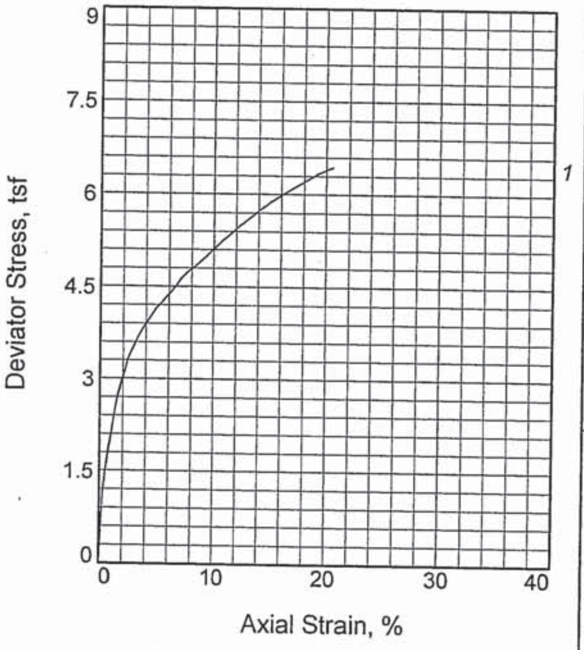
Sample Number: ST-3

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Fouse





Sample No.		1
Initial	Water Content,	11.0
	Dry Density, pcf	88.9
	Saturation,	33.6
	Void Ratio	0.8814
	Diameter, in.	2.00
	Height, in.	3.65
At Test	Water Content,	11.0
	Dry Density, pcf	88.9
	Saturation,	33.6
	Void Ratio	0.8814
	Diameter, in.	2.00
	Height, in.	3.65
Strain rate, %/min.		1.35
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.22
Fail. Stress, tsf		4.25
Ult. Stress, tsf		6.44
σ_1 Failure, tsf		4.47
σ_3 Failure, tsf		0.22

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: SILT (ML), tan, with fine-grain sand, laminated

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-25

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

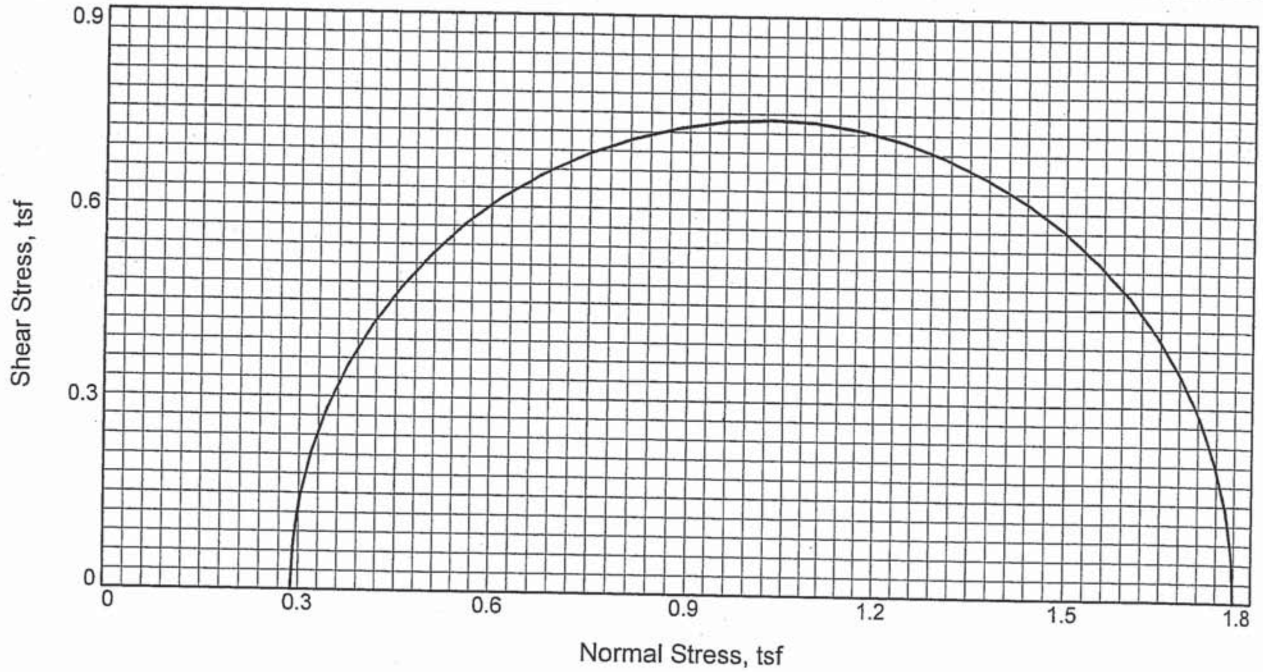
Source of Sample: B-101 **Depth:** 4

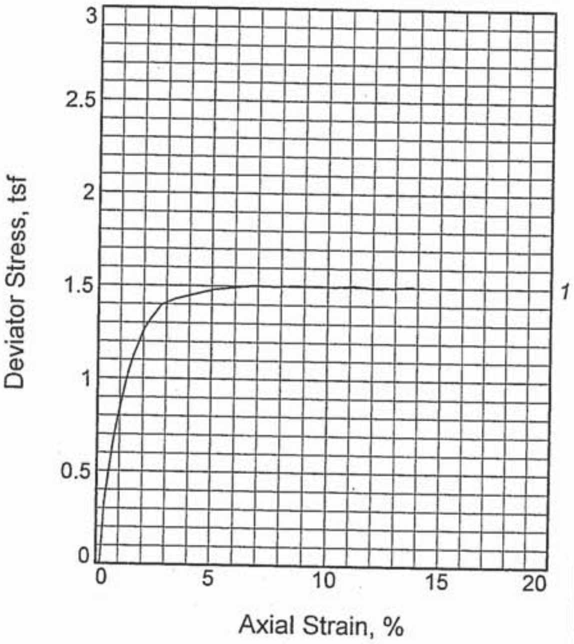
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: J. David **Checked By:** K. Kocher





	Sample No.	1
Initial	Water Content,	33.8
	Dry Density, pcf	73.4
	Saturation,	70.9
	Void Ratio	1.2781
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	33.8
	Dry Density, pcf	73.4
	Saturation,	70.9
	Void Ratio	1.2781
	Diameter, in.	2.85
	Height, in.	5.80
	Strain rate, %/min.	1.43
	Back Pressure, tsf	0.00
	Cell Pressure, tsf	0.29
	Fail. Stress, tsf	1.48
	Ult. Stress, tsf	1.51
	σ_1 Failure, tsf	1.77
	σ_3 Failure, tsf	0.29

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark brown, with silt seams

LL= 75 **PL=** 26 **PI=** 49

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-26

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

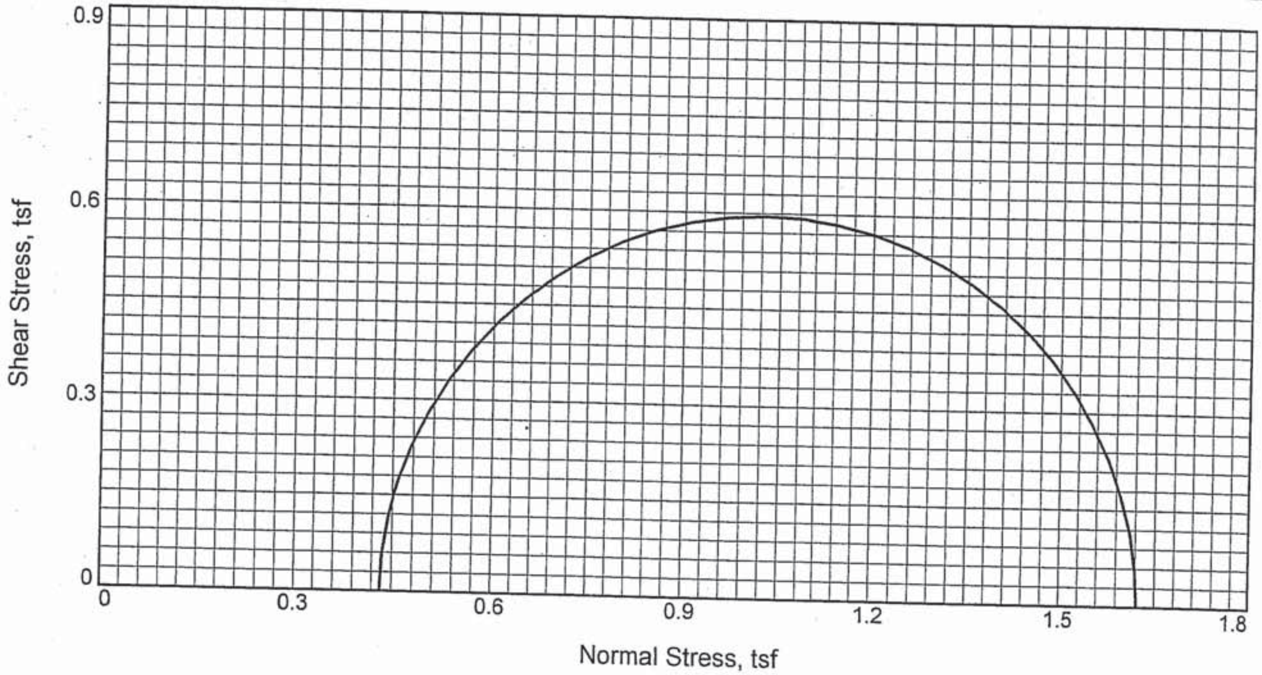
Source of Sample: B-103 **Depth:** 4

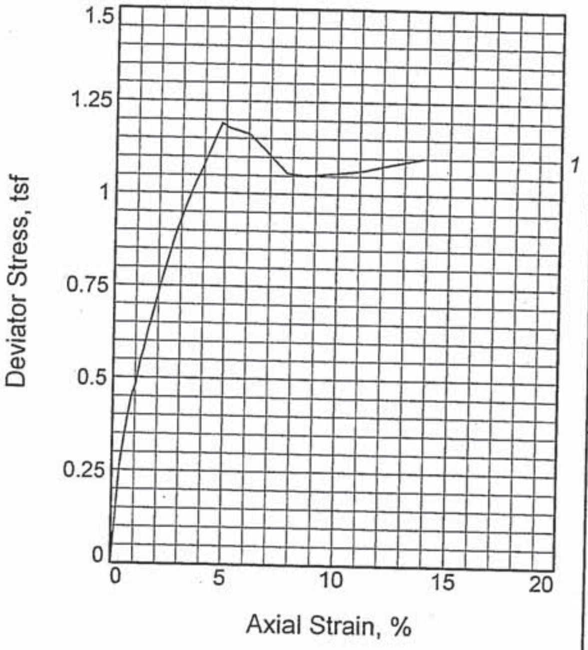
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: R. Healey **Checked By:** K. Kocher





Sample No.		1
Initial	Water Content,	26.6
	Dry Density, pcf	89.2
	Saturation,	81.4
	Void Ratio	0.8748
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	26.6
	Dry Density, pcf	89.2
	Saturation,	81.4
	Void Ratio	0.8748
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.43
Fail. Stress, tsf		1.19
Ult. Stress, tsf		
σ_1 Failure, tsf		1.62
σ_3 Failure, tsf		0.43

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: Silty CLAY/Clayey SILT (ML-CL), dark brown to light brown (swirls and laminations)

Assumed Specific Gravity= 2.68

Remarks:

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Source of Sample: B-103 **Depth:** 5.25

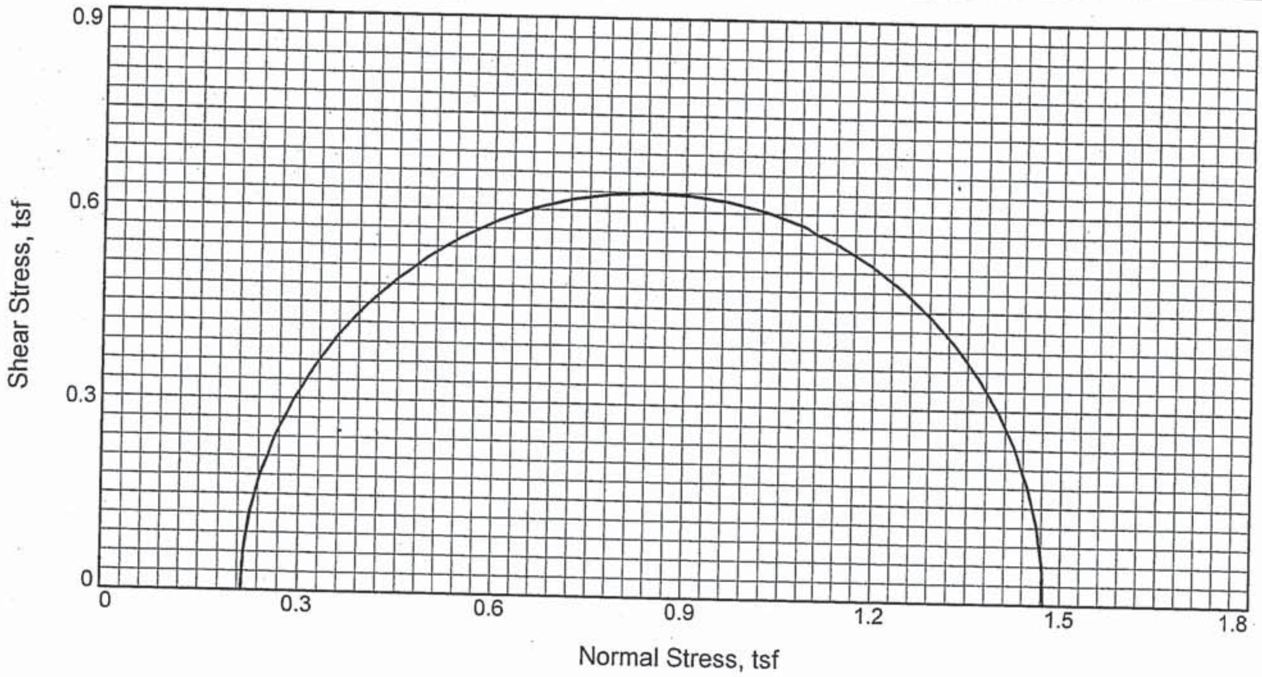
Sample Number: ST-2

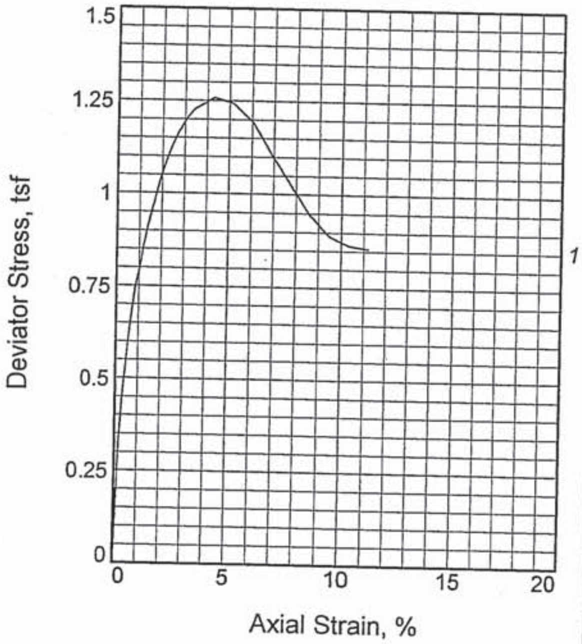
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure B2-27

Tested By: R. Healey **Checked By:** K. Kocher





Sample No.		1
Initial	Water Content,	32.6
	Dry Density, pcf	86.9
	Saturation,	94.5
	Void Ratio	0.9254
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	32.6
	Dry Density, pcf	86.9
	Saturation,	94.5
	Void Ratio	0.9254
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.22
Fail. Stress, tsf		1.26
Ult. Stress, tsf		1.26
σ_1 Failure, tsf		1.47
σ_3 Failure, tsf		0.22

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark brown, with 1/8" silt lense near bottom of sample

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-28

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

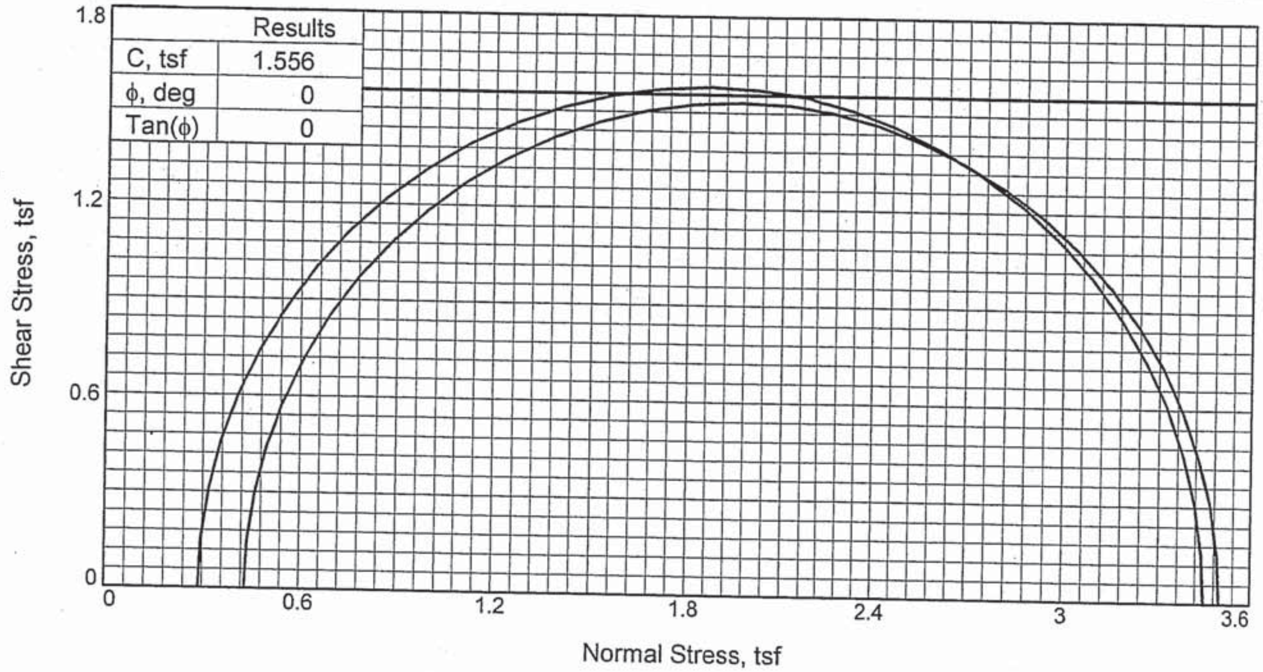
Source of Sample: B-104 **Depth:** 1.5

Sample Number: ST-1

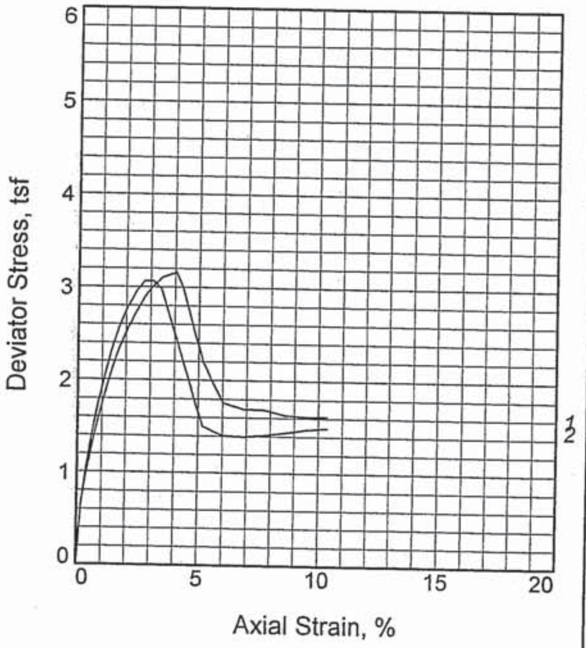
Proj. No.: 2005012477 **Date:**

RJ REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: R. Healey **Checked By:** K. Kocher



	Results
C, tsf	1.556
ϕ, deg	0
Tan(ϕ)	0



Sample No.		1	2
Initial	Water Content,	30.2	30.7
	Dry Density, pcf	91.2	90.0
	Saturation,	97.1	95.9
	Void Ratio	0.8345	0.8588
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
At Test	Water Content,	30.2	30.7
	Dry Density, pcf	91.2	90.0
	Saturation,	97.1	95.9
	Void Ratio	0.8345	0.8588
	Diameter, in.	2.85	2.85
	Height, in.	5.80	5.80
Strain rate, %/min.		1.43	1.43
Back Pressure, tsf		0.00	0.00
Cell Pressure, tsf		0.29	0.43
Fail. Stress, tsf		3.16	3.06
Ult. Stress, tsf		3.16	3.06
σ_1 Failure, tsf		3.45	3.50
σ_3 Failure, tsf		0.29	0.43

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), gray-brown, with pockets of silt, traces of lignite, blocky, mottled,

LL= 87 **PL=** 26 **PI=** 61

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-29

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

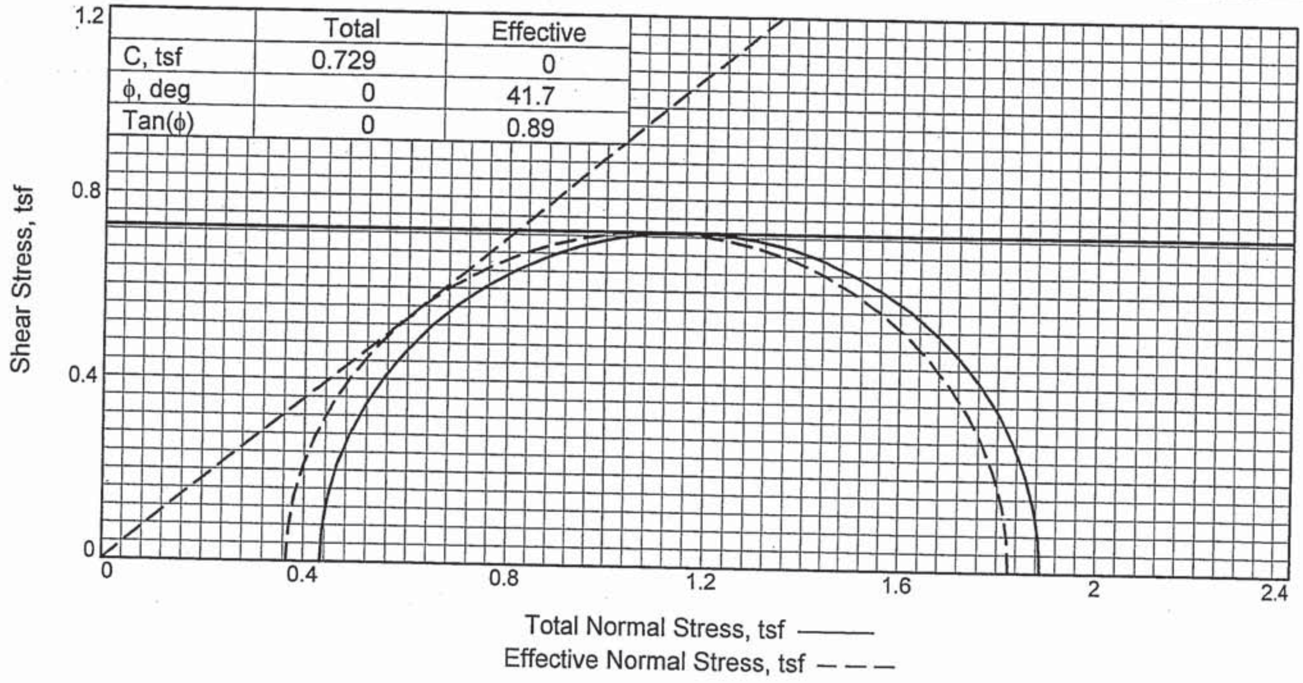
Source of Sample: B-105 **Depth:** 4

Sample Number: ST-2

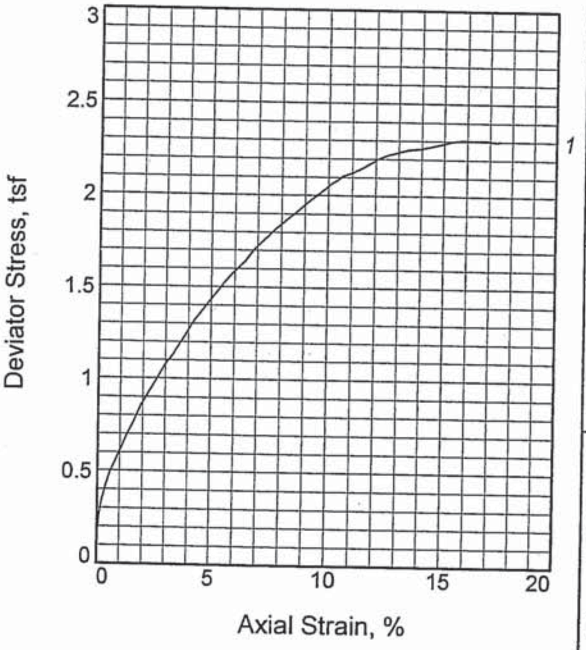
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: J. David **Checked By:** K. Kocher



	Total	Effective
C, tsf	0.729	0
ϕ, deg	0	41.7
Tan(ϕ)	0	0.89



Sample No.		1
Initial	Water Content,	32.4
	Dry Density, pcf	86.4
	Saturation,	92.7
	Void Ratio	0.9364
	Diameter, in.	2.00
	Height, in.	4.49
At Test	Water Content,	35.2
	Dry Density, pcf	86.1
	Saturation,	100.0
	Void Ratio	0.9429
	Diameter, in.	2.00
	Height, in.	4.49
Strain rate, %/min.		0.29
Back Pressure, tsf		4.68
Cell Pressure, tsf		5.11
Fail. Stress, tsf		1.46
Total Pore Pr., tsf		4.74
Ult. Stress, tsf		2.30
Total Pore Pr., tsf		4.36
$\overline{\sigma}_1$ Failure, tsf		1.82
$\overline{\sigma}_3$ Failure, tsf		0.37

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Silty CLAY / Clayey SILT (CL-ML), gray-brown, stiff, moist, with lignite and traces of limonite

Assumed Specific Gravity= 2.68

Remarks:

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Source of Sample: B-105 **Depth:** 11

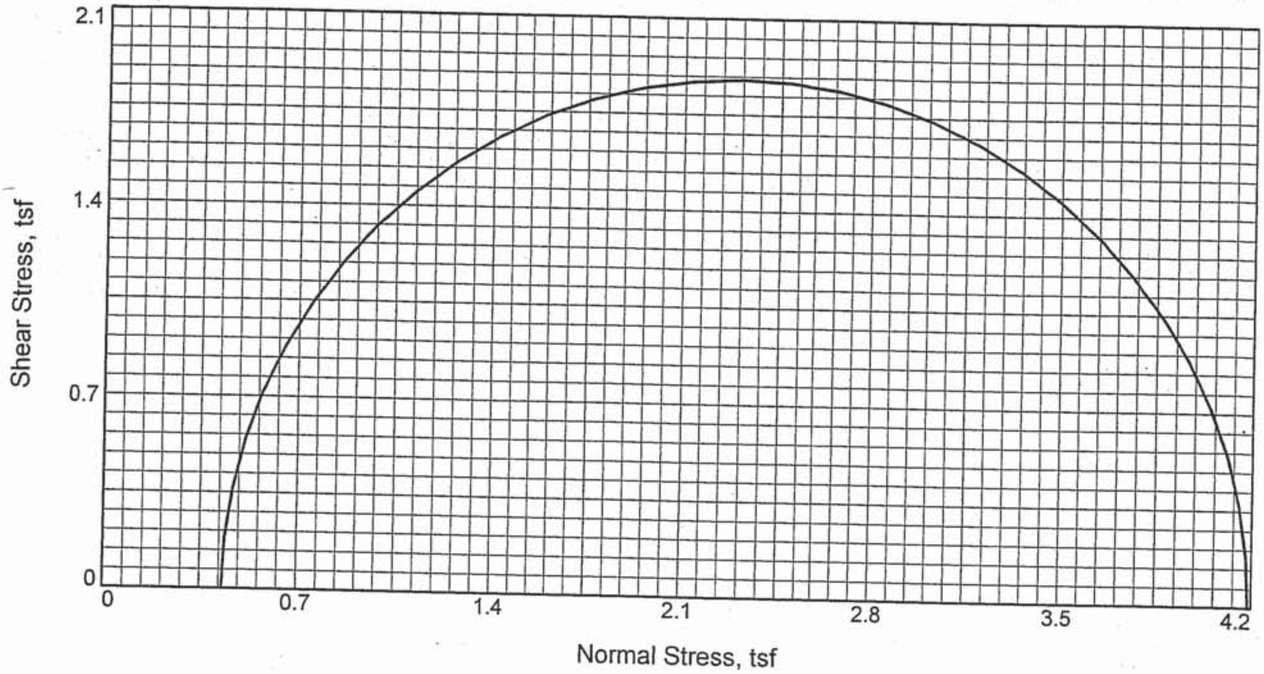
Sample Number: ST-5

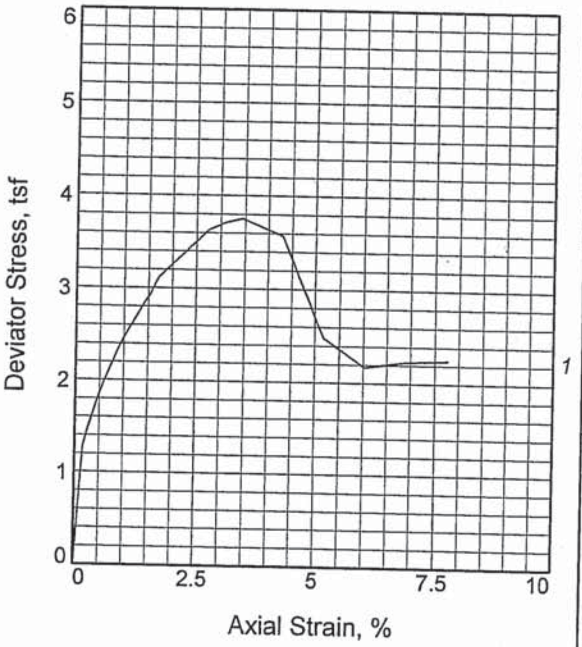
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure B2-30

Tested By: J. David **Checked By:** K. Kocher





	Sample No.	1
Initial	Water Content,	26.8
	Dry Density, pcf	95.0
	Saturation,	94.2
	Void Ratio	0.7620
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	26.8
	Dry Density, pcf	95.0
	Saturation,	94.2
	Void Ratio	0.7620
	Diameter, in.	2.85
	Height, in.	5.80
	Strain rate, %/min.	1.43
	Back Pressure, tsf	0.00
	Cell Pressure, tsf	0.43
	Fail. Stress, tsf	3.76
	Ult. Stress, tsf	3.76
	σ_1 Failure, tsf	4.19
	σ_3 Failure, tsf	0.43

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark grayish brown, with traces of lignite, limonite, pockets of silt,

LL= 88 **PL=** 25 **PI=** 63

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-31

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

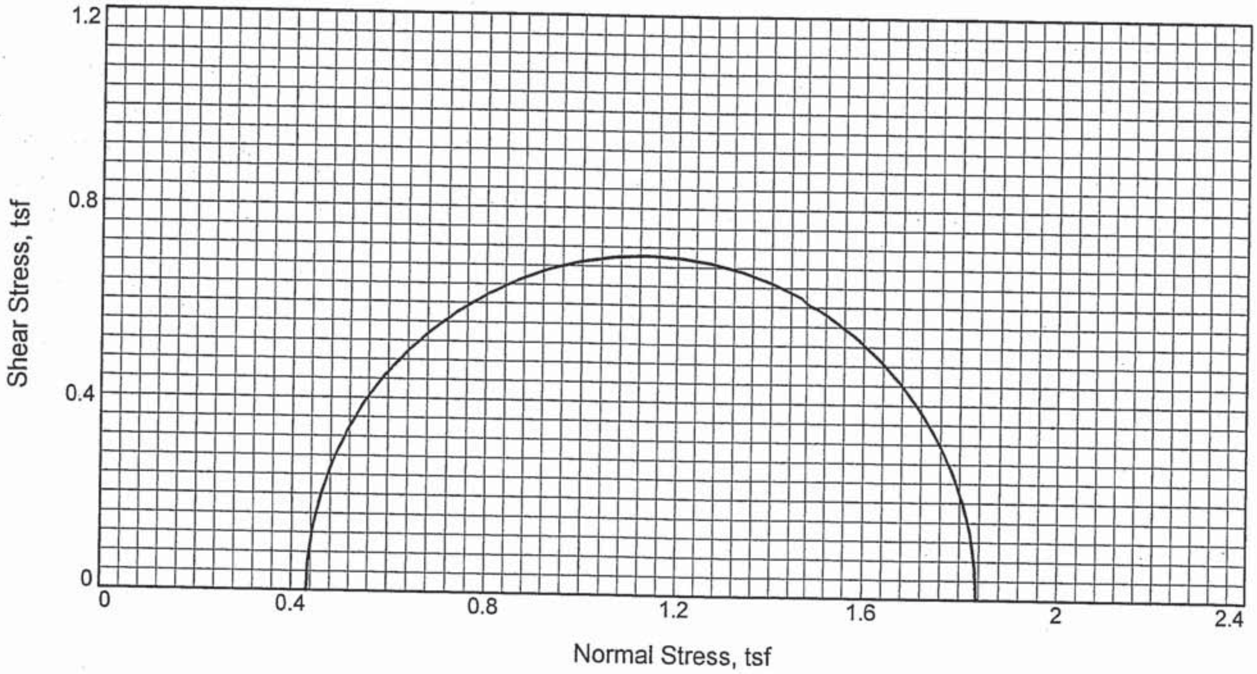
Source of Sample: B-106 **Depth:** 4

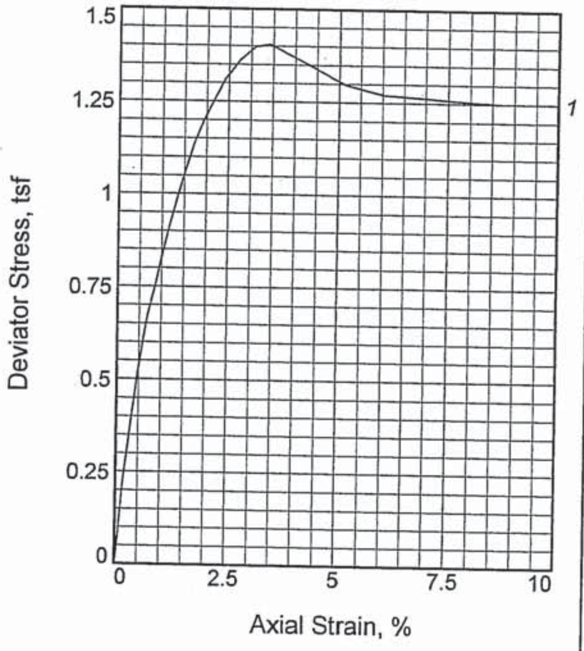
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: R. Healey **Checked By:** K. Kocher





Sample No.		1
Initial	Water Content,	42.2
	Dry Density, pcf	80.7
	Saturation,	105.4
	Void Ratio	1.0735
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	42.2
	Dry Density, pcf	80.7
	Saturation,	105.4
	Void Ratio	1.0735
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.43
Fail. Stress, tsf		1.40
Ult. Stress, tsf		1.40
σ_1 Failure, tsf		1.84
σ_3 Failure, tsf		0.43

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark brown, with silty clay bottom of sample

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-32

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

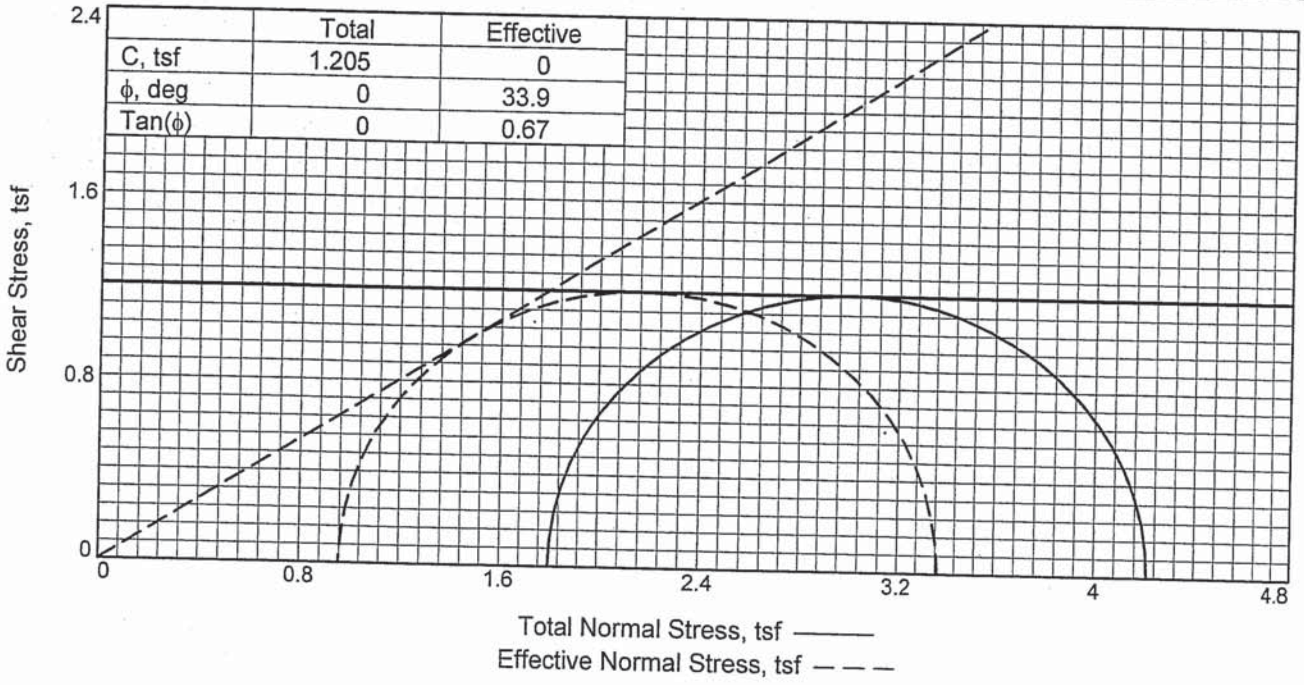
Source of Sample: B-109 **Depth:** 4

Sample Number: ST-2

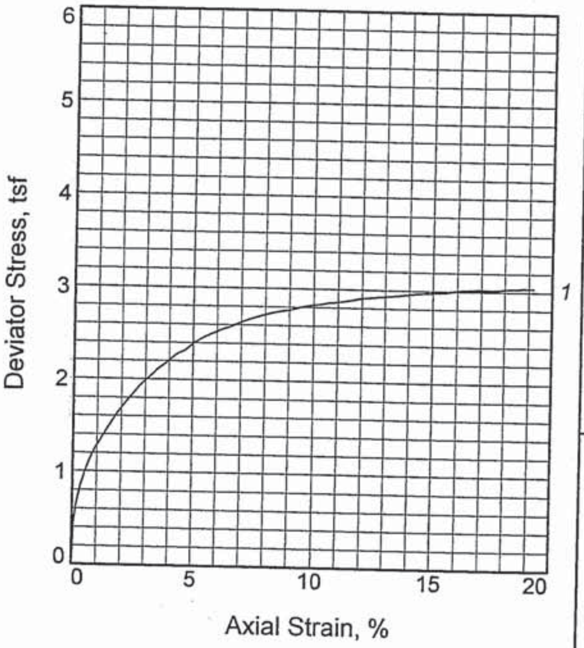
Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Fouse



	Total	Effective
C, tsf	1.205	0
φ, deg	0	33.9
Tan(φ)	0	0.67



Sample No.		1
Initial	Water Content,	26.6
	Dry Density, pcf	93.0
	Saturation,	89.3
	Void Ratio	0.7996
	Diameter, in.	2.83
	Height, in.	5.81
At Test	Water Content,	26.7
	Dry Density, pcf	97.5
	Saturation,	100.0
	Void Ratio	0.7168
	Diameter, in.	2.79
	Height, in.	5.72
Strain rate, %/min.		0.31
Eff. Cell Pressure, tsf		1.80
Fail. Stress, tsf		2.41
Total Pore Pr., tsf		4.08
Strain, %		5.1
Ult. Stress, tsf		3.04
Total Pore Pr., tsf		3.66
Strain, %		19.2
$\bar{\sigma}_1$ Failure, tsf		3.37
$\bar{\sigma}_3$ Failure, tsf		0.96

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: Top 4" clayey SILT, Bottom 1.8" silty CLAY

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-33

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

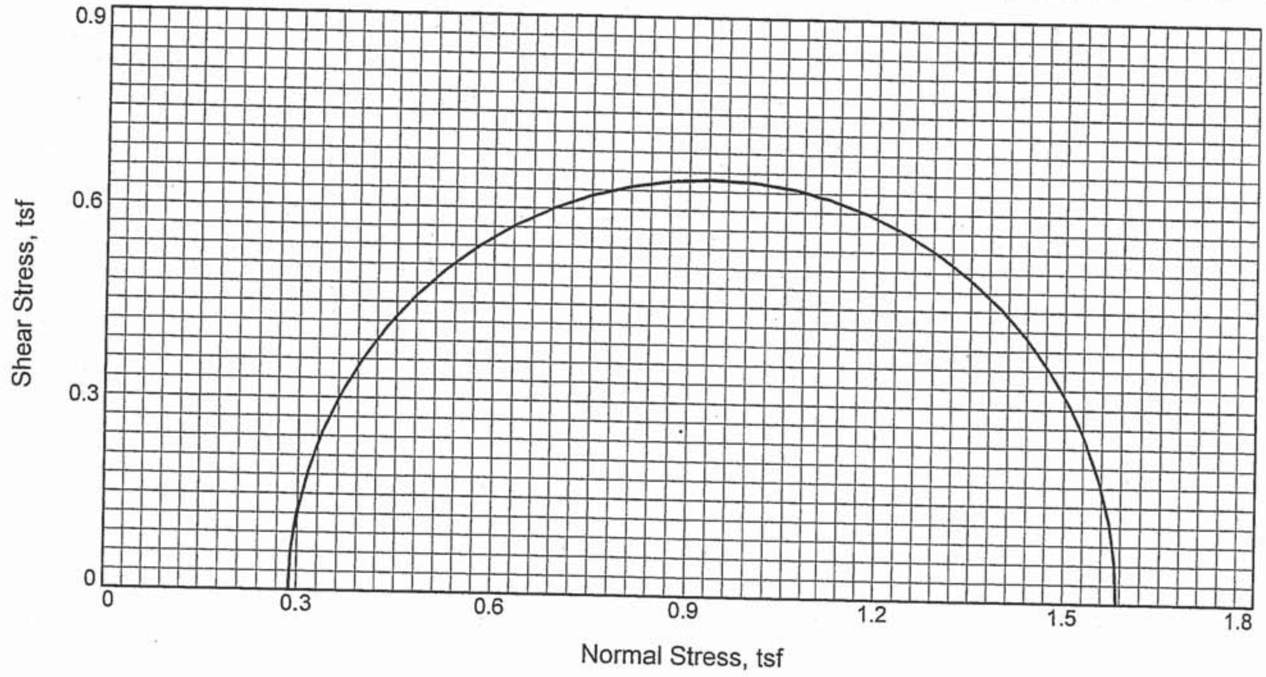
Source of Sample: B-109 **Depth:** 4

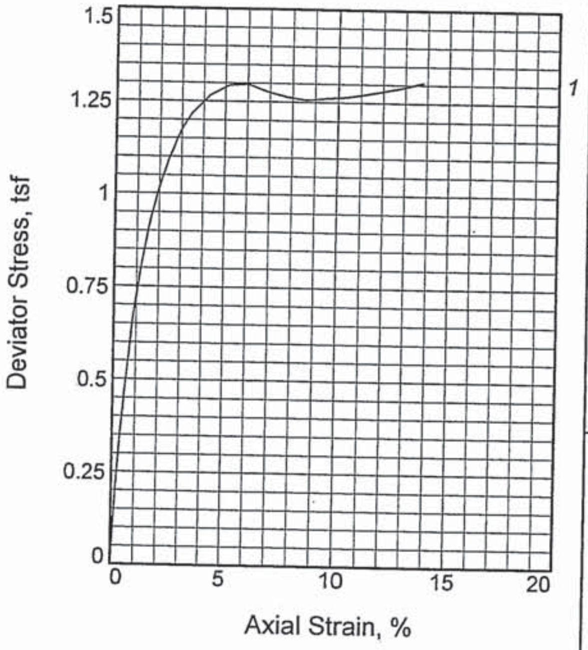
Sample Number: ST-2

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher **Checked By:** J. Fouse





	Sample No.	1
Initial	Water Content,	26.5
	Dry Density, pcf	92.4
	Saturation,	87.5
	Void Ratio	0.8112
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	26.5
	Dry Density, pcf	92.4
	Saturation,	87.5
	Void Ratio	0.8112
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.29
Fail. Stress, tsf		1.30
Ult. Stress, tsf		1.31
σ_1 Failure, tsf		1.59
σ_3 Failure, tsf		0.29

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), grayish brown, with traces of silt and fine-grain sand pockets

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-34

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

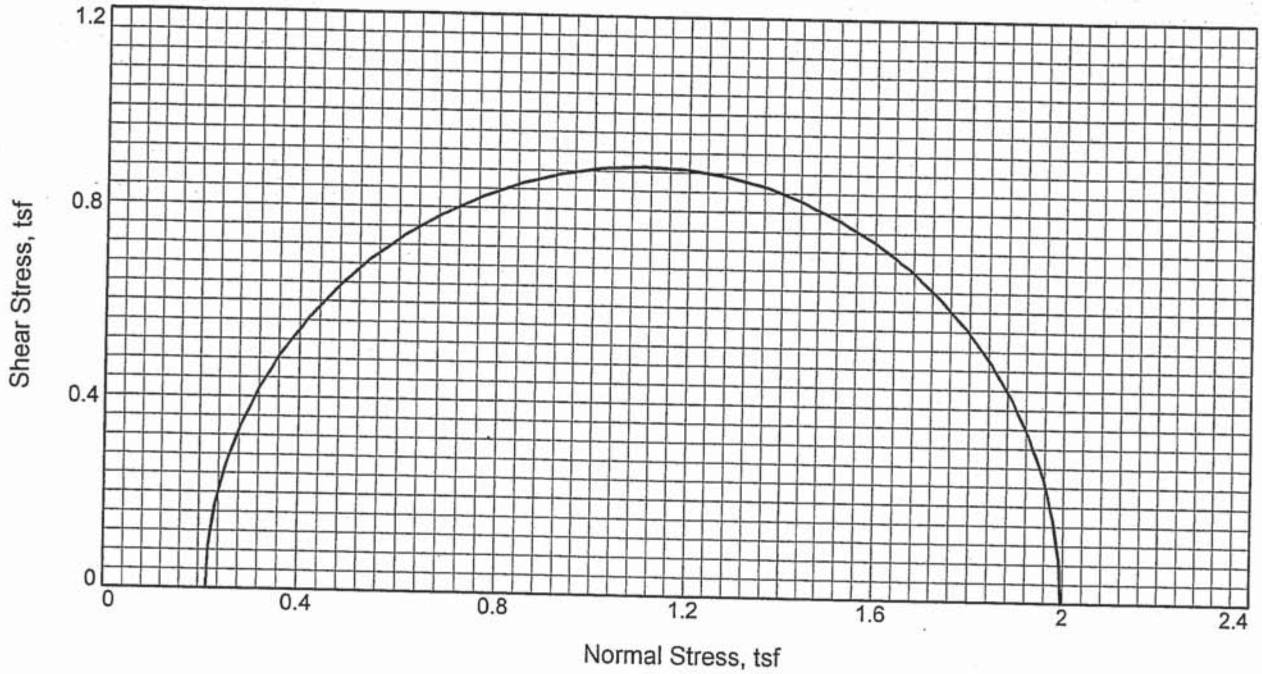
Source of Sample: B-110 **Depth:** 1.5

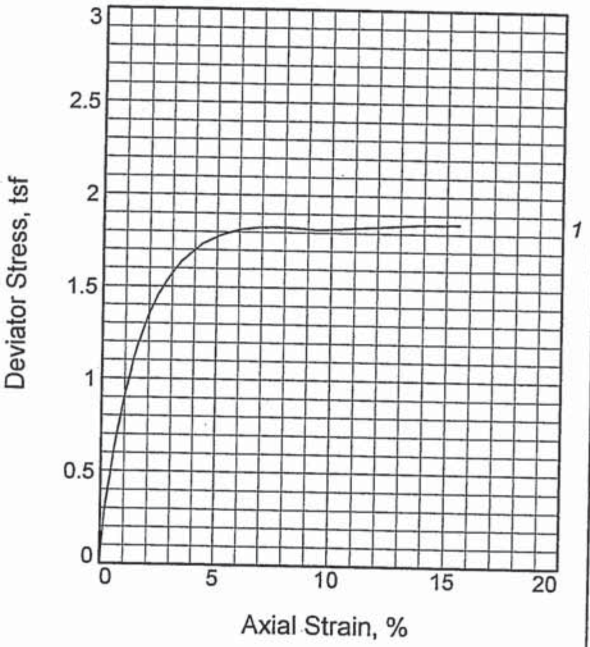
Sample Number: ST-1

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: J. David **Checked By:** K. Kocher





Sample No.		1
Initial	Water Content,	33.6
	Dry Density, pcf	88.3
	Saturation,	100.9
	Void Ratio	0.8939
	Diameter, in.	2.85
	Height, in.	5.80
At Test	Water Content,	33.6
	Dry Density, pcf	88.3
	Saturation,	100.9
	Void Ratio	0.8939
	Diameter, in.	2.85
	Height, in.	5.80
Strain rate, %/min.		1.43
Back Pressure, tsf		0.00
Cell Pressure, tsf		0.22
Fail. Stress, tsf		1.78
Ult. Stress, tsf		1.85
σ_1 Failure, tsf		2.00
σ_3 Failure, tsf		0.22

Type of Test:
Unconsolidated Undrained

Sample Type: Shelby Tube

Description: CLAY (CH), dark brownish gray, with lignite and traces of limonite

LL= 91 **PL=** 25 **PI=** 66

Assumed Specific Gravity= 2.68

Remarks:

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Source of Sample: B-112 **Depth:** 1.5

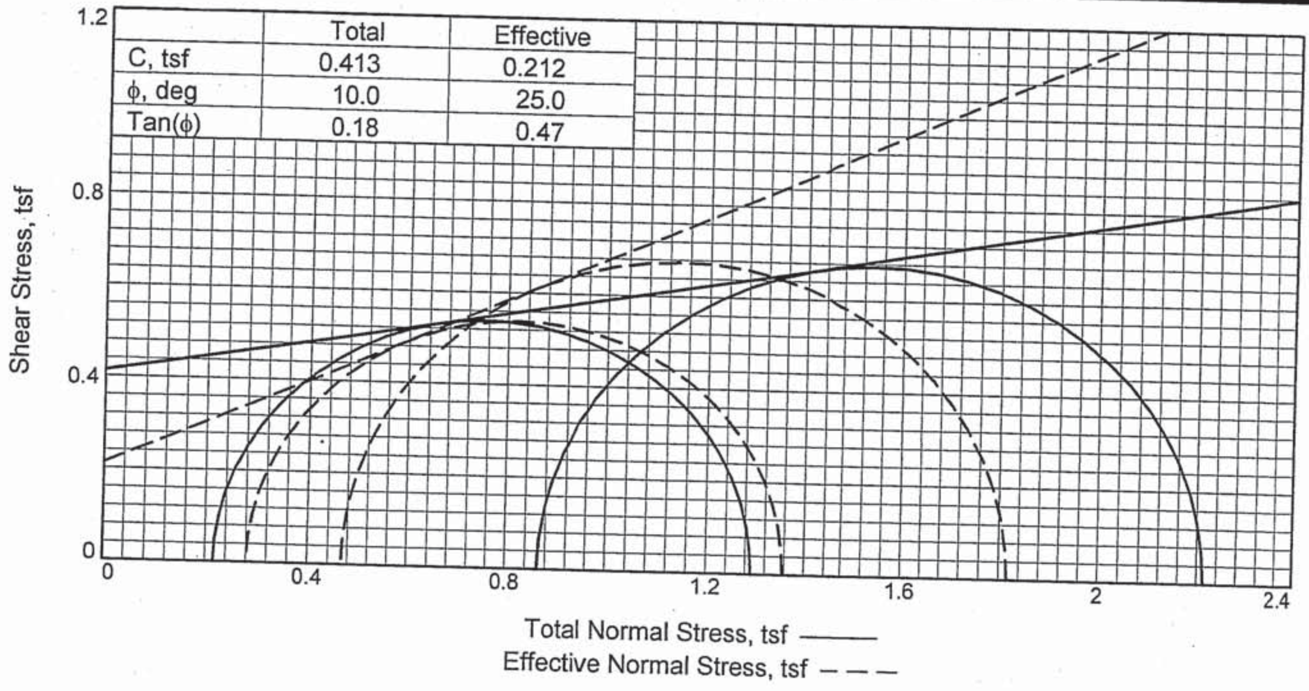
Sample Number: ST-1

Proj. No.: 2005012477 **Date:**

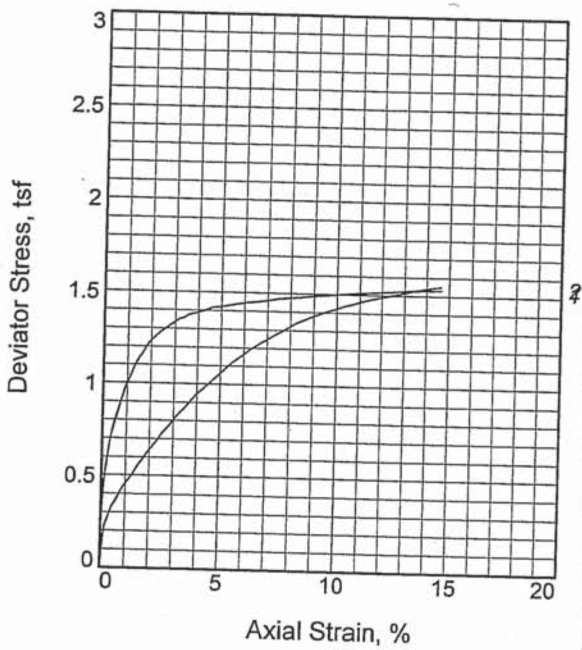
REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure B2-35

Tested By: R. Healey **Checked By:** K. Kocher



	Total	Effective
C, tsf	0.413	0.212
ϕ, deg	10.0	25.0
Tan(ϕ)	0.18	0.47



	Sample No.	1	2
Initial	Water Content,	29.9	27.9
	Dry Density, pcf	89.5	93.8
	Saturation,	92.2	95.5
	Void Ratio	0.8694	0.7840
	Diameter, in.	2.00	1.98
	Height, in.	4.13	4.17
At Test	Water Content,	30.9	28.5
	Dry Density, pcf	91.5	94.8
	Saturation,	100.0	100.0
	Void Ratio	0.8275	0.7648
	Diameter, in.	1.98	1.98
	Height, in.	4.10	4.15
	Strain rate, %/min.	0.06	0.27
	Eff. Cell Pressure, tsf	0.86	0.22
	Fail. Stress, tsf	1.35	1.08
	Total Pore Pr., tsf	5.08	4.62
	Strain, %	3.2	5.1
	Ult. Stress, tsf	1.53	1.55
	Total Pore Pr., tsf	5.00	4.38
	Strain, %	14.6	14.6
	$\bar{\sigma}_1$ Failure, tsf	1.82	1.36
	$\bar{\sigma}_3$ Failure, tsf	0.47	0.28

Type of Test:
CU with Pore Pressures

Sample Type: Shelby Tube

Description: CLAY (CL), brown, very silty

LL= 42 **PL=** 26 **PI=** 16

Assumed Specific Gravity= 2.68

Remarks:

Figure B2-36

Client: Ameren U.E.

Project: Sioux Power Plant UWLF

Source of Sample: B-113 **Depth:** 1.5

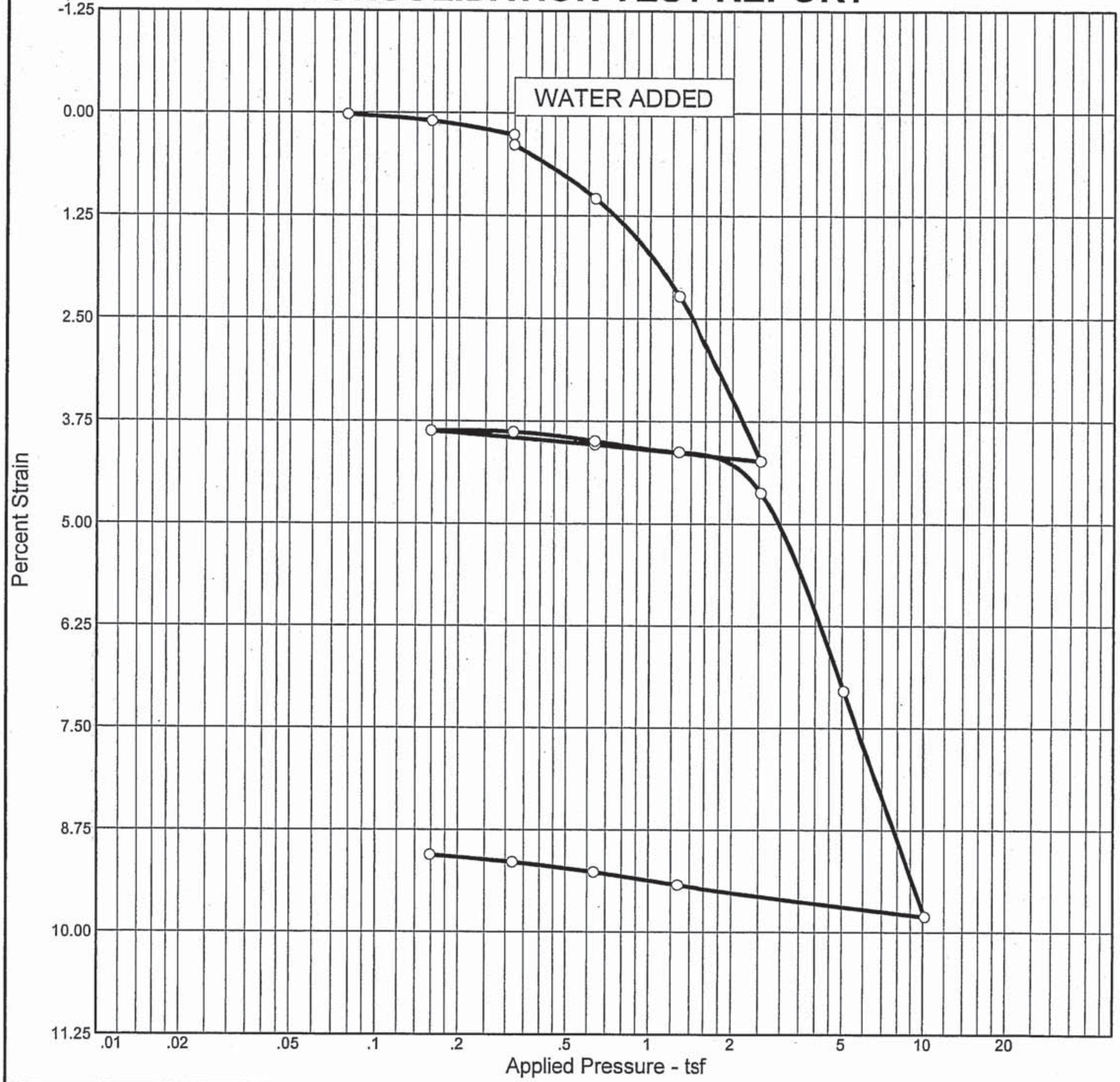
Sample Number: ST-1

Proj. No.: 2005012477 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Tested By: K. Kocher & J. David **Checked By:** J. Fouse

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_s	Swell Press. (tsf)	Clpse. %	e_o
Sat.	Moist.											
56.4 %	21.2 %	83.3	29		2.68	0.40	1.47	0.18	0.01		0.1	1.007

MATERIAL DESCRIPTION	USCS	AASHTO
Silty SAND (SM), tan, fine grain, dry	SM	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

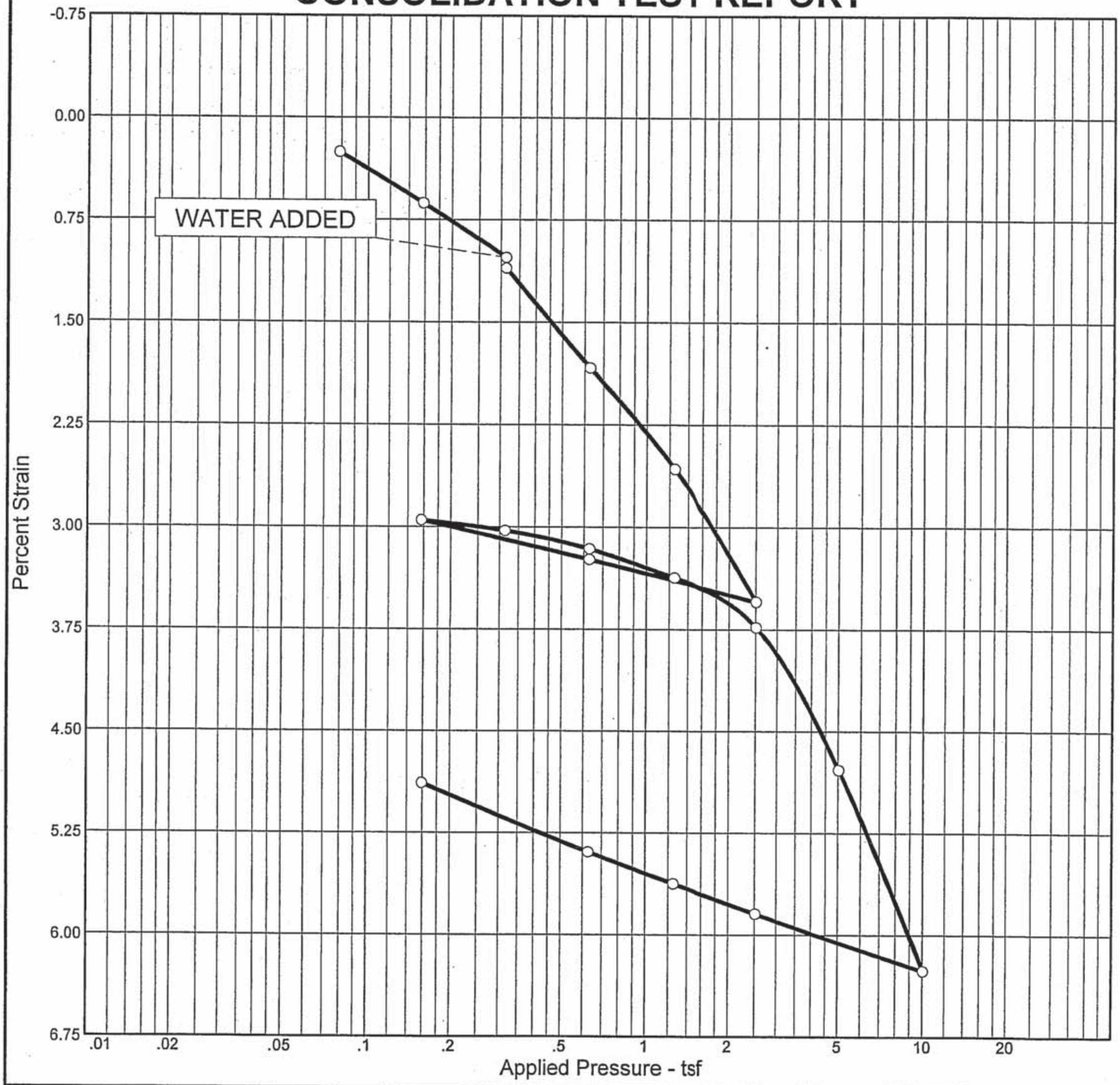
Source: B-73 **Sample No.:** ST-3 **Elev./Depth:** 6

REITZ & JENS, INC.
CONSULTING ENGINEERS

Remarks:

Figure B3-1

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_s	Swell Press. (tsf)	Clpse. %	e_o
Sat.	Moist.											
52.6 %	23.2 %	76.7	31		2.68	0.60	2.13	0.11	0.01		0.1	1.182

MATERIAL DESCRIPTION	USCS	AASHTO
Sandy Silty CLAY (CL), dark gray with light brown, stiff, low plastic, with shell frag.	CL	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

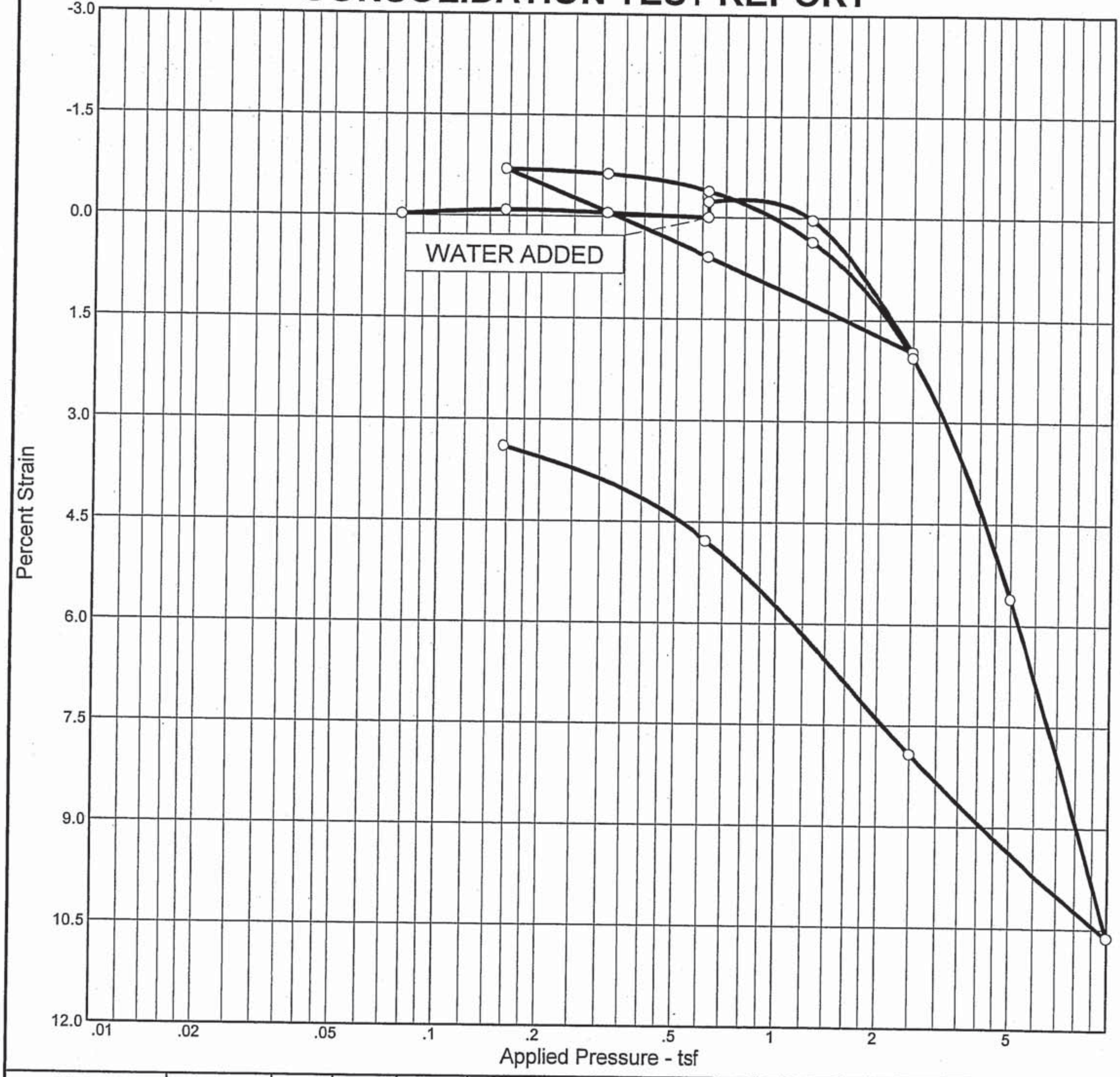
Source: B-76 **Sample No.:** ST-4 **Elev./Depth:** 8.5

Remarks:

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure B3-2

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_s	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
88.2 %	37.0 %	78.7	94	54	2.68	0.25	2.55	0.36	0.07	1.22	0.2	1.125

MATERIAL DESCRIPTION	USCS	AASHTO
CLAY (CH), Dark brown, stiff, high plstic, with lignite and limonite, slick-n-sided	CH	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

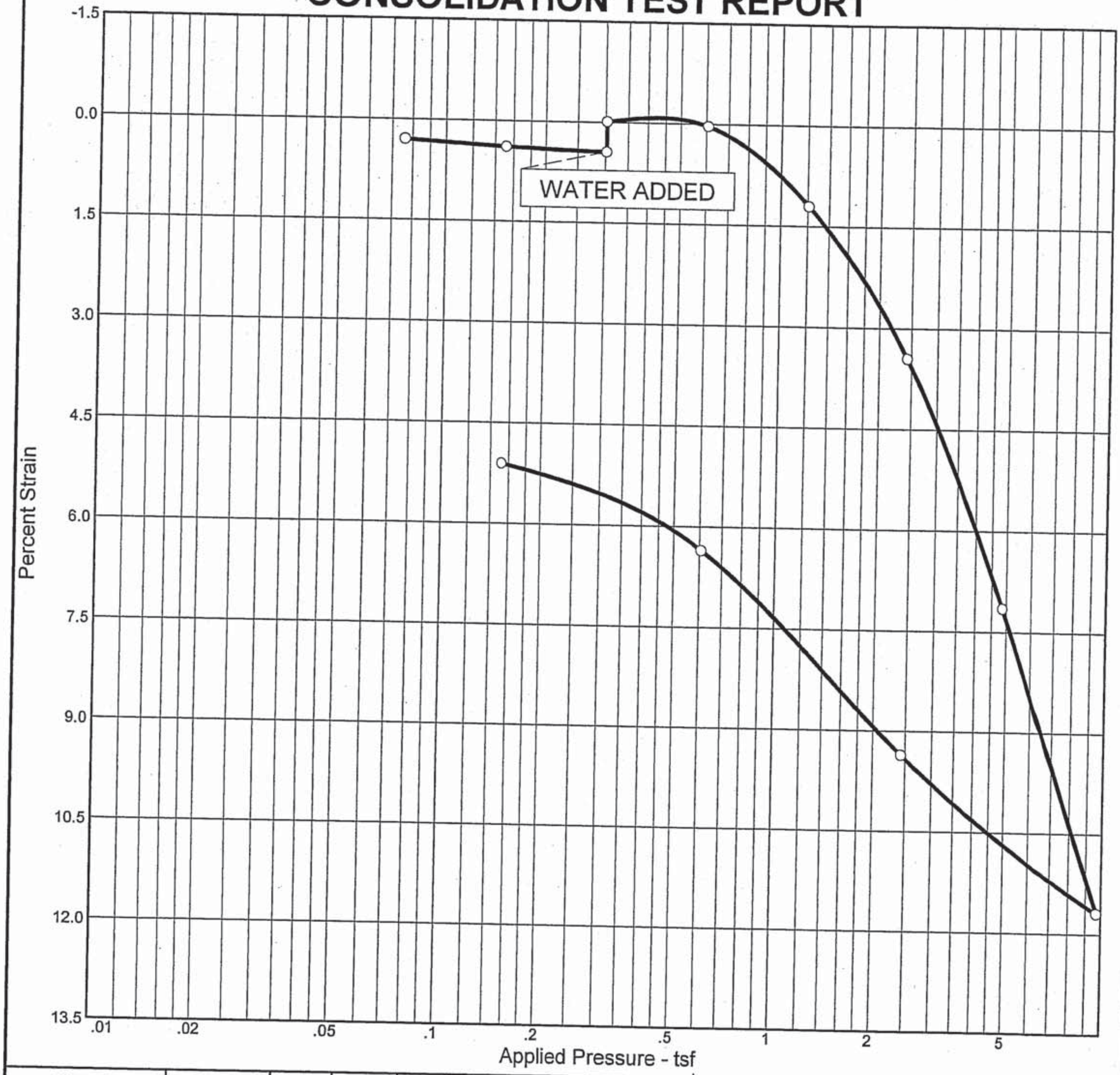
Source: B-111 **Sample No.:** ST-2 **Elev./Depth:** 3.5

REITZ & JENS, INC.
CONSULTING ENGINEERS

Remarks:

Figure B3-3

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_s	Swell Press. (tsf)	Swell %	e_o
Sat.	Moist.											
93.9 %	37.1 %	81.3	91	66	2.68	0.11	1.78	0.31	0.08	0.84	0.4	1.058

MATERIAL DESCRIPTION	USCS	AASHTO
CLAY (CH), dark brown, firm, high plastic, with lignite, traces of limonite, sandy silt pockets	CH	

Project No. 2005012477 **Client:** Ameren U.E.

Project: Sioux Power Plant UWLF

Remarks:

Source: B-112 **Sample No.:** ST-1 **Elev./Depth:** 1.5

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure B3-4

Analyses from Flexible-Wall Hydraulic Conductivity Test

Ameren Sioux

Project 2005012477

Sample B-58, ST-2, 4'-6'

Hydraulic Conductivity

Soil Conditions	
Pre-test conditions	**Post-test Conditions**
Wet Density = 114.23 (lbs/ft^3	Wet Density = 110.0 (lbs/ft^3)
% Moisture = 34.0%	% Moisture = 40.6%
Dry Density = 85.22 (lbs/ft^3)	Dry Density = 78.25 (lbs/ft^3)

Test Information	
a (cm^2)=	0.19685
L (cm)=	5.8733
A (cm^2)=	20.94249

Trial 1

				Base Burette		Top Burette							
Date	Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Reading (ml)	Distance from Datum (cm)	Reading (ml)	Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (°C)	Weighted Average Temp. (°C)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Corrected Hydraulic Conductivity (cm/sec)
1/24/2006	8:20	0	0.4	9.99	27.251	0.01	77.949	86.969	17.5				
	12:50	16200	0.4	9.67	28.876	0.28	76.578	83.972	20.6	19.05	5.98E-08	1.0239372	6.12E-08
	4:20	28800	0.1	9.42	30.146	0.45	75.714	81.839	22.5	20.14	5.83E-08	0.9967395	5.81E-08
1/25/2006	7:35	83700	0.6	8.60	34.312	1.22	71.802	73.761	16	19.56	5.43E-08	1.0111589	5.49E-08
	12:10	100800	0.8	8.43	35.176	1.42	70.786	71.882	18.8	19.19	5.22E-08	1.0203458	5.32E-08
	4:00	114600	0.5	8.25	36.090	1.55	70.126	70.307	21	19.28	5.12E-08	1.0181914	5.22E-08
1/26/2006	7:45	170700	0.9	7.65	39.138	2.12	67.230	64.363	16.6	19.12	4.87E-08	1.0221549	4.98E-08

Ave= 5.25E-08

Analyses from Flexible-Wall Hydraulic Conductivity Test

Ameren Sioux

Project 2005012477

Sample B-70, ST-4, 9'-11'

Hydraulic Conductivity

Soil Conditions	
Pre-test conditions	**Post-test Conditions**
Wet Density = 111.76 (lbs/ft^3	Wet Density = 112.7 (lbs/ft^3)
% Moisture = 40.5%	% Moisture = 47.7%
Dry Density = 79.54 (lbs/ft^3)	Dry Density = 76.3 (lbs/ft^3)

Test Information	
a (cm^2)=	0.19685
L (cm)=	6.5494
A (cm^2)=	20.10662

Trial 1

				Base Burette		Top Burette							
Date	Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Reading (ml)	Distance from Datum (cm)	Reading (ml)	Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (°C)	Weighted Average Temp. (°C)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Corrected Hydraulic Conductivity (cm/sec)
1/26/2006	7:45	0	11.4	9.98	27.302	0.10	77.492	86.461	17.7				
	8:05	1200	11.4	8.93	32.636	1.13	72.260	75.895	17.7	17.70	3.48E-06	1.0593607	3.69E-06
	8:25	2400	11.4	8.09	36.903	1.94	68.145	67.513	17.8	17.73	3.30E-06	1.0586846	3.50E-06
	8:45	3600	11.4	7.37	40.560	2.66	64.487	60.198	17.9	17.77	3.22E-06	1.0575596	3.41E-06
	9:05	4800	11.4	6.77	43.608	3.27	61.388	54.051	18.0	17.81	3.14E-06	1.0563246	3.31E-06
	9:25	6000	11.4	6.22	46.402	3.79	58.747	48.615	18.2	17.87	3.08E-06	1.0547790	3.25E-06

Trial 2

				Base Burette		Top Burette							
Date	Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Reading (ml)	Distance from Datum (cm)	Reading (ml)	Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (°C)	Weighted Average Temp. (°C)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Corrected Hydraulic Conductivity (cm/sec)
1/26/2006	10:15	0	11.5	9.95	27.454	0.47	75.612	84.429	18.7				
	10:45	1800	11.5	8.68	33.906	1.76	69.059	71.425	19.2	18.95	2.98E-06	1.0264883	3.06E-06
	11:15	3600	11.4	7.71	38.833	2.72	64.182	61.620	19.5	19.15	2.80E-06	1.0213971	2.86E-06
	11:45	5400	11.4	6.88	43.050	3.54	60.017	53.238	19.8	19.32	2.74E-06	1.0171883	2.78E-06
	12:15	7200	11.4	6.20	46.504	4.22	56.562	46.329	20.3	19.50	2.67E-06	1.0125933	2.71E-06
	13:15	10800	11.4	5.11	52.041	5.28	51.178	35.407	21	19.88	2.58E-06	1.0031011	2.59E-06
	16:15	21600	11.2	3.34	61.033	6.98	42.542	17.780	22.9	20.92	2.31E-06	0.9782561	2.26E-06

Ave= 2.59E-06

Analyses from Flexible-Wall Hydraulic Conductivity Test

Ameren Sioux

Project 2005012477

Sample B-85, ST-2, 4'-6'

Hydraulic Conductivity

Soil Conditions	
Pre-test conditions	**Post-test Conditions**
Wet Density = 110.21 (lbs/ft^3	Wet Density = 110.86 (lbs/ft^3)
% Moisture = 38.5%	% Moisture = 43.8%
Dry Density = 79.57 (lbs/ft^3)	Dry Density = 77.09(lbs/ft^3)

Test Information	
a (cm^2)=	0.19685
L (cm)=	9.07796
A (cm^2)=	42.32068

Trial 1

				Base Burette		Top Burette							
Date	Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Reading (ml)	Distance from Datum (cm)	Reading (ml)	Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (°C)	Weighted Average Temp. (°C)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Corrected Hydraulic Conductivity (cm/sec)
1/20/2006	9:00	0	6.4	9.98	27.302	0.05	77.746	86.715	21.6				
		120	6.6	7.08	42.034	2.69	64.335	58.572	21.6	21.60	6.90E-05	0.9623875	6.64E-05
		240	6.6	5.28	51.178	4.48	55.242	40.335	21.6	21.60	6.73E-05	0.9623875	6.48E-05
		360	6.6	4.00	57.680	5.74	48.841	27.432	21.6	21.60	6.75E-05	0.9623875	6.50E-05
		480	6.6	3.15	61.998	6.71	43.913	18.186	21.6	21.60	6.87E-05	0.9623875	6.61E-05
												AVE=	6.56E-05

Trial 2

				Base Burette		Top Burette							
Date	Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Reading (ml)	Distance from Datum (cm)	Reading (ml)	Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (°C)	Weighted Average Temp. (°C)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Corrected Hydraulic Conductivity (cm/sec)
1/20/2006	9:10	0	6.6	9.92	27.606	0.30	76.476	85.141	19.5				
		120	6.7	7.26	41.119	2.87	63.420	58.572	20.4	19.95	6.58E-05	1.0014659	6.59E-05
		240	6.7	5.50	50.060	4.73	53.972	40.183	21.4	20.43	6.61E-05	0.9899459	6.54E-05
		360	6.7	4.23	56.512	5.89	48.079	27.838	21.9	20.83	6.56E-05	0.9802210	6.43E-05
		480	6.7	3.34	61.033	6.91	42.897	18.135	18.0	20.61	6.80E-05	0.9854603	6.70E-05
		600	6.7	2.74	64.081	7.51	39.849	12.039	20	20.29	6.88E-05	0.9931970	6.84E-05
												AVE=	6.63E-05

Analyses from Flexible-Wall Hydraulic Conductivity Test

Ameren Sioux

Project 2005012477

Sample B-86, ST-1, 1.5'-3.5'

Hydraulic Conductivity

Soil Conditions	
Pre-test conditions	**Post-test Conditions**
Wet Density = 112.5 (lbs/ft^3)	Wet Density = 105.9 (lbs/ft^3)
% Moisture = 42.3%	% Moisture = 45.4%
Dry Density = 79.1 (lbs/ft^3)	Dry Density = 72.9 (lbs/ft^3)

Test Information	
a (cm^2)=	0.19685
L (cm)=	6.582918
A (cm^2)=	20.15698

Trial 1													
				Base Burette		Top Burette							
Date	Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Reading (ml)	Distance from Datum (cm)	Reading (ml)	Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (°C)	Weighted Average Temp. (°C)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Corrected Hydraulic Conductivity (cm/sec)
2/3/2006	12:20	0	1.5	9.92	27.606	0.12	77.390	86.055	20.2				
2/4/2006	13:20	90000	1.6	9.82	28.114	0.30	76.476	84.633	16.7	18.45	5.95E-09	1.0394146	6.19E-09
2/6/2006	7:20	241200	1.6	9.73	28.572	0.57	75.104	82.804	15.8	17.07	5.13E-09	1.0766391	5.53E-09
2/6/2006	15:00	268800	1.4	9.73	28.572	0.64	74.749	82.448	19.6	17.14	5.12E-09	1.0748410	5.50E-09
2/7/2006	7:20	327600	1.6	9.68	28.826	0.72	74.342	81.788	16.6	17.31	4.99E-09	1.0700493	5.34E-09
2/8/2006	8:20	417600	1.4	9.62	29.130	0.86	73.631	80.772	18.4	17.35	4.88E-09	1.0689135	5.21E-09
2/9/2006	8:00	502800	1.6	9.60	29.232	1.00	72.920	79.959	16.8	17.39	4.70E-09	1.0677486	5.02E-09
2/10/2006	7:15	586500	1.6	9.55	29.486	1.12	72.310	79.095	16.6	17.29	4.62E-09	1.0704672	4.95E-09

AVE= 5.06E-09

Analyses from Flexible-Wall Hydraulic Conductivity Test

Ameren Sioux

Project 2005012477

Sample B-100, ST-1, 1'-3'

Hydraulic Conductivity

Soil Conditions	
Pre-test conditions	**Post-test Conditions**
Wet Density = 118.2 (lbs/ft^3)	Wet Density = 119.8 (lbs/ft^3)
% Moisture = 27.9%	% Moisture = 33.6%
Dry Density = 92.4 (lbs/ft^3)	Dry Density = 89.7 (lbs/ft^3)

Test Information	
a (cm^2)=	0.19685
L (cm)=	7.973907
A (cm^2)=	19.99895

Trial 1

Date	Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Base Burette Reading (ml)	Base Burette Distance from Datum (cm)	Top Burette Reading (ml)	Top Burette Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (°C)	Weighted Average Temp. (°C)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Corrected Hydraulic Conductivity (cm/sec)
11/14/2005	9:40	0	7.1	9.93	27.556	0.50	75.460	83.083	21.4				
	12:15	9300	7.0	9.73	28.572	0.70	74.444	81.051	22.1	21.75	1.04E-07	0.9589610	1.00E-07
	14:30	17400	7.0	9.58	29.334	0.85	73.682	79.527	22.1	21.91	9.87E-08	0.9552617	9.42E-08
	16:05	23100	609.0	9.48	29.842	0.96	73.123	78.461	22	21.95	9.73E-08	0.9544967	9.28E-08
11/15/2005	7:35	78900	7.2	8.67	33.956	1.84	68.653	69.875	20.6	21.49	8.61E-08	0.9649280	8.31E-08
	8:24	100500	7.1	7.40	40.408	2.10	67.332	62.103	22.6	21.51	1.14E-07	0.9643810	1.10E-07
11/16/2005	7:10	163800	7.2	7.79	38.427	2.82	63.674	60.427	19.5	21.33	7.63E-08	0.9685100	7.39E-08

Trial 2

Date	Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Base Burette Reading (ml)	Base Burette Distance from Datum (cm)	Top Burette Reading (ml)	Top Burette Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (℃)	Weighted Average Temp. (℃)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Corrected Hydraulic Conductivity (cm/sec)
11/16/2005	7:55	0	7.2	9.94	27.505	0.63	74.800	82.474	19.5				
	10:15	8400	7.2	9.82	28.114	0.78	74.038	81.102	20.4	19.95	1.13E-07	1.0014659	1.13E-07
	13:45	21000	7.3	9.62	29.130	0.93	73.276	79.324	21.4	20.52	8.65E-08	0.9876689	8.55E-08
	15:20	26700	7.2	9.53	29.588	1.01	72.869	78.461	21.9	20.76	8.41E-08	0.9819264	8.26E-08
11/17/2005	7:30	84900	7.5	8.79	33.347	1.79	68.907	70.739	18.0	20.21	7.43E-08	0.9952503	7.40E-08
	15:15	112800	7.4	8.50	34.820	2.12	67.230	67.589	20	19.91	7.18E-08	1.0025189	7.20E-08
11/18/2005	7:20	170700	7.4	7.94	37.665	2.68	64.386	61.900	19.1	19.79	6.77E-08	1.0054982	6.80E-08

Analyses from Flexible-Wall Hydraulic Conductivity Test

Ameren Sioux

Project 2005012477

Sample B-104, ST-1, 1.5'-3.5'

Hydraulic Conductivity

Soil Conditions	
Pre-test conditions	**Post-test Conditions**
Wet Density = 115.5 (lbs/ft^3)	Wet Density = 109.9 (lbs/ft^3)
% Moisture = 33.9%	% Moisture = 37.1%
Dry Density = 86.3 (lbs/ft^3)	Dry Density = 80.2 (lbs/ft^3)

Test Information	
a (cm^2)=	0.19685
L (cm)=	6.528308
A (cm^2)=	20.17315

Trial 1													
				Base Burette		Top Burette							
Date	Time	Elapsed Time (seconds)	Cell Burette Reading (ml)	Reading (ml)	Distance from Datum (cm)	Reading (ml)	Distance from Datum (cm)	Total Head Across Sample (cm of water)	Temperature (°C)	Weighted Average Temp. (°C)	Uncorrected Hydraulic Conductivity (cm/sec)	Correction Factor	Corrected Hydraulic Conductivity (cm/sec)
2/3/2006	12:20	0	2.8	9.90	27.708	0.26	76.679	85.242	22.2				
2/4/2006	13:20	90000	3.3	8.36	35.531	1.55	70.126	70.866	16.7	19.45	6.54E-08	1.0138429	6.63E-08
2/6/2006	7:20	241200	3.5	6.84	43.253	3.01	62.709	55.727	15.8	17.44	5.61E-08	1.0663286	5.98E-08
2/6/2006	15:00	268800	3.4	6.63	44.320	3.27	61.388	53.340	19.6	17.47	5.56E-08	1.0656093	5.92E-08
2/7/2006	7:20	327600	3.6	6.19	46.555	3.71	59.153	48.869	16.6	17.58	5.41E-08	1.0625261	5.75E-08
2/8/2006	8:20	417600	3.4	5.67	49.196	4.25	56.410	43.485	18.4	17.57	5.13E-08	1.0630149	5.46E-08
2/9/2006	8:00	502800	3.7	5.34	50.873	4.65	54.378	39.776	16.8	17.57	4.83E-08	1.0628552	5.13E-08
2/10/2006	7:15	586500	3.7	5.06	52.295	4.97	52.752	36.728	16.6	17.45	4.57E-08	1.0662499	4.88E-08
2/13/2006	8:30	763800	3.9	4.44	55.445	5.72	48.942	29.769	16.4	17.23	4.39E-08	1.0723003	4.70E-08
												AVE=	4.90E-08

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SIOUX POWER PLANT - UTILITY WASTE LANDFILL

ST. CHARLES COUNTY MISSOURI

SECTION 20, T48N R6E

CONSTRUCTION OF CELL 1 AND RECYCLE POND

GENERAL DEVELOPMENT NOTES (Not Applicable to Construction)

1. Owner/Developer/Operator: AmerenUE
8501 N. State Route 94
West Alton, MO 63386
Contact: Harry Benhardt
Superintendent Technical Support
(314)-992-6206

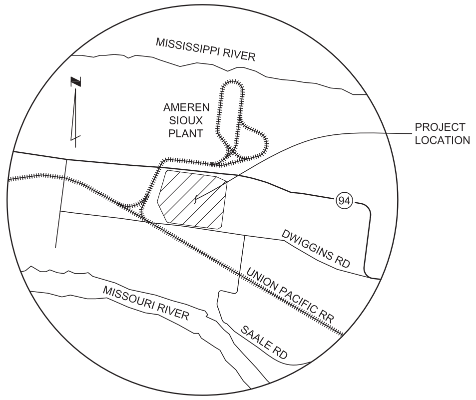
2. Property Id: 5-0023-1838-00-1

3. Maximum height of completed Utility Waste Landfill is limited to 525 feet NGVD.

4. The perimeter berms will be landscaped with a mixture of native grasses and forbs. Exterior landfill slopes will be landscaped with native grasses and forbs as they are completed.

5. Only utility waste products consisting of a combination of fly ash, bottom ash, and flue gas scrubber by-products from the Ameren Sioux plant may be stored at this site. No similar waste products from other utility plants may be stored on this site without the prior written approval of St. Charles County.

6. According to Panel 150 of the August 2, 1996 Flood Insurance Rate Map for St. Charles County, Missouri, the 100-Year flood elevation at the site (RM 209) is approximately 438.5 NGVD. The limits of the density floodway are shown on sheet 2 of the plans. All of the improvements except the secondary access road will be made within the 100-year floodplain but outside the floodway. In compliance with the St. Charles County floodplain development ordinance, the 1 acre fill footprint for the secondary access road is less than 4.1% of the total 24.4 acres of property in parcel 5-0023-1838-00-1 that is within the density floodway.



LOCATOR
NO SCALE

GENERAL CONSTRUCTION NOTES

1. Underground facilities, structures, and utilities have been plotted from available surveys and records and therefore, their locations must be considered approximate only. There may be others, the existence and location of which are not known at the present. Verification of the size, location, and type of underground utilities, shown or not shown, is the sole responsibility of the Contractor.

2. The Contractor shall notify the Chief Inspector of the St. Charles County Highway Department and Missouri Department of Transportation a minimum of 24 hours prior to beginning any construction within the right-of-way.

3. Unless otherwise noted, all grades shown are finished grades. Contractor shall over excavate as necessary to subgrade prior to placement of site improvements to finished grade.

4. General perimeter berm fill from an off-site source will be required. The Contractor shall be solely responsible to locate a borrow source, excavate, and transport suitable materials to the site for use in the perimeter berm general fill. The Contractor shall be solely responsible for obtaining all necessary permits associated with the borrow site(s), and notifying and obtaining St. Charles County's approval of the borrow site(s) and haul route(s) prior to its use.

5. A special use permit for the existing construction entrance on Dwiggins Road was obtained from the St. Charles County Highway Department. The Contractor shall obtain a new special use permit before modifying or relocating the construction entrance. See Sheet 12 for construction entrance requirements and details.

St. Charles County
Community Development Department
Approval

Planning and Zoning Director

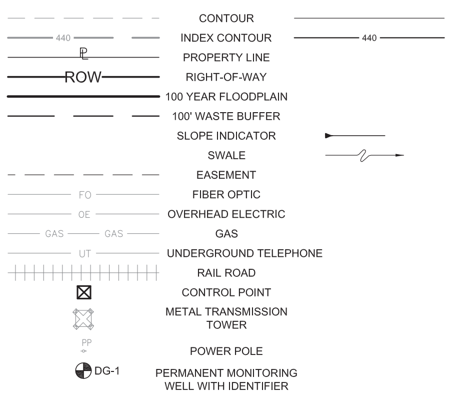
Date

Development Review Director

Date

This approval is based upon conformity with the regulations embodied in the Unified Development Ordinance, and all standards contained or referenced therein, and does not relieve the engineer of responsibility for mathematical or design errors.

LEGEND



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314.993.4132 (voice) 314.993.4177 (fax)

GREDELL Engineering Resources, Inc.
ENVIRONMENTAL ENGINEERING
LAND AIR WATER
1505 East High Street Telephone: (573) 659-9078
Jefferson City, Missouri 65101 Facsimile: (573) 659-9079

PREPARED FOR AmerenUE

DRAWN M.R.F.
CHKD. J.L.F.
SUPV.
APPD.

SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 1 OF 16
COVER

LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE ST. LOUIS, MISSOURI
8430-Y-0168601
REV. 4

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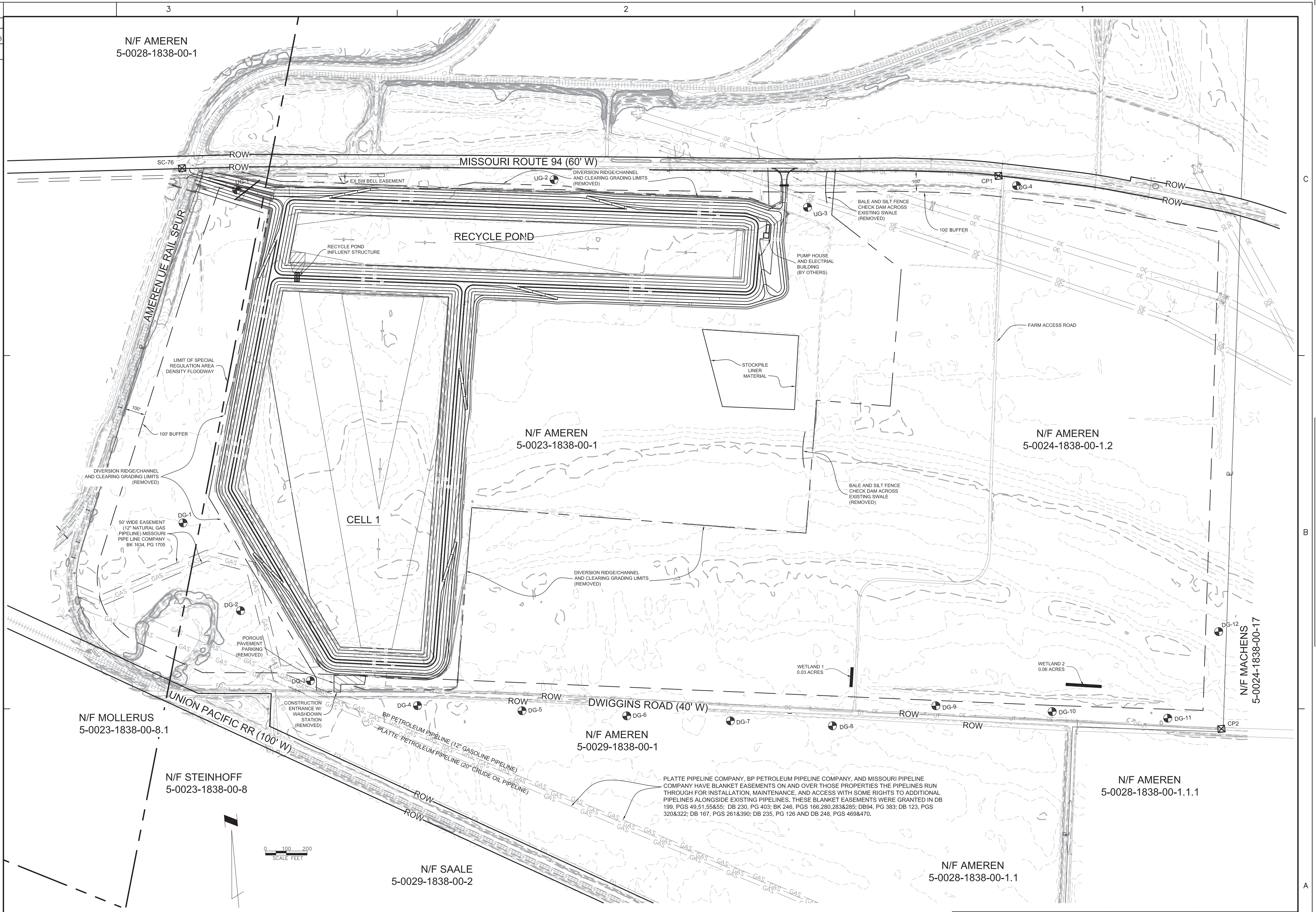

PLATTE PIPELINE COMPANY, BP PETROLEUM PIPELINE COMPANY, AND MISSOURI PIPELINE COMPANY HAVE BLANKET EASEMENTS ON AND OVER THOSE PROPERTIES THE PIPELINES RUN THROUGH FOR INSTALLATION, MAINTENANCE, AND ACCESS WITH SOME RIGHTS TO ADDITIONAL PIPELINES ALONGSIDE EXISTING PIPELINES. THESE BLANKET EASEMENTS WERE GRANTED IN DB 199, PGS 49,51,55&55; DB 230, PG 403; BK 246, PGS 166,280,283&285; DB94, PG 383; DB 123, PGS 320&322; DB 167, PGS 261&390; DB 235, PG 126 AND DB 248, PGS 469&470.

The site is shown on FEMA Flood Insurance Rate Map (FIRM) 29183C0150E for St. Charles County Missouri and Incorporated Areas with an effective date of August 2, 1996. According to the FIRM the entire site is located in zone AE with a Base (100-year) Flood Elevation of approximately 438.5 NGVD.

BM	NORTHING	EASTING	ELEVATION (NAVD)	DESCRIPTION
SC-76	1119087.33	877543.26	438.32	MO GEODETIC SURVEY BM
CP-1	1118671.98	881447.03	426.29	IRON ROD W/CAP IN CONCRETE
CP-2	1115919.13	882257.95	426.26	IRON ROD W/CAP IN CONCRETE
CP-3	1113921.00	881880.22	428.94	IRON ROD W/CAP IN CONCRETE
CP-4	1117281.70	876152.34	433.63	IRON ROD W/CAP IN CONCRETE

ALL ELEVATIONS SHOWN WERE ESTABLISHED IN NAVD88 USING THE MISSOURI GEODETIC REFERENCE SYSTEM BENMARK SC-76 IMMEDIATELY SOUTH OF I-94 AND WEST OF THE AMEREN RAIL SPUR. TO COVERT THE NAVD88 ELEVATIONS SHOWN TO NGVD29(USGS) ADD 0.23 FEET.

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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 2 OF 16
SITE PLAN

LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE ST. LOUIS, MISSOURI
8430-Y-0168602
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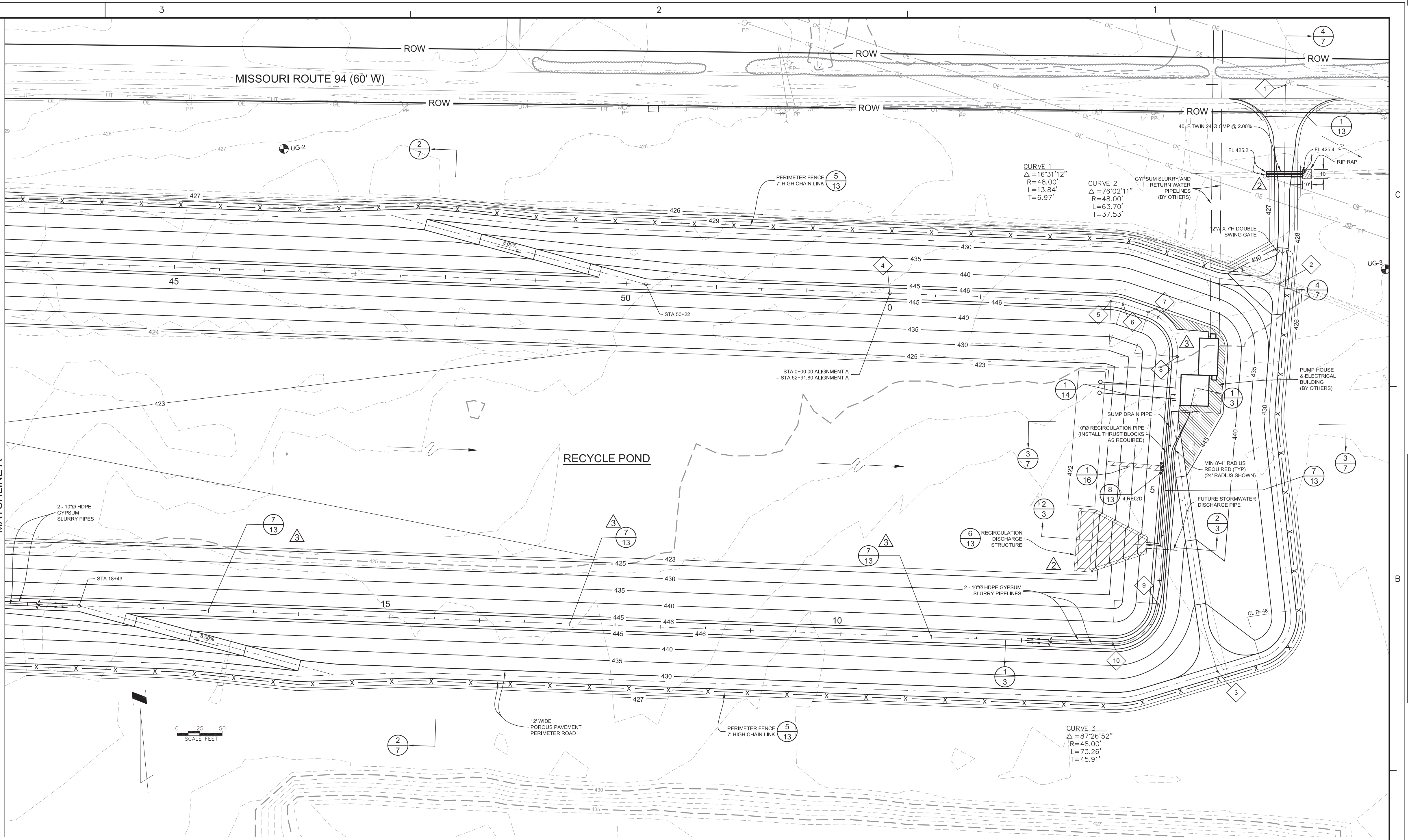
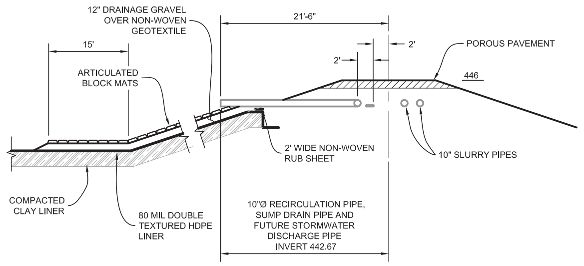


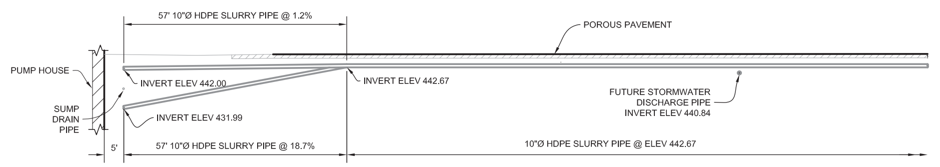
POINT NUMBER	COORDINATES		DESCRIPTION
	N	E	
1	1118822.12	880428.31	CL ENTRANCE ROAD - CL MO 94
2	1118604.56	880401.07	INTERSECTION
3	1118184.11	880290.92	INTERSECTION
4	1118635.34	879970.70	STA 0+00 ALIGNMENT A
5	1118602.86	880213.05	STA 2+44.51 ALIGNMENT A - PC CURVE 1
6	1118599.09	880226.31	STA 2+58.35 ALIGNMENT A - PT CURVE 1
7	1118587.02	880253.22	STA 2+87.84 ALIGNMENT A - PC CURVE 2
8	1118534.73	880280.82	STA 3+51.54 ALIGNMENT A - PT CURVE 2
9	1118264.79	880232.32	STA 6+25.81 ALIGNMENT A - PC CURVE 3
10	1118225.70	880178.71	STA 6+99.07 ALIGNMENT A - PT CURVE 3

1. CONTRACTOR SHALL COORDINATE CONSTRUCTION OF EAST BERM OF RECYCLE POND WITH INSTALLATION OF PIPELINES FROM PLANT TO PUMP HOUSE AND CONSTRUCTION OF PUMP HOUSE AND ELECTRICAL BUILDING BY OTHERS.
2. CONTRACTOR SHALL PROVIDE TEMPORARY 10"Ø HDPE PIPELINE AT GRADE FROM PUMP HOUSE TO CELL 1 TO CONVEY WATER TO FILL CELL 1 BEGINNING NOV 2008. CONTRACTOR MAY USE ONE OF THE PERMANENT GYPSUM SLURRY PIPELINES INSTEAD OF A TEMPORARY WATER PIPELINE.
3. NO CONSTRUCTION IS PERMITTED IN R.O.W. OF HWY 94 UNTIL PERMITS ARE ISSUED BY MISSOURI D.O.T. THE COMPANY WILL OBTAIN PERMITS.
4. GRADES SHOWN ARE FINAL GRADES. CONTRACTOR SHALL GRADE ALL SURFACES TO APPROPRIATE SUBGRADE TO RECIEVE DESIGNATED COVER (CLAY & HDPE LINER, RIP RAP, VEGATATIVE COVER, POROUS PAVEMENT).



△2 2/3 **SECTION THROUGH RECIRCULATION DISCHARGE STRUCTURE**

NO SCALE



△2 1/3 **PARTIAL PROFILE 10"Ø HDPE SLURRY PIPE**

SCALE: 1" = 20'

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CHKD. J.L.F.
SUPV.
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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 3 OF 16
GRADING PLAN

LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE ST. LOUIS, MISSOURI
8430-Y-0168603
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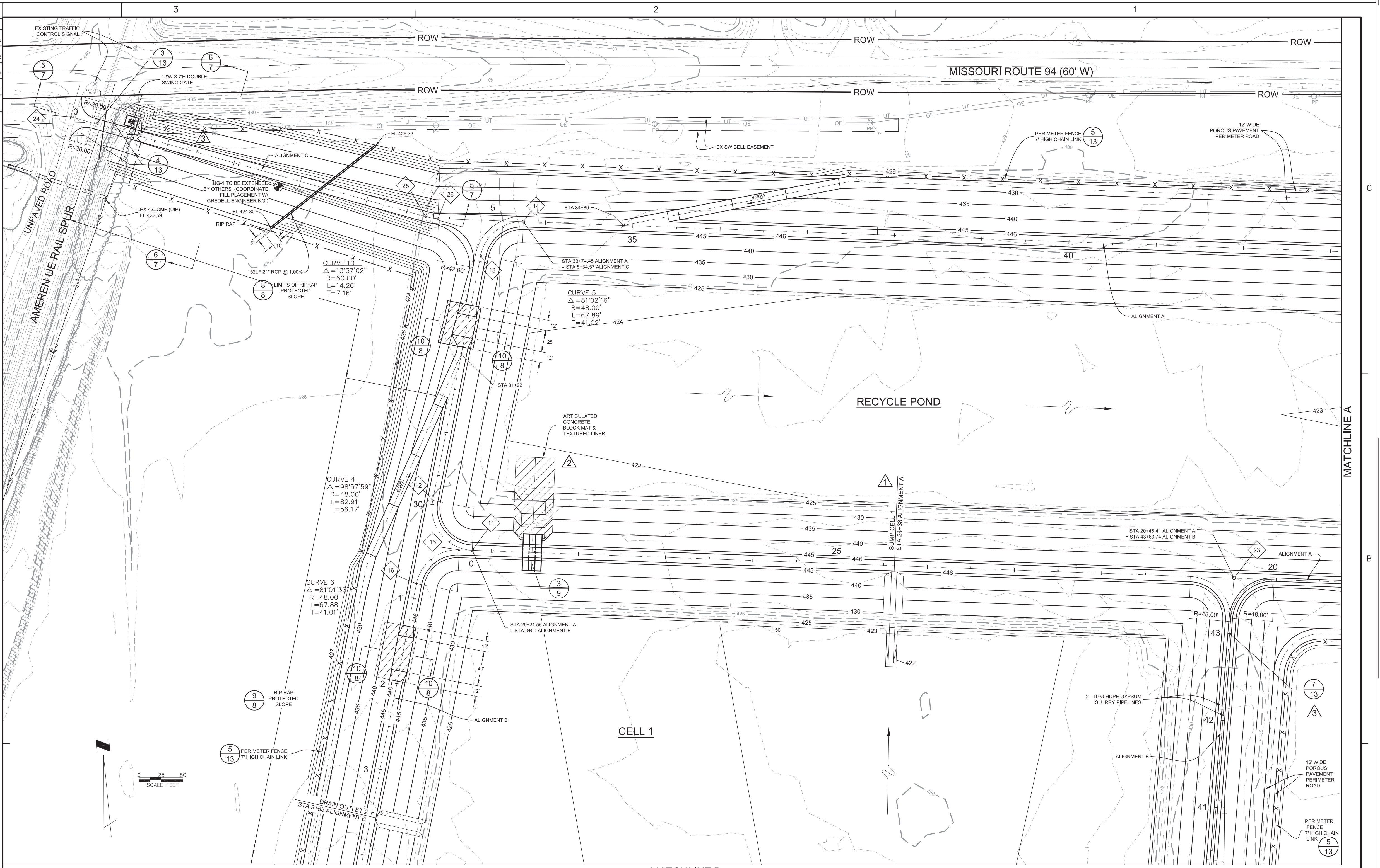

MATCHLINE B

POINT NUMBER	COORDINATES		DESCRIPTION
	N	E	
11	1118520.76	877975.88	STA 29+21.56 ALIGNMENT A - PC CURVE 4
12	1118582.05	877936.25	STA 30+20.53 ALIGNMENT A - PT CURVE 4
13	1118856.16	878017.97	STA 33+06.56 ALIGNMENT A - PC CURVE 5
14	1118890.02	878070.34	STA 33+74.45 ALIGNMENT A - PT CURVE 5
15	1118522.77	877960.86	STA 0+15.15 ALIGNMENT B - PC CURVE 6
16	1118488.91	877908.49	STA 0+83.03 ALIGNMENT B - PT CURVE 6
23	1118404.84	878841.30	STA 43+63.74 TERMINUS ALIGNMENT B
24	1119059.70	877565.84	STA 0+00 ALIGNMENT C - CL UNPAVED ROAD
25	1118906.56	877959.62	STA 4+22.50 ALIGNMENT C - PC CURVE 10
26	1118903.02	877973.40	STA 4+36.76 ALIGNMENT C - PT CURVE 10

GRADES SHOWN ARE FINAL GRADES. CONTRACTOR SHALL GRADE ALL SURFACES TO APPROPRIATE SUBGRADE TO RECIEVE DESIGNATED COVER (CLAY & HDPE LINER, RIP RAP, VEGATATIVE COVER, POROUS PAVEMENT).

