FINAL

Coal Combustion Waste Impoundment
Round 7 - Dam Assessment Report

Burlington Generating Station

Ash Impoundment Dikes
Interstate Power and Light
Burlington, Iowa

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

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INTRODUCTION, SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The release of over five million cubic yards of coal combustion residue from the Tennessee Valley Authority's Kingston, Tennessee facility in December 2008 flooded more than 300 acres of land, damaging homes and property. In response the U.S. EPA is assessing the stability and functionality of coal combustion ash impoundments and other management units across the country and, as necessary, identifying any needed corrective measures.

This assessment of the stability and functionality of the Burlington Generating Station ash management units is based on a review of available documents and on the site assessment conducted by Dewberry personnel on Thursday, October 7, 2010. Dewberry originally found the supporting technical documentation lacking critical information. A draft report was written that described recommendations for providing the critical technical documentation required to upgrade the ash management unit ratings from the POOR rating given in the draft report.

The utility, Interstate Power and Light (IPL), responded by performing and providing a series of engineering reports on structural stability of the ash ponds. The initial studies, completed in February 2011 and based upon original construction soils data, indicated major structural stability issues associated with the ponds and ash management systems onsite. Subsequent studies in April-May 2011, developed new soils data and showed the concerns of the earlier studies to be unfounded. The utility, at the behest of USEPA, took specific actions and changed its operating procedures in ways to significantly reduce the potential for failure of the Economizer Ash Pond and ash management system. Based on those findings and actions, the Ash Seal Pond, Main Ash Pond, Upper Ash Pond, and Economizer Ash Pond ratings are considered **Satisfactory**.

PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA) is embarking on an initiative to investigate the potential for catastrophic failure of Coal Combustion Surface Impoundments (i.e., management unit) from occurring at electric utilities in an effort to protect lives and property from the consequences of a dam failure or the improper release of impounded slurry. The EPA initiative is intended to identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures (if present); to note the extent of deterioration (if present), to determine status of maintenance and/or a need for immediate repair; to evaluate conformity with current design and construction practices; and to determine the hazard potential classification for units not currently classified by the management unit owner or by a state or federal agency. The initiative addresses management units that are classified as having a Less-than-Low, Low, Significant or High Hazard Potential ranking. (For Classification, see pp. 3-8 of the 2004 Federal Guidelines for Dam Safety.)

In early 2009 the EPA sent its first wave of letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion waste. This letter was issued under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e), to assist the Agency in assessing the structural stability and functionality of such management units, including which facilities should be visited to perform a safety assessment of the berms, dikes, and dams used in the construction of these impoundments.

EPA requested that utility companies identify all management units including surface impoundments or similar diked or bermed management units or management units designated as landfills that receive liquid-borne material used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

The purpose of this report is **to evaluate the condition and potential of waste release from management units and to determine the hazard potential classification**. This evaluation included a site visit. Prior to conducting the site visit, a two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit hazard potential classification (if any), and accepted information provided via telephone communication with the management unit owner. Also, after the field visit, additional studies and information was received by Dewberry & Davis LLC about the Burlington Generating Station ash management units that were reviewed and used in preparation of this report.

Factors considered in determining the hazard potential classification of the management units(s) included the age and size of the impoundment, the quantity of coal combustion residuals or by-products that were stored or disposed of in these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

FINAL

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s).

LIMITATIONS

The assessment of dam safety reported herein is based on field observations and review of readily available information provided by the owner/operator of the subject coal combustion waste management unit(s). Qualified Dewberry engineering personnel performed the field observations and review and made the assessment in conformance with the required scope of work and in accordance with reasonable and acceptable engineering practices. No other warranty, either written or implied, is made with regard to our assessment of dam safety.

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1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from a one-day site visit, Thursday October 7, 2010, and review of technical documentation provided by Interstate Power and Light "IPL," including documentation provided after the site visit outlined in Section 10 of this report.

1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

The ratings for the various onsite ponds are based on the documentation of critical engineering data and studies performed in 2011 to verify design slope stability analyses and the potential release of the contents of the Economizer Ash Pond under static and seismic conditions, and from the Main Ash Pond under seismic conditions. The structural soundness of the management units is **Satisfactory** based upon all studies completed and information provided**.**

1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)

Documentation of critical hydrologic/hydraulic data, studies performed in 2011, and information received following the Spring 2011 flooding of the Mississippi River verify adequate impoundment capacity to prevent overtopping of the Upper Ash pond and Main Ash Pond. The hydrologic/hydraulic soundness of the management units is **Satisfactory**.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

The supporting technical documentation is now adequate, based on the engineering studies performed by Aether DBS in 2011 that indicate:

- Onsite soils are not susceptible to liquefaction
- the Economizer Ash Pond slopes have Factors of Safety that meet minimum required values for both static and seismic conditions,
- the Main Ash Pond slopes have Factors of Safety required for seismic conditions, and

- the catastrophic release of the contents of the Economizer Ash Pond would not overtop the Upper Ash Pond dikes.

Technical documentation provided after submittal of the Draft report included critical engineering analyses addressing slope stability of the dikes and dam break scenarios that provided critical hydrologic/hydraulic analyses of the capacity of the impoundments to store the design precipitation event and hold the contents of the Economizer Ash Pond.

1.1.4 Conclusions Regarding the Description of the Management Unit(s)

The description of the management units provided by Interstate Power and Light "IPL" was an accurate representation of what Dewberry observed in the field.

1.1.5 Conclusions Regarding the Field Observations

Dewberry staff was provided access to all areas in the vicinity of the management units required to conduct a thorough field observation. The visible parts of the embankment dikes and outlet structures were observed to have no signs of overstress, significant settlement, shear failure, or other signs of instability, although visual observations were hampered by the presence of thick vegetation in some areas.

The Ash Pond 2 dike and outlet structure were inundated by flood water from the Mississippi River at the time of Dewberry's site visit. The flood water prevented Dewberry from observing the Ash Pond 2 dike and outlet structure.

From visual observations the embankments appear to be structurally sound. There are no visual indications of unsafe conditions or needed remedial actions.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

The current maintenance and methods of operation appear to be adequate. There was evidence of recent rehabilitation of the Ash Pond 1 dike to repair wave erosion damage. Also a slurry wall was installed at the Ash Seal Pond in 2007.

There was no evidence of releases observed during the field inspection.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

The surveillance program appears to be adequate. Dikes forming the management units are not instrumented. Installation of a dike instrumentation program is not warranted at this time, based on the size of the dikes, the portion of the impoundments currently used to store wet ash and storm water runoff, the recent soils and engineering studies, the history of satisfactory performance, and the ongoing inspection program.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The facility rating is SATISFACTORY at this time for continued safe and reliable operation. The classification reflects the studies performed after the site visit that show the dikes meet minimum Factors of Safety.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

Observations made during the site visit do not indicate signs of overstress, significant settlement, shear failure, or other signs of instability. Technical documentation provided after submittal of the initial Draft report (See Section 10.0 and Appendix D) initially indicated slope stability issues, but subsequent soils analyses and engineering calculations concerning dike stability showed adequate structural stability exists for all dikes onsite.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

Observations made during the site visits and discussions with the participants indicated that impoundment dikes, except for the Lower Ash Pond, have not been overtopped in previous storms that produced flooding in the Mississippi River. Hydrologic/hydraulic analyses provided after issuing the Draft report indicate that the Main Ash Pond and Upper Ash Pond can retain the 100-year, 24-hour storm events without overtopping. Therefore there are no recommendations concerning hydrologic/hydraulic safety.

1.2.3 Recommendations Regarding the Supporting Technical Documentation

The supporting technical documentation provided in response to recommendations in the initial draft report was sufficient.

1.2.4 Recommendations Regarding the Description of the Management Unit(s)

No recommendations appear warranted at this time.

1.2.5 Recommendations Regarding the Field Observations

No recommendations appear warranted at this time.

1.2.6 Recommendations Regarding the Maintenance and Methods of Operation

Although the maintenance program appears to be adequate, the following recommendations should improve maintenance and ensure trouble-free operation:

- Develop a written operation and maintenance plan
- Remove trees from the downstream slopes of the Ash Seal Pond and Bottom Ash Pond dikes, pending approval from the Army Corps of Engineers and the Iowa Department of Natural Resources.

1.2.6 Recommendations Regarding the Surveillance and Monitoring Program

No recommendations appear warranted at this time.

1.2.7 Recommendations Regarding Continued Safe and Reliable Operation

Continue to minimize stockpiling of ash on the Economizer Ash Pond northern embankment.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

William P. Skalitzky, Alliant Energy
Buddy Hasten, Interstate Power and Light “IPL”
Robin Nelson, Interstate Power and Light “IPL”
Mark Hoskins, P.E., Dewberry
Joseph P. Klein, III, P.E., Dewberry

1.3.2 Acknowledgement and Signature

We acknowledge that the Burlington Generating Station management units referenced herein were assessed on October 7, 2010

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2.0 DESCRIPTION OF THE COAL COMBUSTION WASTE MANAGEMENT UNIT(S)

2.1 LOCATION AND GENERAL DESCRIPTION

The Burlington Generating Station is located on the west bank of the Mississippi River, approximately 5 miles south of Burlington, Iowa (See Appendix A – Doc 1). The plant is operated by Interstate Power and Light (IPL). The fly ash management system consists of five impoundments. The impoundment locations are shown on Figure 2.1-1 (Note: Proposed Coal Pile Runoff Pond has been completed).

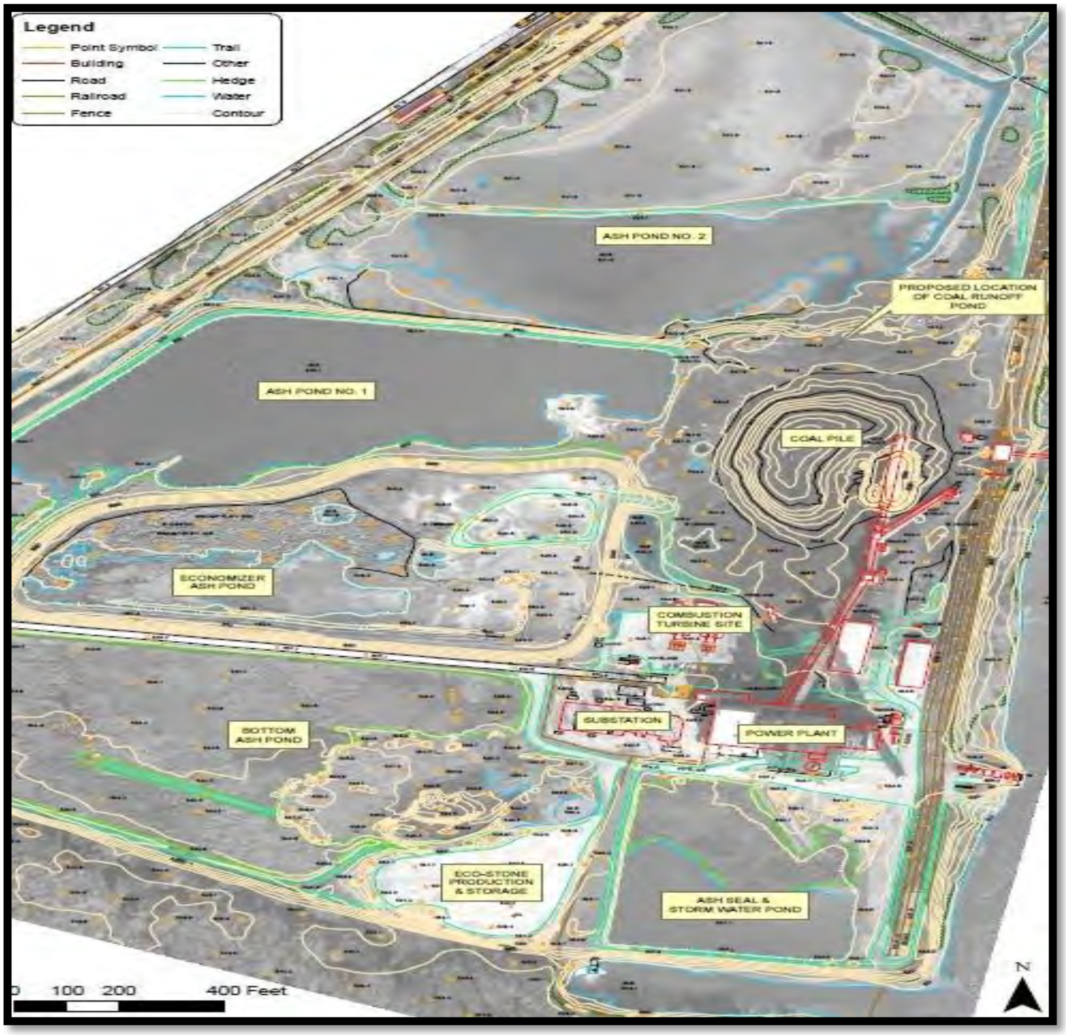

Figure 2.1-1: Burlington Generating Station Site Plan

The impoundment names indicated on the Site Plan are, in some cases, different than used in other technical documents. A cross-walk of impoundment names used on the site plan and other technical documents is provided in Table 2.1a. As plant personnel use the Site Plan impoundment names, this report also uses the impoundment names indicated on the site plan.

Table 2.1a Coal Combustion Waste Impoundment Reference Names

Site Plan	Ash Seal Pond	Bottom Ash Pond	Economizer Ash Pond	Ash Pond 1	Ash Pond 2
Technical Documents	Ash Seal Pond	Main Ash Pond	Economizer Ash Pond	Upper Ash Pond	Lower Ash Pond

The Ash Seal Pond was designed in the 1960s by Black & Veatch Consulting Engineers. The Ash Seal Pond was constructed as part of the general site fill placed to form the plant building pad (See Appendix A – Doc 2).

Design information for the other ponds was not provided to Dewberry for review. Information provided indicate Ash Ponds 1 and 2 were commissioned in 1971 and the Main Ash Pond commissioned in 1980. The Economizer Ash Pond was commissioned in 1986 and appears to have been formed by dividing Ash Pond 1 into two sections with an interior dike (See Appendix A – Doc 3).

The Ash Seal Pond had a spillway riser that discharged to a canal that emptied into the Mississippi River on the east site of the plant. That discharge was decommissioned in 2009. Storm water entering the Ash Seal Pond is pumped into the Main Ash Pond. The Main Ash Pond and Economizer Ash Ponds each discharge to Ash Pond 1 which discharges to Ash Pond 2. Ash Pond 2 discharges to an open drainage way flowing to the Mississippi River. An aerial photograph of the plant site and impoundments is provided in Appendix A – Doc 4.

Table 2.1b: Summary of Dam Dimensions and Size[1]					
	Ash Seal Pond	**Bottom Ash Pond**	**Economizer Ash Pond**	**Ash Pond 1**	**Ash Pond 2**
Dam Height (ft)	15	5	10	5	3
Crest Width (ft)	21[2]	10	15	12[3]	N/A[4]
Length (ft)	550	2,100	1,400	2,100	700
Side Slopes (upstream) H:V	Data Not Available				
Side Slopes (downstream) H:V	3:1	3:1	3:1	5:1	DNA

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[1] Based on Site Plan Drawing (Figure 2.1-1)

[2] *Burlington Generating Station Berm/Seep Investigation,* Hard Hat Services, August 31, 2007 (See Appendix A –Doc 5)

[3] *Upper Ash Pond 2009 Work Summary*, Klingner & Assoc., July 4, 2010 (See Appendix A – Doc 6)

[4] Lower Ash Pond dike was inundated by flooding from the Mississippi River at the time of Dewberry site inspection.

2.2 SIZE AND HAZARD CLASSIFICATION

The classification for size, based on the height of the embankment and the impoundment storage, of each impoundment is “Small” based on the U.S. Army Corps of Engineers (USACE) Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria summarized in Table 2.2.2:

Table 2.2a: USACE ER 1110-2-106 Size Classification		
	Impoundment	
Category	**Storage (Ac-ft)**	**Height (ft)**
Small	50 and < 1,000	25 and < 40
Intermediate	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

Dewberry conducted a qualitative hazard classification based on the Federal Guidelines for Dam Safety, dated April, 2004. The hazard assessment classifications are summarized on Table 2.2.b.

Table 2.2b: FEMA Federal Guidelines for Dam Safety Hazard Classification

	Loss of Human Life	**Economic, Environmental, Lifeline Losses**
Low	None Expected	Low and generally limited to owner property
Significant	None Expected	Yes
High	Probable. One or more expected	Yes (but not necessary for classification)

There are no residences within 2 miles down-gradient of the ash impoundments. Based on dike heights ranging from 3 to 15 feet and the impoundment locations on the edge of the Mississippi River or contributory drainage ways, the failure or misoperation of the dikes is not expected to result in the loss of human life. The economic impact is expected to be limited to the cost of removing released ash from portions of the Mississippi River and short stretches of contributing tributaries forming the boundary of the plant.

Based on the relatively small size of the impoundments, loss of life and significant economic damages are not expected in the event of a failure or misoperation of the impoundments, Dewberry evaluated **each ash impoundment as "LOW hazard potential".**

2.3 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY

Materials stored in the Ash Seal Pond may include fly ash, bottom ash, and economizer ash from past sluicing activities. Due to the 2009 rerouting of the ash seal pond water, the Ash Seal Pond only receives storm water runoff from the plant site and the hydrated fly ash (product name C-Stone, or Eco-Stone) storage pile (See Appendix A – Doc 6).

Material stored in the Bottom Ash Pond may include fly ash, bottom ash, and economizer ash from past sluicing activities. Wastewaters sent to the pond for further treatment include bottom ash sluicing water; non-chemical boiler wash water; ash seal water; floor drains from the plant during only during an emergency;

and storm water contributions from the plant site runoff and the storage pile associated with hydrated fly ash (Product Name C-Stone) storage pile. Due to the 2009 rerouting of the Ash Seal Pond, ash seal waters are processed through the Bottom Ash Pond (See Appendix A – Doc 6).

Materials stored in the Economizer Ash Pond may include fly ash, bottom ash, and economizer ash from past sluicing activities. Wastewaters sent to the Economizer Ash Pond for further treatment include economizer ash sluice waters; boiler blowdown; non-chemical air heater washes; oil water separator discharge resulting from the treatment of plant floor drains; plant storm water runoff; and wastewaters associated with the treatment of Mississippi River water for steam grade waters. In addition the Economizer Ash Pond receives coal pile runoff and Solids Contact Unit sludge created during the first phase of treatment of Mississippi River water in the steam grade water production (See Appendix A – Doc 6).

Materials stored in Ash Ponds 1 and 2 may include fly ash, bottom ash, and economizer ash from past sluicing activities. Wastewaters sent to the ponds for further treatment include effluent from the Bottom Ash Pond; Economizer Ash Pond and coal pile runoff pond (See Appendix A – Doc 6).

Table 2.3: Maximum Capacity of Unit

Ash Pond Name	Ash Seal Pond	Bottom (Main) Ash Pond	Economizer Ash Pond	(Upper) Ash Pond 1	(Lower) Ash Pond 2
Surface Area (acre)[1]	4.5	17.0	11.0	13.3	22.9
Current Storage Capacity (cubic yards)[1]	73,389	110,000	249,405	107,000	110,000
Current Storage Capacity (acre-feet)	45.9	68.2	154.6	66.3	68.2
Total Storage Capacity (cubic yards)[1]	110,083	137,214	267,219	215,000	184,000
Total Storage Capacity (acre-feet)	68.2	85.1	165.8	133.1	114.4
Crest Elevation (feet)	533.7	533.8	540	530	527.7
Normal Pond Level (feet)[2]	531.1	530.3	NA	529.1	521.5

[1] Data taken from Interstate Power and Light "IPL" May 22, 2010 letter to EPA (See Appendix A – Doc 6)

[2] Data taken from Site Plan with Elevations (See Appendix A – Doc 3)

2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankments

The Ash Seal Pond was constructed at the south end of the plant building pad (Appendix A – Doc 2) in the mid-to-late 1960s. The Ash Seal Pond was constructed by adding fill to form two parallel dikes extending approximately 550 feet south from the main fill pad. The impoundment was enclosed by a 500-foot long east-west dike at the south end. The embankment forming the east dike is part of the main building pad and supports three parallel railroad tracks and a vehicle access drive. The south embankment crest width is approximately 21 feet. The west embankment original crest width was probably 15 feet but appears to have been widened in conjunction with construction of the abutting Bottom Ash Pond.

The Bottom Ash Pond (i.e., Main Ash Pond) was constructed in the late 1970s by impounding the area on the west side of the Ash Seal Pond. The Bottom Ash Pond was formed by constructing an approximately 2,100 ft. "L" shaped dike abutting the Ash Seal Pond and the plant main access road embankment in the southeast and northwest corner of the Bottom Ash Pond respectively (Appendix A - Doc 3). The Bottom Ash Pond crest width is approximately 10 feet.

Ash Pond 1 (i.e., Upper Ash Pond) was constructed in the late 1960s and early 1970s by impounding the area on the north side of the plant access road. Ash Pond 1 was formed by constructing an approximately 2,100 ft. "L" shaped dike abutting the plant access road and the plant fill pad at in the southwest and northeast corners of Ash Pond, respectively (Appendix A Doc 3). The Ash Pond 1 dike crest width is approximately 12 feet.

Ash Pond 2 (i.e., Lower Ash Pond) was also constructed in the late 1960s and early 1970s by impounding the area adjacent to, and north of, Ash Pond 1. (Appendix A - Doc 3). Ash Pond 2 was formed by construction of a 700 ft. long dike between the embankment carrying the plant railroad tracks along the Mississippi River and the main line railroad embankment to the west of the plant (Appendix A – Doc 3).

The Economizer Ash Pond was constructed in the mid 1980s by dividing Ash Pond 1 into two sections. The Economizer Ash Pond is the southern portion of the original Ash Pond 1. The Economizer Ash Pond was formed by the construction of a diagonal dike from the abutting plant access road and the plant fill pad at in the southwest and northeast potions of Ash Pond, respectively (Appendix Doc 3). The east abutment of the Economizer Ash Pond is located approximately 400 feet south of the Ash Pond 1 abutment. The Economizer Pond west abutment is approximately 300 ft. east of the Ash Pond 1 abutment. The crest width of the Economizer Ash Pond is approximately 15 feet.

2.4.2 Outlet Structures

The Ash Seal Pond primary outlet was closed in 2009. The Iowa Department of Natural Resources amended the NPDES permit in January 2010 to reflect the closure.

The Bottom Ash Pond primary outlet consists of two 18-inch diameter corrugated metal pipes located in the northwest corner of the impoundment. The pipes carry water through the plant main access road embankment into Ash Pond 1.

The Economizer Ash Pond primary outlet consists of two 18-inch diameter concrete pipes located in the southwest corner of the impoundment. The pipes carry water through the Economizer Ash Pond dike into Ash Pond 1.

The Ash Pond 1 primary outlet is a riser located in the northeast corner of the impoundment. The outlet discharges into Ash Pond 2. The Ash Pond 1 spillway was submerged at the time of Dewberry's site visit, preventing observation of the spillway configuration.

The Ash Pond 2 spillway outlet is located in the northeast corner of the impoundment. The outlet discharges into the Mississippi River. The Ash Pond 2 spillway was submerged at the time of Dewberry engineers' site visit, preventing observation of the spillway configuration.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

Critical infrastructure information was not provided to Dewberry for review.

Based on available topographic maps (See Appendix A –Doc 7) surface drainage at the plant is toward the ash pond network which drains to the Mississippi River through Ash Ponds 1 and 2. Based on available aerial photographs (See Appendix A – Doc 4) and a brief driving tour of the area, Dewberry did not identify critical infrastructure assets within 5 miles down gradient of the ash ponds.

There is a main railroad line along the west side, and cross gradient to, the Ash Pond 1 and Ash Pond 2 impoundments. Based on the heights of the dikes along the western boundaries of those impoundments and the presences of a substantial drainage ditch between the dikes and the railroad, it is not expected that a failure of a western dike would have a significant impact on the adjoining railroad. Figure 2.5- 1 show the railroad tracks relative to the west boundary of Ash Pond 1. The Ash Pond 1 dike has a height of approximately 5 feet.

Figure 2.5-1: Railroad Right-of-Way Along West Boundary of Ash Pond 1.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

Interstate Power and Light "IPL" provided a pond inspection report conducted by plant personnel on March 4, 2009 (See Appendix A - Doc 8). The report identified several issues generally associated with signs of animal activity on the dike slopes, and trees and other woody type vegetation growing on the slopes.

Other issues identified in the inspection report include:

- Build up of settled ash near dike walls or discharge structure in the Economizer Ash Pond
    - Resolved. Observations during Dewberry's site visit indicated the area around the Economizer Ash Pond discharge structure was unobstructed.
- Visual seeps through the dike wall, erosion of dike outside slope, and ponding water outside the dike wall of Ash Pond 1
    - Resolved. Engineering firm retained to design and repair the Ash Pond 1 dike submitted a post-construction report indicating the work was successfully completed (See Appendix A – Doc 13).

The inspection report (See Appendix A - Doc 8) included three recommendations:

- Repair damage to Ash Pond 1 caused by animal activity.
    - Resolved. Engineering firm retained to repair the Ash Pond 1 dike submitted a post-construction report indicating the work was successfully completed (See Appendix A – Doc 13).
- Dredge the Economizer Pond to restore capacity
    - Resolved. Dredging of the Economizer Pond was underway during Dewberry's site visit. Documentation provided after submission of the initial Draft report indicated that dredging operations had been completed and stockpiled ash removed from the pond site.

- Remove tree from dikes.
    - Resolved. Observations during Dewberry's site visit indicated trees had been removed from the dike walls. The exceptions were along the outside slopes of the Ash Seal and Bottom Ash Ponds. Removal of trees in those locations require approval from the Army Corps of Engineers and the Iowa Department of Natural Resources due to the potential for some trees being habitat for endangered species thought to be present in the area.

IPL also provided a pond inspection report conducted by IPL personnel on July 23, 2010. The report identified two issues requiring corrective action:

- Trees growing on the Storm Water Pond (Ash Seal Pond) embankment
- Woody shrubs growing on the Economizer Ash Pond embankment

The report also identified soft soils and/or dead vegetation on the Ash Seal Pond dike wall. The report does not indicate whether corrective action was required.

Documentation provided to Dewberry for review indicated that the impoundments have not been rated by federal or state regulatory agencies and safety inspections by federal or state agencies have been neither conducted nor planned.

3.1 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS.

Water discharge from the Burlington Generating Station is regulated by the Iowa Department of Natural Resources (DNR). Iowa DNR has issued a National Pollutant Discharge Elimination System (NPDES) Permit, Iowa permit number 2900101 (See Appendix A – Doc 9). The permit was issued on September 5, 2006 and expires on September 4, 2011.

Supplemental information provided after submittal of the initial Draft report to EPA indicated that Burlington Generating Station submitted a NPDES Permit Renewal Application on February 18, 2011, which is greater than 180 days prior to permit expiration. The NPDES permit includes five outfalls:

- 001 – Discharge from Ash Pond Treatment System
- 002 – Discharge from plant septic tank and wastewater treatment system
- 004 – Condenser cooling water, non-contact cooling water and water intake screen backwash
- 005 – Discharge of chemical metal cleanings wastes
- 007 – Discharge from Coal Pile Runoff Retention Pond

The NPDES permit does not include an outfall designated 003. Outfall 006, the Ash Seal Pond, was removed from the permit in Amendment No. 2 since it no longer discharges to the condenser canal located along the south dike. (The condenser discharge canal discharges directly into the Mississippi River.) The Bottom Ash Pond and Economizer Ash Pond discharge into Ash Pond 1 which discharges into Ash Pond 2. Ash Pond 2 discharges into the Mississippi River. (See Appendix A – Doc 10).

3.2 SUMMARY OF SPILL/RELEASE INCIDENTS

Data reviewed by Dewberry did not indicate any spills, unpermitted releases, or other performance problems with the embankments over the last 10 years.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

The Burlington Generating Station Ash Seal Pond was designed in the mid-1960s by Black & Veatch Consulting Engineers. The Ash Seal Pond was formed as part of the site original plant construction site preparation, which included construction of a fill pad for the plant (See Appendix A – Doc 2).

The other impoundments were added to the coal combustion waste management system between 1971 and 1980. The sequence of construction for the additional ponds was (See Appendix A – Doc 6):

- Ash Pond 1 and Ash Pond 2 – commissioned 1971
- Bottom Ash Pond – commissioned 1980
- Economizer Ash Pond – commissioned 1986.

4.1.2 Significant Changes/Modifications in Design since Original Construction

Data provided to Dewberry for review indicated the Economizer Ash Pond was modified in 1990, 1992, and 2010. Specific information was not provided on the first two modifications.

In 2010 a large volume of economizer ash was dredged from the Economizer Ash Pond. The dredging changed the flow pattern within the pond to provide greater retention time and increased the size of the equipment pad to facilitate future dredging, dewatering and ash handling and loading.

Operational procedures for the Ash Seal Pond were changed in 2009. Prior to 2009, decant water from the Ash Seal Pond was discharged to the condenser discharge canal located adjacent to the south embankment of the pond. The condenser discharge pond drains directly into the Mississippi River. In 2009 the Ash Seal Pond spillway, identified on the NPDES Permit as Outfall 006, was closed and the outfall removed from the permit. Ash Seal Pond water is collected in a pump seal well and is discharged to the Bottom Ash Pond using a portable pump.

The other impoundments have not been significantly changed or modified since their original construction.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

Documentation provided to Dewberry for review included engineering data pertaining to repairs of dikes at the Ash Seal Pond and Ash Pond 1.

In the summer of 2007 a geotechnical investigation was conducted along the south dike of the Ash Seal Pond in response to apparent embankment seepage identified by plant personnel. The geotechnical investigation included soil test borings, soil strength tests conducted in the field, ground water level measurements and slope stability analyses (Appendix A – Doc 5). The investigation concluded that the calculated slope stability safety factor of 1.5 was adequate to "support the typical loads from normal site operations at the facility". The investigation also concluded that the shallow seeps were the result of sand seams in the clay fill used to construct the embankment.

In response to recommendations included in the geotechnical report, a 275-ft. long, approximately 8-ft. deep slurry cut-off wall was designed (Appendix A – Doc 11) and constructed (Appendix A – Doc 12) at the eastern end of the Ash Seal Pond south dike.

In early 2010, the Ash Pond 1 dike underwent rehabilitation to correct the effects of wave erosion. The rehabilitation included excavation of the damage areas; importing clay to regrade the levee crest and upstream slope; placing a geotextile membrane on the new subgrade, placing riprap along the upstream slope and crushed stone on the crest (Appendix A – Doc 13).

Documentation provided suggests that a similar rehabilitation was planned for Ash Pond 2 (Appendix A – Doc 14)

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

The Ash Seal Pond, commissioned in 1968, was the initial coal combustion waste management unit at the Burlington Generating Station. The Ash Seal Pond stored wet fly ash, wet bottom ash, process water from various plant sources and storm runoff from the south end of the plant. Decant water from the Ash Seal Pond discharged to the condenser discharge canal abutting the south dike. The condenser discharge canal discharged directly into the Mississippi River until 2009.

Ash Ponds 1 and 2, commissioned in 1971, stored wet fly ash, wet bottom ash, wet economizer ash, process water from various plant sources, coal pile runoff and storm runoff from the north end of the plant. Ash Pond 1 was the primary settlement pond and Ash Pond 2 was used to provide additional settlement time prior to discharge to the Mississippi River.

The Bottom Ash Pond, commissioned in 1980, to store fly ash, bottom ash, process water from various plant sources, and runoff from the hydrated ash (product name C-Stone) storage pile.

The Economizer Ash Pond, commissioned in 1986, stored wet fly ash, wet bottom ash, wet economizer ash, process water from various plant sources, coal pile runoff and storm runoff from the north end of the plant.

Decant waters from the Bottom Ash and Economizer Ash Ponds are routed to Ash Pond 1 and then to Ash Pond 2.

In 2010 a large volume of economizer ash was dredged from the Economizer Ash Pond. The dredging changed the flow pattern within the pond to provide greater retention time and increase the size of the equipment pad to facilitate future dredging, dewatering and ash handling and loading.

Operational procedures for the Ash Seal Pond were changed in 2009. Prior to 2009, decant water from the Ash Seal Pond was discharged to the condenser discharge canal located adjacent to the south embankment of the pond.

In 2009 the Ash Seal Pond spillway, identified on the NPDES Permit as Outfall 006, was closed and the outfall removed from the permit. Currently, Ash Seal Pond water is collected in a pump seal well and discharged to the Bottom Ash Pond using a portable pump.

4.2.2 Significant Changes in Operational Procedures and Original Startup

Documentation provided to Dewberry for review described the operational procedures of the Economizer Ash Pond in 1990 and 1992 (Appendix A – Doc 6). Information provided during Dewberry’s site visit indicated that the Economizer Ash Pond began to be used primarily to store dry (dewatered) ash. Wet ash was sluiced to a sump in the northeast corner of the Economizer Ash Pond. Perimeter ditches conducted decant water along the interior perimeter to a spillway at the southwest corner of the impoundment for discharge to Ash Pond 1. The majority of the Economizer Ash Pond footprint became used for storage of dry ash.

4.2.3 Current Operational Procedures

No significant changes in operational procedures have been made to the Bottom Ash Pond, Ash Pond 1 or Ash Pond 2 since the commissioning of the ponds.

As a result of engineering studies performed after the site visit, operating procedures have changed concerning the placement of dredged dry ash and location of heavy equipment relative to the north embankment of the Economizer Ash Pond. Ash is now only stored temporarily along the north dike and heavy equipment is no longer stored on that dike.

In 2009 the Ash Seal Pond spillway, identified on the NPDES Permit as Outfall 006, was closed and the outfall removed from the permit.

4.2.4 Other Notable Events since Original Startup

No additional information was provided to Dewberry concerning other notable events impacting operation of the Ash Seal Pond, Bottom Ash Pond, Economizer Ash Pond, Ash Pond 1 or Ash Pond 2.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Mark Hoskins, P.E. and Joseph P. Klein, III, P.E. performed a site visit on Thursday October 7, 2010 in company with the participants.

The site visit began at 8:00 AM. The weather was sunny and warm. Photographs were taken of conditions observed. Please refer to photographs in Appendix B and the Dam Inspection Checklist forms in Appendix C. Selected photographs are included here for ease of visual reference. All pictures in this section were taken by Dewberry personnel during the site visit.

Based on the observations during the site visit no significant findings were noted. The site observations did not include the Ash Pond 2 dike which was inundated by flood water from the Mississippi River at the time of the site visit.

5.2 ASH SEAL POND

5.2.1 Crest

The north boundary of the Ash Seal Pond is formed by the south end of the plant fill pad, making the crest part of the main plant site.

The east boundary of the Ash Seal Pond is formed by an embankment having a crest that supports a wide grassy area, a gravel covered vehicle roadway and three lines of railroad tracks. The crest had no signs of significant depressions, tension cracks or other indications of settlement or shear failure. Photograph 5.2.1-1 shows the Ash Seal Pond east dike crest.

The Ash Seal Pond south dike crest is paved with a gravel surface roadway. The crest had no signs of significant depressions, tension cracks or other indications of settlement or shear failure. Photograph 5.2.1-2 shows the Ash Seal Pond south dike crest.

Figure 5.2.1-1: Ash Seal Pond East Dike Crest

Figure 5.2.1-2: Ash Seal Pond South Dike Crest

The Ash Seal Pond west dike is also the west edge of the plant fill pad. The crest is covered with grass and gravel surface roadway for vehicle access. The crest had no signs of significant depressions, tension cracks or other indications of settlement or shear failure. Photograph 5.2.1-3 shows the Ash Seal Pond west dike crest.

Figure 5.2.1-3: Ash Seal Pond West Dike Crest and Inside Slope

5.2.2 Upstream/Inside Slope

The inside slopes of the Ash Seal Pond dikes are vegetated with various species of grass and weeds. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability. Figure 5.2.2-1 shows typical vegetation conditions of the inside slopes of Ash Seal Pond embankments

Figure 5.2.2-1: Ash Seal Pond Typical Inside Slope Vegetation Cover

5.2.3 Downstream/Outside Slope and Toe

The Ash Pond north boundary is the south edge of the plant fill pad with no outside slope impacting the impoundment. Similarly, the width of the east dike is such that the outside slope does not impact the 15 ft. high impoundment.

The outside slope of the Ash Seal Pond south dike is vegetated with grass and weeds near the crest and small to medium trees beginning a short distance below the crest. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability. Figure 5.2.3-1 shows the outside slope of the Ash Seal Pond south dike.

Figure 5.2.3-1: Ash Seal Pond South Dike Outside Slope

The Ash Seal Pond south dike is bordered by the condenser discharge canal that empties directly into the Mississippi River. At the time of Dewberry's site visit flooding of the Mississippi River raised the water level in the canal to reach the toe of the outside slope of the dike. Figure 5.2.3-2 shows the canal against the slope of the embankment.

Figure 5.2.3-2: Ash Seal Pond South Dike: Canal High Water against Toe of Outside Slope

The area adjacent to the outside slope of the Ash Seal Pond west dike had been filled to become the C-Stone (local product name for hydrated fly ash) storage. The C-Stone pile at the outside slope of the Ash Seal Pond west dike is shown in Figure 5.2.3-3.

Figure 5.2.3-3: C-Stone Storage Pile over Outside Slope Ash Seal Pond West Dike

5.2.4 Abutments and Groin Areas

The Ash Seal Pond is a diked impoundment formed by fill on four sides; therefore there are no abutments. Neither erosion nor uncontrolled seepage was observed along the groins. Groin slopes were protected with the same vegetative cover as the adjoining slopes. Figure 5.2.4-1 shows typical conditions observed at inside groins.

Figure 5.2.4-1: Ash Seal Pond inside Groin at Southeast Corner

5.3 BOTTOM ASH POND

5.3.1 Crest

The north boundary of the Bottom Ash Pond is the fill embankment constructed as part of the structural site preparation work. The embankment was originally constructed as the traffic access road to the plant. The crest is paved with rigid concrete pavement. The crest had no signs of significant depressions, tension cracks or other indications of settlement or shear failure. Photograph 5.3.1-1 shows the Bottom Ash north dike crest.

Figure 5.3.1-1: Bottom Ash Pond North Dike Crest

The Bottom Ash Pond east dike is also the west dike of the Ash Seal Pond. Dewberry's observations of the crest of that dike are presented in Section 5.2.1.

The crest of the Bottom Ash Pond south dike is heavily vegetated with weeds and swamp vegetation, much of which in over 6-ft. high making observations of surface conditions problematic. Figure 5.3.1-2 shows the conditions observed over much of the crest of the Bottom Ash Pond south dike.

Figure 5.3.1-2: Bottom Ash Pond South Dike Crest.

Similar vegetative conditions were observed at the Bottom Ash Pond west dike, except at the northern end of the dike. Figure 5.3.1-3 shows conditions at the northern end of the Bottom Ash Pond west dike. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability where observations were possible.

Figure 5.3.1-3: Bottom Ash Pond North End of West Dike

Additional data provided by Interstate Power and Light after submission of Dewberry's draft report indicate the crest of the Bottom Ash Pond dikes has been mowed.

5.3.2 Upstream/Inside Slope

The upstream slope of the Bottom Ash Pond north dike is vegetated with grass, except near the normal pool elevation. Near the normal pool elevation vegetation consisted of small trees and bushes. Figure 5.3.2-1 shows conditions along the upstream slope of the Bottom Ash Pond north dike.

Figure 5.3.2-1: Bottom Ash Pond North Dike Upstream Slope

The upstream slope of the Bottom Ash Pond east dike is the downstream slope of the Ash Seal Pond west dike. Hydrated fly ash (product name C-Stone) is stored along the downstream slope of the Bottom Ash Pond east dike. Figure 5.2.2.-3 shows the area along the Bottom Ash Pond east dike upstream slope on the left side of the photograph.

The upstream slopes of the Bottom Ash Pond south and west dikes were generally vegetated with marsh grasses, bamboo and small trees. Photograph 5.3.2-2 shows conditions typical of the upstream slope of the west dike.

Figure 5.3.2-2: Bottom Ash Pond Upstream Slopes South and West Dikes

5.3.3 Downstream/Outside Slope and Toe

The downstream slope of the Bottom Ash Pond north dike is the upstream slope of the Economizer Ash Pond south dike. Fly ash stored in the Economizer Ash Pond is above the crest elevation of the Bottom Ash Pond north dike so that the downstream slope is not visible. In Figure 5.3.2-1 the embankment on the right side of the photograph is the downstream side of the Bottom Ash Pond north dike.

The downstream slope of the Bottom Ash Pond east dike is the upstream slope of the Ash Seal Pond west dike which is vegetated with grass. Figure 5.2.3-3 shows the Bottom Ash Pond east dike downstream slope on the right side of the photograph.

The downstream slope of the Bottom Ash Pond south dike was vegetated with tall grass and weeds, and small bushes. Figure 5.3.3-1 shows typical conditions of the downstream slope of the Bottom Ash south dike.

Figure 5.3.3-1: Bottom Ash Pond Downstream Slope South Dike

Flooding of the Mississippi River into the condenser discharge canal resulted in high water along the toe of the Bottom Ash Pond south dike downstream slope. Figure 5.3.3-2 shows canal water along the slope toe.

Figure 5.3.3-2: Bottom Ash Pond South Embankment: Discharge Canal Flooding back-up to Downstream Slope Toe

The downstream slope of the Bottom Ash Pond west slope is vegetated with tall plants and small trees. Figure 5.3.3-3 shows conditions along the Bottom Ash Pond west dike downstream embankment. No areas of seepage were observed along the toe of the downstream slope.

Figure 5.3.3-3: Bottom Ash Pond West Dike Downstream Slope

5.3.4 Abutments and Groin Areas

The documentation provided to Dewberry indicates the Bottom Ash Pond was impounded by constructing the south and west dikes to abut the north and east dikes which were constructed as part of the original site.

Neither erosion nor seepage was observed along the groins or abutments. Groin slopes are protected with the same vegetation cover as the adjoining slopes. Figure 5.3.2-2 shows the upstream groin between the Bottom Ash Pond south and west dikes.

5.4 ECONOMIZER ASH POND

5.4.1 Crest

The crest of the Economizer Ash Pond had no signs of significant depressions, tension cracks or other indications of settlements or shear failure. The crest is gravel covered to provide access for service vehicles. Figure 5.4.1-1 shows typical crest conditions. Note that subsequent to this picture, IPL has agreed to minimize the stockpiling of ash and storage of heavy equipment on the north embankment.

Figure 5.4.1-1: Overhead View of Economizer Ash Pond Crest with Dredging Equipment.

5.4.2 Upstream/Inside Slope

The upstream slope of the Economizer Ash Pond is vegetated with various species of grass and weeds. Figure 5.4.1-1 above shows the upstream slope of the Economizer Ash Pond. The upstream slope is shown in the center of the photograph with the dredging equipment.

5.4.3 Downstream/Outside Slope and Toe

The downstream slope of the Economizer Ash Pond forms the southern boundary of Ash Pond 1. Above the water line the slope is vegetated with grass, weeds and small trees.

The toe of the Economizer Ash Pond dike downstream slope was below the Ash Pond 1 water level and was not observed.

5.4.4 Abutments and Groin Areas

The Economizer Ash Pond east abutment area was filled with dry fly ash. As the west abutment was the location of the gravity discharge to Ash Pond 1, standing water was present. Figure 5.4.4-1 shows standing water at the western abutment of the Economizer Ash Pond dike.

Figure 5.4.4-1: Economizer Ash Pond West Abutment and Pipe Spillway Invert

5.5 ASH POND 1

5.5.1 Crest

The crest Ash Pond 1 dike had no significant depressions, tension cracks or other indications of settlements or shear failure. The crest of the Ash Pond 1 dike is gravel paved for service vehicle access. Figure 5.5.1-1 shows typical crest conditions.

Figure 5.5.1-1: Ash Pond 1 Crest at Southwest End

5.5.2 Upstream/Inside Slope

The upstream slope of Ash Pond 1 dike was protected by crushed stone riprap. There were no observed scarps, sloughs, bulging, cracks, depressions or other indications of slope instability. Figure 5.5.2-1 shows a representative section of the upstream slope of the embankment.

Figure 5.5.2-1: Ash Pond 1 Embankment Upstream Slope

5.5.3 Downstream/Outside Slope and Toe

At the east and center portion of Ash Pond 1 the downstream slope is the southern boundary of Ash Pond 2. Above the Ash Pond 2 water level the downstream slope of the embankment is vegetated with small weeds. Figure 5.5.3-1 shows the conditions of the eastern and central portion of Ash Pond 1 dike downstream slope. Ash Pond 2 is on the right side of the photograph.

Figure 5.5.3-1: Ash Pond 1 Dike Central Section Downstream Slope

The western portion of the Ash Pond 1 dike is bordered by a railroad drainage ditch. Figure 5.5.3-2 shows the conditions along the western portion of the dike downstream slope.

Figure 5.5.3-2: Ash Pond 1 West Section Downstream Slope

The toe of the downstream slope along the entire length of the Ash Pond 1 dike is submerged either by Ash Pond 2 or the railroad drainage ditch.

5.5.4 Abutments and Groin Areas

No erosion we observed at the abutments or groins. No seepage was observed above the water elevation at the abutments. Potential seepage below the water level could not be observed. Figure 5.5.4-1 shows conditions at the western abutment.

Figure 5.5.4-1: Ash Pond 1 West Abutment

5.6 ASH POND 2

5.6.1 Crest

The Ash Pond 2 dike was overtopped by flood waters from the Mississippi river. Flood flow into a drainage way on the discharge side of Ash Pond 2 was back-flowing over the 3-ft. high Ash Pond 2 dike at the time of the site visit. Figure 5.6.1-1 shows the location of the ash pond dike. The elevated pipeline is supported by foundation along the Ash Pond 2 dike crest.

Figure 5.6.1-1: Ash Pond 2 Dike Crest Location beneath Pipe Support Columns.

5.6.2 Upstream/Inside Slope

Due to flood waters overtopping the Ash Pond 2 dike, observations of the upstream slope were not possible at the time of Dewberry's site visit.

5.6.3 Downstream/Outside Slope and Toe

Due to flood waters overtopping the Ash Pond 2 dike, observations of the downstream slope and toe were not possible at the time of Dewberry's site visit.

5.6.4 Abutments and Groins

Due to flood waters overtopping the Ash Pond 2 dike, observations of the abutments and groins slope were not possible at the time of Dewberry's site visit.

5.7 OUTLET STRUCTURES

5.7.1 Overflow Structures

The Ash Seal Pond former overflow structure is located in the southwest corner of the impoundment at the intersection of the south and west dikes. The overflow structure was permanently closed and decommissioned in 2009. The outfall has been removed from the NPDES permit. Figure 5.7.1-1 shows the overflow structure.

Figure 5.7.1-1: Ash Seal Pond Primary Spillway Structure.

Water in the Bottom Ash Pond is routed by interior ditches to the south and west, then north to the main plant access road embankment, which also serves as the north dike of the Bottom Ash Pond. Water then flows from the Bottom Ash Pond through two 18-inch diameter corrugated metal pipes through the access road embankment. Figure 5.7.1-2 shows the Bottom Ash spillway pipes.

Figure 5.7.1-2: Bottom Ash Pond Primary Spillway Structure

Water in the Economizer Ash Pond is routed by interior ditches to the southwest corner of the impoundment. Water flows through an inlet structure to two 18-inch diameter concrete pipes. At the time of Dewberry's site visit the Economizer Ash Pond water level had submerged the spillway inlet. Figure 5.7.1-3 shows the Economizer Ash Pond spillway inlet location.

Figure 5.7.1-3: Economizer Ash Pond Spillway Location

The Ash Pond 1 primary spillway is located in the northeast corner of the impoundment. The spillway area is bordered by wire fencing serving as a trash rack. A manually operated screw lift stop log is used to control discharge from Ash Pond 1. Figure 5.7.1-4 shows the Ash Pond 1 spillway inlet location.

Figure 5.7.1-4: Ash Pond 1 Spillway Location

The Ash Pond 2 spillway is located in the northeastern portion of the impoundment. As floodwater from the Mississippi River had overtopped the Ash Pond 2 dike, only the top of the spillway stop log was visible during Dewberry's site inspection. Figure 7.7.1-5 shows the top of the manually operated spillway stop log device.

Figure 5.7.1-5: Ash Pond 2 Top of Spillway Stop Log Device

5.7.2 Outlet Conduit

The original outlet structure of the Ash Seal Pond discharged into the condenser discharge canal. The ash seal pond outlet has been permanently sealed and the outfall has been removed from the NPDES permit. At the time of Dewberry's site visit, the Mississippi River was flooding into the condenser discharge canal. As a result Dewberry was unable to observe the Ash Seal Pond outlet.

The Bottom Ash Pond discharges into an interior drainage ditch at the southwest corner of Ash Pond 1. Figure 5.7.2-1 shows the Bottom Ash Pond spillway outlet discharge.

Figure 5.7.2-1: Bottom Ash Pond Spillway Outlet Conduits

The Economizer Ash Pond spillway pipes also discharge into the interior drainage ditch at the southwest corner of Ash Pond 1. Figure 5.7.2-2 shows the Economizer Ash Pond spillway discharge pipes.

Figure 5.7.2-2: Economizer Ash Pond Spillway Outlet Conduits

The spillway outlet for Ash Pond 1 discharges into Ash Pond 2. The outlet was submerged at the time of Dewberry's site inspection and could not be observed.

The Ash Pond 2 spillway outlet conduits carry flow through an embankment along the river and discharge into for Mississippi River. The embankment is not part of the Ash Pond 2 structure. High water in the Mississippi River prevented Dewberry's observation of the Ash Pond 2 spillway outlet.

5.7.3 Emergency Spillway

None of the Burlington Generating Station ash ponds have an emergency spillway.

5.7.4 Low Level Outlet

None of the Burlington Generating Station ash pond had a low level outlet.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

No documentation has been provided concerning the flood of record.

6.1.2 Inflow Design Flood

Prior to submission of the draft report no documentation had been provided about the inflow design flood for Ash Seal Pond, Bottom Ash Pond, Economizer Pond, Ash Pond 1 or Ash Pond 2. Subsequent to the site visit hydrologic studies were performed by the utility. Section 10.2.2 presents information concerning the inflow design flood.

6.1.3 Spillway Rating

Prior to submission of the draft report, IPL had not provided documentation about Ash Seal Pond, Bottom Ash Pond, Economizer Pond, Ash Pond 1 or Ash Pond 2 spillway ratings. Subsequent to the site visit hydrologic/hydraulic studies were performed by the utility. Section 10.2.3 presents spillway rating information.

6.1.4 Downstream Flood Analysis

No downstream flood analysis data were provided to Dewberry for review.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

The technical documentation provided to Dewberry prior to submission of the draft report lacked critical hydrologic and hydraulic analyses data to assess the hydrologic/hydraulic safety of the Ash Seal Pond, Bottom Ash Pond, Economizer Pond, Ash Pond 1 or Ash Pond 2. Subsequent to the submission of the Draft report, IPL provided EPA with supplemental hydrologic and hydraulic documentation for the Bottom Ash Pond and Ash Pond 1. The supplemental hydrologic and hydraulic documentation is discussed in Section 10.2 of this report.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Based on the supplemental technical documentation, the hydrologic and hydraulic safety of the Ash Seal Pond, Bottom Ash Pond, Economizer Pond, Ash Pond 1 or Ash Pond 2 is rated **SATISFACTORY.**

7.0 STRUCTURAL STABILITY

IPL provided stability analysis information concerning the Ash Seal Pond prior to production of the draft report. This section only presents a discussion of the structural stability of the ash seal pond.

No stability analyses of the Bottom Ash Pond, Economizer Ash Pond, Ash Pond 1 or Ash Pond 2 were provided to Dewberry for review prior to writing the draft site assessment report. After reviewing the draft report, IPL directed that a series of engineering studies be conducted concerning structural stability of the dikes, soil composition, and liquefaction of soils underlying the ponds (see Appendix D). The results of those studies were provided to USEPA during March-June 2011 and are presented, along with a discussion of the engineering studies, in Section 10 of this report.

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

Documentation of slope stability analyses for the Ash Seal Pond south dike was provided to Dewberry for review. The documentation was provided in the August 31, 2007 report *Burlington Generating Station Berm/Seep Investigation*, prepared by Hard Hat Services (See Appendix A – Doc 5).

The stability analyses for the Ash Seal Pond included only one long-term loading condition. The report concluded that the calculated safety factor of 1.5 "*will be adequate to support typical loads from normal site operations at the facility*…"

7.1.2 Design Parameters and Dam Materials

The Ash Seal Pond stability analyses were based on parameters developed during the geotechnical investigation (see Appendix A - Doc 6). The documentation indicated the stability analyses assumed three strata: soft clay, sand and firm clay. The material properties used in the analyses are shown in Table 7.1.2

Table 7.1.2: Summary of Soil Properties Used in the Stability Analyses

Soil Strata	Total Unit Weight (pounds per cubic foot)	Saturated Unit Weight (pounds per cubic foot)	Cohesion (pounds per square foot)	Friction Angle (degrees)
Soft Clay	120	120	500	0
Sand	130	130	0	30
Firm Clay	125	125	1250	0

No data pertaining to the Ash Seal Pond embankment original design parameters were provided to Dewberry for review.

7.1.3 Uplift and/or Phreatic Surface Assumptions

The Ash Seal Pond slope stability documentation provided to Dewberry did not specifically identify uplift forces acting on the base of the dike. However, the documentation indicates the analyses were conducted using STABL5M 2-D software which includes uplift pressures in the algorithms used to compute stability factors of safety.

The phreatic surface used in the analyses used the pool elevation at the upstream slope and the level of the reported shallow seep at the downstream slope (Appendix A – Doc 5).

7.1.4 Factors of Safety and Base Stresses

The safety factor computed in the slope stability report (Appendix D – Doc 5) is listed in Table 7.1.4

Table 7.1.4 Slope Stability Factors of Safety Burlington Generating Station Ash Seal Pond		
Loading Condition	**Required Safety Factor (U.S. Army Corps of Engineers)[1]**	**Ash Seal Pond**
Long-Term Stability	1.5	1.5
Rapid Drawdown Stability	1.2	Not Calculated
Seismic Stability	1.2	Not Calculated

[1] U.S. Army Corps of Engineers Engineering Manual 1110-2-1903 *Slope Stability*, 31 October 2003

7.1.5 Liquefaction Potential

No documentation of soil liquefaction analyses was provided to Dewberry for review.

7.1.6 Critical Geological Conditions

Documentation provided for the Ash Seal Pond included a geologic cross section of the south dike. The cross section included three strata: soft clay, sand and firm clay (See Appendix A – Doc 5)

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

The technical documentation provided to Dewberry lacked critical engineering analyses data required to assess the structural stability of all the ponds. Technical documentation for the Ash Seal Pond was incomplete and no technical documentation was provided for the Bottom Ash Pond, Economizer Pond, Ash Pond 1 or Ash Pond 2 embankments. In the Draft report, Dewberry recommended new geotechnical engineering analyses be conducted to verify that the existing slope stability safety factors meet or exceed acceptable standards.

Subsequent to the submission of the Draft report, IPL provided EPA with supplemental structural stability documentation for the Bottom Ash Pond (referred to as the Main Ash Pond in the supplemental documentation), Ash Seal Pond, Economizer Ash Pond, and Ash Pond 1. The supplemental structural stability documentation is discussed in Section 10.3 of this report.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

The structural stability of the Ash Seal Pond was rated as fair in the draft report, based on the data provided that showed this four acre pond meets minimum Factors of Safety under static conditions. Further studies (see Section 10.3) showed improved Factors of Safety so the rating is changed to **Satisfactory.**

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

Ash Seal Pond - Materials stored in the Ash Seal Pond may include fly ash, bottom ash, and economizer ash from past sluicing activities. Due to the 2009 re-routing of the ash seal water, the Ash Seal Pond only receives storm water runoff from the plant site and the hydrated fly ash (Product name C-Stone) storage. No new coal combustions wastes are added to the Ash Seal Pond. A low dike around the spillway riser was constructed to prevent water from being discharged thought the closed outfall. Figure 8.1-1 shows the interior dike and sealed spillway inlet.

Figure 8.1-1: Ash Seal Pond Interior Low Dike and Spillway Riser

Bottom Ash Pond [Main Ash Pond] - Materials stored in the Bottom Ash Pond may include fly ash, bottom ash, and economizer ash from past sluicing activities. Wastewaters sent to the pond for further treatment include bottom ash sluice water; non-chemical air heater and boiler wash waters; ash seal water; and storm water from plant runoff and the storage pile associated with the hydrated ash (Project name C-Stone). Due to the 2009 re-routing of ash seal water, ash seal waters are processed through the Bottom Ash Pond. Water collected in the Bottom Ash Pond is routed through interior drainage ditches to the northwest corner of the impoundment where is flows through a spillway consisting of two 18-inch diameter corrugated metal pipes beneath the plant main access road embankment into Ash Pond 1. Figure 8.1-2 shows the spillway inlet.

Figure 8.1-2: Bottom Ash Pond Primary Spillway Inlet

Economizer Ash Pond - Materials stored in the Economizer Ash Pond may include fly ash, bottom ash, and economizer ash from previous sluicing activities. Wastewaters sent to the Economizer Ash Pond for further treatment include economizer and sluice waters; boiler blowdown; non-chemical air heater basket wash water; oil water separator discharge resulting in the treatment of plant floor drains; plant storm water runoff; and wastewaters associated with the treatment of Mississippi River water for steam grade water makeup. In addition, the Economizer Ash Pond receives coal pile runoff and Solids Contact Unit sludge created during the first phase of treatment of the Mississippi River water in steam grade water production (see Appendix A – Doc 6). Water collected in the Economizer Ash Pond is routed to the south and west with interior perimeter ditches to the southwest corner of the impoundment. The water flows through two 18-inch diameter concrete pipes beneath the Economizer Ash Pond dike discharging into an Ash Pond 1 interior drainage ditch. Figure 8.1-3 shows the Economizer Ash Pond spillway inlet.

Figure 8-1-3: Economizer Ash Pond Spillway Inlet

Ash Pond 1 [Upper Ash Pond] - Materials stored in Ash Pond 1 may include fly ash, bottom ash, and economizer ash from past sluicing activities. Wastewaters sent to Ash Pond 1 for further treatment include effluent from the Bottom Ash Pond, Economizer Ash Pond, and Coal Pile Runoff Pond (see Appendix A – Doc 6). Ash Pond 1 decant water flows to the primary spillway located in the northeast corner of the impoundment. Figure 8.1-4 shows the location of the low interior dike and the primary spillway entrance.

Figure 8.1-4: Ash Pond 1 Primary Spillway Riser

Ash Pond 2 [Lower Ash Pond] - Materials stored in Ash Pond 2 may include fly ash, bottom ash, and economizer ash from past sluicing activities. Wastewaters sent to Ash Pond 2 for further treatment include effluent from the Bottom Ash Pond, Economizer Ash Pond, and Coal Pile Runoff Pond (See Appendix A – Doc 6). Ash Pond 2 decant water flows to the primary spillway located in the northeast corner of the impoundment. The spillway structure was inundated at the time of Dewberry's site visit preventing observation.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Documentation of an operations and maintenance plan was not provided to Dewberry for review.

Based on observations made during the site visit, the crests of the Ash Seal Pond, Economizer Ash Pond and Ash Pond 1 were generally clear of vegetation except for occasional short grass along the edge of the crests. The crest of the south and west dikes of the Bottom Ash Pond were heavily vegetated with tall weeds and bamboo over 6-feet tall. At the time of Dewberry's site visit, the crest of the Ash Pond 2 dike was inundated by flood water from the Mississippi River and could not be observed.

The downstream slopes of the Ash Seal Pond and Bottom Ash Pond were vegetated with tall weeds and small to medium trees. The downstream slope of the Economizer Ash Pond was vegetated with various species of tall grass and weeds. The downstream slope of Ash Pond 1 was course crushed stone with occasional weeds. At the time of Dewberry's site visit the Ash Pond 2 dike downstream slope was inundated by flood water from the Mississippi River and could not be observed.

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

8.3.1 Adequacy of Operating Procedures

Based on the assessments of this report, operating procedures appear to be adequate.

8.3.2 Adequacy of Maintenance

Although the current maintenance program appears to be adequate for the Economizer Ash Pond and Ash Pond 1, several recommendations are provided to improve maintenance and ensure a trouble free operation:

- Develop a written operations and maintenance plan
- Clear tall vegetation from the crest of the Bottom Ash dikes
    - Information provided by IPL subsequent to submittal of the Dewberry Draft report indicates tall vegetation along the crest of the Bottom Ash Pond has been removed.
- Remove trees from the downstream slopes of the Ash Seal Pond and Bottom Ash Pond dikes pending regulatory approval from the Army Corps of Engineers and the Iowa Department of Natural Resources.

.

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Surveillance procedures are specified in the Alliant Energy “Genco Standard Guide for Pond Inspections, Procedure No. GENCO-0-OP-402-01” dated April 30, 2009 (See Appendix A – Doc 15). The program requirements include:

- Inspections by knowledgeable plant personnel at intervals determined based on physical construction and arrangement, and local operating conditions, including spring snow melt and flooding. Inspections must be conducted at least annually.
- Additional corporate environmental staff pond inspection conducted a minimum of once a year. The latest annual pond inspection was performed in July 2010.

9.2 INSTRUMENTATION MONITORING

None of the Burlington Generating Station’s five coal waste management impoundment embankments have an instrumentation monitoring system.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Based on the data reviewed by Dewberry, including observations during the site visit, the inspection program is adequate.

9.3.2 Adequacy of Instrumentation Monitoring Program

None of the Burlington Generating Station’s five coal waste management impoundment embankments have an instrumentation monitoring system

Based on the size of the embankments, the current inspection program, and the observations made during the site visit, an embankment monitoring program is not needed at this time.

10.0 SUPPLEMENTAL HYDROLOGIC AND STABILITY DOCUMENTATION

10.1 SUPPLEMENTAL TECHNICAL DOCUMENTATION

Dewberry provided a draft of this report dated November 5, 2010 for review by USEPA. In the report, based on the lack of available hydrologic/hydraulic and stability analyses, Dewberry recommended conducting new analyses based on current design criteria. The EPA sent the draft report to the utility and State of Iowa for review. After reviewing the report, Interstate Power and Light (IPL) provided additional technical documentation entitled *Ash Pond Slope Stability and Hydraulic Analysis, Burlington Generating Station, Burlington, IA,* February 3, 2011, prepared by Aether DBS (See Appendix D - Doc 22).

The findings in the February 2011 Aether DBS report showed that the Economizer Ash Pond and Main Ash pond did not meet minimum Factors of Safety (see Section 10.3.1 below and Appendix D - Doc 23). As a result, the USEPA required immediate actions be taken by IPL to address the safety of the Burlington Generating Station ash ponds. A series of memoranda and studies were developed as a result of the report, including:

- Significant Structural Stability Concerns at the Burlington Generating Station, correspondence dated March 18, 2011 from USEPA to Alliant Energy Corporate Services (See Appendix D – Doc 24)

- Response to USEPA Concerns, Burlington Generating Station, correspondence dated March 23, 2011 from IPL to EPA (See Appendix D – Doc 25)

- Response to Additional Activities Request, United States Environmental Protection Agency March 29, 2011 Response, correspondence dated April 4, 2011 from Aether DBS to IPL (See Appendix D – Doc 26).

- Burlington Generating Station Response to USEPA Letter dated 3-29-2011, Memorandum dated April 5, 2011 from Burlington Generating Station Plant Manager to Alliant Energy Managing Attorney (See Appendix D – Doc 27)

- Ash Pond Slope Stability and Seismic Analysis – Supplement BGS (dated June 1, 2011) correspondence from Aether DBS to IPL (See Appendix D – Doc 28).

10.2 HYDROLOGIC AND HYDRAULIC SAFETY

10.2.1 Flood of Record

No information was provided about the flood of record in the additional documentation. However, flooding is commonplace at the site, as observed during the site visit. Design flood information was provided.

10.2.2 Inflow Design Flood

Documentation provided to Dewberry (See Appendix D - Doc 22) indicated the design storm was the 100-year (1-percent probability of occurrence in any given year), 24-hour event with an intensity of 6.8 inches. The documentation concluded that the Main Ash Pond can store net inflow from the design storm with a freeboard of 0.8 feet, and the Upper Ash Pond can store the design storm net inflow with a freeboard of 0.75 feet.

10.2.3 Spillway Rating

Documentation provided to Dewberry for review indicated the Main Ash Pond spillway capacity was 18 cubic feet per second (CFS), and the Upper Ash Pond spillway capacity was 7 CFS.

10.2.4 Summary Analysis

A freeboard of 0.8 feet or less is below the desired 1.0 ft freeboard, but should be sufficient. Spillway capacities are adequate for the two ponds.

10.3 IMPOUNDMENT STRUCTURAL STABILITY

10.3.1 Stability Analyses and Load Cases Analyzed, February 3, 2011 Report

Aether DBS, at the direction of IPL, conducted slope stability analyses for the CCR impoundment embankments. Results of the analyses were provided in the report cited above, dated February 3, 2011 (See Appendix D- Doc 22). The analyses were conducted following the guidelines of the U.S. Army Corps of Engineers slope stability manuals and computer modeling software.

The stability analyses assumed soil strata data from original design documents and included results for two loading conditions:

- Long-term, steady conditions at normal pool elevations
- Seismic loading at normal pool elevations.

The results of the February 3 report showed Factors of Safety less than required minimum values, that the site was susceptible to liquefaction, and there was potential for imminent and substantial endangerment. The results of the February 3 report and subsequent recommendations for further study and immediate action by the USEPA are summarized in Appendix D, Document 28.

10.3.2 Stability Analyses and Load Cases Analyzed, June 1, 2011 Report

The June 1 report provided new soil composition and strength data based on cone penetrometer and geoprobe sampling. See Tables 10.3.1(a) and (b) below.

Table 10.3.1(a) Economizer Ash Pond Stability Analysis Soil Properties, June 1, 2011 Report

Soil Type	Depth Range (ft)	Cohesion (psf)	Friction Angle (Ø) (Degrees)
Eastern Cross Section			
CCR Cohesionless	0 – 20	0	34
CCR Cohesionless	20 – 33	0	32
CCR Cohesive	20 -33	1,000	0
Native Clay	33 – 41	600	0
Native Sense 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 Sense Sand	>40	0	30

Table 10.3.1 (b) Ash Seal, Main Ash and Upper Ash Ponds Stability Analyses Soil Properties

CCR Pond	Soil Strata	Cohesion (psf)	Friction Angle (Ø) (Degrees)
Ash Seal Pond	Embankment	700	
	Sand		37
	Clay	900	
Main Ash Pond	Embankment	700	
	Clay	1,200	
Upper Ash Pond	Embankment	1,950	
	Clay	900	
	Sand		35

Using the updated soils information, new structural stability analyses were performed. See Table 10.3.2.The results indicate that the slope stability Factors of Safety for all four ponds meet or exceed the minimum requirements.

Table 10.3.2 Results of Slope Stability Analyses

Loading Condition	CCR Pond	Slope Stability Safety Factor		
		Minimum	Feb. 3, 2011 Analyses	June 1, 2011 Analyses
Long Term - Static	Ash Seal Pond	1.5	1.6	2.2
	Main Ash Pond		2.1	4.3
	Economizer Ash Pond		1.1	1.5
	Upper Ash Pond		2.1	3.4
Long Term - Earthquake	Ash Seal Pond	>1.0	1.2	1.8
	Main Ash Pond		1.0	2.6
	Economizer Ash Pond		0.7	1.5
	Upper Ash Pond		1.5	2.6

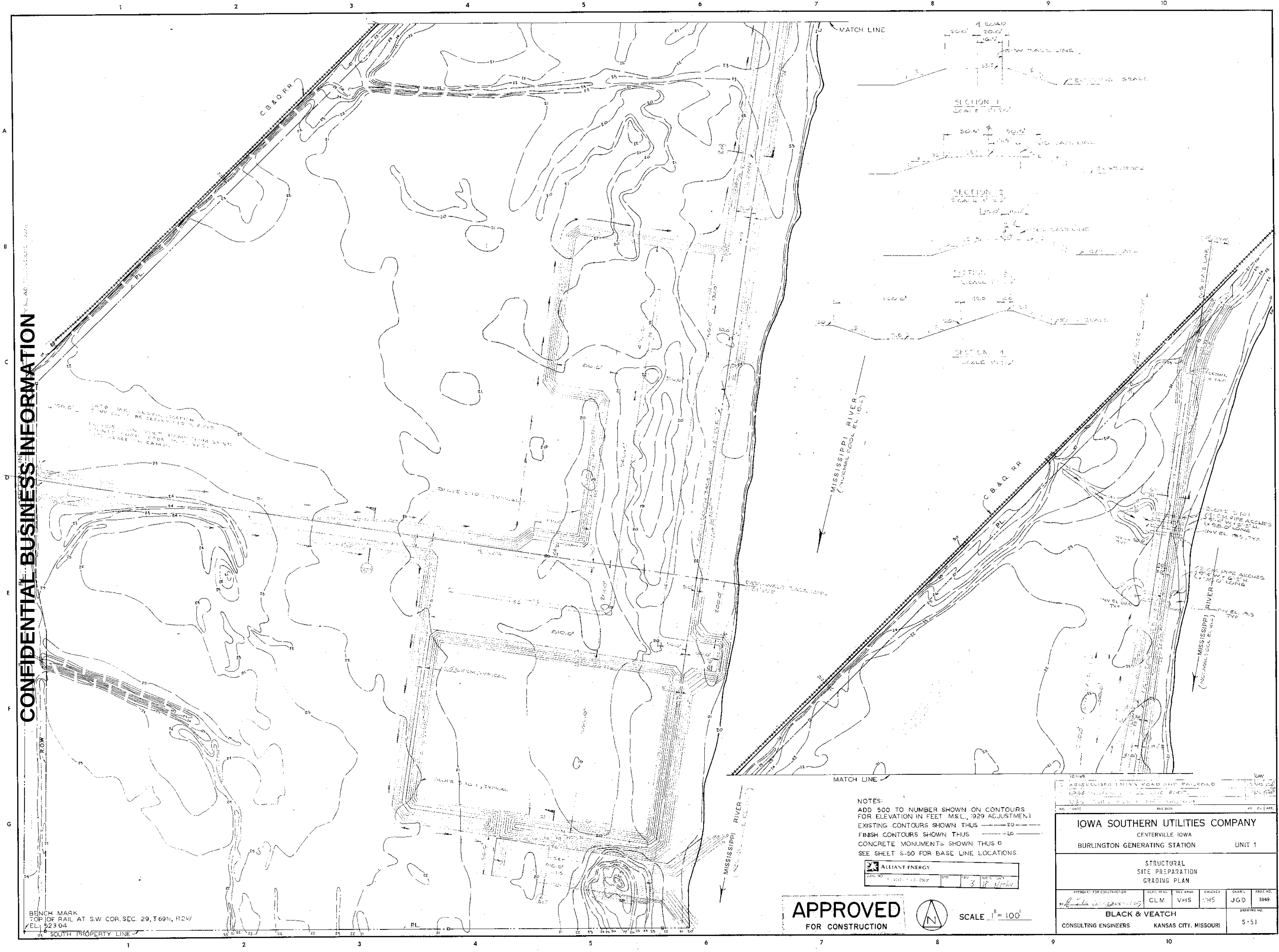
10.1 10.4 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

The technical documentation provided to USEPA for the Burlington Generating Station is adequate to perform the critical engineering analyses required to assess the structural stability of all the ponds.

10.1 10.5 ASSESSMENT OF STRUCTURAL STABILITY

Based upon the data provided by IPL (see Appendix D) and summarized in this section, the structural stability of the four ash ponds at the Burlington Generating Station is rated as **Satisfactory.**

Alliant Energy Burlington Generating Station
Burlington, Iowa
Site Location Plan



NOTES:

ADD 500 TO NUMBER SHOWN ON CONTOURS FOR ELEVATION IN FEET M.S.L., 1929 ADJUSTMENT

EXISTING CONTOURS SHOWN THUS ——20——

FINISH CONTOURS SHOWN THUS ——20——

CONCRETE MONUMENTS SHOWN THUS ▫

SEE SHEET S-50 FOR BASE LINE LOCATIONS.

ALLIANT ENERGY

DWG NO	SHT	REV	INITIAL DATE
[illegible]		3	[illegible]

APPROVED
FOR CONSTRUCTION

SCALE 1" = 100'

NO.	DATE	REVISION	BY	CK	APP.
	12-11-69	REVISED ENTRY ROAD AND RAILROAD	KAY	VHS	
	[illegible]	[illegible]			
	[illegible]	[illegible]			

IOWA SOUTHERN UTILITIES COMPANY

CENTERVILLE, IOWA

BURLINGTON GENERATING STATION UNIT 1

STRUCTURAL
SITE PREPARATION
GRADING PLAN

APPROVED FOR CONSTRUCTION	DEPT. HEAD	DES. ENGR.	CHECKED	DRAWN	PROJ. NO.
BY [illegible]	CLM	VHS	VHS	JGD	3849

BLACK & VEATCH
CONSULTING ENGINEERS KANSAS CITY, MISSOURI

DRAWING NO. S-51

30" x 42" = 8.75 SQ. FT.

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BURLINGTON GENERATING STATION SITE

IP&L ALLIANT ENERGY
BURLINGTON, IOWA

STRAND ASSOCIATES, INC.®
ENGINEERS

FIGURE 1
1-292.008


© 2010 Google
Image USDA Farm Service Agency
©2009 Google
Imagery Dates: Jun 20, 2009 - Jun 28, 2009
40°44'37.78" N 91°07'04.40" W elev 525 ft
Eye alt 5435 ft

HARD HAT SERVICES
Engineering, Construction and Management Solutions
940 E. Diehl Road Suite 150, Naperville, IL 60563
Phone (630) 637-9470 Fax (630) 637-9471
www.hardhatinc.com

August 31, 2007

Robin R. Nelson
Environmental & Safety Specialist
Alliant Energy/Interstate Power & Light Co.
4282 Sullivan Slough Road
Burlington, IA 52601-9015

Re: Burlington Generating Station Berm/Seep Investigation
Interstate Power & Light Co.

Introduction

Interstate Power & Light Co. (IP&L) retained Hard Hat Services (HHS) to investigate the stability of the berm that isolates the settling pond from the drainage channel, which discharges directly in the Mississippi River, and to determine the origin of the seep that was observed by IP&L in the southeast corner of the settling pond (Figure 1).

Investigation Activities

The investigative activities were conducted on Tuesday, August 7, 2007 and included advancing nine soil borings at the Burlington Generating Station (BGS) to depths between 6 and 15 feet. The borings were completed on the berm that separates the BGS's settling pond from the discharge channel to the Mississippi River. A photographic log has been included in Exhibit A.

A licensed geologist logged the borings in the field. Water bearing zones and the presence of groundwater were also recorded. In most borings 1-inch diameter schedule 40 PVC piezometers with 5-foot screens were installed. Water levels from the piezometers were measured and the borings and piezometers were surveyed for relative elevations (Exhibit B). The south end of west rail was used as the benchmark elevation. Soil boring logs are provided in Exhibit C.

Soil lithology starting at ground surface generally consists of 2 to 3 feet of brown, fine to coarse grained ash. Underlying the ash, to an approximate depth of 10 feet below ground surface, is a dark grayish-brown, low to high plasticity clay. At most soil boring locations the clay contained several thin (approximately 1/16th inch thick) sand seams, which appeared wet. In soil borings SB-1, SB-5, SB-6, and SB-8 a black, medium to coarse grained, wet sand was encountered at 10 feet below ground surface. Based on borings SB-1 and SB-5, the sand is between 3.5 and 4 feet thick. Also based on borings SB-1 and SB-5, the sand is underlain by a black, high plasticity, highly organic clay.

Depth to water in the piezometers was surveyed on Tuesday, August 7 and again on Tuesday, August 14, 2007. Water was not present in all piezometers on August 7, but after allowing them to equilibrate for seven days, water was found to be present in all piezometers. Groundwater elevations in the piezometers varied between 2.5 to 8 feet BGS (Exhibit D).

The collected geotechnical and groundwater information was used to determine slope stability of the berm. The slope stability calculations have been completed based on a conservative approach using the STABL5M 2-D limit equilibrium slope stability program from Purdue University (1996). A conservative dike/soil profile using conservative soil strengths were entered into the slope stability program. The program showed an acceptable slope stability Factor of Safety of approximately 1.5 (The factor of safety is equal to the soil shear strength/soil shear stress along the most critical potential shear surface). The ten most critical surfaces analyzed are shown in Exhibit E along with the soil strengths and dike/sub-surface geometry. The analysis conservatively assumed;

- Dike side slope of 2:1 with a 3:1 side slope into the ash pond,
- Top of dike is approximately 21 feet wide,
- Ash pond water level near the top at elevation 101' with relatively high pore pressure through out the dike as shown by the "W1" water table/piezometric surface,
- Cohesionless materials are assumed to only have a relatively low 30-degree angle of internal fiction (which is appropriate for loose fine sand whereas much is medium to coarse grained), and
- Cohesive materials have been assigned the lowest non-zero shear strength results found based on field pocket penetrometer testing in all nine borings. For the clay above the "deep" sand layer, 500 PSF shear strength/cohesion was assumed whereas 1,250 PSF cohesion was specified below the deep sand layer.

Conclusions

Berm Slope Stability – Based on the slope stability calculations, the berm will be adequate to support the typical loads from normal site operations at the facility, although the area of the seeps should be regraded to avoid further erosion after the shallow seeps are stopped. If the shallow seeps not stopped, the leakage over time may cause increased erosion and could have detrimental impacts to the stability of the berm.

Shallow Seeps – While on site, the berm bank along the water discharge channel was inspected and several shallow seeps were observed. The shallow seep, observed by IP&L near the southeast corner of the settling pond berm, appears to be fed from the settling pond through sand seams that exist within the clay berm. The sand seams exit the south side of the berm at the exact elevation where the shallow seep is first observed. This information is conclusive that the seeps originate from the settling pond. As a result, the Iowa Department of Natural Resources would most likely consider this a non-permitted discharge from the pond and would require that IP&L conduct repair work to prevent the seeps from occurring.

Deep Seeps – Because the Mississippi River elevation was sufficiently low, a deeper seep was observed along the southern base of the berm slope that extended for about 250 feet. At that elevation, the 3.5 to 4 foot sand seam was exposed at the ground surface. This sand seam produced groundwater seeping onto the toe of slope. It is unclear if the liquids from the lower sand seam were from natural groundwater discharge or influenced by the settling pond. Because the depth and construction of the settling pond is unknown, HHS cannot determine if the settling pond is hydraulically connected through the sand seam unless further testing is completed or additional information is provided by IP&L.

Suggested Approach

After carefully assessing the site geology and hydrogeology, HHS recommends the following:

Shallow Seeps – IP&L should prevent the water from discharging through the shallow sand seams. By stopping water from traveling through the shallow sand seams, the seeps observed on the southern slope of the berm would be eliminated.

Deep Seeps – The groundwater discharging through the deep sand seam should be left unchanged. HHS recommends leaving the deep sand seam because if it were isolated, significant hydraulic pressure may build up and could potentially create a larger problem at a different location along the berm.

Suggested Solution

Our suggested method for preventing the flow of water through the shallow sand seams would be to construct a shallow slurry wall comprised of native soil and a combination of fly ash and/or bentonite powder to create a low permeability barrier along the majority of the length of the settling pond. Slurry walls must be carefully designed and constructed to ensure that a constant mixture of materials is used to create a barrier that will prevent the groundwater flow, which will in turn eliminate the shallow seeps along the southern berm.

Please feel free to call me if you have any questions with this investigation report.

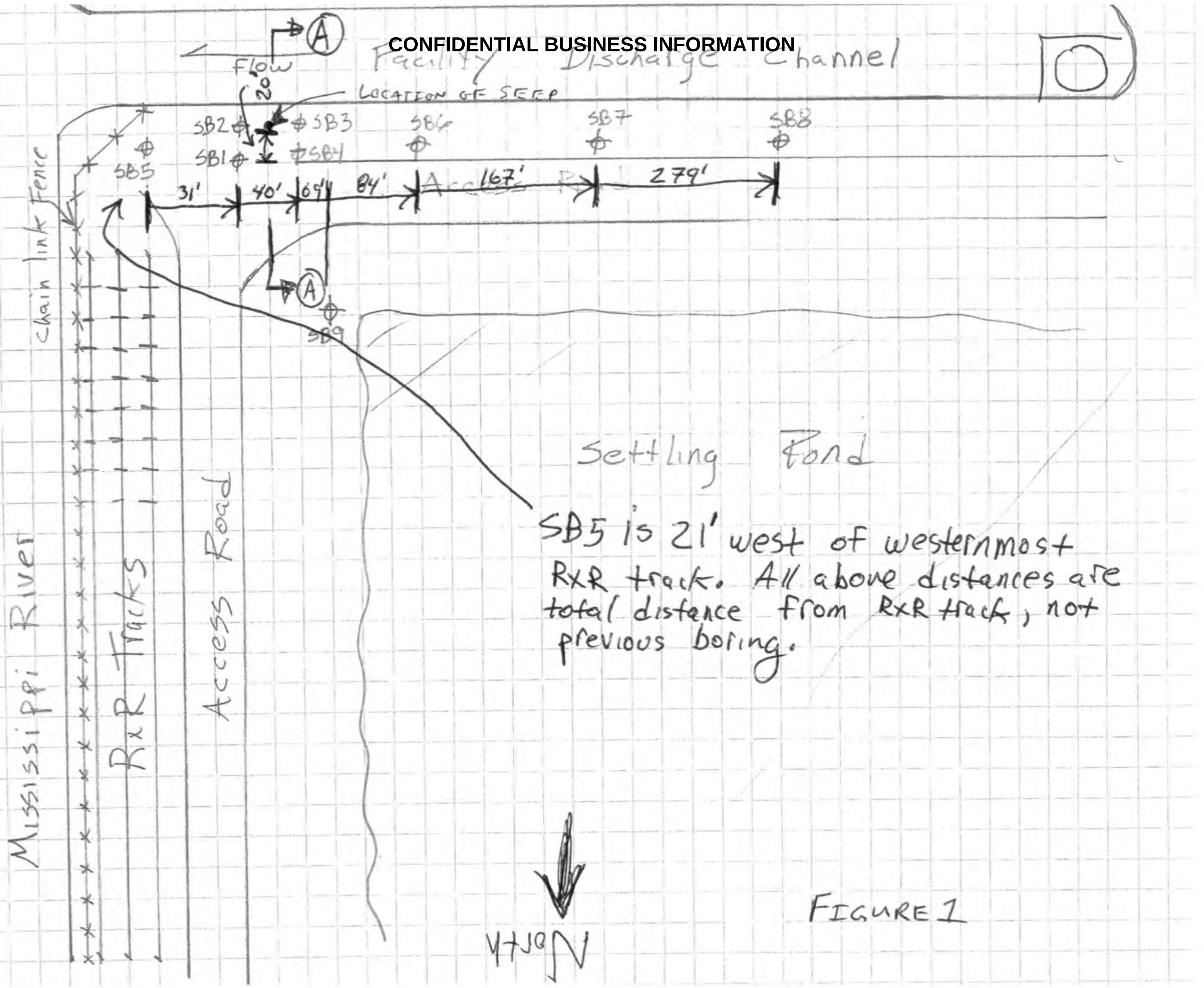
Sincerely,
HARD HAT SERVICES

Mark Loerop

Mark W. Loerop, P.E.
Project Manager

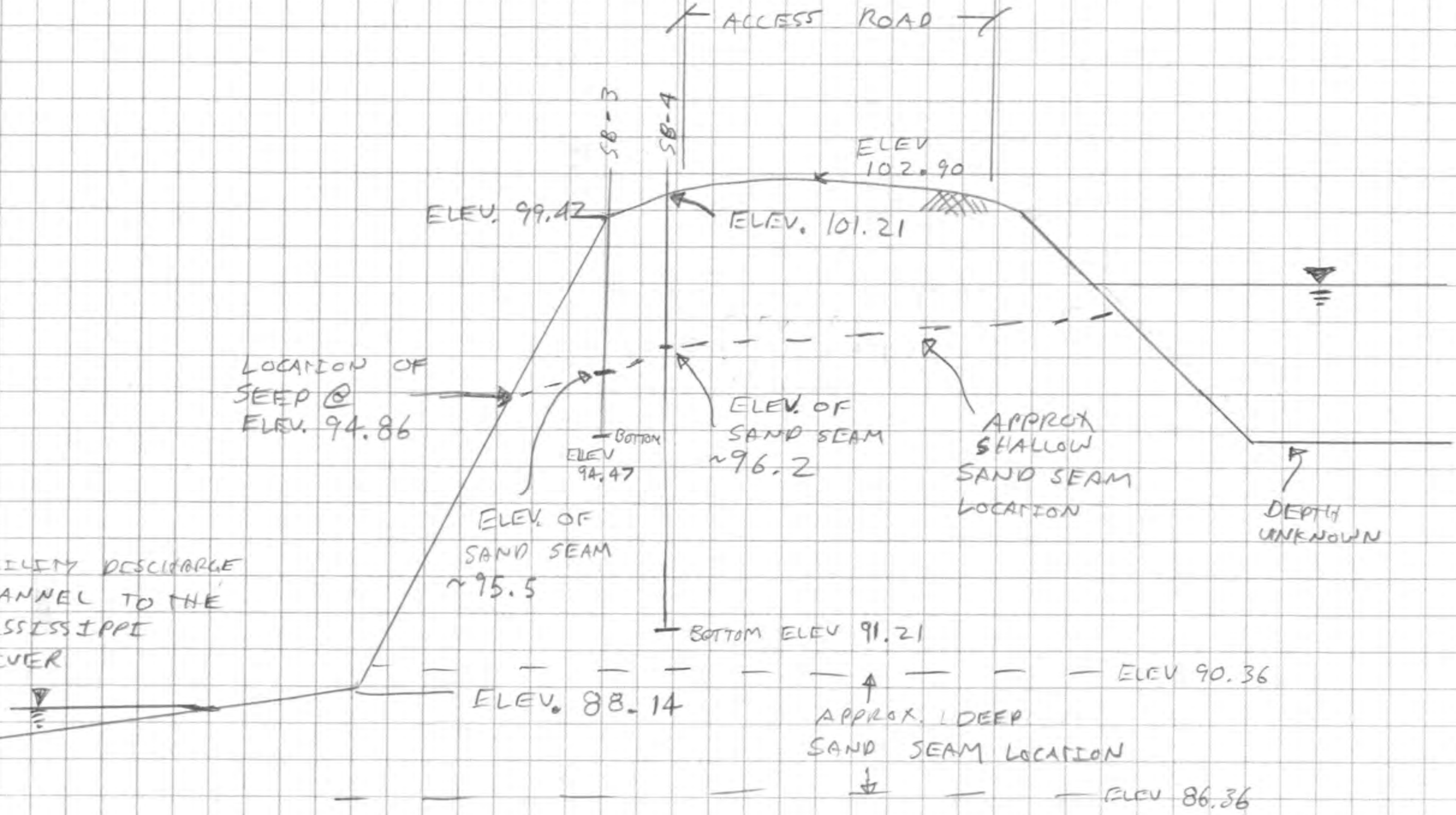
Cc: John McDonough – Via Email
Bill Skalitzky – Via Email

O:\154 - Alliant Energy\154.002 Burlington\002 - Berm Investigation\Burlington - Berm Investigation.doc



SB5 is 21' west of westernmost RxR track. All above distances are total distance from RxR track, not previous boring.

FIGURE 1



SECTION A-A

NTS

FIGURE 2

Exhibit A – Photographic Log

Photo 1) Southeast – Facility Discharge Channel Toward the Mississippi River

Photo 2) South – Seep Location in from Berm

Photo 3) East - Facility Discharge Channel Toward the Mississippi River

Photo 4) West – Facility Discharge Channel; Continuous Wet Ground after Dry Weather

Photo 5) Soil Core from Geoprobe

Photo 6) Soil Core from Geoprobe

Exhibit B – Elevation Survey

Borehole and Temp. Well Survey Data
Allinat Energy Plant
Burlington, IA
August 7, 2007

Location	B.M.	B.S.	F.S.	Elevation	Notes
Rail	100.00			100.00	Top or westernmost steel RxR rail.
H.I.			6.82	106.82	Height of instrument
SB1		6.46		100.36	Groundsurface
SB2		7.56		99.26	Groundsurface
SB2		3.84		102.98	TOC
SB3		7.35		99.47	Groundsurface
SB3		5.75		101.07	TOC
SB4		5.61		101.21	Groundsurface
SB4		4.60		102.22	TOC
SB5		7.06		99.76	Groundsurface
SB6		4.54		102.28	Groundsurface
SB6		1.90		104.92	TOC
SB7		4.92		101.90	Groundsurface
SB7		1.80		105.02	TOC
SB8		5.20		101.62	Groundsurface
SB8		2.22		104.60	TOC
SB9		4.72		102.10	Groundsurface
SB9		3.82		103.00	TOC
Seep		11.96		94.86	Groundsurface @ flowing seep approx. halfway down slope
Base of slope		18.68		88.14	Groundsurface @ base of slope below seep

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Exhibit C – Soil Boring Logs

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Environmental Field Services, LLC

BORING LOG

CONFIDENTIAL BUSINESS INFORMATION

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alnt - Burlington

BORING NO.: *SB-1*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Mark Lorep*
DATE BEGAN: *8-7-07*
DATE FINISHED: *8-7-07*
GROUND SURFACE ELEVATION: *100.36*

TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS (PPM)	PID vs. DEPTH	POCKET PENETROMETER (TSF)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
								0	🟥	ASH; well graded; fine to coarse grained; dry.
	SP1	3.5'/5'							🟥	
						2.75			🟩	CLAY; dark grayish brown; low to high plasticity; moist; trace sand, gravel and organic matter.
						2.0			🟨	
						4.0		-5	🟨	@ 4.5' and 5.0' are thin (1/16" thick) sand seams, wet.
▽						1.0			🟩	
	SP2	5'/5'				1.0			🟩	
						1.25			🟩	
						1.0			🟩	
								-10	🟨	SAND; black; medium to coarse grained; graded; wet.
	SP3	5'/5'							🟨	
						1.25			🟩	CLAY; black; high plasticity; moist; trace to some organic matter.
						2.0		-15		Bottom of boring @ 15'. Boring advanced w/ track mounted Geoprobe Model 6610DT using Macrocore soil sampling system (60"long x 1.5" wide). Boring backfilled to groundsurface w/ bentonite chips and hydrated on 8-7-07.
								-20		

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Environmental Field Services, LLC

BORING LOG

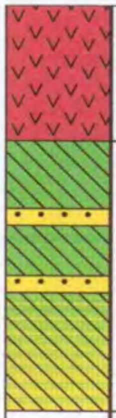
CONFIDENTIAL BUSINESS INFORMATION [redacted] COORDINATES: N NOT SURVEYED
E NOT SURVEYED

PROJECT: Alnt - Burlington

BORING NO.: *SB-2*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Mark Lorep*
DATE BEGAN: *8-7-07*
DATE FINISHED: *8-7-07*
GROUND SURFACE ELEVATION: *99.26*

TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS (PPM)	PID vs. DEPTH	POCKET PENETROMETER (TSF)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
								0		ASH; well graded; fine to coarse grained; dry.
	SP1	3'/4'				2.5				CLAY; dark grayish brown; low to high plasticity; moist; trace sand, gravel and organic matter.
						2.75				@ 3' and 4' are a thin 1/16" thick sand seams, wet, trace satl deopsit in sand.
∇						2.75				
	SP2	2'/2'				2.75		-5		
						2.75				
										Bottom of boring @ 6'.
										Boring advanced w/ track mounted Geoprobe Model 6610DT using Macrocore soil sampling system (60"long x 1.5" wide).
								-10		1-inch PVC temp. well installed to 6-feet bgs w/ 5' screen on 8-7-07. TOC elevation = 102.98
								-15		
								-20		

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BORING LOG

CONFIDENTIAL BUSINESS INFORMATION

CLIENT: Hard Hat

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alnt - Burlington

BORING NO.: *SB-3*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Mark Lorep*
DATE BEGAN: *8-7-07*
DATE FINISHED: *8-7-07*
GROUND SURFACE ELEVATION: *99.47*

TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS (PPM)	PID vs. DEPTH	POCKET PENETROMETER (TSF)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
								0		ASH; well graded; fine to coarse grained; dry.
∇										CLAY; dark grayish brown; low to high plasticity; moist to wet; trace sand, gravel and organic matter.
	SP1	4'/5'				4.0				@ 1.5' water is present and confined to an approximate 1-inch seam.
						3.5				
∇						3.0				@ 3.5' to 4.0' are three 1/16-inch thin sand seams, wet.
								−5		
										Bottom of boring @ 5'.
										Boring advanced w/ track mounted Geoprobe Model 6610DT using Macrocore soil sampling system (60"long x 1.5" wide).
								−10		1-inch PVC temp. well installed to 5-feet bgs w/ 5' screen on 8-7-07. TOC elevation = 101.07
								−15		
								−20		

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Environmental Field Services, LLC

BORING LOG

CONFIDENTIAL BUSINESS INFORMATION

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alnt - Burlington

BORING NO.: *SB-4*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Mark Lorep*
DATE BEGAN: *8-7-07*
DATE FINISHED: *8-7-07*
GROUND SURFACE ELEVATION: *101.21*

TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS (PPM)	PID vs. DEPTH	POCKET PENETROMETER (TSF)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
								0		ASH; well graded; fine to coarse grained; dry.
	SP1	4'/5'								
										CLAY; dark grayish brown; low to high plasticity; moist; trace sand, gravel and organic matter.
∇										
										SAND, GRAVEL & ASH; brown to black; fine to coarse grained; graded; wet; trace to some silt and clay.
						1.0		-5		
										CLAY; dark grayish brown; low to high plasticity; moist; trace sand, gravel and organic matter.
						0.5				
						0.5				
	SP2	4'/5'								
						1.0				
						1.5				
						2.0		-10		
										Bottom of boring @ 10'.
										Boring advanced w/ track mounted Geoprobe Model 6610DT using Macrocore soil sampling system (60"long x 1.5" wide).
								-15		1-inch PVC temp. well installed to 10-feet bgs w/ 5' screen on 8-7-07. TOC elevation = 102.22
								-20		

CABENO

Environmental Field Services, LLC

BORING LOG

CONFIDENTIAL BUSINESS INFORMATION

CLIENT: Hard Hat

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alnt - Burlington

BORING NO.: *SB-5*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Mark Lorep*
DATE BEGAN: *8-7-07*
DATE FINISHED: *8-7-07*
GROUND SURFACE ELEVATION: *99.76*

O WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS (PPM)	PID vs. DEPTH	POCKET PENETROMETER (TSF)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
								0		ASH; well graded; fine to coarse grained; dry.
	SP1	4'/5'								
▽										CLAY; dark grayish brown; low to high plasticity; moist; trace sand, gravel and organic matter.
						3.0				
								-5		@ 4.5' is a 2-inch brown, fine sand, moist.
						1.5				
						1.25				
						1.0				
	SP2	4'/5'								
						0.5				
						1.5				
▽										
								-10		SAND; black; med to coarse grained; graded; wet.
	SP3	5'/5'								
										CLAY; black; high plasticity; some (high) organic matter.
						2.0				
								-15		
						2.0				
										Bottom of boring @ 15'. Boring advanced w/ track mounted Geoprobe Model 6610DT using Macrocore soil sampling system (60"long x 1.5" wide).
								-20		

CABENO

Environmental Field Services, LLC

BORING LOG

CONFIDENTIAL BUSINESS INFORMATION

CLIENT: Hard Hat

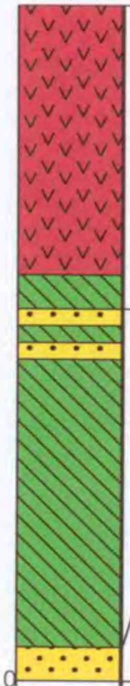
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alnt - Burlington

BORING NO.: *SB-6*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Mark Lorep*
DATE BEGAN: *8-7-07*
DATE FINISHED: *8-7-07*
GROUND SURFACE ELEVATION: *102.28*

TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS (PPM)	PID vs. DEPTH	POCKET PENETROMETER (TSF)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
								0		ASH; well graded; fine to coarse grained; dry.
	SP1	4'/5'								
▽						2.5				
						2.5		-5		CLAY; dark grayish brown; low to high plasticity; moist; trace sand, gravel and organic matter. @ 4.5' and 5' is a 1-inch brown, fine sand, wet.
						2.5				
						2.5				
	SP2	4'/5'								
						2.5				
						2.0				SAND; black; med to coarse grained; graded; wet.
								-10		Bottom of boring @ 10'.
										Boring advanced w/ track mounted Geoprobe Model 6610DT using Macrocore soil sampling system (60"long x 1.5" wide).
								-15		Boring backfilled w/ bentonite chips from 10' bgs to 5' bgs. 1-inch PVC screen set to 5' bgs on 8-7-07. TOC Elevation = 104.92.
								-20		

CABENO

Environmental Field Services, LLC

BORING LOG

CONFIDENTIAL BUSINESS INFORMATION

CLIENT: [redacted]

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alnt - Burlington

BORING NO.: *SB-7*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Mark Lorep*
DATE BEGAN: *8-7-07*
DATE FINISHED: *8-7-07*
GROUND SURFACE ELEVATION: *101.90*

TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS (PPM)	PID vs. DEPTH	POCKET PENETROMETER (TSF)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
								0	▨	CLAY; dark brown to black; non-plastic to low plasticity; dry to moist; trace sand, gravel and ash.
	SP1	4'/5'								
∇										
								-5		
									▨	Interbedded SAND & CLAY
	SP2	4'/5'								
								-10		Bottom of boring @ 10'.
										Boring advanced w/ track mounted Geoprobe Model 6610DT using Macrocore soil sampling system (60"long x 1.5" wide).
								-15		1-inch PVC screen set to 10' bgs w/ 5' screen on 8-7-07. TOC Elevation = 105.02.
								-20		

BORING LOG

CABENO
Environmental Field Services, LLC

CONFIDENTIAL BUSINESS INFORMATION

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alnt - Burlington

BORING NO.: *SB-8*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Mark Lorep*
DATE BEGAN: *8-7-07*
DATE FINISHED: *8-7-07*
GROUND SURFACE ELEVATION: *101.62*

TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS (PPM)	PID vs. DEPTH	POCKET PENETROMETER (TSF)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
								0		CLAY; dark brown to black; non-plastic to low plasticity; dry to moist; trace sand, gravel and ash.
	SP1	4'/5'								
∇										
						2.5		-5		
						2.25				
						2.25				
∇	SP2	4'/5'								
										SAND; 1st 1.5-inches stained orange-red then grades gray to black; fine to coarse grained; well graded; wet.
								-10		Bottom of boring @ 10'. Boring advanced w/ track mounted Geoprobe Model 6610DT using Macrocore soil sampling system (60"long x 1.5" wide). 1-inch PVC screen set to 10' bgs w/ 5' screen on 8-7-07. TOC Elevation = 104.60.
								-15		
								-20		

CABENO
Environmental Field Services, LLC

BORING LOG

CONFIDENTIAL BUSINESS INFORMATION

CLIENT: Hard Hat

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

PROJECT: Alnt - Burlington

BORING NO.: *SB-9*

page 1 of 1

LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Mark Lorep*
DATE BEGAN: *8-7-07*
DATE FINISHED: *8-7-07*
GROUND SURFACE ELEVATION: *102.10*

TO WATER WHILE DRILLING	SAMPLE NO. AND TYPE	SAMPLE RECOVERY	SAMPLE INFROMATION	PID READINGS (PPM)	PID vs. DEPTH	POCKET PENETROMETER (TSF)	CONSISTENCY vs. DEPTH	DEPTH IN FEET
								0
						0.5		
						1.25		
	SP1	4'/5'						
						1.0		
∇						1.0		
						0.5		-5
						0.5		
						0		
	SP2	4'/5'						
						0		
						1.0		
						1.25		-10
								-15
								-20

PROFILE

DESCRIPTION

CLAY; dark brown to black; non-plastic to low plasticity; dry to moist; trace sand, gravel and ash.

@ 4.5' is a wet seam, approx. 1-inch thick.

@ 7' is a wet seam, approx. 1.5-inch thick.

Bottom of boring @ 10'.

Boring advanced w/ track mounted Geoprobe Model 6610DT using Macrocore soil sampling system (60"long x 1.5" wide).

1-inch PVC screen set to 10' bgs w/ 5' screen on 8-7-07. TOC Elevation = 103.00.

Exhibit D – Water Levels

Water Level Data

CONFIDENTIAL BUSINESS INFORMATION

Alliant Energy - Burlington, IA

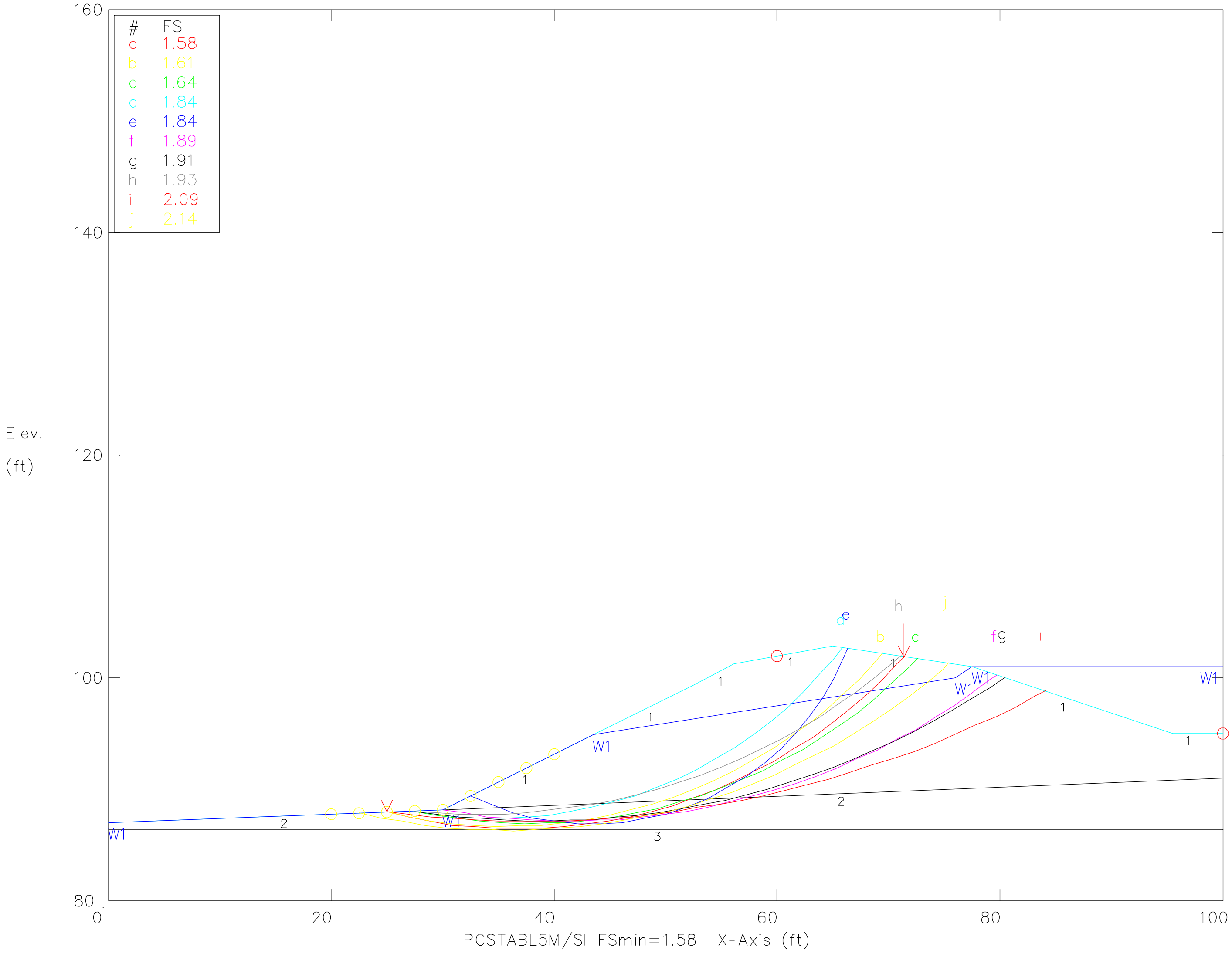
August 2007

8-7-07 Water Levels			
Location	Depth to Water (TOC)	TOC Elevation	GW Elevation
SB2	dry	102.98	NA
SB3	dry	101.07	NA
SB4	9.48	102.22	92.74
SB6	dry	104.92	NA
SB7	9.37	105.02	95.65
SB8	12.06	104.60	92.54
SB9	6.85	103.00	96.15

8-14-07 Water Levels			
Location	Depth to Water (TOC)	TOC Elevation	GW Elevation
SB2	8.57	102.98	94.41
SB3	4.74	101.07	96.33
SB4	6.75	102.22	95.47
SB6	7.20	104.92	97.72
SB7	9.42	105.02	95.60
SB8	11.80	104.60	92.80
SB9	6.85	103.00	96.15

Exhibit E – Slope Stability Calculations

Burlington Generating Station Berm All Clay above deep seam
Ten Most Critical. C:154HHS01.PLT By: Tom Wells 08-30-07 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 Clay	120	120	500	0	0	0	W1
2 Sand	130	130	0	30	0	0	W1
3 Clay	125	125	1250	0	0	0	W1

ALLIANT ENERGY

Alliant Energy Corporate Services, Inc.
Legal Department
200 First Street SE
P.O. Box 351
Cedar Rapids, IA 52406-0351

Office: 319.786.4505
www.alliantenergy.com

May 22, 2009

VIA OVERNIGHT DELIVERY – TUESDAY DELIVERY

Mr. Richard Kinch
US Environmental Protection Agency
Two Potomac Yard
2733 S. Crystal Dr.
5th Floor: N-5738
Arlington, VA 22202-2733

RE: Response to Request for Information Under Section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act

Dear Mr. Kinch:

On May 4, 2009, the Burlington Generating Station, a facility owned and operated by Interstate Power and Light Company ("IPL"), on whose behalf this response is submitted, received a "Request for Information Under Section 104(e) of the Comprehensive Environmental Response, Compensation, and Liability Act" (hereinafter "Request") from the United States Environmental Protection Agency ("EPA"). EPA's Request was undated. EPA's Request required a response within 10 business days of receipt. During a telephone conversation on May 12, 2009, EPA granted a five (5) working day time extension. Therefore, this response is timely filed.

EPA's Request seeks information relating to Burlington Generating Station's surface impoundments or similar diked or bermed management unit(s) or management units designated as landfills which receive liquid-borne material from a surface impoundment used for storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. EPA seeks responses to ten specific questions set forth in Enclosure A to the Request.

This letter and the enclosed documents respond to EPA's Request. IPL has made diligent and good faith efforts to provide documents and information that are in its possession and which IPL could reasonably collect and prepare for production within the timeframe allotted.

A. General Objections

Based on its review of and good-faith efforts to respond timely to the Request, IPL wishes to note for the record that it has several objections to the form and content of the Request.

IPL objects to the Request on the grounds that it is unduly burdensome and overly broad, seeks irrelevant information, is vague and unclear in its scope, requires legal conclusions to be made, and is otherwise unreasonable, thereby exceeding EPA's authority under CERCLA Section 104(e).

IPL objects to the Request to the extent that it seeks information beyond the scope of EPA's authority under Section 104(e) of CERCLA. Section 104(e) authorizes EPA to request, upon reasonable notice, information or documents relating to the following:

1. The identification, nature, and quantity of materials which have been or are generated, treated, stored, or disposed of at a vessel or facility or transported to a vessel or facility.
2. The nature or extent of a release or threatened release of a hazardous substance or pollutant or contaminant at or from a vessel or facility.
3. Information relating to the ability of a person to pay for or to perform a cleanup.

IPL does not object to questions relating to the (1) type and quantity of materials stored, temporarily or permanently, in the surface impoundments and (2) nature and extent of actual releases or threatened releases; however, IPL believes that the other questions in the Request, e.g., structural integrity, dates of commissioning/expansion, PE certifications, etc., are beyond the scope of EPA's authority under Section 104(e).

IPL also objects to the extent that the Request seeks information that may be subject to attorney-client privilege or other applicable privilege, or which constitutes protected attorney work product, or which is otherwise not discoverable.

Where the questions in the Request are vague, ambiguous, overbroad, or beyond the scope of EPA's CERCLA Section 104(e) authority, IPL has made appropriate and reasonable efforts to provide responsive information to the best of its ability to interpret the questions. Subject to and without waiving its objections, IPL states that it is providing information at this time based on its review conducted in response to the specific items in the Request. In the event that IPL discovers additional responsive material, it will submit such material to EPA as soon as reasonably possible.

Because EPA has requested that IPL respond to this request within the short timeframe of 15 business days, IPL has not had the opportunity to determine whether the responsive contents of this letter constitute **"confidential business information,"** as defined by 40

CFR Part 2, Subpart B. Therefore, with the exception of the Iowa Department of Natural Resources inspection report provided in response to item number 6 of EPA's Enclosure A, IPL requests that **EPA treat this letter and the narrative responses within as "confidential business information."**

Finally, IPL objects to the following phrase as vague, unclear, and ambiguous: "surface impoundment or similar diked or bermed management unit(s) or management units designated as landfills which receive liquid-borne material for storage or disposal of residual or by-products from the combustion of coal." For purposes of this Request, IPL interprets this phrase to mean:

1. Any surface impoundment that directly receives coal combustion by-products (CCB) in a liquid-borne manner (i.e., water mixed with ash) from the coal combustion process in the boiler, as well as any subsequent surface impoundments through which this CCB and water mixture may pass before the water exits the CCB management units via the NPDES permitted discharge point. This includes current operating CCB management units, as well as any surface impoundments which historically received CCB and which still contain free liquids.
2. IPL's interpretation of this phrase does not include storm water retention ponds, coal pile runoff retention ponds, cooling water ponds, etc. which may contain small incidental amounts of CCB which was transmitted via rain waters or as fugitive dust. These ponds and impoundments were neither designed nor intended for temporary or long-term storage or disposal of CCB.

B. <u>Specific Responses to Items in Enclosure A</u>

1. Relative to the National Inventory of Dams criteria for High, Significant, Low, or less-than-Low Hazard Potential, please provide the potential hazard rating for each management unit and indicate who established the rating, what the basis of the rating is, and what federal or state agency regulates the unit(s). If the unit(s) does not have a rating, please note that fact.

a. <u>Main Ash Pond</u>: Based on its review of readily available records and interviews with long term staff, IPL has not identified that this pond was ever rated relative to the "National Inventory of Dams" criteria by any federal or state regulatory agency.

b. <u>Upper Ash Pond</u>: Based on its review of readily available records and interviews with long term staff, IPL has not identified that this pond was ever rated relative to the "National Inventory of Dams" criteria by any federal or state regulatory agency.

c. Lower Ash Pond: Based on its review of readily available records and interviews with long term staff, IPL has not identified that this pond was ever rated relative to the "National Inventory of Dams" criteria by any federal or state regulatory agency.

d. Ash Seal Pond: Based on its review of readily available records and interviews with long term staff, IPL has not identified that this pond was ever rated relative to the "National Inventory of Dams" criteria by any federal or state regulatory agency.

e. Economizer Ash Pond: Based on its review of readily available records and interviews with long term staff, IPL has not identified that this pond was ever rated relative to the "National Inventory of Dams" criteria by any federal or state regulatory agency.

---

2. What year was each management unit commissioned and expanded?

a. Main Ash Pond: Commissioned in 1980

b. Upper Ash Pond: Commissioned in 1971;

c. Lower Ash Pond: Commissioned in 1971

d. Ash Seal Pond: Commissioned in 1968

e. Economizer Ash Pond: Commissioned in 1986; modified in 1990 and 1992

---

3. What materials are temporarily or permanently contained in the unit? Use the following categories to respond to this question: (1) fly ash; (2) bottom ash: (3) boiler slag; (4) flue gas emission control residuals; (5) other. If the management unit contains more than one type of material, please identify all that apply. Also, if you identify "other", please specify the other types of materials that are temporarily or permanently contained in the unit(s).

a. Main Ash Pond: Materials temporarily or permanently contained are:

- Fly ash
- Bottom ash
- Other: ash transport water, boiler water wash, air heater wash (fly ash), storm water runoff from plant site, storm water runoff from C-Stone (hydrated flyash) Storage Pile; and plant floor drains.

b. Upper Ash Pond: Materials temporarily or permanently contained are:

- Fly ash
- Bottom ash

- Economizer Ash
- Other: ash transport water, boiler water wash, air heater wash (fly ash), steam grade water production wastewaters, storm water runoff from plant site, storm water runoff from C-Stone (hydrated flyash) Storage Pile; plant floor drains, Solids Contact Units sludge for the treatment of Mississippi River water; coal pile runoff; and boiler blowdown (steam/water).

c. Lower Ash Pond: Materials temporarily or permanently contained are:

- Fly ash
- Bottom ash
- Economizer Ash
- Other: ash transport water, boiler water wash, air heater wash (fly ash), steam grade water production wastewaters, storm water runoff from plant site, storm water runoff from C-Stone (hydrated flyash) Storage Pile; plant floor drains, Solids Contact Units sludge for the treatment of Mississippi River water; coal pile runoff; and boiler blowdown (steam/water).

d. Ash Seal Pond: Materials temporarily or permanently contained are:

- Fly ash
- Bottom ash
- Economizer Ash
- Other: Boiler Seal Water; boiler water wash, storm water runoff from plant site, storm water runoff from C-Stone (hydrated flyash) Storage Pile; and plant floor drains.

e. Economizer Ash Pond: Materials temporarily or permanently contained are:

- Fly ash
- Bottom ash
- Economizer Ash
- Other: ash transport water, boiler water wash, air heater wash (fly ash), steam grade water production wastewaters, storm water runoff from plant site, storm water runoff from C-Stone (hydrated flyash) Storage Pile; plant floor drains, Solids Contact Units sludge for the treatment of Mississippi River water; coal pile runoff; and boiler blowdown (steam/water).

