ALLIANT ENERGY
Interstate Power and Light Company
Burlington Generating Station

CCR SURFACE IMPOUNDMENT

SAFETY FACTOR ASSESSMENT

Report Issued: August 25, 2016
Revision 0

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EXECUTIVE SUMMARY

This Safety Factor Assessment (Report) is prepared in accordance with the requirements of the United States Environmental Protection Agency (USEPA) published Final Rule for Hazardous and Solid Waste Management System – Disposal of Coal Combustion Residual (CCR) from Electric Utilities (40 CFR Parts 257 and 261, also known as the CCR Rule) published on April 17, 2015 and effective October 19, 2015.

This Report assess the safety factors of each CCR unit at the IPL – Burlington Generating Station in Burlington, Iowa in accordance with §257.73(b) and §257.73(e) of the CCR Rule. For purposes of this Report, "CCR unit" refers to existing CCR surface impoundments.

Primarily, this Report assesses if each CCR surface impoundment achieves the minimum safety factors, which include:

- Static factor of safety under long-term, maximum storage pool loading condition,
- Static factor of safety under the maximum surcharge pool loading condition,
- Seismic factor of safety; and,
- Post-Liquefaction factor of safety for embankments constructed of soils that will experience liquefaction during the design earthquake.

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1 Introduction

The owner or operator of the Coal Combustion Residual (CCR) unit must conduct an initial and periodic safety factor assessments to determine if each CCR surface impoundment achieves the minimum safety factors, which include:

- Static factor of safety under long-term, maximum storage pool loading condition,
- Static factor of safety under the maximum surcharge pool loading condition,
- Seismic factor of safety; and,
- Post-Liquefaction factor of safety for embankments constructed of soils that have susceptibility to liquefaction.

This Report has been prepared in accordance with the requirements of §257.73(b) and §257.73(e) of the CCR Rule.

1.1 CCR Rule Applicability

The CCR Rule requires a periodic safety factor assessment by a qualified professional engineer (PE) for existing CCR surface impoundments with a height of 5 feet or more and a storage volume of 20 acre-feet or more or the existing CCR surface impoundment has a height of 20 feet or more (§257.73(b)).

1.2 Safety Factor Assessment Applicability

The Burlington Generating Station (BGS) in Burlington, Iowa (Figure 1) has four existing CCR surface impoundments that meet the requirements of §257.73(b)(1) or §257.73(b)(2) of the CCR Rule, which are identified as follows:

- BGS Ash Seal Pond
- BGS Main Ash Pond
- BGS Economizer Pond
- BGS Upper Ash Pond

2 FACILITY DESCRIPTION

The following sub-section provides a summary description of the facility and existing CCR surface impoundments located at BGS.

BGS is located southeast of the City of Burlington, Iowa on the western shore of the Mississippi River in Des Moines County, at 4282 Sullivan Slough Road, Burlington, Iowa (Figure 1). BGS is a fossil-fueled electric generating station consisting of one steam electric generating unit and four combustion turbine units. Sub-bituminous coal is the primary fuel for producing steam, and natural gas is used for the combustion turbines. The burning of coal in the steam electric unit produces CCR. The CCR at BGS is categorized into three types, bottom ash, economizer ash, and precipitator fly ash.

Date of Initial Facility Operations: 1968
NPDES Permit Number: IA29-00-1-01
Facility Title V Operating Permit: 98-TV-023R1-M004
Latitude / Longitude: 40°44’29”N 91°07’04”W
Site Coordinates: Section 29, Township 69 North, Range 02 West

2.1 BGS Ash Seal Pond

The BGS Ash Seal Pond is located south of the generating plant and east of the BGS Main Ash Pond. The CCR, in 1968, was originally managed by discharging into the BGS Ash Seal Pond for settling. Presently, the BGS Ash Seal Pond only receives storm water runoff from the surrounding area associated with the fly ash storage silo. The BGS Ash Seal Pond also may receive facility process water, such as ash seal water, but only if there is an issue with the ash seal water pumps. At the time of the initial annual inspection on October 26, 2015 this CCR surface impoundment did not contain standing water.

The surface area of the BGS Ash Seal Pond is approximately 5.7 acres and has an embankment height of approximately 12 feet from the crest to the toe of the downstream slope. The embankment crest is at elevation 534 the same as the adjacent plant site grade and equivalent to the 100 year flood water elevation of the Mississippi River. The interior storage depth of the BGS Ash Seal Pond is approximately 12 feet. If water were present, the total volume of impounded CCR and water within the BGS Ash Seal Pond would be approximately 97,000 cubic yards, which would include general fill that has been added in the northeast corner of the impoundment. The original outfall for the impoundment is sealed to prevent discharge to the Mississippi River and the impoundment normally contains no water. Rainfall that accumulates exfiltrates through the bottom of the impoundment. A manually operated pump is available to lift storm water to the adjacent BGS Main Ash Pond, if necessary.

2.2 BGS Main Ash Pond

The BGS Main Ash Pond is located southwest of the generating plant and west of the BGS Ash Seal Pond. The CCR, prior to being sluiced to the BGS Main Ash Pond, was originally managed in the BGS Ash Seal Pond in 1968. In 1971, BGS managed CCR in the BGS Upper Ash Pond. In 1980, the BGS Main Ash Pond became the primary receiver of CCR, with the BGS Upper Ash Pond becoming a downstream receiver.

Presently, the BGS Main Ash Pond receives bottom ash that is sluiced from the generating plant to the northeast corner of the BGS Main Ash Pond. The sluiced bottom ash discharges into the northeast corner where the majority of the bottom ash settles out. The bottom ash that settles out is recovered for beneficial reuse. Hydrated fly ash is also stored within the BGS Main Ash Pond area prior to being sold as aggregate material for beneficial reuse. Fly ash from the on-site storage silo is no longer added to the embankment.

The water that is used to sluice the bottom ash into the BGS Main Ash Pond is routed towards the west end of the BGS Main Ash Pond. The water is discharged in batch quantities as bottom ash accumulates in the boiler and averages 1 cubic foot per second (cfs) on a daily basis. The water flows to the west along the north side of a road constructed out of bottom ash through the center of the BGS Main Ash Pond, Figure 2.

The water flows along the north side of the road until it reaches the west end where it transitions into a ponded area in the northwest corner of the BGS Main Ash Pond. The water in the northwest corner of the BGS Main Ash Pond flows through two 15 inch diameter corrugated metal culverts with identical invert elevation under the generating plant entrance road. The water discharges into a small channel in the southwest corner of the BGS Upper Ash Pond located north of the generating plant entrance road.

The surface area of the BGS Main Ash Pond is approximately 18.7 acres and has an embankment height of approximately 12 feet from the crest to the toe of the downstream slope. The embankment crest is at elevation 534 the same as the plant site grade and equivalent to the 100 year flood water elevation in the Mississippi River. The interior storage depth of the BGS Main Ash Pond is approximately 8 feet. The total volume of impounded CCR and water within the BGS Main Ash Pond at normal water operation elevation is approximately 240,000 cubic yards. Additional volume of impounded CCR, located in the eastern half of the BGS Main Ash Pond above the crest elevation of the embankment, includes the bottom ash storage area and C-stone embankment (hydrated fly ash). In 2008, the quantity of the additional CCR above the crest elevation of the embankment is approximately 104,000 cubic yards.

2.3 BGS Economizer Pond

The BGS Economizer Pond is located west of the generating plant and north of the BGS Main Ash Pond. In 1986, BGS constructed the BGS Economizer Pond in the southern and eastern portion of the original footprint of the BGS Upper Ash Pond. The impoundment has resulted from economizer ash that has been deposited since 1986, which created the economizer embankment which is higher than the embankments of the BGS Upper Ash Pond at approximately elevation 548.

Presently, the BGS Economizer Pond receives economizer ash. The economizer ash is sluiced from the generating plant to the east end of the BGS Economizer Pond via a 10-inch diameter polyvinyl chloride pipe at a flow rate of 1.5 cfs (including approximately

10% plant process water). The economizer ash settles out through the water column of the 0.4 acre BGS Economizer Pond while the water flows to the west. The water discharges from the BGS Economizer Pond through an 18-inch diameter high-density polyethylene pipe into a storm water and process water treatment channel located along the south side of the economizer embankment.

The storm water and process water treatment channel receives runoff from 8 acres surrounding the generating plant. The collected storm water drains into a pump vault located at the toe of the downstream slope of the east embankment of the BGS Economizer Pond. Plant process water flows through an oil/water separator and receives influent flows from the plant floor drains and water treatment process water. After the oil/water separator, the process water discharges into the pump vault. The storm water and process water is then pumped from the vault up to the storm water treatment channel. The storm water treatment channel flows to the west along the south side of the economizer embankment until it discharges through an 18-inch diameter high-density polyethylene pipe located in the southwest corner of the economizer embankment. The water from the storm water treatment channel discharges into a small channel in the southwest corner of the BGS Upper Ash Pond located north of the generating plant entrance road.

The total surface area of the BGS Economizer Pond and economizer embankment is approximately 11 acres and has an embankment height of approximately 13 feet from the crest to the toe of slope on the CCR in the BGS Upper Ash Pond. The interior storage depth of the top of the economizer embankment to the bottom of the original footprint of the BGS Upper Ash Pond is approximately 27 feet. Thus, the total volume of impounded CCR and water within the BGS Economizer Pond including CCR already in place when the impoundment was established is approximately 480,000 cubic yards.

2.4 BGS Upper Ash Pond

The BGS Upper Ash Pond is located northwest of the generating plant and north of the BGS Main Ash Pond. In 1971, BGS began managing CCR in the BGS Upper Ash Pond. In 1980, the BGS Main Ash Pond became the primary receiver of CCR and the BGS Upper Ash Pond became a downstream receiver of the BGS Main Ash Pond.

Presently, the BGS Upper Ash Pond receives influent flows from the BGS Main Ash Pond, BGS Economizer Pond, and storm water and process water flow from the generating plant. The influent flows all discharge into a small channel located in the southwest corner of the BGS Upper Ash Pond. The water in the channel routed along the south side of the gravel dike of the BGS Upper Ash Pond until it discharges into the southwest corner of the BGS Upper Ash Pond water body.

The water flows through the BGS Upper Ash Pond water body to the northeast towards a 24-inch wide precast concrete Parshall flume that discharges into a concrete catch basin. The water in the catch basin flows through a 15-inch diameter polyvinyl chloride pipe and discharges into the BGS Lower Pond. Instrumentation associated with the BGS Upper Ash Pond includes a flow meter that monitors the discharges. The discharge from the concrete catch basin enters the Lower Pond. The Lower Pond contains the facility's National Pollution Discharge Elimination System (NPDES) Outfall 001. The water flows through the NPDES Outfall 001 hydraulic structure, which consists of cast in place weir box.

The total surface area of the BGS Upper Ash Pond is approximately 13.3 acres and has an embankment height of approximately 10 feet from the crest to the toe of the downstream slope. The elevation of the embankments is 531 feet, 3 feet lower than the 100 year flood elevation of the Mississippi River. The embankment is armored with cobble size stone on the crest and both outer and inner embankment slopes to prevent erosion of the embankment during overtopping from extreme flood stage of the Mississippi River. The interior storage depth of the BGS Upper Ash Pond is approximately 7 feet. The volume of impounded CCR and water within the BGS Upper Ash Pond at normal operation water elevation is approximately 150,000 cubic yards.

3 SAFETY FACTOR ASSESSMENT- §257.73(e)

This Report documents if each CCR surface impoundment achieves the minimum safety factors, which are identified on the table below.

Safety Factor Assessment	Minimum Safety Factor
Static Safety Factor Under Maximum Storage Pool Loading	1.50
Static Safety Factor Under Maximum Surcharge Pool Loading	1.40
Seismic Safety Factor	1.00
Post-Liquefaction Safety Factor	1.20

3.1 Safety Factor Assessment Methods

The safety factor assessment is completed with the two dimensional limit-equilibrium slope stability analyses program STABL5M (1996)[1]. The program analyzes many potential failure circles or block slides by random generation of failure surfaces using toe and crest search boundaries set for each analysis. The solution occurs by balancing the resisting forces along the failure plane due to Mohr-Columb failure strength parameters of friction angle and cohesion against the gravity forces. The gravity driving forces are divided into the resisting forces to produce a safety factor for the slope. The minimum of hundreds of searches is presented as the applicable safety factor of the embankment.

There are both total stress and effective stress friction angle and cohesion values for clay. For the total stress case clay has only cohesion. For effective stress clay has both cohesion and friction angle. When clay receives a load that is applied only briefly (i.e., earthquake or high water), it responds as a total stress soil. For long term loadings such as normal water elevation, the clay resistance to failure is based on effective stress parameters. Because effective stress clay parameters are not readily available from normal soil testing and because the total stress parameters for compacted and over consolidated clay yield a

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[1] STABL User Manual by Ronald A. Siegel, Purdue University, June 4, 1975 and STABL% -- The SPENCER Method of Slices: Final Report, by J. R. Carpenter, Purdue University, August 28, 1985

conservative answer for safety factor, the static analysis with normal operating water elevation is performed with the total stress parameters for the clay components in the embankments.

3.1.1 Soil Conditions in and under the impoundments

The BGS is constructed on a natural levee deposit on the west back of the Mississippi River at River Mile 399. Numerous soil borings were installed for construction activities at the plant in 1962 and 2008, Figure 2. The borings are presented in Appendix A and indicate bedrock at elevation 450, very dense sand and gravel to elevation 470, and medium dense sand to elevation 510. Above 510 the plant area and BGS Ash Seal Pond have loose layers of silt and silty sand with compacted filled to bring the site grade to elevation 534.

Because there were no soil borings in the areas of the BGS Main Ash Pond, BGS Economizer Ash Pond, and BGS Upper Ash Pond, new geoprobe borings for soil samples and cone penetrometer borings for strength/density measurement were taken on the three ash ponds west of the plant site in 2011. The sample locations are shown on Figure 2 with the geoprobe boring logs in Appendix B and the Cone Penetrometer results in Appendix C. In addition to the borings, samples from the geoprobes were tested to determine water content, Atterberg limits, and grain size of the soils found above the medium dense sand layer at elevation 510. The laboratory test results are in Appendix D.

The 2011 results find a natural clay layer below the embankments of the ash ponds with plastic index greater than 20% and natural water content greater than 25%. The soil is a low plasticity clay deposited during river flooding in the backwater areas west of the plant site. The embankments of the BGS Main Ash Pond and the BGS Upper Ash Pond are constructed of clayey silt that was compacted over the natural clay deposit. From an interview with a long time staff member at the facility, it is understood that the clay borrow site was a rock quarry just west of the Station. The surface soil in the Burlington

Iowa area is loess with a glacial till found between the loess and limestone bedrock. The observed properties of the clay embankments confirm that loess is the likely source soil. In the BGS Economizer Pond, the imported clayey silt is found in the embankments constructed to raise the BGS Economizer Pond above the BGS Upper Ash Pond on the south, east, and west sides and on the western half of the north side. However, the eastern half of the north side embankment contains no imported clay and is CCR constructed on top of CCR in the BGS Upper Ash Pond.

The CPT data results for clay layers are assigned an undrained shear strength (cohesion) based on the procedure recommended by Robertson[2]. The undrained shear strength is:

$$S_u = (q_c - \alpha_0) / N_k$$

Where: S_u = undrained shear strength
qc = cone penetration pressure
α_0 = total vertical overburden stress
N_k = a constant varying from 11 to 19 (15 recommended for normally consolidated clay)

The friction angle for cohesionless soil is related to the cone penetration value empirically as a variation on effective confining stress. The method is shown in Robertson and on Figure 19.5 of Terzaghi[3]. The figure from Terzaghi is included in Attachment C.

The results indicate the native clay cohesion ranges from 600 to 1200 pounds per square foot (psf). For the CCR, friction angle ranges from 30 to 34 degrees and for the imported clayey silt embankment soil the cohesion ranges from 700 to 1950 psf.

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[2] Robertson, P.K. and Campanella, R.G., 1986, “Guidelines for Use, Interpretation and Application of the CPT and CPTU, “UBC, Soil Mechanics Series No. 105, Civil Engineering Department, Vancouver BC, V6T 1W5

[3] Terzaghi, Karl, Ralph Peck and Gholamreza Mesri, “Soil Mechanics in Engineering Practice”, Third Edition, John Wiley and Sons, 1996.

3.1.2 Design water surface in impoundments maximum normal pool and maximum pool under design inflow storm

The BGS CCR ponds each have a specific function in the handling of bottom ash and economizer ash process flow or in total suspended solids removal from process and storm water. Fly ash at BGS is handled in a dry silo system and does not go to the CCR ponds.

Based on the 2016 Hazard Potential Analysis conducted by HHS, two of the four ponds are significant hazard potential ponds, and two are low hazard potential ponds. Since the low hazard potential ponds combine with flow from one of the significant hazard potential ponds, the maximum pool elevation is determined from routing a 1,000 year return event 24 hour Type II storm through the ponds[4]

The corresponding normal and maximum water elevations are:

CCR Unit	Normal Pool Water Elevation (feet)	Maximum Pool Elevation (feet)	Embankment Crest Elevation (feet)
BGS Ash Seal Pond	No water	533.4	534
BGS Main Ash Pond	531.5	533.4	534
BGS Economizer Pond	528.0	530.3	548
BGS Upper Ash Pond	528.0	530.3	531

The BGS Economizer Pond is a CCR embankment constructed within the confines of the original BGS Upper Ash Pond and has only a ditch and small ponded area near the center of the 11 acre embankment. Water elevation in the ditch and small Economizer Ash settling pond does not impact the stability of the outer embankment slope. The water elevation in the outer slope is impacted only by the water elevation in the BGS Upper Ash Pond.

3.1.3 Selection of Seismic Design Parameters and Description of Method

The design earthquake ground acceleration is selected from the United States Geologic Survey (USGS) detailed seismic maps based on the latitude and longitude of the BGS.

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[4] Inflow Flood Control Plan, Burlington Generating Station, 2016

The peak ground acceleration (PGA) value is selected for a 2% probability of exceedance in 50 years (2500 year return period) as required by §257.53. Since the site soils consist of medium dense to very dense sand from bedrock to elevation 510 and soft to medium stiff clay or loose to very loose CCR above elevation 510, a bedrock PGA of 0.054 g (2500 year return period) was selected using the USGS web site. The ground acceleration for embankment design was determined by multiplying the bedrock acceleration by the weighted amplification factors for PGA using the procedure in the 2009 International Building Code 1613.5.5. The weighting factor calculation based on the know site soil conditions is shown in Appendix E. The Design PGA at the ground surface used for embankment analysis is 0.105 g.

3.1.4 Liquefaction Assessment Method and Parameters

3.1.4.1 Data for Liquefaction Assessment

Certain soils may have zero effective stress (liquefaction) during an earthquake or from static shear of a saturated embankment slope. Soils that will liquefy include loose or very loose uniform fine sand or silt, and soft low-plasticity clay (Plastic Index of less than 12). The liquefaction resistance of a soil is based on its strength and effective confining stress. The strength of the CCR and soil immediately below the CCR may be measured with a Cone Penetrometer Test (ASTM D 5778) or with a standard split spoon test (ASTM D 1586).

The Cone Penetrometer Test was used in 2011 to determine the strength of the embankment soils and to determine the potential for liquefaction during the design earthquake. The Cone Penetrometer test results are coupled with geoprobe push samples to examine the type of soil present and to allow laboratory testing to determine if the soil is a liquefiable soil.

The data indicates that embankment soils and underlying native clay at the BGS Ash Seal Pond, BGS Main Ash Pond and BGS Upper Ash Pond have Plastic Index greater than 20 and will not liquefy in an earthquake or during static shearing. Soils below elevation 510 are sand but are too strong to liquefy during an earthquake. The only soils that could liquefy during an earthquake are the CCR materials in the north embankment of the BGS Economizer Pond. The CCR is saturated in the bottom ten feet of the CCR due to the BGS Upper Ash Pond and the CCR is silt and/or silty sand that is very loose to loose. In reviewing the CPT results, Appendix B, for the north slope of the BGS Economizer Pond, the results from CPT 7 and CPT 8 indicate that the CCR under the clay embankment is denser than the eastern end of the north embankment. The liquefaction assessment is therefore limited to the eastern half of the north embankment where no clay embankment exists over the CCR placed in the BGS Upper Ash Pond.

3.1.4.2 Liquefaction Assessment

The liquefaction assessment using the CPT data is completed using the procedures for simplified assessment of liquefaction potential first proposed by Seed and most recently updated and published by Idriss and Boulanger[5]. The procedure uses the strengths determined by the CPT test adjusted to normalized pressure and for sand fines content to determine the cyclic resistance ratio for the soil at earthquake magnitude 7.5 and at 1 atmosphere pressure. The cyclic resistance ratio is then adjusted for the actual earthquake magnitude of the design event which is 7.7 for a New Madrid Fault source earthquake[6]. The cyclic stress ratio caused by the design surface PGA is then used to determine the actual cyclic stress ratio at 65% of maximum strain at depth in the soil profile. The cyclic resistance ratio is divided by the cyclic stress ratio to determine the factor of safety for liquefaction.

The results for the soil profile on the eastern end of the north embankment of the BGS Economizer Pond are shown in Appendix E. The results indicate that the bottom five

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[5] Idriss I. M. and R. W. Boulanger, "Soil Liquefaction During Earthquakes", EERI MNO-12, 2008.

[6] Elnashai et al, "Impact of Earthquakes on the Central USA", FEMA Report 8-02, Mid-American Earthquake Center, 2002

foot of the CCR just above the native clay will liquefy during the design earthquake of 0.105 g at ground surface.

3.2 BGS Ash Seal Pond

The cross-section analyzed for the BGS Ash Seal Pond is shown on Figure 2. The Section was chosen for its height and proximity to the condenser discharge channel.

The CPT results (CPT-13 and CPT-14) and the laboratory confirmation (SB-8) show the native clay layer is present beneath a coarse grained levee sand deposit and a compacted clay embankment. The compacted clay embankment has cohesion of 700psf and the native clay cohesion of 900 psf. The levee sand has an internal friction angle of 37°.

3.2.1 Static Safety Factor Assessment Under Maximum Storage Pool Loading - §257.73(e)(1)(i)

The BGS Ash Seal Pond is a zero discharge pond and does not hold water under normal storage pool conditions. The lowest surface elevation of the pond inside of the embankment is elevation 531 and the maximum storage pool is assigned equal to the elevation 526 seven feet above normal pool elevation of the adjacent Mississippi River (elevation 519). Analysis for both a circular and block sliding surface, Appendix F, show a minimum factor of safety of 2.5 for the circular surface.

3.2.2 Static Safety Factor Assessment Under Maximum Surcharge Pool Loading - §257.73(e)(1)(ii)

The BGS Ash Seal Pond is a zero discharge pond that will contain the 1,000 year return period design storm without discharge. Neglecting the likely exfiltration into the coarse levee sand, the full storm is stored in the pond bringing the water elevation to elevation 533.4. Analysis for both a circular and block sliding surface, Appendix F, show a minimum factor of safety of 2.2 for the circular surface.

3.2.3 Seismic Safety Factor Assessment - §257.73(e)(1)(iii)

The BGS Ash Seal Pond was assigned a pseudo-static earthquake coefficient equal to 0.105 g acceleration and a vertical upward component equal to $^2/_3$ of the horizontal component (0.07 g) as recommended by Newmark[7]. Analysis for both a circular and block sliding surface, Appendix F, show a minimum factor of safety of 1.9 for the circular surface.

3.2.4 Post-Liquefaction Safety Factor Assessment - §257.73(e)(1)(iv)

The BGS Ash Seal Pond embankment is constructed of clay that is not susceptible to liquefaction. The underlying native soils are dense coarse sand or native clay neither of which is subject to liquefaction. No post liquefaction slope stability assessment is required.

3.3 BGS Main Ash Pond

The cross-section analyzed for the BGS Main Ash Pond is shown on Figure 2. The Section was chosen for its steeper front slope and proximity to the main ponding area of the BGS Main Ash Pond.

The CPT results (CPT-15 to CPT-18) and the laboratory confirmation (SB-6 and SB-7) show the native clay layer is present beneath a compacted clay embankment. The compacted clay embankment has cohesion of 700 psf and the native clay cohesion of 1200 psf.

3.3.1 Static Safety Factor Assessment Under Maximum Storage Pool Loading - §257.73(e)(1)(i)

The BGS Main Ash Pond receives 1 cubic foot per second of daily average process water flow from the sluicing of bottom ash. The daily flow maintains a storage pool water elevation of 531.5 at the west end of the pond. Analysis of both circular and block sliding surfaces, Appendix F, show a minimum factor of safety of 3.9 for the block slide surface.

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[7] Newmark, N. M. and W. J. Hall, "Earthquake Spectra and Design". EERI Monograph, Earthquake Engineering Research Institute, Berkley California, 1982

3.3.2 Static Safety Factor Assessment Under Maximum Surcharge Pool Loading - §257.73(e)(1)(ii)

The BGS Main Ash Pond will contain the 1000 year return period design storm through a combination of storage in the pond and discharge to the BGS Upper Ash Pond. The maximum surcharge pool loading elevation is 533.4 feet at the peak of the storm.. Analysis for both a circular and block sliding surface, Appendix F, show a minimum factor of safety of 3.8 for the block slide surface.

3.3.3 Seismic Safety Factor Assessment - §257.73(e)(1)(iii)

The BGS Main Ash Pond was assigned a pseudo-static earthquake coefficient equal to 0.105 g acceleration and a vertical upward component equal to $^2/_3$ of the horizontal component (0.07 g) as recommended by Newmark[7]. Analysis for both a circular and block sliding surface, Appendix F, show a minimum factor of safety of 2.6 for the block slide surface.

3.3.4 Post-Liquefaction Safety Factor Assessment - §257.73(e)(1)(iv)

The BGS Main Ash Pond embankment is constructed of clay that is not susceptible to liquefaction. The underlying native clay is also not subject to liquefaction. No post liquefaction slope stability assessment is required.

3.4 BGS Economizer Pond

The BGS Economizer Pond was constructed on top of a portion of the original BGS Upper Ash Pond. The south embankment and the east embankment of the Pond are constructed of imported clay over the clay embankments of the original BGS Upper Ash Pond (CPT 9, 10, 11, and 12 and SB-3). The north and west embankment of the Pond are constructed over CCR that was deposited into the BGS Upper Ash Pond prior to construction of the economizer embankment and are the least stable embankments of the BGS Economizer Pond. Two cross-sections shown on Figure 2 were chosen for analysis on this less stable north embankment.

In 2011 a subsurface investigation was completed, which showed that the eastern 500-feet of the northern embankment of the BGS Economizer Pond was constructed of CCR.

The western part of the north embankment was imported clay compacted on top of CCR. The strength parameters from the CPT results are:

Soil Type	Depth Range (ft)	Cohesion (PSF)	Friction Angle (deg)
Eastern Cross-Section			
CCR cohesionless	0-20	0	34
CCR cohesionless	20-33		32
CCR cohesive (two small layers)	20-33	1,000	0
Native Clay	33-41	600	0
Native Dense Sand	>41	0	30
Western Cross-Section			
Embankment Clay	0-15	1,200	0
CCR	15-25	0	32
Native Clay	25-35	700	0
Native Dense Sand	>40	0	30

3.4.1 Static Safety Factor Assessment Under Maximum Storage Pool Loading - §257.73(e)(1)(i)

The BGS Economizer Pond receives 1.5 cubic foot per second of daily average process water flow from the sluicing of economizer ash and other minor plant process flows. The daily flow discharges through a small 0.4 acre settling pond and ditch to exit the Economizer at the west end discharging to the BGS Upper Ash Pond. The ditch and ponded water have no impact on the north embankment and the static water elevation is the same as the BGS Upper Ash Pond at elevation 528. Analysis of both circular and block sliding surfaces, Appendix F, show a minimum factor of safety of 2.1 western slope and 2.2 eastern slope for the block slide surface.

3.4.2 Static Safety Factor Assessment Under Maximum Surcharge Pool Loading - §257.73(e)(1)(ii)

The BGS Economizer Pond will route the 1000 year return period design storm with virtually no storage. The maximum surcharge pool loading elevation will be the rise in water elevation to 531 feet in the BGS Upper Ash Pond. Analysis for both a circular and block sliding surface, Appendix F, show a minimum factor of safety of 2.1 for the western slope and 2.1 for the eastern slope for the block slide surface.

3.4.3 Seismic Safety Factor Assessment - §257.73(e)(1)(iii)

The BGS Economizer Pond was assigned a pseudo-static earthquake coefficient equal to 0.105 g acceleration and a vertical upward component equal to $^2/_3$ of the horizontal component (0.07 g) as recommended by Newmark[7]. Analysis for both a circular and block sliding surface, Appendix F, show a minimum factor of safety of 1.3 for the western slope and 1.2 for the eastern slope for the block slide surface.

3.4.4 Post-Liquefaction Safety Factor Assessment - §257.73(e)(1)(iv)

The BGS Economizer Pond western north embankment is constructed of clay that is not susceptible to liquefaction and overlies medium dense CCR (equivalent SPT blow count > 10). The eastern embankment is constructed of CCR and overlies a very loose layer of CCR near the base of the Pond just above the native clay. Analysis of liquefaction potential indicates the very loose layer will liquefy during the design earthquake.

Idriss and Boulanger[4] provide empirical data to estimate the post-liquefaction strength of the liquefied layer based on its fines content corrected normalized CPT value. The result is a cohesion of 100 psf as shown in Appendix E. Analysis of the eastern slope using both a circle and block slide mode with the reduced post-liquefaction strength of the CCR layer which liquefied indicates a minimum factor of safety of 1.4 for the block slide.

3.5 BGS Upper Ash Pond

The cross-section analyzed for the BGS Upper Ash Pond is shown on Figure 2. The Section was chosen for its steeper front slope and proximity to the discharge of the BGS Upper Ash Pond.

The CPT results (CPT-20 and CPT-21) and the laboratory confirmation (SB-11 and SB-12) show the native clay layer is present beneath a compacted clay embankment. The compacted clay embankment has cohesion of 1950 psf and the native clay cohesion of 900 psf. Below the native clay is a medium dense sand with a friction angle of 35°.

3.5.1 Static Safety Factor Assessment Under Maximum Storage Pool Loading - §257.73(e)(1)(i)

The BGS Upper Ash Pond receives 2.5 cubic foot per second of daily average process water flow from the BGS Main Ash Pond and the Economizer Ash Pond. The daily flow maintains a storage pool water elevation of 528.0. Analysis of both circular and block sliding surfaces, Appendix F, show a minimum factor of safety of 3.3 for the block slide surface.

3.5.2 Static Safety Factor Assessment Under Maximum Surcharge Pool Loading - §257.73(e)(1)(ii)

The BGS Upper Ash Pond will contain the 1000 year return period design storm through a combination of storage in the pond and discharge to the Lower Ash Pond. The maximum surcharge pool loading elevation is 530.3 feet at the peak of the storm. Analysis for both a circular and block sliding surface, Appendix F, show a minimum factor of safety of 3.2 for the block slide surface.

3.5.3 Seismic Safety Factor Assessment - §257.73(e)(1)(iii)

The BGS Upper Ash Pond was assigned a pseudo-static earthquake coefficient equal to 0.105 g acceleration and a vertical upward component equal to $^2/_3$ of the horizontal component (0.07 g) as recommended by Newmark[7]. Analysis for both a circular and block sliding surface, Appendix F, show a minimum factor of safety of 2.4 for the block slide surface.

3.5.4 Post-Liquefaction Safety Factor Assessment - §257.73(e)(1)(iv)

The BGS Main Ash Pond embankment is constructed of clay that is not susceptible to liquefaction. The underlying native clay is also not subject to liquefaction. No post liquefaction slope stability assessment is required.

4 Results Summary

The results of the safety factor assessment indicate that the embankments of all four CCR ponds at BGS meet the requirements of §257.73 (e). The results are summarized as:

Summary
Slope Stability Safety Factors
BGS CCR Units

	Static Stability Normal Water Elevation	Static Stability Flood Water Elevation	Pseudo-Static Earthquake with Normal Water Elevation	Liquefaction Potential	Post-Earthquake Static Stability Normal Water Elevation
Required Safety Factor	1.5	1.4	1.0		1.2
BGS Ash Seal Pond	2.5	2.2	1.9	no	
BGS Main Ash Pond	3.9	3.8	2.6	no	
BGS Economizer Pond East Slope	2.2	2.1	1.2	yes	1.4
BGS Economizer Pond West Slope	2.1	2.1	1.3	no	
BGS Upper Ash Pond	3.3	3.2	2.4	no	

5 QUALIFIED PROFESSIONAL ENGINEER CERTIFICATION

To meet the requirements of 40 CFR 257.73(e)(2), I Mark W. Loerop hereby certify that I am a licensed professional engineer in the State of Iowa; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in 40 CFR 257.73(b) and 40 CFR 257.73(e).

MARK W. LOEROP
22197

By:

Name: MARK LOERop

Date: 8 - 25 - 2016

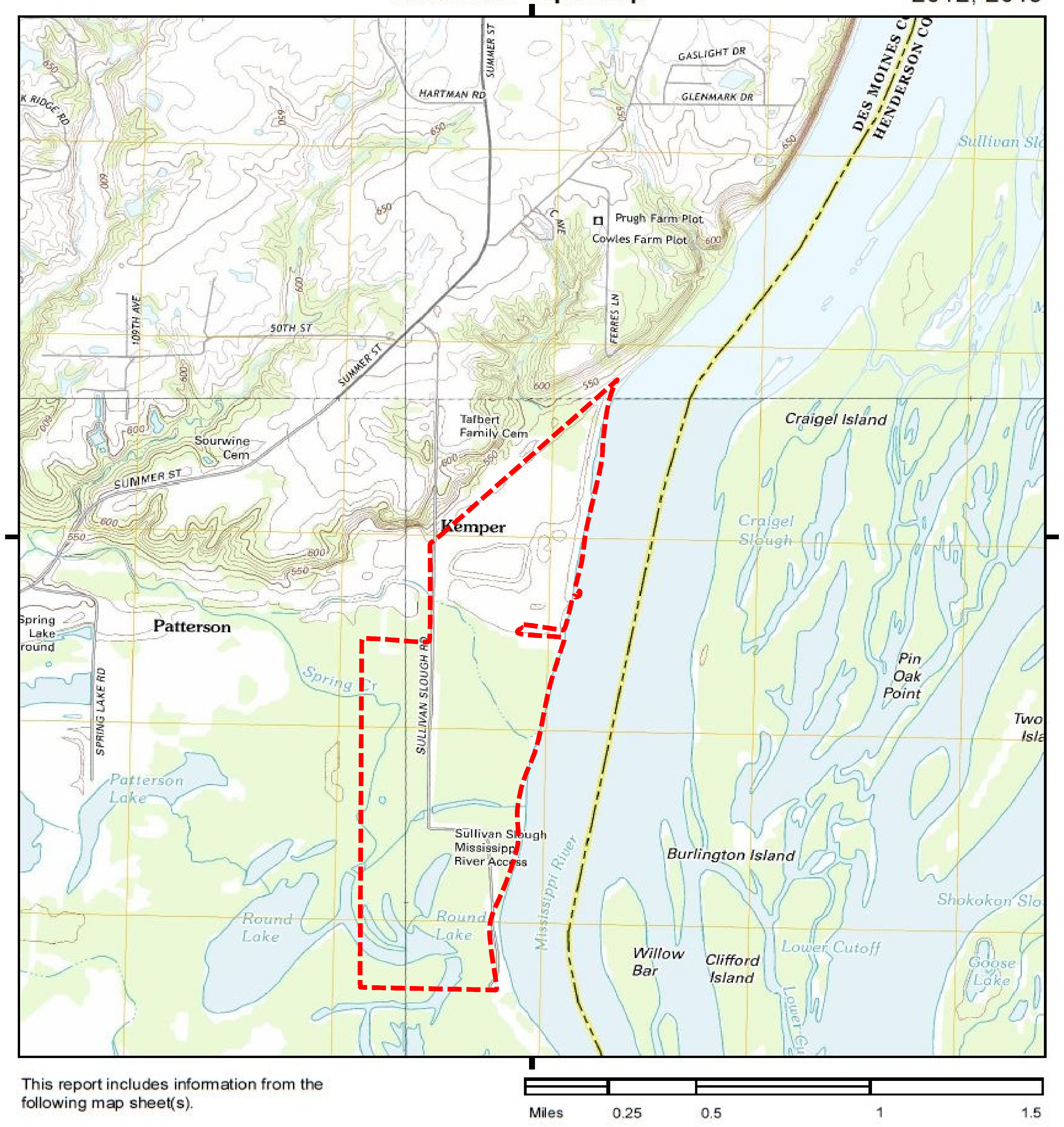
FIGURES

Alliant Energy
Interstate Power and Light Company
Burlington Generating Station
Burlington, Iowa

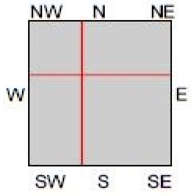
Safety Factor Assessment

Historical Topo Map

2012, 2013



This report includes information from the following map sheet(s).



TP, Lomax, 2012, 7.5-minute

NE, Burlington, 2013, 7.5-minute

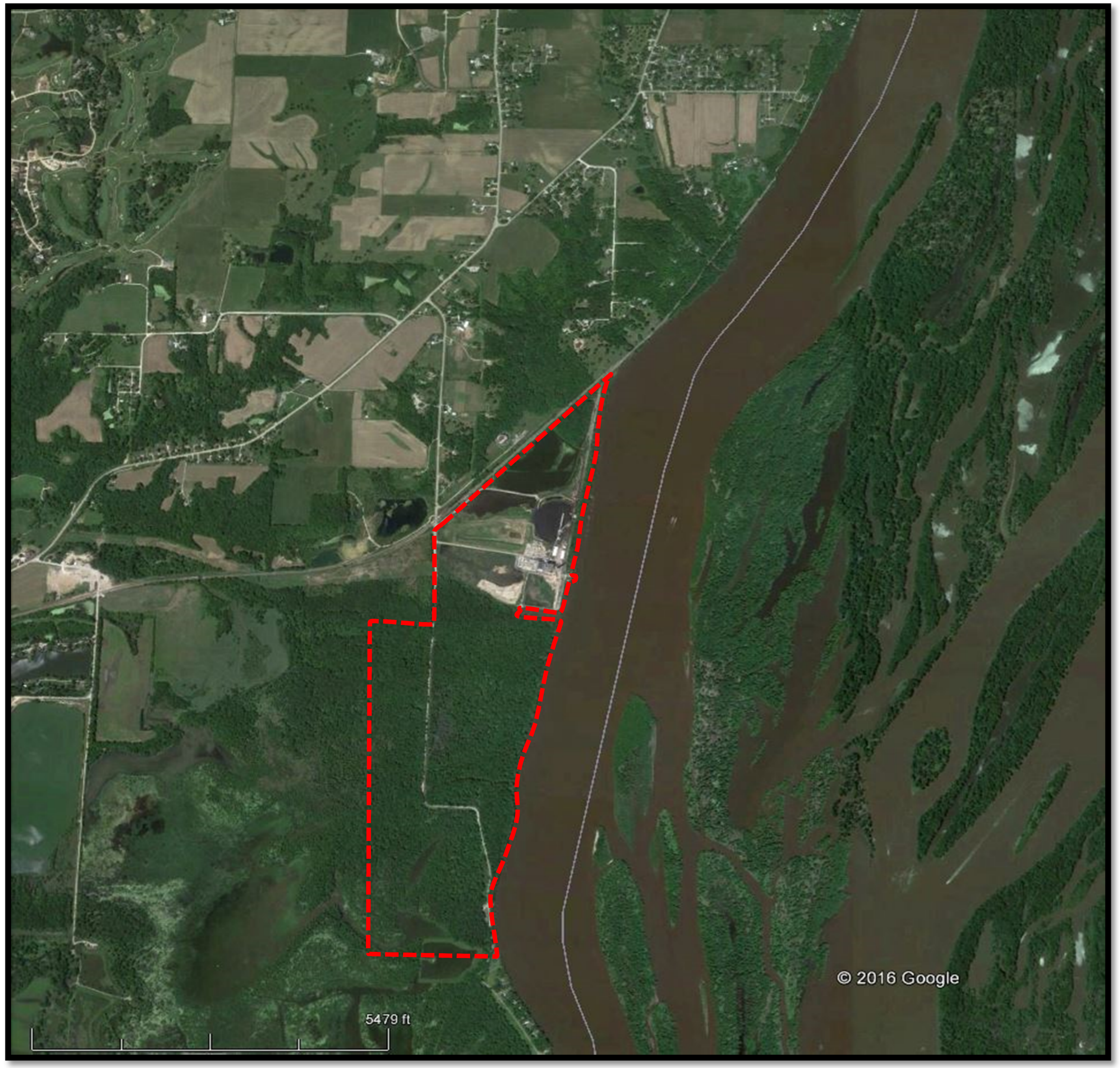
SW, Dallas City, 2012, 7.5-minute

NW, West Burlington, 2013, 7.5-minute

SITE NAME:	Burlington Generating Station
ADDRESS:	4282 Sullivan Slough Road Burlington, IA 52601
CLIENT:	Environmental Site Assessors

4555570 - 3 page 4

Historical Aerial Photo 6/12/2014



Approximate Property Boundary

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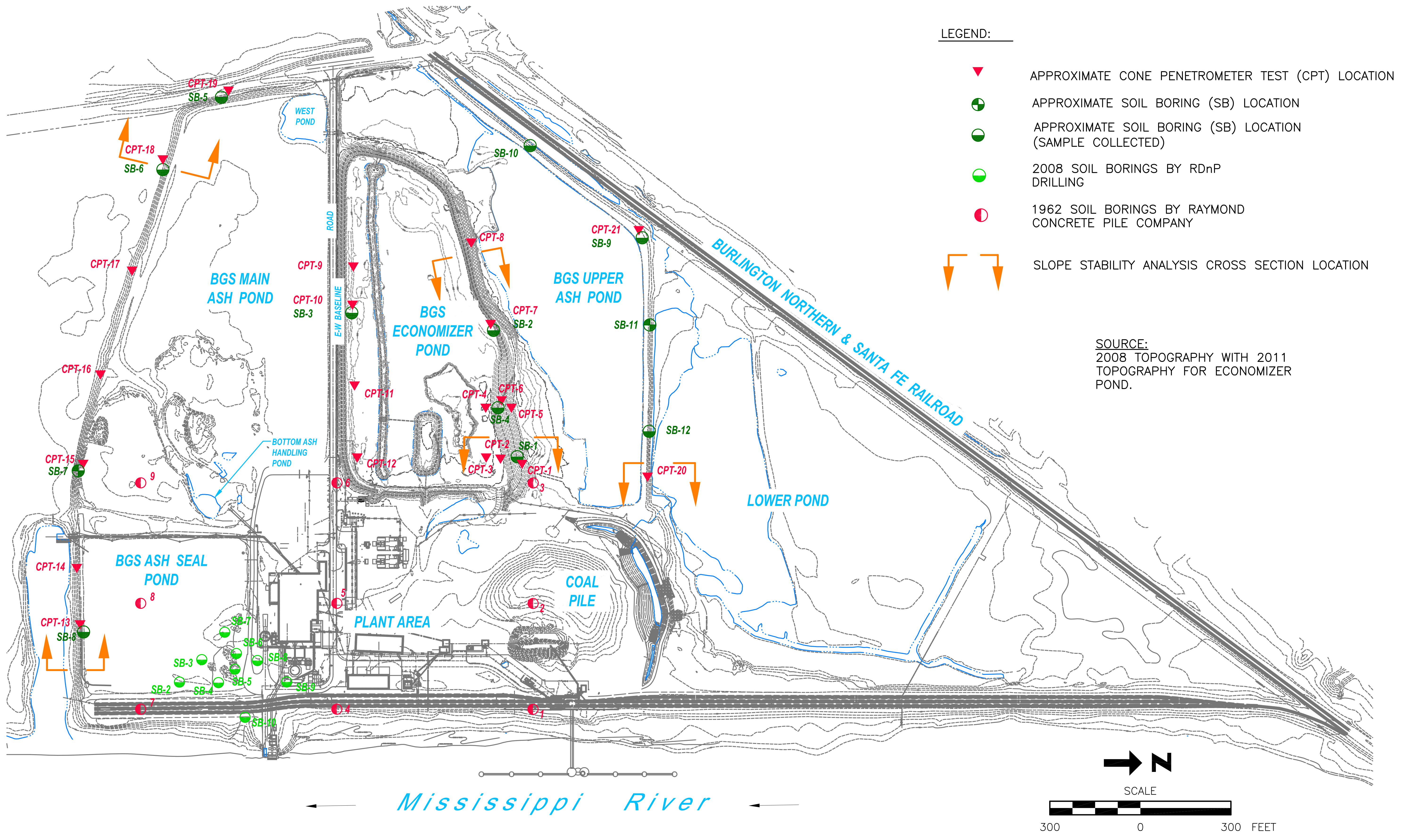
Site Location
Burlington Generating Station
Intersate Power and Light Company

Drawing
Figure 1
Date
5/25/2016



LEGEND:

🔻	APPROXIMATE CONE PENETROMETER TEST (CPT) LOCATION
◕	APPROXIMATE SOIL BORING (SB) LOCATION
◒	APPROXIMATE SOIL BORING (SB) LOCATION (SAMPLE COLLECTED)
◒	2008 SOIL BORINGS BY RDnP DRILLING
◐	1962 SOIL BORINGS BY RAYMOND CONCRETE PILE COMPANY
⌐ ¬	SLOPE STABILITY ANALYSIS CROSS SECTION LOCATION

SOURCE:
2008 TOPOGRAPHY WITH 2011 TOPOGRAPHY FOR ECONOMIZER POND.

REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

SCALE: AS SHOWN DATE: 5–13–16
DRAWN BY: JFD CHECKED BY: TJH APPROVED BY: MWL

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CLIENT / LOCATION
ALLIANT ENERGY
BURLINGTON GENERATING STATION
BURLINGTON, IOWA

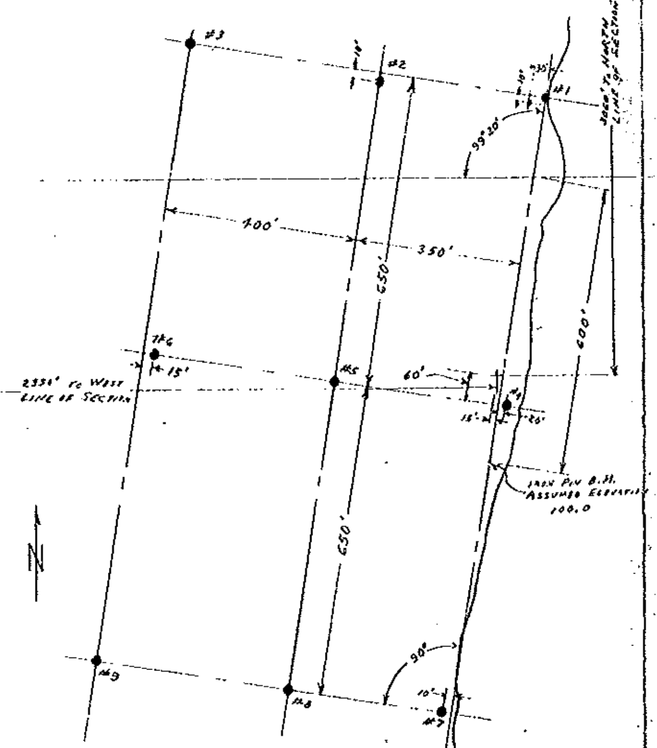
DRAWING DESCRIPTION
SOIL BORINGS, CPT, AND
SLOPE STABILITY CROSS SECTION LOCATIONS

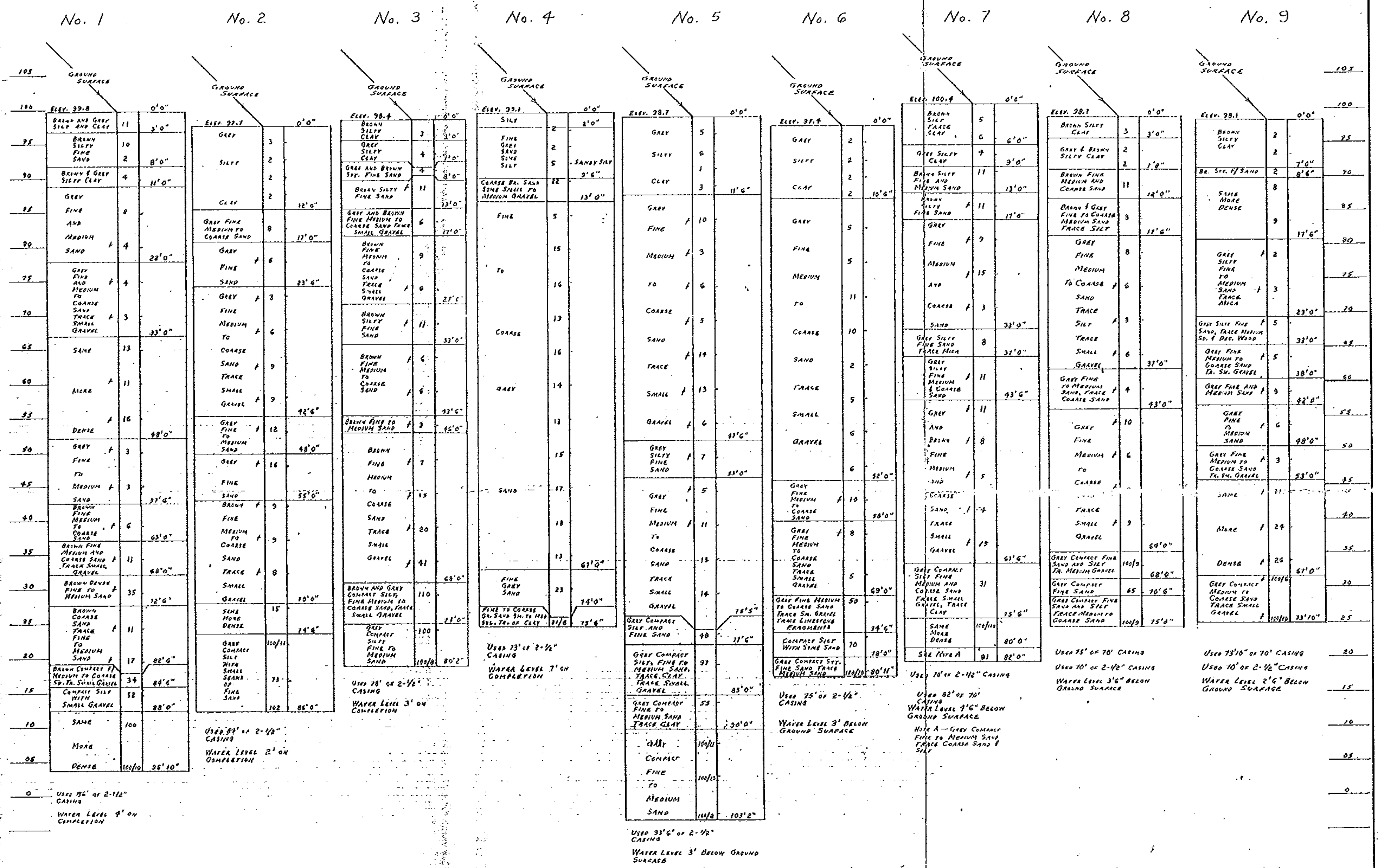
JOB 154.018.012.001
SHT. FIGURE 2
DWG. 154.018.012.001–D2

APPENDIX A – Deep Soil Borings

Alliant Energy
Interstate Power and Light Company
Burlington Generating Station
Burlington, Iowa

Safety Factor Assessment





Used 86' of 2-1/2" Casing

Water Level 4' on Completion

Used 81' of 2-1/2" Casing

Water Level 2' on Completion

Used 78' of 2-1/2" Casing

Water Level 3' on Completion

Used 73' of 2-1/2" Casing

Water Level 7' on Completion

Used 93'6" of 2-1/2" Casing

Water Level 3' Below Ground Surface

Used 75' of 2-1/2" Casing

Water Level 3' Below Ground Surface

Used 10' of 2-1/2" Casing

Used 82' of 70' Casing

Water Level 4'6" Below Ground Surface

Note A — Grey Compact Fine to Medium Sand Trace Coarse Sand & Silt

Used 75' of 70' Casing

Used 70' of 2-1/2" Casing

Water Level 3'6" Below Ground Surface

Used 73'10" of 70' Casing

Used 10' of 2-1/2" Casing

Water Level 2'6" Below Ground Surface

1/25/62 1/27/62 1/31/62 1/10/62 1/15/62 1/22/62 2/1/62 2/2/62 2/5/62

Figures in Right Hand Column Shown as Fractions — Numerator = No. of Blows / Denominator = Penetration in Inches

‡ Indicates Wash Sample Recovered

Classifications are made by visual inspection. 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.