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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 4 OF 16
GRADING PLAN

LOCATION 001009
SIOUX PLANT
CLASS 02010

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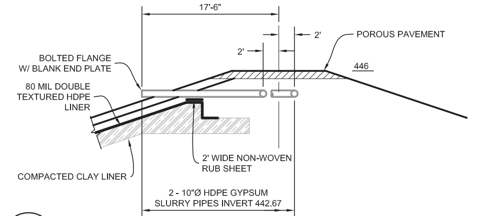
POINT NUMBER	COORDINATES		DESCRIPTION
	N	E	
17	1117544.83	877627.05	STA 10+68.17 ALIGNMENT B - PC CURVE 7
18	1117510.69	877629.61	STA 11+03.18 ALIGNMENT B - PT CURVE 7



1/5 PARTIAL PROFILE 10"Ø HDPE SLURRY PIPES STA 34+40 ALIGNMENT B

SCALE: 1" = 10'

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SHEET 5 OF 16
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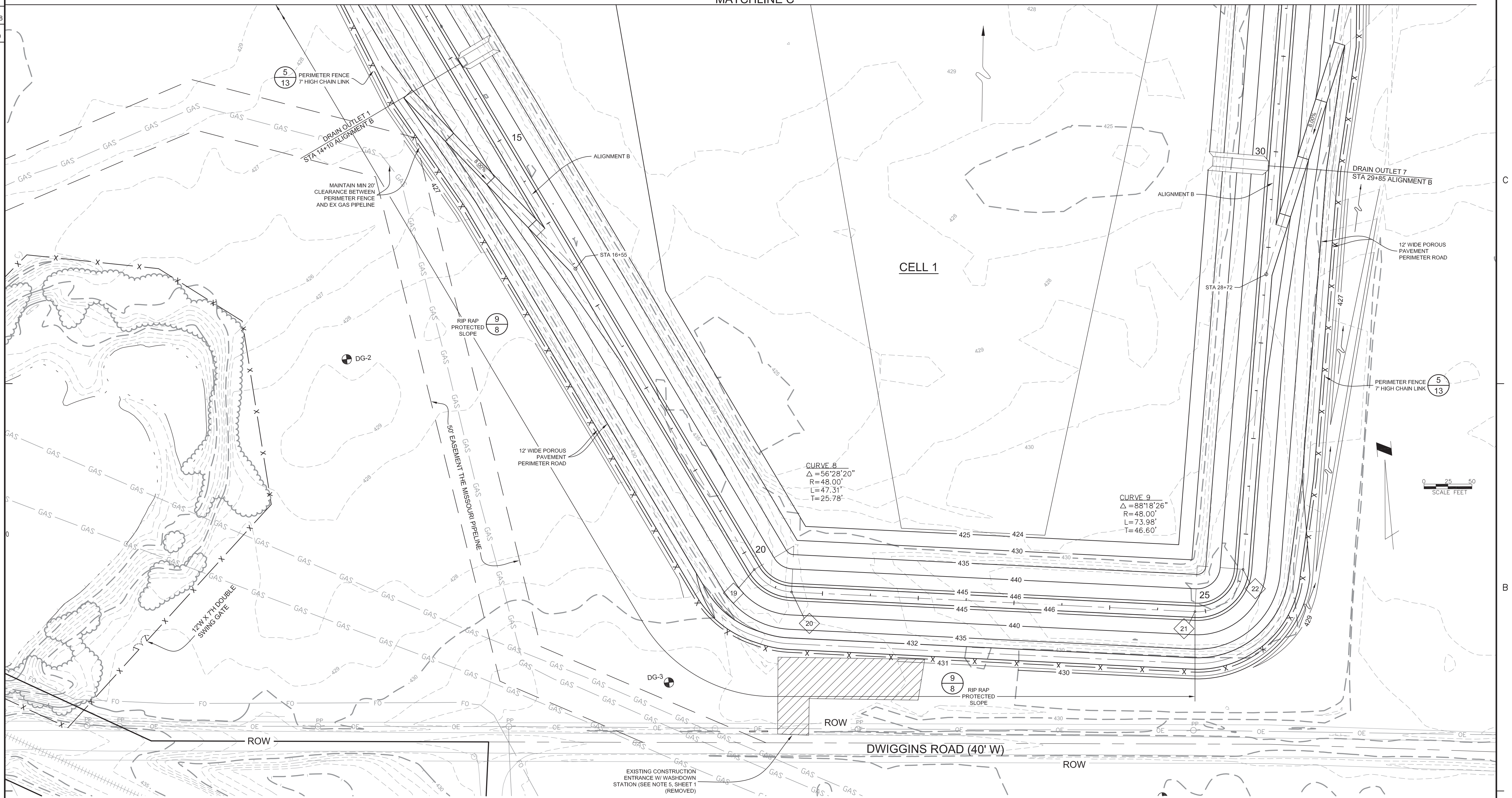

POINT NUMBER	COORDINATES		DESCRIPTION
	N	E	
19	1116680.73	878020.04	STA 20+20.39 ALIGNMENT B - PC CURVE 8
20	1116653.66	878056.51	STA 20+67.70 ALIGNMENT B - PT CURVE 8
21	1116592.54	878473.41	STA 24+89.06 ALIGNMENT B - PC CURVE 9
22	1116631.67	878527.64	STA 25+63.04 ALIGNMENT B - PT CURVE 9

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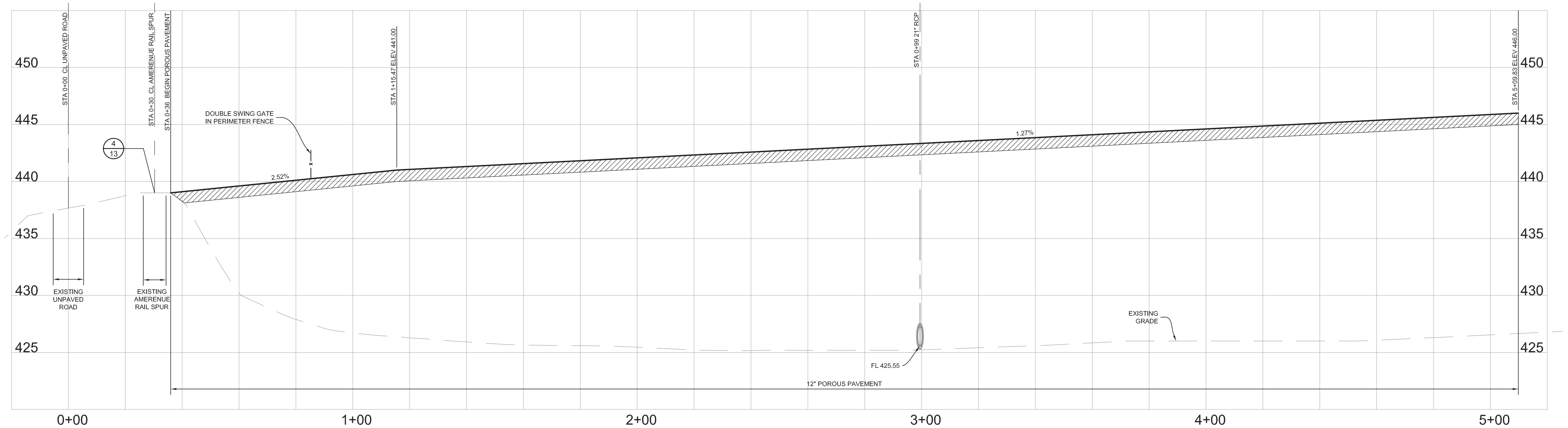
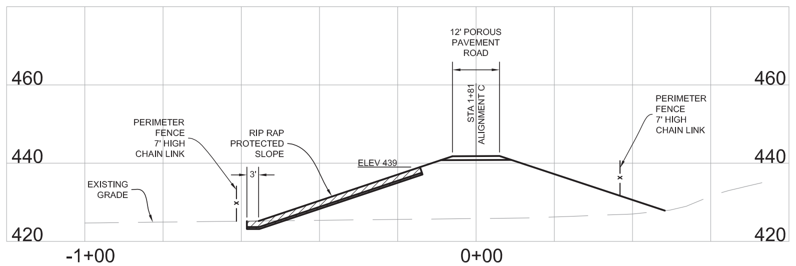
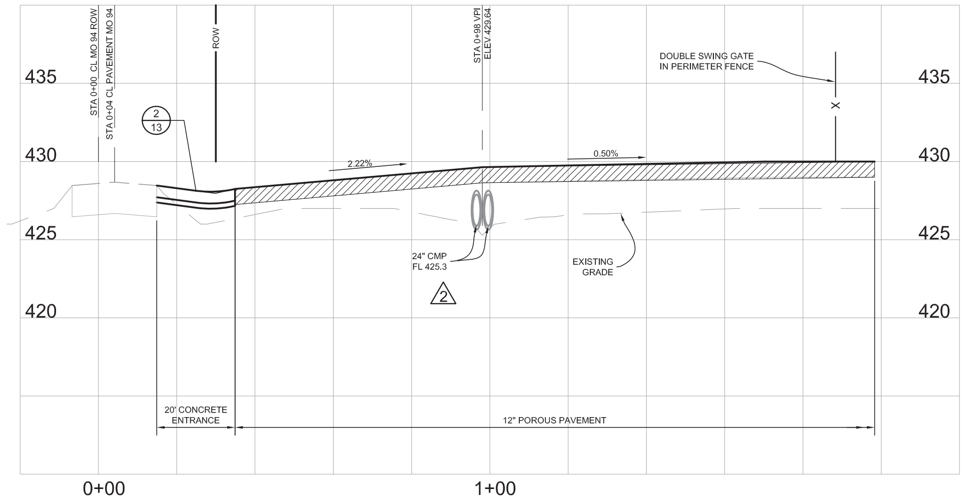


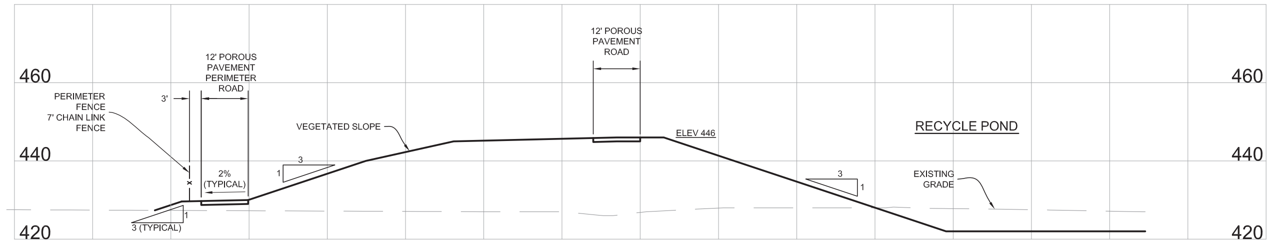
5
7
EMERGENCY ACCESS ROAD PROFILE
SCALE: 1" = 20' H
1" = 5' V



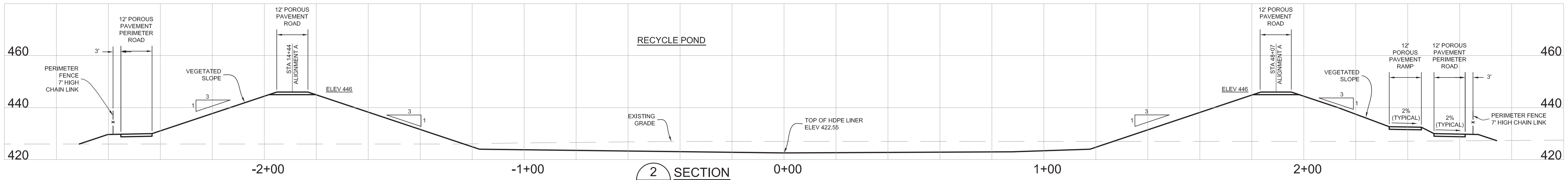
6
7
EMERGENCY ACCESS ROAD SECTION
SCALE: 1" = 20'



4
7
ENTRANCE ROAD PROFILE
SCALE: 1" = 20' H
1" = 5' V



3
7
SECTION
SCALE: 1" = 20'



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SECTION
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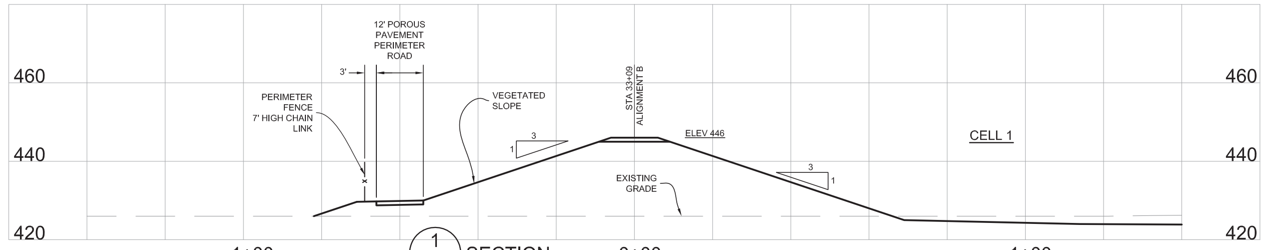

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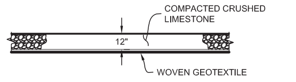
SECTION
SCALE: 1" = 20'



TYPICAL POROUS PAVEMENT SECTION
NO SCALE

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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 7 OF 16
PROFILES & TYPICAL SECTIONS

LOCATION		CLASS
001009	SIOUX PLANT	02010

AmerenUE ST. LOUIS, MISSOURI

8430-Y-0168607

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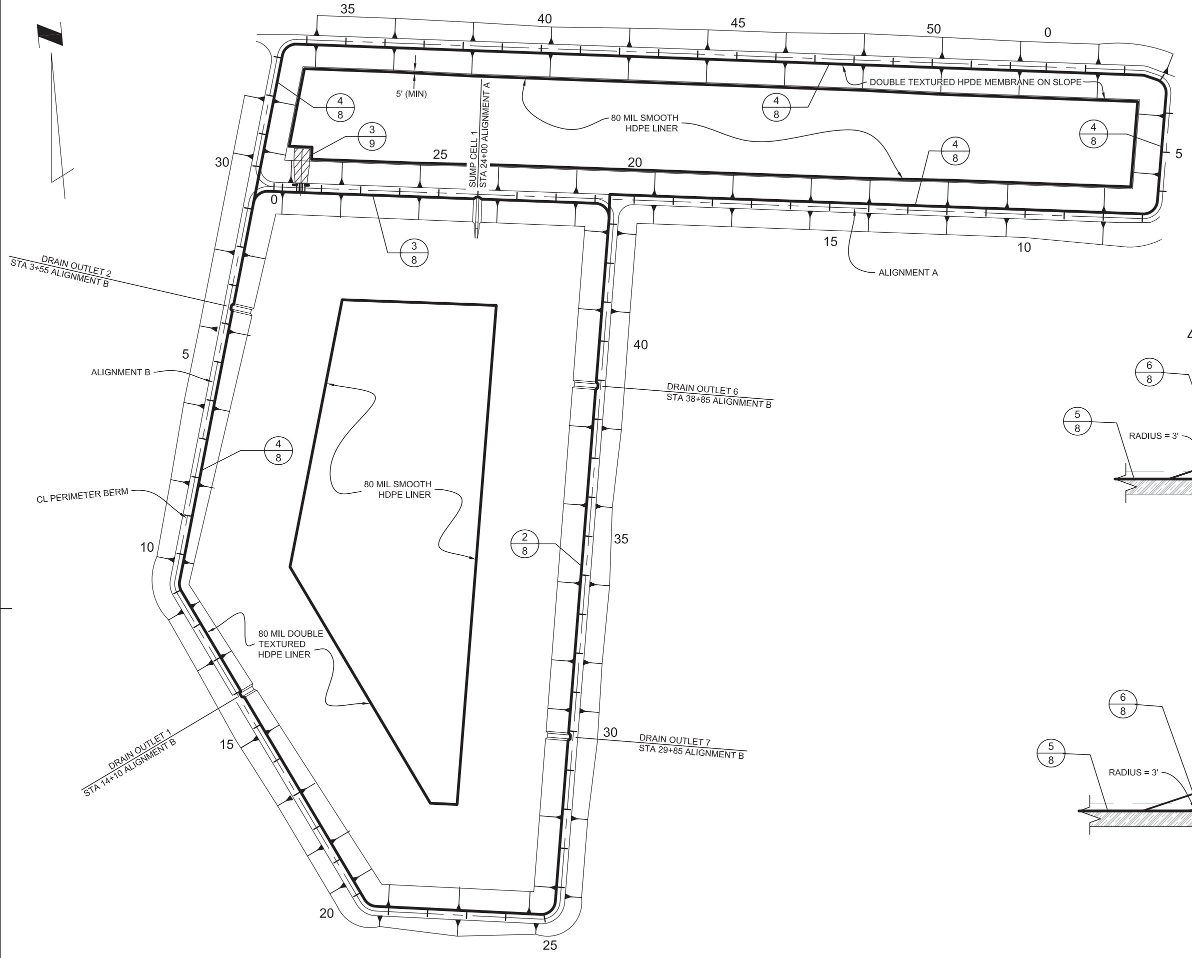
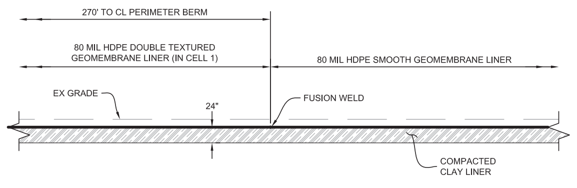


1/8 LINER PLAN
SCALE: 1" = 200'



5/8 BOTTOM LINER
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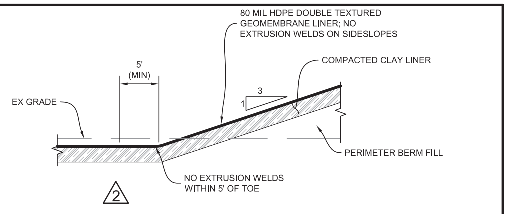

6/8 TRANSITION LINER
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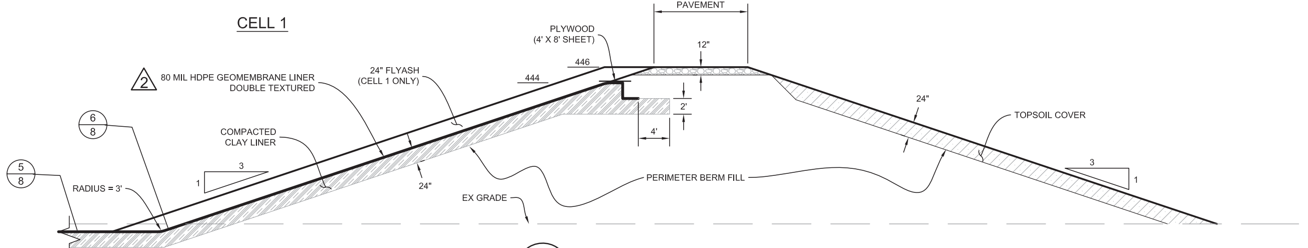
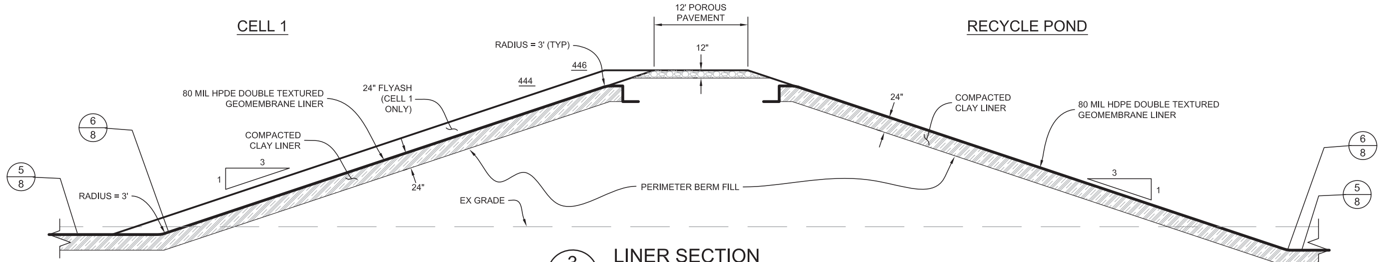
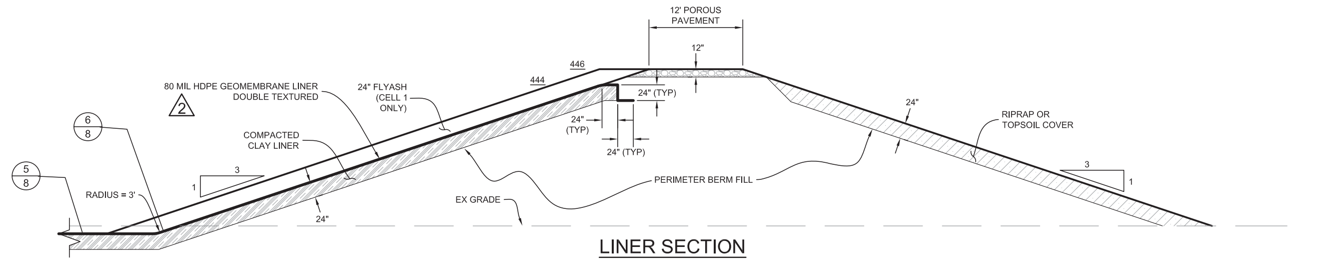


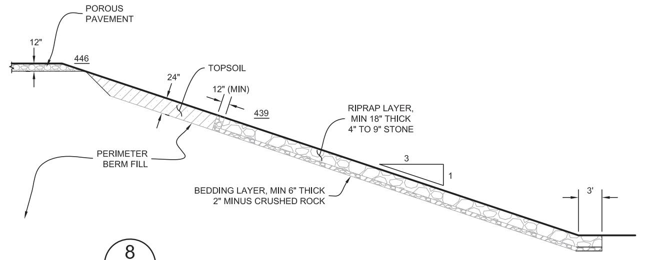
2/8 LINER SECTION STA 24+89 B TO 43+64 B
SCALE: 1" = 10'



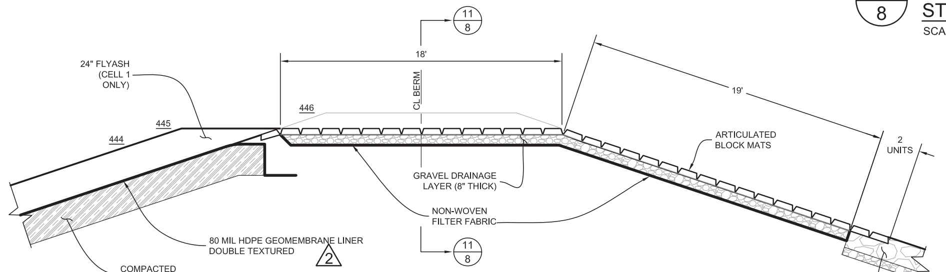
3/8 LINER SECTION STA 20+48 A TO 29+22 A
SCALE: 1" = 200'



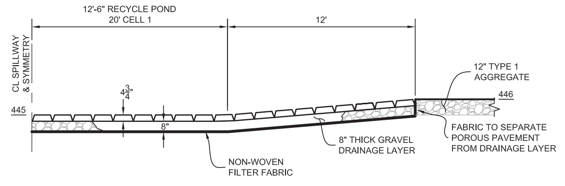
4/8 LINER SECTION STA 0+00 A TO 20+48 A STA 29+22 A TO 52+92 A STA 0+00 B TO 25+00 B
SCALE: 1" = 10'



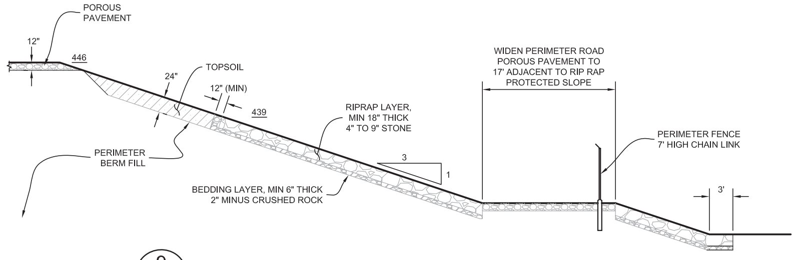
8/8 RIPRAP PROTECTION, OUTSIDE SLOPE OF PERIMETER BERM STA 31+39 A TO 5+35 C
SCALE: 1" = 10'



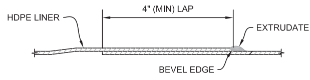
10/8 SECTION THROUGH EMERGENCY SPILLWAY STA 32+24 A STA 1+65 B
SCALE: 1" = 5'



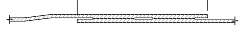
11/8 EMERGENCY SPILLWAY/ ROAD PROFILE
SCALE: 1" = 5'



9/8 RIPRAP PROTECTION, OUTSIDE SLOPE OF PERIMETER BERM STA 24+89 B TO 31+39 A
SCALE: 1" = 10'



EXTRUSION FILLET WELD



DOUBLE WEDGE FUSION WELD

7/8 FUSION AND EXTRUSION WELDS (TYP)
NO SCALE

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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 8 OF 16
GEOMEMBRANE LINER PLAN AND DETAILS

LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE ST. LOUIS, MISSOURI
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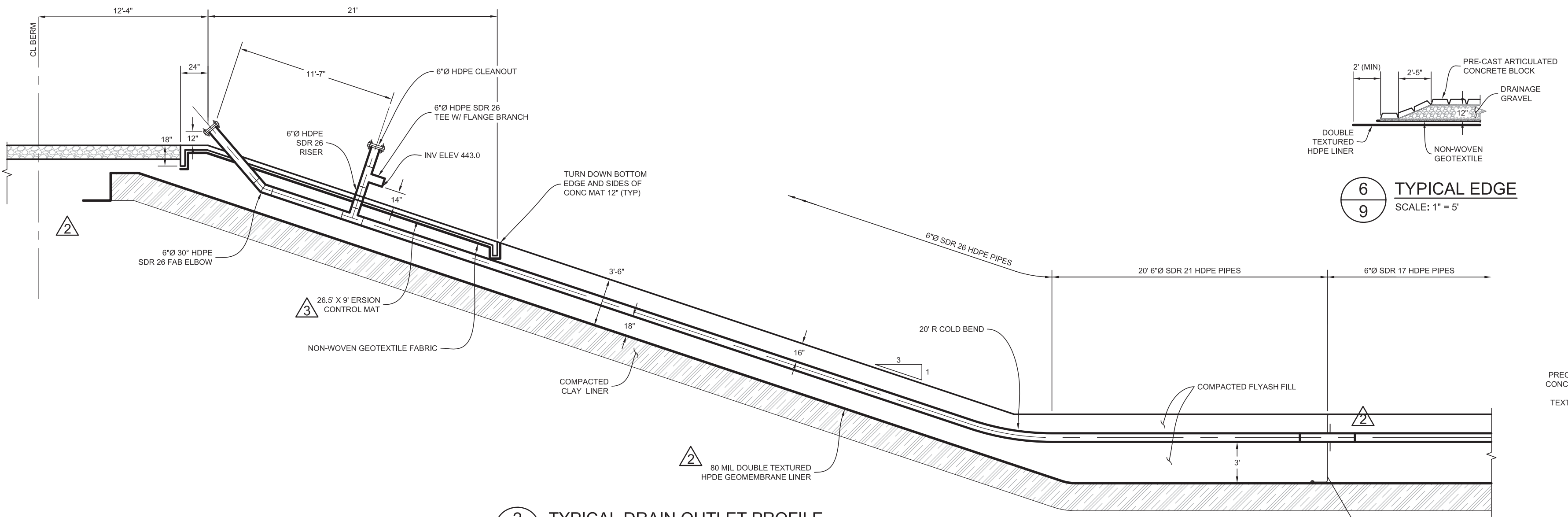
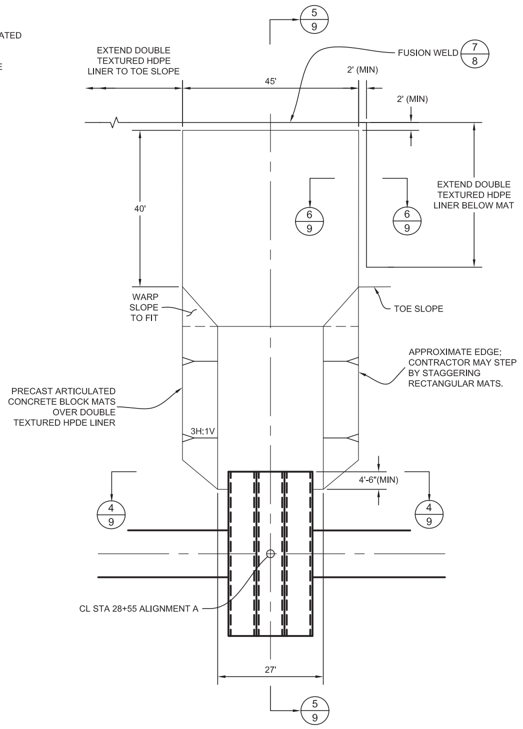


2/9 TYPICAL DRAIN OUTLET PROFILE
SCALE: 1" = 5'

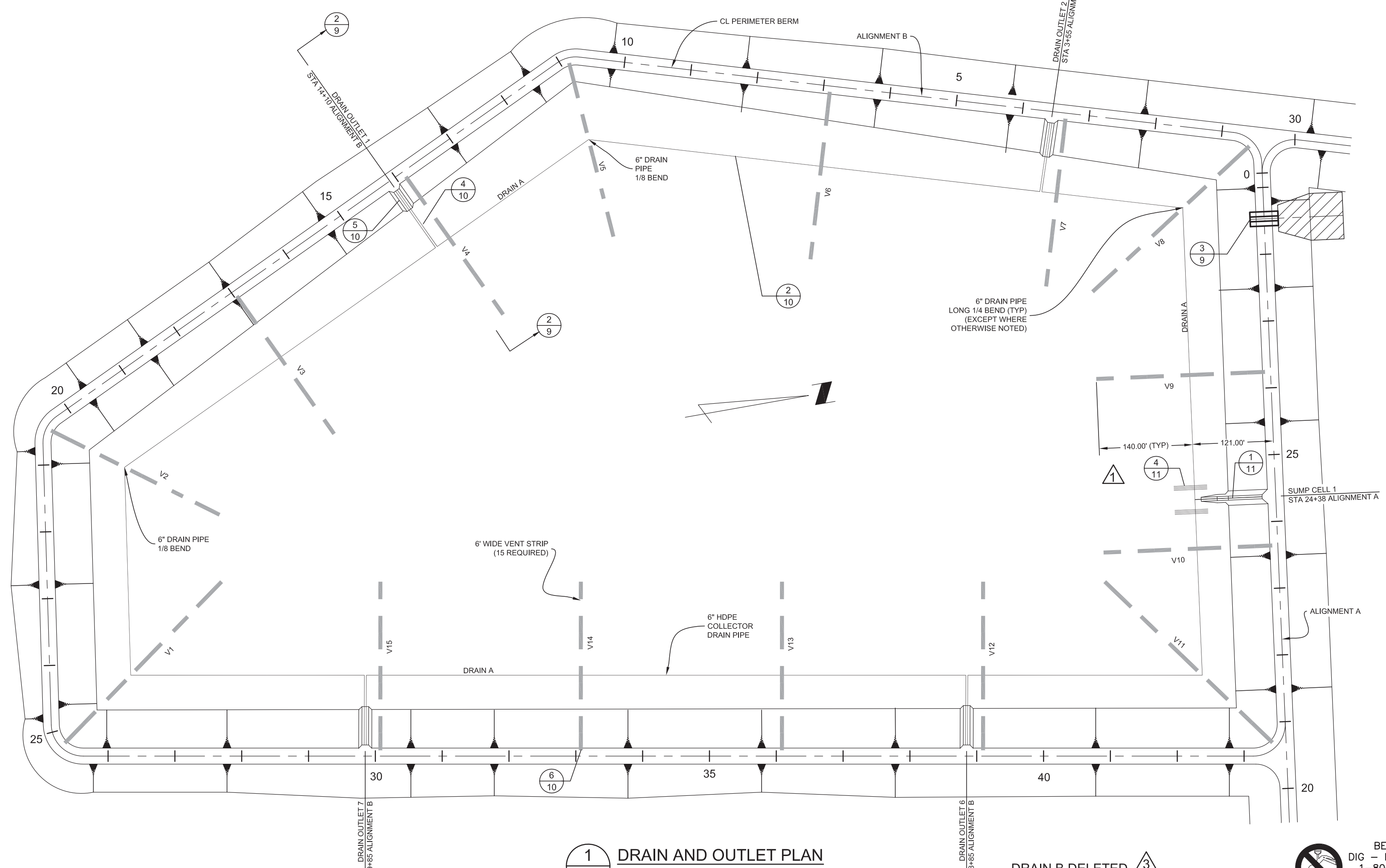
11/10

2 PIPES REQUIRED AT EACH OUTLET

6/9 TYPICAL EDGE
SCALE: 1" = 5'



3/9 RECYCLE POND INFLUENT STRUCTURE PLAN
SCALE: 1" = 20'



1/9 DRAIN AND OUTLET PLAN
SCALE: 1" = 100'

DRAIN B DELETED 3

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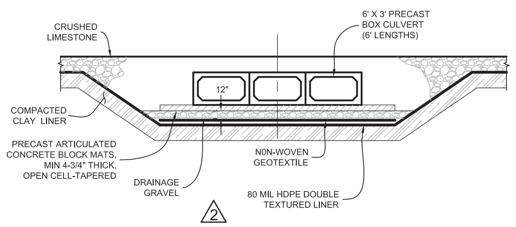

4/9 INFLUENT STRUCTURE SECTION
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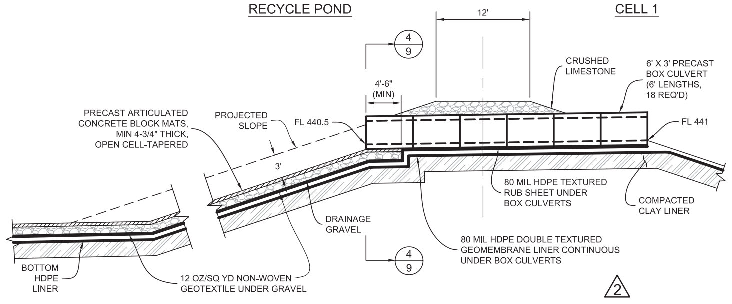

5/9 INFLUENT STRUCTURE SECTION
NO SCALE

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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 9 OF 16
RING DRAIN / OUTLET PLAN AND DETAILS

LOCATION		CLASS
001009	SIOUX PLANT	02010

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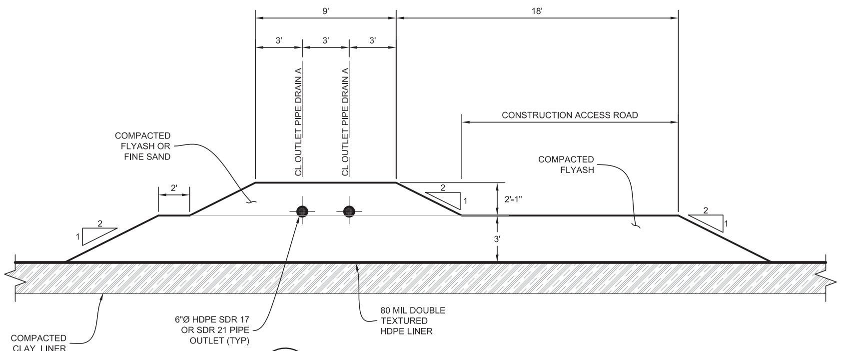
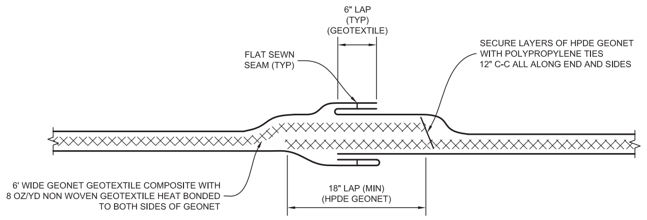


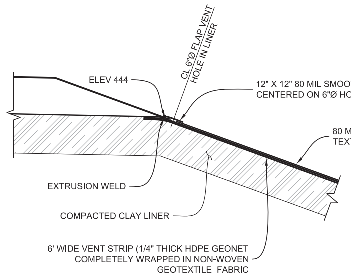
3 **4/10 DRAIN OUTLET (2 PIPES)**

SCALE: 1" = 5'



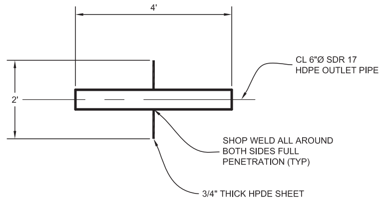
10/10 AIR VENT END TO END CONNECTION

NO SCALE



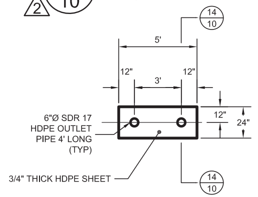
7/10 FLAP VENT SECTION

NO SCALE



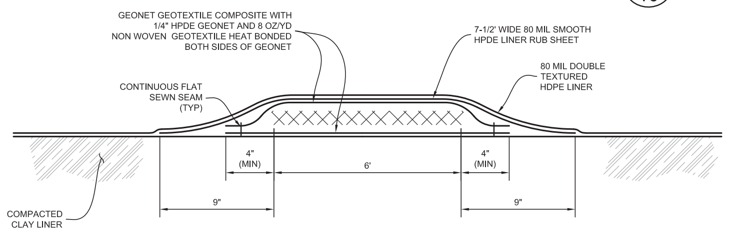
2 **14/10 OUTLET MANIFOLD SECTION**

NO SCALE



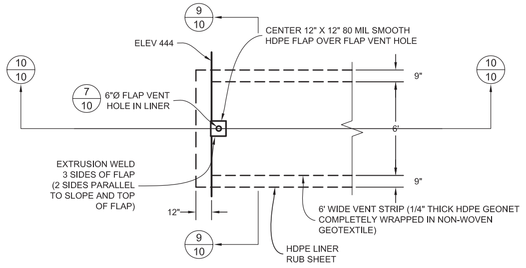
3 2 **13/10 OUTLET MANIFOLD**

NO SCALE



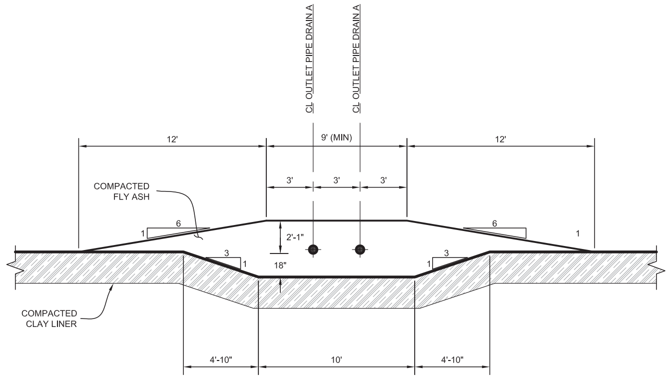
9/10 AIR VENT CROSS SECTION

NO SCALE



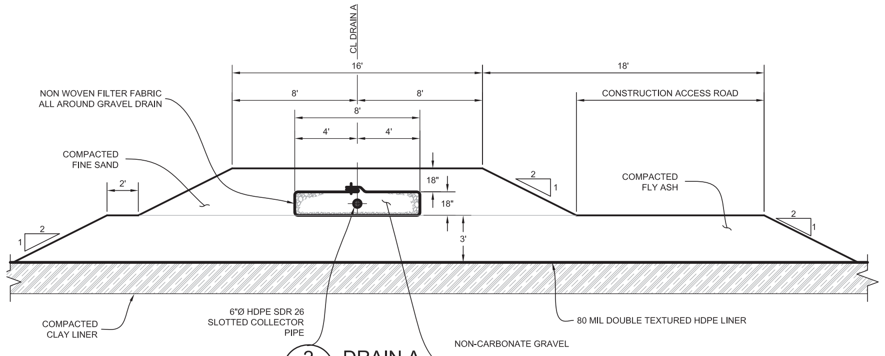
6/10 TEMPORARY FLAP VENT

NO SCALE



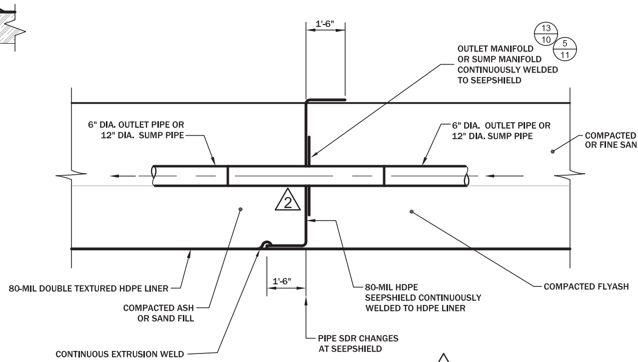
3 **5/10 DRAIN OUTLET SECTION (2 PIPES)**

SCALE: 1" = 5'



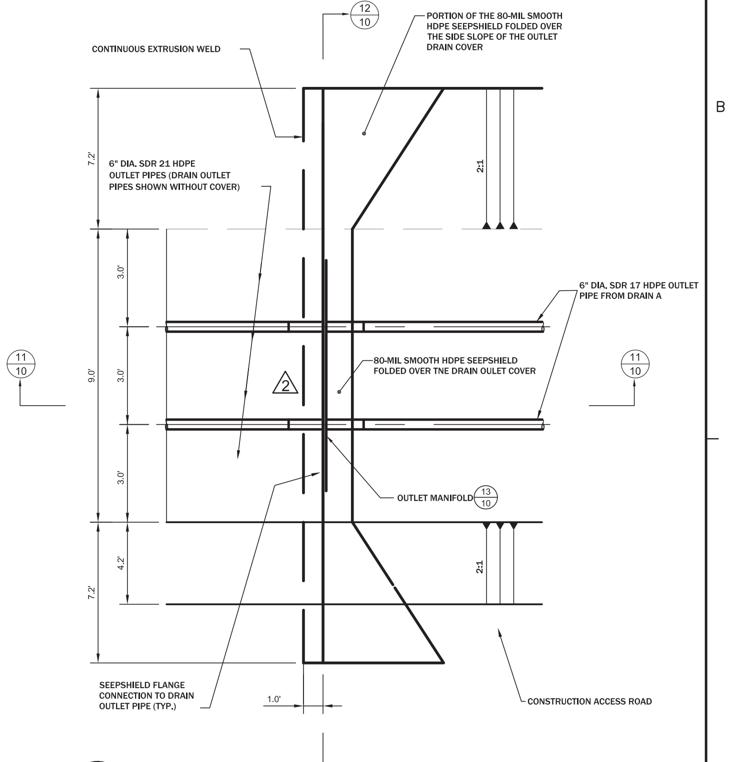
2/10 DRAIN A 3

SCALE: 1" = 5'



11/10 CROSS SECTION 3

NO SCALE

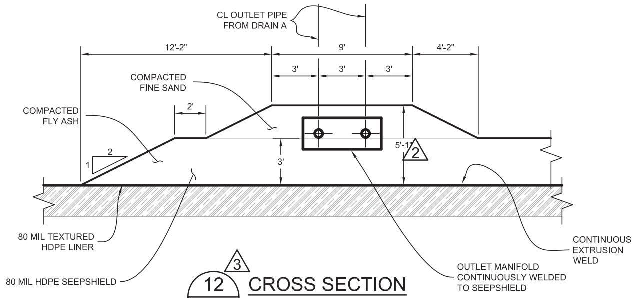


8/10 SEEPSHEILD 3

NO SCALE

12/10

3/10
1/10 OMITTED



3 **12/10 CROSS SECTION**

NO SCALE

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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 10 OF 16
RING DRAIN / OUTLET PLAN AND DETAILS

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LOCATION		CLASS
001009	SIOUX PLANT	02010

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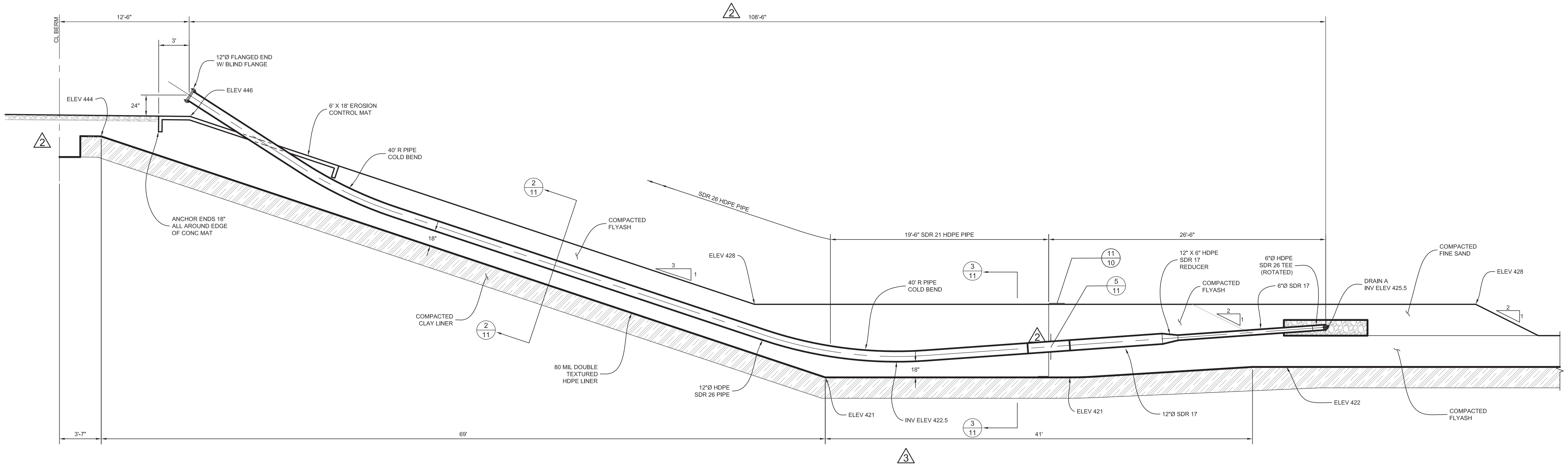

1/11 SUMP PIPE PROFILE
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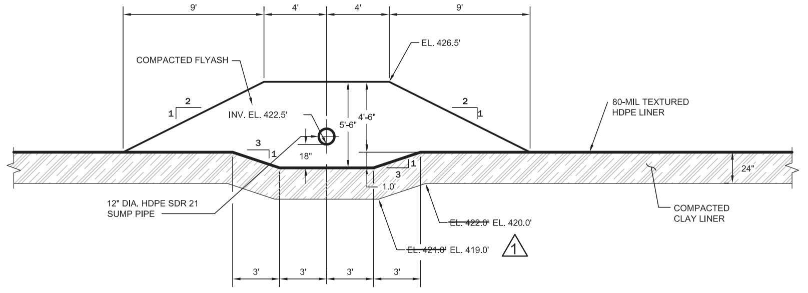
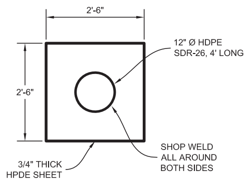


3/11 SUMP PIPE CROSS SECTION AT CELL BOTTOM
NO SCALE



5/11 SUMP MANIFOLD
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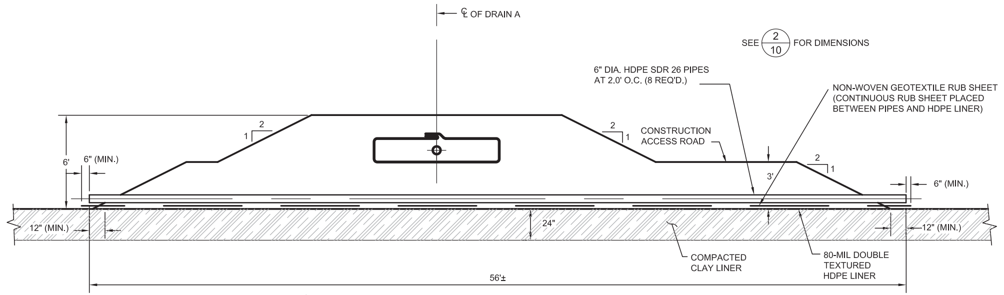
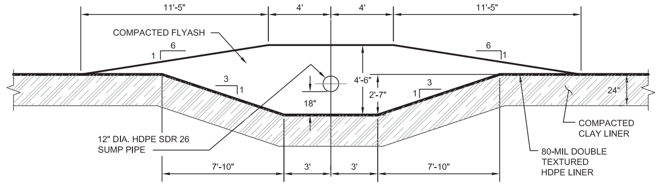


3 AT DRAIN A



2/11 SUMP PIPE CROSS SECTION ON 3:1 SLOPE
NO SCALE

4/11 OMITTED

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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 11 OF 16
RING DRAIN / OUTLET PLAN AND DETAILS

LOCATION 001009
SIOUX PLANT
CLASS 02010

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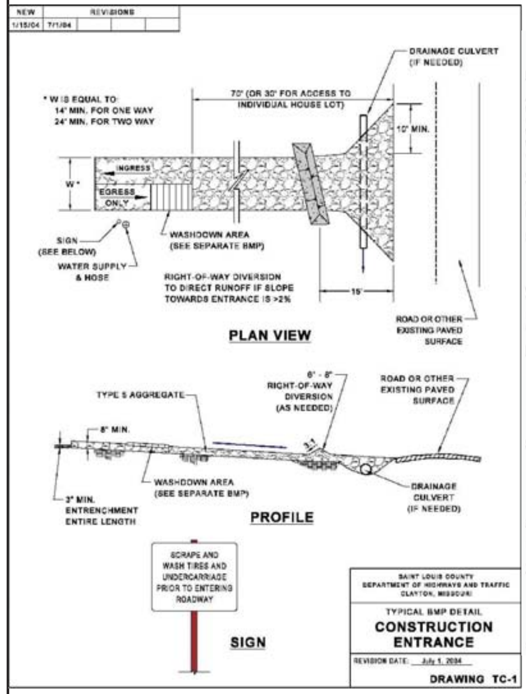
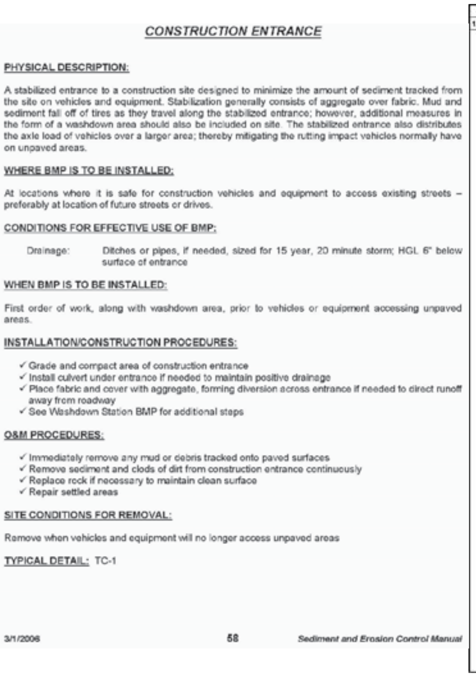




CONSTRUCTION ENTRANCE

PHYSICAL DESCRIPTION:

A stabilized entrance to a construction site designed to minimize the amount of sediment tracked from the site on vehicles and equipment. Stabilization generally consists of aggregate over fabric. Mud and sediment fall off of tires as they travel along the stabilized entrance; however, additional measures in the form of a washdown area should also be included on site. The stabilized entrance also distributes the axle load of vehicles over a larger area; thereby mitigating the rutting impact vehicles normally have on unpaved areas.

WHERE BMP IS TO BE INSTALLED:

At locations where it is safe for construction vehicles and equipment to access existing streets – preferably at location of future streets or drives.

CONDITIONS FOR EFFECTIVE USE OF BMP:

Drainage: Ditches or pipes, if needed, sized for 15 year, 20 minute storm; HGL 6" below surface of entrance

WHEN BMP IS TO BE INSTALLED:

First order of work, along with washdown area, prior to vehicles or equipment accessing unpaved areas.

INSTALLATION/CONSTRUCTION PROCEDURES:

- ✓ Grade and compact area of construction entrance
- ✓ Install culvert under entrance if needed to maintain positive drainage
- ✓ Place fabric and cover with aggregate, forming diversion across entrance if needed to direct runoff away from roadway
- ✓ See Washdown Station BMP for additional steps

O&M PROCEDURES:

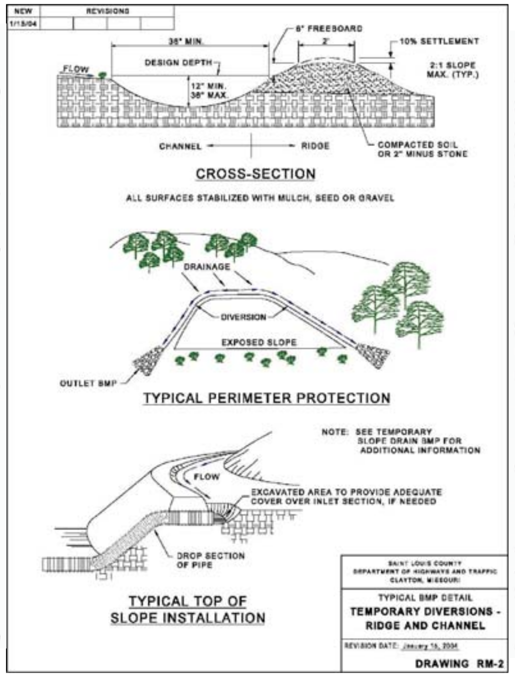
- ✓ Immediately remove any mud or debris tracked onto paved surfaces
- ✓ Remove sediment and clods of dirt from construction entrance continuously
- ✓ Replace rock if necessary to maintain clean surface
- ✓ Repair settled areas

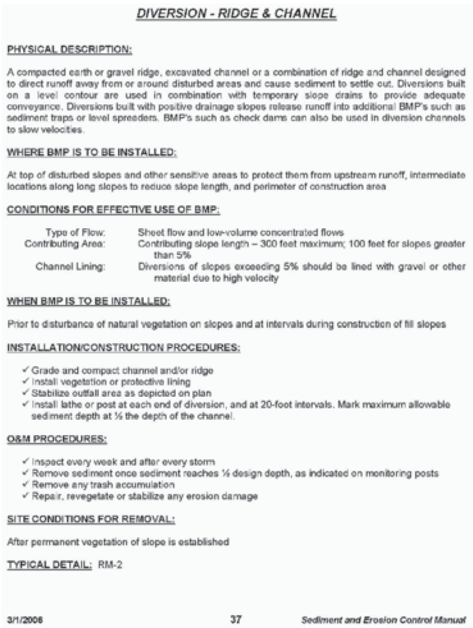
SITE CONDITIONS FOR REMOVAL:

Remove when vehicles and equipment will no longer access unpaved areas

TYPICAL DETAIL: TC-1

3/1/2006 58 *Sediment and Erosion Control Manual*





DIVERSION - RIDGE & CHANNEL

PHYSICAL DESCRIPTION:

A compacted earth or gravel ridge, excavated channel or a combination of ridge and channel designed to direct runoff away from or around disturbed areas and cause sediment to settle out. Diversions built on a level contour are used in combination with temporary slope drains to provide adequate conveyance. Diversions built with positive drainage slopes release runoff into additional BMP's such as sediment traps or level spreaders. BMP's such as check dams can also be used in diversion channels to slow velocities.

WHERE BMP IS TO BE INSTALLED:

At top of disturbed slopes and other sensitive areas to protect them from upstream runoff, intermediate locations along long slopes to reduce slope length, and perimeter of construction area

CONDITIONS FOR EFFECTIVE USE OF BMP:

Type of Flow: Sheet flow and low-volume concentrated flows
Contributing Area: Contributing slope length – 300 feet maximum; 100 feet for slopes greater than 5%
Channel Lining: Diversions of slopes exceeding 5% should be lined with gravel or other material due to high velocity

WHEN BMP IS TO BE INSTALLED:

Prior to disturbance of natural vegetation on slopes and at intervals during construction of fill slopes

INSTALLATION/CONSTRUCTION PROCEDURES:

- ✓ Grade and compact channel and/or ridge
- ✓ Install vegetation or protective lining
- ✓ Stabilize outfall area as depicted on plan
- ✓ Install lathe or post at each end of diversion, and at 20-foot intervals. Mark maximum allowable sediment depth at ½ the depth of the channel.

O&M PROCEDURES:

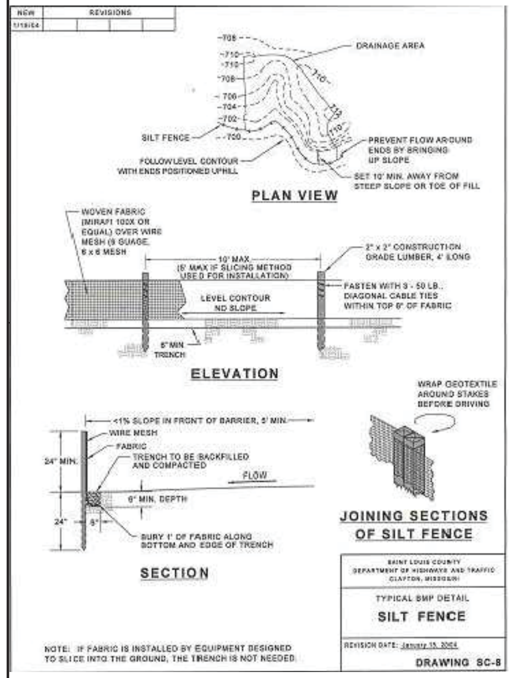
- ✓ Inspect every week and after every storm
- ✓ Remove sediment once sediment reaches ½ design depth, as indicated on monitoring posts
- ✓ Remove any trash accumulation
- ✓ Repair, revegetate or stabilize any erosion damage

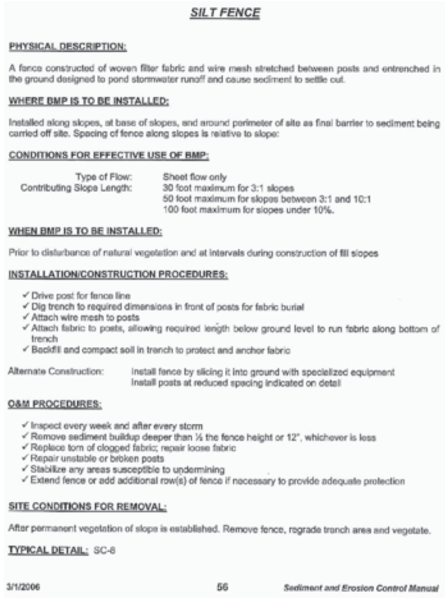
SITE CONDITIONS FOR REMOVAL:

After permanent vegetation of slope is established

TYPICAL DETAIL: RM-2

3/1/2006 37 *Sediment and Erosion Control Manual*





SILT FENCE

PHYSICAL DESCRIPTION:

A fence constructed of woven filter fabric and wire mesh stretched between posts and entrenched in the ground designed to pond stormwater runoff and cause sediment to settle out.

WHERE BMP IS TO BE INSTALLED:

Installed along slopes, at base of slopes, and around perimeter of site as final barrier to sediment being carried off site. Spacing of fence along slopes is relative to slope:

CONDITIONS FOR EFFECTIVE USE OF BMP:

Type of Flow: Sheet flow only
Contributing Slope Length: 30 foot maximum for 3:1 slopes
50 foot maximum for slopes between 3:1 and 10:1
100 foot maximum for slopes under 10%.

WHEN BMP IS TO BE INSTALLED:

Prior to disturbance of natural vegetation and at intervals during construction of fill slopes

INSTALLATION/CONSTRUCTION PROCEDURES:

- ✓ Drive post for fence line
- ✓ Dig trench to required dimensions in front of posts for fabric burial
- ✓ Attach wire mesh to posts
- ✓ Attach fabric to posts, allowing required length below ground level to run fabric along bottom of trench
- ✓ Backfill and compact soil in trench to protect and anchor fabric

Alternate Construction: Install fence by slicing it into ground with specialized equipment
Install posts at reduced spacing indicated on detail

O&M PROCEDURES:

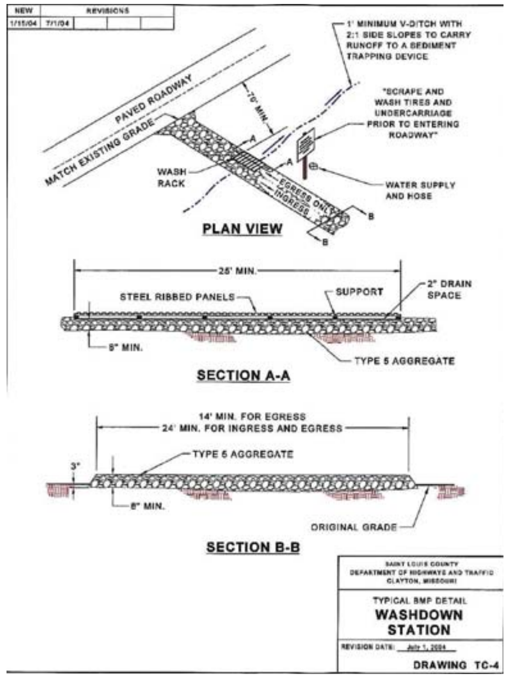
- ✓ Inspect every week and after every storm
- ✓ Remove sediment buildup deeper than ½ the fence height or 12", whichever is less
- ✓ Replace torn of clogged fabric; repair loose fabric
- ✓ Repair unstable or broken posts
- ✓ Stabilize any areas susceptible to undermining
- ✓ Extend fence or add additional row(s) of fence if necessary to provide adequate protection

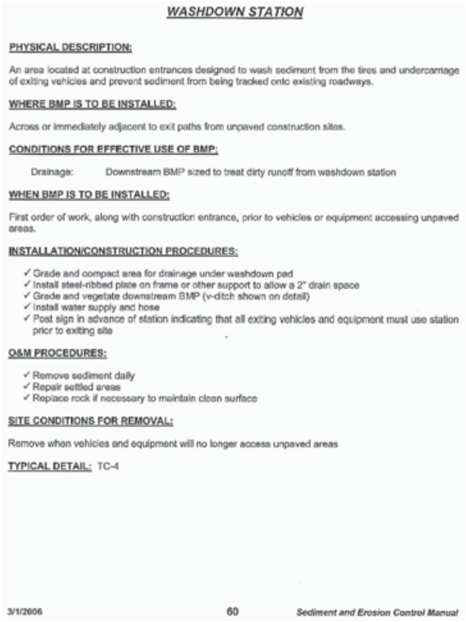
SITE CONDITIONS FOR REMOVAL:

After permanent vegetation of slope is established. Remove fence, regrade trench area and vegetate.

TYPICAL DETAIL: SC-8

3/1/2006 56 *Sediment and Erosion Control Manual*





WASHDOWN STATION

PHYSICAL DESCRIPTION:

An area located at construction entrances designed to wash sediment from the tires and undercarriage of exiting vehicles and prevent sediment from being tracked onto existing roadways.

WHERE BMP IS TO BE INSTALLED:

Across or immediately adjacent to exit paths from unpaved construction sites.

CONDITIONS FOR EFFECTIVE USE OF BMP:

Drainage: Downstream BMP sized to treat dirty runoff from washdown station

WHEN BMP IS TO BE INSTALLED:

First order of work, along with construction entrance, prior to vehicles or equipment accessing unpaved areas.

INSTALLATION/CONSTRUCTION PROCEDURES:

- ✓ Grade and compact area for drainage under washdown pad
- ✓ Install steel-ribbed plate on frame or other support to allow a 2" drain space
- ✓ Grade and vegetate downstream BMP (v-ditch shown on detail)
- ✓ Install water supply and hose
- ✓ Post sign in advance of station indicating that all exiting vehicles and equipment must use station prior to exiting site

O&M PROCEDURES:

- ✓ Remove sediment daily
- ✓ Repair settled areas
- ✓ Replace rock if necessary to maintain clean surface

SITE CONDITIONS FOR REMOVAL:

Remove when vehicles and equipment will no longer access unpaved areas

TYPICAL DETAIL: TC-4

3/1/2006 60 *Sediment and Erosion Control Manual*

SEDIMENT & EROSION CONTROL NOTES

1) Sediment and erosion control shall not be limited to the measures shown on the plans. The contractor, with the approval of the County inspector, shall utilize best management practices to prevent sediment from entering adjacent properties, roadways, storm sewers, and drainageways.

2) All filled places under proposed storm and sanitary sewer lines and/or paved areas including trench backfills within and off the road right-of-way shall be compacted to 90 percent of maximum density as determined by the "Modified AASHTO T-180 Compaction Test" (ASTM D-1557). All tests shall be verified by a Soils Engineer concurrent with grading and backfilling operations.

3) All filled places in proposed and existing St. Charles County roads (highways) shall be compacted from the bottom of the fill up to 90 percent maximum density as determined by the "Modified AASHTO T-180 Compaction Test" (ASTM D-1557). Paved areas in cuts shall meet the same compaction requirements. All tests shall be verified by a Soils Engineer concurrent with grading operations.

4) Any wells and/or springs which may exist on this property should be located and sealed in a manner acceptable to the St. Charles County Highway Department and the Building Division of the Community Development Department.

5) All trash and debris on-site, either existing or from construction, must be removed and properly disposed of off-site.

6) Debris and foundation material from any existing on-site building or structure which is scheduled to be razed for this development must be properly disposed of off-site.

7) Soft soils in the bottom and banks of any existing or former pond sites or tributaries or any sediment basins or traps should be removed, spread out and permitted to dry sufficiently to be used as fill. None of this material should be placed in proposed public right-of-way locations or on any storm sewer location.

8) A Pre-Construction Conference must be scheduled with the Director of Development Review prior to the start of each construction phase of land disturbance activity. The Permitee will be responsible for notifying all contractors, utility crews, and other entities that will perform work at the site to be in attendance.

9) Please notify the Erosion Control Inspector of the Community Development Department a minimum of 48 hours prior to the commencement of clearing, grading, and/or prior to the commencement of construction to arrange for an inspection of the site.

10) All excavations, grading, or filling shall have a finished grade not to exceed a 3:1 slope (33%).

11) Temporary siltation control measures (structural) shall be maintained until vegetative cover is established at a sufficient density to provide erosion control on the site.

12) Upon completion of storm sewers, siltation control shall be provided around all open sewer inlets and shall remain until the disturbed drainage areas have been properly stabilized.

13) Where natural vegetation is removed during grading, vegetation shall be re-established in such a density as to prevent erosion.

14) When mechanized land clearing activities are completed or suspended for more than 30 days, either temporary vegetation must be established or temporary siltation control measures must be put in place with the review and approval of the Director of the Division of Development Review.

15) Construction entrances with washdown stations shall be installed and maintained at all entrances used during construction. All water needed to wash down vehicles shall be provided by the contractor.

16) Total area of on-site land distubance = 130 acres.

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PREPARED FOR AmerenUE

DRAWN M.R.F.
CHKD. J.L.F.
SUPV.
APPD.

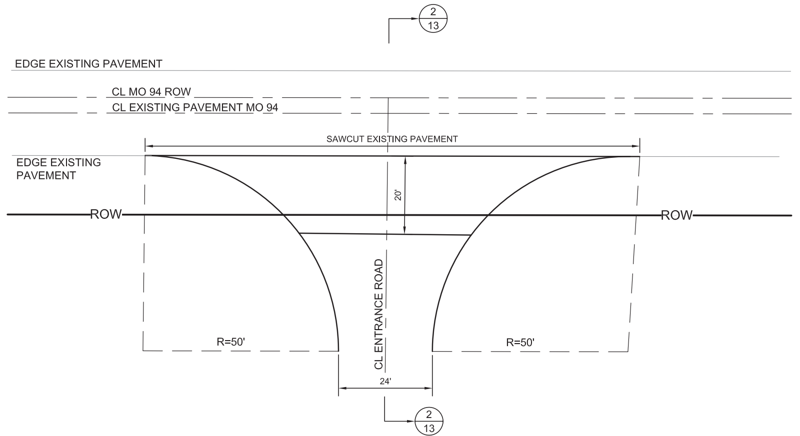
SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 12 OF 16
SEDIMENT AND EROSION CONTROL DETAILS

LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE ST. LOUIS, MISSOURI
8430-Y-0168612
REV. 4

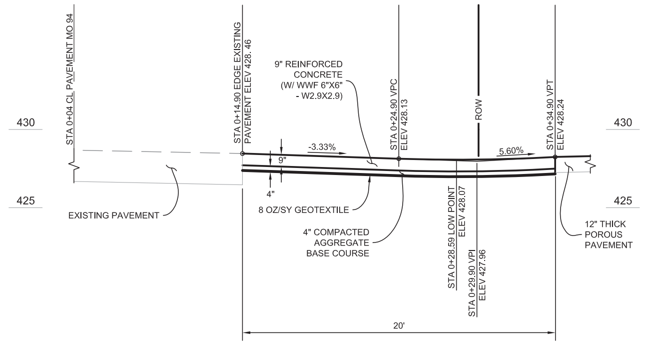
PRINT DIST.

REVISIONS		
REV.	W.O.	
0		4/03/08
2		4/09/09
3		11/2/09
4		6/7/10



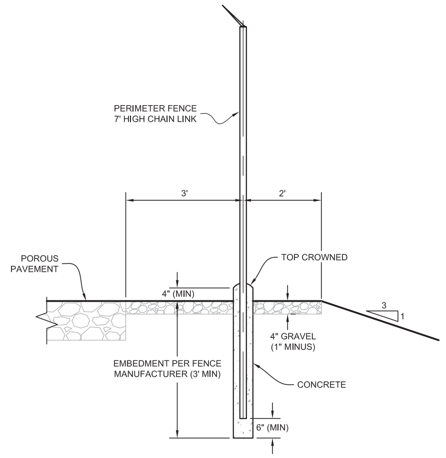
1/13 ENTRANCE DETAIL PLAN VIEW

SCALE: 1" = 20'



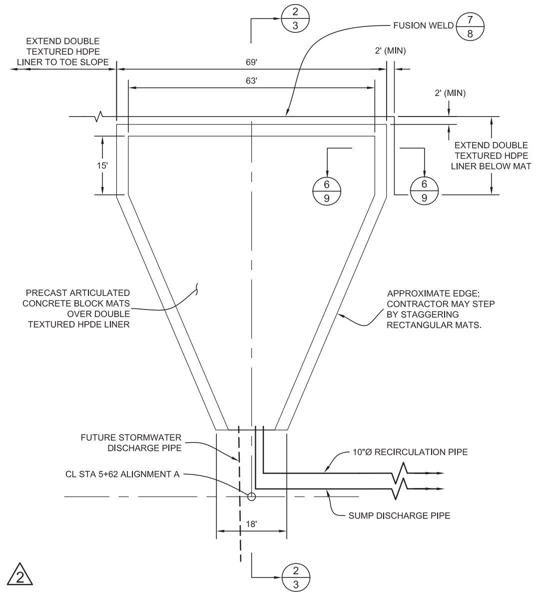
2/13 ENTRANCE CL PROFILE

SCALE: 1" = 5'



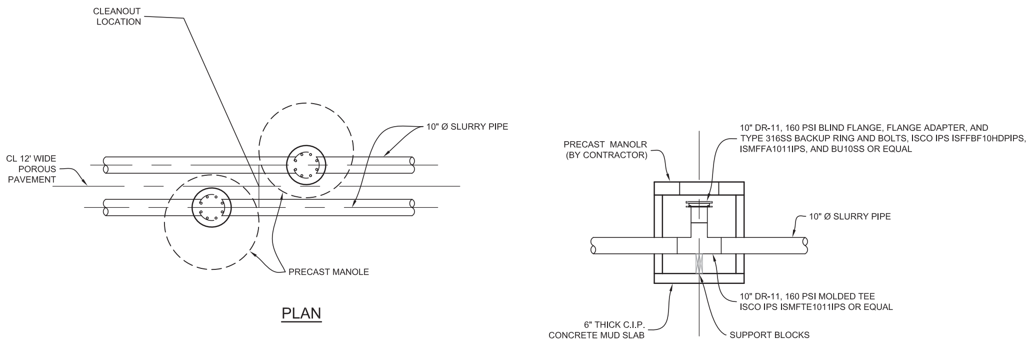
5/13 TYPICAL PERIMETER FENCE INSTALLATION DETAIL

NO SCALE



6/13 RECIRCULATION DISCHARGE STRUCTURE PLAN

SCALE: 1" = 20'

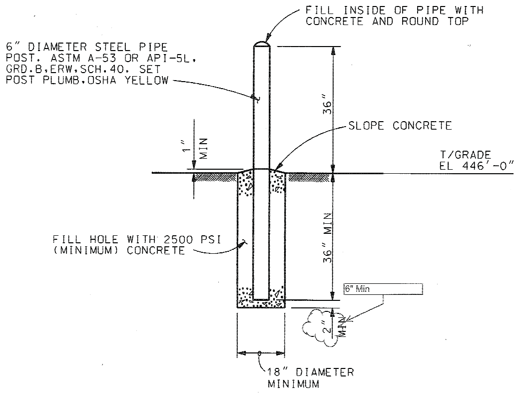


PLAN

TYPICAL SECTION

7/13 SLURRY PIPE CLEANOUT

NO SCALE:



8/13 PIPE BOLLARD

NO SCALE:

3/13 4/13 OMITTED

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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 13 OF 16
MISCELLANEOUS DETAILS 2

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APPENDIX B

PERIODIC HAZARD CLASSIFICATION

AMEREN MISSOURI SIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. CHARLES COUNTY, MISSOURI

APPENDIX B: PERIODIC HAZARD POTENTIAL CLASSIFICATION
257.73(a)(2)

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AMEREN MISSOURI SIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
ST. CHARLES COUNTY, MISSOURI

APPENDIX B: PERIODIC HAZARD POTENTIAL CLASSIFICATION §257.73(a)(2)

1.0 INTRODUCTION

The Sioux Energy Center (SEC) is located in northeast St. Charles County, Missouri along the Mississippi River, approximately 14 miles upstream of the confluence with the Missouri River and approximately 3 miles east of Portage de Sioux, Missouri. The SEC is located within the floodplain of the Mississippi and Missouri Rivers and has three active CCR surface impoundments within an approximate 149-acre area. The CCR surface impoundments, designated as Bottom Ash Pond (SCPA), Fly Ash Pond (SCPB) and Gypsum Pond, Cell 1 (SCPC), are used for managing coal combustion residuals (CCR). SCPA and SCPB have been dewatered and are currently being closed. SCPC is currently actively receiving CCRs. Before closure, pooled water from SCPA and SCPB discharged through NPDES permitted outfalls into Poeling Lake. Decant water in SCPC discharges into the Recycle Pond where pumps recirculate the water back to the power plant. A map showing the location of the surface impoundments and the Recycle Pond is attached as Figure 1.

1.1 Purpose

40 CFR Part §257.73(a)(2) requires the owner or operator of an existing surface impoundment to conduct an initial and periodic hazard potential classification assessment of the CCR unit. The owner or operator must document the hazard classification of each CCR unit as either a high hazard potential CCR surface impoundment, a significant hazard potential CCR surface impoundment, or a low hazard potential CCR surface impoundment. The owner or operator must obtain a certification from a qualified professional engineer stating that the initial and each subsequent periodic classification was conducted in accordance with the requirements of §257.73(a)(2). The following documents Reitz & Jens, Inc.'s initial hazard potential classification evaluation for active surface impoundments; SCPA, SCPB and SCPC at the Ameren Missouri Sioux Energy Center.

2.0 SIOUX ENEREGY CENTER CCR UNITS

The Sioux Energy Center has three active surface impoundments, SCPA, SCPB and SCPC. The surface impoundments are incised with perimeter berms extending above the natural ground surface. The surface impoundment locations and the centerline of the embankments are shown in Figure 1.

The initial hazard potential classifications were determined for the active surface impoundments at the Sioux Energy Center based on the Federal Emergency Management Agency (FEMA) hazard potential classification criteria. Pertinent data regarding each surface impoundment are shown in Table 1.

Table 1 – Active Surface Impoundments at the Sioux Energy Center

CCR Unit	Maximum Surface Area (acres)	Dam Height (feet)	Crest Length (feet)	Normal Pool Elevation (feet)
SCPA (Bottom Ash Pond)	49.1	27	6,700	NA
SCPB (Fly Ash Pond)	62.0	22	7,900	NA
SCPC (Cell 1 – Gypsum)	37.3	24	5,200	441.0

The FEMA classification system has three levels of Hazard Potential Classification: Low, Significant, and High. The hazard potential classification system categorizes dams based on the probable loss of human life and the impacts on economic, environmental, and lifeline interests should the dam fail. The classification system relies heavily on judgement and common sense, because all possibilities cannot be defined. Allowances for evacuation or emergency actions by the population were not considered because emergency procedures should not be a substitute for appropriate design, construction, and maintenance of dam structures. A summary for the FEMA hazard classification system of dams is shown in Table 2.

Table 2 - FEMA Hazard Classification System of Dams

Hazard Potential Classification	Loss of Human Life	Economic, Environmental, Lifeline Losses
Low	None expected	Low and generally limited to owner
Significant	None expected	Yes
High	Probable. One or more expected	Yes (but not necessary for this classification)

2.1 SCPA (Bottom Ash Pond)

The SCPA is incised with an earth fill embankment dam. The pond is bound by plant fill to the east and northeast, and the embankment dam ties into the plant fill. The dam has a crest length of 6,700 lineal feet, a crest width of 10 feet, and the steepness of the side slopes varies from 2 horizontal (H) to 1 vertical (V) to 2.5H to 1V. The maximum height of the dam is 27 feet. The pond historically received process water used to sluice bottom ash, and flow from the plant combined drained sump (CDS). Currently the pond is being closed and no longer receives flow from either of these sources. Stormwater falling within the footprint of the impoundment is actively managed by the closure contractor to prevent overtopping.

Failure of the SCPA would result in the release of water and CCR into Poeling Lake and/or the Brick House Slough. Failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner. Therefore, according to the FEMA Hazard Potential Classification of Dams, the SCPA should have a Low Hazard Potential Classification.

2.2 SCPB (Fly Ash Pond)

The SCPB is incised with a compacted earth fill embankment dam. The pond is bound to the north and east by plant fill, and the embankment section is thickened to the south by a railroad embankment, and to the west by the plant access road. The dam has a crest length of 7,900 lineal feet, minimum crest width of 20 feet, and the steepness of the side slopes varies from 2H to 1V to 3H to 1V. The maximum height of the dam is 24 feet. The pond historically received process water used to sluice fly ash and stormwater runoff from the coal pile. The pond is currently being closed and no longer receives process or coal pile stormwater runoff. Stormwater falling within the footprint of the impoundment is actively managed by the closure contractor to prevent overtopping.

Failure of the SCPB would result in the release of water and CCR into the surrounding Ameren property and/or Poeling Lake. Failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner. Therefore, according to the FEMA Hazard Potential Classification of Dams, the SCPB should have a Low Hazard Potential Classification.

2.3 SCPC (Cell 1)

SCPC is incised with a compacted earth fill embankment dam. The dam has a crest length of 5,200 lineal feet, minimum crest width of 12 feet, and the steepness of the side slopes is 3H to 1V. Currently, the maximum height of the dam is 22 feet. Gypsum slurry discharges into the cell at the approximate midpoint of the east embankment. The gypsum settles out into the pond and decant water flows into the Recycle Pond through a set of triple box culverts with an invert elevation of 441 feet. SCPC also has an emergency spillway on the west side of the impoundment. The bottom and side slopes of SCPC are lined with 80-mil HDPE liner, which was constructed over 24 inches of compacted, impervious clay.

Failure of SCPC would result in the release of water and CCR into the surrounding Ameren property and adjacent agricultural fields. Failure of the impoundment is not expected to cause a loss of human life, and the economic, environmental and lifeline losses are expected to be low and generally limited to the owner.

Therefore, according to the FEMA Hazard Potential Classification of Dams, the Cell 1 – Gypsum pond should have a Low Hazard Potential Classification.

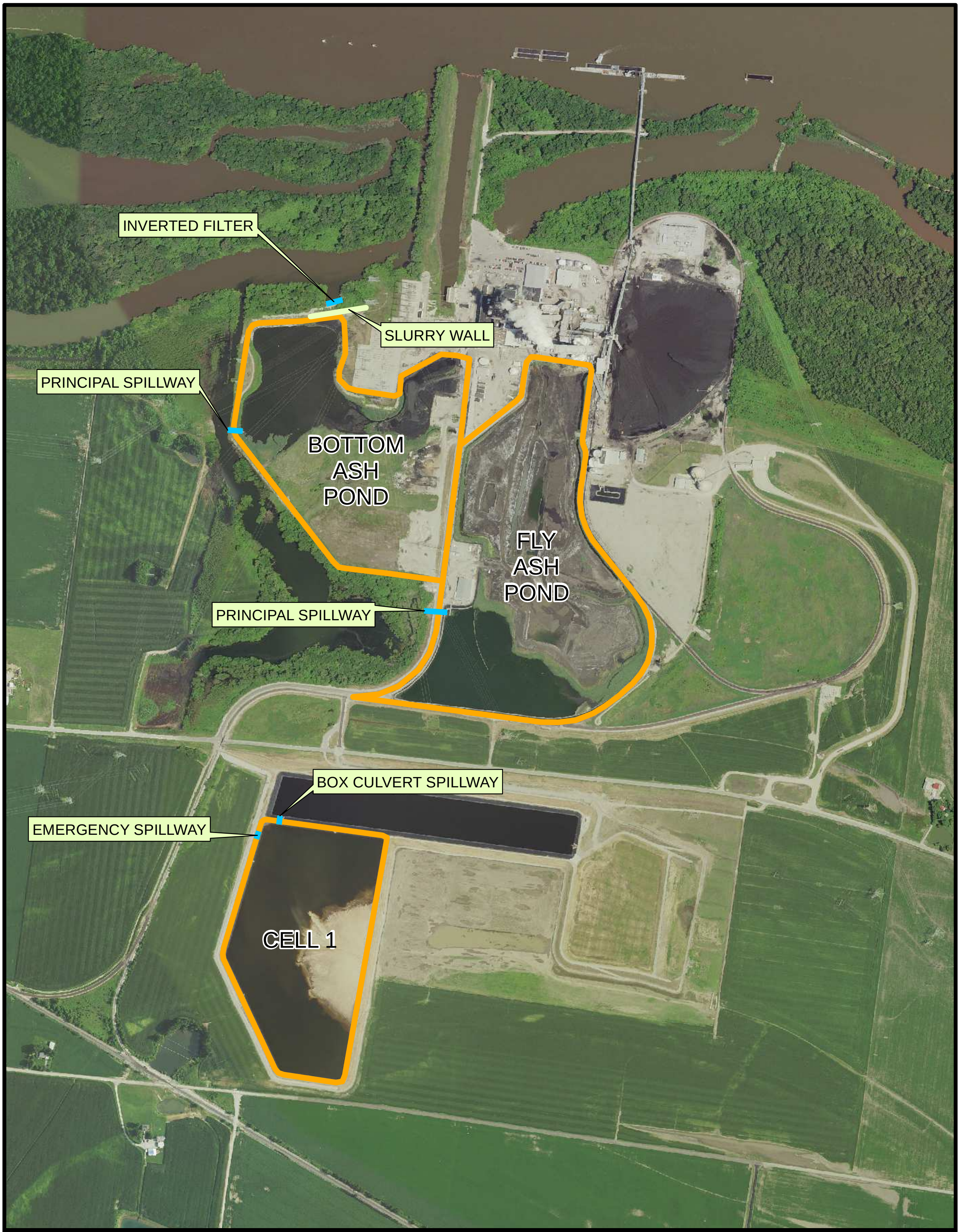
3.0 CONCLUSION

The initial hazard potential classifications for the active CCR surface impoundments at the Sioux Energy Center is Low Hazard Potential for the SCPA, SCPB and SCPC. The hazard potential classification should be re-evaluated within 5 years of the initial hazard potential classification.

4.0 REFERENCES

Environmental Protection Agency. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." 40 CFR Parts 257 and 261., Vol. 80, No. 74.

Federal Emergency Management Agency. (2004). "Federal Guidelines for Dam Safety, Hazard Potential Classification System for Dams." Interagency Committee on Dam Safety.



AMEREN MISSOURI
SIOUX ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

REITZ & JENS, INC.
CONSULTING ENGINEERS

APPENDIX C

PERIODIC STRUCTURAL STABILITY ASSESSMENT

AMEREN MISSOURI SIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. CHARLES COUNTY, MISSOURI

APPENDIX C: PERIODIC STRUCTURAL STABILITY ASSESSMENT 257.73(d)(1)

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AMEREN MISSOURI SIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
ST. CHARLES COUNTY, MISSOURI

APPENDIX C: PERIODIC STRUCTURAL STABILITY ASSESSMENT 257.73(d)(1)

1.0 INTRODUCTION

The Sioux Energy Center (SEC) is located in northeast St. Charles County, Missouri along the Mississippi River, approximately 14 miles upstream of the confluence with the Missouri River and approximately 3 miles east of Portage de Sioux, Missouri. The SEC is located within the floodplain of the Mississippi and Missouri Rivers and has three active CCR surface impoundments within an approximate 149-acre area. The CCR surface impoundments, designated as Bottom Ash Pond (SCPA), Fly Ash Pond (SCPB) and Gypsum Pond, Cell 1 (SCPC), are used for managing coal combustion residuals (CCR). SCPA and SCPB have been dewatered and are currently being closed. SCPC is currently actively receiving CCRs. Before closure, pooled water from SCPA and SCPB discharged through NPDES permitted outfalls into Poeling Lake. Decant water in SCPC discharges into the Recycle Pond where pumps recirculate the water back to the power plant. A map showing the location of the surface impoundments and the Recycle Pond is attached as Figure 1.

1.1 Purpose

40 CFR Part 257.73(d)(1) specifies that the owner or operator of all existing CCR surface impoundments, except for incised CCR units, shall conduct initial and periodic structural stability assessments and document whether the design, construction, operation and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein.

The purpose of this periodic structural stability assessment for the SCPA, SCPB and SCPC at the Sioux Energy Center is to provide the information required by 40 CFR Part 257.73(d)(1). The periodic structural stability assessment consisted of field inspections, design and construction document review, and review of operation and maintenance records. Additional information for each CCR surface impoundment at the Sioux Energy Center is included in the History of Construction Report.

2.0 FIELD INSPECTION

A field inspection of the SCPA and SCPB, and SCPC at the Sioux Energy Center was conducted on October 14, 2020 by Reitz & Jens, Inc. personnel Jeff Bertel, PE, Laura Sutton, PE and Ashley Martinez EI; who was accompanied by Ameren Missouri personnel Marc Lueckenhoff, PE. The weather was sunny with temperatures in the 60s. The approximate Mississippi River elevation at the SEC was 419.1. The field inspection consisted of walking the crest and toe of the perimeter berms for the SCPA, SCPB and SCPC, and a visual evaluation of the hydraulic outlet structures.

Observations made during the inspection were recorded on the Ameren Annual Inspection Check Sheet for each surface impoundment and are included in Appendix I. A photograph log of the main inspection findings is also included in Appendix I. Photographs taken during the inspection are included on a DVD contained in Appendix II. Observations from the field inspection are summarized below for each CCR unit.

2.1 SCPA

2.1.1 Embankment and Foundation Stability

Field inspection of the SCPA perimeter berm found no signs of instability. There was no visible vertical or horizontal misalignment of the crest. No slides, sloughs, tension cracking, slope depressions or bulges were observed in the crest or downstream slope. Some sloughing due to wave erosion was observed on the upstream slopes at the thickened section on the west side of pond. Ameren will monitor this area and armor with riprap if additional erosion occurs.

Intermittent wet areas have been observed at the embankment toe from the discharge structure to the north for approximately 250 feet and to the south approximately 130 feet. The wet areas were above the water level in Poeling Lake. The wet areas were not observed during the current inspection. Ameren should continue to monitor these areas and record observations relative to the pond level, recent precipitation events and adjacent river levels.

Riprap along the channel bank downstream of the downstream embankment toe near the northwest corner of the impoundment has a scarp like feature at the top of the slope. This area should be monitored to determine if movement or erosion is occurring.

The downstream slopes have been inundated multiple times from Poeling Lake flooding due to high water levels in the Mississippi River and there was no sign of instability due to sudden drawdown.

Some of the animal burrows identified during previous Ameren inspections have been repaired by filling them with crushed limestone. We recommend that the crushed limestone be removed and replaced with compacted soil having similar properties to that of the surrounding soil.

There is good access at the crown of the embankment for surveillance of the crest and slopes. No operational activities or adjacent developments were observed that might threaten the integrity of the embankment.

2.1.2 Slope Protection

The upstream slopes are armored with riprap where they are subject to wave action from impounded water. The downstream slopes are armored with riprap from the toe to the crest along the south and southwest SCPA perimeter berms. This section was flattened to a 2.5H:1V slope in 2015. The downstream slope on the north and northwest sides of the impoundment are armored with riprap from the toe and to about mid-slope.

The riprap armor was visually inspected to be in good condition. Ameren had recently sprayed the riprap to control the excess vegetation; however, there are some areas with significant vegetation growth from within the riprap, especially on the north side of the impoundment. Ameren states they will monitor the riprap and adjust the frequency of spraying as needed to control vegetation within the riprap.

The embankment slopes had recently been mowed. Vegetation was generally in good condition, but the upstream slopes between the primary spillway and the closed portion of pond were covered with dense vegetation. The vegetation had been sprayed but needs to be removed. The sod cover above the riprap on the north side of the impoundment was sparse. This area should be seeded and maintained with dense sod cover.

Minor erosion was observed in crushed rock on an access ramp at the southeast corner of the impoundment. An erosion feature observed in 2019 had been repaired.

2.1.3 Hydraulic Structures

The SCPA water level could not be determined because the ponded water level was below the staff gage and spillway inlet. The impoundment was at a low level because it no longer receives sluice water or flow from the CDS. Following the periodic inspection, the pond was dewatered and is currently being closed. Stormwater falling within the footprint of the impoundment is actively managed by the closure contractor to prevent overtopping.

The spillway for the SCPA is a 30-inch reinforced concrete pipe (RCP). The 30-inch RCP inlet is connected to a concrete outlet structure that has a weir, steel bulkhead and large diameter, galvanized, corrugated, steel skimmer on the upstream side. The steel skimmer has lost some functionality because of ponded ash, so water bypassed the skimmer through a 24-inch HDPE pipe and an orifice cut in the side of the skimmer. The 24-inch HDPE pipe has been removed. The orifice cut in the skimmer is approximately 12 inches by 12 inches. The steel bulkhead routes water through a 2-foot high and 2.5-foot wide orifice that has an invert elevation of 429 feet. A manually operated sluice gate is installed to regulate flow through the orifice on the upstream side of the bulkhead. The top of the steel bulkhead is at el. 440 feet. Water then flows into the concrete outlet structure and 30-inch diameter RCP pipe. Discharge from the pipe flows through a short outlet channel that is armored with riprap and into Poeling Lake.

The spillway structure was visually inspected and in good condition. Some rust was observed on the spillway appurtenances but considering the structure will be removed with pond closure, scheduled for 2020, there is no immediate need to repair the corroded areas.

The sluice gate was tagged out in an open position. The sluice gate was not operated during the inspection, but Ameren reports it is functional.

No video inspections have been completed since August 2014. The spillway outlet pipe is scheduled to be removed during pond closure.

2.1.4 SCPA Field Investigation Conclusions

There were no significant deficiencies or signs of instability observed during the field inspection of the SCPA, however there are maintenance items and additional monitoring that should occur. The following remedial items should be addressed as soon as feasible. Ameren should prepare documentation detailing the corrective measures taken as these items are addressed.

- Continue monitoring vegetation growth along the embankment slopes and within the riprap. The embankment slopes should be maintained with a dense vegetative cover, and the riprap should be sprayed so that it is free of vegetation. The current frequency of mowing and spraying should be increased to prevent excess vegetation growth.
- Continue monitoring the wet areas 130 feet south of the discharge structure and from the discharge structure and north 250 feet. Monitoring should include documenting observations of the area relative to pond levels, recent precipitation events and adjacent river levels. If at any time water is observed flowing and carrying fines in this area, take immediate action as required to prevent degradation of the integrity of the embankment and foundation soils.
- Continue monitoring the embankments for gulley erosion at concentrated flow points. Consider rerouting runoff flow to areas that are sufficiently armored to prevent erosion.
- When observed, animal burrows should be excavated to find their extent, and filled with compacted soil that has similar properties to that of the surrounding soil.

2.2 SCPB

2.2.1 Embankment and Foundation Stability

Field inspection of the SCPB perimeter berm found no signs of instability. There was no visible vertical or horizontal misalignment of the crest. No slides, sloughs, tension cracking, slope depressions or bulges were observed in the crest or either slope.

Ponding and wetness were observed at the downstream toe of the west embankment approximately 290 feet south of the outfall. There was no flowing water observed. This condition appears unchanged based on descriptions of observation from past inspections. Ameren will monitor this area and make observations relative to pond level, recent rain events and river level.

Portions of the downstream slopes have been inundated due to high water levels in the Mississippi River and there was no sign of instability due to sudden drawdown.

There is good access at the crown of the embankment for surveillance of the crest and slopes. No operational activities or adjacent developments were observed that might threaten the integrity of the embankment.

2.2.2 Slope Protection

The upstream slopes of the SCPB perimeter berm are lined with 60-mil HDPE. The downstream slopes are adequately vegetated and were recently mowed prior to visual inspection.

An erosion gully was observed on the southeast downstream slope. The gulley has been noted in past inspections. The gulley is vegetated and does not appear to be actively eroding. The gulley should be monitored and repaired if additional erosion occurs.

2.2.3 Hydraulic Structures

The SCPB water level was below the staff gage. The impoundment was at a low level because it no longer receives sluice water or stormwater flow from the coal pile. The pond is being dewatered for active closure construction. Stormwater falling within the footprint of the impoundment is actively managed by the closure contractor to prevent overtopping.

The principal spillway for the SCPB consists of an 18-inch HDPE pipe with an upturned inlet to elevation 434.5 feet. The downstream invert elevation is at elevation 430 feet where discharged water is routed into Poeling Lake. The flow through the discharge pipe is regulated by two motor operated butterfly valves. The valves were demonstrated to be functional and appear to be in good condition. The outlet and inlet piping were visually inspected and determined to be in good condition. The outlet channel was observed to be in good condition with no obstructions to flow and no significant displacement of riprap in the stilling basin.

No video inspections have been completed since August 2014. The spillway outlet pipe is scheduled to be removed during pond closure.

2.2.4 SCPB Field Investigation Conclusions

There were no significant deficiencies or signs of instability observed during the field inspection of the SCPB, however there are maintenance items or additional monitoring that should occur. The following remedial items should be addressed as soon as feasible. Ameren should prepare documentation detailing the corrective measures taken as these items are addressed.

- Continue monitoring the wet area 290 feet south of the outlet pipe. Monitoring should include documenting observations of the area relative to pond levels, recent precipitation events and adjacent river levels. If at any time water is observed flowing and carrying fines in this area, take immediate action as required to prevent degradation of the integrity of the embankment and foundation soils.
- Continue monitoring the condition of the staff gage and perform maintenance as needed so at least one reference elevation on the gage is legible.
- Continue monitoring the embankment for ruts, and erosion at concentrated flow points. Consider routing runoff to areas that are sufficiently armored to prevent erosion.

2.3 SCPC

2.3.1 Embankment and Foundation Stability

Field inspection of the SCPC pond perimeter berm found no signs of instability. There was no visible vertical or horizontal misalignment of the crest. No slides, sloughs, tension cracking, slope depressions or bulges were observed in the crest or either slope. There was no visible sign of seepage along the perimeter embankment toe.

There is good access at the crown of the embankment for visually reviewing the crest and slopes. No operational activities or adjacent developments were observed that might threaten the integrity of the embankment.

2.3.2 Slope Protection

The upstream slopes of the SCPC pond perimeter berm are lined with 80-mil HDPE. The vegetated downstream slopes were recently mowed and in good condition. The riprap on the downstream slopes was free of vegetation and in good condition.

Minor gulley erosion was observed on the southeast access ramp. The erosion did not impede access. Ameren states they will continue to monitor and address the erosion through their work control process.

Erosion was observed around the concrete pads for the sump pipe and the drain outlets. Ameren will monitor these structures and fill any voids beneath the concrete pads if cracking or movement is observed.

2.3.3 Hydraulic Structures

The SCPC water level was observed to be at elevation 441.1 feet at the time of inspection. The principal spillway for the pond is a set of triple box culverts with an invert elevation of 441 feet. Flow was observed through the principal spillway. The box culverts facilitate gravity flow of pond decant water to the Recycling Pond. The box culverts were observed to be in good condition. The downstream box culvert on the west side appears offset approximately 1 inch downstream. Pictures from the original construction indicate that the box culverts may have initially been placed with an offset. Monitor the offset between the two wester box culverts to see if there is movement occurring.

The point of discharge of gypsum process water is below the surrounding gypsum level and is only unobstructed because it has scoured a hole. Install a hose and adjust the point of discharge so that flow is not obstructed.

The emergency spillway for the pond was observed to be in good condition. Ponded water from SCPC has never flowed over the emergency spillway.

2.3.4 SCPC - Gypsum Field Investigation Conclusions

There were no significant deficiencies or signs of instability observed during the field inspection of SCPC, however there are maintenance items or additional monitoring that should occur. The following remedial items should be addressed as soon as feasible. Ameren should prepare documentation detailing the corrective measures taken as these items are addressed.

- Monitor box culvert on the west side to determine if it is actively moving.
- Install a hose and adjust the point of gypsum slurry discharge so that flow is not obstructed.

3.0 OPERATIONS AND MAINTENANCE REVIEW

The available operations and maintenance records were reviewed as part of the periodic structural stability assessment. The review included the Sioux Fly Ash and SCPA Embankment Operation and Maintenance (O&M) Manual, O&M Manual for SCPC and Recycle Pond, the preceding weekly and annual inspections for a period of 1-year, on-site meetings to discuss ongoing maintenance, and the most recent survey data provided by Ameren Missouri.

The O&M Manuals specifies minimum requirements for maintenance and establishes operational requirements for CCR placement. The manual states that no alterations or repairs to structural elements should be made without the approval of the Chief Dam Safety Engineer. The O&M Manuals are attached in Appendix A of the *Ameren Missouri Sioux Energy Center: Evaluation of CCR Units* report.

3.1 SCPA

3.1.1 Operations

The SCPA historically received flow from the combined drain sump (CDS) and bottom ash sluice flow. Currently the pond is being closed and no longer receives flow from either of these sources. When active, sluice flow was conveyed east to west through interior pond ditches created in the CCR. Bottom ash deposited on the east side of the pond was primarily consumed for beneficial use. As a result, the volume of impounded CCRs in this ponds has changed very little over the last several years. There have been no recent operational changes. Field observations and aerial photographs show that there has been little change to the volume of impounded CCR since the most recent topographic survey in 2019.

Table 1 includes pertinent data regarding the volume and depth of impounded CCR in the SCPA. During the field investigation on October 14, 2020 there was no visually identifiable change to the minimum or maximum depth of CCR from that shown in the 2019 topographic survey. The estimated remaining storage capacity for the pond is 1,720,144 cubic yards.

Table 1 – Volume and Depth of Impounded CCR in the SCPA

CCR Unit	Est. Volume of Water and CCR (CY)	Est. Bottom Elev. of CCR Unit (feet)	Est. Minimum CCR Elev. (feet)	Est. Minimum Depth of CCR (feet)	Est. Maximum CCR Elev. (feet)	Est. Maximum Depth of CCR (feet)
SCPA (Bottom Ash Pond)	1,680,338	400	422	22	445	45

The SCPA has a water level staff gage. Ameren measures and records pool levels during weekly inspections.

3.1.2 Maintenance

Weekly inspection check sheets from October 2019 through July 2020, and the 2019 annual inspection check sheet were reviewed. The following is a summary of observations from these inspections and their condition during the current inspection.

The 2019 annual inspection found the perimeter embankment and spillway in good condition. The inspection did note an erosion feature on the downstream slope near the guardhouse and multiple animal burrows on the west and north embankment downstream slopes. The erosion feature was repaired and an armored swale constructed prior to the current inspection. The animal burrows were also filled, but with crushed rock. Animal burrows should be filled with compacted soil that has similar properties to that of the surrounding soil.

No items were observed during the weekly or annual inspections requiring immediate maintenance. In general, the inspection reports indicate that the level of maintenance within the last year is adequate, and nearly all deficiencies recorded during weekly and annual inspection reports within the last year have been addressed. The current frequency of vegetation maintenance should be increased to prevent excess vegetation growth and to promote a dense vegetative cover. The 2019 Sioux Annual Levee Inspection is included in Appendix I.

The O&M Manual states that all maintenance activities should be documented; however no maintenance records were available for review. The O&M Manual should be updated so that the responsibility and procedures for maintaining maintenance records are clearly defined.

3.2 SCPB

3.2.1 Operations

The SCPB historically received process water used to sluice fly ash and stormwater runoff from the coal pile. The pond no longer receives process water or stormwater runoff from the coal pile. The SCPB has been dewatered and is currently being closed. Flow through the SCPB is conveyed north to south through interior pond ditches created in the CCR. Decant water accumulates in the southwest corner before discharging through the outlet works. The interior of the pond is currently being graded to facilitate drainage post-closure. A significant portion of the pond has been filled. The pond level was at the invert elevation of the principal spillway. Stormwater falling within the footprint of the impoundment is actively managed by the closure contractor to prevent overtopping.

Table 2 includes pertinent data regarding the volume and depth of impounded CCR in the SCPB based on 2019 topographic survey. The approximate remaining storage volume is 41,564 cubic yards. The pond is actively being closed, the remaining storage volume is currently being filled.

Table 2 - Volume and Depth of Impounded CCR in the SCPB

CCR Unit	Est. Volume of Water and CCR (CY)	Est. Bottom Elev. of CCR Unit (feet)	Est. Minimum CCR Elev. (feet)	Est. Minimum Depth of CCR (feet)	Est. Maximum CCR Elev. (feet)	Est. Maximum Depth of CCR (feet)
SCPB (Fly Ash Pond)	2,234,805	422	431	9	458	32

The SCPB has a water level staff gage. Ameren measures and records pool levels during weekly inspections.

3.2.2 Maintenance

Weekly inspection check sheets from October 2019 through July 2020, and the 2019 annual inspection check sheet were reviewed. The following is a summary of observations from these inspections and their condition during the current inspection.

The 2019 Annual Inspection documented erosion on the south end of the pond outside of the perimeter fence. No significant rutting was observed during the current inspection.

No items were observed during the weekly or annual inspections requiring immediate maintenance. In general, the inspection reports indicate that the current level of maintenance is adequate. The 2019 Sioux Annual Levee Inspection is included in Appendix I.

The O&M Manual states that all maintenance activities should be documented; however no maintenance records were available for review. The O&M Manual should be updated so that the responsibility and procedures for maintaining maintenance records are clearly defined.

3.3 SCPC

3.3.1 Operations

The SCPC receives gypsum sluice flow. There is no contributing watershed to the impoundment outside of the perimeter dike. Gypsum slurry is discharged near the south end of the impoundment. Flow is conveyed south to north towards the box culverts that discharge into the Recycle Pond. The gypsum stack is spreading radially from the gypsum slurry discharge location along the east embankment. An ash beach has formed along the southern half of the east embankment.

Table 3 includes pertinent data regarding the volume and depth of impounded CCR in the SCPC. During the field investigation on October 14, 2020 there was no visually identifiable change to the minimum or maximum depths of CCR from that shown in a 2020 topographic survey. The estimated remaining storage capacity for water within SCPC based on the 2020 topographic survey is approximately 270,000 cubic yards.

Table 3 - Volume and Depth of Impounded CCR in the SCPC

CCR Unit	Est. Volume of Water and CCR (CY)	Est. Bottom Elev. of CCR Unit (feet)	Est. Minimum CCR Elev. (feet)	Est. Minimum Depth of CCR (feet)	Est. Maximum CCR Elev. (feet)	Est. Maximum Depth of CCR (feet)
SCPC (Cell 1 – Gypsum)	812,617	422	426	4	445	21

There was no instrumentation installed for monitoring the SCPC pool level. Pool levels relative to the flowline of the box culverts are recorded during weekly inspections.. The normal pool elevation is 441.1 feet, which is approximately the flowline of the box culverts. The normal pool elevation is 3.1 feet below the emergency spillway elevation.

Ameren states there are no planned operational changes for the SCPC. Prior to the next periodic structural stability assessment, a topographic survey of the pond interior will be required to update the estimated volume and depth of impounded CCR.

3.3.2 Maintenance

Weekly inspection check sheets from October 2019 through July 2020, and the 2019 annual inspection check sheet were reviewed. The 2019 Annual Inspection noted the gypsum slurry discharge line is below the pond level but flowing. The report further states that the pipe moved every 3 months to ensure no obstruction impact flow. During the current inspection the no pipe was being used and the point of discharge was below the level of the surrounding gypsum.

In general, the inspection reports indicate that the current level of maintenance is adequate; however, additional maintenance is needed to handle process water. The 2019 Sioux Annual Levee Inspection is included in Appendix I.

The O&M Manual states that all maintenance activities should be documented; however no maintenance records were available for review. The O&M Manual should be updated so that the responsibility and procedures for maintaining maintenance records are clearly defined.

4.0 DESIGN AND CONSTRUCTION DOCUMENT REVIEW

4.1 SCPA

4.1.1 Embankment and Foundation Stability

The original construction plans for the SCPA is presented in the O&M manual. The embankment was originally constructed with 2H to 1V side slopes. Since the original construction the embankment has been modified to improve the stability. Riprap has been placed on the upstream slopes that are subject to wave loading. Riprap was placed on the downstream slope on the north side of the pond from the toe and to about mid-height of the embankment, and a 17-foot wide stability berm was constructed at the toe. On the west side of the pond a rock wedge was constructed along a steep bank of Poeling Lake. Riprap was placed on the downstream slope from the toe to about mid-slope south of the discharge structure for about 760 lineal feet. Further south, the downstream slope was graded to a steepness of 2.5H to 1V and armored with riprap. A slurry wall and inverted filter were constructed near the northeast corner of the pond to address an area with seepage.

Borings through the embankment show the embankment was constructed with compacted layers with varying amounts of clay, silt and sand that were excavated from the incised portion of the pond. Fill material is generally soft to firm or loose to medium-dense.

The periodic safety factor assessment is provided in the *Ameren Missouri Sioux Energy Center: Evaluation of CCR Units* report Appendix D. This report shows that the minimum factors of safety specified in 40 CFR Part 257.73(d)(1) for the critical embankment cross sections are achieved for the range of loading expected.

4.1.2 Slope Protection

The embankment was originally designed with vegetated downstream and upstream slopes. Presently all or portions of the downstream slopes along the south, southwest, northwest and north embankments are armored with riprap to provide stability and erosion protection. The upstream slopes that are subjected to wave loading are armored with riprap. Based on field observations the riprap armor appears to be functioning adequately.

4.1.3 Spillways

The spillway for the SCPA is a 30-inch reinforced concrete pipe (RCP). The 30-inch RCP inlet is connected to a concrete outlet structure that has a weir, steel bulkhead and large diameter, galvanized, corrugated, steel skimmer on the upstream side. The steel skimmer has lost some functionality because of ponded ash, so an orifice has been cut in the side of the skimmer. The orifice cut in the skimmer is approximately 12 inches by 12 inches. The steel bulkhead routes water through a 2-foot high and 2.5 feet wide orifice that has an invert elevation of 429 feet. A manually operated sluice gate is installed to regulate flow through the orifice on the upstream side of the bulkhead. The top of the steel bulkhead is at el. 440 feet. Water then flows into the concrete outlet structure and 30-inch diameter RCP pipe. Discharge from the pipe flows through a short outlet channel that is armored with riprap and into Poeling Lake. There is no emergency spillway for the SCPA. The pond has been dewatered and is currently being closed. Stormwater falling within the footprint of the impoundment is actively managed by the closure contractor to prevent overtopping.

4.2 SCPB

4.2.1 Embankment and Foundation Stability

The perimeter embankment was originally constructed with 3H to 1V upstream and downstream slopes and a crest elevation of approximately 441.5 to 446.4 feet. The minimum crest width is 20 feet. The pond is bound to the north and east by plant fill. The embankment section has been thickened to the south by a railroad embankment, and to the west by the plant access road. In the locations where the embankment has been widened the downstream slopes can vary from 2H to 1V and 3H to 1V. The pond was incised to a bottom elevation of approximately 422 feet, and has a 60-mil HDPE liner on the bottom and slopes.

Embankment fill generally consists of compacted layers of clays, silts and sands that were excavated from the incised portion of the pond. Fill material is generally firm to stiff or medium dense.