---

4. Was the management unit(s) designed by a Professional Engineer? Is or was the construction of the waste management (s) under the supervision of a Professional Engineer? Is inspection and monitoring of the safety of the waste management unit(s) under the supervision of a Professional Engineer?'

a. Main Ash Pond:

- Based on its review of readily available records, IPL believes the pond was designed by a Professional Engineer.
- Based on its review of readily available records, IPL believes the pond was constructed under the supervision of a Professional Engineer.
- Inspection and monitoring of the safety of the pond is not under the supervision of a Professional Engineer

b. Upper Ash Pond:

- Based on its review of readily available records, IPL believes the pond was designed by a Professional Engineer.
- Based on its review of readily available records, IPL believes the pond was constructed under the supervision of a Professional Engineer.
- Inspection and monitoring of the safety of the pond is not under the supervision of a Professional Engineer

c. Lower Ash Pond:

- Based on its review of readily available records, IPL believes the pond was designed by a Professional Engineer.
- Based on its review of readily available records, IPL believes the pond was constructed under the supervision of a Professional Engineer.
- Inspection and monitoring of the safety of the pond is not under the supervision of a Professional Engineer

d. Ash Seal Pond:

- Based on its review of readily available records, IPL believes the pond was designed by a Professional Engineer.
- Based on its review of readily available records, IPL believes the pond was constructed under the supervision of a Professional Engineer.
- Inspection and monitoring of the safety of the pond is not under the supervision of a Professional Engineer

e. Economizer Ash Pond:

- Based on its review of readily available records, IPL believes the pond was designed by a Professional Engineer.
- Based on its review of readily available records, IPL believes the pond was constructed under the supervision of a Professional Engineer.
- Inspection and monitoring of the safety of the pond is not under the supervision of a Professional Engineer

---

5. When did the company last assess or evaluate the safety (i. e., structural integrity) of the management unit(s)? Briefly describe the credentials of those conducting the structural integrity assessments/evaluations. Identify actions taken or planned by facility personnel as a result of these assessments or evaluations. If corrective actions were taken, briefly describe the credentials of those performing the corrective actions, whether they were company employees or contractors. If the company plans an assessment or evaluation in the future, when is it expected to occur?

a. Main Ash Pond:

- IPL conducted a visual structural inspection on March 4, 2009.
- The assessment team inspecting the pond on March 4, 2009, consisted of a Civil Engineer; Senior Environmental Specialist; and a Plant Manager with an Engineering Degree.
- The March 4, 2009, inspection recommended some animal activity control improvements. This work will be accomplished or issue resolved by plant personnel or contractors working under the direct supervision of plant personnel by December 31, 2009.
- IPL currently has no future assessment/evaluation scheduled, but has developed an internal evaluation program that includes periodic inspections.

b. Upper Ash Pond:

- IPL conducted a visual structural inspection on March 4, 2009.
- The assessment team inspecting the pond on March 4, 2009, consisted of a Civil Engineer; Senior Environmental Specialist; and a Plant Manager with an Engineering Degree.
- The March 4, 2009, inspection recommended some tree removal and erosion repair of the berm that separates the upper and lower ash ponds; and some animal activity control improvements. This work will be accomplished or issue resolved by plant personnel or contractors working under the direct supervision of plant personnel by December 31, 2009.
- IPL currently has no future assessment/evaluation scheduled, but has developed an internal evaluation program that includes periodic inspections.

c. Lower Ash Pond:

- IPL conducted a visual structural inspection on March 4, 2009.
- The assessment team inspecting the pond on March 4, 2009, consisted of a Civil Engineer; Senior Environmental Specialist; and a Plant Manager with an Engineering Degree.

- The March 4, 2009, inspection recommended some tree removal and erosion repair of the berm that separates the upper and lower ash ponds; and some animal activity control improvements. This work will be accomplished or issue resolved by plant personnel or contractors working under the direct supervision of plant personnel by December 31, 2009.
- IPL currently has no future assessment/evaluation scheduled, but has developed an internal evaluation program that includes periodic inspections.

d. Ash Seal Pond:

- IPL conducted a visual structural inspection on March 4, 2009.
- The assessment team inspecting the pond on March 4, 2009, consisted of a Civil Engineer; Senior Environmental Specialist; and a Plant Manager with an Engineering Degree.
- The March 4, 2009, inspection recommended some tree removal on the inside portion of the berm. This work will be accomplished by plant personnel or contractors working under the direct supervision of plant personnel by December 31, 2009.
- IPL currently has no future assessment/evaluation scheduled, but has developed an internal evaluation program that includes periodic inspections.

e. Economizer Ash Pond:

- IPL conducted a visual structural inspection on March 4, 2009.
- The assessment team inspecting the pond on March 4, 2009, consisted of a Civil Engineer; Senior Environmental Specialist; and a Plant Manager with an Engineering Degree.
- The March 4, 2009, inspection recommended some tree removal on the inside portion of the berm and to continue efforts within the pond to increase the wastewater treatment capabilities. This work will be accomplished or issue resolved by plant personnel or contractors working under the direct supervision of plant personnel by December 31, 2009.
- IPL currently has no future assessment/evaluation scheduled, but has developed an internal evaluation program that includes periodic inspections.

---

6. When did a State or a Federal regulatory official last inspect or evaluate the safety (structural integrity) of the management unit(s)? If you are aware of a planned state or federal inspection or evaluation in the future, when is it expected to occur? Please identify the Federal or State regulatory agency or department which conducted or is planning the inspection or evaluation.
Please provide a copy of the most recent official inspection report or evaluation.

a. Main Ash Pond:

  - This pond is part of a wastewater management unit subject to an NPDES permit. The Iowa Department of Natural Resources performed a Facility Wastewater Inspection on December 2007. The inspection report does not include an evaluation of the structural integrity of the pond.
  - IPL is not aware of any planned state or federal regulatory agency future inspection to evaluate the safety (structural integrity) of this pond.
  - A copy of the Iowa Department of Natural Resources Facility Wastewater Inspection report is attached for your awareness.

b. Upper Ash Pond:

  - This pond is part of a wastewater management unit subject to an NPDES permit. The Iowa Department of Natural Resources performed a Facility Wastewater Inspection on December 2007. The inspection report does not include an evaluation of the structural integrity of the pond.
  - IPL is not aware of any planned state or federal regulatory agency future inspection to evaluate the safety (structural integrity) of this pond.
  - A copy of the Iowa Department of Natural Resources Facility Wastewater Inspection report is attached for your awareness.

c. Lower Ash Pond:

  - This pond is part of a wastewater management unit subject to an NPDES permit. The Iowa Department of Natural Resources performed a Facility Wastewater Inspection on December 2007. The inspection report does not include an evaluation of the structural integrity of the pond.
  - IPL is not aware of any planned state or federal regulatory agency future inspection to evaluate the safety (structural integrity) of this pond.
  - A copy of the Iowa Department of Natural Resources Facility Wastewater Inspection report is attached for your awareness.

d. Ash Seal Pond:

  - This pond is part of a wastewater management unit subject to an NPDES permit. The Iowa Department of Natural Resources performed a Facility Wastewater Inspection on December 2007. The inspection report does not include an evaluation of the structural integrity of the pond.
  - IPL is not aware of any planned state or federal regulatory agency future inspection to evaluate the safety (structural integrity) of this pond.
  - A copy of the Iowa Department of Natural Resources Facility Wastewater Inspection report is attached for your awareness.

e. Economizer Ash Pond:

- This pond is part of a wastewater management unit subject to an NPDES permit. The Iowa Department of Natural Resources performed a Facility Wastewater Inspection on December 2007. The inspection report does not include an evaluation of the structural integrity of the pond.
- IPL is not aware of any planned state or federal regulatory agency future inspection to evaluate the safety (structural integrity) of this pond.
- A copy of the Iowa Department of Natural Resources Facility Wastewater Inspection report is attached for your awareness.

---

7. Have assessments or evaluations, or inspections conducted by State or Federal regulatory officials conducted within the past year uncovered a safety issue(s) with the management unit(s), and if so, describe the actions that have been or are being taken to deal with the issue or issues.
Please provide any documentation that you have for these actions.

a. Main Ash Pond: There have been no assessments, evaluations, or inspections by a state or federal regulatory agency within the past year.

b. Upper Ash Pond: There have been no assessments, evaluations, or inspections by a state or federal regulatory agency within the past year.

c. Lower Ash Pond: There have been no assessments, evaluations, or inspections by a state or federal regulatory agency within the past year.

d. Ash Seal Pond: There have been no assessments, evaluations, or inspections by a state or federal regulatory agency within the past year.

e. Economizer Ash Pond: There have been no assessments, evaluations, or inspections by a state or federal regulatory agency within the past year.

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8. What is the surface area (acres) and total storage capacity of each of the management units? What is the volume of materials currently stored in each of the management unit(s). Please provide the date that the volume measurement was taken. Please provide the maximum height of the management unit(s). The basis for determining maximum height is explained later in this Enclosure.

a. Main Ash Pond:

- Surface area: 17.0 acres
- Total storage capacity: 137,214 cubic yards; measurement date – April 2009.

- Volume of materials stored: 110,000 cubic yards; measurement date – April 2009.
- Maximum height of management unit: 5 feet

b. Upper Ash Pond:
   - Surface area: 13.3 acres
   - Total storage capacity: 215,000 cubic yards; measurement date – April 2009.
   - Volume of materials stored: 107,000 cubic yards; measurement date – 2008.
   - Maximum height of management unit: 5 feet

c. Lower Ash Pond:
   - Surface area: 22.9 acres
   - Total storage capacity: 184,000 cubic yards; measurement date – April 2009.
   - Volume of materials stored: 110,000 cubic yards; measurement date – 2008.
   - Maximum height of management unit: 3 feet

d. Ash Seal Pond:
   - Surface area: 4.54 acres
   - Total storage capacity: 110083 cubic yards; measurement date – April 2009.
   - Volume of materials stored: 73,389 cubic yards; measurement date – 2008.
   - Maximum height of management unit: 15 feet

e. Economizer Ash Pond:
   - Surface area: 11 acres.
   - Total storage capacity: 267,219 cubic yards; measurement date – April 2009.
   - Volume of materials stored: 249, 405 cubic yards; measurement date – 2008.
   - Maximum height of management unit: 10 feet

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9. Please provide a brief history of known spills or unpermitted releases from the unit within the last ten years, whether or not these were reported to State or federal regulatory agencies. For purposes of this question, please include only releases to surface water or to the land (do not include releases to groundwater).

a. Main Ash Pond: IPL is not aware of any known spills or unpermitted releases from this pond within the past 10 years. For purposes of this question, all discharges exiting the pond via the discharge point governed under the NPDES permit, including any water quality exceedances, are interpreted to be "permitted releases".

b. Upper Ash Pond: IPL is not aware of any known spills or unpermitted releases from this pond within the past 10 years. For purposes of this question, all discharges exiting the pond via the discharge point governed under the NPDES permit, including any water quality exceedances, are interpreted to be "permitted releases".

c. Lower Ash Pond: IPL is not aware of any known spills or unpermitted releases from this pond within the past 10 years. For purposes of this question, all discharges exiting the pond via the discharge point governed under the NPDES permit, including any water quality exceedances, are interpreted to be "permitted releases".

d. Ash Seal Pond: IPL is not aware of any known spills or unpermitted releases from this pond within the past 10 years. For purposes of this question, all discharges exiting the pond via the discharge point governed under the NPDES permit, including any water quality exceedances, are interpreted to be "permitted releases".

e. Economizer Ash Pond; IPL is not aware of any known spills or unpermitted releases from this pond within the past 10 years. For purposes of this question, all discharges exiting the pond via the discharge point governed under the NPDES permit, including any water quality exceedances, are interpreted to be "permitted releases".

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10. Please identify all current legal owner(s) and operator(s) at the facility.

a. The Operator is: Interstate Power and Light Company

b. The Owner is: Interstate Power and Light Company

C. Confidentiality of IPL's Response.

As noted above, IPL requests that EPA treat the information submitted herein as "confidential business information".

* * * *

Please find attached the affidavit of John Larsen, Vice President-Generation, that is being submitted with this response to the information request. Please feel free to contact me at (319) 786-4686 if you have any questions concerning this response.

Very truly yours,

Daniel L. Siegfried
Managing Attorney

Enclosure: Iowa DNR Wastewater Compliance Inspection Report dated January 22, 2008

Certification

I certify that the information contained in this response to EPA's request for information and the accompanying documents is, based on my personal belief and my knowledge of the actions taken to respond to the information request and subject to the explanation that follows, true, accurate, and complete. The response points out ambiguities and other difficulties in responding to the request, and where that is true, a good faith effort has been made to provide information that is reasonably available and responsive to the request. As to the portions of this response for which I cannot personally verify their accuracy, I certify under penalty of law that this response and all attachments were prepared in accordance with a system designed to reasonably assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Signature: ______________________

Name: John O. Larsen

Title: Vice President - Generation

Fields of Opportunities

STATE OF IOWA

CHESTER J. CULVER, GOVERNOR
PATTY JUDGE, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
RICHARD A. LEOPOLD, DIRECTOR

January 22, 2008

Vernon Hasten, Plant Manager
Alliant Energy
Burlington Generating Station
4282 Sullivan Slough Rd.
Burlington, IA 52601-9015

SUBJECT: Wastewater Inspection Report
Facility No. 6-29-00-1-00

Dear Mr. Hasten:

On 12-17-2007, I conducted a wastewater inspection at the Burlington Generating Station. Enclosed is a copy of my inspection report which you will find to be self-explanatory.

If you have any further questions, feel free to contact me at this office.

Sincerely,

FIELD SERVICES & COMPLIANCE BUREAU

Paul Brandt

Paul Brandt
Environmental Specialist Senior

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Encl. ✓Inspection Report

xc: ✓DNR Records Section, DNR, Des Moines
✓Robin Nelson, E&S Specialist, Burlington Generating Station, 4282 Sullivan Slough Rd., Burlington, IA 52601
✓William Skalitzky, Senior Environmental Specialist, Alliant Energy P.O. Box 77007, Madison, WI 53707-1007
✓File - Alliant Industrial

Environmental Services Division, Field Office #6, 1023 W. Madison, Washington, Iowa 52353-1623 Tel 319-653-2135 Fax 319-653-2856
WALLACE STATE OFFICE BUILDING / DES MOINES, IOWA 50319
515-281-5918 TDD 515-242-5967 FAX 515-281-6794 www.state.ia.us/dnr

IOWA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL SERVICES DIVISION
WASTEWATER TREATMENT FACILITY INSPECTION

NPDES Permit #: 6-29-00-1-00

FACILITY	NAME: Alliant Energy – Burlington Generating Station		OWNER: Interstate Light & Power Co.	
	ADDRESS: 4282 Sullivan Slough Rd.	CITY: Burlington	STATE: Iowa	ZIP: 52601-9015

PHONE:
319-758-5304
(24 Hr. number)

RECEIVING STREAM	STREAM NAME: Mississippi River

INSPECTION	DATE THIS INSPECTION: 12-17-2007	DATE LAST INSPECTION: 3-23-2006
PURPOSE	Compliance Evaluation Inspection	

DESIGN CAPACITY	MGD: NA	POUNDS BOD/DAY: NA	PE (BOD) : NA

NOW TREATING	MGD (average daily) : NA	POUNDS BOD: NA	PE (BOD) : NA
	POPULATION SERVED: NA		

SAMPLES COLLECTED	TYPE: (none collected)	LAB DATA ATTACHED? [ ]Yes [ ] No

ATTACHMENTS	PLANT DESCRIPTION CARD: [X] On File [ ] Attached to DNR copy	CERTIFICATION UPDATE MEMO: [ ] Attached [ ] No change in Responsible Op
	SIGNIFICANT INDUSTRIAL CONTRIBUTOR FORM: [ ] Attached [ ] On file [ ] No Sig. Contr.	

RESPONSIBLE OPERATOR	NAME: Vernon Hasten, Plant Manager	GRADE: NA	CERTIFICATION NUMBER: NA

PERSONS INTERVIEWED	NAME: Robin Nelson	TITLE: E&S Specialist
	NAME: Vernon Hasten	TITLE: Plant Manager

TREATMENT PROCESS	[ ] TRICKLING FILTER [ ] ACTIVATED SLUDGE = > MODIFICATION: [ ] LAGOON [ ] AERATED LAGOON [X] OTHER/SUPPLEMENTARY: **Settling Ponds**
PROCESS WASTE DESCRIPTION	Electrical power plant cooling water, ash transport and associated waste streams

PERMIT COMPLIANCE SUMMARY

EFFLUENT LIMITATIONS	SELF-MONITORING RESULTS: [X] Sat. [ ] Marg.* [ ] Unsat.*	SAMPLES THIS INSPECTION: [ ] Sat. [ ] Marg.* [ ] Unsat.* [X] None Collected
	VISUAL APPEARANCE OF EFFLUENT: Clear	VISUAL APPEARANCE OF RECEIVING STREAM: Normal – ice forming

SELF-MONITORING	Operation Reports submitted: [X] Sat. [ ] Marg.* [ ] Unsat.*	REQUIRED DATA ON REPORT: [X] Sat. [ ] Marg.* [ ] Unsat.*	TESTING ADEQUACY: [X] Sat. [ ] Marg.* [ ] Unsat.*

COMPLIANCE SCHEDULE	COMPLIANCE WITH SCHEDULE: [X] Sat. [ ] Marg.* [ ] Unsat.*	NEXT ITEM DUE: All items completed (Iron Study)	DATE DUE: NA

* Explain in Comments and Recommendations Section

AUTHENTICATION	INSPECTOR: Paul Brandt	DATE: 1-18-08	REVIEWER: James T. Stevens	DATE: 1/22/08

General Description:

On 12-17-2007, I conducted a wastewater inspection of the Interstate Power & Light, Burlington Generating Station (BGS). Prior to the inspection, I reviewed monthly operating reports for the period 1-07 through 11-07. At the facility, I observed all the outfalls and associated treatment processes. No samples were collected during this inspection.

The Burlington Generating Station's NPDES permit lists 6 outfalls:

001 - ash pond treatment system
002 - sanitary waste plant
003 - (there is no 003)
004 - once through non-contact condenser cooling water
005 - chemical metal cleaning wastewater (never used)
006 - ash seal pond treatment system
007 - coal pile runoff retention pond

Storm water is discharged through outfalls 001 & 006; however, a storm water inspection was not conducted at this time.

Monitoring & Reporting:

Monthly operating reports are submitted to Field Office #6. Reports are on time (by the 15th) and contain all required data, sampled at the specified frequencies. Most of the testing is sent out to a contract lab, Test America, which is a DNR certified laboratory (#7).

Outfall 001 (ash pond) - is regulated for TSS, pH, Fe, O/G and effluent toxicity. One TSS exceedence was noted for Sept. 07. This was due to silt in the discharge channel from earlier flooding. One O/G exceedence was noted in August '07 for unknown reasons. The O/G is always less than detection and the sample had appeared normal at the time of collection. The average flow at this outfall ranges from about 1 to 2 MGD.

Outfall 002 is a septic tank/recirculating textile media filter/UV disinfection system for the sanitary wastes. Average flow is about 1000 GPD and no discharge violations were noted.

Outfall 004 is the non-contact cooling water and by far the largest volume of discharge, running from about 76 MGD up to 112 MGD in the summer. No discharge violations were noted.

Outfall 005 - Chemical cleaning of the boiler; this is never used.

Outfall 006 (ash seal pond) - is regulated for the same parameters as 001 (TSS, pH, Fe, O/G, eff. tox.). Average flow is lower than 001, ranging from about 0.50 to 0.90 MGD. No violations noted.

Outfall 007 is the coal pile runoff retention pond. It is sampled for pH & TSS when there is a discharge. This is more of a batch discharge since a valve must be manually opened to drain the pond. All discharges were within limits.

Site Inspection:

Outfall 001 (ash pond) There is an upper and lower ash pond. The lower ash pond is a somewhat marshy area. The discharge channel runs to a culvert under the railroad and to the Mississippi River. Effluent samples are collected at the end of the discharge channel. When the Mississippi is flooding, water will back up into the discharge channel and sampling has to be moved to the upper ash pond discharge.

The upper ash pond discharges into the lower pond through a concrete discharge structure. Flow is measured here for the 001 discharge. The effluent looked clear at this point. The lower ash pond outfall to the Mississippi River was not observed, due to a train parked on the tracks.

Outfall 002 (sanitary wastewater plant) Stopped to look at this plant. It has been operating normally. The septic tank is checked twice per year. It has not been necessary to remove any sludge yet.

Outfalls 004/006 These two outfalls discharge into a stub channel, running about 200 yards back from the Mississippi main channel. Outfall 004 is a large pipe for cooling water return to the river, while 006 is a small pipe (~12″ diameter) from the adjacent ash seal pond.

We observed the SE corner of the ash seal pond, where the slurry wall was installed late last fall. The wall had been installed to address seepage through the pond berm, but during construction it was discovered that the seepage was actually coming from a tile line from up along the railroad siding. The tile line outlet had apparently been buried in the lagoon berm at some point. The slurry wall was installed and the tile line outlet has been exposed to drain to the ground surface now and runs down into the river.

Outfall 007 This is the discharge from the coal pile runoff retention basin. There is a closed valve on the outlet line, so it must be opened manually to discharge. It runs into the lower ash pond, and is sampled for TSS and pH when discharged.

Intake Structure I observed the intake structure - nothing unusual here. Ice was forming on the Mississippi River and floating by in large, unconsolidated rafts. Zebra mussel control has not been conducted here in over 6 years, and the utility has not experienced any problems with them.

Administrative Issues:

Intake Structure, Comprehensive Design Study (CDS) Under the NPDES permit, the intake structure is required to meet national performance standards to reduce impingement mortality of fish and shellfish. A CDS was due 1-7-2008 for this facility as well as some other Alliant facilities. The study was completed and submitted to the DNR central office on 12-20-2007.

Monitoring Well Testing For many years, Alliant has been testing two monitoring wells on the plant grounds - an up-gradient and down-gradient well. They are sampled in April and October and the groundwater is analyzed for pH, TDS and specific conductance. At some point, the requirement for this has become lost. I reviewed old files at Field Office #6. Iowa Southern Utilities, in a letter dated 10-3-1990, asked permission to make some modifications to the ash pond. The department responded (letter of Wayne Farrand, dated 10-29-1990) that the proposed modification was OK, but due to the unknown liner quality of the existing pond and concern for impact on local ground water, Iowa Southern was required to install these 2 wells. Once installed, they were to be sampled for pH, TSS and specific conductivity every April and October thereafter.

I looked at some of the data. The earliest report on file was for October, 1992. This data is compared to the October, 2007 report in the following table.

Down-gradient Well			
	pH	TDS	Specific Cond.
Date			
Oct. 1992	7.7	764	1200
Oct. 2007	7.19	720	991

Up-gradient Well			
	pH	TDS	Specific Cond.
Date			
Oct. 1992	7.4	618	783
Oct. 2007	7.03	1040	1420

While there have been a few fluctuations over the years, overall, there has been no significant change in these parameters. The up gradient well has actually increased over the years to where it is now more similar to the down-gradient well, but this increase is still of minor magnitude. Based on the data, there does not appear to have been an impact to the ground water quality thus far, and continued monitoring at a semi-annual interval is probably not necessary (see comments in Conclusion Section).

<u>Compliance Schedule - Iron Study</u> There is a compliance schedule in the new NPDES permit regarding iron limits for outfalls 001/006. The schedule is:

09-05-2006	begin sampling for 12 months (raw/final, 1/month grab)
03-05-2007	progress report summarizing ability to meet limits
10-06-2007	submit report summarizing all data and conclusion as to whether facility can comply or not
10-06-2007	limits become final if that is the conclusion

Alliant began sampling as required. The 03-05-2007 progress report was submitted on 2-26-2007. By this time in the study, Alliant had realized that iron levels in the Mississippi River had a direct bearing on iron in the 001/006 effluent and that the total iron limits could be periodically exceeded. And so, they decided to develop site-specific total iron limits (this is an option in the compliance schedule) and submitted a study plan for review/approval on 02-12-2007. The plan was approved by DNR Wastewater Permits staff on 03-06-2007.

A final report was submitted on 08-15-2007. Alliant's conclusion was that iron discharge limits on 001/006 should not be required - iron limits well in excess of the current limits would be protective of the receiving stream. At the time of this writing, Alliant is awaiting a reply from the DNR in this matter.

<u>Conclusions:</u>

- Wastewater monitoring is being conducted according to the frequencies specified in the permit, and reported to the DNR field office monthly.
- During the review period (1-07 through 11-07) there were two minor discharge violations, one TSS and one O/G, both from outfall 001.
- The intake structure Comprehensive Design Study has been completed and submitted to the Department.
- The Iron Study (compliance schedule) has been completed and submitted to the department. Alliant is awaiting a response on this matter.
- Monitoring Wells - sampling and submitting reports for the two ash pond monitoring wells can be suspended. It is recommended however, that the utility continue to check a sample every few years to verify that nothing unusual is occurring.
- No further recommendations are made at this time.

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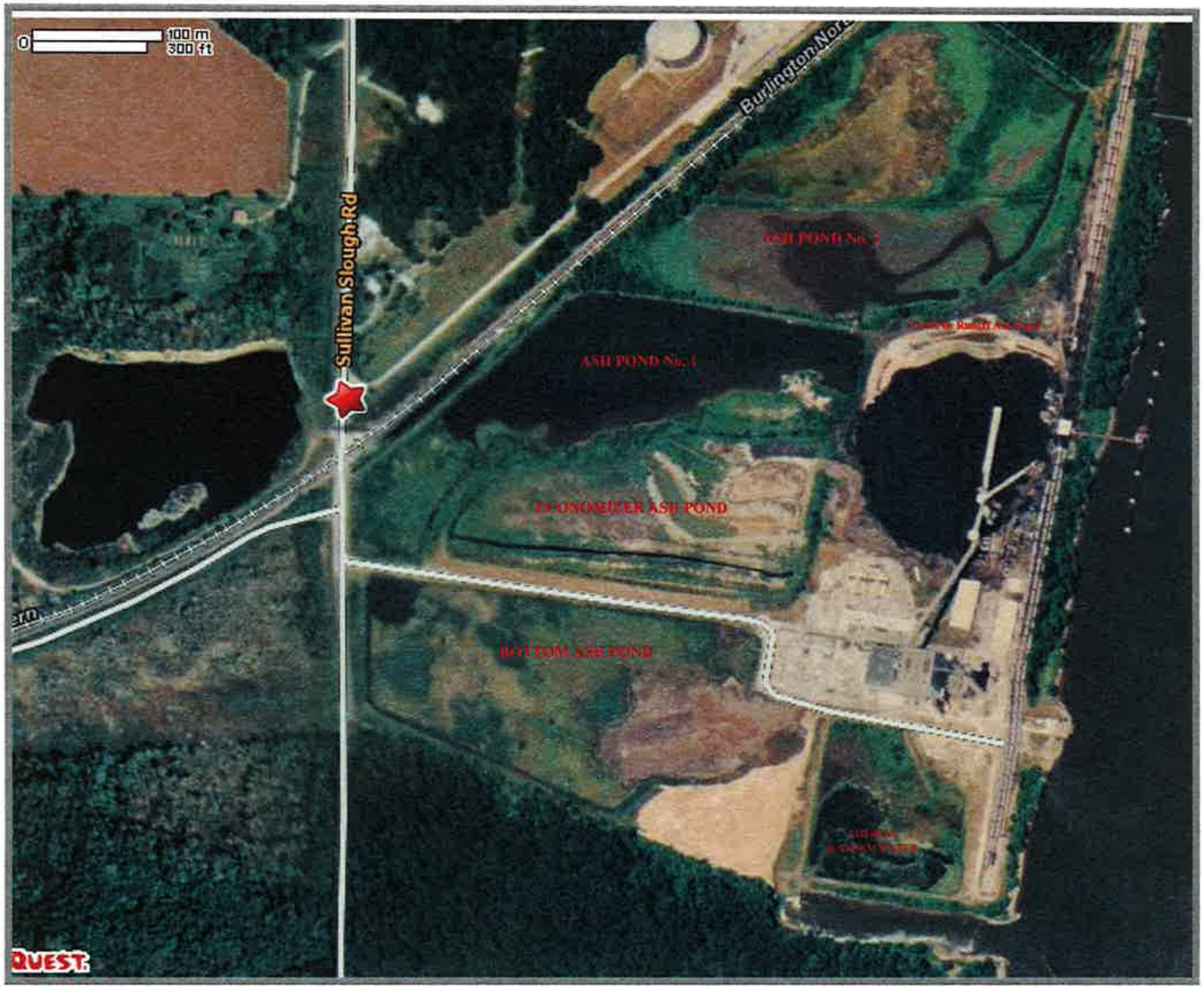
Alliant Energy Burlington Generating Station
Burlington, Iowa
Site Location Topographic Map

Burlington Generating Station Ash Ponds Satellite View
By Using Map Quest



ALLIANT ENERGY SURFACE POND VISUAL INSPECTION

PLANT NAME:	**DATE COMPLETED:**	**LIST POND INSPECTED:**
Burlington Generating Station	**Wednesday, March 04, 2009**	**Ash Pond No.1, Ash Pond No.2, Economizer, Bottom Ash Pond, Ash Seal Water**
INSPECTOR(S): List Below	**WEATHER CONDITIONS:**	
Bill Skalitzky, Bielka Liriano, and Buddy Hasten	**Mostly Cloudy**	
PLANT MANAGEMENT REVIEW(if applicable): Spell Name	**HIGH TEMP: 54^0F**	
Plant Manager: Vernon Hasten	**LOW TEMP: 26^0F**	
Operations Manager: Kermit Smith	**WIND: -**	**PRESS: 0 inches**
Maintenance Manager: Steve Conrad	**SIGNATORY REVIEW:**	
E&S Specialist: Robin Nelson		

Description:

On Wednesday, March 4, 2009 the Alliant Energy inspection team visited Burlington Generating Station. During our inspection of the Ash Ponds at BGS we noted numerous issues and are most concerned with the erosion and physical condition of the levee associated with Ash Pond No.1. This pond has the significant animal activities (e.g., beaver and muskrat) along the northwest of the levee wall, erosion, and a lot of trees. The inspection team believes that a significant damage occurred to this levee during the major flooding the plant experienced in 2008. This ash pond needs immediate attention to prevent future levee breaches.

Additionally, the Economizer Ash Pond is completely full of ash and is no longer able to be used as a settling pond for the plant's ash. This is causing ash to carryover to the lower pond systems and is impacting the flow of water and sediment in the lower pond systems. The Economizer Ash Pond needs to be dredged to restore it to a settling pond to alleviate the ash loading on the lower pond system.

Based on the Independent Levee Investigation Team: Trees that are planted on top of or adjacent to the levee structure can result in significant damage. Trees that are blown over in ***high wind conditions*** , not only create a large void that can destabilize the levee or like, but t***he root systems associated with the tree can result in preferred piping channels if the roots are pulled out of the dike or levee*** (such as if a tree is blown over in a strong wind storm.) ***To mitigate possible impacts of tree damage on levees or dikes*** , design and maintenance guidelines generally specify that trees be ***kept clear of the dike or levee structure*** .

ALLIANT ENERGY SURFACE POND VISUAL INSPECTION

PLANT NAME: Burlington Generating Station

DATE COMPLETED: March 4, 2009

LIST POND INSPECTED: Ash Pond No. 1

INSPECTOR(S): List Below
Bill Skalitzky, Bielka Liriano, and Buddy Hasten

WEATHER CONDITIONS: Describe Weather Conditions
Mostly Cloudy

PLANT MANAGEMENT REVIEW(if applicable): Spell Name
Plant Manager: Vernon Hasten
E&S Specialist: Robin Nelson

SIGNATORY REVIEW:

1. Dike/Levee Integrity	Yes	No	Action Needed?
Visual Signs of Animal Activity into the dike wall that may impact the integrity of the dike wall?	X		Yes
Trees growing on top or side of dike in which the root system may impact the integrity of the dike wall?	X		Yes
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?	X		Yes
Any visual seeps of water through the dike wall?		X	
Any areas of soft soil/dead vegetation on the dike wall?	X		Yes
Any areas of eroison caused either by wind eroison; storm water runoff into or outside the dike wall?	X		Yes
Any evidence of ash pond water washing over the dike wall?		X	
Where applicable, are any of the valving or piping used to control the discharge from a pond leaking?		X	
Any ponding of water outside the dike wall?	X		Yes
Any evidence of damage caused by heavy equipment?		X	
2. Outfall Structure			
Any areas of erosion or animal activity near or at the entrance of the outfall structure or pipe that may cause wastewater to travel along the outside of the pipe?	X		Yes
Any areas of erosion; animal activity; swirling of wastewater on the discharge side of the outfall structure that may impact the integrity of the dike or structure?	X		Yes
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?	X		Yes
3. Visable Solids			
Is there a build up of settled ash visible near the dike walls or discharge structure?		X	

ALLIANT ENERGY SURFACE POND VISUAL INSPECTION

PLANT NAME: Burlington Generating Station

DATE COMPLETED: March 4, 2009

LIST POND INSPECTED: Ash Pond No. 2

INSPECTOR(S): List Below
Bill Skalitzky, Bielka Liriano, and Buddy Hasten

WEATHER CONDITIONS: Describe Weather Conditions
Mostly Cloudy ⛅

PLANT MANAGEMENT REVIEW(if applicable): Spell Name
Plant Manager: Vernon Hasten
E&S Specialist: Robin Nelson

SIGNATORY REVIEW:

1. Dike/Levee Integrity	**Yes**	**No**	**Action Needed?**
Visual Signs of Animal Activity into the dike wall that may impact the integrity of the dike wall?		X	
Trees growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
Any visual seeps of water through the dike wall?		X	
Any areas of soft soil/dead vegetation on the dike wall?		X	
Any areas of eroison caused either by wind eroison; storm water runoff into or outside the dike wall?		X	
Any evidence of ash pond water washing over the dike wall?		X	
Where applicable, are any of the valving or piping used to control the discharge from a pond leaking?		X	
Any ponding of water outside the dike wall?		X	
Any evidence of damage caused by heavy equipment?		X	
2. Outfall Structure			
Any areas of erosion or animal activity near or at the entrance of the outfall structure or pipe that may cause wastewater to travel along the outside of the pipe?		X	
Any areas of erosion; animal activity; swirling of wastewater on the discharge side of the outfall structure that may impact the integrity of the dike or structure?		X	
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
3. Visable Solids			
Is there a build up of settled ash visible near the dike walls or discharge structure?		X	

ALLIANT ENERGY SURFACE POND VISUAL INSPECTION

PLANT NAME: Burlington Generating Station	**DATE COMPLETED:** March 4, 2009	**LIST POND INSPECTED:** Economizer Ash Pond
INSPECTOR(S): List Below Bill Skalitzky, Bielka Liriano, and Buddy Hasten	**WEATHER CONDITIONS: Describe Weather Conditions** Mostly Cloudy	
PLANT MANAGEMENT REVIEW(if applicable): Spell Name **Plant Manager:** Vernon Hasten **E&S Specialist:** Robin Nelson	**SIGNATORY REVIEW:**	

1. Dike/Levee Integrity	**Yes**	**No**	**Action Needed?**
Visual Signs of Animal Activity into the dike wall that may impact the integrity of the dike wall?	X		Yes
Trees growing on top or side of dike in which the root system may impact the integrity of the dike wall?	X		Yes
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?	X		Yes
Any visual seeps of water through the dike wall?		X	
Any areas of soft soil/dead vegetation on the dike wall?		X	
Any areas of eroison caused either by wind eroison; storm water runoff into or outside the dike wall?		X	
Any evidence of ash pond water washing over the dike wall?		X	
Where applicable, are any of the valving or piping used to control the discharge from a pond leaking?		X	
Any ponding of water outside the dike wall?		X	
Any evidence of damage caused by heavy equipment?		X	
2. Outfall Structure			
Any areas of erosion or animal activity near or at the entrance of the outfall structure or pipe that may cause wastewater to travel along the outside of the pipe?		X	
Any areas of erosion; animal activity; swirling of wastewater on the discharge side of the outfall structure that may impact the integrity of the dike or structure?		X	
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
3. Visable Solids			
Is there a build up of settled ash visible near the dike walls or discharge structure?	X		Yes

ALLIANT ENERGY SURFACE POND VISUAL INSPECTION

PLANT NAME: Burlington Generating Station

DATE COMPLETED: March 4, 2009

LIST POND INSPECTED: Bottom Ash Pond

INSPECTOR(S): List Below
Bill Skalitzky, Bielka Liriano, and Buddy Hasten

WEATHER CONDITIONS: Describe Weather Conditions
Mostly Cloudy

PLANT MANAGEMENT REVIEW(if applicable): Spell Name
Plant Manager: Vernon Hasten
E&S Specialist: Robin Nelson

SIGNATORY REVIEW:

1. Dike/Levee Integrity	**Yes**	**No**	**Action Needed?**
Visual Signs of Animal Activity into the dike wall that may impact the integrity of the dike wall?	X		Yes
Trees growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
Any visual seeps of water through the dike wall?		X	
Any areas of soft soil/dead vegetation on the dike wall?		X	
Any areas of eroison caused either by wind eroison; storm water runoff into or outside the dike wall?		X	
Any evidence of ash pond water washing over the dike wall?		X	
Where applicable, are any of the valving or piping used to control the discharge from a pond leaking?		X	
Any ponding of water outside the dike wall?		X	
Any evidence of damage caused by heavy equipment?		X	
2. Outfall Structure			
Any areas of erosion or animal activity near or at the entrance of the outfall structure or pipe that may cause wastewater to travel along the outside of the pipe?		X	
Any areas of erosion; animal activity; swirling of wastewater on the discharge side of the outfall structure that may impact the integrity of the dike or structure?		X	
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
3. Visable Solids			
Is there a build up of settled ash visible near the dike walls or discharge structure?		X	

ALLIANT ENERGY SURFACE POND VISUAL INSPECTION

PLANT NAME: Burlington Generating Station

DATE COMPLETED: March 4, 2009

LIST POND INSPECTED: Ash Seal Storm Water

INSPECTOR(S): List Below
Bill Skalitzky, Bielka Liriano, and Buddy Hasten

WEATHER CONDITIONS: Describe Weather Conditions
Mostly Cloudy

PLANT MANAGEMENT REVIEW(if applicable): Spell Name
Plant Manager: Vernon Hasten
E&S Specialist: Robin Nelson

SIGNATORY REVIEW:

1. Dike/Levee Integrity	Yes	No	Action Needed?
Visual Signs of Animal Activity into the dike wall that may impact the integrity of the dike wall?	X		Yes
Trees growing on top or side of dike in which the root system may impact the integrity of the dike wall?	X		Yes
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
Any visual seeps of water through the dike wall?		X	
Any areas of soft soil/dead vegetation on the dike wall?		X	
Any areas of eroison caused either by wind eroison; storm water runoff into or outside the dike wall?		X	
Any evidence of ash pond water washing over the dike wall?		X	
Where applicable, are any of the valving or piping used to control the discharge from a pond leaking?		X	
Any ponding of water outside the dike wall?		X	
Any evidence of damage caused by heavy equipment?		X	
2. Outfall Structure			
Any areas of erosion or animal activity near or at the entrance of the outfall structure or pipe that may cause wastewater to travel along the outside of the pipe?		X	
Any areas of erosion; animal activity; swirling of wastewater on the discharge side of the outfall structure that may impact the integrity of the dike or structure?		X	
Woody type shrubs growing on top or side of dike in which the root system may impact the integrity of the dike wall?		X	
3. Visable Solids			
Is there a build up of settled ash visible near the dike walls or discharge structure?		X	

NOTES or OBSERVATIONS

Provide a description of the issue or observation below:

ISSUE	Description and Location of Issue	Maximo Work Order #	Due Date	Date Completed
Trees along the levee	On the northwest side and west side wall on the Ash Pond No.1 need to be remove			
Animals activities	Monitor the beavers activities locate on the west side and northwest side on the Ash Pond No.1			
Erosion	Monitor the erosion on the west and northwest of the Ash Pond No.1 along the wall			

Review this Sheet Prior to each Inspection

BGS - Economizer Ash Pond Pic #1

BGS - Economizer Ash Pond Pic #2

BGS - Bottom Ash Pond Pic #3

BGS - Bottom Ash Pond Pic #4

CONFIDENTIAL BUSINESS INFORMATION

BGS - Ash Pond No.1 Pic #5

BGS - Ash Pond No.1 Pic #6

BGS - Ash Pond No.1 Pic #7

BGS - Ash Pond No.1 Pic #8

BGS - Ash Pond No.1 Pic #10

BGS - Ash Pond No.1 Pic #12

BGS - Ash Pond No.1 Pic #9

BGS - Ash Pond No.1 Pic #11

CONFIDENTIAL BUSINESS INFORMATION


BGS - Ash Pond No.1 Pic #13


BGS - Ash Pond No.1 Pic #14


BGS -Ash Pond No.1 Pic #15


BGS - Ash Pond No.1 Pic #16

CONFIDENTIAL BUSINESS INFORMATION

BGS - Ash Pond No.1 Pic #17

BGS - Ash Pond No.1 Pic #18

BGS - Ash Pond No.1 Pic #19

BGS - Ash Pond No.1 Pic #20

BGS - Seal Ash Pond Pic #21

BGS - Seal Ash Pond Pic #22

BGS - Seal Ash Pond Pic #23

BGS - Ash Pond No.2 Pic #24

ALLIANT ENERGY SURFACE POND PHOTO LOG

PLANT NAME: Burlington Generating Station

DATE	PHOTO NUMBER	DESCRIPTION of the PHOTO
3/4/2009	BGS Pic #1	Economizer Ash Pond picture shows shrubs along the channel
3/4/2009	BGS Pic #2	Economizer Ash Pond picture shows the erosion
3/4/2009	BGS Pic #3	Bottom Ash Pond picture shows animals burrow
3/4/2009	BGS Pic #4	Bottom Ash Pond picture shows erosion
3/4/2009	BGS Pic #5	Ash Pond No.1 picture shows animals burrow
3/4/2009	BGS Pic #6	Ash Pond No.1 picture shows flood letf over
3/4/2009	BGS Pic #7	Ash Pond No.1 picture shows soft soil
3/4/2009	BGS Pic #8	Ash Pond No.1 picture shows erosion
3/4/2009	BGS Pic #9	Ash Pond No.1 picture shows erosion
3/4/2009	BGS Pic #10	Ash Pond No.1 picture shows beaver mound
3/4/2009	BGS Pic #11	Ash Pond No.1 picture shows animals burrow
3/4/2009	BGS Pic #12	Ash Pond No.1 picture shows animals burrow
3/4/2009	BGS Pic #13	Ash Pond No.1 picture shows animals burrow
3/4/2009	BGS Pic #14	Ash Pond No.1 picture shows animals burrow
3/4/2009	BGS Pic #15	Ash Pond No.1 picture shows animals burrow
3/4/2009	BGS Pic #16	Ash Pond No.1 picture shows beaver mound
3/4/2009	BGS Pic #17	Ash Pond No.1 picture shows erosion
3/4/2009	BGS Pic #18	Ash Pond No.1 picture shows erosion
3/4/2009	BGS Pic #19	Ash Pond No.1 picture shows erosion
3/4/2009	BGS Pic #20	Ash Pond No.1 picture shows animals burrow
3/4/2009	BGS Pic #21	Seal Ash Pond picture shows animals burrow
3/4/2009	BGS Pic #22	Seal Ash Pond picture shows trees on the inside of the levee
3/4/2009	BGS Pic #23	Seal Ash Pond picture shows trees on the inside of the levee
3/4/2009	BGS Pic #24	Ash Pond No.2 - No coment

INSPECTION FORM INSTRUCTIONS

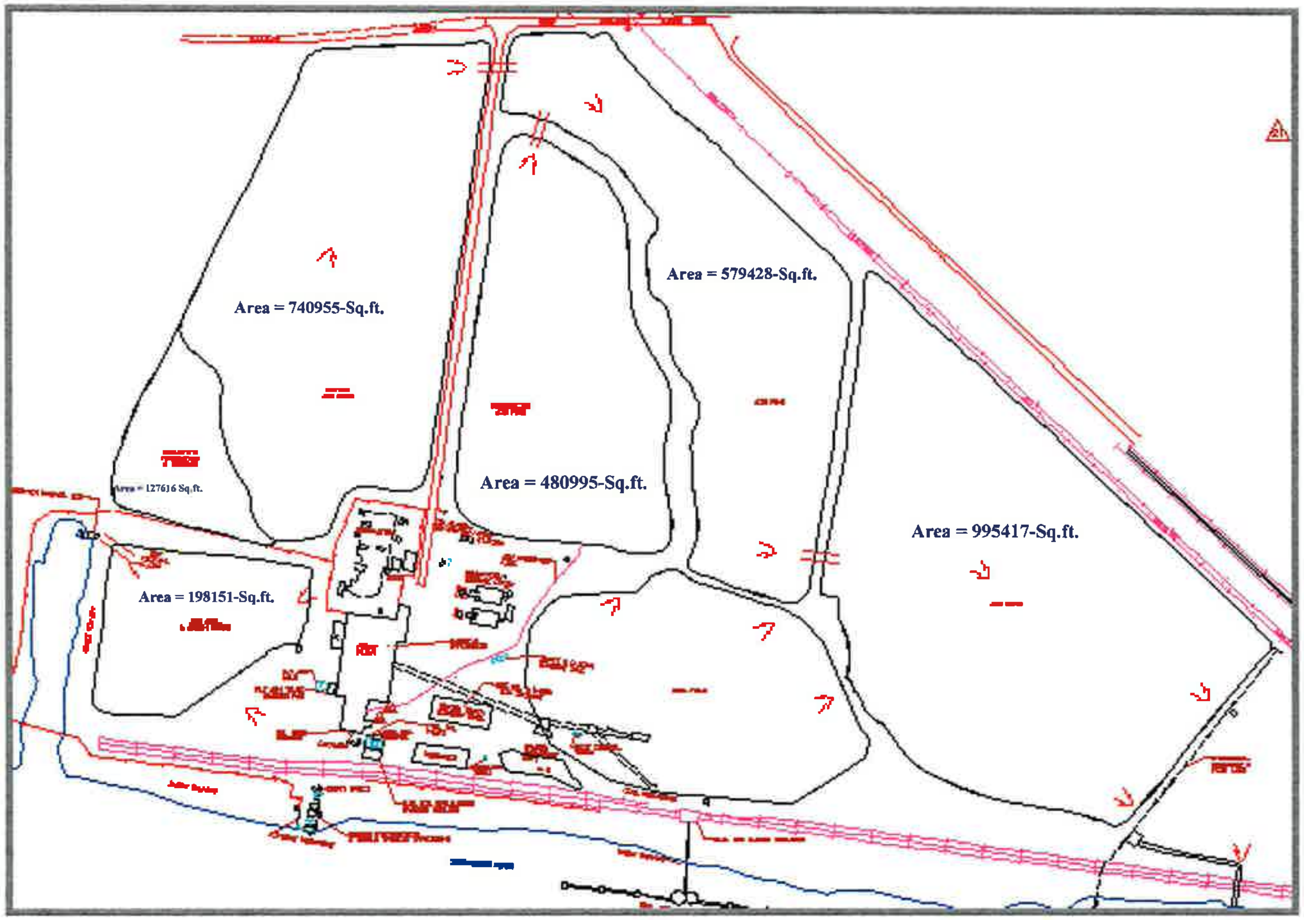
1)	**Plant Name**	Insert name of facility being inspected
2)	**Date**	List date of when inspection was completed
3)	**List Pond Inspected**	List plant name of pond being inspected. For plants with multiple ponds, use one inspection form per pond. Example: Coal Pile Runoff Pond
4)	**Inspectors**	List name of employee(s) who performed the inspection
5)	**Weather Conditions**	List the current weather conditions (cloud cover/precip/temp/wind strength) If there was a substantial rain or runoff event, please note as well
6)	**Plant Mgmt Review**	Plant Management staff is required to review and sign off on the inspection form.
		It is advisible that 1 member of the plant management team review the report with the inspector(s)
7)	**Signatory Review**	Each plant management staff must sign off on the report
8)	**Inspection Process**	Physically walk around each side of the pond looking for conditions present on the report Answer each question and note any issues on page 2 If any issue is discovered, please note the location of the area in question and the steps taken to resolve the issue Examples: For animal caused issues, contracted with a Alliant Approved Company to remove/relocate the animals For erosion/dead vegitation issues, filled in the area and applied grass seed For large trees and woody shrubs, removed or cut down the trees/shrubs For wind erosion, used clean rip/rap to prevent futher eroison For seepage/dike integrity issues, try to determine the source of the issue and eliminate. If seepage continues, may need to perform soil structual analysis and repair dike.

INSPECTION PROCESS

Inspection Frequency	Minimum inspection frequency is as follow: Spring/Summer/Fall. Inspections can be combined with other inspections
Additional Inspection Frequencies	In addition to item #1 above, inspections should take (at the descretion of the Plant Manager) during these events Large Rain Event or meltoff and flood events (other than typical spring events)
Pictures	Pictures are a great opportunity to capture existing condtions and allows a site to compare from year to year Pictures shall be taken during the initial inspection and then during each Spring Inspection Pictures shall be taken at the same location each year. These areas will be defined during the initial inspection Pictures shall be taken to show areas of concern that are observed during each inspection and attached to the report
Addressing Items of Concern	Inspectors will review the pictures and the inspection form with Plant Management Staff. Decisions shall be made to address the current issue. Corporate Environmental shall be contacted regarding the issue; review of solutions; and determine if any type of Permitting or Approval is required, prior to commencing the work, from the State Agency; Federal Agenicies; or County Agencies Engineering shall be contacted regarding structural concerns of a dike or what might the impact be to the integrity of the Dike if a trees or other living objects are removed (root concerns)
Review of Records	Prior to a new year of inspections, plant staff shall review the previous year inspections to review past issues and if they were resolved Total Suspended Soilds (TSS) analysis from past Discharge Monitoring Reports shall be reviewed each year to determine if the ponds require more intensive dredging

CONFIDENTIAL BUSINESS INFORMATION

Burlington Generating Station - Ash Pond
Total Area Calculations by using AutoCAD LT 2007 Software



Bielka A. Liriano
Projects Engineer - Central
1000 Main St
Dubuque, IA 52003
(563) 584-7337 (Office)
(563) 513-8145 (Cell)

9/28/2010
6:44 PM

Burlington Generating Station - Ash Pond
Total Area Calculations by using the Bentley View V8i Software

Bielka A. Liriano
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1000 Main St
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(563) 513-8145 (Cell)

Fields of Opportunities

STATE OF IOWA

CHESTER J. CULVER, GOVERNOR
PATTY JUDGE, LT. GOVERNOR

DEPARTMENT OF NATURAL RESOURCES
RICHARD A. LEOPOLD, DIRECTOR

April 10, 2009

RECEIVED
APR 2 0 2009

Mr. Bill Skalitsky
Senior Environmental Specialist
Alliant Energy
4902 North Biltmore Lane
Madison, WI 53707-1007

Subject: Final NPDES Permit Amendment
NPDES Permit No.: 29-00-1-01

Dear Mr. Skalitsky:

Enclosed is a final amendment to the National Pollutant Discharge Elimination System (NPDES) permit issued to the Interstate Power & Light Burlington Generating Station on September 5, 2006. This amendment deletes all interim effluent limitations from the permit, deletes the effluent limitations and monitoring requirements for iron at outfall 001, revises the mass limits for iron at outfall 006 and replaces the schedule of compliance with a schedule for eliminating all discharges from outfall 006 by November 1, 2009. The basis for these changes was described in some detail in our January 20, 2009 letter and is further described in the rationale for this amendment which can be found at https://programs.iowadnr.gov/wwpie.

You submitted several comments in response to our public notice of the draft amendment dated February 24, 2009. I replied to those comments by email on March 31, 2009 and I repeat your comments and my responses here.

Comment: In the permit rationale dated 2/20/09 it is stated that the iron limit for Outfall 006 is 5.1 mg/l yet the draft NPDES permit lists 1.44 mg/l. Will the limit be 5.1 mg/l and if "yes" the mass limits will need to be changed accordingly.

Response: If outfall 006 was going to remain an active outfall it is possible that the permit limit for iron could be raised to 5.1 mg/l. That was the water quality-based limit calculated using data from toxicity testing performed in 2007. The current limit is 1.44 mg/l and outfall 006 has so far consistently met this limit. Since the outfall meets the current concentration limit and because the outfall is going to be eliminated there is no reason to adjust the concentration limits today. The mass limits for iron have been increased based on new information on discharge flow rates that was not available at the time the permit was issued because the facility has not, and likely cannot, comply with the current mass limits in the interim until this outfall is eliminated. Once the outfall is eliminated the permit will need to be amended again to delete all limits and monitoring for outfall 006.

Comment: With the higher flows listed in the permit rationale, it would appear the 30 day monthly average and the maximum daily mass limits should increase due to the higher flow. I believe the flow used to calculate the mass for iron was 1.29 MGD. This would change the 30 day average mass limit from 100 lbs/day to 323 lbs/day and the daily maximum from 334 lbs/day to 1075 lbs/day.

Response: I believe the same argument for not changing the iron concentration limits applies to not changing the mass limits for TSS or Oil & grease at outfall 006. The current limits are being met and there is every reason to expect that they will continue to be met in the interim period until this outfall is eliminated. Thus, there is no justification for increasing the mass limits at this time. Once the outfall is eliminated the permit will need to be amended again to delete all limits and monitoring for outfall 006.

The final amendment reflects several other minor changes that were not included in the draft. These include the deletion of all interim limits and the compliance schedule from the permit. With the issuance of this amendment and the revised iron limits the facility should now be in compliance with all final effluent limits making the interim limits and compliance schedule unnecessary. Also, the title on page 27 has been changed from "Compliance Schedule" to "Outfall Elimination Schedule" to reflect that the department is not requiring that this outfall be eliminated in order to achieve compliance but that Interstate Power and Light Co. has elected to do so for other reasons.

I recommend you provide a copy of the amendment to each person who received a copy of the original permit and that the original of the amendment be attached to the original permit in your files.

Please call 515-281-8884 or e-mail me at steve.williams@dnr.iowa.gov if you have questions concerning the permit or this amendment.

Sincerely yours,

Steven N. Williams

Steven N. Williams
Environmental Specialist, Sr.
NPDES Section

Enclosure: Final NPDES Permit Amendment

c: Field Office #6

RECEIVED
APR 2 0 2009

STATE OF IOWA
DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROGRAM
AMENDMENT TO NPDES PERMIT

Iowa NPDES Permit No: 29-00-1-01
Date of Issuance: September 5, 2006
Date of Expiration: September 4, 2011
Date of this Amendment: April 10, 2009

EPA NUMBER: IA0001783

Name and Mailing Address of Applicant:

Interstate Power and Light Company
Burlington Generating Station
4282 Sullivan Slough Road
Burlington, Iowa 52601-9015

Identity and Location of Facility:

Interstate Power and Light Company
Burlington Generating Station
Section 29, Township 69N, Range 02W
Des Moines County, Iowa

Pursuant to the authority of Iowa Code Section 455B.174, and of Rule 567--64.3, Iowa Administrative Code, the Director of the Iowa Department of Natural Resources has issued the above referenced permit. Pursuant to the same authority the Director hereby amends said permit for the reason(s) stated below:

> The permit is modified to delete all interim effluent limits, to include a schedule which requires elimination of outfall 006 by November 1, 2009, to revise the mass limits for iron at outfall 006 based on new and more accurate discharge flow information and to delete the iron limits and monitoring at outfall 001 based on the results of toxicity testing and effluent data showing the discharge has no reasonable potential to cause or contribute to a violation of water quality standards due to iron. Replace pages 4, 6, 7, 8, 10, 12, 14, 15, 16 and 27 of the permit with the attached pages.

For the Department of Natural Resources

Steven N. Williams

Steven N. Williams
NPDES Section
ENVIRONMENTAL SERVICES DIVISION

Enclosure

c: Field Office #6

IOWA DEPARTMENT OF NATURAL RESOURCES
National Pollutant Discharge Elimination System (NPDES) Permit

OWNER NAME & ADDRESS	**FACILITY NAME AND ADDRESS**
INTERSTATE POWER & LIGHT COMPANY 200 FIRST STREET SE P.O. BOX 351 CEDAR RAPIDS, IA 52406 - 0351	IP&L-BURLINGTON GENERATING STATION 4282 SULLIVAN SLOUGH ROAD BURLINGTON, IA 52601 - 9015 Section 29, T 69N, R 02W DES MOINES County

IOWA NPDES PERMIT NUMBER: 2900101

DATE OF ISSUANCE: 9/5/2006

DATE OF EXPIRATION: 9/4/2011

YOU ARE REQUIRED TO FILE FOR RENEWAL OF THIS PERMIT BY: 3/8/2011

EPA NUMBER: IA0001783

This permit is issued pursuant to the authority of section 402(b) of the Clean Water Act (33 U.S.C 1342(b)), Iowa Code section 455B.174, and rule 567--64.3, Iowa Administrative Code. You are authorized to operate the disposal system and to discharge the pollutants specified in this permit in accordance with the effluent limitations, monitoring requirements and other terms set forth in this permit.

You may appeal any condition of this permit by filing a written notice of appeal and request for administrative hearing with the director of this department within 30 days of your receipt of this permit.

Any existing, unexpired Iowa operation permit or Iowa NPDES permit previously issued by the department for the facility identified above is revoked by the issuance of this permit. This provision does not apply to any authorization to discharge under the terms and conditions of a general permit issued by the department or to any permit issued exclusively for the discharge of stormwater.

FOR THE DEPARTMENT OF NATURAL RESOURCES

By_______________________________

John Warren
NPDES Section
ENVIRONMENTAL SERVICES DIVISION

Facility Na P&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Outfall Number	**Outfall Description**
001	DISCHARGE FROM THE ASH POND TREATMENT SYSTEM CONSISTING OF BOILER BLOWDOWN, ASH TRANSPORT WATER; REVERSE OSMOSIS/DEMINERALIZER REJECT WATERS; WATER TREATMENT BLOWDOWN; PLANT FLOOR SUMPS (PROCESSED THROUGH OIL/WATER SEPARATOR); STORM WATER RUNOFF FROM PORTIONS OF THE PLANT INCLUDING, PARKING LOTS, ROOF DRAINS, TRACTOR SHED, AND THE COAL PILE RUNOFF RETENTION POND.

Receiving Stream: MISSISSIPPI RIVER

Route of Flow:

002	DISCHARGE FROM A SEPTIC TANK AND RECIRCULATION TEXTILE MEDIA FILTER WASTEWATER TREATMENT SYSTEM.

Receiving Stream: MISSISSIPPI RIVER

Route of Flow:

004	DISCHARGE CONSISTS OF ONCE THROUGH NON-CONTACT CONDENSER COOLING WATER, NON-CONTACT COOLING WATER OF VARIOUS PLANT EQUIPMENT, AND WATER INTAKE SCREEN BACKWASH.

Receiving Stream: MISSISSIPPI RIVER

Route of Flow:

005	DISCHARGE OF CHEMICAL METAL CLEANING WASTES.

Receiving Stream: MISSISSIPPI RIVER

Route of Flow: ASH POND TO MISSISSIPPI RIVER

006	DISCHARGE FROM THE ASH SEAL POND TREATMENT SYSTEM CONSISTING OF ASH SEAL WATER; AN ALTERNATE EMERGENCY FLOOR SUMP DISCHARGE; AND STORM WATER RUNOFF FROM PORTIONS OF THE PLANT INCLUDING, FLYASH LOADING AREA, AND PLANT GROUNDS.

Receiving Stream: MISSISSIPPI RIVER

Route of Flow:

Facility Na P&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

007 DISCHARGE FROM THE COAL PILE RUNOFF RETENTION POND.

Receiving Stream: MISSISSIPPI RIVER

Route of Flow: ASH POND TO MISSISSIPPI RIVER

The permit was written to protect warm water game fish populations along with a resident aquatic community that includes a variety of native nongame fish and invertebrate species. The permit also protects for recreational or other uses that may result in prolonged and direct contact with the water, involving considerable risks of ingesting water in quantities sufficient to pose a health hazard. Such activities would include, but not be limited to, swimming, diving, water skiing, and water contact recreational canoeing.

Facility Name: IP&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Effluent Limitations

Outfall No.: 001 DISCHARGE FROM THE ASH POND TREATMENT SYSTEM CONSISTING OF BOILER BLOWDOWN, ASH TRANSPORT WATER, REVERSE OSMOSIS/DEMINERALIZER REJECT WATERS, WATER TREATMENT BLOWDOWN, PLANT FLOOR SUMPS (PROCESSED THROUGH OIL/WATER SEPARATOR), STORM WATER RUNOFF FROM PORTIONS OF THE PLANT INCLUDING, PARKING LOTS, ROOF DRAINS, TRACTOR SHED, AND THE COAL PILE RUNOFF RETENTION POND

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

				EFFLUENT LIMITATIONS							
				Concentration				Mass			
Wastewater Parameter	Season	Type of Limit	% Removal	7 Day Average/Min	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL			30.0	100.0	MG/L		751.0	2,502.0	LBS/DAY
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL		6.0		9.0	STD UNITS				
OIL AND GREASE	YEARLY	FINAL			15.0	20.0	MG/L		375.0	500.0	LBS/DAY
ACUTE TOXICITY, CERIODAPHNIA	YEARLY	FINAL							1.0		NO TOXICITY
ACUTE TOXICITY, PIMEPHALES	YEARLY	FINAL							1.0		NO TOXICITY

Note: If seasonal limits apply, summer is from March 15 through November 15, and winter is from November 16 through March 14.

Non-Standard Effluent Limitations

OUTFALL NO.: 001 DISCHARGE FROM THE ASH POND TREATMENT SYSTEM CONSISTING OF BOILER BLOWDOWN; ASH TRANSPORT WATER; REVERSE OSMOSIS/DEMINERALIZER REJECT WATERS; WATER TREATMENT BLOWDOWN; PLANT FLOOR SUMPS (PROCESSED THROUGH OIL/WATER SEPARATOR); STORM WATER RUNOFF FROM PORTIONS OF THE PLANT INCLUDING, PARKING LOTS, ROOF DRAINS, TRACTOR SHED, AND THE COAL PILE RUNOFF RETENTION POND.

The effluent limitations for total suspended solids specified on page 4 of this permit are net limits. The permittee is authorized to deduct the amount of total suspended solids in river water used for ash transport that subsequently discharge through outfall 001. The net discharge shall be calculated as follows:

$$(Q_d \text{ x } 8.34 \text{ x } C_d) - (Q_{at} \text{ x } 8.34 \text{ x } C_i) = \frac{\underline{\text{Net discharge (lbs/day)}}}{8.34 \text{ x } Q_d} = \text{Net discharge (mg/L)}$$

Where:

Q_d = Flow rate from outfall 001 (mgd)
C_d = Concentration of total suspended solids measured in outfall 001 (mg/L)
Q_{at} = Flow rate of river water used for ash transport (mgd)
C_i = Concentration of total suspended solids measured in intake water (mg/L)

Note! The net discharge may never be less than zero. All measurements needed to calculate the net discharge of total suspended solids must be made a minimum of 24 hours since the last measurable storm event. Additionally, the water intake sample shall be collected 24 hours prior to the collection of the discharge sample from the ash pond.

pH

When the pH of the intake water from the Mississippi River, prior to any chemical addition, exceeds 9.0 pH units the maximum pH effluent limitation shall be equal to or less than that of the intake water.

Facility Name: IP&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Effluent Limitations

Outfall No.: 002 DISCHARGE FROM A SEPTIC TANK AND RECIRCULATING TEXTILE MEDIA FILTER WASTEWATER TREATMENT SYSTEM

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

				EFFLUENT LIMITATIONS							
				Concentration				Mass			
Wastewater Parameter	Season	Type of Limit	% Removal	7 Day Average/Min	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
CBOD5	YEARLY	FINAL		40.0	25.0		MG/L	0.33	0.21		LBS/DAY
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL		45.0	30.0		MG/L	0.38	0.25		LBS/DAY
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL		6.0		9.0	STD UNITS				
COLIFORM FECAL	SUMMER	FINAL			200.0	373.0	#/100 ML				

Note: If seasonal limits apply, summer is from March 15 through November 15, and winter is from November 16 through March 14.

Facility Name: IP&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Effluent Limitations

Outfall No.: 004 DISCHARGE CONSISTS OF ONCE THROUGH NON-CONTACT CONDENSER COOLING WATER, NON-CONTACT COOLING WATER OF VARIOUS PLANT EQUIPMENT, AND WATER INTAKE SCREEN BACKWASH.

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

Wastewater Parameter	Season	Type	EFFLUENT LIMITATIONS							
			Concentration				Mass			
			7 Day Average	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
*TEMPERATURE . VARIABLE	YEARLY	FINAL	-	-	-	-	-	-	-	-
TEMPERATURE, FIXED	JAN	FINAL			104	FAHRENHEIT				
TEMPERATURE, FIXED	FEB	FINAL			104	FAHRENHEIT				
TEMPERATURE, FIXED	MAR	FINAL			104	FAHRENHEIT				
TEMPERATURE, FIXED	APR	FINAL			104	FAHRENHEIT				
TEMPERATURE, FIXED	NOV	FINAL			104	FAHRENHEIT				
TEMPERATURE, FIXED	DEC	FINAL			104	FAHRENHEIT				
CHLORINE, TOTAL RESIDUAL	YEARLY	FINAL			0.2	MG/L			188	LBS/DAY
DURATION OF CHLORINE DISCHARGE	YEARLY	FINAL							2.0	HOURS/DAY

*Compliance with the flow variable temperature limit shall be determined using the formulas specified on pages #21 and #22 of this permit. The variable temperature limits shall only be applied during the months of May through October. The fixed temperature limits are applicable to the remaining months, November through April.

NOTE: If seasonal limits apply, summer is from March 15 through November 15, and winter is from November 16 through March 14.

Facility Name: IP&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Effluent Limitations

Outfall No.: 005 DISCHARGE OF CHEMICAL METAL CLEANING WASTES

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

				EFFLUENT LIMITATIONS							
				Concentration				Mass			
Wastewater Parameter	Season	Type of Limit	% Removal	7 Day Average/Min	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL		6 0		9 0	STD UNITS				
COPPER, TOTAL (AS CU)	YEARLY	FINAL				1 0	MG/L			1 7	LBS/DAY
IRON, TOTAL (AS FE)	YEARLY	FINAL				1 0	MG/L			1 7	LBS/DAY

Note: If seasonal limits apply, summer is from March 15 through November 15, and winter is from November 16 through March 14.

Non-Standard Effluent Limitations

OUTFALL NO.: 005 DISCHARGE OF CHEMICAL METAL CLEANING WASTES.

The effluent limitations for total iron specified on page 8 of this permit are net limits and apply directly to the chemical metal cleaning wastes prior to mixing with other wastestreams. The permittee is authorized to deduct the amount of total iron in river water used for chemical metal cleaning wastes. The net discharge shall be calculated for total iron as follows:

$$(Q_d \text{ x } 8.34 \text{ x } C_d) - (Q_{mc} \text{ x } 8.34 \text{ x } C_i) = \frac{\underline{\text{Net discharge (lbs/day)}}}{8.34 \text{ x } Q_d} = \text{Net discharge (mg/L)}$$

Where:

Q_d = Flow rate from metal cleaning wastes (mgd)
C_d = Concentration of total iron in chemical metal cleaning wastes (mg/L)
Q_{mc} = Flow rate of river water used for the chemical metal cleaning wastes (mgd)
C_i = Concentration of total iron measured in intake water (mg/L)

Note! The net discharge may never be less than zero. All measurements needed to calculate the net discharge of total iron must be made on the same day.

Facility Name: IP&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Effluent Limitations

Outfall No.: 006 DISCHARGE FROM THE ASH SEAL POND TREATMENT SYSTEM CONSISTING OF ASH SEAL WATER, AN ALTERNATIVE EMERGENCY FLOOR SUMP DISCHARGE, AND STORM WATER RUNOFF FROM PORTIONS OF THE PLANT INCLUDING, FLY ASH LOADING AREA, AND PLANT GROUNDS.

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

				EFFLUENT LIMITATIONS							
				Concentration				Mass			
Wastewater Parameter	Season	Type of Limit	% Removal	7 Day Average/Min	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL			30.0	100.0	MG/L		100.0	334.0	LBS/DAY
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL		6.0		9.0	STD UNITS				
IRON,TOTAL (AS FE)	YEARLY	FINAL			1.44	1.44	MG/L		15.6	15.6	LBS/DAY
OIL AND GREASE	YEARLY	FINAL			15.0	20.0	MG/L		50.0	67.0	LBS/DAY

Note: If seasonal limits apply, summer is from March 15 through November 15, and winter is from November 16 through March 14.

Non-Standard Effluent Limitations

OUTFALL NO.: 006 DISCHARGE FROM THE ASH SEAL POND TREATMENT SYSTEM CONSISTING OF ASH SEAL WATER; AN ALTERNATE EMERGENCY FLOOR SUMP DISCHARGE; AND STORM WATER RUNOFF FROM A PORTION OF THE PLANT, FLYASH LOADING AREA, AND PLANT GROUNDS.

The effluent limitations for total suspended solids specified on page 10 of this permit are net limits. The permittee is authorized to deduct the amount of total suspended solids in river water used for ash seal water that subsequently discharge through outfall 006. The net discharge shall be calculated as follows:

$$(Q_d \text{ x } 8.34 \text{ x } C_d) - (Q_{as} \text{ x } 8.34 \text{ x } C_i) = \underline{\text{Net discharge (lbs/day)}} = \text{Net discharge (mg/L)}$$
$$8.34 \text{ x } Q_d$$

River - Pond - River

Where:

PC

Q_d = Flow rate from outfall 006 (mgd)
C_d = Concentration of total suspended solids measured in outfall 006 (mg/L)
Q_{as} = Flow rate of river water used for ash seal water (mgd)
C_i = Concentration of total suspended solids measured in intake water (mg/L)

Note! The net discharge may never be less than zero. All measurements needed to calculate the net discharge of total suspended solids must be made a minimum of 24 hours since the last measurable storm event. Additionally, the water intake sample shall be collected 24 hours prior to the collection of the discharge sample from the ash seal pond.

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pH

When the pH of the intake water from the Mississippi River, prior to any chemical addition, exceeds 9.0 pH units the maximum pH effluent limitations shall be equal to or less than that of the intake water.

Facility Name: IP&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Effluent Limitations

Outfall No.: 007 DISCHARGE FROM THE COAL PILE RUNOFF RETENTION POND

Interim Limits Start: 09/05/2006 Interim Limits End: 10/05/2007

You are prohibited from discharging pollutants except in compliance with the following effluent limitations:

				EFFLUENT LIMITATIONS							
				Concentration				Mass			
Wastewater Parameter	Season	Type of Limit	% Removal	7 Day Average/Min	30 Day Average	Daily Maximum	Units	7 Day Average	30 Day Average	Daily Maximum	Units
TOTAL SUSPENDED SOLIDS	YEARLY	FINAL				50.0	MG/L				
PH (MINIMUM - MAXIMUM)	YEARLY	FINAL		6.0		9.0	STD UNITS				

Note: If seasonal limits apply, summer is from March 15 through November 15, and winter is from November 16 through March 14.

Facility Name IP&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Non-Standard Effluent Limitations

OUTFALL NO.: 007 DISCHARGE FROM THE COAL PILE RUNOFF RETENTION POND.

Wastewater Parameter	Non-Standard Limits
TOTAL SUSPENDED SOLIDS	Any untreated overflow from facilities designed, constructed, and operated to treat the volume of coal pile runoff which is associated with a 10 year, 24 hour rainfall event shall not be subject to the total suspended solids limitation.

Facility Name: IP&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Monitoring and Reporting Requirements

(a) Samples and measurements taken shall be representative of the volume and nature of the monitored wastewater

(b) Analytical and sampling methods specified in 40 CFR Part 136 or other methods approved in writing by the department shall be utilized

(c) Chapter 63 of the Iowa Administrative Code provides you with further explanation of your monitoring requirements

(d) You are required to report all data including calculated results needed to determine compliance with the limitations contained in this permit This includes daily maximums and minimums, 30-day averages and 7-day averages for all parameters that have concentration (mg/l) and mass (lbs/day) limits Also, flow data shall be reported in million gallons per day (MGD)

(e) Results of all monitoring shall be recorded on forms provided by, or approved by, the department, and shall be submitted to the department by the fifteenth day following the close of the reporting period Your reporting period is on a monthly basis, ending on the last day of each reporting period

Outfall Number	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
001	TOTAL SUSPENDED SOLIDS	1 EVERY MONTH	GRAB	INTAKE FROM STREAM
001	PH (MINIMUM - MAXIMUM)	1 EVERY MONTH	GRAB	INTAKE FROM THE MISSISSIPPI RIVER PRIOR TO ANY CHEMICAL ADDITION
001	TOTAL SUSPENDED SOLIDS	1 EVERY MONTH	CALCULATED	FINAL EFFLUENT (NET ADDITION)
001	FLOW	1 TIME PER WEEK	24 HOUR TOTAL	FINAL EFFLUENT FROM THE FLOW METER LOCATED BETWEEN THE UPPER AND LOWER ASH POND
001	TOTAL SUSPENDED SOLIDS	1 EVERY MONTH	GRAB	FINAL EFFLUENT
001	PH (MINIMUM - MAXIMUM)	1 EVERY MONTH	GRAB	FINAL EFFLUENT
001	OIL AND GREASE	1 EVERY MONTH	GRAB	FINAL EFFLUENT
001	ACUTE TOXICITY, CERIODAPHNIA	1 EVERY 12 MONTHS	24 HOUR COMPOSITE	FINAL EFFLUENT
001	ACUTE TOXICITY, PIMEPHALES	1 EVERY 12 MONTHS	24 HOUR COMPOSITE	FINAL EFFLUENT
002	FLOW	1 TIME PER WEEK	24 HOUR TOTAL	FINAL EFFLUENT
002	CBOD5	1 EVERY 3 MONTHS	24 HOUR COMPOSITE	FINAL EFFLUENT
002	TOTAL SUSPENDED SOLIDS	1 EVERY 3 MONTHS	24 HOUR COMPOSITE	FINAL EFFLUENT
002	PH (MINIMUM - MAXIMUM)	1 EVERY 3 MONTHS	GRAB	FINAL EFFLUENT
002	COLIFORM,FECAL	1 EVERY 3 MONTHS	GRAB	FINAL EFFLUENT
002	SETTLEABLE SOLIDS	1 TIME PER WEEK	GRAB	FINAL EFFLUENT

Monitoring and Reporting Requirements

(a) Samples and measurements taken shall be representative of the volume and nature of the monitored wastewater

(b) Analytical and sampling methods specified in 40 CFR Part 136 or other methods approved in writing by the department shall be utilized

(c) Chapter 63 of the Iowa Administrative Code provides you with further explanation of your monitoring requirements

(d) You are required to report all data including calculated results needed to determine compliance with the limitations contained in this permit This includes daily maximums and minimums, 30-day averages and 7-day averages for all parameters that have concentration (mg/l) and mass (lbs/day) limits. Also, flow data shall be reported in million gallons per day (MGD).

(e) Results of all monitoring shall be recorded on forms provided by, or approved by, the department, and shall be submitted to the department by the fifteenth day following the close of the reporting period. Your reporting period is on a monthly basis, ending on the last day of each reporting period

Outfall Number	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
002	TEMPERATURE	1 EVERY 3 MONTHS	GRAB	FINAL EFFLUENT
004	STREAM FLOW	7/WEEK OR DAILY	MEASUREMENT	RIVER FLOW AT LOCK & DAM 18 DURING THE MONTHS OF MAY THROUGH OCTOBER (VARIABLE TEMPERATURE LIMITS TIMEFRAME)
004	FLOW	7/WEEK OR DAILY	24 HOUR TOTAL	INTAKE FROM RIVER DURING THE MONTHS OF MAY THROUGH OCTOBER (VARIABLE TEMPERATURE LIMITS TIMEFRAME)
004	TEMPERATURE	7/WEEK OR DAILY	MEASUREMENT	RIVER TEMPERATURE AT LOCK & DAM 18 DURING THE MONTHS OF MAY THROUGH OCTOBER (VARIABLE TEMPERATURE LIMITS TIMEFRAME)
004	FLOW	7/WEEK OR DAILY	24 HOUR TOTAL	FINAL EFFLUENT
004	PH (MINIMUM - MAXIMUM)	1 TIME PER WEEK	GRAB	FINAL EFFLUENT
004	CHLORINE,TOTAL RESIDUAL	1 EVERY 2 WEEKS	GRAB	SAMPLING TO OCCUR DURING PERIODS OF CHLORINE ADDITION
004	TEMPERATURE	7/WEEK OR DAILY	GRAB	FINAL EFFLUENT
004	DURATION OF CHLORINE DISCHARGE	7/WEEK OR DAILY	MEASUREMENT	MONTHLY REPORT
005	IRON,TOTAL (AS FE)	7/WEEK OR DAILY	GRAB	INTAKE FROM RIVER ONLY DURING A DISCHARGE EVENT
005	IRON,TOTAL (AS FE)	7/WEEK OR DAILY	CALCULATED	FINAL EFFLUENT (NET ADDITION) ONLY DURING A DISCHARGE EVENT
005	FLOW	7/WEEK OR DAILY	24 HOUR TOTAL	CHEMICAL METAL CLEANING WASTES PRIOR TO MIXING WITH OTHER WASTESTREAMS ONLY DURING A DISCHARGE EVENT
005	PH (MINIMUM - MAXIMUM)	7/WEEK OR DAILY	GRAB	CHEMICAL METAL CLEANING WASTES PRIOR TO MIXING WITH OTHER WASTESTREAMS ONLY DURING A DISCHARGE EVENT
005	COPPER,TOTAL (AS CU)	7/WEEK OR DAILY	GRAB	CHEMICAL METAL CLEANING WASTES PRIOR TO MIXING WITH OTHER WASTESTREAMS ONLY DURING A DISCHARGE EVENT

Monitoring and Reporting Requirements

(a) Samples and measurements taken shall be representative of the volume and nature of the monitored wastewater

(b) Analytical and sampling methods specified in 40 CFR Part 136 or other methods approved in writing by the department shall be utilized

(c) Chapter 63 of the Iowa Administrative Code provides you with further explanation of your monitoring requirements.

(d) You are required to report all data including calculated results needed to determine compliance with the limitations contained in this permit This includes daily maximums and minimums, 30-day averages and 7-day averages for all parameters that have concentration (mg/l) and mass (lbs/day) limits. Also, flow data shall be reported in million gallons per day (MGD).

(e) Results of all monitoring shall be recorded on forms provided by, or approved by, the department, and shall be submitted to the department by the fifteenth day following the close of the reporting period Your reporting period is on a monthly basis, ending on the last day of each reporting period

Outfall Number	Wastewater Parameter	Sample Frequency	Sample Type	Monitoring Location
005	IRON,TOTAL (AS FE)	7/WEEK OR DAILY	GRAB	CHEMICAL METAL CLEANING WASTES PRIOR TO MIXING WITH OTHER WASTESTREAMS ONLY DURING A DISCHARGE EVENT
006	TOTAL SUSPENDED SOLIDS	1 EVERY MONTH	GRAB	INTAKE FROM STREAM
006	PH (MINIMUM - MAXIMUM)	1 EVERY MONTH	GRAB	INTAKE FROM THE MISSISSIPPI RIVER PRIOR TO ANY CHEMICAL ADDITION
006	TOTAL SUSPENDED SOLIDS	1 EVERY MONTH	CALCULATED	FINAL EFFLUENT (NET ADDITION)
006	TOTAL SUSPENDED SOLIDS	1 EVERY MONTH	GRAB	FINAL EFFLUENT
006	PH (MINIMUM - MAXIMUM)	1 EVERY MONTH	GRAB	FINAL EFFLUENT
006	IRON,TOTAL (AS FE)	1 EVERY MONTH	GRAB	FINAL EFFLUENT
006	OIL AND GREASE	1 EVERY MONTH	GRAB	FINAL EFFLUENT
007	TOTAL SUSPENDED SOLIDS	1 EVERY MONTH	GRAB	FINAL EFFLUENT FROM THE COAL PILE RUNOFF RETENTION POND PRIOR TO MIXING WITH OTHER WASTESTREAMS IF A DISCHARGE OCCURS
007	PH (MINIMUM - MAXIMUM)	1 EVERY MONTH	GRAB	FINAL EFFLUENT FROM THE COAL PILE RUNOFF RETENTION POND PRIOR TO MIXING WITH OTHER WASTESTREAMS IF A DISCHARGE OCCURS

Facility Name IP&L-BURLINGTON GENERATING STATION

Permit Number: 2900101

Special Monitoring Requirements

Outfall Number **Description**

001 TOTAL SUSPENDED SOLIDS

Druing flooding events, when the Mississippi River level is at an elevation where the effluent pipe from the lower ash pond becomes submerged, all compliance monitoring shall be conducted at the discharge from the upper ash pond prior to entering the lower ash pond.

During normal operations, when the effluent pipe from the lower ash pond is not submerged, all compliance monitoirng shall be conducted at the effluent pipe from the lower ash pond. Following a flooding event, monitoring shall continue from the upper ash pond for one week after the river level has dropped below the effluent pipe.

002 COLIFORM,FECAL

The average limit for fecal coliform of 200 org/100 ml specified in page 6 of this permit is a geometric mean, not a 30-day average and the maximum limit of 373 org/100 ml is a sample maximum, not a daily maximum limit. These limits are equivalent to the E. coli Water Quality Standard of 126 org/100 ml geometric mean and 235 org/100 ml sample maximum.

The facility must collect and analyze a minimum of five samples in one calendar month during each 3-month period (quarter) from March 15 to November 15. This will result in a minimum of 15 samples being collected during a calendar year. For example, for the first 3-month period, the operator may choose April as the calendar month to collect the 5 individual fecal coliform samples to determine compliance with the limits. The operator may also choose the months of March or May as well, as long as each of the 5 samples are collected during a single calendar month. The same principle applies to the other two 3-month periods during the disinfection season. The following requirements apply to the individual samples collected in one calendar month:
Samples must be spaced over one calendar month.
No more than one sample can be collected on any one day.
There must be a minimum of two days between each sample.
No more than two samples may be collected in a period of seven consecutive days.

Each individual sample result will be compared to the sample maximum limit to determine compliance. The geometric mean must be calculated using all valid sample results collected during a month. The geometric mean formula is as follows: Geometric Mean = (Sample one * Sample two * Sample three * Sample four *Sample five…Sample N)(1/N), which is the Nth root of the result of the multiplication of all of the sample results where N = the number of samples. If a sample result is a less than value, the value reported by the lab without the less than sign should be used in the geometric mean calculation.

The geometric mean can be calculated in one of the following ways:
Use a scientific calculator that can calculate the powers of numbers.
Enter the samples in Microsoft Excel and use the function "GEOMEAN" to perform the calculation.
Use the geometric mean calculator on the Iowa DNR webpage at: http://www.iowadnr.com/water/npdes/calculator.html.

Outfall Number: 001

Ceriodaphnia and Pimephales Toxicity Effluent Testing

1. For facilities that have not been required to conduct toxicity testing by a previous NPDES permit, the initial annual toxicity test shall be conducted within three (3) months of permit issuance. For facilities that have been required to conduct toxicity testing by a previous NPDES permit, the initial annual toxicity test shall be conducted within twelve months (12) of the last toxicity test.

2. The test organisms that are to be used for acute toxicity testing shall be Ceriodaphnia dubia and Pimephales promelas. The acute toxicity testing procedures used to demonstrate compliance with permit limits shall be those listed in 40 CFR Part 136 and adopted by reference in rule 567--63.1(1). The method for measuring acute toxicity is specified in USEPA. October 2002, Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition. U.S. Environmental Protection Agency, Office of Water, Washington, D.C., EPA 821-R-02-012.

3. The diluted effluent sample must contain a minimum of 5.50 % effluent and no more than 94.50 % of culture water.

4. One valid positive toxicity result will require quarterly testing for effluent toxicity.

5. Two successive valid positive toxicity results or three positive results out of five successive valid effluent toxicity tests will require a toxic reduction evaluation to be completed to eliminate the toxicity.

6. A non-toxic test result shall be indicated as a "1" on the monthly operation report. A toxic test result shall be indicated as a "2" on the monthly operation report. DNR Form 542-1381 shall also be submitted to the DNR field office along with the monthly operation report.

Ceriodaphnia and Pimephales Toxicity Effluent Limits

The 30 day average mass limit of "1" for the parameters Acute Toxicity, Ceriodaphnia and Acute Toxicity, Pimephales means no positive toxicity results.

Definition: "Positive toxicity result" means a statistical difference of mortality rate between the control and the diluted effluent sample. For more information see USEPA. October 2002, Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA 821-R-01-012.

PROHIBITIONS

1. There shall be no discharge of polychlorinated biphenyl compounds such as those used for transformer fluid.
2. Neither free available nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time.

SPECIAL CONDITIONS APPLICABLE TO THE ZEBRA MUSSEL CONTROL PROGRAM

The permittee is authorized to use chemical treatments to prevent and control zebra mussel infestations subject to the following special conditions:

1. The permittee must comply at all times with the effluent limitations, monitoring and reporting requirements and all other requirements specified in this NPDES permit and amendments thereto.

2. The duration of each chemical molluscicide treatment shall be as short as possible to effect control but in no case shall any single treatment exceed 24 hours in duration.

3. The maximum number of chemical molluscicide treatments each year is four (4). Treatments should be planned to occur immediately after each zebra mussel spawning period and at 1-2 times throughout the remainder of the year.

4. The following effluent limitations shall be met at the end of the discharge pipe:

Active Ingredient	Limit
dimethylalkylamine	120 µg/l
alkyl dimethyl benzyl ammonium chloride	600 µg/l
didecyldimethylammonium chloride	220 µg/l

5. Detoxification with bentonite clay or another absorptive medium is required whenever a non-oxidizing molluscicide containing quaternary ammonium compounds is used unless the permittee can demonstrate with engineering calculations that the concentration of quaternary ammonium compounds in the final discharge will not exceed the limits specified in #4 above.

6. When a molluscicide containing any of the above listed active ingredients is used, monitoring for the active ingredient shall be conducted each day of treatment. The analyses shall be performed on a 24 hr composite sample of the final effluent from outfall #004 using a test method capable of measuring at the specified concentration.

7. The permittee shall conduct acute toxicity tests using Ceriodaphnia dubia and Pimephales promelas during the first treatment with any molluscicide not previously tested. The tests shall be performed in accordance with the requirements for toxicity testing specified elsewhere in this permit. Only outfall #004 is required to be tested. The results shall be submitted to the department's NPDES Section and shall clearly identify the facility number, outfall number, date(s) of the tests and the brand name of the molluscicide.

8. The mechanism for feeding chemicals used for controlling zebra mussels shall be designed to shut down when the raw water intake is not operating to prevent the discharge of chemical through the intake structure. An anti-siphon device shall also be incorporated in the design, if possible, to prevent the discharge of chemical remaining in the line after the chemical feed pump shuts down.

9. As new information is received and reviewed, and the results of the approved treatments evaluated, previously unanticipated environmental impacts might be detected. This permit may be amended or, revoked and reissued, if unanticipated environmental or human health impacts occur or are reported from other locations in scientific literature. The permittee is encouraged to continually evaluate alternative methods of zebra mussel control and to investigate innovative, non-chemical methods of preventing zebra mussels from interfering with facility operations.

TEMPERATURE LIMITS, MONITORING AND REPORTING

LIMITS

The temperature of the discharge during the months of May through October from outfall 004 shall not exceed the most stringent value for T_e calculated using both equations #1 and #2.

Equation #1 – Maximum limit that will not cause more than a 5.4° F increase in river temperature.

$$T_e = 5.4 \times \frac{\left[\frac{Q_r - Q_i}{10} + Q_e\right]}{Qe} + Tr$$

Equation #2 – Maximum limit that will not cause the river temperature to exceed the maximum allowable.

$$T_e = \left[\frac{\left(\left(\frac{Q_r - Q_i}{10} + Q_e\right) \times T_{\max}\right) - \left(\frac{Q_r - Q_i}{10} \times T_r\right)}{Q_e}\right]$$

Where:

Te = Maximum allowable discharge temperature (°F)
Tr = Temperature of river water at lock & dam 18 (°F)
Q_i = Intake flow rate (cfs)
Qe = Discharge flow rate (cfs)
Qr = (River flow (cfs) at lock & dam 18) x 0.80

Tmax = 48.2° F January
= 48.2° F February
= 60.8° F March
= 71.6° F April
= 82.4° F May
= 87.8° F June
= 89.6° F July
= 89.6° F August
= 87.8° F September
= 78.8° F October
= 68.0° F November
= 55.4° F December

MONITORING

The following shall be measured directly or obtained from the Army Corps of Engineers or U.S. Geological Survey at the specified frequency:

Measurement	Frequency
River water temperature (T_r)	Daily
Discharge water temperature (T_e)	Daily
Intake water flow (Q_i)	Daily
Discharge water flow (Q_e)	Daily
River flow (Q_r)	Daily

River flow (Q_r) and river temperature (T_r) shall be obtained from the Army Corp of Engineers' website at http://www2.mvr.usace.army.mil/WaterControl/stationinfo2.cfm?sid=MI18&fid=GLDI2&dt=L for gage MI18 at Mississippi River Lock & Dam 18.

The measurement results shall be used with equation #1 and equation #2 to calculate the maximum allowable discharge temperature. The measured discharge temperature shall be compared with the most stringent value for T_e to determine compliance with this permit.

On a day that Lock & Dam 18 gauge is inoperable; the facility shall use the average of the previous 5 days of Mississippi River flow and temperature from Lock & Dam 18.

For purposes of this permit "inoperable" shall mean at times when no reported values for river flow and temperature are recorded at Lock & Dam 18.

REPORTING

All measurement results shall be entered in the Excel spreadsheet titled, "Monthly Operation Report, Interstate Power and Light, Burlington Generating Station", a copy of which is attached to this permit. A copy has also been provided to the permittee in electronic format. A printed copy of the completed spreadsheet shall be submitted for the months of May through October as part of the discharge monitoring report.

COOLING WATER INTAKE STRUCTURE REQUIREMENTS

A. You shall maintain in good working order and operate all existing equipment and continue to implement operational measures to minimize impingement of fish and shellfish. Such equipment and measures shall include but not be limited to maintaining trash racks with a maximum 4-inch spacing installed in front of the intake to prevent impingement of large fish and not recirculating cooling water to the intake to prevent icing during winter.

B. You must select and implement one of the five (5) alternatives specified in 40 CFR §125.94(a) for establishing best technology available for minimizing adverse environmental impact. If you chose compliance alternatives (a)(2), (a)(3) or (a)(4) you must meet the national performance standard by reducing impingement mortality for all life stages of fish and shellfish by 80 to 95 percent from the calculation baseline. The calculation baseline will be established by the Comprehensive Demonstration Study (CDS) required below.

   1. Compliance alternative (a)(2) allows you to demonstrate that your existing design and construction technologies, operational measures, and/or restoration measures meet the performance standard for impingement mortality or requirements for restoration.

   2. Compliance alternative (a)(3) allows you to demonstrate that you have selected and will install and properly operate and maintain, design and construction technologies, operational measures, and/or restoration measures that will, in combination with any existing design and construction technologies, operational measures, and/or restoration measures, meet the performance standard for impingement mortality or requirements for restoration.

   3. Compliance alternative (a)(4) allows you to demonstrate that you have installed, or will install, and properly operate and maintain an approved design and construction technology in accordance with 40 CFR §125.99(a) or (b).

C. As expeditiously as possible but not later than **January 7, 2008**, you shall submit the Comprehensive Demonstration Study (CDS) and any other information required by 40 CFR §125.95. The CDS shall include the following:

   1. Proposal for Information Collection (PIC) [The PIC for this facility was submitted June 15, 2005]
   2. Source Waterbody Flow Information
   3. Impingement Mortality Characterization Study
   4. Technology and Compliance Assessment Information
   5. Restoration Plan (optional)
   6. Information to Support a Site Specific Determination of Best Technology Available for Minimizing Adverse Environmental Impact: Cost/Cost or Cost/Benefit (optional)
   7. Verification Monitoring Plan

E. You must keep records of report information and data used to complete the permit application, including information contained in the PIC and CDS for a period of at least three (3) years from the date of issuance of this permit.

F. This permit may be modified, or alternatively revoked and reissued, to contain additional requirements applicable to design, construction and operation of the cooling water intake structure to minimize impingement mortality of fish and shellfish based on reports and information submitted to the director under 40 CFR §125.94, §125.95 and §126.96.

DESIGN CAPACITY

Outfalls: 002 – Discharge from a septic tank and recirculation textile media filter wastewater treatment system.

Design Capacity: The design capacity of the treatment works is specified in Construction Permit No. 2005-0439-S, issued April 29, 2005. The treatment plant is designed to treat an organic loading of 2 pounds of 5-day biochemical oxygen demand (BOD_5) per day while handling an average daily hydraulic loading of 1,000 gallons and a maximum daily flow of 2,500 gallons.

Iowa Administrative Code 567—62.1(7): Wastes in such volumes or quantities as to exceed the design capacity of the treatment works or reduce the effluent quality below that specified in the operation permit of the treatment works are considered to be a waste which interferes with the operation or performance of a publicly owned treatment works or a privately owned domestic sewage treatment works and are prohibited.

SEPTIC TANKS OPERATIONAL REQUIREMENTS

Septic Tanks, Procedures and Schedules:

1. Twice a year, at approximately six month intervals,
   a) Check conditions of outlet and inlet baffles, key joints, and the tank itself. Repair as needed.
   b) Measure sludge level; if within 8 inches of outlet baffle, pumping is necessary.
   c) Measure scum level; if within 3 inches of outlet baffle, pumping is necessary.
2. Pump tank as necessary.
3. Solids must be disposed of according to the requirements listed on page 26 of this permit or by a licensed commercial septic tank cleaner.

SEWAGE SLUDGE HANDLING AND DISPOSAL REQUIREMENTS

"Sewage sludge" is solid, semisolid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge does not include the grit and screenings generated during preliminary treatment.

1. The permittee shall comply with all existing Federal and State laws and regulations that apply to the use and disposal of sewage sludge, not including sludge from the ash pond, and with technical standards developed pursuant to Section 405(d) of the Clean Water Act when such standards are promulgated. If an applicable numerical limit or management practice for pollutants in sewage sludge is promulgated after issuance of this permit that is more stringent than a sludge pollutant limit or management practice specified in existing Federal or State laws or regulations, this permit shall be modified, or revoked and reissued, to conform to the regulations promulgated under Section 405(d) of the Clean Water Act. The permittee shall comply with the limitation no later than the compliance deadline specified in the applicable regulations.

2. The permittee shall provide written notice to the Department of Natural Resources prior to any planned changes in sludge disposal practices.

3. Land application of sewage sludge shall be conducted in accordance with criteria established rule IAC 567--67.1 through 67.11(455B).

Outfall Elimination Schedule

The permittee shall eliminate all discharge from outfall 006 by November 1, 2009. Within fourteen (14) days of ceasing discharge from outfall 006 the permittee shall notify the department, in writing, that outfall 006 has been eliminated and that the outfall pipe has been permanently plugged to prevent the possibility of a discharge in the future.

STORM WATER DISCHARGES COVERED UNDER THIS PERMIT

PART I. DESCRIPTION OF STORM WATER DISCHARGES

A. DISCHARGES COVERED UNDER THIS PERMIT

This permit authorizes the discharge of storm water associated with industrial activity from outfalls 001 and 006 identified on pages #2 and #3 of this permit.

B. STORM WATER DISCHARGE NOT ASSOCIATED WITH INDUSTRIAL ACTIVITY

Storm water discharge associated with industrial activity (as defined in chapter 567-60 of the Iowa Administrative Code) authorized by this permit may be combined with other sources of storm water that are not classified as associated with industrial activity pursuant to 40 CFR 122.26(b)(14) or with wastewater from outfalls defined elsewhere in this permit.

C. LIMITATION ON COVERAGE

Unless specifically identified elsewhere in this permit, the following discharges are not authorized by this permit:

- non-storm water discharges except those listed elsewhere in this permit,
- the discharge of substances resulting from an on-site spill;
- storm water discharge associated with industrial activity from construction activity, specifically any land disturbing activity of one or more acres;
- washwaters from material handling and processing areas,
- washwaters from drum, tank, or container rinsing and cleaning, and
- vehicle and equipment washwaters.

D. NON-STORM WATER DISCHARGES

The following non-storm water discharges may be authorized by this permit provided the non-storm water component of the discharge is in compliance with the conditions listed in the storm water portion of this permit:

discharges from fire fighting activities, fire hydrant flushing, potable water sources including waterline flushing, drinking fountain water, uncontaminated compressor condensate, irrigation drainage, lawn watering, routine external building washdown that does not use detergents or other compounds, pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used, air conditioning condensate, uncontaminated springs, uncontaminated ground water, and foundation or footing drains where flows are not contaminated with process materials such as solvents.

PART II. SPECIAL CONDITIONS

ADDITIONAL REQUIREMENTS FOR FACILITIES WITH SALT STORAGE

Storage piles of salt used for deicing or other commercial or industrial purposes and that generate a storm water discharge to waters of the United States shall be enclosed or covered to prevent exposure to precipitation, except for exposure resulting from adding or removing materials from the pile.

PART III. STORM WATER POLLUTION PREVENTION PLAN

The storm water pollution prevention plan as described and required in the permit previously issued to this facility must continue to be implemented. The plan must identify potential sources of pollution that may reasonably be expected to affect the quality of storm water discharge associated with industrial activity from the facility. In addition, the plan must describe and ensure the implementation of practices that are used to reduce the pollutants in storm water discharge associated with industrial activity at the facility and to ensure compliance with the terms and conditions of this permit. The permittee must continue to implement the provisions of the storm water pollution prevention plan required under the previous permit.

The plan shall be amended whenever there is a change in design, construction, operation, or maintenance, that has a significant effect on the potential for the discharge of pollutants to the waters of the United States or if the storm water pollution prevention plan proves to be ineffective in eliminating or significantly minimizing the discharge of pollutants or in otherwise achieving the general objectives of controlling pollutants in storm water discharges associated with industrial activity. New owners shall review the existing plan and make appropriate changes.

The storm water pollution prevention plan required by this permit must be modified within 14 calendar days of the occurrence of any "hazardous condition" to provide a description of the release, the circumstances leading to the release, and the date of the release. In addition, the plan must be reviewed by the permittee to identify measures to prevent the reoccurrence of such a condition and to respond to such discharges, and the plan must be modified where appropriate.

PART IV. DEFINITIONS

1. Storm water means storm water runoff, snow melt runoff, and surface runoff and drainage.
2. Waters of the United States means all waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide;

a. All interstate waters, including interstate wetlands;

b. All other waters such as interstate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:

c. That are or could be used by interstate or foreign travelers for recreational or other purposes;

d. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

e. That are used or could be used for industrial purposes by industries in interstate commerce;

f. All impoundment of waters otherwise defined as waters of the United States under this definition;

g. Tributaries of waters identified in paragraphs (a) through (d) of this definition;

h. The territorial sea; and

i. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) through (f) of this definition,

STANDARD CONDITIONS

1. **DEFINITIONS**

   (a) 7 day average means the sum of the total daily discharges by mass, volume or concentration during a 7 consecutive day period, divided by the total number of days during the period that measurements were made. Four 7 consecutive day periods shall be used each month to calculate the 7-day average. The first 7-day period shall begin with the first day of the month.

   (b) 30 day average means the sum of the total daily discharges by mass, volume or concentration during a calendar month, divided by the total number of days during the month that measurements were made.

   (c) daily maximum means the total discharge by mass, volume or concentration during a twenty-four hour period.

2. **DUTY TO COMPLY**

   You must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; permit termination, revocation and reissuance, or modification; or denial of a permit renewal application. Issuance of this permit does not relieve you of the responsibility to comply with all local, state and federal laws, ordinances, regulations or other legal requirements applying to the operation of your facility.
   {See 40 CFR 122.41(a) and 567-64.7(4)(e)) IAC}

3. **DUTY TO REAPPLY**

   If you wish to continue to discharge after the expiration date of this permit you must file an application for reissuance at least 180 days prior to the expiration date of this permit.
   {See 567-64.8(1) IAC}

4. **NEED TO HALT OR REDUCE ACTIVITY**

   It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.
   {See 40 CFR 122.41(c) and 567-64.7(5)(j) IAC}

5. **DUTY TO MITIGATE**

   You shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.
   {See 40 CFR 122.41(d) and 567-64.7(5)(i) IAC}

6. **PROPERTY RIGHTS**

   This permit does not convey any property rights of any sort or any exclusive privileges.

7. **TRANSFER OF TITLE**

   If title to your facility, or any part of it, is transferred the new owner shall be subject to this permit.
   {See 567-64.14 IAC}

   You are required to notify the new owner of the requirements of this permit in writing prior to any transfer of title. The Director shall be notified in writing within 30 days of the transfer

8. **PROPER OPERATION AND MAINTENANCE**

   All facilities and control systems shall be operated as efficiently as possible and maintained in good working order. A sufficient number of staff, adequately trained and knowledgeable in the operation of your facility shall be retained at all times and adequate laboratory controls and appropriate quality assurance procedures shall be provided to maintain compliance with the conditions of this permit.
   {See 40 CFR 122.41(e) and 567 64.7(5)(f) IAC}

9. **DUTY TO PROVIDE INFORMATION**

   You must furnish to the Director, within a reasonable time, any information the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit or to determine compliance with this permit. You must also furnish to the Director, upon request, copies of any records required to be kept by this permit.

10. **MAINTENANCE OF RECORDS**

    You are required to maintain records of your operation in accordance with 567-63.2 IAC.

11. **PERMIT MODIFICATION, SUSPENSION OR REVOCATION**

    (a) This permit may be modified, suspended, or revoked and reissued for cause including but not limited to those specified in 567-64.3(11) IAC.

    (b) This permit may be modified due to conditions or information on which this permit is based, including any new standard the department may adopt that would change the required effluent limits.
    {See 567-64.3(11) IAC}

    (c) If a toxic pollutant is present in your discharge and more stringent standards for toxic pollutants are established under Section 307(a) of the Clean Water Act, this permit will be modified in accordance with the new standards.
    {See 40 CFR 122.62(a)(6) and 567-64.7(5)(g) IAC}

    The filing of a request for a permit modification, revocation or suspension, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

12. **SEVERABILITY**

    The provisions of this permit are severable and if any provision or application of any provision to any circumstance is found to be invalid by this department or a court of law, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected by such finding.

STANDARD CONDITIONS

13. INSPECTION OF PREMISES, RECORDS, EQUIPMENT, METHODS AND DISCHARGES

You are required to permit authorized personnel to:

(a) Enter upon the premises where a regulated facility or activity is located or conducted or where records are kept under conditions of this permit.

(b) Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit.

(c) Inspect, at reasonable times, any facilities, equipment, practices or operations regulated or required under this permit.

(d) Sample or monitor, at reasonable times, for the purpose of assuring compliance or as otherwise authorized by the Clean Water Act.

14. TWENTY-FOUR HOUR REPORTING

You shall report any noncompliance that may endanger human health or the environment. Information shall be provided orally within 24 hours from the time you become aware of the circumstances. A written submission that includes a description of noncompliance and its cause; the period of noncompliance including exact dates and times, whether the noncompliance has been corrected or the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent a reoccurrence of the noncompliance must be provided within 5 days of the occurrence. The following instances of noncompliance must be reported within 24 hours of occurrence:

(a) Any unanticipated bypass which exceeds any effluent limitation in the permit.
{See 40 CFR 122.41(l)(5)(ii)(A)}

(b) Any upset which exceeds any effluent limitation in the permit.
{See 40 CFR 122.41(l)(5)(ii)(B)}

(c) Any violation of a maximum daily discharge limit for any of the pollutants listed by the Director in the permit to be reported within 24 hours.
{See 40 CFR 122.41(l)(5)(ii)(C)}

15. OTHER NONCOMPLIANCE

You shall report all instances of noncompliance not reported under Condition #14 at the time monitoring reports are submitted.

16. ADMINISTRATIVE RULES

Rules of this Department which govern the operation of your facility in connection with this permit are published in Part 567 of the Iowa Administrative Code (IAC) in Chapters 60-65 and 121. Reference to the term "rule" in this permit means the designated provision of Part 567 of the Iowa Administrative Code.

17. NOTICE OF CHANGED CONDITIONS

You are required to report any changes in existing conditions or information on which this permit is based:

(a) Facility expansions, production increases or process modifications which may result in new or increased discharges of pollutants must be reported to the Director in advance. If such discharges will exceed effluent limitations, your report must include an application for a new permit.
{See 567-64.7(5)(a) IAC}

(b) If any modification of, addition to, or construction of a disposal system is to be made, you must first obtain a written permit from this Department.
{See 567-64.2 IAC}

(c) If your facility is a publicly owned treatment works or otherwise may accept waste for treatment from industrial contributors see 567-64.3(5) IAC for further notice requirements.

(d) You shall notify the Director as soon as you know or have reason to believe that any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in this permit.
{See 40 CFR 122.42(a)}

(e) No construction activity that will result in disturbance of one acre or more shall be initiated without first obtaining coverage under NPDES General Permit No. 2 for "Storm water discharge associated with construction activity".

You must also notify the Director if you have begun or will begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application

18. OTHER INFORMATION

Where you become aware that you failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report, you must promptly submit such facts or information.

STANDARD CONDITIONS

19. UPSET PROVISION

(a) Definition - "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

(b) Effect of an upset. An upset constitutes an affirmative defense in an action brought for noncompliance with such technology based permit effluent limitations if the requirements of paragraph *"c"* of this condition are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

(c) Conditions necessary for demonstration of an upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate through properly signed, contemporaneous operating logs, or other relevant evidence that;

1. An upset occurred and that the permittee can identify the cause(s) of the upset.
2. The permitted facility was at the time being properly operated; and
3. The permittee submitted notice of the upset to the Department in accordance with 40 CFR 122.41(l)(6)(ii)(B).
4. The permittee complied with any remedial measures required by Item #5 of the Standard Conditions of this permit.

(d) Burden of Proof. In any enforcement proceeding, the permittee seeking to establish the occurrence of an upset has the burden of proof.

20. FAILURE TO SUBMIT FEES

This permit may be revoked, in whole or in part, if the appropriate permit fees are not submitted within thirty (30) days of the date of notification that such fees are due.

21. BYPASSES

(a) Definition - Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

(b) Prohibition of bypass, Bypass is prohibited and the department may take enforcement action against a permittee for bypass unless:

BYPASSES (Continued)

1. Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
2. There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate backup equipment should have been installed in the exercise of reasonable engineering judgement to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance;
3. The permittee submitted notices as required by paragraph *"d"* of this section.

(c) The Director may approve an anticipated bypass after considering its adverse effects if the Director determines that it will meet the three conditions listed above.

(d) Reporting bypasses. Bypasses shall be reported in accordance with 567-63.6 IAC.

22. SIGNATORY REQUIREMENTS

Applications, reports or other information submitted to the Department in connection with this permit must be signed and certified as required by 567-64.3(8) IAC.

23. USE OF CERTIFIED LABORATORIES

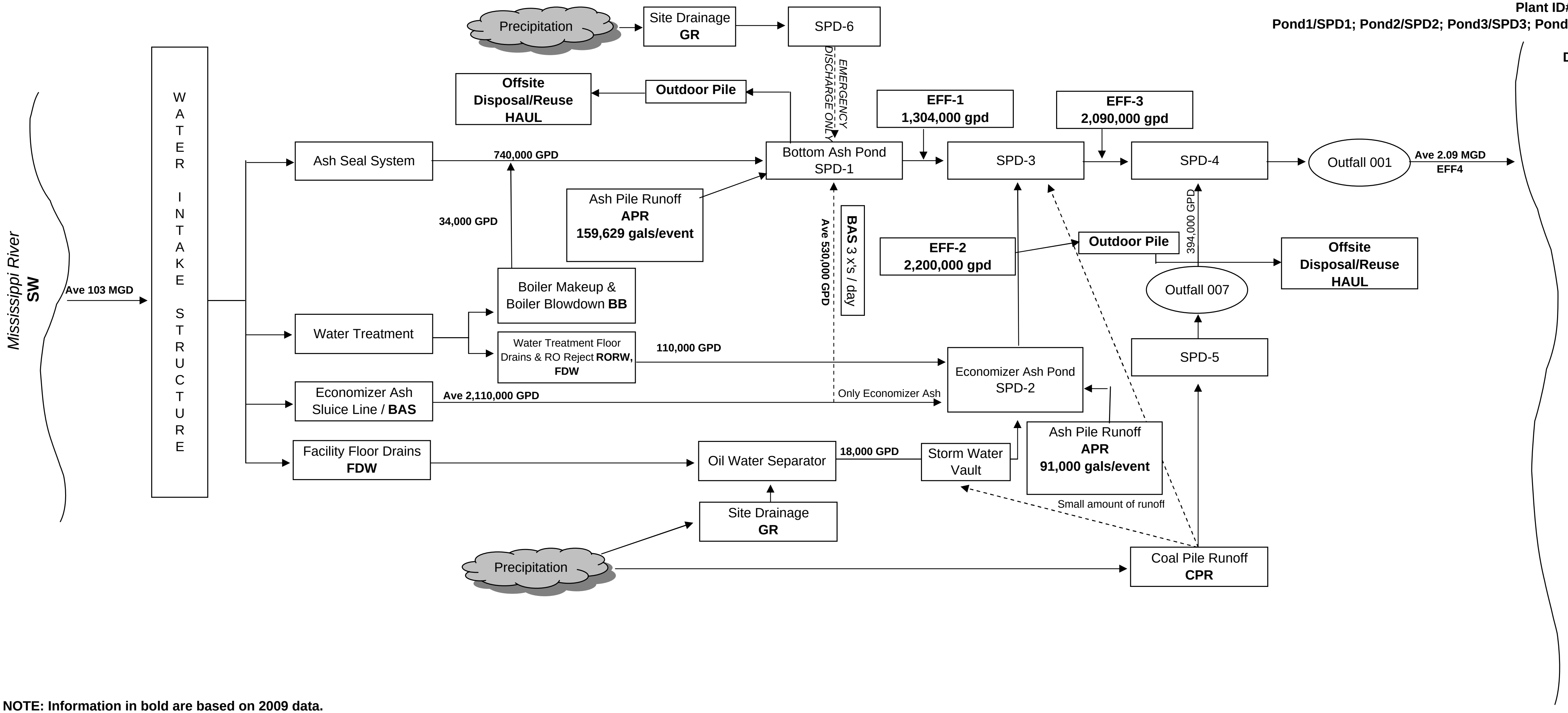
Effective October 1, 1996, analyses of wastewater, groundwater or sewage sludge that are required to be submitted to the department as a result of this permit must be performed by a laboratory certified by the State of Iowa. Routine, on-site monitoring for pH, temperature, dissolved oxygen, total residual chlorine and other pollutants that must be analyzed immediately upon sample collection, settleable solids, physical measurements, and operational monitoring tests specified in 567-63.3(4) are excluded from this requirement.

24. LEGAL AND FINANCIAL LIABILITY WAIVER

No legal or financial responsibility arising from the operation or maintenance of any disposal system or part thereof installed by the permittee to achieve compliance with this permit shall attach to the State of Iowa or the Iowa Department of Natural Resources.

CONFIDENTIAL BUSINESS INFORMATION

IPL - Burlington Generating Station
Plant ID# 00189
Pond1/SPD1; Pond2/SPD2; Pond3/SPD3; Pond4/SPD4
D3-1
D-1, D-2

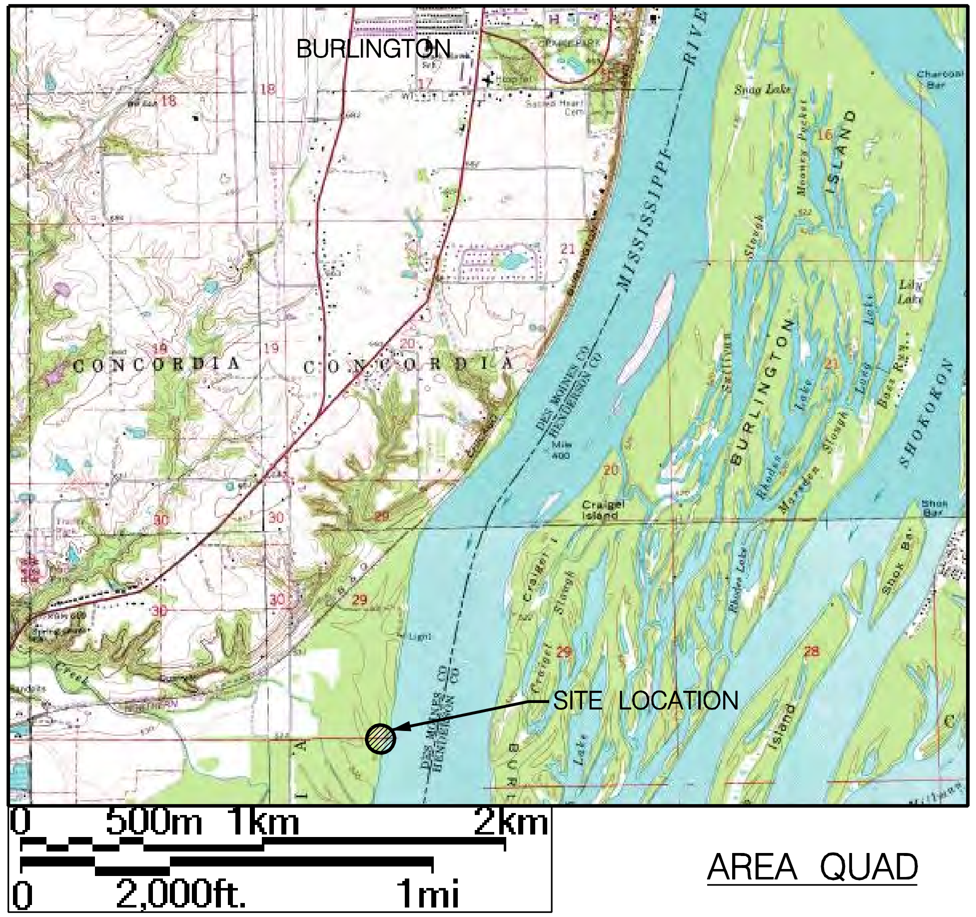


NOTE: Information in bold are based on 2009 data.

