FINAL

Coal Combustion Waste Impoundment

Round 7 - Dam Assessment Report

Rush Island Power Station

Ameren Missouri

Festus, Missouri

Prepared for:

United States Environmental Protection Agency
Office of Resource Conservation and Recovery

Prepared by:

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Fairfax, Virginia

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INTRODUCTION, SUMMARY CONCLUSIONS AND RECOMMENDATIONS

The release of over five million cubic yards of coal combustion waste 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 Rush Island Power Station Ash Pond management unit is based on a review of available documents and on the site assessment conducted by Dewberry personnel on Wednesday, September 29, 2010. We found the supporting technical documentation to be adequate (Section 1.1.3). As detailed in Section 1.2.5, there are two recommendations based on field observations that may help to maintain a safe and trouble-free operation.

In summary, the Rush Island Power Station Ash Pond is **SATISFACTORY** for continued safe and reliable operation, with no recognized existing or potential management unity safety deficiencies.

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), 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 will address 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 the management units that have not been rated for 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 information were received by Dewberry & Davis LLC about the Rush Island Power Station Ash Pond 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.

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, September 29, 2010, and review of technical documentation provided by Rush Island Power Station, Ameren Missouri.

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

The permit report gives a summary of soil strengths of the embankments and foundation of the ash pond based on SPT (Soil Penetration Test) sampling, Shelby tube sampling, and Cone penetration testing. The soil analyses results showed the permanent pool elevations should be limited to 403 feet, with the exclusion of temporary rises in pool elevations to more than 403 feet following major rainfall events. This limit would ensure the structural stability of the embankment slopes.

The ash pond did not appear to have any significant structural concerns during the site visit. Furthermore, Ameren Missouri weekly, annual and special inspection reports show no record of any serious structural instability of the ash pond.

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

Ameren Missouri provided Dewberry with a copy of the Rush Island Permit Report (referred to as permit report when reference in the subsequent sections of this assessment report) that was submitted as part of the plant's application for a registration permit from Missouri Department of Natural Resources, see Appendix A Document 4. The permit report included Hydrologic/Hydraulic information confirming the pond's capacity to contain the 100-year storm event, based on specific conditions of the ash pond.

A hydrology/hydraulics analysis for the ash pond during a 100-year rainfall event considered numerous parameters, including pond elevation of 398 feet, a slope stability permanent pool elevation limit of 403 feet, an embankment low point elevation of 408.2 feet, and a fully open/closed pond outlet condition. Consequently the report maintains that proper containment of a 100-year rainfall event is achieved considering the desirable operating water surface elevation and no emergency spillway is required.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

The supporting technical documentation was found adequate for the proper completion of this report. Technical documentation reviewed is referenced in Appendix A, Documents 3 thru 5.

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

The description of the ash pond provided by Ameren Missouri was an accurate representation of what Dewberry observed in the field.

1.1.5 Conclusions Regarding the Field Observations

During the site visit, Dewberry was provided access to all areas in the vicinity of the ash pond. The pond embankment and outlet structure showed no visible signs of significant erosion, seepage, overstress, settlement, shear failure or other signs of instability. Visual inspection of the exterior embankment was limited due to thick vegetation. There were no indications of unsafe conditions or need for remedial action.

There were minor erosion areas from road runoff and a minor seepage area on the northeastern side of the embankment, see Appendix C Document 7: Dam Inspection Checklist Form.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

Maintenance and methods of operation both appear to be adequate. During the site visit, the pond embankments interior slopes were in the process of being rehabilitated as a result of Ameren Missouri annual inspections. Interior embankment slopes were being repaired due to wave action erosion and riprap lining was being placed to protect against future embankment degradation due to continual wave action.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

The surveillance and monitoring program appears to be adequate. Weekly and annual inspections of the ash pond are periodically completed by Ameren Missouri operating personnel. Technical documents supplied to Dewberry included site plans that detail ash pond discharge, piping and sampling system. The site visit confirmed staff gages used for monitoring water surface elevations within the pond and at the pond discharge area (Mississippi River). See Appendix A Document 3: Rush Island Site Plans and Appendix B for site photographs.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The facility is SATISFACTORY for continued safe and reliable operation. No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

Frequent inspections should be performed at least once per month during optimal weather conditions to monitor and record pool elevations. Pool elevations should also be monitored periodically after significant rain events to ensure pool elevation increases higher than the allowable 403 feet are reduced to 403 feet or less within an adequate time frame.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

The permit report recommends the operating water surface elevation of the ash pond should be no higher than 398 feet, and a full 27 acres of water surface should be available. Periodic monitoring of water surface elevations, not to exceed 398 feet, as well as identification and removal of ash deltas above a 398 foot elevation (limiting water surface acreage) is recommended to ensure hydrologic/hydraulic safety of the ash pond. The development of an operating procedure to monitor water elevation and maintain waste elevations is recommended.

1.2.3 Recommendations Regarding the Field Observations

It should be noted that although visual inspections of the ash pond embankment and outlet structure showed no visible signs of significant erosion, seepage, overstress, settlement, shear failure or other signs of instability, minor areas of concerns were noted. It is recommended that the utility monitor the erosion and seepage areas to ensure problems are not developing.

1.2.4 Recommendations Regarding the Maintenance and Methods of Operation

A need for slope maintenance for the external embankment is necessary to limit the growth of vegetation and facilitate visual dam inspection. It should be noted that in 2006, the Corps of Engineers armored with rip-rap the entire length of the Isle du Boise Creek bank adjoining the ash pond. Careful consideration should be taken in monitoring signs of erosion of the ash pond external embankment due to flood waters of either the Isle du Bois Creek or the Mississippi River.

1.2.5 Recommendations Regarding Continued Safe and Reliable Operation

No recommendations appear warranted at this time.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

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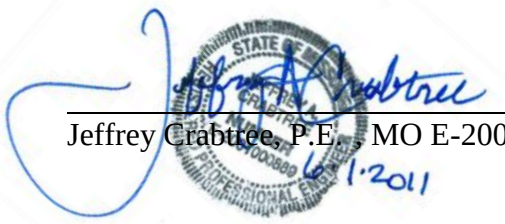
Jeffrey Crabtree, P.E. Dewberry
James Filson, P.E. Dewberry

1.3.2 Acknowledgement and Signature

We acknowledge that the Rush Island CCW management unit referenced herein was assessed on September 29, 2010.



Jeffrey Crabtree, P.E. , MO E-2001000889

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

2.1 LOCATION AND GENERAL DESCRIPTION

Rush Island Power Station is located near the southeastern limits of Jefferson County in Festus, Missouri. The plant is operated by Ameren Missouri. It was built within a delineated FEMA floodplain, bordering the Mississippi River on its east side and situated just north of the Isle du Bois Creek. This facility is a coal-fired power station that currently maintains a settling pond to hold fly ash by-products. See Appendix A, Documents 1 and 2 for a site map and aerial photograph of the power station, respectively. The total drainage area of the plant is 261 acres.

The Rush Island Power Station was built in the early 1970's. The station has a diked ash pond, commissioned in 1976, that is a ring levee said to have been constructed of material from the surrounding floodplain. It should be noted that the current layout of the ash pond deviates from the original. What was once designed to be a larger settling pond is now composed of an ash disposal area and a small polish pond used for final settlement. The ash disposal area was created by the addition of an internal divider dike; date of construction of said divider is unknown. As described in the permit report and verified through field observations, north of the dike the ash pond is full and has excavated pits for ash disposal. Ash is disposed into the individual pits using a wetted dry ash nozzle, making it possible to minimize water and ash mix.

Summaries contained within this report pertain to the complete area of the ash pond, considering both the ash disposal area and the polish pond are located within the original ring levee. Therefore for the purpose of this assessment, the ash disposal area and polish pond together compose the ash pond as a complete unit.

2.2 SIZE AND HAZARD CLASSIFICATION

The ash pond has a reservoir area of 29 acres of active water storage and a maximum height of dam of 46 ft (see Table 2.2a).

Table 2.2a: CCW Diked Pond Dimensions and Size	
	Ash Pond
Dam Height (ft)	46 [1]
Crest Width (ft)	14 [1]
Side Slopes H:V	3:1 [1]
Top Elevations (ft)	408.2 - 412.2 [1]

[1]- Appendix A, Document 4: Missouri Department of Natural Resources Application for Registration Permit.

The classification, based on the height of dam, is intermediate in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria (see Table 2.2a for size classification criteria).

Table 2.2b: 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

The ash pond is categorized as an industrial water retention dam according to the Regulations of the Missouri Dam and Reservoir Safety Council of the Missouri Department of Natural Resources. It is further described to have a Class III Environmental Site Classification, as it is considered to exhibit no threat to life downstream of the dam in the event of failure. Dam failure would result in immediate discharge into the Mississippi River and the economic, environmental, and lifeline losses of the impoundment would generally be limited to the owner. Dewberry has conducted a qualitative hazard classification based on 2004 Federal Guidelines for Dam Safety classification, shown in Table 2.2c.

Table 2.2c: 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
Significant	None Expected	Yes
High	Probable. One or more expected	Yes (but not necessary for classification)

The ash pond has a Low Hazard Classification.

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

The ash pond receives fly ash by-products and processing water as well as all plant site runoff. Data reviewed by Dewberry did not include the volume of residuals stored in the ash pond at the time of inspection. During the site visit the actual pool elevation was lower than the normal pool elevation of 396 feet. The low pool elevation was due to the need to facilitate interior slope rehabilitation and protection. Pool elevations range from 384 feet to 390 feet, at any given time during construction.

Table 2.3: Maximum Capacity of Unit	
Ash Pond	
Surface Area (acre)	29
Current Storage Capacity (cy)	*Information Not Available*
Current Storage Capacity (acre-ft)	*Information Not Available*
Total Storage Capacity (cy)[1]	269,717
Total Storage Capacity (acre-ft)[1]	167.19
Crest Elevation (ft)	408.2 - 412.2
Normal Pond Level (ft)	396

[1]- Appendix A Document 4: Missouri Department of Natural Resources Application for Registration Permit.

2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankment

The original design layout for the ash pond is now composed of an ash disposal area and a smaller ash pond divided by an internal dike. The top elevation of the ash pond remains within range of the original design top elevation of 410 feet. Based on the provided site plans, both internal and external embankment slopes were designed to be 3H:1V. During the site visit, the small polish pond was under construction for the rehabilitation and riprap protection of the internal slopes, as requested in the permit report.

2.4.2 Outlet Structure

The pond outlet structure is located in the northeast corner of the ash pond. The structure consists of an overflow structure (a vertical riser with design top of 388.00 feet) connected to outlet conduit (a 24 inch diameter high density polyethylene, HDPE). A skimmer boom is located around the riser, both of which are made accessible through a metal platform. The 24 inch diameter HDPE is contained within the previous outlet conduit, a 36 inch diameter corrugated metal pipe (CMP), and is held in place by filling voids between the two pipes with grout/flowable fill. The outlet pipe has two CO_2 control valves and a sampling pump that regulate discharge. Site plans indicate a design inlet invert of 382.54 feet and a design outlet invert of 372.49 feet. One of the valves is controlled by the pH level of the discharge and is either 100% or 0% open depending on pH. The other valve is not tied to any parameter and is a manually controlled throttle valve. The ash pond has no emergency spillway.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

Aerial photography shows no critical infrastructure within five miles downstream of the Rush Island Power Station ash pond. The downstream town, St. Genevieve, is located approximately 16 miles south of the plant.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

Summary of Reports on the Safety of the Management Unit

Ameren Missouri provided weekly and annual inspection documents as well as special inspection reports. Weekly and annual inspection documents provided were conducted by plant personnel while special inspection reports were completed by a professional engineer at Reitz & Jens, Inc. The following is a list of reports provided:

- Rush Island Fly Ash/Bottom Ash Pond *Weekly Inspection Check Sheets*, dated August 26, 2010/September 03, 2010 and September 10, 2010.
- Rush Island Ash Pond *Inspection Check Sheets*, dated January 21, 2010 and November 23, 2010.
- Ameren Missouri Dam Inventory and Inspection Program, dated August 2007.
- Rush Island Permit Report *Fly-ash Pond Levee System Dam Safety Registration Analysis* MO 40179, dated April 6, 2010.

The weekly inspection sheets report the ash pond to be in good condition and there is no evidence of a problem. Notes were included on the inspection reports to monitor seepage, erosion and the vegetative growth along the earthen embankment. These notes included:

- *Seepage spot on the NE, condition requires regular observation to ensure that the condition does not become worse.*
- *West slope slide, will fix with ash pond work that has begun, condition requires regular observation to ensure that the condition does not become worse.*
- *Vegetative growth increase from 18 inches to 2.5 feet, item needing minor maintenance and/or repairs within the year. The safety or integrity of the item is not yet imperiled. Page is 3-1*

The January 21, 2010 annual inspection document concludes that there are no dam safety concerns and the recommendations were maintenance-type activities that should be addressed over the next year. Maintenance items included were:

- *Reestablish interior slope of embankment and armor with riprap.*
- *Armor outfall discharge area to prevent scouring.*
- *Repair wheel ruts to prevent further rutting and drainage problems.*
- *Quarterly mowing of ash pond slopes to extend at least 15 feet beyond the downstream toe.*
- *Video inspection of outfall pipes to detect voids, deterioration or deformities.*
- *Clean staff gages and re-label or install new staff gage.*

The November 23, 2009 annual inspection document concludes that there are no dam safety concerns and the recommendations were maintenance-type activities that should be addressed in 2010. Maintenance items included were:

- *Monitor minor seepage areas on east exterior slope near the toe of dam.*
- *Rutting and erosion gullies should be repaired.*
- *Control vegetation on interior slopes.*
- *Protect interior slope from erosion at south end of pond with riprap armor.*
- *Clean staff gages and re-label or install new staff gage.*
- *Video inspection of outfall pipes to detect voids, deterioration or deformities.*

The Ameren Missouri Dam Inventory and Inspection Program, dated August 2007 and the Rush Island Permit Report *Fly ash Pond Levee System Dam Safety Registration Analysis* MO 40179, dated April 6, 2010 are both more detailed reports that give recommendations for maintenance of the ash pond as well as hydrologic evaluations. The reports are similar in nature with the exception that the latter provides a more accurate and up to date version of the current conditions of the ash pond. See Appendix A Document 4: Missouri Department of Natural Resources Application for Registration Permit.

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

The ash pond is categorized as an Industrial Water Retention Dam with a Class III Environmental Site Classification, according to Missouri DNR, Dam and Reservoir Safety regulations. Missouri DNR requires dam operators to obtain a registration permit for all dams with a height greater than 35 feet. In April 2010, Ameren Missouri submitted a registration permit application, complete with a permit report for its ash pond, see Appendix A Document 4. The impoundment was issued a Missouri State Operation Permit for 2009; Permit No. MO-0000043, see Appendix A Document 5.

3.2 SUMMARY OF SPILL/RELEASE INCIDENTS

Data reviewed by Dewberry did not indicate any spills, unpermitted release, or other performance related problems with the dam 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

Rush Island Power Station was built in the early 1970's and its ash pond was commissioned in 1976. The original design proposed a dam height of 57 feet with a crest elevation of 410 feet.

4.1.2 Significant Changes/Modifications in Design since Original Construction

The current layout of the ash pond has been modified from the original design shown in the provided site plans, see Appendix A Document 3. The area originally designated for a large settling pond is now composed of an ash disposal area and a smaller ash pond used for final settlement. The ash disposal area was created by the addition of an internal divider dike; date of construction of the divider dike is unknown.

The original site plans also indicate two outfall pipes. Based on field observations as well as further inspection of provided documents, it seems only one outfall pipe is considered operational. Plans have been provided that show modifications made to this outfall pipe to install EPA required monitoring devices that include a sample pump and CO_2 valves and injectors. Site plans for the modifications are dated August 1991.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

No significant repairs or rehabilitation have been performed for the ash pond since its original design. No evidence of repairs or rehabilitation due to prior releases, failures or patchwork have been recorded. No rehabilitation activities were seen during the visual site assessment.

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

Fly ash by-products, processing water and plant site runoff are directed into the ash pond through a side channel.

4.2.2 Significant Changes in Operational Procedures and Original Startup

No documents provided indicated any significant changes in operational procedures since original startup.

4.2.3 Current Operational Procedures

Current operational procedures remain unchanged from the original operational procedures.

4.2.4 Other Notable Events since Original Startup

No additional information was provided of other notable events impacting the operation of the pond.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Jeffrey Crabtree, P.E. and James Filson, P.E. performed a site visit on September 29, 2010 in company with the participants.

The site visit began at 9:00 AM. The weather was 80 degrees Fahrenheit, sunny, and dry. Photographs were taken of conditions observed. Please refer to photographs in Appendix B and the Dam Inspection Checklist in Appendix C. Selected photographs are included here for ease of visual reference. All pictures were taken by Dewberry personnel during the site visit.

The overall assessment of the dam was that it is in satisfactory condition and no significant findings were noted.

5.2 ASH POND

5.2.1 Crest

The crest of the ash pond showed no signs of significant depressions, tension cracks or other indications of settlement or shear failure. Figure 5.2.1-1 shows the typical crest condition of the embankment.

Figure 5.2.1-1: Typical crest condition of embankment, South.

5.2.2 Upstream/Inside Slope

The inside embankment of the ash pond was under rehabilitation during the site assessment. Riprap armor was placed along inside slopes of pond to protect against wave action erosion. Figure 5.2.2-1 and Figure 5.2.2-2 show completed rehabilitation along interior slopes and groins on the south end of ash pond.

Figure 5.2.2-1: Riprap armored interior slopes of ash pond protected against wave action erosion, Southwest.

Figure 5.2.2-2: Riprap armored interior slope of ash pond.

5.2.3 Downstream/Outside Slope and Toe

The external embankment has medium to heavy vegetative cover ranging from tall grass to trees. Some areas along the embankment were observed to have minimal grass cover and signs of minor erosion due to roadway runoff or the use of maintenance equipment. There were no scarps, sloughs, bulging, cracks or depressions observed along the embankment indicating slope instability. No evidence of spills, release or performance related problems could be found through field observations. The pond borders the Isle du Boise Creek on the southern portions of its embankment. A five foot bench between the banks of the creek and the toe of the pond embankment exists. This area was covered by medium to heavy vegetation. Figure 5.2.3-1 shows the conditions of the external embankment.

Figure 5.2.3-1: Ash pond external embankment with medium to heavy vegetative cover, Southeast.

5.2.4 Abutments and Groin Areas

The ash pond is a continuous dike and has no abutments. See Section 5.2.2 for information regarding pond groin areas.

5.3 OUTLET STRUCTURES

5.3.1 Overflow Structure

The pond outlet structure is located in the northeast corner of the ash pond. The ash pond discharges to the Mississippi River through an overflow structure consisting of a vertical riser and 24 inch HDPE outlet pipe. A skimmer boom is located around the riser and the structure is made accessible through a metal platform. The overflow structure was not completely visible at the time of the site assessment. Figure 5.3.1-1 shows both the active and inactive outlet structures for the ash pond.

Figure 5.3.1-1: Ash pond inactive (left) and active (right) overflow structures, Northwest.

5.3.2 Outlet Conduit

The outlet conduit for the ash pond is a 24 inch diameter HDPE pipe. This HDPE pipe is contained within the previous outlet pipe, a 36 inch diameter CMP, and is held in place by filling voids between pipes with grout/flowable fill. The outlet pipe has two CO_2 control valves and a sampling pump that regulates discharge water. One of the valves controlled by the pH level of the discharge and is either 100% or 0% open depending on pH. Control of the other valve is not tied to any parameter; it is a manually controlled throttle valve. Site plans indicate a design inlet invert of 382.54 feet and a maximum design outlet invert of 372.49 feet. Staff gages at both the inlet and outlet ends of the conduit monitor water

levels. Both ends of the conduit were fully submerged during the site visit. Figure 5.3.2-1 shows the discharge area of the ash pond outlet conduit.

Figure 5.3.2-1: Ash pond outlet to Mississippi River.

5.3.3 Emergency Spillway

The ash pond has no emergency spillway.

5.3.4 Low Level Outlet

A low level outlet was not observed for the ash pond. Site plans provided to Dewberry did not indicate the presence of a low level outlet.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

No documentation was provided to Dewberry regarding local flood records. USGS River gages (USGS 07010000 and USGS 07020500) located along the Mississippi River both upstream and downstream of the power station show the largest peak flows occurred during 1903, 1927 and 1993, see Exhibits 1 and 2. These peak flows are comparable to Mississippi River 100 year discharges found in the Jefferson County FIS Study, see Exhibit 3. Consequently it can be concluded that the flood of record is comparable to the base flood elevation of 405 feet as specified in Jefferson County FIRM dated April 5, 2006, Map Numbers 29099C0395E and 29099C0500E, see Exhibit 4 and 5.

6.1.2 Inflow Design Flood

The permit report indicates that the ash pond has the capacity to contain the 100-year storm event, assuming an operating water surface elevation of 398 feet or lower and ash deltas within the pond do not exceed 398 feet of elevation. Pond capacity was determined considering both the 24 hour and 6 hour event, which considers 7.10 inch and 5.20 inch intensity, respectively. The 100-year storm event produces a maximum pool elevation of 402.55 feet, allowing 4.15 feet of freeboard for the lowest point of the top of dam.

6.1.3 Spillway Rating

No documentation was provided regarding the spillway hydraulics.

6.1.4 Downstream Flood Analysis

The ash pond is within an existing FEMA delineated floodplain, located along the Mississippi River. The FEMA Flood Insurance Rate Map (FIRM) for Jefferson County, Map Numbers 29099C0395E and 29099C0500E, indicates a 100-year flood elevation of 405 feet at the Isle du Bois Creek. The United States Corp of Engineers has also completed a Flood Flow Frequency (FFF) study, in which the 100 year flood elevation along the Mississippi River at the plant location was determined to be 403.7 feet. Both base flood elevations, on the approved FIRM and in the FFF study, are below the ash pond top of embankment.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Documents provided to Dewberry for review are adequate.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Hydrologic and hydraulic results found in the permit report indicate the operating water surface elevation of the ash pond and the elevation of ash delta deposits should be kept at a elevation of 398 feet or less to ensure sufficient pond capacity. During a 100-year 24 hour storm event, the maximum pool elevation for the ash pond is of 404.50 feet. Compared to the lowest point along the pond embankment surveyed at 408.12 feet, this would ensure a freeboard of 4.15 feet. Failure of the ash pond due to overtopping of embankment during a 100-year storm event is improbable.

7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

The permit report includes a soil stability analysis of the ash pond embankment. The stability analysis was based on the steady seepage surface that was calculated using the procedures referenced in the Missouri DNR 1989 Publication "Engineering Analysis of Dams".

Study results indicate that the stability safety factor for the ash pond embankment is equal to or greater than the minimum recommended values as long as permanent pool elevations do not exceed an elevation of 403 feet. The likelihood that pool elevations exceed this limit is low. Additionally such elevations would be subject to minimal duration.

7.1.2 Design Parameters and Dam Materials

Design parameters for the stability analysis were based on Standard Penetration Test sampling and 3 inch undisturbed thin walled Shelby tube sampling, derived from six drilled test holes as well as 5 cone penetration tests (CPT). Test hole and CPT logs indicate drilling was completed in August and September 2009, see Appendix A, Document 4: Missouri Department of Natural Resources Application for Registration Permit.

A summary of design parameters used for the stability analysis, as they were derived from soil logs and testing, was not included as part of the permit report.

7.1.3 Uplift and/or Phreatic Surface Assumptions

No documentation was provided to Dewberry related to uplift calculations or assumptions made with respect to the phreatic surface.

7.1.4 Factors of Safety and Base Stresses

The permit report lists safety factors resulting from the slope stability analysis at various cross sections along the ash pond embankment. Safety factors related to the critical section are summarized in Table 7.1.4.

Table 7.1.4-1: Ash Pond Embankment, Critical Section Safety Factors

Cross Section	Stress Phase	Seismic Force (g)	Pool Elevation (ft)	MO DNR Required Safety Factor	Safety Factor
7	Total	None	407	1.5	1.7
7	Steady Seepage	None	398	1.5	1.7
7	Steady Seepage	0.046	398	1.0	1.5
7	Steady Seepage	None	407	1.5	1.4
7	Steady Seepage	None	403	1.5	1.5
7	Steady Seepage	0.046	403	1.0	1.3

The permit report limits structural stability of the ash pond embankment to an elevation of 403 feet. The limitation is supported by the structural stability analysis summarized through safety factors.

7.1.5 Liquefaction Potential

Documents provided to Dewberry did not include an evaluation of liquefaction potential.

7.1.6 Critical Geological Conditions

Slope stability summaries included in the permit report reference seismic forces of 0.046g, which match the 2008 USGS Seismic-Hazard Maps for Central/ Eastern United States, considering peak ground acceleration with a 10-percent probability of exceedance in 50-years, see Exhibit 6.

The permit report states the seismic stability of the ash pond is adequate.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Documents provided to Dewberry for review are adequate.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Overall, the structural stability of the dam appears to be satisfactory based on observations made during the site assessment visit by Dewberry and upon the review of the permit report provided. See Appendix A, Document 4: Missouri Department of Natural Resources Application for Registration Permit and Appendix C, Document 6: Dam Inspection Checklist Form.

- The embankment appears free of depressions. No signs of significant erosion damage, cracks, or release material could be observed or found documented.
- No indication could be found of major scarps, sloughs or bulging along the embankment of the ash pond.
- No significant boils, sinks or uncontrolled seepage was observed along the embankment slopes, near groins, and at the toe of the embankment.
- Safety factors generated from slope stability analyses meet minimum state criteria requirements.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

The ash pond operates as a final settling pond for fly ash by-product, process water and site drainage runoff.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Ameren Missouri developed and maintains both a dam safety program and an emergency procedures protocol. Guidelines and regulations for each can be found in the Dam Safety Program for Ameren Missouri Non-Hydroelectric Facilities, dated September 4, 2009 and the Emergency Plant Dam Failure/Loss of Integrity Procedures, dated December 5, 2002. The Ameren Missouri dam safety program includes but is not limited to:

- Duties and responsibilities of dam operating personnel,
- Details regarding dam safety training requirements for operating personnel,
- Weekly, annual and special inspection requirements specific to the Rush Island Power Station ash pond.

Weekly, annual, and special inspection reports were provided to EPA for this assessment.

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

Based on weekly, annual and special inspection documents provided by Ameren Missouri as well as the field inspection performed by Dewberry staff, there are no significant maintenance issues that jeopardize the integrity of the ash pond. Although maintenance procedures for both the ash pond and project facilities appear to be adequate, several maintenance recommendations have been included as part of the CCW Dam Inspection Checklist Form:

- Areas where erosion has occurred as a result of equipment traffic should be rehabilitated.
- Tree encroachment along the interior and exterior side of the ash pond embankment should be minimized. Periodic maintenance of vegetation and tree growth is necessary, including at the toe of embankment.
- Minor seepage in areas along the embankment should be closely monitored.
- Water surface elevations for the ash pond should be closely monitored and recorded to ensure conformance to slope stability and hydrologic/hydraulic analysis limitations.

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

As previously stated, weekly and annual inspections of the ash pond are periodically completed by Ameren Missouri operating personnel. Special inspections, as needed, are also part of surveillance procedures.

9.2 INSTRUMENTATION MONITORING

9.2.1 Instrumentation Plan

Discharge water, both entering and leaving the outfall structure, is monitored through a sampling system composed of sampling pumps, CO_2 valves, CO_2 injectors and a sample control house. Staff gages can be found at both the inlet and outlet end of the outfall structure for monitoring water surface elevations. See Appendix A Document 3: Rush Island Site Plans and Appendix B for site photographs.

No instrumentation used for monitoring slope stability was identified. There is no ongoing program to monitor the stability of the Rush Island ash pond embankment slopes.

9.2.2 Instrumentation Results

No summaries or mention of instrumentation results could be found in documents provided to Dewberry by Ameren Missouri.

No instrumentation results for slope stability monitoring could be found as there are no monitoring devices installed in the facility.

9.2.3 Dam Performance Data Evaluation

See section 9.2.2, above.

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

Data reviewed by Dewberry and field observations confirmed some sort of instrumentation monitoring is in effect to monitor ash pond discharge. However, insufficient information was available to adequately rate the effectiveness of an instrumentation monitoring program.

The Rush Island ash pond dike is not instrumented to monitor slope stability. Based on the size of the embankments, the history of satisfactory performance, and the current inspection program, installation of a dike monitoring system is not needed at this time.

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EXHIBITS

Exhibit 1: USGS Peak Streamflow, 07010000 Mississippi River at St. Louis, MO

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Peak Streamflow for the Nation

USGS 07010000 Mississippi River at St. Louis, MO

Available data for this site | Surface-water: Peak streamflow | GO

St Louis City, Missouri
Hydrologic Unit Code 07140101
Latitude 38°37'44.4", Longitude 90° 10'47.2" NAD83
Drainage area 697,000 square miles
Gage datum 379.94 feet above sea level NGVD29

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Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1844	Jun. 27, 1844	41.32	1,000,000[7]
1862	Apr. 26, 1862		712,000[1]
1863	Mar. 04, 1863		252,000[1]
1864	May 14, 1864		310,000[1]
1865	Jul. 28, 1865		513,000[1]
1866	Apr. 25, 1866		513,000[1]
1867	May 01, 1867		568,000[1]
1868	May 14, 1868		421,000[1]
1869	Jul. 24, 1869		615,000[1]
1870	Apr. 16, 1870		491,000[1]
1871	Mar. 17, 1871		348,000[1]
1872	Jun. 12, 1872		383,000[1]
1873	Apr. 11, 1873		462,000[1]
1874	Jun. 19, 1874		261,000[1]
1875	Aug. 03, 1875		637,000[1]
1876	May 10, 1876		741,000[1]
1877	Jun. 14, 1877		506,000[1]
1935	Jun. 07, 1935	33.52	649,000
1936	Mar. 01, 1936	21.18	336,000
1937	May 05, 1937	23.76	374,000
1938	May 27, 1938	26.57	434,000
1939	Apr. 20, 1939	30.13	529,000
1940	Jun. 14, 1940	13.37	188,000
1941	Apr. 22, 1941	26.15	451,000
1942	Jun. 30, 1942	34.48	666,000
1943	May 24, 1943	38.94	840,000
1944	Apr. 30, 1944	39.14	844,000
1945	Apr. 21, 1945	35.30	610,000
1946	Jan. 13, 1946	28.00	502,000
1947	Jul. 01, 1947	40.26	783,000
1948	Mar. 27, 1948	34.63	633,000
1949	Mar. 11, 1949	24.41	425,000
1950	May 14, 1950	27.02	466,000
1951	Jul. 21, 1951	40.28	782,000
1952	Apr. 29, 1952	33.83	684,000
1953	Apr. 04, 1953	22.57	369,000

1878	Jun. 15, 1878		477,000[1]
1879	Jul. 03, 1879		332,000[1]
1880	Jul. 12, 1880		466,000[1]
1881	May 05, 1881		822,000[1]
1882	Jul. 05, 1882		739,000[1]
1883	Jun. 25, 1883		863,000[1]
1884	Apr. 09, 1884		544,000[1]
1885	Jun. 17, 1885		504,000[1]
1886	May 13, 1886		500,000[1]
1887	Apr. 03, 1887		308,000[1]
1888	Jun. 04, 1888		599,000[1]
1889	Jun. 01, 1889		416,000[1]
1890	Jul. 01, 1890		308,000[1]
1891	Jul. 04, 1891		388,000[1]
1892	May 19, 1892		926,000[1]
1893	May 03, 1893		700,000[1]
1894	May 11, 1894		380,000[1]
1895	Jul. 08, 1895		229,000[1]
1896	May 26, 1896		507,000[1]
1897	May 02, 1897		645,000[1]
1898	May 23, 1898		487,000[1]
1899	Feb. 18, 1899		970,000[1]
1900	Mar. 16, 1900		366,000[1]
1901	Apr. 18, 1901	22.58	343,400
1902	Jul. 26, 1902	26.89	475,300
1903	Jun. 10, 1903	38.00	1,020,000
1904	Apr. 29, 1904	33.60	778,000
1905	Sep. 21, 1905	30.20	613,200
1906	Apr. 15, 1906	26.20	449,400
1907	Jul. 25, 1907	28.00	519,000
1908	Jun. 20, 1908	34.95	850,000
1909	Jul. 15, 1909	35.25	861,000
1910	Jan. 13, 1910	25.20	416,400
1911	Feb. 23, 1911	19.90	283,000
1912	Apr. 05, 1912	30.80	641,000
1913	Apr. 16, 1913	27.20	487,000
1914	Jun. 21, 1914	20.40	294,000
1954	Jun. 06, 1954	18.65	292,000
1955	Feb. 23, 1955	18.62	312,000
1956	Oct. 08, 1955	14.68	230,000
1957	May 27, 1957	22.91	342,000
1958	Jul. 24, 1958	29.40	504,000
1959	Jun. 04, 1959	23.35	366,000
1960	Apr. 10, 1960	33.78	670,000
1961	May 11, 1961	33.20	588,000
1962	Mar. 25, 1962	30.18	591,000
1963	Mar. 07, 1963	18.35	309,000
1964	Apr. 24, 1964	18.35[5]	309,000
1965	Sep. 28, 1965	30.44	552,000
1966	Apr. 25, 1966	23.00[5]	359,000[1]
1967	Jul. 01, 1967	30.49	530,000
1968	May 26, 1968	22.00	352,000
1969	Jul. 14, 1969	35.92	618,000
1970	Sep. 28, 1970	32.20[5]	540,000
1971	Mar. 02, 1971	23.40	421,000
1972	May 04, 1972	25.00	408,000
1973	Apr. 28, 1973	43.23	852,000
1974	May 24, 1974	33.00[5]	584,000
1975	Apr. 27, 1975	29.95	483,000
1976	Apr. 30, 1976	27.29	488,000
1977	Sep. 16, 1977	20.67	339,000
1978	Mar. 27, 1978	30.38	570,000
1979	Apr. 14, 1979	37.79	694,000
1980	Apr. 02, 1980	22.33	358,000
1981	May 21, 1981	30.00[5]	511,000
1982	Jun. 12, 1982	32.27	546,000
1983	Dec. 07, 1982	39.20[5]	739,000
1984	Apr. 24, 1984	34.02	579,000
1985	Feb. 28, 1985	34.40	690,000
1986	Nov. 22, 1985	33.09	589,000
1987	Oct. 09, 1986	39.13	728,000
1988	Dec. 29, 1987	22.38	344,000
1989	Sep. 13, 1989	19.87	327,000
1990	May 18, 1990	33.18	605,000
1991	May 08, 1991	27.40	439,000
1992	Apr. 24, 1992	26.17	421,000

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1915	Jun. 24, 1915	31.60	678,200
1916	Jan. 31, 1916	31.40	676,100
1917	Jun. 14, 1917	32.90	743,400
1918	Jun. 12, 1918	20.80	324,100
1919	May 11, 1919	26.90	515,000
1920	Apr. 24, 1920	28.00	554,000
1921	May 14, 1921	23.00	397,000
1922	Apr. 20, 1922	33.95	786,000
1923	Jun. 17, 1923	20.70	341,200
1924	Jul. 02, 1924	26.30	495,000
1925	Jun. 25, 1925	19.90	326,000
1926	Sep. 29, 1926	24.50	438,000
1927	Apr. 26, 1927	36.10	889,300
1928	Jun. 22, 1928	27.60	552,000
1929	Apr. 25, 1929	34.60	739,000
1930	Jun. 21, 1930	19.60	310,000
1931	Jun. 15, 1931	13.30	200,000
1932	Dec. 01, 1931	22.11	356,000
1933	May 17, 1933	27.00	434,000
1934	Apr. 24, 1934	9.00	136,000
1993	Aug. 01, 1993	49.58	1,070,000
1994	Oct. 01, 1993	38.91	693,000
1995	May 22, 1995	41.89	800,000
1996	Jun. 02, 1996	35.35	615,000
1997	Mar. 01, 1997	32.25	544,000
1998	Apr. 17, 1998	33.36	547,000
1999	May 08, 1999	32.62	551,000
2000	Jun. 29, 2000	25.43	386,000
2001	Jun. 10, 2001	34.79	612,000
2002	May 17, 2002	37.34	682,000
2003	May 12, 2003	25.00	400,000
2004	May 29, 2004	28.19	463,000
2005	Jan. 07, 2005	28.80	479,000
2006	May 05, 2006	19.02	303,000
2007	May 11, 2007	29.30	490,000
2008	Jun. 30, 2008	38.67	720,000
2009	May 20, 2009	33.24	574,000

Peak Gage-Height Qualification Codes.

- 5 -- Gage height is an estimate

Peak Streamflow Qualification Codes.

- 1 -- Discharge is a Maximum Daily Average
- 7 -- Discharge is an Historic Peak

Exhibit 2: USGS Peak Streamflow, 07020500 Mississippi River at Chester, IL

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USGS 07020500 Mississippi River at Chester, IL

Available data for this site | Surface-water: Peak streamflow | GO

Randolph County, Illinois
Hydrologic Unit Code 07140105
Latitude 37°54'13.5", Longitude 89° 50'08.0" NAD83
Drainage area 708,600 square miles
Gage datum 341.05 feet above sea level NGVD29

Output formats

- Table
- Graph
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- peakfq (watstore) format
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Water Year	Date	Gage Height (feet)	Stream-flow (cfs)	Water Year	Date	Gage Height (feet)	Stream-flow (cfs)
1844	Jun. 30, 1844	39.8	1,050,000[1,6,7]	1967	Jul. 01, 1967	30.33	530,000[6]
1926	Sep. 30, 1926	23.80	501,000[1,6]	1968	May 27, 1968	23.07	383,000[6]
1927	Apr. 27, 1927	34.40	1,060,000[1,6]	1969	Jul. 15, 1969	35.73	644,000[6]
1928	Jun. 23, 1928	28.00	626,000[1,6]	1970	May 19, 1970	30.89	544,000[6]
1929	Apr. 29, 1929	33.30	878,000[1,6]	1971	Mar. 03, 1971	24.55[2]	421,000[6]
1930	Jun. 21, 1930	19.70	342,000[1,6]	1972	May 05, 1972	25.87	416,000[6]
1931	Jun. 16, 1931	14.40	221,000[1,6]	1973	Apr. 30, 1973	43.32	886,000[6]
1932	Dec. 01, 1931	23.30	451,000[1,6]	1974	May 26, 1974	[2]	537,000[6]
1933	May 18, 1933	28.90	500,000[1,6]	1975	Apr. 28, 1975	31.39	544,000[6]
1934	Apr. 25, 1934	10.20	137,000[1,6]	1976	May 01, 1976	28.10	453,000[6]
1935	Jun. 10, 1935	33.40	335,000[1,6]	1977	Sep. 17, 1977	21.99	339,000[6]
1936	Mar. 01, 1936	20.80	326,000[1,6]	1978	Mar. 29, 1978	32.86	632,000[6]
1937	May 06, 1937	24.60	422,000[1,6]	1979	Apr. 16, 1979	39.79	760,000[6]
1938	May 28, 1938	27.10	540,000[1,6]	1980	Apr. 03, 1980	24.14	364,000[6]
1939	Apr. 21, 1939	30.60	618,000[1,6]	1981	May 22, 1981	31.24	524,000[6]
1940	Apr. 21, 1940	13.60	193,000[1,6]	1982	Jun. 13, 1982	32.24	550,000[6]
1941	Apr. 24, 1941	26.90	455,000[1,6]	1983	Dec. 09, 1982	41.02	825,000[6]
1942	Jul. 01, 1942	34.00	603,000[6]	1984	Apr. 25, 1984	34.97	605,000[6]

1943	May 24, 1943	38.08	873,000[6]	1985	Feb. 28, 1985	36.60	749,000[6]
1944	May 02, 1944	37.40	842,000[6]	1986	Nov. 23, 1985	35.14	620,000[6]
1945	Apr. 02, 1945	33.00	716,000[6]	1987	Oct. 10, 1986	39.54	754,000[6]
1946	Jan. 13, 1946	27.50	502,000[6]	1988	Dec. 29, 1987	25.57	426,000[6]
1947	Jul. 03, 1947	38.00	886,000[6]	1989	Sep. 14, 1989	21.57	330,000[6]
1948	Mar. 28, 1948	32.80	668,000[6]	1990	May 20, 1990	35.53	661,000[6]
1949	Apr. 03, 1949	24.70	426,000[6]	1991	May 09, 1991	27.78	448,000[6]
1950	May 15, 1950	27.60	476,000[6]	1992	Apr. 24, 1992	27.11	434,000[6]
1951	Jul. 22, 1951	39.10	795,000[6]	1993	Aug. 07, 1993	49.74	1,000,000[6]
1952	Apr. 30, 1952	34.10	685,000[6]	1994	Oct. 01, 1993	41.41	756,000[6]
1953	Apr. 05, 1953	22.20	378,000[6]	1995	May 22, 1995		876,000[6]
1954	Jun. 07, 1954	18.80	289,000[6]	1996	Jun. 03, 1996	36.08	626,000[6]
1955	Feb. 23, 1955	19.50	332,000[6]	1997	Mar. 02, 1997	34.31	580,000[6]
1956	Oct. 09, 1955	14.90	221,000[6]	1998	Apr. 18, 1998	35.09	574,000[6]
1957	May 28, 1957	25.60	426,000[6]	1999	May 09, 1999	34.04	552,000[6]
1958	Jul. 25, 1958	29.30	510,000[6]	2000	Jun. 30, 2000	27.74	425,000[6]
1959	Jun. 04, 1959	23.10	361,000[6]	2001	Jun. 11, 2001	35.31	591,000[6]
1960	Apr. 11, 1960	33.70	680,000[6]	2002	May 17, 2002	40.95	738,000[6]
1961	May 12, 1961	34.30	691,000[6]	2003	May 13, 2003	27.11	427,000[6]
1962	Mar. 26, 1962	30.60	625,000[6]	2004	May 30, 2004	29.35	457,000[6]
1963	Mar. 08, 1963	19.00	308,000[6]	2005	Jan. 07, 2005	30.76	496,000[6]
1964	Apr. 24, 1964	20.04	304,000[6]	2006	May 06, 2006	20.72	308,000[6]
1965	Sep. 29, 1965	29.79	544,000[6]	2007	May 13, 2007	30.28	486,000[6]
1966	Oct. 01, 1965	28.61	498,000[6]	2008	Jul. 01, 2008	39.44	696,000[6]
				2009	May 21, 2009	34.86	585,000

? Peak Gage-Height Qualification Codes.

- 2 -- Gage height not the maximum for the year

? Peak Streamflow Qualification Codes.

- 1 -- Discharge is a Maximum Daily Average
- 6 -- Discharge affected by Regulation or Diversion
- 7 -- Discharge is an Historic Peak

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Exhibit 3: FEMA Jefferson County FIS Study, Table 1-Summary of Discharges

Table 1 – Summary of Discharges (*continued*)

Flooding Source and Location	Drainage Area (square miles)	Peak Discharges (cubic feet per second) 10-Percent-Annual-Chance	2-Percent-Annual-Chance	1-Percent-Annual-Chance	0.2-Percent-Annual-Chance
KNEFF ROAD TRIBUTARY					
At confluence with Glaize Creek	3.79	*	*	4,200	*
At Kneff Farm Crossing	2.84	*	*	3,550	*
At Old Lemay Ferry Road	2.41	*	*	3,350	*
At confluence of unnamed tributary 0.5 mile upstream of Old Lemay Ferry Road	1.60	*	*	2,650	*
At Dry Fork Road	1.40	*	*	2,500	*
MERAMEC RIVER					
At confluence with Mississippi River	3,081.00	76,100	120,000	139,000	197,000
At confluence of Big River	2,816.00	61,000	109,000	133,000	197,000
MISSISSIPPI RIVER					
At confluence of Joachim Creek	705,600.00	735,000	980,000	1,085,000	1,380,000
At confluence of Rock Creek	705,500.00	735,000	980,000	1,085,000	1,380,000
At River Mile 160.7	701,000.00	690,000	925,000	1,020,000	1,250,000

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Exhibit 4: FEMA Jefferson County FIRM, Map Number 29099C0500E

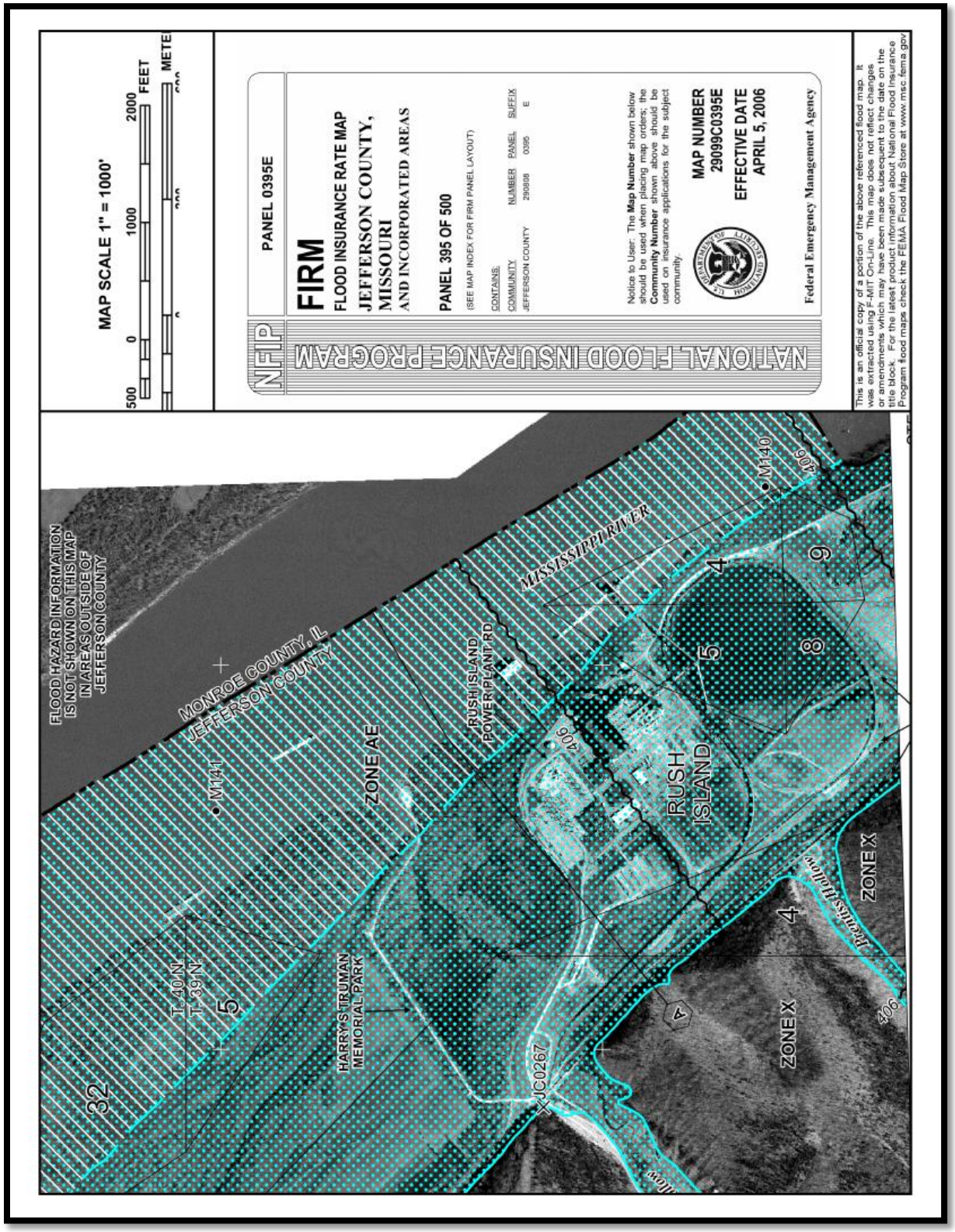

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Exhibit 5: FEMA Jefferson County FIRM, Map Number 29099C0500E

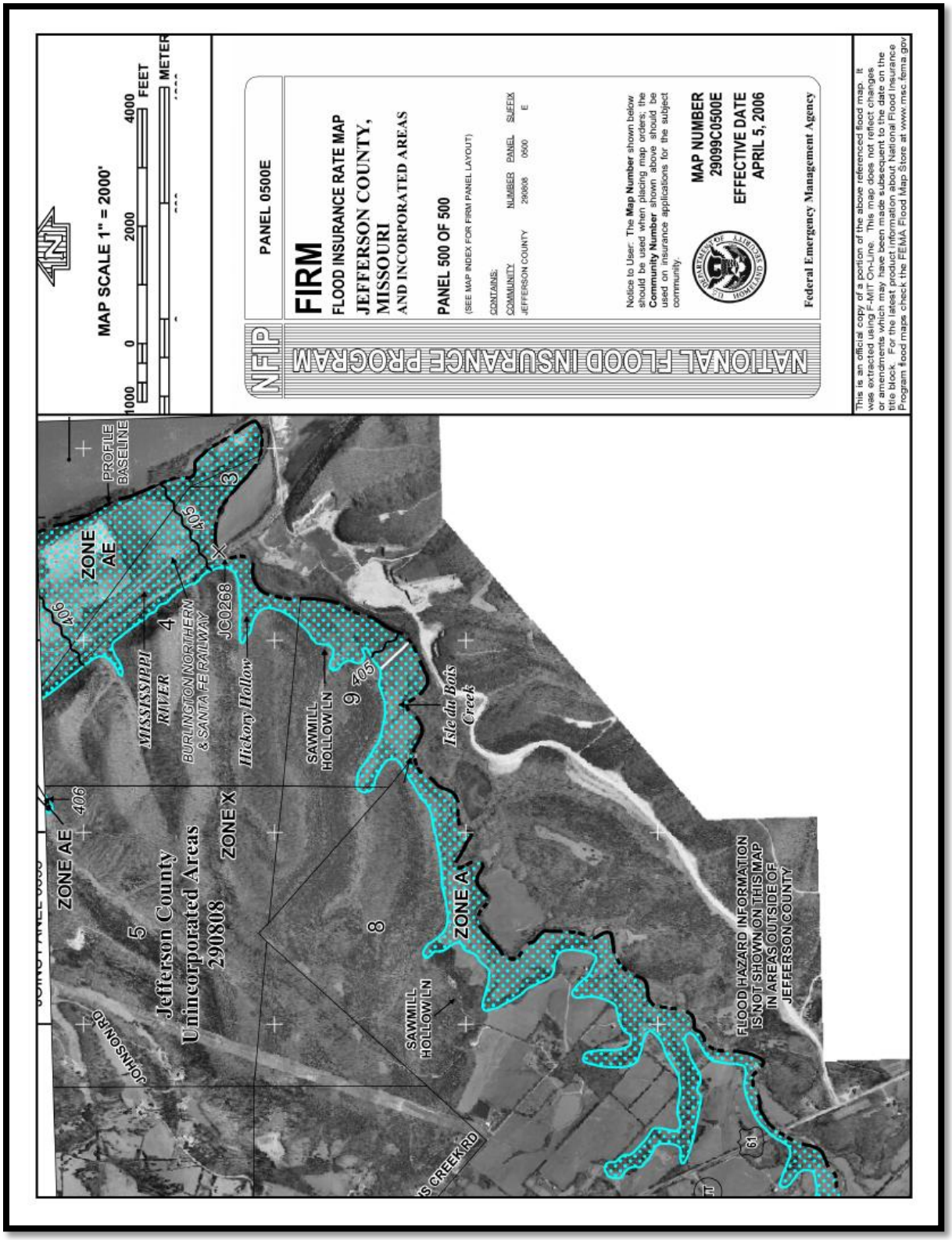
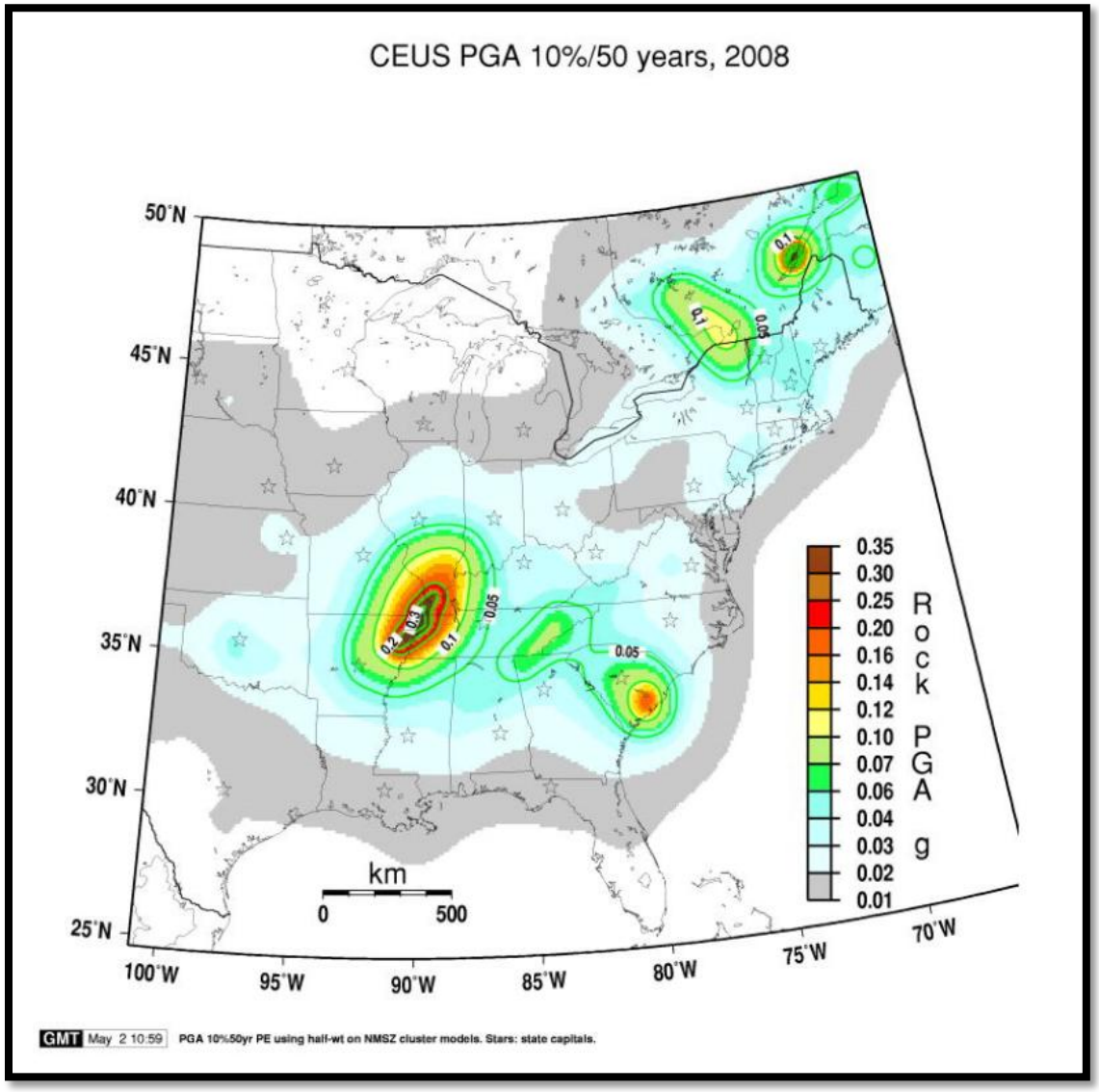
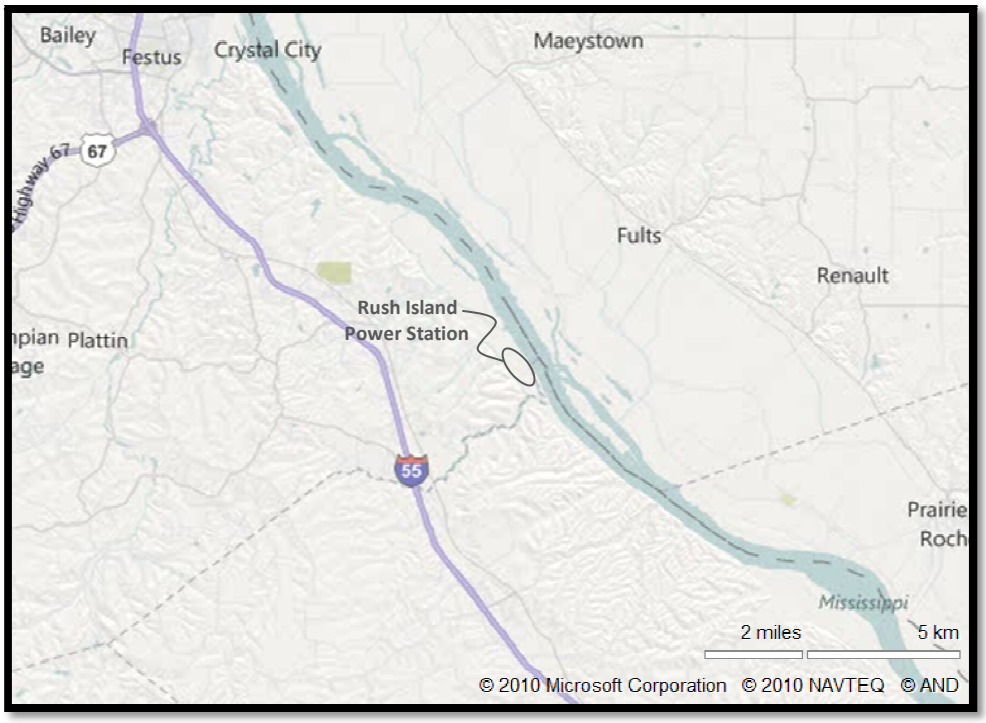


Exhibit 6: USGS Seismic-Hazard Map for Central/Eastern US, 10%/50 Years, 2008



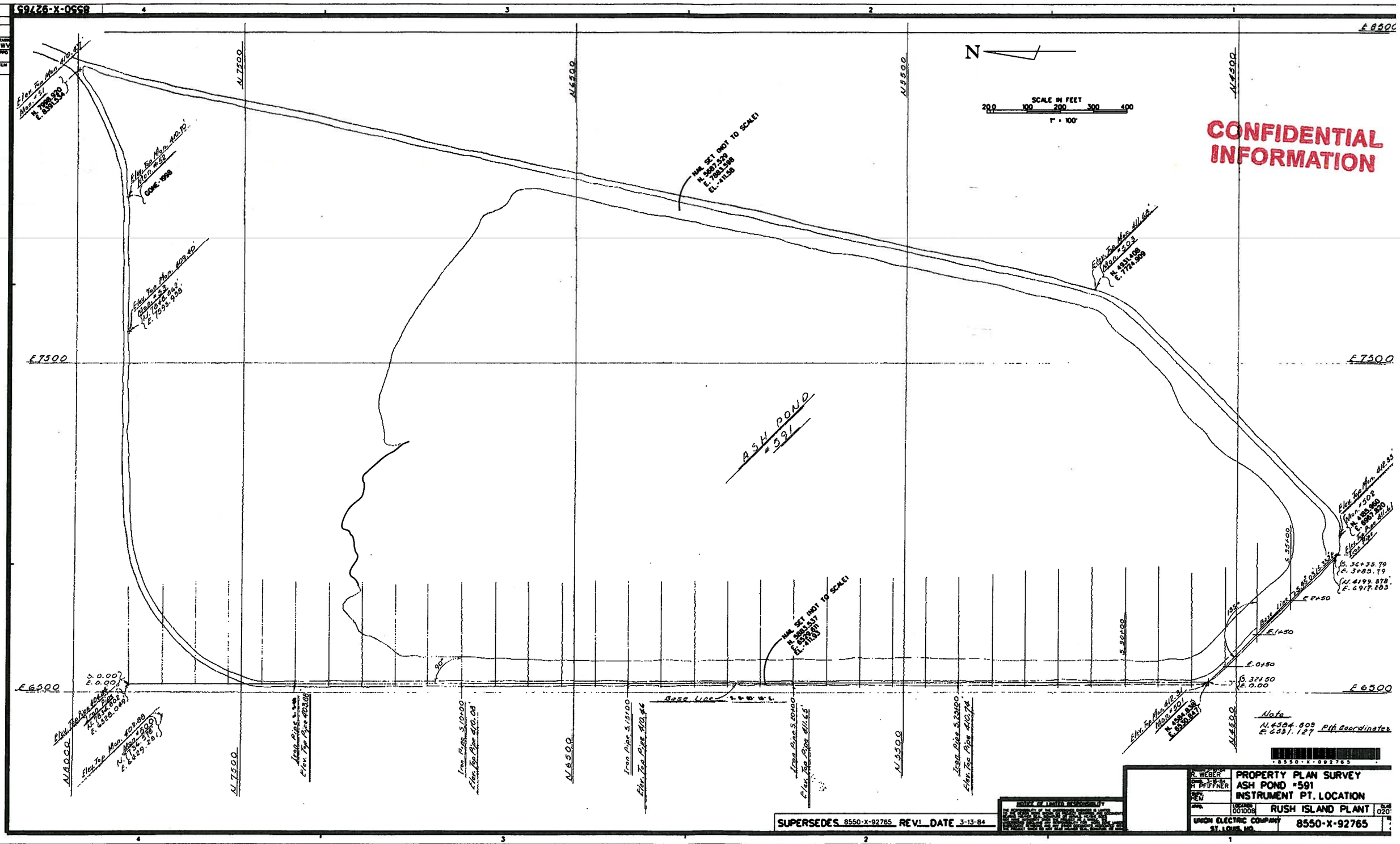
APPENDIX A

Document 1: Site Map



Document 2: Aerial Photograph

Document 3: Rush Island Power Station Site Plans



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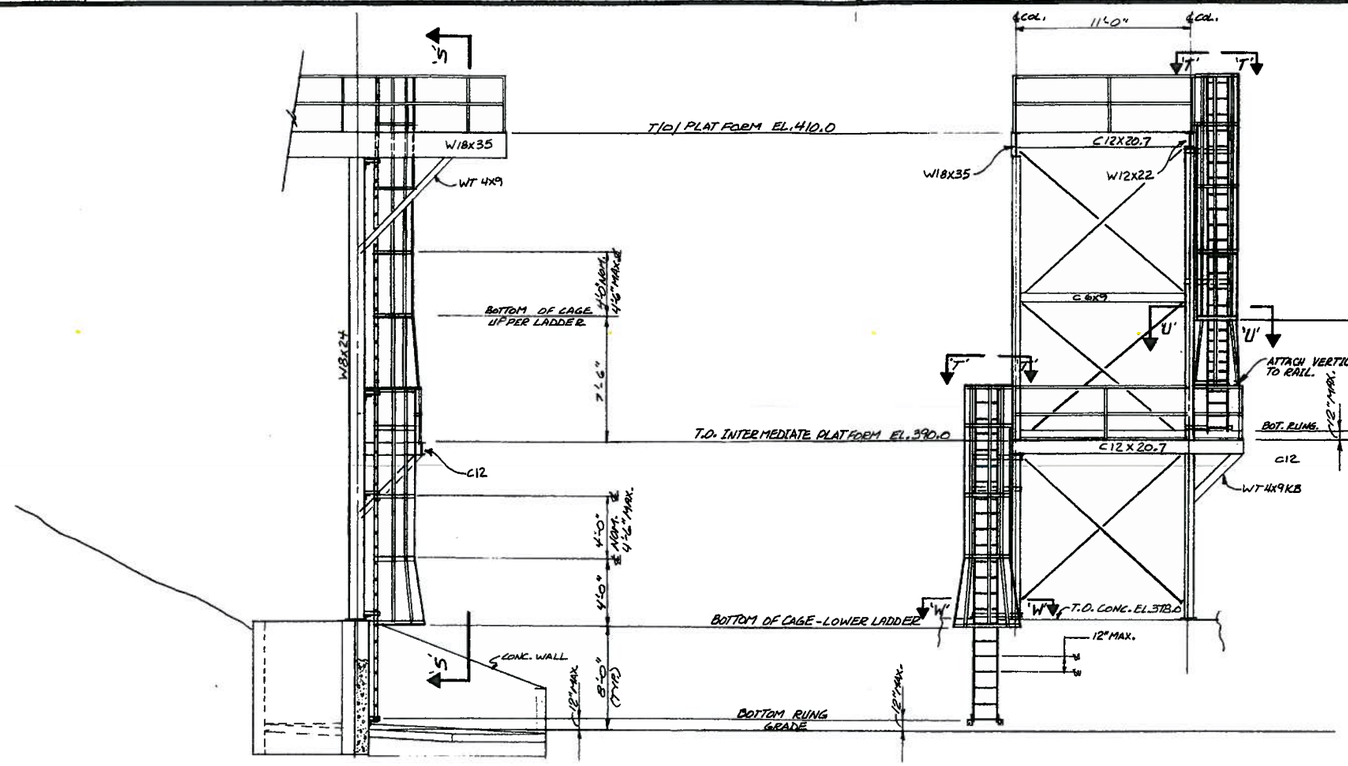
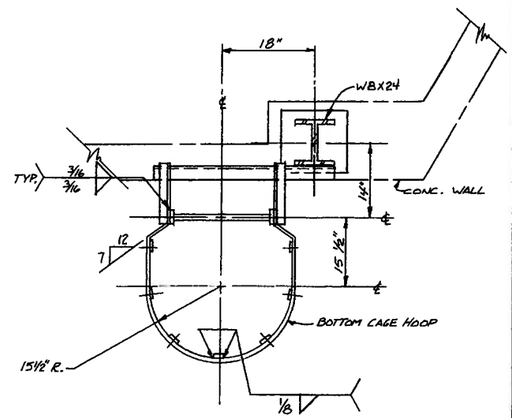


ELEVATION '5-S'

NO SCALE

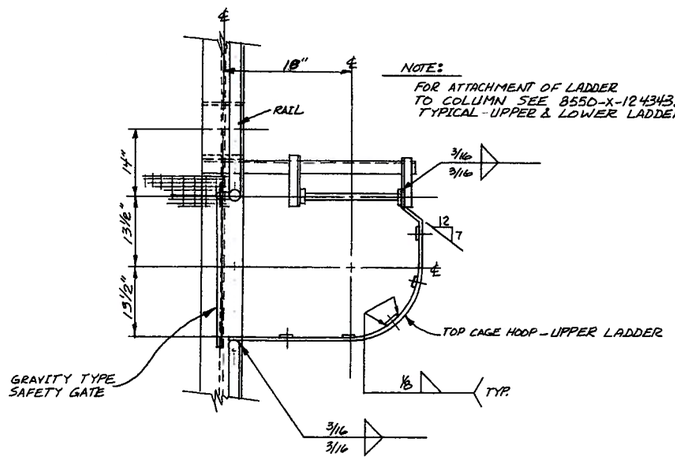


SECTION 'W-W'

AT LOWER LADDER NO SCALE

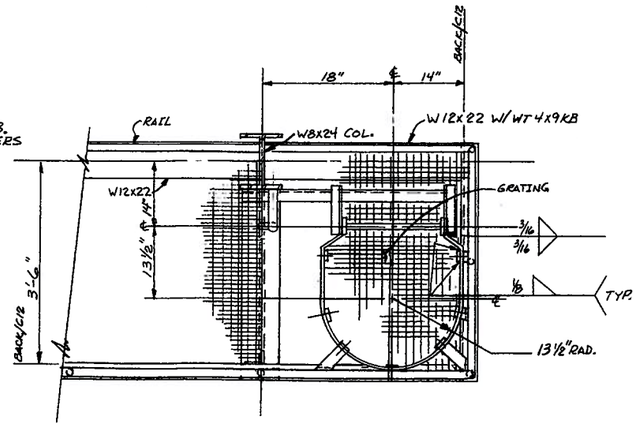
ELEVATION AT LADDERS

NO SCALE



SECTION 'T-T'

AT UPPER LADDER-SHOWN
AT LOWER LADDER-OPPOSITE HAND
NO SCALE.



SECTION 'U-U'

AT UPPER LADDER. NO SCALE

NOTES:

1. ALL WORK TO BE DONE IN ACCORDANCE WITH UNION ELECTRIC SPECIFICATION EC-2438.

REFERENCE DRAWING:

STRUCTURE ASSEMBLY AND DETAILS ------ 8550-X-124343

CONFIDENTIAL INFORMATION

NOTICE OF LIMITED RESPONSIBILITY

THE RESPONSIBILITY OF THE UNDERSIGNED ENGINEER IS LIMITED TO THE DESIGN SHOWN ON PROJECT DRAWINGS AND DOCUMENTS BEARING ENGINEER SEAL, SIGNATURE OR INITIALS. NO DESIGN FOR ANY ITEMS NOT SHOWN ON THE PROJECT P.E.& S. SEALED, SIGNED OR INITIALED DRAWINGS AND DOCUMENTS IS INTENDED OR REPRESENTED. ENGINEER AND HIS OR HER FIRM DO NOT WARRANT OR GUARANTEE UNDER ANY CIRCUMSTANCES THAT ITEMS NOT SHOWN ON THE P.E.& S. SEALED DRAWINGS WITH THE PROJECT WHICH DO NOT BEAR ENGINEER SEAL, SIGNATURE OR INITIALS.

STATE OF MISSOURI RANDALL C. KINDER NUMBER E-20178

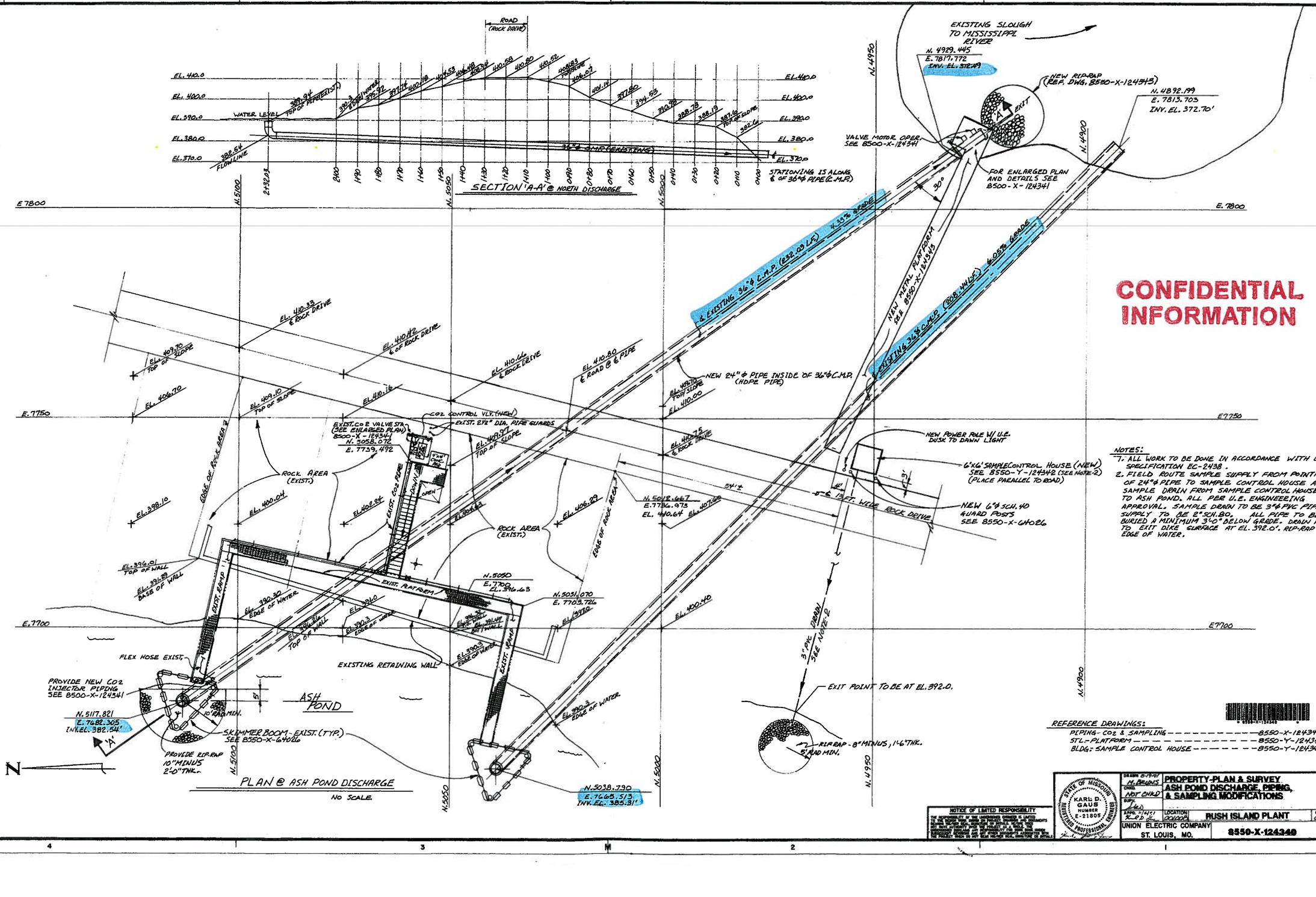
DRAWN 9-25-91 MSB	STRUCTURE-STEEL FRAMING & DETS. LADDER DETAILS ASH POND DISCHARGE 1991 MODS.		
CHKD. NOT CHKD.			
SUPV. [illegible]			
APPD. 11-4-91 R. KINDER	LOCATION 001008	RUSH ISLAND PLANT	CLASS 04060
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8550-Y-124127		REV. 0

37-2118 Rev 473

8550-X-124340

REVISIONS

REV	DESCRIPTION	DATE
0	FIRST ISSUE	



PLAN @ ASH POND DISCHARGE

NO SCALE.

NOTES:

1. ALL WORK TO BE DONE IN ACCORDANCE WITH U.E. SPECIFICATION EC-2438.
2. FIELD ROUTE SAMPLE SUPPLY FROM POINT AT EXIT OF 24"ϕ PIPE TO SAMPLE CONTROL HOUSE AND SAMPLE DRAIN FROM SAMPLE CONTROL HOUSE TO ASH POND. ALL PER U.E. ENGINEERING APPROVAL. SAMPLE DRAIN TO BE 3"ϕ PVC PIPE & SUPPLY TO BE 2" SCH. 80. ALL PIPE TO BE BURIED A MINIMUM 3'-0" BELOW GRADE. DRAIN PIPE TO EXIT DIKE SURFACE AT EL. 392.0'. RIP-RAP TO EDGE OF WATER.

REFERENCE DRAWINGS:

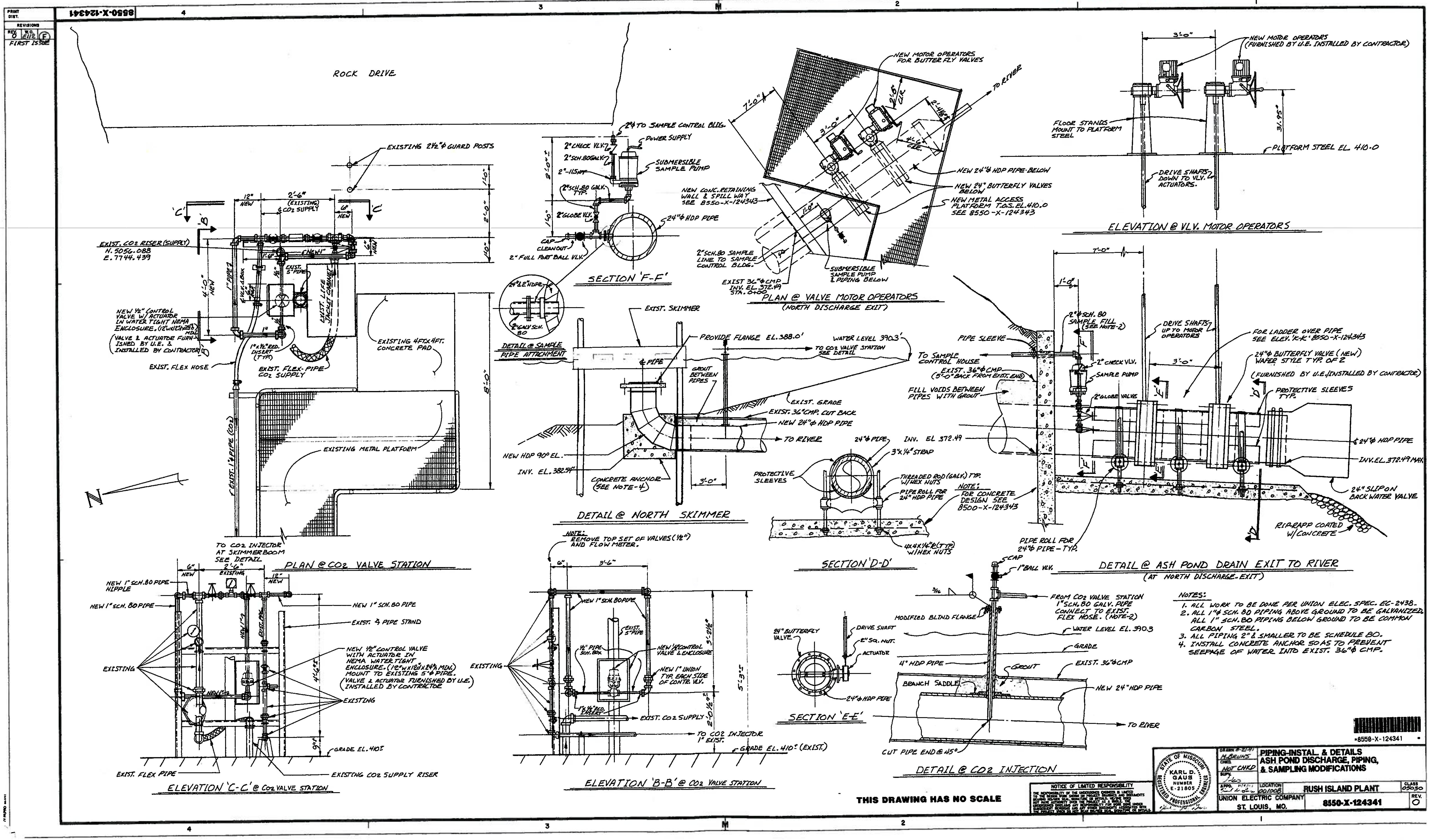
PIPING - CO2 & SAMPLING ---------- 8550-X-124341
STL. - PLATFORM ---------- 8550-Y-124343
BLDG: SAMPLE CONTROL HOUSE ---------- 8550-Y-124342

NOTICE OF LIMITED RESPONSIBILITY

STATE OF MISSOURI KARL D. GAUS NUMBER E-21805 REGISTERED PROFESSIONAL ENGINEER

DRAWN 5-19-97 M. BRUNS	PROPERTY-PLAN & SURVEY ASH POND DISCHARGE, PIPING, & SAMPLING MODIFICATIONS	
CHKD NOT CHKD		
APPD. 5-21-97	LOCATION 124005 RUSH ISLAND PLANT	CLASS 0230
APPD. 5-21-97	UNION ELECTRIC COMPANY ST. LOUIS, MO.	8550-X-124340 REV. 0

CONFIDENTIAL INFORMATION



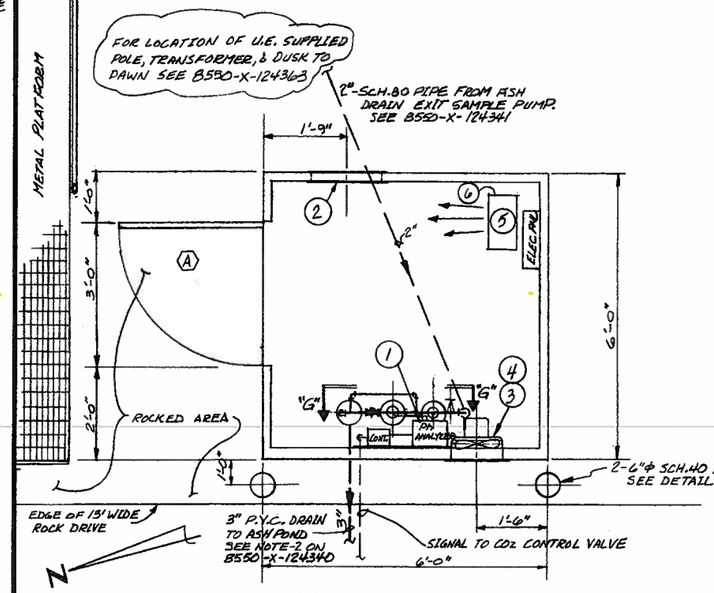
PRINT DIST.

REVISIONS

REV	W.P.	E.W.
8	E112	F

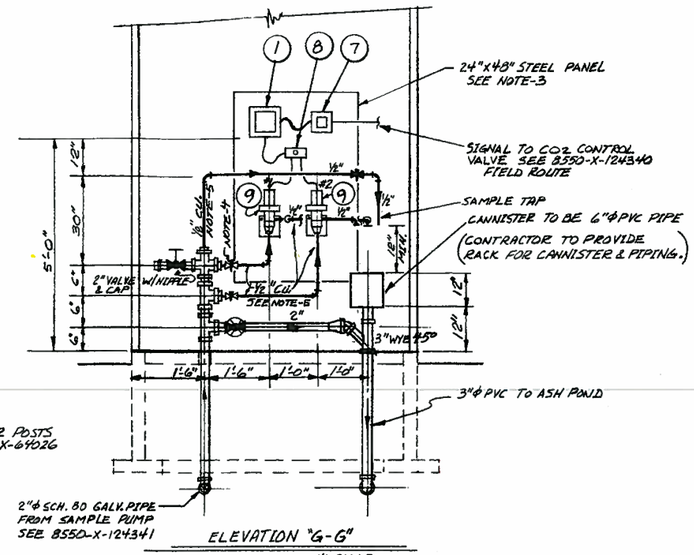
FIRST ISSUE

8550-Y-124342



PLAN @ SAMPLE CONTROL HOUSE

SEE 8550-X-124340 NO SCALE



ELEVATION "G-G"

NO SCALE

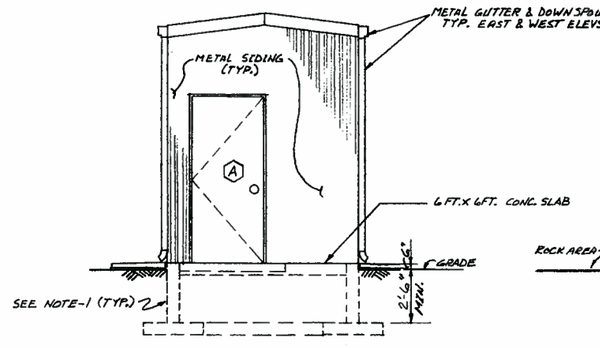
EQUIPMENT BILL OF MATERIALS

ITEM NO.	ITEM QTY.	DESCRIPTION	REMARKS
1	1	#pH400-P-U-1*A/U MICROPROCESSOR pH ANALYZER YOKOGAWA	MOUNT ON STL. PANEL SEE NOTE-3 BY U.E. CO.
2	1	INLET LOUVER - RUSKIN MODEL ELC 6375D COMBINATION LOUVER, 18"X18", EXTRUDED ALUMINUM, DRAINABLE BLADE, 6" DEPTH, MILL FINISH, FLANGED FRAME, INSECT SCREEN, WITH BARBER-COLEMAN MODEL MA-418-500 W/AUX. END SWITCH.	
3	1	EXHAUST FAN - NEW YORK BLOWER MODEL E82-H W/ MOTOR SIDE FAN GUARD, AUTOMATIC SHUTTER, 115V, 1ϕ MOTOR.	
4	1	THERMOSTAT (EXHAUST FAN) BARBER-COLEMAN #TC-4111. MOUNT SENSING BULB ON EXHAUST FAN GUARD.	
5	1	UNIT HEATER - MARLEY "Q-MARK" MODEL MUH-03-81. 3.0 KW, 208V, 1ϕ, WITH WALL & CEILING MOUNTING BRACKET #MMB-5, WITH POWER DISCONNECT SWITCH MPDS-25.	
6	1	THERMOSTAT (UNIT HEATER) MARLEY "Q-MARK" MODEL WR-1E30-5.	MOUNT ON WALL 3'-6" AFF.
7	1	#UT35-A13301*A/SPD CONTROLLER YOKOGAWA	MOUNT ON STL. PNL SEE NOTE-3 BY U.E. CO.
8	1	SWITCH BOX	MOUNT ON STL. PNL. SEE NOTE-3 BY U.E. CO.
9	2	FLOW-THROUGH SENSOR ASSEMBLY #FF20-S33-FNU-C2-SA-T YOKOGAWA	MOUNT ON STL. PNL SEE NOTE-3 BY U.E. CO.

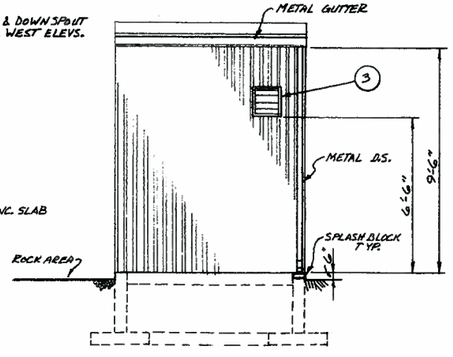
DOOR SCHEDULE

DOOR NO.	DOOR SIZE	DESCRIPTION
A	1-3°x7°x1¾"	HOLLOW METAL FLUSH TYPE DOOR (INSULATED) W/ PRESSED METAL FRAME (5¼" STD.), 1½ PAIR FULL MORTISED 2 B.B HINGE - 4½"x4½" x 0.134 GA. HOSPITAL TYPE. PROVIDE "LCN" 4040 DOOR CLOSER, LOCKSET 86B, BEST CYLINDER & CONSTRUCTION CORE. PROVIDE FLOOR MOUNTED STOP W/ HOLD OPEN IVES 449. DOOR TO BE FULLY WEATHERSTRIPPED, HAVE ALUMINUM THRESHOLD (NATIONAL GUARD #525) & DOOR BOTTOM SEAL (NATIONAL GUARD #19). ALL HARDWARE US26D FINISH.

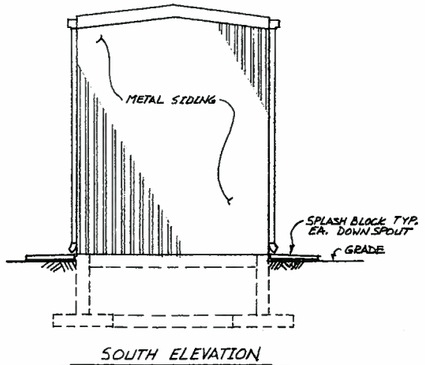
NOTES:
1). ALL HARDWARE TO BE US26D FINISH.
2). LOCKSETS TO RECIEVE "BEST" CYLINDERS. PERMANENT CORES TO BE PROVIDED BY UNION ELECTRIC CO.
3). CONSTRUCTION CORES TO BE PROVIDED BY CONTRACTOR.



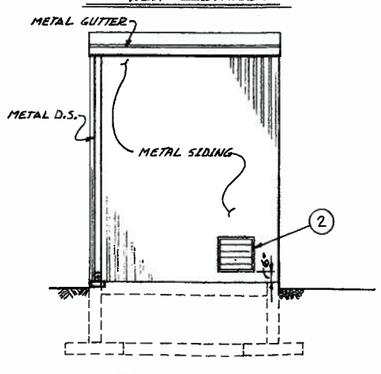
NORTH ELEVATION



WEST ELEVATION



SOUTH ELEVATION



EAST ELEVATION

NOTES:
1). CONCRETE TO BE DESIGNED BY BUILDING MANUFACTURER.
2). CONCRETE TO HAVE MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI AFTER 28 DAYS.
3). 24"x48" STEEL PNL. & ITEMS 1, 7, & 9 FURNISHED BY U.E. CO. & INSTALLED BY CONTRACTOR. PIPING & ELECTRICAL CONNS. BY CONTRACTOR.
4). VALVES FOR ½" COPPER TUBING TO SENSORS TO BE WHITEY NEEDLE VALVES, BRONZE BODY, TYPICAL.
5). COPPER TUBING CONNECTIONS TO BE MADE WITH SWAGLOK FITTINGS.
6). ALL WORK TO BE DONE PER UNION ELECTRIC SPECIFICATION #2438.

CONFIDENTIAL INFORMATION

8550-Y-124342

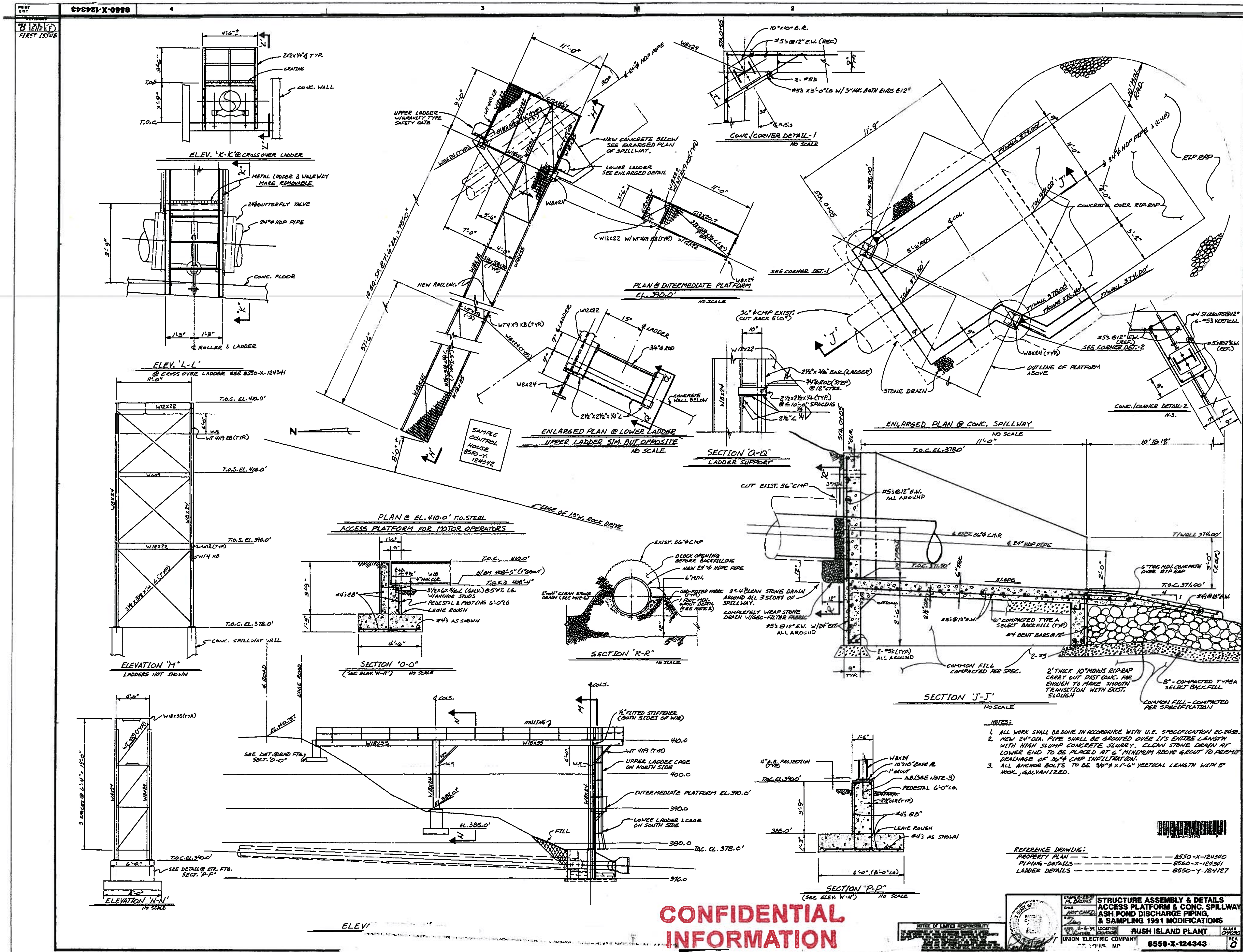
REFERENCE DRAWINGS:

PROPERTY - PLAN	8550-X-124340
PIPING DETAILS	8550-X-124341
BUILDING SERVICES	8550-X-124363

STATE OF MISSOURI KARL D. GAUS NUMBER E-21805 REGISTERED PROFESSIONAL ENGINEER

DRAWN 3-21-91 M. BRUNS	BUILDING-ARCHITECTURAL PLAN SAMPLE CONTROL BUILDING ASH POND DISCHARGE PIPING, SAMPLING 1991 MODIFICATIONS	
CHKD. NOT CHKD.		
SUPV.		
APPD. 4/6/91	LOCATION 00008 RUSH ISLAND PLANT	CLASS 03022
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8550-Y-124342	REV. 0

37-13-118 Rev. 4-73



NOTES:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH U.E. SPECIFICATION EC-2438.
2. NEW 24" DIA. PIPE SHALL BE GROUTED OVER ITS ENTIRE LENGTH WITH HIGH SLUMP CONCRETE SLURRY. CLEAN STONE DRAIN AT LOWER END TO BE PLACED AT 6" MINIMUM ABOVE GROUT TO PERMIT DRAINAGE OF 36"φ CMP INFILTRATION.
3. ALL ANCHOR BOLTS TO BE 3/4"φ x 1'-6" VERTICAL LENGTH WITH 3" HOOK, GALVANIZED.

