DRAFT

Coal Combustion Residue Impoundment
Round 11 - Dam Assessment Report

Gallatin Fossil Plant
Ash Pond / Stilling Pond Complex
TVA
Gallatin, Tennessee

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 residue from the Tennessee Valley Authority's Kingston, Tennessee facility in December 2008, which flooded more than 300 acres of land and damaged homes and property, is a wake-up call for diligence on coal combustion residue disposal units. A first step toward this goal is to assess the stability and functionality of the ash impoundments and other units, then quickly take any needed corrective measures.

This assessment of the stability and functionality of the Gallatin Fossil plant CCR management facilities is based on a review of available documents and on the site assessment conducted by Dewberry personnel on September 8, 2011. There are five coal combustion residue (CCR) management units at the plant. Two of the units Bottom Ash Pond A and Fly Ash Pond E contain significant amounts of ash and water. Three of the units, Stilling Ponds B, C, and D, function as one pond and receive clarified water from the primary CCR management units; the stilling ponds contain minimal amounts of ash. We found that there is a need for remedial measures to improve stability against relatively shallow slough failures (Subsection 1.1.1) and a need to improve spillway capacity for hydrologic/hydraulic safety (Subsection 1.1.2). We further found the supporting technical documentation to be inadequate in some respects (Subsection 1.1.3). As detailed in Section 1.2, there are recommendations based on field observations and documentation reviews that may help to maintain a safe and trouble-free operation.

In summary, the Gallatin Bottom Ash Pond A and Fly Ash Pond E are rated **FAIR** for continued safe and reliable operation. The system of Stilling Ponds B, C, and D are rated **POOR** for continued safe and reliable operation. These ratings are influenced by poor existing hydrologic/hydrologic performance, which TVA is actively correcting, lack of some engineering analyses, and potential for shallow slope failures (Subsection 1.1.8).

PURPOSE AND SCOPE

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

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).

Note: The terms "embankment", "berm", "dike" and "dam" are used interchangeably within this report, as are the terms "pond", "basin", and "impoundment".

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 residue 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 on September 8, 2011, and review of technical documentation provided by TVA.

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

The structural stability of the dike embankments for Bottom Ash Pond A and Fly Ash Pond E and their outlet works appears to be satisfactory in most respects, based on a review of the engineering data provided by the owner’s technical staff and Dewberry engineers’ observations during the site visit. However, liquefaction potential of these ponds’ embankment sections, which were largely founded on sluiced ash, is unknown, since no quantitative analyses of liquefaction potential have been performed. In addition, these dikes have low factors of safety against relatively shallow slough failures, for which TVA’s consultant has recommended remedial measures. Thus, until recommended remedial measures are implemented, and documented liquefaction analyses have been performed that show no liquefaction or significant consequences of liquefaction, the overall structural stability of the Bottom Ash Pond A and Fly Ash Pond E containment dikes is considered Fair.

The structural stability of the relatively low saddle dikes impounding the stilling ponds and the associated spillway appears to be satisfactory, based on the stability analyses performed for the more significant dikes impounding Bottom Ash Pond A and Fly Ash Pond E and based on the observations made during the site visit. In addition, the stilling pond saddle dikes appear to be founded on materials that would not be susceptible to liquefaction. However, as with the primary ash ponds, the stilling ponds have been assigned a “Significant” hazard potential classification. An impoundment with this hazard potential classification should have documentation of quantitative analyses showing that its impounding dikes have satisfactory stability. Thus, until documented quantitative stability analyses have been performed to verify satisfactory stability, the overall stability of the stilling pond saddle dikes is considered Poor.

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

Hydrologic and hydraulic (H & H) analyses provided to Dewberry indicate inadequate spillway or outlet capacity to pass the spillway design flood (SDF) without overtopping the stilling pond system or the Bottom Ash Pond A divider dike. (The Fly Ash Pond E dikes are shown not to be overtopped during the SDF.) The SDF is the flood produced by the 6-hour duration probable maximum precipitation (PMP), which is the SDF criterion adopted by TVA. Furthermore, the H & H analyses show that the stilling pond system would also be overtopped during the 100-year, 24-hour duration storm. (Both the Bottom Ash A and Fly Ash Pond E dikes are shown not to be overtopped during the 100-year storm.) In addition, the stilling ponds were unable to handle any of the analyzed potential breach scenarios without overtopping. TVA's consultant provided recommended actions to prevent overtopping during such events. TVA is following through with the recommendations. TVA is currently evaluating engineering designs for a spillway replacement and has provided USEPA with a schedule that shows spillway replacement completion in December 2013.

Based on the results of the H & H analyses, the CCR Complex is currently considered Poor for handling hydrologic and hydraulic events. However, given that TVA has taken the necessary action to replace an existing spillway to improve the design flood routing through the CCR Complex without overtopping the dikes, the Poor rating for H&H will be upgraded in the near future, which could lead to an upgrading of the overall rating of the stilling ponds.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

The documentation of the H & H analyses for the Ash Pond (CCR Complex) appears overall to be adequate. The structural stability documentation that was provided is adequate. However, the structural stability documentation is deficient in several respects. The documentation deficiencies include: 1) lack of liquefaction potential analyses for the Bottom Ash Pond A and Fly Ash Pond E dike raise embankment sections that are largely founded on sluiced ash, and 2) lack of slope stability and piping potential analyses for the stilling ponds saddle dikes.

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

The description of the five management units provided by the owner was an accurate representation of what Dewberry observed in the field.

1.1.5 Conclusions Regarding the Field Observations

Dewberry staff was provided access to all areas in the vicinity of the management units required to conduct a thorough filed observation. The visible parts of the embankment dikes and outlet structure were observed to have no signs of overstress, significant settlement, shear failure, or other signs of instability, although visual observations were hampered by the presence of thick vegetation in some areas. Embankments appear structurally sound. There are no apparent indications of unsafe conditions or conditions needing immediate remedial action.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

The current maintenance and methods of operation appear to be adequate for the CCR management units. There was no evidence of significant unexplained embankment repairs or prior releases observed during the field assessment.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

The surveillance program appears to be adequate. The management unit dikes are instrumented with piezometers.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

The Gallatin Bottom Ash Pond A and Fly Ash Pond E are rated FAIR for continued safe and reliable operation. This rating for the Bottom Ash Pond A and Fly Ash Pond E is influenced by the lack of engineering analyses concerning potential soils liquefaction and the need to implement remedial measures to improve the factor of safety against potential non-global (shallow) slope failures. The Stilling Ponds B, C, and D system is rated POOR. This rating for the Stilling Ponds B, C, and D is influenced by the inability of the complex to handle design flood conditions, which TVA is actively addressing by proceeding with plans to replace a spillway. The rating for the stilling ponds is also influenced by lack of structural stability documentation for the saddle dikes; even though the stability of the low-height saddle

dikes impounding the stilling ponds appears to be satisfactory on the basis of the stability documentation for the more significant ash-impounding dikes. Structural stability of the "Significant" hazard potential stilling pond dikes should be verified by documented analyses.

No other existing or potential management unit safety deficiencies are recognized in the field assessment and review of furnished operations, maintenance, surveillance, and monitoring information. Except as noted above with respect to liquefaction potential and potential for shallow slope failures, acceptable slope stability performance is expected under applicable static and seismic (pseudostatic) loading conditions in accordance with the applicable criteria. Implementation of recommendations as presented below would help improve the ratings.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

Implement Stantec's recommended remedial measures for increasing the factor of safety against non-global (shallow) slope failures to the minimum factor of safety criterion for the Bottom Ash Pond A and Fly Ash Pond E containment dikes.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

Continue the project to replace the Pond A spillway; when available, provide final H & H analyses documenting that the CCR Complex will safely pass the design flood once the spillway project is completed.

1.2.3 Recommendations Regarding the Supporting Technical Documentation

1) Perform a quantitative liquefaction analysis of dike raise embankment sections overlying sluiced ash at the Bottom Ash Pond A and Fly Ash Pond E; evaluate the impact of liquefaction on the sluiced-ash-supported sections of the containment dikes, if liquefaction is indicated; and evaluate the consequences of liquefaction failure of these sections of the containment dikes.

2) Perform slope stability analyses for all credible static and seismic loading conditions, as well as piping potential analyses, for the stilling pond complex saddle dikes (Ponds C and D) to verify and document that these dikes have adequate structural stability.

1.2.4 Recommendations Regarding the Field Observations

1) Repair minor erosion observed at various locations during the site visit; use cohesive soil cover on the eroded slopes and improve the vegetation growth.

2) Continue to inspect/monitor the dikes for new and existing seeps for changes that might affect the dikes' integrity. Closely inspect for new sinkholes that could impact the integrity and function of the dikes, particularly after heavy rainfalls or flooding.

1.2.5 Recommendations Regarding Continued Safe and Reliable Operation

No additional recommendations appear warranted at this time.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

Pamela Stanford, Dewberry
Michael McLaren, Dewberry
John Dizer, TVA
Scott Turnbow, TVA CCP
Rachel Combs, TVA CCP
Brett Wyatt, TVA RHO&M
Jake Booth, TVA RHO&M
Gary Schopfer, TVA CCP
Michael Gray, TVA
Stanley Nixon, Jr., TVA RHO&M
Marty Helton, TVA CCP
Bill Pond, Trans Ash
Randy Roberts, Stantec

1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on September 8, 2011.

Pamela Stanford, P.E. Tennessee License #104977	Michael McLaren, P.E.

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

2.1 LOCATION AND GENERAL DESCRIPTION

The Gallatin Fossil Plant is located approximately 5 miles south southeast of Gallatin, Tennessee on land between a meander of the Cumberland River that bounds the east, south, and west sides of the plant. The plant is operated by the Tennessee Valley Authority (TVA). The CCR management unit complex (CCR Complex) encompasses approximately 480 acres and consists of Bottom Ash Pond A (269 acres), Fly Ash Pond E (157 acres), and an interconnected network of Stilling Ponds B, C, and D (55 acres). A project location map is provided in Appendix A – Doc 1. An aerial photograph of the impoundment is provided in Appendix A- Doc 2. Initial information provided by the TVA about the CCR Complex is included in Appendix A – Doc 3.

Stilling Ponds B, C, and D are all part of the same pond. Each pond is separated by narrow pond sections, but all are hydraulically connected and are at the same pool elevation. Stilling Pond B receives decant water from Bottom Ash Pond A. Stilling Pond B flows to Pond C. Pond C also receives decant water from Fly Ash Pond E. Stilling Pond C flows into Pond D, where the outfall is located. The stilling pond system is situated in a natural low area on the north side of the Ash Pond A and Ash Pond E containment dikes, which actually serve as divider dikes that separate the retention pond areas from the stilling pond areas. To the north of the stilling ponds the natural topography generally rises to high enough elevations that no containment dike is needed, except across a low area on the north side of Stilling Pond C, where a saddle dike is located. The east end of the stilling pond system at Stilling Pond B is bounded by higher natural ground and in small part by a railroad embankment. The west end of the stilling pond system at Stilling Pond D is closed off with another saddle dike, through which the outfall pipes are located. This discharge point is known as Outfall 001. This outfall is permitted and is the single point of discharge for clarified water from the CCR Complex at the Gallatin Fossil Plant.

The general dimensions and size of the Bottom Ash Pond A dikes, the Fly Ash Pond E dikes, and the stilling pond dikes are provided in Tables 2.1a, 2.1b, and Table 2.1c, respectively. Note that because Stilling Pond B is incised on three sides and shares its one above ground dike with Bottom Ash Pond A, it is not included in Table 2.1c (i.e., it has no separate dike).

Table 2.1a: Summary of Dam Dimensions and Size

	Bottom Ash Pond A
Dam Height (ft)	26
Crest Width (ft)	30-40, 70 @ spillway outlet
Length (ft)	7300
Side Slopes (upstream) H:V	1.5:1 to 2:1
Side Slopes (downstream) H:V	1.5:1 to 2:1

Table 2.1b: Summary of Dam Dimensions and Size

	Fly Ash Pond E
Dam Height (ft)	25
Crest Width (ft)	50
Length (ft)	7000 (portion shared with D, C)
Side Slopes (upstream) H:V	3:1 to 4:1
Side Slopes (downstream) H:V	2.5:1 to 4:1

Table 2.1c: Summary of Dam Dimensions and Size

	Stilling Ponds C, D
Dam Height (ft)	15 (Pond C), 12 (Pond D)
Crest Width (ft)	30 (Pond C), 22(Pond D)
Length (ft)	450 (North Pond C), 150 (Pond D outlet)
Side Slopes (upstream) H:V	2.5:1 (Pond C), 3.5:1 (Pond D)
Side Slopes (downstream) H:V	4:1 (Pond C), 3:1 (Pond D)

2.2 COAL COMBUSTION RESIDUE HANDLING

Questions and answers concerning CCR generation and handling are presented in tabular form in Appendix A – Doc 14. The handling of each type of coal combustion residue is briefly described in the following subsections.

2.2.1 Fly Ash

Fly ash is collected from Air Heater Hoppers, Economizer Hoppers, and Precipitator Hoppers. The fly ash is sent through Hydroveyors in pipes to Fly Ash Pond E.

2.2.2 Bottom Ash

Bottom ash is conveyed from the Bottom Ash Hoppers through jet pumps and piping to Bottom Ash Pond A.

2.2.3 Boiler Slag

No information was provided.

2.2.4 Flue Gas Desulfurization Sludge

Gallatin does not operate a flue gas desulfurization system.

2.3 SIZE AND HAZARD CLASSIFICATION

The classification for the Bottom Ash Pond A, based on height of the dam, is "small" and, based on the storage capacity, is "intermediate". The classification for the Fly Ash Pond E, based on height of the dam, is "small" and, based on the storage capacity, is "intermediate". As discussed in Section 6, the more conservative Intermediate size classification was used for hydrologic analyses. The classification for the Stilling Ponds B, C, and D, based on height of the dam, is "small" and, based on the storage capacity, is "small" in accordance with USACE Recommended Guidelines for Safety Inspections of Dams ER 1110-2-106 criteria summarized in Table 2.3a.

Table 2.3a: USACE ER 1110-2-106
Size Classification

	Impoundment	
Category	**Storage (Ac-ft)**	**Height (ft)**
Small[1]	50 and < 1,000	25 and < 40
Intermediate[2]	1,000 and < 50,000	40 and < 100
Large	> 50,000	> 100

[1] *Stilling Pond classification*
[2] *Bottom Ash Pond A and Fly Ash Pond E*

The ponds are not in the National Inventory of Dams; therefore these dikes do not have established hazard classifications. The TVA provided preliminary hazard classifications to the USEPA on July 16, 2009 for the CCR impoundment facilities at all their plants with coal-fired units, and amended the hazard classifications on October 22, 2010, after a more detailed assessment was performed by their consultant, Stantec Consulting Services, Inc (Stantec). The classification was made based on the 2004 Federal Guidelines for Dam Safety classifications system (shown in Table 2.3b).

Table 2.3b: 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)

TVA's current hazard classifications for the CCR facilities at the Gallatin Fossil Plant are as follows:

Fly Ash Pond E	Significant
Bottom Ash Pond A	Significant
Stilling Pond B, C, & D	Significant

Loss of human life is not probable in the event of a catastrophic failure of the dikes impounding these facilities, but a failure of the dikes is expected to have potential for environmental damage to the Cumberland River. Therefore, Dewberry concurs with TVA's current **"Significant"** hazard potential classification for these facilities.

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

The data reviewed by Dewberry did not include the volume of the residuals stored in the ponds at the time of inspection. Volume information in Table 2.4 reflects data collected in 2006 by TVA.

Table 2.4: Capacity of Units	
Bottom Ash Pond A	
Surface Area (acre)[1]	269
Current Storage Capacity (cubic yards)	4,951,409
Current Storage Capacity (acre-feet)	3,069.06
Total Storage Capacity (cubic yards)	7,083,000
Total Storage Capacity (acre-feet)	4,390.29
Crest Elevation (feet)	474.9
Normal Pond Level (feet)	469.9
Fly Ash Pond E	
Surface Area (acre)[1]	157
Current Storage Capacity (cubic yards)	4,968,00
Current Storage Capacity (acre-feet)	3,079.34
Total Storage Capacity (cubic yards)	7,100,00
Total Storage Capacity (acre-feet)	4,400.83
Crest Elevation (feet)	474.6
Normal Pond Level (feet)	463.4
Stilling Ponds B, C, and D (combined)	
Surface Area (acre)[1]	55
Current Storage Capacity (cubic yards)	400,000
Current Storage Capacity (acre-feet)	247.93
Total Storage Capacity (cubic yards)	600,000
Total Storage Capacity (acre-feet)	371.90
Crest Elevation (feet)	462.9
Normal Pond Level (feet)	456.9

2.5 PRINCIPAL PROJECT STRUCTURES

2.5.1 Earth Embankment

The Bottom Ash Pond A and Fly Ash Pond E are divided by an internal divider dike. To the north these ponds are separated from the Stilling Ponds B, C, and D by divider dikes constructed of bottom ash, although the dike between Pond E and Stilling Ponds D and C contains a layer of clay between bottom ash layers. Dike raise embankments along the divider dikes are constructed of bottom ash largely founded on sluiced ash. The saddle dike along the low area on the north side of Stilling Pond B is constructed of bottom ash. The west sides of Fly Ash Pond E and Stilling Pond D are separated from the Cumberland River by dikes; the saddle dike along the west side of Pond D is constructed of clay, and the perimeter containment dike along the west side of Pond E is constructed of clay over bottom ash fill. The dike embankments are estimated to be nominally 15 to 25 feet high.

2.5.2 Outlet Structures

The principal spillway at the Bottom Ash Pond A consists of three 48-inch diameter RCP riser pipe/weirs with TVA steel skimmers that discharge through three 30-inch diameter RCP sections into the adjacent Stilling Pond B, where the outlet pipes are submerged. Pond E wastewater outfalls through two 48-inch diameter RCP riser/weir sections that discharge through two 30-inch diameter combination steel and PVC pipe sections into the adjacent Stilling Pond C, where the outlet pipes are partially submerged.

The outfall of the stilling ponds located at the west end of Pond D consists of four 48-inch diameter RCP riser/weir sections that discharge through four 36-inch diameter RCP sections into an adjacent discharge pool. From there water discharges through a 36-inch CMP into the adjacent Old Hickory Lake/ Cumberland River.

The stilling ponds pool elevation is about 11 to 12 feet lower than adjacent Bottom Ash Pond A, and about 8 feet lower than adjacent Ash Pond E.

2.6 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

Critical infrastructure inventory data was not provided to Dewberry for review.

Based on the available area topographic maps, surface drainage in the area of the ponds are to the northwest through the stilling ponds to the Cumberland River. The nearest downstream town, Hendersonville, Tennessee, is approximately 9 miles downstream of the CCR Complex at the Gallatin Fossil Plant.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS, AND INCIDENTS

3.1 SUMMARY OF REPORTS ON THE SAFETY OF THE MANAGEMENT UNIT

TVA provided daily, weekly, monthly, and quarterly internal inspections of the ponds performed in 2010, plus the 2010 Annual Inspection of CCP Facilities and Ponds performed by Stantec, dated August 13, 2010 (see Appendix A – Docs 04 and 05).

The reports concluded that the structures were performing adequately with only minor maintenance items that needed to be addressed. No conditions were observed that would affect the continued safe operations of the impoundment.

Stantec also prepared a "Seepage Action Plan (SAP)" dated June 25, 2010 that provides guidelines for controlling different levels of seepage, should they be observed in routine inspections (see Appendix A – Doc 9).

3.2 SUMMARY OF LOCAL, STATE, AND FEDERAL ENVIRONMENTAL PERMITS

The dams for the management units are not regulated and permitted under a dam safety agency.

Discharge from Stilling Pond D is regulated by the State of Tennessee Department of Environmental and Conservation Division of Water Pollution Control and the impoundment has been issued a National Pollutant Discharge Elimination System Permit. Permit No. TN0005428 was issued November 30, 2005 (see Appendix A – Doc 12).

3.3 SUMMARY OF SPILL/RELEASE INCIDENTS

On May 1-2, 2010, the Gallatin Fossil Plant experienced unusually heavy rainfall (up to 13 inches for the Gallatin/Nashville area), which resulted in an overflow event of the stilling ponds between May 1 and May 3. One stilling pond (apparently Stilling Pond D) breached (overtopped) to the north across an access road in a natural low area, which actually helped to serve as an "emergency" spillway. The overflow (with little or no ash) drained into the Cumberland River. It was indicated that the pool level in the stilling ponds rose to within 12 inches of overflowing the dike at the outlet. See Appendix A – Doc 7 for post rain event site visit documentation by Stantec and Doc 8 for follow-up site visit documentation.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

The Gallatin Fossil Plant construction began in 1953 and plant operations commenced in August 1959. The Gallatin Fossil Plant main ash pond, known as Ash Pond 3, was commissioned in 1970 covering what is today both Bottom Ash Pond A and Fly Ash Pond E. It appears that the original containment system included a series of saddle dikes where lower ground elevations existed along the west side of current Fly Ash Pond E, west side of current Stilling Pond D, and north side of current Stilling Pond C.

It appears that the areas now occupied by the stilling ponds were peripherally within the original ash pond area but generally on rising ground north of an east to west natural drainage feature. Outfall 001, located through the saddle dike at the west end of the area currently known as Stilling Pond D, was commissioned in 1970 as the discharge point from the former Ash Pond 3 into the Cumberland River.

4.1.2 Significant Changes/Modifications in Design since Original Construction

Bottom Ash Pond A was formed by constructing a bottom ash divider dike in the original main ash pond in the mid 1980’s; this dike also formed the Stilling Ponds B and C on the north side. The divider dike was raised in the late 1980’s for additional storage. The dike raise embankment was constructed of bottom ash and was largely founded on sluiced ash. The existing outfall from Bottom Ash Pond A to the Stilling Pond B was also constructed in the late 1980s at the northeast corner of Pond A.

In 2006, Fly Ash Pond E was expanded by constructing a new raised perimeter dike. The perimeter dike embankment was raised from elevation 465 to 477. The new perimeter dike was constructed over the existing saddle dikes, and built inwardly over sluiced fly ash. The existing outfall from Fly Ash Pond E to the Stilling Pond C was also constructed in 2006 near the northeast corner of Pond E.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

Pond leakage was reported in the early to mid 1970's through a sinkhole on the north side of Fly Ash Pond E and was repaired in 1977.

Pond leakage was reported in the early to mid 1970's through a sinkhole on the south side of Bottom Ash Pond A and was remediated by excavation and capping in 1990.

In 2010 TVA installed piezometers around the ash pond complex to permit continuous remote monitoring of the water levels.

4.2 SUMMARY OF OPERATIONAL PROCEDURES

4.2.1 Original Operational Procedures

The original main ash pond (Ash Pond 3) was designed and operated for bottom/fly ash sedimentation and control. The pond received plant process waste water, and coal combustion waste slurry. Treated (via sedimentation through a series of ponds) process water was discharged through an overflow outlet structure in Stilling Pond D.

4.2.2 Significant Changes in Operational Procedures and Original Startup

No documents were provided to indicate any operational procedures have changed.

4.2.3 Current Operational Procedures

No documents were provided to indicate any operational procedures have changed.

4.2.4 Other Notable Events since Original Startup

None reported.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry personnel Pamela Stanford, P.E. and Michael McLaren, P.E. performed a site visit on Thursday, September 8, 2011 in company with personnel listed in section 1.3.1.

The site visit began at 9:00 AM. The weather was cool and cloudy. Photographs were taken of conditions observed. Please refer to the Dam Assessment Checklists (Docs 16, 17, and 18) in Appendix B. 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 three management units was that they are in fair condition; no significant findings were noted.

5.2 NORTH DIVIDER DIKE AND BOTTOM ASH POND A

5.2.1 Crest

The north dike divides the Bottom Ash Pond A from the Stilling Pond B. The crest (see Figure 5.2.1-1) had no signs of depressions, tension cracks, or other indications of settlement or shear failure, and appeared to be in satisfactory condition.

Figure 5.2.1-1 Crest separating Bottom Ash Pond A (left) and Stilling Pond B (right)

5.2.2 Upstream/Inside Slope

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. Figure 5.2.2-1 shows the general condition of inside slope. Vegetation should be better maintained to allow for inspection of the slopes.

Figure 5.2.2-1 Inside slope of Bottom Ash Pond A

5.2.3 Downstream/Outside Slope and Toe

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. Figure 5.2.3-1 shows the general condition of the outside slope. Vegetation should be installed to help minimize erosion and maintained to allow for inspection of slopes.

Figure 5.2.3-1 Crest and outside slope of Bottom Ash Pond A (Stilling Pond B is shown on right side)

5.3 STILLING POND C WEST DIKE

5.3.1 Crest

The west dike divides Fly Ash Pond E from Stilling Pond C. The crest had no signs of depressions, tension cracks, or other indications of settlement or shear failure, and appeared to be in satisfactory condition.

Figure 5.3.1-1 West Dike with Fly Ash Pond E (to left)

5.3.2 Upstream/Inside Slope

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. The lower portion of the inside slope was protected by rip rap. Figure 5.3.2-2 shows the generally good condition of the inside slope.

Figure 5.3.2-2 Inside Slope for Fly Ash Pond E

5.3.3 Downstream/Outside Slope and Toe

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. Figure 5.3.3-1 shows the general condition of the outside slope. Vegetation should be installed to help minimize erosion in bare areas and maintained to allow for inspection of slopes.

Figure 5.3.3-1 Outside Slope of Fly Ash Pond E showing Stilling Pond C (right)

5.4 FLY ASH (POND E) NORTH DIVIDER DIKE

5.4.1 Crest

The Fly Ash Pond E north dike divides Fly Ash Pond E from Stilling Pond D. The crest had no signs of depressions, tension cracks, or other indications of settlement or shear failure, and appeared to be in satisfactory condition.

Figure 5.4.1-1 Fly Ash Pond E North Dike (Stilling Pond D in background)

5.4.2 Upstream/Inside Slope

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. The lower portion of the inside slope was protected by rip rap. Figure 5.3.1-1 above showed the good condition of the inside slope.

5.4.3 Outside Slope and Toe

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. Figure 5.4.3-1 shows the generally good condition of the outside slope.

Figure 5.4.3-1 Outside Slope of Fly Ash Pond E and Stilling Pond D

5.5 FLY ASH (POND E) WEST PERIMETER DIKE

5.5.1 Crest

The west dike separates the Fly Ash Pond E from the Cumberland River. The crest had no signs of depressions, tension cracks, or other indications of settlement or shear failure; some rutting was present due to recent rainfall and should be filled. The crest appeared to be in satisfactory condition (see Figure 5.5.1-1).

Figure 5.5.1-1 West Perimeter Dike Crest (Fly Ash Pond E is to the right)

5.5.2 Upstream/Inside Slope

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. Figure 5.5.2-1 shows generally fair condition of the inside slope. Vegetation should be installed to help minimize erosion in bare areas and maintained to allow for inspection of the slopes.

Figure 5.5.2-1 Inside Slope for West Perimeter Dike (Fly Ash Pond E to the right of the picture)

5.5.3 Downstream/Outside Slope and Toe

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. Figure 5.5.3-1 shows the generally fair condition of the outside slope. Vegetation should be installed to help minimize erosion in bare areas and maintained to allow for inspection of slopes.

Figure 5.5.3-1 Outside Slope of Fly Ash Pond E (West Dike looking South).

5.6 STILLING POND D WEST DIKE

5.6.1 Crest

The west dike separates Stilling Pond D from the Cumberland River. The crest had no signs of depressions, tension cracks, or other indications of settlement or shear failure, and appeared to be in satisfactory condition (see Figure 5.6.1-1).

Figure 5.6.1-1 West Dike crest showing discharge structures in Stilling Pond D (right side)

5.6.2 Upstream/Inside Slope

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. Figure 5.6.2-1 shows the general condition of the inside slope. Vegetation should be better maintained to allow for inspection of the slopes.

Figure 5.6.2-1 West Dike inside slope showing discharge structures in Stilling Pond D

5.6.3 Downstream/Outside Slope and Toe

There were no observed scarps, sloughs, bulging, cracks, or depressions or other indications of slope instability or signs of erosion. The picture below (Figure 5.6.3-1) represents the general condition of the outside slope. Vegetation should be better maintained to allow for inspection of the slopes.

Figure 5.6.3-1 Outside slope of West Dike. Outlet channel is the water-body shown.

5.7 OUTLET STRUCTURES

5.7.1 Overflow Structure

The outfall of the Stilling Ponds are located on the west end of Pond D and consists of four 48-inch RCP riser/weir sections that discharge through four 36-inch RCP sections into an adjacent discharge pool. From there, water discharges through 36-inch CMP into the adjacent Old Hickory Lake/ Cumberland River.

The primary overflow structures were observed to be working properly, discharging flow from the stilling ponds. The outlet structure (see Figure 5.7.1-1) visually appeared to be in satisfactory condition. There were no signs of clogging of the spillway.

Figure 5.7.1-1 Outlet structures in Stilling Pond D

5.7.2 Outlet Conduit

The outlet pipes appeared to be operating normally with no signs of clogging and the water exiting the outlets was flowing clear.

5.7.3 Emergency Spillway

No emergency spillway was present. If the dike was overtopped, water would drain to the river via overland flow.

5.7.4 Low Level Outlet

No low level outlet is present.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Flood of Record

Historic climate data available on-line from the National Weather Service (NWS) indicate that record rainfall was experienced in middle Tennessee in the two-day period of May 1-2, 2010. A precipitation contour map developed by the NWS shows that the Gallatin Fossil Plant was within some of the heaviest precipitation, with rainfall amounts for the 48-hour period in the range of 12 to 14 inches. According to an "Average Recurrence Intervals Map for 48-Hour Duration," prepared by the Hydrometeorological Design Studies Center, the plant is in a location that experienced rainfall having an average recurrence interval on the order of 1000 years. At the Old Hickory Dam, approximately 10 miles west southwest of the plant, the all-time record daily rainfall was 6.73 inches on May 3, 2010.

Based on furnished historical information, the May 1-2, 2010 rainfall event appears to have produced the flood of record for the CCR Complex at the Gallatin Fossil Plant. According to the historical data, "Stormwater overtopped Steam Plant Road exceeding the storm drain pipe capacity to route flow into Stilling Pond B. The ash pond complex experienced erosion damage and Stilling Pond D was overtopped in a natural low area (not the saddle dike) by less than 1 foot." It is noted that the stilling pond system receives considerable off-site drainage from the north and east, in addition to drainage from the ash ponds.

6.1.2 Inflow Design Flood

For the assigned "small" size classification and "significant" hazard potential classification for the stilling pond system (Ponds B, C, and D), the USACE hydrologic evaluation guidelines (ER-1110-2-106 26 Sept 1979 "Recommended Guidelines for the Safety Inspection of Dams") recommend a spillway design flood (SDF) of 100-year frequency to 1/2 Probable Maximum Flood (1/2 PMF), where the magnitude selected most closely relates to the involved risk. For comparison, the Tennessee Dam Safety Laws and Regulations (2007) require (for existing dams) use of a Freeboard Design Storm of 1/3 Probable Maximum Precipitation (1/3 PMP) (6-hour duration) to develop the design flood. However, taking into consideration that Outfall 001 at Stilling Pond D is the final discharge point for the entire CCR Complex, the appropriate size classification should probably be “”intermediate,” rather than small. In this case the recommended SDF according to the USACE guidelines is 1/2 Probable Maximum Flood (1/2 PMF) to PMF.