CONFIDENTIAL BUSINESS INFORMATION

ALLIANT ENERGY
BURLINGTON GENERATING STATION
SLURRY WALL CONSTRUCTION AND SEEP REPAIR

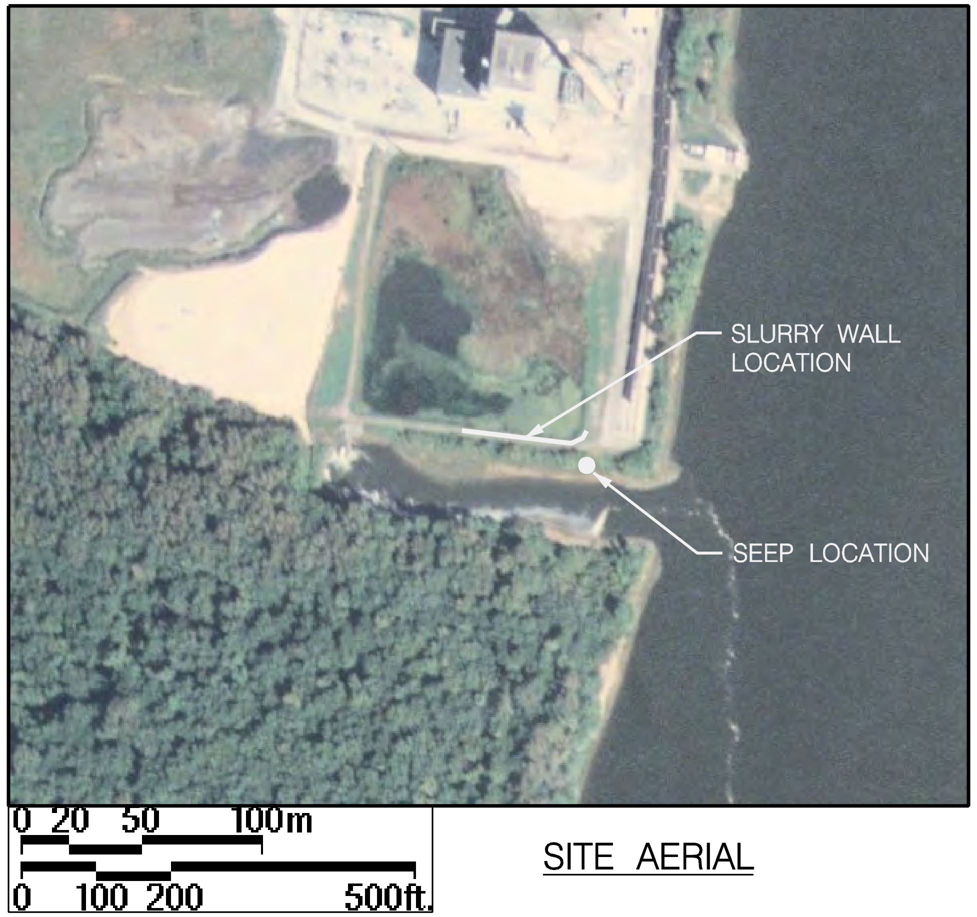
4282 SULLIVAN SLOUGH ROAD
BURLINGTON, IA 52601
OCTOBER 2007



AREA QUAD

DRAWING INDEX

1 COVER SHEET
2 GENERAL SITE LAYOUT
3 SPECIFICATIONS AND DETAILS



SITE AERIAL

REV	DATE	BY	DESCRIPTION

SCALE: NONE

DESIGNED: M. Loerop
DRAWN: HHSI
CHECKED: HHSI

CLIENT: ALLIANT ENERGY
BURLINGTON GENERATING STATION

TITLE: COVER SHEET

HARD HAT SERVICES ™
Engineering, Construction and Management Solutions

940 E. Diehl Rd, Suite 150
Naperville, IL 60563
(630) 637-9470

SHEET: 1
OF 3 SHEETS

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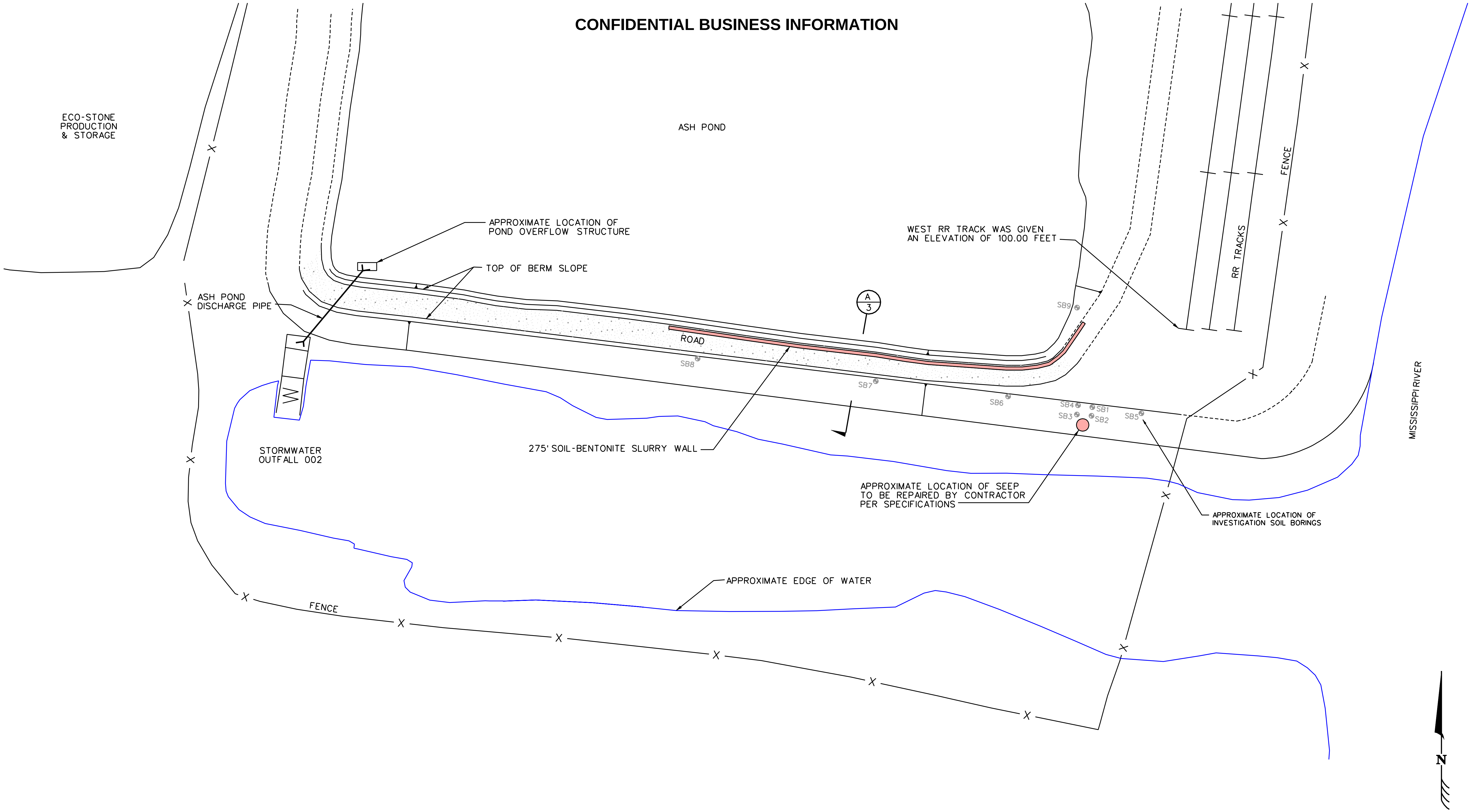
10/12/2007

CONFIDENTIAL BUSINESS INFORMATION



REV	DATE	BY	DESCRIPTION

SCALE:
0 30 60
SCALE IN FEET

DESIGNED: M. Loerop
DRAWN: HHSI
CHECKED: HHSI

CLIENT:
ALLIANT ENERGY
BURLINGTON GENERATING STATION

TITLE:
GENERAL SITE LAYOUT

HARD HAT SERVICES TM
Engineering, Construction and Management Solutions

940 E. Diehl Rd, Suite 150
Naperville, IL 60563
(630) 637-9470

SHEET:
2
OF 3 SHEETS

...\SITE LAYOUT.dgn

10/12/2007

CONFIDENTIAL BUSINESS INFORMATION

DESIGN SPECIFICATIONS

Contractor Experience

An experienced slurry wall Contractor shall construct a soil-bentonite slurry wall. Experience shall include at least 100,000 square feet of soil-bentonite slurry wall construction with the contractors proposed site superintendent having at least 50,000 square feet of soil bentonite wall experience. Contractor shall submit their experience to the Project Manager for approval prior to installation of the slurry wall or purchase of materials.

Sodium Bentonite

Contractor shall supply the Construction Manager with the bentonite manufacturer's certificate of compliance. The bentonite shall be pulverized premium grade sodium cation montmorillonite.

Test results for each lot of bentonite must be provided:

• YP/PV ratio	API Std. 13A	Less than 3
• Viscometer		Greater than 30
• Filtrate Loss		15 - 25 cm3 loss at 100psi, and 12-15cm3 loss at 42 psi with no more than 2 mm of filter cake on the paper
• Moisture Content	ASTM D 2216	less than 10 percent

Sodium Bentonite must be stored in an above ground dry enclosure. High humidity storage locations shall not be used. Prematurely hydrated sodium bentonite shall not be used for construction of the slurry wall and shall be properly disposed.

Make-up Water

Clean and fresh water, free from excessive quantities of deleterious substances that could adversely affect the properties of the slurry, shall be used to manufacture the bentonite slurry. It is the responsibility of the contractor that the slurry resulting from the water used shall always meet the following standards:

• pH	6 - 9
• Hardness	less than 200 ppm
• Total Dissolved Solids	less than 500 ppm
• Oil, organics, acids, alkali	less than 50 ppm each
• Chloride	report

Sodium Bentonite Slurry

The initial bentonite slurry must be tested prior to placement in the trench. The slurry may either be mixed in high shear mixers or mixed and hydrated in slurry hydration ponds. If slurry ponds are used for hydration, dry bentonite shall be added in a venturi mixer, not in bulk. Sodium Bentonite shall be added to the make-up water at a minimum of 5% by weight.

• Viscosity - Marsh Funnel (API RP 13B-1)	less than 40 seconds
• Density	less than 64 pcf
• pH	6.5 to 10

A minimum hydration time of 8 hours shall be used.

After placement in the trench, the slurry shall be tested two times at two locations for each 8-hour shift. At each location the slurry shall be tested two feet from the surface and two feet from the bottom of the trench

- The viscosity shall be measured using the Marsh Funnel test (API RP 13B-1) and shall be between 30 to 40 seconds.
- Slurry shall have a unit weight between 64 pcf and 85 pcf unless approved by the Project Manager. If the slurry exceeds 85 pcf the excess solids must be removed by desanding or the slurry replaced with fresh slurry.

In place slurry shall be no more than 2 feet below the top of the working platform and at least 2 feet above the ash pond water elevation.

Soil-Bentonite Backfill

Soil used to produce the soil-bentonite backfill shall pass the following gradation specification.

- 65 to 100 percent passing 3/8" sieve
- 40 to 85 percent passing the #20 sieve
- 25 to 40 percent passing the #200 sieve
- Roll soil that passes the #200 sieve to 1/8 inch thread

Bentonite backfill shall be mixed with the soil removed from the excavation and mixed until the material is homogeneous with a slump of 2 to 6 inches, as measured per ASTM D 143. The Contractor shall mix the materials at the location determined by the Project Manager. Contractor shall provide documentation to the Project Manager that the soil-bentonite backfill contains at least 2% bentonite by weight. A passing slump test is required for each 750 CY of backfill material. All particles should be coated with bentonite slurry and large particles (> 4 inches) should be removed or segregated. The tracks of a bulldozer and excavator or other method may be used in reducing the clod size and in producing a homogeneous material prior to material placement within the slurry wall. The slurry wall shall be constructed at least 12 inches above the high water elevation within the settling pond, which will be provided by the Project Manager. The Contractor shall place the soil-bentonite backfill to a depth of 18 inches below the surrounding ground elevation.

The Contractor shall demonstrate, to the satisfaction of the Project Manager, that each section of the slurry-filled trench is continuous prior to backfilling. Trench continuity shall be assured by demonstrating the free action and movement of the excavation equipment within the trench prior to backfilling. Digging tools must pass vertically from top to bottom of the trench, and horizontally along the alignment of the trench, without encountering unexcavated material. The trench shall be verified and documented by the Contractor for proper depth every 10 feet.

The contractor shall demonstrate, to the satisfaction of the Project Manager, that the trench is keyed the minimum specified depth into the underlying hard silty clay. Penetration of the bottom of the trench into the underlying hard silty clay shall be assured by observation of the cuttings removed from the trench and by comparing direct trench depth measurements to anticipated depths based on the design details.

Temporary and Permanent Clay Cap

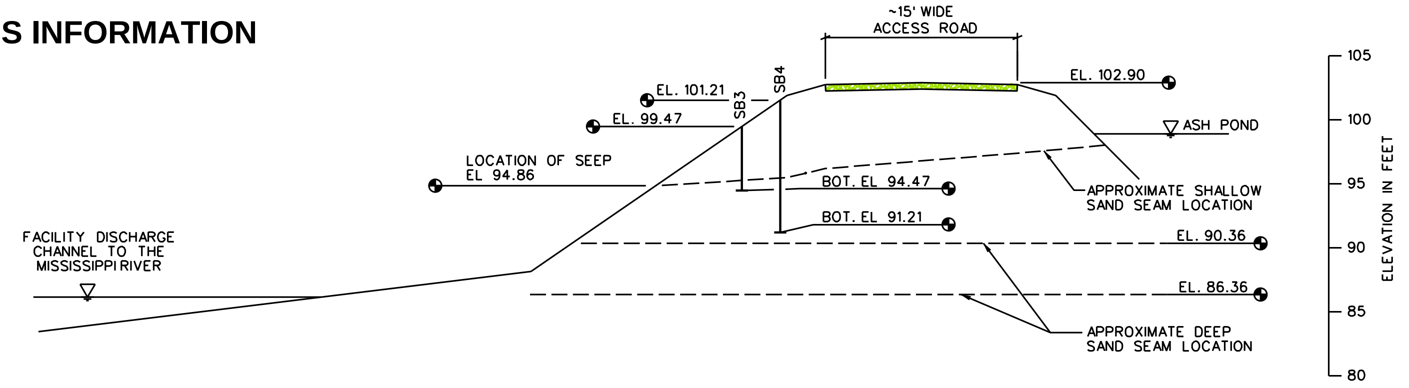
A two-foot deep temporary protective slurry wall cap shall be constructed in the form of non-compacted soil cover and placed within 24-hours of each 100-foot length of slurry wall. The temporary cap shall be completely removed after greater than two weeks of consolidation time. In place of the temporary cap, Contractor may chose to place soil-bentonite to finish grade and then remove soil bentonite to construct the permanent cap. The permanent clay cap shall be constructed by replacing the void space with at least, three, 6-inch compacted clay lifts, placed at +/- 2% of optimum moisture content or as approved by project manager and compacted to 95% of a Standard Proctor, per ASTM D698. The compacted clay lifts shall be installed to match the surrounding ground surface, as necessary. The clay fill material shall pass the backfill gradation requirement as specified above.

Restoration Activities

A six-ounce geotextile shall be placed atop the completed soil bentonite slurry wall in accordance with the manufacture's installation instructions. The geotextile shall extend 5 feet beyond all disturbed areas along the berm. Finally, 6 inches of well-graded Iowa DOT 4120.03 Class C gravel shall be placed and compacted atop the geotextile at a minimum of 5 passes with a smooth drum roller. The gravel gradation shall be provided to and approved by the Project Manager prior to placement by the Contractor.

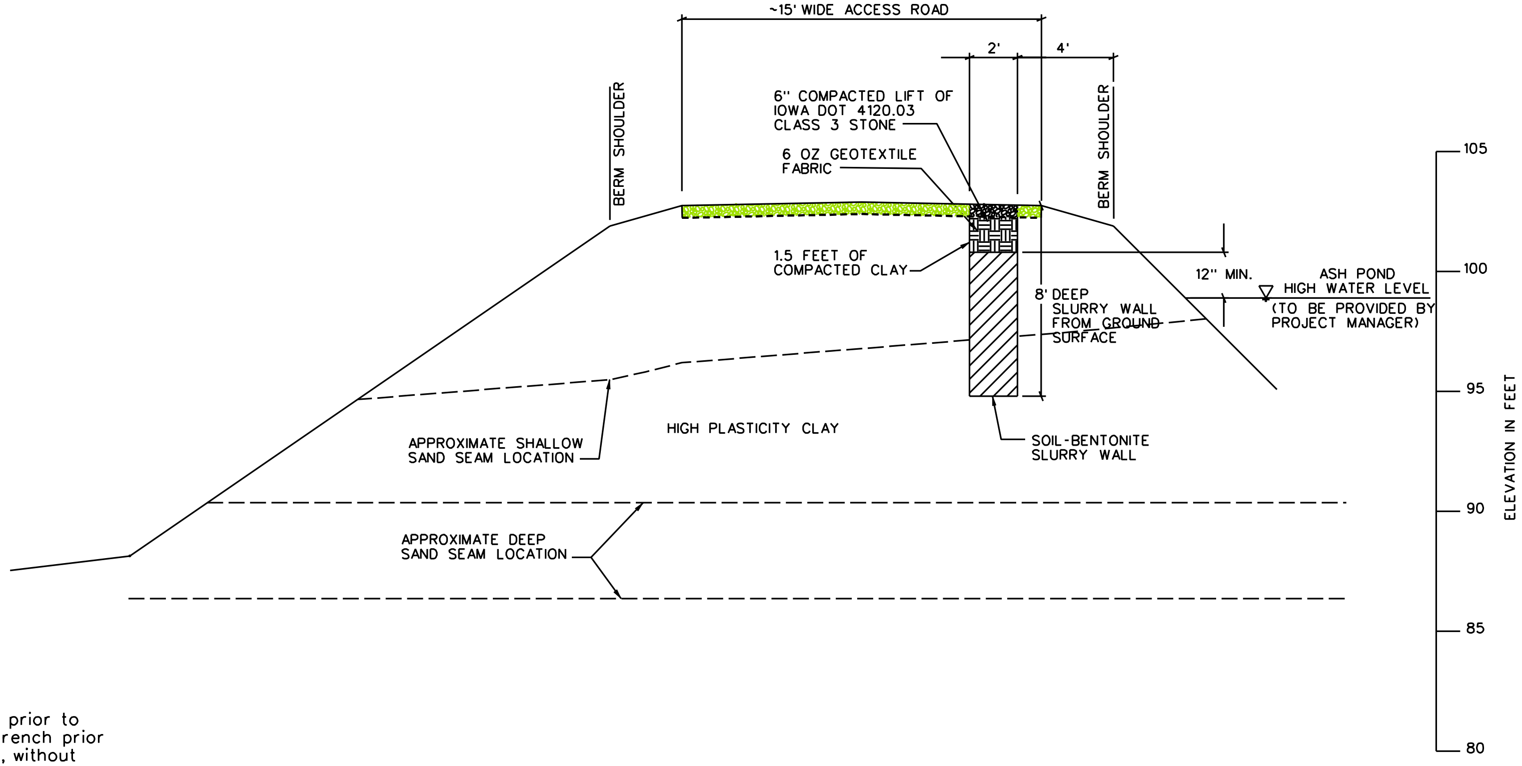
The Contractor shall repair the seep on the south east corner of the berm as shown on Sheet 2. The erosion area shall be regraded, seeded with Iowa DOT approved seed mix, and straw shall be placed on disturbed areas to prevent erosion along the berm face.

After Completion of backfilling and capping, remove and level all remaining excavated material and slurry as directed by the Project Manager. Dispose of excess slurry by spreading in thin layers at the location designated by the Project Manager. No slurry shall be left in ponds, and all ponds shall be pumped dry and backfilled with suitable material approved by the Project Manager.



EXISTING BERM DETAIL

0 4 10 15
SCALE IN FEET



SLURRY WALL SECTION ①/②

0 4 8
SCALE IN FEET

REV	DATE	BY	DESCRIPTION

SCALE: AS SHOWN

DESIGNED: M. Loerop
DRAWN: HHSI
CHECKED: HHSI

CLIENT: ALLIANT ENERGY
BURLINGTON GENERATING STATION

TITLE: SPECIFICATIONS AND DETAILS

HARD HAT SERVICES ™
Engineering, Construction and Management Solutions

940 E. Diehl Rd, Suite 150
Naperville, IL 60563
(630) 637-9470

SHEET: 3
OF 3 SHEETS

10/12/2007
...\DETAILS.dgn

GEOTECHNICS
Soil & Material Testing
A DIVISION OF KLINGNER
610 N. 4th St., Suite 100 • Burlington, IA 52601 • voice 319.753.0816 • fax 319.752.3605

CONFIDENTIAL BUSINESS INFORMATION

January 8, 2008

Mr. Ron Veach, Project Manager
Alliant Energy
4282 Sullivan Slough Road
Burlington, IA 52601

RE: Ash Pond Repairs
Burlington Generating Station
Engineer Certification

Dear Ron:

Pursuant to the Iowa DNR correspondence dated October 30, 2007, we are providing a certification and supporting documentation that the repair work to the ash pond as proposed by Hard Hat Services has been completed in accordance with the 10/29/07 engineering drawings.

We observed key portions of the repair work including trench excavation, bentonite slurry mixing, soil bentonite mixing, slurry and soil placement, and final cap placement. Additionally, we performed various tests to determine if the slurry and soil mixture properties were in conformance with those specified. The documentation is included as attachments.

It was subsequently learned through the use of a backhoe that the “seep to be repaired by contractor” is actually an old drain tile outfall that likely originates somewhere near the railroad tracks, possibly installed at the time of construction to dewater that area. The slurry wall construction has not had a noticeable impact on the flow from this drain tile.

I certify that, to the best of my knowledge, the repair work for the Alliant Energy Ash Pond was completed according to the design specifications of the Hard Hat engineering drawings dated 10/29/07. As always, if you have any questions please do not hesitate to contact us.

Very truly yours,

GEOTECHNICS

Bryan Bross

Bryan C. Bross, PE, RG
Licensed Professional Engineer
Iowa License Certificate No. 17084
Valid Through 12/31/2009

BCB/sjb/P:\05749 INTERSTATE POWER & LIGHT CO\002-072298_SLURRYWALLTESTING\RV20071213.DOC

C: Ms. Robin Nelson, Alliant Energy

Enclosure: On-Site Representative's Daily Construction Report (2 pages)
Sieve Analyses of Native Soils (3 pages)
Hard Hat Services – Slurry Wall Design (3 pages)
Site Photographs (4 pages)

CONFIDENTIAL BUSINESS INFORMATION

ON-SITE REPRESENTATIVE'S DAILY CONSTRUCTION REPORT

(07-2298)

Project: ALLIANT SLURRY WALL Project No: 5749-2

Project Location: BURLINGTON GENERATING STATION

Day: MONDAY Date: 11/12/07 Site Conditions Suitable for Work: Yes X No ____

Weather: CLOUDY, OCCASIONAL LIGHT RAIN Hi Temp: 60° Lo Temp: 45°

Contractor: FYE Supt.: ____

Subcontractor: ____ Supt.: ____

Contractor Force:

Supervisory	X	Operators	X	Carpenters		Finishers	
Ironworkers		Electricians		Plumbers		Painters	
Laborers	X	Teamsters		Welders		Others	

Description of Work: INITIAL SLURRY TEST BEFORE MIN. 8 HR. HYDRATION TIME. A MIXING BASIN WAS DUG AND FILLED WITH WATER, FOLLOWED BY ADDITION OF BENTONITE. MIXING ACCOMPLISHED W/ TRACTOR PTO-DRIVEN PUMP.

Special Instruction Given or Problems Encountered:

SLURRY TESTS:

Tests Taken: PH = 9.1

MARSH FUNNEL VISCOSITY = 29 SECONDS

DENSITY = 63 PCF

TEMP = 56°F

GREGG GODFREY

On-Site Representative

GEOTECHNICS
Soil & Material Testing
A Division of Klingner

☐ 4510 Paris Gravel Road - Hannibal, MO (573) 221-7714 FAX (573) 221-7762
☐ 616 North 24th Street - Quincy, IL (217) 223-3670 FAX (217) 223-3603
☒ 610 North 4th Street, Suite 100 - Burlington, IA (319) 753-0816 FAX (319) 752-3605

FORM 520 Rev. 09/14/07

CONFIDENTIAL BUSINESS INFORMATION

ON-SITE REPRESENTATIVE'S DAILY CONSTRUCTION REPORT

(07-2298)

Project: ALLIANT SLURRY WALL Project No: 5749-2

Project Location: BURLINGTON GENERATING STATION

Day: WED Date: 11/14/07 Site Conditions Suitable for Work: Yes X No ____

Weather: CLEAR, WINDY Hi Temp: 55° Lo Temp: 40°

Contractor: FYE Supt.: ____

Subcontractor: ____ Supt.: ____

Contractor Force:

Supervisory	X	Operators	X	Carpenters		Finishers	
Ironworkers		Electricians		Plumbers		Painters	
Laborers	X	Teamsters		Welders		Others	

Description of Work: SOIL WAS MIXED W/ BENTONITE BY USE OF BULLDOZER IN A SHALLOW PIT, THEN WATER ADDED AND MIXED BY USE OF A BACKHOE BUCKET UNTIL A SUITABLE CONSISTANCY WAS ACHIEVED. TRENCH FOR SLURRY WALL WAS BEGUN AND SLURRY PUMPED IN, FOLLOWED BY PLACEMENT OF SOIL/BENTONITE MIXTURE.

Special Instruction Given or Problems Encountered:

Tests Taken: SLUMP OF SOIL/BENTONITE MIXTURE WAS 3".

IN-TRENCH SLURRY TESTS:

LOCATION #1, 2' ABOVE TRENCH BOTTOM – pH 7.9, MARSH FUNNEL VISCOSITY = 34 SEC, 71 PCF

" 2' BELOW TRENCH SURFACE – pH 8.0, M.F.V. = 32 SEC, 70 PCF

LOCATION #2, 2' ABOVE TRENCH BOTTOM – pH 7.9, M.F.V. = 34 SEC, 70 PCF

" 2' BELOW TRENCH SURFACE – pH 7.9, M.F.V. = 34 SEC, 70 PCF

GREGG GODFREY

On-Site Representative

GEOTECHNICS
Soil & Material Testing
A Division of Klingner

☐ 4510 Paris Gravel Road - Hannibal, MO (573) 221-7714 FAX (573) 221-7762
☐ 616 North 24th Street - Quincy, IL (217) 223-3670 FAX (217) 223-3603
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FORM 520 Rev. 09/14/07

GEOTECHNICS
Soil & Material Testing

SOIL AND FOUNDATION CONSULTANTS
610 N. 4 TH Street, Burlington, Iowa 52601, 319-753-0816

SIEVE ANALYSIS DATA

TO: Interstate Power & Light
P.O. Box 5007
Dubuque, Iowa 52004-5007

P.O. NO. ____________

DATE 11/15/07

JOB NO. 5749-2/07-2298

PROJECT: SLURRY WALL

DESCRIPTION OF SAMPLE NO. Soil/Clay Mixture

LOCATION Alliant Generating Plant

SAMPLED BY: GSG DATE: 11/12/07 DRY WT.: 746.9 gm TESTED BY: GSG DATE: 11/13/07

SIEVE NO.	WT. RETAINED	% RETAINED	% PASSING	SPEC. LIMITS
1"	0	0	100	
3/8"	77.59	10.4	90	65-100
8	51.86	6.9	83	
20	35.54	4.8	78	40-85
30	36.84	4.9	73	
50	98.65	13.2	60	
100	100.60	13.5	46	
200	63.98	8.6	38	25-40
PAN	15.89	2.1		
WASH	266.1	35.6		

REMARKS: -200 ROLLED OUT TO 1/8" RIBBONS WHEN MIXED WITH WATER

Respectfully submitted,

Bryan Bross, P.E., R.G.
Branch Manager

MEETS
REQUIREMENTS

GEOTECHNICS
Soil & Material Testing

SOIL AND FOUNDATION CONSULTANTS
610 N. 4 TH Street, Burlington, Iowa 52601, 319-753-0816

SIEVE ANALYSIS DATA

P.O. NO. ______

TO: Interstate Power & Light
P.O. Box 5007
Dubuque, Iowa 52004-5007

DATE 11/15/07

JOB NO. 5749-2/07-2298

PROJECT: SLURRY WALL

DESCRIPTION OF SAMPLE NO. Soil/Clay Mixture

LOCATION Alliant Generating Plant

SAMPLED BY: GSG DATE: 11/8/07 DRY WT.:1205.0 gm TESTED BY: GSG DATE: 11/9/07

SIEVE NO.	WT. RETAINED	% RETAINED	% PASSING	SPEC. LIMITS
1"	0	0	100	
1/2"	147.88	12.3	88	
3/8"	65.35	5.4	82	65-100
4	35.37	3.0	79	
8	20.71	1.7	78	
20	38.23	3.2	74	40-85
30	27.03	2.2	72	
50	70.10	5.8	66	
100	68.38	5.7	61	
200	52.81	4.4	56	25-40
PAN	29.88	2.5		
WASH	645.2	53.8	56	

REMARKS: Not Suitable

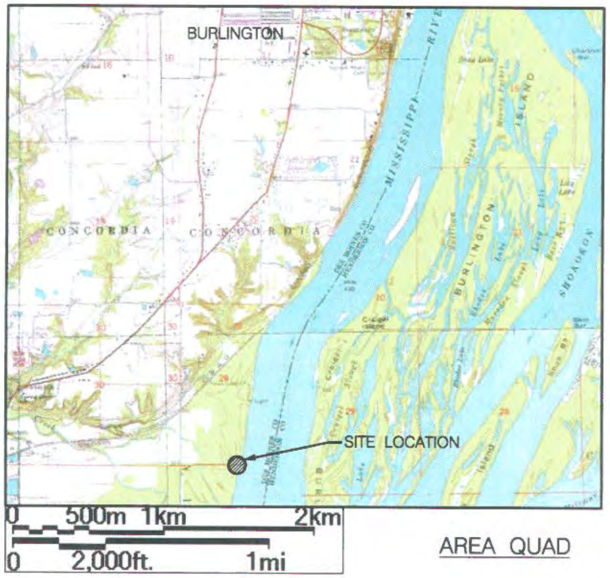
Respectfully submitted,

Bryan Bross, P.E., R.G.
Branch Manager

CONFIDENTIAL BUSINESS INFORMATION

ALLIANT ENERGY
BURLINGTON GENERATING STATION
SLURRY WALL CONSTRUCTION AND SEEP REPAIR

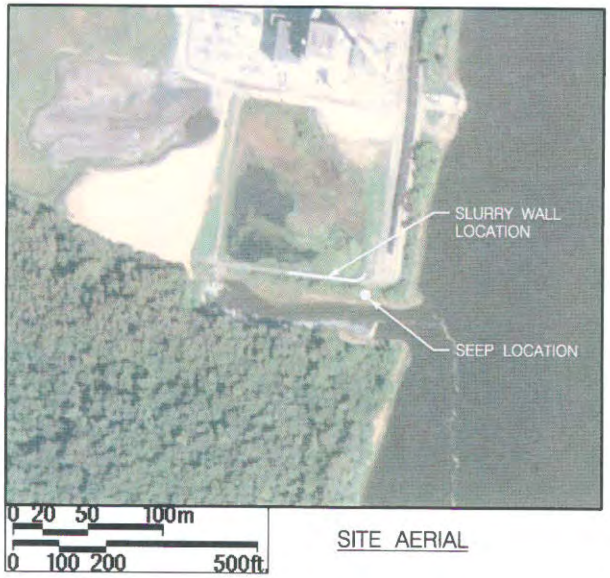
4282 SULLIVAN SLOUGH ROAD
BURLINGTON, IA 52601
OCTOBER 2007



AREA QUAD

DRAWING INDEX

1 COVER SHEET
2 GENERAL SITE LAYOUT
3 SPECIFICATIONS AND DETAILS



SITE AERIAL

10/12/2007 ...\cover.dgn

REV	DATE	BY	DESCRIPTION

SCALE: NONE
DESIGNED: M. Loerop
DRAWN: HHSI
CHECKED: HHSI

CLIENT: ALLIANT ENERGY
BURLINGTON GENERATING STATION

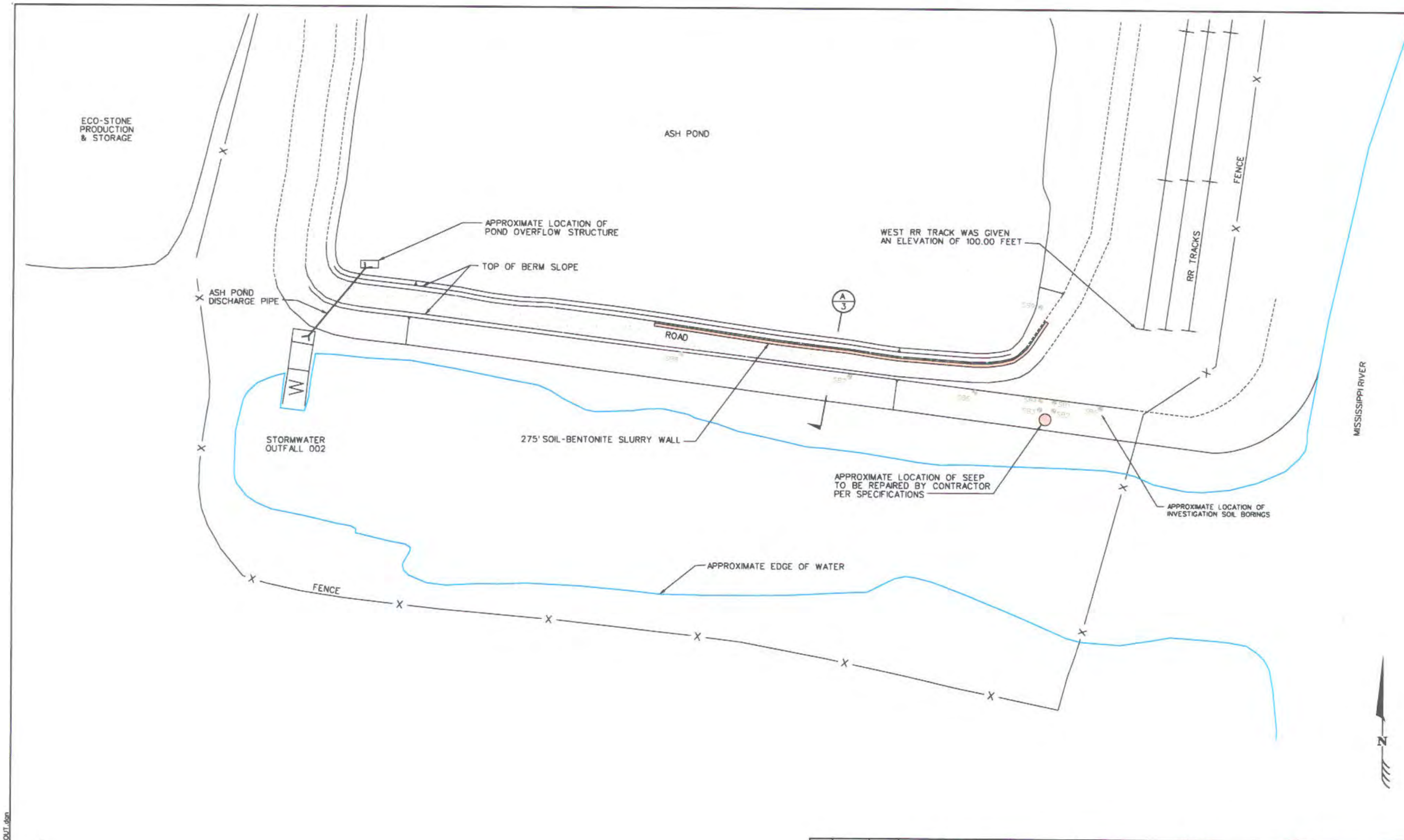
TITLE: COVER SHEET

HARD HAT SERVICES TM
Engineering, Construction and Management Solutions

940 E. Diehl Rd, Suite 150
Naperville, IL 60563
(630) 637-9470

SHEET: 1
OF 3 SHEETS

CONFIDENTIAL BUSINESS INFORMATION



REV	DATE	BY	DESCRIPTION

SCALE: 0 30 60
SCALE IN FEET
DESIGNED: M. Loerop
DRAWN: HHSI
CHECKED: HHSI

CLIENT: ALLIANT ENERGY
BURLINGTON GENERATING STATION

TITLE: GENERAL SITE LAYOUT

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SHEET: 2
OF 3 SHEETS

10/12/2007 ...\SITE LAYOUT.dgn

DESIGN SPECIFICATIONS

Contractor Experience

An experienced slurry wall Contractor shall construct a soil-bentonite slurry wall. Experience shall include at least 100,000 square feet of soil-bentonite slurry wall construction with the contractors proposed site superintendent having at least 50,000 square feet of soil bentonite wall experience. Contractor shall submit their experience to the Project Manager for approval prior to installation of the slurry wall or purchase of materials.

Sodium Bentonite

Contractor shall supply the Construction Manager with the bentonite manufacturer's certificate of compliance. The bentonite shall be pulverized premium grade sodium cation montmorillonite.

Test results for each lot of bentonite must be provided:

• YP/PV ratio	API Std. 13A	Less than 3
• Viscometer		Greater than 30
• Filtrate Loss		15 - 25 cm3 loss at 100psi, and 12-15cm3 loss at 42 psi with no more than 2 mm of filter cake on the paper
• Moisture Content	ASTM D 2216	less than 10 percent

Sodium Bentonite must be stored in an above ground dry enclosure. High humidity storage locations shall not be used. Prematurely hydrated sodium bentonite shall not be used for construction of the slurry wall and shall be properly disposed.

Make-up Water

Clean and fresh water, free from excessive quantities of deleterious substances that could adversely affect the properties of the slurry, shall be used to manufacture the bentonite slurry. It is the responsibility of the contractor that the slurry resulting from the water used shall always meet the following standards:

• pH	6 - 9
• Hardness	less than 200 ppm
• Total Dissolved Solids	less than 500 ppm
• Oil, organics, acids, alkali	less than 50 ppm each
• Chloride	report

Sodium Bentonite Slurry

The initial bentonite slurry must be tested prior to placement in the trench. The slurry may either be mixed in high shear mixers or mixed and hydrated in slurry hydration ponds. If slurry ponds are used for hydration, dry bentonite shall be added in a venturi mixer, not in bulk. Sodium Bentonite shall be added to the make-up water at a minimum of 5% by weight.

• Viscosity - Marsh Funnel (API RP 13B-1)	less than 40 seconds
• Density	less than 64 pcf
• pH	6.5 to 10

A minimum hydration time of 8 hours shall be used.

After placement in the trench, the slurry shall be tested two times at two locations for each 8-hour shift. At each location the slurry shall be tested two feet from the surface and two feet from the bottom of the trench

- The viscosity shall be measured using the Marsh Funnel test (API RP 13B-1) and shall be between 30 to 40 seconds.
- Slurry shall have a unit weight between 64 pcf and 85 pcf unless approved by the Project Manager. If the slurry exceeds 85 pcf the excess solids must be removed by desanding or the slurry replaced with fresh slurry.

In place slurry shall be no more than 2 feet below the top of the working platform and at least 2 feet above the ash pond water elevation.

Soil-Bentonite Backfill

Soil used to produce the soil-bentonite backfill shall pass the following gradation specification.

- 65 to 100 percent passing ⅜" sieve
- 40 to 85 percent passing the #20 sieve
- 25 to 40 percent passing the #200 sieve
- Roll soil that passes the #200 sieve to ⅛ inch thread

Bentonite backfill shall be mixed with the soil removed from the excavation and mixed until the material is homogeneous with a slump of 2 to 6 inches, as measured per ASTM D 143. The Contractor shall mix the materials at the location determined by the Project Manager. Contractor shall provide documentation to the Project Manager that the soil-bentonite backfill contains at least 2% bentonite by weight. A passing slump test is required for each 750 CY of backfill material. All particles should be coated with bentonite slurry and large particles (> 4 inches) should be removed or segregated. The tracks of a bulldozer and excavator or other method may be used in reducing the clod size and in producing a homogeneous material prior to material placement within the slurry wall. The slurry wall shall be constructed at least 12 inches above the high water elevation within the settling pond, which will be provided by the Project Manager. The Contractor shall place the soil-bentonite backfill to a depth of 18 inches below the surrounding ground elevation.

The Contractor shall demonstrate, to the satisfaction of the Project Manager, that each section of the slurry-filled trench is continuous prior to backfilling. Trench continuity shall be assured by demonstrating the free action and movement of the excavation equipment within the trench prior to backfilling. Digging tools must pass vertically from top to bottom of the trench, and horizontally along the alignment of the trench, without encountering unexcavated material. The trench shall be verified and documented by the Contractor for proper depth every 10 feet.

The contractor shall demonstrate, to the satisfaction of the Project Manager, that the trench is keyed the minimum specified depth into the underlying hard silty clay. Penetration of the bottom of the trench into the underlying hard silty clay shall be assured by observation of the cuttings removed from the trench and by comparing direct trench depth measurements to anticipated depths based on the design details.

Temporary and Permanent Clay Cap

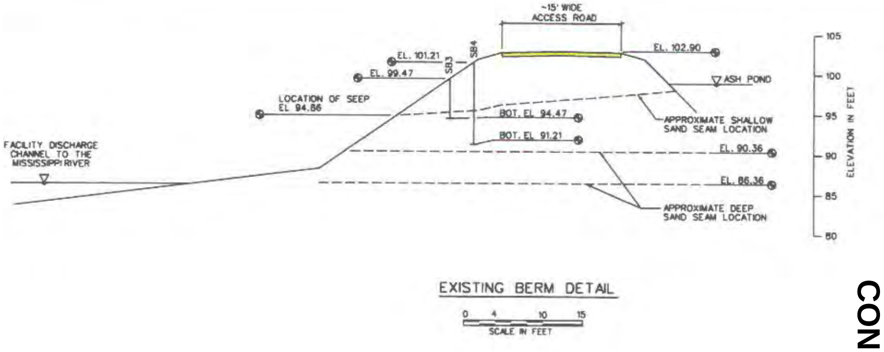
A two-foot deep temporary protective slurry wall cap shall be constructed in the form of non-compacted soil cover and placed within 24-hours of each 100-foot length of slurry wall. The temporary cap shall be completely removed after greater than two weeks of consolidation time. In place of the temporary cap, Contractor may chose to place soil-bentonite to finish grade and then remove soil bentonite to construct the permanent cap. The permanent clay cap shall be constructed by replacing the void space with at least, three, 6-inch compacted clay lifts, placed at +/- 2% of optimum moisture content or as approved by project manager and compacted to 95% of a Standard Proctor, per ASTM D698. The compacted clay lifts shall be installed to match the surrounding ground surface, as necessary. The clay fill material shall pass the backfill gradation requirement as specified above.

Restoration Activities

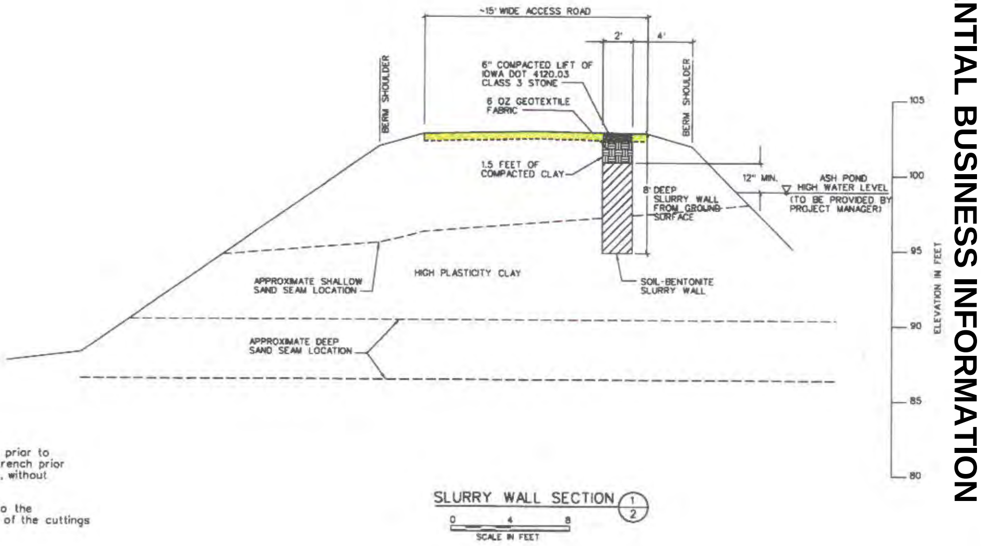
A six-ounce geotextile shall be placed atop the completed soil bentonite slurry wall in accordance with the manufacture's installation instructions. The geotextile shall extend 5 feet beyond all disturbed areas along the berm. Finally, 6 inches of well-graded Iowa DOT 4120.03 Class C gravel shall be placed and compacted atop the geotextile at a minimum of 5 passes with a smooth drum roller. The gravel gradation shall be provided to and approved by the Project Manager prior to placement by the Contractor.

The Contractor shall repair the seep on the south east corner of the berm as shown on Sheet 2. The erosion area shall be regraded, seeded with Iowa DOT approved seed mix, and straw shall be placed on disturbed areas to prevent erosion along the berm face.

After Completion of backfilling and capping, remove and level all remaining excavated material and slurry as directed by the Project Manager. Dispose of excess slurry by spreading in thin layers at the location designated by the Project Manager. No slurry shall be left in ponds, and all ponds shall be pumped dry and backfilled with suitable material approved by the Project Manager.



EXISTING BERM DETAIL



SLURRY WALL SECTION

REV	DATE	BY	DESCRIPTION	SCALE: AS SHOWN	CLIENT: ALLIANT ENERGY BURLINGTON GENERATING STATION
				DESIGNED: M. Loerop DRAWN: HHSI CHECKED: HHSI	TITLE: SPECIFICATIONS AND DETAILS

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Engineering, Construction and Management Solutions

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(630) 637-9470

SHEET: 3 OF 3 SHEETS

10/12/2007 ...\DETAILS.dgn

Soil/bentonite mixing pit. Slurry trench excavation is visible in background.

Another view of soil/bentonite mixing pit with generating station in background.

Looking across ash pond at excavator digging slurry trench in ash pond berm.

Photograph of bentonite slurry mixing pit. The Mississippi River is at background left and the ash pond is at far right.

Another photo looking across the ash pond at the excavator digging the slurry trench.

Photograph of slurry trench in berm along ash pond. Standing water is simply the bentonite slurry at the top of the trench.


11/15/2007

Photograph of bentonite slurry mixing in process.


11/15/2007

Photograph close-up of bentonite slurry running and filling the trench prior to placement of the soil/bentonite mixture.

Photograph of final cap placement.

Photograph of filled-in mixing area.

12/21/2007

Photograph of drain tile outfall pipe. Old drain tile was determined to be the source of the seep. It was properly plumbed out to daylight so it can be observed in the future.

KLINGNER
& ASSOCIATES, P. C.
Engineers & Land Surveyors
610 North 4th St., Suite 100 • Burlington, IA 52601 • voice 319.752.3603 • fax 319.752.3605

January 4, 2010

Mr. Vernon Hasten
Interstate Power & Light-Burlington Generating Station
A subsidiary of Alliant Energy
4282 Sullivan Slough Road
Burlington, Iowa 52601

RE: Upper Ash Pond
2009 Work Summary

Dear Mr. Hasten

Klingner & Associates developed specifications for the rehabilitation of the Upper Ash Pond levee. Fye Excavating completed the reconstruction and our firm performed construction observation in conjunction with Bielka Liriano of Alliant Energy.

The project had several objectives. The first objective was to create a uniform twelve foot wide top. This was accomplished by importing clay to build the levee top and inside slope. The normal pond elevation was lowered approximately two feet so the inside slope of the levee could be reconstructed to create uniform slope (~6:1). After the placement and compaction of clay, a geotextile fabric was laid down as a boundary between the aggregate and rip-rap finished surfaces. Additionally the geotextile fabric should reduce erosion in the event the Mississippi River would raise enough to "back" over the levee.

Initially when the fabric was being placed the contractor did not have the recommended lap between the rolls of fabric. It was recommended to the contractor to create a notch and place an additional strip of fabric in the notch, fill with rip-rap and lap this fabric over the already placed geotextile fabric. (See attached photo). This procedure was completed. After the fabric placement was completed a 6" aggregate base was laid so vehicles could travel on the levee without damaging it or becoming stuck. Rip-rap was placed to a depth of approximately 12" on the inside of the reconstructed levee from the top down (road) to two feet below normal pool elevation. When the pond elevation returns to normal, the rip-rap will be below normal water elevation and thus minimize erosion due to wave lap and overtopping.

Completing the project, Fye Excavation removed an abandoned pipe that went through the levee and removed many small and large trees from the outside slope of the levee. Klingner & Associates performed a post construction topographic survey of the levee.

CONFIDENTIAL BUSINESS INFORMATION

This information was forwarded to Patrick Kelleher with Burlington Generating Station to update the facility master drawing.

It is recommended that the Burlington Generating Station investigate a larger size of discharge monitoring pipe for the Upper Ash Pond levee. In October 2009, Outfall 006 was closed because the boiler seal lift station was brought online. This lift station discharge now flows to the Upper Ash Pond. This additional discharge has maximized the capacity of the existing monitoring pipe.

Enclosed are several pictures of the Upper Ash Pond during and after construction.

As always, if you have any questions please do not hesitate to contact us.

Very truly yours,

KLINGNER & ASSOCIATES, P.C.

Matt Morgan, P.E.

DMM/P:\05749 INTERSTATE POWER & LIGHT CO\007-2009_PROJECTS\092131.001_UPPERASHPONDLEVEE\001_SUMMARY 12-31-09.DOC

C: Bielka Liriano

Enclosure: Photos

CONFIDENTIAL BUSINESS INFORMATION

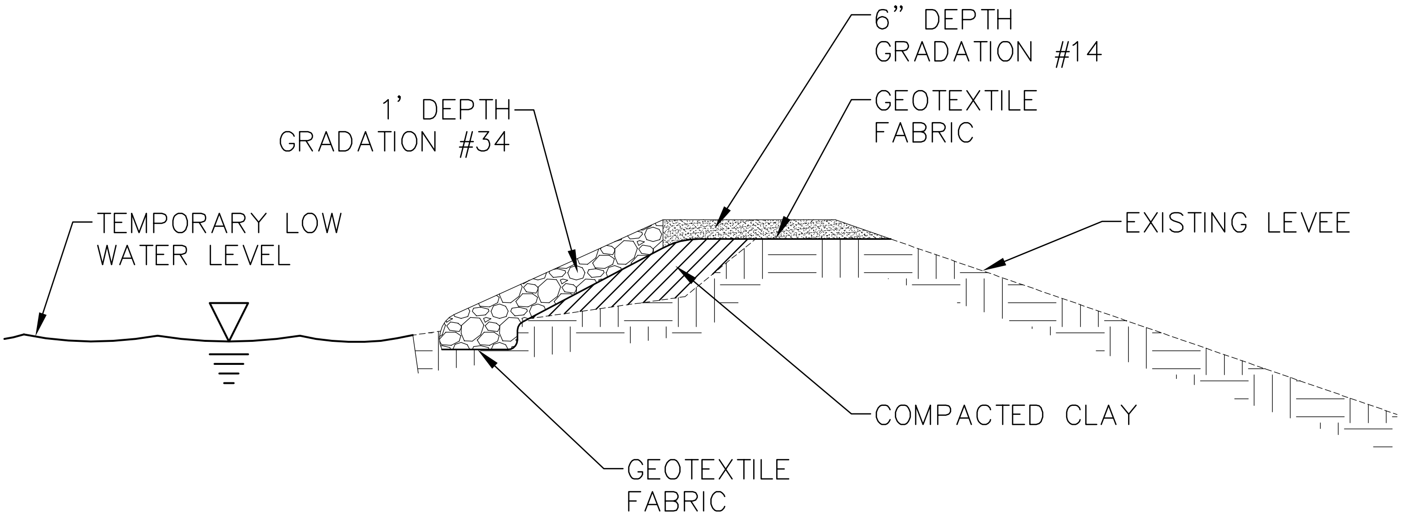
Upper Ash Pond levee prior to rehabilitation

Upper Ash Pond levee after rehabilitation

CONFIDENTIAL BUSINESS INFORMATION

Notching geotextile fabric into top and inside slope

CONFIDENTIAL BUSINESS INFORMATION



SCALE: NTS

TYPICAL SECTION

KLINGNER
& ASSOCIATES, P.C.
Engineers · Architects · Surveyors
☐ 616 North 24th Street, Quincy, IL Ph (217)223-3670 - Fax (217)223-3603
☐ 3318 Market Street, Hannibal, MO Ph (573)221-0020 - Fax (573)221-0012
■ 610 N. 4th Street, Suite 100, Burlington, IA Ph (319)752-3603 - Fax (319)752-3605
☐ 49 North Prairie Street, Galesburg, IL Ph (309)342-4042 - Fax (309)341-3781
Internet Address: www.klingner.com

NO.	APPR.	REVISION DESCRIPTION	DATE
△	.	.	.
△	.	.	.
△	.	.	.
△	.	.	.
△	.	.	.

FULL SCALE DRAWING: 8 1/2" x 11"
SCALE: AS SHOWN

DESIGNED DMM	DRAWN DMM
FIELD .	FIELD BOOK .
CHECKED	DATE 5/2/09
PROJECT NO. 09-2131.001	FILE NAME .

INTERSTATE POWER & LIGHT
LOWER ASH POND LEVEE
BURLINGTON, IOWA

SHEET
1/1

CONFIDENTIAL BUSINESS INFORMATION

GENCO STANDARD GUIDE FOR POND INSPECTIONS

Procedure No. GENCO-0-OP-402-01

Approved By: Paul Treangen Date: 4/29/2009
Regional Director Generation West

Terry Kouba Date: 4/30/2009
Regional Director Generation Central

Linda Poe Date: 4/30/2009
Regional Director Generation East

TABLE OF CONTENTS

ENCLOSURES

1. GENCO Pond Inspection Guide

GENCO STANDARD GUIDE FOR POND INSPECTIONS

1. INTRODUCTION

Alliant Energy owns numerous generating stations and other facilities that utilize engineered process water systems (ash ponds) to handle coal combustion byproducts (e.g., bottom ash, economizer ash, and fly ash) coal pile and landfill storm water runoff, and cooling ponds. In nearly every case, state mandated monitoring and water quality testing requirements are associated with the discharges of these ponds and a compromise of the structural integrity of these ponds could lead to an uncontrolled or unmonitored discharge to the environment.

2. OBJECTIVE

The purpose of this Guide is to formalize guidance regarding routine Pond inspections including frequency of inspections, management review requirements, and guidance on issue resolution. This procedure will be utilized by all GENCO power plants to establish a comprehensive and corporate-wide compliance and inspection program for ash ponds, storm water runoff ponds including coal piles and landfill ponds, and cooling ponds (if applicable). Failure to routinely inspect and document the integrity of ponds can result in unidentified structural or operational problems that if unresolved can lead to noncompliance with environmental requirements. Encl (1) provides a general overview of the inspection process as well as detailed instructions and a checklist for performing and documenting the inspections.

3. DISCUSSION

Each generating station or facility with a pond system, that may pose a risk to the environment and the company, generally has a system that is unique to their site. This guide along with Encl (1) is meant to provide general guidance to each plant manager or site director to perform routine inspections of their pond systems to allow prompt identification of problems or potential problems. Although no formal state guidelines exist in Iowa, Minnesota, or Wisconsin regarding pond inspections, each plant manager or site director is responsible to ensure that these pond systems operate properly with discharges that are within permit limits and with no breeches in structural integrity.

The GENCO inspection guidelines are a tool for plant or site management to help standardize routine pond inspections. Deficiencies that are identified during the process should be properly vetted through the environmental and engineering groups to determine what corrective actions are required and what state permitting or approvals are necessary to conduct corrective actions.

4. GENCO POND INSPECTION GUIDELINES

4.1 Pond Inspection Periodicities

1. Due to the uniqueness of each plant or site's pond systems, plant managers, site directors, environmental specialists, and engineering representatives must jointly determine inspection periodicities. Routine inspection periodicities should be determined based upon physical construction and arrangement and should also take historical environmental factors into account (e.g. spring melt and flooding). However, ponds should be inspected at a minimum of once per year in accordance with Enclosure (1). Additionally, corporate environmental will participate in site pond inspections a minimum of once a year.

2. To facilitate planning and execution of these inspections each plant should set up a task in Enviance or Maximo to ensure that the inspections are performed and documented at the desired periodicity.

4.2 Pond Inspection Procedure

1. Inspections- knowledgeable plant personnel (corporate environmental if applicable) will use Enclosure (1) as a standard checklist to perform the required pond inspections. Inspectors should review previous inspection reports to review past issues and corrective actions prior to each pond inspection. Inspectors will complete Encl (1) for each pond inspected and note any concerns on page two Encl (1). Inspectors shall take pictures of any discrepant conditions and attach them to the report to allow corporate environmental and engineering resources to better understand the exact nature of the concern.

2. Review Requirements- the Plant Manager and Environmental and Safety Specialist will review the report with the inspector(s) and sign off on the inspection form.

3. Issue Resolution- plant management will determine how to correct any deficiencies noted during the inspection process. Outside assistance may be required in some cases.

  a. Prior to commencing the work, Corporate Environmental shall be contacted to review solutions; and to determine if any type of permitting or approval is required from the State, Federal, or County Agencies.

  b. Engineering shall be contacted to resolve any structural concerns of a dike or levee (e.g. tree removal or erosion).

4.3 Record Retention- plants shall maintain a copy of each pond's Encl (1) inspection results for a period of five years. This requirement may be met by attaching an electronic copy of the Encl (1) pond Inspection results for each pond to the Enviance task or Maximo PM that tracks the inspections.

5.0 Revision / Review Record

Any amendments or revisions to this procedure **must** be approved by GENCO Regional Directors

Revision / Review Record				
Revision	**Reason for Revision**	**Date**	**Author**	**Approved By**
Original	Initial Issue of new GENCO Procedure	4/30/09	Buddy Hasten	Paul Treangen Terry Kouba Linda Poe

**** End of Procedure ****

APPENDIX B: SITE PHOTOGRAPHS

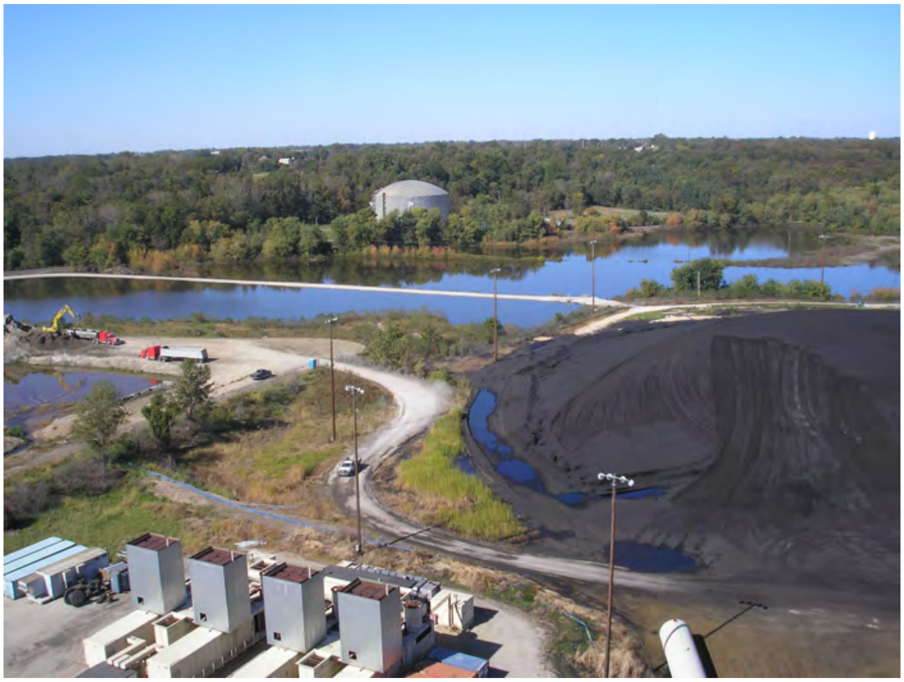
Photograph 1: Rooftop View of East Side of Ash Seal Pond

Photograph 2: Rooftop View of West Side of Ash Seal Pond

Photograph 3: Rooftop View of South Side of Bottom Ash Pond with Eco-Stone Storage Pile

Photograph 4: Rooftop View of North Side of Bottom Ash Pond

Photograph 5: Rooftop View of Economizer Ash Pond. Economizer Ash Pond in Foreground. Ash Pond 1 in Background



Photograph 6: Rooftop View of Ash Pond 1 Ash Pond 1 Upstream Dike Abutment Located at Construction Equipment. Ash Pond 1 Downstream Dike Located Above Downstream Dike.

Photograph 7: Rooftop View of Ash Pond 2. Downstream Dike Located beneath Pipe Crossing in Upper Right. Dike Inundated by Flood Water from Mississippi River

Site Name:	**Burlington Generating Station**	**Date:**	**7 October 2010**
Unit Name:	**Ash Seal & Storm Water Pond**	**Operator's Name:**	**Interstate Power and Light**
Unit I.D.:		**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** ☒
	Inspector's Name:	Mark Hoskins, P.E. and Joseph P. Klein, III, P.E.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	531.1		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	N/A		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?		X	Is water entering inlet, but not exiting outlet?	See Note	
5. Lowest dam crest elevation (operator records)?	533.7		Is water exiting outlet, but not entering inlet?	See Note	
6. If instrumentation is present, are readings recorded (operator records)?	N/A		Is water exiting outlet flowing clear?	See Note	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	X		From underdrain?	N/A	
9. Trees growing on embankment? (If so, indicate largest diameter below)	X		At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?	N/A	
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?		X	From downstream foundation area?	See Note	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?	See Note		Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?	See Note		22. Surface movements in valley bottom or on hillside?	See Note	
16. Are outlets of decant or underdrains blocked?	See Note		23. Water against downstream toe?	X	
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
14, 15 and 16	Primary spillway riser pipe is located inside a low gravel berm. Current impoundment pool elevation is below the crest of the berm such that water is not entering the spillway riser.
20	In addition to water not entering the primary spillway riser, the riser discharge pipe was below the flood water elevation of the canal adjacent to the toe of the west dike.
21 and 22	A combination of flooding and thick vegetation along the west dike made observation of the slopes and toe ineffective.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit 6-26-00-1-00 **INSPECTOR** Mark Hoskins, P.E. & J.P. Klein, III, P.E.

Date 7 October 2010
Impoundment Name Ash Seal & Storm Water Pond

Impoundment Company Interstate Power and Light Co.
EPA Region 7

State Agency Iowa Department of Natural Resources, Environmental Services Division
(Field Office) Address 502 E. 9th St., Des Moines, IA 50319
Name of Impoundment

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	**No**
Is impoundment currently under construction?	☐	☒
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION:

Nearest Downstream Town Name: Chillicothe, IA

Distance from the impoundment: 1.6 miles

Location:

Latitude	41	Degrees	5	Minutes	47	Seconds	**N**
Longitude	92	Degrees	33	Minutes	14	Seconds	**W**

State **County**

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Iowa Department of Natural Resources

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☒ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

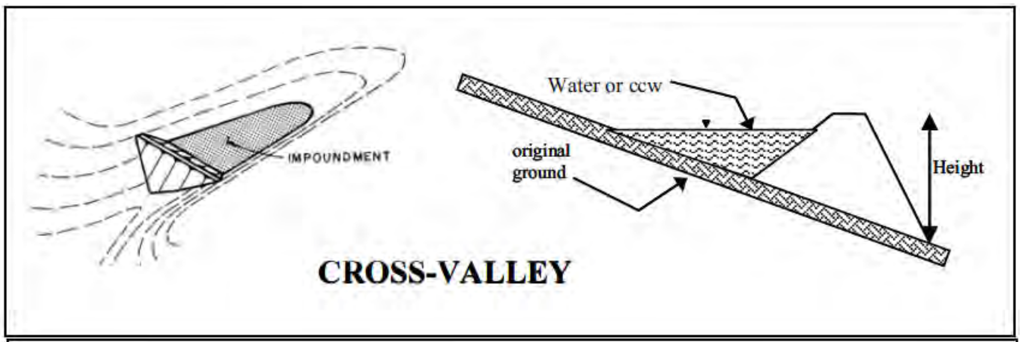
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

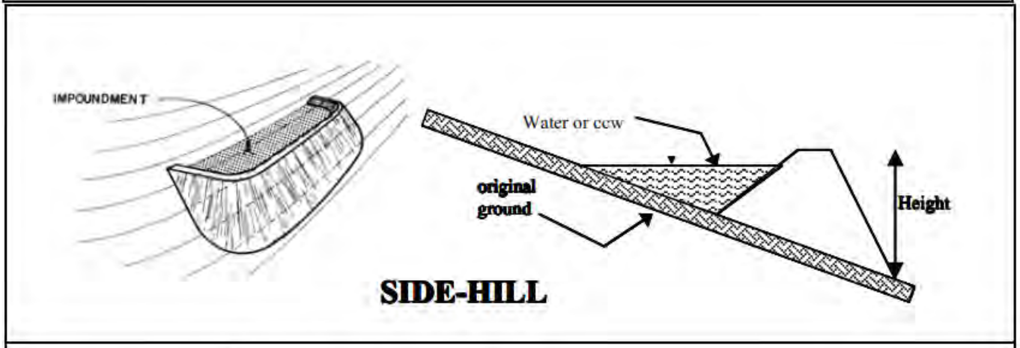
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

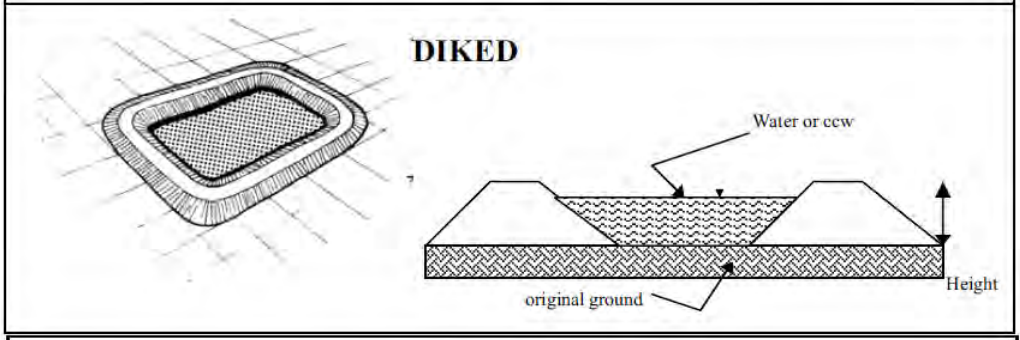
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

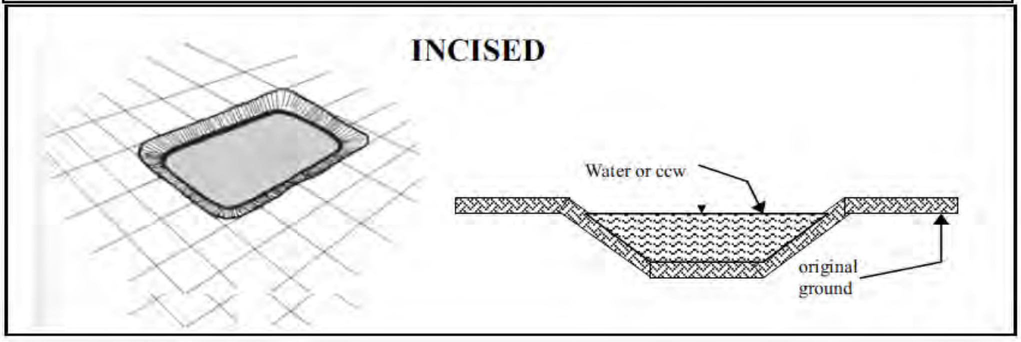
Based on the 15 ft. height of the dam and the adjacent discharge canal to the Mississippi River, failure or misoperation of the dike is not expected to result in loss of human life. The economic impact is expected to include wooded and/or Company owned property and possible ash recovery from the Mississippi River.

CONFIGURATION:









☐ Cross-Valley ☐ Side-Hill ☒ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	15	**Embankment Material**	Documentation not provided
Pool Area (ac)	4.54	**Liner**	Documentation not provided
Current Freeboard (ft)	2.6	**Liner Permeability**	N/A

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

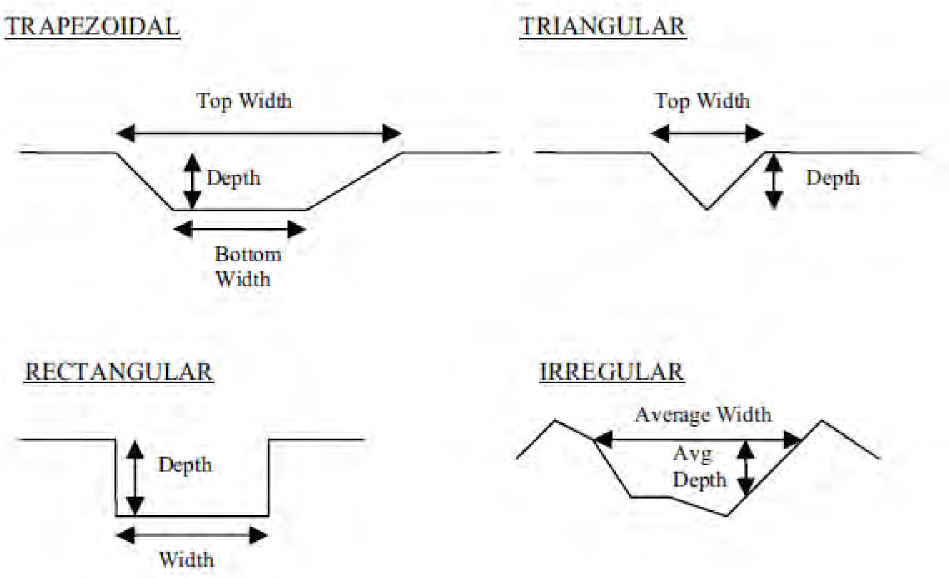
☐ Rectangular

☐ Irregular

depth (ft)

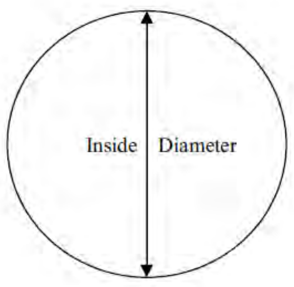
average bottom width (ft)

top width (ft)



☒ **Outlet**

N/A inside diameter
(SDR 17 – smooth lined – 19.5” OD)



Material

☐ corrugated metal

☐ welded steel

☒ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☐

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By **Black & Veatch**

	Yes	No
Has there ever been a failure at this site?	☐	☒

If So When?

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☒	☐

If So When? 2007

If So Please Describe : Seepage was reportedly observed at two depths near in the embankment at the southeast corner of the impoundment. A geotechnical investigation was conducted by Hard Hat Services that recommended construction of a slurry cut-off wall. An approximately 280 ft. long slurry wall was installed along the south dike beginning at the near the southeastern corner of the impoundment.

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

Construction drawings indicate embankment constructed over natural ground. Original configuration has not been altered. Construction specifications indicate foundation preparation was required.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

Documentation not provided during site visit. Owner is conducting additional search for design documentation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

Neither observations during the site visit nor photographic documentation indicated prior releases, failures or patchwork on the dikes.

Site Name:	**Burlington Generating Station**	**Date:**	**7 October 2010**
Unit Name:	**Main Ash Pond (aka Bottom Ash Pond)**	**Operator's Name:**	**Interstate Power and Light**
Unit I.D.:		**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** ☒
Inspector's Name:		Mark Hoskins, P.E. and Joseph P. Klein, III, P.E.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	530.3		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	530		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	533.8		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	N/A		Is water exiting outlet flowing clear?		See Note
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	**N/A**		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)	**X**		At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?	See Note		At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?	See Note		Over widespread areas?		X
12. Are decant trashracks clear and in place?		X	From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?	X	
17. Cracks or scarps on slopes?	See Note		24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
8	Documentation of foundation preparation available at the time of site inspection.
10, 11 & 17	Heavy vegetation growth along crest and embankments of south dike prevented observations of potential cracks, scarps or settlements.
20	Bottom Ash Pond Spillway two 18-inch diameter corrugated metal pipes through the north dike into Ash Pond 1
23	High water in Mississippi River has flooded Ash Seal Pond discharge canal resulting in water backing up along the toe of the adjacent Main Ash south dike.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit 6-29-00-1-00 **INSPECTOR** Mark Hoskins, P.E. & J. P. Klein, III P.E.

Date 7 October 2010
Impoundment Name Main or Bottom Ash Pond

Impoundment Company Interstate Power and Light Co.
EPA Region 7

State Agency State of Iowa Department of Natural Resources, Environmental Services Div.
(Field Office) Address 502 E. 9th St., Des Moines, IA 50319
Name of Impoundment Main or Bottom Ash Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	**No**
Is impoundment currently under construction?	☐	☒
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: Storage of fly ash, bottom ash, ash transport water, storm water runoff from plant site, storm water runoff from hydrated fly ash storage piles and plant floor drains.

Nearest Downstream Town Name: Chillicothe, IA

Distance from the impoundment: 1.6 miles

Location:

Latitude	41	Degrees	5	Minutes	50	Seconds	**N**
Longitude	92	Degrees	33	Minutes	14	Seconds	**W**

State Iowa **County** Des Moines

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Iowa Department of Natural Resources

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☒ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

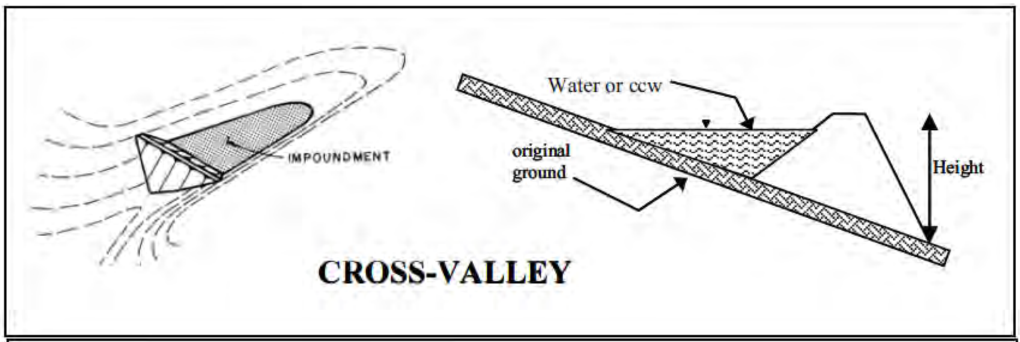
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

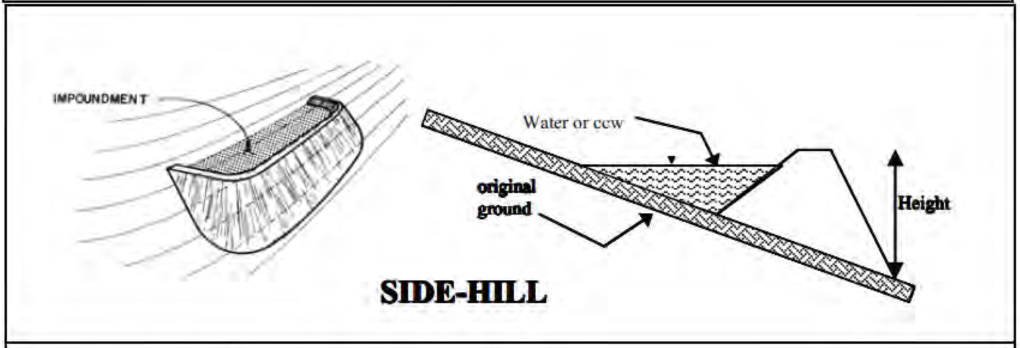
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

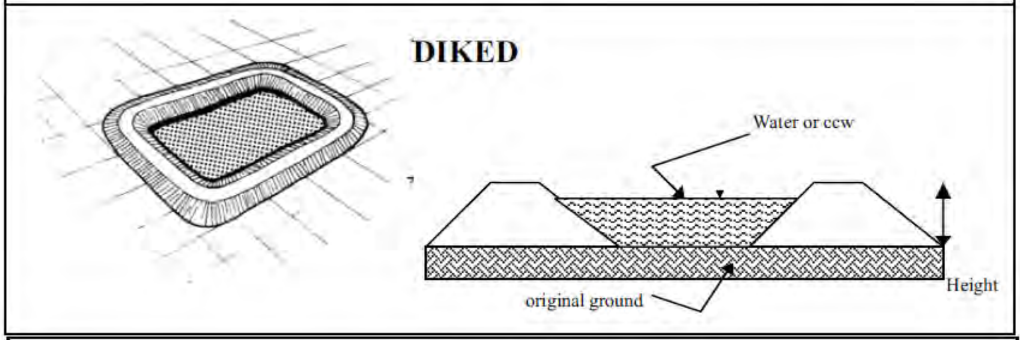
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

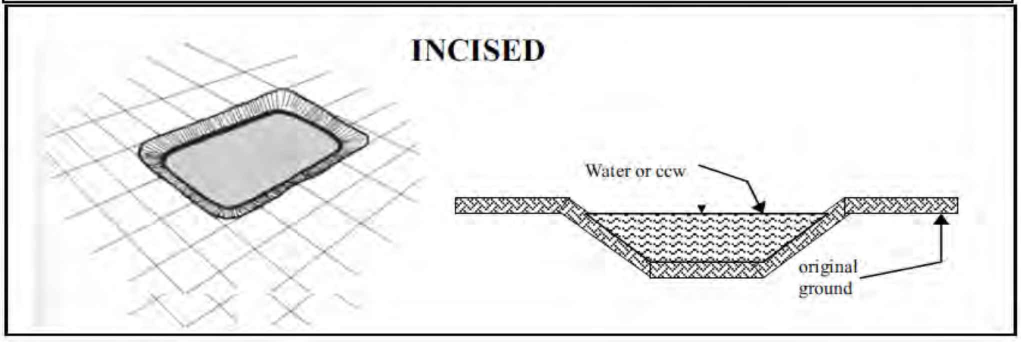
Based on the 5 ft. height of the dam and the heavily wooded area between the impoundment and the Mississippi River, failure or misoperation of the dike is not expected to result in loss of human life. The economic impact is expected to include wooded and/or Company owned property and possible ash recovery from the Mississippi River.

CONFIGURATION:









☐ Cross-Valley ☒ Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	5	**Embankment Material**	Documentation not provided
Pool Area (ac)	17	**Liner**	Documentation not provided
Current Freeboard (ft)	3.5	**Liner Permeability**	N/A

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

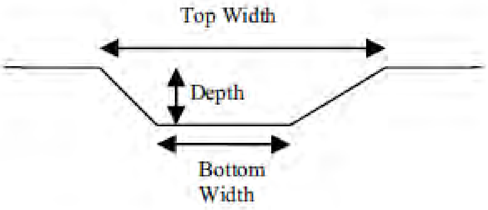
- ☐ Trapezoidal
- ☐ Triangular
- ☐ Rectangular
- ☐ Irregular

depth (ft)

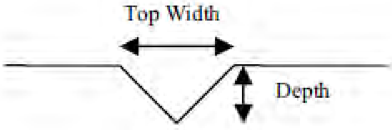
average bottom width (ft)

top width (ft)

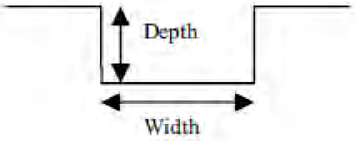
TRAPEZOIDAL



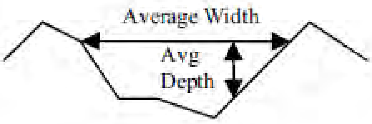
TRIANGULAR



RECTANGULAR

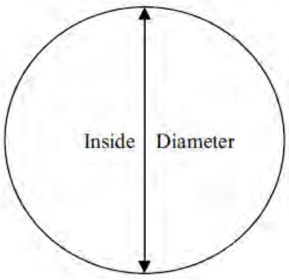


IRREGULAR



☒ **Outlet**

18” inside diameter (two pipes)
(SDR 17 – smooth lined – 19.5” OD)



Material

- ☒ corrugated metal
- ☐ welded steel
- ☐ concrete
- ☐ plastic (hdpe, pvc, etc.)
- ☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☒

☐ **No Outlet**

☐ **Other Type of Outlet**
(specify):

	Yes	No
Has there ever been a failure at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

Correspondence from Alliant Energy to the EPA (letter dated May 22, 1009) indicates that based on a review of available records Alliant believes the impoundment was designed by a Professional Engineer. Documentation was not available at the time of the site visit.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

The dam assessor did not meet with nor have documentation from the design Engineer-of-Record concerning foundation preparation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

Neither observations during the site visit nor photographic documentation indicated prior releases, failures or patchwork on the dikes.

Site Name:	**Burlington Generating Station**	**Date:**	**7 October 2010**
Unit Name:	**Economizer Ash Pond**	**Operator's Name:**	**Interstate Power and Light**
Unit I.D.:		**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** ☒
	Inspector's Name:	Mark Hoskins, P.E. and Joseph P. Klein, III, P.E.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	See Note		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?			20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	540		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?	N/A		Is water exiting outlet flowing clear?	X	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	**N/A**		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?		X	From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?	X	
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
3	Economizer Ash Pond used primarily to store/stockpile dry ash. Water limited to small amount of occasional ash transport water and direct storm rainfall stored in small excavations within the ash pile. Recorded pool elevations of the small water storage areas range from 548.9 to 550.3. Water is routed surface ditches to southwest corner of pond to flow into Upper Ash Pond (aka Ash Pond 1)
8	Documentation of foundation preparation available at the time of site inspection.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit 6-29-00-1-00 **INSPECTOR** Mark Hoskins, P.E. & J. P. Klein, III P.E.

Date 7 October 2010
Impoundment Name Economizer Ash Pond

Impoundment Company Interstate Power and Light Co.
EPA Region 7

State Agency State of Iowa Department of Natural Resources, Environmental Services Div.
(Field Office) Address 502 E. 9th St., Des Moines, IA 50319
Name of Impoundment Main or Bottom Ash Pond

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	**No**
Is impoundment currently under construction?	☐	☒
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: Storage of fly ash, bottom ash, economizer ash, ash transport water, boiler wash water, air heater water, steam grade water productions wastewater, storm water runoff from plant site, solids contact units sludge for treatment of Mississippi River water, coal pile runoff and boiler blowdown.

Nearest Downstream Town Name: Chillicothe, IA

Distance from the impoundment: 1.6 miles

Location:

Latitude	41	Degrees	5	Minutes	50	Seconds	**N**
Longitude	92	Degrees	33	Minutes	14	Seconds	**W**

State Iowa **County** Des Moines

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Iowa Department of Natural Resources

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☒ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

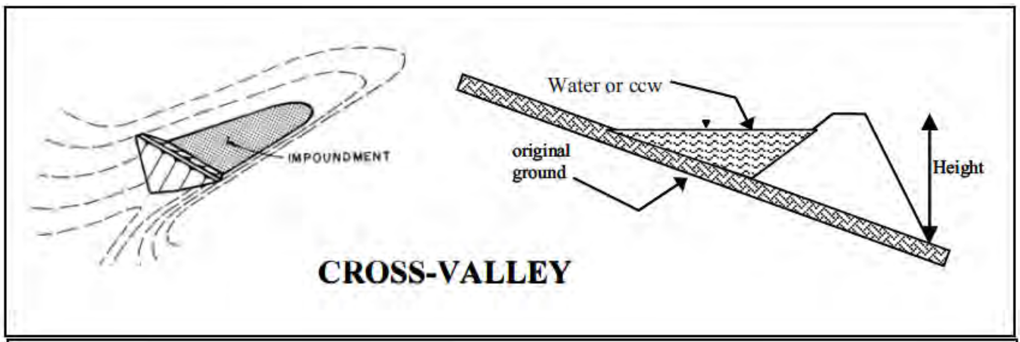
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

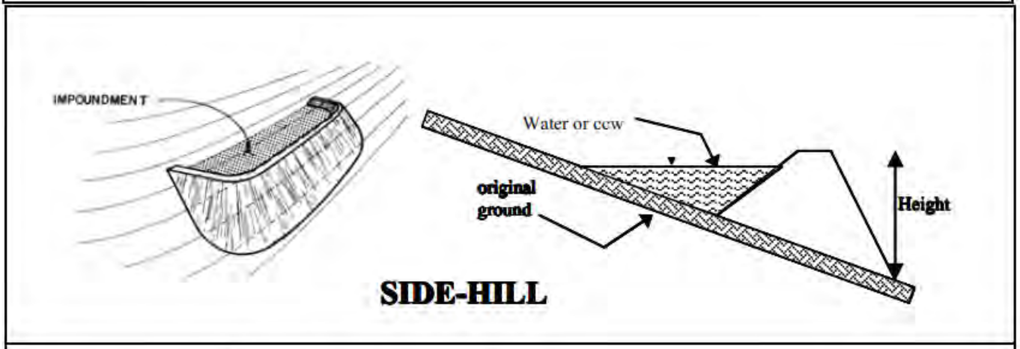
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

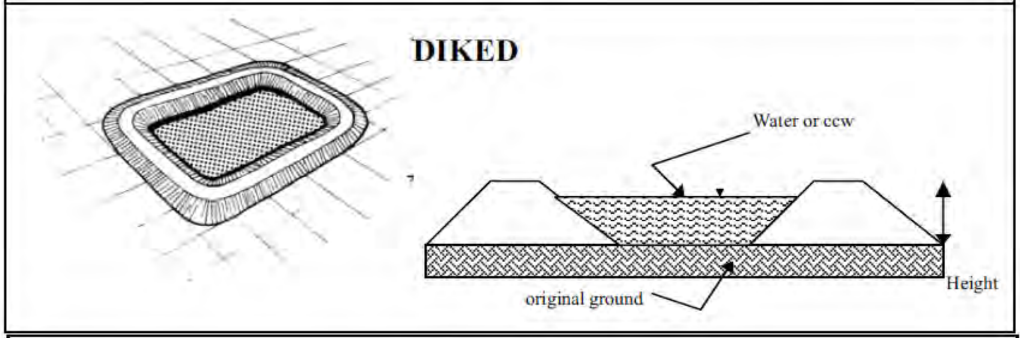
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

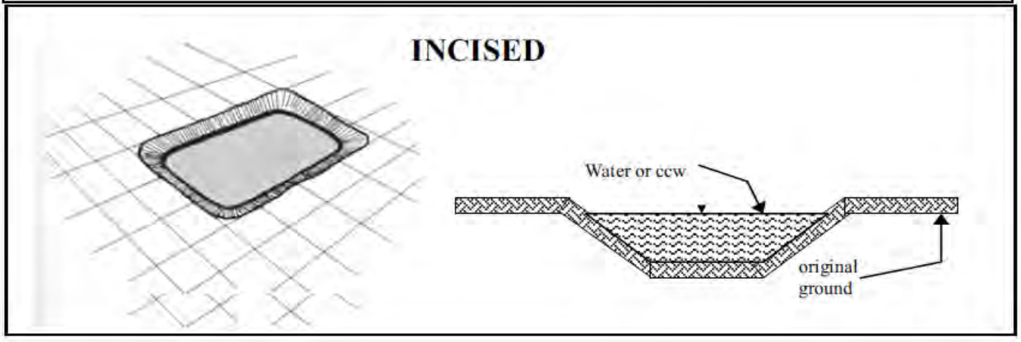
Based on the 10 ft. height of the dam and the area between the impoundment and the Mississippi River being limited to the plant site, failure or misoperation of the dike is not expected to result in loss of human life. The economic impact is expected to include wooded and/or Company owned property and possible ash recovery from the Mississippi River.

CONFIGURATION:









☐ Cross-Valley ☒ Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	10	**Embankment Material**	Documentation not provided
Pool Area (ac)	11	**Liner**	Documentation not provided
Current Freeboard (ft)	1.8	**Liner Permeability**	N/A

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

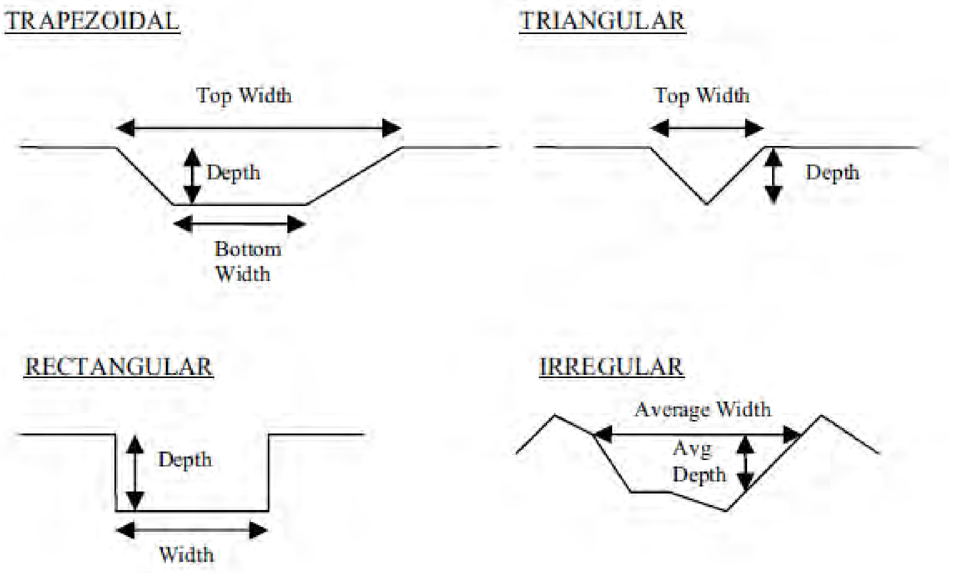
☐ Rectangular

☒ Irregular

3 depth (ft)

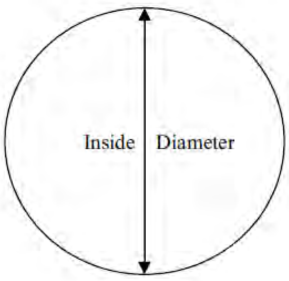
N/A average bottom width (ft)

5 top width (ft)



☐ **Outlet**

inside diameter
(SDR 17 – smooth lined – 19.5” OD)



Material

☐ corrugated metal

☐ welded steel

☐ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☐

☐ **No Outlet**

☐ **Other Type of Outlet**
(specify):

The Impoundment was Designed By: N/A

	Yes	No
Has there ever been a failure at this site?	☐	☒

If So When?

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

Correspondence from Alliant Energy to the EPA (letter dated May 22, 1009) indicates that based on a review of available records Alliant believes the impoundment was designed by a Professional Engineer. Documentation was not available at the time of the site visit.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

The dam assessor did not meet with nor have documentation from the design Engineer-of-Record concerning foundation preparation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

Neither observations during the site visit nor photographic documentation indicated prior releases, failures or patchwork on the dikes.

Site Name:	**Burlington Generating Station**	**Date:**	**7 October 2010**
Unit Name:	**Upper Ash Pond (aka Ash Pond 1)**	**Operator's Name:**	**Interstate Power and Light**
Unit I.D.:		**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** ☒
Inspector's Name:		Mark Hoskins, P.E. and Joseph P. Klein, III, P.E.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	529.1		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?	529		20. Decant Pipes:	■	■
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?	See Note	
5. Lowest dam crest elevation (operator records)?	530		Is water exiting outlet, but not entering inlet?	See Note	
6. If instrumentation is present, are readings recorded (operator records)?	N/A		Is water exiting outlet flowing clear?	See Note	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):	■	■
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	**N/A**		From underdrain?		X
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?		X
10. Cracks or scarps on crest?		X	At natural hillside in the embankment area?		X
11. Is there significant settlement along the crest?		X	Over widespread areas?		X
12. Are decant trashracks clear and in place?	X		From downstream foundation area?		X
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		X	"Boils" beneath stream or ponded water?		X
14. Clogged spillways, groin or diversion ditches?		X	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		X	22. Surface movements in valley bottom or on hillside?		X
16. Are outlets of decant or underdrains blocked?		X	23. Water against downstream toe?	X	
17. Cracks or scarps on slopes?		X	24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
8	Documentation of foundation preparation available at the time of site inspection.
20	Spillway pipe through north dike is gravity flow into Lower Ash Pond (aka Ash Pond 2). Lower Ash Pond was flooded by Mississippi River at the time of the site inspection to an elevation above the spillway outlet invert. Discharge could not be observed.

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit 6-29-00-1-00 **INSPECTOR** Mark Hoskins, P.E. & J. P. Klein, III P.E.

Date 7 October 2010
Impoundment Name Upper Ash Pond (aka Ash Pond 1)

Impoundment Company Interstate Power and Light Co.
EPA Region 7

State Agency State of Iowa Department of Natural Resources, Environmental Services Div.
(Field Office) Address 502 E. 9th St., Des Moines, IA 50319
Name of Impoundment Upper Ash Pond (aka Ash Pond 1)

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	**No**
Is impoundment currently under construction?	☐	☒
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: Storage of fly ash, bottom ash, economizer ash, ash transport water, boiler wash water, air heater water, storm water runoff from plant site, solids contact units sludge for treatment of Mississippi River water, coal pile runoff and boiler blowdown.

Nearest Downstream Town Name: Chillicothe, IA

Distance from the impoundment: 1.6 miles

Location:

Latitude	41	Degrees	5	Minutes	50	Seconds	**N**
Longitude	92	Degrees	33	Minutes	5	Seconds	**W**

State Iowa **County** Des Moines

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Iowa Department of Natural Resources

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☒ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

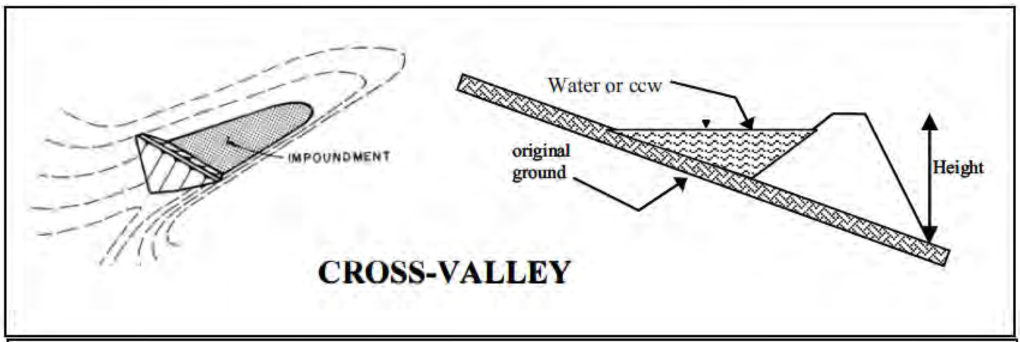
☐ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

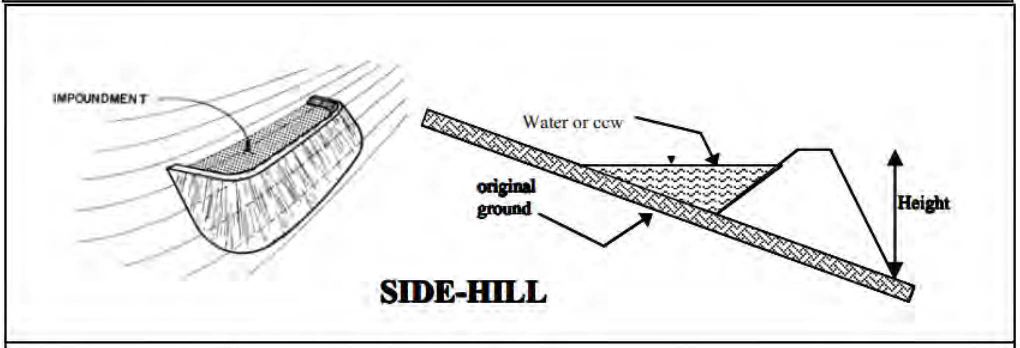
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

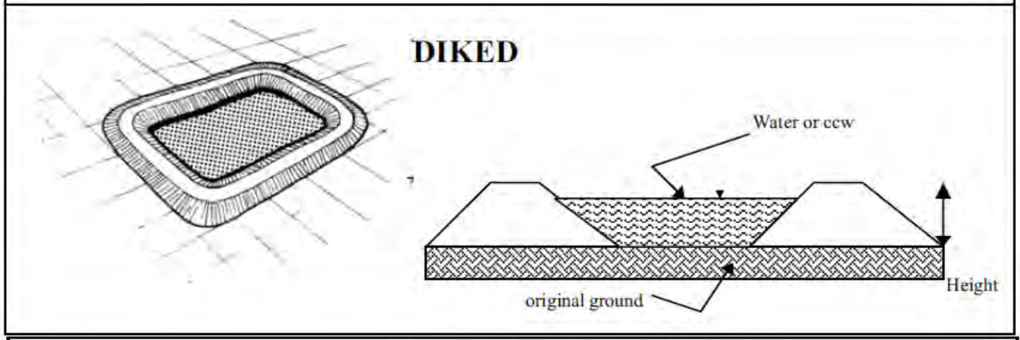
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

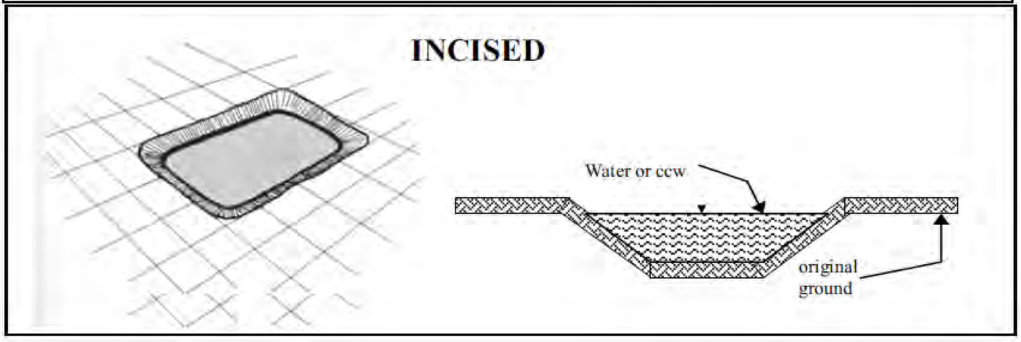
Based on the 5 ft. height of the dam and the heavily wooded area between the impoundment and the Mississippi River, failure or misoperation of the dike is not expected to result in loss of human life. The economic impact is expected to include wooded and/or Company owned property and possible ash recovery from the Mississippi River.

CONFIGURATION:









☐ Cross-Valley ☒ Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	5	**Embankment Material**	Documentation not provided
Pool Area (ac)	13.3	**Liner**	Documentation not provided
Current Freeboard (ft)	0.9	**Liner Permeability**	N/A

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

☐ Rectangular

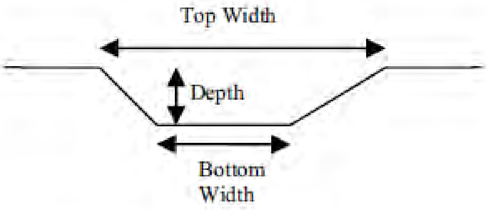
☐ Irregular

depth (ft)

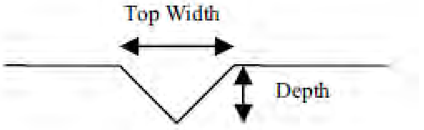
average bottom width (ft)

top width (ft)

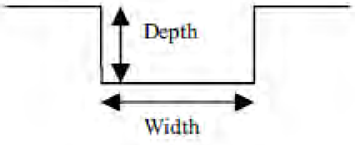
TRAPEZOIDAL



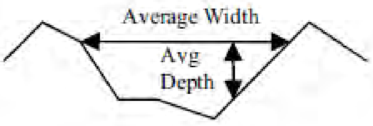
TRIANGULAR



RECTANGULAR

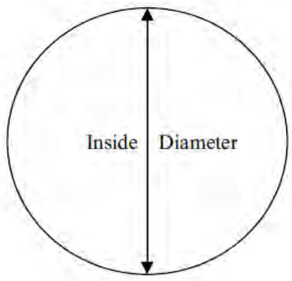


IRREGULAR



☒ **Outlet**

18” inside diameter (two pipes)
(SDR 17 – smooth lined – 19.5” OD)



Material

☒ corrugated metal

☐ welded steel

☐ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☐

☐ **No Outlet**

☐ **Other Type of Outlet**
(specify):

The Impoundment was Designed By: N/A

	Yes	No
Has there ever been a failure at this site?	☐	☒

If So When?

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

Correspondence from Alliant Energy to the EPA (letter dated May 22, 1009) indicates that based on a review of available records Alliant believes the impoundment was designed by a Professional Engineer. Documentation was not available at the time of the site visit.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

The dam assessor did not meet with nor have documentation from the design Engineer-of-Record concerning foundation preparation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

Neither observations during the site visit nor photographic documentation indicated prior releases, failures or patchwork on the dikes.

Site Name:	Burlington Generating Station	**Date:**	7 October 2010
Unit Name:	Lower Ash Pond (aka Ash Pond 2)	**Operator's Name:**	Interstate Power and Light
Unit I.D.:		**Hazard Potential Classification:**	High ☐ Significant ☐ Low ☒
	Inspector's Name:	Mark Hoskins, P.E. and Joseph P. Klein, III, P.E.	

Check the appropriate box below. Provide comments when appropriate. If not applicable or not available, record "N/A". Any unusual conditions or construction practices that should be noted in the comments section. For large diked embankments, separate checklists may be used for different embankment areas. If separate forms are used, identify approximate area that the form applies to in comments.

	Yes	No		Yes	No
1. Frequency of Company's Dam Inspections?	Annual		18. Sloughing or bulging on slopes?	See Note	
2. Pool elevation (operator records)?	521.5		19. Major erosion or slope deterioration?	See Note	
3. Decant inlet elevation (operator records)?	522		20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?	N/A		Is water entering inlet, but not exiting outlet?	See Note	
5. Lowest dam crest elevation (operator records)?	522.7		Is water exiting outlet, but not entering inlet?	See Note	
6. If instrumentation is present, are readings recorded (operator records)?	N/A		Is water exiting outlet flowing clear?	See Note	
7. Is the embankment currently under construction?		X	21. Seepage (specify location, if seepage carries fines, and approximate seepage rate below):		
8. Foundation preparation (remove vegetation, stumps, topsoil in area where embankment fill will be placed)?	**N/A**		From underdrain?	See Note	
9. Trees growing on embankment? (If so, indicate largest diameter below)		X	At isolated points on embankment slopes?	See Note	
10. Cracks or scarps on crest?	See Note		At natural hillside in the embankment area?	See Note	
11. Is there significant settlement along the crest?	See Note		Over widespread areas?	See Note	
12. Are decant trashracks clear and in place?	See Note		From downstream foundation area?	See Note	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?	See Note		"Boils" beneath stream or ponded water?	See Note	
14. Clogged spillways, groin or diversion ditches?	See Note		Around the outside of the decant pipe?	See Note	
15. Are spillway or ditch linings deteriorated?	See Note		22. Surface movements in valley bottom or on hillside?	See Note	
16. Are outlets of decant or underdrains blocked?	See Note		23. Water against downstream toe?	X	
17. Cracks or scarps on slopes?	See Note		24. Were Photos taken during the dam inspection?	X	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments
8	Documentation of foundation preparation available at the time of site inspection.
10 - 22	Lower Ash Pond upstream dike is common as Upper Ash Pond Dike. Downstream dike of Lower Ash Pond was inundated by Mississippi River flooding at the time of the site inspection. Neither the dike nor spillway structures were visible. Observation of drainage swale downstream of the dike location indicated floodwaters were still flowing into the pond during the site visit. The plant has installed a secondary NPDES monitoring station near the Upper Ash Pond spillway to meet compliance monitoring requirements due to the frequency of floods overtopping the Lower Ash Pond dike

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit 6-29-00-1-00 **INSPECTOR** Mark Hoskins, P.E. & J. P. Klein, III P.E.

Date 7 October 2010
Impoundment Name Lower Ash Pond (aka Ash Pond 2)

Impoundment Company Interstate Power and Light Co.
EPA Region 7

State Agency State of Iowa Department of Natural Resources, Environmental Services Div.
(Field Office) Address 502 E. 9th St., Des Moines, IA 50319
Name of Impoundment Lower Ash Pond (aka Ash Pond 2)

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New ☐ **Update** ☒

	Yes	**No**
Is impoundment currently under construction?	☐	☒
Is water or ccw currently being pumped into the impoundment?	☒	☐

IMPOUNDMENT FUNCTION: Storage of fly ash, bottom ash, economizer ash, ash transport water, boiler wash water, air heater water, storm water runoff from plant site, solids contact units sludge for treatment of Mississippi River water, coal pile runoff and boiler blowdown.

Nearest Downstream Town Name: Chillicothe, IA

Distance from the impoundment: 1.6 miles

Location:

Latitude	41	Degrees	5	Minutes	55	Seconds	**N**
Longitude	92	Degrees	33	Minutes	5	Seconds	**W**

State Iowa **County** Des Moines

	Yes	No
Does a state agency regulate this impoundment?	☒	☐

If So Which State Agency? Iowa Department of Natural Resources

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☒ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

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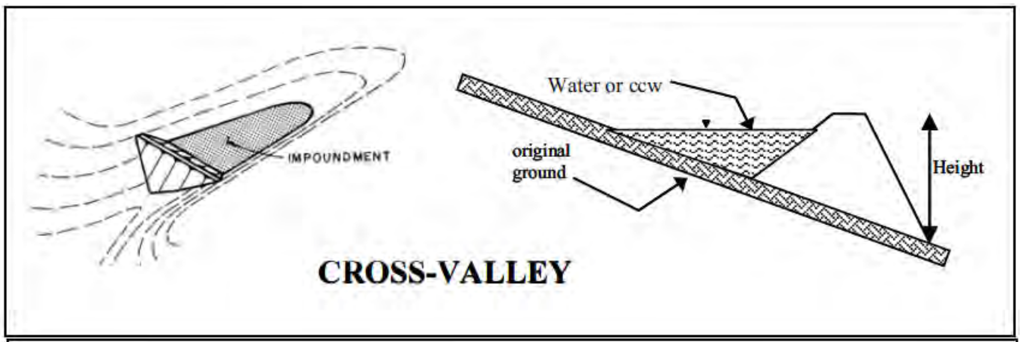
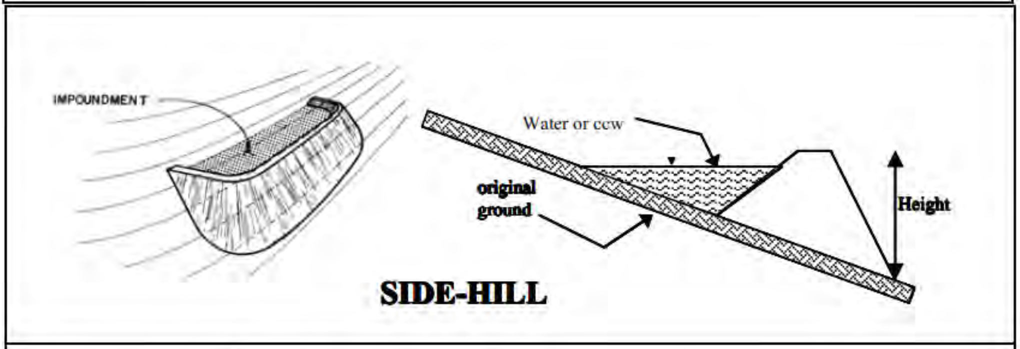
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

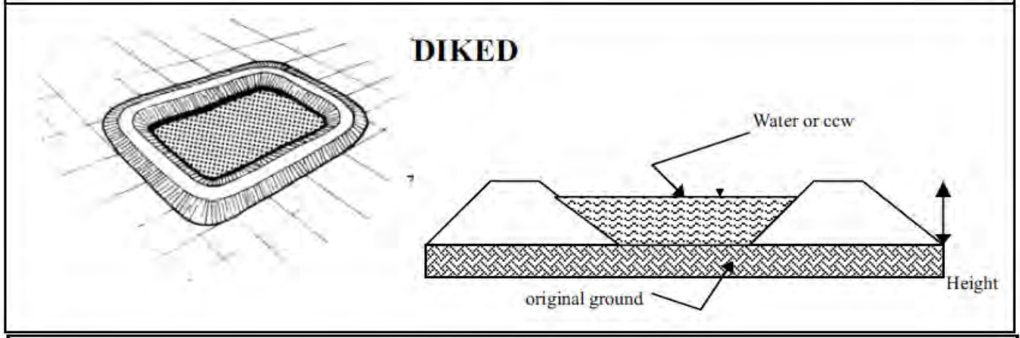
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

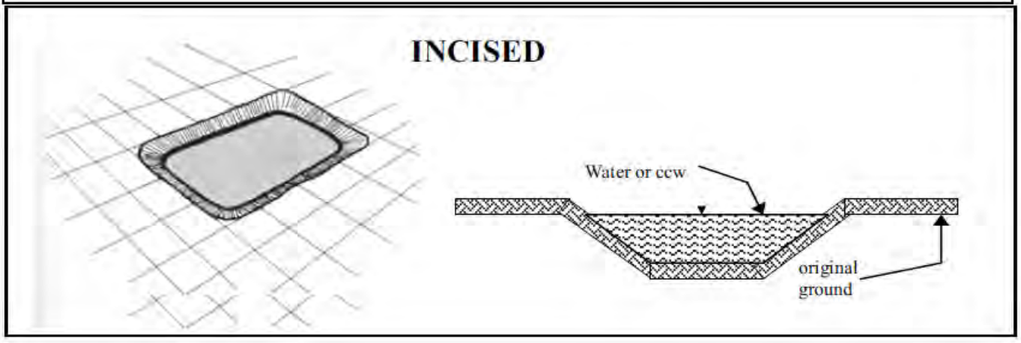
Based on the 3 ft. height of the dam and the heavily wooded area between the impoundment and the Mississippi River, failure or misoperation of the dike is not expected to result in loss of human life. The economic impact is expected to include wooded and/or Company owned property and possible ash recovery from the Mississippi River.

CONFIGURATION:









☐ Cross-Valley ☒ Side-Hill ☐ Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	3	**Embankment Material**	Documentation not provided
Pool Area (ac)	22.9	**Liner**	Documentation not provided
Current Freeboard (ft)	Pond flooded	**Liner Permeability**	N/A

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

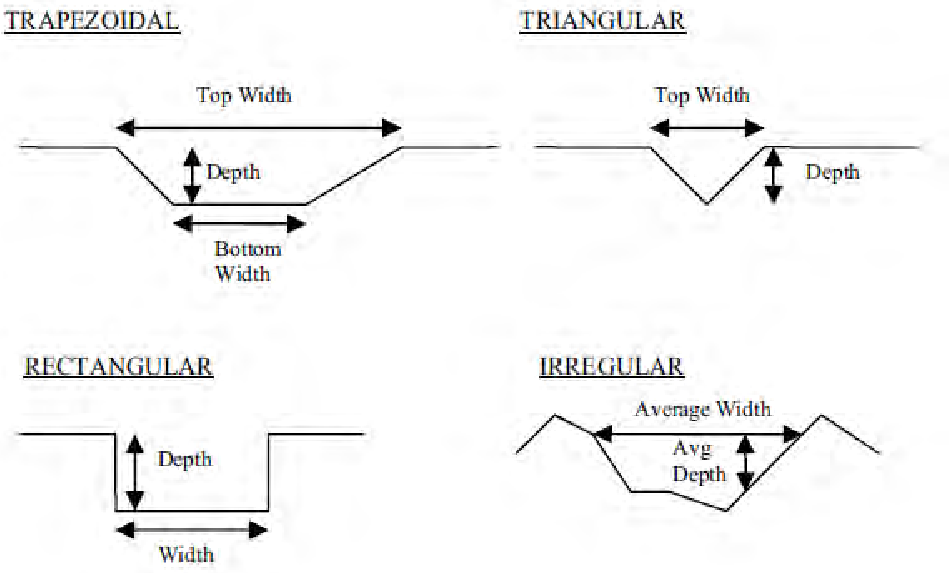
☐ Rectangular

☐ Irregular

depth (ft)

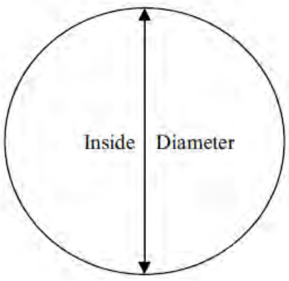
average bottom width (ft)

top width (ft)



☒ **Outlet**

18” inside diameter
(SDR 17 – smooth lined – 19.5” OD)



Material

☒ corrugated metal

☐ welded steel

☐ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☐

☐ **No Outlet**

☐ **Other Type of Outlet**
(specify):

The Impoundment was Designed By: N/A

	Yes	No
Has there ever been a failure at this site?	☐	☒

If So When?

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that.