The periodic safety factor assessment is provided in the *Ameren Missouri Sioux Energy Center: Evaluation of CCR Units* report Appendix D. This report shows that the minimum factors of safety specified in 40 CFR Part 257.73(d)(1) for the critical embankment cross sections are achieved for the range of loading expected.

4.2.2 Slope Protection

The perimeter berm was designed with vegetated downstream slopes and upstream slopes lined with 60-mil HDPE. The O&M Manual includes design documents for upstream and downstream slope protection. Based on observations during the field inspection for the 2020 Periodic Structural Stability Assessment the slopes appear to be functioning adequately.

4.2.3 Spillway

The spillway for the SCPB is an 18-inch HDPE pipe with an inlet upturned to an elevation of 434.5 feet. The downstream invert elevation for the discharge pipe is at elevation 430 feet. Two motor operated butterfly valves are used to regulate the pool level and flow through the outlet into Poeling Lake. The outlet pipe is upturned on the downstream end and discharges onto a concrete slab. The outlet channel is armored with riprap for a short distance immediately downstream of the concrete slab. There is no emergency spillway for the SCPB. The pond has been dewatered and is currently being closed. Stormwater falling within the footprint of the impoundment is actively managed by the closure contractor to prevent overtopping.

4.3 SCPC

4.3.1 Embankment and Foundation Stability

The perimeter berm for the SCPC was constructed to el. 446 with 3H to 1V upstream and downstream slopes. The minimum crown width is 12 feet. The interior of the pond is lined with 80-mil HDPE liner overlaying a 2 feet thick clay liner.

Embankment fill consists of compacted layers of clay and silt with varying amounts of sand. Fill material was compacted to an average of 100% of the maximum dry unit weight determined from the standard Proctor Moisture-Density Test (ASTM D698). Fill placement was monitored and moisture-density tests were obtained during construction. The upstream and downstream slopes have a steepness of 3H to 1V. Riprap armor was placed from the downstream toe to about the mid-height of the embankment along the south and west berms.

The periodic safety factor assessment is provided in the *Ameren Missouri Sioux Energy Center: Evaluation of CCR Units* report Appendix D. This report shows that the minimum factors of safety specified in 40 CFR Part 257.73(d)(1) for the critical embankment cross sections are achieved for the range of loading expected.

4.3.2 Slope Protection

The perimeter berm was designed with vegetated, or riprap armored downstream slopes and upstream slopes lined with 80-mil HDPE. Based on observations during the 2020 Periodic Structural Stability Assessment the slopes appear to be functioning adequately. The riprap was in good condition, there was good sod cover on the downstream slopes and there were no tears or punctures observed in the liner.

4.3.3 Spillway

The principal spillway for SCPC is a set of triple box culverts that discharge into the Recycling Pond. The *Ameren Missouri Sioux Energy Center: Evaluation of CCR Units* report in Appendix E shows that the outlet works adequately manages flow during the 24-hour, 100-year storm event.

5.0 PERIODIC STRUCTURAL STABILITY ASSESSMENT SUMMARY

The initial periodic structural stability assessment found no structural stability deficiencies, no significant issues with the current operations and maintenance, and that the design and construction of the embankments and spillways were adequate for the range of loading conditions under which the CCR unit should be subjected. However, the deficiencies listed below do need to be addressed.

5.1 SCPA

- Continue monitoring vegetation growth along the embankment slopes and within the riprap. The embankment slopes should be maintained with a dense vegetative cover, and the riprap should be sprayed so that it is free of vegetation. The current frequency of mowing and spraying should be increased to prevent excess vegetation growth.
- Continue monitoring the wet areas 130 feet south of the discharge structure and from the discharge structure and north 250 feet. Monitoring should include documenting observations of the area relative to pond levels, recent precipitation events and adjacent river levels. If at any time water is observed flowing and carrying fines in this area, take immediate action as required to prevent degradation of the integrity of the embankment and foundation soils.
- Continue monitoring the embankments for gulley erosion at concentrated flow points. Consider rerouting runoff flow to areas that are sufficiently armored to prevent erosion.
- When observed, animal burrows should be excavated to find their extent, and filled with compacted soil that has similar properties to that of the surrounding soil.
- Prior to subsequent periodic structural stability assessment obtain a topographic survey of the interior of the pond and update the volume and depth estimates of impounded CCR.
- The O&M Manual states that all maintenance activities should be documented; however, no maintenance records were available for review. The O&M Manual should be updated so that the responsibility and procedures for maintaining maintenance records are clearly defined.

5.2 SCPB

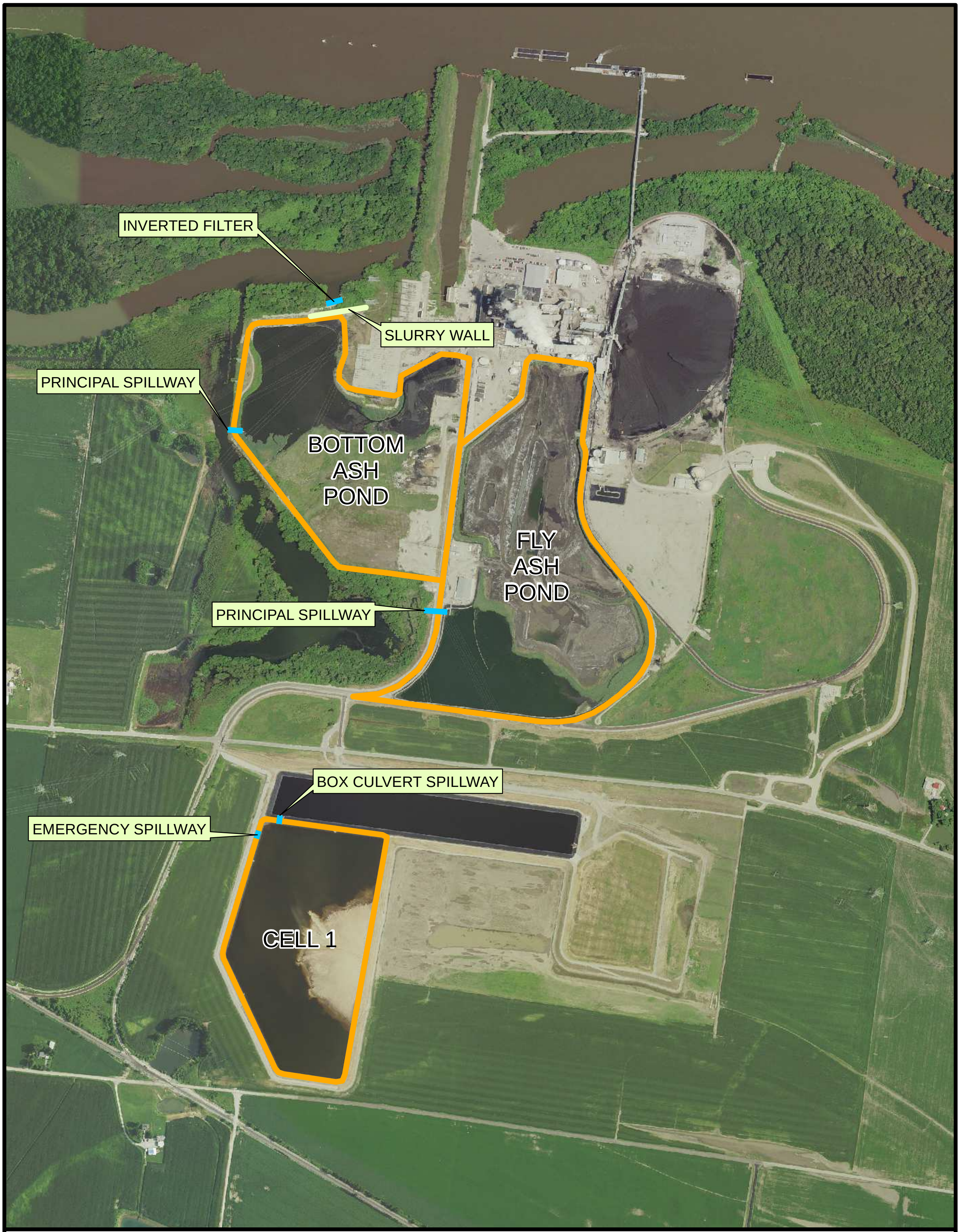
- Continue monitoring the wet area 290 feet south of the outlet pipe. Monitoring should include documenting observations of the area relative to pond levels, recent precipitation events and adjacent river levels. If at any time water is observed flowing and carrying fines in this area, take immediate action as required to prevent degradation of the integrity of the embankment and foundation soils.
- Continue monitoring the condition of the staff gage and perform maintenance as needed so at least one reference elevation on the gage is legible. Record and document pool levels on a regular basis.
- Continue monitoring the embankments for ruts, and erosion at concentrated flow points. Consider routing runoff to areas that are sufficiently armored to prevent erosion.
- Prior to subsequent periodic structural stability assessments obtain a topographic survey of the interior of the pond and update the volume and depth estimates of impounded CCR.
- The O&M Manual states that all maintenance activities should be documented; however, no maintenance records were available for review. The O&M Manual should be updated so that the responsibility and procedures for maintaining maintenance records are clearly defined.

5.3 SCPC

- Monitor box culvert on the west side to determine if it is actively moving.
- Install a hose and adjust the point of gypsum slurry discharge so that flow is not obstructed.
- Prior to subsequent periodic structural stability assessments obtain a topographic survey of the interior of the pond and update the volume and depth estimates of impounded CCR.
- The O&M Manual states that all maintenance activities should be documented; however, no maintenance records were available for review. The O&M Manual should be updated so that the responsibility and procedures for maintaining maintenance records are clearly defined.

6.0 REFERENCES

Environmental Protection Agency. (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule." 40 CFR Parts 257 and 261., Vol. 80, No. 74.



Legend

▬ Embankment

▬ Spillway

N

0 500 1,000 Feet

AMEREN MISSOURI
SIOUX ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

REITZ & JENS, INC.
CONSULTING ENGINEERS

APPENDIX I

2020 PERIODIC INSPECTION CHECK SHEETS

2020 PERIODIC INSPECTION PHOTOGRAPH LOG

2019 SIOUX ENERGY CENTER ANNUAL INSPECTION CHECK SHEET

REITZ & JENS, INC.
CONSULTING ENGINEERS

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December 14, 2020

Jeffrey Greer, P.E.
Manager of Dam Safety & Hydro Licensing
Ameren Missouri
11149 Lindbergh Business Ct.
St. Louis, MO 63123

RE: Ameren Missouri – Sioux Energy Center
2020 Annual Surface Impoundment and Landfill Inspection
Gypsum Pond Cell 1 (SCPC), Fly Ash Pond (SCPB), Bottom Ash Pond (SCPA), Recycle Pond and Landfill Cell 4A (SCL4A)

Dear Matt,

Enclosed herewith are Annual Inspection Check Sheets for the 2020 Annual Inspection of the active surface impoundment Gypsum Pond Cell 1 (SCPC), Fly Ash Pond (SCPB) and Bottom Ash Pond (SCPA), Recycle Pond and Landfill Cell 4A (SCL4A) at Ameren Missouri's Sioux Energy Center conducted on October 14, 2020 by Reitz & Jens and Ameren Personnel. The Annual Inspection was in general accordance with 40 CFR Part 257.83(b) and 257.84(b), and included a review of available information regarding the status and condition of the CCR unit, including files available in the operating record.

No signs of structural weakness which would impact the operation and safety of the unit were observed. Minor maintenance items observed in the 2020 Annual Inspection associated with routine upkeep, presently do not impact the structural integrity of the embankment. Nonetheless, Ameren should address these minor maintenance items in a timely manner.

The following documents were reviewed as part of the Inspection:

1. *Ameren Missouri. (2010). "Operation and Maintenance Manual; Sioux Fly Ash and Bottom Ash Pond Embankment, West Alton, Missouri, St. Charles County." Dam Safety and Hydro Engineering, St. Louis, Missouri.*
2. *Ameren Missouri. (2011). "Operation and Maintenance Manual for Cell 1 and Recycle Pond, Sioux Power Plant Utility Waste Landfill, St. Charles County, Missouri." Dam Safety and Hydro Engineering, St. Louis, Missouri.*
3. *Ameren Missouri. (2015). "Ameren Missouri Sioux Energy Center, Bottom Ash Pond Bank Stabilization, Southeast Section (Revised)."*
4. *Ameren Missouri. (2016). "Sioux 2016 Annual Inspection Checklist." September 7, 2016*

5. *Ameren Missouri. (2017). "Sioux 2017 Annual Inspection Checklist." September 7, 2017*

6. *Ameren Missouri. (2018). "Sioux 2018 Annual Inspection Checklist." September 7, 2018*

7. *Ameren Missouri. (2019). "Sioux 2019 Annual Inspection Checklist." September 6, 2019*

8. *Ameren Missouri. (2019). "Sioux Fly Ash Pond, Bottom Ash Pond, Cell 1, Recycle Pond and Cell 4A Weekly Inspection Checksheet." January 4 to December 26, 2019*

9. *Ameren Missouri. (2020). "Sioux Fly Ash Pond, Bottom Ash Pond, Cell 1, Recycle Pond and Cell 4A Weekly Inspection Checksheet." January 2 to July 10, 2020*

10. *Ameren Ash Volumes Inventory, Excel Spreadsheet*

11. *Ameren CCR Unit Inventory, Excel Spreadsheet*

12. *Ameren Missouri. (2011). "Sioux Energy Center Bottom Ash Pond (SCPA) Closure St. Charles County, Missouri."*

13. *Dewberry & Davis, LLC. (2011). "Coal Combustion Waste Impoundment Round 7 – Dam Assessment Report, Sioux Power Station, Ameren Missouri, St. Charles County, Missouri." USEPA Contract Number; EP-09W001727*

14. *Environmental Protection Agency (EPA). (2015). "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities." 40 CFR Parts 257 to 261. Vol. 80. No. 74. Federal Register*

The subsequent annual inspection must be conducted no later than October 5, 2021.

Sincerely,

Jeff Bertel

Jeff Bertel, P.E.
Project Manager
Reitz & Jens, Inc.

SIOUX ENERGY CENTER
Bottom Ash Pond (SCPA)

Annual Inspection Check Sheet

Date	10/14/2020
Inspector	J. Bertel, L. Sutton, A. Martinez, M. Lueckenhoff
Pool Level	Below staff gage and spillway inlet.
River Level	419.1
Temperature	60's
Weather	Sunny

Date of Previous Annual Inspection: 09/06/2019

Date of Previous Periodic Inspection: 09/08/2015

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
The impoundment is currently being closed. Approximately 16 acres of the closure has been completed. Sluice water is no longer discharged in the impoundment.

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
Approximately 16 acres in the southeast corner of the impoundment has been closed. A parking lot and wastewater treatment plant have been constructed above the closed portion of the impoundment.

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
Other than temporary pumping for construction, no water is being pumped into the impoundment.

List the approximate remaining storage capacity of the impounding structure:
1,720,144 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max – el. 439.5 ft, depth 39.5 ft; Min – el. 432 ft, depth 32 ft; Present – el. <433 ft, depth <33 ft

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Max – el. 455 ft, depth 55 ft; Min – el. unknown, depth – unknown; Present – el. 455 ft, depth 55 ft

Approximate volume of impounded water and CCR at the time of the inspection:
1,680,338 CY of CCR

Describe any changes to the downstream watershed:
None

Inlet and Outlet Works

Item	Condition Code	Comments
Outlet Condition	OB	Minor rust was observed on spillway bridge and other metal appurtenances. Since this structure is scheduled to be removed with impoundment closure, there does not seem to be an immediate need to repair the corroded areas.(IMG_3310 and IMG_3315)
Gate Condition/ Operability	GC	The gate was tagged out and in an open position. The gate was not operated but appears to be in an operable condition. (IMG_3312)
Outfall Pipe Condition	OB	The invert of the outfall pipe is rusted. The outfall structure and pipe are scheduled to be removed during closure of the unit. (IMG_3354)
Outlet Channel/Rock Armor	GC	The outlet channel riprap appears to be stable. (IMG_3354)
Discharge (color and/or sediment)	GC	There was no discoloration or sediment in the discharge.
Obstructions	GC	No obstructions were observed.
Instrumentation	GC	The staff gage is above the current water level. (IMG_3310)
Inlet Piping/ Supports Condition	NI	The inlet pipes are no longer in use and the outfall channel for these pipes was being filled during the current inspection. (IMG_3288)
Leakage	GC	No leakage was observed.
Other		

Earth Embankment

Item	Condition Code	Comments
Vertical &	GC	There was no visible vertical or horizontal misalignment of the crest. (IMG_3295,

Earth Embankment

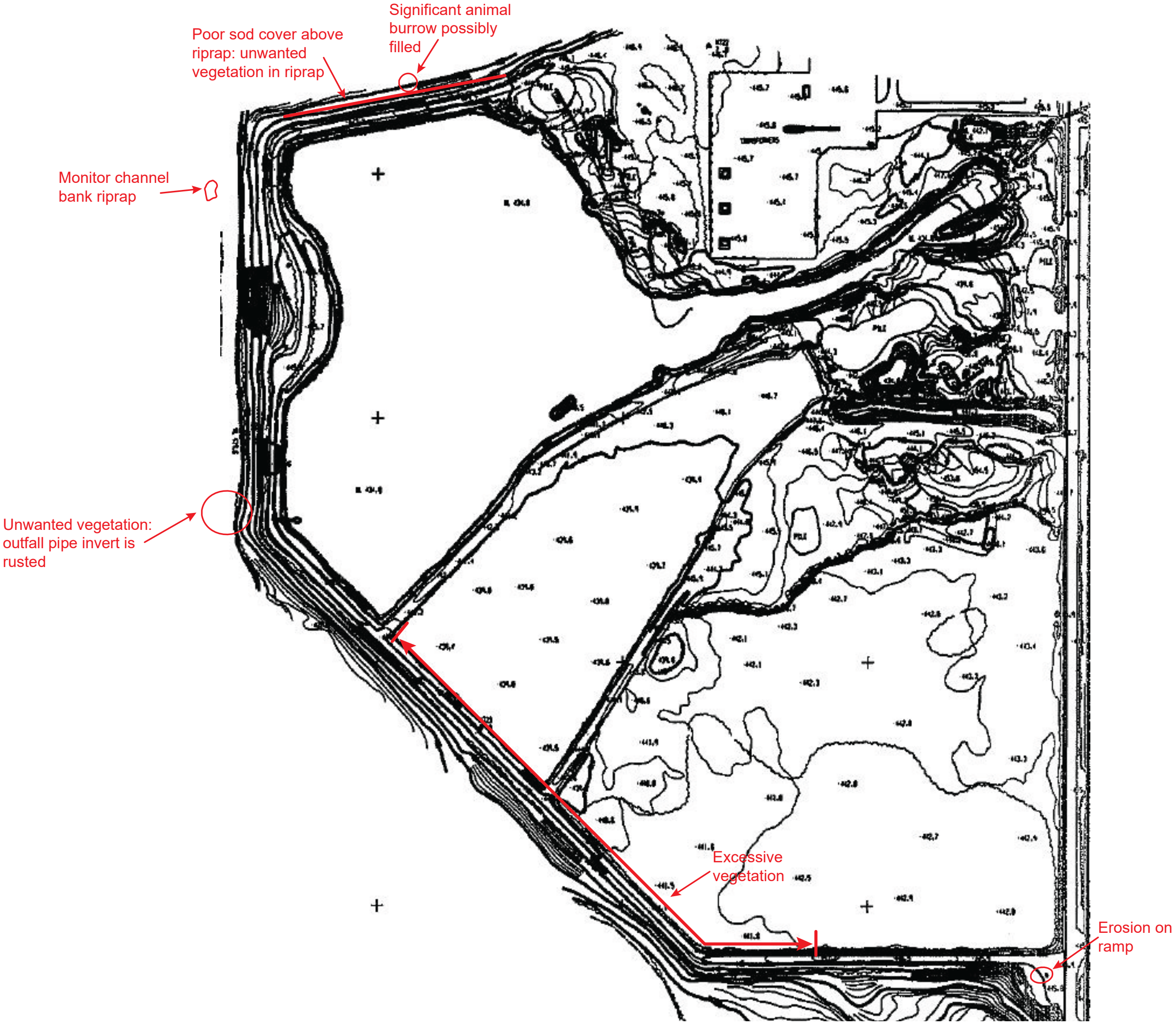
Item	Condition Code	Comments
Horizontal Alignment of Crest		IMG_3306, IMG_3316 and IMG_3320)
Seepage/Wetness/ Ponding Areas	GC	Did not observe any sign of seepage and wetness.
Erosion/Rutting	OB	Erosion feature noted during the 2019 inspection has been repaired. (IMG_3335) Erosion occurring in crushed rock on adjacent access ramp. Repair erosion on ramp. (IMG_3337)
Fencing	GC	The perimeter fence is in good condition.
Vegetation	MM	The upstream slopes between the primary spillway and the closed portion of the pond are covered with dense vegetation. (IMG_3316) The vegetation has been sprayed, but should be removed. The sod cover above the riprap on the north side of the pond was sparse. Establish and maintain dense sod cover. (IMG_6671) Riprap on the north side of the pond has some excessive non-woody and emerging woody growth. The outlet channel riprap is also covered with excessive vegetation. Remove unwanted vegetation from riprap areas. (IMG_6669 and IMG_3368)
Sloughs/Slides/ Cracks	OB	The riprap placed along the channel bank on the west side of impoundment has a scarp or crack like feature at the top of the slope, but there is no movement evident at the bottom of the slope at the waterline. Monitor the riprap to verify if movement is occurring. (IMG_3365 and IMG_3367)
Rock Armor	OB	
Animal Control	MM	At least some of the animal burrows identified during the most recent inspection have been filled with crushed limestone. (IMG_3347) The crushed limestone should be removed and replaced with compacted soil that has similar properties to that of the surrounding soil. A large animal burrow with a significant volume of soil removed was observed on the north side of the pond. Verify that the burrow has been properly abandoned. (IMG_3372)

SIOUX ENERGY CENTER
Bottom Ash Pond (SCPA)
Annual Inspection Check Sheet

Earth Embankment

Item	Condition Code	Comments
Other		

Note location of observation on attached plan sheet.



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.

MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

OB = Condition requires regular observation and potential future minor maintenance.

GC = Good Condition

NO = No observation possible.

NI = Not Inspected. State reason in comment column.

Figure 1 – Minor rust was observed on spillway bridge and other metal appurtenances.

Figure 2 - Minor rust was observed on spillway bridge and other metal appurtenances.

Figure 3 – Principal spillway gate.

Figure 4 – Outlet channel riprap.

Figure 5 – The inlet pipes are no longer in use and the outfall channel for these pipes was being filled.

Figure 6 - Perimeter embankment crest and upstream slope on north side of impoundment.

Figure 7 – Perimeter embankment upstream slope on west side of impoundment.

Figure 8 – Perimeter embankment crest on west side of impoundment.

Figure 9 - Perimeter embankment crest on south side of impoundment.

Figure 10 - Repaired erosion feature and new armored swale.

Figure 11 - Erosion feature on access ramp near the guard house.

Figure 12 - Vegetation on downstream slope on north side of impoundment is sparse.

Figure 13 - Riprap on north side of pond has some excessive non-woody and emerging woody growth.

Figure 14 - Riprap on north side of pond has some excessive non-woody and emerging woody growth.

Figure 15 - Riprap along channel bank on the west side of the impoundment should be monitored to determine if any movement is occurring.

Figure 16 - Riprap along channel bank on the west side of the impoundmente should be monitored to determine if any movement is occurring.

Figure 17 - Animal burrow backfilled with crushed limestone.

Figure 18 - Large animal burrow with a significant volume of soil removed from the embankment on the north side of the pond.

SIOUX ENERGY CENTER
Fly Ash Pond (SCPB)

Annual Inspection Check Sheet

Date	10/14/2020
Inspector	J. Bertel, L. Sutton, A. Martinez, M. Lueckenhoff
Pool Level	Below Staff Gage
River Level	419.1
Temperature	60's
Weather	Sunny

Date of Previous Annual Inspection: 09/06/2019

Date of Previous Periodic Inspection: 09/08/15

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
The impoundment is currently being closed. A low area near the northwest corner of the impoundment has been filled or the embankment has been widened for new fly ash handling systems.

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
The impoundment is currently being closed.

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
Sluice water is no longer discharged in the impoundment.

List the approximate remaining storage capacity of the impounding structure:
Approximately 41,564 CY; however this is decreasing as ash is placed during closure.

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max – el. 440.6 feet, depth 14.6 feet; Min – el. 432.2 feet, depth 6.2 feet; Present – el.434.5 feet, depth 8.5 feet

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Max – el.458 feet, depth 32 feet; Min – el. 430 feet, depth 4 feet; Present – el. 450 to 455 ft, depth 24 to 29 feet

Approximate volume of impounded water and CCR at the time of the inspection:
2,324,805 CY

Describe any changes to the downstream watershed:
None

Inlet and Outlet Works

Item	Condition Code	Comments
Outlet Condition	OB	The outlet is generally in good condition with rust on the gate stems, pedestals and housing, and the bridge frame. The outlet is being removed as part of closure. (IMG_3387, IMG_3388, IMG_3392, IMG_3394, IMG_6684 and IMG_3395)
Gate Condition/ Operability	GC	The gates are tagged out but appear to be operable. One is in a closed position and the other is in an open position. No flow from the structure. (IMG_3388 and IMG_3390)
Outfall Condition	GC	The outfall is in good condition. (IMG_3392)
Outlet Channel	GC	The outlet channel is in good condition. (IMG_3389)
Discharge (color and/or sediment)	GC	There was no discharge from the outfall. (IMG_3392)
Obstructions	GC	No obstructions were observed.
Instrumentation	MM	The water level was below the bottom of the staff gage. The lower portion of the gage is covered in sediment and no longer legible. Maintain staff gage so that it is legible. (IMG_3397)
Inlet Piping/Supports Condition	GC	Fly ash is no longer sluiced to the pond. Only a small amount of water from an unknown source was being discharged into the pond. (IMG_3440 and IMG_3442)
Leakage	GC	No leakage was observed.
Other		

Earth Embankment

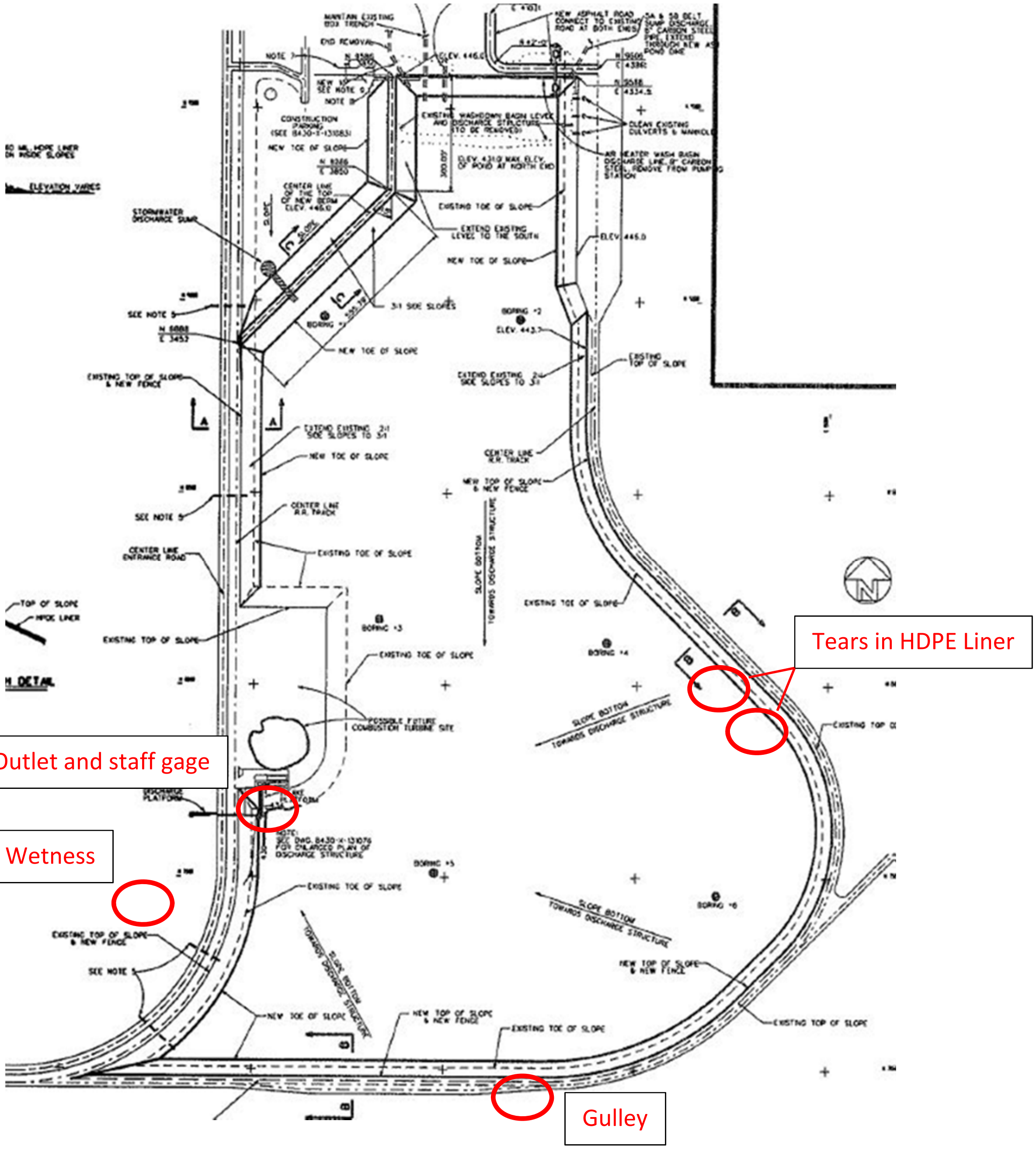
Item	Condition Code	Comments
Vertical & Horizontal Alignment of Crest	GC	There was no vertical or horizontal misalignment of the crest. (IMG_3408 and IMG_6685)
Seepage/Wetness/ Ponding Areas	OB	Ponding and wetness was observed at the downstream toe of the west embankment slope approximately 290 feet south of the outfall. No flowing water was observed. This condition

Earth Embankment

Item	Condition Code	Comments
		appears unchanged based on descriptions of observations from past flood events. (IMG_6689)
Erosion/Rutting	OB	The erosion gulley noted in past inspections was still present. The gulley is vegetated and does not appear to be actively eroding. We recommend monitoring the feature and repair if additional erosion occurs. (IMG_6708)
Fencing	GC	The perimeter fence is in good condition. (IMG_3412)
Vegetation	GC	Vegetation was generally in adequate condition on the downstream slopes. (IMG_6700)
Sloughs/Slides/ Cracks	GC	No sloughs, slides or cracks were observed.
HDPE Liner	MM	Two tears were observed in the HDPE Geomembrane on the southeast side of the pond. Repair HDPE Geomembrane. (IMG_3423 and IMG_3424)
Animal Control	GC	No animal burrows were observed.
Other		

Note location of observation on attached plan sheet.

SIOUX ENERGY CENTER
Fly Ash Pond (SCPB)
Annual Inspection Check Sheet



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.

MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

OB = Condition requires regular observation and potential future minor maintenance.

GC = Good Condition

NO = No observation possible.

NI = Not Inspected. State reason in comment column.

Figure 1 – Minor rust was observed on spillway bridge and other metal appurtenances.

Figure 2 - Minor rust was observed on gate pedestals, housing, handwheels and conduit.

Figure 3 – Minor rust on spillway gate stems.

Figure 4 – Minor rust was observed on spillway bridge and other metal appurtenances.

Figure 5 – Minor rust was observed on spillway bridge and other metal appurtenances.

Figure 6 – Principal spillway outlet.

Figure 7 – Principal spillway outlet.

Figure 8 – Principal spillway inlet.

Figure 9 – Inlet piping, fly ash is no longer sluiced to the pond.

Figure 10 - Inlet piping, fly ash is no longer sluiced to the pond.

Figure 11 – Embankment crest on south side of pond.

Figure 12 – Downstream slope on west side of pond.

Figure 13 – Ponding and wetness at the downstream toe of the west embankment slope approximately 290 feet south of the outfall.

Figure 14 – Erosion feature on downstream slope of the south embankment, east of the access ramp.

Figure 15 – The perimeter fence is in good condition.

Figure 16 – Downstream embankment slope on the south side of the impoundment.

Figure 17 – Small tear in HDPE liner.

Figure 18 – Small tear in HDPE liner.

SIOUX ENERGY CENTER
Cell 1 (SCPC), 4A (SCL1) & Recycle Pond

Annual Inspection Check Sheet

Date	10/14/2020
Inspector	J. Bertel, L. Sutton, A. Martinez, M. Lueckenhoff
Recycle Pond Level by Visual Reading	Approx. 430
Recycle Pond Level Reading through DCS	431.27
Cell 1 Level	441.1
Weather	Sunny
Temperature	60's

Date of Previous Annual Inspection: 10/03/2019

Date of Previous Periodic Inspection: 10/5/2015

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
Ameren no longer plans to stack dewatered gypsum above the the top of the Cell 1 perimeter embankment. Cell 1 was originally designed for gypsum to be stacked to a height of approximately 100 ft.

List the approximate remaining storage capacity of the impounding structure:
Cell 1 – 212,383 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water in Cell 1 since the previous annual inspection:

	Maximum		Minimum		Present	
	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)
Cell 1	441.1	18.1	441.1	18.1	441.1	18.1

List the approximate maximum, minimum and present depth and elevation of the impounded CCR in Cell 1 and Cell 4A since the previous annual inspection:

	Maximum		Minimum		Present	
	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)
Cell 4A	438	18.0	435	15.0	-	-
Cell 1	443	19.1	423	0	443	19.1

Approximate volume of CCR at the time of the inspection:
Cell 4A – 200,635 CY, Cell 1 – 812,617 CY

Describe any changes to the downstream watershed:
None.

Recycle Pond

Item	Condition Code	Comments
Erosion, sloughing, sliding, boils, seepage	OB	There appears to be shallow sloughing or sliding of the clay liner beneath the HDPE Geomembrane. Evaluate the extent, cause and risk of the current condition and repair as needed. (IMG_3449)
Condition of grass cover, woody vegetation, burrows	GC	The vegetative cover on the exterior embankments was in good condition. Only infrequent small animal burrows were observed. (IMG_6721)
Recycle Pond between el. 428 and 443	GC	The level of the recycle pond was within the specified operation limits.
Settlement, depression or crack in embankment	GC	No settlement, depressions or cracks were observed. (IMG_3457)
Effluent Pump Intake Structures (when visible)	NI	The effluent pump intake structures were submerged. (IMG_3455)
Gravel Ballast Covering Pump Intake Pipes (when visible)	NI	The intake pipes were submerged.
Damage to transducer level controls or pipes	MM	There was no visible damage; however, the pipes have moved. We recommend recalibrating the level transducers. The two upper ballast trays were filled with gravel, but the lower tray has no ballast. Place erosion resistant ballast in the lower tray. (IMG_3449)
Unevenness, movement of triple box culverts	OB	The downstream box culvert on the west side appears offset approximately 1” downstream. Pictures from construction indicate that the box culverts may have initially been placed with an offset. Monitor the offset between the two western box culverts to see if there is movement occurring. (IMG_3516 and IMG_3517)
HDPE Recirculation Pipe	GC	There was no visible damage to the recirculation pipe.
Erosion or rutting gravel top & perimeter roads and ramps	GC	No erosion or rutting was observed on access roads and ramps. (IMG_6725)

Recycle Pond

Item	Condition Code	Comments
HDPE Liner	GC	No tears or punctures were observed.
Precast Concrete Revetment below Box Culverts	GC	The revetment is in good condition. (IMG_3470)
Precast Concrete Revetment below Discharge Pipes	GC	The revetment is in good condition. (IMG_3450)
Emergency Spillway	OB	The emergency spillway has been rutted and the interconnected articulated blocks have been damaged. Blocks outside of the vehicle pathways also have damage, probably due to freeze-thaw. It does not appear that the sill elevation has been significantly changed. Repair the emergency spillway with materials that are adequate to handle the anticipated traffic loads. Verify that the sill elevation is unchanged. (IMG_3465)
Imminent discharge thru emergency spillway	GC	The water level was several feet below the emergency spillway. (IMG_3462)

Cell 1

Item	Condition Code	Comments
Erosion, sloughing, sliding, boils, seepage	GC	No sloughing, sliding, boils, or significant erosion was observed. (IMG_3474)
Condition of grass cover, woody vegetation, burrows	GC	The vegetative cover on the embankments was in good condition. Only infrequent small animal burrows were observed. (IMG_6749)
Settlement, depression or crack in embankment	GC	No settlement, depressions or cracks were observed. (IMG_3488)
Emergency Spillway	GC	The emergency spillway is in good condition. (IMG_3472)
Imminent discharge thru emergency spillway	GC	The water level was several feet below the emergency spillway. (IMG_3472)

Cell 1

Item	Condition Code	Comments
Gypsum slurry flowing unobstructed	MM	There are no hoses attached to the point of discharge. The point of discharge is below the surrounding gypsum level and is only unobstructed because it has scoured a hole. Install hose and adjust point of discharge so that flow is not obstructed. (IMG_3491)
Slurry spraying or running out of cleanouts	NI	The cleanouts were not inspected.
Height from discharge pipe flow line to gypsum level	MM	No discharge pipe is being used. The discharge is below the level of the surrounding gypsum. (IMG_3492)
HDPE Liner	GC	No tears or punctures were observed.
Erosion or rutting gravel top & perimeter roads and ramps	GC	No erosion or rutting was observed on access roads and ramps. (IMG_6751)
Sump Outlet & Concrete Pad	OB	There did not appear to be active erosion around the sump. The gypsum level at the sump appears only a few feet below the water level. (IMG_3509 and IMG_3510)
Drain Outlets & Concrete Pads	NI	Since gypsum will no longer be stacked within the impoundment, these features serve no function.
Movement of riprap	GC	The riprap is in good condition. (IMG_6739)

Cell 4

Item	Condition Code	Comments
Condition of Vegetative Cover	GC	Vegetative cover was in good condition.
Erosion, sloughing, sliding, boils, seepage	GC	No erosion, sloughing, sliding, boils or seepage observed.
Settlement, depression or crack in embankment	GC	No settlement, depressions or cracks observed in the embankment.
Interior	GC	The interior sump pump was not run but appeared functional and there was minimal ponding at the

Cell 4

Item	Condition Code	Comments
Drainage/Sump Pump		sump. (IMG_3501, IMG_3502 and IMG-3503)
Leachate Vault, Pipes and Pump Controls	GC	Leachate vault, pipes and pumps controls appeared in good condition. (IMG_3506, IMG_3507 and IMG_3508)
Leachate Discharge (color and/or sediment)	NO	The leachate pumps were not operating during the inspection. (IMG_3450)
Erosion or rutting gravel top & perimeter roads and ramps	GC	No erosion or ruts on perimeter roads or ramps.
Leachate Time from hour meter and level readings		Hours: 5952.7, Level: 42.3 in.

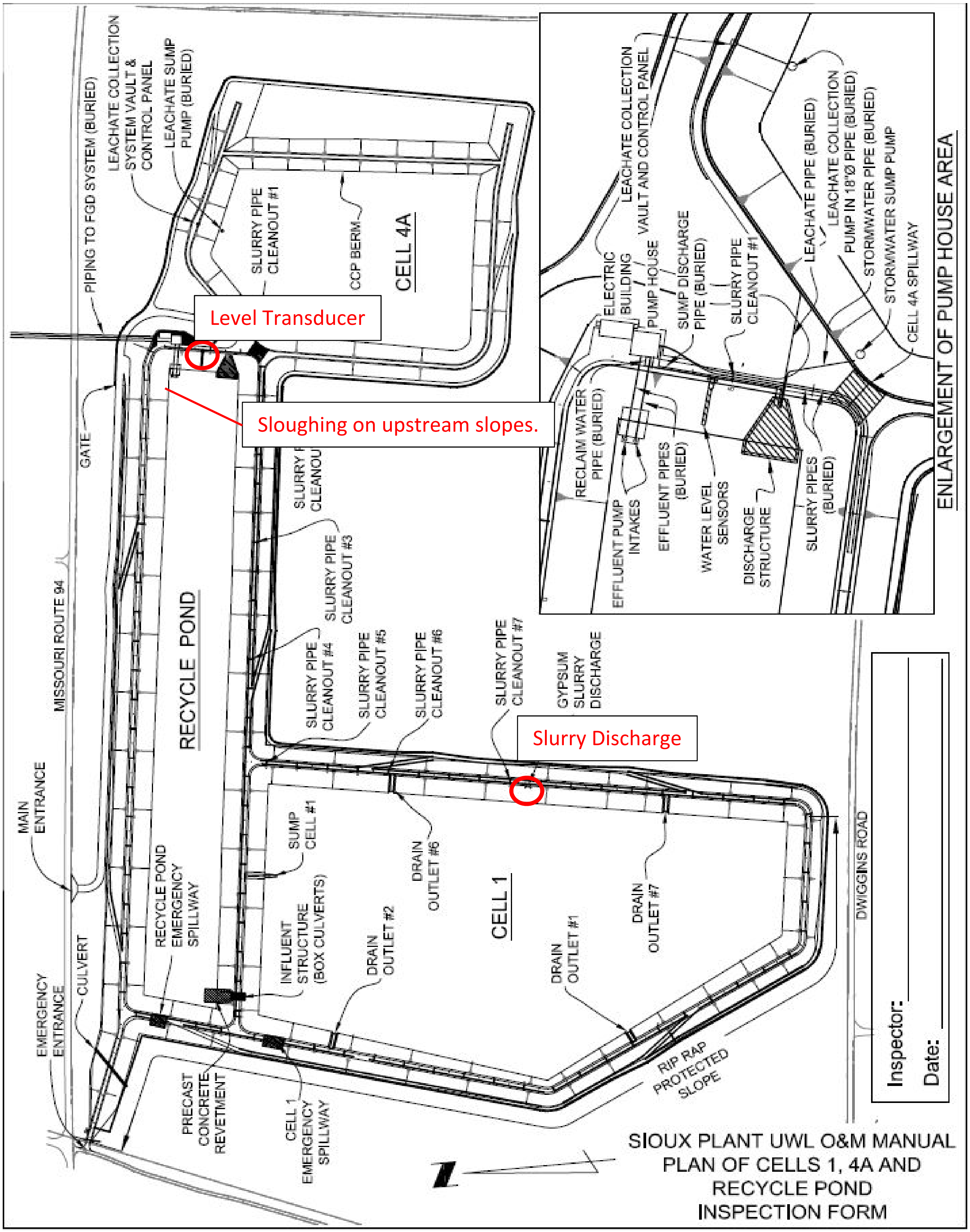
Other

Item	Condition Code	Comments
Holes or breaks in perimeter fence, vandalism	GC	None observed.
Main and emergency gates locked	GC	Both gates were locked.

Drive slowly around tops of embankments looking for visible signs of present or developing major problems. Indicate location(s)) of problems or anomalies on inspection plan - sign, date and attach sheet to report.

If a problem is noted, email or FAX report to appropriate persons. If emergency condition is noted, immediately contact the Shift Operations Supervisor and Chief Dam Safety Engineer.

SIOUX ENERGY CENTER
Cell 1 (SCPC), 4A (SCL1) & Recycle Pond
Annual Inspection Check Sheet



Level Transducer

Sloughing on upstream slopes.

Slurry Discharge

Inspector: ____________

Date: ____________

SIOUX PLANT UWL O&M MANUAL
PLAN OF CELLS 1, 4A AND
RECYCLE POND
INSPECTION FORM

Condition Code

Figure 1 – Embankment crest on west side of impoundment.

Figure 2 – Downstream slope on the east side of the impoundment.

Figure 3 – Embankment crest on the east side of the impoundment.

Figure 4 – Cell 1 emergency spillway.

Figure 5 – Point of discharge for gypsum slurry.

Figure 6 – Point of discharge for gypsum slurry.

Figure 7 – Access ramp on downstream slope on east side of the impoundment.

Figure 8 – Cell 1 sump.

Figure 9 – Cell 1 sump.

Figure 10 – Riprap is in good condition.

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.

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OB = Condition requires regular observation and potential future minor maintenance.

GC = Good Condition

NO = No observation possible.

NI = Not Inspected. State reason in comment column.

2019 Annual Inspection

SIOUX ENERGY CENTER
Bottom Ash Pond (SCPA)
Annual Inspection Check Sheet

Date	9/6/2019
Inspector	M. Lueckenhoff
Pool Level	<433
River Level	419'
Temperature	70
Weather	Clear

Date of Previous Annual Inspection: 9/7/2018

Date of Previous Periodic Inspection: None

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
Lowered the water level of the pond to facilitate the construction of the low volume waste basin.

List the approximate remaining storage capacity of the impounding structure:
1,727,653 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max 438 EL, Min <433 EL, Present <433 EL and depth of <11 feet.

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Current and max elevation is 470 feet with estimated depth of 70 feet. Minimum is unknown.

Approximate volume of impounded water and CCR at the time of the inspection:
1,672,829 CY

Describe any changes to the downstream watershed:
None

Inlet and Outlet Works

Item	Condition Code	Comments
Outlet Condition	GC	
Gate Condition/ Operability	GC	
Outfall Pipe Condition	GC	
Outlet Channel/Rock Armor	GC	
Discharge (color and/or sediment)	GC	Clear
Obstructions	GC	
Instrumentation	GC	
Inlet Piping/ Supports Condition	NO	Cannot see, pipe is at water surface.
Leakage	GC	No leakage observed.
Other		

Earth Embankment

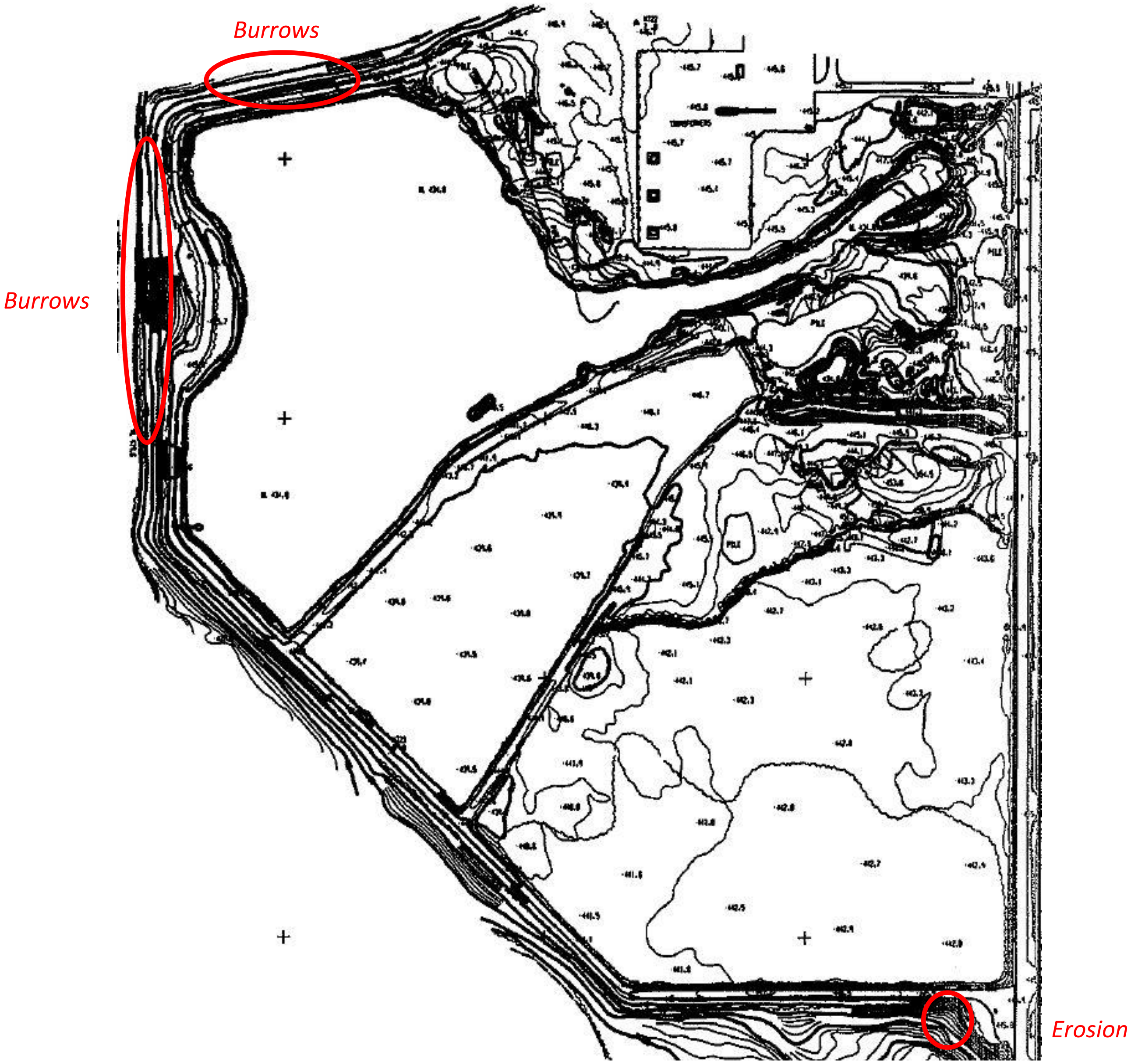
Item	Condition Code	Comments
Vertical & Horizontal Alignment of Crest	GC	
Seepage/Wetness/ Ponding Areas	GC	None witnessed.
Erosion/Rutting	OB	Erosion near guard house.
Fencing	GC	
Vegetation	GC	

Earth Embankment

Item	Condition Code	Comments
Sloughs/Slides/ Cracks	GC	
Rock Armor	GC	
Animal Control	MM	Multiple burrows along north and west embankment.
Other		

Note location of observation on attached plan sheet.

SIOUX ENERGY CENTER
Bottom Ash Pond (SCPA)
Annual Inspection Check Sheet



Condition Code

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IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.
MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.
OB = Condition requires regular observation and potential future minor maintenance.
GC = Good Condition
NO = No observation possible.
NI = Not Inspected. State reason in comment column.

SIOUX ENERGY CENTER
Fly Ash Pond (SCPB)
Annual Inspection Check Sheet

Date	9/6/2019
Inspector	M. Lueckenhoff
Pool Level	438.5'
River Level	419'
Temperature	70 F
Weather	Clear

Date of Previous Annual Inspection: 9/7/2018

Date of Previous Periodic Inspection: 8/23/2019

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None

Describe any action taken to restore or improve safety and integrity of impounding structure:
None.

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
None

List the approximate remaining storage capacity of the impounding structure:
41,564 CY

List the approximate maximum, minimum and present depth and elevation of the impounded water since the previous annual inspection:
Max 440.9 EL, Min 432.2 EL, and present is 438.5 EL with 8.5 feet of depth.

List the approximate maximum, minimum and present depth and elevation of the impounded CCR since the previous annual inspection:
Max 460 EL, with current and Min 431 feet at an estimated depth of 1 foot.

Approximate volume of impounded water and CCR at the time of the inspection:
2,219,447 CY

Describe any changes to the downstream watershed:
None

Inlet and Outlet Works

Item	Condition Code	Comments
Outlet Condition	GC	
Gate Condition/ Operability	GC	
Outfall Condition	GC	
Outlet Channel	GC	
Discharge (color and/or sediment)	GC	Clear
Obstructions	GC	None
Instrumentation	GC	
Inlet Piping/Supports Condition	GC	
Leakage	GC	None observed.
Other		

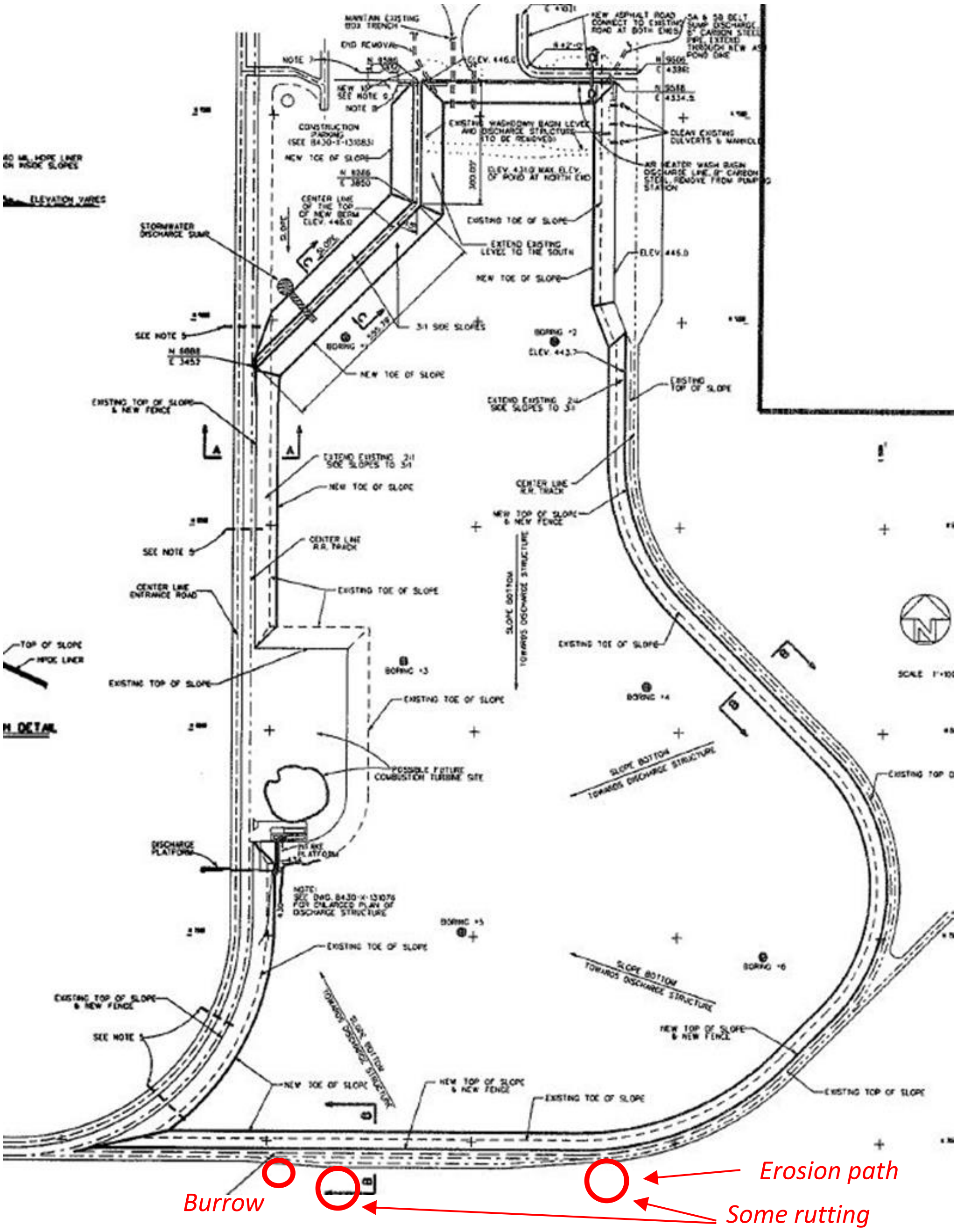
Earth Embankment

Item	Condition Code	Comments
Vertical & Horizontal Alignment of Crest	GC	
Seepage/Wetness/ Ponding Areas	GC	No wet or ponded water was identified in any locations.
Erosion/Rutting	OB	Some minor rutting on the south end of the pond outside the perimeter fence.
Fencing	GC	
Vegetation	GC	
Sloughs/Slides/ Cracks	GC	None.

Earth Embankment

Item	Condition Code	Comments
HDPE Liner	GC	
Animal Control	GC	None witnessed.
Other		

Note location of observation on attached plan sheet.



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OB = Condition requires regular observation and potential future minor maintenance.

GC = Good Condition

NO = No observation possible.

NI = Not Inspected. State reason in comment column.

SIOUX ENERGY CENTER
Cell 1 (SCPC), 4A (SCL1) & Recycle Pond
Annual Inspection Check Sheet

Date	10/3/19
Inspector	M. Lueckenhoff
Recycle Pond Level by Visual Reading of	< 433'
Recycle Pond Level Reading through DCS	432.04'
Cell 1 Level	440.5'
Weather	Cloudy
Temperature	70 F

Date of Previous Annual Inspection: 10/3/2018

Date of Previous Periodic Inspection: 8/23/2019

Description of Emergency (EC) or Immediate Maintenance (IM) conditions observed since the last annual inspection:
None.

Describe any action taken to restore or improve safety and integrity of impounding structure:
None.

Describe any modifications to the geometry of the impounding structure since the previous annual inspection:
None.

Describe any modifications to the operation of the impounding structure since the previous annual inspection:
None.

List the approximate remaining storage capacity of the impounding structure:
Cell 1 is 23,237 CY, Cell 4A is 339,365

List the approximate maximum, minimum and present depth and elevation of the impounded water in Cell 1 since the previous annual inspection:

	Maximum		**Minimum**		**Present**	
	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)
Cell 1	440.5	17.5	440.5	17.5	440.5	17.5

List the approximate maximum, minimum and present depth and elevation of the impounded CCR in Cell 1 and Cell 4A since the previous annual inspection:

	Maximum		**Minimum**		**Present**	
	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)	Elevation (ft)	Depth (ft)
Cell 4A	444	24	444	24	444	24
Cell 1	442.5	19.5	442.5	19.5	442.5	19.5

Approximate volume of CCR at the time of the inspection:
Cell 1 is 706,763 CY, Cell 4A is 200,635 CY

Describe any changes to the downstream watershed:
NA. System is closed loop.

Recycle Pond

Item	Condition Code	Comments
Erosion, sloughing, sliding, boils, seepage	OB	Sloughing of the clay liner under the HDPE liner noticed on the east interior embankment.
Condition of grass cover, woody vegetation, burrows	GC	
Recycle Pond between el. 428 and 443	GC	Yes
Settlement, depression or crack in embankment	GC	None
Effluent Pump Intake Structures (when visible)	NO	
Gravel Ballast Covering Pump Intake Pipes (when visible)	NO	
Damage to transducer level controls or pipes	MM	Please add gravel ballast to the gravel trays on the transducer conduits. Slope could be off due to sloughing of clay liner.
Unevenness, movement of triple box culverts	OB	Some slight gapping between 2 and 3 (reference going east to west). There does not seem to be any observable damage, if there was movement. It is possible that this has existed from construction and not noticed due to gravel obstructing the gap in previous inspections.
HDPE Recirculation Pipe	NO	Buried. Not observed.
Erosion or rutting gravel top & perimeter roads and ramps	MM	Erosion on some ramps.
HDPE Liner	OB	Some settlement at waterline.

Recycle Pond

Item	Condition Code	Comments
Precast Concrete Revetment below Box Culverts	GC	
Precast Concrete Revetment below Discharge Pipes	GC	
Emergency Spillway	OB	Minor but some rutting/depressions causing blocks to lift. This appears to be from traffic over the spillway.
Imminent discharge thru emergency spillway	GC	None occurred.

Cell 1

Item	Condition Code	Comments
Erosion, sloughing, sliding, boils, seepage	GC	
Condition of grass cover, woody vegetation, burrows	GC	
Settlement, depression or crack in embankment	GC	
Emergency Spillway	GC	
Imminent discharge thru emergency spillway	GC	
Gypsum slurry flowing unobstructed	GC	
Slurry spraying or running out of cleanouts	GC	None witnessed

SIOUX ENERGY CENTER
Cell 1 (SCPC), 4A (SCL1) & Recycle Pond
Annual Inspection Check Sheet

Cell 1

Item	Condition Code	Comments
Height from discharge pipe flow line to gypsum level	OB	Close. Currently below the pond level but flowing. Pipe is moved every 3 months to ensure no obstructions impact flow.
HDPE Liner	GC	
Erosion or rutting gravel top & perimeter roads and ramps	MM	Erosion on some ramps.
Sump Outlet & Concrete Pad	NA	System is closed loop.
Drain Outlets & Concrete Pads	GC	
Movement of riprap	GC	

Cell 4

Item	Condition Code	Comments
Condition of Vegetative Cover	GC	
Erosion, sloughing, sliding, boils, seepage	OB	Some erosion on east levee at south end not new. May want to take blade & drag to smooth ruts.
Settlement, depression or crack in embankment	GC	
Interior Drainage/Sump Pump	GC	
Leachate Vault, Pipes and Pump Controls	GC	
Leachate Discharge (color and/or sediment)	GC	Clear.
Erosion or rutting	OB	Erosion on some ramps.

Cell 4

Item	Condition Code	Comments
gravel top & perimeter roads and ramps		
Leachate Time from hour meter and level readings	GC	Hour Readings 4477.2 Level (inches) 45.4

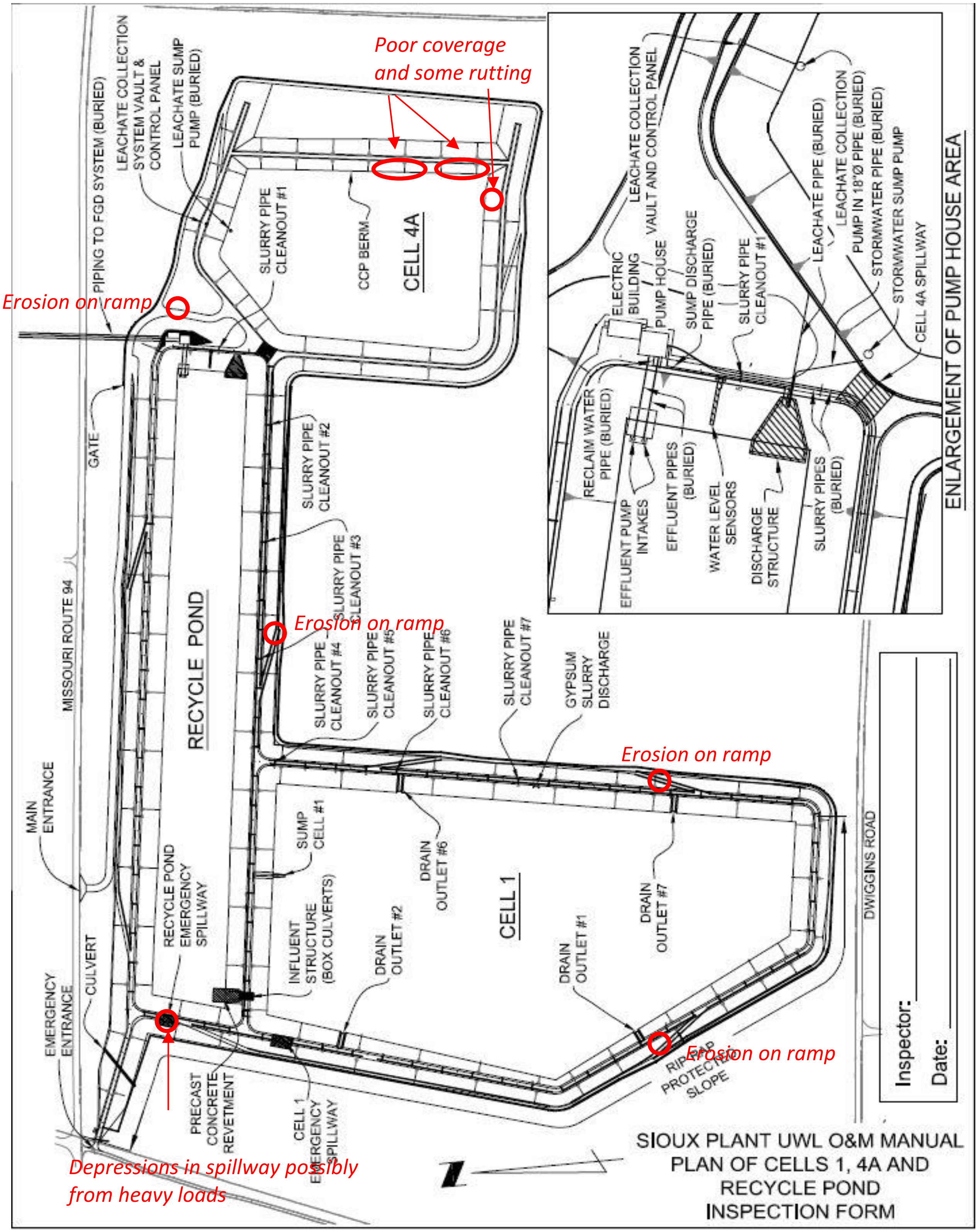
Other

Item	Condition Code	Comments
Holes or breaks in perimeter fence, vandalism	GC	None
Main and emergency gates locked	GC	Locked

Drive slowly around tops of embankments looking for visible signs of present or developing major problems. Indicate location(s)) of problems or anomalies on inspection plan - sign, date and attach sheet to report.

If a problem is noted, email or FAX report to appropriate persons. If emergency condition is noted, immediately contact the Shift Operations Supervisor and Chief Dam Safety Engineer.

SIOUX ENERGY CENTER
Cell 1 (SCPC), 4A (SCL1) & Recycle Pond
Annual Inspection Check Sheet



Condition Code

EC = Emergency Condition. A serious dam safety condition exists that need immediate action. Emergency measures implemented as instructed by Chief Dam Safety Engineer; pool draw down, work stoppage, plant stoppage.

IM = Item needing immediate maintenance to restore or ensure its safety and integrity. Remediation should be complete within 1 month or as required.

MM = Minor Maintenance. Item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled.

OB = Condition requires regular observation and potential future minor maintenance.

GC = Good Condition

NO = No observation possible.

NI = Not Inspected. State reason in comment column.

APPENDIX II

DVD CONTAINING 2020 PERIODIC INSPECTION PHOTOGRAPHS

APPENDIX D

PERIODIC SAFETY FACTOR ASSESSMENT

AMEREN MISSOURI SIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. CHARLES COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

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AMEREN MISSOURI SIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
ST. CHARLES COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

1.0 INTRODUCTION

The Sioux Energy Center (SEC) is located in northeast St. Charles County, Missouri along the Mississippi River, approximately 14 miles upstream of the confluence with the Missouri River and approximately 3 miles east of Portage de Sioux, Missouri. The SEC is located within the floodplain of the Mississippi and Missouri Rivers and has three active CCR surface impoundments within an approximate 149-acre area. The CCR surface impoundments, designated as Bottom Ash Pond (SCPA), Fly Ash Pond (SCPB) and Gypsum Pond, Cell 1 (SCPC), are used for managing coal combustion residuals (CCR). SCPA and SCPB have been dewatered and are currently being closed. SCPC is currently actively receiving CCRs. Before closure, pooled water from SCPA and SCPB discharged through NPDES permitted outfalls into Poeling Lake. Decant water in SCPC discharges into the Recycle Pond where pumps recirculate the water back to the power plant. A map showing the location of the surface impoundments and the Recycle Pond is attached as Figure 1.

1.1 Purpose

40 CFR §257.73(e) requires that the owner or operator of an existing CCR surface impoundment conduct initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum factors of safety for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments should be supported by appropriate engineering calculations. The specified minimum safety factors are shown in Table 1.

Table 1 - Minimum Safety Factors

Loading Condition	Minimum Factor of Safety
Static, long-term, maximum storage pool	1.50
Static, maximum surcharge pool	1.40
Seismic	1.00
Liquefaction	1.20

A periodic safety factor assessment has been conducted only for SCPC at the Sioux Energy Center. SCPA and SCPB have been dewatered and are currently being closed.

2.0 REVIEW OF PREVIOUS SAFETY FACTOR ASSESSMENT

The initial periodic safety factor assessments for SCPA, SCPB and SCPC were completed in October 2016. During the current periodic safety factor assessment, the initial assessment and the assumptions made for analyses of SCPC were reviewed. The 2016 assessment assumed that SCPC was filled with gypsum to an approximate elevation of 444, 2 foot below SCPCs perimeter berm. Currently SCPC is filled with gypsum to approximate elevations ranging from 440 to 445. As a result, the current conditions are representative of those used in the 2016 assessment and the results of the 2016 safety factor assessment are still valid. The Initial Periodic Safety Factor Assessment report that documents the analyses performed and includes graphical outputs of the results of the stability analyses is included in Appendix I.

SCPA and SCPB have been dewatered and are currently being closed. Golder Associates completed analyses of these CCR surface impoundments in the closed condition. Golder's reports documenting the analyses for the closed condition of SCPA and SCPB are included in Appendix II. The Initial Periodic Safety Factor Assessment included in Appendix I documents the stability of these ponds prior to closure.

3.0 SCPC - PERIODIC SAFETY FACTOR ASSESSMENT METHODOLOGY

3.1 Static Stability Analyses

Slope stability analyses were performed in general accordance with United States Army Corps of Engineers (USACE) EM1110-2-1902 *Slope Stability* and MSHA's 2009 *Engineering and Design Manual for Coal Refuse Disposal Facilities*, and using the computer program SLIDE 6.0. This program uses the Spencer method in a limit-equilibrium analysis, which resolves the static forces on each vertical slice of soil profile along a given circular or irregular assumed failure surface. The program searches for the minimum Factor of Safety (FS) against slope failure for each center point in the grid by incrementally varying the radius of the failure surface. The plotted results from the program show the minimum FS, and the center and radius of the failure surface with the minimum FS. The output of the program also plots contours of equal FS within the grid of possible center points.

3.2 Seismic Stability Analyses

The critical cross-section was analyzed using a pseudo-static acceleration as a horizontal body force on the soil mass to calculate the minimum factor of safety for a seismic event. The seismic acceleration was based upon the USGS 2014 seismic hazard maps for a Peak Horizontal Ground Acceleration (PHGA) for seismic loading event with a 2% probability of exceedance in 50 years. The PHGA was factored for the seismic site class in accordance with ASCE 7 *Minimum Design Loads for Buildings and Other Structures, International Building Code*. A seismic coefficient of 0.5 was applied to the PHGA, which is consistent with MSHA's 2009 *Engineering and Design Manual for Coal Refuse Disposal Facilities*, in particular Chapter 7, "Seismic Design: Stability and Deformation Analyses." The manual cites research by Hynes-Griffen and Franklin (1984) which found that for seismic coefficient of 0.5 would result in deformations of less than 3 feet for a safety factor of 1.0.

The published 2014 USGS hazard map for the Sioux Energy Center is reproduced in Figure 2. This is the latest map available from the USGS website. The probabilistic PHGA for the design earthquake at the

Sioux site is 0.183g (that is, 18.3% of standard gravity acceleration of 32.2 feet/sec^2). This value takes into account attenuation of bedrock shaking with distance from the probable sources and general soil interactions such as damping for a hypothetical soil profile. This value is meant to be a conservative estimate. Based upon the data, the most probable earthquake magnitudes (M_w) for these accelerations are between 7.0 and 8.0. We applied a multiplier of 1.434 to the base PHGA to account for the soil profile at the Sioux Energy Center to obtain a site specific PHGA of 0.262g. Therefore, the pseudo-static seismic load was 0.131g.

3.3 Liquefaction Stability Analyses

The liquefaction slope stability analysis is a post-earthquake, static analysis which includes the effects of potential liquefaction or softening of the soils. Liquefaction occurs when ground shaking is sufficient to produce cyclic particle movements that cause excess pore water pressures to build to the point that some of the shear strength of the soil is lost. Liquefaction occurs in loose sandy soils with less than about 35% fines (soils which are finer than standard U.S. #200 or 0.075mm). Liquefaction can occur in very loose soils with up to 50 percent fines and soils up to the size of fine gravel. Liquefaction only occurs below the ground water table (phreatic surface). The presence of soil susceptible to liquefaction in the top 50 feet of the soil profile at the Sioux Energy Center typically included the silty sand and sand. Conservative estimates of post-earthquake or residual shear strengths in the liquefied strata were assumed.

4.0 SCPC – STABILITY ANALYSES RESULTS

The 2016 results of the stability analyses for SCPC for each load case are presented in Table 2. The search for critical failure surfaces was limited to those that significantly impact SCPC's perimeter berm. The analyses showed that the calculated factors of safety exceed the minimum presented in §257.73(e) for each loading condition.

Table 2 – SCPC – 2016 Stability Analyses Results

Loading Condition	Minimum Factor of Safety	Calculated Factor of Safety
Static, long-term, maximum storage pool	1.50	2.14
Static, maximum surcharge pool	1.40	2.14
Seismic	1.00	1.27
Liquefaction	1.20	1.33

5.0 CONCLUSIONS

The periodic safety factor assessment for SCPC at the Sioux Energy Center found that the calculated factors of safety for the critical cross-sections for this CCR unit exceed the minimum factors of safety for each loading condition required by 40 CFR §257.73(e). The subsequent periodic safety factor assessment should be conducted within 5 years of the date of this report.

6.0 REFERENCES

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American Society of Civil Engineers (2013), *Minimum Design Loads for Buildings and Other Structures*, Standards ASCE/SEI 7-10, 3rd Printing.

EM1110-2-1902 (2003), *Slope Stability*. U.S. Army Corps of Engineers, Washington, D.C.

Hynes-Griffen, M.E. and A.G. Franklin (1984), “Rationalizing the Seismic Coefficient Method,” Miscellaneous Paper GL-84-13, U.S. Department of the Army, Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

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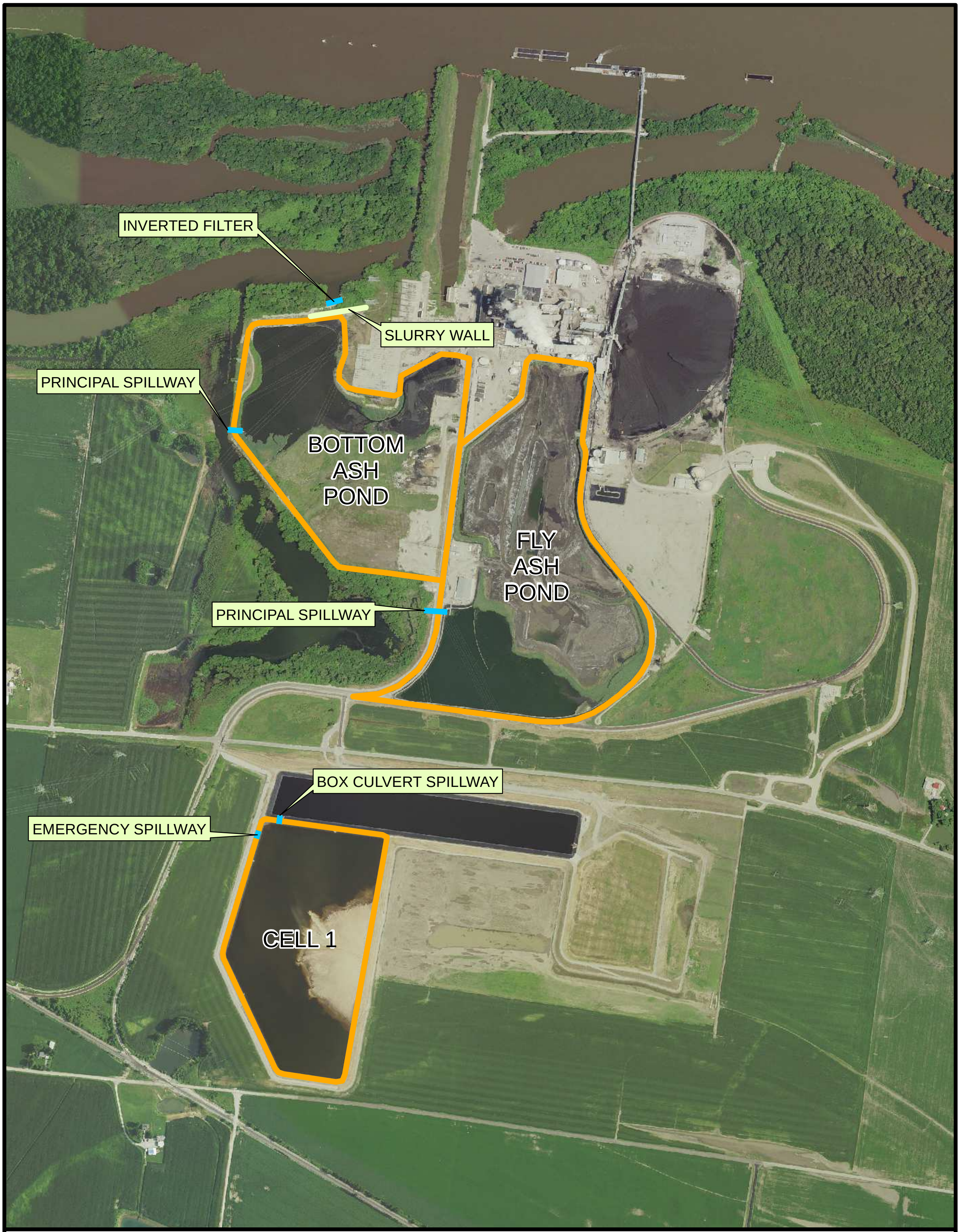
Idriss, I.M. and R.W. Boulanger (2008), “Soil Liquefaction During Earthquakes,” Earthquake Engineering Research Institute, Oakland, California, EERI Publication No. MNO-12.

Mine Safety and Health Administration (2010), *Engineering and Design Manual, Coal Refuse Disposal Facilities*. Second Edition.

Naval Facilities Engineering Command (1986). *Soil Mechanics, Design Manual 7.01*. Alexandria, Virginia.



Legend

- Embankment
- Spillway

N

0 500 1,000
Feet

AMEREN MISSOURI
SIOUX ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren
MISSOURI

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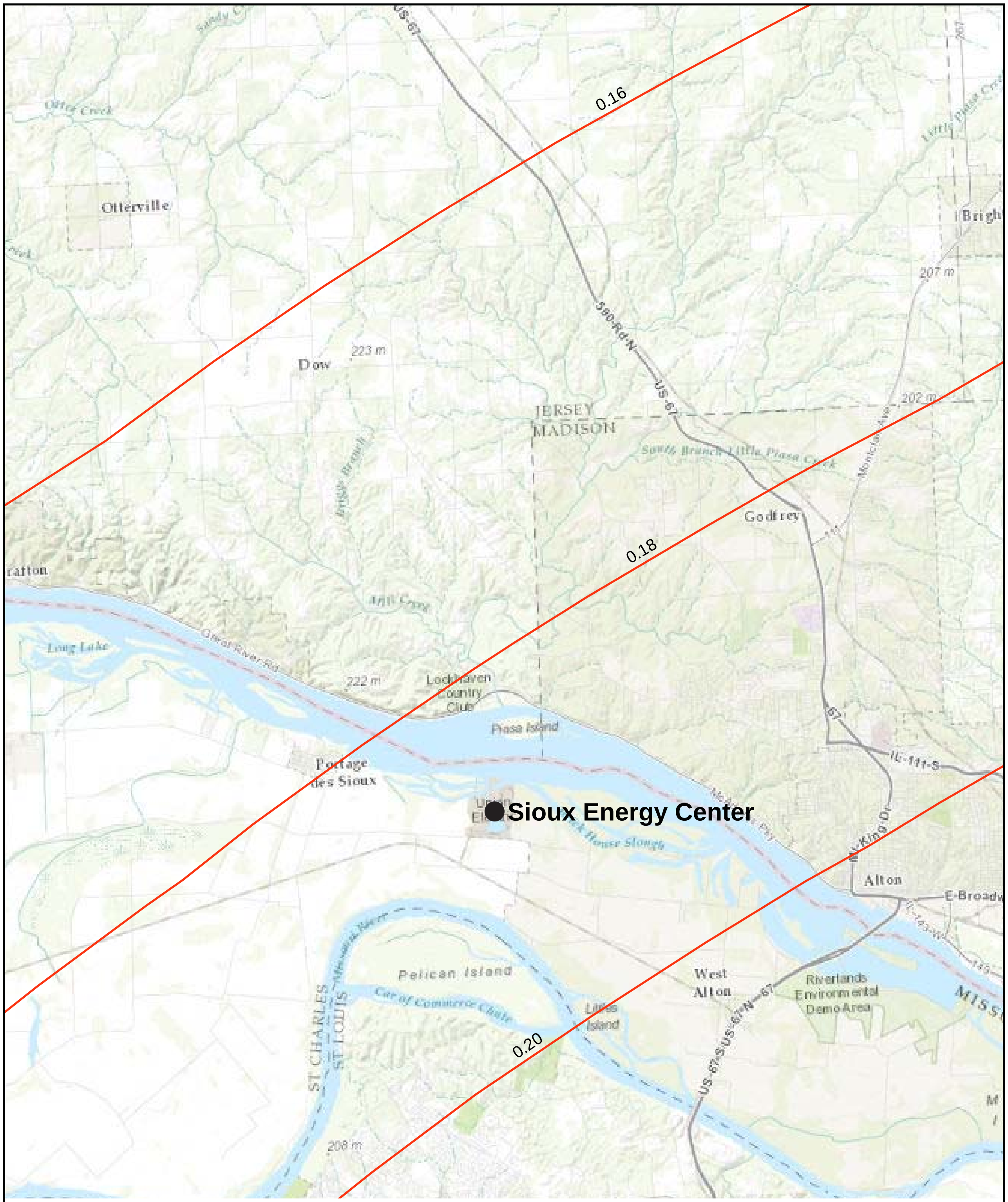
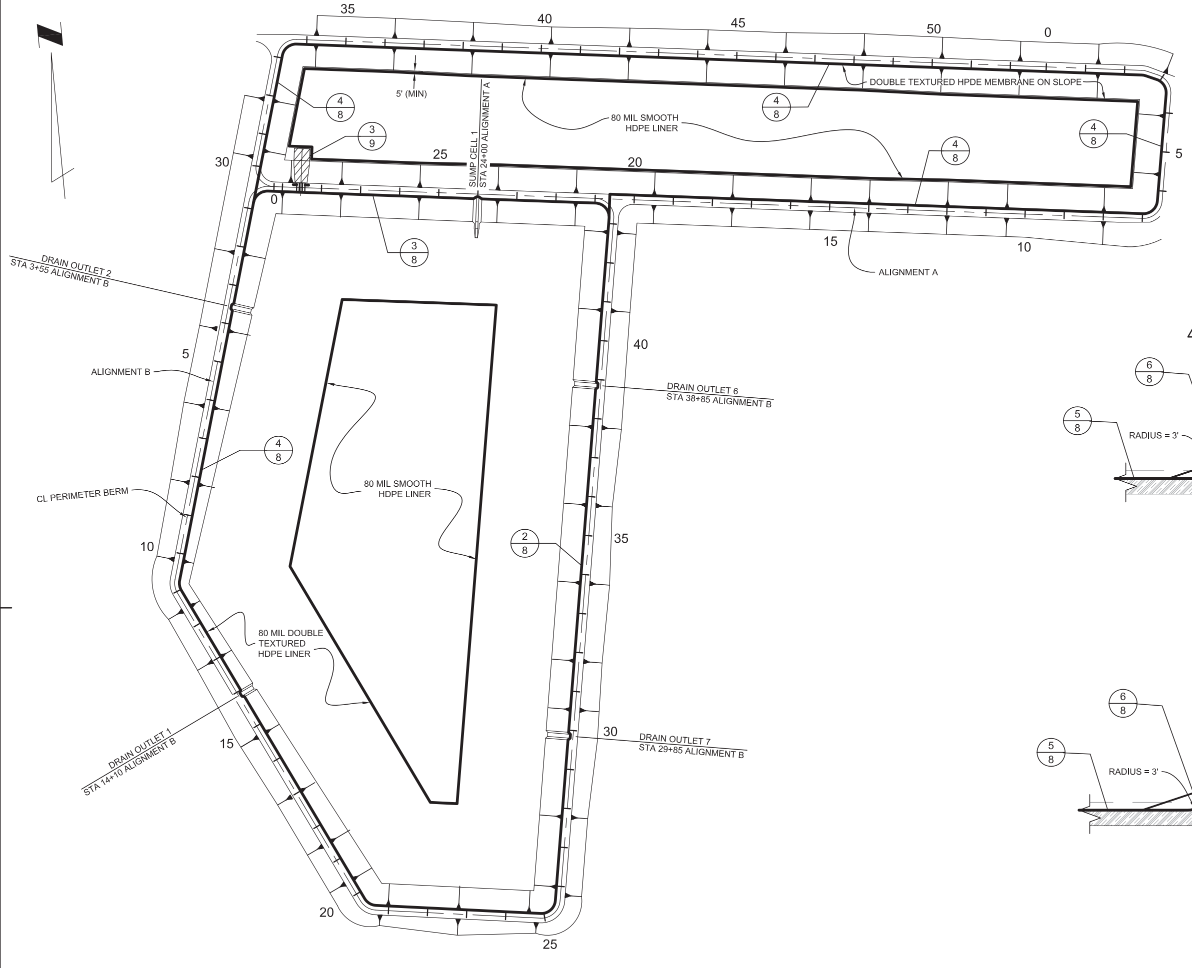


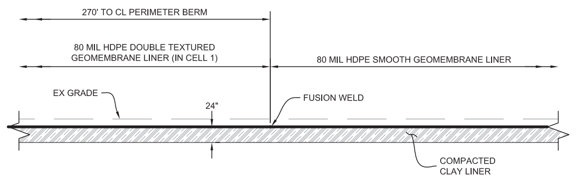
2% Probability of Exceedance in 50 Years Map of Peak Ground Acceleration

Ameren Missouri: Sioux Energy Center
2014 USGS Seismic Hazard Map

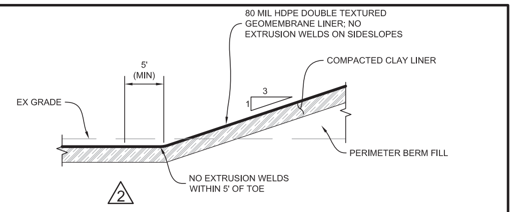
PRINT DIST.		
REVISIONS		
REV.	W.O.	
0		4/03/08
2		5/18/09
4		6/7/10



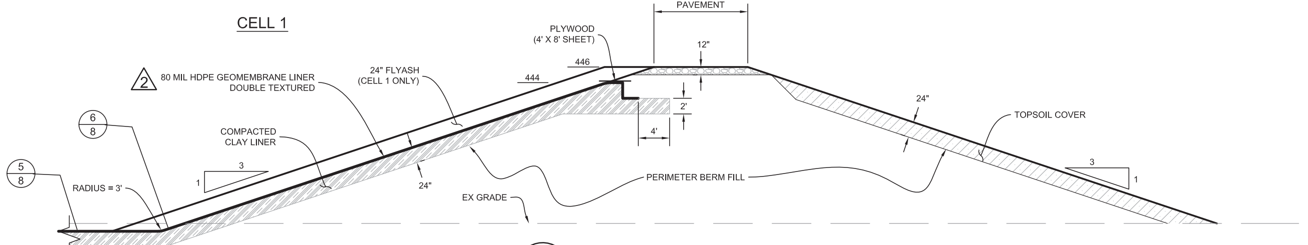
1/8 LINER PLAN
SCALE: 1" = 200'



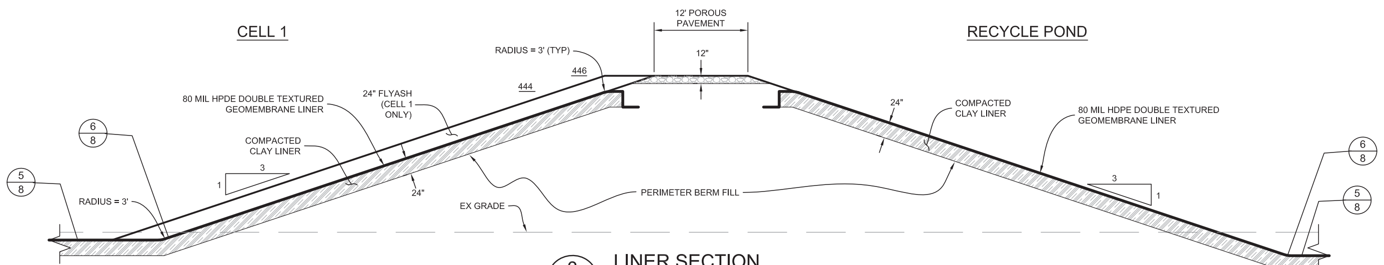
5/8 BOTTOM LINER
NO SCALE



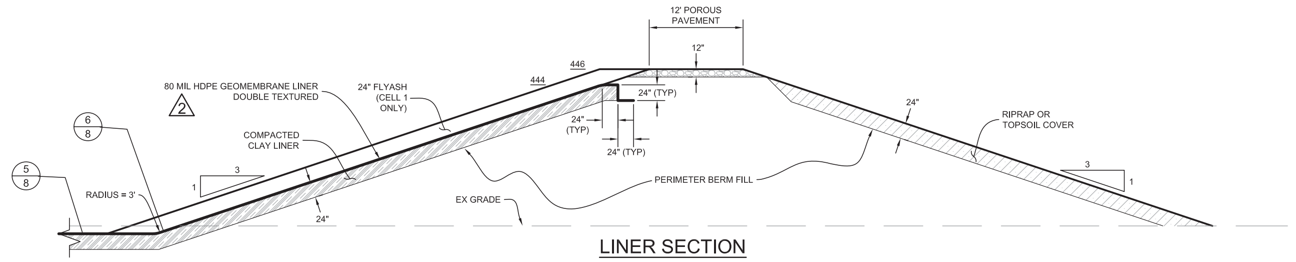
6/8 TRANSITION LINER
NO SCALE



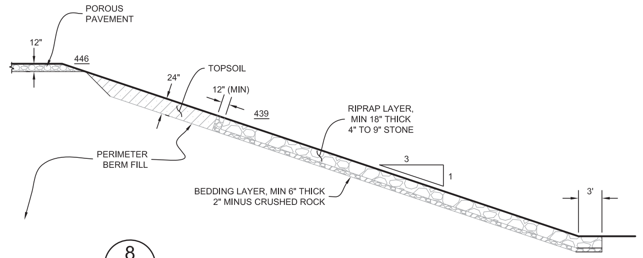
2/8 LINER SECTION STA 24+89 B TO 43+64 B
SCALE: 1" = 10'



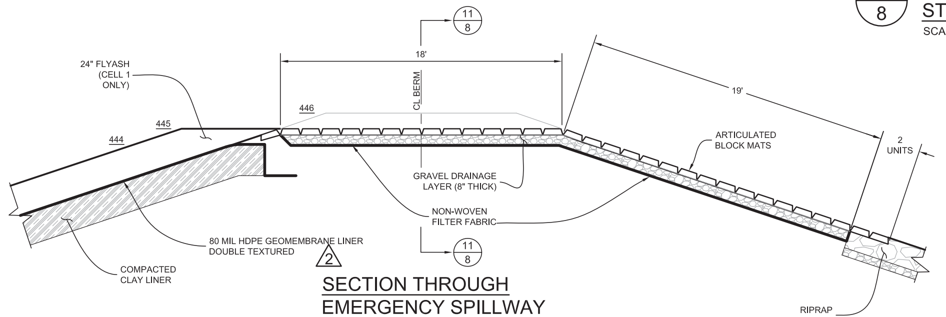
3/8 LINER SECTION STA 20+48 A TO 29+22 A
SCALE: 1" = 200'



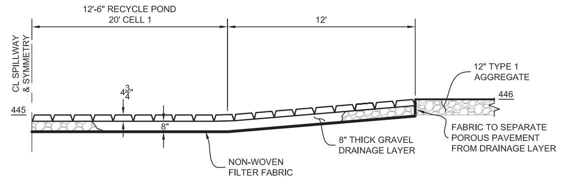
LINER SECTION
4/8 STA 0+00 A TO 20+48 A
STA 29+22 A TO 52+92 A
STA 0+00 B TO 25+00 B
SCALE: 1" = 10'



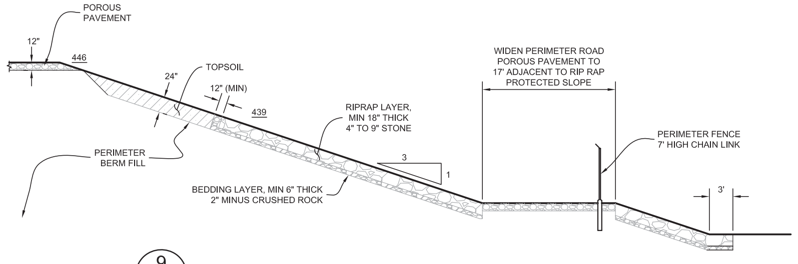
8/8 RIPRAP PROTECTION, OUTSIDE SLOPE OF PERIMETER BERM STA 31+39 A TO 5+35 C
SCALE: 1" = 10'



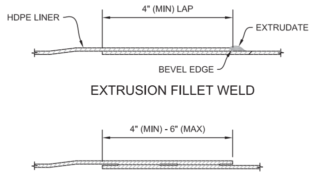
10/8 SECTION THROUGH EMERGENCY SPILLWAY STA 32+24 A STA 1+65 B
SCALE: 1" = 5'



11/8 EMERGENCY SPILLWAY/ ROAD PROFILE
SCALE: 1" = 5'



9/8 RIPRAP PROTECTION, OUTSIDE SLOPE OF PERIMETER BERM STA 24+89 B TO 31+39 A
SCALE: 1" = 10'



EXTRUSION FILLET WELD

DOUBLE WEDGE FUSION WELD

7/8 FUSION AND EXTRUSION WELDS (TYP)
NO SCALE

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Jefferson City, Missouri 65101 Facsimile: (573) 659-9079

PREPARED FOR Ameren UE

DRAWN M.R.F.
CHKD. J.L.F.
SUPV.
APPD.

SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 8 OF 16
GEOMEMBRANE LINER PLAN AND DETAILS

LOCATION 001009
SIOUX PLANT
CLASS 02010

Ameren UE ST. LOUIS, MISSOURI
8430-Y-0168608
REV. 4

Figure 3

APPENDIX I

INITIAL SAFETY FACTOR ASSESSMENT (2016)

AMEREN MISSOURI SIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. CHARLES COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

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EVALUATION OF CCR UNITS
ST. CHARLES COUNTY, MISSOURI

APPENDIX D: SAFETY FACTOR ASSESSMENT §257.73(e)

1.0 INTRODUCTION

The Sioux Energy Center (SEC) is located in northeast St. Charles County, Missouri along the Mississippi River, approximately 14 miles upstream of the confluence with the Missouri River and approximately 3 miles east of Portage de Sioux, Missouri. The SEC is located within the floodplain of the Mississippi and Missouri Rivers. The SEC has three active surface impoundments within an approximate 163 acre area. The active surface impoundments, designated as Bottom Ash Pond, Fly Ash Pond and Cell 1 – Gypsum (Cell 1), are used for managing coal combustion residuals (CCR). Pooled water from the Bottom Ash Pond and Fly Ash Pond discharges through NPDES permitted outfalls into Poeling Lake. Decant water in Cell 1is routed north into the Recycling Pond where pumps recirculate the water back to the power plant. A map showing the location of the surface impoundments and the Recycling Pond is attached as Figure 1.

1.1 Purpose

40 CFR §257.73(e) requires that the owner or operator of an existing CCR surface impoundment to conduct initial and periodic safety factor assessments for each CCR unit and document whether the calculated factors of safety for each CCR unit achieve the minimum factors of safety for the critical cross section of the embankment. The critical cross section is the cross section anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions. The safety factor assessments should be supported by appropriate engineering calculations. The specified minimum safety factors are shown in Table 1.

Table 1 - Minimum Safety Factors

Loading Condition	Minimum Factor of Safety
Static, long-term, maximum storage pool	1.50
Static, maximum surcharge pool	1.40
Seismic	1.00
Liquefaction	1.20

A periodic safety factor assessment has been conducted for the active surface impoundments at the Sioux Energy Center, which includes the Bottom Ash Pond, Fly Ash Pond and Cell 1.

2.0 PERIODIC SAFETY FACTOR ASSESSMENT

2.1 Static Stability Analyses

Slope stability analyses were performed in general accordance with United States Army Corps of Engineers (USACE) EM1110-2-1902 *Slope Stability* and MSHA's 2009 *Engineering and Design Manual for Coal Refuse Disposal Facilities*, and using the computer program SLIDE 6.0. This program uses the Spencer method in a limit-equilibrium analysis, which resolves the static forces on each vertical slice of soil profile along a given circular or irregular assumed failure surface. The program searches for the minimum Factor of Safety (FS) against slope failure for each center point in the grid by incrementally varying the radius of the failure surface. The plotted results from the program show the minimum FS, and the center and radius of the failure surface with the minimum FS. The output of the program also plots contours of equal FS within the grid of possible center points.

2.2 Seismic Stability Analyses

The critical cross-section was analyzed using a pseudo-static acceleration as a horizontal body force on the soil mass to calculate the minimum factor of safety for a seismic event. The seismic acceleration was based upon the USGS 2014 seismic hazard maps for a Peak Horizontal Ground Acceleration (PHGA) for seismic loading event with a 2% probability of exceedance in 50 years. The PHGA was factored for the seismic site class in accordance with ASCE 7 *Minimum Design Loads for Buildings and Other Structures, International Building Code*. A seismic coefficient of 0.5 was applied to the PHGA, which is consistent with MSHA's 2009 *Engineering and Design Manual for Coal Refuse Disposal Facilities*, in particular Chapter 7, "Seismic Design: Stability and Deformation Analyses." The manual cites research by Hynes-Griffen and Franklin (1984) which found that for seismic coefficient of 0.5 would result in deformations of less than 3 feet for a safety factor of 1.0.

The published 2014 USGS hazard map for the Sioux Energy Center is reproduced in Figure 2. This is the latest map available from the USGS website. The probabilistic PHGA for the design earthquake at the Sioux site is 0.183g (that is, 18.3% of standard gravity acceleration of 32.2 feet/sec^2). This value takes into account attenuation of bedrock shaking with distance from the probable sources and general soil interactions such as damping for a hypothetical soil profile. This value is meant to be a conservative estimate. Based upon the data, the most probable earthquake magnitudes (M_w) for these accelerations are between 7.0 and 8.0. We applied a multiplier of 1.434 to the base PHGA to account for the soil profile at the Sioux Energy Center to obtain a site specific PHGA of 0.262g. Therefore, the pseudo-static seismic load was 0.131g.

2.3 Liquefaction Stability Analyses

The liquefaction slope stability analysis is a post-earthquake, static analysis which includes the effects of potential liquefaction or softening of the soils. Liquefaction occurs when ground shaking is sufficient to produce cyclic particle movements that cause excess pore water pressures to build to the point that some of the shear strength of the soil is lost. Liquefaction occurs in loose sandy soils with less than about 35% fines (soils which are finer than standard U.S. #200 or 0.075mm). Liquefaction can occur in very loose soils with up to 50 percent fines, and soils up to the size of fine gravel. Liquefaction only occurs below the ground water table (phreatic surface). The presence of soil susceptible to liquefaction in the top 50 feet of the soil profile at the Sioux Energy Center typically included the silty sand and sand. Conservative estimates of post-earthquake or residual shear strengths in the liquefied strata were assumed.

3.0 SCPA (BOTTOM ASH POND)

3.1 Critical Section and Assumptions

The critical section for the Bottom Ash Pond is located at the northwest corner of the perimeter berm, adjacent to Poeling Lake. The location of the section is shown as Cross-section 1 in Figure 3, and a cross-section at the location is presented in Figure 4. The embankment at this location is about 27 feet high.

For stability analysis, it was conservatively assumed Poeling Lake had no ponded water and the line of seepage was unaffected by the low lake levels. For the static, long-term, maximum storage pool load case the water level in the Bottom Ash Pond was assumed to be at the normal pool el. 438. The water surface elevation was increased to el. 442.5 for the maximum surcharge pool load case.

Soil parameters used for stability analysis of the Bottom Ash Pond critical section were derived from borings and CPT soundings made in 2010 for the Ash Pond Stability Analyses Project and borings for the original plant construction that were drilled in 1963. The boring and CPT sounding logs are included in Appendix A of the *Ameren Missouri Sioux Energy Center: Evaluation of CCR Units* report.

The perimeter berm was constructed of compacted layers with varying amounts of clay, silt and sand that were excavated from the incised portion of the pond. A geotechnical boring at the section location and CPT soundings near the section location were used to develop conservative assumptions for the undrained and effective stress parameters. The boring at the section location showed primarily silts and clays with some sand in the embankment fill. The top of the berm at this section was at about el. 443 with the natural ground surface at about el. 425. The boring and nearby CPT sounding showed the foundation material to be silty clay to el. 415, followed by silty sand to el. 405, sand to el. 390, and gravelly sand to at least el. 385 where the sounding was terminated. The embankment fill and underlying foundation clay were generally firm. Results from CU triaxial tests on similar fill material and foundation clays sampled along the Bottom Ash Pond west embankment were referenced for effective and total stress parameters in the lower fill and silty clay. Correlations for tip resistance, sleeve friction and pore water pressure showed the silty sand, sand and gravelly sand had friction angles of about 31°, 34° and 38°, respectively.

Liquefaction analysis (Idriss and Boulanger, 2008) determined that layers within the silty sand and sand would liquefy during post-earthquake conditions. Undrained residual strengths for the liquefied layers were chosen based on correlations for normalized residual shear strength ratio of liquefied sand versus equivalent clean-sand SPT corrected blow count or normalized residual shear strength ratio for liquefied soil versus overburden-corrected CPT penetration resistance (Idriss and Boulanger, 2007). The undrained residual strengths were assumed to be a ratio of the confining pressure, so liquefied strata outside the footprint of the embankment typically have lower strengths. The soil parameters assumed in the stability analyses are summarized in Table 2.

Table 2 – Soil Properties Assumed in the Bottom Ash Pond Critical Section Stability Analyses

Material	Unit Weight		Normal/Max Pool		Seismic		Liquefaction	
	γ (pcf)	γ' (pcf)	c' (psf)	ϕ' (°)	c (psf)	ϕ' (°)	c (psf)	ϕ' (°)
Rip Rap	110	48	0	40	0	40	0	40
Upper Fill	120	58	100	26	1000	0	1000	0
Lower Fill	115	53	70	27	90	18	90	18
Silty Cay	115	53	350	24	380	17	380	17
Silty Sand	120	58	0	31	0	31	0	31
Silty Sand (Liq1)	120	58	-	-	-	-	260	0
Silty Sand (Liq2)	120	58	-	-	-	-	110	0
Sand	124	62	0	34	0	34	0	34
Sand (Liq1)	124	62	-	-	-	-	400	0
Sand (Liq2)	124	62	-	-	-	-	275	0
Gravelly Sand	128	66	0	38	0	38	0	38

4.2 Stability Analysis Results

The results of the stability analyses for the Bottom Ash Pond for each load case are presented in Table 3. The search for critical failure surfaces was limited to those that significantly impact the dam. The analyses showed that the calculated factors of safety exceed the minimum presented in §257.73(e) for each loading condition. Graphical outputs of the results of the stability analyses are shown in Appendix I.

Table 3 – Bottom Ash Pond Stability Analyses Results

Loading Condition	Minimum Factor of Safety	Calculated Factor of Safety
Static, long-term, maximum storage pool	1.50	1.50
Static, maximum surcharge pool	1.40	1.42
Seismic	1.00	1.12
Liquefaction	1.20	1.26

4.0 SCPB (FLY ASH POND)

4.1 Critical Section and Assumptions

The critical section for the Fly Ash Pond is at the approximate mid-point of the south perimeter berm of the pond. A plan view showing the location of the section is shown in Figure 3 as Cross-section 5. A cross section through the perimeter berm at this location is shown as Section 5 in Figure 5. The typical embankment height for the pond, and the height at Section 5 are about 15 feet.

The groundwater table for stability analysis was assumed to be at the ground surface at the downstream toe of the embankment. The normal pool level for the Fly Ash Pond was assumed to be at el. 439.2. The interior water surface elevation was increased to el. 441.2 for the maximum surcharge pool. HDPE liner is present along the bottom and interior slopes of the pond. The analysis assumes the groundwater table was not influenced by the pond level, and there was no seepage from the pond.

Soil parameters used for stability analysis of the Bottom Ash Pond critical section were derived from borings and CPT soundings made in 2010 for the Ash Pond Stability Analyses Project and borings for the original plant construction that were drilled in 1963. The boring and CPT sounding logs are included in Appendix A of the *Ameren Missouri Sioux Energy Center: Evaluation of CCR Units* report.

The perimeter berm was constructed of compacted layers of clays, silts and sands that were excavated from the incised portion of the pond. A CPT sounding at the section location indicated primarily silts and clays with some sand in the embankment fill. The top of the berm at this section was about el. 443 with the natural ground surface at about el. 428. The CPT sounding showed the foundation clay to about el. 418, followed by silty sand to el. 408, followed by sand to the termination depth at el. 392. The embankment fill and underlying foundation clay were generally stiff. Correlations for tip resistance, sleeve friction and pore water pressure showed the fill and clay had an average s_u of about 3300 psf and 1800 psf, respectively, and minimum s_u of about 2500 and 1100 psf, respectively. Results from a CU triaxial test on similar foundation clay material sampled along the Bottom Ash Pond west embankment was referenced for effective stress parameters in the foundation clay. Correlations for tip resistance, sleeve friction and pore water pressure showed the silty sand and sand had friction angles of about 33° and 37°, respectively.

Liquefaction analysis determined the sand from el. 404 to 403 would liquefy during post-earthquake conditions. Undrained residual strengths for the liquefied layer was chosen based on correlations for normalized residual shear strength ratio for liquefied soil versus overburden-corrected CPT penetration resistance (Idriss and Boulanger, 2007). The soil parameters assumed in the stability analyses are summarized in Table 4.

Table 4 – Soil Properties Assumed in the Fly Ash Pond Critical Section Stability Analyses

Material	**Unit Weight**		**Normal/Max Pool**		**Seismic**		**Liquefaction**	
	γ (pcf)	**γ' (pcf)**	**c' (psf)**	**ϕ' (°)**	**c (psf)**	**ϕ (°)**	**c (psf)**	**ϕ (°)**
Upper Fill	120	58	0	25	0	25	0	25
Lower Fill	120	58	100	26	2500	0	2500	0
Clay	118	56	350	24	1100	0	1100	0
Silty Sand	125	63	0	33	0	33	0	33
Sand	128	66	0	37	0	37	0	37
Sand (Liq)	128	66	-	-	-	-	300	0
Fly Ash	110	48	-	25	0	25	0	25

4.2 Stability Analysis Results

The Fly Ash Pond stability analysis results for each load case are presented in Table 5. The search for critical failure surfaces was limited to those that significantly impact the dike. The analyses show that the calculated factors of safety exceeds the minimum presented in §257.73(e) for each loading condition. Graphical outputs of the results of the stability analyses are shown in Appendix I.

Table 5 – Fly Ash Pond Stability Analyses Results

Loading Condition	Minimum Factor of Safety	Calculated Factor of Safety
Static, long-term, maximum storage pool	1.50	2.78
Static, maximum surcharge pool	1.40	2.78
Seismic	1.00	2.11
Liquefaction	1.20	3.45

5.0 SCPC (CELL 1)

5.1 Critical Section and Assumptions

The critical section for Cell 1 is located along the southwest portion of the perimeter berm. Shown in Figure 6 are the critical cross section location and cross section at the location. The critical cross section was located at station 17+50A and is shown as section 4 in Figure 6. The downstream riprap armor was ignored in the stability analysis. The typical height of the embankment and height at the critical section is about 20 feet.

The groundwater table for stability analysis was assumed to be at the top of the natural ground surface. The pool level in the Cell 1 is controlled by triple box culverts that have a flow line elevation of 441. Water from Cell 1 is gravity fed through the box culverts into the Recycle Pond, where the recycled decant water is returned to the plant. The normal pool level was assumed to be el. 441. The maximum pool level was conservatively assumed to be at el. 445 for the maximum surcharge pool load case. 80-mil HDPE liner is present along the bottom and interior slopes of the pond. The analysis assumes the groundwater table was not influenced by the pond level, and there was no seepage from the pond.

Soil parameters used for stability analysis of the Cell 1 critical section were derived from borings made in 2005 for the Proposed Utility Waste Landfill Dam Construction Permit Application. The boring logs are included in Appendix A of the *Ameren Missouri Sioux Energy Center: Evaluation of CCR Units* report.

Embankment fill consists of compacted layers of clay and silt with varying amounts of sand. Fill material was compacted to an average of 100% of the maximum dry unit weight determined from the standard Proctor Moisture-Density Test (ASTM D698). Fill placement was monitored and moisture-density tests were obtained during construction. Geotechnical borings near the section location were used to develop conservative assumptions for the undrained and effective stress parameters. The top of the berm at this section is at about el. 446 with the natural ground surface at about el. 427. The borings showed the foundation material to be high plastic clay to about el. 423, followed by silt to about el. 414. The silt was underlain by sand, which extended to approximately el. 317 where limestone bedrock was encountered. Results from CU and UU triaxial tests on the high plastic clay and silt from the 2005 geotechnical investigation were used for effective and total stress parameters of the foundation clay and silt. The friction angle of the sand was conservatively assumed to be 27°.

Liquefaction analysis using the borings near the section location determined the sand would liquefy in a 5 foot layer directly under the silt during post-earthquake conditions. Undrained residual strengths for the liquefied layers were chosen based on correlations for normalized residual shear strength ratio of liquefied sand versus equivalent clean-sand SPT corrected blow count (Idriss and Boulanger, 2007). The soil parameters assumed in the stability analyses are summarized in Table 6.

Table 6 – Soil Properties Assumed in the Cell 1 Critical Section Stability Analyses

Material	**Unit Weight**		**Normal/Max Pool**		**Seismic**		**Liquefaction**	
	γ (pcf)	**γ' (pcf)**	**c' (psf)**	**ϕ' (°)**	**c (psf)**	**ϕ' (°)**	**c (psf)**	**ϕ' (°)**
Compacted Fill	120	58	0	30	800	0	800	0
CH	113	51	290	17.5	730	10.5	730	10.5
ML	115	53	0	32	550	0	550	0
Sand	122	60	0	27	0	27	0	27
Sand (Liq)	122	60	-	-	-	-	40	0
Gypsum	110	48	0	40	0	40	0	40

5.2 Stability Analysis Results

The results of the stability analyses for Cell 1 for each load case are presented in Table 7. The search for critical failure surfaces was limited to those that significantly impact the dam. The analyses showed that the calculated factors of safety exceed the minimum presented in §257.73(e) for each loading condition. Graphical outputs of the results of the stability analyses are shown in Appendix I.