Stantec performed a hydrologic and hydraulic (H & H) analysis of the CCR Complex. The analysis is summarized in their report titled “Report of Hydrologic and Hydraulic Analysis Ash Pond A, Ash Pond E, and Stilling Pond Complex, TVA Gallatin Fossil Plant Sumner County, Tennessee” (H & H report) (see Appendix A - Doc 13 for reference). It is noted that the pond identified as “Ash Pond A” in the H & H report is essentially the “Bottom Ash Pond A” discussed in this assessment report. However, in their study Stantec separates out a much smaller pond associated with the overall Bottom Ash Pond A and identifies it as “Bottom Ash Pond A.” This smaller pond is located closer to the main plant structures and is situated southeast of the “Ash Pond A” treated separately in the H & H study. Flow from the small “Bottom Ash Pond A” is through two 42-inch diameter culverts (one RCP and one CMP) in an access road embankment and into a bottom ash conveyance channel. The conveyance channel extends to a culvert through another access road, where the flow passes through the culvert to discharge into the southeast corner of the “Ash Pond A.”

The H & H analysis performed by Stantec used the methods described by the Natural Resources Conservation Service (NRCS) in “Part 630-Hydrology” of the National Engineering Handbook (NEH). Unit hydrograph methods were used to generate runoff hydrographs for routing through the ponds. A HEC-HMS model was developed and used to simulate runoff using the Probable Maximum Precipitation (PMP), 6-hour duration in accordance with TVA design guidance. The rainfall depth for the 6-hour PMP event was taken from the National Weather Service (NWS) Hydrometeorological Report No. 51. In addition, other design storm events were evaluated, including the 2-, 10-, 25-, 100-, and 500-year events. Rainfall depths for these events were taken from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 at 24-hour duration. According to the H & H report, “The ponds were modeled as reservoirs within the HMS along with their contributing watersheds. Stage storage data and rating curves for the spillways were entered into the model along with base flow and the various storms then routed through the system. Further details of the study are included in the Stantec H & H report (Appendix A - Doc 13). The results of selected flood routings are summarized in the following Table 6.1:

Table 6.1: Summary of Water Surface Elevations for 100-year & PMP Routings

Pond Name	Overtopping[1] Elevation (ft)	100-year, 24-hour (ft)	6-hour PMP (ft)
Ash Pond A (Bottom Ash Pond A)	472.69	469.7	**473.5**
Bottom Ash Pond A (Small Pond)	481.5	478.6	480.2
Ash Pond E (Fly Ash Pond E)	473.43	463.5	467.2
Stilling Ponds (Ponds B, C, & D)	459.93	**460.0**	**462.0**

[1] *Surveyed minimum crest elevation* *Note: Bold W.S. El. indicate overtopping*

As shown by the above results, the stilling pond containment system is overtopped slightly (< 0.1 foot) by the 100-year event and more significantly (> 2.0 feet) by the 6-hour PMP event. The overtopping appears to occur at the low point on the Pond D saddle dike. In addition, the Ash Pond A (Bottom Ash Pond A) is overtopped (> 0.8 foot). Because of the lack of precise data and some assumptions that had to be made in this analysis (and subsequent breach analysis), Stantec considered these analyses to be approximate and suitable for screening purposes only.

6.1.3 Spillway Rating

Stantec's H & H report (Appendix A-Doc 13) indicates that rating curves for the spillway systems were developed based on available geometric data and weir, orifice, and culvert discharge relationships, using guidance from standard references [for weirs "Open Channel Hydraulics," V.T. Chow, 1959; for orifices "Handbook of Hydraulics," E.F. Brater and H.W. King, 1976; and for culverts "Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5 (HDS-5)," U.S. Department of Transportation Federal Highway Administration, 1985]. The actual rating curves for each pond are in Appendix C (not provided) of the H & H report.

6.1.4 Downstream Flood Analysis

Three breach analyses were evaluated. The first looked at the capacity of the stilling ponds if the Bottom Ash Pond A (Ash Pond A) or the Fly Ash Pond E (Ash Pond E) overtopped. The second and third scenarios were assumed piping failures of the dikes separating Pond A (Scenario 2) and Pond E (Scenario 3) from the stilling ponds under normal pool conditions.

Table 6.2: Summary of Breach Analysis Results (Abbreviated)

Scenario	**Peak Outflow from Pond A (cfs)**	**Peak Outflow from Pond E (cfs)**	**Peak inflow to Stilling Ponds (cfs)**	**Stilling[1] Ponds Elevation (ft)**
1. Overtopping Failure during PMP Event	1,653	354	2,204	**462**
2. Piping Breach of Ash Pond A	8,196	127	8,313	**462.9**
3. Piping Breach of Ash Pond E	282	2,800	3,077	**461.1**

[1] *Surveyed minimum crest elevation = 459.93 feet*

Under all the analyzed breach scenarios, the stilling pond containment system is shown to be overtopped.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Although the furnished information is not complete in some respects (e.g., missing appendices), there is sufficient information to ascertain that adequate analysis was performed to provide a screening evaluation of the hydrologic/hydraulic performance of the CCR Complex. Therefore the supporting Hydrologic/Hydraulic documentation for the CCR Complex appears overall to be adequate.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Based on the calculations provided in the hydrologic and hydraulic (H & H) study (see Appendix A – Doc 13) the stilling ponds are unable to pass either the 100-year or 6-hour PMP events through the spillway system without overtopping the embankment. In addition, the stilling ponds were unable to handle any of the breach scenarios without overtopping.

For overtopping and potential breach failure only of the stilling pond embankment(s), e.g., during the 100-year event, the downstream consequences of failure appear to be very minor. The release of the relatively small volume of floodwater in the stilling ponds would have little hydraulic impact on Cumberland River/Old Hickory Lake in flood stage and little environmental impact from CCR release. However, overtopping and breach of Bottom Ash Pond A or piping breach of either Bottom Ash Pond A or Fly Ash Pond E, would lead to overtopping and potential breach of the stilling pond embankment(s), and would have more significant downstream consequences. The hydraulic impact on the Cumberland River/Old Hickory Lake would be relatively minor, perhaps moderate in the immediately adjacent areas in the case of an overtopping breach of Bottom Ash Pond A, but there would be significant off-site environmental impact of release of potentially large amounts of CCR. The H & H analysis shows that the CCR Complex at the Gallatin Fossil Plant does not currently have acceptable hydrologic/hydraulic safety.

TVA's consultant recommended remedial action be taken, such as replacing the spillway or lowering the water elevation in Bottom Ash Pond A, to prevent water from overflowing the dikes during heavy rain events. TVA is moving forward with replacing the spillway at Bottom Ash Pond A. The new spillway design will prevent overtopping of the stilling ponds during the PMP. The new design is complete and the spillway replacement construction project is scheduled for completion in December 2013 (see Appendix A – Doc 15).

Therefore the CCR Complex is currently considered **POOR** for handling hydrologic and hydraulic events. However, given that TVA has taken the necessary action to replace an existing spillway to improve the design flood routing through the CCR Complex without overtopping the dikes, the Poor rating is considered temporary and upon completion of the new spillway should be upgraded to Satisfactory.

7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

Stantec performed a geotechnical exploration and slope stability evaluation in March 2010; initial seismic slope stability analysis in September 2011, using ground motions of a 500-year return period seismic event; and additional pseudostatic[1] slope stability analysis in February 2012, using ground motions of a 2,500-year return period seismic event, as requested by the USEPA (see Appendix A- Docs 10, 10a, and 11). In addition, seepage analyses, including evaluation of piping potential, were also performed. The slope stability and seepage analyses were performed for the dikes impounding Bottom Ash Pond A and Fly Ash Pond E; the stilling pond dikes were not included apparently because the stilling ponds contain minimal ash quantities. Only water principally would be released to the environment from the stilling ponds. In addition, the saddle dikes impounding the stilling ponds are lower in height and generally have comparable or flatter slopes than the ash-impounding dikes. Therefore, by inspection, these dikes should have equal or better slope stability performance than the ash impounding dikes.

The stability analysis used computer program SLOPE/W (from GEO-SLOPE International, Inc.). The program is capable of calculating the potential failure surfaces using the Spencer’s procedure. Seepage analyses used SEEP/W.

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[1] The pseudostatic method is a simplified method for determining seismic slope stability that is based on the same approach (i.e., limit equilibrium) used in analyzing static slope stability. In current practice, the pseudostatic method of analysis is used primarily as a screening tool to help assess whether an embankment dam or slope requires a more detailed seismic slope analysis. The pseudostatic method ignores cyclic loading of the earthquake, but accounts for the seismic force by applying an equivalent static force on the slope. In the limit equilibrium approach the stress-strain relationship of the soil is not considered, so the method should not be used for sensitive clays and other materials that lose shear strength during an earthquake or loose soils located below the groundwater table subject to liquefaction.

Conditions assessed were:

- Long term steady state conditions based on ground water level and pore water pressures obtained from the SEEP/W model.
- Potential failure due to piping (internal erosion).
- Seismic loading applied with steady state loading w/ horizontal seismic coefficient = 0.045 (500-year return period) and horizontal seismic coefficient = 0.108 (2,500-year return period).

7.1.2 Design Parameters and Dam Materials

The Stantec report of "Geotechnical Exploration and Slope Stability Evaluation" (see Appendix A – Docs 11) and the seismic (pseudostatic) slope stability reports (see Appendix A – Docs 10, 10a) include design parameters and dam material information used for modeling structural stability.

Based on subsurface profiles and analysis sections in Stantec's geotechnical exploration report, the dike embankment soils on the west side perimeter of the Fly Ash Pond E consist of predominantly clay in the original dike and clay with a constructed bottom layer of bottom ash fill in the dike raise embankment; the dike raise embankment is partially to completely founded on sluiced fly ash. The divider dikes between Fly Ash Pond E and Stilling Ponds D and C are constructed of bottom ash fill layers separated by a clay fill layer and are founded on a relatively thin layer of sluiced fly ash and clay/fly ash that "feather out" before reaching the stilling pond side. The underlying native materials typically consist of clay over limestone bedrock. The saddle dike on the north side of Stilling Pond C is constructed of bottom ash and is founded on limestone bedrock and native clay. The saddle dike around the west end of Stilling Pond D is constructed of clay and is founded on native clay. The original divider dike and dike raise embankments between the Bottom Ash Pond A and Stilling Ponds B and C are constructed of bottom ash; the original bottom ash dike embankment was founded on native clay or directly on limestone bedrock, and the bottom ash dike raise embankment was largely founded on sluiced ash. The dike raise embankments were largely founded on sluiced ash. The design properties and parameters used in stability analyses of both the Bottom Ash Pond and Fly Ash Pond dikes are shown in the following Table 7.1 for static stability analysis and Tables 7.2 and 7.3 for the pseudostatic stability analysis.

Table 7.1: Design Properties and Parameters of Materials used in the Static Stability Analyses – Bot. Ash Pond A & Fly Ash Pond E

Material	**Unit Wt. (pcf)**	**Drained Strength Parameters**	
		C´ (psf)	**Ø´ (deg)**
Pond E Clay Dike	125	200	22
Bottom Ash Fill/Dikes	100-105	0	30-34
Sluiced Ash	85	0	26
Native Clay	125	200	27

Ref: Doc 11 in Appendix A.

Table 7.2: Design Properties and Parameters of Materials used in the Pseudostatic Slope Stability Analyses – Bottom Ash Pond A

Material	**Unit Wt. (pcf)**	**Undrained Strength Parameters**	
		C (psf)	**Ø (deg)**
Initial Bottom Ash Dike	105	0	33
Raised Bottom Ash Dike	105	0	34
Sluiced Ash	85	400	10
Native Clay	125	550	13
Silted Material	85	400	10

Ref: Docs 10 & 10a in Appendix A.

Table 7.3: Design Properties and Parameters of Materials used in the Pseudo Static Stability Analyses – Fly Ash Pond E

Material	**Unit Wt. (pcf)**	**Undrained Strength Parameters**	
		C (psf)	**Ø (deg)**
Clay Dike	125	400	15
Bottom Ash Fill	100	0	34
Sluiced Ash	85	400	10
Native Clay	125	550	13

Ref: Docs 10 & 10a in Appendix A.

7.1.3 Uplift and/or Phreatic Surface Assumptions

The Stantec geotechnical exploration report referenced above included an embankment investigation and evaluation of the phreatic surface elevations based on piezometer data and modeling, using the SEEP/W program (see Appendix A – Doc 11). Water level elevations in the dikes were measured in piezometers installed along the dikes for Ponds A, C, D, and E (see Appendix A – Doc 6 for record of the readings). The phreatic surfaces determined from the evaluation were used in the embankment slope stability analyses. The phreatic surfaces varied but were within the embankment sections below the embankment surface at varying depths with entry at pool level on the interior side and exit at the stilling ponds pool level along the exterior toe.

7.1.4 Factors of Safety and Base Stresses

TVA provided the Factors of Safety for the two management units that contain ash (i.e., the stilling ponds were not modeled). Factors of Safety were computed using Spencer's method of analysis for circular and non-circular slip surfaces. The models identified the critical failure surface along each dike.

Stantec analyzed three representative sections (Sections H, J, and K) of the Bottom Ash Pond A divider dike under long term steady state (SS) loading conditions. Sections K and J had equally lowest SS factors of safety (FS), but Section K was selected as the critical section and was analyzed for two earthquake events (500-year and 2,500-year return period events) using the pseudostatic method. The respective peak ground accelerations (PGA) of 0.045g and 0.108g were determined and used for the seismic coefficients (k = PGA/g). The computed factors of safety for the sections analyzed for the Bottom Ash Pond A divider dike are presented in the following Table 7.4:

Table 7.4 Factors of Safety for Bottom Ash Pond A

Sections Analyzed	Loading Condition	Computed Minimum Factor of Safety (FS)		Required FS (USACE)
		Global (Deep-Seated Potential Failure)	Non-Global (Shallow Potential Failure)	
K (Critical Section Divider Dike – E. Third Point)	Steady State - static (SS)	1.5	1.2	1.5
	Seismic – 500-Yr Return (PGA = 0.045g)	1.17	-	1.0
	Seismic – 2,500-Yr Return (PGA = 0.108g)	1.0	-	
H (Divider Dike – Near Mid-point)	Steady State (static)	1.5	1.4	1.5
J (Divider Dike – Near W. End)	Steady State (static)	1.5	1.2	1.5

Ref: Docs 10, 10a, and 11 in Appendix A.

Stantec analyzed five representative sections of the Fly Ash Pond E perimeter dikes, including west perimeter dike (Sections B, C, and D) and north perimeter divider dikes (Section F at Stilling Pond D and Section G at Stilling Pond C) under long term steady state (SS) loading conditions. The most critical section (B), having the lowest SS factor of safety (FS) against a global (deep-seated) failure, was analyzed for the two earthquake events (500-year and 2,500-year return period events) using the pseudostatic method. The computed factors of safety for the sections analyzed for the Fly Ash Pond E perimeter dikes are presented in the following Table 7.5:

Table 7.5 Factors of Safety for Fly Ash Pond E

Sections Analyzed	Loading Condition	Computed Minimum Factor of Safety (FS)		Required FS (USACE)
		Global (Deep-Seated Potential Failure)	Non-Global (Very Shallow Potential Failure)	
B (Critical Section Perimeter Dike – S.W. Corner)	Steady State – (SS) static	1.5	-	1.5
	Seismic – 500-Yr Return (PGA = 0.045g)	1.59	-	1.0
	Seismic – 2,500-Yr Return (PGA = 0.108g)	1.3	-	
C (Perimeter Dike – S. Third W. Side)	Steady State - static	1.6	-	1.5
D (Perimeter Dike – Mid. W. Side)	Steady State - static	2.0	-	1.5
F (Divider Dike – N. Side @ Pond D)	Steady State - static	2.0	1.1	1.5
G (Perimeter Dike – Near N.E. Corner @ Pond C)	Steady State - static	2.2	1.5	1.5

Ref: Docs 10, 10a, and 11 in Appendix A.

Note that for dikes impounding both Ash Ponds A and E, the analyses of the models found cross sections that have lower than the required minimum factor of safety for failure surfaces that are representative of maintenance-type sloughs (i.e., non-global failures). This is a result of relatively steep slopes (i.e., 1.5H: 1V) along the divider dikes. Such maintenance type sloughs would not be expected to cause an immediate breach failure of the dikes, although *if left untended* could become progressively worse through backward sloughing of the resulting steep failure surface with likely seepage outcrop and *eventually lead to a breach*. Therefore, Stantec recommended that "TVA implement a mitigation design and construction program for the Bottom Ash Pond A divider dike and for the toe area along the north side of Pond E to improve factors of safety against Non-global slope stability." Stantec "envisioned that design features would include rock buttressing, slope flattening, or a combination of both."

Seepage exit gradients were computed and compared with the critical gradient (0.84 to 1.05, depending on location) to calculate a factor of safety against piping ($FS_{piping} = i_{crit}/i$). The minimum computed FS_{piping} = 3.0 at Section C in the west side perimeter dike of the Fly Ash Pond E. For the remaining four analyzed sections of the Fly Ash Pond E dikes, the minimum computed FS_{piping} ranges from 3.5 (Section D) to 11.4 (Section G). For the three analyzed sections of the Bottom Ash Pond A divider dike, the minimum computed FS_{piping} ranges from 10.8 (Section J) to 68.8 (Section H). Stantec adopted a target minimum factor of safety criterion of 3.0 against piping for the existing dikes. This is consistent with the factor of safety criterion of 2.5-3.0 proposed in 1977 by Cedergren and noted in USACE's EM 1110-2-1901. As indicated, the computed minimum factors of safety against a piping failure for all the analyzed sections meet or exceed the minimum factor of safety criterion.

7.1.5 Liquefaction Potential

There was no documentation provided to Dewberry that included an evaluation of potential liquefaction of the dikes and ponds. As a result, Dewberry performed a qualitative analysis of liquefaction potential for TVA management units (see Appendix B – Doc19). Dewberry geotechnical engineers looked at the foundation materials under the management units and materials used to create the dikes. Based on the qualitative analysis of liquefaction potential, the foundation materials are not a concern and the original dike embankments are not a concern, but the upper part of the dikes (dike raise embankments) potentially have liquefaction issues, due to being largely founded on sluiced ash. Overall, there appears to be no significant concern for the liquefaction potential of the management units at Gallatin, but a quantitative analysis would confirm this preliminary assessment.

7.1.6 Critical Geological Conditions

From Stantec's "Report of Geotechnical Exploration and Slope Stability Evaluation" dated May 27, 2010 (Appendix A – Doc 11), the Geologic Map of the Laguardo Quadrangle, Tennessee (Tennessee Department of Conservation, Division of Geology, 1964) is indicated to show the area is predominantly underlain by Ordovician age limestone formations, including to the Bigby-Cannon Limestone, Hermitage Formation, Carters Limestone, and Lebanon Limestone, in general order of descending lithology.

The CCR Complex is noted to be influenced primarily by the Carters Limestone and the Lebanon Limestone. The Carters Limestone is described as densely crystalline limestone with thin shale partings. The Lebanon limestone is described as thinly bedded fossiliferous limestone with thin calcareous shale partings.

Above the limestone bedrock in the majority of the CCR Complex area is residual clay formed by weathering of the parent limestone. The CCR Complex is generally founded on the residual clays, although it is indicated that alluvial soils exist under the extreme south end of the complex. Based on the test borings, the underlying native materials at the locations explored consist of firm to very stiff clay and/or limestone bedrock.

The main hazard associated with the geology of the area is the presence or potential presence of karstic features associated with the limestone, such as sinkholes, irregular bedrock surfaces, clay-filled vertical crevices/slots, and varying degree of solutioning/weathering. Stantec's geotechnical report indicates that correlating USGS topographic mapping of karstic features with the geologic mapping suggests that karst activity is associated with the upper portions of the Carters Limestone near the contact with the overlying Heritage Formation.

Stantec's geotechnical report indicates karst-related problems (sinkholes) were encountered within the ponds in the past. Seepage loss through a sinkhole was first noted in the north part of Fly Ash Pond E in the mid 1970s and repaired in 1977; manner of repair is unknown. Another sinkhole was also discovered in the early to mid 1970s. This sinkhole was isolated by constructing a circular dike around it in 1979; in 1990 it was reportedly repaired by excavation and capping. During the 2006 Fly Ash

Pond E expansion, approximately 10 areas of known sinkholes were mitigated, reportedly during construction. The mitigation activities reportedly included pumping the pond dry, excavating the areas to expose bedrock, filling the sinkholes and crevices with shot rock, and capping with compacted clay. A small sinkhole was discovered just downstream of the saddle dike on the north side of Stilling Pond C after the record rainfall on May 1-2, 2010. Stantec gave recommendations for mitigating this sinkhole in the letter documenting their follow-up (second) site visit of May 27, 2010 after the extreme rainfall event. The recommended repair is similar to that described above, except that crushed stone is used to fill/choke the sinkholes/crevices up the rock surface, then a layer of geotextile is placed, followed by crushed stone fill to 3.0 feet below the ground surface, then placement of another geotextile layer, followed by compacted clay to the ground surface (see Appendix A – Doc 8 for greater detail).

The dikes themselves consist of clays and bottom ash, as described in Subsection 7.1.2. Dikes have been raised by building over the sluiced ash. The sluiced ash that occurs under the dike raise embankments presents a hazard of potential liquefaction during earthquake shaking.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Structural stability and related documentation, including analyses for static slope stability, seismic (pseudostatic) slope stability, seepage, and piping potential, for the Bottom Ash Pond A and Fly Ash Pond E containment dikes is adequate. Liquefaction potential has not been addressed. Although Dewberry's qualitative preliminary evaluation of liquefaction potential indicates no concern overall for liquefaction, this should be verified by quantitative evaluation of liquefaction potential, particularly for the dike raise embankments largely founded on sluiced ash.

Structural stability documentation is not available for the saddle dikes impounding the stilling ponds. However, as previously noted the saddle dikes impounding the stilling ponds are lower in height and have comparable or flatter slopes than the ash-impounding dikes, and should therefore have equal or better slope stability performance than the ash impounding dikes. Nevertheless, there should be slope stability and piping potential documentation to verify that this expected stability performance is the case.

Thus, the overall structural stability documentation is considered to be generally satisfactory but deficient in some respects, as indicated above.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Overall, the structural stability of the Bottom Ash Pond A and Fly Ash Pond E containment dikes appears to be satisfactory in most respects, based on the following:

- The crests appeared free of depressions and no significant vertical or horizontal alignment variations were observed.
- There was no indication of major scarps, sloughs or bulging along the dikes.
- Boils or major uncontrolled seepage was not observed along slopes, or toes of the dikes.
- The number of observed seepage areas are minor and are adequately monitored, with a Seepage Action Plan in place to follow in case of deterioration of the seepage conditions.
- Although sinkholes have been observed in the past, they were not associated with the impounding structures and appear to have been adequately mitigated.
- The computed factors of safety of global (deep-seated) potential failures under static loading and seismic (pseudostatic) loading conditions comply with minimum criteria.
- The computed factors of safety against potential piping failure meet or exceed minimum factor of safety criteria.

However, because the potential for liquefaction of sluiced ash under the dike raise embankments under USEPA required design seismic loading is unknown and because the non-global stability factors of safety for a number of analysis sections are below the minimum factor of safety criterion, the overall stability of the Bottom Ash Pond A and Fly Ash Pond E containment dikes is considered Fair. The structural stability of these management units would be considered Satisfactory if a quantitative liquefaction analysis is provided, confirming there is no significant potential for liquefaction to occur with damaging consequences, and when recommended remedial measures are implemented to increase the non-global factors of safety to the acceptable minimum.

The structural stability of the saddle dikes impounding the stilling ponds has not been quantitatively evaluated by TVA. The logs of test boring made through the dikes adjacent to the stilling ponds do not indicate sluiced ash extending completely under the dikes and into the stilling ponds, providing supporting evidence that settled ash apparently did not reach the northern part of the original Ash Pond 3 before the divider dikes were constructed in the mid 1980s.

Thus, it appears that water principally would be released to the environment from the stilling ponds in case of a breach. Because the saddle dikes impounding the stilling ponds are smaller than the ash-impounding dikes, they are assumed to be adequately stable on the basis of the analyses performed for the ash-impounding dikes. However, since the stilling pond dikes have been assigned a “Significant” hazard potential rating by TVA with concurrence from Dewberry, due to the potential for some off-site environmental damage the stability performance of the stilling pond dikes is considered Poor, until quantitative stability documentation is provided for these dikes.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATING PROCEDURES

The bottom/fly ash ponds are operated for settling and storage of the ash deposits. Clarified water flows from the bottom/fly ash ponds to the stilling ponds through decant structures. The stilling ponds serve as a final polishing step. The treated coal combustion process waste water is discharged through four overflow outlet structures (Outfall 001) into a discharge pool and through a culvert to Old Hickory Lake/Cumberland River.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Plant personnel perform daily, weekly, monthly, and quarterly inspections. TVA hires a third party engineering firm to perform annual inspections. All the inspection results address required maintenance. It appears the maintenance procedures are adequate (see Appendix A – Docs 4 and 5).

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATIONS

8.3.1 Adequacy of Operating Procedures

Operating procedures appear to be adequate, based on observations and documents received for this report.

8.3.2 Adequacy of Maintenance

Based on the assessments of the inspection reports and visual observations during the site visits, maintenance activities appear to be adequate.

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Daily inspections are conducted by plant personnel. Inspection reports are submitted for review and the appropriate corrective actions are performed as required.

9.2 INSTRUMENTATION MONITORING

The Gallatin ash impoundment dikes (Bottom Ash Pond A and Fly Ash Pond E) have 12 piezometers distributed along the dikes to monitor ground water levels. See Appendix A – Doc 06 for plots of approximately two years of record for water-level readings (elevations) from about September 2009 to mid July 2011. In general, the piezometric readings showed that water levels remained relatively consistent with typical fluctuations between 1.0 and 2.0 feet. The extremes in fluctuation were in the range of 3.0 to 4.5 feet in three piezometers around the Fly Ash Pond E and in the piezometer at the Stilling Pond D. However, none of these showed a long-term upward trend and in fact were lower at the end of the monitoring period than at the beginning, as were practically all the piezometer readings. Only two of the piezometer readings were higher at the end but by only 1.0 foot.

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

Based on the data reviewed by Dewberry and observations during the site visit, the instrumentation and dike monitoring program is adequate.

APPENDIX A

Document 1

Project Location Map


Gallatin
Fossil
Plant
Nashville Pike
31E
Lock 4 Rd
109
S Water Ave
Nichols Ln
Cole's Ferry Rd
Steam Plant Rd
Newton Ln
Albright Ln
Cairo Rd
S Wrights Ln
Hidden Cove Rd
Lakeview Rd
Harsh Ln
Macedonia Rd
Corum Hill Rd
LA Green Lake
Lock 4 Rd
Peach Valley Rd
Woods Ferry Rd
S Water Ave
Belle Rd
Plantation Blvd
Plantation Way
Sumner County Park
Windsor Dr
Odoms Bend Rd
Cole's Ferry Rd
Newton Ln
Sandy Chapel Access Area
Drake Rd
Macedonia Rd
E Robertson Rd
Harsh Ln
Preacher Robertson Rd
Corum Hill Rd
Dawn Ln
Bloodworth Rd
109
Cairo Bend Rd
Belotes Bend Rd
Boxwell Reservation
Creighton Ln
Ackers Lake
Woods Ferry Rd
Bates Rd
Tyree Access Rd
NW Williams Rd
109
Benders Ferry Rd
Riverview Rd
LaGuardo
Academy
Coles Ferry Pike
Cairo Bend Rd
Belotes Ferry Rd
Mann Rd
Cave Springs Rd
Burford Rd

APPENDIX A

Document 2

Aerial Photography


S Water Ave
SUMNER
WILSON
Stilling Pond B
Stilling Pond D
Stilling Pond C
Bottom Ash Pond A
Fly Ash Pond E
109
SUMNER
WILSON
SUMNER
WILSON

APPENDIX A

Document 3

Steam Electric Questions and Responses

TVA

Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1401

Anda A. Ray
Senior Vice President
Office of Environment and Research

March 25, 2009

Mr. Richard Kinch
U.S. Environmental Protection Agency
Two Potomac Yard
2733 South Crystal Drive
5th Floor: N-5783
Arlington, Virginia 22202-2733

Dear Mr. Kinch:

Enclosed is the Tennessee Valley Authority's (TVA) response to your requests for information about coal-combustion by-product management impoundments and our signed authorized certification. Your requests were received at TVA's plant sites on March 12 and March 13. Enclosed is the consolidated response from TVA for all of our fossil plants. We have also included in our response two plants (Watts Bar Fossil Plant, inactive and Cumberland Fossil Plant) for which we did not receive a request for information.

Sincerely,

Anda A Ray

Anda A. Ray

Enclosures: 2007-2008 Annual Inspection Reports of Waste Disposal Areas for all
TVA fossil plants.
TVA Responses to EPA Information Request.
Ash Storage Summary.
Certification Form.

EPA believes that the information requested is essential to an evaluation of the threat of releases of pollutants or contaminants from these units. The provisions of Section 104 of CERCLA authorize EPA to pursue penalties for failure to comply with or respond adequately to an information request under Section 104(e). In addition, providing false, fictitious or fraudulent statements or representations may subject you to criminal penalties under 18 U.S.C. 1001.

Your response must include the following certification signed and dated by an authorized representative of Tennessee Valley Authority.

> I certify that the information contained in this response to EPA's request for information and the accompanying documents is true, accurate, and complete. As to the identified portions of this response for which I cannot personally verify their accuracy, I certify under penalty of law that this response and all attachments were prepared in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fines and imprisonment for knowing violations.

Signature:
Name: John C. Kammeyer
Title: VP, Engineering

This request has been reviewed and approved by the Office of Management and Budget pursuant to the Paperwork Reduction Act, 44 U.S.C., 3501-3520.

Please send your reply to:

Mr. Richard Kinch
US Environmental Protection Agency (5306P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

If you are using overnight or hand delivery mail, please use the following address:

Mr. Richard Kinch
US Environmental Protection Agency
Two Potomac Yard
2733 S. Crystal Dr.
5th Floor; N-5783
Arlington, VA 22202 2733

Tennessee Valley Authority Response to Environmental Protection Agency Request for Information

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

   The dam safety hazard potential rating for each management unit is identified on the attached table. The current hazard potential ratings were assigned by TVA using the National Inventory of Dams criteria as a guideline. Hazard classifications have not been assigned to dry disposal management units. The list is updated by TVA every 2 years. No other agencies, federal or state, regulate these facilities from a dam safety perspective.

   Currently, TVA has secured the services of a third party consultant to review the conditions at our coal combustion storage facilities and provide opinions relative to hazard potential. These opinions will be based on the National Inventory of Dams criteria, as well as dam safety regulations of the states in which each unit is located.

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

   The year each management unit was commissioned and expanded is identified in the attached table.

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

   The coal-combustion byproduct materials contained in each unit are identified in the attached table. Impoundments at units are also routinely used to combine and treat a variety of runoff and low volume water wastes prior to discharge.

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

   Permitted solid waste landfill design documents were prepared under the supervision of a registered professional engineer, with design documents stamped by the responsible engineer. In general, for non-permitted management units, the design and construction, along with the inspection and monitoring of all management units, were performed under the supervision of professional engineers.

   TVA is currently revising our program to ensure that the supervision of all design, construction, and monitoring elements for all management units will be performed by professional engineers properly licensed in the states where the project is located and that have specific experience in dam design and operation.

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

   Dates of the most recent facility inspection performed by the company or its consultant are listed in the attached table. These inspections were limited to surface observations. No intrusive sampling or testing, or engineering analyses were involved. Enclosed are the 2007-2008 inspection reports which were performed by TVA staff. All 2009 inspection reports are currently under review. These 2009 inspections were performed by TVA staff (who are experienced, degreed Civil Engineers, under the supervision of a registered professional engineer), with the exception of Cumberland, Shawnee, and Watts Bar (inactive) Fossil Plants, which were performed by Stantec.