Correspondence from Alliant Energy to the EPA (letter dated May 22, 1009) indicates that based on a review of available records Alliant believes the impoundment was designed by a Professional Engineer. Documentation was not available at the time of the site visit.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

The dam assessor did not meet with nor have documentation from the design Engineer-of-Record concerning foundation preparation.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

Neither observations during the site visit nor photographic documentation indicated prior releases, failures or patchwork on the dikes.

aether dbs
elemental design build solutions

CONFIDENTIAL BUSINESS INFORMATION

February 3, 2011

154.002.009

Mr. William Skalitzky
Alliant Energy Corporate Services, Inc,
4902 N. Biltmore Lane
Madison, WI 53718

Re: Ash Pond Slope Stability and Hydraulic Analysis
Burlington Generating Station – Burlington, IA

Mr. Skalitzky;

Aether DBS, reports our findings from the Ash Pond Slope Stability and Hydraulic Analysis performed for the Burlington Generating Station. The purpose of the study is evaluation of the stability of the ash settling ponds under 100-year storm flow and for both seismic and rapid drawdown induced loadings. The analysis is based on existing data on the generating station subsurface conditions, ash pond dike conditions, and surface drainage arrangements and new data on the materials of construction for the pond embankments. The supporting information pertinent to the evaluation is provided in the attachments.

The ash ponds will route a SCS Type II, 24-hour, 100 year storm without overtopping. The ash pond embankments have a factor of safety above the standard acceptable factor of safety of 1.5 for static stability, with the exception of the Economizer Ash Pond, which is internal to the Upper Ash Pond. Saturated ash in the ponds will liquefy under a design earthquake causing reduced strengths in the ash and additional pressure on the embankments. The Upper Ash Pond and the Ash Seal Pond embankments have an acceptable factor of safety of 1.1 for pseudo-static earthquake analysis with liquefied ash. The Main Ash Pond and the Economizer Ash Pond pseudo-static earthquake analysis indicate that excessive deformation could lead to the release of the pond contents.

Background

Interstate Power and Light constructed the Burlington generating station in the 1960's for a current generating capacity of 212MW. The original ash handling operation included the ash seal water pond and the upper and lower ash ponds north of the entrance road, Figure 1. Ash was originally managed by settling in the Ash Seal Pond in 1968 and later the Upper and Lower Ash Ponds in 1971. In 1980, the Main Ash Pond south of the entrance road became the primary ash pond with the Upper and Lower Ponds being downstream receivers, Figure 1. The last addition to the ash handling system was the Economizer Ash Pond that was constructed in the southern and eastern part of the original Upper Ash Pond in 1986, Figure 1.

Presently the Generating Station handles fly ash in a dry condition with storage for off-site transport from an ash silo on the southern side of the generating station near the former Ash Seal Water Pond, which now operates as a storm water collection pond for the ash silo area. The other ponds are operated to contain storm water from the generating station and to handle sluicing water used to transport bottom ash and economizer ash from the Station operations. Details of the ponds provided to USEPA in May 2009[1] include:

1. Ash Seal Water Pond – The Ash Seal Water Pond is presently inactive and does not receive storm water from the plant site or ash sluicing water. Storm water from the plant site that originally entered the Ash Seal Pond, with the exception of a small area around the ash silo, is now routed directly to the Main Ash Pond. The Ash Pond will only receive operating water flow if there is an emergency overflow from the Bottom Ash handling system. The Pond covers 4.5 acres and IPL estimates a total ash volume of 73,000 cubic yards is within the pond.
2. Main Ash Pond – The Main Ash Pond is presently active as a receiver of bottom ash and fly ash. When not sent offsite, the dry ash is hydrated and placed in lifts in the southeast portion of the Main Ash Pond. The material is then ground and sold as aggregate materials under the AgPave brand name. The bottom ash is settled in a pond near the eastern end of the Main Ash Pond and is recovered for resale by IPL. Water from sluicing the bottom ash is routed in ditches just inside of the enclosing embankments on both the east and west sides of the Pond to a discharge through a 24-inch corrugated metal culvert under the entrance road at the Northwest corner of the Pond. The Pond covers 17 acres and IPL estimates a total ash volume of 137,000 cubic yards in the pond.
3. Economizer Ash Pond – The Economizer Ash Pond (actually a pile) is presently active and receives sluiced economizer ash that is settled in a small pond on top of the economizer ash pile. The separated economizer ash is processed and stockpile for resale as an aggregate substitute or landfilled offsite. Water from the sluicing is discharged to the Upper Ash Pond. The Pond covers 11 acres and rests on top of what was part of the original Upper Ash Pond. The Economizer Ash is nearly 20-feet above the embankment crest of the Upper Ash Pond. IPL estimates that the volume of ash in the Economizer Ash Pond is 250,000 cubic yards.
4. Upper Ash Pond – The Upper Ash Pond receives sluicing water from both the Main Ash Pond and the Economizer Ash Pond. The Pond also receives the storm water flow from the Generating Station, exclusive of the Coal Pile. No ash other than incidental solids that do not settle from the bottom ash or economizer ash operations enter the Upper Ash Pond. Water in the Pond discharges at the Northeast corner at a normal operating elevation of 528.3 feet. The discharge from the Upper Ash Pond is the NPDES regulated outfall during Mississippi River flooding events. The Upper Ash Pond is 13.3 acres and IPL estimates the volume of ash in the pond is 107,000 cubic yards.
5. Lower Ash Pond – The Lower Ash Pond outfalls to the Mississippi River through a culvert under the railroad spur from the Burlington Northern Main Line to the Generating Station. The water elevation in the Lower Ash Pond is at least the flat water elevation in Pool 19 on the Mississippi River, elevation 518.25 normal pool. The Lower Ash Pond is 23 acres and IPL estimates the volume of ash in the pond is 110,000 cubic yards.

The water balance diagram for the generating station is included in Attachment A.

In addition to the storm water from the Generating Station, storm water from the coal pile is routed north to a detention/retention basin that overflows to the Lower Ash Pond by opening a gate valve.

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[1] Alliant Energy, "Response to Request for Information Under Section 104(e) of CERCLA", May 22, 2009

Investigation Activities

Details for the construction of the various pond embankments are not available. The ash seal pond embankment was investigated by Aether DBS, formerly Hard Hat Services, in 2007 to determine the source of seepage through the embankment[2]. The embankment borings from that investigation are in Attachment B-1. In 2008 Hard Hat Services completed several deep soil borings in the northeast corner of the Ash Seal Water Pond as part of a foundation design investigation. The deep borings along with the deep borings taken in the early 1960's are included in Attachment B-2. Since there was no information on the materials of construction in the remaining pond embankments, Aether DBS installed borings on the embankments of the Main Ash Pond, the Economizer Ash Pond and the Upper Ash Pond at locations that were judged to be critical locations for stability. The results of the new borings are enclosed in Attachment B-3. Locations of the borings are indicated on Figure 1.

The natural soil stratigraphy at the site shows that refusal for a standard split spoon sampler occurs at approximately 80-feet below ground surface at the generating station (elevation 450-feet). Above the refusal the soil is very dense sand and gravel that grades to medium dense from approximately 20-60 feet below ground surface and is either a very loose silt or fine sand or in places soft clay overlying the medium dense sand. At the Generating Station a natural levee embankment and fill added during construction of the site lie over the loose sand and silt and or soft clay. In the areas further to the west where the ponds are located the very loose sands or silts and/or soft clay are at the original ground surface at elevations of 520-525 feet, Attachment C.

Borings taken to determine the materials of construction for the embankments forming the ponds indicated that most of the embankments are compacted clay. The only exception is the northeastern part of the Economizer Ash Pond where the embankment is ash. The compacted clay in the embankments was tested using a pocket penetrometer and the unconfined strength always equaled or exceeded 1 ton per square foot (TSF). When soft clay was found under the embankment, the pocket penetrometer readings indicated as little as 0.5 TSF and on some test no measureable reading. In some cases sand or silty sand was found directly under the compacted clay of the embankment. Since the investigations were using hydraulic pushed tubes the density or strength of the layers were not measured. Results from the borings in the northeast corner of the Ash Seal Pond in 2008 indicate that the soil under the embankments is likely loose to very loose sand or silt when clay is not present.

In the investigation of the economizer ash pond one of the borings indicated compacted clay overlying soft clay. The other two borings indicated that the face of the economizer ash pond is constructed of ash that appears solid when extruded from the sample sleeve, but liquefied when handled. Twenty-Four hour water elevation readings in these borings indicated that the phreatic water elevation is approximately 15-feet below the crest of the dike and that the saturation observed in the sample is likely from capillary rise in the ash.

Drainage

Drainage from the Generating Station which covers approximately 8.0 acres is routed to the Main Ash Pond. From the Main Ash Pond drainage runs down the inboard side of the south embankment of the

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[2] IPL. "Burlington Generating Station Berm/Seep Investigation", Hard Hat Services, August 31, 2007.

Main Ash Pond to form a pond at the West end of the Main Ash Pond. The pond discharges under the entrance road in two 18-inch diameter corrugated steel culverts with an invert elevation of 531.1. The drainage from the Generating Station and the Main Ash Pond is combined with the drainage from the Economizer Ash Pond in the Upper Ash Pond. Water in the Upper Ash Pond discharges into the Lower Ash Pond through a 15-inch diameter plastic outlet pipe with an invert elevation of 528.3.

The Lower Ash Pond is in direct hydraulic communication with Pool 19 on the Mississippi River.

Discharge from sluicing of bottom ash and economizer ash is 4.6 cubic feet per second (CFS) split between the two operations. Discharge rates from the Upper Ash Pond indicate that approximately one-third of this sluice water seeps into the soil below the pond (exfiltration).

Hydrology and Hydraulics

A 100-year, SCS Type 2, 24-hour storm for Des Moines County, Iowa is 6.8 inches of precipitation[3]. Runoff Curve Numbers of 91 for the generating station, 85 for the Main Pond and 100 for the Economizer Ash Pond and the Upper Ash Pond were used in the storm routing. The values were estimated based on assumed percentage of paved areas and the probable presence of unsaturated ash above the normal ground water elevation in filled ponds. Flow from the East to the West end of the Main Ash Pond was taken through a trapezoidal channel along the inboard slope of the South embankment. The base flow through the culverts from sluicing operations was generated by starting the pond routing at each discharge culvert at an elevation that results in 1 CFS and 3 CFS base discharge at the Main Ash Pond and the Upper Ash Pond, respectively.

Hydraflow by Intelisolve[4] was used to generate and route the storm hydrograph through the ponds. The results indicate that the discharge culverts at both locations convert from open channel flow to full pipe flow during the routing of the 100-year storm. Discharge from the Main Ash Pond peaks at a flow of 18 CFS with a corresponding freeboard of 0.8 foot. Discharge from the Upper Ash Pond peaks at a flow of 7 CFS with a corresponding freeboard of 0.75 foot. The analysis results are provided in Attachment D.

Ash Pond Embankment Stability – Static At Normal Operating Conditions

The static stability of the ash ponds is dependent on the geometry of the embankments and the strength of the embankment and base soils. The presence of soft clay and/or very loose silty sand immediately below the embankments is the likely failure plane for static stability under normal operating conditions. For strength, the soft clay was assigned cohesion of 500 pounds per square foot (PSF) unless conditions indicate otherwise. For a loose sand or silty sand a friction angle of 30° was used. Settled ash contained behind the embankments is assigned a friction angle of 25°. Compacted clay embankments are assigned a cohesive strength of 1000 PSF.

In the case of the southeast corner of the Main Ash Pond, a topographic map from early 2009, Attachment E, showed that AgPave was previously stacked steeply 30-feet above the embankment crest.

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[3] United States Department of Commerce, Rainfall Frequency Analysis of the United States,

[4] Intelisolve. Pond Routing Software Hydraflow, 2002

Consequent, the embankment has demonstrated considerable load carrying capacity in the past when the AgPave stockpile was in place.

For the Economizer Ash Pond embankment, the fly ash in the embankment was assigned a friction angle of 28° for loose ash and the ground water table was shown as percolating down from the ponded area approximately 30-feet south of the crest and then horizontally towards the Upper Ash Pond.

The embankment geometry and soil layers and strengths were used as input to the two dimensional limit-equilibrium slope stability analyses program STABL5M (1996)[5] to analyze hundreds of potential slip surfaces for each case. The program calculates a factor of safety based on the ratio of the driving forces to the resisting forces along each potential slip surface. A calculated factor of safety greater than one indicates stability along the surface analyzed. Both circular surfaces and block slides were investigated and showed similar results with the natural soil under the embankment controlling the stability.

The results for the static analysis are presented in Attachment F and are summarized as:

Ash Pond	Minimum Factor of Safety
Ash Seal	1.6
Main	2.1
Upper	2.1
Economizer	1.1

The Lower Ash Pond drains freely to the Mississippi River and the stability of the railroad embankment that separates the pond from the River was not assessed because of its mass and its location on the natural levee deposits along the edge of the River. For the Economizer Ash pond the embankment was analyzed as ash, but is likely to have an original clay embankment behind the crest. If clay is present, the Economizer Ash embankment should have a higher factor of safety due to a lack of seepage and/or the cohesive strength. In all cases the location of the critical sections on each embankment are shown on Figure 1.

Ash Pond Embankment Stability – Static with Rapid Drawdown Conditions

The Upper Ash Pond may experience rapid changes in water elevation if the Mississippi river were to drop quickly after a flood overtopped the embankment. The Upper Ash Pond was modified in 2010 to line the crest and upstream slopes with rip-rap to protect the embankment when high water elevations in pool 19 on the Mississippi River overtop the dike (i.e., the dike has a top elevation of 531 feet whereas the 100-year flood elevation in Pool 19 is 534 feet).

In addition, the Ash Seal Pond could experience rapid drawdown if emergency overflow goes to the pond and the pumping system quickly lowers the pond back to the normal water elevation.

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[5] STABL User Manual, By Ronald A. Siegel, Purdue University, June 4, 1975 and STABL5 …The SPENCER Method of Slices: Final Report, By J.R.Carpenter, Purdue University, August 28, 1985

Both embankments are constructed of clay so rapid drawdown will not create temporary unbalanced seepage forces in the embankments and rapid drawdown is not considered a destabilizing factor.

Ash Pond Embankment Stability – Earthquake with Normal Operating Conditions

The Main Ash Pond and the Economizer Ash Pond contain saturated ash that was deposited hydraulically in the ponds prior to converting the generating station to a dry ash handling system. The Main Pond is filled with ash close to its crest elevation and is wetted by flow of water from the bottom ash sluicing operation down the south side of the pond. The Economizer Ash Pond is similarly wetted by flow of sluicing water over the northeast surface of the pond.

Since the fly ash in these ponds was deposited by hydraulic methods, the impact of an earthquake on the pond stability is determined by both the additional forces from the earthquake on the pond embankments and the possible liquefaction of the contained fly ash.

To determine the potential for liquefaction, Aether DBS determined the amplification of bedrock ground motion through a typical soil profile (under the main pond) and the cyclic shear stress experienced in the fly ash at the surface of the profile using the program SHAKE[6].

The soil profile above the bedrock was assigned maximum shear modulus values based on the Hardin[7] and a maximum material damping of 5%. The variations of shear modulus and damping with shear strain were selected from records available for soils of similar characteristics in the SHAKE library. Since no recorded bedrock earthquake motions exist for earthquakes on the New Madrid fault system approximately 300-miles south of Burlington, the Northridge 1994 record from California was chosen for its relatively long strong motion content.

The earthquake record was scaled to the peak bedrock earthquake acceleration with a 2% probability in 50 years (2475 year return period)[8] of 0.06g. The use of a 2% probability in 50 years is the standard set by the USEPA for design of Subtitle D landfills[9]. SHAKE performs a one-dimensional analysis of the earthquake motion traveling upward from rock at 80-feet below ground surface and produces an amplified and filtered earthquake response at other depths. SHAKE also determines the peak acceleration in each layer and the ratio of the maximum shear stress to confining pressure at strains that are 65% of the maximum shear strain determined in the analysis. The results of the SHAKE analysis are presented graphically in Attachment G and summarized below:

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[6] GeoMotions, LLC, "SHAKE 2000 A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems"' November 2007.

[7] Hardin Bobby, and Vincent Drenevich, "Shear Modulus and Damping of Soils Measurement and Parameter Effects"' College of Engineering University of Kentuckey, 1970.

[8] International Code Council, "International Building Code, 2006

[9] EPA (1995), "RCRA Subtitle D (258) Seismic design Guidance for Municipal Solid Waste Landfill Facilities". EPA/600/R-95/051

Layer	Depth (ft)	Peak Acceleration (g)	Depth (ft)	Cyclic Stress Ratio (τ/α)
Fly Ash	0	0.22	2.5	0.29
Fly Ash	5	0.16	7.5	0.25
Soft Clay	10	0.13	12.5	0.20
Medium Dense Sand	15	0.105	20	0.175

The cyclic stress ratio (CSR) produced by the earthquake is compared to the cyclic resistance ratio (CRR) measured in the field or laboratory tests on remolded samples. Since no in-situ measurements were available for the fly ash, the CRR measured by Behrad[10] for fly ash at a dry density of 70 lb/ft^3 and for more than 10 cycles of strong motion was selected to represent ash in the Burlington Ponds (CRR = 0.1).

The results indicate that a design level earthquake will result in liquefaction of the fly ash so that it will have virtually no shear strength and will act as a heavy viscous fluid with hydrostatic pressure pushing on the clay embankments of the ponds. These conditions are used in the analysis of the embankment stability to determine if the liquefied ash will move the embankments.

In addition to ash liquefaction during the design earthquake, the very loose sand and/or sandy silt underlying the clay embankments may liquefy during the earthquake. If the underlying layer were to liquefy the entire embankment could be pushed over the base soil resulting in a release of the pond contents. The Factor of Safety results presented by Aether DBS do not account for the potential of embankment foundation liquefaction.

The earthquake acceleration at the base of the embankment, 0.13g, was used as the horizontal earthquake coefficient for a pseudo-static addition to the static limit equilibrium analysis using STABL. The vertical component of the earthquake was taken as $^2/_3$ of the horizontal acceleration as recommended by Newmark[11]. During the earthquake, the ash in the pond was assumed to have liquefied and was assigned a residual cohesion of 100PSF to produce a viscous fluid shear effect with no strength due to particle friction.

The results for the pseudo-static analysis are presented in Attachment H and are summarized as:

Ash Pond	Minimum Factor of Safety
Ash Seal	1.2
Main	1.0
Upper	1.5
Economizer	0.7

---

[10] Behrad Zand, Wei Tu, Pedro J Amaya, William Wolfe, Tarunjit Butalia, "Evaluation of Liquefaction Potential of Impounded Fly Ash"2007 World of Coal Ash, May 7-10, 2007.

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

Results that are 1.0 or less indicate that substantial deformation may occur in the embankment and the deformation could lead to a release of the pond contents.

Conclusion

One Hundred Year Storm Routing – The 100-year storm will route through the Main Ash Pond and the Upper Ash Pond without overtopping of the embankments. Based on the conservative approach to the analysis, a freeboard of one foot is judged to be acceptable. However, both ponds have less than one foot of freeboard and remedial measures to improve storage and/or drainage rate should be considered. The Upper Ash Pond was modified in 2010 to reduce erosion from crest overtopping that occurs whenever Pool 19 of the Mississippi River rises above 531. It has survived overtopping in the past and should survive overtopping without failure of the embankment in the future.

Static Embankment Stability – The Ash Seal Pond, Main Pond, and Upper Ash Pond all have static factors of safety greater than the 1.5 standard for embankments. The Economizer Ash Pond has a static safety factor less than 1.5, because the outer slope of the pond is constructed of ash and the ash is saturated by the ponding operation close to the crest of the slope. A static failure of the Economizer Ash Pile slope could lead to static liquefaction of the pile with flow into the Upper Ash Pond. If such a flow occurred, the flowing material could possibly overtop or push the Upper Ash Pond embankment into the Lower Ash Pond. The failure could have an economic impact, but would remain within the Ash Pond system and would not have an environmental impact to the Mississippi River.

Earthquake Liquefaction – A Subtitle D (Part 258) design earthquake magnitude will result in liquefaction of the saturated ash. The liquefied ash will have a low residual strength and will push on the embankments with a hydrostatic force that could deform the embankments. In addition, the susceptibility to liquefaction of the base soil under the embankments could be an issue for embankment stability.

Pseudo-Static Earthquake Stability -- In the case of the Economizer Ash Pond the embankment could deform or liquefy and the contents of the pond flow into the Upper Ash Pond. If the velocity of the flow was significant, the contents of the Economizer Ash Pond could overtop the Upper Ash Pond embankment and flow into the Lower Ash Pond. Because of the size of the Lower Ash Pond it is unlikely that anything other than water would flow to the Mississippi River.

In the case of the Main Ash Pond, movement of the embankment could release some of its contents into the lowland south of the pond. With the low height of the pond and the volume of the contents relative to the distance to the Mississippi River, an embankment failure is unlikely to result in movement of the pond contents to the river. Consequent damages would be economic with minor environmental impacts to the adjacent lowland.

RL

Recommendations

Aether DBS recommends that Interstate Power and Light consider the following actions and/or assessment.

1. Aether DBS understands that Interstate Power and Light is planning to modify the outlet of the Upper Ash Pond in calendar year 2011. The outlet pipe should be increased to a diameter that allows the pond to maintain a freeboard greater than one-foot under the 100-year flood flow.
2. The sluicing water in both the Main Ash Pond and the Economizer Ash Pond should be rerouted to flow down the center of the ash fill in the pond. A free water surface as far from the pond embankments as possible will reduce the probability of the ash liquefying near the embankment in the event of an earthquake or in the case of the Economizer Ash Pile due to the slumping of the outer face of the pile. The volume of the pond at the West end of the Main Ash Pond should be increased by removing ash to increase the freeboard during storm flow.
3. Further assessment of the potential for liquefaction of the soils directly under the Main Ash embankment and in the Economizer Ash embankment should be completed to determine if the embankments could fail due to failure of the base materials.
4. Further assessment of the critical section of the Economizer Ash pond should be considered to confirm if a buried clay embankment is found south of the ash crested area. A clay embankment would restrict flow liquefaction from a static slump in the ash face that has a safety factor less than 1.5.

Aether DBS believes that the ash piles overall are in fair condition and only extreme hydrologic and/or seismic events could lead to economic or environmental impacts to areas outside of the ash ponds.

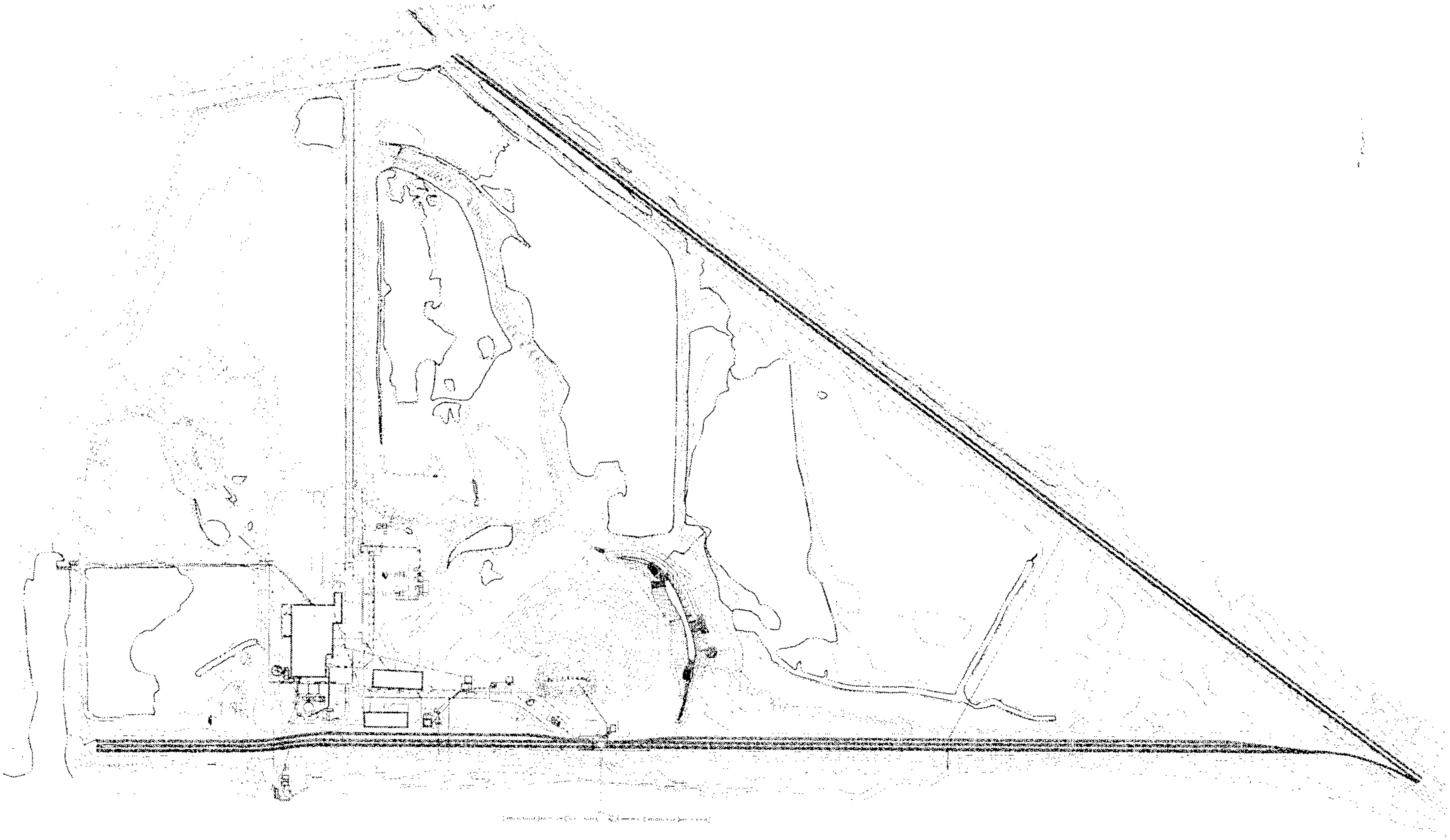
We appreciate the opportunity to perform an assessment of the Burlington Generating Station Ash ponds.

If you have any questions, please call.

Thomas C Wells

Thomas C. Wells, P.E.

Timothy J. Harrington, P.E.



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ERROR: undefined
OFFENDING COMMAND: m&!3TUhC

STACK:
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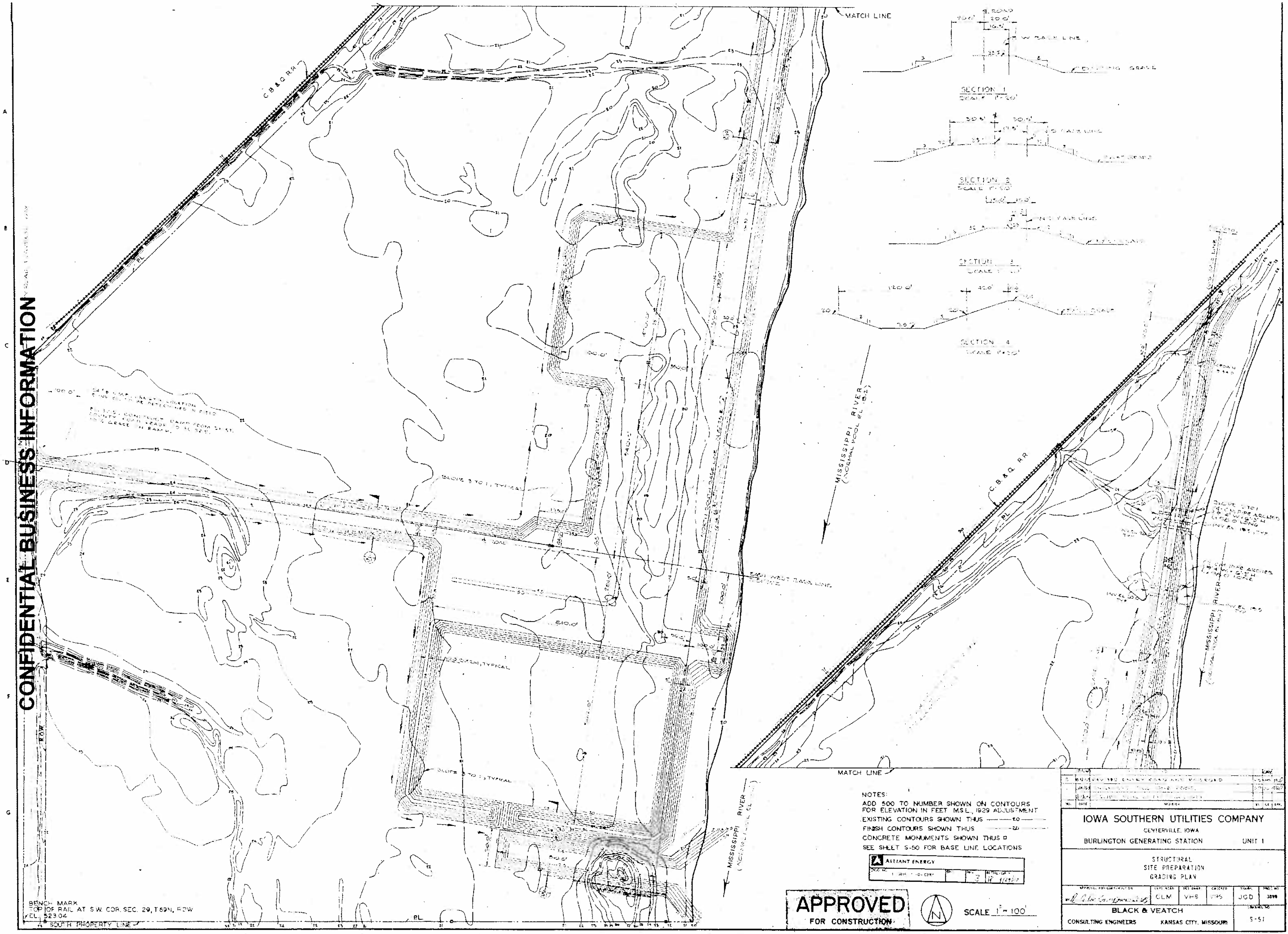
Attachment C

Structural Site Preparation
Grading Plan
Drawing No. S-51

Source:
Black & Veatch, January 29, 1965



NOTES:
ADD 500 TO NUMBER SHOWN ON CONTOURS FOR ELEVATION IN FEET M.S.L., 1929 ADJUSTMENT
EXISTING CONTOURS SHOWN THUS ——— 20 ———
FINISH CONTOURS SHOWN THUS - - - 20 - - -
CONCRETE MONUMENTS SHOWN THUS ◻
SEE SHEET S-50 FOR BASE LINE LOCATIONS

ALLIANT ENERGY

APPROVED
FOR CONSTRUCTION

SCALE 1" = 100'

IOWA SOUTHERN UTILITIES COMPANY
CENTERVILLE, IOWA
BURLINGTON GENERATING STATION UNIT 1

STRUCTURAL
SITE PREPARATION
GRADING PLAN

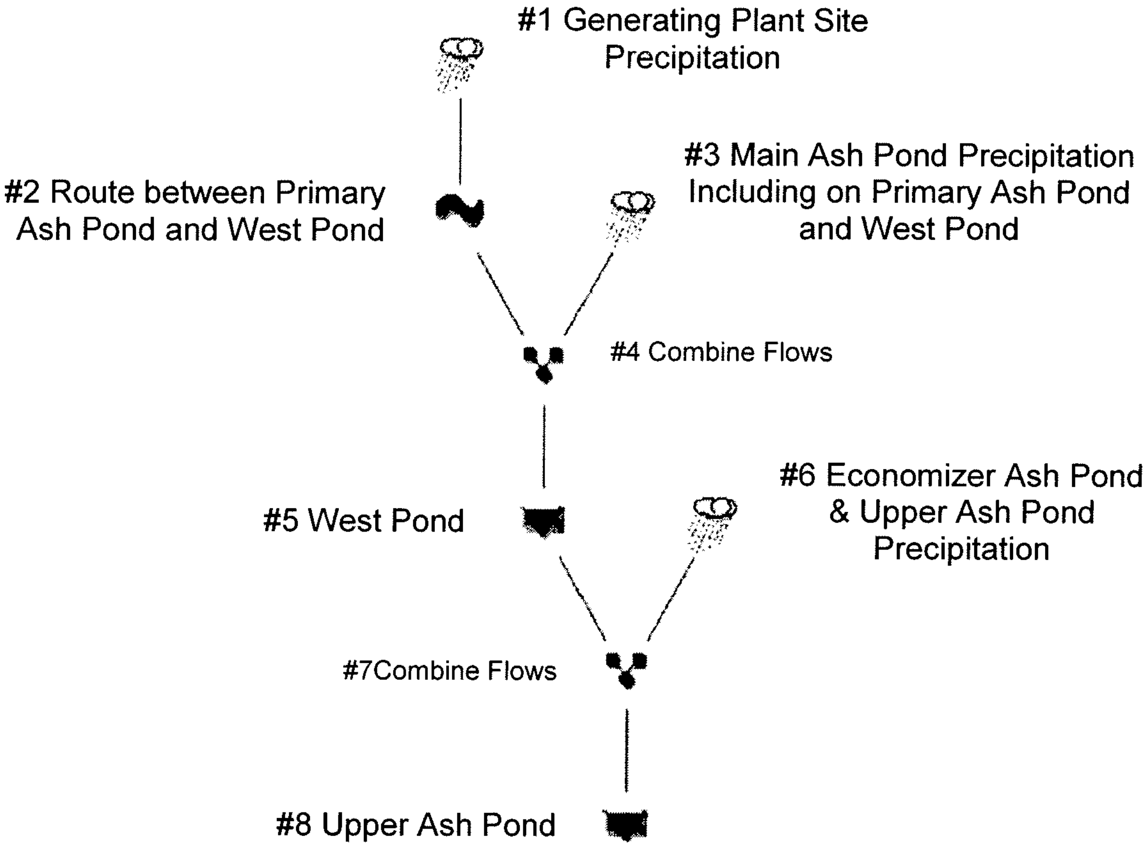
APPROVED FOR CONSTRUCTION			CHECKED	DRAWN	PROJ. NO.
	CLM	VHS	VHS	JGD	3899

BLACK & VEATCH
CONSULTING ENGINEERS KANSAS CITY, MISSOURI
S-51

Attachment D

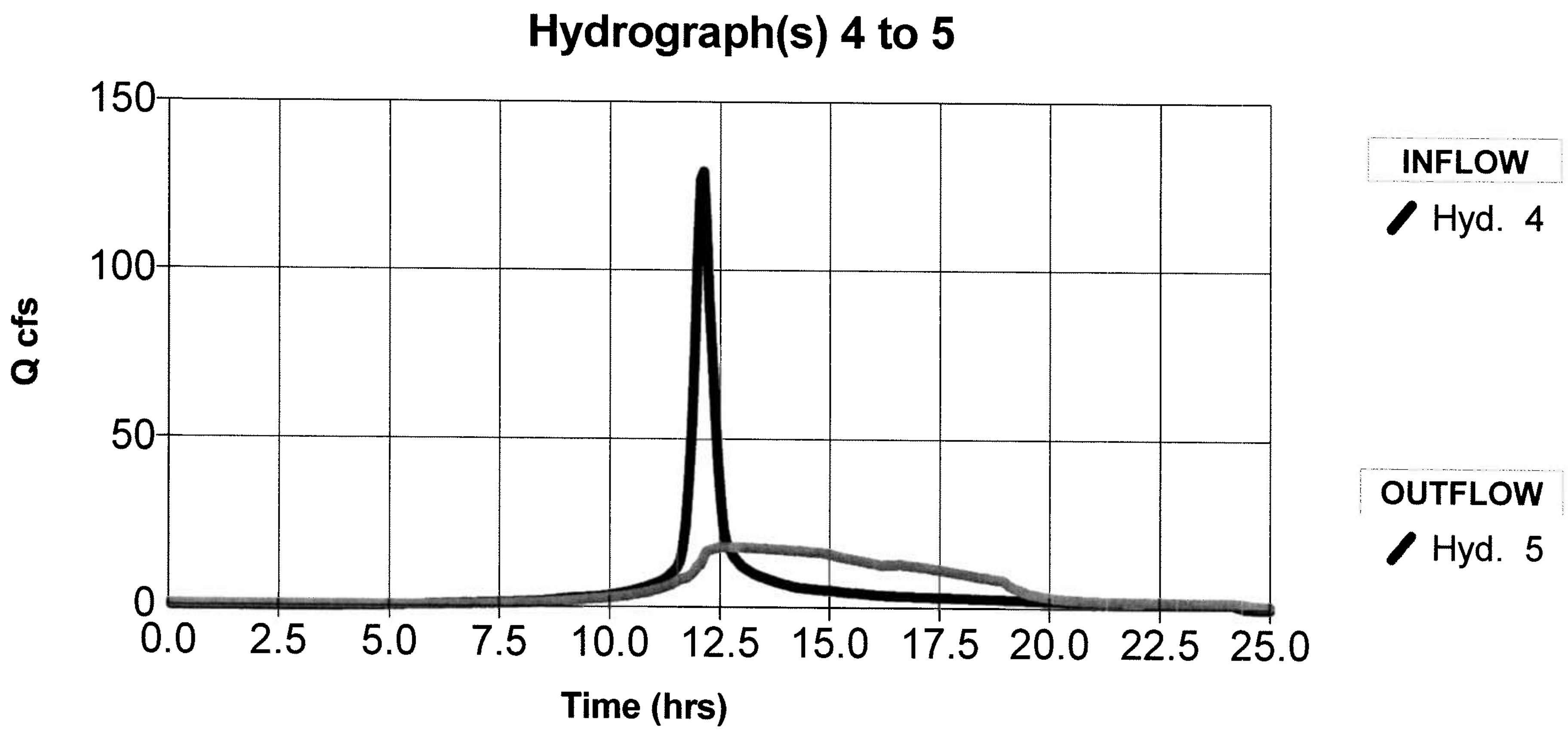
Hydrological and Hydraulics Study

Aether dbs, February, 2011

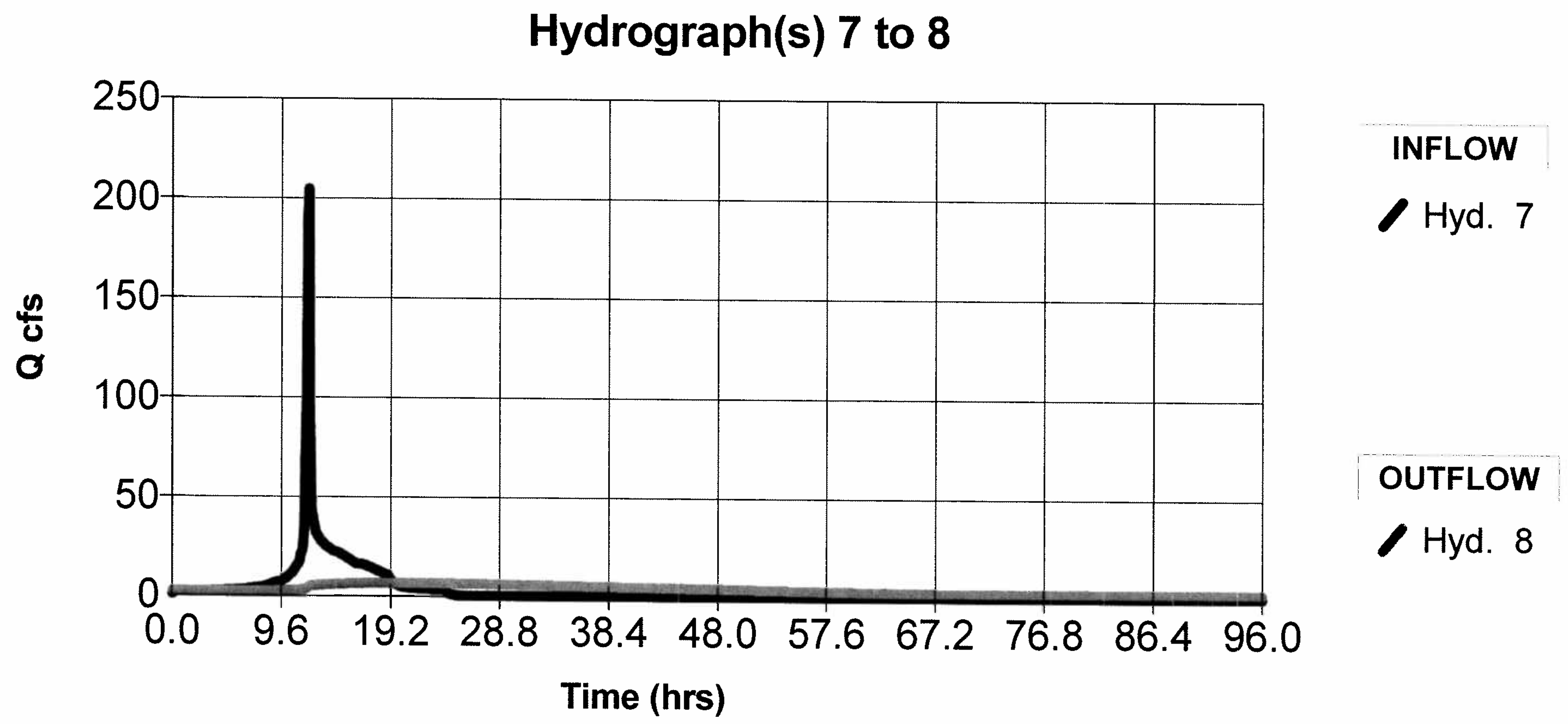


Hydraflow Hydrographs Diagram Project: Burlington-1.gpw 01-20-2011

Main Pond Routing



Upper Ash Pond Routing



Hydrograph Summary Report

CONFIDENTIAL BUSINESS INFORMATION

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Maximum storage (acft)	Hydrograph description
1	SCS Runoff	58.30	4	720	3.589	----	-----	------	Power Plant Area
2	Reach	46.49	4	724	3.589	1	------	------	Route to Western Pond
3	SCS Runoff	84.07	4	728	7.395	----	-----	------	Main Ash Pond Runoff
4	Combine	129.44	4	728	10.983	2, 3	-----	------	Inflow to West Pond
5	Reservoir	18.04	4	764	14.666	4	533.19	4.812	Through Western Pond
6	SCS Runoff	192.20	4	720	13.281	----	------	------	Economizer Pond Runoff
7	Combine	204.68	4	720	27.947	5, 6	-----	------	Upper Ash Pond Inflow
8	Reservoir	6.95	4	1172	32.071	7	530.31	16.096	Through UPPER Ash Pond

Proj. file: Burlington-3.gpw	Return Period: 100 yr	Run date: 02-09-2011

Hyd. No. 1

Power Plant Area

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 8.00 ac
Basin Slope = 1.0 %
Tc method = LAG
Total precip. = 6.80 in
Storm duration = 24 hrs

Peak discharge = 58.30 cfs
Time interval = 4 min
Curve number = 91
Hydraulic length = 500 ft
Time of conc. (Tc) = 12.3 min
Distribution = Type II
Shape factor = 484

Hydrograph Volume = 3.589 acft

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)	Time -- (hrs	Outflow cfs)
7.33	0.59	18.67	0.84
7.67	0.64	19.00	0.80
8.00	0.69	19.33	0.76
8.33	0.79	19.67	0.71
8.67	0.93	20.00	0.67
9.00	1.09	20.33	0.65
9.33	1.17	20.67	0.64
9.67	1.24	21.00	0.63
10.00	1.47	21.33	0.63
10.33	1.80	21.67	0.62
10.67	2.21	22.00	0.61
11.00	2.83	22.33	0.60
11.33	4.00	22.67	0.59
11.67	11.50	23.00	0.58
12.00	58.30 <<		
12.33	7.61		
12.67	4.33	*...End*	
13.00	3.37		
13.33	2.76		
13.67	2.32		
14.00	1.98		
14.33	1.78		
14.67	1.67		
15.00	1.55		
15.33	1.43		
15.67	1.32		
16.00	1.20		
16.33	1.13		
16.67	1.09		
17.00	1.05		
17.33	1.01		
17.67	0.96		
18.00	0.92		
18.33	0.88		

Hyd. No. 2

Route to Western Pond

Hydrograph type = Reach
Storm frequency = 100 yrs
Inflow hyd. No. = 1
Reach length = 1560.0 ft
Manning's n = 0.030
Side slope = 2.0:1
Rating curve x = 0.882
Ave. velocity = 2.59 ft/s

Peak discharge = 46.49 cfs
Time interval = 4 min
Section type = Trapezoidal
Channel slope = 0.27 %
Bottom width = 5.00 ft
Max. depth = 2.00 ft
Rating curve m = 1.346
Routing coeff. = 0.4227

Modified Att-Kin routing method used.

Hydrograph Volume = 3.589 acft

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Outflow cfs
6.67	0.49	0.47
7.00	0.54	0.52
7.33	0.59	0.57
7.67	0.64	0.61
8.00	0.69	0.66
8.33	0.79	0.73
8.67	0.93	0.87
9.00	1.09	1.01
9.33	1.17	1.14
9.67	1.24	1.19
10.00	1.47	1.36
10.33	1.80	1.63
10.67	2.21	2.00
11.00	2.83	2.54
11.33	4.00	3.26
11.67	11.50	5.73
12.00	58.30 <<	37.84
12.33	7.61	18.78
12.67	4.33	6.29
13.00	3.37	3.89
13.33	2.76	3.03
13.67	2.32	2.52
14.00	1.98	2.14
14.33	1.78	1.86
14.67	1.67	1.72
15.00	1.55	1.61
15.33	1.43	1.49
15.67	1.32	1.37
16.00	1.20	1.26
16.33	1.13	1.16
16.67	1.09	1.11
17.00	1.05	1.07
17.33	1.01	1.03
17.67	0.96	0.98

Continues on next page...

Hyd. No. 3

Main Ash Pond Runoff

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 17.00 ac
Basin Slope = 1.5 %
Tc method = LAG
Total precip. = 6.80 in
Storm duration = 24 hrs

Peak discharge = 84.07 cfs
Time interval = 4 min
Curve number = 85
Hydraulic length = 1250 ft
Time of conc. (Tc) = 26.3 min
Distribution = Type II
Shape factor = 484

Hydrograph Volume = 7.395 acft

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)
7.87	0.85
8.20	0.96
8.53	1.15
8.87	1.41
9.20	1.69
9.53	1.87
9.87	2.09
10.20	2.53
10.53	3.17
10.87	4.06
11.20	5.22
11.53	7.85
11.87	36.10
12.20	77.03
12.53	22.67
12.87	9.98
13.20	7.45
13.53	6.11
13.87	5.16
14.20	4.42
14.53	3.99
14.87	3.73
15.20	3.47
15.53	3.21
15.87	2.95
16.20	2.70
16.53	2.54
16.87	2.45
17.20	2.36
17.53	2.26
17.87	2.17
18.20	2.08
18.53	1.98
18.87	1.89
19.20	1.80
19.53	1.70
19.87	1.61
20.20	1.52
20.53	1.47
20.87	1.45
21.20	1.43
21.53	1.42
21.87	1.40
22.20	1.38
22.53	1.36
22.87	1.34
23.20	1.32
23.53	1.30
23.87	1.29
24.20	0.92

...End

Hyd. No. 4

Inflow to West Pond

Hydrograph type	= Combine	Peak discharge	= 129.44 cfs
Storm frequency	= 100 yrs	Time interval	= 4 min
Inflow hyds.	= 2, 3		

Hydrograph Volume = 10.983 acft

Hydrograph Discharge Table

Time (hrs)	Hyd. 2 + (cfs)	Hyd. 3 = (cfs)	Outflow (cfs)
7.67	0.61	0.79	1.41
8.00	0.66	0.89	1.56
8.33	0.73	1.03	1.76
8.67	0.87	1.25	2.12
9.00	1.01	1.52	2.53
9.33	1.14	1.77	2.91
9.67	1.19	1.93	3.12
10.00	1.36	2.24	3.60
10.33	1.63	2.76	4.40
10.67	2.00	3.48	5.48
11.00	2.54	4.52	7.06
11.33	3.26	6.01	9.27
11.67	5.73	11.94	17.67
12.00	37.84	68.97	106.81
12.33	18.78	54.03	72.81
12.67	6.29	13.25	19.54
13.00	3.89	8.68	12.57
13.33	3.03	6.84	9.87
13.67	2.52	5.70	8.22
14.00	2.14	4.84	6.98
14.33	1.86	4.21	6.07
14.67	1.72	3.88	5.61
15.00	1.61	3.62	5.23
15.33	1.49	3.36	4.85
15.67	1.37	3.10	4.48
16.00	1.26	2.84	4.10
16.33	1.16	2.62	3.78
16.67	1.11	2.51	3.62
17.00	1.07	2.41	3.48
17.33	1.03	2.32	3.35
17.67	0.98	2.23	3.21
18.00	0.94	2.13	3.08
18.33	0.90	2.04	2.94
18.67	0.86	1.95	2.81
19.00	0.82	1.85	2.67
19.33	0.78	1.76	2.53
19.67	0.73	1.66	2.40
20.00	0.69	1.57	2.26

Continues on next page...

Hyd. No. 5

Through Western Pond

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Inflow hyd. No. = 4
Max. Elevation = 533.19 ft

Peak discharge = 18.04 cfs
Time interval = 4 min
Reservoir name = Western Pond
Max. Storage = 4.812 acft

Storage Indication method used.

Outflow hydrograph volume = 14.666 acft

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.33	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
0.67	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
1.00	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
1.33	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
1.67	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
2.00	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
2.33	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
2.67	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
3.00	0.02	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
3.33	0.05	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
3.67	0.09	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
4.00	0.13	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
4.33	0.16	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
4.67	0.23	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
5.00	0.33	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
5.33	0.45	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
5.67	0.57	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
6.00	0.70	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.61
6.33	0.84	531.31	0.33	0.33	-----	-----	-----	-----	-----	-----	-----	0.66
6.67	0.97	531.32	0.36	0.36	-----	-----	-----	-----	-----	-----	-----	0.73
7.00	1.11	531.33	0.41	0.41	-----	-----	-----	-----	-----	-----	-----	0.82
7.33	1.26	531.35	0.47	0.47	-----	-----	-----	-----	-----	-----	-----	0.93
7.67	1.41	531.36	0.52	0.52	-----	-----	-----	-----	-----	-----	-----	1.05
8.00	1.56	531.38	0.60	0.60	-----	-----	-----	-----	-----	-----	-----	1.20
8.33	1.76	531.40	0.68	0.68	-----	-----	-----	-----	-----	-----	-----	1.36
8.67	2.12	531.42	0.78	0.78	-----	-----	-----	-----	-----	-----	-----	1.57
9.00	2.53	531.45	0.93	0.93	-----	-----	-----	-----	-----	-----	-----	1.85
9.33	2.91	531.49	1.10	1.10	-----	-----	-----	-----	-----	-----	-----	2.20
9.67	3.12	531.52	1.27	1.27	-----	-----	-----	-----	-----	-----	-----	2.53
10.00	3.60	531.55	1.43	1.43	-----	-----	-----	-----	-----	-----	-----	2.87
10.33	4.40	531.60	1.68	1.68	-----	-----	-----	-----	-----	-----	-----	3.36
10.67	5.48	531.66	2.03	2.03	-----	-----	-----	-----	-----	-----	-----	4.07
11.00	7.06	531.74	2.54	2.54	-----	-----	-----	-----	-----	-----	-----	5.08
11.33	9.27	531.85	3.23	3.23	-----	-----	-----	-----	-----	-----	-----	6.47
11.67	17.67	532.02	4.24	4.24	-----	-----	-----	-----	-----	-----	-----	8.49
12.00	106.81	532.40	6.24	6.24	-----	-----	-----	-----	-----	-----	-----	12.48
12.33	72.81	533.11	8.71	8.71	-----	-----	-----	-----	-----	-----	-----	17.41
12.67	19.54	533.19	9.02	9.02	-----	-----	-----	-----	-----	-----	-----	18.04

Continues on next page...

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
13.00	12.57	533.18	8.98	8.98	-----	-----	-----	-----	-----	-----	-----	17.96
13.33	9.87	533.16	8.89	8.89	-----	-----	-----	-----	-----	-----	-----	17.77
13.67	8.22	533.13	8.77	8.77	-----	-----	-----	-----	-----	-----	-----	17.53
14.00	6.98	533.09	8.63	8.63	-----	-----	-----	-----	-----	-----	-----	17.25
14.33	6.07	533.05	8.47	8.47	-----	-----	-----	-----	-----	-----	-----	16.94
14.67	5.61	533.01	8.31	8.31	-----	-----	-----	-----	-----	-----	-----	16.62
15.00	5.23	532.93	7.96	7.96	-----	-----	-----	-----	-----	-----	-----	15.92
15.33	4.85	532.83	7.53	7.53	-----	-----	-----	-----	-----	-----	-----	15.07
15.67	4.48	532.74	7.10	7.10	-----	-----	-----	-----	-----	-----	-----	14.20
16.00	4.10	532.65	6.67	6.67	-----	-----	-----	-----	-----	-----	-----	13.34
16.33	3.78	532.47	6.45	6.45	-----	-----	-----	-----	-----	-----	-----	12.90
16.67	3.62	532.48	6.47	6.47	-----	-----	-----	-----	-----	-----	-----	12.94
17.00	3.48	532.40	6.23	6.23	-----	-----	-----	-----	-----	-----	-----	12.46
17.33	3.35	532.32	5.90	5.90	-----	-----	-----	-----	-----	-----	-----	11.79
17.67	3.21	532.24	5.53	5.53	-----	-----	-----	-----	-----	-----	-----	11.06
18.00	3.08	532.17	5.16	5.16	-----	-----	-----	-----	-----	-----	-----	10.31
18.33	2.94	532.11	4.79	4.79	-----	-----	-----	-----	-----	-----	-----	9.58
18.67	2.81	532.05	4.44	4.44	-----	-----	-----	-----	-----	-----	-----	8.87
19.00	2.67	531.97	3.94	3.94	-----	-----	-----	-----	-----	-----	-----	7.87
19.33	2.53	531.77	2.70	2.70	-----	-----	-----	-----	-----	-----	-----	5.41
19.67	2.40	531.66	2.03	2.03	-----	-----	-----	-----	-----	-----	-----	4.06
20.00	2.26	531.59	1.65	1.65	-----	-----	-----	-----	-----	-----	-----	3.30
20.33	2.15	531.55	1.42	1.42	-----	-----	-----	-----	-----	-----	-----	2.83
20.67	2.11	531.52	1.27	1.27	-----	-----	-----	-----	-----	-----	-----	2.54
21.00	2.08	531.51	1.18	1.18	-----	-----	-----	-----	-----	-----	-----	2.36
21.33	2.06	531.49	1.12	1.12	-----	-----	-----	-----	-----	-----	-----	2.25
21.67	2.03	531.49	1.08	1.08	-----	-----	-----	-----	-----	-----	-----	2.17
22.00	2.00	531.48	1.05	1.05	-----	-----	-----	-----	-----	-----	-----	2.11
22.33	1.98	531.48	1.03	1.03	-----	-----	-----	-----	-----	-----	-----	2.06
22.67	1.95	531.47	1.01	1.01	-----	-----	-----	-----	-----	-----	-----	2.02
23.00	1.92	531.47	0.99	0.99	-----	-----	-----	-----	-----	-----	-----	1.99
23.33	1.90	531.47	0.98	0.98	-----	-----	-----	-----	-----	-----	-----	1.96
23.67	1.87	531.46	0.96	0.96	-----	-----	-----	-----	-----	-----	-----	1.93
24.00	1.84	531.46	0.95	0.95	-----	-----	-----	-----	-----	-----	-----	1.90
24.33	0.64	531.44	0.84	0.84	-----	-----	-----	-----	-----	-----	-----	1.68
24.67	0.00	531.38	0.58	0.58	-----	-----	-----	-----	-----	-----	-----	1.16
25.00	0.00	531.33	0.40	0.40	-----	-----	-----	-----	-----	-----	-----	0.81
25.33	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
25.67	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
26.00	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
26.33	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
26.67	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
27.00	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
27.33	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
27.67	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
28.00	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
28.33	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
28.67	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
29.00	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
29.33	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59
29.67	0.00	531.30	0.30	0.30	-----	-----	-----	-----	-----	-----	-----	0.59

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Hydraflow Hydrographs by Intelisolve

Reservoir No. 1 - Western Pond

Pond Data

Pond storage is based on known contour areas. Average end area method used.

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	531.30	24,000	0.000	0.000
0.70	532.00	24,000	0.386	0.386
1.70	533.00	235,000	2.973	3.359
2.70	534.00	427,000	7.599	10.957

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise in	= 18.0	18.0	0.0	0.0
Span in	= 18.0	18.0	0.0	0.0
No. Barrels	= 1	1	0	0
Invert El. ft	= 531.10	531.10	0.00	0.00
Length ft	= 60.0	60.0	0.0	0.0
Slope %	= 1.00	1.00	0.00	0.00
N-Value	= .015	.015	.000	.000
Orif. Coeff.	= 0.86	0.86	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len ft	= 0.00	0.00	0.00	0.00
Crest El. ft	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	0.00	0.00	0.00
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration Rate = 0.00 in/hr/sqft Tailwater Elev. = 0.00 ft

---

Note: All outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0.000	531.30	0.31	0.31	---	---	---	---	---	---	---	0.61
0.70	0.386	532.00	4.15	4.15	---	---	---	---	---	---	---	8.30
1.70	3.359	533.00	8.27	8.27	---	---	---	---	---	---	---	16.53
2.70	10.957	534.00	11.69	11.69	---	---	---	---	---	---	---	23.38

Hyd. No. 6

Economizer Pond Runoff

Hydrograph type = SCS Runoff
Storm frequency = 100 yrs
Drainage area = 25.00 ac
Basin Slope = 1.0 %
Tc method = LAG
Total precip. = 6.80 in
Storm duration = 24 hrs

Peak discharge = 192.20 cfs
Time interval = 4 min
Curve number = 100
Hydraulic length = 500 ft
Time of conc. (Tc) = 7.6 min
Distribution = Type II
Shape factor = 484

Hydrograph Volume = 13.281 acft

Hydrograph Discharge Table

Time -- (hrs	Outflow cfs)
2.13	1.93
2.47	1.98
2.80	2.04
3.13	2.09
3.47	2.14
3.80	2.20
4.13	2.26
4.47	2.36
4.80	2.47
5.13	2.57
5.47	2.68
5.80	2.79
6.13	2.90
6.47	3.00
6.80	3.11
7.13	3.22
7.47	3.32
7.80	3.43
8.13	3.58
8.47	4.09
8.80	4.62
9.13	5.11
9.47	5.14
9.80	5.60
10.13	6.50
10.47	7.76
10.80	9.50
11.13	10.98
11.47	16.88
11.80	89.43
12.13	80.81
12.47	19.68
12.80	12.50
13.13	9.84
13.47	8.25
13.80	6.98
14.13	5.98
14.47	5.56
14.80	5.18
15.13	4.81
15.47	4.43
15.80	4.06
16.13	3.71
16.47	3.56
16.80	3.42
17.13	3.29
17.47	3.16
17.80	3.02
18.13	2.89
18.47	2.75
18.80	2.62
19.13	2.49
19.47	2.35
19.80	2.22
20.13	2.10
20.47	2.06
20.80	2.03
21.13	2.01
21.47	1.98
21.80	1.95
22.13	1.93

...End

Hyd. No. 7

Upper Ash Pond Inflow

Hydrograph type = Combine
Storm frequency = 100 yrs
Inflow hyds. = 5, 6

Peak discharge = 204.68 cfs
Time interval = 4 min

Hydrograph Volume = 27.947 acft

Hydrograph Discharge Table

Time (hrs)	Hyd. 5 + (cfs)	Hyd. 6 = (cfs)	Outflow (cfs)
0.33	0.59	1.64	2.23
0.67	0.59	1.69	2.29
1.00	0.59	1.75	2.34
1.33	0.59	1.80	2.39
1.67	0.59	1.86	2.45
2.00	0.59	1.91	2.50
2.33	0.59	1.96	2.55
2.67	0.59	2.02	2.61
3.00	0.59	2.07	2.66
3.33	0.59	2.12	2.71
3.67	0.59	2.18	2.77
4.00	0.59	2.23	2.82
4.33	0.59	2.32	2.91
4.67	0.59	2.42	3.02
5.00	0.59	2.53	3.12
5.33	0.59	2.64	3.23
5.67	0.59	2.75	3.34
6.00	0.61	2.85	3.46
6.33	0.66	2.96	3.62
6.67	0.73	3.07	3.80
7.00	0.82	3.17	4.00
7.33	0.93	3.28	4.21
7.67	1.05	3.39	4.44
8.00	1.20	3.50	4.69
8.33	1.36	3.87	5.23
8.67	1.57	4.41	5.98
9.00	1.85	4.95	6.80
9.33	2.20	5.14	7.34
9.67	2.53	5.29	7.82
10.00	2.87	6.11	8.98
10.33	3.36	7.24	10.60
10.67	4.07	8.67	12.74
11.00	5.08	10.79	15.87
11.33	6.47	14.83	21.30
11.67	8.49	40.89	49.38
12.00	12.48	192.20 <<	204.68 <<
12.33	17.41	24.57	41.98
12.67	18.04	13.92	31.96

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Hydrograph Discharge Table

Time (hrs)	Hyd. 5 + (cfs)	Hyd. 6 = (cfs)	Outflow (cfs)
13.00	17.96	10.82	28.79
13.33	17.77	8.85	26.63
13.67	17.53	7.42	24.96
14.00	17.25	6.34	23.59
14.33	16.94	5.71	22.65
14.67	16.62	5.33	21.96
15.00	15.92	4.96	20.88
15.33	15.07	4.58	19.65
15.67	14.20	4.21	18.41
16.00	13.34	3.83	17.18
16.33	12.90	3.61	16.51
16.67	12.94	3.48	16.42
17.00	12.46	3.34	15.81
17.33	11.79	3.21	15.00
17.67	11.06	3.08	14.13
18.00	10.31	2.94	13.26
18.33	9.58	2.81	12.39
18.67	8.87	2.67	11.55
19.00	7.87	2.54	10.41
19.33	5.41	2.41	7.81
19.67	4.06	2.27	6.33
20.00	3.30	2.14	5.43
20.33	2.83	2.07	4.91
20.67	2.54	2.05	4.59
21.00	2.36	2.02	4.38
21.33	2.25	1.99	4.24
21.67	2.17	1.97	4.13
22.00	2.11	1.94	4.05
22.33	2.06	1.91	3.97
22.67	2.02	1.88	3.91
23.00	1.99	1.86	3.85
23.33	1.96	1.83	3.79
23.67	1.93	1.80	3.73
24.00	1.90	1.78	3.68

...End

Hydrograph Report

Hyd. No. 8

Through UPPER Ash Pond

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Inflow hyd. No. = 7
Max. Elevation = 530.31 ft

Peak discharge = 6.95 cfs
Time interval = 4 min
Reservoir name = Upper Ash Pond
Max. Storage = 16.096 acft

Storage Indication method used.

Outflow hydrograph volume = 32.071 acft

Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
0.33	2.23	529.10	2.52	-----	-----	-----	-----	-----	-----	-----	-----	2.52
0.67	2.29	529.10	2.52	-----	-----	-----	-----	-----	-----	-----	-----	2.52
1.00	2.34	529.10	2.52	-----	-----	-----	-----	-----	-----	-----	-----	2.52
1.33	2.39	529.10	2.52	-----	-----	-----	-----	-----	-----	-----	-----	2.52
1.67	2.45	529.10	2.52	-----	-----	-----	-----	-----	-----	-----	-----	2.52
2.00	2.50	529.10	2.52	-----	-----	-----	-----	-----	-----	-----	-----	2.52
2.33	2.55	529.10	2.52	-----	-----	-----	-----	-----	-----	-----	-----	2.52
2.67	2.61	529.10	2.53	-----	-----	-----	-----	-----	-----	-----	-----	2.52
3.00	2.66	529.10	2.53	-----	-----	-----	-----	-----	-----	-----	-----	2.53
3.33	2.71	529.10	2.53	-----	-----	-----	-----	-----	-----	-----	-----	2.53
3.67	2.77	529.10	2.53	-----	-----	-----	-----	-----	-----	-----	-----	2.53
4.00	2.82	529.10	2.53	-----	-----	-----	-----	-----	-----	-----	-----	2.53
4.33	2.91	529.10	2.54	-----	-----	-----	-----	-----	-----	-----	-----	2.54
4.67	3.02	529.10	2.54	-----	-----	-----	-----	-----	-----	-----	-----	2.54
5.00	3.12	529.10	2.55	-----	-----	-----	-----	-----	-----	-----	-----	2.55
5.33	3.23	529.11	2.55	-----	-----	-----	-----	-----	-----	-----	-----	2.55
5.67	3.34	529.11	2.56	-----	-----	-----	-----	-----	-----	-----	-----	2.56
6.00	3.46	529.11	2.57	-----	-----	-----	-----	-----	-----	-----	-----	2.57
6.33	3.62	529.11	2.58	-----	-----	-----	-----	-----	-----	-----	-----	2.58
6.67	3.80	529.11	2.59	-----	-----	-----	-----	-----	-----	-----	-----	2.59
7.00	4.00	529.12	2.61	-----	-----	-----	-----	-----	-----	-----	-----	2.61
7.33	4.21	529.12	2.62	-----	-----	-----	-----	-----	-----	-----	-----	2.62
7.67	4.44	529.12	2.64	-----	-----	-----	-----	-----	-----	-----	-----	2.64
8.00	4.69	529.13	2.66	-----	-----	-----	-----	-----	-----	-----	-----	2.66
8.33	5.23	529.13	2.69	-----	-----	-----	-----	-----	-----	-----	-----	2.69
8.67	5.98	529.14	2.72	-----	-----	-----	-----	-----	-----	-----	-----	2.72
9.00	6.80	529.14	2.76	-----	-----	-----	-----	-----	-----	-----	-----	2.76
9.33	7.34	529.15	2.81	-----	-----	-----	-----	-----	-----	-----	-----	2.81
9.67	7.82	529.16	2.86	-----	-----	-----	-----	-----	-----	-----	-----	2.86
10.00	8.98	529.17	2.92	-----	-----	-----	-----	-----	-----	-----	-----	2.92
10.33	10.60	529.19	3.00	-----	-----	-----	-----	-----	-----	-----	-----	3.00
10.67	12.74	529.21	3.09	-----	-----	-----	-----	-----	-----	-----	-----	3.09
11.00	15.87	529.23	3.21	-----	-----	-----	-----	-----	-----	-----	-----	3.21
11.33	21.30	529.26	3.37	-----	-----	-----	-----	-----	-----	-----	-----	3.37
11.67	49.38	529.31	3.64	-----	-----	-----	-----	-----	-----	-----	-----	3.64
12.00	204.68 <<	529.56	4.72	-----	-----	-----	-----	-----	-----	-----	-----	4.72
12.33	41.98	529.75	5.36	-----	-----	-----	-----	-----	-----	-----	-----	5.36
12.67	31.96	529.81	5.56	-----	-----	-----	-----	-----	-----	-----	-----	5.56

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Hydrograph Discharge Table

Time (hrs)	Inflow cfs	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Outflow cfs
13.00	28.79	529.86	5.72	-----	-----	-----	-----	-----	-----	-----	-----	5.72
13.33	26.63	529.91	5.86	-----	-----	-----	-----	-----	-----	-----	-----	5.86
13.67	24.96	529.95	5.98	-----	-----	-----	-----	-----	-----	-----	-----	5.98
14.00	23.59	529.99	6.09	-----	-----	-----	-----	-----	-----	-----	-----	6.09
14.33	22.65	530.02	6.19	-----	-----	-----	-----	-----	-----	-----	-----	6.19
14.67	21.96	530.06	6.28	-----	-----	-----	-----	-----	-----	-----	-----	6.28
15.00	20.88	530.09	6.37	-----	-----	-----	-----	-----	-----	-----	-----	6.37
15.33	19.65	530.12	6.45	-----	-----	-----	-----	-----	-----	-----	-----	6.45
15.67	18.41	530.14	6.52	-----	-----	-----	-----	-----	-----	-----	-----	6.52
16.00	17.18	530.17	6.58	-----	-----	-----	-----	-----	-----	-----	-----	6.58
16.33	16.51	530.19	6.63	-----	-----	-----	-----	-----	-----	-----	-----	6.63
16.67	16.42	530.21	6.69	-----	-----	-----	-----	-----	-----	-----	-----	6.69
17.00	15.81	530.23	6.74	-----	-----	-----	-----	-----	-----	-----	-----	6.74
17.33	15.00	530.24	6.78	-----	-----	-----	-----	-----	-----	-----	-----	6.78
17.67	14.13	530.26	6.82	-----	-----	-----	-----	-----	-----	-----	-----	6.82
18.00	13.26	530.27	6.86	-----	-----	-----	-----	-----	-----	-----	-----	6.86
18.33	12.39	530.29	6.89	-----	-----	-----	-----	-----	-----	-----	-----	6.89
18.67	11.55	530.30	6.92	-----	-----	-----	-----	-----	-----	-----	-----	6.92
19.00	10.41	530.31	6.94	-----	-----	-----	-----	-----	-----	-----	-----	6.94
19.33	7.81	530.31	6.95	-----	-----	-----	-----	-----	-----	-----	-----	6.95
19.67	6.33	530.31	6.95	-----	-----	-----	-----	-----	-----	-----	-----	6.95
20.00	5.43	530.31	6.95	-----	-----	-----	-----	-----	-----	-----	-----	6.95
20.33	4.91	530.30	6.94	-----	-----	-----	-----	-----	-----	-----	-----	6.94
20.67	4.59	530.30	6.93	-----	-----	-----	-----	-----	-----	-----	-----	6.93
21.00	4.38	530.29	6.91	-----	-----	-----	-----	-----	-----	-----	-----	6.91
21.33	4.24	530.29	6.90	-----	-----	-----	-----	-----	-----	-----	-----	6.90
21.67	4.13	530.28	6.88	-----	-----	-----	-----	-----	-----	-----	-----	6.88
22.00	4.05	530.28	6.87	-----	-----	-----	-----	-----	-----	-----	-----	6.87
22.33	3.97	530.27	6.85	-----	-----	-----	-----	-----	-----	-----	-----	6.85
22.67	3.91	530.27	6.84	-----	-----	-----	-----	-----	-----	-----	-----	6.84
23.00	3.85	530.26	6.82	-----	-----	-----	-----	-----	-----	-----	-----	6.82
23.33	3.79	530.25	6.81	-----	-----	-----	-----	-----	-----	-----	-----	6.81
23.67	3.73	530.25	6.79	-----	-----	-----	-----	-----	-----	-----	-----	6.79
24.00	3.68	530.24	6.78	-----	-----	-----	-----	-----	-----	-----	-----	6.78
24.33	1.68	530.23	6.75	-----	-----	-----	-----	-----	-----	-----	-----	6.75
24.67	1.16	530.22	6.72	-----	-----	-----	-----	-----	-----	-----	-----	6.72
25.00	0.81	530.21	6.69	-----	-----	-----	-----	-----	-----	-----	-----	6.69
25.33	0.59	530.20	6.66	-----	-----	-----	-----	-----	-----	-----	-----	6.66
25.67	0.59	530.18	6.63	-----	-----	-----	-----	-----	-----	-----	-----	6.63
26.00	0.59	530.17	6.59	-----	-----	-----	-----	-----	-----	-----	-----	6.59
26.33	0.59	530.16	6.56	-----	-----	-----	-----	-----	-----	-----	-----	6.56
26.67	0.59	530.15	6.53	-----	-----	-----	-----	-----	-----	-----	-----	6.53
27.00	0.59	530.13	6.50	-----	-----	-----	-----	-----	-----	-----	-----	6.50
27.33	0.59	530.12	6.46	-----	-----	-----	-----	-----	-----	-----	-----	6.46
27.67	0.59	530.11	6.43	-----	-----	-----	-----	-----	-----	-----	-----	6.43
28.00	0.59	530.10	6.40	-----	-----	-----	-----	-----	-----	-----	-----	6.40
28.33	0.59	530.09	6.37	-----	-----	-----	-----	-----	-----	-----	-----	6.37
28.67	0.59	530.07	6.33	-----	-----	-----	-----	-----	-----	-----	-----	6.33
29.00	0.59	530.06	6.30	-----	-----	-----	-----	-----	-----	-----	-----	6.30
29.33	0.59	530.05	6.27	-----	-----	-----	-----	-----	-----	-----	-----	6.27
29.67	0.59	530.04	6.23	-----	-----	-----	-----	-----	-----	-----	-----	6.23

Continues on next page...

Reservoir No. 2 - Upper Ash Pond

Pond Data

Pond storage is based on known values

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	529.10	00	0.000	0.000
1.00	530.10	00	13.300	13.300
2.00	531.10	00	13.300	26.600
3.00	532.10	00	13.300	39.900

Culvert / Orifice Structures

	[A]	[B]	[C]	[D]
Rise in	= 15.0	0.0	0.0	0.0
Span in	= 15.0	0.0	0.0	0.0
No. Barrels	= 1	0	0	0
Invert El. ft	= 528.30	0.00	0.00	0.00
Length ft	= 11.0	0.0	0.0	0.0
Slope %	= 5.00	0.00	0.00	0.00
N-Value	= .009	.000	.000	.000
Orif. Coeff.	= 0.60	0.00	0.00	0.00
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len ft	= 0.00	0.00	0.00	0.00
Crest El. ft	= 0.00	0.00	0.00	0.00
Weir Coeff.	= 0.00	0.00	0.00	0.00
Weir Type	= ---	---	---	---
Multi-Stage	= No	No	No	No

Exfiltration Rate = 0.00 in/hr/sqft Tailwater Elev. = 0.00 ft

Note: All outflows have been analyzed under inlet and outlet control.

Stage / Storage / Discharge Table

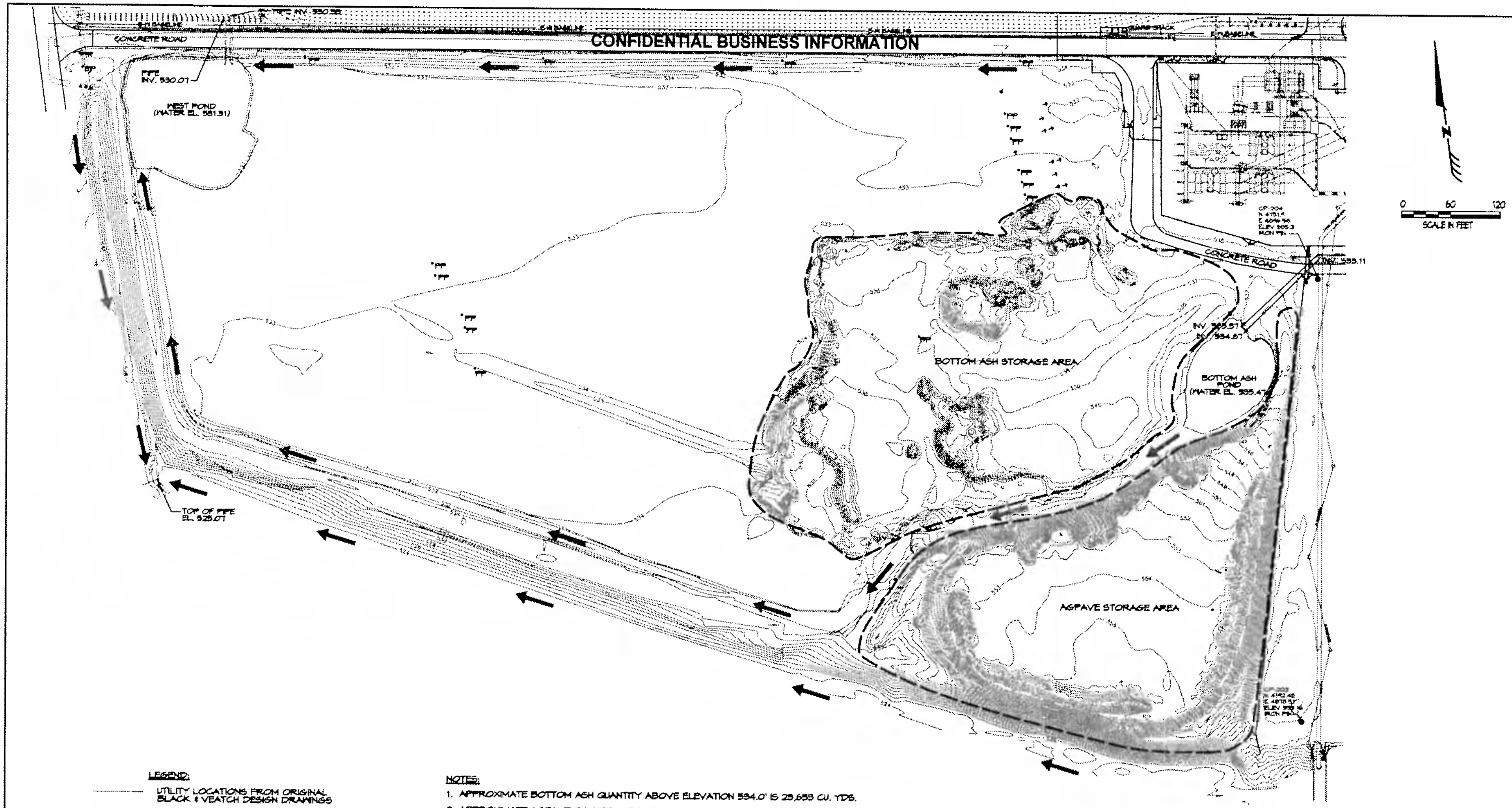
Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	Clv D cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	Total cfs
0.00	0.000	529.10	2.53	---	---	---	---	---	---	---	---	2.53
1.00	13.300	530.10	6.40	---	---	---	---	---	---	---	---	6.40
2.00	26.600	531.10	8.71	---	---	---	---	---	---	---	---	8.71
3.00	39.900	532.10	10.53	---	---	---	---	---	---	---	---	10.53

Attachment E

Existing Conditions - West Burlington Generating Station

Source:
Hard Hat Services, March 27, 2009

CONFIDENTIAL BUSINESS INFORMATION



LEGEND:

UTILITY LOCATIONS FROM ORIGINAL BLACK & VEATCH DESIGN DRAWINGS
SURVEYED UTILITY LOCATIONS
EDGE OF WATER
ESTIMATED CONTOURS SUPPLIED BY ALLIANT ENERGY
SURVEYED CONTOURS
GRAVEL ROAD
PP POWER POLE
● CONTROL POINT / MONUMENT
← OVERLAND FLOW DIRECTION

NOTES:

1. APPROXIMATE BOTTOM ASH QUANTITY ABOVE ELEVATION 534.0' IS 29,659 CU. YDS.
2. APPROXIMATE AGPAVE QUANTITY ABOVE ELEVATION 534.0' IS 80,493 CU. YDS.

EXISTING CONDITIONS - WEST

BURLINGTON GENERATING STATION
BURLINGTON, IOWA
PREPARED FOR
ALLIANT ENERGY

HARD HAT SERVICES™
Engineering, Construction and Management Solutions

DATE: 3-27-09 SCALE: AS SHOWN	SHEET 2	DRAWING NUMBER 154.002.D2

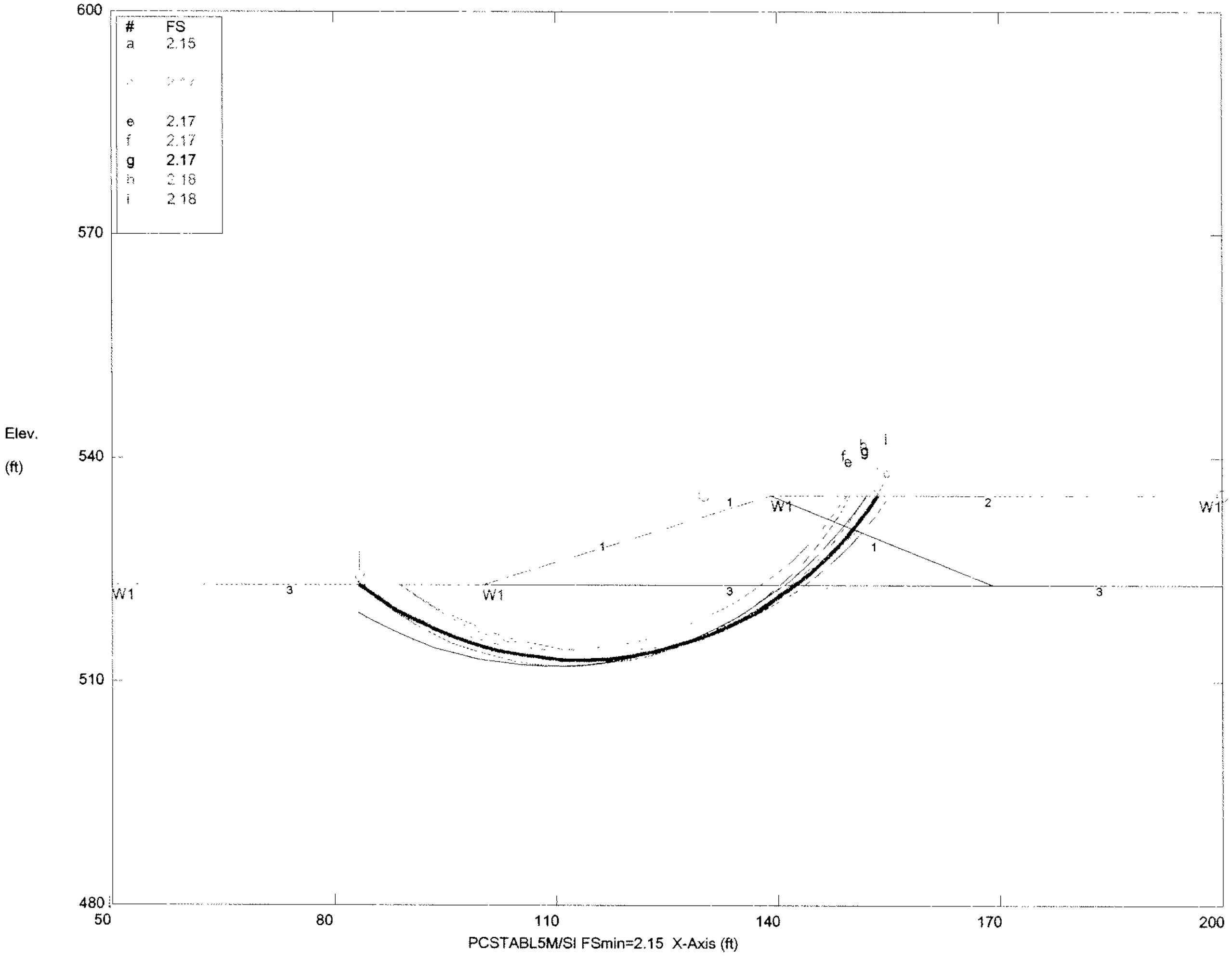
Attachment F

Static Slope Stability Analyses Results
Ten Most Critical Surfaces Per Analysis
Burlington Generating Station

Source:
Program PCSTABLE5M/SI output by Aether dbs, January 2011

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Main Ash Pond South Dike - Static Case
Ten Most Critical. C:BURL20C.PLT By: TCW 01-14-11 1:33pm

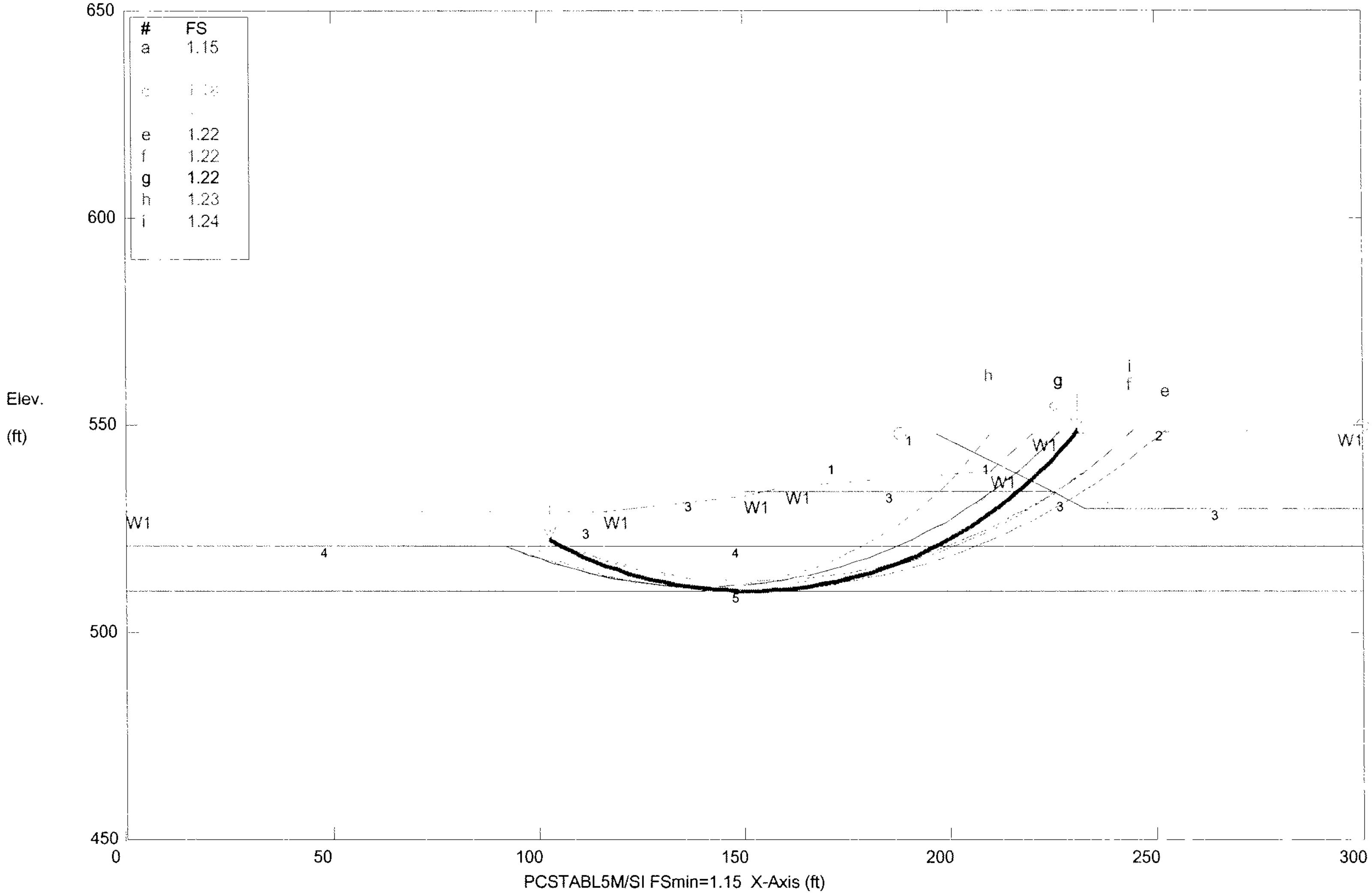


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	1000	0	0	0	W1
2	Ash	120	120	0	25	0	0	W1
3	Natural	120	120	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Economizer Pond North Ash Slope - Static Case

Ten Most Critical. C:BURL30C4.PLT By: TCW 01-17-11 1:38pm

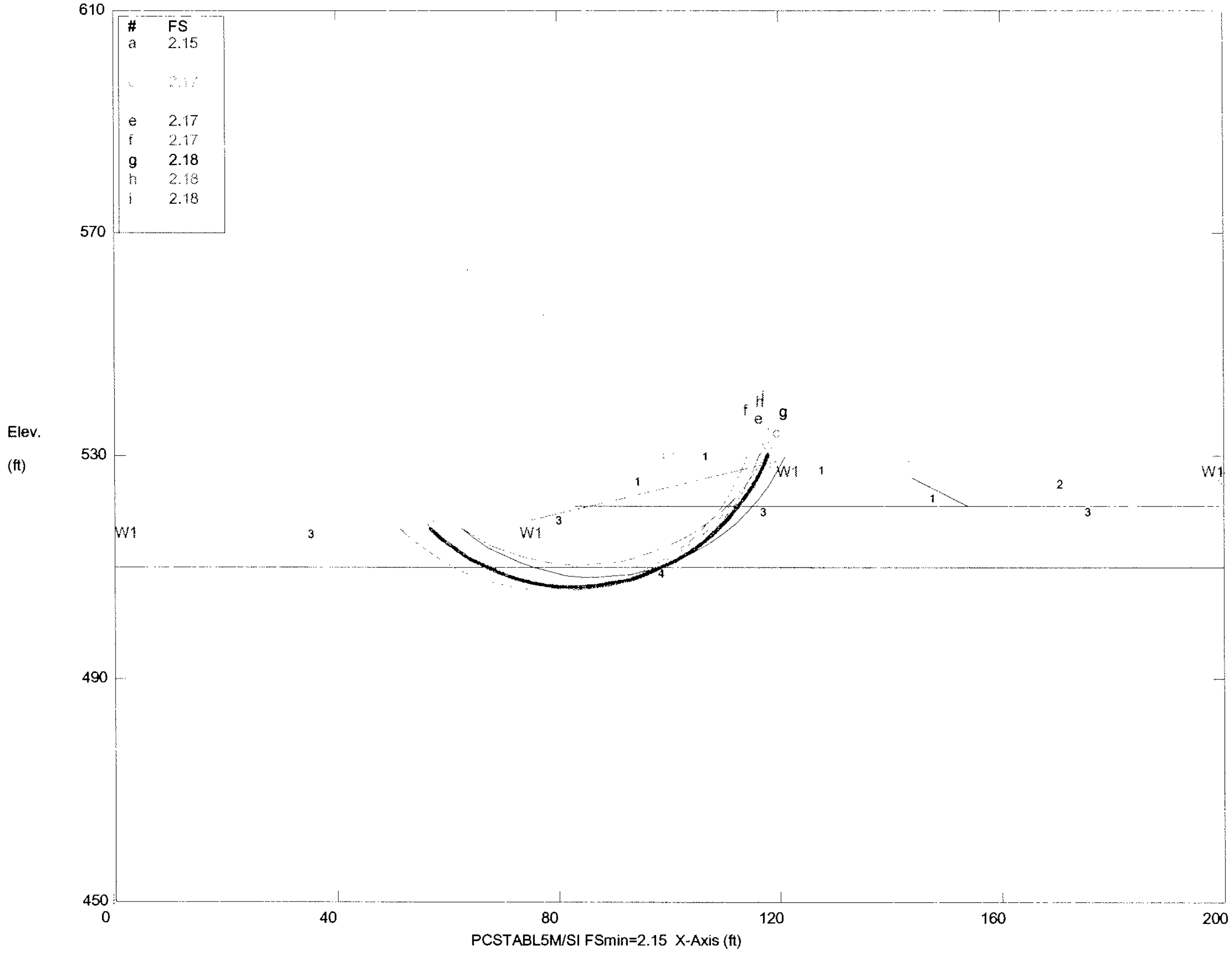


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	130	130	0	28	0	0	W1
2	Ash	120	120	0	25	0	0	W1
3	Clay	125	125	500	0	0	0	W1
4	Clay	125	125	500	0	0	0	W1
5	Sand	125	125	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Between the Ash Ponds North Dike Slope - Static Case

Ten Most Critical. E:BURL40C2.PLT By: Tom Wells 01-15-11 10:03am

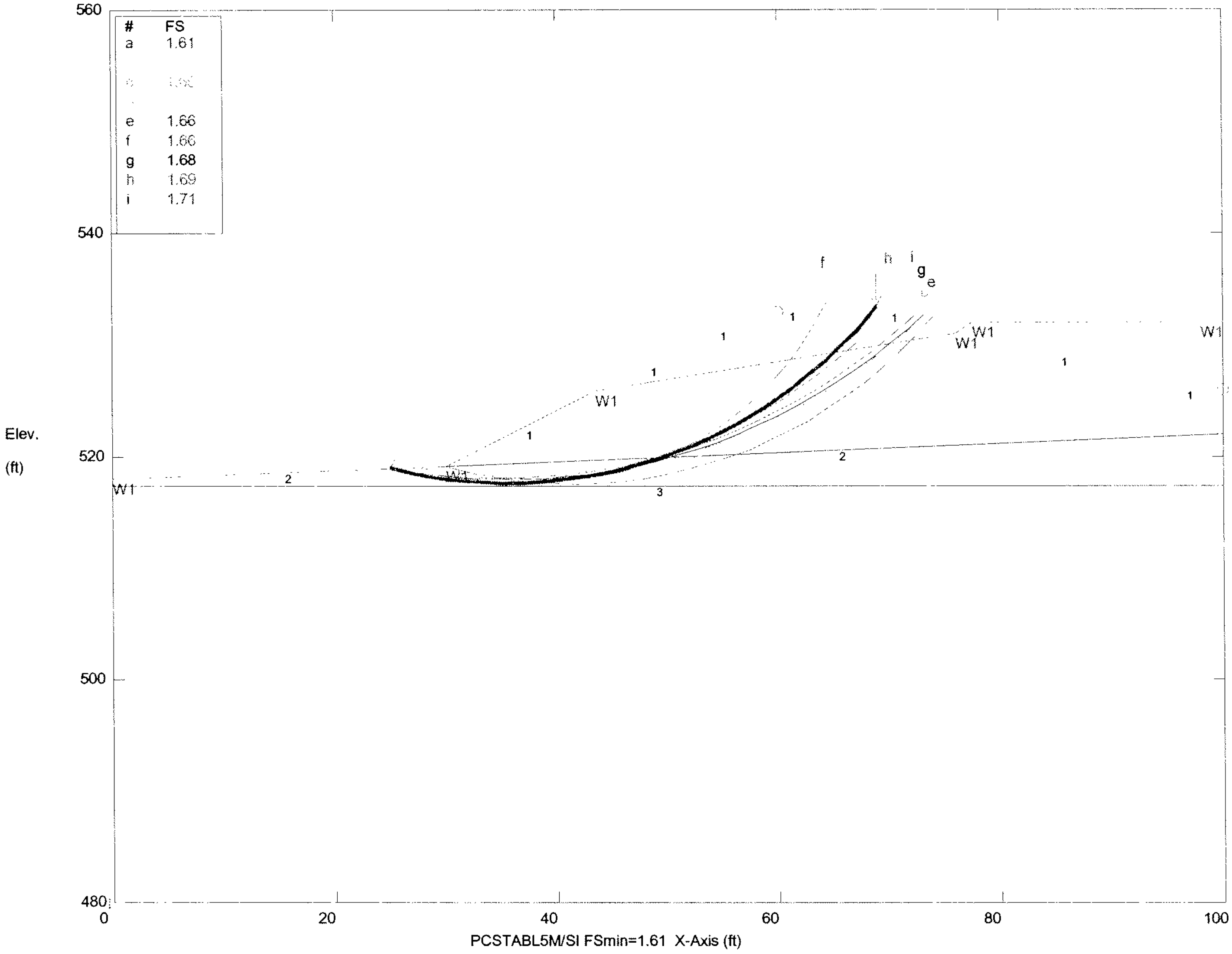


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	130	130	1000	0	0	0	W1
2	Ash	120	120	0	25	0	0	W1
3	Clay	125	125	500	0	0	0	W1
4	Sand	125	125	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Ash Seal Pond South Dike - Static Case

Ten Most Critical. C:BURL50C.PLT By: TCW 01-18-11 11:01am



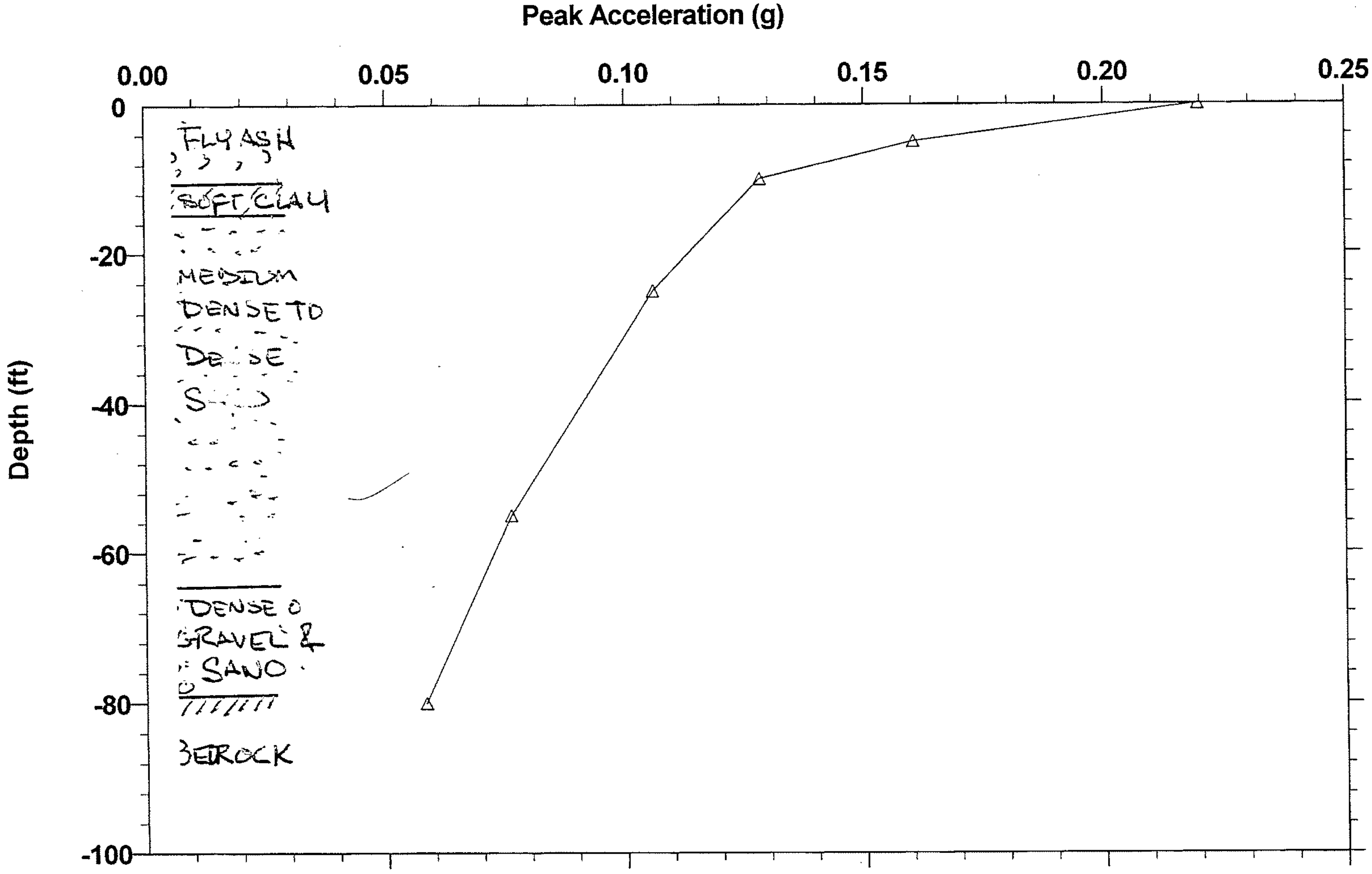
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	120	120	500	0	0	0	W1
2	Sand	130	130	0	30	0	0	W1
3	Clay	125	125	1250	0	0	0	W1

Attachment G

Earthquake Amplification Results

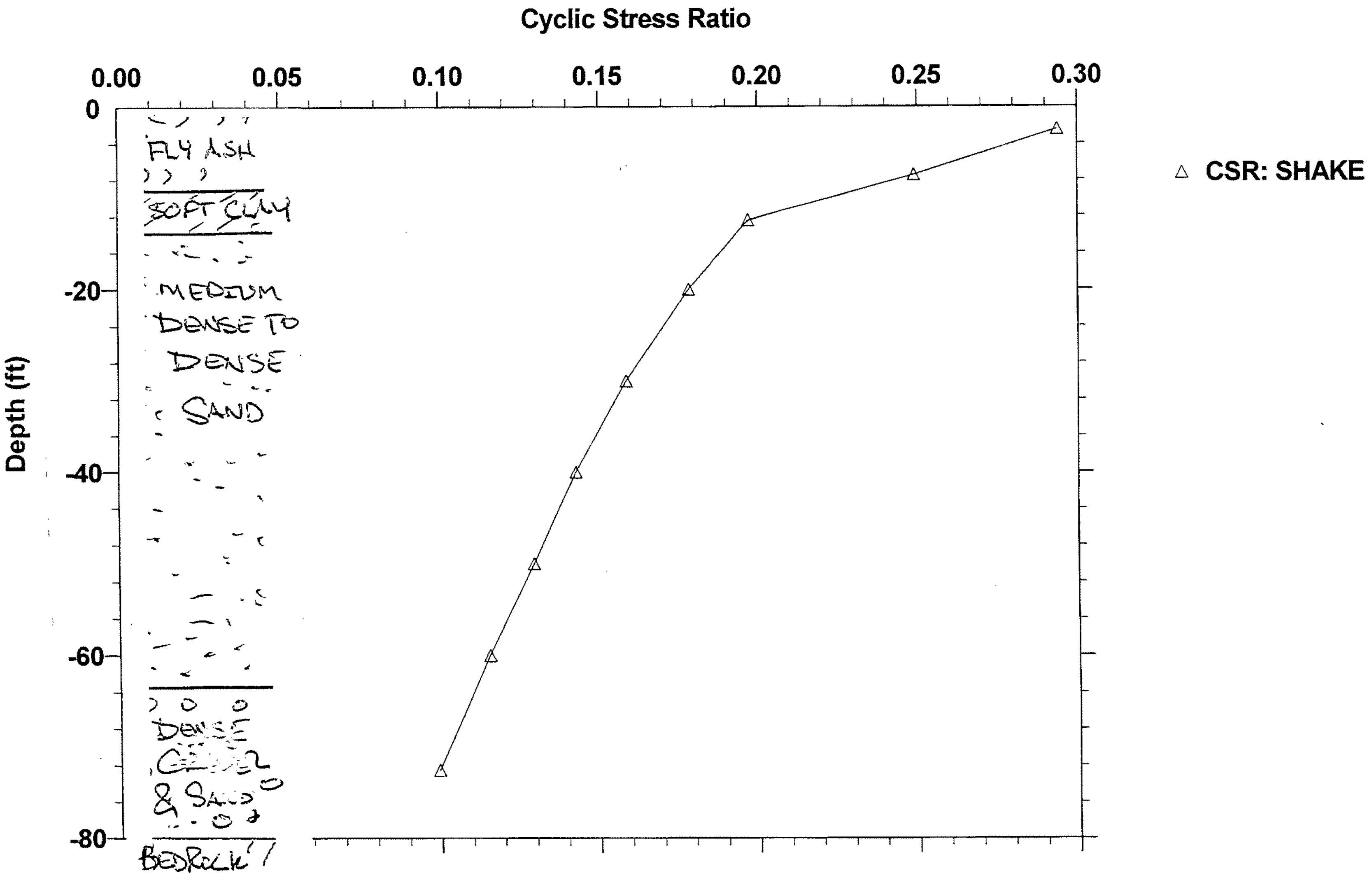
Source:
Program SHAKE 2000 output by Aether dbs, January 2011

CONFIDENTIAL BUSINESS INFORMATION



Acceleration with Depth (2500 year return 0.06 g bedrock acceleration)

CONFIDENTIAL BUSINESS INFORMATION



Cyclic Stress Ratio with Depth (2500 year return 0.06 g bedrock acceleration)

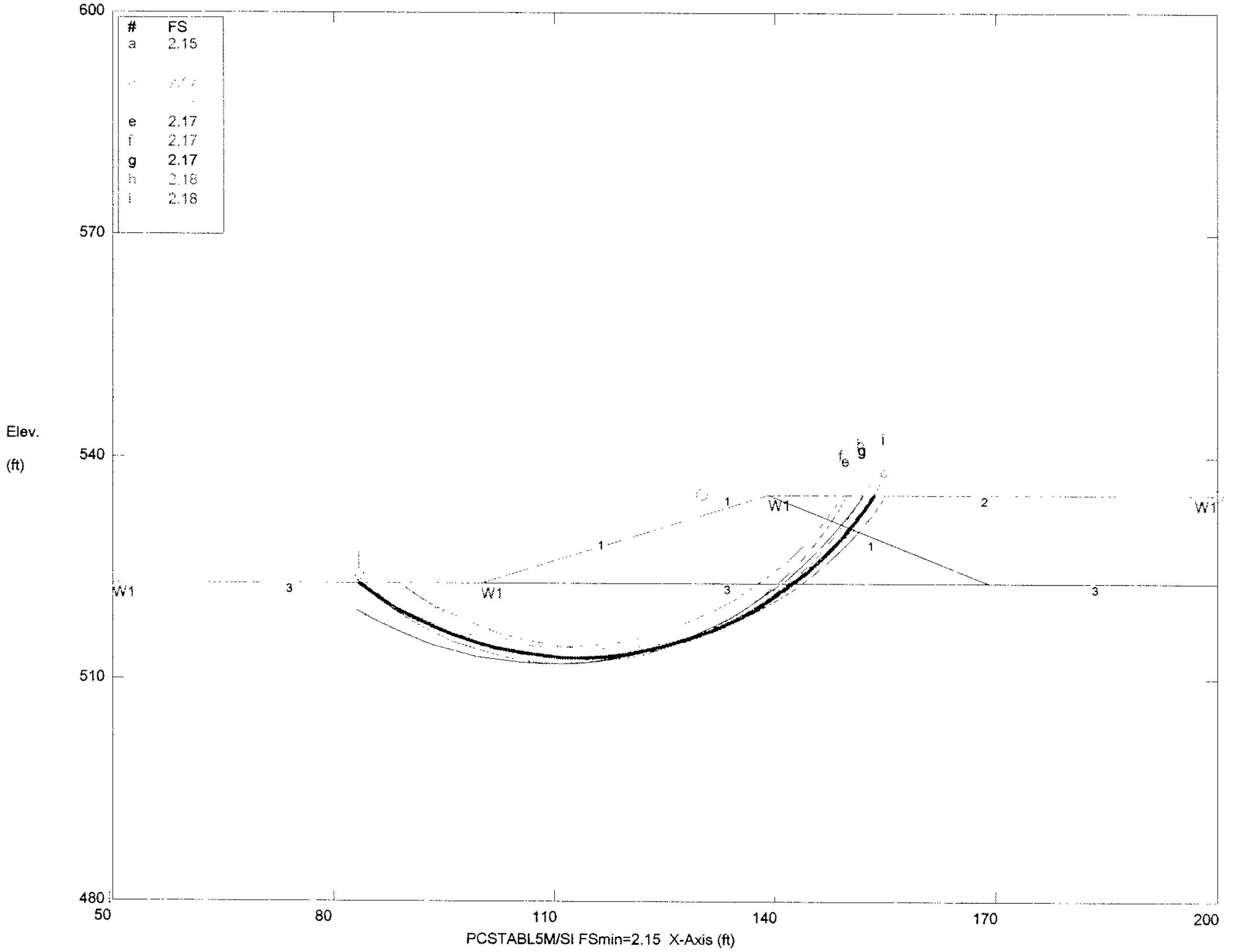
Attachment H

Earthquake Pseudo-Static Slope Stability Analyses Results
Ten Most Critical Surfaces Per Analysis
Burlington Generating Station

Source:
Program PCSTABLE5M/SI output by Aether dbs, January 2011

Alliant Burlington Main Ash Pond South Dike - Static Case

Ten Most Critical. C:BURL20C.PLT By: TCW 01-14-11 1:33pm

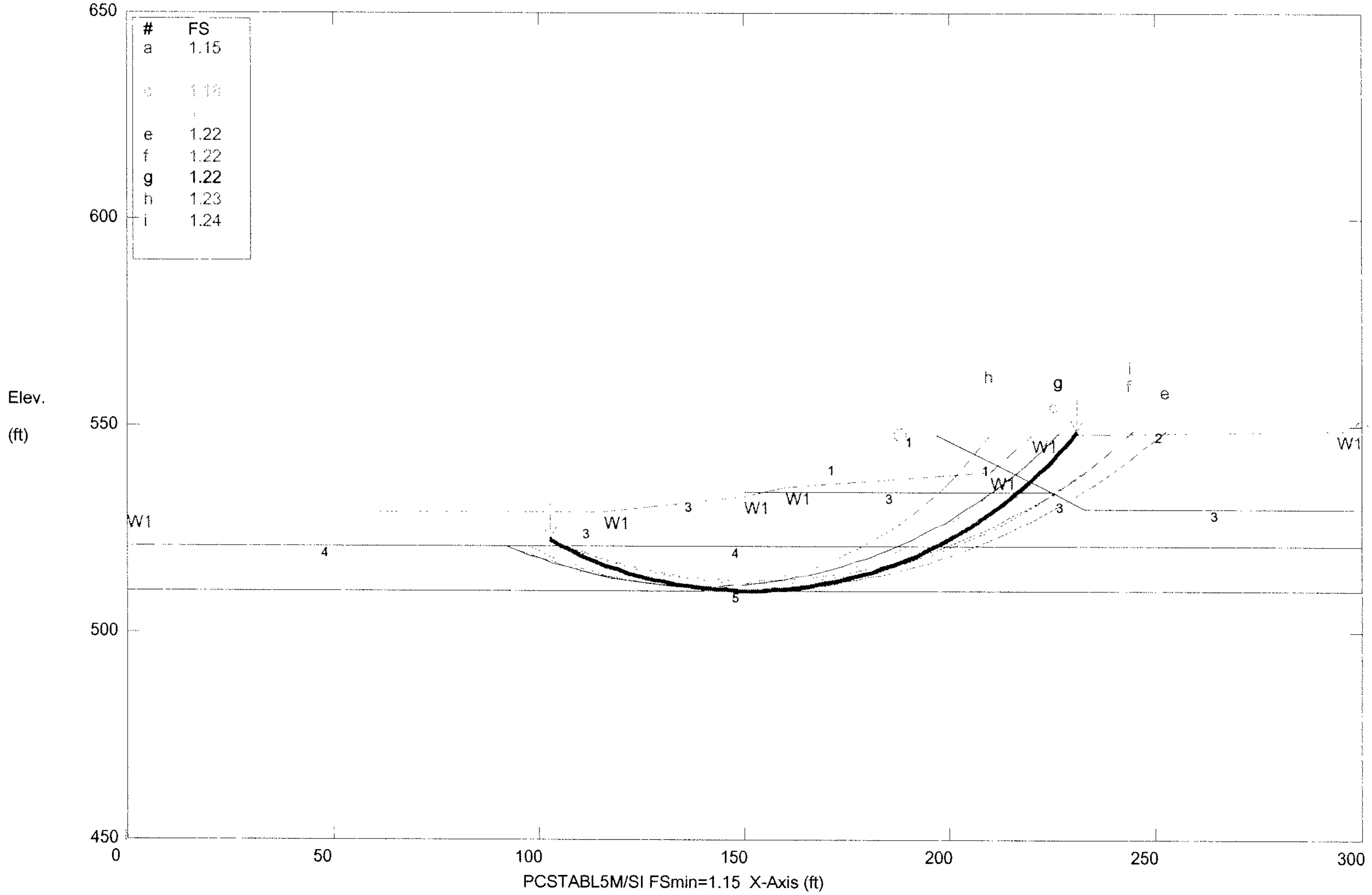


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	1000	0	0	0	W1
2	Ash	120	120	0	25	0	0	W1
3	Natural	120	120	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Economizer Pond North Ash Slope - Static Case

Ten Most Critical. C:BURL30C4.PLT By: TCW 01-17-11 1:38pm

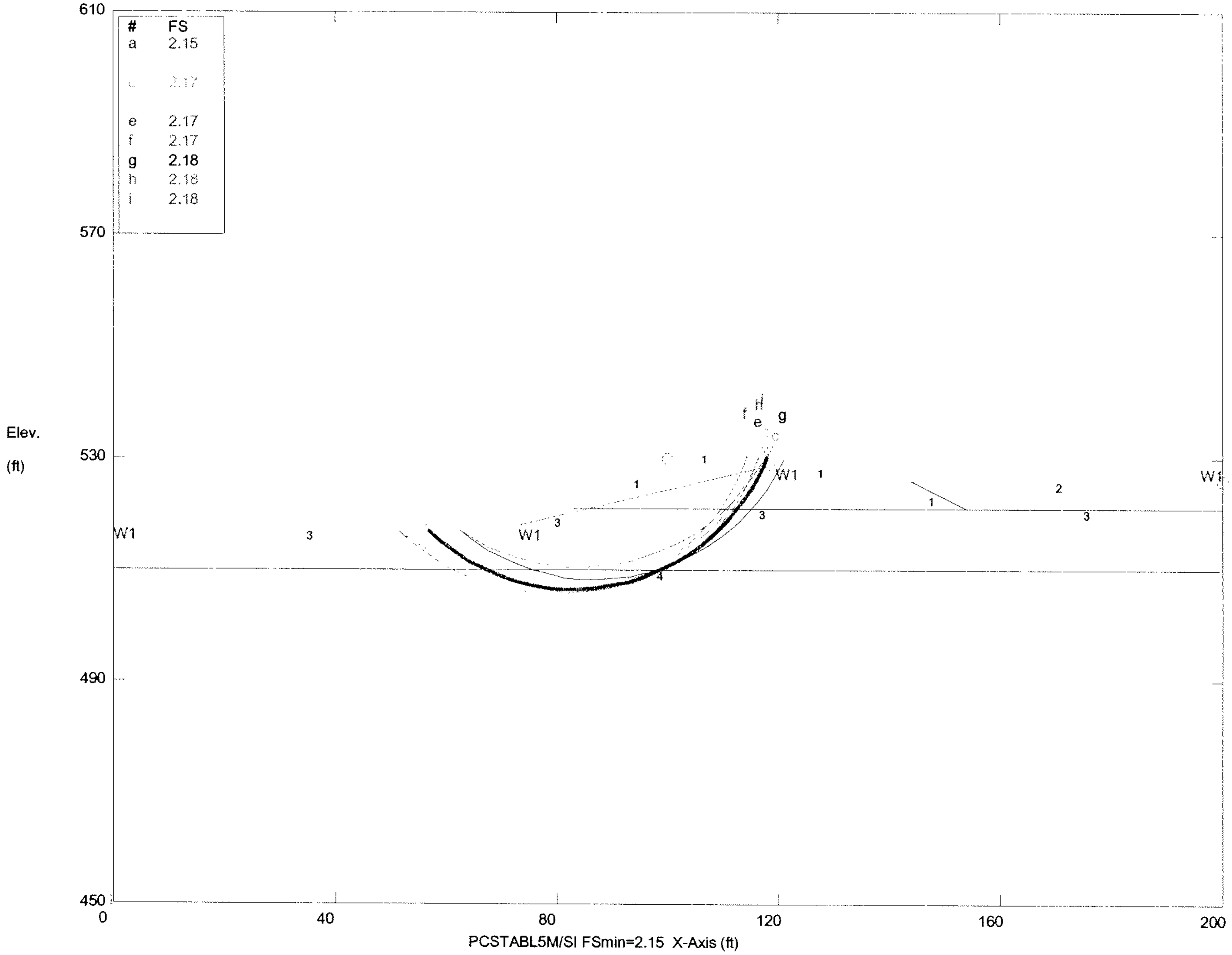


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	130	130	0	28	0	0	W1
2	Ash	120	120	0	25	0	0	W1
3	Clay	125	125	500	0	0	0	W1
4	Clay	125	125	500	0	0	0	W1
5	Sand	125	125	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Between the Ash Ponds North Dike Slope - Static Case