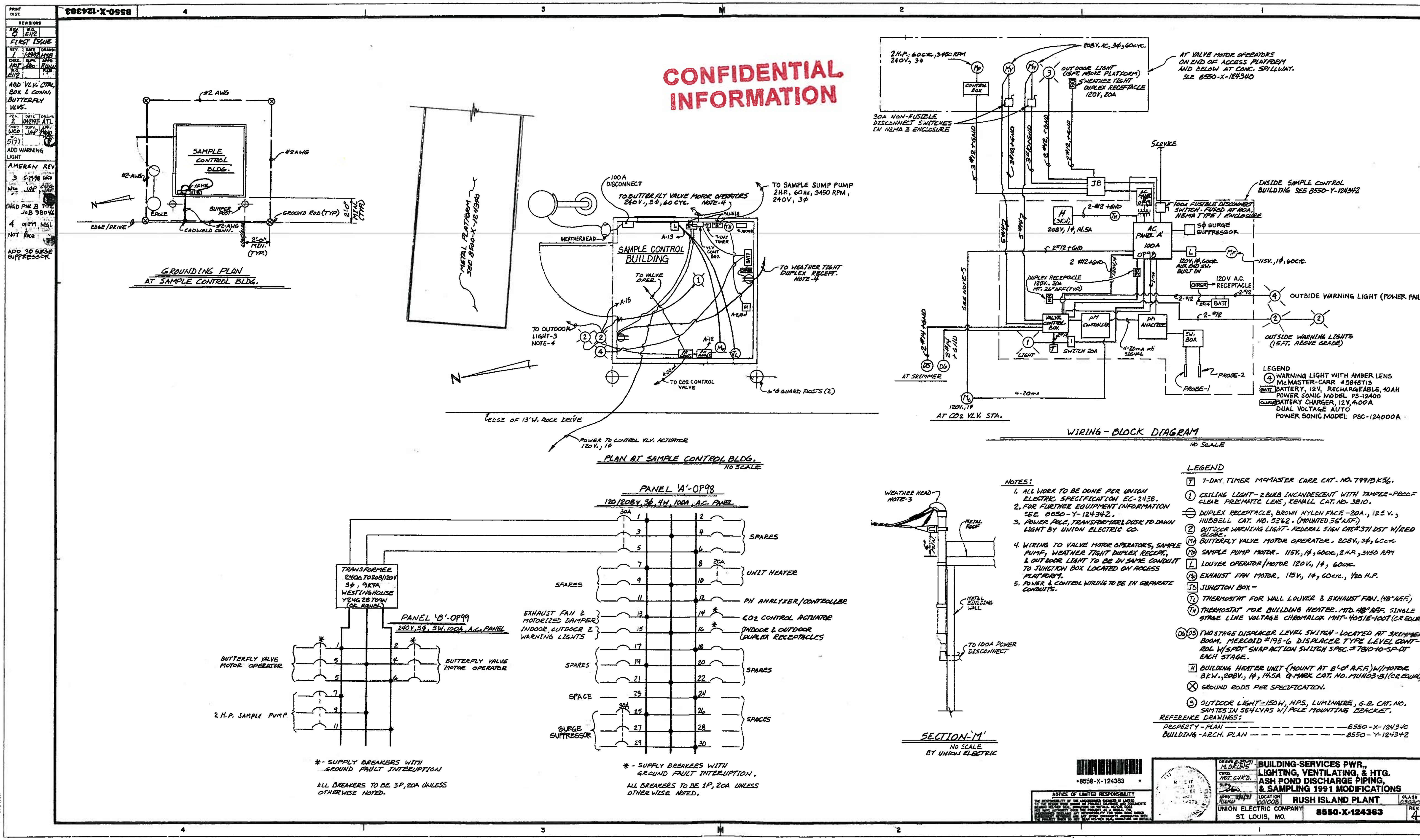
REFERENCE DRAWING:

PROPERTY PLAN	8550-X-124340
PIPING-DETAILS	8550-X-124341
LADDER DETAILS	8550-Y-124127

DRAWN 6-28-91 M. BRUNS	STRUCTURE ASSEMBLY & DETAILS ACCESS PLATFORM & CONC. SPILLWAY ASH POND DISCHARGE PIPING, & SAMPLING 1991 MODIFICATIONS	
CHKD. NOT CHKD.		
SUPV.		
APPD. 11-4-91	LOCATION / RUSH ISLAND PLANT	CLASS 04030
UNION ELECTRIC COMPANY ST. LOUIS, MO	8550-X-124343	REV. 0

NOTICE OF LIMITED RESPONSIBILITY

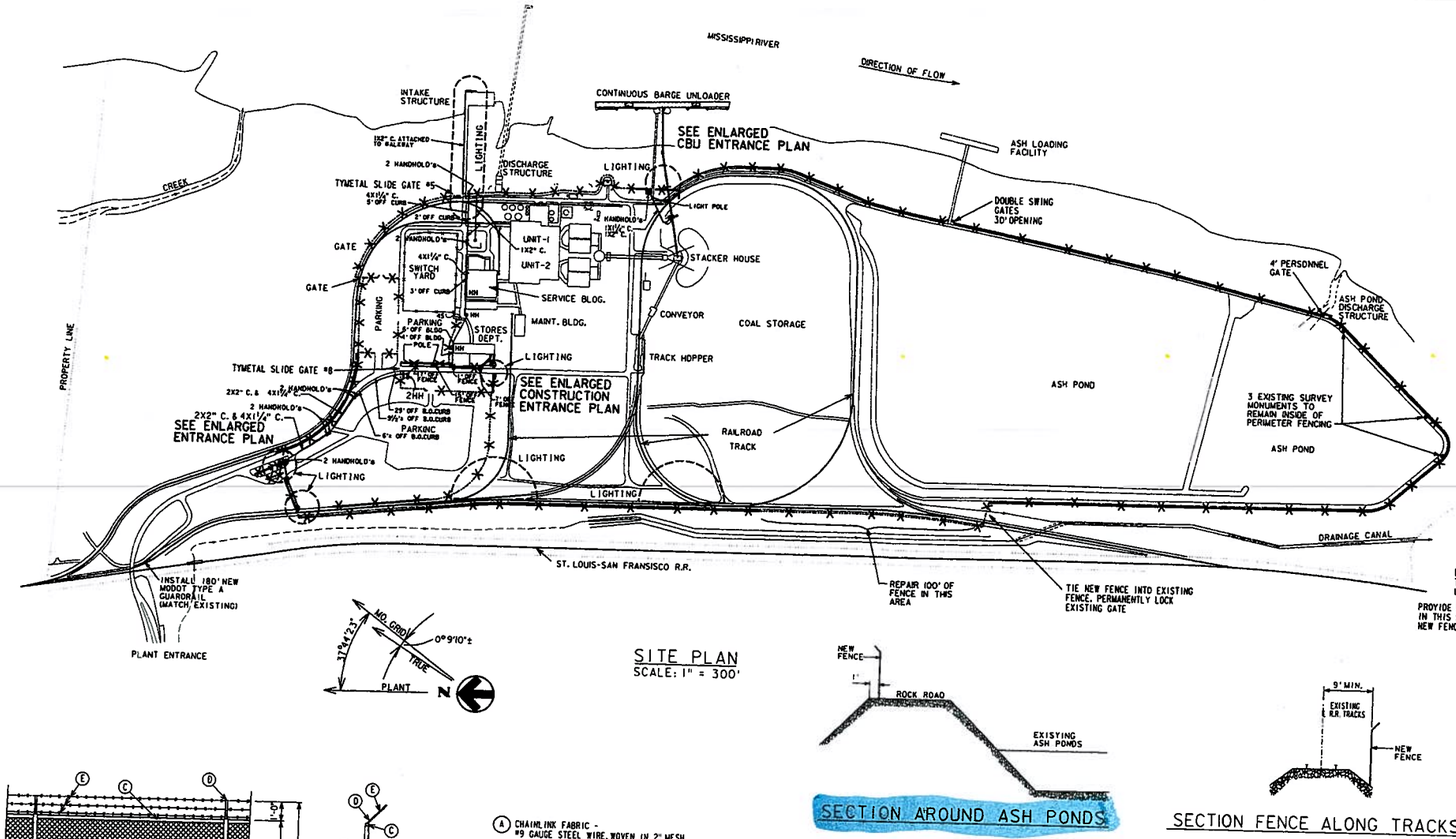
CONFIDENTIAL INFORMATION



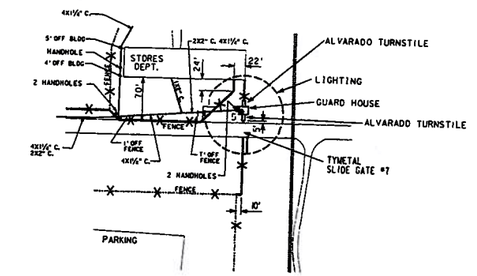
8550-X-124363
CONFIDENTIAL INFORMATION
GROUNDING PLAN
AT SAMPLE CONTROL BLDG.
SAMPLE CONTROL BLDG.
#2 AWG
GROUND ROD (TYP)
EDGE/DRIVE
CADWELD CONN.
BUMPER POST
METAL PLATFORM SEE 8550-X-124340
100A DISCONNECT
TO BUTTERFLY VALVE MOTOR OPERATORS 240V., 3φ, 60 CYC. NOTE-4
TO SAMPLE SUMP PUMP 2HP., 60Hz, 3450 RPM, 240V, 3φ
WEATHERHEAD
SAMPLE CONTROL BUILDING
TO WEATHER TIGHT DUPLEX RECEPT. NOTE-4
TO OUTDOOR LIGHT-3 NOTE-4
TO CO2 CONTROL VALVE
6" φ GUARD POSTS (2)
EDGE OF 13' W. ROCK DRIVE
POWER TO CONTROL VLV. ACTUATOR 120V., 1φ
PLAN AT SAMPLE CONTROL BLDG.
NO SCALE
AT VALVE MOTOR OPERATORS ON END OF ACCESS PLATFORM AND BELOW AT CONC. SPILLWAY. SEE 8550-X-124340
30A NON-FUSIBLE DISCONNECT SWITCHES IN NEMA 3 ENCLOSURE
SERVICE
INSIDE SAMPLE CONTROL BUILDING SEE 8550-Y-124342
100A FUSIBLE DISCONNECT SWITCH, FUSED AT 100A. NEMA TYPE 1 ENCLOSURE
AC PANEL 'A' 100A OP98
3φ SURGE SUPPRESSOR
120V A.C. RECEPTACLE
OUTSIDE WARNING LIGHT (POWER FAIL)
OUTSIDE WARNING LIGHTS (15FT. ABOVE GRADE)
AT SKIMMER
AT CO2 VLV. STA.
LEGEND
WARNING LIGHT WITH AMBER LENS McMASTER-CARR #5848T13
BATTERY, 12V, RECHARGEABLE, 40AH POWER SONIC MODEL PS-12400
BATTERY CHARGER, 12V, 4.00A DUAL VOLTAGE AUTO POWER SONIC MODEL PSC-124000A
WIRING-BLOCK DIAGRAM
NO SCALE
PANEL 'A'-OP98
120/208V, 3φ, 4W, 100A, A.C. PANEL
TRANSFORMER 240Δ TO 208/120V 3φ, 9KVA WESTINGHOUSE (OR EQUAL)
PANEL 'B'-OP99
240V, 3φ, 3W, 100A, A.C. PANEL
BUTTERFLY VALVE MOTOR OPERATOR
2 H.P. SAMPLE PUMP
SPARES
UNIT HEATER
PH ANALYZER/CONTROLLER
EXHAUST FAN & MOTORIZED DAMPER
CO2 CONTROL ACTUATOR
INDOOR, OUTDOOR & WARNING LIGHTS
INDOOR & OUTDOOR DUPLEX RECEPTACLES
SPACE
SPACES
SURGE SUPPRESSOR
*- SUPPLY BREAKERS WITH GROUND FAULT INTERUPTION
ALL BREAKERS TO BE 3P, 20A UNLESS OTHERWISE NOTED.
ALL BREAKERS TO BE 1P, 20A UNLESS OTHERWISE NOTED.
WEATHER HEAD NOTE-3
METAL ROOF
METAL BUILDING WALL
TO 100A POWER DISCONNECT
SECTION 'M'
NO SCALE
BY UNION ELECTRIC
NOTES:
1. ALL WORK TO BE DONE PER UNION ELECTRIC SPECIFICATION EC-2438.
2. FOR FURTHER EQUIPMENT INFORMATION SEE 8550-Y-124342.
3. POWER POLE, TRANSFORMER & DUSK TO DAWN LIGHT BY UNION ELECTRIC CO.
4. WIRING TO VALVE MOTOR OPERATORS, SAMPLE PUMP, WEATHER TIGHT DUPLEX RECEPT., & OUTDOOR LIGHT TO BE IN SAME CONDUIT TO JUNCTION BOX LOCATED ON ACCESS PLATFORM.
5. POWER & CONTROL WIRING TO BE IN SEPARATE CONDUITS.
LEGEND
7-DAY TIMER MCMASTER CARR CAT. NO. 7991K56.
CEILING LIGHT-2 BULB INCANDESCENT WITH TAMPER-PROOF CLEAR PRISMATIC LENS, KENALL CAT. NO. 3810.
DUPLEX RECEPTACLE, BROWN NYLON FACE-20A., 125V., HUBBELL CAT. NO. 5362. (MOUNTED 36" A.F.F.)
OUTDOOR WARNING LIGHT-FEDERAL SIGN CAT. #371 DST W/RED GLOBE.
BUTTERFLY VALVE MOTOR OPERATOR. 208V., 3φ, 60cyc.
SAMPLE PUMP MOTOR. 115V., 1φ, 60cyc., 2H.P., 3450 RPM
LOUVER OPERATOR/MOTOR 120V., 1φ, 60cyc.
EXHAUST FAN MOTOR. 115V., 1φ, 60cyc., 1/20 H.P.
JUNCTION BOX
THERMOSTAT FOR WALL LOUVER & EXHAUST FAN. (48" A.F.F.)
THERMOSTAT FOR BUILDING HEATER. MTD. 48" A.F.F. SINGLE STAGE LINE VOLTAGE CHROMALOX MHT-4051E-1007 (OR EQUAL)
TWO STAGE DISPLACER LEVEL SWITCH - LOCATED AT SKIMMER BOOM. MERCOID #195-6 DISPLACER TYPE LEVEL CONTROL W/SPDT SNAP ACTION SWITCH SPEC. #7810-10-SP-DT EACH STAGE.
BUILDING HEATER UNIT (MOUNT AT 8'-0" A.F.F.) W/MOTOR 3KW., 208V., 1φ, 14.5A Q-MARK CAT. NO. MUH03-81 (OR EQUAL)
GROUND RODS PER SPECIFICATION.
OUTDOOR LIGHT-150W, HPS, LUMINAIRE, G.E. CAT. NO. SAM15S1N 554LVAS W/ POLE MOUNTING BRACKET.
REFERENCE DRAWINGS:
PROPERTY-PLAN — 8550-X-124340
BUILDING-ARCH. PLAN — 8550-Y-124342
BUILDING-SERVICES PWR., LIGHTING, VENTILATING, & HTG. ASH POND DISCHARGE PIPING, & SAMPLING 1991 MODIFICATIONS
RUSH ISLAND PLANT
UNION ELECTRIC COMPANY ST. LOUIS, MO.
8550-X-124363
REV. 4
NOTICE OF LIMITED RESPONSIBILITY
FIRST ISSUE
ADD VLV. CTRL. BOX & CONN. BUTTERFLY VLVS.
ADD WARNING LIGHT
AMEREN REV
ADD 3φ SURGE SUPPRESSOR

REV	DATE	DRAW
1	062804	MSB
CHKD	SUPV	APPD
NOT K.O.	AW	MSB

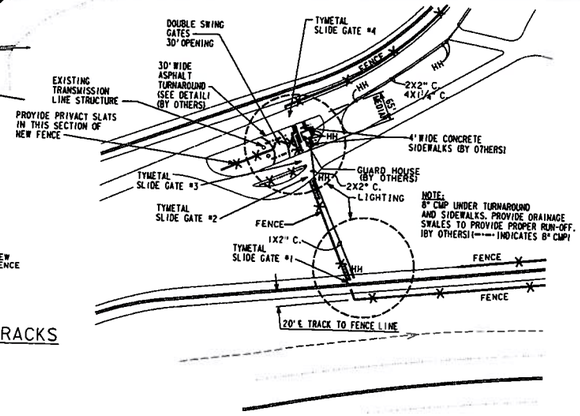
ADDED FIBER OPTIC AND ELECTRICAL CABLING FOR PERIMETER FENCING & GATES



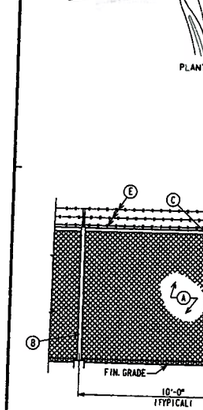
SITE PLAN
SCALE: 1" = 300'



ENLARGED CONSTRUCTION ENTRANCE PLAN
SCALE: 1" = 100'



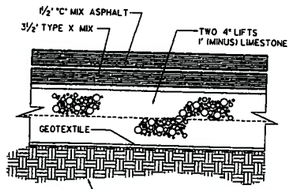
ENLARGED ENTRANCE PLAN
SCALE: 1" = 100'



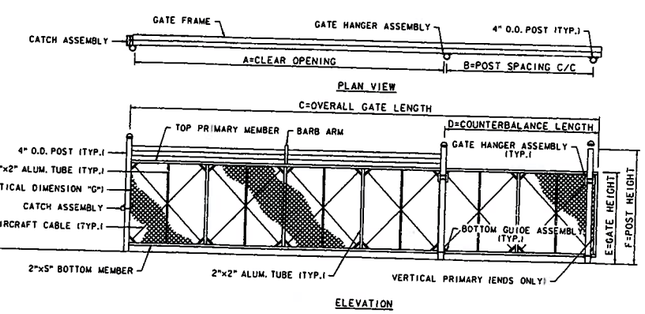
FENCE DETAIL
NO SCALE

SECTION AROUND ASH PONDS

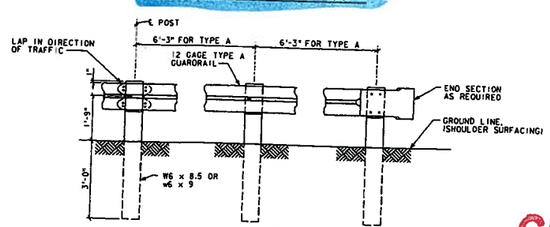
SECTION FENCE ALONG TRACKS

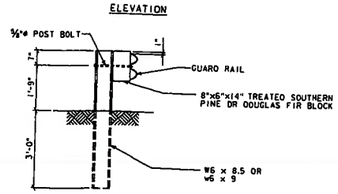


ASPHALT PAVEMENT SECT.

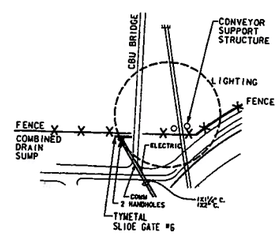


TYMETAL HEAVY DUTY SLIDE GATE
N.T.S.





GUARDRAIL DETAIL
MODOT TYPE A GUARDRAIL



ENLARGED CBU ENTRANCE PLAN
SCALE: 1" = 100'

CONFIDENTIAL INFORMATION

CRITICAL DIMENSION CHART								
GATE NUMBER	1	2	3	4	5	6	7	8
A CLEAR OPENING	20'	30'	30'	30'	20'	20'	30'	30'

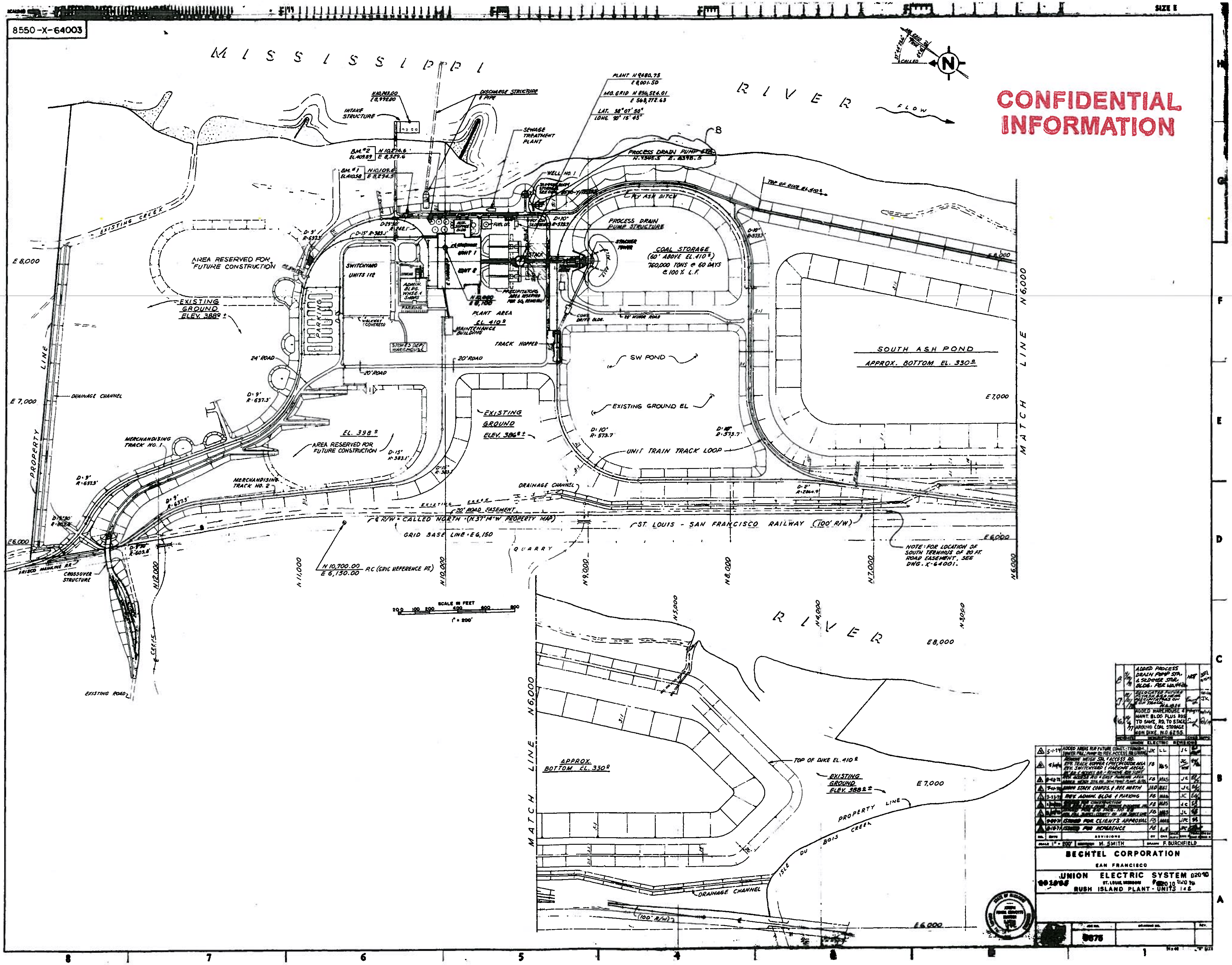
LEGEND
NEW FENCE
EXISTING FENCE

NOTICE OF LIMITED RESPONSIBILITY

PREPARED FOR AmerenUE

DRAW. 032T03 P.OTT	PROPERTY-2003 SECURITY UPGRADES PERIMETER FENCING-& NEW GUARD HOUSES
CHKD. NOT CHECKED	
SUPV. 032T03 SCOTT A. HELD	
APPD. 032T03 B. POETKER	LOCATION 001008 RUSH ISLAND PLANT
Ameren	ST. LOUIS, MISSOURI 8550-X-159053

SCALE 0200 REV. 1


8550-X-64003
MISSISSIPPI RIVER
FLOW
CONFIDENTIAL INFORMATION
INTAKE STRUCTURE
DISCHARGE STRUCTURE
SEWAGE TREATMENT PLANT
PROCESS DRAIN PUMP STR.
TOP OF DIKE EL. 410±
PROCESS DRAIN PUMP STRUCTURE
COAL STORAGE
(60' ABOVE EL. 410±)
760,000 TONS @ 50 DAYS
@ 100% L.F.
AREA RESERVED FOR FUTURE CONSTRUCTION
SWITCHYARD UNITS 1&2
EXISTING GROUND ELEV. 388±
EXISTING CREEK
PLANT AREA
EL. 410±
MAINTENANCE BUILDING
TRACK HOPPER
20' ROAD
24' ROAD
SOUTH ASH POND
APPROX. BOTTOM EL. 330±
SW POND
EXISTING GROUND EL
UNIT TRAIN TRACK LOOP
EXISTING GROUND ELEV. 386±
EL. 398±
AREA RESERVED FOR FUTURE CONSTRUCTION
DRAINAGE CHANNEL
MERCHANDISING TRACK NO. 1
MERCHANDISING TRACK NO. 2
PROPERTY LINE
MATCH LINE N6,000
ST. LOUIS - SAN FRANCISCO RAILWAY (100' R/W)
GRID BASE LINE - E6,150
QUARRY
CROSSOVER STRUCTURE
EXISTING ROAD
N 10,700.00
E 6,150.00
P.C. (GRID REFERENCE PT.)
NOTE: FOR LOCATION OF SOUTH TERMINUS OF 20 FT. ROAD EASEMENT, SEE DWG. X-64001.
RIVER
APPROX. BOTTOM EL. 330±
TOP OF DIKE EL. 410±
EXISTING GROUND ELEV. 388±
PROPERTY LINE
ISLE DU BOIS CREEK
DRAINAGE CHANNEL
BECHTEL CORPORATION
SAN FRANCISCO
UNION ELECTRIC SYSTEM
ST. LOUIS, MISSOURI
RUSH ISLAND PLANT - UNITS 1&2

DIST. | 10000-Z-0000 | 2 | 1

REVISIONS

REV.	W.O.
	5202

FIRST ISSUE

N

"A"

N. 7000

FENCE

E. 6520 ℄ 14'-0" ROAD

ROAD - EL. 410.0'

H.B.

EXIST. 20' GATE

3:1 SLOPE

℄ NEW 12' W. ROAD

3:1 SLOPE

℄ EXIST. 12' W. RAMP

EXIST. 18' W. RAMP

T.O.S. EL. 400.0'±

W.P. AT TOE OF SLOPE OF EXIST. RAMP

B

℄ FENCE

100'-0"±

40'-0"±

PLAN

"A"

CONFIDENTIAL INFORMATION

ROAD - EL. 410.0'

10% MAX. SLOPE

T.O.S. EL. 400.0'±

FILL FOR NEW RAMP TO BE TAKEN FROM BOTTOM ASH POND.

ELEVATION

NOTE: NEW RAMP SURFACE TO HAVE A 5" MIN. COVER OF 3/4" ℄ MINUS CRUSHED ROCK.

EL. 410.0'

NEW FILL

3

1

EXIST.

3

1

EL. 400.0'±

NEW RAMP

SECTION "A-A"

PROP. PLAN - TRACKWORK 8550-X-64030

PROP. PLAN - GRADING 8550-X-64013

A

DRAWN 9-27-79 K. B. Bell	PROPERTY - ROADWAY ACCESS RAMP FROM ASH POND DIKE WEST SIDE - ASH POND		
CHKD. 10-1-79 LINDSLEY			
SUPV. 10-1-79 LAUNHARDT			
APPD. 10/1/79 T. L. HOLLENKAMP	LOCATION 001008	RUSH ISLAND PLANT	CLASS 02010
UNION ELECTRIC COMPANY ST. LOUIS, MO.	8550-Z-96661		REV. O

37-13-068 Rev. 4-73

2 1

Document 4: Missouri Department of Natural Resources Application for Registration Permit

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DAM AND RESERVOIR SAFETY

APPLICATION FOR REGISTRATION PERMIT

DATE: April 15, 2010

GENERAL INFORMATION

* OWNER(S) NAME: AmerenUE

* ADDRESS: 1901 Chouteau Ave.

* CITY: St. Louis | * STATE: MO | * ZIP CODE: 63103

* TELEPHONE NUMBER (REQUIRED): (314) 342-1000

NAME OF DAM: Rush Island Flyash Pond | ID NUMBER: MO 40179

COUNTY: Jefferson

LOCATION OF DAM AT CENTERLINE AT MAXIMUM SECTION
SECTION 3, SW quarter , TOWNSHIP 39N NORTH, RANGE 7E E/W

APPROXIMATE UTM COORDINATES
N E

DAM HEIGHT: 46 feet | RESERVOIR AREA: 29 Acres Active Water Storage

PURPOSE OF DAM AND RESERVOIR: Flyash Settling Pond

* NAME OF PERSON FILLING OUT THIS APPLICATION (TYPE OR PRINT): Thomas L. Hollenkamp, PE, SE

* SIGNATURE

* IN CASE OF EMERGENCY (TYPE OR PRINT)
NAME: Thomas L. Hollenkamp TELEPHONE NUMBER (REQUIRED): (314) 210-4356

CHECK ONE:

☐ YES, I DO HAVE AN EMERGENCY ACTION PLAN FOR THE DAM.

☒ NO, I DO NOT HAVE AN EMERGENCY ACTION PLAN FOR THE DAM.

IT IS MANDATORY THAT YOU COMPLETE ALL ITEMS MARKED WITH AN ASTERISK (*).

SUBMIT TO: Department of Natural Resources
Geological Survey and Resource Assessment Division
Dam and Reservoir Safety
P.O. Box 250
Rolla, Missouri 65402
(573) 368-2175

Note: located at 38 degrees, 07', 13.94" N
90 degrees, 15', 13.97" E

MO 780-1758 (3-04)

MISSOURI DEPARTMENT OF NATURAL RESOURCES
DAM AND RESERVOIR SAFETY

ATTACHMENT - REGISTRATION PERMIT APPLICATION

NAME OF DAM	ID NUMBER
Rush Island Flyash Pond	MO 40179
COUNTY	**DATE**
Jefferson	April 6. 2010

[X] **ENGINEER CERTIFICATION**

I hereby certify that I have inspected the Rush Island Flyash Pond
(NAME OF DAM)

on March 19, 2010 (DATE) in accordance with the law.

[ ] **ENGINEER CERTIFICATION**

I hereby certify that the owner of the _____
(NAME OF DAM)

has complied with my recommendations to correct observed defects as required by law.

[X] **JUDGEMENT OF STABILITY**

At the time of my inspection, there were no observable indications that the dam was unsafe.

Engineers Certification
I hereby certify that I have reviewed and approved preliminary plans for repair of the slopes as recommended in the attached report.
The owner has stated that plans will be completed and the work will be implemented during summer 2010.
It is my opinion that the proposed plans will correct the observed defects as required by law.

STATE OF MISSOURI
DONALD S. ESKRIDGE
NUMBER E-13802
REGISTERED PROFESSIONAL ENGINEER

NAME OF FIRM	ENGINEER'S SEAL
Reitz & Jens, Incorporated	4/6/2010
REGISTERED ENGINEER	**P.E. NUMBER**
Donald S. Eskridge	E-13802

MO 780-1756 (3-04)

Rush Island Permit Report
Flyash Pond Levee System
Dam Safety Registration Analysis
MO 40179

Prepared for

Ameren UE

St. Louis, Missouri

Prepared by

REITZ & JENS, INC.
CONSULTING ENGINEERS

April 6, 2010

The Professional whose signature and personal seal appear hereon assumes responsibility only for what appears in the attached report and disclaims (pursuant to Section 327.411 RSMo) any responsibility for all other plans, estimates, specifications, reports, or other documents or instruments not sealed by the undersigned Professional relating to or intended to be used for any part or parts of the project to which this report refers.

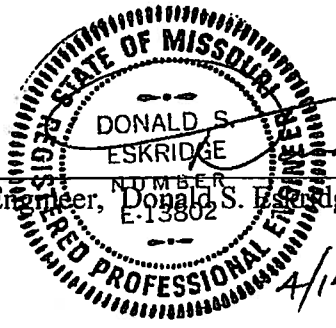
Certification by Experienced Professional Engineer

I hereby certify that the attached report has been prepared by the undersigned in accordance with the Dam Safety Regulations of the Missouri Dam and Reservoir Safety Council.

It is our opinion that when the recommended repairs are completed that this system will comply with the requirements for registration of this system as an industrial dam.

REITZ & JENS, INC.

Firm Name



Registered Engineer, Donald S. Eskridge, PE MO E-13802

4/14/2010

Table of Contents

Analysis of the Existing Fly Ash Pond for Missouri Dam Safety Permit Application

The Rush Island Power Plant, a coal fired power plant located on the west bank of the Mississippi River, deposits the flyash by-product of combustion in a settling pond. The pond was created by construction of a ring levee in the floodplain on the right bank of the Mississippi river. The downstream end of the pond is located at approximately river mile 139 above the mouth of the Ohio River.

It has been determined that the configuration of the levees fit into the regulated category for an industrial water retention dam as codified in the "Regulations of the Missouri Dam and Reservoir Safety Council" of the Missouri Department of Natural Resources. This document is the technical analysis of the existing system and engineering recommendations to accompany the Ameren Company's dam registration application.

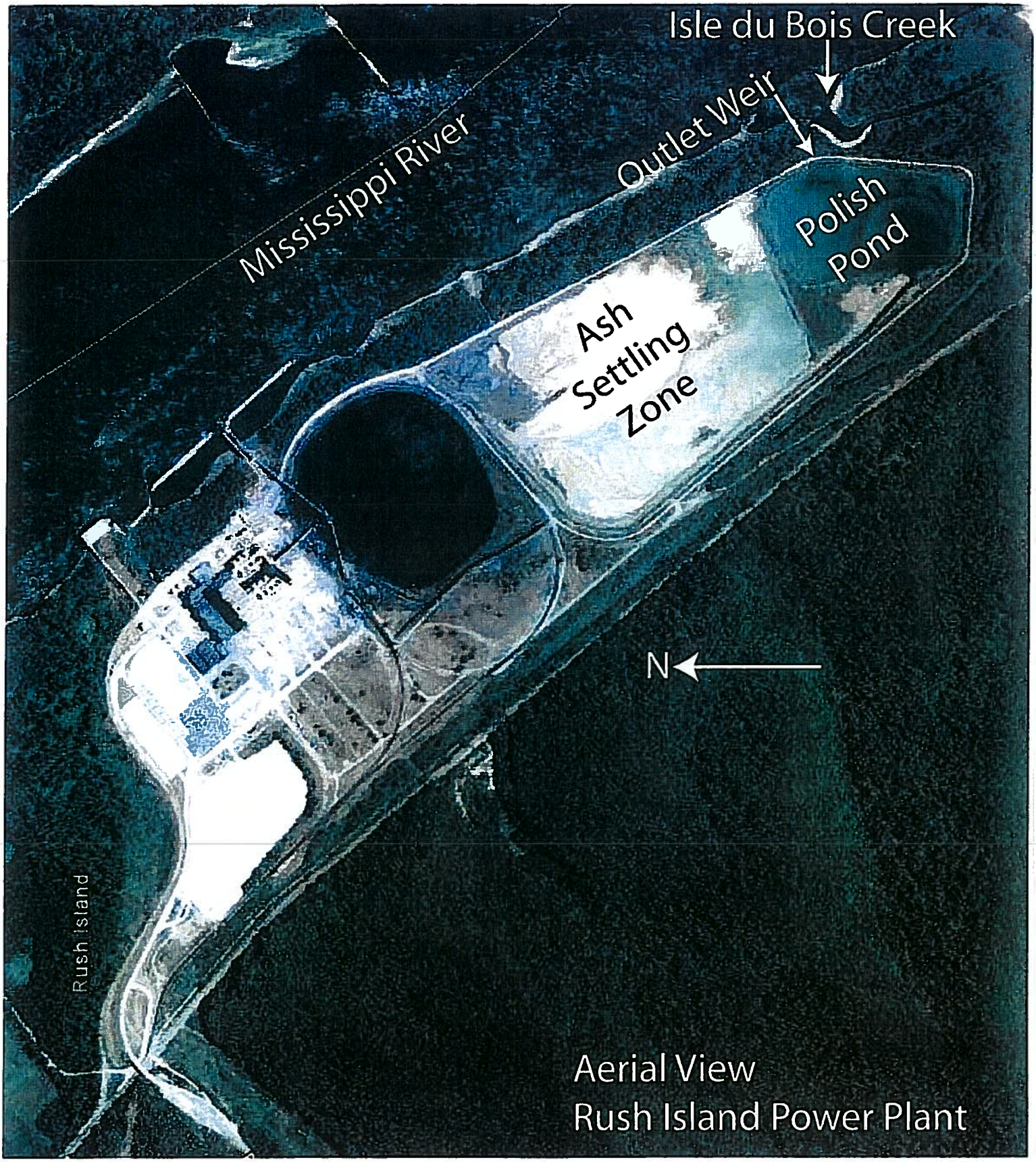
History

The Rush Island Power plant was built starting in the early 1970's. The available site plan, prepared by Bechtel Corporation has an "issued for bidding" date in early 1972. The plans show the initial plant layout with a south ash pond extending over the approximate limits of existing ash storage pond and the present "polish pond". The present pond configuration has an internal divider dike; the date of construction of the internal divider dike to separate the polish pond from the active ash accumulation portion is unknown. It is known that initial discussion of the design needs for the internal dike was started in 1994.

An annotated aerial photo on the following page shows the plant with its relationship to the Mississippi River on the east, the Isle du Bois creek on the south, and the vegetated hillside west of the plant.

The Bechtel site plan shows that the bottom of the ash pond was planned to be excavated to elevation 330, which is approximately 57 feet below the general original site grade of about 387. It is likely that some of the less permeable excavated materials were used to construct the containment dikes that are shown on the plans to be built up to elevation 410. The plans indicate that the containment dikes are supposed to have both internal and external slope surface inclinations of 3 horizontal to 1 vertical. The design top width of the dike is shown to be 14 feet.

The present use for flyash sedimentation is different from the original concept of "just a settling pond". The ash "pond" north of the internal dike is full, and the present ash disposal is into excavated pits within this area using a wetted dry ash nozzle to minimize the amount of water mixed with the ash in the smaller cell ponds. The "polish pond" is a final settlement pond that receives some ash, the plant process water, and the entire plant stormwater runoff.


Isle du Bois Creek
Outlet Weir
Mississippi River
Polish Pond
Ash Settling Zone
N
Rush Island
Aerial View
Rush Island Power Plant

Site Classification

The flyash pond is located along the upstream side of the Isle du Bois Creek that empties into the Mississippi river. In this area the creek forms the south boundary line of Jefferson County. There are no residences or highways downstream of the dam and other public infrastructure. If the ring levee dam were to fail the discharge would flow immediately into the Mississippi river. Because there is no threat to life downstream of this dam in a potential inundation zone, it is our opinion that the Environmental Site Classification for this dam is class III, which is the lowest possible classification in Missouri. It is our understanding that in a site visit, the Chief Engineer for the Dam Safety Council also opined that this is a Class III downstream environment.

There are no dams upstream of this ring levee within the tributary watershed.

Site Survey

The entire top of levee was surveyed to obtain a profile around the ash pond. Five external slope cross sections were also obtained by the survey team. These cross section locations were chosen by Reitz & Jens as the probable locations of critical stability for analysis, the decision was based on both the geometry of the existing surface, and previous history of slope performance.

The top of levee profile is shown in the Appendix. The low point (approximately elevation 408.2) occurs between stations 84+50 and 85+50.

Dam Qualification

The surveyed cross sections show that the maximum "dam height" is 46 feet measured from the top of levee to the discharge channel flowline at the controlled outlet. Since this height is greater than 35 feet, the dam is a regulated dam in accord with the Missouri Dam Safety Council regulations, and the dam will need a registration permit.

The dam (levee) was constructed as a single stage containment levee using soils from the river floodplain. This is an industrial dam.

Slope Stability Analysis

The soil strength of the levee embankments and underlying foundation soils was analyzed using a combination of drilled test holes with both Standard Penetration Test sampling and 3 inch undisturbed thin-walled Shelby tube sampling, and Cone penetration testing. Six drilled test holes and 5 cone penetration test holes were originally proposed. One of the Test holes (TH # 5) was not drilled because of the presence of overhead power lines. The results of the test drilling, laboratory testing, and CPT testing are included in the appendix.

In late 2006 the left descending bank of the Isle du Bois creek where it is closest to the ash pond levee began to show some continued erosion towards the ash pond levee. The entire length of the adjoining creek bank was armored with rip-rap by the Corps of Engineers. There does not seem to be any

movement along that area since the creek bank was stabilized.. There was no obvious movement prior to the bank stabilization, however the bank stabilization was recommended because of the proximity to the ash pond. Levee stability study section # 4 was located through that bank stabilization area. The table on the following page shows the results of slope stability computations for three of the surveyed cross sections. The cross section number 7 was judged the most critical based on the initial total stress analysis of each cross section, therefore the greatest computational effort was on cross section # 7. The other cross sections were checked to assure that the calculated factors of safety meet the Dam Safety regulations.

The steady seepage surface used in the analysis was calculated using the procedures developed by Huang as referenced in the MO DNR 1989 Publication "Engineering Analysis of Dams". The steady seepage surface is shown on the stability computation program outputs appended to this report.

The slope stability summary (shown on the following page) indicates that the steady seepage condition is the controlling limit to maintain the factors of safety within the limits stated by Mo DNR.. This computation of the seepage surface assumes that the embankment is homogeneous, which will require any fills on the inside of the embankment to restore the grades will have to be built with fills having permeability similar to the remainder of the levee embankment. That will rule out using a rock fill to restore the inside inclinations.

The slope stability computations show that the permanent pool cannot be above elevation 403. Short term pool rises, such as a response to a major rainfall can rise above elevation 403 but the pool will have to be returned to no higher than elevation 403 after the rainfall event.

The computations show that the seismic stability is adequate.

There has been a transmission line recently constructed to serve the new Holcim cement plant just south of Rush Island, some of the transmission line towers are along the top of the west boundary levee. These are monopole towers on deep monopole drilled pier foundations. The bottoms of the tower foundations are at lease 45 feet below the top of the levee, and these are judged to have no effect on the stability of the levee.

Hydrology

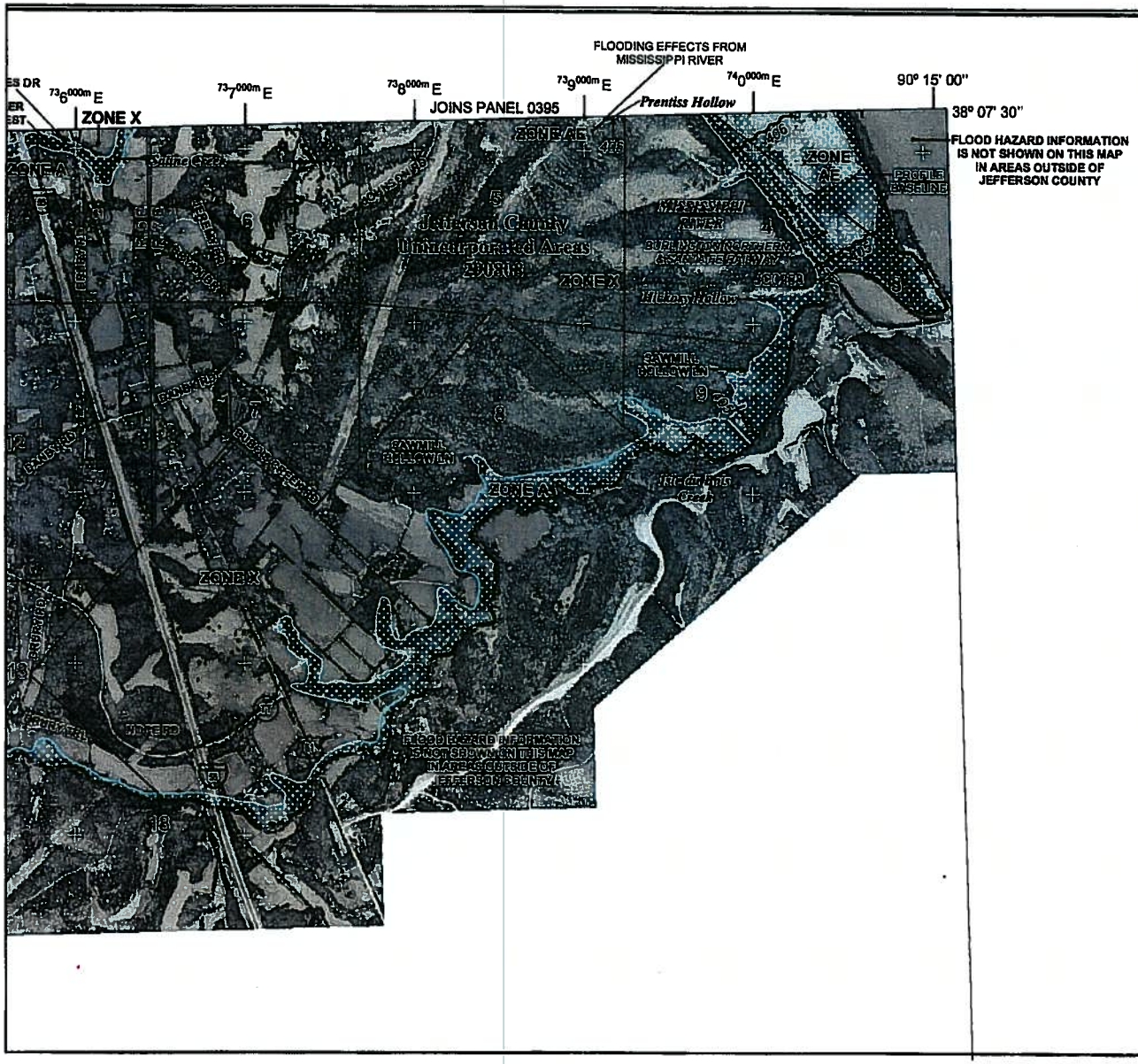
River Floodplain

The ash pond is on the floodplain of the Mississippi river, the south end of the pond is opposite mile marker 139 on the Mississippi river. The FEMA FIRM maps show the 100 year Mississippi river flood at Isle du Bois creek to be at elevation 405 on a Jefferson County FIRM with effective date of July, 2006. The US Corps of Engineers has recently completed a Flood Flow Frequency study (FFF) for the Mississippi, Missouri and Illinois rivers, that modeled all the development along the river. The FFF 100 year flood elevation at Mississippi river mile is 403.7. The Fema FIRM maps have not yet recognized the FFF study. Both of the Mississippi river 100 year flood calculated water surfaces are below the top of the ash pond levee as recently surveyed. A firmette of the area is on the following page.

Rainfall Events

Rush Island Slope Stability Summary Sheet

Section	Stress Phase	Seismic Force	Pool Elevation	Stored Ash	Toe Setback	Factor Safety	Req"d FS	File	
3	total	none	none	395		2.9		3001	
3	total	none	407	395		1.95		3002	
4	total	none	407	407		2.26	1.5	4001	
4	stdy seep	none	403	403		1.51	1.5	4012	normal pool
4	stdy seep	0.046	398	398		1.375	1.0	4011	
4	stdy seep	none	398	398		1.65	1.5	4010	
4	stdy seep	none	407	407		1.404	1.3	4013	max pool @ 407
4	stdy seep	0.046	403	403		1.31	1.0	4014	normal pool
7	total	none	407	407		1.731	1.5	7001	
7	stdy seep	none	398	398		1.711	1.5	7004	
7	stdy seep	0.046	398	398		1.49	1.0	7005	
7	stdy seep	none	407	407		1.41	1.5	7006	1.3 FS for max pool
7	stdy seep	none	403	403		1.54	1.5	7007	normal pool
7	stdy seep	0.046	403	403		1.34	1.0	7008	normal pool



MAP SCALE 1" = 2000'

1000 0 2000 4000 FEET

METER

NFIP

PANEL 0500E

FIRM

FLOOD INSURANCE RATE MAP

JEFFERSON COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 500 OF 500

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JEFFERSON COUNTY	290308	0500	E

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
29099C0500E

EFFECTIVE DATE
APRIL 5, 2006

Federal Emergency Management Agency

NATIONAL FLOOD INSURANCE PROGRAM

A completed existing industrial dam in a Class III environment is required to be able to handle the 100 year storm event without any uncontrolled overtopping or uncontrolled discharge.

The Rush Island power plant, coal stockpile, and ash pond create a stand-alone hydrologic unit that has no additional tributary area. Stormwater collected within the plant confines is pumped into the discharge channel that leads to the present polish pond. The runoff from the coal pile flows into the same discharge channel.

The total tributary area of the plant, coal pile and ash ponds is 261 acres. All the collected stormwater accumulates in the polish pond and is discharged through a 24 inch diameter vertical riser pipe spillway that has several control valves on it. The control valves are necessary to maintain the discharge water within EPA guidelines.

For purposes of storm routing the total plant tributary area was broken up into 4 separate hydrologic units as shown on the following drawing entitled "Storm Drainage Assumptions". Two outflow condtions were analyzed, the first assumes that the 24 inch discharge pipe is fully opened throughout the period of storm runoff storage, and the second condition is that the 24 inch pond discharge pipes are closed to flow. None of the analyses assume any flow over any other spillway on the system.

The hydrologic computations are shown in the appendix. All runoff and routing computations were performed using the computer program "Hydraflow Hydrographs" by Intellisolve. All of the computations include a steady plant process outflow of 20 cfs in addition to the stormwater runoff. A summary table of the computation results is shown on the following page.

The present operating elevation of the polish pond water surface ranges between elevation 396 and 398, the plant operations personnel stated that they would like to operate the pond at an elevation of 398. The hydrology computations show that for both the 100 year 24 hour storm and the 100 year 6 hour storm, the maximum routed pool elevation is 402.55 for a fully functioning pond outlet, and elevation 404.05 for a closed pond outlet. There remains at least 4.15 feet of freeboard below the lowest elevation of the ash pond levee. The system can safely store the 100 year storm for a beginning pool elevation of 398.

Since the slope stability analysis shows that a maximum permanent pool of 403 is possible, the system response was also modeled with a 403 starting pool elevation. A fully functioning pond outlet would pond water to an elevation of 407.44, and a closed outlet would pond water to an elevation of 408.88 which is above the lowest present elevation of the ash pond levee.

The low point of the perimeter levee is at elevation 408.2 between survey stations 84+50 and 85+50, in the north west corner of the ash pond. It is our opinion that as long as the operating water surface is at elevation 398 and the polish pond has a full 27 acres of water surface available (no ash delta above elevation 398) that there is no emergency spillway needed on this system.

Operation & Maintenance Plan

There is no documented operation and maintenance plan available. A plan should be prepared, to integrate the requirements of the regulated outfall and the pool elevation requirements needed to satisfy

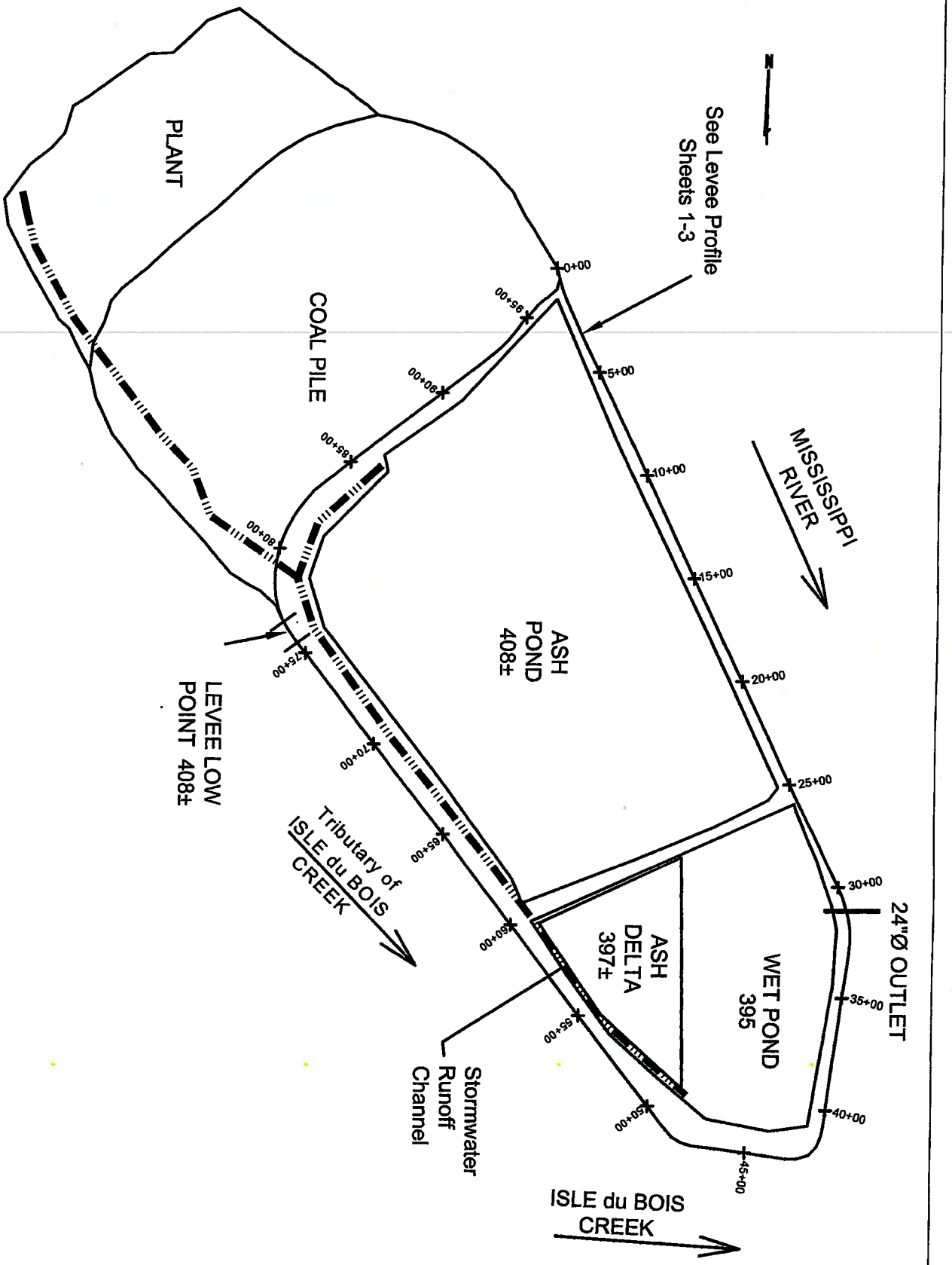
Table of Results
Hydrologic computations

Rush Island Ash Pond Storm Routing

File	Rainfall duration	frequency	Pond Start Elevtion	Base Flow from Plant	Maximum Stage	Max. Outflow cfs	Total Storage ac-ft	Remarks
Trial 03	24 hr	100 yr	395	15 cfs	399.55	27.97	116	8.1 ac Ash delta at 395
Trial 04	24 hr	100 yr	395	20 cfs	399.87	28.95	124	8.1 ac Ash delta at 395
Trial 05	24 hr	100 yr	403	20 cfs	407.44	27.93	126	No Ash Delta @ 403
Trial 09	24 hr	100 yr	398	20 cfs	402.55	28.27	125.2	Ash Delta Submerged @ 397
From Hand computations (sheet 4) - for a blocked outlet pipe								
	24 hr	100 yr	395	20 cfs	401.43	0	167.188	8.1 ac Ash delta at 395
	24 hr	100 yr	398	20 cfs	404.05	0	167.188	Ash Delta Submerged @ 397
	24 hr	100 yr	403	20 cfs	408.88	0	167.188	Stage is higher than 408.2 lowpoint
Trial 06	6 hr	100 yr	395	20 cfs	398.25	23.51	79.8	8.1 ac Ash delta at 395
Trial 07	6 hr	100 yr	403	20 cfs	405.88	22.38	80.3	No Ash Delta @ 403
Trial 08	6 hr	100 yr	398	20 cfs	400.93	22.68	80.21	Ash Delta Submerged @ 397

Note: 100 yr - 24 hour storm - 7.10 inches
100 yr - 6 hour storm - 5.20 inches
Souirce - Bulletin 71, Huff & Angel

rl levee.dwg 01/08/2010



SHEET 1	Dam Safety Permit Storm Drainage Assumptions 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.L.B. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1002 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

both the geotechnical stability and the hydrologic requirements. This plan should be prepared within 6 months.

The operating pool water level needs to be monitored and recorded on at least a daily basis. When a significant rainfall event is predicted the operating staff needs to know what to expect as a response to the storm.

Since there is no emergency spillway recommended, it is our opinion that the maximum operating water surface elevation in the pond should be 400.2, provided that the full pond volume is available for storage. There should be no ash delta robbing the available storage for storm runoff. The recommended starting elevation would allow a 100 year 24 hour storm to be stored no higher than elevation 406.2 even if the outlet is blocked. This still provides a freeboard of 2 feet below the overflow elevation of the perimeter levee.

The plant personnel should develop an operating plan for pond management that reflects this storage need as well as the environmental constraints on the pond outlets.

Site Inspection

As a part of this application a visual site inspection was made by Donald Eskridge, PE on March 19, 2010. The following is a discussion of several observed deficiencies that need to be corrected. The discussion will refer to the stationing used in the 2010 levee survey plan sheets included in the appendix.

Seepage
There are two locations of slight seepage through the face of the slope in the vicinity of stations 14+00 to 15+00. These seeps have always been there and the embankment is not showing any distress except that from mowing disturbance. Since this is opposite the filled ash pond it is our opinion that these seeps do not pose an immediate threat to the stability of the embankment. We recommend that they be monitored and if the seepage increases then localized excavation and repairs may be needed.

External slope erosion
In the vicinity of station 30+00 the toe of the levee embankment slope has been eroded away to form a steep slope about 5 feet high. The surface has no erosion protection. This is shown in the photo to the right. In the event of a Mississippi river flood continued erosion could occur that would not be able to be observed through the flood waters, and the slope could fail. This eroded area needs to be rebuilt and rip-rapped. A similar section occurs about 80 feet south of the discharge platform bridge that also needs to be re-shaped and rip-rapped. The rock rip-rap should be placed on either a bedding layer, or a separation layer of non-woven filter fabric. The finish face of the entire slope should be built to

the original design slope.

In the vicinity of station 57+00 the external slope has experienced severe surface erosion from runoff from the road on the top of the levee. It could also be erosion started at a in-completely filled root ball hole from the slope clearing. This erosion should be filled in and re-seeded.

Polish pond Internal Slope

Wave action style erosion has steepened the internal slopes of the east and south sides of the polish pond from approximately stations 33+00 to 50+00. In many cases the erosion has created slopes as steep as 1H:1V, and along the east shore the erosion is within 10 feet of the edge of the roadway. A photo is shown on the left of this discussion.

The slope stability study has shown that the steady seepage condition is the most critical for the existing external slopes. The internal slopes have to be re-built with soils to a minimum 2H:1V slope to meet the seepage analysis assumptions. These slopes should also be rip-rapped after rebuilding to protect against recurrence of the wave erosion.

Reitz & Jens has been informed that plans are under way to perform this slope repair during the summer of 2010.

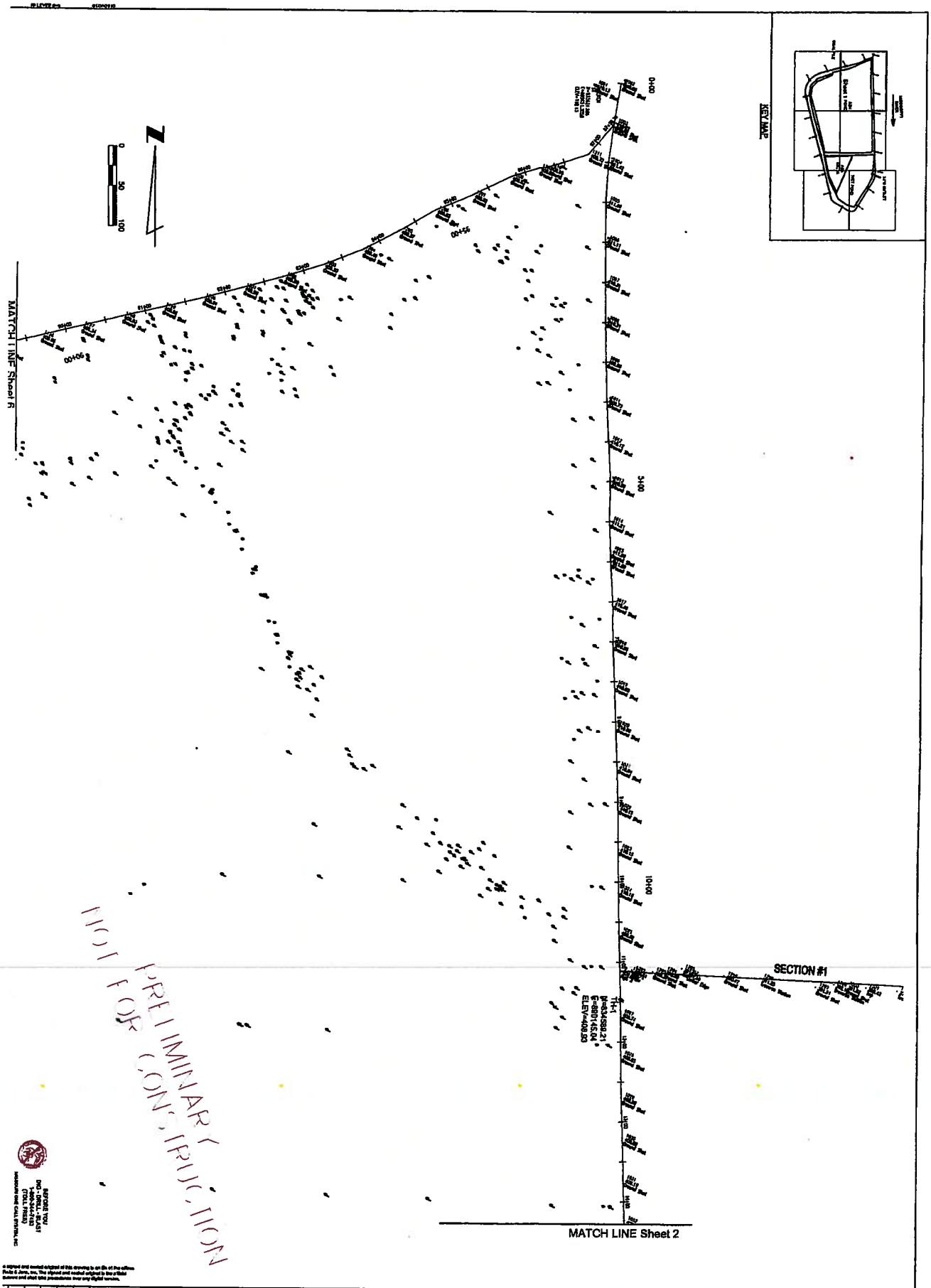
Woody Vegetation

Woody Vegetation is establishing along the interior slope from approximately Stations 48+00 to about 55+00. This needs to be cleared.

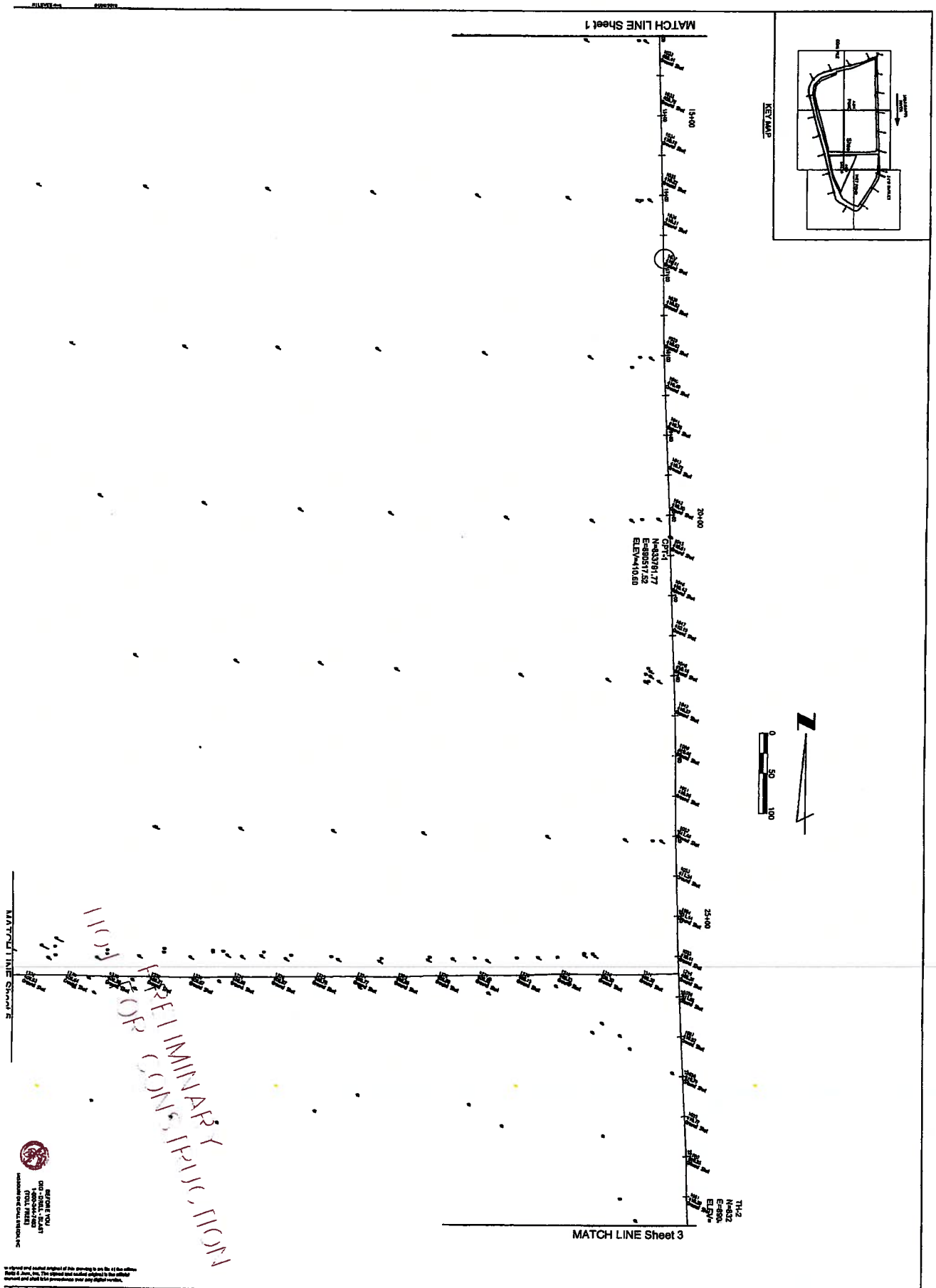
APPENDICES

Top of Levee Elevation Survey
Top of Levee Profile
Cross Section Plots
Test Holes Location Plan
Boring Logs Lab Testing Results
CPT Logs
Slope Stability Analysis
Hydrology Analysis

Top of Levee Elevation Survey



REVISIONS	Dam Safety Permit Ash Pond Levee Ash Pond Plan 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	Rettz & Jens, Inc. CONSULTING ENGINEERS Designed D.A.E. Checked P.H.R. Drawn D.L.E. Issued 01/05/2010	THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS APPURTENANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THIS PROJECT TO WHICH THIS PAGE REFERS.	Date:



REVISIONS

Dam Safety Permit
Ash Pond Levee

Ash Pond Plan
2009012469

AmerenUE

Rush Island Plant
Festus, MO 63028

REITZ & JENS, INC.
CONSULTING ENGINEERS

Designed D.S.E. Checked P.H.R.
Drawn D.L.S. Issued 01/09/2019

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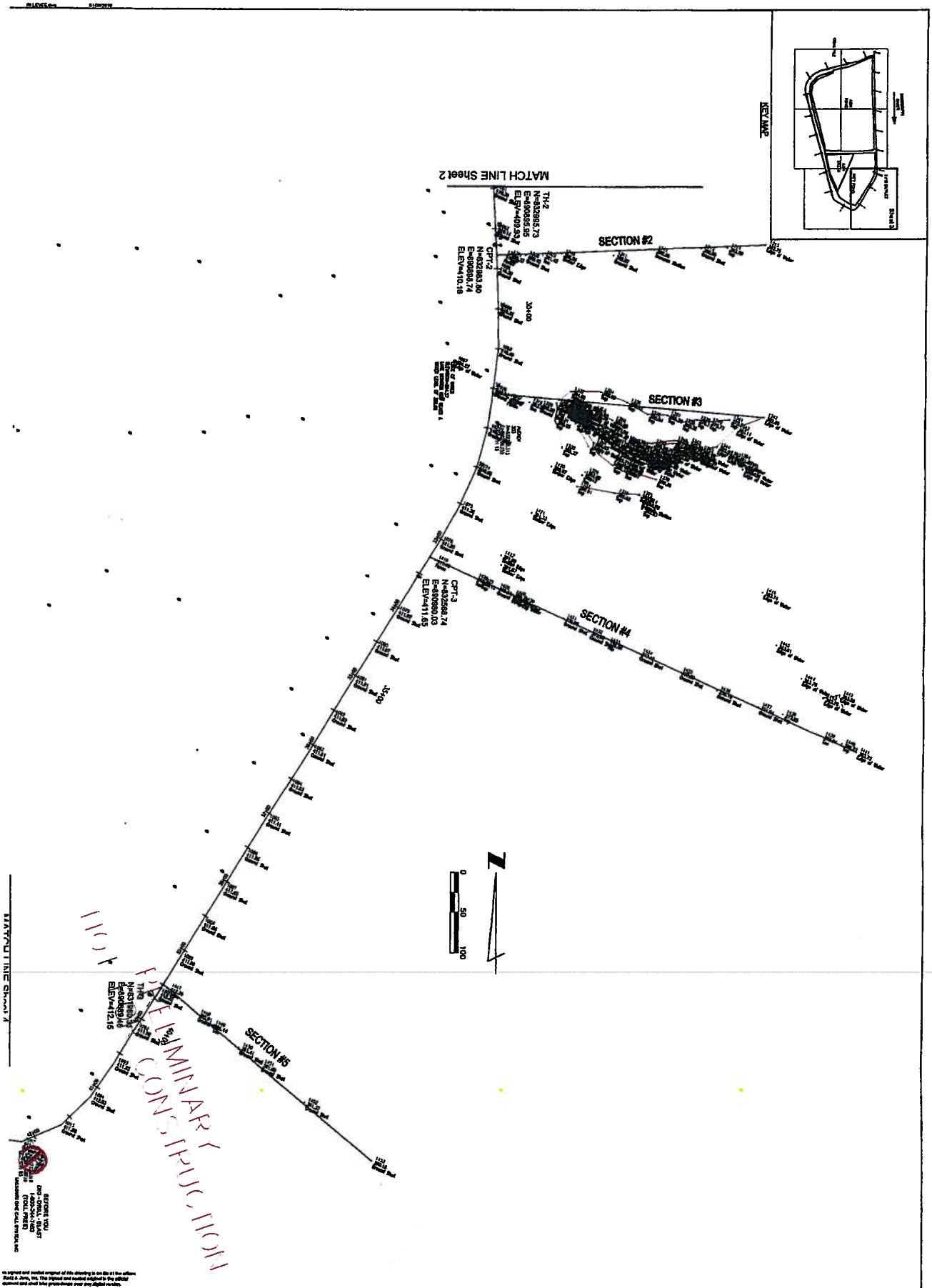
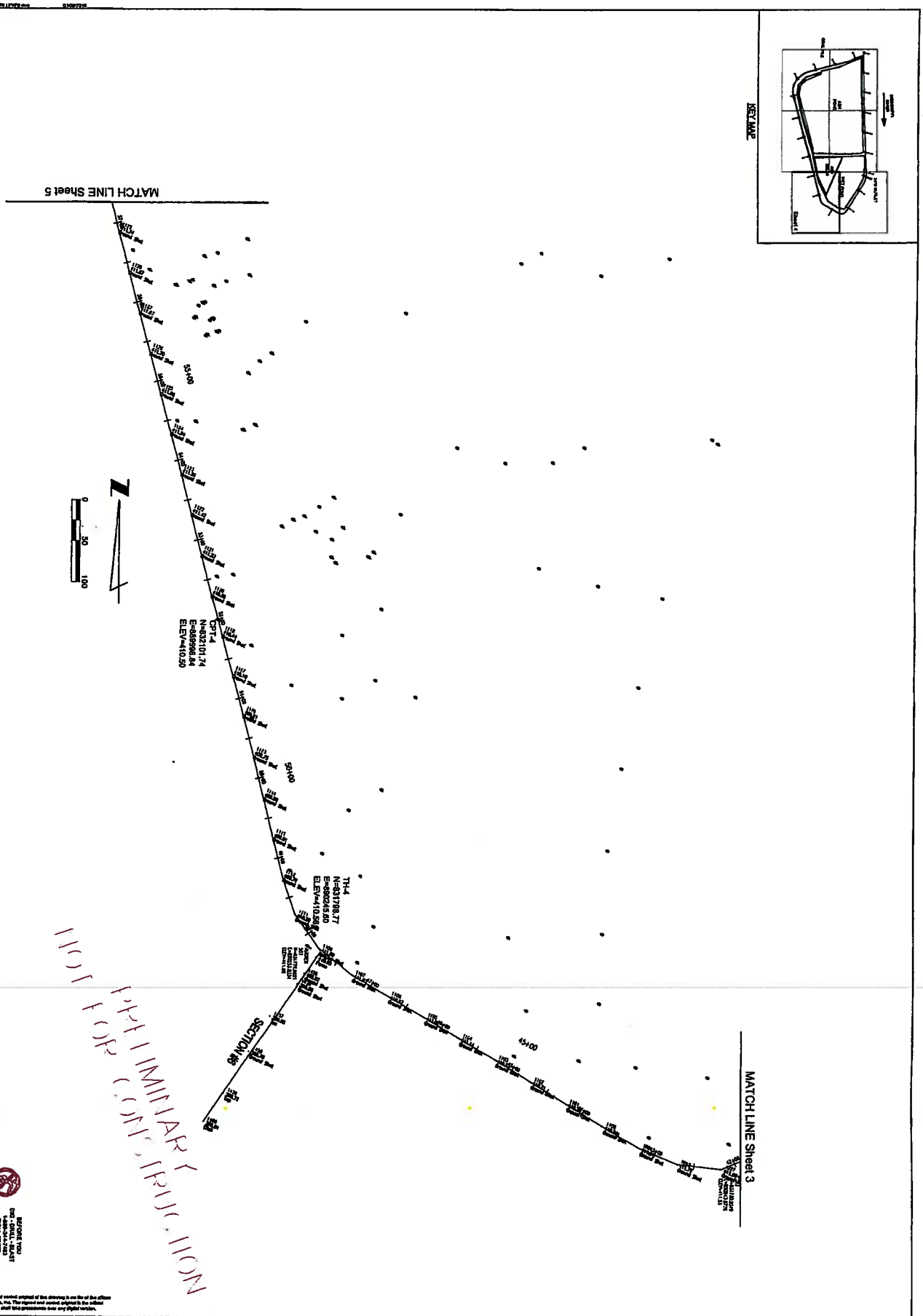
Date

PRELIMINARY
NOT TO BE USED FOR CONSTRUCTION

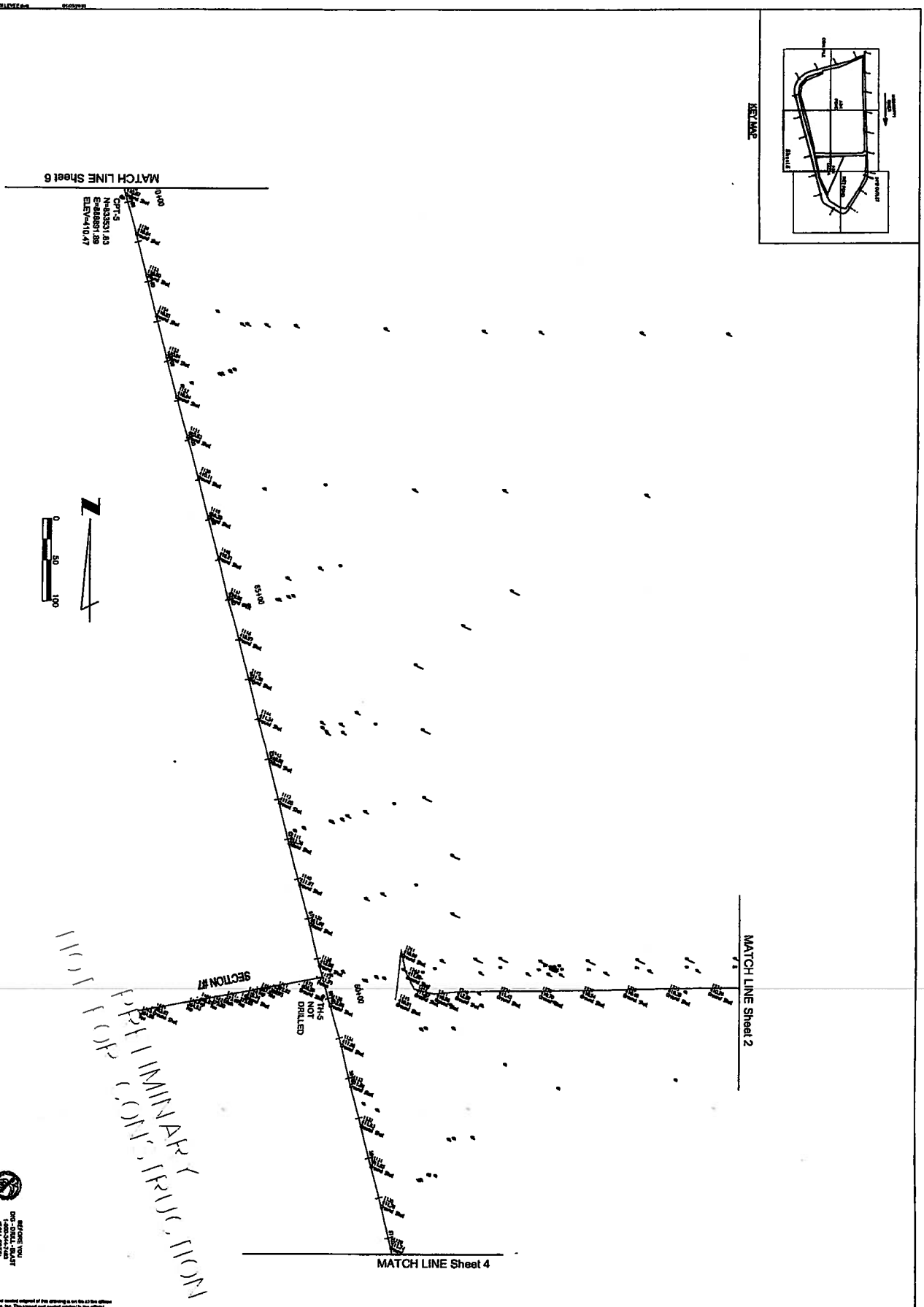
Engineer Seal



REVISIONS	Dam Safety Permit Ash Pond Levee Ash Pond Plan 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	REITZ & JENS, INC. CONSULTING ENGINEERS Designed D.S.E. Checked P.H.R. Drawn D.L.B. Issued 01/06/2010	THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR HIS/HER APPEARS ON THIS PAGE AND DISCLAIMS SIMILARLY SO SECTION 327.411 RSMO ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.	DWG



REVISIONS	Dam Safety Permit Ash Pond Levee Ash Pond Plan 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	REITZ & JENS, INC. CONSULTING ENGINEERS Designed D.B.S. Checked P.H.R. Drawn D.L.B. Issued 01/04/2010	THE ENGINEER WHOSE SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WORK PERFORMED ON THIS PAGE AND DISCLAIMS PURSUANT TO SECTION 327.411 RSMO ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THE PROJECT TO WHICH THIS PAGE REFERS.	DWG



REVISIONS

Dam Safety Permit
Ash Pond Levee

Ash Pond Plan
2009012469

AmerenUE

Rush Island Plant
Festus, MO 63028

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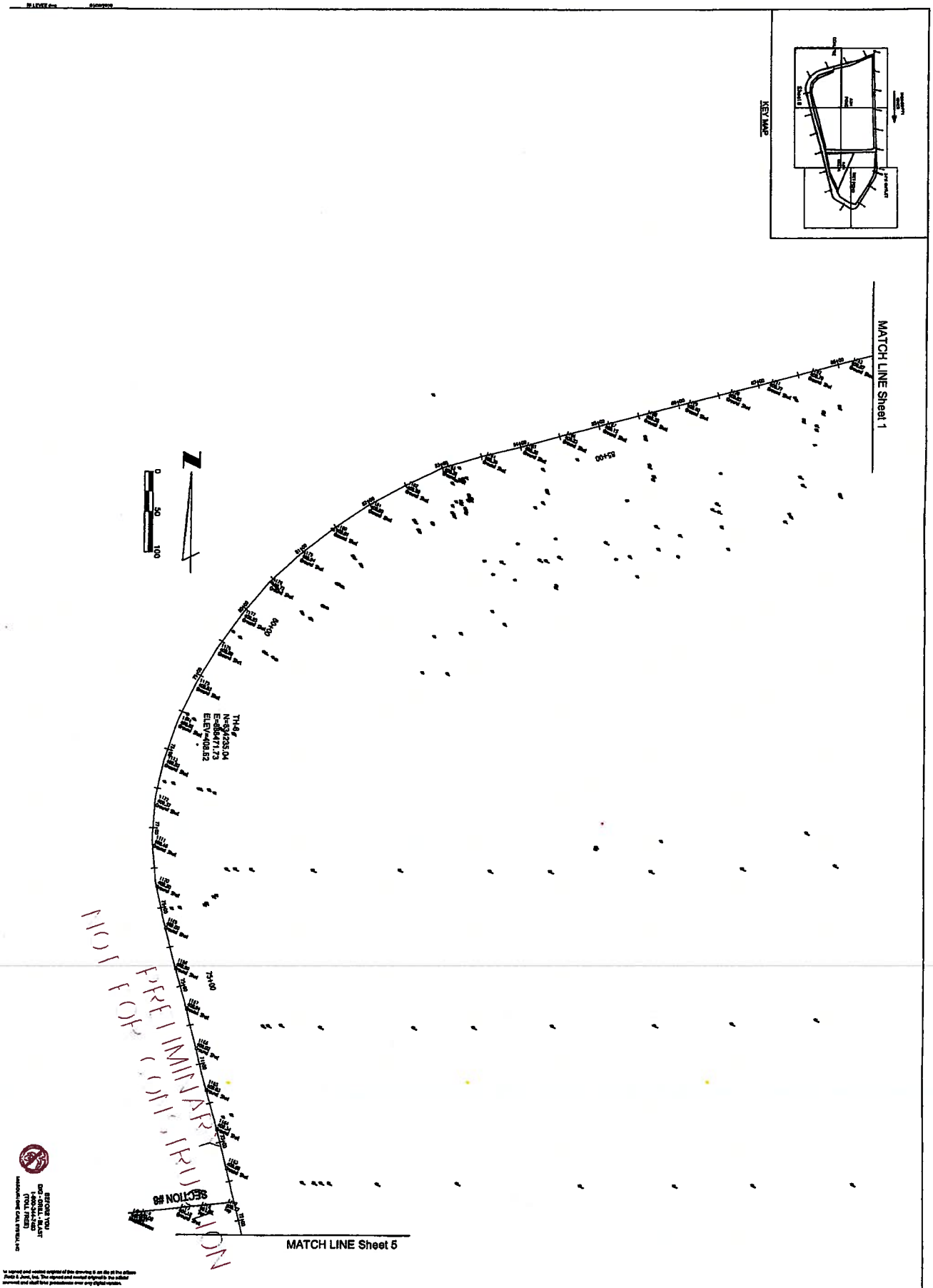


REVISIONS	Dam Safety Permit Ash Pond Levee Ash Pond Plan 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	REITZ & JENS, INC. CONSULTING ENGINEERS Designed D.S.E. Checked P.H.R. Drawn D.L.S. Issued 01/08/2019	THE ENGINEER'S ORIGINAL SIGNATURE AND PERSONAL SEAL APPEAR HEREON ASSUMES RESPONSIBILITY ONLY FOR WHAT APPEARS ON THIS PAGE AND DISCLAIMS (PURSUANT TO SECTION 327.411 RSMO) ANY RESPONSIBILITY FOR ALL OTHER PLANS, SPECIFICATIONS, ESTIMATES, REPORTS OR OTHER DOCUMENTS OR INSTRUMENTS NOT SEALED BY THE UNDERSIGNED ENGINEER RELATING TO OR INTENDED TO BE USED FOR ANY PART OR PARTS OF THIS PROJECT TO WHICH THIS PAGE REFERS.	THIS MEDIA IS CONSIDERED A CERTIFIED DOCUMENT

Top of Levee Profile

DATUM ELEV 395.00

Scale: 400 | 405 | 410

Station	Elevation
0+00	410.0
	410.4
0+50	410.7
	411.1
1+00	411.4
	411.5
1+50	411.5
	411.3
2+00	411.1
	410.7
2+50	410.3
	410.3
3+00	410.2
	409.9
3+50	409.7
	409.7
4+00	409.7
	409.9
4+50	410.1
	410.5
5+00	410.9
	411.1
5+50	411.2
	411.8
6+00	411.9
	411.2
6+50	410.5
	410.3
7+00	410.1
	410.0
7+50	410.0
	410.0
8+00	410.1
	410.1
8+50	410.0
	410.1
9+00	410.1
	410.1
9+50	410.1
	410.2
10+00	410.2
	410.1
10+50	409.9
	409.7
11+00	409.5
	409.2
11+50	408.9
	408.7
12+00	408.7
	408.7
12+50	408.8
	408.9

Station	Elevation
12+50	408.8
	408.9
13+00	408.9
	408.9
13+50	409.1
	409.2
14+00	409.3
	409.4
14+50	409.6
	409.8
15+00	410.0
	410.2
15+50	410.2
	410.2
16+00	410.2
	410.2
16+50	410.3
	410.4
17+00	410.5
	410.5
17+50	410.5
	410.4
18+00	410.5
	410.5
18+50	410.6
	410.7
19+00	410.7
	410.7
19+50	410.7
	410.7
20+00	410.7
	410.6
20+50	410.6
	410.5
21+00	410.4
	410.2
21+50	410.2
	410.2
22+00	410.2
	410.2
22+50	410.3
	410.4
23+00	410.6
	410.8
23+50	411.0
	411.3
24+00	411.5
	411.5
24+50	411.5
	411.5
25+00	411.3
	410.8
25+50	410.1
26+00	411.0
	411.0

Station	Elevation
26+00	411.0
	411.0
26+50	410.9
	410.9
27+00	410.8
	410.8
27+50	410.8
	410.7
28+00	410.6
	410.5
28+50	410.4
	410.3
29+00	410.1
	410.2
29+50	410.3
	410.3
30+00	410.4
	410.4
30+50	410.4
	410.5
31+00	410.5
	410.3
31+50	410.3
	410.5
32+00	410.7
	410.9
32+50	411.2
	411.4
33+00	411.5
	411.6
33+50	411.5
	411.7
34+00	411.9
	411.9
34+50	412.0
	411.9
35+00	411.9
	411.8
35+50	411.7
	411.6
36+00	411.5
	411.5
36+50	411.5
	411.5
37+00	411.4
	411.5
37+50	411.5
	411.6
38+00	411.6
	411.6
38+50	411.6
	411.7
39+00	411.9
	412.1
39+50	412.2
	412.2

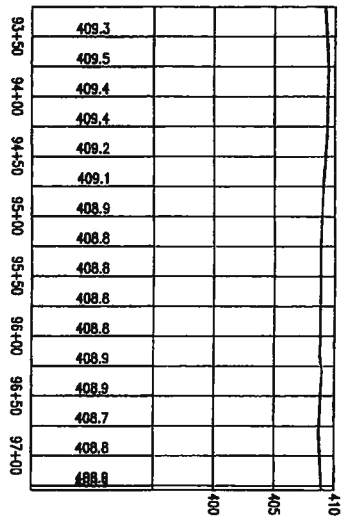
SHEET 1 OF 3	Dam Safety Permit Top of Levee Profile 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	Designed DSE Drawn DSE	Checked DSE Issued 01/11/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