References:
See D-467 For Boring Locations.
‡ Test Boring Report - February 13, 1962, By Raymond Concrete Pile Company, Gow Division, Job No. CB-948-KC Sheets 1 through 4

IOWA SOUTHERN UTILITIES CO.
CENTERVILLE, IOWA

Proposed Burlington Plant Site
Test Boring Reports

SCALE 1"=8' Vertical DATE 3-15-62
SKETCH DHN DWN TRCD LLA CHKD
D-484 APPROVED

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-2**
LOGGED BY LES
PAGE No. 1 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.13
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/11/2008 FINISH 12/12/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	INTERVAL (ft) TO	BLOW COUNT 0" 6"	6" 12"	12" 18"	18" 24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
														Frozen ground
	SS-1	2.0	4.0	2	3	4	4	14.0		0.75			CL	Black and brown mottled SILTY CLAY, little fine to medium sand, medium plasticity, medium stiff, wet
											4'3"	529.88		
5	SS-2	4.0	6.0	1	6	5	3	17.0						Grey SILT, trace fine sand, medium dense, moist
	SS-3	6.0	8.0	1	8	15	7	17.5						medium dense
	SS-4	8.0	10.0	1	6	50/5		18.0					ML	very dense
10														
	SS-5	13.0	15.0	1	1	1	1	13.0	49	0.75	13'5"	520.71		Dark brown and black mottled CLAY, trace silt, high plasticity, medium stiff, wet
15														
	SS-6	18.0	20.0	2	2	3	3	15.0	48	0.25 0.50			CH	soft (LL=52, PI=27)
20														
	SS-7	23.0	25.0	4	5	7	12	20.0			23'6"	510.63		Brown fine to medium SAND, medium dense, wet
25														
	SS-8	28.0	30.0	3	12	17	18	9.0						brownish-grey
30													SP	
	SS-9	33.0	35.0	8	10	11	12	11.5						
35														
	SS-10	38.0	40.0	7	7	10	12	10.0						some coarse sand and wood pieces
40														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-2**
LOGGED BY LES
PAGE No. 2 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.13
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/11/2008
FINISH 12/12/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	INTERVAL (ft) TO	BLOW COUNT 0" 6"	BLOW COUNT 6" 12"	BLOW COUNT 12" 18"	BLOW COUNT 18" 24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
														Brownish-grey fine to medium sand, some coarse sand, medium dense, wet (cont.)
	SS-11	43.0	45.0	3	6	12	14	15.5					SP	2" of black silt at 44'1"
45														
											46'6"	487.63		Brownish-grey fine to coarse SAND, medium dense, wet
	SS-12	48.0	50.0	6	7	8	12	16.0						
50														
	SS-13	53.0	55.0	10	11	12	19	21.0					SW	
55														
	SS-14	58.0	60.0	15	22	32	42	24.0						medium to coarse sand, trace fine sand and fine gravel, very dense
60											60'	474.13		EOB 60' - Sand was causing hole to collapse and would have needed to be cased to 60' to continue.
65														
70														
75														
80														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

BORING LOG

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PROJECT No. 154.002.008.001
BORING No. BH-B-1 **(BH-3)**
LOGGED BY LES
PAGE No. 1 of 2

PROJECT NAME Alliant Energy - Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
DRILLER RDnP Drilling - Chris DATE: START 7/15/2008 FINISH 7/21/2008

DEPTH	SAMPLE			BLOW COUNT				REC	WC	qu	CONTACT DEPTH	USCS SOIL TYPE	SOIL DESCRIPTION
		INTERVAL		0"	6"	12"	18"	(in)	(%)	(TSF)			
	No.	FROM	TO	6"	12"	18"	24"						
	SS-1	0.0	2.0	5	10	10	12	12	23				Brown and black silty clay FILL, medium dense, dry
	SS-2	2.0	4.0	10	11	11	15	9.5		2.0			Coarse sand and fine gravel FILL, trace grey fines, medium dense, dry
5	SS-3	4.0	6.0	5	10	2	2	10	14	4.0		FILL	some silt
	SS-4	6.0	8.0	1	10	16	12	22		6.0			Grey-black sand and gravel FILL with silt, medium dense wet.
	SS-5	8.0	10.0	6	10	22	32	24	24		10.0		
10	SS-6	10.0	12.0	3	8	3	2	14					Grey sandy SILT, trace coarse sand, loose, saturated
	SS-7	12.0	14.0	1	0	1	0	18	50				Grey SILT, little fine sand, very loose, saturated
15	SS-8	14.0	16.0	Rod Weight				17				ML	
20	SS-9	18.0	20.0	1	1	1	1	16	33				trace low plasticity clay, trace fine sand
											22'6"		
													Dark grey SILTY CLAY, trace fine sand, medium to high plasticity, soft, wet
25	SS-10	23.0	25.0	1	2	2	1	18				CL	
											26.5		
													Grey fine to medium grained SAND, trace coarse sand, very loose, saturated
30	SS-11	28.0	30.0	1	0	0	0	3	18				
35	SS-12	33.0	35.0	5	8	12	14	11				SP	medium dense
40	SS-13	38.0	40.0	8	10	11	12	11	13				

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. BH-B-1 **(BH-3)**
LOGGED BY LES
PAGE No. 2 of 2

PROJECT NAME Alliant Energy - Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
DRILLER RDnP Drilling - Chris DATE: START 7/15/2008 FINISH 7/21/2008

DEPTH	SAMPLE			BLOW COUNT				REC	WC	qu	CONTACT DEPTH	USCS SOIL TYPE	SOIL DESCRIPTION
		INTERVAL		0"	6"	12"	18"	(in)	(%)	(TSF)			
	No.	FROM	TO	6"	12"	18"	24"						
													Grey fine to medium SAND, trace coarse sand, medium dense, saturated
	SS-14	43.0	45.0	5	10	14	22	11					
45													
	SS-15	48.0	50.0	9	14	16	16	12	15				
50													
	SS-16	53.0	55.0	8	12	14	15	11				SP	
55													
	SS-17	58.0	60.0	10	11	18	24	10	13				several pieces of coarse grained gravel at 58.5'
60													
	SS-18	63.0	65.0	15	24	26	36	10					dense
65													
											66.5		Grey fine to coarse SAND and fine grained gravel, very dense, saturated
	SS-19	68.0	70.0	32	32	38		12	9				
70												SW	
	SS-20	73.0	75.0	32	75/3			4					
75													
											76.5		Fine GRAVEL with fine to coarse sand, very dense, saturated
	SS-21	78.0	80.0	50	100/3			4	8		79.5	GP	Spoon bounced at 79.5'
80													EOB at 80'

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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Engineering, Construction and Management Solutions

BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-4**
LOGGED BY LES
PAGE No. 1 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.43
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/2/2008 FINISH 12/3/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	INTERVAL (ft) TO	BLOW COUNTS 0"-6"	BLOW COUNTS 6"-12"	BLOW COUNTS 12"-18"	BLOW COUNTS 18"-24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
														Frozen ground
	SS-1	2.0	4.0	3	4	5	15	16.0					FILL	Black and brown silty clay FILL, some fine sand, dry
5	SS-2	4.0	6.0	9	8	11	12	17.0						Black and brown fine to coarse sand and fine gravel FILL, trace fines, wet
	SS-3	6.0	8.0	10	5	12	15	20.0			6'6"	527.93	ML	Grey SILT, little fine sand, medium dense, saturated
	SS-4	8.0	10.0	2	2	3	20	24.0						loose 4" fine sand seam at 9'6"
10														
											11'6"	522.93	CL	Grey SILTY-CLAY, trace fine sand, medium plasticity, soft, moist to wet
	SS-5	13.0	15.0	2	2	3	4	14.0	50	2.00				
15														
	SS-6	18.0	20.0	7	9	8	11	15.0			18'4"	516.10	SP	Grey-brown fine to coarse SAND, medium dense, wet
20														
	SS-7	23.0	25.0	10	11	15	15	12.0	18					
25														
	SS-8	28.0	30.0	6	10	12	14	11.0						
30														
	SS-9	33.0	35.0	6	7	9	11	11.0	19					trace fine gravel
35														
											36'6"	497.93	SW	Brown fine to coarse SAND, little fine gravel, trace silt, medium dense, wet
	SS-10	38.0	40.0	7	9	7	10	10.0						
40														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-4**
LOGGED BY LES
PAGE No. 2 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.43
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/2/2008 FINISH 12/3/2008

DEPTH	SAMPLE			BLOW COUNT				REC	WC	qu	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
	No.	INTERVAL (ft) FROM	TO	0" 6"	6" 12"	12" 18"	18" 24"	(in)	(%)	(TSF)				
														(cont.) Brown fine to coarse SAND, little fine gravel, medium dense, wet
	SS-11	43.0	45.0	5	6	6	8	11.0	14					
45														
	SS-12	48.0	50.0	12	12	16	19	10.0						
50														
													SW	
	SS-13	53.0	55.0	8	9	11	14	12.0	13					
55														
	SS-14	58.0	60.0	10	8	10	13	12.0						
60														
														very dense
	SS-15	63.0	65.0	18	21	32	50/5	16.0	11					
65														
											64'6"	469.93		Grey silty CLAY, trace fine sand, medium plasticity, hard, wet
	SS-16	68.0	70.0	21	32	42	44	24.0		+4.5				
70													CL	
	SS-17	73.0	75.0	10	17	22	23	20.0	25					
75											75'	459.43		EOB 75'
80														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-5**
LOGGED BY LES
PAGE No. 1 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.71
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/4/2008 FINISH 12/5/2008

DEPTH	SAMPLE			BLOW COUNT				REC	WC	qu	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
		INTERVAL (ft)		0"	6"	12"	18"	(in)	(%)	(TSF)				
	No.	FROM	TO	6"	12"	18"	24"							
														Frozen ground
	SS-1	2.0	4.0	15	19	22	23	12.0						Black and brown sand and gravel FILL, some fines, wet
5	SS-2	4.0	6.0	10	19	34	50/3	16.0					FILL	
	SS-3	6.0	8.0	32	32	22	8	18.0						Brown-grey silt with sand FILL
	SS-4	8.0	10.0	9	12	23	14	20.0						6" brown-red fine to coarse sand FILL
10	SS-5	10.0	12.0	1	2	4	1	24.0			10'	524.71	ML	Grey SILT, little fine sand, loose, wet
	SS-6	13.0	15.0	1	1	2	3	21.0	36		13'	521.71		Mottled green, black, and light grey SILTY CLAY, little fine sand, trace silt and wood pieces, medium stiff, wet
15														
	SS-7	18.0	20.0	2	2	3	3	13.0	34	1.00			CL	
20														
	SS-8	23.0	25.0	5	7	7	9	14.5			23'2"	511.54		Black and brown fine to medium SAND, trace coarse sand, medium dense, wet 23'7" grey
25														
	SS-9	28.0	30.0	3	4	6	7	13.0	19					
30														
													SP	
	SS-10	33.0	35.0	7	7	9	11	12.0						
35														
	SS-11	38.0	40.0	7	10	11	14	14.0	22					5" fine sand seam 2" coarse sand and fine gravel seam
40														

Drilled with Dietrich -120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-5**
LOGGED BY LES
PAGE No. 2 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.71
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/4/2008 FINISH 12/5/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	INTERVAL (ft) TO	BLOW COUNT 0" 6"	BLOW COUNT 6" 12"	BLOW COUNT 12" 18"	BLOW COUNT 18" 24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
														(cont.) Grey fine to medium SAND, trace coarse sand, wet
	SS-12	43.0	45.0	12	15	22	26	13.5						dense
45														
	SS-13	48.0	50.0	10	12	12	15	12	17				SP	medium dense
50														
	SS-14	53.0	55.0	5	15	21	15	13						dense, 53'6" - 1" gravel piece
55														
														medium dense
	SS-15	58.0	60.0	6	8	11	15	10	12		58'7"	476.13		Grey fine to coarse SAND, some fine gravel, very dense
60														
	SS-16	63.0	65.0	50/0				0					SW	
65														(rig was grinding heavily to get from 65' to 68')
	SS-17	68.0	70.0	50/4				4						
70											70'	464.71		EOB 70'
75														
80														

Drilled with Dietrich -120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-6**
LOGGED BY LES
PAGE No. 1 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.33
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/4/2008 FINISH 12/5/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	TO	BLOW COUNT 0" 6"	6" 12"	12" 18"	18" 24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
														Frozen ground
	SS-1	2.0	4.0	10	11	15	17	17.0						Brown silty sand FILL, trace medium sand, medium dense
5	SS-2	4.0	6.0	1	3	5	11	13.0					FILL	
	SS-3	6.0	8.0	50/5				7.5						(possibly gravel inhibiting sampling)
	SS-4	8.0	10.0	41	50/3			5.5						
10											10'	524.33		
	SS-5	10.0	12.0	3	2	1	4	20.0	49					Brownish-grey SILT, trace fine sand, very loose, saturatec
	SS-6	13.0	15.0	3	4	4	5	24.0	53				ML	loose
15														
											16'6"	517.83		Brownish-grey SILTY CLAY, trace fine sand, soft, wet
	SS-7	18.0	20.0	1	1	1	2	17.0	49	0.50				
20													CL	
	SS-8	23.0	25.0	1	3	4	5	16.0			24'	510.33		Brown fine to medium SAND, trace coarse sand, medium dense, wet
25														
	SS-9	28.0	30.0	6	7	9	11	15.5	18					
30													SP	
	SS-10	33.0	35.0	10	11	14	14	12.0						
35														
											36'6"	497.83		Brown fine to coarse SAND, little fine gravel, medium dense, wet
	SS-11	38.0	40.0	6	8	9	12	12.5	9				SW	
40														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-6**
LOGGED BY LES
PAGE No. 2 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.33
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/4/2008 FINISH 12/5/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	INTERVAL (ft) TO	BLOW COUNT 0"-6"	BLOW COUNT 6"-12"	BLOW COUNT 12"-18"	BLOW COUNT 18"-24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
													SW	Brown fine to coarse SAND, little fine gravel, medium dense, wet (cont.)
											42'6"	491.83		Brown fine to medium sand, trace fine sand, medium dense to dense, wet (cont.)
	SS-12	43.0	45.0	8	10	14	17	12.0						
45														
														little coarse sand
	SS-13	48.0	50.0	8	9	12	14	12.0	14					
50														
													SP	
	SS-14	53.0	55.0	10	17	17	15	12.5						
55														
	SS-15	58.0	60.0	10	12	14	14	10.0	14					
60														
											62' 6"	472.00		Grey SILTY CLAY, little fine to medium sand, medium plasticity, hard, wet 1" fine to medium sand seam at 63'6" 1" gravel piece at 6'8"
	SS-16	63.0	65.0	17	31	36	42	22.0	14	4.5+ 4.5+				
65													CL	
										4.5+				
	SS-17	68.0	70.0	21	50/3			9.0						
70											70'	464.33		EOB 70'
75														
80														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-7**
LOGGED BY LES
PAGE No. 1 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 536.51
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/5/2008 FINISH 12/8/2008

DEPTH	SAMPLE			BLOW COUNT				REC	WC	qu	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
		INTERVAL (ft)		0"	6"	12"	18"	(in)	(%)	(TSF)				
	No.	FROM	TO	6"	12"	18"	24"							
														Frozen ground
	SS-1	2.0	4.0	6	7	10	12	22.5		1.00			FILL	Black sand, gravel, and silt FILL 6" alternating brown and black fine sand and silt at 3'
5	SS-2	4.0	6.0	1	3	10	14	15.0		0.75				6"grey clay, medium stiff, moist at 4'
	SS-3	6.0	8.0	10	31	21	33	18.0			6'	530.51		Dark grey SILT, some fine sand, very dense, wet
	SS-4	8.0	10.0	15	21	18	15	17.0						
10	SS-5	10.0	12.0	10	22	32	44	21.0					ML	trace fine sand
	SS-6	13.0	15.0	3	4	1	5	23.0	67					loose
15														
											16'6"	520.01		Grey SILTY CLAY, trace fine sand, very soft, wet
	SS-7	18.0	20.0	1	2	1	2	24.0					CL	
20														
											23'6"	513.01		Grey fine to medium SAND with clay, loose, wet
	SS-8	23.0	25.0	1	2	4	12	16.0	19				SP-SC	
25														
											26'6"	510.01		Grey fine to medium SAND, medium dense, wet
	SS-9	28.0	30.0	2	5	8	8	18.0						
30														
	SS-10	33.0	35.0	8	14	16	15	12.0	17				SP	trace coarse sand
35														
	SS-11	38.0	40.0	8	14	10	8	12.0						medium dense
40														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

HARD HAT SERVICES™
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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-7**
LOGGED BY LES
PAGE No. 2 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 536.51
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/5/2008 FINISH 12/8/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	INTERVAL (ft) TO	BLOW COUNT 0"-6"	BLOW COUNT 6"-12"	BLOW COUNT 12"-18"	BLOW COUNT 18"-24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
														Grey fine to medium SAND, trace coarse sand medium dense, wet
	SS-12	43.0	45.0	5	8	10	11	12.0	15					
45														
	SS-13	48.0	50.0	8	10	15	18	14.0					SP	
50														
	SS-14	53.0	55.0	10	12	15	16	10.0	15					
55														
											56'6"	480.01		Brown fine to coarse SAND, trace fine gravel, medium dense, wet
	SS-15	58.0	60.0	8	11	15	17	24.0						
60													SW	
														very dense
	SS-16	63.0	65.0	18	23	50/4		10.0	7					
65											65'	471.51		EOB 65'
70														
75														
80														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-8**
LOGGED BY LES
PAGE No. 1 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.72
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/15/2008 FINISH 12/17/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	INTERVAL (ft) TO	BLOW COUNT 0"-6"	BLOW COUNT 6"-12"	BLOW COUNT 12"-18"	BLOW COUNT 18"-24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
														Frozen ground
	SS-1	2.0	4.0	8	12	10	12	18.0						Brown and grey mottled silty clay FILL, little fine to coarse sand, medium dense, frozen
5	SS-2	4.0	6.0	3	4	6	6	16.0		1.75			FILL	
	SS-3	6.0	8.0	3	5	7	10	10.0						fine gravel pieces mixed in clay
	SS-4	8.0	10.0	3	4	6	9	15.0	17	2.50				
10	SS-5	10.0	12.0	4	5	7	4	14.0	23	3.00	10'6"	524.22		Grey SILT, trace fine sand, medium dense to loose, wet
	SS-6	13.0	15.0	2	3	3	3	8.0	26				ML	alternating silt and brown silty clay, stiff
15														
											16'6	518.22		Grey SILTY CLAY, medium plasticity, medium stiff, mois to wet (LL=46, PI=24)
	SS-7	18.0	20.0	1	2	3	2	10.0	34	1.25				
20													CL	
											23'3"	511.47		Brown fine to medium SAND, loose, wet
	SS-8	23.0	25.0	5	6	7	7	12.0						
25														
	SS-9	28.0	30.0	2	5	4	5	24.0	20					
30													SP	trace coarse sand
	SS-10	33.0	35.0	2	3	4	5	12.0						
35														
	SS-11	38.0	40.0	4	5	5	7	11.5	12					
40														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-8**
LOGGED BY LES
PAGE No. 2 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.72
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/15/2008 FINISH 12/17/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	INTERVAL (ft) TO	BLOW COUNT 0" 6"	BLOW COUNT 6" 12"	BLOW COUNT 12" 18"	BLOW COUNT 18" 24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
														Brown fine to medium SAND, trace coarse sand, medium dense, wet (cont.)
	SS-12	43.0	45.0	9	10	11	15	11.0						
45													SP	
	SS-13	48.0	50.0	14	17	9	7	13.0	16					
50														
											49'6"	485.22		Brown fine to coarse SAND, trace fine gravel, medium dense, wet
	SS-14	53.0	55.0	4	8	7	6	13.0						
55														
														dense
	SS-15	58.0	60.0	8	15	19	22	15.0	8				SW	
60														
														little fine gravel
	SS-16	63.0	65.0	5	15	24	26	17.0						
65														
											66'6"	468.22		Grey sandy SILTY CLAY, hard, moist to wet
	SS-17	68.0	70.0	48	50/4			13.0	14				CL	
70											70'	464.72		EOB 70'
75														
80														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-9**
LOGGED BY LES
PAGE No. 1 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 534.67
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/17/2008 FINISH 12/18/2008

DEPTH	SAMPLE No.	INTERVAL (ft) FROM	INTERVAL (ft) TO	BLOW COUNT 0" 6"	BLOW COUNT 6" 12"	BLOW COUNT 12" 18"	BLOW COUNT 18" 24"	REC (in)	WC (%)	qu (TSF)	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
														Frozen ground
	SS-1	2.0	4.0	3	4	2	2	14.0		2.50				Grey and brown mottled silty clay FILL, some fine to medium sand, very stiff, moist
5	SS-2	4.0	6.0	3	4	6	5	17.0		4.00			FILL	
	SS-3	6.0	8.0	4	5	5	8	17.0		2.50				Alternating grey, brown, and orange clay and silt
	SS-4	8.0	10.0	4	5	10	10	17.0		2.00	8'11"	525.75		
10	SS-5	10.0	12.0	5	7	9	12	16.0		4.00			CL	Grey SILTY CLAY, trace fine sand, medium plasticity, very stiff, moist
	SS-6	13.0	15.0	3	4	6	6	21.0			13'	521.67		Dark grey CLAY, high plasticity, stiff, wet
15														
	SS-7	18.0	20.0	3	3	4	5	21.0	51	1.00				(LL=64, PI=34)
20													CH	
	SS-8	23.0	25.0	5	6	8	9	0.0						
25														(hole is taking a lot of water)
											24'6"	510.17		Grey fine to medium SAND, medium dense, wet
	SS-9	28.0	30.0	8	10	12	14	10.0	25					
30														
	SS-10	33.0	35.0	8	15	19	22	16.0					SP	trace coarse sand, dense
35														
	SS-11	38.0	40.0	10	16	17	19	11.0	18					
40														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

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BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-9**
LOGGED BY LES
PAGE No. 2 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/17/2008 FINISH 12/18/2008

DEPTH	SAMPLE			BLOW COUNT				REC	WC	qu	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
		INTERVAL (ft)		0"	6"	12"	18"	(in)	(%)	(TSF)				
	No.	FROM	TO	6"	12"	18"	24"							
														Grey fine to medium SAND, trace coarse sand, dense, wet
	SS-12	43.0	45.0	10	17	24	29	8.0						trace fine gravel
45														
	SS-13	48.0	50.0	8	16	20	21	12.0	17				SP	
50														
	SS-14	53.0	55.0	9	11	15	19	13.0						
55														
											56'6"	478.17		Grey-brown fine to coarse SAND, trace fine gravel, dense, wet
	SS-15	58.0	60.0	10	12	18	17	16.0	17					
60													SW	
	SS-16	63.0	65.0	12	15	24	26	15.0						dense
65														
											66'6"	468.17	CL	Grey CLAY, little fine to medium sand, medium plasticity, hard, moist to wet
	SS-17	68.0	70.0	37	50/4			10.0						
70											70'	464.67		EOB 70'
75														
80														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-10**
LOGGED BY LES
PAGE No. 1 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 531.92
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/12/2008 FINISH 12/15/2008

DEPTH	SAMPLE			BLOW COUNT				REC	WC	qu	CONTACT DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
		INTERVAL (ft)		0"	6"	12"	18"	(in)	(%)	(TSF)				
	No.	FROM	TO	6"	12"	18"	24"							
														Frozen ground
	SS-1	2.0	4.0	4	5	5	4	13.0	17	2.00				Grey and brown mottled SILTY CLAY, trace fine sand, medium plasticity, stiff, moist
5	SS-2	4.0	6.0	3	4	5	6	15.0	15	2.50				little fine to coarse sand, very stiff
	SS-3	6.0	8.0	4	4	5	6	15.0	13	2.50			CL	
	SS-4	8.0	10.0	3	6	8	8	15.0	24	2.50 1.50				Brown, silt content increasing, thin brown silt seams
10														
	SS-5	13.0	15.0	1	2	3	4	15.0		0.75 1.00	13'	518.92		Dark grey CLAY, high plasticity, medium stiff, wet
15														
	SS-6	18.0	20.0	4	6	5	7	13.5		1.25				stiff
20													CH	
	SS-7	23.0	25.0	3	4	5	5	6.0		1.00				
25														
	SS-8	28.0	30.0	8	9	11	12	0.0			29'	502.92		Grey-brown fine to medium SAND, medium dense, wet
30														
	SS-9	33.0	35.0	6	8	5	5	10.0						
35														
	SS-10	38.0	40.0	8	9	11	12	11.0						trace coarse sand
40														

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

BORING LOG

PROJECT No. 154.002.008.001
BORING No. **BH-10**
LOGGED BY LES
PAGE No. 2 of 2

PROJECT NAME Alliant Energy - December 2008 Baghouse Geotechnical Investigation
BORING LOCATION Burlington, Iowa
SURFACE ELEVATION 531.92
DRILLER RDnP Drilling - Kris Norwick
DATE: START 12/12/2008 FINISH 12/15/2008

DEPTH	SAMPLE			BLOW COUNT				REC	WC	qu	CONTACT	DEPTH	ELEV. (MSL)	USCS SOIL TYPE	SOIL DESCRIPTION
		INTERVAL (ft)		0"	6"	12"	18"	(in)	(%)	(TSF)					
	No.	FROM	TO	6"	12"	18"	24"								
															Grey-brown fine to medium SAND, trace coarse sand, medium dense, wet (cont.)
	SS-11	43.0	45.0	3	6	9	15	15.0							
45															
															dense
	SS-12	48.0	50.0	8	15	21	30	15.0							
50															
														SP	
	SS-13	53.0	55.0	50/0				0.0							(spoon bouncing, possibly on a cobble or boulder)
55															
	SS-14	58.0	60.0	14	17	17	15	16.0							trace fine gravel
60															
	SS-15	63.0	65.0	50/1				0.0			64'		467.92		Grey CLAY, little fine sand, hard, moist to wet
65															
														CL	
	SS-16	68.0	70.0	32	50/3			10.0		4.5+					(spoon bouncing)
70											70'		461.92		EOB 70'
75															
80															

Drilled with Dietrich-120
Method: auger and mud rotary
Hole was backfilled with bentonite slurry

APPENDIX B – Geoprobe Soil Borings on CCR Embankments

Alliant Energy
Interstate Power and Light Company
Burlington Generating Station
Burlington, Iowa

Safety Factor Assessment

Boring Log
Legend

Sample

No: (Number) Soil samples are numbered consecutively from the ground surface. Core samples are numbered consecutively from the first core run.

Type: A= Auger Cuttings CR= Core Run MS= Modified Spoon PB= Pitcher Barrel
PT= Piston Tube ST= Shelby Tube SS= Split Spoon (2" O.D.) WC= Wash Cuttings

Interval: The depth of sampling interval in feet below ground surface

Blow Count

The number of blows required to drive a 2-inch O.D. split-spoon sampler with a 140 pound hammer falling 30-inches. When appropriate, the sampler is driven 18 inches and blow counts are reported for each 6-inch interval. The sum of blow counts for the last two 6-inch intervals is designated as the standard penetration resistance (N) expressed as blows per foot.

Recovery in Inches

The length of sample recovered by the sampling device.

U.S.C.S. Soil Type

The Unified Soil Classification System symbol for recovered soil samples determined by visual examination or laboratory tests. Refer to ASTM D2487-69 for a detailed description of procedure and symbols. Underlined symbols denote classifications based on laboratory tests (i.e. ML), all others are based on visual classification only.

Percent Moisture

Natural moisture content of sample expressed as percent of dry weight.

q_u TSF

Unconfined compressive strength in tons per square foot obtained by hand penetrometer. Laboratory compression test values are indicated by underlining.

Contact Depth

The contact depth between soil layers is interpreted from significant changes in recovered samples and observations during drilling. Actual changes between soil layers often occur gradually and the contact depths shown on the boring logs should be considered as approximate.

Soil Description and Remarks

Soil descriptions include consistency or density, color, predominant soil types and modifying constituents.

Cohesive Soils			Cohesionless Soils	
Consistency	q_u (TSF)	Blows/ft.	Density	Blows/ft.
Very Soft	less than 0.25	0-1	Very Loose	4 or less
Soft	0.25 to 0.50	2-4	Loose	5 to 10
Medium Stiff	0.50 to 1.00	5-8	Medium Dense	11 to 30
Stiff	1.00 to 2.00	9-15	Dense	30 to 50
Very Stiff	2.00 to 4.00	15-30	Very Dense	Over 50
Hard	more than 4.00	Over 30		

Particle Size Description

Boulder =	Larger than 12 inches
Cobble =	3 to 12 inches
Gravel =	0.187 to 3 inches
Sand =	0.074 to 4.76 mm
Silt and Clay =	smaller than 0.074 mm

Definition of Terms

Trace =	5 to 12 percent by weight
Some =	12 to 30 percent by weight
And =	Approximately equal fractions
( ) =	Driller's observation

Piezo.

(Piezometer) Screened interval of the piezometer installation is denoted by cross-hatching.

General Note

The boring log and related information depicted subsurface conditions only at the specified locations and date indicated. Soil conditions and water levels at other locations may differ from conditions occurring at these boring locations. Also the passage of time may result in a change in the conditions at these boring locations.

Soil Test Boring Refusal

Defined as any material causing a blow count greater that 50 blows/6 inches. Such material may include bedrock, "floating" rock slabs, boulders, dense gravel seams, hard pan clay, or cemented soils. Refusal is usually indicated in fractional notation showing number of blows as the numerator and inches of penetration as the denominator.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

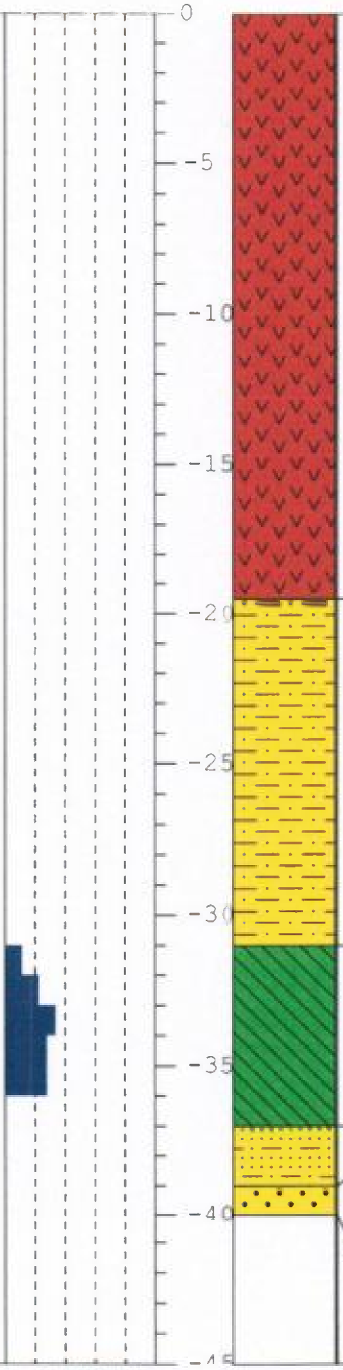
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

BORING NO.: *SB1 (CPT1)*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-11-11*
DATE FINISHED: *05-11-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
	SP1	2.5'/5'		
	SP2	5'/5'		
	SP3	5'/5'		
∇	SP4	5'/5'		
	SP5	0'/5'		
	SP6	5'/5'		
	SP7	1.5'/5'		2.75 2.75 3.25 3.75 1.5
	SP8	5'/5'		



DESCRIPTION

ASH; brown; poorly graded; fine grained; moist. (Fill)

@ 14' grades dark gray to black.

Clayey SILT; black to gray; non-plastic to low plasticity; moist to wet; some organic matter. (OL)
@ too soft for pocket penn from 19.5' to 31', no hammer required to push sampler.

CLAY; gray to black; high plasticity; soft tc firm; moist; trace organic. (OH)

Sandy SILT; gray; non-plastic; wet. (ML)

SAND; gray; well graded; fine to coarse grained; rounded to sub-rounded; wet. (SW)

Bottom of boring @ 40'
Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-11-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

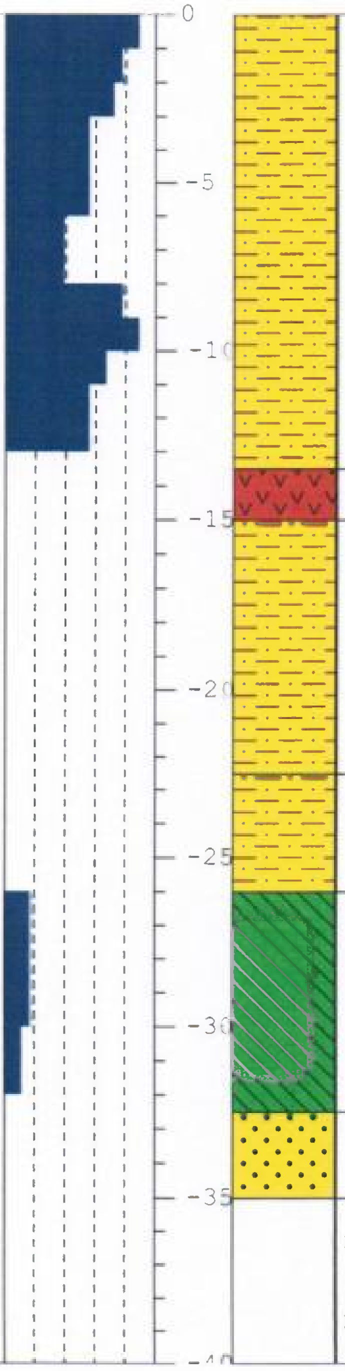
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

BORING NO.: *SB2 (CPT7)*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-11-11*
DATE FINISHED: *05-11-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
				4.0
				3.5
	SP1	5'/5'		3.25
				2.5
				2.5
				2.5
	SP2	5'/5'		1.75
				1.75
				3.5
				4.0
				3.0
	SP3	5'/5'		2.5
				2.5
	SP4	4'/5'		
∇	SP5	4'/5'		
				0.75
	SP6	5'/5'		0.75
				0.75
				0.75
				0.5
				0.5
	SP7	4'/5'		



DESCRIPTION

Clayey SILT; brown to gray; non-plastic; firm to stiff; dry to moist; trace roots/organic matter. (Fill)

ASH; black; non-plastic; moist. (FILL)

Clayey SILT; gray to black; non-plastic; trace organic matter/shells. (OL)

SILT; gray; non-plastic; wet. (ML)

CLAY; gray to black; soft; high plasticity; moist; trace to some organic matter. (OH)

SAND; gray; poorly graded; medium grained; wet. (SP)

Bottom of boring @ 35'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-11-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

BORING NO.: *SB3 (CPT10)*

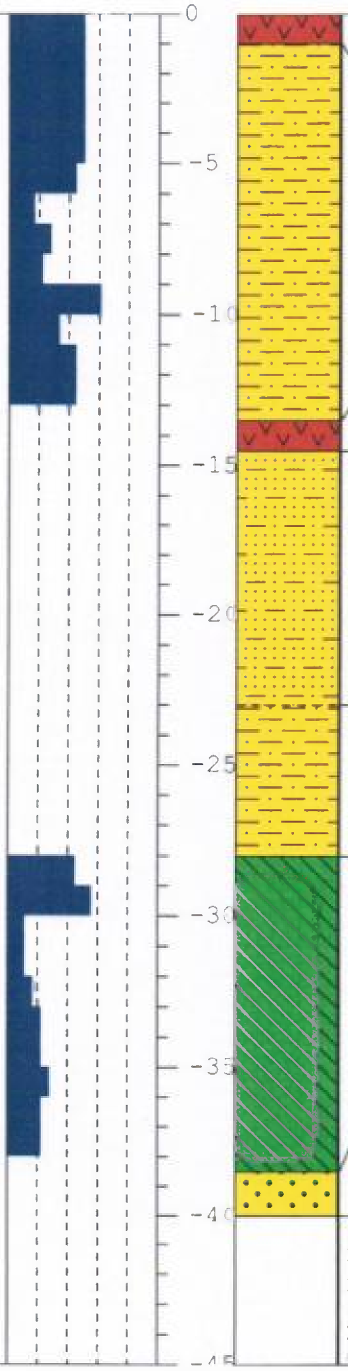
page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-11-11*
DATE FINISHED: *05-11-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION
	SP1	3.5'/5'	
	SP2	5'/5'	
▽	SP3	5'/5'	
	SP4	5'/5'	
	SP5	5'/5'	
	SP6	5'/5'	
	SP7	5'/5'	
	SP8	5'/5'	

POCKET PENETROMETER (TONS/FT2)
2.25
2.25
2.25
2.25
2.25
2.0
0.75
1.25
1.0
2.75
1.5
2.0
2.0
2.0
2.5
0.5
0.5
0.75
1.0
1.0
1.25
1.0
1.0
1.0

CONSISTENCY vs. DEPTH | DEPTH IN FEET | PROFILE



DESCRIPTION

ASH; brown; non-plastic; moist. (FILL)

Clayey SILT; brown to gray; non-plastic; firm to stiff; dry to moist; trace roots/organic matter. (Fill)

ASH; gray; non-plastic; moist. (FILL)

Silty SAND; dark gray to light gray; poorly graded; fine grained; wet. (SP)

SILT; gray; non-plastic; wet. (ML)

Silty CLAY; gray to black; soft; low plasticity; moist; trace to some organic matter. (OH)

SAND; gray; poorly graded; fine grained; wet. (SP)

Bottom of boring @ 40'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-11-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

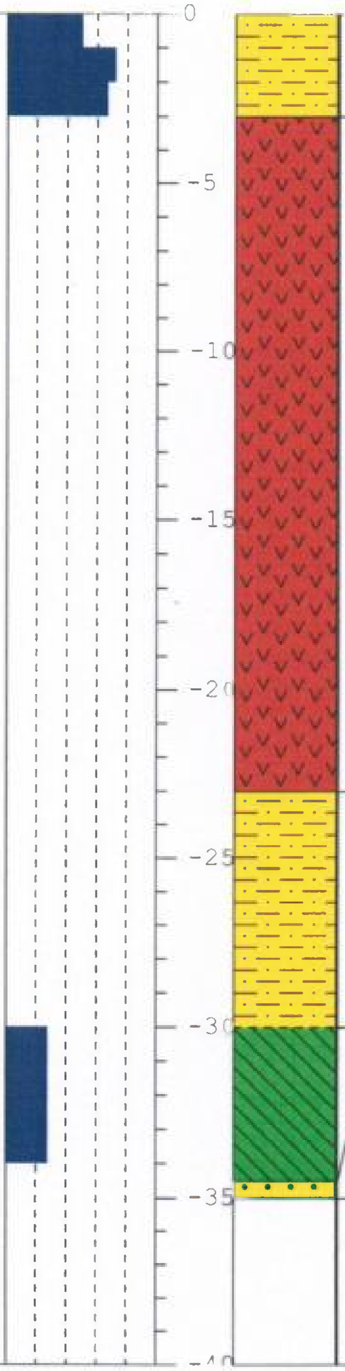
BORING NO.: *SB4 (CPT6)*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-11-11*
DATE FINISHED: *05-11-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
	SP1	4.5'/5'		2.25 3.25 3.0
	SP2	5'/5'		
	SP3	5'/5'		
	SP4	5'/5'		
∇	SP5	3.5'/5'		
	SP6	4'/5'		
	SP7	5'/5'		1.25 1.25 1.25 1.25

CONSISTENCY vs. DEPTH · **DEPTH IN FEET** · **PROFILE**



DESCRIPTION

Clayey SILT; brown to gray; non-plastic; firm to stiff; dry to moist; trace roots/organic matter. (Fill)

ASH; gray; non-plastic; moist. (FILL)

SILT; gray; non-plastic; wet. (ML)

CLAY; gray to black; low to high plasticity; wet; some organic matter. (OL/OH)

SAND; gray; poorly graded; fine grained; wet. (SP)

Bottom of boring @ 35'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-11-11.

BORING LOG

CLIENT: Aether dbs
PROJECT: Burlington, IA
COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*
BORING NO.: *SB5 (cpt19)*
page 1 of 1

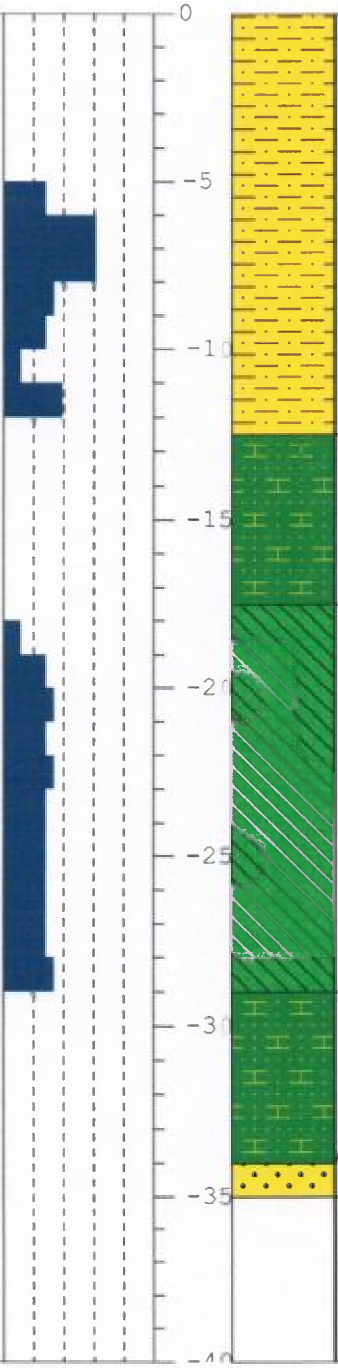
LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-16-11*
DATE FINISHED: *05-16-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION
	SP1	5'/5'	
	SP2	5'/5'	
	SP3	4'/5'	
	SP4	4'/5'	
	SP5	3.5'/5'	
▽	SP6	3.5'/5'	
	SP7	3'/5'	

POCKET PENETROMETER (TONS/FT2)

1.25
2.75
2.75
1.5
1.25
0.5
1.75
2.0

0.5
1.25
1.5
1.25
1.5
1.25
1.25
1.25
1.25
1.25
1.5
1.25



DESCRIPTION

SILT; brown; non-plastic; dry to moist; trace organic matter. (Fill)

@ 5' grades Clayey SILT; low plasticity; firm to stiff.

Sandy CLAY; black to dark gray; non-plastic to low plasticity; moist. (CL)

CLAY; black to dark gray; low to high plasticity; moist; trace organic matter. (CL)

Sandy CLAY; dark gray; low to high plasticity; wet; trace silt. (CL)

@ 33' grades several thin sand seams.

SAND; gray; poorly graded; coarse grained; wet. (SP)

Bottom of boring @ 35'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-16-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

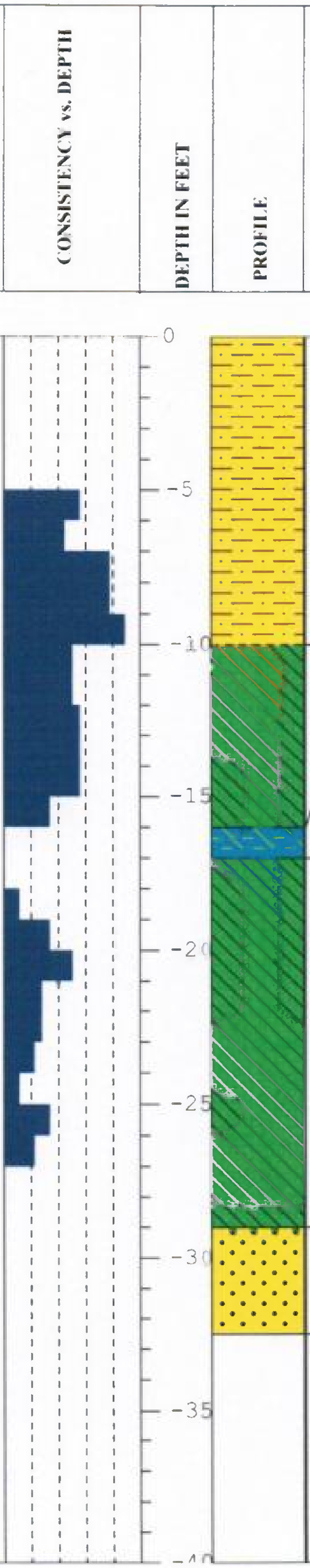
COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

BORING NO.: *SB6 (cpt18)*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-16-11*
DATE FINISHED: *05-16-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
	SP1	5'/5'		
				2.5
				2.0
				3.5
	SP2	5'/5'		
				3.5
				4.0
				2.25
				2.25
				2.5
	SP3	5'/5'		
				2.5
				2.5
				2.5
▽				
				1.5
	SP4	4.5'/5'		
				0.5
				1.5
				2.25
				1.25
				1.25
	SP5	2.5'/5'		
				1.0
				0.5
				1.5
				1.0
				0
	SP6	3.8'/5'		
				0
				0
	SP7	2.5'/2.5'		



DESCRIPTION

SILT; brown; non-plastic; dry to moist; trace organic matter (FILL)

@ 5' grades Clayey SILT; low plasticity; very stiff.

CLAY; gray to olive; low to high plasticity; stiff to very stiff; moist; trace organic matter (Fill)

Clayey SAND; gray; poorly graded; medium grained; wet. (SP)

CLAY; gray to olive; high plasticity; very soft to firm; moist to wet. (CL)

@ 19' is a thin 1" sand seam, wet.

SAND; gray; well graded; fine to coarse grained; wet. (SW)

Bottom of boring @ 32.5'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-16-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

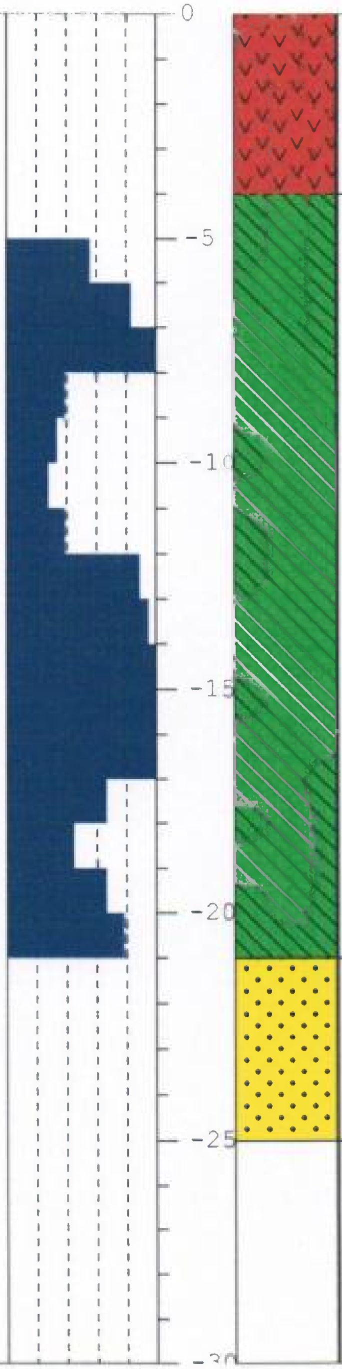
COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

BORING NO.: *SB7 (cpt15)*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-16-11*
DATE FINISHED: *05-16-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
	SP1	3.8'/5'		
				2.5
				3.75
				>4.5
	SP2	5'/5'		
				1.75
				1.5
				1.25
				1.75
				4.0
	SP3	5'/5'		
				4.25
				4.5
				4.5
				>4.5
				3.0
	SP4	5'/5'		
				2.0
∇				
				3.0
				3.5
	SP5	3'/5'		



DESCRIPTION

```
ASH; gray; fine grained; moist. (Fill)

CLAY; black; low plasticity; stiff to very
stiff; moist; trace organic matter (Fill)

@ 18' grades (OH)

@ 19' is a 6-inch SAND seam; fine grained; wet.
@ 20' grades high plasticity.

SAND; gray; poorly graded; fine grained; wet.
```

(sw)

```
Bottom of boring @ 25'

Boring advanced W/ Geoprobe Model 6610DT using
60-inch Macrocore sampling system.  Boring
backfilled to groundsurface w/ bentonite chips on
05-16-11.
```

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

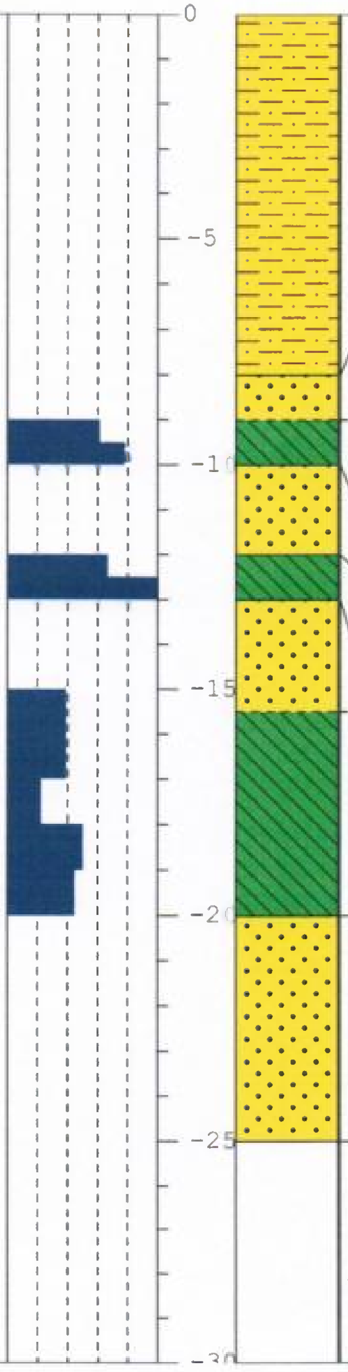
BORING NO.: *SB8 (cpt13)*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-16-11*
DATE FINISHED: *05-16-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
	SP1	4'/5'		
▽	SP2	4'/5'		2.75 3.5
	SP3	5'/5'		3.0 4.5
	SP4	4'/5'		1.75 1.75 1.0 2.25 2.0
	SP5	4.5'/5'		

CONSISTENCY vs. DEPTH | **DEPTH IN FEET** | **PROFILE** | **DESCRIPTION**



SILT; brown; non-plastic; dry to moist; trace to some gravel, sand & ash. (Fill)

SAND; gray; fine grained; poorly graded; wet. (SP)

CLAY; gray; low to high plasticity; stiff; moist. (CL)

SAND; gray to black; fine grained; poorly graded; wet. (SP)

CLAY; gray; low to high plasticity; stiff; moist. (CL)

SAND; gray; well graded; fine to coarse grained; wet. (SW)

CLAY; dark gray; high plasticity; firm to stiff; moist; trace organic matter. (OH)

SAND; gray to black; poorly graded; fine grained; wet. (SP)

Bottom of boring @ 25'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-16-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

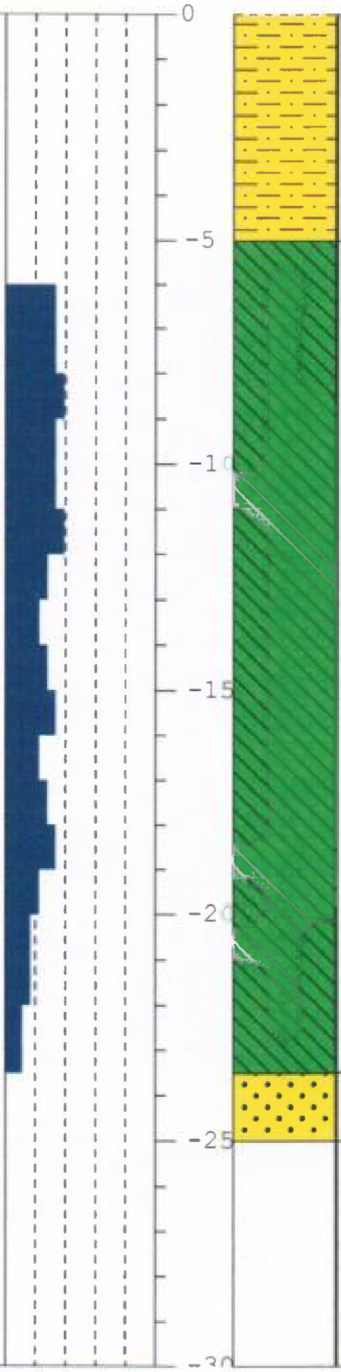
PROJECT: Burlington, IA

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

BORING NO.: *SB9 (cpt21)*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-16-11*
DATE FINISHED: *05-16-11*
GROUND SURFACE ELEVATION:



DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)	DESCRIPTION
					SILT; brown; non-plastic; dry to moist; trace organic matter. (Fill)
	SP1	2.5'/5'			
					CLAY:gray to olive; low to high plasticity; moist; trace organics. (OH)
				1.5	
				1.5	
	SP2	4'/5'			
				1.75	
				1.5	
				1.5	
				1.75	
				1.25	
	SP3	4.5'/5'			
				1.0	
				1.25	
				1.5	
				1.0	
				1.25	
	SP4	5'/5'			
				1.5	
				1.0	
				0.75	
				0.75	
				0.5	
	SP5	3.5'/5'			
▽				0.5	
					SAND; gray; fine grained; poorly graded; wet. (SP)
					Bottom of boring @ 25' Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-16-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

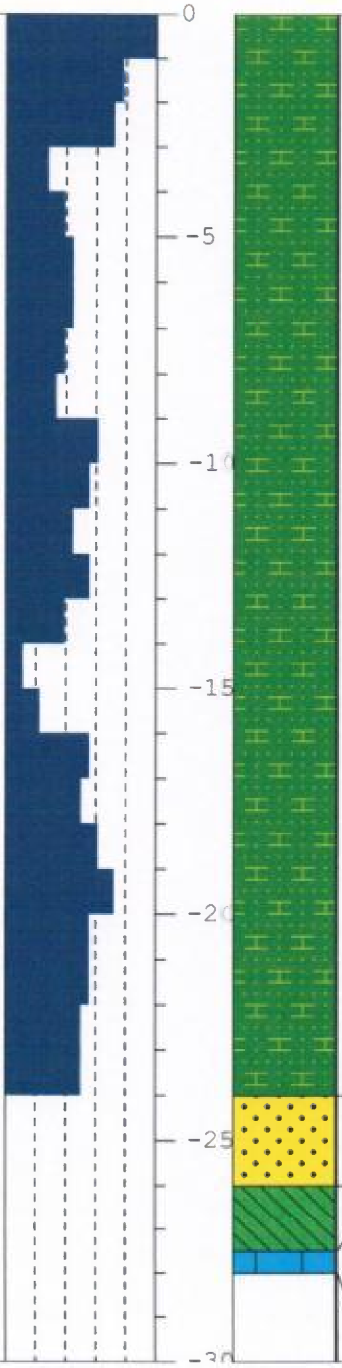
BORING NO.: ***SB10***

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-16-11*
DATE FINISHED: *05-16-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
				>4.5
	SP1	2.5'/5'		3.5
				3.25
				1.25
				1.75
				2.0
	SP2	4'/5'		2.0
				1.75
				1.5
				2.75
				2.5
	SP3	4.5'/5'		2.0
				2.5
				1.75
				0.5
				1.0
	SP4	5'/5'		2.5
				2.25
				2.75
				3.25
				2.5
	SP5	3.5'/5'		2.5
				2.25
▽				
	SP6	2'/3'		

CONSISTENCY vs. DEPTH | **DEPTH IN FEET** | **PROFILE**



DESCRIPTION

Silty CLAY; brown; low plasticity; firm to very stiff; moist; trace organics and gravels. (CL - OH)

SAND; gray to brown; well graded; fine to coarse grained; wet. (SW)

CLAY; gray; high plasticity; moist. (CL)

LIMESTONE; gray; thinly bedded; highly weathered. (Bedrock)

Bottom of boring @ 25'
Boring advanced W/ Geoprobe Model 6610DT using

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: **Aether dbs**

PROJECT: **Burlington, IA**

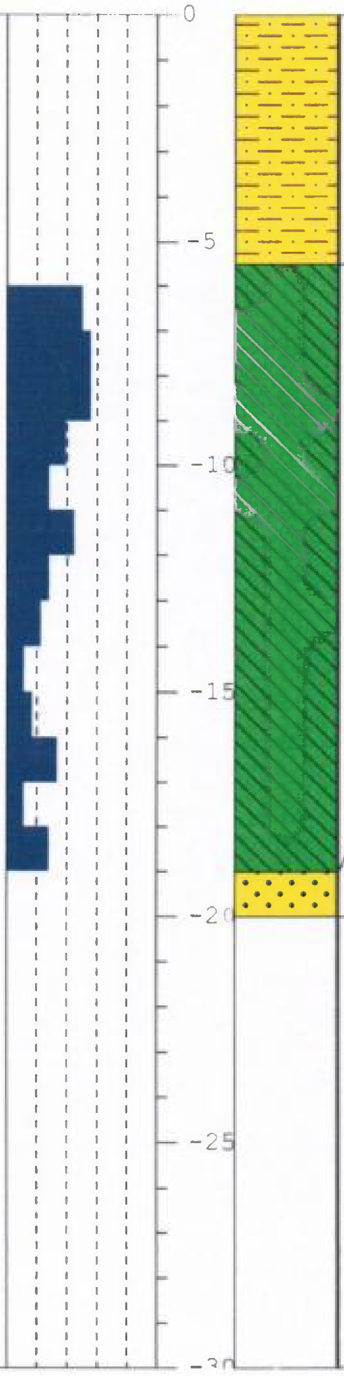
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

BORING NO.: ***SB11***

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-16-11*
DATE FINISHED: *05-16-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
	SP1	2.5'/5'		
				2.25
				2.5
	SP2	4'/5'		
				2.5
				1.75
				1.25
				2.0
				1.25
	SP3	4.5'/5'		
				1.0
▽				0.5
				0.75
				1.5
				0.5
	SP4	5'/5'		
				1.25
				1.0



DESCRIPTION

Gravely SILT; brown; non-plastic; dry to moist. (Fill)

CLAY; brown; high plasticity; moist; stiff to soft; trace sand & gravel. (CL)

@ 11.5' grades black to gray, trace organics. (OH)

@ 14.5' are several thin, 1-inch, fine grained sand seams; wet.