Table 7 – Cell 1 Stability Analyses Results

Loading Condition	**Minimum Factor of Safety**	**Calculated Factor of Safety**
Static, long-term, maximum storage pool	1.50	2.14
Static, maximum surcharge pool	1.40	2.14
Seismic	1.00	1.27
Liquefaction	1.20	1.33

6.0 CONCLUSIONS

The initial periodic safety factor assessment for the Sioux Energy Center Bottom Ash Pond, Fly Ash Pond and Cell 1 found that the calculated factors of safety for the critical cross-sections at each CCR unit exceed the minimum factors of safety for each loading condition required by 40 CFR §257.73(e). The subsequent periodic safety factor assessment should be conducted within 5 years of the date of this report.

6.0 REFERENCES

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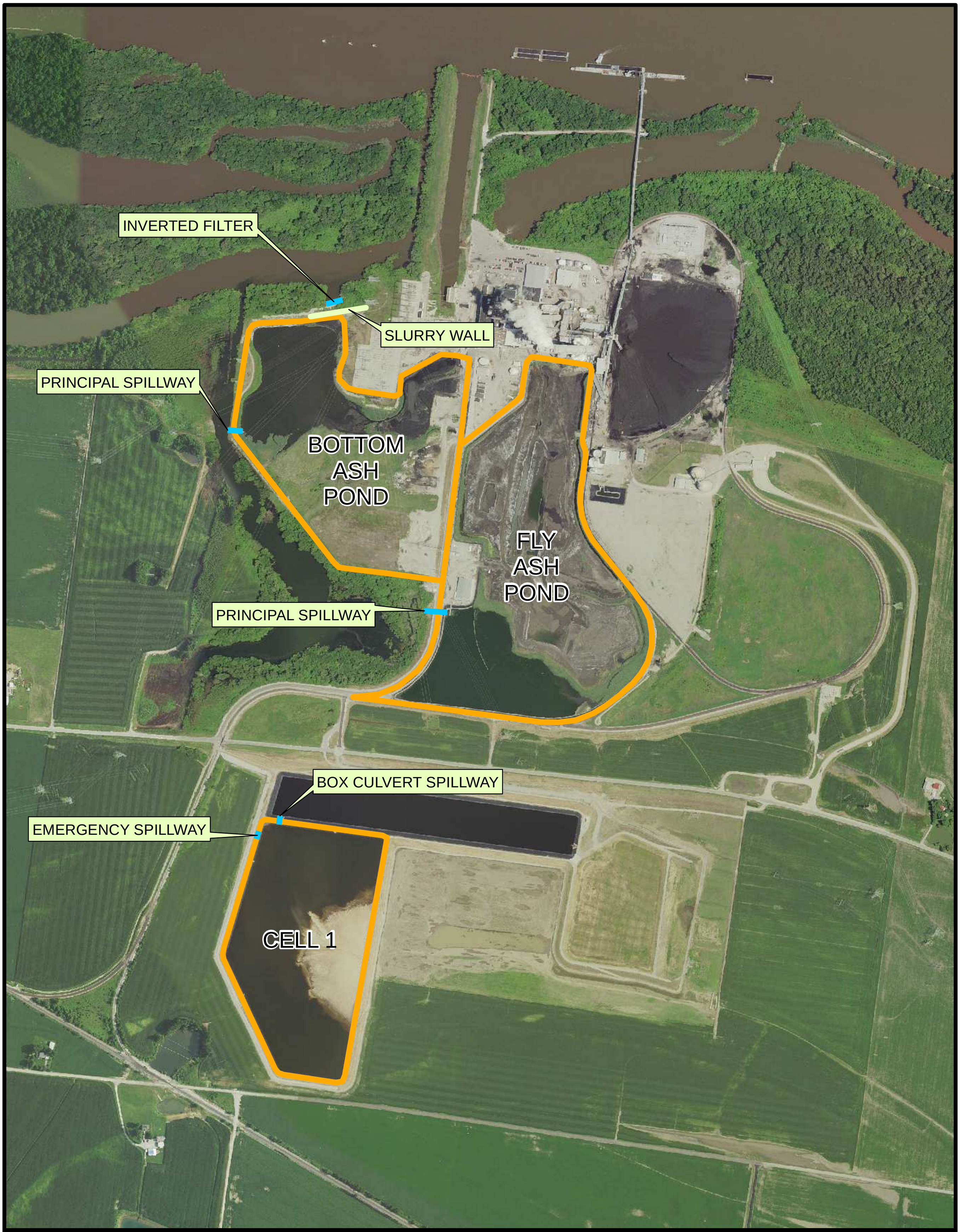

Legend

- Embankment
- Spillway

N

0 500 1,000 Feet

AMEREN MISSOURI
SIOUX ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

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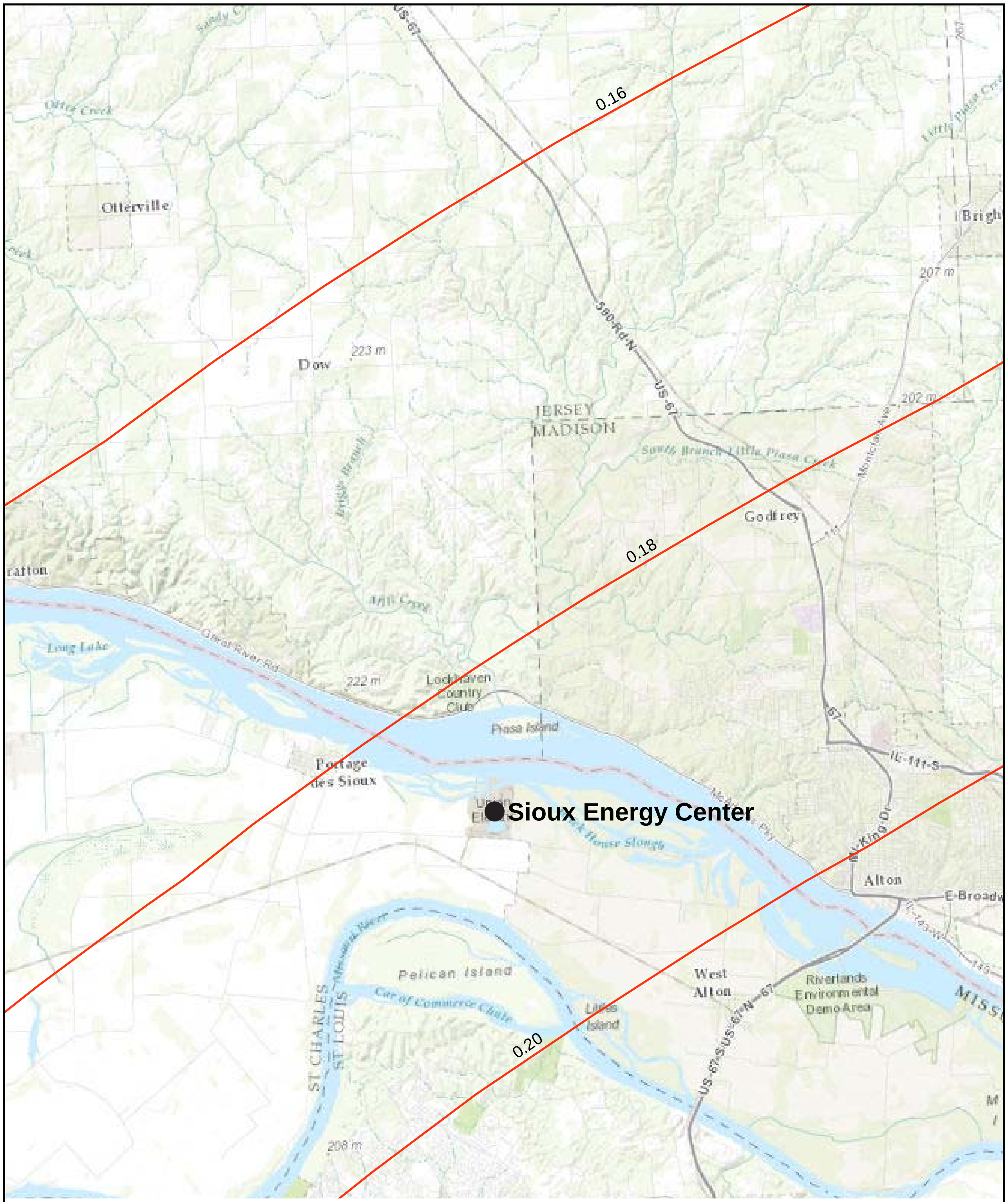

2% Probability of Exceedance in 50 Years Map of Peak Ground Acceleration

Ameren Missouri: Sioux Energy Center
2014 USGS Seismic Hazard Map

Elevation Profile Survey Limits
Locations of Cross-section and Borings

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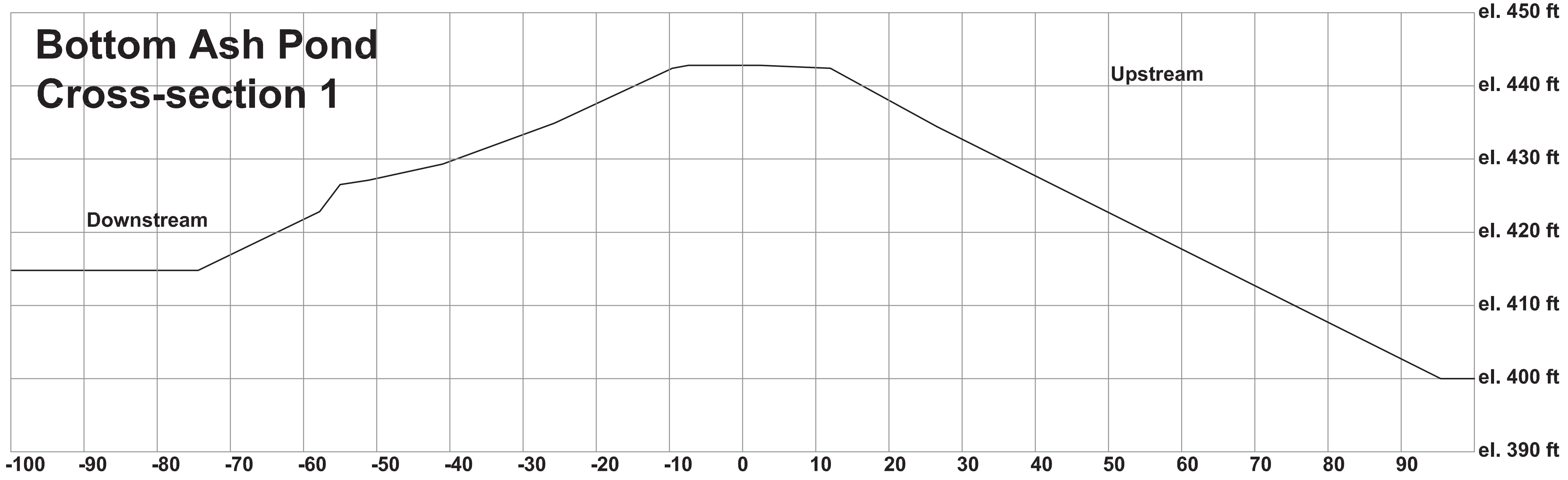
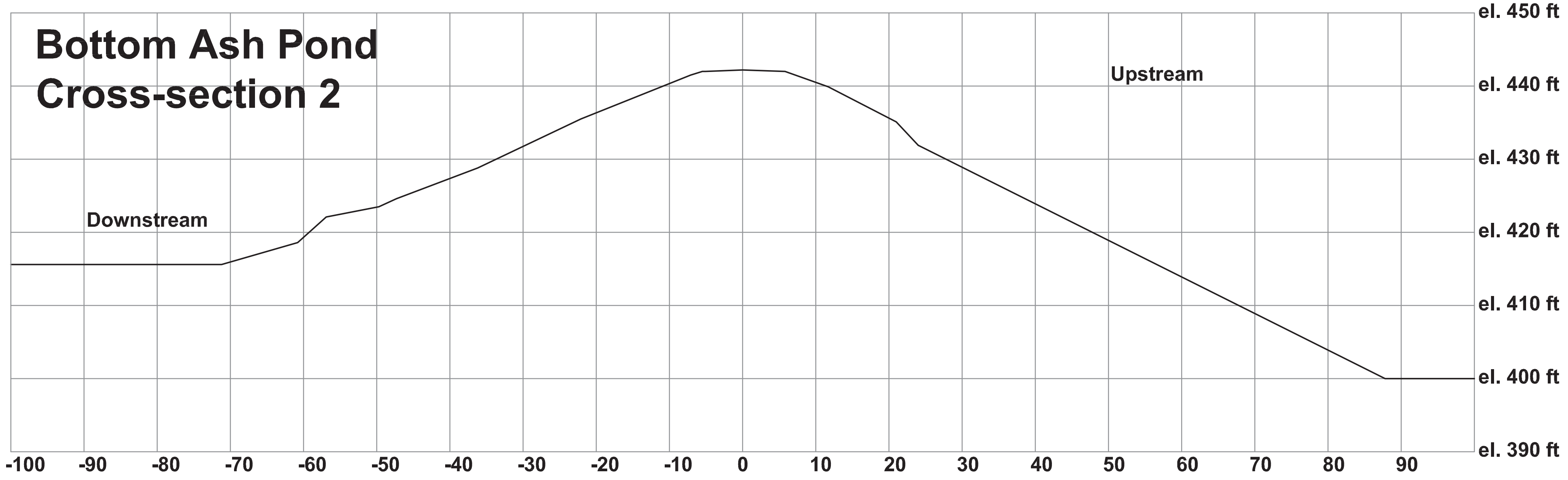
Figure 3

Sioux Power Station





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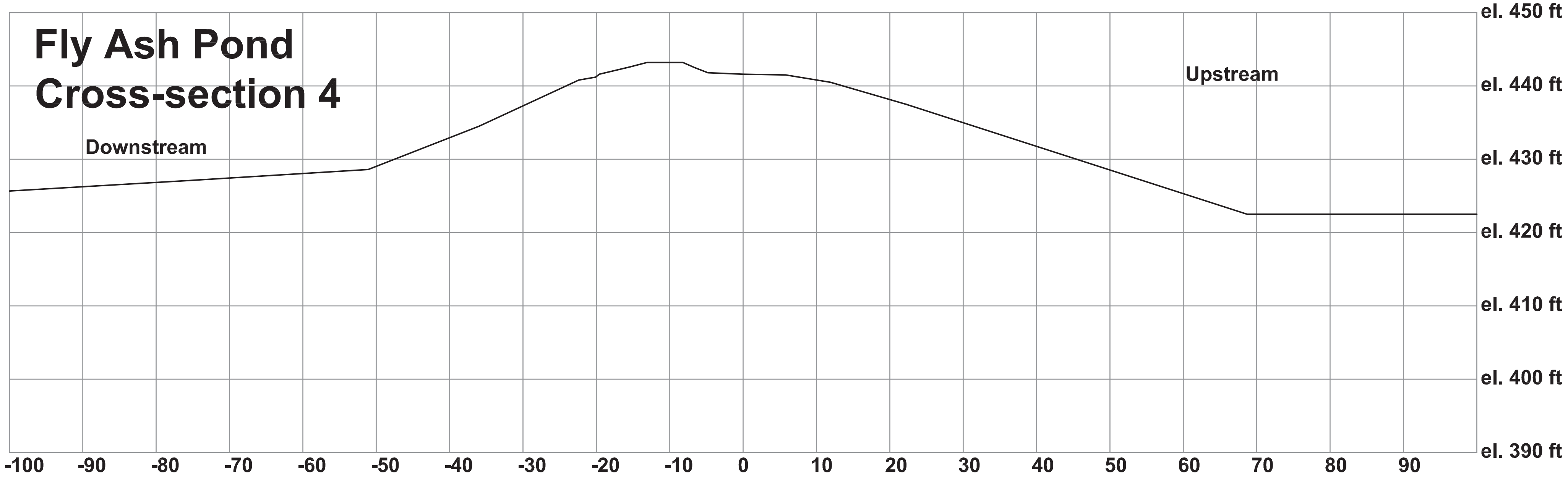
St. Louis, Missouri 63132

Figure 4

Sioux Power Station


Fly Ash Pond
Cross-section 4

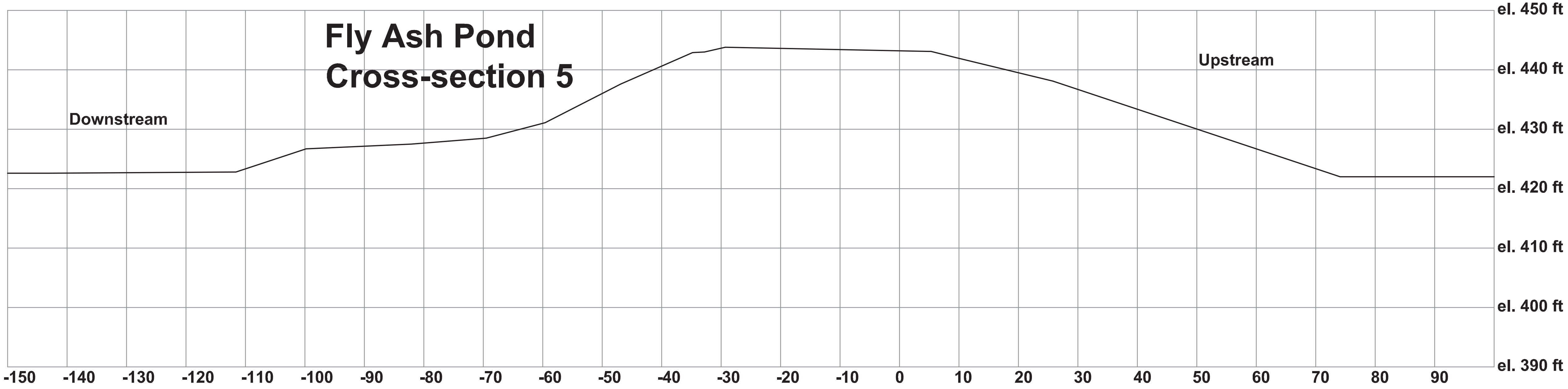

Fly Ash Pond
Cross-section 5

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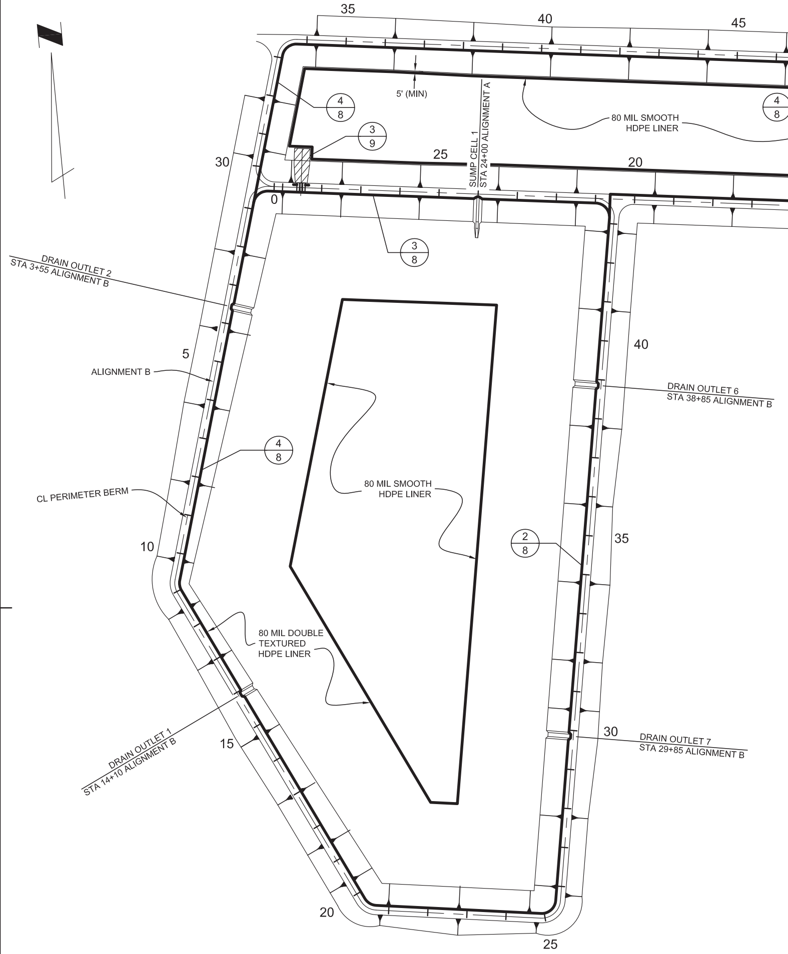
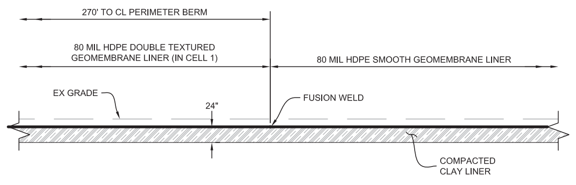
Figure 5

PRINT DIST.

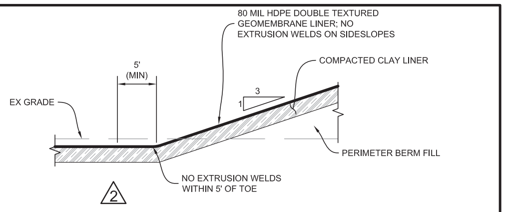
REVISIONS		
REV.	W.O.	
0		4/03/08
2		5/18/09
4		6/7/10



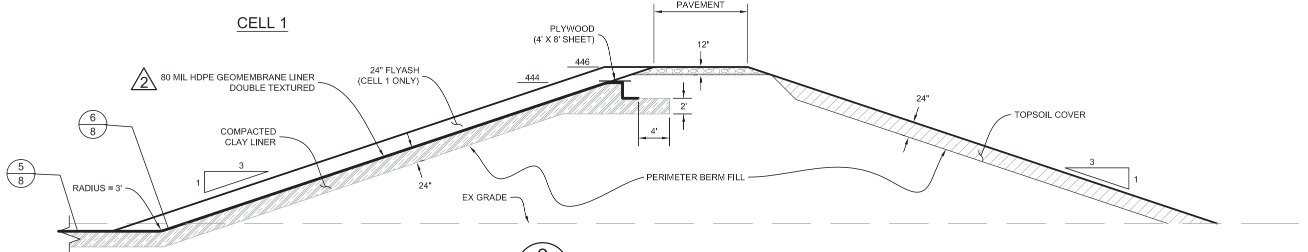
1/8 LINER PLAN
SCALE: 1" = 200'



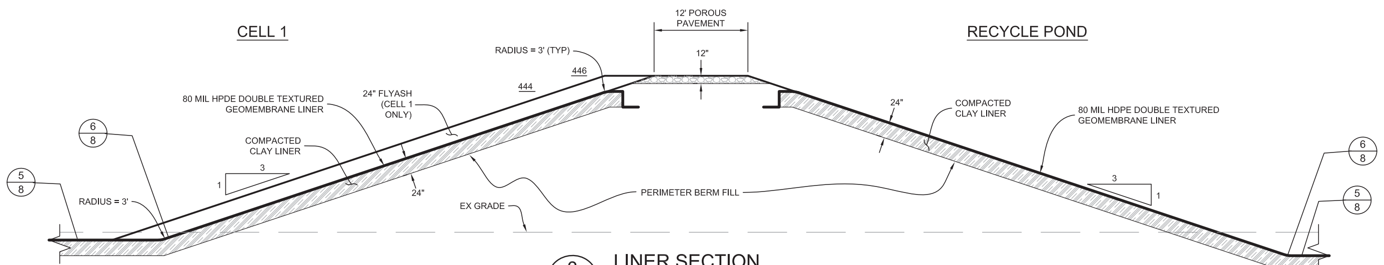
5/8 BOTTOM LINER
NO SCALE



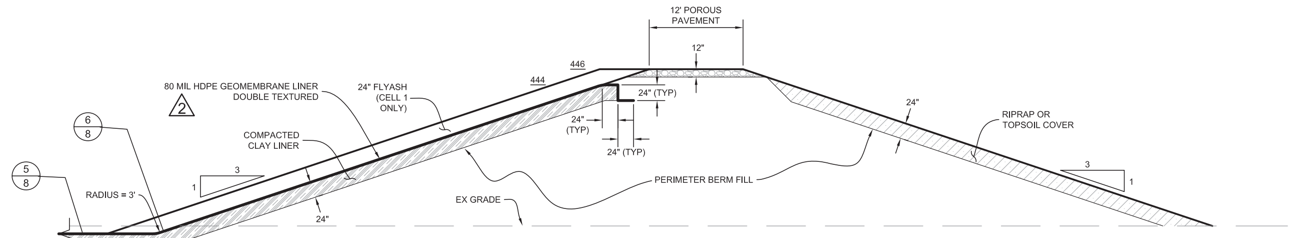
6/8 TRANSITION LINER
NO SCALE



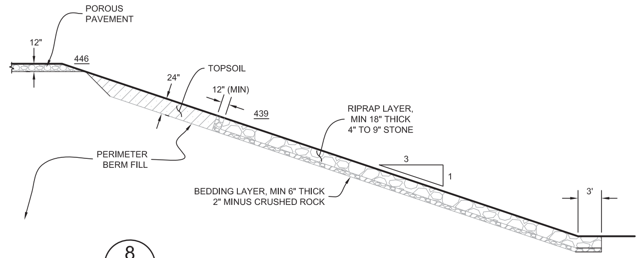
2/8 LINER SECTION
STA 24+89 B TO 43+64 B
SCALE: 1" = 10'



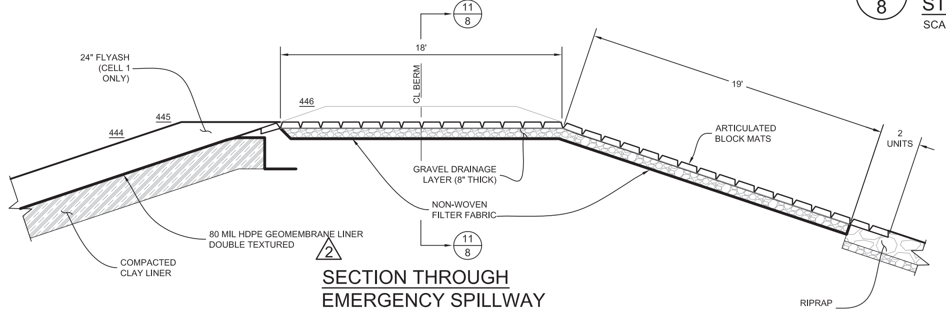
3/8 LINER SECTION
STA 20+48 A TO 29+22 A
SCALE: 1" = 200'



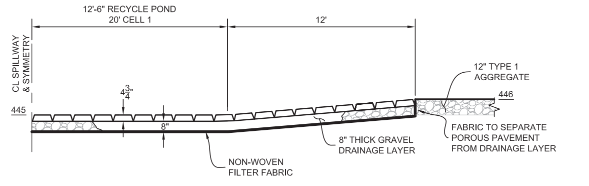
LINER SECTION
4/8 STA 0+00 A TO 20+48 A
STA 29+22 A TO 52+92 A
STA 0+00 B TO 25+00 B
SCALE: 1" = 10'



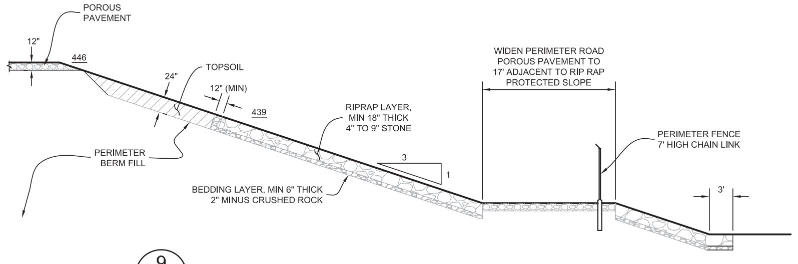
8/8 RIPRAP PROTECTION, OUTSIDE SLOPE OF PERIMETER BERM
STA 31+39 A TO 5+35 C
SCALE: 1" = 10'



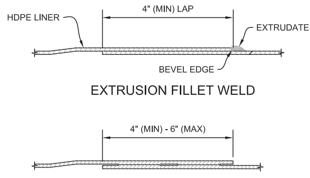
10/8 SECTION THROUGH EMERGENCY SPILLWAY
STA 32+24 A
STA 1+65 B
SCALE: 1" = 5'



11/8 EMERGENCY SPILLWAY/ ROAD PROFILE
SCALE: 1" = 5'



9/8 RIPRAP PROTECTION, OUTSIDE SLOPE OF PERIMETER BERM
STA 24+89 B TO 31+39 A
SCALE: 1" = 10'



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SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 8 OF 16
GEOMEMBRANE LINER PLAN AND DETAILS

LOCATION 001009
SIOUX PLANT
CLASS 02010

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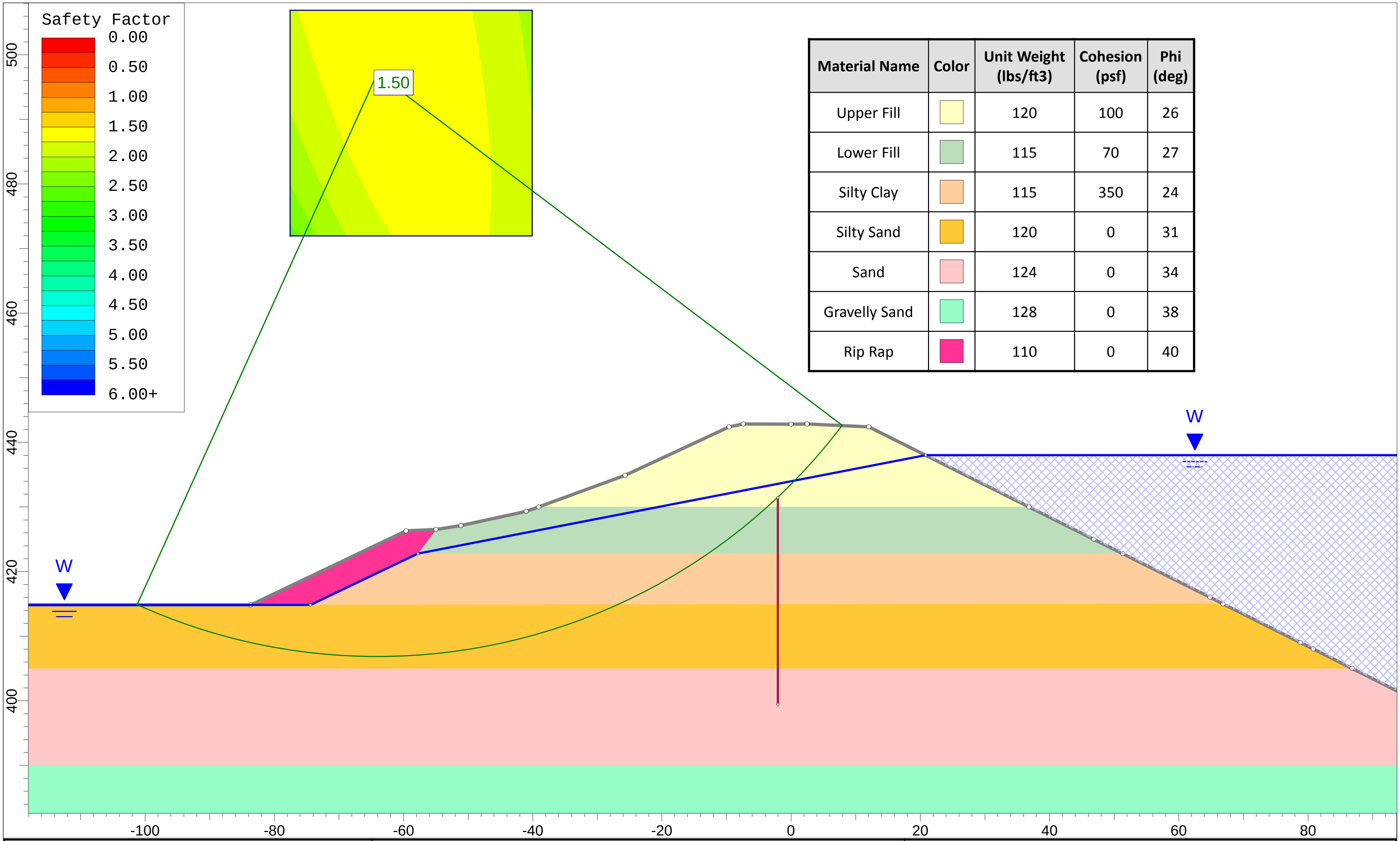
Figure 6

APPENDIX I

GRAPHICAL RESULTS OF SLOPE STABILITY ANALYSES



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upper Fill	🟨	120	100	26
Lower Fill	🟩	115	70	27
Silty Clay	🟧	115	350	24
Silty Sand	🟧	120	0	31
Sand	🟥	124	0	34
Gravelly Sand	🟩	128	0	38
Rip Rap	🟪	110	0	40

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Project Name: Periodic Safety Factor Assessment	Client: Ameren - Sioux Energy Center
Section Location: Section 1 - Bottom Ash Pond	Load Case: Static, Maximum Storage Pool

File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section 1\Xsect 1 - existing + norm pool jdb.slim

Project Number: 2015012432	Analysis By: J. Gilliam	Checked By: J. Bertel	Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Xsect 1 - existing + norm pool jdb
Slide Modeler Version:	6.038
Project Title:	Periodic Safety Factor Assessment
Analysis:	Static, Maximum Storage Pool
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section 1 - Bottom Ash Pond
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]: 62.4
Use negative pore pressure cutoff: Yes
Maximum negative pore pressure [psf]: 0
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Material Properties

Property	Upper Fill	Lower Fill	Silty Clay	Silty Sand	Sand	Gravelly Sand	Rip Rap
Color	🟨	🟩	🟧	🟨	🟥	🟩	🟪
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	115	115	120	124	128	110
Cohesion [psf]	100	70	350	0	0	0	0
Friction Angle [deg]	26	27	24	31	34	38	40
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1

Global Minimums

Method: spencer

FS	**1.502130**
Center:	-64.071, 497.100
Radius:	90.316
Left Slip Surface Endpoint:	-101.268, 414.800
Right Slip Surface Endpoint:	7.935, 442.583
Resisting Moment:	6.2438e+006 lb-ft
Driving Moment:	4.15665e+006 lb-ft
Resisting Horizontal Force:	63108.5 lb
Driving Horizontal Force:	42012.8 lb
Total Slice Area:	1510.7 ft2

Method: gle/morgenstern-price

FS	**1.504100**
Center:	-64.071, 497.100
Radius:	90.316
Left Slip Surface Endpoint:	-101.268, 414.800
Right Slip Surface Endpoint:	7.935, 442.583
Resisting Moment:	6.25201e+006 lb-ft
Driving Moment:	4.15665e+006 lb-ft
Resisting Horizontal Force:	63179.4 lb
Driving Horizontal Force:	42004.8 lb
Total Slice Area:	1510.7 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	7436
Number of Invalid Surfaces:	0

Method: gle/morgenstern-price

Number of Valid Surfaces:	7436
Number of Invalid Surfaces:	0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.50213

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.38495	485.255	-22.8126	Silty Sand	0	31	37.5406	56.3909	151.395	57.5452	93.8502
2	4.38495	1386.42	-19.8248	Silty Sand	0	31	99.6585	149.7	413.555	164.412	249.143
3	4.38495	2152.67	-16.8924	Silty Sand	0	31	144.718	217.386	617.071	255.28	361.791
4	4.38495	2790.76	-14.005	Silty Sand	0	31	176.37	264.93	771.868	330.95	440.918
5	4.38495	3795.77	-11.1535	Silty Sand	0	31	255.016	383.067	1029.58	392.047	637.532
6	4.38495	5202.96	-8.32986	Silty Sand	0	31	379.034	569.358	1386.62	439.052	947.572
7	4.38495	6512.11	-5.52648	Silty Sand	0	31	466.204	700.299	1686.64	521.148	1165.49
8	4.38495	7735.64	-2.73635	Silty Sand	0	31	506.093	760.217	1937.18	671.965	1265.21
9	4.38495	8846.89	0.0472921	Silty Sand	0	31	536.254	805.523	2150.05	809.432	1340.62
10	4.38495	9732.57	2.83104	Silty Sand	0	31	546.65	821.139	2300.2	933.595	1366.61
11	4.38495	9876.38	5.62151	Silty Sand	0	31	509.882	765.909	2273.33	998.651	1274.68
12	4.38495	9936.19	8.42547	Silty Sand	0	31	485.851	729.812	2232.62	1018.01	1214.61
13	4.38495	10003.9	11.25	Silty Sand	0	31	469.009	704.512	2196.13	1023.62	1172.51
14	4.38495	9977.03	14.1025	Silty Sand	0	31	450.121	676.14	2140.41	1015.12	1125.29
15	4.38495	10065.2	16.9913	Silty Sand	0	31	447.043	671.516	2109.63	992.036	1117.59
16	4.38495	10138.5	19.9254	Silty Sand	0	31	448.153	673.184	2074.09	953.726	1120.37
17	4.38495	10077.3	22.9153	Silty Sand	0	31	444.069	667.05	2009.55	899.387	1110.16
18	4.64249	10545.5	26.065	Silty Clay	350	24	553.426	831.318	1906.41	825.35	1081.06
19	4.64249	10439.7	29.395	Silty Clay	350	24	555.985	835.161	1818.8	729.107	1089.69
20	4.64249	10146.5	32.8383	Silty Clay	350	24	554.138	832.387	1693.69	610.23	1083.46
21	4.58939	9499.63	36.4002	Lower Fill	70	27	422.304	634.356	1574.67	467.062	1107.61
22	4.58939	8075	40.1129	Lower Fill	70	27	376.695	565.845	1269.58	296.425	973.151
23	3.851	5067.84	43.7068	Upper Fill	100	26	316.606	475.583	882.1	112.041	770.059
24	3.851	3256.33	47.1947	Upper Fill	100	26	233.313	350.467	513.533	0	513.533
25	3.851	1136.16	50.9312	Upper Fill	100	26	112.718	169.317	142.122	0	142.122

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.5041

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.38495	485.255	-22.8126	Silty Sand	0	31	26.9806	40.5815	125.084	57.5452	67.539
2	4.38495	1386.42	-19.8248	Silty Sand	0	31	79.7693	119.981	364.095	164.412	199.683
3	4.38495	2152.67	-16.8924	Silty Sand	0	31	127.511	191.789	574.47	255.28	319.19
4	4.38495	2790.76	-14.005	Silty Sand	0	31	168.046	252.758	751.61	330.95	420.66
5	4.38495	3795.77	-11.1535	Silty Sand	0	31	254.504	382.799	1029.13	392.047	637.084
6	4.38495	5202.96	-8.32986	Silty Sand	0	31	387.765	583.238	1409.72	439.052	970.672
7	4.38495	6512.11	-5.52648	Silty Sand	0	31	486.714	732.066	1739.51	521.148	1218.36
8	4.38495	7735.64	-2.73635	Silty Sand	0	31	535.77	805.852	2013.13	671.965	1341.16
9	4.38495	8846.89	0.0472921	Silty Sand	0	31	569.52	856.615	2235.08	809.432	1425.65
10	4.38495	9732.57	2.83104	Silty Sand	0	31	577.437	868.523	2379.06	933.595	1445.47
11	4.38495	9876.38	5.62151	Silty Sand	0	31	532.522	800.967	2331.68	998.651	1333.03
12	4.38495	9936.19	8.42547	Silty Sand	0	31	497.448	748.211	2263.25	1018.01	1245.24
13	4.38495	10003.9	11.25	Silty Sand	0	31	468.658	704.909	2196.78	1023.62	1173.16
14	4.38495	9977.03	14.1025	Silty Sand	0	31	438.561	659.64	2112.95	1015.12	1097.83
15	4.38495	10065.2	16.9913	Silty Sand	0	31	426.483	641.473	2059.63	992.036	1067.59
16	4.38495	10138.5	19.9254	Silty Sand	0	31	421.659	634.218	2009.24	953.726	1055.52
17	4.38495	10077.3	22.9153	Silty Sand	0	31	415.375	624.765	1939.17	899.387	1039.78
18	4.64249	10545.5	26.065	Silty Clay	350	24	532.439	800.841	1837.96	825.35	1012.61
19	4.64249	10439.7	29.395	Silty Clay	350	24	538.059	809.295	1760.7	729.107	1031.59
20	4.64249	10146.5	32.8383	Silty Clay	350	24	542.179	815.492	1655.74	610.23	1045.51
21	4.58939	9499.63	36.4002	Lower Fill	70	27	422.715	635.805	1577.52	467.062	1110.45
22	4.58939	8075	40.1129	Lower Fill	70	27	388.033	583.641	1304.5	296.425	1008.08
23	3.851	5067.84	43.7068	Upper Fill	100	26	331.603	498.764	929.628	112.041	817.587
24	3.851	3256.33	47.1947	Upper Fill	100	26	246.095	370.152	553.894	0	553.894
25	3.851	1136.16	50.9312	Upper Fill	100	26	115.346	173.492	150.68	0	150.68

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.50213

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-101.268	414.8	0	0	0
2	-96.8833	412.956	443.976	110.357	13.9588
3	-92.4984	411.375	1535.08	381.565	13.9588
4	-88.1134	410.043	2991.86	743.669	13.9588
5	-83.7285	408.949	4610.02	1145.89	13.9588
6	-79.3435	408.085	6619.25	1645.31	13.9588
7	-74.9586	407.443	9172.85	2280.04	13.9588
8	-70.5737	407.019	11934.3	2966.45	13.9588
9	-66.1887	406.809	14561.2	3619.4	13.9588
10	-61.8038	406.813	16906.7	4202.41	13.9588
11	-57.4188	407.03	18806.9	4674.72	13.9588
12	-53.0339	407.461	20063.2	4987.01	13.9588
13	-48.6489	408.111	20745.2	5156.53	13.9588
14	-44.264	408.983	20887.9	5192	13.9588
15	-39.879	410.084	20505.3	5096.89	13.9588
16	-35.4941	411.424	19640.5	4881.92	13.9588
17	-31.1091	413.014	18310.3	4551.29	13.9588
18	-26.7242	414.868	16534	4109.78	13.9589
19	-22.0817	417.138	14776.2	3672.84	13.9588
20	-17.4392	419.754	12602.6	3132.55	13.9588
21	-12.7967	422.75	10102.4	2511.1	13.9588
22	-8.20734	426.134	6713.97	1668.85	13.9588
23	-3.61795	430	3535.45	878.786	13.9588
24	0.233054	433.681	1508.67	375.003	13.9589
25	4.08406	437.839	272.63	67.7661	13.9588
26	7.93506	442.583	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.5041

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-101.268	414.8	0	0	0
2	-96.8833	412.956	349.075	13.4456	2.20582
3	-92.4984	411.375	1274.61	97.4101	4.37025
4	-88.1134	410.043	2599.01	293.985	6.45354
5	-83.7285	408.949	4158.3	615.461	8.4191
6	-79.3435	408.085	6164.6	1113.01	10.2344
7	-74.9586	407.443	8770.91	1843.83	11.8719
8	-70.5737	407.019	11644.3	2754.47	13.3087
9	-66.1887	406.809	14416.7	3735.72	14.5272
10	-61.8038	406.813	16907.2	4693.08	15.5135
11	-57.4188	407.03	18924.7	5518.84	16.2578
12	-53.0339	407.461	20254.7	6097.23	16.7533
13	-48.6489	408.111	20967.1	6408.65	16.9959
14	-44.264	408.983	21107.1	6446.53	16.9837
15	-39.879	410.084	20703.5	6217.94	16.7167
16	-35.4941	411.424	19815	5755.7	16.1971
17	-31.1091	413.014	18471.1	5097.96	15.4293
18	-26.7242	414.868	16698.9	4293.86	14.4203
19	-22.0817	417.138	14998.4	3490.39	13.1006
20	-17.4392	419.754	12892.8	2632.14	11.5387
21	-12.7967	422.75	10450.1	1796.99	9.75711
22	-8.20734	426.134	7053.4	967.145	7.80757
23	-3.61795	430	3791.46	378.726	5.70431
24	0.233054	433.681	1647.2	110.826	3.84914
25	4.08406	437.839	292.357	9.89572	1.93861
26	7.93506	442.583	0	0	0

List Of Coordinates

Water Table

X	Y
-150	414.8
-74.4	414.8
-57.8	422.75
20.8	438
100	438

Focus Search Line

X	Y
-2.058	399.376
-2.058	431.439

External Boundary

X	Y
96.8	400
86.8	405
80.8	408
78.8	409
66.8	415
64.8	416
51.3	422.75
46.8	425
36.8	430
12	442.4
2.44	442.83
0	442.8
-7.4	442.83
-9.6	442.4
-25.7	434.9
-39.0875	430
-41	429.3
-51.1	427.1
-55	426.5
-59.6	426.3
-83.66	414.8
-150	414.8
-150	409
-150	408
-150	405
-150	391
-150	390
-150	350
100	350
100	390
100	391
100	400

Material Boundary

X	Y
-57.8	422.75
-23.805	422.75
51.3	422.75

Material Boundary

X	Y
-74.4	414.8
66.8	415

Material Boundary

X	Y
-150	405
86.8	405

Material Boundary

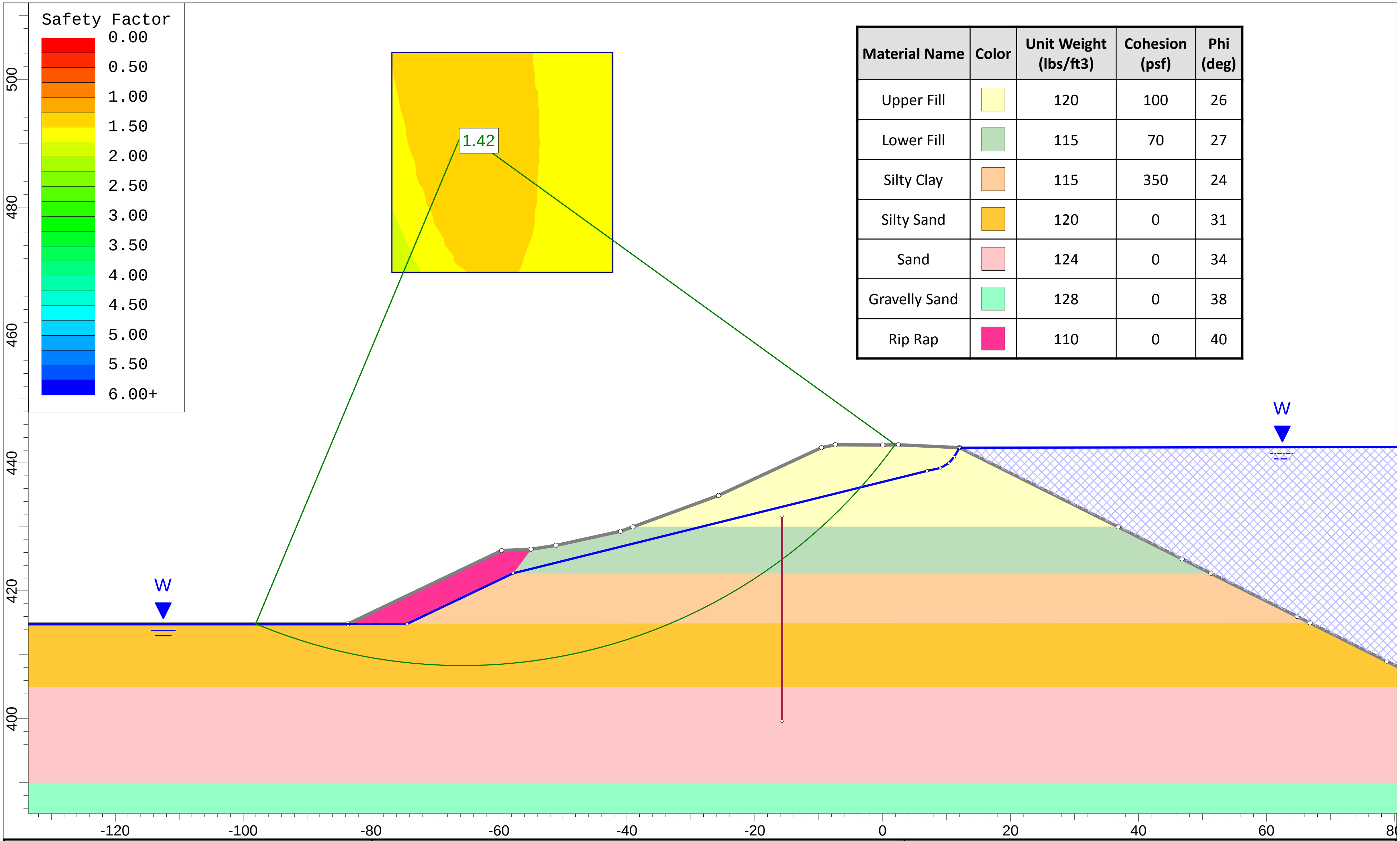
X	Y
-83.66	414.8
-74.4	414.8
-73.985	415
-71.91	416
-57.8	422.75
-55	426.5

Material Boundary

X	Y
-39.0875	430
36.8	430

Material Boundary

X	Y
-150	390
100	390



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upper Fill	🟨	120	100	26
Lower Fill	🟩	115	70	27
Silty Clay	🟧	115	350	24
Silty Sand	🟧	120	0	31
Sand	🟥	124	0	34
Gravelly Sand	🟩	128	0	38
Rip Rap	🟪	110	0	40

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment	Client: Ameren - Sioux Energy Center
Section Location: Section 1 - Bottom Ash Pond	Load Case: Static, Maximum Surcharge Pool

File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section 1\Xsect 1 - existing + max pool jdb.slim

Project Number: 2015012432	Analysis By: J. Gilliam	Checked By: J. Bertel	Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Xsect 1 - existing + max pool jdb
Slide Modeler Version:	6.038
Project Title:	Periodic Safety Factor Assessment
Analysis:	Static, Maximum Surcharge Pool
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section 1 - Bottom Ash Pond
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Upper Fill	Lower Fill	Silty Clay	Silty Sand	Sand	Gravelly Sand	Rip Rap
Color	🟨	🟩	🟧	🟨	🟥	🟩	🟪
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	115	115	120	124	128	110
Cohesion [psf]	100	70	350	0	0	0	0
Friction Angle [deg]	26	27	24	31	34	38	40
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1	1	1

Global Minimums

Method: spencer

FS	1.423270
Center:	-65.706, 491.828
Radius:	83.551
Left Slip Surface Endpoint:	-98.069, 414.800
Right Slip Surface Endpoint:	1.965, 442.824
Resisting Moment:	4.64097e+006 lb-ft
Driving Moment:	3.26079e+006 lb-ft
Resisting Horizontal Force:	50686.7 lb
Driving Horizontal Force:	35612.9 lb
Total Slice Area:	1226.06 ft2

Method: gle/morgenstern-price

FS	1.425740
Center:	-65.706, 491.828
Radius:	83.551
Left Slip Surface Endpoint:	-98.069, 414.800
Right Slip Surface Endpoint:	1.965, 442.824
Resisting Moment:	4.64905e+006 lb-ft
Driving Moment:	3.26079e+006 lb-ft
Resisting Horizontal Force:	50774 lb
Driving Horizontal Force:	35612.3 lb
Total Slice Area:	1226.06 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 7436
Number of Invalid Surfaces: 0

Method: gle/morgenstern-price

Number of Valid Surfaces: 7436
Number of Invalid Surfaces: 0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.42327

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.05405	384.419	-21.2974	Silty Sand	0	31	34.3276	48.8575	130.621	49.3082	81.3126
2	4.05405	1095.74	-18.3407	Silty Sand	0	31	90.6666	129.043	355.31	140.547	214.763
3	4.05405	1694.89	-15.4339	Silty Sand	0	31	130.798	186.161	527.221	217.399	309.822
4	4.05405	2272.8	-12.5673	Silty Sand	0	31	170.374	242.488	684.083	280.517	403.566
5	4.05405	3393.13	-9.73252	Silty Sand	0	31	285.901	406.914	1007.63	330.409	677.219
6	4.05405	4546.62	-6.92163	Silty Sand	0	31	401.904	572.018	1319.46	367.458	951.999
7	4.05405	5627.32	-4.12744	Silty Sand	0	31	465.869	663.058	1575.6	472.09	1103.51
8	4.05405	6625.17	-1.34307	Silty Sand	0	31	500.113	711.796	1789.96	605.335	1184.63
9	4.05405	7527.08	1.43812	Silty Sand	0	31	525.019	747.244	1969.9	726.278	1243.62
10	4.05405	8230.71	4.22272	Silty Sand	0	31	530.292	754.749	2091.03	834.916	1256.11
11	4.05405	8295.68	7.01737	Silty Sand	0	31	485.781	691.398	2048.6	897.921	1150.68
12	4.05405	8284.85	9.82895	Silty Sand	0	31	452.015	643.34	1993.65	922.955	1070.7
13	4.05405	8283.48	12.6647	Silty Sand	0	31	426.181	606.57	1944.64	935.135	1009.5
14	4.05405	8199.62	15.5325	Silty Sand	0	31	398.891	567.729	1878.94	934.075	944.861
15	4.05405	8130.88	18.4408	Silty Sand	0	31	379.73	540.458	1818.73	919.261	899.472
16	4.05405	8132.23	21.3994	Silty Sand	0	31	373.222	531.195	1774.09	890.034	884.058
17	3.62438	7195.72	24.2557	Silty Clay	350	24	508.762	724.105	1688.97	848.718	840.253
18	3.62438	7047.25	27.014	Silty Clay	350	24	498.989	710.196	1605.02	796.005	809.014
19	3.62438	6873.77	29.8419	Silty Clay	350	24	491.428	699.435	1514.22	729.373	784.844
20	3.62438	6688.49	32.7525	Silty Clay	350	24	487.14	693.332	1418.78	647.65	771.134
21	4.59844	8037.06	36.1842	Lower Fill	70	27	335.265	477.173	1332.49	533.364	799.124
22	4.59844	7302.01	40.2029	Lower Fill	70	27	323.231	460.045	1143.58	378.077	765.507
23	3.8249	4985.42	44.0942	Upper Fill	100	26	297.69	423.693	869.816	206.148	663.668
24	3.8249	3210.47	47.8762	Upper Fill	100	26	234.339	333.527	496.349	17.5469	478.802
25	3.8249	1114.54	51.9607	Upper Fill	100	26	115.271	164.062	131.347	0	131.347

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.42574

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.05405	384.419	-21.2974	Silty Sand	0	31	24.3342	34.6942	107.049	49.3082	57.7409
2	4.05405	1095.74	-18.3407	Silty Sand	0	31	71.9205	102.54	311.203	140.547	170.656
3	4.05405	1694.89	-15.4339	Silty Sand	0	31	114.717	163.557	489.603	217.399	272.204
4	4.05405	2272.8	-12.5673	Silty Sand	0	31	161.711	230.558	664.23	280.517	383.713
5	4.05405	3393.13	-9.73252	Silty Sand	0	31	282.739	403.113	1001.3	330.409	670.893
6	4.05405	4546.62	-6.92163	Silty Sand	0	31	409.82	584.297	1339.89	367.458	972.433
7	4.05405	5627.32	-4.12744	Silty Sand	0	31	486.886	694.173	1627.39	472.09	1155.3
8	4.05405	6625.17	-1.34307	Silty Sand	0	31	530.402	756.216	1863.89	605.335	1258.55
9	4.05405	7527.08	1.43812	Silty Sand	0	31	558.489	796.26	2051.48	726.278	1325.2
10	4.05405	8230.71	4.22272	Silty Sand	0	31	560.585	799.249	2165.09	834.916	1330.17
11	4.05405	8295.68	7.01737	Silty Sand	0	31	507.134	723.041	2101.26	897.921	1203.34
12	4.05405	8284.85	9.82895	Silty Sand	0	31	461.696	658.259	2018.48	922.955	1095.53
13	4.05405	8283.48	12.6647	Silty Sand	0	31	423.664	604.035	1940.42	935.135	1005.28
14	4.05405	8199.62	15.5325	Silty Sand	0	31	385.383	549.456	1848.52	934.075	914.448
15	4.05405	8130.88	18.4408	Silty Sand	0	31	357.879	510.242	1768.45	919.261	849.185
16	4.05405	8132.23	21.3994	Silty Sand	0	31	346.527	494.057	1712.29	890.034	822.251
17	3.62438	7195.72	24.2557	Silty Clay	350	24	487.832	695.522	1624.77	848.718	776.054
18	3.62438	7047.25	27.014	Silty Clay	350	24	478.044	681.567	1540.72	796.005	744.713
19	3.62438	6873.77	29.8419	Silty Clay	350	24	472.512	673.679	1456.37	729.373	726.995
20	3.62438	6688.49	32.7525	Silty Clay	350	24	472.146	673.157	1373.47	647.65	725.823
21	4.59844	8037.06	36.1842	Lower Fill	70	27	331.025	471.956	1322.25	533.364	788.882
22	4.59844	7302.01	40.2029	Lower Fill	70	27	331.821	473.091	1169.19	378.077	791.11
23	3.8249	4985.42	44.0942	Upper Fill	100	26	313.706	447.263	918.144	206.148	711.996
24	3.8249	3210.47	47.8762	Upper Fill	100	26	247.65	353.084	536.445	17.5469	518.898
25	3.8249	1114.54	51.9607	Upper Fill	100	26	117.628	167.707	138.819	0	138.819

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.42327

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-98.0693	414.8	0	0	0
2	-94.0153	413.22	345.717	91.8185	14.8737
3	-89.9612	411.876	1191.11	316.346	14.8738
4	-85.9072	410.756	2311.92	614.02	14.8737
5	-81.8531	409.853	3621.46	961.819	14.8737
6	-77.7991	409.157	5482.15	1456	14.8738
7	-73.7451	408.665	7762.25	2061.57	14.8738
8	-69.691	408.373	10113.5	2686.02	14.8737
9	-65.637	408.278	12312.8	3270.14	14.8737
10	-61.5829	408.379	14242.6	3782.67	14.8737
11	-57.5289	408.679	15768.4	4187.9	14.8737
12	-53.4748	409.178	16717.1	4439.88	14.8738
13	-49.4208	409.88	17150.9	4555.09	14.8738
14	-45.3667	410.791	17108.6	4543.85	14.8737
15	-41.3127	411.918	16610	4411.43	14.8737
16	-37.2586	413.27	15692.2	4167.67	14.8737
17	-33.2046	414.858	14388	3821.29	14.8737
18	-29.5802	416.491	13475.3	3578.88	14.8737
19	-25.9558	418.339	12319.6	3271.93	14.8737
20	-22.3315	420.418	10953.8	2909.21	14.8738
21	-18.7071	422.75	9413	2499.99	14.8738
22	-14.1086	426.114	6474.06	1719.44	14.8738
23	-9.51019	430	3517.28	934.148	14.8737
24	-5.68529	433.706	1433.49	380.719	14.8737
25	-1.86038	437.935	231.236	61.4137	14.8737
26	1.96452	442.824	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.42574

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-98.0693	414.8	0	0	0
2	-94.0153	413.22	267.886	11.0861	2.36976
3	-89.9612	411.876	977.853	80.2794	4.69332
4	-85.9072	410.756	1991.17	241.892	6.92649
5	-81.8531	409.853	3247.42	516.017	9.02885
6	-77.7991	409.157	5090.53	986.273	10.965
7	-73.7451	408.665	7412.3	1671.15	12.7053
8	-69.691	408.373	9863.34	2500.51	14.2257
9	-65.637	408.278	12192	3382.93	15.5078
10	-61.5829	408.379	14248.5	4230.91	16.5381
11	-57.5289	408.679	15874.4	4946.35	17.3067
12	-53.4748	409.178	16882.9	5422.89	17.8073
13	-49.4208	409.88	17337.9	5645.58	18.0363
14	-45.3667	410.791	17288.7	5614.72	17.9918
15	-41.3127	411.918	16769.1	5343.42	17.6743
16	-37.2586	413.27	15830.1	4865.77	17.0861
17	-33.2046	414.858	14515.4	4225.8	16.2316
18	-29.5802	416.491	13631.1	3715.81	15.2482
19	-25.9558	418.339	12517.7	3136.22	14.0655
20	-22.3315	420.418	11203	2523.45	12.6939
21	-18.7071	422.75	9712.97	1913.79	11.1465
22	-14.1086	426.114	6788.48	1070.01	8.95735
23	-9.51019	430	3771.27	433.414	6.55597
24	-5.68529	433.706	1569.33	121.701	4.43439
25	-1.86038	437.935	248.152	9.69189	2.23662
26	1.96452	442.824	0	0	0

List Of Coordinates

Water Table

X	Y
-150	414.8
-74.4	414.8
-57.8	422.75
6.959	438.754
9.036	439.222
10.321	439.954
11.209	440.961
12	442.4
100	442.5

Focus Search Line

X	Y
-15.7423	399.591
-15.7423	431.654

External Boundary

X	Y
96.8	400
86.8	405
78.8	409
66.8	415
64.8	416
51.3	422.75
46.8	425
36.8	430
12	442.4
2.44	442.83
0	442.8
-7.4	442.83
-9.6	442.4
-25.7	434.9
-39.0875	430
-41	429.3
-51.1	427.1
-55	426.5
-59.6	426.3
-83.66	414.8
-150	414.8
-150	409
-150	405
-150	391
-150	390
-150	350
100	350
100	390
100	391
100	400

Material Boundary

X	Y
-83.66	414.8
-74.4	414.8
-73.985	415
-71.91	416
-57.8	422.75
-23.805	422.75
51.3	422.75

Material Boundary

X	Y
-74.4	414.8
66.8	415

Material Boundary

X	Y
-150	405
86.8	405

Material Boundary

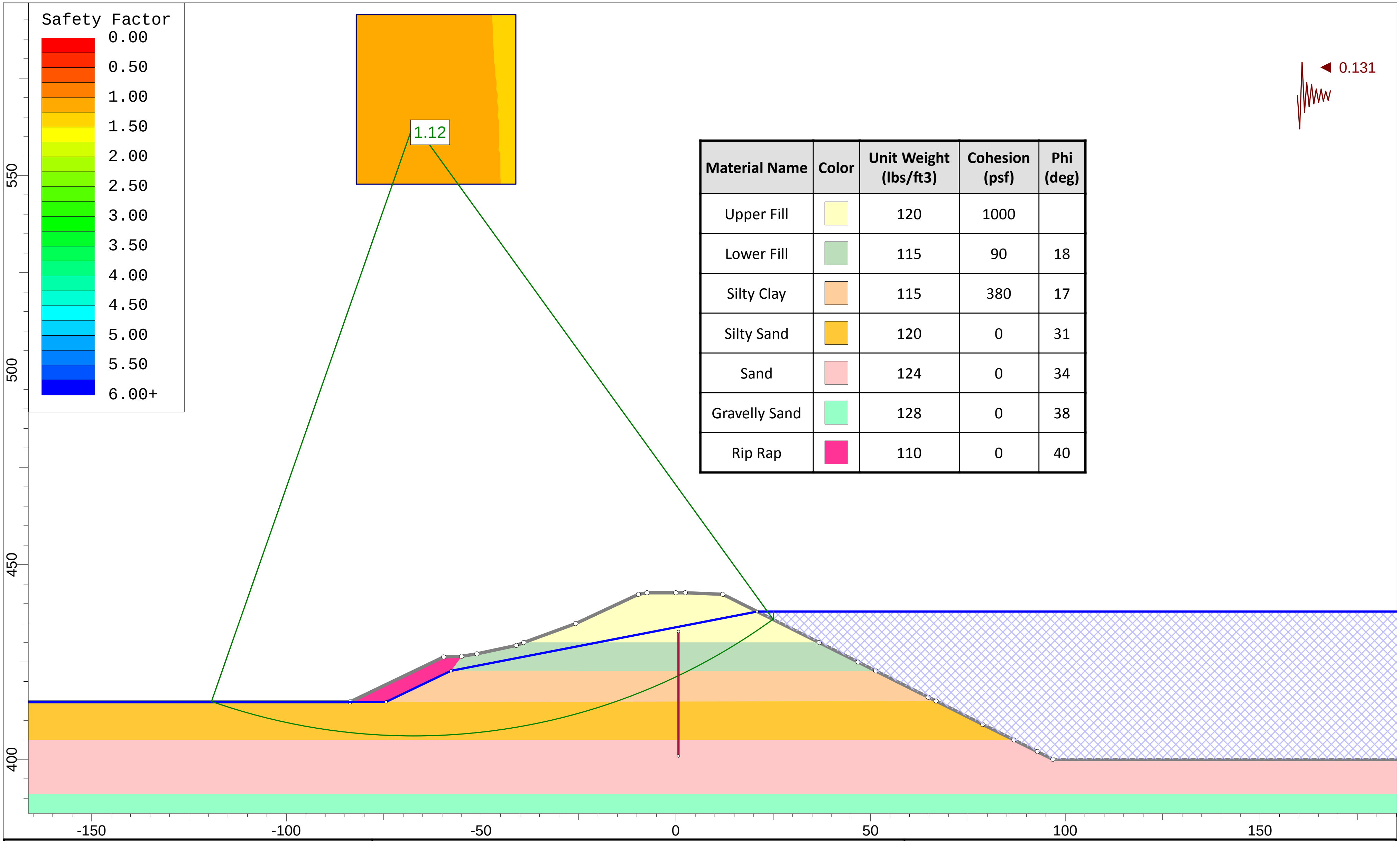
X	Y
-57.8	422.75
-55	426.5

Material Boundary

X	Y
-39.0875	430
36.8	430

Material Boundary

X	Y
-150	390
100	390



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upper Fill	🟨	120	1000	
Lower Fill	🟩	115	90	18
Silty Clay	🟧	115	380	17
Silty Sand	🟧	120	0	31
Sand	🟥	124	0	34
Gravelly Sand	🟩	128	0	38
Rip Rap	🟪	110	0	40

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment	Client: Ameren - Sioux Energy Center
Section Location: Section 1 - Bottom Ash Pond	Load Case: Seismic

File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section 1\Xsect 1 - existing + norm pool + seismic jdb.slim

Project Number: 2015012432	Analysis By: J. Gilliam	Checked By: J. Bertel	Figure:

Slide Analysis Information
Periodic Safety Factor Assessment

Project Summary

File Name:	Xsect 1 - existing + norm pool + seismic jdb
Slide Modeler Version:	6.038
Project Title:	Periodic Safety Factor Assessment
Analysis:	Seismic
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section 1 - Bottom Ash Pond
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]: 62.4
Use negative pore pressure cutoff: Yes
Maximum negative pore pressure [psf]: 0
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Loading

Seismic Load Coefficient (Horizontal): 0.131

Material Properties

Property	Upper Fill	Lower Fill	Silty Clay	Silty Sand	Sand	Gravelly Sand	Rip Rap
Color	🟨	🟩	🟧	🟨	🟥	🟩	🟥
Strength Type	Undrained	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	115	115	120	124	128	110
Cohesion [psf]		90	380	0	0	0	0
Friction Angle [deg]		18	17	31	34	38	40
Cohesion Type	1000						
Water Surface	None	Water Table	Water Table	Water Table	Water Table	Water Table	Water Table
Hu Value		1	1	1	1	1	1
Ru Value	0						

Global Minimums

Method: spencer

FS	1.124430
Center:	-67.322, 563.431
Radius:	157.448
Left Slip Surface Endpoint:	-119.271, 414.800
Right Slip Surface Endpoint:	25.007, 435.896
Left Slope Intercept:	-119.271 414.800
Right Slope Intercept:	25.007 438.000
Resisting Moment:	1.47055e+007 lb-ft
Driving Moment:	1.30782e+007 lb-ft
Resisting Horizontal Force:	88750.3 lb
Driving Horizontal Force:	78928.9 lb
Total Slice Area:	2182.03 ft2

Method: gle/morgenstern-price

FS	1.129210
Center:	-67.322, 556.465
Radius:	151.365
Left Slip Surface Endpoint:	-120.636, 414.800
Right Slip Surface Endpoint:	24.514, 436.143
Left Slope Intercept:	-120.636 414.800
Right Slope Intercept:	24.514 438.000
Resisting Moment:	1.46992e+007 lb-ft
Driving Moment:	1.30173e+007 lb-ft
Resisting Horizontal Force:	91767 lb
Driving Horizontal Force:	81266.8 lb
Total Slice Area:	2261.81 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	7436
Number of Invalid Surfaces:	0

Method: gle/morgenstern-price

Number of Valid Surfaces:	7436
Number of Invalid Surfaces:	0

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.12443

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	5.78638	658.839	-18.1572	Silty Sand	0	31	53.8509	60.5516	159.982	59.2074	100.775
2	5.78638	1891.99	-15.954	Silty Sand	0	31	143.616	161.486	438.783	170.025	268.758
3	5.78638	2958.8	-13.7748	Silty Sand	0	31	209.605	235.686	658.145	265.896	392.249
4	5.78638	3864.26	-11.6158	Silty Sand	0	31	256.528	288.448	827.323	347.266	480.057
5	5.78638	4612.43	-9.47344	Silty Sand	0	31	287.917	323.742	953.299	414.501	538.798
6	5.78638	5206.59	-7.34436	Silty Sand	0	31	306.479	344.614	1041.43	467.896	573.534
7	5.78638	6278.83	-5.22546	Silty Sand	0	31	388.352	436.675	1234.43	507.676	726.75
8	5.78638	8313.72	-3.1137	Silty Sand	0	31	580.83	653.103	1620.95	534.007	1086.95
9	5.78638	10276.4	-1.00618	Silty Sand	0	31	675.086	759.087	1939.24	675.901	1263.34
10	5.78638	12113.8	1.09997	Silty Sand	0	31	727.696	818.243	2210.32	848.527	1361.79
11	5.78638	13435.2	3.20762	Silty Sand	0	31	730.188	821.045	2374.31	1007.87	1366.44
12	5.78638	13659	5.31963	Silty Sand	0	31	685.872	771.215	2347.21	1063.68	1283.53
13	5.78638	13972.2	7.43892	Silty Sand	0	31	667.324	750.359	2342.17	1093.36	1248.81
14	5.78638	14274.8	9.56852	Silty Sand	0	31	656.073	737.708	2337.16	1109.41	1227.75
15	5.78638	14888.8	11.7116	Silty Sand	0	31	680.022	764.637	2384.17	1111.6	1272.57
16	5.78638	15447.1	13.8714	Silty Sand	0	31	704.815	792.515	2418.61	1099.65	1318.96
17	5.78638	15981.7	16.0515	Silty Sand	0	31	733.27	824.511	2445.39	1073.18	1372.21
18	5.78638	16607.1	18.2559	Silty Sand	0	31	774.437	870.8	2481	1031.74	1449.26
19	6.16505	18220.8	20.5627	Silty Clay	380	17	751.089	844.547	2491.84	972.378	1519.46
20	6.16505	17604.4	22.9794	Silty Clay	380	17	732.015	823.1	2342.62	893.294	1449.32
21	6.16505	15656.5	25.4402	Silty Clay	380	17	671.496	755.05	2021.61	794.868	1226.74
22	6.44045	13872.2	28.01	Lower Fill	90	18	375.837	422.602	1696.42	672.787	1023.64
23	6.44045	10467.9	30.7004	Lower Fill	90	18	287.694	323.492	1243.18	524.561	718.615
24	4.37363	4070.5	33.0124	Upper Fill	1000	0	889.339	1000	495.517	0	495.517
25	4.37363	1651.62	34.9322	Upper Fill	1000	0	889.339	1000	18.2981	0	18.2981

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.12921

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	5.62488	672.014	-19.4939	Silty Sand	0	31	39.7641	44.902	136.855	62.1253	74.7295
2	5.62488	1933.47	-17.2497	Silty Sand	0	31	118.622	133.949	401.671	178.743	222.928
3	5.62488	3032.73	-15.0325	Silty Sand	0	31	192.235	217.074	641.636	280.365	361.271
4	5.62488	3975.17	-12.8382	Silty Sand	0	31	257.299	290.545	851.038	367.491	483.547
5	5.62488	4765.22	-10.6629	Silty Sand	0	31	310.782	350.938	1024.59	440.528	584.058
6	5.62488	5406.46	-8.50304	Silty Sand	0	31	350.363	395.633	1158.25	499.808	658.445
7	5.62488	6052.87	-6.35532	Silty Sand	0	31	392.856	443.617	1283.9	545.592	738.303
8	5.62488	7794.01	-4.21655	Silty Sand	0	31	564.75	637.721	1639.42	578.077	1061.35
9	5.62488	9689.76	-2.08366	Silty Sand	0	31	718.586	811.435	1994.94	644.476	1350.46
10	5.62488	11495	0.0463353	Silty Sand	0	31	775.603	875.819	2276.42	818.815	1457.61
11	5.62488	13144	2.1764	Silty Sand	0	31	809.454	914.044	2501.32	980.099	1521.23
12	5.62488	13761.3	4.30948	Silty Sand	0	31	753.376	850.72	2511.25	1095.41	1415.84
13	5.62488	13965	6.44858	Silty Sand	0	31	702.46	793.225	2450.6	1130.45	1320.15
14	5.62488	14241	8.59675	Silty Sand	0	31	667.468	753.712	2406.57	1152.19	1254.38
15	5.62488	14584.6	10.7572	Silty Sand	0	31	649.101	732.971	2380.28	1160.41	1219.87
16	5.62488	15164	12.9332	Silty Sand	0	31	662.901	748.555	2400.68	1154.87	1245.81
17	5.62488	15607.6	15.1285	Silty Sand	0	31	675.579	762.871	2404.85	1135.22	1269.63
18	5.62488	16124.2	17.3467	Silty Sand	0	31	706.181	797.427	2428.19	1101.06	1327.13
19	5.62488	16624.4	19.5922	Silty Sand	0	31	747.047	843.573	2455.82	1051.87	1403.95
20	5.79179	17451.7	21.9038	Silty Clay	380	17	738.412	833.822	2470.24	985.864	1484.38
21	5.79179	16547.6	24.2881	Silty Clay	380	17	719.078	811.99	2314.77	901.782	1412.98
22	5.79179	14702	26.7181	Silty Clay	380	17	671.15	757.869	2035.35	799.401	1235.95
23	6.12005	13178	29.2734	Lower Fill	90	18	402.797	454.842	1796.39	673.515	1122.87
24	6.12005	10019.4	31.9669	Lower Fill	90	18	330.354	373.039	1392.51	521.41	871.098
25	8.66226	5658.94	35.3426	Upper Fill	1000	0	885.575	1000	75.6729	0	75.6729

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.12443

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-119.271	414.8	0	0	0
2	-113.485	412.902	529.062	168.302	17.6466
3	-107.698	411.248	1838.52	584.86	17.6466
4	-101.912	409.83	3598.08	1144.6	17.6466
5	-96.1254	408.64	5561.11	1769.07	17.6466
6	-90.339	407.675	7544.26	2399.94	17.6466
7	-84.5526	406.929	9413.3	2994.51	17.6466
8	-78.7662	406.4	11492.4	3655.91	17.6467
9	-72.9798	406.085	14276.3	4541.52	17.6467
10	-67.1935	405.983	17035.7	5419.31	17.6466
11	-61.4071	406.094	19416.3	6176.61	17.6466
12	-55.6207	406.419	21113.9	6716.63	17.6466
13	-49.8343	406.957	22030.8	7008.33	17.6467
14	-44.0479	407.713	22294.5	7092.2	17.6466
15	-38.2615	408.688	21943.2	6980.44	17.6466
16	-32.4752	409.888	21069.9	6702.65	17.6466
17	-26.6888	411.317	19670.9	6257.62	17.6467
18	-20.9024	412.982	17751.5	5647	17.6466
19	-15.116	414.89	15324.1	4874.82	17.6466
20	-8.95096	417.203	11807.3	3756.09	17.6467
21	-2.78591	419.817	7892.32	2510.66	17.6466
22	3.37914	422.75	4054.7	1289.86	17.6466
23	9.81959	426.176	-1152.41	-366.599	17.6467
24	16.26	430	-5423.85	-1725.41	17.6467
25	20.6337	432.842	-3473.34	-1104.92	17.6466
26	25.0073	435.896	138.07	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.12921

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-120.636	414.8	0	0	0
2	-115.011	412.809	408.523	18.4688	2.58851
3	-109.386	411.062	1525.15	136.879	5.12844
4	-103.762	409.552	3180.28	422.846	7.57355
5	-98.1367	408.27	5200.23	905.887	9.88184
6	-92.5118	407.211	7412.19	1577.8	12.0169
7	-86.887	406.37	9652.11	2397.37	13.9487
8	-81.2621	405.743	11877.1	3328.13	15.6536
9	-75.6372	405.329	14718.1	4531.72	17.1137
10	-70.0123	405.124	17905.9	5927.42	18.3162
11	-64.3875	405.128	20759.8	7250.62	19.2524
12	-58.7626	405.342	23064.2	8356.66	19.9166
13	-53.1377	405.766	24441.9	9043.95	20.3054
14	-47.5128	406.402	25012.6	9310.59	20.4171
15	-41.8879	407.252	24861.4	9172.5	20.2513
16	-36.2631	408.321	24064.5	8667.86	19.8087
17	-30.6382	409.613	22712.2	7860.87	19.0911
18	-25.0133	411.133	20817.2	6805.1	18.1025
19	-19.3884	412.89	18417.6	5577.78	16.849
20	-13.7636	414.892	15532.3	4260.83	15.3401
21	-7.97177	417.221	11777.7	2834.94	13.5339
22	-2.17998	419.835	7731.88	1571.98	11.4923
23	3.61181	422.75	3766.17	612.858	9.24256
24	9.73186	426.181	-1653.59	-193.605	6.67788
25	15.8519	430	-6259.33	-434.304	3.96911
26	24.5142	436.143	107.602	0	0

List Of Coordinates

Water Table

X	Y
-650	414.8
-74.4	414.8
-57.8	422.75
20.8	438
600	438

Focus Search Line

X	Y
0.633782	400.863
0.633782	432.873

External Boundary

X	Y
96.8	400
92.8	402
86.8	405
78.8	409
66.7699	415.015
64.8	416
51.3	422.75
46.8	425
36.8	430
12	442.4
2.44	442.83
0	442.8
-7.4	442.83
-9.6	442.4
-25.7	434.9
-39.0875	430
-41	429.3
-51.1	427.1
-55	426.5
-59.6	426.3
-83.66	414.8
-650	414.8
-650	409
-650	405
-650	391
-650	350
600	350
600	391
600	400

Material Boundary

X	Y
-57.8	422.75
-27	422.75
51.3	422.75

Material Boundary

X	Y
-74.4	414.8
66.7699	415.015

Material Boundary

X	Y
-650	405
86.8	405

Material Boundary

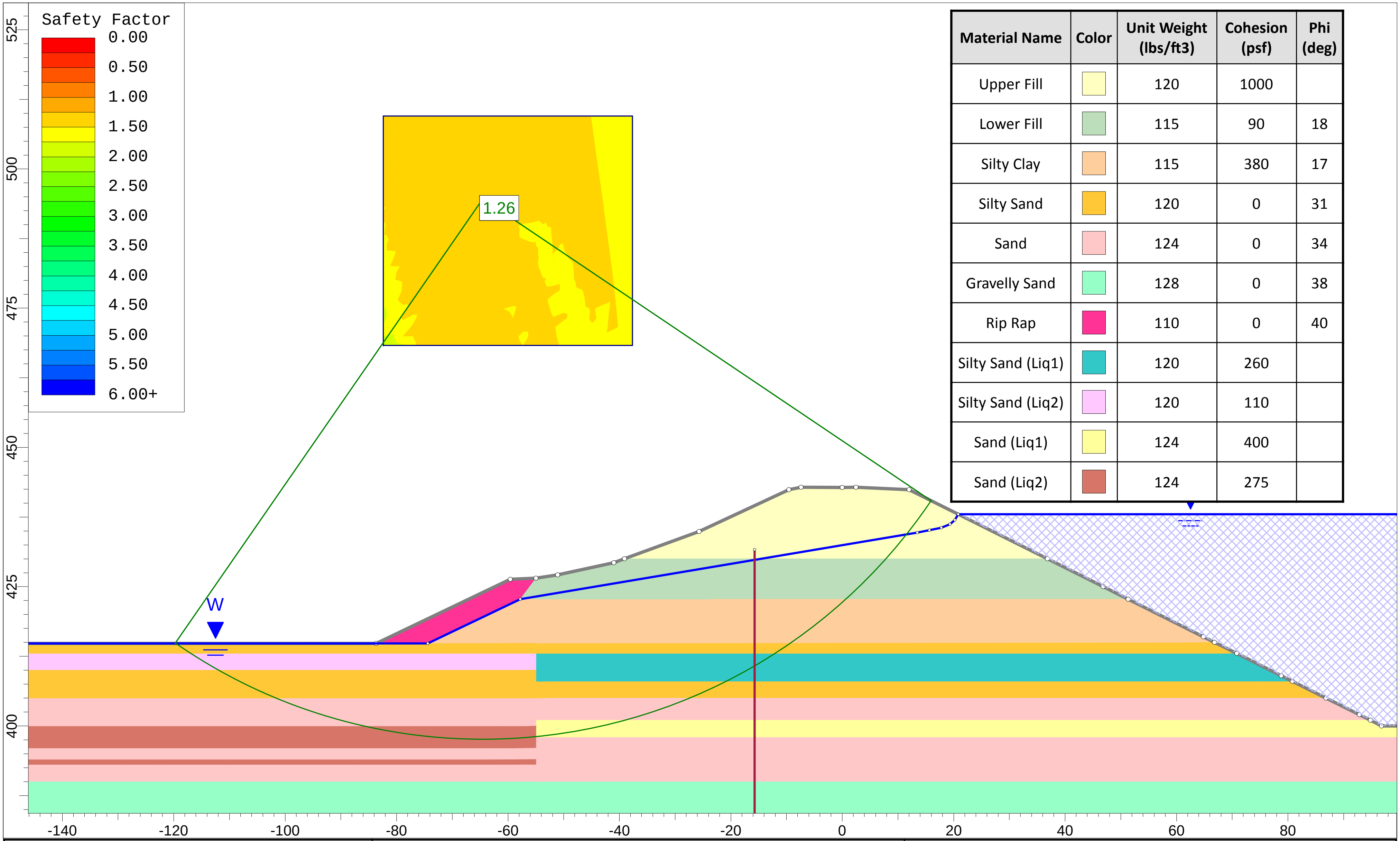
X	Y
-83.66	414.8
-74.4	414.8
-71.91	416
-57.8	422.75
-55	426.5

Material Boundary

X	Y
-650	391
600	391

Material Boundary

X	Y
-39.0875	430
36.8	430



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upper Fill	🟨	120	1000	
Lower Fill	🟩	115	90	18
Silty Clay	🟧	115	380	17
Silty Sand	🟧	120	0	31
Sand	🟥	124	0	34
Gravelly Sand	🟩	128	0	38
Rip Rap	🟪	110	0	40
Silty Sand (Liq1)	🟦	120	260	
Silty Sand (Liq2)	🟪	120	110	
Sand (Liq1)	🟨	124	400	
Sand (Liq2)	🟫	124	275	

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment

Client: Ameren - Sioux Energy Center

Section Location: Section 1 - Bottom Ash Pond

Load Case: Liquefaction

File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section 1\Xsect 1 - existing + norm pool + postEQ jdb.slim

Project Number: 2015012432

Analysis By: J. Gilliam

Checked By: J. Bertel

Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Xsect 1 - existing + norm pool + postEQ jdb
Slide Modeler Version:	6.038
Project Title:	Periodic Safety Factor Assessment
Analysis:	Liquefaction
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center

Comments

2015012432
Section 1 - Bottom Ash Pond
J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type: Vertical

Analysis Methods Used

GLE/Morgenstern-Price with interslice force function:	Half Sine
	Spencer

Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]: 62.4
Use negative pore pressure cutoff: Yes
Maximum negative pore pressure [psf]: 0
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Material Properties

Property	Upper Fill	Lower Fill	Silty Clay	Silty Sand	Sand	Gravelly Sand	Rip Rap	Silty Sand (Liq1)
Color	🟨	🟩	🟧	🟨	🟥	🟩	🟪	🟦
Strength Type	Undrained	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Undrained
Unit Weight [lbs/ft3]	120	115	115	120	124	128	110	120
Cohesion [psf]		90	380	0	0	0	0	
Friction Angle [deg]		18	17	31	34	38	40	
Cohesion Type	1000							260
Water Surface	None	None	Water Table	Water Table	Water Table	Water Table	Water Table	None
Hu Value			1	1	1	1	1	
Ru Value	0	0						0

Property	Silty Sand (Liq2)	Sand (Liq1)	Sand (Liq2)
Color	🟪	🟨	🟥
Strength Type	Undrained	Undrained	Undrained
Unit Weight [lbs/ft3]	120	124	124
Cohesion Type	110	400	275
Water Surface	None	None	None
Ru Value	0	0	0

Global Minimums

Method: spencer

FS	1.264890
Center:	-64.504, 494.657
Radius:	97.118
Left Slip Surface Endpoint:	-119.774, 414.800
Right Slip Surface Endpoint:	16.034, 440.383
Resisting Moment:	8.42769e+006 lb-ft
Driving Moment:	6.66276e+006 lb-ft
Resisting Horizontal Force:	74466.1 lb
Driving Horizontal Force:	58871.4 lb
Total Slice Area:	2739.44 ft2

Method: gle/morgenstern-price

FS	1.260940
Center:	-64.504, 494.657
Radius:	97.118
Left Slip Surface Endpoint:	-119.774, 414.800
Right Slip Surface Endpoint:	16.034, 440.383
Resisting Moment:	8.40132e+006 lb-ft
Driving Moment:	6.66276e+006 lb-ft
Resisting Horizontal Force:	74140.6 lb
Driving Horizontal Force:	58798 lb
Total Slice Area:	2739.44 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	6836
Number of Invalid Surfaces:	600

Error Codes:

Error Code -108 reported for 339 surfaces
Error Code -111 reported for 261 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 6873
Number of Invalid Surfaces: 563

Error Codes:

Error Code -108 reported for 337 surfaces
Error Code -111 reported for 226 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.26489

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.69579	291.146	-33.7313	Silty Sand	0	31	43.4454	54.9537	147.618	56.16	91.4582
2	4.9811	1972.51	-31.0596	Silty Sand (Liq2)	110	0	86.9641	110	476.499	0	476.499
3	5.13153	3782.98	-27.6352	Silty Sand	0	31	259.064	327.688	928.709	383.346	545.363
4	5.13153	5322.44	-24.2657	Silty Sand	0	31	342.226	432.878	1259.78	539.346	720.431
5	5.20181	6760.03	-20.9617	Sand	0	34	473.347	598.732	1561.35	673.695	887.658
6	5.20181	7938.37	-17.7073	Sand	0	34	527.404	667.108	1776.72	787.689	989.028
7	5.20181	8908.23	-14.5112	Sand	0	34	563.628	712.928	1938.46	881.514	1056.95
8	6.24564	12044.9	-11.0485	Sand (Liq2)	275	0	217.41	275	2016.87	0	2016.87
9	6.24564	14705.6	-7.31326	Sand (Liq2)	275	0	217.41	275	2422.08	0	2422.08
10	6.24564	17275.9	-3.60916	Sand (Liq2)	275	0	217.41	275	2809.37	0	2809.37
11	6.24564	19569.6	0.0798183	Sand (Liq2)	275	0	217.41	275	3149	0	3149
12	6.24564	21062.6	3.76913	Sand (Liq2)	275	0	217.41	275	3357.76	0	3357.76
13	5.39733	18328.8	7.22083	Sand (Liq1)	400	0	316.233	400	3347.68	0	3347.68
14	5.39733	18441	10.445	Sand (Liq1)	400	0	316.233	400	3335.93	0	3335.93
15	5.39733	18438.6	13.7032	Sand (Liq1)	400	0	316.233	400	3302.39	0	3302.39
16	5.81713	20063.7	17.1381	Sand	0	34	874.906	1106.66	3170.83	1530.14	1640.69
17	5.81713	20107.6	20.7696	Sand	0	34	872.353	1103.43	3102.04	1466.14	1635.9
18	6.516	22376.6	24.7216	Silty Sand	0	31	787.167	995.68	3025.26	1368.16	1657.1
19	4.36408	14904.4	28.3003	Silty Sand (Liq1)	260	0	205.551	260	3191.34	0	3191.34
20	4.36408	14660	31.2688	Silty Sand (Liq1)	260	0	205.551	260	3108.54	0	3108.54
21	2.82919	9297.64	33.7792	Silty Sand	0	31	780.439	987.17	2686.51	1043.58	1642.93
22	4.93761	15102.9	36.5978	Silty Clay	380	17	676.829	856.114	2468.03	910.726	1557.3
23	4.93761	12895.4	40.323	Silty Clay	380	17	612.513	774.762	2008.39	717.18	1291.21
24	7.18784	13978.5	45.2467	Lower Fill	90	18	437.693	553.633	1426.91	0	1426.91
25	8.07093	6537.31	52.1418	Upper Fill	1000	0	790.583	1000	-139.435	0	-139.435

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.26094

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.69579	291.146	-33.7313	Silty Sand	0	31	36.7397	46.3265	133.26	56.16	77.1004
2	4.9811	1972.51	-31.0596	Silty Sand (Liq2)	110	0	87.2365	110	454.929	0	454.929
3	5.13153	3782.98	-27.6352	Silty Sand	0	31	238.944	301.294	884.784	383.346	501.438
4	5.13153	5322.44	-24.2657	Silty Sand	0	31	327.895	413.456	1227.45	539.346	688.105
5	5.20181	6760.03	-20.9617	Sand	0	34	465.63	587.132	1544.15	673.695	870.458
6	5.20181	7938.37	-17.7073	Sand	0	34	531.611	670.33	1781.49	787.689	993.804
7	5.20181	8908.23	-14.5112	Sand	0	34	577.99	728.811	1962.03	881.514	1080.51
8	6.24564	12044.9	-11.0485	Sand (Liq2)	275	0	218.091	275	2050.97	0	2050.97
9	6.24564	14705.6	-7.31326	Sand (Liq2)	275	0	218.091	275	2458.08	0	2458.08
10	6.24564	17275.9	-3.60916	Sand (Liq2)	275	0	218.091	275	2841.89	0	2841.89
11	6.24564	19569.6	0.0798183	Sand (Liq2)	275	0	218.091	275	3172.74	0	3172.74
12	6.24564	21062.6	3.76913	Sand (Liq2)	275	0	218.091	275	3368.85	0	3368.85
13	5.39733	18328.8	7.22083	Sand (Liq1)	400	0	317.224	400	3347.04	0	3347.04
14	5.39733	18441	10.445	Sand (Liq1)	400	0	317.224	400	3323.77	0	3323.77
15	5.39733	18438.6	13.7032	Sand (Liq1)	400	0	317.224	400	3280.86	0	3280.86
16	5.81713	20063.7	17.1381	Sand	0	34	865.933	1091.89	3148.93	1530.14	1618.79
17	5.81713	20107.6	20.7696	Sand	0	34	860.644	1085.22	3075.05	1466.14	1608.91
18	6.516	22376.6	24.7216	Silty Sand	0	31	776.735	979.416	2998.19	1368.16	1630.03
19	4.36408	14904.4	28.3003	Silty Sand (Liq1)	260	0	206.195	260	3175.76	0	3175.76
20	4.36408	14660	31.2688	Silty Sand (Liq1)	260	0	206.195	260	3112.64	0	3112.64
21	2.82919	9297.64	33.7792	Silty Sand	0	31	784.491	989.196	2689.88	1043.58	1646.3
22	4.93761	15102.9	36.5978	Silty Clay	380	17	683.381	861.703	2486.3	910.726	1575.58
23	4.93761	12895.4	40.323	Silty Clay	380	17	622.227	784.591	2040.54	717.18	1323.36
24	7.18784	13978.5	45.2467	Lower Fill	90	18	451.179	568.91	1473.94	0	1473.94
25	8.07093	6537.31	52.1418	Upper Fill	1000	0	793.059	1000	-194.828	0	-194.828

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.26489

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-119.774	414.8	0	0	0
2	-117.078	413	383.284	28.6339	4.27244
3	-112.097	410	2247.62	167.912	4.27244
4	-106.965	407.313	6077.32	454.017	4.27245
5	-101.834	405	10754.4	803.429	4.27246
6	-96.6318	403.007	16337.7	1220.53	4.27242
7	-91.43	401.346	22042.5	1646.72	4.27244
8	-86.2282	400	27595.6	2061.57	4.27243
9	-79.9825	398.78	31418.3	2347.16	4.27245
10	-73.7369	397.979	34722.8	2594.03	4.27245
11	-67.4913	397.585	37192.6	2778.54	4.27245
12	-61.2456	397.594	38528.3	2878.32	4.27244
13	-55	398.005	38509.9	2876.94	4.27243
14	-49.6027	398.689	37934	2833.92	4.27244
15	-44.2053	399.684	36328.2	2713.96	4.27244
16	-38.808	401	33695.5	2517.28	4.27244
17	-32.9909	402.794	33116.7	2474.04	4.27244
18	-27.1737	405	31367.1	2343.33	4.27244
19	-20.6578	408	27440.3	2049.97	4.27243
20	-16.2937	410.35	20841.6	1557.01	4.27245
21	-11.9296	413	13504	1008.84	4.27245
22	-9.1004	414.892	10636.3	794.605	4.27245
23	-4.16278	418.559	4941.63	369.173	4.27244
24	0.774827	422.75	-439.143	-32.8069	4.27244
25	7.96267	430	-7626.09	-569.72	4.27244
26	16.0336	440.383	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 1.26094

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-119.774	414.8	0	0	0
2	-117.078	413	339.067	1.86049	0.314384
3	-112.097	410	2139.07	33.2708	0.891099
4	-106.965	407.313	5744.33	147.672	1.4726
5	-101.834	405	10269	364.543	2.03311
6	-96.6318	403.007	15772.2	708.401	2.57168
7	-91.43	401.346	21500.6	1154.16	3.07271
8	-86.2282	400	27153.6	1674.56	3.52896
9	-79.9825	398.78	31019	2173.65	4.00844
10	-73.7369	397.979	34353.6	2645.9	4.4042
11	-67.4913	397.585	36837.4	3033.91	4.70823
12	-61.2456	397.594	38174.1	3282.33	4.91439
13	-55	398.005	38152.2	3350.35	5.01858
14	-49.6027	398.689	37578.2	3304.06	5.0248
15	-44.2053	399.684	35986	3118.75	4.9532
16	-38.808	401	33383.1	2806.09	4.80483
17	-32.9909	402.794	32779.7	2615.23	4.56151
18	-27.1737	405	31010	2296.74	4.23585
19	-20.6578	408	27084.6	1789.64	3.78038
20	-16.2937	410.35	20523.3	1228.83	3.42649
21	-11.9296	413	13175.7	699.156	3.0375
22	-9.1004	414.892	10308.1	498.454	2.76841
23	-4.16278	418.559	4571.13	181.267	2.27086
24	0.774827	422.75	-903.205	-27.4908	1.74337
25	7.96267	430	-8341.09	-136.319	0.936305
26	16.0336	440.383	0	0	0

List Of Coordinates

Water Table

X	Y
-150	414.8
-74.4	414.8
-57.8	422.75
13.435	434.682
15.637	435.138
17.782	435.58
19.328	436.211
20.212	436.968
20.8	438
100	438

Focus Search Line

X	Y
-15.7423	377.838
-15.7423	431.654

External Boundary

X	Y
96.8	400
94.8	401
92.8	402
86.8	405
80.8	408
78.8	409
70.8	413
66.8	415
64.8	416
51.3	422.75
46.8	425
36.8	430
12	442.4
2.44	442.83
0	442.8
-7.4	442.83
-9.6	442.4
-25.7	434.9
-39.0875	430
-41	429.3
-51.1	427.1
-55	426.5
-59.6	426.3
-83.66	414.8
-150	414.8
-150	413
-150	410
-150	409
-150	405
-150	402
-150	400
-150	396
-150	394
-150	393
-150	392
-150	391
-150	390
-150	350
-55	350
100	350
100	390
100	391
100	392
100	398
100	400

Material Boundary

X	Y
-83.66	414.8
-74.4	414.8
-73.985	415
-71.91	416
-57.8	422.75
-55	422.75
-23.805	422.75
51.3	422.75

Material Boundary

X	Y
-74.4	414.8
-55	414.827
66.8	415

Material Boundary

X	Y
-150	405
-55	405
86.8	405

Material Boundary

X	Y
-57.8	422.75
-55	426.5

Material Boundary

X	Y
-39.0875	430
36.8	430

Material Boundary

X	Y
-150	390
-55	390
100	390

Material Boundary

X	Y
-55	350
-55	390
-55	393
-55	394
-55	396
-55	398
-55	400
-55	401
-55	405
-55	408
-55	410
-55	413
-55	414.827

Material Boundary

X	Y
-55	398
100	398

Material Boundary

X	Y
-55	401
94.8	401

Material Boundary

X	Y
-55	413
70.8	413

Material Boundary

X	Y
-55	408
80.8	408

Material Boundary

X	Y
-150	413
-55	413

Material Boundary

X	Y
-150	410
-55	410

Material Boundary

X	Y
-150	400
-55	400

Material Boundary

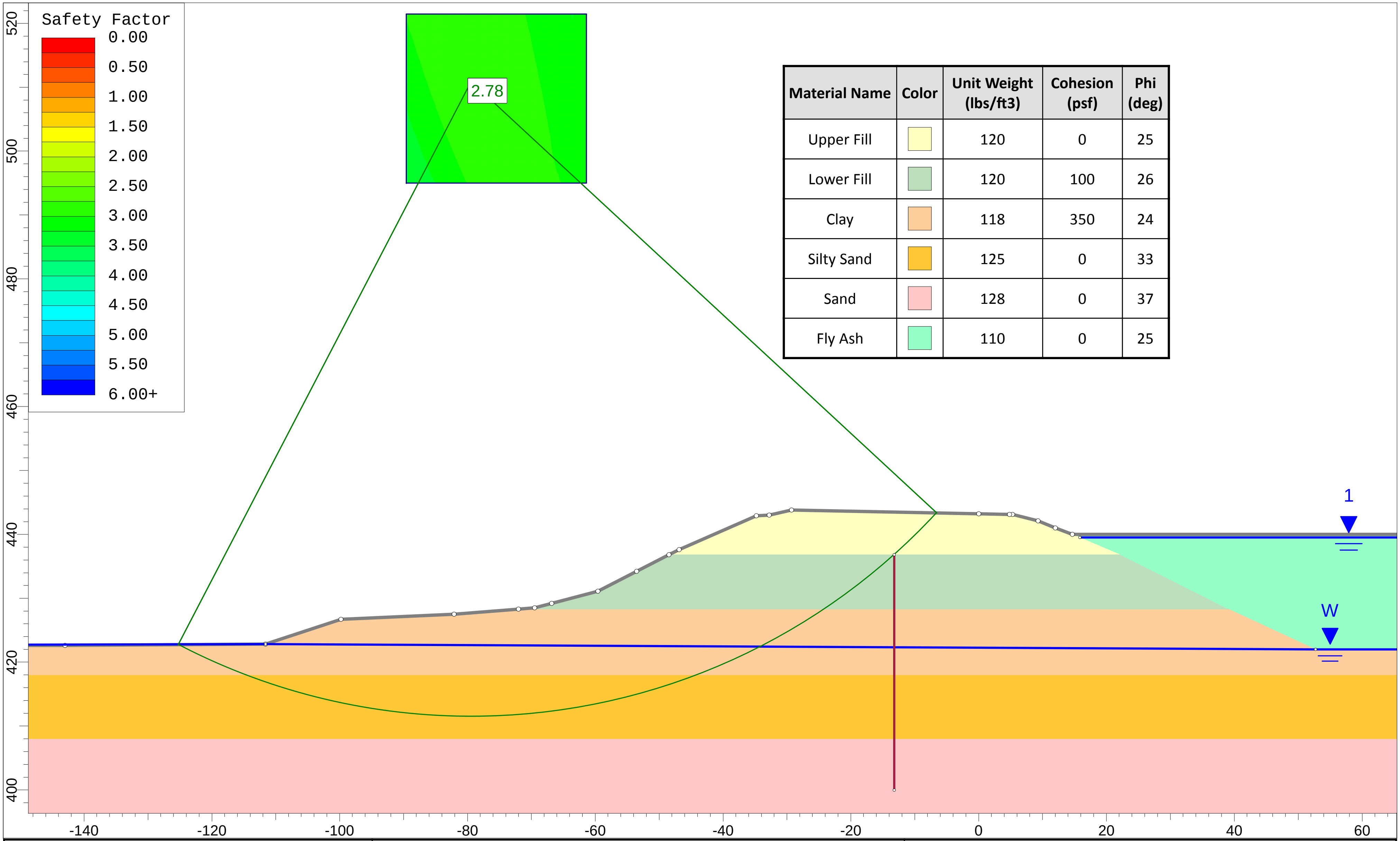
X	Y
-150	396
-55	396

Material Boundary

X	Y
-150	394
-55	394

Material Boundary

X	Y
-150	393
-55	393



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upper Fill	🟨	120	0	25
Lower Fill	🟩	120	100	26
Clay	🟧	118	350	24
Silty Sand	🟨	125	0	33
Sand	🟥	128	0	37
Fly Ash	🟩	110	0	25

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment
Client: Ameren - Sioux Energy Center
Section Location: Section 5 - Fly Ash Pond
Load Case: Static, Maximum Storage Pool
File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section 5\Xect 5 norm pool.slim
Project Number: 2015012432
Analysis By: J. Gilliam
Checked By: J. Bertel
Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Xect 5 norm pool
Slide Modeler Version:	6.035
Project Title:	Periodic Safety Factor Assessment
Analysis:	Static, Maximum Storage Pool
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section 5 - Fly Ash Pond
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]: 62.4
Use negative pore pressure cutoff: Yes
Maximum negative pore pressure [psf]: 0
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Material Properties

Property	Upper Fill	Lower Fill	Clay	Silty Sand	Sand	Fly Ash
Color	🟨	🟩	🟧	🟨	🟥	🟩
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	118	125	128	110
Cohesion [psf]	0	100	350	0	0	0
Friction Angle [deg]	25	26	24	33	37	25
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Piezometric Line 1
Hu Value	1	1	1	1	1	0

Global Minimums

Method: spencer

FS	2.781150
Center:	-79.448, 510.864
Radius:	99.356
Left Slip Surface Endpoint:	-125.285, 422.713
Right Slip Surface Endpoint:	-6.568, 443.334
Left Slope Intercept:	-125.285 422.769
Right Slope Intercept:	-6.568 443.334
Resisting Moment:	1.01962e+007 lb-ft
Driving Moment:	3.66619e+006 lb-ft
Resisting Horizontal Force:	95686.2 lb
Driving Horizontal Force:	34405.2 lb
Total Slice Area:	1630.37 ft2

Method: gle/morgenstern-price

FS	2.786930
Center:	-79.448, 509.805
Radius:	98.569
Left Slip Surface Endpoint:	-125.605, 422.711
Right Slip Surface Endpoint:	-6.661, 443.336
Left Slope Intercept:	-125.605 422.768
Right Slope Intercept:	-6.661 443.336
Resisting Moment:	1.02443e+007 lb-ft
Driving Moment:	3.67583e+006 lb-ft
Resisting Horizontal Force:	96766.1 lb
Driving Horizontal Force:	34721.4 lb
Total Slice Area:	1654.17 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	7245
Number of Invalid Surfaces:	191

Error Codes:

Error Code -108 reported for 1 surface
Error Code -110 reported for 190 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	7245
Number of Invalid Surfaces:	191

Error Codes:

Error Code -108 reported for 1 surface
Error Code -110 reported for 190 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.78115

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	5.25542	812.69	-25.7904	Clay	350	24	157.127	436.993	278.499	83.1101	195.389
2	5.25542	2287.68	-22.4672	Clay	350	24	181.684	505.29	579.679	230.893	348.786
3	4.41578	2959.68	-19.4766	Silty Sand	0	33	97.3302	270.69	764.935	348.108	416.827
4	4.41578	4325.07	-16.7959	Silty Sand	0	33	156.372	434.895	1107.18	437.506	669.678
5	4.41578	5760.69	-14.1526	Silty Sand	0	33	220.508	613.266	1456.84	512.49	944.347
6	4.41578	6955.54	-11.5398	Silty Sand	0	33	270.689	752.827	1733.27	574.019	1159.25
7	4.41578	7550.5	-8.95119	Silty Sand	0	33	286.708	797.377	1850.36	622.507	1227.85
8	4.41578	7982.74	-6.38089	Silty Sand	0	33	295.832	822.754	1925.2	658.274	1266.93
9	4.41578	8304.47	-3.82346	Silty Sand	0	33	301.402	838.245	1972.33	681.546	1290.79
10	4.41578	8531.19	-1.27364	Silty Sand	0	33	304.474	846.789	1996.42	692.475	1303.94
11	4.41578	8707.53	1.27364	Silty Sand	0	33	307.628	855.56	2008.58	691.134	1317.45
12	4.41578	8781.76	3.82346	Silty Sand	0	33	308.115	856.915	1997.06	677.521	1319.54
13	4.41578	8868.73	6.38089	Silty Sand	0	33	312.158	868.157	1988.41	651.565	1336.84
14	4.41578	9141.31	8.95119	Silty Sand	0	33	328.548	913.741	2020.15	613.116	1407.04
15	4.41578	9389.48	11.5398	Silty Sand	0	33	346.05	962.417	2043.94	561.944	1481.99
16	4.41578	9959.58	14.1526	Silty Sand	0	33	381.925	1062.19	2133.35	497.732	1635.62
17	4.41578	10482	16.7959	Silty Sand	0	33	417.176	1160.23	2206.65	420.064	1786.59
18	4.41578	10846.6	19.4766	Silty Sand	0	33	446.617	1242.11	2241.11	328.413	1912.7
19	4.98612	12402.2	22.3822	Clay	350	24	447.809	1245.43	2225.35	214.197	2011.16
20	4.98612	12394.4	25.5307	Clay	350	24	461.379	1283.17	2170.23	74.3142	2095.92
21	4.98612	11616.8	28.7644	Clay	350	24	442.855	1231.65	1980.21	0	1980.21
22	4.98612	10162.2	32.1021	Clay	350	24	395.003	1098.56	1681.3	0	1681.3
23	5.4788	8788.33	35.7463	Lower Fill	100	26	264.431	735.423	1302.81	0	1302.81
24	5.4788	5920.38	39.7481	Lower Fill	100	26	183.754	511.047	842.771	0	842.771
25	6.65126	2662.11	44.4927	Upper Fill	0	25	51.7189	143.838	308.461	0	308.461

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.78693

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	5.13605	792.742	-26.2577	Clay	350	24	150.024	418.105	235.97	83.0027	152.967
2	5.13605	2233.31	-22.9715	Clay	350	24	174.813	487.191	538.842	230.705	308.137
3	4.48569	3005.09	-19.9628	Silty Sand	0	33	93.2854	259.98	750.48	350.146	400.334
4	4.48569	4367.86	-17.2107	Silty Sand	0	33	151.858	423.217	1095.33	443.633	651.697
5	4.48569	5867.35	-14.499	Silty Sand	0	33	221.393	617.007	1471.92	521.814	950.106
6	4.48569	7142.74	-11.8202	Silty Sand	0	33	279.305	778.404	1784.57	585.932	1198.64
7	4.48569	7788.74	-9.16745	Silty Sand	0	33	301.491	840.233	1930.29	636.444	1293.84
8	4.48569	8243.06	-6.53441	Silty Sand	0	33	313.45	873.563	2018.87	673.698	1345.17
9	4.48569	8580.49	-3.91519	Silty Sand	0	33	319.673	890.907	2069.82	697.944	1371.88
10	4.48569	8816.69	-1.30416	Silty Sand	0	33	321.406	895.737	2088.66	709.346	1379.31
11	4.48569	8998.35	1.30416	Silty Sand	0	33	321.679	896.498	2088.47	707.983	1380.48
12	4.48569	9072.28	3.91519	Silty Sand	0	33	318.148	886.656	2059.19	693.855	1365.33
13	4.48569	9168.53	6.53441	Silty Sand	0	33	318.236	886.902	2032.59	666.883	1365.71
14	4.48569	9445.18	9.16745	Silty Sand	0	33	330.249	920.381	2044.17	626.904	1417.26
15	4.48569	9712.76	11.8202	Silty Sand	0	33	344.52	960.152	2052.17	573.666	1478.5
16	4.48569	10305.9	14.499	Silty Sand	0	33	377.699	1052.62	2127.72	506.822	1620.9
17	4.48569	10827	17.2107	Silty Sand	0	33	410.132	1143.01	2185.99	425.915	1760.07
18	4.48569	11167.1	19.9628	Silty Sand	0	33	437.223	1218.51	2206.71	330.365	1876.35
19	4.88697	12283.6	22.8919	Clay	350	24	440.441	1227.48	2184.56	213.723	1970.84
20	4.88697	12232.4	26.0145	Clay	350	24	454.411	1266.41	2131.73	73.4424	2058.29
21	4.88697	11409.8	29.2229	Clay	350	24	437.037	1217.99	1949.53	0	1949.53
22	4.88697	9954.53	32.5356	Clay	350	24	392.169	1092.95	1668.69	0	1668.69
23	5.39747	8655.77	36.164	Lower Fill	100	26	266.903	743.84	1320.07	0	1320.07
24	5.39747	5831.47	40.1605	Lower Fill	100	26	189.106	527.025	875.53	0	875.53
25	6.55797	2624.78	44.9056	Upper Fill	0	25	55.9641	155.968	334.475	0	334.475

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.78115

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-125.285	422.713	0.0985529	0	0
2	-120.029	420.173	1533.84	253.062	9.3686
3	-114.774	418	3749.43	618.604	9.36861
4	-110.358	416.438	5374.2	886.67	9.36863
5	-105.942	415.105	7541.07	1244.17	9.3686
6	-101.526	413.992	10137.8	1672.61	9.36869
7	-97.1107	413.09	12897	2127.82	9.36859
8	-92.6949	412.395	15451.2	2549.23	9.3686
9	-88.2792	411.901	17709.4	2921.81	9.36863
10	-83.8634	411.606	19623.6	3237.63	9.36863
11	-79.4476	411.508	21165.4	3492	9.36862
12	-75.0318	411.606	22327.9	3683.79	9.3686
13	-70.616	411.901	23100.3	3811.24	9.36864
14	-66.2003	412.395	23498.1	3876.87	9.36863
15	-61.7845	413.09	23545.2	3884.64	9.36863
16	-57.3687	413.992	23231.9	3832.94	9.36861
17	-52.9529	415.105	22544.5	3719.53	9.36861
18	-48.5371	416.438	21447.2	3538.5	9.36864
19	-44.1214	418	19921.3	3286.75	9.36864
20	-39.1352	420.053	17586.9	2901.59	9.3686
21	-34.1491	422.435	14721	2428.76	9.36861
22	-29.163	425.172	11511.1	1899.18	9.36865
23	-24.1769	428.3	8223.33	1356.74	9.36864
24	-18.6981	432.244	4535.64	748.319	9.36863
25	-13.2193	436.8	1703.35	281.029	9.36861
26	-6.56803	443.334	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.78693