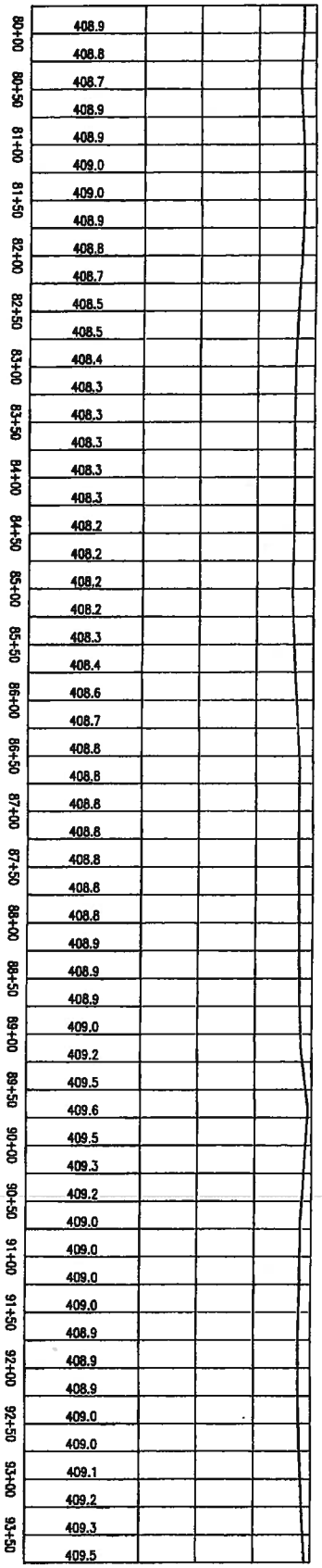
Station	Elevation
66+50	410.4
	410.5
67+00	410.6
	410.7
67+50	410.9
	410.9
68+00	410.9
	410.9
68+50	410.9
	410.8
69+00	410.8
	410.8
69+50	410.8
	410.8
70+00	410.7
	410.6
70+50	410.4
	410.2
71+00	409.9
	409.7
71+50	409.6
	409.5
72+00	409.6
	409.7
72+50	409.7
	409.7
73+00	409.5
	409.3
73+50	409.2
	409.0
74+00	409.0
	409.0
74+50	409.0
	408.9
75+00	408.9
	408.9
75+50	408.9
	409.0
76+00	409.1
	409.2
76+50	409.3
	409.4
77+00	409.4
	409.4
77+50	409.3
	409.1
78+00	409.0
	408.9
78+50	408.8
	408.8
79+00	408.8
	408.8
79+50	408.8
	408.9
80+00	408.9
	408.8

Station	Elevation
53+00	411.3
	411.4
53+50	411.4
	411.4
54+00	411.4
	411.5
54+50	411.6
	411.6
55+00	411.7
	411.7
55+50	411.7
	411.7
56+00	411.7
	411.7
56+50	411.7
	411.7
57+00	411.7
	411.8
57+50	411.8
	411.8
58+00	411.8
	411.8
58+50	411.8
	411.8
59+00	411.9
	411.9
59+50	412.0
	412.0
60+00	412.1
	412.1
60+50	412.0
	412.0
61+00	412.0
	411.8
61+50	411.7
	411.5
62+00	411.4
	411.2
62+50	411.1
	411.0
63+00	410.9
	411.1
63+50	411.3
	411.4
64+00	411.4
	411.2
64+50	411.0
	410.9
65+00	410.9
	410.8
65+50	410.7
	410.5
66+00	410.4
	410.4
66+50	410.4
	410.5

Station	Elevation
39+50	412.2
	412.2
40+00	412.0
	411.9
40+50	411.9
	412.0
41+00	412.0
	412.0
41+50	411.9
	411.9
42+00	411.9
	411.9
42+50	411.8
	411.7
43+00	411.5
	411.3
43+50	411.1
	410.9
44+00	410.8
	410.8
44+50	410.7
	410.7
45+00	410.8
	410.9
45+50	411.0
	411.1
46+00	411.1
	411.0
46+50	411.0
	411.0
47+00	411.0
	411.0
47+50	411.1
	411.1
48+00	410.8
	410.3
48+50	410.1
	409.8
49+00	409.8
	409.8
49+50	409.8
	409.8
50+00	409.8
	409.8
50+50	409.8
	409.9
51+00	410.0
	410.1
51+50	410.2
	410.4
52+00	410.5
	410.6
52+50	410.8
	411.1
53+00	411.3
	411.4

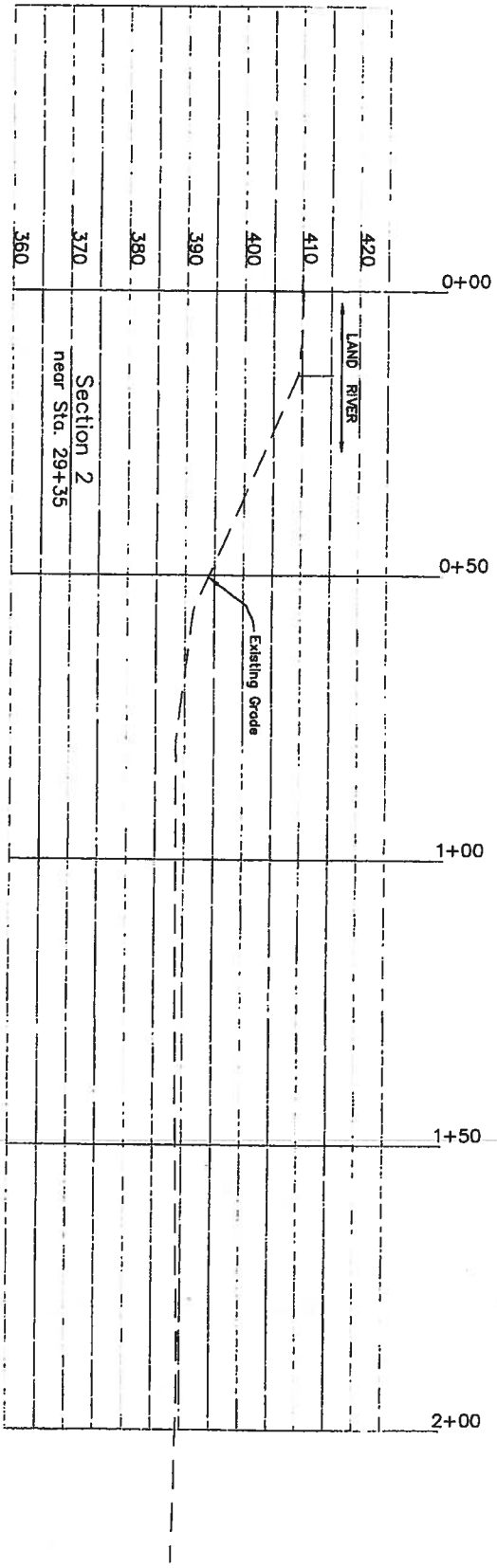
SHEET 2 OF 3	Dam Safety Permit Top of Levee Profile 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	Designed DSE Drawn DSE	Checked DSE Issued 01/11/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000216



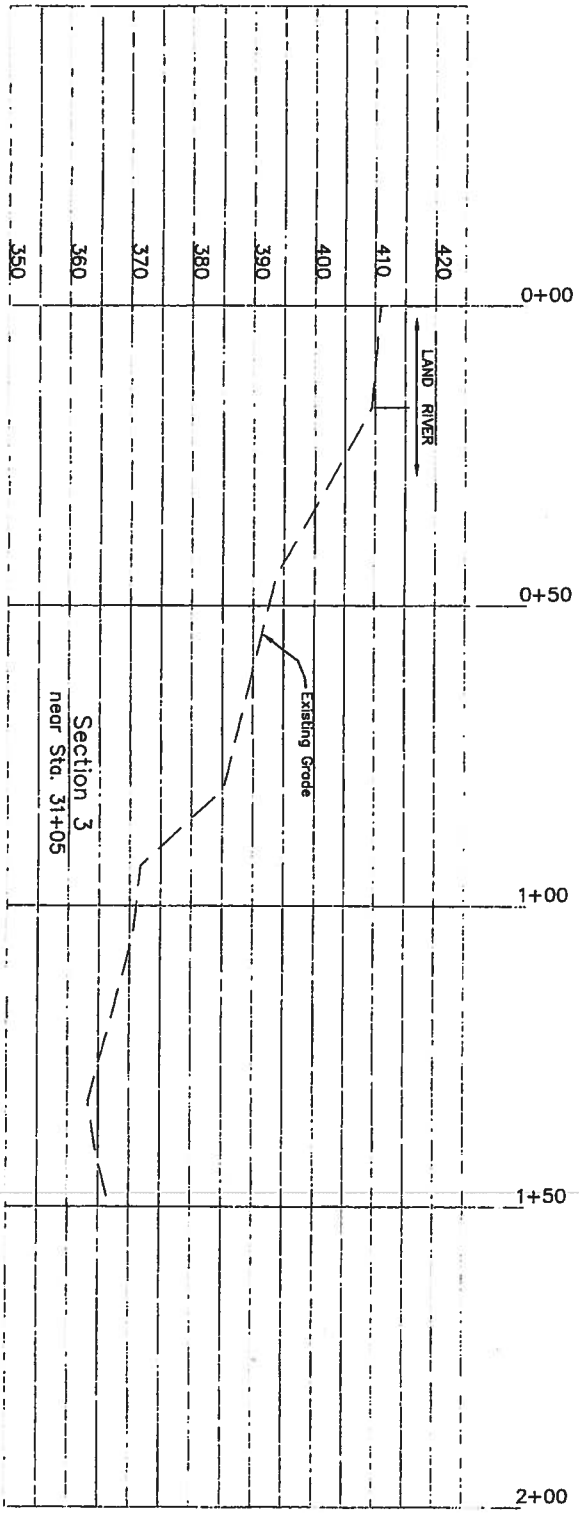


SHEET 3 OF 3	Dam Safety Permit Top of Levee Profile 2009012469	AmerenUE Rush Island Plant Festus, MO 63028	Designed DSE Checked DSE Drawn DSE Issued 01/11/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

Cross Section Plots

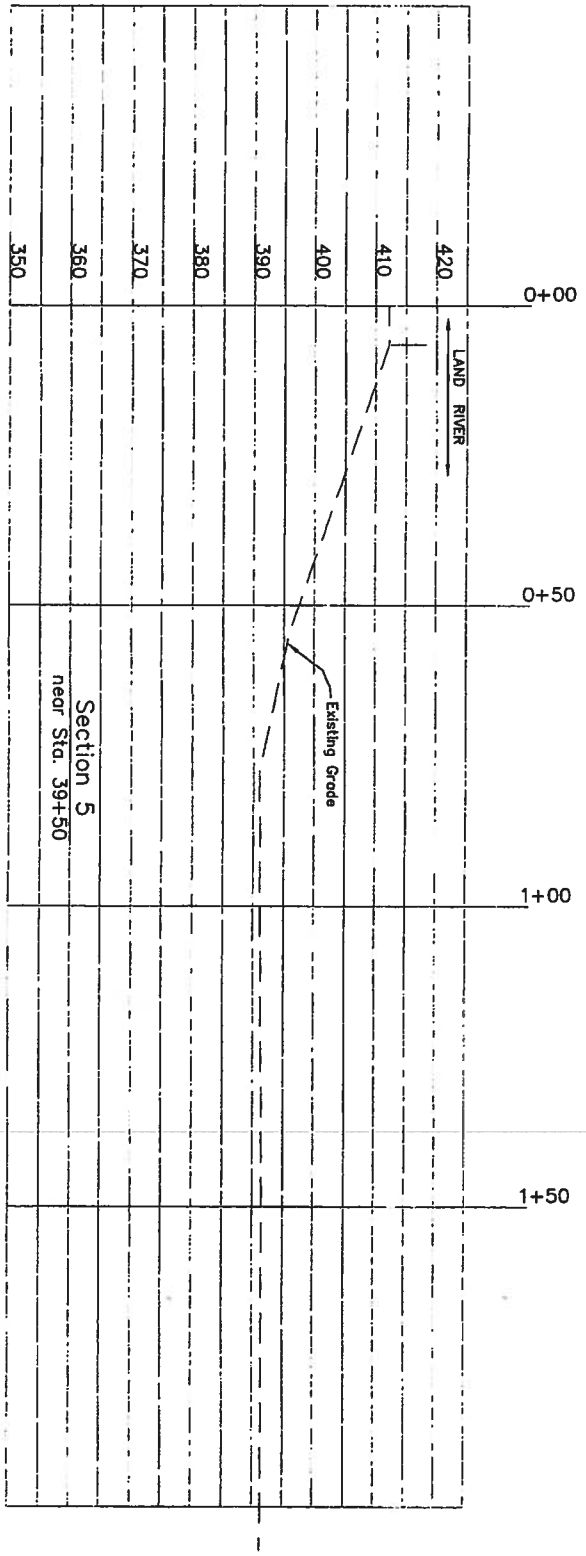


SHEET 2 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/10	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

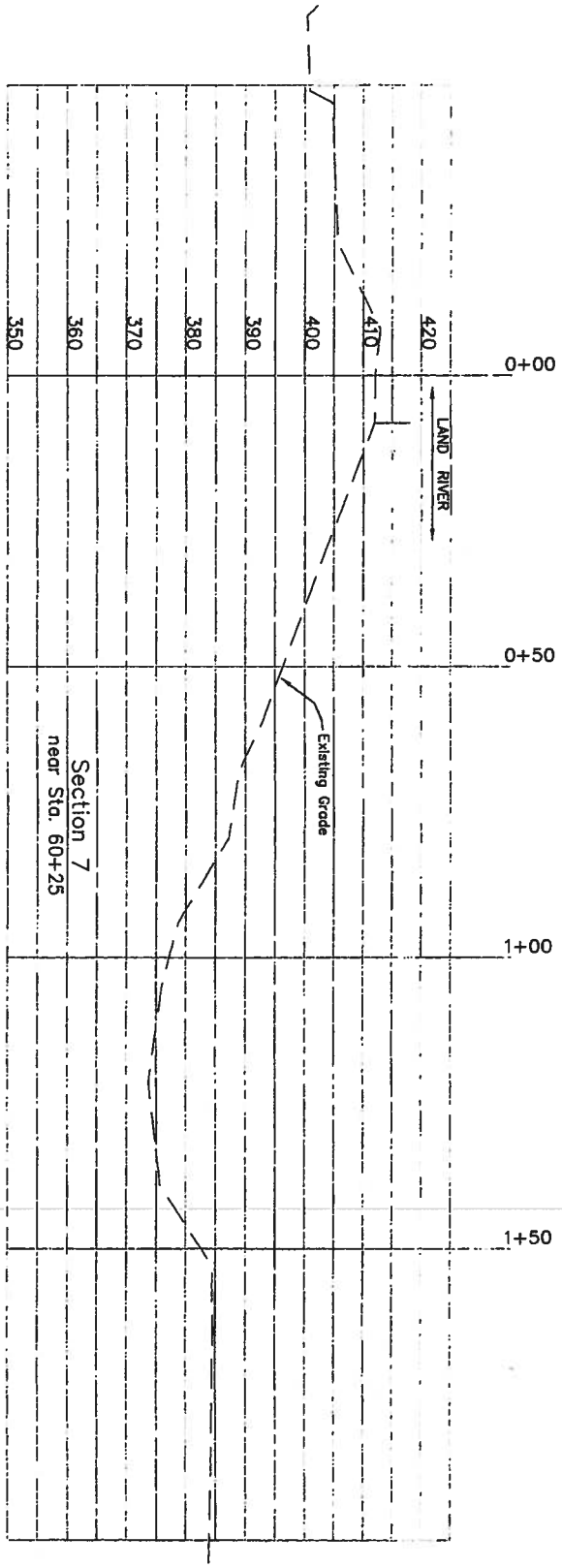


SHEET	Dam Safety Permit	AmerenUE		
3 OF 5	Survey Sections	Rush Island Plant	Designed D.S.E. Checked D.S.E.	REITZ & JENS, INC.
	2009012469	Festus MO, 63028	Drawn D.S.E. Issued 01/08/2010	CONSULTING ENGINEERS

1055 CORPORATE SQUARE DRIVE
ST. LOUIS MISSOURI 63132
(314) 993-4122
PROFESSIONAL ENGINEERING CORP., LICENSE #000215

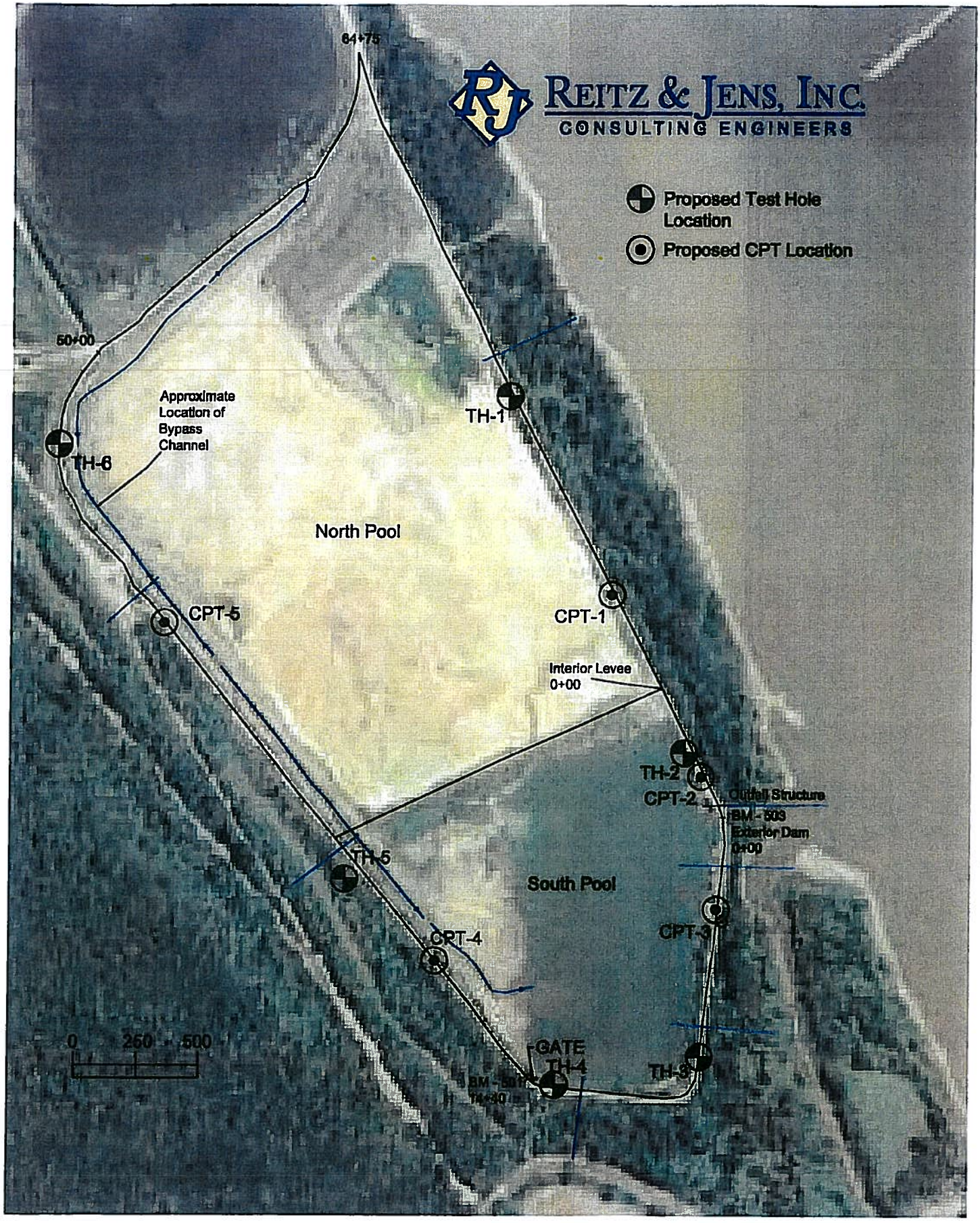


SHEET 5 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1063 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP. - LICENSE #000218



SHEET 7 OF 5	Dam Safety Permit Survey Sections 2009012469	AmerenUE Rush Island Plant Festus MO, 63028	Designed D.S.E. Checked D.S.E. Drawn D.S.E. Issued 01/08/2010	REITZ & JENS, INC. CONSULTING ENGINEERS 1055 CORPORATE SQUARE DRIVE ST. LOUIS MISSOURI 63132 (314) 993-4132 PROFESSIONAL ENGINEERING CORP., LICENSE #000215

Test Hole Location Plan



2009012469/dwg/RushIslandAerial

Ameren UE Dam Inventory and Inspection Program
Rush Island Plant Proposed Testing Layout
Rev. 9/8/09

Figure 1

Boring Logs – Lab Testing Results

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 834589.2 E 890145.1
ELEVATION: 408.9 DATUM:
DATE DRILLED: 09-14-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES ROD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						Top 10 feet vacuum extracted no sampling		
5	405				0			
10	400							
15	395				100	Clay FILL? (CH), grey to dark grey, high plastic, slightly silty, with fine roots, and 3" layer of silty fine sand at 15'-7"	94.0	27.6
20	390				88	SILT (ML), grey and brown, with fine sand and pockets of high plastic clay	95.2	23.8
25	385				96	SAND (SP), golden tan, fine grain, becoming silty and greyish near bottom of sample	87.3 99.7	21.7 14.3
30	380	▽			100	Sandy SILT (ML), tan, fine grain, loose, saturated	2-2-4	31.8

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES

WATER LEVELS: DURING DRILLING 29.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

File: 2009012469

Figure

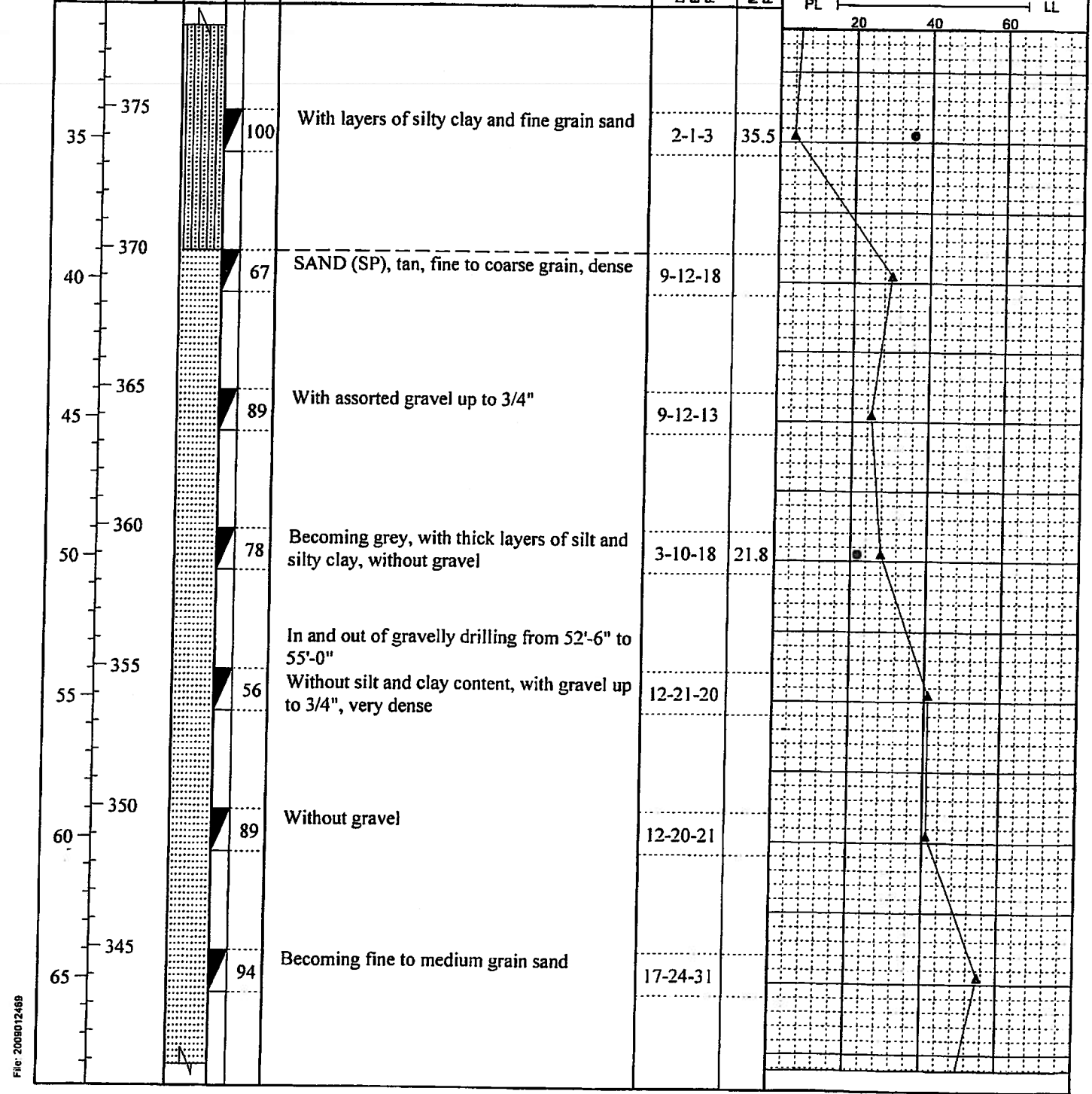
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
35	375					
			100	With layers of silty clay and fine grain sand	2-1-3	35.5
40	370		67	SAND (SP), tan, fine to coarse grain, dense	9-12-18	
45	365		89	With assorted gravel up to 3/4"	9-12-13	
50	360		78	Becoming grey, with thick layers of silt and silty clay, without gravel	3-10-18	21.8
				In and out of gravelly drilling from 52'-6" to 55'-0"		
55	355		56	Without silt and clay content, with gravel up to 3/4", very dense	12-21-20	
60	350		89	Without gravel	12-20-21	
65	345		94	Becoming fine to medium grain sand	17-24-31	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60



File: 2008012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-1

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Becoming fine to coarse sand	14-20-27	
75	335				78		18-23-28	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL ⊢——⊣ LL
20 40 60

File 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 832995.7 E 890896.0
ELEVATION: 409.9 DATUM:
DATE DRILLED: 09-15-09

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0						Top 10 feet vacuum extracted no sampling		
5	405				0			
10	400							
15	395	▽			96	Silt FILL (ML), grey, slightly silty, trace fine grain sand, with high plastic clay lenses Perched water at 14'-6"	89.2	30.1
						Clay FILL (CH), grey, high plastic, trace roots		
20	390				88	Sandy Silt FILL (SM), grey and brown, slightly clayey, with high plastic clay balls, limoninte and iron staining, trace clay seams and sand lenses	94.4	27.4
25	385				100	Clay FILL (CH), grey, silty, high plastic, stiff, moist	2-3-5	29.8
					88	Becoming dark grey, with trace fine roots, lignite, coal, cinders, iron staining	84.8	33.4
						Clayey SILT (ML), brown and grey, with trace fine sand, limonite, and iron staining, becoming sandy with depth, natural?	89.5	29.0
30	380				100	Silty CLAY (CL), grey, with traces of lignite	2-2-3	27.5

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 14.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ___ FEET

File 20080124G9

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	MATERIAL DESCRIPTION	PERCENT RECOVERY	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
		and limonite, trace fine grain sand, firm			
35	375	Sandy SILT (ML), tan and grey, highly laminated with silt and clay, traces of lignite, medium dense	100	0-2-8	28.7
40	370	Becoming loose, saturated	100	0-1-3	33.0
45	365	Without laminations of silt and clay, very loose	100	0-1-2	34.1
50	360	Becoming loose, with 2" clay seam near end of spoon	100	1-2-4	29.9
55	355	SAND (SP), grey, fine to coarse grain, with trace 1/4" gravel, very dense	100	15-22-26	
60	350	Becoming dense, with trace gravel up to 1"	89	6-11-20	
65	345	Becoming fine grain sand, without gravel	89	11-14-17	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-2

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Fine grain sandy SILT (ML), grey, medium dense	1-1-9	30.9
75	335				78	SAND (SP), grey, fine to coarse grain, with gravel up to 1/4", dense	9-14-12	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL ⊢ LL
20 40 60

File 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 831960.3 E 890889.5
ELEVATION: 412.2 DATUM:
DATE DRILLED: 09-15-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL ⊢ LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES ROD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	410					6" crushed LIMESTONE Silty Clay FILL (CL), brown, with silt and high plastic clay inclusions and laminations		
5	405				83		88.9	32.0
10	400				100	Sandy Silt FILL (SM), tan, with dark grey high plastic balls, trace lignite, limonite, and small gravel	104.1	19.9
15	395				100	Becoming grey and tan, with fine to medium grain sand, without gravel	102.7 96.1	22.0 25.6
20	390				100	Silty Clay FILL (CL), grey and brown, with grey high plastic balls and tan fine to medium sand seams, becoming more clayey with depth	100.8 99.1	20.4 24.5
25	385				100	CLAY (CH), grey, high plastic, with traces fine sand lenses, trace limonite and iron staining, trace medium sand, some fine roots in top of sample, natural?	90.0	31.0
30					71	Becoming dark grey	95.6	25.0

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY, ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES

WATER LEVELS: DURING DRILLING 49.5 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
PIEZOMETER: INSTALLED AT ____ FEET

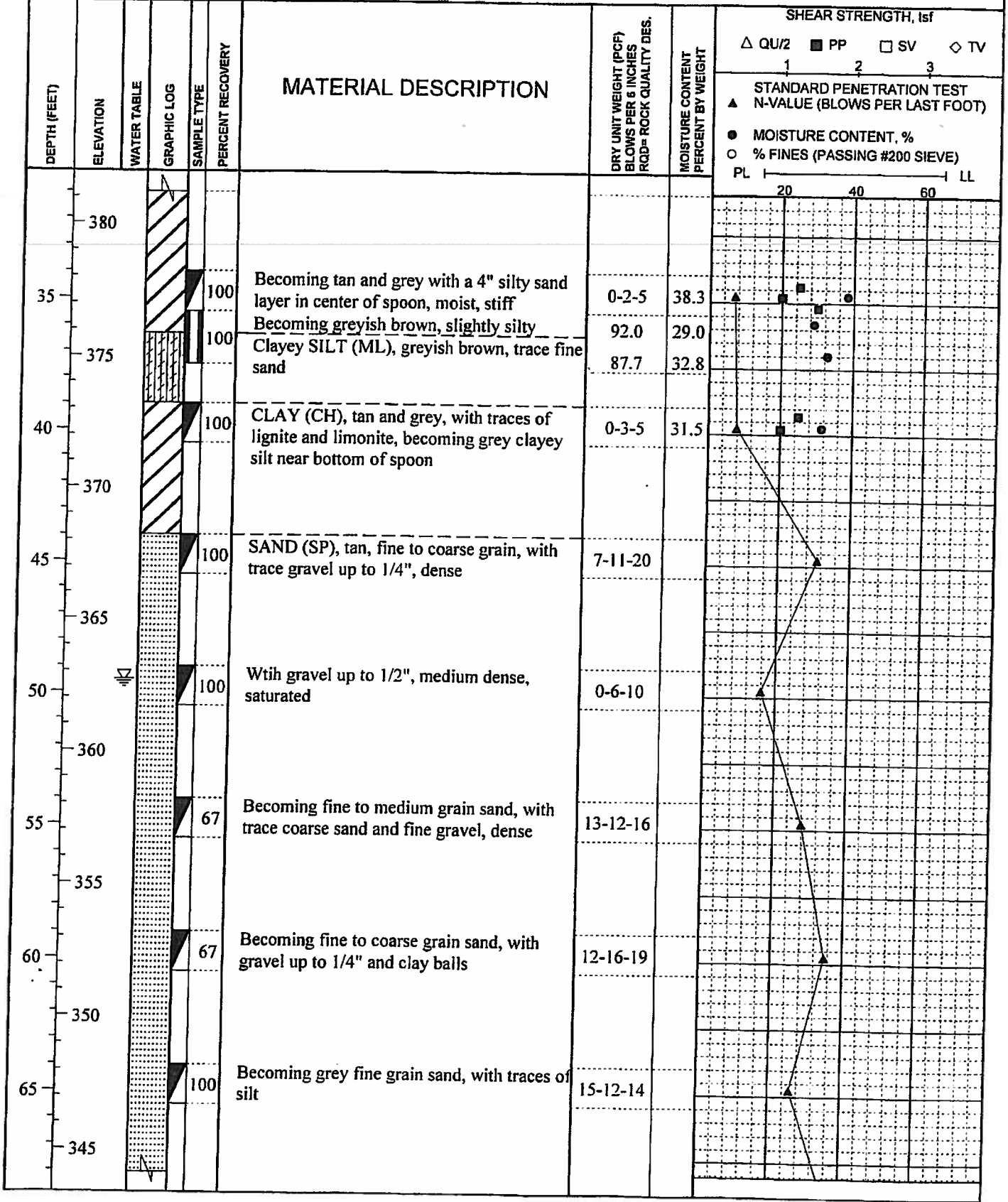
File: 20090012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety



File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-3

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				94	Becoming fine to medium grain sand, with gravel up to 1/4"	10-15-23	
75	335				78	Becoming fine to coarse grain sand	12-15-22	
80	330					Boring terminated in sand at 75'-6"		
85	325							
90	320							
95	315							
100	310							
105								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL ⊢——⊣ LL
20 40 60

File: 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 831798.8 E 890245.6
ELEVATION: 410.6 DATUM:
DATE DRILLED: 09-16-09

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL LL
20 40 60

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
0	410					6" crushed LIMESTONE Silty Clay FILL (CL), brown and grey, trace fine sand, with layers up to 6" of high plastic clay, firm, moist		
5	405				71		96.1 97.6	24.1 25.5
10	400				96		93.1	28.1
15	395				75	Silt FILL (ML), brown, slightly clayey, with trace fine sand, 1/2" high plastic clay seam	93.4	21.2
20	390				100	Becoming tan, very sandy Note: Shelby Tube was pushed with no recovery, Spilt Spoon pushed for sample		29.1
25	385				100	Clayey SILT (ML), grey, highly layered, with layers of clayey silt, sandy silt, and high plastic clay, loose, natural?	1-2-4	29.4
30	380				100	Becoming very loose	1-1-1	33.1

DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES.

WATER LEVELS: DURING DRILLING 37 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ____ FEET

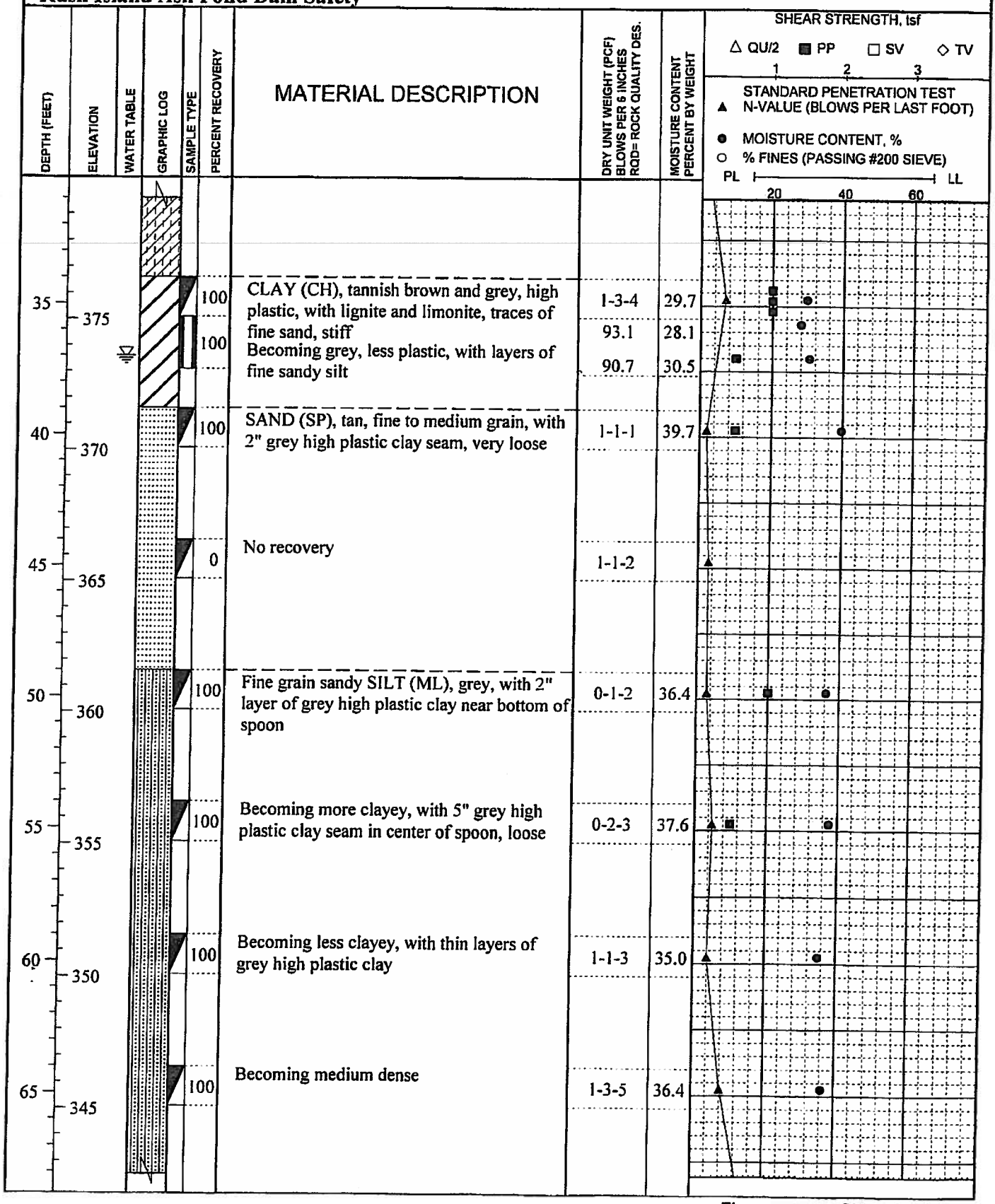
File 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety



File 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-4

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				72	SAND (SP), grey, fine grain, slightly silty, with trace gravel up to 1/8", medium dense	5-6-9	
75	335				61	Becoming fine to medium grain, without gravel, very dense	15-22-26	
						Boring terminated in sand at 75'-6"		
80	330							
85	325							
90	320							
95	315							
100	310							
105								

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)

● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

PL ⊢ LL
20 40 60

File 2009012488

Figure Sheet 3 of 3

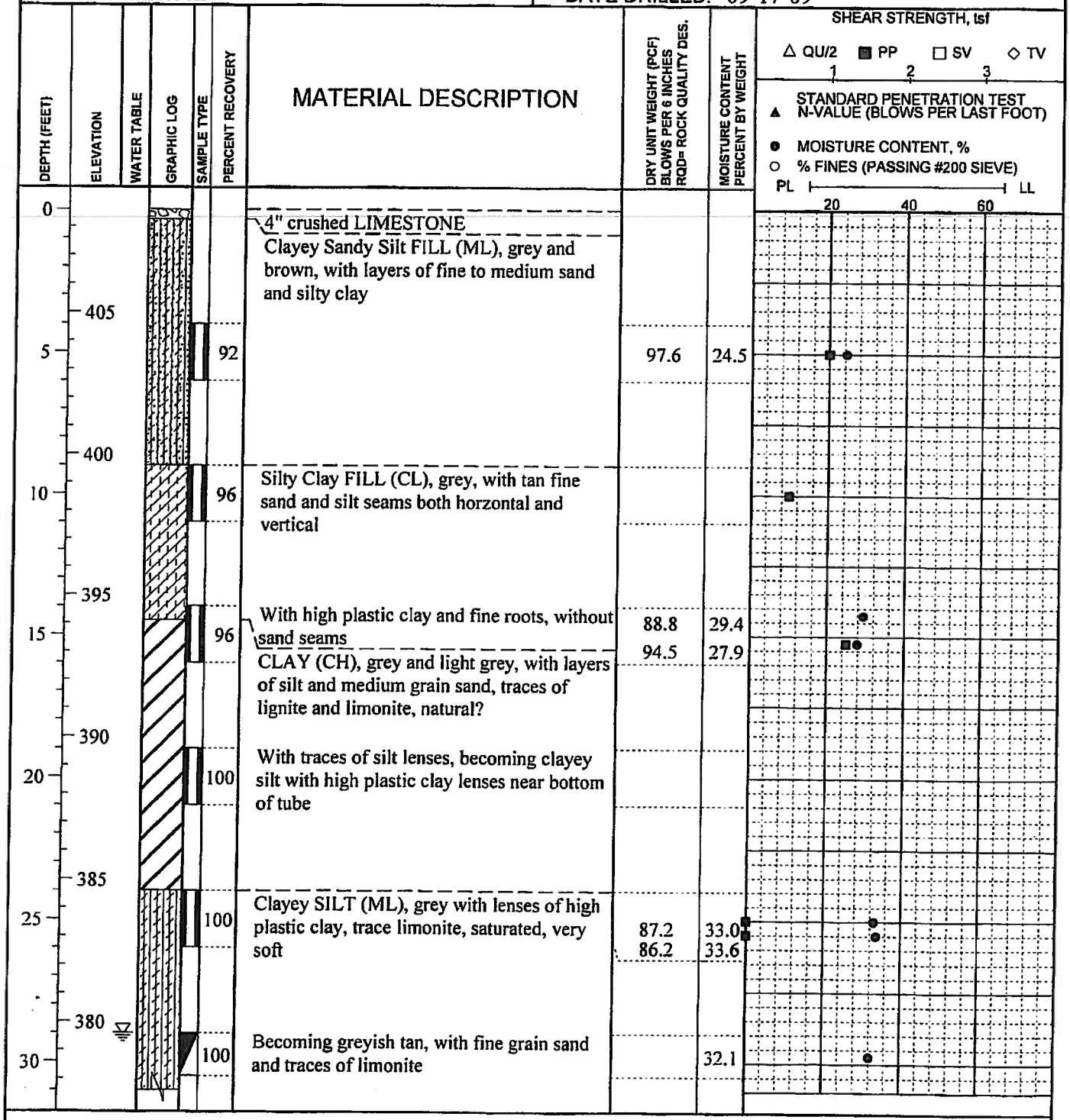
REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

CLIENT: **Ameren**

LOCATION: N 834235.0 E 888471.7
ELEVATION: 408.6 DATUM:
DATE DRILLED: 09-17-09



DRILLER: Jet Drilling
METHOD: 4.25" HSA/Rotary
TYPE OF SPT HAMMER: Automatic
HAMMER EFFICIENCY (%): 78.2
LOGGED BY: J. Pruett

STRATIFICATION LINES ARE APPROXIMATE SOIL BOUNDARIES ONLY; ACTUAL CHANGES MAY BE GRADUAL OR MAY OCCUR BETWEEN SAMPLES

WATER LEVELS: DURING DRILLING 29 FEET
N BORING DRY AT COMPLETION OF DRILLING
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS

PIEZOMETER: INSTALLED AT ___ FEET

File: 2009012468

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) BLOWS PER 6 INCHES RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
			Note: Shelby Tube was pushed with no recovery, Spilt Spoon pushed for sample		
35	375	100	Fine grain sandy SILT (ML), greyish tan, slightly clayey, loose	3-2-3	34.6
40	370	100	SAND (SP), grey, fine to medium grain	2-6-12	
45	365	100	CLAY (CH-CL), grey, layers of high plastic clay and low plastic silty clay, stiff	0-1-5	42.4
50	360	100	SAND (SP), grey, fine to coarse grain, medium dense	0-3-13	55.7
55	355	89	With 3" layer of high plastic clay at bottom of spoon	13-10-5	44.5
60	350	61	Becoming fine to medium grain sand, with gravel up to 1/4", dense	13-17-15	
65	345	78	Becoming fine to coarse grain sand, very dense	13-16-24	

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)
PL ⊢ LL
20 40 60

File 2009012469

Figure

REITZ & JENS, INC.
CONSULTING ENGINEERS

BORING LOG B-6

Rush Island Ash Pond Dam Safety

DEPTH (FEET)	ELEVATION	WATER TABLE	GRAPHIC LOG	SAMPLE TYPE	PERCENT RECOVERY	MATERIAL DESCRIPTION	DRY UNIT WEIGHT (PCF) / BLOWS PER 6 INCHES / RQD= ROCK QUALITY DES.	MOISTURE CONTENT PERCENT BY WEIGHT
70	340				83		16-23-34	
75	335				61	Without gravel, dense	10-15-19	
80	330					Boring terminated in sand at 75'-6"		
85	325							
90	320							
95	315							
100	310							
105	305							

SHEAR STRENGTH, tsf
△ QU/2 ■ PP □ SV ◇ TV
1 2 3

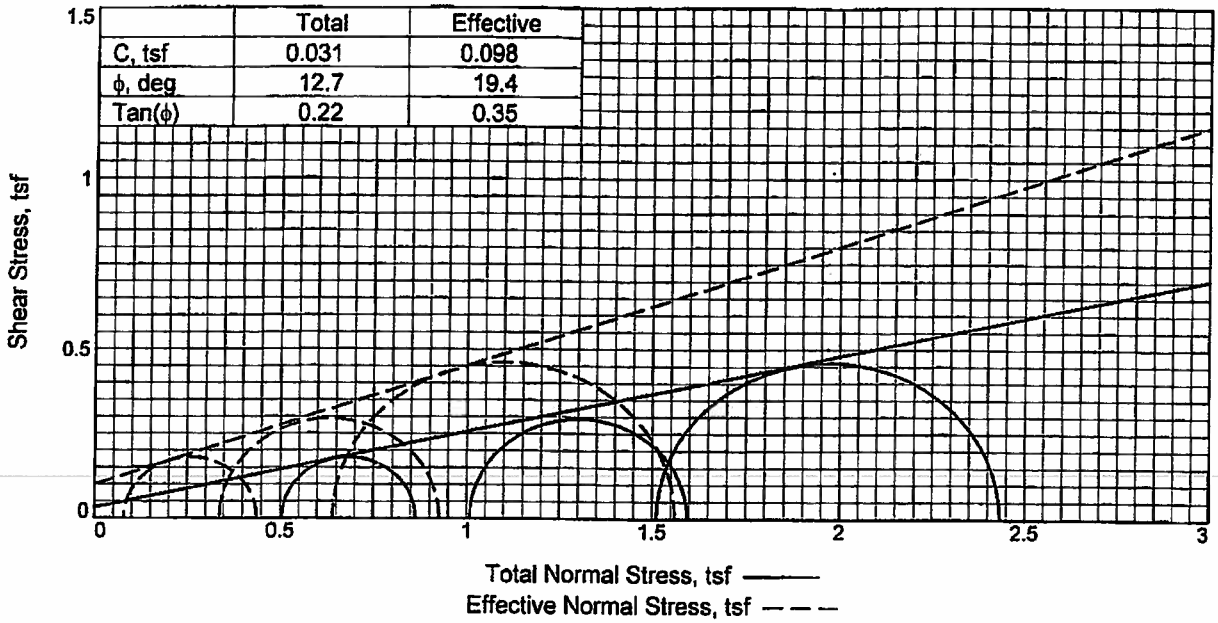
STANDARD PENETRATION TEST
▲ N-VALUE (BLOWS PER LAST FOOT)
● MOISTURE CONTENT, %
○ % FINES (PASSING #200 SIEVE)

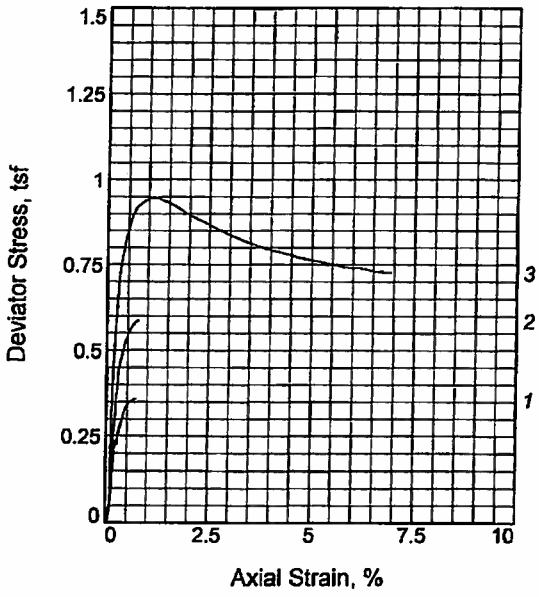
PL ⊢ LL
20 40 60

File: 2008012469

Figure

	Total	Effective
C, tsf	0.031	0.098
ϕ, deg	12.7	19.4
Tan(ϕ)	0.22	0.35





Sample No.		1	2	3
Initial	Water Content,	34.5	34.5	34.5
	Dry Density, pcf	64.1	64.1	64.1
	Saturation,	59.7	59.7	59.7
	Void Ratio	1.4555	1.4555	1.4555
	Diameter, in.	2.86	2.86	2.86
	Height, in.	6.00	6.00	6.00
At Test	Water Content,	50.5	49.0	48.2
	Dry Density, pcf	69.2	70.4	71.1
	Saturation,	100.0	100.0	100.0
	Void Ratio	1.2721	1.2346	1.2135
	Diameter, in.	2.79	2.78	2.79
	Height, in.	5.85	5.78	5.72
Strain rate, %/min.		0.30	0.30	0.10
Back Pressure, tsf		4.68	5.11	5.83
Cell Pressure, tsf		5.18	6.12	7.34
Fail. Stress, tsf		0.36	0.59	0.92
Total Pore Pr., tsf		5.10	5.78	6.70
Ult. Stress, tsf		0.36	0.59	0.92
Total Pore Pr., tsf		5.10	5.78	6.70
$\bar{\sigma}_1$ Failure, tsf		0.44	0.93	1.56
$\bar{\sigma}_3$ Failure, tsf		0.08	0.34	0.64

Type of Test:
CU with Pore Pressures

Sample Type: Compacted

Description: Fly Ash, at approximately 81% of standard proctor maximum dry density

Assumed Specific Gravity= 2.52

Remarks:

Client: Ameren UE

Project: UWL Dry Cell Design

Source of Sample: Sioux Fly Ash

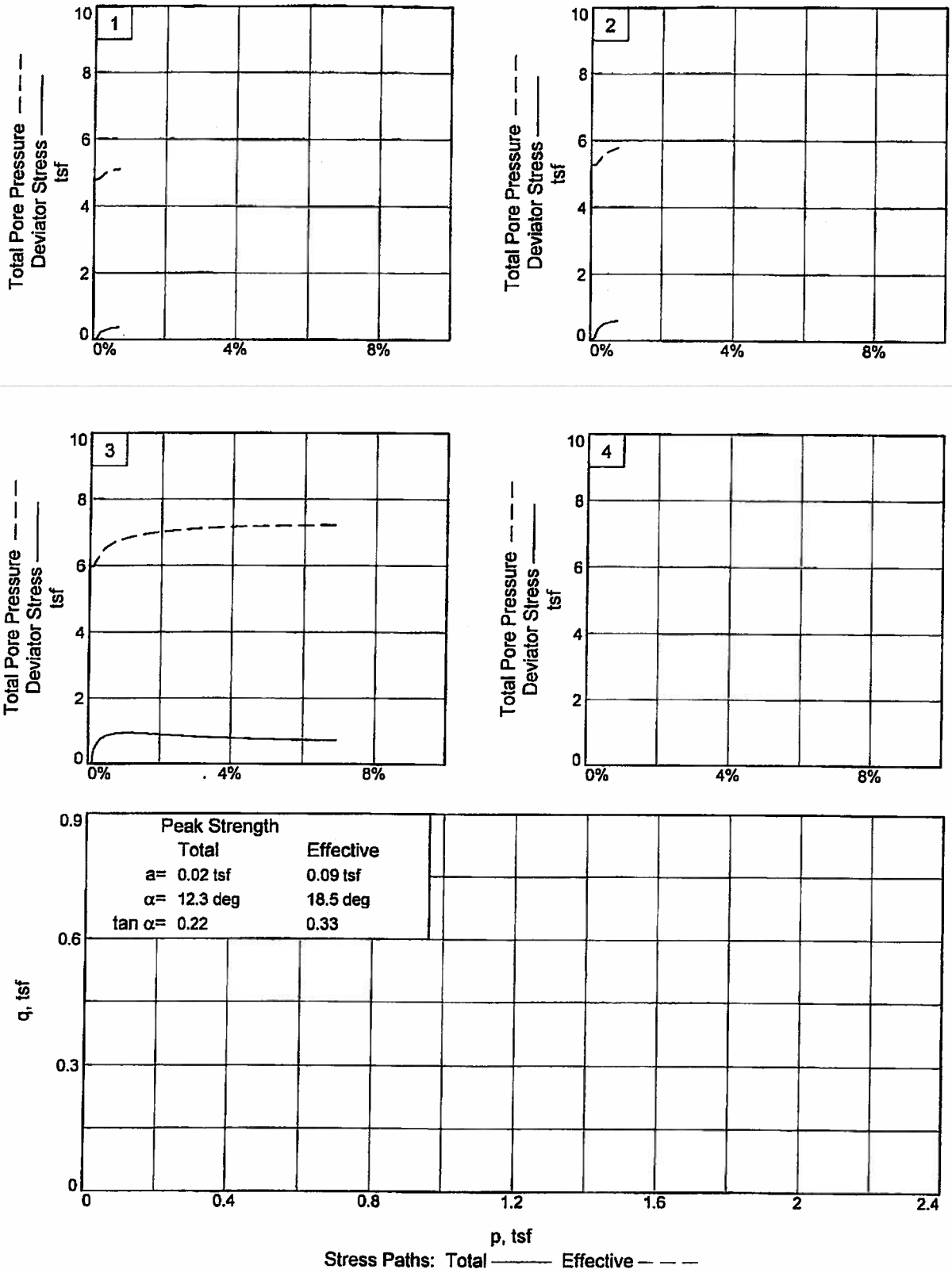
Sample Number: Grab-1

Proj. No.: 2009012470 **Date:**

REITZ & JENS, INC.
CONSULTING ENGINEERS

Figure 1

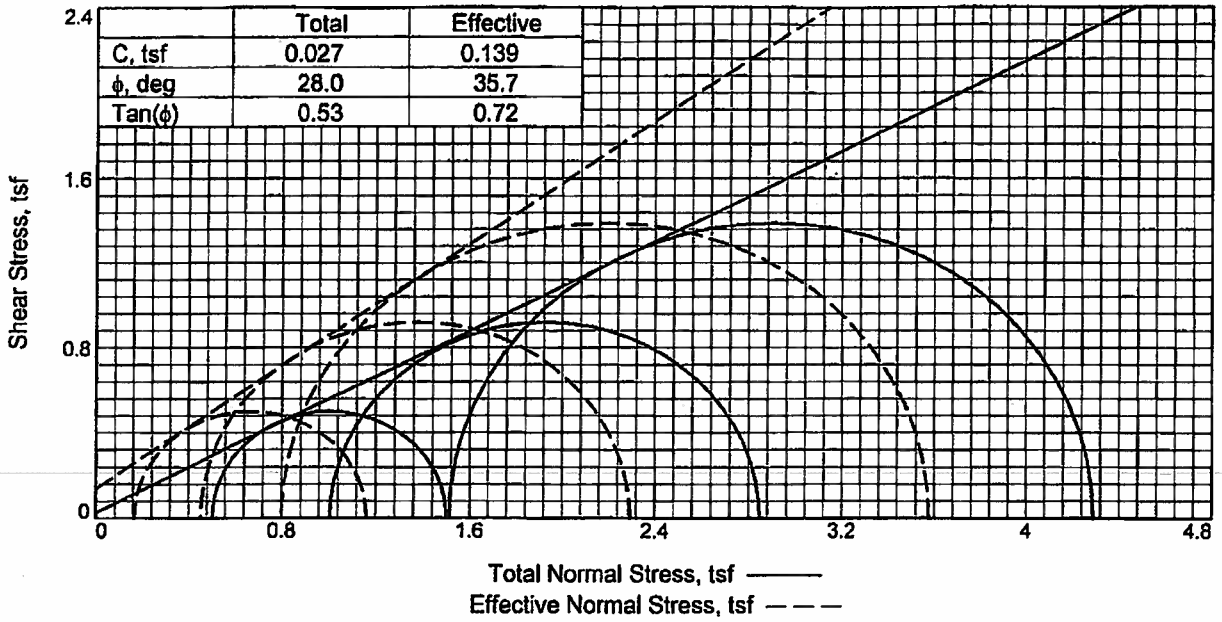
Tested By: K. Kocher **Checked By:** J. Fouse



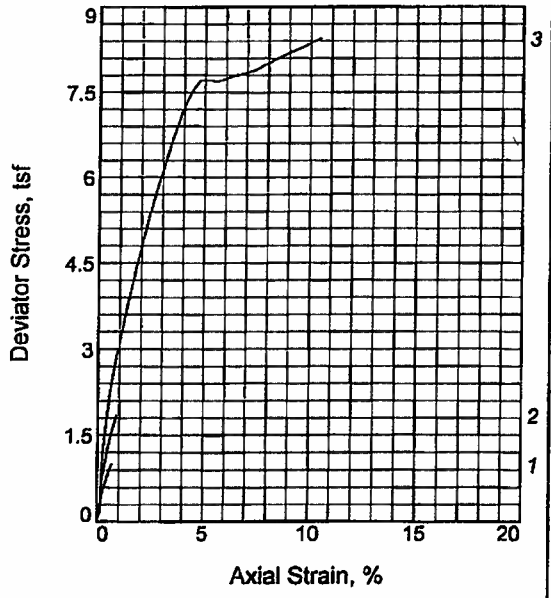
Client: Ameren UE
Project: UWL Dry Cell Design
Source of Sample: Sioux Fly Ash **Sample Number:** Grab-1
Project No.: 2009012470 **Figure** _____

REITZ & JENS, INC.

Tested By: K. Kocher **Checked By:** J. Fouse



	Total	Effective
C, tsf	0.027	0.139
ϕ, deg	28.0	35.7
Tan(ϕ)	0.53	0.72



Sample No.		1	2	3
Initial	Water Content,	35.2	35.2	35.2
	Dry Density, pcf	78.9	78.9	78.9
	Saturation,	89.3	89.3	89.3
	Void Ratio	0.9944	0.9944	0.9944
	Diameter, in.	2.86	2.86	2.86
	Height, in.	6.00	6.00	6.00
At Test	Water Content,	37.2	36.9	36.7
	Dry Density, pcf	81.2	81.5	81.8
	Saturation,	100.0	100.0	100.0
	Void Ratio	0.9370	0.9311	0.9242
	Diameter, in.	2.84	2.84	2.85
	Height, in.	5.95	5.90	5.84
Strain rate, %/min.		0.30	0.30	0.30
Back Pressure, tsf		3.96	4.32	4.90
Cell Pressure, tsf		4.46	5.33	6.41
Fail. Stress, tsf		1.00	1.84	2.78
Total Pore Pr., tsf		4.30	4.87	5.61
Ult. Stress, tsf		1.00	1.84	2.78
Total Pore Pr., tsf		4.30	4.87	5.61
$\bar{\sigma}_1$ Failure, tsf		1.16	2.29	3.58
$\bar{\sigma}_3$ Failure, tsf		0.17	0.45	0.80

Type of Test:
CU with Pore Pressures

Sample Type: Compacted

Description: Fly Ash, at approximately 100% of standard proctor maximum dry density

Assumed Specific Gravity= 2.52

Remarks:

Client: Ameren UE

Project: UWL Dry Cell Design

Source of Sample: Sioux Fly Ash

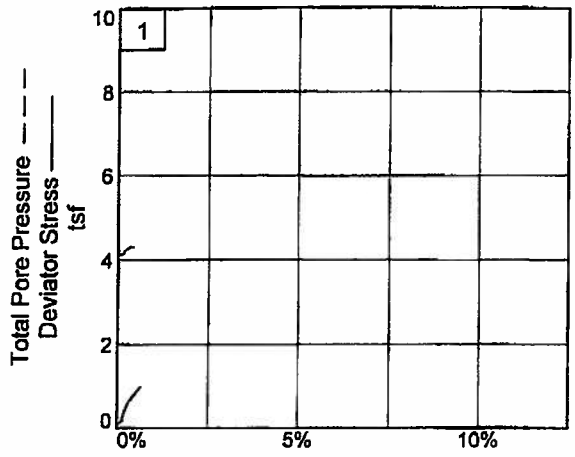
Sample Number: Grab-1

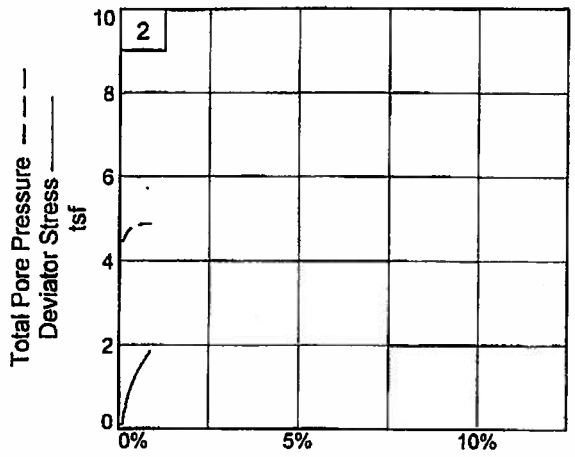
Proj. No.: 2009012470 **Date:**

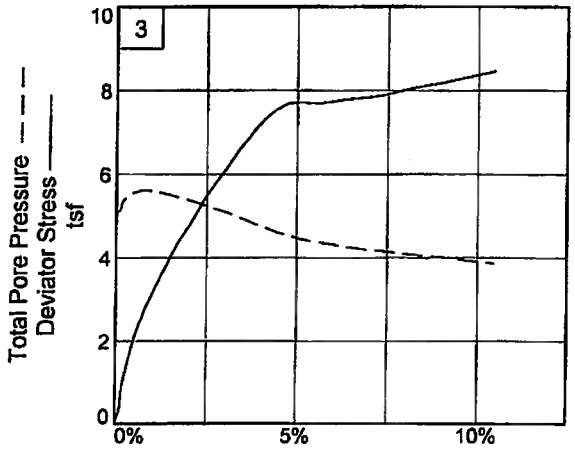
REITZ & JENS, INC.
CONSULTING ENGINEERS

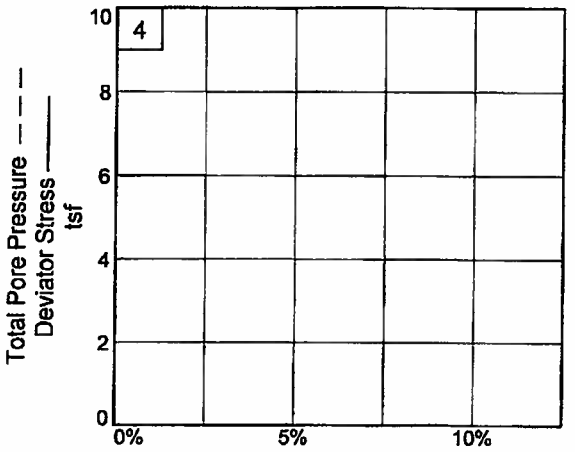
Figure 2

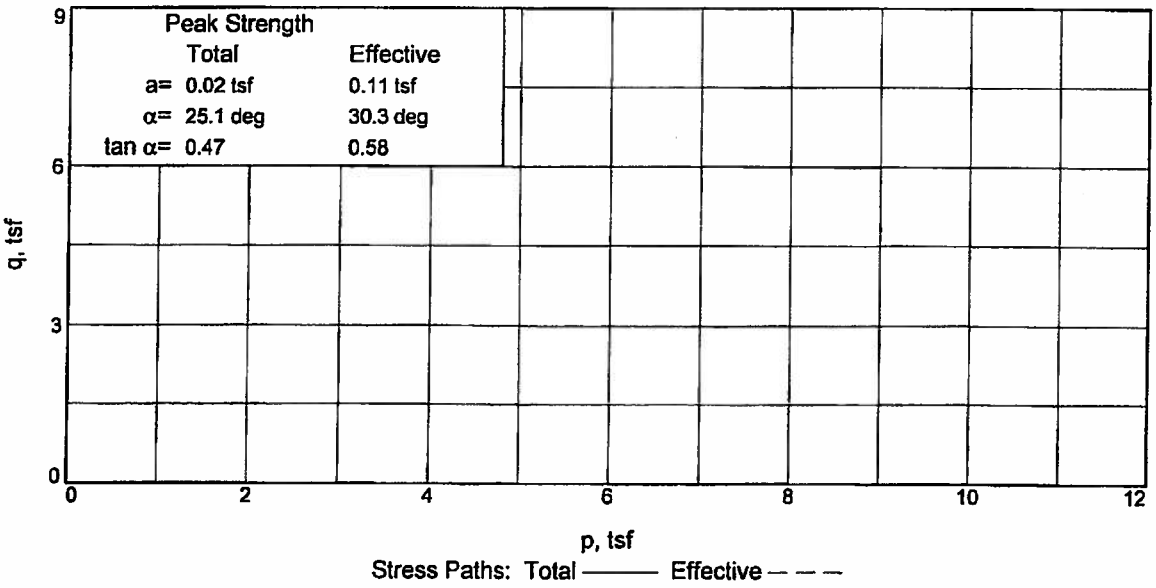
Tested By: K. Kocher **Checked By:** J. Fouse











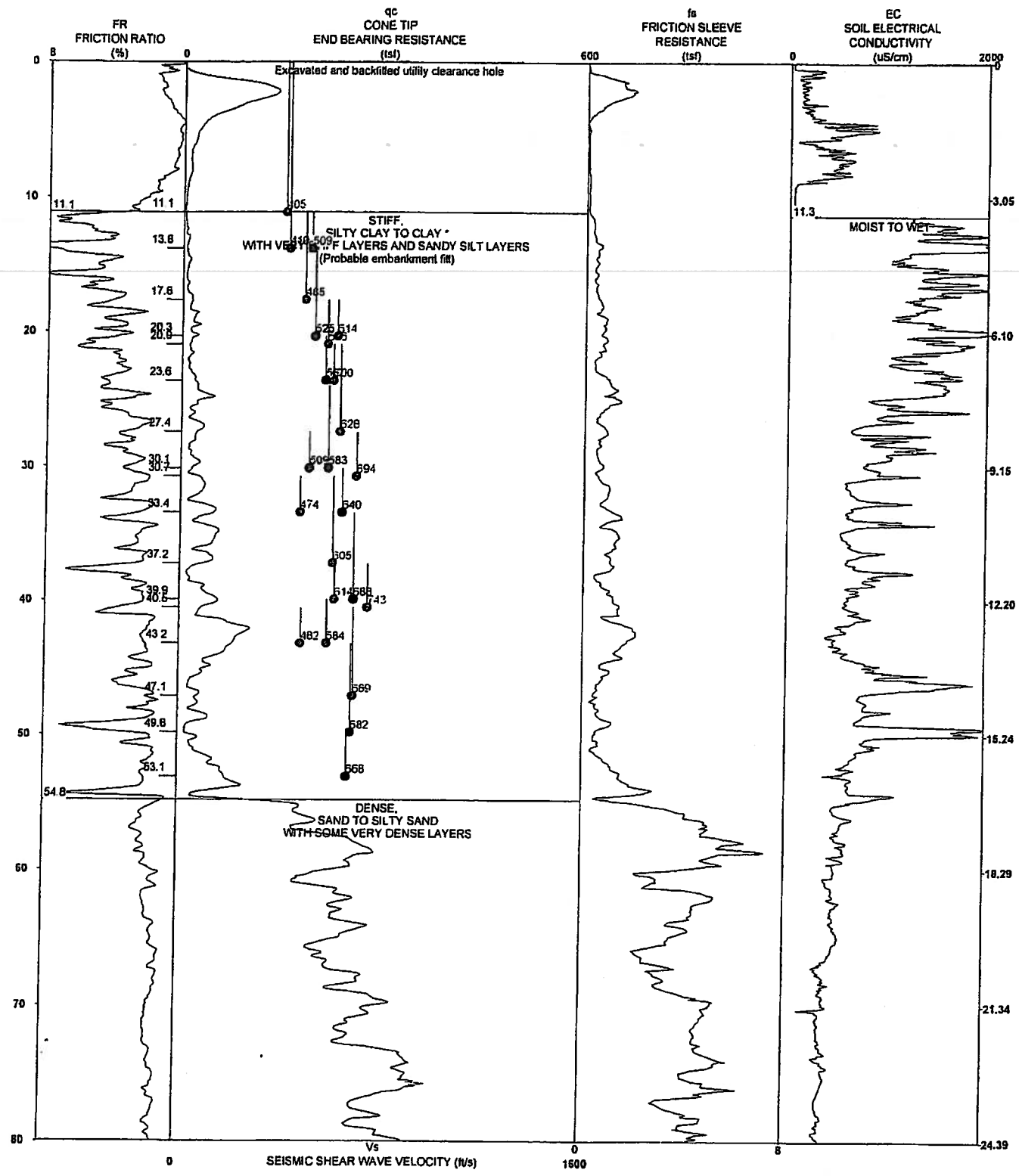
Client: Ameren UE
Project: UWL Dry Cell Design
Source of Sample: Sioux Fly Ash
Sample Number: Grab-1
Project No.: 2009012470
Figure _____

REITZ & JENS, INC.

Tested By: K. Kocher
Checked By: J. Fouse

CPT Logs

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12324 Longitude: -90.25558

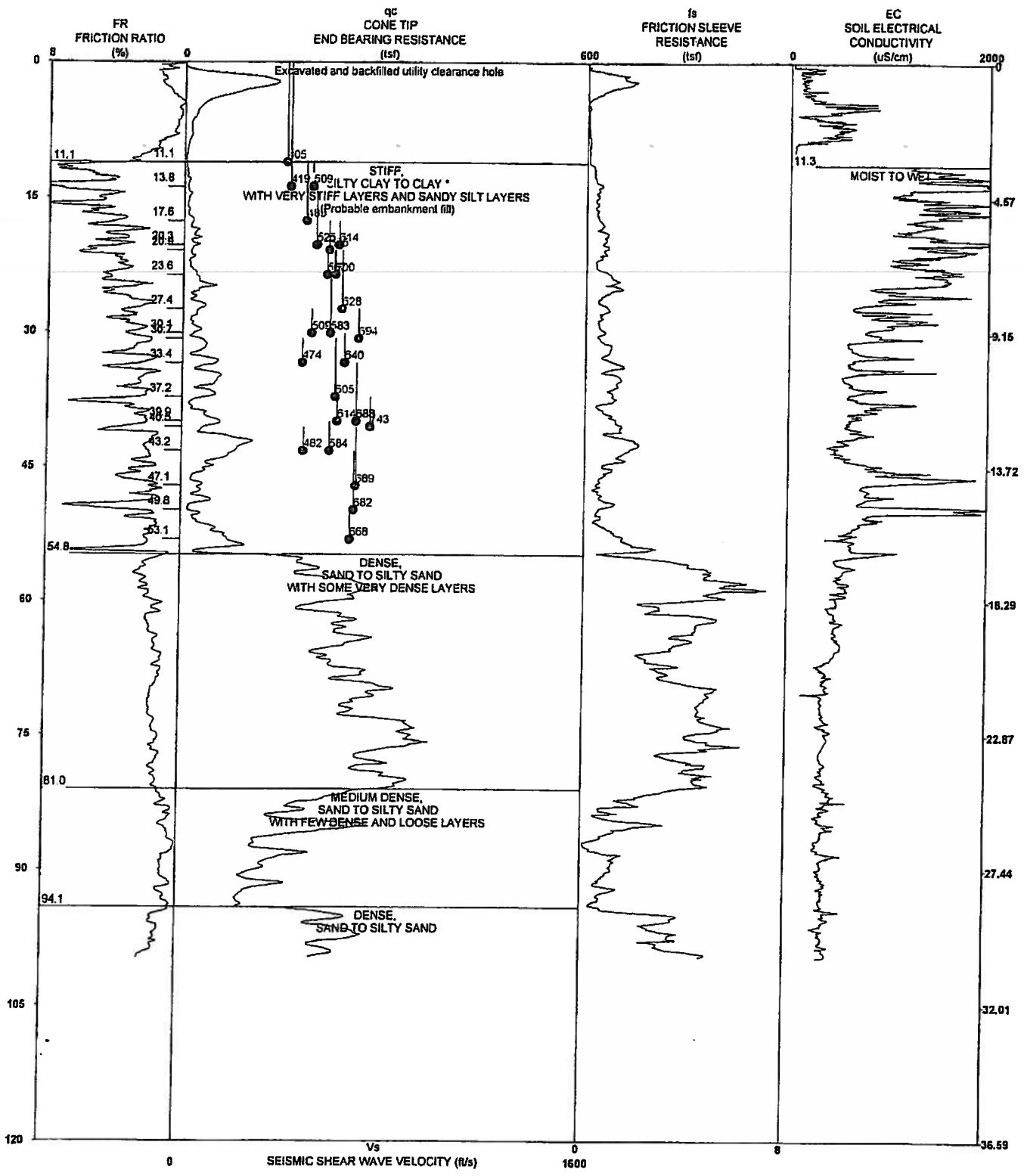
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



- 1600 ft/sec True Shear Wave Velocity
- 1600 ft/sec Pseudo Interval Receiver 1
- 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12324 Longitude: -90.25558

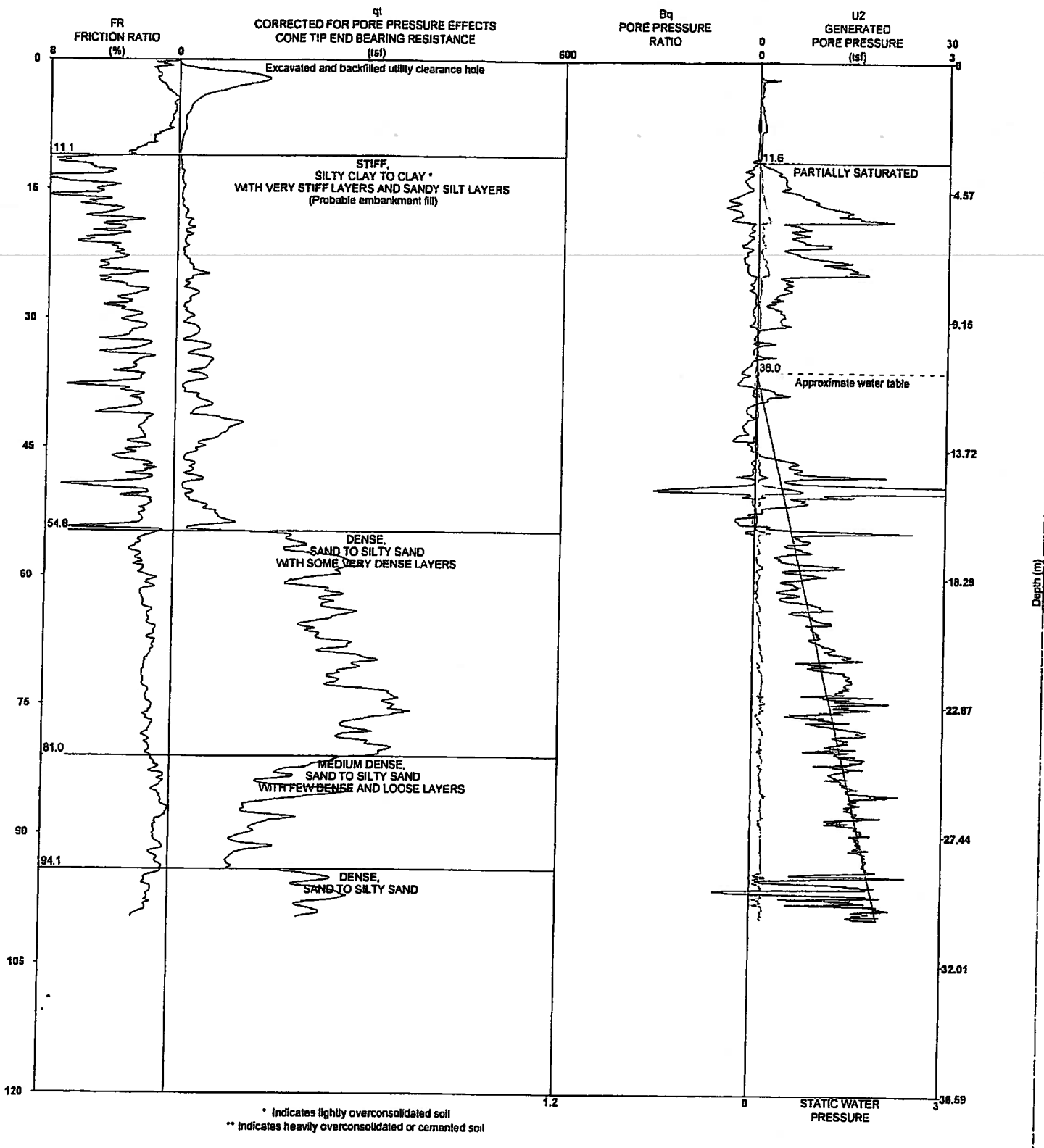
PROJECT NAME:Ameren UE Rush Island Levee Investigation
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

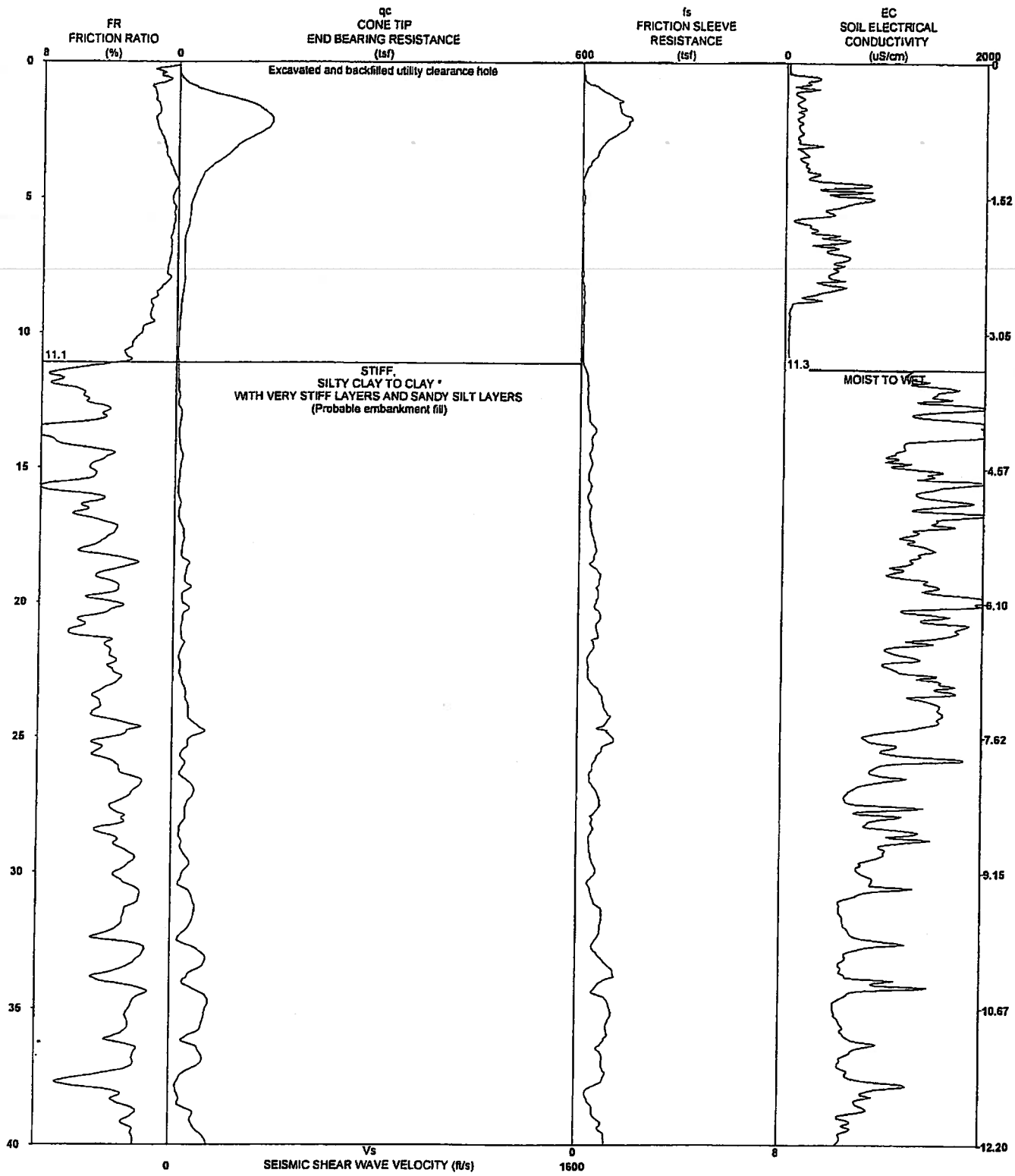
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

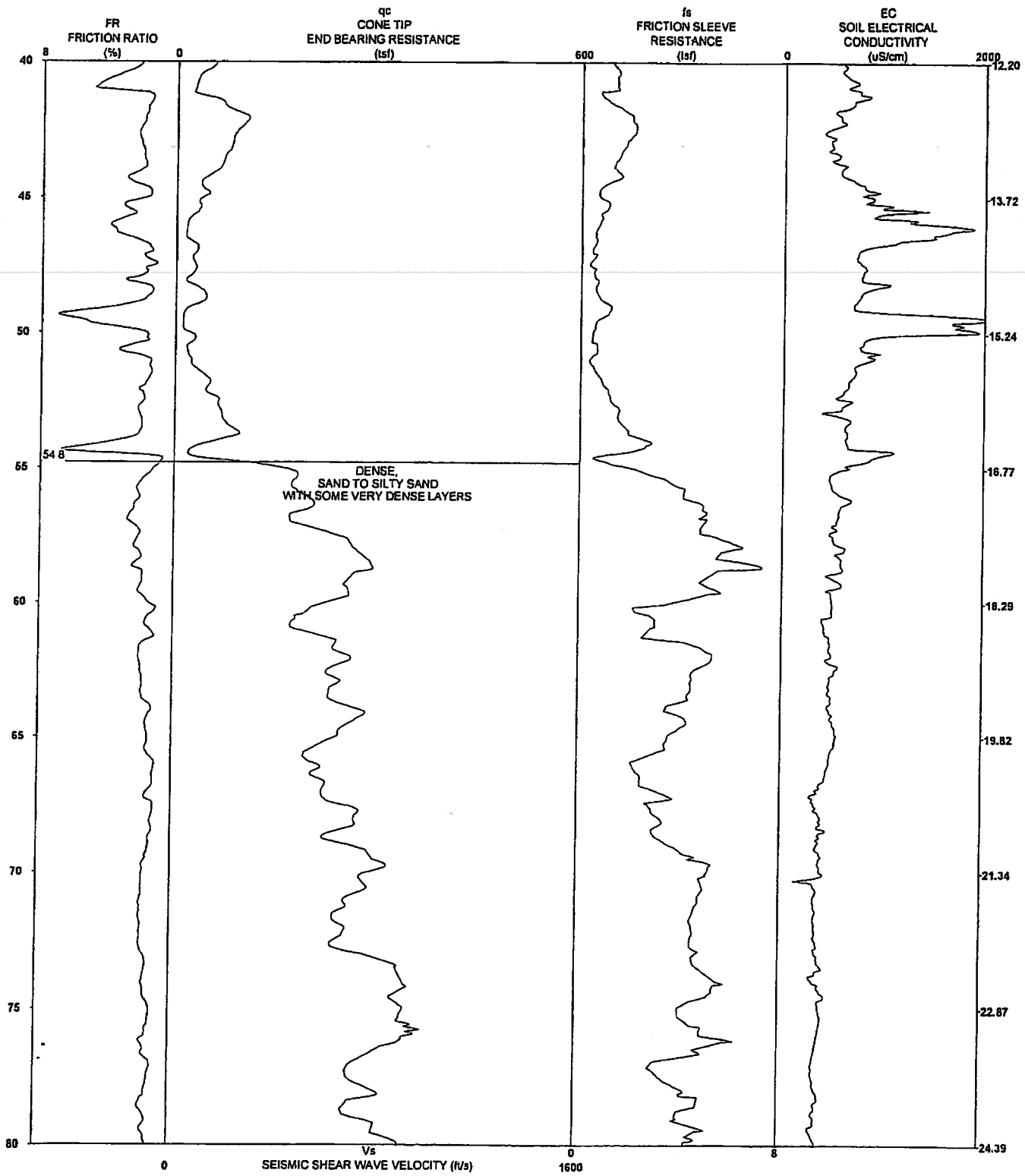
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

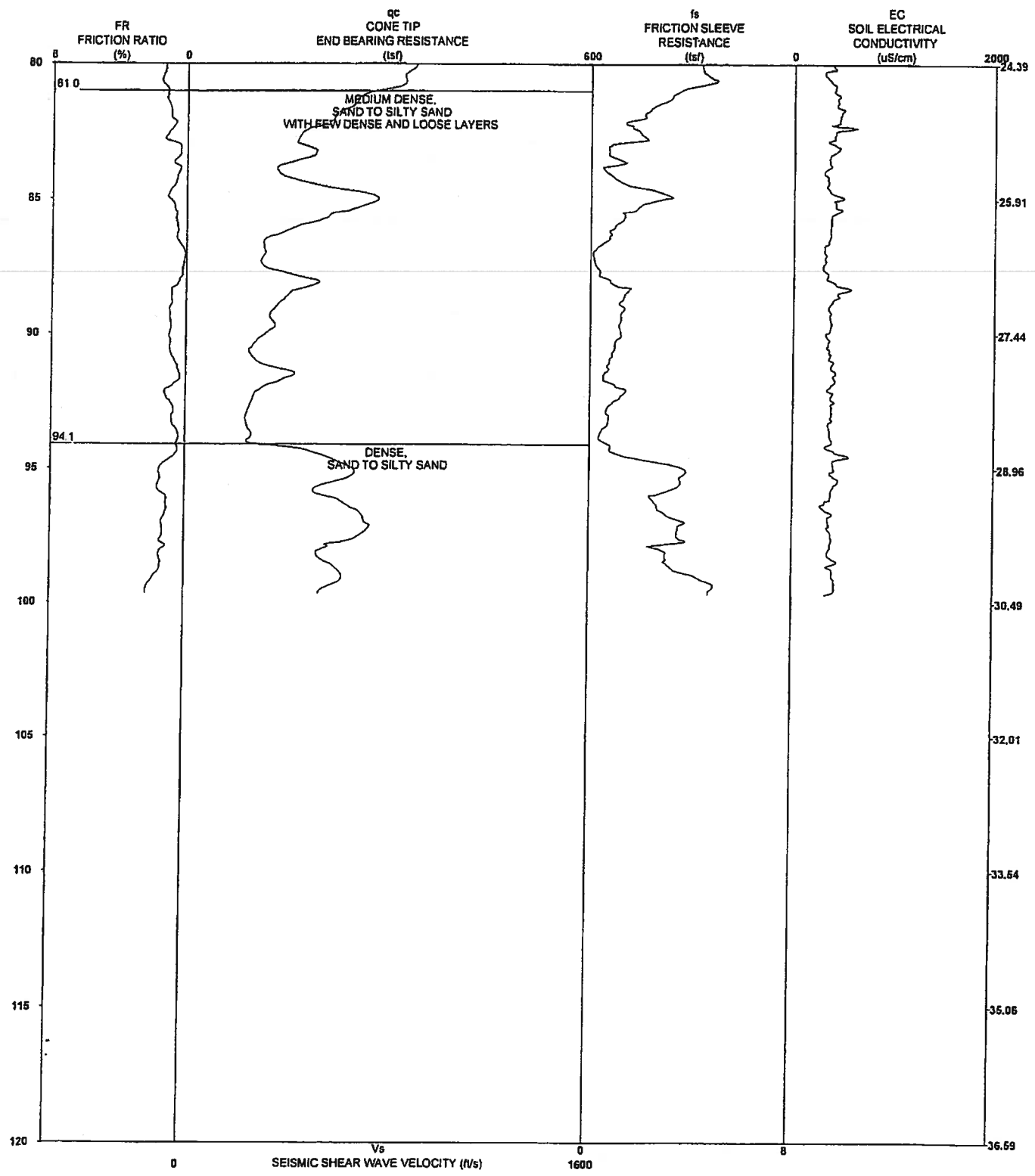
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP01



Latitude: 38.12324 Longitude: -90.25558

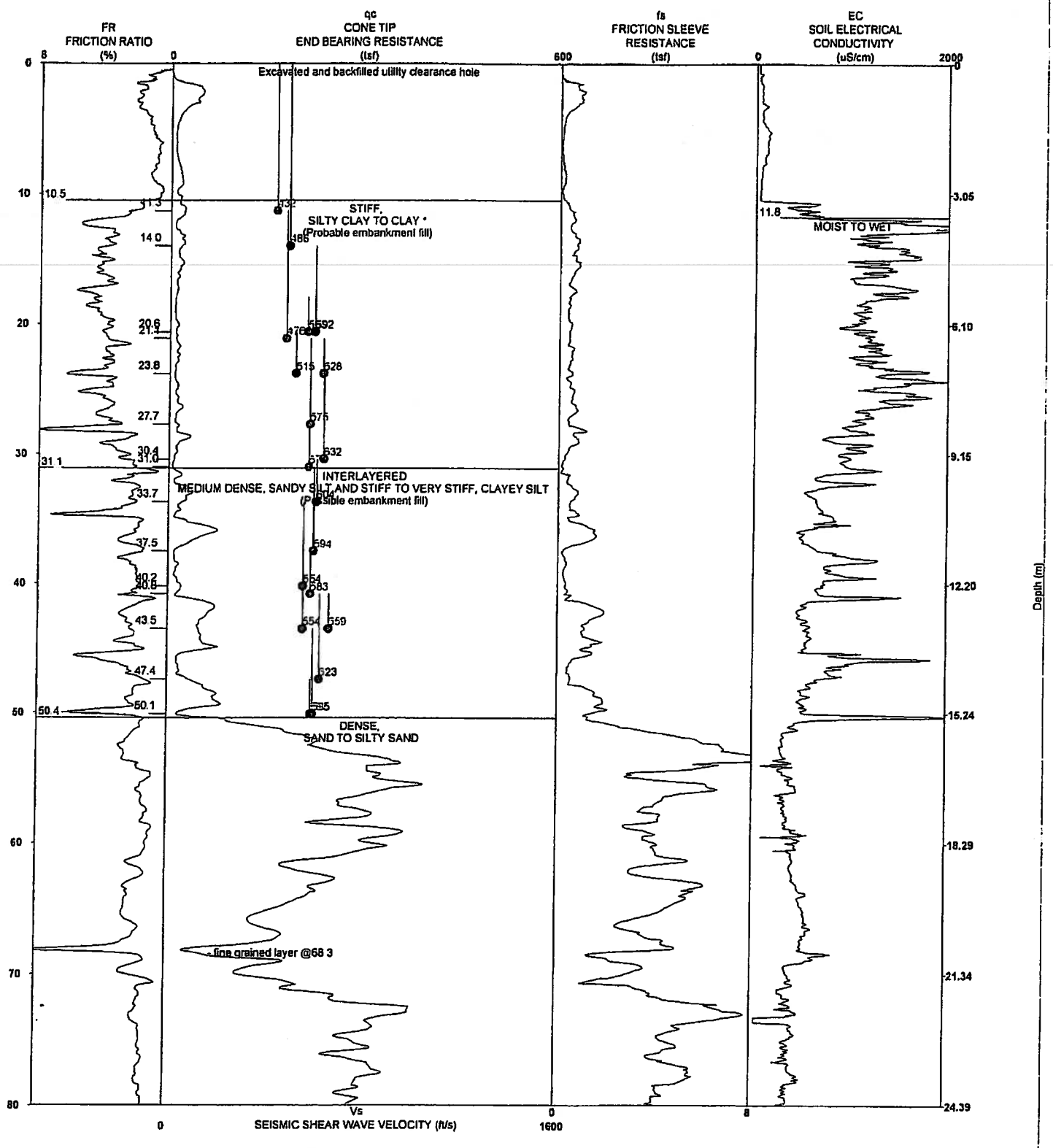
PROJECT NAME:Ameren UE Rush Island Levee Investigation
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/28/2009 TIME:9:35 AM
SOUNDING NUMBER:CP-01

CP01

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



- 1600 ft/sec True Shear Wave Velocity
- 1600 ft/sec Pseudo Interval Receiver 1
- 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