SAND; gray; poorly graded; fine grained; wet. (SP)

Bottom of boring @ 20'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-16-11.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

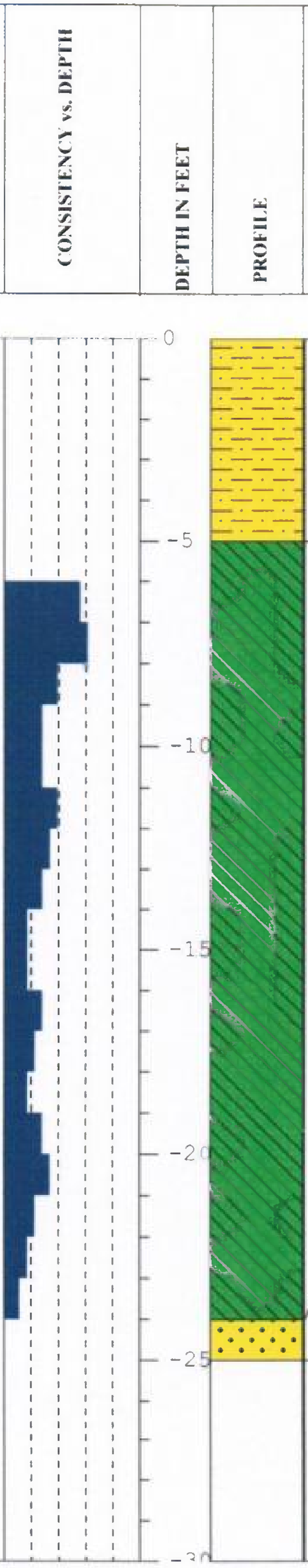
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

BORING NO.: *SB12*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-16-11*
DATE FINISHED: *05-16-11*
GROUND SURFACE ELEVATION:

DEPTH TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	POCKET PENETROMETER (TONS/FT2)
	SP1	2.5'/5'		
				2.5
				2.75
	SP2	5'/5'		
				1.75
				1.25
				1.25
				1.75
				1.5
	SP3	5'/5'		
				1.25
				0.75
				0.75
				1.25
				1.0
	SP4	4.5'/5'		
				0.75
				1.25
				1.5
				1.0
				0.75
	SP5	5'/5'		
				0.5
▽				



DESCRIPTION

Gravely SILT; brown; non-plastic; dry to moist. (Fill)

CLAY; brown; high plasticity; moist; stiff to soft; trace sand & gravel. (CL)

@ 14' grades dark gray to black; trace organics. (OH)

SAND; black to dark gray; poorly graded; fine grained; wet. (SP)

Bottom of boring @ 25'

Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-16-11.

APPENDIX C – CPT Soil Probes on CCR Embankments

Alliant Energy
Interstate Power and Light Company
Burlington Generating Station
Burlington, Iowa

Safety Factor Assessment

CONE PENETROMETER TEST (CPT)

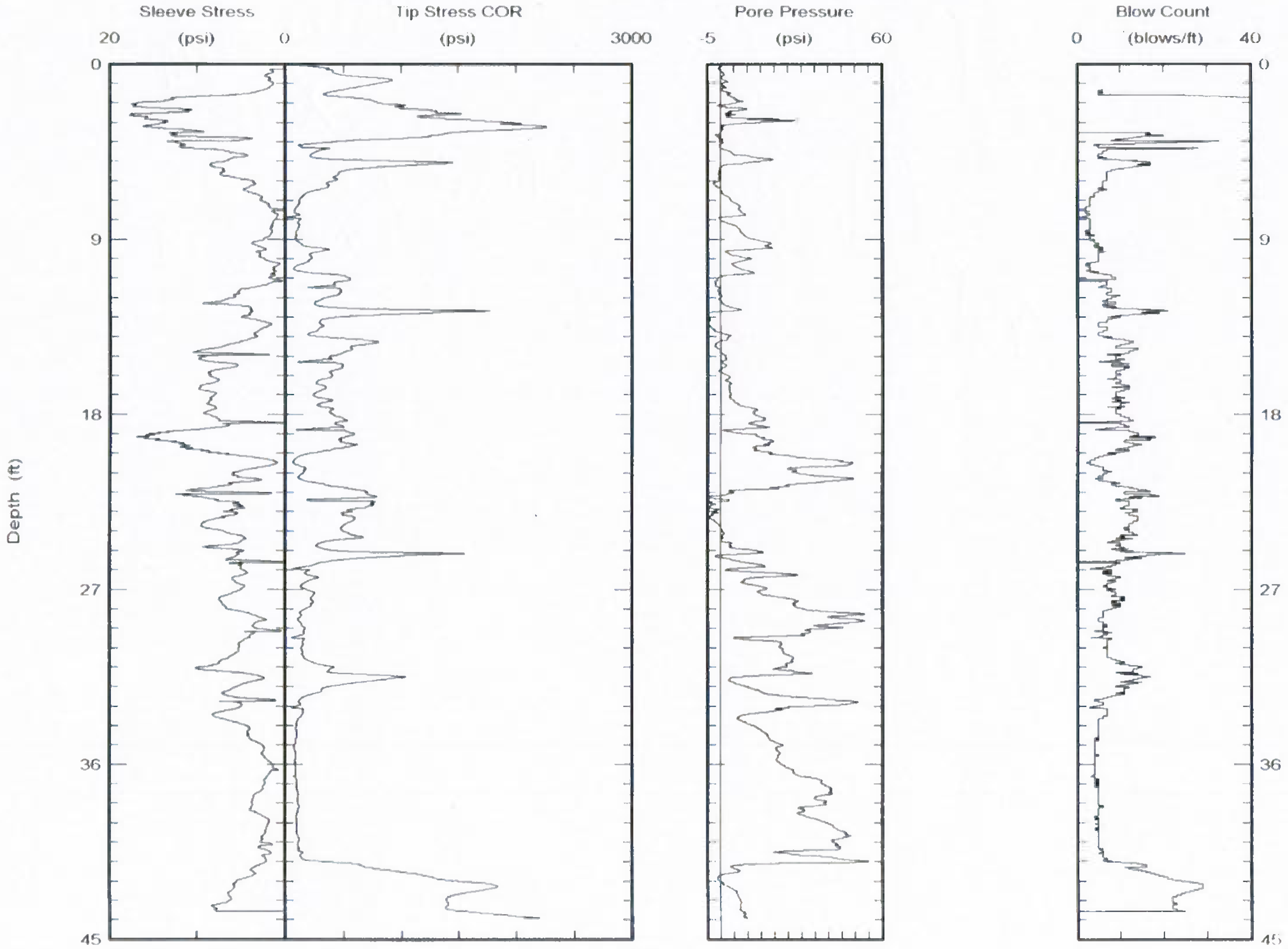
CPT I.D.	LOCATION	GROUND ELEVATION (FT)
CPT-1	Economizer Ash Pond	548.78
CPT-2	Economizer Ash Pond	550.34
CPT-3	Economizer Ash Pond	549.91
CPT-4	Economizer Ash Pond	549.65
CPT-5	Economizer Ash Pond	549.74
CPT-6	Economizer Ash Pond	550.57
CPT-7	Economizer Ash Pond	545.78
CPT-8	Economizer Ash Pond	546.26
CPT-9	Economizer Ash Pond	549.48
CPT-10	Economizer Ash Pond	549.42
CPT-11	Economizer Ash Pond	547.86
CPT-12	Economizer Ash Pond	548.25
CPT-13	Ash Seal Water Pond	534.22
CPT-14	Ash Seal Water Pond	533.67
CPT-15	Main Ash Pond	536.75
CPT-16	Main Ash Pond	534.84
CPT-17	Main Ash Pond	534.52
CPT-18	Main Ash Pond	533.89
CPT-19	Main Ash Pond	535.32
CPT-20	Upper Ash Pond	530.47
CPT-21	Upper Ash Pond	530.42

Applied Research Associates, Inc.
South Royalton, VT 05068
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:

Date: 09/May/2011
Test ID: cpt1
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



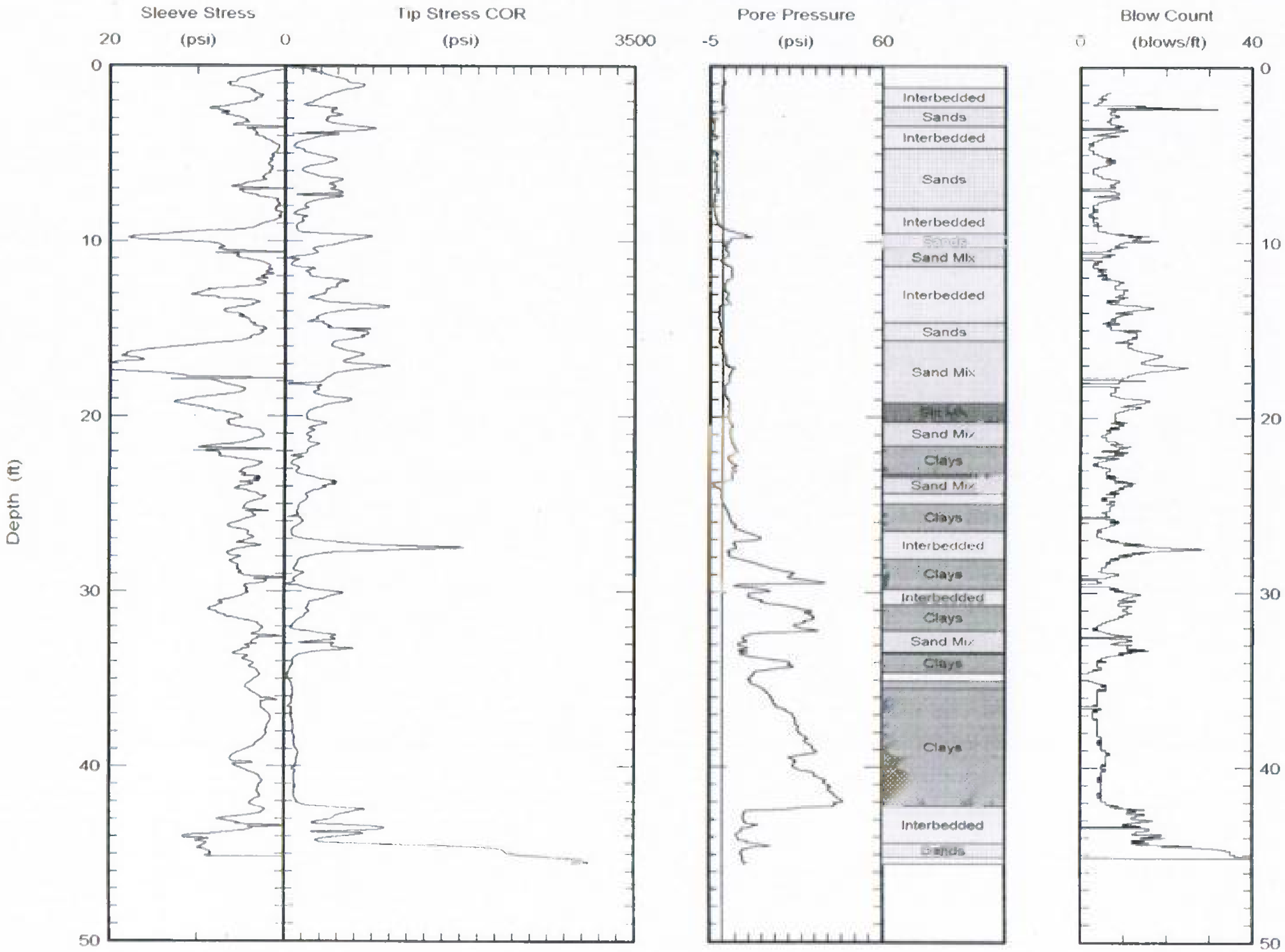
Maximum depth: 43.92 (ft)

Test ID: cpt1
File: A09Y1101C.ECP

Applied Research Associates, Inc.
South Royalton, VT 05068
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:
Client: Aetherdbs
Job Site: Burlington

Date: 09/May/2011
Test ID: cpt2
Project: Alliant



Maximum depth: 45.54 (ft)

Test ID: cpt2
File: A09Y1102C.ECP

Applied Research Associates, Inc.
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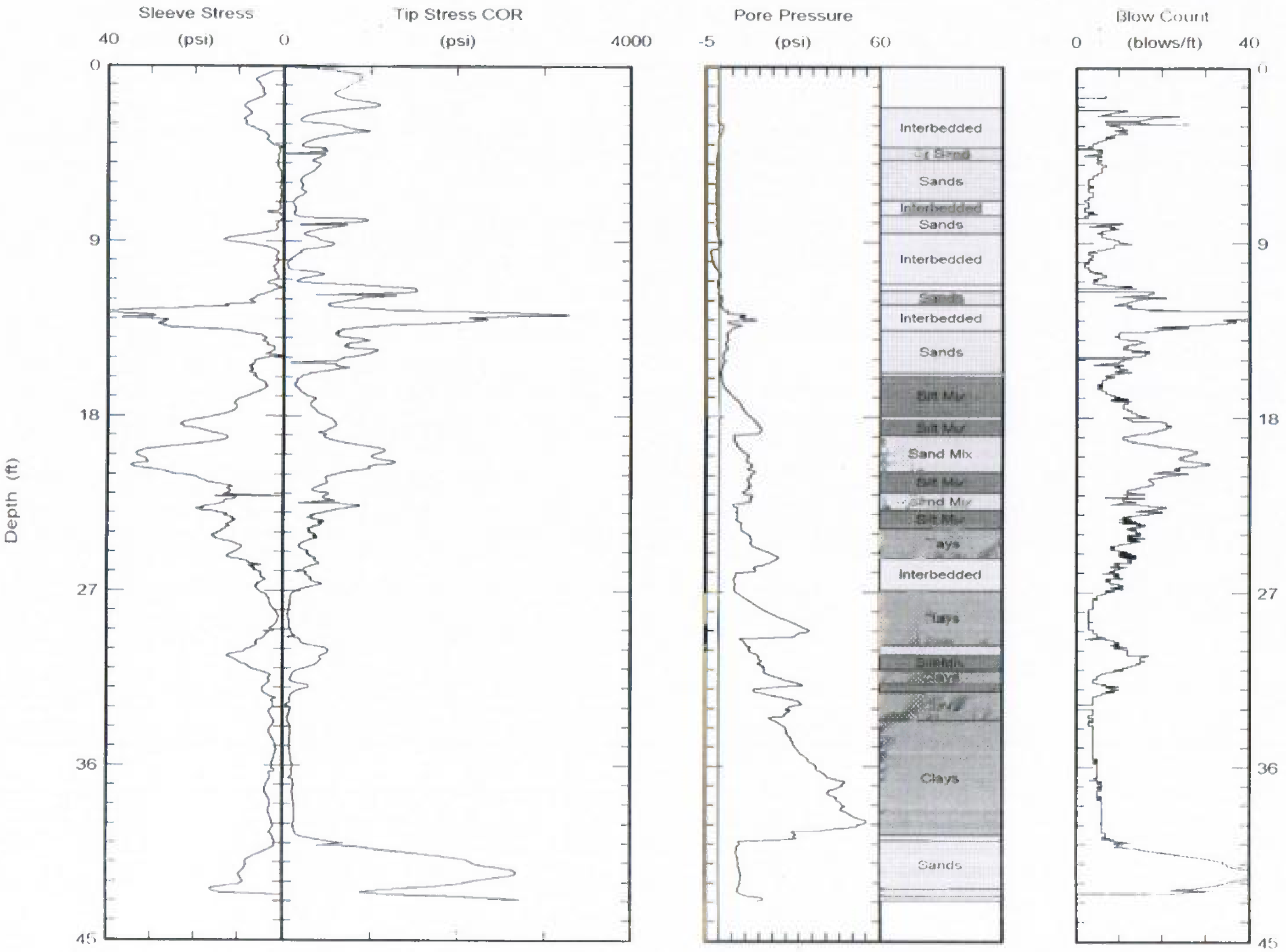
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:

Date: 09/May/2011
Test ID: cpt3
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



Maximum depth: 42.94 (ft)

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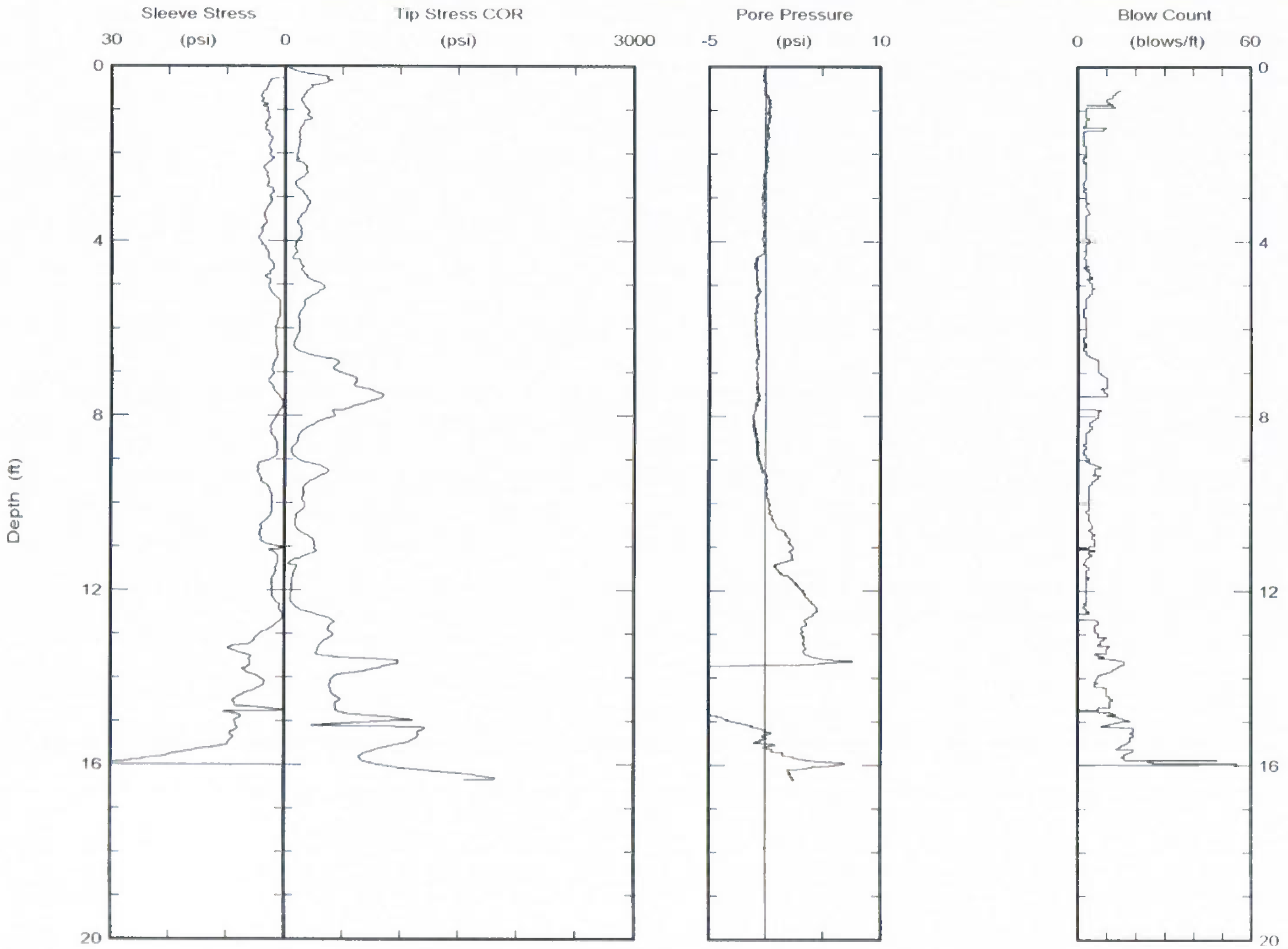
South Royalton, VT 05068
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:

Date: 09/May/2011
Test ID: cpt4
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



Maximum depth: 16.35 (ft)

Test ID: cpt4
File: A09Y1104C.ECP

Applied Research Associates, Inc.
South Royalton, VT 05068
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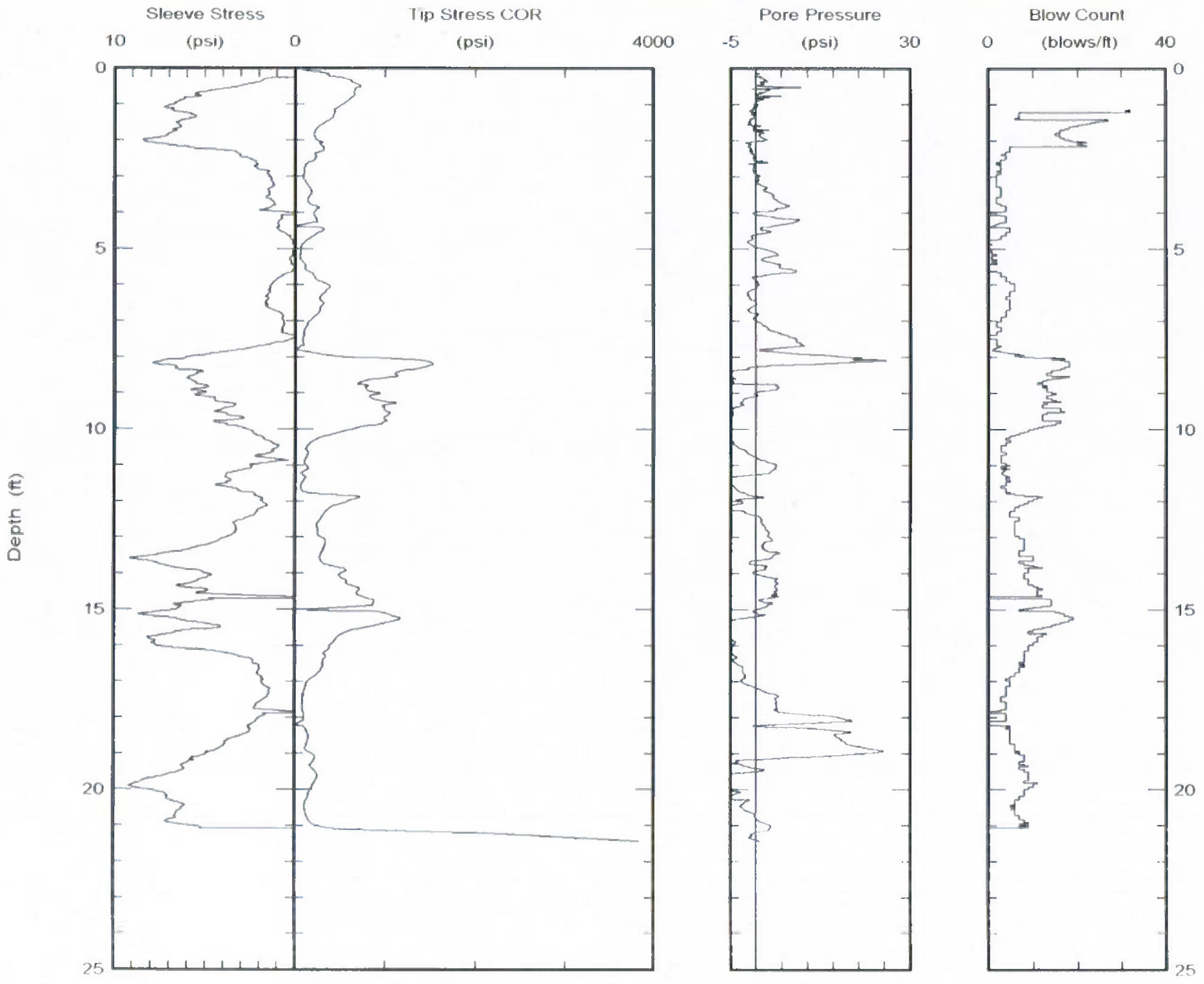
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:

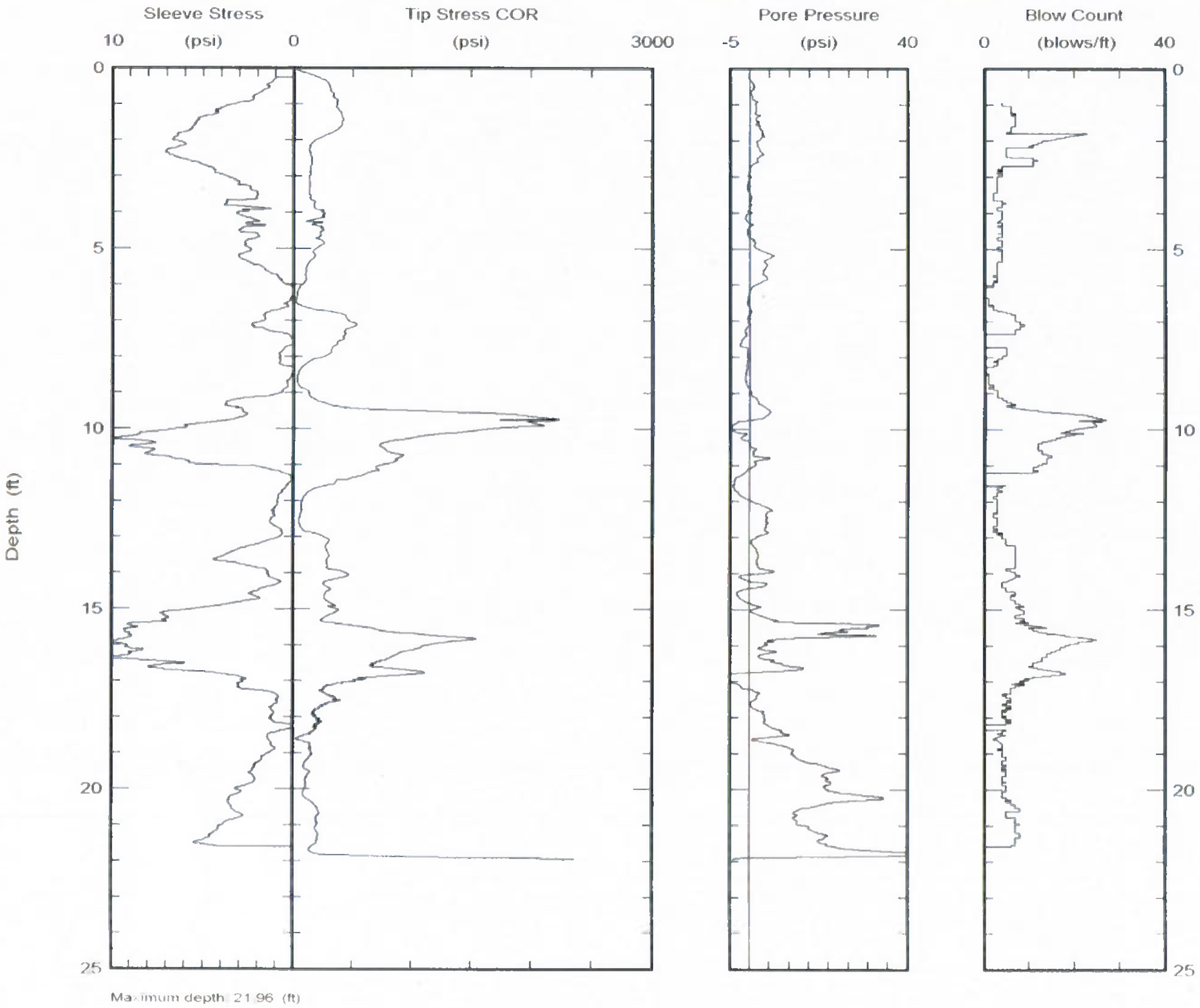
Date: 10/May/2011
Test ID: cpt5
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



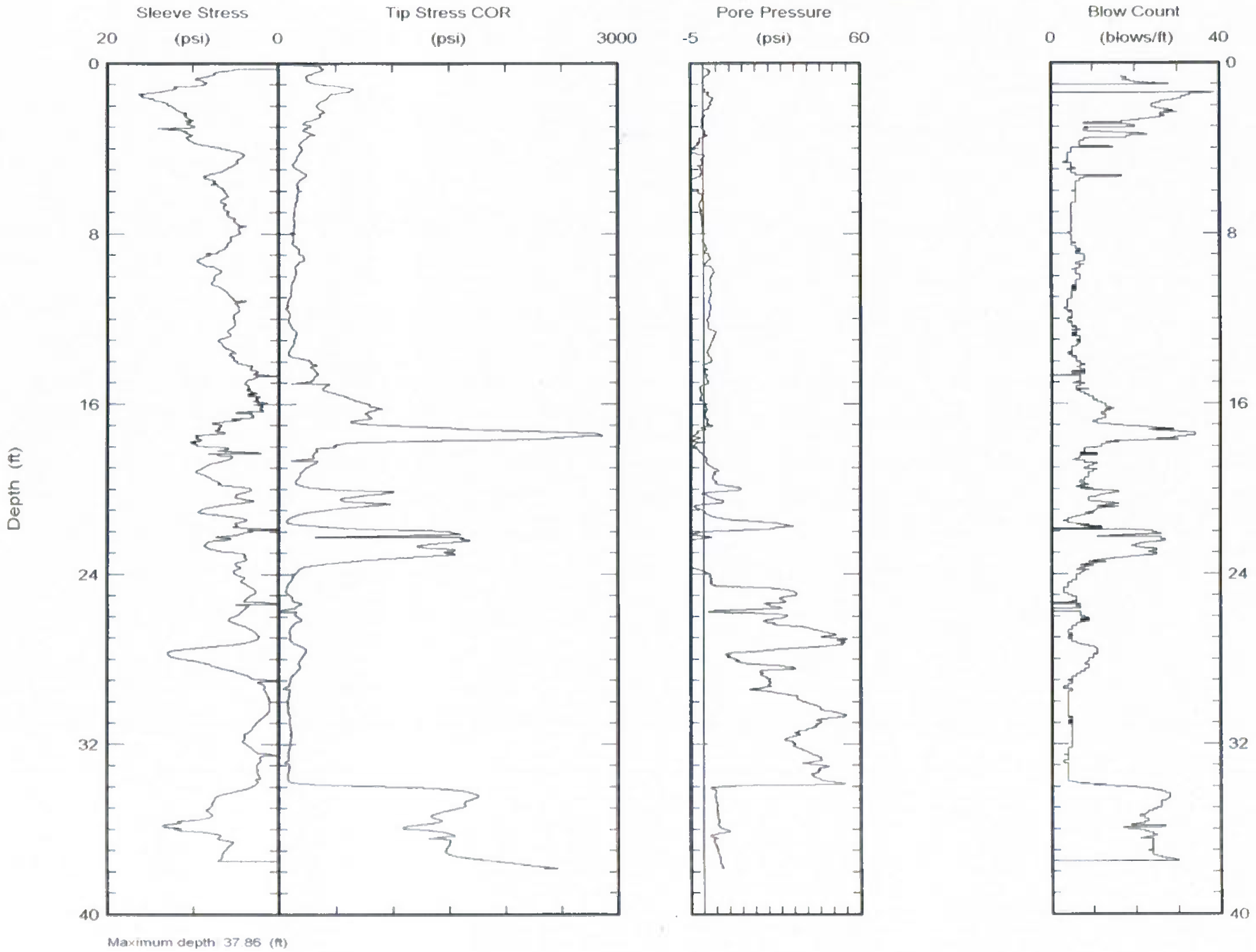
Maximum depth: 21.43 (ft)

Applied Research Associates, Inc. South Royalton, VT 05068 802-763-8348 cpt@ned.ara.com www.ara.com	Northing: Easting: Elevation:	Date: 10/May/2011 Test ID: cpt6 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



Maximum depth: 21.96 (ft)

Applied Research Associates, Inc. South Royalton, VT 05068 802-763-8348 cpt@ned.ara.com www.ara.com	Northing: Easting: Elevation:	Date: 10/May/2011 Test ID: cpt7 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



Maximum depth: 37.86 (ft)

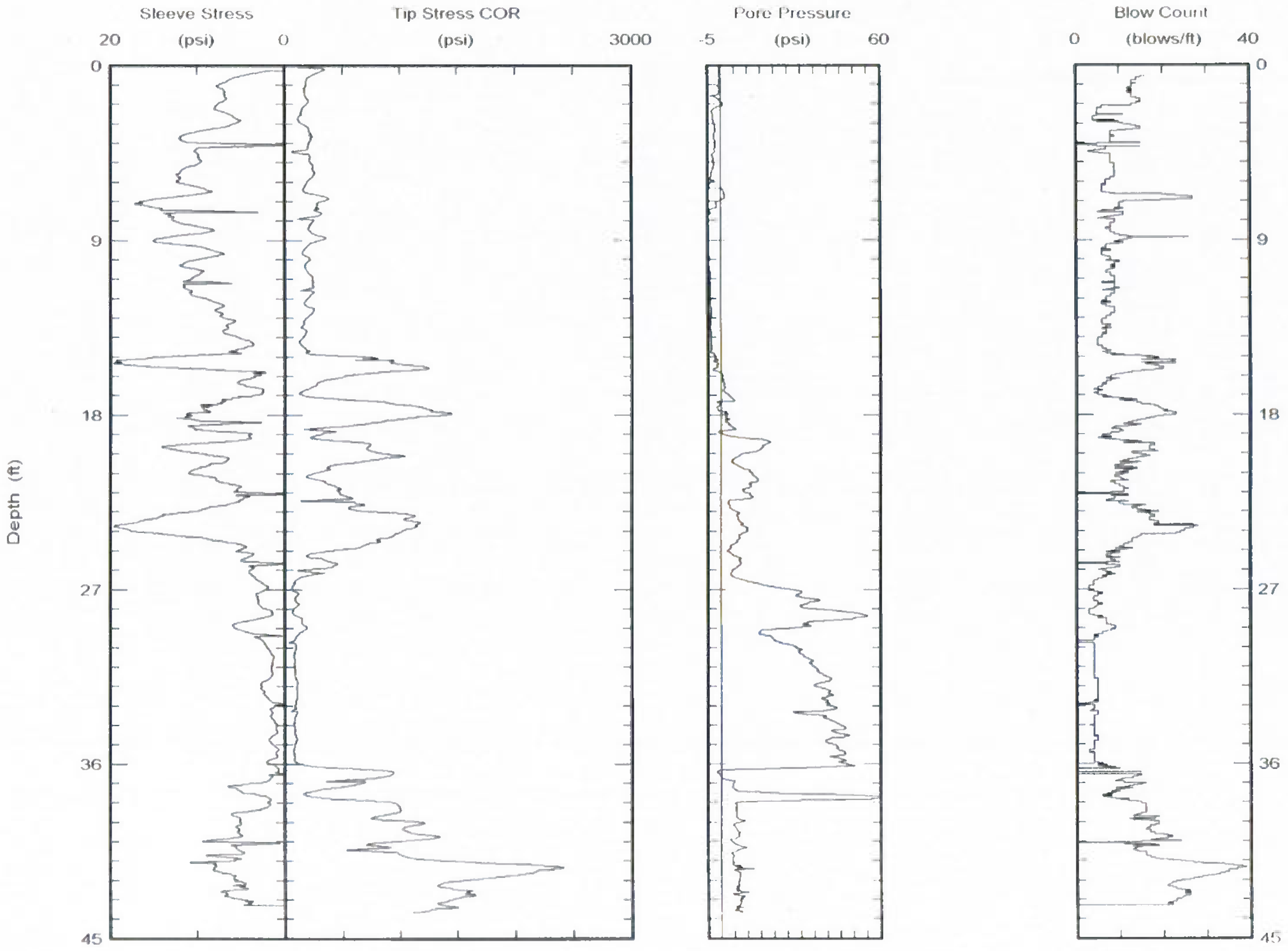
Test ID: cpt7
File: A10Y1103C.ECP

Applied Research Associates, Inc.
South Royalton, VT 05068
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:

Date: 10/May/2011
Test ID: cpt8
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



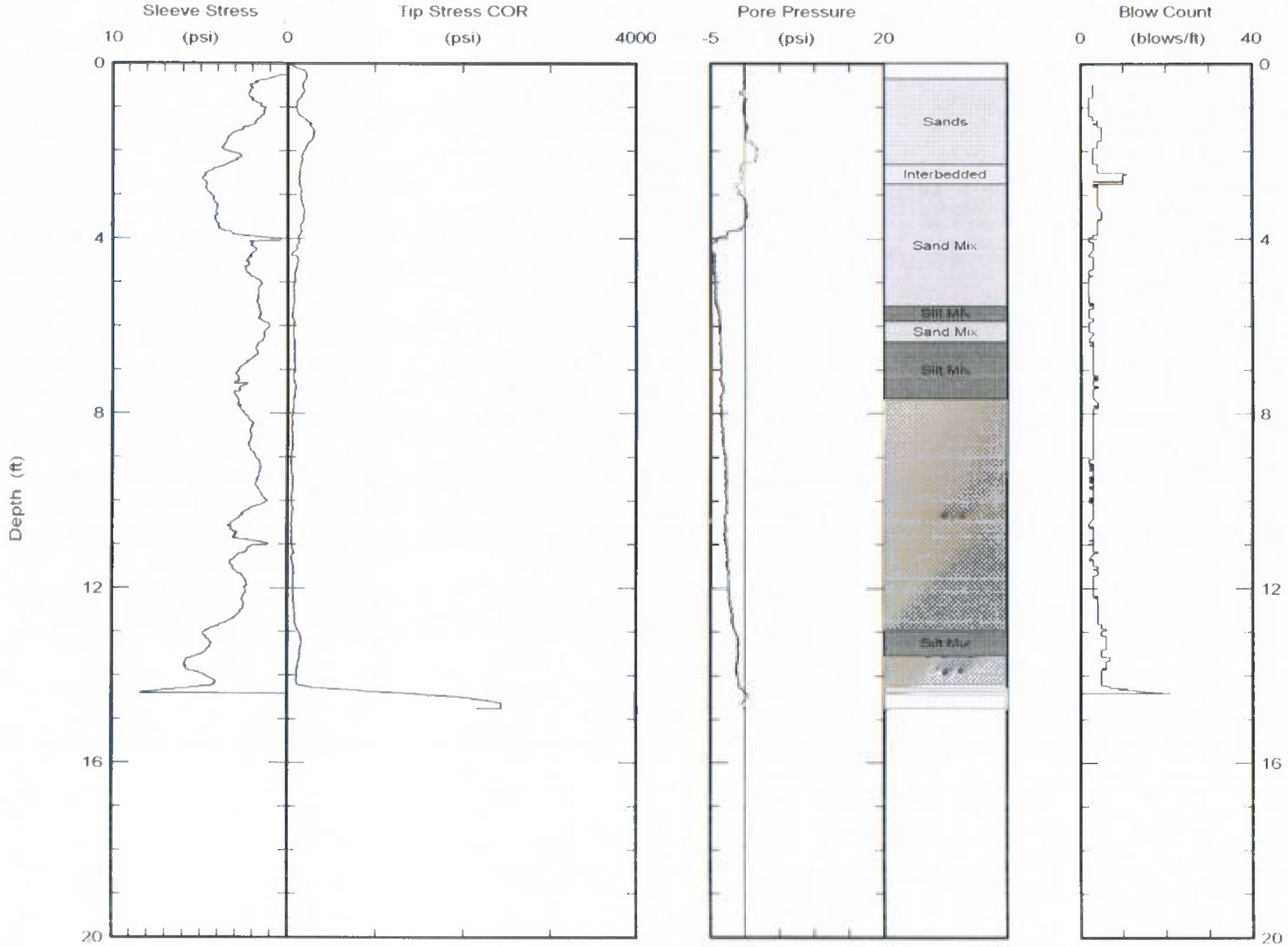
Maximum depth: 43.65 (ft)

Applied Research Associates, Inc.
South Royalton, VT 05068
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:

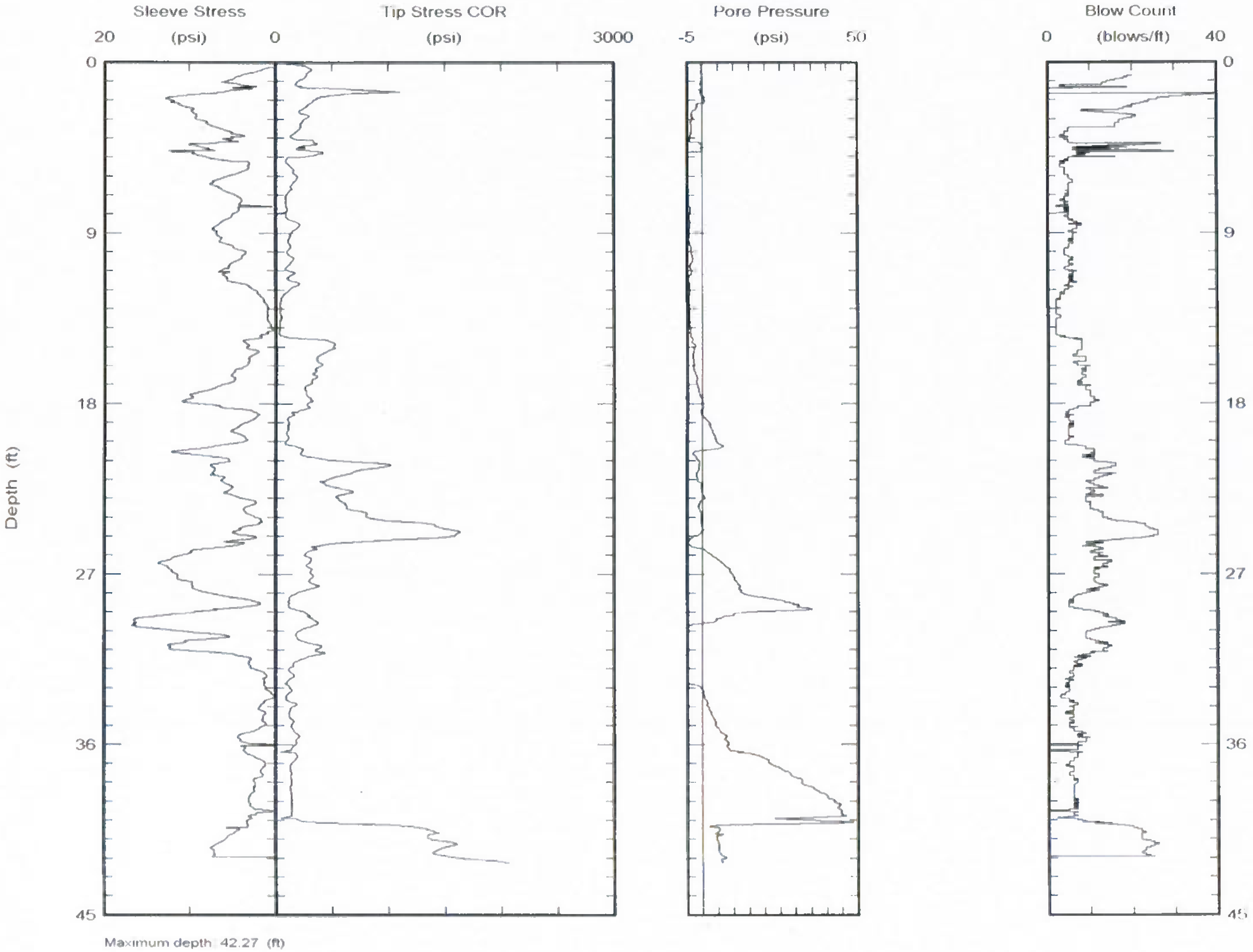
Date: 10/May/2011
Test ID: cpt9
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



Maximum depth: 14.76 (ft)

Applied Research Associates, Inc. South Royalton, VT 05068 802-763-8348 cpt@ned.ara.com www.ara.com	Northing: Easting: Elevation:	Date: 10/May/2011 Test ID: cpt10 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



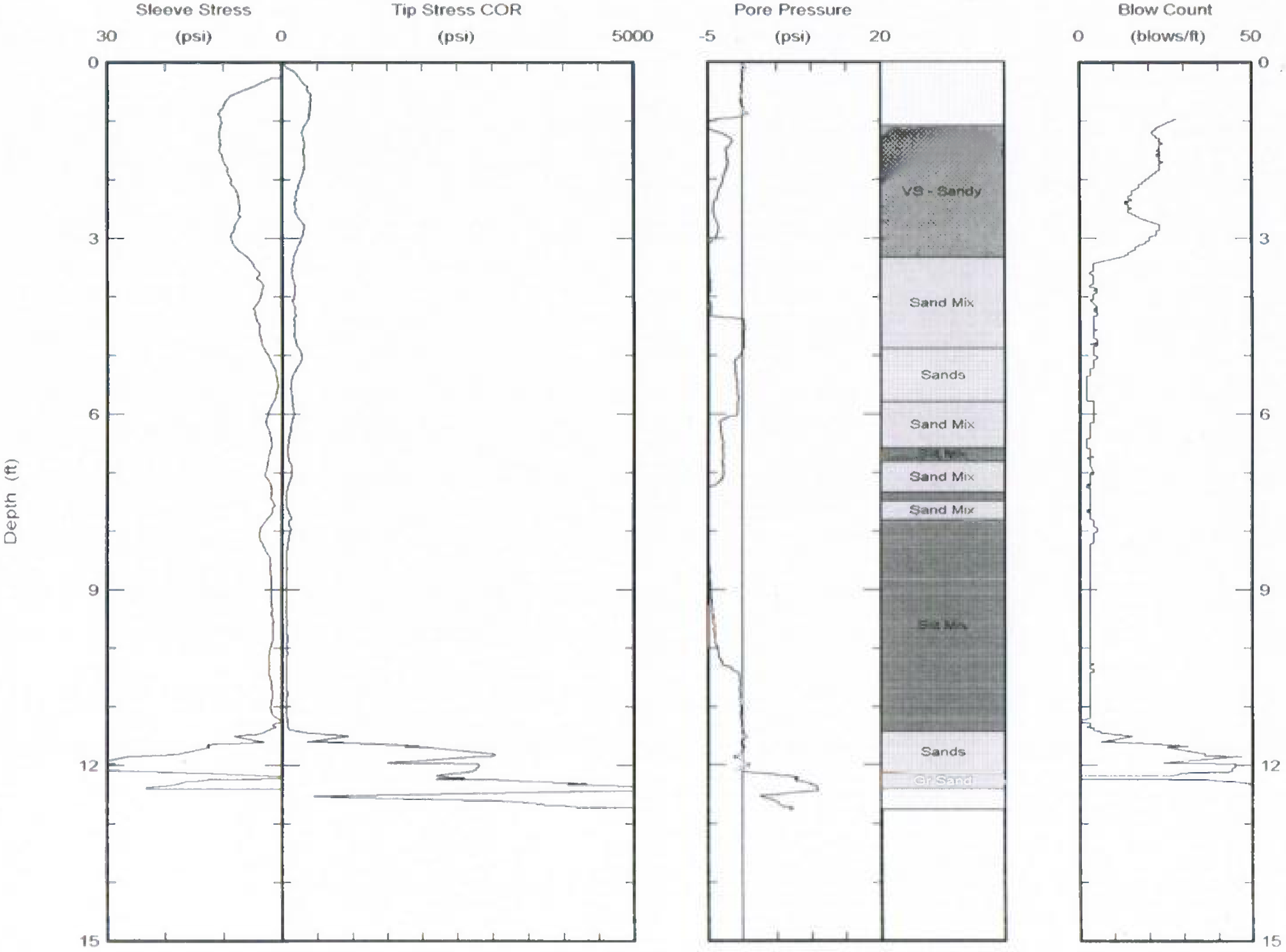
Test ID: cpt10
File: A10Y1106C.ECP

Applied Research Associates, Inc.
South Royalton, VT 05068
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:

Date: 10/May/2011
Test ID: cpt11
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



Maximum depth: 12.76 (ft)

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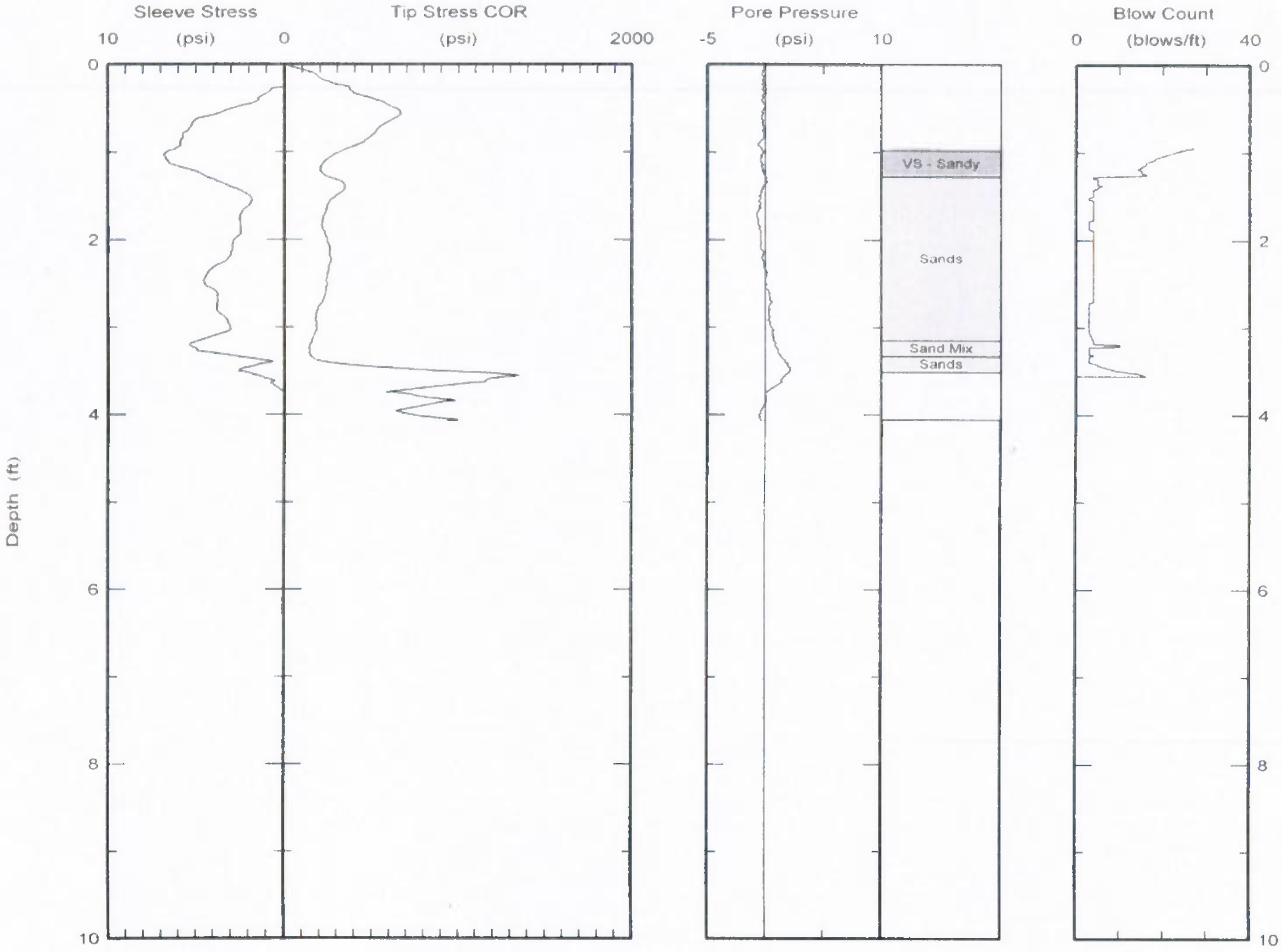
www.ara.com