Ten Most Critical. E:BURL40C2.PLT By: Tom Wells 01-15-11 10:03am

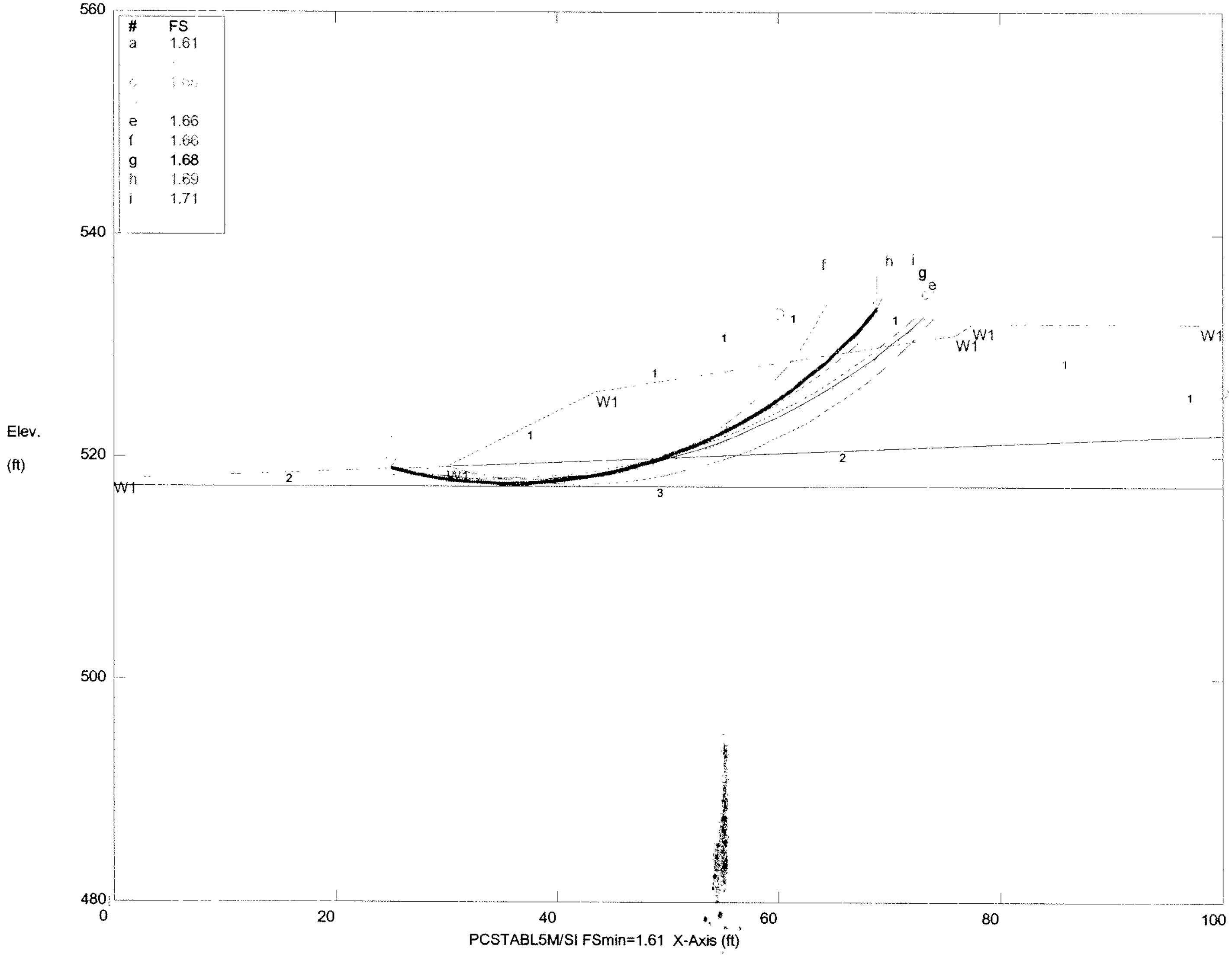


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	130	130	1000	0	0	0	W1
2	Ash	120	120	0	25	0	0	W1
3	Clay	125	125	500	0	0	0	W1
4	Sand	125	125	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Ash Seal Pond South Dike - Static Case

Ten Most Critical. C:BURL50C.PLT By: TCW 01-18-11 11:01am



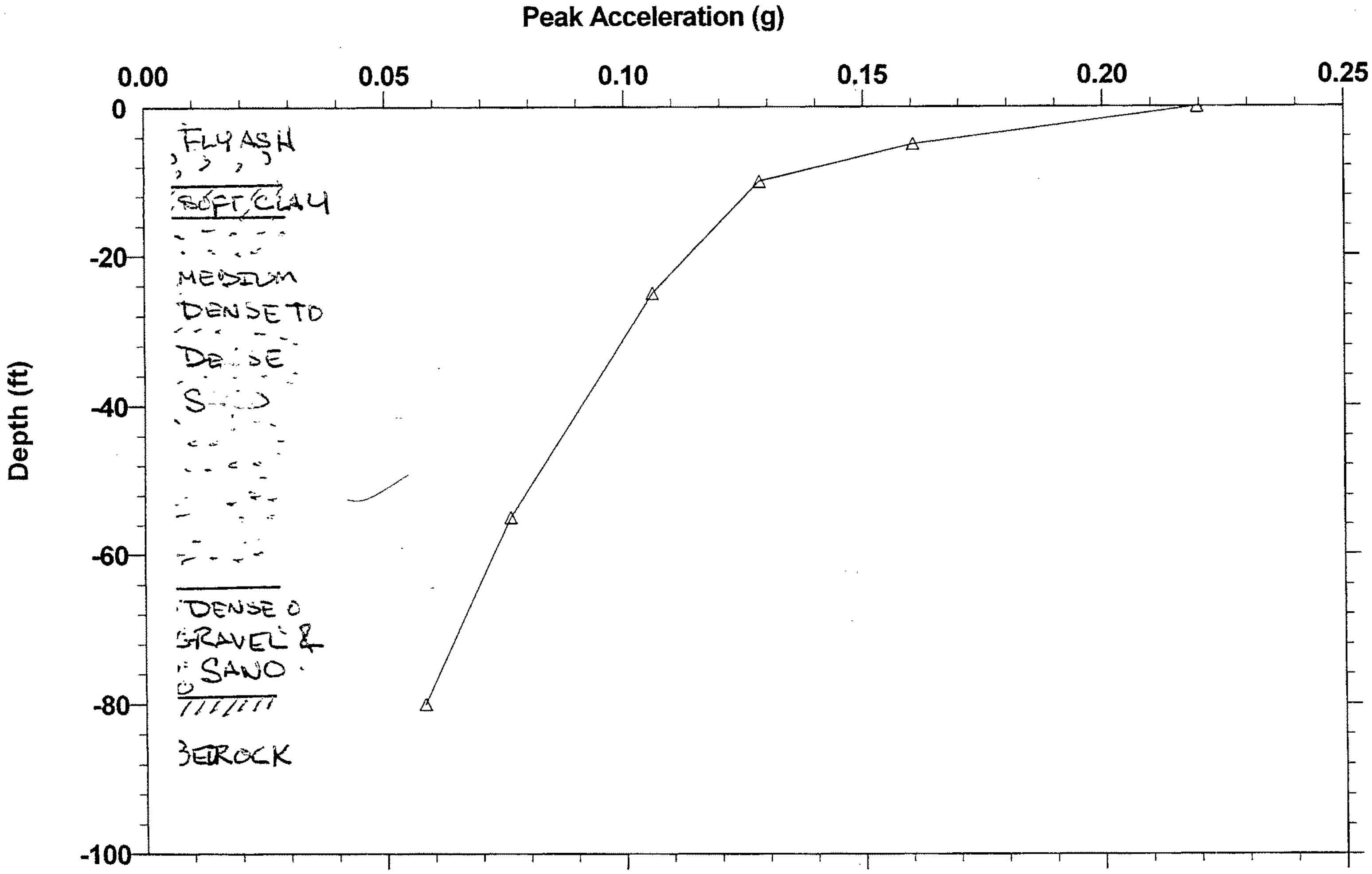
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	120	120	500	0	0	0	W1
2	Sand	130	130	0	30	0	0	W1
3	Clay	125	125	1250	0	0	0	W1

Attachment G

Earthquake Amplification Results

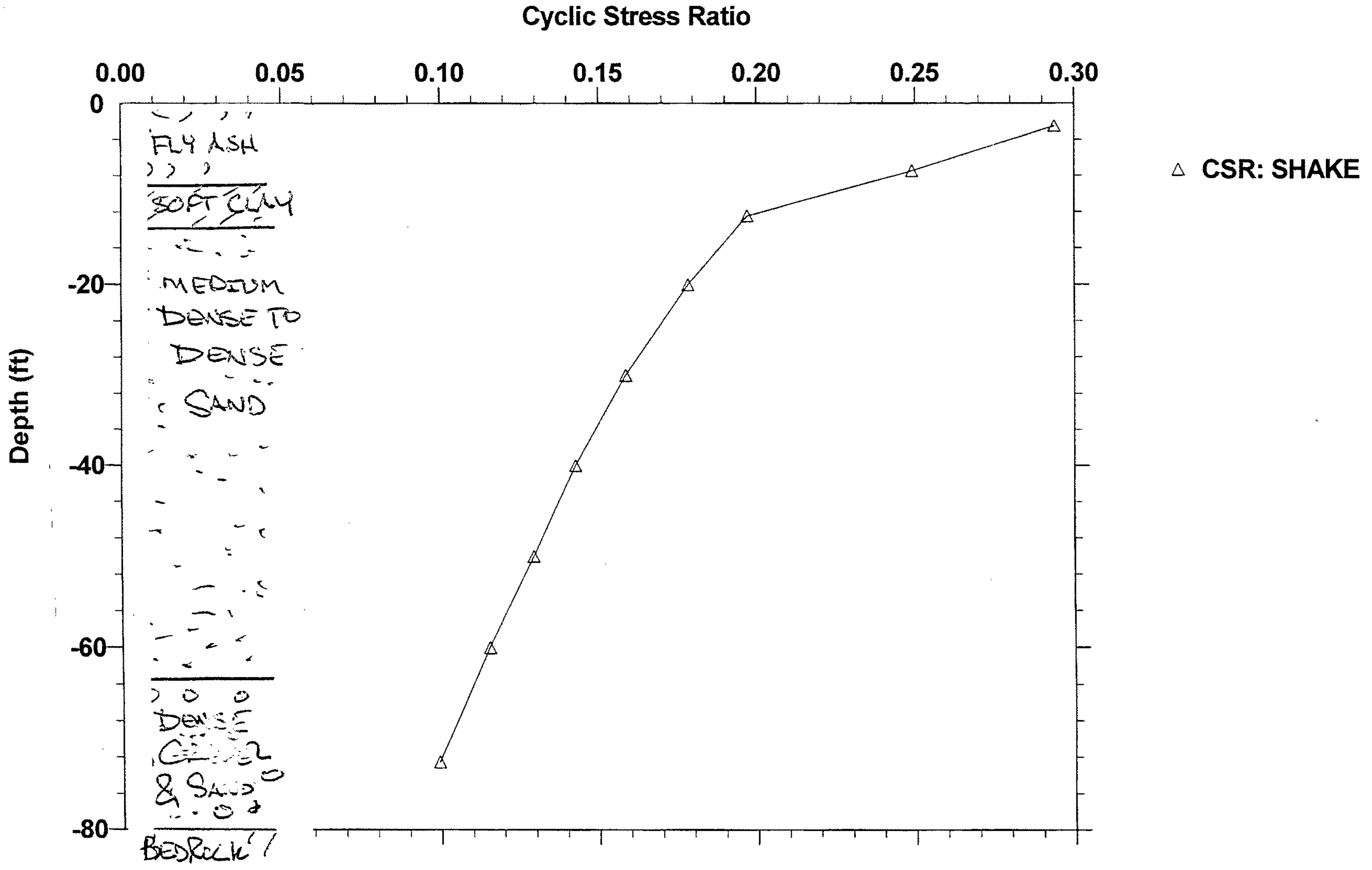
Source:
Program SHAKE 2000 output by Aether dbs, January 2011

CONFIDENTIAL BUSINESS INFORMATION



Acceleration with Depth (2500 year return 0.06 g bedrock acceleration)

CONFIDENTIAL BUSINESS INFORMATION



Cyclic Stress Ratio with Depth (2500 year return 0.06 g bedrock acceleration)

Attachment H

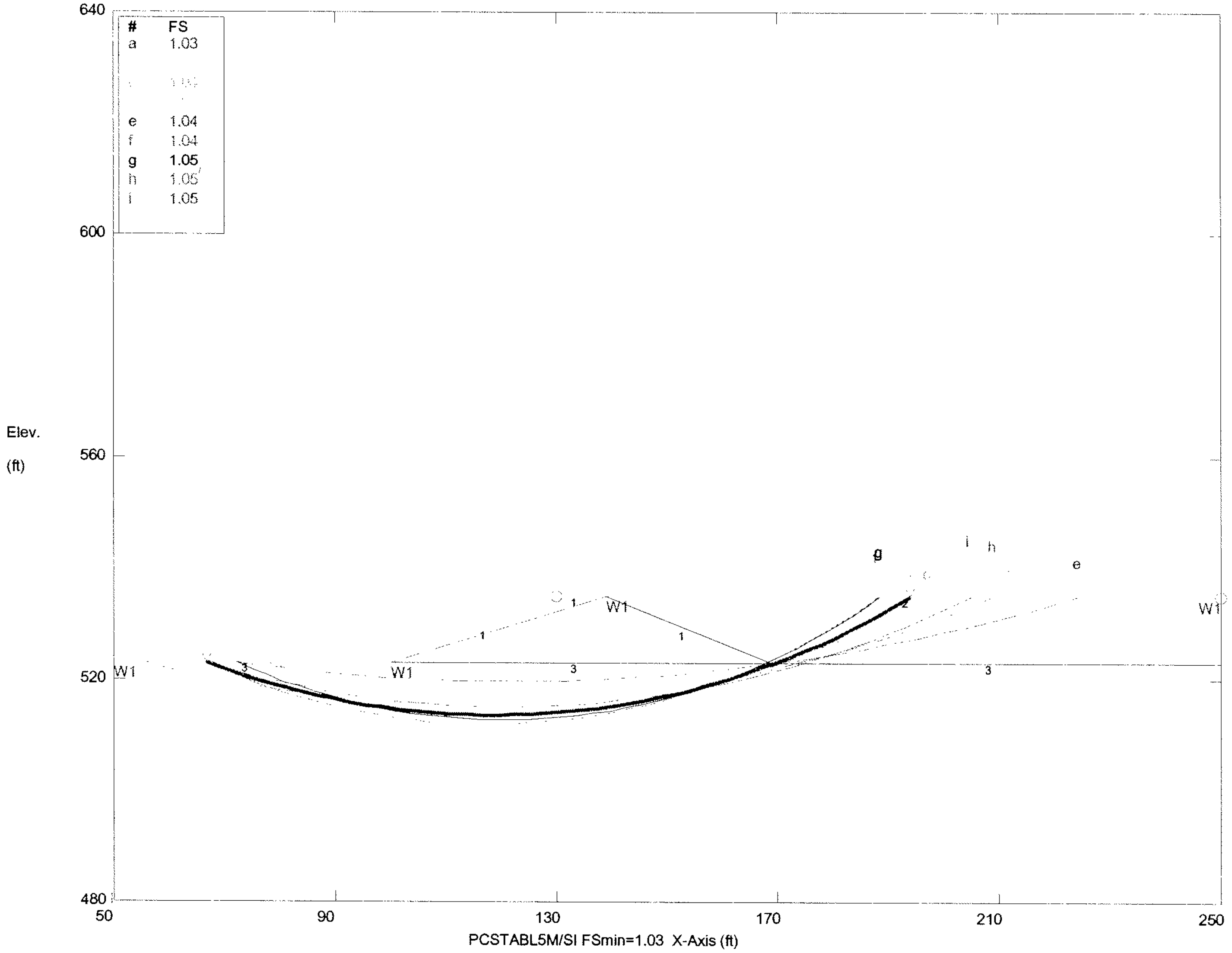
Earthquake Pseudo-Static Slope Stability Analyses Results
Ten Most Critical Surfaces Per Analysis
Burlington Generating Station

Source:
Program PCSTABLE5M/SI output by Aether dbs, January 2011

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Main Ash Pond South Dike - Earthquake Case

Ten Most Critical. E:BURL22C.PLT By: Tom Wells 01-22-11 11:46am

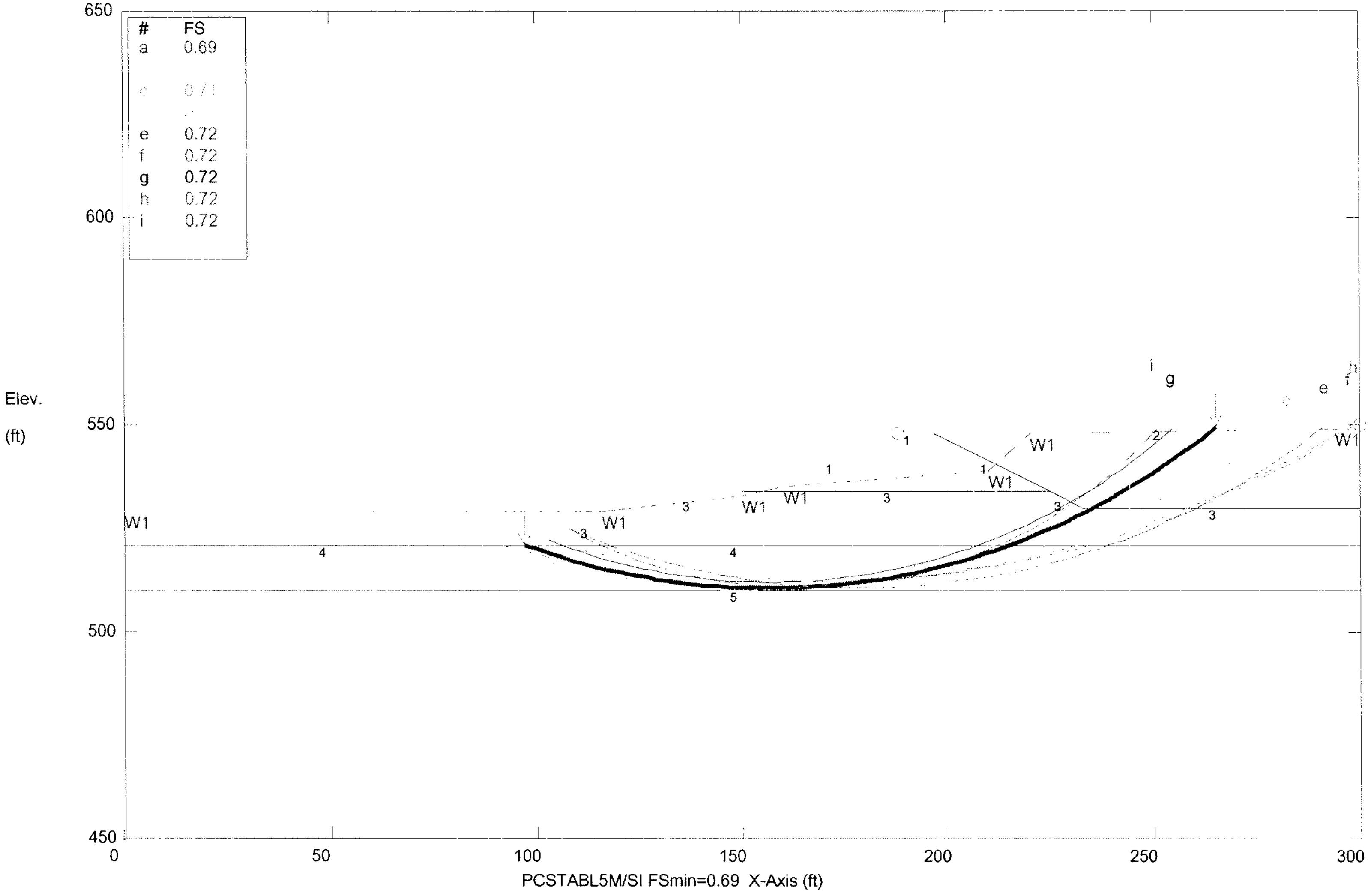


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	1000	0	0	0	W1
2	Ash	120	120	100	0	0	0	W1
3	Natural	120	120	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Economizer Pond North Ash Slope - Earthquake Case

Ten Most Critical. C:BURL31C4.PLT By: TCW 01-17-11 2:15pm

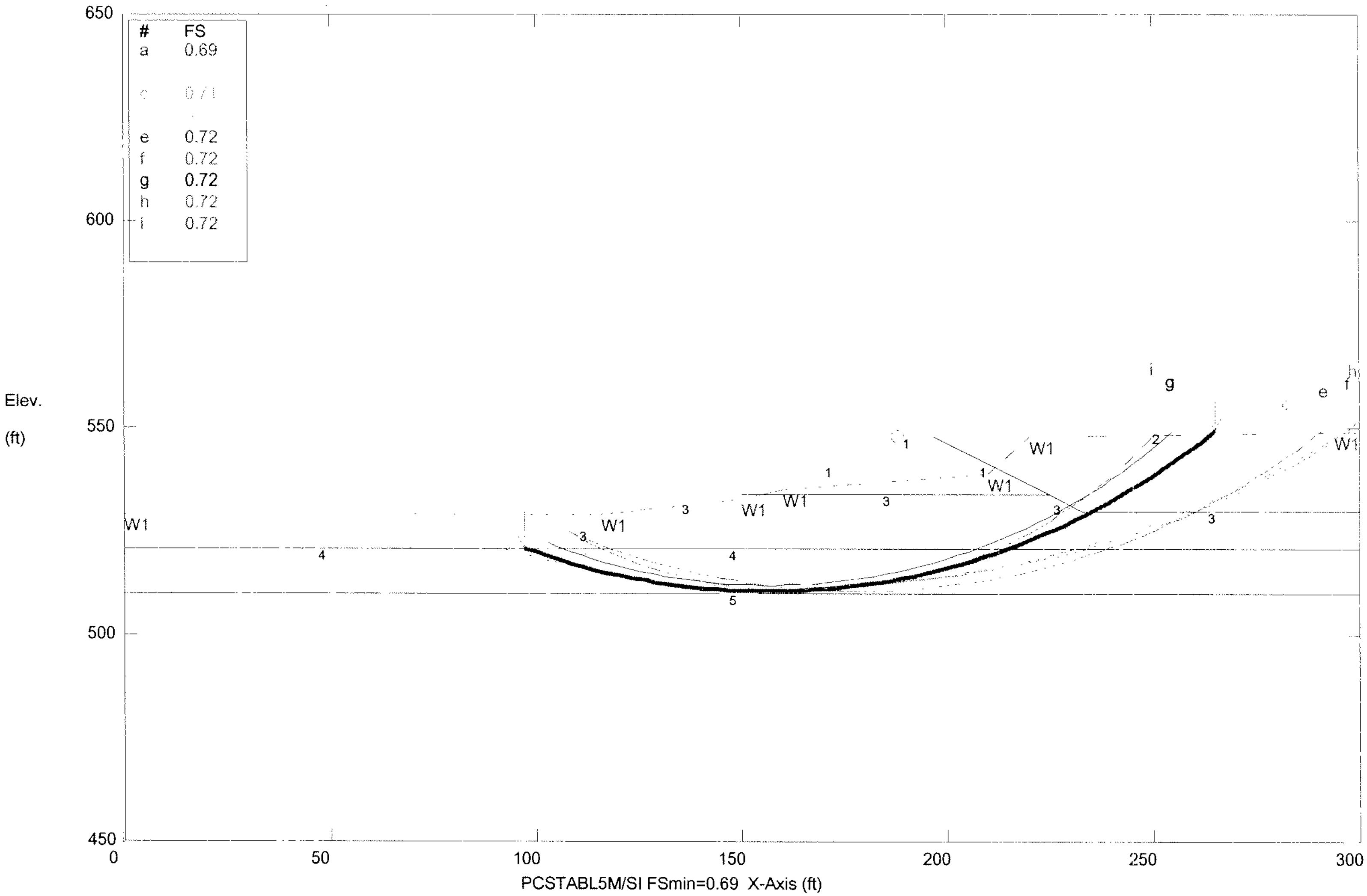


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	130	130	0	28	0	0	W1
2	Ash	120	120	100	0	0	0	W1
3	Clay	125	125	500	0	0	0	W1
4	Clay	125	125	500	0	0	0	W1
5	Sand	125	125	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Economizer Pond North Ash Slope - Earthquake Case

Ten Most Critical. C:BURL31C4.PLT By: TCW 01-17-11 2:15pm

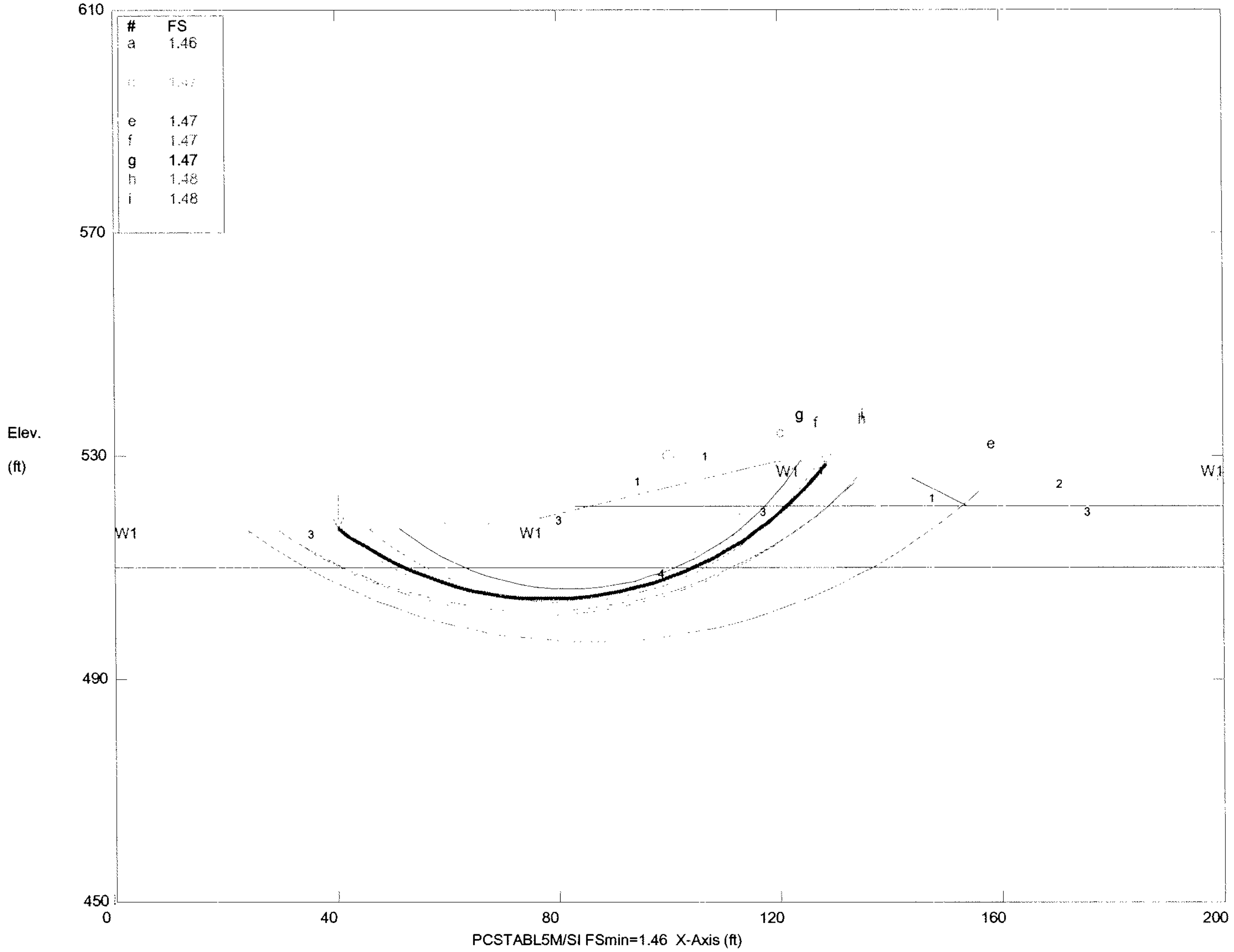


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	130	130	0	28	0	0	W1
2	Ash	120	120	100	0	0	0	W1
3	Clay	125	125	500	0	0	0	W1
4	Clay	125	125	500	0	0	0	W1
5	Sand	125	125	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Between the Ash Ponds North Dike Slope - Earthquake Case

Ten Most Critical. E:BURL41C2.PLT By: Tom Wells 01-15-11 12:31pm

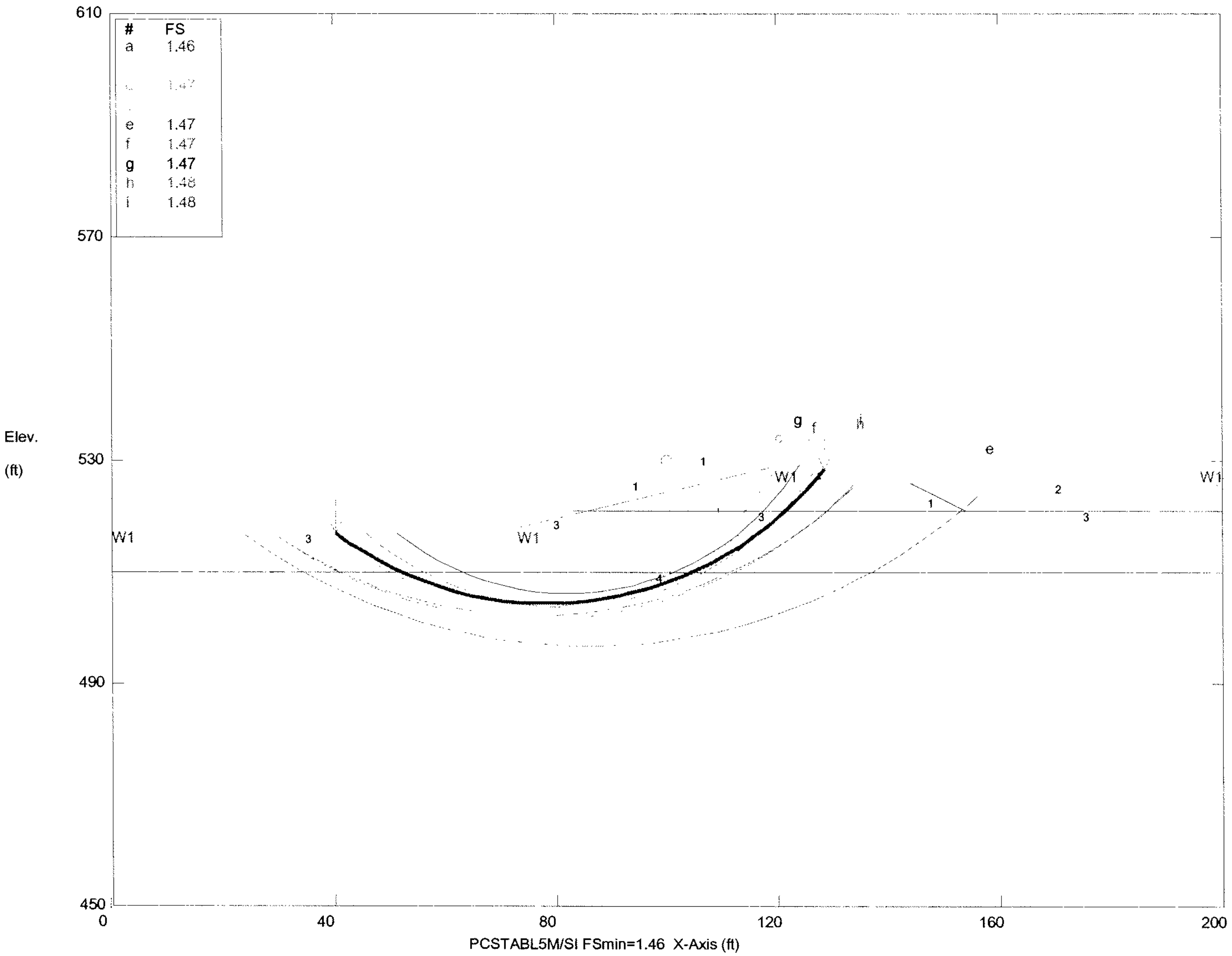


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	130	130	1000	0	0	0	W1
2	Ash	120	120	100	0	0	0	W1
3	Clay	125	125	500	0	0	0	W1
4	Sand	125	125	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Between the Ash Ponds North Dike Slope - Earthquake Case

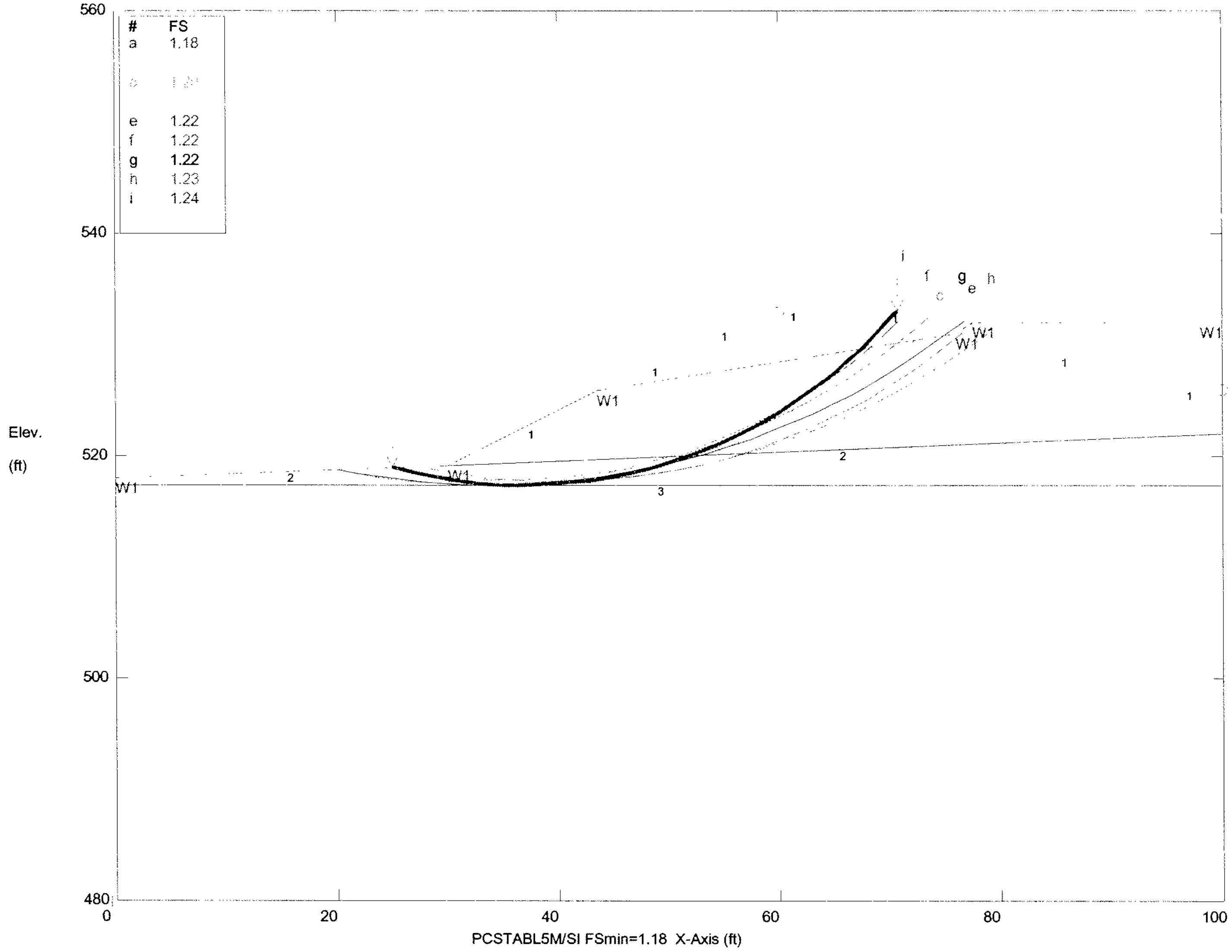
Ten Most Critical. E:BURL41C2.PLT By: Tom Wells 01-15-11 12:31pm



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	1000	0	0	0	W1
2	Ash	120	120	100	0	0	0	W1
3	Clay	125	125	500	0	0	0	W1
4	Sand	125	125	0	30	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Ash Seal Pond South Dike - Earthquake Case
Ten Most Critical. C:BURL51C.PLT By: TCW 01-18-11 11:04am

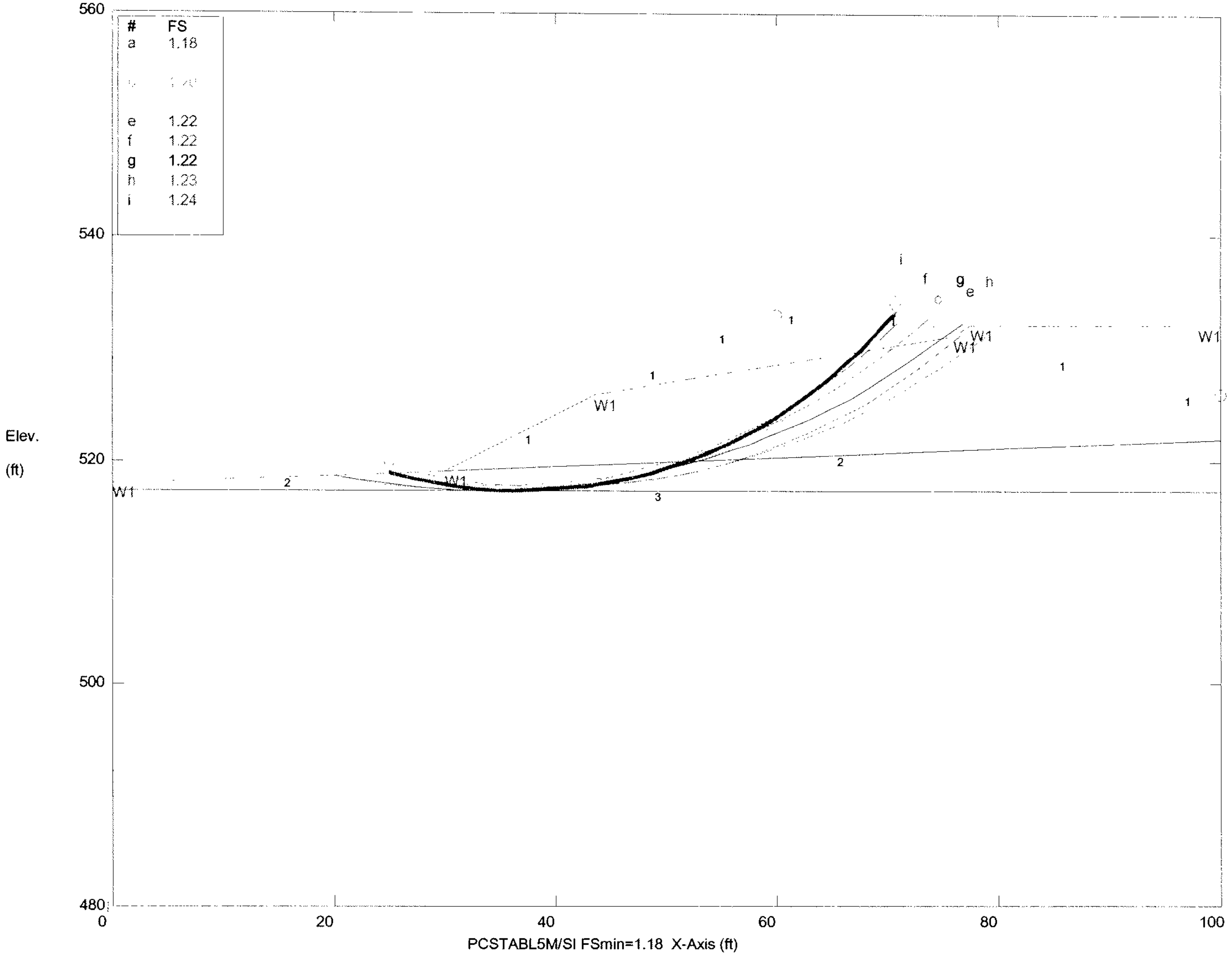


Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Clay	120	120	500	0	0	0	W1
2	Sand	130	130	0	30	0	0	W1
3	Clay	125	125	1250	0	0	0	W1

CONFIDENTIAL BUSINESS INFORMATION

Alliant Burlington Ash Seal Pond South Dike - Earthquake Case

Ten Most Critical. C:BURL51C.PLT By: TCW 01-18-11 11:04am



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	500	0	0	0	W1
2	Sand	130	130	0	30	0	0	W1
3	Clay	125	125	1250	0	0	0	W1

SUMMARY OF AETHER FINDINGS - FEBRUARY 2011 REPORT AND USEPA/DEWBERRY RESPONSE

1.1 Soil Data Summary, February 3, 2011 Report

Table 10.2.2 – Soil Properties Used in Stability Analyses[1]

Main Ash Pond – South Dike

Soil Description		Soil Unit Weight (pcf)		Shear Strength Parameters	
Layer	**Soil Type**	**Total**	**Saturated**	**Cohesion (psf)**	**Friction (Degrees)**
1	Dike	125	125	1000	0
2	Ash - Static	120	120	0	25
	Ash - Seismic			100	0
3	Natural	120	120	0	30

Economizer Ash Pond – North Dike

Soil Description		Soil Unit Weight (pcf)		Shear Strength Parameters	
Layer	**Soil Type**	**Total**	**Saturated**	**Cohesion (psf)**	**Friction (Degrees)**
1	Dike	130	130	0	28
2	Ash – Static	120	120	0	25
	Ash – Seismic	120	120	100	0
3 and 4	Clay	125	125	500	0
5	Sand	125	125	0	30

Table 10.2.2 – Soil Properties Used in Stability Analyses[1]

Upper Ash Pond North Dike

Soil Description		Soil Unit Weight (pcf)		Shear Strength Parameters	
Layer	Soil Type	Total	Saturated	Cohesion (psf)	Friction (Degrees)
1	Dike	130	130	1000	0
2	Ash – Static	120	120	0	25
	Ash – Seismic	120	120	100	0
3	Clay	125	125	500	0
4	Sand	125	125	0	30

Ash Seal Pond – South Dike

Soil Description		Soil Unit Weight (pcf)		Shear Strength Parameters	
Layer	Soil Type	Total	Saturated	Cohesion (psf)	Friction (Degrees)
1	Clay	120	120	500	0
2	Sand	130	130	0	30
3	Clay	125	125	1250	0

[1] Soil shear strength parameters used for both static and seismic analyses unless otherwise noted.

Soil stratification and parameters are based on prior geotechnical data for the Main Ash Pond, Upper Ash Pond, and Ash Seal Pond. New soil borings were conducted for the Economizer Ash Pond.

1.1.1 Uplift and/or Phreatic Surface Assumptions

No uplift calculations were provided to Dewberry for review. Based on the stability analyses in the February 3 report, the phreatic surface was modeled as being slightly below the dike crest on the upstream slope to the toe of the embankment on the downstream slope of each embankment.

1.1.2 Factors of Safety

Safety factors computed in the slope stability analyses in the February 3 report are shown in Table 10.2.4

Table 10.2.4 Factor of Safety Impoundment Dike Slopes for Burlington Generating Station

Main Ash Pond		
Impoundment/ Failure condition	Required Minimum Factor of Safety	Computed Factor of Safety
Long-term, Normal Pool	1.5	2.1
Seismic, Normal Pool	**>1.0**	**1.0**
Economizer Ash Pond		
Long-term, Normal Pool	**1.5**	**1.1**
Seismic, Normal Pool	**>1.0**	**0.7**
Upper Ash Pond		
Impoundment/ Failure condition	Required Minimum Factor of Safety	Computed Factor of Safety
Long-term, Normal Pool	1.5	2.1
Seismic, Normal Pool	>1.0	1.5
Ash Seal Pond		
Long-term, Normal Pool	1.5	1.6
Seismic, Normal Pool	>1.0	1.2

For long term, normal pool loading, the computed Factor of Safety for the Economizer Ash Pond of 1.1 **is lower than the required minimum value of 1.5.** The Aether DBS report indicated that a static failure of the Economizer Ash Pond dike could result in static liquefaction of the ash pile with flow into the Upper Ash Pond. Aether DBS states in the report that,

"… the Economizer Ash Pond embankment was analyzed as ash, but it is likely to have an original clay embankment behind the crest... A static failure of the Economizer Ash slope could lead to static liquefaction of the pile with flow into the Upper Ash Pond. If such a flow occurred, the flowing material could possibly overtop or push the Upper Ash Pond embankment into the Lower Ash Pond."

The implications of this finding are that the Economizer Ash Pond dike, including the 25 foot pile of ash stored above the dike, could fail at any time. **Since the Lower Ash pond floods periodically its content would be released to the Mississippi River**. The Aether report indicated immediate action should be taken by the utility, recommending the discharge pipe location be changed, such that the discharge would be far from the point of failure. The USEPA responded that further studies be taken immediately (see Section 10.4).

For seismic normal pool loading the computed factor of safety of 1.0 for the Main Ash Pond and 0.7 for the Economizer Ash Pond are lower than the required minimum value of greater than 1.0. ***The Aether DBS analyses concluded, "Results that are 1.0 or less indicate that substantial deformation may occur in the embankment and the deformation could lead to the release of the pond contents."***

That is, the Main Ash Pond and Economizer Ash Pond pose an imminent and substantial endangerment to the environment under seismic conditions.

1.1.3 Critical Geologic Conditions

The February 3 report indicated the Burlington Generating Station site is underlain by two geologic units overlying a layer described as "refusal material" based on standard penetration resistance values in prior soil test borings.

The upper geologic stratum is described as very loose silt or fine sand and soft clay to depths of 20 to 60 feet. The lower geologic stratum is described as medium dense to very dense sand and gravel to a depth of about 80 feet.

The documentation provided to Dewberry for review indicated a peak bedrock acceleration of 0.06g for an earthquake with a 2 percent probability in 50 years. Dewberry validated that peak acceleration value based on U.S.G.S. seismic risk maps.

Liquefaction Potential

Documentation provided to Dewberry (see Appendix D - Doc 22) included an assessment of liquefaction for both ash fill used in the Economizer Ash Pond embankment, and for the very loose natural silts and sand underlying other embankments. The assessment concludes that <u>the ash fill is susceptible to liquefaction in the event of a design earthquake and that it will lose nearly all of its shear strength</u>. Liquefaction potential of the ash fill was included in the stability analyses.

The documentation also concludes that the very loose sand and/or sandy silt underlying clay embankments will liquefy during the design earthquake. The potential for liquefaction of the embankment foundation soils was not considered in the stability analyses.

1.1.4 Documentation Recommendations

The February 3 report includes three recommendations addressing slope stability concerns:

- Reroute sluice water in the Main Ash Pond and Economizer Ash Pond as a means of relocating the free water surface as far from the pond embankment as possible to reduce the probability of embankment liquefaction in the event of a design earthquake.
- Conduct additional assessment of the potential for liquefaction of foundation soils beneath the Main Ash Pond and Economizer Ash Pond embankments
- Conduct additional assessment of the critical section of the Economizer Ash Pond embankment to determine if a buried clay embankment exists that would restrict flow liquefaction from a static slump in the ash face with a safety factor less than 1.5.

1.2 ACTIONS BASED ON SUPPLEMENTAL DOCUMENTATION

1.2.1 Structural Stability

Dewberry's technical review of the supplemental documentation concurred with the findings. Dewberry considered the calculated slope stability Factors of Safety for the Economizer Ash Pond of 1.1 for static loading and 0.7 for seismic loading as significant concerns.

Dewberry also assessed the potential for liquefaction of foundation soils beneath other embankments; this was identified as a significant concern.

On March 16, 2011, U.S. EPA initiated a conference call with IPL and Dewberry to discuss structural stability concerns at Burlington Generating Station. USEPA followed the call with a letter dated March 18, 2011 requesting that IPL:

- Review the Aether DBS report and any other related engineering studies, and
- Submit a written response presenting alternative evaluations of the structural stability concerns and proposed short term and long term actions to mitigate the concerns.

Alliant Energy, on behalf of IPL, provided a response to the EPA request on correspondence dated March 23, 2011. In their response the utility indicated:

- The potential for static liquefaction failure was limited to the east end of the north slope of the Economizer Ash Pond where the geotechnical investigation results found only ash on the constructed embankment. Failure of that section of the embankment was not expected to leave Burlington Generating Station Property.
    - A simplified dam break analysis by Aether DBS was provided to support the evaluation that the only release to the Mississippi River would be water pushed out of the Upper Ash Pond during inflow from the Economizer Ash Pond.

- IPL owns the land for a distance of about 1mile south of the Main Ash Pond. The utility expects that any potential release from the Main Ash Pond resulting from a design earthquake would be retained on IPL-owned property. To further resolve the stability concerns, IPL proposed the following actions:

    - IPL would authorize Aether DBS to conduct a detailed assessment of the liquefaction potential of the foundation soils beneath the former Ash Seal Water Pond and Main Ash Pond. The assessment would include collection of additional in situ soil strength and density data using cone penetrometer technology.

    - IPL would change the existing flow patterns of the Economizer Ash Pond away from the western embankment as recommended in the Aether DBS report.

        - IPL would also reroute flow through the Main Ash Pond as soon as conditions allowed excavation equipment to access the work area.

    - IPL is planning upgrades to increase the capacity of the Upper Ash Pond to improve freeboard during design storm events. Although scheduled to be completed in 2011, the specific schedule is dependent on potential spring flooding along the Mississippi River.

    - IPL would authorize Aether DBS to investigate the cyclic resistance capacity of soils under the clay embankments of the former Ash Seal Pond, Main Ash Pond, and Upper Ash Pond. Based on expected work area access limitations during spring flooding, IPL expects this work to be accomplished during the summer of 2011.

    - IPL would authorize Aether DBS to investigate the north bank of the Economizer Ash Pond to identify whether a clay embankment is located in the cross section of the present slope, and if so, to recalculate the slope stability Factors of Safety. This work is also expected to occur during the summer of 2011.

    - IPL would provide EPA with Aether DBS reports and conduct a meeting to determine if supplementary actions are necessary.

In correspondence dated March 29, 2001 to IPL, the USEPA indicated agreement with IPL's proposed actions, and that the actions be taken as soon as possible. EPA also requested that IPL take six additional activities:

A. Conduct a dam break analysis based on a catastrophic failure of the Economizer Ash Pond

B. Conduct a hydraulic study to verify that only water is released in the event of an Economizer Ash Pond embankment failure

C. Avoid stockpiling reclaimed Economizer Ash on the north side of the pond

D. Relocate handling and loading operations for the reclaimed Economizer Ash to the south side of the pond

E. Establish a ten-foot equipment-free perimeter along the entire water's edge of the Economizer Ash Pond.

F. Install slope inclinometers in association with the new soil borings drilled in conjunction with the investigation to determine the presence of a clay embankment in the Economizer Ash Pond dike. Such inclinometers would show embankment movement under static conditions.

IPL provided correspondence dated April 4, 2011 (see Appendix D – Doc 25) in response to EPA's request for additional activities. The utility had performed studies and developed findings to address items A, B and F of the March 29, 2011 EPA correspondence.

- Dam Break Analysis (Item A): The dam break analysis provided calculations and source references that supported the prior conclusion that in the event of a catastrophic failure of the Economizer Ash Pond embankment, the stability of the Upper Ash Pond would be maintained and the ash would not be released to the Mississippi River (see Appendix D – Doc 25, calculations dated April 1, 2011).

- Hydraulic Analysis (Item B): Documentation provided included calculations and source references that support the conclusion that water overtopping the Upper Ash Pond resulting from a catastrophic failure of the Economizer Ash Pond embankment will have been retained for a time sufficient for most of the fluid ash to have settled prior to discharge into the Mississippi River.

- Slope Inclinometers (Item F): The correspondence stated that the failure mechanism associated with liquefaction flow would not show on slope inclinometer readings. Therefore IPL proposed to complete the investigation to determine the presence of a clay embankment within the Economizer Ash Pond before implementing a slope monitoring program.

Items C, D and E of the March 29, 2011 EPA correspondence involved specific actions. The utility responded as follows:

- Avoid Stockpiling on North Side of Economizer Ash Pond (Item C): In March the utility removed the observed ash stockpile off the North Side embankment. The utility stated that no further dredging and stockpiling is anticipated until late summer after the proposed additional geotechnical investigation is completed.

- Relocate Handling and Loading Operations to South Side of Pond (Item D): The utility stated that based on the physical arrangement of the Economizer Ash Pond, most of the dredging operations would be performed from the south side of the pond. However, the utility indicated that there remains a need to place some material on the north side of the pond. As noted above, further dredging and stockpiling is curtailed until summer.

- Establish Equipment Free Perimeter (Item E): Burlington Generating Station agreed to keep heavy construction equipment off the north embankment until the soil borings are completed. Smaller equipment required for routine site maintenance will have access to the embankment.

Figure 10.4.1-1 shows the Economizer Ash Pond as observed during the October 7, 2010 site visit. The stockpiles are as high as 20 feet. Figure 10.4.1-2 shows the Economizer Ash Pond with the stockpiles removed and construction equipment removed from the embankments.

Figure 10.4.1-1" Economizer Ash Pond with Stockpile and Construction Equipment October 7, 2010 (Photo by Dewberry)

Figure 10.4.1-2: Economizer Ash Pond with Stockpile and Construction Equipment Removed. (Photo courtesy of Burlington Generating Station)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

March 18, 2011

OFFICE OF
SOLID WASTE AND
EMERGENCY RESPONSE

Mr. Daniel Siegfried, Managing Attorney
Alliant Energy Corporate Services
Legal Department
200 First Street SE
PO Box 351
Cedar Rapids, IA 52406-0351

Dear Mr. Siegfried,

Re: Significant Structural Stability Concerns at the Burlington Generating Station

On Wednesday, March 16, 2011, U.S. EPA initiated a conference call with Alliant Energy (Dan Siegfried, Buddy Hastings, and Bill Slinks) and EPA's engineering contractor, Dewberry and Davis (Jerome Strauss and Joseph Klein) to discuss structural stability concerns for coal ash impoundments at the Alliant Energy Burlington Generating Station. EPA appreciates the cooperation Alliant Energy has been providing us.

After reviewing Alliant's engineering contractor's report (Aether), it was apparent to EPA that the Economizer Pond did not meet a minimum factor of safety under projected seismic loadings. Dewberry and Davis have substantiated this opinion.

However, a greater concern to EPA was that Aether reported that the entire impoundment complex (Ash Seal Pond, Bottom Ash Pond, Economizer Ash Pond, Ash Pond 1, and Ash Pond 2,) was underlain with sands and silts which may become fluidized under anticipated seismic loadings. If the impoundments at the site were to fail under projected seismic loadings, there may be progressive failures of impoundments at the site. Dewberry and Davis have also substantiated this opinion.

EPA must now proceed under an "abundance of caution" approach. EPA is therefore requesting that Alliant: 1) review the Aether report and any other related engineering studies and

2) submit a written response by close of business March 23, 2011 which either agrees with our concerns and presents the actions Alliant intends to undertake immediately, in the short term and long term, or if there is a disagreement with our concerns, the technical basis for adopting that position.

We look forward to your response.

Sincerely,

Stephen Hoffman
Senior Environmental Scientist

ALLIANT
ENERGY.

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March 23, 2011

Via E-mail to: hoffman.stephen@epa.gov

Mr. Stephen Hoffman
U.S. Environmental Protection Agency (5304P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

Re: Response to EPA Concerns
Burlington Generating Station
Confidential Business Information

Dear Mr. Hoffman:

This letter is sent on behalf of Interstate Power and Light Company's ("IPL") Burlington Generating Station in response to your letter dated March 18, 2011, expressing significant structural stability concerns and requesting a response from IPL by close of business on March 23, 2011. Consistent with our prior submittals, and at least until we reach a mutually satisfactory resolution of these concerns, IPL requests and claims "Confidential Business Information" treatment and protection of this letter and its attachments.

IPL appreciates the United States Environmental Protection Agency's ("EPA") acceptance of its analysis of structural stability for the ash ponds at the Burlington Generating Station. IPL retained Aether DBS in late 2010 to assess the structural condition of the ponds using available subsurface information and new information collected on the soil used to construct the pond embankments. In the assessment, certain issues were identified which indicate that a release of pond contents within the Generating Station property could occur due to either static or earthquake induced liquefaction of the pond embankments or the underlying soil.

The potential for a ***static*** liquefaction failure is limited to the east end of the north slope of the Economizer Ash Pond where the embankment containing the pond appears to be constructed of ash. Because Aether did not find a clay embankment at this section of the Economizer Ash Pond, the analysis for structural stability assumed the embankment is only ash (no clay behind the ash) resulting in a factor of safety lower than accepted standards. Based on engineering judgment, Aether believes that a slope failure of the Economizer Ash embankment in question would result in a release that remains on the Burlington Generating Station Property. The only release to the Mississippi River would consist of water expelled from the Upper Ash Pond during the flow of the economizer ash. Attachment A presents a simplified dam break analysis for a static liquefaction release of economizer ash to support Aether's judgment. IPL hopes that this analysis helps to alleviate some of EPA's concerns.

IPL also believes it helpful to note that it owns the parcel of property immediately to the south of the BGS facility and the main ash pond as shown on the previously submitted site diagram. Attached to this letter is a site drawing showing that IPL (formerly IES Utilities, Inc.) owns the land one mile to the south of the plant along the Mississippi River. Thus, any potential release of ash or water/ash mixture from the Main Ash Pond south of the plant will continue to be on IPL property.

Failure @
SE corner
would drain
to canal/also
Ash Seal P
Pond Tk

The potential for ***earthquake*** induced liquefaction of the foundation soils under the clay pond embankments on the former Ash Seal Water Pond and Main Ash Pond is dependent on the characteristics of the natural river deposited soil underlying the embankments. A detailed assessment of these soils will be undertaken by Aether to determine the probability of liquefaction. A basic plan for the use of in-situ cone penetrometer methods to determine the cyclic resistance capacity of the natural soils is enclosed in Attachment B. IPL commits to initiating this assessment as soon EPA concurs that the basic plan is reasonable. As with any project of this nature, the scheduling of contractors, analysis of soil results, and drafting of reports will take some time. IPL commits to completing this work as soon as reasonably possible.

Additionally, IPL will take the following actions based on the results of the simplified dam break analysis and present understanding of the structural stability of the Ash Pond systems.

1. In the interim, IPL will retrench the existing flow patterns of the Economizer Ash Pond away from the western embankment, per Recommendation 2 in the Aether Ash Pond Slope Stability and Hydraulic Analysis report. IPL is currently unable to retrench the Main Ash Pond because conditions are too wet to allow for the use of a track hoe. When conditions support use of a track hoe, IPL will similarly retrench.

2. IPL is planning upgrades to increase capacity of the outfall for the Upper Ash Pond to improve freeboard during storm events. IPL expects to have the improvements installed by late 2011 at the latest. While IPL would like to accomplish this work sooner, IPL believes it not practically able to commit to doing so sooner due to necessary construction permitting requirements and the potential for high flooding predicted for this area which would delay on-site work of this nature.

3. IPL will authorize Aether to investigate the cyclic resistance capacity of the soils under the clay embankments on the former Ash Seal Pond, Main Ash Pond, and Upper Ash Pond. Because of high flooding potential, and the need to get equipment on the embankments, the results of this assessment will likely be complete during the Summer of 2011.

4. IPL will authorize Aether to investigate the north bank of the Economizer Ash Pond to identify whether a clay embankment is located in the cross-section of the present slope. Because of high flooding potential, and the need to get equipment on the embankments, the results of this assessment will likely be complete during the Summer of 2011.

5. Upon receipt of Aether's reports, IPL will provide EPA with the results of items 3 and 4 and will conduct a meeting with the EPA to determine if any supplementary actions are necessary and determine the associated implementation schedule.

IPL hopes that this letter responds satisfactorily to the EPA's significant structural stability concerns at the Burlington Generating Station. If you have any questions, please call me at (319) 786-4686. Thank you.

Very truly yours,

Daniel L. Siegfried
Managing Attorney
Alliant Energy Corporate Services, Inc., for
Interstate Power and Light Company

DLS/bap
Attachments

cc: Terry Kouba - AECS
Vernon Hasten – IPL
William Skalitzky – AECS
Timothy Harrington – AETHER DBS

CONFIDENTIAL BUSINESS INFORMATION

Attachment A

Simplified Dam Break Analysis

A slope failure in the face of the ash embankment containing the Economizer Ash Pond would shear the ash behind the slope which could liquefy approximately 5,000,000 cubic feet of ash. The liquefied ash would flow into the Upper Ash Pond. The flow would be similar to the flow of water from a sudden dam break. The United States Army Corps of Engineers (USACE) published a simple analytical procedure for determine the initial wave height and velocity in Chapter 16 of EM 1110-2-1420[1]. The dynamic motion of the fluidized ash will be similar to water with the higher viscosity of the fluidized ash slowing the wave motion. Assuming that the wave is water leads to a conservative assessment of the wave height and velocity.

The USACE indicates an initial wave height 4/9 of the depth of water behind the dam (open channel flow energy conservation). The Economizer Ash Pond is 18 feet high from the toe of slope at the intersection with the Upper Ash Pond delta. If the full slope is mobilized, the height of the wave front will be 8-feet. As the wave advances the roughness of the bottom may further reduce wave height. It is approximately 400-feet to the Upper Ash Pond Clay embankment. It is conservative to assume that the wave front will remain 8-feet high as it moves towards the Upper Ash Pond Embankment. A scale cross-section of the Main Ash, Economizer Ash, Upper Ash, and Lower Ash ponds is shown on Figures 2 and 3. The location of the cross-section is shown on Figure 1.

Missing

When the 8-foot high wave impacts the clay embankment, it will have a force that is equal to ½ of the mass times the velocity squared. Wiegel[2] presents a simplified method for analysis of the force from a Tsunamis wave. The maximum velocity is 16 ft/sec (2/3 of the square root of 32.2 ft/sec^2 times initial height of 18-feet). At the embankment, the pond is 6-feet deep as measured in 2009 and the crest of the embankment is 2-feet above normal pond water elevation. The 8-foot advancing wave is approximately the same height as the Upper Ash Pond embankment.

To determine the impact force the weight of the fluid is assumed as 95 pounds per cubic foot which produces a force of 380 lb/ft^2. For an eight foot high embankment and a one foot thick slice the force is 3000 pounds per foot. To resist this force the embankment must slide over a length of approximately 60-foot (3:1 side slopes and 12-foot wide crest). The cohesion of the clay in the embankment is 1000 pounds per square foot (Attachment B-3 to February 3, 2011

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[1] USACE, Engineering and Design – Hydrologic Engineering Requirements for Reservoirs, EM 1110-2-1420, October 1997

[2] Wiegel Robert L., Earthquake Engineering, Prentice Hall, Inc., 1970

report). The resisting capacity is 60,000 pounds per foot which is much greater than the dynamic force from the flowing ash.

The result indicates that the flow will be arrested by the Upper Ash Pond embankment. However, the motion of the wave will push the water in the Upper Ash pond and possibly some of the fluid mud in the Upper Ash Pond over the embankment and into the Lower Ash Pond.

The capacity of the Upper Ash pond is approximately 1,000,000 cubic feet using only the eastern half of the Upper Ash pond for storage. If some ash goes over the Upper Ash pond embankment, the Lower Ash Pond is contained on the north end by a three foot high embankment, see photo below, with a concrete overflow weir. This is the final pond containment prior to discharge to the Mississippi River. The volume of the Lower Ash Pond from the top of the Upper Ash Pond embankment at 531 to the top of the final Lower Ash Pond embankment at 524 is approximately 5,000,000 cubic feet.

The analysis indicates that it is a sound judgment to conclude that the contents of a release from the Economizer Ash Pond will remain primarily in the Upper Ash Pond and that any release over the top of the Upper Ash Pond Embankment will be contained in the Lower Ash Pond. The only unusual event will be a pulse of water flowing to the Mississippi river at the time of the contained ash flow.

CONFIDENTIAL BUSINESS INFORMATION

Attachment B

Cone Penetrometer Testing to Determine Cyclic Resistance Capacity

Some of the results from the investigation performed in late 2010 and other information on the soils found below the ash ponds at the Burlington Generating Station indicate a potential for liquefaction of the soil during an earthquake with a 2% probability of occurring in 50-years (Landfill Subtitle D Guidance Document Standards). In-situ penetrometer testing using a dutch cone penetrometer (ASTM D5778) is a proven method for determining the cyclic resistance of soil to liquefaction under earthquake loadings. The National Center for Earthquake Engineering Research (NCEER) published a summary of the methods for assessing the liquefaction resistance of soil in the Geotechnical Journal, Youd[3]. The method for using a cone penetrometer was enhance by Moss et al[4] to include probabilistic enhancements based on the world wide database of actual liquefaction experience. The approach to using the tip resistance and sleeve friction for determining a probabilistic prediction of liquefaction resistance will be the method used in assessing the in-situ results at the Burlington Generating Station.

In addition to determining the tip resistance, sleeve resistance, and pore pressure response with depth at the 21 locations shown on Figure 1, discrete samples of soil will be recovered from locations below the clay embankments or in the Economizer embankment. The samples will be tested for Atterberg limits, water content, and grain size. The Atterberg limits test will be used to determine if the soil will liquefy. Soils with a plastic index greater than 12% will not be considered to be liquefiable in an earthquake. Soils with a plastic index less than 12% and with natural water content greater than 80% of the liquid limit will be considered a liquefiable soil.

Soils that are fine sand or silt (SP and SM) or silt (ML) along with the very low plasticity very soft clays will be assessed to determine their cyclic resistance ratio (dynamic shear stress to effective confining pressure ratio). The ratio will be compared to the corrected tip resistance values from the cone penetrometer normalized based on the procedure of Youd and Moss.

During the cone penetrometer testing, extra probes will be installed on the north slope of the Economizer ash pond to determine if a clay embankment is covered in the ash deposit on the face of the slope. If a clay embankment is found, the static structural stability of the embankment will be reassessed and reported with the cyclic resistance results.

---

[3] Youd, T. Tl. And I. M. Idriss, Liquefaction Resistance of Soils, Journal of Geotechnical Engineering, April 2001.

[4] Moss R.E.S, R. B. Seed, R.E. Kayen, J.P. Stewart, T.L. Youd, and K. Tokimatsu, Geoengineering Research Report No.n UCB/GE-2003/04, 2003

A final report will be prepared indicating the results of the assessment and if liquefiable soils are confirmed, providing recommendations on in-situ improvements to mitigate the risk of earthquake induced liquefaction.

EARTHQUAKE
ENGINEERING

ROBERT L. WIEGEL

Coordinating Editor

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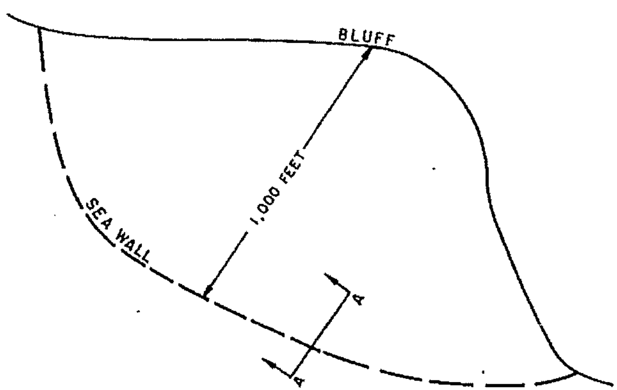

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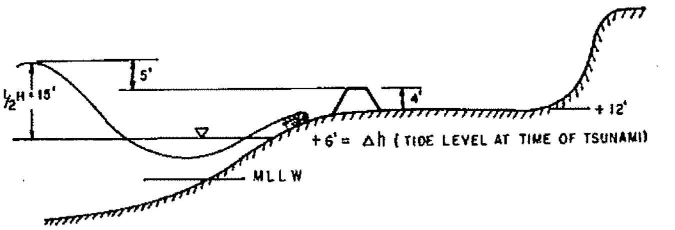


b. SECTION A–A

Fig. 11.43. Hypothetical case. (From Wiegel, 1965.)

The action of the March 27–28, 1964, tsunami at Crescent City, California, is an example of an event somewhat of the type described above. There was a small seawall built within the harbor, and the area landward of it was filled with sand. The elevation of the top of the seawall was from about +8 ft above mean lower low water in the most protected region to +13 ft in the least protected region. The fill landward of this wall was from about +10 to +14 ft above mean lower low water. The highest two tsunami waves apparently went over the top and flooded the towns as if the wall were not present. It is evident from Fig. 11.42 that a seawall, to be effective, must be designed to permit only a few feet of overtopping for the "improbable" tsunami and for no overtopping for the "design" tsunami. This is especially true in light of some laboratory experiments by Iwasaki (1965) that showed that the height would be increased at a seawall, at least for waves that are relatively short compared with tsunami waves.

11.9 TSUNAMI WAVE FORCES

Few studies have been made of the forces exerted by tsunami waves. In the ocean, and in bays, the waves probably can be treated in the manner of the shorter progressive and standing waves such as swell and seiches. Forces exerted by these types of waves will not be treated here as there are a number of papers on the subject (see, e.g., Wiegel, 1964d). The forces exerted on structures by tsunami waves running onto the land present a much more difficult problem. No actual measurements of these forces have been made, and only a few estimates of the forces are available.

Matlock, Reese, and Matlock (1962) made a study of the damage to structures in Hilo, Hawaii, caused by the May 23, 1960, Chilean tsunami. They treated the problem as if a bore moved over a dry bed in a manner similar to a surge running downstream from a dam that had failed. They used the equation given by Keulegan (1949) for the approximate speed V_s of such a surge for the case in which bottom friction is of major importance:

$$V_s = 2\sqrt{gd_s} \tag{11.70}$$

where g is the acceleration of gravity and d_s is the height of the surge. A further assumption was made that the water particles, from top to bottom, all moved with the speed of the surge. They examined the numerous observations made of the maximum elevation reached by the highest wave over the land submerged by the highest wave and decided that the crest was at about 15 ft above mean lower low water datum. Finally, they took the vertical distance from the ground to the plus 15-ft level for each particular point of interest in the region from the line of maximum inland inundation ($d_s = 0$) to the line of maximum withdrawal (−7 ft below mean lower low water, $d_s = 7 + 15 = 22$ ft) and used this as d_s in Eq. 11.70 to calculate the maximum velocity at that point. Thus, the speed of the bore, and the water within the bore, was assumed to move at speeds between 0 and 53 ft/sec. The observations made by Eaton, Richter, and Ault (1961) indicated that the bore traveled from the breakwater to shore, a distance of about 7000 ft, in from 2½ to 3 min, at a speed of from 40 to 45 ft/sec. This would fix the upper limit of the surge speed, which is not too different from the estimate made by Matlock, Reese, and Matlock. It must be cautioned, however, that practically nothing is known of the velocity distribution within a tsunami as it moves over land.

Matlock, Reese, and Matlock examined in detail 14 cases of structural failure, or near failure, for which they were reasonably certain that secondary causes, such as a drifting log or automobile hitting the structure, were not involved. In all cases but one, they neglected hydrostatic forces and assumed that the horizontal fluid force intensity (pressure) exerted by the flowing waters on the structure was given by the equation

$$p = \tfrac{1}{2}C_D\rho V_s^2 \tag{11.71}$$

The values of C_D used in their calculation were the ones normally used in steady flow problems in which the object was completely submerged in a fluid. For one case, a reinforced concrete wall of a building, they included the hydrostatic force. Their approach was to calculate the forces necessary to cause structural failure and then to use Eq. 11.72 to calculate the velocity necessary to obtain this force. They then compared this velocity with the velocities calculated from Eq. 11.70 and found reasonable correlation.

A theoretical and laboratory study was made by Fukui, Nakamura, Shiraishi, and Sasaki (1963), and they found that the tip of a bore advancing over a dry bed, or in a channel with an initial water depth $\bar{d}$, traveled at a speed of

$$V_t = \left(\frac{g\bar{D}(\bar{D} + \bar{d})}{2(\bar{D} - \eta H)}\right)^{1/2} \qquad (11.72)$$

where $\bar{D}$ is the total depth of water in the bore, H is the bore height $(\bar{D} - \bar{d})$, and η is a resistance term. It was found experimentally that η was equal to about 0.85 (equivalent to a Manning's n of 0.13) for a dry bed and increased with increasing $\bar{d}/\bar{D}$ to a value of about 1.03 at $\bar{d}/\bar{D} = 0.5$ and then remained constant for greater values of $\bar{d}/H$.

For an initially dry bed, $\bar{d} = 0$ and $\bar{D} = H$ (i.e., the equivalent of d_t); then Eq. 11.72 becomes

$$V_t \approx 1.8\sqrt{g\bar{D}} = 1.8\sqrt{gH} = 1.8\sqrt{gd_t} \quad (11.73)$$

which agrees rather well with the approximation given by Keulegan (Eq. 11.70). It is interesting to note that all of the bore tip speeds, for the case in which there was an initial depth of water in the channel, were in the region between $V_t = 2\sqrt{gd_t}$ and $V_t = \sqrt{gH}$. They found for the case in which there was an initial water depth in the channel that the bore had a relatively steep front and that the top of the bore was nearly horizontal. It should be pointed out in regard to the "nearly horizontal" top of the bore that the reservoir in the channel was of a fairly limited extent. They found the maximum pressure developed on a vertical wall, which extended the entire width of the laboratory channel, to be

$$p_{\max} = \frac{K_0 \rho g V_t^4}{g^2 d_t} = K_0 V_t^2\left(\frac{V_t^2}{gd_t}\right) \qquad (11.74)$$

This can be expressed as

$$p_{\max} = \tfrac{1}{2} C_D \rho V_t^2 N_F^2 \qquad (11.75)$$

where $C_D/2 = K_0$ and the Froude number N_F is given by $V/\sqrt{gd_t}$. They found for a vertical wall that $K_0 \approx 0.5$, which would be the equivalent of $C_D \approx 1$.

It is not clear how Eqs. 11.74 and 11.75 can be used in practice. Three pressure cells were used in one set of tests and six pressure cells were used in another set of tests. The maximum measured pressure was used to determine the exponential of V_t in Eqs. 11.74 and 11.75, and this maximum might have occurred at a different cell for each bore height.

Dressler (1952, 1954) and Whitham (1955) developed theories for the speed and shape of a surge moving over a dry bottom in which bottom friction plays a major role. The initial height of water in the reservoir is d_0 above the channel, and d is the depth of the surge in the channel at some distance x from the dam at time t. In the portion of the flow substantially removed from the tip of the surge, the flow can be considered to be the same as for the frictionless case, and the set of parametric equations for d and the speed V at this x and t can be solved to give the water speed as

$$V = 2\sqrt{gd_0} - 2\sqrt{gd} \qquad (11.76)$$

If the flow were frictionless, the speed of the surge tip would be

$$V_t = 2\sqrt{gd_0} \qquad (11.77)$$

This, however, is not the case. In fact, the shape and speed of the tip are controlled largely by the friction of the bottom. The results for the tip speed from the theories of Whitham and Dressler are very similar. An average of the results of the two theories is given in Table 11.5. In this table the ratio of the tip speed to $2\sqrt{gd_0}$ is given as a function of $Rt\sqrt{g/d_0}$, where R is a dimensionless resistance coefficient ($R = g/C^2$, in which C is the Chezy roughness coefficient in the square root of feet per second).

Table 11.5. TIP SPEED FOR SURGE IN A DRY BED

$Rt\sqrt{g/d_0}$	0	0.1	0.2	0.3	0.4	0.5	0.6
$V_t/2\sqrt{gd_0}$	1.0	0.48	0.40	0.35	0.32	0.29	0.26

Cross (1967) made a laboratory and theoretical study of a surge running over a dry bottom (and also over a bottom with a film of water on it) and of the forces exerted by the surge on a structure placed in a channel. He found that the tip speeds were generally a little faster than those shown in Table 11.5, using the appropriate value of the Chezy roughness coefficient. He used both a smooth and a rough bottom in his tests and in his calculations.

In his studies of the shape of the surge tip, Cross found that the theory predicted the shape reasonably well in the immediate region of the tip of the smooth bottom after the surge had run several feet down the channel. However, after the surge had traveled 15 ft or so, the depth of the surge became nearly constant a few feet back from the tip, while the theory showed a continually increasing depth. It should be pointed out that the reservoir used in the experiment was of limited extent, while the theory is for the case of a reservoir of unlimited extent.

Cross also found that when the channel bed had a thin film of water over it (0.015 ft deep) the tip became steeper and the speed of the tip was less, compared with the dry bottom case.

The theory of Cumberbatch (1960) for the force exerted by a fluid wedge impinging on a wall was

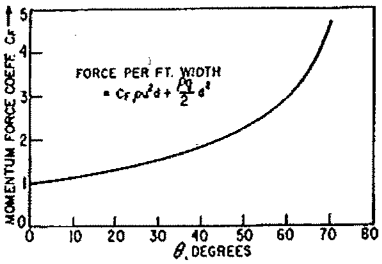


Fig. 11.44. Plot of force coefficient C_f vs θ. (From Cross, 1967.)

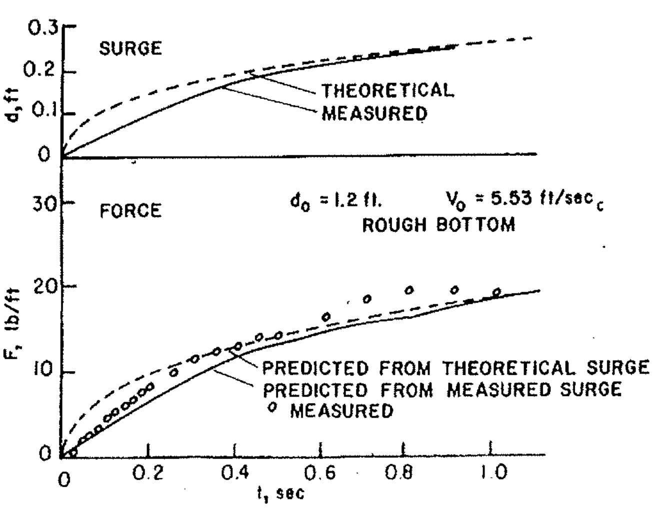
modified by Cross to include the hydrostatic force and was given as

$$F = \tfrac{1}{2}\rho g d_s^2 + C_F \rho V^2 d_s \qquad (11.78)$$

where F is the force per unit width of wall and d_s is taken as the height of the surge at the structure, if the structure were not present. Equation 11.78 is for the case of a surge striking a vertical wall extending the entire width of a channel. Cross calculated values of C_F as a function of the slope of the water surface relative to the horizontal ϕ. The results are shown in Fig. 11.44. The value of ϕ for any time t at which the surge would be moving past the obstruction were the obstruction not present can be obtained from measurements, or approximately by using the theory of a surge given by Cross.

As an example, one set of measurements is shown in Fig. 11.45, together with the profile calculated from theory using the measured surge tip speed. In this figure d_0 is the original water level in the reservoir prior to the opening of the gate to cause the surge and V_0 is the theoretical velocity of the surge front at the structure were the structure not present. The term "predicted from measured surge" refers to the measurement of a surge that was developed in the channel in a prior test, under identical conditions, but without the vertical wall being installed.

Fig. 11.45. Surge profiles (5/26 data) with predicted and measured force profiles (6/2 data), $x = 16.33$ ft. (From Cross, 1967.)



Several force records are shown in Fig. 11.46. It can be seen that a force peak occurs at about 0.75 sec after the initial force rise and that then the force remains at about a constant magnitude. The reason for this force peak was studied in detail. The surge, upon striking the vertical wall, ran up the wall a distance approximately equal to V_0^2/g for the wet bottom case and from $V_0^2/2g$ to V_0^2/g for the dry bottom case. This run-up curled back to some extent and then fell, hitting the surface of the reflecting surge. The peak force occurred at the moment this mass of water hit the surface of the reflecting surge.

If the peak force, described above, is neglected, it was found that the "steady" maximum force that occurred (and predicted with a good degree of accuracy by Eq. 11.78 together with Fig. 11.44) is also equal to the hydrostatic force computed using the depth of the reflected surge. Figure 11.44 shows, except near the immediate tip of the surge, that ϕ is small enough for $C_F \approx 1$ to be a valid approximation. Using the further approximation that $V \approx 2\sqrt{gd_s}$ and substituting this together with $C_F \approx 1$ into Eq. 11.78 results in

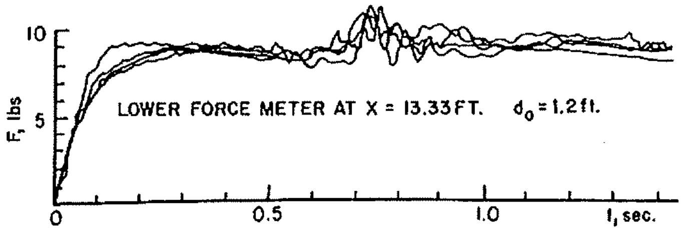


Fig. 11.46. Typical force profiles; smooth bottom. (From Cross, 1967.)

$$F = 4.5\rho g d_s^2 \qquad (11.79)$$

Now, consider a surge of depth d_s and velocity $2\sqrt{gd_s}$ being reflected by a vertical wall. If no energy is lost, the top streamline will be displaced vertically by $V^2/2g$ (i.e., by $2d_s$), so that the depth of the reflected surge should be $d_r = 3d_s$. Some previous work by the author showed that this was approximately correct, and the studies by Fukui *et al.* (1963) also showed this to be approximately correct for a surge moving in a dry channel. Then,

$$F = \tfrac{1}{2}\rho g d_r^2 = \tfrac{1}{2}\rho g(3d_s)^2 = 4.5\rho g d_s^2 \qquad (11.80)$$

which is the same as Eq. 11.77. It must be emphasized that the surge depth d_s referred to here is taken as the depth of the nearly horizontal portion of the surge a few feet to the rear of the tip.

Cross also made a limited study of the forces exerted by a surge on vertical wall that extended only part way across the channel and found that when the width of the wall was less than about twice the height of the surge, the force started to decrease rather rapidly, with $C_F \approx \frac{1}{2}$ for a section about one-half the surge height in width.

Laboratory studies similar to Cross's were made by Alavi (1964) for the author, in which the characteristics of surges in a dry bed were studied, together with the forces exerted by the surge on square and circular plies 0.145 ft in diameter. Owing to the restricted width of the channel (0.5 ft) compared with the size of the piles, and owing to the fact that the surge flows are supercritical, the results are only indicative of the forces. The equation

$$F = \tfrac{1}{2} C_D \rho D d_s V^2 \qquad (11.81)$$

was used to express the force, where D is the pile diameter and C_D is the coefficient of drag. It was found that C_D averaged 1.1 for the circular pile and 1.8 for the square pile for Reynolds numbers (DV/ν, where ν is the kinematic viscosity) between about 10^4 and 10^5.

In these studies, Alavi found that there was a linear relationship between d_s and d_0, with $d_s = 0.26d_0$, at the point where he measured d_s, about 20 ft downstream from the dam. It was found that $V_s \approx 2\sqrt{gd_s}$ for values of $d_s < 0.2$ ft and $V_s \approx 2.2\sqrt{gd_s}$ for $0.2 < d_s < 0.35$ ft. It was also found that although the maximum run-up on a vertical wall was a function of d_s (hence, V_s), $d_r/d_s = 3$.

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HANDBOOK

ROBERT D. BLEVINS

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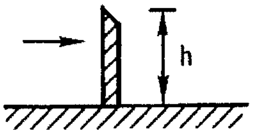
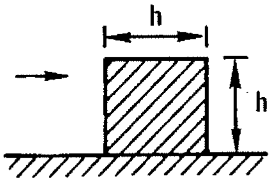
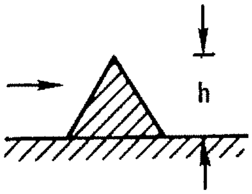
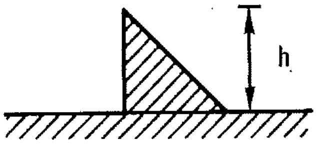
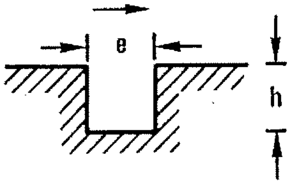
Table 10-15. Drag of Protuberances.

Notation: C_D = coefficient of drag of a protuberance for boundary layer thickness much less than height, $h >> \delta$, where δ is the boundary layer thickness and h is the protuberance height. The drag force is $F_D = \frac{1}{2}\rho U^2 A C_D$ for $h >> \delta$. A is the projected area A = bh for two-dimensional sections and rectangular bodies where b is width. See text for drag force for h comparable to δ. (Refs. 10-99. 10-102, 10-106, 10-107.) Errors in C_D of ±20% can be expected. Also see Tables 10-17 and 10-19 and Chapter 11.

Protuberance	Drag Coefficient, C_D and Remarks
1. Fence Section  	1.4 (also see Fig. 10-14)
2. Square Section  	1.2
3. Equilateral Triangle Section  	1.0
4. Right Triangle  	→ 1.3 ← 1.0
5. Gap Section  	0.01 h > e > 0.1 h 0.25 8h > e > 20 h (also see Ref. 10-105)

Attachment B

Hydraulic Analysis of Lower Ash Pond to
Release of Water from
Economizer Ash Pond
Burlington Generating Station

SHEET NO. 1 OF 3
PROJECT NO. 154.002.009
DATE 4-1-11
BY TJH CKD MWL

HYDRAULIC ANALYSIS - ECONOMIZER ASH POND
'DISCHARGE FROM LIQ. MASS FLOW

PROBLEM DEFINITION

1.) A SLOPE FAILURE OCCURS IN THE NORTH FACE OF THE ECONOMIZER ASH POND IN THE AREA INDICATED ON FIGURE 1

2.) SHEAR STRESS FROM THE SLOPE FAILURE LIQUIFIES A SUBSTANTIAL VOLUME OF THE ECONOMIZER ASH, FIGURE 2.

3.) THE LIQUIFIED ASH FILLS THE EASTERN HALF OF THE UPPER ASH POND FORCING WATER AND FLUID ASH IN THE UPPER ASH POND TO THE WEST AND NORTH OVER THE TOP OF THE UPPER ASH POND EMBANKMENT AND INTO THE LOWER ASH POND.

WHAT IS THE HYDRAULIC RESPONSE IN THE LOWER ASH POND?

- SOUNDINGS IN THE UPPER ASH POND TAKEN IN 2009 SHOW APPROXIMATELY 5 ft. OF WATER

- NORMAL WATER ELEVATION IN UPPER ASH POND 529 ft AND TOP OF EMBANKMENT 531 ft.

FROM FIGURE 1 DISPLACED WATER IN UPPER ASH POND

$$(5')(700')(300') \simeq 1{,}000{,}000 \text{ ft}^3$$

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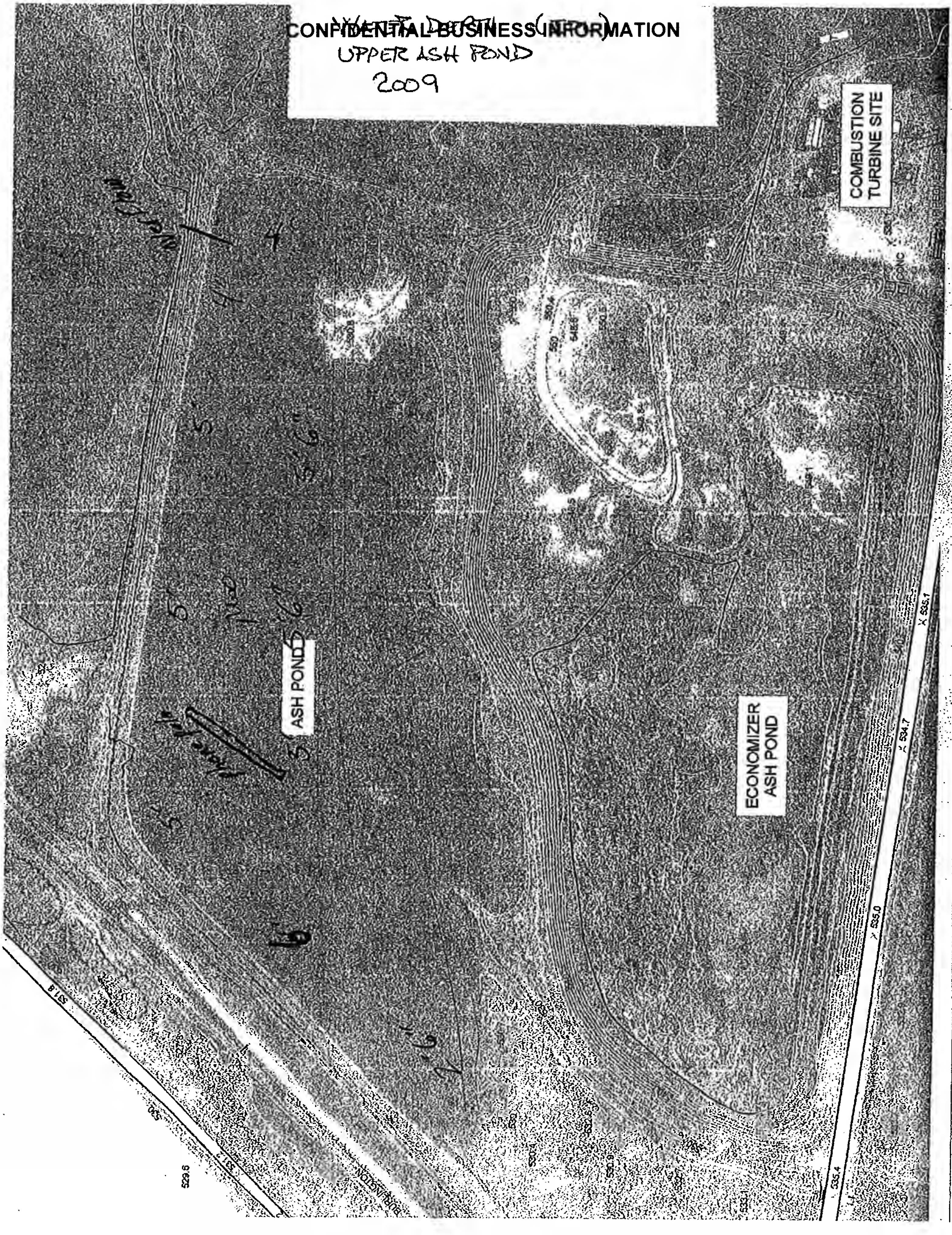
UPPER ASH POND

2009



SHEET NO. 2 OF 3
PROJECT NO. 154.002.009
DATE 4-1-11
BY TJH CKD MWL

HYDRAULIC ANALYSIS – ECONOMIZER ASH POND
DISCHARGE FROM LIQ. MASS FLOW

- WATER MUST RISE 2' TO OVERTOP EMBANKMENT PART OF WATER BACKS UP INTO WEST END OF UPPER ASH POND

$$(2')(900')(250') \simeq 500,000 \text{ ft}^3$$

- REMAINING 500,000 ft³ GOES OVER TOP OF UPPER ASH POND EMBANKMENT AND INTO THE LOWER ASH POND

- ASSUME TIME RATE OF WATER PUSHED TO LOWER ASH POND SAME AS LIQUIFIED MASS ARRIVAL AT EMBANKMENT Pg. 2 of 2 "ECONOMIZER ASH FLOW CALCULATION".

TIME (MIN)	ft	% COMPLETE (depth/8 ft)
1	~~5.3~~ 5.9 MWL	~~69~~ 74 MWL
2	~~6.0~~ 6.9 MWL	~~85~~ 86 MWL
3	~~7.2~~ 7.3 MWL	~~90~~ 91 MWL
4	7.4	93
5	7.5	94
6	7.6	95
7	7.7	96

ASSUME COMPLETE @ 10 MINUTES

90% IN FIRST 3 MINUTES $0.90\,(500,000 \text{ ft}^3) = 450,000$
10% IN LAST 7 MINUTES $0.10\,(500,000 \text{ ft}^3) = 50,000$

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SHEET NO. 3 OF 3
PROJECT NO. 154.002.009
DATE 4-1-11
BY TJH CKD MWL

HYDRAULIC ANALYSIS - ECONOMIZER ASH POND
DISCHARGE FROM LIQ. MASS FLOW

BUFFER CAPACITY IN LOWER ASH POND

$$(1100')(700')(1') = 770{,}000\ ft^3/ft$$

TIME 0-3 MINUTES $450{,}000 ft^3 / 770{,}000 ft^3/ft = 0.58 ft$

TIME 3-10 MINUTES $50{,}000 ft^3 / 770{,}000 ft^3/ft = 0.065 ft$

TOTAL RISE IN LOWER ASH POND $= 0.58^{ft} + 0.065^{ft}$
$\cong$ 8 INCHES

- BERM AT NORTH END OF LOWER ASH POND IS APPROXIMATELY THREE FEET ABOVE NORMAL FLOW LEVEL
- EIGHT INCH WATER SURGE WILL DISCHARGE THROUGH EXISTING OVERFLOW WEIR AT INCREASED FLOW RATE
- SOLIDS IN WATER SURGE WILL SETTLE IN LOWER ASH POND

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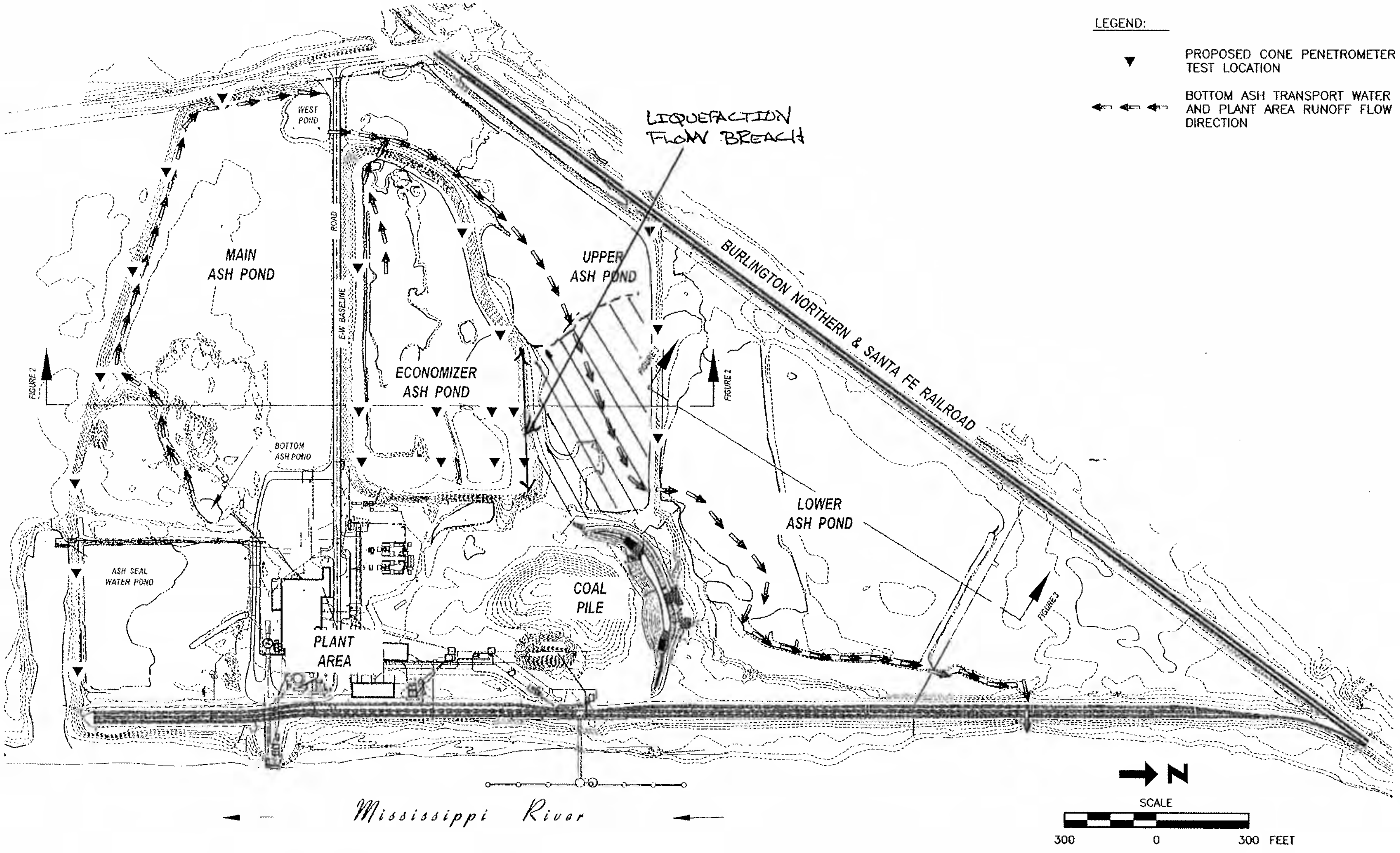

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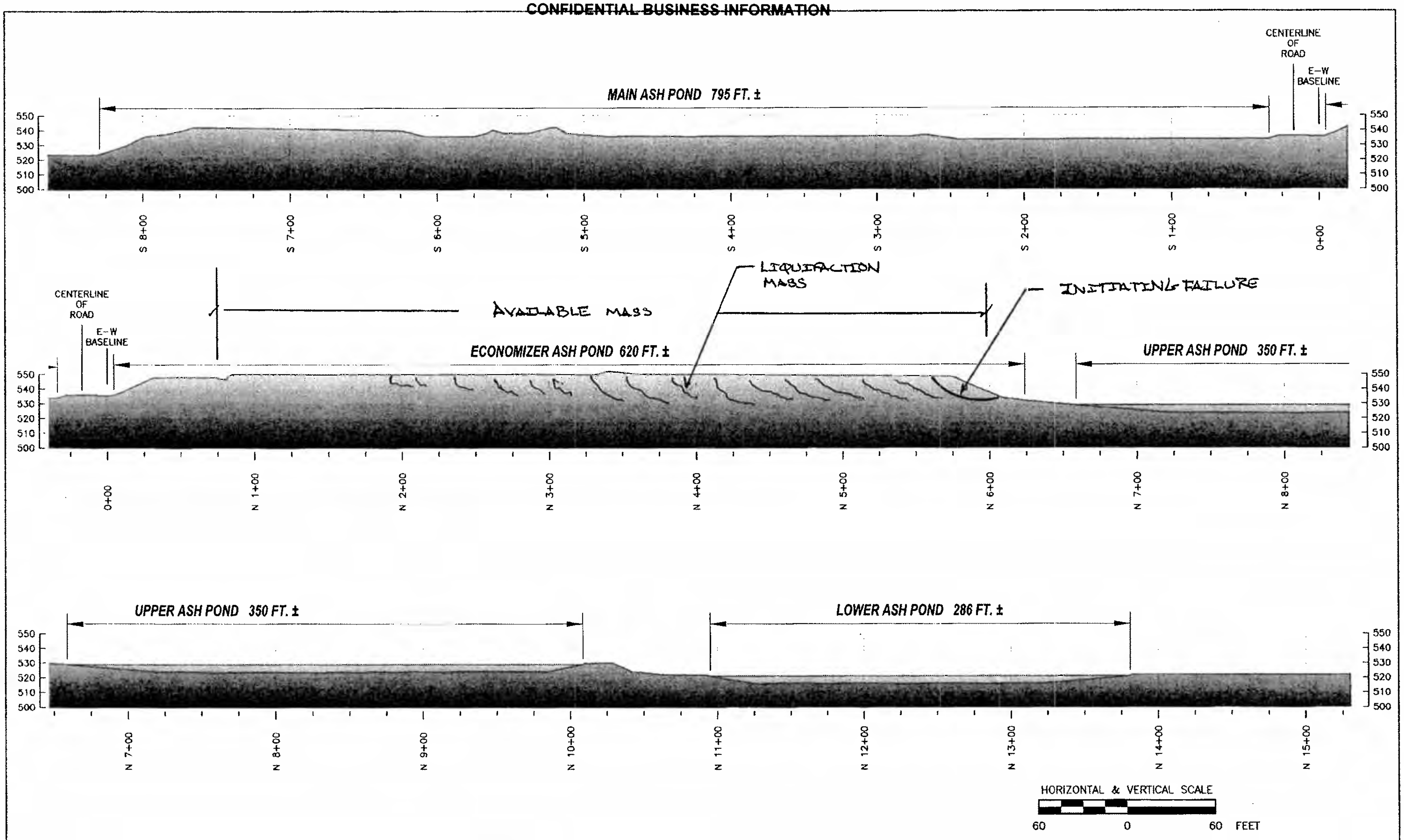

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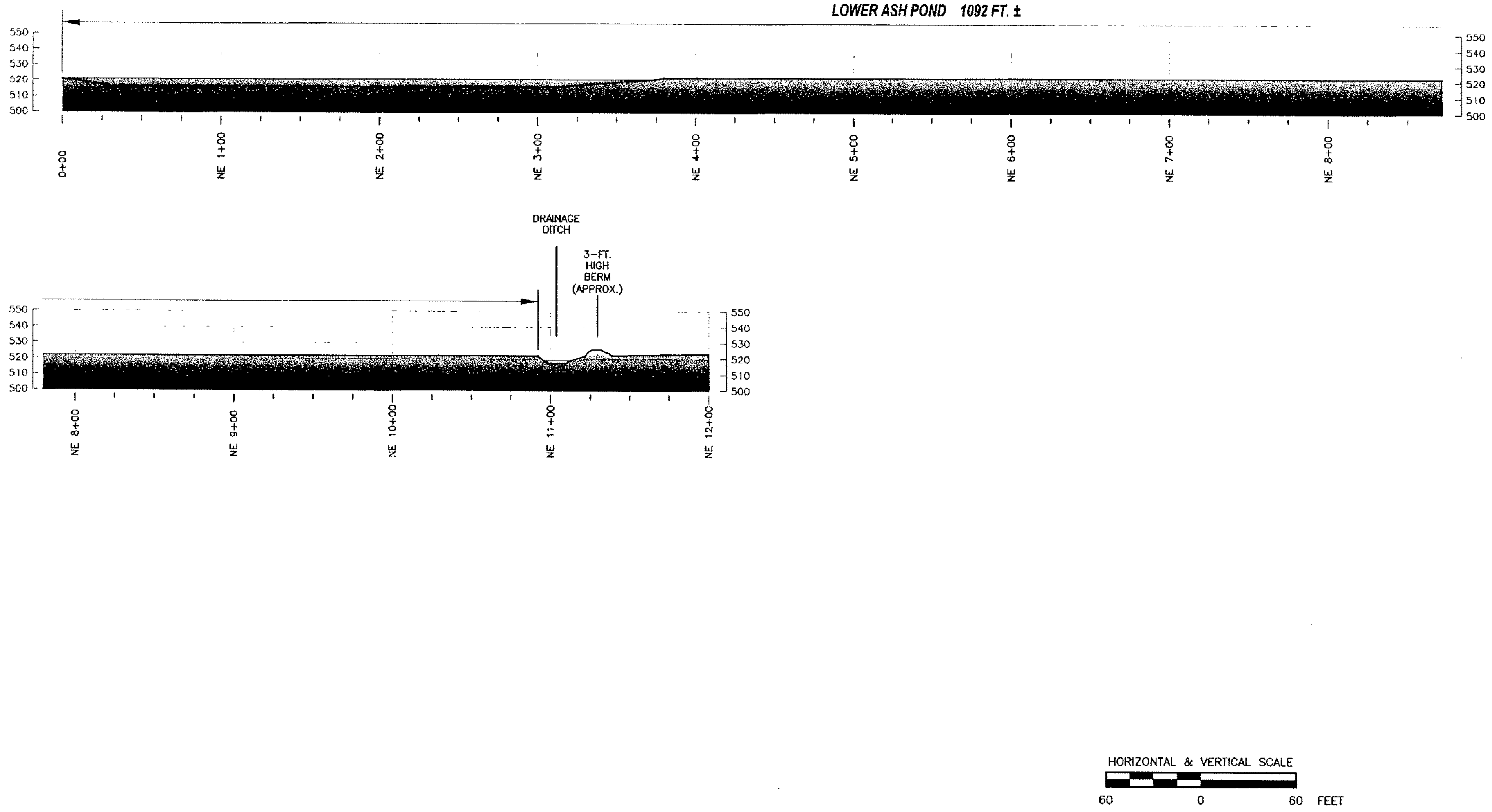
DRAWING DESCRIPTION
NORTH - SOUTH
CROSS SECTION
(VIEW LOOKING WEST)

JOB 154.002.009
SHT. 2
DWG. FIGURE 2

CONFIDENTIAL BUSINESS INFORMATION



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SCALE: AS SHOWN
DATE: 03-22-11
DRAWN BY: MM
CHKD. BY:
APPROVED:

CLIENT / LOCATION
ALLIANT ENERGY
BURLINGTON GENERATING STATION
BURLINGTON, IOWA

DRAWING DESCRIPTION
NORTHEAST - SOUTHWEST
CROSS SECTION
(VIEW LOOKING NORTHWEST)

JOB 164.002.009
SHT. 3
DWG. FIGURE 3

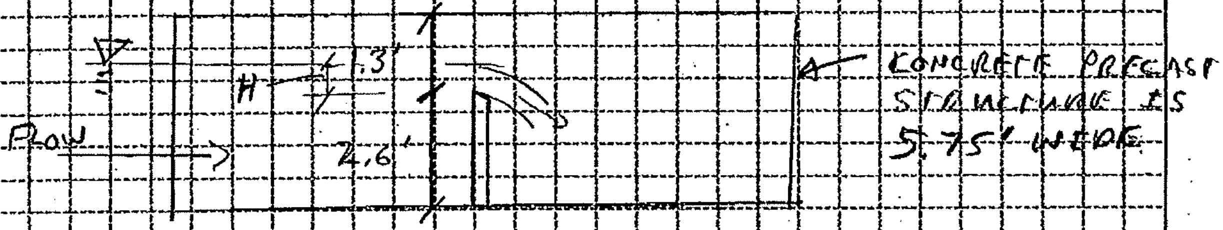
CONFIDENTIAL BUSINESS INFORMATION

SHEET NO. 1 OF
PROJECT
DATE 3/1/11
BY MWL CKD TJH

RECTANGULAR WEIR CALCS.
LOWER ASH POND

① CONCRETE DISCHARGE WEIR IS A SHARP CRESTED RECTANGULAR WEIR

WEIR DIMENSIONS



② USE THE FOLLOWING EQUATION

$$Q = CLH^{(3/2)}$$

Q = FLOW IN FT³/S
C = DISCHARGE COEFFICIENT = 3.33
L = LENGTH OF WEIR = 5.75'
H = HEIGHT OF WATER ABOVE WEIR

③ CALC H_N OF NORMAL FLOW

$$Q_{AVG} = 3.216 \text{ MGD} = 4.98 \text{ FT}^3/\text{SEC}$$

$$4.98 \text{ FT}^3/\text{SEC} = (3.33)(5.75 \text{ FT})(H)^{(3/2)}$$

$$H_N = 0.407 \text{ FT} = 4.89 \text{ IN}$$

④ IS THE HEIGHT OF THE WEIR SUFFICIENT TO HOLD AVERAGE FLOW PLUS 500,000 FT³ OF LIQUIDS?

$H_L = 0.645$ FT (SEE HYDRAULIC ANALYSES - ECONOMIZER ASH POND)

SHEET NO. 2 of
PROJECT
DATE 4/1/11
BY M.W.L CKD TJH

RECTANGULAR WEIR CALCS (CONT.)
LOWER ASH POND

$H_T = H_L + H_V = 0.407\ ft + 0.645\ ft$

$= 1.052\ FT$

STRUCTURE HAS 1.3 FT OF FREEBOARD

$\therefore$ OK

⑤ CALCULATE Q_0 AT TIME ZERO USING H_T

$Q_0 = C L H_T^{(3/2)}$

$= (3.33)(5.75')(1.052\ FT)^{3/2}$

$Q_0 = 20.66\ FT^3/SEC$

→ SEE ATTACHED SPREADSHEET FOR FLOWS OVER TIME

CONCLUSIONS:

- WATER FLOW FROM ECONOMIZER LIQUEFACTION IS THREE TIMES THE AVERAGE FLOW
- THE FIRST 25% OF THE DISPLACED WATER WILL DRAIN IN 2.5 HOURS
- 50% OF THE DISPLACED WATER WILL DRAIN IN 6 HOURS
- 90% OF THE DISPLACED WATER WILL DRAIN IN 24 HOURS

LOWER ASH POND

TJH

CONFIDENTIAL BUSINESS INFORMATION

GIVEN:

$C = 3.33$

L (ft) = 5.75

Area of Lower Ash Pond (sf) = 770,000

$H_T = H_N + H_L = 1.052$

Time (hr)	Time (Day)	$Height_T$ (ft)	Q_T (ft^3/sec) = $C*L*H^{(3/2)}$	Q_{AVG} (ft3/sec)	$Q_{from\ liqu}$ (ft3/sec)	$V_{from\ liqu}$ (ft^3)	Delta H (ft) = V/A	% of Total	Cumulative
0.0	0.00	1.052							
0.5	0.02	1.015	20.66	4.98	15.68	28,224	0.03666	5.6%	5.6%
1.0	0.04	0.981	19.59	4.98	14.61	26,298	0.03415	5.3%	10.9%
1.5	0.06	0.949	18.61	4.98	13.63	24,534	0.03186	4.9%	15.8%
2.0	0.08	0.920	17.71	4.98	12.73	22,915	0.02976	4.6%	20.4%
2.5	0.10	0.892	16.88	4.98	11.90	21,428	0.02783	4.3%	24.7%
3.0	0.13	0.866	16.12	4.98	11.14	20,059	0.02605	4.0%	28.7%
3.5	0.15	0.841	15.42	4.98	10.44	18,797	0.02441	3.8%	32.5%
4.0	0.17	0.818	14.77	4.98	9.79	17,631	0.02290	3.5%	36.0%
5.0	0.21	0.775	14.18	4.98	9.20	33,105	0.04299	6.6%	42.6%
6.0	0.25	0.738	13.07	4.98	8.09	29,137	0.03784	5.8%	48.4%
7.0	0.29	0.704	12.13	4.98	7.15	25,734	0.03342	5.1%	53.6%
8.0	0.33	0.675	11.31	4.98	6.33	22,800	0.02961	4.6%	58.1%
9.0	0.38	0.648	10.61	4.98	5.63	20,258	0.02631	4.1%	62.2%
10.0	0.42	0.625	9.99	4.98	5.01	18,046	0.02344	3.6%	65.8%
11.0	0.46	0.604	9.46	4.98	4.48	16,113	0.02093	3.2%	69.0%
12.0	0.50	0.585	8.98	4.98	4.00	14,417	0.01872	2.9%	71.9%
13.0	0.54	0.568	8.57	4.98	3.59	12,924	0.01678	2.6%	74.5%
14.0	0.58	0.553	8.20	4.98	3.22	11,606	0.01507	2.3%	76.8%
15.0	0.63	0.540	7.88	4.98	2.90	10,439	0.01356	2.1%	78.9%
16.0	0.67	0.527	7.59	4.98	2.61	9,403	0.01221	1.9%	80.8%
17.0	0.71	0.516	7.34	4.98	2.36	8,481	0.01101	1.7%	82.5%
18.0	0.75	0.507	7.11	4.98	2.13	7,658	0.00995	1.5%	84.0%
19.0	0.79	0.498	6.90	4.98	1.92	6,922	0.00899	1.4%	85.4%
20.0	0.83	0.489	6.72	4.98	1.74	6,264	0.00813	1.3%	86.6%
21.0	0.88	0.482	6.56	4.98	1.58	5,673	0.00737	1.1%	87.8%
22.0	0.92	0.475	6.41	4.98	1.43	5,142	0.00668	1.0%	88.8%
23.0	0.96	0.469	6.28	4.98	1.30	4,664	0.00606	0.9%	89.7%
24.0	1.00	0.464	6.16	4.98	1.18	4,234	0.00550	0.8%	90.6%
					TOTAL Discharge	**452,904.5**		**90.6%**	

ALLIANT ENERGY.

CONFIDENTIAL BUSINESS INFORMATION

April 5, 2011

Memorandum

To: Dan Siegfried (Alliant Energy Managing Attorney)

CC: Terry Kouba (Director Generation Operations)
William Skalitzky (Senior Environmental Specialist)

From: Plant Manager (Buddy Hasten)

Re: BGS Response to EPA Letter dated 3-29-2011(Re: Response to Alliant Energy March 23, 2001 Letter: Significant Structural Stability Concerns at the Burlington Generating Station)

The memo provides a response to EPA's letter dated March 29, 2011 that was in answer to our letter addressing significant structural stability concerns at the Burlington Generating Station. EPA concurred with the actions that BGS proposed to address concerns with structural stability of the ash ponds on site; however, they included an additional seven action items in their response. This memo specifically addresses additional requested activities C, D, and E in the letter.