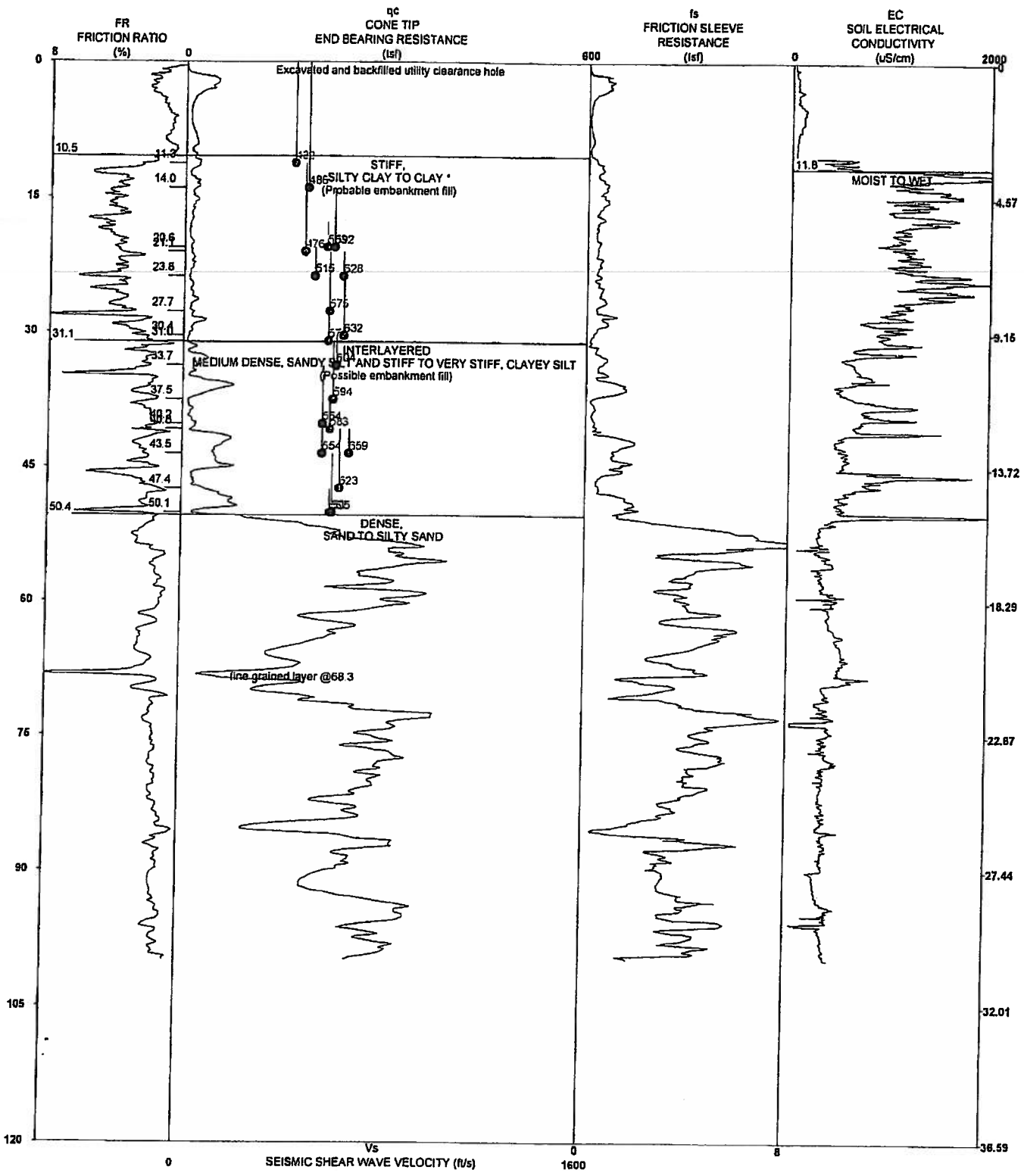
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



- 1600 ft/sec True Shear Wave Velocity
- 1600 ft/sec Pseudo Interval Receiver 1
- 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

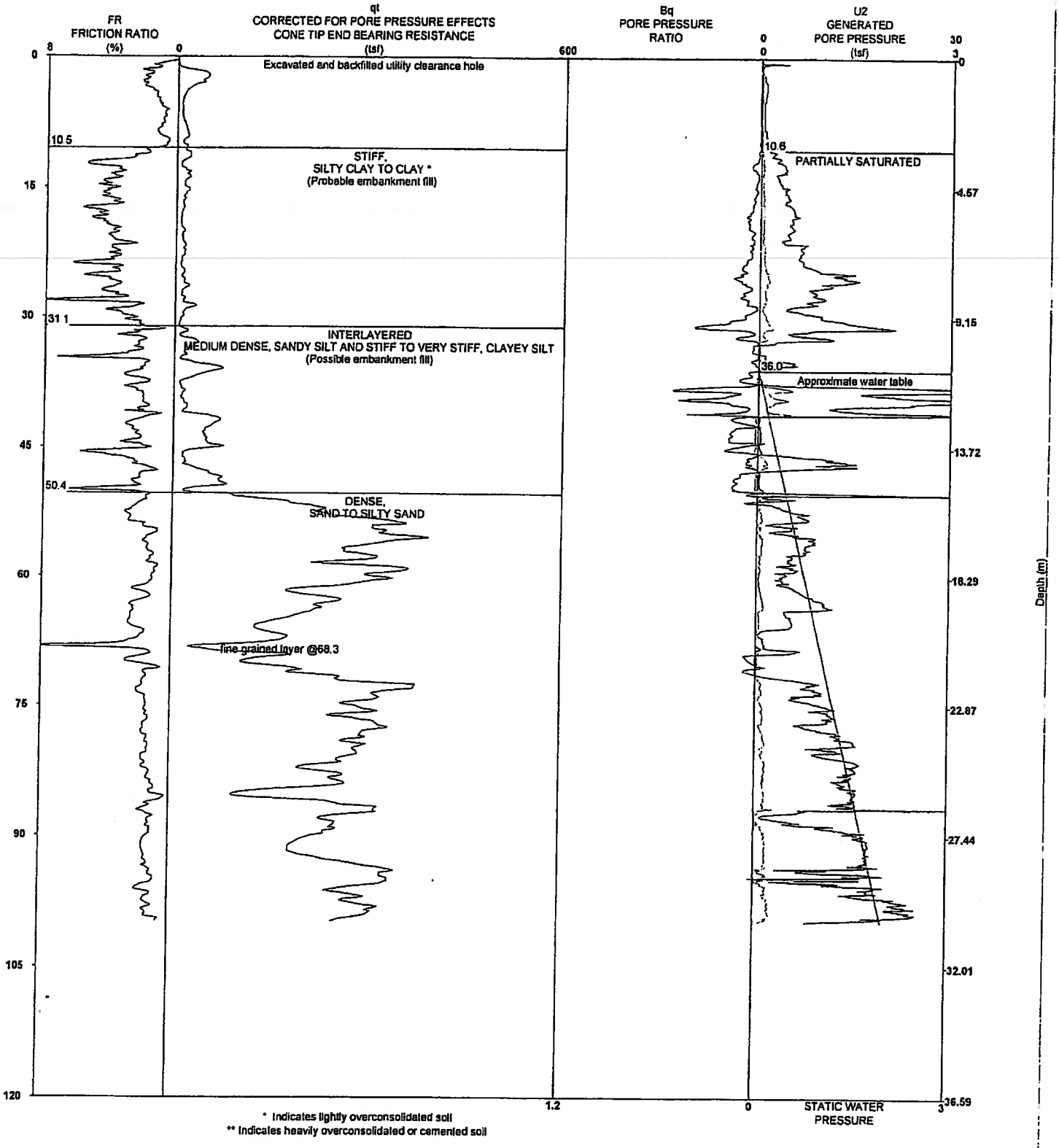
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



Latitude: 0.00000 Longitude: 0.00000

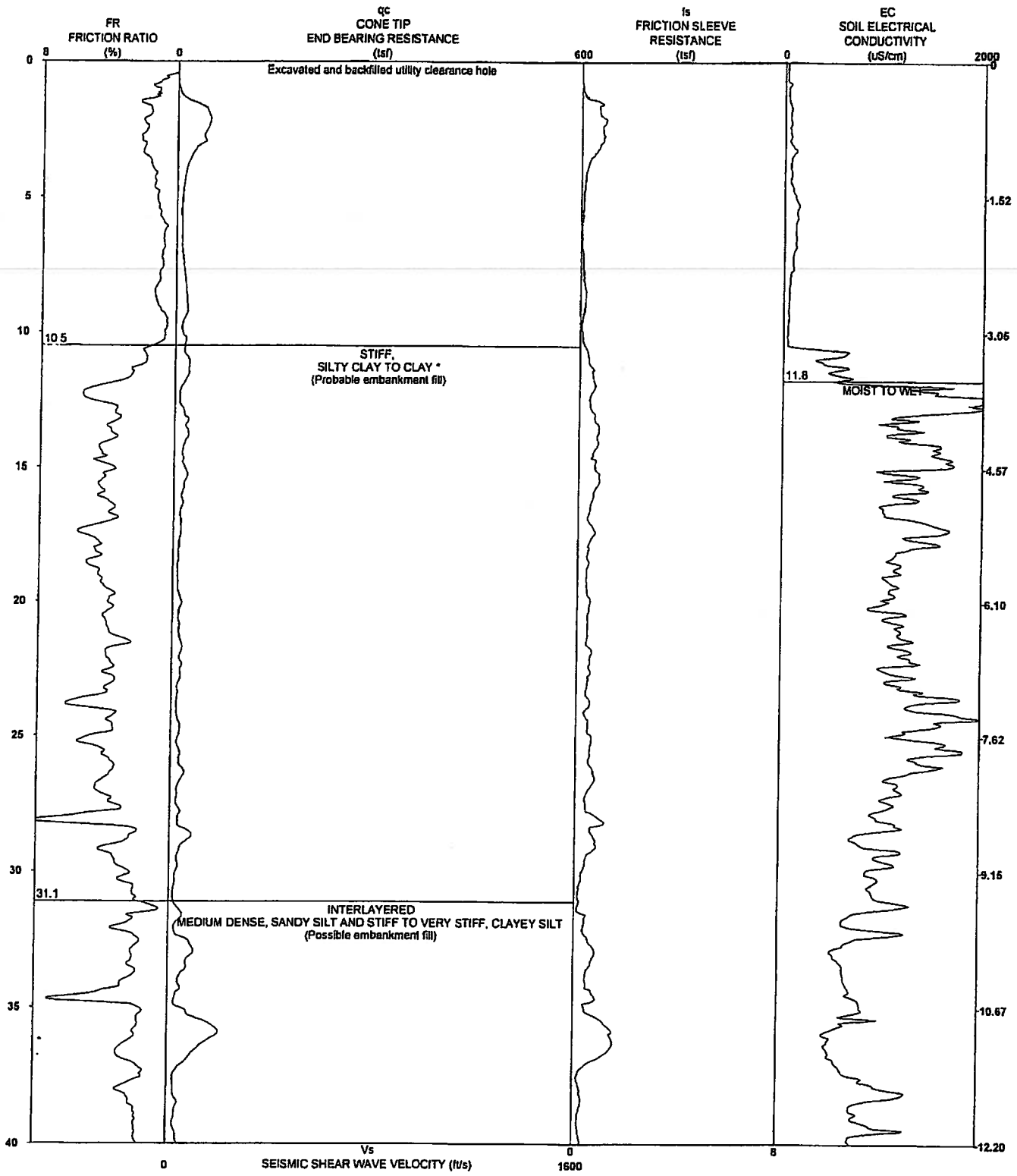
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



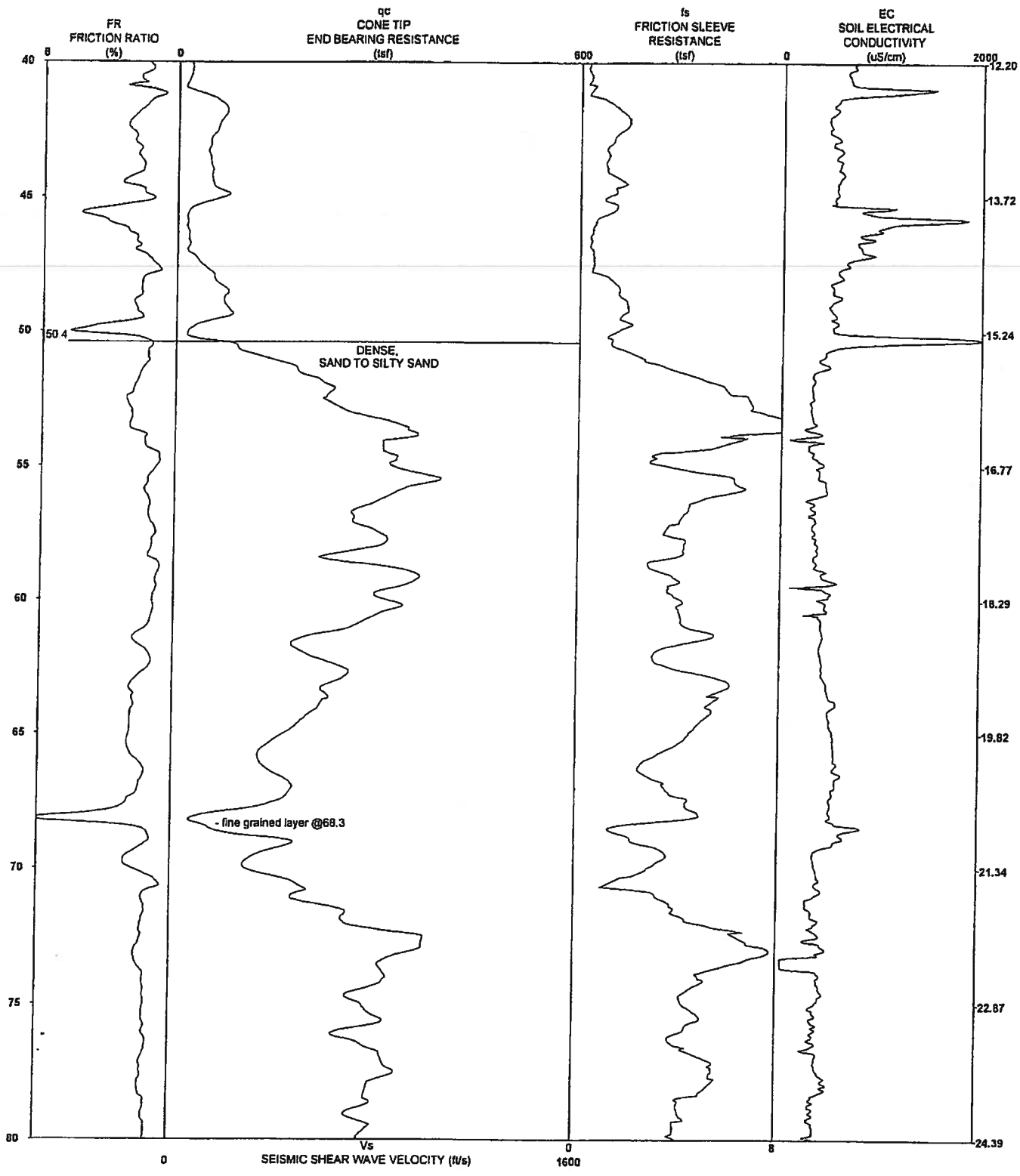
Latitude: 0.00000 Longitude: 0.00000

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02
CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



Latitude: 0.00000 Longitude: 0.00000

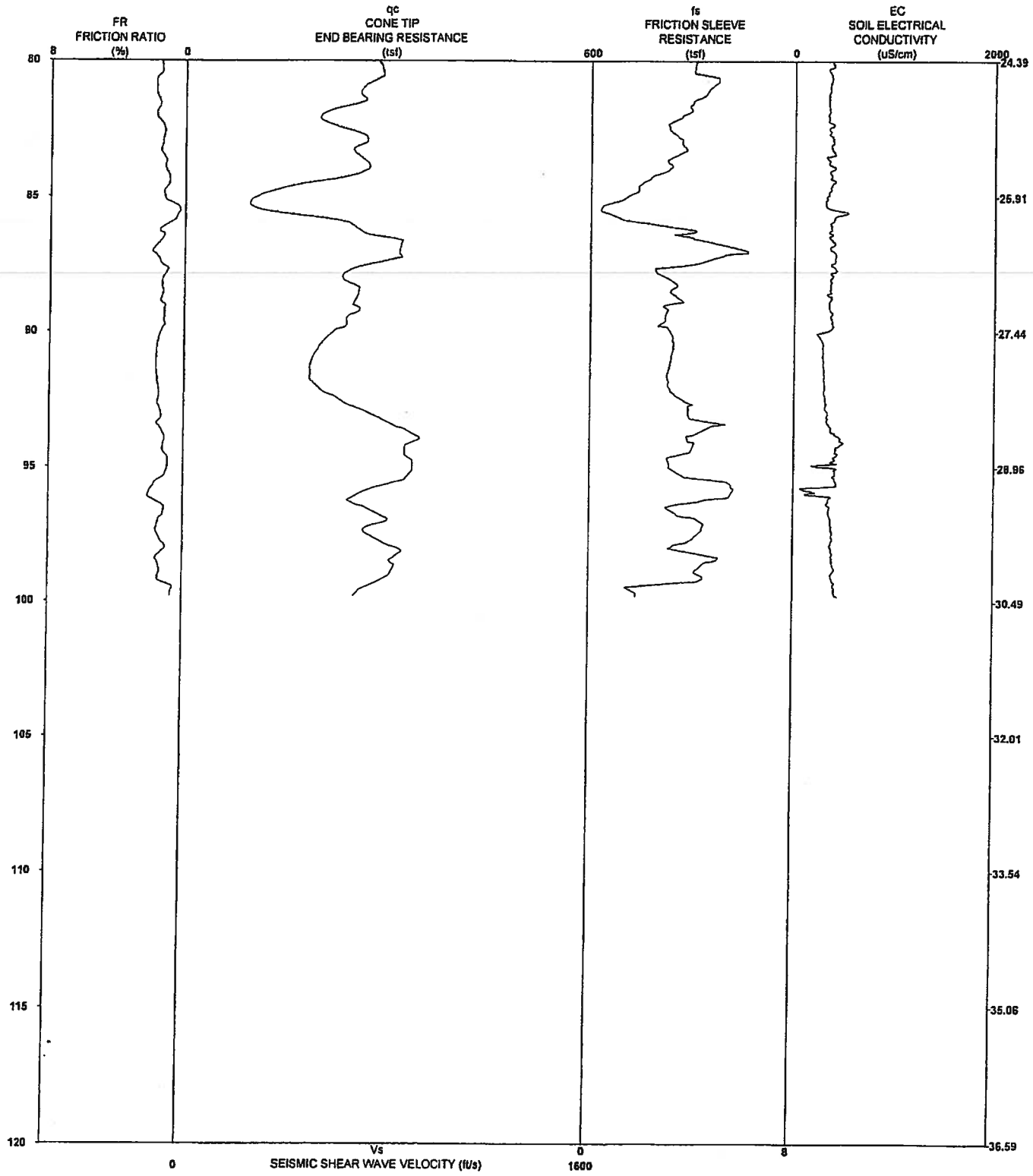
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP02



Latitude: 0.00000 Longitude: 0.00000

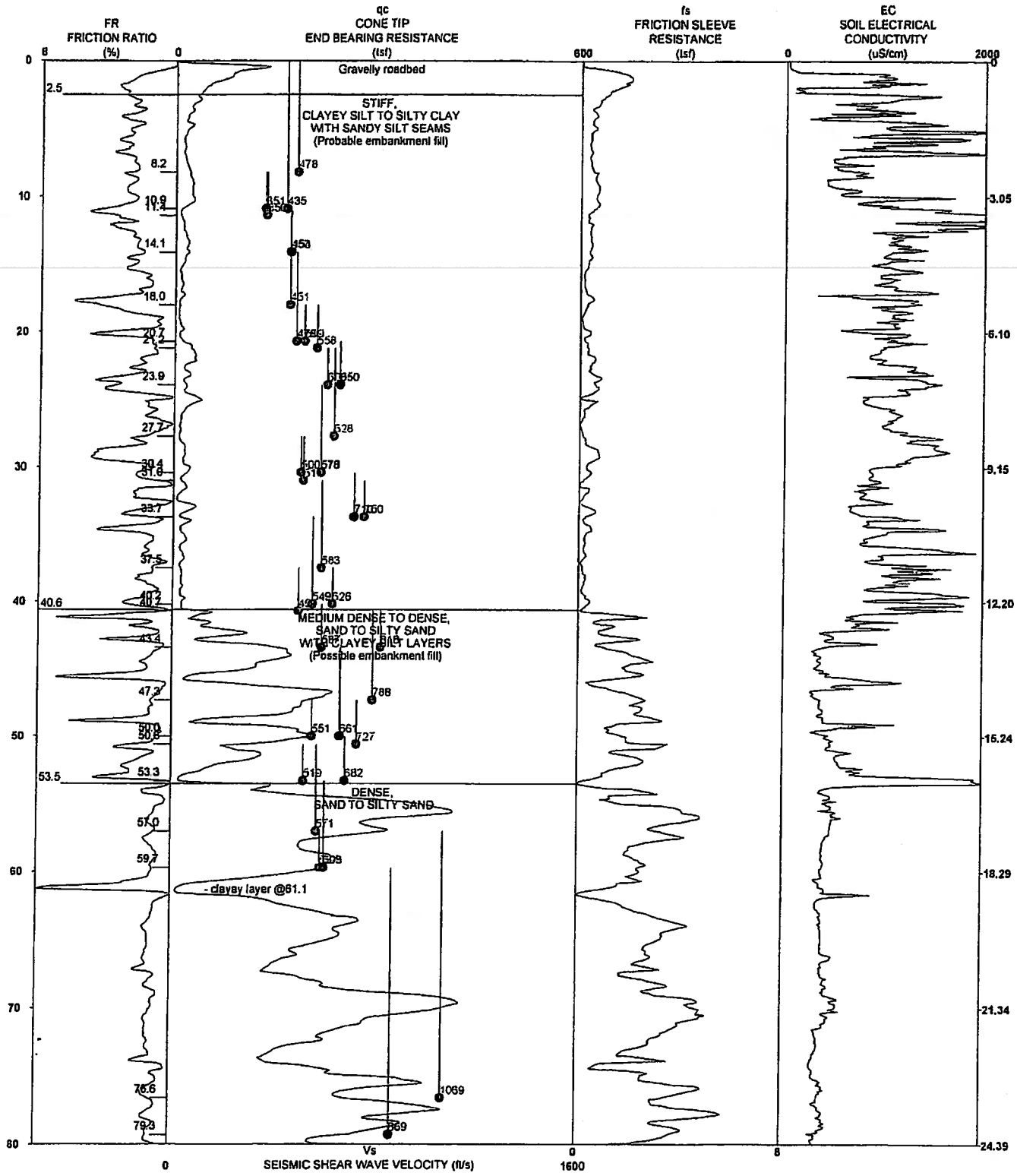
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:5:25 PM
SOUNDING NUMBER:CP-02

CP02

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



- 1600 ft/sec True Shear Wave Velocity
- 1600 ft/sec Pseudo Interval Receiver 1
- 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 0.00000 Longitude: 0.00000

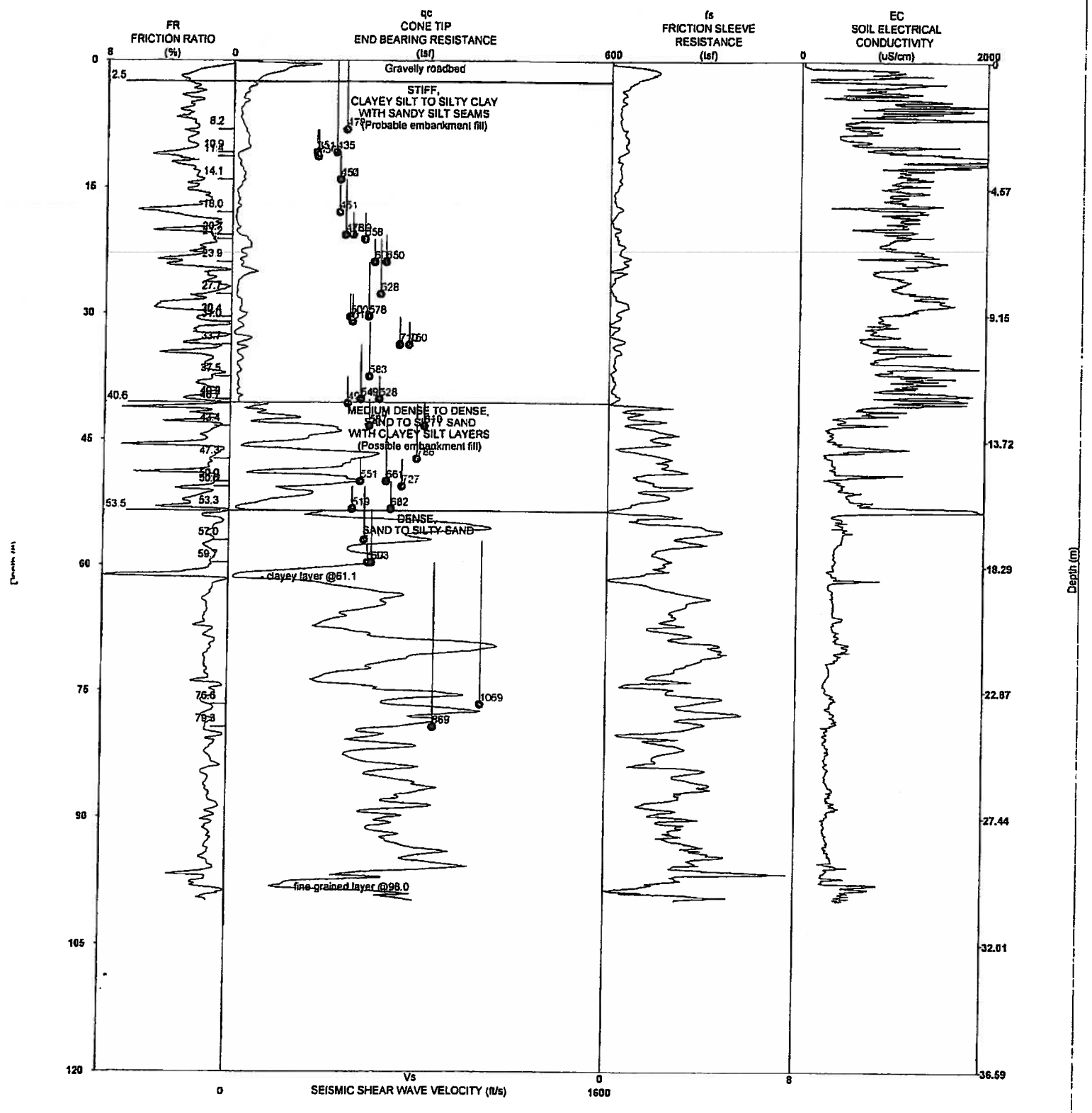
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



Latitude: 0.00000 Longitude: 0.00000

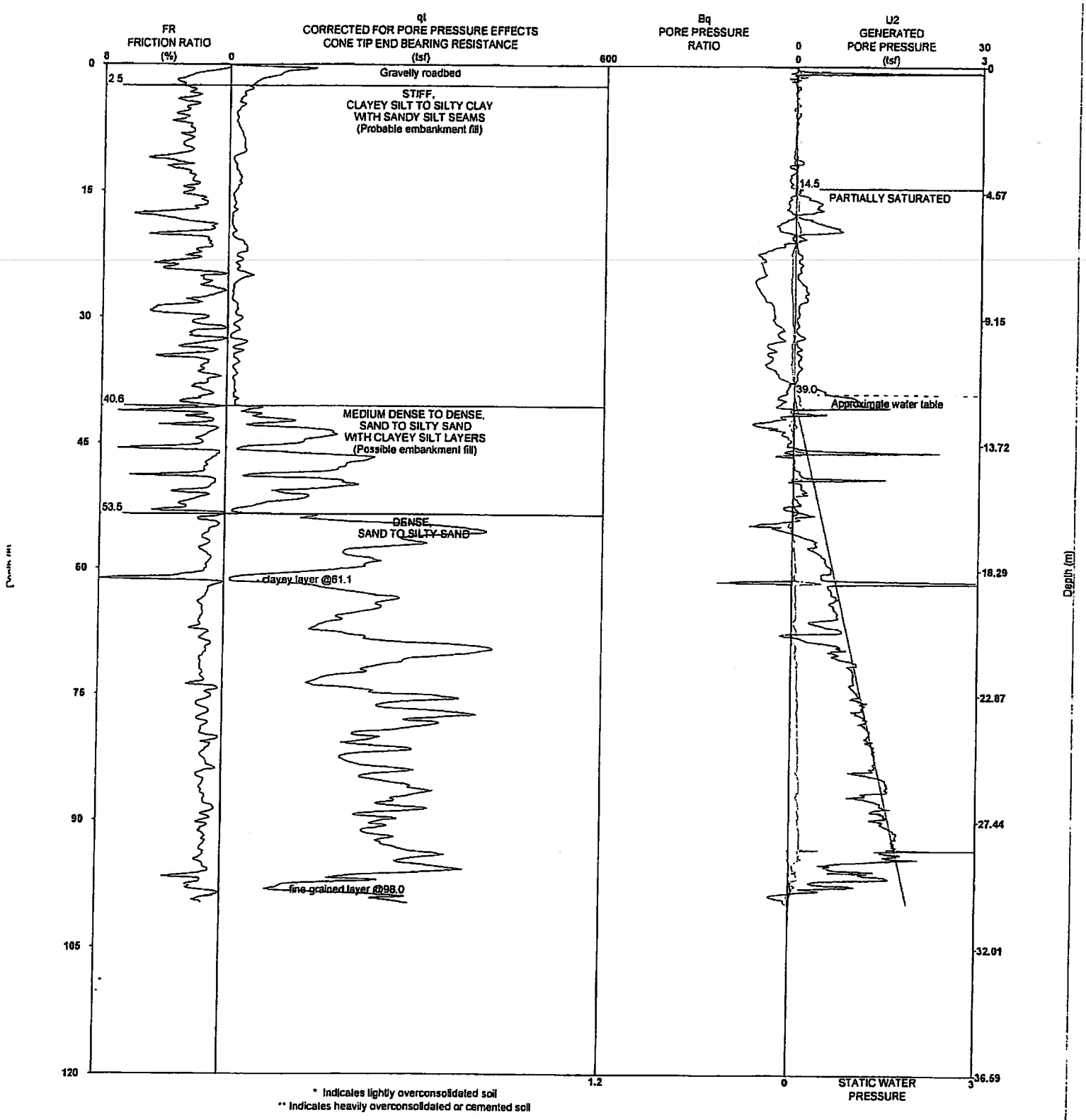
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



* Indicates lightly overconsolidated soil
** Indicates heavily overconsolidated or cemented soil

Latitude: 0.00000 Longitude: 0.00000

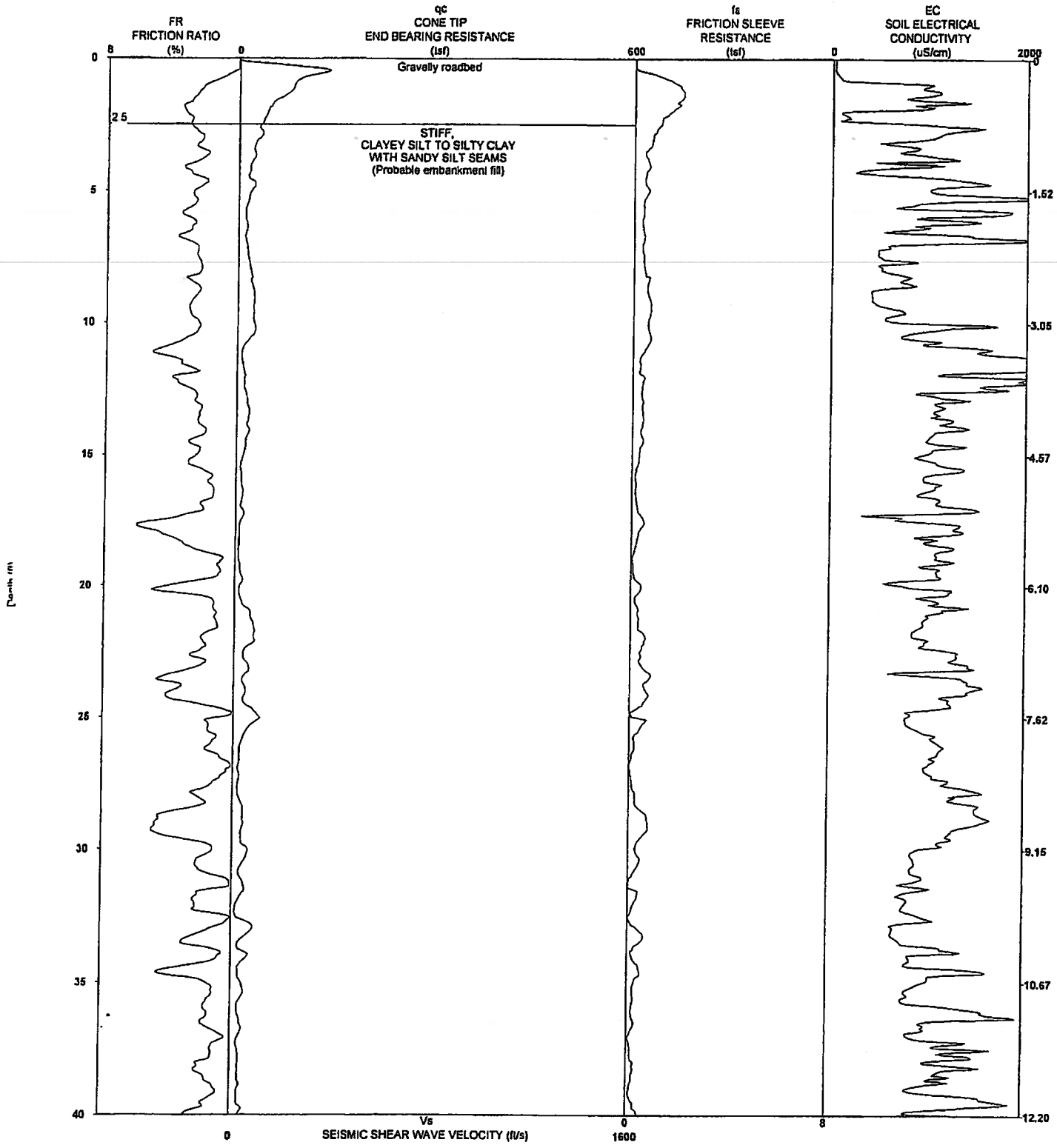
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



Latitude: 0.00000 Longitude: 0.00000

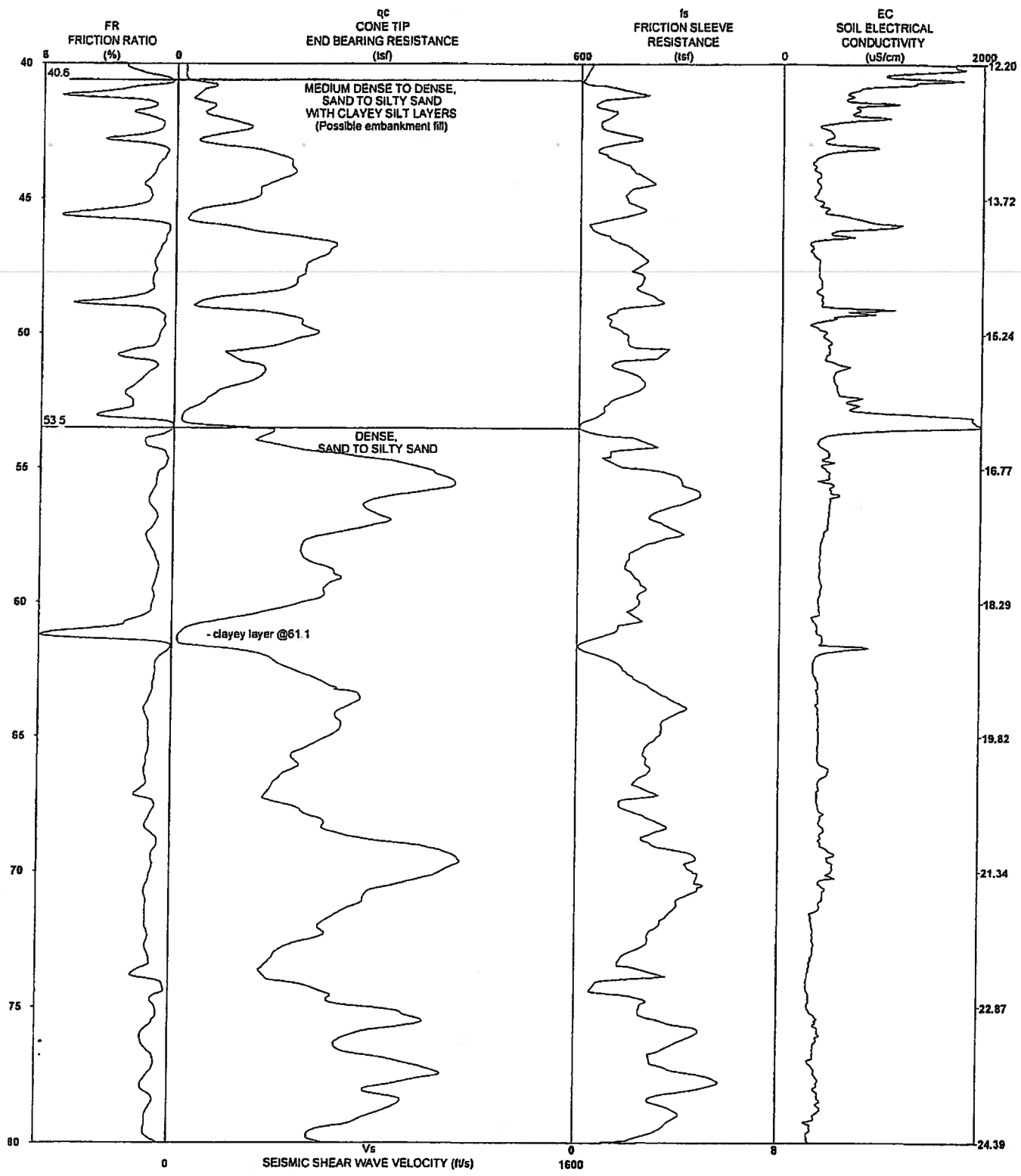
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



Latitude: 0.00000 Longitude: 0.00000

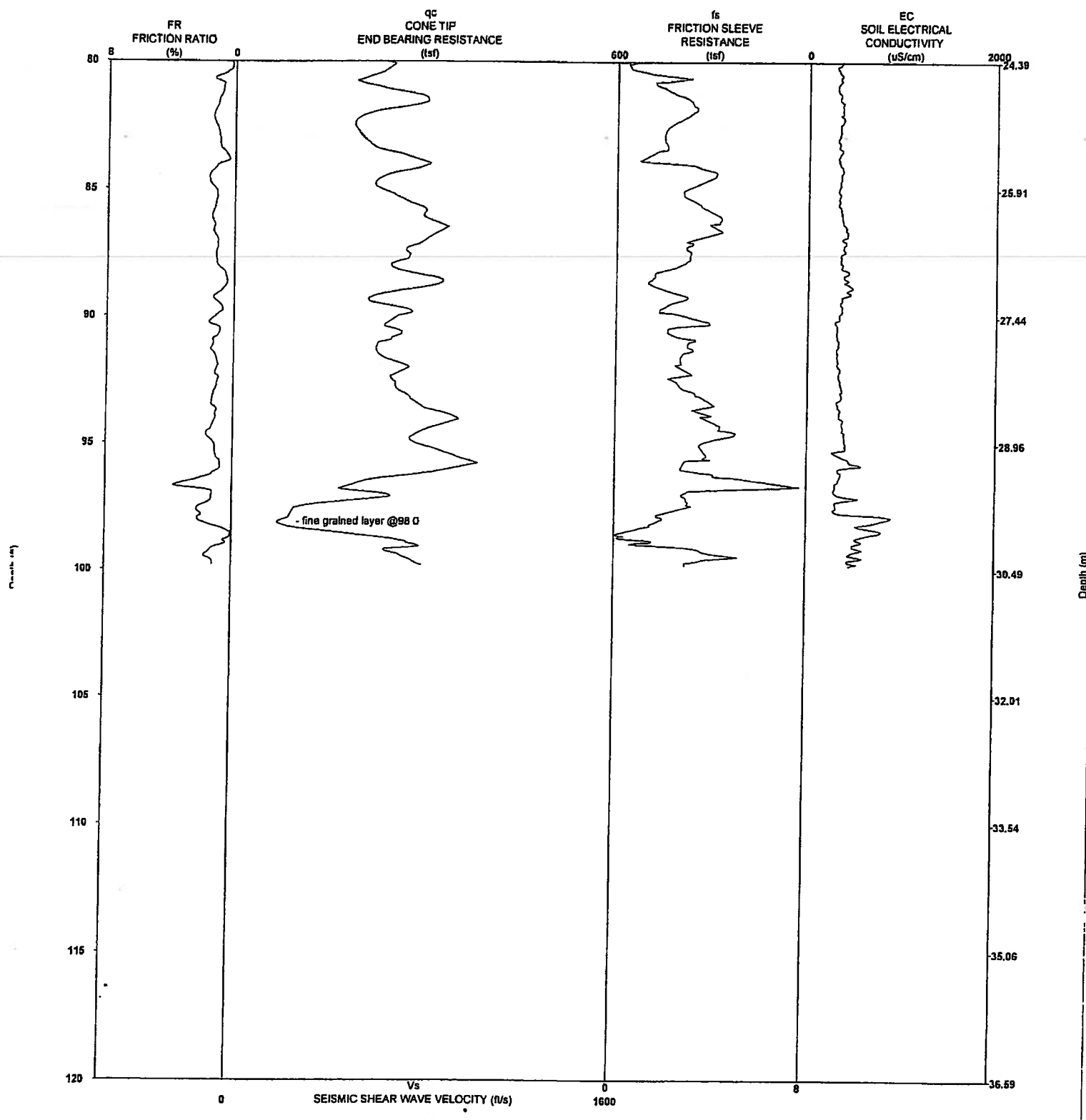
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-EC-S LOG WITH LITHOLOGIC EVALUATION CP03



Latitude: 0.00000 Longitude: 0.00000

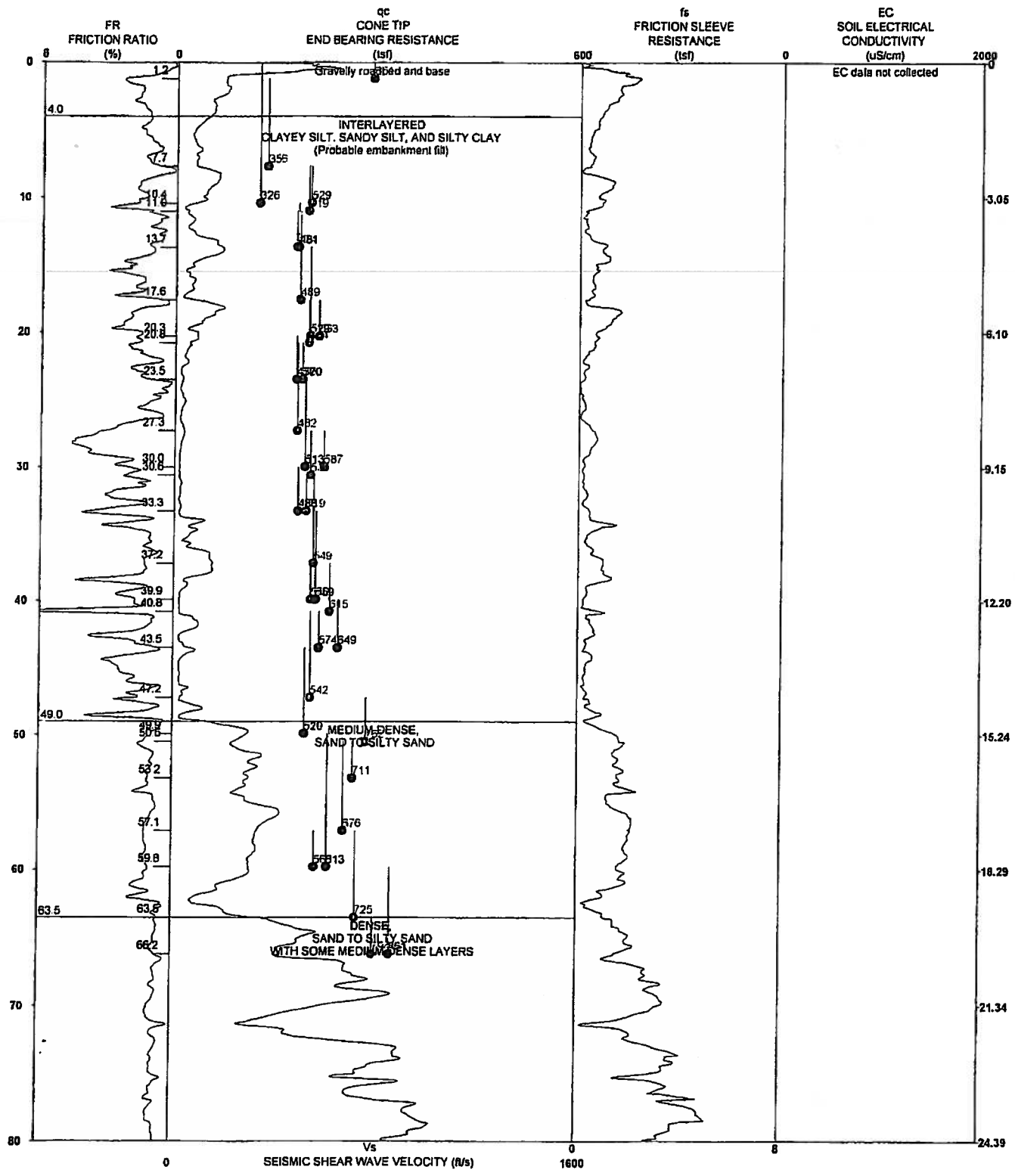
PROJECT NAME:Ameren UE Rush Island Levee Inveptory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:3:19 PM
SOUNDING NUMBER:CP-03

CP03

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



0 - 1600 ft/sec True Shear Wave Velocity
0 - 1600 ft/sec Pseudo Interval Receiver 1
0 - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.11862 Longitude: -90.25739

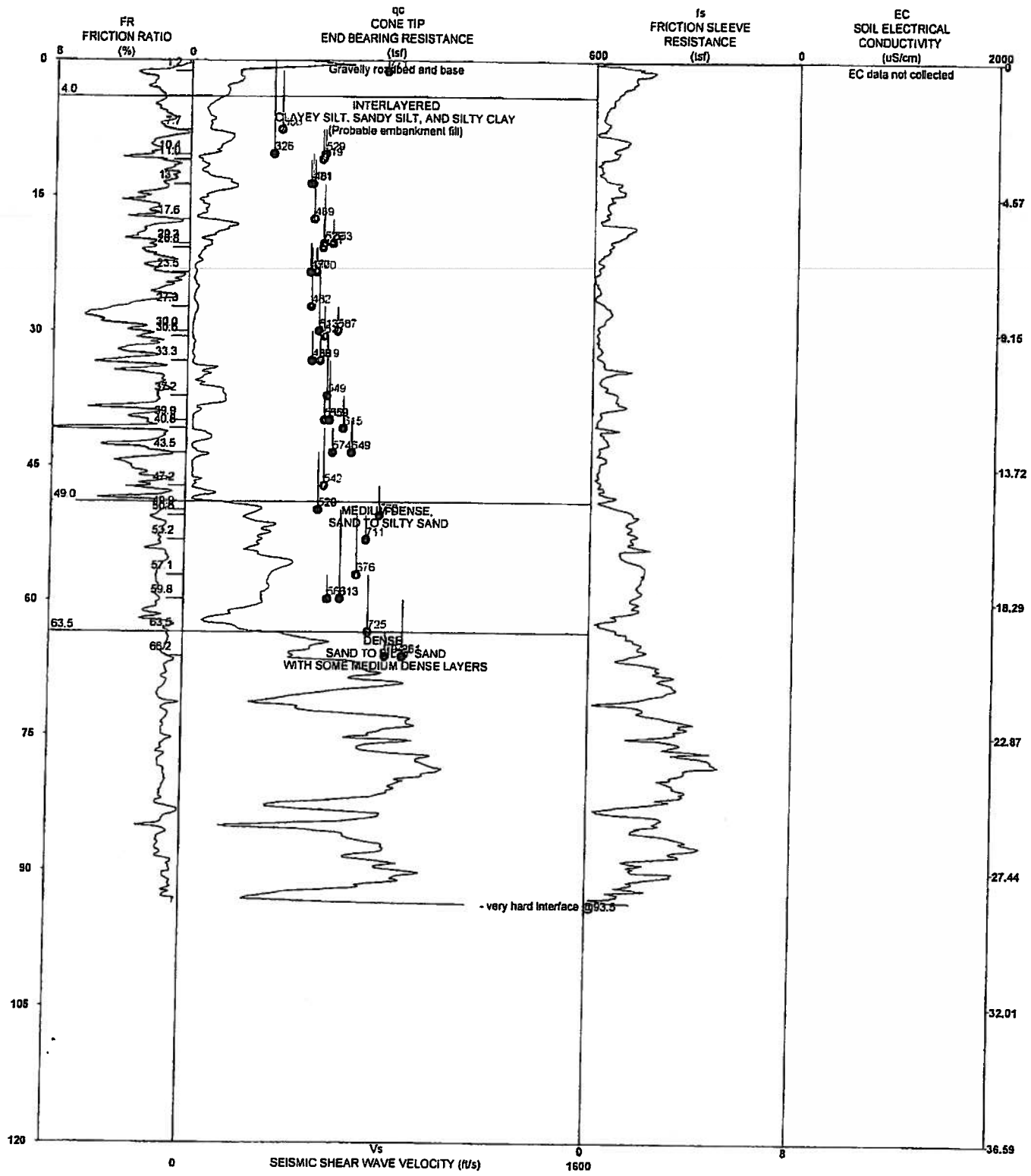
PROJECT NAME:Ameren UE Rush Island Levee Investigation
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

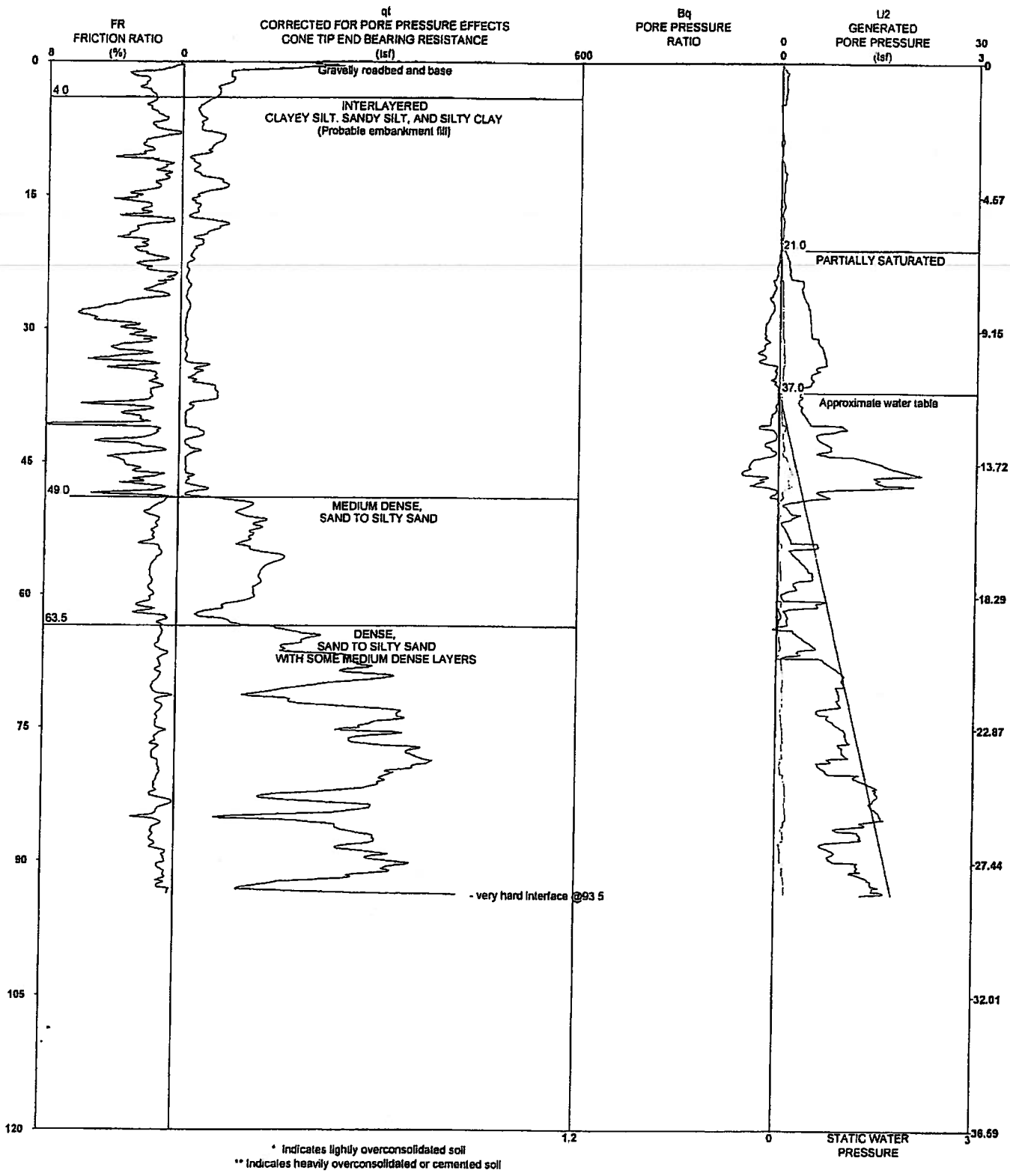
PROJECT NAME:Ameren UE Rush Island Levee Inverton
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

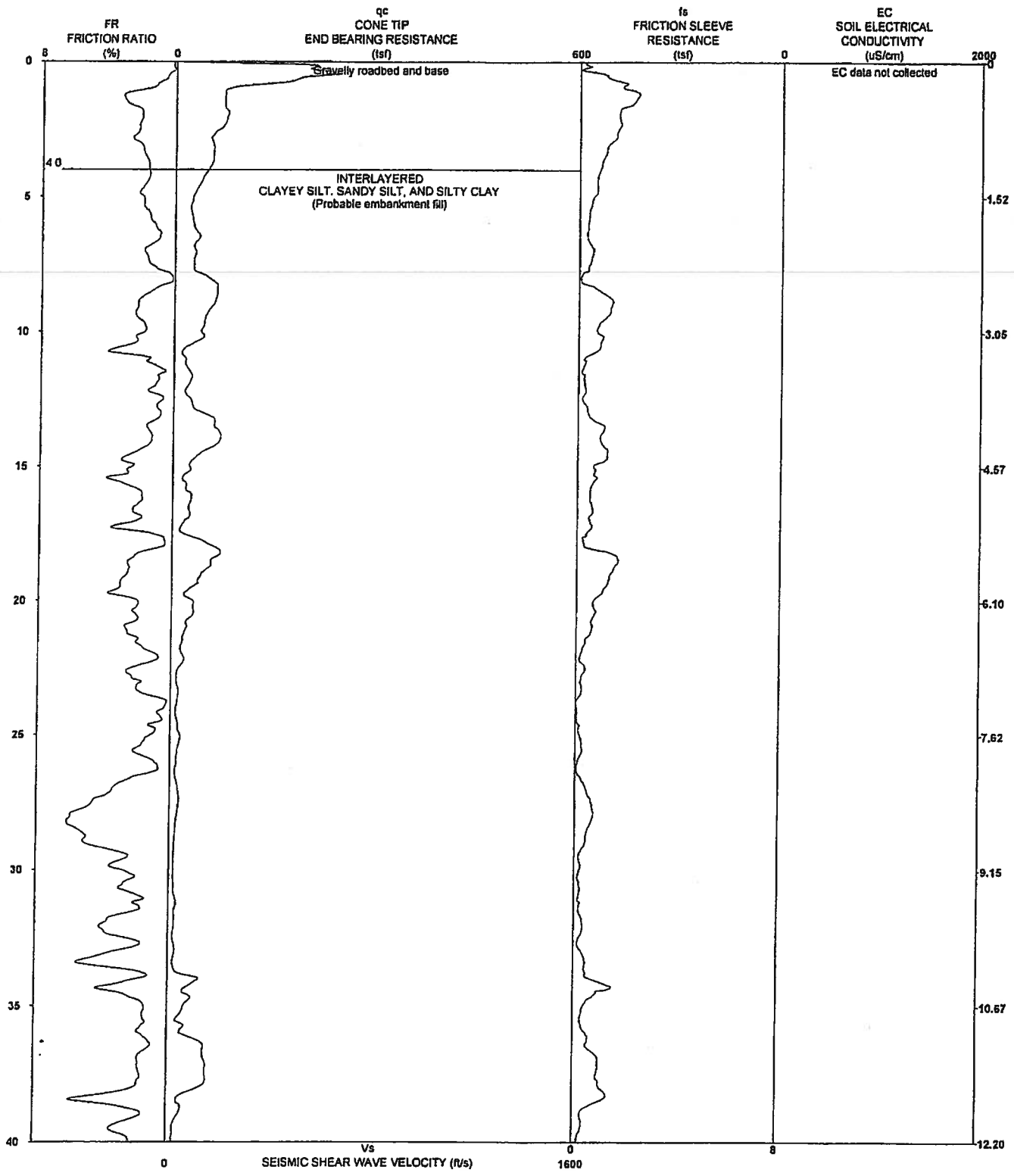
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11882 Longitude: -90.25739

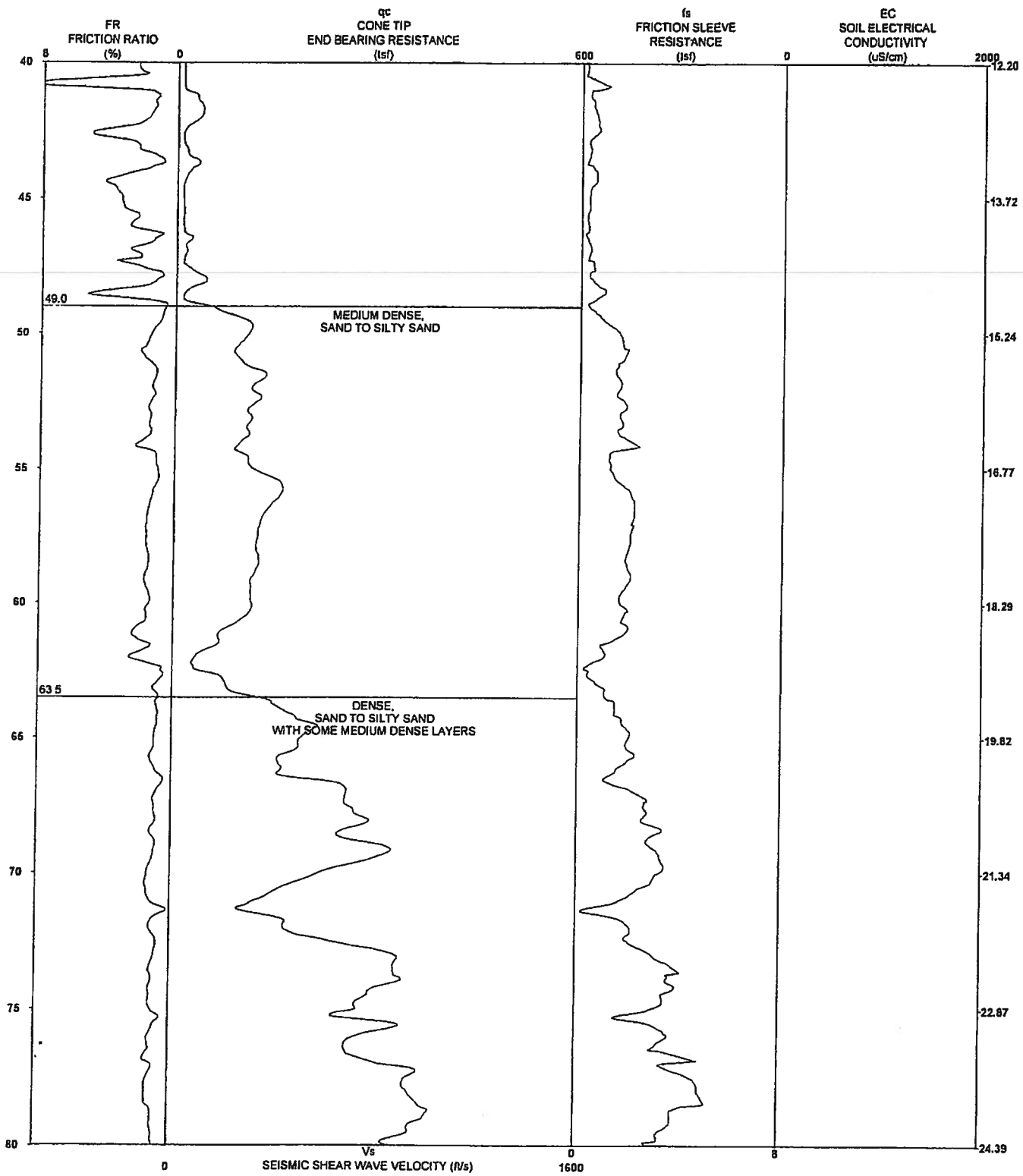
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

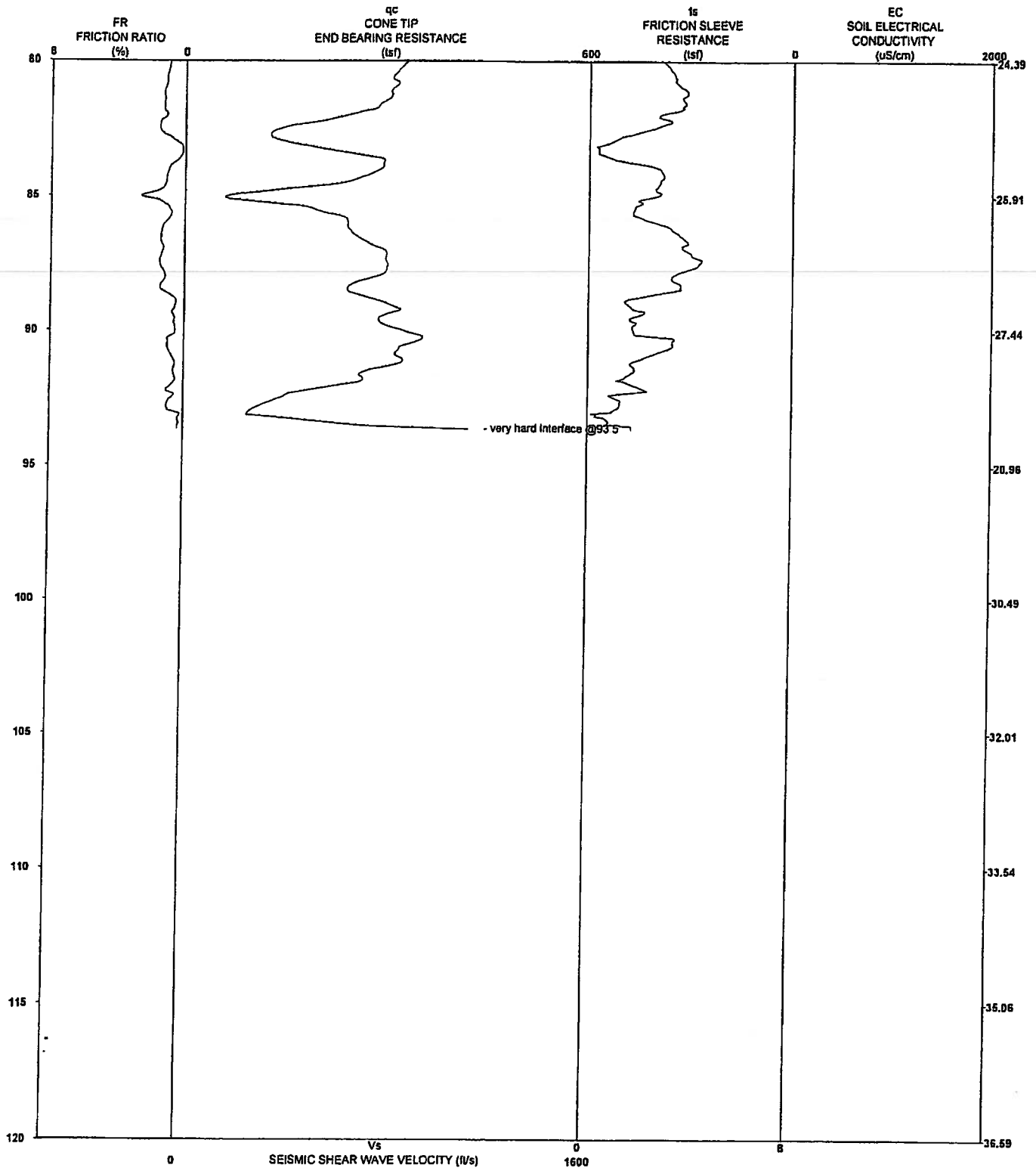
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP04



Latitude: 38.11862 Longitude: -90.25739

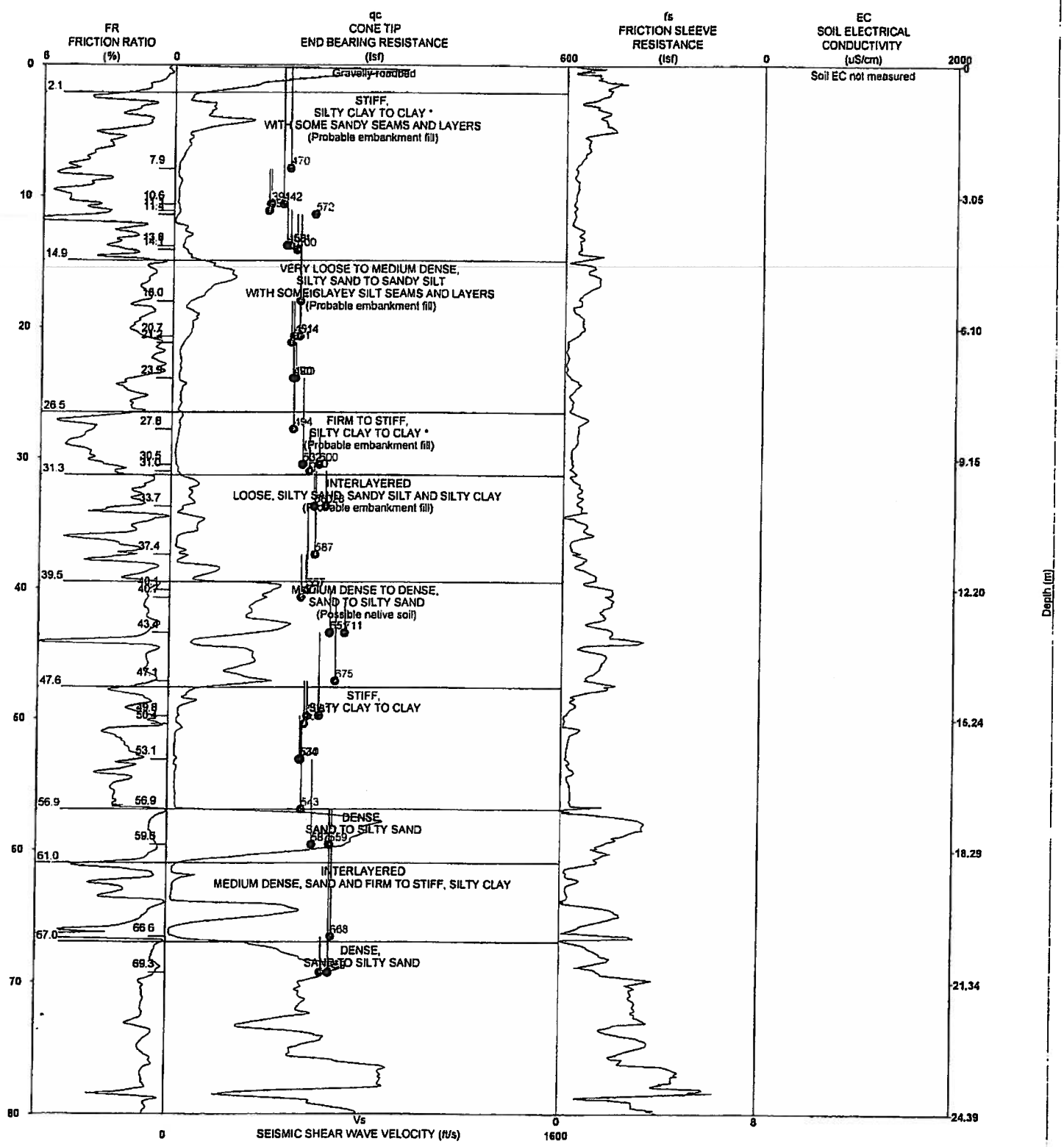
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:11:42 AM
SOUNDING NUMBER:CP-04

CP04

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



● - 1600 ft/sec True Shear Wave Velocity
● - 1600 ft/sec Pseudo Interval Receiver 1
● - 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12255 Longitude: -90.26122

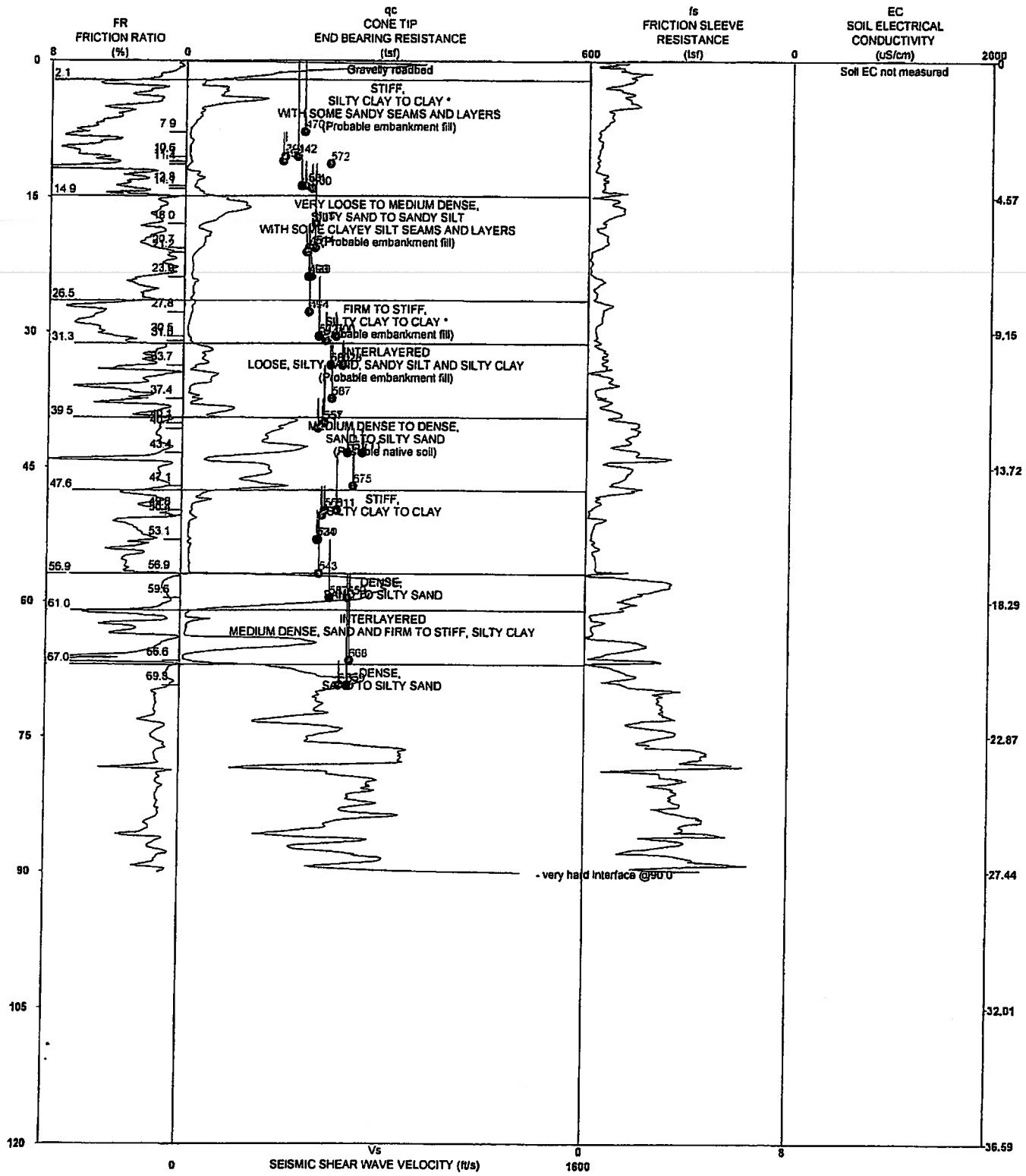
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



- 1600 ft/sec True Shear Wave Velocity
- 1600 ft/sec Pseudo Interval Receiver 1
- 1600 ft/sec Pseudo Interval Receiver 2

Latitude: 38.12255 Longitude: -90.26122

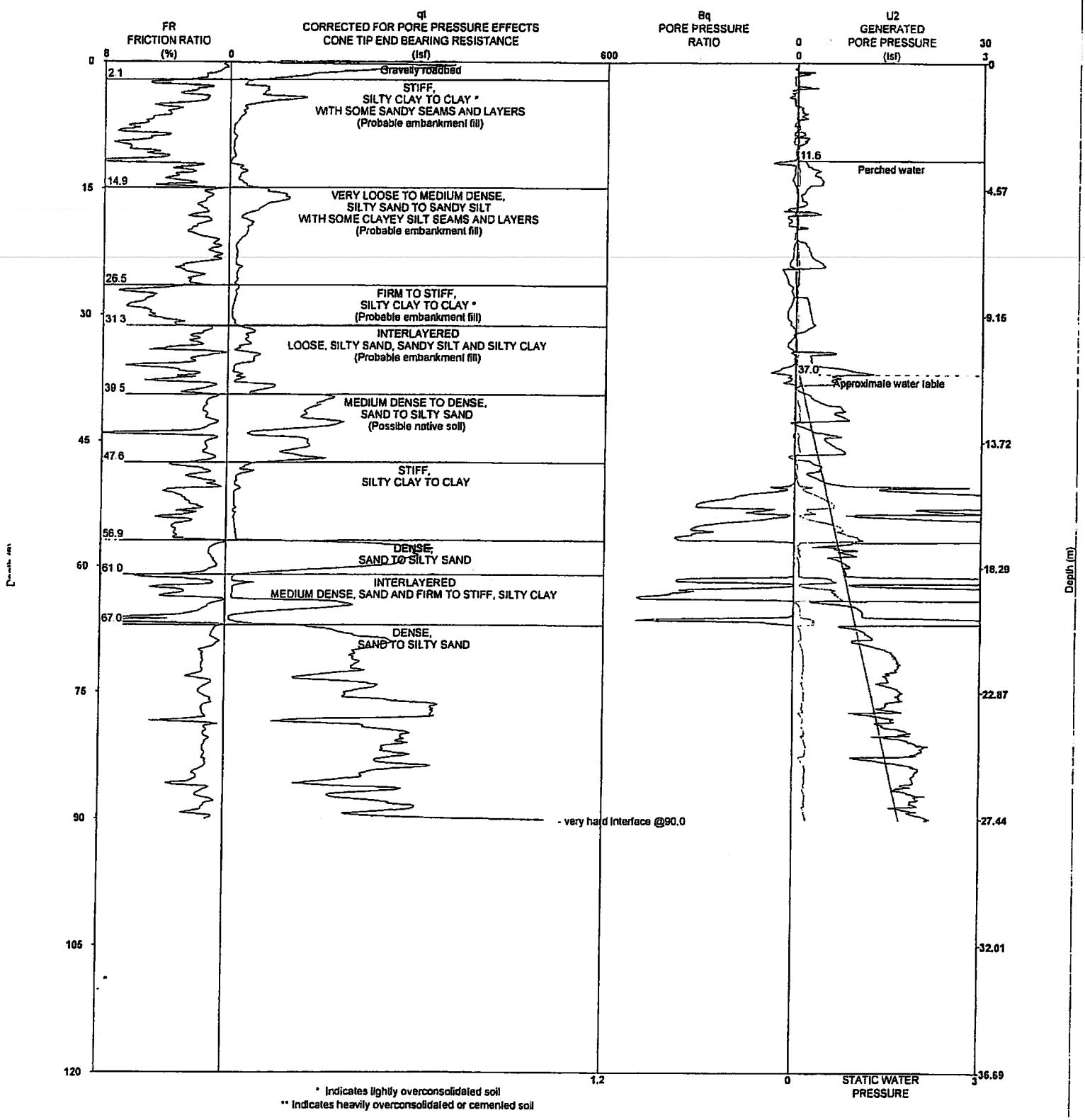
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

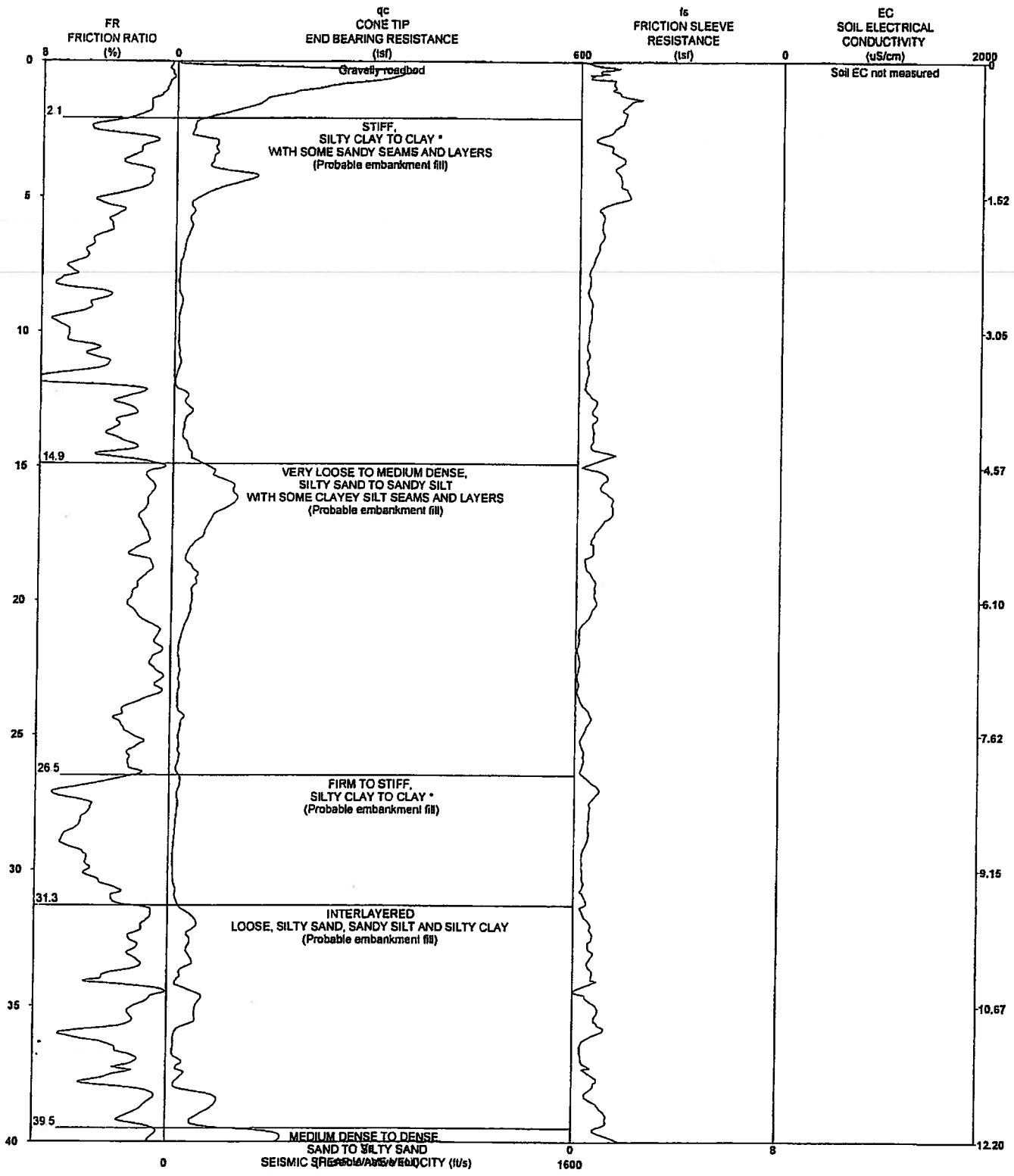
PROJECT NAME:Ameren UE Rush Island Levee Investigation
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

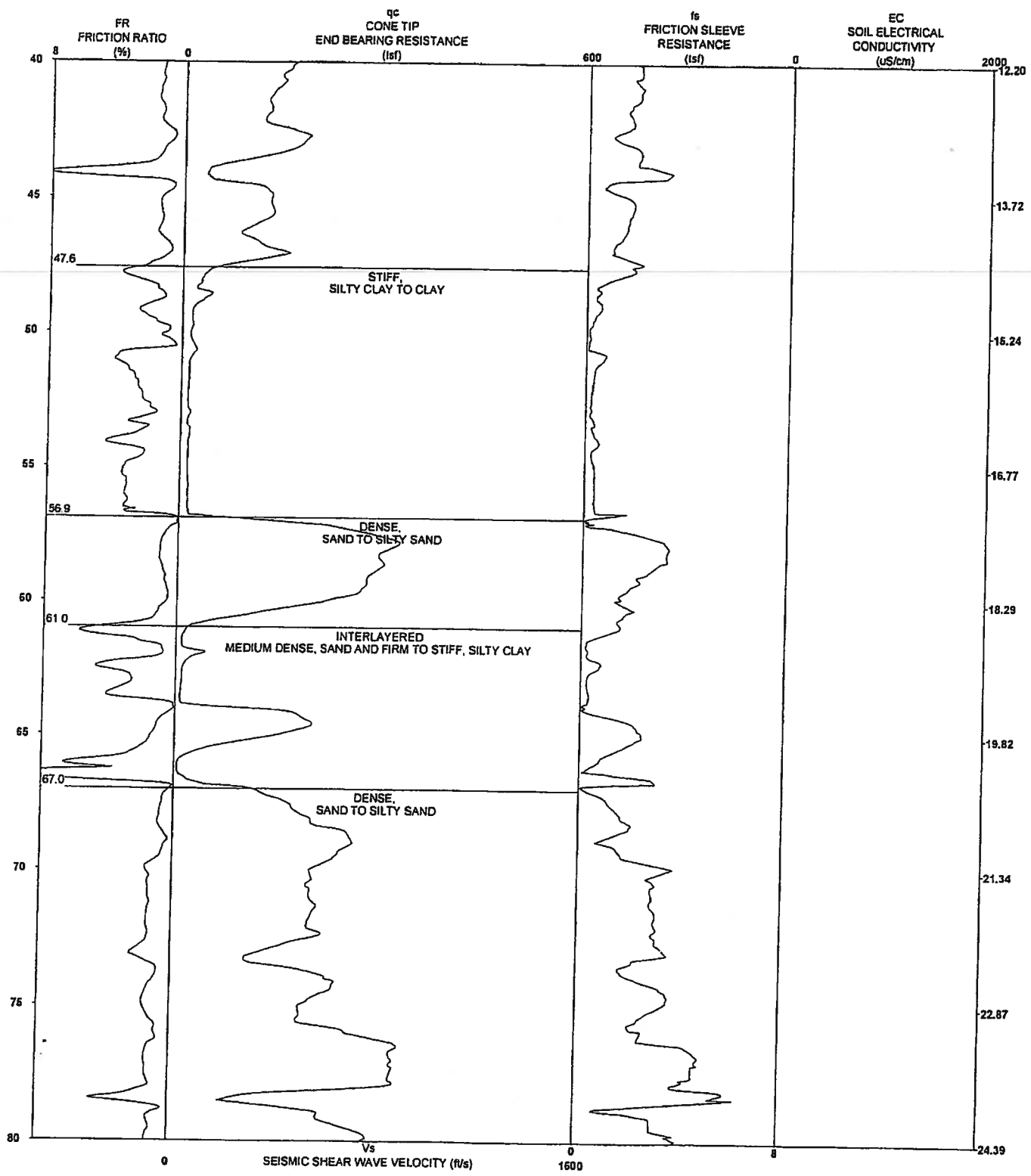
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12255 Longitude: -90.26122

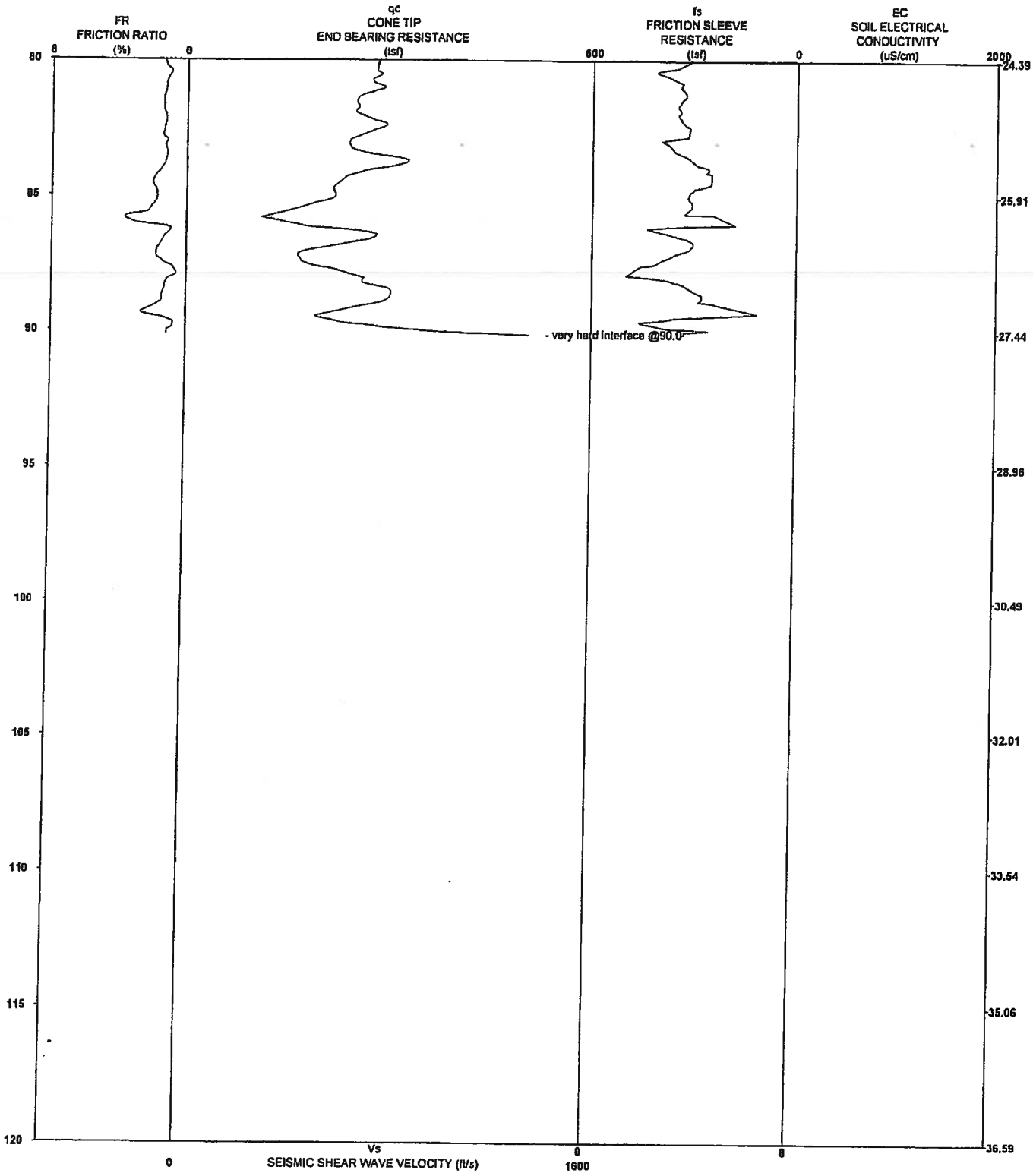
PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

CP05

CPTU-S LOG WITH LITHOLOGIC EVALUATION CP05



Latitude: 38.12256 Longitude: -90.26122

PROJECT NAME:Ameren UE Rush Island Levee Inventory
PROJECT NUMBER:09-110-090

STRATIGRAPHICS

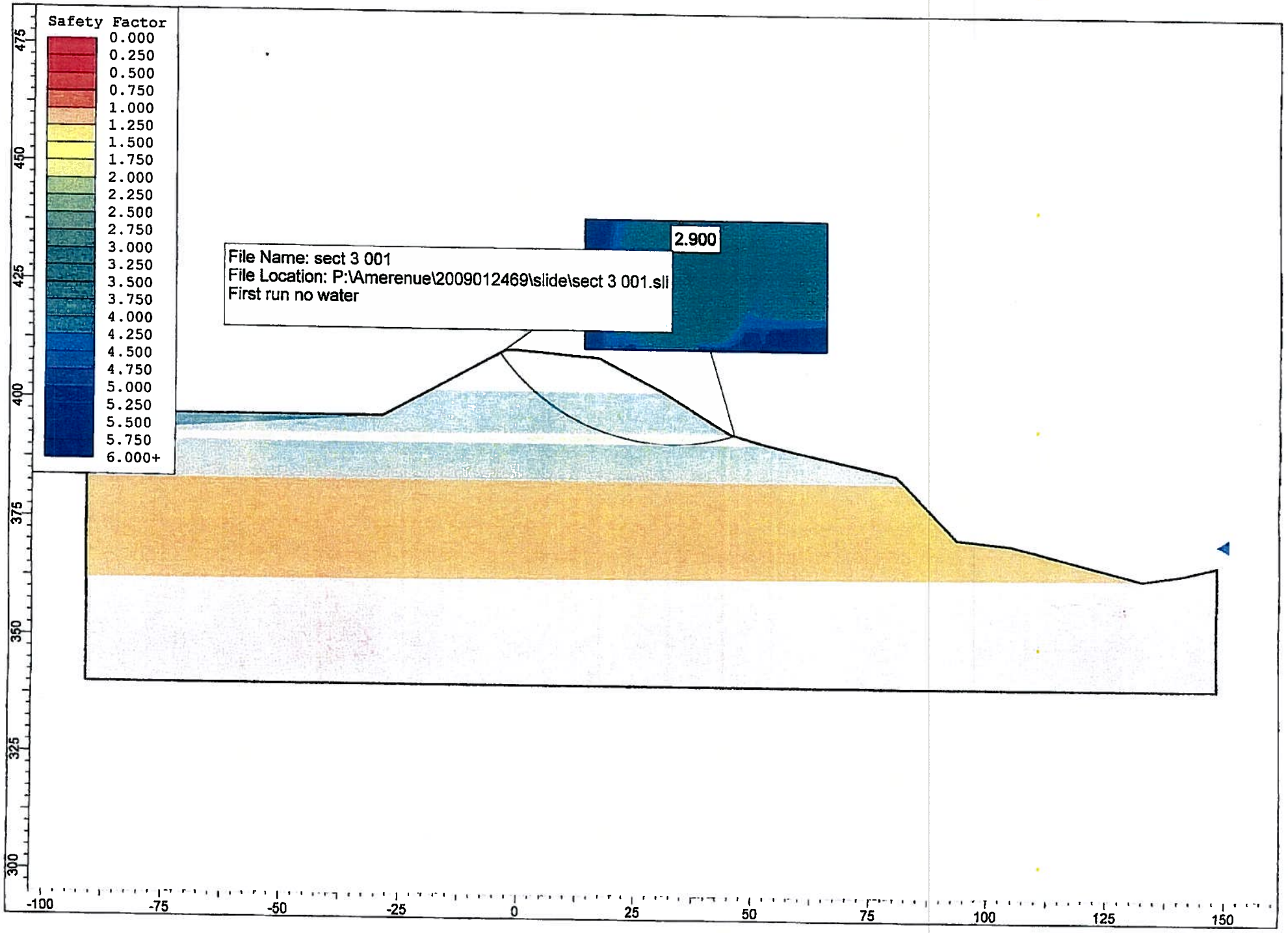
R1 DATE:8/27/2009 TIME:9:12 AM
SOUNDING NUMBER:CP-05