Northing:
Easting:
Elevation:

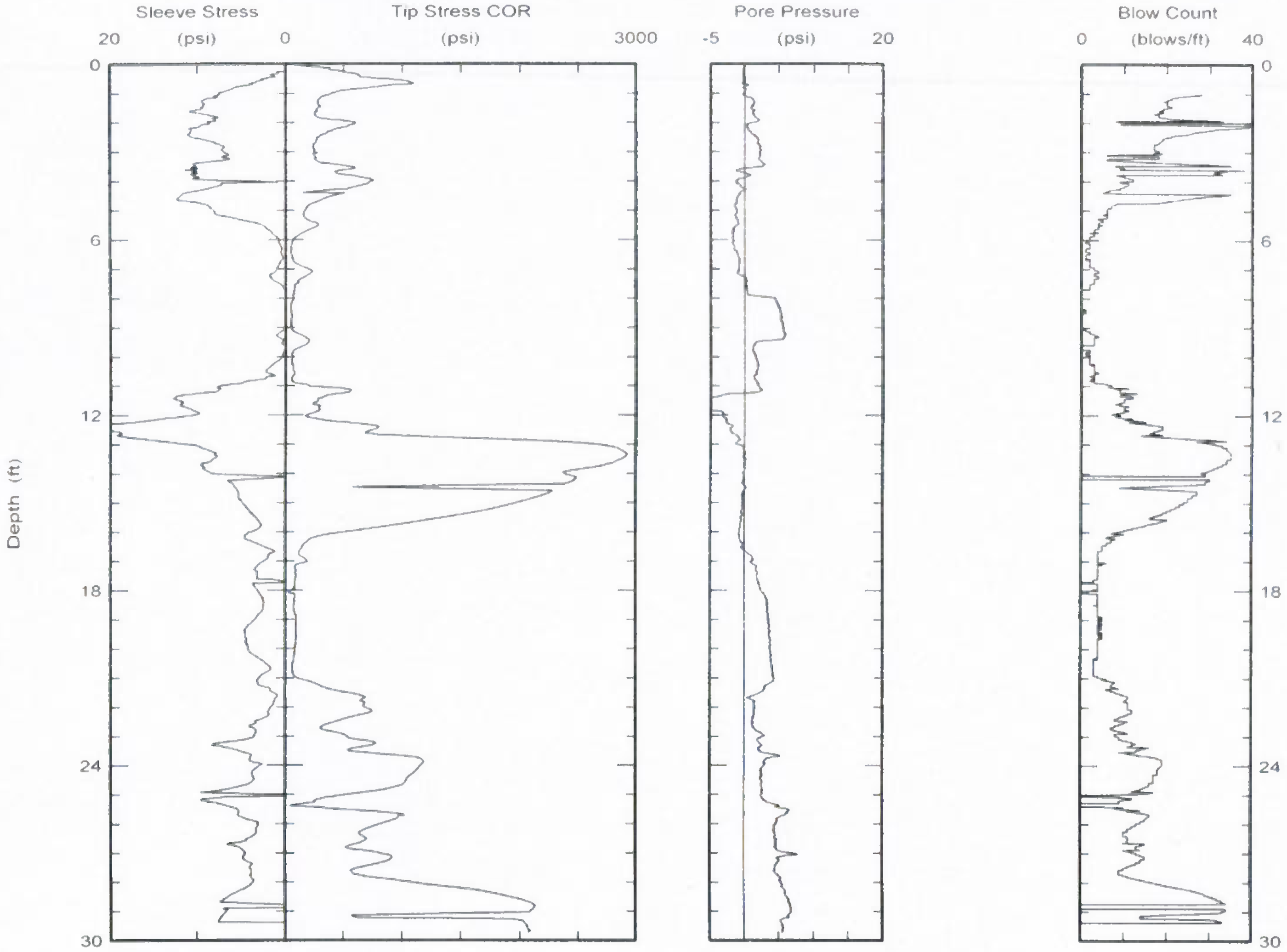
Date: 10/May/2011
Test ID: cpt12
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



Maximum depth: 4.06 (ft)

Applied Research Associates, Inc. South Royalton, VT 05068 802-763-8348 cpt@ned.ara.com www.ara.com	Northing: Easting: Elevation:	Date: 10/May/2011 Test ID: cpt13 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



Maximum depth: 29.72 (ft)

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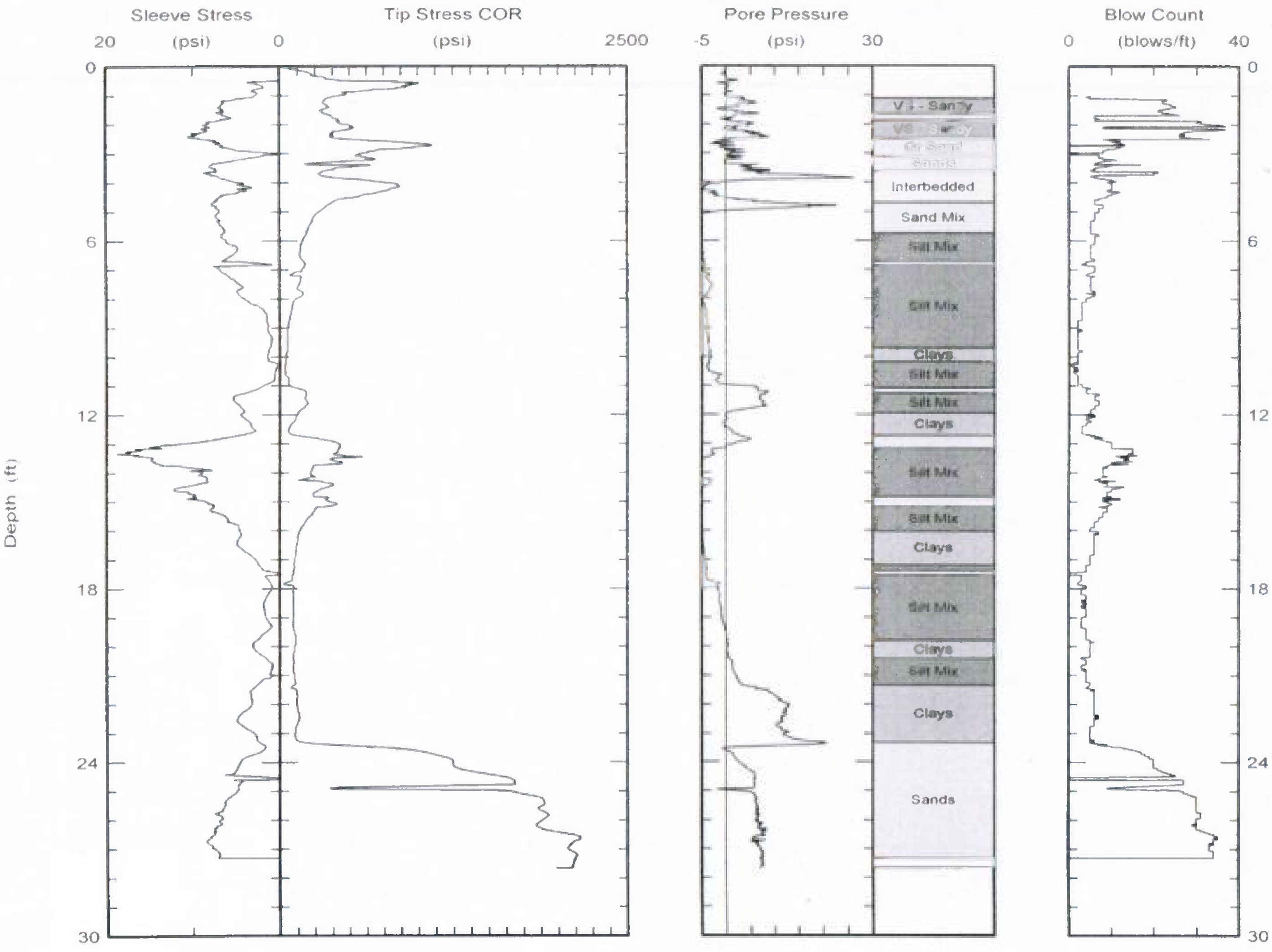
Northing:
Easting:
Elevation:

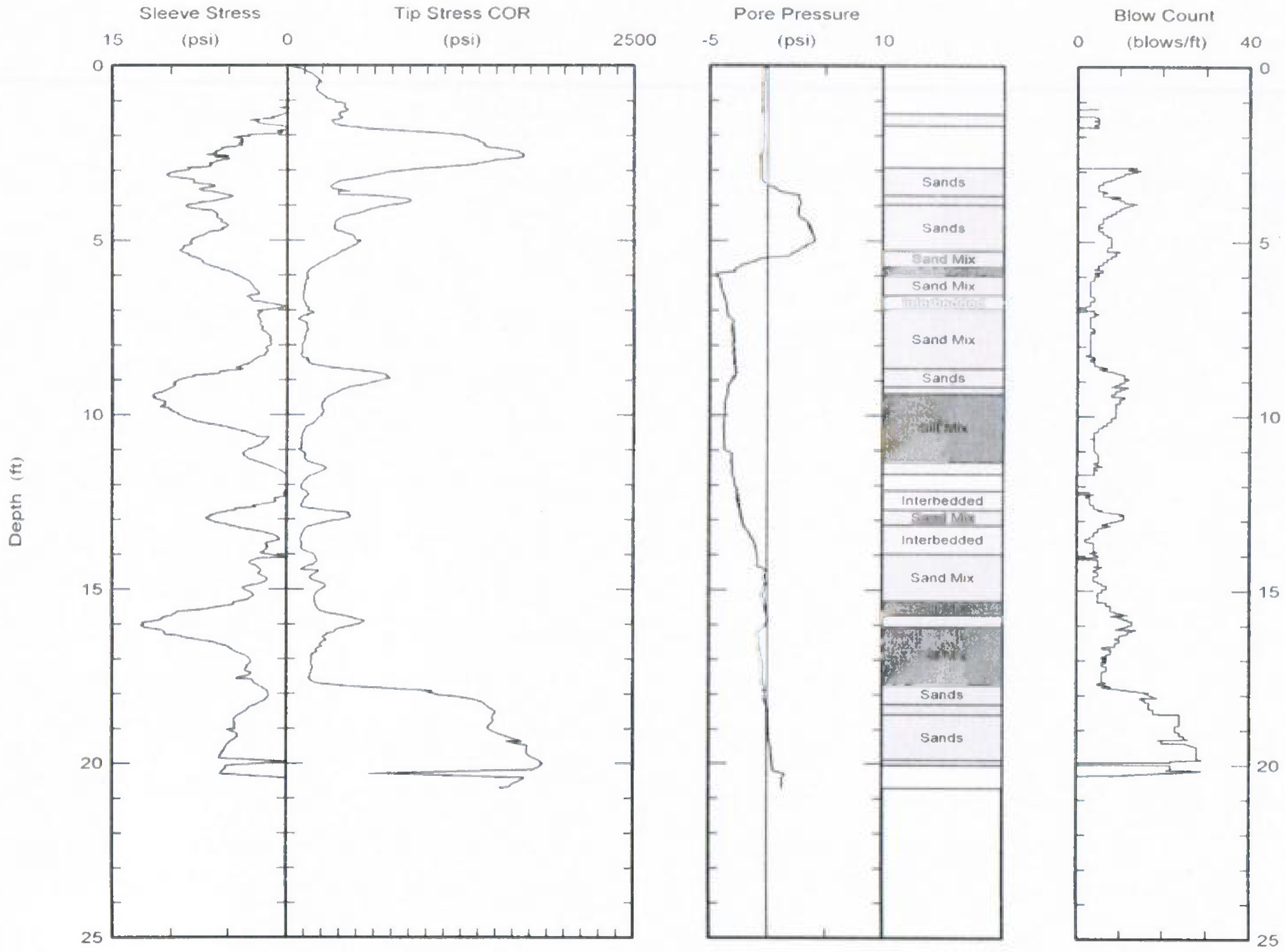
Date: 15/May/2011
Test ID: cpt14
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



Maximum depth: 27.65 (ft)

Applied Research Associates, Inc. South Royalton, VT 05068 802-763-8348 cpt@ned.ara.com www.ara.com	Northing: Easting: Elevation:	Date: 15/May/2011 Test ID: cpt15 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



Maximum depth: 20.70 (ft)

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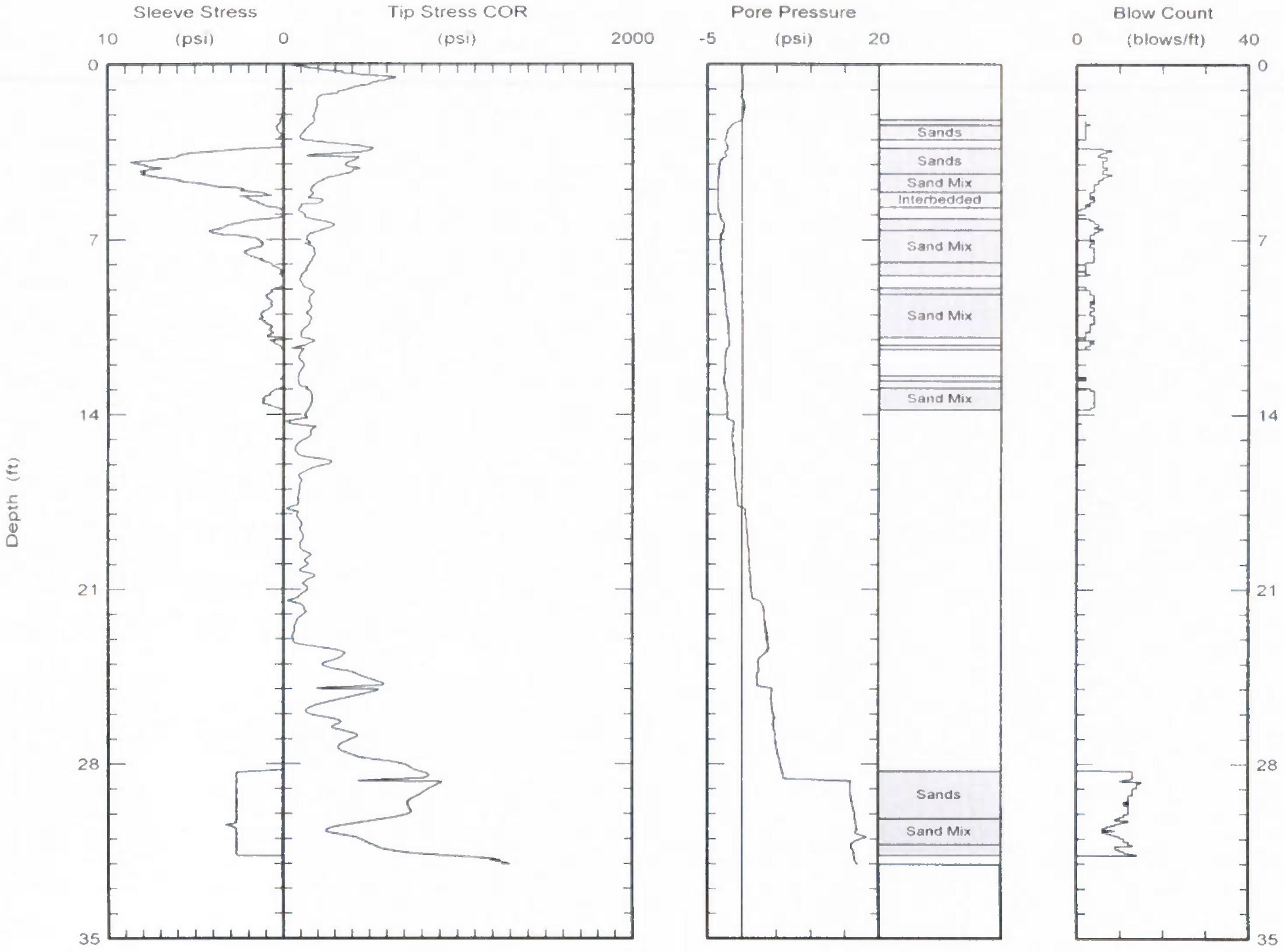
www.ara.com

Northing:
Easting:
Elevation:

Date: 15/May/2011
Test ID: cpt16
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



Maximum depth: 32.02 (ft)

Test ID: cpt16
File: A15Y1103C ECP

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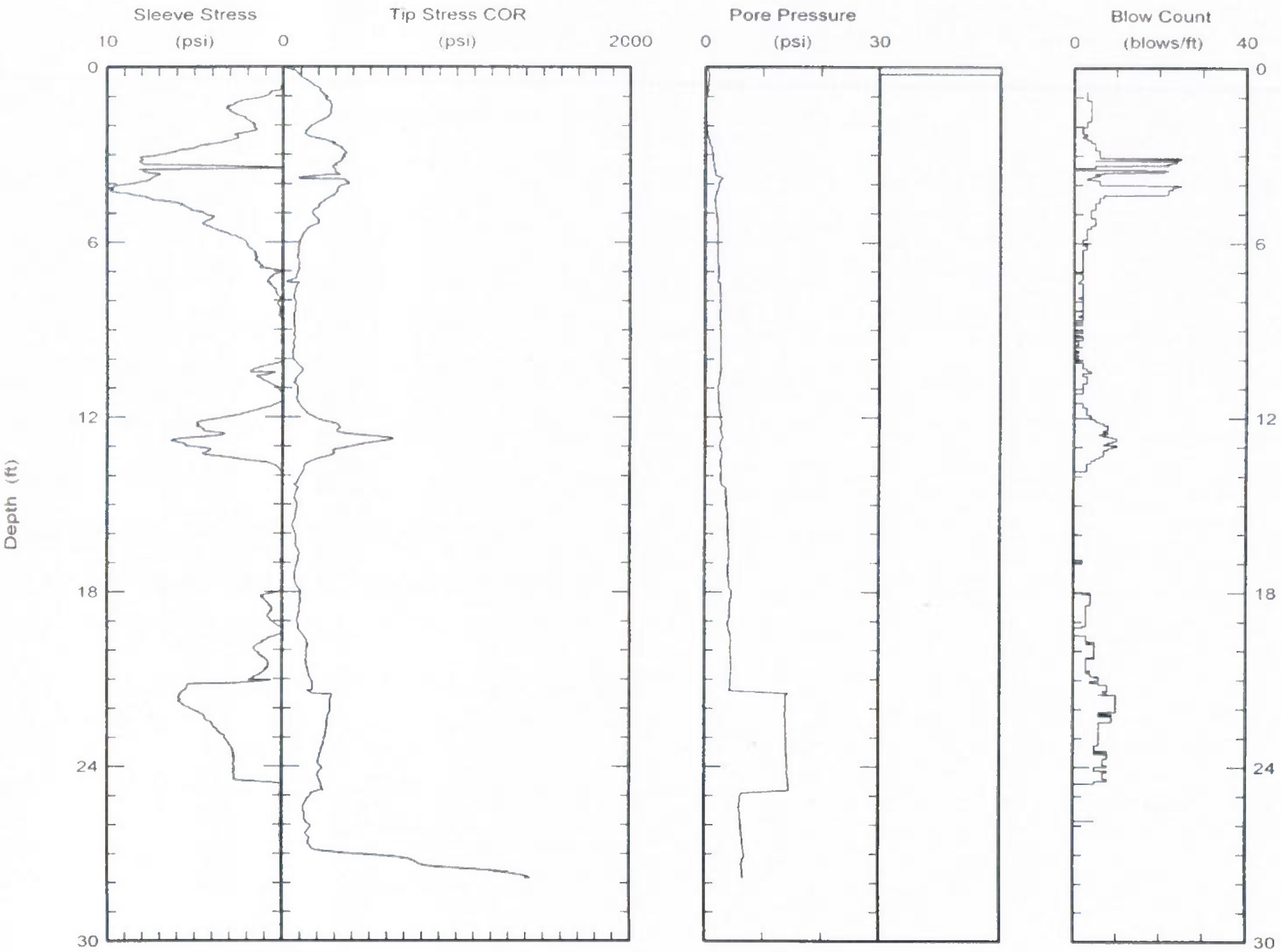
www.ara.com

Northing:
Easting:
Elevation:
Client: Aetherdbs
Job Site: Burlington

Date: 15/May/2011
Test ID: cpt17
Project: Alliant

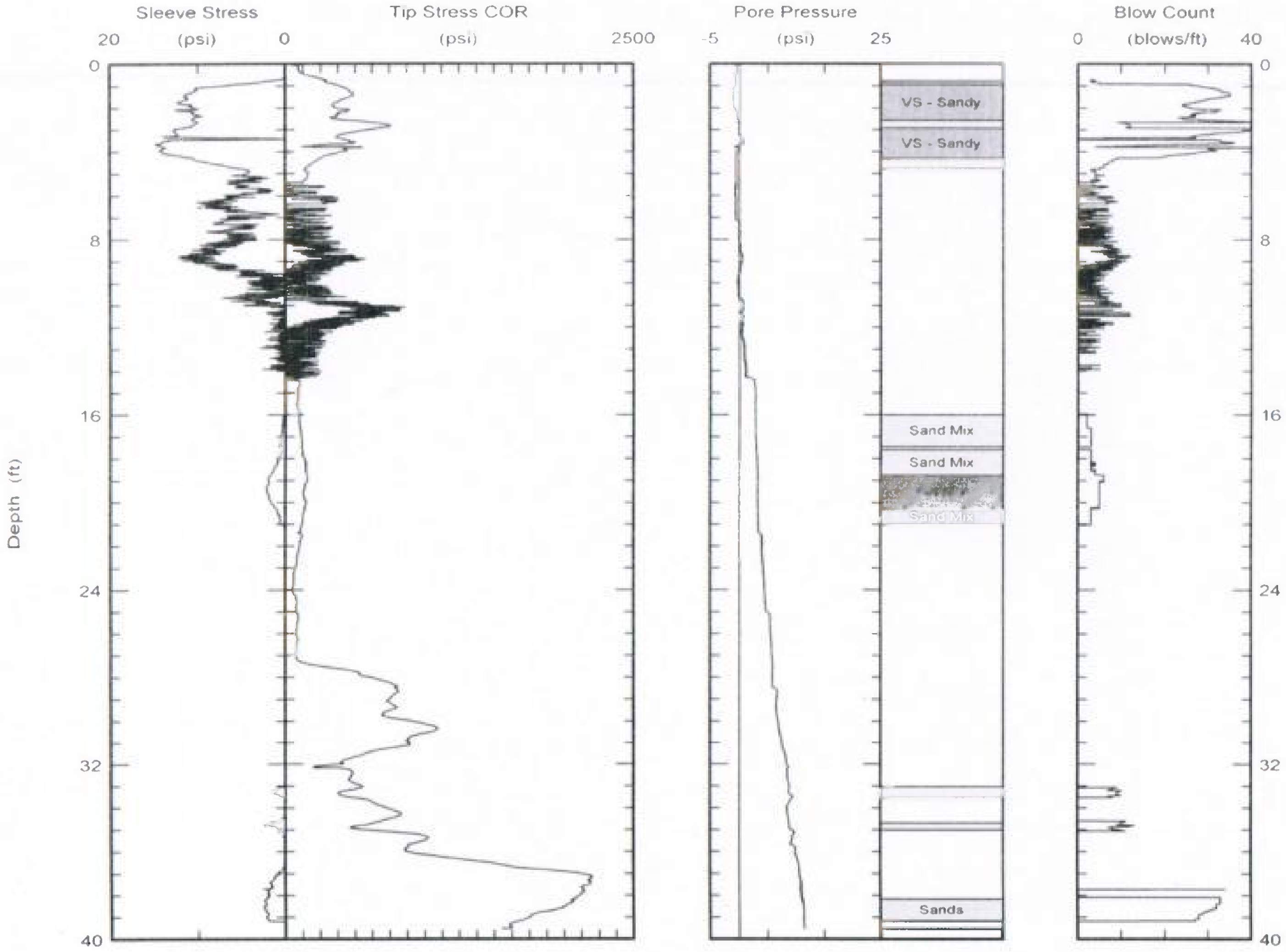


Maximum depth: 27.84 (ft)

Applied Research Associates, Inc.
South Royalton, VT 05068
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:
Client: Aetherdbs
Job Site: Burlington

Date: 15/May/2011
Test ID: cpt18
Project: Alliant

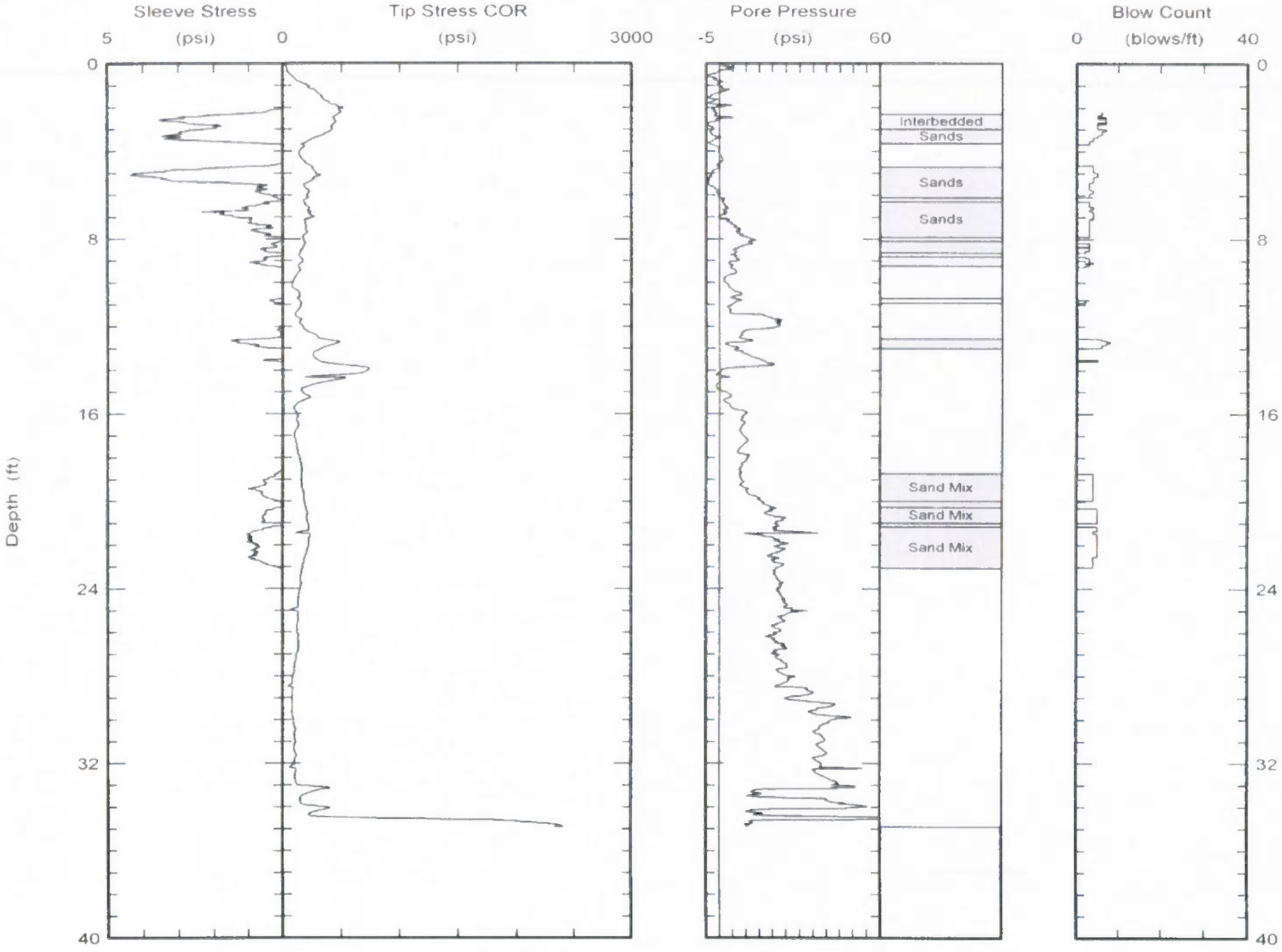


Maximum depth: 39.53 (ft)

Applied Research Associates, Inc.
South Royalton, VT 05068
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:
Client: Aetherdbs
Job Site: Burlington

Date: 16/May/2011
Test ID: cpt19
Project: Alliant



Maximum depth: 34.90 (ft)

Test ID: cpt19
File: A16Y1101C.ECP

Applied Research Associates, Inc.
South Royalton, VT 05068
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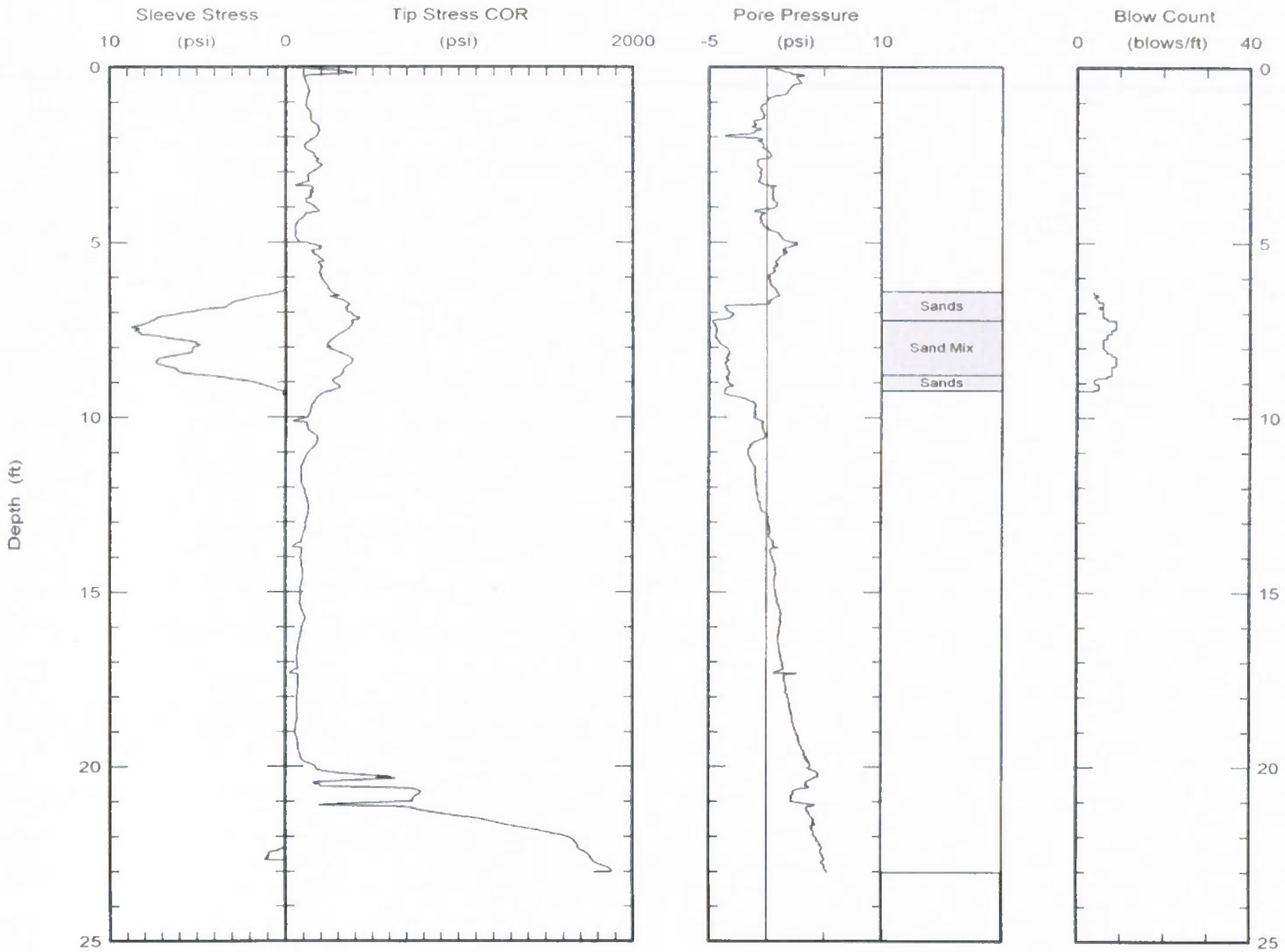
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:
Client: Aetherdbs
Job Site: Burlington

Date: 16/May/2011
Test ID: cpt20
Project: Alliant



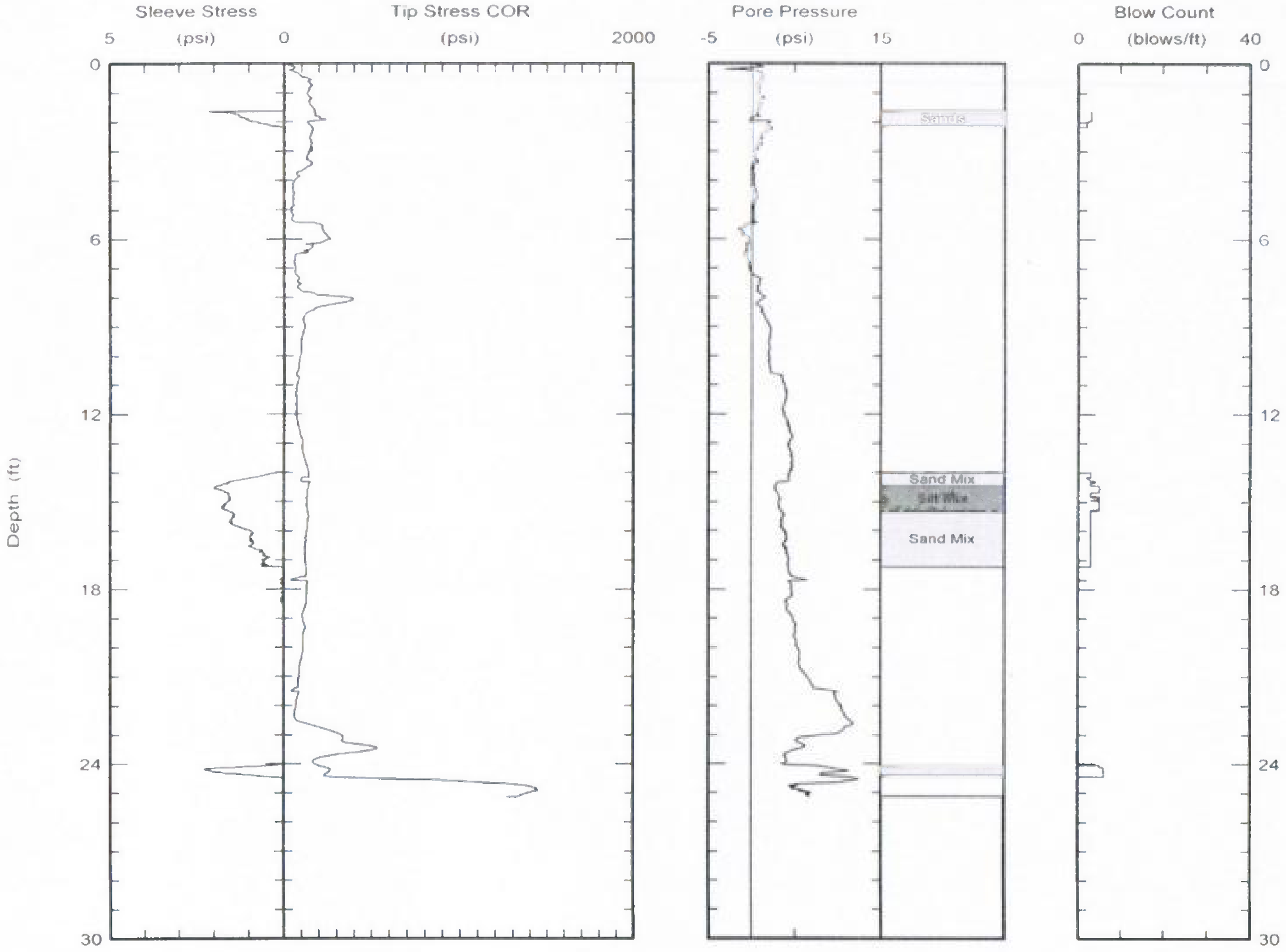
Maximum depth: 23.02 (ft)

Test ID: cpt20
File: A16Y1102C.ECP

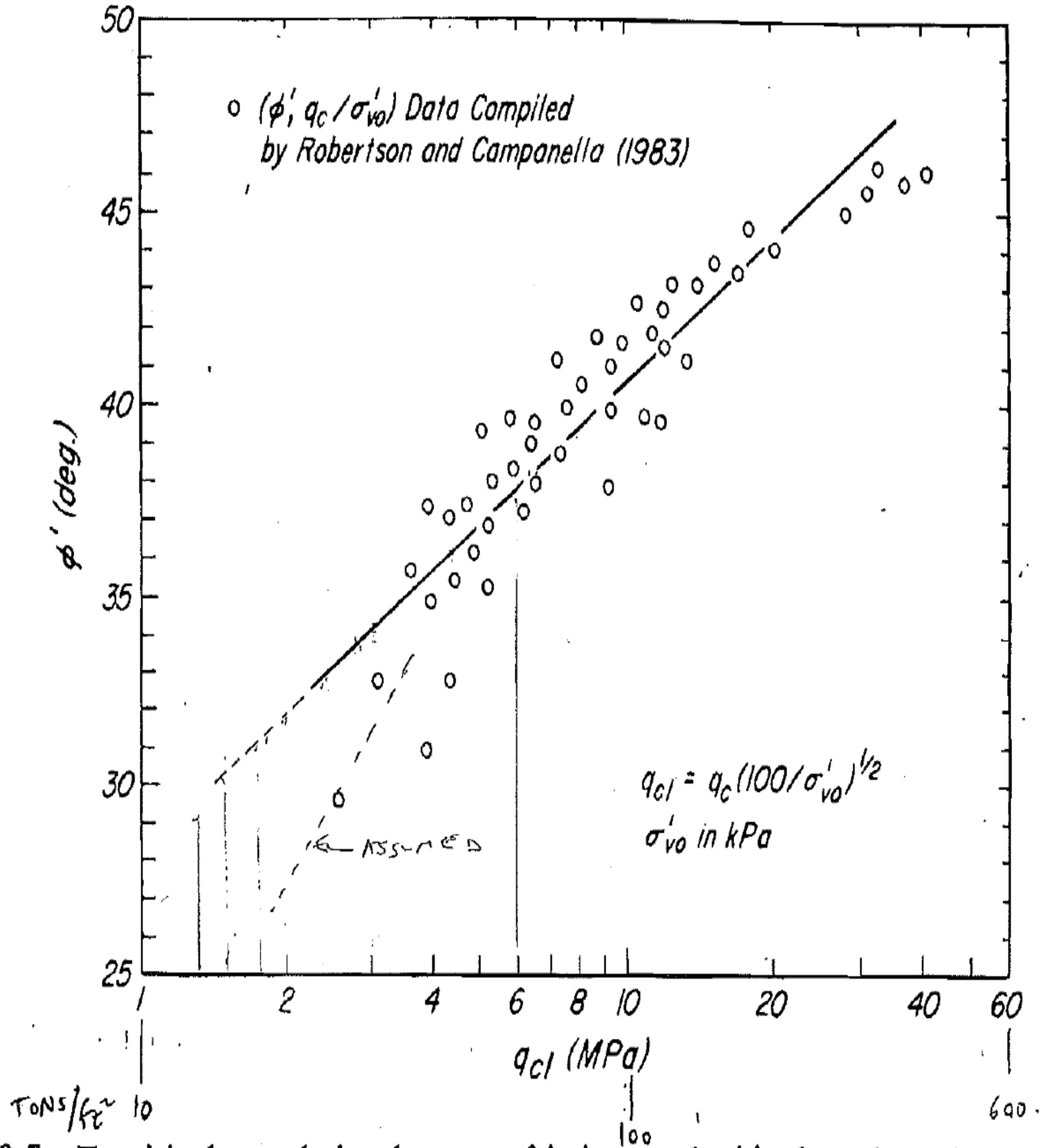
Applied Research Associates, Inc.
South Royalton, VT 05068
802-763-8348
cpt@ned.ara.com
www.ara.com

Northing:
Easting:
Elevation:
Client: Aetherdbs
Job Site: Burlington

Date: 16/May/2011
Test ID: cpt21
Project: Alliant



Maximum depth: 25.13 (ft)



19.5 Empirical correlation between friction angle φ′ of sands and norma
penetration resistance.

Re: TERZAGHI PECK & MESRI
(1996), SOIL MECHANICS IN ENG. PRACTICE,
3RD ED., JOHN WILEY & SONS, INC

APPENDIX D – Laboratory Testing on CCR Embankment Soils

Alliant Energy
Interstate Power and Light Company
Burlington Generating Station
Burlington, Iowa

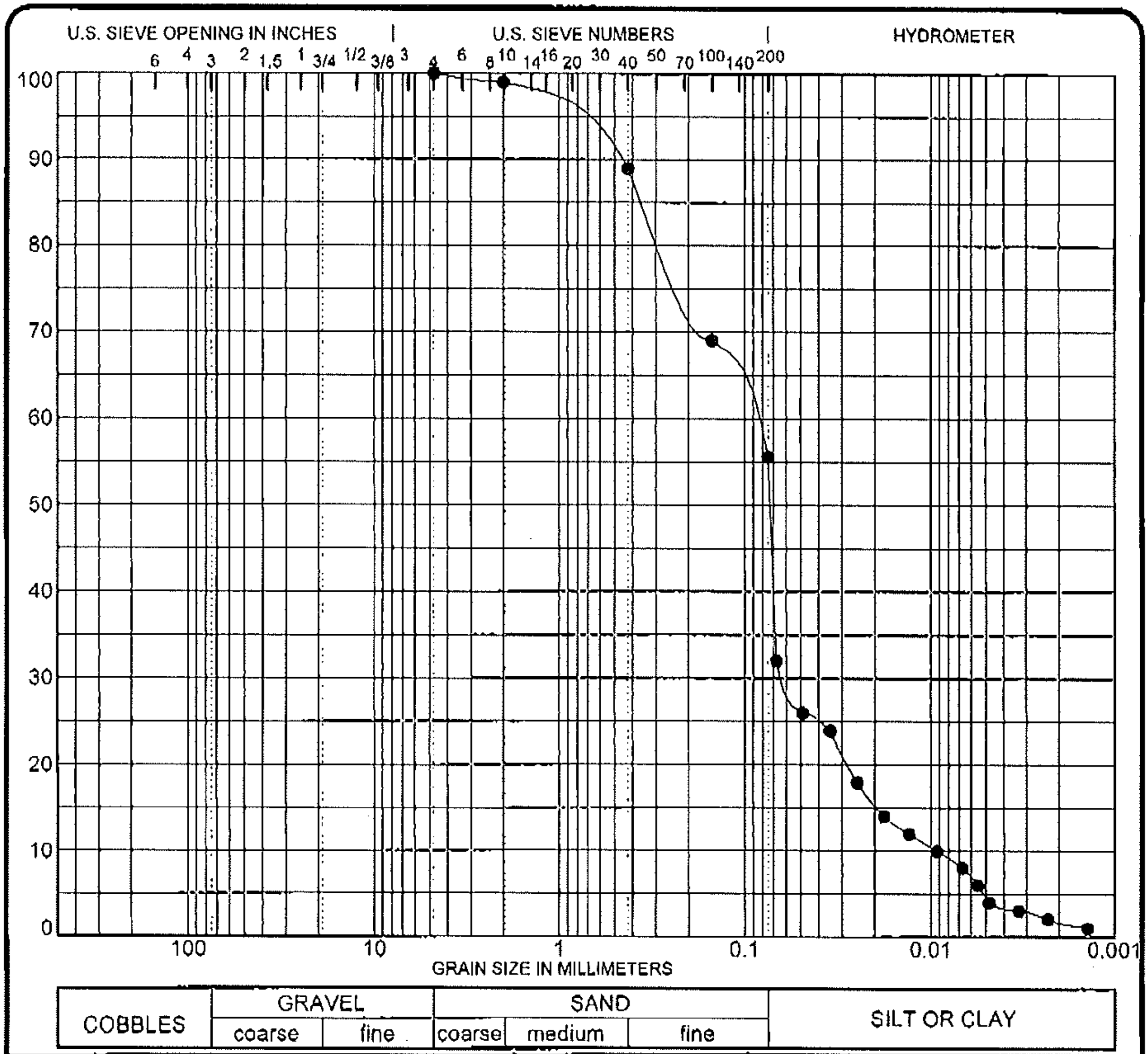
Safety Factor Assessment

Attachment C

Soil Laboratory Results

Burlington Generating Station

Source: Testing Service Corporation, May 2011



SPECIMEN IDENTIFICATION

Broing: SB-1

Sample: Ash

NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	100
# 4	100
# 10	99
# 40	89
# 100	69
# 200	56

SOIL CLASSIFICATION

Brown ASH

%GRAVEL	%SAND	%SILT	%CLAY
0	44	54	2

MC%		LL	PL	PI
44.0		NP	NP	NP

PROJECT Geotechnical Testing
LOCATION ,

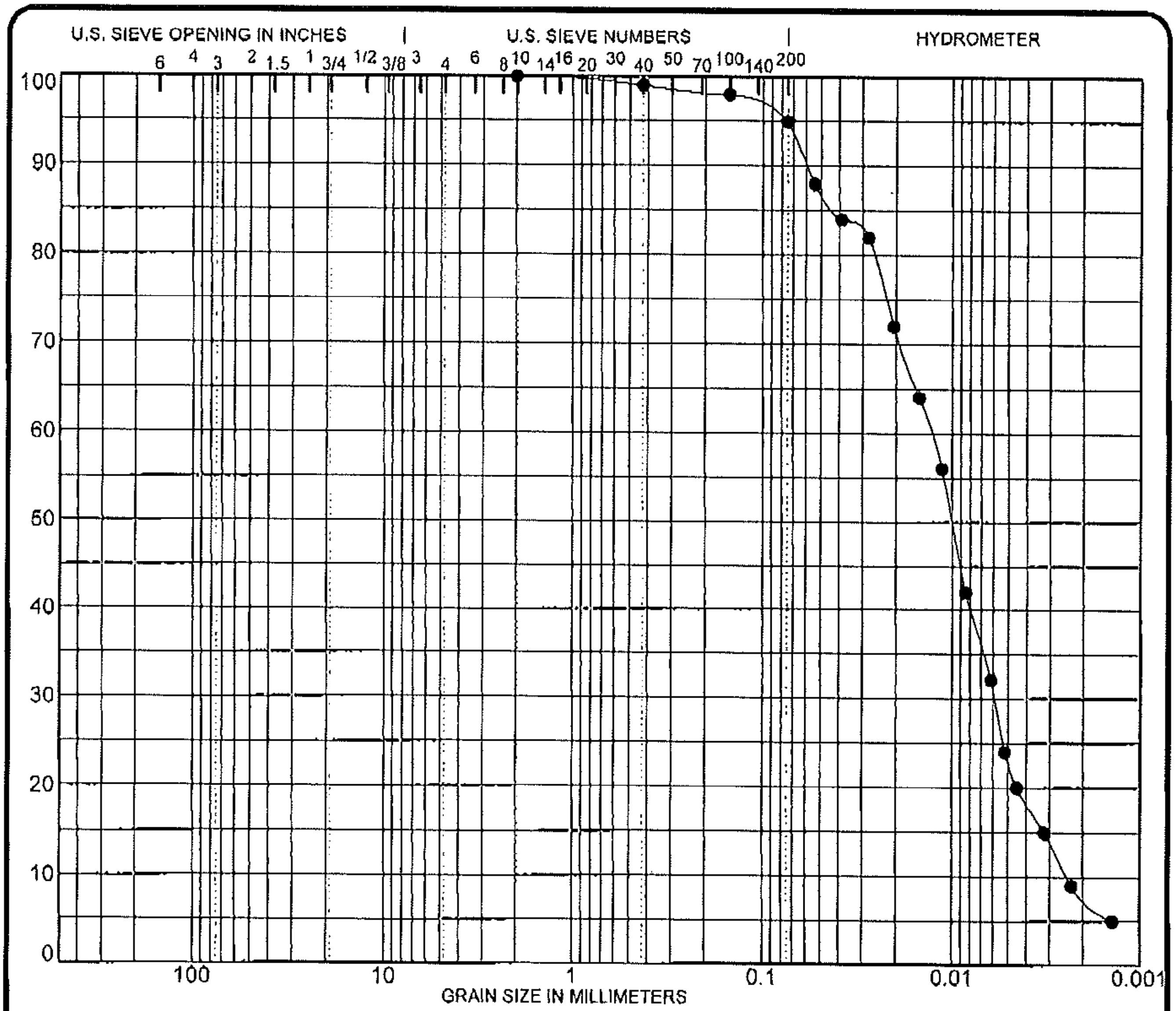
JOB NO. L - 76,757
DATE May 20, 2011

SB1

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/20/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION	SIEVE	% PASS	SOIL CLASSIFICATION			
Boring: SB-1	3 inch	100	Gray clayey SILT, trace sand (ML)			
Sample: A	2	100				
Depth: 25.0'-26.0'	1 1/2	100				
	1	100	%GRAVEL	%SAND	%SILT	%CLAY
NOTES:	3/4	100	0	5	87	8
	3/8	100				
	# 4	100	MC%	LL	PL	PI
	# 10	100	69.4	36	31	5
	# 40	99				
	# 100	98				
	# 200	95				

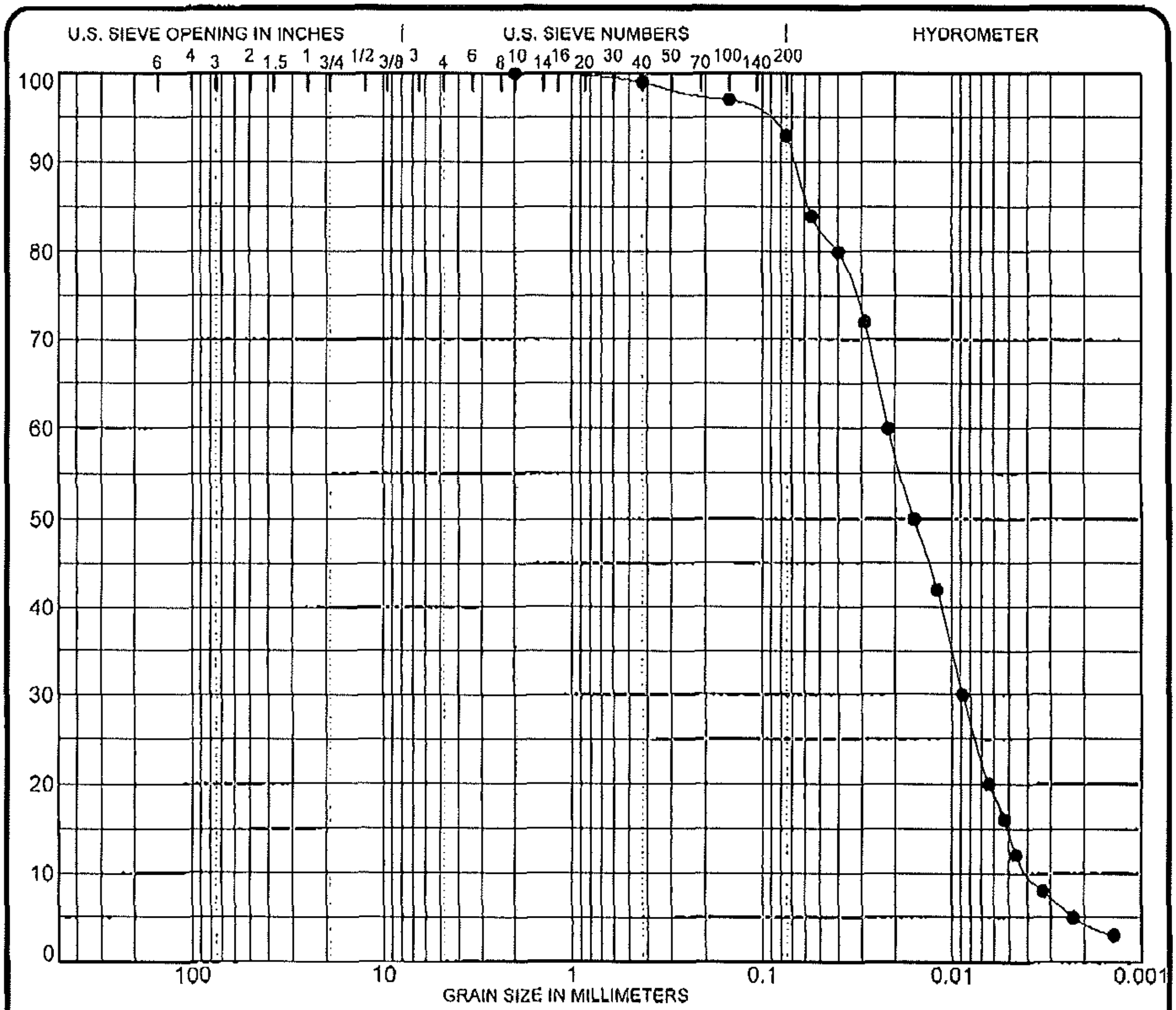
PROJECT Geotechnical Testing
LOCATION ,
SB1