Item C: "Avoid stockpiling reclaimed Economizer Ash on the north side of the pond." The BGS Economizer Ash pond has changed since the Dewberry site visit. During the Dewberry visit, ash deposits were observed on top of the Economizer Ash pond as a result of a major rearrangement of the pond's settling basin and discharge path. The excavated ash was dewatered and taken to a landfill. BGS does not stock pile ash on top of the pond for long time storage. The attached picture shows the current configuration of the pond and clearly shows that no ash is stockpiled on either the north or south sides of the pond. The only ash that will be placed on top of the pond will be as a result of our periodic dredging, dewatering and hauling process. BGS will not perform dredging operations until late summer, by which time the results of additional soil borings and formal dam break analysis will be known.

Item D: "Relocate handling and loading operations for the reclaimed Economizer Ash to the south side of the pond." Our process for maintaining the Economizer Ash pond settling basin requires us to periodically dredge ash from the basin. Based on the physical arrangement of the ash pond, most of the dredging operations can be performed on the south and east sides of the pond but there will still be some need to dredge and place material on the north side of the pond to dewater prior to hauling away. The section of the pond on the north side that would be used is approximately 120' wide and the handling and loading operations are nearly 100' from the north edge of the levee. As stated above, BGS will not perform dredging operations until late summer by which time the results of additional soil borings and formal dam break analysis will be known.

Item E: Establish an equipment-free perimeter (minimum 10 feet) along the entire water's edge of the Economizer pond." BGS assumes that EPA is referring to the exterior water's edge. If EPA is referring to the exterior North side of the Economizer Ash pond only, then this request should be feasible once the discharge path is rerouted to the center of the pond. BGS will agree to not use heavy equipment (e.g. dozers, dump trucks, etc.) along the water's edge on the North side of the levee until the additional soil borings and analysis have been completed and the results communicated to EPA. However, equipment access inside a 10 foot zone along the water's edge is required for routine maintenance (e.g. grass cutting, minor landscaping, etc.).

The actions above are being taken at this time based on inconclusive soil boring data in which ash and not clay was reported as the subsurface foundation material for the north east corner of the levee.

BGS will reevaluate the need for the cautionary actions of items C, D, and E above following a follow-up set of soil borings that are scheduled to be taken on the Economizer Ash pond levee.

Buddy Hasten
Plant Manager

CONFIDENTIAL BUSINESS INFORMATION

aether dbs

elemental design build solutions

April 4, 2011 154.002.009.001

Mr. Daniel Siegfried, Managing Attorney
Alliant Energy Corporate Services
Legal Department
200 First Street SE
PO Box 351
Cedar Rapids, IA 52406-0351

Re: Response to Additional Activities Request
United States Environmental Protection Agency
March 29. 2011 Response to Alliant's March 23, 2011 Submittal

Dear Mr. Siegfried;

Aether DBS, LLC is responding to additional activities requests A, B and F from the United States Environmental Protection Agencies (USEPA's) letter to Alliant Energy Corporation (Alliant) of March 29, 2011. For completion in our response, the USEPA request is repeated along with Aether's response.

A. *Conduct a formal dam break analysis based on a catastrophic failure of the Economizer Ash Pond, with accompanying calculations and reference material, signed by a Professional Engineer on letterhead.*

   The calculations and references in support of the dam break analysis summarized in Alliant's March 23, 2011 submittal are enclosed as Attachment A. The analysis is based on the momentum principals of Saint-Venant. The liquefied ash is conservatively treated as water with no viscosity. The force of the released wave on the clay embankment at the north end of the Upper Ash Pond is based on the conservation of energy.

   The release of a negative roll wave as presented in Chow, is based on an infinite source of water (liquefied soil). The equation projects that the flow reaches a constant thickness forever. The Economizer Ash Pond is not infinite and the spreading of liquefaction in the Economizer Ash Pond will run out of source at about the same time it reaches the Upper Ash Pond north embankment. In support of this finite limiting concept, the TVA Kingston ash pile ran out of source before the entire pond contents flowed out of the pond area.

When the flowing ash stops it stops suddenly and reverts to a solid form. From experience at Kingston the change from fluid behavior to solid behavior occurs at a unit weight of 70 to 75 pounds per cubic foot. For conservatism, Aether assumed that the unit weight of the flowing ash was 95 pounds per cubic foot when it contacts the Upper Ash Pond embankment. The resultant pressure will not move the clay embankment.

Aether trusts that a review of the calculations and references in conjunction with the Figures showing the true scale variations of site features will assure the USEPA that the contents of a liquefied Economizer Ash Pond will remain within the confines of the Economizer Ash Pond and the Upper Ash Pond at the Burlington Generating Station.

The work by Aether was perform by or under the supervision of Mr. Timothy J. Harrington, P.E. who has over 35-years of engineering experience including significant work on the liquefaction of soils and the effects of earthquakes on structures founded on soil. Mr. Harrington directed work at TVA Kingston to remove ash from the Emory River and is experienced with the ways that ash handles when in a liquefied state. Mr. Harrington is a registered professional engineer in ten states and is responsible for the technical content of Aether's presentation.

B. *Conduct a hydraulic study that verifies only water is released in the event of an Economizer embankment failure.*

If static liquefaction results in fluidized economizer ash flowing north into the Upper Ash Pond the flowing ash would displace water and settled fluid ash in the Upper Ash Pond. The displaced water would flow to the western end of the Upper Ash Pond and up and over the crest of the Upper Ash Pond. The liquefied mass of Economizer Ash would be arrested at the Upper Ash Embankment with all motion complete in less than 10-minutes (Attachment A).

Aether estimates that the Upper Ash Pond contains approximately 1,000,000 cubic feet of water and that 50% of the water will flow to the western end of the pond and 50% will go over the top of the Upper Ash Pond embankment and enter the Lower Ash Pond, Attachment B. The rate of flow over the top of the embankment will be proportional to the arrival of the liquefied Economizer Ash with 90% of the flow in the first three minutes and the remaining 10% over the next seven minutes.

The water overtopping the Upper Ash Pond will be detained in the Lower Ash Pond and will result in an increase of the Lower Ash Pond water elevation by approximately 8-inches. The flow over the Lower Ash Pond discharge weir will increase by three times the normal flow and the first 25% of the surge of water will take approximately 2.5 hours to discharge from the Lower Ash Pond. Half of the displaced water will take about 6 hours to discharge and approximately 24 hours to drain approximately 90% of the displaced water over the lower ash pond weir structure. The retention will provide more than adequate time for the fluid ash from the Upper Ash Pond to settle prior to discharge of the water to the Mississippi River.

F. *Install slope inclinometers in association with the new borings. The slope inclinometer data should provide locations and magnitude of horizontal movement within the Economizer Ash Pond embankment and underlying materials. Periodic measurements should provide data on the rate of movement. This data should be part of a geotechnical report that describes the actions taken by Alliant to address the embankment stability issue.*

Aether does not understand how the use of slope inclinometers would lower the ash release risk at the Burlington Station. The failure mechanisms that would lead to liquefaction flow are either a design level earthquake or a static shear event that causes static liquefaction of the Economizer Ash Pond. Both of these events would be sudden without movement of the embankments prior to the liquefaction event. The slope inclinometers would not show movement prior to the event.

Liquefaction is triggered by sudden increases of pore water pressure in fine sands, silts or sensitive clays. Sudden means occurring in less than a minute. These increases may result from the cyclic shearing that occurs in the strong motion of a large earthquake or by the sudden shearing failure of a slope that is saturated. In both cases the slope will not be moving prior to the shearing event. At TVA Kingston the slope failed due to increased seepage pressure and weight from suddenly increasing the hydraulic flow to the pile.

Aether understands that the hydraulic flow to the Economizer Ash Pond has not increased and that Alliant is removing Economizer Ash as it accumulates and taking it off the top of the Economizer Ash Pond.

Aether suggests that we first determine if a clay embankment is present in the eastern half of the north Economizer Ash Pond embankment before making decisions on the use of inclinometers as a monitoring tool. The purpose in that case would be to monitor the relative movements between the embankment and the underlying soil that might be occurring because of increased loadings.

Respectfully,

Timothy J. Harrington, P.E.

Mark Loerop

Mark W. Loerop, P.E

Attachment A

Liquefaction Flow Analysis

Economizer Ash Pond

Burlington Generating Station

SHEET NO. 1 OF 4
PROJECT NO. 154.002.009
DATE 3-22-11
BY TCW CKD TJH

Alliant Burlington
ECONOMIZER ASH FLOW ESTIMATE

Economizer Pond Dam Break Problem

$$X = 2t\sqrt{gY_2} - 3t\sqrt{gY} \quad (19\text{-}62) \text{ equ.}^{*}$$

Note: Initial Velocity = 0

Y_2 = Initial Fluid Height = 18'
(550' - 532')

X = distance of interest
= distance to upper ash pond dike
= 400'

with X specified then $Y = f(t)$
where Y = depth @ X

$$\frac{400'}{t} = 2\sqrt{gY_2} - 3\sqrt{gY}$$

$$3\sqrt{gY} = 2\sqrt{gY_2} - 400'/t$$

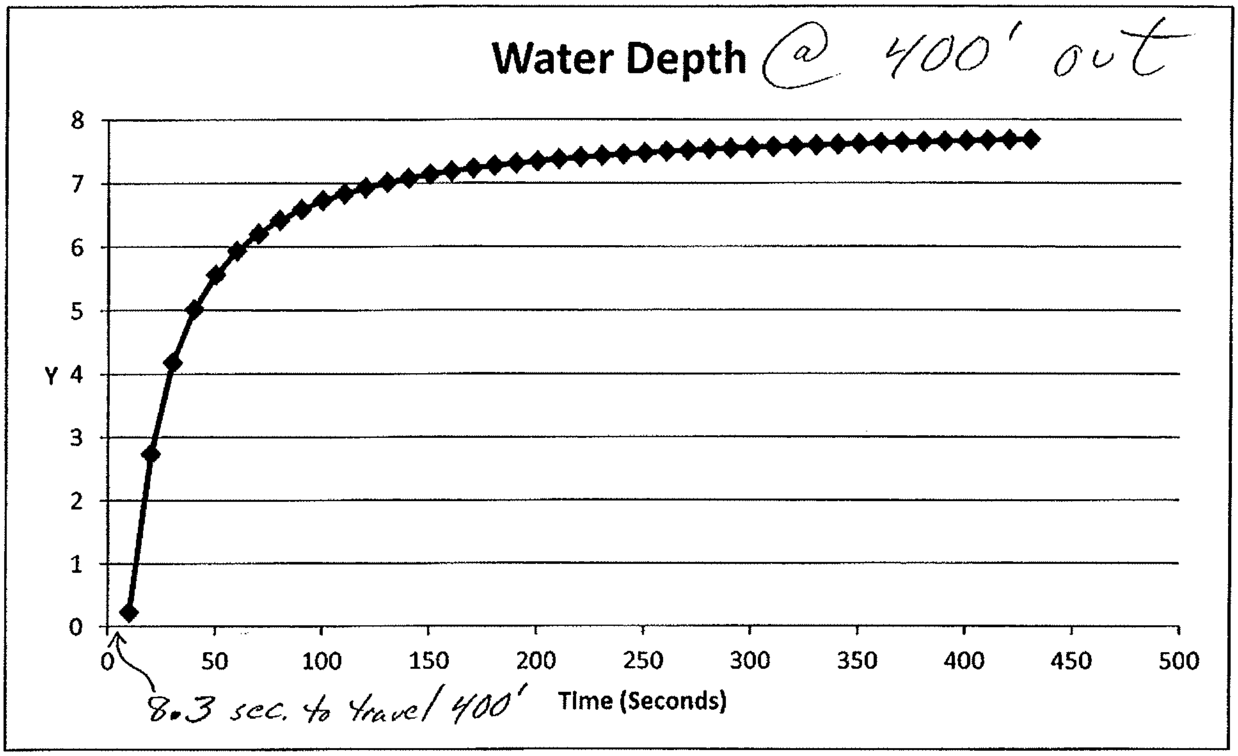
$$Y = \left(2\sqrt{gY_2} - 400/t\right)^2 / (9g)$$

if $t \to \infty$ then $Y = 8'$ regardless of X
(given an infinite resevoir)

* Ref: Open Channel Hydraulics
Chow 1959 p 568

CONFIDENTIAL BUSINESS INFORMATION/154.002.009

Economizer Pond Dam-Break Problem


Water Depth @ 400' out

8.3 sec. to travel 400'

G 32.174 ft/sec2
Y0 18 ft
X 400 ft

t (sec.)	y (ft.)
10	0.22828
20	2.732762
30	4.181535
40	5.021037
50	5.561574
60	5.937281
70	6.213161
80	6.424182
90	6.590746
100	6.725532
110	6.836826
120	6.930269
130	7.009831
140	7.078389
150	7.138076
160	7.190507
170	7.236929
180	7.278319
190	7.315452
200	7.348952
210	7.379328

' ' ' '

By TCW 3-22-2011
154.002.009
Alliant Energy - Burlington Generating Station
Ash Pond Stability

SHEET NO. 3 OF 4
PROJECT NO. 154.002.009
DATE 3-22-11
BY TCW CKD TJH

Alliant Burlington
Economizer Ash Flow

wave front speed $= 2\sqrt{gh}$

$= 48$ fps $= 33$ mph

so 8.3 seconds to travel 400'
but heigth = zero on the leading edge

$$Q_{max} = \frac{8}{27} Y_0 \sqrt{g \cdot Y_0} \quad (\text{equ. } 1^*)$$

$$V_{max} = \frac{2}{3} \sqrt{g \cdot Y_0} \quad (\text{equ. } 11^*)$$

where V_{max} is at the dam location

$\Rightarrow$ assume $V_{max} = V_{max}$ at the dike 400 feet away

$V = 16.0$ fps

The pressure on the dike from such a velocity can be calculated by

$$p = \frac{1}{2} C_D \rho V^2 \quad (11.71^{**})$$

ignoring hydrostatic forces

$\rho =$ mass of fluid

** Ref; Earthquake Engineering, Robert L. Wiegel 1970, p 299

* Ref; Guidelines for Calculating and Routing a Dam-Break Flood, USACE January 1977 RD-5

SHEET NO. 4 OF 4
PROJECT NO. 154.002.009
DATE 3-22-11
BY TCW CKD TJH

Alliant Burlington
ECONOMIZER ASH FLOW

C_D = drag coefficient

$\approx$ 1.0 for Equilateral Triangle

Ref: Applied Fluid Dynamics Handbook, Robert D. Blevins, Phd. 1984, p 310

$$\rho = 95 \text{ PCF}/g$$

$$p = \frac{1}{2}\ 1.0\ \frac{95}{32.2}\ \frac{\text{PCF}}{\text{fps}^2}\ (16 \text{ fps})^2$$

$$= 380 \text{ PSF}$$

Acting on a eight foot high Dike/ft.

$$F = p * H = 380 \text{ PSF} * 8'/\text{ft}$$

$$= 3{,}040 \text{ Pounds}/\text{ft width}$$

Which is much less than the force required to shear off the dike with its cohesion at 1,000 PSF+.

OPEN-CHANNEL HYDRAULICS

VEN TE CHOW, Ph.D.
Professor of Hydraulic Engineering
University of Illinois

McGRAW-HILL BOOK COMPANY
New York Toronto London
1959

where w is the unit weight of water, T is the top width, and h is the surge height. The kinetic energy of the element is evidently equal to

$$\text{K.E.} = \frac{wV^2yT}{2g} \qquad (19\text{-}47)$$

where y is the depth of water and V is the velocity of flow. By Eq. (19-23) or Eq. (19-19), as the case may be, the above equation may be reduced to

$$\text{K.E.} = \frac{wh^2gyT}{2c^2} \qquad (19\text{-}48)$$

Assuming a surge of small height,

$$c = \sqrt{gy}$$

and the above equation becomes

$$\text{K.E.} = \tfrac{1}{2}wh^2T \qquad (19\text{-}49)$$

The total energy of surge per unit length is, therefore,

$$E = \text{P.E.} + \text{K.E.} = wh^2T \qquad (19\text{-}50)$$

19-4. Negative Surges. Negative surges are not stable in form, because the upper portions of the wave travel faster than the lower portions (Art. 19-1). If the initial profile of the surge is assumed to have a steep front, it will soon flatten out as the surge moves through the channel (Fig. 19-8). If the height of the surge is moderate or small compared with the depth of flow, the equations derived for a positive surge can be applied to determine approximately the propagation of the negative surge. If the height of the surge is relatively large, a more elaborate analysis is necessary as follows:

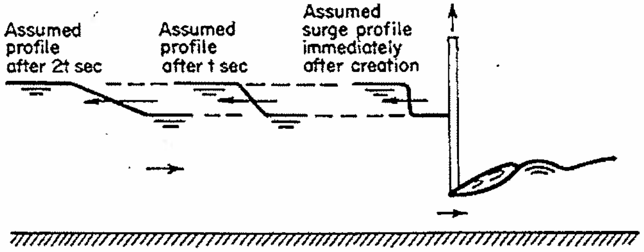


Fig. 19-8. Propagation of a negative surge due to sudden lift of a sluice gate.

Figure 19-9 shows a type D surge (Fig. 19-2) of relatively large height, retreating in an upstream direction. The surge is caused by the sudden lifting of a sluice gate. The wave velocity of the surge actually varies from point to point. For example, V_w is the wave velocity at a point on the surface of the wave where the depth is y and the velocity of flow through the section is V. During a time interval dt, the change in y is dy. The value of dy is positive for an increase of y and negative for a decrease of y. By the momentum principle, the corresponding change in hydrostatic pressure should be equal to the force required to change the momentum of the vertical element between y and $y + dy$. Considering a unit width of the channel and assuming $\beta_1 = \beta_2 = 1$,

$$\frac{w}{2}y^2 - \frac{w}{2}(y + dy)^2 = \frac{w}{g}(y + \tfrac{1}{2}dy)(V + V_w)\,dV \qquad (19\text{-}51)$$

Simplifying the above equation and neglecting the differential terms of higher order,

$$dy = -\frac{V + V_w}{g}\,dV \qquad (19\text{-}52)$$

As described previously (Art. 19-1), the whole wavefront can be assumed to be made up of a large number of very small waves placed one on top of the other. The velocity of the small wave at the point under consideration may be expressed according to Eq. (19-11) as

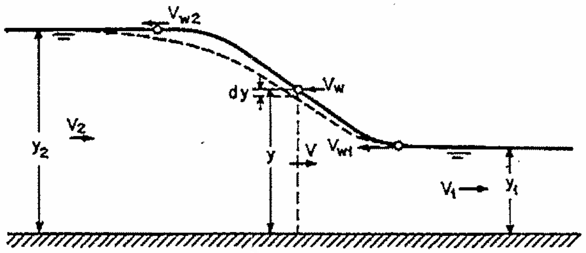


Fig. 19-9. Analysis of a negative surge.

$$V_w = \sqrt{gy} - V \qquad (19\text{-}53)$$

Similarly, the velocity at the wave crest is

$$V_{w2} = \sqrt{gy_2} - V_2 \qquad (19\text{-}54)$$

and, at the wave trough,

$$V_{w1} = \sqrt{gy_1} - V_1 \qquad (19\text{-}55)$$

When the surge is not too high, a straight-line relation between V_{w1} and V_{w2} may be assumed. Thus, the mean velocity of the wave may be considered to be

$$V_m = \frac{V_{w1} + V_{w2}}{2} \qquad (19\text{-}56)$$

Now, eliminating V_w between Eqs. (19-52) and (19-53),

$$\frac{dy}{\sqrt{y}} = -\frac{dV}{\sqrt{g}} \qquad (19\text{-}57)$$

Integrating this equation from y_2 to y and from V_2 to V, and solving for V,

$$V = V_2 + 2\sqrt{gy_2} - 2\sqrt{gy} \qquad (19\text{-}58)$$

From Eq. (19-53),

$$V_w = 3\sqrt{gy} - 2\sqrt{gy_2} - V_2 \qquad (19\text{-}59)$$

Thus, the wave velocity at the trough of the wave is

$$V_{w1} = 3\sqrt{gy_1} - 2\sqrt{gy_2} - V_2 \qquad (19\text{-}60)$$

Let t be the time elapsed since the surge was created or, in this case, since the sluice gate was opened. At $t = 0$, the wavelength $\lambda = 0$. After t sec, the wavelength is equal to

$$\lambda = (V_{w2} - V_{w1})t \qquad (19\text{-}61)$$

The above analysis can be applied similarly to a negative surge of type C.

Example 19-5. Show that the equation of the wave profile, resulting from the failure of a dam is in the form of

$$x = 2t\sqrt{gy_2} - 3t\sqrt{gy} \qquad (19\text{-}62)$$

where x is the distance measured from the dam site, y is the depth of the wave profile, y_2 is the depth of the impounding water, and t is the time after the dam broke.

Solution. Since the impounding water has zero velocity, or $V_2 = 0$, the wave velocity by Eq. (19-59) is $V_w = 3\sqrt{gy} - 2\sqrt{gy_2}$. Since V_w is in the negative direction of x, $x = -V_wt$, which gives Eq. (19-62).

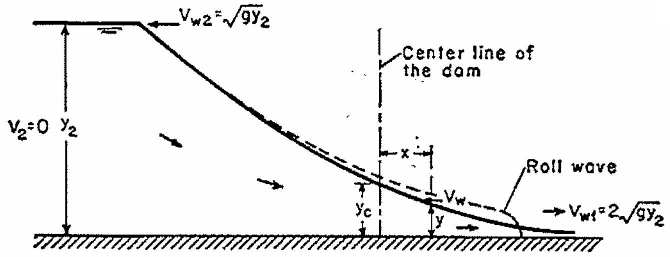


FIG. 19-10. Wave profile due to dam failure.

Equation (19-62) represents a parabola with vertical axis and vertex on the channel bottom, as shown in Fig. 19-10. At the site of the dam, $x = 0$ and the depth $y_c = 4y_2/9$. Owing to the channel friction, the actual profile takes the form indicated by the dashed line. This profile has a rounded front at the downstream end, forming a bore (see Example 18-1). At the upstream end, the theoretical profile thus developed has been checked satisfactorily with experiments by Schoklitsch [12].

19-5. Surge in Power Canals. Engineers are interested in the determination of the maximum stage of water that could be developed as a result of a sudden rejection of load in a power canal. This information is required in the design of the canal for establishing the height of wall necessary to prevent overflow.

Figure 19-11*a* shows the condition of steady flow in a power canal. The flow profile and the friction loss can be computed. When the load is suddenly thrown off, a rejection surge advancing upstream is produced, as shown in Fig. 19-11*b*. According to usual observations, the water surface *ab* downstream from the wavefront is approximately level. Thus, when the wavefront reaches the reservoir, the water surface throughout the entire canal becomes level (Fig. 19-11*c*). However, a steadily

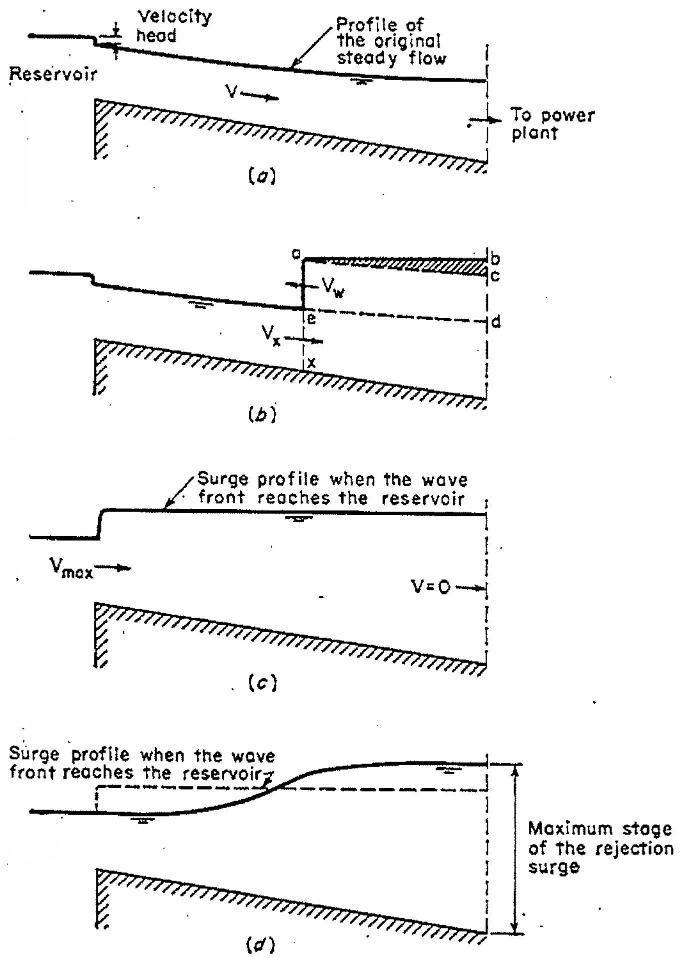


FIG. 19-11. Development of rejection surge in frictional channel.

US Army Corps
of Engineers
Hydrologic Engineering Center

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14. ABSTRACT

This report describes procedures necessary to calculate and route a dam-break flood using an existing generalized unsteady open channel flow model. The recent Teton Dam event was reconstituted to test the model's performance on such a highly dynamic wave. The procedures outlined relate, primarily, to require some further research and programming to improve the applicability of the program to dam-break flood events. The special project memo established four objectives for this study. The first two, (1) level of accuracy of existing techniques, and (2) sensitivity of calculated results to n-values and breach size, were summarized and presented in detail in Appendix A of this document. The third objective, (3) description of physical phenomena controlling depth and travel time and a discussion of pertinent field data, wasp resented in the body of this report. The fourth objective, (4) documentation of the methodology, was included in Appendix B of this document. Computer programs utilized in the methodology may be obtained from the Hydrologic Engineering Center. The computer program was applied to the Teton Dam data set to demonstrate the level of accuracy one might expect in such analyses. The results were shown and, in general, appear reasonable.

15. SUBJECT TERMS
dam failure ,flood profiles, model studies, waves (water), open channel flow, flood routing, mathematical models, analytical techniques, analysis, hydrographs, hydrograph analysis, water levels, discharge (water), reservoirs, peak discharge, rupturing, unsteady flow, steady flow, Teton Dam

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FOREWORD

This Research Note reports the findings of The Hydrologic Engineering Center on appropriate methodologies for calculating and routing floods resulting from suddenly-breached dams.

This study was prepared for the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss. with funding provided by the Defense Nuclear Agency under subtask L19HAXSX337, "Above Ground Structures," work unit 07, "Damage of Dams," and by the Office, Chief of Engineers under DA project 4A762719AT40, task A1, work unit 006.

The material contained herein is offered for information purposes only and should not be construed as Corps of Engineers policy or as being recommended guidance for field offices of the Corps of Engineers.

9/84

GUIDELINES FOR
CALCULATING AND ROUTING A DAM-BREAK FLOOD

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RESEARCH NOTE NO. 5

GUIDELINES FOR CALCULATING AND ROUTING A DAM-BREAK FLOOD

1. Introduction. Planning and design requirements for a wide range of projects, such as emergency preparedness and siting of nuclear power plants, have generated widespread interest in dam break floods. Much academic research and some laboratory research have been accomplished on this topic. Generalized analytic techniques for calculating and routing such floods, particularly in non-prismatic valleys, have not been readily available. Furthermore, prototype verification data are almost non-existent. This report describes procedures necessary to calculate and route a dam break flood using an existing generalized unsteady open channel flow model. The recent Teton Dam event was reconstituted to test the model's performance on such a highly dynamic wave. The procedures outlined herein relate, primarily, to partial breaches. Some deficiencies in the model were identified which will require some further research and programming to improve the applicability of the program to dam break flood events.

2. Summary. The special projects memo cited as reference (a) established four objectives for this study. The first two, a) level of accuracy of existing techniques and b) sensitivity of calculated results to n-values and breach size, are summarized below and presented in detail in Appendix A. The third objective, c) description of physical phenomena controlling depth and travel time and a discussion of pertinent field data, is presented in the body of this report. The fourth objective, d) documentation of the methodology, is included in Appendix B. Computer programs utilized in the methodology, references (b) and (c), may be obtained from The Hydrologic Engineering Center.

The computer program of reference (c) was applied to the Teton Dam data set to demonstrate the level of accuracy one might expect in such analyses. The results are shown on pages A-26 through A-28 of Appendix A and, in general, appear reasonable. This test case demonstrates the usefulness of a generalized computer program because the methods proposed in references (d) and (e) were not applicable to the Teton data set for reasons given in paragraph 10.

Regarding sensitivity to breach size, pages A-22 and A-23 show the two breach sizes considered. The breach that developed at Teton was estimated, by others, to be 40 percent of the dam embankment. Geometric data were not available to verify this, therefore, our best estimate of the final Teton breach geometry, page A-22, is based on photographs. The breach shown on page A-23 has the same side slope as that on page A-22; 0.6 on 1, but it has zero bottom width. This seemed a likely intermediate condition, but no field data were available at the time of this study to establish an observed intermediate condition.

The calculated outflow is shown on page A-24. The hydrograph labeled "trapezoidal breach" assumed the 40 percent breach size, page A-22, developed instantaneously. The hydrograph labeled "triangular breach" was determined in a similar manner for the 30% breach size. The third hydrograph on page A-24 was calculated for the trapezoidal breach (labeled 40% breach size on page A-22), but an observed reservoir drawdown curve at the dam, page A-20, was used which implies a gradual development of the breach rather than instantaneous failure. The last approach was considered best in estimating the discharge hydrographfrom Teton reservoir given the data set and analytical techniques available to us.

The sensitivity of calculated outflows to breach size and rate of development is illustrated on page A-24. It is summarized in the following table together with pertinent elevation data for an n value of 0.04.

Table 1: Sensitivity to Breach Size and Rate of Development

Final Breach Size % of Total Dam	Rate of Development	Calculated Peak Water Discharge at Dam Axis 10^6 CFS (1)	Calculated Peak Elevations MSL		
			At Dam Axis	Miles Downstream from Dam Axis	
				5	10
40%	(2)	1.8 (3)	5123	5014	4933
30%	instantaneous	2.4	5151	5015	4933
40%	instantaneous	3.4	5175	5020	4935

(1) Multiply by 0.02832 to get Cubic Meters Per Second

(2) Actual rate of development was unknown so the observed reservoir drawdown curve, page A-20, was used to approximate outflow conditions.

(3) The actual peak discharge, as estimated by personnel of the Walla Walla District, Army Corps of Engineers from observed data in the Teton Canyon three miles downstream from the dam, was 2,300,000 cfs.

From these results it is apparent that neither the size of breachs tested nor the rates of failure assumed were very significant in predicting peak elevations five miles downstream from the dam.

The calculated peak flood elevations, near the dam, were very sensitive to n-values. Increasing n from .03 to .06 raised the peak flood elevation 25 feet at the dam, as illustrated on page A-8, Table 3. At 5 miles downstream the calculated difference was only 8 feet. Differences continued to diminish with distance.

Calculated Travel Times are shown on page A-29. They correspond to the discharge hydrograph labeled "simulated from observed data" on page A-24 and n-values of 0.04.

Searching for a simplified approach in place of references (d) and (e) led to a trial application of the Modified Puls routing technique. The hydrograph labeled "simulated from observed data" on page A-24 was routed and a water surface profile calculated for the resulting peak discharges. A comparison of the results with the observed elevations and the peak elevations computed with the full equations is shown on pages A-30 through A-32. Additional investigation is needed to establish the range of applicability of this method.

3. Physical Phenomena and Field Data. Analysis of the dam-break flood involves understanding the physical processes before applying analytical techniques which approximate those physical processes. Three distinctly different processes are involved: the process of structural failure causing the breach to develop; the process of setting water into motion in a reservoir; and the process of flood wave attenuation.

The size, shape and rate of breach development are primarily responsible for the peak rate of outflow from the reservoir. Yet, of the three physical processes, this one is the most difficult to quantify. With the exception of man-made breaches, it is difficult to visualize the instantaneous development of a breach. Some have occurred, however. The St. Frances Dam, a high head concrete gravity structure, apparently suffered an abutment failure which resulted in virtually the instantaneous failure of the entire structure. The Johnstown flood of 1889 was caused by the complete failure of an earth fill dam. Reports indicate that less than half an hour was required for overtopping flow to breach the structure. The recent Teton failure, a full depth-partial width breach of an earth fill dam, is estimated to have developed in less than two hours. Since natural failure of a major structure is so improbable, establishing a mode of failure requires a policy decision rather than an analytical technique. In general, instantaneous failure of the entire structure produces the largest flood wave.

The second physical process results from the depth of water above the breach invert. That is, a reservoir has a total energy head equal to the elevation of the water surface. If the dam is breached, the force of gravity will set water into motion. The effect will propogate, as a negative wave, to the upstream end of the reservoir at a velocity equal to $\sqrt{gy}$ where g is acceleration of gravity and y is water depth. Because of the great depth in a reservoir, very little frictional resistance is mobilized during the passage of this negative wave. As a result, water gains specific energy rapidly as it moves toward the breach. In instantaneous breach development, the peak outflow will occur within a minute or two after breaching.

Whereas the total energy head setting the water into motion is the specific energy (i.e., the initial water depth) above the breach invert, the energy which must be dissipated in the downstream channel is equal to the specific energy from the downstream channel invert to the initial pool elevation. The fact that the water surface elevation drops down rapidly at the dam axis does not reflect a corresponding loss in energy head. When flow begins, that specific energy above the breach invert is transformed into three components: a pressure head, a kinetic energy head and an inertia head. (The relative size of each of these energy head components is discussed more fully in sections 4 and 5.) Friction loss is relatively small and may be neglected unless the reservoir bottom is extremely rough (more than 5% or 10% of the water depth).

The third physical process, flood wave attenuation, involves energy dissipation and valley storage. As the flood wave moves downstream, the peak discharge tends to decrease, the base of the flood wave will become longer and the wave velocity will decrease. Near the dam, energy dissipation is primarily responsible for behavior of the flood wave. However, valley storage soon becomes the primary factor in flood wave attenuation. The key to the transition from energy dissipation to valley storage control is the rate at which the slope of the total energy gradient, a line which must intersect the initial pool elevation at the dam, is reduced to that of a major rainfall flood in the downstream valley. It seems obvious that the total energy at any cross section in the valley should not exceed the initial reservoir elevation, and yet some analytical techniques occasionally violate that constraint. It is good policy to always check the total energy, as well as the water volume, in a calculated flood wave.

The rate of energy dissipation is governed primarily by friction loss. Minor losses from bends and contractions-expansions are often included in the n-values.

The volume of water in the reservoir is the final piece of field data required. This volume strongly influences the peak elevations at downstream points.

4. Energy Components and Peak Outflow from Complete, Instantaneous Breaches. It is useful to develop the relative size for each energy component in the flow at the dam axis and to compare all of them to the more common case of steady state critical flow at a contraction.

By assuming a rectangular cross section, zero bottom slope and instantaneous removal of the entire dam, Saint-Venant developed an analytical solution for the elevation of the free surface, reference (f), page 755. Utilizing that equation, the depth of flow at the dam axis was determined, by Saint-Venant and others, to be $\frac{4}{9} Y_0$ where Y_0 is the original water depth at the dam. Also, the velocity corresponding to the peak outflow was shown to be $\frac{2}{3} \sqrt{gY_0}$. Combining these relationships leads to the equation for peak discharge

$$q_{max} = \frac{8}{27} Y_0 \cdot \sqrt{g \cdot Y_0} \tag{1}$$

Y_0 is the initial water depth at the dam

g is acceleration of gravity

q_{max} is peak water discharge in cfs/ft

Since this equation was developed for a rectangular section, the total discharge may be calculated by multiplying q_{max} by the width.

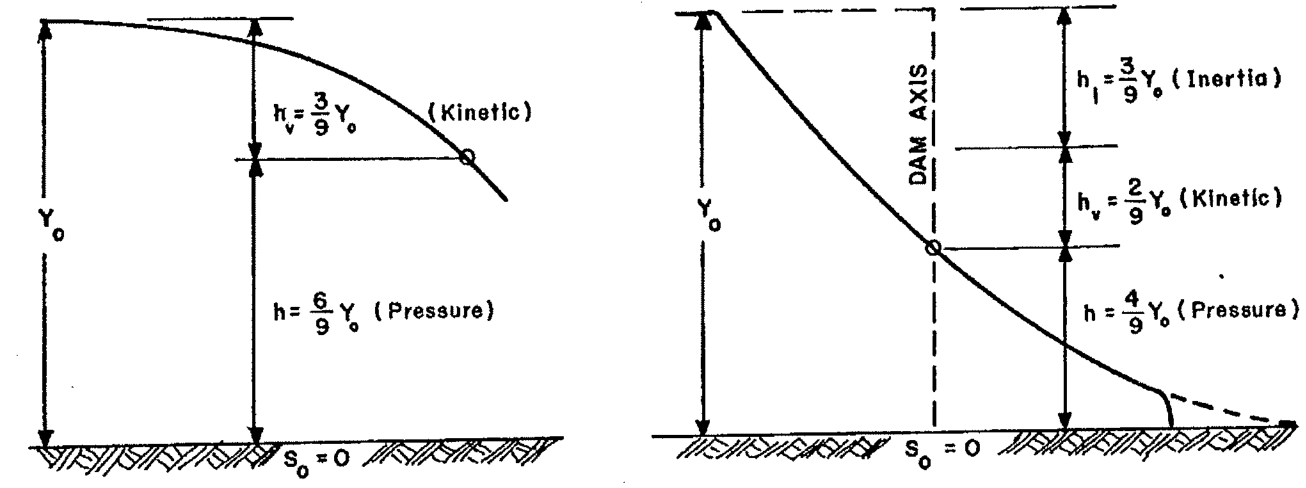
Using the relationships referenced above, the velocity head (i.e., the kinetic energy head component of the specific energy head) was calculated to be $\frac{2}{9} Y_0$. Since, in the absence of friction and other losses, inertia is the only remaining term in the basic, unsteady flow equations of Saint-Venant, it may be calculated as follows.

$$Y_0 = h_i + \frac{2}{9} Y_0 + \frac{4}{9} Y_0 \tag{2}$$

$$h_i = \frac{3}{9} Y_0$$

These components are shown in Figure 1 along with the energy components for critical, steady state flow.

This figure shows that in the dam break flood analysis, as well as steady state critical flow at a contraction, the velocity head is half the pressure head. However, the inertia head component is zero in Figure 1a because flow is steady state.



(a) Critical flow at a contraction (steady flow conditions)

(b) Critical flow from a breached dam (unsteady flow conditions)

Figure 1. Components of Specific Energy Head.

The drawdown in water surface elevation to $\frac{4}{9} Y_0$ at the dam axis, Figure 1b, does not reflect a corresponding energy loss. Experimental results obtained by Schoklitsch, reproduced on page 755 of reference 1f, show relatively little friction loss in flow approaching the dam axis. As might be expected, the model results showed friction to be very significant downstream. Tests reported by WES in reference (g) showed no impact from friction loss at the dam axis. However, the WES flume sloped at 0.005 ft/ft, whereas the flume in Schoklitsch's experiment had zero bottom slope.

The significance of this point is that all three energy components, pressure head, kinetic energy head and inertia head, are significant in complete, instantaneous breachings. Consequently, investigators encourage the use of the complete routing equations, often referred to as the Saint-Venant equations. Simplifications of the complete equations, such as Muskingham, Tatum, Straddle-Stagger and Modified Puls, are not recommended because the empirical coefficients would invariably be developed from rainfall floods and would reflect different values of energy components relative to Y_0.

5. Instantaneous, Partial Breaches. Partial breaches are classified, according to hydraulic performance, as full depth-partial width, partial depth-full width or partial depth-partial width. A separate equation has been developed for calculating the peak water discharge for each class, page 25 of reference (g).

Full Depth-Partial Width

$$Q_{max} = \frac{8}{27} \cdot b \cdot Y_o \cdot (\frac{B}{b})^{\frac{1}{4}} \sqrt{gY_o} \qquad (3)$$

B is width of channel, feet
b is width of breach, feet

Partial Depth-Full Width

$$Q_{max} = \frac{8}{27} \cdot B \cdot y(\frac{Y_o}{y})^{\frac{1}{3}} \sqrt{gy} \qquad (4)$$

y is depth of water above bottom of breach

Partial Depth-Partial Width

$$Q_{max} = \frac{8}{27} \cdot b \cdot y \cdot (\frac{B}{b})^{\frac{1}{4}} \cdot (\frac{Y_o}{y})^{\frac{1}{3}} \sqrt{gy} \qquad (5)$$

An empirical equation for partial depth-partial width breaches was reported in references (g) and (h).

$$Q_{max} = 0.29 \cdot b \cdot y \cdot (\frac{B}{b} \cdot \frac{Y_o}{y})^{0.28} \cdot \sqrt{gy} \qquad (6)$$

For breach sizes in the following range.

$$1 \leq (\frac{B}{b} \cdot \frac{Y_o}{y}) \leq 20 \qquad (7)$$

Since the discharge equations for partial breaches are similar, in form, to that for a full breach (1), the total specific energy has the same three basic components. However, their size, relative to initial water depth, is considerably different from that shown in Figure 1. There is no analytical solution for partial breaches, therefore, experimental results, presented in reference(g), were used to calculate the individual energy head components. The following table presents experimental results for full depth breaches ranging in width from 10% to 100% of the flume width in columns 1, 2 and 3. Fractions of initial water depth, calculated with equation 3, are shown in columns 4 and 5. A sample of the calculations is presented in the paragraph following the table. This sample calculation utilizes equation 3 and a 100% breach size (i.e., full breach) to demonstrate that the relative value of each energy component is the same as the respective value produced by equation 1, the analytical, full breach equation, when equation 3 is carried to its upper limit.

Table 2: Relative Size of Energy Components in Partial Width Breaches(1)

Test No	Breach Size %	Pressure Head % of Y_0	Velocity Head (2) % of Y_0	Inertia Head (3) % of Y_0
(1)	(2)	(3)	(4)	(5)
1.1	Full	44	22	34
2.1	60	70	12	18
3.1	30	82	12	6
4.1	15	89	(4)	- -
5.1	10	94	(4)	- -

Notes:

1. Values in columns 1 and 2 are from Table A, page 8, reference (g)and values in column 3 are from experimental results from Tables 1 through 5, Station 200, reference (g).
2. Velocity head is calculated with equations 8 and 9, following.
3. Inertia head is Y_0 - (pressure head + velocity head).
4. Calculated values exceeded 100 percent of Y_0, which probably reflects scatter in experimental results.

$$V_{max} = \frac{Q_{max}}{b \cdot y} \qquad (8)$$

where:

y = depth of water at dam axis

b = breach width

Q_{max} from equation (3)

$$V_{max} = \frac{\frac{8}{27} \cdot b \cdot Y_0 \left(\frac{B}{b}\right)^{\frac{1}{4}} \sqrt{gY_0}}{b \cdot y} \qquad (9)$$

For the full breach, $b = 1.0B$ and $y = \frac{4}{9} Y_0$

$$V_{max} = \frac{\frac{8}{27} \cdot Y_o \left(\frac{B}{1.0B}\right)^{\frac{1}{4}} \sqrt{gY_o}}{\frac{4}{9} \cdot Y_o} \tag{10}$$

$$V_{max} = \frac{2}{3} \sqrt{gY_o} \tag{11}$$

$$\frac{V^2_{max}}{2g} = \frac{4}{9} \frac{gY_o}{2g} \tag{12}$$

$$= \frac{2}{9} Y_o \tag{13}$$

This agrees with section 4 and shows the procedure followed in completing Table 2. The inertia head, column 5 in Table 2, was calculated assuming zero energy loss upstream from the dam.

$$Y_o = h_i + \frac{2}{9} Y_o + \frac{4}{9} Y_o \tag{14}$$

$$h_i = \frac{3}{9} Y_o \tag{15}$$

Because of the decrease in relative significance of inertia head and even velocity head, it is satisfactory to apply simplifications of the full Saint-Venant equations to partially breached dams.

6. Attenuation of the Flood Wave. As a flood wave moves downstream, friction and other losses change the relative size of the three energy components. Even floods from fully breached dams eventually take on the characteristics of a rainfall flood and may be routed with a simplified routing method such as Modified Puls. Major areas of uncertainty are 1) how much distance is required for this transition, 2) how does this distance vary when considering partial breaches and 3) what is the maximum breach size to consider as a partial breach.

7. Proposed Analytical Technique. The guidelines presented in Appendix B of this report are developed for the computer program "Gradually Varied Unsteady Flow Profiles". It is a solution of the basic Saint-Venant equations for unsteady flow and may be used to calculate the outflow hydrograph through any size or shape of breach, as well as to route that hydrograph downstream and provide water discharge and water surface elevation

hydrographs at any number of computation points up to 45. The maximum discharge, maximum elevation and maximum flow velocity are summarized for each computation point.

Sufficient information is printed out so the time of arrival, time of peak and duration of the flood may be plotted.

This computer program accounts for the movement of the negative wave through the reservoir, for the tailwater submergence at the dam, for the three components of energy presented earlier, for friction loss and for storage in the reservoir and the downstream valley.

Cross sections need not be rectangular or prismatic. A companion program, "Geometric Elements from Cross Section Coordinates", is available to transform complex cross sections into the required geometric data set for the routing program.

These computer programs are generalized. That is, they are sufficiently flexible and adaptable to be used without code changes. They are portable from one computer to another and documentation is available, from The Hydrologic Engineering Center.

8. Program Limitations.

a. Routing with the Gradually Varied Unsteady Flow Profiles computer program requires a large high speed computer (50,000, 60-bit words) and personnel who are experienced in applying mathematical models.

b. Any breach size may be modeled, but the program assumes instantaneous development.

c. All channels must be wet initially. That is, computations cannot be made if any portion of the model is dry. This is overcome by prescribing a base flow; however, the computer program has difficulty in establishing this profile.

d. Movement of the negative wave through the reservoir causes no computational problem until it reaches the upstream end of the reservoir. Computation nodes tend to go dry and abort the computer run.

e. The analysis of multiple failures would require manual intervention to stop and restart the calculation process as each new structure is brought into the system.

f. The program assumes a horizontal water surface transverse to the flow, whereas a great deal of transverse slope can exist in the actual prototype situation.

9. Proposed Areas of Research. All of the program limitations were circumvented in analyzing the Teton Data Set. The trade-off, however, was analysis time. Seven weeks were required to set up the data, debug it and perform the analysis. The two tasks requiring the most time, probably 75%, were establishing initial base flow conditions for the model (8c) and stabilizing the computations when the negative surge reached the upstream boundary (8d). Both of these problem areas can be overcome by additional programming. The improvements would reduce analysis time to four or five weeks.

Instantaneous breach development, 8b, could be replaced by equations which let progressive development take place. In the absence of a theory, the rate of development would have to be prescribed with input data.

Developing the capability to handle multiple dam failures (8e), especially in tandem, will be a major modification.

This analytical technique is a one-dimensional model and will always have a horizontal water surface transverse to the flow. At present, two-dimensional modeling is not feasible.

10. Alternate Analytical Procedures. Alternate analytical procedures were proposed in references (d) and (e). Neither were applicable to the Teton Data Set.

The dimensionless curves were developed from numerical solution of the St. Venant equations and include special treatment of the wave front as it moves along a dry channel. By knowing reservoir volume, valley cross section at the dam, initial reservoir elevation, stream slope and stream roughness, the curves will provide three properties of the flood wave:

1. Time of arrival at downstream points
2. Maximum depth profile in the downstream channel
3. Time of maximum depth at downstream points.

The curves extend for distances ranging up to fifteen times the reservoir length. The outflow hydrograph at the dam is not needed to use these curves. It was assumed, in developing the curves, that the entire dam is breached instantaneously and that the valley is prismatic. Neither condition was satisfied by the Teton case.

The procedure in reference (e)was developed for smaller structures and the Teton Data Set was completely beyond the range of nomographs and curves presented there. In any case, the procedure does not route the flood wave downstream. Only the outflow discharge hydrograph is calculated at the dam axis. The procedure can handle a wide range of breach sizes, but it is designed with partial breaches in mind. It has the advantage of tail water correction, which is essential when breaching of a low dam coincides with a high flow condition in the stream. The procedure is well documented and is easily applied.

A possible alternative approach for partial breaches is the Modified Puls routing technique. Preliminary work with this technique produced the results shown on pages A-30 through A-32 for the Teton Data Set. A Manning n value of 0.04 was used; further details are given in Paragraph 5, Appendix A. The advantage of this technique is that readily available and easily applied computer programs (e.g., HEC-1 and HEC-2) can be utilized; total analysis time would probably be reduced to two to three weeks.

The disadvantage is that the range of application is limited whereas the technique presented in Paragraph 7 is generally applicable.

Additional research is needed to define the range of applicability of the Modified Puls technique. The present hypothesis is that the size of the inertia component, Table 2, would provide a suitable parameter for defining that range.

This research would not require additional physical modeling. Studies reported in references (g) and (h) offer test data for numerical studies. Other numerical experiments could be performed by using results from analyzing variations of the Teton Data Set with the complete equations. These results could be obtained while pursuing any of the areas of research proposed in Section 9.

Computer programs which utilize the Modified Puls routing technique are available and are presently developed to a higher degree of serviceability than programs solving the full equations. Water surface profile computations will be required in conjunction with the Modified Puls routing to produce a water surface profile. These computations are computerized also. No major computer program development would be required. The appropriate existing computer programs, HEC-1 and HEC-2, are well documented.

11. References.

a. Special Projects Memo No. 473 subject Calculating and Routing the Flood Resulting from a Suddenly Breached Dam, dated 26 August 1976.

b. "Geometric Elements from Cross Section Coordinates", The Hydrologic Engineering Center, June 1976.

c. "Gradually Varied Unsteady Flow Profiles", The Hydrologic Engineering Center, June 1976.

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h. "Floods Resulting From Suddenly Breached Dams", Conditions of High Resistance, Hydraulic Model Investigation, Miscellaneous Paper No. 2-374, Report 2, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, Mississippi, November 1961.

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June 1, 2011

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Re: Ash Pond Slope Stability and Seismic Analysis - Supplement
Burlington Generating Station – Burlington, IA

Mr. Skalitzky;

With this report, Aether DBS (Aether), supplements the findings from our February 3, 2011 “Ash Pond Stability and Hydraulic Analysis, Burlington Generating Station” report. In the February 3, 2011 report, Aether found that the stability of the Economizer Ash Pile did not meet a minimum acceptable factor of safety under both static and seismic loading; and that the Main Ash Pond fell below the seismic loading acceptable factor of safety used by the United States Environmental Protection Agency (EPA) for Coal Combustion Residuals (CCR). In addition, soil information available on February 3, 2011 indicated that native soils immediately below the CCR may be subject to liquefaction during an earthquake of International Building Code design intensity.

To extend the knowledge of soil conditions at the CCR facilities, Aether recommended that Interstate Power and Light consider collection of additional data on the strength of the CCR and native soils immediately below the CCR using in-situ testing methods. The work was authorized in April 2011 with the data collection occurring between May 9 and May 16, 2011.

Means and Methods for Data Collection

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. The liquefaction resistance of a soil is based on its strength and the effective confining stress (pressure from the self-weight of the soil). The resistance may be tested by obtaining samples of the soil and testing the soil in the laboratory by the cyclic triaxial test (ASTM D 5311). Since soils that have low resistance to liquefaction are difficult to sample in an undisturbed condition, the laboratory test is usually run on a reconstituted sample and often does not reflect the in-situ conditions. Because of this limitation, Aether recommended that the strength of the CCR and soil immediately below the CCR be measured with a Cone Penetrometer Test (ASTM D 5778) which collects a continuous measure of soil strength with depth.

The Cone Penetrometer Test pushes a standard dimension cone into the soil on a continuous basis followed by a sleeve that is advanced separately behind the cone. In addition to the pressure required to advance the cone and the sleeve, the pore pressure at the cone tip is measured by a pressure transducer. The cone, sleeve and pore pressure transducers are calibrated in accordance with ASTM D 5778 and the data is collected continuously with stops only to add additional drill rod to the pushing string. The rods were added every four feet and the pauses required for these rod additions are sometimes evident in the data (i.e., a pore pressure decline). The Cone Penetrometer test is correlated to soil borings or samples recovered to calibrate the observations of the Cone Penetrometer. The calibration borings also produce soil samples for laboratory testing to determine the basic soil properties needed to confirm soil classification in accordance with the Unified Soil Classification System (ASTM D 2487).

The additional May 2011 investigation was made to accomplish three purposes:

1. Determine if a clay berm was present in the eastern 500 feet of the north embankment of the Economizer Ash Pile.
2. Determine the soil strength properties for the embankment soils and the native soil present under the embankments.
3. Determine the susceptibility of the embankment soils and the native soils to liquefaction and the cyclic resistance strength of the soils that are susceptible to liquefaction.

The proposed investigation included the installation of 21 Cone Penetrometer probes. The probes include two series of cross-sectional probings of the eastern 500-feet of the Economizer Ash Pile to determine if a clay berm is within the CCR. The remainder of the Economizer Ash Pile was probed only from the centerline of the visible clay berm. In addition to the Economizer Ash Pile, more Cone Penetrometer probes were advanced on the berm centerline of the Ash Seal Pond, Main Ash Pond, and Upper Ash Pond. After completion of the Cone Penetrometer probes, geo-probe locations were selected for correlation with the cone penetrometers in effort to collect soil samples at locations where it was determined that liquefaction susceptibility was questionable and Unified Soil Classification parameters were needed to clarify the Cone Penetrometer results.

The goal of the Cone Penetrometer testing was to advance the penetrometers into the dense sand layer that is present starting at approximately elevation 510 feet. Soils at the site below that depth are not liquefaction susceptible and do not impact the stability of the CCR impoundments.

Investigation Activities

The conditions of the CCR impoundments presented in the February 3, 2011 report show that the CCR is placed over a native soil that was deposited by flooding of the Mississippi River. Near the river at the Ash Seal Water Pond, the native soils are characterized by coarser natural levee soils. Regardless of location on the property, a dense sand layer begins at approximately elevation 510 and becomes coarser and denser with depth. The dense soil is not the focus of the additional investigation and is an indicator of reaching the depth of interest.

Previous site soil information is presented in the February 3, 2011 report and is not repeated herein.

The CCR and soil data collected in May 2011 includes Cone Penetrometer Tests (CPTs), Geo-Probe samples for correlation, and soil testing of geo-probe core sections. Locations of the CPTs and geo-probes are indicated on Figure 1.

The CPT equipment conformed to ASTM D 5778-95, Standard Test Method for Performing Electronic Friction and Piezocone Testing of Soils. The electronic measurements collected include cone-tip resistance, sleeve friction, and pore pressure output in pounds per square inch (psi). The results are recorded at depth intervals of approximately 0.5 centimeters at a standard cone penetration rate of 2 centimeters/second. The CPT provides continuous, real-time output of soil lithology data over the full depth of the embankments, through the native soils, and stopping in the dense sand when the CPT probe could not be advanced further. The data was viewed graphically as the CPT probe was advanced through the CCR and native soil. A total of twenty one (21) CPT probings were completed in May 2011. The data plots from the CPTs are provided for each location in Attachment A.

The CPT data plots were observed real-time in the field to determine where native soil or CCR may be susceptible to liquefaction. Geo-probe samples were collected at the chosen locations and soil samples recovered from the geo-probe sleeve. The geo-probe borings were logged in the field in accordance with the Unified Soil Classification System (ASTM D 2487). Field characterization of the geo-probe borings included evaluation for the presence of saturation and the use of a pocket penetrometer on cohesive soils for estimates of unconfined compressive strengths recorded in tons per square foot (TSF). A total of twelve (12) geo-probe borings were completed as part of the extended soil investigation. The geo-probe boring logs are provided in Attachment B. A summary of the Unified Soil Classification and soil consistency adjectives is provided with the geo-probe borings in Attachment B.

Using the CPT data and geo-probe boring visual classifications, specific sections of the soil cores were recovered for index testing. A total of twenty (20) samples were taken from the 12 soil borings completed on the embankments of the CCR ponds. The samples were analyzed for moisture content (ASTM D-2216), Atterberg limits (ASTM D-4318), and grain size (ASTM D-422). Laboratory reported results of the soil samples are provided in Attachment C.

On May 19, 2011, Aether surveyed the elevation of each CPT probe location using known benchmarks located throughout the site. The results indicate that the top elevation of each embankment is within ± 1 foot of the same elevation as previous topographic maps show with the exception of CPT7 and CPT 8 which are 3-feet lower than the other CPTs on the Economizer Ash Pile. The ground surface elevations are provided in Attachment A.

CCR and Native Soil Lithology and Properties

The data collected from the CPT and Geoprobe borings confirm that the native dense sand is encountered at elevation 505 to 510 feet consistently across the site except at the very western edge of the site where loess or clay till soils from the adjacent uplands intercede into the floodplain. Throughout the floodplain the soil directly underlying the CCR and overlying the dense sand is medium stiff clay. The imported clay embankment that contains the CCR is medium stiff to stiff clayey silt with some sand. From an interview with a long time staff member at the Generating Station, Aether understands 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.

Where the CPT and geo-probes encountered CCR in the Economizer Ash Pile, the first twenty feet of CCR has properties distinct from the lower ten feet of CCR. The properties of the CCR vary greatly due to cemented layers within the CCR. The cross-section of CPT 4, 5, and 6 encountered a cemented layer at 16 to 20 feet below grade that caused refusal of the CPT probe. Geo-probe boring SB-4 installed coincident with CPT-6 showed that the CCR and native soil lithology was the same as the cross-section at CPT 1, 2, and 3. The cross-section CPT 1, 2, and 3 was used to delineate the embankment. The elevation of saturation in the CCR at the north embankment is elevation 529, which is the same as the water elevation in the Upper Ash Pond. Surface water from the settling pond on top of the Economizer Ash Pile seeps vertically downward beneath the settling pond. A cross-section of the eastern end of the Economizer Ash Pile is shown on Figure 2.

The CPT test results were reviewed to determine the Mohr Coulomb friction angle and cohesion for each layer of CCR or native soil. Figure 3 shows the method used by Aether to interpret the distinct layers of CCR or native soil from the CPT probe results. Figure 3 also shows the method of comparing the geo-probe boring results to the CPT data plot and relating the laboratory test results to stratification shown on the CPT.

The CPT data results indicate that strength parameters for the CCR and native soil may be cohesionless, cohesive or some combination. For purposes of analyzing the strength of the embankments under suddenly applied loads (i.e., seismic), Aether assigned an undrained cohesion only strength to clay and a friction angle only strength to CCR and native sand. The cemented layers in the CCR and the apparent cohesion are ignored and friction angle only is assigned to the CCR, with some minor exceptions.

The CPT data results for clay layers are assigned an undrained shear strength (cohesion) based on the procedure recommended by Robertson[1]. The undrained shear strength is:

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

Where: S_u = undrained shear strength
q_c = 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[2]. The figure from Terzaghi is included in Attachment A.

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[1] 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

The results indicate the native clay cohesion ranges from 600 to 1200 pounds per square foot (psf). The measured cohesion of the native clay is higher than used for the February 3, 2011 analysis. For the CCR, friction angle ranges from 30 to 34 degrees without factoring in cemented layers. For pseudo-static stability analysis, when liquefaction occurs, the saturated ash at the bottom of the CCR (immediately above the native clay) is assigned a friction angle of 25 degrees (silt with relative density of 0%), NAVFAC[3].

Embankment Stability – Static At Normal Operating Conditions

Economizer Ash Pile – The Economizer Ash Pile was constructed on top of a portion of the original Upper Ash Pond. The south embankment and the east embankment of the Pile are constructed of imported clay over the clay embankments of the original Upper Ash Pond (CPT 9, 10, 11, and 12 and SB-3). The north and west embankment of the Pile are constructed over CCR that was deposited into the Upper Ash Pond prior to construction of the Pile and are the least stable embankments of the Economizer Ash Pile. The thickness of the CCR from the Upper Ash Pond is greatest on the East end and becomes thinner to the West (CPT 1 through 8 and SB 1, 2 and 4).

The results of the May 2011 investigation show that the eastern 500-feet of the northern embankment of the Economizer Ash Pile is constructed of CCR. The western part of the north embankment is imported clay compacted on top of CCR. Both cross-sections were evaluated for static stability of the Economizer Ash Pile. 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	1000	0
Native Clay	33-41	600	0
Native Dense Sand	>41	0	30
Western Cross-Section			
Embankment Clay	0-15	1200	0
CCR	15-25	0	32
Native Clay	25-35	700	0
Native Dense Sand	>40	0	30

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

[3] Naval Facilities Command, Design Manual – Soil Mechanics, Foundations, and Earth Structures, March 1971, Figure 3-7.

The embankment geometry and soil layers and strengths were used as input to the two dimensional limit-equilibrium slope stability analyses program STABL5M (1996)[4] to analyze hundreds of potential slip surfaces for each case. The program calculates a factor of safety based on the ratio of the driving forces to the resisting forces along each potential slip surface. A calculated factor of safety greater than one indicates stability along the surface analyzed. Both circular surfaces and block slides were investigated with the block slide showing slightly lower factor of safety and with the native clay layer under the CCR controlling the stability.

The minimum static factor of safety for the eastern cross-section is 1.5 and for the western cross-section 1.7. The output results for the static analysis of multiple searches are presented in Attachment D.

Ash Seal, Main Ash and Upper Ash Ponds – The soil strength parameters from the CPT results for the stability of the other three CCR Ponds are:

Ash Pond	Strata	Cohesion PSF	Friction Angle Degrees
Ash Seal	Embankment	700	
	Sand		37
	Clay	900	
Main	Embankment	700	
	Clay	1200	
Upper	Embankment	1950	
	Clay	900	
	Sand		35

The CPT results and laboratory confirmation show the native clay layer is present under all of the ponds with the exception of the eastern Ash Seal pond where coarser grained levee deposit are under the imported clay embankment. The static stability of each pond was reassessed with the measured strength parameters. The results of the analysis indicate that revised static stability factors are greater than 1.5. The results are presented in Attachment D.

Ash Pond	Minimum Factor of Safety
Ash Seal	2.2
Main	4.3
Upper	3.4
Economizer	1.5

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[4] STABL User Manual, By Ronald A. Siegel, Purdue University, June 4, 1975 and STABL5 …The SPENCER Method of Slices: Final Report, By J.R. Carpenter, Purdue University, August 28, 1985

Embankment Stability – Earthquake with Normal Operating Conditions

An earthquake induced loading on the embankments may cause excessive displacement of the embankment resulting in a release of the contents or could result in liquefaction of the CCR in the embankment for the Economizer Ash Pile. The native soils below the embankments are predominantly clay with a plastic index greater than 12 and will not liquefy during an earthquake, Moss[5]. The only liquefiable soil found during the CPT investigation is the saturated ash above the native clay and below the water table at elevation 529 feet under the north embankment of the Economizer Ash Pile.

To determine if the saturated CCRs will liquefy, an analysis of the cyclic stress ratio (CSR) from the design earthquake was completed for the Economizer Ash Pile and was compared to the cyclic resistance ratio (CRR) determined from the CPT data. The CPT data was converted to a CRR using the procedure proposed by Moss. The procedure incorporates data from known worldwide liquefaction results into the recommended procedures of the National Council for Earthquake Engineering and Research for establishing CRR from CPT results. The CRR results for the Economizer Ash Pile are shown in Attachment E. The CRR that will cause liquefaction in the saturated zone just above the native clay is 0.08. (CRR is the ratio of the shear stress to the effective confining stress).

The CCR ponds and piles are low hazard embankments as determined by the EPA. A low hazard dam (embankment) will not result in loss of life if the dam fails. FEMA[6] indicates that a safety evaluation earthquake (maximum design earthquake) should be selected based on the hazard rating of the dam. The International Building code uses a probability of 2% in 50 years (return period of 2475 years) for design of structures that are moderate to high risk for loss of life. For low risk structures, a probability of 10% in 50 years (return period of 475 years) is an acceptable standard. For analysis of the impacts on the liquefaction and the pseudo-static safety factors, Aether used the 475 year return period for the analysis.

Economizer Ash Pile – The CSR and maximum earthquake acceleration were determined by analyzing the soil profile at the Economizer Ash Pile using the program SHAKE[7]. SHAKE performs a one-dimensional analysis of the earthquake motion traveling upward from rock/very dense gravel at 80-feet below ground surface and produces an amplified and filtered earthquake response at other depths. SHAKE also determines the peak acceleration in each layer and the ratio of the maximum shear stress to confining pressure at strains that are 65% of the maximum shear strain determined in the analysis. The input earthquake record was scaled to an effective peak horizontal acceleration of 2.5% of gravity at bedrock. The scale factor was determined using the United States Army Corps of Engineers program DEQRAS which provides the probabilistic effective scale factor based on the

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[5] Moss R.E.S., R. B. Seed, R. E. Kayen, J.P. Stewart and K. Tokimatsu, "Probabilistic Liquefaction Triggering based on Cone Penetrometer Test", Geo-Frontiers 2005.

[6] Federal Emergency Management Agency, "Federal Guidelines for Dam Safety", May 2005

[7] SHAKE 2000, A Computer Program for the 1-D Analysis of Geotechnical Earthquake Engineering Problems, November 2007

latitude and longitude of the site. For Burlington Station the 475 year return scalar is 2.5% of gravity.

The result of the SHAKE analysis is shown in Attachment E. The CSR in the saturated CCR is 0.105 which is greater than the CRR of 0.08 and liquefaction is probable during the seismic design event. Liquefaction will result in the saturated layer losing strength and the loss of strength along with the forces of ground motion could cause the slope of the north Economizer Ash Pile to slide into the Upper Ash Pond.

To evaluate the potential of movement, the Economizer Ash Pile embankment was analyzed for pseudo-static forces from the earthquake. The analyses from the SHAKE run indicate that the horizontal earthquake force in the embankment above the liquefied CCR averages 7.5% of gravity. This force along with a vertical force $^2/_3$ of the horizontal force (5.0% of gravity) was applied to the embankment and a block slide was analyzed going through the liquefied layer. The liquefied layer was assigned a reduced friction angle of 25°, the minimum friction angle for silt with a relative density of 0% (NAVFAC).

The result of the pseudo-static analysis is a safety factor of 1.0 with the surface going through the native clay and not the liquefied CCR which has a higher safety factor. The results of the analysis are presented in Attachment F. For the western cross-section of the Economizer Ash Pile, the failure also goes through the native clay with a minimum factor of safety of 1.1. Both safety factors indicate acceptable earthquake response in accordance with FEMA Guidelines for Dam Safety. Only the western cross-section meets the minimum safety factor of 1.1 established as EPA policy.

Ash Seal, Main Ash and Upper Ash Ponds – The remainder of the ponds are constructed of imported clay over native clay or at the east of the Ash Seal Pond dense levee deposits under the embankment. There is no risk of the native soil liquefying with resultant stability issues for the embankment. However, the embankments will be subject to extra loading during a seismic event. The results of the analysis using a horizontal acceleration of 6.8% of gravity and a vertical acceleration of 4.5% of gravity are:

Ash Pond	Minimum Factor of Safety
Ash Seal	1.8
Main	2.6
Upper	2.6

Conclusion

Static Embankment Stability – The Economizer Ash Pile has a minimum static safety factor of 1.5. The increase from 1.1 reported in February 3, 2011 is due to using stronger native clay and stronger ash embankment strengths based on the CPT data and the lowering of the ground water table to represent measured conditions. Based on the CPT data results, the Ash Seal, Main and Upper Ash Ponds have minimum static factors of safety from 2.2 to 4.3 based on higher strengths of the embankment clay and native clay layers as measured in the CPT data.

<u>Pseudo-Static Earthquake Stability</u> – For a design basis earthquake at the Economizer Ash Pile the embankment may deform or liquefy and the contents of the pond may slide into the Upper Ash Pond. Since the slide would likely occur in the native clay layer below the CCR the movement would be slow and contained within the Upper Ash Pond keeping the impact within the existing CCR management units. The minimum factor of safety for the Economizer Ash Pile under pseudo-static earthquake is 1.0. Based on soil strengths from the CPT results, the Ash Seal, Main and Upper Ash Ponds have minimum pseudo-static factors of safety of 1.8 to 2.6.

We appreciate the opportunity to perform an assessment of the Burlington Generating Station Ash ponds.

If you have any questions, please call.

STUART H. RUSSELL
8752

Stuart Russell, Iowa P.E. # 8752

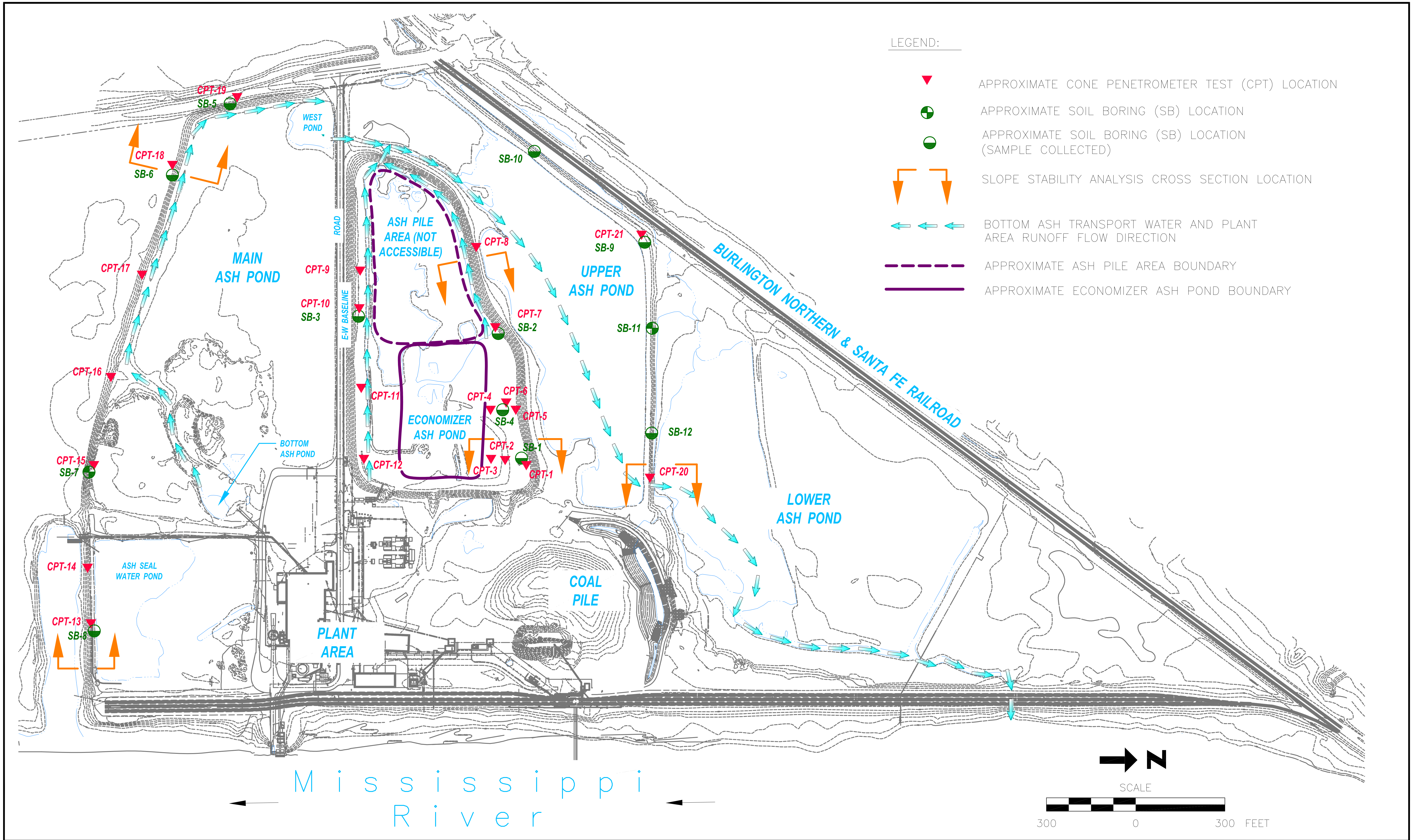
Timothy J. Harrington, P.E.

Figures:

- Figure 1- CPT and SB Locations
- Figure 2 – Economizer Ash Pond Cross Section
- Figure 3 – CPT and SB Correlation

Attachments:

- Attachment A – Cone Penetrometer Test Results
- Attachment B – Boring/Geoprobe Logs
- Attachment C – Soil Laboratory Results
- Attachment D – Static Slope Stability Analyses
- Attachment E – Cyclic Resistance Ratio and Cyclic Stress Ratio
- Attachment F – Dynamic/Pseudo-Static Slope Stability Analyses



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REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

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SCALE:	AS SHOWN
DATE:	5-31-11
DRAWN BY:	JFD
CHKD. BY:	CTS
APPROVED:	TJH

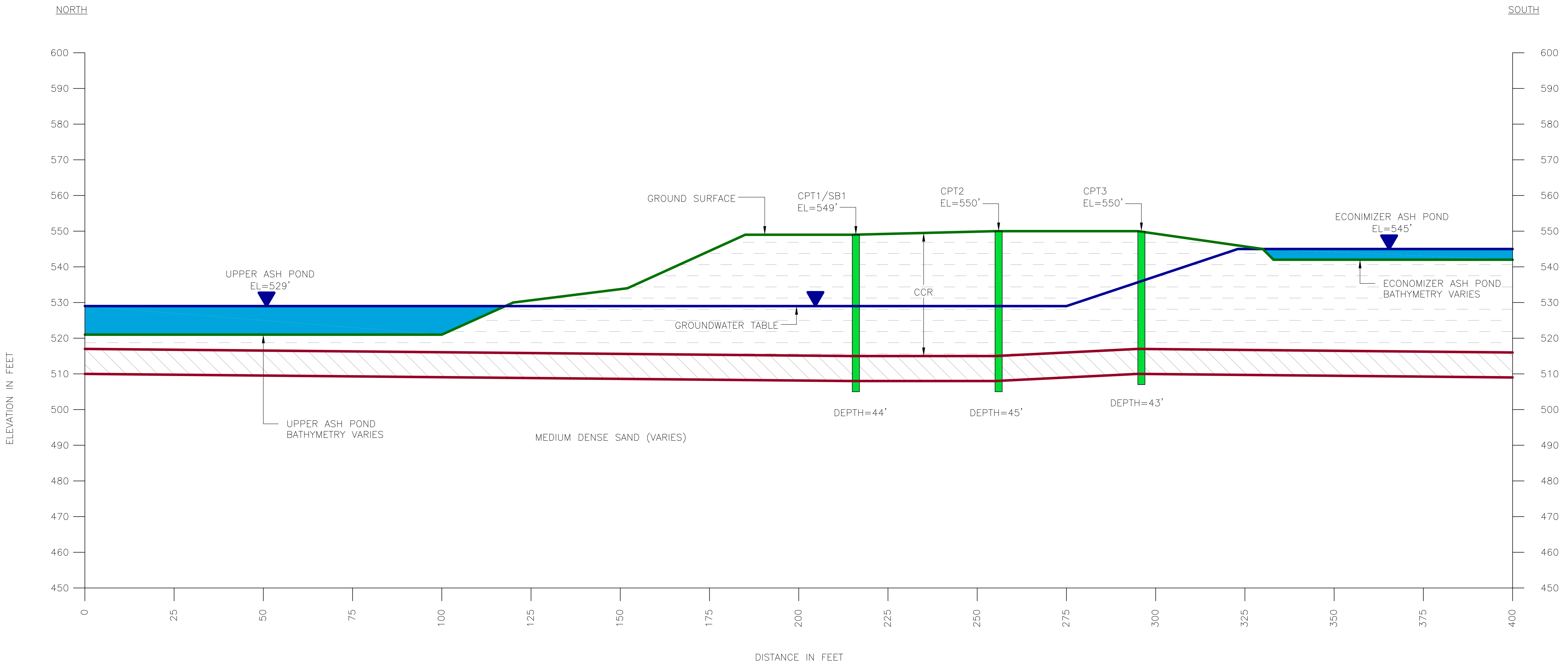
CLIENT / LOCATION

ALLIANT ENERGY
BURLINGTON GENERATING STATION
BURLINGTON, IOWA

DRAWING DESCRIPTION

CPT AND SB LOCATIONS

JOB 154.002.009.002
SHT. 1
DWG. FIGURE 1



CROSS–SECTION

0 15 30

SCALE IN FEET

LEGEND:

- TOP OF WATER
- TOP OF GROUND SURFACE
- COAL COMBUSTION RESIDUALS (CCR)
- NATIVE CLAY

REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

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SCALE:	AS SHOWN
DATE:	5–31–11
DRAWN BY:	JFD
CHKD. BY:	CTS
APPROVED:	TJH

CLIENT / LOCATION

ALLIANT ENERGY
BURLINGTON GENERATING STATION
BURLINGTON, IOWA

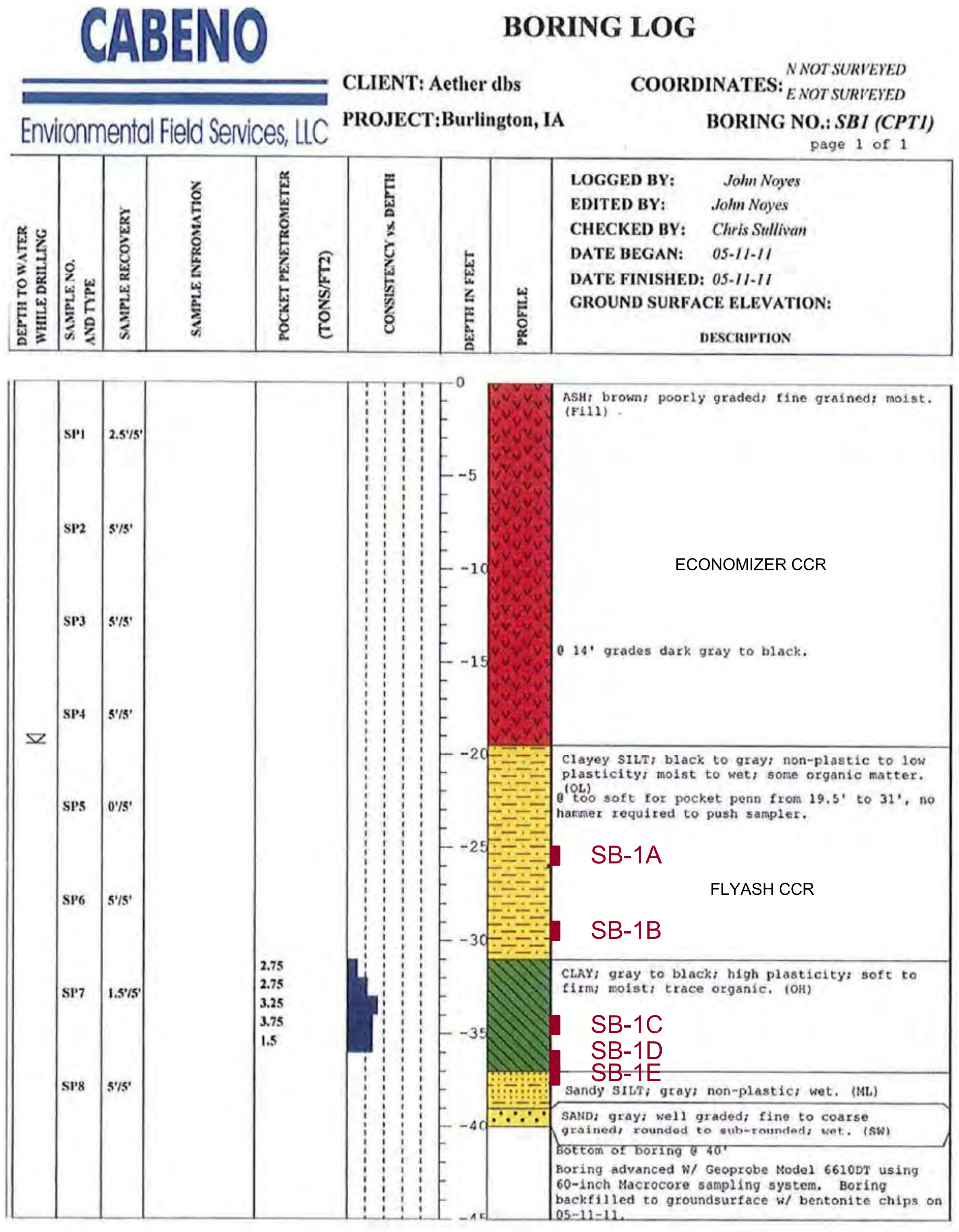
DRAWING DESCRIPTION

ECONOMIZER ASH POND CROSS–SECTION

JOB 154.002.009.002

SHT. 2

DWG. FIGURE 2



CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

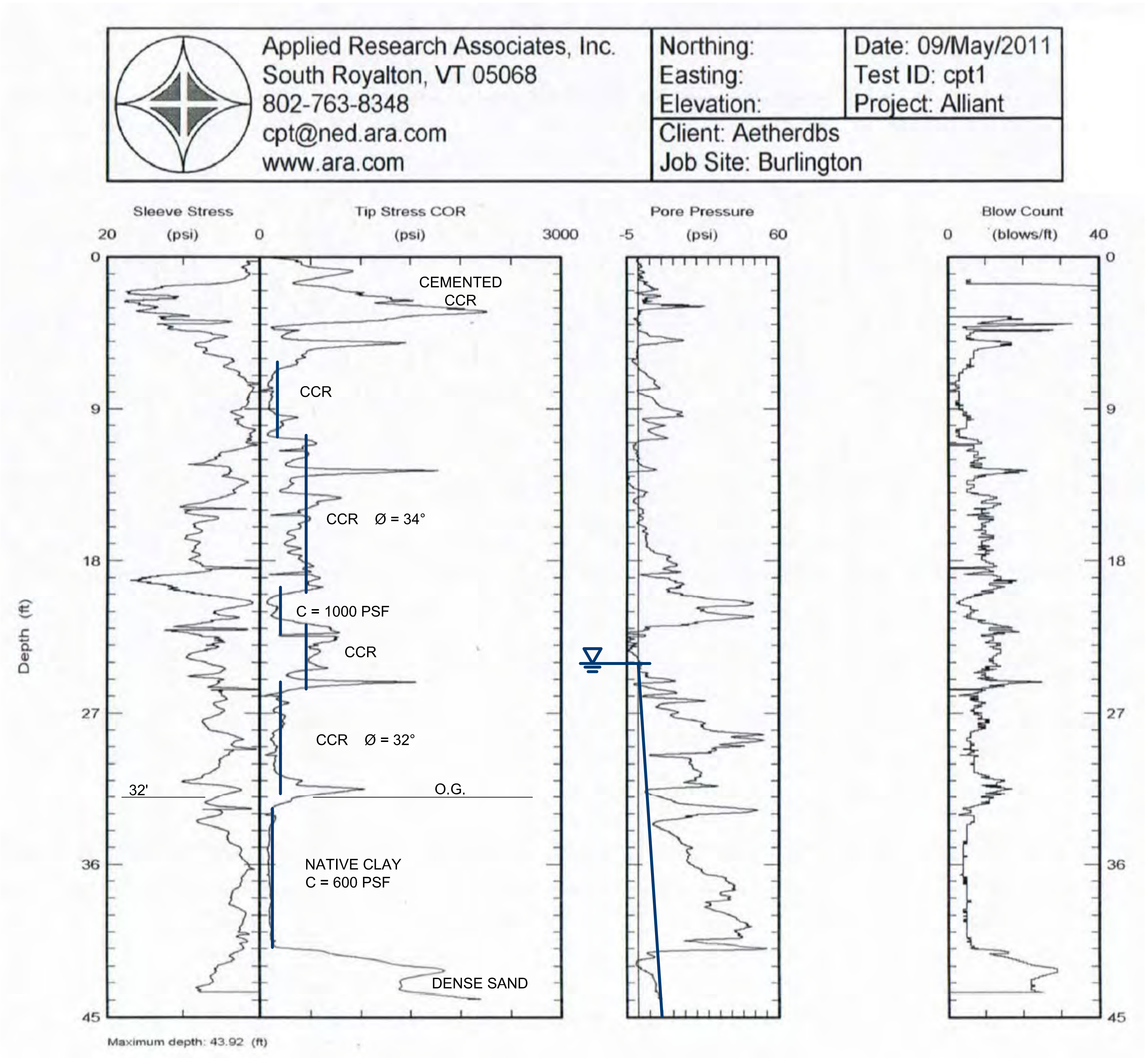
BORING NO.: *SB1 (CPT1)*

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)	CONSISTENCY vs. DEPTH	DEPTH IN FEET	PROFILE	DESCRIPTION
	SP1	2.5'/5'				0		ASH; brown; poorly graded; fine grained; moist. (Fill) .
	SP2	5'/5'				-5		ECONOMIZER CCR
	SP3	5'/5'				-10		@ 14' grades dark gray to black.
∇	SP4	5'/5'				-15		
	SP5	0'/5'				-20		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.
	SP6	5'/5'				-25		SB-1A FLYASH CCR SB-1B
	SP7	1.5'/5'		2.75 2.75 3.25 3.75 1.5		-30		CLAY; gray to black; high plasticity; soft to firm; moist; trace organic. (OH) SB-1C SB-1D SB-1E
	SP8	5'/5'				-35		Sandy SILT; gray; non-plastic; wet. (ML)
						-40		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.
						-45		

SAMPLE LOACTIONS



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

REV	DATE	BY	DESCRIPTION
5			
4			
3			
2			
1			

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SCALE: AS SHOWN
DATE: 5-31-11
DRAWN BY: JFD
CHKD. BY: CTS
APPROVED: TJH

CLIENT / LOCATION
ALLIANT ENERGY
BURLINGTON GENERATING STATION
BURLINGTON, IOWA

DRAWING DESCRIPTION
CPT AND SB CORRELATION

JOB 154.002.009.002
SHT. 3
DWG. FIGURE 3

Attachment A

Cone Penetrometer Test (CPT) Results

Burlington Generating Station

Source:
CABENO Environmental Field Services, LCC May 2011

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

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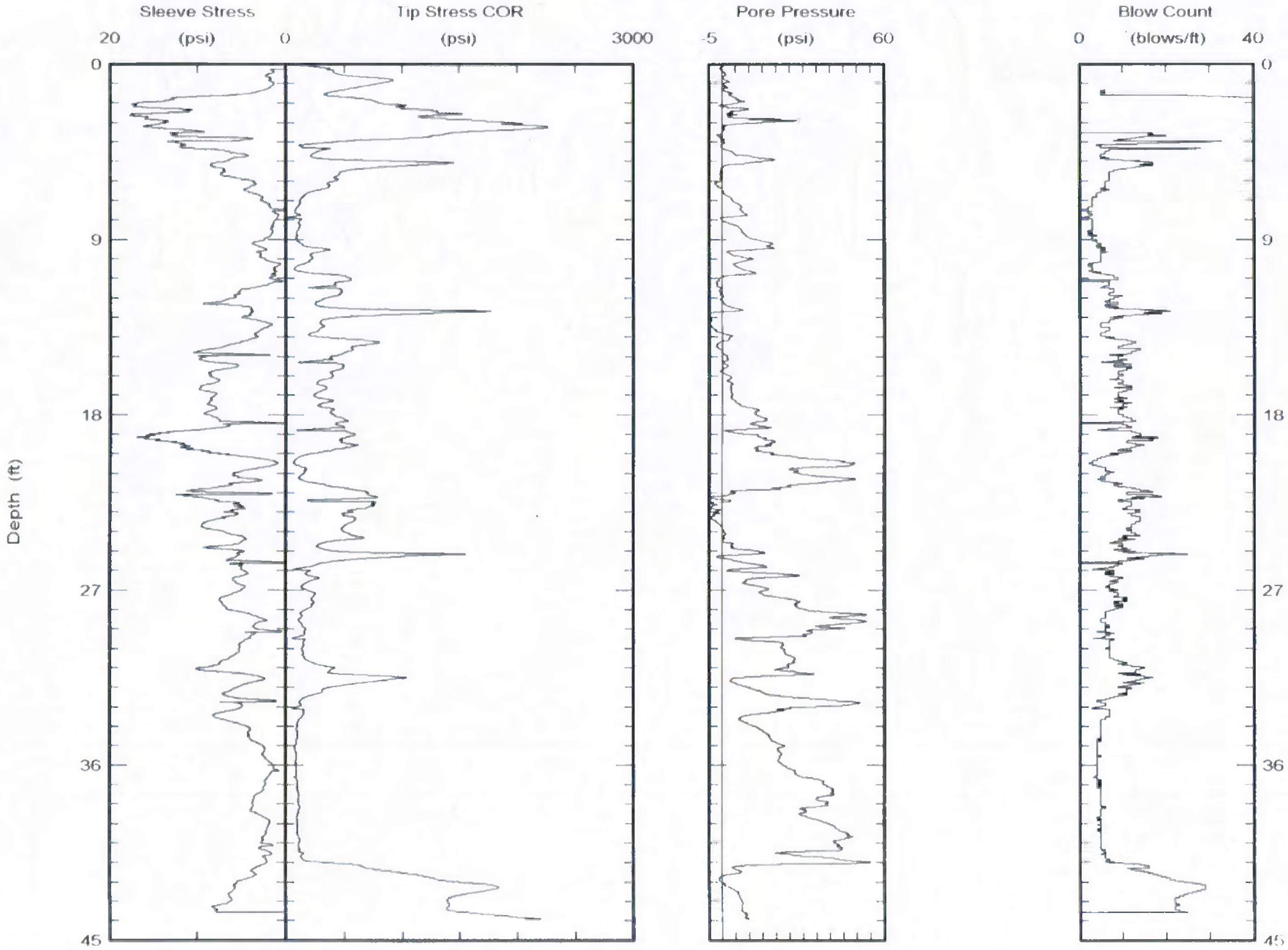
Northing:
Easting:
Elevation:
Client: Aetherdbs
Job Site: Burlington

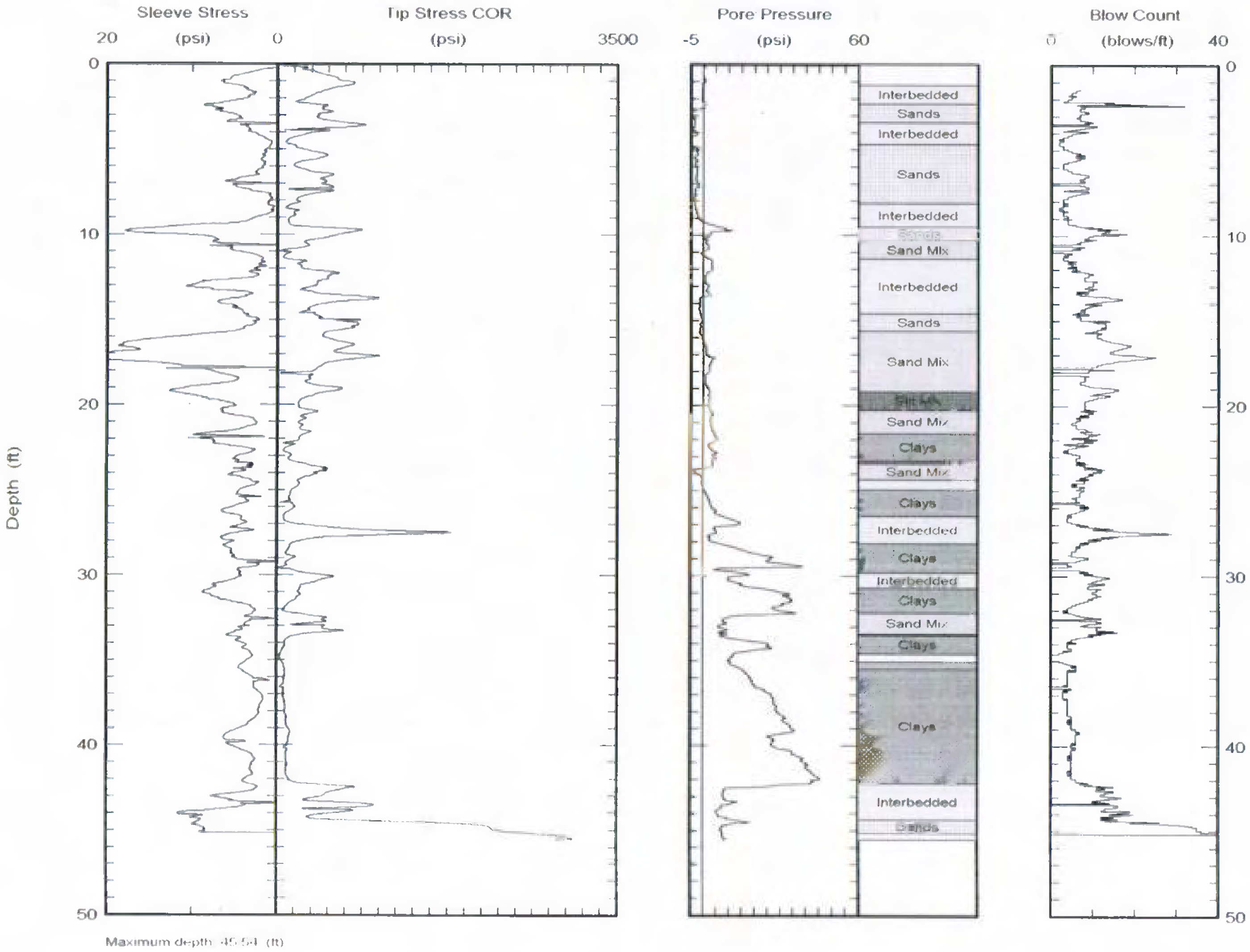
Date: 09/May/2011
Test ID: cpt1
Project: Alliant



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:	Date: 09/May/2011 Test ID: cpt2 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



Maximum depth: 45.54 (ft)

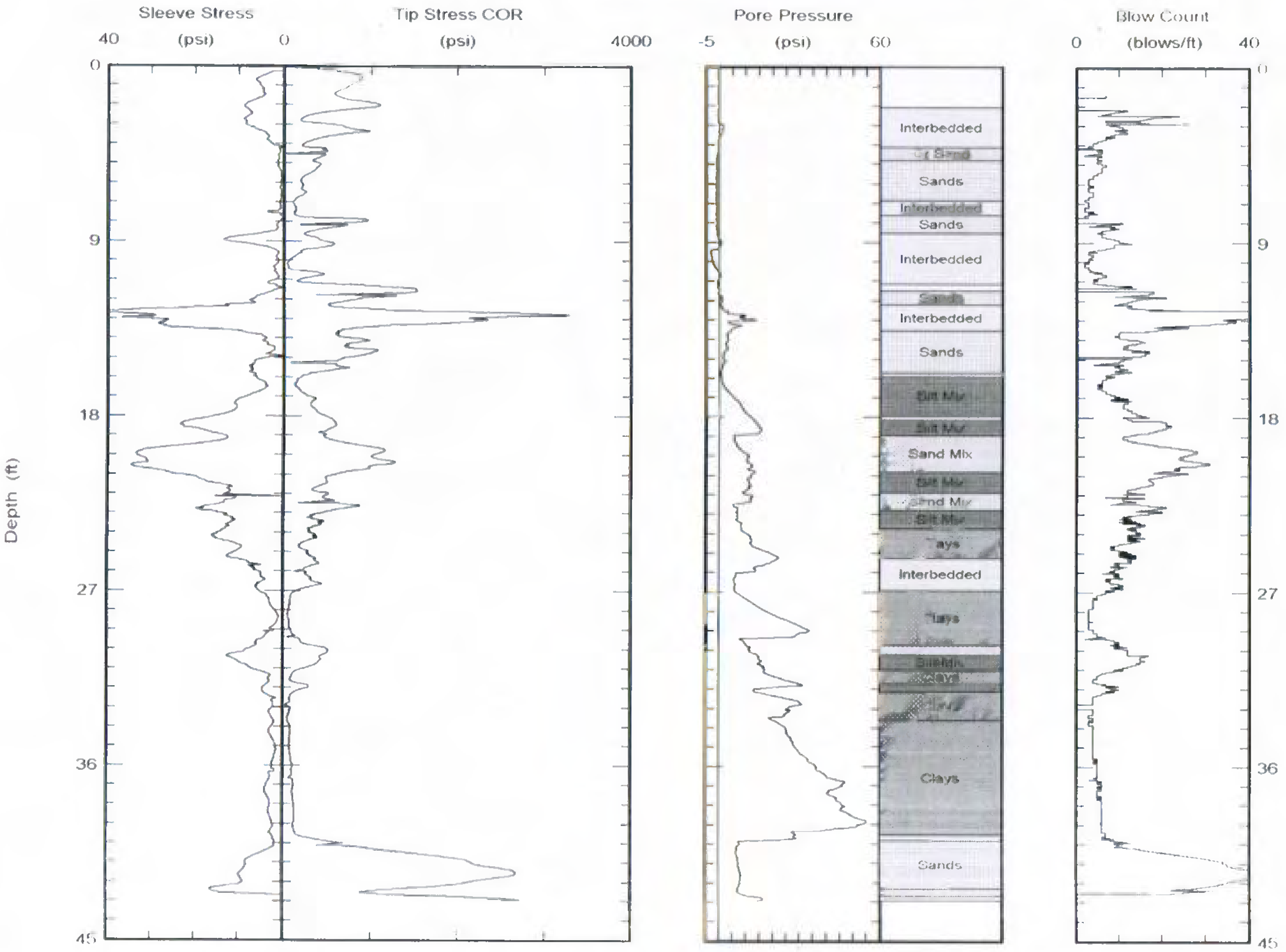
Test ID: cpt2
File: A09T1102C.ECP

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: cpt3
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



Maximum depth: 42.94 (ft)

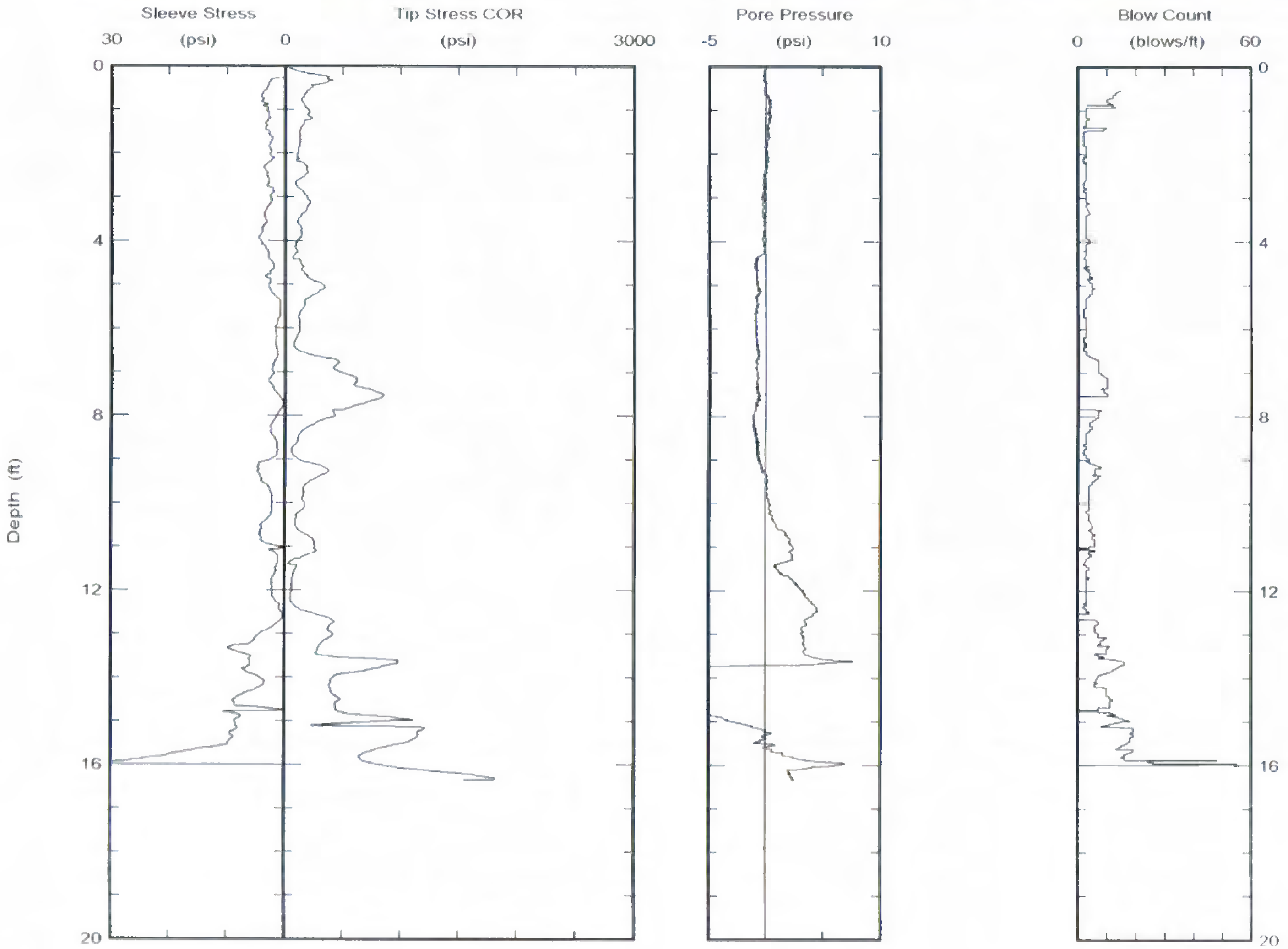
Test ID: cpt3
File: A09Y1103C.ECP

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: cpt4
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



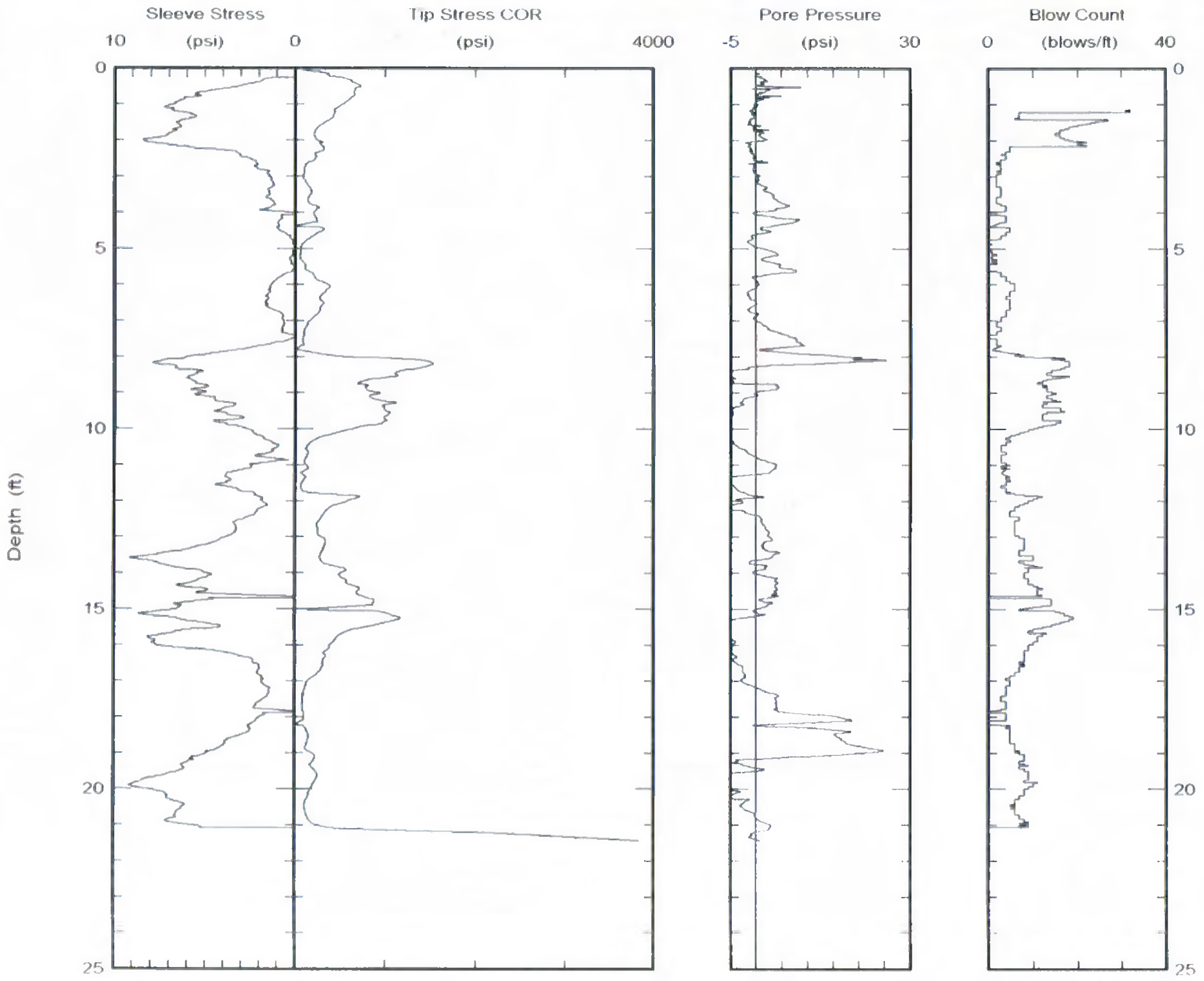
Maximum depth: 16.35 (ft)

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: cpt5
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



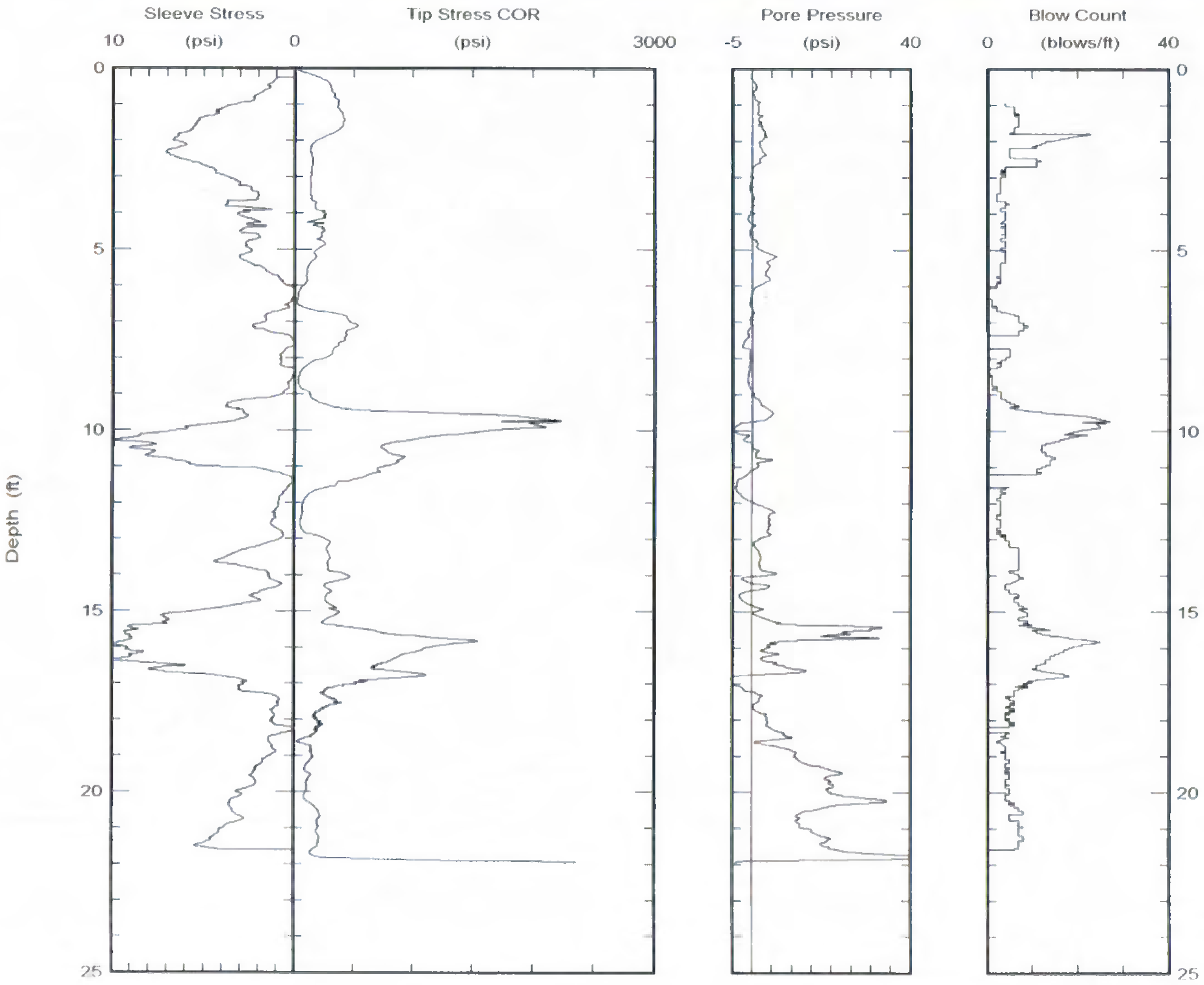
Maximum depth: 21.43 (ft)

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



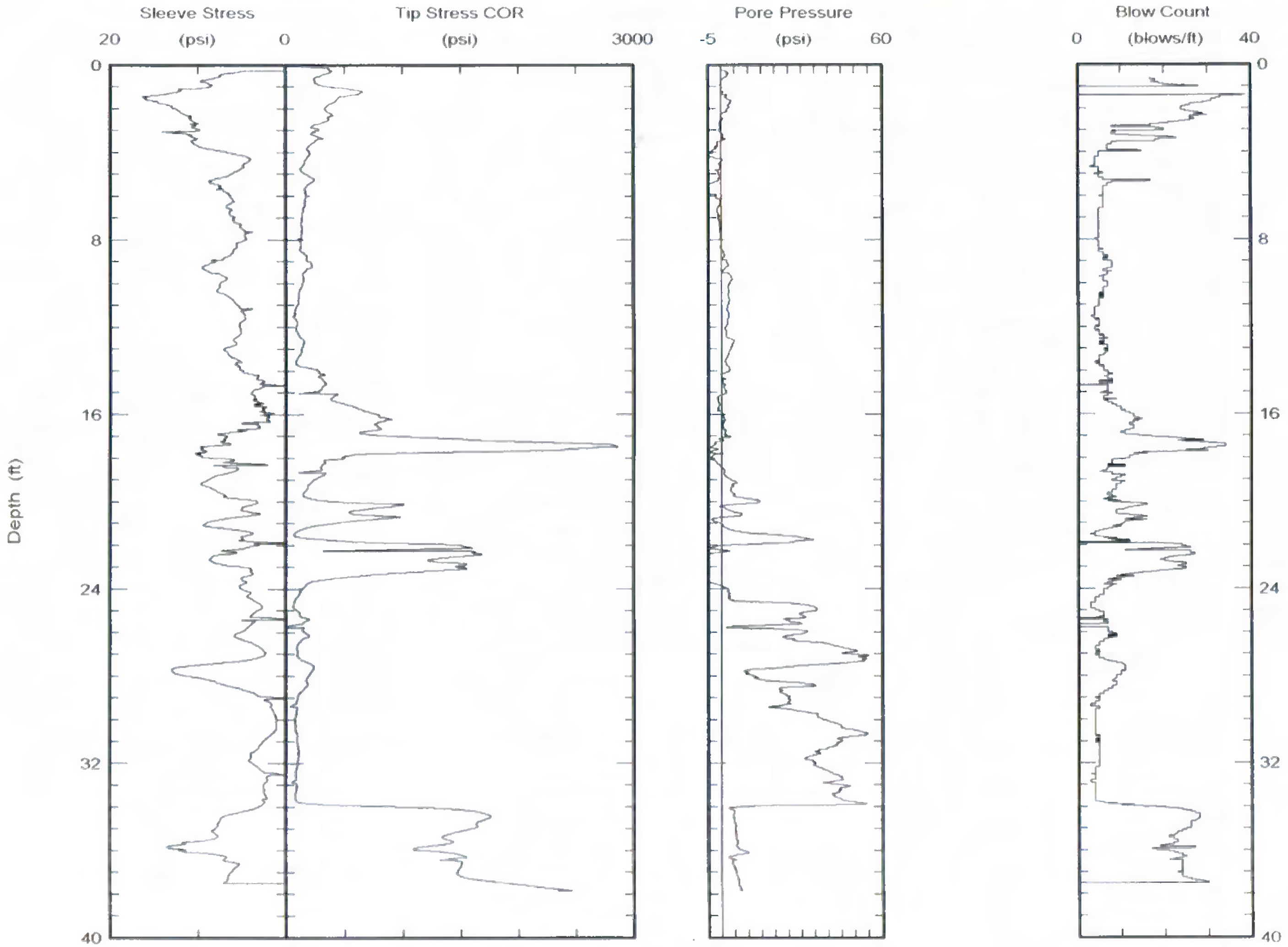
Maximum depth: 21.96 (ft)