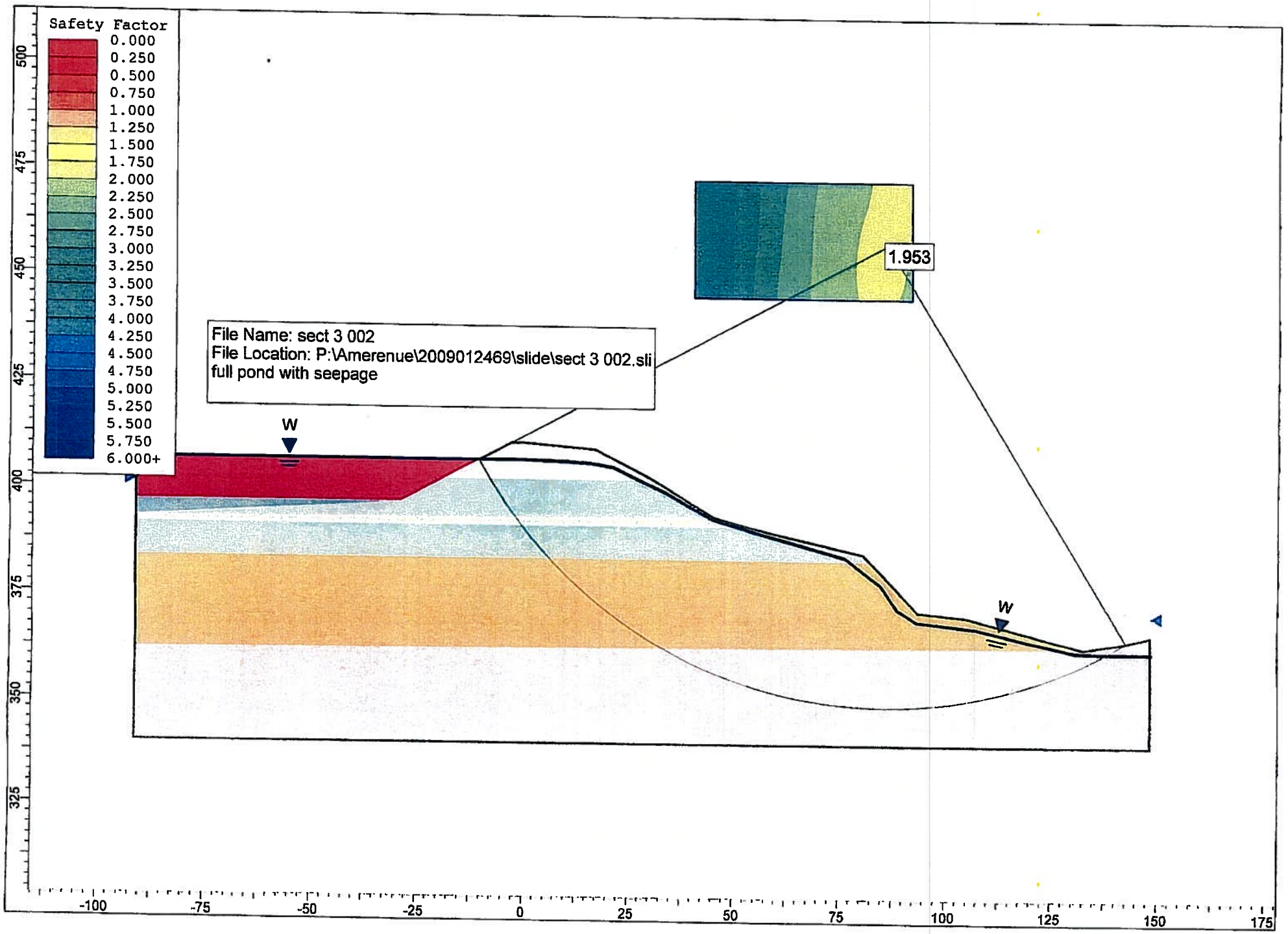
CP05

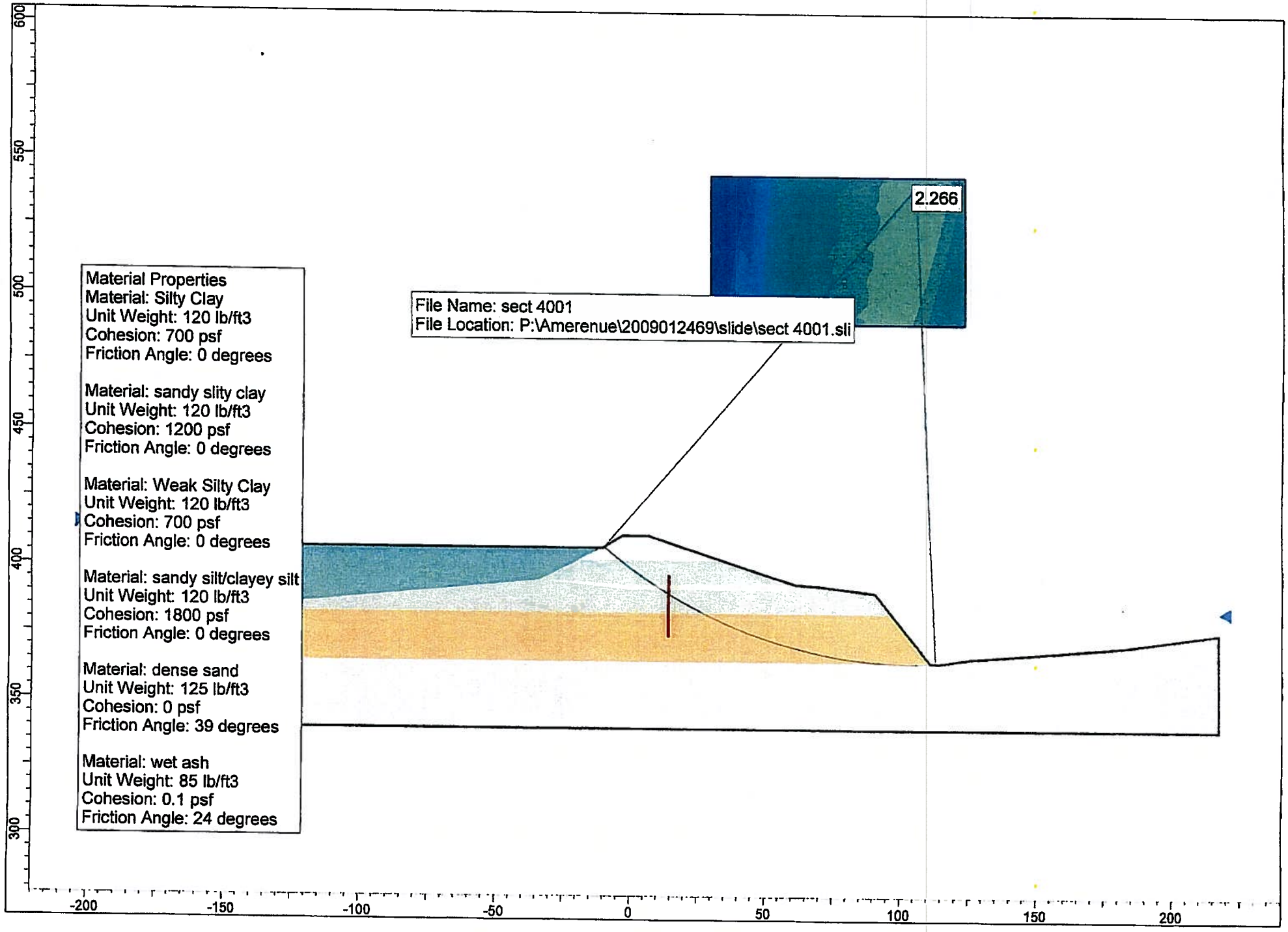
Slope Stability Analysis

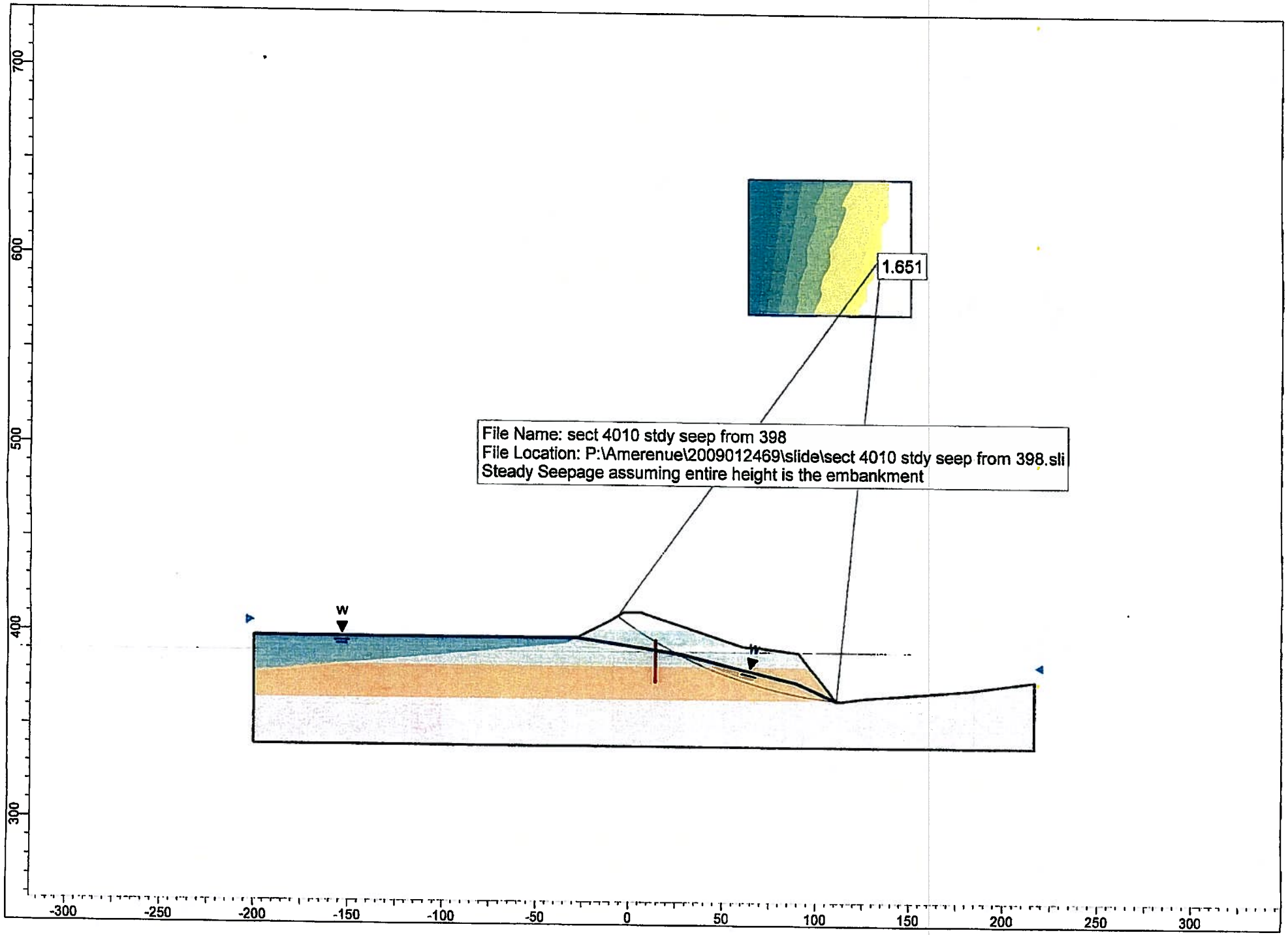
Rush Island Slope Stability Summary Sheet

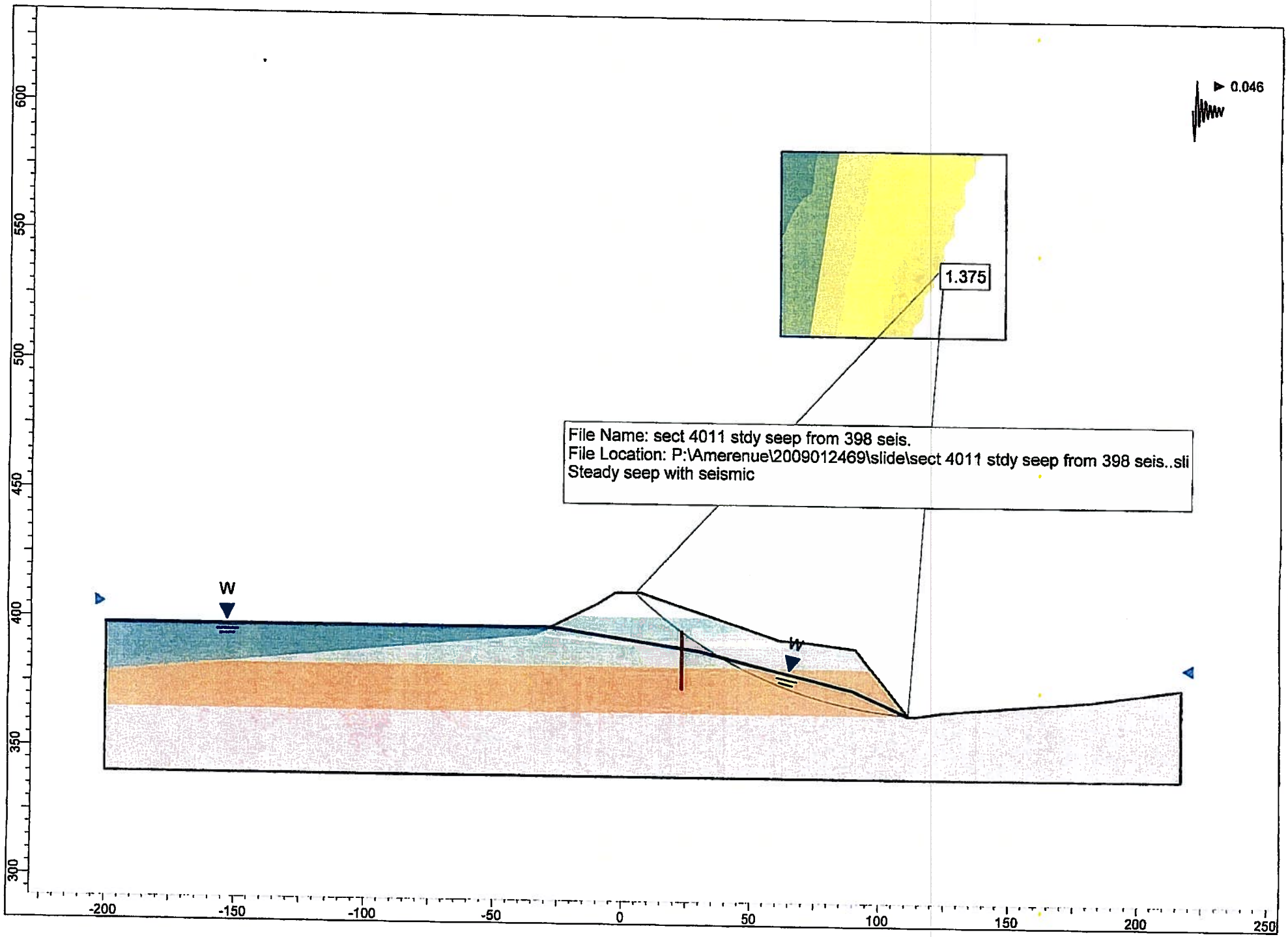
Section	Stress Phase	Seismic Force	Pool Elevation	Stored Ash	Toe Setback	Factor Safety	Req"d FS	File	
3	total	none	none	395		2.9		3001	
3	total	none	407	395		1.95		3002	
4	total	none	407	407		2.26	1.5	4001	
4	stdy seep	none	403	403		1.51	1.5	4012	normal pool
4	stdy seep	0.046	398	398		1.375	1.0	4011	
4	stdy seep	none	398	398		1.65	1.5	4010	
4	stdy seep	none	407	407		1.404	1.3	4013	max pool @ 407
4	stdy seep	0.046	403	403		1.31	1.0	4014	normal pool
7	total	none	407	407		1.731	1.5	7001	
7	stdy seep	none	398	398		1.711	1.5	7004	
7	stdy seep	0.046	398	398		1.49	1.0	7005	
7	stdy seep	none	407	407		1.41	1.5	7006	1.3 FS for max pool
7	stdy seep	none	403	403		1.54	1.5	7007	normal pool
7	stdy seep	0.046	403	403		1.34	1.0	7008	normal pool


Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
2.900
File Name: sect 3 001
File Location: P:\Amerenue\2009012469\slide\sect 3 001.sli
First run no water
475
450
425
400
375
350
325
300
-100
-75
-50
-25
0
25
50
75
100
125
150


Safety Factor
0.000
0.250
0.500
0.750
1.000
1.250
1.500
1.750
2.000
2.250
2.500
2.750
3.000
3.250
3.500
3.750
4.000
4.250
4.500
4.750
5.000
5.250
5.500
5.750
6.000+
1.953
File Name: sect 3 002
File Location: P:\Amerenue\2009012469\slide\sect 3 002.sli
full pond with seepage
W
W
500
475
450
425
400
375
350
325
-100
-75
-50
-25
0
25
50
75
100
125
150
175


2.266
File Name: sect 4001
File Location: P:\Amerenue\2009012469\slide\sect 4001.sli
Material Properties
Material: Silty Clay
Unit Weight: 120 lb/ft3
Cohesion: 700 psf
Friction Angle: 0 degrees
Material: sandy slity clay
Unit Weight: 120 lb/ft3
Cohesion: 1200 psf
Friction Angle: 0 degrees
Material: Weak Silty Clay
Unit Weight: 120 lb/ft3
Cohesion: 700 psf
Friction Angle: 0 degrees
Material: sandy silt/clayey silt
Unit Weight: 120 lb/ft3
Cohesion: 1800 psf
Friction Angle: 0 degrees
Material: dense sand
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 39 degrees
Material: wet ash
Unit Weight: 85 lb/ft3
Cohesion: 0.1 psf
Friction Angle: 24 degrees
600
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


1.651
File Name: sect 4010 stdy seep from 398
File Location: P:\Amerenue\2009012469\slide\sect 4010 stdy seep from 398.sli
Steady Seepage assuming entire height is the embankment
W
700
600
500
400
300
-300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300


0.046
1.375
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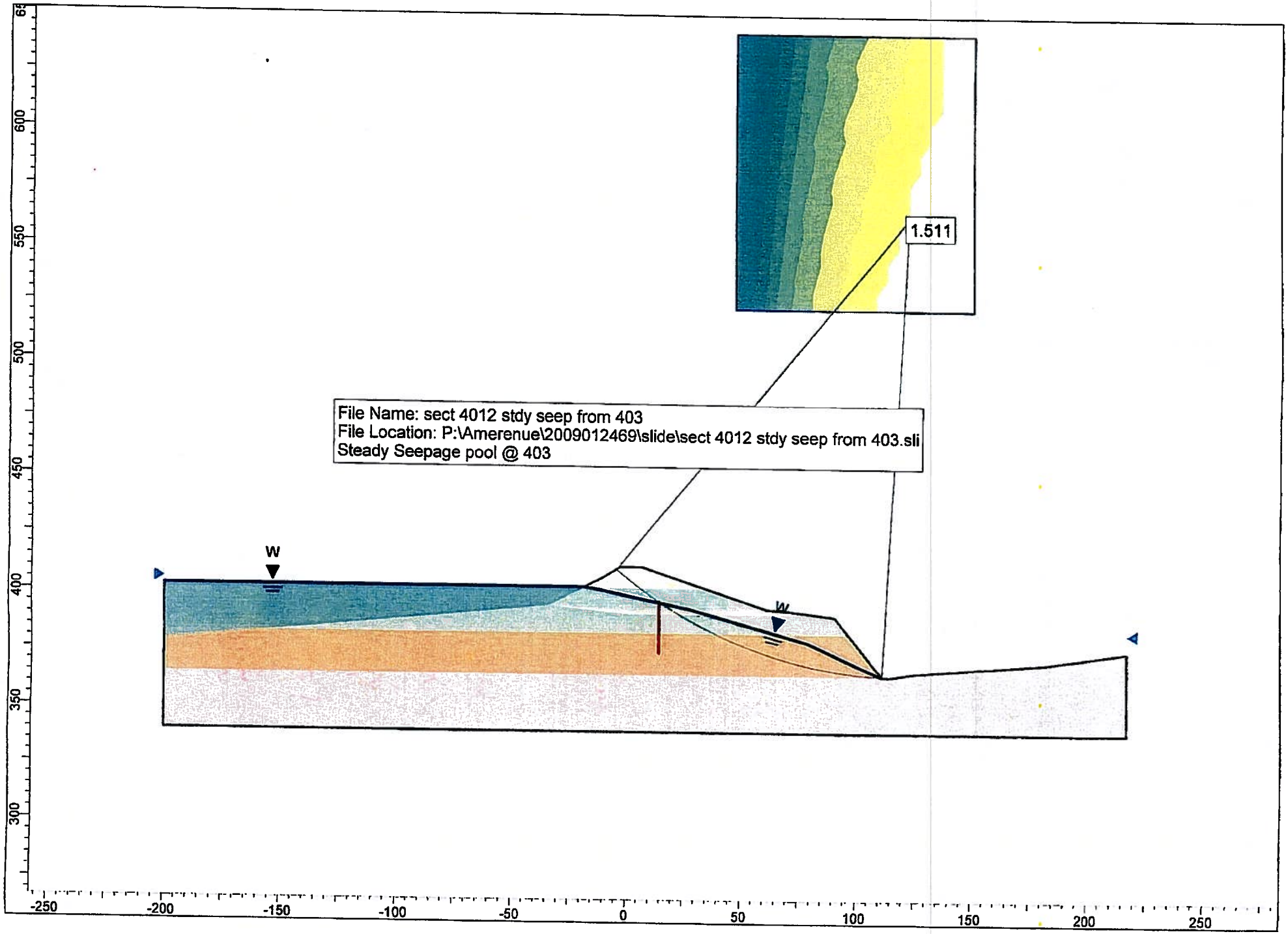
File Location: P:\Amerenue\2009012469\slide\sect 4011 stdy seep from 398 seis..sli
Steady seep with seismic
W
W
600
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200
250


1.511
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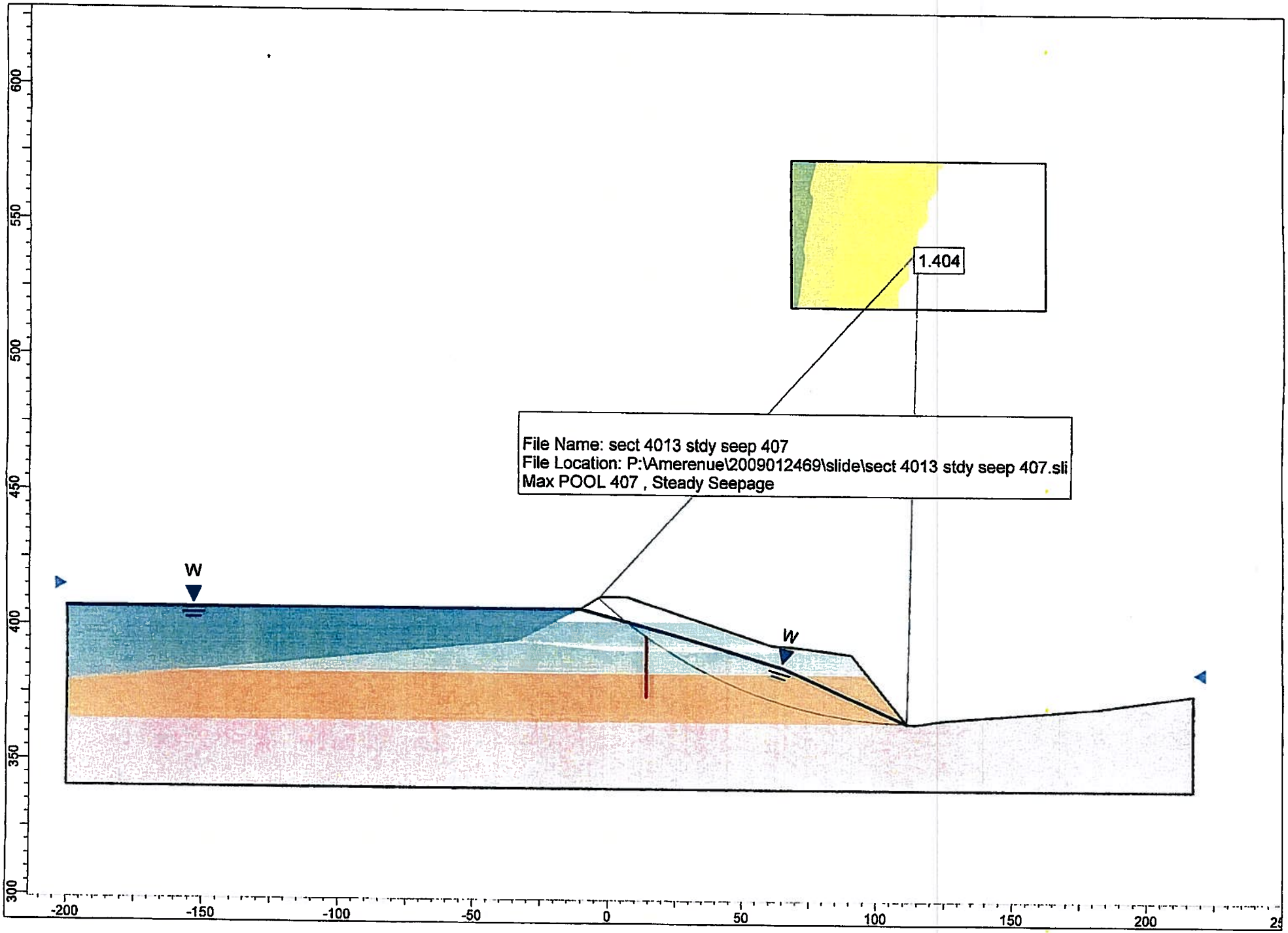
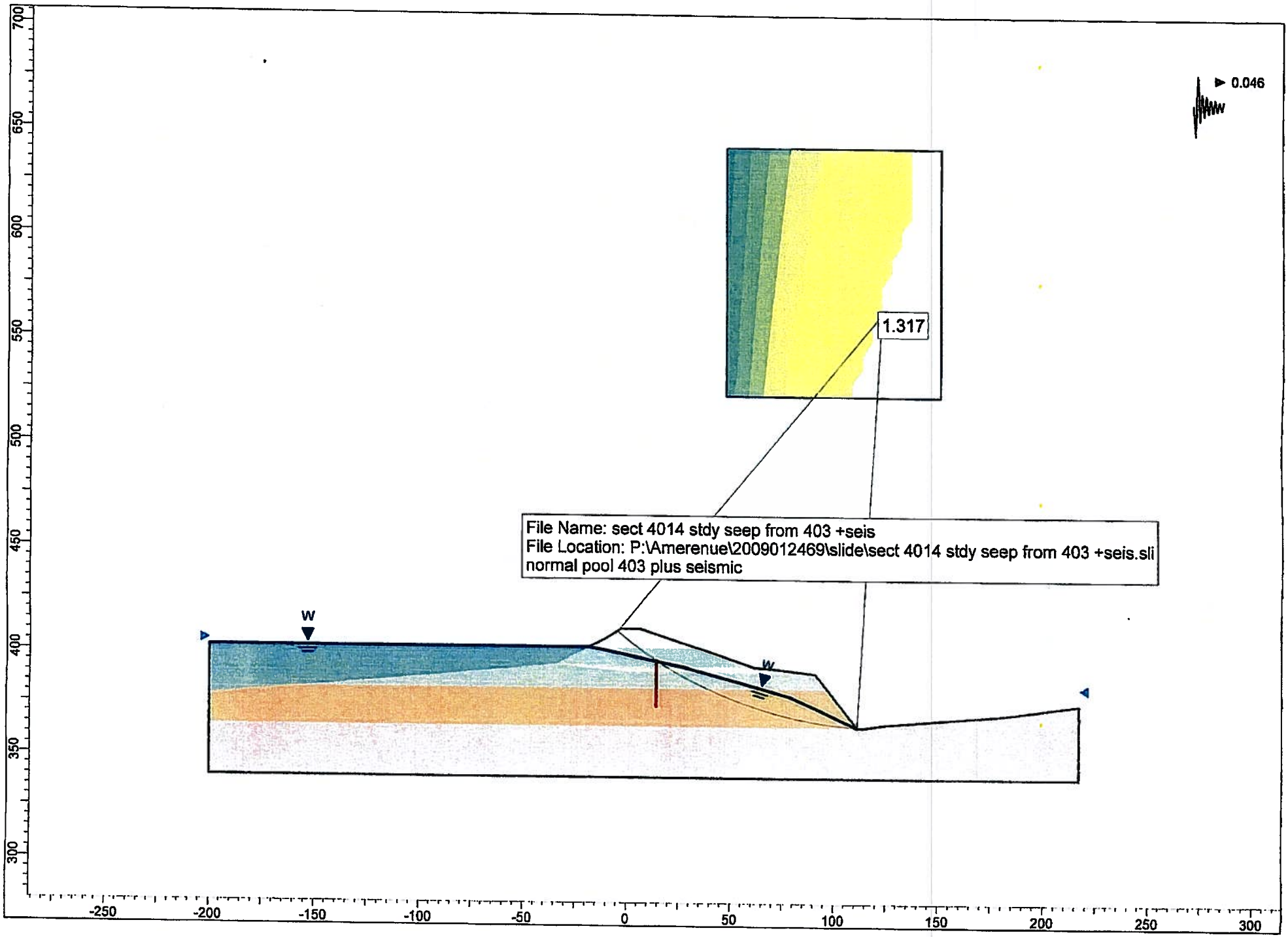
File Location: P:\Amerenue\2009012469\slide\sect 4012 stdy seep from 403.sli
Steady Seepage pool @ 403
W
W
600
550
500
450
400
350
300
-250
-200
-150
-100
-50
0
50
100
150
200
250


1.404
File Name: sect 4013 stdy seep 407
File Location: P:\Amerenue\2009012469\slide\sect 4013 stdy seep 407.sli
Max POOL 407 , Steady Seepage
W
W
600
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


0.046
1.317
File Name: sect 4014 stdy seep from 403 +seis
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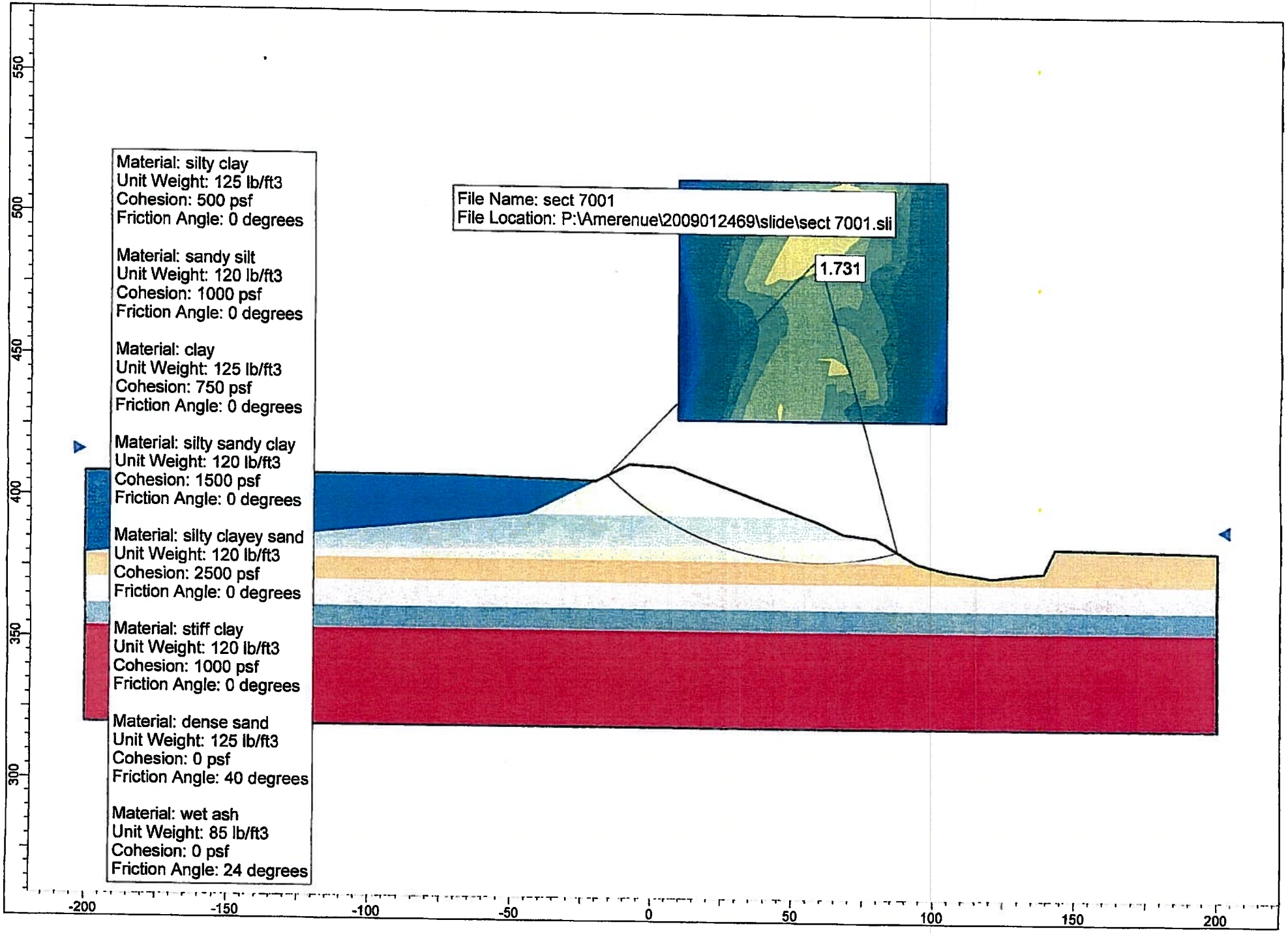
normal pool 403 plus seismic
W
W
700
650
600
550
500
450
400
350
300
-250
-200
-150
-100
-50
0
50
100
150
200
250
300


Material: silty clay
Unit Weight: 125 lb/ft3
Cohesion: 500 psf
Friction Angle: 0 degrees
Material: sandy silt
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
Material: clay
Unit Weight: 125 lb/ft3
Cohesion: 750 psf
Friction Angle: 0 degrees
Material: silty sandy clay
Unit Weight: 120 lb/ft3
Cohesion: 1500 psf
Friction Angle: 0 degrees
Material: silty clayey sand
Unit Weight: 120 lb/ft3
Cohesion: 2500 psf
Friction Angle: 0 degrees
Material: stiff clay
Unit Weight: 120 lb/ft3
Cohesion: 1000 psf
Friction Angle: 0 degrees
Material: dense sand
Unit Weight: 125 lb/ft3
Cohesion: 0 psf
Friction Angle: 40 degrees
Material: wet ash
Unit Weight: 85 lb/ft3
Cohesion: 0 psf
Friction Angle: 24 degrees
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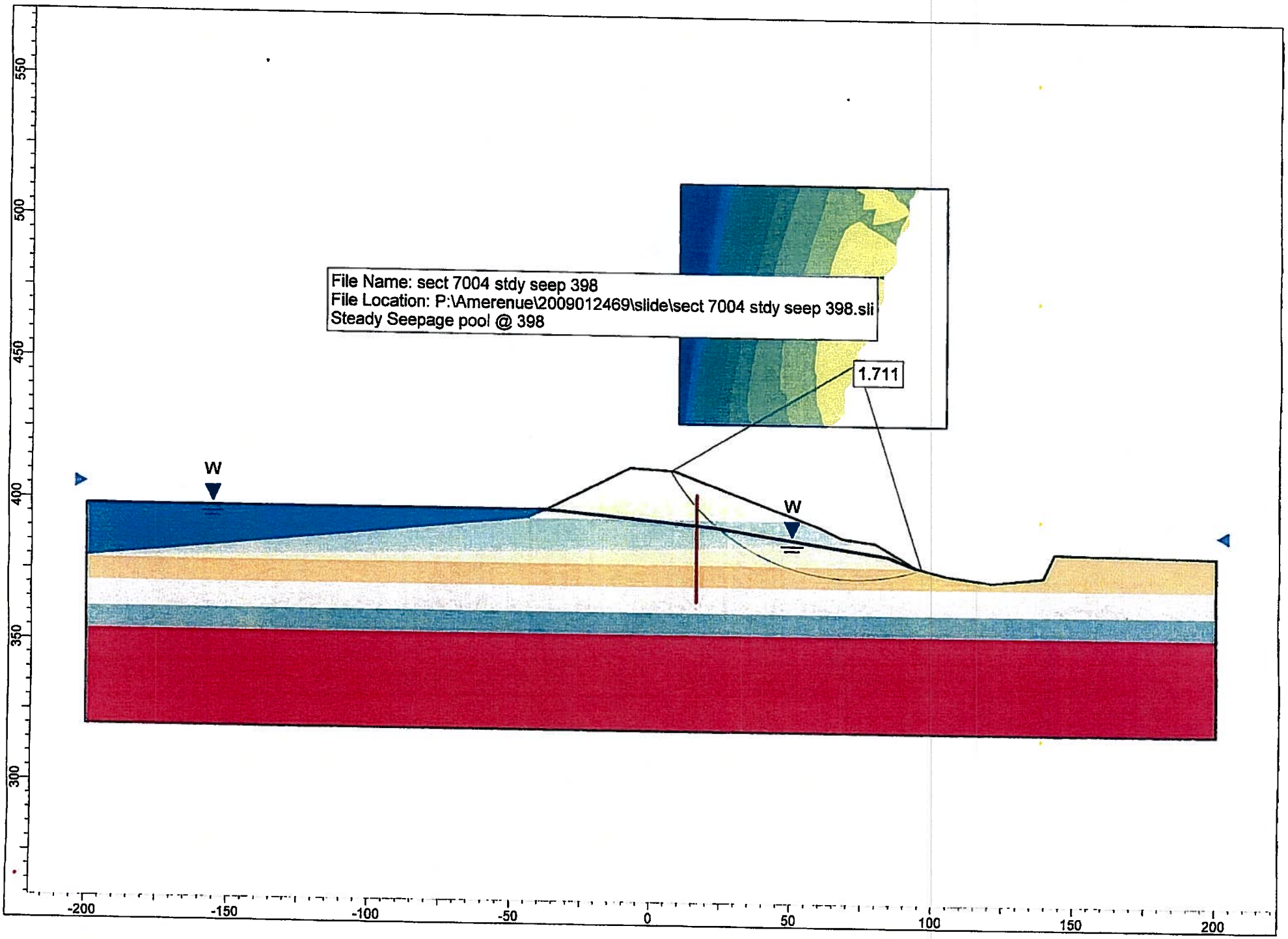
1.731
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200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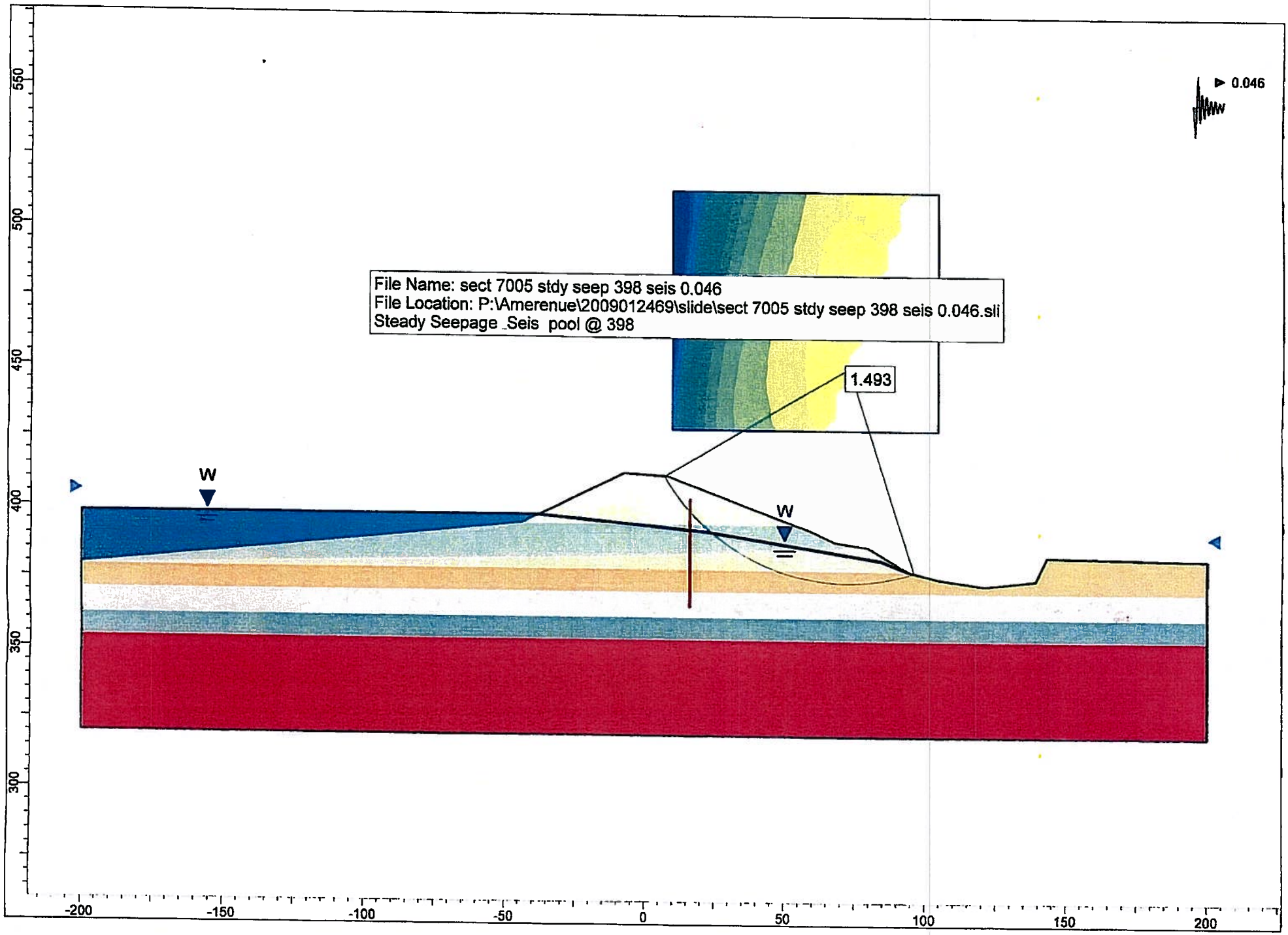
Steady Seepage pool @ 398
1.711
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


0.046
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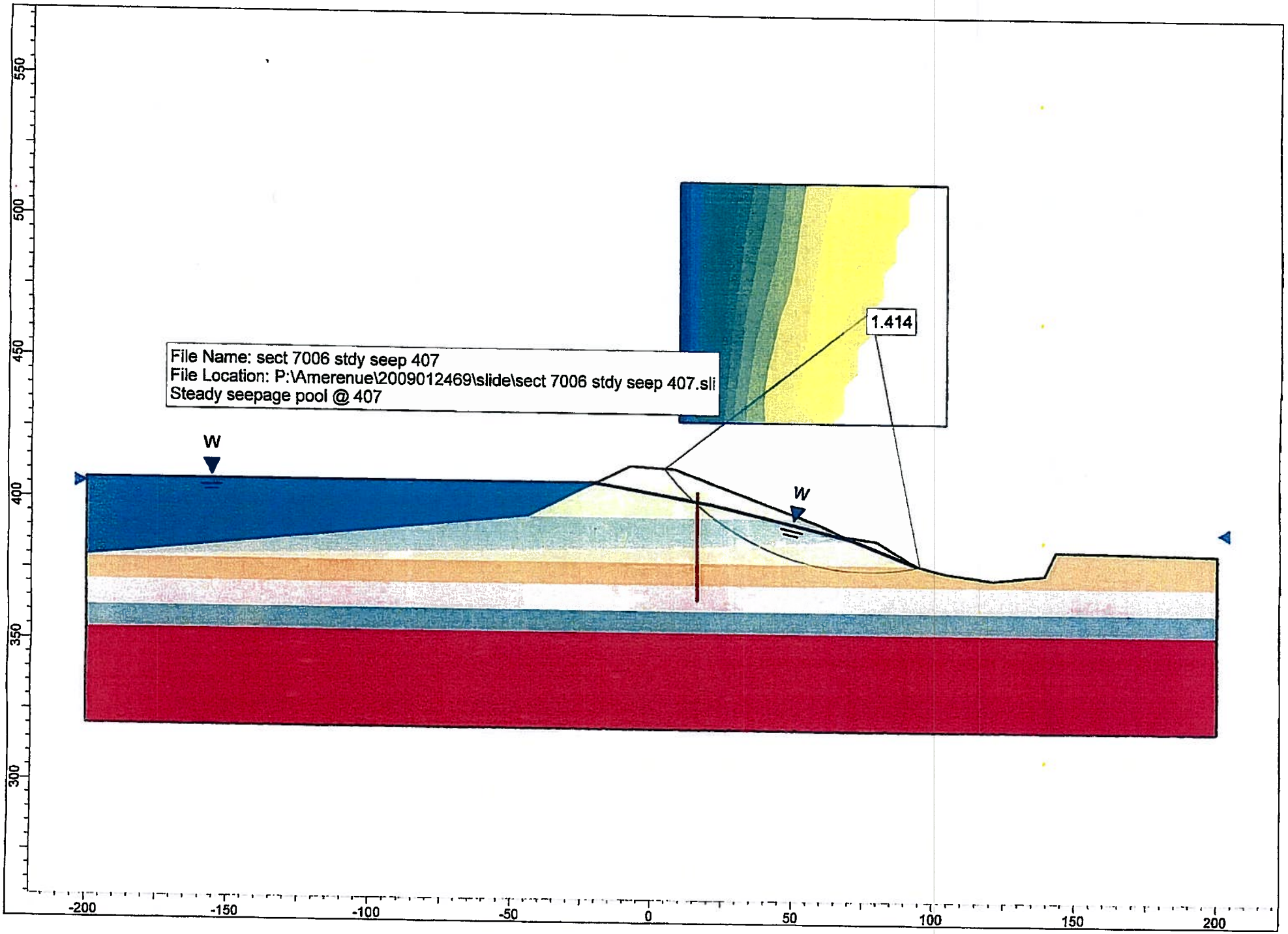
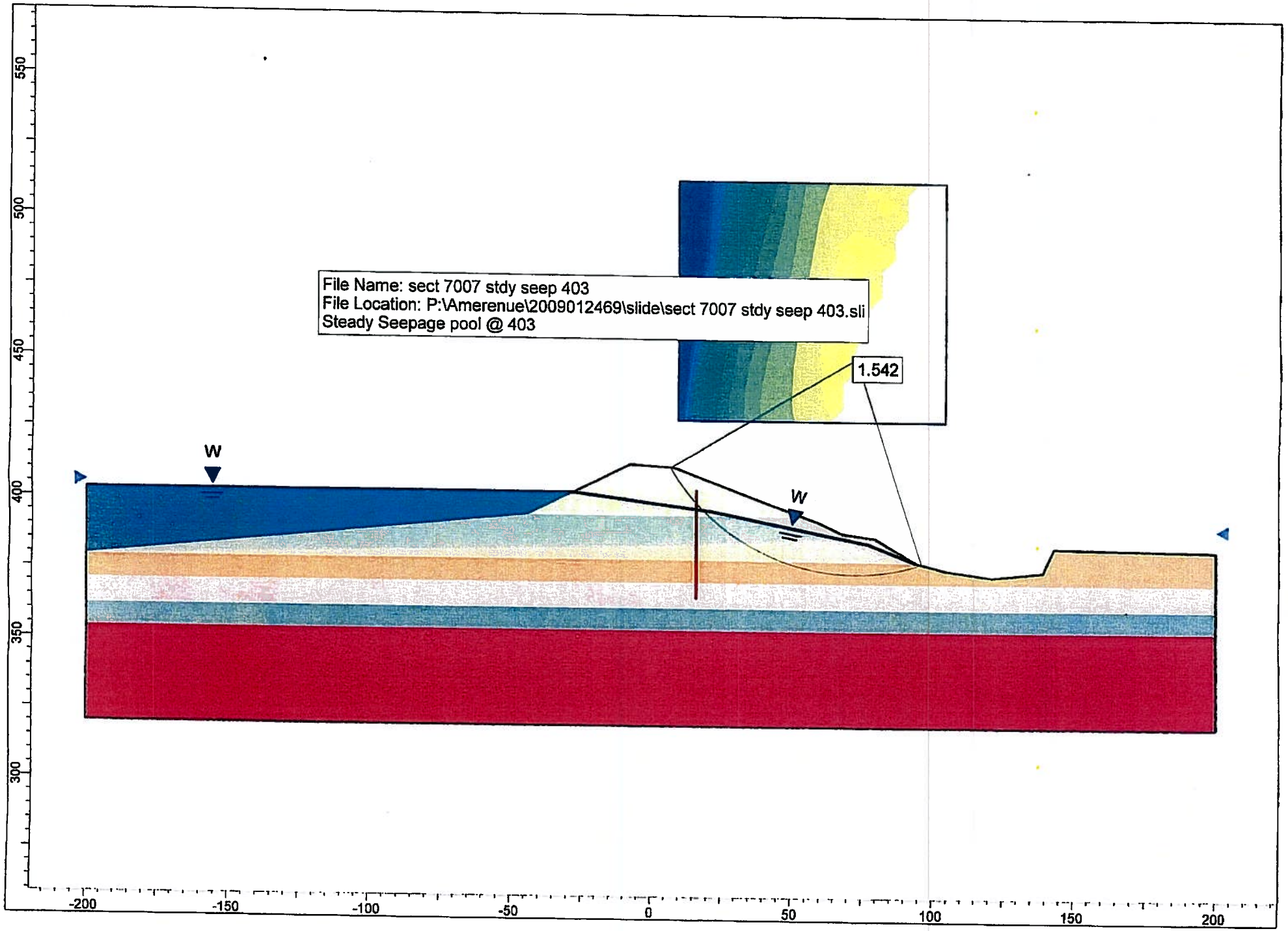
File Location: P:\Amerenue\2009012469\slide\sect 7005 stdy seep 398 seis 0.046.sli
Steady Seepage _Seis pool @ 398
1.493
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


1.414
File Name: sect 7006 stdy seep 407
File Location: P:\Amerenue\2009012469\slide\sect 7006 stdy seep 407.sli
Steady seepage pool @ 407
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200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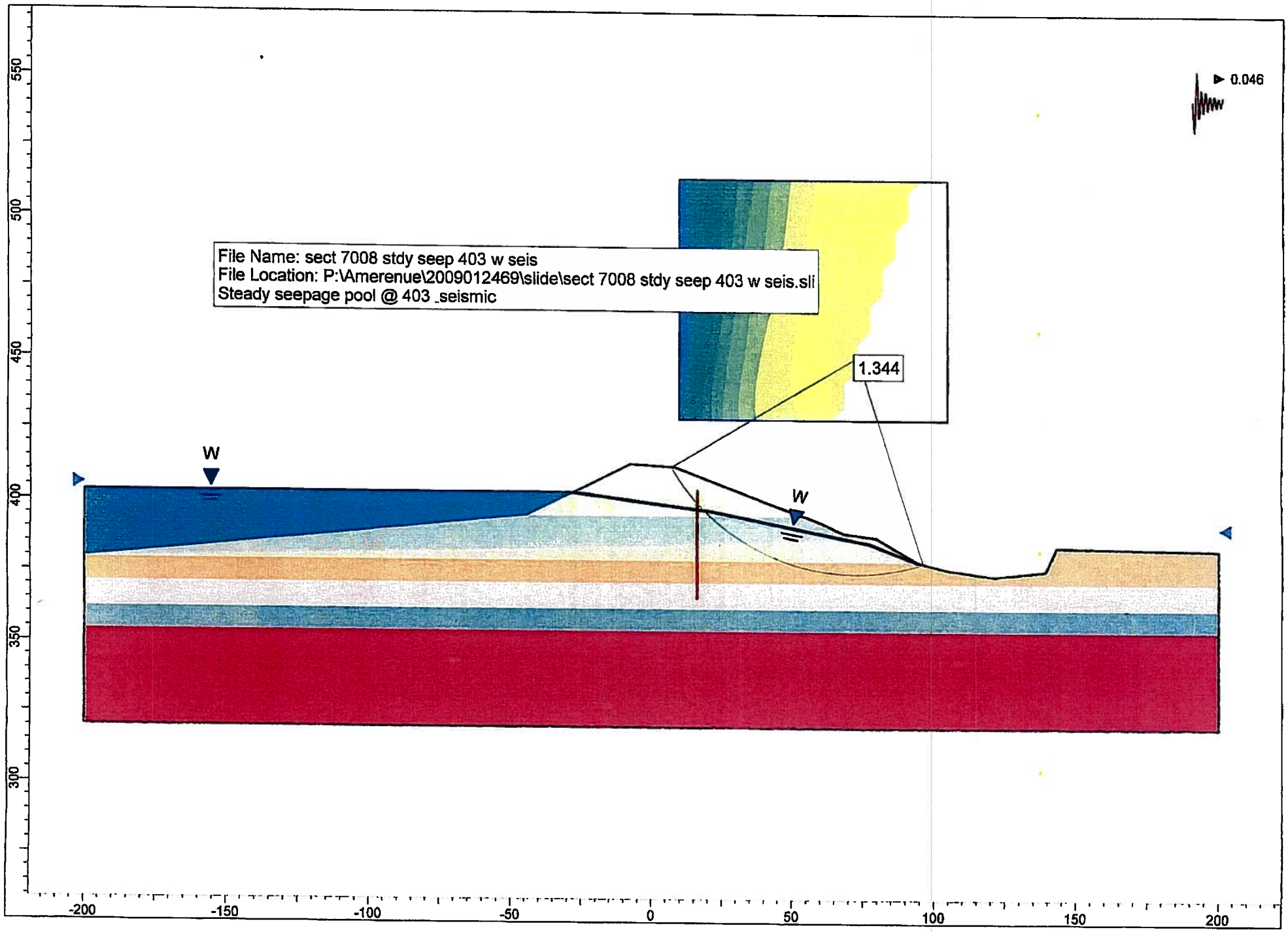
File Location: P:\Amerenue\2009012469\slide\sect 7007 stdy seep 403.sli
Steady Seepage pool @ 403
1.542
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200


0.046
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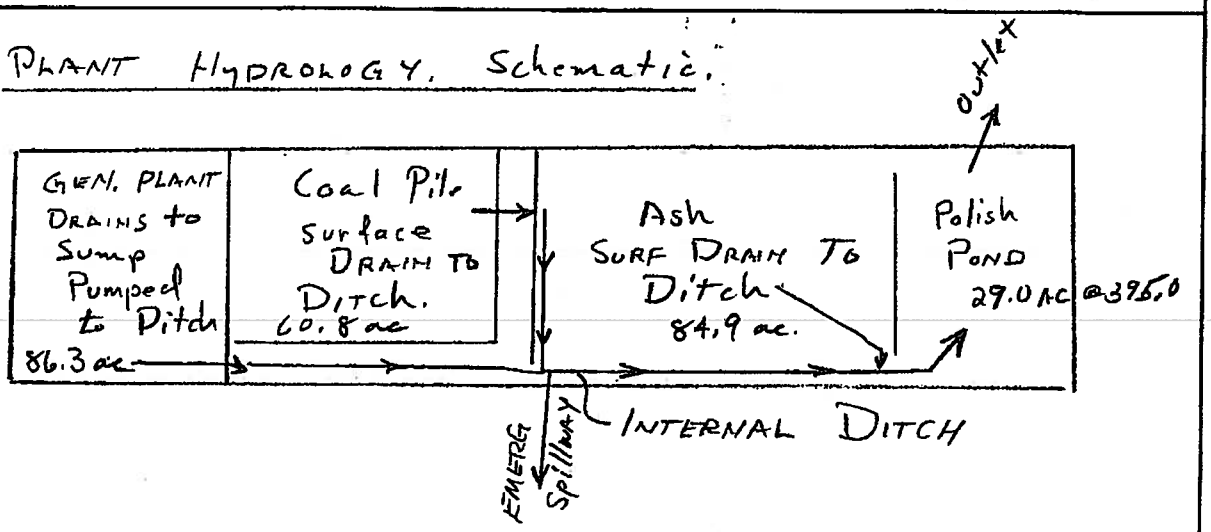
Steady seepage pool @ 403 _seismic
1.344
W
W
550
500
450
400
350
300
-200
-150
-100
-50
0
50
100
150
200

Hydrology Analysis

REITZ & JENS, INC.
CONSULTING ENGINEERS

PROJECT Rush Island
SUBJECT F.A. Pond. Hyd
DATE 1/2/10 BY DSE CHK'D _____ SHEET 1 OF _____

PLANT HYDROLOGY. SCHEMATIC.



GEN PLANT.

PLANT PROCESS H_2O assume 15 cfs - & 20 cfs.

MAX. SUMP FLOW ≈ 38 cfs. ∴ STORM MAX CAP ≈ 23 cfs.

COAL PILE

MAX TRAVEL PATH 0.3 miles. to ditch

AVG Slope = $20'/.3 \times 5280 = 0.0126$ 1/1

CN - COMPOSIT.

	CN	WT. CN
60% PACKED COAL	90	54
40% FLAT Weedy	80	32
	COMP CN =	86

using SCS LAG Eq'n

$$T_c = \frac{.000879 \times 1584^{.8}\left(\frac{1000}{86} - 9\right)^{.7}}{(.0126)^{1/2}} = \frac{.319 \times 1.966}{.1122} = 5.58 \text{ hr.}$$

too long - DO NOT USE.

USING KIRPICH

$T_c = 0.00013 \times 1584^{.77}(.0126)^{-.385} = 0.20$ hr. $v = 2.2$ fps. reasonable - use.

REITZ & JENS, INC.
CONSULTING ENGINEERS

DATE 1/2/2010

PROJECT RUSH ISLAND
SUBJECT F. A. PONDS HYD.
BY DSE CHK'D _____ SHEET 2 OF _____

ASH STORAGE. MIN. Elev. = 404.0

SLOPE OF SURF = $5'/(.46 \times 5280) = 0.0021$ ft/ft

MAX Drain L = $.46 \times 5280 = 2428'$

Ash C_N = 80 ≈ a gravel area.

$$T_c = \frac{.00013 \times 2428^{.77}}{(.0021)^{.385}} = \frac{.0526}{.0931} = 0.56 \text{ hr.}$$

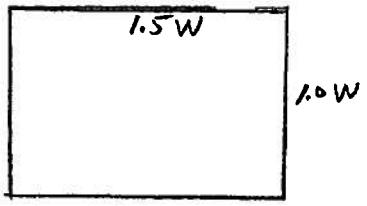
Polish Pond.

Ash Delta @ 395

@ 395 WET SURF = 27 - 8.1 = 18.9 ac.
@ 397 = 27.0 AC

assume 2.5:1 SIDE Slopes. - do not have CONTOURS so have to synthesize POND Area

Gen. POND Shape
1.5:1 Rectangle.



$A_0 = 1.5W \times 1.0W = 1.5W^2$

for Δh rise. (w 2.5 SS)
$W_0 = W + 5\Delta h$

$L = 1.5W + 5\Delta h$

$A = (W + 5\Delta h)(1.5W + 5\Delta h)$

$A = 1.5W^2 + 12.5W\Delta h + 25\Delta h^2$

W = 0.21 mi = 1108. Meas.

FOR Theo A = 27 ac @ 397

$A = 27 \times 43560 = 1.5W^2$
$W = 885'$

See Sheet 3 for Area vs Depth.

Polish Pond Area

assume rectangular shape (page 2 of computations)

Elev	delta H	Width	Length	Equation parts			Area sum (sq ft)	Acres	Ditch Area	Total Area
				1.5 W^2	5*dH*(PW +W)	25 dH^2				
397	0	885.5	1328.25	1176165	0	0	1176165	27.00	1.01	28.01
398	1			1176165	11068.75	25	1187259	27.26	1.01	28.27
399	2			1176165	13282.5	100	1189548	27.31	1.01	28.32
400	3			1176165	19923.75	225	1196314	27.46	1.01	28.47
401	4			1176165	26565	400	1203130	27.62	1.01	28.63
402	5			1176165	33206.25	625	1209997	27.78	1.01	28.79
403	6			1176165	39847.5	900	1216913	27.94	1.01	28.95
404	7			1176165	46488.75	1225	1223879	28.10	1.01	29.11
405	8			1176165	53130	1600	1230895	28.26	1.01	29.27
406	9			1176165	59771.25	2025	1237962	28.42	1.01	29.43
407	10			1176165	66412.5	2500	1245078	28.58	1.01	29.59
408	11			1176165	73053.75	3025	1252244	28.75	1.01	29.76
409	12			1176165	79695	3600	1259460	28.91	1.01	29.92
410	13			1176165	86336.25	4225	1266727	29.08	1.01	30.09

pond only storage volumes - starting @ 397

Elev	Area (ac.)	delta Volume	Storage
397	27.00		0.00
398	27.26	27.13	27.13
399	27.31	27.28	54.41
400	27.46	27.39	81.80
401	27.62	27.54	109.34
402	27.78	27.70	137.04
403	27.94	27.86	164.89
404	28.10	28.02	192.91
405	28.26	28.18	221.09
406	28.42	28.34	249.43
407	28.58	28.50	277.93
408	28.75	28.67	306.59
409	28.91	28.83	335.42
410	29.08	29.00	364.42

sheet 3 of

REITZ & JENS, INC.
CONSULTING ENGINEERS

DATE 3/15/10

PROJECT RUSH ISLAND
SUBJECT F.A. POND HYD.
BY DSE CHK'D _____ SHEET 4 OF _____

DISCUSSION W/ PLANT MANAGERS

1) Would like to operate polish Pond as high as 398.

2) COMPUTATIONS STARTED @ 398 WERE ADDED.

SEE SHEET 5 FOR COMP SUMMARY

Check POND RISE ASSUMING That Outlet is Closed

100 yr Storm - 24 hr Volume = 167.188 ac ft.

USING STAGE STORAGE TABLE - TRIAL 04

START ELEV	START STOR.	+167.188	RQD STORAGE	INTERPOLATED STAGE	
395	0	167.188	167.188	401 155.239 402 182.938	401.43
398	73.029		240.217	404 238.812 405 216.989	404.05

USING TRIAL 05

403	0		167.188	408 141.699 409 170.529	408.884

using storage values on sheet 3
for 2' F.B = 408.2 - 2.0 = 406.2

START STOR = 249.43 + 0.2(28.5) = 255.13
MAX POSS. START ELEV W/ BLOCKED Outlet
255.13 - 167.88 = 87.94 Start Stor.
= 400.2 MAX POSS. POND ELEV.

Table of Results
Hydrologic computations

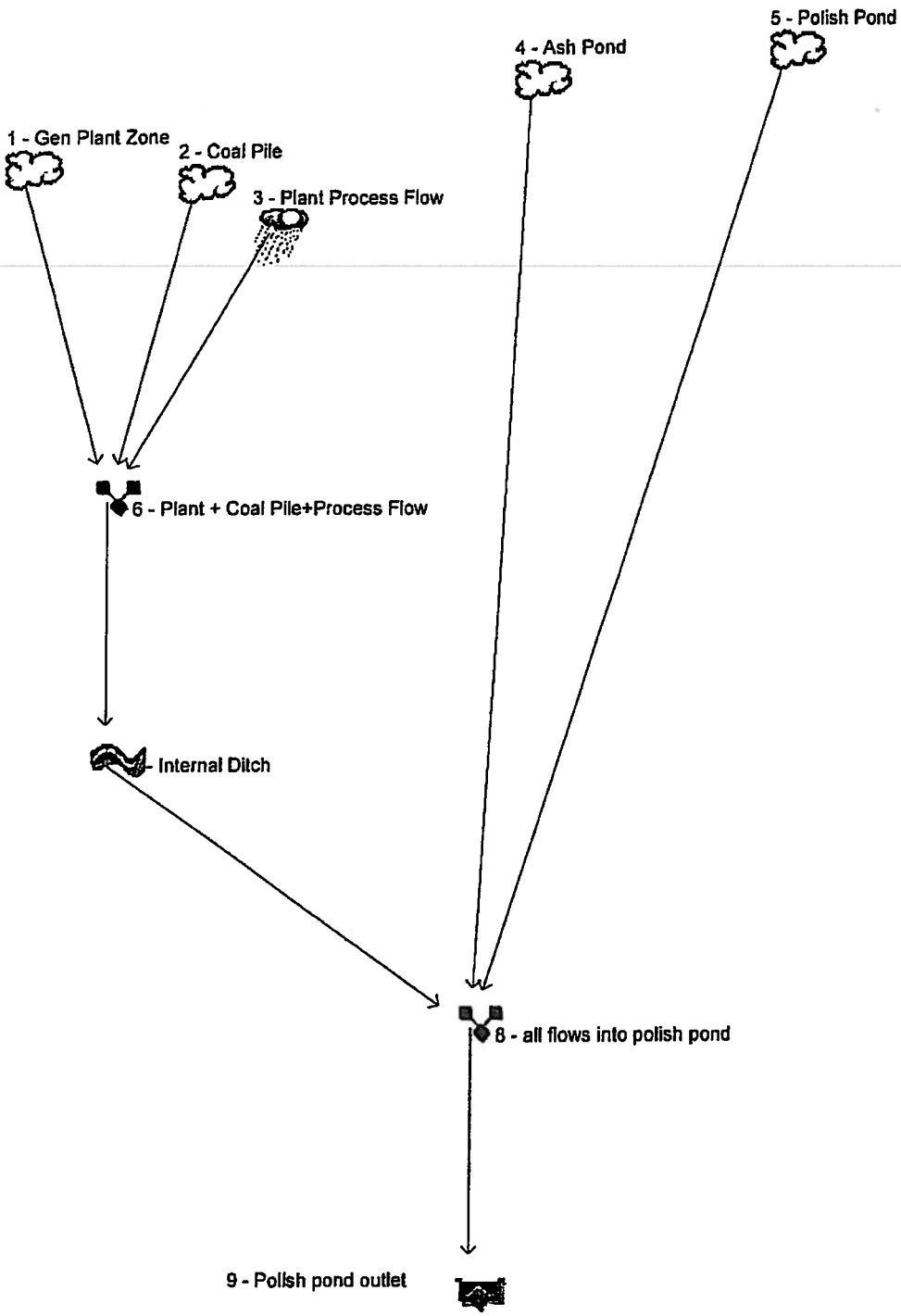
Rush Island Ash Pond Storm Routing

File	Rainfall duration	frequency	Pond Start Elevtion	Base Flow from Plant	Maximum Stage	Max. Outflow cfs	Total Storage ac-ft	Remarks
Trial 03	24 hr	100 yr	395	15 cfs	399.55	27.97	116	8.1 ac Ash delta at 395
Trial 04	24 hr	100 yr	395	20 cfs	399.87	28.95	124	8.1 ac Ash delta at 395
Trial 05	24 hr	100 yr	403	20 cfs	407.44	27.93	126	No Ash Delta @ 403
Trial 09	24 hr	100 yr	398	20 cfs	402.55	28.27	125.2	Ash Delta Submerged @ 397
Trial 06	6 hr	100 yr	395	20 cfs	398.25	23.51	79.8	8.1 ac Ash delta at 395
Trial 07	6 hr	100 yr	403	20 cfs	405.88	22.38	80.3	No Ash Delta @ 403
Trial 08	6 hr	100 yr	398	20 cfs	400.93	22.68	80.21	Ash Delta Submerged @ 397

Note: 100 yr - 24 hour storm - 7.10 inches
100 yr - 6 hour storm - 5.20 inches
Souirce - Bulletin 71, Huff & Angel

Sheet 5 of

Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

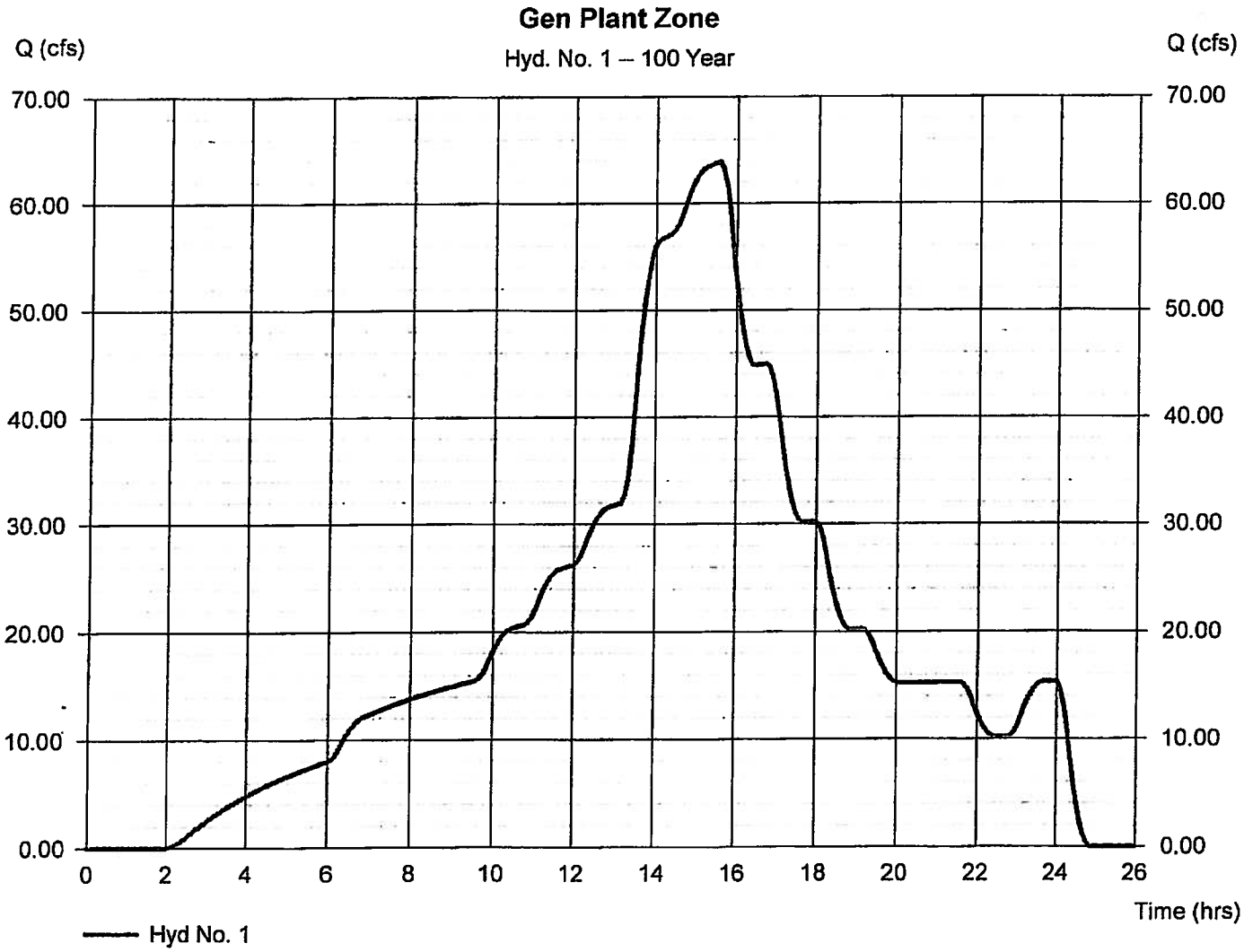
d. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	63.88	5	935	40.508	---	-----	-----	Gen Plant Zone
2	SCS Runoff	41.10	5	935	25.944	---	-----	-----	Coal Pile
3	Manual	20.00	5	5	49.587	---	-----	-----	Plant Process Flow
4	SCS Runoff	58.35	5	935	34.925	---	-----	-----	Ash Pond
5	SCS Runoff	21.09	5	925	16.086	---	-----	-----	Polish Pond
6	Combine	124.99	5	935	116.039	1, 2, 3,	-----	-----	Plant + Coal Pile+Process Flow
7	Reach	124.99	5	940	116.177	6	-----	-----	Internal Ditch
8	Combine	204.24	5	935	167.188	4, 5, 7	-----	-----	all flows into polish pond
9	Reservoir	28.95	5	1470	165.227	8	399.87	124	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

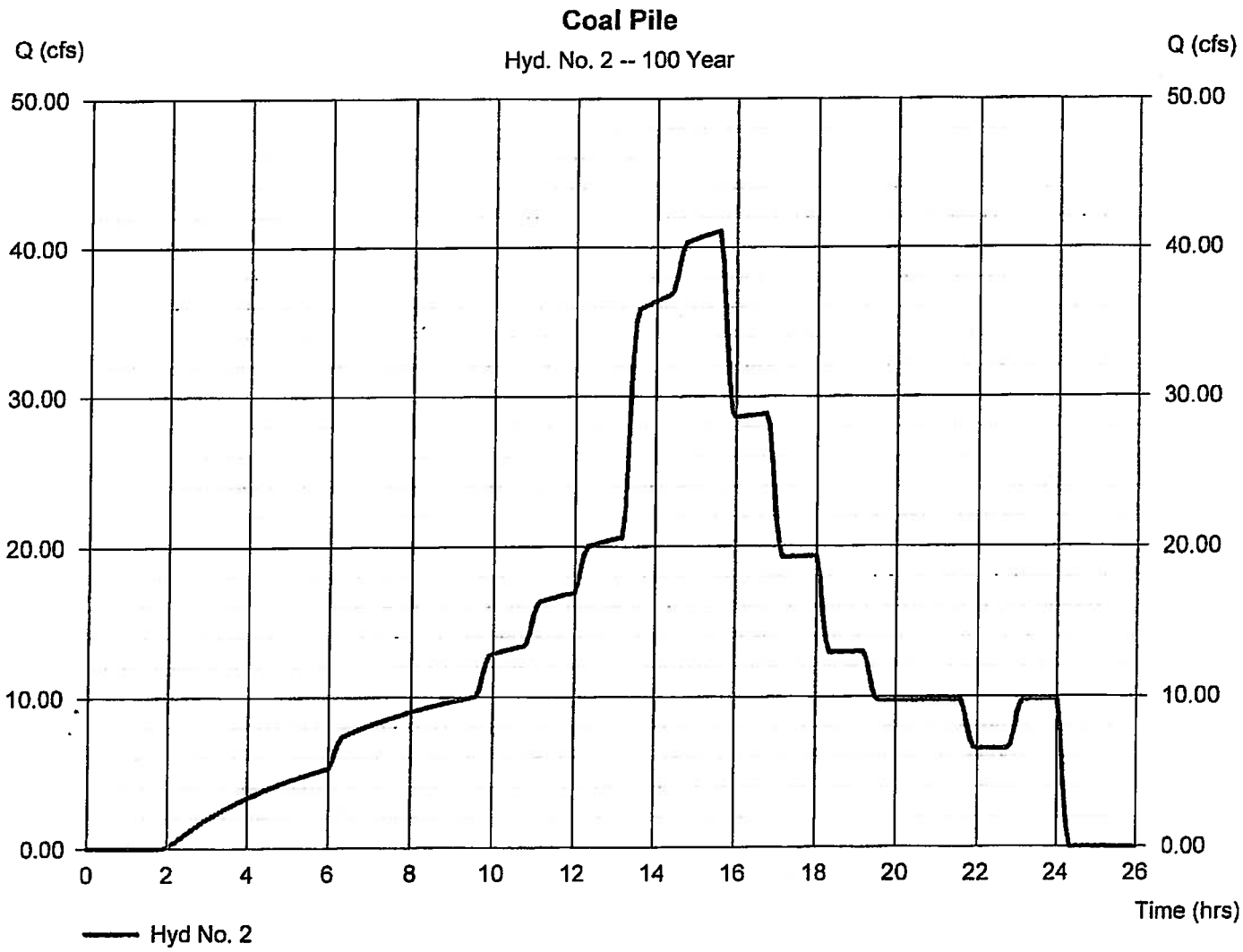


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

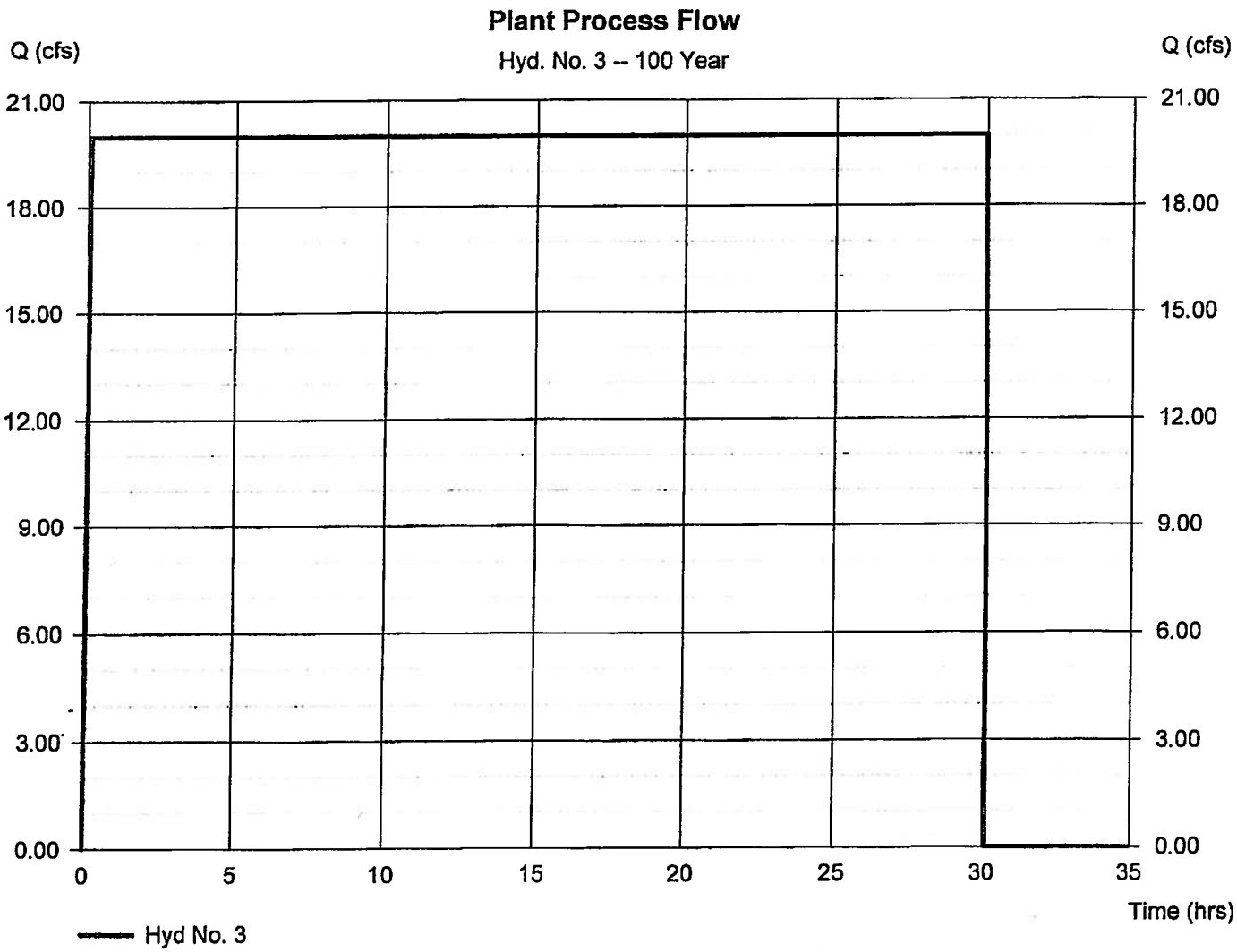


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft



Hydrograph Report

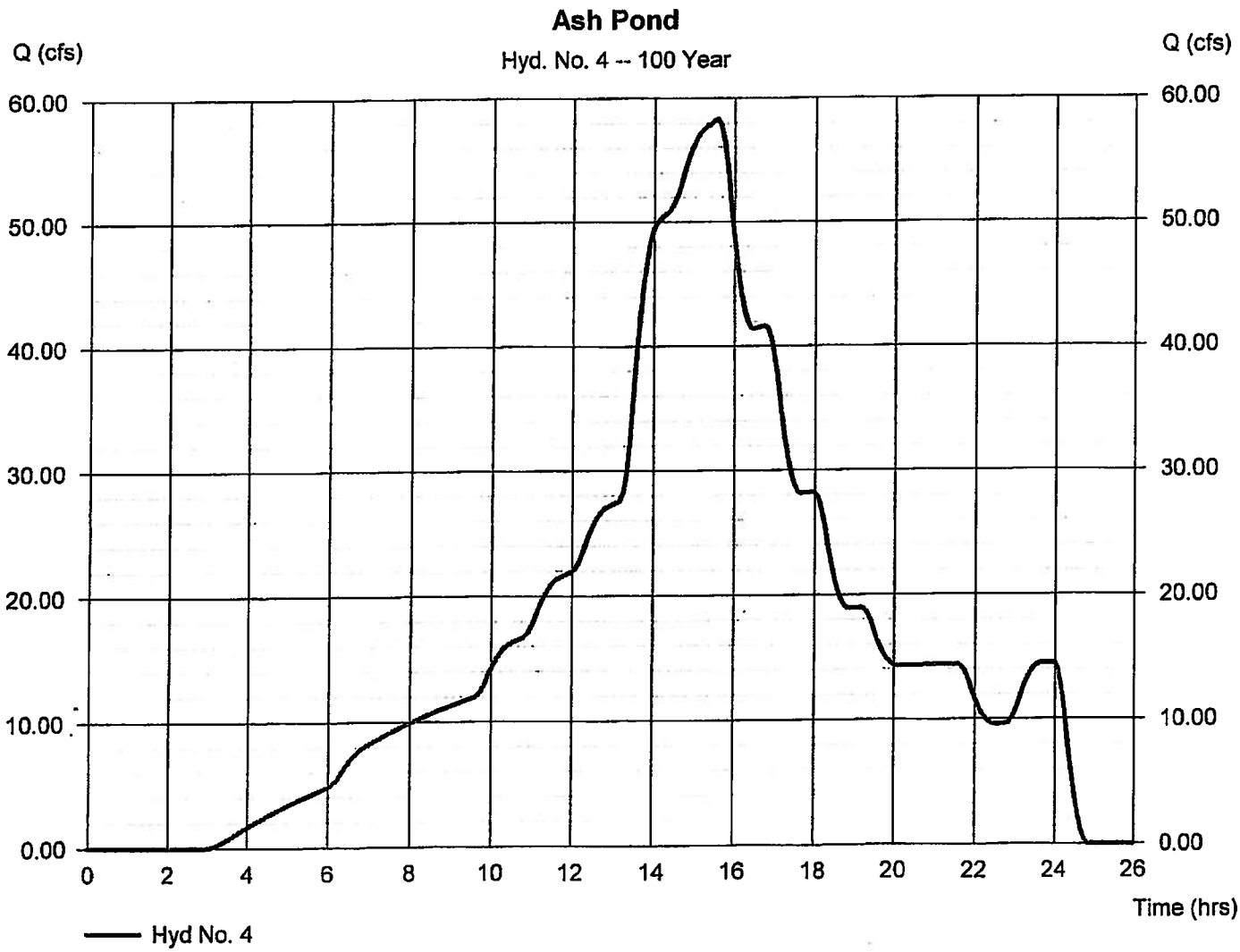
Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

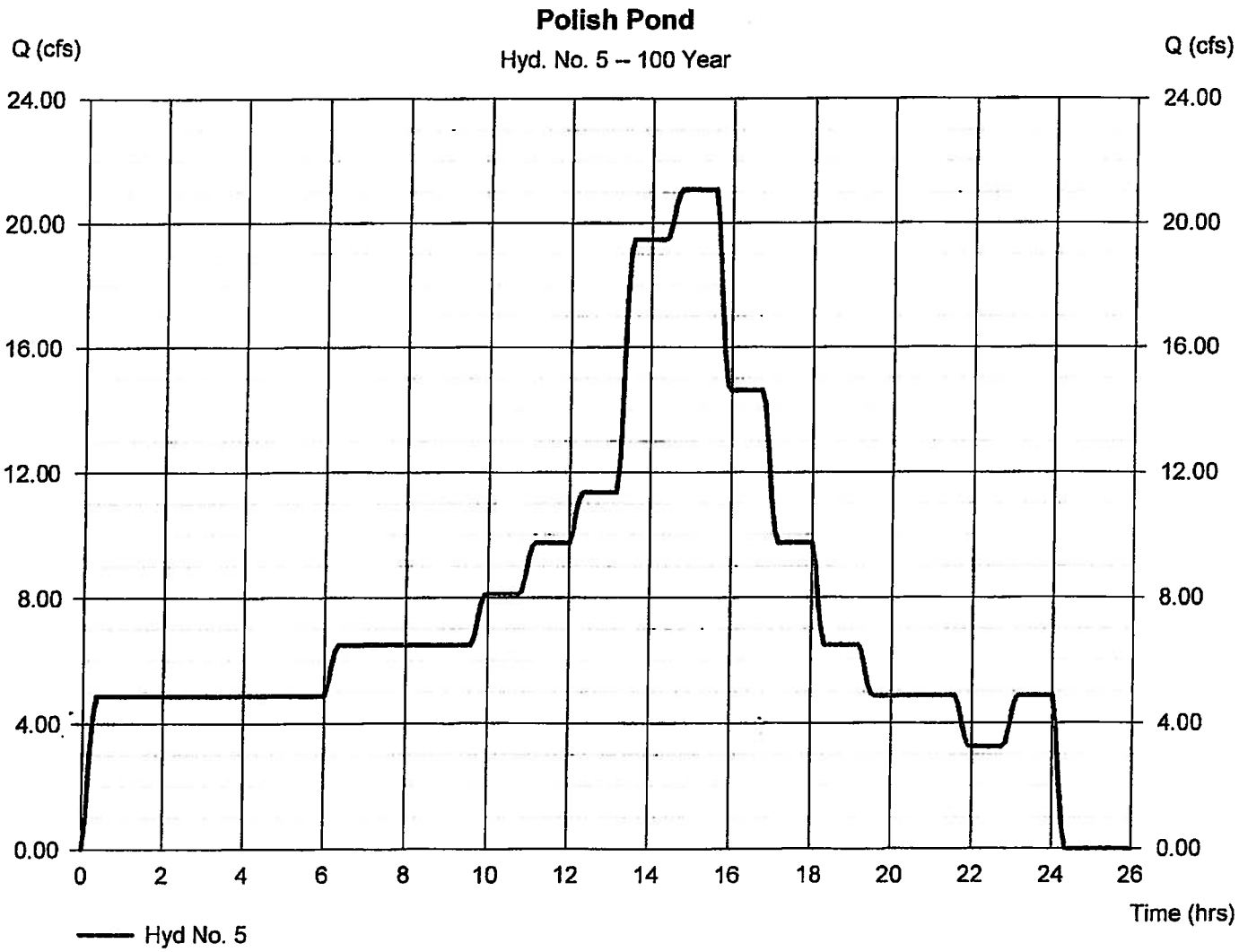


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

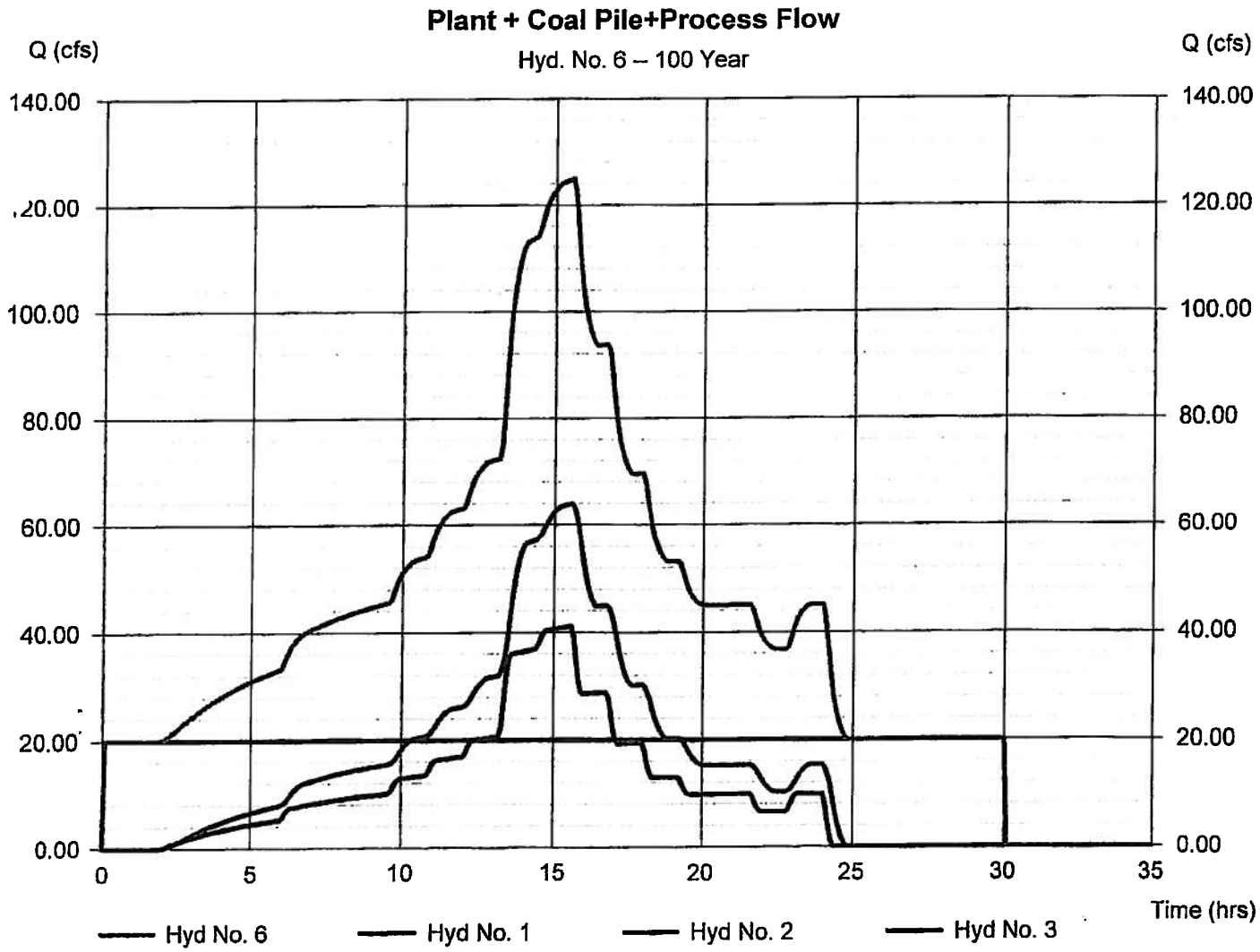


Hydrograph Report

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

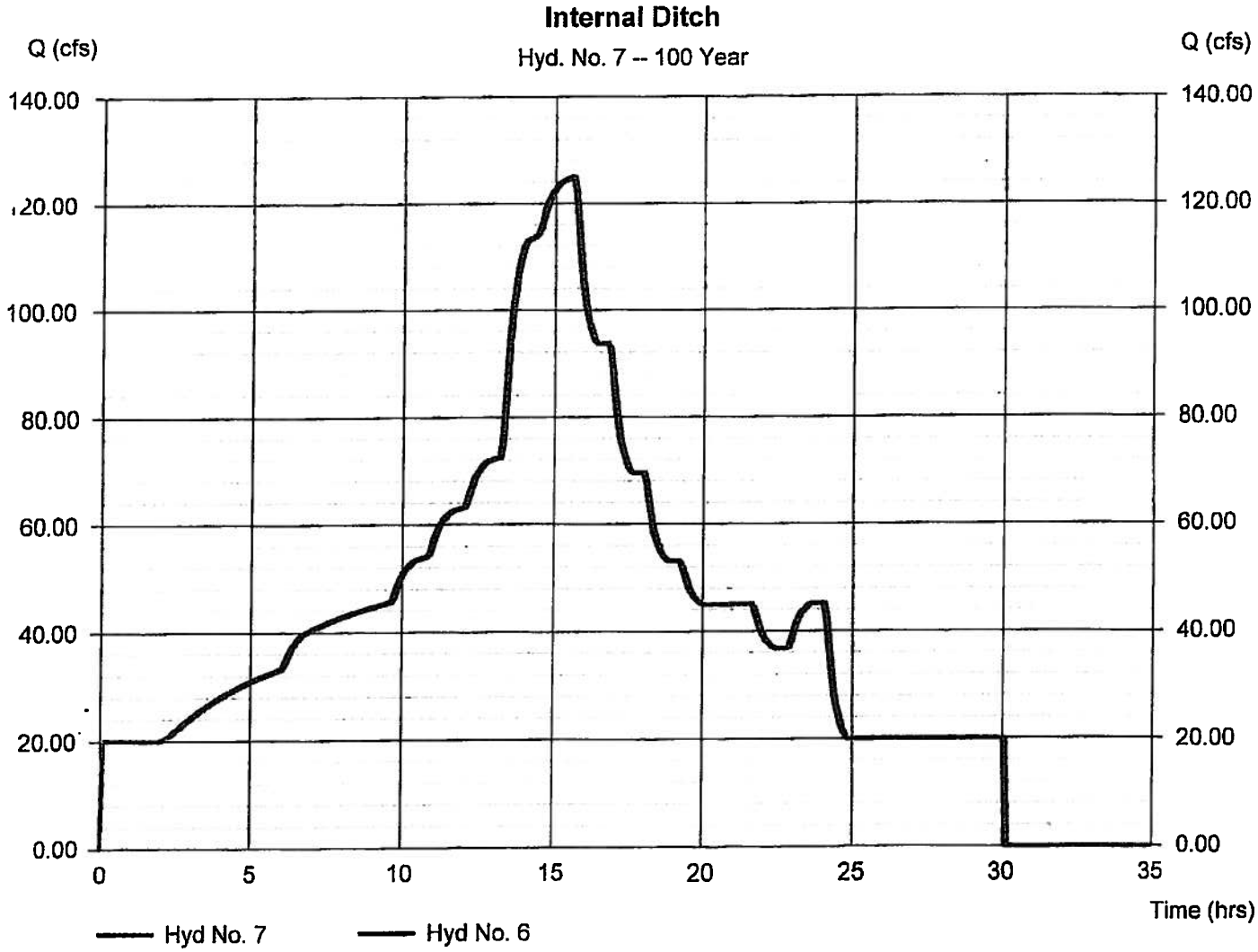
Tuesday, Jan 5, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.