JOB NO. L - 76,757
DATE May 20, 2011

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/20/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION

Boring: SB-1

Sample: 8

Depth: 29.0'-30.0'

NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	100
# 4	100
# 10	100
# 40	99
# 100	97
# 200	93

SOIL CLASSIFICATION

Gray clayey SILT, trace sand (ML)

%GRAVEL	%SAND	%SILT	%CLAY
0	7	89	4

MC%		LL	PL	PI
58.6		40	37	3

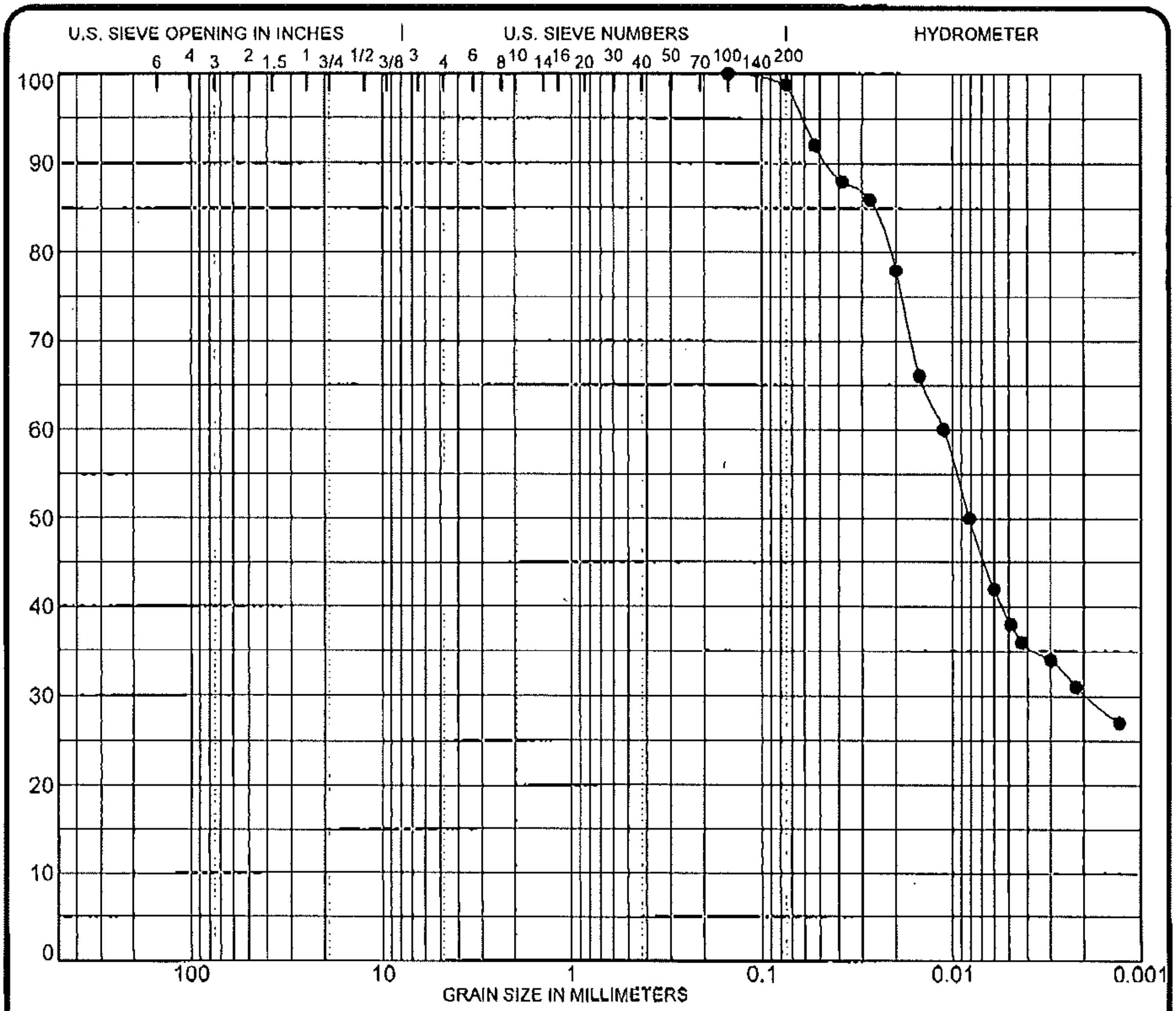
PROJECT Geotechnical Testing
LOCATION ,
SB1

JOB NO. L - 76,757
DATE May 20, 2011

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_AIL.GDT 5/20/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION
Boring: SB-1
Sample: C
Depth: 34.0'-35.0'
NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	100
# 4	100
# 10	100
# 40	100
# 100	100
# 200	99

SOIL CLASSIFICATION

Gray silty CLAY, trace sand (CH)

%GRAVEL	%SAND	%SILT	%CLAY
0	1	69	30

MC%		LL	PL	PI
31.3		52	17	35

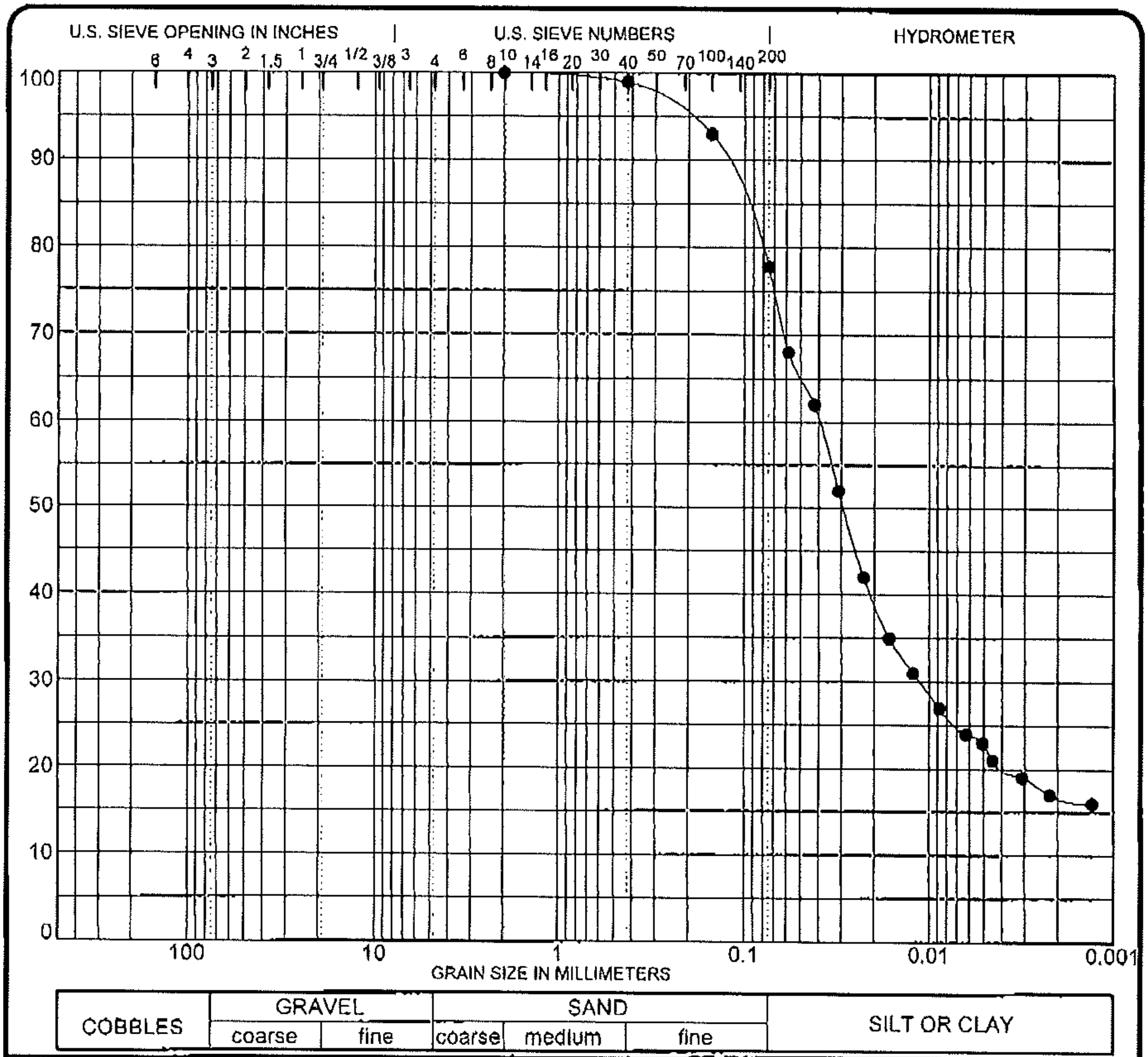
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 20, 2011

SB1

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/20/11



SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-1	3 inch	100
Sample: D	2	100
Depth: 36.0'-37.0'	1 1/2	100
	1	100
NOTES:	3/4	100
	3/8	100
	# 4	100
	# 10	100
	# 40	99
	# 100	93
	# 200	78

SOIL CLASSIFICATION

Gray very silty CLAY, some sand (CL)

%GRAVEL	%SAND	%SILT	%CLAY
0	22	61	17

MC%		LL	PL	PI
29.1		36	16	20

PROJECT Geotechnical Testing
LOCATION ,

JOB NO. L - 76,757
DATE May 20, 2011

SB1

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

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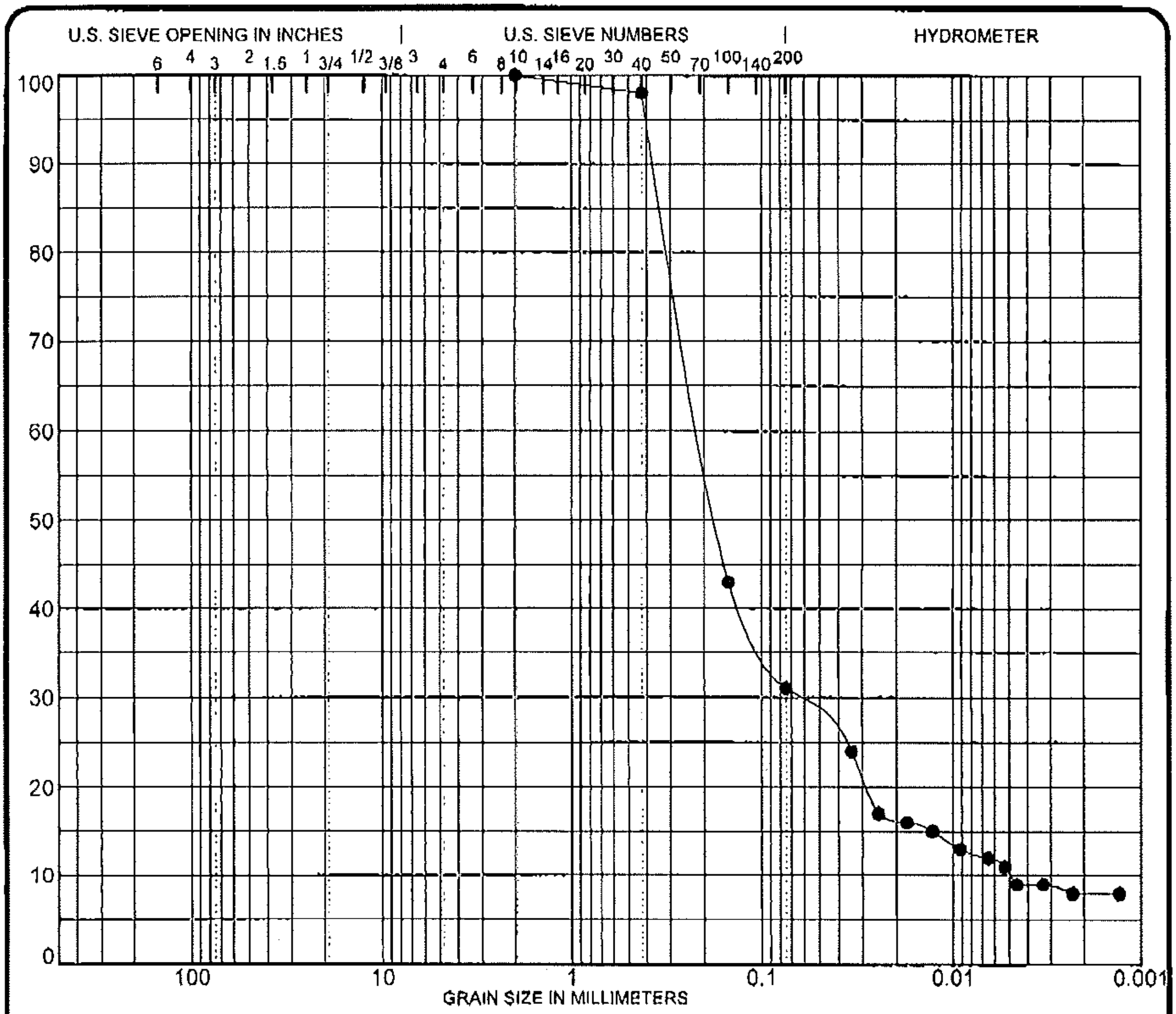


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION

Boring: SB-1

Sample: E

Depth: 37.0'-38.0'

NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	100
# 4	100
# 10	100
# 40	98
# 100	43
# 200	31

SOIL CLASSIFICATION

Gray clayey SAND (SC)

%GRAVEL	%SAND	%SILT	%CLAY
0	69	23	8

MC%		LL	PL	PI
30.4		22	14	8

PROJECT Geotechnical Testing

LOCATION ,

JOB NO. L - 76,757

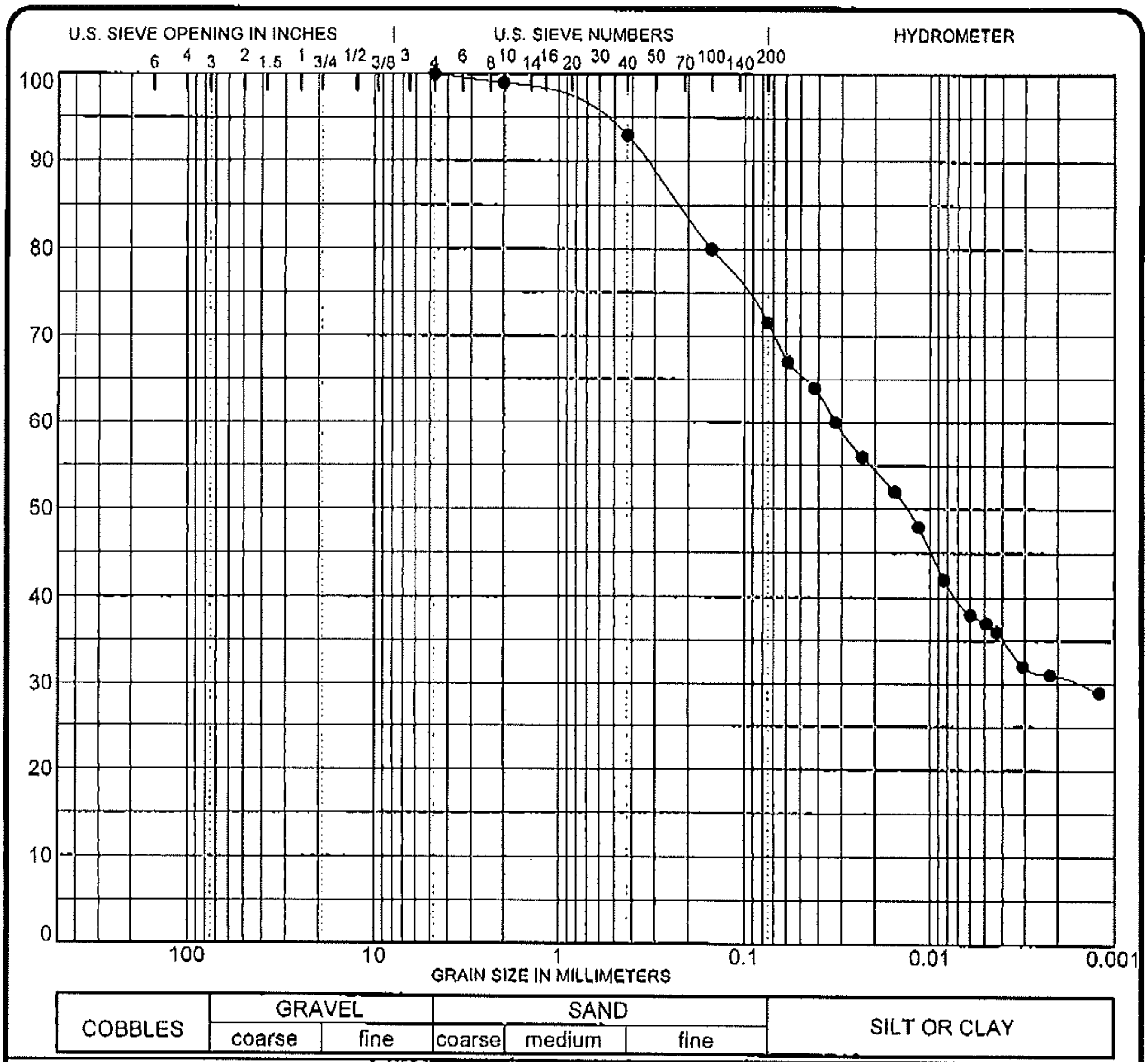
DATE May 20, 2011

SB1

SOIL DATA SHEET

Testing Service Corporation

Carol Stream, IL 60188



SPECIMEN IDENTIFICATION
Boring: SB-2
Sample: A
Depth: 8.0'-9.0'
NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	100
# 4	100
# 10	99
# 40	93
# 100	80
# 200	72

SOIL CLASSIFICATION

Brownish gray silty CLAY, some sand
(CL)

%GRAVEL	%SAND	%SILT	%CLAY
0	28	41	31

MC%		LL	PL	PI
15.7		46	12	34

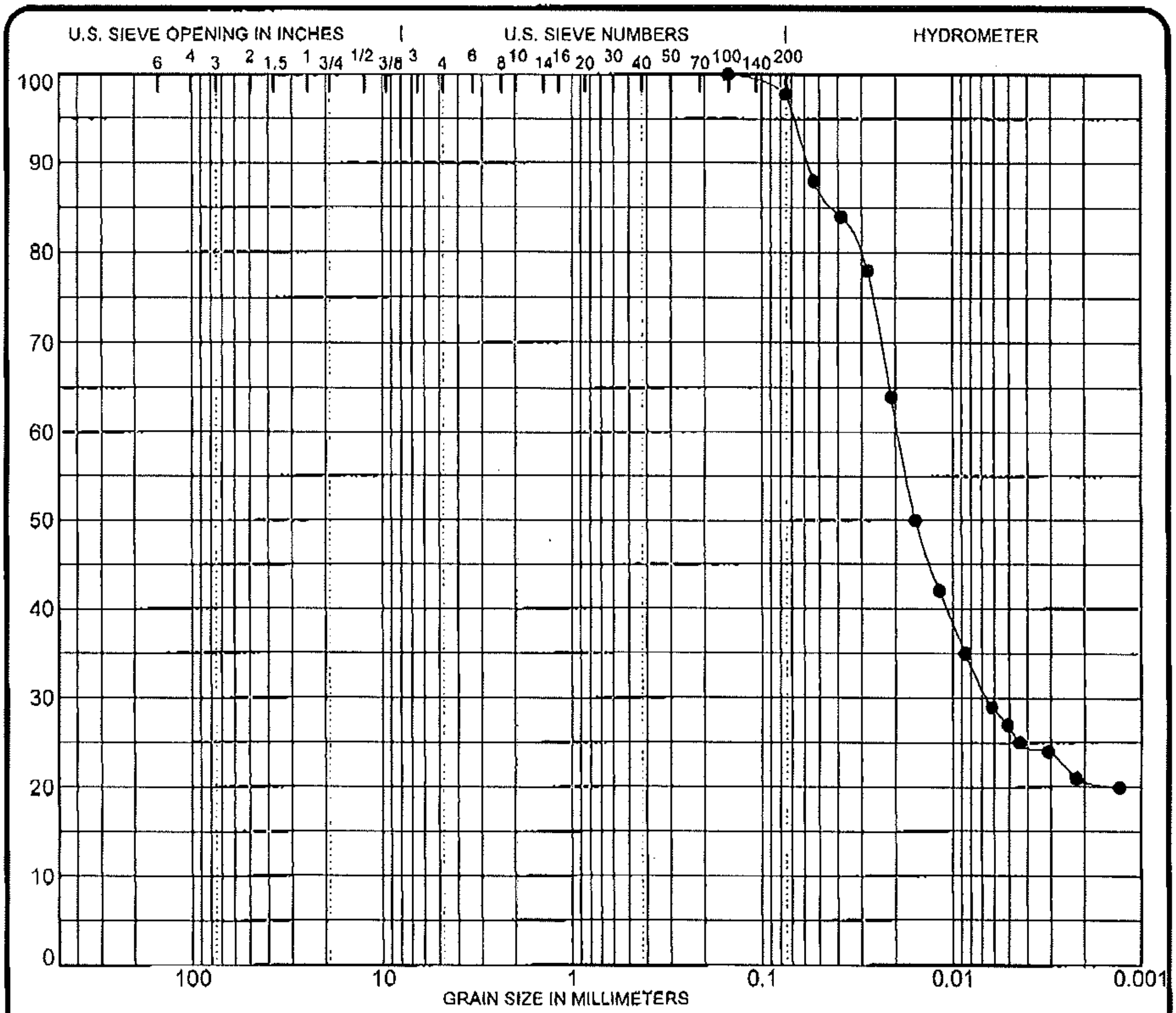
PROJECT Geotechnical Testing
LOCATION ,
SB2

JOB NO. L-76,757
DATE May 20, 2011

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC ALL.GDT 5/20/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION
Boring: SB-2
Sample: B
Depth: 28.0'-29.0
NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	100
# 4	100
# 10	100
# 40	100
# 100	100
# 200	98

SOIL CLASSIFICATION

Dark gray very silty CLAY, trace sand

(CL)

%GRAVEL	%SAND	%SILT	%CLAY
0	2	77	21

MC%		LL	PL	PI
35.1		42	18	24

PROJECT Geotechnical Testing
LOCATION ,

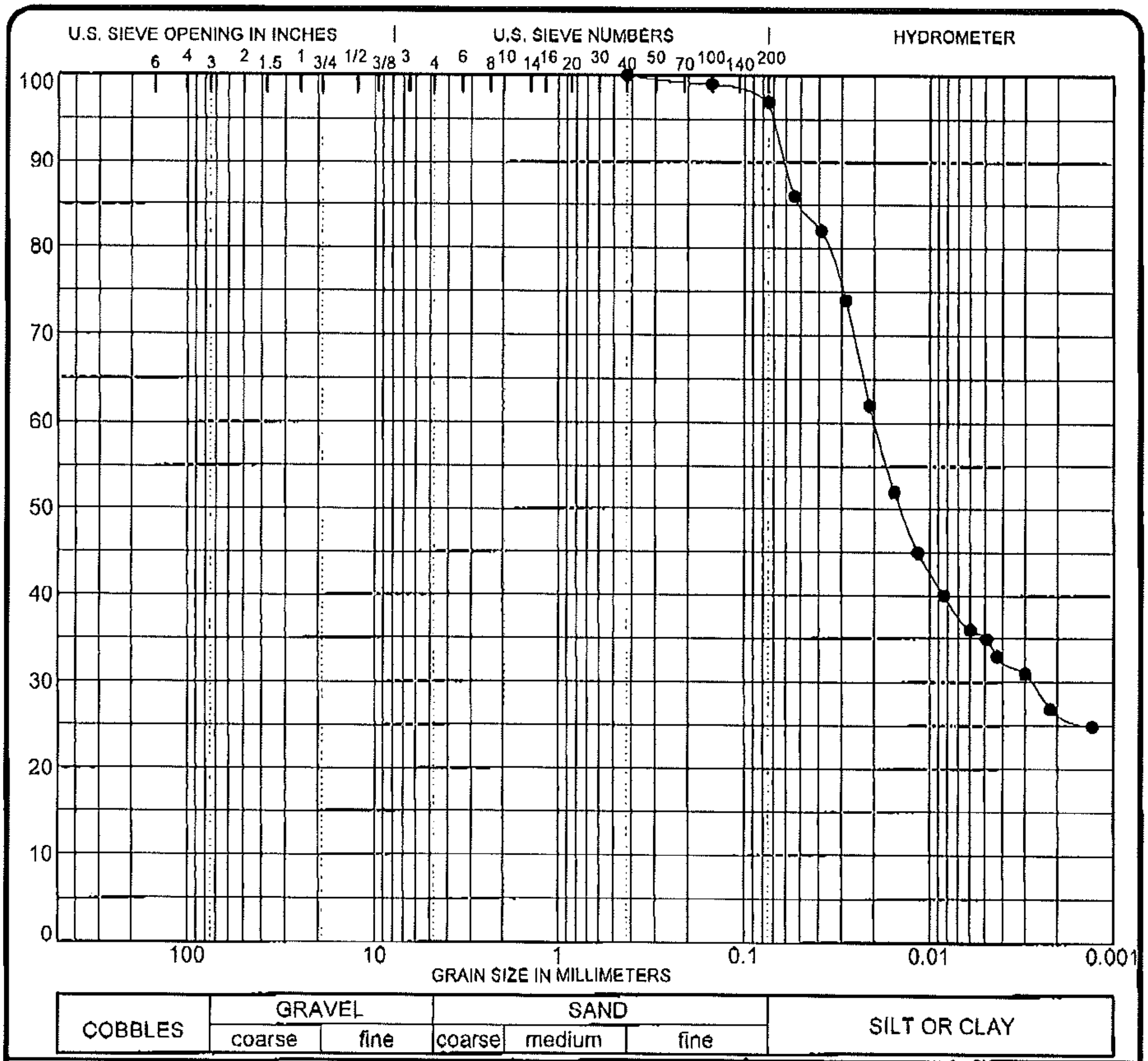
JOB NO. L - 76,757
DATE May 20, 2011

SB2

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/20/11



SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-2	3 inch	100
Sample: C	2	100
Depth: 32.0'	1 1/2	100
	1	100
NOTES:	3/4	100
	3/8	100
	# 4	100
	# 10	100
	# 40	100
	# 100	99
	# 200	97

SOIL CLASSIFICATION

Dark gray silty CLAY, trace sand (CH)

%GRAVEL	%SAND	%SILT	%CLAY
0	3	70	27

MC%		LL	PL	PI
32.9		51	16	35

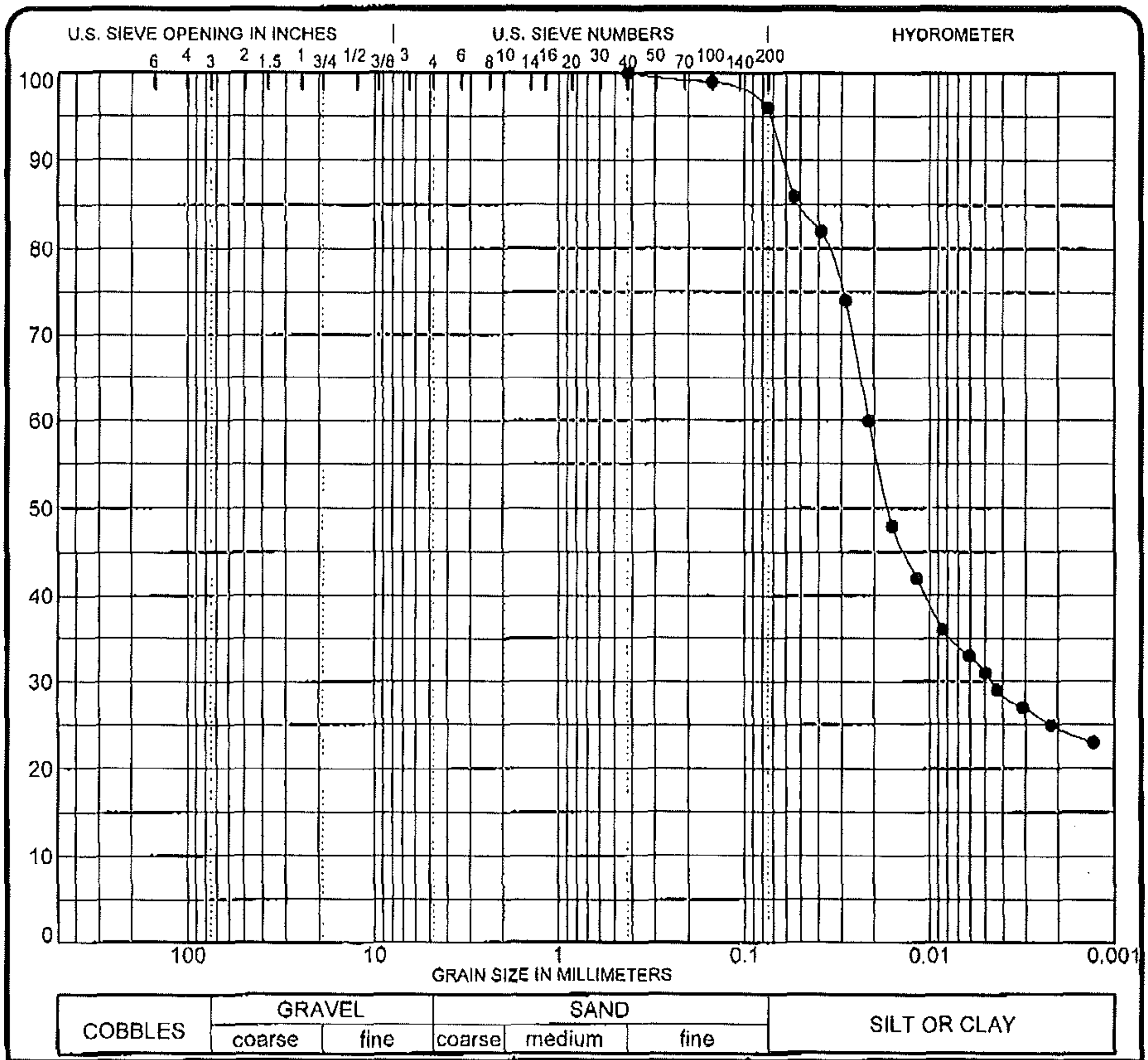
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 20, 2011

SB2

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/20/11



SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-3	3 inch	100
Sample: A	2	100
Depth: 38.0'	1 1/2	100
	1	100
NOTES:	3/4	100
	3/8	100
	# 4	100
	# 10	100
	# 40	100
	# 100	99
	# 200	96

SOIL CLASSIFICATION

Dark gray very silty CLAY, trace sand

(CL)

%GRAVEL	%SAND	%SILT	%CLAY
0	4	71	25

MC%		LL	PL	PI
34.4		46	15	31

PROJECT Geotechnical Testing
LOCATION ,

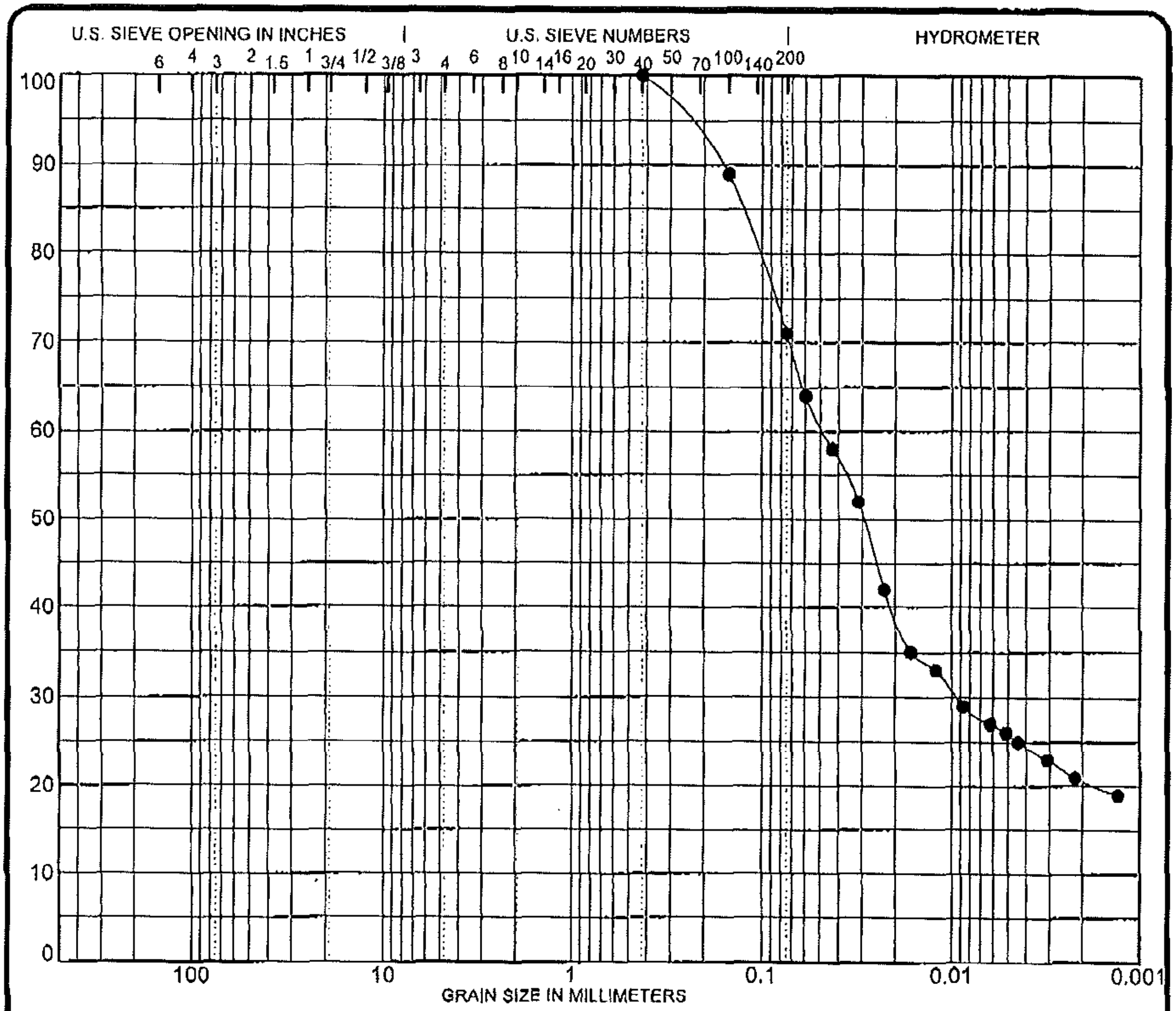
JOB NO. L - 76,757
DATE May 20, 2011

SB3

SOILGENR 76757.GPJ TSC_ALL.GDT 5/20/11

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-4	3 inch	100
Sample: A	2	100
Depth: 34.0'	1 1/2	100
	1	100
NOTES:	3/4	100
	3/8	100
	# 4	100
	# 10	100
	# 40	100
	# 100	89
	# 200	71

SOIL CLASSIFICATION

Dark gray silty CLAY, some sand (CL)

%GRAVEL	%SAND	%SILT	%CLAY
0	29	50	21

MC%		LL	PL	PI
24.1		41	12	29

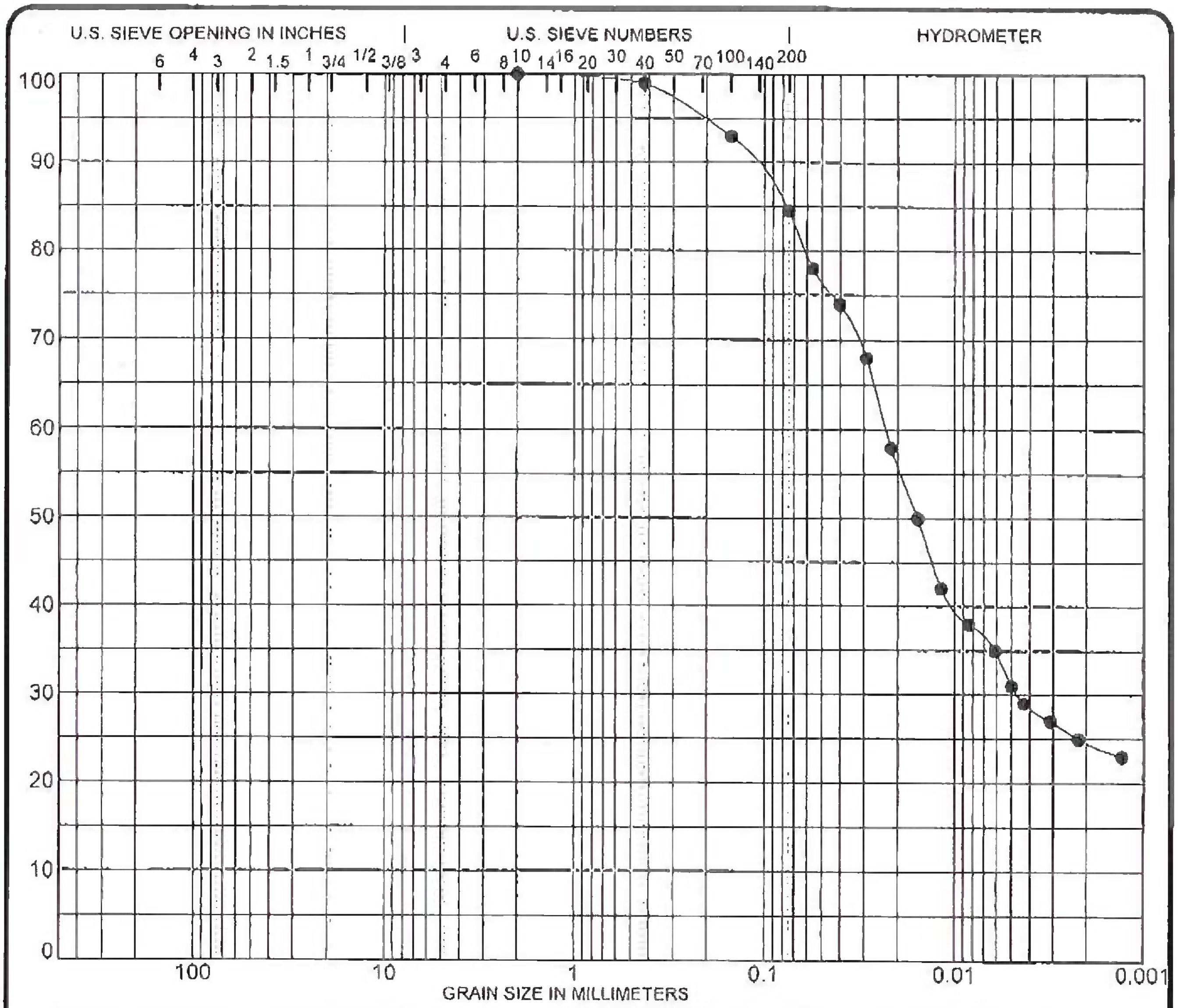
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 20, 2011

SB4

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC ALL.GDT 5/20/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION
Boring: SB-5
Sample: A
Depth: 34.0'

NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	100
# 4	100
# 10	100
# 40	99
# 100	93
# 200	85

SOIL CLASSIFICATION
Gray very silty CLAY, little sand (CL)

%GRAVEL	%SAND	%SILT	%CLAY
0	15	60	25

MC%		LL	PL	PI
23.3		43	16	27

PROJECT Geotechnical Testing
LOCATION ,

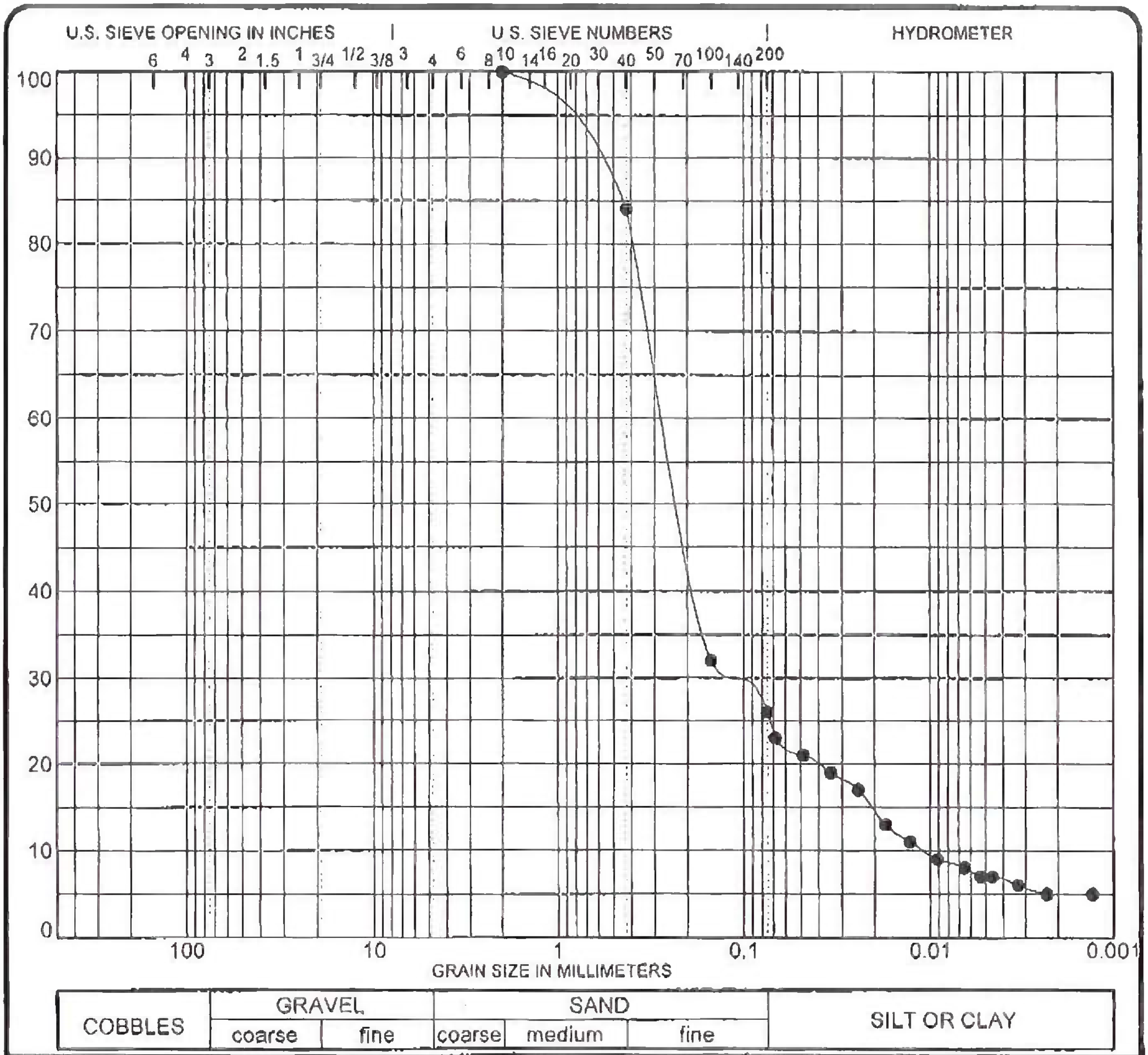
JOB NO. L - 76,757
DATE May 23, 2011

SB5

SOILGENR 76757.GPJ TSC_AL1.GDT 5/23/11

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188



SPECIMEN IDENTIFICATION

Boring: SB-6

Sample: A

Depth: 16.0'-17.0'

NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	100
# 4	100
# 10	100
# 40	84
# 100	32
# 200	26

SOIL CLASSIFICATION

Gray clayey SAND (SC)

%GRAVEL	%SAND	%SILT	%CLAY
0	74	21	5

MC%		LL	PL	PI
24.6		16	13	3

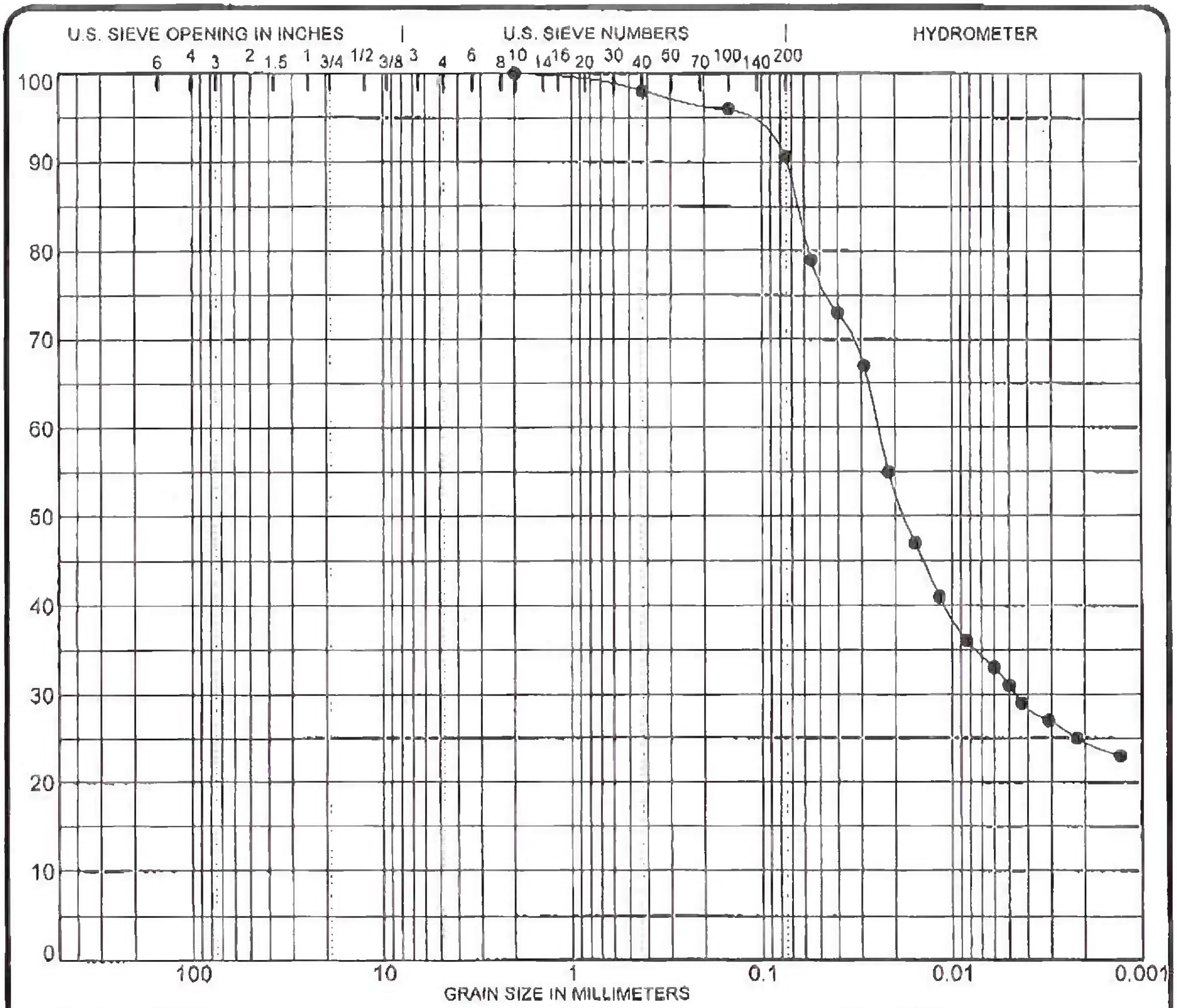
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 23, 2011

SB6

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/23/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-6	3 inch	100
Sample: B	2	100
Depth: 28.0'-29.0'	1 1/2	100
	1	100
NOTES:	3/4	100
	3/8	100
	# 4	100
	# 10	100
	# 40	98
	# 100	96
	# 200	91

SOIL CLASSIFICATION

Brownish gray very silty CLAY, trace sand
(CL)

%GRAVEL	%SAND	%SILT	%CLAY
0	9	66	25

MC%		LL	PL	PI
28.3		43	13	30

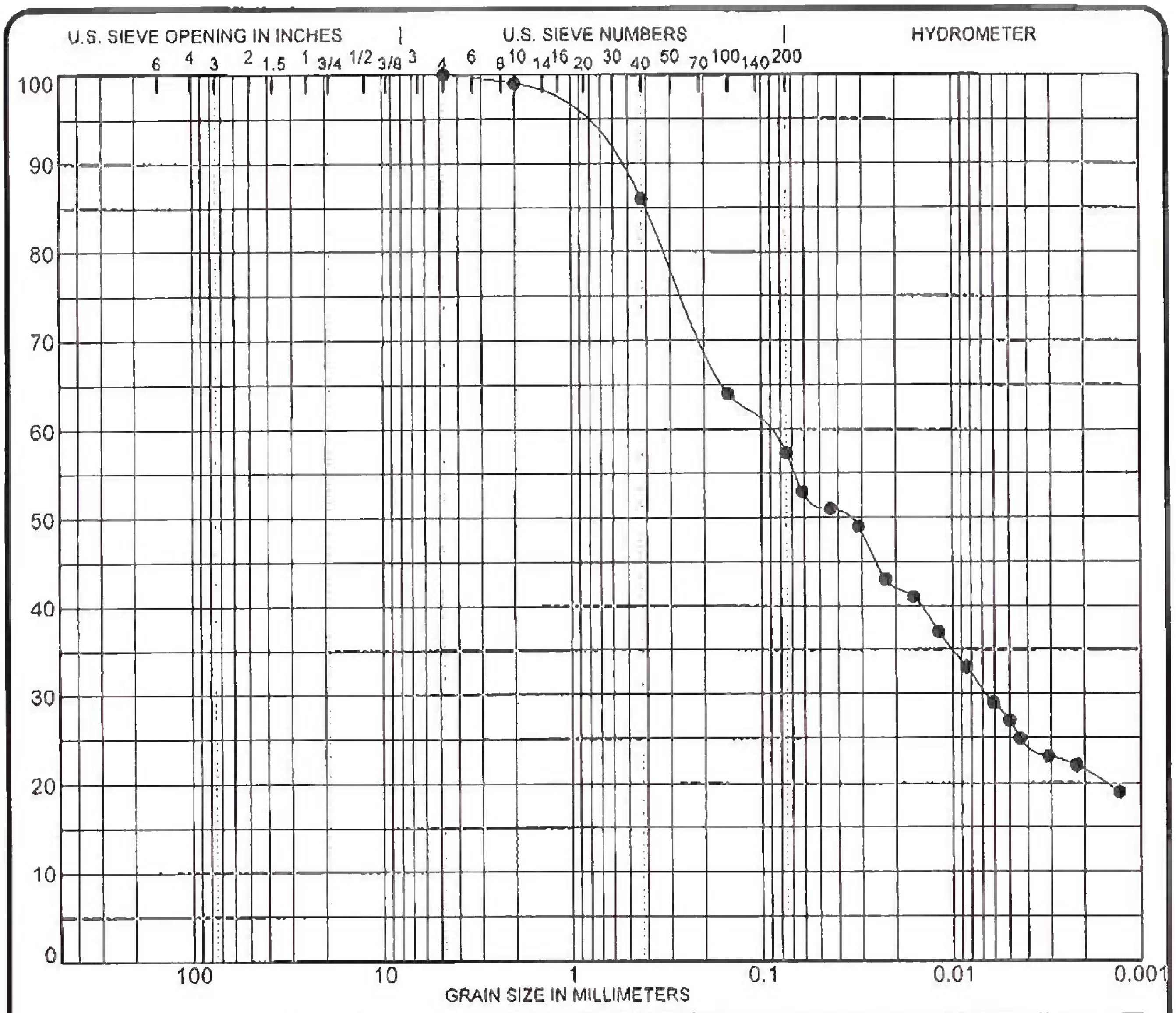
PROJECT Geotechnical Testing
LOCATION ,
SB6

JOB NO. L - 76,757
DATE May 23, 2011

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/23/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-8	3 inch	100
Sample: A	2	100
Depth: 10.0'	1 1/2	100
	1	100
NOTES:	3/4	100
	3/8	100
	# 4	100
	# 10	99
	# 40	86
	# 100	64
	# 200	57

SOIL CLASSIFICATION

Gray sandy CLAY (CL)