   The most recent reviews at the Cumberland and Shawnee Fossil Plants were performed by Stantec. Stan Harris, PE, led those reviews. Mr. Harris has over 25 years experience in dam design, construction, and monitoring. In addition, Mr. Harris has experience leading dam safety training initiatives for the United States Army Corps of Engineers.

   Recommended corrective actions resulting from these evaluations are listed in the attached table. The corrective actions have been assigned to TVA staff or contractors experienced in general earth work construction and operation/construction of coal combustion disposal facilities.

TVA has retained the services of a third party consultant, Stantec, to assess each coal combustion byproducts storage facility at the eleven (11) active and one (1) inactive fossil plant. The assessments include field reconnaissance and records review for each facility. Reports will include recommendations and a priority list for additional geotechnical and engineering evaluations, if necessary. The study is on-going with results expected by the end of April 2009.

As a part of this study, TVA has initiated geotechnical explorations of the gypsum stack at our Paradise Fossil Plant, the ash pond at our Johnsonville Fossil Plant, the gypsum stack and ash dredge cell at our Widows Creek Fossil Plant, the ash disposal facility at our John Sevier Fossil Plant, and the gypsum stack and ash stack at our Cumberland Fossil Plant.

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

   TVA facilities are subject to regulation by state agencies responsible for permitting solid waste disposal and discharging of process or storm water flows. These state agencies do perform field reviews; however TVA facilities are not subject to regulation by state agencies relative to dam safety permitting and have not been subject to review or inspections by any federal regulatory agency. Copies of the most recent issued inspection report are enclosed for the 2007-2008 time period.

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

   TVA facilities are subject to regulation by state agencies responsible for permitting solid waste disposal and discharging of process or storm water flows. These state agencies do perform field reviews however; TVA facilities are not subject to regulation by state or federal regulatory agencies relative to dam safety permitting and have not been subject to review or inspections. Copies of the most recent issued inspection report are enclosed for the 2007-2008 time period.

   Primarily maintenance issues were identified *during the most recent inspections. A summary of items identified are provided in the attached table. TVA is currently preparing work orders to address these items. The work will be performed by TVA staff or contractors experienced in earth work and the operation of coal combustion product disposal facilities.*

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

   The surface area, total storage capacity, volume of materials currently stored, and date of last volume measurement for each management unit are provided in the attached table. Data based on 2006 long-range plans of the projected remaining capacities ending at Fiscal Year 2008.

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

   A history of known spills or unpermitted releases from each unit within the last ten (10) years, if applicable, is listed in the attached table. All spills and unpermitted releases were reported to the appropriate state or federal agencies as required by regulation or law.

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

    The United States is the owner of TVA facilities, and TVA is the operator of each facility listed in the attached table.

PLANT	FACILITY	HAZARD POTENTIAL CLASSIFICATION See footnote #1	Hazard Rating Performed By	YR MGT UNIT COMMISSIONED See footnote #2	YR MGT UNIT EXPANDED	MATERIALS CONTAINED IN UNIT	LAST TVA ASSESSMENT	NEXT SCHEDULED TVA ANNUAL INSPECTION	ACTIONS TAKEN OR PLANNED RESULTING FROM LAST ANNUAL INSPECTION	ISSUES REPORTED BY STATE OR FEDERAL ASSESSMENTS AND ACTIONS TAKEN See footnote #3	SURFACE AREA (ACRES)	TOTAL STORAGE CAPACITY (Cubic Yards)	CURRENT VOLUME OF MATERIAL (Cubic Yards)	REMAINING CAPACITY (Cubic Yards)	DATE VOLUME TAKEN	CURRENT HEIGHT (FT)	FUTURE MAX. HEIGHT (FT)	KNOWN SPILLS OR UNPERMITTED RELEASES (SURFACE WATER/LAND) See footnote #4	CURRENT LEGAL OWNER(S)) & OPERATOR(S)) AT FACILITY
Allen Fossil Plant	EAST ASH DISPOSAL	LOW	TVA	1967	1978	FLY ASH	Nov-08	2009	Maintenance concerns such as rutting, erosion, vegetation, etc., were noted; a seep was noted north of the plant - TVA has an independent consultant evaluating the seep.	NR	70	1,775,000	1,029,000	746,000	2006	20	20	NR	Owner - United States, Operator - TVA
	EAST ASH STILLING POND	Not Rated		1978	Not Expanded	Fly ash, bottom ash					23	290,000	INCLUDED IN EAST ASH DISPOSAL AREA	INCLUDED IN EAST ASH DISPOSAL AREA	2006	20	20		
Bull Run Fossil Plant	DRY FLY ASH DISPOSAL AREA	Not Rated		1982 - Phase 1	1990 - Phase II	FLY ASH	Nov-08	2009	(1) Work order written to regrade top of Bottom Ash Stack, (2) work order for regrading and placement of rip rap below drainage pipe erosion on east side of Bottom Ash Stack, (3) work orders written for numerous animal paths and burrows noted around Bottom Ash Stack and Active Fly Ash Pond Area 2, (4) work order for repair of erosion areas along the bank of Bull Run Creek on south side of Active Fly Ash Pond Area 2, (5) removal of fallen trees on west side of Area 2 Stilling Pond and north side of Gypsum Disposal Area 2A, (6) work order written to repair eroded area on south slope of Gypsum Disposal Area 2A.	NR	17 (Phase II)	4,800,000.00	3,903,000	897000	2006	60	84	NR	Owner - United States, Operator - TVA
	FLY ASH POND AND STILLING BASIN AREA 2	LOW	TVA	1967	1976 - divider dike constructed to form Stilling Pond 1981 - dike constructed to form Pond 2A	Fly ash, bottom ash					49	2,700,000	2,332,600	367,400	2006	20	20		
	BOTTOM ASH DISPOSAL AREA 1	Not Rated		1967	1980 - Dike constructed to form stacking area within former pond	BOTTOM ASH (flows to Fly Ash Pond)					32	876,500	627,000	250,000	2006	52	65		
	GYPSUM DISPOSAL AREA 2A	Not Rated		1981 (originally fly ash settlement pond) 2008 (Gypsum Disposal Area)	Not Expanded	FLUE GAS EMISSION CONTROL RESIDUALS (Flows to fly ash pond)					42	2,743,000	896,000	1,847,000	2006	45	165		
rt Fossil Plant	DISPOSAL AREA 5	LOW	TVA	1983	1990 - converted to dry ash operation	FLY ASH, potentially ammoniated.	Mar-08	2009	Disposal Area 5 - reported annual maintenance items include: cover and vegetate stack slopes semi-annually, repair erosion as needed, regrade perimeter ditch as needed. Ash Pond 4 - joint sealant applied to RCP spillway riser joints annually, semi-annual mowing of dike slopes, reportedly applied tree killer substance to sparse tress on west side of pond last year (trees not yet removed though), weekly monitoring of seepage areas.	NR	75	8,800,000	6,765,000	2,035,000	2006	120	135	NR	Owner - United States, Operator - TVA
	ASH POND 4	LOW	TVA	1972	1984	Bottom ash, fly ash (historical)					45	2,200,000	1,159,000	1,041,000	2006	40	40		
	DISPOSAL AREA 5 BASIN	Not Rated		1983	N/A	Fly Ash					12	600,000	150,000	450,000	2006	17	17		
erland Fossil Plant	DRY ASH STACK	Not Rated		1969	Dry Ash stacking began in mid- 1990s over old pond	FLY ASH/BOTTOM ASH	Feb-09	2009	Maintenance activities needed include repairs for erosion, monitoring seepage, tree removal, clearing and cleaning inner slopes and perimeter ditches, repair of animal burrows, establishing vegetation in exposed areas, and recommendations for construction of the current gypsum dikes.	NR	110	12,600,000	4,781,000	7,819,000	2006	35	200	NR	Owner - United States, Operator - TVA
	ASH POND	LOW	TVA	1969	Dikes raised in 1979	Bottom ash, fly ash (historical)					50	2,000,000	1,305,000	695,000	2006	35	35		
	GYPSUM STORAGE AREA	LOW	TVA	1969	Gypsum area constructed over old pond in mid 1990s	FLUE GAS EMISSION CONTROL RESIDUALS					170	20,000,000	1,826,000	18,174,000	2006	60	140		
in Fossil Plant	FLY ASH POND E	LOW	TVA	1970	1986 - Divider Dike Constructed Forming Ponds A and E; 2006 - Pond E Expanded	FLY ASH, bottom ash. E flows to C.	2008	2009	Annual maintenance items reported by GAF include: annual seeding of new dikes for Pond E, mow along Pond E dike slopes beneath power lines along river.	NR	157	7,100,000	4,968,000	2,132,000	2006	30	35	NR	Owner - United States, Operator - TVA
	BOTTOM ASH POND A	LOW	TVA	1970	1986 - Divider Dike Constructed Forming Ponds A and E; 1994 - Divider dike raised	BOTTOM ASH; A flows to B					269	7,083,000	4,951,409	2,131,591	2006	25	25		
	STILLING POND B, C & D	Not Rated		1970	1986 - Ponds B and C formed when divider dike constructed to form Ash Ponds A and E	FLY ASH & BOTTOM ASH and other listed in E.					55	600,000	400,000	200,000	2006	10	10		
Sevier Fossil Plant	DRY ASH STACK	Not Rated		1955 (former ash ponds)	1979 - all sluicing stopped, designated for dry ash disposal	FLY ASH	Nov-07	2009	(A) to monitor the exterior dikes slopes and toe areas of all disposal areas for surface sloughs, new seepage area, changes in existing seeps, or movements; (B) continuation of mowing program and prevention of tree growth on dikes; (C) cover exposed slopes with earth, seed, fertilize and mulch as described in the operations manual; (D) removal of sediment from Coal Yard Drainage basin; (E) reclaim animal burrows.	NR	84	3,800,000	2,098,000	1,702,000	2006	101	143	NR	Owner - United States, Operator - TVA
	BOTTOM ASH POND	LOW	TVA	1979	Not Expanded	BOTTOM ASH, FLY ASH					26 (pond area only) 41 (total area)	1,200,000	1,035,293	165,000	2006	25	25		

PLANT	FACILITY	HAZARD POTENTIAL CLASSIFICATION See footnote #1	Hazard Rating Performed By	YR MGT UNIT COMMISSIONED See footnote #2	YR MGT UNIT EXPANDED	MATERIALS CONTAINED IN UNIT	LAST TVA ASSESSMENT	NEXT SCHEDULED TVA ANNUAL INSPECTION	ACTIONS TAKEN OR PLANNED RESULTING FROM LAST ANNUAL INSPECTION	ISSUES REPORTED BY STATE OR FEDERAL ASSESSMENTS AND ACTIONS TAKEN See footnote #3	SURFACE AREA (ACRES)	TOTAL STORAGE CAPACITY (Cubic Yards)	CURRENT VOLUME OF MATERIAL (Cubic Yards)	REMAINING CAPACITY (Cubic Yards)	DATE VOLUME TAKEN	CURRENT HEIGHT (FT)	FUTURE MAX. HEIGHT (FT)	KNOWN SPILLS OR UNPERMITTED RELEASES (SURFACE WATER/LAND) See footnote #4	CURRENT LEGAL OWNER(S)) & OPERATOR(S)) AT FACILITY
Johnsonville Fossil Plant	**ASH DISPOSAL AREA 2**	LOW	TVA	1970	1978	FLY ASH & BOTTOM ASH	Nov-07	2009	Recommendations include maintenance activities: filling animal burrows, repairing erosion, filling in depressed areas, clearing heavy vegetation, and tree removal. Additionally, also monitoring seepage.	NR	87	4,360,000	4,164,000	199000	2006	30	30	Reported release of small quantity of ceneospheres on March 27, 2004 when discharge structure was disturbed during maintenance.	Owner - United States, Operator - TVA
Kingston Fossil Plant	**MAIN ASH POND**	LOW	TVA	1951	1968 - raised dike	FLY ASH & BOTTOM ASH	Oct-08	2009	Standard recommendations were to repair all erosion ditches, repair wheel ruts, remove floating ash from the pond to prevent a permit violation, remove trees from dikes and mow the dikes regularly to control the growth of vegetation. Repair broken monitoring wells along Swan Pond Road, monitor seeps and under drains.	NR	92	14,370,000	UNKNOWN	UNKNOWN	NA	50	UNKNOWN	November 7, 2003 and November 1, 2006, an ash release occurred to land from a slough in the Dredge Cell embankment. A release into the Emory River occurred on December 22, 2008 from the Dredge Cell embankment failure. No reports found of releases from the Main Ash Pond or Stilling Basin.	Owner - United States, Operator - TVA
	STILLING POND	LOW See footnote 1	TVA	1978	Not Expanded	Materials from main ash pond					29	468,000	260,000	208,000	2006	50	50		
Paradise Fossil Plant	**SCRUBBER SLUDGE COMPLEX (Gypsum Stack and Scrubber Sludge Stilling Pond)**	LOW	TVA	1986	Not Expanded	FLY ASH, FLUE GAS EMISSION CONTROL RESIDUALS	Oct-08	2009	With respect to dam safety, primarily minor concerns (rutting, erosion, vegetation, etc.) were identified in the report. The under drain ditch at the Gypsum Stack needs to be cleaned out to prevent flow over the road. Several seeps were noted at the Daniel Run Pond 3, but were not flowing. Recommended removal of fines from the Coal Yard Runoff Ponds and all of the Red Water Ponds.	NR	255	858,000	11,783,000	35,074,000	2006	62	270	NR	Owner - United States, Operator - TVA
	FLY ASH EXTENSION AREA POND (Peabody Ash and Stilling Pond and Jacob's Creek Fly Ash and Stilling Pond)	LOW	TVA	1971	1997	FLY ASH					203	6,348,000	2,956,000	3,392,000	2006	34	34		
	SLAG AREAS 2A & 2B	LOW	TVA	1967	1970	BOTTOM ASH. A portion of the flow is routed to the fly ash extension area pond.					27	968,000	752,000	216,000	2006	24	24		
Shawnee Fossil Plant	**CONSOLIDATED WASTE DRY STACK**			1984	Horizontal expansion design prepared in 2000	FLY ASH/BOTTOM ASH. Drains to ash pond	Feb-09	2009	Maintenance activities needed include repairs for erosion, monitoring seepage, tree removal, clearing and cleaning inner slopes, repair of animal burrows, establishing vegetation in exposed areas, monitoring animal paths, repairing leaking raw water line, removing sediment build-up, and recommendations for regrading intake channel dredge cell.	NR	200	33,194,000	22,811,000	10,382,000	2006	100	270	NR	Owner - United States, Operator - TVA
	ASH POND	LOW	TVA	1952	Area 2 was constructed in 1971 and the dikes were raised in 1979	FLY ASH/BOTTOM ASH					180	5,000,000	4,712,000	287,000	2006	25	25		
Widows Creek Fossil Plant	**ASH POND (Complex consists of Bottom Ash Stack, Iron Pond, Cooper Pond, Old Scrubber Sludge Pond (Dredge Cell), Asbestos Waste Disposal Area, Pump Pond, Upper and Lower Stilling Ponds)**	LOW	TVA	1950	During 2005, a dredge cell was constructed over the old scrubber sludge pond area. During 2007 dredging ceased.	FLUE GAS EMISSION CONTROL RESIDUALS, FLY ASH & BOTTOM ASH	Oct-08	2009	Review with the Constructor the Gypsum Stack operations manual and drawings to ensure the operations continue in accordance with the current stacking plan, monitor the wet area along the southern lower perimeter dike, rework a portion of the west slope next to the Stilling Pond, install sub drains on the west slope adjacent to the Gypsum Stilling Pond, uncover the slope drains on the 650/655 bench and grade per design drawings. In regards to the Wet Gypsum Stacking Stilling Pond, the planned actions are to consider and alternate skimmer design on TVA drawing 10W235-19. In regards to the Pump Pond, the planned actions are to monitor the seep in the dike between the Stilling Pond and the Pump Pond. In regards to the Active Ash Pond, the planned actions are to monitor the seepage along the south Perimeter dike next to the stilling pond.	NR	310	18,890,000	1,856,000	17,034,000	2006	50	115	Reported release of small quantity of ceneosperes from the Ash Pond which occurred on December 10, 2004 due to intense precipitation. Reported release of small quantity of ceneospheres from the Ash Pond which occurred on January 30, 2008. An abandoned decant weir in Pond 2B of the Gypsum Stack failed on January 9, 2009.	Owner - United States, Operator - TVA
	GYPSUM STACK (Wet Stacking Area)	LOW	TVA	1986	Phase I vertical expansion occurred from 1986 to 1992. Phase II horizontal expansion began in 1992.	FLUE GAS EMISSION CONTROL RESIDUALS, FLY ASH & BOTTOM ASH					110	17,683,000	7,892,000	9,791,000	2006	75	150		
Watts Bar Fossil Plant (Inactive)	**ASH POND and STILLING BASIN**	LOW	TVA	1974	1977	Previous fly ash, bottom ash	Feb-09	2009	Complete Closure Plan - currently construction is approximately 95 percent complete.	NR	14	230,000	150000	80,000	2006	30	30	NR	Owner - United States, Operator - TVA

Notes: 1. Hazard Potential listed for those facilities previously rated by TVA, all facilities are currently under evaluation. Based on hindsight at Kingston Fossil Plant, the ranking did not adequately represent the actual risk experienced on 12/22/2008.
2. Year Management Unit Commissioned approximated from available reports, drawings, or permit documents.
3. NR - None Reported
4. Does not include NPDES permit exceedences

APPENDIX A

Document 4

2010 Annual Inspection of CCP Facilities Ponds, August 13, 2010

Stantec

2010 Annual Inspection of CCP Facilities and Ponds

Gallatin Fossil Plant
Gallatin, Sumner County, Tennessee

Stantec Consulting Services Inc.
One Team. Infinite Solutions
1901 Nelson Miller Parkway
Louisville, KY 40223-2177
Tel: (502) 212-5000 • Fax: (502) 212-5055
www.stantec.com

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

August 13, 2010

Stantec

Stantec Consulting Services Inc.
1901 Nelson Miller Parkway
Louisville, KY 40223-2177
Tel: (502) 212-5000
Fax: (502) 212-5055

August 13, 2010

rpt_0001_175550002

Mr. Michael S. Turnbow
Tennessee Valley Authority
1101 Market Street
LP 2G-C
Chattanooga, Tennessee 37402

Re: 2010 Annual Inspection of CCP Facilities and Ponds
Gallatin Fossil Plant
Gallatin, Sumner County, Tennessee

Dear Mr. Turnbow:

Stantec Consulting Services Inc. (Stantec) has completed the 2010 annual inspections for CCP facilities and ponds at the Gallatin Fossil Plant. Facilities reviewed included:

- Bottom Ash Pond A
- Fly Ash Pond E
- Stilling Ponds B, C and D
- Chemical Treatment Pond
- Coal Yard Drainage Ditch
- Closed Disposal Area

The field work was executed on July 14 and 15, 2010. The results of the work along with facility-specific recommendations for maintenance or other activities are included on the enclosed documents. The results of the TVA Third Quarter Facility Inspection have been included in Enclosure J. Portions of that inspection report have been cross-referenced within the annual report where appropriate.

In addition, the following general plant-wide recommendations and comments are offered:

- It is recommended that vegetation maintenance continue, including mowing and clearing tall grass/cattail growth at regular intervals. If lack of vegetation is observed during these operations, re-seeding should be performed as soon as possible. If vegetation establishment difficulties continue in any areas, then TVA should consider refining existing procedures or developing site specific specifications which address topsoil, fertilizing, seed mixtures, etc.

- It is recommended that TVA catalogue, assign a responsible party and due date, and track the completion of the facility-specific recommendations provided herein.
- Please note that this scope did not include a review of the current Operations and Maintenance Manual (O&M) for GAF. Stantec understands that TVA plans to update the current O&M manual to include dam safety-related items. Stantec also understands that TVA plans to develop an Emergency Action Plan for GAF as well.
- It is recommended that TVA personnel continue dike inspections/monitoring to look for changes or conditions that might affect dike integrity. The frequency and procedures for inspections should be consistent with TVA's newly implemented inspection program. Particular emphasis should be placed on reviewing and monitoring the seepage areas for changed or worsened conditions, and identifying and repairing other maintenance items such as animal burrows, erosion, and lack of vegetation.

Stantec appreciates the opportunity to provide continued engineering services for the fossil plants. If you have any questions, or if we may be of further assistance, feel free to contact our office.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Paul Cooper

Paul J. Cooper, PE
Project Engineer

Randy L. Roberts

Randy L. Roberts, PE
Senior Associate

/cdm

Enclosures:

APPENDIX A

Document 5

TVA Monthly / Quarterly Safety Inspections, October 13, 2010

TVA Monthly / Quarterly Facility Safety Inspection Form

GAF __ ____ **3. Date: ______10-13-2010____________**

TVA Monthly / Quarterly Facility Safety Inspection Form **Note: Inspection Must Be Performed Walking**

Harold Catlett **6. Hazard Classification: ☐ High ☐ Significant X Low**

7. Observation Frequency ☐X Monthly ☐ Quarterly ☐ Other (significant event)

8. Weather Conditions / Temperature Sunny & Hot

Check the appropriate box below. If not applicable, record "N/A". Provide comments when appropriate. Any other areas that should be brought to the attention of the Program Manager should also be noted in the "Comments" section. Indicate the locations of any areas identified, and photograph and attach to the form. Previous observation forms should be reviewed and any NEW observations or degradation of pervious conditions should be reported on this observation form. (NOTE ONE (1) FACILITY PER FORM)

	Yes	No		Yes	No
9. Pre-Job Safety Briefing Performed	X		**14. DIKE TOE AREAS**		
10. Activity / Construction on/ at facility	X		A. Seepage ○ New ○ Existing		X
11. DIKE CREST			○ Clear or Muddy	N/A	
A. Settlement / Cracking		X	○Flow Increase / Decrease	N/A	gpm
B. Rutting		X	○ Aquatic Vegetation Growing	N/A	
C. Lateral Displacement		X	○ Ash or Clay Deposits Below Seep Outlet	N/A	N/A
D. Erosion		X	B. Boils ○ New ○ Existing		X
12. INTERIOR / EXTERIOR DIKE SLOPES			○ Clear or Muddy	N/A	N/A
A. Minimum Pool Elevation Measurement	N/A	ft.	○ Flow Increase / Decrease	N/A	gpm
B. Maximum Pool Elevation Measurement	N/A	ft.	○ Growing in Size	**N/A**	**N/A**
C. Actual Pool Elevation Measurement	N/A	ft.	C. Sinkholes/Depressions ○ New ○ Existing		**X**
D. Freeboard		> 4'	**15. SEEPAGE COLLECTION SYSTEM**		
E. Instabilities (Sloughs or Slides)		X	A. Estimated Flow Measurement	N/A	gpm
F. Erosion		X	B. Increased Flow	**N/A**	
G. Sinkholes/Depressions ○ New ○ Existing		X	C, Emitting Clear or Dirty Water	**N/A**	
H. Vegetation / Brush / Trees		X	**16. SPILLWAY WEIRS & OUTLETS**		
I. Animal Burrows ○ New ○ Existing		X	A. Decant Riser Misaligned		X
J. Seepage ○ New ○ Existing		X	B. Decant Pipe Joints		X
○ Clear or Muddy	**N/A**		○ Leaking	**N/A**	
○ Increased Flow	**N/A**		○ Separated	**N/A**	
○ Ash or Clay Deposits Below Seep Outlet	**N/A**		C. Headwall In Good Condition		X
K. Seep around Drain Pipe (s)	**N/A**		**17. OPERATIONS & MAINTENANCE**		
13. DEFICIENCIES			A. Routine O&M Performed	**X**	
A. Prior Deficiencies Checked	**X**		B. Weekly Observations Performed	X	
B. New Deficiencies Identified / Flagged		X	C. Changes in Operations		X
C. Immediate Actions Taken (Note Below)		X			
D. Photos of deficiencies attached		X			

18. Major adverse changes in these items could cause instability and should be reported to the Program Manager as soon as possible for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, etc.) in the space below and on the backside of this sheet if needed.

NOTE: Quarterly Inspection Deficiencies to be documented on spreadsheet with applicable latitude and longitude coordinates referenced. SHOW ALL QUARTERLY INSPECTION DEFICENCIES ON AERIAL PHOTOS ALSO

19. Item #	Comments/Observations/Action Taken:
Building interior dikes to help retension time in main ash pond	

20. Who was Notified of New Deficiency: (Date / Time)

21. I hereby attest the above is based on actual field observations made during the period indicated, by either myself or an appointed representative and are accurate, complete, and correct to the best of my knowledge.

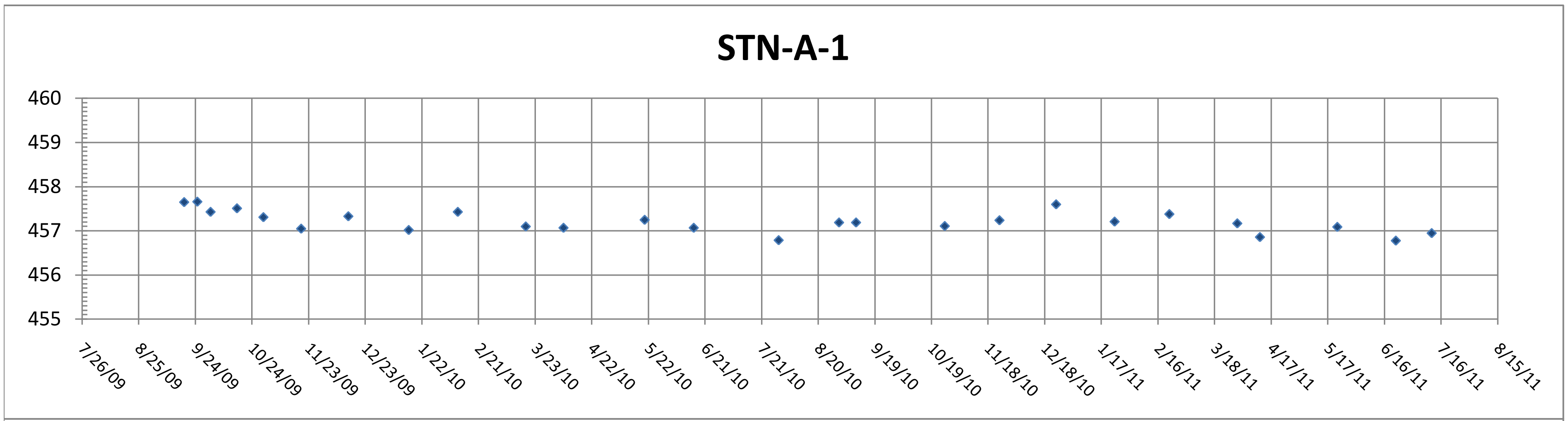
Period Covered:

10/01-31/2010 **Signature: __ Harold Catlett** **Date: ____ 10-13-10**

APPENDIX A

Document 6

URS Gallatin Piezometer Summary Report, August 2011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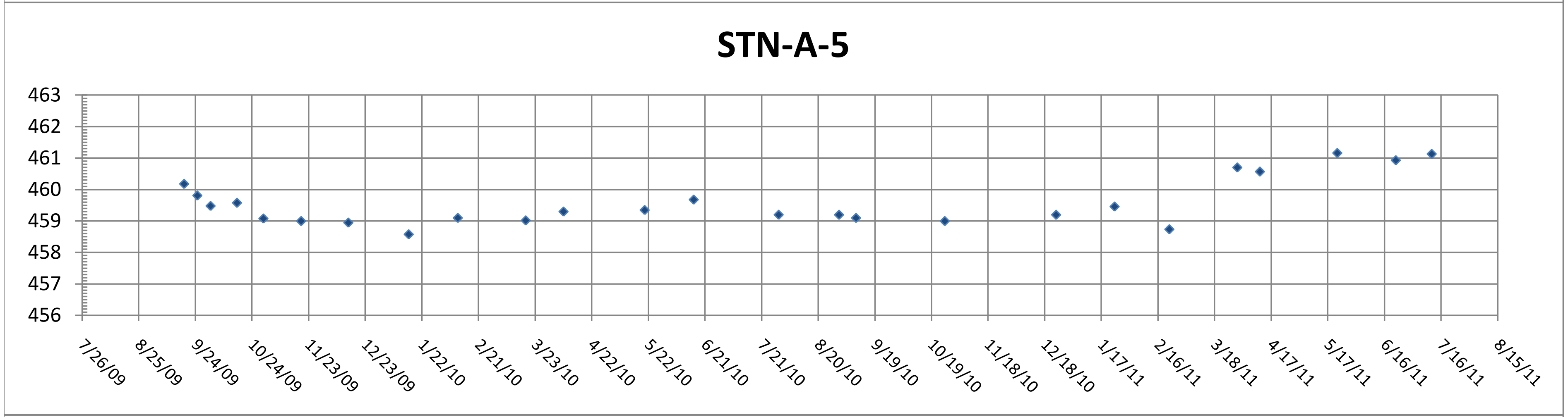
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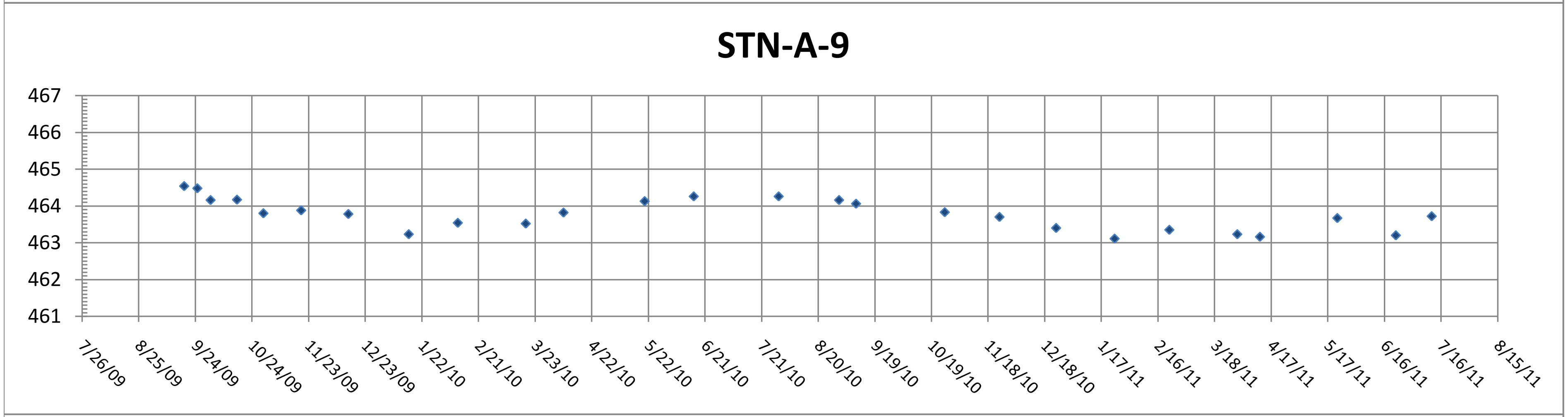
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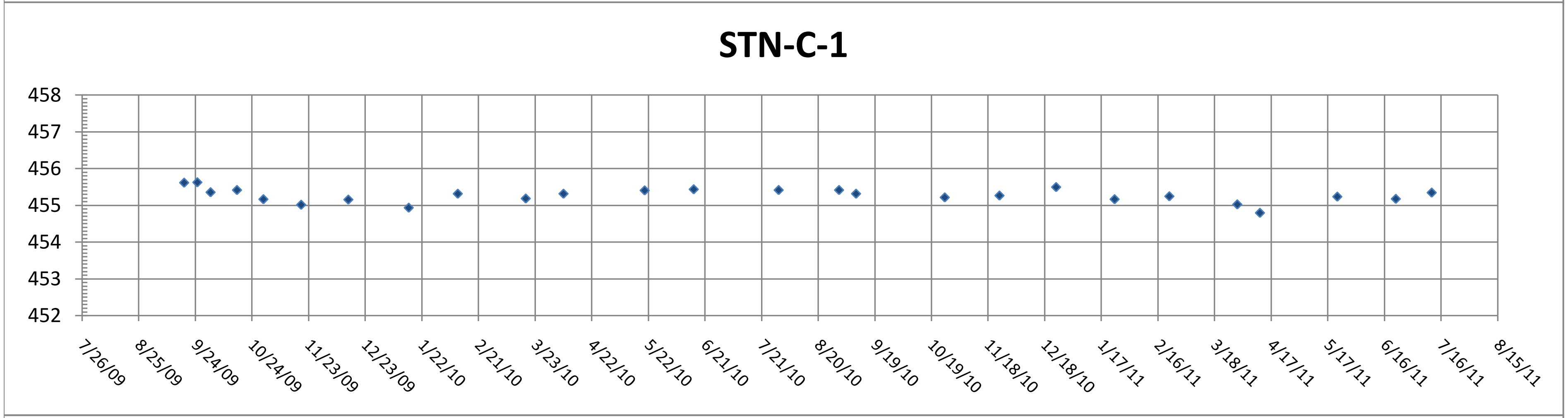
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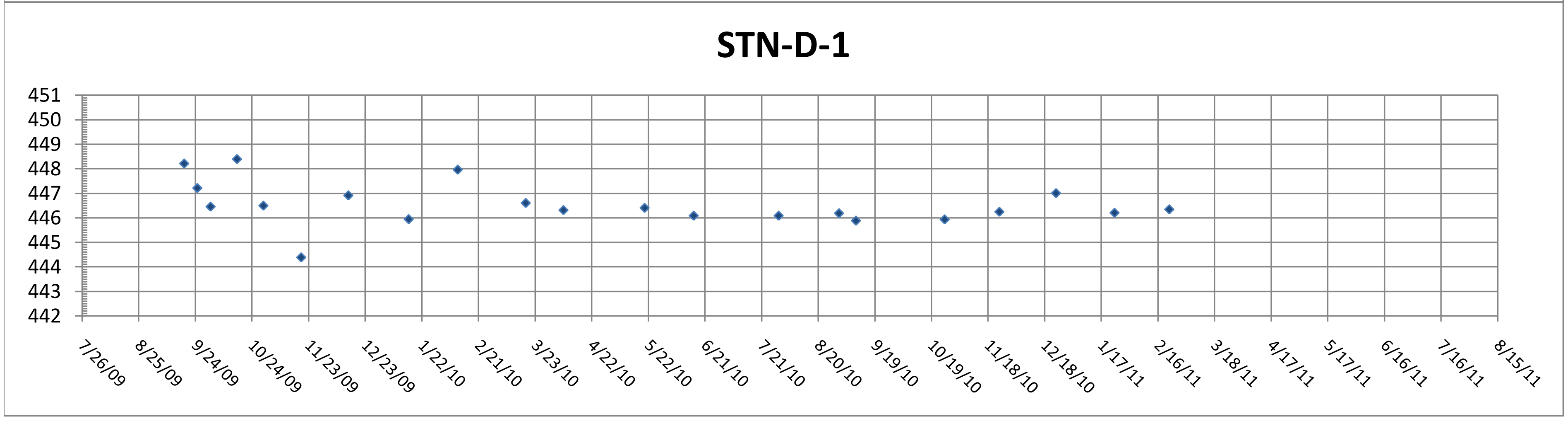
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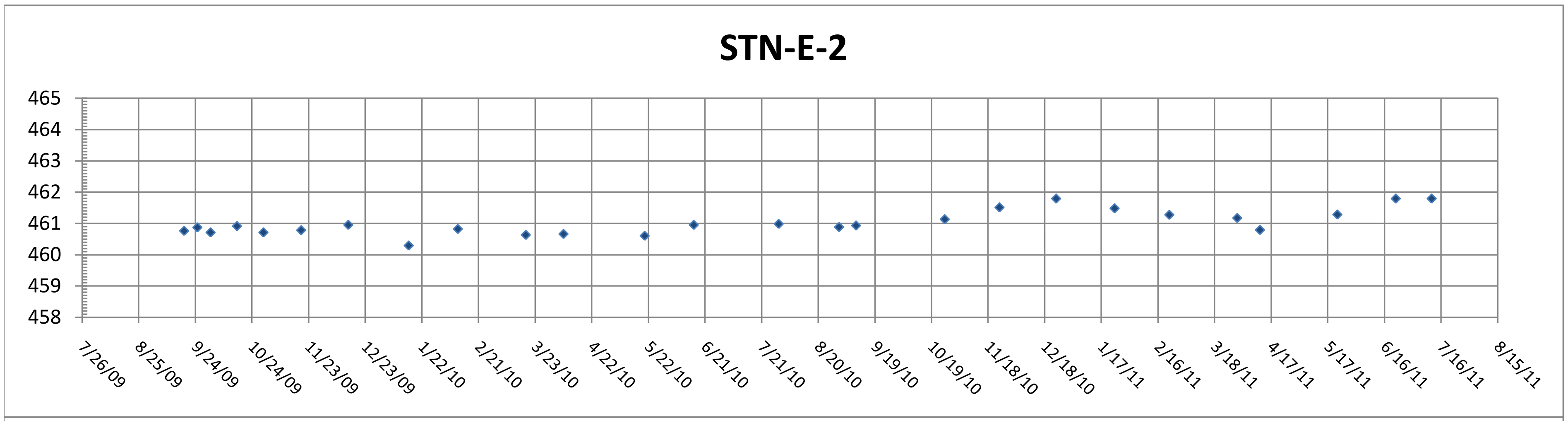

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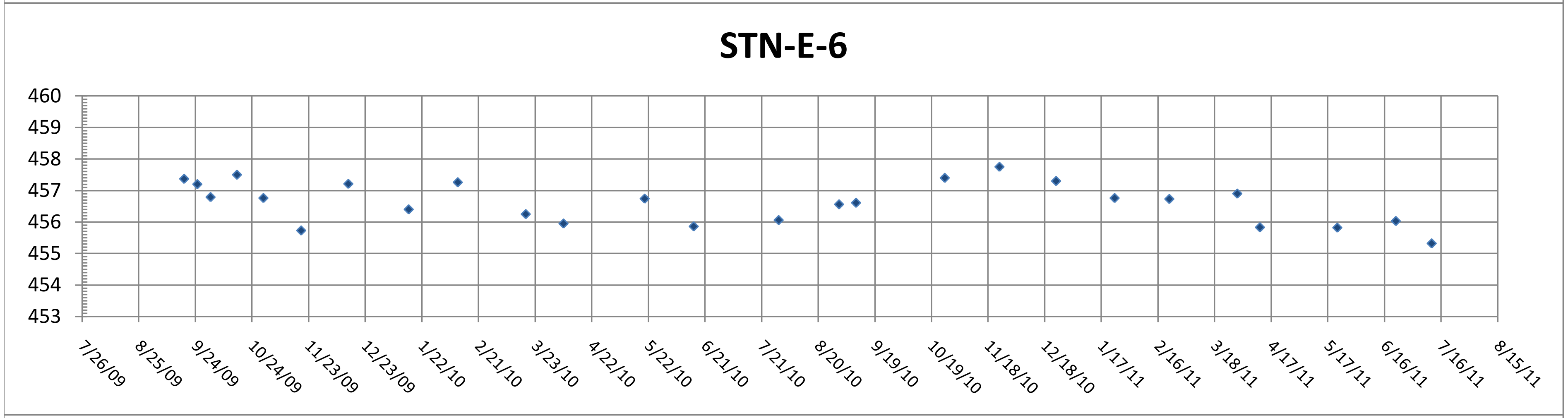

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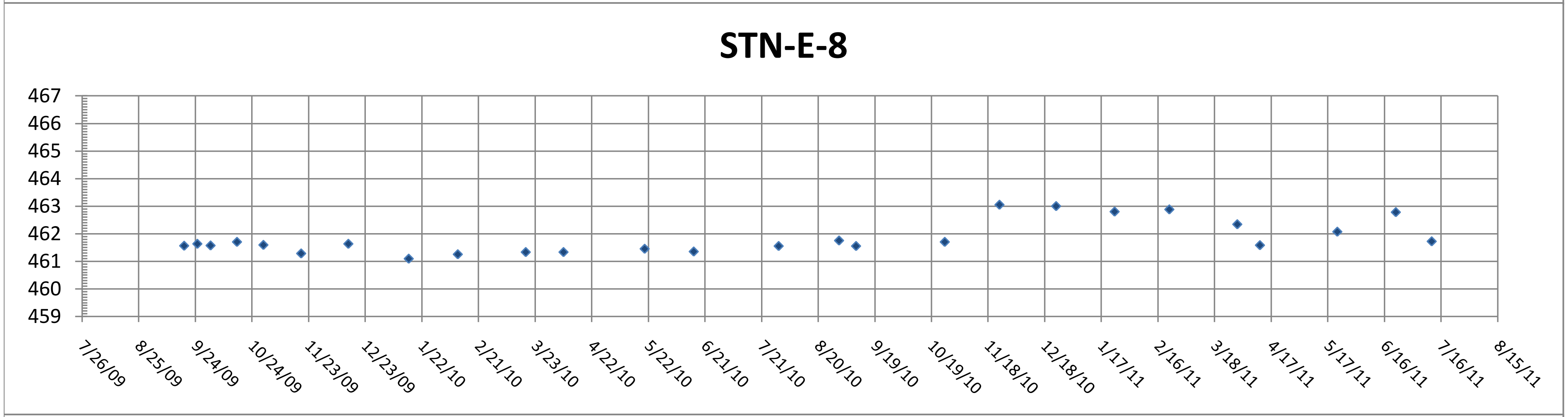

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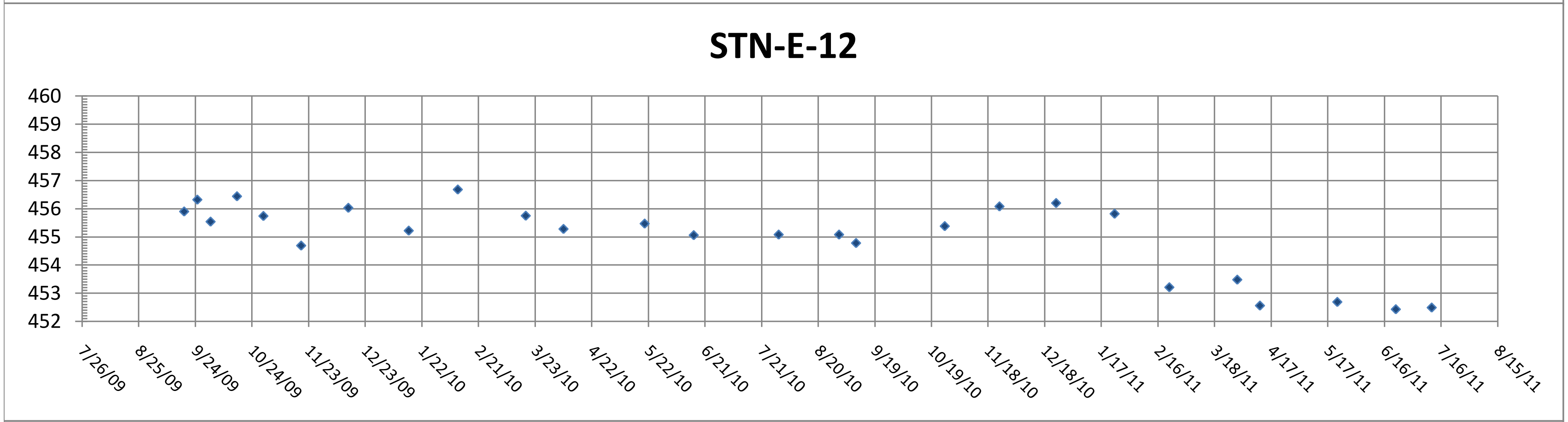

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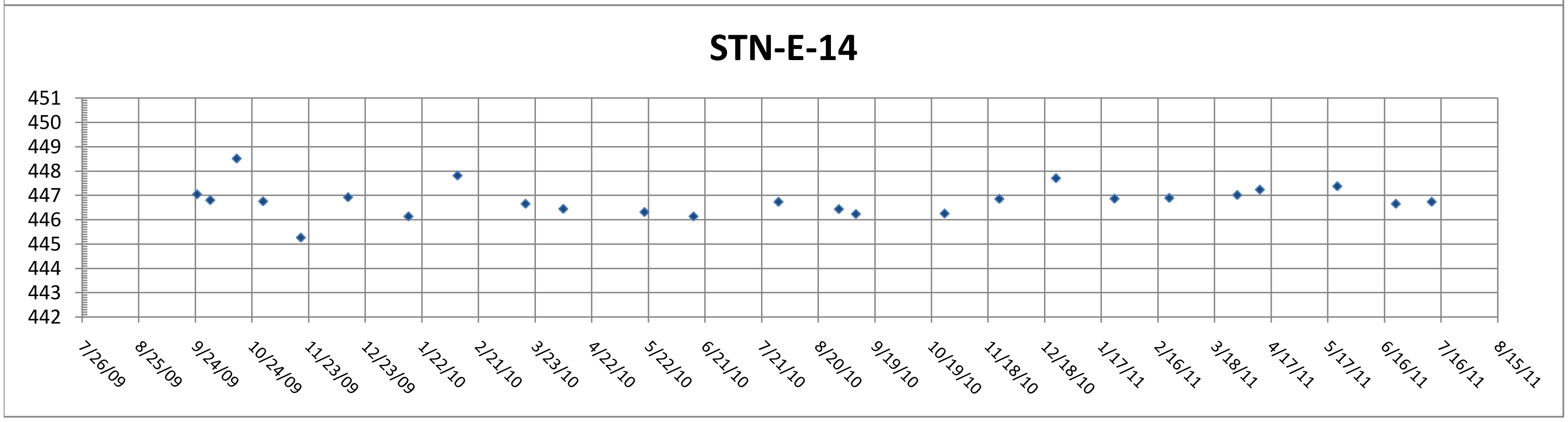

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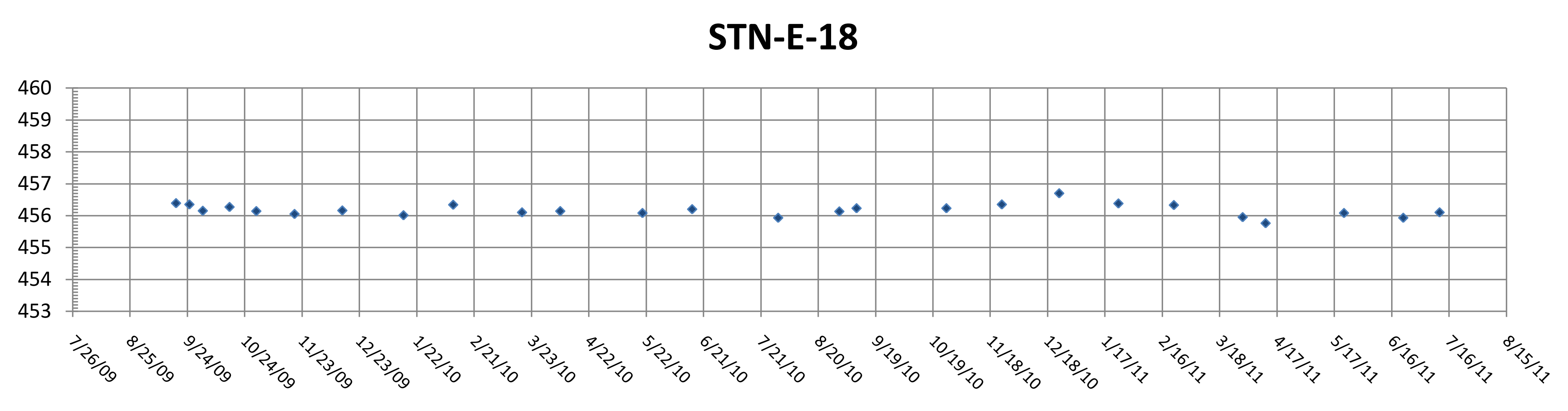
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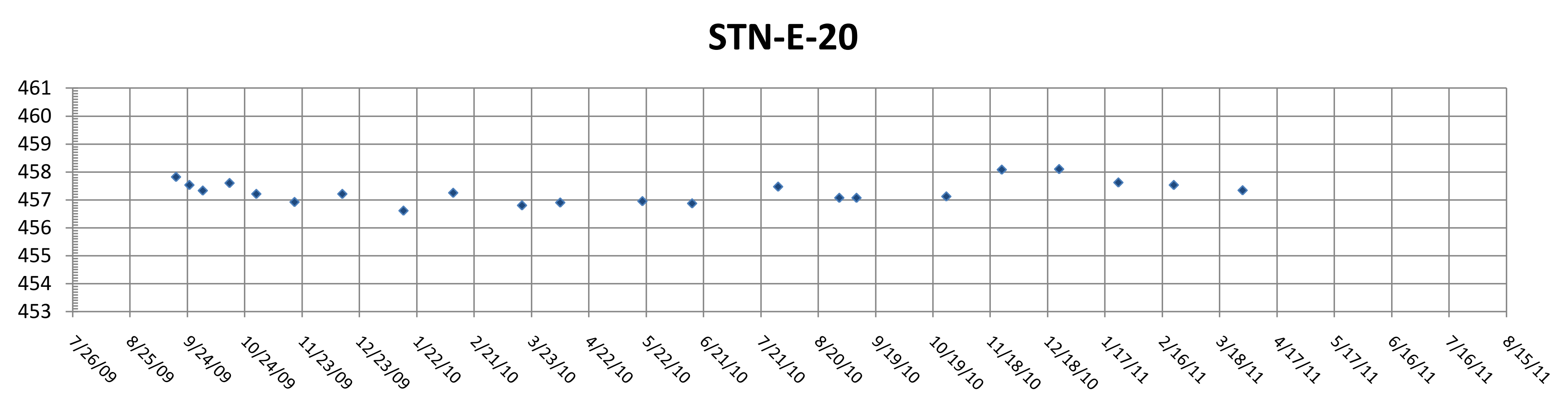
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APPENDIX A

Document 7

Post Rain Event Site Visit Gallatin Fossil Plant, May 5, 2010

Memo

Stantec

To:	Rachel Combs, TVA Roy Quinn, TVA	From:	Randy L. Roberts, PE
File:	175559018	Date:	May 5, 2010

Reference: Post-Rain Event Site Visit to Gallatin Fossil Plant

Here is a summary of our post-rain site visit to GAF. Paul Cooper and I visited the plant on May 3, 2010 following heavy weekend rain. A few selected photos are attached.

1. No signs of slope instability observed along dikes.

2. Two new potential small toe seepage locations discovered – one at NW corner of Pond A (pointed out by William Perry), one at S side of Pond E just west of other known seep (see attached site plan). These could just be areas where rain has infiltrated the dikes and water is now slowly exiting down slope. Need to keep watching under drier conditions for further evaluation. These do not appear to be critical.

3. Widespread rill and gully erosion observed primarily along dikes and slopes constructed of bottom ash. These include:

    - Pond A north and west divider dikes.
    - Pond E north toe area just above stilling ponds.
    - Pond C bottom ash saddle dike.

    Eroded areas should be repaired. Foundation benches will need to be cut along along dike edges to facilitate placement and compaction of material. William Perry suggested doing some possible re-sloping of dike crests as repairs are made.

4. Pool level of adjacent Old Hickory Lake reached about El. 451 feet – just at the dike toe of Pond E at its lowest point.

5. Pool levels in Ponds A and E appeared to rise no more than about 18 to 24 inches.

6. Stilling pond observations:

    - Breach occurred to the north at natural low area across access road – this actually helped to serve as an "emergency" spillway.

- Pool level rose within about 12 inches or so of overtopping dike at outlet. This corresponds to a pool rise of about 3.5 feet or so.
- Drainage from off-site enters the east end of the stilling pond.

TVA personnel should continue to review areas as pool levels recede and conditions become drier.

If you have any questions, please call.

STANTEC CONSULTING SERVICES INC.

Randy L. Roberts

Randy L. Roberts, PE
Senior Associate

/cdm

Attachments

c. Alan Casaday
Michael S. Turnbow

Photo 1

Typical erosion north toe area of Pond E dike just above stilling ponds.

Photo 2

Typical erosion along Pond A divider dike.

Photo 2

Typical erosion along Pond C bottom ash saddle dike.

Photo 4

Old Hickory lake at Pond E dike toe on west side.

Photo 5

Area of stilling pond breach across access road on north side.

Photo 6

Stilling pond outlet area.

Photo 7

Stilling pond spillway area.

Photo 8

Offsite drainage entering stilling pond complex through pipe from the east.

Photo 9

Source of off-site drainage into stilling pond east of Pond B. Photo taken from top of railroad embankment looking northeast.

GAF Possible New Seepage Locations

5/3/2010

APPENDIX A

Document 8

Secondary Rain Event Site Visit Gallatin Fossil Plant, May 5, 2010

Memo

Stantec

To: Rachel Combs, TVA
Roy Quinn, TVA

From: Randy L. Roberts, PE
Paul J. Cooper, PE

File: 175559018

Date: May 28, 2010

Reference: Second Post-Rain Event Site Visit to Gallatin Fossil Plant

Here is a summary of our second post-rain site visit to GAF. Paul Cooper, PE made a second follow-up visit on May 27, 2010 to view areas around the stilling ponds that could not be seen on May 3 due to high water, and to follow up on other items. A few selected photos are attached.

1. No signs of instability or new seepage were observed at the Stilling Pond D outlet area or Stilling Pond C bottom ash saddle dike. Stantec could not review these areas during the previous visit because of high water in the stilling pond, and at the low-lying area beyond the Stilling Pond C saddle dike.

2. A small sinkhole has formed to the north of the Stilling Pond C bottom ash saddle dike. This sinkhole was recently discovered by TVA. The area beyond the saddle dike is a low-lying drainage basin and was flooded during the rain event. It is believed that the formation of the sinkhole is related to the flood event. During heavy rain, groundwater will fill the bedrock joints/crevices and will rise up into soil overburden. When the groundwater recedes (and in this case when additional flood waters drain), soil particles are eroded downwardly into the bedrock joints/crevices and sinkhole collapses can form. It does not appear that this sinkhole is related to the adjacent dike; however, since it is close to the dike toe, Stantec recommends that it be repaired.

   Repair should consist of the following:

   - Step 1 - Excavate the area downwardly to expose the bedrock surface, or to a maximum depth of approximately 6 to 7 feet. If bedrock is encountered, follow procedures described in Step 2. If bedrock is not encountered, proceed to Step 3. (While on site Stantec probed the immediate vicinity around the sinkhole to depths of about 3 to 5 feet and did not encounter bedrock). Pumping of groundwater from the excavation will likely be necessary. The edge of the excavation should not extend any closer than 5 feet from the dike toe on the south side. Also, side slopes of the excavation should be no steeper than 1H:1V.

- Step 2 (if bedrock encountered) - Clean loose/wet soil from the bedrock surface and search for obvious crevices or open joints within the bedrock. If these are found, clean them of loose soil as much as practicable (using shovels or other hand-held equipment) and fill/choke the joints/crevices with TDOT No. 3 crushed stone. Place stone in crevices up to the level of the bedrock surface and proceed to Step 3. If joints or crevices of sufficient size for cleaning/filling are not discovered, then proceed to Step 3.

- Step 3 – Remove loose material and line the entire excavation (bottom and sides) with TDOT Type IV Geotextile Fabric (non-woven). Place TDOT No. 3 crushed stone up to within 3 feet of the surface. Place Type IV geotextile fabric over crushed stone. Place and compact clay over fabric to fill the excavation and restore grade. Clay should be placed in 8 inch lifts and thoroughly compacted with a hand held mechanical tamper.

It is recommended that a Stantec representative be present on site to review the repair excavation, make observations, and to provide consultation as the repair progresses. Field adjustments may be needed depending on actual conditions encountered. Also, it should be noted that ground was very soft during this visit. Crushed stone may be needed to stabilize the surface for construction equipment access. Small equipment should be used.

3. During Stantec's May 3 visit, two new potential small toe seepage locations were discovered – one at NW corner of Pond A (pointed out by William Perry), one at S side of Pond E just west of other known seep (see attached site plan). At that time, Stantec judged that these could just be areas where rain has infiltrated the dikes and water is now slowly exiting down slope. During this site visit, these two areas were dry and Stantec did not observe any seepage or wet ground conditions. This tends to support our initial conclusion, but additional observations with time should still be made.

4. Stantec observed that erosion areas along the divider dike between Pond A and E had been repaired. Erosion repairs were also observed along the Stilling Pond C saddle dike, but some new minor erosion had re-appeared. Erosion repairs had not yet been performed along the Pond A divider dike or along the dike toe area of Pond E. Erosion repairs and monitoring should continue.

5. Pool level of adjacent Old Hickory Lake has returned to normal pool.

6. Pool levels in ponds appear to have returned to normal.

Reference: Second Post-Rain Event Site Visit to Gallatin Fossil Plant

If you have any questions, please call.

STANTEC CONSULTING SERVICES INC.

Randy L. Roberts

Paul Cooper

Randy L. Roberts, PE
Senior Associate

Paul J. Cooper, PE
Project Engineer

/cdm

Attachments

c. Alan Casaday
Michael S. Turnbow

Photo 1

Small sinkhole just beyond Stilling Pond C Saddle dike.

Photo 2

Close up view of small sinkhole just beyond Stilling Pond C Saddle dike.

Photo 3

Stilling Pond D outlet area.

Photo 4

Divider dike between Pond A and Pond E showing erosion repairs.

Photo 5

Erosion beginning to re-form along Stilling Pond C saddle dike.

GAF Possible New Seepage Locations

5/3/2010

APPENDIX A

Document 9

Seepage Action Plan, Stantec, June 25, 2010

Seepage Action Plan (SAP)

Gallatin Fossil Plant
Gallatin, Sumner County, Tennessee

Stantec Consulting Services Inc.
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Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

June 25, 2010

Seepage Action Plan (SAP)

Gallatin Fossil Plant
Gallatin, Sumner County, Tennessee

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Seepage Action Plan (SAP)

Gallatin Fossil Plant
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1. Potential Seepage Areas

For readers not familiar with seepage through dams, refer to Appendix B, “Possible Seepage Problems and Recommendations” for more illustrative details. Seepage through an impoundment dam can typically be found on the lower third of the slope and extending beyond the toe approximately fifty feet. Figure 1 below displays the typical area on a cross section that should be reviewed during the seepage inspection for the Ash Pond Complex. However, other seepage areas may exist, and the field inspector should be familiar with previous inspection reports and observations. Based on geotechnical analysis, plan views illustrating potential seepage areas have been prepared and are included in Appendix A. The areas identified, along with any other area previously identified during inspections, should be reviewed on a regular basis as identified in this document.

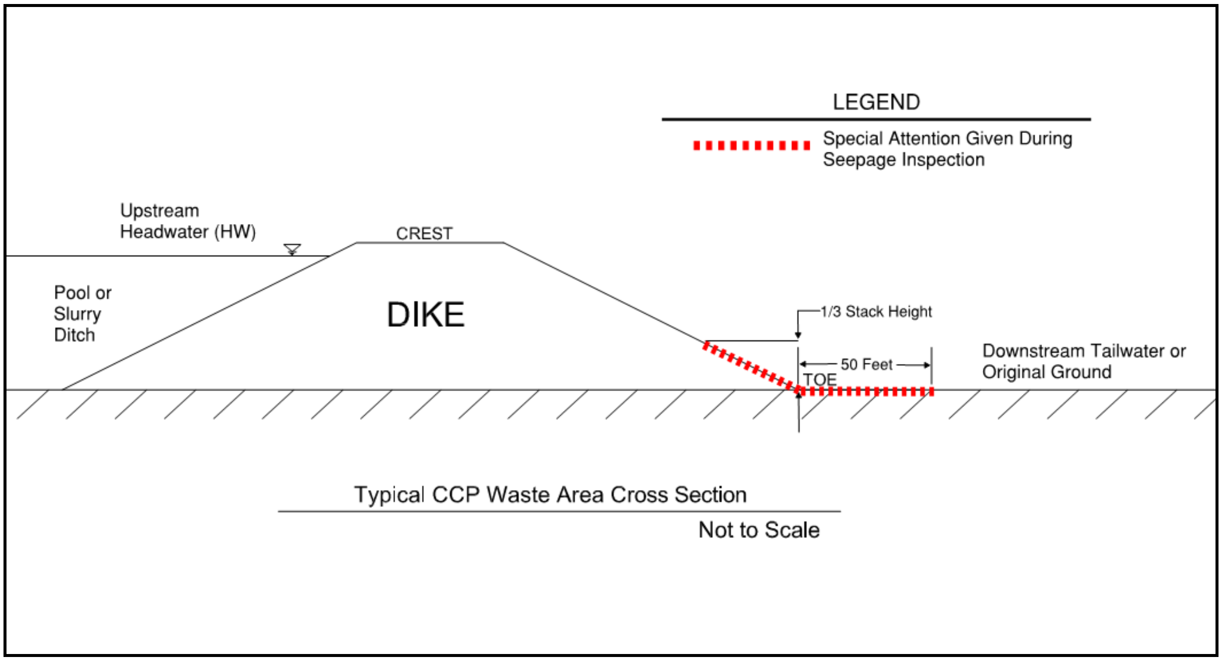


Figure 1. Seepage Inspection Location

2. Basic SAP Data

2.1. Purpose

The purpose of this SAP is to describe potential seepage action levels, and provide seepage short term management measures and actions in the event these action levels are observed.

2.2. Potential Impacted Area

Seepage related issues impact the integrity of earthen embankments. Seepage can lead to internal erosion of the embankment, known as piping, which has been the cause of many catastrophic failures in the past. Piping is a process where soil particles slowly carried out from inside the dam, eventually creating a tunnel or pipe. If the pipe forms all the way to the reservoir, the embankment will fail rapidly. Since the embankments at Gallatin Fossil Plant serve as an impoundment for ash slurry, it is imperative to maintain the embankments and prevent any possible failure from occurring. If a failure were to occur, the ash slurry could potentially contaminate Gallatin Fossil Plant and the Cumberland River.

2.3. Primary Responsibility and Frequency of Dike Safety Inspections

1. TVA RHO&M Field Supervisor for Gallatin Fossil Plant (**Field Supervisor**)

2. TVA RHO&M East Region Construction Manager

3. TVA RHO&M Program Manager for Gallatin Fossil Plant

Documented inspections should occur at a minimum of once per month. Additionally, there are two criteria which warrant an inspection. A documented inspection should occur following a significant precipitation event (0.5 inches of rain, 4 inches of snow), as well as following a change in the operation of the wet stack, pond, or other CCP wet waste area (switching between east/west ditch, switching ponds, raising pool elevations, etc.). A documented inspection involves inspecting the potential seepage areas noted on the plan views in Appendix A, paying particular attention to areas of concern previously identified. The **Seepage Log** should be updated to include new descriptions and photographs of any new areas of concern or changes to previously identified areas. Random inspections can occur on a more frequent basis if deemed necessary by the **Field Supervisor**.

3. Seepage Action Level Determination

For the purpose of this plan, three seepage action levels have been identified. The levels are based on potential risk associated with progressive erosion due to seepage and resulting breach of the embankment or impoundment.