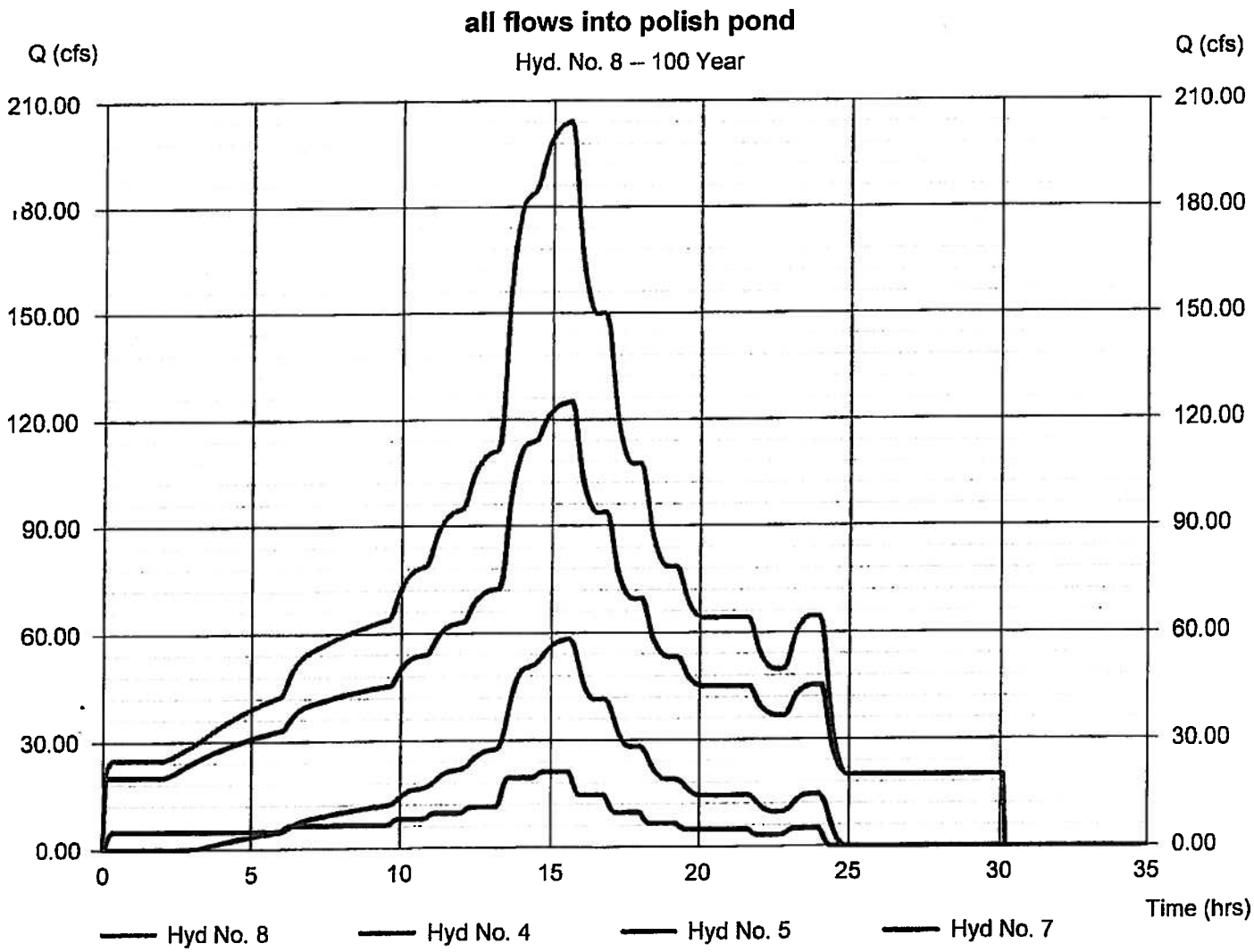


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

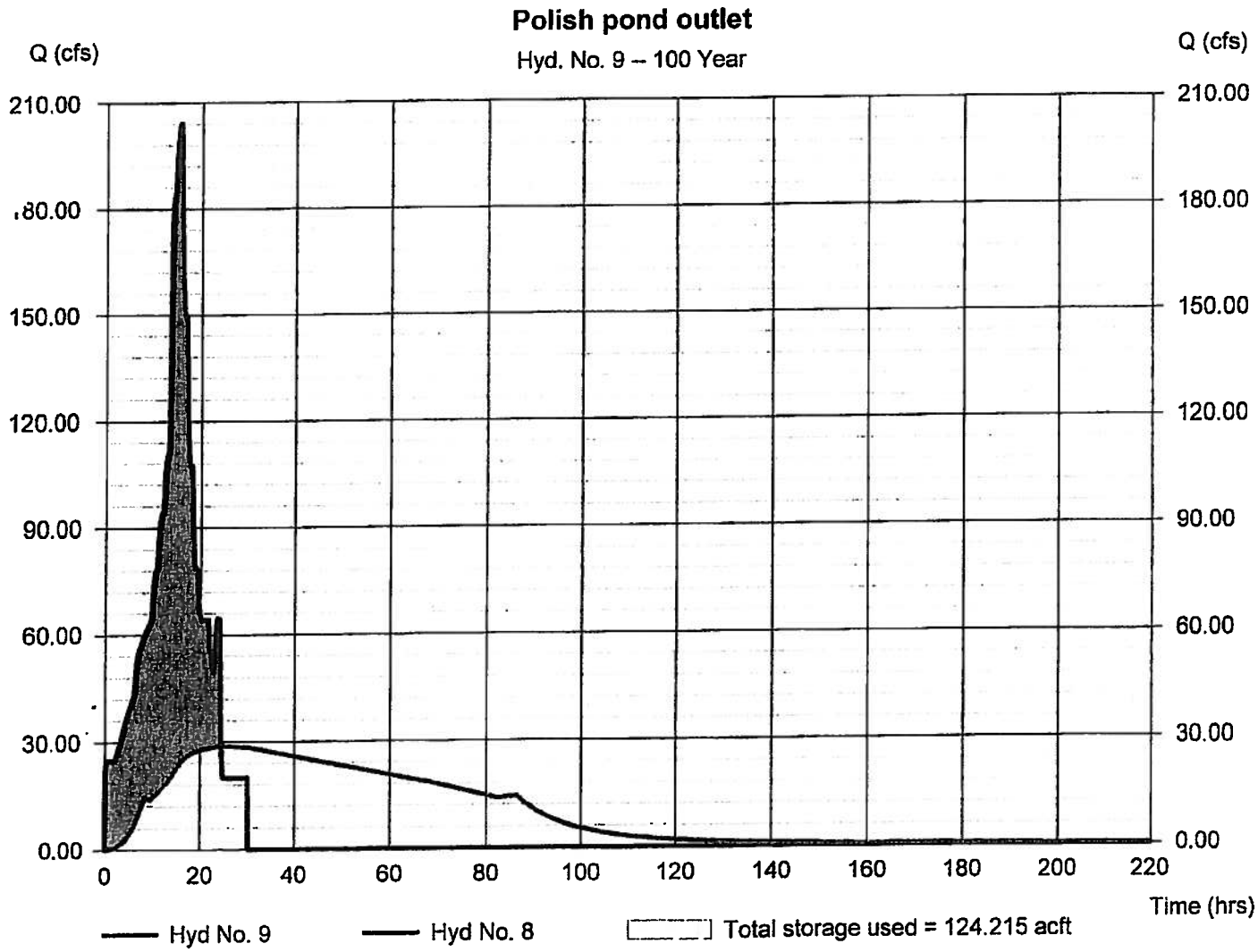
Tuesday, Jan 5, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 28.95 cfs
Storm frequency	= 100 yrs	Time to peak	= 24.50 hrs
Time interval	= 5 min	Hyd. volume	= 165.227 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 399.87 ft
Reservoir name	= Polish pond	Max. Storage	= 124.215 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.23

Tuesday, Jan 5, 2010

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 395.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	395.00	823,284	0.000	0.000
2.00	397.00	1,176,165	45.901	45.901
3.00	398.00	1,187,259	27.128	73.029
4.00	399.00	1,189,548	27.282	100.311
5.00	400.00	1,196,314	27.386	127.697
6.00	401.00	1,203,130	27.542	155.239
7.00	402.00	1,209,997	27.699	182.938
8.00	403.00	1,216,913	27.857	210.795
9.00	404.00	1,223,879	28.016	238.812
10.00	405.00	1,230,895	28.177	266.989

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

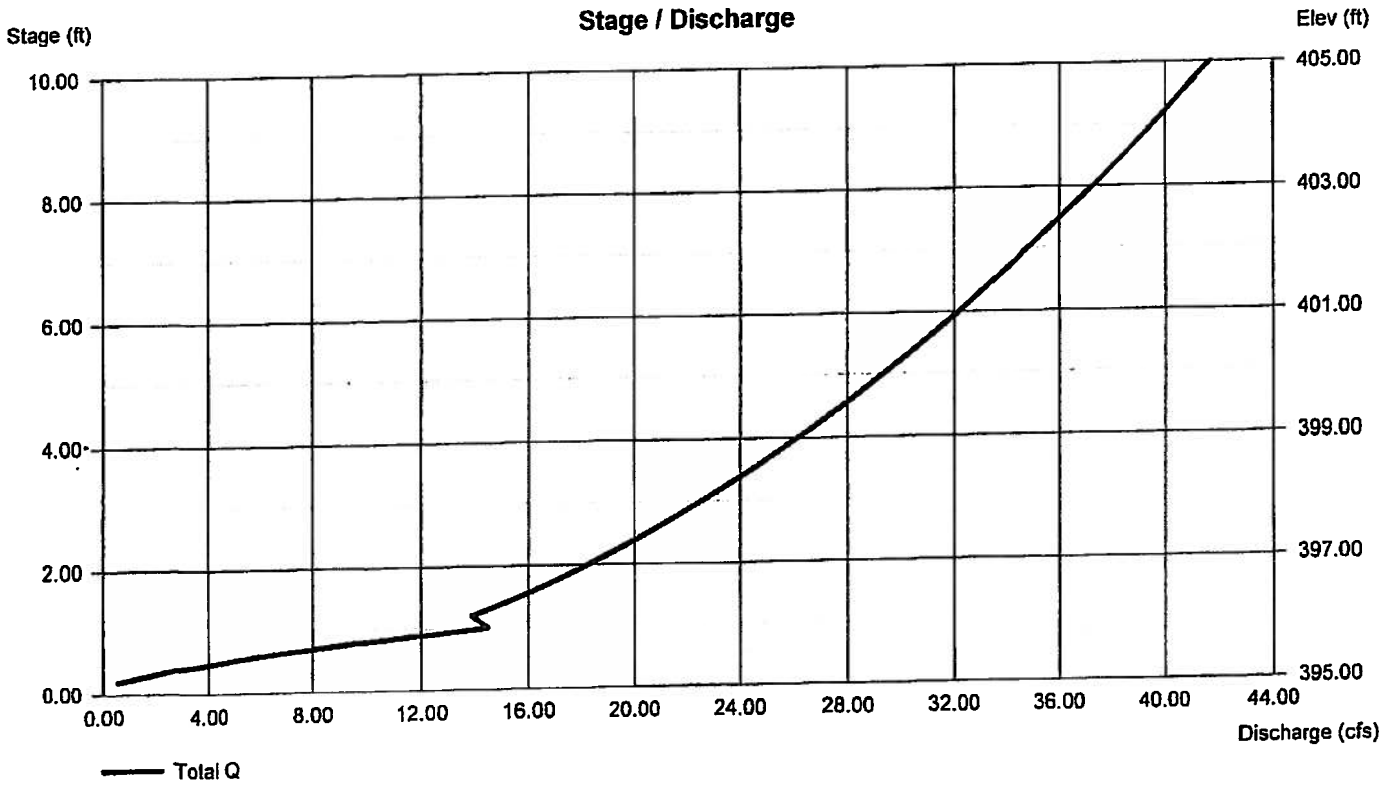
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 395.10	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

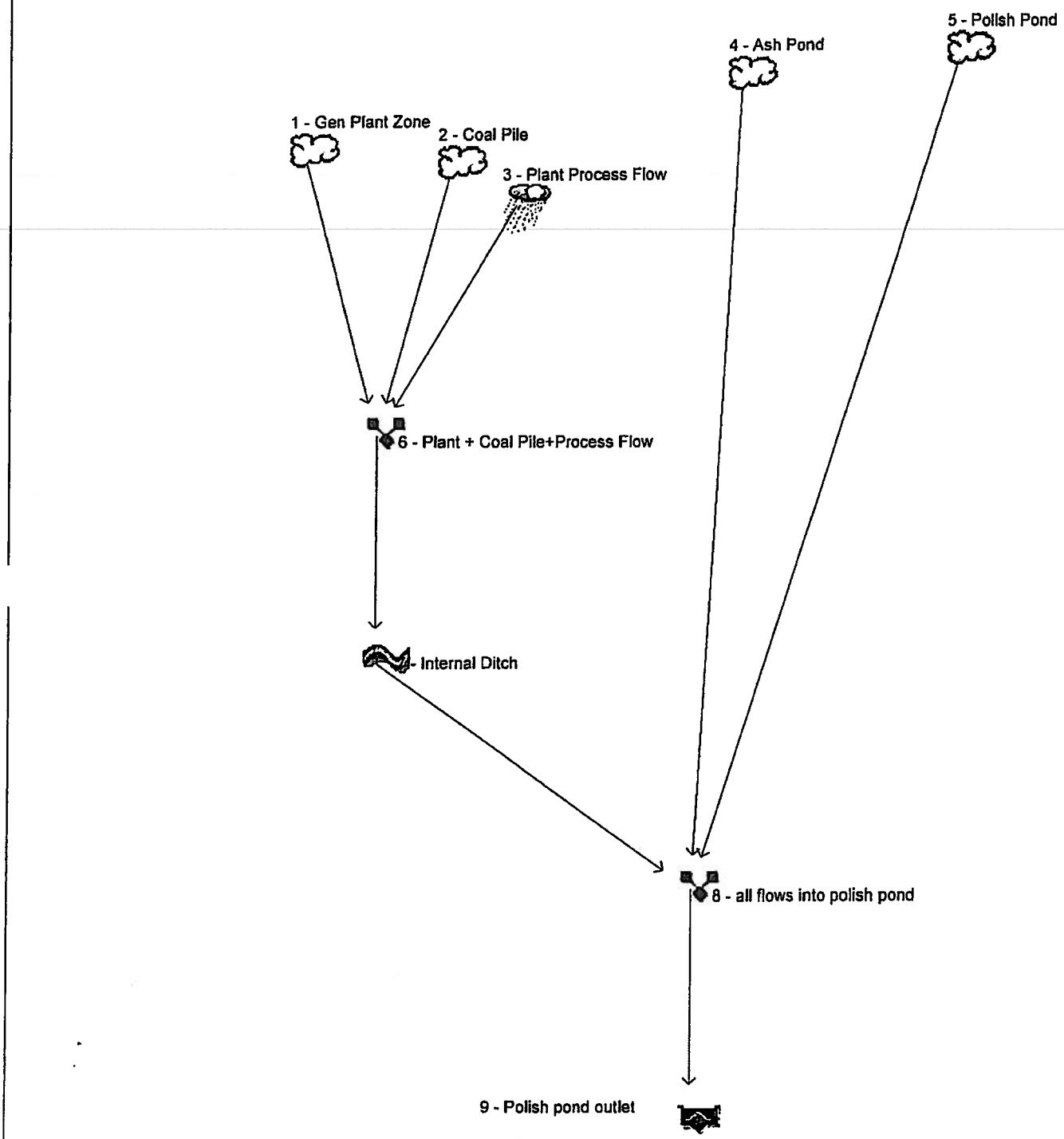
Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 360.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s)



Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

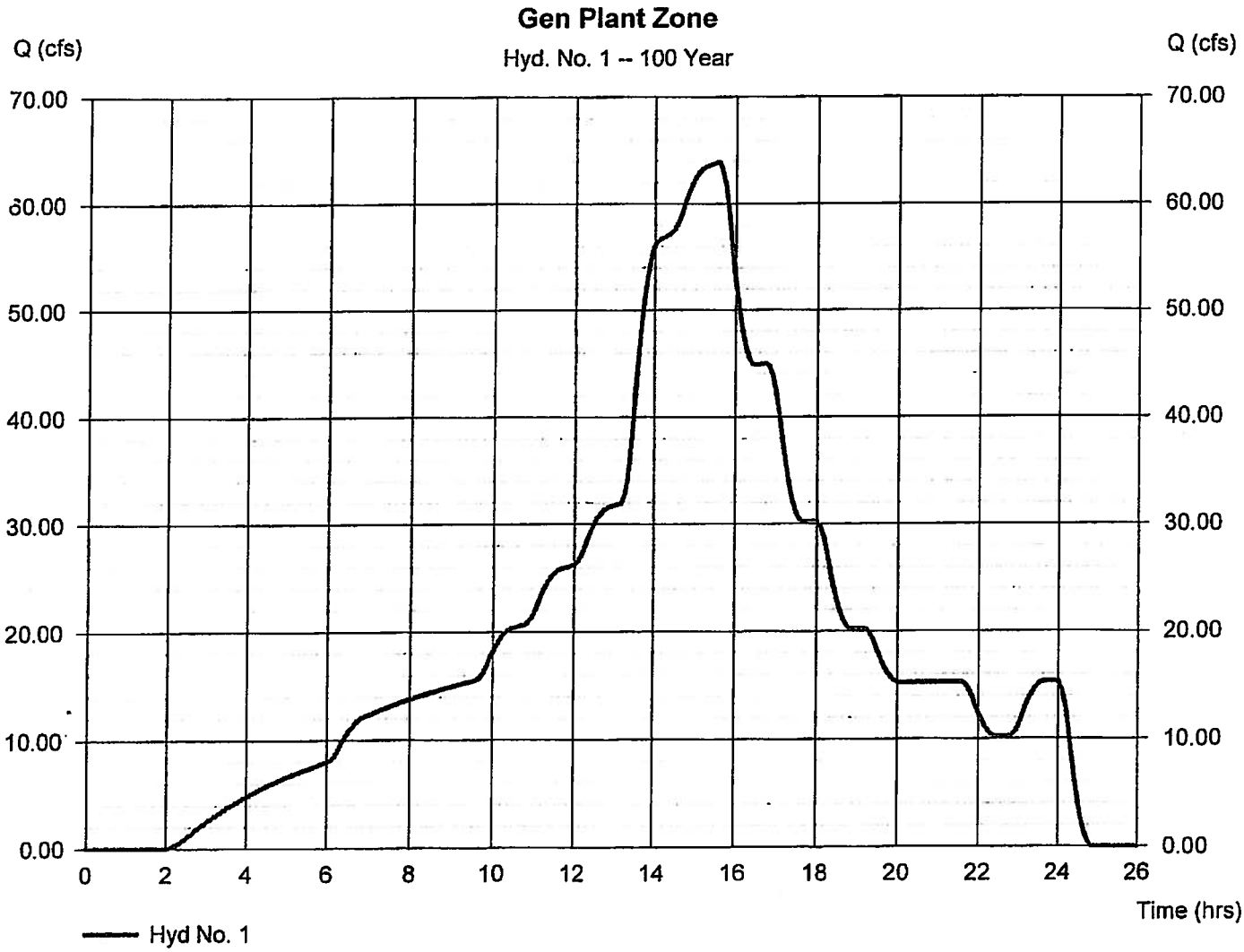
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	63.88	5	935	40.508	----	------	------	Gen Plant Zone
2	SCS Runoff	41.10	5	935	25.944	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	58.35	5	935	34.925	----	------	------	Ash Pond
5	SCS Runoff	21.09	5	925	16.086	----	------	------	Polish Pond
6	Combine	124.99	5	935	116.039	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	124.99	5	940	116.177	6	------	------	Internal Ditch
8	Combine	204.24	5	935	167.188	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	27.93	5	1475	166.243	8	407.44	126	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

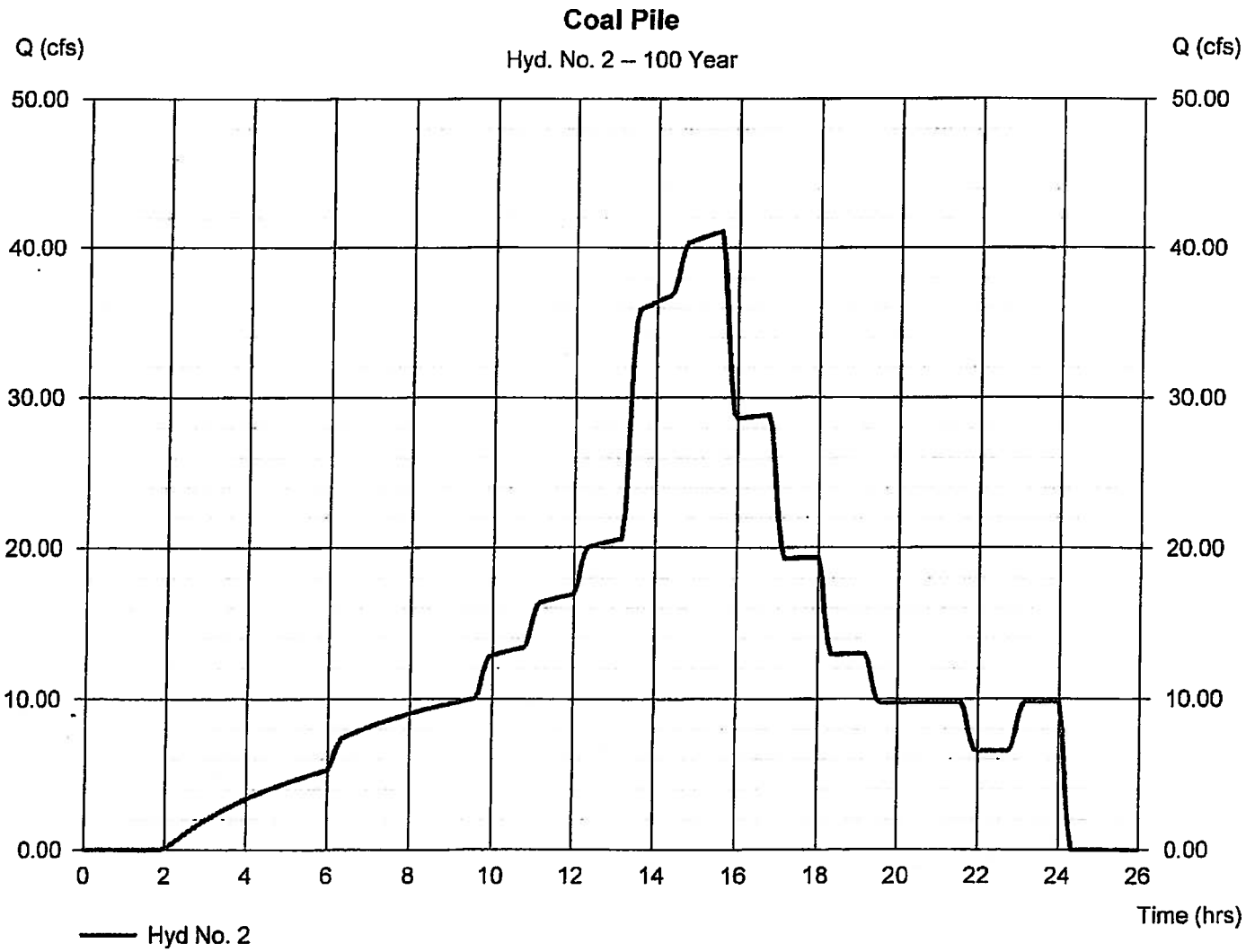


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

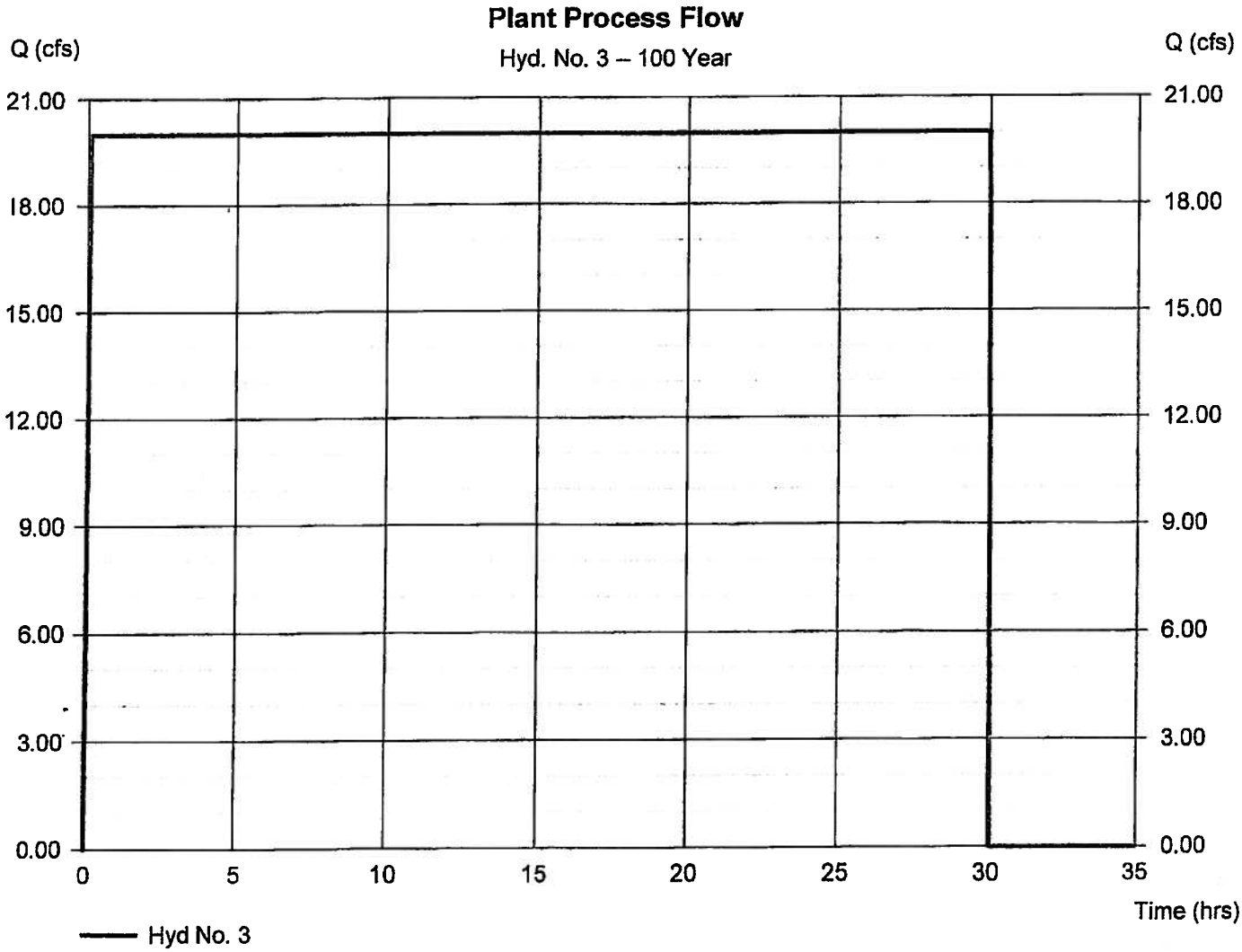


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

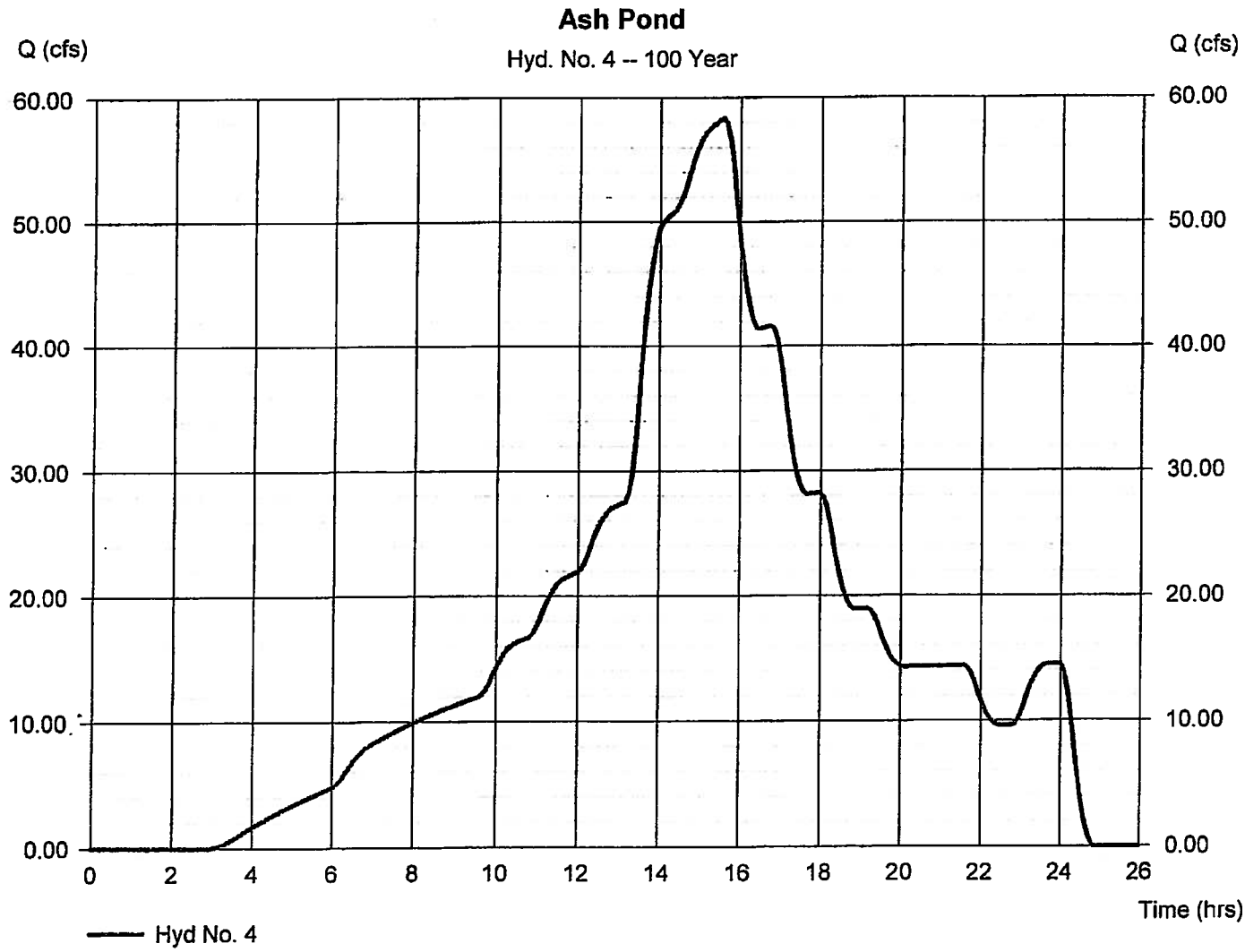


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484



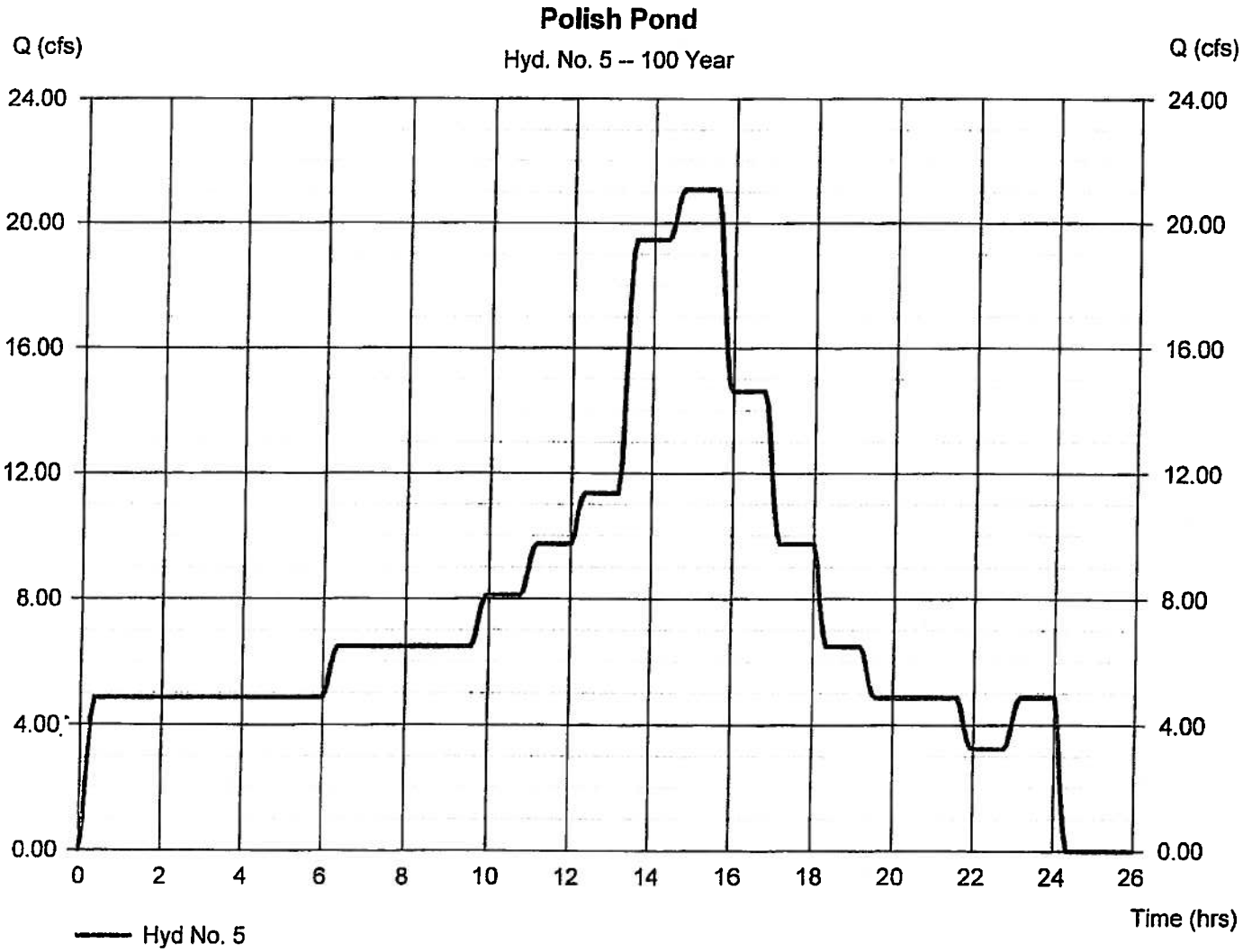
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Tuesday, Jan 5, 2010

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

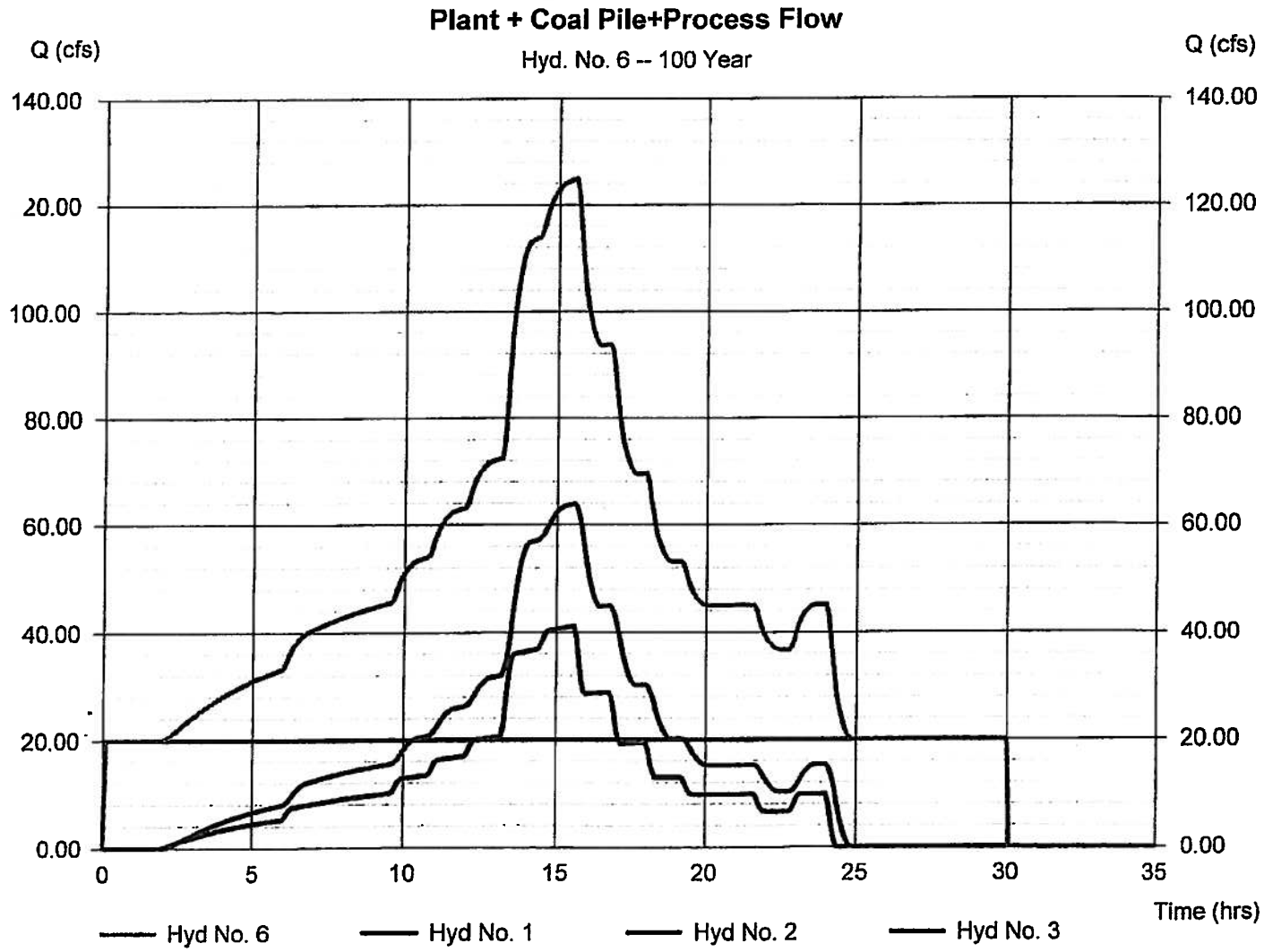


Hydrograph Report

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



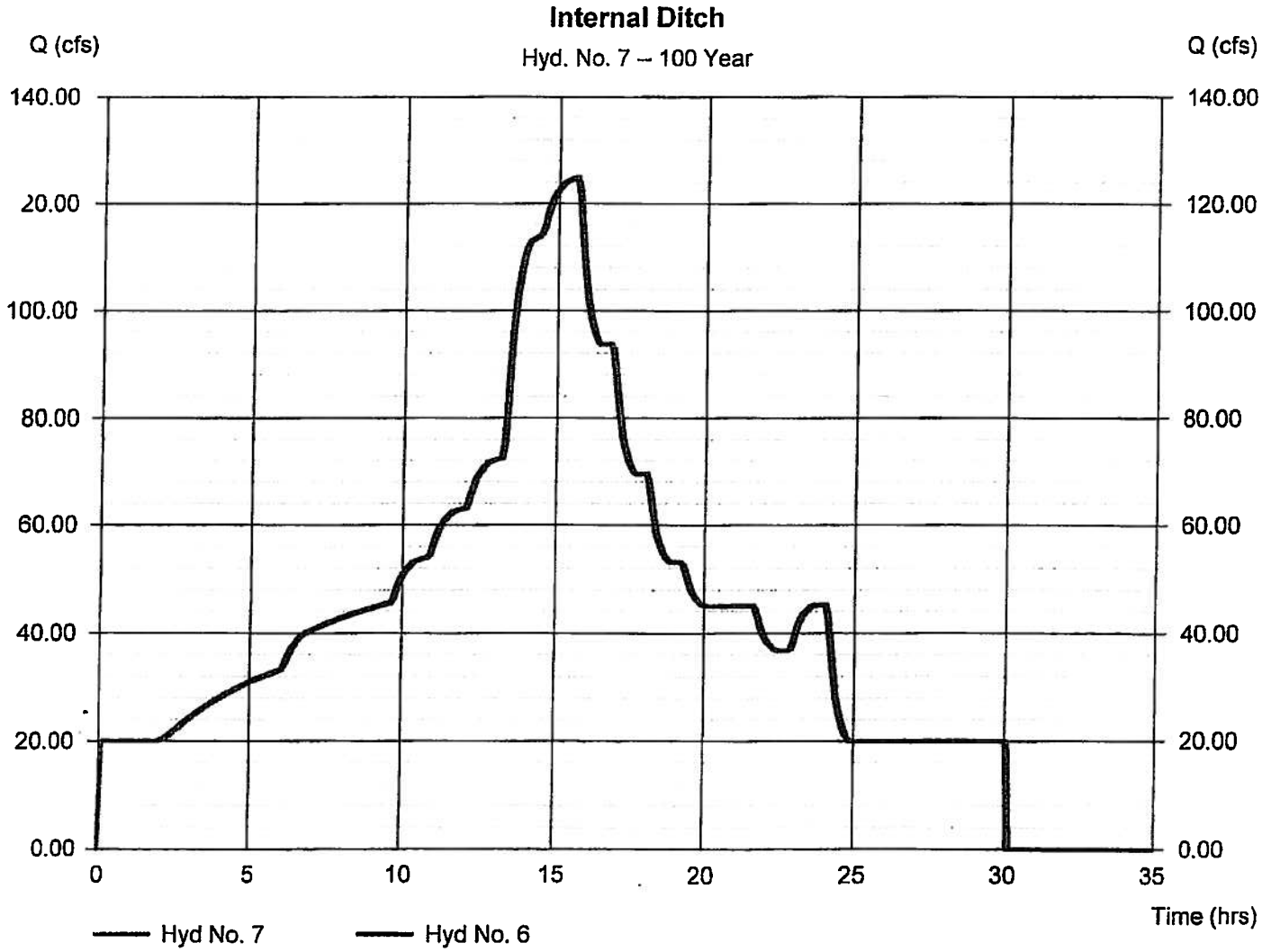
Hydrograph Report

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.

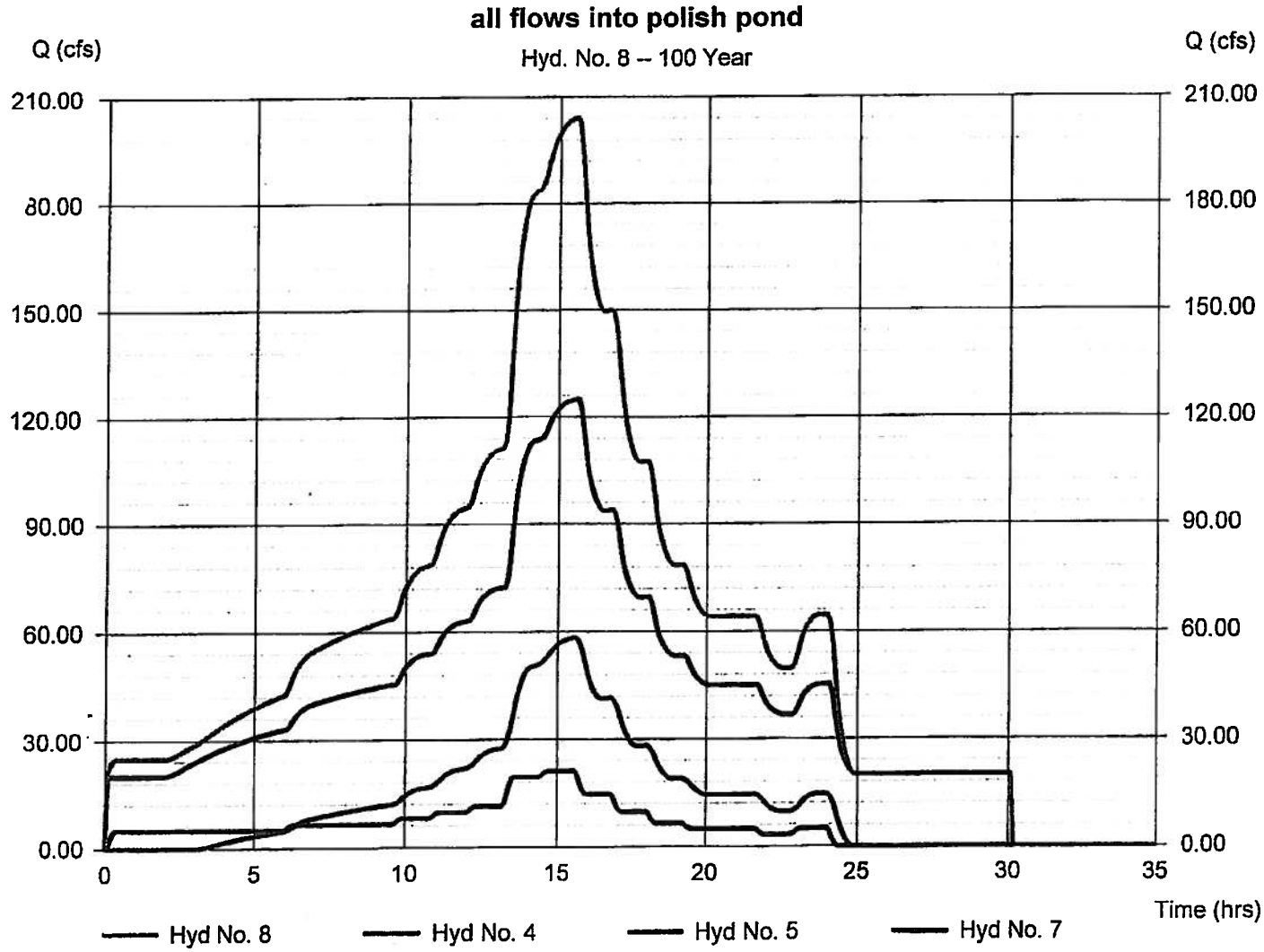


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

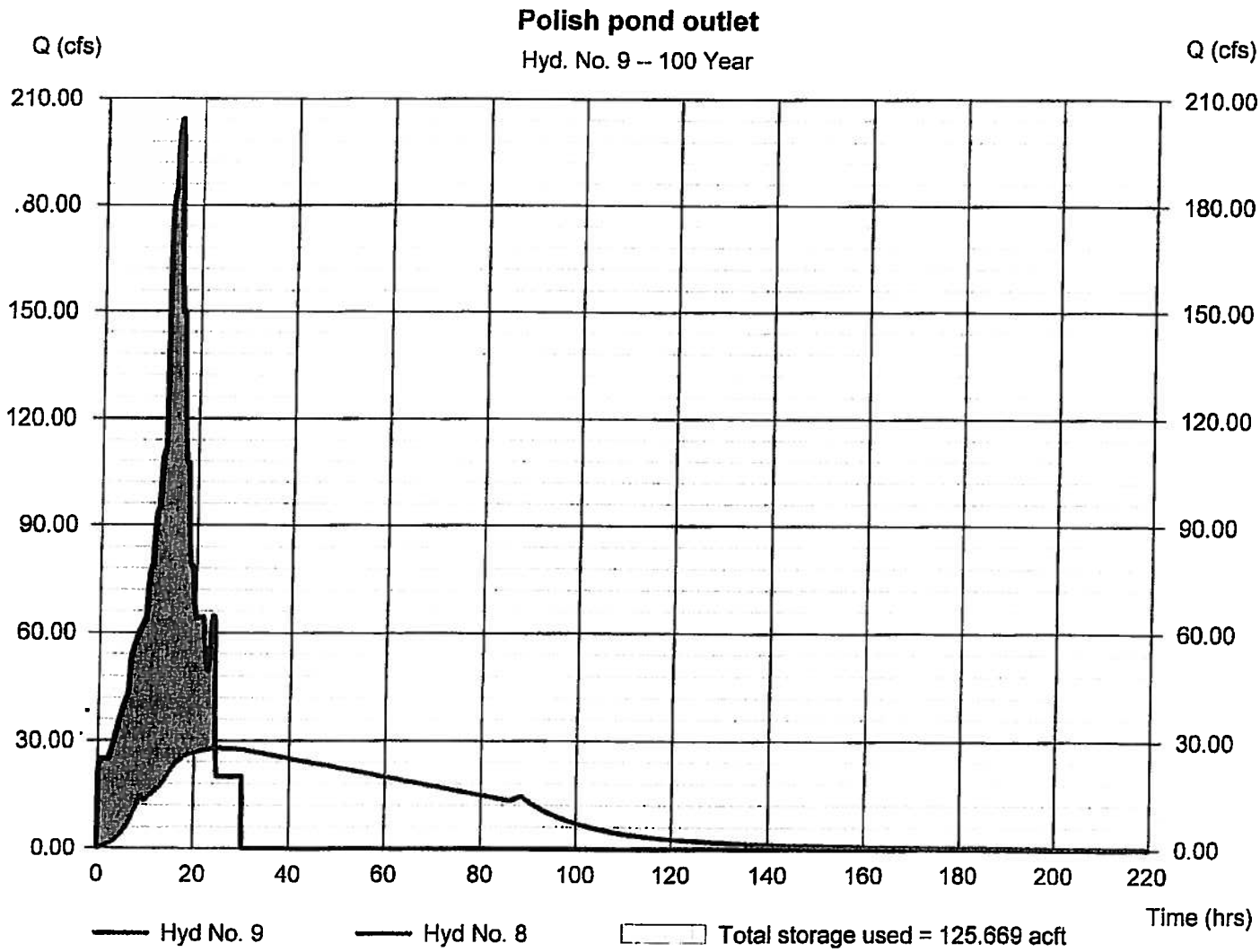
Hydraflow Hydrographs by Intelisolve v9.23 — Tuesday, Jan 5, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 27.93 cfs
Storm frequency	= 100 yrs	Time to peak	= 24.58 hrs
Time interval	= 5 min	Hyd. volume	= 166.243 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 407.44 ft
Reservoir name	= Polish pond	Max. Storage	= 125.669 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.23 — Tuesday, Jan 5, 2010

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 403.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	403.00	1,216,913	0.000	0.000
1.00	404.00	1,223,879	28.016	28.016
2.00	405.00	1,230,895	28.177	56.193
3.00	406.00	1,237,962	28.339	84.532
4.00	407.00	1,245,078	28.501	113.033
5.00	408.00	1,252,244	28.665	141.699
6.00	409.00	1,259,460	28.830	170.529
7.00	410.00	1,266,727	28.997	199.526

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

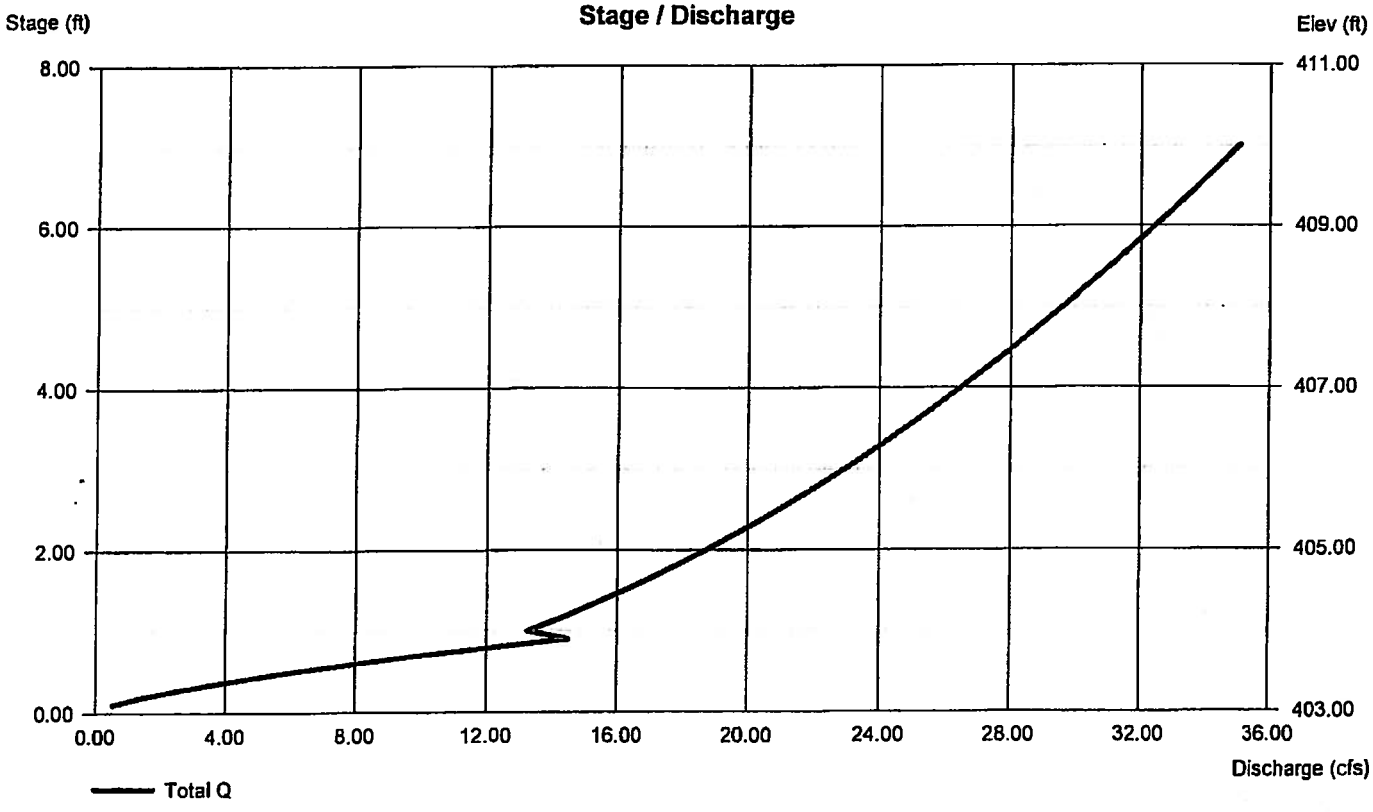
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 403.00	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

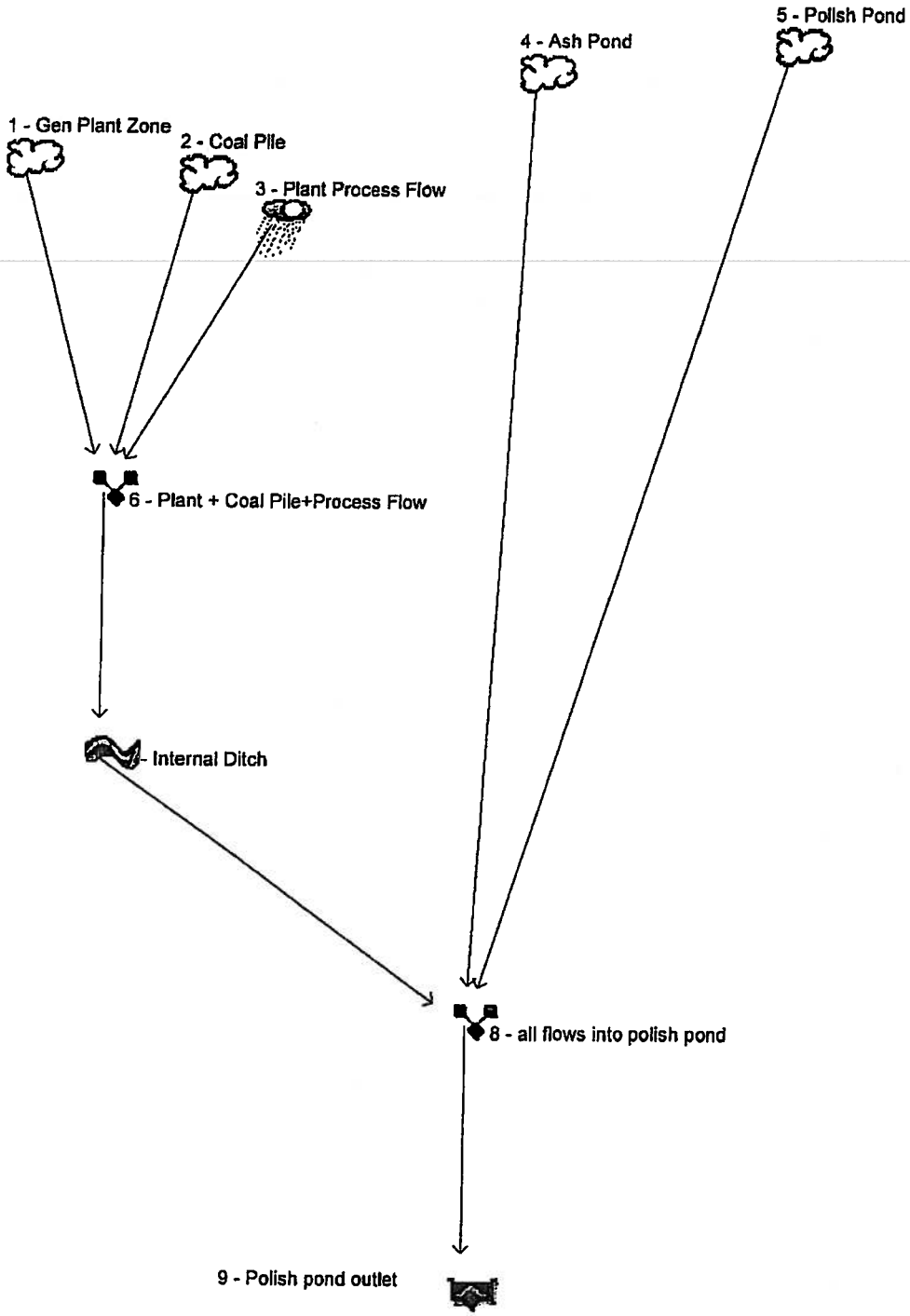
Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

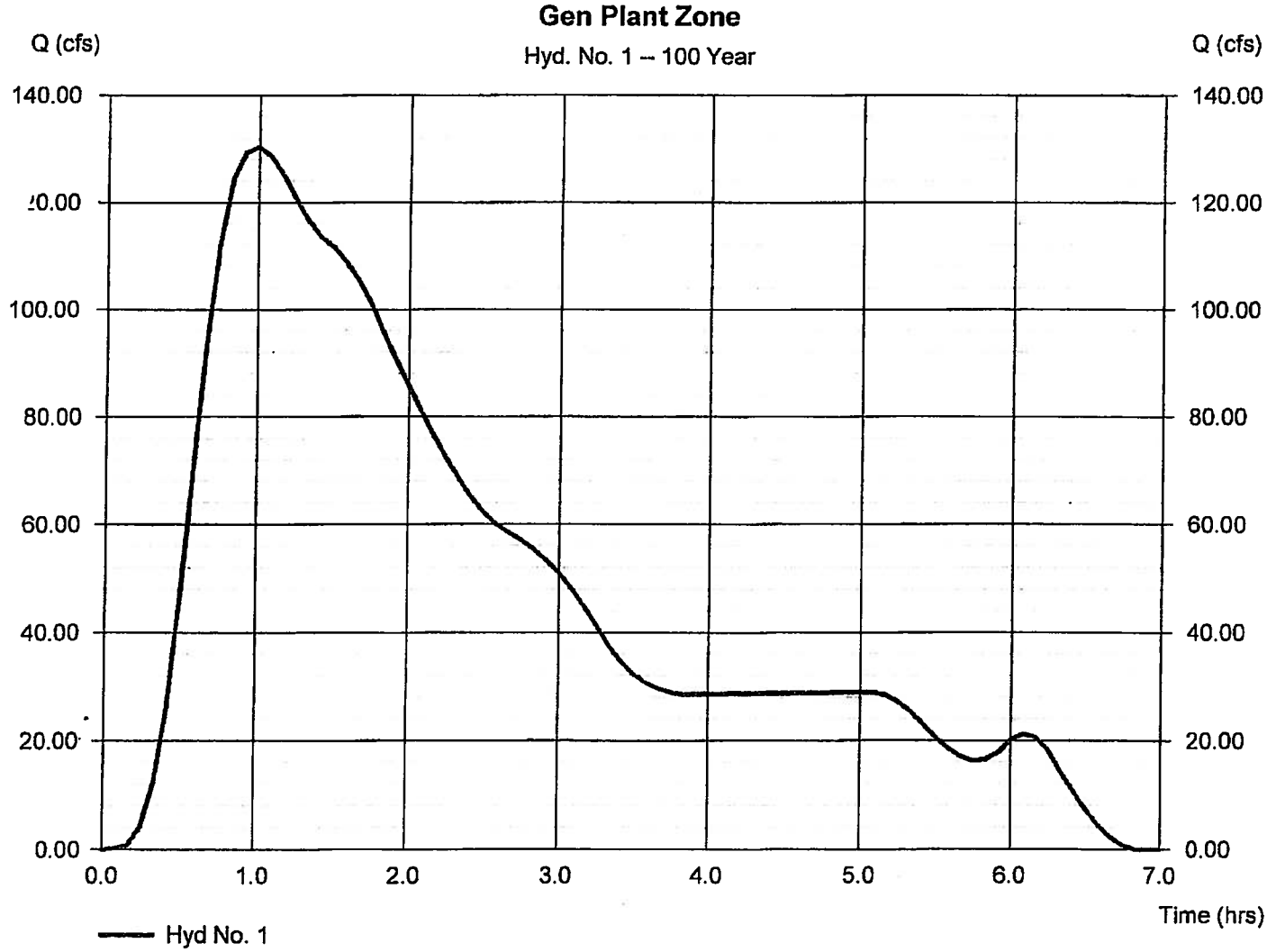
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	130.36	5	60	27.092	----	------	------	Gen Plant Zone
2	SCS Runoff	100.99	5	40	17.352	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	97.72	5	70	22.381	----	------	------	Ash Pond
5	SCS Runoff	80.40	5	35	11.781	----	------	------	Polish Pond
6	Combine	226.00	5	50	94.031	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	226.18	5	55	94.174	6	------	------	Internal Ditch
8	Combine	367.43	5	65	128.336	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	23.51	5	405	126.749	8	398.25	79.8	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 130.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.00 hrs
Time interval	= 5 min	Hyd. volume	= 27.092 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

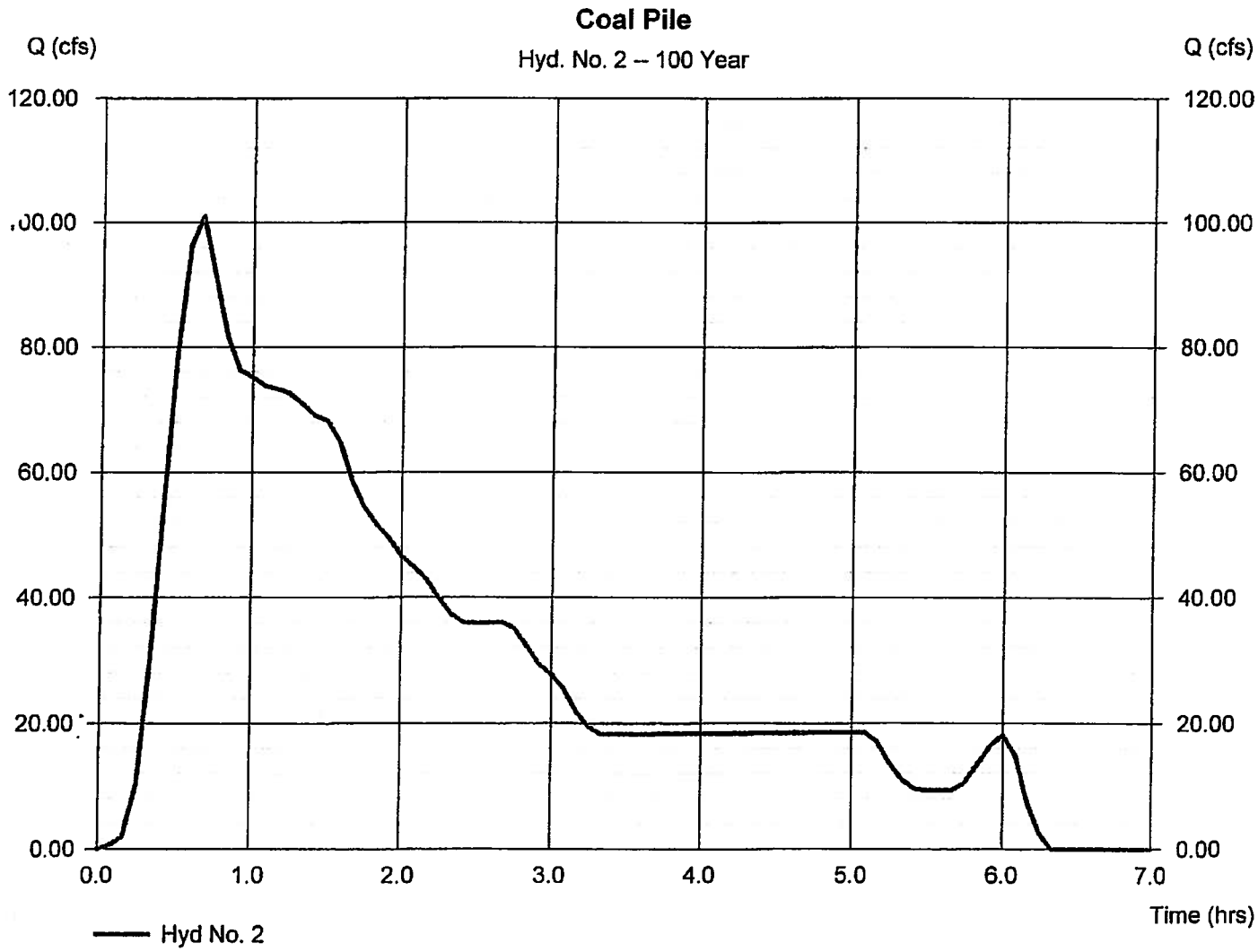


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 100.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.67 hrs
Time interval	= 5 min	Hyd. volume	= 17.352 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

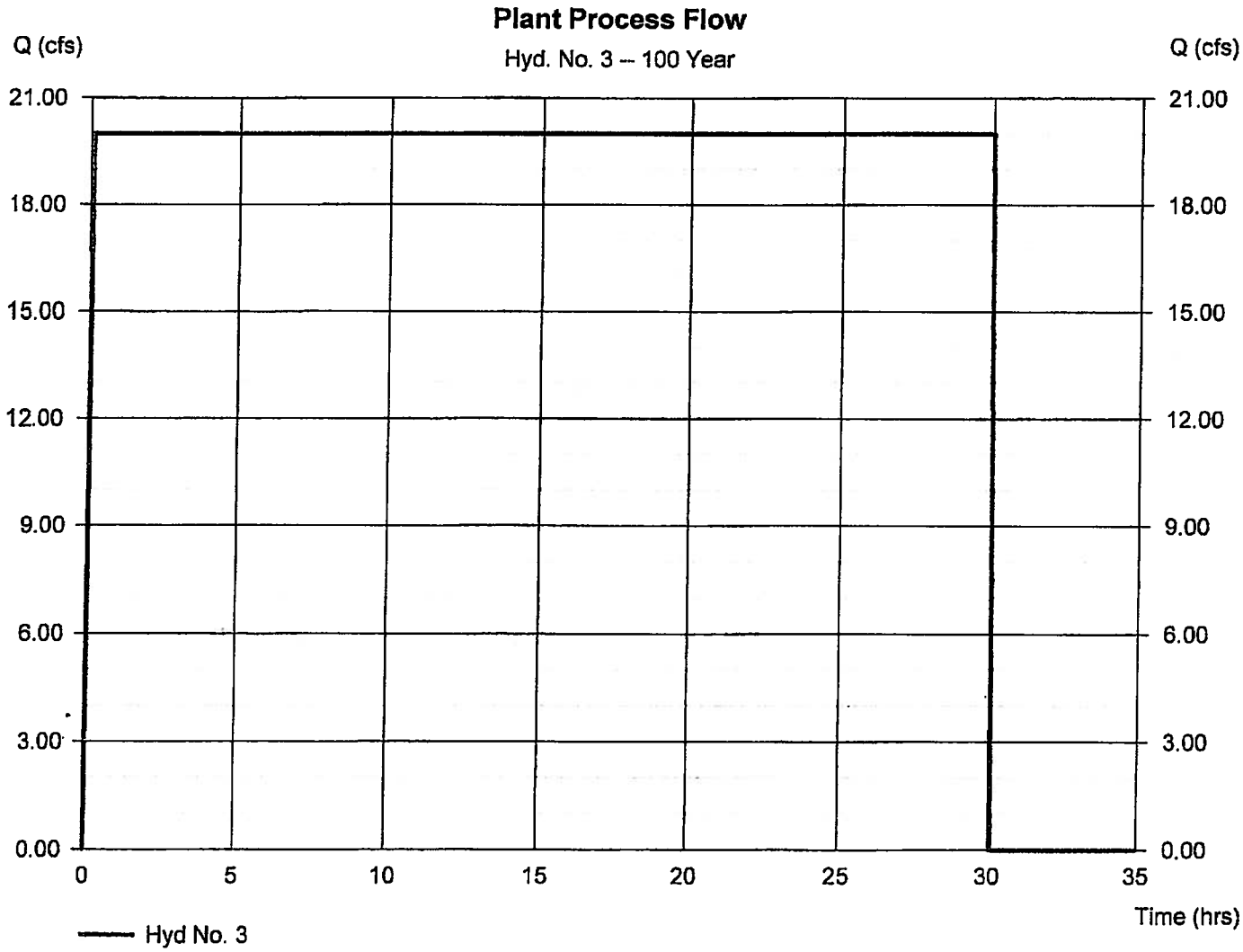


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

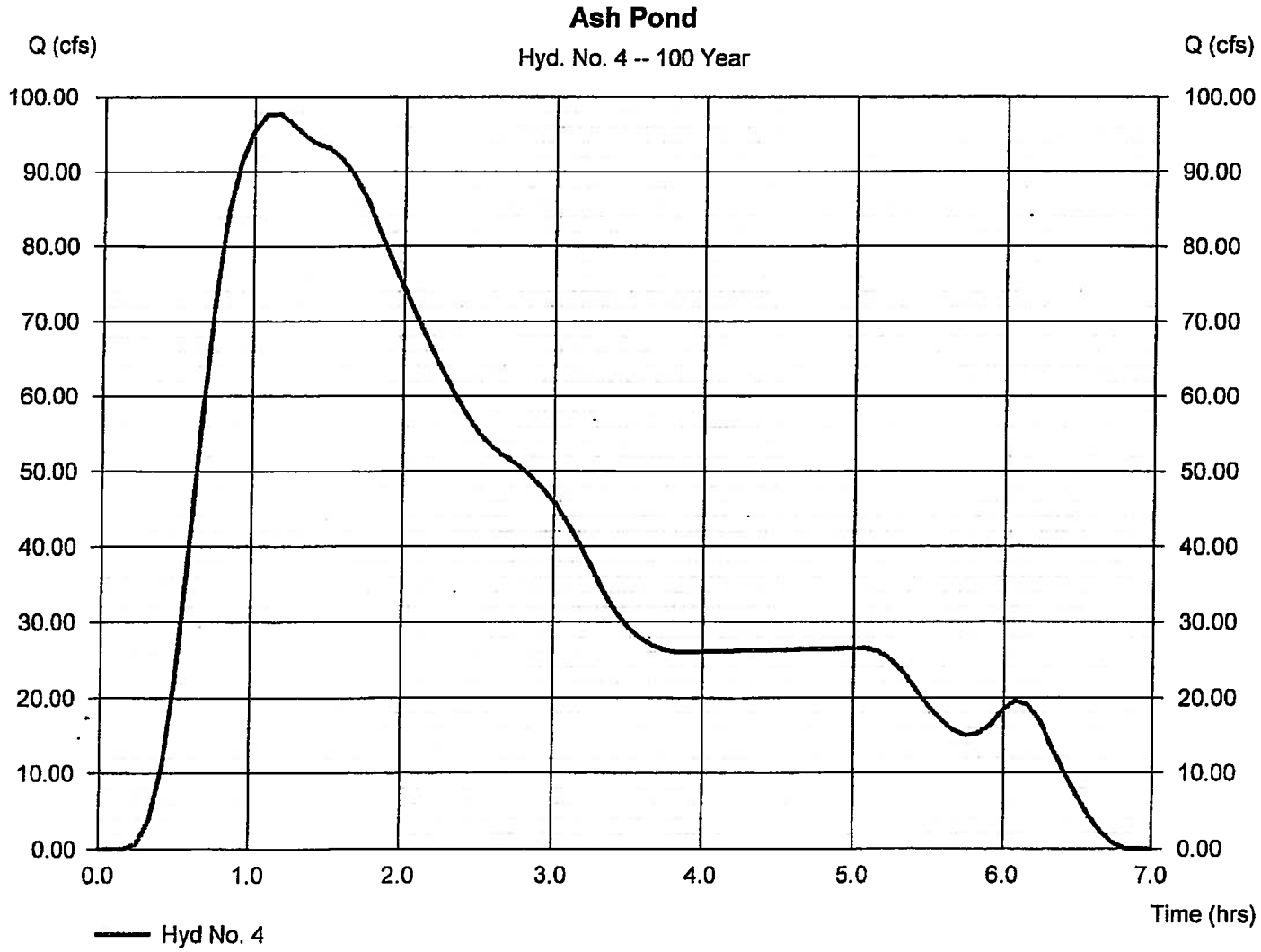


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 97.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.17 hrs
Time interval	= 5 min	Hyd. volume	= 22.381 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

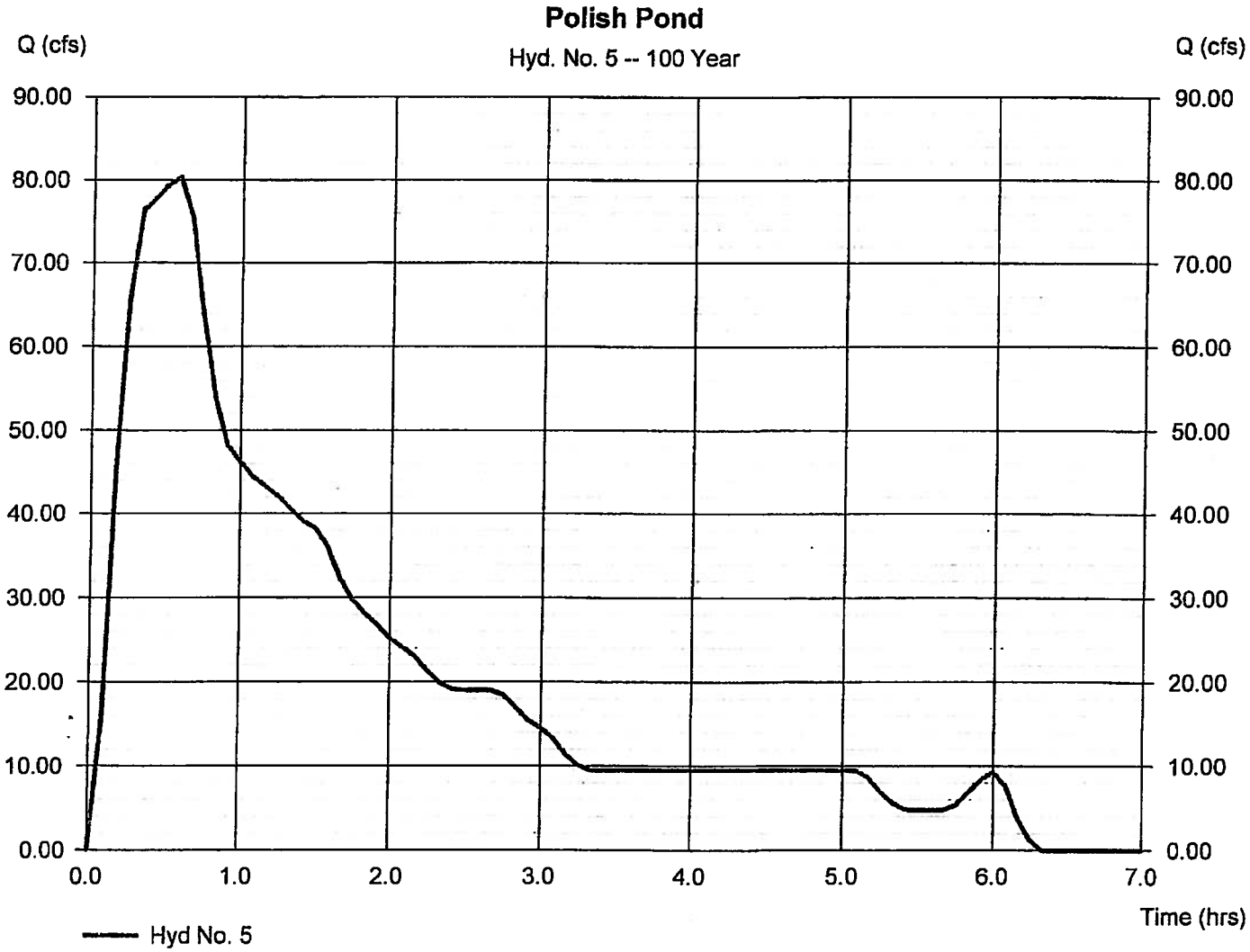


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 80.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.58 hrs
Time interval	= 5 min	Hyd. volume	= 11.781 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

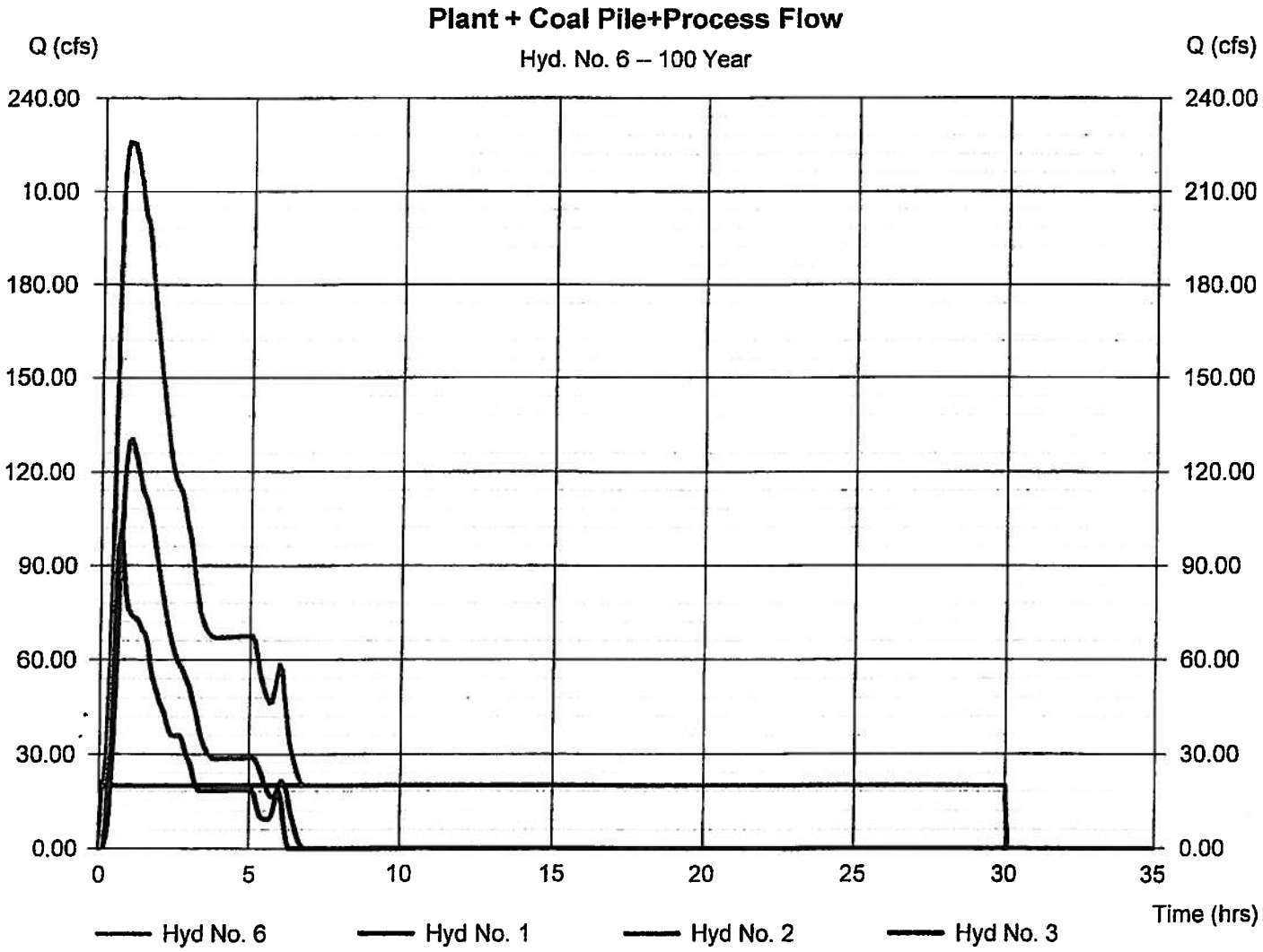


Hydrograph Report

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 226.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.83 hrs
Time interval	= 5 min	Hyd. volume	= 94.031 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

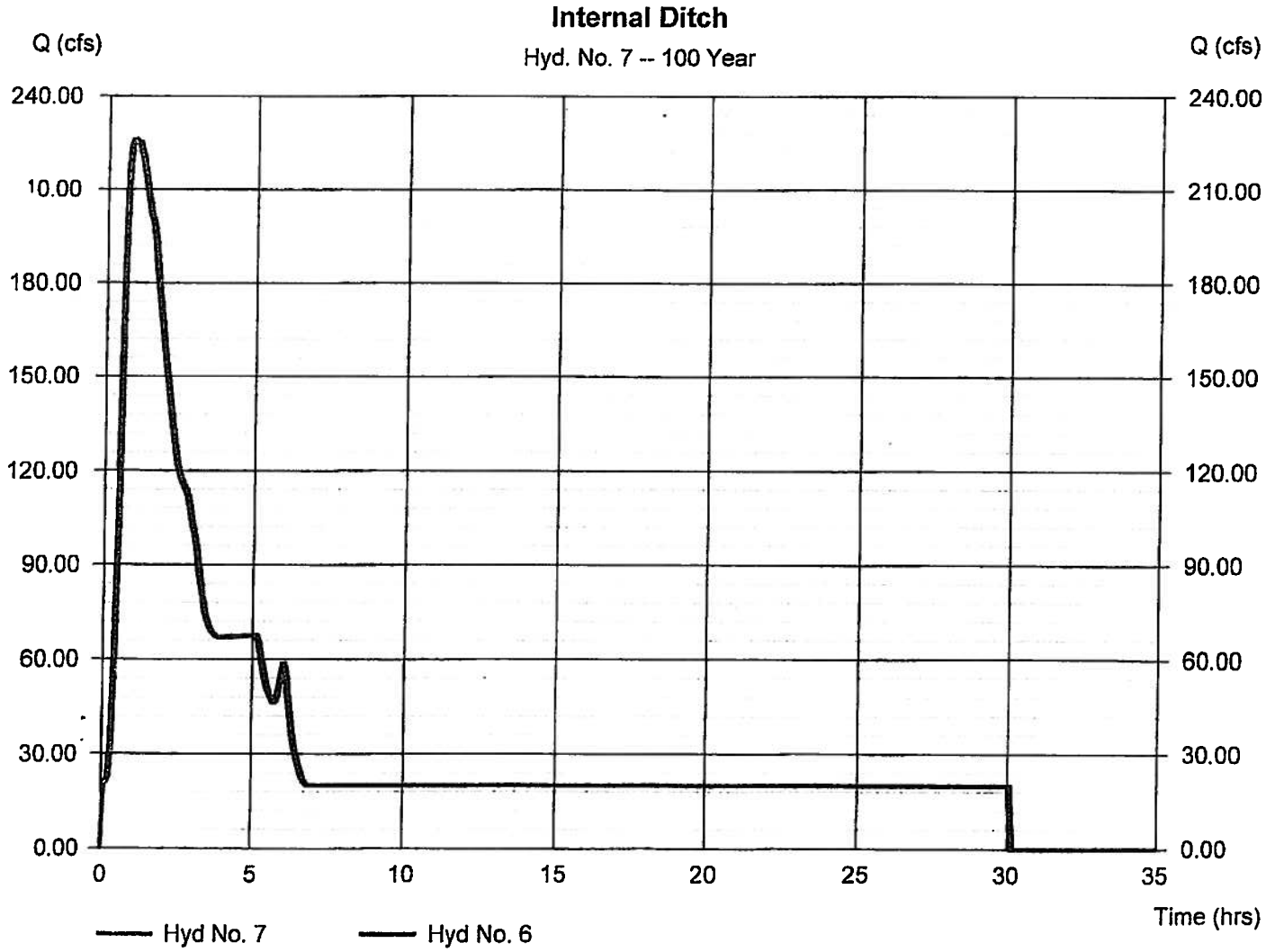
Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 226.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.92 hrs
Time interval	= 5 min	Hyd. volume	= 94.174 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 9.62 ft/s	Routing coeff.	= 1.0972

Modified Att-Kin routing method used.