%GRAVEL	%SAND	%SILT	%CLAY
0	43	36	21

MC%		LL	PL	PI
21.6		36	12	24

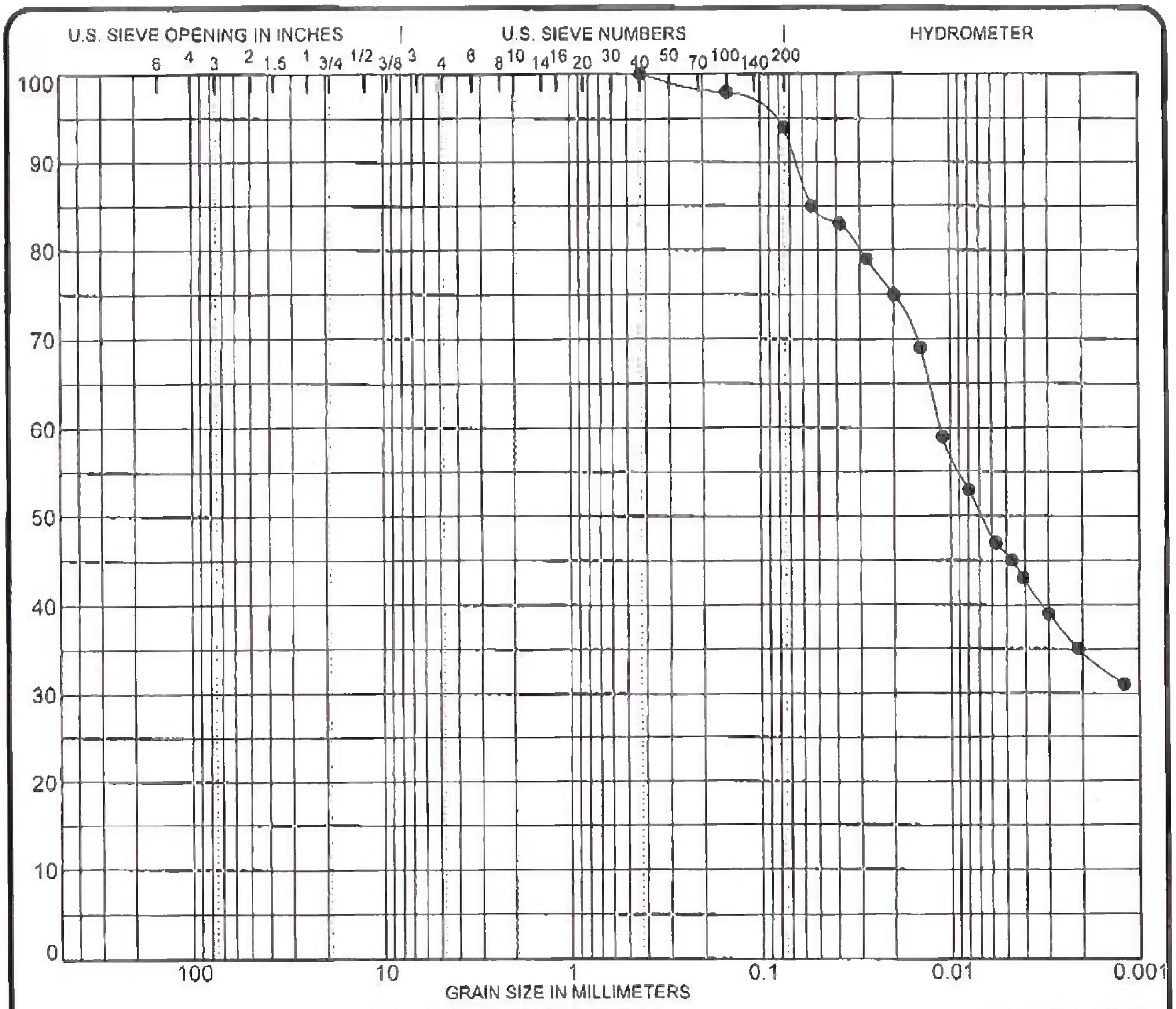
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 23, 2011

SB8

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/23/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION
Boring: SB-8
Sample: B
Depth: 20.0'
NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	100
# 4	100
# 10	100
# 40	100
# 100	98
# 200	94

SOIL CLASSIFICATION				
Gray very silty CLAY, trace sand (CL)				
%GRAVEL	%SAND	%SILT	%CLAY	
0	6	59	35	
MC%		LL	PL	PI
31.1		56	19	37

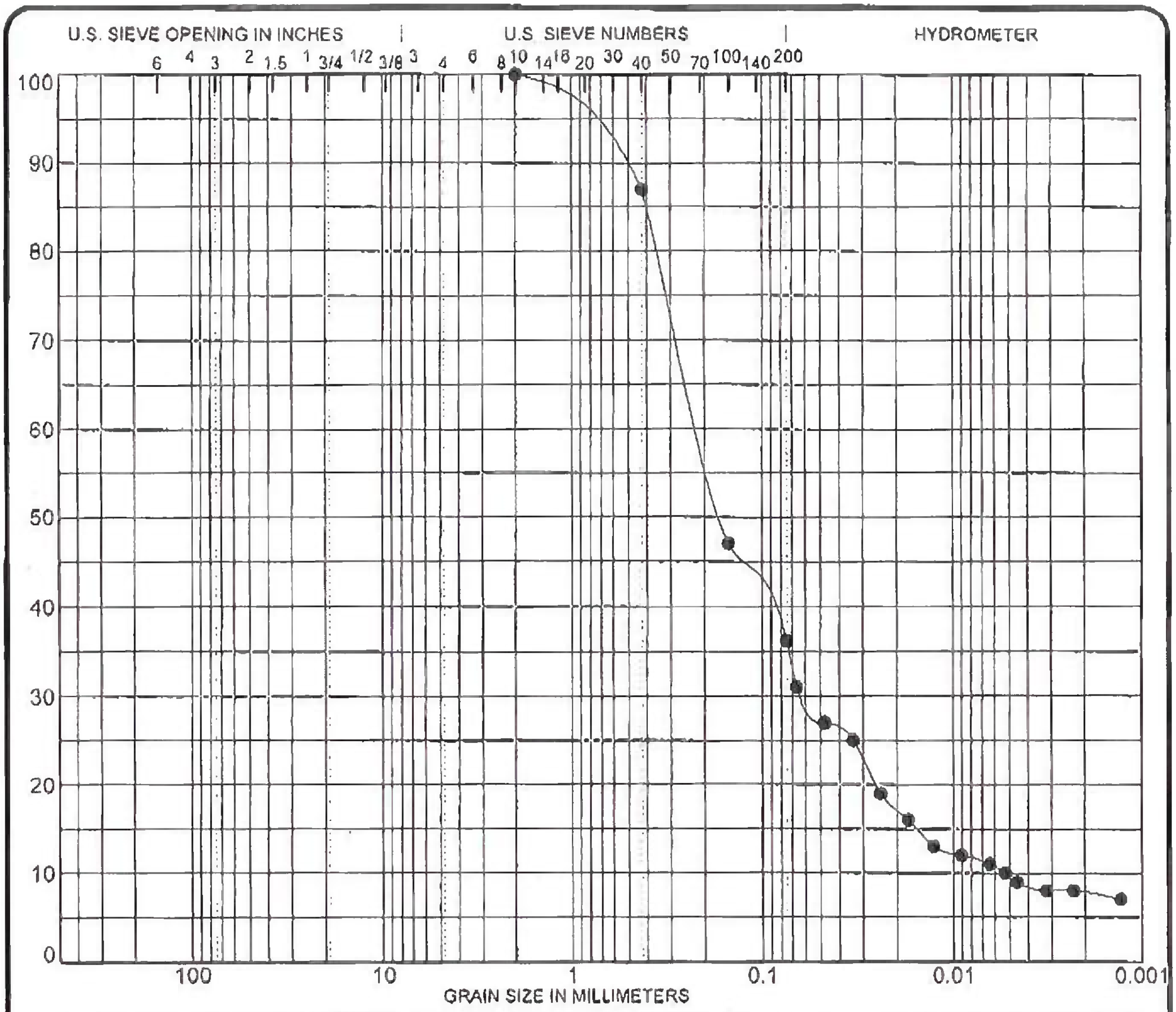
PROJECT Geotechnical Testing
LOCATION ,

JOB NO. L - 76,757
DATE May 23, 2011

SB8

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188



<table>
<tr><td rowspan="2">COBBLES</td><td colspan="2">GRAVEL</td><td colspan="3">SAND</td><td rowspan="2">SILT OR CLAY</td></tr>
<tr><td>coarse</td><td>fine</td><td>coarse</td><td>medium</td><td>fine</td></tr>
</table>

SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-8	3 inch	100
Sample: C	2	100
Depth: 22.0'	1 1/2 "	100
	1	100
NOTES:	3/4	100
	3/8	100
	# 4	100
	# 10	100
	# 40	87
	# 100	47
	# 200	36

SOIL CLASSIFICATION

Gray clayey SAND (SC)

%GRAVEL	%SAND	%SILT	%CLAY
0	64	28	8

MC%		LL	PL	PI
26.9		21	13	8

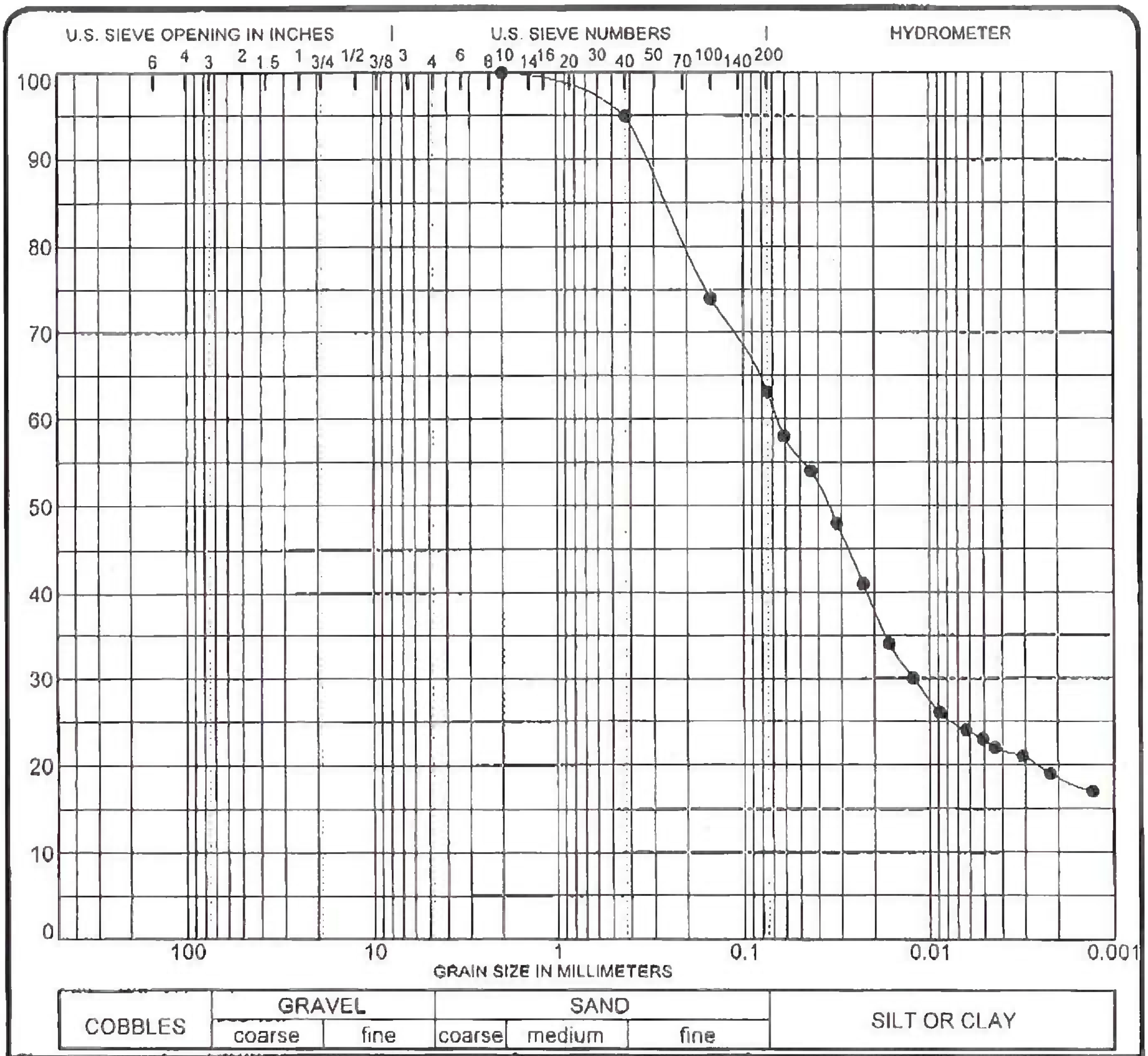
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 23, 2011

SB8

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/23/11



SPECIMEN IDENTIFICATION	SIEVE	% PASS	SOIL CLASSIFICATION				
Boring: SB-9	3 inch	100	Brownish gray sandy CLAY (CL)				
Sample: A	2	100					
Depth: 18.0'	1 1/2	100					
	1	100	%GRAVEL	%SAND	%SILT	%CLAY	
NOTES:	3/4	100	0	37	44	19	
	3/8	100					
	# 4	100	MC%		LL	PL	PI
	# 10	100	34.0		35	13	22
	# 40	95					
	# 100	74					
	# 200	63					

PROJECT Geotechnical Testing
LOCATION ,

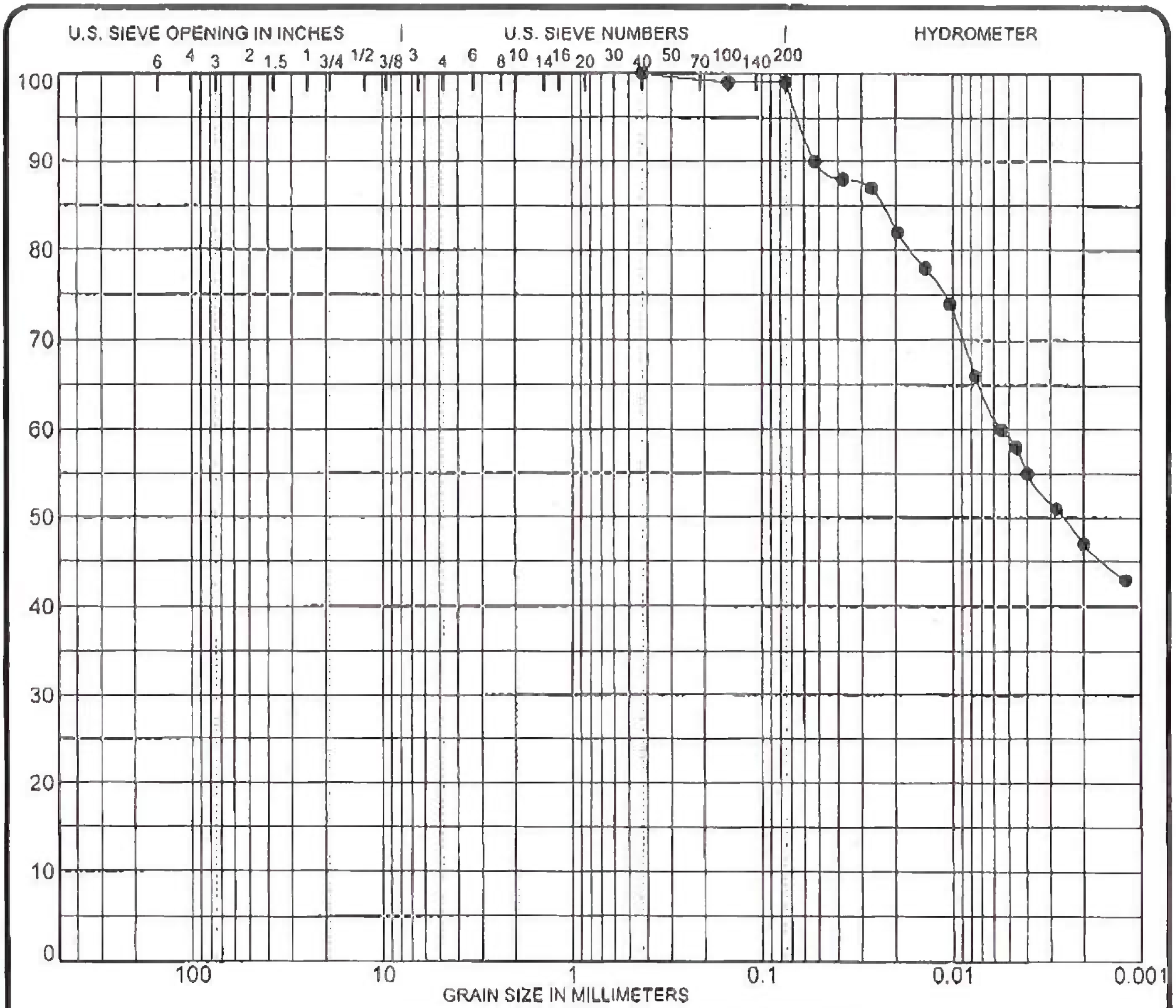
JOB NO. L - 76,757
DATE May 23, 2011

SB9

SOILGENR 76757.GPJ TSC_ALL.GDT 5/23/11

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-10	3 inch	100
Sample: A	2	100
Depth: 20.0'	1 1/2	100
	1	100
NOTES:	3/4	100
	3/8	100
	# 4	100
	# 10	100
	# 40	100
	# 100	99
	# 200	99

SOIL CLASSIFICATION

Brownish gray silty CLAY, trace sand

(CH)

%GRAVEL	%SAND	%SILT	%CLAY
0	1	52	47

MC%		LL	PL	PI
26.9		74	15	59

PROJECT Geotechnical Testing
LOCATION ,

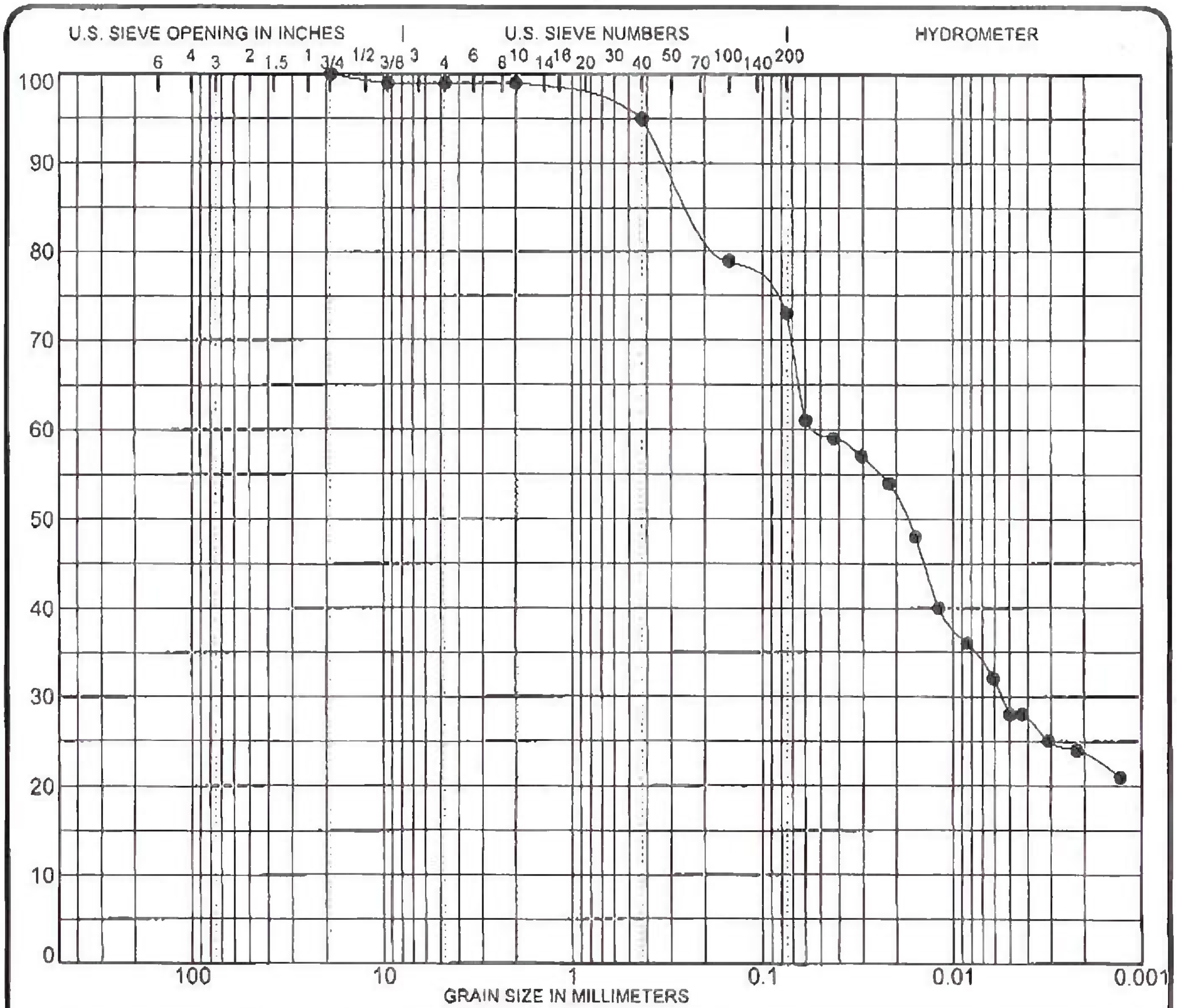
JOB NO. L - 76,757
DATE May 23, 2011

SB10

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC_ALL.GDT 5/23/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION

Boring: SB-12

Sample: A

Depth: 23.0'-24.0'

NOTES:

SIEVE	% PASS
3 inch	100
2	100
1 1/2	100
1	100
3/4	100
3/8	99
# 4	99
# 10	99
# 40	95
# 100	79
# 200	73

SOIL CLASSIFICATION

Gray silty CLAY, some sand, trace gravel

(CL)

%GRAVEL	%SAND	%SILT	%CLAY
1	26	50	23

MC%		LL	PL	PI
35.9		42	16	26

PROJECT Geotechnical Testing
LOCATION ,

JOB NO. L - 76,757
DATE May 23, 2011

SB12

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC ALL.GDT 5/23/11

APPENDIX E – Earthquake and Liquefaction Analysis

Alliant Energy
Interstate Power and Light Company
Burlington Generating Station
Burlington, Iowa

Safety Factor Assessment

IPL Burlington Generating Station
Generalized Soil Profile

Soils Data for the Burlington Generating Station Includes the following information:

1. Nine soil borings installed in 1962 by Raymond Drilling for design of the foundations of the power plant
2. Ten soil borings installed by RDnP in 2008 for planning of air pollution control equipment installation in Ash Seal Pond area near plant
3. Twelve soil borings and CPT probes from May 2011

a. The borings for #1 and #2 are focused on the area of the power plant and extend to refusal on or near the bedrock surface of the river valley.
b. The borings for #1 and #2 include measurement of soil density by standard split spoon blowcount.
c. The borings of #3 are focused on the embankments of the CCR ponds and the underlying soft clay terminating at the surface of the medium dense sand found in the borings of #1 and #3
d. The borings of #3 for the economizer pond measure the strength and liquefaction potential of the fly ash using a cone penetrometer.

Generalized Soil Profile Based on Soil Boring Information

	Contact Elevation						
	Ground	Ground Contact	Soft Clay	Medium Dense Sand		Very Dense Sand	Rock
Ash Seal Pond	534	Clay	520	510		470	450
Main Ash Pond	534	Clay	520	510		470	450
Economizer Pond	548	Fly Ash	520	510		470	450
Upper Ash Pond	531	Clay	520	510		470	450

`

Generalized Soil Profile Soil Strength/Density

	N	S_u (psf)	Source:
Very Dense Sand	70		Boring BH-B-1
Medium Dense Sand	25		Boring BH-B-1
Soft Clay		600	Embankment SB borings
Medium Stiff Clay		800	Embankment SB borings
CCR	6		CPT-1 Economizer Pond

Site Classification IBC 2009 Section 1613.5.5

Weight N_{ch} = 32 deep sands Site Class D
Weighted s_u = 700 psf Site Class E
N_{ccr} = 6 Site Class E

	Thickness (ft)		% of Class		Combined F_{pga}	Surface
	Class D	Class E	Class D	Class E		PGA
Clay Embankments	60	24	71%	29%	1.86	0.100
Economizer Pond	60	38	61%	39%	1.95	0.105

PGA Site Coefficient Table 11.8-1 for PGA<0.1 on bedrock
Bedrock PGA based on 2% probability in 50 Years USGS = 0.054 g

Site Class D = 1.6
Site Class E = 2.5

Simplified Seed and Idriss Liquefaction Analysis
CPT Based Analysis CPT1
Burlington Generating Station
Interstate Electric Power

Input Parameters:

Peak Ground Acceleration (g) =	0.105
Earthquake Magnitude, M =	7.7
Water Table Depth (m) =	6.1
Average Soil Density above water table (kN/m^3) =	18.0
Average Soil Density below water table (kN/m^3) =	19.0

Computed Constants:

Magnitude Scaling Factor =	0.95

Depth (m)	Tip $q_{cn\ (kPa)}$	$F_{sn\ (kPa)}$	σ_{vc} (kPa)	σ_{vc}' (kPa)	Q_t	F_r	I_c	Flag	Fines (%)	C_n	q_{c1N}	q_{c1N-cs}	r_D	CSR	k_σ for sand	CRR M=7.5 & 1 atm	CRR	Factor of Safety
0.75	54	0.6	14	14	403.0	1.11	1.53	U	10	1.70	91.6	104.4	1.00	0.068	1.10	0.150	n.a.	n.a.
2.25	12	0.2	41	41	28.9	1.72	2.48	U	10	1.70	19.7	27.3	0.99	0.068	1.05	0.060	n.a.	n.a.
3.75	32	0.26	68	68	46.9	0.83	2.13	U	10	1.32	41.5	50.6	0.98	0.067	1.03	0.078	n.a.	n.a.
5.25	32	0.59	95	95	33.2	1.90	2.46	U	50	1.06	32.8	74.7	0.96	0.066	1.01	0.106	n.a.	n.a.
6.75	32	0.39	122	116	26.9	1.27	2.43		80	0.89	27.5	66.9	0.95	0.068	0.99	0.096	0.090	1.32
8.25	15	0.39	151	130	10.5	2.89	2.97		80	0.78	10.5	44.1	0.93	0.074	0.98	0.072	0.067	0.91
9.75	10	0.19	179	143	5.8	2.31	3.14	Clay	1	0.70	n.a.	n.a.	0.91	0.078	0.89	n.a.	n.a.	n.a.

water pressures, so the dis
accompanied by densificat
available experimental da
for sands and silty sands i
would increase rapidly as
relationship can be repres

$$\frac{S_r}{\sigma'_{vo}} = \exp\left(\frac{(N_1)_{60c}}{16}\right.$$

$$\times\left(1 + \exp\left(\right.\right.$$

The lower relations
in which the effects of
would include sites wit
that are overlain by lowe
post-earthquake dissipat
ter pressures. In this ca
water beneath the lower
loosening, strength loss
films (Whitman 1985).
following equation:

IDRISS & BOULANGER
CHAPTER 4

$q_{c1N_{cs-Sr}}$ = 54 kPa

σ'_{vc} = 130 kPa

S_r/σ'_{vc} = 0.05

S_r = 0.05(130 kPa)
= 6.5 kPa
≃ 100 psf

$$\frac{S_r}{\sigma'_{vo}} = \exp\left(\frac{(N_1)_{60cs-Sr}}{16} + \left(\frac{(N_1)_{60cs-Sr} - 16}{21.2}\right)^3 - 3.0\right) \le \tan\phi' \qquad (81)$$

The potential role of void redistribution or other strength loss mechanisms in the case histories is not fully clear at this time. Physical and analytical models indicate that void redistribution is potentially most severe for loose sands and is likely to have played a role in many of the currently available case histories. This would suggest that the two design relationships should be somewhat different at the lower penetration resistances, but the current state of knowledge does not provide a basis for incorporating any difference at this time.

Similar relationships for a CPT-based evaluation of S_r/σ'_{vc} are shown in Figure 90, along with the same case histories that were used to develop the SPT-based relationship in Figure 89. For many of the case histories, it was necessary to convert available SPT data into CPT data via a combination of empirical correlations (e.g., Suzuki et al. 1998, Cubrinovski and Ishihara 1999, Salgado et al. 1997b),

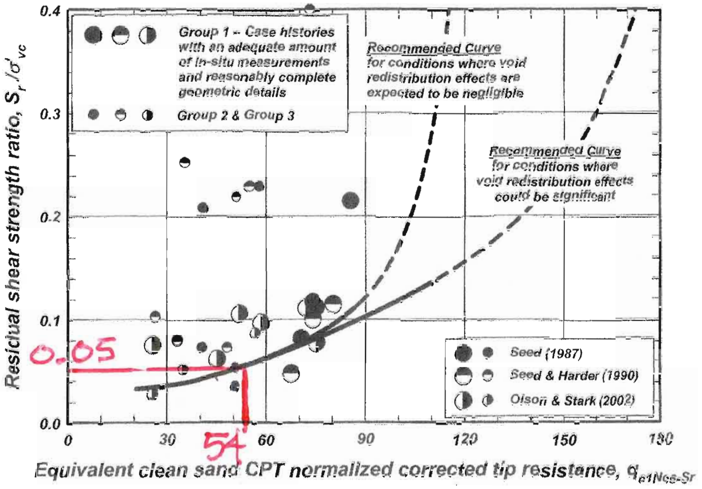


Figure 90. Correlation between the normalized residual shear strength ratio for liquefied soils and overburden-corrected CPT penetration resistance (σ'_{vc} < 400 kPa).

as described in Idriss and Boulanger (2007). CPT penetration resistances were then adjusted to equivalent clean-sand values by using the Δq_{c1N} values in Table 5, which were derived for consistency with the SPT corrections recommended by Seed (1987). The recommended relationships for S_r/σ'_{vc} can be calculated as

$$\frac{S_r}{\sigma'_{vo}} = \exp\left(\frac{q_{c1Ncs-Sr}}{24.5} - \left(\frac{q_{c1Ncs-Sr}}{61.7}\right)^2 + \left(\frac{q_{c1Ncs-Sr}}{106}\right)^3 - 4.42\right)$$

$$\le \tan\phi' \qquad (82)$$

Table 5 Approximate values of Δq_{c1N-Sr} for CPT correlation with residual strengths.

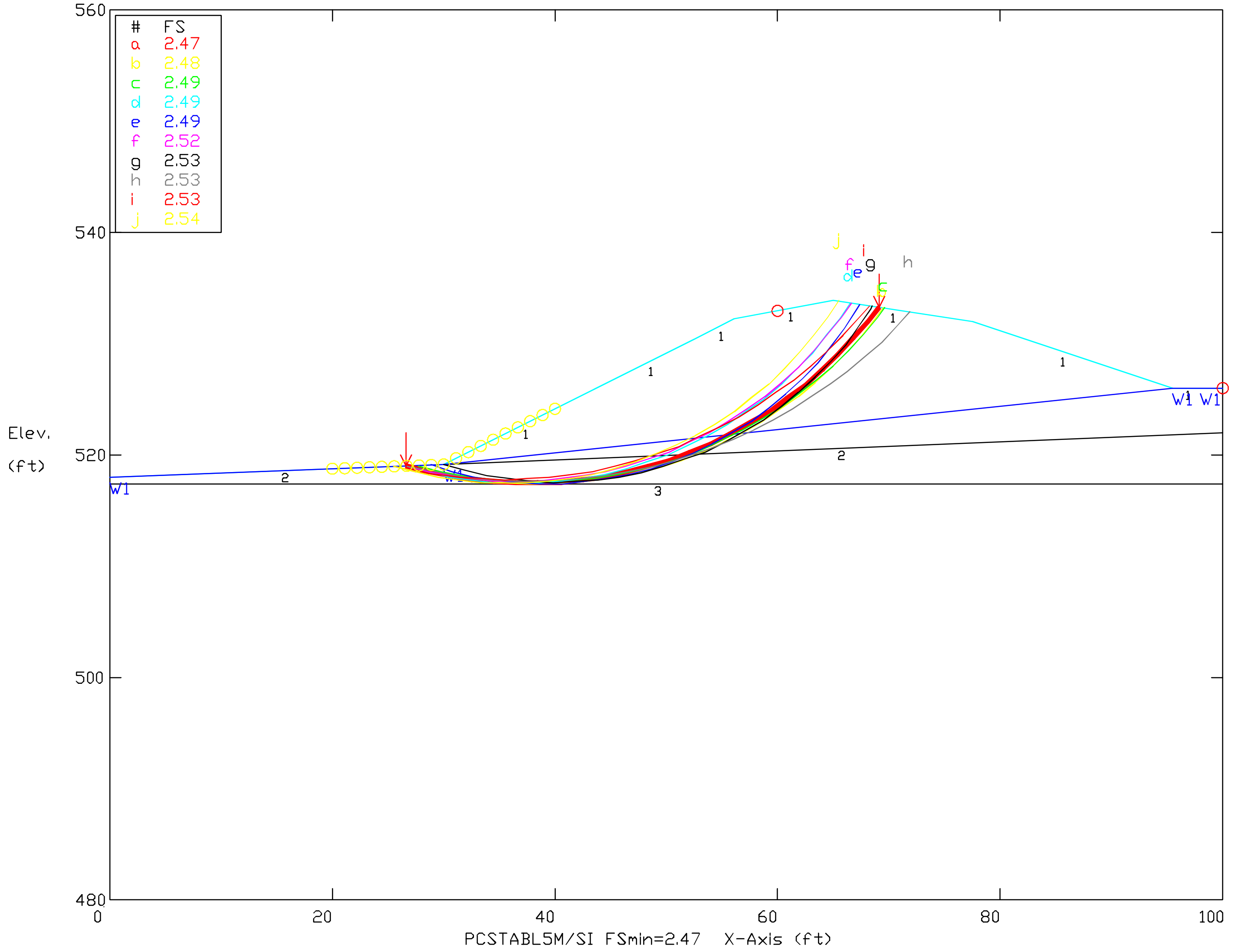
Fines content (% passing No. 200 sieve)	Δq_{c1N-Sr}
10	10
25	25
50	45
75	55

APPENDIX F – Slope Stability Analysis

Alliant Energy
Interstate Power and Light Company
Burlington Generating Station
Burlington, Iowa

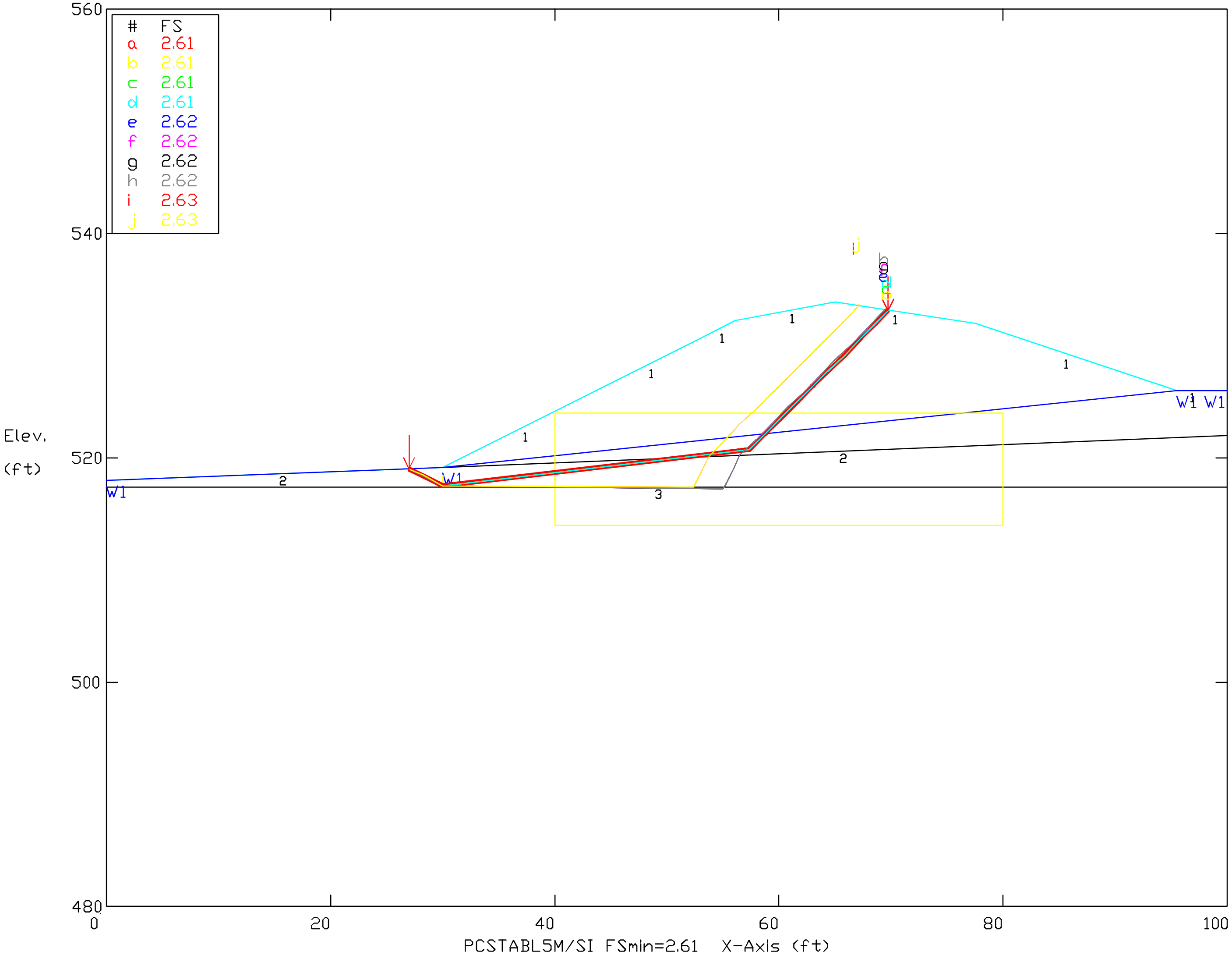
Safety Factor Assessment

BSG - Ash Seal Pond South Dike Static Case & Normal Water Level
Ten Most Critical. E:BSG50C.PLT 04-26-16 11:22am



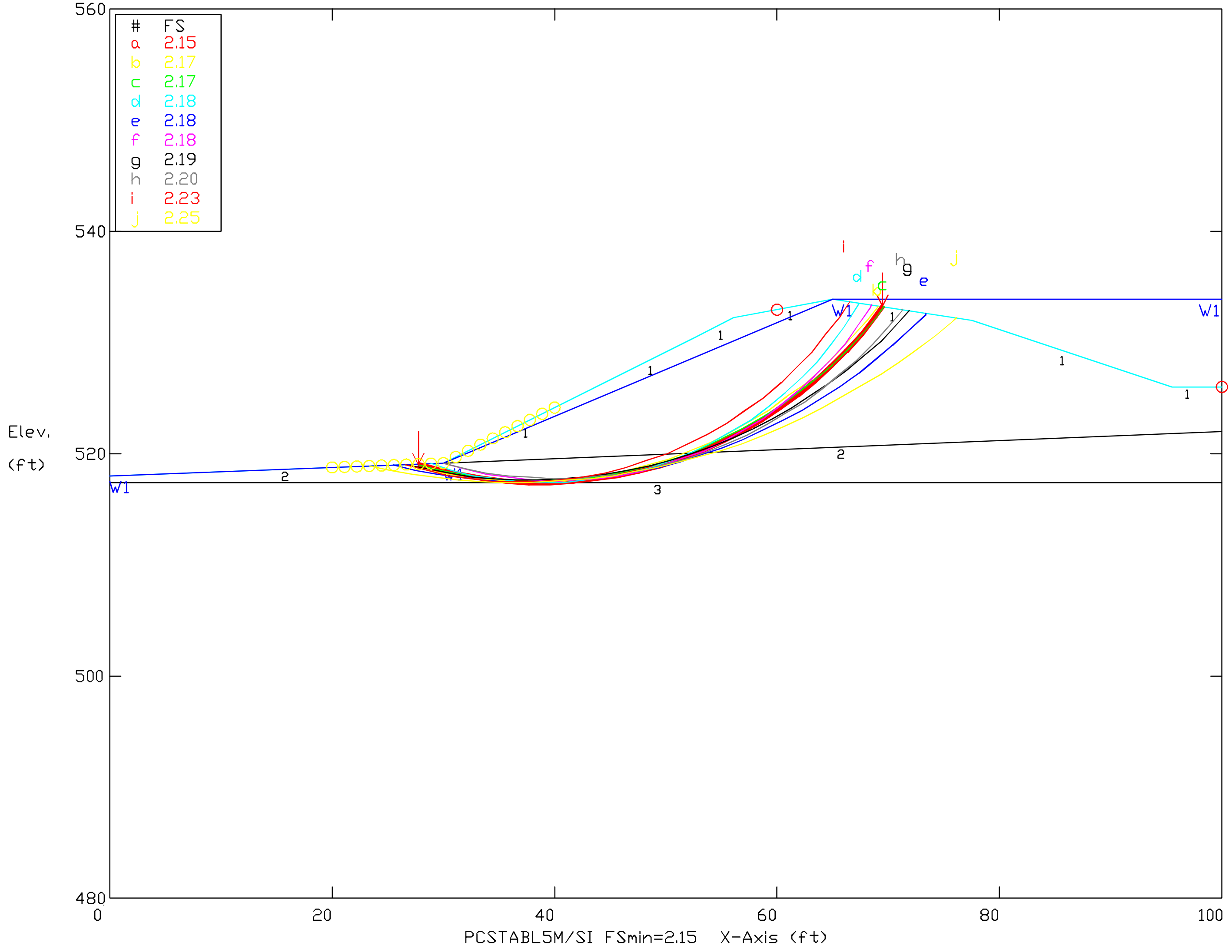
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Clay	120	120	700	0	0	0	W1
2 Sand	130	130	0	37	0	0	W1
3 Clay	125	125	900	0	0	0	W1

BSG - Ash Seal Pond South Dike Static Case & Normal Water Level
Ten Most Critical. E:BSG50B.PLT 04-26-16 10:53am



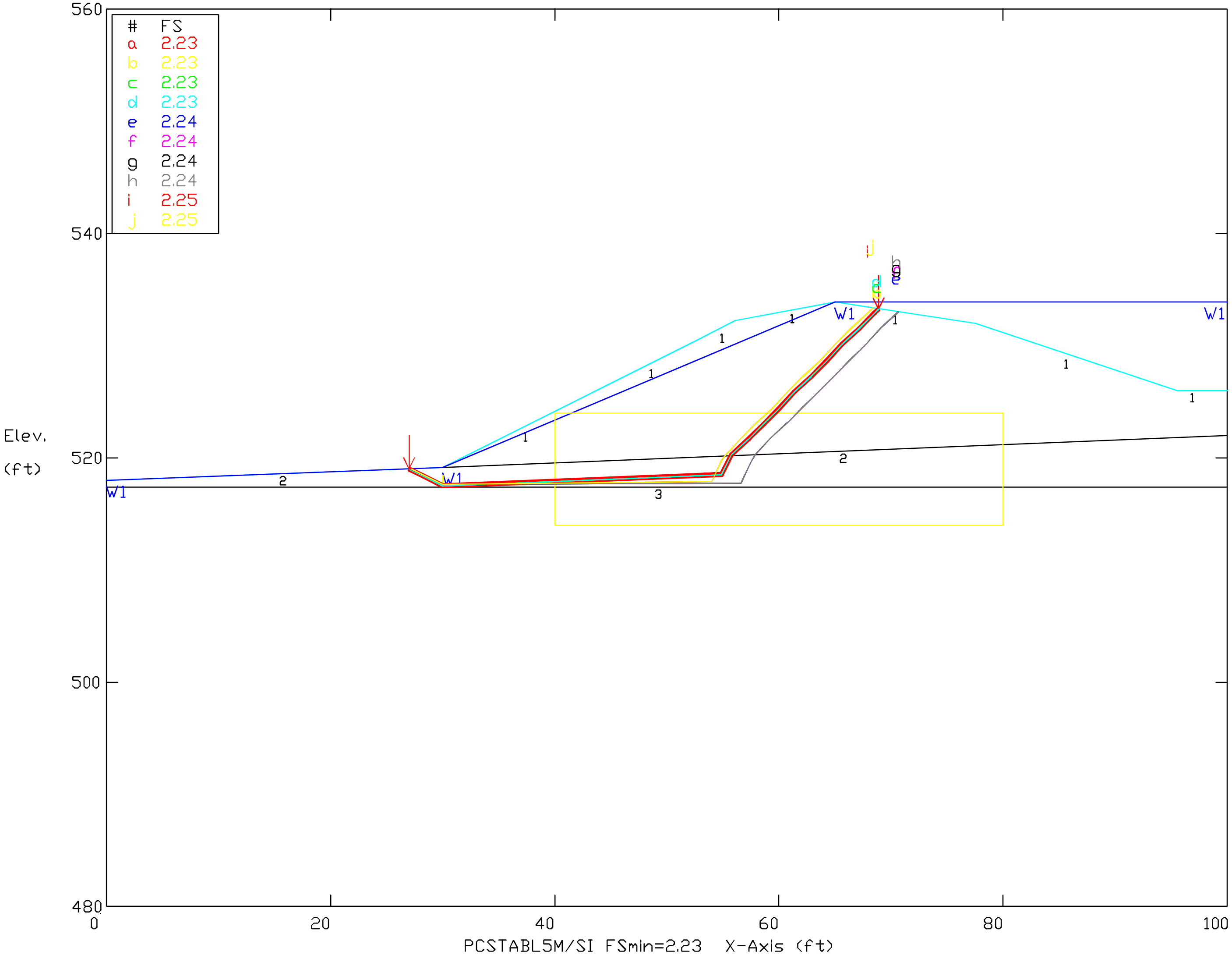
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	120	120	700	0	0	0	W1
2	Sand	130	130	0	37	0	0	W1
3	Clay	125	125	900	0	0	0	W1

BSG - Ash Seal Pond South Dike Static Case with High Water Level
Ten Most Critical. E:BSG50CW.PLT 04-26-16 11:15am



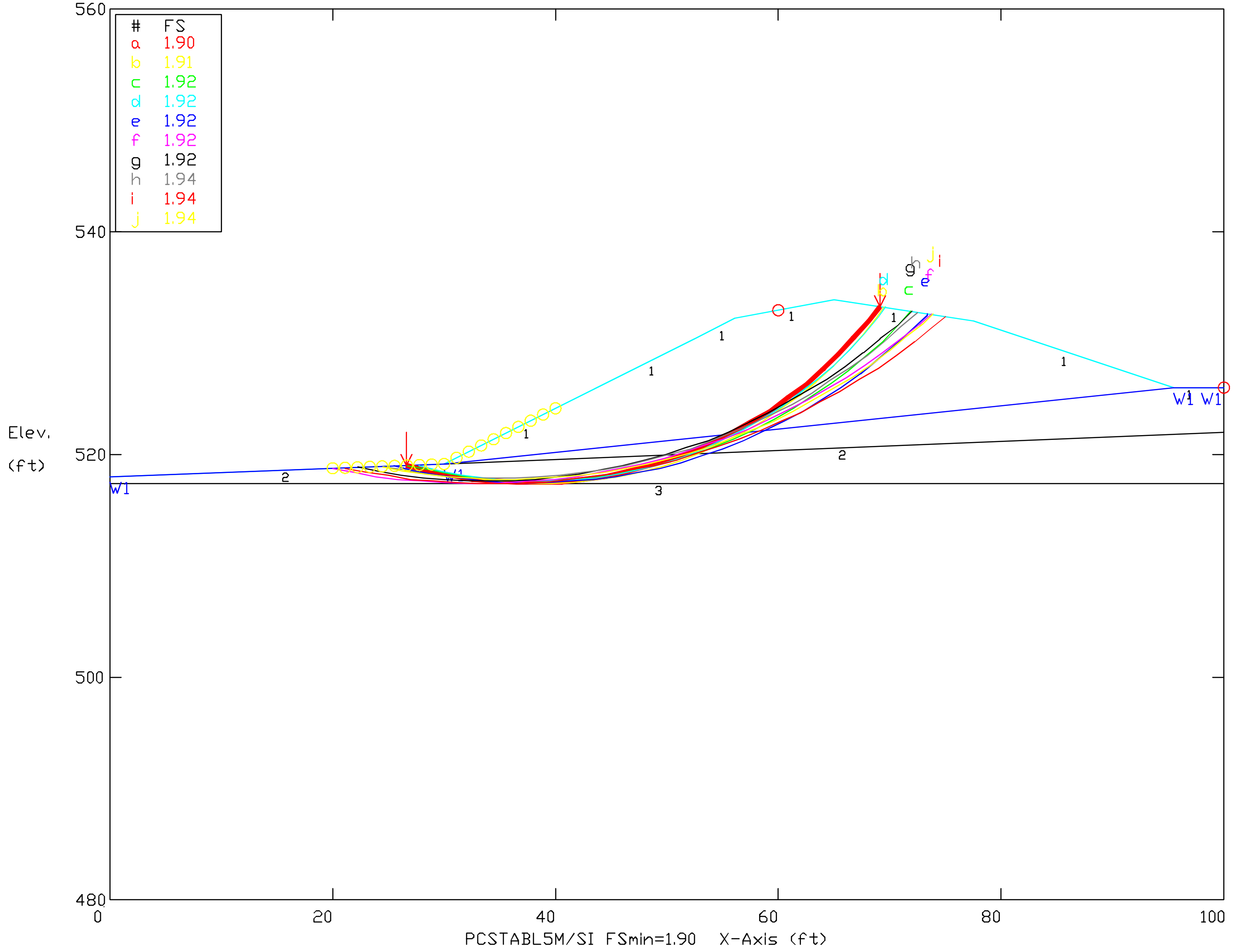
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Clay	120	120	700	0	0	0	W1
2 Sand	130	130	0	37	0	0	W1
3 Clay	125	125	900	0	0	0	W1

BSG - Ash Seal Pond South Dike Static Case with High Water Level
Ten Most Critical. E:BSG50BW.PLT 04-26-16 11:18am



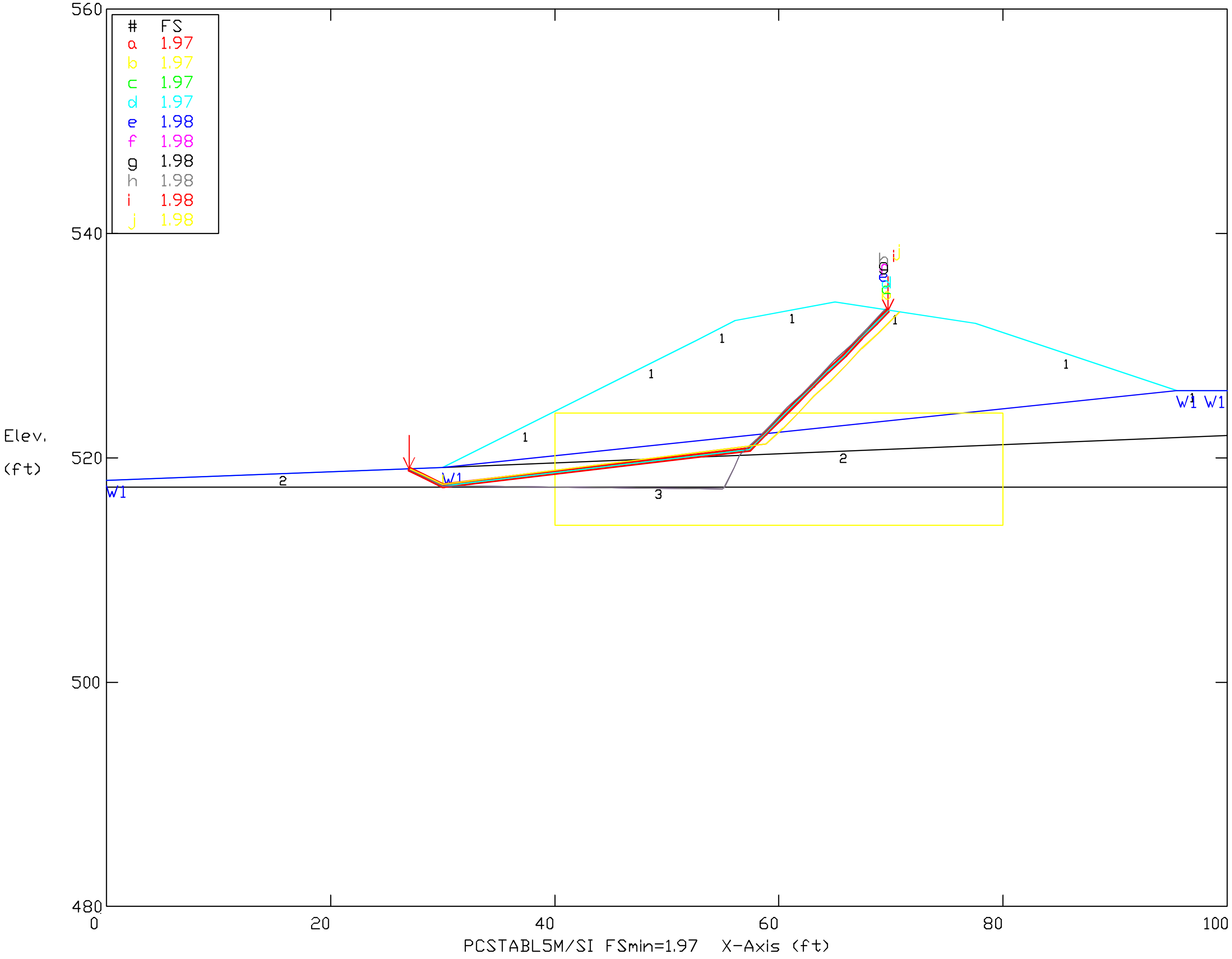
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Clay	120	120	700	0	0	0	W1
2 Sand	130	130	0	37	0	0	W1
3 Clay	125	125	900	0	0	0	W1

BSG - Ash Seal Pond South Dike EQ Case (0.105 & -0.070) & Normal Water
Ten Most Critical. E:BSG50CEQ.PLT 04-26-16 10:56am