Test ID: cpt6
File: A10Y1102C.ECP

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

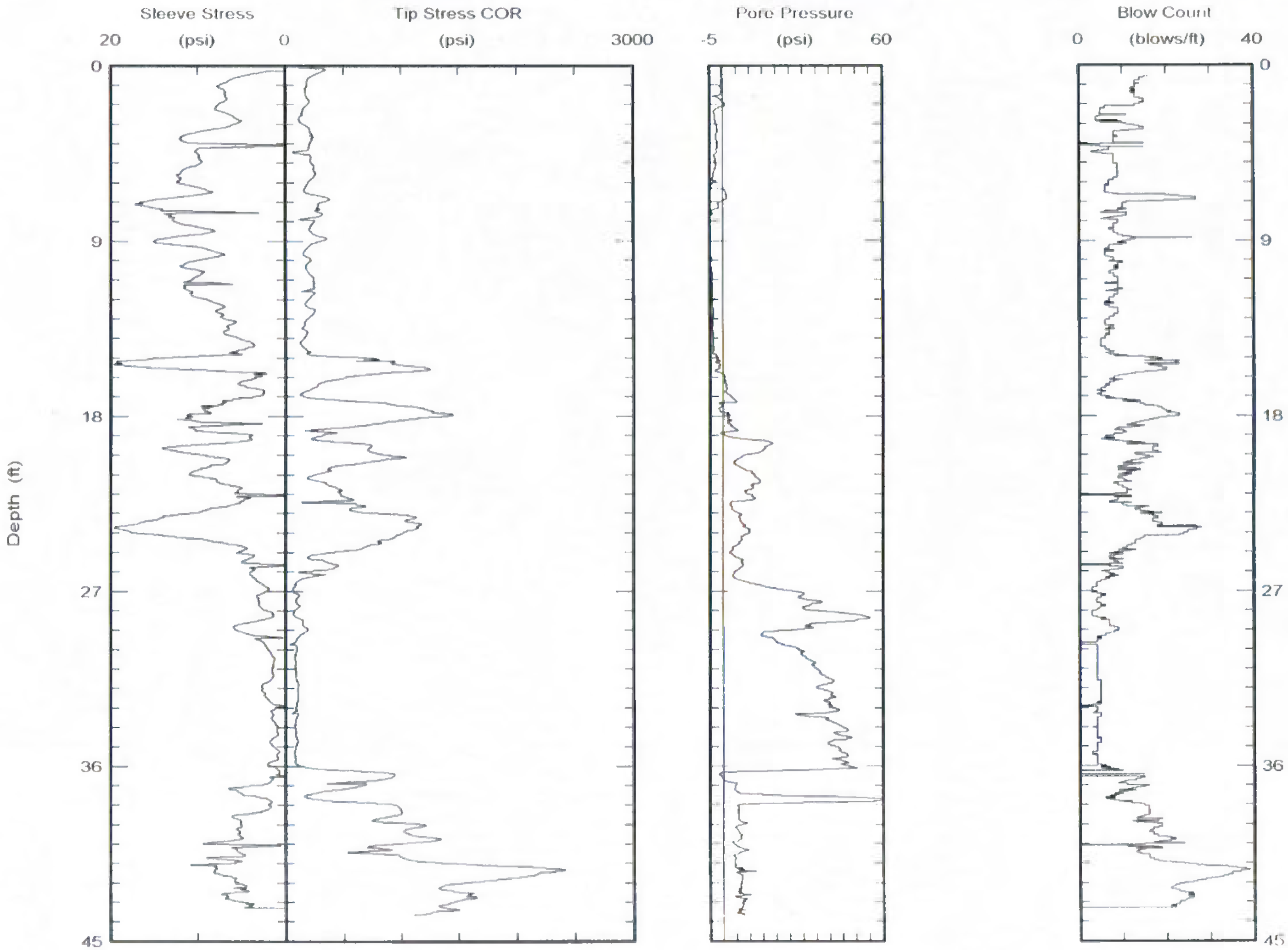
Northing:
Easting:
Elevation:
Client: Aetherdbs
Job Site: Burlington

Date: 10/May/2011
Test ID: cpt7
Project: Alliant



Maximum depth: 37.86 (ft)

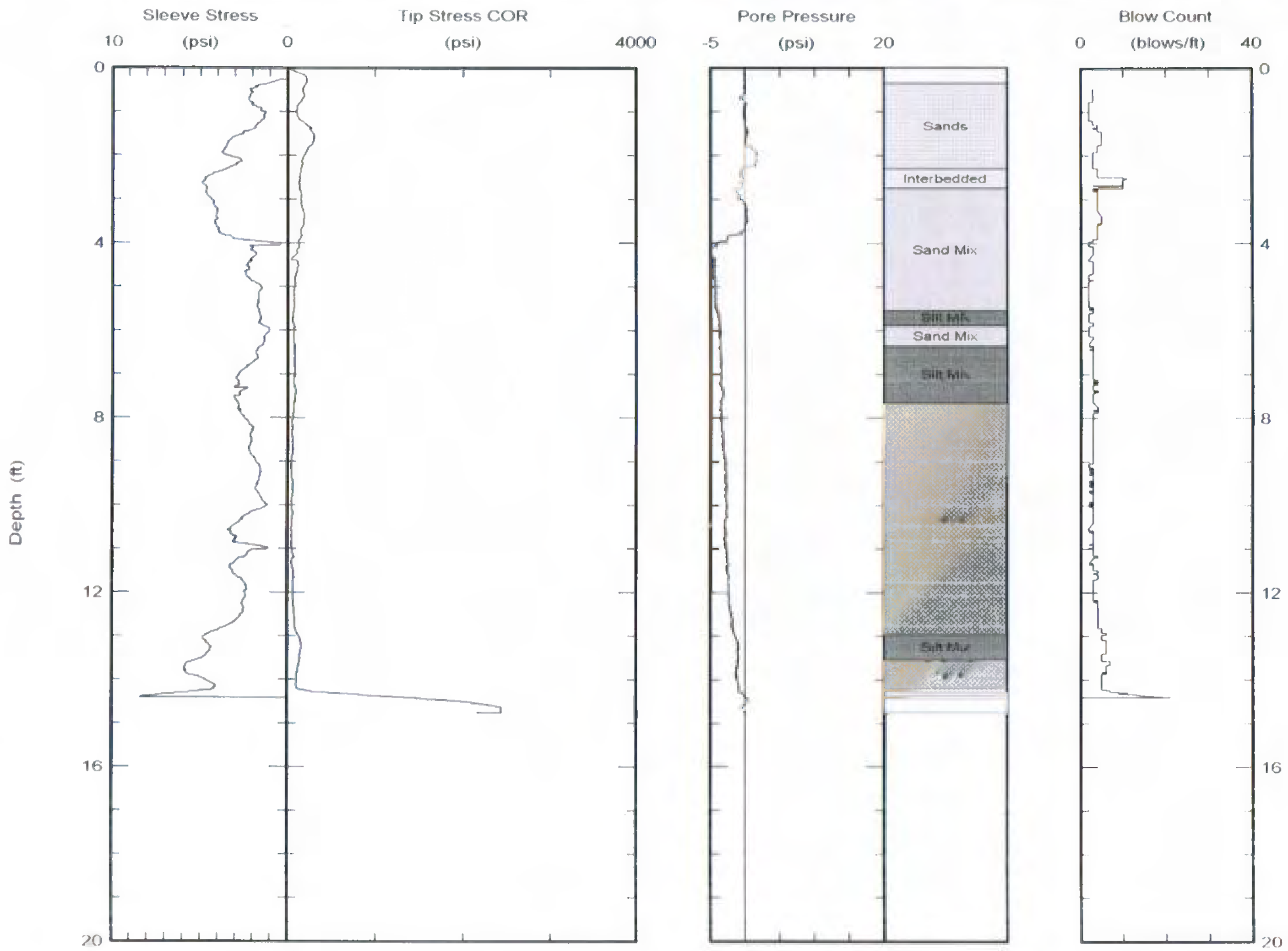
Applied Research Associates, Inc. South Royalton, VT 05068 802-763-8348 cpt@ned.ara.com www.ara.com	Northing: Easting: Elevation:	Date: 10/May/2011 Test ID: cpt8 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



Maximum depth: 43.65 (ft)

Test ID: cpt8
File: A10Y1104C.ECP

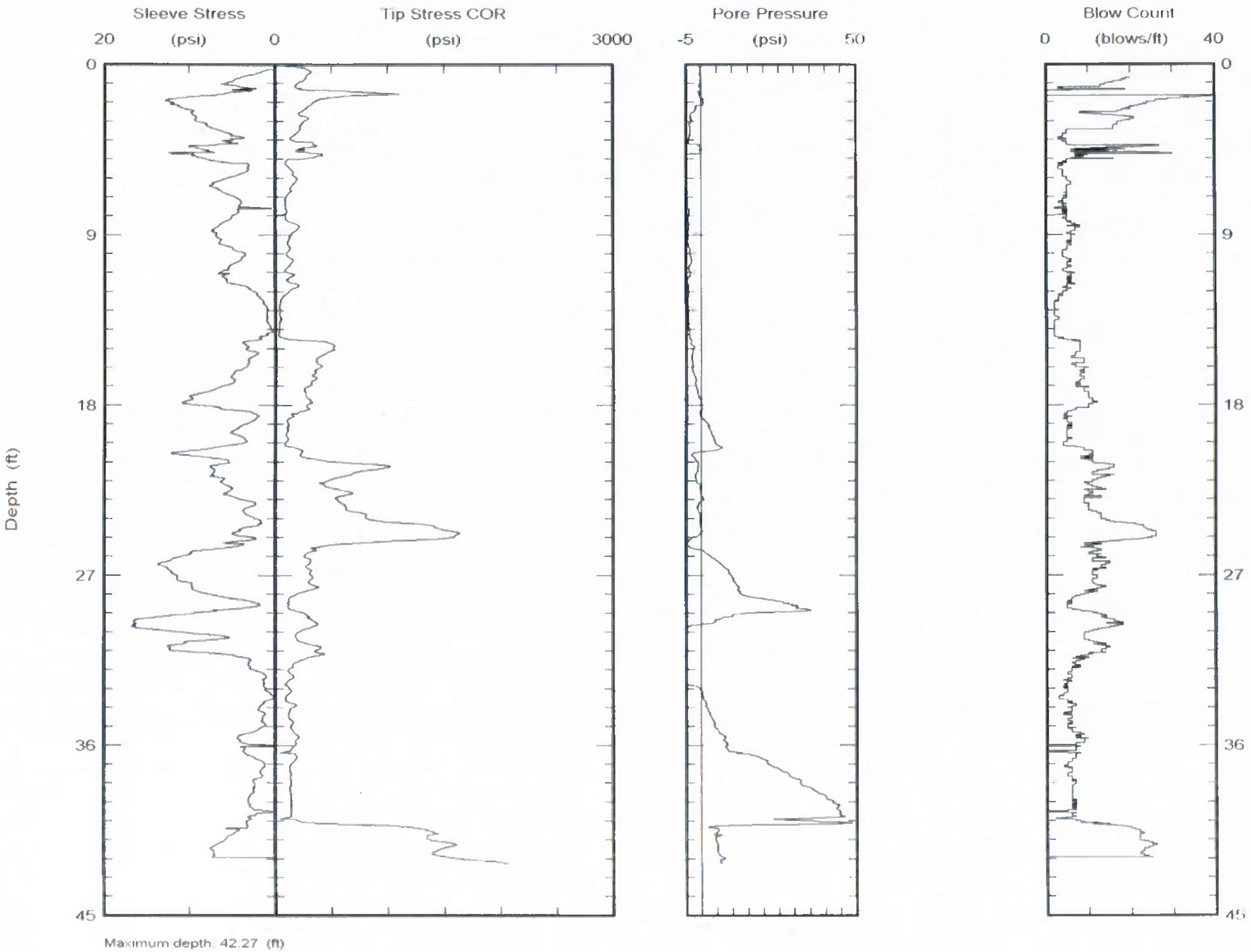
Applied Research Associates, Inc. South Royalton, VT 05068 802-763-8348 cpt@ned.ara.com www.ara.com	Northing: Easting: Elevation:	Date: 10/May/2011 Test ID: cpt9 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



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	

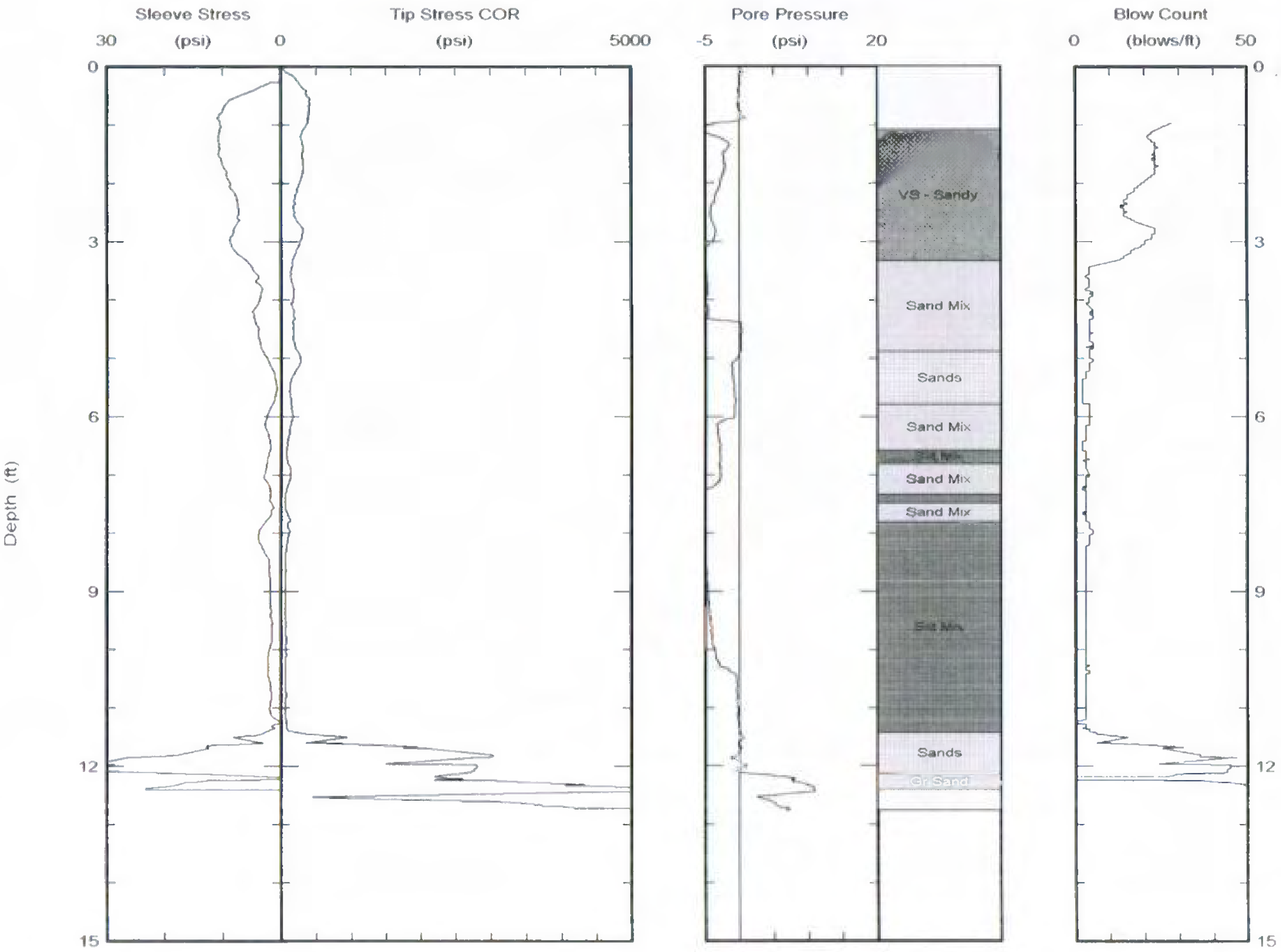


Test ID: cpt10
File: A10Y1106C.ECP

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

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

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



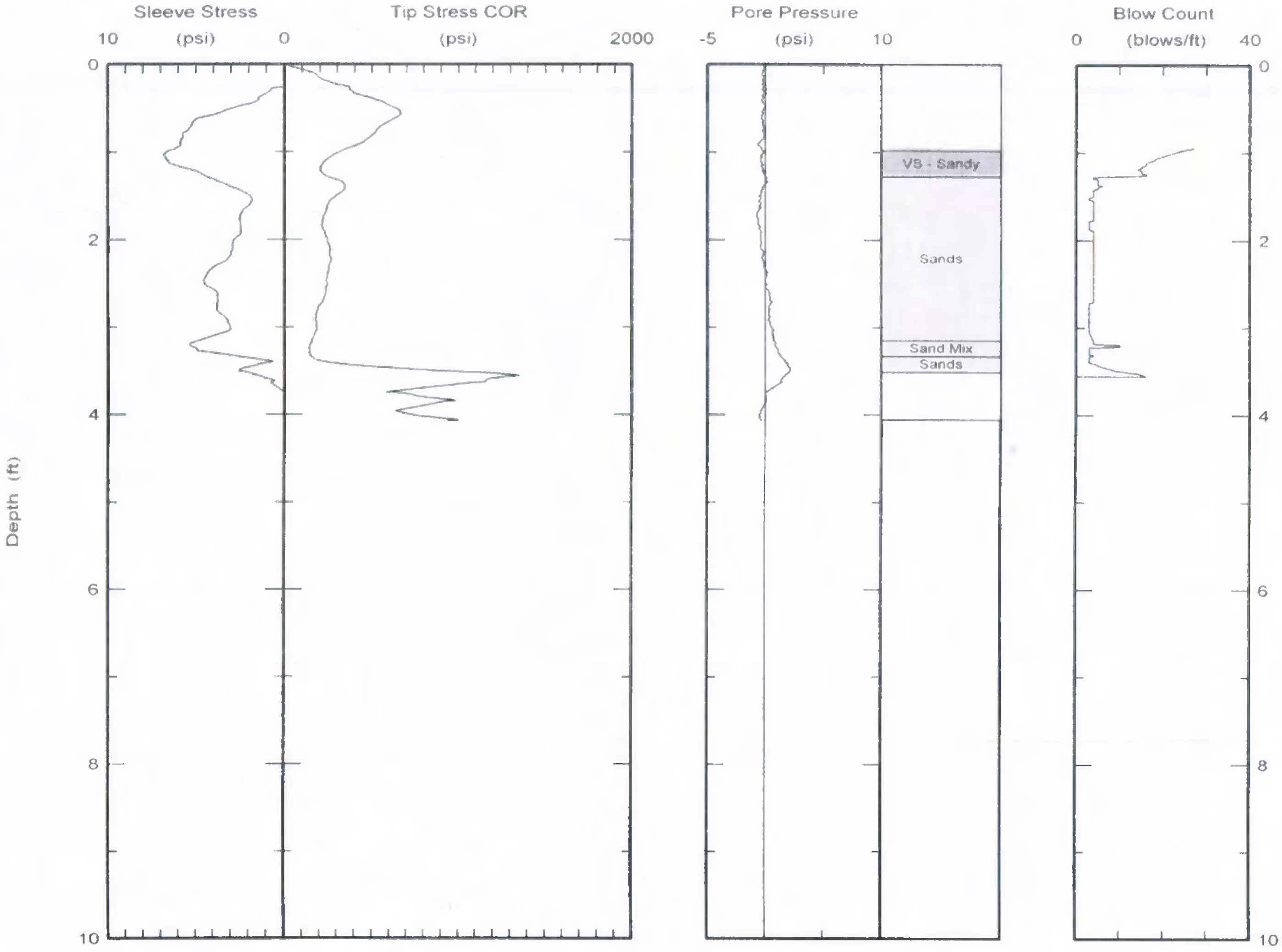
Maximum depth: 12.76 (ft)

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: cpt12
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



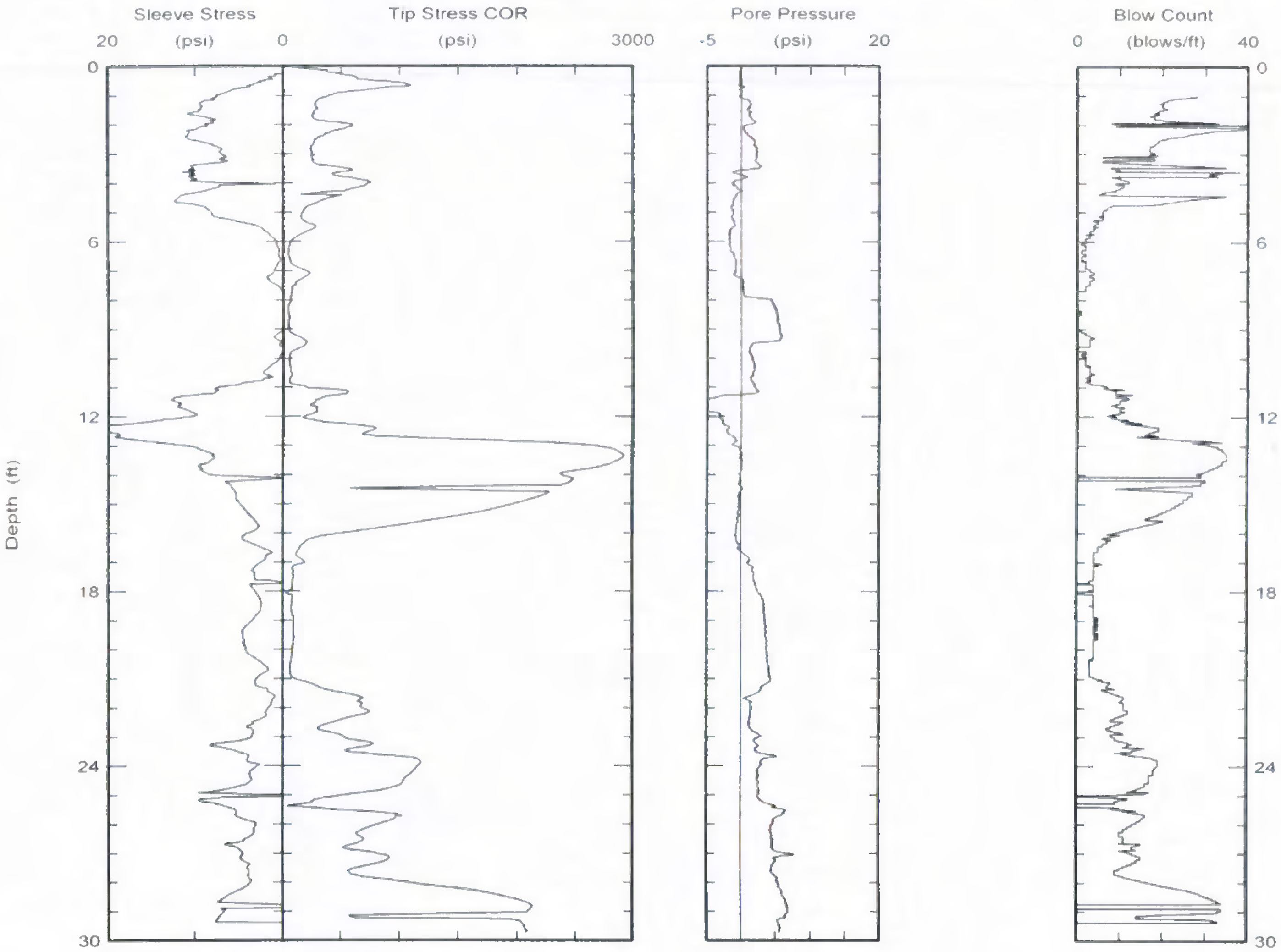
Maximum depth: 4.06 (ft)

Test ID: cpt12
File: A10Y1108C.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: 10/May/2011
Test ID: cpt13
Project: Alliant



Maximum depth: 29.72 (ft)

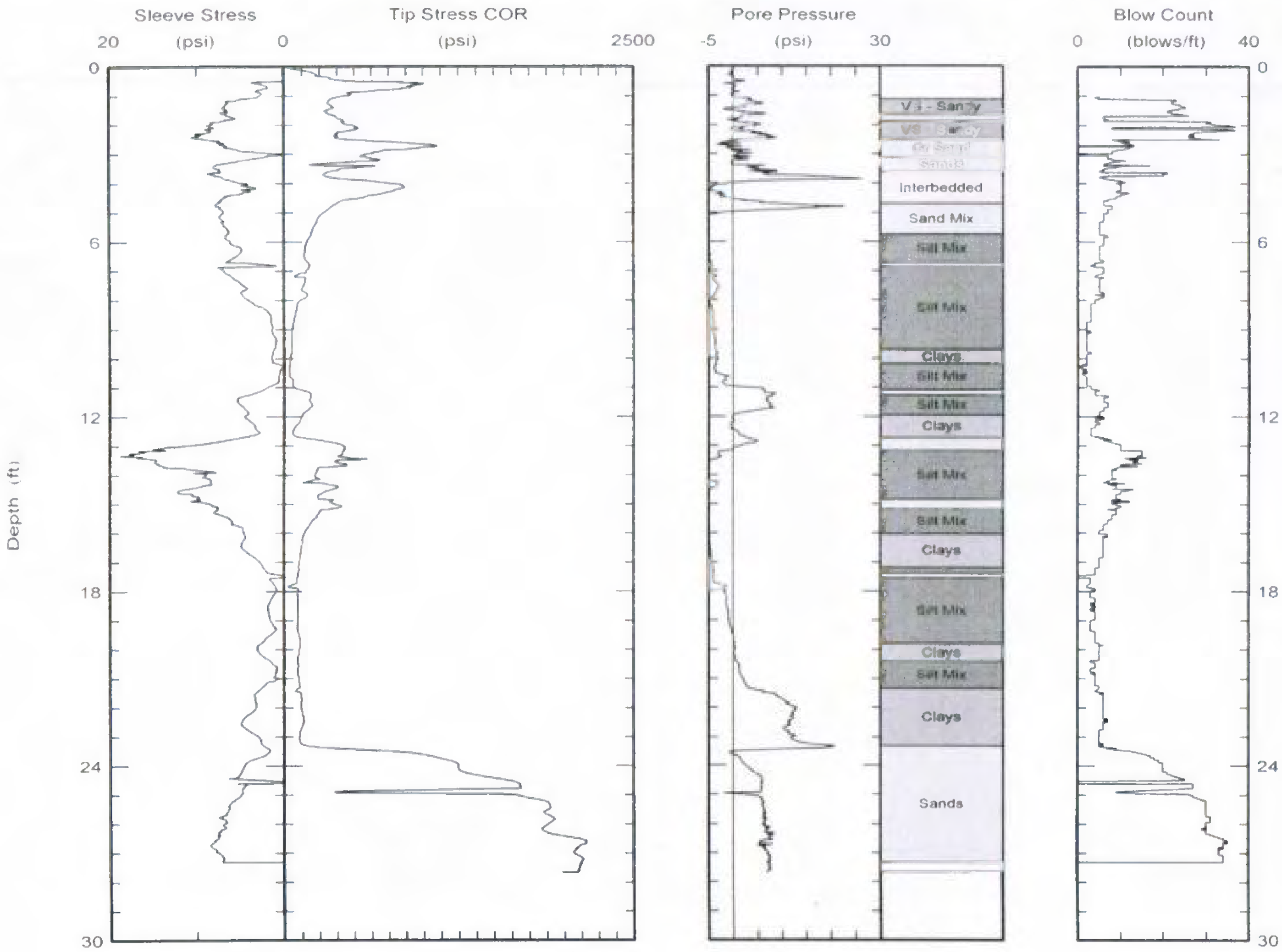
Test ID: cpt13
File: A10Y1109C.ECP

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: cpt14
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



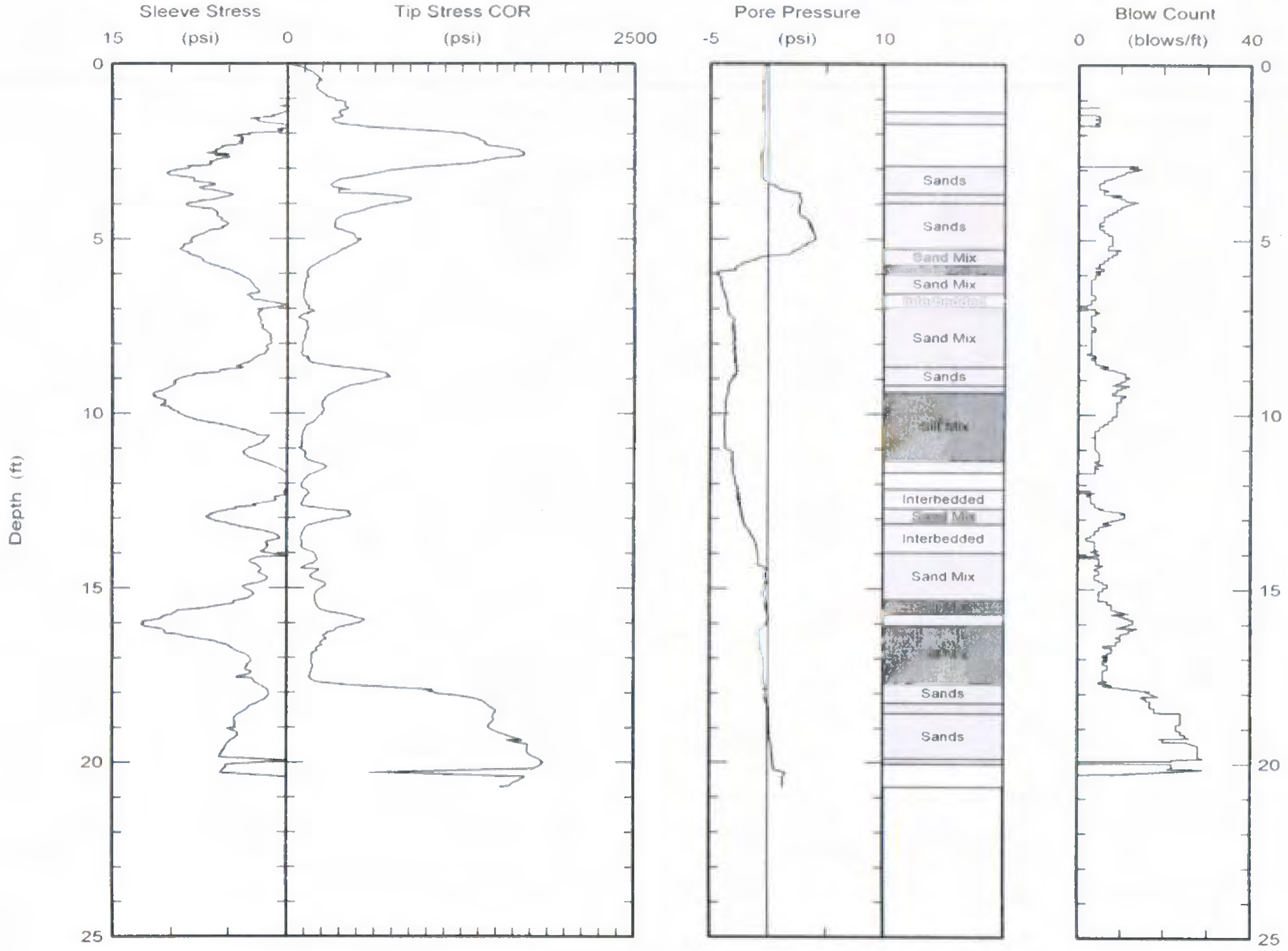
Maximum depth: 27.65 (ft)

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



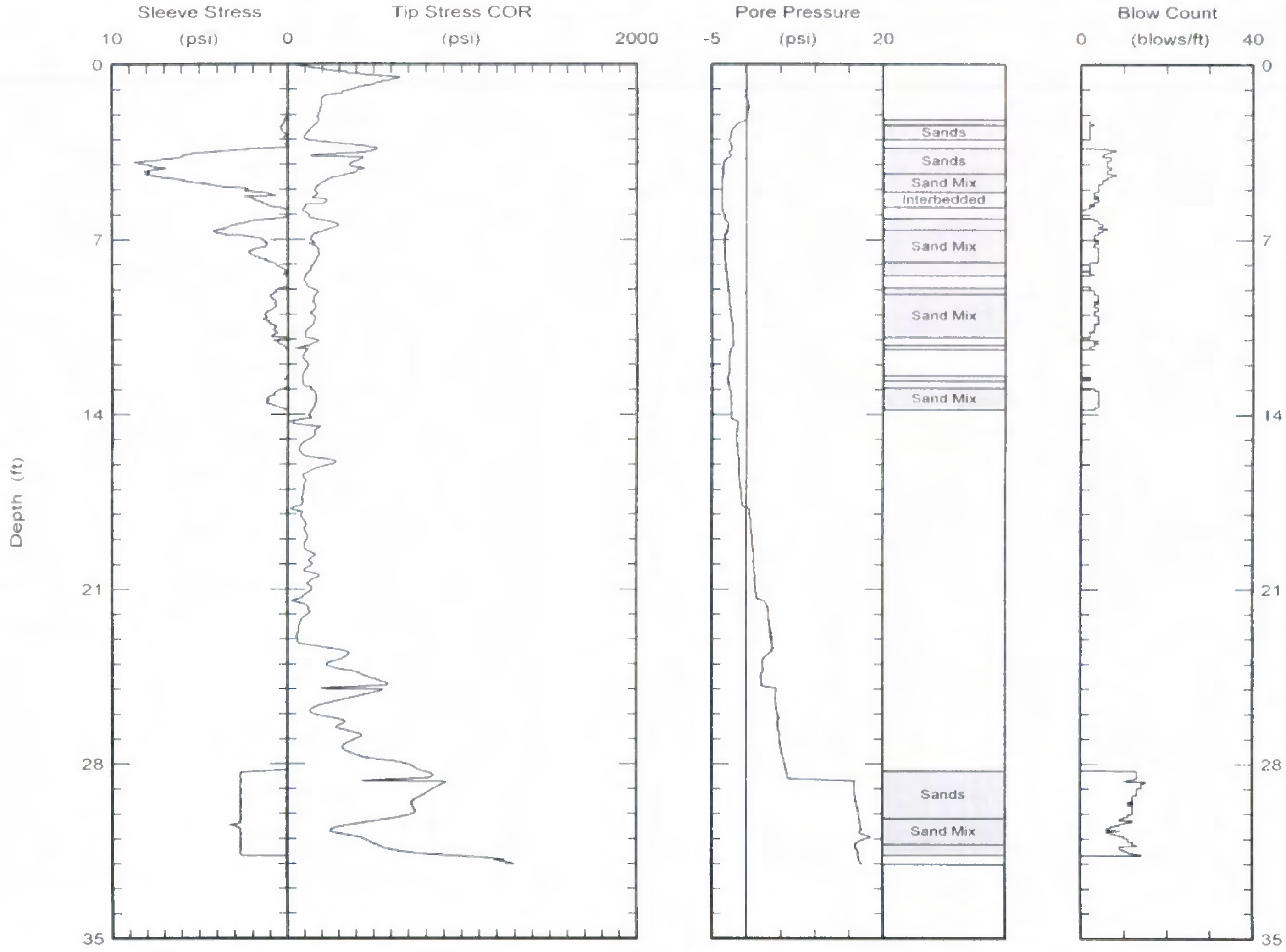
Maximum depth: 20.70 (ft)

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: cpt16
Project: Alliant

Client: Aetherdbs
Job Site: Burlington



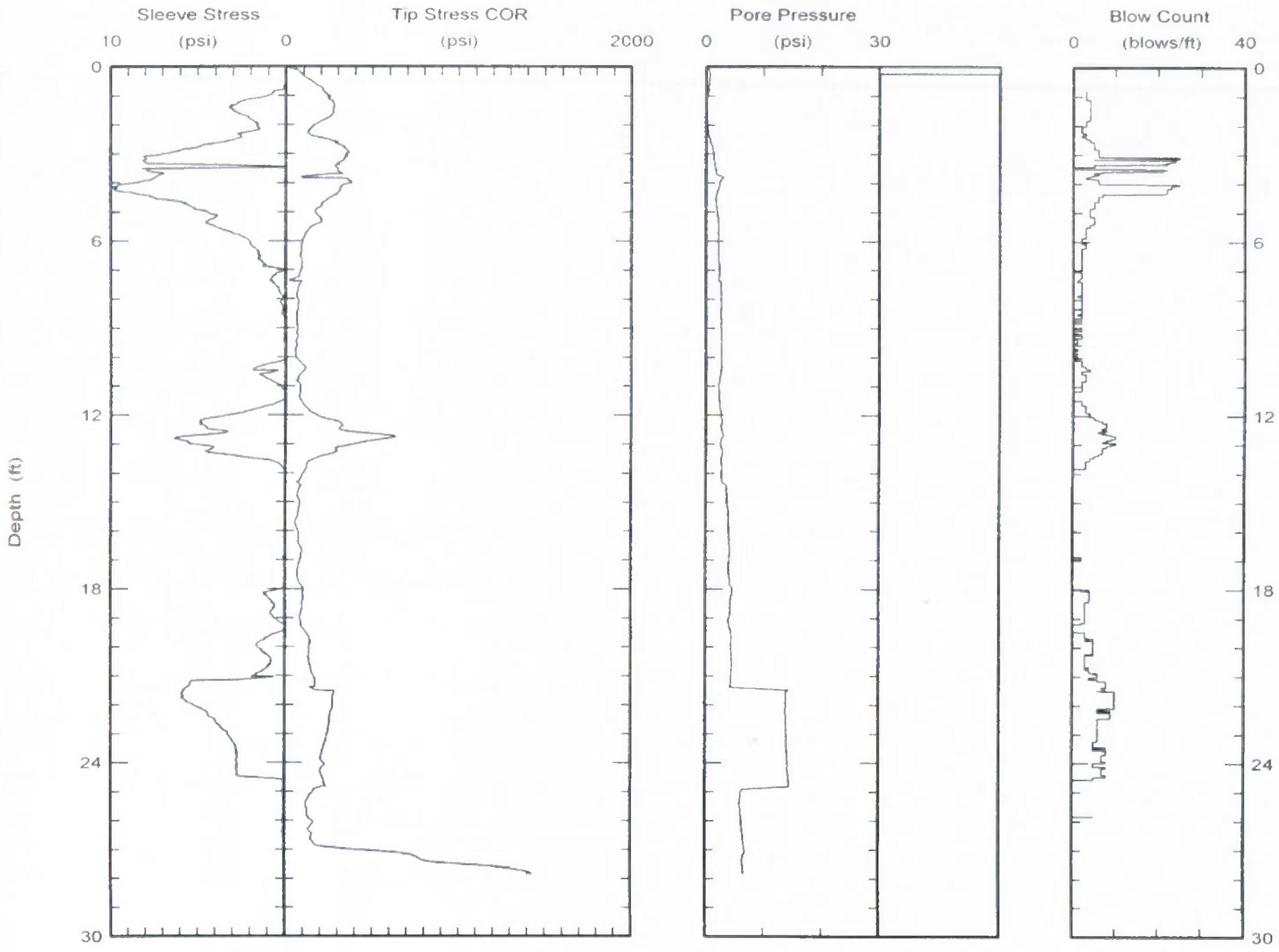
Maximum depth: 32.02 (ft)

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: cpt17
Project: Alliant

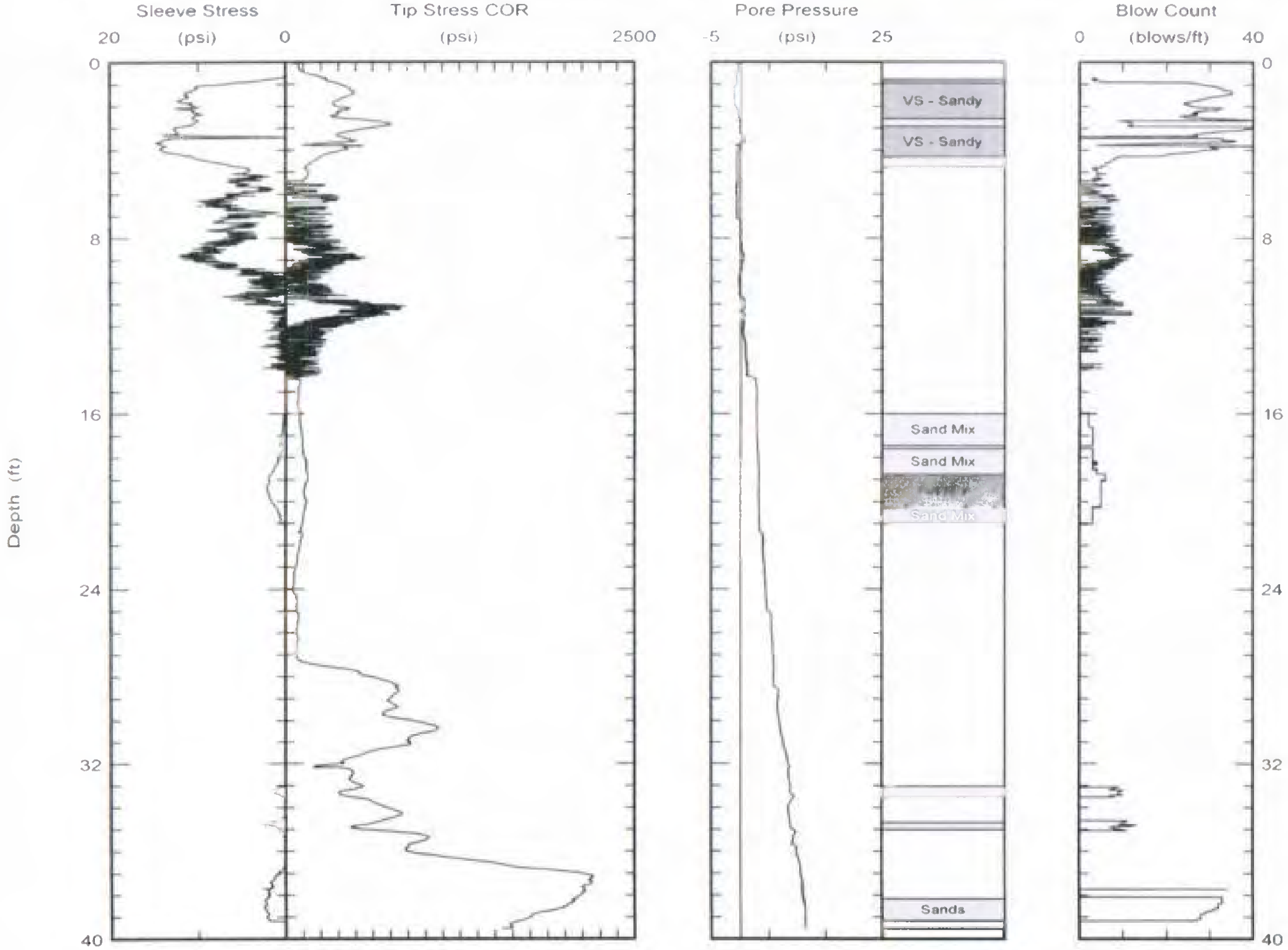
Client: Aetherdbs
Job Site: Burlington



Maximum depth: 27.84 (ft)

Test ID: cpt17
File: A15Y1104C.ECP

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: cpt18 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



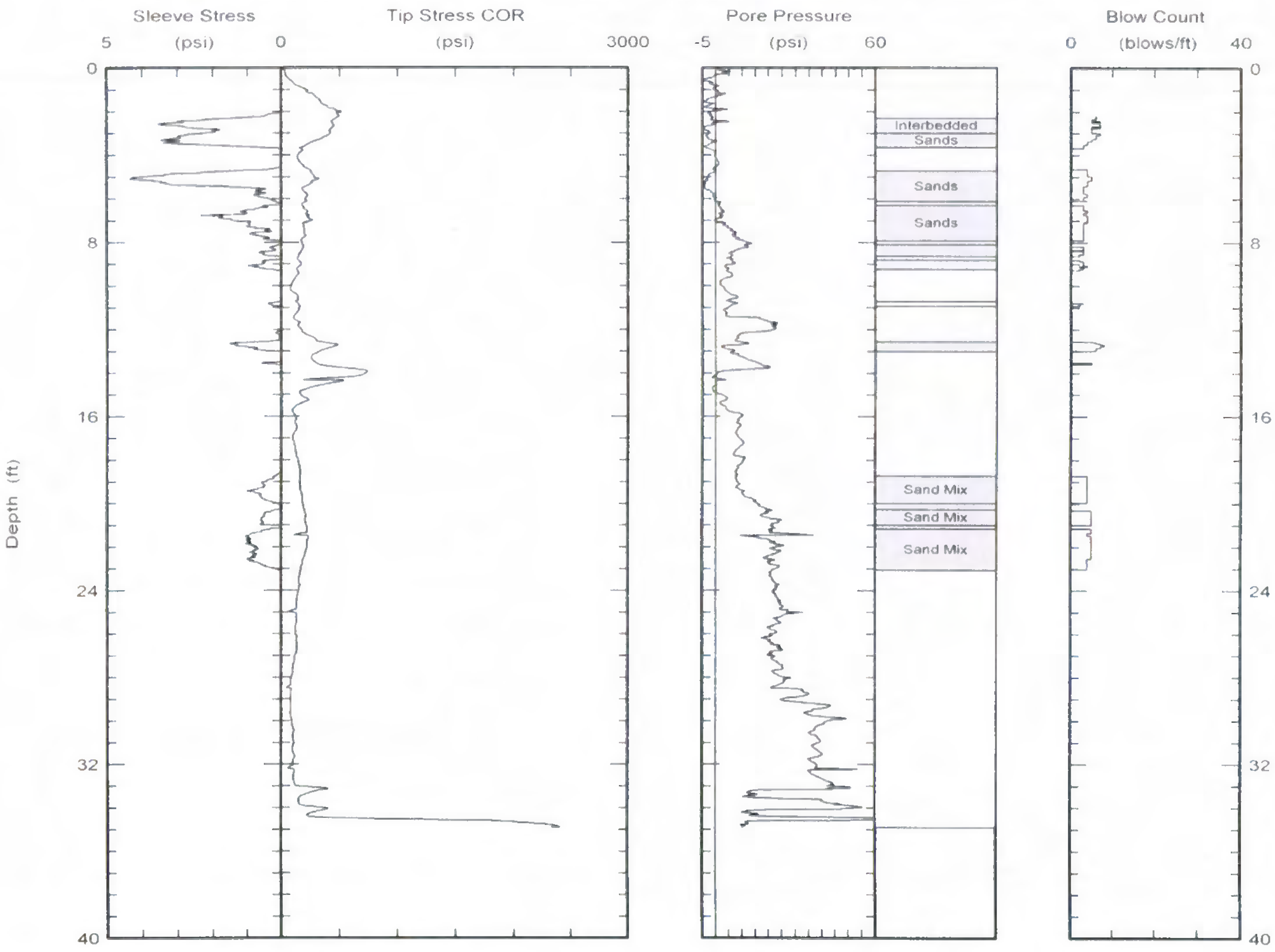
Maximum depth: 39.53 (ft)

Test ID: cpt18
File: A15Y1105C.ECP

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

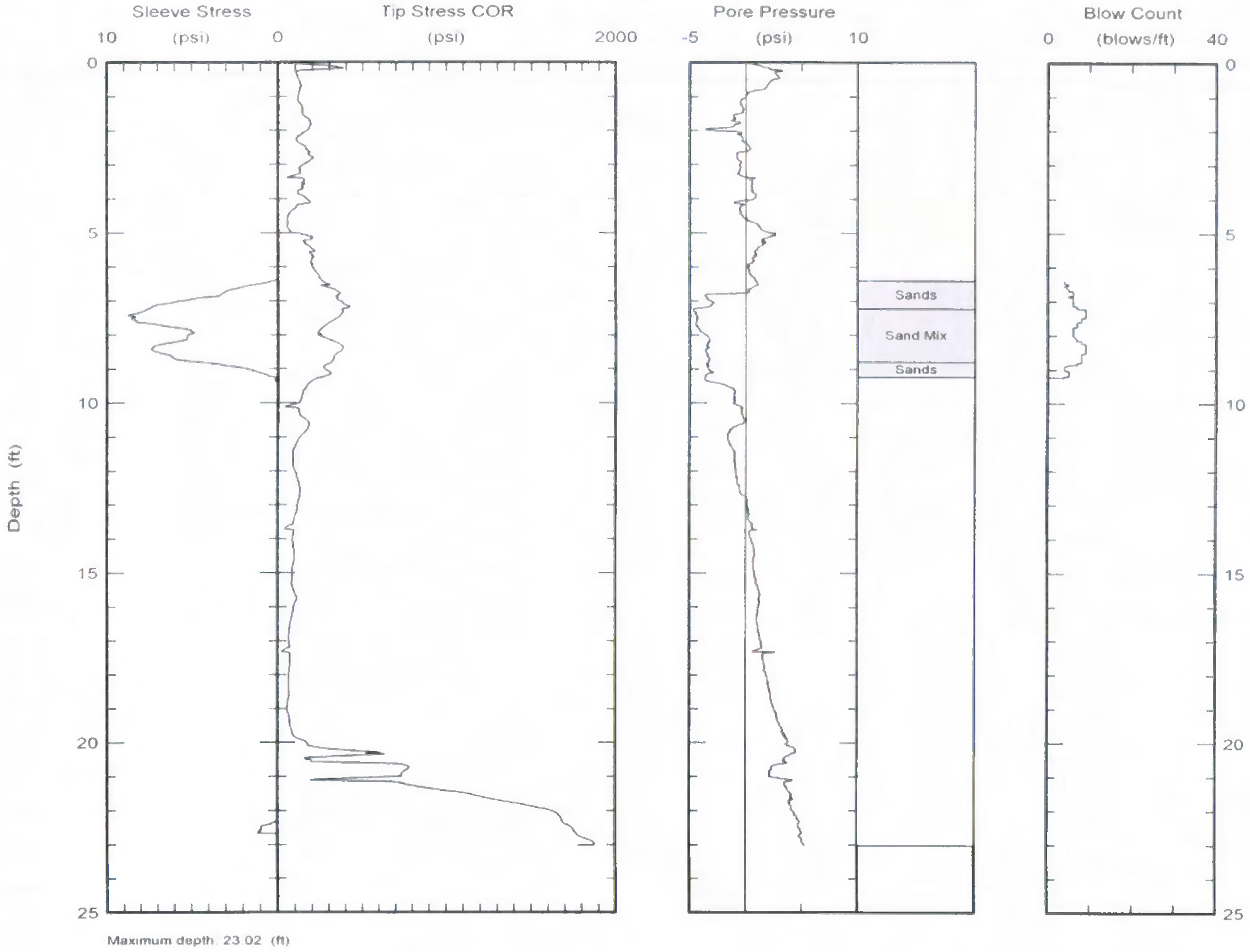
Northing:
Easting:
Elevation:
Client: Aetherdbs
Job Site: Burlington

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



Maximum depth: 34.90 (ft)

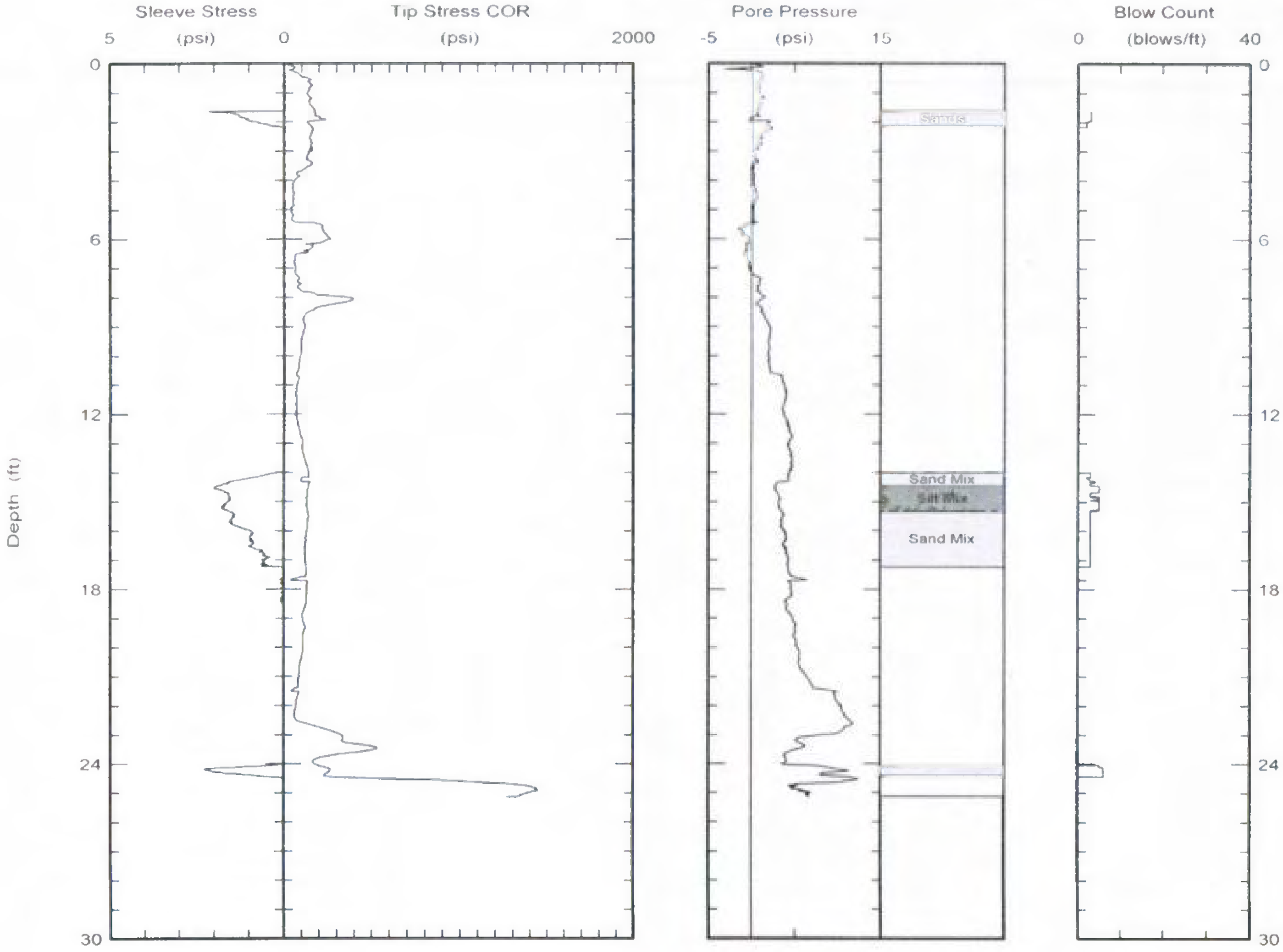
Applied Research Associates, Inc. South Royalton, VT 05068 802-763-8348 cpt@ned.ara.com www.ara.com	Northing: Easting: Elevation:	Date: 16/May/2011 Test ID: cpt20 Project: Alliant
	Client: Aetherdbs Job Site: Burlington	



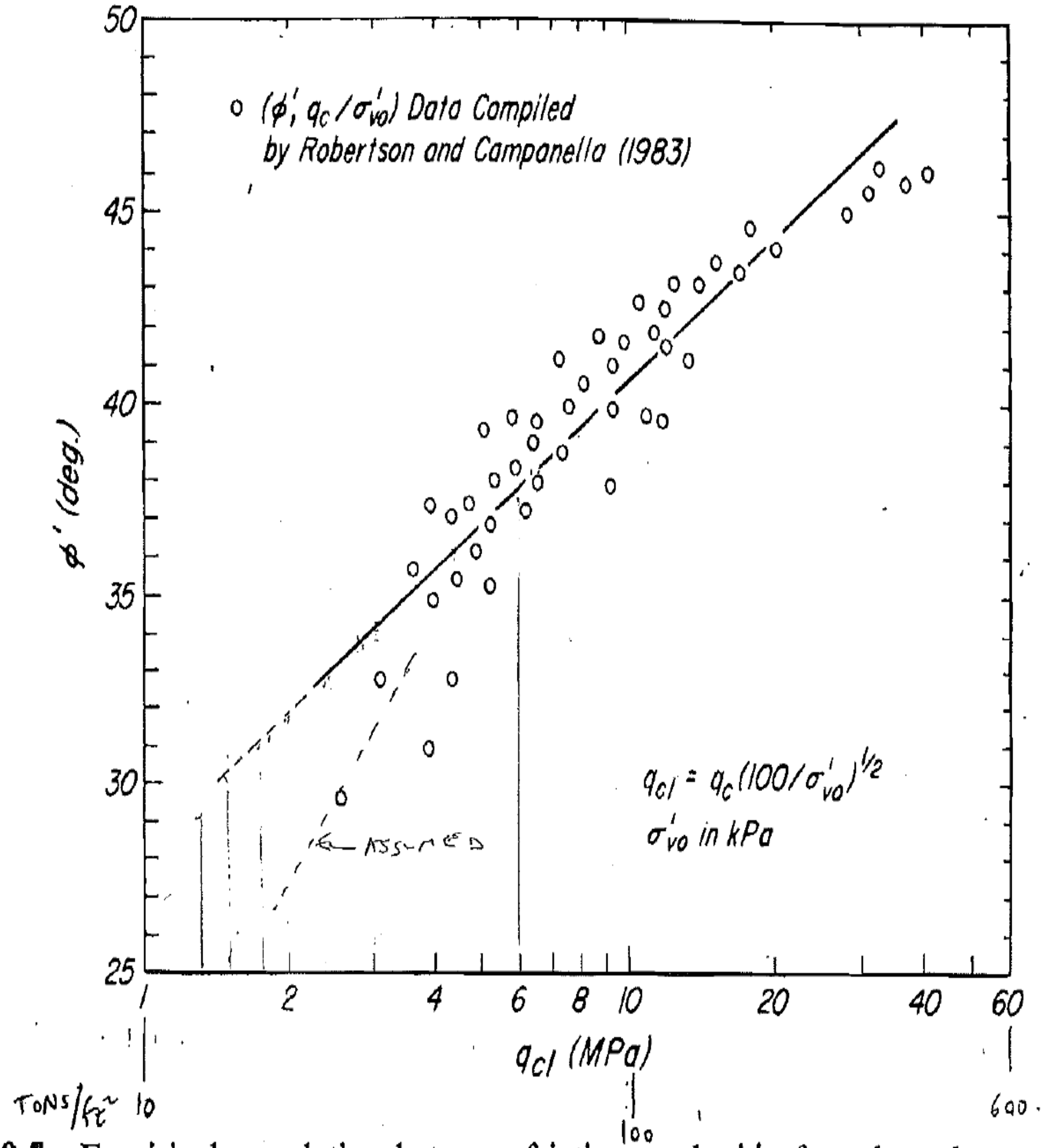
Maximum depth: 23.02 (ft)

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

Northing: Easting: Elevation:	Date: 16/May/2011 Test ID: cpt21 Project: Alliant
Client: Aetherdbs Job Site: Burlington	



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

Attachment B

Boring / Geoprobe Logs

Burlington Generating Station

Source:
CABENO Environmental Field Services, LCC May 2011

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.

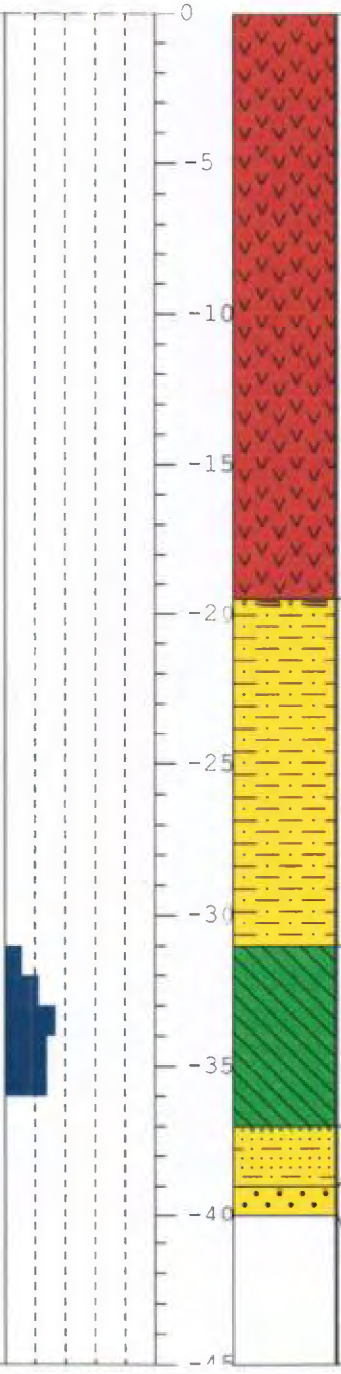
CABENO
Environmental Field Services, LLC

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

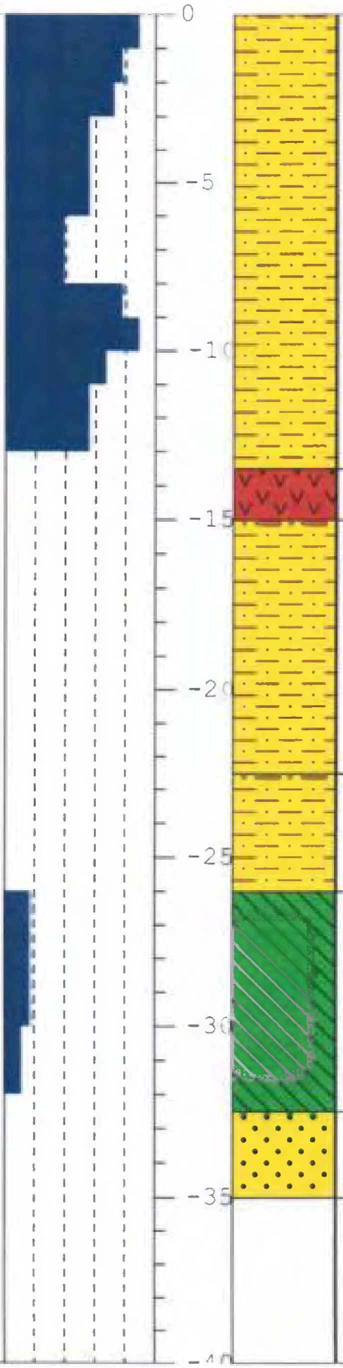
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

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)
	SP1	5'/5'		4.0 3.5 3.25 2.5
	SP2	5'/5'		2.5 2.5 1.75 1.75 3.5
	SP3	5'/5'		4.0 3.0 2.5 2.5
	SP4	4'/5'		
▽	SP5	4'/5'		
	SP6	5'/5'		0.75 0.75 0.75 0.75
	SP7	4'/5'		0.5 0.5



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

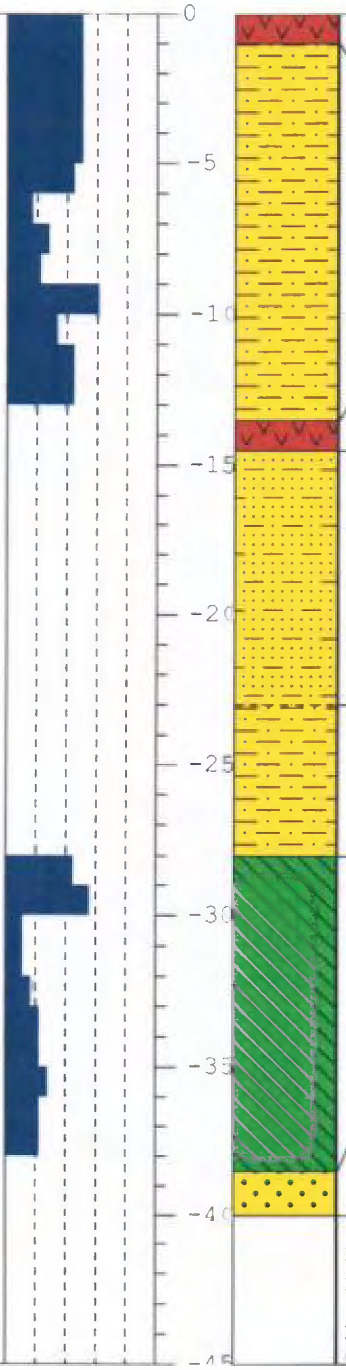
LOGGED BY: *John Noyes*
EDITED BY: *John Noyes*
CHECKED BY: *Chris Sullivan*
DATE BEGAN: *05-11-11*
DATE FINISHED: *05-11-11*
GROUND SURFACE ELEVATION:

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



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

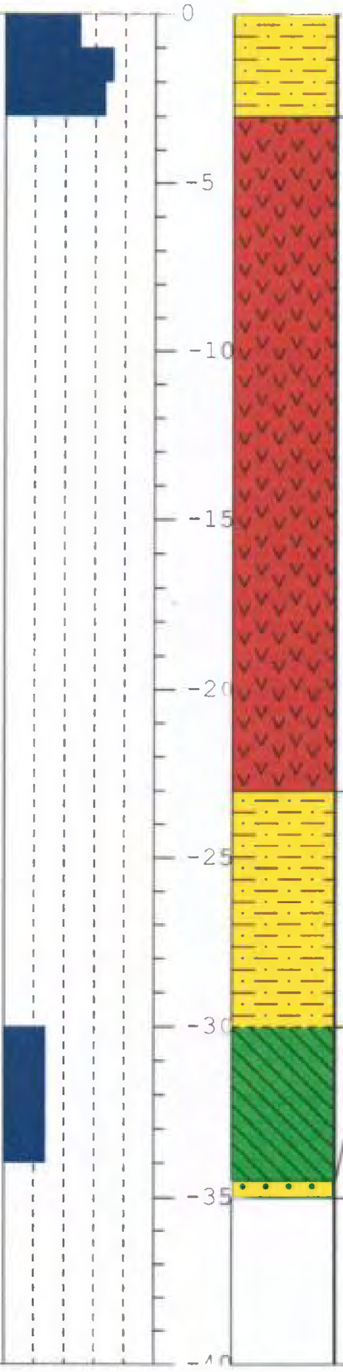
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

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



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.

CABENO

Environmental Field Services, LLC

BORING LOG

CLIENT: Aether dbs

PROJECT: Burlington, IA

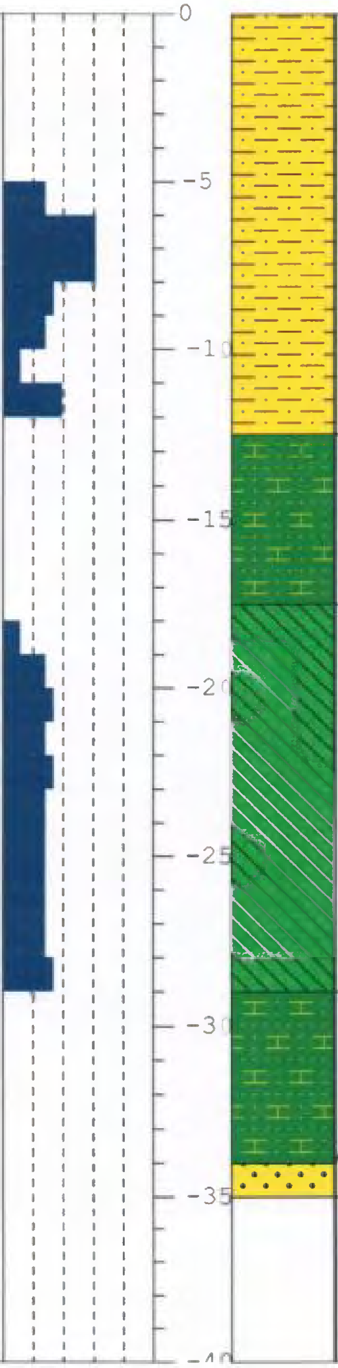
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

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	POCKET PENETROMETER (TONS/FT2)
	SP1	5'/5'		
				1.25
				2.75
				2.75
	SP2	5'/5'		
				1.5
				1.25
				0.5
				1.75
				2.0
	SP3	4'/5'		
	SP4	4'/5'		
				0.5
				1.25
				1.5
				1.25
				1.5
	SP5	3.5'/5'		
				1.25
				1.25
				1.25
				1.25
				1.25
	SP6	3.5'/5'		
				1.5
∇				
				1.25
	SP7	3'/5'		



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

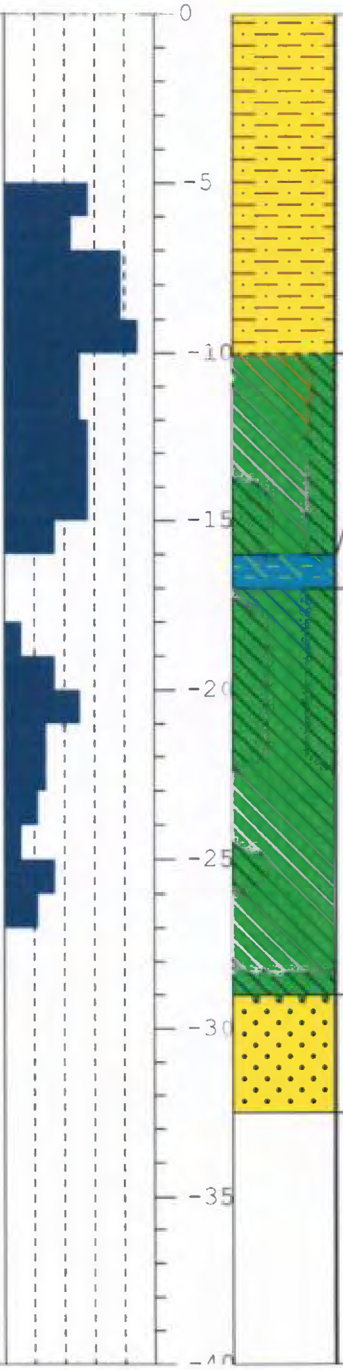
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

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

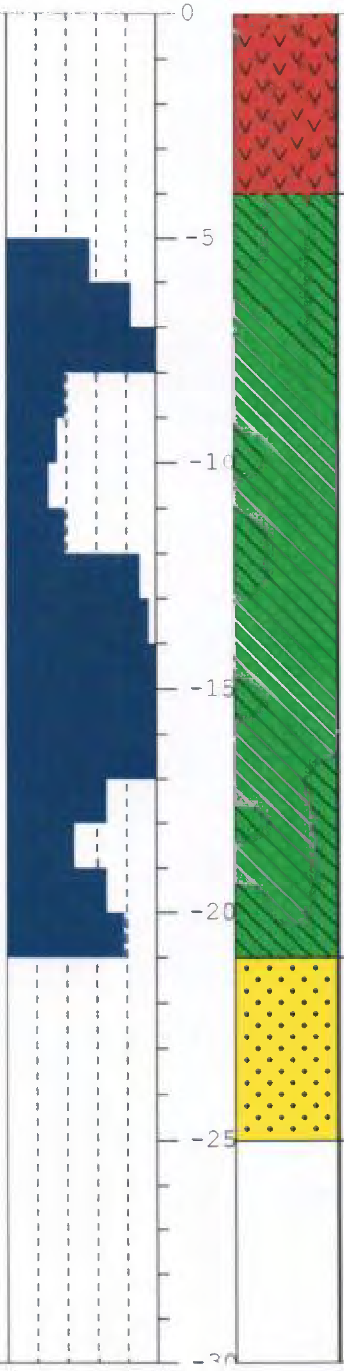
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

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

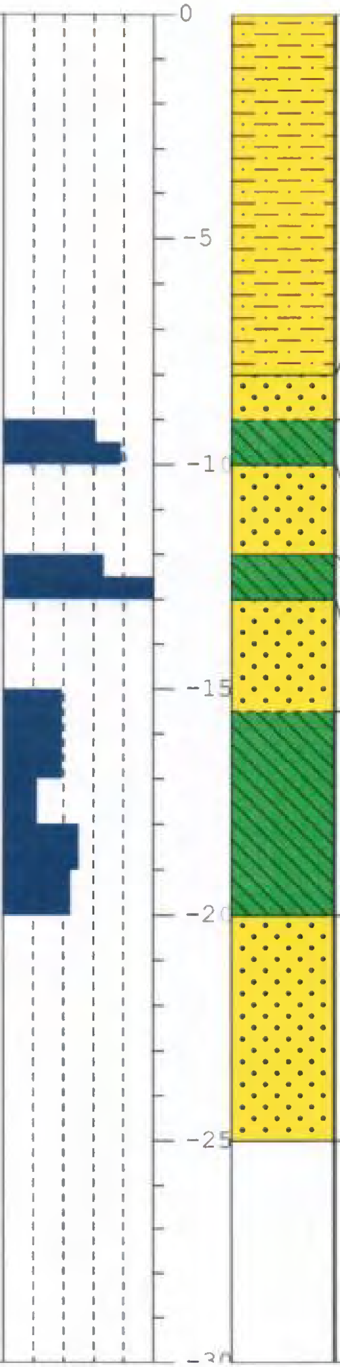
COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

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
				3.0
	SP3	5'/5'		4.5
				1.75
				1.75
				1.0
	SP4	4'/5'		
				2.25
				2.0
	SP5	4.5'/5'		



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

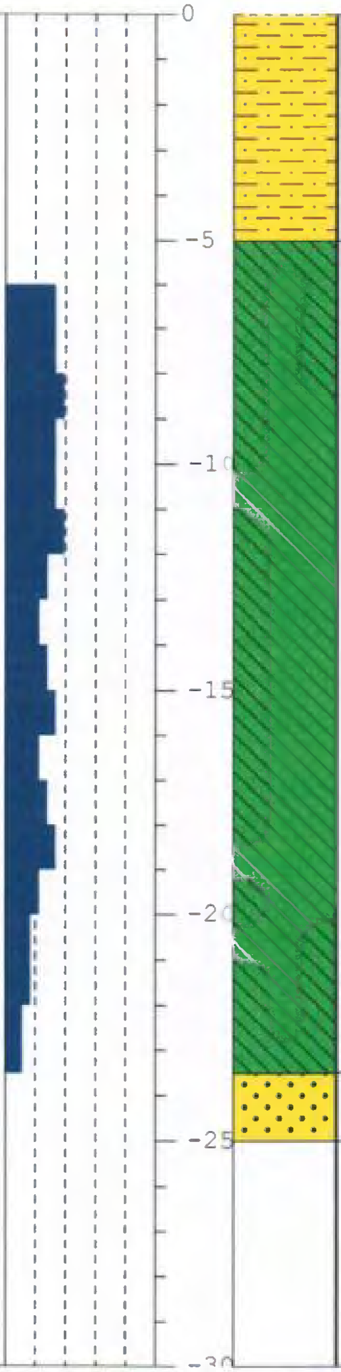
BORING NO.: *SB9 (cpt21)*

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)
	SP1	2.5'/5'		
				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

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



DESCRIPTION

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

CLAY:gray to olive; low to high plasticity; moist; trace organics. (OH)

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

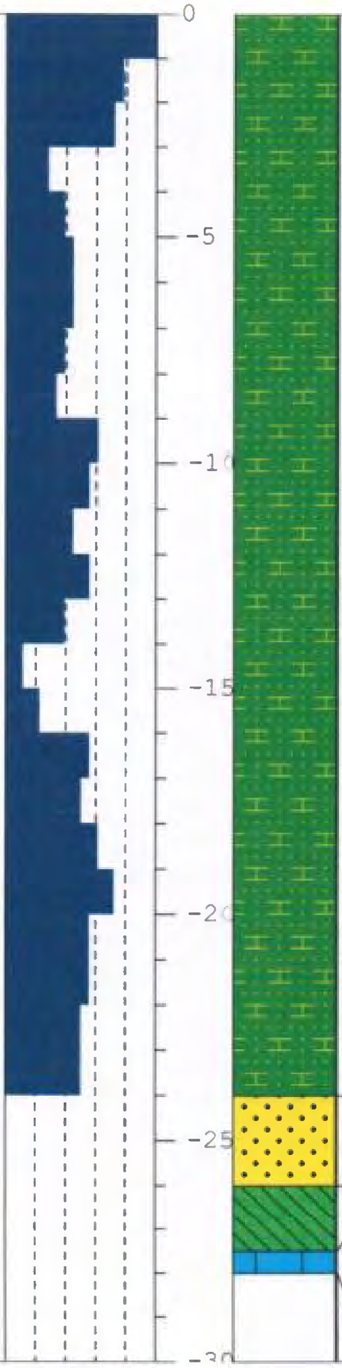
COORDINATES: *N NOT SURVEYED* *E NOT SURVEYED*

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
				3.5
	SP1	2.5'/5'		
				3.25
				1.25
				1.75
				2.0
				2.0
	SP2	4'/5'		
				1.75
				1.5
				2.75
				2.5
				2.0
	SP3	4.5'/5'		
				2.5
				1.75
				0.5
				1.0
				2.5
	SP4	5'/5'		
				2.25
				2.75
				3.25
				2.5
				2.5
	SP5	3.5'/5'		
				2.25
▽				
	SP6	2'/3'		



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

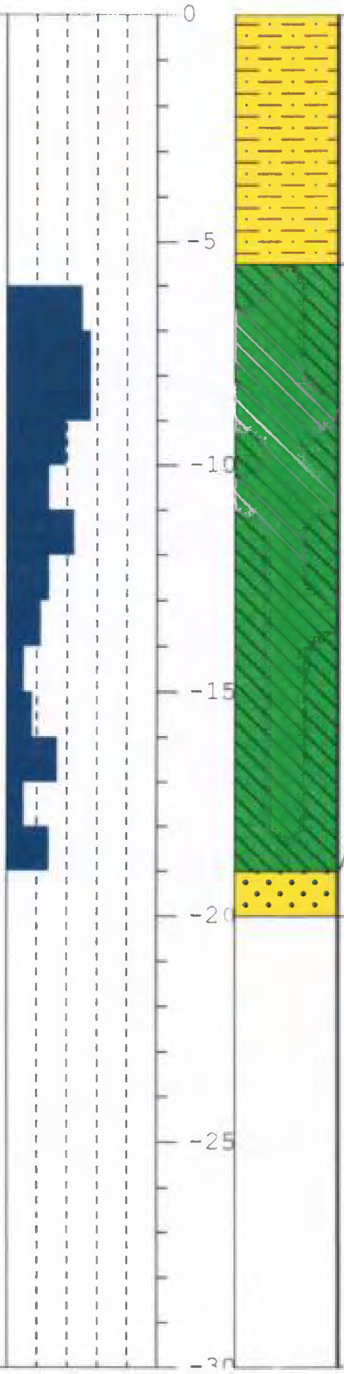
COORDINATES: *N NOT SURVEYED*
E NOT SURVEYED

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

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

PROJECT: Burlington, IA

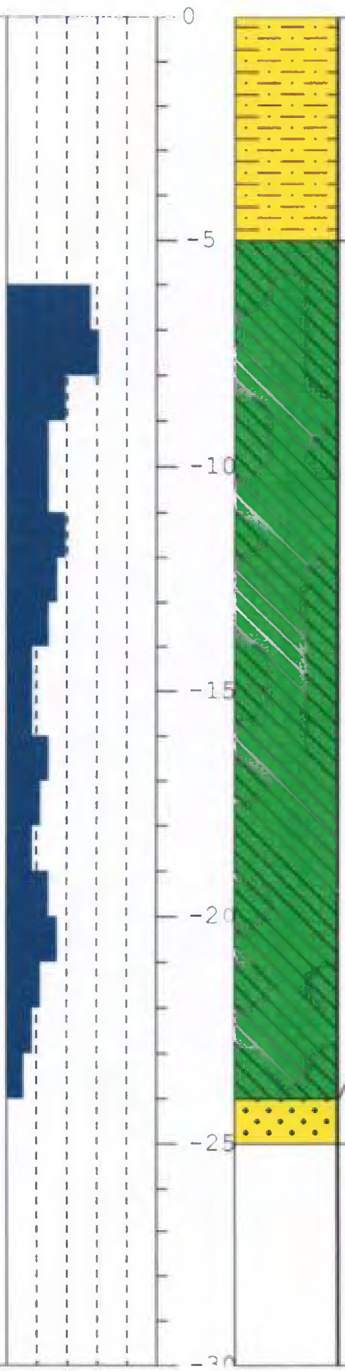
BORING NO.: *SB12*

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
▽				

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



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'

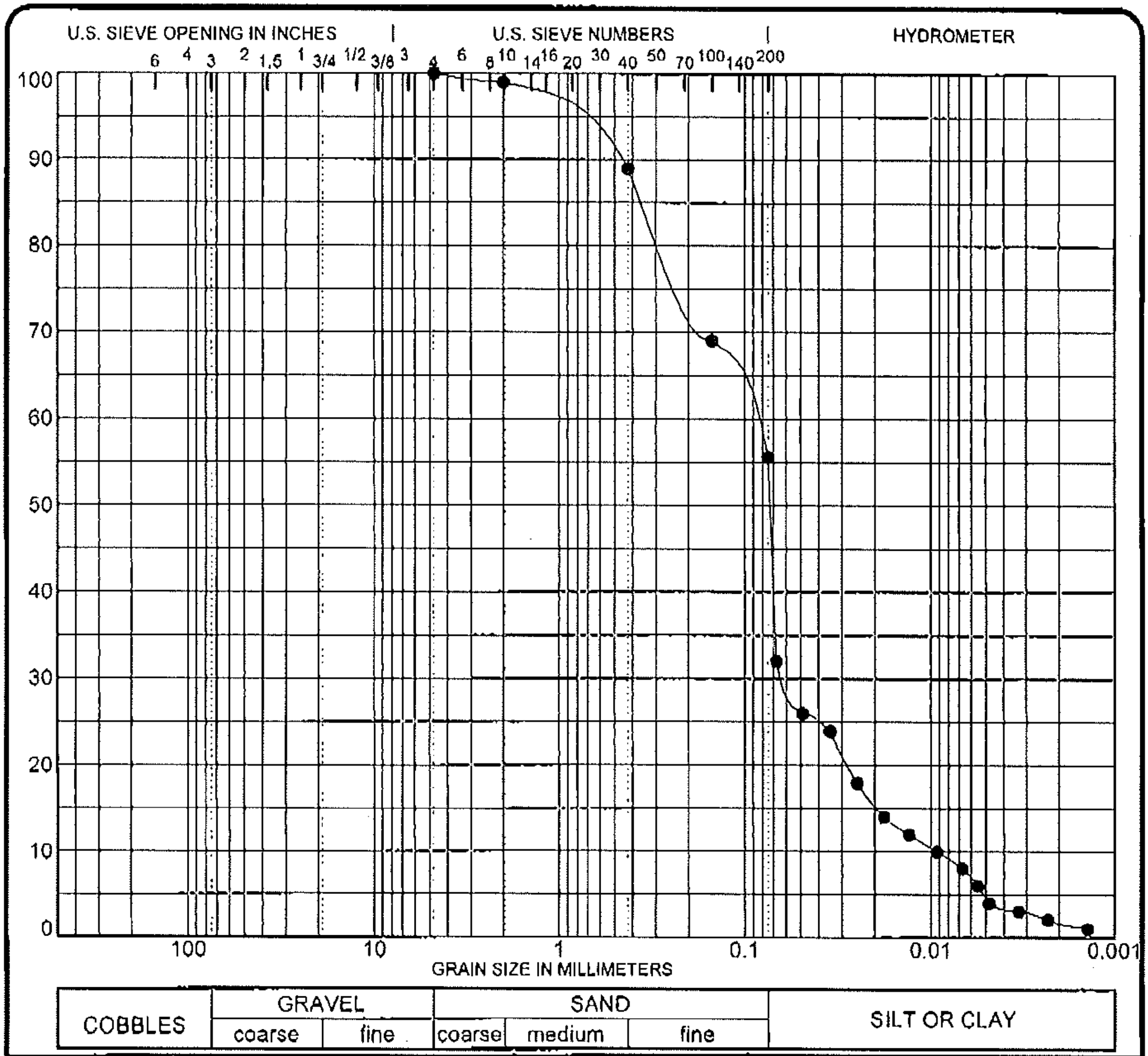
Boring advanced W/ Geoprobe Model 6610DT using 60-inch Macrocore sampling system. Boring backfilled to groundsurface w/ bentonite chips on 05-16-11.

Attachment C

Soil Laboratory Results

Burlington Generating Station

Source: Testing Service Corporation, May 2011



SPECIMEN IDENTIFICATION	SIEVE	% PASS
Broing: SB-1	3 inch	100
Sample: Ash	2	100
	1 1/2	100
	1	100
NOTES:	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 ,

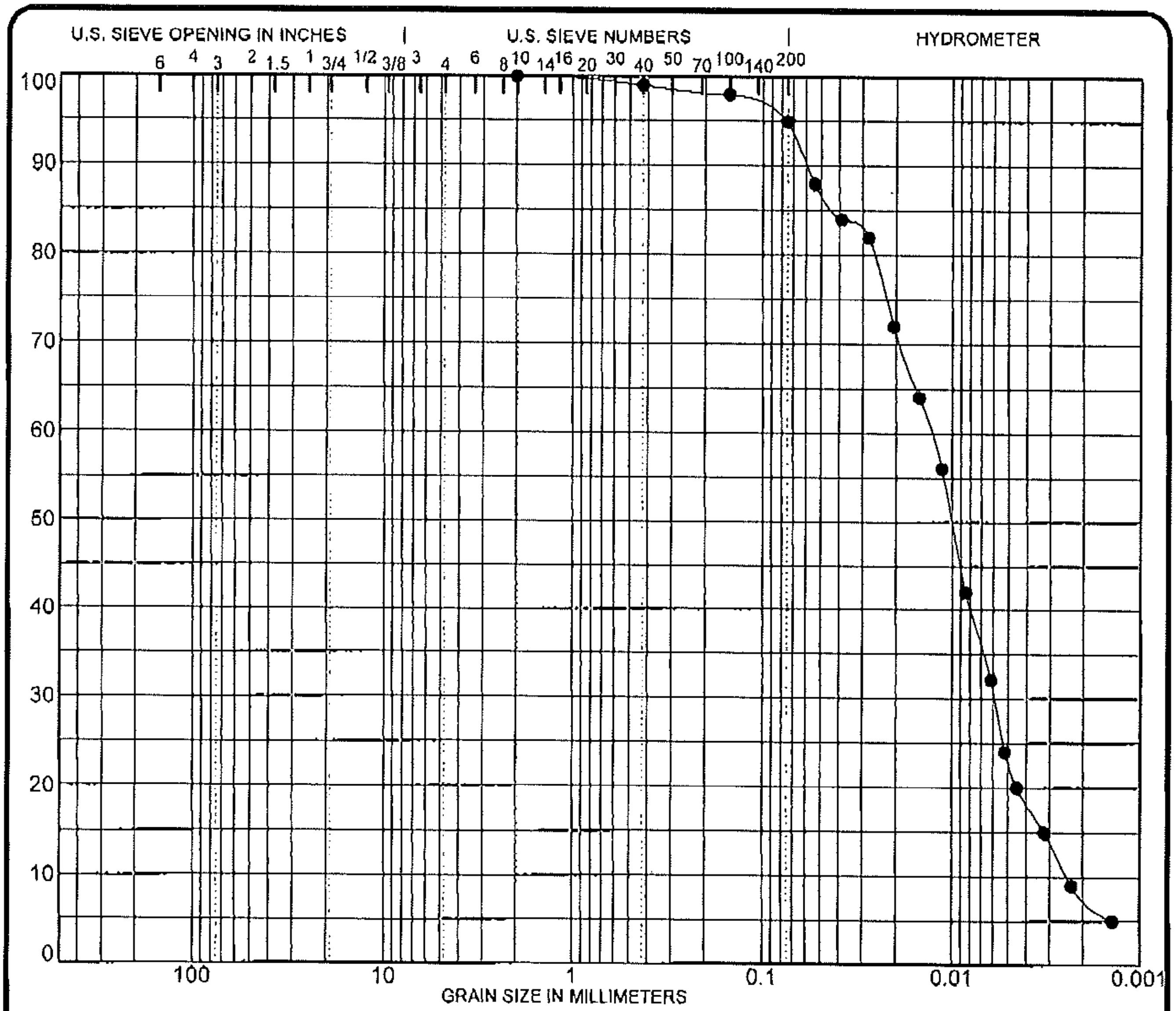
JOB NO. L - 76,757
DATE May 20, 2011

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				

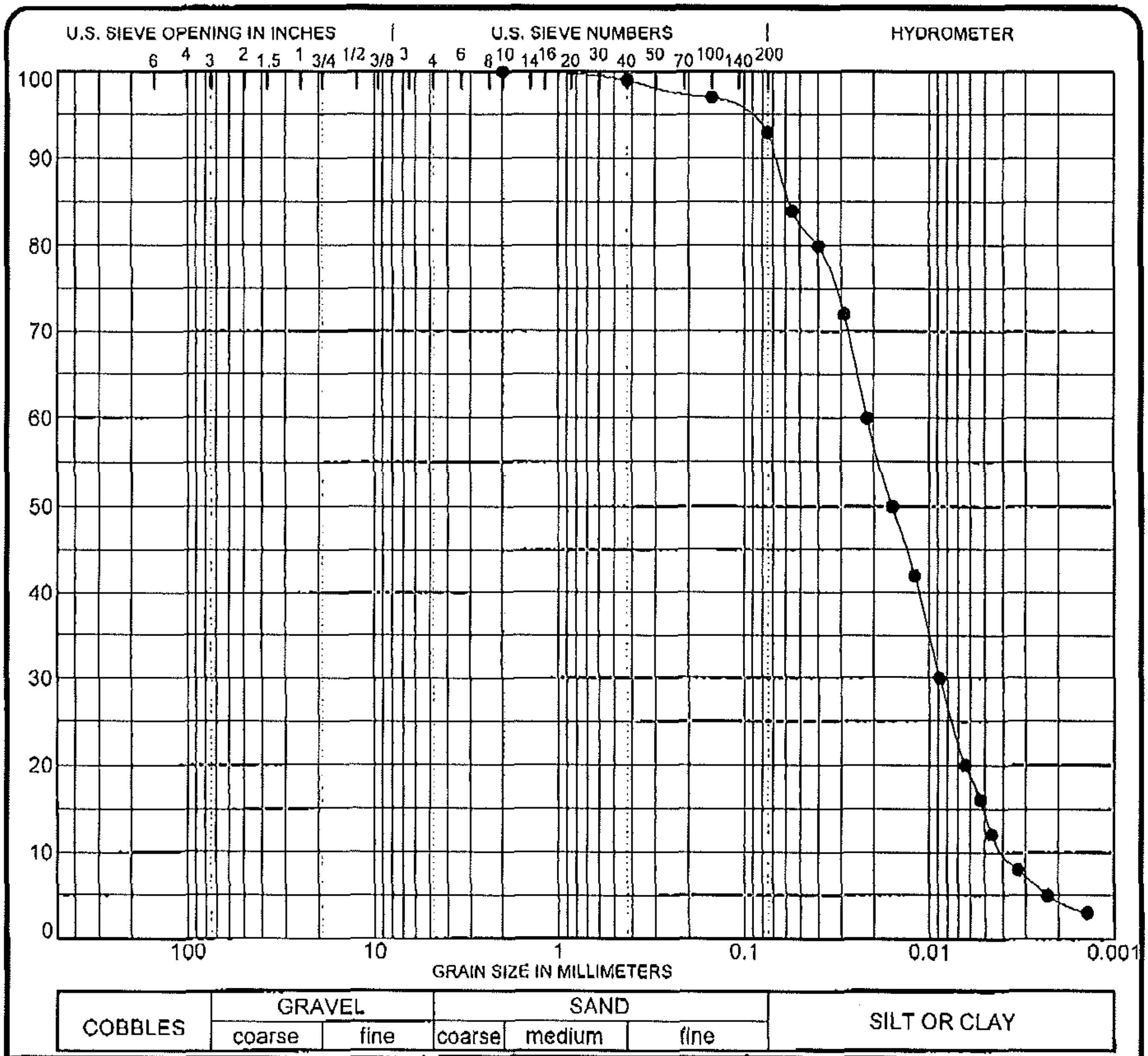
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 20, 2011

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: 8	2	100
Depth: 29.0'-30.0'	1 1/2	100
	1	100
NOTES:	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

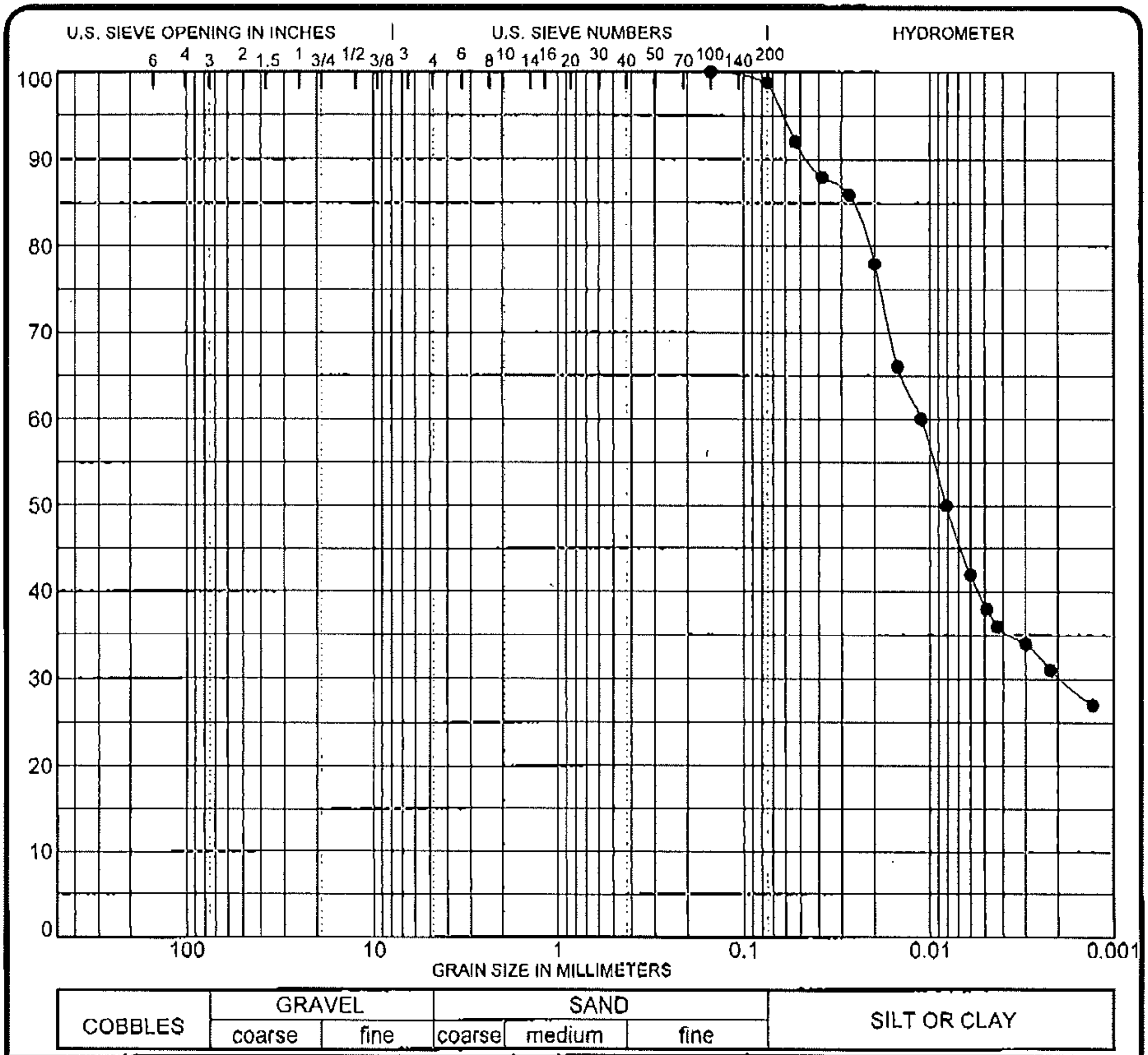
PROJECT Geotechnical Testing
LOCATION ,
SB1

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

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

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



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

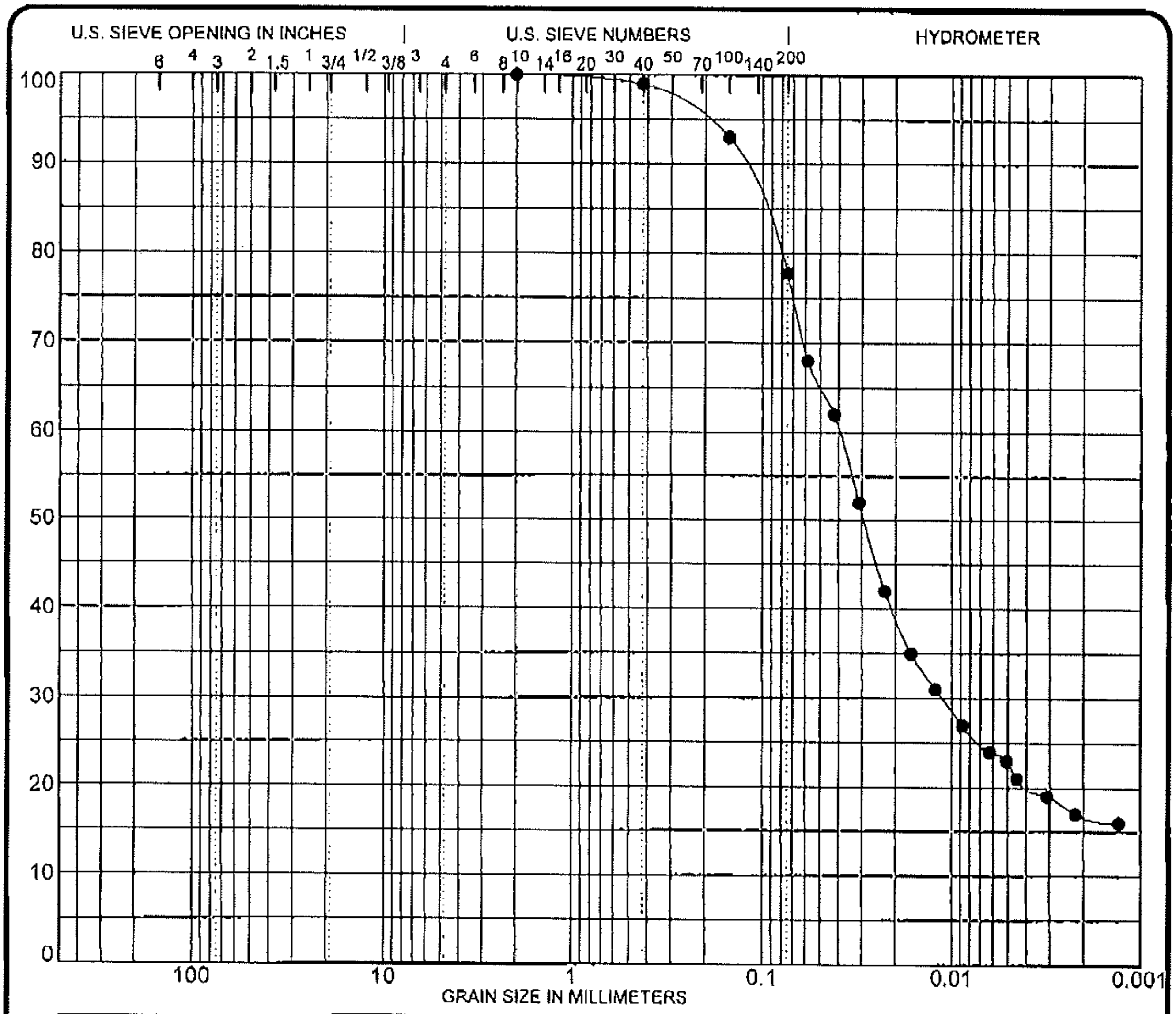
PROJECT Geotechnical Testing
LOCATION ,

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

SB1

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

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 ,

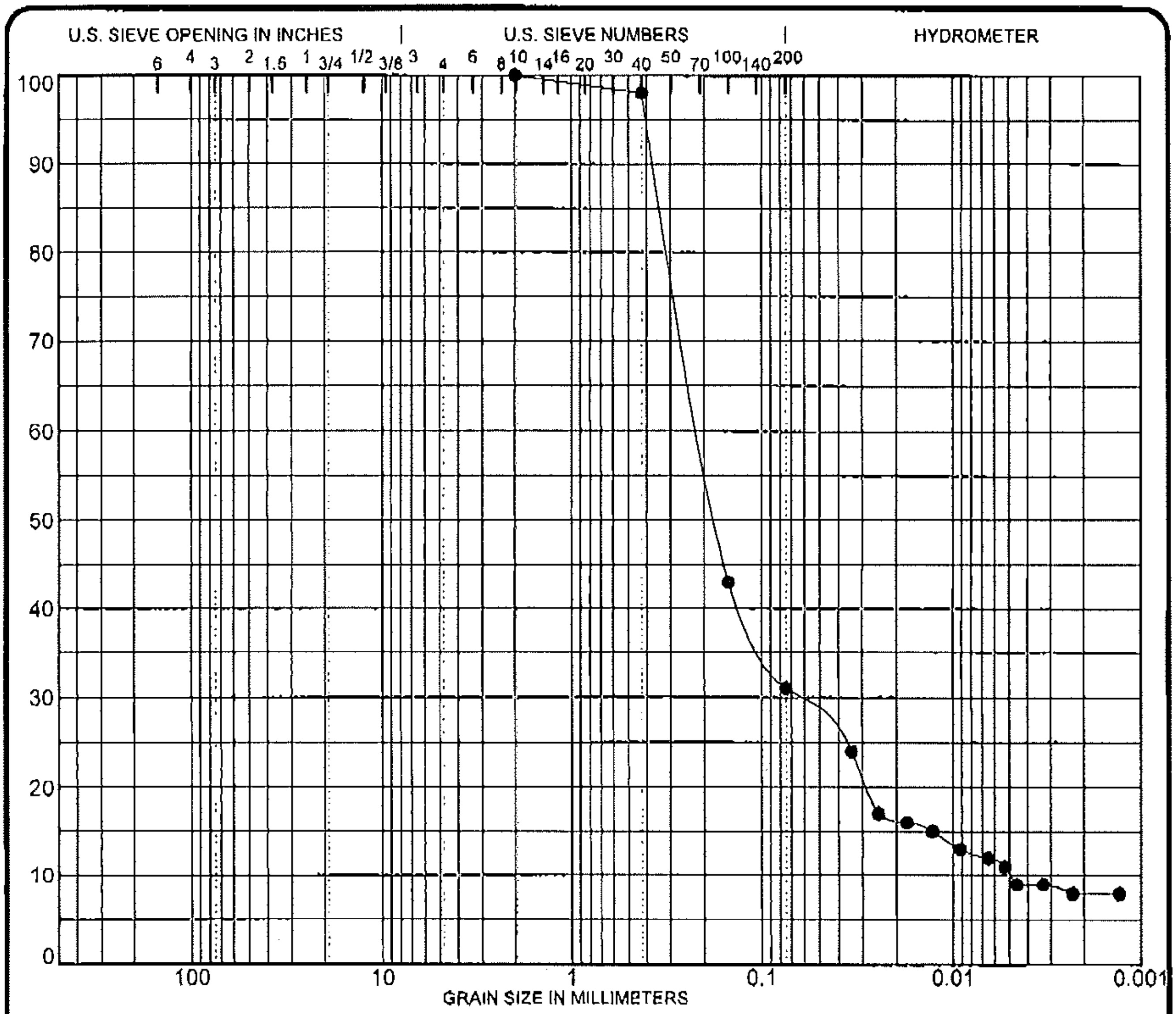
JOB NO. L - 76,757
DATE May 20, 2011

SB1

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

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: 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 ,

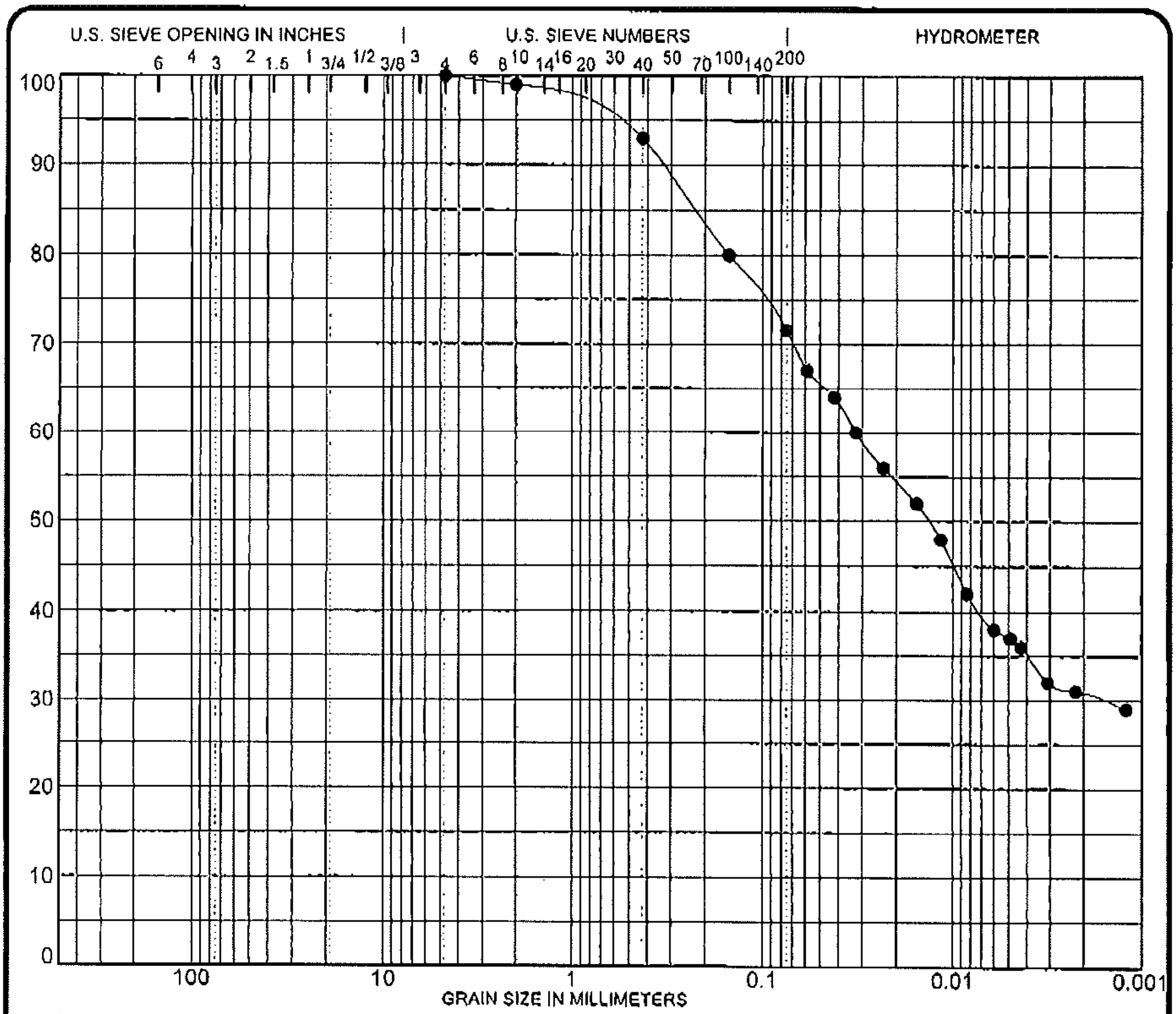
JOB NO. L - 76,757
DATE May 20, 2011

SB1

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

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



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<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-2	3 inch	100
Sample: A	2	100
Depth: 8.0'-9.0'	1 1/2	100
	1	100
NOTES:	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 ,

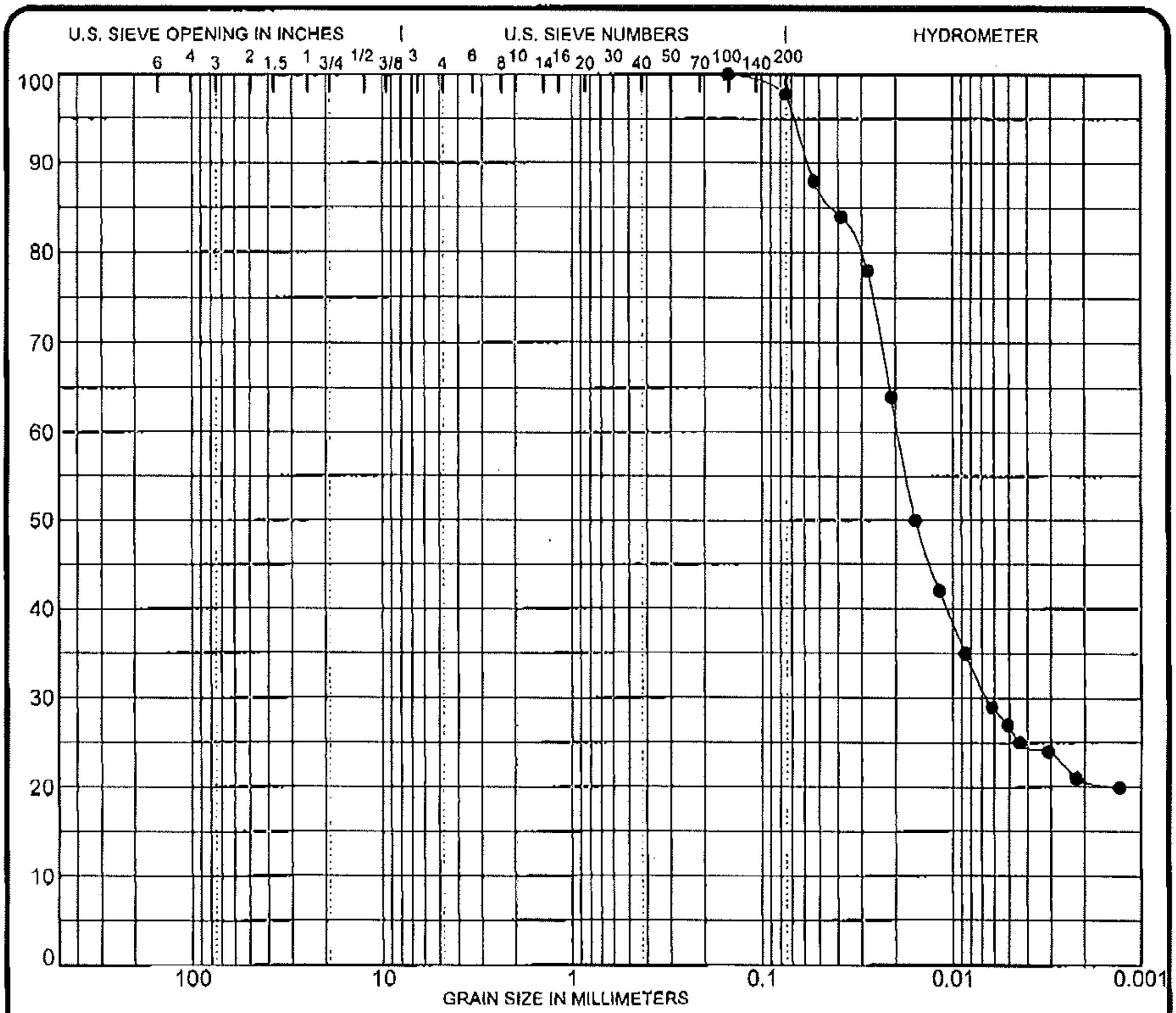
JOB NO. L - 76,757
DATE May 20, 2011

SB2

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-2	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	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 ,

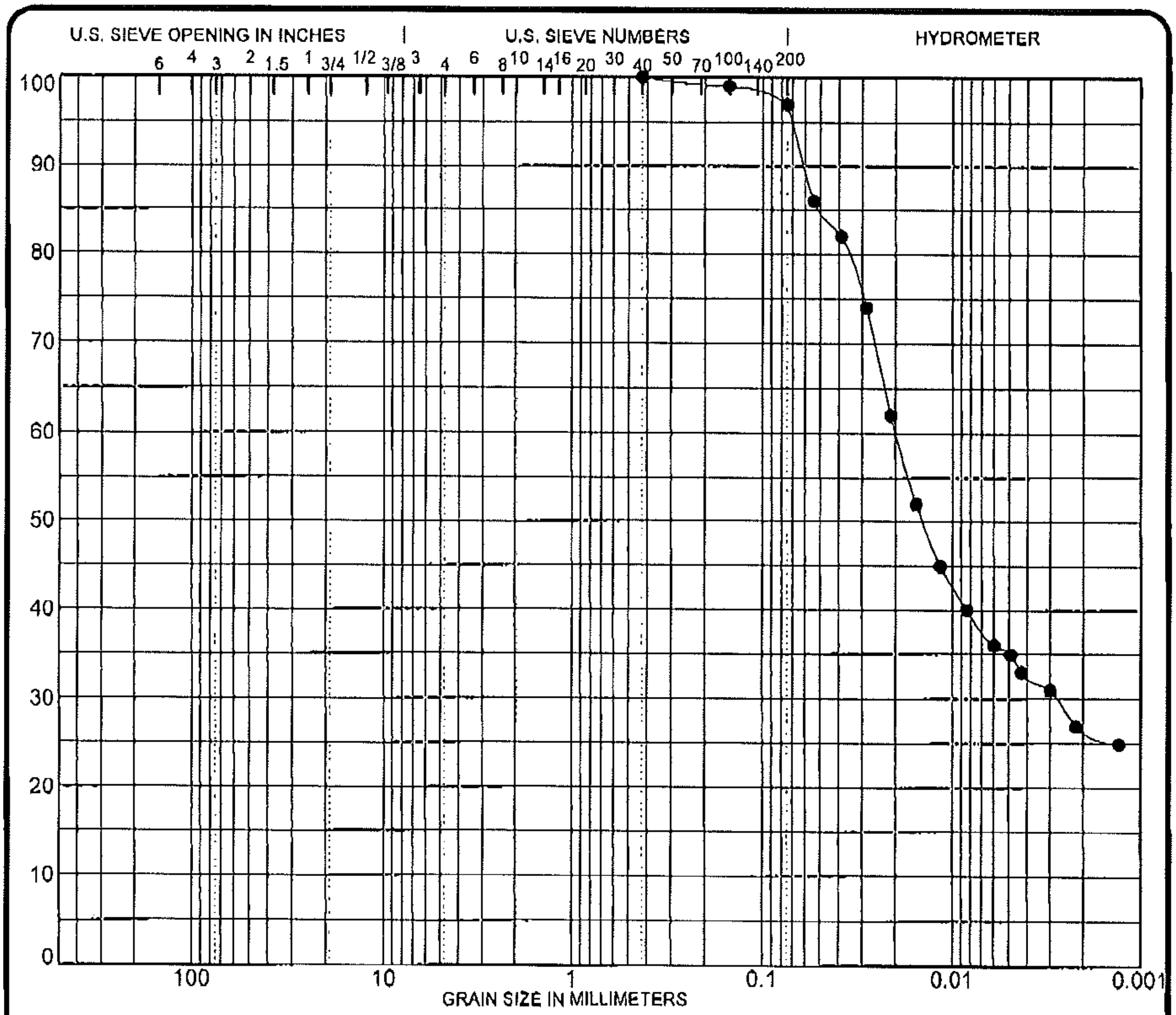
JOB NO. L - 76,757
DATE May 20, 2011

SB2

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

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



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

SPECIMEN IDENTIFICATION	SIEVE	% PASS	SOIL CLASSIFICATION			
Boring: SB-2	3 inch	100	Dark gray silty CLAY, trace sand (CH)			
Sample: C	2	100				
Depth: 32.0'	1 1/2	100				
	1	100	%GRAVEL	%SAND	%SILT	%CLAY
NOTES:	3/4	100	0	3	70	27
	3/8	100				
	# 4	100	MC%	LL	PL	PI
	# 10	100	32.9	51	16	35
	# 40	100				
	# 100	99				
	# 200	97				