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-125.605	422.711	0.103224	0	0
2	-120.469	420.177	1369.77	38.4165	1.60649
3	-115.333	418	3442.3	191.311	3.18103
4	-110.847	416.371	5084.28	400.654	4.50574
5	-106.362	414.981	7288.55	735.587	5.76299
6	-101.876	413.821	9990.76	1215.18	6.93484
7	-97.3903	412.882	12921.1	1817.1	8.00503
8	-92.9047	412.159	15673.1	2471.02	8.9595
9	-88.419	411.645	18118.9	3125.11	9.78597
10	-83.9333	411.338	20190.7	3732.83	10.4745
11	-79.4476	411.236	21848.2	4253.56	11.0169
12	-74.9619	411.338	23080.3	4656.82	11.4072
13	-70.4762	411.645	23877.7	4919.18	11.641
14	-65.9905	412.159	24263.3	5031.65	11.7158
15	-61.5049	412.882	24267.4	4994.98	11.6308
16	-57.0192	413.821	23888.9	4811.21	11.387
17	-52.5335	414.981	23117.9	4488.19	10.9869
18	-48.0478	416.371	21923.4	4037.54	10.435
19	-43.5621	418	20292.5	3482.31	9.73744
20	-38.6751	420.064	17940.7	2784.22	8.82137
21	-33.7882	422.449	15080.8	2053.91	7.75561
22	-28.9012	425.182	11890.6	1366.59	6.55625
23	-24.0142	428.3	8608.06	789.835	5.24251
24	-18.6168	432.245	4843.25	311.913	3.68485
25	-13.2193	436.8	1877.77	67.1137	2.04695
26	-6.66132	443.336	0	0	0

List Of Coordinates

Water Table

X	Y
-200	422.6
-111.6	422.8
52.7	422
100	422

Piezoline

X	Y
15.8339	439.5
100	439.5

Focus Search Line

X	Y
-13.2193	399.952
-13.2193	436.8

External Boundary

X	Y
12	441
9.3	442.1
5.3	443.1
4.8	443.1
0	443.2
-29.3	443.8
-32.8	443
-34.8	442.9
-46.9	437.6
-48.4631	436.8
-53.5431	434.2
-59.6	431.1
-66.8346	429.2
-69.5	428.5
-72.02	428.3
-82.1	427.5
-99.8	426.7
-111.6	422.8
-143	422.6
-177.9	422.6
-200	422.6
-200	418
-200	408
-200	350
100	350
100	408
100	418
100	422
100	440
14.651	440.002

Material Boundary

X	Y
-200	418
100	418

Material Boundary

X	Y
-48.4631	436.8
22.128	436.8

Material Boundary

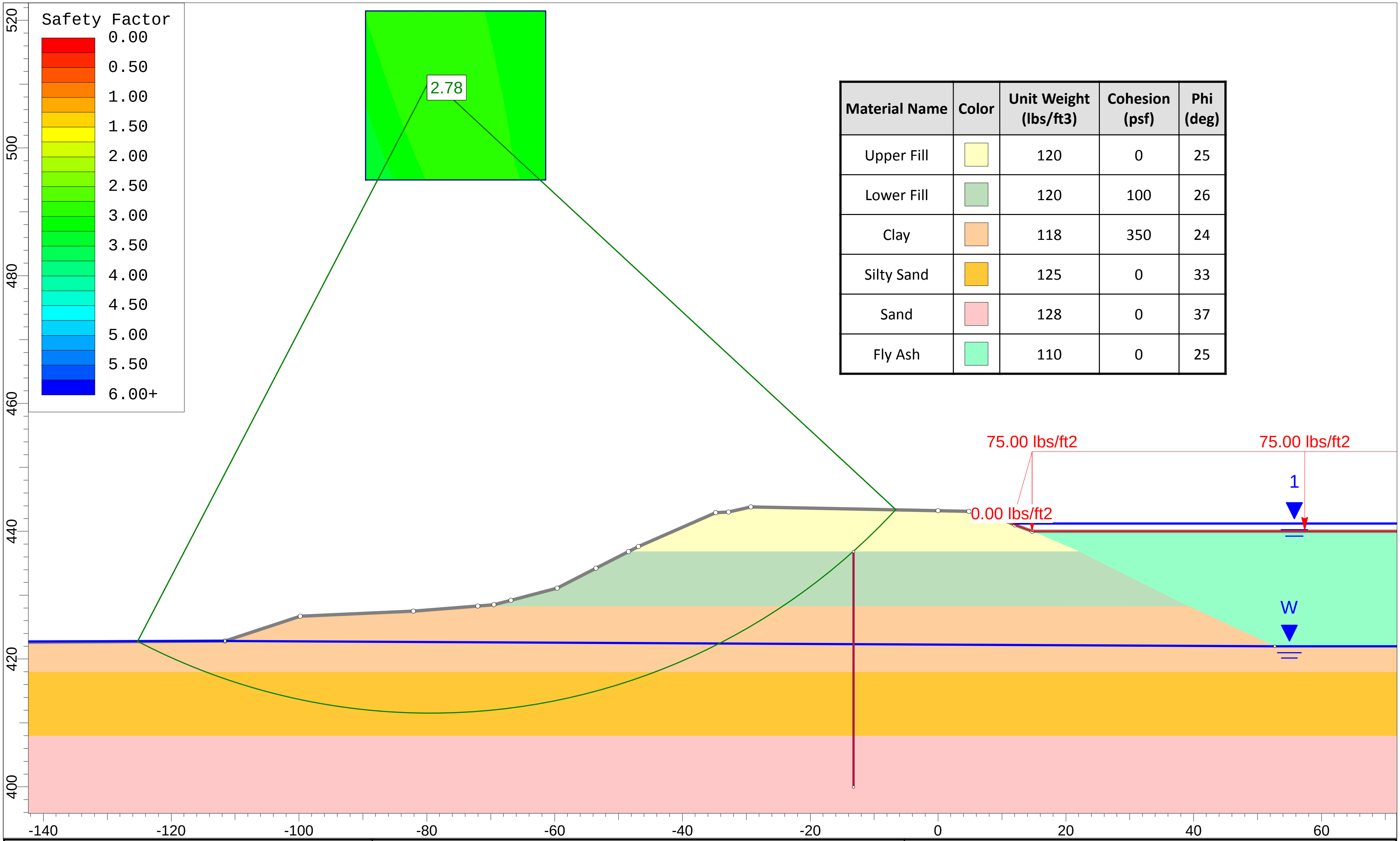
X	Y
-72.02	428.3
39.112	428.3

Material Boundary

X	Y
-200	408
100	408

Material Boundary

X	Y
14.651	440.002
22.128	436.8
39.112	428.3
52.7	422
100	422



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upper Fill	🟨	120	0	25
Lower Fill	🟩	120	100	26
Clay	🟧	118	350	24
Silty Sand	🟨	125	0	33
Sand	🟥	128	0	37
Fly Ash	🟩	110	0	25

Reitz & Jens, Inc.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment
Client: Ameren - Sioux Energy Center
Section Location: Section 5 - Fly Ash Pond
Load Case: Static, Maximum Surcharge Pool
File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section 5\Xect 5 max pool.slim
Project Number: 2015012432
Analysis By: J. Gilliam
Checked By: J. Bertel
Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Xect 5 max pool
Slide Modeler Version:	6.035
Project Title:	Periodic Safety Factor Assessment
Analysis:	Static, Maximum Surcharge Pool
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
	Comments
	2015012432
	Section 5 - Fly Ash Pond
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

2 Distributed Loads present

Distributed Load 1	
Distribution:	Constant
Magnitude [psf]:	75
Orientation:	Normal to boundary

Distributed Load 2	
Distribution:	Triangular
Magnitude 1 [psf]:	0
Magnitude 2 [psf]:	75
Orientation:	Vertical

Material Properties

Property	Upper Fill	Lower Fill	Clay	Silty Sand	Sand	Fly Ash
Color	🟨	🟩	🟧	🟨	🟥	🟩
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	118	125	128	110
Cohesion [psf]	0	100	350	0	0	0
Friction Angle [deg]	25	26	24	33	37	25
Water Surface	Water Table	Water Table	Water Table	Water Table	Water Table	Piezometric Line 1
Hu Value	1	1	1	1	1	0

Global Minimums

Method: spencer

FS	2.781170
Center:	-79.448, 510.864
Radius:	99.356
Left Slip Surface Endpoint:	-125.285, 422.713
Right Slip Surface Endpoint:	-6.568, 443.334
Left Slope Intercept:	-125.285 422.769
Right Slope Intercept:	-6.568 443.334
Resisting Moment:	1.01963e+007 lb-ft
Driving Moment:	3.66619e+006 lb-ft
Resisting Horizontal Force:	95686.3 lb
Driving Horizontal Force:	34405 lb
Total Slice Area:	1630.37 ft2

Method: gle/morgenstern-price

FS	2.786780
Center:	-79.448, 509.805
Radius:	98.569
Left Slip Surface Endpoint:	-125.605, 422.711
Right Slip Surface Endpoint:	-6.661, 443.336
Left Slope Intercept:	-125.605 422.768
Right Slope Intercept:	-6.661 443.336
Resisting Moment:	1.02437e+007 lb-ft
Driving Moment:	3.67583e+006 lb-ft
Resisting Horizontal Force:	96765.4 lb
Driving Horizontal Force:	34723 lb
Total Slice Area:	1654.17 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces: 7433
Number of Invalid Surfaces: 3

Error Codes:

Error Code -108 reported for 3 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces: 7433
Number of Invalid Surfaces: 3

Error Codes:

Error Code -108 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.78117

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	5.25542	812.69	-25.7904	Clay	350	24	157.126	436.994	278.503	83.1101	195.393
2	5.25542	2287.68	-22.4672	Clay	350	24	181.683	505.292	579.684	230.893	348.791
3	4.41578	2959.68	-19.4766	Silty Sand	0	33	97.331	270.694	764.939	348.108	416.831
4	4.41578	4325.07	-16.7959	Silty Sand	0	33	156.373	434.899	1107.19	437.506	669.686
5	4.41578	5760.69	-14.1526	Silty Sand	0	33	220.509	613.272	1456.85	512.49	944.356
6	4.41578	6955.54	-11.5398	Silty Sand	0	33	270.689	752.833	1733.28	574.019	1159.26
7	4.41578	7550.5	-8.95119	Silty Sand	0	33	286.708	797.383	1850.37	622.507	1227.86
8	4.41578	7982.74	-6.38089	Silty Sand	0	33	295.832	822.759	1925.21	658.274	1266.94
9	4.41578	8304.47	-3.82346	Silty Sand	0	33	301.402	838.249	1972.34	681.546	1290.79
10	4.41578	8531.19	-1.27364	Silty Sand	0	33	304.473	846.792	1996.42	692.475	1303.95
11	4.41578	8707.53	1.27364	Silty Sand	0	33	307.627	855.563	2008.59	691.134	1317.45
12	4.41578	8781.76	3.82346	Silty Sand	0	33	308.114	856.917	1997.06	677.521	1319.54
13	4.41578	8868.73	6.38089	Silty Sand	0	33	312.155	868.157	1988.41	651.565	1336.84
14	4.41578	9141.31	8.95119	Silty Sand	0	33	328.546	913.741	2020.15	613.116	1407.04
15	4.41578	9389.48	11.5398	Silty Sand	0	33	346.048	962.417	2043.94	561.944	1481.99
16	4.41578	9959.58	14.1526	Silty Sand	0	33	381.918	1062.18	2133.35	497.732	1635.62
17	4.41578	10482	16.7959	Silty Sand	0	33	417.173	1160.23	2206.65	420.064	1786.59
18	4.41578	10846.6	19.4766	Silty Sand	0	33	446.614	1242.11	2241.09	328.413	1912.67
19	4.98612	12402.2	22.3822	Clay	350	24	447.805	1245.42	2225.35	214.197	2011.16
20	4.98612	12394.4	25.5307	Clay	350	24	461.375	1283.16	2170.23	74.3142	2095.92
21	4.98612	11616.8	28.7644	Clay	350	24	442.85	1231.64	1980.19	0	1980.19
22	4.98612	10162.2	32.1021	Clay	350	24	394.999	1098.56	1681.29	0	1681.29
23	5.4788	8788.33	35.7463	Lower Fill	100	26	264.428	735.42	1302.8	0	1302.8
24	5.4788	5920.38	39.7481	Lower Fill	100	26	183.752	511.045	842.767	0	842.767
25	6.65126	2662.11	44.4927	Upper Fill	0	25	51.7182	143.837	308.459	0	308.459

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.78678

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	5.13605	792.742	-26.2577	Clay	350	24	150.032	418.105	235.968	83.0027	152.965
2	5.13605	2233.31	-22.9715	Clay	350	24	174.82	487.184	538.826	230.705	308.121
3	4.48569	3005.09	-19.9628	Silty Sand	0	33	93.2836	259.961	750.45	350.146	400.304
4	4.48569	4367.86	-17.2107	Silty Sand	0	33	151.855	423.186	1095.28	443.633	651.65
5	4.48569	5867.35	-14.499	Silty Sand	0	33	221.389	616.963	1471.85	521.814	950.037
6	4.48569	7142.74	-11.8202	Silty Sand	0	33	279.3	778.348	1784.48	585.932	1198.55
7	4.48569	7788.74	-9.16745	Silty Sand	0	33	301.485	840.173	1930.2	636.444	1293.75
8	4.48569	8243.06	-6.53441	Silty Sand	0	33	313.445	873.503	2018.77	673.698	1345.08
9	4.48569	8580.49	-3.91519	Silty Sand	0	33	319.671	890.852	2069.73	697.944	1371.79
10	4.48569	8816.69	-1.30416	Silty Sand	0	33	321.407	895.69	2088.59	709.346	1379.24
11	4.48569	8998.35	1.30416	Silty Sand	0	33	321.684	896.462	2088.41	707.983	1380.43
12	4.48569	9072.28	3.91519	Silty Sand	0	33	318.157	886.634	2059.15	693.855	1365.3
13	4.48569	9168.53	6.53441	Silty Sand	0	33	318.25	886.893	2032.58	666.883	1365.7
14	4.48569	9445.18	9.16745	Silty Sand	0	33	330.268	920.385	2044.17	626.904	1417.27
15	4.48569	9712.76	11.8202	Silty Sand	0	33	344.544	960.167	2052.19	573.666	1478.53
16	4.48569	10305.9	14.499	Silty Sand	0	33	377.73	1052.65	2127.76	506.822	1620.94
17	4.48569	10827	17.2107	Silty Sand	0	33	410.165	1143.04	2186.05	425.915	1760.14
18	4.48569	11167.1	19.9628	Silty Sand	0	33	437.261	1218.55	2206.77	330.365	1876.41
19	4.88697	12283.6	22.8919	Clay	350	24	440.476	1227.51	2184.64	213.723	1970.91
20	4.88697	12232.4	26.0145	Clay	350	24	454.447	1266.44	2131.81	73.4424	2058.36
21	4.88697	11409.8	29.2229	Clay	350	24	437.071	1218.02	1949.6	0	1949.6
22	4.88697	9954.53	32.5356	Clay	350	24	392.198	1092.97	1668.74	0	1668.74
23	5.39747	8655.77	36.164	Lower Fill	100	26	266.924	743.859	1320.11	0	1320.11
24	5.39747	5831.47	40.1605	Lower Fill	100	26	189.119	527.033	875.547	0	875.547
25	6.55797	2624.78	44.9056	Upper Fill	0	25	55.9675	155.969	334.477	0	334.477

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.78117

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-125.285	422.713	0.0985529	0	0
2	-120.029	420.173	1533.85	253.086	9.36941
3	-114.774	418	3749.44	618.66	9.36942
4	-110.358	416.438	5374.23	886.751	9.36942
5	-105.942	415.105	7541.11	1244.29	9.36944
6	-101.526	413.992	10137.9	1672.76	9.36942
7	-97.1107	413.09	12897	2128.02	9.36945
8	-92.6949	412.395	15451.2	2549.46	9.36943
9	-88.2792	411.901	17709.5	2922.08	9.36942
10	-83.8634	411.606	19623.7	3237.92	9.36941
11	-79.4476	411.508	21165.4	3492.31	9.36944
12	-75.0318	411.606	22327.9	3684.12	9.36943
13	-70.616	411.901	23100.4	3811.58	9.36942
14	-66.2003	412.395	23498.2	3877.21	9.3694
15	-61.7845	413.09	23545.2	3884.98	9.36944
16	-57.3687	413.992	23231.9	3833.28	9.36942
17	-52.9529	415.105	22544.5	3719.86	9.36943
18	-48.5371	416.438	21447.2	3538.8	9.36942
19	-44.1214	418	19921.3	3287.03	9.36943
20	-39.1352	420.053	17586.8	2901.84	9.36944
21	-34.1491	422.435	14721	2428.97	9.3694
22	-29.163	425.172	11511.1	1899.34	9.36943
23	-24.1769	428.3	8223.31	1356.85	9.36941
24	-18.6981	432.244	4535.62	748.38	9.36942
25	-13.2193	436.8	1703.34	281.053	9.36945
26	-6.56803	443.334	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.78678

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-125.605	422.711	0.103224	0	0
2	-120.469	420.177	1369.81	38.3941	1.60551
3	-115.333	418	3442.34	191.196	3.17908
4	-110.847	416.371	5084.26	400.407	4.50299
5	-106.362	414.981	7288.45	735.128	5.75949
6	-101.876	413.821	9990.56	1214.41	6.93063
7	-97.3903	412.882	12920.7	1815.94	8.00023
8	-92.9047	412.159	15672.7	2469.45	8.95413
9	-88.419	411.645	18118.4	3123.12	9.78013
10	-83.9333	411.338	20190.2	3730.46	10.4682
11	-79.4476	411.236	21847.6	4250.86	11.0104
12	-74.9619	411.338	23079.8	4653.88	11.4004
13	-70.4762	411.645	23877.2	4916.08	11.6341
14	-65.9905	412.159	24262.9	5028.49	11.7088
15	-61.5049	412.882	24267.1	4991.87	11.6239
16	-57.0192	413.821	23888.7	4808.22	11.3802
17	-52.5335	414.981	23117.8	4485.42	10.9804
18	-48.0478	416.371	21923.4	4035.06	10.4287
19	-43.5621	418	20292.5	3480.18	9.7316
20	-38.6751	420.064	17940.7	2782.52	8.81607
21	-33.7882	422.449	15080.8	2052.66	7.75094
22	-28.9012	425.182	11890.6	1365.76	6.55231
23	-24.0142	428.3	8608.03	789.351	5.23933
24	-18.6168	432.245	4843.19	311.718	3.6826
25	-13.2193	436.8	1877.7	67.0702	2.0457
26	-6.66132	443.336	0	0	0

List Of Coordinates

Water Table

X	Y
-200	422.6
-111.6	422.8
52.7	422
100	422

Piezoline

X	Y
11.5091	441.2
100	441.2

Distributed Load

X	Y
100	440
14.718	440

Distributed Load

X	Y
11.5168	441.197
12	441
14.718	440

Focus Search Line

X	Y
-13.2193	399.952
-13.2193	436.8

External Boundary

X	Y
12	441
9.3	442.1
5.3	443.1
4.8	443.1
0	443.2
-29.3	443.8
-32.8	443
-34.8	442.9
-46.9	437.6
-48.4631	436.8
-53.5431	434.2
-59.6	431.1
-66.8346	429.2
-69.5	428.5
-72.02	428.3
-82.1	427.5
-99.8	426.7
-111.6	422.8
-143	422.6
-177.9	422.6
-200	422.6
-200	418
-200	408
-200	350
100	350
100	408
100	418
100	422
100	440
14.718	440

Material Boundary

X	Y
-200	418
100	418

Material Boundary

X	Y
-48.4631	436.8
22.128	436.8

Material Boundary

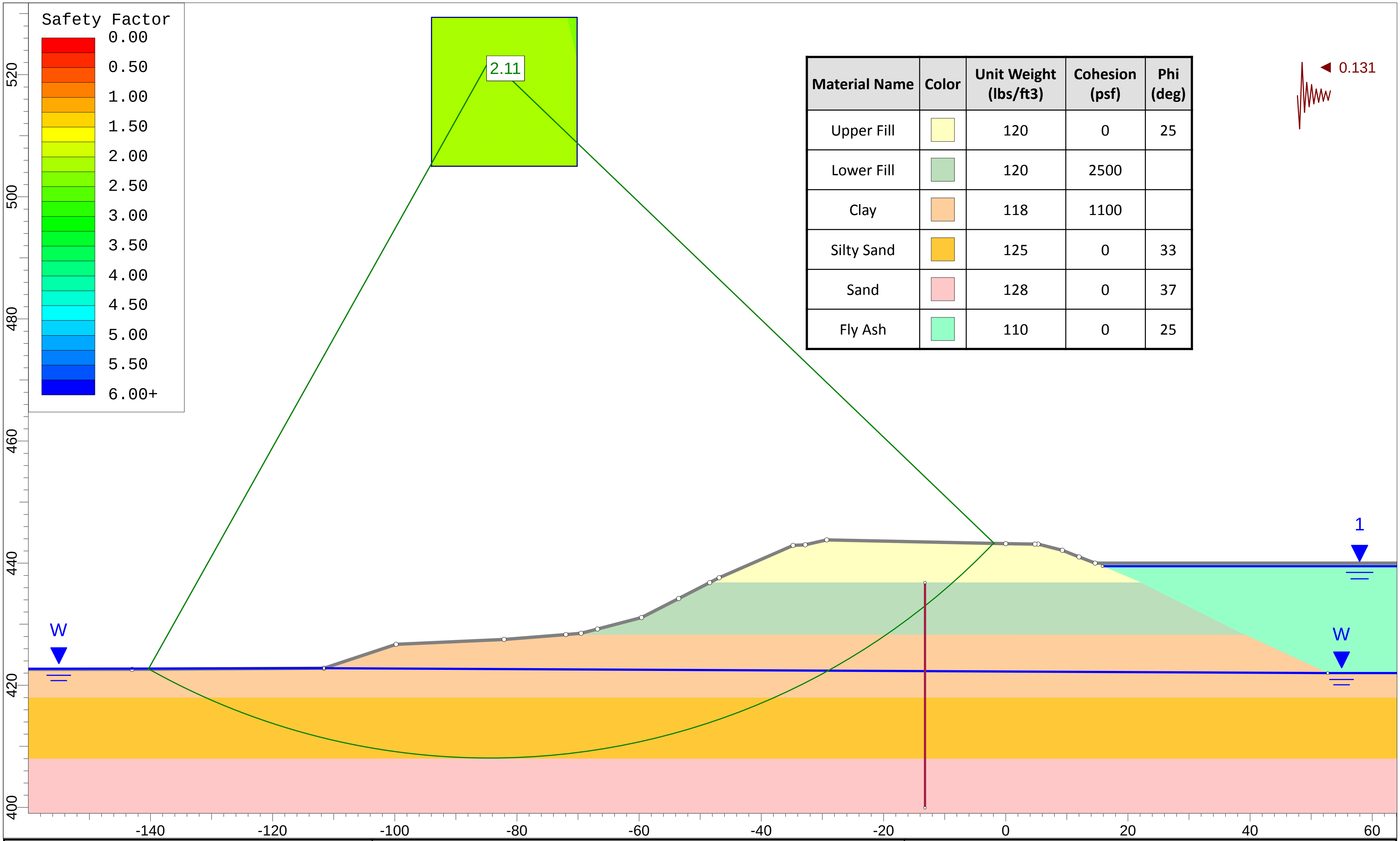
X	Y
-72.02	428.3
39.112	428.3

Material Boundary

X	Y
-200	408
100	408

Material Boundary

X	Y
14.718	440
22.128	436.8
39.112	428.3
52.7	422
100	422



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upper Fill	🟨	120	0	25
Lower Fill	🟩	120	2500	
Clay	🟧	118	1100	
Silty Sand	🟧	125	0	33
Sand	🟥	128	0	37
Fly Ash	🟩	110	0	25

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment

Client: Ameren - Sioux Energy Center

Section Location: Section 5 - Fly Ash Pond

Load Case: Seismic

File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section 5\Xect 5 norm pool + seismic.slim

Project Number: 2015012432

Analysis By: J. Gilliam

Checked By: J. Bertel

Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Xect 5 norm pool + seismic
Slide Modeler Version:	6.035
Project Title:	Periodic Safety Factor Assessment
Analysis:	Seismic
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section 5 - Fly Ash Pond
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal):	0.131

Material Properties

Property	Upper Fill	Lower Fill	Clay	Silty Sand	Sand	Fly Ash
Color	🟨	🟩	🟧	🟨	🟥	🟩
Strength Type	Mohr-Coulomb	Undrained	Undrained	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	118	125	128	110
Cohesion [psf]	0			0	0	0
Friction Angle [deg]	25			33	37	25
Cohesion Type		2500	1100			
Water Surface	Water Table	None	None	Water Table	Water Table	Piezometric Line 1
Hu Value	1			1	1	0
Ru Value		0	0			

Global Minimums

Method: spencer

FS	2.113340
Center:	-84.446, 522.530
Radius:	114.489
Left Slip Surface Endpoint:	-140.348, 422.617
Right Slip Surface Endpoint:	-1.859, 443.238
Left Slope Intercept:	-140.348 422.735
Right Slope Intercept:	-1.859 443.238
Resisting Moment:	1.76929e+007 lb-ft
Driving Moment:	8.37202e+006 lb-ft
Resisting Horizontal Force:	140103 lb
Driving Horizontal Force:	66294.5 lb
Total Slice Area:	2146.9 ft2

Method: gle/morgenstern-price

FS	2.125450
Center:	-84.446, 522.530
Radius:	114.489
Left Slip Surface Endpoint:	-140.348, 422.617
Right Slip Surface Endpoint:	-1.859, 443.238
Left Slope Intercept:	-140.348 422.735
Right Slope Intercept:	-1.859 443.238
Resisting Moment:	1.77943e+007 lb-ft
Driving Moment:	8.37202e+006 lb-ft
Resisting Horizontal Force:	140931 lb
Driving Horizontal Force:	66306.1 lb
Total Slice Area:	2146.9 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	7238
Number of Invalid Surfaces:	198

Error Codes:

Error Code -110 reported for 198 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	7238
Number of Invalid Surfaces:	198

Error Codes:

Error Code -110 reported for 198 surfaces

Error Codes

The following errors were encountered during the computation:

-110 = The water table or a piezoline does not span the slip region for a given slip surface, when Water Surfaces is specified as the method of pore pressure calculation. If this error occurs, check that the water table or piezoline(s) span the appropriate soil cells.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.11334

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.59963	700.723	-27.9246	Clay	1100	0	520.503	1100	581.457	0	581.457
2	4.59963	1964.13	-25.3483	Clay	1100	0	520.503	1100	836.7	0	836.7
3	5.49449	3851.21	-22.5854	Silty Sand	0	33	143.778	303.851	836.346	368.455	467.891
4	5.49449	5324.23	-19.6363	Silty Sand	0	33	191.731	405.192	1125.64	501.704	623.94
5	5.49449	6579.94	-16.7405	Silty Sand	0	33	227.858	481.541	1356.72	615.208	741.507
6	5.49449	7742.56	-13.8883	Silty Sand	0	33	261.669	552.995	1561.47	709.934	851.537
7	5.49449	9574.76	-11.0708	Silty Sand	0	33	343.455	725.837	1902.02	784.335	1117.68
8	5.49449	11351.9	-8.28032	Silty Sand	0	33	422.932	893.8	2217.48	841.157	1376.33
9	5.49449	12222.4	-5.50948	Silty Sand	0	33	448.395	947.611	2340.17	880.971	1459.2
10	5.49449	12656.1	-2.75155	Silty Sand	0	33	452.056	955.347	2375.19	904.076	1471.11
11	5.49449	12908.1	0	Silty Sand	0	33	450.363	951.77	2376.23	910.645	1465.59
12	5.49449	13047.9	2.75155	Silty Sand	0	33	447.666	946.07	2357.55	900.737	1456.81
13	5.49449	13058.1	5.50948	Silty Sand	0	33	443.149	936.524	2316.42	874.293	1442.12
14	5.49449	13089.5	8.28032	Silty Sand	0	33	445.158	940.77	2279.8	831.14	1448.66
15	5.49449	13381	11.0708	Silty Sand	0	33	465.909	984.624	2287.16	770.98	1516.18
16	5.49449	13928.5	13.8883	Silty Sand	0	33	504.008	1065.14	2333.55	693.381	1640.17
17	5.49449	14748.4	16.7405	Silty Sand	0	33	559.181	1181.74	2417.48	597.761	1819.72
18	5.49449	15302.4	19.6363	Silty Sand	0	33	604.067	1276.6	2449.16	483.364	1965.8
19	5.49449	15446	22.5854	Silty Sand	0	33	632.7	1337.11	2408.18	349.222	2058.96
20	6.10772	16878.4	25.772	Clay	1100	0	520.503	1100	2328.88	0	2328.88
21	6.10772	15335	29.2207	Clay	1100	0	520.503	1100	2039.43	0	2039.43
22	6.10772	12675.8	32.7904	Clay	1100	0	520.503	1100	1592.37	0	1592.37
23	5.42788	8629.64	36.294	Lower Fill	2500	0	1182.96	2500	794.926	0	794.926
24	5.42788	5789.02	39.7461	Lower Fill	2500	0	1182.96	2500	242.523	0	242.523
25	6.70436	2645.02	43.8393	Upper Fill	0	25	63.1588	133.476	286.241	0	286.241

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.12545

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.59963	700.723	-27.9246	Clay	1100	0	517.537	1100	444.482	0	444.482
2	4.59963	1964.13	-25.3483	Clay	1100	0	517.537	1100	728.632	0	728.632
3	5.49449	3851.21	-22.5854	Silty Sand	0	33	139.347	296.175	824.524	368.455	456.069
4	5.49449	5324.23	-19.6363	Silty Sand	0	33	192.125	408.352	1130.51	501.704	628.806
5	5.49449	6579.94	-16.7405	Silty Sand	0	33	235.344	500.212	1385.47	615.208	770.257
6	5.49449	7742.56	-13.8883	Silty Sand	0	33	275.663	585.908	1612.15	709.934	902.219
7	5.49449	9574.76	-11.0708	Silty Sand	0	33	361.386	768.108	1967.12	784.335	1182.79
8	5.49449	11351.9	-8.28032	Silty Sand	0	33	443.467	942.566	2292.59	841.157	1451.43
9	5.49449	12222.4	-5.50948	Silty Sand	0	33	469.256	997.38	2416.8	880.971	1535.83
10	5.49449	12656.1	-2.75155	Silty Sand	0	33	470.069	999.109	2442.58	904.076	1538.5
11	5.49449	12908.1	0	Silty Sand	0	33	463.006	984.096	2426.03	910.645	1515.38
12	5.49449	13047.9	2.75155	Silty Sand	0	33	453.471	963.83	2384.91	900.737	1484.17
13	5.49449	13058.1	5.50948	Silty Sand	0	33	441.721	938.856	2320	874.293	1445.71
14	5.49449	13089.5	8.28032	Silty Sand	0	33	437.028	928.881	2261.48	831.14	1430.34
15	5.49449	13381	11.0708	Silty Sand	0	33	452.26	961.255	2251.19	770.98	1480.21
16	5.49449	13928.5	13.8883	Silty Sand	0	33	486.551	1034.14	2285.83	693.381	1592.45
17	5.49449	14748.4	16.7405	Silty Sand	0	33	540.116	1147.99	2365.51	597.761	1767.75
18	5.49449	15302.4	19.6363	Silty Sand	0	33	586.271	1246.09	2402.17	483.364	1918.81
19	5.49449	15446	22.5854	Silty Sand	0	33	619.29	1316.27	2376.1	349.222	2026.88
20	6.10772	16878.4	25.772	Clay	1100	0	517.537	1100	2327.78	0	2327.78
21	6.10772	15335	29.2207	Clay	1100	0	517.537	1100	2080.55	0	2080.55
22	6.10772	12675.8	32.7904	Clay	1100	0	517.537	1100	1668.26	0	1668.26
23	5.42788	8629.64	36.294	Lower Fill	2500	0	1176.22	2500	777.025	0	777.025
24	5.42788	5789.02	39.7461	Lower Fill	2500	0	1176.22	2500	136.645	0	136.645
25	6.70436	2645.02	43.8393	Upper Fill	0	25	69.7264	148.2	317.815	0	317.815

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.11334

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-140.348	422.617	0.434932	0	0
2	-135.749	420.179	3724.46	705.389	10.7244
3	-131.149	418	7688.29	1456.11	10.7244
4	-125.654	415.715	9888.56	1872.83	10.7244
5	-120.16	413.754	12453.6	2358.63	10.7244
6	-114.665	412.101	15087.1	2857.4	10.7244
7	-109.171	410.743	17632.3	3339.45	10.7244
8	-103.676	409.668	20310.2	3846.63	10.7245
9	-98.182	408.868	22920.5	4340.99	10.7244
10	-92.6875	408.338	25023.7	4739.32	10.7244
11	-87.193	408.074	26477.1	5014.6	10.7244
12	-81.6985	408.074	27261.1	5163.08	10.7244
13	-76.204	408.338	27389.3	5187.37	10.7245
14	-70.7095	408.868	26886.3	5092.11	10.7245
15	-65.215	409.668	25794.9	4885.4	10.7245
16	-59.7205	410.743	24143.5	4572.62	10.7244
17	-54.226	412.101	21918.3	4151.19	10.7244
18	-48.7315	413.754	19063.9	3610.58	10.7244
19	-43.2371	415.715	15577.4	2950.27	10.7245
20	-37.7426	418	11527	2183.15	10.7245
21	-31.6348	420.949	5627.9	1065.89	10.7244
22	-25.5271	424.365	-168.87	-31.983	10.7245
23	-19.4194	428.3	-4915.32	-930.93	10.7244
24	-13.9915	432.286	-2792.63	-528.906	10.7244
25	-8.56364	436.8	1776.33	336.426	10.7244
26	-1.85929	443.238	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 2.12545

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-140.348	422.617	0.434932	0	0
2	-135.749	420.179	3377.35	81.6434	1.38479
3	-131.149	418	7092.53	341.041	2.75292
4	-125.654	415.715	9241.58	701.805	4.3427
5	-120.16	413.754	11818.5	1212.78	5.85902
6	-114.665	412.101	14540.9	1856.91	7.27743
7	-109.171	410.743	17232.2	2598.71	8.57589
8	-103.676	409.668	20079	3444.95	9.73544
9	-98.182	408.868	22862.7	4336.39	10.7398
10	-92.6875	408.338	25121.6	5145.67	11.5758
11	-87.193	408.074	26692.4	5787.21	12.233
12	-81.6985	408.074	27546.3	6209.72	12.7037
13	-76.204	408.338	27699.7	6386.12	12.9826
14	-70.7095	408.868	27187.5	6309.95	13.0665
15	-65.215	409.668	26066.5	5996.13	12.9545
16	-59.7205	410.743	24379.2	5470.8	12.6479
17	-54.226	412.101	22123.5	4763.07	12.15
18	-48.7315	413.754	19250.7	3904.93	11.4666
19	-43.2371	415.715	15759.3	2950.9	10.6057
20	-37.7426	418	11709.2	1975.88	9.5782
21	-31.6348	420.949	5795.81	841.091	8.25715
22	-25.5271	424.365	-158.973	-18.8722	6.77008
23	-19.4194	428.3	-5221.51	-470.095	5.1445
24	-13.9915	432.286	-3062.79	-193.184	3.60912
25	-8.56364	436.8	1948.73	68.5242	2.01389
26	-1.85929	443.238	0	0	0

List Of Coordinates

Water Table

X	Y
-200	422.6
-111.6	422.8
52.7	422
100	422

Piezoline

X	Y
15.8339	439.5
100	439.5

Focus Search Line

X	Y
-13.2193	399.952
-13.2193	436.8

External Boundary

X	Y
12	441
9.3	442.1
5.3	443.1
4.8	443.1
0	443.2
-29.3	443.8
-32.8	443
-34.8	442.9
-46.9	437.6
-48.4631	436.8
-53.5431	434.2
-59.6	431.1
-66.8346	429.2
-69.5	428.5
-72.02	428.3
-82.1	427.5
-99.8	426.7
-111.6	422.8
-143	422.6
-177.9	422.6
-200	422.6
-200	418
-200	408
-200	350
100	350
100	408
100	418
100	422
100	440
14.651	440.002

Material Boundary

X	Y
-200	418
100	418

Material Boundary

X	Y
-48.4631	436.8
22.128	436.8

Material Boundary

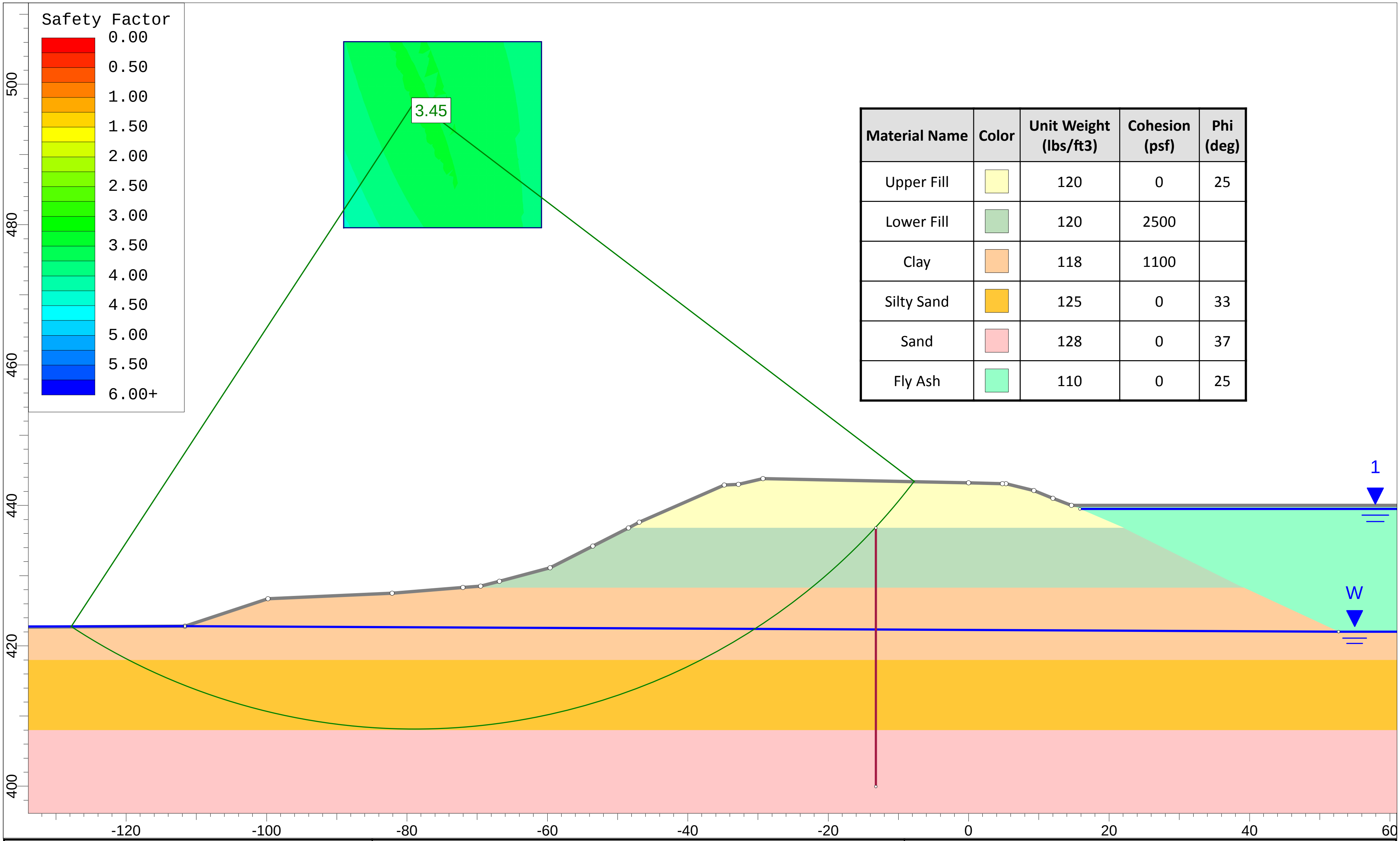
X	Y
-72.02	428.3
39.112	428.3

Material Boundary

X	Y
-200	408
100	408

Material Boundary

X	Y
14.651	440.002
22.128	436.8
39.112	428.3
52.7	422
100	422



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Upper Fill	🟨	120	0	25
Lower Fill	🟩	120	2500	
Clay	🟧	118	1100	
Silty Sand	🟨	125	0	33
Sand	🟥	128	0	37
Fly Ash	🟩	110	0	25

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment
Client: Ameren - Sioux Energy Center
Section Location: Section 5 - Fly Ash Pond
Load Case: Liquefaction
File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section 5\Xect 5 norm pool + postEQ.slim
Project Number: 2015012432
Analysis By: J. Gilliam
Checked By: J. Bertel
Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Xect 5 norm pool + postEQ
Slide Modeler Version:	6.035
Project Title:	Periodic Safety Factor Assessment
Analysis:	Liquefaction
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section 5 - Fly Ash Pond
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	seconds
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
GLE/Morgenstern-Price with interslice force function:	Half Sine
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]: 62.4
Use negative pore pressure cutoff: Yes
Maximum negative pore pressure [psf]: 0
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Material Properties

Property	Upper Fill	Lower Fill	Clay	Silty Sand	Sand	Fly Ash
Color	🟨	🟩	🟧	🟨	🟥	🟩
Strength Type	Mohr-Coulomb	Undrained	Undrained	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	120	120	118	125	128	110
Cohesion [psf]	0			0	0	0
Friction Angle [deg]	25			33	37	25
Cohesion Type		2500	1100			
Water Surface	Water Table	None	None	Water Table	Water Table	Water Table
Hu Value	1			1	1	0
Ru Value		0	0			

Global Minimums

Method: spencer

FS	3.451540
Center:	-78.876, 497.571
Radius:	89.465
Left Slip Surface Endpoint:	-127.842, 422.697
Right Slip Surface Endpoint:	-7.708, 443.358
Left Slope Intercept:	-127.842 422.763
Right Slope Intercept:	-7.708 443.358
Resisting Moment:	1.28249e+007 lb-ft
Driving Moment:	3.7157e+006 lb-ft
Resisting Horizontal Force:	126828 lb
Driving Horizontal Force:	36745.4 lb
Total Slice Area:	1927.17 ft2

Method: gle/morgenstern-price

FS	3.457120
Center:	-78.876, 497.571
Radius:	89.465
Left Slip Surface Endpoint:	-127.842, 422.697
Right Slip Surface Endpoint:	-7.708, 443.358
Left Slope Intercept:	-127.842 422.763
Right Slope Intercept:	-7.708 443.358
Resisting Moment:	1.28456e+007 lb-ft
Driving Moment:	3.7157e+006 lb-ft
Resisting Horizontal Force:	127079 lb
Driving Horizontal Force:	36758.7 lb
Total Slice Area:	1927.17 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	7396
Number of Invalid Surfaces:	40

Error Codes:

Error Code -108 reported for 40 surfaces

Method: gle/morgenstern-price

Number of Valid Surfaces:	7396
Number of Invalid Surfaces:	40

Error Codes:

Error Code -108 reported for 40 surfaces

Error Codes

The following errors were encountered during the computation:

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 3.45154

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.03605	613.609	-31.6651	Clay	1100	0	318.698	1100	408.879	0	408.879
2	4.03605	1740.05	-28.6733	Clay	1100	0	318.698	1100	678.232	0	678.232
3	4.81109	3401.07	-25.4931	Silty Sand	0	33	79.5685	274.634	793.181	370.281	422.9
4	4.81109	4731.03	-22.1228	Silty Sand	0	33	109.604	378.303	1086.09	503.556	582.536
5	4.81109	6498	-18.8316	Silty Sand	0	33	162.078	559.418	1476.16	614.732	861.429
6	4.81109	8298.11	-15.604	Silty Sand	0	33	217.715	751.452	1863.52	706.385	1157.13
7	4.81109	9642.67	-12.4265	Silty Sand	0	33	255.374	881.433	2137.22	779.92	1357.3
8	4.81109	10330.3	-9.28752	Silty Sand	0	33	267.568	923.523	2258.18	836.081	1422.1
9	4.81109	10846.9	-6.17652	Silty Sand	0	33	275.604	951.259	2340.23	875.411	1464.82
10	4.81109	11206.2	-3.08376	Silty Sand	0	33	280.196	967.107	2387.49	898.281	1489.21
11	4.81109	11468.8	0	Silty Sand	0	33	283.896	979.878	2413.78	904.906	1508.87
12	4.81109	11607.6	3.08376	Silty Sand	0	33	285.678	986.03	2413.71	895.357	1518.35
13	4.81109	11669.3	6.17652	Silty Sand	0	33	287.451	992.149	2397.35	869.564	1527.78
14	4.81109	11954.4	9.28752	Silty Sand	0	33	300.689	1037.84	2425.44	827.311	1598.13
15	4.81109	12212.8	12.4265	Silty Sand	0	33	315.549	1089.13	2445.35	768.226	1677.12
16	4.81109	12822.8	15.604	Silty Sand	0	33	345.962	1194.1	2530.51	691.767	1838.75
17	4.81109	13347	18.8316	Silty Sand	0	33	375.406	1295.73	2592.43	597.191	1995.24
18	4.81109	13612.4	22.1228	Silty Sand	0	33	397.86	1373.23	2598.11	483.515	2114.59
19	4.81109	13553.3	25.4931	Silty Sand	0	33	411.509	1420.34	2536.59	349.458	2187.13
20	5.24073	14395.3	29.1214	Clay	1100	0	318.698	1100	2458.28	0	2458.28
21	5.24073	13091.4	33.0452	Clay	1100	0	318.698	1100	2174.87	0	2174.87
22	5.24073	10918.7	37.1536	Clay	1100	0	318.698	1100	1736.55	0	1736.55
23	4.52007	7231.5	41.1831	Lower Fill	2500	0	724.314	2500	954.35	0	954.35
24	4.52007	4876.06	45.1597	Lower Fill	2500	0	724.314	2500	385.844	0	385.844
25	5.51111	2205.78	49.9568	Upper Fill	0	25	42.5474	146.854	314.929	0	314.929

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 3.45712

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.03605	613.609	-31.6651	Clay	1100	0	318.184	1100	355.602	0	355.602
2	4.03605	1740.05	-28.6733	Clay	1100	0	318.184	1100	630.62	0	630.62
3	4.81109	3401.07	-25.4931	Silty Sand	0	33	76.7604	265.37	778.914	370.281	408.633
4	4.81109	4731.03	-22.1228	Silty Sand	0	33	108.588	375.403	1081.63	503.556	578.069
5	4.81109	6498	-18.8316	Silty Sand	0	33	163.179	564.13	1483.42	614.732	868.684
6	4.81109	8298.11	-15.604	Silty Sand	0	33	221.543	765.9	1885.77	706.385	1179.38
7	4.81109	9642.67	-12.4265	Silty Sand	0	33	261.932	905.53	2174.32	779.92	1394.4
8	4.81109	10330.3	-9.28752	Silty Sand	0	33	275.934	953.936	2305.01	836.081	1468.93
9	4.81109	10846.9	-6.17652	Silty Sand	0	33	284.38	983.137	2389.31	875.411	1513.9
10	4.81109	11206.2	-3.08376	Silty Sand	0	33	288.094	995.977	2431.95	898.281	1533.67
11	4.81109	11468.8	0	Silty Sand	0	33	289.883	1002.16	2448.09	904.906	1543.19
12	4.81109	11607.6	3.08376	Silty Sand	0	33	289.052	999.288	2434.13	895.357	1538.77
13	4.81109	11669.3	6.17652	Silty Sand	0	33	287.872	995.209	2402.06	869.564	1532.5
14	4.81109	11954.4	9.28752	Silty Sand	0	33	298.161	1030.78	2414.59	827.311	1587.28
15	4.81109	12212.8	12.4265	Silty Sand	0	33	310.391	1073.06	2420.58	768.226	1652.36
16	4.81109	12822.8	15.604	Silty Sand	0	33	338.741	1171.07	2495.06	691.767	1803.29
17	4.81109	13347	18.8316	Silty Sand	0	33	367.019	1268.83	2551.02	597.191	1953.83
18	4.81109	13612.4	22.1228	Silty Sand	0	33	389.498	1346.54	2557	483.515	2073.48
19	4.81109	13553.3	25.4931	Silty Sand	0	33	404.53	1398.51	2502.97	349.458	2153.51
20	5.24073	14395.3	29.1214	Clay	1100	0	318.184	1100	2441.83	0	2441.83
21	5.24073	13091.4	33.0452	Clay	1100	0	318.184	1100	2185.38	0	2185.38
22	5.24073	10918.7	37.1536	Clay	1100	0	318.184	1100	1773.27	0	1773.27
23	4.52007	7231.5	41.1831	Lower Fill	2500	0	723.145	2500	960.623	0	960.623
24	4.52007	4876.06	45.1597	Lower Fill	2500	0	723.145	2500	357.708	0	357.708
25	5.51111	2205.78	49.9568	Upper Fill	0	25	45.7465	158.151	339.155	0	339.155

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 3.45154

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-127.842	422.697	0.138832	0	0
2	-123.806	420.207	2304.37	243.291	6.02685
3	-119.77	418	5087.91	537.171	6.02684
4	-114.959	415.706	7290.41	769.706	6.02684
5	-110.148	413.75	9942	1049.66	6.02687
6	-105.337	412.109	13144	1387.71	6.02682
7	-100.526	410.766	16695.5	1762.67	6.02682
8	-95.7147	409.706	20190	2131.62	6.02685
9	-90.9036	408.919	23254.1	2455.13	6.02687
10	-86.0925	408.398	25798.8	2723.78	6.02683
11	-81.2814	408.139	27765.8	2931.46	6.02685
12	-76.4703	408.139	29131.9	3075.69	6.02685
13	-71.6592	408.398	29880.9	3154.77	6.02686
14	-66.8481	408.919	30015.9	3169.02	6.02685
15	-62.037	409.706	29554.5	3120.3	6.02684
16	-57.226	410.766	28480.5	3006.91	6.02684
17	-52.4149	412.109	26745.1	2823.69	6.02684
18	-47.6038	413.75	24297.9	2565.32	6.02684
19	-42.7927	415.706	21130.9	2230.96	6.02685
20	-37.9816	418	17291.9	1825.65	6.02687
21	-32.7409	420.92	11785.4	1244.28	6.02685
22	-27.5001	424.329	6041.23	637.821	6.02685
23	-22.2594	428.3	815.431	86.0916	6.02685
24	-17.7394	432.255	315.758	33.3371	6.02685
25	-13.2193	436.8	1836.42	193.885	6.02683
26	-7.70818	443.358	0	0	0

Global Minimum Query (gle/morgenstern-price) - Safety Factor: 3.45712

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	-127.842	422.697	0.138832	0	0
2	-123.806	420.207	2168.77	29.9479	0.79113
3	-119.77	418	4844.23	133.041	1.57316
4	-114.959	415.706	7000.23	303.314	2.48103
5	-110.148	413.75	9637.83	563.905	3.34853
6	-105.337	412.109	12856.5	935.499	4.16177
7	-100.526	410.766	16455.5	1413.04	4.90797
8	-95.7147	409.706	20020	1954.31	5.57543
9	-90.9036	408.919	23160.4	2497.21	6.15399
10	-86.0925	408.398	25771.8	2997.84	6.63497
11	-81.2814	408.139	27787.4	3417.4	7.01125
12	-76.4703	408.139	29181.3	3726.48	7.27734
13	-71.6592	408.398	29940.3	3904.19	7.4294
14	-66.8481	408.919	30073.9	3940.77	7.46529
15	-62.037	409.706	29607.8	3837.23	7.38449
16	-57.226	410.766	28534.2	3598.7	7.18813
17	-52.4149	412.109	26810.6	3234.48	6.87902
18	-47.6038	413.75	24389.7	2762.32	6.46165
19	-42.7927	415.706	21261.5	2212.97	5.94215
20	-37.9816	418	17464.7	1628.82	5.3282
21	-32.7409	420.92	12002.4	957.865	4.56288
22	-27.5001	424.329	6218.5	403.284	3.71057
23	-22.2594	428.3	843.006	41.0395	2.78709
24	-17.7394	432.255	310.921	10.5685	1.94679
25	-13.2193	436.8	1951.88	36.7443	1.07847
26	-7.70818	443.358	0	0	0

List Of Coordinates

Water Table

X	Y
-200	422.6
-111.6	422.8
52.7	422
100	422

Piezoline

X	Y
15.8339	439.5
100	439.5

Focus Search Line

X	Y
-13.2193	399.952
-13.2193	436.8

External Boundary

X	Y
12	441
9.3	442.1
5.3	443.1
4.8	443.1
0	443.2
-29.3	443.8
-32.8	443
-34.8	442.9
-46.9	437.6
-48.4631	436.8
-53.5431	434.2
-59.6	431.1
-66.8346	429.2
-69.5	428.5
-72.02	428.3
-82.1	427.5
-99.8	426.7
-111.6	422.8
-143	422.6
-177.9	422.6
-200	422.6
-200	418
-200	408
-200	350
100	350
100	408
100	418
100	422
100	440
14.651	440.002

Material Boundary

X	Y
-200	418
100	418

Material Boundary

X	Y
-48.4631	436.8
22.128	436.8

Material Boundary

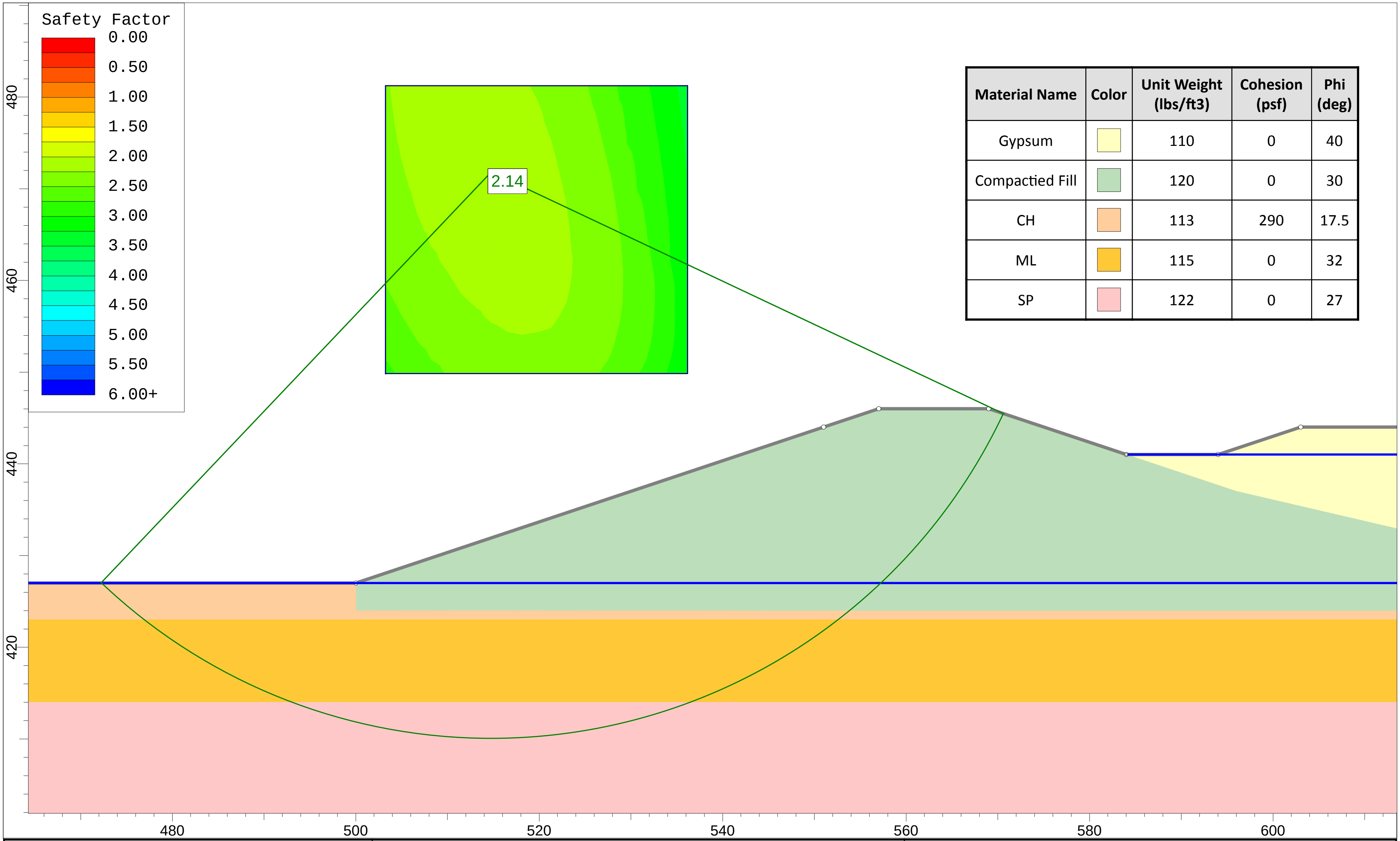
X	Y
-72.02	428.3
39.112	428.3

Material Boundary

X	Y
-200	408
100	408

Material Boundary

X	Y
14.651	440.002
22.128	436.8
39.112	428.3
52.7	422
100	422



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Gypsum	🟨	110	0	40
Compacted Fill	🟩	120	0	30
CH	🟧	113	290	17.5
ML	🟧	115	0	32
SP	🟥	122	0	27

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment

Client: Ameren - Sioux Energy Center

Section Location: Section F-F - Cell 1

Load Case: Static, Maximum Storage Pool

File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section F-F\Sec F-F - static, maximum storage pool.slim

Project Number: 2015012432

Analysis By: J. Gilliam

Checked By: J. Bertel

Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Sec F-F - static, maximum storage pool
Slide Modeler Version:	6.035
Project Title:	Periodic Safety Factor Assessment
Analysis:	Static, Maximum Storage Pool
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section F-F - Cell 1
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used	
	Spencer

Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Gypsum	Compacted Fill	CH	ML	SP
Color	🟨	🟩	🟧	🟨	🟥
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb
Unit Weight [lbs/ft3]	110	120	113	115	122
Cohesion [psf]	0	0	290	0	0
Friction Angle [deg]	40	30	17.5	32	27
Water Surface	Piezometric Line 1	Water Table	Water Table	Water Table	Water Table
Hu Value	1	1	1	1	1

Global Minimums

Method: spencer

FS	2.140620
Center:	514.747, 471.805
Radius:	61.785
Left Slip Surface Endpoint:	472.204, 427.000
Right Slip Surface Endpoint:	570.632, 445.456
Resisting Moment:	5.08259e+006 lb-ft
Driving Moment:	2.37436e+006 lb-ft
Resisting Horizontal Force:	71937 lb
Driving Horizontal Force:	33605.7 lb
Total Slice Area:	1681.96 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	879
Number of Invalid Surfaces:	3972

Error Codes:

Error Code -103 reported for 3969 surfaces
Error Code -108 reported for 3 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.14062

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.6555	1052.14	-40.6691	CH	290	17.5	187.244	400.818	476.271	124.8	351.471
2	4.01774	2478.87	-35.5322	ML	0	32	142.933	305.966	828.769	339.12	489.649
3	4.01774	3700.91	-31.067	ML	0	32	195.517	418.528	1173.95	504.16	669.787
4	4.01774	4729.04	-26.804	ML	0	32	231.979	496.579	1437.7	643.012	794.691
5	4.01774	5586.18	-22.6967	ML	0	32	256.952	550.037	1639.01	758.772	880.243
6	3.9666	6223.85	-18.7346	SP	0	27	217.006	464.527	1764.86	853.173	911.685
7	3.9666	6837.6	-14.8887	SP	0	27	230.154	492.672	1894.97	928.049	966.923
8	3.9666	7783.24	-11.1106	SP	0	27	269.594	577.098	2117.88	985.256	1132.62
9	3.9666	8725.41	-7.38103	SP	0	27	310.929	665.58	2331.87	1025.59	1306.28
10	3.9666	9540.87	-3.68283	SP	0	27	346.09	740.847	2503.58	1049.59	1453.99
11	3.9666	10232	0	SP	0	27	375.666	804.159	2635.81	1057.56	1578.25
12	3.9666	10799.6	3.68283	SP	0	27	400.087	856.435	2730.44	1049.59	1680.85
13	3.9666	11242.8	7.38103	SP	0	27	419.661	898.334	2788.68	1025.59	1763.09
14	3.9666	11559.4	11.1106	SP	0	27	434.599	930.312	2811.1	985.256	1825.84
15	3.9666	11745.1	14.8887	SP	0	27	445.034	952.648	2797.73	928.049	1869.68
16	3.9666	11793.8	18.7346	SP	0	27	451.022	965.467	2748.01	853.173	1894.84
17	4.01774	11869.5	22.6967	ML	0	32	549.425	1176.11	2640.94	758.772	1882.17
18	4.01774	11658	26.804	ML	0	32	546.856	1170.61	2516.37	643.012	1873.36
19	4.01774	11275.6	31.067	ML	0	32	538.802	1153.37	2349.94	504.16	1845.78
20	4.01774	10699.3	35.5322	ML	0	32	524.951	1123.72	2137.46	339.12	1798.34
21	1.25421	3194.43	38.5658	CH	290	17.5	403.936	864.673	2041.03	218.4	1822.63
22	4.18584	9913.12	41.9188	Compactied Fill	0	30	461.848	988.64	1782.32	69.9435	1712.37
23	4.18584	8019.75	47.3964	Compactied Fill	0	30	364.853	781.012	1352.75	0	1352.75
24	4.18584	5454.27	53.5319	Compactied Fill	0	30	230.001	492.345	852.766	0	852.766
25	4.18584	2099.3	60.7778	Compactied Fill	0	30	79.3985	169.962	294.382	0	294.382

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.14062

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	472.204	427	0	0	0
2	476.86	423	2778.33	415.996	8.51557
3	480.878	420.131	5731.54	858.177	8.51557
4	484.895	417.71	9360	1401.46	8.51556
5	488.913	415.68	13212	1978.22	8.51558
6	492.931	414	17000.4	2545.45	8.51557
7	496.897	412.655	20236.9	3030.05	8.51558
8	500.864	411.6	23149.8	3466.2	8.51559
9	504.831	410.821	25870.9	3873.62	8.51557
10	508.797	410.307	28304.6	4238.01	8.51556
11	512.764	410.052	30319	4539.63	8.51557
12	516.73	410.052	31811.7	4763.13	8.51557
13	520.697	410.307	32704.3	4896.79	8.51559
14	524.664	410.821	32939	4931.92	8.51557
15	528.63	411.6	32476.1	4862.61	8.51557
16	532.597	412.655	31294	4685.62	8.51558
17	536.563	414	29389.3	4400.43	8.51558
18	540.581	415.68	27162.8	4067.06	8.51558
19	544.599	417.71	24255.9	3631.81	8.51558
20	548.617	420.131	20736.4	3104.84	8.51558
21	552.634	423	16716.4	2502.92	8.51555
22	553.889	424	15182.8	2273.31	8.5156
23	558.074	427.758	10421.1	1560.34	8.51557
24	562.26	432.31	5793.94	867.521	8.51558
25	566.446	437.973	1928.79	288.796	8.51559
26	570.632	445.456	0	0	0

List Of Coordinates

Water Table

X	Y
0	427
1370	427

Piezoline

X	Y
584	441
1370	441

External Boundary

X	Y
603	444
594	441
584	441
569	446
557	446
551	444
500	427
0	427
0	423
0	414
0	409
0	327
1370	327
1370	414
1370	423
1370	424
1370	427
1370	444

Material Boundary

X	Y
584	441
596	437
639	427
1370	427

Material Boundary

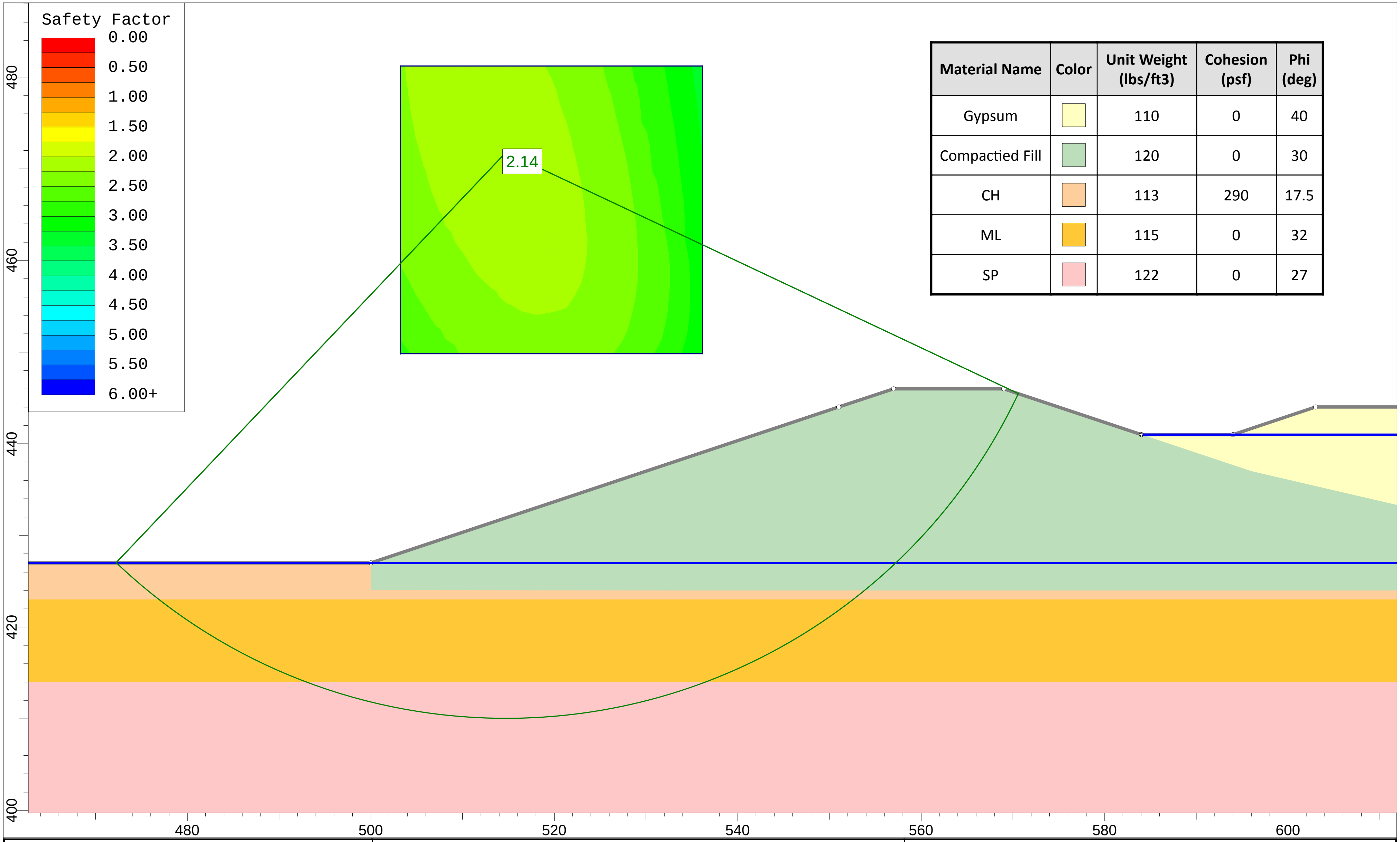
X	Y
500	427
500	424
1370	424

Material Boundary

X	Y
0	423
1370	423

Material Boundary

X	Y
0	414
1370	414



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Gypsum	🟨	110	0	40
Compacted Fill	🟩	120	0	30
CH	🟧	113	290	17.5
ML	🟧	115	0	32
SP	🟥	122	0	27

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment

Client: Ameren - Sioux Energy Center

Section Location: Section F-F - Cell 1

Load Case: Static, Maximum Surcharge Pool

File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section F-F\Sec F-F - static, maximum surcharge pool.slim

Project Number: 2015012432

Analysis By: J. Gilliam

Checked By: J. Bertel

Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Sec F-F - static, maximum surcharge pool
Slide Modeler Version:	6.038
Project Title:	Periodic Safety Factor Assessment
Analysis:	Static, Maximum Surcharge Pool
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section F-F - Cell 1
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]: 62.4
Use negative pore pressure cutoff: Yes
Maximum negative pore pressure [psf]: 0
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Invalid Surfaces
Minimum Elevation: Not Defined
Minimum Depth: Not Defined
Minimum Area: Not Defined
Minimum Weight: Not Defined

Seismic

Advanced seismic analysis: No
Staged pseudostatic analysis: No

Material Properties

Property	Gypsum	Compacted Fill	CH	ML	SP	Ponded Water
Color	🟨	🟩	🟧	🟨	🟥	🟦
Strength Type	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	Mohr-Coulomb	No strength
Unit Weight [lbs/ft3]	110	120	113	115	122	62.4
Cohesion [psf]	0	0	290	0	0	
Friction Angle [deg]	40	30	17.5	32	27	
Water Surface	Piezometric Line 1	Water Table	Water Table	Water Table	Water Table	None
Hu Value	1	1	1	1	1	
Ru Value						0

Global Minimums

Method: spencer

FS	2.143080
Center:	516.395, 470.236
Radius:	59.951
Left Slip Surface Endpoint:	474.864, 427.000
Right Slip Surface Endpoint:	570.938, 445.354
Resisting Moment:	4.90659e+006 lb-ft
Driving Moment:	2.28951e+006 lb-ft
Resisting Horizontal Force:	71505 lb
Driving Horizontal Force:	33365.6 lb
Total Slice Area:	1653 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	877
Number of Invalid Surfaces:	3974

Error Codes:

Error Code -103 reported for 3969 surfaces
Error Code -108 reported for 3 surfaces
Error Code -112 reported for 2 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-112 = The coefficient M-Alpha = cos(alpha)(1+tan(alpha)tan(phi)/F) < 0.2 for the final iteration of the safety factor calculation. This screens out some slip surfaces which may not be valid in the context of the analysis, in particular, deep seated slip surfaces with many high negative base angle slices in the passive zone.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 2.14308

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.61305	1042.55	-40.9287	CH	290	17.5	187.839	402.554	481.777	124.8	356.977
2	4.03525	2495.15	-35.6366	ML	0	32	144.539	309.758	835.573	339.857	495.716
3	4.03525	3729.24	-31.0128	ML	0	32	197.013	422.215	1181.49	505.801	675.685
4	4.03525	4761.06	-26.6053	ML	0	32	232.772	498.85	1442.87	644.548	798.326
5	4.03525	5615.22	-22.3626	ML	0	32	256.761	550.259	1640	759.404	880.599
6	3.77757	5906.38	-18.3746	SP	0	27	215.765	462.401	1757.86	850.349	907.512
7	3.77757	6690.38	-14.6064	SP	0	27	244.947	524.942	1950.47	920.212	1030.26
8	3.77757	7661.06	-10.902	SP	0	27	289.955	621.397	2193.19	973.627	1219.56
9	3.77757	8510.16	-7.24344	SP	0	27	328.146	703.244	2391.5	1011.31	1380.19
10	3.77757	9246.58	-3.61446	SP	0	27	360.636	772.871	2550.58	1033.73	1516.85
11	3.77757	9872.37	0	SP	0	27	387.949	831.406	2672.91	1041.18	1631.73
12	3.77757	10388.2	3.61446	SP	0	27	410.474	879.679	2760.19	1033.73	1726.46
13	3.77757	10793.4	7.24344	SP	0	27	428.488	918.285	2813.53	1011.31	1802.22
14	3.77757	11085.9	10.902	SP	0	27	442.184	947.636	2833.46	973.627	1859.83
15	3.77757	11262.2	14.6064	SP	0	27	451.681	967.988	2819.99	920.212	1899.78
16	3.77757	11317	18.3746	SP	0	27	457.031	979.455	2772.64	850.349	1922.29
17	4.03525	12025.4	22.3626	ML	0	32	556.442	1192.5	2667.8	759.404	1908.4
18	4.03525	11822.6	26.6053	ML	0	32	553.208	1185.57	2541.87	644.548	1897.32
19	4.03525	11442.1	31.0128	ML	0	32	544.287	1166.45	2372.52	505.801	1866.72
20	4.03525	10859.4	35.6366	ML	0	32	529.313	1134.36	2155.22	339.857	1815.36
21	1.24495	3204.37	38.7729	CH	290	17.5	405.717	869.484	2056.29	218.4	1837.89
22	4.09529	9780.48	42.1776	Compacted Fill	0	30	463.037	992.325	1790.19	71.4334	1718.76
23	4.09529	7881.05	47.73	Compacted Fill	0	30	363.979	780.036	1351.06	0	1351.06
24	4.09529	5390.52	53.9695	Compacted Fill	0	30	230.147	493.223	854.287	0	854.287
25	4.09529	2087.14	61.3883	Compacted Fill	0	30	79.4767	170.325	295.011	0	295.011

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 2.14308

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	474.864	427	0	0	0
2	479.477	423	2795.27	428.404	8.71337
3	483.512	420.107	5796.83	888.423	8.71336
4	487.548	417.681	9459.46	1449.76	8.71337
5	491.583	415.66	13316.8	2040.94	8.71338
6	495.618	414	17077.5	2617.3	8.71336
7	499.396	412.745	20099.9	3080.51	8.71335
8	503.173	411.761	22947	3516.87	8.71338
9	506.951	411.033	25640.2	3929.62	8.71336
10	510.728	410.553	28030.4	4295.94	8.71335
11	514.506	410.314	30003.9	4598.41	8.71337
12	518.283	410.314	31472.2	4823.44	8.71337
13	522.061	410.553	32367.1	4960.59	8.71337
14	525.839	411.033	32638	5002.11	8.71337
15	529.616	411.761	32250	4942.64	8.71336
16	533.394	412.745	31183.4	4779.18	8.71337
17	537.171	414	29434.2	4511.09	8.71336
18	541.206	415.66	27254.9	4177.1	8.71338
19	545.242	417.681	24354	3732.5	8.71337
20	549.277	420.107	20799.2	3187.69	8.71336
21	553.312	423	16704.5	2560.13	8.71335
22	554.557	424	15154.2	2322.54	8.71338
23	558.652	427.71	10411.7	1595.7	8.71337
24	562.748	432.216	5818.06	891.677	8.71336
25	566.843	437.846	1952.43	299.229	8.71334
26	570.938	445.354	0	0	0

List Of Coordinates

Water Table

X	Y
0	427
1370	427

Piezoline

X	Y
571.98	445.007
1370	445

External Boundary

X	Y
603.711	445.007
594.269	445.007
571.98	445.007
569	446
557	446
551	444
500	427
0	427
0	423
0	414
0	409
0	327
1370	327
1370	414
1370	423
1370	424
1370	427
1370	444
1370	445

Material Boundary

X	Y
571.98	445.007
583.952	441.016
596	437
639	427
1370	427

Material Boundary

X	Y
500	427
500	424
1370	424

Material Boundary

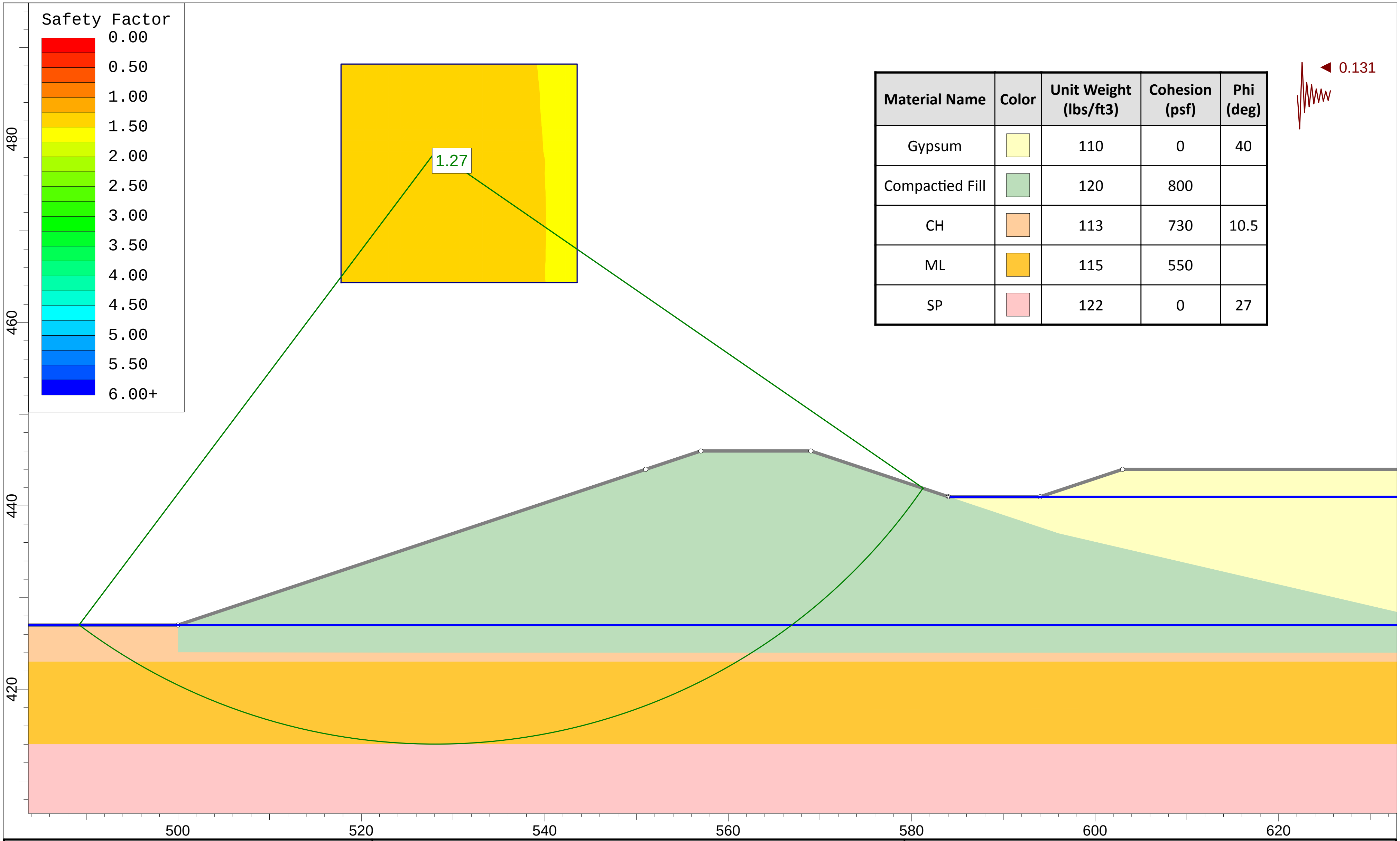
X	Y
0	423
1370	423

Material Boundary

X	Y
0	414
1370	414

Material Boundary

X	Y
583.952	441.016
594	441
603	444
1370	444



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Gypsum	🟨	110	0	40
Compactied Fill	🟩	120	800	
CH	🟧	113	730	10.5
ML	🟧	115	550	
SP	🟥	122	0	27

REITZ & JENS, INC.
CONSULTING ENGINEERS

Project Name: Periodic Safety Factor Assessment	Client: Ameren - Sioux Energy Center
Section Location: Section F-F - Cell 1	Load Case: Seismic

File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section F-F\Sec F-F - seismic.slim

Project Number: 2015012432	Analysis By: J. Gilliam	Checked By: J. Bertel	Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Sec F-F - seismic
Slide Modeler Version:	6.035
Project Title:	Periodic Safety Factor Assessment
Analysis:	Seismic
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section F-F - Cell 1
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used

Spencer

Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Loading

Seismic Load Coefficient (Horizontal):	0.131

Material Properties

Property	Gypsum	Compactied Fill	CH	ML	SP
Color	🟨	🟩	🟧	🟨	🟥
Strength Type	Mohr-Coulomb	Undrained	Mohr-Coulomb	Undrained	Mohr-Coulomb
Unit Weight [lbs/ft3]	110	120	113	115	122
Cohesion [psf]	0		730		0
Friction Angle [deg]	40		10.5		27
Cohesion Type		800		550	
Water Surface	Piezometric Line 1	None	Water Table	None	Water Table
Hu Value	1		1		1
Ru Value		0		0	

Global Minimums

Method: spencer

FS	1.273830
Center:	528.084, 478.653
Radius:	64.645
Left Slip Surface Endpoint:	489.212, 427.000
Right Slip Surface Endpoint:	581.272, 441.909
Resisting Moment:	4.34861e+006 lb-ft
Driving Moment:	3.41381e+006 lb-ft
Resisting Horizontal Force:	58088.7 lb
Driving Horizontal Force:	45601.6 lb
Total Slice Area:	1567.97 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	973
Number of Invalid Surfaces:	3878

Error Codes:

Error Code -103 reported for 3878 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.27383

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.99058	358.294	-35.3388	CH	730	10.5	682.396	869.257	817.525	66.1592	751.366
2	2.99058	1034.16	-32.1484	CH	730	10.5	690.544	879.636	998.325	190.959	807.366
3	3.86948	2218.97	-28.629	ML	550	0	431.769	550	960.643	0	960.643
4	3.86948	3320.03	-24.7858	ML	550	0	431.769	550	1208.27	0	1208.27
5	3.86948	4650.11	-21.0589	ML	550	0	431.769	550	1515.55	0	1515.55
6	3.86948	5850.72	-17.4235	ML	550	0	431.769	550	1784.01	0	1784.01
7	3.86948	6932.24	-13.8595	ML	550	0	431.769	550	2017.53	0	2017.53
8	3.86948	7900.8	-10.3496	ML	550	0	431.769	550	2218.56	0	2218.56
9	3.86948	8760.8	-6.87875	ML	550	0	431.769	550	2388.87	0	2388.87
10	3.86948	9515.23	-3.43316	ML	550	0	431.769	550	2529.75	0	2529.75
11	3.86948	10165.8	0	ML	550	0	431.769	550	2642.03	0	2642.03
12	3.86948	10713.1	3.43316	ML	550	0	431.769	550	2726.19	0	2726.19
13	3.86948	11156.5	6.87875	ML	550	0	431.769	550	2782.35	0	2782.35
14	3.86948	11494.3	10.3496	ML	550	0	431.769	550	2810.31	0	2810.31
15	3.86948	11723.6	13.8595	ML	550	0	431.769	550	2809.52	0	2809.52
16	3.86948	11839.9	17.4235	ML	550	0	431.769	550	2779.05	0	2779.05
17	3.86948	11837.1	21.0589	ML	550	0	431.769	550	2717.55	0	2717.55
18	3.86948	11706.7	24.7858	ML	550	0	431.769	550	2623.03	0	2623.03
19	3.86948	11122.6	28.629	ML	550	0	431.769	550	2420.15	0	2420.15
20	1.63616	4411.9	31.4328	CH	730	10.5	839.637	1069.56	2050.47	218.4	1832.07
21	3.73222	9283.26	34.2847	Compactied Fill	800	0	628.027	800	1888.55	0	1888.55
22	3.73222	8027.98	38.3978	Compactied Fill	800	0	628.027	800	1506.26	0	1506.26
23	3.73222	6176.74	42.762	Compactied Fill	800	0	628.027	800	986.817	0	986.817
24	3.73222	3935.78	47.4625	Compactied Fill	800	0	628.027	800	382.225	0	382.225
25	3.73222	1373.15	52.6361	Compactied Fill	800	0	628.027	800	-281.449	0	-281.449

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.27383

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	489.212	427	0	0	0
2	492.203	424.88	3727.59	642.163	9.77457
3	495.193	423	7533.83	1297.87	9.77453
4	499.063	420.888	10943.2	1885.21	9.77453
5	502.932	419.101	14338	2470.05	9.77457
6	506.802	417.611	17657.8	3041.96	9.77457
7	510.671	416.397	20728.7	3571	9.77459
8	514.541	415.442	23417.6	4034.22	9.77457
9	518.41	414.735	25621.3	4413.86	9.77458
10	522.28	414.269	27259.7	4696.1	9.77455
11	526.149	414.036	28271.3	4870.38	9.77457
12	530.019	414.036	28610.5	4928.81	9.77456
13	533.888	414.269	28245.2	4865.87	9.77454
14	537.758	414.735	27155.8	4678.2	9.77455
15	541.627	415.442	25335	4364.52	9.77454
16	545.497	416.397	22787.8	3925.72	9.77457
17	549.366	417.611	19532.9	3364.99	9.77457
18	553.236	419.101	15604.2	2688.18	9.77456
19	557.105	420.888	11054.7	1904.43	9.77459
20	560.974	423	6156.63	1060.62	9.77456
21	562.611	424	4902.12	844.502	9.77456
22	566.343	426.544	1224.8	211	9.77457
23	570.075	429.502	-1938.01	-333.866	9.77455
24	573.807	432.954	-3808.95	-656.179	9.77457
25	577.54	437.022	-3535.12	-609.004	9.77455
26	581.272	441.909	0	0	0

List Of Coordinates

Water Table

X	Y
0	427
1370	427

Piezoline

X	Y
584	441
1370	441

External Boundary

X	Y
603	444
594	441
584	441
569	446
557	446
551	444
500	427
0	427
0	423
0	414
0	409
0	327
1370	327
1370	414
1370	423
1370	424
1370	427
1370	444

Material Boundary

X	Y
584	441
596	437
639	427
1370	427

Material Boundary

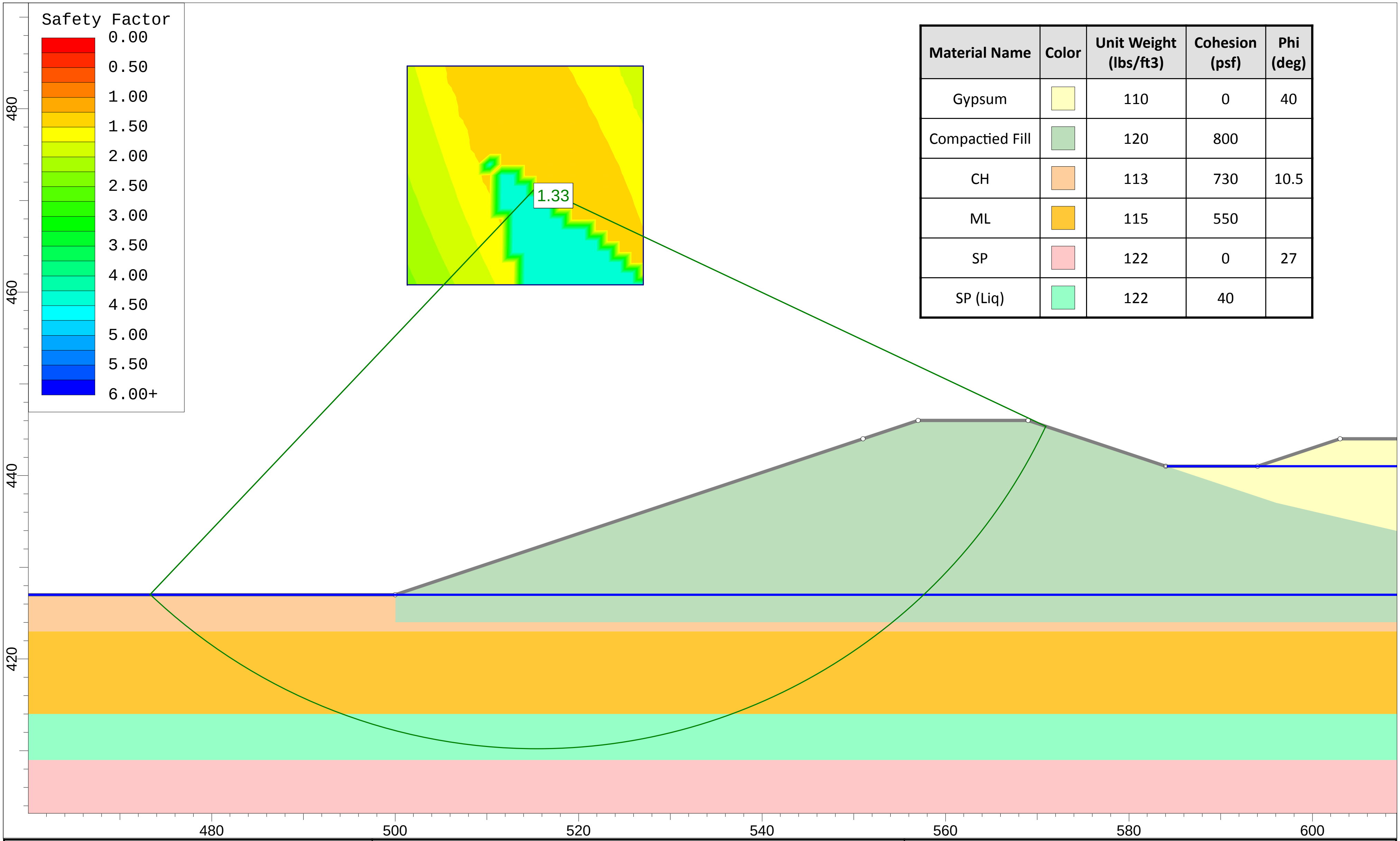
X	Y
500	427
500	424
1370	424

Material Boundary

X	Y
0	423
1370	423

Material Boundary

X	Y
0	414
1370	414



Material Name	Color	Unit Weight (lbs/ft3)	Cohesion (psf)	Phi (deg)
Gypsum	🟨	110	0	40
Compacted Fill	🟩	120	800	
CH	🟧	113	730	10.5
ML	🟧	115	550	
SP	🟥	122	0	27
SP (Liq)	🟩	122	40	

Reitz & Jens, Inc.
Consulting Engineers

Project Name: Periodic Safety Factor Assessment

Client: Ameren - Sioux Energy Center

Section Location: Section F-F - Cell 1

Load Case: Liquefaction

File Path/Name: P:\Amerenue\2015012432\Sioux\calc\Final Sections\Section F-F\Sec F-F - liquefaction.slim

Project Number: 2015012432

Analysis By: J. Gilliam

Checked By: J. Bertel

Figure:

Slide Analysis Information

Periodic Safety Factor Assessment

Project Summary

File Name:	Sec F-F - liquefaction
Slide Modeler Version:	6.035
Project Title:	Periodic Safety Factor Assessment
Analysis:	Liquefaction
Author:	J. Gilliam
Company:	Ameren - Sioux Energy Center
Comments	
	2015012432
	Section F-F - Cell 1
	J. Bertel

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Failure Direction:	Right to Left
Data Output:	Standard
Maximum Material Properties:	20
Maximum Support Properties:	20

Analysis Options

Slices Type:	Vertical

Analysis Methods Used	
	Spencer

Number of slices:	25
Tolerance:	0.005
Maximum number of iterations:	50
Check malpha < 0.2:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes

Groundwater Analysis

Groundwater Method:	Water Surfaces
Pore Fluid Unit Weight [lbs/ft3]:	62.4
Use negative pore pressure cutoff:	Yes
Maximum negative pore pressure [psf]:	0
Advanced Groundwater Method:	None

Random Numbers

Pseudo-random Seed:	10116
Random Number Generation Method:	Park and Miller v.3

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Disabled
Reverse Curvature:	Invalid Surfaces
Minimum Elevation:	Not Defined
Minimum Depth:	Not Defined
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Material Properties

Property	Gypsum	Compactied Fill	CH	ML	SP	SP (Liq)
Color	🟨	🟩	🟧	🟧	🟥	🟩
Strength Type	Mohr-Coulomb	Undrained	Mohr-Coulomb	Undrained	Mohr-Coulomb	Undrained
Unit Weight [lbs/ft3]	110	120	113	115	122	122
Cohesion [psf]	0		730		0	
Friction Angle [deg]	40		10.5		27	
Cohesion Type		800		550		40
Water Surface	Piezometric Line 1	None	Water Table	None	Water Table	None
Hu Value	1		1		1	
Ru Value		0		0		0

Global Minimums

Method: spencer

FS	**1.327050**
Center:	515.456, 471.532
Radius:	61.360
Left Slip Surface Endpoint:	473.243, 427.000
Right Slip Surface Endpoint:	570.950, 445.350
Resisting Moment:	3.12721e+006 lb-ft
Driving Moment:	2.35651e+006 lb-ft
Resisting Horizontal Force:	38087.1 lb
Driving Horizontal Force:	28700.6 lb
Total Slice Area:	1672.39 ft2

Valid / Invalid Surfaces

Method: spencer

Number of Valid Surfaces:	815
Number of Invalid Surfaces:	4036

Error Codes:

Error Code -103 reported for 3959 surfaces
Error Code -108 reported for 3 surfaces
Error Code -111 reported for 74 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).
-111 = safety factor equation did not converge

Slice Data

Global Minimum Query (spencer) - Safety Factor: 1.32705

Slice Number	Width [ft]	Weight [lbs]	Angle of Slice Base [degrees]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	4.66727	1054.8	-40.5976	CH	730	10.5	623.35	827.216	649.332	124.8	524.532
2	4.0531	2503.4	-35.4044	ML	550	0	414.453	550	818.538	0	818.538
3	4.0531	3739.6	-30.8768	ML	550	0	414.453	550	1071.22	0	1071.22
4	4.0531	4776.5	-26.5555	ML	550	0	414.453	550	1286.14	0	1286.14
5	4.0531	5637.78	-22.3924	ML	550	0	414.453	550	1465.9	0	1465.9
6	3.87884	6073.77	-18.4361	SP (Liq)	40	0	30.142	40	1525.2	0	1525.2
7	3.87884	6729.87	-14.6546	SP (Liq)	40	0	30.142	40	1698.24	0	1698.24
8	3.87884	7711.1	-10.9377	SP (Liq)	40	0	30.142	40	1955.39	0	1955.39
9	3.87884	8607.3	-7.26695	SP (Liq)	40	0	30.142	40	2193.7	0	2193.7
10	3.87884	9384.31	-3.62614	SP (Liq)	40	0	30.142	40	2404.09	0	2404.09
11	3.87884	10044.3	0	SP (Liq)	40	0	30.142	40	2586.68	0	2586.68
12	3.87884	10587.9	3.62614	SP (Liq)	40	0	30.142	40	2741.28	0	2741.28
13	3.87884	11014.6	7.26695	SP (Liq)	40	0	30.142	40	2867.42	0	2867.42
14	3.87884	11322	10.9377	SP (Liq)	40	0	30.142	40	2964.21	0	2964.21
15	3.87884	11506.4	14.6546	SP (Liq)	40	0	30.142	40	3030.38	0	3030.38
16	3.87884	11562.3	18.4361	SP (Liq)	40	0	30.142	40	3064.19	0	3064.19
17	4.0531	12015.9	22.3924	ML	550	0	414.453	550	2865.92	0	2865.92
18	4.0531	11811.7	26.5555	ML	550	0	414.453	550	2799.72	0	2799.72
19	4.0531	11431.9	30.8768	ML	550	0	414.453	550	2684.72	0	2684.72
20	4.0531	10852.8	35.4044	ML	550	0	414.453	550	2511.99	0	2511.99
21	1.25821	3223.2	38.477	CH	730	10.5	799.03	1060.35	2000.83	218.4	1782.43
22	4.17243	9929.71	41.8432	Compactied Fill	800	0	602.841	800	1947.1	0	1947.1
23	4.17243	8011.17	47.3346	Compactied Fill	800	0	602.841	800	1346.32	0	1346.32
24	4.17243	5466.93	53.4858	Compactied Fill	800	0	602.841	800	502.744	0	502.744
25	4.17243	2114.69	60.7517	Compactied Fill	800	0	602.841	800	-753.244	0	-753.244

Interslice Data

Global Minimum Query (spencer) - Safety Factor: 1.32705

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	473.243	427	0	0	0
2	477.91	423	5508.13	-518.762	-5.38031
3	481.963	420.119	9546.89	-899.136	-5.38031
4	486.016	417.696	13823.7	-1301.93	-5.3803
5	490.069	415.67	18109.7	-1705.59	-5.3803
6	494.122	414	22238.3	-2094.43	-5.38032
7	498.001	412.707	24327.4	-2291.18	-5.38031
8	501.88	411.693	26166.9	-2464.43	-5.38031
9	505.759	410.943	27749.6	-2613.49	-5.38031
10	509.638	410.448	28951.6	-2726.7	-5.38032
11	513.516	410.203	29659.6	-2793.37	-5.3803
12	517.395	410.203	29776.5	-2804.39	-5.38032
13	521.274	410.448	29219.7	-2751.94	-5.3803
14	525.153	410.943	27918.4	-2629.38	-5.3803
15	529.032	411.693	25813.4	-2431.14	-5.38032
16	532.911	412.707	22856.7	-2152.67	-5.38031
17	536.789	414	19011.6	-1790.53	-5.3803
18	540.843	415.67	15906.3	-1498.07	-5.3803
19	544.896	417.696	11915.6	-1122.22	-5.38029
20	548.949	420.119	7089.86	-667.73	-5.3803
21	553.002	423	1533.83	-144.457	-5.38028
22	554.26	424	538.852	-50.7497	-5.38031
23	558.432	427.736	-4219.41	397.388	-5.3803
24	562.605	432.263	-7797.75	734.4	-5.3803
25	566.777	437.899	-8114.54	764.235	-5.3803
26	570.95	445.35	0	0	0

List Of Coordinates

Water Table

X	Y
0	427
1370	427

Piezoline

X	Y
584	441
1370	441

External Boundary

X	Y
603	444
594	441
584	441
569	446
557	446
551	444
500	427
0	427
0	423
0	414
0	409
0	327
1370	327
1370	414
1370	423
1370	424
1370	427
1370	444

Material Boundary

X	Y
584	441
596	437
639	427
1370	427

Material Boundary

X	Y
500	427
500	424
1370	424

Material Boundary

X	Y
0	423
1370	423

Material Boundary

X	Y
0	414
666	414
1370	414

Material Boundary

X	Y
0	409
666	409
666	414

APPENDIX II

SCPA AND SCPB CLOSURE
SLOPE STABILITY ANALYSES REPORTS

SUBJECT:	Sioux Energy Center - CCR Pond Closures		
Job No.:	154-7197-01	**Prepared:**	MSG
Location:	St. Charles County, MO	**Checked:**	PJJ/AGC
Date:	Jan-02-2018	**Reviewed:**	KMB

Slope Stability Analyses for the Closure of SCPA

Objective:

Evaluate the static and pseudo-static stability of the earth impoundments and critical cross-sections within the closure system at the Ameren-Missouri Sioux Energy Center for SCPA (Bottom Ash Pond) for the CCR pond closure design.

References:

Reference No.	Source of Information
1	EPA. - Coal Combustion Waste Impoundment Round 7 - Dam Assessment Report - Sioux Power Station - Ameren Missouri - Final
2	Golder Associates Inc. (Golder) - 2015 Ameren Groundwater Monitoring Program - MO - Well Installation Borings
3	PDF format As-Built provided by Ameren (SX-DWG-PROP-000001) dated 06-14-2011
4	PDF format As-Built provided by Ameren (8430- X-128772) dated 03-30-1993
5	Golder Associates Inc. (Golder) - Previous experience with CCR
6	PDF Format - As-Built provided by Ameren (SX-8420-X-182002) dated 01-04-2013
7	PDF Format - Utility Waste Landfill - Proposed Construction Permit Modification - Construction Permit # 0918301 (SX-2014-PMT-001 Rev. 000) Dated August 2014, Reitz & Jens
8	PDF Format - Physical Engineering Properties of CCP (#2008012455) dated 01-24-2011, Reitz & Jens
9	PDF Format - Cell 4A CQA Summary Report for Phase 3 (#2009012470) dated 05-24-2014, Reitz & Jens
10	PDF Format - EPRI Field Evaluation/Comanagement Document (TR-108409) dated 09-1998
11	PDF Format - Wet FGD Retrofit (#2006012481) dated 05-31-2006, Reitz & Jens
12	PDF Format - Proposed Material Handling Facility dated 09-05-2000, URS
13	PDF Format - Ameren DSI Final - Detailed Geologic and Hydrologic Site Investigation Report dated 08-2006, GREDELL Engineering Resources, Inc.
14	Golder Associates Inc. (Golder) - Field and Laboratory Investigation Data (2016)
15	PDF Format - Test Boring Report, Raymond Concrete Pile Company, dated 1963
16	Abramson, L.W. et al; "Slope Stability and Stabilization Methods"; 2nd Edition; Wiley; 2002
17	Hynes-Griffin, M.E. and Franklin, A.G. (1984), "Rationalizing the Seismic Coefficient Method, " Miscellaneous Paper GL-84-13, U.S. Army Engineer Waterways Experiment Station, Vicksbug, Mississippi, 34p.
18	Rocscience (2016), SLIDE Version 7.021 64-bit
19	United States Geological Society (USGS) online hazard mapping website (http://earthquake.usgs.gov/research/hazmaps/design/).
20	Golder Associates Inc. (Golder) - Basis of Design - Fly Ash Pond Modification (2016)
21	Golder Associates Inc. (Golder) - Basis of Design - CCR Pond Closures (2018)
22	Boulanger & Idriss (2004); Evaluating the Potential for Liquefaction or Cyclic Failure of Silts and Clays
23	Boulanger & Idriss (2005); Evaluating Cyclic Failure in Silts and Clays
24	Boulanger & Idriss (2007); Evaluation of Cyclic Softening in Silts and Clays
25	Olson, SM; Stark, TD (2002); Liquefied Strength Ratio from Liquefaction Flow Failure Case Histories
26	Wright, SG; Zornberg, JG; Aguettant, JE (2007); The Fully Softened Shear Strength of High Plasticity Clays

Analysis Sections:

Analyses performed included the loading conditions based on the 40 CFR Parts 257 & 261 (EPA Final CCR Rule) and included: (1) Long-Term Steady State Static (Maximum Storage Pool), (2) Steady State with Surcharges Static (Maximum Surcharge Pool), (3) Seismic (Pseudo-static), and (4) Post-Liquefaction. Undrained (End-of-Construction) conditions were not considered for the berm slopes due to no new construction for closure.

Notes for the loading conditions:
(1) Long-Term Steady State Static conditions considered the maximum pool height experienced and expected in the ash pond prior to closure. Water levels in the pond are artificially elevated due to plant discharges and will recede when pond operations cease.
(2) Steady State with Surcharges looks at conditions with a uniform 300 lbs/ft^2 surcharge representing equipment and other construction operations during closure on top of the berm and closure cap.
(3) For Pseudo-static Limit Equilibrium method, see next section of report.
(4) Post-liquefaction conditions assessed the closure system with the expectations that the ash would liquefy and the shear strength reduction of the materials within the berm. Cohesive materials were reduced to residual strength conditions (a conservative approach; conceptualized by Boulanger & Idriss 2004, 2005, 2007) and non-cohesive contractive materials were reduced to cyclic softened conditions, if applicable (per Olson and Stark (2002). Estimation of the residual strength for cohesive materials used an empirical method developed by Wright et al (2007) based on liquid limit, confining stresses, and effective friction angles from the field investigations and laboratory testing results. Subsequent sections below (Liquefied Shear Strength of Non-Cohesive Materials and Liquefied Shear Strength of Cohesive Materials) show the values used for the cohesive and non-cohesive materials, respectively. The sand/silt fill layers in the top portion of the berms were not evaluated due to the material being unsaturated (above the expected piezometric line) and state of practice considers unsaturated material to have a very low potential for liquefaction during a seismic event.

Analysis Methods:

Slope stability was evaluated using the computer program SLIDE Version 7.030 64-bit (Rocscience, 2017) using the generalized limit equilibrium method of stability analysis developed by Morgenstern and Price (Abramson et al., 2002). Circular and block search patterns were used to find the failure surface, which resulted in a minimum calculated factor of safety for the preliminary desktop review. Static and pseudo-static methods were performed during the analyses.

Pseudo-static limit equilibrium analyses were conducted to evaluate the stability of the proposed slope under seismic loads for earthquake hazards. Pseudo-static stability analyses apply a constant horizontal force to the system to represent the forces generated during an earthquake event, with the magnitude of the applied force typically related to the peak ground acceleration (PGA) of a specific earthquake hazard risk. A pseudo-static limit equilibrium analysis was conducted to evaluate the stability of the containment berms under a seismic load for the earthquake hazard representing a 2% probability of exceedance in 50 years (equaling 0.187g; i.e. a return period of 2475 years) based on the United States Geological Survey (USGS) Hazard Maps. The seismic hazard as determined from the USGS 2014 Hazard Maps and Data for 2% probability of exceedance in 50 years is presented in Figure 1A. Figure 1B shows the USGS 2008 Deggregation plot for reference. As recommended by Hynes-Griffin and Franklin (1984), a horizontal force of 1/2 of the maximum PGA (EPA 1995) was used in this analysis (0.094g). In addition, the shear strength properties of the ash were reduced by 20% per the method's requirements.

Material Properties:

The material properties outlined in the Basis of Design were used in the this stability analysis. For the Basis of Design material properties, the values were obtained by considering a combination of the following: a) Laboratory soil tests by Golder Associates Inc. (Golder) from samples obtained in March/April 2016, b) Standard Penetration (SPT) testing performed by Golder in March/April 2016, c) Golder's May 23, 2018 Basis of Design, d) EPA Final Closure Report (2011), e) Laboratory soil tests reported by URS, f) Original Plant Construction Borings (Raymond,1963), g) Reitz & Jens Geotechnical Reports, h) published typical values for the observed soil and rock types, i) published engineering correlations between in-situ data and characteristic soil and rock properties, and j) Golder's professional experience. Table 1 summarizes the soil/material parameters used for the stability analyses.

Table 1. Golder's Basis of Design Soil / Material Parameters

Material	Shear Strength				In-situ Unit Weight (lb/ft^3)	Source (Resources)
	Effective Friction Angle (degrees)	Effective Cohesion (lb/ft^2)	Total Friction Angle (degrees)	Total Cohesion (lb/ft^2)		
Ash	24	10	12	400	100	(1), (5), (8), (10), (20)
Clay (CL) Fill	22	350	0	600	115	(9), (11), (12), (14), (15), (21)
Silt (MH) Fill	27	250	0	600	105	(9), (11), (12), (14), (15), (21)
Sand (SP) Fill	31	0	28	0	110	(9), (11), (12), (14), (15), (21)
Clay (CH) Alluvium	24	350	0	500	115	(9), (11), (12), (14), (15), (21)
Silt (MH) Alluvium	27	250	0	600	105	(9), (11), (12), (14), (15), (21)
Sand (SP) Alluvium	34	0	30	0	120	(9), (11), (12), (14), (15), (21)

Note: Sands contain minor amounts of cohesive materials

Liquefied Shear Strength of Non-Cohesive Materials:

Post-liquefaction analysis and liquefied shear strength for non-cohesive materials was evaluated by reviewing SPT blow counts and using the empirical method outlined by Olson & Stark (2002) for SPT N values. The equation below was used to evaluate the liquefaction potential of the saturated sands and contained ash within the SCPA boundaries. Ash within the containment berms is potentially liquefiable. A vertical stress ratio of 0.08 has been established for ash based on Golder's experience and was applied to the model for analysis for post-liquefcation conditions. Olson & Stack provide the SPT blow count range of 15 to 20 as the transition between contractive (liquefiable) sands and dilatative (non-liquefiable) sands. Alluvial sands in the area appear to be dilative in nature due to an average blow count of 21 and therefore considered non-liquefiable.

Olson & Stark (2002) Equation

$$[19b] \qquad \frac{s_u(\mathrm{LIQ})}{\sigma'_{vo}} = 0.03 + 0.0075[(N_1)_{60}] \pm 0.03$$

$$\text{for } (N_1) \lesssim 12$$

where:

s_u = liquefied undrained stear strength
$(N_1)_{60}$ = corrected SPT blow counts
σ'_{vo} = effective overburden pressure
s_u / σ'vo = vertical stress ratio

Liquefied Shear Strength of Cohesive Materials:

Post-liquefaction analysis and liquefied shear strength for cohesive materials was evaluated using the empirical method outlined by Wright et al (2007) for liquid limit (LL) values. Cohesive materials that may experience seismic strength reduction exist between EL 442 and EL 390. The materials at this elevation range are a low plasticity clay Clay (CL) Fill RES and a high plasticity Clay (CH) Alluvium RES. Analysis used the liquid limits of these materials, confining stresses at the top and bottom depths of each material layer, and applied the values in the method's equation to determine the estimated reduced shear strength.

Wright et al (2007) Equation

$$\varphi_{secant,r} = 52.5^\circ - 21.3^\circ \log_{10}(\omega_{LL}) - 3^\circ \log_{10}\left(\frac{\sigma'_f}{p_a}\right) \qquad (8.1)$$

where:

ϕ'_{secant} = secant friction angle
ω_{LL} = liquid limit (Atterberg limits)
σ'_f = effective overburden pressure
p_a = atmospheric pressure

Investigation Data

		PL	**LL**
B-17-01			
	CL	20	33
	CH	23	36
B-17-07			
	CH	56	92
B-17-11			
	CL	18	24
	CH	21	29
	MH	15	22
B-17-12			
	CH	13	38
B-17-13			
	CL	17	45
	CH	17	58
	MH	14	32
B-17-15			
	CH	15	53
B-17-16			
	CL	16	39
	CH	19	61

Liquid Limits (from Golder Borings)

	CL	**CH**	**MH**
	33	36	22
	24	92	32
	29	38	
	45	58	
	39	53	
		61	
Geomean	33.20	52.18	26.53
Average	34	55.4	27

Note: The soil designation is based on Table 1 and not the classification from the laboratory data. The classification parameter was used to identify the associated soil laver in the model.