Action Level 1 – Non-Flowing

- Wet areas
- Ponded Water

Action Level 2 – Flowing Seepage – No Erosion

- Non turbid (clear water) flow

Action Level 3 – Flowing Seepage – Active Erosion

- Turbid Flow
- Deposition of Sediment from Dike or Dam
- Boils (Ground Surface/ Underwater)
- Upstream Collapse or Sinkhole

3.1. Action Level 1 – Non Flowing

Seepage occurs in all earthen dams and dikes. The key is to properly collect and control seepage in a manner that does not cause damage to the embankment. Seepage that is not flowing but is evident by damp areas or ponded water does not generally represent an imminent threat to the embankment in terms of erosion (see Figure 2). However, if left unattended this seepage can lead to slope instabilities. Therefore, this should be noted so that it can be observed for changing conditions both at the downstream observation point and immediately upstream along the interior slopes.

Figure 2. Example of Action Level 1 – Non-Flowing – Wet Area

3.2. Action Level 2 – Flowing Seepage – No Erosion

Action Level 2 involves observations of flowing seepage, but evidence of erosion is not noted. Evidence of erosion can be in the form of turbid (muddy water) flow, sediment deposition, obvious hole or soil “pipe”. Evidence of erosion can be subtle and as a result, any flowing seepage should be carefully reviewed and monitored at least monthly. A picture of flowing seepage water showing no evidence of erosion is depicted in Figure 3. Note that a seep does not need to be continuously turbid for a piping situation to be forming.

Figure 3. Example of Action Level 2 – Clear Flowing – Seepage Boil

3.3. Action Level 3 – Flowing Seepage – Active Erosion

Left unmitigated seepage demonstrating active erosion can lead to progressive failure of the embankment and catastrophic loss of the impoundment. Evidence of erosion can be in the form of turbid flow, sediment deposition, boil, obvious hole or soil “pipe”. Evidence of erosion can be subtle and as a result, any flowing seepage should be carefully reviewed and monitored frequently. Careful attention should be given to seepage below water such as a stilling pond, creek or river (see Figure 6). This type of seepage is difficult to observe and determine if soil erosion is occurring. In moving water, evidence of seepage boils conveying embankment soil/ash materials will likely be (partially) washed away. Examples of active erosion are shown in Figures 4 thru 5.

Figure 4. **Example of Action Level 3 – Turbid Flowing – Seepage Boil**

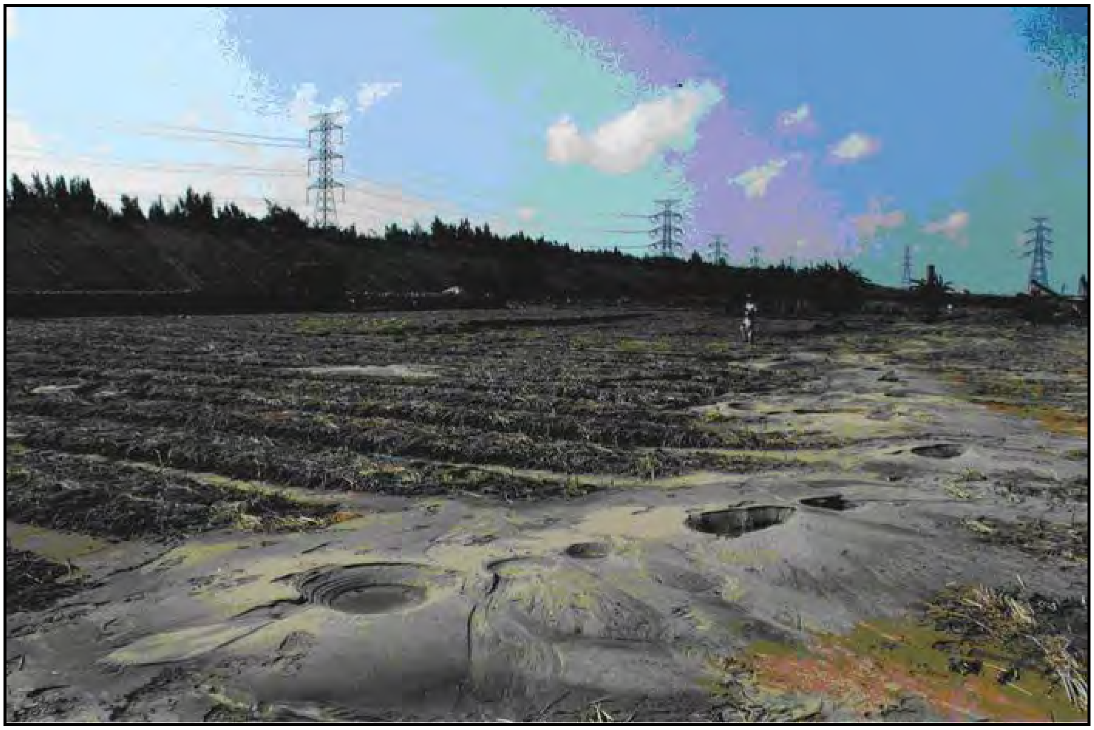


Figure 5. **Example of Action Level 3 – Deposition of Sediment from Dike**

Figure 6. Example of Action Level 3 – Underwater Turbid Flowing – Seepage Boil

4. Intermediate Corrective Measures

For each action level a typical corrective measure is listed below.

4.1. Action Level 1 – Non Flowing

- **Field Supervisor** should document the seepage area into the **Seepage Log** (see below).
- All observers should pay particular attention to conduits through the embankments.
- **Field Supervisor** should record the date, time, size of area, location, and photographs in the **Seepage Log**.

The **Seepage Log** should be kept at the Shift Operation Supervisor's (SOS) office such that inspectors (TVA, geotechnical consultant, or others) can document event triggers (date, time, location, pool level, etc.) and the site conditions observed for each seepage event. The **Seepage Log** shall function as a "living document" and be part of an ongoing monitoring program (to be controlled by TVA). As the monitoring program progresses, the **Seepage Log** will allow inspectors to summarize the historical conditions observed and provide a baseline of events to compare with future readings.

4.2. Action Level 2 – Flowing Seepage – No Erosion

- **Field Supervisor** should carefully inspect the area for outflow quantity, any transported material, and take photographs.
- If the seepage involves a conduit penetration associated with a spillway pipeline, storm culvert, or underdrain pipeline, the observer(s) should carefully inspect the

area by probing and /or carefully shoveling to see if the cause can be determined, determine if embankment materials are being transported, evident by turbid or cloudy water, and determine quantity of flow.

- Contact team members in accordance with Figure 8.
- Send photographs to the RHO&M Regional Construction Manager and CCP Program Manager for distribution.
- Geotechnical consultant, with concurrence of the TVA Program Manager and CCP Engineering Manager, should determine a plan of action within four hours of notification
- **Field Supervisor** should record the date, time, size of area, location, and photographs in the **Seepage Log**.

4.3. Action Level 3 – Flowing Seepage – Active Erosion

- **Field Supervisor** should carefully inspect the area for outflow quantity and transported material.
- **Field Supervisor** should determine if piping has occurred and extent by observing locations of seepage exits, take photographs, and contact team members in accordance with Figure 9.
- Geotechnical consultant, TVA Program Manager, and CCP Engineering Manager should determine a plan of action within four hours of notification such as lowering the pool, constructing a reverse graded filter, or sand bagging
- A typical reverse graded filter will consist of the following:
    - One foot of Concrete Sand (TDOT Concrete Sand)
    - One foot of TDOT No. 89 Stone
    - Two feet of TDOT Machine Rip Rap Class A-3
    - Silt Fence as required by guidance provided in the Best Management Practices for Erosion Prevention and Sediment Control
- An example of sandbagging is provided in Figure 7.
- **Field Supervisor** should record the date, time, size of area, location, and photographs in the **Seepage Log**.

Figure 7. Sand Bag Treatment (Temporary)

5. Materials On-Site

In case an emergency situation is observed during the inspection of the potential seepage areas, it is necessary to have materials readily available on-site to correct the situation. Table 1 below lists the materials to be stockpiled on-site and the quantity of each material.

Table 1. Stockpile Material Quantities

Material	Tons	Cubic Yards
Concrete Sand	90	60
TDOT No. 89 Stone	90	60
TDOT Machine Rip Rap Class A-3	180	120
Sandbags (filled)	300 (total)	NA
30" Diameter HDPE Pipe	100 feet	NA

The amount of materials to be stockpiled is based on a production rate of 60 cubic yards per hour for a 2.5 CY long reach excavator assuming a material unit weight of 110 PCF.

The materials should be stockpiled at the location determined by the **Field Supervisor**. The following earthwork equipment and qualified operator(s) should be located to place the material in case of an emergency:

- Long Reach Excavator
- Dump Truck
- Compactor, Bulldozer, Bobcat, any other nearby equipment which aids in the emergency

6. The SAP Process

6.1. Step 1 – Dike Observation or Event Detection

This step describes the detection of an unusual observation or emergency event and provides information to assist the Gallatin RHO&M **Field Supervisor** or appropriate personnel in determining the appropriate emergency level for the observation or event. These observations could be made by inspectors during routine inspections of the embankments, or by everyday personnel.

6.2. Step 2 – Emergency Level Determination

Following an unusual observation or emergency event detection, the **Field Supervisor** is responsible for classifying the event into one of the following three emergency levels:

6.2.1. Action Level 1 – Non Flowing

Observation is routine to other observations and a similar established plan of action for minor repair or continued observation will be required. If a Level 1 Emergency is identified, the following steps should be taken:

- Update maps and **Seepage Log**
- Inform GAF personnel if repairs are needed
- Determine if other work activities need to be made aware of observation.

6.2.2. Action Level 2 – Flowing – No Erosion

A change in condition or a condition that has not been previously identified and discussed with the geotechnical engineers. If a Level 2 Emergency is identified, the following steps should be taken:

- Inform individuals in accordance with the flowchart in Figure 8.
- Update map and **Seepage Log**
- Inform GAF personnel if repairs are needed
- Determine if other work activities need to be made aware of new conditions.

6.2.3. Action Level 3 – Flowing – Active Erosion

A change in condition that is drastic and could rapidly lead to failure of the embankment if not corrected. If a Level 3 Emergency is identified, the following steps should be taken:

- Inform plant SOS, who will initiate TVA plant-specific Emergency Action Plan (see Figure 9).
- Inform geotechnical consultant
- Develop safe plan of action for repair with geotechnical consultants
- Initiate repairs once plan has been approved by site safety and geotechnical consultant
- Update map and **Seepage Log**.

6.3. Step 3 – Notification and Communication

6.3.1. Notification

Following the determination of a possible seepage situation, it is necessary to notify the appropriate personnel discussed below for the required action to occur.

6.3.2. Communication

In case of an Action Level 2 emergency, the flowchart presented in Figure 8 should be followed to ensure the proper personnel are contacted. In an Action Level 3 emergency, the flowchart presented in Figure 9 should be followed.

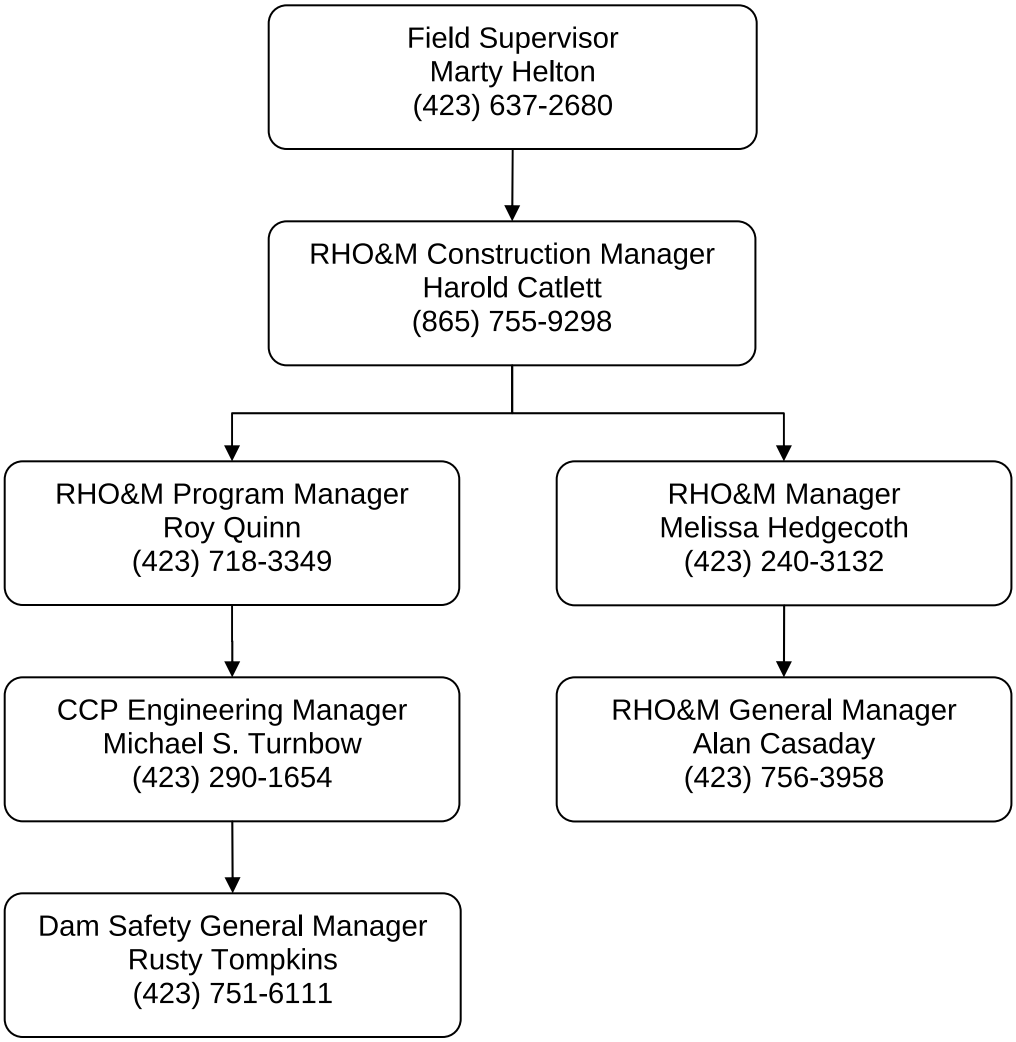


Figure 8. Level 2 Emergency Contact Flowchart

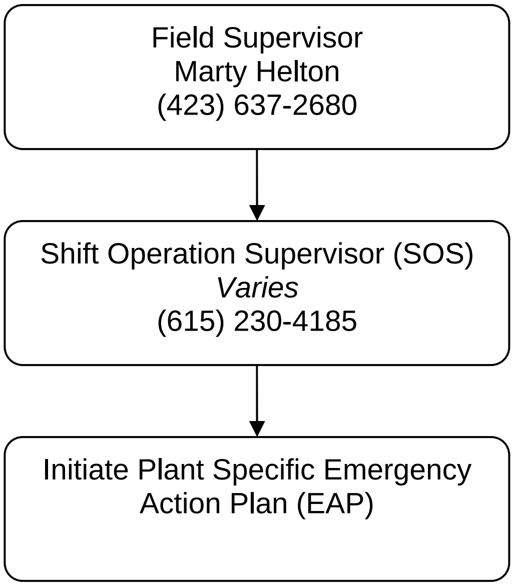
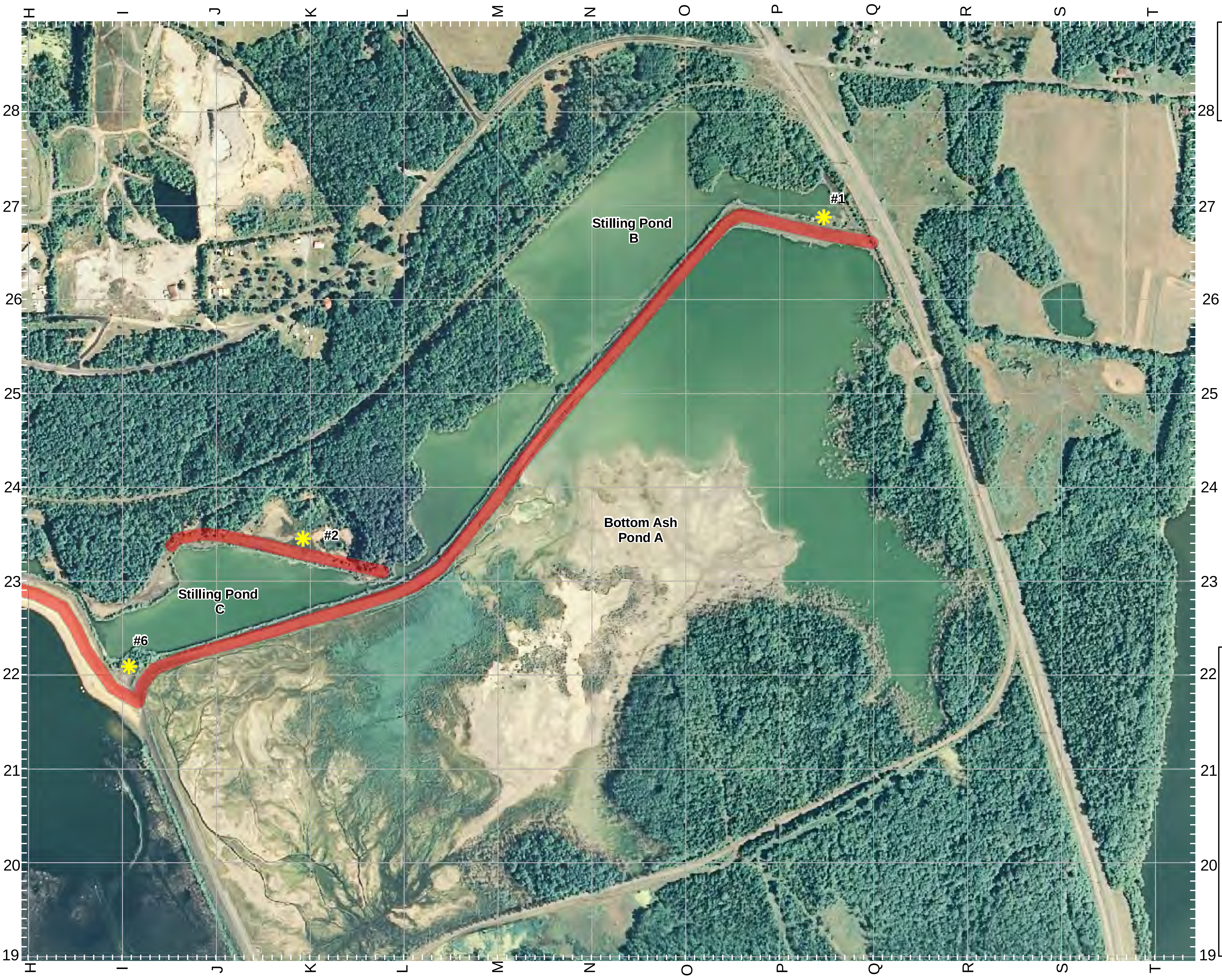


Figure 9. Level 3 Emergency Contact Flowchart

Appendix A

Ash Pond Complex Site Plans



Notes:
1. The areas identified on this drawing should not be considered as the only areas where seepage might occur. Therefore, a complete inspection of the dike should be performed annually as outlined in Stantec's Dam Safety Training Presentation dated August, 2009.
2. Grid spacing is 500 feet.

LEGEND

N

✳ ▬ **Areas of Concern**

🟥 **Potential Seepage Zone**

Feet
0 250 500

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Site Overview - GAF

Tennessee Valley Authority
Gallatin Fossil Plant
Gallatin, Summer County, Tennessee

PROJECT NO.	175560021
DATE	MAY 2010
DRAWN BY	AMG
CHECKED BY	
CHECKED BY	
SCALE	1" = 500'
REVISED	
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

SHEET

1 OF 3

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Notes:
1. The areas identified on this drawing should not be considered as the only areas where seepage might occur. Therefore, a complete inspection of the dike should be performed annually as outlined in Stantec's Dam Safety Training Presentation dated August, 2009.
2. Grid spacing is 500 feet.

LEGEND

N

✳ ▬	**Areas of Concern**
▭	**Stockpile Location**
🟥	**Potential Seepage Zone**

0 250 500 Feet

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40511-2050
859-422-3000

Site Overview - GAF

Tennessee Valley Authority
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Gallatin, Summer County, Tennessee

PROJECT NO.	175560021
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SCALE	1" = 500'
REVISED	
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SHEET

2 OF 3

Notes:
1. The areas identified on this drawing should not be considered as the only areas where seepage might occur. Therefore, a complete inspection of the dike should be performed annually as outlined in Stantec's Dam Safety Training Presentation dated August, 2009.
2. Grid spacing is 500 feet.

LEGEND

N

✳ ▬ Areas of Concern

🟥 Potential Seepage Zone

Feet
0 250 500

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Stantec

Site Overview - GAF

Tennessee Valley Authority
Gallatin Fossil Plant
Gallatin, Summer County, Tennessee

PROJECT NO.	175560021
DATE	MAY 2010
DRAWN BY	AMG
CHECKED BY	
CHECKED BY	
SCALE	1 ' = 500'
REVISED	
1.	
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SHEET

3 OF 3

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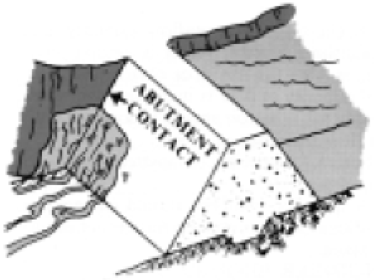
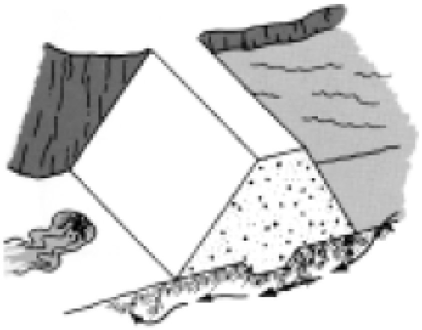
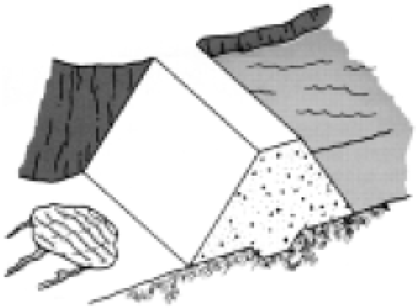
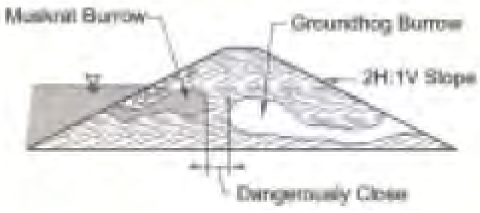
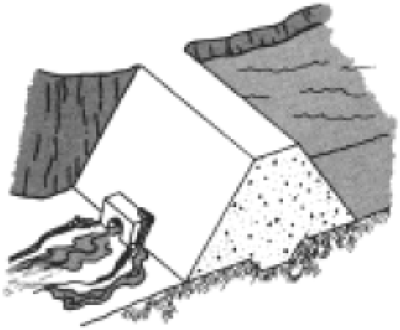
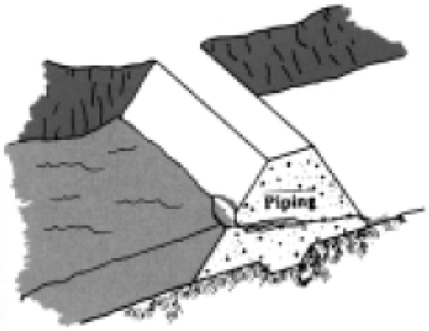
Appendix B

Possible Seepage Problems and Recommendations

Appendix B – Possible Problems and Recommendations

Seepage Problem	Recommendations
Seepage Water Exiting at Abutment Contact  	Study leakage area to determine quantity of flow and extent of saturation. Stake out the saturated area and monitor for growth or shrinkage. Inspect frequently for slides. Water level in the impoundment may be lowered to increase embankment safety. A QUALIFIED ENGINEER should inspect the conditions and recommend further actions to be taken.
Seepage Water Exiting as a Boil in the Foundation 	Examine boil for transportation of foundation materials, evidenced by discoloration. If soil particles are moving downstream, create a sand bag or earth dike around the boil. This is a temporary control measure. The pressure created by the water level within the dike may control flow velocities and prevent further erosion. If erosion continues, lower the reservoir level. A QUALIFIED ENGINEER should inspect the condition and recommend further actions to be taken.
Spongy Condition at Toe of Dam 	Carefully inspect the area for outflow quantity and any transported material. A QUALIFIED ENGINEER should inspect the condition and recommend further actions to be taken.

Appendix B – Possible Problems and Recommendations

Seepage Problem	Recommendations
Rodent Activity 	Control rodents to prevent more damage. Determine exact location of digging and extent of tunneling. Remove rodents and backfill existing holes.
Seepage Water Exiting from a Point Adjacent to the Outlet 	Investigate the area by probing and/or carefully shoveling to see if the cause can be determined. Determine if leakage water is carrying soil particles evidenced by discoloration. Determine quantity of flow. If flow increases, or is carrying embankment materials, reservoir level should be lowered until leakage stops. A QUALIFIED ENGINEER should inspect the condition and recommend further actions to be taken.
Sinkhole 	Inspect other parts of the dam for seepage or more sinkholes. Identify exact cause of sinkholes. Check seepage and leakage outflows for dirty water. A QUALIFIED ENGINEER should inspect the conditions and recommend further actions to be taken.

Appendix B – Possible Problems and Recommendations

Seepage Problem	Recommendations
Trees and Brush  	Remove all trees and shrubs on and within 25 feet of the embankment. Properly backfill void with compacted material. A QUALIFIED ENGINEER may be required.

Source: Connecticut Department of Environmental Protection, Guidelines for Inspection and Maintenance of Dams, September 2001.

Appendix C

Seepage Log

GAF Seepage Log

Gallatin Fossil Plant
Gallatin Tennessee
Updated June 22, 2010 Rev. 1

Area of Concern	Coordinate Location (Northing/Easting)		Date	Time	Approximate Size (Linear Feet)	SAP Level	Description	Mitigation Status/ Future Plans
1	Survey Requested		4/13/2010	N/A	2' x 3'	1	Redwater seep discovered by Stantec in January 2009 just above pool level of stilling pond to the east of pond A outlet system. Minimal to no flow observed. No piping, SAP Level 1.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure
2	Survey Requested		4/13/2010	N/A	400' to 500' long along toe of saddle dike	1	Redwater seep discovered by Stantec in January 2009 along toe of saddle dike Stilling Pond C. Minimal to no flow observed. No piping, SAP Level 1.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure
3	702974.32	187910.75	4/13/2010	N/A	5' x 20'	1	Redwater seep discovered by TVA personnel in March 2010 just above the south dike toe at Pond E. Very mall flow observed. No piping, SAP Level 1.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure
4	703547.89	1877848.78	4/13/2010	N/A	5' x 20'	1	Seep discovered by TVA personnel in March 2010 just above west dike at toe of Pond E. Wet/soft ground observed with no flow and no piping. SAP Level 1.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure
5	703906.95	1877803.21	4/13/2010	N/A	10' to 15' wide by 100' to 200' long	1	Seep area is located just beyond the west Pond E dike area adjacent to the pool level of Old Hickory Lake. This could be remaining wet areas from recent high pool events of Old Hickory Lake, and needs further observations. SAP Level 1.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure
6	Survey Requested		3/10/2010	N/A	1' x 1'	1	Possible seep located at the northwest dike toe of Pond A, discovered in February by TVA. Some minor flow was noted by Stantec on May 3, 2010 after heavy rain event. The dike crest in this area tends to pool water during rain, area could be result of stromwater infiltration into the dike that is slowly exiting at the toe below. SAP Level 1.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure
7	Survey Requested		5/3/2010	N/A	2' x 2'	1	Possible seep located just west of Seep 3 at the south dike toe of Pond E. Discovered by Stantec May 3, 2010 just after heavy rain event. Area exhibited very low flow and could be a result of stormwater infiltration into the dike that is slowly exiting at the toe below. SAP level 1.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure

GAF Seepage Log

Gallatin Fossil Plant
Gallatin Tennessee
Updated June 22, 2010 Rev. 1

Area of Concern	Coordinate Location (Northing/Easting)	Date	Time	Approximate Size (Linear Feet)	SAP Level	Description	Mitigation Status/ Future Plans
8	Survey Requested	1998	N/A	30' to 40' rectangular area	2	GAF Seep 1A - seepage area located at the toe of Closed Disposal Area on southeast side. Monitored by TVA to comply with TDEC-approved closure plan. Seepage points located within 30' to 40' rectangular area. Typically exhibits saturared ground conditions. Seepage amounts and flow vary depending on prevailing weather conditions. Seepage is clear water and slow flowing to no flow. SAP Level 2.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure
9	Survey Requested	1998	N/A	approximately 500' long along toe of dike	2	GAF Seep 2E - seepage area located at the toe of Closed Disposal Area on northwest side. Monitored by TVA to comply with TDEC-approved closure plan. Several seepage points located within strip along the dike toe for a length of 500 feet. Typically exhibits saturared ground conditions. Seepage amounts and flow vary depending on prevailing weather conditions. Seepage is clear water and slow flowing to no flow. SAP Level 2.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure
10	Survey Requested	6/22/2010	AM	N/A	1	Seep Initially observed by TVA on 6/22/2010 approximately 35 feet west of existing seep on Pond E dike. Observed to have clear discharge. SAP Level 1.	Continued monitoring - Closure design currently being conducted by URS seep areas potentially will be adressed during closure

Note: Initial Seepage Log was developed based on Stantec's understanding of known issues from Phase 1 and Phase 2 assessments and the 2010 Annual Inspection. No field visit was conducted to verify current seepage areas of concern.

Area of Concern 1

4/13/2010
Small (2' x 3') red-water seep discovered by Stantec in January, 2009 just above pool level of stilling pond and to the east of Pond A outlet system. No change observed in appearance throughout course of this work. Minimal to no flow observed. No piping. SAP Level 1.

Area of Concern 2

4/13/2010
Red-water seeps approximately 400' to 500' long discovered by Stantec in January, 2009 along toe of saddle dike at Stilling Pond C. No significant change observed in appearance throughout course of this work. Minimal to no flow observed. No piping. SAP Level 1.

Area of Concern 3

4/13/2010
Small red-water (5' x 20') seep discovered by TVA personnel in March, 2010 just above the south dike toe at Pond E. Very small flow observed. No change observed in appearance throughout course of this work. No piping. SAP Level 1.

Area of Concern 4

4/13/2010
Small (5’ x 20’) seep discovered by TVA personnel in March, 2010 just above west dike toe at Pond E. Wet/soft ground observed with no flow and no piping. No change observed in appearance throughout course of this work. SAP Level 1.

Area of Concern 5

4/13/2010
This approximately 10’ to 15’ wide by 100’ to 200’ long possible seepage area is located just beyond the west Pond E dike toe area adjacent to the pool level of Old Hickory Lake. This could be remaining wet areas from recent high pool events of Old Hickory Lake, and needs further observations with time to reach conclusions. SAP Level 1.

Area of Concern 6

3/10/2010
This small (1’ x 1’) possible seepage area is located at the northwest dike toe of Pond A. It was discovered in February by TVA. It also had some minor flow that was noted by Stantec on May 3, 2010 just after the very heavy rain event that occurred May 1 and 2, 2010. The dike crest in this area tends to pool water during rain, and this area could be a result of stormwater infiltration into the dike that is slowly exiting at the dike toe below. SAP level 1.