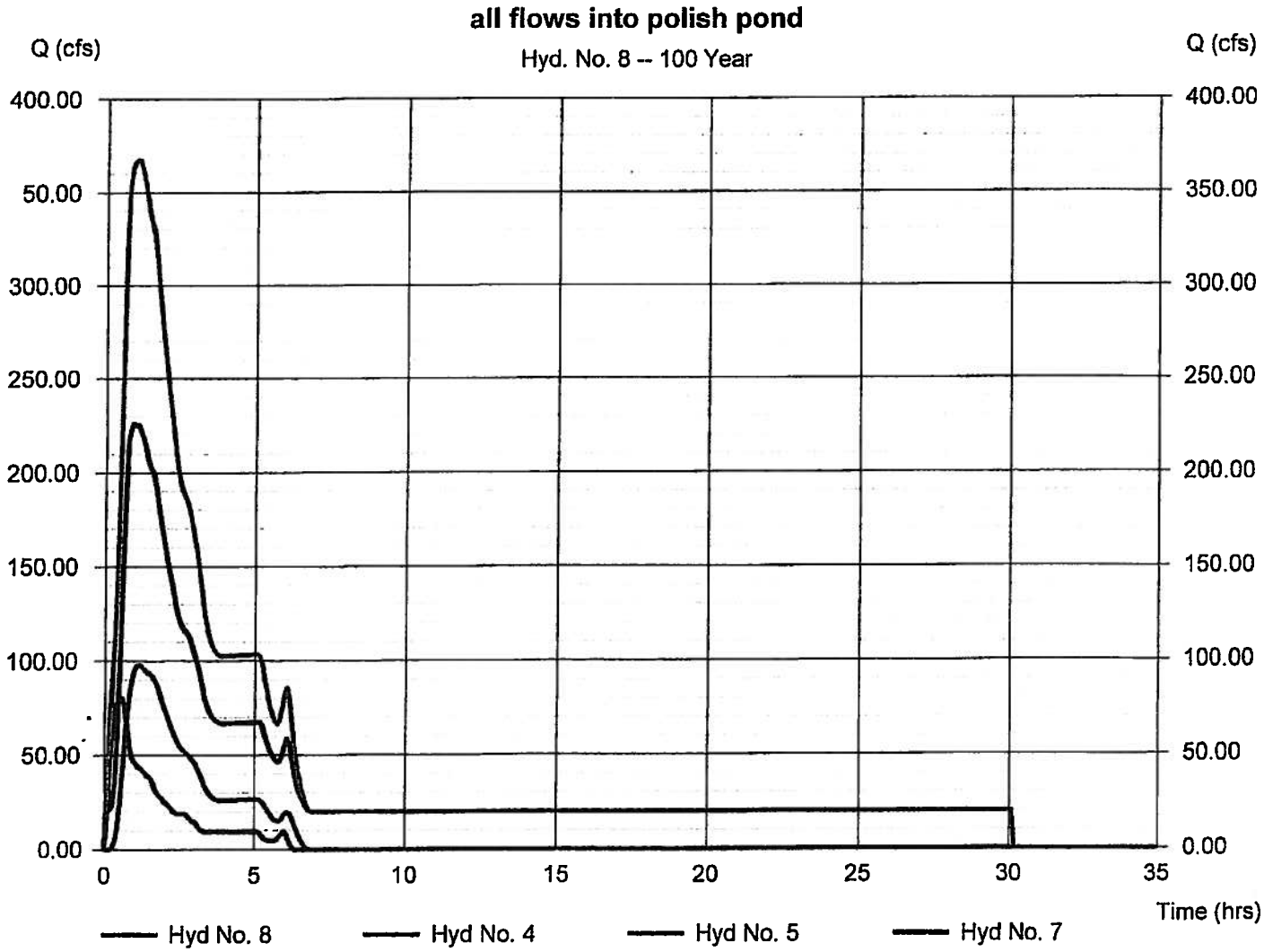
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 367.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.08 hrs
Time interval	= 5 min	Hyd. volume	= 128.336 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23

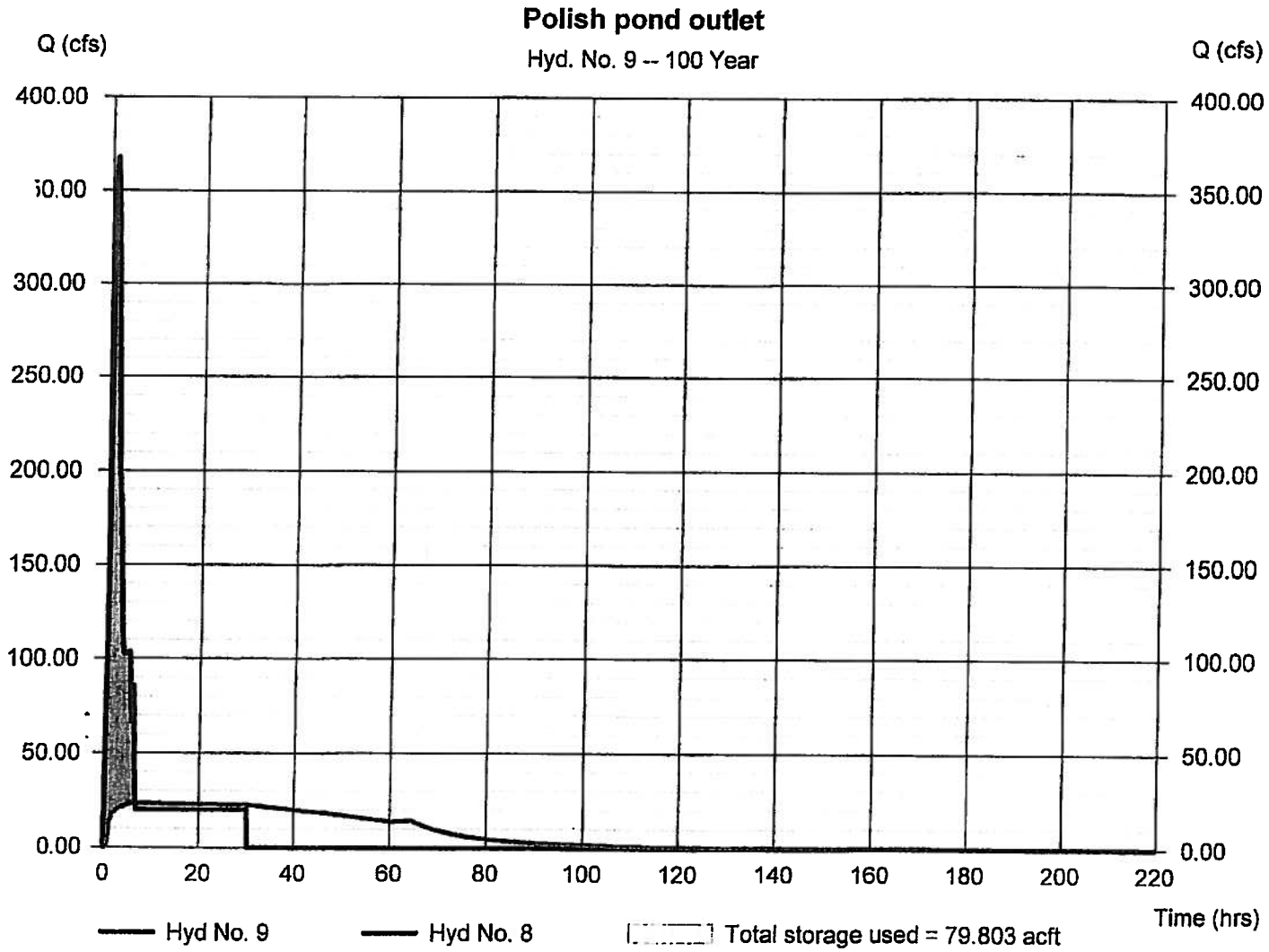
Friday, Jan 8, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 23.51 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.75 hrs
Time interval	= 5 min	Hyd. volume	= 126.749 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 398.25 ft
Reservoir name	= Polish pond	Max. Storage	= 79.803 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs by Intellsolve v9.23 — Friday, Jan 8, 2010

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 395.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	395.00	823,284	0.000	0.000
2.00	397.00	1,176,165	45.901	45.901
3.00	398.00	1,187,259	27.128	73.029
4.00	399.00	1,189,548	27.282	100.311
5.00	400.00	1,196,314	27.386	127.697
6.00	401.00	1,203,130	27.542	155.239
7.00	402.00	1,209,997	27.699	182.938
8.00	403.00	1,216,913	27.857	210.795
9.00	404.00	1,223,879	28.016	238.812
10.00	405.00	1,230,895	28.177	266.989

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 395.10	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

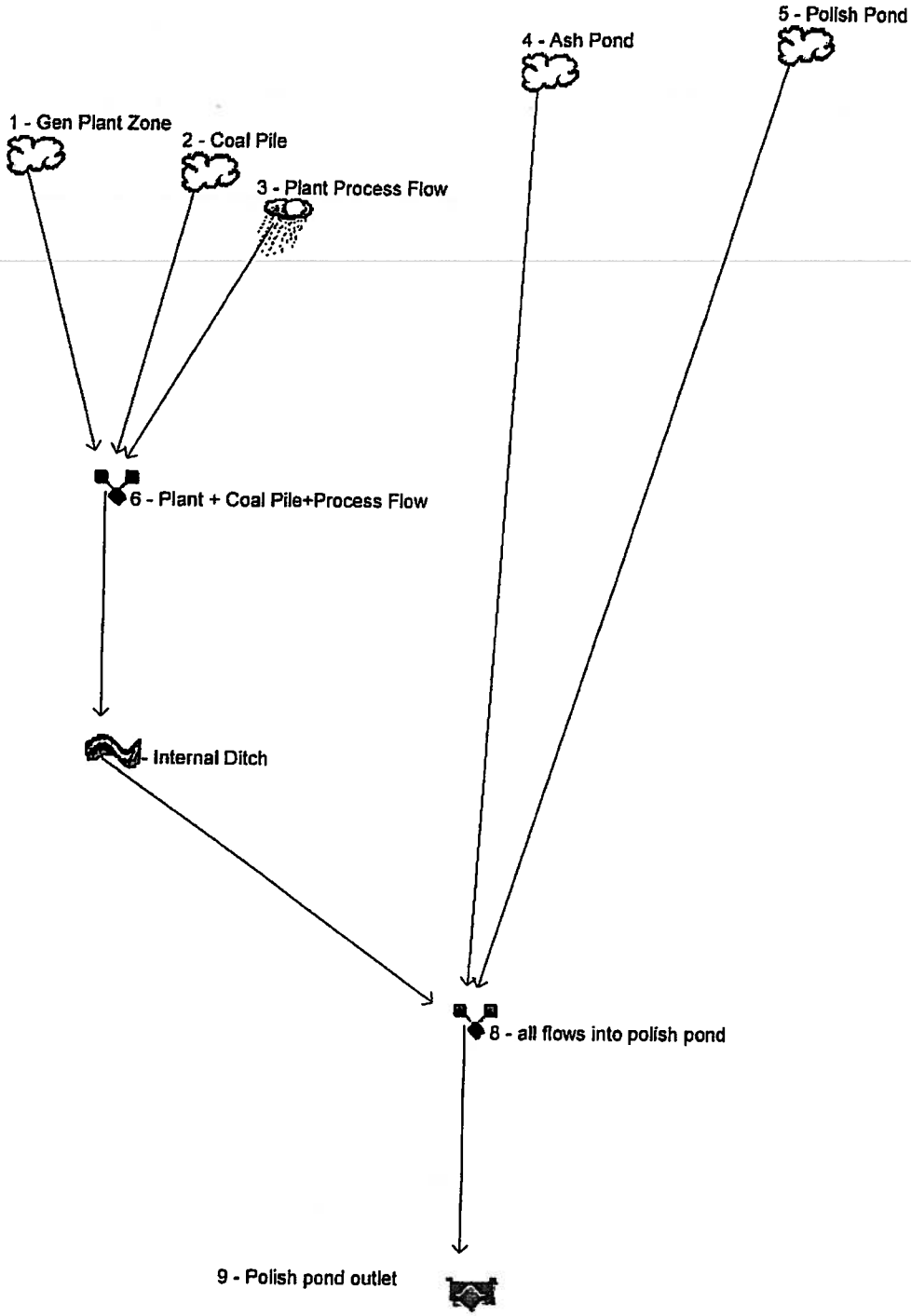
TW Elev. (ft) = 360.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	395.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
2.00	45.901	397.00	50.67 ic	---	---	---	18.27 ic	---	---	---	---	---	18.27
3.00	73.029	398.00	50.67 ic	---	---	---	22.57 ic	---	---	---	---	---	22.57
4.00	100.311	399.00	50.67 ic	---	---	---	26.17 ic	---	---	---	---	---	26.17
5.00	127.697	400.00	50.67 ic	---	---	---	29.34 ic	---	---	---	---	---	29.34
6.00	155.239	401.00	50.67 ic	---	---	---	32.19 ic	---	---	---	---	---	32.19
7.00	182.938	402.00	50.67 ic	---	---	---	34.81 ic	---	---	---	---	---	34.81
8.00	210.795	403.00	50.67 ic	---	---	---	37.25 ic	---	---	---	---	---	37.25
9.00	238.812	404.00	50.67 ic	---	---	---	39.54 ic	---	---	---	---	---	39.54
10.00	266.989	405.00	50.67 ic	---	---	---	41.70 ic	---	---	---	---	---	41.70

Watershed Model Schematic



Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

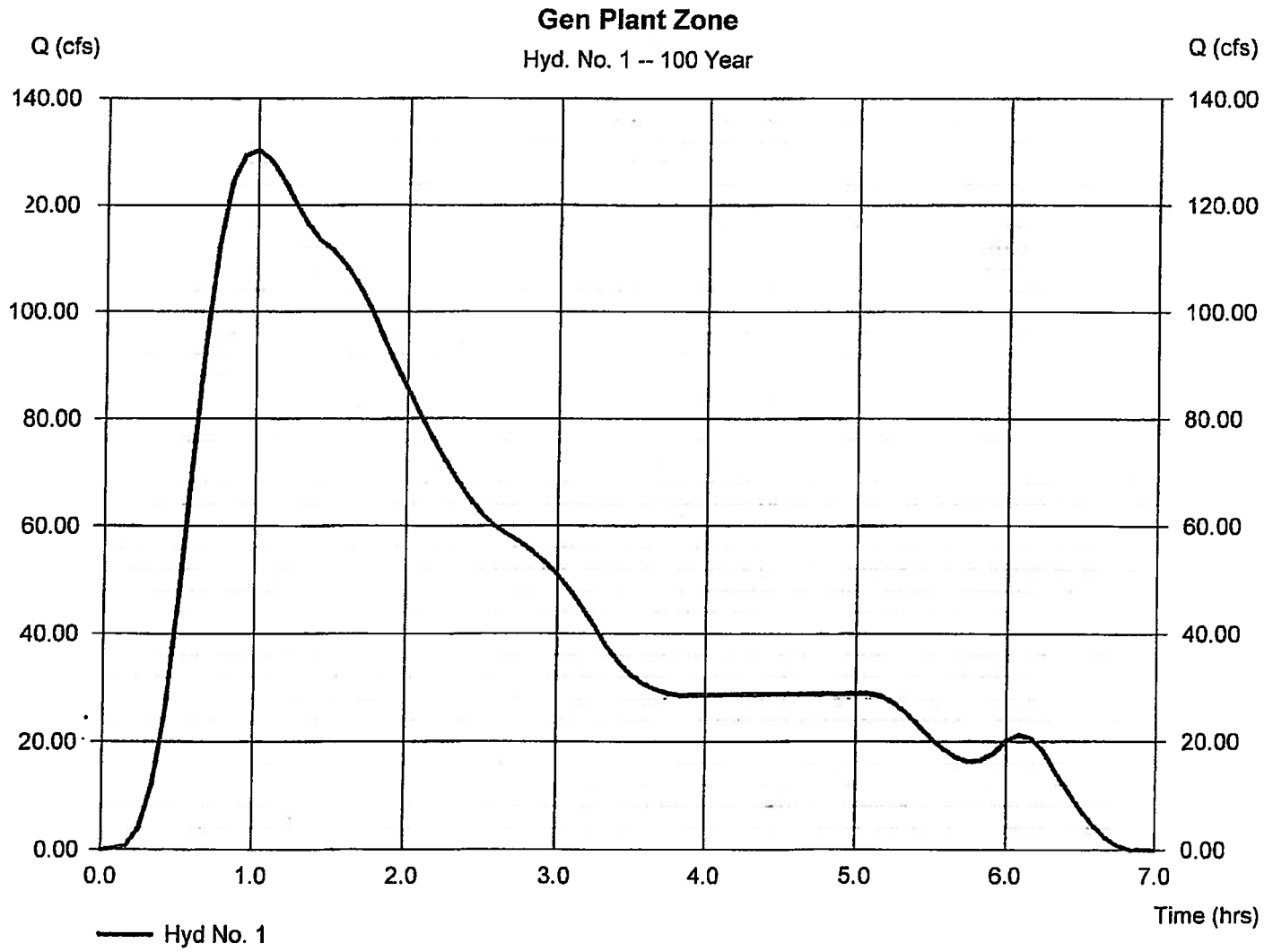
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	130.36	5	60	27.092	----	------	------	Gen Plant Zone
2	SCS Runoff	100.99	5	40	17.352	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	97.72	5	70	22.381	----	------	------	Ash Pond
5	SCS Runoff	80.40	5	35	11.781	----	------	------	Polish Pond
6	Combine	226.00	5	50	94.031	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	226.18	5	55	94.174	6	------	------	Internal Ditch
8	Combine	367.43	5	65	128.336	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	22.38	5	405	127.674	8	405.85	80.3	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 130.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.00 hrs
Time interval	= 5 min	Hyd. volume	= 27.092 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

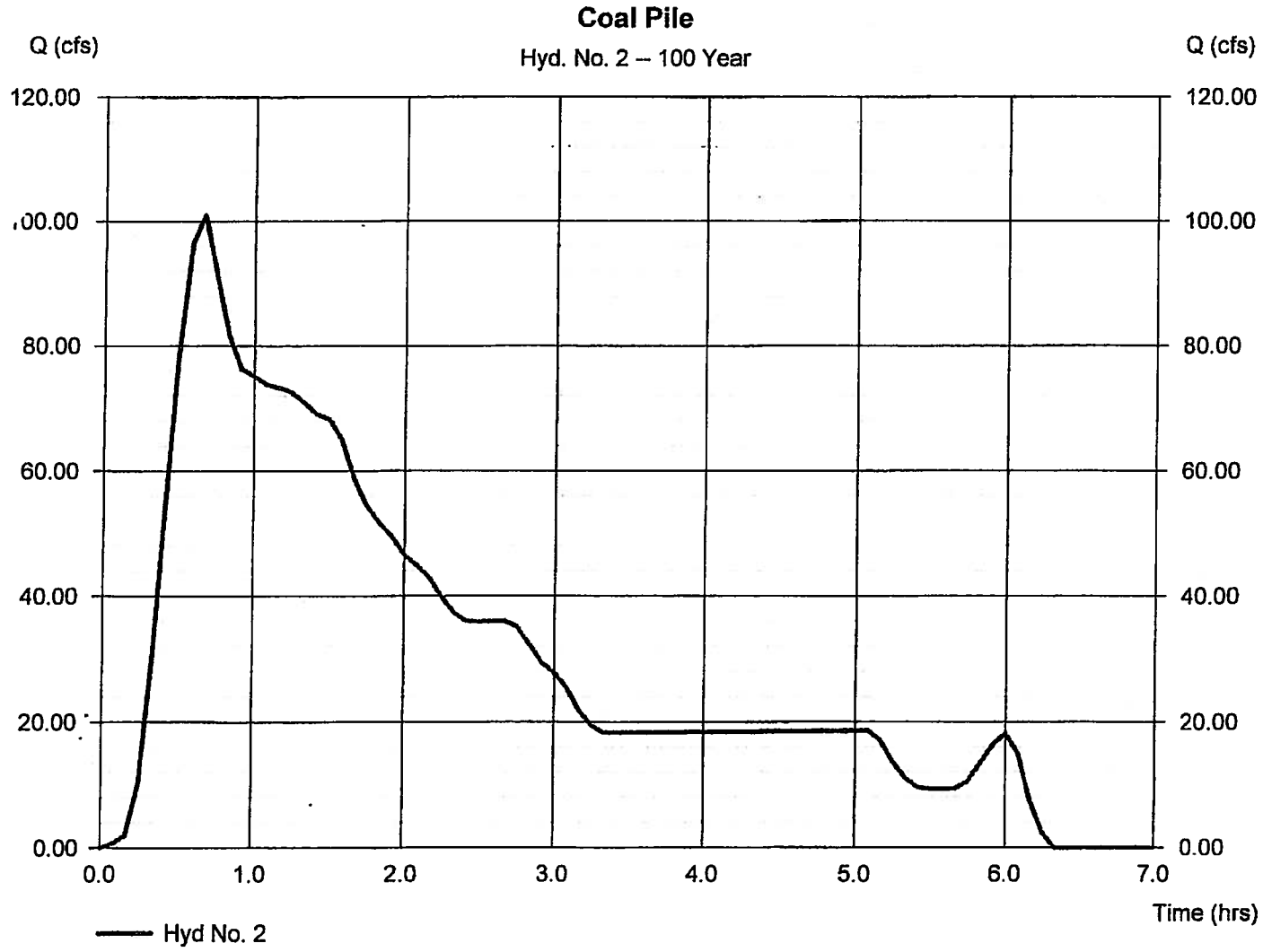


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 100.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.67 hrs
Time interval	= 5 min	Hyd. volume	= 17.352 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484



Hydrograph Report

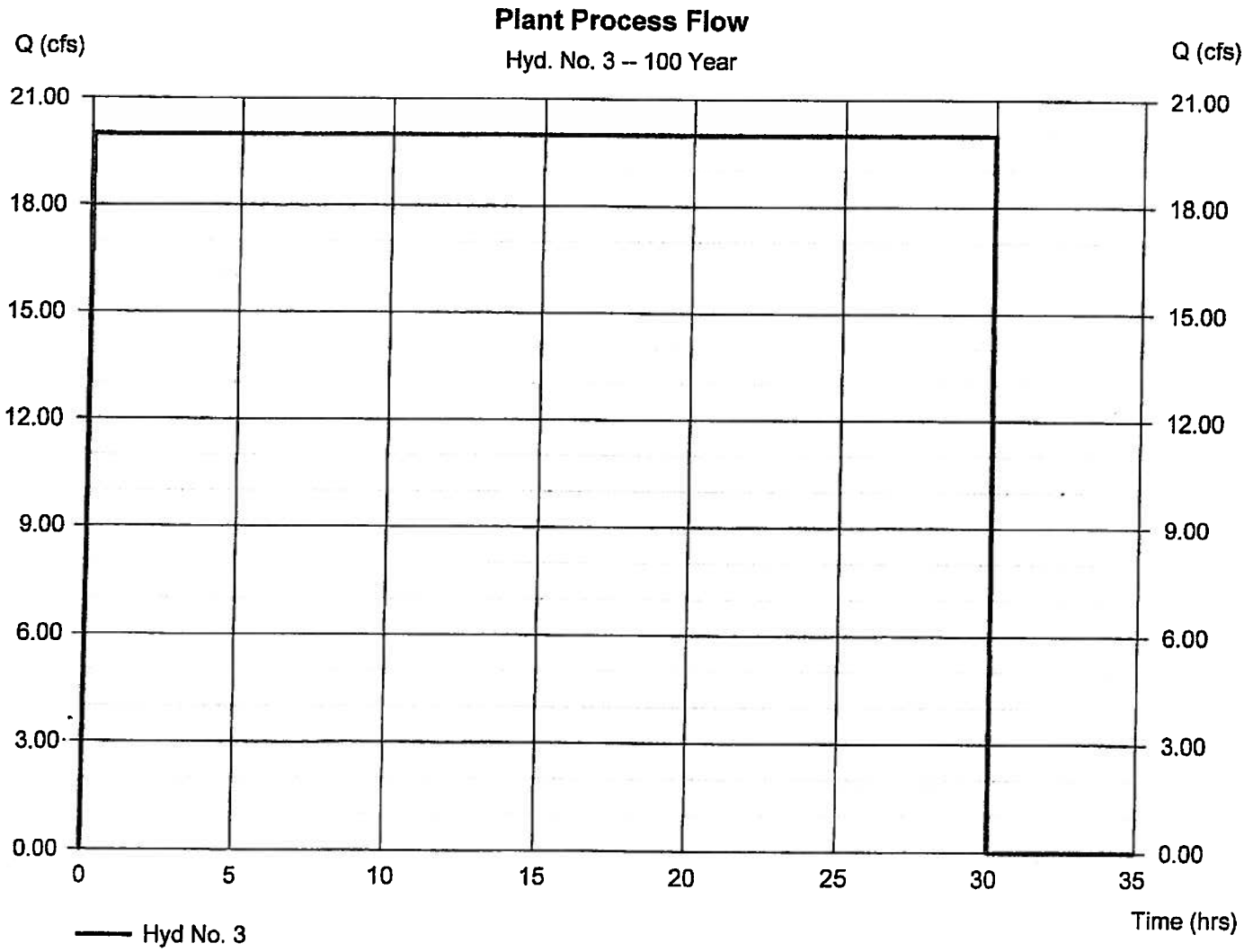
Hydraflow Hydrographs by Intelisolve v9.23

Friday, Jan 8, 2010

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft



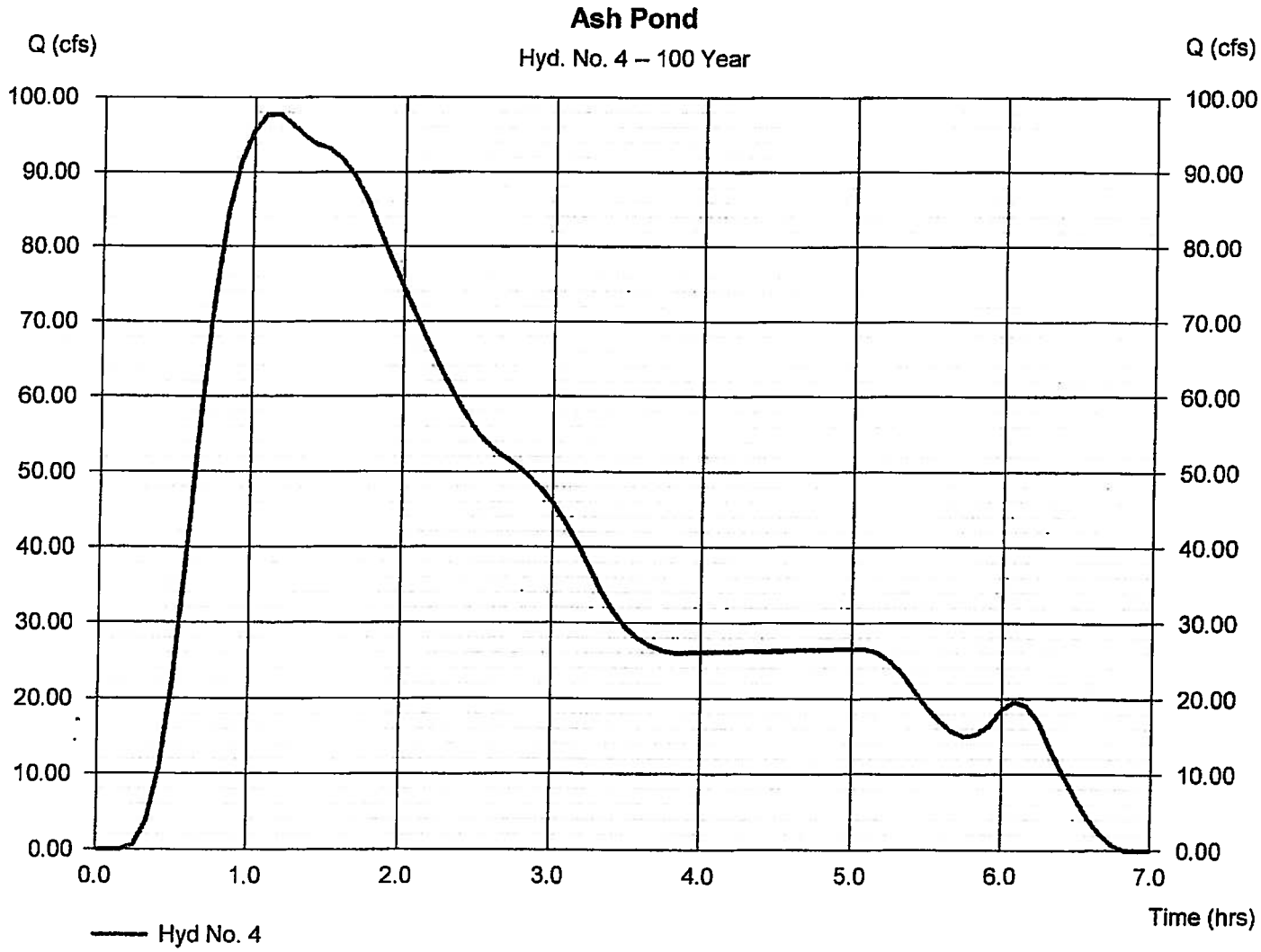
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 97.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.17 hrs
Time interval	= 5 min	Hyd. volume	= 22.381 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

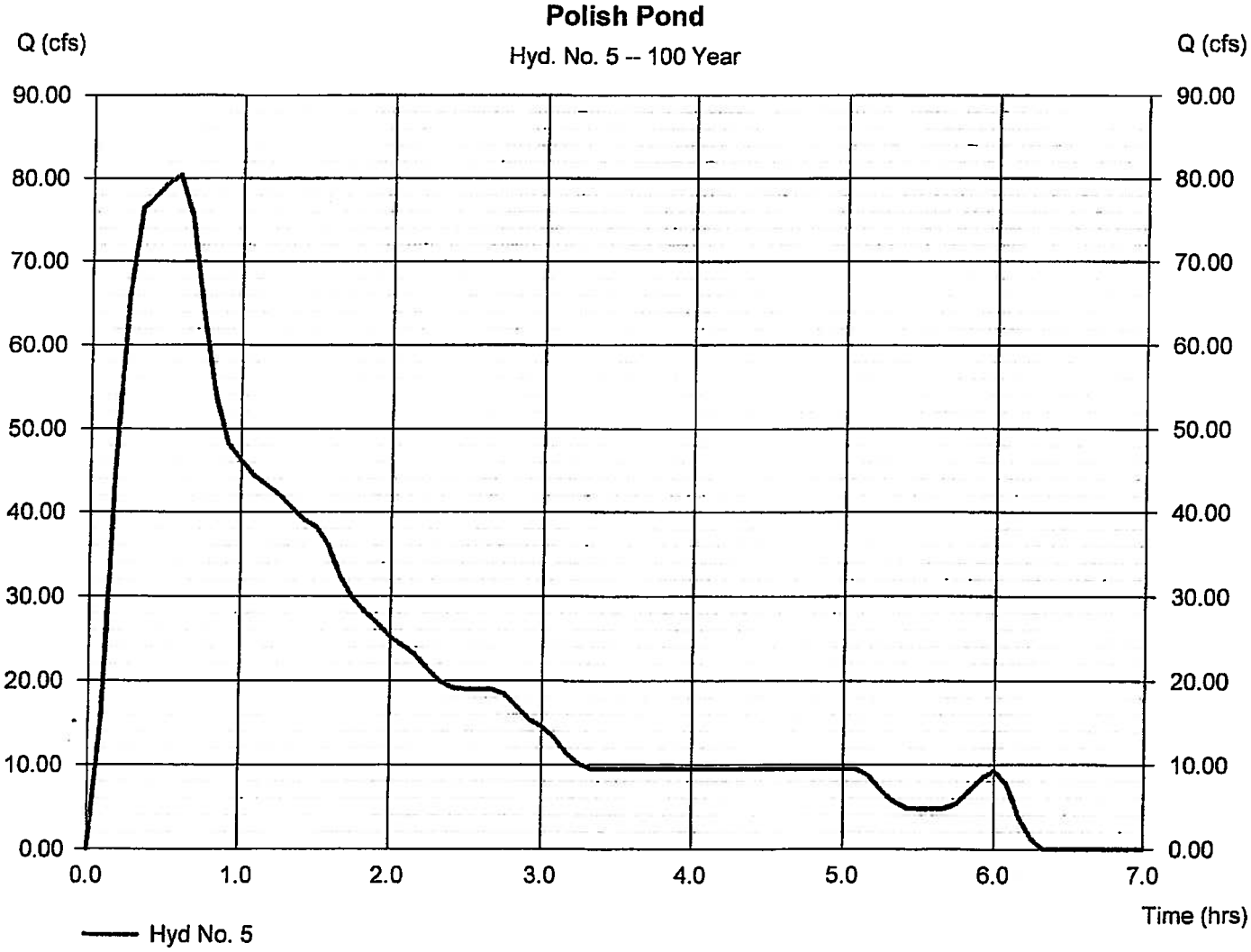


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 80.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.58 hrs
Time interval	= 5 min	Hyd. volume	= 11.781 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

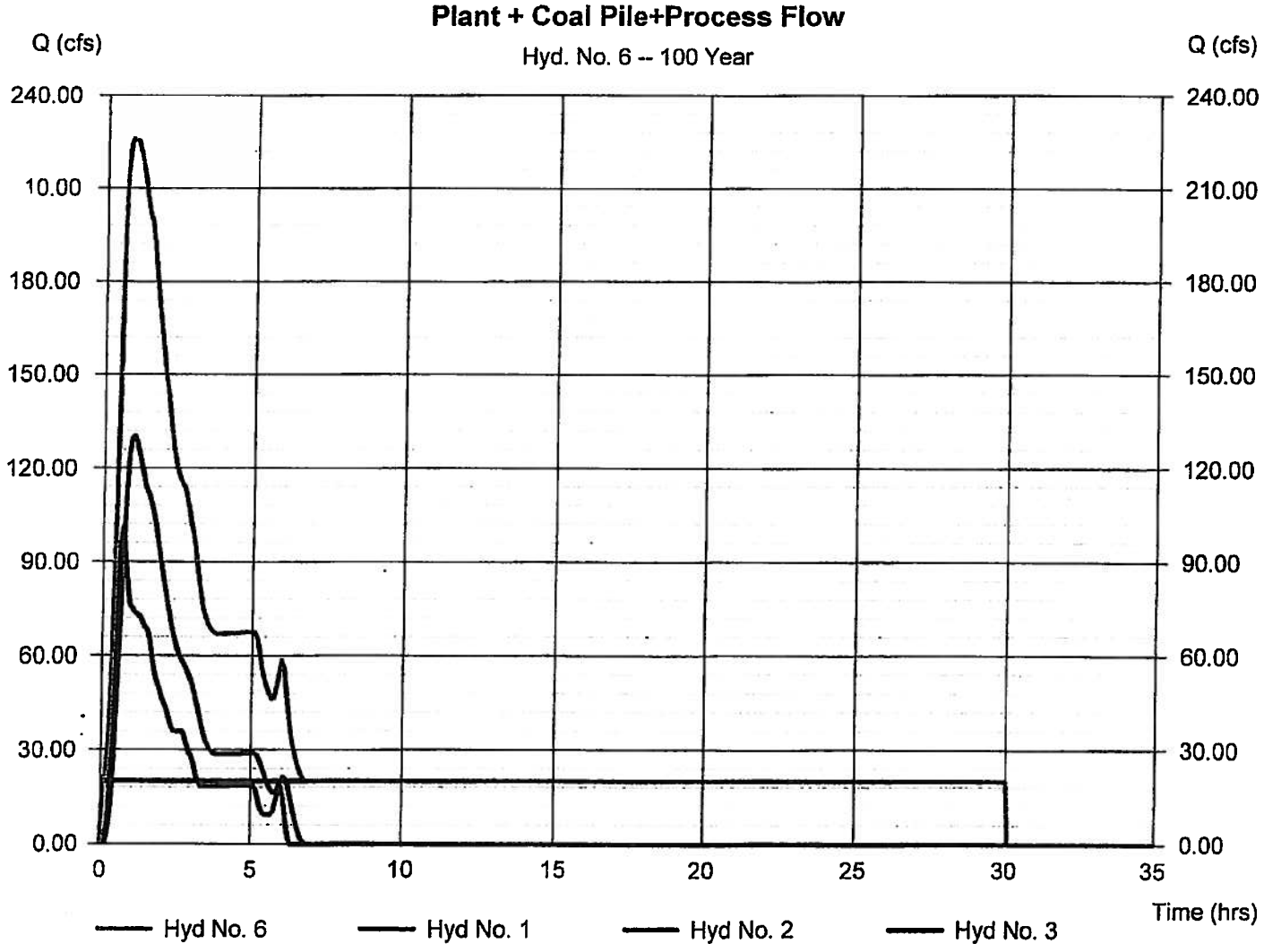


Hydrograph Report

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 226.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.83 hrs
Time interval	= 5 min	Hyd. volume	= 94.031 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

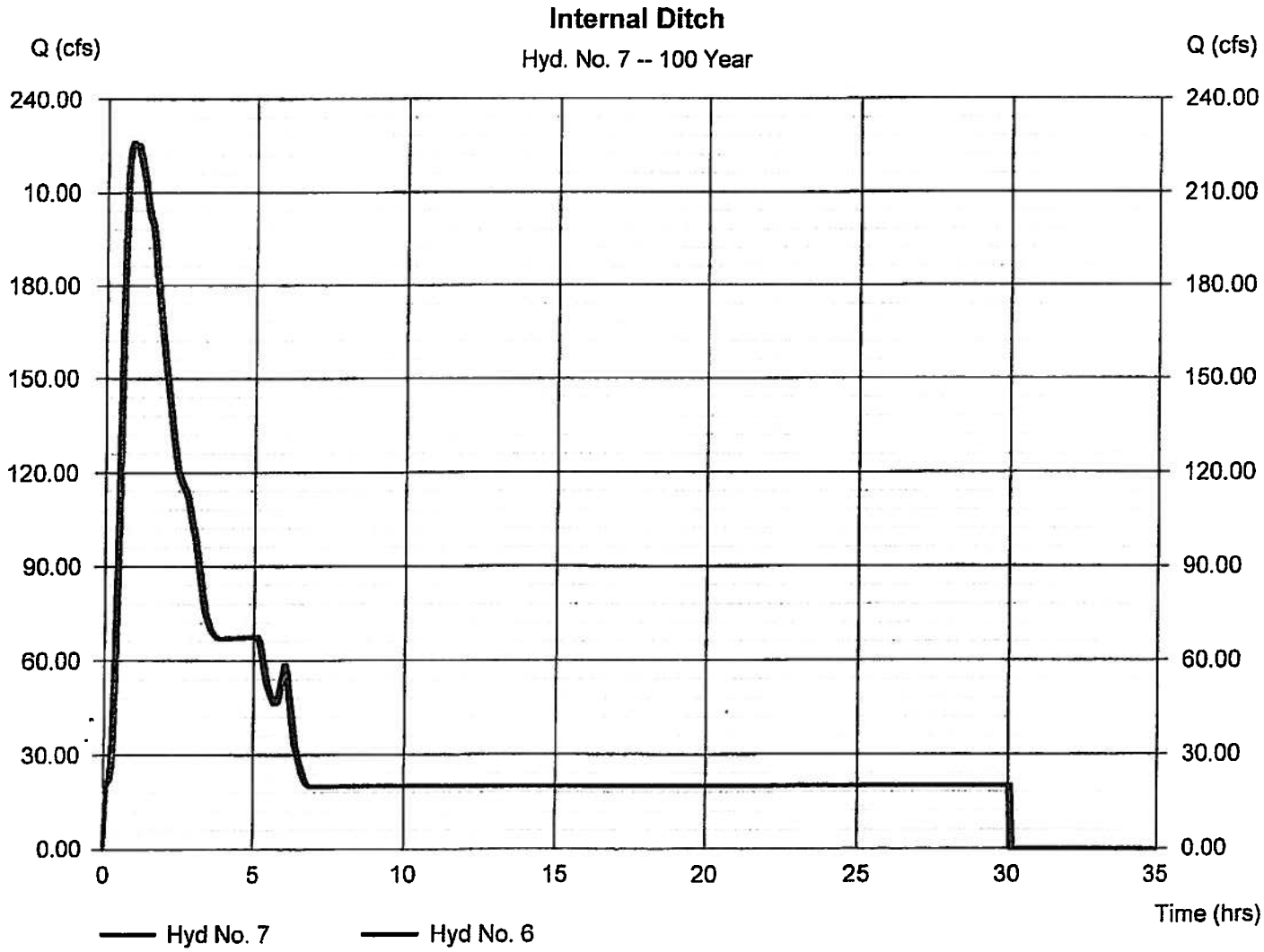
Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 226.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.92 hrs
Time interval	= 5 min	Hyd. volume	= 94.174 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 9.62 ft/s	Routing coeff.	= 1.0972

Modified Att-Kin routing method used.

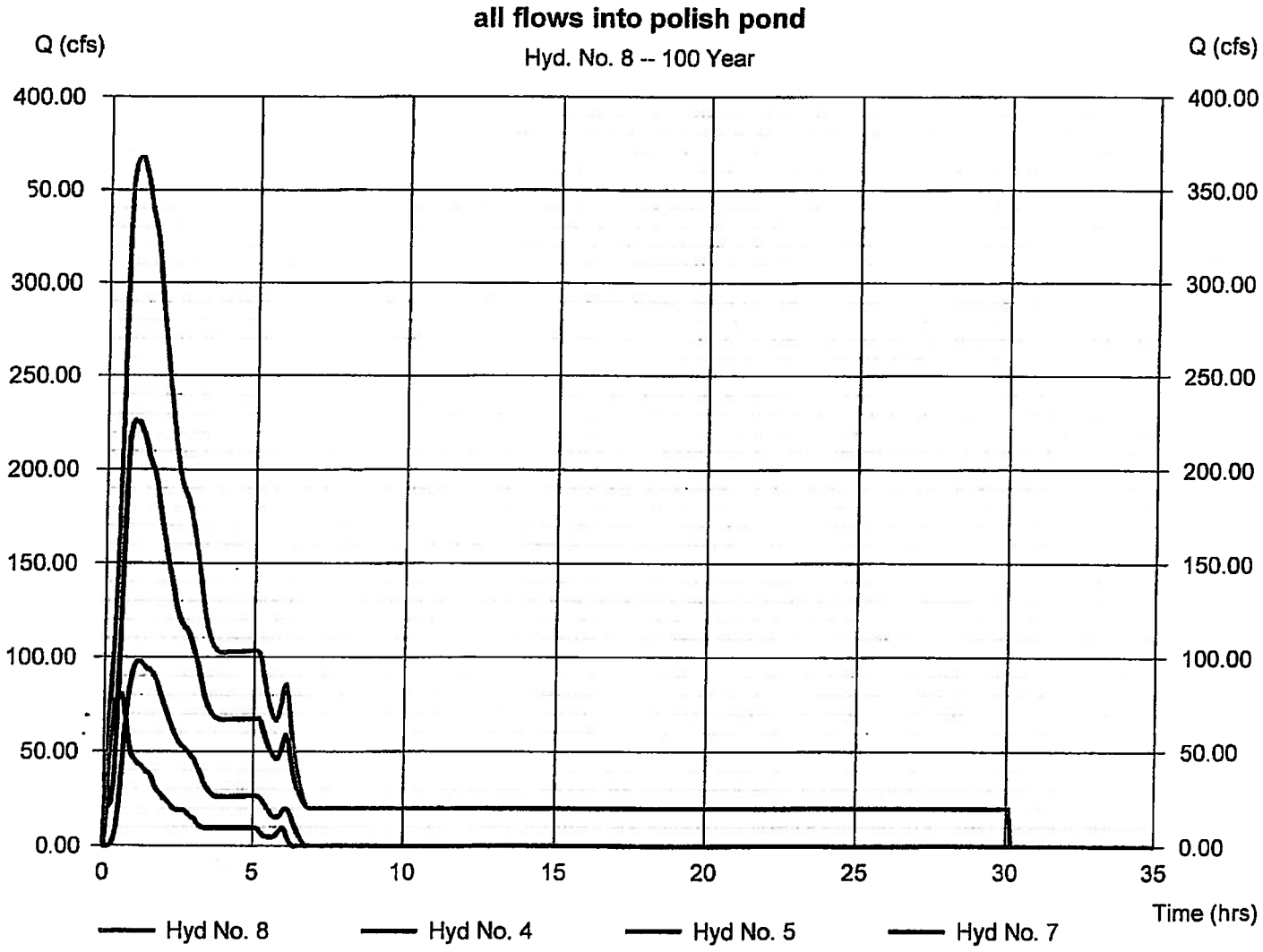


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 367.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.08 hrs
Time interval	= 5 min	Hyd. volume	= 128.336 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

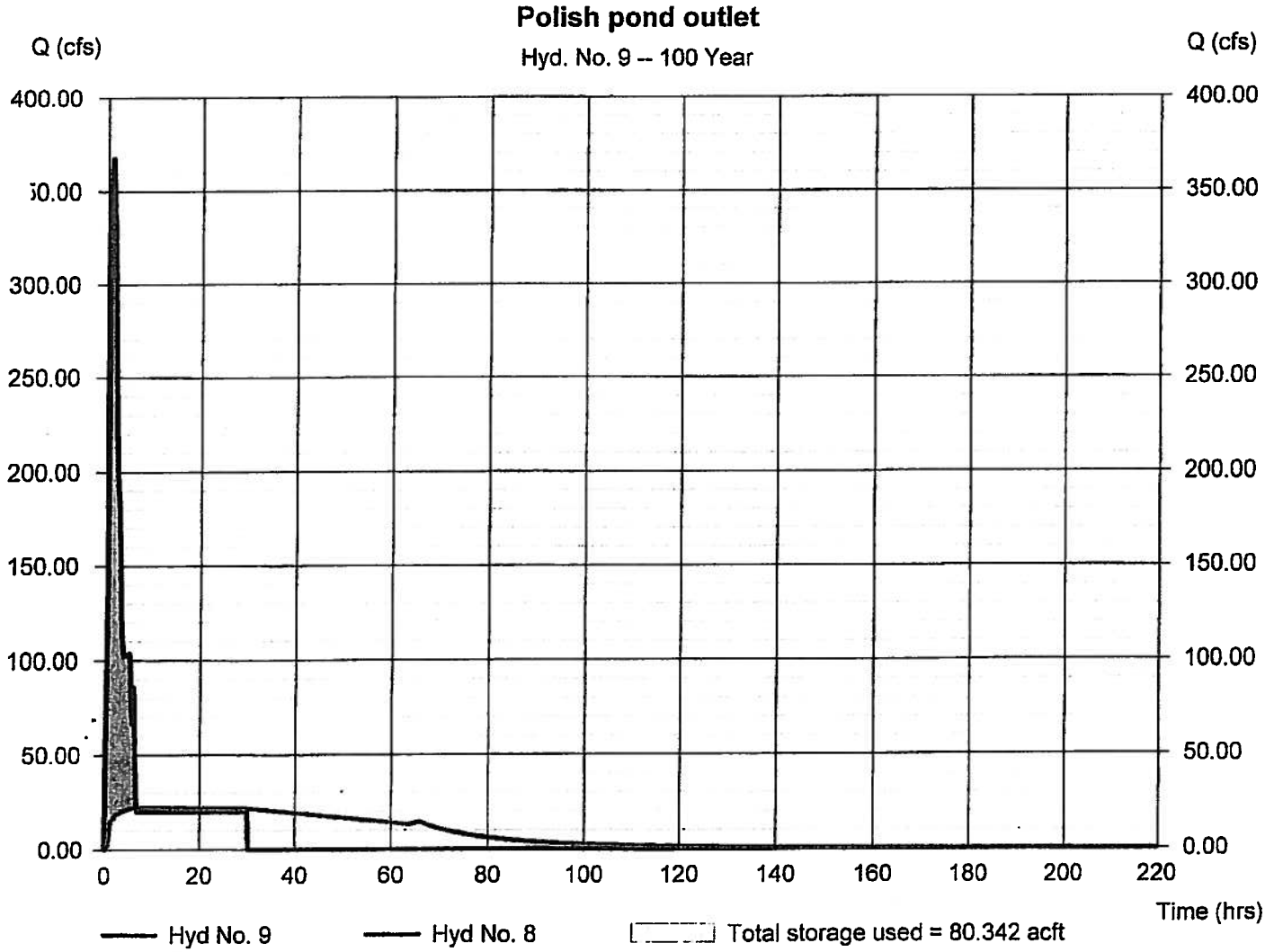
Hydraflow Hydrographs by Intellsolve v9.23 — Friday, Jan 8, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 22.38 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.75 hrs
Time interval	= 5 min	Hyd. volume	= 127.674 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 405.85 ft
Reservoir name	= Polish pond	Max. Storage	= 80.342 acft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs by Intelisolve v9.23 — Friday, Jan 8, 2010

Pond No. 2 - Polish pond

Pond Data

Contours - User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 403.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (acft)	Total storage (acft)
0.00	403.00	1,216,913	0.000	0.000
1.00	404.00	1,223,879	28.016	28.016
2.00	405.00	1,230,895	28.177	56.193
3.00	406.00	1,237,962	28.339	84.532
4.00	407.00	1,245,078	28.501	113.033
5.00	408.00	1,252,244	28.665	141.699
6.00	409.00	1,259,460	28.830	170.529
7.00	410.00	1,266,727	28.997	199.526

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	Inactive	Inactive	Inactive
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 385.00	0.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 5.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.67	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.28	Inactive	Inactive	Inactive
Crest El. (ft)	= 403.00	0.00	0.00	0.00
Weir Coeff.	= 2.70	3.33	3.33	3.33
Weir Type	= Riser	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

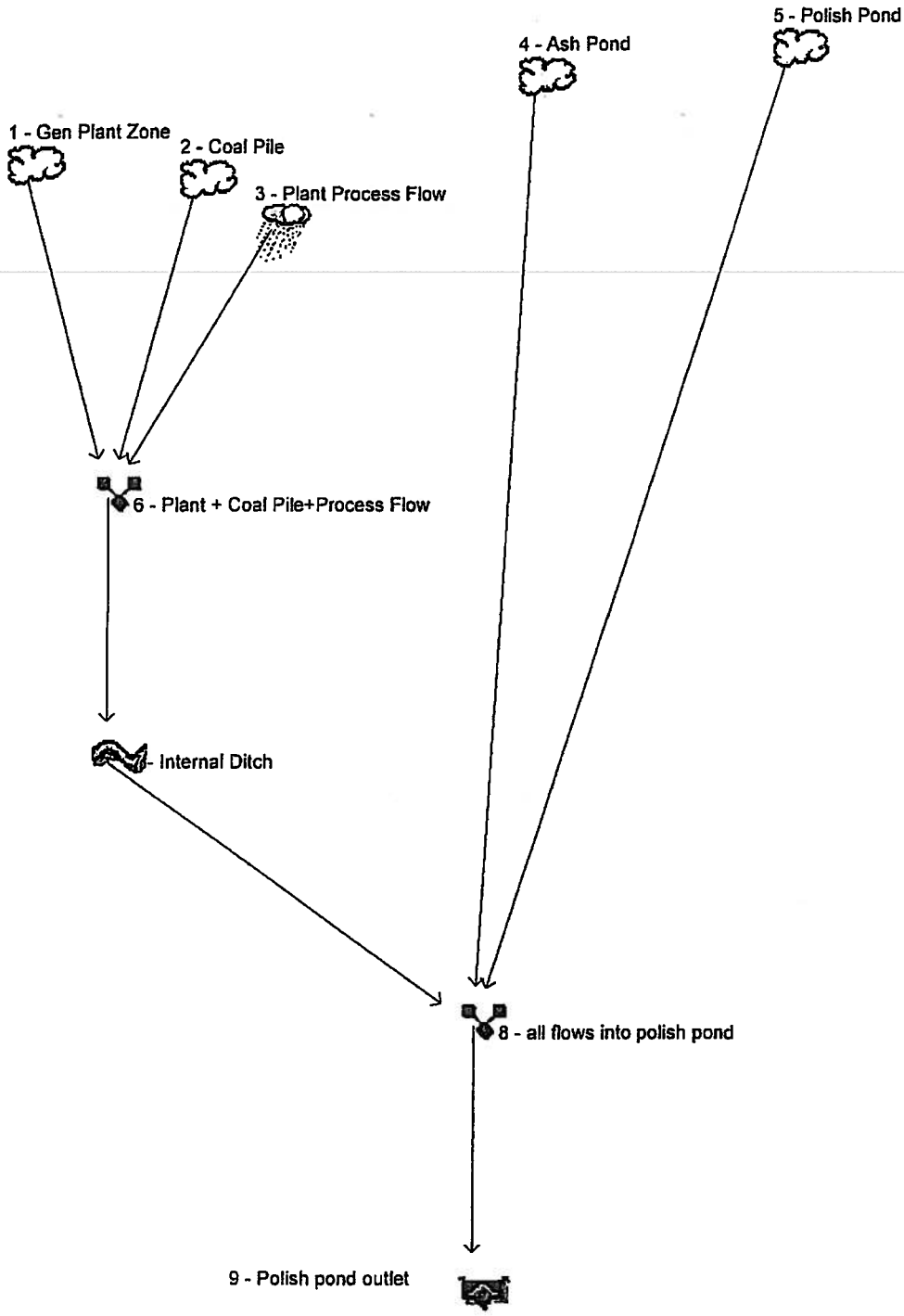
Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).

Stage / Storage / Discharge Table

Stage ft	Storage acft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0.000	403.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
1.00	28.016	404.00	69.64 ic	---	---	---	13.25 ic	---	---	---	---	---	13.25
2.00	56.193	405.00	69.64 ic	---	---	---	18.74 ic	---	---	---	---	---	18.74
3.00	84.532	406.00	69.64 ic	---	---	---	22.96 ic	---	---	---	---	---	22.96
4.00	113.033	407.00	69.64 ic	---	---	---	26.51 ic	---	---	---	---	---	26.51
5.00	141.699	408.00	69.64 ic	---	---	---	29.63 ic	---	---	---	---	---	29.63
6.00	170.529	409.00	69.64 ic	---	---	---	32.46 ic	---	---	---	---	---	32.46
7.00	199.526	410.00	69.64 ic	---	---	---	35.06 ic	---	---	---	---	---	35.06

Watershed Model Schematic

Hydraflow Hydrographs by Intelisolve v9.23



Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	130.36	Gen Plant Zone
2	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	100.99	Coal Pile
3	Manual	-------	-------	-------	-------	-------	-------	-------	-------	20.00	Plant Process Flow
4	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	97.72	Ash Pond
5	SCS Runoff	-------	-------	-------	-------	-------	-------	-------	-------	80.40	Polish Pond
6	Combine	1, 2, 3,	-------	-------	-------	-------	-------	-------	-------	226.00	Plant + Coal Pile+Process Flow
7	Reach	6	-------	-------	-------	-------	-------	-------	-------	226.18	Internal Ditch
8	Combine	4, 5, 7	-------	-------	-------	-------	-------	-------	-------	367.43	all flows into polish pond
9	Reservoir	8	-------	-------	-------	-------	-------	-------	-------	22.68	Polish pond outlet

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

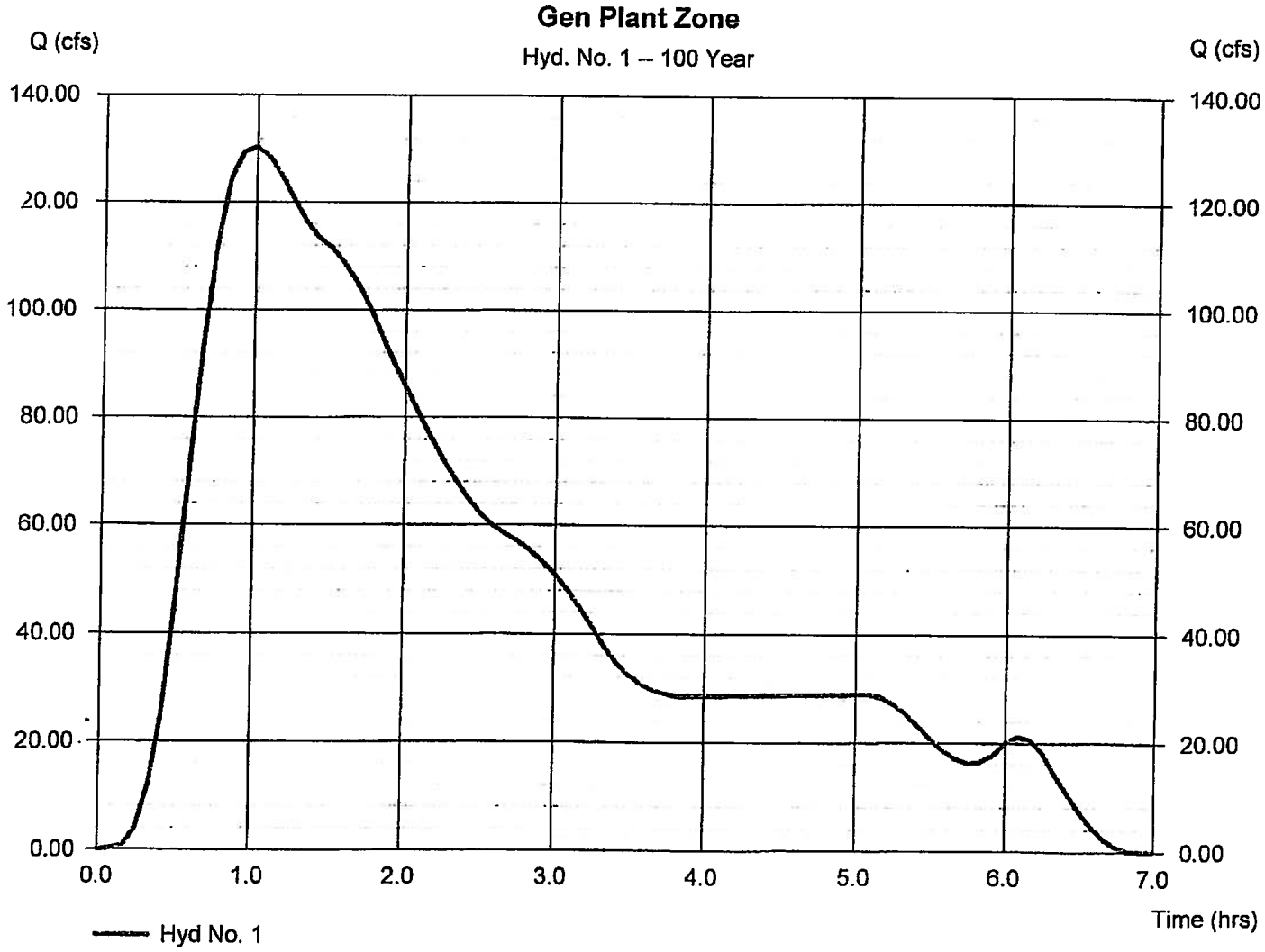
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	130.36	5	60	27.092	----	------	------	Gen Plant Zone
2	SCS Runoff	100.99	5	40	17.352	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	97.72	5	70	22.381	----	------	------	Ash Pond
5	SCS Runoff	80.40	5	35	11.781	----	------	------	Polish Pond
6	Combine	226.00	5	50	94.031	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	226.18	5	55	94.174	6	------	------	Internal Ditch
8	Combine	367.43	5	65	128.336	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	22.68	5	405	127.740	8	400.93	80.2	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 130.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.00 hrs
Time interval	= 5 min	Hyd. volume	= 27.092 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

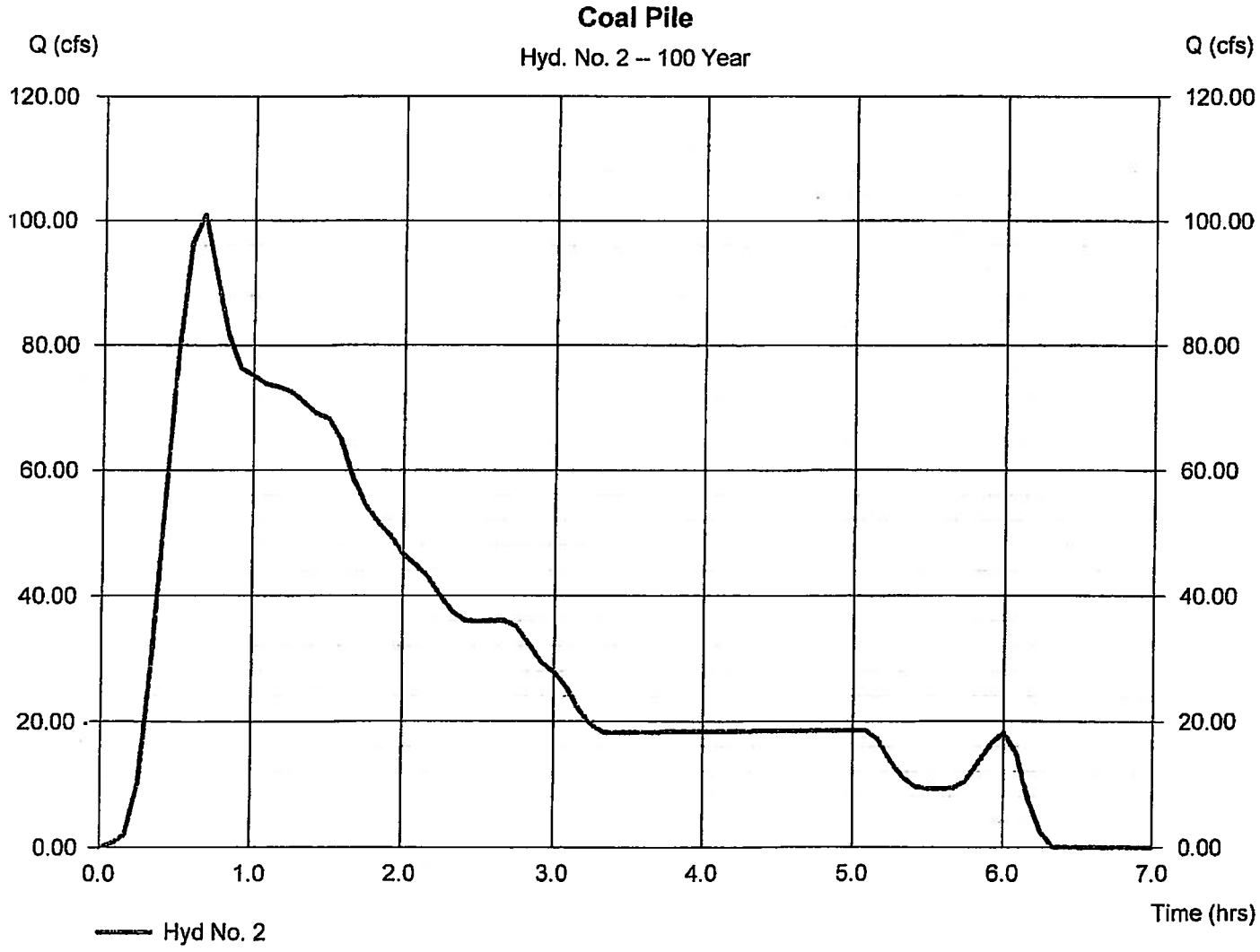


Hydrograph Report

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 100.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.67 hrs
Time interval	= 5 min	Hyd. volume	= 17.352 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

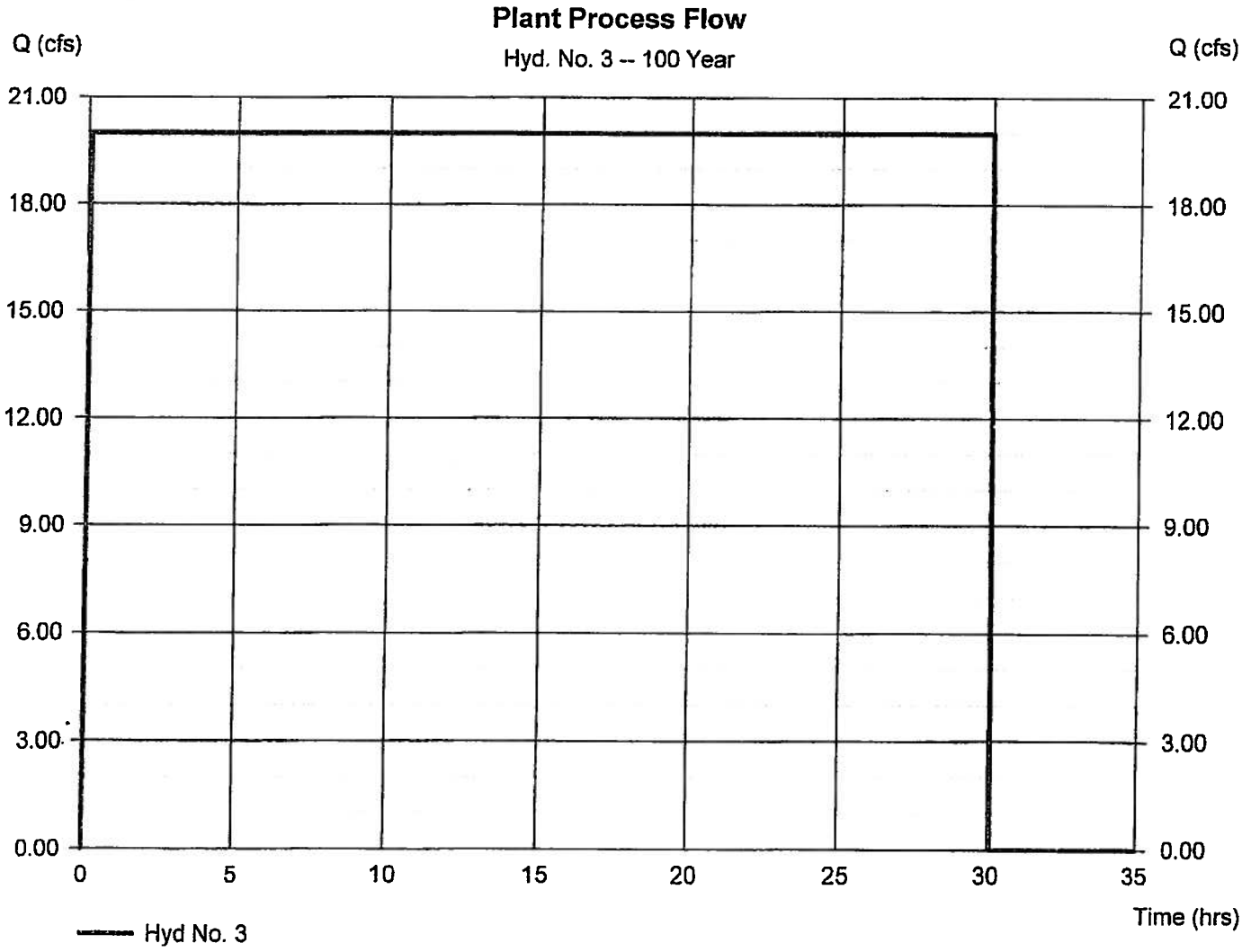


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

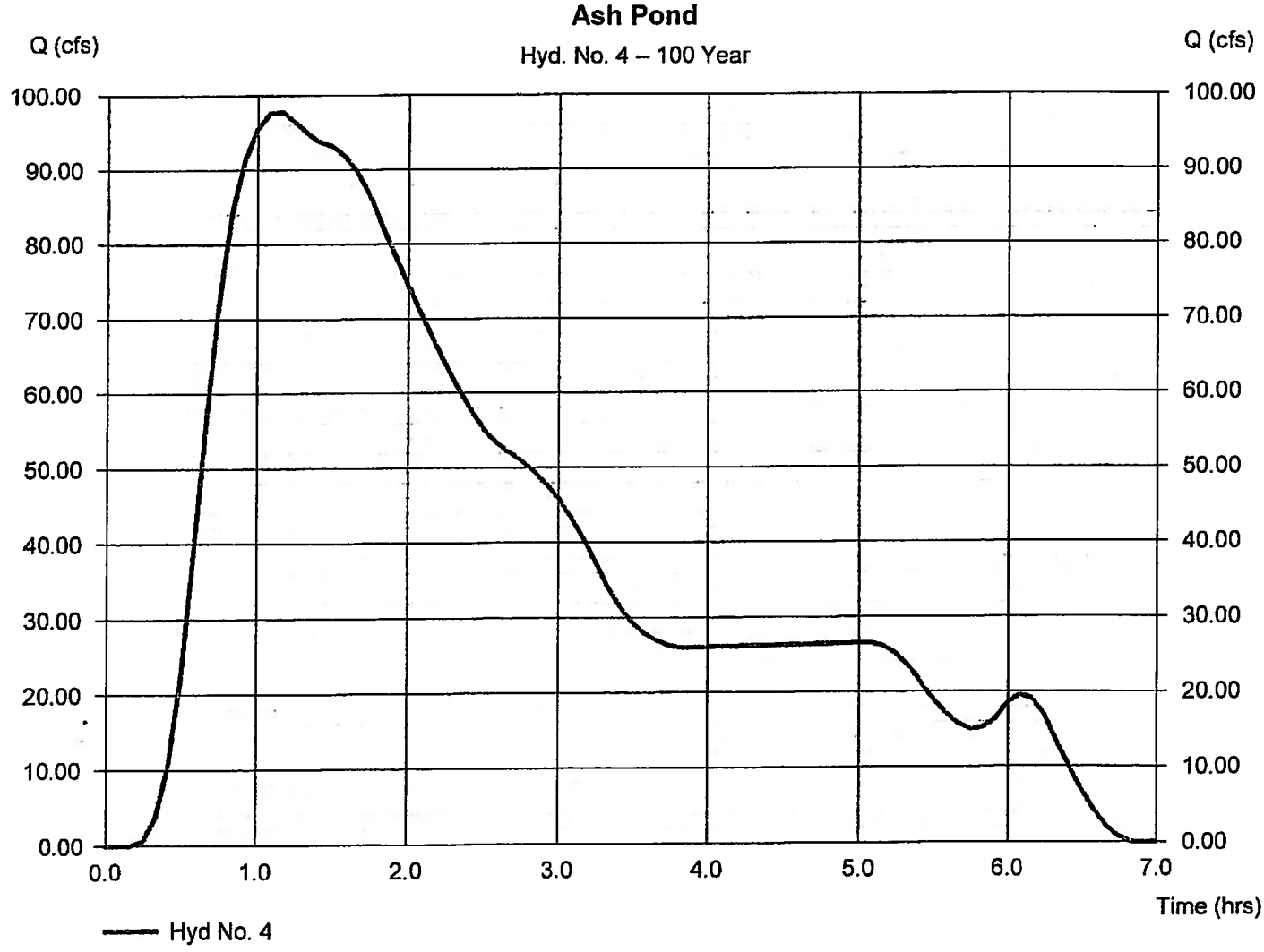


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 97.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.17 hrs
Time interval	= 5 min	Hyd. volume	= 22.381 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484

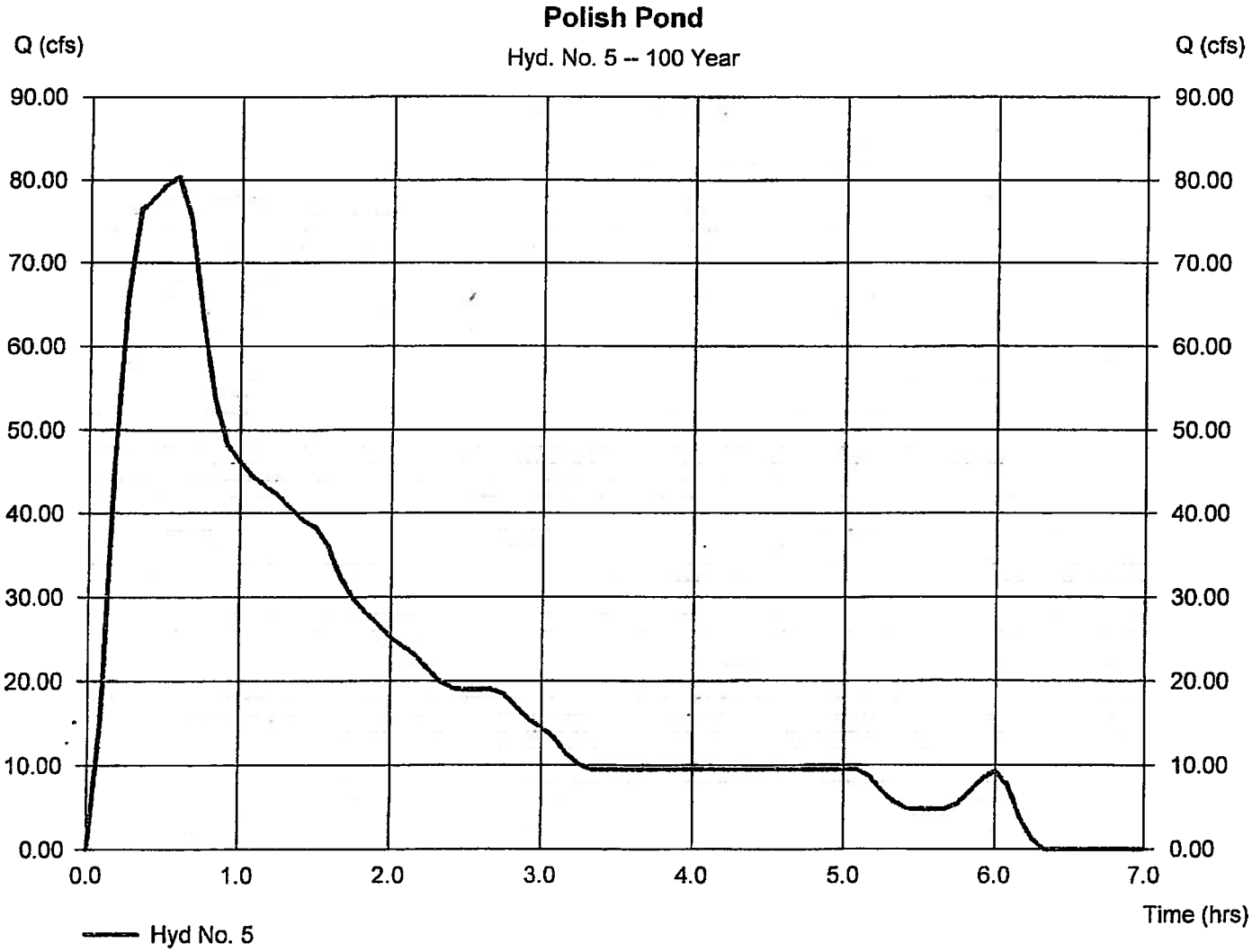


Hydrograph Report

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 80.40 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.58 hrs
Time interval	= 5 min	Hyd. volume	= 11.781 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 5.20 in	Distribution	= Huff-1st
Storm duration	= 6.00 hrs	Shape factor	= 484



Hydrograph Report

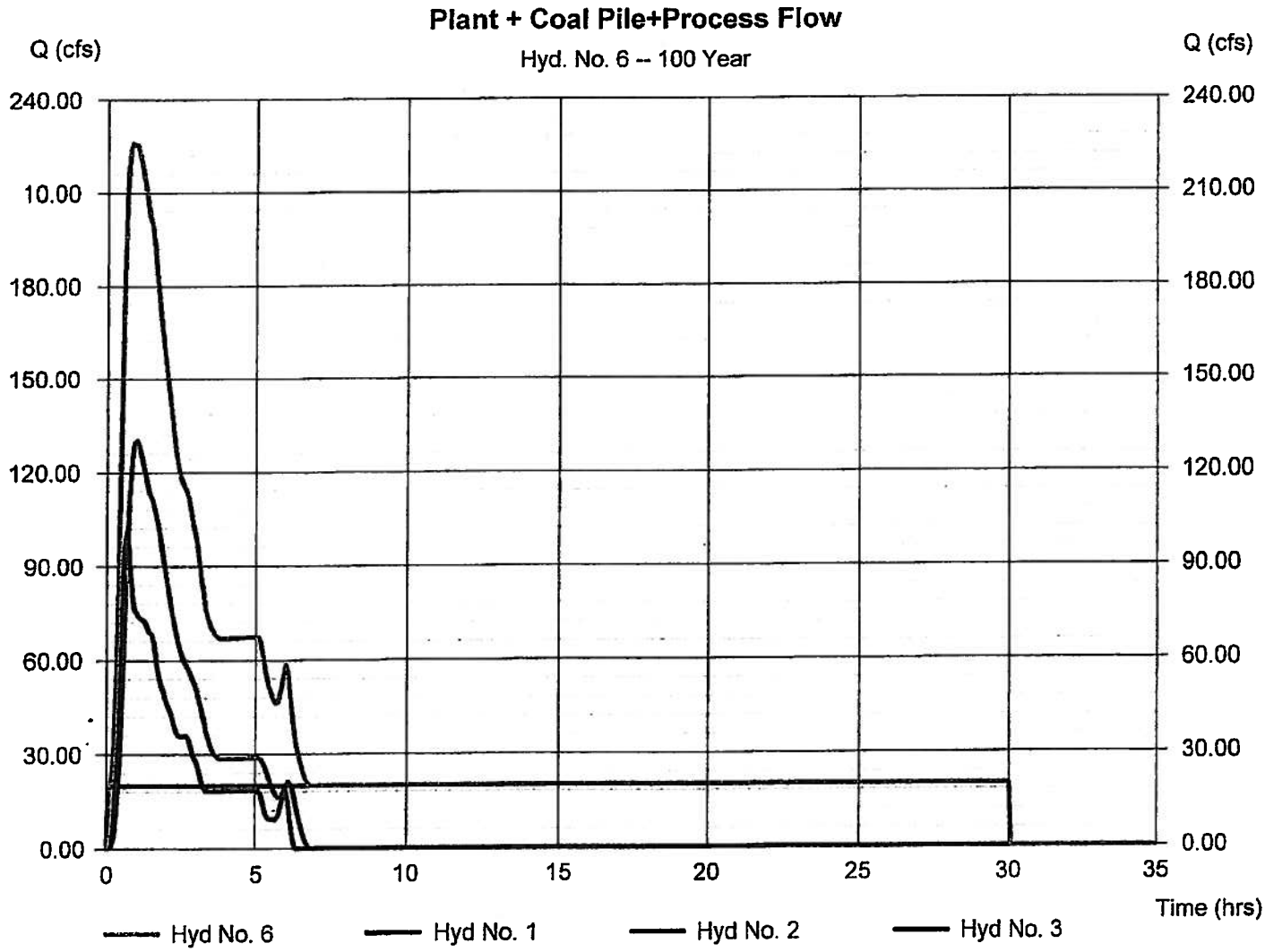
Hydraflow Hydrographs by Intelisolve v9.23

Monday, Mar 15, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 226.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.83 hrs
Time interval	= 5 min	Hyd. volume	= 94.031 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



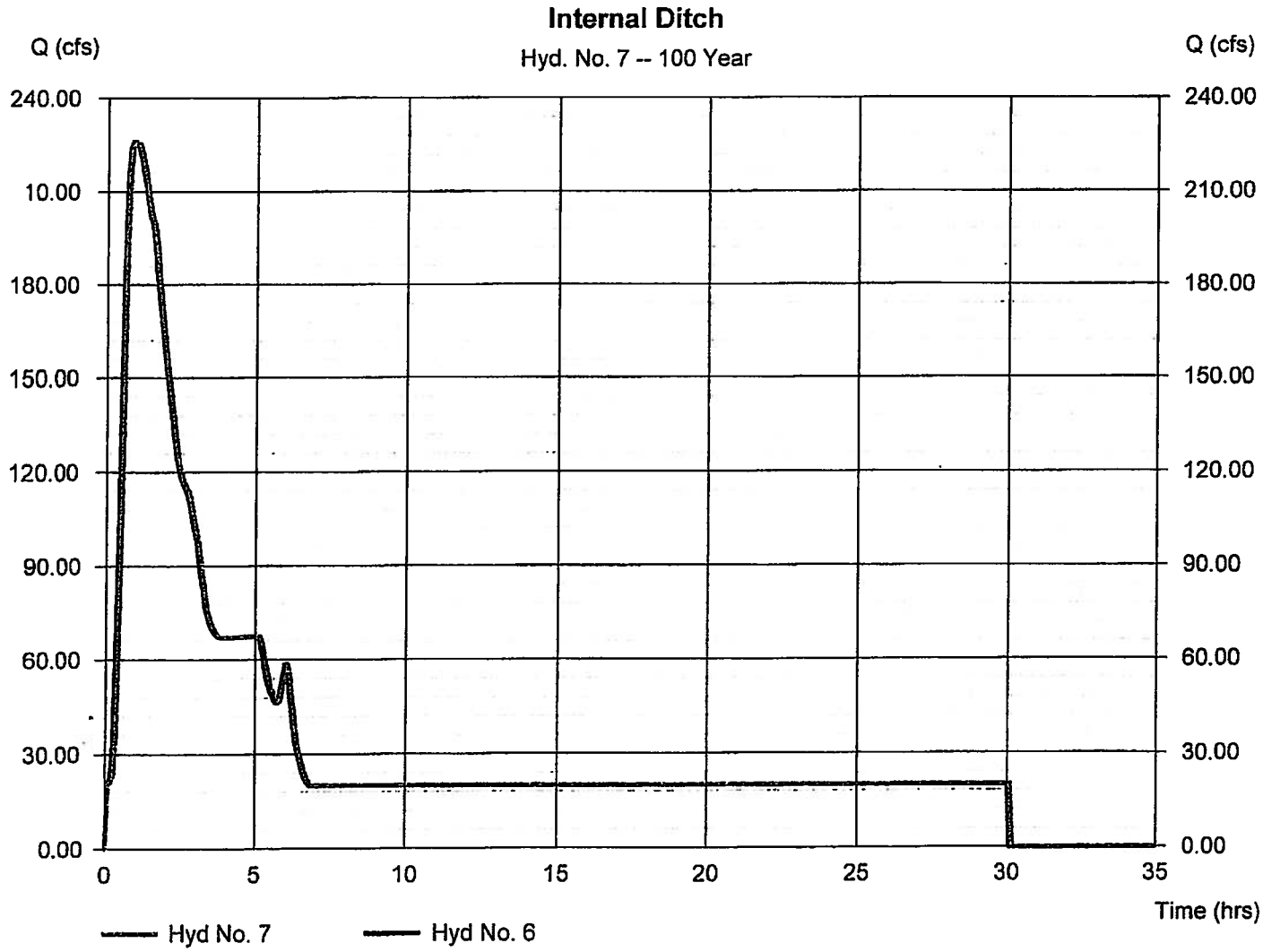
Hydrograph Report

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 226.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.92 hrs
Time interval	= 5 min	Hyd. volume	= 94.174 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 0.00 ft/s	Routing coeff.	= 1.0972

Modified Att-Kin routing method used.