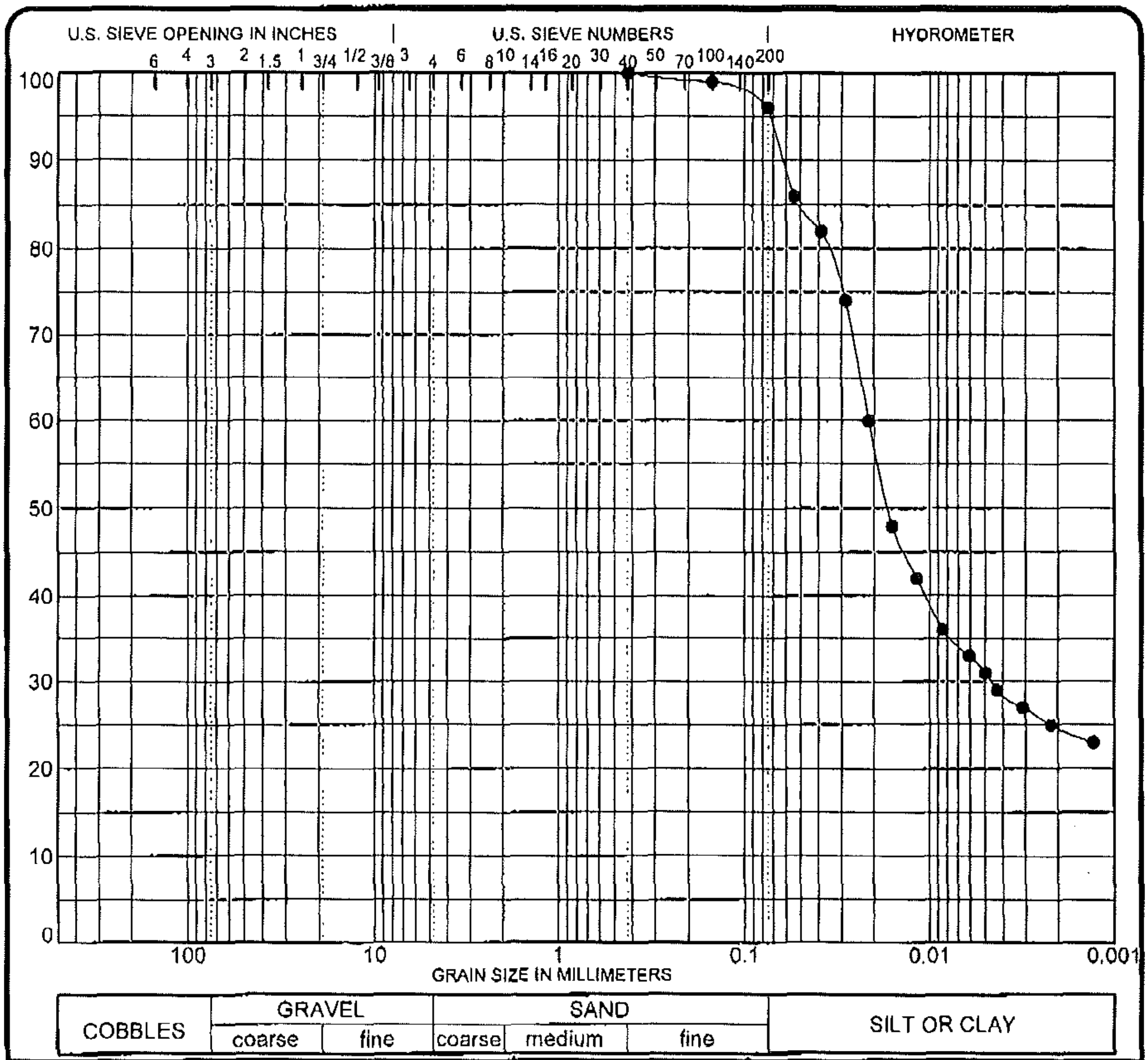
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 20, 2011

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

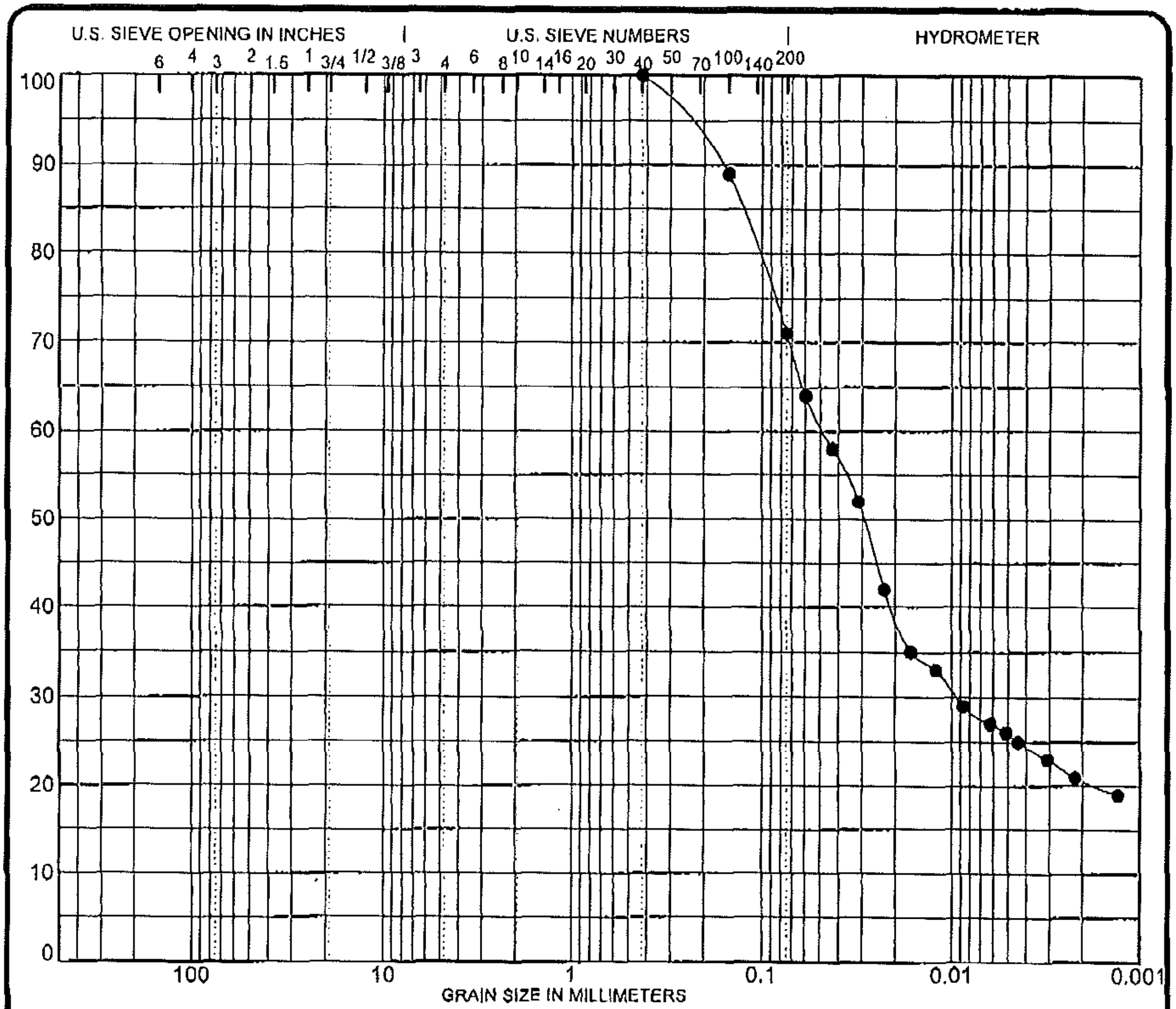
SB3

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
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

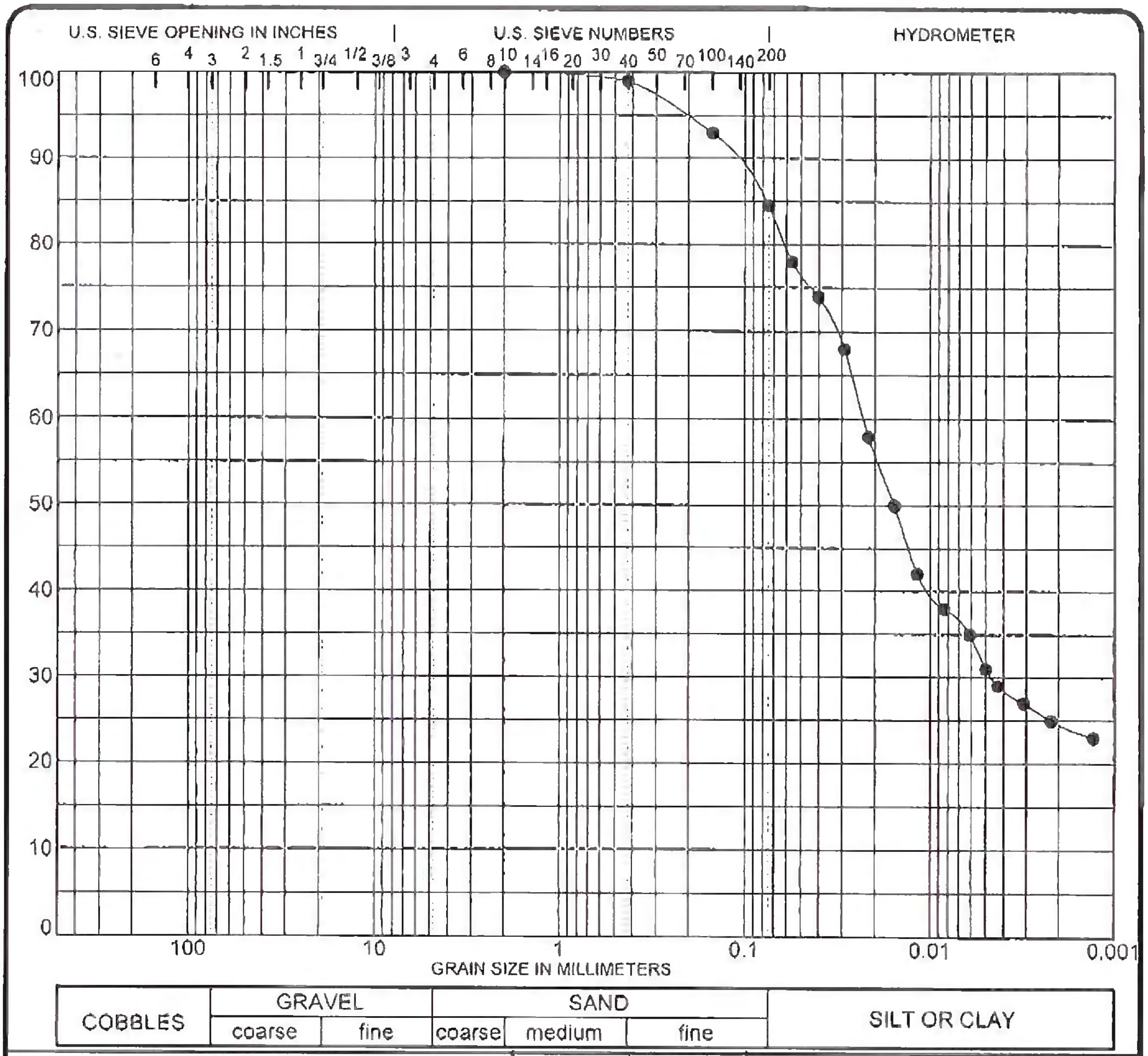
PROJECT Geotechnical Testing
LOCATION ,
SB4

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



SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-5	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	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

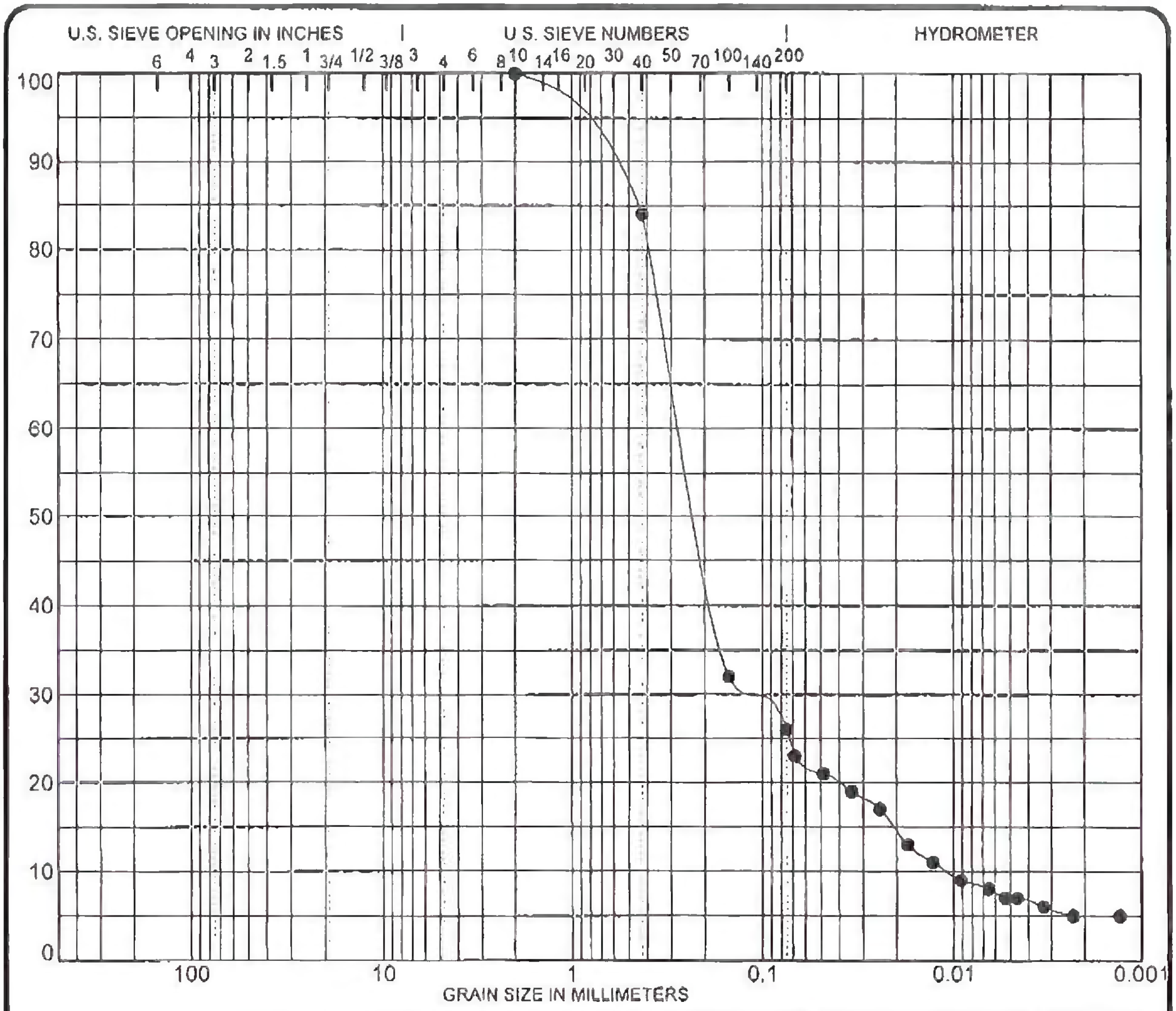
DATE May 23, 2011

SB5

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

SOILGENR 76757.GPJ TSC AL1.GDT 5/23/11



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

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

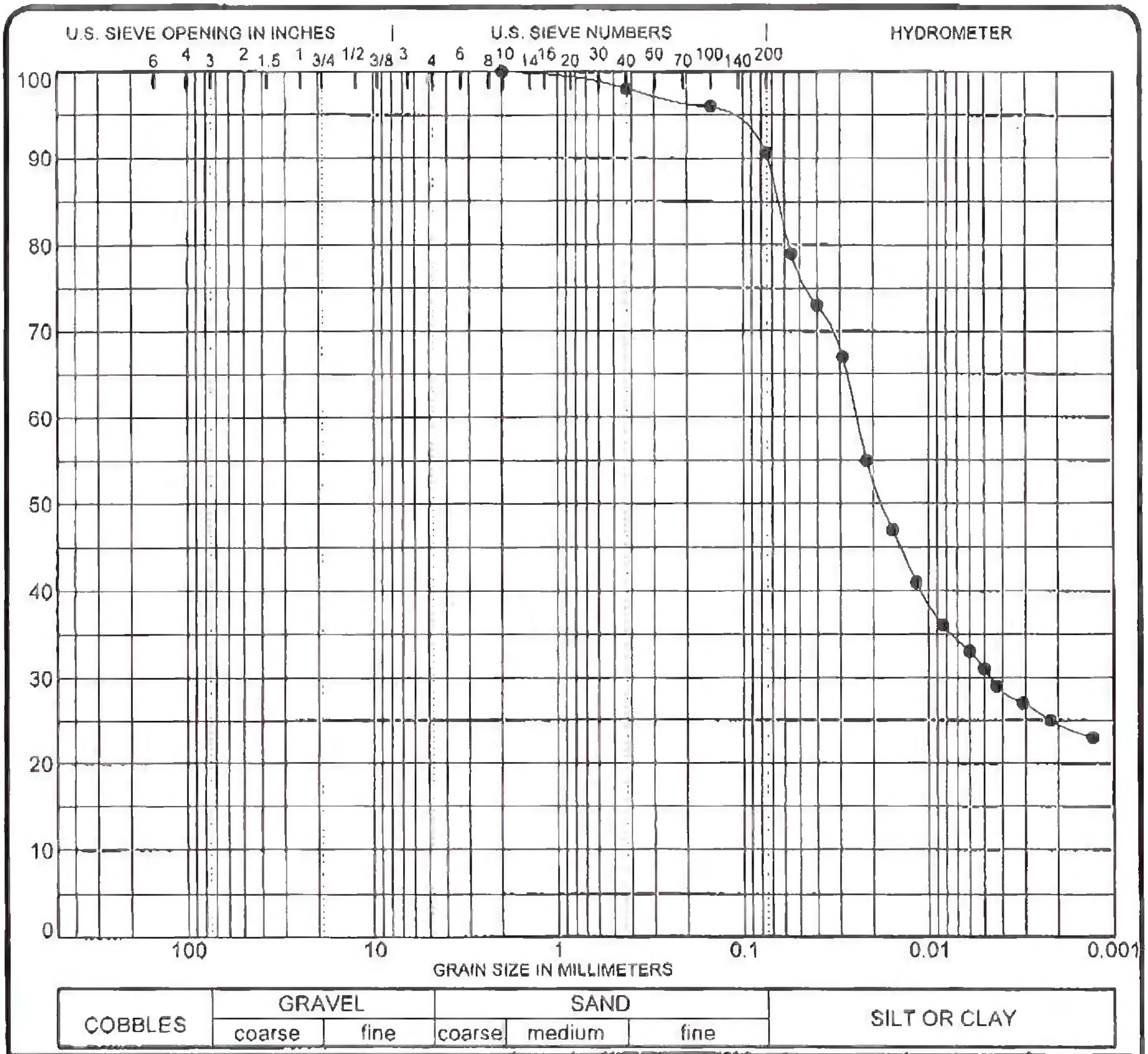
PROJECT **Geotechnical Testing**
LOCATION ,
JOB NO. **L - 76,757**
DATE **May 23, 2011**

SB6

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

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



SPECIMEN IDENTIFICATION	SIEVE	% PASS	SOIL CLASSIFICATION
Boring: SB-6	3 inch	100	Brownish gray very silty CLAY, trace sand
Sample: B	2	100	(CL)
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	

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

MC%		LL	PL	PI
28.3		43	13	30

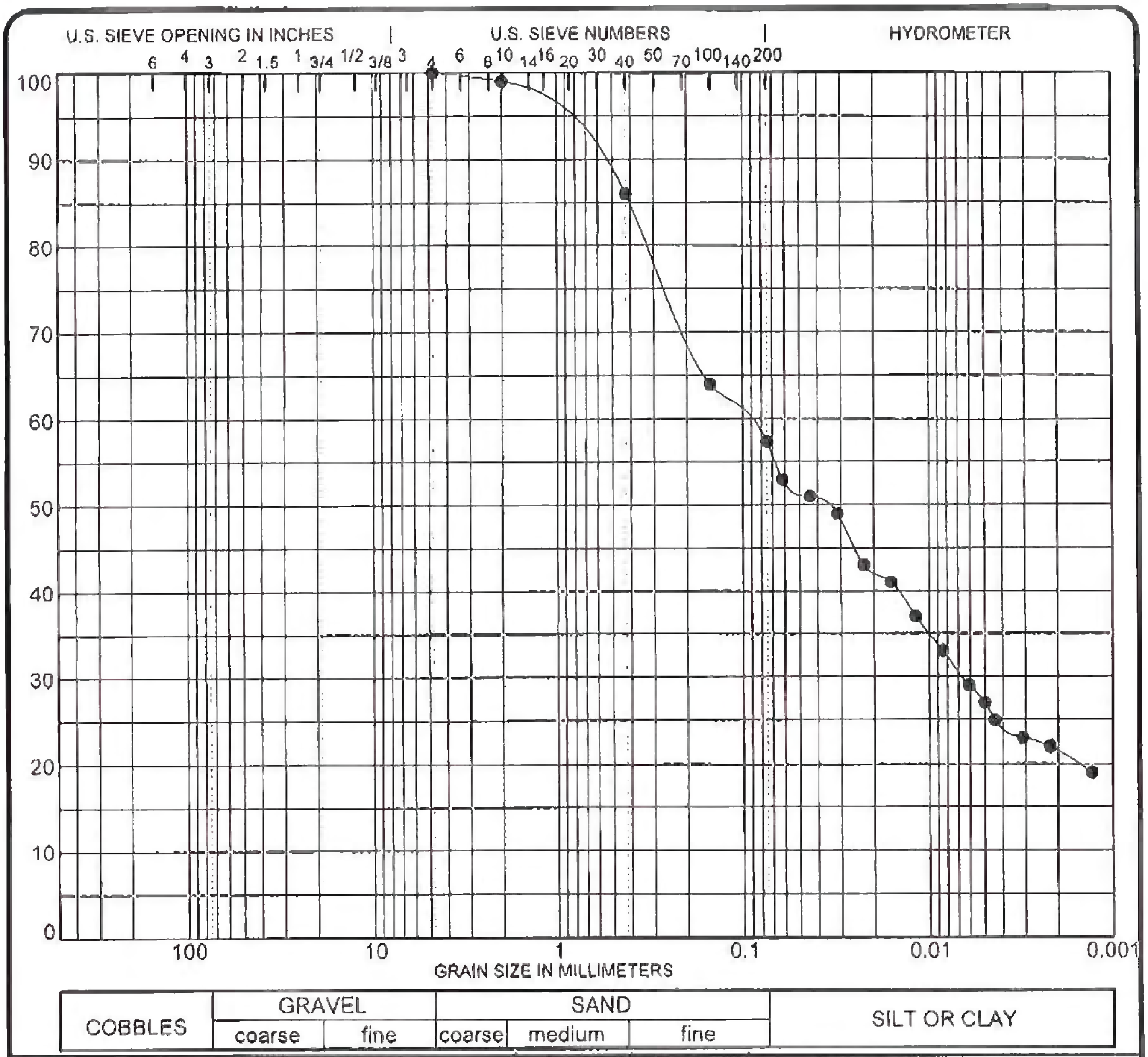
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 23, 2011

SB6

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

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



SPECIMEN IDENTIFICATION
Boring: SB-8
Sample: A
Depth: 10.0'
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	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

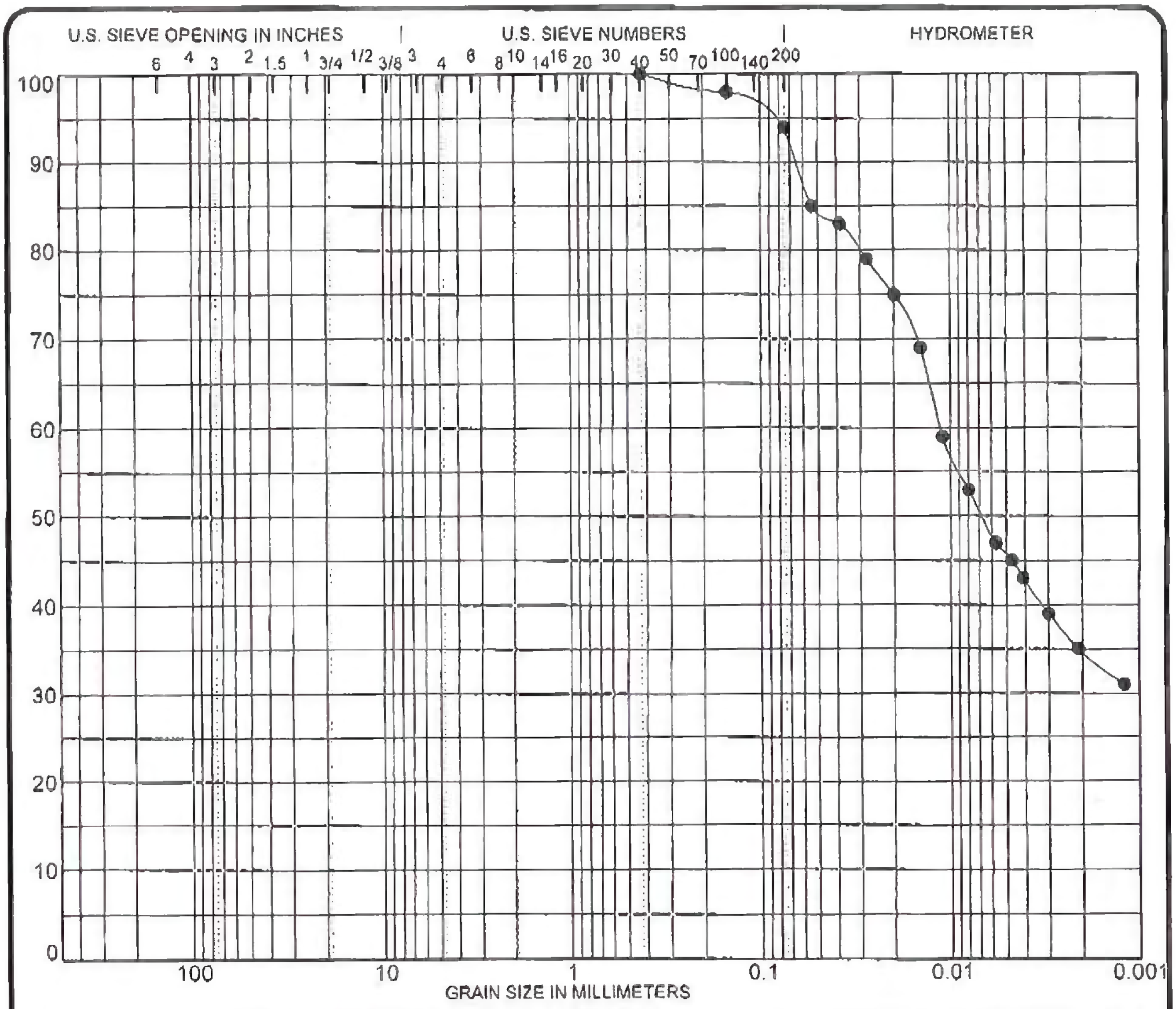
PROJECT Geotechnical Testing
LOCATION ,
SB8

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
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 ,

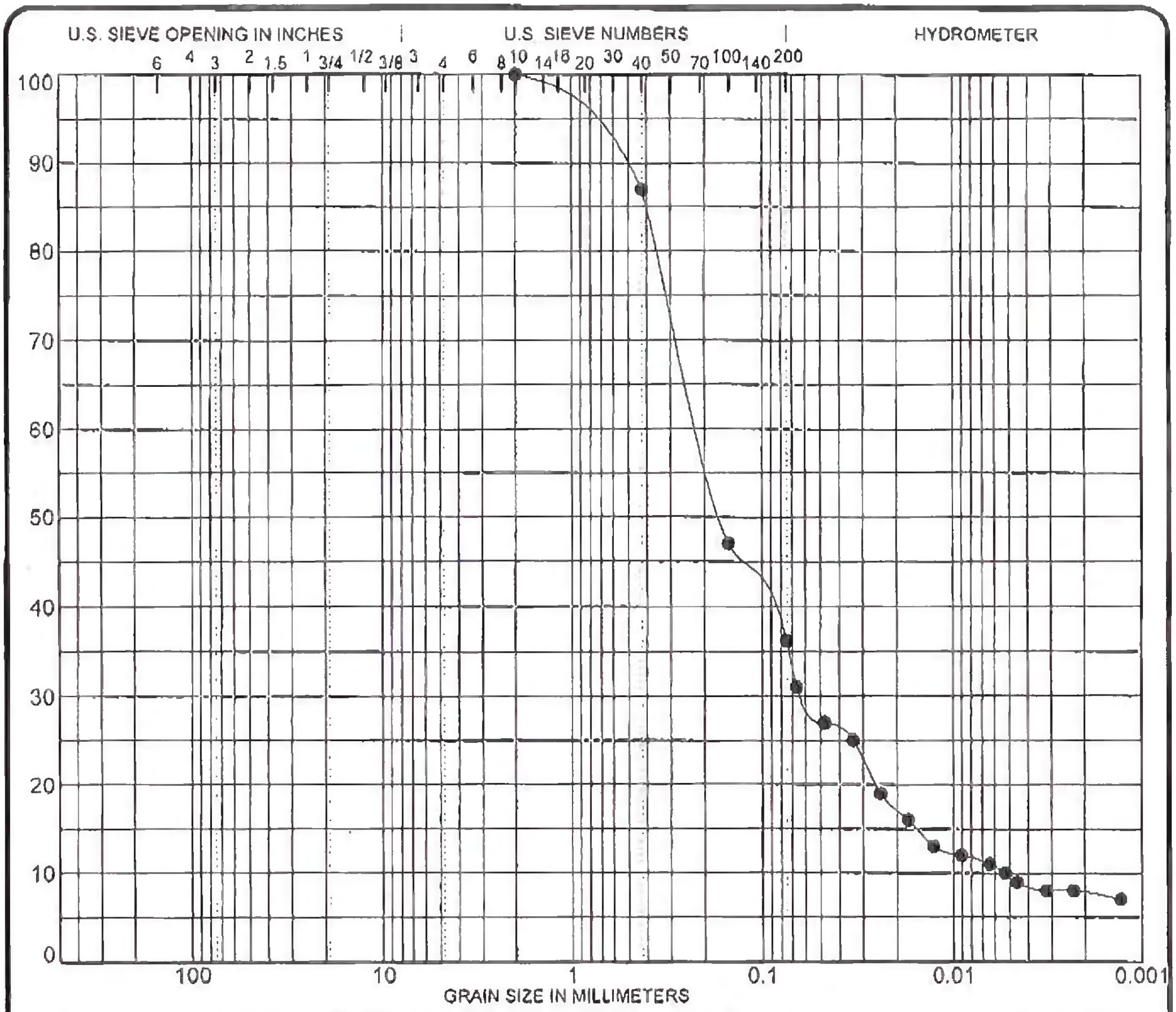
JOB NO. L - 76,757
DATE May 23, 2011

SB8

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

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: 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

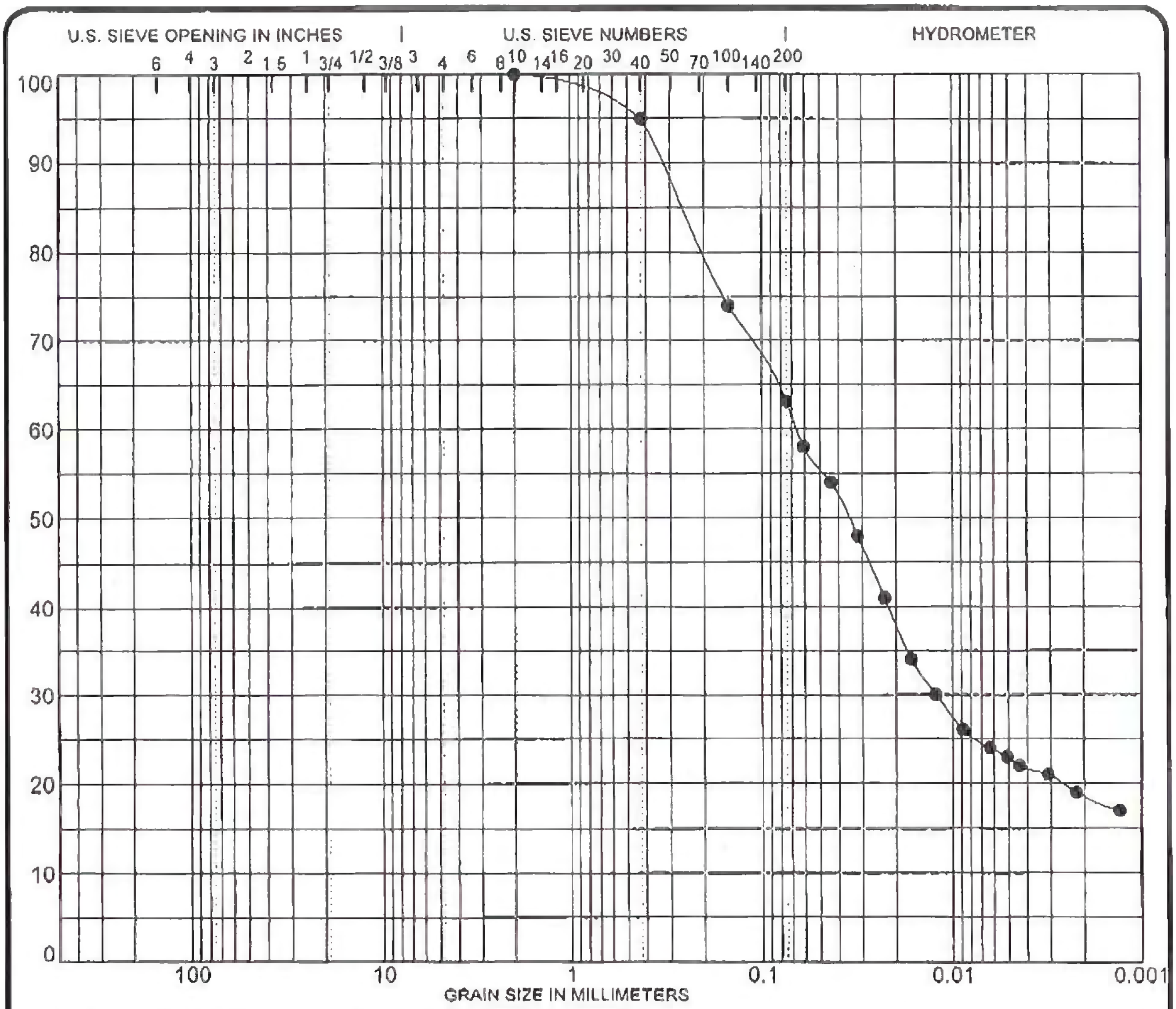
PROJECT Geotechnical Testing
LOCATION ,
SB8

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-9	3 inch	100
Sample: A	2	100
Depth: 18.0'	1 1/2	100
	1	100
NOTES:	3/4	100
	3/8	100
	# 4	100
	# 10	100
	# 40	95
	# 100	74
	# 200	63

SOIL CLASSIFICATION

Brownish gray sandy CLAY (CL)

%GRAVEL	%SAND	%SILT	%CLAY
0	37	44	19

MC%		LL	PL	PI
34.0		35	13	22

PROJECT Geotechnical Testing
LOCATION ,

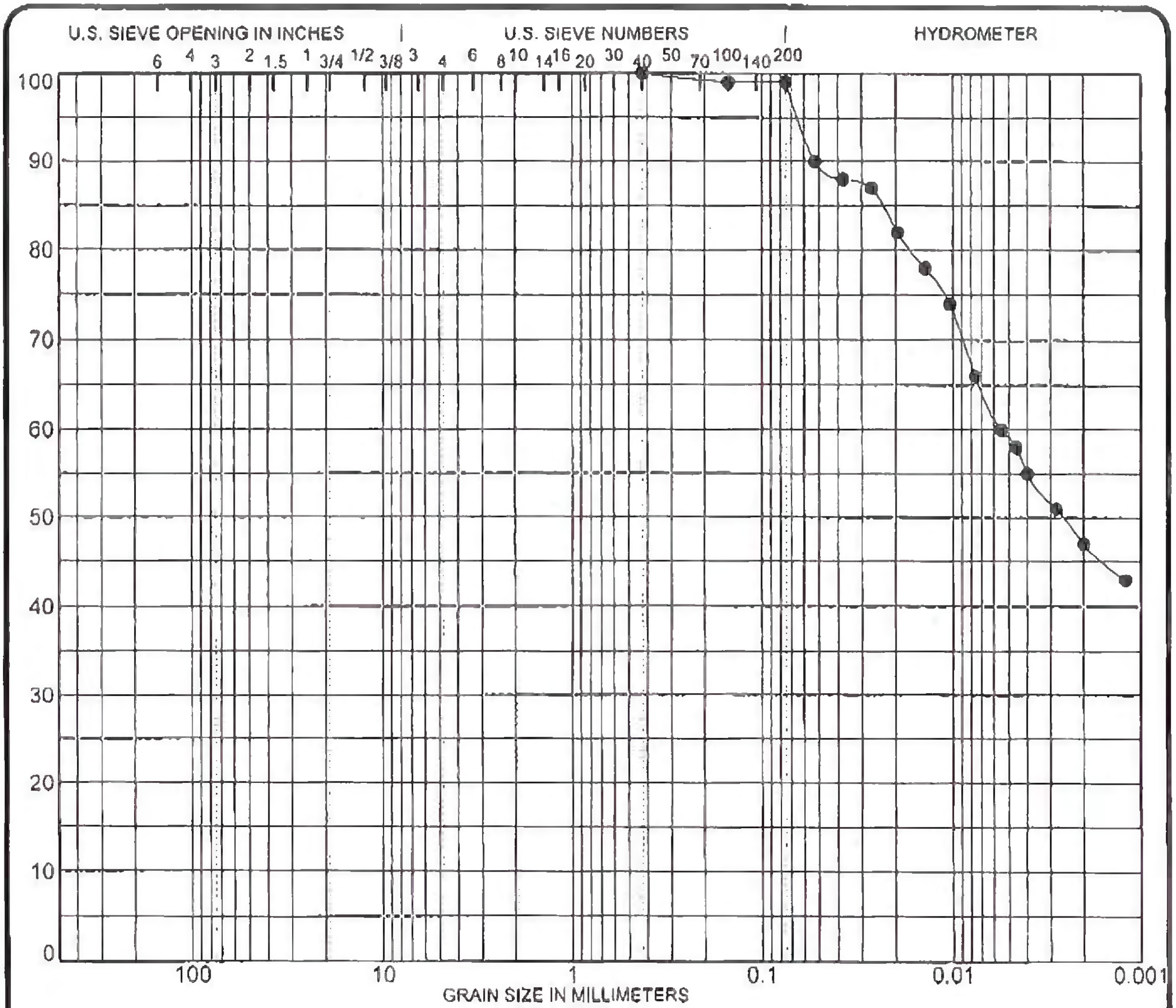
JOB NO. L - 76,757
DATE May 23, 2011

SB9

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-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

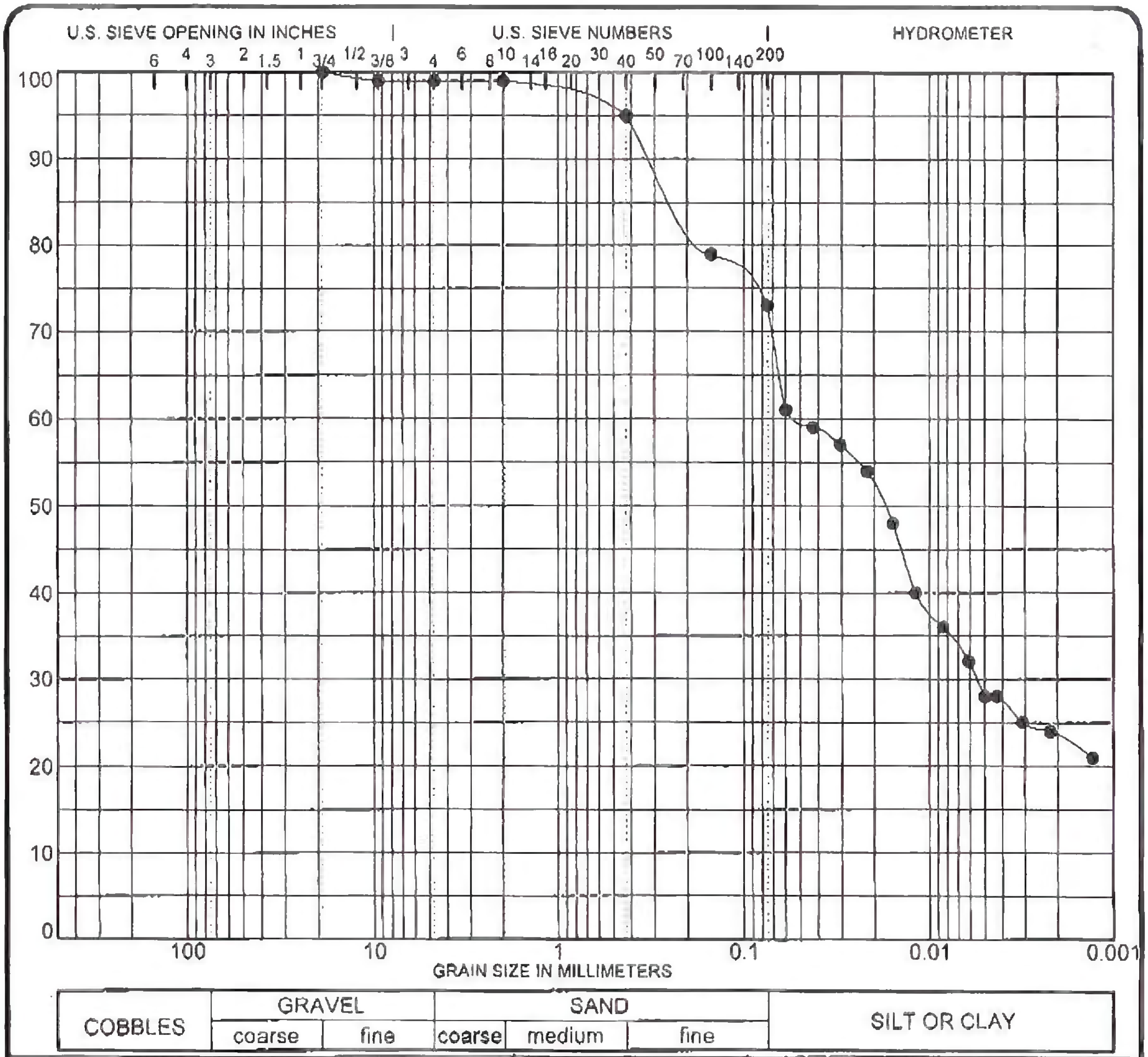
PROJECT Geotechnical Testing
LOCATION ,
JOB NO. L - 76,757
DATE May 23, 2011

SB10

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

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188



SPECIMEN IDENTIFICATION	SIEVE	% PASS
Boring: SB-12	3 inch	100
Sample: A	2	100
Depth: 23.0'-24.0'	1 1/2	100
	1	100
NOTES:	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 ,
SB12

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

SOIL DATA SHEET

Testing Service Corporation
Carol Stream, IL 60188

Attachment D

Static Slope Stability Analyses

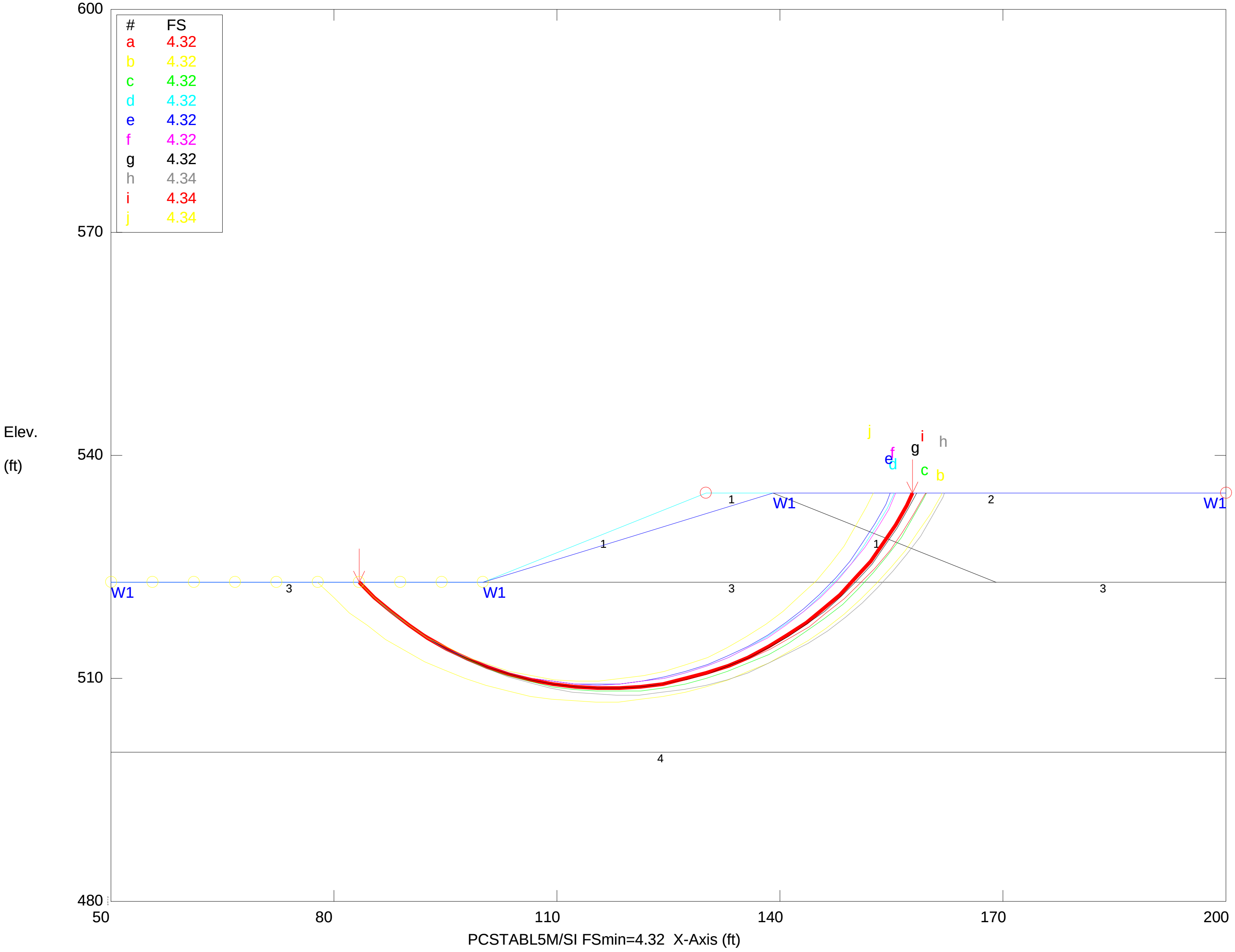
Ten Most Critical Surfaces Per Analysis

Burlington Generating Station

Source:
Program pcSTABL5m/SI output by Aether dbs May 2011

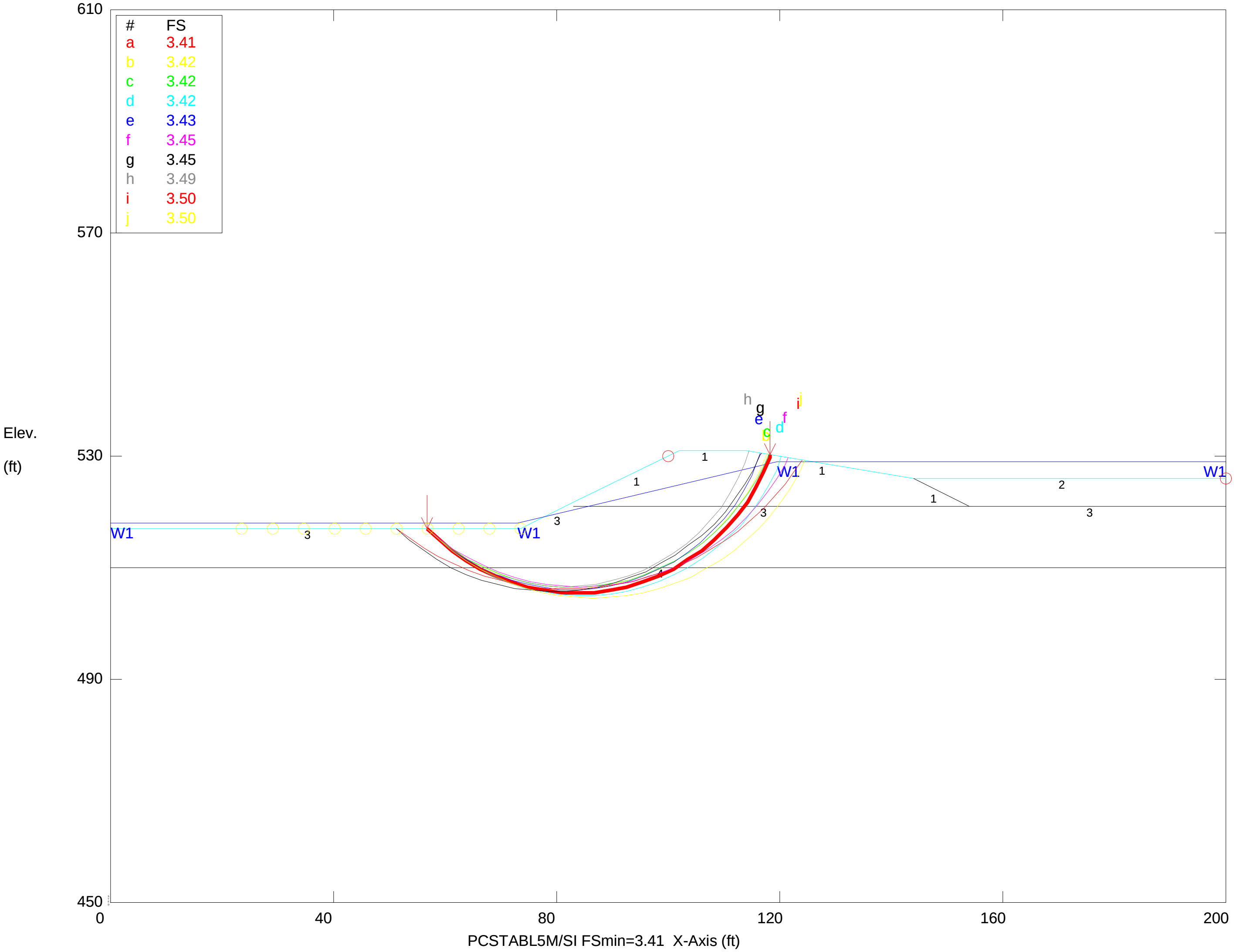
Alliant Burlington Main Ash Pond South Dike - Static Case

Ten Most Critical. C:BURL20C2.PLT By: TCW 05-31-11 7:47am



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

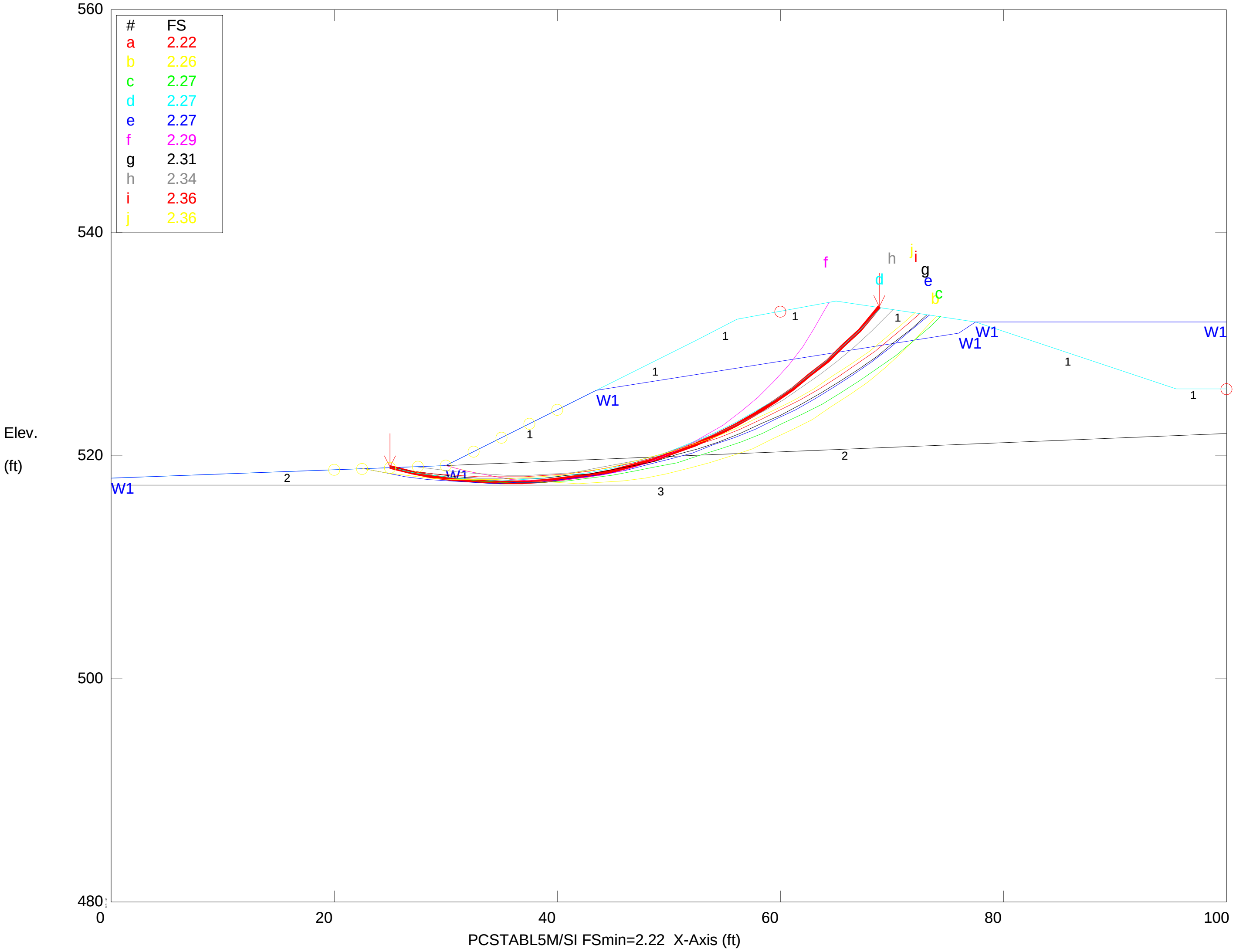
Alliant Burlington Upper Ash Pond North Dike Slope - Static Case
Ten Most Critical. E:BURL40C3.PLT By: TCW 05-29-11 1:07pm



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

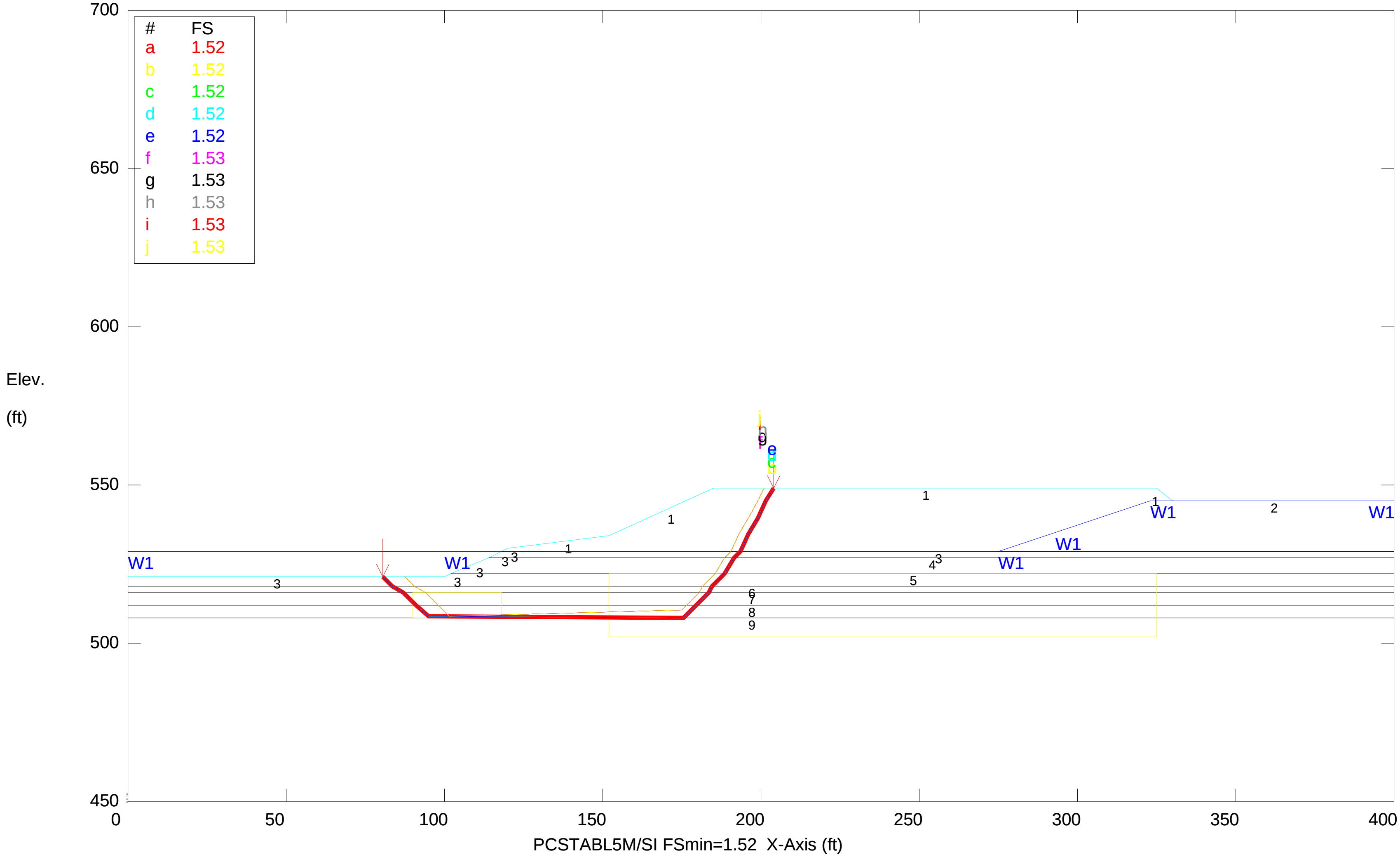
Alliant Burlington Ash Seal Pond South Dike - Static Case

Ten Most Critical. E:BURL50C2.PLT By: TCW 05-29-11 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	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

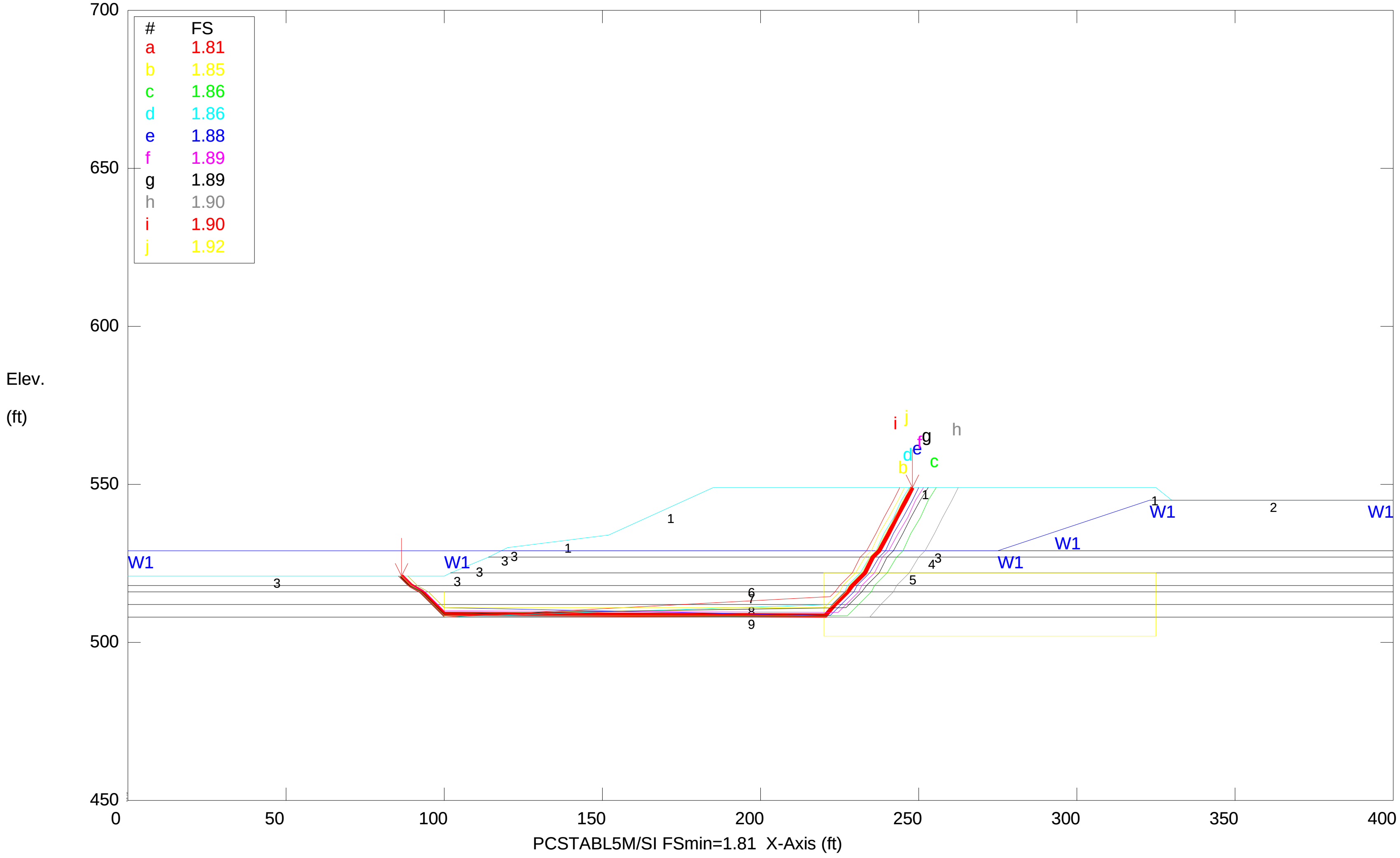
Alliant Burlington Economizer Pile East, North Ash Slope - Static Case
Ten Most Critical. C:BURL60B.PLT By: TCW 05-27-11 10:53am



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	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

Alliant Burlington Economizer Pile East, North Ash Slope - Static Case

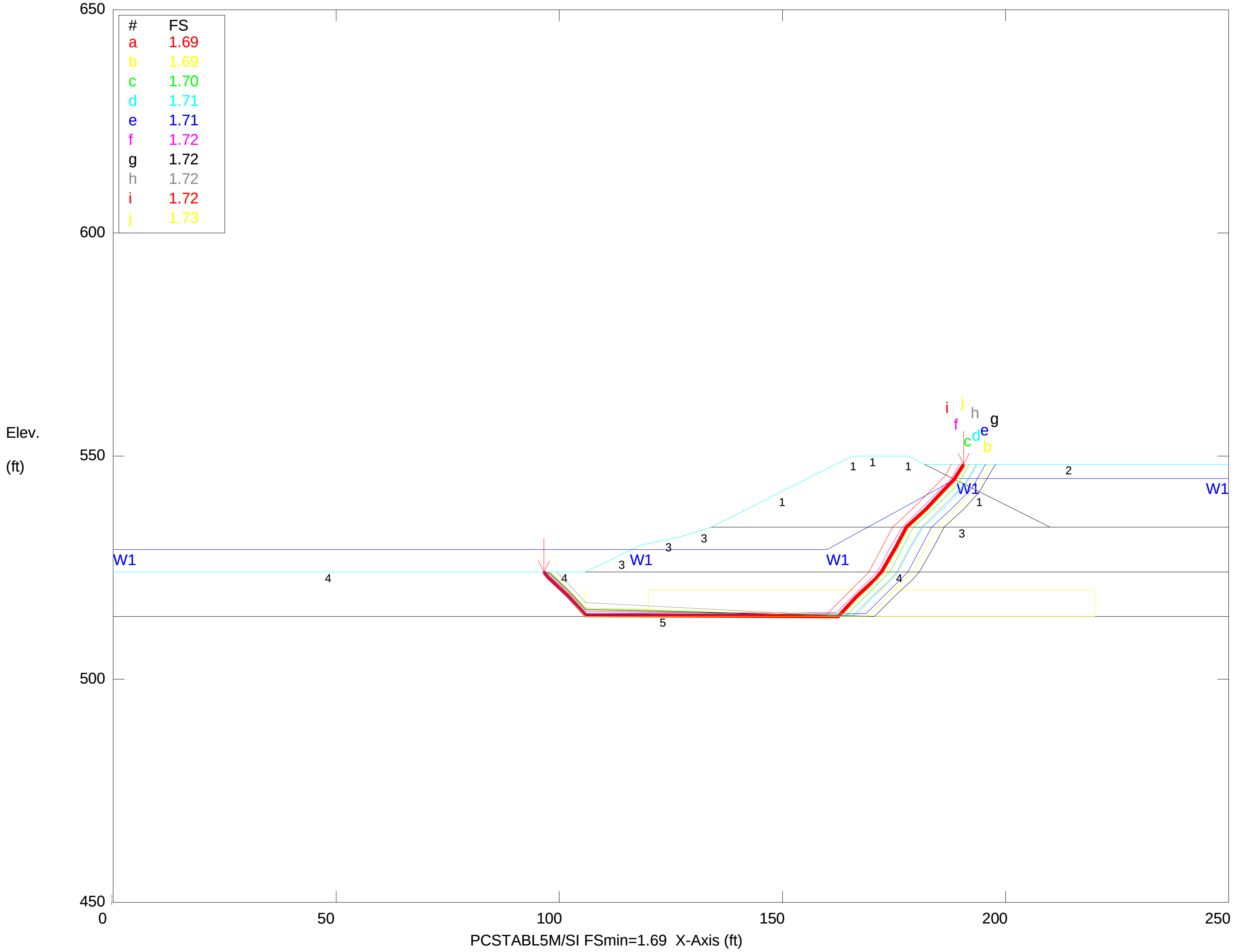
Ten Most Critical. C:BURL65B1.PLT By: TCW 05-27-11 11:00am



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	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

Alliant Burlington Economizer Pile West, North Ash Slope - Static Case

Ten Most Critical. C:BURL70B.PLT By: TCW 05-31-11 2:32pm



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

Attachment E

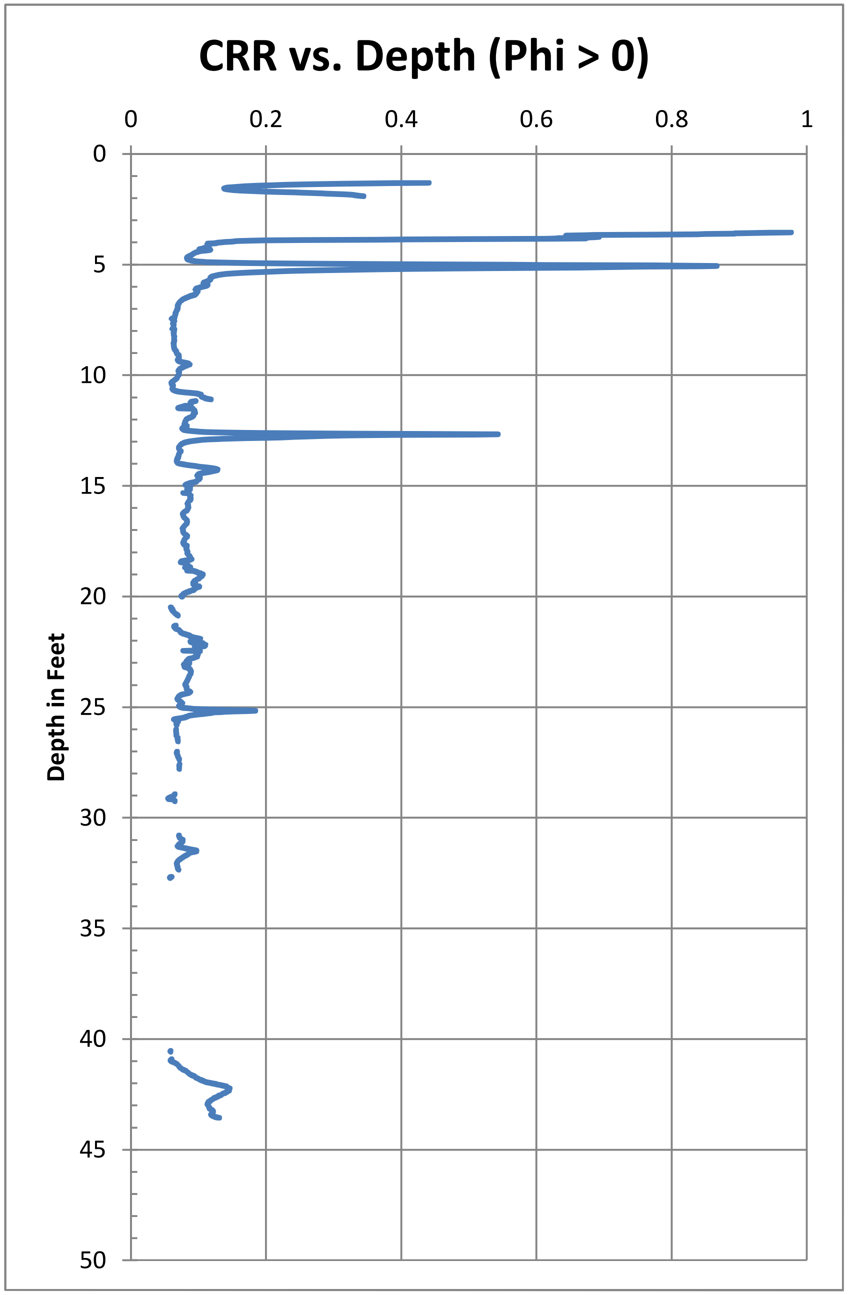
Cyclic Resistance Ratio (CRR)
and
Cyclic Stress Ratio (CSR)

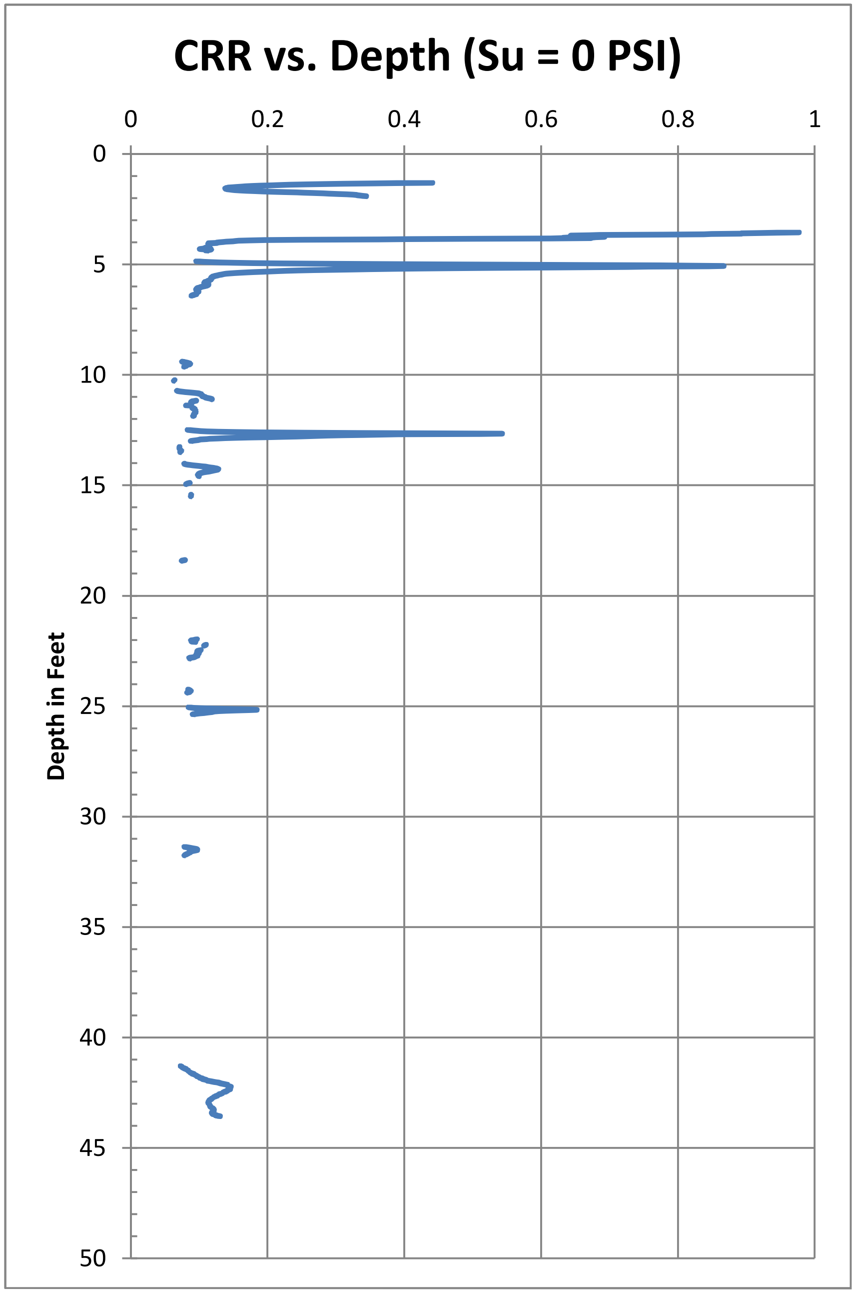
Burlington Generating Station

Source:
CRR based on CPT results by Aether dbs May 2011, and
Program SHAKE CSR calculations by Aether dbs May 2011

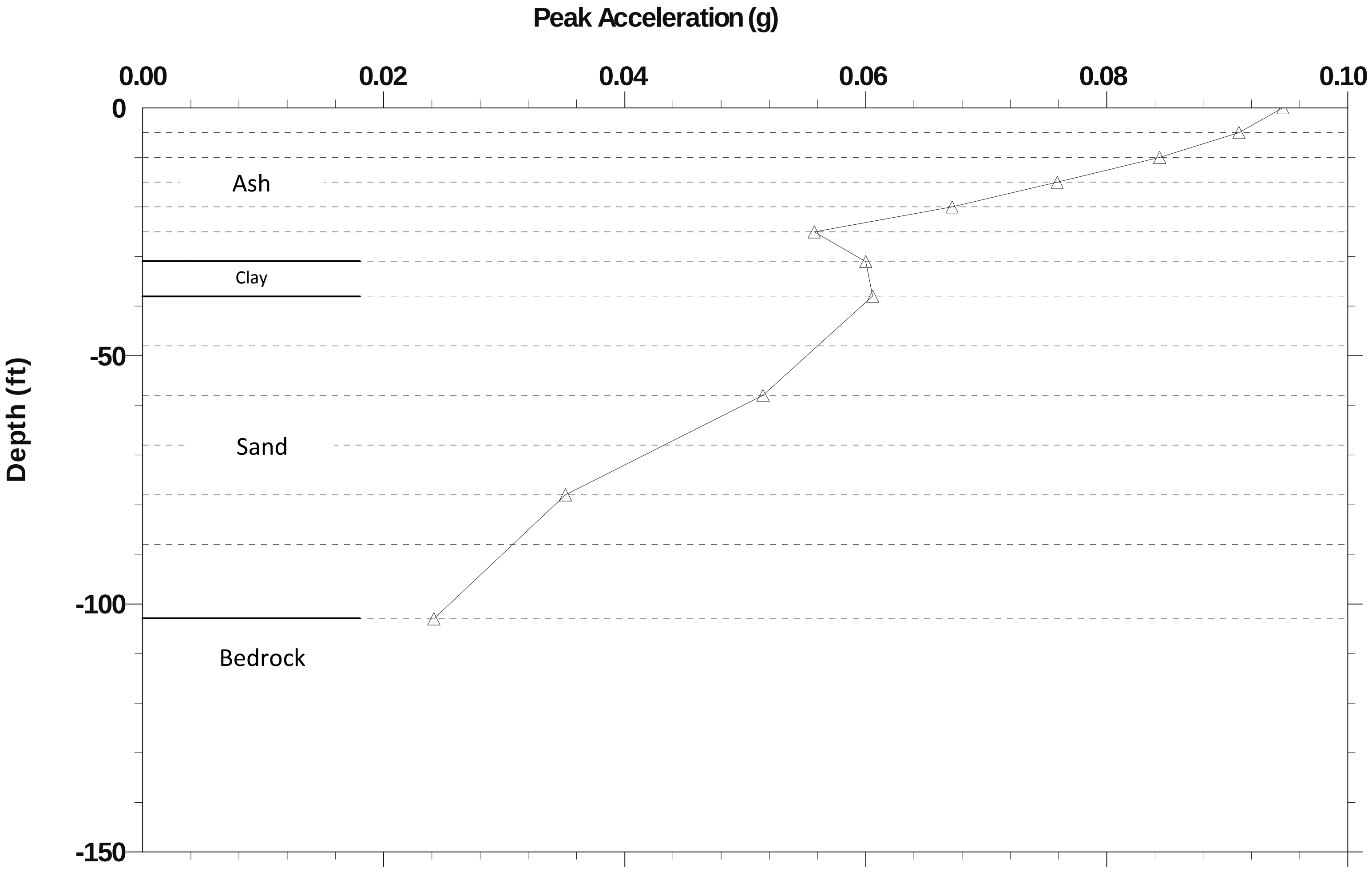
CPT-1

(Economizer Ash Pond Embankment)



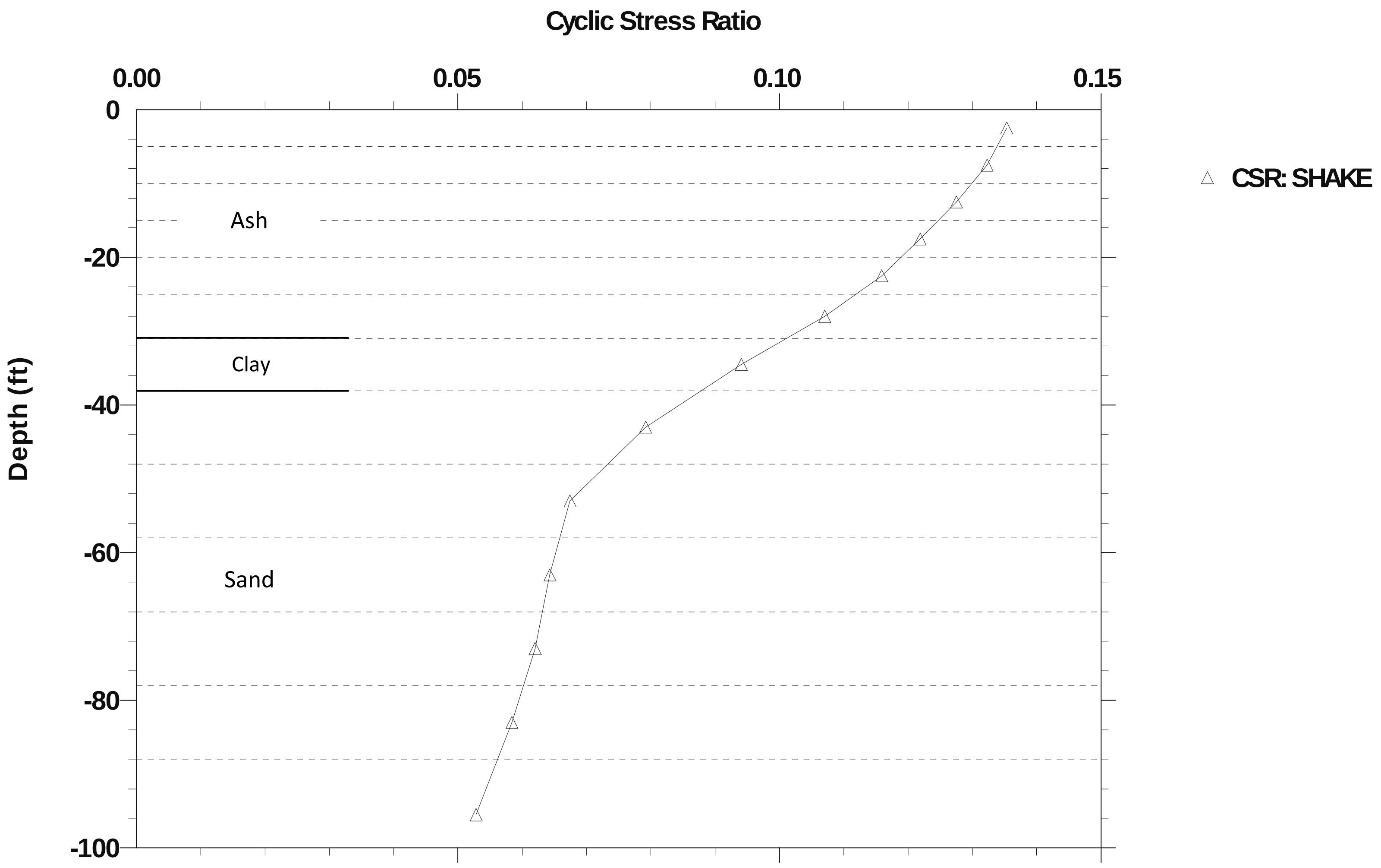


Economizer Ash Pile Sub-Surface Profile



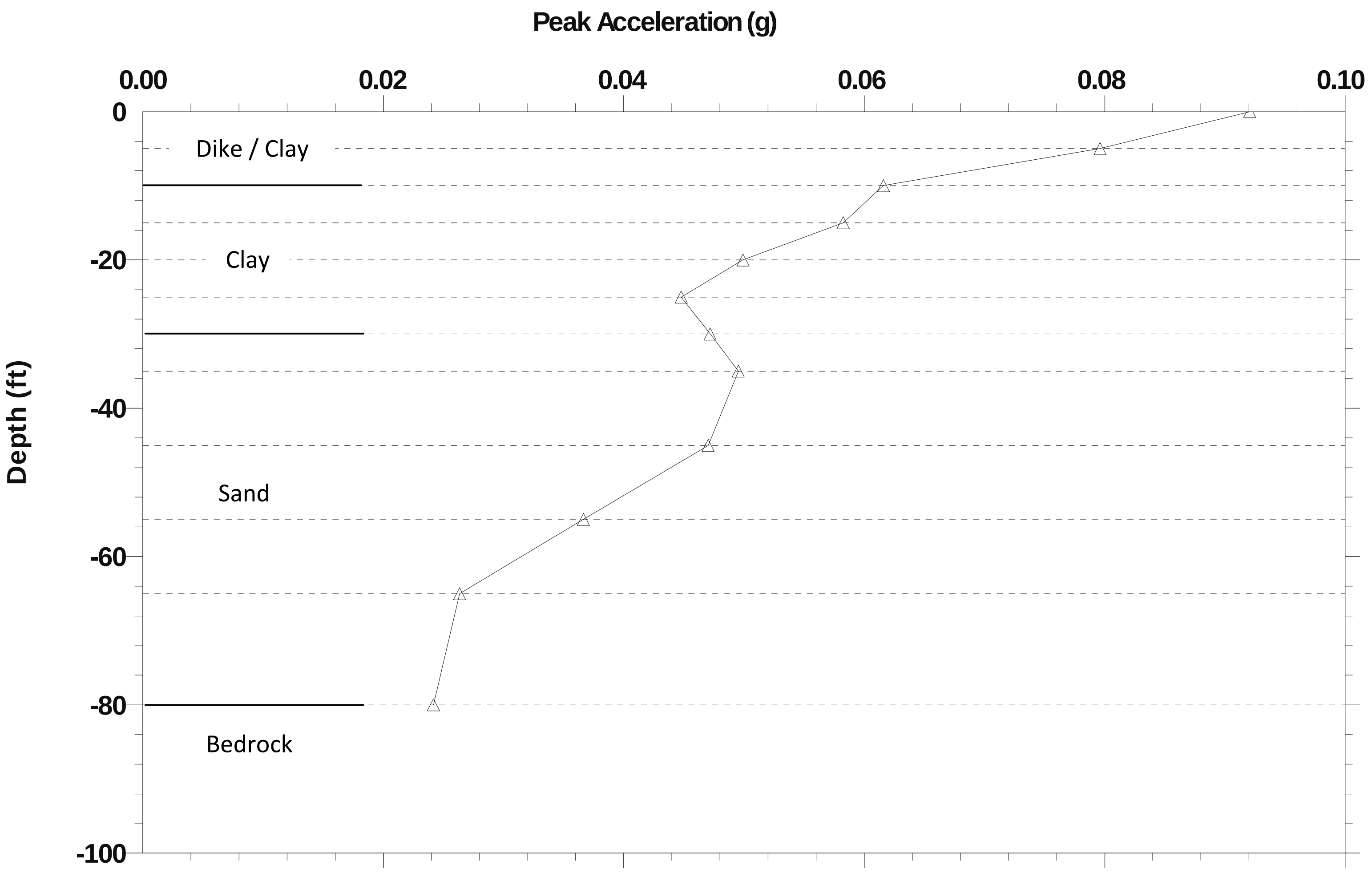
Acceleration with Depth (475 year return period with 0.025 g bedrock acceleration)

Economizer Ash Pile Sub-Surface Profile



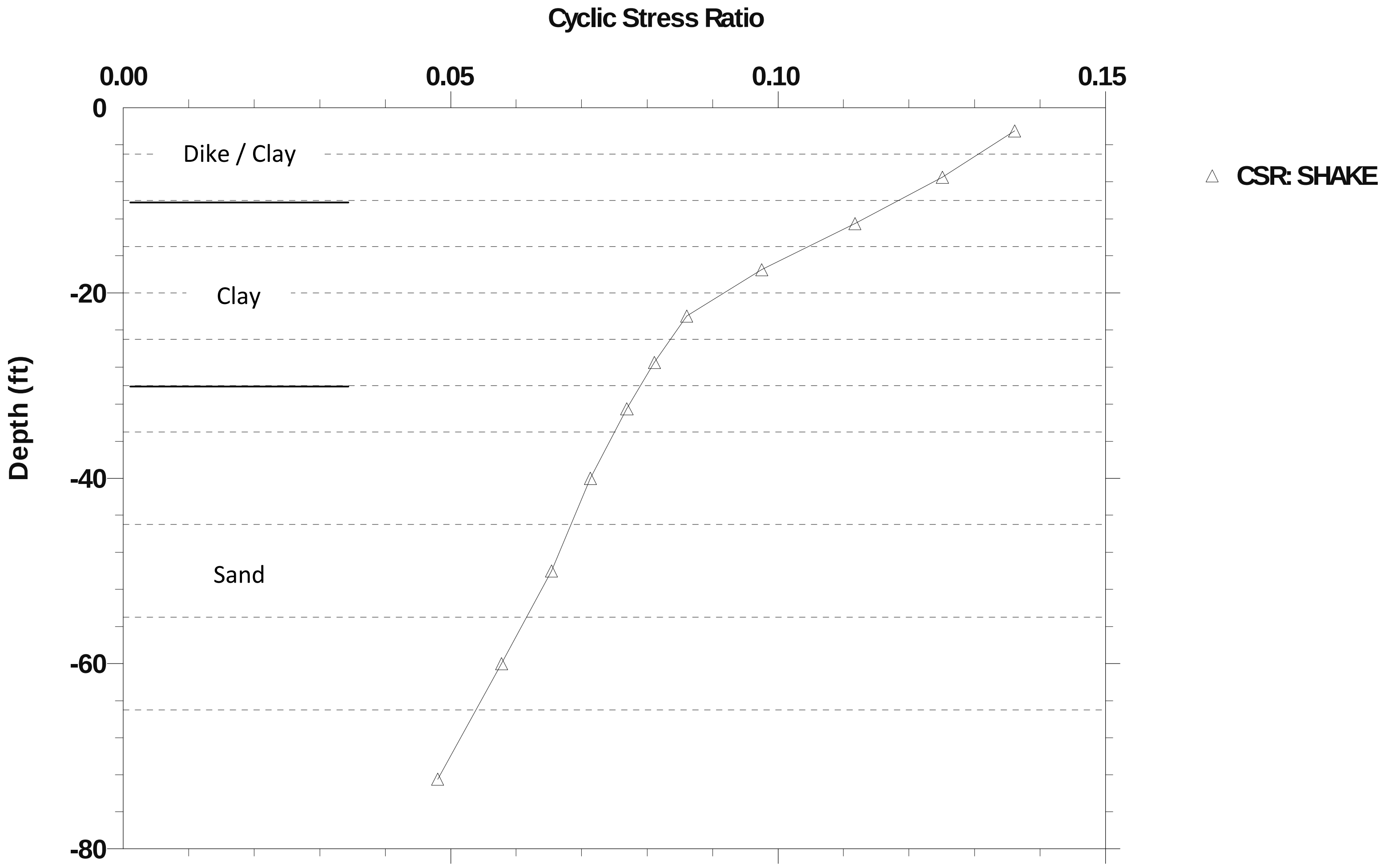
Cyclic Stress Ratio with Depth (475 year return period with 0.025 g bedrock acceleration)

Main Ash Pile Sub-Surface Profile



Acceleration with Depth (475 year return period with 0.025 g bedrock acceleration)

Main Ash Pile Sub-Surface Profile



Cyclic Stress Ratio with Depth (475 year return period with 0.025 g bedrock acceleration)

Attachment F

Dynamic / Pseudo-Static Slope Stability Analyses

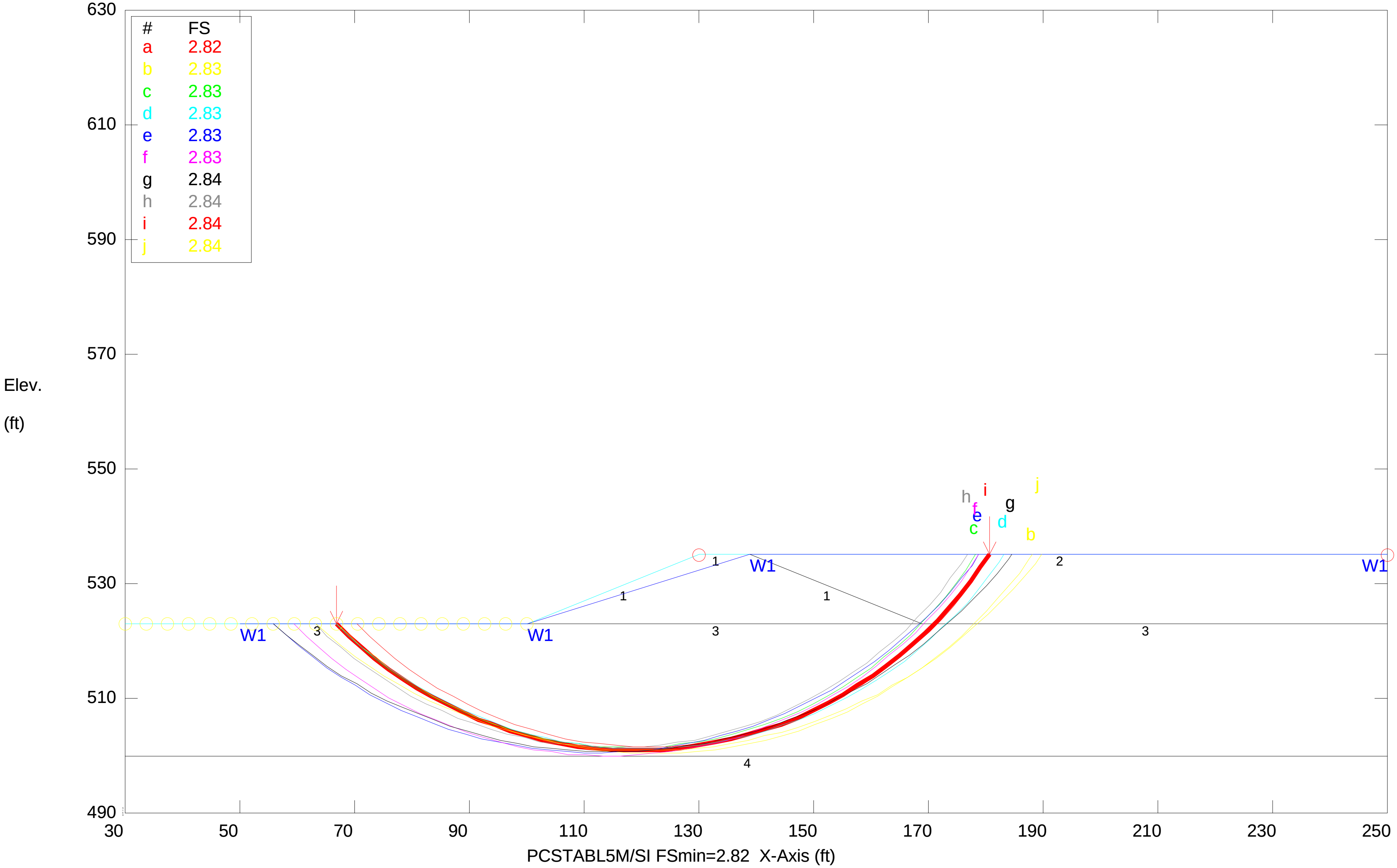
Ten Most Critical Surfaces Per Analysis

Burlington Generating Station

Source:
Program pcSTABL5m/SI output by Aether dbs May 2011

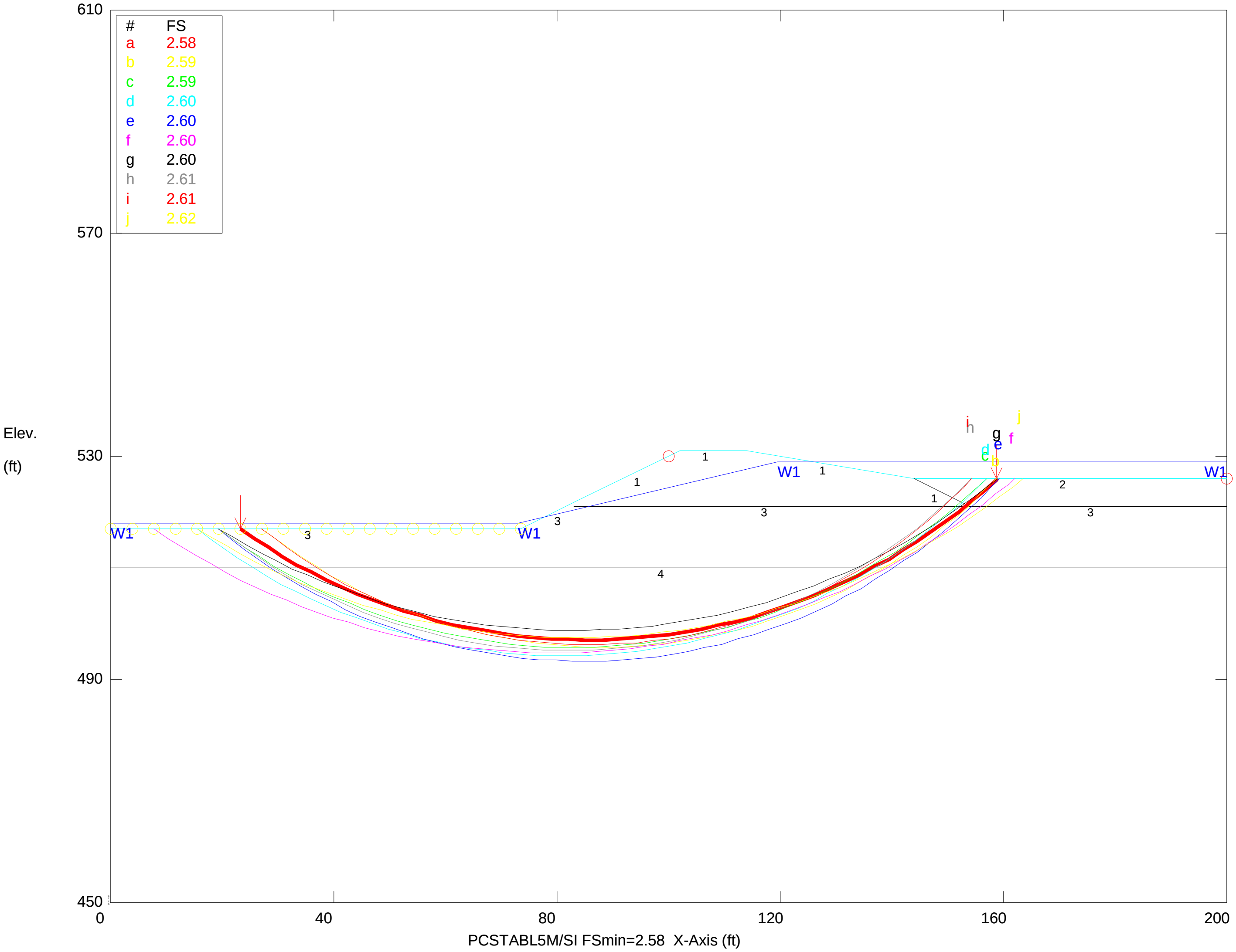
Alliant Burlington Main Ash Pond South Dike - EQ Case (0.077 & -0.051)

Ten Most Critical. C:BURL22C2.PLT By: TCW 05-31-11 7:42am



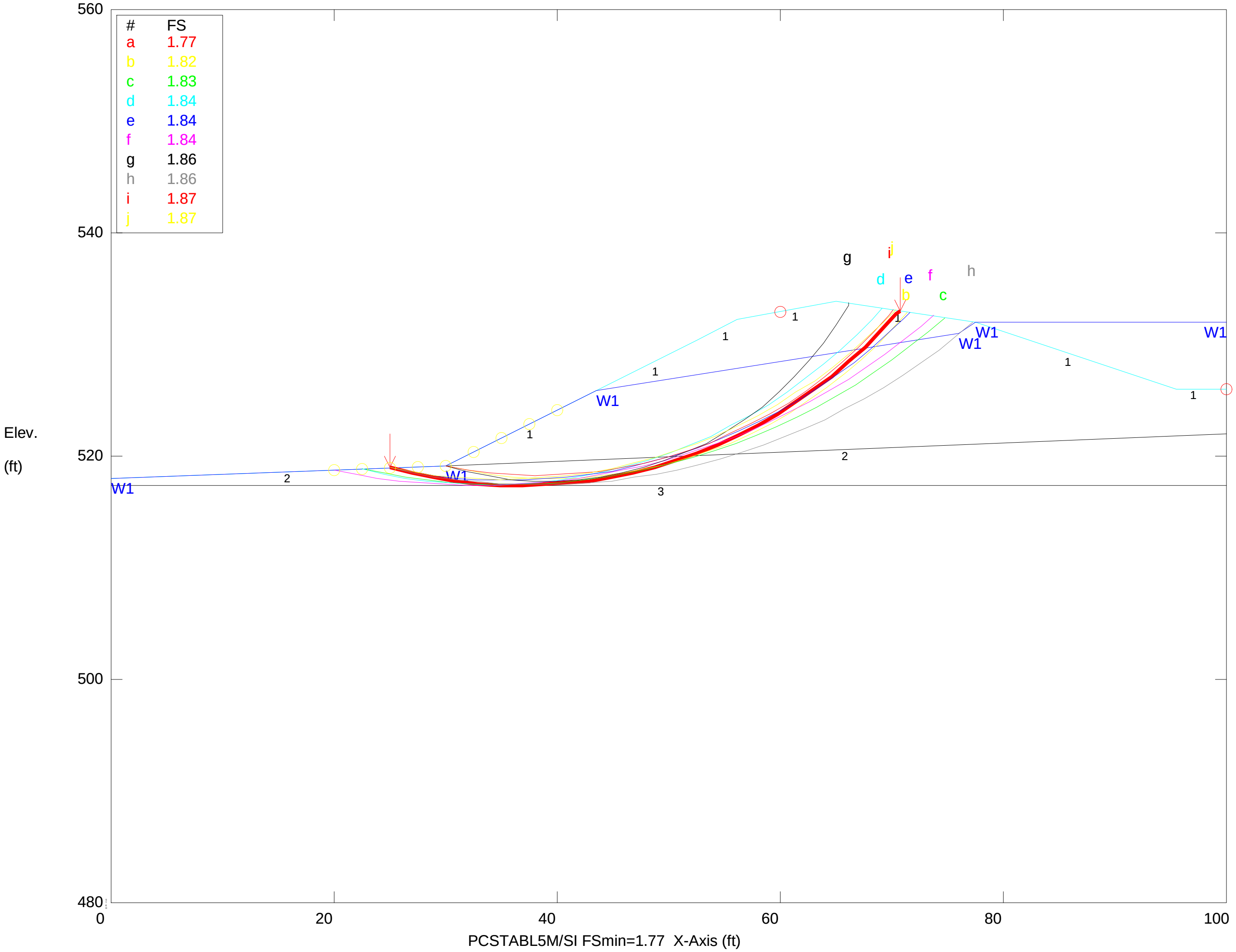
Soil Type No.	Label	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	Dike	125	125	700	0	0	0	W1
2	Ash	120	120	100	0	0	0	W1
3	Natural	120	120	1200	0	0	0	W1
4	Sand	130	130	0	37	0	0	W1

Alliant Burlington Upper Ash Pond North Dike Slope - EQ Case (.077 & .051)
Ten Most Critical. E:BURL41C3.PLT By: TCW 05-29-11 1:45pm



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	100	0	0	0	W1
3	Clay	125	125	900	0	0	0	W1
4	Sand	125	125	0	35	0	0	W1

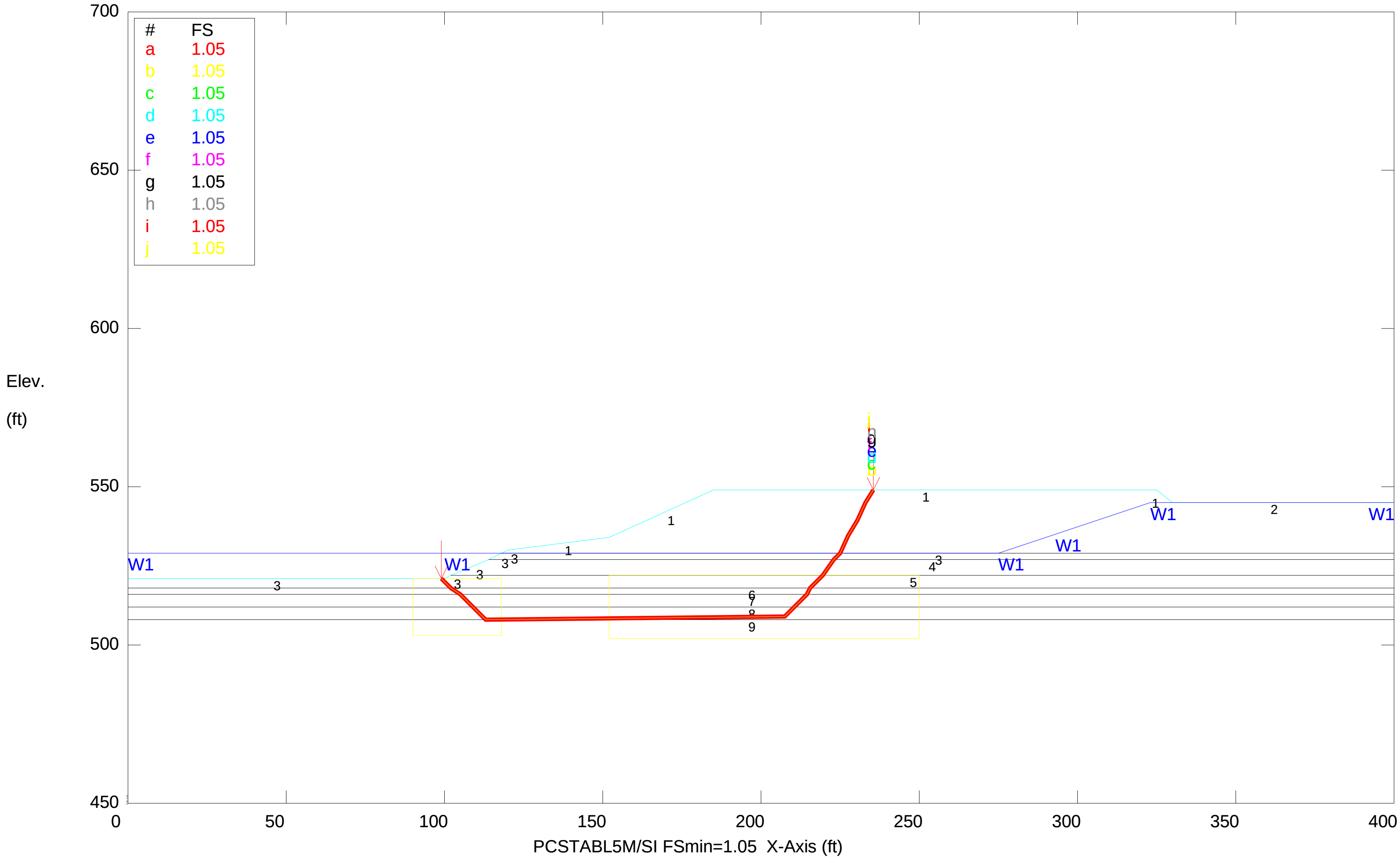
Alliant Burlington Ash Seal Pond South Dike - EQ Case (0.075 & -0.05)
Ten Most Critical. E:BURL51C2.PLT By: TCW 05-29-11 3:53pm



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 Clay	120	120	700	0	0	0	W1
2 Sand	130	130	0	37	0	0	W1
3 Clay	125	125	950	0	0	0	W1

Alliant Burlington Economizer Pile East, North Ash Slope - EQ Case (0.075 & -0.05)

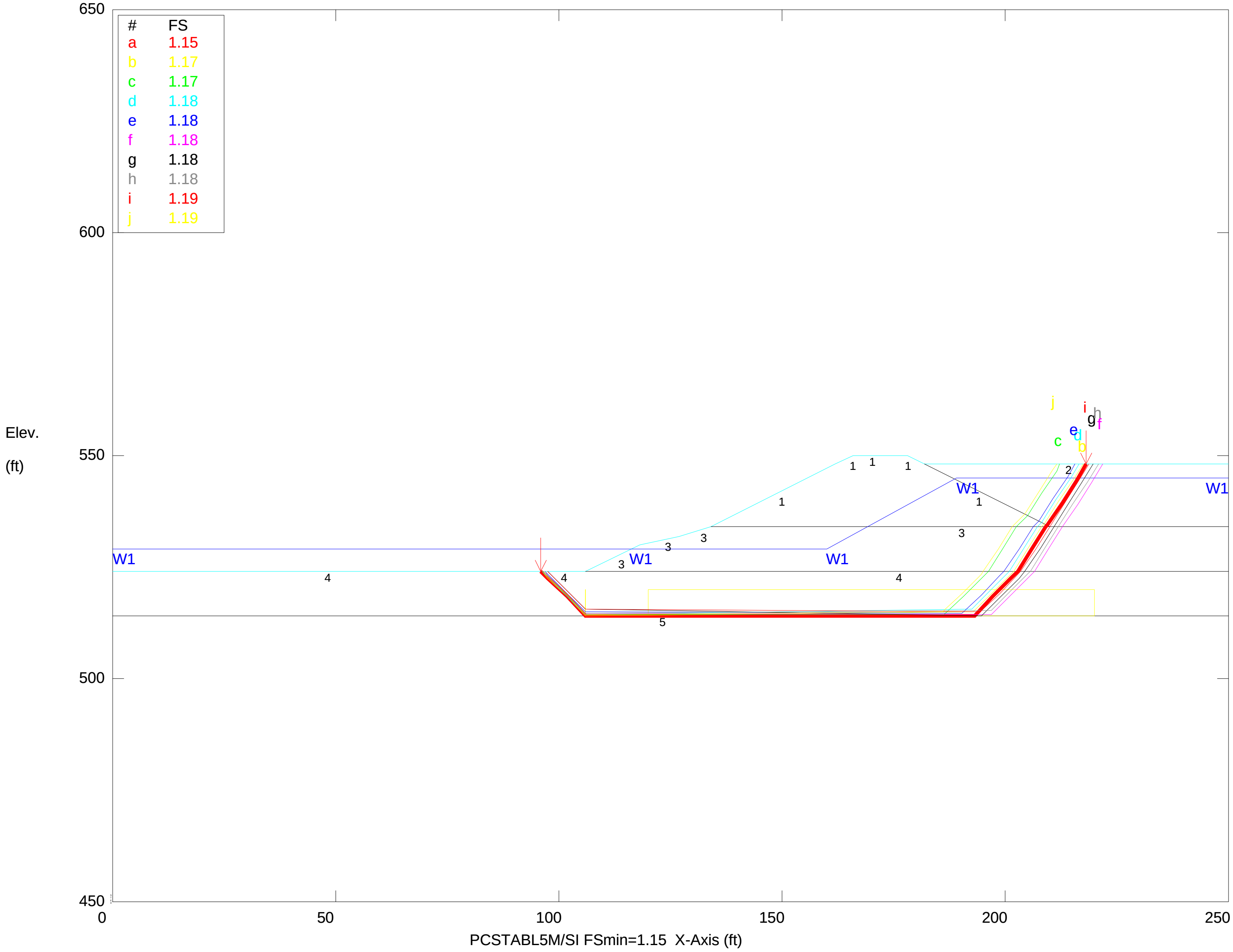
Ten Most Critical. C:BURL61B.PLT By: TCW 05-27-11 3:23pm



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	25	0	0	W1
5	CLAY	125	125	1000	0	0	0	W1
6	ASH	120	120	0	25	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

Alliant Burlington Economizer Pile West, North Ash Slope - EQ Case (0.075 & -0.05)

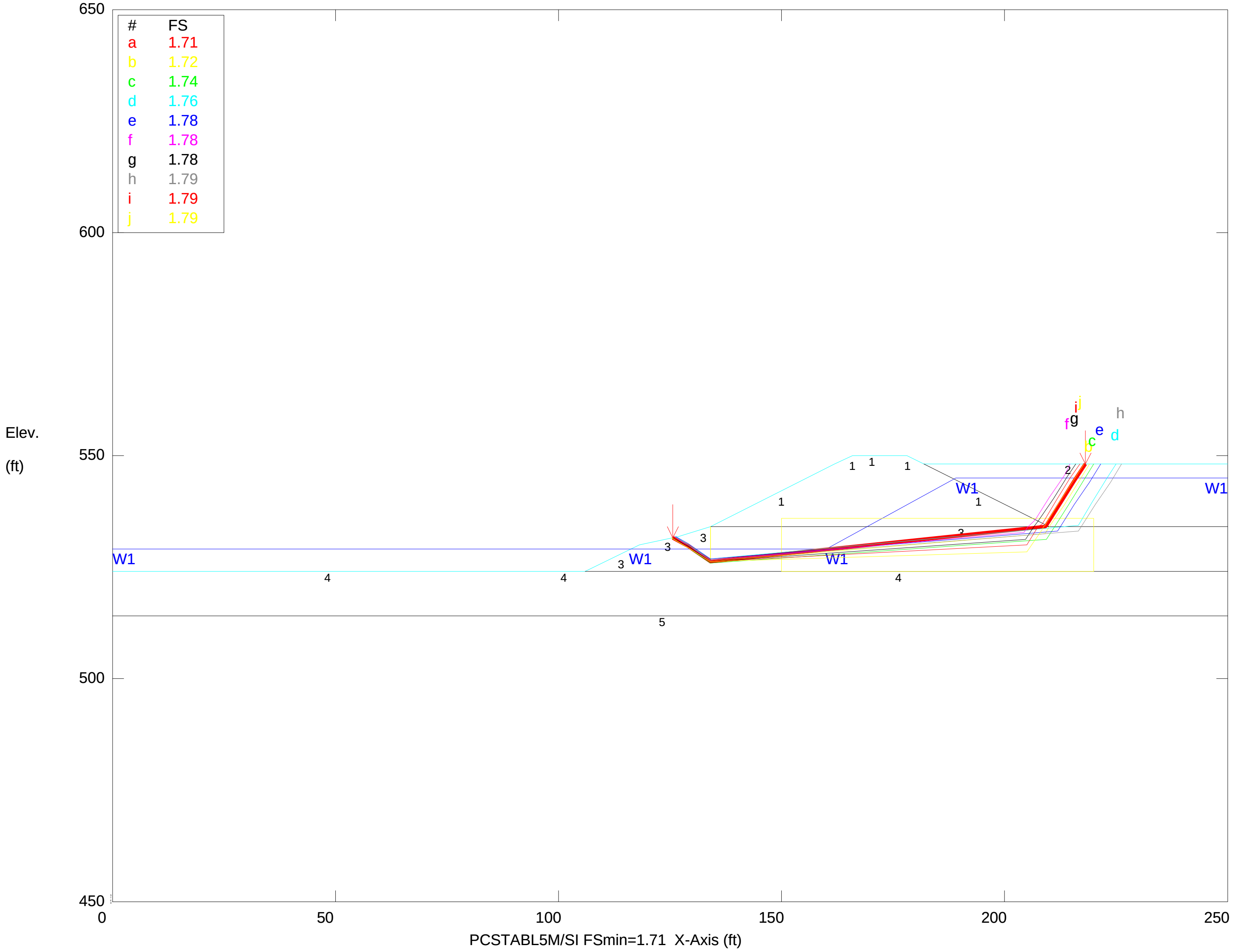
Ten Most Critical. C:BURL71B.PLT By: TCW 05-31-11 2:50pm



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	25	0	0	W1
3	Ash Fdn	125	125	0	25	0	0	W1
4	Clay	125	125	700	0	0	0	W1
5	Sand	125	125	0	30	0	0	W1

Alliant Burlington Economizer Pile West, North Ash Slope - EQ Case (0.075 & 0.05)

Ten Most Critical. C:BURL71B2.PLT By: TCW 05-31-11 2:57pm



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	25	0	0	W1
3 Ash Fdn	125	125	0	25	0	0	W1
4 Clay	125	125	700	0	0	0	W1
5 Sand	125	125	0	30	0	0	W1