Area of Concern 7

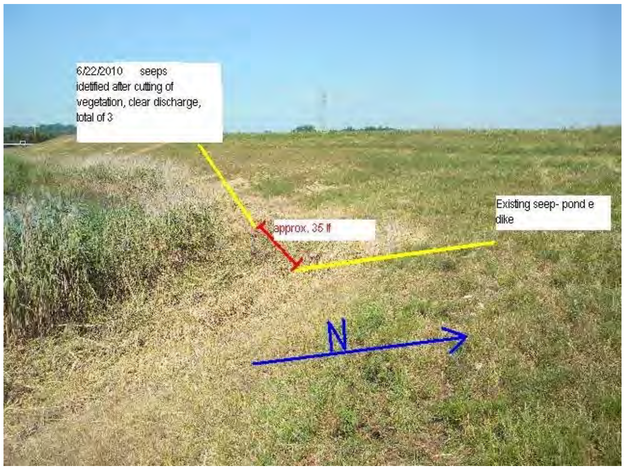
5/3/2010
This (2’ x 2) possible seepage area is located just west of Seep 3 at the south dike toe of Pond E. It was discovered by Stantec on May 3, 2010 just after the very heavy rain event that occurred May 1 and 2, 2010. The area exhibited very low flow. Because it was discovered just after the heavy rains, this area could be a result of stormwater infiltration into the dike that is slowly exiting at the dike toe below. SAP Level 1

Area of Concern 8

1998
GAF Seep 1A. Seepage area at toe of Closed Disposal Area on southeast side. Being monitored quarterly by TVA to comply with TDEC-approved closure plan. A few seepage points located within an approximate 30 to 40 ft. rectangular area. Typically exhibits saturated ground conditions. Seepage amounts and flow vary depending on prevailing weather conditions. Typical seepage is clear water and slow flowing to no flow. SAP Level 2.

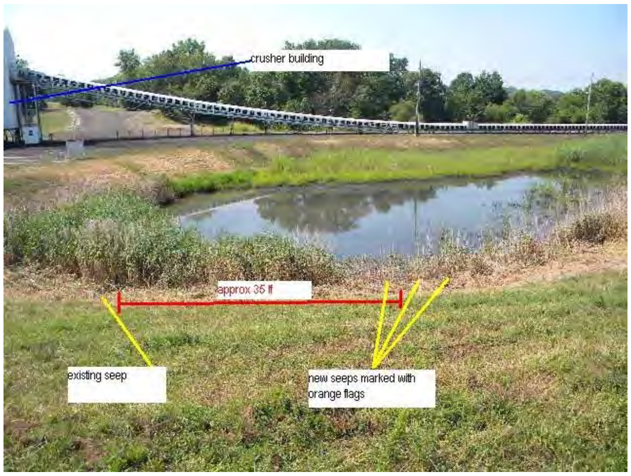
Area of Concern 9

1998
GAF Seep 2E. Seepage area at toe of Closed Disposal Area on northwest side. Being monitored quarterly by TVA to comply with TDEC-approved closure plan. Consists of several seepage points located within strip along the dike toe for a length of approximately 500 feet. Seepage amount and flow vary depending on prevailing weather conditions. Also typically exhibits saturated ground conditions. Typical seepage is clear water and slow flowing to no flow. SAP Level 2.



Area of Concern 10

6/22/2010
Seep Initially observed by TVA on 6/22/2010 approximately 35 feet west of existing seep on Pond E dike. Observed to have clear discharge. SAP Level 1.



Area of Concern 10

6/22/2010
Seep Initially observed by TVA on 6/22/2010 approximately 35 feet west of existing seep on Pond E dike. Observed to have clear discharge. SAP Level 1.

Appendix D

GAF CCP Emergency Action Plan

APPENDIX A

Document 10

Seismic Slope Stability Analysis, Stantec, September 22, 2011; February 15, 2012

Stantec

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Louisville, KY 40223-5301
Tel: (502) 212-5000
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September 22, 2011 ltr_002_175551015

Mr. Michael S. Turnbow
Tennessee Valley Authority
1101 Market Street, LP 2G-C
Chattanooga, Tennessee 37402-2801

Re: Results of Seismic Slope Stability Analysis
Active CCP Disposal Facilities
Gallatin Fossil Plant

Dear Mr. Turnbow:

As requested, Stantec Consulting Services Inc. (Stantec) has conducted seismic slope stability analyses to support the U.S. Environmental Protection Agency's assessment of TVA's CCP disposal facilities. The results for Gallatin Fossil Plant (GAF) are presented in this letter.

1. Introduction

The U.S. Environmental Protection Agency is undertaking a nationwide effort to assess coal combustion product (CCP) disposal facilities. These assessments are now underway for facilities at TVA's fossil plants. To support TVA, Stantec has conducted seismic stability analyses for GAF's active disposal facilities, which include Ash Ponds A and E.

The seismic slope stability analyses results presented in this letter employ a pseudostatic approach and are representative of current conditions. For seismic assessment in upcoming closure design of these facilities, TVA will undertake a comprehensive risk/consequences-based approach, with design and mitigation decisions being based on the likelihood and consequences of failure. This approach is described in the document presented in Enclosure A. For GAF, closure of Ash Pond E is currently planned for 2019 – 2020, and closures of Ash Pond A and the Stilling Ponds are currently planned for 2020 – 2021.

2. Seismic Stability Analysis Approach

Seismic slope stability has been performed for current conditions using pseudostatic stability methods, where the added inertial load from an earthquake is represented by a simple horizontal pseudostatic coefficient which provides an approximate representation of the dynamic loads imposed by an earthquake. Specifics related to the analyses/approach are as follows:

- Subsurface data was obtained from Stantec's geotechnical report entitled Report of Geotechnical Exploration and Slope Stability Evaluation; Ash Pond/Stilling Pond Complex; Gallatin Fossil Plant; Gallatin, Tennessee; May 27, 2010.

- SLOPE/W software (from GEO-SLOPE International, Inc.) was used to perform the calculations.

- One existing SLOPE/W cross-section model per disposal facility was selected for analysis. The selected sections are representative of the facility's lowest current static (long-term) factor of safety, with consideration given to proper representation of a release/breach. The selected SLOPE/W models were updated to reflect any significant mitigations or operational changes that have occurred since completion of Stantec's geotechnical studies.

- Undrained shear strength parameters were used.

- Ground motion level corresponding to a return period of 500 years (or approximate exceedance probability of 10% in 50 years) was used for selection of horizontal seismic coefficients. This return period is consistent with seismic stability analysis guidance provided by Tennessee's dam safety regulations Chapter 1200-5-7, "Rules and Regulations Applied to the Safe Dams Act of 1973". The peak ground acceleration (or seismic coefficient) for a 500 year return period was selected from Table 17 of TVA's March 28, 2011 region-specific seismic hazard study performed by AMEC Geomatrix, Inc.

- A target factor of safety (FS) of 1.0 was considered for comparing results.

3. Results

The results of the pseudostatic stability analyses indicate factors of safety of 1.2 for Ash Pond A and 1.6 for Ash Pond E, which exceed the target of 1.0. Enclosure B contains a summary spreadsheet, SLOPE/W cross-sections, and plan views showing cross-section locations.

Stantec appreciates the opportunity to provide these services. If you have questions, or if we can provide additional information, please let us know.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Randy L. Roberts

Randy L. Roberts, PE
Principal

Enclosures

/cdm

Enclosure A

White Paper - Seismic Risk Assessment Closed CCP Storage Facilities

Seismic Risk Assessment
Closed CCP Storage Facilities
Tennessee Valley Authority Fossil Plants

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Seismic Risk Assessment
Closed CCP Storage Facilities
Tennessee Valley Authority Fossil Plants

This document outlines proposed engineering analyses to estimate seismic failure risks at wet storage facilities for coal combustion products, following closure, at various TVA fossil power plants. The specific details outlined in this document are subject to future discussion and modification by the project team.

OVERVIEW

Tennessee Valley Authority (TVA) operates storage facilities for coal combustion products (CCPs) at eleven fossil power generating stations. As TVA transitions to dry systems for handling these materials, 18 to 25 wet storage facilities (CCP ponds, impoundments, dredge cells, etc.) will be closed (drained and capped). The CCP storage facilities are currently operated in accordance with state and federal regulations, but previously issued permits have not required evaluations for seismic performance. Moreover, the existing permits do not require seismic qualification for the storage facilities in their closed configurations.

TVA recognizes there is a potential for strong earthquakes to occur within the region, and there is a tangible risk for seismic failure at each closed CCP facility. These risks, including both the likelihood of failure and the consequences, must be understood to effectively manage TVA's portfolio of byproduct storage sites. This white paper summarizes the methodology that will be used to estimate these risks at the CCP storage facilities following closure.

Seismicity in the TVA service area is attributed to the New Madrid fault and smaller, less concentrated crustal faults. These two earthquake scenarios generate significantly different seismic hazards at each locality and will be considered independently within the risk assessment. At each closed byproduct facility, potential seismic failure modes will be evaluated in sequence. Instability due to soil liquefaction, slope instability due to inertial loading, and other potential failure mechanisms will be addressed. Seismic performance will be evaluated for differing earthquake return periods until a limiting (lowest return period) event that would cause failure is obtained. The probability of seismic failure will then correspond to the probability of this limiting earthquake event. The assessment of risk will also include estimates of potential consequences, as well as costs to mitigate the risks, that reflects the unique setting of the individual storage facilities after closure.

Following the same general methodology, seismic risks will be estimated in two phases. The near-term "Portfolio Seismic Assessment" will provide a rough estimate of seismic risks. The likely performance of each facility will be evaluated using simplified analyses, empirical methods, and the judgment of experienced engineers. The results will establish a ranking of the relative risks across the closure portfolio and also provide a preliminary picture of overall seismic risk. For the subsequent "Facility Seismic Assessments", seismic performance will be judged on the basis of site-specific data and detailed engineering analyses, which will be completed during the closure design process for individual facilities.

SEISMIC RISKS

This white paper provides an overview of the engineering methods proposed by Stantec for estimating seismic risks at TVA's closed byproduct storage sites. For each facility, four specific questions must be answered quantitatively:

(1) What is the approximate probability that a strong earthquake will occur?

Several seismic source zones could produce earthquakes large enough to impact these TVA sites. Very large magnitude earthquakes have occurred within the New Madrid seismic zone, which is located along the western boundaries of Tennessee and Kentucky. Because of their observed large magnitude and frequency of occurrence, New Madrid events contribute substantially to the seismic risks at all TVA sites. Ground motions from a New Madrid earthquake would attenuate with distance toward the east, such that local area sources also contribute significantly to site-specific seismic hazards.

Seismicity across the Tennessee Valley was previously characterized by AMEC/Geomatrix (2004), in a probabilistic study that focused on TVA dam sites. The same seismogenic model can be applied in evaluating earthquakes that would impact other TVA sites. Accordingly, probabilistic seismic hazards obtained from the 2004 AMEC/Geomatrix model will be used in the seismic risk assessment of the closed CCP storage facilities.

(2) Will a given earthquake cause failure in the closed facility?

Many of the TVA byproduct storage facilities are underlain by a substantial thickness of loose, saturated, alluvial soils (silts and sands). Some facilities will have layers of ash or other uncemented CCPs that remain saturated following closure. These materials, especially sluiced fly ash, are prone to liquefaction in a strong earthquake, as cyclic motions cause a build up of pore water pressure and a consequent loss of effective stress and shearing resistance. Extensive liquefaction in a foundation or CCP deposit under a storage facility would be expected, in most cases, to result in lateral spreading and massive slope movements (failure). Even without liquefaction, large slope deformations or failures may be triggered by lateral inertial loads during an earthquake. Liquefaction and dynamic loading of slopes are the most likely failure mechanisms, but other seismic failure modes, which may be unique to a particular closed storage facility, must also be evaluated.

(3) What are the potential consequences of a failure?

In addition to understanding the probability of failure, a risk assessment should consider the potential consequences. A failure is likely to have economic costs associated with clean-up and restoration of the site. Depending on the local site conditions, failure of a closed CCP facility may or may not cause significant impacts on the environment, waterways, transportation routes, buried or overhead utilities, or other infrastructure. Substantial economic costs would result if power generation is interrupted. Failure consequences may also include the potential loss of human life at some sites.

In this proposed seismic risk assessment, the definition of "failure" will be constrained to mean the displacement of stored materials to a distance beyond the permitted boundary of the facility. While smaller deformations in a closed storage facility could cause economic damages, the resulting consequences for TVA should be manageable. Hence, this risk assessment will focus on potential "failures" where stored materials could move past the permitted boundary.

(4) What are the approximate costs to mitigate the risks of a seismic failure?

With an understanding of the probability and consequences of failure, the potential risks can be quantified and understood, possibly leading to decisions to mitigate seismic risks in the closure of certain facilities. Mitigation measures might include ground improvement to reduce liquefaction potential (stone columns, deep soil mixing, jet grouting, or other appropriate technology), stabilization of slopes by flattening or buttressing, enhanced drainage features, or some other engineered solution. The potential cost of these risk mitigation strategies are needed to make appropriate management decisions.

PORTFOLIO AND FACILITY ASSESSMENTS

Seismic evaluations will be completed for each of the CCP storage facilities that TVA has slated for closure; a tentative list is given in Table 1. The assessment of seismic risks will be accomplished in two phases:

A. Portfolio Seismic Assessment

In this first phase, the seismic risk assessment will be carried out using general site information, simplified analyses, empirical methods, and the judgment of experienced engineers. A team of four to five engineers will complete this evaluation for the entire portfolio, with assistance from the engineering teams currently working on each facility. After the probabilistic seismic hazards are defined, this phase of the work can be completed in a relatively short timeframe.

Given the level of effort and the simplified engineering analyses to be employed, the seismic risk estimates from the Phase A assessment will be approximate. Rather than attempting to compute precise risk numbers, Phase A will focus on capturing the relative risks between the different closed facilities. The key to successfully meeting this objective will be the consistent application of the assessment process across the portfolio.

This effort will result in a ranked list of sites that can be used to illustrate where seismic risks are greatest within the portfolio. The results will also provide some insight for understanding and communicating the magnitude of potential risks associated with seismic loading of the closed CCP facilities.

As a secondary objective, the Phase A assessment team will also consider the potential for failure of the active storage facilities, due to an earthquake occurring prior to closure. The seismic risks associated with the operating facility will not be estimated, but the Phase A assessment process provides an opportunity to identify potential failure mechanisms that should be addressed in the short term. This information may suggest the need to re-prioritize the closure schedule. Prior to closure, many of the wet CCP storage facilities retain large pools of water and are thus more susceptible to uncontrolled releases in an earthquake. TVA has already made the decision to close these wet storage facilities to manage these risks, so the effort in Phase A will focus on identifying sites that may have unusually high seismic risks and deserve more study or higher priority in the closure program.

B. Facility Seismic Assessment

In this subsequent phase of work, more detailed engineering analyses will be carried out using site-specific geometry, subsurface conditions, material parameters, and results from static slope stability analyses. Simplified, state-of-the-practice methods of engineering analysis will be used; more complex analytical methods will be generally impractical for this risk assessment.

This phase of the work will be accomplished for individual facilities as part of the closure design, after the completion of other engineering analyses. The risks will be quantified by the design team, with assistance from the portfolio seismic assessment team. Significant, detailed effort will be required to assess each closed facility.

Compared to Phase A, the risk estimates obtained at this stage will be more reliable and better represent the actual risks for seismic failure. While it will be impossible to know how accurately the risks have been characterized at the completion of Phase B, the objective is to obtain results that are within perhaps ± 30% of the “actual” risk numbers. TVA expects to use the Phase B results to decide if the risks are acceptable, or if the closure design should be modified to mitigate risks for a seismic failure.

The engineering methodology (described below) to be followed in the Phase A and B evaluations will not characterize all of the uncertainties with respect to seismic performance. The uncertainties in the soil parameters and in the liquefaction, stability, and deformation analyses will not be quantified and carried through the risk assessment. Consequently, the estimated risk numbers will be approximate, but the results will be sufficiently accurate to support TVA decisions regarding prioritization for closure or the need for seismic mitigation. At most sites, the risks are expected to be high enough or low enough that further refinement in the risk numbers would not change these decisions. More detailed analysis beyond Phase B would be unjustified in these cases.

This assessment plan does not preclude the possibility that more detailed risk evaluations could be undertaken in subsequent phases of work. The Phase B results might reveal a subset of closed facilities with marginal risks, where a more rigorous and complete calculation of the risks would be needed to support a management decision. Hence, at the conclusion of the Phase B assessments, a “Phase C” evaluation may be needed for select sites and facilities, wherein uncertainties in the soil parameters and performance analyses would be quantified and carried through the risk assessment.

RESULTS AND APPLICATION

The results from the Phase A Portfolio Assessment will be presented in a table, like Table 1. For each facility evaluated, the estimated annual probability of failure due to a seismic event, the expected consequences (economic costs and potential loss of life), and the mitigation costs (design features to reduce risks) will be tabulated. The same parameters, but more accurate numbers, will be reported from the more in-depth Phase B assessments. A qualitative description of the data quality (based on the number of borings, test data on key soil properties, etc.) will also be included, to indicate how well the site conditions were characterized at the time of the Phase A or B assessment.

In both Phase A and B, the evaluation teams will prepare a discussion of significant issues driving the seismic risks at each site. This summary will include knowledge gaps, likely failure mechanisms, unique consequences, suggested approaches for risk mitigation, and other key information. The Phase A evaluation of a facility may point out the need for additional data to support later seismic analyses in Phase B; needed field or laboratory testing could then be accomplished and documented as part of the facility closure design effort.

In the short term, TVA will utilize the Phase A results to better plan budgets and schedules for managing the closure process over the next several years. The Phase A assessment will also be used as an opportunity to identify operating facilities with especially high seismic risks. While these risks will not be quantified for conditions prior to closure, the consideration of potential seismic failure modes may prompt additional study and reconsideration of priorities. Where justified, the priorities for closure may be changed to more quickly address sites with higher seismic risks.

More accurate risk estimates will be obtained from the Phase B assessments, which will be completed as part of the closure design process. Those results will be used, within TVA's existing decision making framework, to judge if seismic mitigation is needed. For context, the criteria in Tables 2 and 3 represent the risk-based framework TVA uses to guide enterprise-level decisions. This framework relies upon broad, qualitative scoring of consequences and risks for the organization. For managing the seismic risks at the closed CCP facilities, complete probabilistic calculations of risk are not needed; approximate estimates of seismic risk will be sufficient to support TVA decisions.

The risks computed in Phase A and B will not be compared to a prescribed threshold or design risk level. Criteria for tolerable seismic risk in these closed CCP storage facilities has not been defined in the existing permits, in TVA policy, or in TVA design guidance.

METHODOLOGY

The same general methodology, outlined in ten steps below and in Figures 1 through 4, will be used to evaluate seismic risk in both the Phase A Portfolio Assessments and the Phase B Facility Assessments. While advanced engineering analyses may be required to demonstrate acceptable seismic performance in a design situation, simplified analyses will be used here, consistent with the goal of estimating the probability of failure.

In Step 1, seismic hazard parameters will be defined for each site; the results will be used as inputs for both the Phase A and Phase B assessments. Then, the evaluation of a particular facility will begin with a review of existing site information (Step 2), followed by engineering analyses for seismic performance. As described in Steps 3 through 7 below, the engineering analyses in Phase B will be more detailed than the simplified estimates in Phase A. The analyses will commence with an initial selection of an earthquake return period and evaluation for seismic performance. Steps 3 through 7 will be repeated until the limiting (lowest) earthquake return period expected to cause failure is obtained. Flowcharts summarizing Steps 1 through 7 in the Phase A and B seismic performance assessments are given in Figures 3 and 4, respectively. The earthquake event with the lowest return period that causes failure will then be used to compute the probability of failure in Step 8. The potential consequences and mitigation costs will be estimated in Steps 9 and 10.

Step 1 – Define Seismic Input Parameters

Seismic hazards at TVA dam sites were quantified in a 2004 study by AMEC/Geomatrix. The New Madrid fault zone and several area source zones contribute to the seismicity of the region, as represented schematically in Figure 1. The New Madrid seismic zone is characterized by a large linear, combined reverse/strike-slip fault. Earthquakes in the area source zones are more diffuse (less concentrated in clusters) and tend to occur in zones of weakness of large crustal extent rather than along narrow, well-defined faults. Earthquakes occurring within the New Madrid Seismic Zone and in area sources outside of it will be considered in developing seismic input parameters for each CCP facility. However, only seismic source zones that contribute significantly to the ground motion hazard at a particular site will be used to develop seismic input parameters.

The national USGS seismic hazard model will not be used in these seismic risk assessments; instead, TVA will ask AMEC/Geomatrix to compute the site-specific seismic hazards for each closed CCP facility. The needed information can be obtained from the existing seismogenic model, but will need to separately consider the hazards associated with the New Madrid events and all other seismic sources (Figure 2), hereafter referred to in this white paper as the "earthquake scenarios". The following parameters are needed for each earthquake scenario:

- Uniform hazard spectra for frequencies from 0.25 to 100 Hz (100 Hz value is equivalent to peak ground acceleration, PGA) at the top of rock for a range of return periods from 100 to 2,500 years.
- De-aggregation for relevant ground motion frequencies (one or more of the following: 0.5, 1.0, 2.5, 5.0, and 100 Hz) at each return period. The de-aggregation results will be used to select appropriate, representative earthquake parameters (magnitude and distance from the site), from which inputs needed for liquefaction analyses can be developed.

In the Phase A effort, the project team (including seismologists designated by TVA) will meet to consider the earthquake hazard data produced by the AMEC/Geomatrix model for each site. The team will reach consensus on the appropriate parameters (return period, earthquake magnitude, and peak ground acceleration) to be used in evaluating each facility, before proceeding with work on subsequent steps of the analysis. The seismic parameters to be tabulated (Table 4) will then be used in both the Phase A and Phase B assessments.

Ground motion time histories will be needed for the detailed Phase B calculations, and TVA will need to ask AMEC/Geomatrix to provide:

- Representative acceleration time histories (two orthogonal components), representing ground motions at the top of the rock profile for the specified earthquake return periods.

Given the results of the Phase A assessment, the Phase B analyses will focus on a narrower range of possible earthquakes. Hence, acceleration time histories will not be needed for every seismic event listed in Table 4.

Step 2 – Review Site and Facility Information

To meet the requirements for closure of TVA ash storage facilities, the closed condition may involve placement of compacted ash behind a strengthened dike, drainage of pond water to the levels of the surrounding groundwater table, and capping of the area with native soils. The collection of available site information for each facility will be reviewed from a seismic performance perspective. For the Phase B assessment, this information will be augmented with new data that becomes available during the closure design process.

The project information needed for each storage facility includes:

- Planned geometry of the closed storage facility, as needed to meet current design criteria and regulatory requirements.
- Geologic mapping and related information about the site geology.
- Historical records and other information related to site development.
- Boring logs, SPT data, CPT data, shear wave velocities, etc. from field explorations.
- Laboratory data from testing of site materials, including classification, Atterberg limits, moisture content, particle size, specific gravity, unit weight, compaction tests, and other relevant test data.
- Laboratory data on measured strength properties, for both drained and undrained conditions.
- Previously completed slope stability analyses, where available, will be modified for calculations in the risk assessments.

Step 3 - Evaluate Potential for Soil Liquefaction

The potential for soil liquefaction may be the greatest contributor to failure risk at many of the TVA storage sites. Liquefaction will thus be considered first in the assessment of seismic performance at each closed facility (Figures 3 and 4).

The Phase A assessment will utilize empirical charts and back-of-the-envelope calculations to judge if liquefaction would be likely for a given earthquake scenario. For example, Ambraseys (1988) compiled magnitude, epicentral distance, and whether or not liquefaction was observed in past earthquakes, and then suggested a threshold boundary (in terms of magnitude and epicentral distance) where liquefaction might occur in natural soil deposits. Selected, parametric calculations with the simplified procedure outlined by Youd et al (2001) will also be useful in judging what earthquakes would cause liquefaction in the Phase A Portfolio Assessments. These empirical methods may be unconservative for evaluating saturated CCPs, which are often more prone to liquefaction than a sandy soil, but the results will still provide useful guidance in the Phase A assessment.

For the Phase B liquefaction evaluations, detailed engineering analyses will be undertaken to obtain estimates of cyclic loading, soil resistance, and factor of safety as described below. Potentially liquefiable soils include saturated alluvial soils, loose granular fills, and sluiced ash. The detailed analyses will focus on critical cross sections of the closed facilities; liquefaction safety factors will not be computed for all boring locations at a site.

(a) Soil Loading from Earthquake Motions

The magnitude of the cyclic shear stresses induced by an earthquake are represented by the cyclic stress ratio (CSR). The simplified method proposed by Seed and Idriss (1971) will be used to estimate CSR in the Phase A parametric analyses (ground response analyses will not be completed in Phase A).

In Phase B, the CSR at specific locations (borings and depths where in situ penetration resistance are measured) will be computed using one-dimensional, equivalent-linear elastic methods as implemented in the ProSHAKE software. Using an acceleration time history at the top of rock (obtained from the seismic hazards study in Step 1), the computer program will model the upward propagation of the ground motions through a one-dimensional soil profile. For cases where the one-dimensional assumption is inadequate, the calculations can be accomplished using QUAKE, a two-dimensional finite element program that implements the same dynamic modulus reduction curves and damping relationships as used in ProSHAKE.

The cyclic stresses imparted to the soil will be estimated from the earthquake parameters described in Step 1, representing earthquakes on the New Madrid fault and local crustal events.

(b) Soil Resistance from Correlations with Penetration Resistance

The resistance to soil liquefaction, expressed in terms of the cyclic resistance ratio (CRR), will be assessed using the NCEER empirical methodology (Youd et al. 2001). Updates to the procedure from recently published research will be used where warranted. The analyses will be based on the blowcount value (N) measured in the Standard Penetration Test (SPT) or the tip resistance (q_c) measured in the Cone Penetration Test (CPT). In Phase A, typical or representative values will be used in parametric hand calculations; detailed data from site-specific explorations will be analyzed in Phase B.

The NCEER procedure involves a large number of correction factors. Based on the site-specific conditions and soil characteristics, engineering judgment will be used to select appropriate correction factors consistent with the consensus recommendations of the NCEER panel (Youd et al. 2001). To avoid inappropriately inflating the CRR, the NCEER fines content adjustment will not be applied where zero blowcounts (“weight of hammer” or “weight of rod”) are recorded. The magnitude scaling factor (MSF) is used in the empirical liquefaction procedure to normalize the representative earthquake magnitude to a baseline 7.5M earthquake. The earthquake magnitude (M) considered to be most representative of the liquefaction risk will be determined by applying the MSF to the de-aggregation data (from Step 1) for each selected earthquake return period.

Saturated fly ash, where it remains following closure, is likely to be more susceptible to liquefaction than indicated by these empirical methods. Values of CRR determined via the NCEER procedure are related to the observation of liquefaction in natural soils, mostly silty sands. Given the spherical particle shape and uniform, small grain size of fly ash, the NCEER procedure may give CRR values that are too high for saturated fly ash.

Lacking better methods of analysis, the lower-bound, “clean sand” base curve (Youd et al. 2001) will be assumed to apply for fly ash in the Phase A assessment. Within the liquefaction calculations, this will be accomplished for these materials by neglecting the fines content adjustment to the normalized penetration resistance. For Phase B, published and unpublished data from cyclic laboratory testing on similar materials will be sought to augment the indications of liquefaction resistance obtained from in situ penetration tests.

(c) Factor of Safety Against Liquefaction

The factor of safety against liquefaction (FS_{liq}) is defined as the ratio of the liquefaction resistance (CRR) over the earthquake load (CSR). Following TVA design guidance and the precedent set by Seed and Harder (1990), FS_{liq} is interpreted as follows:

- Soil will liquefy where $FS_{liq} \leq 1.1$.
- Expect substantial soil softening where $1.1 < FS_{liq} \leq 1.4$.
- Soil does not liquefy where $FS_{liq} > 1.4$.

Using this criteria for guidance, values of FS_{liq} computed throughout a soil deposit or cross section (at specific CPT-q_c and SPT-N locations) will be reviewed in aggregate. Occasional pockets of liquefied material in isolated locations are unlikely to induce a larger failure, and are typically considered tolerable. Instead, problems associated with soil liquefaction are indicated where continuous zones of significant lateral extent exhibit low values of FS_{liq}. Engineering judgment, including consideration for the likely performance in critical areas, will be used for the overall assessment of each facility. A determination of “extensive” or “insignificant” liquefaction will then lead to the appropriate stability analyses in the next stage of the evaluation, as indicated in Figures 3 and 4.

Step 4 – Characterize Post-Earthquake Soil Strengths

The post-earthquake shearing resistance of each soil and CCP will be estimated, with consideration for the specific characteristics of that material. The full, static shear strength will be assigned to unsaturated soils. Excess pore pressures will not develop in an unsaturated soil during seismic loading, so drained strength parameters can be used. The undrained strengths of saturated soils will be decreased to account for the softening effects of pore pressure buildup during the earthquake. Specifically:

- In saturated clays and soils with $FS_{liq} > 1.4$, 80% of the static undrained strength will be assumed.
- In saturated, low-plasticity, granular soils with $1.1 < FS_{liq} \leq 1.4$, a reduced strength will be assigned, based on the excess pore pressure ratio, r_u (Seed and Harder 1990).

Typical relationships between FS_{liq} and r_u have been published by Marcuson and Hynes (1989).

- In saturated, low-plasticity, granular soils with $FS_{liq} \leq 1.1$, a residual (steady state) strength (S_{us}) will be estimated for the liquefied soil. Values of S_{us} can be obtained from the empirical correlations published by Seed and Harder (1990), Castro (1995), Olson and Stark (2002), Seed et al. (2003), and Idriss and Boulanger (2008).

Subsequent stability and deformation analyses will be accomplished using these reduced strength parameters. No attempt will be made to model the cyclic reduction in soil shear strength during an earthquake. In the deformation analyses, the fully reduced strengths will be assumed at the start of cyclic loading, which will yield conservative estimates of slope displacements.

Step 5 – Analyze Slope Stability

The next step in the performance evaluation (Figures 3 and 4) will consider slope stability, for conditions with or without significant liquefaction. Slope stability will be evaluated using two-dimensional, limit equilibrium, slope stability methods. Reduced soil strengths (from Step 4), conservatively representing the loss of shearing resistance due to cyclic pore pressure generation during the earthquake, will be used in the stability calculations. The analyses will be accomplished using Spencer's method of analysis, as implemented in the SLOPE/W software, considering both circular and translational slip mechanisms.

Input files for static stability calculations, where previously completed for a particular facility, will be updated to represent seismic conditions. These stability analyses may be not available, or the closure geometry may be undefined, for the Phase A assessment of some sites. In those cases, simplified or approximate geometries will be developed for approximate analysis in Phase A. Engineering experience will also be useful in judging likely seismic stability. For example, a complete failure is likely if liquefaction undermines the foundation of the outslope. In the absence of liquefaction, a slope that exhibits adequate safety factors under static conditions is unlikely to fail in an earthquake. Back-of-the-envelope hand calculations can be useful in assessing stability where extensive liquefaction occurs in the saturated materials within or below CCPs retained by a stable perimeter dike. Detailed slope stability calculations, which accurately represent the planned closure geometry, will be used in the Phase B facility assessments.

(a) Slope Stability if Extensive Liquefaction

If extensive liquefaction is indicated, stability will be evaluated for the static conditions immediately following the cessation of the earthquake motions. Residual or steady state strengths will be assigned in zones of liquefied soil, with reduced strengths that account for cyclic softening and pore pressure build up assumed in non-liquefied soil. In both Phase A and B, complete failure (large, unacceptable displacements) will be assumed if the safety factor (FS_{slope}) computed in this step is less than one (Figures 3 and 4).

For slopes where the post-earthquake $FS_{slope} \geq 1$, deformations will be estimated in the Phase B assessment (Step 6 and Figure 4). Slope deformations will not be estimated in the Phase A portfolio assessment, where ground motion time histories will not be available. In Phase A, slopes exhibiting $FS_{slope} \geq 1$ with liquefaction will be assumed stable with tolerable deformations; this condition may exist, for example, where liquefied ash at the base of a closed storage facility is contained within a stable perimeter dike.