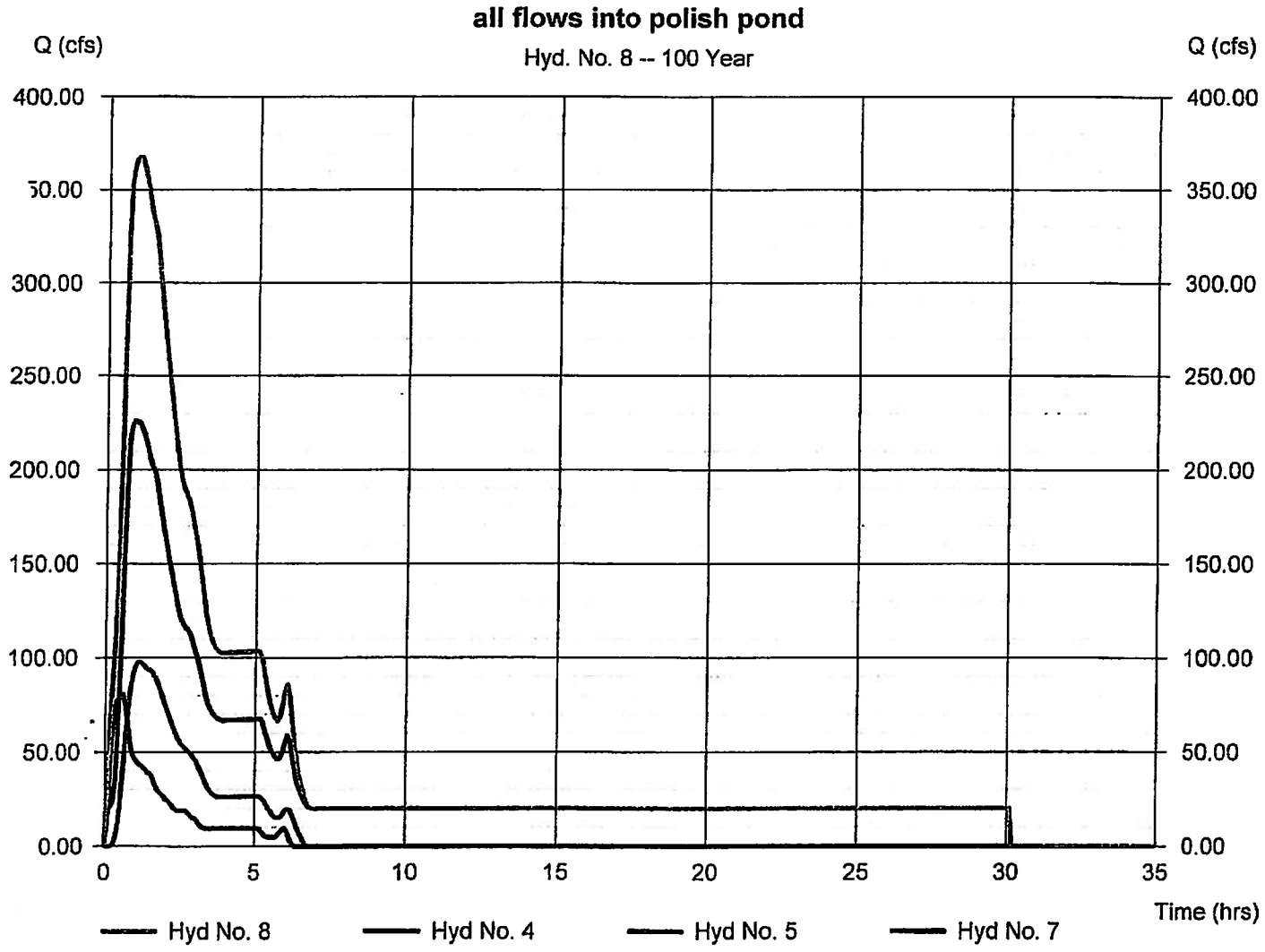


Hydrograph Report

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 367.43 cfs
Storm frequency	= 100 yrs	Time to peak	= 1.08 hrs
Time interval	= 5 min	Hyd. volume	= 128.336 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

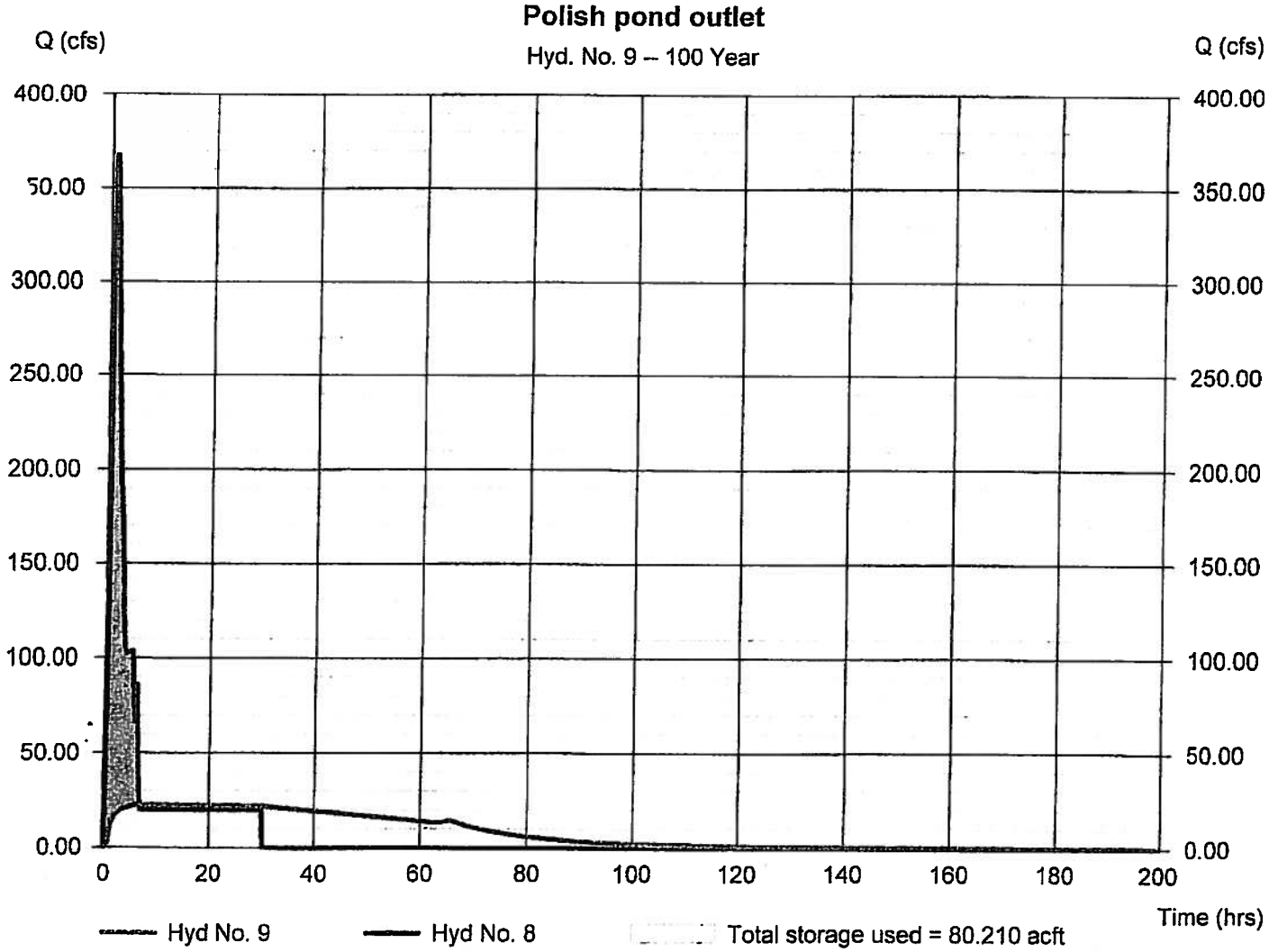
Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 22.68 cfs
Storm frequency	= 100 yrs	Time to peak	= 6.75 hrs
Time interval	= 5 min	Hyd. volume	= 127.740 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 400.93 ft
Reservoir name	= Polish pond	Max. Storage	= 80.210 acft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	------
2	69.8703	13.1000	0.8658	------
3	0.0000	0.0000	0.0000	------
5	79.2597	14.6000	0.8369	------
10	88.2351	15.5000	0.8279	------
25	102.6072	16.5000	0.8217	------
50	114.8193	17.2000	0.8199	------
100	127.1596	17.8000	0.8186	------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

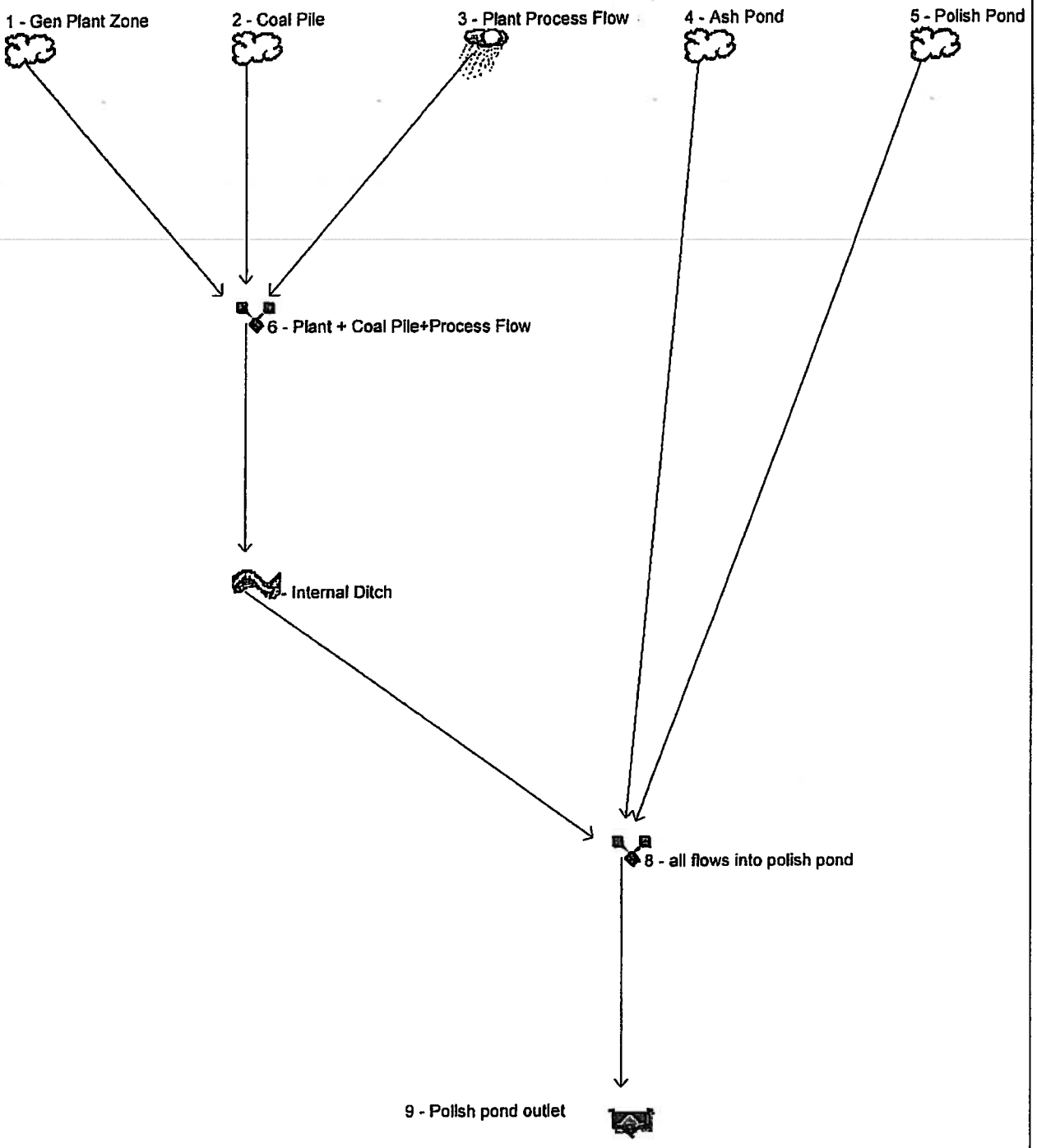
Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.20	0.00	3.30	4.25	5.77	6.80	0.00
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	0.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	5.20
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.10
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	0.00

Watershed Model Schematic

Hydraflow Hydrographs by Intelisolve v9.23



Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.23

Hyd. No.	Hydrograph type (origin)	Inflow Hyd(s)	Peak Outflow (cfs)								Hydrograph description
			1-Yr	2-Yr	3-Yr	5-Yr	10-Yr	25-Yr	50-Yr	100-Yr	
1	SCS Runoff	------	------	------	------	------	------	------	------	63.88	Gen Plant Zone
2	SCS Runoff	------	------	------	------	------	------	------	------	41.10	Coal Pile
3	Manual	------	------	------	------	------	------	------	------	20.00	Plant Process Flow
4	SCS Runoff	------	------	------	------	------	------	------	------	58.35	Ash Pond
5	SCS Runoff	------	------	------	------	------	------	------	------	21.09	Polish Pond
6	Combine	1, 2, 3,	------	------	------	------	------	------	------	124.99	Plant + Coal Pile+Process Flow
7	Reach	6	------	------	------	------	------	------	------	124.99	Internal Ditch
8	Combine	4, 5, 7	------	------	------	------	------	------	------	204.24	all flows into polish pond
9	Reservoir	8	------	------	------	------	------	------	------	28.27	Polish pond outlet

Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.23

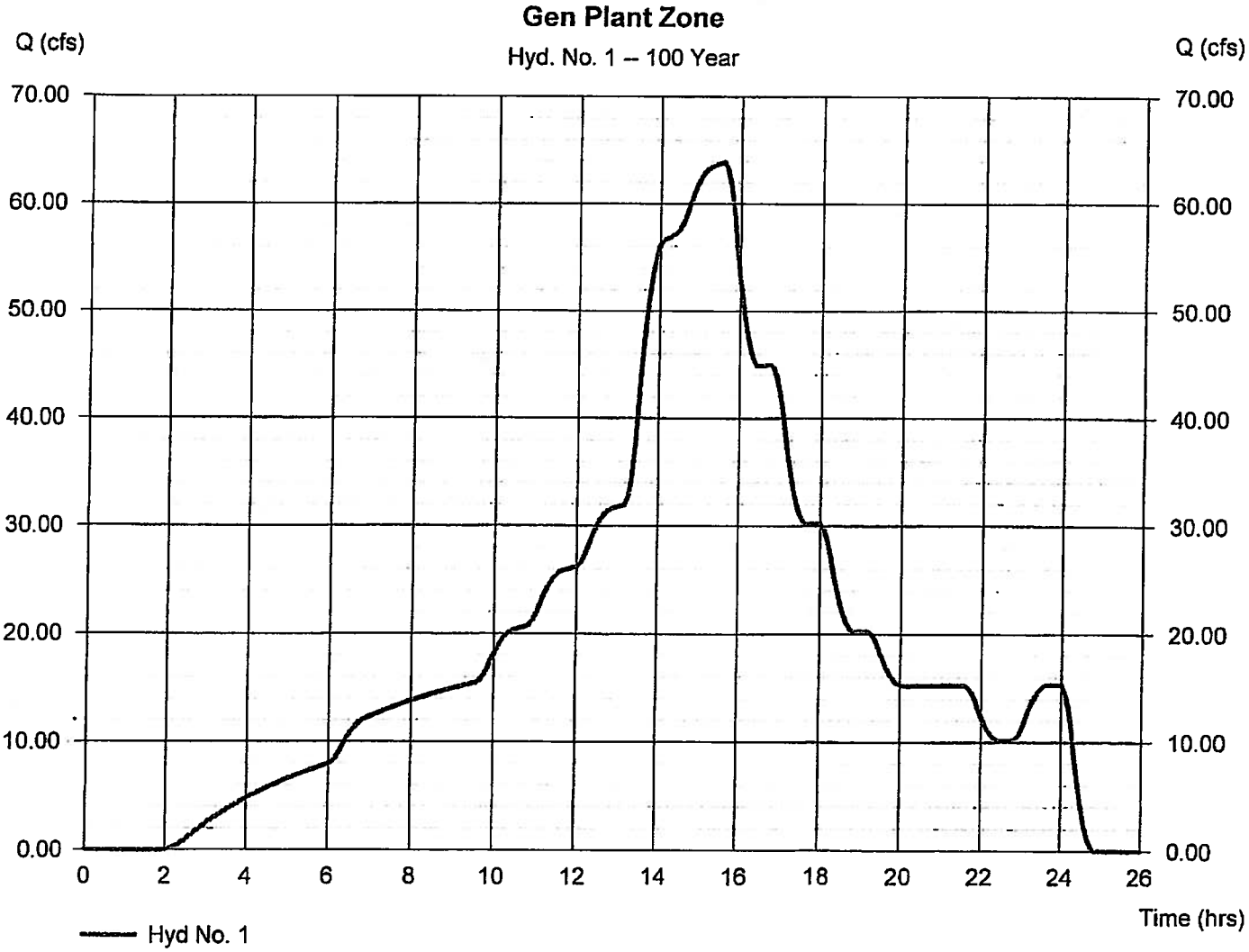
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to peak (min)	Hyd. volume (acft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (acft)	Hydrograph description
1	SCS Runoff	63.88	5	935	40.508	----	------	------	Gen Plant Zone
2	SCS Runoff	41.10	5	935	25.944	----	------	------	Coal Pile
3	Manual	20.00	5	5	49.587	----	------	------	Plant Process Flow
4	SCS Runoff	58.35	5	935	34.925	----	------	------	Ash Pond
5	SCS Runoff	21.09	5	925	16.086	----	------	------	Polish Pond
6	Combine	124.99	5	935	116.039	1, 2, 3,	------	------	Plant + Coal Pile+Process Flow
7	Reach	124.99	5	940	116.177	6	------	------	Internal Ditch
8	Combine	204.24	5	935	167.188	4, 5, 7	------	------	all flows into polish pond
9	Reservoir	28.27	5	1470	166.331	8	402.55	125	Polish pond outlet

Hydrograph Report

Hyd. No. 1

Gen Plant Zone

Hydrograph type	= SCS Runoff	Peak discharge	= 63.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 40.508 acft
Drainage area	= 86.300 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 30.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

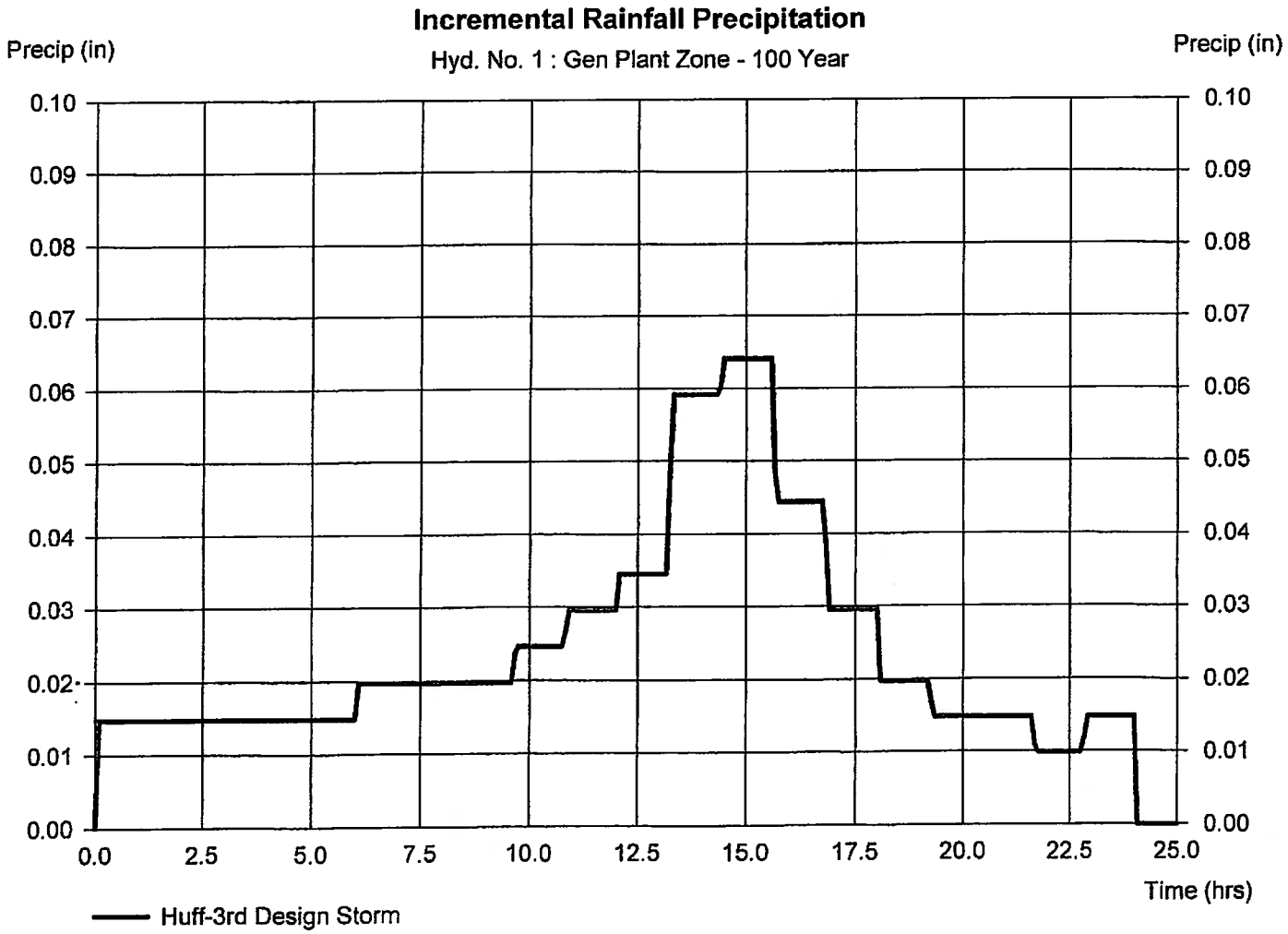


Precipitation Report

Hyd. No. 1

Gen Plant Zone

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		



Hydrograph Report

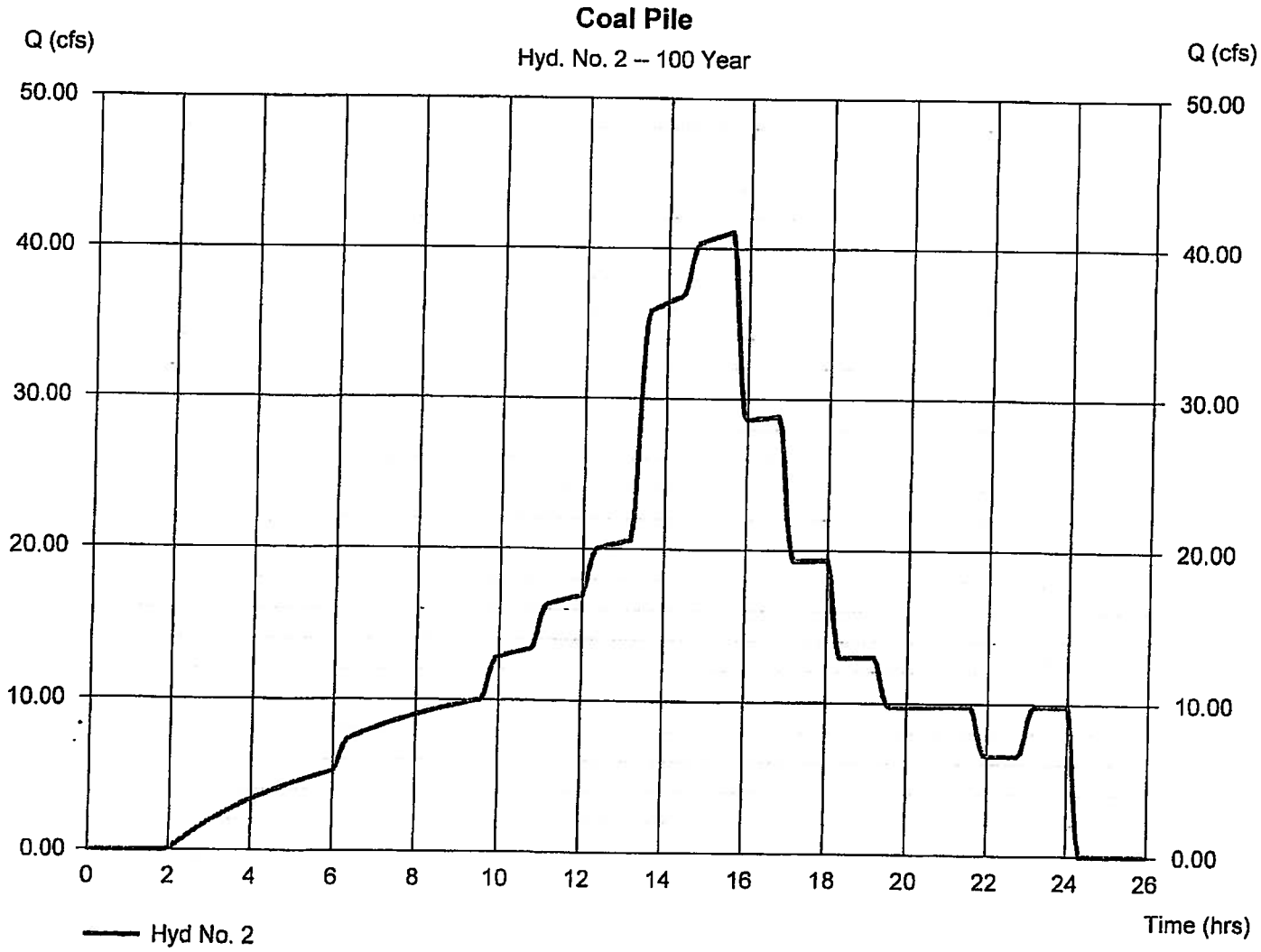
Hydraflow Hydrographs by Intelisolve v9.23

Monday, Mar 15, 2010

Hyd. No. 2

Coal Pile

Hydrograph type	= SCS Runoff	Peak discharge	= 41.10 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 25.944 acft
Drainage area	= 60.800 ac	Curve number	= 86
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 12.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

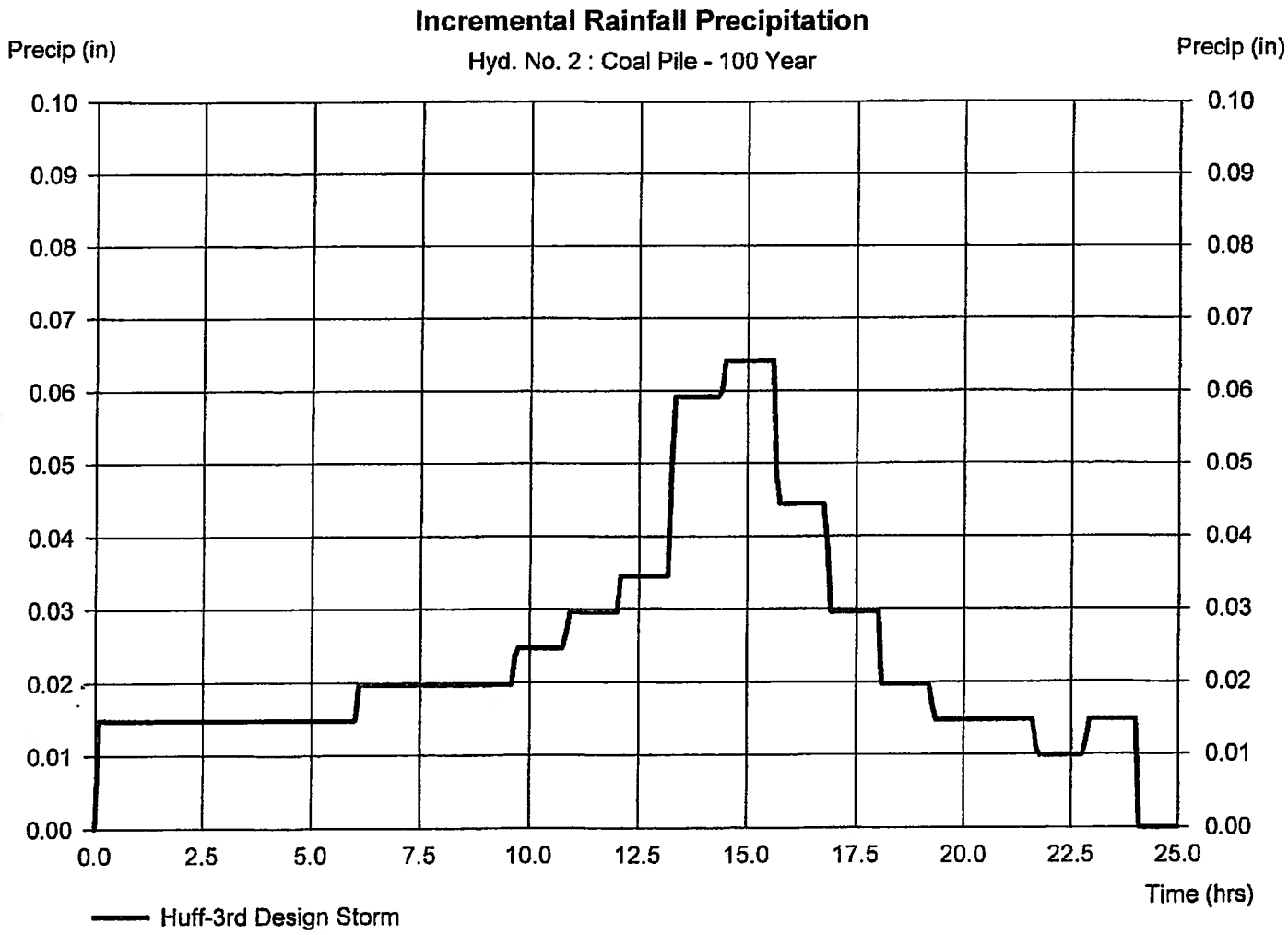


Precipitation Report

Hyd. No. 2

Coal Pile

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		

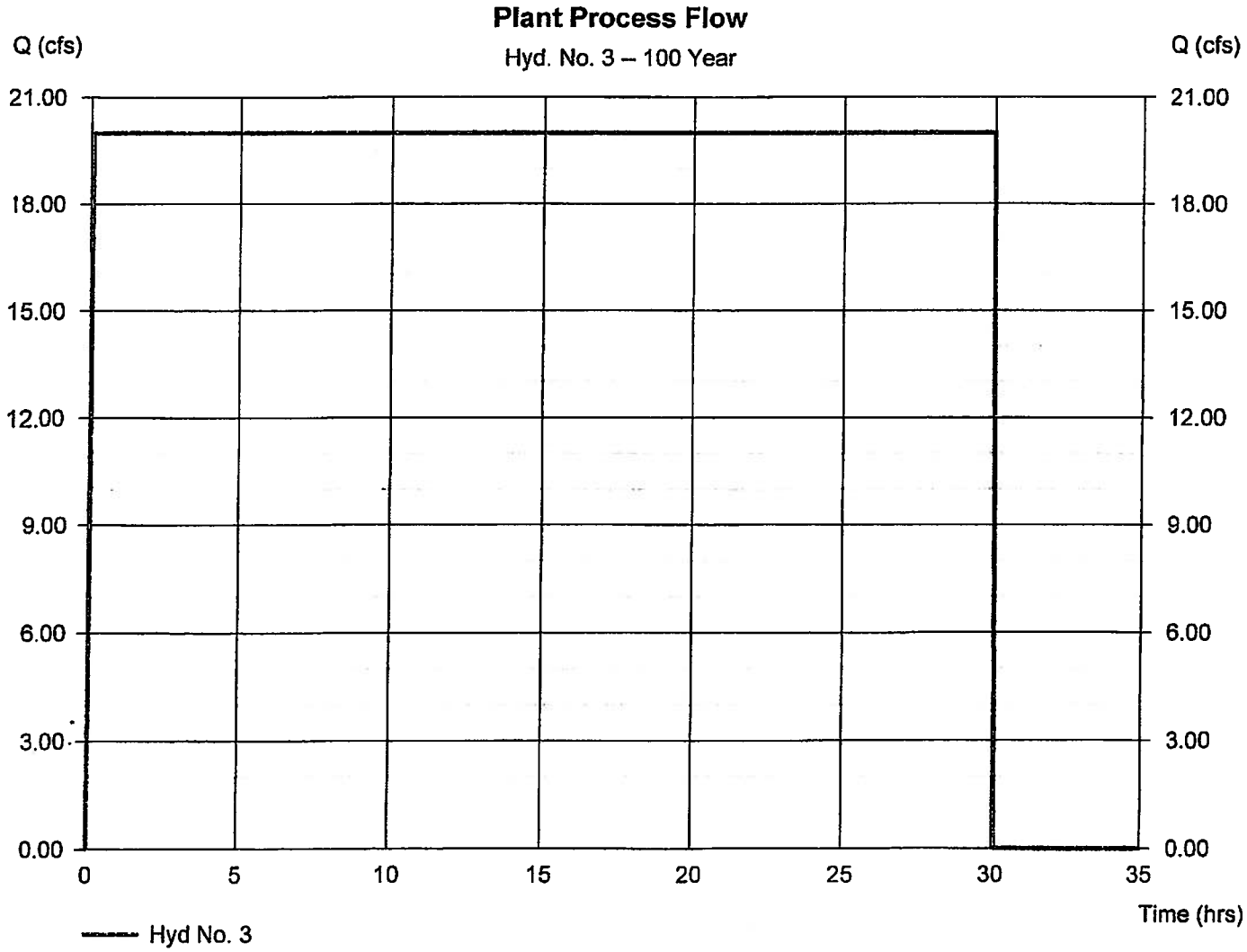


Hydrograph Report

Hyd. No. 3

Plant Process Flow

Hydrograph type	= Manual	Peak discharge	= 20.00 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 5 min	Hyd. volume	= 49.587 acft

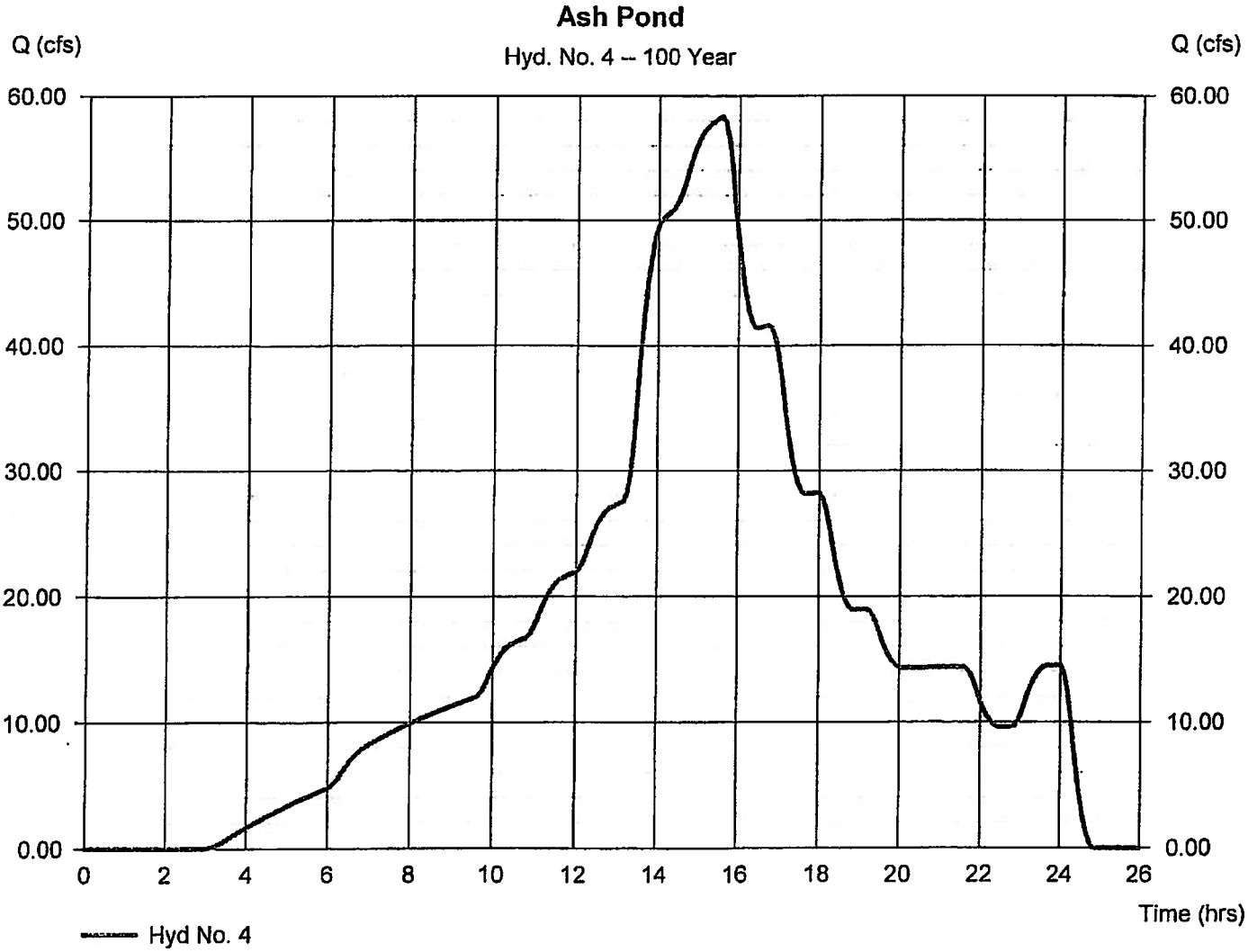


Hydrograph Report

Hyd. No. 4

Ash Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 58.35 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 34.925 acft
Drainage area	= 84.900 ac	Curve number	= 80
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 33.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

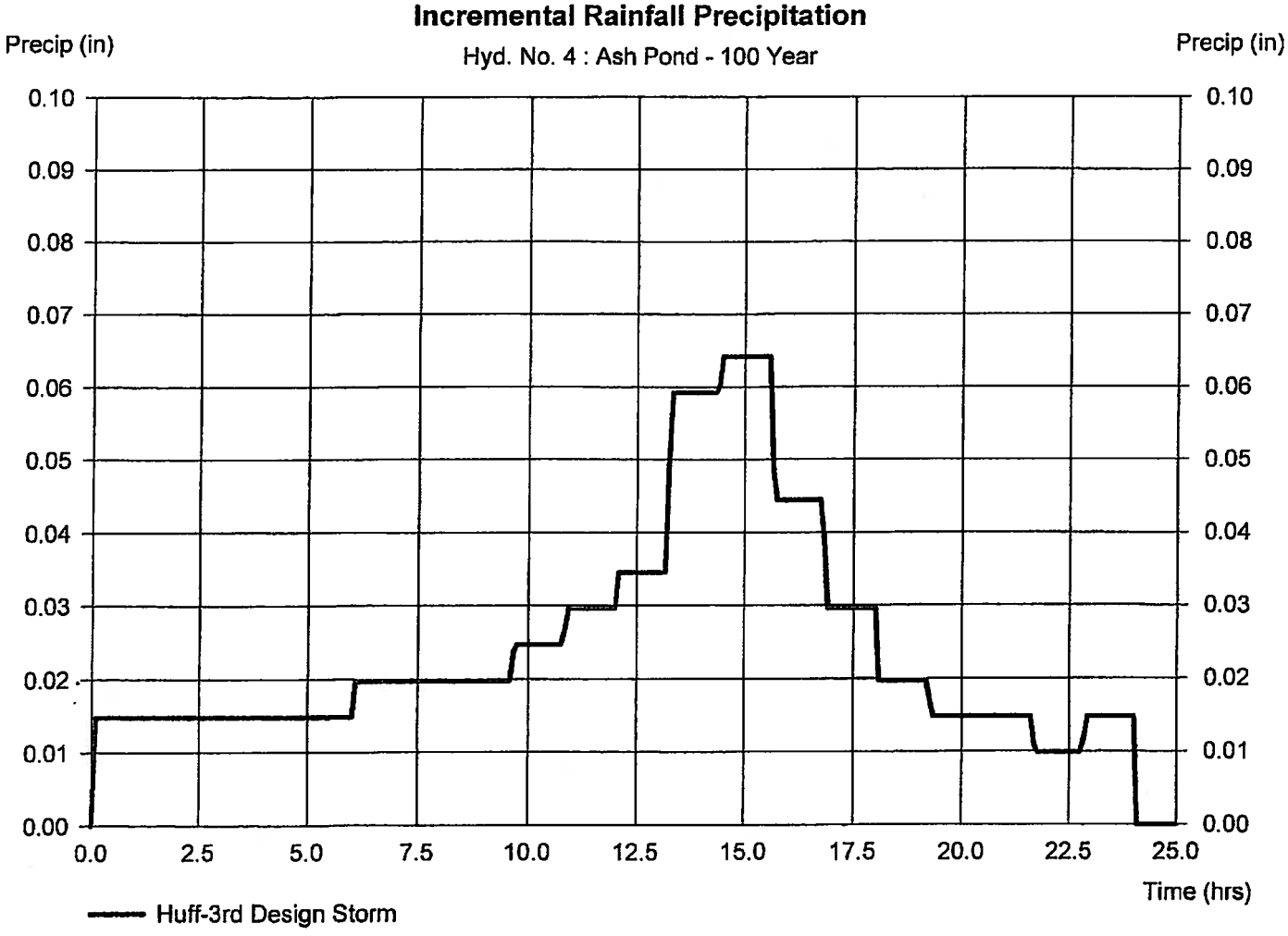


Precipitation Report

Hyd. No. 4

Ash Pond

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		



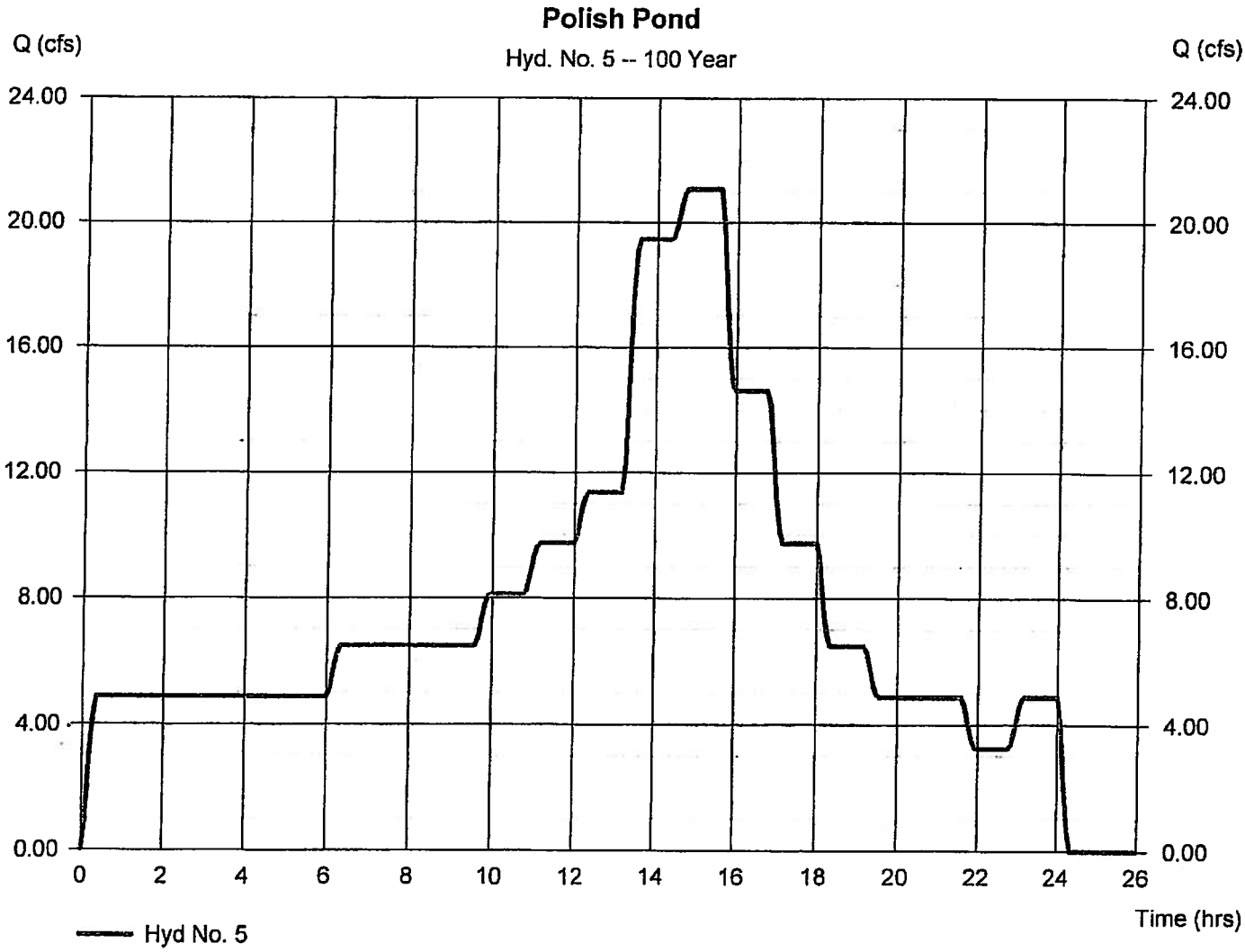
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 5

Polish Pond

Hydrograph type	= SCS Runoff	Peak discharge	= 21.09 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.42 hrs
Time interval	= 5 min	Hyd. volume	= 16.086 acft
Drainage area	= 29.000 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= USER	Time of conc. (Tc)	= 10.00 min
Total precip.	= 7.10 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs	Shape factor	= 484

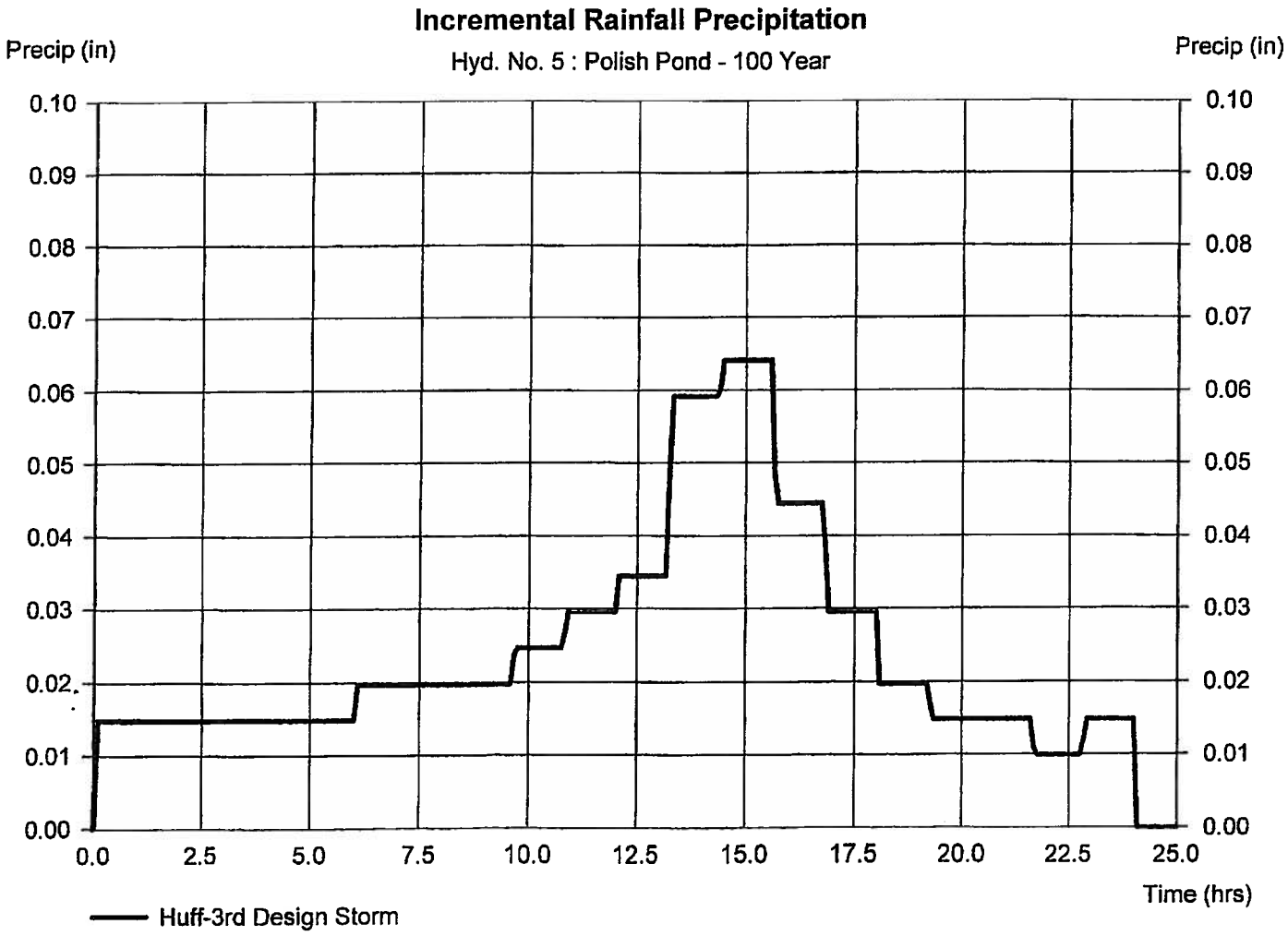


Precipitation Report

Hyd. No. 5

Polish Pond

Storm Frequency	= 100 yrs	Time interval	= 5 min
Total precip.	= 7.1000 in	Distribution	= Huff-3rd
Storm duration	= 24.00 hrs		



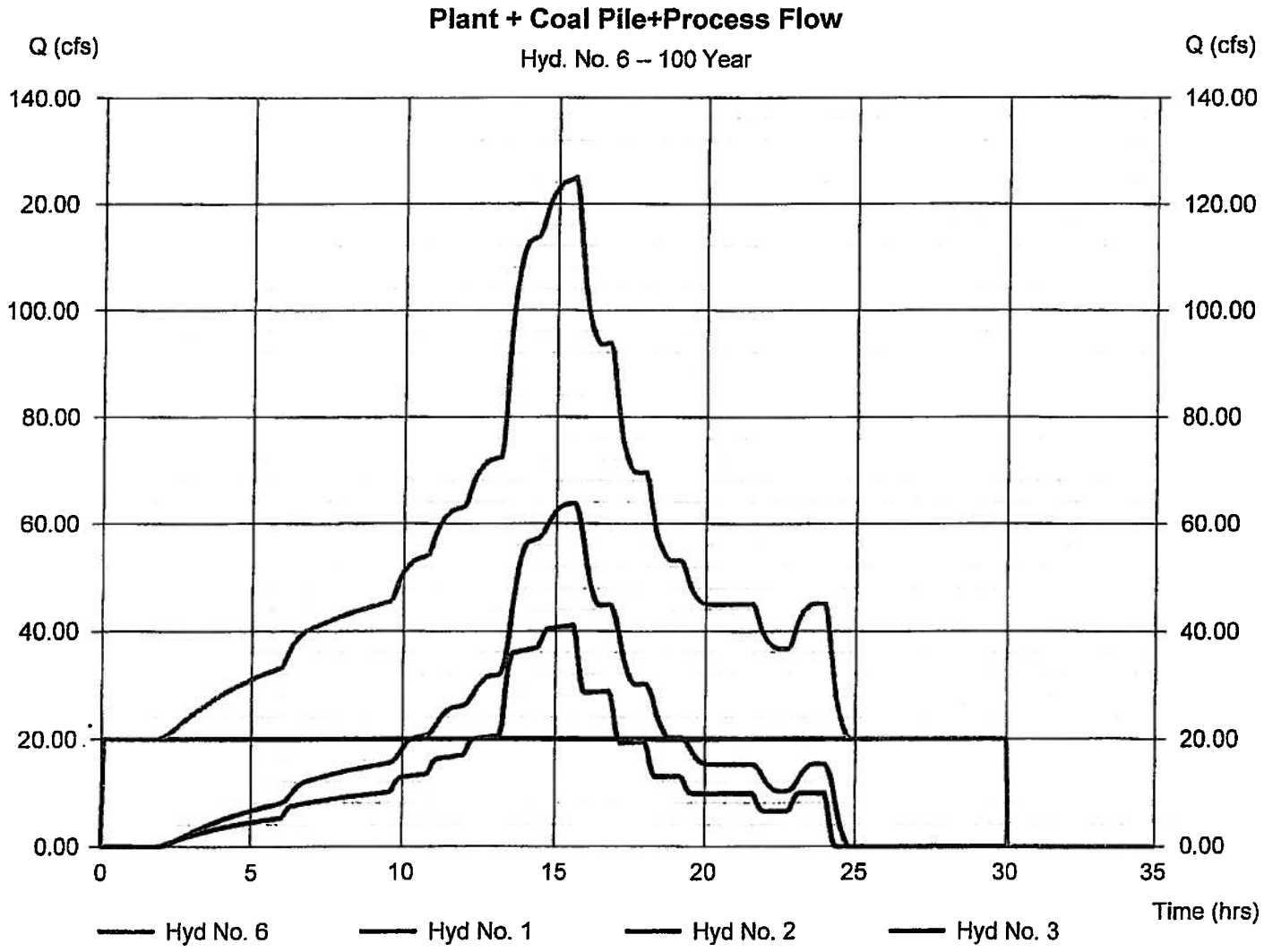
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 6

Plant + Coal Pile+Process Flow

Hydrograph type	= Combine	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 116.039 acft
Inflow hyds.	= 1, 2, 3	Contrib. drain. area	= 147.100 ac



Hydrograph Report

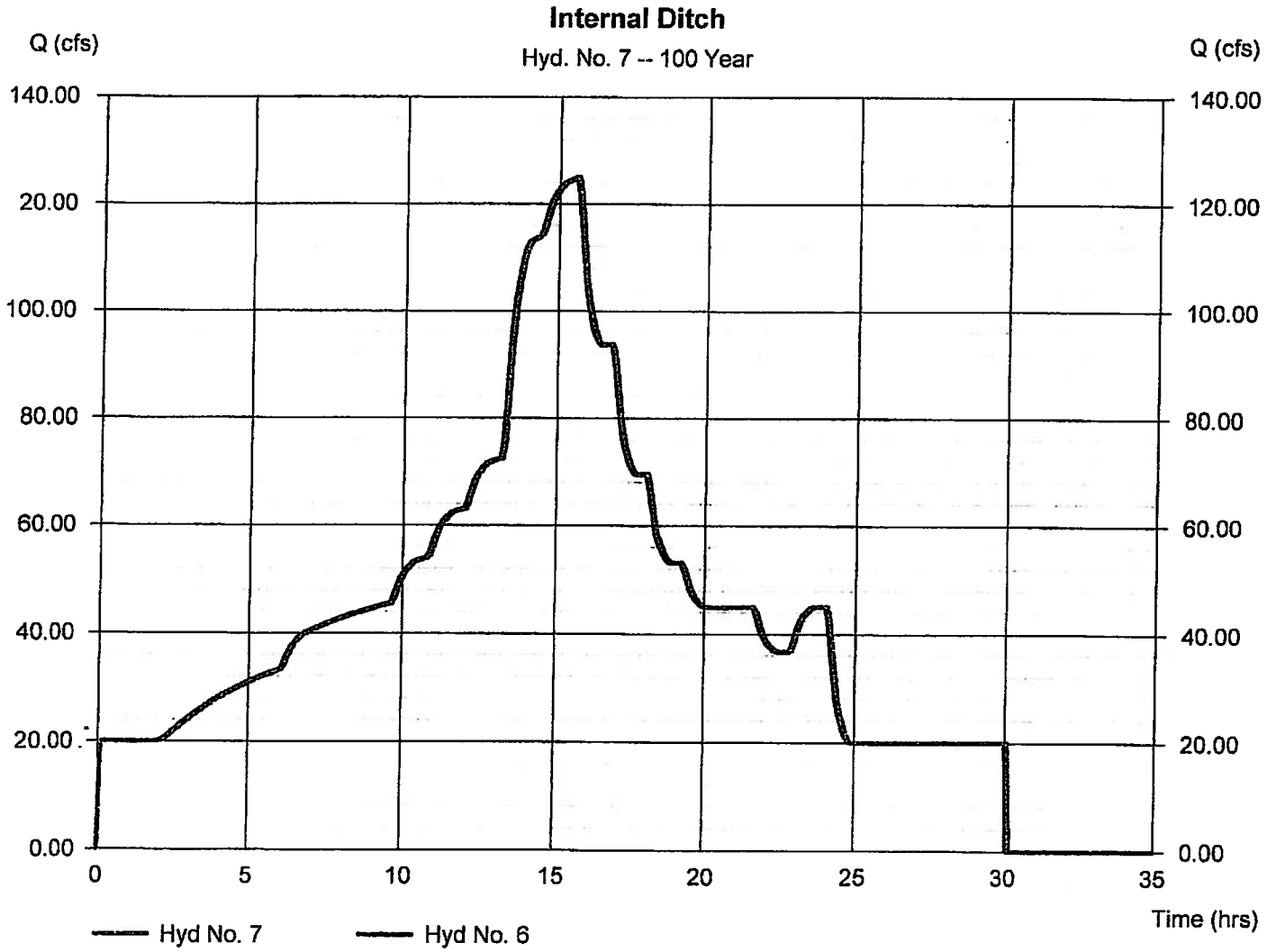
Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 7

Internal Ditch

Hydrograph type	= Reach	Peak discharge	= 124.99 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.67 hrs
Time interval	= 5 min	Hyd. volume	= 116.177 acft
Inflow hyd. No.	= 6 - Plant + Coal Pile+Process Flow	Section type	= Trapezoidal
Reach length	= 1800.0 ft	Channel slope	= 0.3 %
Manning's n	= 0.009	Bottom width	= 10.0 ft
Side slope	= 0.5:1	Max. depth	= 8.0 ft
Rating curve x	= 1.886	Rating curve m	= 1.516
Ave. velocity	= 7.86 ft/s	Routing coeff.	= 0.9967

Modified Att-Kin routing method used.



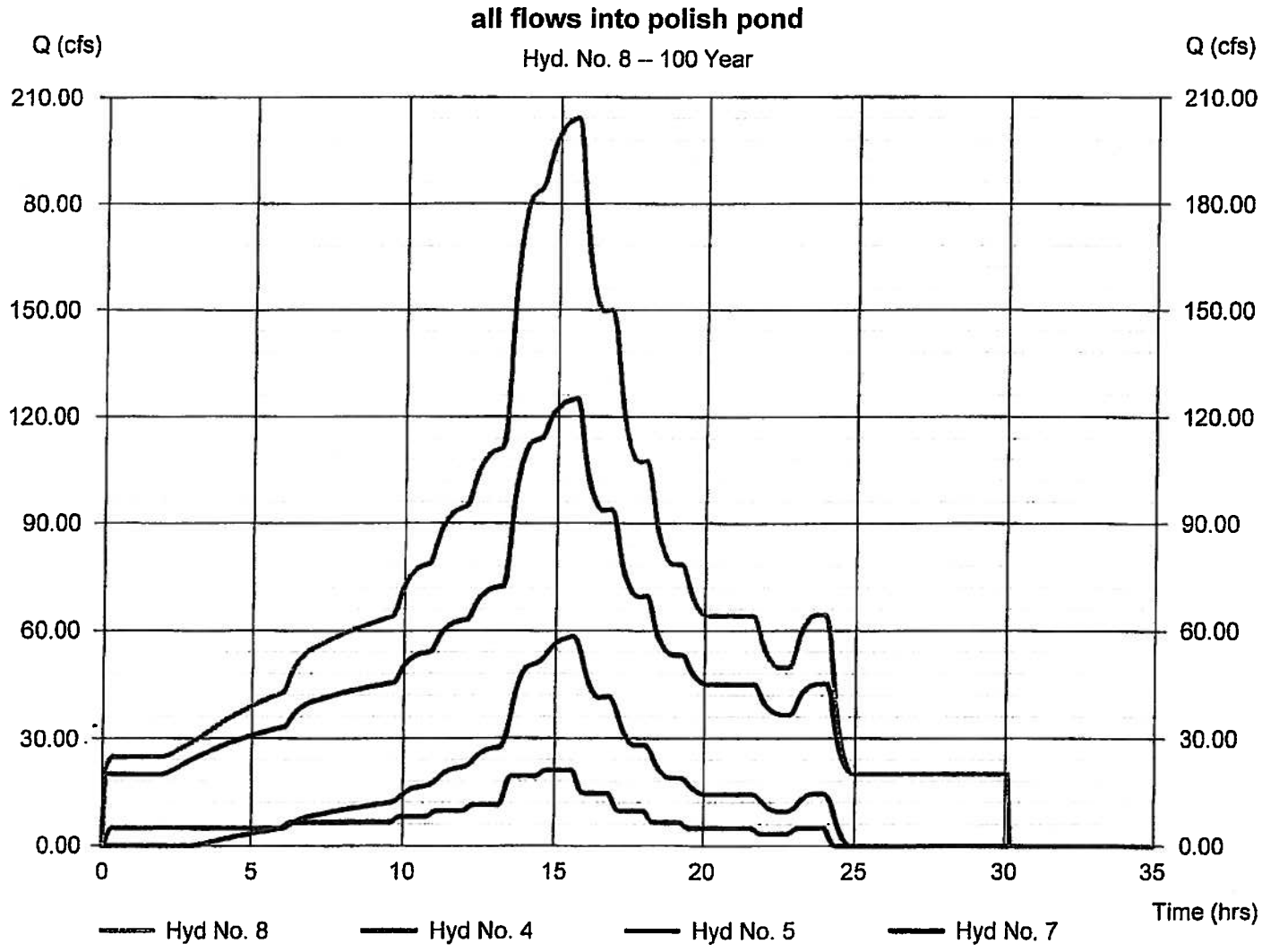
Hydrograph Report

Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 8

all flows into polish pond

Hydrograph type	= Combine	Peak discharge	= 204.24 cfs
Storm frequency	= 100 yrs	Time to peak	= 15.58 hrs
Time interval	= 5 min	Hyd. volume	= 167.188 acft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 113.900 ac



Hydrograph Report

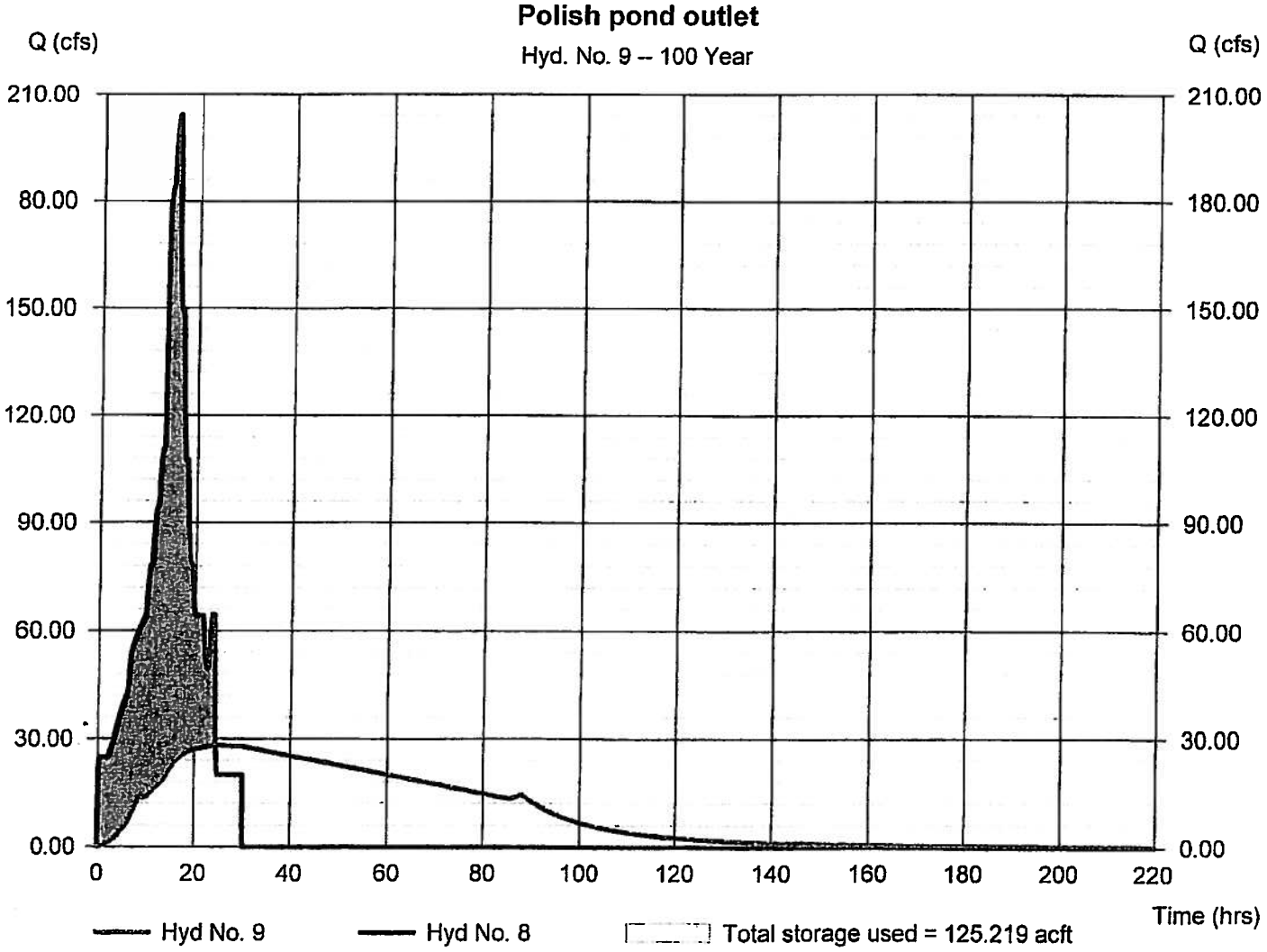
Hydraflow Hydrographs by Intelisolve v9.23 — Monday, Mar 15, 2010

Hyd. No. 9

Polish pond outlet

Hydrograph type	= Reservoir	Peak discharge	= 28.27 cfs
Storm frequency	= 100 yrs	Time to peak	= 24.50 hrs
Time interval	= 5 min	Hyd. volume	= 166.331 acft
Inflow hyd. No.	= 8 - all flows into polish pond	Max. Elevation	= 402.55 ft
Reservoir name	= Polish pond	Max. Storage	= 125.219 acft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	-------
2	69.8703	13.1000	0.8658	-------
3	0.0000	0.0000	0.0000	-------
5	79.2597	14.6000	0.8369	-------
10	88.2351	15.5000	0.8279	-------
25	102.6072	16.5000	0.8217	-------
50	114.8193	17.2000	0.8199	-------
100	127.1596	17.8000	0.8186	-------

File name: SampleFHA.idf

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: Sample.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	2.20	0.00	3.30	4.25	5.77	6.80	0.00
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	0.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	0.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.10
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	0.00

STATE OF MISSOURI

DEPARTMENT OF NATURAL RESOURCES

MISSOURI CLEAN WATER COMMISSION

MISSOURI STATE OPERATING PERMIT

In compliance with the Missouri Clean Water Law, (Chapter 644 R.S. Mo. as amended, hereinafter, the Law), and the Federal Water Pollution Control Act (Public Law 92-500, 92nd Congress) as amended,

Permit No.:	MO-0000043
Owner:	AmerenUE
Address:	PO Box 66149, MC602, St. Louis, MO 63166-6149
Continuing Authority:	Same as above
Address:	Same as above
Facility Name:	AmerenUE, Rush Island Power Plant
Address:	100 Big Hollow Road, Festus, MO 63028
Legal Description:	NE ¼, Sec. 5, T39N, R7E, Jefferson County
Receiving Stream:	Mississippi River (P)
First Classified Stream and ID:	Mississippi River (P)(01707)
USGS Basin & Sub-watershed No.:	(07140101-230001)

is authorized to discharge from the facility described herein, in accordance with the effluent limitations and monitoring requirements as set forth herein:

FACILITY DESCRIPTION

See page 2

This permit authorizes only wastewater discharges under the Missouri Clean Water Law and the National Pollutant Discharge Elimination System; it does not apply to other regulated areas. This permit may be appealed in accordance with Section 644.051.6 of the Law.

October 1, 2004
Effective Date

Stephen M. Mahfood, Director, Department of Natural Resources
Executive Secretary, Clean Water Commission

September 30, 2009
Expiration Date

Jim Hull, Director of Staff, Clean Water Commission

MO 780-0041 (10-93)

FACILITY DESCRIPTION (continued)

Outfall #001 - Power Plant - SIC #4911
Non-contact cooling water.
Design flow is 1,098 MGD.
Actual flow is 804 MGD.

Outfall #002 - Power Plant - SIC #4911
Ash pond/pH neutralization.
Design flow is 43.10 MGD.
Actual flow is 15.84 MGD.

Outfall #003 - Power Plant - SIC #4911
Extended aeration/sludge disposal is by contract hauler.
Design population equivalent is 235.
Design flow is 0.02 MGD.
Actual flow is 0.019 MGD.

Outfall #004 - Power Plant - SIC #4911
Monitoring at this outfall has been eliminated for this permit cycle. However, Form 2F must be completed at next renewal.

Outfall #005 - Power Plant - SIC #4911
This outfall has been eliminated.

Outfall #006 - Power Plant - SIC #4911
This outfall has been eliminated.

Outfall #007 - Power Plant - SIC #4911
This outfall has been eliminated.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:

OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	FINAL EFFLUENT LIMITATIONS			MONITORING REQUIREMENTS	
		DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
Outfall #001 - Non-Contract Cooling Water						
Flow	MGD	*		*	once/weekday**	24 hr. estimate
Intake Temperature	°F	*		*	once/weekday**	grab
Outfall Temperature	°F	*		*	once/weekday**	grab
Thermal Discharge	btu/hr	5.81×10^9			once/weekday**	N/A
MONITORING REPORTS SHALL BE SUBMITTED MONTHLY; THE FIRST REPORT IS DUE November 28, 2004.						
Whole Effluent Toxicity (WET) Test	% Survival	See Special Condition #17			once/year	grab
MONITORING REPORTS SHALL BE SUBMITTED ANNUALLY; THE FIRST REPORT IS DUE October 28, 2005.						
Outfall #002 - Ash Pond						
Flow	MGD	*		*	once/week	24 hr. estimate
Intake Total Suspended Solids	mg/L	*		*	once/week	grab
Effluent Total Suspended Solids	mg/L	*		*	once/week	grab
Net Total Suspended Solids***	mg/L	100		30	once/week	grab
Oil & Grease	mg/L	20		15	once/month	grab
pH - Units	SU	****		****	once/week	grab
MONITORING REPORTS SHALL BE SUBMITTED MONTHLY; THE FIRST REPORT IS DUE November 28, 2004.						
Sulfate	mg/L	*		*	once/quarter*****	grab
MONITORING REPORTS SHALL BE SUBMITTED QUARTERLY; THE FIRST REPORT IS DUE January 28, 2005.						
Whole Effluent Toxicity (WET) Test	% Survival	See Special Condition #17			once/year	grab
MONITORING REPORTS SHALL BE SUBMITTED ANNUALLY; THE FIRST REPORT IS DUE October 28, 2005. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.						

B. STANDARD CONDITIONS

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Parts I & III STANDARD CONDITIONS DATED October 1, 1980, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

The permittee is authorized to discharge from outfall(s) with serial number(s) as specified in the application for this permit. The final effluent limitations shall become effective upon issuance and remain in effect until expiration of the permit. Such discharges shall be controlled, limited and monitored by the permittee as specified below:

OUTFALL NUMBER AND EFFLUENT PARAMETER(S)	UNITS	FINAL EFFLUENT LIMITATIONS			MONITORING REQUIREMENTS	
		DAILY MAXIMUM	WEEKLY AVERAGE	MONTHLY AVERAGE	MEASUREMENT FREQUENCY	SAMPLE TYPE
Outfall #003 - Sewage Treatment Plant						
Flow	MGD	*		*	once/month	24 hr. estimate
Biochemical Oxygen Demand$_5$	mg/L		45	30	once/quarter*****	******
Total Suspended Solids	mg/L		45	30	once/quarter*****	******
pH - Units	SU	****		****	once/quarter*****	grab
Aeration Tank Testing - See Special Condition #10						
Total Suspend Solids	mg/L	*		*	once/month	grab
Settleability	mL/L	*		*	once/month	grab
Dissolved Oxygen	mg/L	*		*	once/month	grab
Outfall #004 - See Special Condition #11						

MONITORING REPORTS SHALL BE SUBMITTED QUARTERLY; THE FIRST REPORT IS DUE January 28, 2005. THERE SHALL BE NO DISCHARGE OF FLOATING SOLIDS OR VISIBLE FOAM IN OTHER THAN TRACE AMOUNTS.

B. STANDARD CONDITIONS

IN ADDITION TO SPECIFIED CONDITIONS STATED HEREIN, THIS PERMIT IS SUBJECT TO THE ATTACHED Part I STANDARD CONDITIONS DATED October 1, 1980, AND HEREBY INCORPORATED AS THOUGH FULLY SET FORTH HEREIN.

MO 780-0010 (8/91)

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS (continued)

* Monitoring requirement only.
** Once each weekday means: Monday, Tuesday, Wednesday, Thursday and Friday.
*** Intake Total Suspended Solids (TSS) values and Effluent TSS are used to calculate "net" limitations, however, permittee must continue to maintain the ash pond system for adequate retention time for settling. River solids present in intake water are "treated" in the ash pond system but treatment levels are dependent on concentration and types of river solids present in intake water.
**** pH is measured in pH units and is not to be averaged. The pH is limited to the range of 6.0-9.0 pH units.
***** Sample once per quarter in the months of February, May, August, and November.
****** A composite sample made up from a minimum of four grab samples collected within a 24 hour period with a minimum of two hours between each grab sample.

C. SPECIAL CONDITIONS

1. All outfalls must be clearly marked in the field.

2. Permittee is to abandon the treatment facilities for Outfall #003 as described herein and shall connect the tributary waste load to trunk sewers within 90 days of notice of availability if trunk sewers operated by one of the authorities outlined in Section (3)(B) 1 or 2 of Clean Water Commission Regulation 10 CSR 20-6.010 are made available to the site during the time a valid discharge permit exists.

C. SPECIAL CONDITIONS (continued)

3. This permit may be reopened and modified, or alternatively revoked and reissued, to:
   (a) Comply with any applicable effluent standard or limitation issued or approved under Sections 301(b)(2)(C) and (D), 304(b)(2), and 307(a) (2) of the Clean Water Act, if the effluent standard or limitation so issued or approved:
      (1) contains different conditions or is otherwise more stringent than any effluent limitation in the permit; or
      (2) controls any pollutant not limited in the permit.
   (b) Incorporate new or modified effluent limitations or other conditions, if the result of a waste load allocation study, toxicity test or other information indicates changes are necessary to assure compliance with Missouri's Water Quality Standards.
   (c) Incorporate new or modified effluent limitations or other conditions if, as the result of a watershed analysis, a Total Maximum Daily Load (TMDL) limitation is developed for the receiving waters which are currently included in Missouri's list of waters of the state not fully achieving the state's water quality standards, also called the 303(d) list.

   The permit as modified or reissued under this paragraph shall also contain any other requirements of the Clean Water Act then applicable.

4. Changes in Discharges of Toxic Substances

   The permittee shall notify the Director as soon as it knows or has reason to believe:
   (a) That any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels:"
      (1) One hundred micrograms per liter (100 µg/L);
      (2) Two hundred micrograms per liter (200 µg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 µg/L) for 2,5 dinitrophenol and for 2-methyl-4, 6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
      (3) Five (5) times the maximum concentration value reported for the pollutant in the permit application;
      (4) The level established in Part A of the permit by the Director.
   (a) That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant, which was not reported in the permit application.

5. Report as no-discharge when a discharge does not occur during the report period.

6. Treatment or Storage of Ash From Power Plants
   (a) Disposal of ash is not authorized by this permit.
   (b) This permit does not pertain to permits for disposal of ash or exemptions for beneficial uses of ash under the Missouri Solid Waste Management law and regulations.
   (c) This permit does not authorize off-site storage, use or disposal of ash in regard to water pollution control permits required under 10 CSR 20-6.015 and 10 CSR 20-6.200
   (d) Subsurface discharges from wastewater treatment ponds or ash ponds shall, at the property boundary, meet the effluent limitations for subsurface waters of the state under 10 CSR 20-7.015 (7), with appropriate consideration of up-gradient water quality

7. Permittee is exempt from Clean Water Act, Section 311, reporting for sulfuric acid and sodium hydroxide as per 40 CFR 117.12.

8. Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day.

C. SPECIAL CONDITIONS (continued)

9. General Criteria. The following water quality criteria shall be applicable to all waters of the state at all times including mixing zones. No water contaminant, by itself or in combination with other substances, shall prevent the waters of the state from meeting the following conditions:
   (a) Waters shall be free from substances in sufficient amounts to cause the formation of putrescent, unsightly or harmful bottom deposits or prevent full maintenance of beneficial uses;
   (b) Waters shall be free from oil, scum and floating debris in sufficient amounts to be unsightly or prevent full maintenance of beneficial uses;
   (c) Waters shall be free from substances in sufficient amounts to cause unsightly color or turbidity, offensive odor or prevent full maintenance of beneficial uses;
   (d) Waters shall be free from substances or conditions in sufficient amounts to result in toxicity to human, animal or aquatic life;
   (e) There shall be no significant human health hazard from incidental contact with the water;
   (f) There shall be no acute toxicity to livestock or wildlife watering;
   (g) Waters shall be free from physical, chemical or hydrologic changes that would impair the natural biological community;
   (h) Waters shall be free from used tires, car bodies, appliances, demolition debris, used vehicles or equipment and solid waste as defined in Missouri's Solid Waste Law, section 260.200, RSMo, except as the use of such materials is specifically permitted pursuant to section 260.200-260.247.

10. Sludge and Biosolids Use For Domestic Wastewater Treatment Facilities
   (a) Permittee shall comply with the pollutant limitations, monitoring, reporting, and other requirements in accordance with the attached permit Standard Conditions.

11. Outfall #004 - The company has elected to use best management practices (BMP) on this outfall. Monitoring is waived for this permit cycle. If problems occur monitoring will be re-established by the department. Periodic inspection of this outfall will be carried out by Ameren UE to ascertain that BMP's are working.

12. There shall be no discharge of polychlorinated biphenyl compounds.

13. Discharge of wastewater from this facility must not alone or in combination with other sources cause the receiving stream to violate the following:
   (a) Water temperatures and temperature differentials specified in Missouri Water Quality Standards shall be met.

14. Any pesticide discharge from any point source shall comply with the requirements of Federal Insecticide, Fungicide and Rodenticide Act, as amended (7 U.S.C. 136 et. seq.) and the use of such pesticides shall be in a manner consistent with its label.

15. An upset provision, identical to the upset provision set forth at 40 CSR 122.41(n), is hereby incorporated in this permit.

16. AmerenUE needs to be aware that the MDNR January 11, 1980 approval of the "Best Technology Available" in regards to section 316(b) of the Clean Water Act is still valid. However, in the near future new standards may apply to this intake structure, which may invalidate that approval.

C. SPECIAL CONDITIONS (continued)

17. Whole Effluent Toxicity (WET) tests shall be conducted as follows:

SUMMARY OF WET TESTING FOR THIS PERMIT				
OUTFALL	A.E.C. %	FREQUENCY	SAMPLE TYPE	MONTH
001	57%	see text below	grab	January
002	10%	see text below	grab	January

At the AmerenUE-Rush Island Plant, Whole Effluent Toxicity (WET) tests will be required for Outfall #001 only if biocides are used. The WET test will only be required in the first year if the initial test passes. If the WET test does not pass in the first year, the test must be run annually for the duration of the permit or until biocide used is discontinued. Sample must be taken during Biocide use.

An initial WET test will be required for outfall #002 (Ash Pond). The WET test will only be required in the first year if it passes at all effluent concentrations. If the WET test fails at any concentration in the first year, the test must be run annually for the duration of the permit.

(a) Test Schedule and Follow-Up Requirements

(1) Perform a single-dilution test in the months and at the frequency specified above. If the effluent passes the test, do not repeat the test until the next test period.
Submit test results along with complete copies of the test reports as received from the laboratory within 30 calendar days of availability to the WPP, Water Quality Monitoring and Assessment Section, P.O. Box 176, Jefferson City, MO 65102.

(2) If the effluent fails the test, a multiple dilution test shall be performed within 30 calendar days, and biweekly thereafter, until one of the following conditions are met:

(a) THREE CONSECUTIVE MULTIPLE-DILUTION TESTS PASS. No further tests need to be performed until next regularly scheduled test period.
(b) A TOTAL OF THREE MULTIPLE-DILUTION TESTS FAIL.

(3) The permittee shall submit a summary of all test results for the test series along with complete copies of the test reports as received from the laboratory to the WPP, Water Quality Monitoring and Assessment Section, P.O. Box 176, Jefferson City, MO 65102 within 14 calendar days of the third failed test.

(4) Additionally, the following shall apply upon failure of the third test: A toxicity identification evaluation (TIE) or toxicity reduction evaluation (TRE) is automatically triggered. The permittee shall contact WPP, Water Quality Monitoring and Assessment Section to ascertain as to whether a TIE or TRE is appropriate. The permittee shall submit a plan for conducting a TIE or TRE to the Planning Section of the WPP within 60 calendar days of the date of DNR's direction to perform either a TIE or TRE. This plan must be approved by DNR before the TIE or TRE is begun. A schedule for completing the TIE or TRE shall be established in the plan approval.

C. SPECIAL CONDITIONS (continued)

17. Whole Effluent Toxicity (WET)(continued)

(a) Test Schedule and Follow-Up Requirements (continued)

(5) Upon DNR's approval, the TIE/TRE schedule may be modified if toxicity is intermittent during the TIE/TRE investigations. A revised WET test schedule may be established by DNR for this period.

(6) If a previously completed TIE has clearly identified the cause of toxicity, additional TIEs will not be required as long as effluent characteristics remain essentially unchanged and the permittee is proceeding according to a DNR approved schedule to complete a TRE and reduce toxicity. Regularly scheduled WET testing as required in the permit, without the follow-up requirements, will be required during this period.

(7) All failing test results shall be reported to WPP, Water Quality Monitoring and Assessment Section, P.O. Box 176, Jefferson City, MO 65102 within 14 calendar days of the availability of the results.

(8) When WET test sampling is required to run over one DMR period, each DMR report shall contain information generated during the reporting period.

(9) Submit a concise summary of all test results with the annual report.

(b) PASS/FAIL procedure and effluent limitations:

(1) To pass a single-dilution test, mortality observed in the AEC test concentration shall not be significantly different (at the 95% confidence level; $p = 0.05$) than that observed in the upstream receiving-water control sample. The appropriate statistical tests of significance will be those outlined in the most current USEPA acute toxicity manual or those specified by the MDNR.

(2) To pass a multiple-dilution test:

(a) the computed percent effluent at the edge of the zone of initial dilution, Acceptable Effluent Concentration (AEC), must be less than three-tenths (0.3) of the LC_{50} concentration for the most sensitive of the test organisms; or,
(b) all dilutions equal to or greater than the AEC must be nontoxic. Failure of one multiple-dilution test is an effluent limit violation.

(c) Test Conditions

(1) Test Type: Acute Static non-renewal

(2) Test species: Ceriodaphnia dubia and Pimephales promelas (fathead minnow). Organisms used in WET testing shall come from cultures reared for the purpose of conducting toxicity tests and cultured in a manner consistent with the most current USEPA guidelines. All test animals shall be cultured as described in the most current edition of Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms.

(3) Test period: 48 hours at the "Acceptable Effluent Concentration" (AEC) specified above.

C. SPECIAL CONDITIONS (continued)

17. Whole Effluent Toxicity (WET)(continued)

(c) Test Conditions (continued)

(4) When dilutions are required, upstream receiving stream water shall be used as dilution water. If upstream water is unavailable or if mortality in the upstream water exceeds 10%, "reconstituted" water will be used as dilution water. Procedures for generating reconstituted water will be supplied by the MDNR upon request.

(5) Single-dilution tests will be run with:
(a) Effluent at the AEC concentration;
(b) 100% receiving-stream water (if available), collected upstream of the outfall at a point beyond any influence of the effluent; and
(c) reconstituted water.

(6) Multiple-dilution tests will be run with:
(a) 100%, 50%, 25%, 12.5%, and 6.25% effluent, unless the AEC is less than 25% effluent, in which case dilutions will be 4 times the AEC, two times the AEC, AEC, 1/2 AEC and 1/4 AEC;
(b) 100% receiving-stream water (if available), collected upstream of the outfall at a point beyond any influence of the effluent; and
(c) reconstituted water.

(7) If reconstituted-water control mortality for a test species exceeds 10%, the entire test will be rerun.

SUMMARY OF TEST METHODOLOGY FOR WHOLE-EFFLUENT TOXICITY TESTS

Whole-effluent-toxicity test required in NPDES permits shall use the following test conditions when performing single or multiple dilution methods. Any future changes in methodology will be supplied to the permittee by the Missouri Department of Natural Resources (MDNR). Unless more stringent methods are specified by the DNR,the procedures shall be consistent with the most current edition of Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms,

Test conditions for Ceriodaphnia dubia:

Test duration:	48 h
Temperature:	25 ± 1°C Temperatures shall not deviate by more than 3°C during the test.
Light Quality:	Ambient laboratory illumination
Photoperiod:	16 h light, 8 h dark
Size of test vessel:	30 mL (minimum)
Volume of test solution:	15 mL (minimum)
Age of test organisms:	<24 h old
No. of animals/test vessel:	5
No. of replicates/concentration:	4
No. of organisms/concentration:	20 (minimum)
Feeding regime:	None (feed prior to test)
Aeration:	None
Dilution water:	Upstream receiving water; if no upstream flow, synthetic water modified to reflect effluent hardness.
Endpoint:	Pass/Fail (Statistically significant Mortality when compared to upstream receiving water control or synthetic control if upstream water was not available at $p \leq 0.05$)
Test acceptability criterion:	90% or greater survival in controls

Test conditions for (Pimephales promelas):

Test duration:	48 h
Temperature:	25 ± 1°C Temperatures shall not deviate by more than 3°C during the test.
Light Quality:	Ambient laboratory illumination
Photoperiod:	16 h light/ 8 h dark
Size of test vessel:	250 mL (minimum)
Volume of test solution:	200 mL (minimum)
Age of test organisms:	1-14 days (all same age)
No. of animals/test vessel:	10
No. of replicates/concentration:	4 (minimum) single dilution method 2 (minimum) multiple dilution method
No. of organisms/concentration:	40 (minimum) single dilution method 20 (minimum) multiple dilution method
Feeding regime:	None (feed prior to test)
Aeration:	None, unless DO concentration falls below 4.0 mg/L; rate should not exceed 100 bubbles/min.
Dilution water:	Upstream receiving water; if no upstream flow, synthetic water modified to reflect effluent hardness.
Endpoint:	Pass/Fail (Statistically significant Mortality when compared to upstream receiving water control or synthetic control if upstream water was not available at $p \leq 0.05$)
Test Acceptability criterion:	90% or greater survival in controls

APPENDIX B

Figure 1: Perimeter road near ash disposal area, Northwest.

Figure 2: Ash disposal area, South.

Figure 3: Ash pond external embankment with medium vegetation, Northwest.

Figure 4: Ash pond external embankment with minimal ground cover and minor erosion from roadway runoff.

Figure 5: Ash disposal area near discharge to ash pond.

Figure 6: Ash pond outlet to Mississippi River, Southeast.

Figure 7: Staff gage at ash pond discharge area, Mississippi River. Outlet fully submerged.

Figure 8: Interior slopes of ash pond currently under rehabilitation, South.

Figure 9: Inactive ash pond overflow structure.

Figure 10: Access platform to ash pond overflow structure, Northwest.

Figure 11: Ash pond, Northwest.

Figure 12: Ash pond exterior embankment with heavy vegetation, Northwest.

Figure 13: Ash pond exterior embankment erosion.

Figure 14: Heavily eroded area along exterior embankment of ash pond.

Figure 15: Downstream embankment of ash pond at Isle du Bois Creek. (High water noted during assessment. There is a 5' bench from toe of embankment to creek.)

Figure 16: Vegetative growth adjacent to top of ash pond embankment, North. (A contract is in place to clear trees.)

Figure 17: Exterior embankment of ash pond along the tributary to Isle du Boise Creek.

Figure 18: Ash disposal area, Northeast.

Figure 19: Perimeter road near ash disposal area, Northwest.

Figure 20: Perimeter road at top of the ash pond embankment, Southwest.

Document 6: Dam Inspection Checklist Form
Coal Combustion Dam Inspection Checklist Form

US Environmental Protection Agency

Site Name:	**Rush Island**	**Date:**	**September 29, 2010**
Unit Name:	**Ash Pond**	**Operator's Name:**	**AmerenUE**
Unit I.D.:		**Hazard Potential Classification:**	**High** ☐ **Significant** ☐ **Low** X
	Inspector's Name:	Jeffrey Crabtree, PE and James Filson, PE	

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?	Annually		18. Sloughing or bulging on slopes?		X
2. Pool elevation (operator records)?	390-384'		19. Major erosion or slope deterioration?		X
3. Decant inlet elevation (operator records)?		X	20. Decant Pipes:		
4. Open channel spillway elevation (operator records)?		X	Is water entering inlet, but not exiting outlet?		X
5. Lowest dam crest elevation (operator records)?	410		Is water exiting outlet, but not entering inlet?		X
6. If instrumentation is present, are readings recorded (operator records)?		X	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)?	X		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?	See Note		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?		N/A	Around the outside of the decant pipe?		X
15. Are spillway or ditch linings deteriorated?		N/A	22. Surface movements in valley bottom or on hillside?		X
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
#2	384' to 390' during construction to keep pond level down. Normally Pool level is at 396'
#3	Can obtain from plans
#4	No current instrument
#7	Construction entails placement of riprap on interior slopes
#12 #16	Not able to investigate – underwater
#17	Minor erosion areas – from road runoff.
#21	Seepage area NE side small isolated area – Noted on AmerenUE 2008 and 2009 annual inspections and is being monitored

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit MO-0000043 **INSPECTOR**

Date 10/1/2004 to 9/30/2009
Impoundment Name Rush Island Power Plant

Impoundment Company AmerenUE
EPA Region Region 7

State Agency (Field Office) Address State of Missouri Department of Natural Resources
Name of Impoundment Ash Pond – Outfall permit 002 SIC #4911

(Report each impoundment on a separate form under the same Impoundment NPDES Permit number)

New X **Update** ☐

	Yes	No
Is impoundment currently under construction?	X	☐
Is water or ccw currently being pumped into the impoundment?	X	☐

IMPOUNDMENT FUNCTION: Storage (Ash pond and PH neutralization)

Nearest Downstream Town Name: Ste. Genevieve

Distance from the impoundment: 15 miles

Location:

Latitude	38	Degrees	07	Minutes	20.44	Seconds	**N**
Longitude	90	Degrees	15	Minutes	28.36	Seconds	**W**

State Missouri **County** Jefferson

	Yes	No
Does a state agency regulate this impoundment?	X	☐

If So Which State Agency? State of Missouri 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.

x **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.

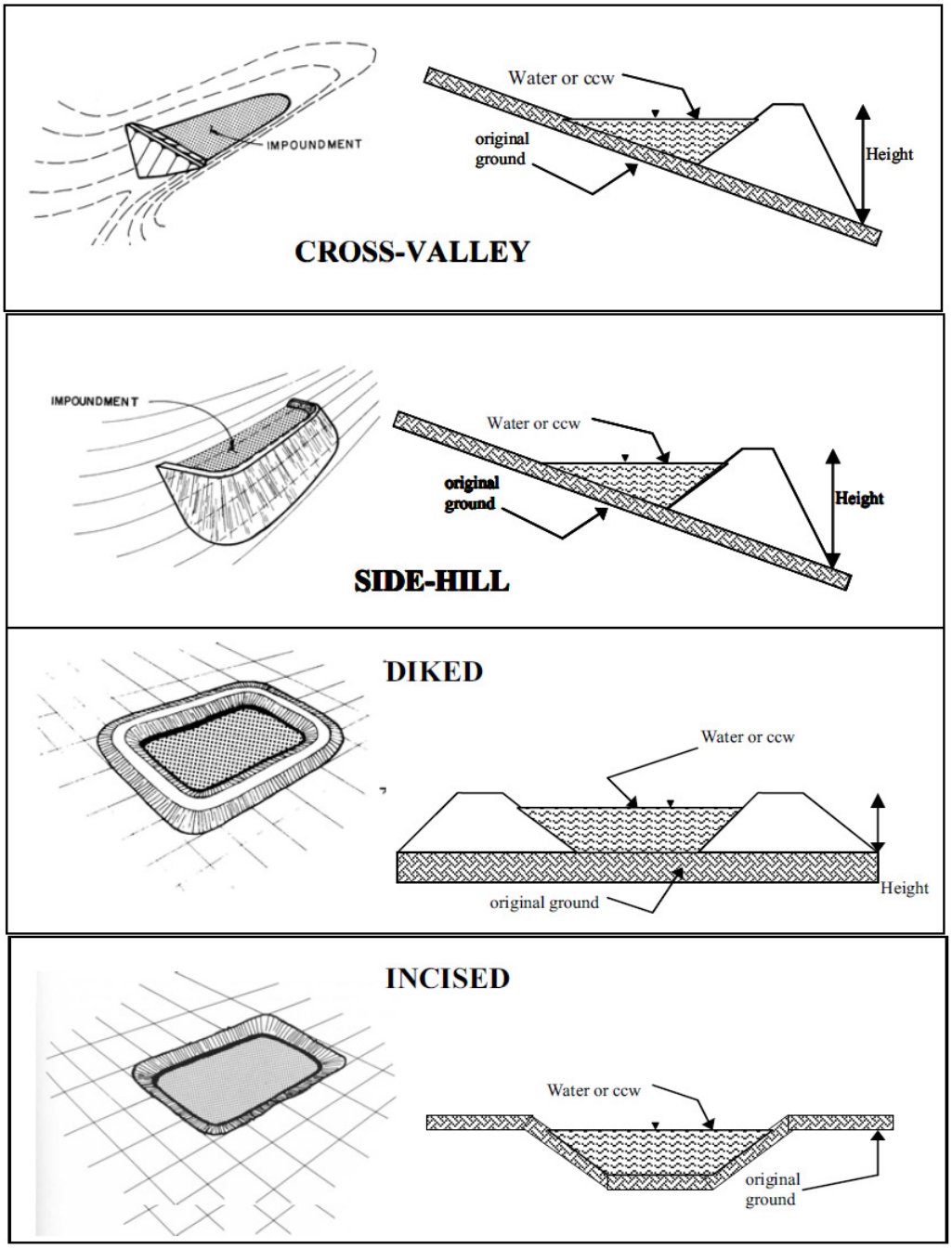
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

The Ash pond was commissioned in 1976 and there is data available to determine the structural geology layers of the embankments. The Dam in is in the process of obtaining the required permits for registration of the Dam with MO-Department of Natural Resources (DNR). The construction at the unit is in the efforts of AmerenUE to meet the requirement for the registration permit. The additional improvements will be gradual side slopes internal, armored (Rip-Rap – Class 3) internal slope and an added spillway. Ameren has an annual inspection program and is concurrent with the maintenance program and this site.

There were no sign or evidence of known major erosion, major seepage and/or failure at this site. The plans show the construction layering of the embankment which consist s of silty clay and clay material.

CONFIGURATION:



☐ Cross-Valley ☐ Side-Hill X Diked

☐ Incised (form completion optional) ☐ Combination Incised/Diked

Embankment Height (ft)	46	**Embankment Material**	Silty Clay, Clay
Pool Area (ac)	104 ac	**Liner**	No
Current Freeboard (ft)	14'normal;20'currently	**Liner Permeability**	No

TYPE OF OUTLET (Mark all that apply)

N/A **Open Channel Spillway** (Currently part of construction and requirement for state Dam Permit)

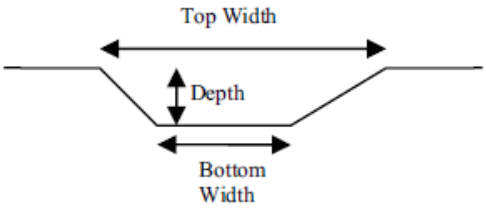
- ☐ Trapezoidal
- ☐ Triangular
- ☐ Rectangular
- ☐ Irregular

depth (ft)

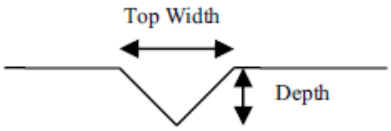
average bottom width (ft)

top width (ft)

TRAPEZOIDAL



TRIANGULAR



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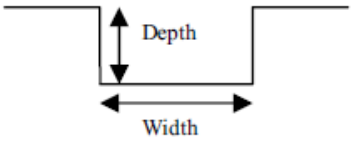
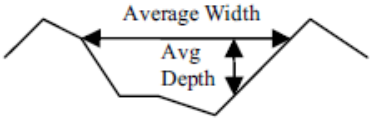
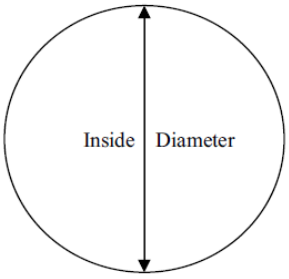


IRREGULAR



x **Outlet**

24” inside diameter



Material

- ☐ corrugated metal
- ☐ welded steel
- ☐ concrete
- x plastic (hdpe, pvc, etc.)
- ☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☐	☐

Not able to determine – pipe under water

- ☐ **No Outlet**
- ☐ **Other Type of Outlet** (specify):

	Yes	No
Has there ever been a failure at this site?	☐	X

If So When?

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	X
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?	☐	X
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.

No- plans are available and have been requested from Ameren.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation?

Assessor will have documentation when requested data from Ameren clears the legal.

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes?

No-Only noted minor erosion and is part of Ameren Maintenance program.

Document 7: Available Information Checklist

Available Information Checklist Coal Combustion Waste Impoundment (CCWI) Dam **RUSH ISLAND ASH POND**			
ITEM DESCRIPTION	PROVIDED BY UTILITY		
	YES	NO	N/A
1. Descriptive Information:			
a) Impoundment Capacity (Normal & Max) (**304920000 FT^3 ORIGINAL DESIGN**)	X		
b) Impoundment Surface Area (104 ACRES)	X		
c) Hazard Classification (CLASS III)	X		
d) Freeboard (Normal & Min) **(9.7 FT NORMAL 2 FT MIN)**	X		
e) Maximum Dam Height (46 FT)	X		
f) Dam Crest Elevation (410 FT)	X		
g) Crest Width (14 FT)	X		
h) Upstream Slope Inclination (3H:1V)	X		
i) Downstream Slope Inclination (3H:1V)	X		
j) Spillway Type, Size, & Crest Elevation (CURRENTLY BEING CONSTRUCTED)	X		
k) Outlet Condit Type, Size, & Max Flow Capacity (24 INCH HDPE 40 CFS)	X		
l) Historical Maximum Pond Elevation	X		
m) Year Built (1970'S)	X		
n) Design Life (MAY VARY)	X		
o) Specific Wastes Permitted in Impoundment	X		
p) Other (describe)			
2. Regional Map showing CCWI & schools, hospitals, etc. w/i 5 mi downgradient		X	
3. Management Unit Dwgs:			
a) Plans	X		
b) Sections	X		
c) Elevations	X		
d) Other (describe)			
4. Design Information:			
a) Name of Designer of Record (BECHTEL CORP)	X		
b) Design Assumptions			X
c) Design Analyses			X

Available Information Checklist (Continued)

Coal Combustion Waste Impoundment (CCWI) Dam

ITEM DESCRIPTION	PROVIDED BY UTILITY		
	YES	NO	N/A
d) Spillway Design Flood or Design Basis	X		
e) Slope Stability Factors of Safety	X		
f) Design Soil Properties and Parameters	X		
g) Other (describe)			
5. Permits:			
a) NPDES? Number? MO-0000043	X		
b) Dam Safety - Operating Permit? Number? MO 40179	X		
c) Other (describe) 002 outfall			
6. Subsurface Information:			
a) Geology	X		
b) Geotechnical Report	X		
c) Test Boring Logs	X		
d) Subsurface Profiles	X		
f) Other (describe)			
7. Monitoring Information:			
a) Observation Wells/Piezometer Readings			X
b) Seepage Readings		X	
c) Settlement Readings		X	
d) Alignment Readings		X	
e) Inclinometer Readings			X
f) Time vs Reading Graphs			X
g) Other (describe)			
8. Instrumentation Dwgs:			
a) Location Plan			X
b) Section Views			X
c) Other (describe)			

Available Information Checklist (Continued)

Coal Combustion Waste Impoundment (CCWI) Dam

ITEM DESCRIPTION	PROVIDED BY UTILITY		
	YES	NO	N/A
9. Operation, Maintenance, & Surveillance:			
a) Operating Procedures			
b) Maintenance Procedures			
c) Inspection Procedures	X		
d) Third Party Inspection Reports			
e) Other (describe)			
10. Emergency Action Plan			X
11. Inundation Map			X