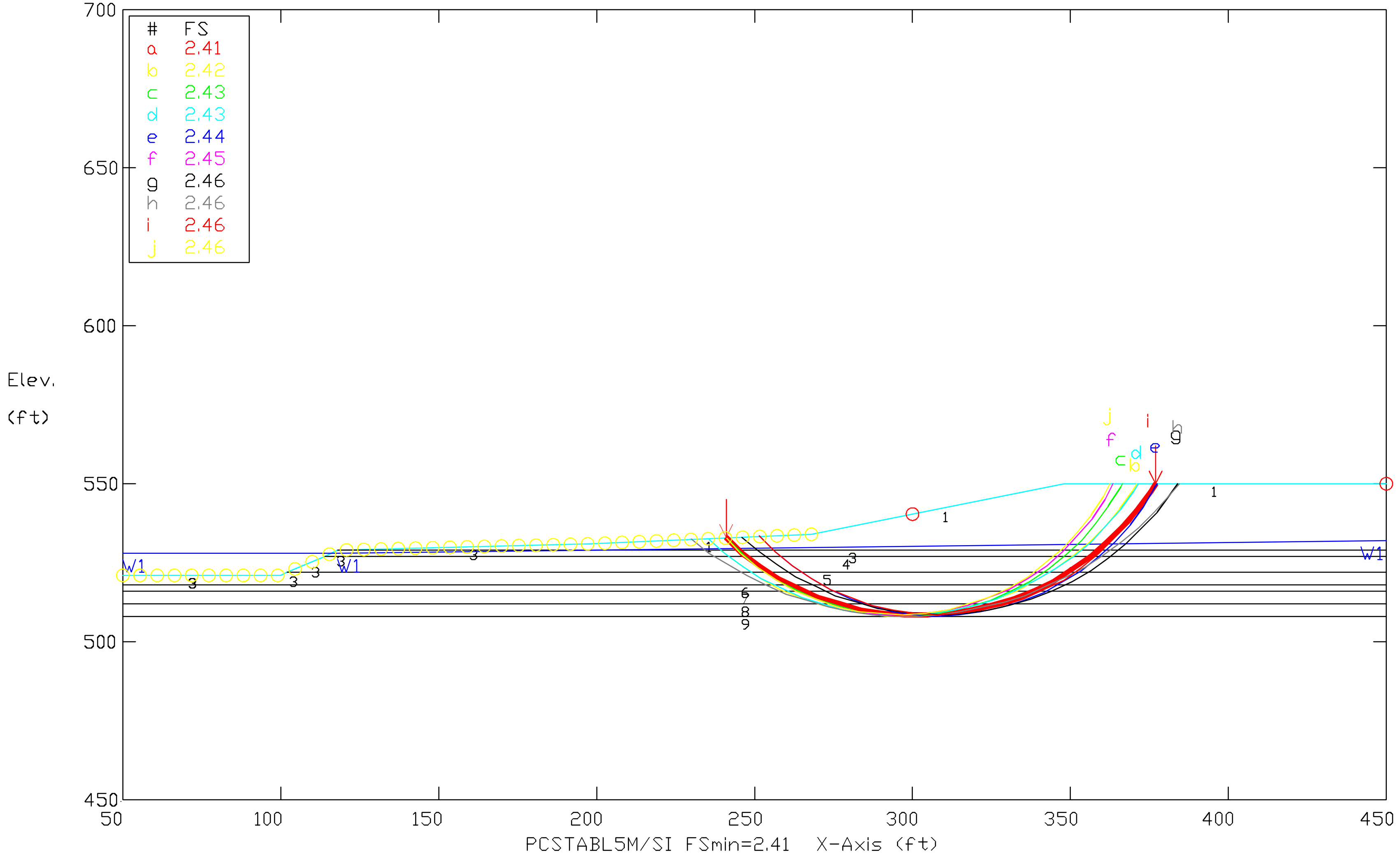
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Clay	120	120	700	0	0	0	W1
2 Sand	130	130	0	37	0	0	W1
3 Clay	125	125	900	0	0	0	W1

BSG - Ash Seal Pond South Dike EQ Case (0.105 & -0.070) & Normal Water
Ten Most Critical. E:BSG50BEQ.PLT 04-26-16 10:59am



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Clay	120	120	700	0	0	0	W1
2 Sand	130	130	0	37	0	0	W1
3 Clay	125	125	900	0	0	0	W1

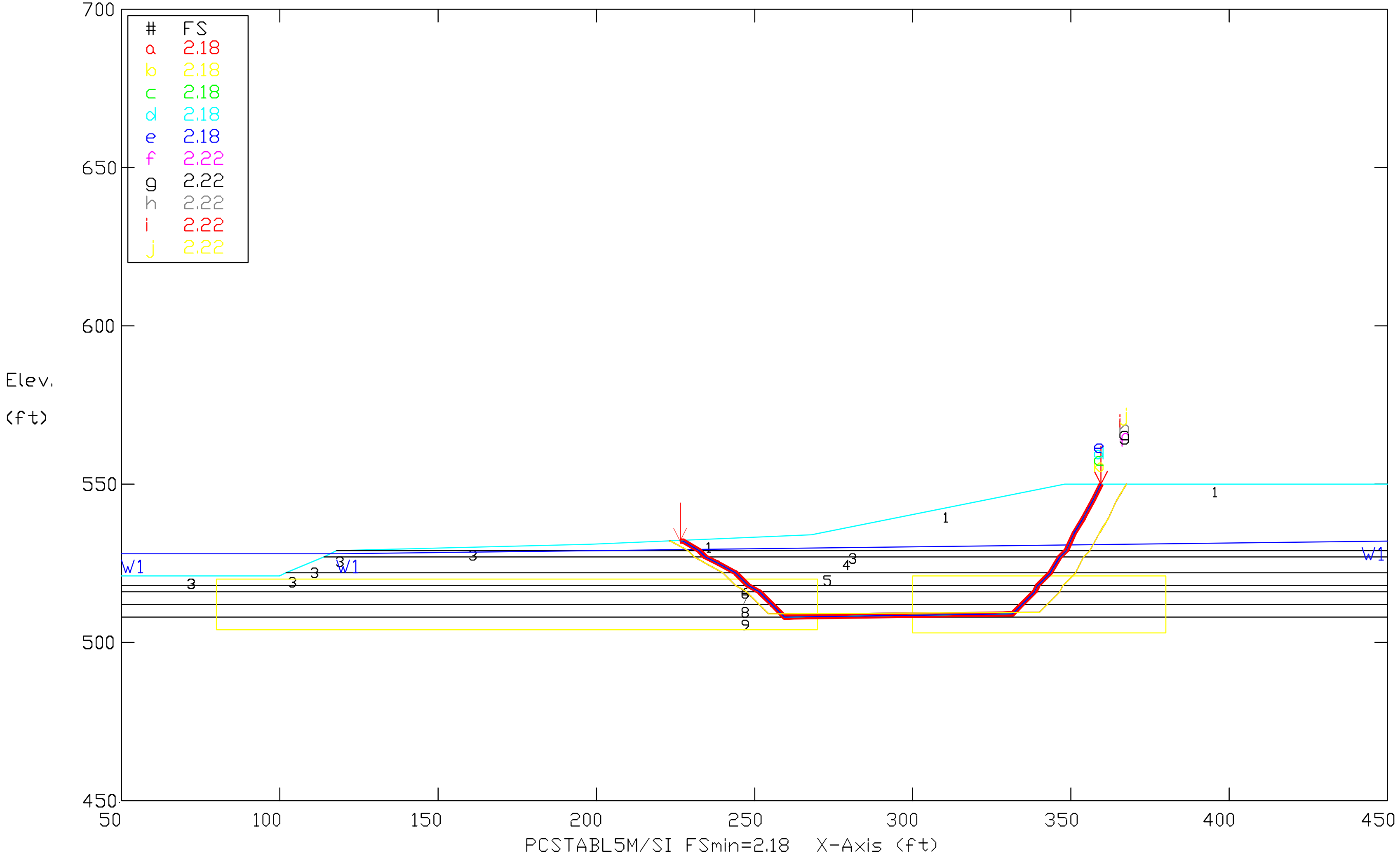
BSG - Economizer Pond North Eastern Sec. As Rebuilt, Static Case & Normal Pond
Ten Most Critical. E:BGS00C.PLT 04-24-16 3:04pm



Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	DIKE	125	125	0	34	0	0	W1
2	ASH	120	120	0	34	0	0	W1
3	CLAY	125	125	1000	0	0	0	W1
4	ASH	120	120	0	32	0	0	W1
5	CLAY	125	125	1000	0	0	0	W1
6	ASH	120	120	0	32	0	0	W1
7	CLAY	125	125	600	0	0	0	W1
8	CLAY	125	125	600	0	0	0	W1
9	SAND	125	125	0	30	0	0	W1

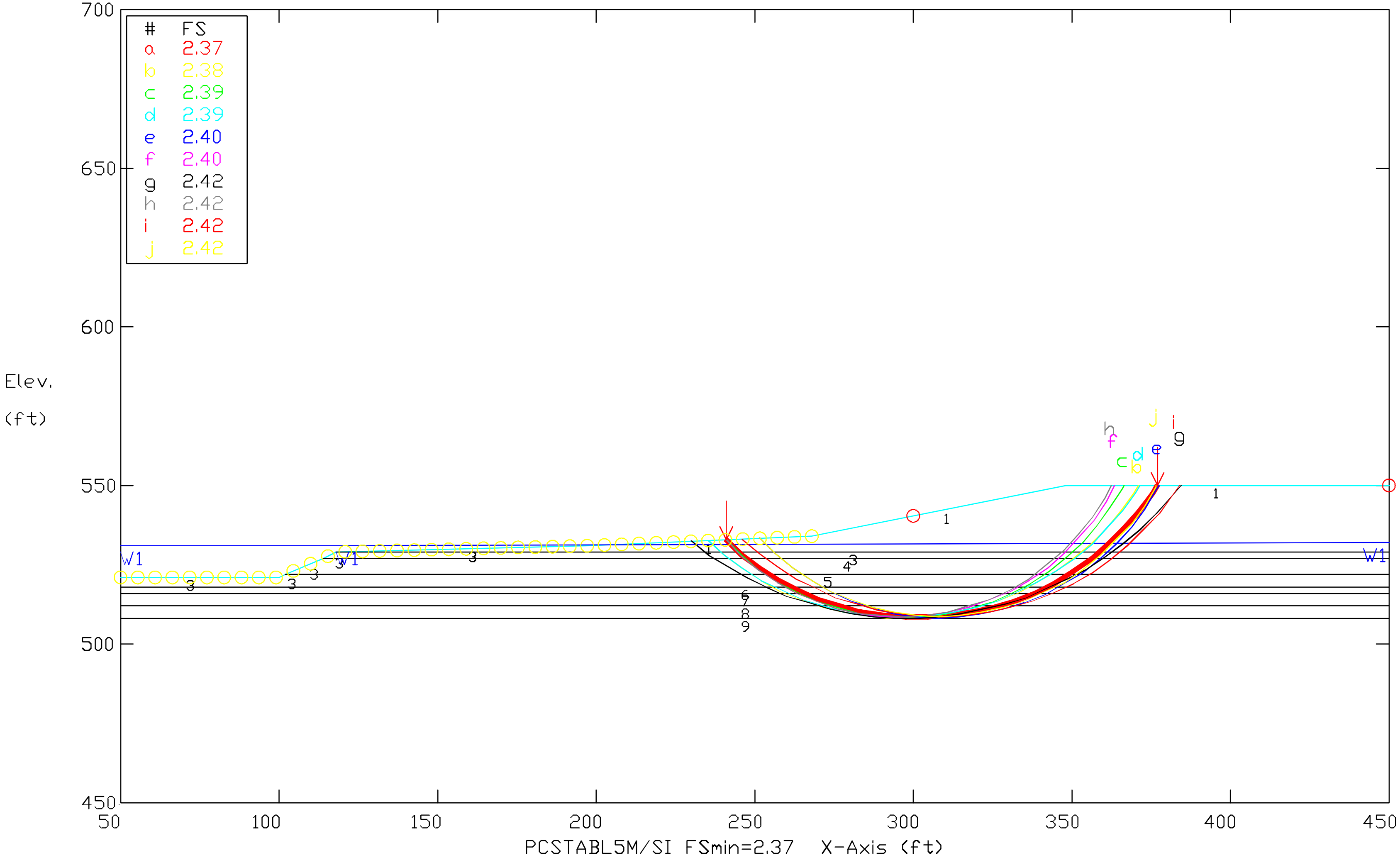
BSG - Economizer Pond North Eastern Sec. As Rebuilt, Static Case & Normal Pond

Ten Most Critical. E:BGS00B.PLT 04-24-16 2:56pm



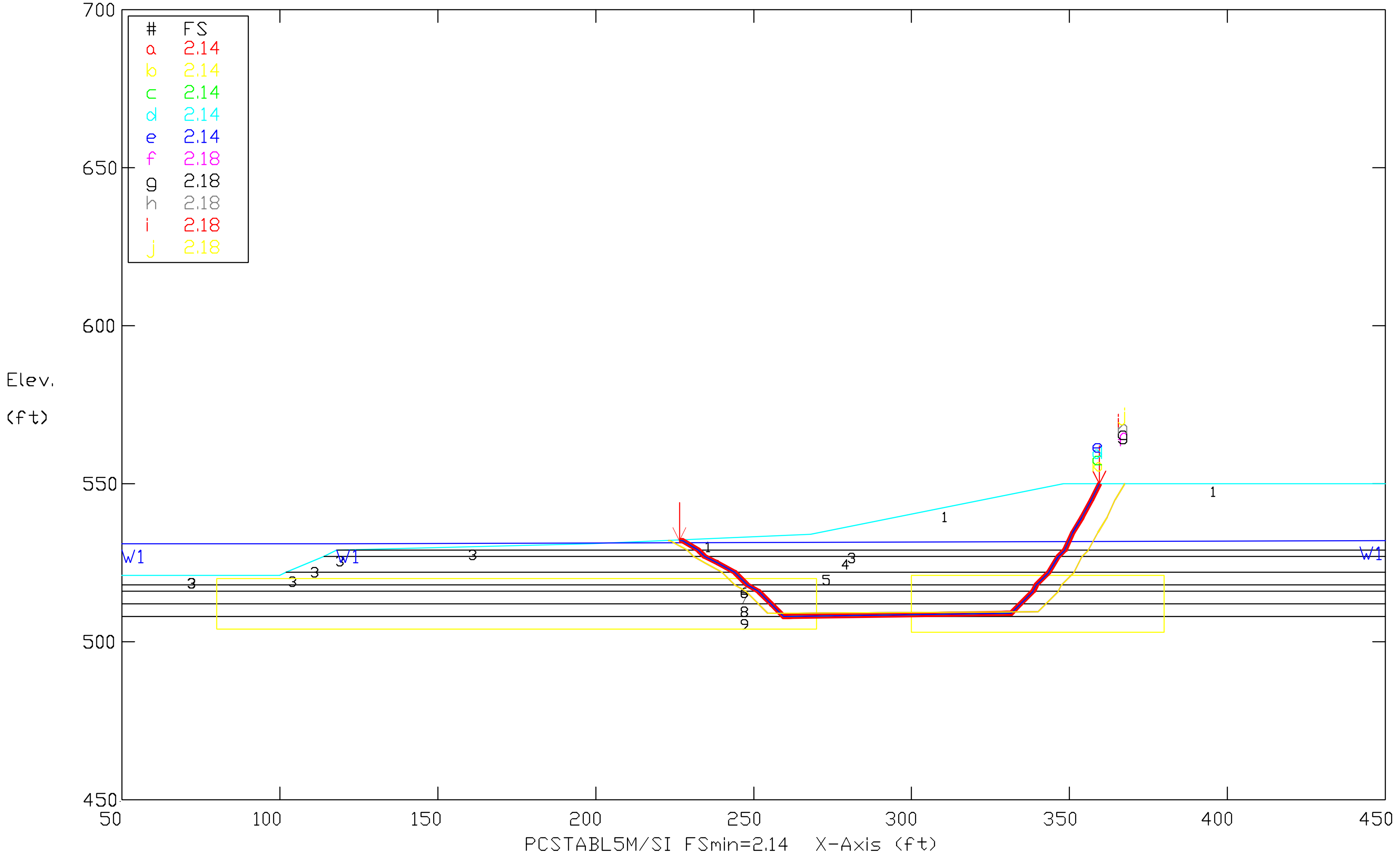
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	DIKE	125	125	0	34	0	0	W1
2	ASH	120	120	0	34	0	0	W1
3	CLAY	125	125	1000	0	0	0	W1
4	ASH	120	120	0	32	0	0	W1
5	CLAY	125	125	1000	0	0	0	W1
6	ASH	120	120	0	32	0	0	W1
7	CLAY	125	125	600	0	0	0	W1
8	CLAY	125	125	600	0	0	0	W1
9	SAND	125	125	0	30	0	0	W1

BSG - Economizer Pond North Eastern Sec. As Rebuilt, Static Case & Pond @ 531'
Ten Most Critical. E:BGS00CW.PLT 04-24-16 3:09pm



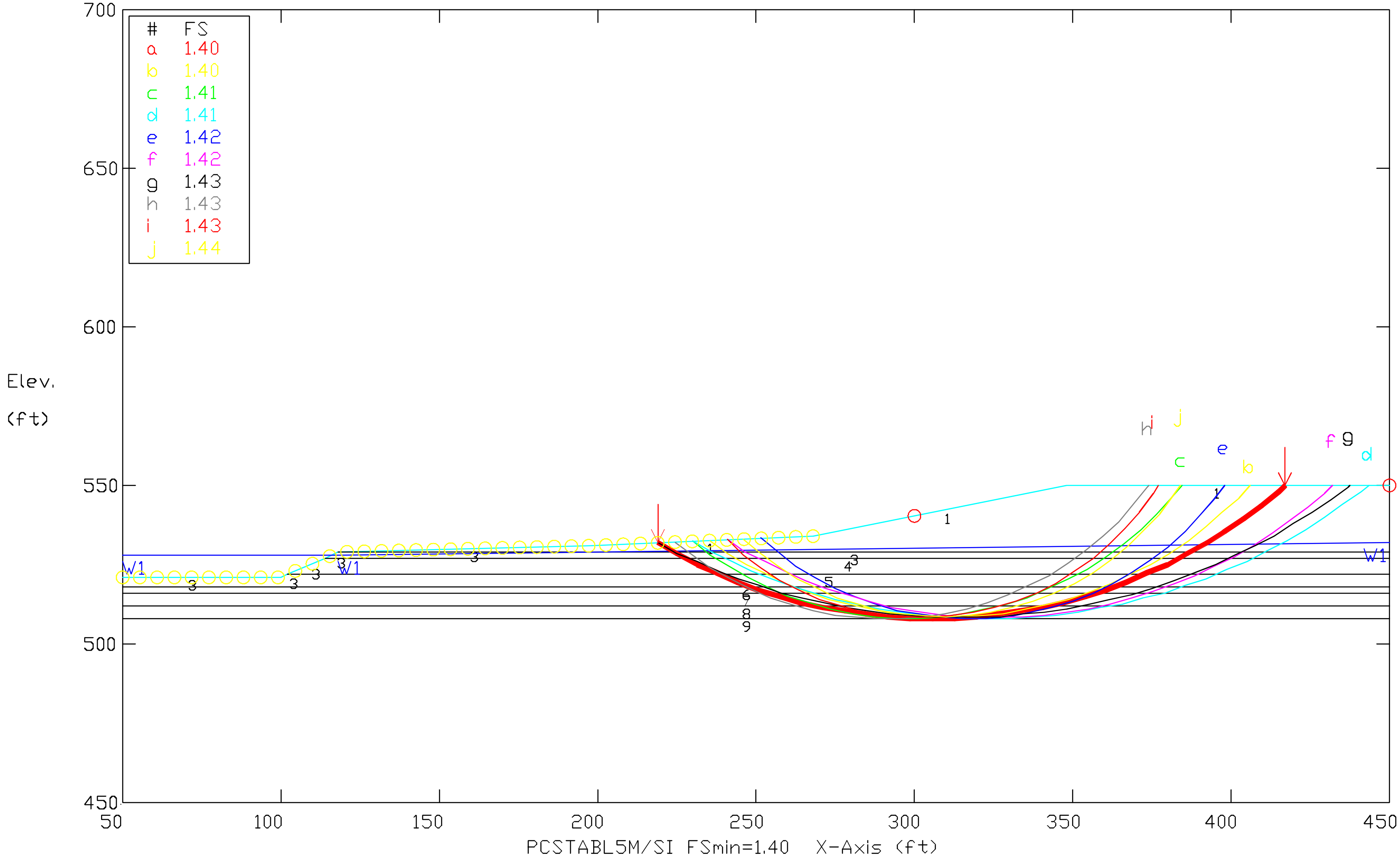
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 DIKE	125	125	0	34	0	0	W1
2 ASH	120	120	0	34	0	0	W1
3 CLAY	125	125	1000	0	0	0	W1
4 ASH	120	120	0	32	0	0	W1
5 CLAY	125	125	1000	0	0	0	W1
6 ASH	120	120	0	32	0	0	W1
7 CLAY	125	125	600	0	0	0	W1
8 CLAY	125	125	600	0	0	0	W1
9 SAND	125	125	0	30	0	0	W1

BSG - Economizer Pond North Eastern Sec. As Rebuilt, Static Case & Pond @ 531'
Ten Most Critical. E:BGS00BW.PLT 04-24-16 2:59pm



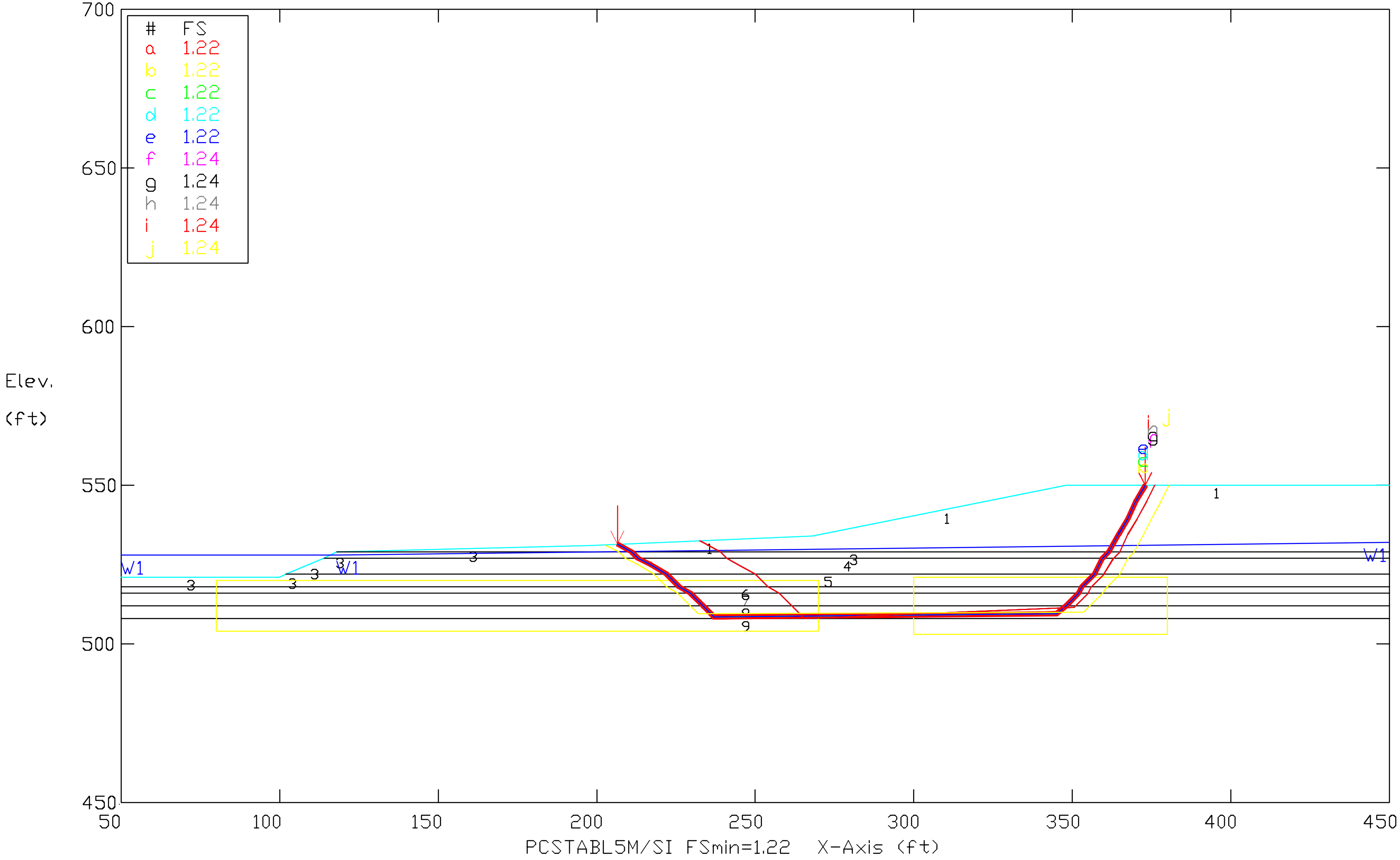
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	DIKE	125	125	0	34	0	0	W1
2	ASH	120	120	0	34	0	0	W1
3	CLAY	125	125	1000	0	0	0	W1
4	ASH	120	120	0	32	0	0	W1
5	CLAY	125	125	1000	0	0	0	W1
6	ASH	120	120	0	32	0	0	W1
7	CLAY	125	125	600	0	0	0	W1
8	CLAY	125	125	600	0	0	0	W1
9	SAND	125	125	0	30	0	0	W1

BSG - Economizer Pond North Eastern Sec. As Rebuilt, EQ Case & Normal Pond
Ten Most Critical. E:BGS00CEQ.PLT 04-24-16 3:11pm



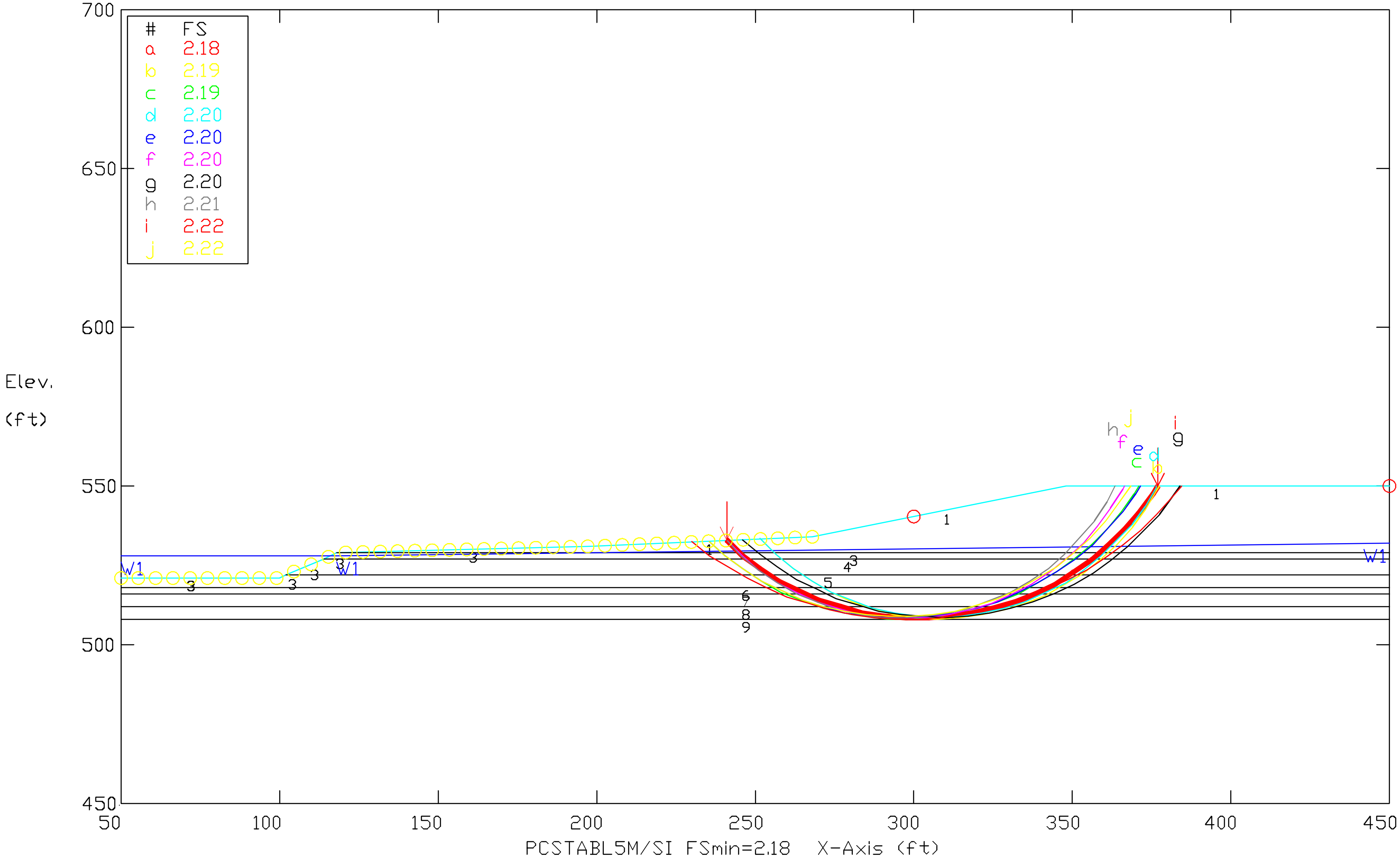
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	DIKE	125	125	0	34	0	0	W1
2	ASH	120	120	0	34	0	0	W1
3	CLAY	125	125	1000	0	0	0	W1
4	ASH	120	120	0	32	0	0	W1
5	CLAY	125	125	1000	0	0	0	W1
6	ASH	120	120	0	32	0	0	W1
7	CLAY	125	125	600	0	0	0	W1
8	CLAY	125	125	600	0	0	0	W1
9	SAND	125	125	0	30	0	0	W1

BSG - Economizer Pond North Eastern Sec. As Rebuilt, EQ Case & Normal Pond
Ten Most Critical. E:BGS00BEQ.PLT 04-24-16 3:02pm



Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	DIKE	125	125	0	34	0	0	W1
2	ASH	120	120	0	34	0	0	W1
3	CLAY	125	125	1000	0	0	0	W1
4	ASH	120	120	0	32	0	0	W1
5	CLAY	125	125	1000	0	0	0	W1
6	ASH	120	120	0	32	0	0	W1
7	CLAY	125	125	600	0	0	0	W1
8	CLAY	125	125	600	0	0	0	W1
9	SAND	125	125	0	30	0	0	W1

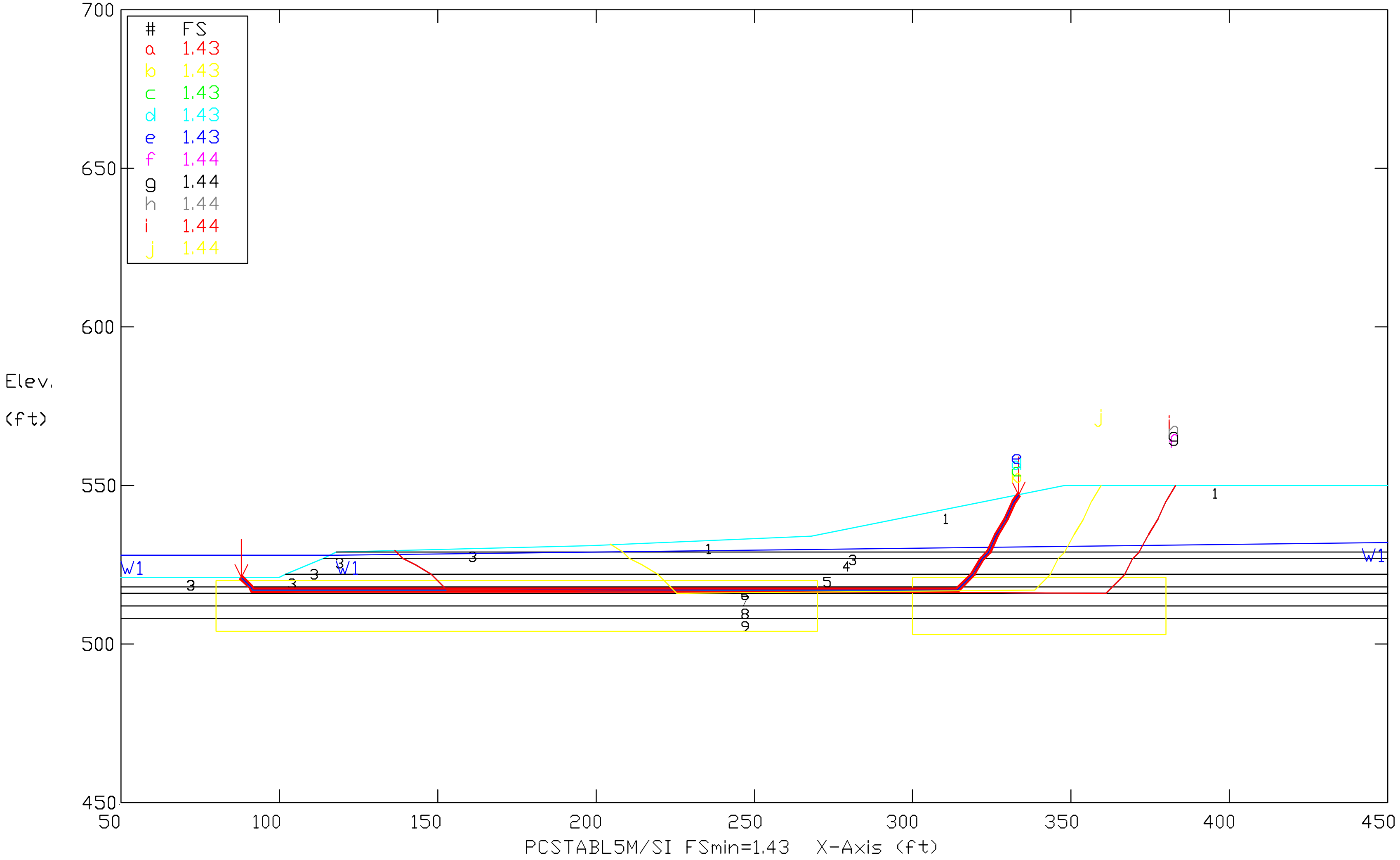
BSG - Economizer Pond North Eastern Sec.As Rebuilt, Liquified Case & Normal Pond
Ten Most Critical. E:BGS00CL.PLT   04-24-16   7:19pm



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 DIKE	125	125	0	34	0	0	W1
2 ASH	120	120	0	34	0	0	W1
3 CLAY	125	125	1000	0	0	0	W1
4 ASH	120	120	0	32	0	0	W1
5 CLAY	125	125	1000	0	0	0	W1
6 ASH	120	120	100	0	0	0	W1
7 CLAY	125	125	600	0	0	0	W1
8 CLAY	125	125	600	0	0	0	W1
9 SAND	125	125	0	30	0	0	W1

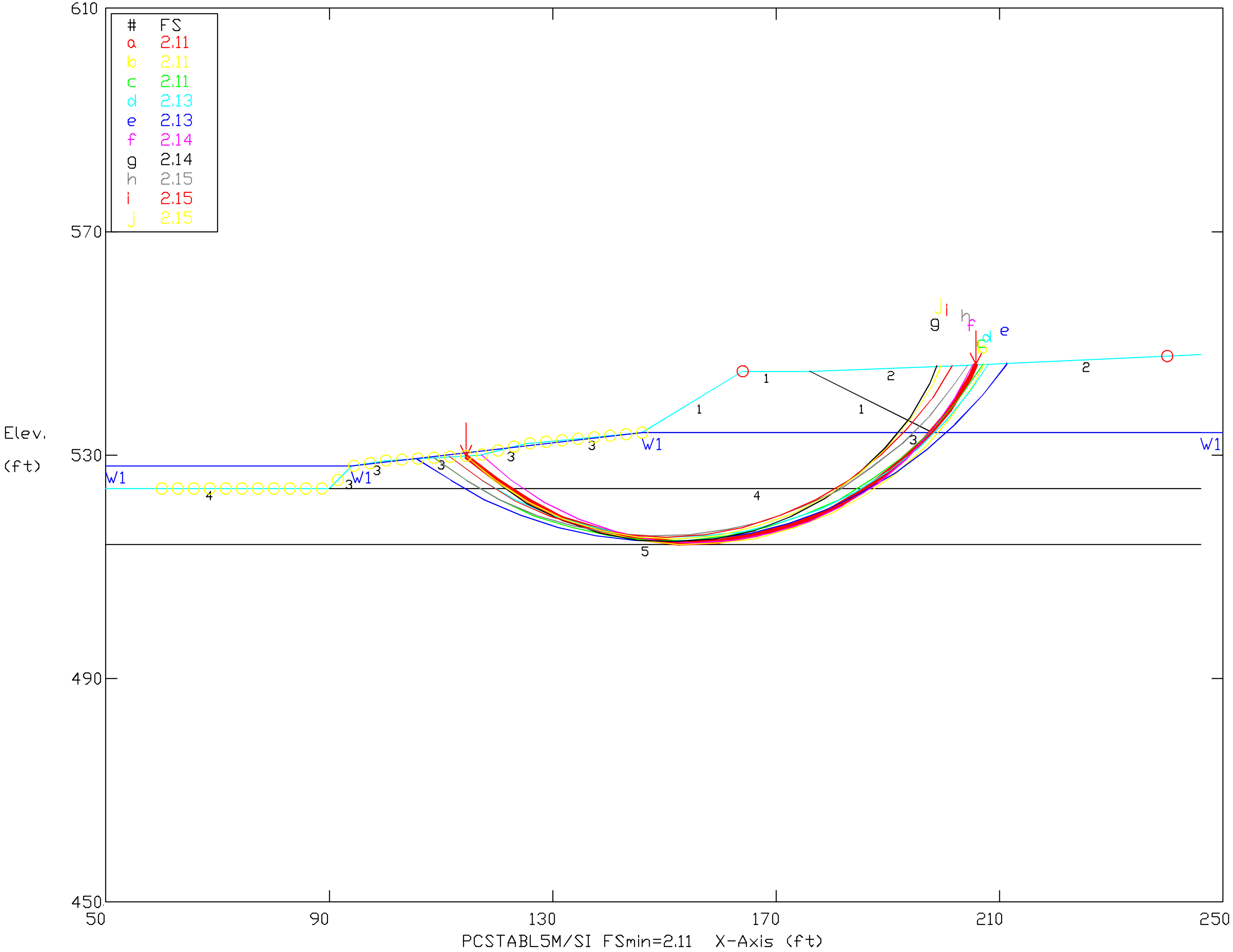
BSG - Economizer Pond North Eastern Sec.As Rebuilt, Liquified Case & Normal Pond

Ten Most Critical. E:BGS00BL.PLT 04-24-16 7:21pm



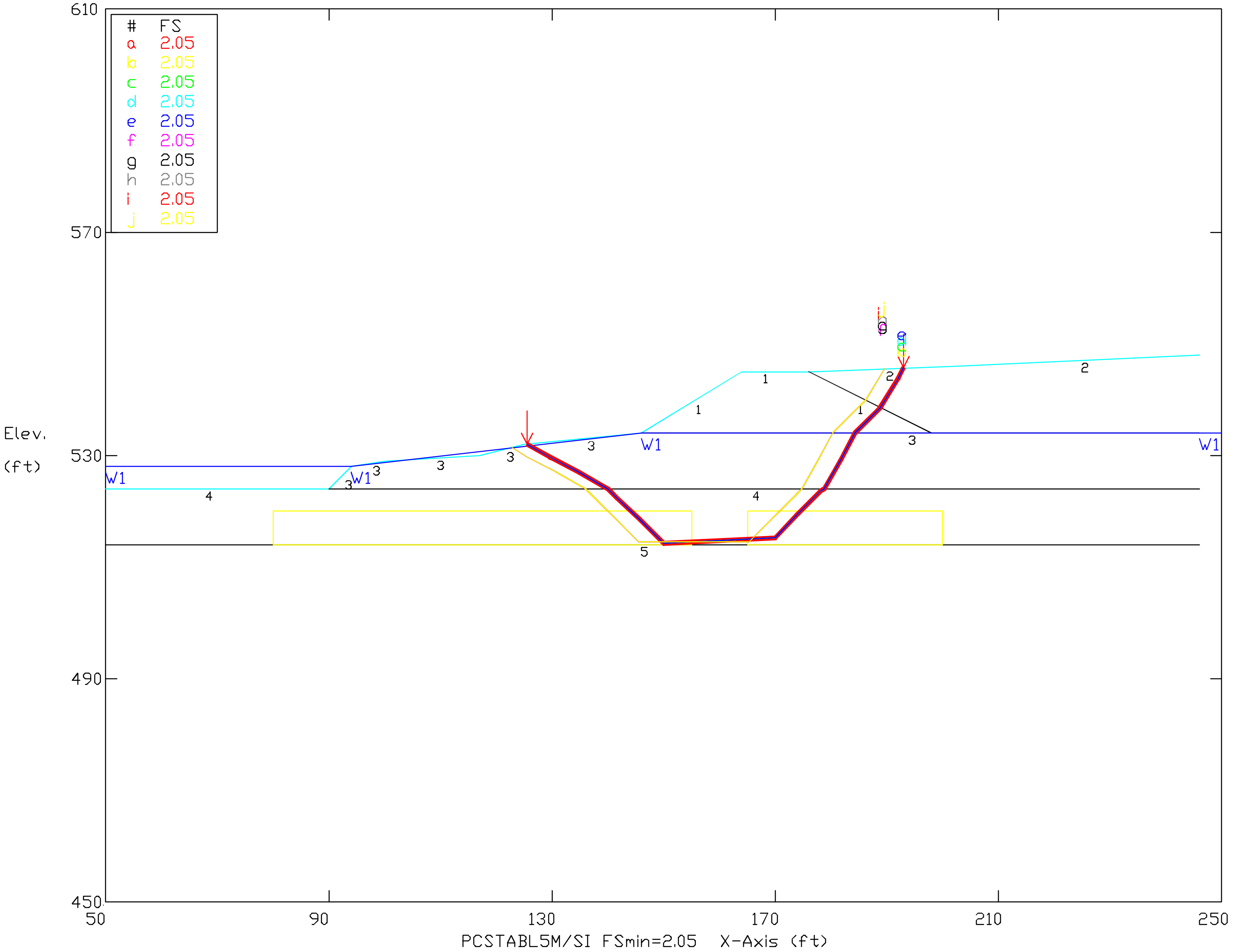
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	DIKE	125	125	0	34	0	0	W1
2	ASH	120	120	0	34	0	0	W1
3	CLAY	125	125	1000	0	0	0	W1
4	ASH	120	120	0	32	0	0	W1
5	CLAY	125	125	1000	0	0	0	W1
6	ASH	120	120	100	0	0	0	W1
7	CLAY	125	125	600	0	0	0	W1
8	CLAY	125	125	600	0	0	0	W1
9	SAND	125	125	0	30	0	0	W1

BSG - Economizer Pond Western Section As Rebiult, Static Case & Normal Pond
Ten Most Critical. E:BGS10C.PLT 04-24-16 3:40pm



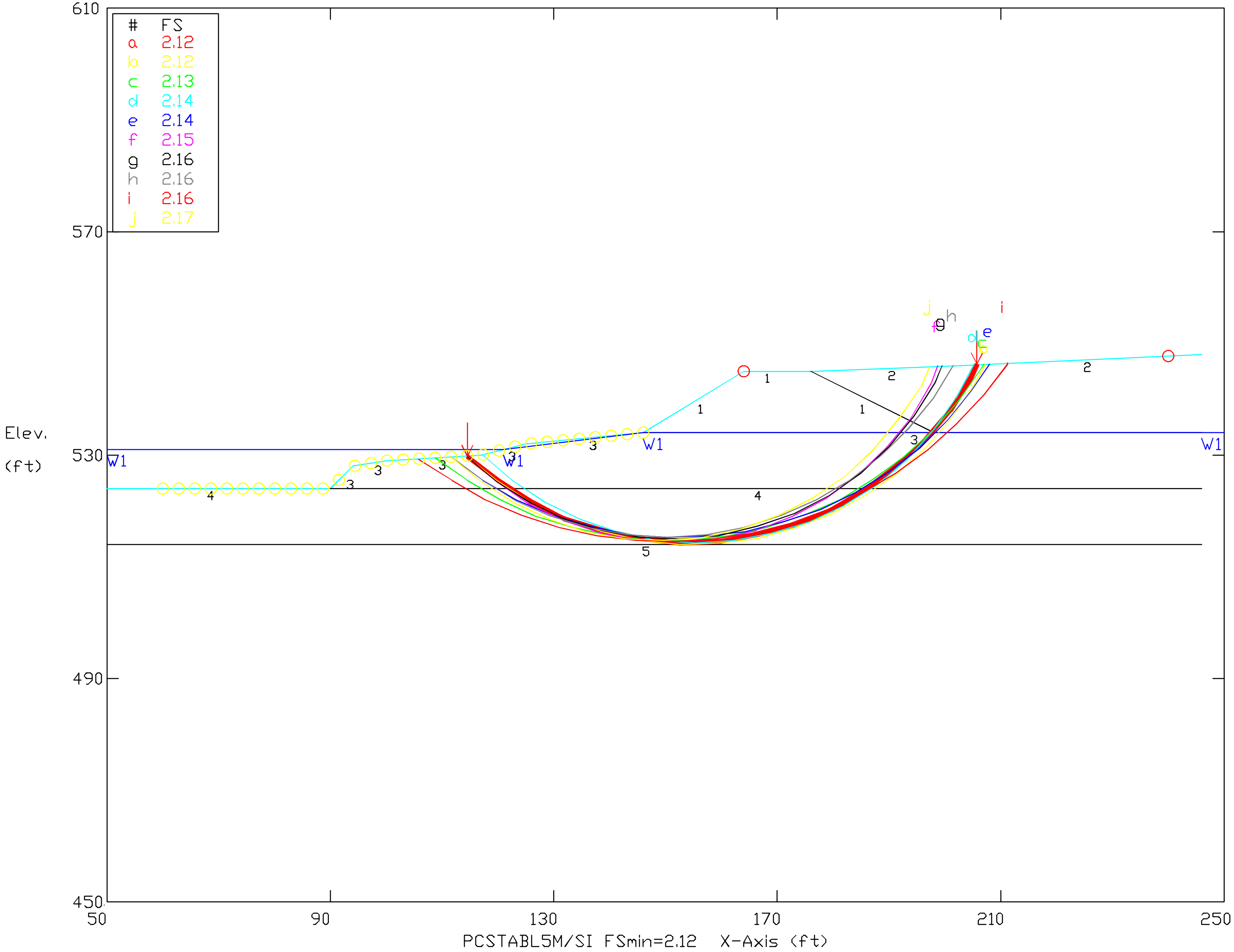
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	1200	0	0	0	W1
2 Ash	120	120	0	28	0	0	W1
3 Ash Fdn	125	125	0	32	0	0	W1
4 Clay	125	125	700	0	0	0	W1
5 Sand	125	125	0	30	0	0	W1

BSG - Economizer Pond Western Section As Rebiult, Static Case & Normal Pond
Ten Most Critical. E:BGS10B.PLT 04-24-16 3:55pm



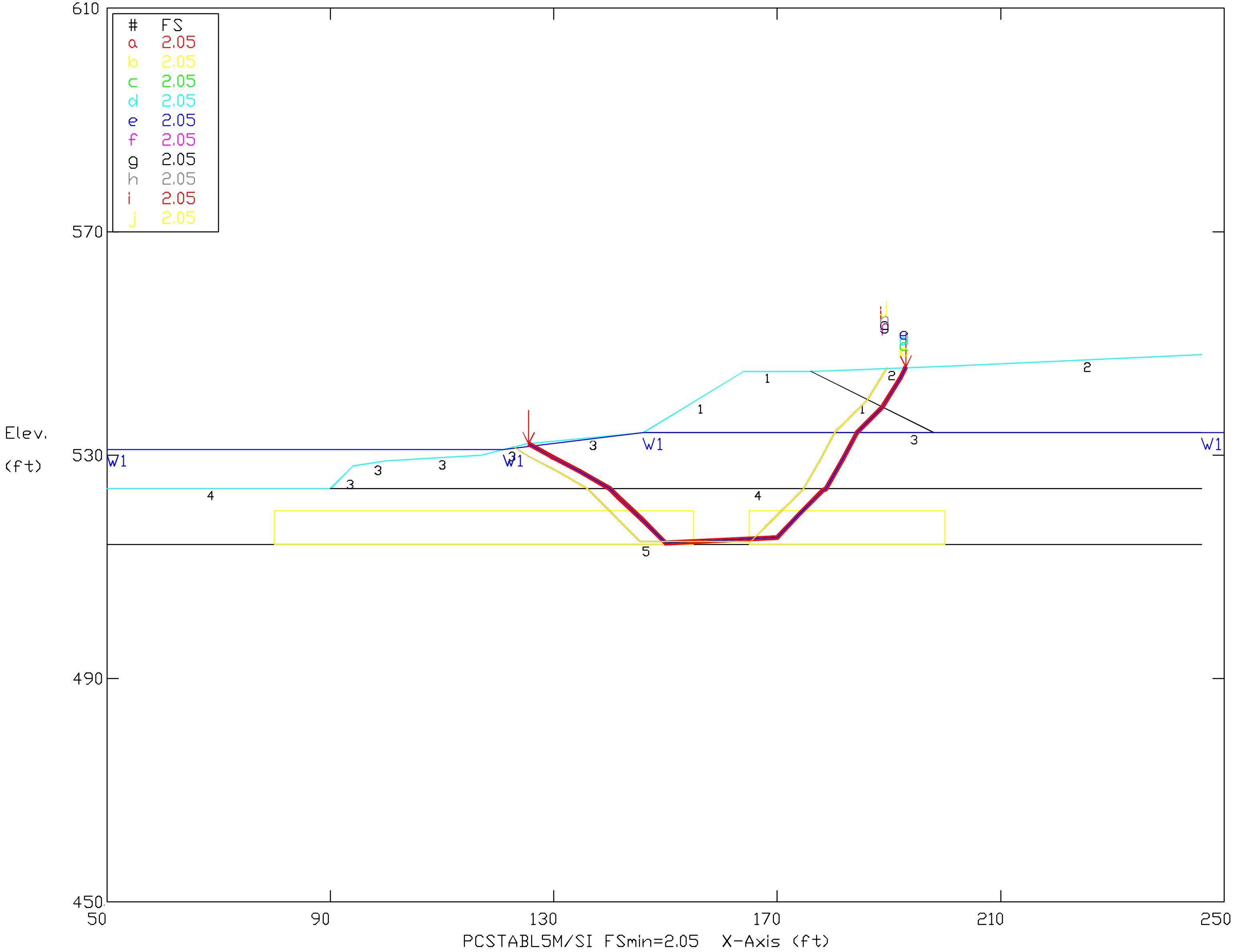
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	1200	0	0	0	W1
2 Ash	120	120	0	28	0	0	W1
3 Ash Fdn	125	125	0	32	0	0	W1
4 Clay	125	125	700	0	0	0	W1
5 Sand	125	125	0	30	0	0	W1

BSG - Economizer Pond Western Section As Rebiult, Static Case & Pond @ 531'
Ten Most Critical. E:BGS10CW.PLT 04-24-16 3:43pm



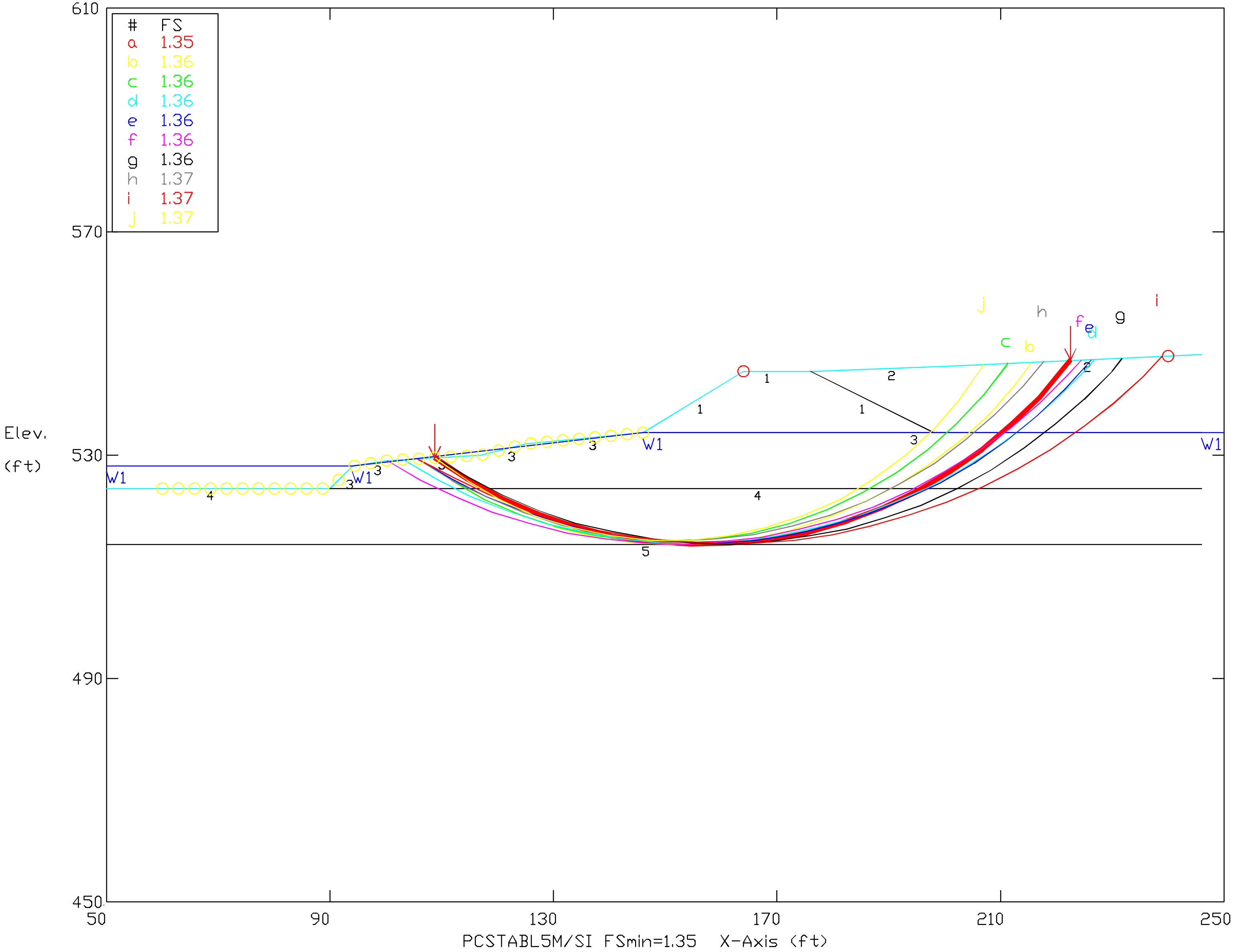
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	1200	0	0	0	W1
2 Ash	120	120	0	28	0	0	W1
3 Ash Fdn	125	125	0	32	0	0	W1
4 Clay	125	125	700	0	0	0	W1
5 Sand	125	125	0	30	0	0	W1