For MH soil 1			**For CL soil 2**			**For CH soil 3**		
σ_f =	1365	psf	σ_f =	2975	psf	σ_f =	3550	psf
p_a =	2116	psf	p_a =	2116	psf	p_a =	2116	psf
ω_{LL} =	26.53		ω_{LL} =	33.20		ω_{LL} =	52.18	
ϕ'_{secant} =	23		ϕ'_{secant} =		20	ϕ'_{secant} =		15

Note: Overburden pressure calculated at the bottom of each material layer.

Table 2. Post-Liquefaction Strength Values for Cohesive Materials

Material	Liquefied Shear Strength	
	Friction Angle	Cohesion
	(deg)	(psf)
Clay (CL) Fill RES	20	200
Clay (CH) Alluvium RES	15	200

Summary of Stability Analyses Results:

Tables 3, 4, 5 6, and 7 summarize the minimum required safety factors for the five analyzed cross-sections using Basis of Design material properties. The tables list the minimum factor of safety for each slope and the factor of safety for a failure. For additional information, see the attached stability figures presented for each analysis case. Note that Cross-Sections A-A', B-B', and C-C' are cross-sections that include the containment berm and consider global stability of the pond closure system. Cross-Section D-D' is considered the critical cross-section of the stacked ash and analyzes the stability of the contained ash inside of the containment berms. Cross-Section E-E' is considered the critical cross-section for the proposed Low Volume Waste (LVW) water treatment facility located within the SCPA closure boundaries as part of the Phase 1 construction. Note that the water contained in the LVW will have a greater unit weight than clean water (assumed to be 70 pcf for these analyses).

Table 3. Calculated factors of safety - Slope Cross-Section A-A'

Slope Stability Case	Minimum Acceptable Factor of Safety	Calculated Factor of Safety		Evaluation	Figure(s)
		Circular	Non-Circular		
Long-Term Steady State	1.50	2.71	2.39	Satisfactory	3,4
Steady State with Surcharges	1.40	2.28	1.98	Satisfactory	5,6
Pseudo-Static Seismic	1.00	1.53	1.46	Satisfactory	7,8
Post-Liquefaction Conditions	1.20	2.73	2.39	Satisfactory	9,10

Table 4. Calculated factors of safety - Slope Cross-Section B-B'

Slope Stability Case	Minimum Acceptable Factor of Safety	Calculated Factor of Safety		Evaluation	Figure(s)
		Circular	Non-Circular		
Long-Term Steady State	1.50	2.51	2.46	Satisfactory	11,12
Steady State with Surcharges	1.40	2.32	2.28	Satisfactory	13,14
Pseudo-Static Seismic	1.00	1.53	1.57	Satisfactory	15,16
Post-Liquefaction Conditions	1.20	1.91	1.88	Satisfactory	17,18

Table 5. Calculated factors of safety - Slope Cross-Section C-C'

Slope Stability Case	Minimum Acceptable Factor of Safety	Calculated Factor of Safety		Evaluation	Figure(s)
		Circular	Non-Circular		
Long-Term Steady State	1.50	1.82	1.72	Satisfactory	19,20
Steady State with Surcharges	1.40	1.78	1.67	Satisfactory	21,22
Pseudo-Static Seismic	1.00	1.20	1.12	Satisfactory	23,24
Post-Liquefaction Conditions	1.20	1.52	1.47	Satisfactory	25,26

Table 6. Calculated factors of safety - Slope Cross-Section D-D'

Slope Stability Case	Minimum Acceptable Factor of Safety	Calculated Factor of Safety		Evaluation	Figure(s)
		Circular	Non-Circular		
Long-Term Steady State	1.50	2.96	2.87	Satisfactory	27,28
Steady State with Surcharges	1.40	2.79	2.64	Satisfactory	29,30
Pseudo-Static Seismic	1.00	1.55	1.50	Satisfactory	31,32
Post-Liquefaction Conditions	1.20	2.96	2.87	Satisfactory	33,34

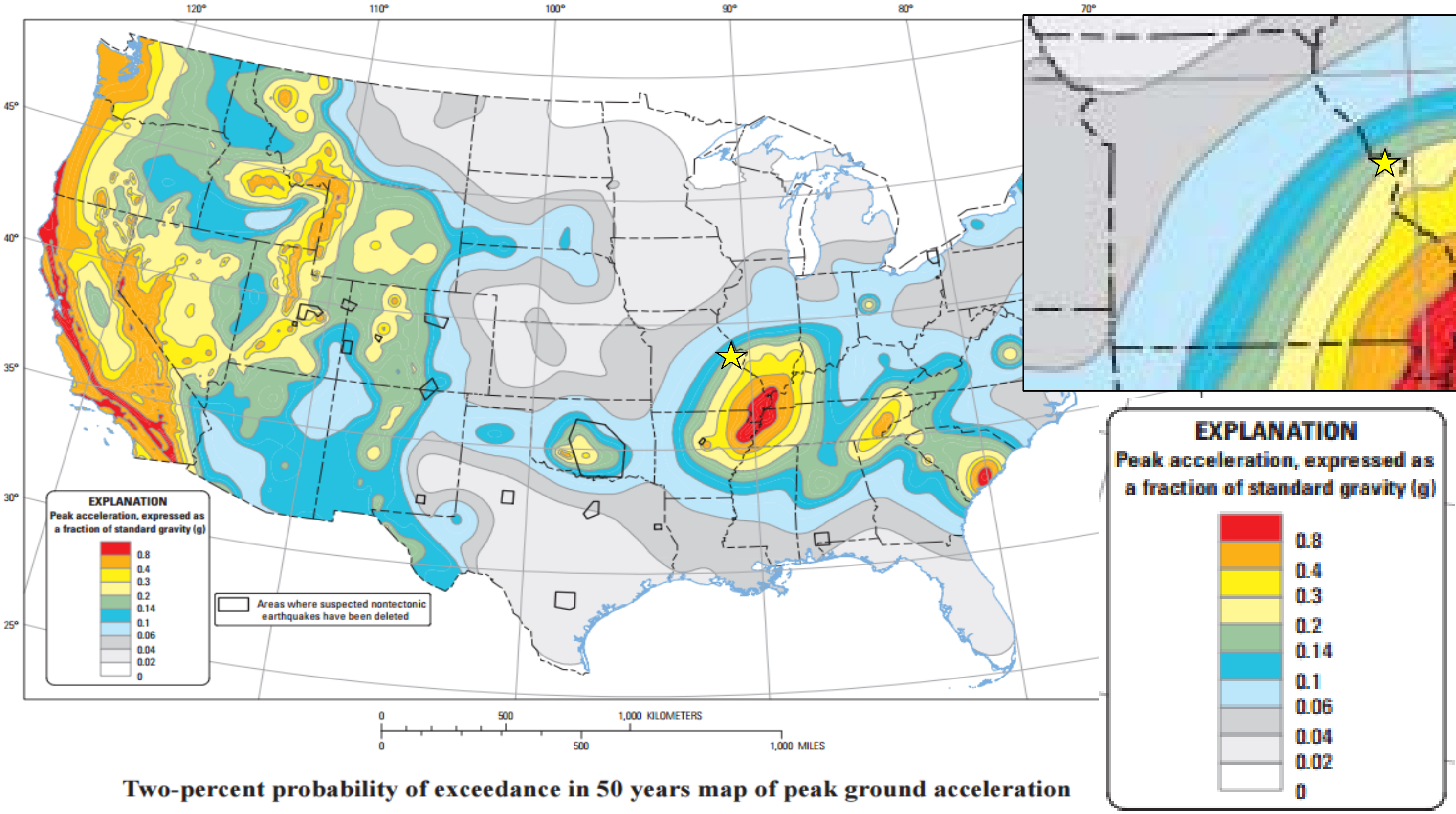
Table 7. Calculated factors of safety - Slope Cross-Section E-E'

Slope Stability Case	Minimum Acceptable Factor of Safety	Calculated Factor of Safety		Evaluation	Figure(s)
		Circular	Non-Circular		
Long-Term Steady State	1.50	1.83	1.79	Satisfactory	35,36
Steady State with Surcharges	1.40	1.74	1.73	Satisfactory	37,38
Pseudo-Static Seismic	1.00	1.12	1.41	Satisfactory	39,40
Post-Liquefaction Conditions	1.20	1.32	1.25	Satisfactory	41,42

Discussion:

The results indicate that the slopes along SCPA and within the proposed closure plan do meet the minimum requirements set forth by MDNR and the EPA CCR Final Rule for Long-Term Steady State, Steady State with Surcharges, Pseudo-Static Seismic, and Post-Liquefaction. This conclusion includes cross-sections A-A', B-B', C-C', D-D', and E-E'.

Horizontal Ground
Acceleration for
Analysis = (1/2)*0.187g
= 0.094 (per Hynes-Griffin
& Franklin (1984)



Two-percent probability of exceedance in 50 years map of peak ground acceleration

Golder Associates
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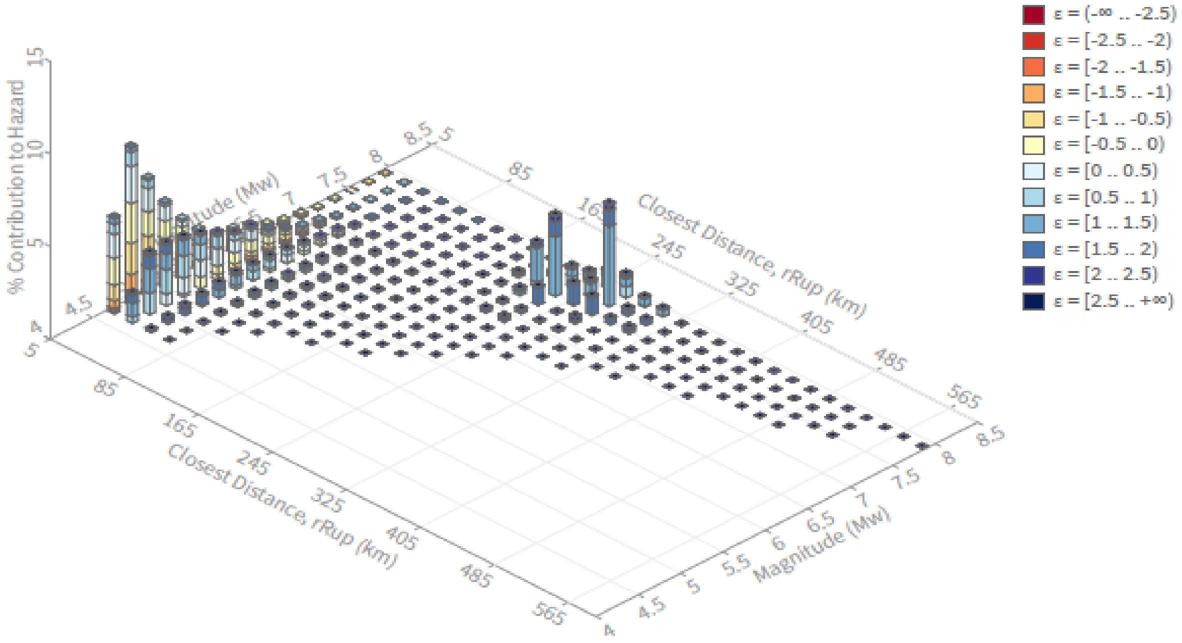
SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Slope USGS Peak Horizontal Ground Acceleration Hazard Assessment (2% in 50 Year Event) (2014)**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**1A**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Horizontal Ground
Acceleration for
Analysis = (1/2)*0.187g
= 0.094 (per Hynes-Griffin &
Franklin (1984)



Golder Associates
Golder Associates Inc.

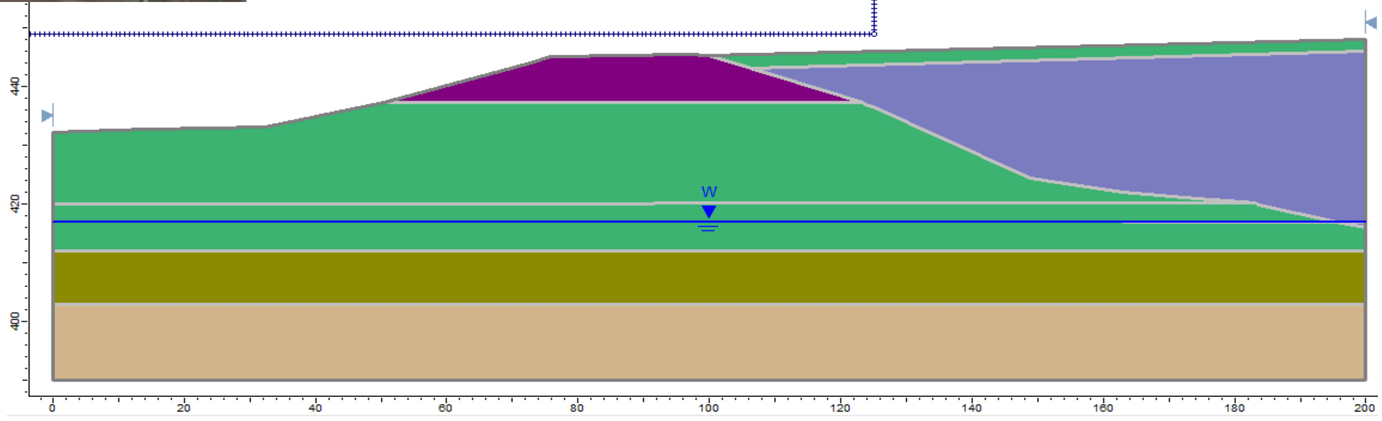
SCALE	AS SHOWN	PROJECT	Sioux Energy Center - CCR Pond Closures - SCPA		
DATE	Jan 2018	TITLE	Slope USGS PSH Deaggregation Plot (2% in 50 Year Event) (2014)		
MADE BY	MSG				
CAD	-				
CHECK	PJJ/AGC	CLIENT	Ameren - Missouri	FIGURE	1B
REVIEW	KMB				

FILE STABILITY

PROJECT No. 154-7197-01 REV. 0

Cross-Section A-A' Profile
Looking West

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟦	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31



Golder Associates
Golder Associates Inc.

FILE	STABILITY		
PROJECT No.	154-7197-01	REV.	0

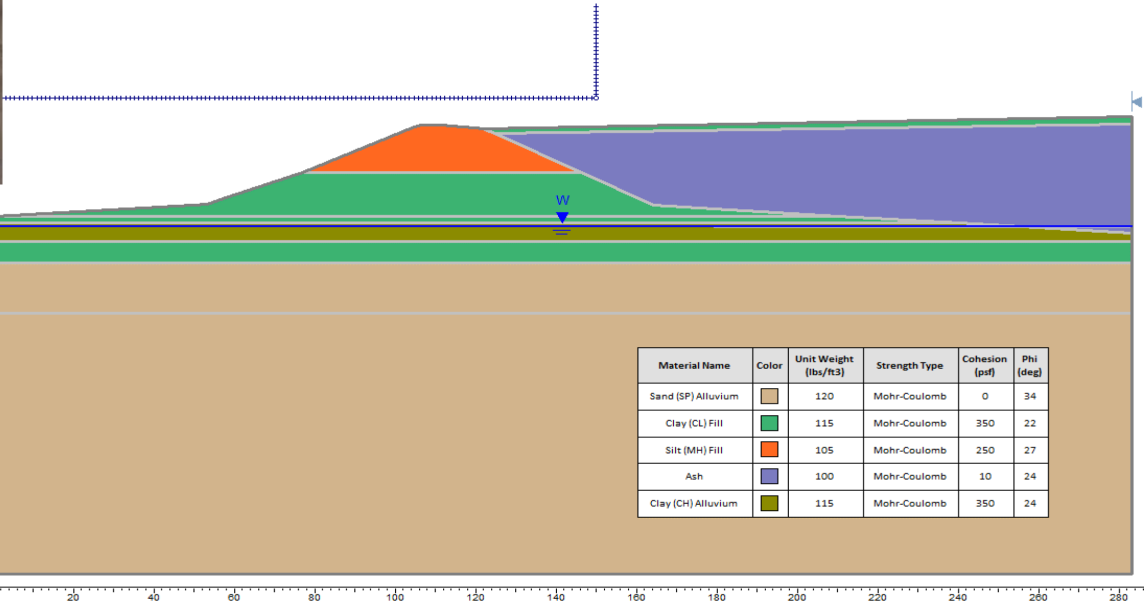
SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **SCPA Cross-Section A-A'**

CLIENT **Ameren - Missouri**

FIGURE **2A**


Cross-Section B-B' Profile
Looking Northwest

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟩	115	Mohr-Coulomb	350	24

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

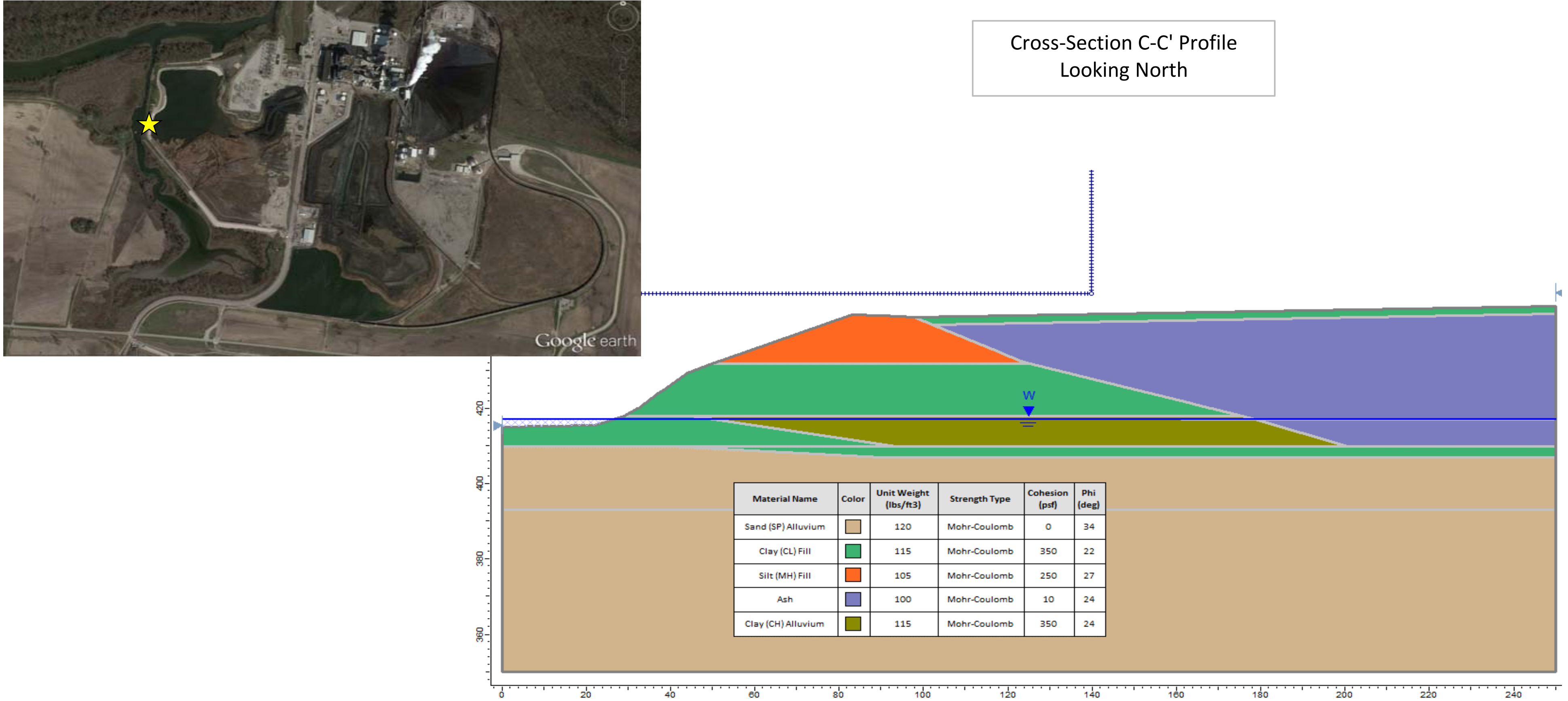
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **SCPA Cross-Section B-B'**

CLIENT **Ameren - Missouri**

FIGURE **2B**

Cross-Section C-C' Profile
Looking North



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB
FILE	STABILITY
PROJECT No.	154-7197-01
REV.	0

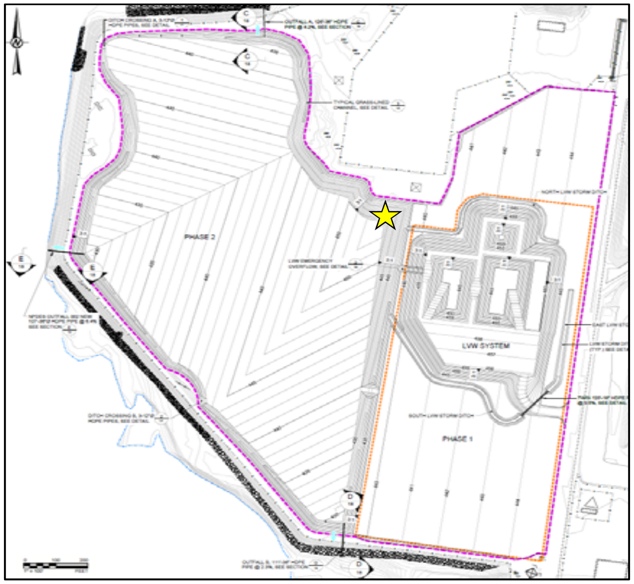
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE

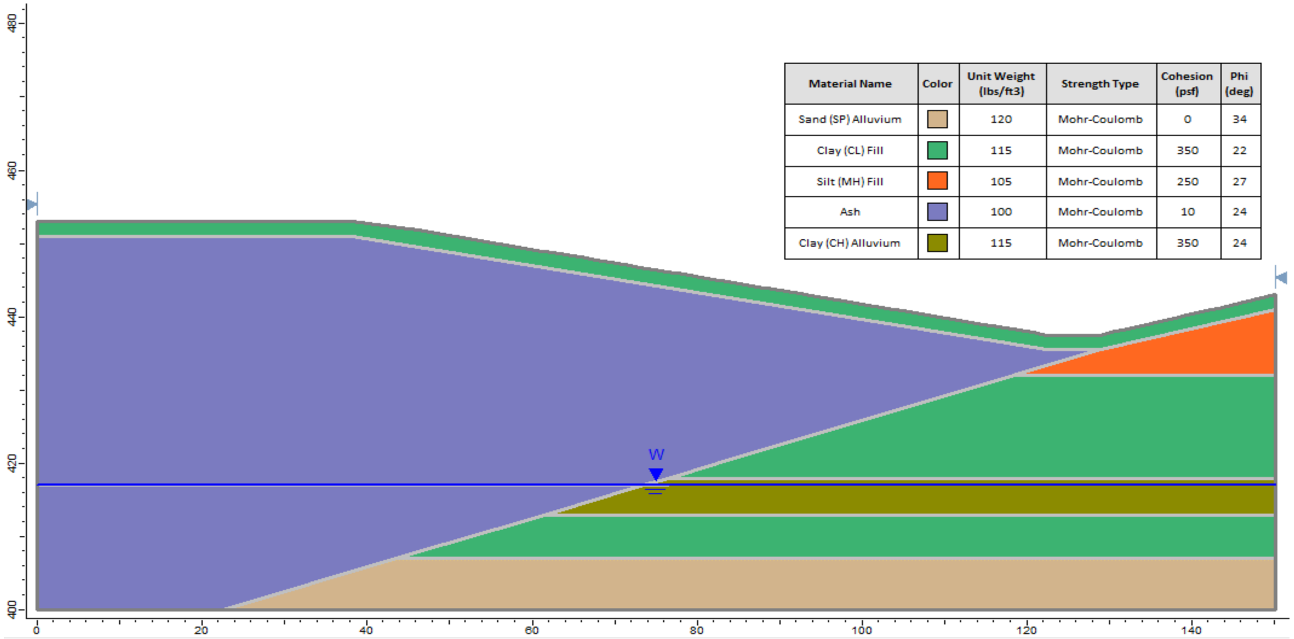
SCPA Cross-Section C-C'

CLIENT **Ameren - Missouri**

FIGURE **2C**



Cross-Section D-D' Profile
Looking West



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24

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Golder Associates Inc.

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB

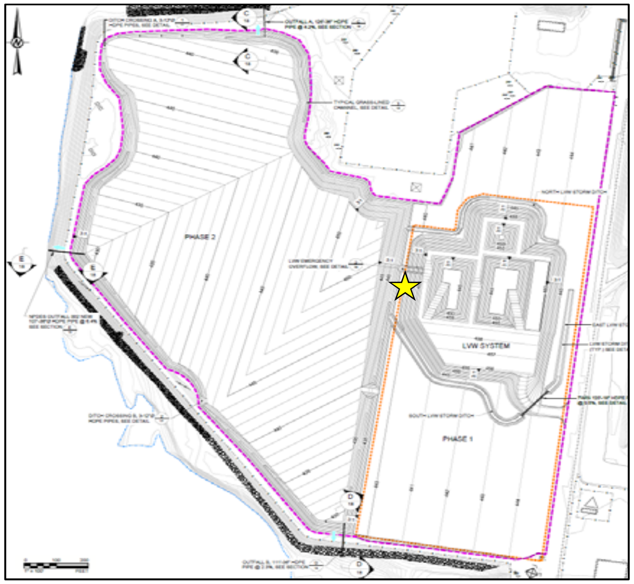
FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

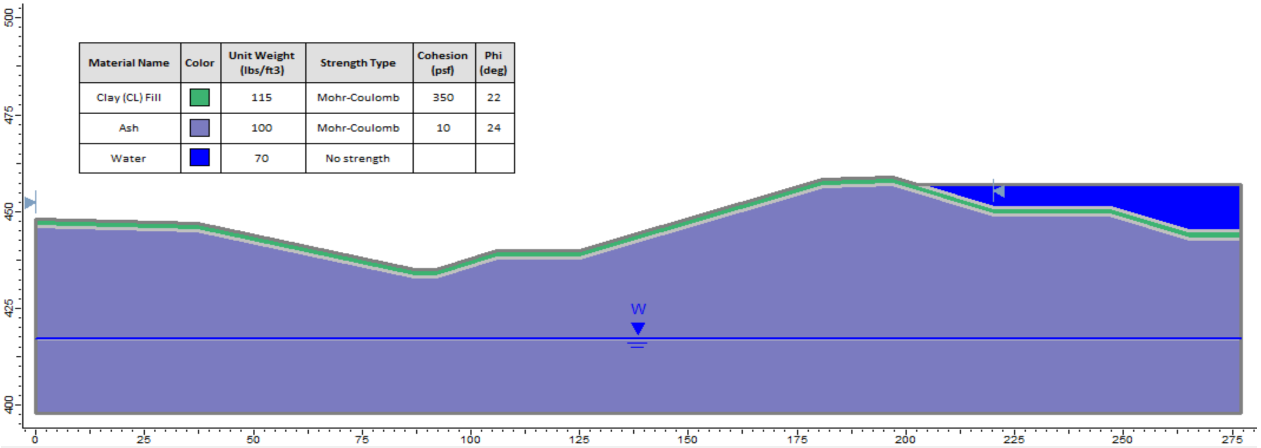
TITLE **SCPA Cross-Section D-D'**

CLIENT **Ameren - Missouri**

FIGURE **2D**



Cross-Section E-E' Profile
Looking North



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟪	100	Mohr-Coulomb	10	24
Water	🟦	70	No strength		

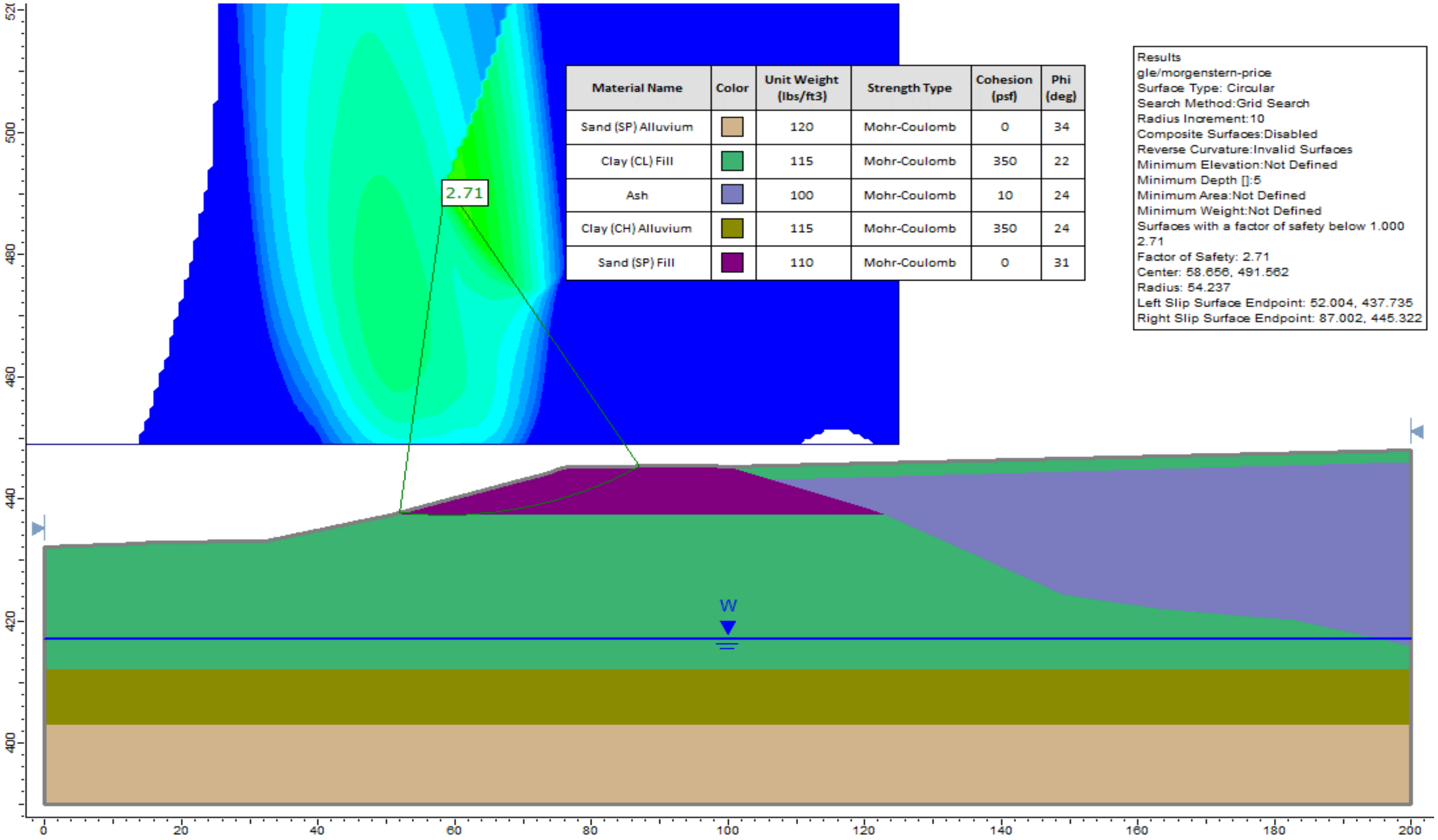
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	Sioux Energy Center - CCR Pond Closures - SCPA
DATE	Jan 2018	TITLE	SCPA Cross-Section E-E'
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	Ameren - Missouri
REVIEW	KMB	FIGURE	2E

FILE STABILITY

PROJECT No. 154-7197-01 REV. 0

Minimum
FS = 2.71



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟦	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31

```
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
2.71
Factor of Safety: 2.71
Center: 58.656, 491.562
Radius: 54.237
Left Slip Surface Endpoint: 52.004, 437.735
Right Slip Surface Endpoint: 87.002, 445.322
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Golder Associates
Golder Associates Inc.

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

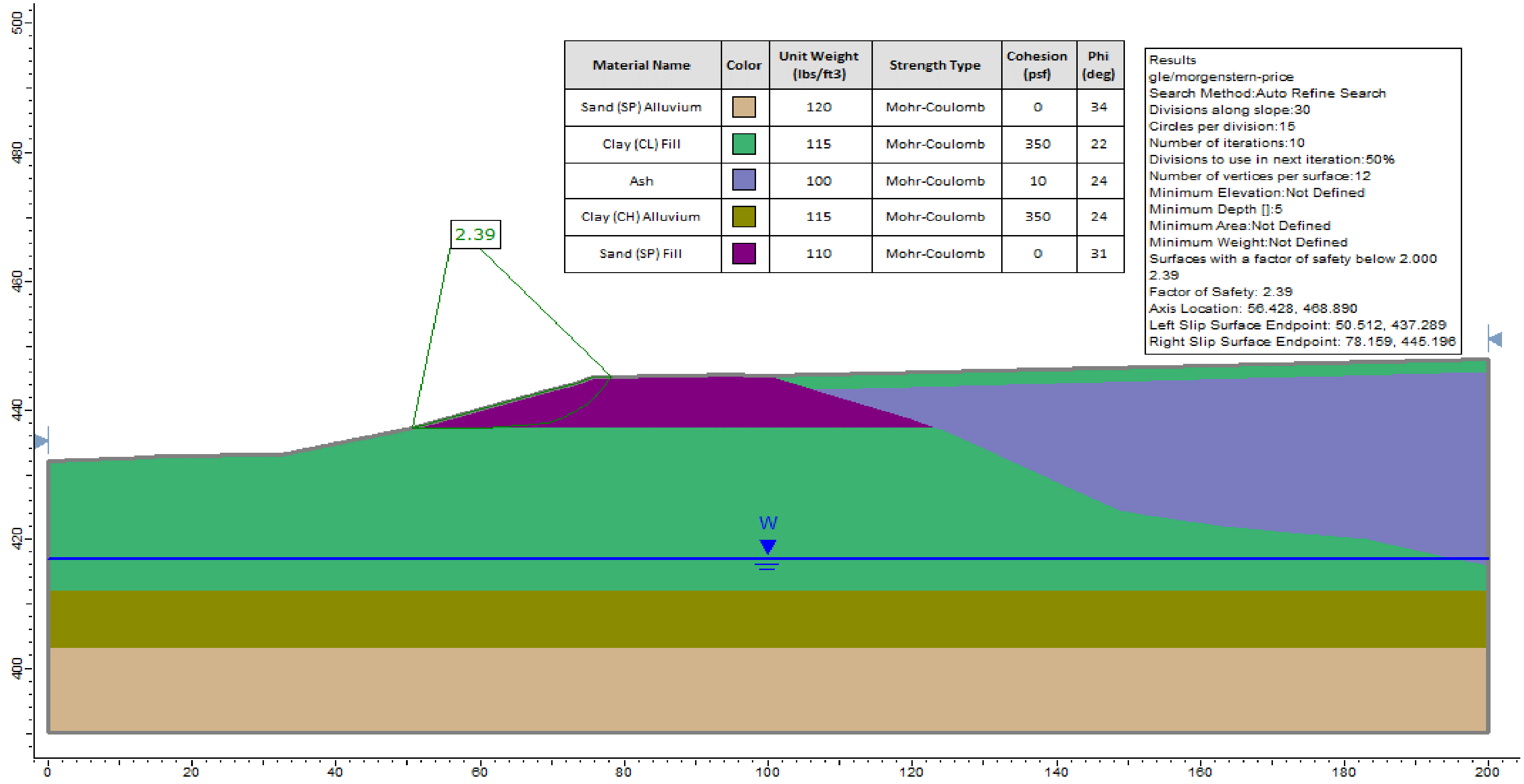
TITLE **Cross-Section A-A' Long-Term Steady State Loading - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **3**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 2.39



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟦	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31

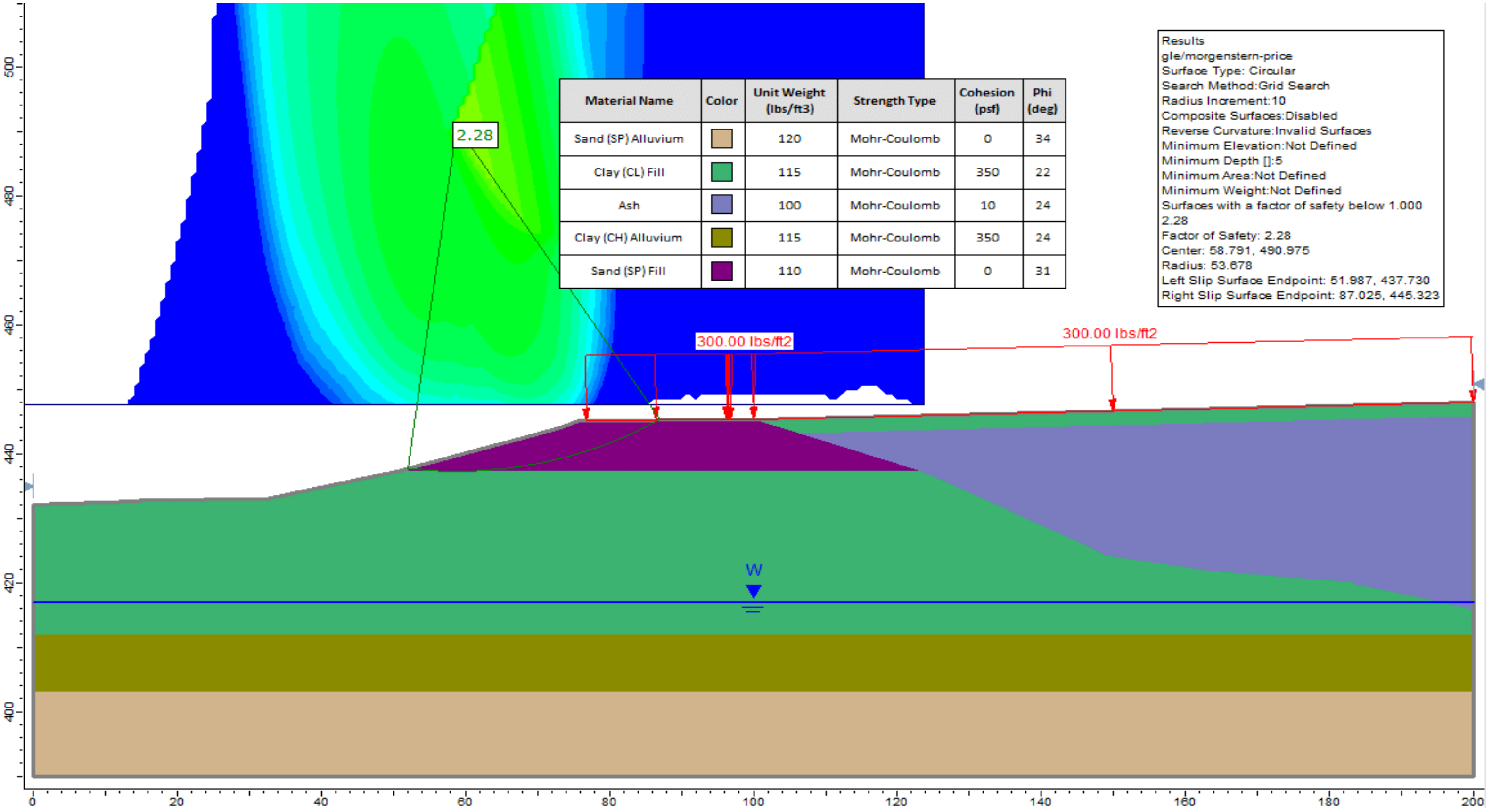
Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
2.39
Factor of Safety: 2.39
Axis Location: 56.428, 468.890
Left Slip Surface Endpoint: 50.512, 437.289
Right Slip Surface Endpoint: 78.159, 445.196

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section A-A' Long-Term Steady State Loading - Non-Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**4**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 2.28



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31

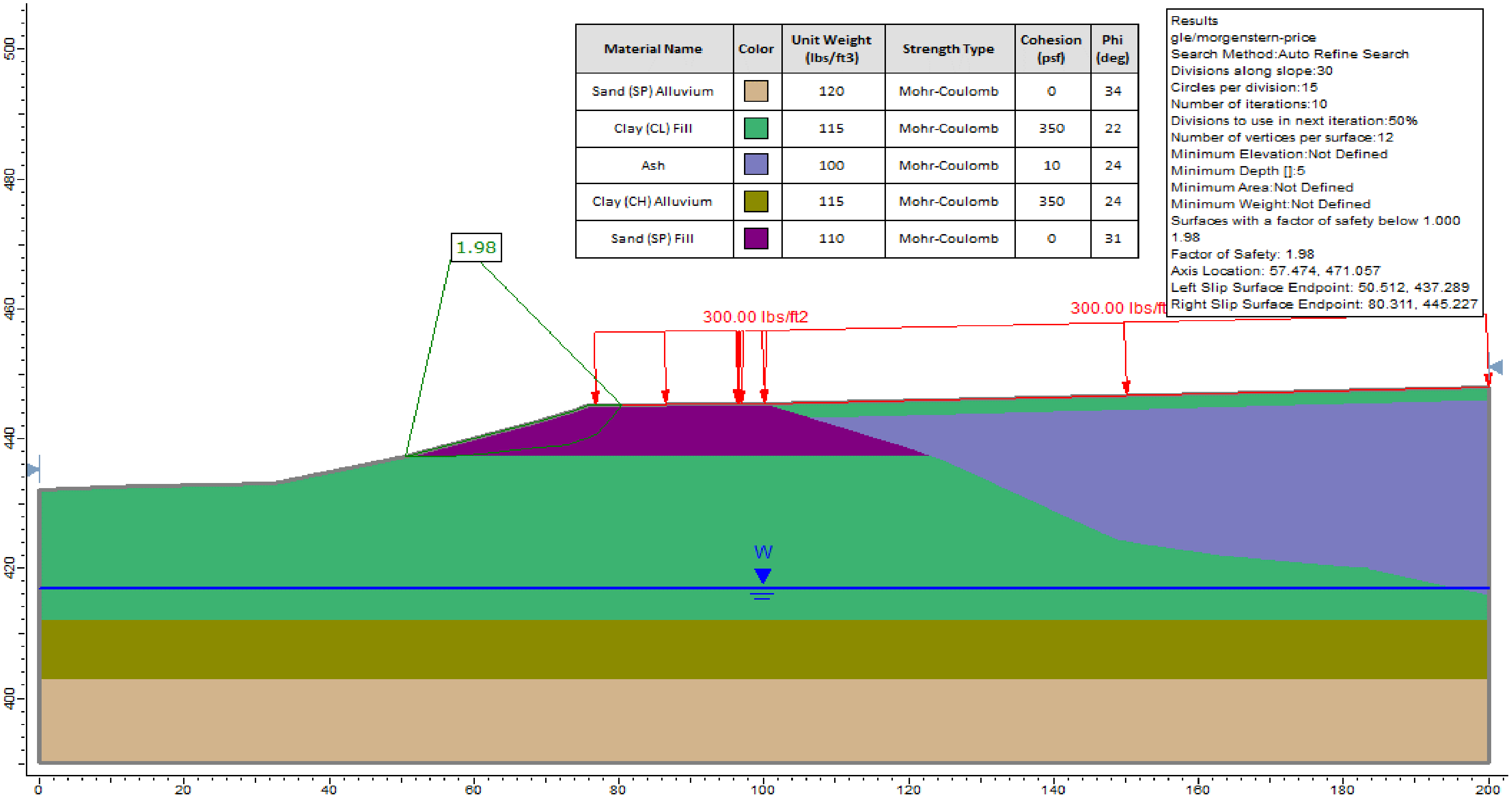
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
2.28
Factor of Safety: 2.28
Center: 58.791, 490.975
Radius: 53.678
Left Slip Surface Endpoint: 51.987, 437.730
Right Slip Surface Endpoint: 87.025, 445.323

Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section A-A' Steady State with Surcharges Loading - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**5**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.98



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31

```
Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.98
Factor of Safety: 1.98
Axis Location: 57.474, 471.057
Left Slip Surface Endpoint: 50.512, 437.289
Right Slip Surface Endpoint: 80.311, 445.227
```

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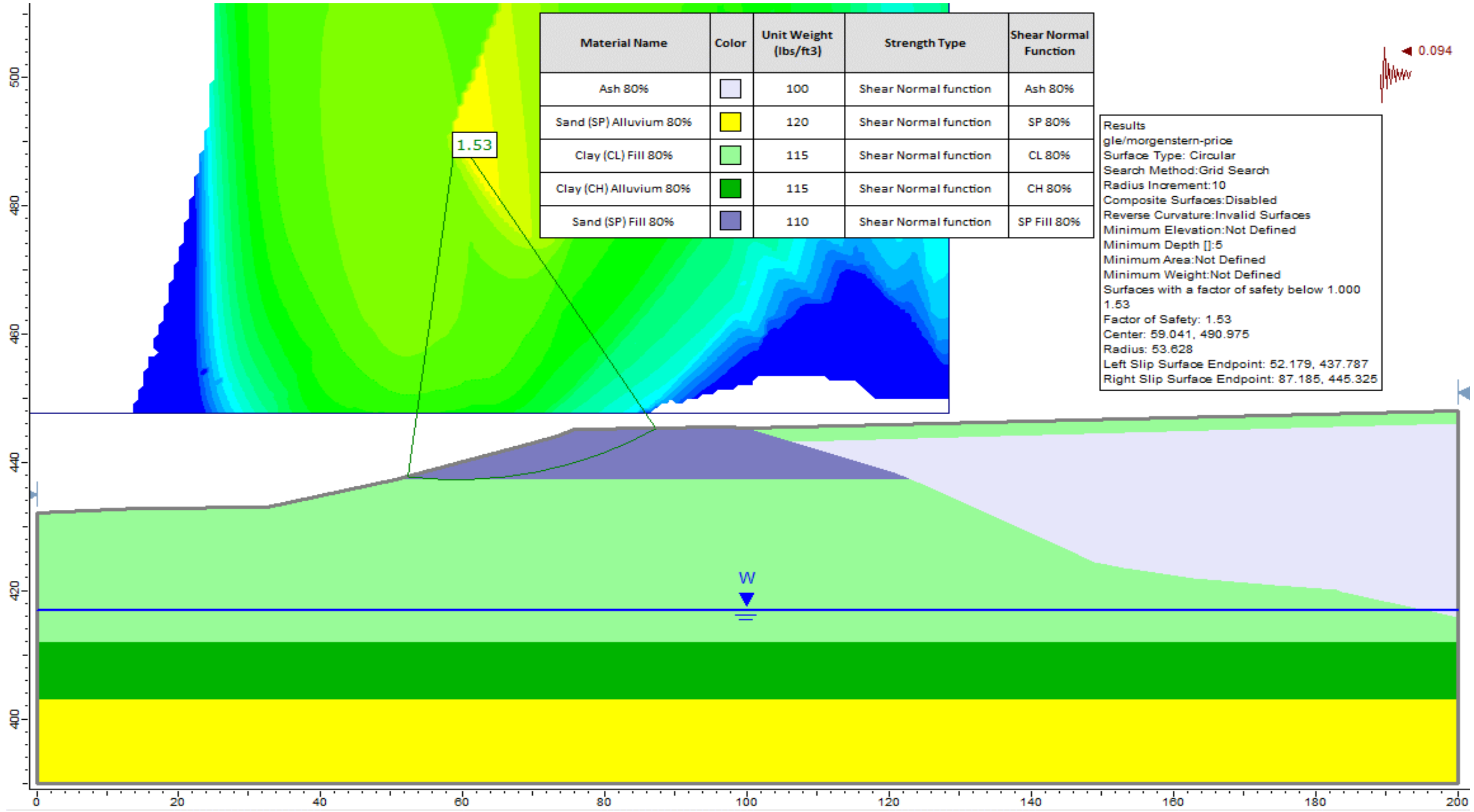
SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section A-A' Steady State with Surcharges Loading - Non-Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	6

FILE STABILITY

PROJECT No. 154-7197-01

REV. 0

Minimum
FS = 1.53



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%
Sand (SP) Fill 80%	🟪	110	Shear Normal function	SP Fill 80%

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.53
Factor of Safety: 1.53
Center: 59.041, 490.975
Radius: 53.628
Left Slip Surface Endpoint: 52.179, 437.787
Right Slip Surface Endpoint: 87.185, 445.325

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SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

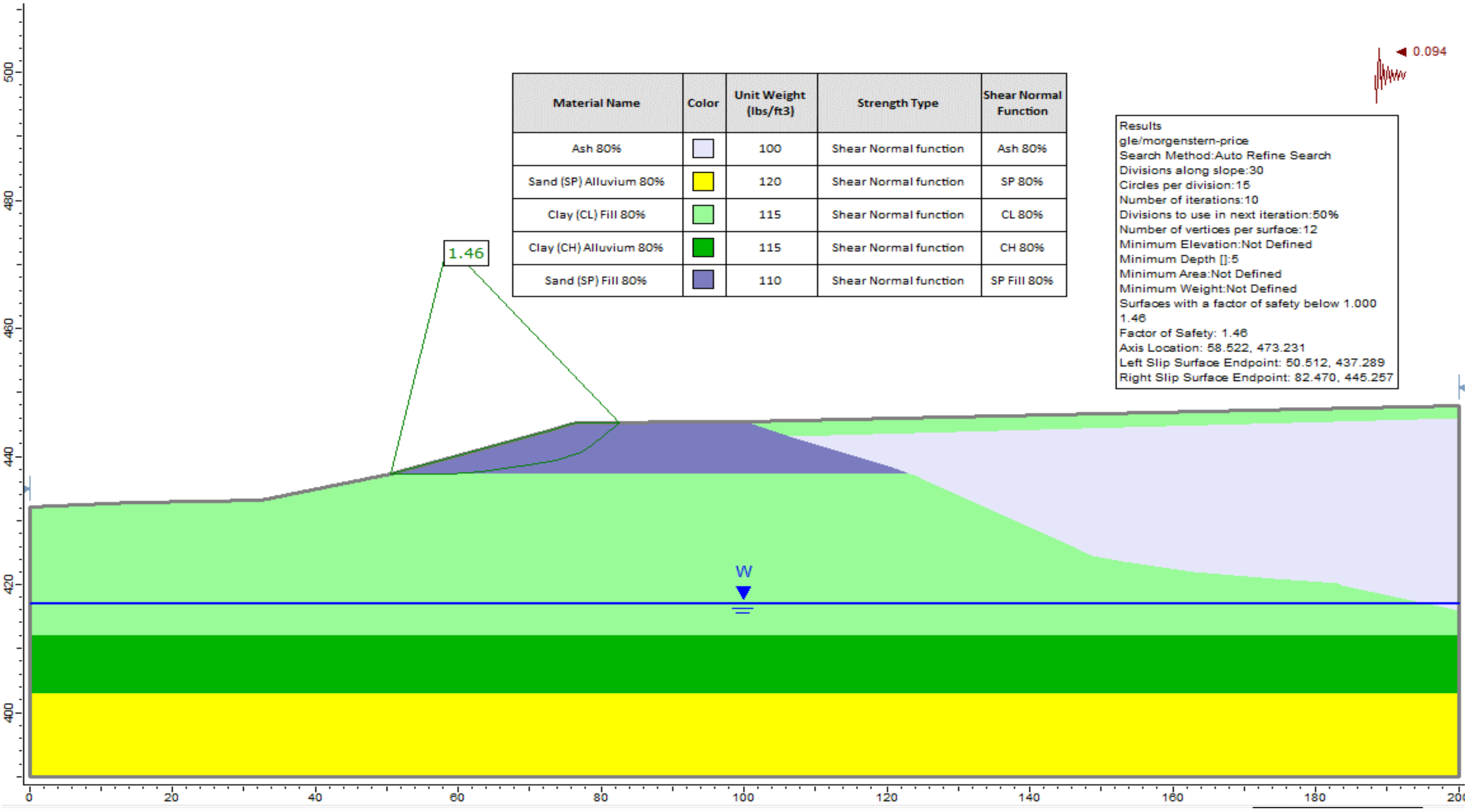
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section A-A' Pseudo-Static Seismic Loading - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE 7

Minimum
FS = 1.46



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%
Sand (SP) Fill 80%	🟪	110	Shear Normal function	SP Fill 80%

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.46
Factor of Safety: 1.46
Axis Location: 58.522, 473.231
Left Slip Surface Endpoint: 50.512, 437.289
Right Slip Surface Endpoint: 82.470, 445.257

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SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

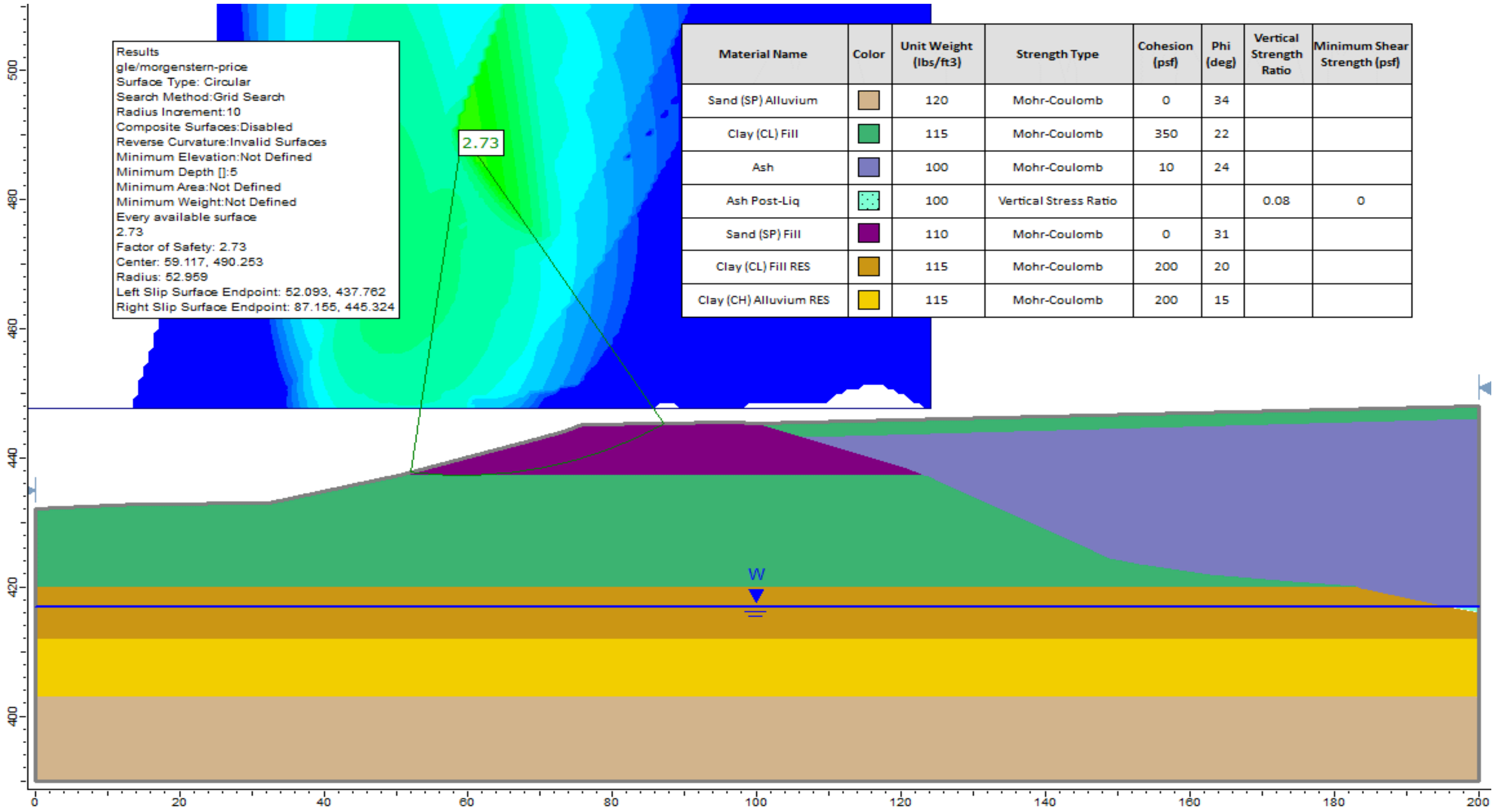
FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section A-A' Pseudo-Static Seismic Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **8**



Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
2.73
Factor of Safety: 2.73
Center: 59.117, 490.253
Radius: 52.959
Left Slip Surface Endpoint: 52.093, 437.762
Right Slip Surface Endpoint: 87.155, 445.324

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Ash	🟦	100	Mohr-Coulomb	10	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31		
Clay (CL) Fill RES	🟧	115	Mohr-Coulomb	200	20		
Clay (CH) Alluvium RES	🟨	115	Mohr-Coulomb	200	15		

Minimum
FS = 2.73

Golder Associates
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SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

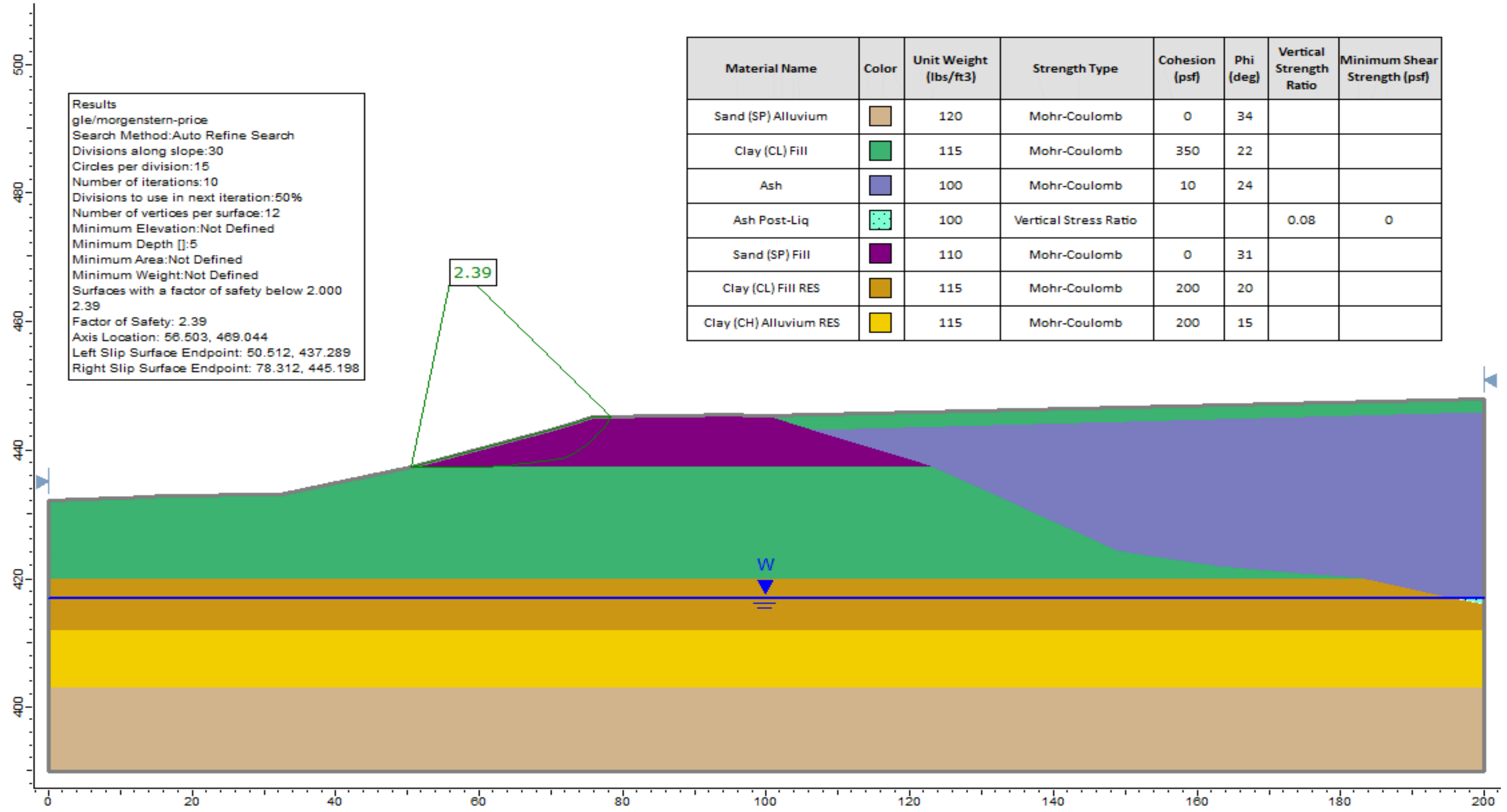
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section A-A' Post-Liquefaction Conditions - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **9**

Minimum
FS = 2.39



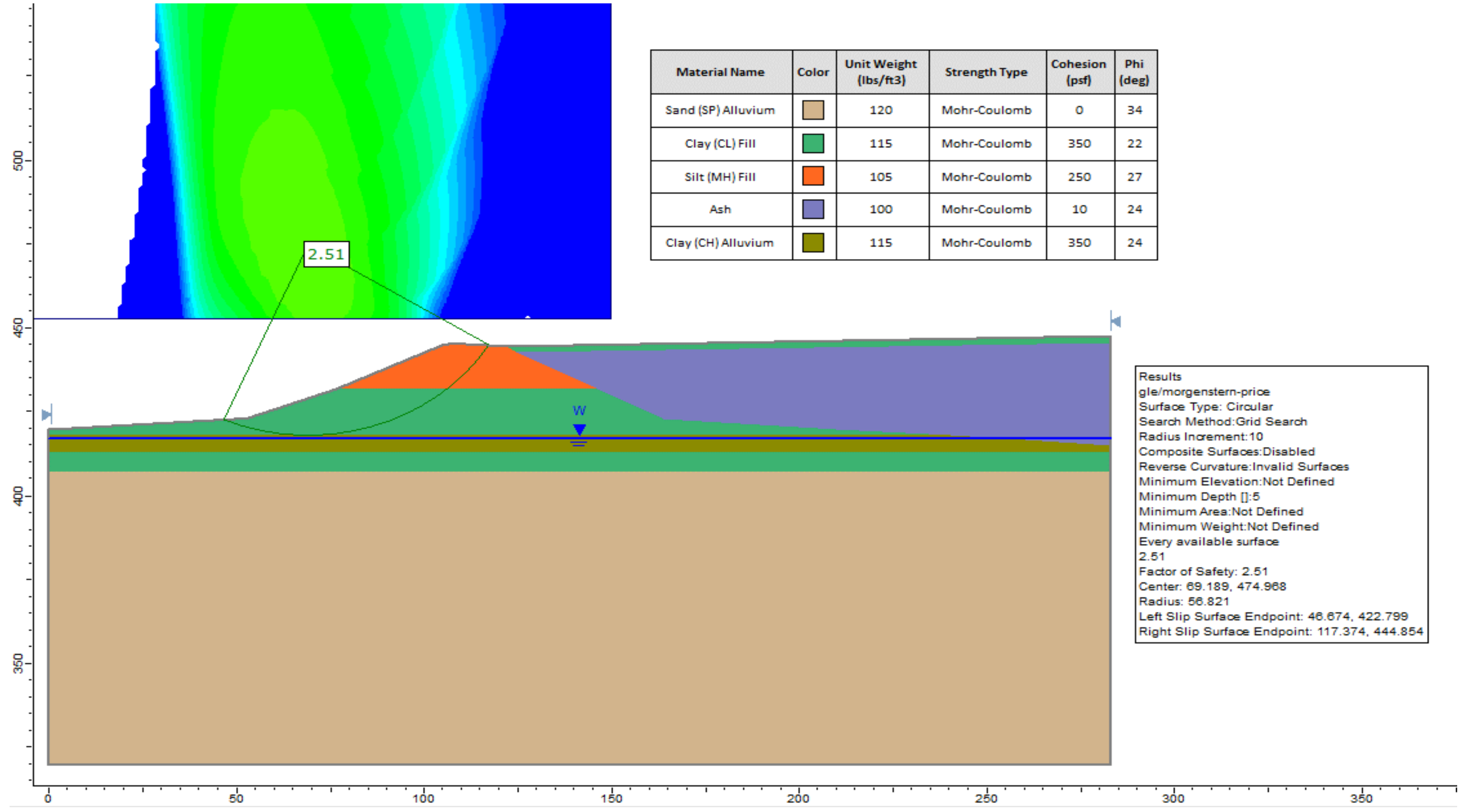
```
Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
2.39
Factor of Safety: 2.39
Axis Location: 56.503, 469.044
Left Slip Surface Endpoint: 50.512, 437.289
Right Slip Surface Endpoint: 78.312, 445.198
```

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Ash	🟪	100	Mohr-Coulomb	10	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31		
Clay (CL) Fill RES	🟧	115	Mohr-Coulomb	200	20		
Clay (CH) Alluvium RES	🟨	115	Mohr-Coulomb	200	15		

Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section A-A' Post-Liquefaction Conditions - Non-Circular Failure Plane**
MADE BY	MSG		
CAD	-		
FILE	STABILITY	CHECK	PJJ/AGC
PROJECT No.	154-7197-01	REV.	0
REVIEW	KMB	CLIENT	**Ameren - Missouri**
FIGURE	**10**		

Minimum
FS = 2.51



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
2.51
Factor of Safety: 2.51
Center: 69.189, 474.968
Radius: 56.821
Left Slip Surface Endpoint: 46.674, 422.799
Right Slip Surface Endpoint: 117.374, 444.854

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SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB
FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

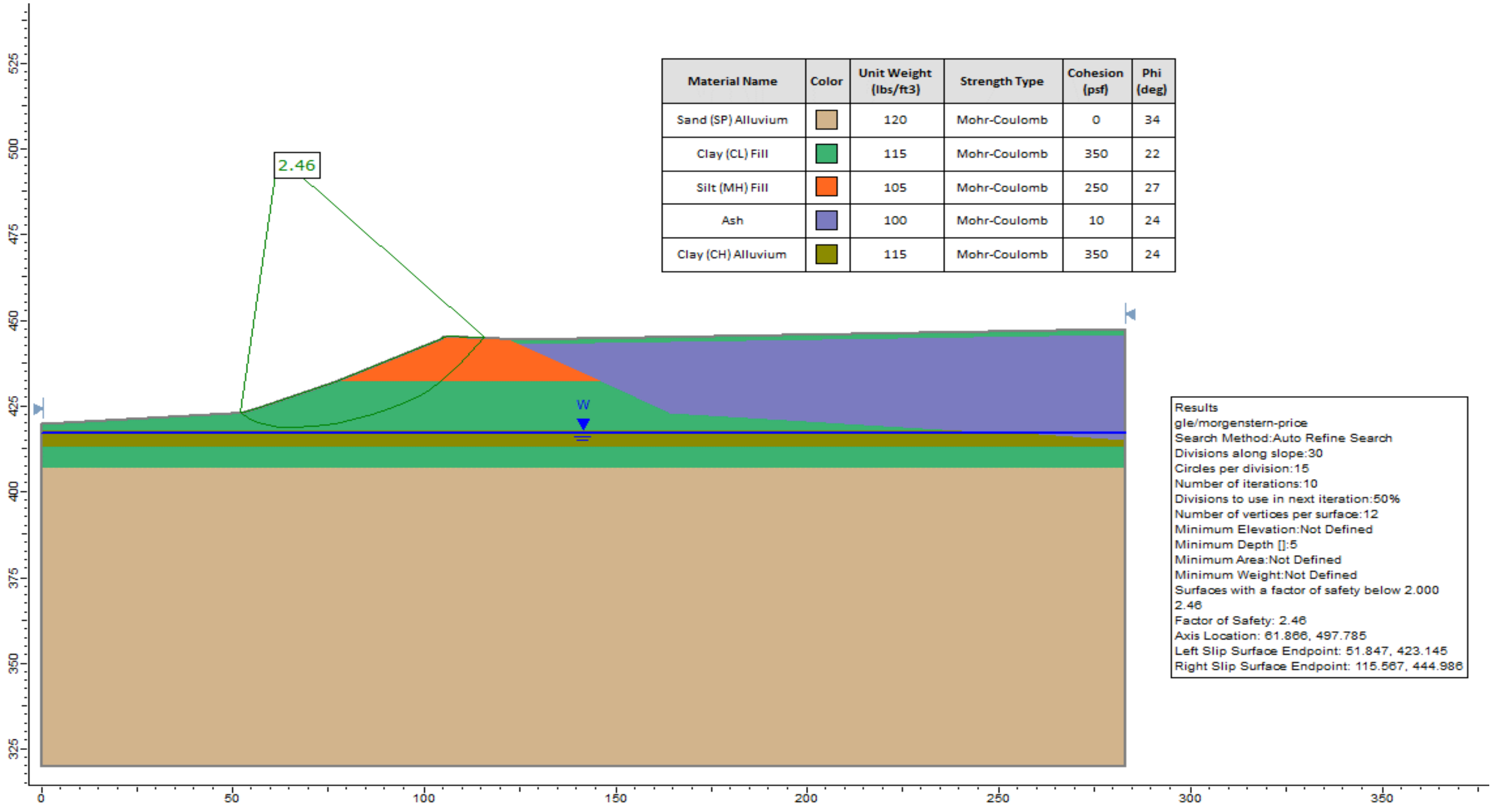
TITLE

Cross-Section B-B' Long-Term Steady State Loading - Circular Failure Plane

CLIENT **Ameren - Missouri**

FIGURE **11**

Minimum
FS = 2.46



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24

```
Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
2.46
Factor of Safety: 2.46
Axis Location: 61.866, 497.785
Left Slip Surface Endpoint: 51.847, 423.145
Right Slip Surface Endpoint: 115.567, 444.986
```

Golder Associates
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SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

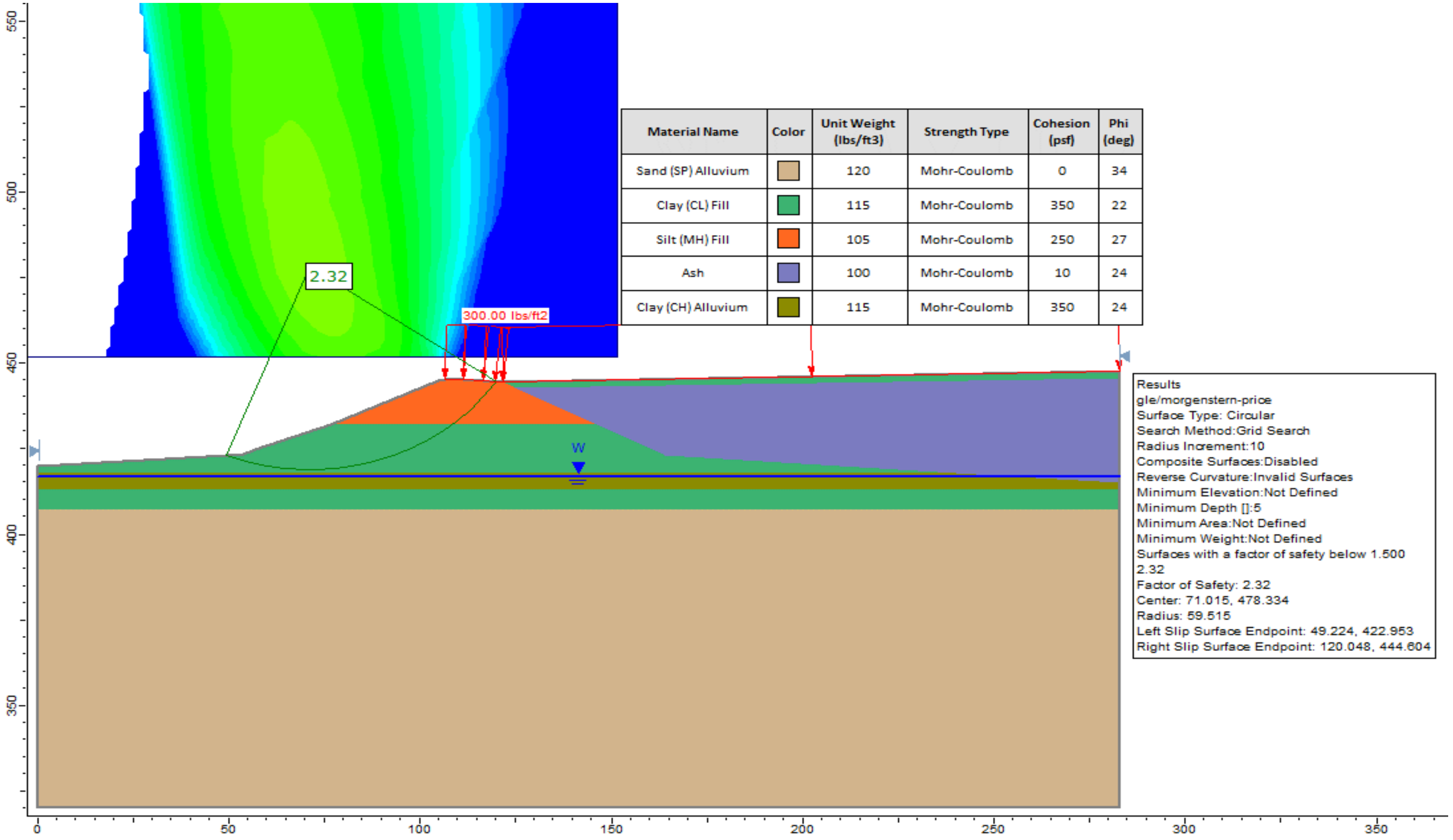
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section B-B' Long-Term Steady State Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **12**

Minimum
FS = 2.32



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.500
2.32
Factor of Safety: 2.32
Center: 71.015, 478.334
Radius: 59.515
Left Slip Surface Endpoint: 49.224, 422.953
Right Slip Surface Endpoint: 120.048, 444.604

Golder Associates
Golder Associates Inc.

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

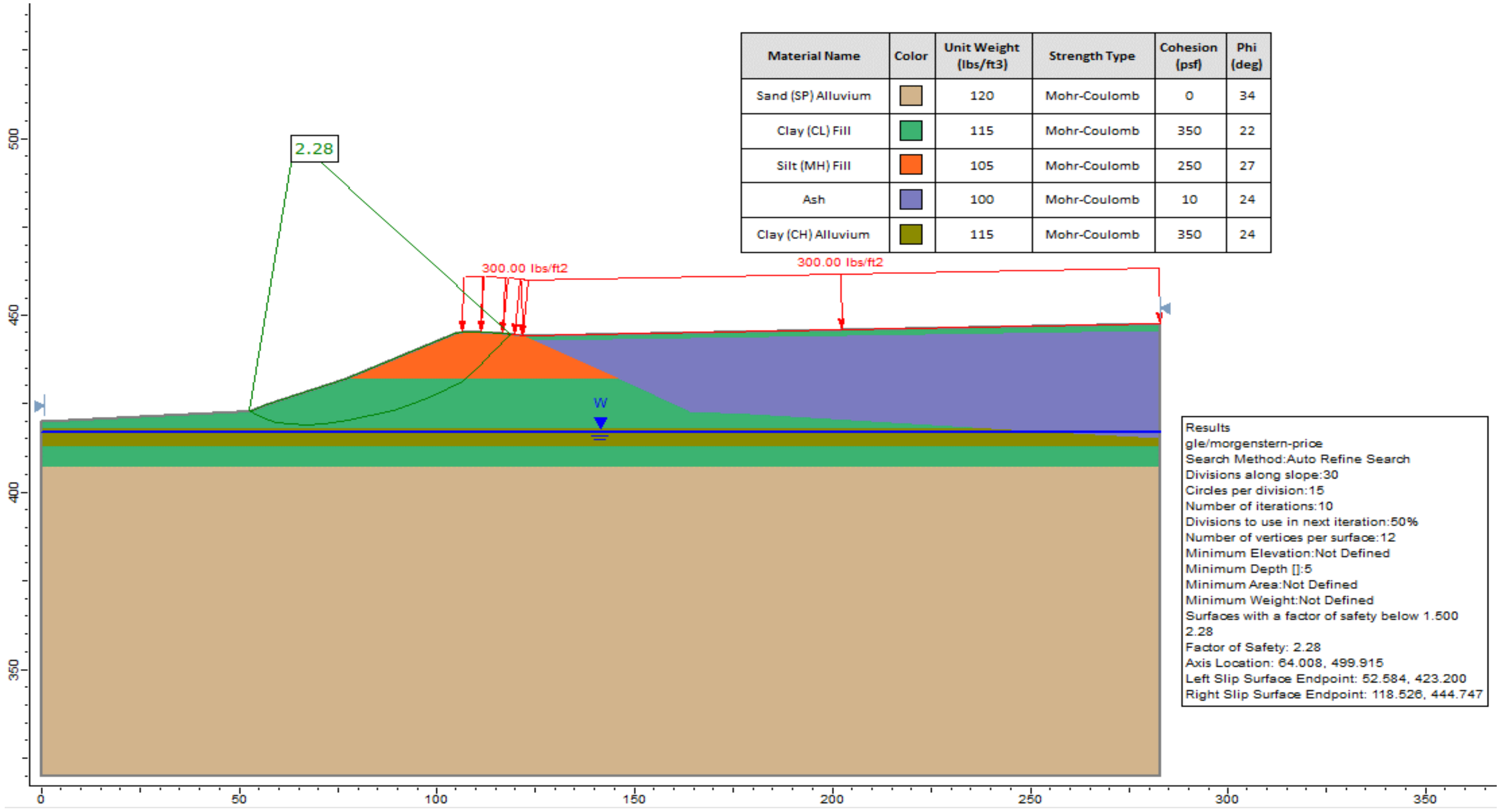
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section B-B' Steady State with Surcharges Loading - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **13**

Minimum
FS = 2.28



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24

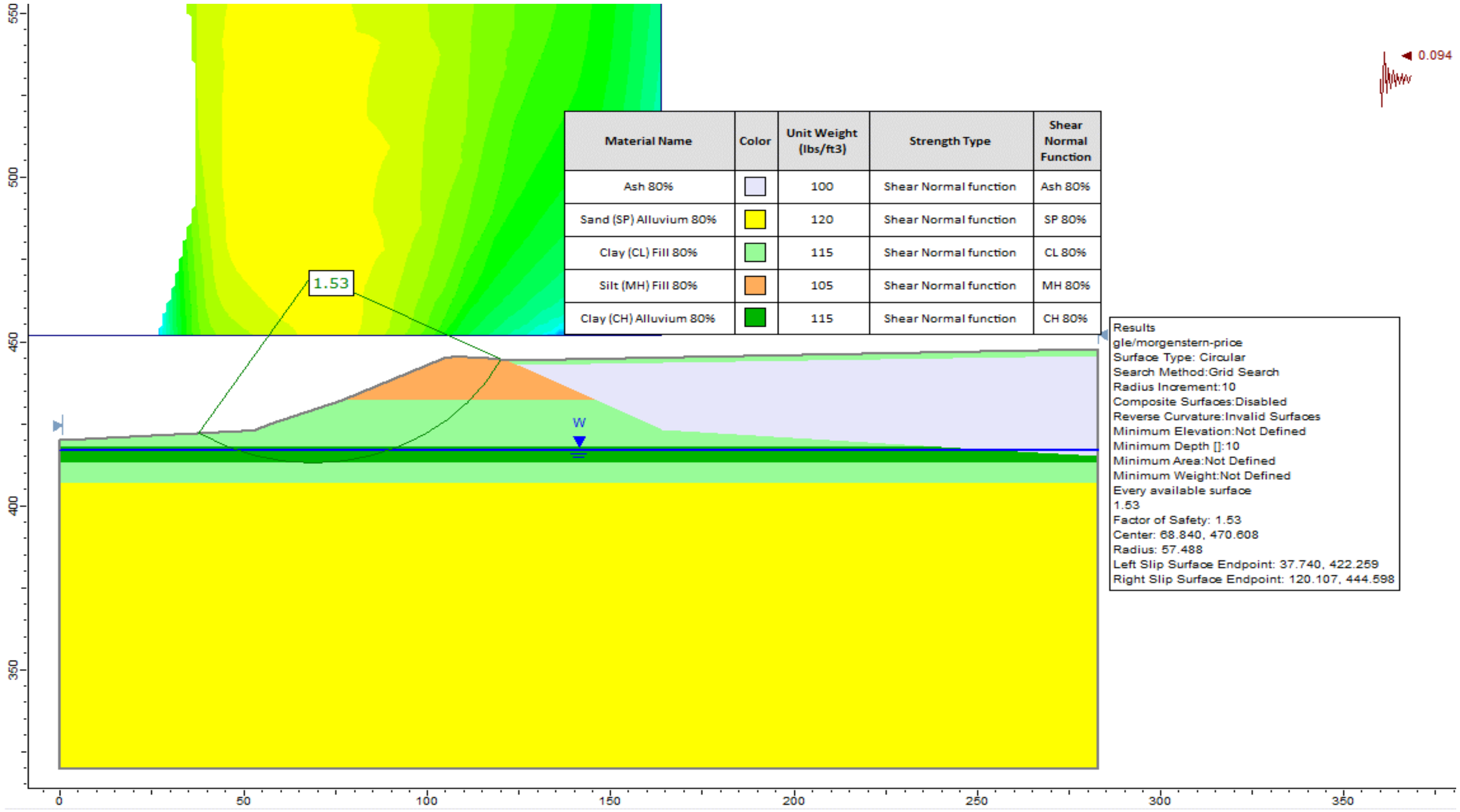
Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.500
2.28
Factor of Safety: 2.28
Axis Location: 64.008, 499.915
Left Slip Surface Endpoint: 52.584, 423.200
Right Slip Surface Endpoint: 118.526, 444.747

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section B-B' Steady State with Surcharges Loading - Non-Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**14**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.53



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Silt (MH) Fill 80%	🟧	105	Shear Normal function	MH 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%

```
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.53
Factor of Safety: 1.53
Center: 68.840, 470.608
Radius: 57.488
Left Slip Surface Endpoint: 37.740, 422.259
Right Slip Surface Endpoint: 120.107, 444.598
```

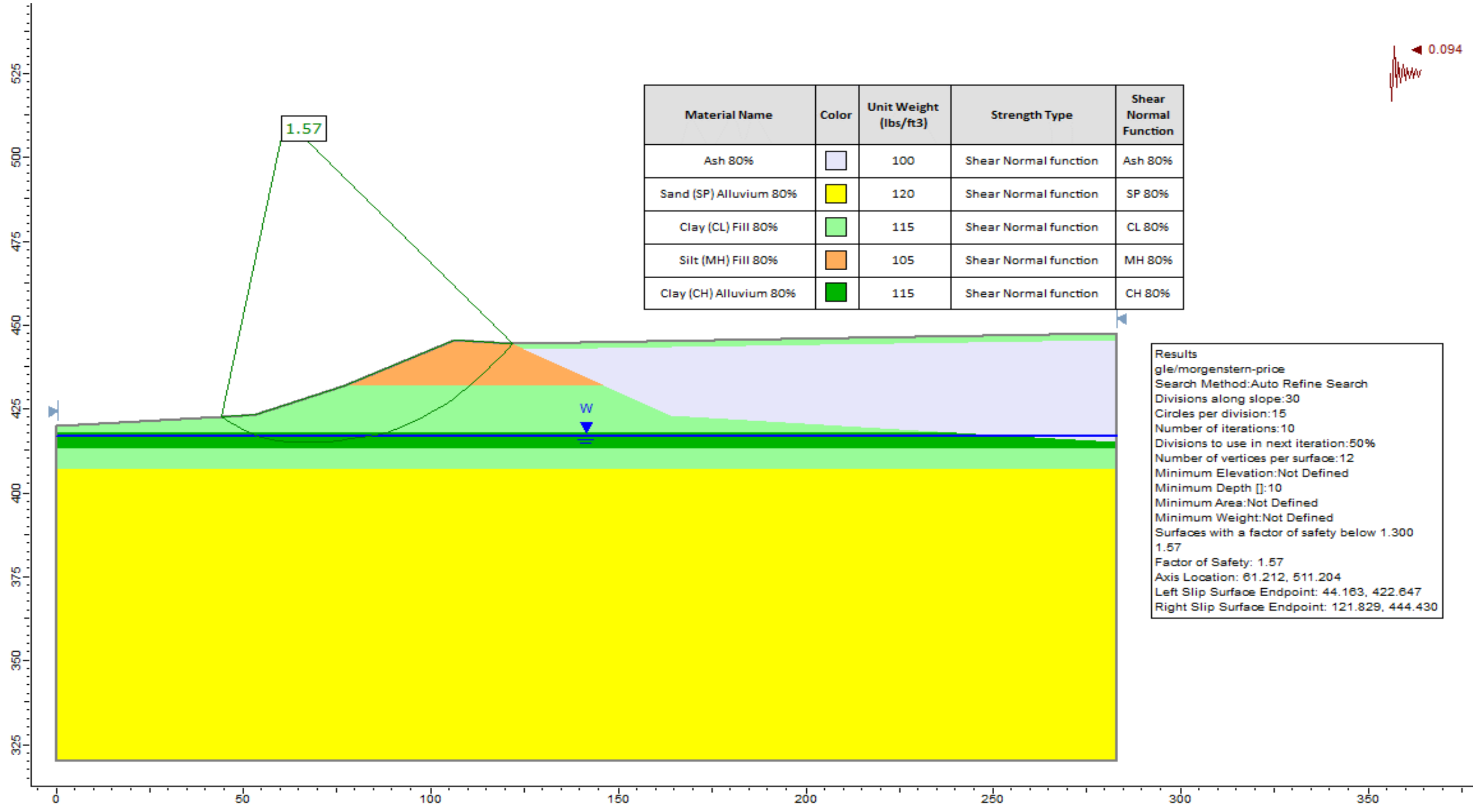
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section B-B' Pseudo-Static Seismic Loading - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**15**

FILE STABILITY

PROJECT No. 154-7197-01 REV. 0

Minimum
FS = 1.57



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Silt (MH) Fill 80%	🟧	105	Shear Normal function	MH 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.300
1.57
Factor of Safety: 1.57
Axis Location: 61.212, 511.204
Left Slip Surface Endpoint: 44.163, 422.647
Right Slip Surface Endpoint: 121.829, 444.430

Golder Associates
Golder Associates Inc.

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

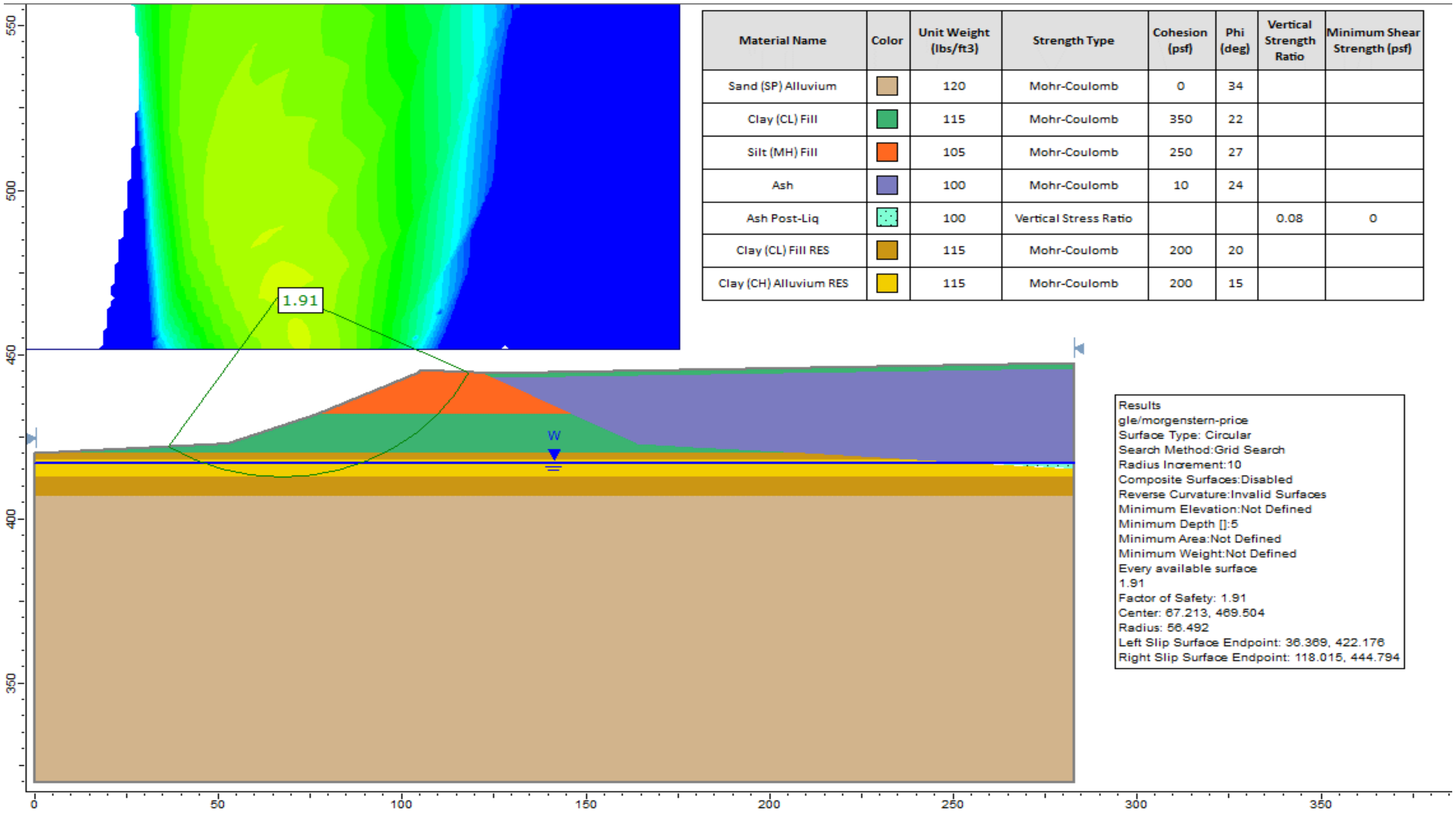
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section B-B' Pseudo-Static Seismic Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **16**

Minimum
FS =1.91



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Ash	🟪	100	Mohr-Coulomb	10	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Clay (CL) Fill RES	▨	115	Mohr-Coulomb	200	20		
Clay (CH) Alluvium RES	🟨	115	Mohr-Coulomb	200	15		

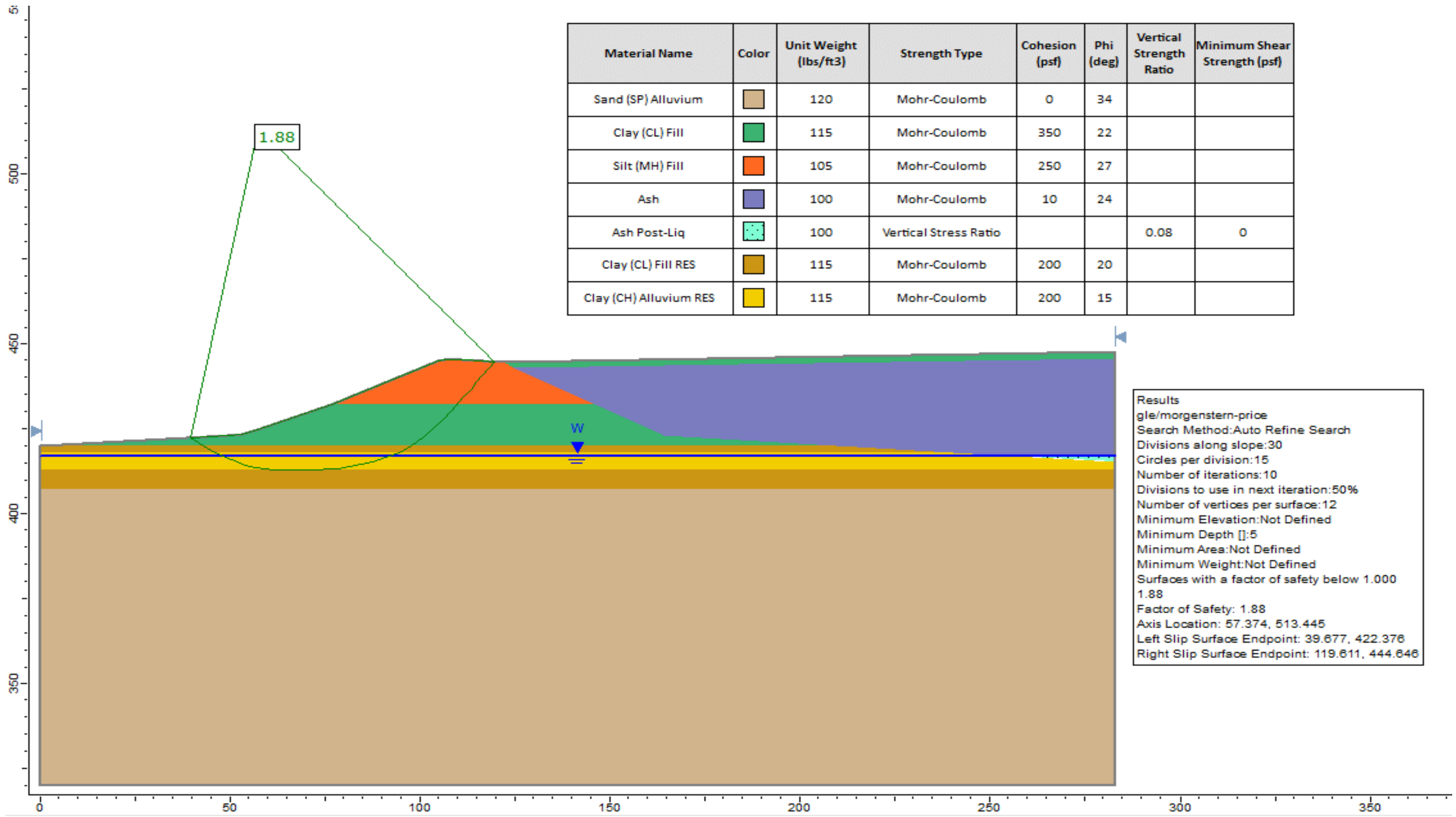
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.91
Factor of Safety: 1.91
Center: 67.213, 469.504
Radius: 56.492
Left Slip Surface Endpoint: 36.369, 422.176
Right Slip Surface Endpoint: 118.015, 444.794

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section B-B' Post-Liquefaction Conditions - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**17**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.88



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Ash	🟪	100	Mohr-Coulomb	10	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Clay (CL) Fill RES	🟫	115	Mohr-Coulomb	200	20		
Clay (CH) Alluvium RES	🟨	115	Mohr-Coulomb	200	15		

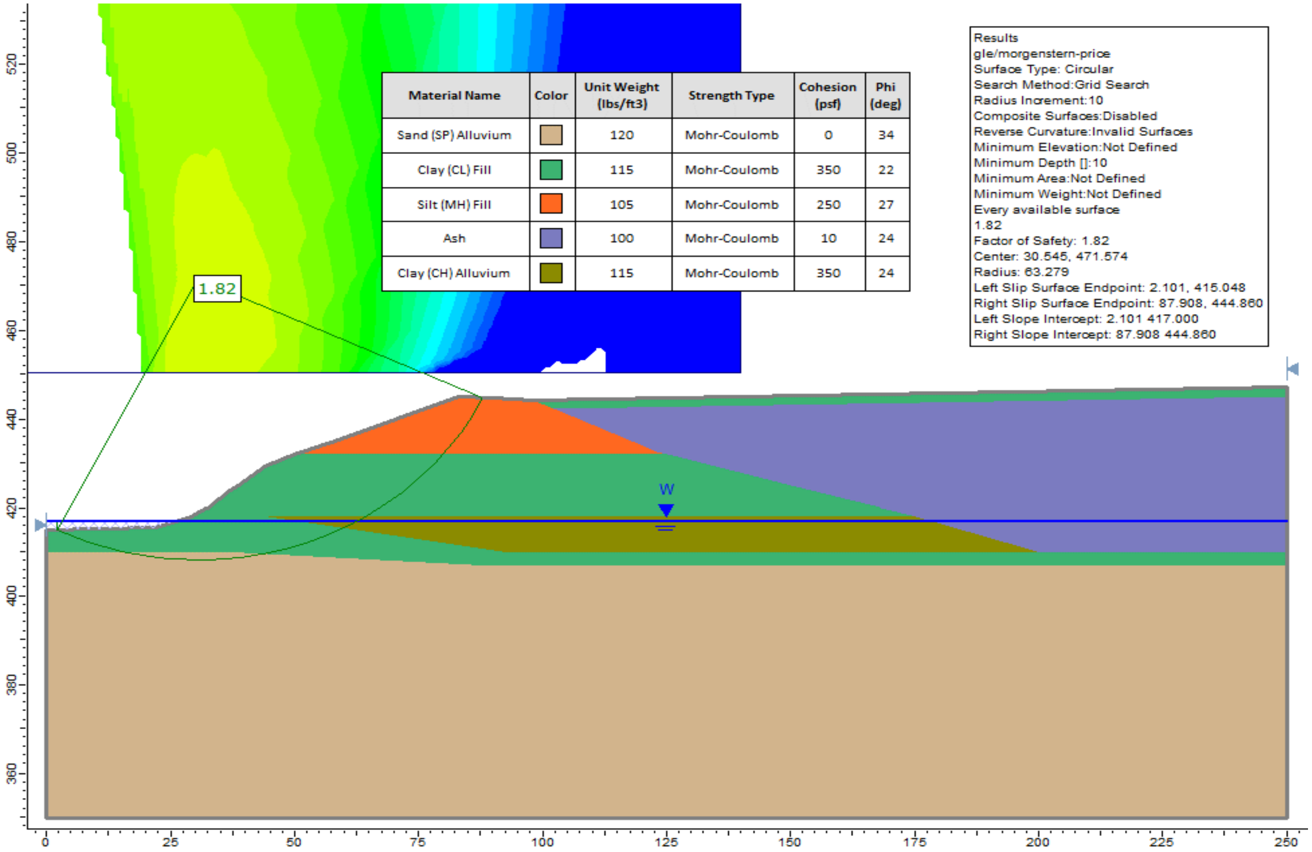
Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.88
Factor of Safety: 1.88
Axis Location: 57.374, 513.445
Left Slip Surface Endpoint: 39.677, 422.376
Right Slip Surface Endpoint: 119.611, 444.646

Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	Sioux Energy Center - CCR Pond Closures - SCPA
DATE	Jan 2018	TITLE	Cross-Section B-B' Post-Liquefaction Conditions - Non-Circular Failure Plane
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	Ameren - Missouri
REVIEW	KMB	FIGURE	18

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.82



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.82
Factor of Safety: 1.82
Center: 30.545, 471.574
Radius: 63.279
Left Slip Surface Endpoint: 2.101, 415.048
Right Slip Surface Endpoint: 87.908, 444.860
Left Slope Intercept: 2.101 417.000
Right Slope Intercept: 87.908 444.860

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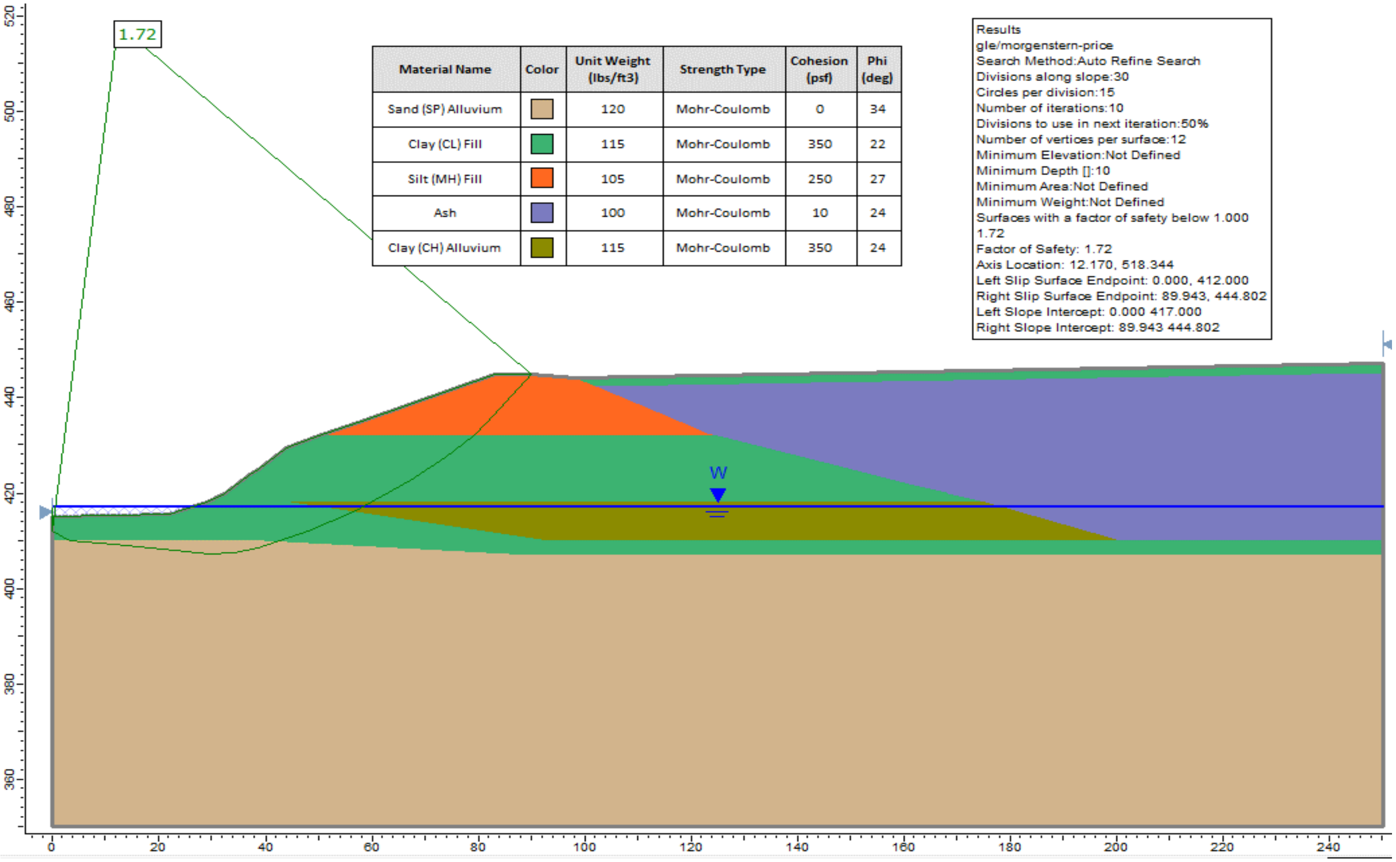
SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section C-C' Long-Term Steady State Loading - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**19**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.72



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.72
Factor of Safety: 1.72
Axis Location: 12.170, 518.344
Left Slip Surface Endpoint: 0.000, 412.000
Right Slip Surface Endpoint: 89.943, 444.802
Left Slope Intercept: 0.000 417.000
Right Slope Intercept: 89.943 444.802

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SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

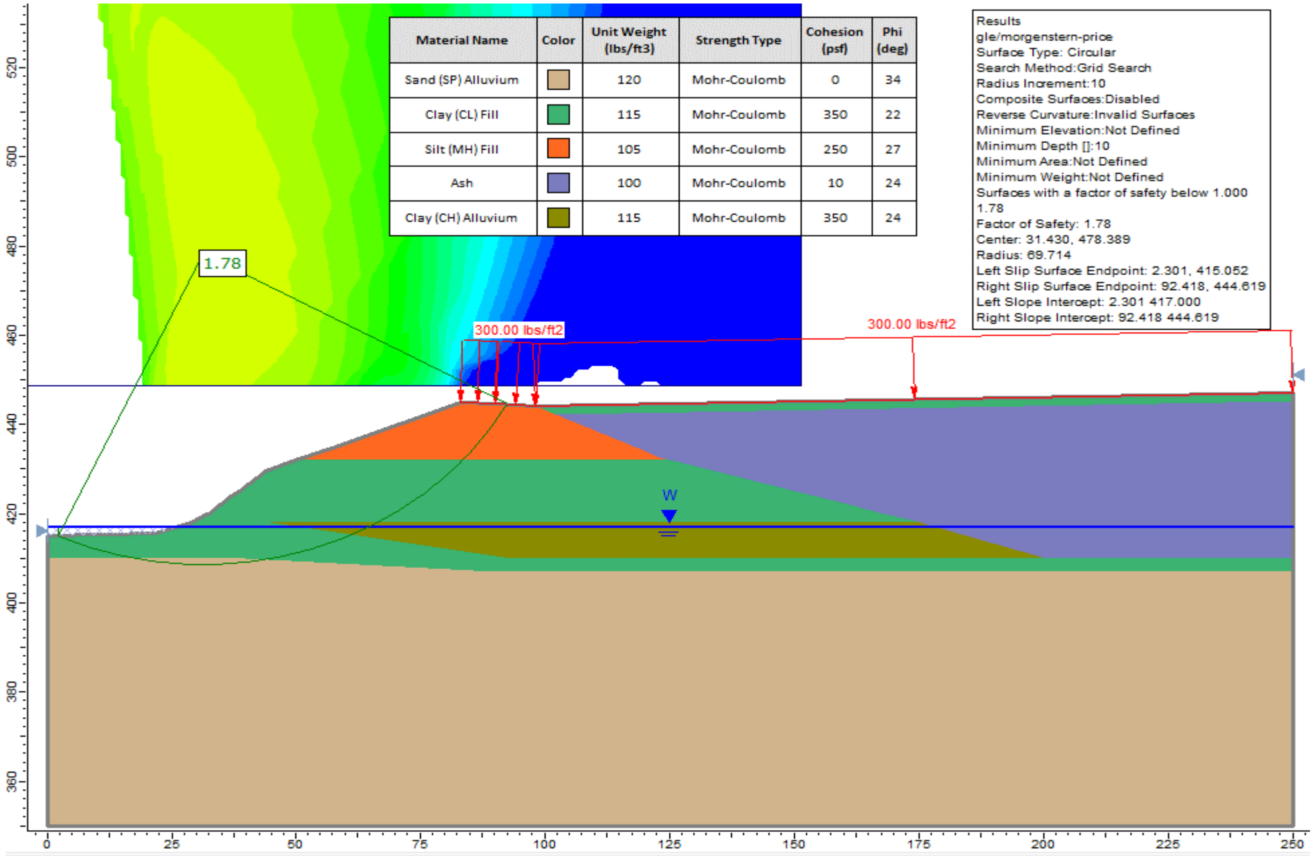
TITLE **Cross-Section C-C' Long-Term Steady State Loading - Non-Circular Failure Plane**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

CLIENT **Ameren - Missouri**

FIGURE **20**

Minimum
FS = 1.78



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.78
Factor of Safety: 1.78
Center: 31.430, 478.389
Radius: 69.714
Left Slip Surface Endpoint: 2.301, 415.052
Right Slip Surface Endpoint: 92.418, 444.619
Left Slope Intercept: 2.301 417.000
Right Slope Intercept: 92.418 444.619

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SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB
FILE	STABILITY
PROJECT No.	154-7197-01
REV.	0

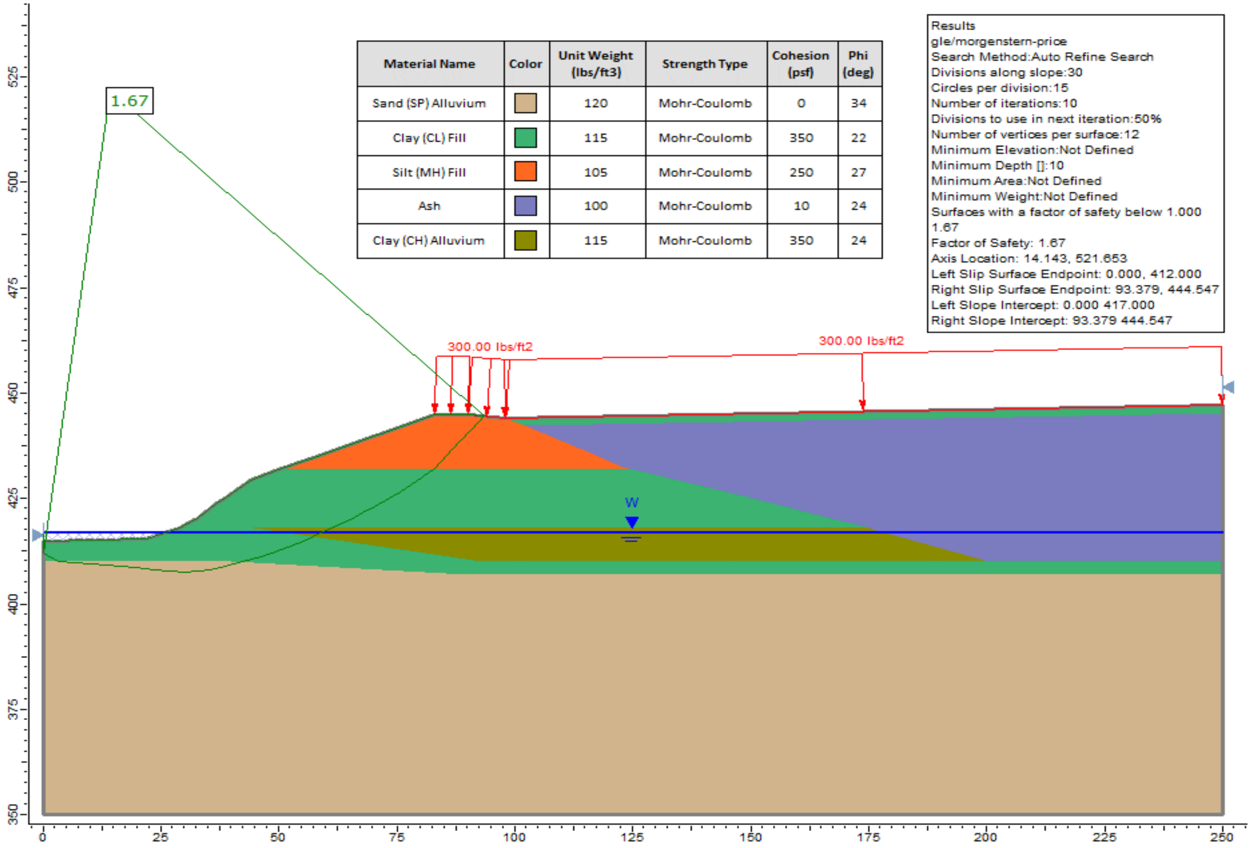
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section C-C' Steady State with Surcharges Loading - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **21**

Minimum
FS = 1.67



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.67
Factor of Safety: 1.67
Axis Location: 14.143, 521.653
Left Slip Surface Endpoint: 0.000, 412.000
Right Slip Surface Endpoint: 93.379, 444.547
Left Slope Intercept: 0.000 417.000
Right Slope Intercept: 93.379 444.547

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB

Golder Associates Inc.

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

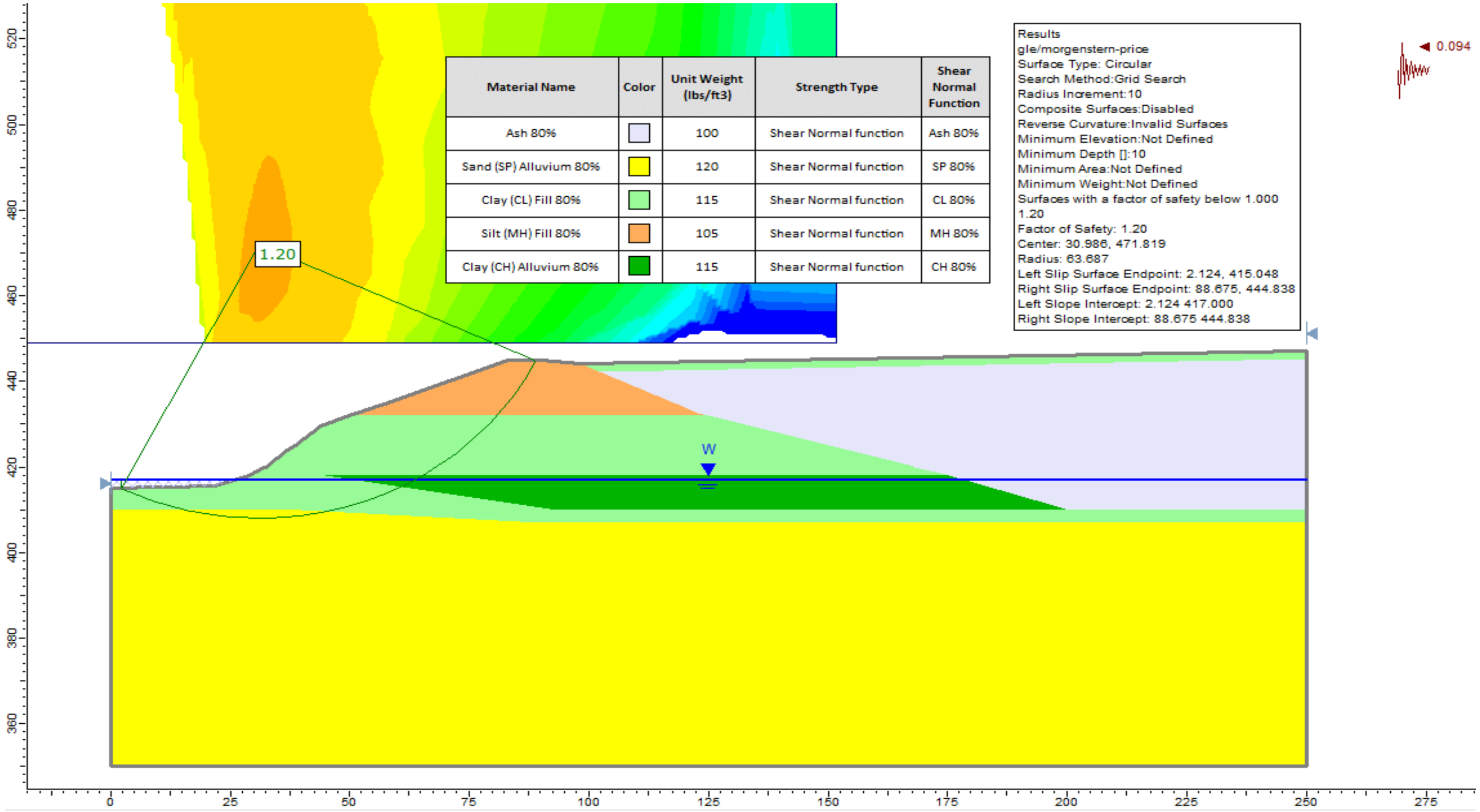
TITLE

Cross-Section C-C' Steady State with Surcharges Loading - Non-Circular Failure Plane

CLIENT **Ameren - Missouri**

FIGURE **22**

Minimum
FS = 1.20



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Silt (MH) Fill 80%	🟧	105	Shear Normal function	MH 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.20
Factor of Safety: 1.20
Center: 30.986, 471.819
Radius: 63.687
Left Slip Surface Endpoint: 2.124, 415.048
Right Slip Surface Endpoint: 88.675, 444.838
Left Slope Intercept: 2.124 417.000
Right Slope Intercept: 88.675 444.838

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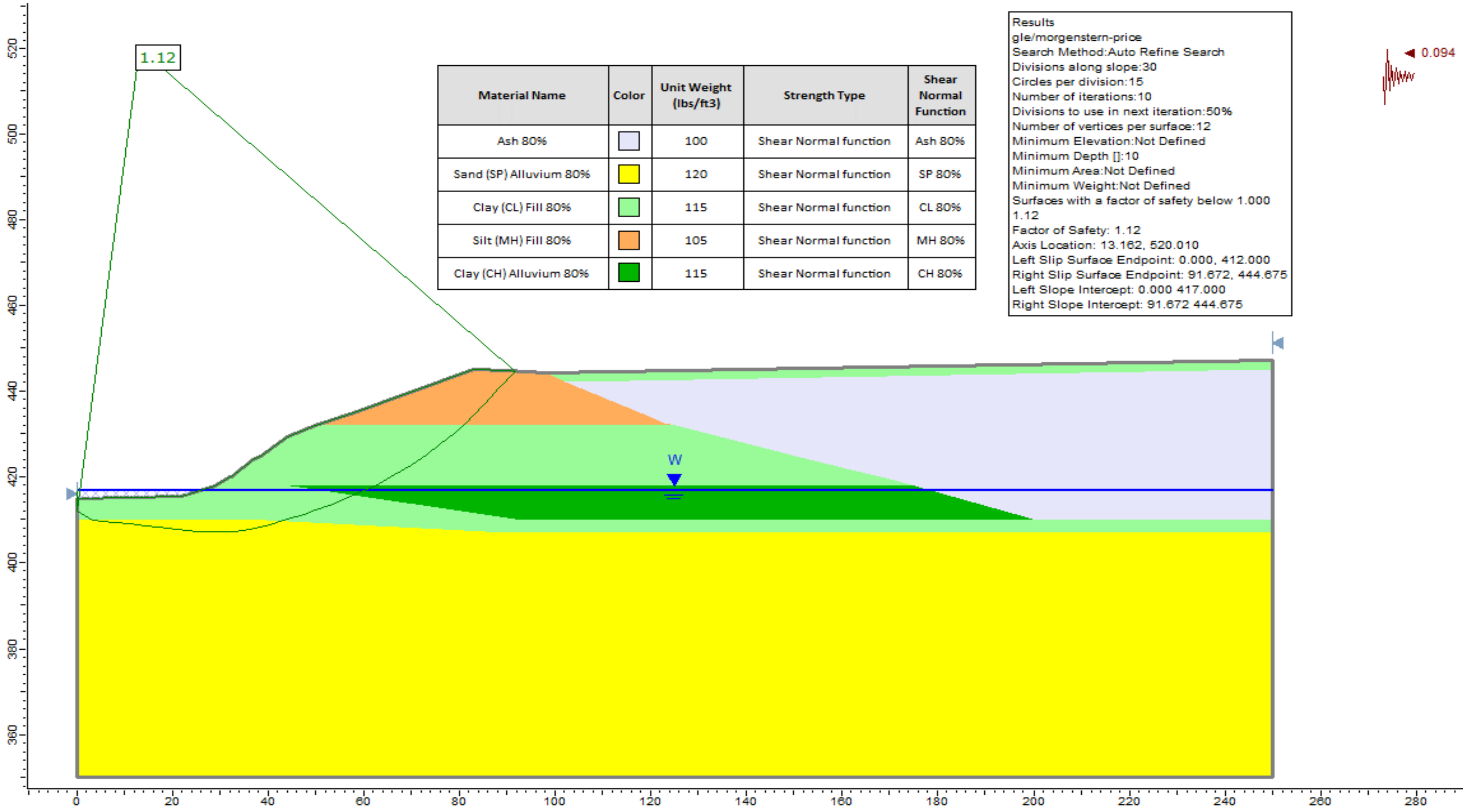
SCALE	AS SHOWN	PROJECT	Sioux Energy Center - CCR Pond Closures - SCPA
DATE	Jan 2018	TITLE	Cross-Section C-C' Pseudo-Static Seismic Loading - Circular Failure Plane
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	Ameren - Missouri
REVIEW	KMB	FIGURE	23

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.12



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Silt (MH) Fill 80%	🟧	105	Shear Normal function	MH 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.12
Factor of Safety: 1.12
Axis Location: 13.162, 520.010
Left Slip Surface Endpoint: 0.000, 412.000
Right Slip Surface Endpoint: 91.672, 444.675
Left Slope Intercept: 0.000 417.000
Right Slope Intercept: 91.672 444.675

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SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

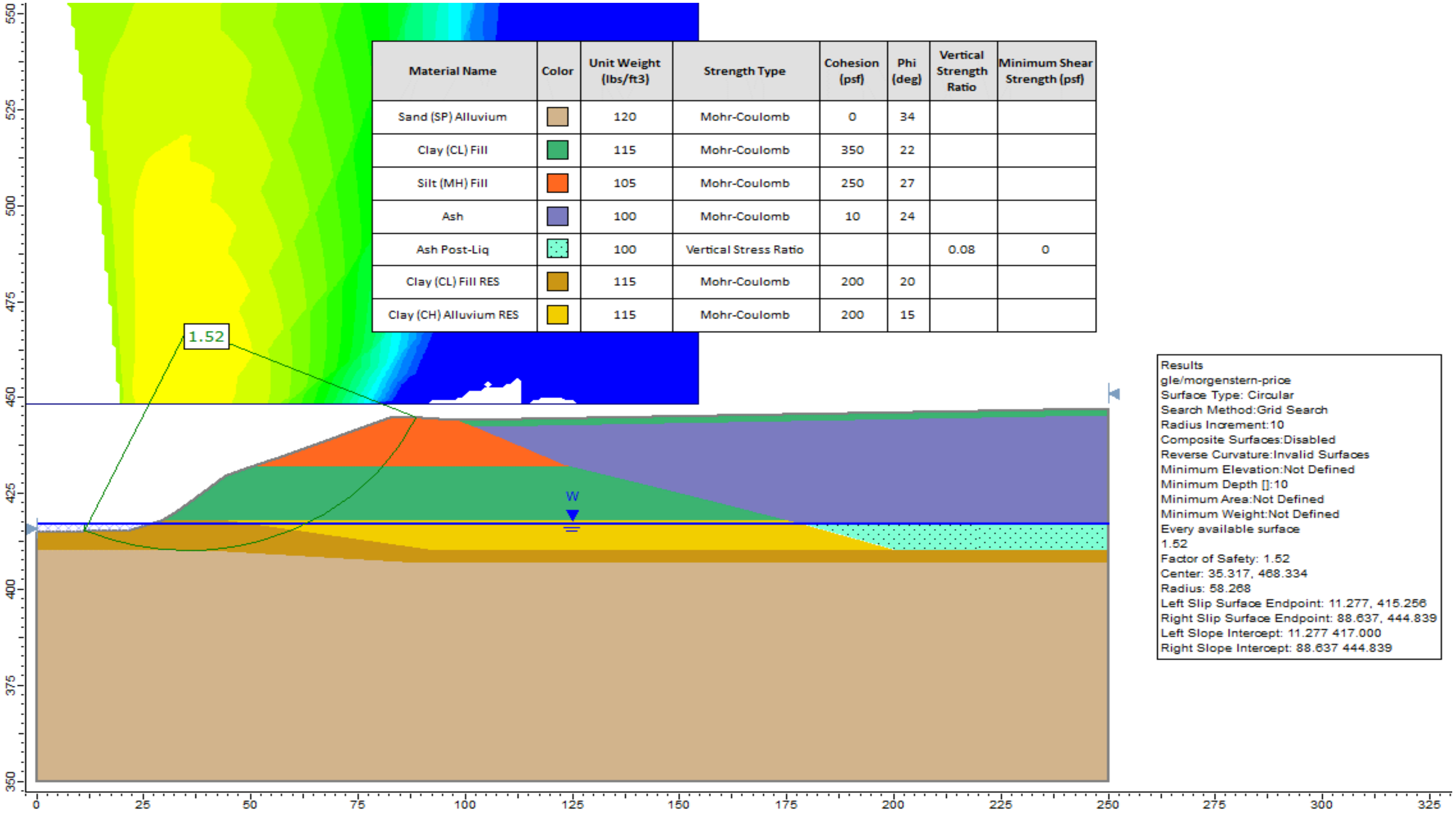
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section C-C' Pseudo-Static Seismic Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **24**

Minimum
FS = 1.52



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Ash	🟪	100	Mohr-Coulomb	10	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Clay (CL) Fill RES	🟫	115	Mohr-Coulomb	200	20		
Clay (CH) Alluvium RES	🟨	115	Mohr-Coulomb	200	15		