BSG - Economizer Pond Western Section As Rebiult, Static Case & Pond @ 531'
Ten Most Critical. E:BGS10BW.PLT 04-24-16 3:49pm



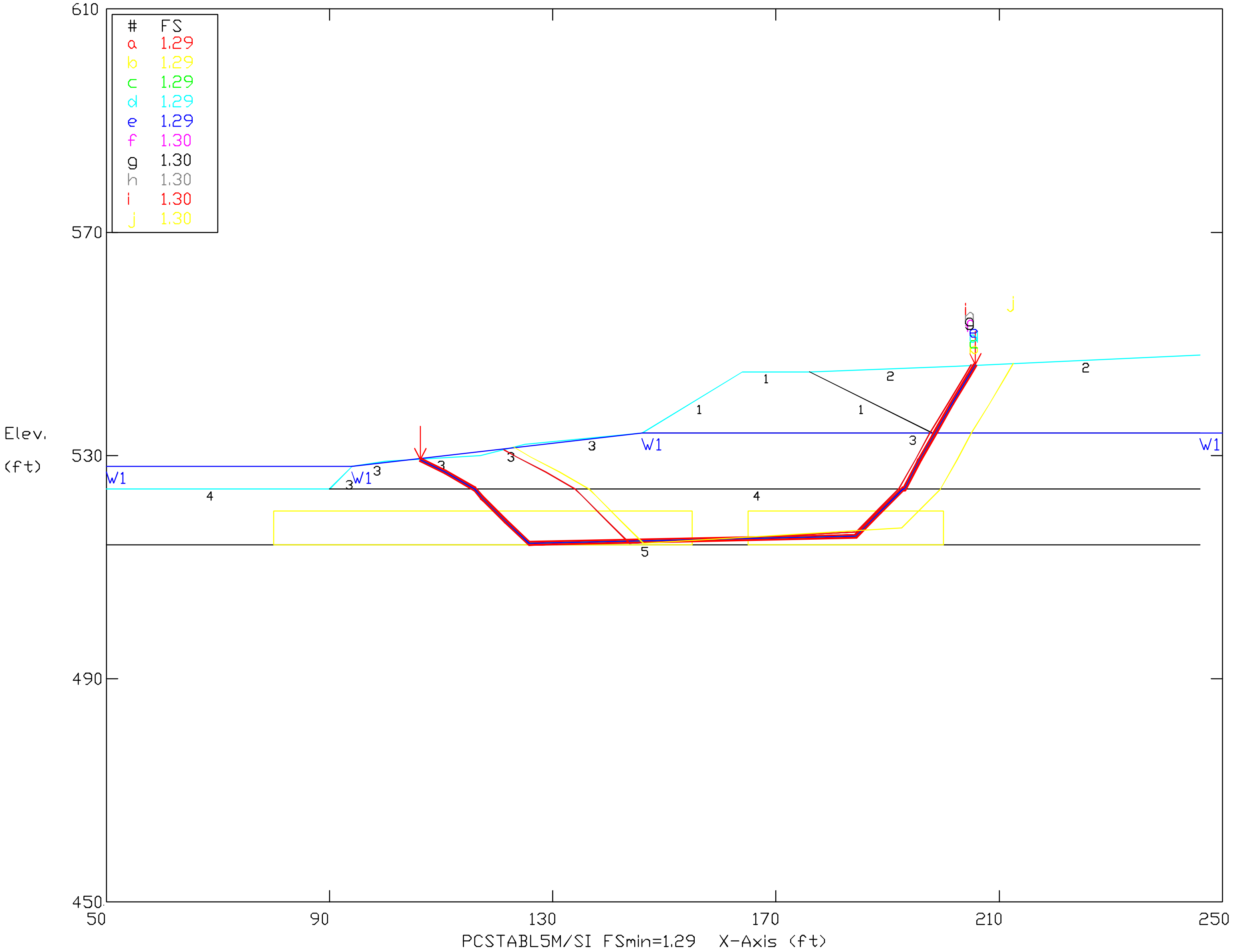
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	1200	0	0	0	W1
2 Ash	120	120	0	28	0	0	W1
3 Ash Fdn	125	125	0	32	0	0	W1
4 Clay	125	125	700	0	0	0	W1
5 Sand	125	125	0	30	0	0	W1

BSG - Economizer Pond Western Section As Rebiult, EQ Case & Normal Pond
Ten Most Critical. E:BGS10CEQ.PLT 04-24-16 4:02pm



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	1200	0	0	0	W1
2 Ash	120	120	0	28	0	0	W1
3 Ash Fdn	125	125	0	32	0	0	W1
4 Clay	125	125	700	0	0	0	W1
5 Sand	125	125	0	30	0	0	W1

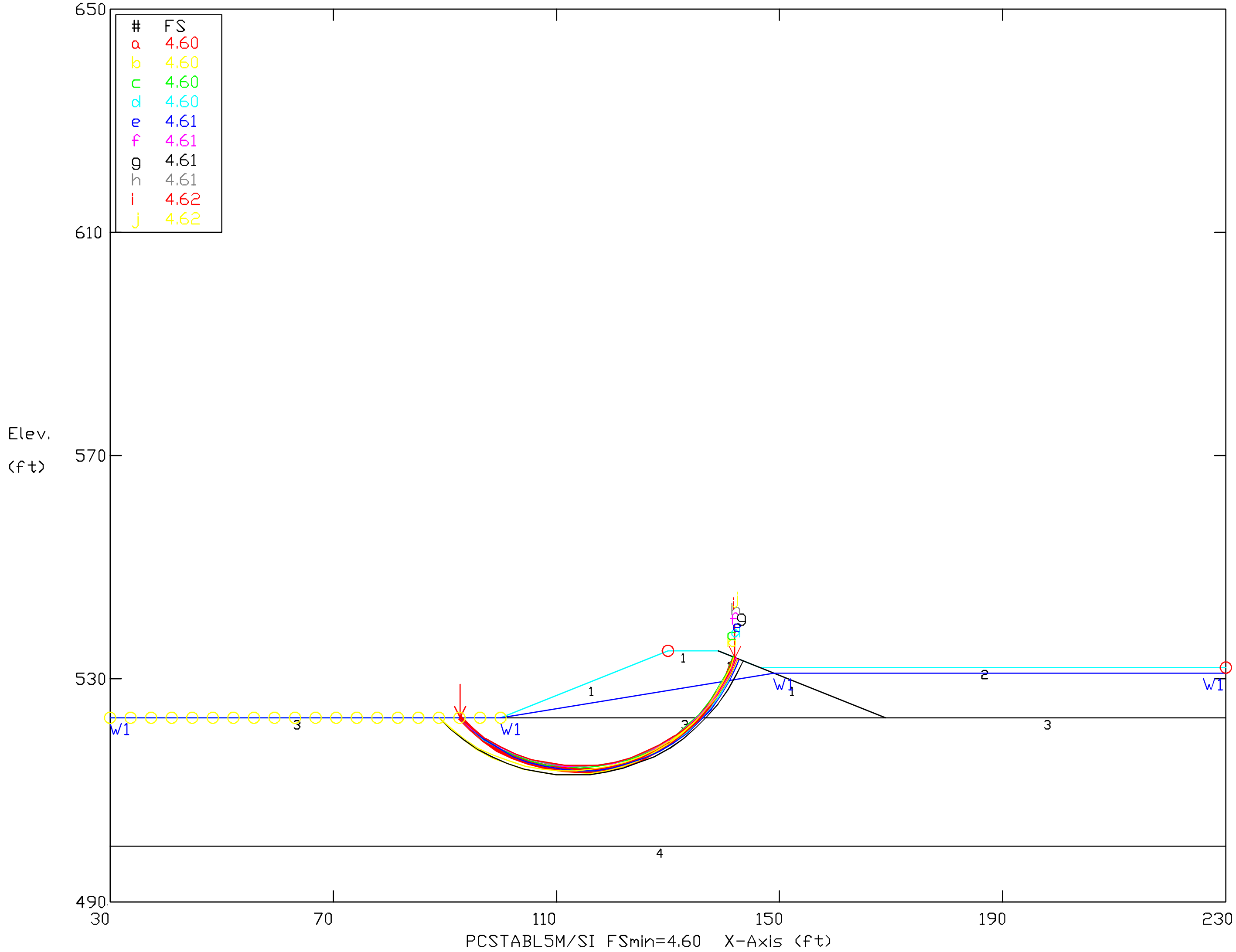
BSG - Economizer Pond Western Section As Rebiult, EQ Case & Normal Pond
Ten Most Critical. E:BGS10BEQ.PLT 04-24-16 3:58pm



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	1200	0	0	0	W1
2 Ash	120	120	0	28	0	0	W1
3 Ash Fdn	125	125	0	32	0	0	W1
4 Clay	125	125	700	0	0	0	W1
5 Sand	125	125	0	30	0	0	W1

BSG - Main Ash Pond South Dike Normal Water Level @ 531'

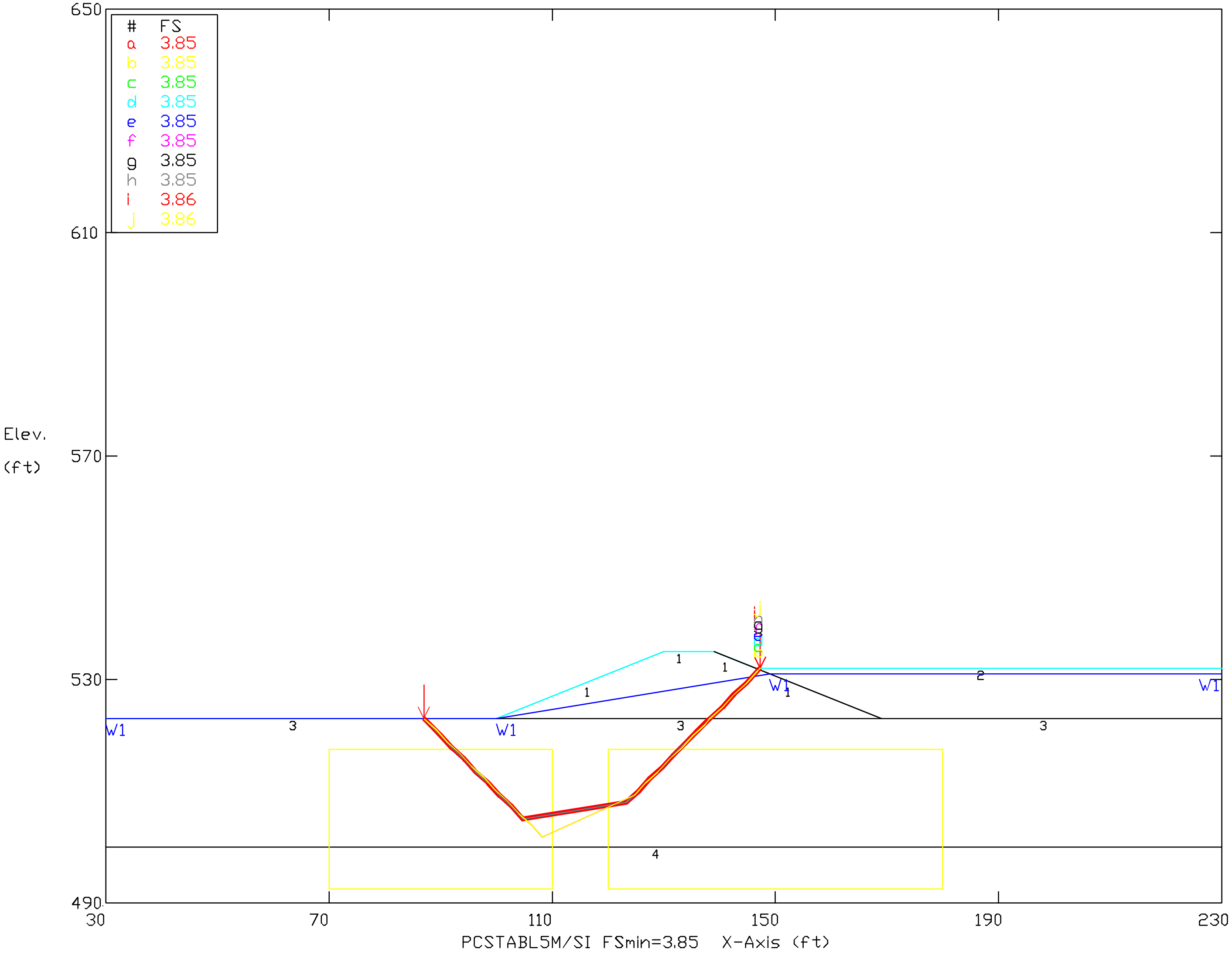
Ten Most Critical. E:BSG20C.PLT 04-26-16 8:57am



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	700	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Natural	120	120	1200	0	0	0	W1
4 Sand	130	130	0	37	0	0	W1

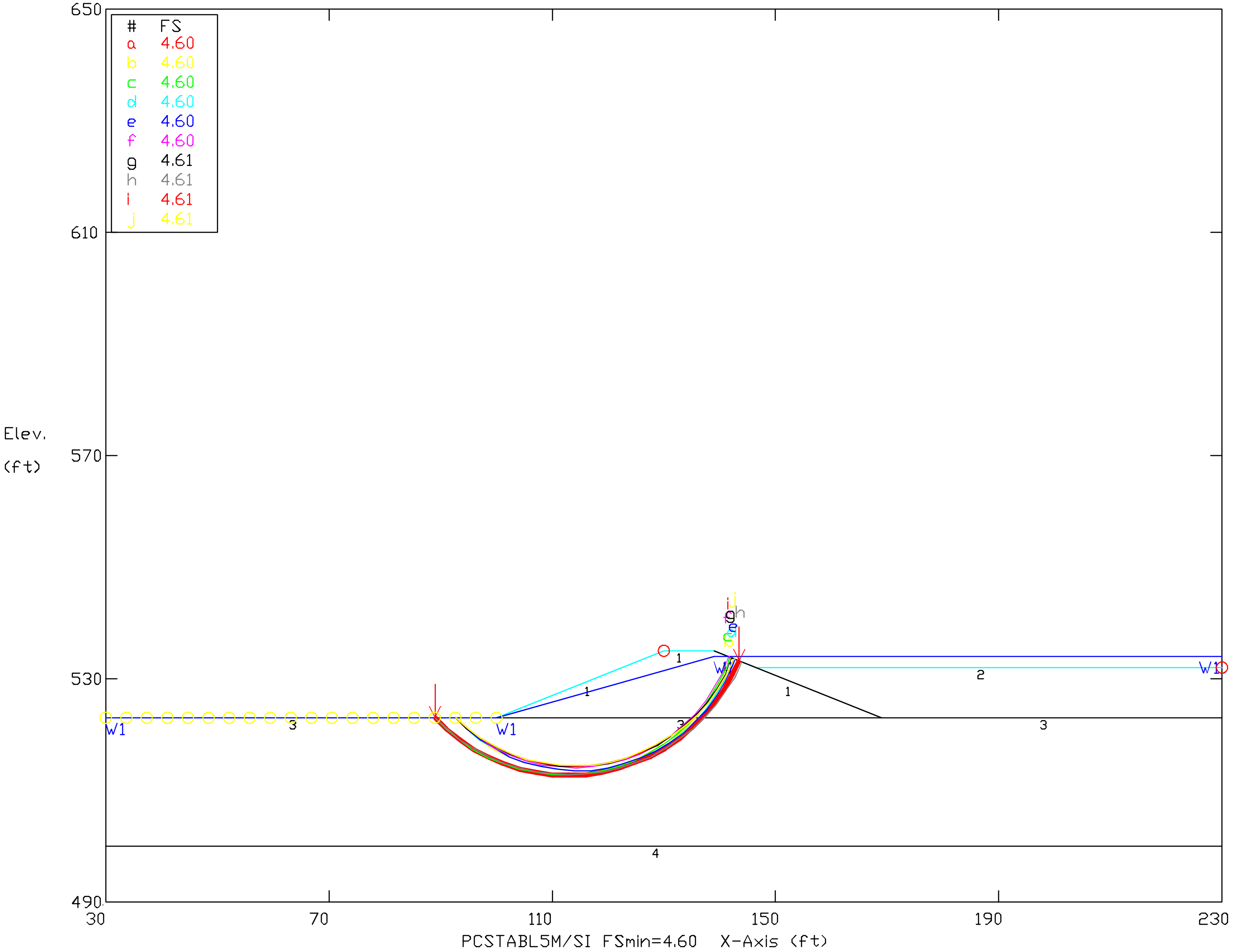
BSG - Main Ash Pond South Dike Normal Water Level @ 531'

Ten Most Critical. E:BSG20B.PLT 04-26-16 8:58am



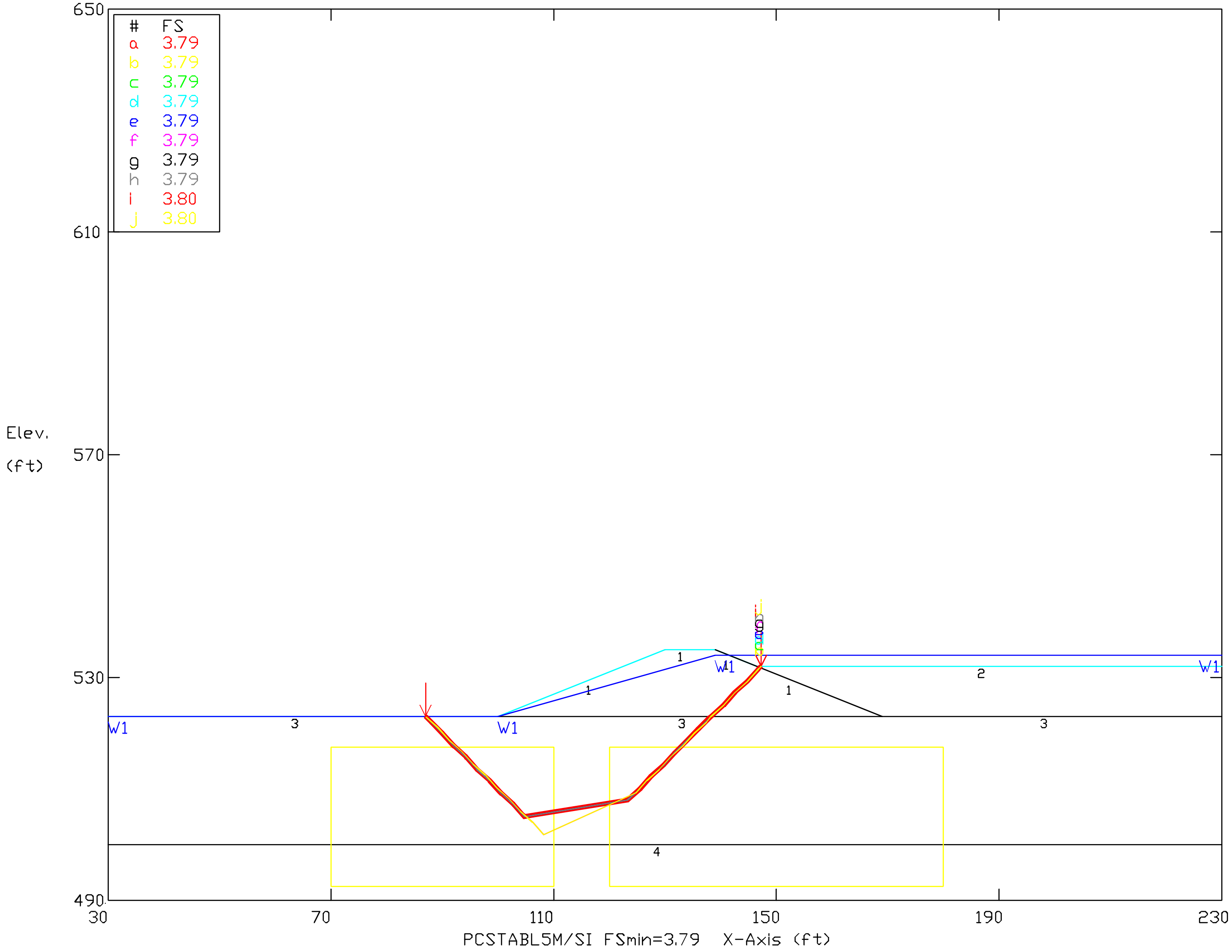
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	700	0	0	0	W1
2	Ash	120	120	0	25	0	0	W1
3	Natural	120	120	1200	0	0	0	W1
4	Sand	130	130	0	37	0	0	W1

BSG - Main Ash Pond South Dike High Water Level @ 534'
Ten Most Critical. E:BSG20CW.PLT 04-26-16 8:56am



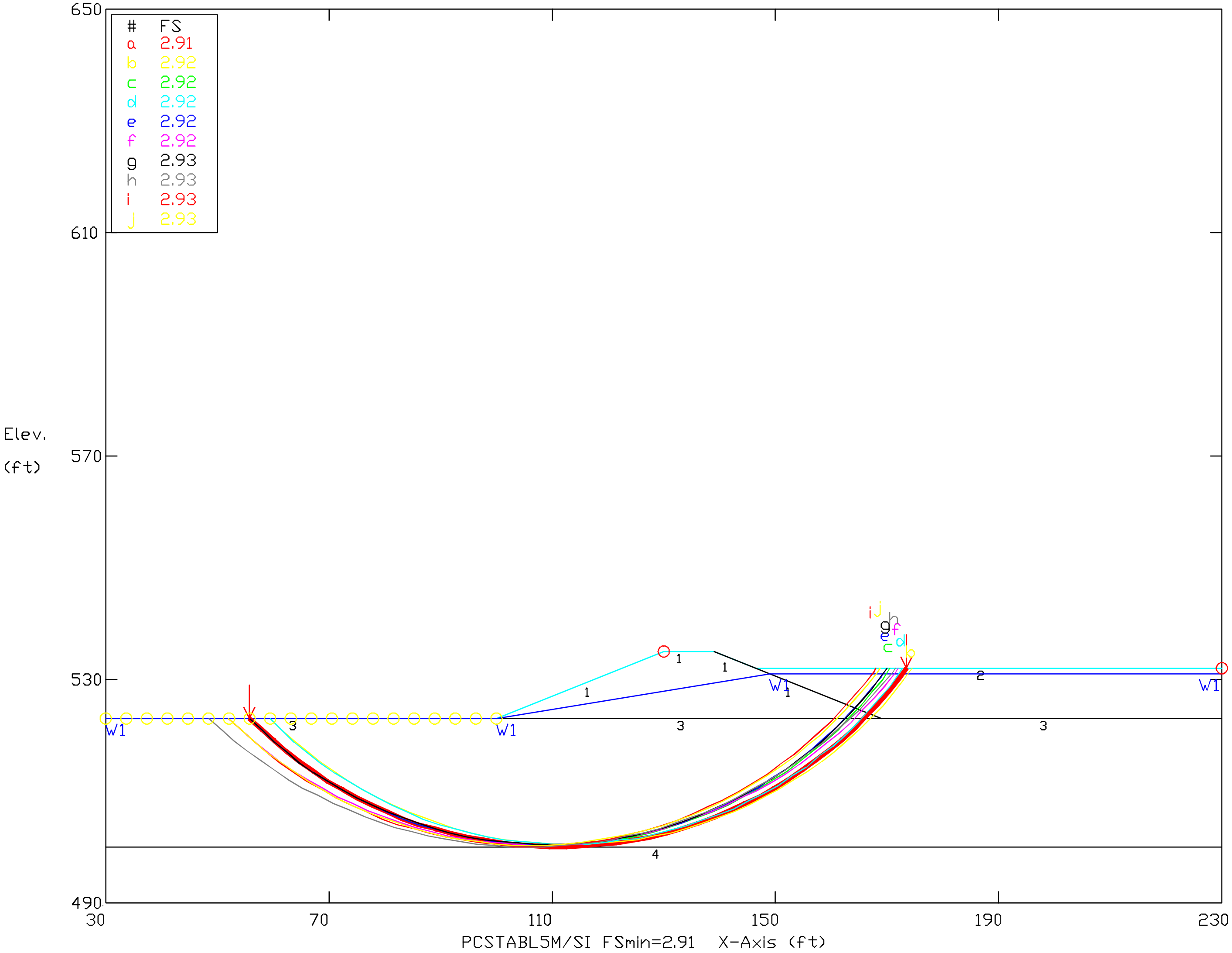
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	700	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Natural	120	120	1200	0	0	0	W1
4 Sand	130	130	0	37	0	0	W1

BSG - Main Ash Pond South Dike High Water Level @ 534'
Ten Most Critical. E:BSG20BW.PLT 04-26-16 9:00am



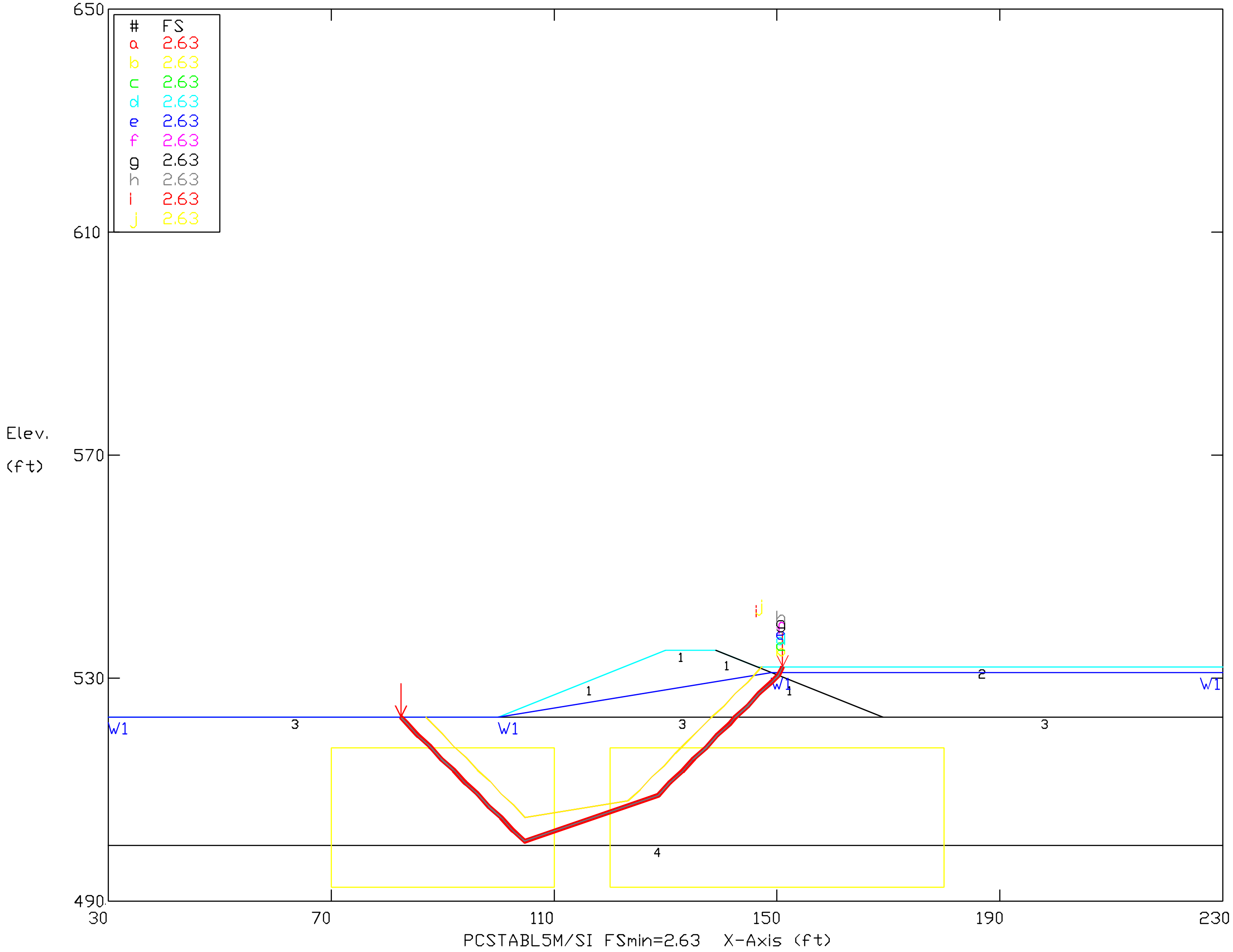
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	700	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Natural	120	120	1200	0	0	0	W1
4 Sand	130	130	0	37	0	0	W1

BSG - Main Ash Pond South Dike Normal Water Level & EQ (0.105 & -0.070)
Ten Most Critical. E:BSG20CEQ.PLT 04-26-16 9:08am



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	700	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Natural	120	120	1200	0	0	0	W1
4 Sand	130	130	0	37	0	0	W1

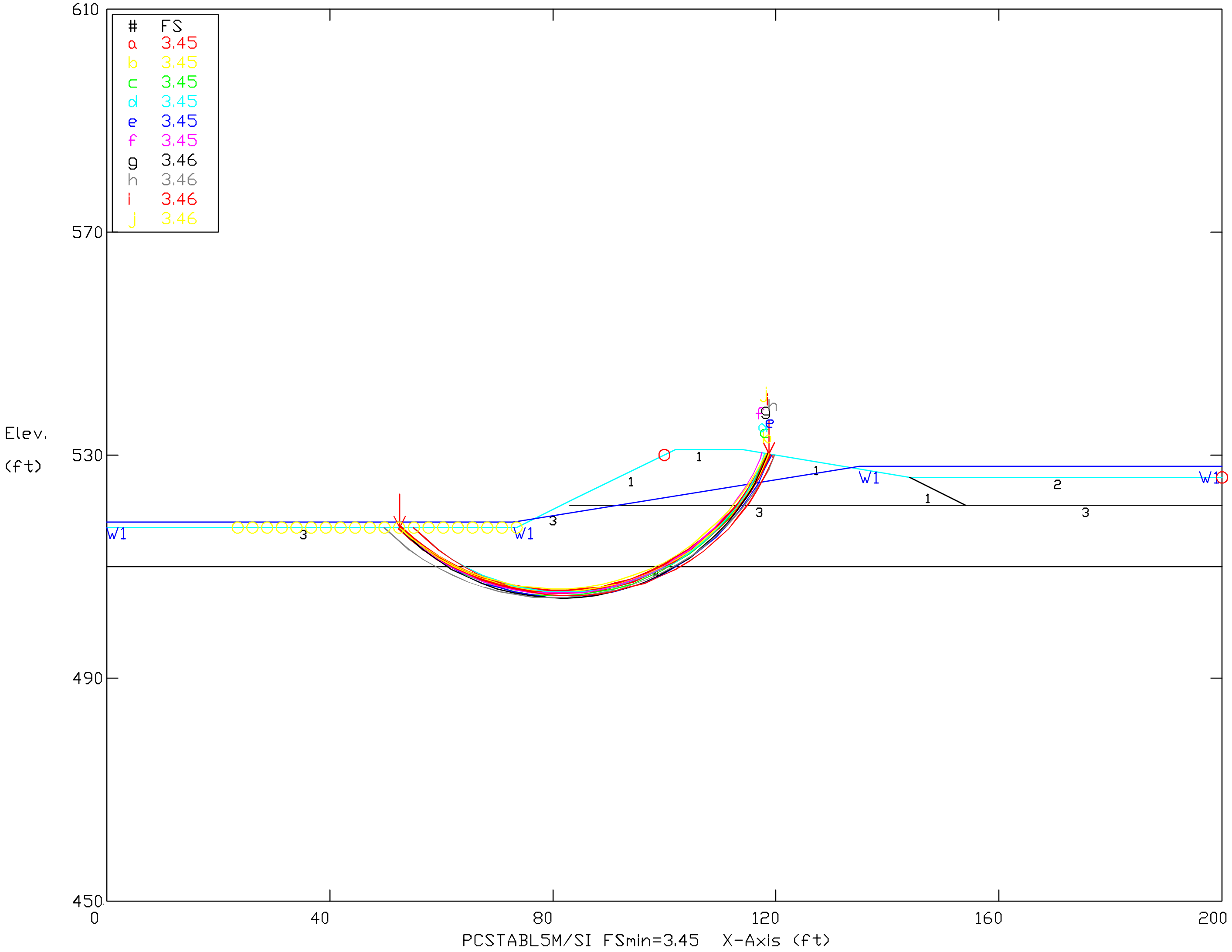
BSG - Main Ash Pond South Dike Normal Water Level & EQ (0.105 & -0.070)
Ten Most Critical. E:BSG20BEQ.PLT 04-26-16 9:03am



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	125	125	700	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Natural	120	120	1200	0	0	0	W1
4 Sand	130	130	0	37	0	0	W1

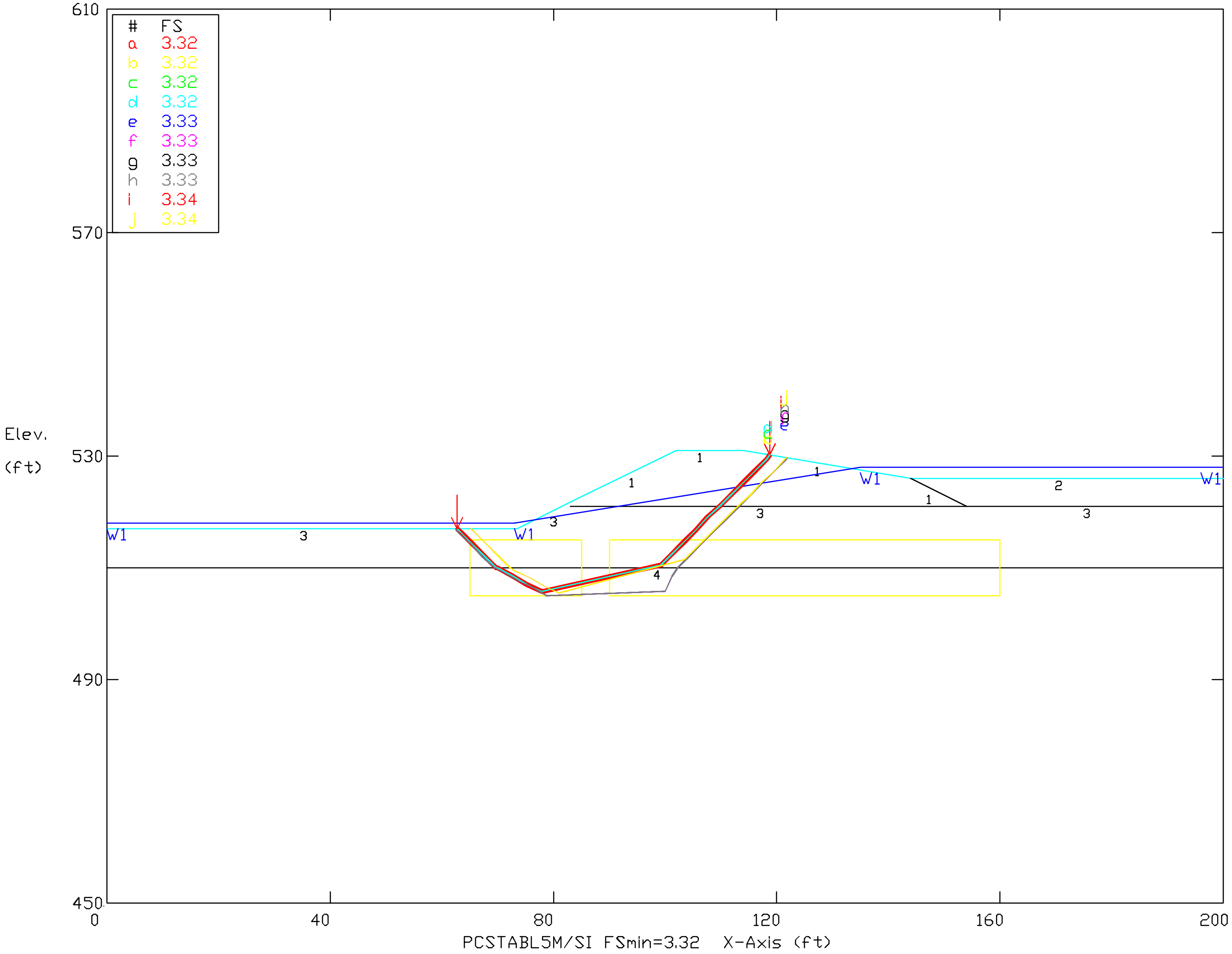
BSG - Upper to Lower Ash Pond Dike Static Case & Normal Upper Pond (@ 528')

Ten Most Critical. E:BSG40C.PLT 04-25-16 4:45pm



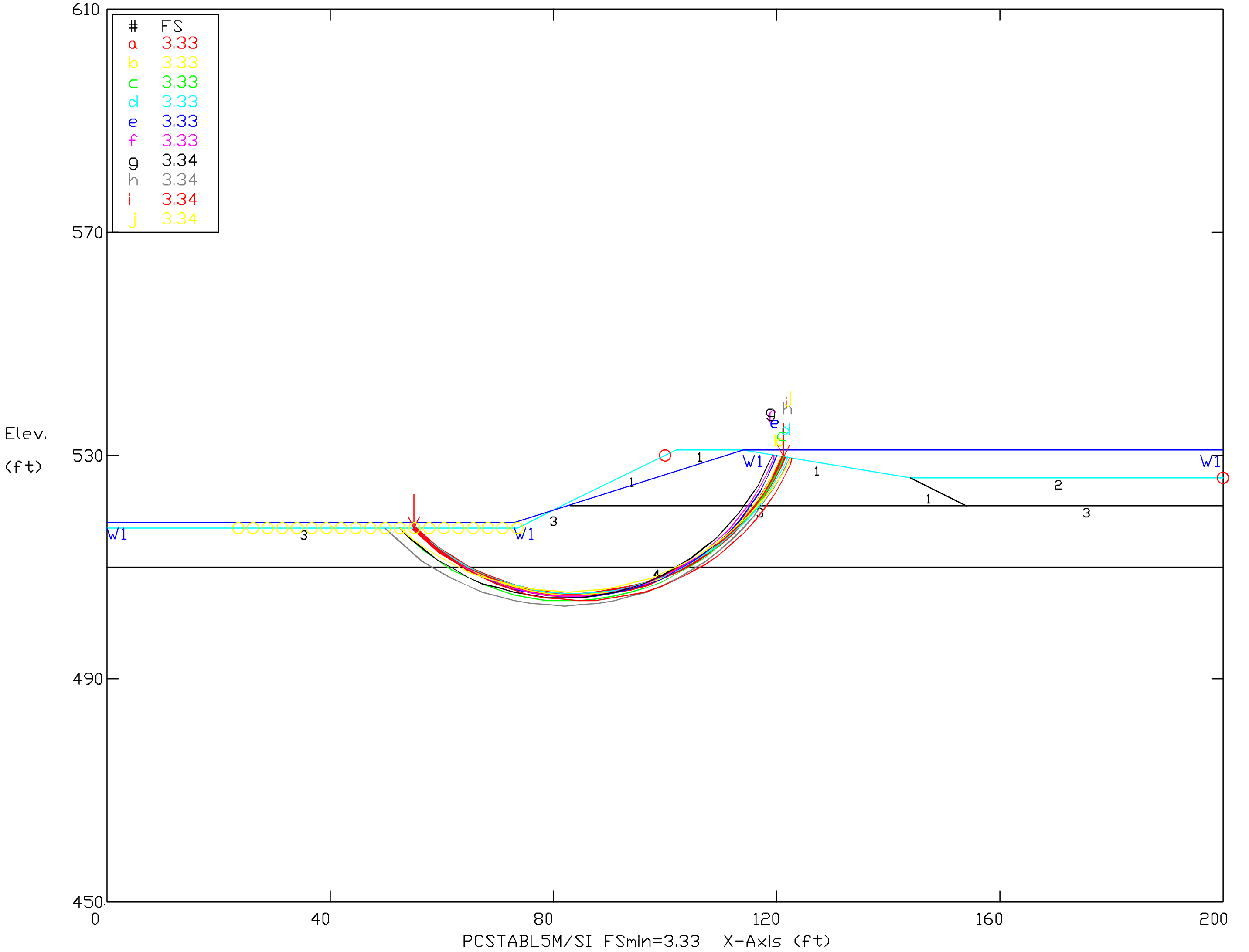
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	130	130	1950	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Clay	125	125	900	0	0	0	W1
4 Sand	125	125	0	35	0	0	W1

BSG - Upper to Lower Ash Pond Dike Static Case & Normal Upper Pond (@ 528')
Ten Most Critical. E:BSG40B.PLT 04-25-16 4:53pm



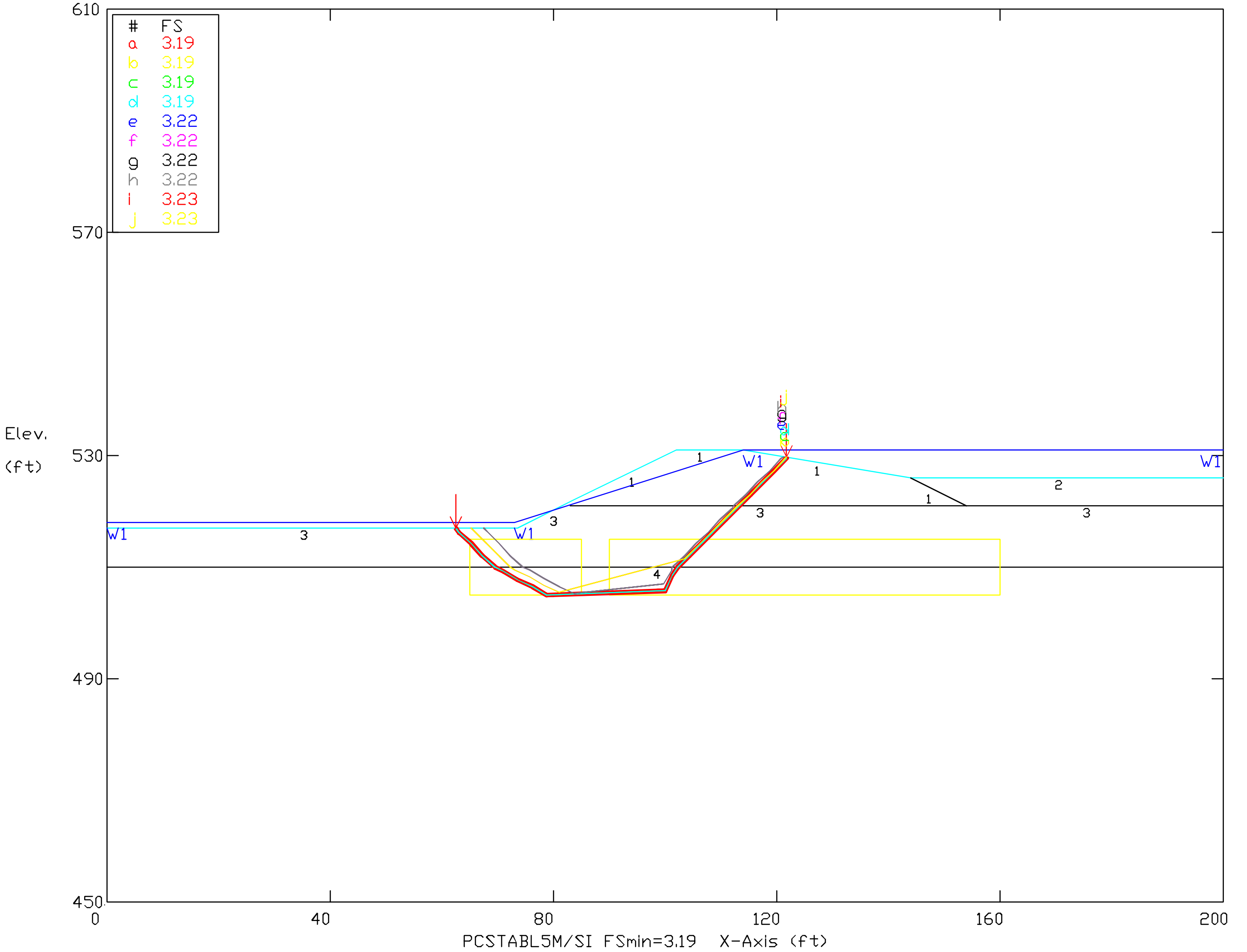
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	130	130	1950	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Clay	125	125	900	0	0	0	W1
4 Sand	125	125	0	35	0	0	W1

BSG - Upper to Lower Ash Pond Dike Static Case & Max. Upper Pond (@ 531')
Ten Most Critical. E:BSG40CW.PLT 04-25-16 5:01pm



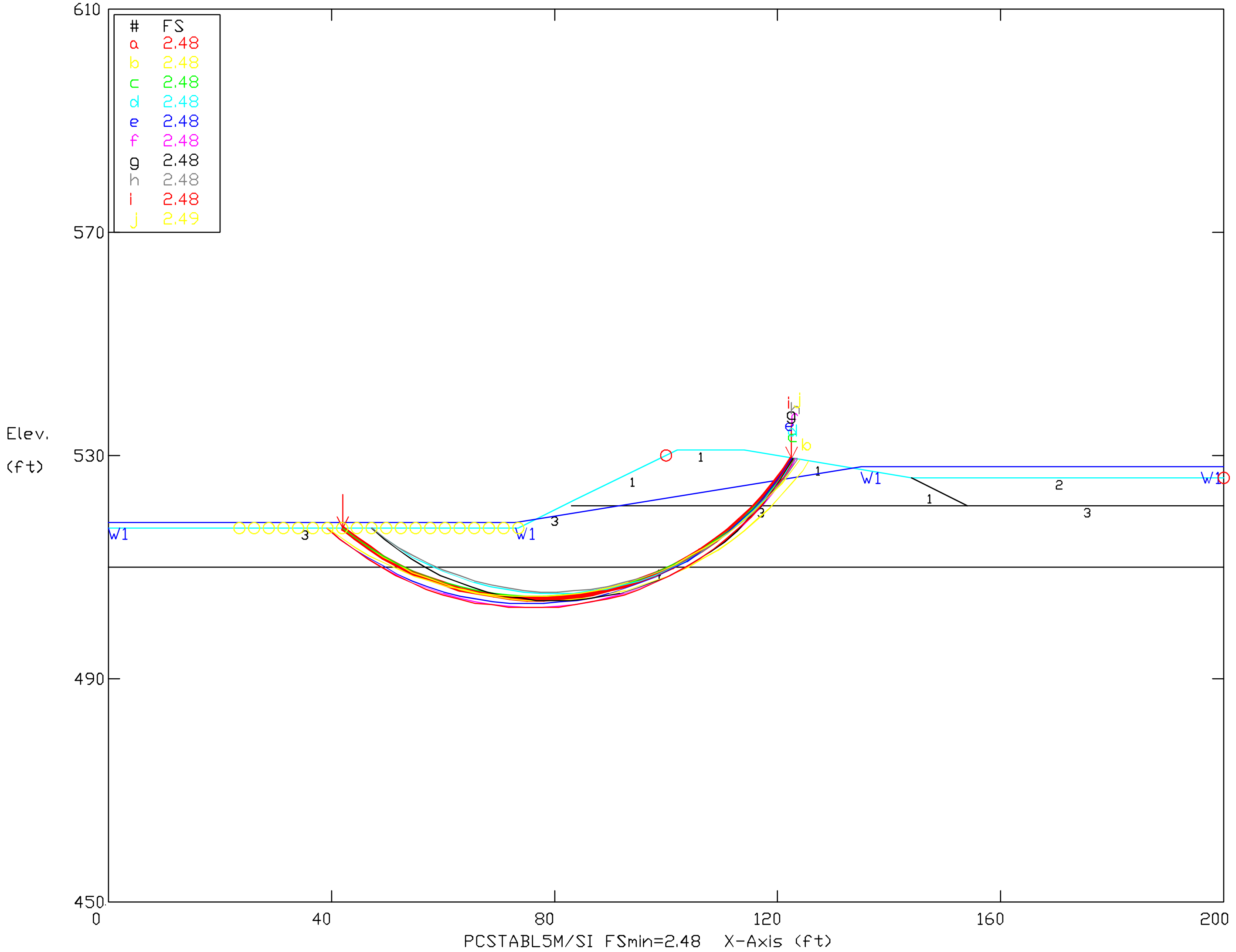
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	130	130	1950	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Clay	125	125	900	0	0	0	W1
4 Sand	125	125	0	35	0	0	W1

BSG - Upper to Lower Ash Pond Dike Static Case & Max. Upper Pond (@ 531')
Ten Most Critical. E:BSG40BW.PLT 04-25-16 5:29pm



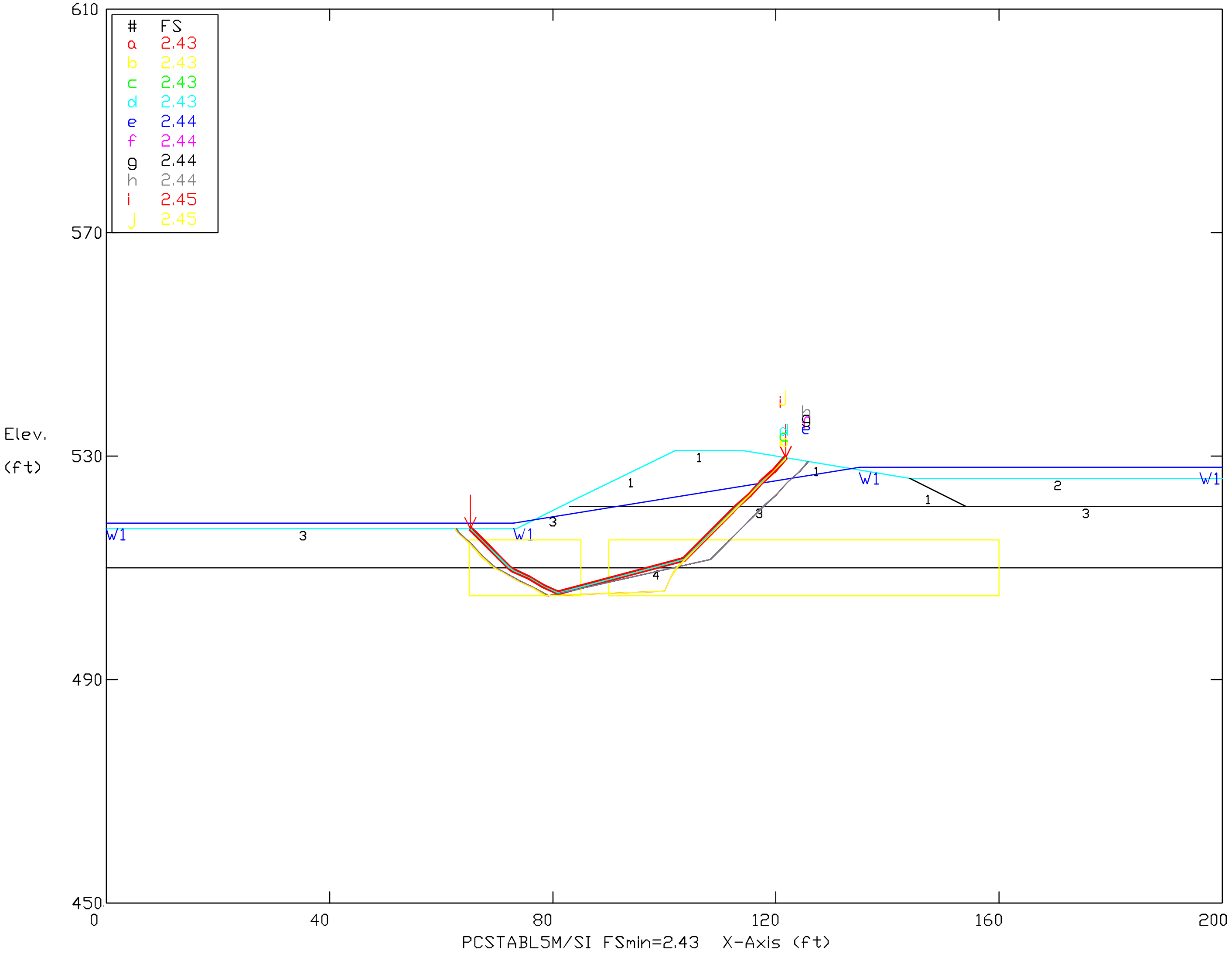
Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	130	130	1950	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Clay	125	125	900	0	0	0	W1
4 Sand	125	125	0	35	0	0	W1

BSG - Upper to Lower Ash Pond Dike EQ (.105 & -.070) & Normal Upper Pond
Ten Most Critical. E:BSG40CEQ.PLT 04-25-16 5:06pm



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	130	130	1950	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Clay	125	125	900	0	0	0	W1
4 Sand	125	125	0	35	0	0	W1

BSG - Upper to Lower Ash Pond Dike EQ (.105 & -.070) & Normal Upper Pond
Ten Most Critical. E:BSG40BEQ.PLT   04-25-16   5:13pm



Soil Type No. Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1 Dike	130	130	1950	0	0	0	W1
2 Ash	120	120	0	25	0	0	W1
3 Clay	125	125	900	0	0	0	W1
4 Sand	125	125	0	35	0	0	W1