```
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.52
Factor of Safety: 1.52
Center: 35.317, 468.334
Radius: 58.268
Left Slip Surface Endpoint: 11.277, 415.256
Right Slip Surface Endpoint: 88.637, 444.839
Left Slope Intercept: 11.277 417.000
Right Slope Intercept: 88.637 444.839
```

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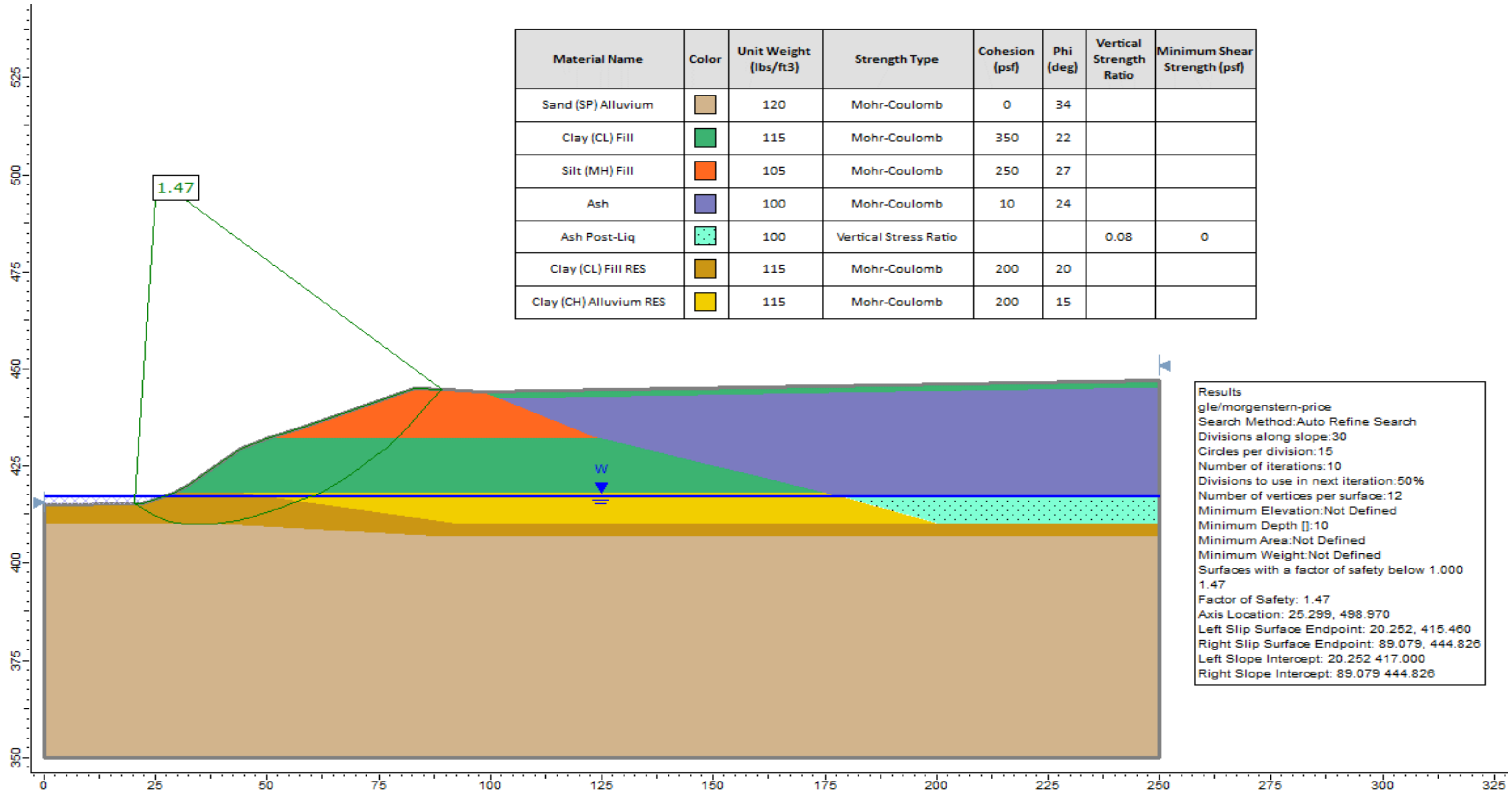
SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section C-C' Post-Liquefaction Conditions - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**25**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.47



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Ash	🟪	100	Mohr-Coulomb	10	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Clay (CL) Fill RES	🟫	115	Mohr-Coulomb	200	20		
Clay (CH) Alluvium RES	🟨	115	Mohr-Coulomb	200	15		

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.47
Factor of Safety: 1.47
Axis Location: 25.299, 498.970
Left Slip Surface Endpoint: 20.252, 415.460
Right Slip Surface Endpoint: 89.079, 444.826
Left Slope Intercept: 20.252 417.000
Right Slope Intercept: 89.079 444.826

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SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

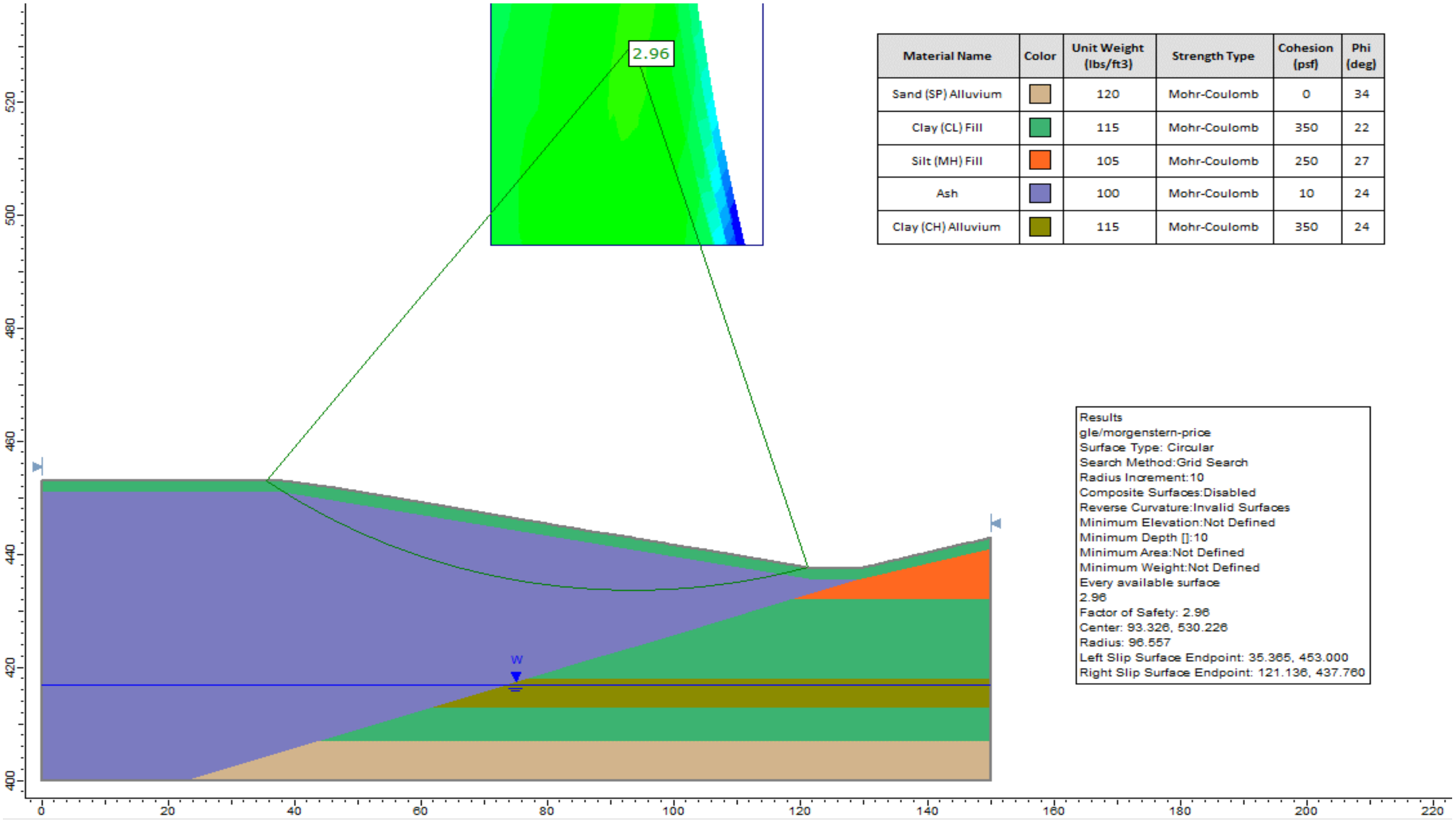
TITLE **Cross-Section C-C' Post-Liquefaction Conditions - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **26**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 2.96



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
2.96
Factor of Safety: 2.96
Center: 93.326, 530.226
Radius: 96.557
Left Slip Surface Endpoint: 35.365, 453.000
Right Slip Surface Endpoint: 121.136, 437.760

Golder Associates
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SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB
FILE	STABILITY
PROJECT No.	154-7197-01
REV.	0

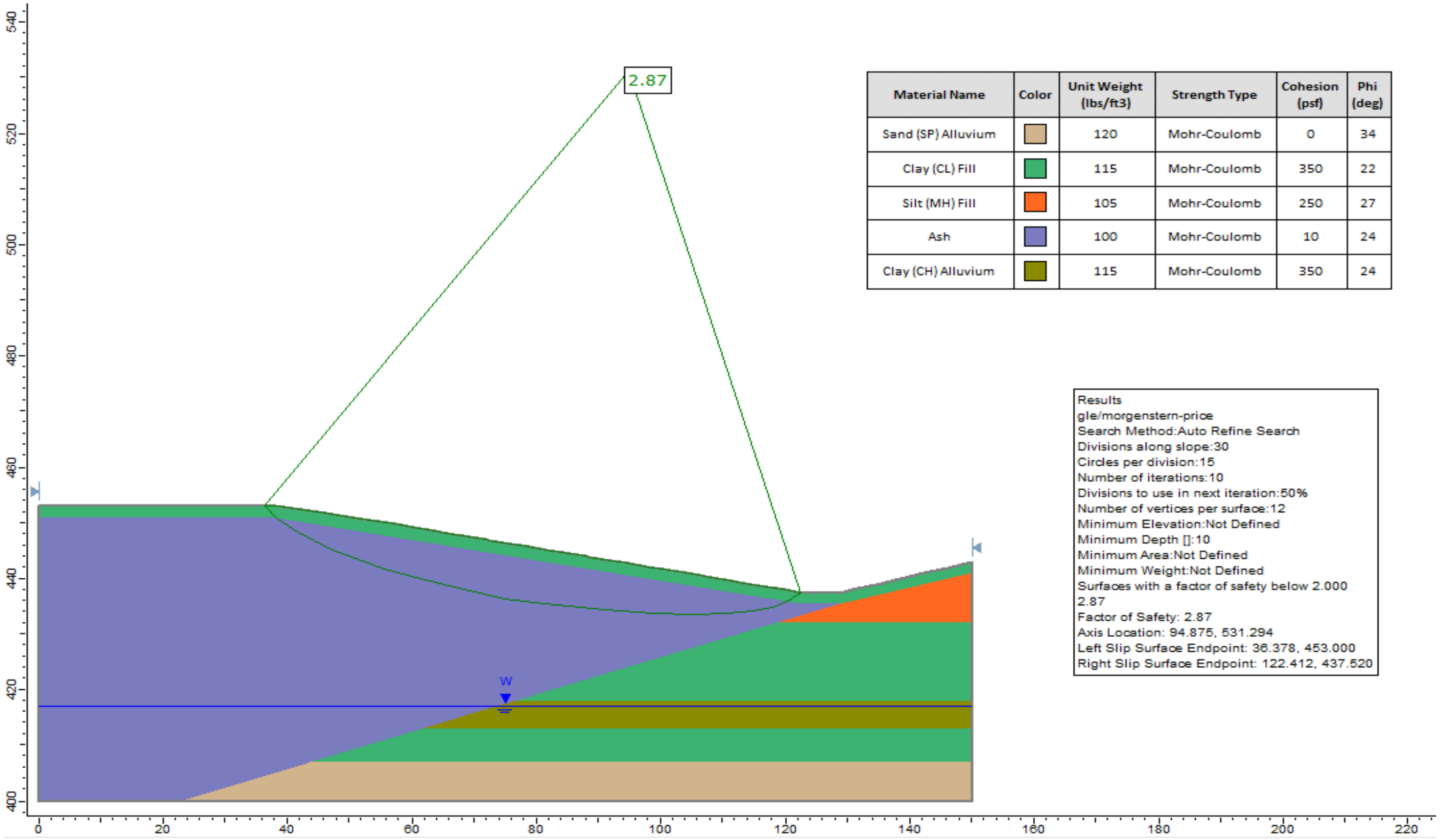
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section D-D' Long-Term Steady State Loading - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **27**

Minimum
FS = 2.87



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24

```
Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
2.87
Factor of Safety: 2.87
Axis Location: 94.875, 531.294
Left Slip Surface Endpoint: 36.378, 453.000
Right Slip Surface Endpoint: 122.412, 437.520
```

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SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB
FILE	STABILITY
PROJECT No.	154-7197-01
REV.	0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

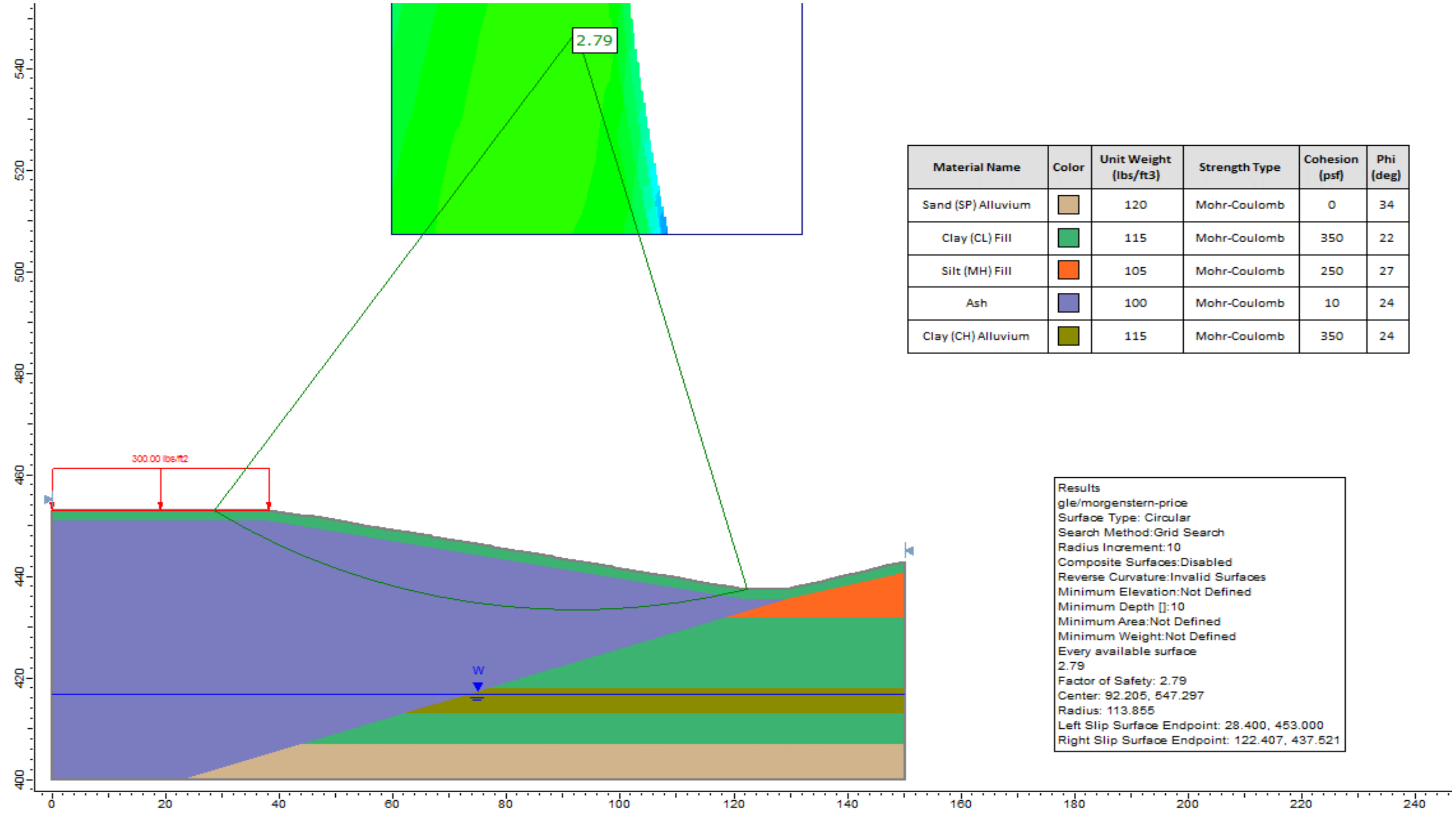
TITLE

Cross-Section D-D' Long-Term Steady State Loading - Non-Circular Failure Plane

CLIENT **Ameren - Missouri**

FIGURE **28**

Minimum
FS = 2.79



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24

```
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
2.79
Factor of Safety: 2.79
Center: 92.205, 547.297
Radius: 113.855
Left Slip Surface Endpoint: 28.400, 453.000
Right Slip Surface Endpoint: 122.407, 437.521
```

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB
FILE	STABILITY
PROJECT No.	154-7197-01
REV.	0

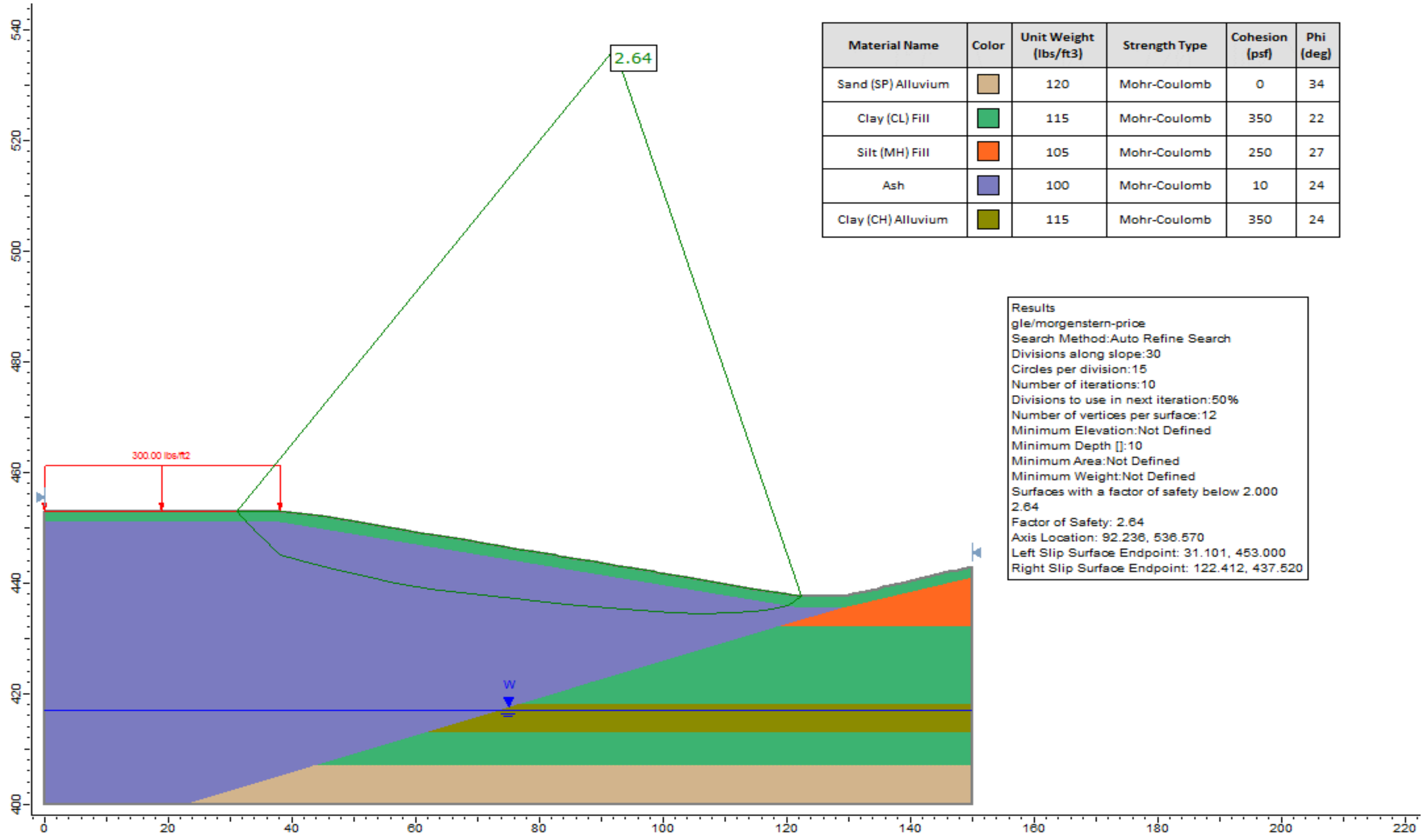
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section D-D' Steady State with Surcharges Loading - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **29**

Minimum
FS = 2.64



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟪	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
2.64
Factor of Safety: 2.64
Axis Location: 92.236, 536.570
Left Slip Surface Endpoint: 31.101, 453.000
Right Slip Surface Endpoint: 122.412, 437.520

Golder Associates
Golder Associates Inc.

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

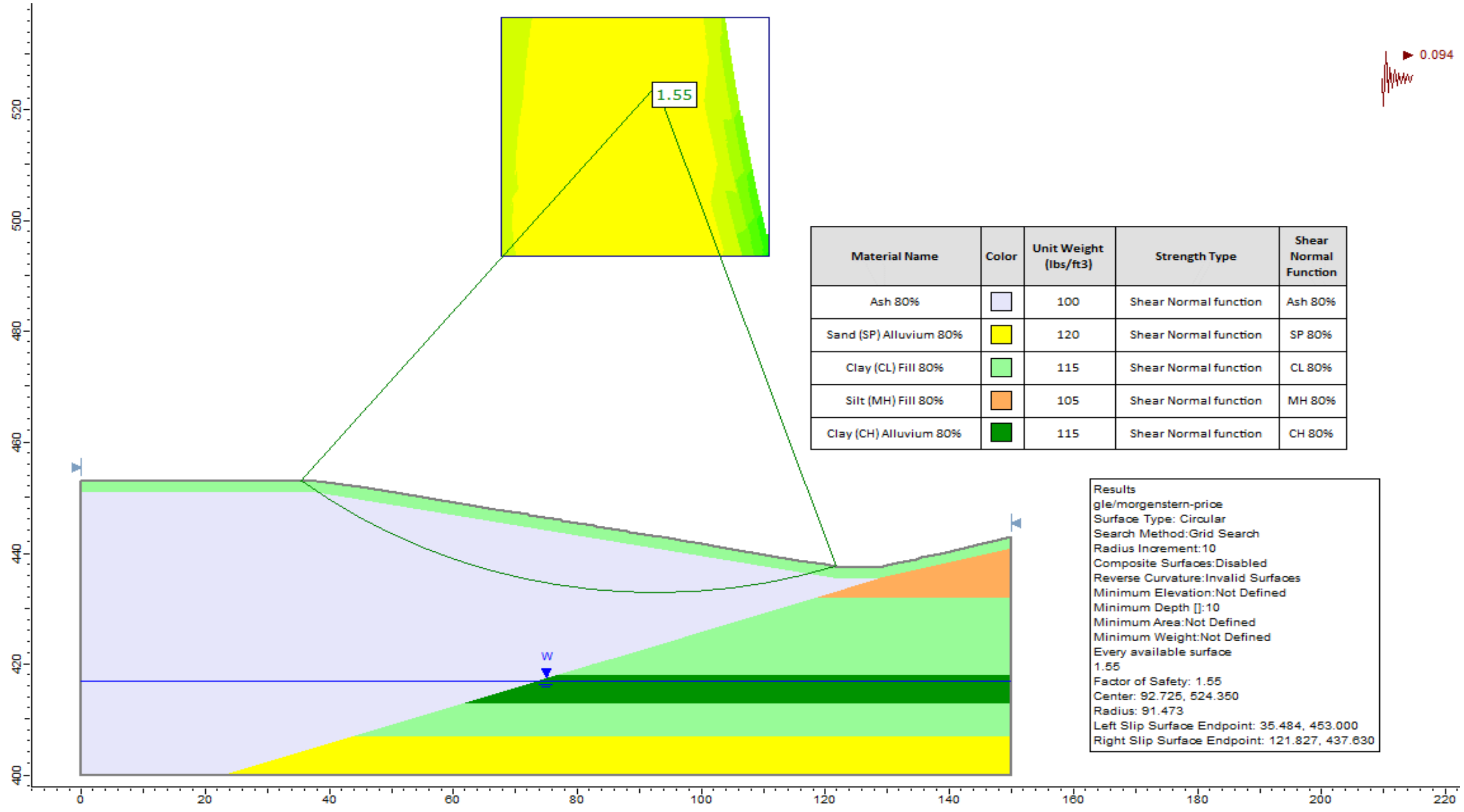
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section D-D' Steady State with Surcharges Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **30**

Minimum
FS = 1.55



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Silt (MH) Fill 80%	🟧	105	Shear Normal function	MH 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%

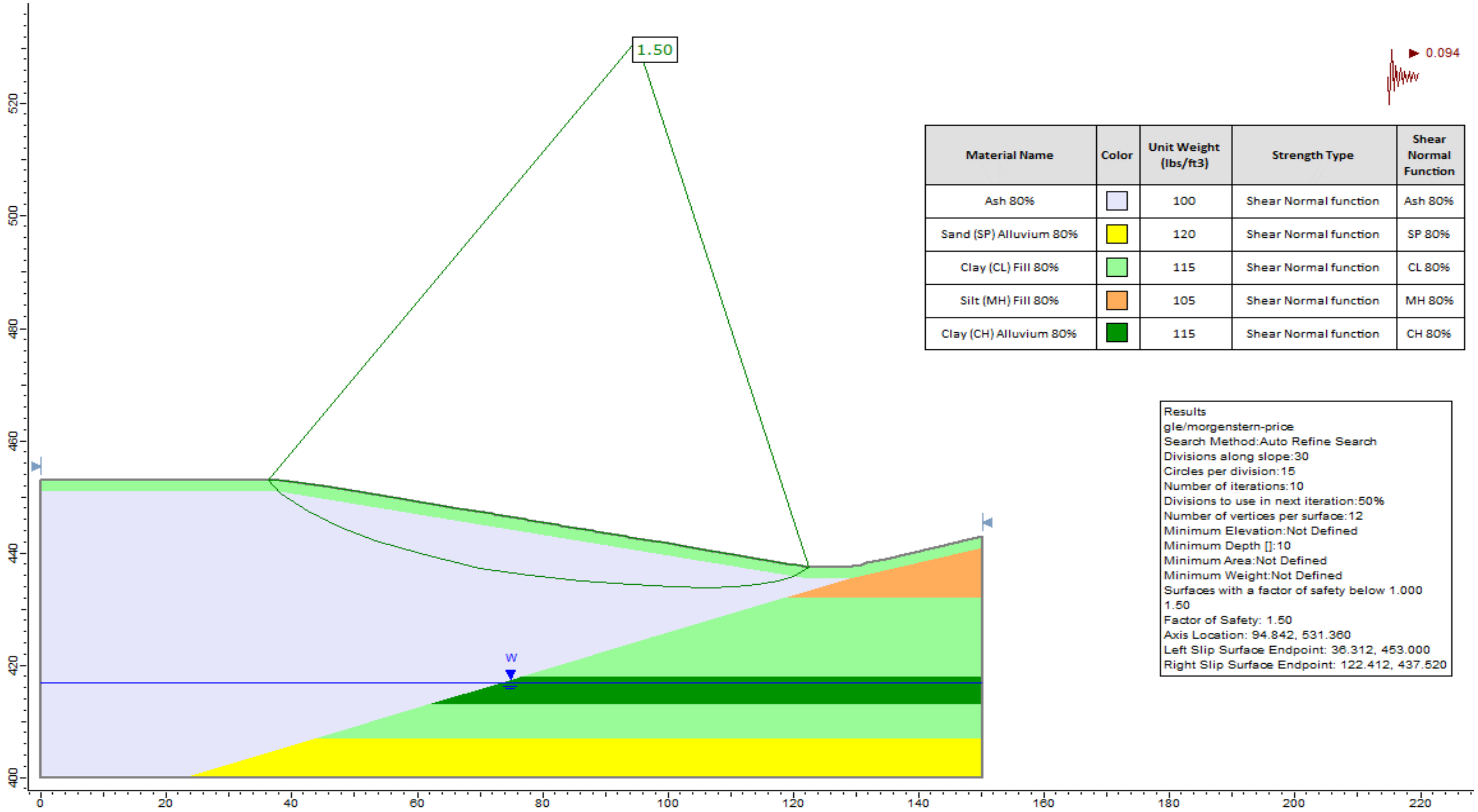
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.55
Factor of Safety: 1.55
Center: 92.725, 524.350
Radius: 91.473
Left Slip Surface Endpoint: 35.484, 453.000
Right Slip Surface Endpoint: 121.827, 437.630

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section D-D' Pseudo-Static Seismic Loading - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**31**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.50



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Silt (MH) Fill 80%	🟧	105	Shear Normal function	MH 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.50
Factor of Safety: 1.50
Axis Location: 94.842, 531.360
Left Slip Surface Endpoint: 36.312, 453.000
Right Slip Surface Endpoint: 122.412, 437.520

Golder Associates
Golder Associates Inc.

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

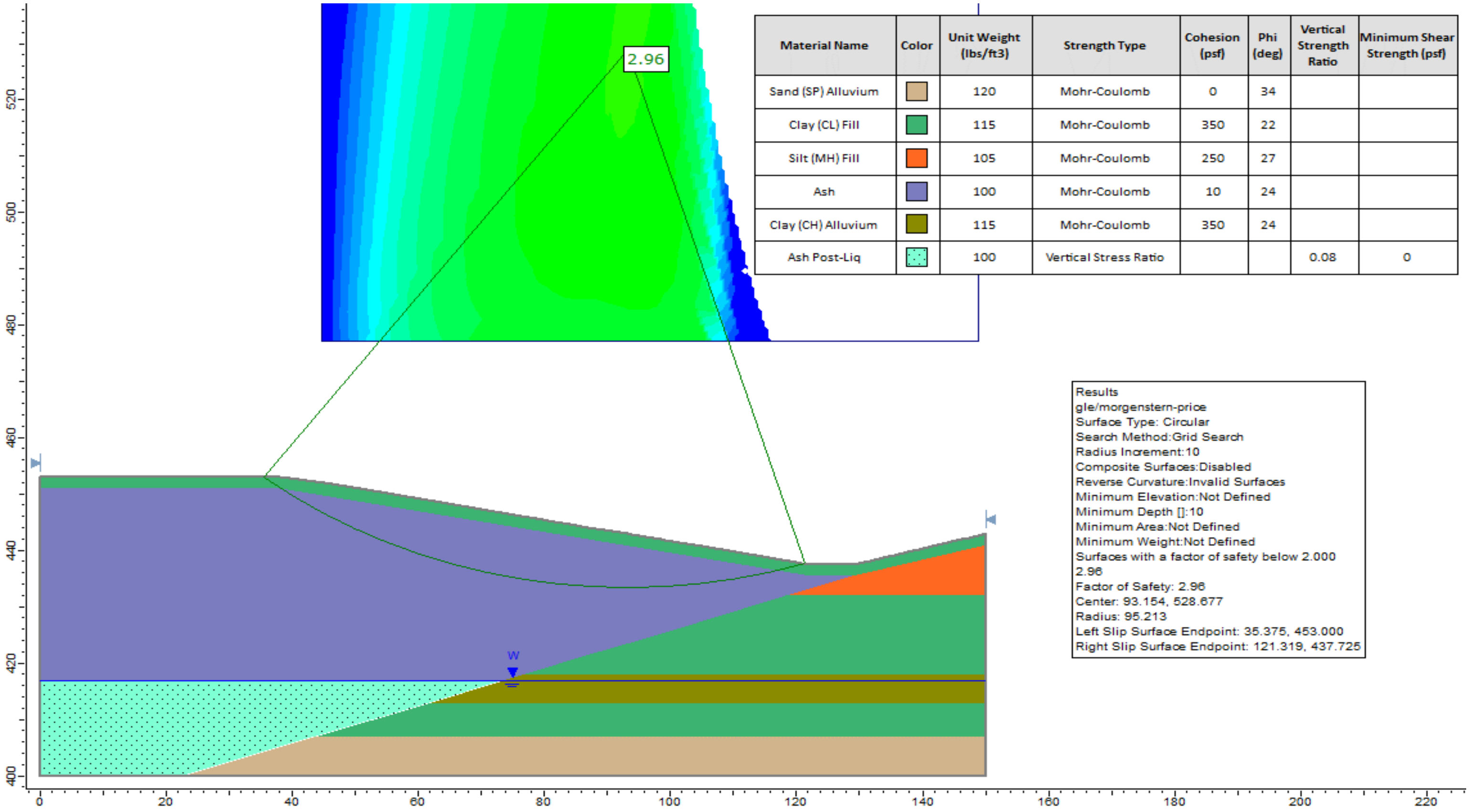
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section D-D' Pseudo-Static Seismic Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **32**

Minimum
FS = 2.96



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Ash	🟪	100	Mohr-Coulomb	10	24		
Clay (CH) Alluvium	🟩	115	Mohr-Coulomb	350	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
2.96
Factor of Safety: 2.96
Center: 93.154, 528.677
Radius: 95.213
Left Slip Surface Endpoint: 35.375, 453.000
Right Slip Surface Endpoint: 121.319, 437.725

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

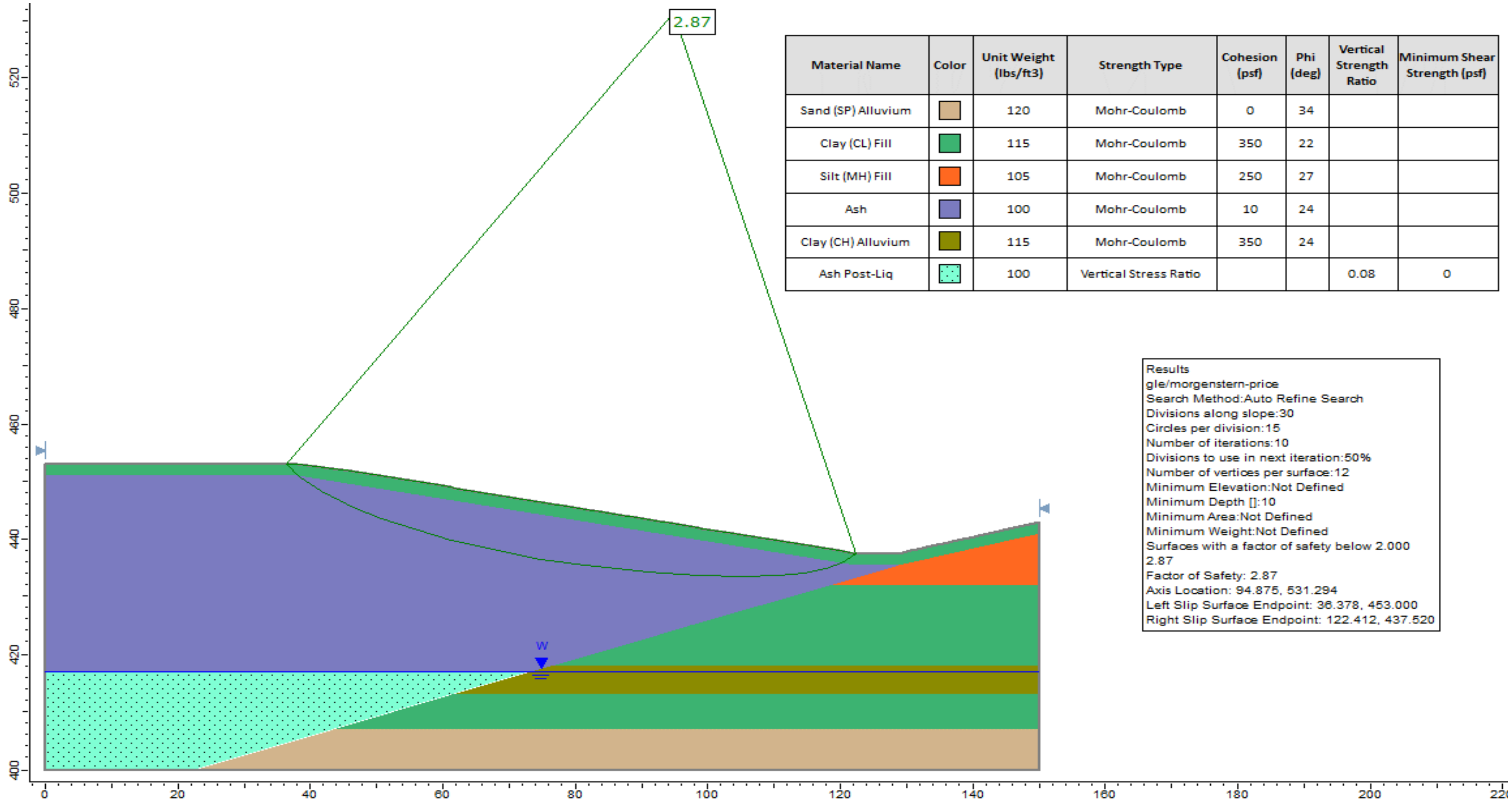
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section D-D' Post-Liquefaction Conditions - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **33**

Minimum
FS = 2.87



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Ash	🟪	100	Mohr-Coulomb	10	24		
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
2.87
Factor of Safety: 2.87
Axis Location: 94.875, 531.294
Left Slip Surface Endpoint: 36.378, 453.000
Right Slip Surface Endpoint: 122.412, 437.520

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE

Cross-Section D-D' Post-Liquefaction Conditions - Non-Circular Failure Plane

CLIENT **Ameren - Missouri**

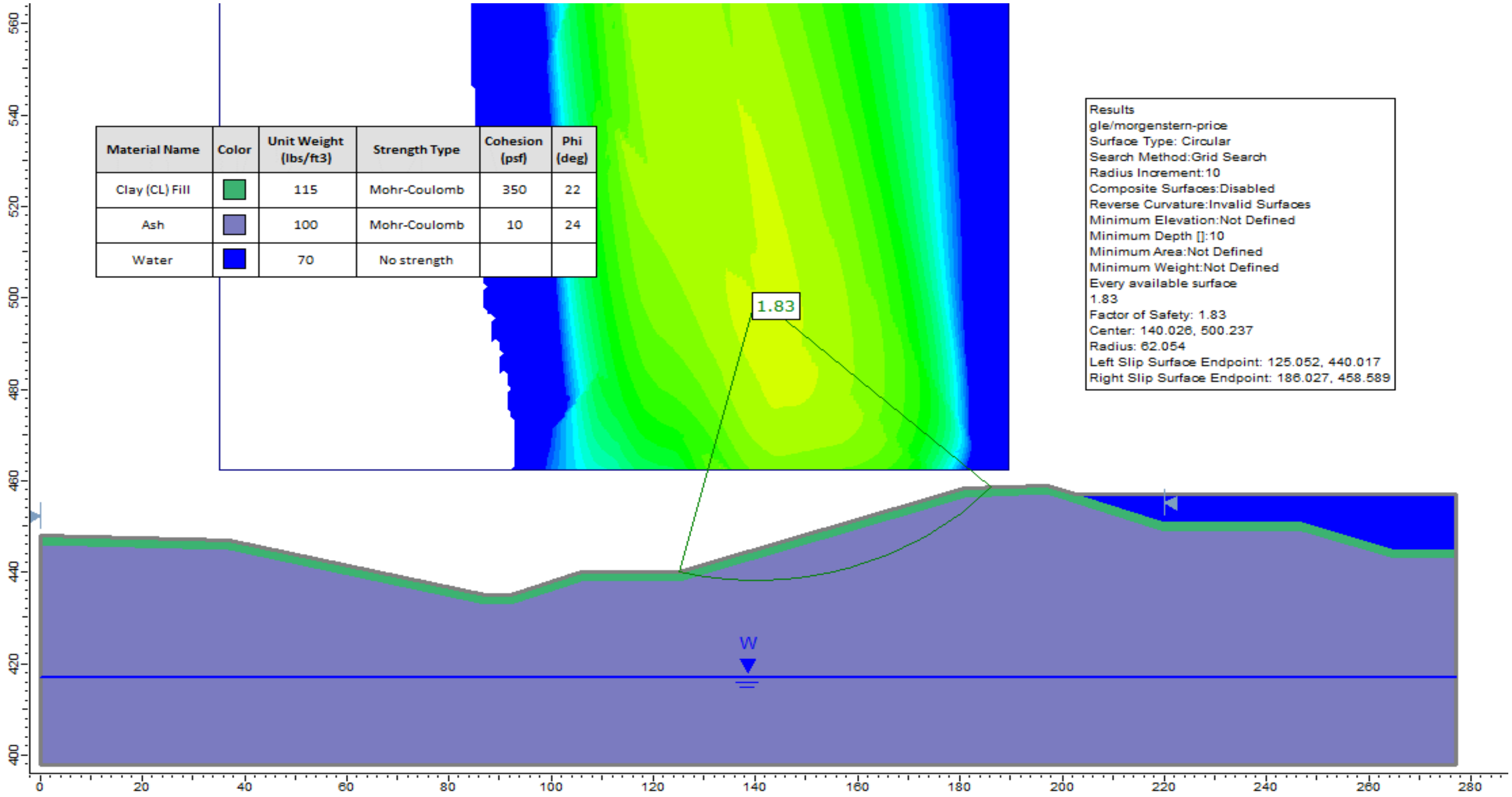
FIGURE **34**

FILE STABILITY

PROJECT No. 154-7197-01

REV. 0

Minimum
FS = 1.83



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟪	100	Mohr-Coulomb	10	24
Water	🟦	70	No strength		

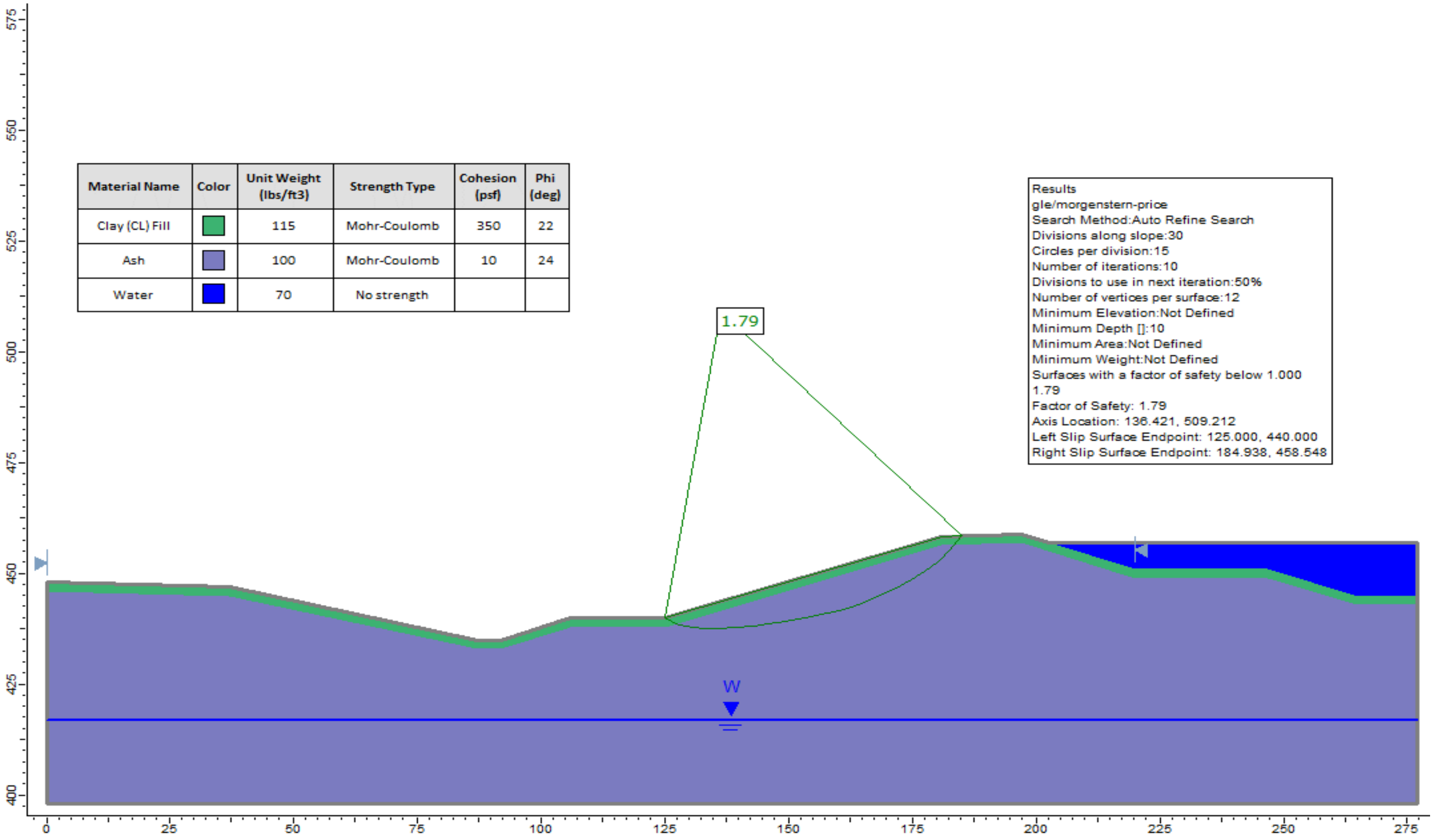
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.83
Factor of Safety: 1.83
Center: 140.026, 500.237
Radius: 62.054
Left Slip Surface Endpoint: 125.052, 440.017
Right Slip Surface Endpoint: 186.027, 458.589

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**
DATE	Jan 2018	TITLE	**Cross-Section E-E' Long-Term Steady State Loading - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**
REVIEW	KMB	FIGURE	**35**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.79



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟪	100	Mohr-Coulomb	10	24
Water	🟦	70	No strength		

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.79
Factor of Safety: 1.79
Axis Location: 136.421, 509.212
Left Slip Surface Endpoint: 125.000, 440.000
Right Slip Surface Endpoint: 184.938, 458.548

Golder Associates
Golder Associates Inc.

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK PJJ/AGC
REVIEW KMB

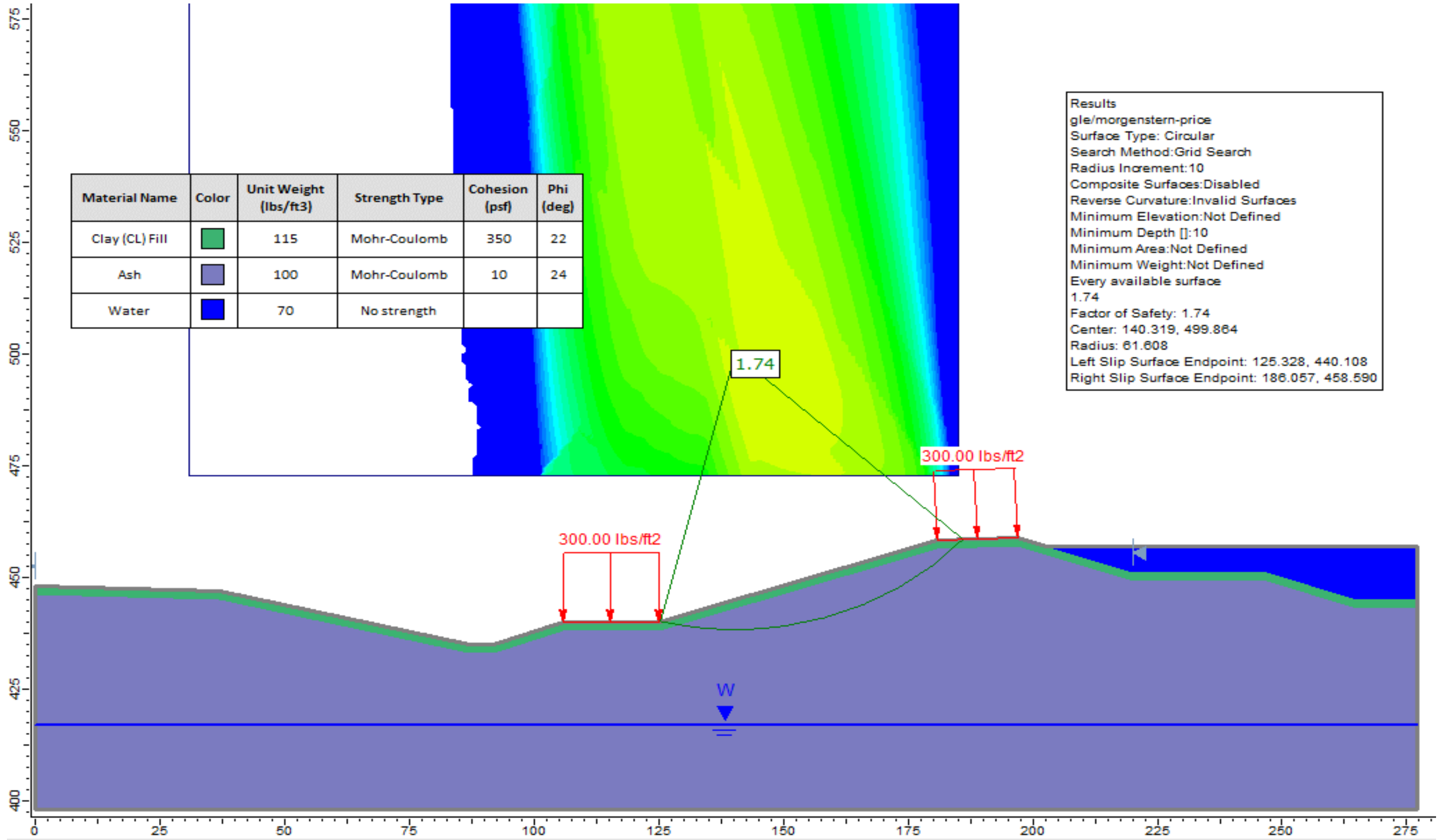
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section E-E' Long-Term Steady State Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **36**

Minimum
FS = 1.74



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟪	100	Mohr-Coulomb	10	24
Water	🟦	70	No strength		

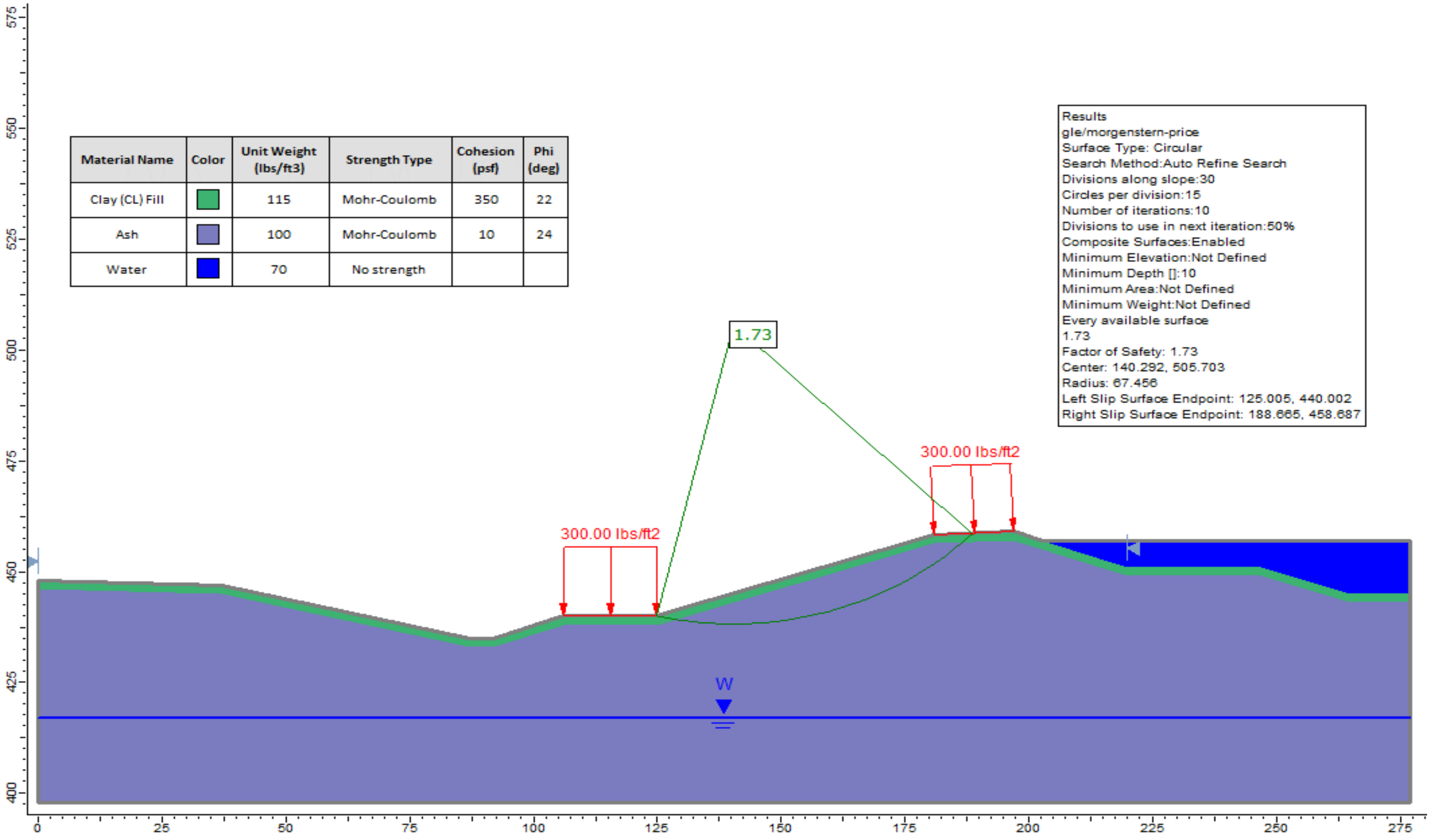
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.74
Factor of Safety: 1.74
Center: 140.319, 499.864
Radius: 61.608
Left Slip Surface Endpoint: 125.328, 440.108
Right Slip Surface Endpoint: 186.057, 458.590

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	Sioux Energy Center - CCR Pond Closures - SCPA
DATE	Jan 2018	TITLE	Cross-Section E-E' Steady State with Surcharges Loading - Circular Failure Plane
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	Ameren - Missouri
REVIEW	KMB	FIGURE	37

FILE STABILITY
PROJECT No. 154-7197-01 REV. 0

Minimum
FS = 1.73



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Ash	🟪	100	Mohr-Coulomb	10	24
Water	🟦	70	No strength		

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Composite Surfaces:Enabled
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.73
Factor of Safety: 1.73
Center: 140.292, 505.703
Radius: 67.456
Left Slip Surface Endpoint: 125.005, 440.002
Right Slip Surface Endpoint: 188.665, 458.687

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB

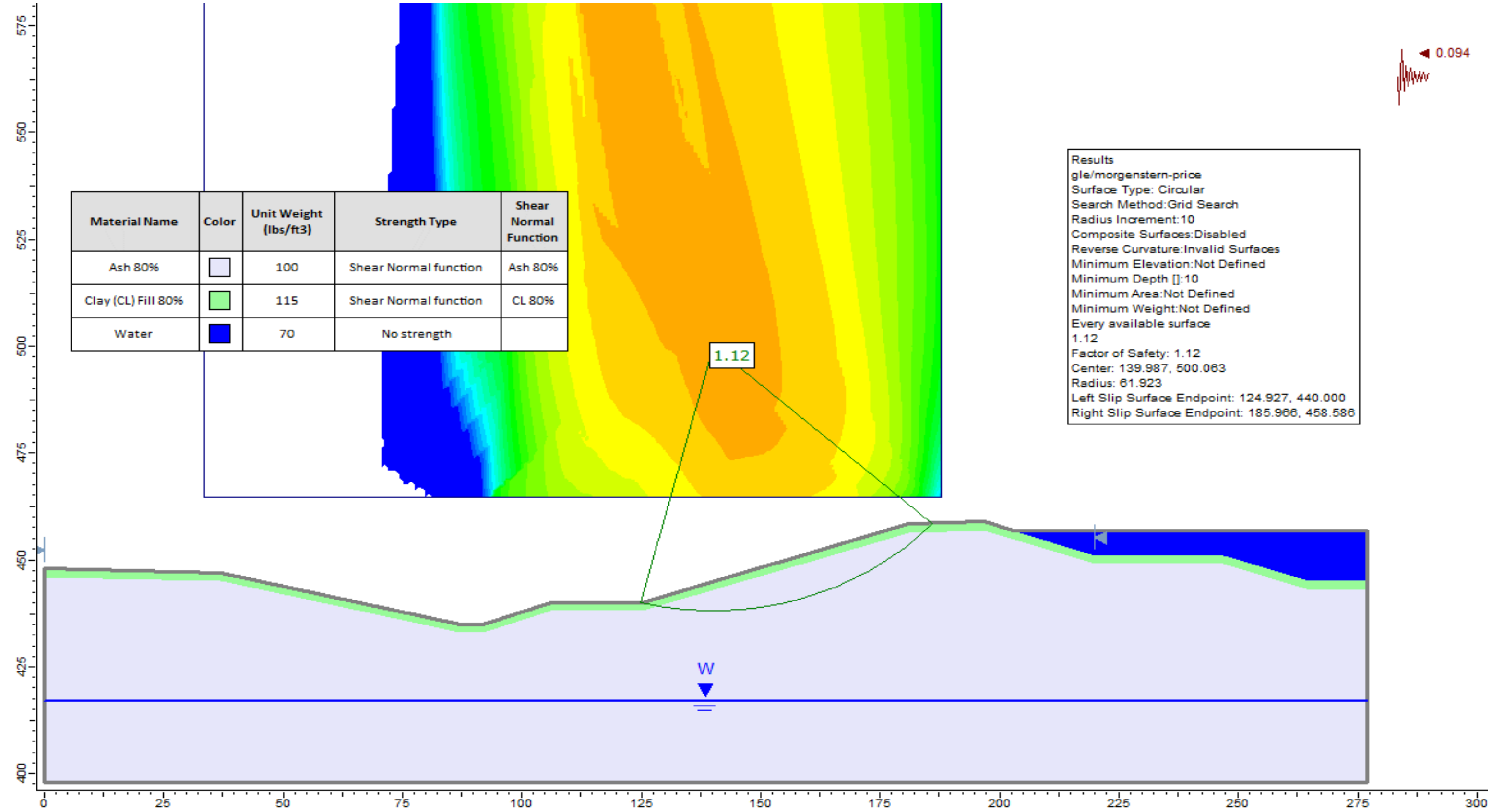
FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

TITLE **Cross-Section E-E' Steady State with Surcharges Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **38**



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Water	🟦	70	No strength	

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.12
Factor of Safety: 1.12
Center: 139.987, 500.063
Radius: 61.923
Left Slip Surface Endpoint: 124.927, 440.000
Right Slip Surface Endpoint: 185.966, 458.586

Minimum
FS = 1.12

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	PJJ/AGC
REVIEW	KMB
FILE	STABILITY
PROJECT No.	154-7197-01
REV.	0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPA**

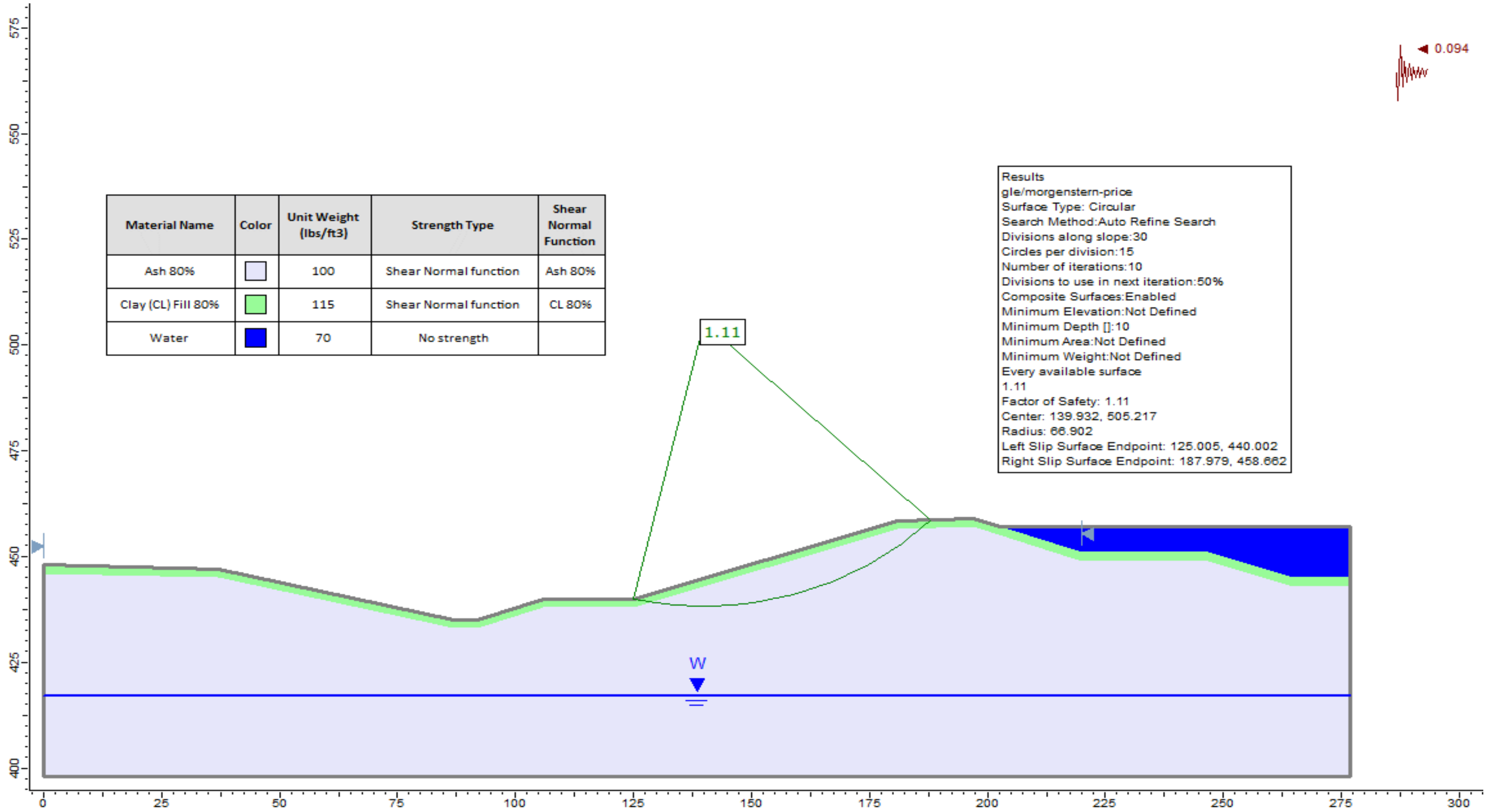
TITLE

Cross-Section E-E' Pseudo-Static Seismic Loading - Circular Failure Plane

CLIENT **Ameren - Missouri**

FIGURE **39**

Minimum
FS = 1.41



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	☐	100	Shear Normal function	Ash 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Water	🟦	70	No strength	

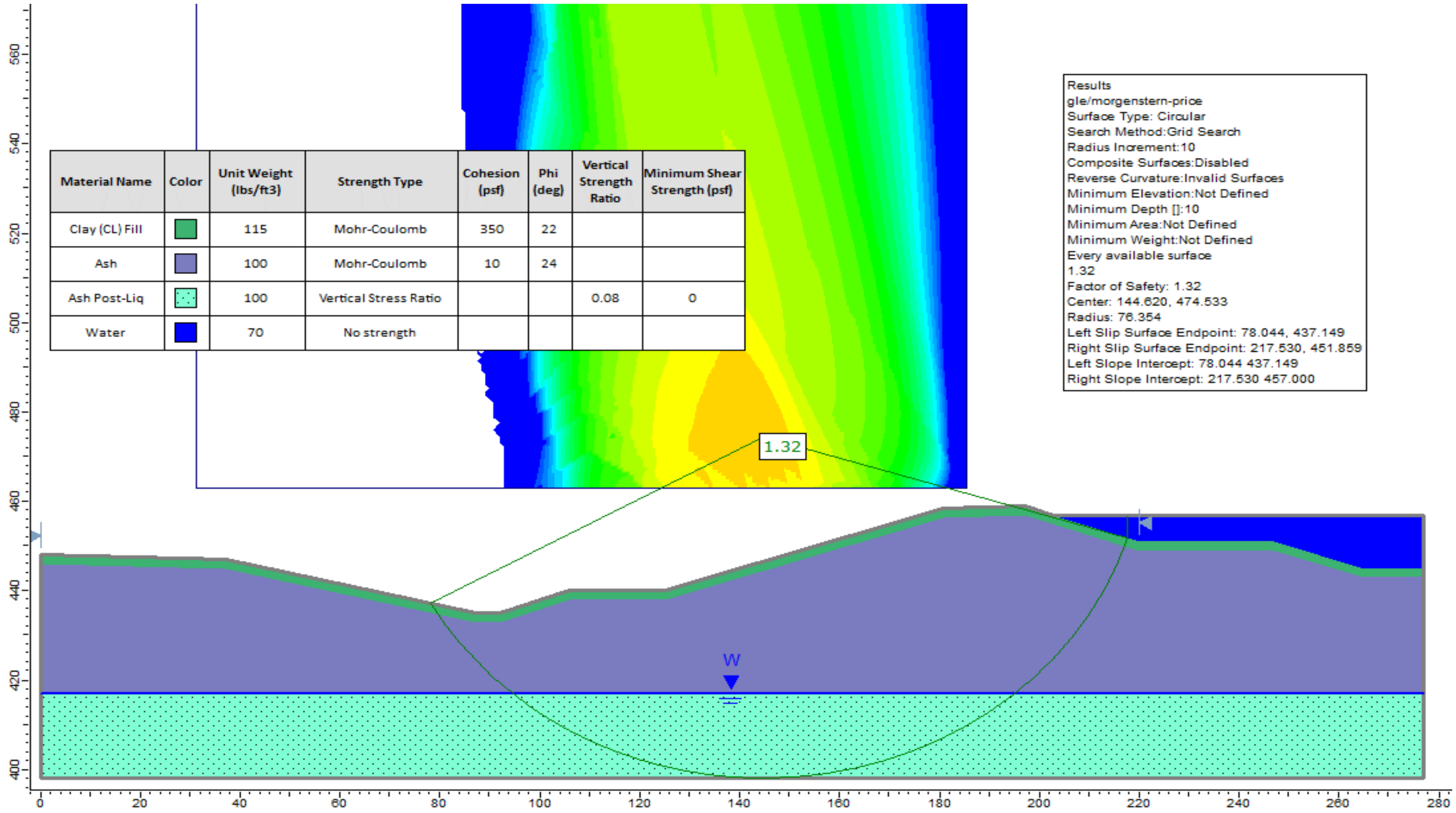
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Composite Surfaces:Enabled
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.11
Factor of Safety: 1.11
Center: 139.932, 505.217
Radius: 66.902
Left Slip Surface Endpoint: 125.005, 440.002
Right Slip Surface Endpoint: 187.979, 458.662

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	Sioux Energy Center - CCR Pond Closures - SCPA
DATE	Jan 2018	TITLE	Cross-Section E-E' Pseudo-Static Seismic Loading - Non-Circular Failure Plane
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	Ameren - Missouri
REVIEW	KMB	FIGURE	40

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.32



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Ash	🟪	100	Mohr-Coulomb	10	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Water	🟦	70	No strength				

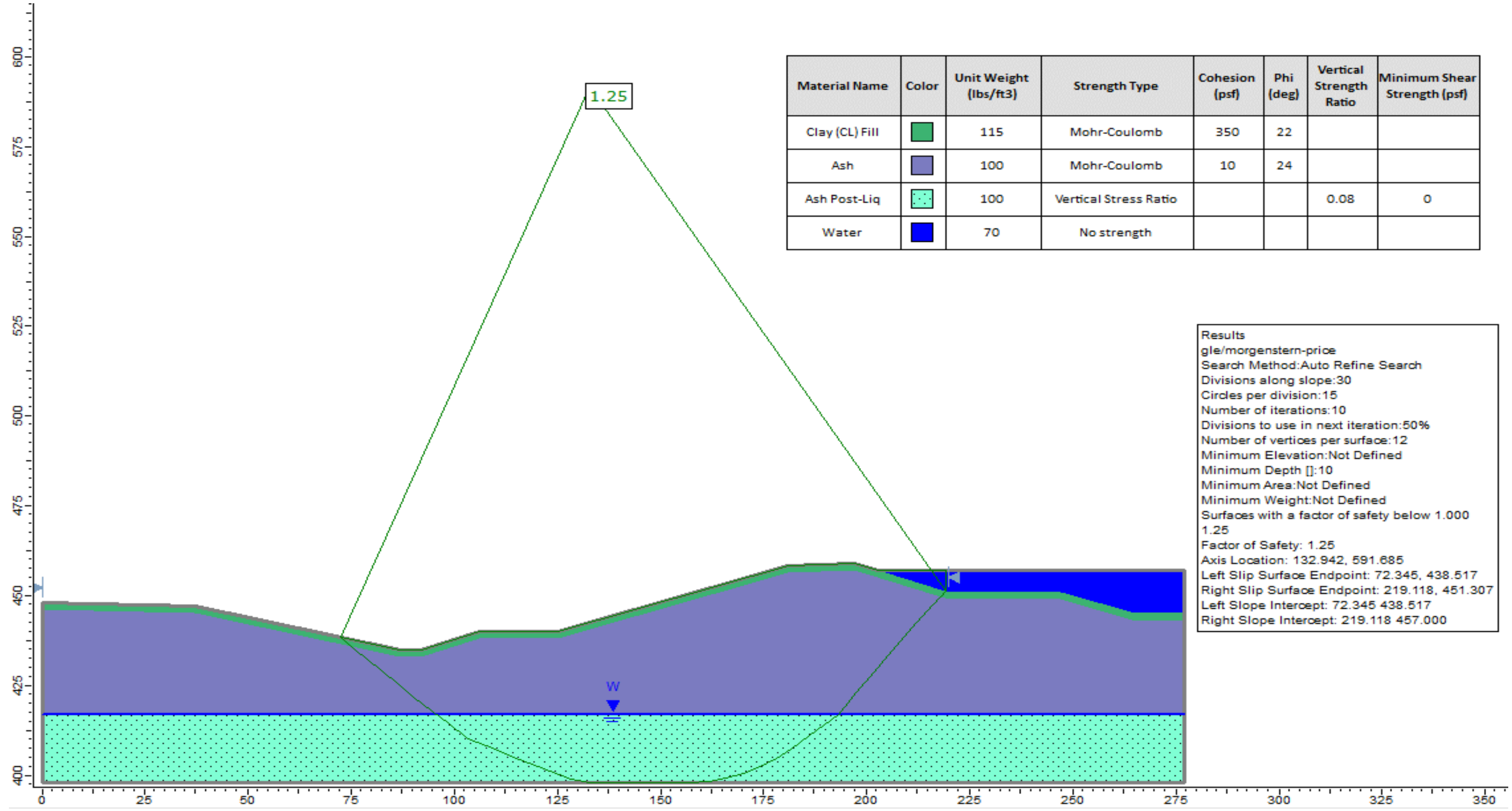
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.32
Factor of Safety: 1.32
Center: 144.620, 474.533
Radius: 76.354
Left Slip Surface Endpoint: 78.044, 437.149
Right Slip Surface Endpoint: 217.530, 451.859
Left Slope Intercept: 78.044 437.149
Right Slope Intercept: 217.530 457.000

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPA**		
DATE	Jan 2018	TITLE	**Cross-Section E-E' Post-Liquefaction Conditions - Circular Failure Plane**		
MADE BY	MSG				
CAD	-				
CHECK	PJJ/AGC	CLIENT	**Ameren - Missouri**	FIGURE	**41**
REVIEW	KMB				

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.25



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Ash	🟪	100	Mohr-Coulomb	10	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Water	🟦	70	No strength				

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:10
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.25
Factor of Safety: 1.25
Axis Location: 132.942, 591.685
Left Slip Surface Endpoint: 72.345, 438.517
Right Slip Surface Endpoint: 219.118, 451.307
Left Slope Intercept: 72.345 438.517
Right Slope Intercept: 219.118 457.000

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	Sioux Energy Center - CCR Pond Closures - SCPA
DATE	Jan 2018	TITLE	Cross-Section E-E' Post-Liquefaction Conditions - Non-Circular Failure Plane
MADE BY	MSG		
CAD	-		
CHECK	PJJ/AGC	CLIENT	Ameren - Missouri
REVIEW	KMB	FIGURE	42

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

SUBJECT:	Sioux Energy Center - CCR Pond Closures - SCPB			
Job No.:	154-7197-01	**Prepared:**	MSG	
Location:	St. Charles County, MO	**Checked:**		
Date:	Jan-04-2018	**Reviewed:**		

Slope Stability Analyses for the Closure of SCPB

Objective:

Evaluate the static and pseudo-static stability of the dam impoundments and critical cross-sections within the closure system at the Ameren-Missouri Sioux Energy Center for SCPB (Fly Ash Pond) for the CCR pond closure design.

References:

Reference No.	Source of Information
1	EPA. - Coal Combustion Waste Impoundment Round 7 - Dam Assessment Report - Sioux Power Station - Ameren Missouri - Final
2	Golder Associates, Inc. (Golder) - 2015 Ameren Groundwater Monitoring Program - MO - Well Installation
3	PDF format As-Built provided by Ameren (SX-DWG-PROP-000001) dated 06-14-2011
4	PDF format As-Built provided by Ameren (8430- X-128772) dated 03-30-1993
5	Golder Associates, Inc. (Golder) - Previous experience with CCR
6	PDF Format - As-Built provided by Ameren (SX-8420-X-182002) dated 01-04-2013
7	PDF Format - Utility Waste Landfill - Proposed Construction Permit Modification - Construction Permit # 0918301 (SX-2014-PMT-001 Rev. 000) Dated August 2014, Reitz & Jens
8	PDF Format - Physical Engineering Properties of CCP (#2008012455) dated 01-24-2011, Reitz & Jens
9	PDF Format - Cell 4A CQA Summary Report for Phase 3 (#2009012470) dated 05-24-2014, Reitz & Jens
10	PDF Format - EPRI Field Evaluation/Comanagement Document (TR-108409) dated 09-1998
11	PDF Format - Wet FGD Retrofit (#2006012481) dated 05-31-2006, Reitz & Jens
12	PDF Format - Proposed Material Handling Facility dated 09-05-2000, URS
13	PDF Format - Ameren DSI Final - Detailed Geologic and Hydrologic Site Investigation Report dated 08-2006, GREDELL Engineering Resources, Inc.
14	Golder Associates, Inc. (Golder) - Field and Laboratory Investigation Data (2016)
15	PDF Format - Test Boring Report, Raymond Concrete Pile Company, dated 1963
16	Abramson, L.W. et al; "Slope Stability and Stabilization Methods"; 2nd Edition; Wiley; 2002
17	Hynes-Griffin, M.E. and Franklin, A.G. (1984), "Rationalizing the Seismic Coefficient Method, " Miscellaneous Paper GL-84-13, U.S. Army Engineer Waterways Experiment Station, Vicksbug, Mississippi, 34p.
18	Rocscience (2016), SLIDE Version 7.021 64-bit
19	United States Geological Society (USGS) online hazard mapping website (http://earthquake.usgs.gov/research/hazmaps/design/).
20	Golder Associates, Inc. (Golder) - Basis of Design - Fly Ash Pond Modification (2016)
21	Golder Associates, Inc. (Golder) - Basis of Design - CCR Pond Closures (2018)
22	Boulanger & Idriss (2004); Evaluating the Potential for Liquefaction or Cyclic Failure of Silts and Clays
23	Boulanger & Idriss (2005); Evaluating Cyclic Failure in Silts and Clays
24	Boulanger & Idriss (2007); Evaluation of Cyclic Softening in Silts and Clays
25	Olson, SM; Stark, TD (2002); Liquefied Strength Ratio from Liquefaction Flow Failure Case Histories
26	Wright, SG; Zornberg, JG; Aguettant, JE (2007); The Fully Softened Shear Strength of High Plasticity Clays

Analysis Sections:

Analyses performed included the loading conditions based on the 40 CFR Parts 257 & 261 (EPA Final CCR Rule) and included: (1) Long-Term Steady State Static (Maximum Storage Pool), (2) Steady State with Surcharges Static (Maximum Surcharge Pool), (3) Seismic (Pseudo-static), and (4) Post-Liquefaction. Undrained (End-of-Construction) conditions were not considered for the berm slopes due to no new construction for closure.

Notes for the loading conditions:
(1) Long-Term Steady State Static conditions considered the maximum pool height experienced and expected in the ash pond prior to closure. Water levels in the pond are artificially elevated due to plant discharges and will recede when pond operations cease.
(2) Steady State with Surcharges looks at conditions with a uniform 300 lbs/ft^2 surcharge representing equipment and other construction operations during closure on top of the berm and closure cap.
(3) For Pseudo-static Limit Equilibrium method, see next section of report.
(4) Post-liquefaction conditions assessed the closure system with the expectations that the ash would liquefy and the shear strength reduction of the materials within the berm. Cohesive materials were reduced to residual strength conditions (a conservative approach; conceptualized by Boulanger & Idriss 2004, 2005, 2007) and non-cohesive contractive materials were reduced to cyclic softened conditions, if applicable (per Olson and Stark (2002). Estimation of the residual strength for cohesive materials used an empirical method developed by Wright et al (2007) based on liquid limit, confining stresses, and effective friction angles from the field investigations and laboratory testing results. Subsequent sections below (Liquefied Shear Strength of Non-Cohesive Materials and Liquefied Shear Strength of Cohesive Materials) show the values used for the cohesive and non-cohesive materials, respectively. The sand/silt fill layers in the top portion of the berms were not evaluated due to the material being unsaturated (above the expected piezometric line) and state of practice considers unsaturated material to have a very low potential for liquefaction during a seismic event.

Analysis Methods:

Slope stability was evaluated using the computer program SLIDE Version 7.030 64-bit (Rocscience, 2017) using the generalized limit equilibrium method of stability analysis developed by Morgenstern and Price (Abramson et al., 2002). Circular and block search patterns were used to find the failure surface, which resulted in a minimum calculated factor of safety for the preliminary desktop review. Static and pseudo-static methods were performed during the analyses.

Pseudo-static limit equilibrium analyses were conducted to evaluate the stability of the proposed slope under seismic loads for earthquake hazards. Pseudo-static stability analyses apply a constant horizontal force to the system to represent the forces generated during an earthquake event, with the magnitude of the applied force typically related to the peak ground acceleration (PGA) of a specific earthquake hazard risk. A pseudo-static limit equilibrium analysis was conducted to evaluate the stability of the containment berms under a seismic load for the earthquake hazard representing a 2% probability of exceedance in 50 years (equaling 0.187g; i.e. a return period of 2475 years) based on the United States Geological Survey (USGS) Hazard Maps. The seismic hazard as determined from the USGS 2014 Hazard Maps and Data for 2% probability of exceedance in 50 years is presented in Figure 1A. Figure 1B shows the USGS 2008 Deggregation plot for reference. As recommended by Hynes-Griffin and Franklin (1984), a horizontal force of 1/2 of the maximum PGA (EPA 1995) was used in this analysis (0.094g). In addition, the shear strength properties of the ash were reduced by 20% per the method's requirements.

Material Properties:

The material properties outlined in the Basis of Design were used in the this stability analysis. For the Basis of Design material properties, the values were obtained by considering a combination of the following: a) Laboratory soil tests by Golder Associates Inc. (Golder) from samples obtained in March/April 2016, b) Standard Penetration (SPT) testing performed by Golder in March/April 2016, c) Golder's May 23, 2018 Basis of Design, d) EPA Final Closure Report (2011), e) Laboratory soil tests reported by URS, f) Original Plant Construction Borings (Raymond,1963), g) Reitz & Jens Geotechnical Reports, h) published typical values for the observed soil and rock types, i) published engineering correlations between in-situ data and characteristic soil and rock properties, and j) Golder's professional experience. Table 1 summarizes the soil/material parameters used for the stability analyses.

Table 1. Golder's Basis of Design Soil / Material Parameters

Material	Shear Strength				In-situ Unit Weight (lb/ft^3)	Source (Resources)
	Effective Friction Angle (degrees)	Effective Cohesion (lb/ft^2)	Total Friction Angle (degrees)	Total Cohesion (lb/ft^2)		
Ash	24	10	12	400	100	(1), (5), (8), (10), (20)
Clay (CL) Fill	22	350	0	600	115	(9), (11), (12), (14), (15), (21)
Silt (MH) Fill	27	250	0	600	105	(9), (11), (12), (14), (15), (21)
Sand (SP) Fill	31	0	28	0	110	(9), (11), (12), (14), (15), (21)
Clay (CH) Alluvium	24	350	0	500	115	(9), (11), (12), (14), (15), (21)
Silt (MH) Alluvium	27	250	0	600	105	(9), (11), (12), (14), (15), (21)
Sand (SP) Alluvium	34	0	30	0	120	(9), (11), (12), (14), (15), (21)

Note: Sands contain minor amounts of cohesive material.

Liquefied Shear Strength of Non-Cohesive Materials:

Post-liquefaction analysis and liquefied shear strength for non-cohesive materials was evaluated by reviewing SPT blow counts and using the empirical method outlined by Olson & Stark (2002) for SPT N values. The equation below was used to evaluate the liquefaction potential of the saturated sands and contained ash within the SCPA boundaries. Ash within the containment berms is potentially liquefiable. A vertical stress ratio of 0.08 has been established for ash based on Golder's experience and was applied to the model for analysis for post-liquefcation conditions. Olson & Stack provide the SPT blow count range of 15 to 20 as the transition between contractive (liquefiable) sands and dilatative (non-liquefiable) sands. Alluvial sands in the area appear to be dilative in nature due to an average blow count of 21 and therefore considered non-liquefiable.

Olson & Stark (2002) Equation

$$[19b] \quad \frac{s_u(\mathrm{LIQ})}{\sigma'_{vo}} = 0.03 + 0.0075[(N_1)_{60}] \pm 0.03$$

for $(N_1) \lesssim 12$

where:

s_u = liquefied undrained stear strength
$(N_1)_{60}$ = corrected SPT blow counts
σ'_{vo} = effective overburden pressure
s_u / σ'vo = vertical stress ratio

Liquefied Shear Strength of Cohesive Materials:

Post-liquefaction analysis and liquefied shear strength for cohesive materials was evaluated using the empirical method outlined by Wright et al (2007) for liquid limit (LL) values. Cohesive materials that may experience seismic strength reduction exist between EL 442 and EL 390. The materials at this elevation range are a low plasticity clay Clay (CL) Fill RES and a high plasticity Clay (CH) Alluvium RES. Analysis used the liquid limits of these materials, confining stresses at the top and bottom depths of each material layer, and applied the values in the method's equation to determine the estimated reduced shear strength.

Wright et al (2007) Equation

$$\varphi_{\mathrm{secant,r}} = 52.5° - 21.3°\log_{10}(\omega_{LL}) - 3°\log_{10}\left(\frac{\sigma'_f}{p_a}\right) \tag{8.1}$$

where:

ϕ'_{secant} = secant friction angle
ω_{LL} = liquid limit (Atterberg limits)
σ'_f = effective overburden pressure
p_a = atmospheric pressure

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SUBJECT:	Sioux Energy Center - CCR Pond Closures - SCPB			
Job No.:	154-7197-01	**Prepared:**	MSG
Location:	St. Charles County, MO	**Checked:**	
Date:	Jan-04-2018	**Reviewed:**	

Investigation Data			
B-17-01		**PL**	**LL**
	CL	20	33
	CH	23	36
B-17-07			
	CH	56	92
B-17-11			
	CL	18	24
	CH	21	29
	MH	15	22
B-17-12			
	CH	13	38
B-17-13			
	CL	17	45
	CH	17	58
	MH	14	32
B-17-15			
	CH	15	53
B-17-16			
	CL	16	39
	CH	19	61

Liquid Limits (from Golder Borings)			
	CL	**CH**	**MH**
	33	36	22
	24	92	32
	29	38	
	45	58	
	39	53	
		61	

Geomean	33.20	52.18	26.53
Average	34	55.4	27

Note: The soil designation is based on Table 1 and not the classification from the laboratory data. The classification parameter was used to identify the associated soil layer in the model.

For MH soil 1			**For CL soil 2**			**For CH soil 3**		
σ_f =	1365	psf	σ_f =	2975	psf	σ_f =	3550	psf
p_a =	2116	psf	p_a =	2116	psf	p_a =	2116	psf
ω_{LL} =	26.53		ω_{LL} =	33.20		ω_{LL} =	52.18	
ϕ'_{secant} =	23		ϕ'_{secant} =		20	ϕ'_{secant} =		15

Note: Overburden pressure calculated at the bottom of each material layer.

Table 2. Post-Liquefaction Strength Values for Cohesive Materials

Material	Liquefied Shear Strength	
	Friction Angle	Cohesion
	(deg)	(psf)
Clay (CL) Fill RES	20	200
Clay (CH) Alluvium RES	15	200

Summary of Stability Analyses Results:

Tables 3 and 4 summarize the minimum required safety factors for the analyzed cross-sections using Basis of Design material properties. The tables list the minimum factor of safety for each slope and the factor of safety for a failure. For additional information, see the attached stability figures presented for each analysis case. Note that Cross-Sections A-A' is a cross-section that include the containment berm and consider global stability of the pond closure system and Cross-Section B-B' represents the critical section within the interior containment system.

Table 3. Calculated factors of safety - Slope Cross-Section A-A'

Slope Stability Case	Minimum Acceptable Factor of Safety	Calculated Factor of Safety		Evaluation	Figure(s)
		Circular	Non-Circular		
Long-Term Steady State	1.50	2.73	1.97	Satisfactory	3,4
Steady State with Surcharges	1.40	2.44	1.60	Satisfactory	5,6
Pseudo-Static Seismic	1.00	1.31	1.22	Satisfactory	7,8
Post-Liquefaction Conditions	1.20	2.73	1.97	Satisfactory	9,10

Note: Water Table Not Lowered to EL 428 for these Results. Lowering the water table will increase the calculated factor of safety for the above stability cases. Also, worse case with no interior storm water ditch analyzed for stability calculations.

Table 4. Calculated factors of safety - Slope Cross-Section B-B'

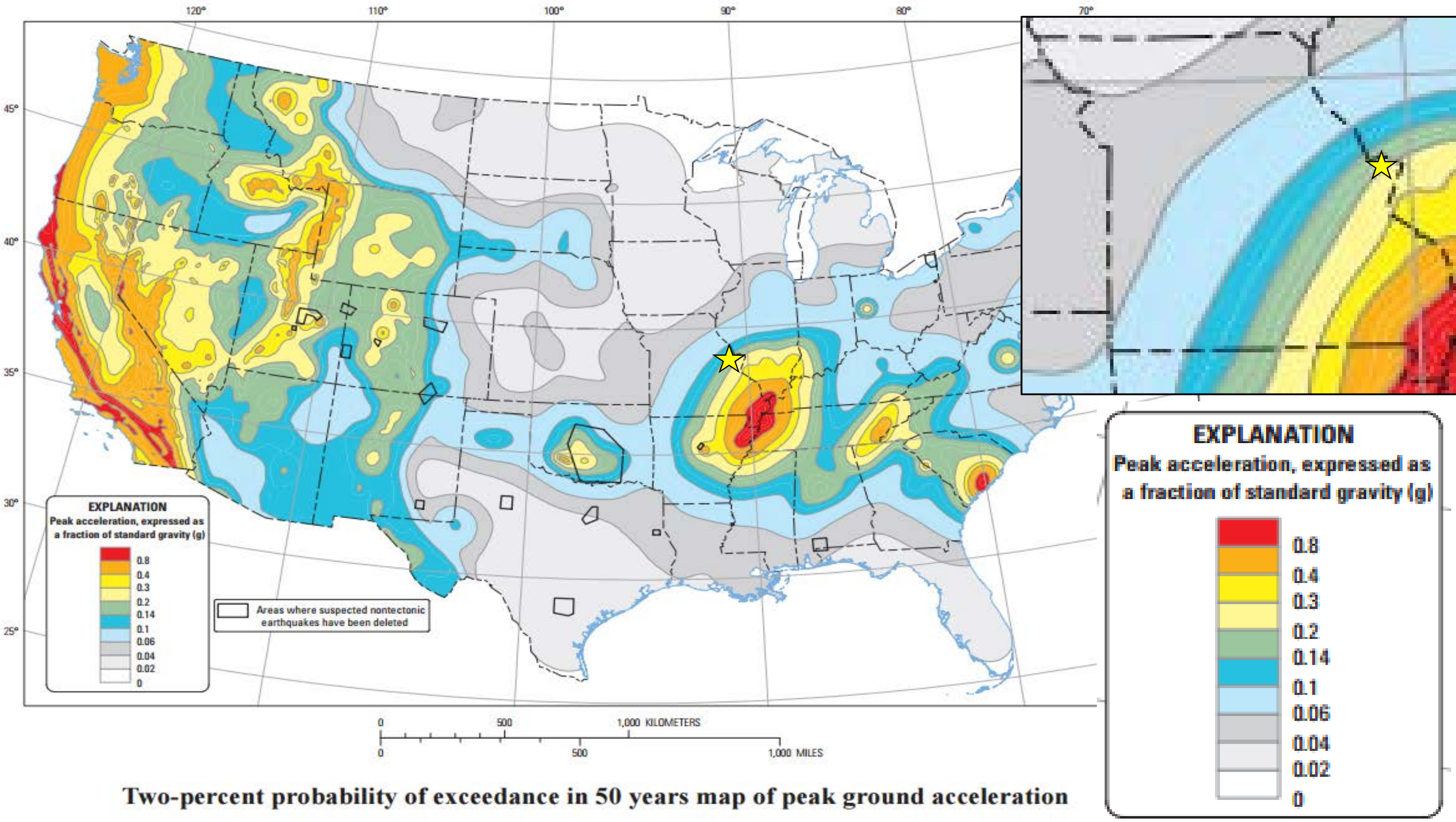
Slope Stability Case	Minimum Acceptable Factor of Safety	Calculated Factor of Safety		Evaluation	Figure(s)
		Circular	Non-Circular		
Long-Term Steady State	1.50	2.15	2.11	Satisfactory	11,12
Steady State with Surcharges	1.40	1.81	1.70	Satisfactory	13,14
Pseudo-Static Seismic	1.00	1.22	1.17	Satisfactory	15,16
Post-Liquefaction Conditions	1.20	1.56	1.45	Satisfactory	17,18

Note: Water Table Lowered to EL 428 to Meet Requirements

Discussion:

The results indicate that the slopes along SCPB and within the proposed closure plan do meet the minimum requirements set forth by MDNR and the EPA CCR Final Rule for Long-Term Steady State, Steady State with Surcharges, Pseudo-Static Seismic, and Post-Liquefaction if the piezometric level within the pond is lowered to EL 428. This conclusion includes cross-sections A-A' and B-B'.

Horizontal Ground Acceleration for Analysis = (1/2)*0.187g = 0.094 (per Hynes-Griffin & Franklin (1984)



Two-percent probability of exceedance in 50 years map of peak ground acceleration

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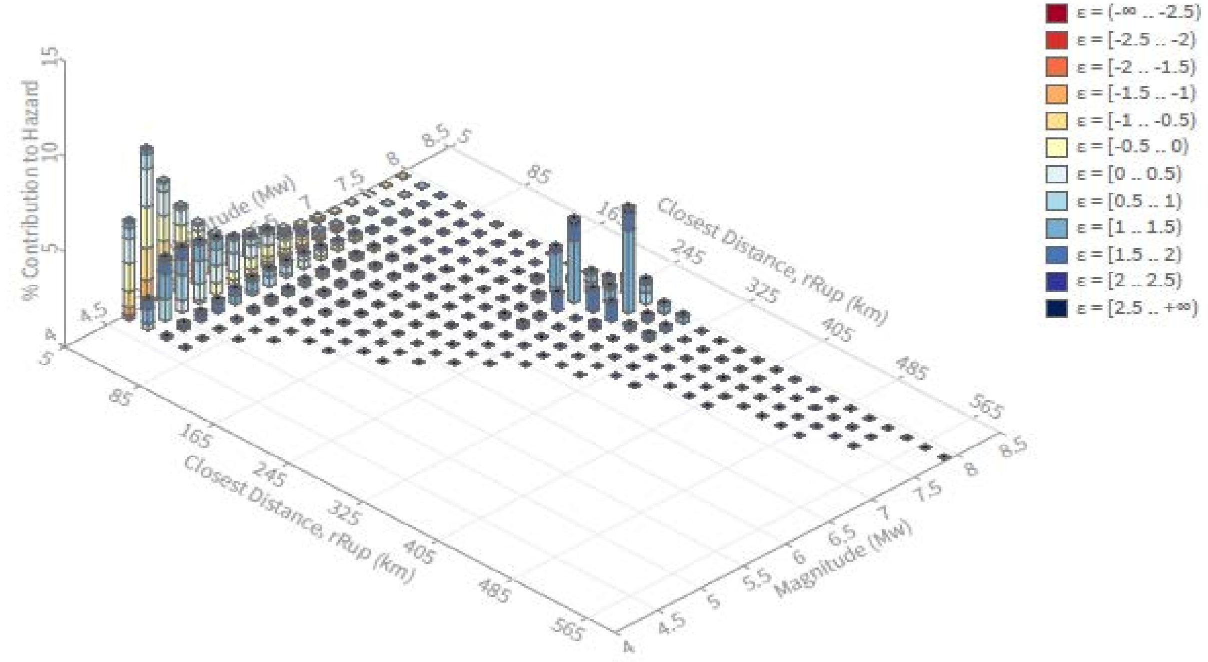
SCALE	AS SHOWN	PROJECT	Sioux Energy Center - CCR Pond Closures - SCPB
DATE	Jan 2018	TITLE	Slope USGS Peak Horizontal Ground Acceleration Hazard Assessment (2% in 50 Year Event) (2014)
MADE BY	MSG		
CAD	-		
CHECK	0	CLIENT	Ameren - Missouri
REVIEW	0	FIGURE	1A

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Horizontal Ground Acceleration for Analysis = (1/2)*0.187g = 0.094 (per Hynes-Griffin & Franklin (1984)



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Golder Associates Inc.

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK 0
REVIEW 0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

TITLE **Slope USGS PSH Deaggregation Plot (2% in 50 Year Event) (2014)**

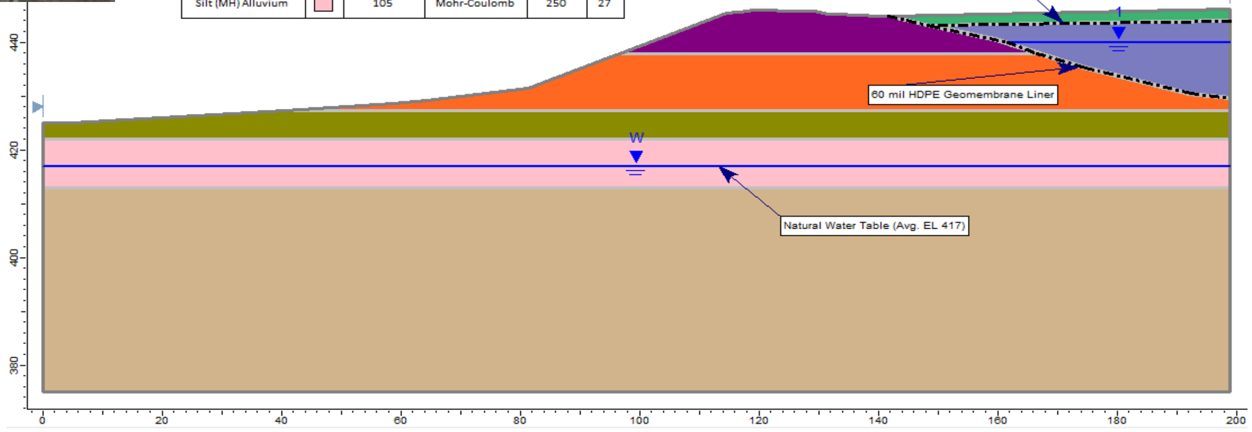
CLIENT **Ameren - Missouri**

FIGURE **1B**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Cross-Section A-A' Profile
Looking West

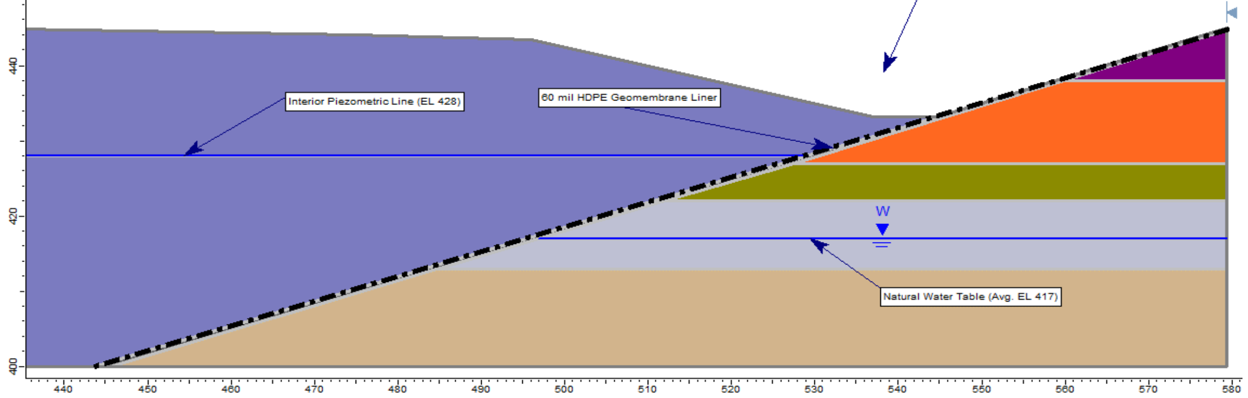
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟦	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟩	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31
Silt (MH) Alluvium	🟥	105	Mohr-Coulomb	250	27



Golder Associates Golder Associates Inc.	SCALE AS SHOWN	PROJECT	Sioux Energy Center - CCR Pond Closures - SCPB
	DATE Jan 2018	TITLE	SCPA Cross-Section A-A'
	MADE BY MSG		
	CAD -		
FILE STABILITY	CHECK 0	CLIENT	Ameren - Missouri
PROJECT No. 154-7197-01 REV. 0	REVIEW 0	FIGURE	2A

Cross-Section B-B' Profile
Looking South

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CH) Alluvium	🟩	115	Mohr-Coulomb	350	24
Silt (MH) Alluvium	⬜	105	Mohr-Coulomb	250	27
Ash	🟦	100	Mohr-Coulomb	10	24
GM Liner	⬛	58	Infinite strength		



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FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK 0
REVIEW 0

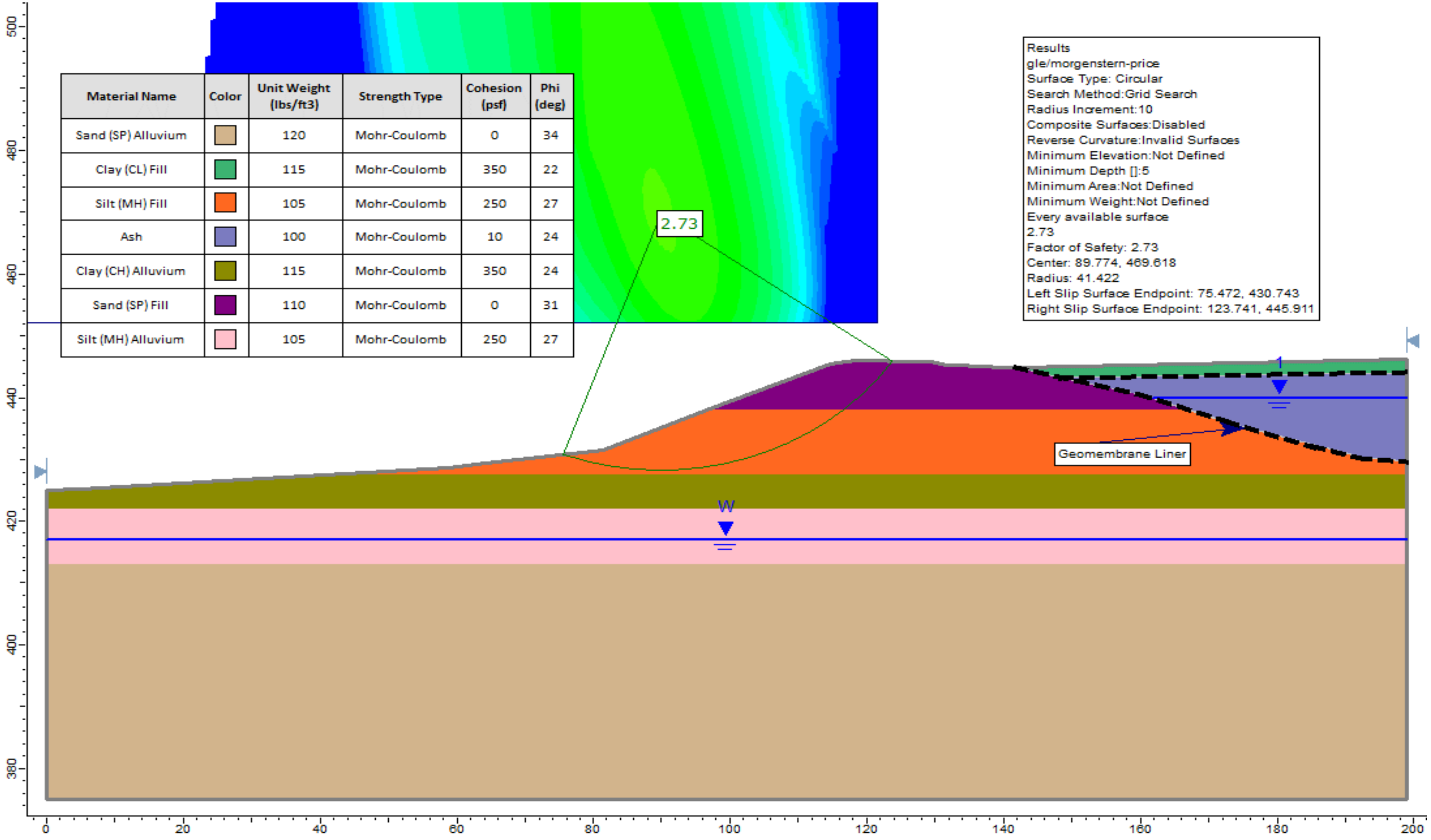
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

TITLE **SCPA Cross-Section B-B'**

CLIENT **Ameren - Missouri**

FIGURE **2B**

Minimum
FS = 2.73



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟦	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31
Silt (MH) Alluvium	🟥	105	Mohr-Coulomb	250	27

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
2.73
Factor of Safety: 2.73
Center: 89.774, 469.618
Radius: 41.422
Left Slip Surface Endpoint: 75.472, 430.743
Right Slip Surface Endpoint: 123.741, 445.911

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SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK 0
REVIEW 0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

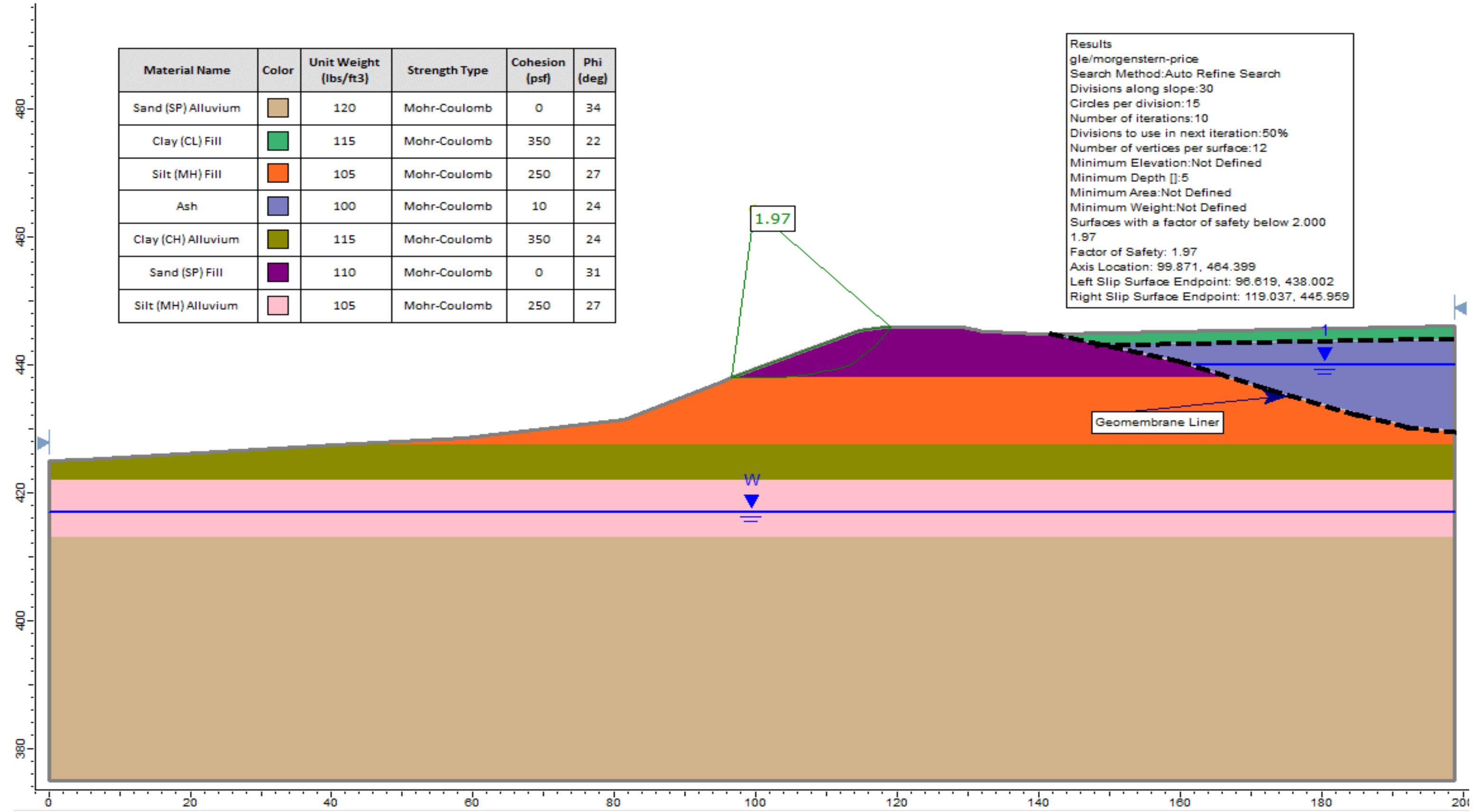
TITLE **Cross-Section A-A' Long-Term Steady State Loading - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **3**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.97



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟦	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31
Silt (MH) Alluvium	🟥	105	Mohr-Coulomb	250	27

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
1.97
Factor of Safety: 1.97
Axis Location: 99.871, 464.399
Left Slip Surface Endpoint: 96.619, 438.002
Right Slip Surface Endpoint: 119.037, 445.959

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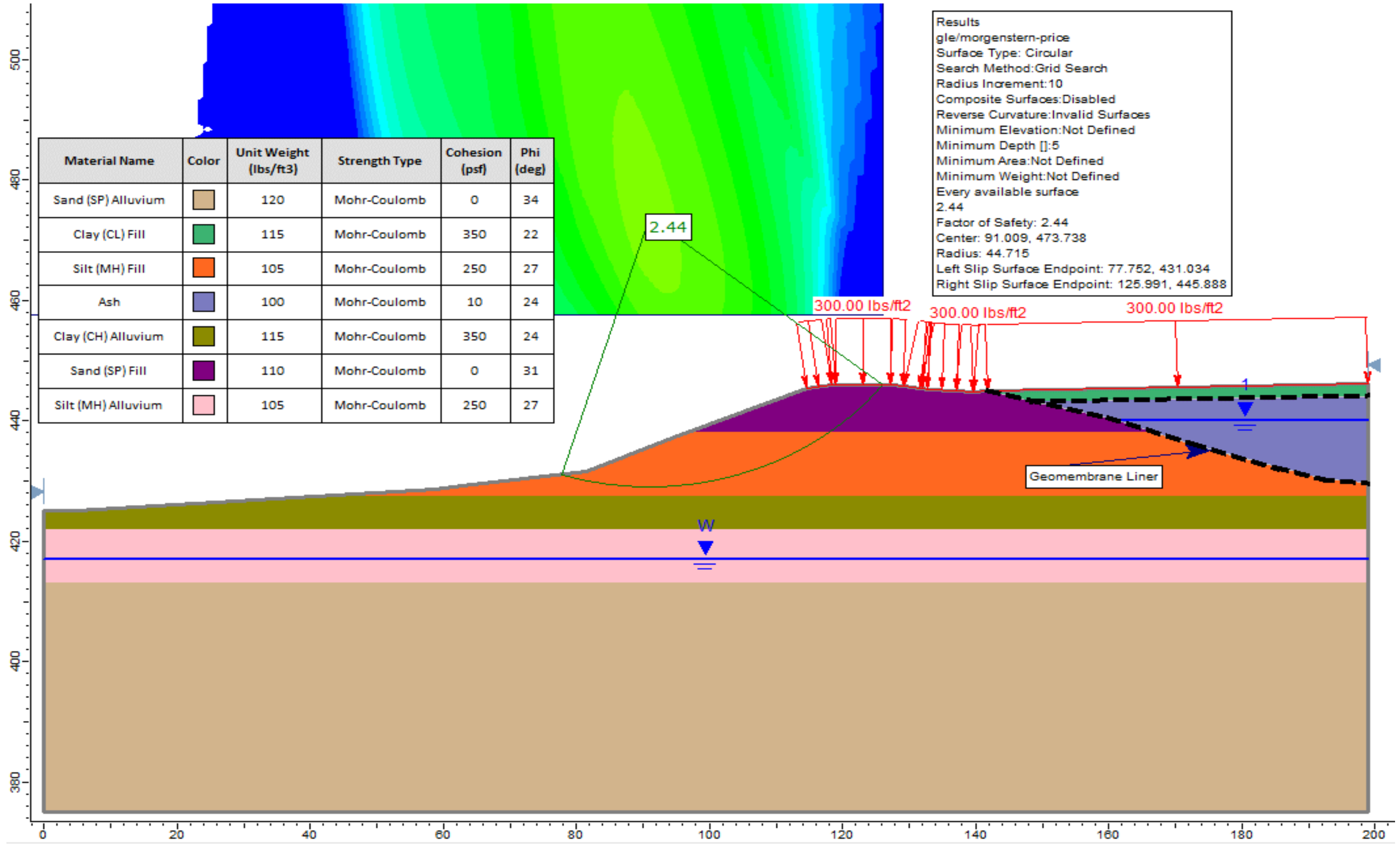
SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPB**
DATE	Jan 2018	TITLE	**Cross-Section A-A' Long-Term Steady State Loading - Non-Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	0	CLIENT	**Ameren - Missouri**
REVIEW	0	FIGURE	4

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 2.44



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟦	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31
Silt (MH) Alluvium	🟥	105	Mohr-Coulomb	250	27

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
2.44
Factor of Safety: 2.44
Center: 91.009, 473.738
Radius: 44.715
Left Slip Surface Endpoint: 77.752, 431.034
Right Slip Surface Endpoint: 125.991, 445.888

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FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK 0
REVIEW 0

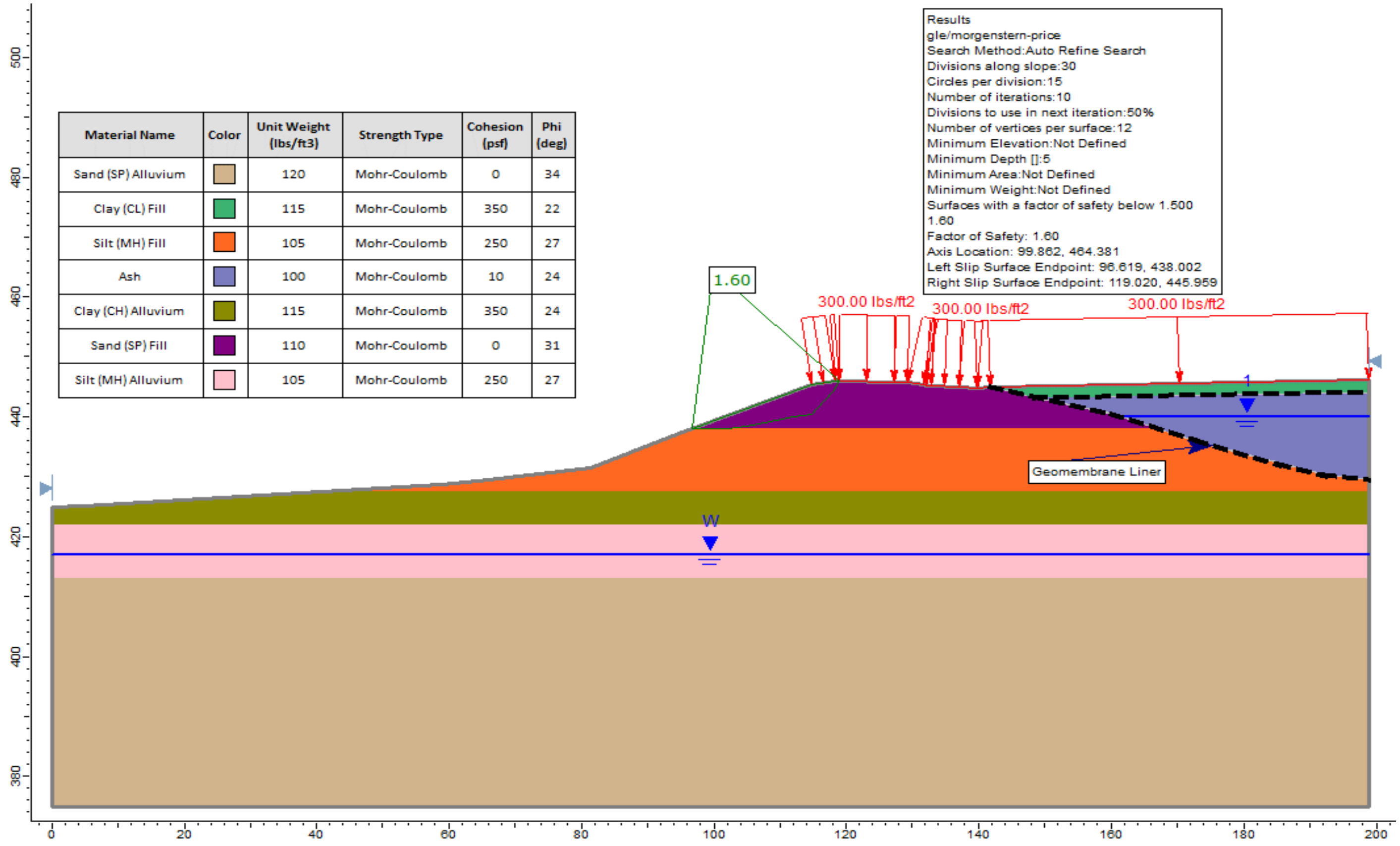
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

TITLE **Cross-Section A-A' Steady State with Surcharges Loading - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **5**

Minimum
FS = 1.60



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Ash	🟦	100	Mohr-Coulomb	10	24
Clay (CH) Alluvium	🟨	115	Mohr-Coulomb	350	24
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31
Silt (MH) Alluvium	🟥	105	Mohr-Coulomb	250	27

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.500
1.60
Factor of Safety: 1.60
Axis Location: 99.862, 464.381
Left Slip Surface Endpoint: 96.619, 438.002
Right Slip Surface Endpoint: 119.020, 445.959

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FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK 0
REVIEW 0

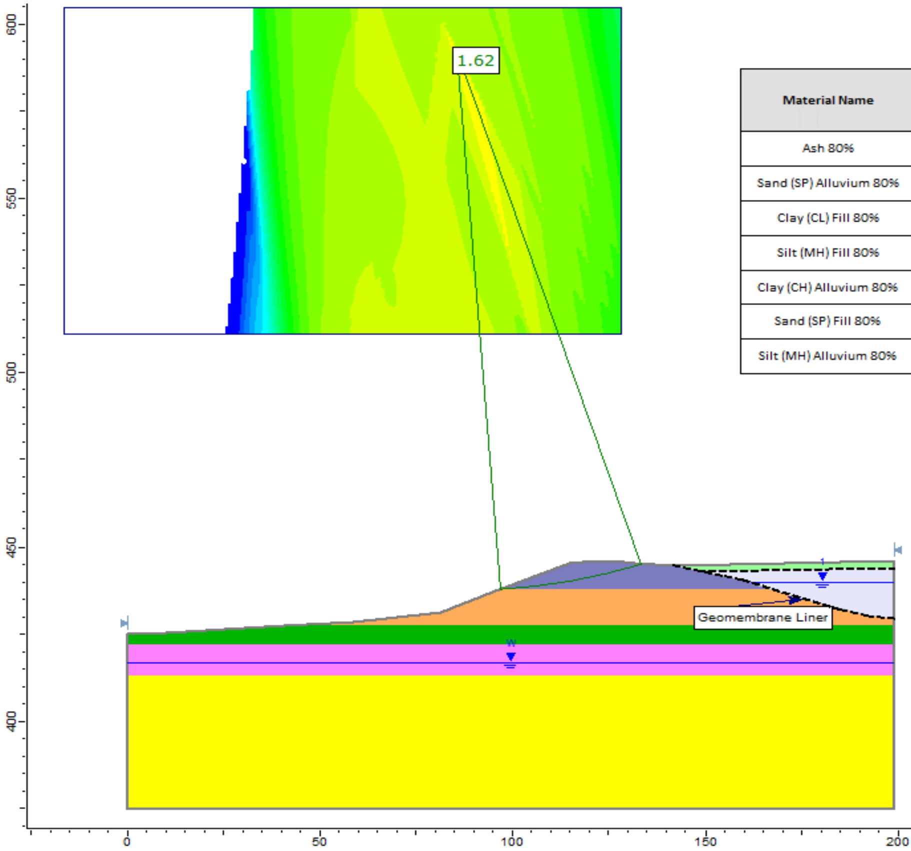
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

TITLE **Cross-Section A-A' Steady State with Surcharges Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **6**

Minimum
FS = 1.31



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP Fill 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Silt (MH) Fill 80%	🟧	105	Shear Normal function	MH 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%
Sand (SP) Fill 80%	🟪	110	Shear Normal function	SP Fill 80%
Silt (MH) Alluvium 80%	🟪	105	Shear Normal function	MH 80%

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.62
Factor of Safety: 1.62
Center: 85.403, 592.467
Radius: 154.867
Left Slip Surface Endpoint: 96.633, 438.008
Right Slip Surface Endpoint: 133.357, 445.212

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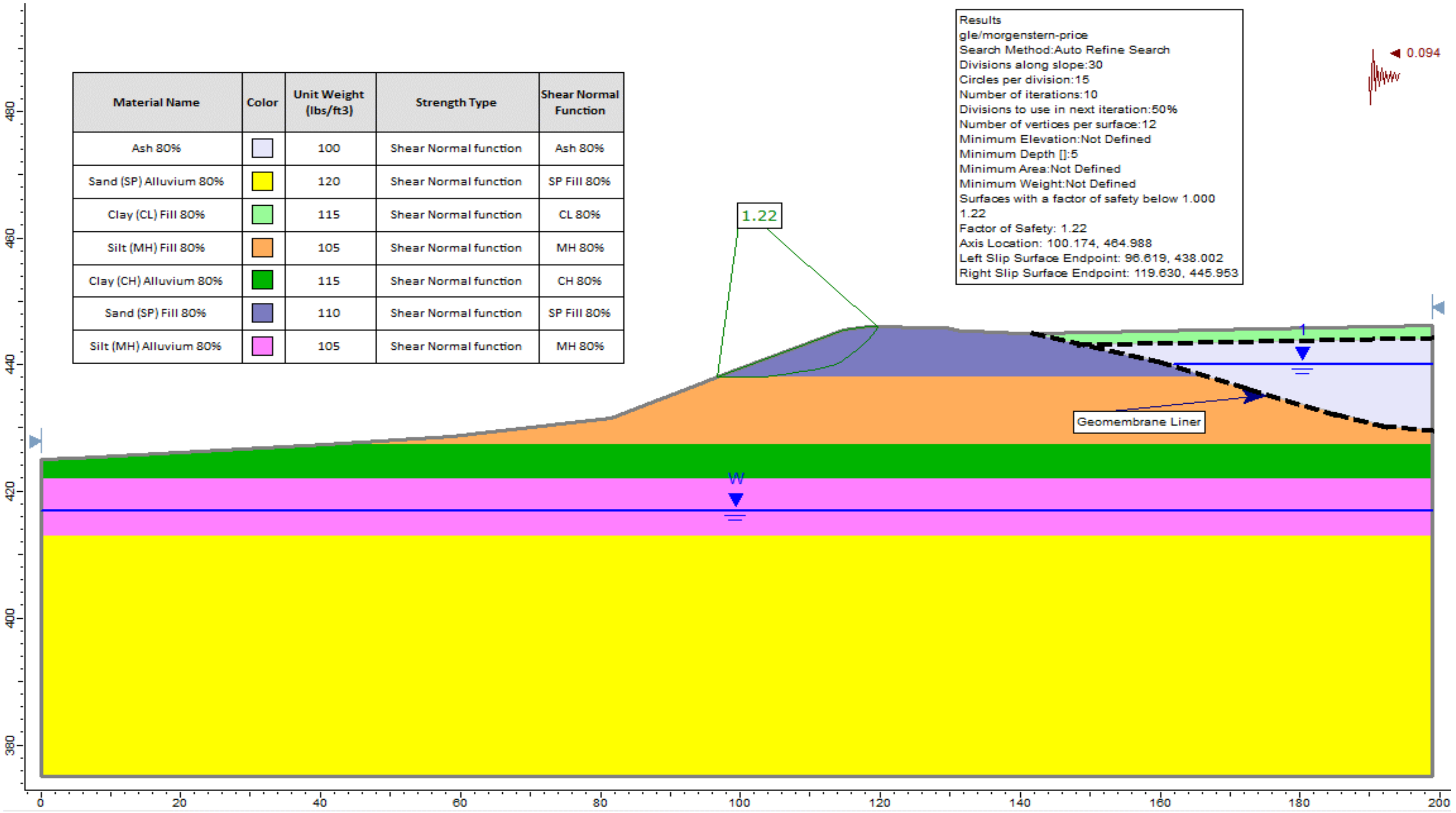
SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPB**
DATE	Jan 2018	TITLE	**Cross-Section A-A' Pseudo-Static Seismic Loading - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
FILE	STABILITY	CHECK	0
PROJECT No.	154-7197-01	REV.	0
REVIEW	0	CLIENT	**Ameren - Missouri**
FIGURE	7		

Minimum
FS = 1.22



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Ash 80%	⬜	100	Shear Normal function	Ash 80%
Sand (SP) Alluvium 80%	🟨	120	Shear Normal function	SP Fill 80%
Clay (CL) Fill 80%	🟩	115	Shear Normal function	CL 80%
Silt (MH) Fill 80%	🟧	105	Shear Normal function	MH 80%
Clay (CH) Alluvium 80%	🟩	115	Shear Normal function	CH 80%
Sand (SP) Fill 80%	🟦	110	Shear Normal function	SP Fill 80%
Silt (MH) Alluvium 80%	🟪	105	Shear Normal function	MH 80%

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.22
Factor of Safety: 1.22
Axis Location: 100.174, 464.988
Left Slip Surface Endpoint: 96.619, 438.002
Right Slip Surface Endpoint: 119.630, 445.953

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SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	0
REVIEW	0

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

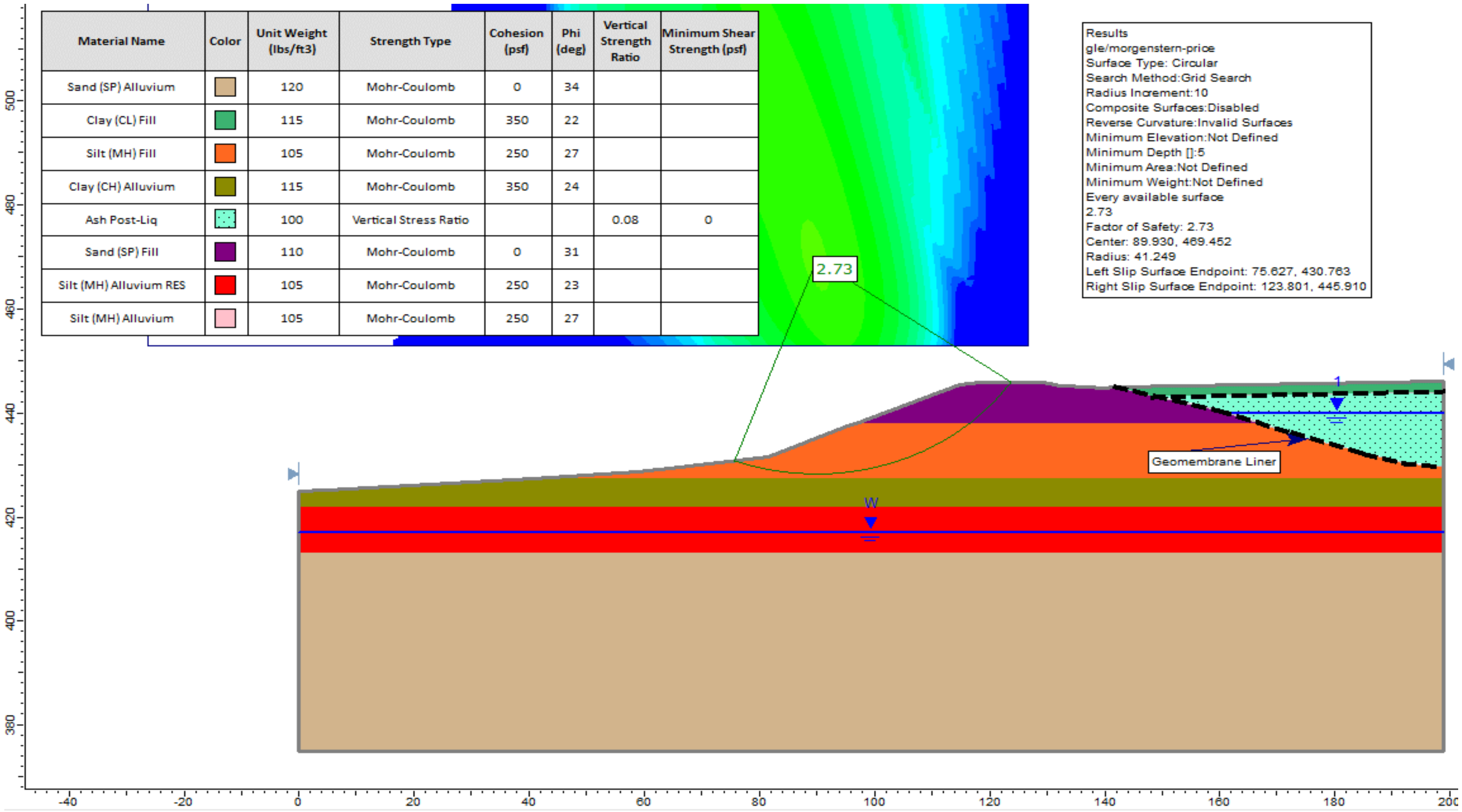
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

TITLE **Cross-Section A-A' Pseudo-Static Seismic Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **8**

Minimum
FS = 2.73



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31		
Silt (MH) Alluvium RES	🟥	105	Mohr-Coulomb	250	23		
Silt (MH) Alluvium	🟥	105	Mohr-Coulomb	250	27		

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
2.73
Factor of Safety: 2.73
Center: 89.930, 469.452
Radius: 41.249
Left Slip Surface Endpoint: 75.627, 430.763
Right Slip Surface Endpoint: 123.801, 445.910

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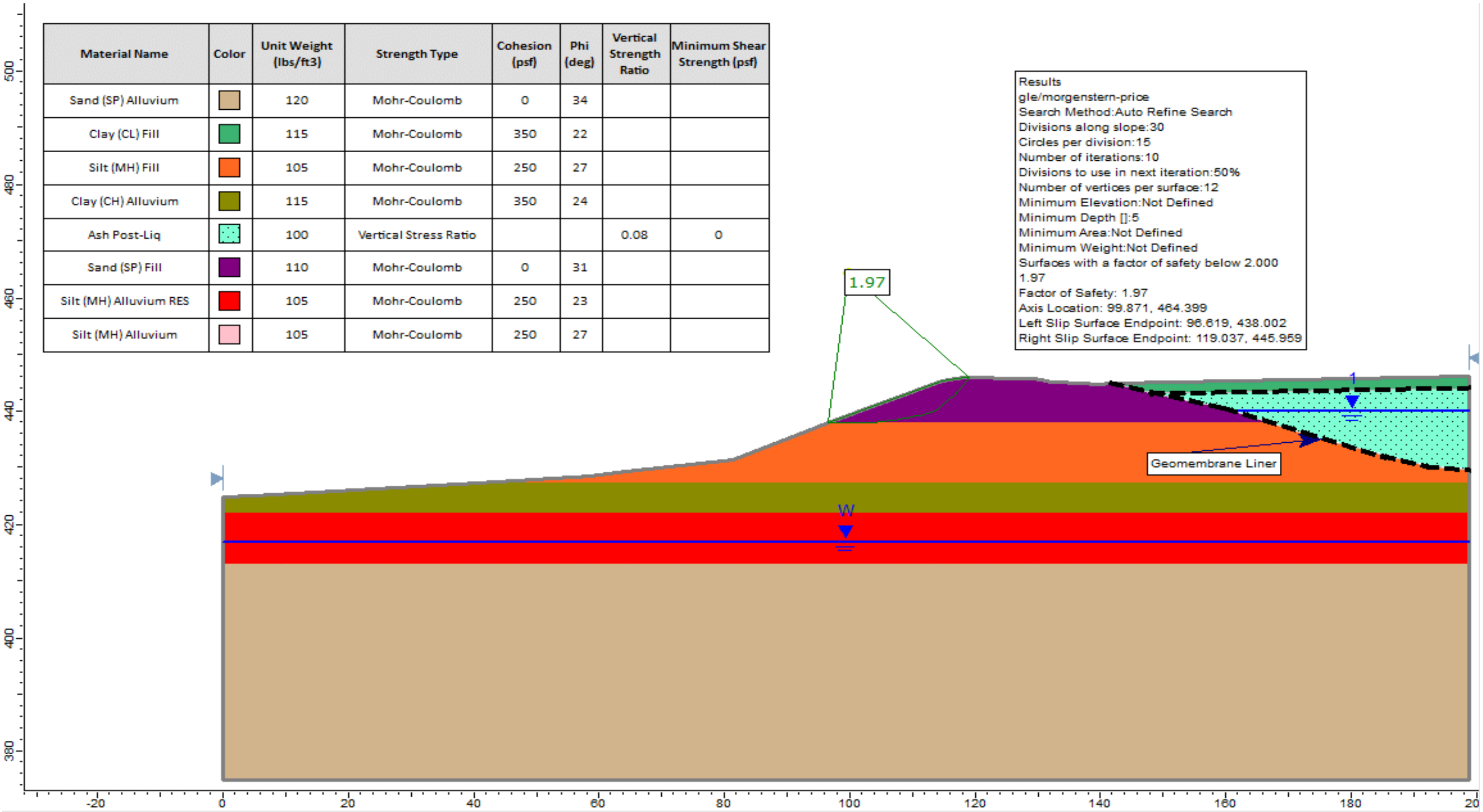
SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPB**
DATE	Jan 2018	TITLE	**Cross-Section A-A' Post-Liquefaction Conditions - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	0	CLIENT	**Ameren - Missouri**
REVIEW	0	FIGURE	**9**

FILE STABILITY
PROJECT No. 154-7197-01 REV. 0

Minimum
FS = 1.97



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CL) Fill	🟩	115	Mohr-Coulomb	350	22		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24		
Ash Post-Liq	▨	100	Vertical Stress Ratio			0.08	0
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31		
Silt (MH) Alluvium RES	🟥	105	Mohr-Coulomb	250	23		
Silt (MH) Alluvium	⬜	105	Mohr-Coulomb	250	27		

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
1.97
Factor of Safety: 1.97
Axis Location: 99.871, 464.399
Left Slip Surface Endpoint: 96.619, 438.002
Right Slip Surface Endpoint: 119.037, 445.959

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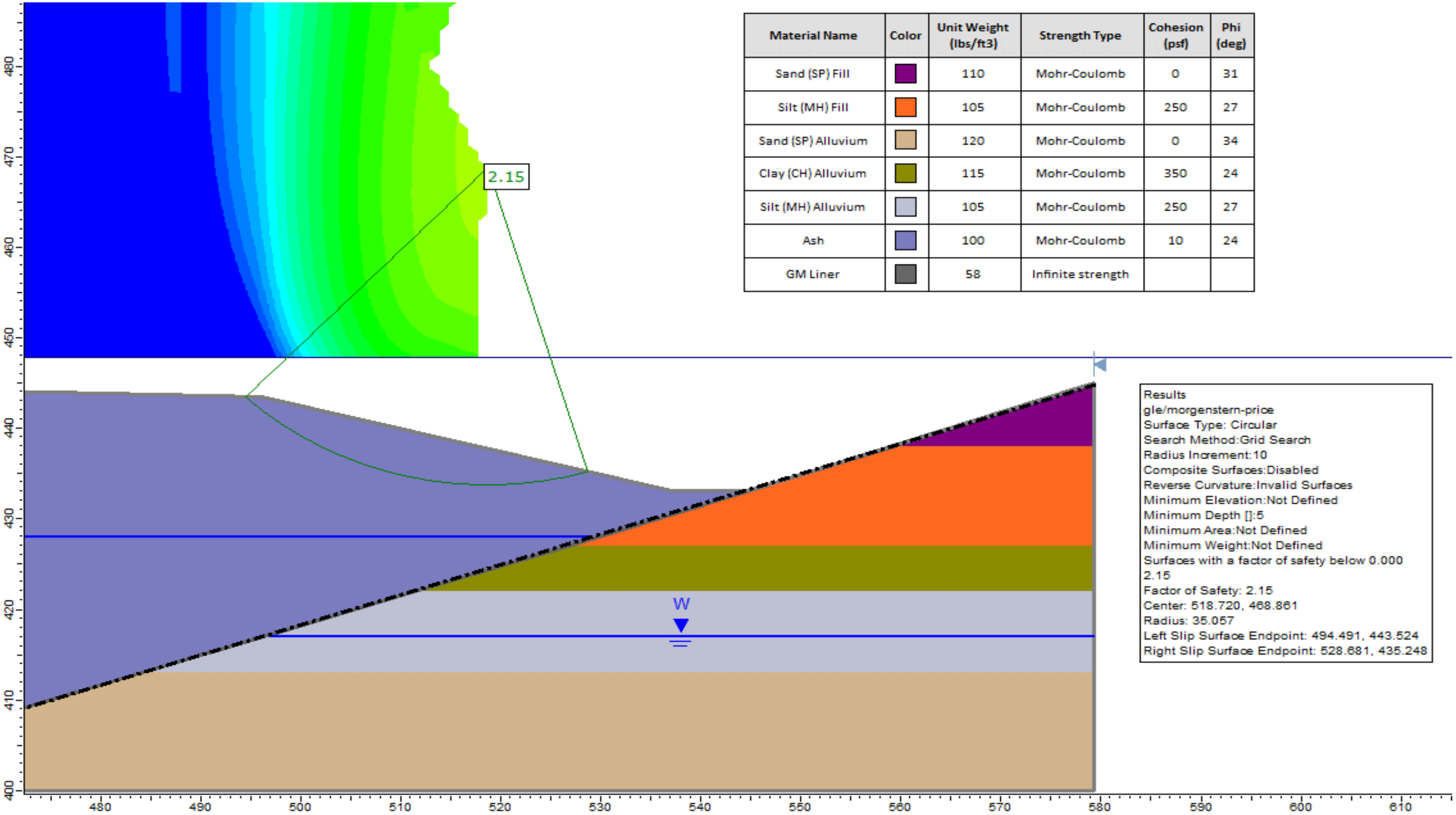
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPB**
DATE	Jan 2018	TITLE	**Cross-Section A-A' Post-Liquefaction Conditions - Non-Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	0	CLIENT	**Ameren - Missouri**
REVIEW	0	FIGURE	**10**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 2.15



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CH) Alluvium	🟩	115	Mohr-Coulomb	350	24
Silt (MH) Alluvium	⬜	105	Mohr-Coulomb	250	27
Ash	🟦	100	Mohr-Coulomb	10	24
GM Liner	⬛	58	Infinite strength		

Results
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Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 0.000
2.15
Factor of Safety: 2.15
Center: 518.720, 468.861
Radius: 35.057
Left Slip Surface Endpoint: 494.491, 443.524
Right Slip Surface Endpoint: 528.681, 435.248

Golder Associates
Golder Associates Inc.

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK 0
REVIEW 0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

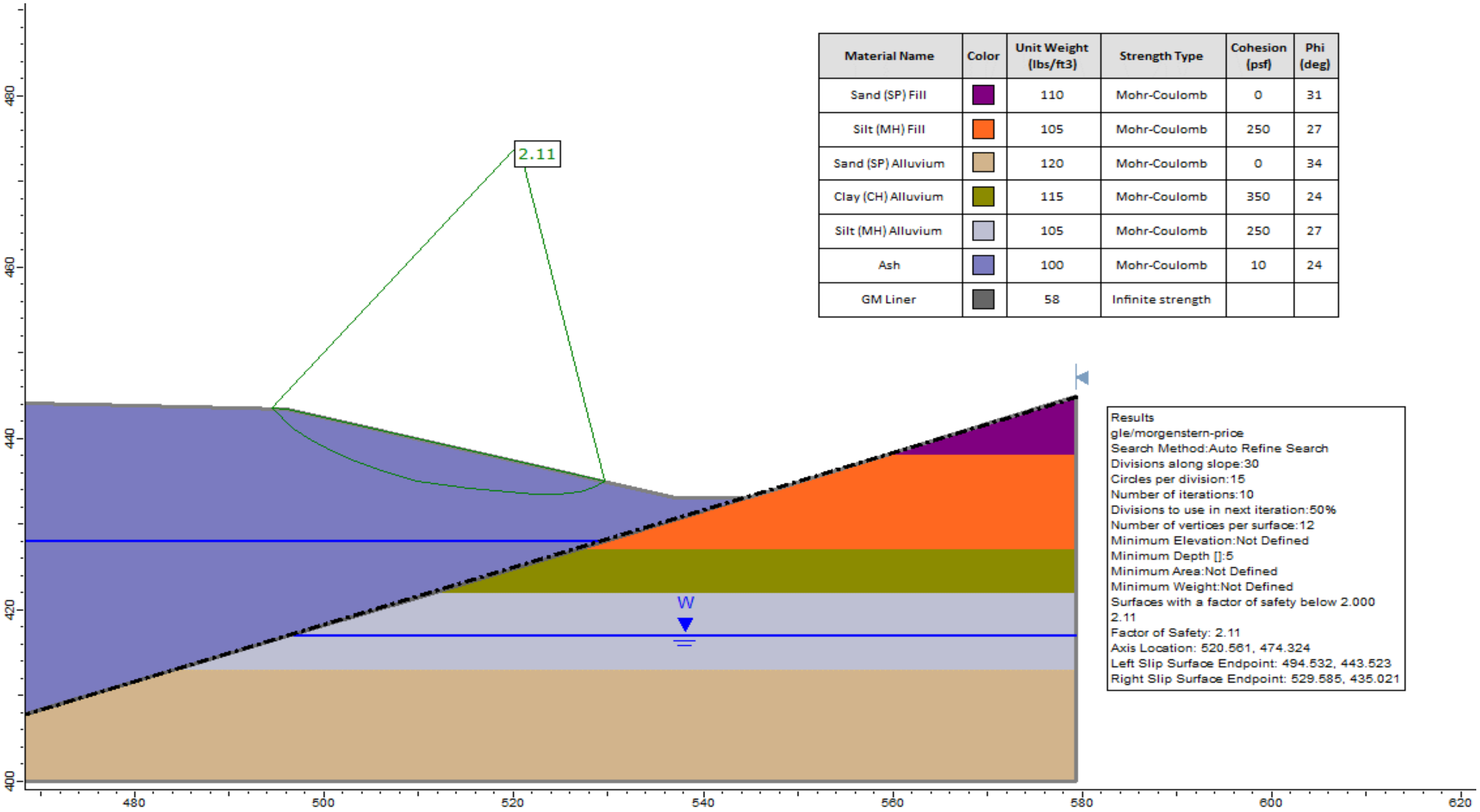
TITLE **Cross-Section B-B' Long-Term Steady State Loading - Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **11**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 2.11



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
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Silt (MH) Fill	■	105	Mohr-Coulomb	250	27
Sand (SP) Alluvium	■	120	Mohr-Coulomb	0	34
Clay (CH) Alluvium	■	115	Mohr-Coulomb	350	24
Silt (MH) Alluvium	■	105	Mohr-Coulomb	250	27
Ash	■	100	Mohr-Coulomb	10	24
GM Liner	■	58	Infinite strength		

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 2.000
2.11
Factor of Safety: 2.11
Axis Location: 520.561, 474.324
Left Slip Surface Endpoint: 494.532, 443.523
Right Slip Surface Endpoint: 529.585, 435.021

Golder Associates
Golder Associates Inc.

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK 0
REVIEW 0

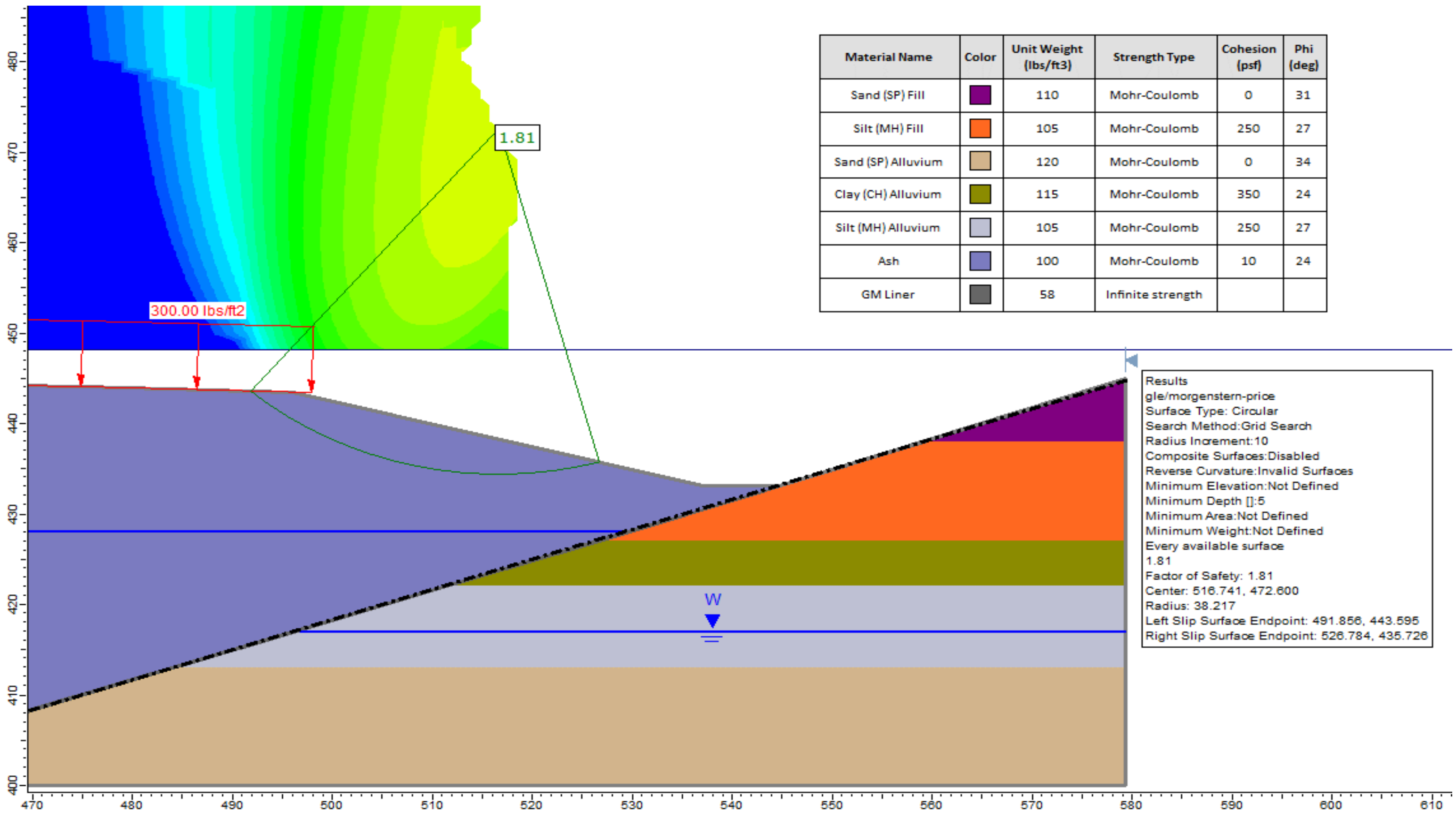
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

TITLE **Cross-Section B-B' Long-Term Steady State Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **12**

Minimum
FS = 1.81



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CH) Alluvium	🟩	115	Mohr-Coulomb	350	24
Silt (MH) Alluvium	⬜	105	Mohr-Coulomb	250	27
Ash	🟦	100	Mohr-Coulomb	10	24
GM Liner	⬛	58	Infinite strength		

Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.81
Factor of Safety: 1.81
Center: 516.741, 472.600
Radius: 38.217
Left Slip Surface Endpoint: 491.856, 443.595
Right Slip Surface Endpoint: 526.784, 435.726

Golder Associates
Golder Associates Inc.

SCALE AS SHOWN
DATE Jan 2018
MADE BY MSG
CAD -
CHECK 0
REVIEW 0

PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

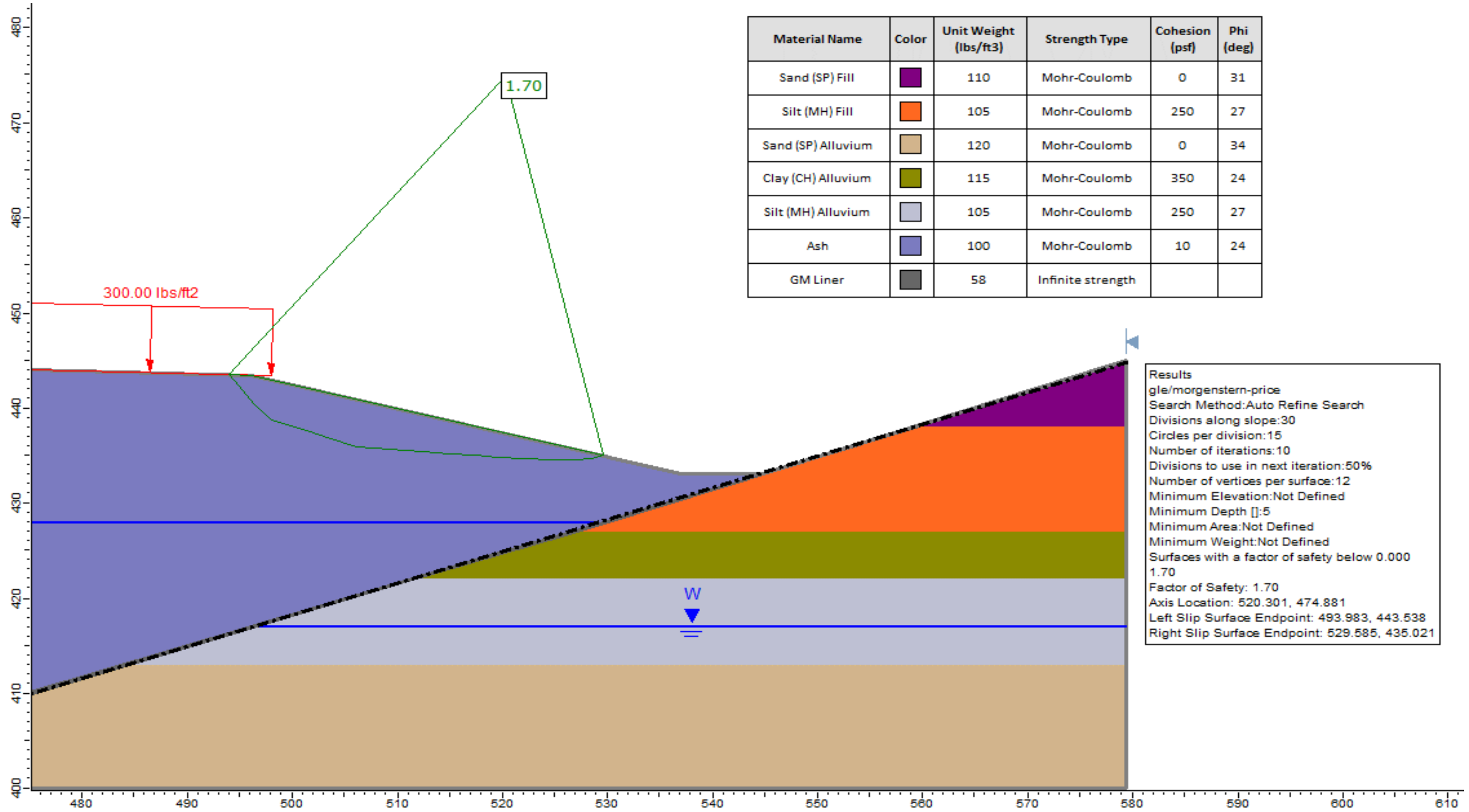
TITLE **Cross-Section B-B' Steady State with Surcharges Loading - Circular Failure Plane**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

CLIENT **Ameren - Missouri**

FIGURE **13**

Minimum
FS = 1.70



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34
Clay (CH) Alluvium	🟩	115	Mohr-Coulomb	350	24
Silt (MH) Alluvium	⬜	105	Mohr-Coulomb	250	27
Ash	🟦	100	Mohr-Coulomb	10	24
GM Liner	⬛	58	Infinite strength		

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 0.000
1.70
Factor of Safety: 1.70
Axis Location: 520.301, 474.881
Left Slip Surface Endpoint: 493.983, 443.538
Right Slip Surface Endpoint: 529.585, 435.021

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN
DATE	Jan 2018
MADE BY	MSG
CAD	-
CHECK	0
REVIEW	0
FILE	STABILITY
PROJECT No.	154-7197-01
REV.	0

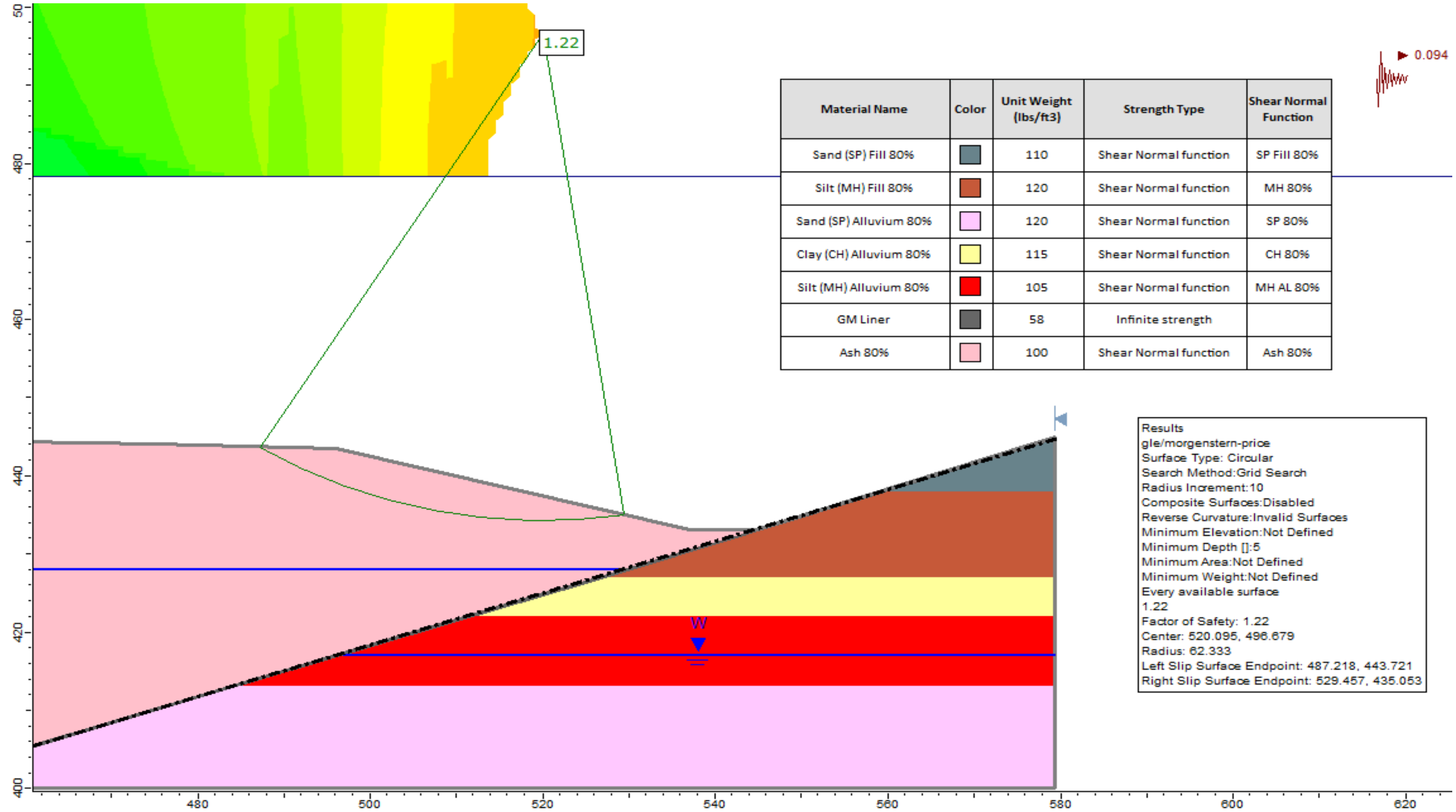
PROJECT **Sioux Energy Center - CCR Pond Closures - SCPB**

TITLE **Cross-Section B-B' Steady State with Surcharges Loading - Non-Circular Failure Plane**

CLIENT **Ameren - Missouri**

FIGURE **14**

Minimum
FS = 1.22



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
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Silt (MH) Fill 80%	🟫	120	Shear Normal function	MH 80%
Sand (SP) Alluvium 80%	■	120	Shear Normal function	SP 80%
Clay (CH) Alluvium 80%	🟨	115	Shear Normal function	CH 80%
Silt (MH) Alluvium 80%	🟥	105	Shear Normal function	MH AL 80%
GM Liner	■	58	Infinite strength	
Ash 80%	■	100	Shear Normal function	Ash 80%

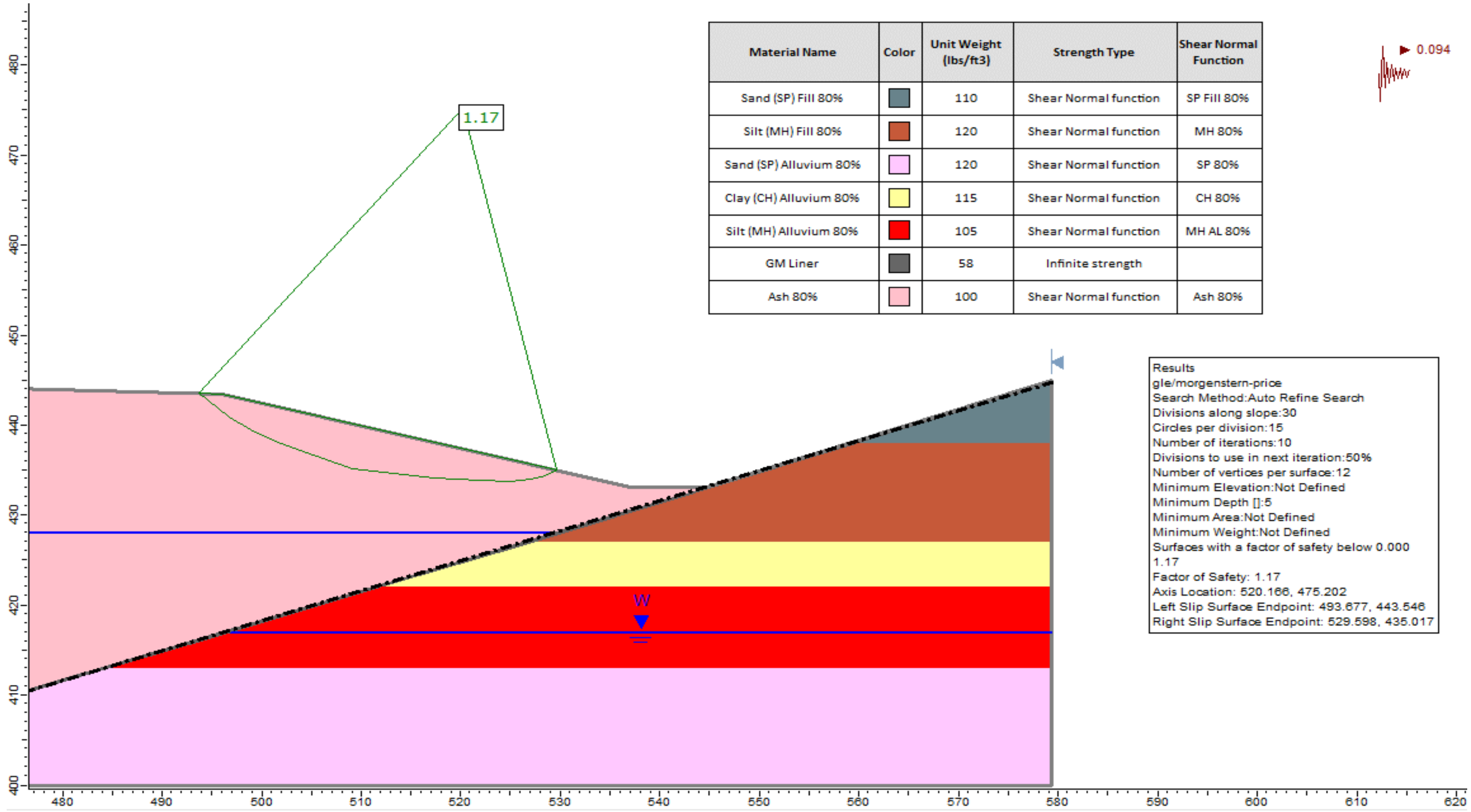
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Every available surface
1.22
Factor of Safety: 1.22
Center: 520.095, 496.679
Radius: 62.333
Left Slip Surface Endpoint: 487.218, 443.721
Right Slip Surface Endpoint: 529.457, 435.053

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPB**
DATE	Jan 2018	TITLE	**Cross-Section B-B' Pseudo-Static Seismic Loading - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	0	CLIENT	**Ameren - Missouri**
REVIEW	0	FIGURE	**15**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.17



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Shear Normal Function
Sand (SP) Fill 80%	■	110	Shear Normal function	SP Fill 80%
Silt (MH) Fill 80%	■	120	Shear Normal function	MH 80%
Sand (SP) Alluvium 80%	■	120	Shear Normal function	SP 80%
Clay (CH) Alluvium 80%	🟨	115	Shear Normal function	CH 80%
Silt (MH) Alluvium 80%	🟥	105	Shear Normal function	MH AL 80%
GM Liner	■	58	Infinite strength	
Ash 80%	■	100	Shear Normal function	Ash 80%

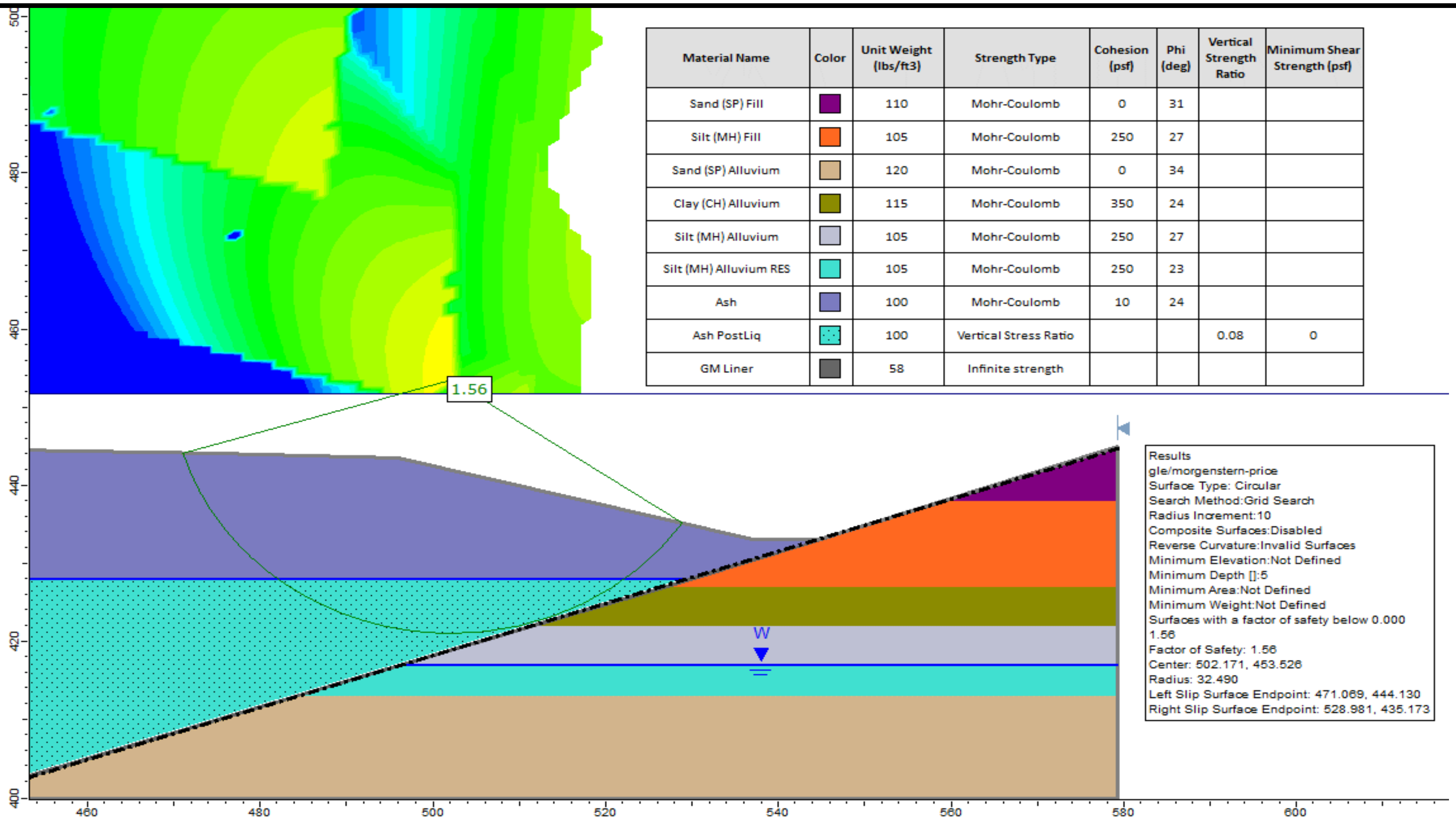
Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 0.000
1.17
Factor of Safety: 1.17
Axis Location: 520.166, 475.202
Left Slip Surface Endpoint: 493.677, 443.546
Right Slip Surface Endpoint: 529.598, 435.017

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPB**
DATE	Jan 2018	TITLE	**Cross-Section B-B' Pseudo-Static Seismic Loading - Non-Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	0	CLIENT	**Ameren - Missouri**
REVIEW	0	FIGURE	**16**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

Minimum
FS = 1.56



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CH) Alluvium	🟫	115	Mohr-Coulomb	350	24		
Silt (MH) Alluvium	⬜	105	Mohr-Coulomb	250	27		
Silt (MH) Alluvium RES	🟦	105	Mohr-Coulomb	250	23		
Ash	🟦	100	Mohr-Coulomb	10	24		
Ash PostLiq	▨	100	Vertical Stress Ratio			0.08	0
GM Liner	⬛	58	Infinite strength				

```
Results
gle/morgenstern-price
Surface Type: Circular
Search Method:Grid Search
Radius Increment:10
Composite Surfaces:Disabled
Reverse Curvature:Invalid Surfaces
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 0.000
1.56
Factor of Safety: 1.56
Center: 502.171, 453.526
Radius: 32.490
Left Slip Surface Endpoint: 471.069, 444.130
Right Slip Surface Endpoint: 528.981, 435.173
```

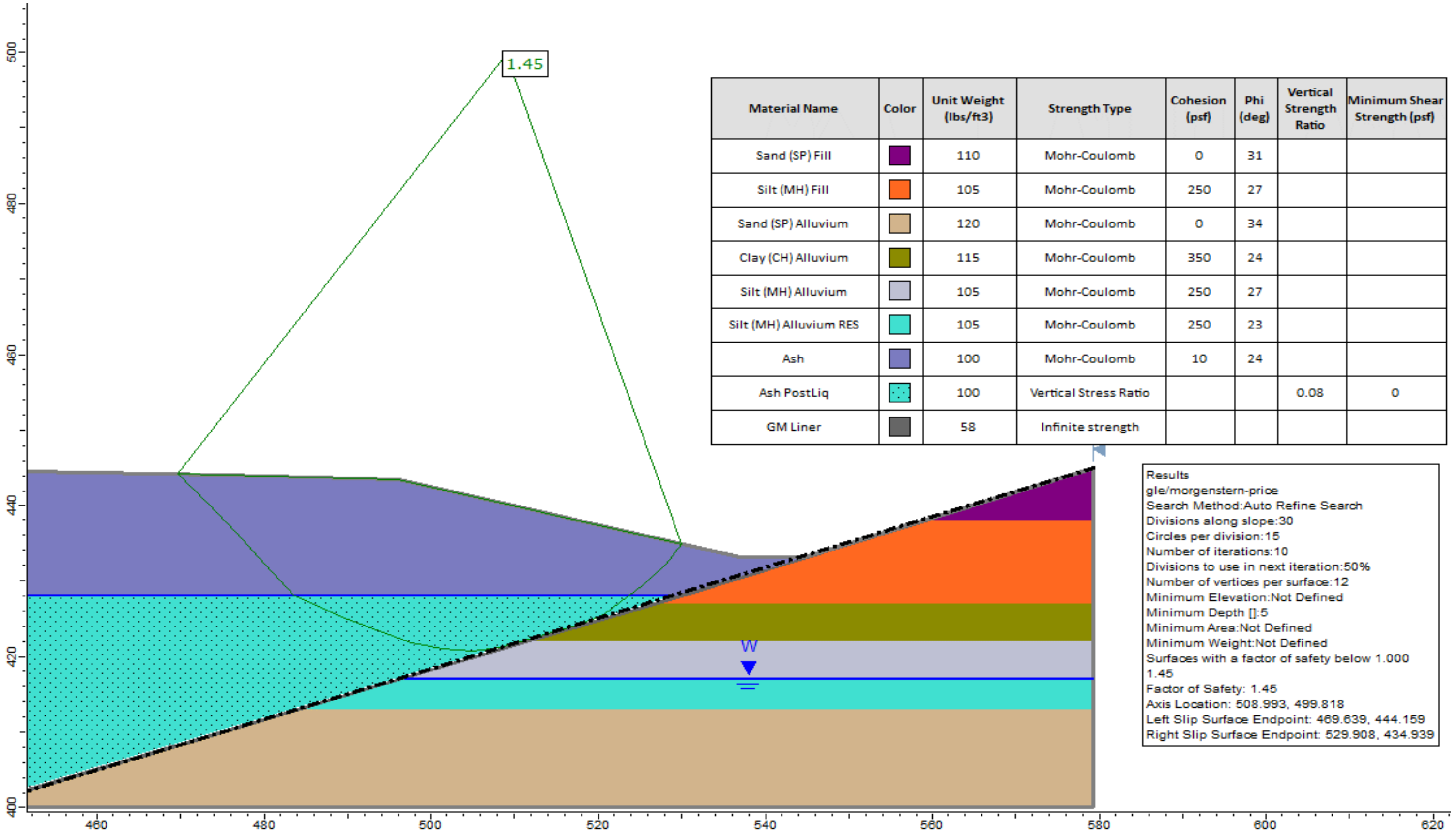
Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPB**
DATE	Jan 2018	TITLE	**Cross-Section B-B' Post-Liquefaction Conditions - Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	0	CLIENT	**Ameren - Missouri**
REVIEW	0	FIGURE	17

FILE STABILITY

PROJECT No. 154-7197-01 REV. 0

Minimum
FS = 1.45



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (psf)
Sand (SP) Fill	🟪	110	Mohr-Coulomb	0	31		
Silt (MH) Fill	🟧	105	Mohr-Coulomb	250	27		
Sand (SP) Alluvium	🟫	120	Mohr-Coulomb	0	34		
Clay (CH) Alluvium	🟩	115	Mohr-Coulomb	350	24		
Silt (MH) Alluvium	⬜	105	Mohr-Coulomb	250	27		
Silt (MH) Alluvium RES	🟦	105	Mohr-Coulomb	250	23		
Ash	🟦	100	Mohr-Coulomb	10	24		
Ash PostLiq	▨	100	Vertical Stress Ratio			0.08	0
GM Liner	⬛	58	Infinite strength				

Results
gle/morgenstern-price
Search Method:Auto Refine Search
Divisions along slope:30
Circles per division:15
Number of iterations:10
Divisions to use in next iteration:50%
Number of vertices per surface:12
Minimum Elevation:Not Defined
Minimum Depth []:5
Minimum Area:Not Defined
Minimum Weight:Not Defined
Surfaces with a factor of safety below 1.000
1.45
Factor of Safety: 1.45
Axis Location: 508.993, 499.818
Left Slip Surface Endpoint: 469.639, 444.159
Right Slip Surface Endpoint: 529.908, 434.939

Golder Associates
Golder Associates Inc.

SCALE	AS SHOWN	PROJECT	**Sioux Energy Center - CCR Pond Closures - SCPB**
DATE	Jan 2018	TITLE	**Cross-Section B-B' Post-Liquefaction Conditions - Non-Circular Failure Plane**
MADE BY	MSG		
CAD	-		
CHECK	0	CLIENT	**Ameren - Missouri**
REVIEW	0	FIGURE	**18**

FILE STABILITY
PROJECT No. 154-7197-01
REV. 0

APPENDIX E

HYDROLOGY AND HYDRAULICS

AMEREN MISSOURI SIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
40 CFR PART 257
ST. CHARLES COUNTY, MISSOURI

APPENDIX E: INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN §257.82

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AMEREN MISSOURI SIIOUX ENERGY CENTER
EVALUATION OF CCR UNITS
ST. CHARLES COUNTY, MISSOURI

APPENDIX E: INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN §257.82

1.0 INTRODUCTION

The Sioux Energy Center (SEC) is located in northeast St. Charles County, Missouri along the Mississippi River, approximately 14 miles upstream of the confluence with the Missouri River and approximately 3 miles east of Portage de Sioux, Missouri. The SEC is located within the floodplain of the Mississippi and Missouri Rivers. The SEC has three active surface impoundments within an approximate 149-acre area. The active surface impoundments, designated as Bottom Ash Pond (SCPA), Fly Ash Pond (SCPB) and Gypsum Pond, Cell 1 (SCPC), are used for managing coal combustion residuals (CCR). Pooled water from the Bottom Ash Pond and Fly Ash Pond discharges through NPDES permitted outfalls into Poeling Lake; however, these surface impoundments have been dewatered and are currently being closed. Decant water in Cell 1is routed north into the Recycle Pond where pumps recirculate the water back to the power plant. A map showing the location of the surface impoundments and the Recycle Pond is attached as Figure 1.

1.1 Purpose

40 CFR §257.82 requires the owner or operator of an existing CCR surface impoundment to prepare periodic inflow design flood control system plans for the CCR unit. The plan should document how the inflow design flood control system has been designed, constructed, operated and maintained to meet the requirements of §257.82. The section specifies that the inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood, and must manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood. Because the existing CCR surface impoundments at the Sioux Energy Center are classified as Low Hazard Potential dams, 40 CFR §257.82 requires that the 100-Year flood is used as the design flood in this analysis. The periodic inflow design flood control system plan has been developed for the active Sioux Energy Center surface impoundment, Cell 1.

2.0 REVIEW OF PREVIOUS INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

The initial periodic inflow design flood control system plan was developed in October 2016 for SCPA, SCPB and SCPC. SCPA and SCPB have been dewatered and are currently being closed. Closure of SCPA and SCPB was designed by Golder Associates so that water is not permanently impounded within the perimeter embankment. Operation of SCPC is generally unchanged, the impoundment continues to receive process water. The inflow design flood control system plan was updated only for the SCPC.

3.0 SCPC (CELL 1)

3.1 Pertinent Data

The SCPC was brought online in 2010 and is incised with a perimeter dike. The Flue Gas Desulfurization (FGD) system produces gypsum as a byproduct. The gypsum slurry is pumped to SCPC where it is managed for long-term or permanent storage. The pond does not receive any additional stormwater run-off outside its bounded area. The gypsum slurry point of discharge is moved periodically by temporary pipes, but the origin of the discharge is at the approximate midpoint of the east embankment. The gypsum settles out into the pond and the decant water flows into the Recycle Pond through a set of triple box culverts. SCPC and the Recycle Pond are separated by an embankment. Triple box culverts connect SCPC with the Recycle Pond, and the culverts control the maximum normal water level in SCPC to el. 441. SCPC also has an emergency spillway on the west side of the impoundment. The outlet works construction drawings are shown in Figures 2 and 3.

The normal pool elevation of the SCPC is el. 441.1 feet and the top of the embankment elevation is at 446 feet. The flowline of the emergency spillway is at el. 445 feet. The estimated volume of CCR impounded in the Bottom Ash Pond is about 812,617 cubic yards, leaving an approximate remaining storage capacity of about 212,383 cubic yards. Table 5 includes pertinent hydrologic and hydraulic data regarding SCPC.

Table 5 – SCPC (Cell 1) Hydrologic and Hydraulic Data

CCR Unit	Normal Pool Elev. (feet)	Normal Pool Water Surface Area (acres)	Max. Pool Elev. (feet)	Max. Pool Water Surface Area (acres)	Total Watershed Area (acres)	Sluice Flow (cfs)
SCPC (Cell 1)	441.1	27.8	445.0	36.8	37.5	2.0

3.2 Hydrologic and Hydraulic Analysis

Hydrologic and hydraulic analysis was completed for SCPC to confirm the adequacy of the current inflow design flood control system. The total volume of stormwater and process water over a 24-hour time period was compared to the available storage. The 24-hour, 100-year precipitation event was taken from Bulletin 71, Rainfall Frequency Atlas of the Midwest (Huff and Angel, 1992). The total rainfall over the

24-hour period was 7.21 inches. The discharge of process water was assumed as 2 cfs, or the nominal flow rate assumed for design. The total volume of stormwater and process water over a 24-hour time period during the 24-hour, 100-year precipitation event is approximately 26.3 acre-feet.

The area-capacity curve for SCPC is presented in Figure 4. Based on the available storage and assuming no flow through the box culvert, the pool level would rise to about el. 442.5 during the 24-hour, 100-year storm event and with the assumed process water flow. This analysis suggests the inflow design flood control system for SCPC adequately manages flow into this CCR unit during the 24-hour, 100-year storm event as required by §257.82 even without a functioning primary spillway.

3.3 Inflow Design Flood Control System Plan

The Area-Capacity Curve presented in Figure 4 shows that provided SCPC is operated with a normal pool elevation of 441 feet, the pond has adequate storage capacity to contain the total rainfall from the 24-hour, 100-year flood event without the primary spillway operating. The area capacity curve is based on 2020 bathymetric survey data and the as-built plans. Additional CCR disposal in this pond will lower the available storage. A topographic survey should be completed for the interior of the SCPC to confirm the necessary storage is available prior to developing the next periodic inflow design flood control system plans.

4.0 CONCLUSIONS

The periodic inflow design flood control system has been evaluated for the SCPC at the Sioux Energy Center. The inflow control system for this pond can adequately handle and discharge the 24-hour, 100-year design storm event. The following summarizes the conclusions of this report, and outlines recommendations for surveillance and operation of each CCR unit.

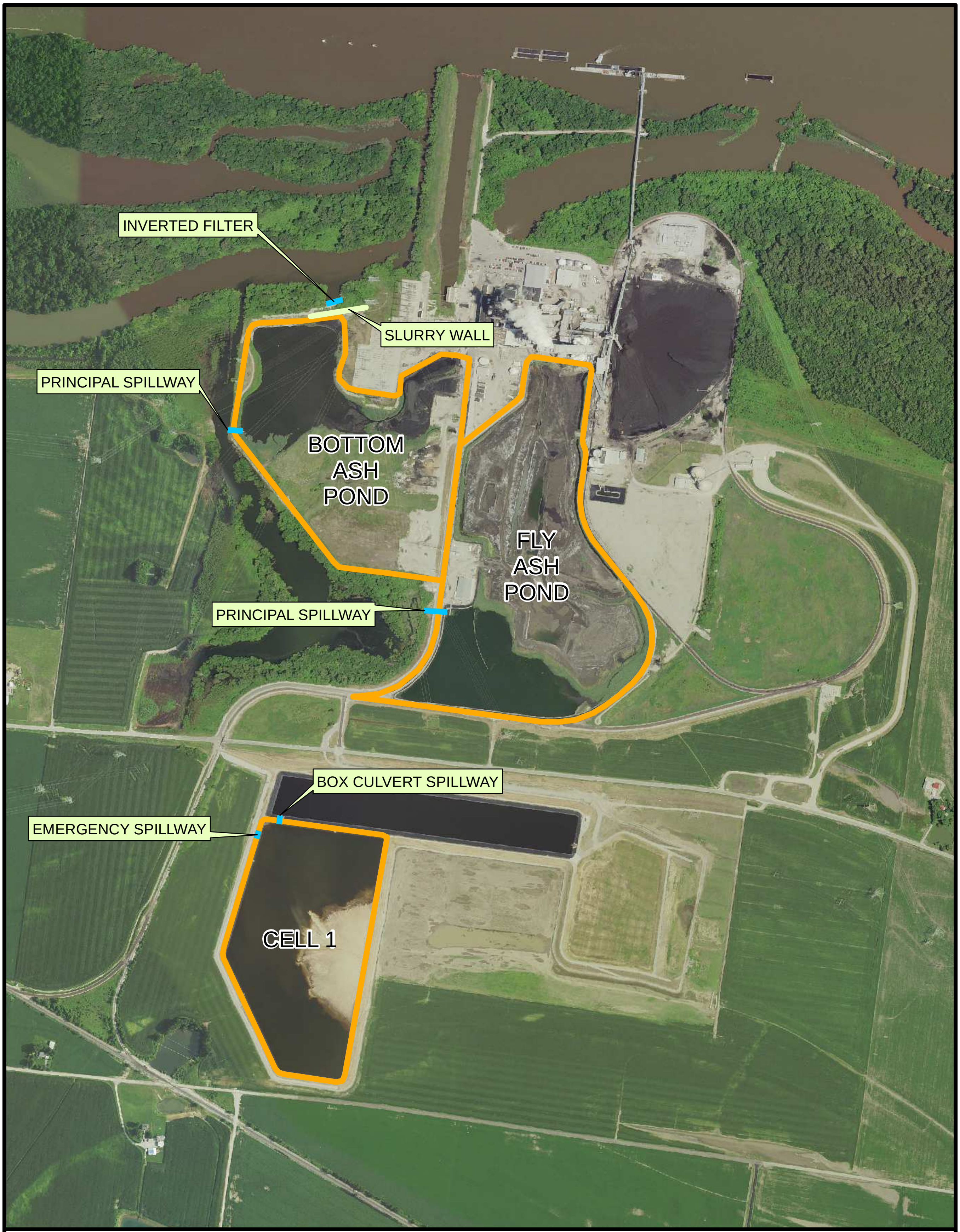
- If the water levels exceed the maximum surcharge pool elevations, special inspections of the primary spillways should be completed, and temporary measures should be implemented to prevent the water from overtopping the pond embankments until the primary spillways are functioning as designed.
- Before completing additional evaluations of the Periodic Inflow Design Flood Control System Plan, topographic surveys should be completed on the interior of all active ponds to confirm the necessary water storage is available.
- Staff gage readings should be recorded during weekly inspections to confirm the assumed normal pool elevations.

5.0 REFERENCES

Ameren Missouri. (2015). “Operation and Maintenance Manual for Cells 1 & 4A and Recycle Pond, Sioux Energy Center Utility Waste Landfill, St. Charles County, Missouri.” Power Operations Services, St. Louis, Missouri.

Environmental Protection Agency. (2015). “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule.” 40 CFR Parts 257 and 261., Vol. 80, No. 74.

Huff, F.A. and J.R. Angel. (1992). “Rainfall Frequency Atlas of the Midwest.” Bulletin 71, Midwestern Climate Center and Illinois State Water Survey.



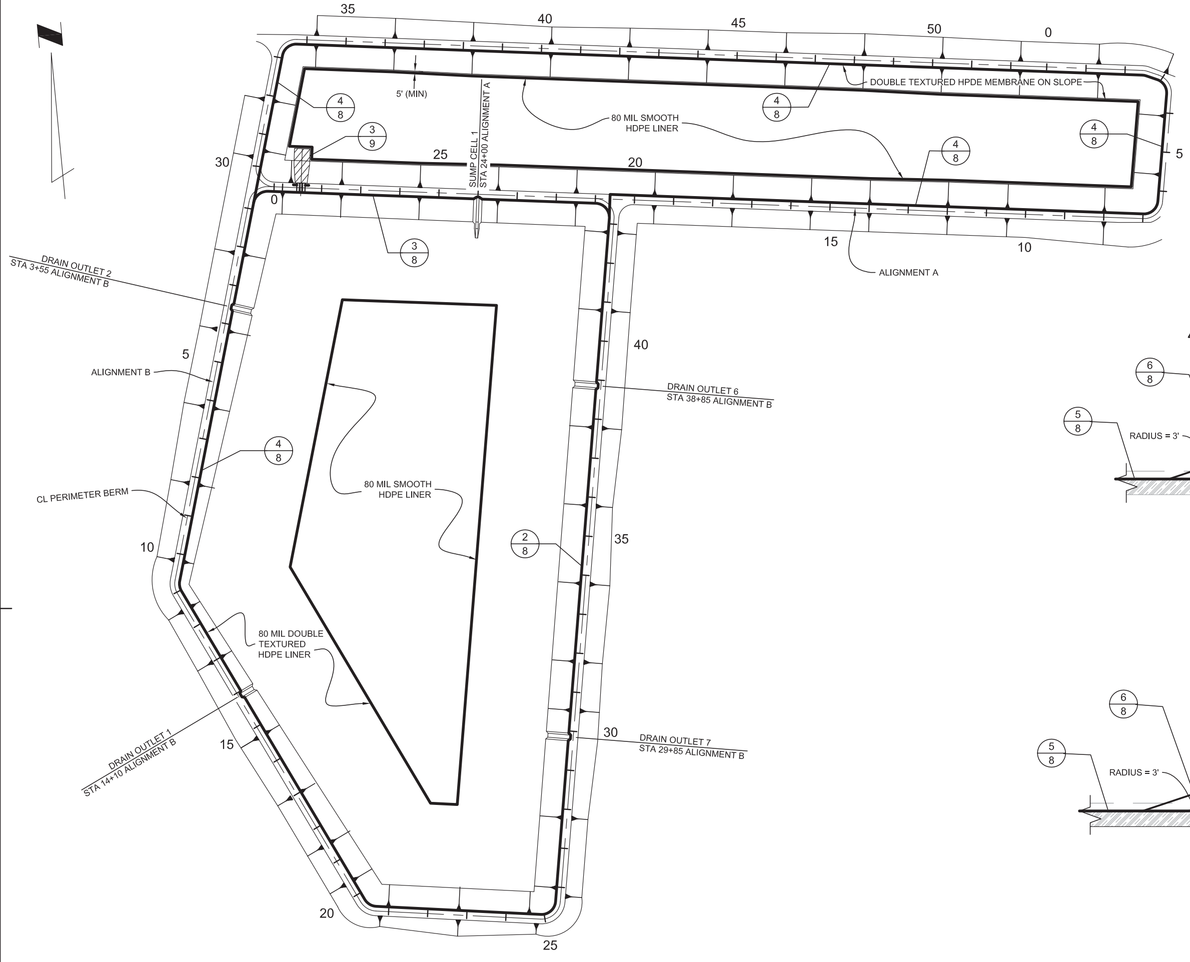
AMEREN MISSOURI
SIOUX ENERGY CENTER
ACTIVE CCR SURFACE IMPOUNDMENTS
FIGURE 1

Ameren MISSOURI

REITZ & JENS, INC.
CONSULTING ENGINEERS

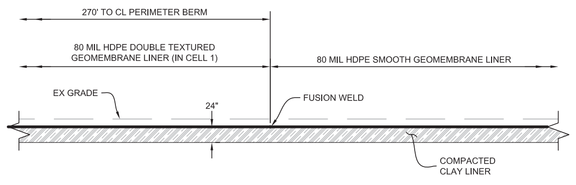
PRINT
DIST.

REVISIONS		
REV.	W.O.	
0		4/03/08
2		5/18/09
4		6/7/10



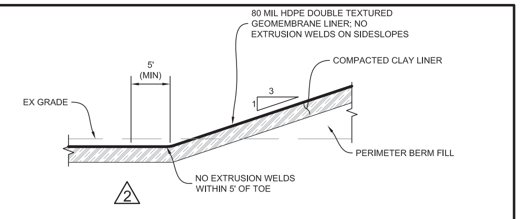
1/8 LINER PLAN

SCALE: 1" = 200'



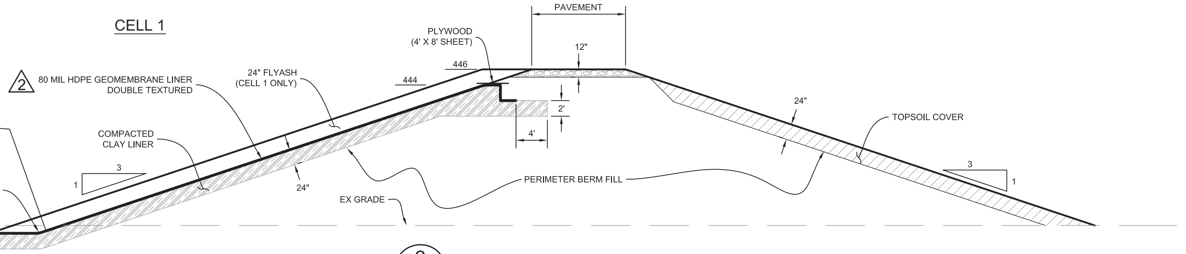
5/8 BOTTOM LINER

NO SCALE



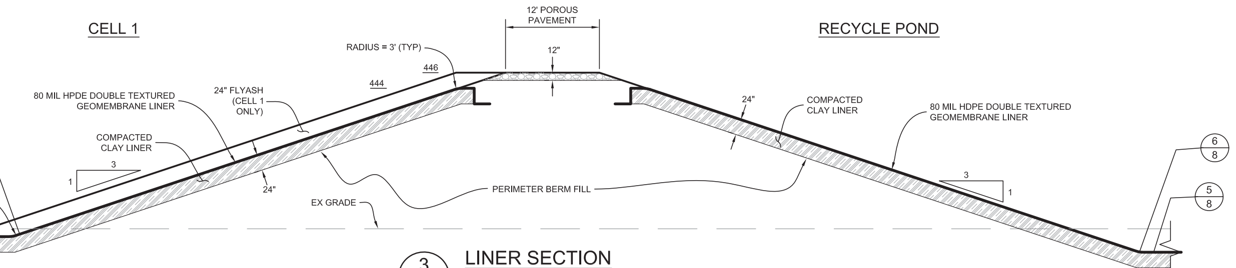
6/8 TRANSITION LINER

NO SCALE



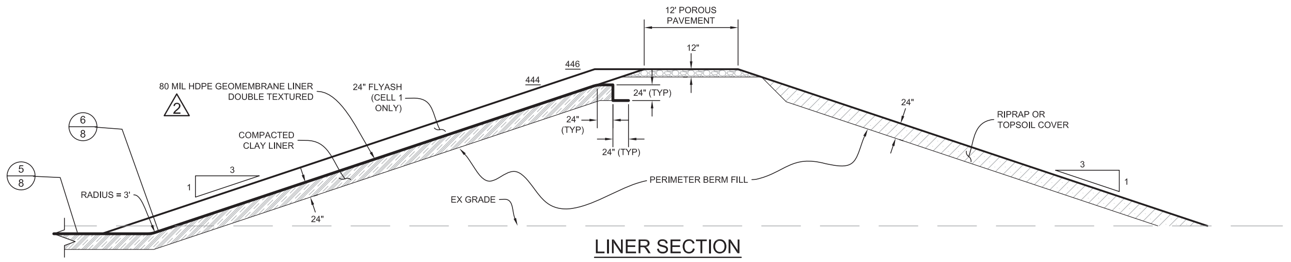
2/8 LINER SECTION STA 24+89 B TO 43+64 B

SCALE: 1" = 10'



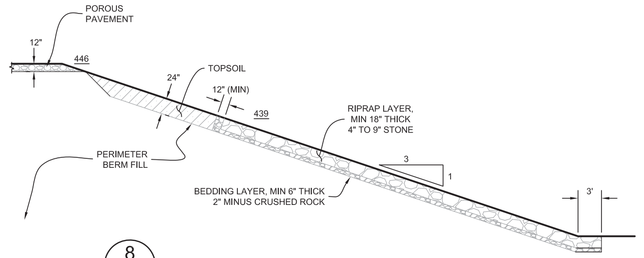
3/8 LINER SECTION STA 20+48 A TO 29+22 A

SCALE: 1" = 200'



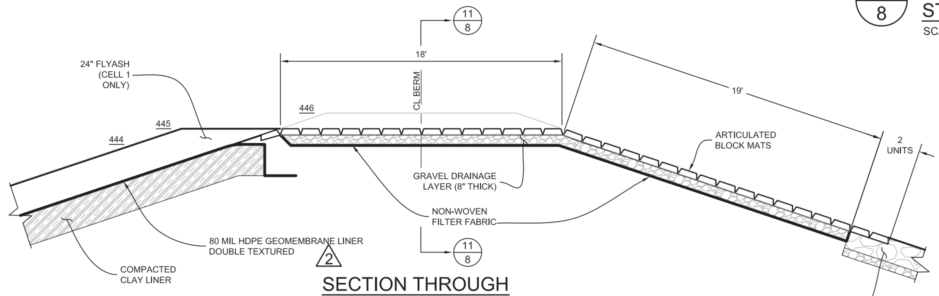
4/8 LINER SECTION STA 0+00 A TO 20+48 A STA 29+22 A TO 52+92 A STA 0+00 B TO 25+00 B

SCALE: 1" = 10'



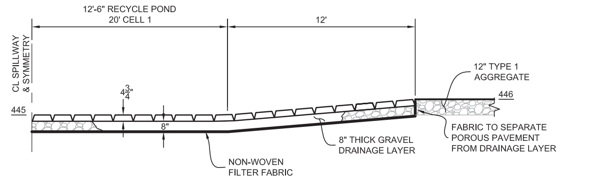
8/8 RIPRAP PROTECTION, OUTSIDE SLOPE OF PERIMETER BERM STA 31+39 A TO 5+35 C

SCALE: 1" = 10'



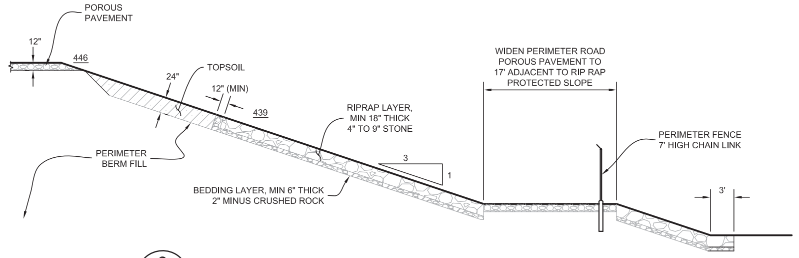
10/8 SECTION THROUGH EMERGENCY SPILLWAY STA 32+24 A STA 1+65 B

SCALE: 1" = 5'



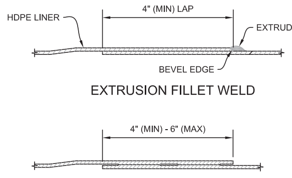
11/8 EMERGENCY SPILLWAY/ ROAD PROFILE

SCALE: 1" = 5'



9/8 RIPRAP PROTECTION, OUTSIDE SLOPE OF PERIMETER BERM STA 24+89 B TO 31+39 A

SCALE: 1" = 10'



EXTRUSION FILLET WELD

DOUBLE WEDGE FUSION WELD

7/8 FUSION AND EXTRUSION WELDS (TYP)

NO SCALE

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DRAWN M.R.F.
CHKD. J.L.F.
SUPV.
APPD.

SIOUX POWER PLANT
UTILITY WASTE LANDFILL
SHEET 8 OF 16
GEOMEMBRANE LINER PLAN AND DETAILS

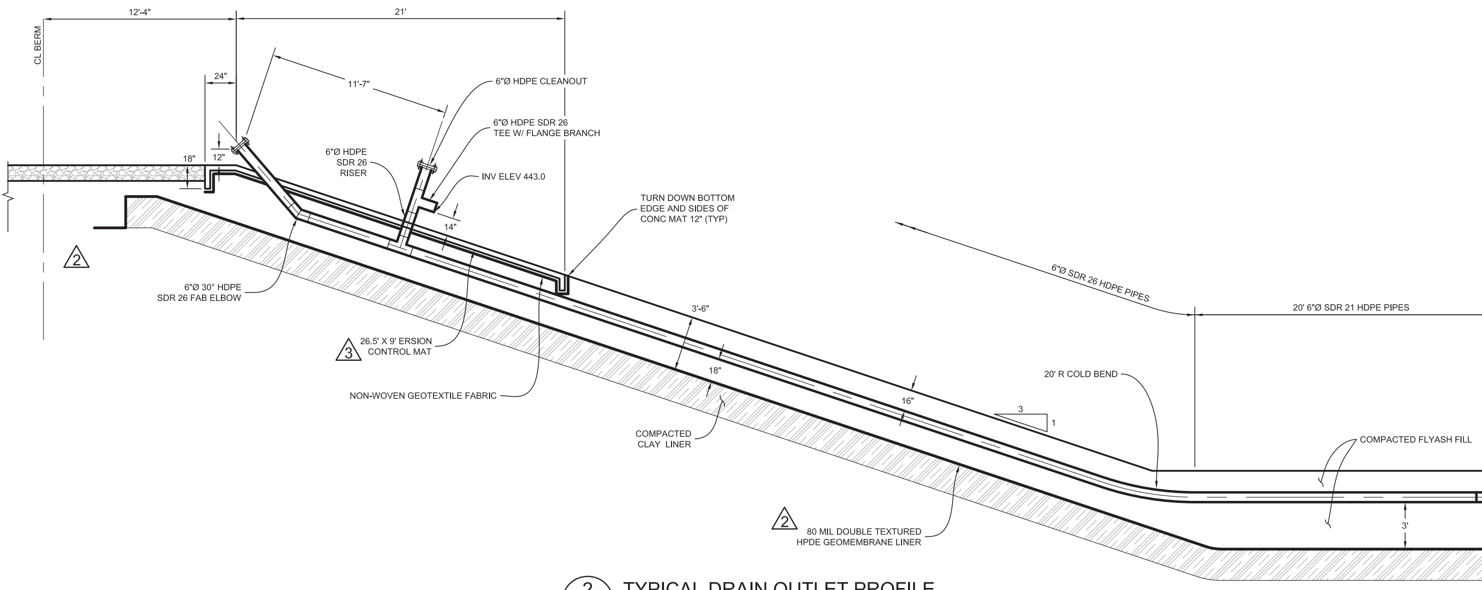
LOCATION 001009
SIOUX PLANT
CLASS 02010

AmerenUE ST. LOUIS, MISSOURI
8430-Y-0168608
REV. 4

Figure 2

PRINT DIST.

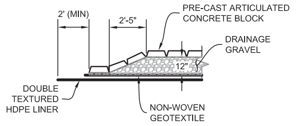
REVISIONS		
REV.	W.O.	
0		4/03/08
1		10/10/08
2		5/18/09
3		10/23/09
4		6/7/10



2 / 9 TYPICAL DRAIN OUTLET PROFILE

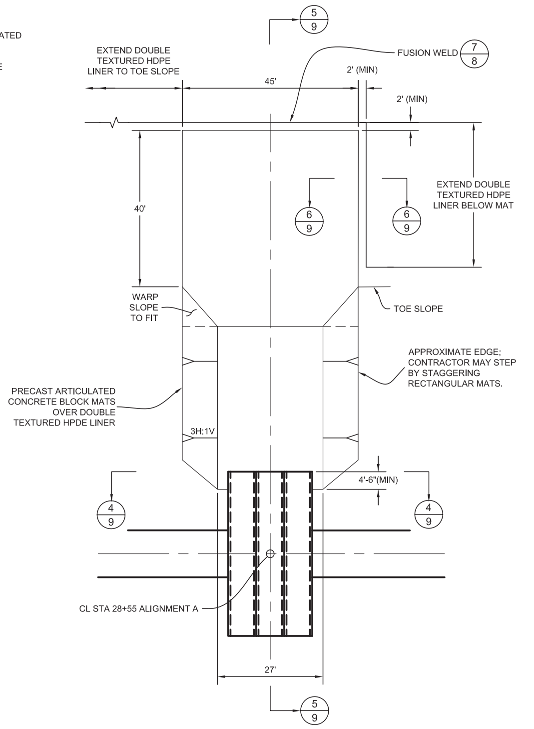
SCALE: 1" = 5'

2 PIPES REQUIRED AT EACH OUTLET



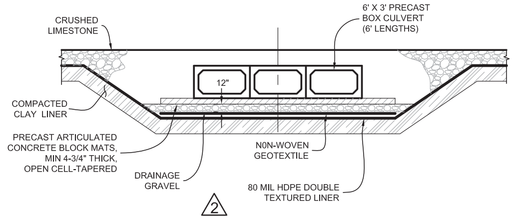
6 / 9 TYPICAL EDGE

SCALE: 1" = 5'



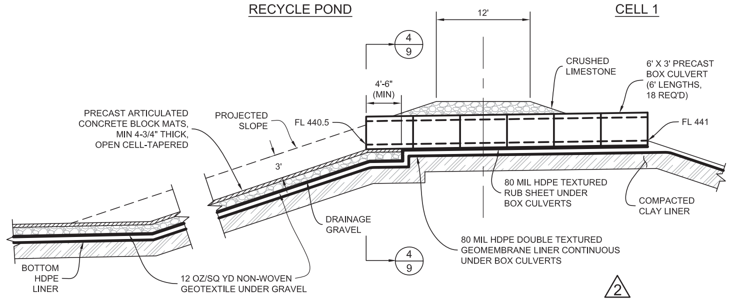
3 / 9 RECYCLE POND INFLUENT STRUCTURE PLAN

SCALE: 1" = 20'



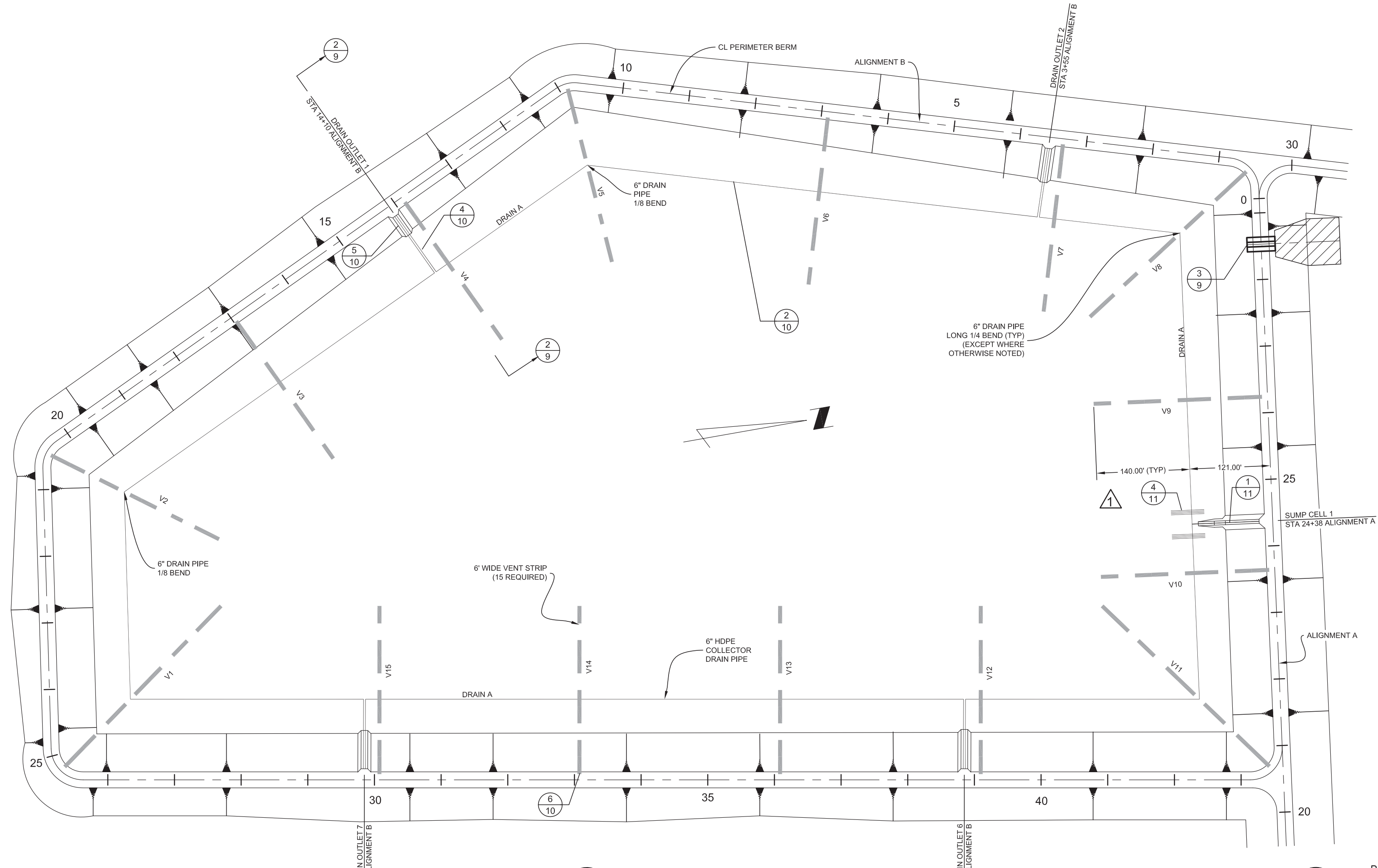
4 / 9 INFLUENT STRUCTURE SECTION

NO SCALE



5 / 9 INFLUENT STRUCTURE SECTION

NO SCALE



1 / 9 DRAIN AND OUTLET PLAN

SCALE: 1" = 100'

DRAIN B DELETED 3

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CHKD. J.L.F.		
SUPV.		
APPD.	LOCATION 001009 | SIOUX PLANT	CLASS 02010
AmerenUE ST. LOUIS, MISSOURI	8430-Y-0168609	REV. 4

Figure 3

Ameren Missouri: Sioux Energy Center
SCPC (Cell 1)
AREA CAPACITY CURVES

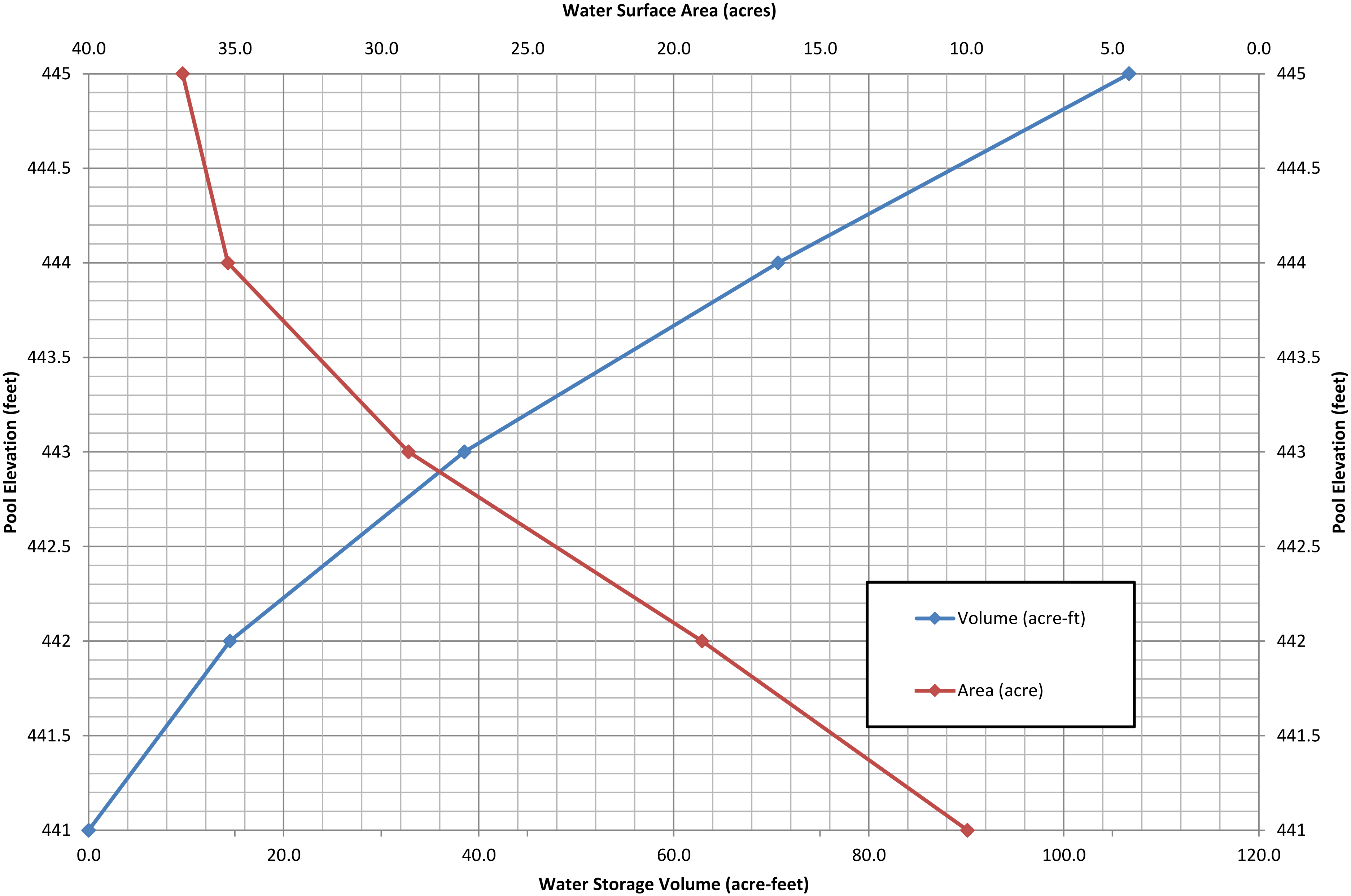

Figure 4