Note that pseudostatic stability analyses are not useful for evaluating a factor of safety where extensive liquefaction is expected, because appropriate pseudostatic coefficients can not be defined.

(b) Slope Stability if No Significant Liquefaction

If no significant liquefaction is expected, seismic stability will be analyzed in Phase A using approximate, pseudostatic stability methods (Figure 3). The added inertial loads from the earthquake will be represented with a simple, horizontal pseudostatic coefficient (k_h), which provides an approximate representation of the dynamic loads imposed by an earthquake. The horizontal pseudostatic coefficient will be set to one-tenth of the peak ground acceleration in rock ($k_h = 0.1 \cdot PGA_{rock}$). In Phase A, tolerable deformations (less than about 5 meters) will be assumed if the pseudostatic $FS_{slope} \geq 1$, and failure will be assumed if the pseudostatic $FS_{slope} < 1$.

This approach and criteria are based on the work of Hynes-Griffin and Franklin (1984). They performed Newmark deformation analyses, integrated over 350 ground motion time histories, used an amplification factor of three to represent peak accelerations at the base of an earth embankment, and assumed a displacement of 1 meter would be tolerable for an embankment dam. For a typical CCP facility, assuming no pool is retained following closure, “failure” would imply displacements significantly greater than 1 meter. A tolerable displacement of about 5 meters will be assumed here, for the Phase A risk assessments. From the upper bound curve plotted by Hynes-Griffin and Franklin (1984), a displacement of 5 meters would correspond to a yield acceleration of about 0.03 times the peak acceleration along the slip surface. Then, assuming an amplification factor of 3 for the ground motions at the base of the embankment, this suggests $k_h = 0.1 \cdot PGA_{rock}$ can be used conservatively in the pseudostatic analysis to judge failure, as described above.

Pseudostatic factors of safety will not be computed in the Phase B assessment. Instead, where a liquefaction failure is not predicted, potential slope displacements will be computed as described in Step 6.

Step 6 – Predict Deformations

In the Phase A Portfolio Assessment, closed facilities that are expected to remain stable (pseudostatic $FS_{slope} \geq 1$ with no liquefaction, or post-earthquake $FS_{slope} \geq 1$ with liquefaction) will be assumed to have tolerable displacements. Dynamic slope deformations are difficult to estimate without detailed analysis; the available empirical or approximate methods do not represent the conditions of interest, or the level of effort is not consistent with the goals of the first phase of risk assessments. In addition, earthquake ground motion time histories will not be available for the Phase A analyses.

In the Phase B Facility Assessments, the potential deformation of stable slopes will be evaluated as indicated in Figure 4. Conventional methods of analysis will be implemented to estimate potential slope displacements that accumulate during earthquake shaking; movements are assumed to stop when the earthquake ends, consistent with a post-earthquake safety factor greater than one. The acceleration time histories obtained from the ground response analyses in Step 3a will be used as inputs for computing deformations with one of the following simplified methods:

- Newmark's (1965) method involves double integration of accelerations greater than the yield acceleration (k_y), which will be determined from a succession of pseudostatic slope stability analyses in which k_h is varied. The value of k_h where the pseudostatic FS_{slope} = 1.0 corresponds to the yield acceleration.
- The Makdisi-Seed (1978, 1979) procedure, which better accounts for the dynamic response of embankments. This procedure was developed based on parametric numerical simulations for earthen dams. The procedure is iterative, considers the fundamental periods of the embankment response, and can be completed in steps using published charts. Results from QUAKE can also be used as input in this procedure.

The slope deformations predicted in Phase B will be conservative, because the yield acceleration will be computed based on reduced, post-earthquake soil strengths. In reality, the yield acceleration declines in successive cycles of seismic loading, as pore pressures accumulate and saturated soils become weaker. The analysis outlined in Figure 4 assumes reduced strengths and, where liquefaction is predicted, residual strengths at the start of the earthquake. Detailed numerical simulations can be used to track the progressive softening and liquefaction of soil within an embankment during an earthquake; such analyses are expensive and time consuming. Rigorous analyses of this type will not be justified except in a "Phase C" analysis, or where performance in a given seismic design event must be demonstrated. Note that the logic in Figure 4 might appear to assume a slope will be stable if there is no significant liquefaction; however, the deformation analysis will indicate unlimited deformations and certain failure if $FS_{slope} < 1$ for static, post-earthquake conditions.

Step 7 – Consider Other Potential Failure Modes

For most of the closed facilities, soil liquefaction, slope instability, and slope deformations will be the most likely seismic failure modes. However, depending on the unique configuration of each CCP facility, other potential failure modes may contribute significantly to the seismic risks. For example, the loss of critical drainage structures or retaining walls could lead to a failure condition. Other potential failure modes will be identified and evaluated quantitatively in this step.

As a secondary objective of the Phase A effort, the assessment team will consider the potential for failure of the active storage facilities, due to an earthquake occurring prior to closure. Many of the wet CCP storage facilities retain large pools of water, so this assessment will need to consider additional failure modes such as seepage and embankment cracking. The objective here will be to identify operating facilities that may have unusually high seismic risks, and might deserve more study or higher priority in the closure program.

Step 8 – Estimate Annual Probability of Seismic Failure

As indicated in the flowcharts in Figures 3 and 4, the assessments of seismic performance (in both the Phase A and Phase B efforts) will consider a range of potential earthquakes with differing return periods. The analyses will be repeated until the limiting (lowest) earthquake return period (from the candidate events defined in Step 1) that predicts failure of a particular CCP storage facility is obtained. Interpolation may be used, as appropriate, to narrow the definition of the limiting earthquake.

The return period for each earthquake scenario (Table 4) represents the annual probability of exceedance for the associated ground motion parameter. Hence, for each earthquake scenario, the event with the smallest return period that causes failure represents a limiting case, where all events having longer return periods would also cause failure. The inverse of the limiting return period thus represents the annual probability of seismic failure due to that earthquake scenario.

Step 9 – Estimate Potential Consequences of Failure

The potential consequences of a failure at each closed facility will be estimated in this step. The potential consequences will be unique to each site, but may include any of the following:

- restoration of the site and storage facility,
- clean-up to address environmental impacts,
- off-site disposal of released materials,
- damages and loss of use for transportation routes, including buried or overhead utilities,
- damages to buildings and other infrastructure,
- economic losses from the possible shutdown of power generation, and
- loss of human life (expected to be unlikely at most sites following closure).

Except for the potential loss of life, the failure consequences will be expressed in terms of present day costs. Detailed cost estimates of the potential consequences of failure will not be attempted in the Phase A assessments; instead, the potential magnitude of total consequence costs will be estimated using broad categories (< \$100K, < \$500K, < \$1M, < \$5M, < \$10M, < \$50M, < \$100M). Cost estimates that better reflect the local site conditions will be produced by the closure design teams during the Phase B assessments.

Step 10 – Estimate Possible Mitigation Costs

The final step in the process will involve estimating the costs to mitigate seismic risks, perhaps by altering the closure design to withstand stronger earthquakes. Examples of possible mitigation measures include:

- ground improvements to reduce liquefaction potential (stone columns, deep soil mixing, jet grouting, or other appropriate technology),
- altering the geometry of outslopes (setbacks, benches, or flatter slopes) to improve

stability,

- adding buttresses or other supporting structures at the toe of slopes,
- enhanced drainage features, and
- relocation of infrastructure or people away from potential impact zones.

These mitigation approaches generally involve higher construction costs, which can be quantified in terms of present dollars. As with the consequence costs, detailed estimates of mitigation costs will not be attempted in the Phase A assessments. The potential magnitude of mitigation will be estimated in categories (< $100K, < $500K, < $1M, < $5M, < $10M, < $50M, < $100M). Mitigation cost estimates that better reflect the local conditions and facility layout will be developed by the closure design teams during the Phase B assessments.

Table 1. Expected Results from the Phase A and B Seismic Risk Assessments

TVA Facility	Prob. Failure	Econ. Costs	Loss of Life	Mitigat. Costs	Data Quality
ALF East Ash Disposal					
ALF East Stilling Pond					
BRF Dry Fly Ash Disposal					
BRF Fly Ash Pond And Stilling Basin Area 2					
BRF Bottom Ash Disposal Area 1					
BRF Gypsum Disposal Area 2a					
COF Disposal Area 5					
COF Ash Pond 4					
CUF Dry Ash Stack					
CUF Ash Pond					
CUF Gypsum Storage Area					
GAF Fly Ash Pond E					
GAF Bottom Ash Pond A					
GAF Stilling Pond B, C & D					
JSF Dry Fly Ash Stack					
JSF Bottom Ash Disposal Area 2					
JOF Ash Disposal Area 2					
KIF Dike C					
PAF Scrubber Sludge Complex					
PAF Peabody Ash Pond					
PAF Slag Areas 2a & 2b					
SHF Consolidated Waste Dry Stack					
SHF Ash Pond					
WCF Ash Pond Complex					
WCF Gypsum Stack					

Prob Failure = Annual probability of failure due to earthquakes
Econ. Costs = Economic costs resulting from a failure
Loss of Life = Potential loss of life resulting from a failure
Mitigat. Costs = Costs to mitigate seismic risks in closure design
Data Quality = Qualitative indication of how well conditions in the facility are characterized

Table 2. Risk Severity Scoring (Draft) used by TVA

as of 4/22/2009

TVA Risk Event Consequence Rating Scale (Work-In-Progress)						
Strategic Objective	Success Factor	5 Worst Case	4 Severe	3 Major	2 Moderate	1 Minor
Customer	Public Image	International media attention; nearly unanimous public criticism	National media attention; federal, state officials, and customers publicly critical	Regional / local media attention; customers voice concern	Minimal media attention; letters / emails to executive leadership voicing concern	No media attention; sparse criticism
	Rate Impact	Average total retail rate increases by 15%, relative to peers	Average total retail rate increases by 10%-15%, relative to peers	Average total retail rate increases by 5%-10%, relative to peers	Average total retail rate increases by 2%-5%, relative to peers	Average total retail rate increases by 0-2%, relative to peers
People	Safety	Fatalities	Wide spread injuries	Major injuries	Significant injuries	Minor injuries
	Employee Confidence	Widespread departures of key staff with scarce skills or knowledge	Sharp, sustained drop in CHI results; departures of key staff with scarce skills or knowledge	Sharp decline in CHI results	Modest decline in CHI results	No effect on CHI results
Financial	Cash Flow Impact	>$500M	$100M - $500M	$25M - $100M	$5M - $25M	<$5M
	Credit Worthiness	Credit rating downgrade to below investment grade	Credit Rating Downgrade	TVA put on credit watch	TVA put on negative outlook	Credit rating agencies and bondholders express concern
Assets and Operations	LNS (Load not served)*	10% of System Daily Sales (48,000 MWhrs)	1% of System Daily Sales (4,800 MWhrs)	0.1% of System Daily Sales (480 MWhrs)	0.05% of System Daily Sales (240 MWhrs)	140 MWhrs
	CPI (Connection Point Interruptions)	10% of CPs are down simultaneously	5% of CPs are down simultaneously	CPI totaling 10% of current CP count (124 for FY09)	CPI totaling 7.5% of current CP count (93 for FY09)	CPI totaling 5% of current CP count (62 for FY09)
	Duration (in Hours) of Service Interruption	3,000 cumulative hours for CPs	1,000 cumulative hours for CPs	500 cumulative hours for CPs	150 cumulative hours for CPs	50 cumulative hours for CPs
	Delivered Cost of Power	Sustained increase in delivered cost of power >1 year	Increase in delivered cost of power <1 year	Increase in delivered cost of power <1 month	Increase in delivered cost of power <1 week	Delivered cost of power not effected
	Damage to environment; type and magnitude of contamination / discharge	Major coal, nuclear plant accident or dam failure	Significant hazardous waste discharged; nuclear plant accident; dam integrity failure resulting in drawdown of pool elevation	Hazardous materials / waste discharge; clean up / remediation time takes approximately two weeks	Localized environmental damage, no impact to wildlife, clean up / remediation time less than two weeks	Minimal environmental damage, no hazardous discharge; clean up time takes a few days

Table 3. Risk Likelihood Scoring used by TVA

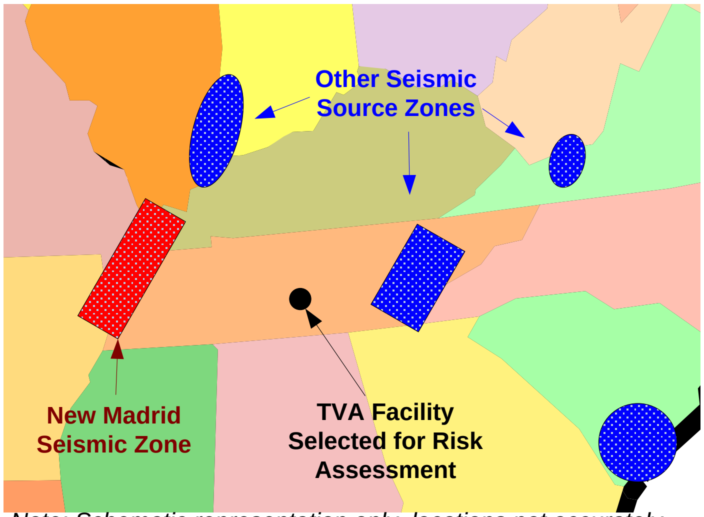
TVA Risk Event Probability Rating Scale		
Score	Rating	Description
5	Virtually Certain	95% probability that the event will occur in the next 3 years /10 years
4	Very Likely	75% probability that the event will occur in the next 3 years/10 years
3	Even Odds	50% probability that the event will occur in the next 3 years/10 years
2	Unlikely	25% probability that the event will occur in the next 3 years/10 years
1	Remote	5% probability that the event will occur in the next 3 years/10 years

- *The 3-year timeframe will be the primary focus for the business unit risk maps*
- *The 10-year risks will be collected by the ERM organization and charted separately for the enterprise*

Table 4. Seismic Hazard Input Data for Probabilistic Assessment of TVA Facilities

Seismic Sources	Return Period (years)	Annual Probability of Exceedance	Peak Ground Acceleration (g)	Earthquake Magnitude
New Madrid Seismic Zone	2,500 1,000 500 250 100	0.0004 0.001 0.002 0.004 0.01	*Values to be determined from the seismic hazard curves*	*Values to be determined from the hazard de-aggregation data**
All Other Seismic Sources	2,500 1,000 500 250 100	0.0004 0.001 0.002 0.004 0.01		

** Representative magnitude corresponding to the maximum contribution to the seismic hazard for liquefaction, as determined from the de-aggregation data weighted by the magnitude scaling factor (maximum PGA / MSF)*



Note: Schematic representation only, locations not accurately depicted, some sources omitted.

Figure 1. Schematic Representation of Seismic Source Model for TVA Facilities

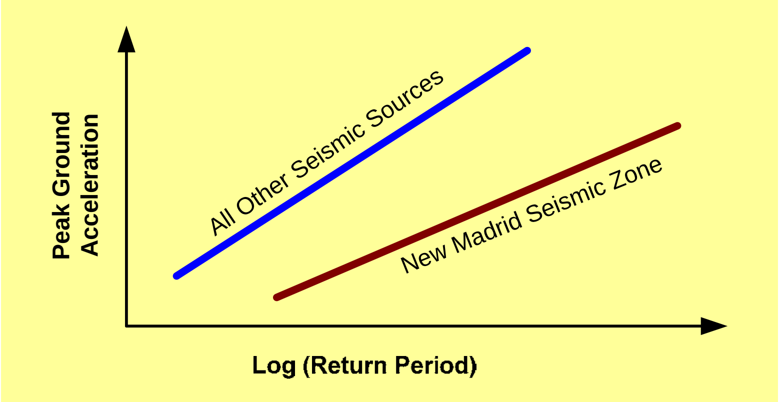


Figure 2. Typical Seismic Hazard Curves for Proposed Probabilistic Assessment of TVA Facilities

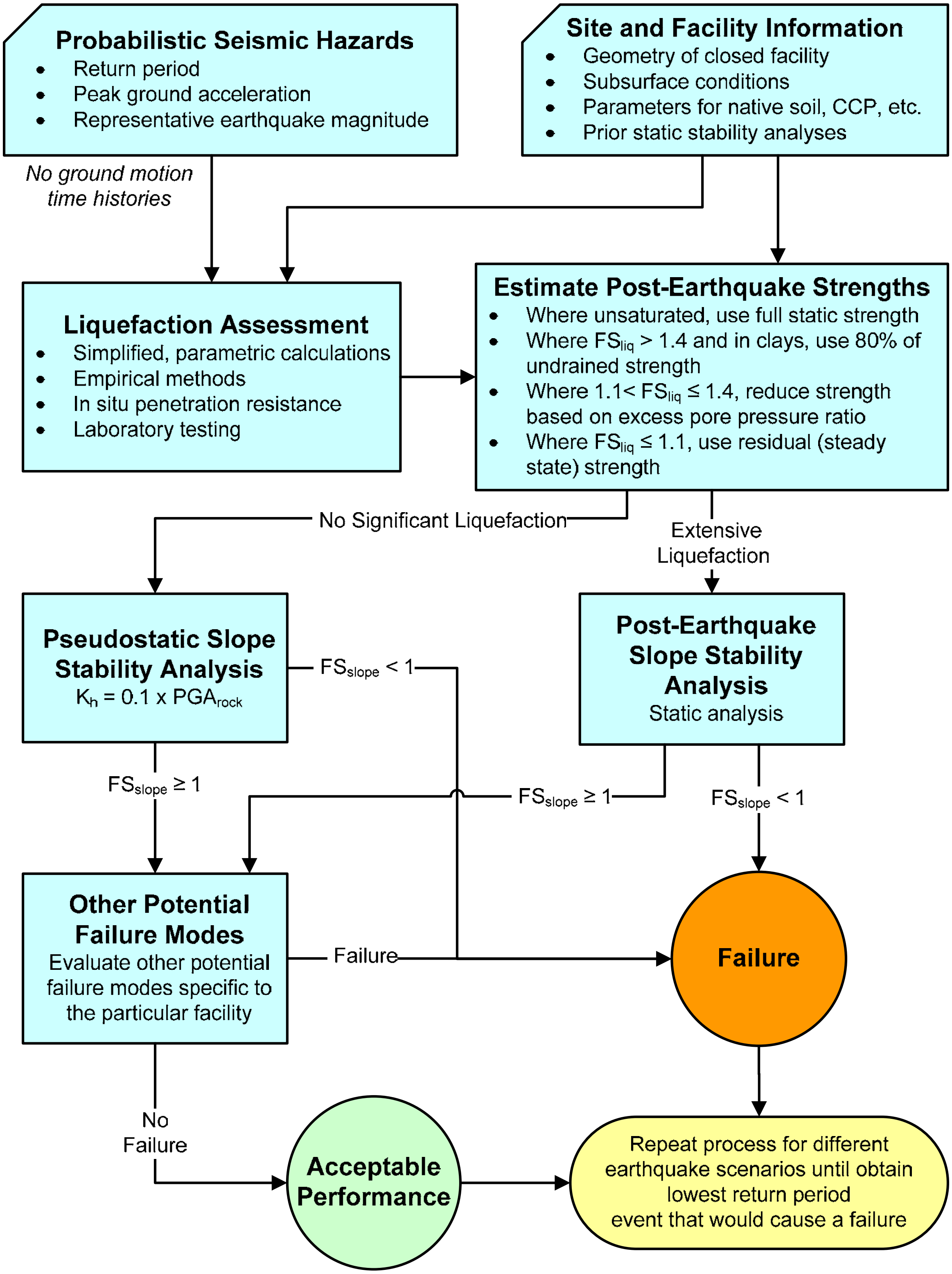


Figure 3. Simplified Flowchart for Assessing Facility Performance During a Probabilistic Seismic Event in Phase A

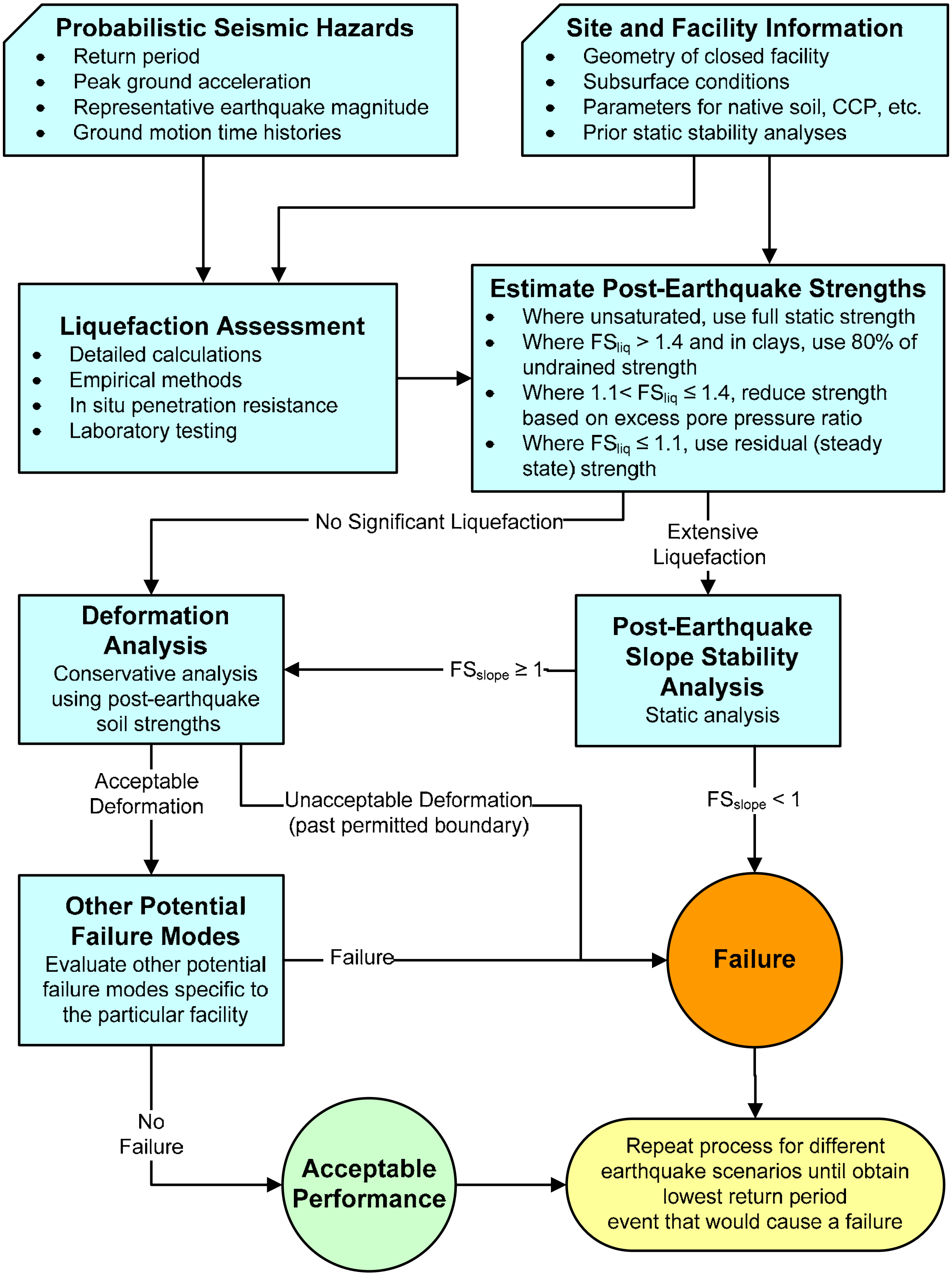


Figure 4. Simplified Flowchart for Assessing Facility Performance During a Probabilistic Seismic Event in Phase B

Enclosure B

Pseudostatic Analysis Results

Gallatin Fossil Plant - Pseudostatic Stability Analysis Summary

CCP Disposal Facility		Cross-Section Information		500 yr Return		Mitigation and Improvement Activities Since January 2009 As-Found Conditions
Name	Type	Section Analyzed	Section Location	PGA (g) for COF	Factor of Safety	
Ash Pond A	Impoundment	K	Represents bottom ash divider dike between Pond A and stilling ponds along north side.	0.045	1.2	2009 as-found conditions produced acceptable static long-term factor of safety for global conditions. No mitigation efforts needed. However, pool level was raised 1 foot since 2009. Section K represents current conditions. Future mitigation will be undertaken to address non-global stability.
Ash Pond E	Impoundment	B	Southwest corner.		1.6	2009 as-found conditions produced acceptable static long-term factor of safety. No mitigation efforts needed. Section B represents current conditions.

Notes:

1) Acceleration are from March 28, 2011 TVA region-specific sesismic hazard study performed by AMEC Geomatrix, Inc. (total hazard).
2) Refer to layout plan for locations of cross-sections.
3) Stability models reflect current ground lines and conditions.
4) Liquefaction was not considered in this analysis.

Pseudostatic Slope Stability Analysis
CCP Storage Facilities - Existing Conditions
Tennessee Valley Authority Fossil Plants

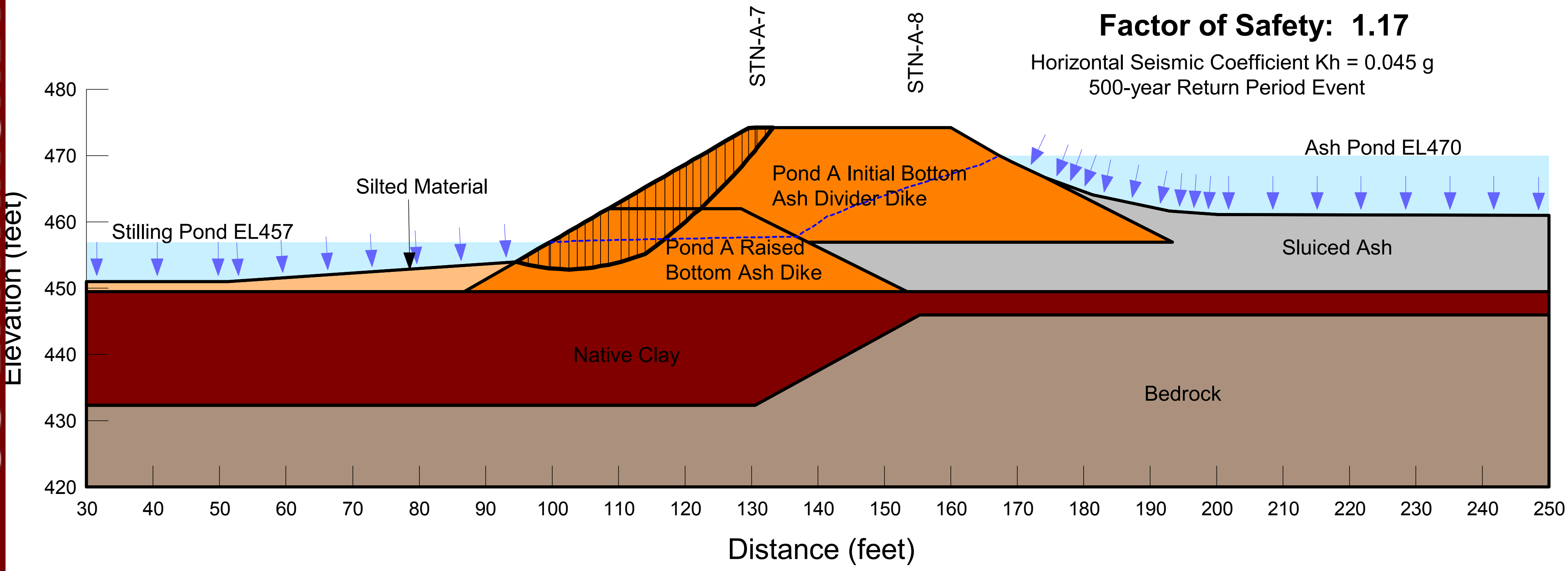
Section K - Ash Pond A
Gallatin Fossil Plant
Gallatin, Tennessee

Material Type	Unit Weight	Cohesion	Friction Angle
Pond A Initial Bottom Ash Divider Dike	105 pcf	0 psf	33 °
Pond A Raised Bottom Ash Dike	105 pcf	0 psf	34 °
Sluiced Ash	85 pcf	400 psf	10 °
Native Clay	125 pcf	550 psf	13 °
Silted Material	85 pcf	400 psf	10 °

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Factor of Safety: 1.17

Horizontal Seismic Coefficient Kh = 0.045 g
500-year Return Period Event



Project No. 175551015

Date of Assessment - 09/09/2011

Pseudostatic Slope Stability Analysis
CCP Storage Facilities - Existing Conditions
Tennessee Valley Authority Fossil Plants

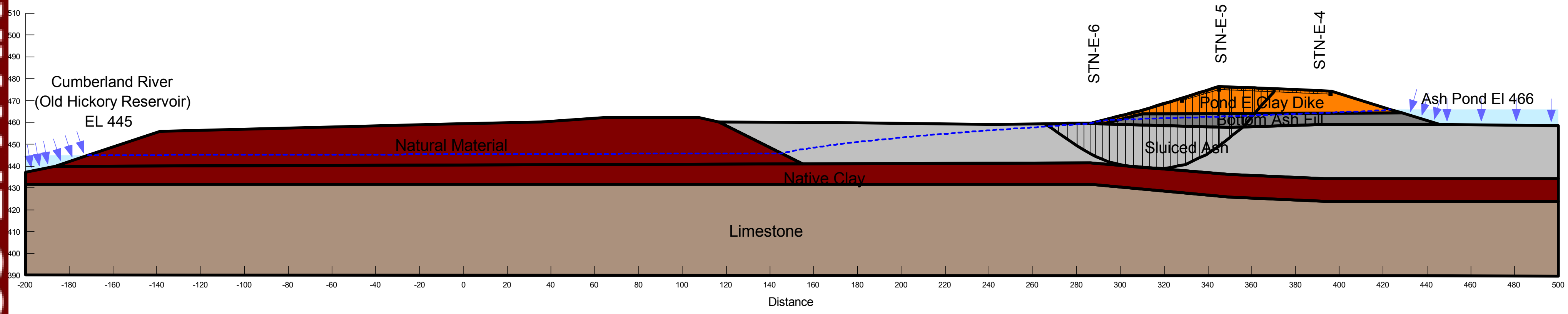
Section B - Ash Pond E
Gallatin Fossil Plant
Gallatin, Tennessee

Stantec

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Unit Weight	Cohesion	Friction Angle
Pond E Clay Dike	125 pcf	400 psf	15 °
Bottom Ash Fill	100 pcf	0 psf	34 °
Sluiced Ash	85 pcf	400 psf	10 °
Native Clay	125 pcf	550 psf	13 °

Factor of Safety: 1.59
Horizontal Seismic Coefficient Kh = 0.045 g
500-year Return Period Event



Date of Assessment - 09/09/2011

Project No. 175551015

Gallatin Fossil Plant, Ash Pond A. Cross Section K used to perform pseudostatic slope stability analysis.

MATCHLINE (See Sheet 02)

LEGEND

○	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling
◉	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core
▣	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Piezometer Location
▣	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core And Piezometer Location
A A'	Cross Section

NOTES

1. Topographic and survey information provided by the Tennessee Valley Authority.
2. The boring logs and related information shown on this drawing depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations. Any correlations shown between borings are generally based on straight line interpolation. Actual conditions between borings are unknown and may differ from those shown.

BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEVATION (ft.)
STN-A-1	707,019.68	1,879,799.57	472.8
STN-A-2	706,994.16	1,879,810.94	473.3
STN-A-3	707,510.75	1,880,731.90	472.9
STN-A-4	707,498.65	1,880,758.47	473.8
STN-A-5	708,368.74	1,881,417.01	473.7
STN-A-6	708,353.42	1,881,433.71	474.0
STN-A-7	708,921.58	1,881,894.55	474.5
STN-A-8	708,907.06	1,881,914.61	474.8
STN-A-9	709,132.64	1,882,470.74	472.4
STN-A-10	709,085.67	1,882,461.16	474.1
STN-C-1	707,402.48	1,879,680.01	462.0

FOR INFORMATION ONLY
This Record Drawing which has been previously submitted to TVA is provided for Information Only.

RECORD DRAWING

100 0 200 400 FEET
GRAPHIC SCALE: 1"=200'

PLOT DATE: 05/20/2010 USER: BRADSHAW, STEVEN
V:\1755\ACTIVE\175559...

For Supporting Design Calculations see FPGGAFFESCDX00000020100001

RANDY LEE ROBERTS
No. 113825
Randy L. Roberts
5/27/10

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R 0	05/27/10	PC	RP	PC	RLR	RLR	RLR	TJ	–	–	–
RECORD DRAWING											

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1'=200' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
BORING LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. COOPER	R. PETTY	P. COOPER	R. ROBERTS	R. ROBERTS	R. ROBERTS	T. JOHNSON

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Louisville, Kentucky
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GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

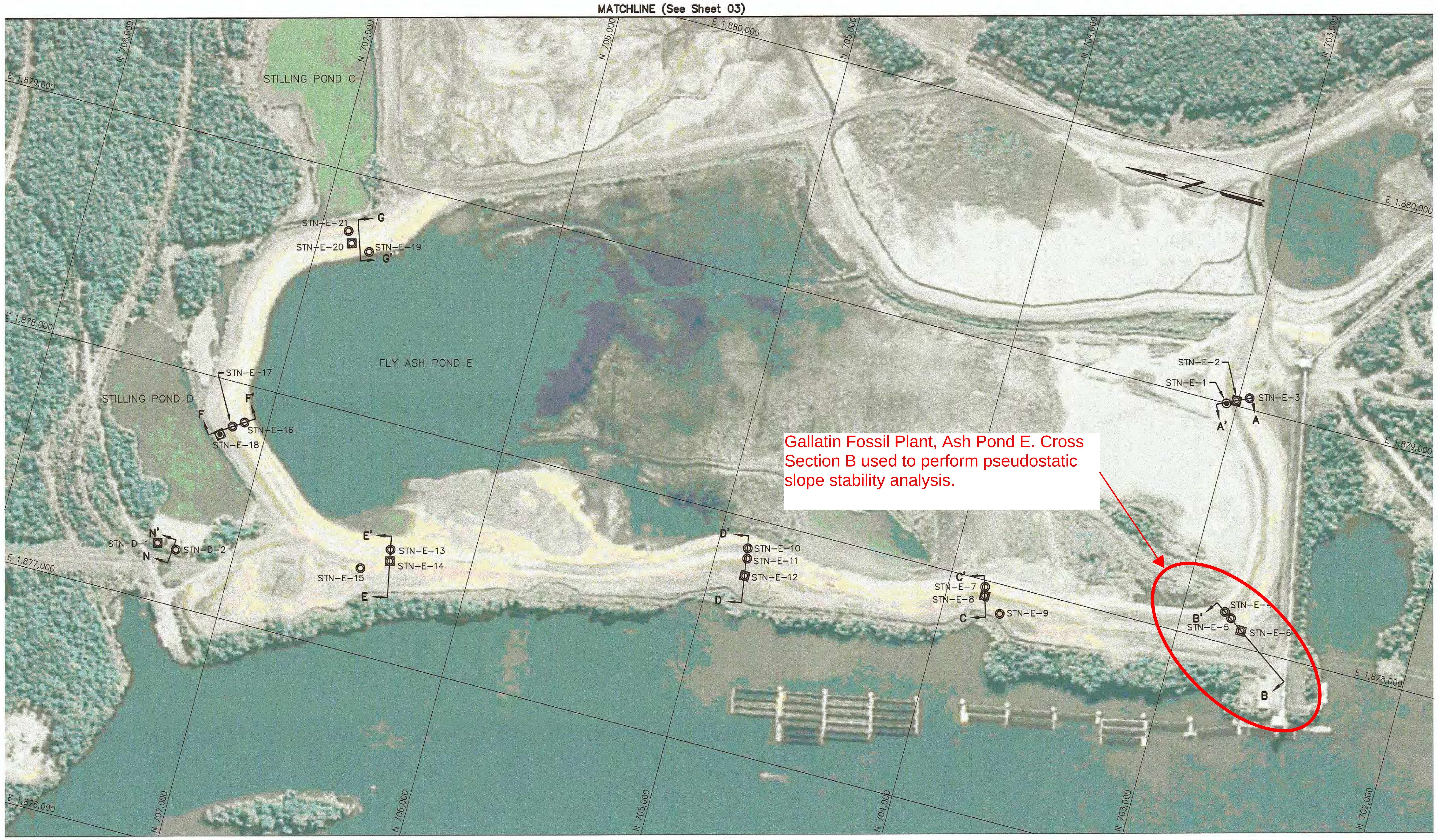
AUTOCAD R 2000	DATE 05/27/10	39	C	10W504-03	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

MATCHLINE (See Sheet 03)



Gallatin Fossil Plant, Ash Pond E. Cross Section B used to perform pseudostatic slope stability analysis.

LEGEND

◎	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling
◉	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core
▣	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Piezometer Location
▣	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core And Piezometer Location
A A'	Cross Section

NOTES

1. Topographic and survey information provided by the Tennessee Valley Authority.
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BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEVATION (ft.)
STN-D-1	707,328.99	1,877,246.92	460.8
STN-D-2	707,245.18	1,877,237.96	460.4
STN-E-1	703,045.88	1,879,000.10	474.1
STN-E-2	703,007.37	1,879,022.21	475.7
STN-E-3	702,955.21	1,879,046.66	459.6
STN-E-4	702,820.82	1,878,131.27	474.3
STN-E-5	702,788.65	1,878,111.48	476.1
STN-E-6	702,733.38	1,878,070.14	459.6
STN-E-7	703,843.80	1,877,971.87	475.1
STN-E-8	703,835.47	1,877,934.64	476.5
STN-E-9	703,753.39	1,877,876.25	451.8
STN-E-10	704,870.32	1,877,862.37	474.9
STN-E-11	704,863.36	1,877,828.40	476.1
STN-E-12	704,854.47	1,877,754.46	455.3
STN-E-13	706,353.41	1,877,474.21	474.3
STN-E-14	706,343.79	1,877,425.50	477.0
STN-E-15	706,458.09	1,877,364.00	463.4
STN-E-16	707,101.38	1,877,842.04	474.9
STN-E-17	707,146.54	1,877,811.85	475.4
STN-E-18	707,190.77	1,877,765.92	461.6
STN-E-19	706,774.43	1,878,687.08	472.8
STN-E-20	706,856.53	1,878,704.54	476.0
STN-E-21	706,883.00	1,878,751.72	461.6

RECORD DRAWING

100 0 200 400 FEET
GRAPHIC SCALE: 1"=200'

FOR INFORMATION ONLY
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For Supporting Design Calculations see FPGGAFFESCDX00000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R 0	05/27/10	PC	RP	PC	RLR	RLR	RLR	TJ	–	–	–

RECORD DRAWING

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1'=200' EXCEPT AS NOTED

RANDY LEE ROBERTS
No. 113825
Randy L. Roberts
5/27/10

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
BORING LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. COOPER	R. PETTY	P. COOPER	R. ROBERTS	R. ROBERTS	R. ROBERTS	T. JOHNSON

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GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | DATE 05/27/10 | 39 | C | 10W504-02 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

APPENDIX A

Document 10a

Seismic Slope Stability Analysis, Stantec, February 15, 2012

Stantec

Stantec Consulting Services Inc.
10509 Timberwood Circle Suite 100
Louisville, KY 40223-5301
Tel: (502) 212-5000
Fax: (502) 212-5055

February 15, 2012 ltr_002_175551015

Mr. Michael S. Turnbow
Tennessee Valley Authority
1101 Market Street, LP 2G-C
Chattanooga, Tennessee 37402-2801

Re: Results of Pseudostatic Slope Stability Analysis
Active CCP Disposal Facilities
BRF, COF, GAF, JSF, JOF, KIF, PAF, and WCF

Dear Mr. Turnbow:

As requested, Stantec Consulting Services Inc. (Stantec) has conducted pseudostatic slope stability analyses for ground motion levels corresponding to a return period of 2,500 years to support the U.S. Environmental Protection Agency's assessment of TVA's CCP disposal facilities. The results for Bull Run (BFR), Colbert (COF), Gallatin (GAF), John Sevier (JSF), Johnsonville (JOF), Kingston (KIF), Paradise (PAF), and Widows Creek (WCF) are provided in this letter.

Approach

The analyses were performed for current conditions using pseudostatic stability methods, where the added inertial load from an earthquake is assumed to be represented by a simple horizontal pseudostatic coefficient. Specifics related to the analyses/approach are as follows:

- Subsurface data was obtained from the Stantec's recent geotechnical studies performed in 2009 and 2010 time frame.
- SLOPE/W software (from GEO-SLOPE International, Inc.) was used to perform the calculations.
- One existing SLOPE/W cross-section model per disposal facility was selected from the previous studies for analysis. For simplicity and conservatism, the selected sections represent the facility's lowest current static (long-term) factor of safety. The SLOPE/W models were updated to reflect any significant mitigations or operational changes that have occurred since completion of Stantec's geotechnical studies.
- Undrained shear strength parameters were used.
- Ground motion levels corresponding to a return period of 2,500 years (or approximate exceedance probability of 2% in 50 years) was used for selection of a horizontal seismic coefficient. For simplicity, the horizontal seismic coefficient was selected to equal the total hazard peak ground acceleration (rock) for 2,500 year return periods as shown in plant-

specific tables (Tables 13 through 23) of TVA's March 28, 2011 region-specific seismic hazard study performed by AMEC Geomatrix, Inc.

- A target factor of safety (FS) of 1.0 was considered for comparing results.

Results

The results of the pseudostatic stability analyses are enclosed (summary spreadsheet, SLOPE/W cross-sections, and plan views showing cross-section locations). The results indicate factors of safety greater than or equal to the target of 1.0.

Stantec appreciates the opportunity to provide these services. If you have questions, or if we can provide additional information, please let us know.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Randy L. Roberts

Randy L. Roberts, PE
Principal

Enclosures

/cdm

Pseudostatic Stability Analysis Summary - TVA Active CCP Disposal Facilities

BRF, COF, GAF, JSF, JOF, KIF, PAF, WCF

Plant	CCP Disposal Facility		Cross-Section	2,500 yr Return	
	Name	Type		PGA (g)	Factor of Safety
BRF	Gypsum Disposal Area 2A	Wet Stack	I	0.131	1.0
	Fly Ash Disposal Area 2	Impoundment	S		1.4
	Bottom Ash Disposal Area 1	Stack	D		1.1
COF	Disposal Area 5 Stack	Stack	I	0.138	1.0
	Disposal Area 5 Stilling Basin	Impoundment	J		1.2
	Ash Pond 4	Impoundment	D		1.0
GAF	Ash Pond A	Impoundment	K	0.108	1.0
	Ash Pond E	Impoundment	B		1.3
JSF	Bottom Ash Pond	Impoundment	I	0.115	2.2
JOF	Ash Disposal Area 2	Impoundment	K	0.254	1.0
KIF	Stilling Pond	Impoundment	132+37	0.115	1.0
PAF	Slag Ponds 2A and 2B	Impoundment	Typical	0.157	1.1
	Scrubber Sludge Complex	Impoundment	G		1.0
	Peabody Ash Pond	Impoundment	A		1.0
WCF	Gypsum Stack	Wet Stack	F	0.1	1.5
	Dredge Cell (Old Scrubber Sludge Pond)	Impoundment	D		1.1
	Main Ash Pond	Impoundment	J		1.4

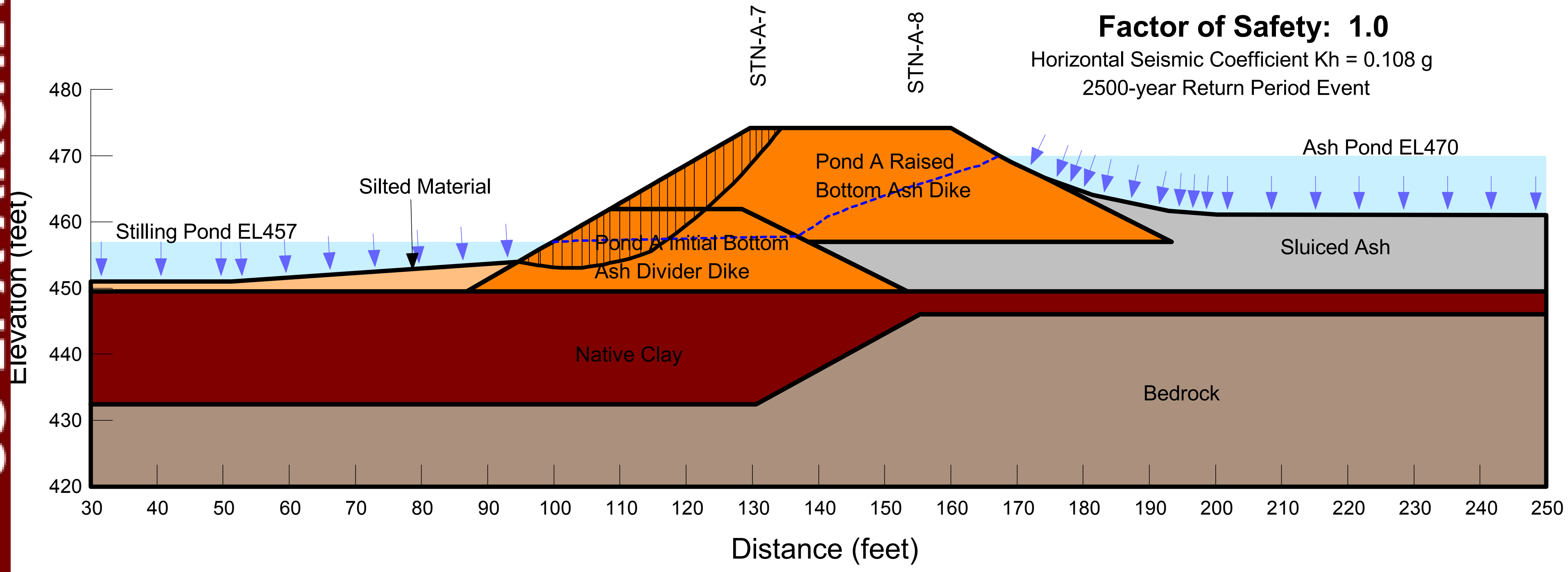
Gallatin Fossil Plant
(GAF)

Pseudostatic Slope Stability Analysis
CCP Storage Facilities - Existing Conditions
Tennessee Valley Authority Fossil Plants

Section K - Ash Pond A
Gallatin Fossil Plant
Gallatin, Tennessee

Material Type	Unit Weight	Cohesion	Friction Angle
Pond A Initial Bottom Ash Divider Dike	105 pcf	0 psf	33 °
Pond A Raised Bottom Ash Dike	105 pcf	0 psf	34 °
Sluiced Ash	85 pcf	400 psf	10 °
Native Clay	125 pcf	550 psf	13 °
Silted Material	85 pcf	400 psf	10 °

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Project No. 175551015

Date of Assessment - 11/4/2011

Pseudostatic Slope Stability Analysis
CCP Storage Facilities - Existing Conditions
Tennessee Valley Authority Fossil Plants

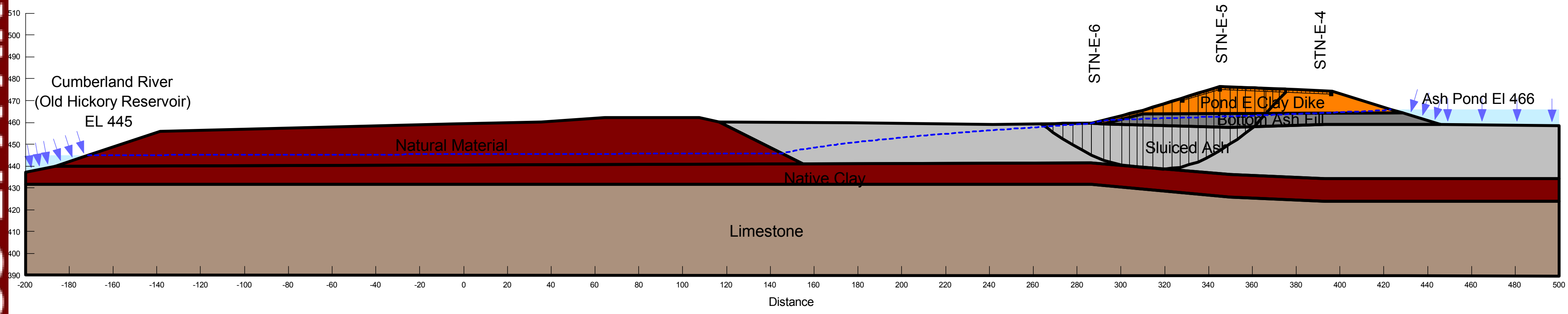
Section B - Ash Pond E
Gallatin Fossil Plant
Gallatin, Tennessee

Stantec

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Unit Weight	Cohesion	Friction Angle
Pond E Clay Dike	125 pcf	400 psf	15 °
Bottom Ash Fill	100 pcf	0 psf	34 °
Sluiced Ash	85 pcf	400 psf	10 °
Native Clay	125 pcf	550 psf	13 °

Factor of Safety: 1.3
Horizontal Seismic Coefficient Kh = 0.108 g
2500-year Return Period Event



Date of Assessment - 11/4/2011

Project No. 175551015

Gallatin Fossil Plant, Ash Pond A. Cross Section K used to perform pseudostatic slope stability analysis.

MATCHLINE (See Sheet 02)

LEGEND

◎ Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling

◉ Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core

▣ Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Piezometer Location

▣ Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core And Piezometer Location

A A' Cross Section

NOTES

1. Topographic and survey information provided by the Tennessee Valley Authority.
2. The boring logs and related information shown on this drawing depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations. Any correlations shown between borings are generally based on straight line interpolation. Actual conditions between borings are unknown and may differ from those shown.

BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEVATION (ft.)
STN-A-1	707,019.68	1,879,799.57	472.8
STN-A-2	706,994.16	1,879,810.94	473.3
STN-A-3	707,510.75	1,880,731.90	472.9
STN-A-4	707,498.65	1,880,758.47	473.8
STN-A-5	708,368.74	1,881,417.01	473.7
STN-A-6	708,353.42	1,881,433.71	474.0
STN-A-7	708,921.58	1,881,894.55	474.5
STN-A-8	708,907.06	1,881,914.61	474.8
STN-A-9	709,132.64	1,882,470.74	472.4
STN-A-10	709,085.67	1,882,461.16	474.1
STN-C-1	707,402.48	1,879,680.01	462.0

FOR INFORMATION ONLY
This Record Drawing which has been previously submitted to TVA is provided for Information Only.

RECORD DRAWING

100 0 200 400 FEET
GRAPHIC SCALE: 1"=200'

PLOT DATE: 05/20/2010 USER: BRADSHAW, STEVEN
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\REV0_RECORD\10W504-03-R0.DWG

For Supporting Design Calculations see FPGGAFFESCDX00000020100001

REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD
R –	–	–	–	–	–	–	–	–	–	–	–
R 0	05/27/10	PC	RP	PC	RLR	RLR	RLR	TJ	–	–	–

RECORD DRAWING

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1'=200' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION BORING LAYOUT

RANDY LEE ROBERTS
No. 113825
Randy Lee Roberts
5/27/10

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. COOPER	R. PETTY	P. COOPER	R. ROBERTS	R. ROBERTS	R. ROBERTS	T. JOHNSON

Stantec Consulting Services Inc.
1901 Nelson Miller Pky.
Louisville, Kentucky
40223-2177
Tel. 502.212.5000
Fax 502.212.5055
www.stantec.com

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

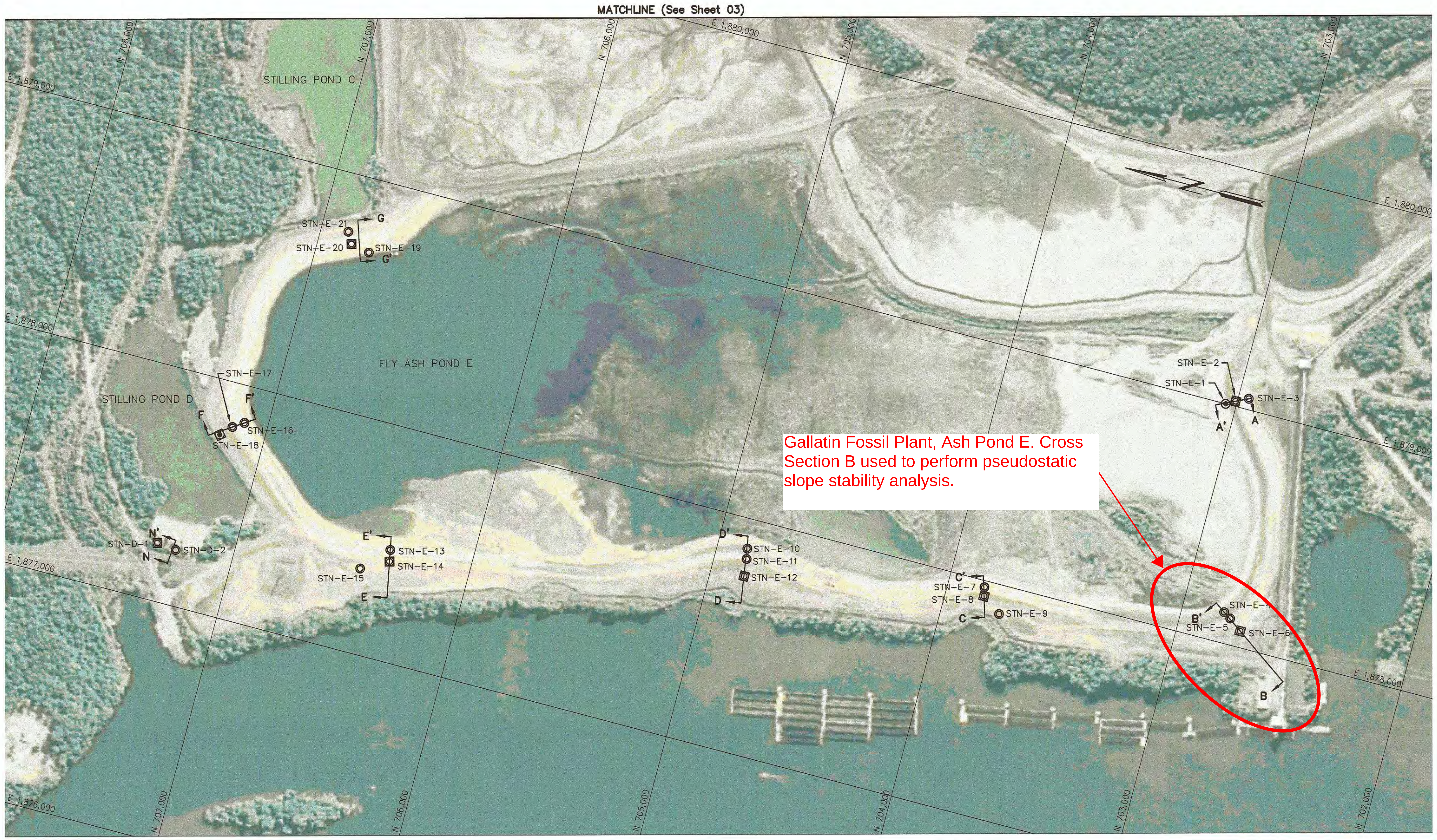
AUTOCAD R 2000 | DATE 05/27/10 | 39 | C | 10W504-03 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

39 C 10W504-02



Gallatin Fossil Plant, Ash Pond E. Cross Section B used to perform pseudostatic slope stability analysis.

LEGEND

◎	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling
◉	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core
▣	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Piezometer Location
▣	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core And Piezometer Location
A A'	Cross Section

NOTES

1. Topographic and survey information provided by the Tennessee Valley Authority.
2. The boring logs and related information shown on this drawing depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations. Any correlations shown between borings are generally based on straight line interpolation. Actual conditions between borings are unknown and may differ from those shown.

BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEVATION (ft.)
STN-D-1	707,328.99	1,877,246.92	460.8
STN-D-2	707,245.18	1,877,237.96	460.4
STN-E-1	703,045.88	1,879,000.10	474.1
STN-E-2	703,007.37	1,879,022.21	475.7
STN-E-3	702,955.21	1,879,046.66	459.6
STN-E-4	702,820.82	1,878,131.27	474.3
STN-E-5	702,788.65	1,878,111.48	476.1
STN-E-6	702,733.38	1,878,070.14	459.6
STN-E-7	703,843.80	1,877,971.87	475.1
STN-E-8	703,835.47	1,877,934.64	476.5
STN-E-9	703,753.39	1,877,876.25	451.8
STN-E-10	704,870.32	1,877,862.37	474.9
STN-E-11	704,863.36	1,877,828.40	476.1
STN-E-12	704,854.47	1,877,754.46	455.3
STN-E-13	706,353.41	1,877,474.21	474.3
STN-E-14	706,343.79	1,877,425.50	477.0
STN-E-15	706,458.09	1,877,364.00	463.4
STN-E-16	707,101.38	1,877,842.04	474.9
STN-E-17	707,146.54	1,877,811.85	475.4
STN-E-18	707,190.77	1,877,765.92	461.6
STN-E-19	706,774.43	1,878,687.08	472.8
STN-E-20	706,856.53	1,878,704.54	476.0
STN-E-21	706,883.00	1,878,751.72	461.6

RECORD DRAWING

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GRAPHIC SCALE: 1"=200'

PLOT DATE: 05/21/2010 USER: BRADSHAW, STEVEN
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\REV0_RECORD\10W504-02-R0.DWG

FOR INFORMATION ONLY
This Record Drawing which has been previously submitted to TVA is provided for Information Only.

For Supporting Design Calculations see FPGGAFFESCDX00000020100001

RANDY LEE ROBERTS
No. 113825
5/27/10

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Fax 502.212.5055
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R –	–	–	–	–	–	–	–	–	–	–	–
–											
R 0	05/27/10	PC	RP	PC	RLR	RLR	RLR	TJ	–	–	–
RECORD DRAWING											
REV. NO.	DATE	DSGN	DRWN	CHKD	SUPV	RVWD	APPD	ISSD	PROJECT ID	AS CONST	REV CD

DISCIPLINE INTERFACE
1
2
3
4

SCALE: 1'=200' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
BORING LAYOUT

DESIGNED BY:	DRAWN BY:	CHECKED BY:	SUPERVISED BY:	REVIEWED BY:	APPROVED BY:	ISSUED BY:
P. COOPER	R. PETTY	P. COOPER	R. ROBERTS	R. ROBERTS	R. ROBERTS	T. JOHNSON

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000	DATE 05/27/10	39	C	10W504-02	R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

Pseudostatic Slope Stability Analysis
CCP Storage Facilities - Existing Conditions
Tennessee Valley Authority Fossil Plants

Section A - Peabody Ash Pond
Paradise Fossil Plant
Drakesboro, Kentucky

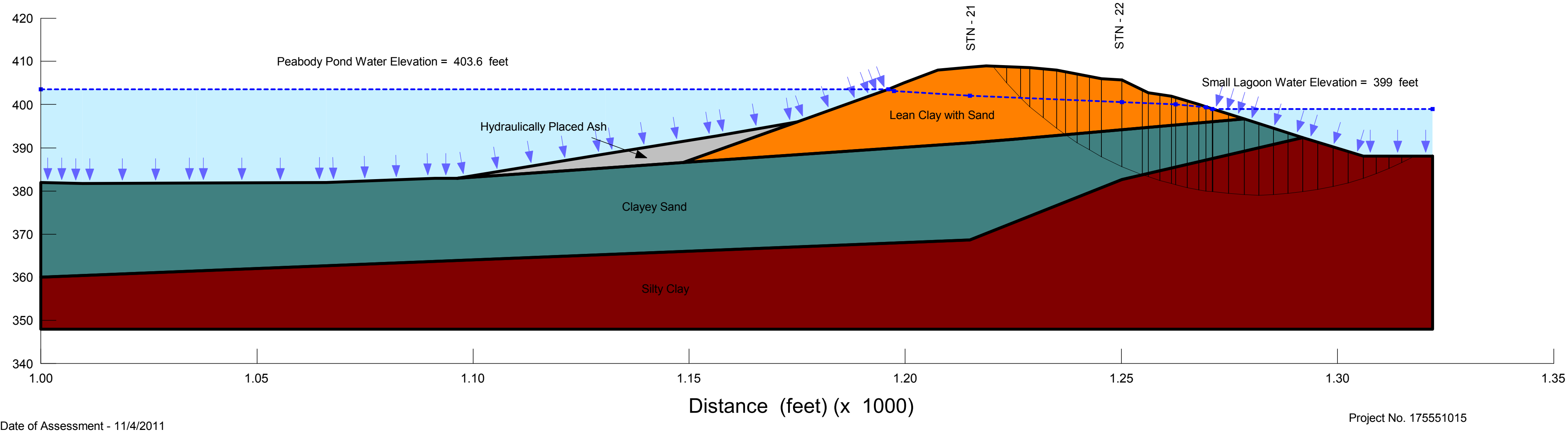
Stantec

Material Type	Unit Weight	Cohesion	Friction Angle
Lean Clay with Sand	139 pcf	0 psf	25 °
Hydraulically Placed Ash	107 pcf	100 psf	18.4 °
Clayey Sand	133 pcf	120 psf	21 °
Silty Clay	129 pcf	120 psf	20 °

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Factor of Safety: 1.0

Horizontal Seismic Coefficient Kh = 0.157 g
2500 year Return Period Event



Date of Assessment - 11/4/2011

Project No. 175551015

APPENDIX A

Document 11

Slope Stability Evaluation, Stantec, March 27, 2010

Report of Geotechnical Exploration and Slope Stability Evaluation

Ash Pond / Stilling Pond Complex
Gallatin Fossil Plant
Gallatin, Tennessee

Stantec Consulting Services Inc.
One Team. Infinite Solutions.
1901 Nelson Miller Parkway
Louisville KY 40223-2177
Tel: (502) 212-5000 • Fax: 502) 212-5055
www.stantec.com

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

May 27, 2010

Stantec

Stantec Consulting Services Inc.
1901 Nelson Miller Parkway
Louisville KY 40223-2177
Tel. (502) 212-5000
Fax (502) 212 5055

May 27, 2010

rpt_001_175559018

Mr. Michael S. Turnbow
Tennessee Valley Authority
1101 Market Street, LP 2G-C
Chattanooga, Tennessee 37402

Re: Report of Geotechnical Exploration and Slope Stability Evaluation
Ash Pond / Stilling Pond Complex
Gallatin Fossil Plant
Gallatin, Tennessee

Dear Mr. Turnbow:

As requested, Stantec Consulting Services Inc. (Stantec) has completed our Geotechnical Exploration and Slope Stability Evaluation for the Ash Pond / Stilling Pond Complex at the Gallatin Fossil Plant. The report documents the subsurface conditions, results of laboratory testing, findings from the historical document reviews, results of our analyses and evaluation, and recommendations for the facility. These services were performed under Engineering Service Request ESR/TAO 894 in accordance with the terms and provisions established in our System-Wide Services Agreement dated December 22, 2008.

Stantec appreciates the opportunity to provide engineering services for this project. If you have any questions, or if we may be of further assistance, feel free to contact our office.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Paul Cooper

Paul J. Cooper, PE
Project Engineer

Randy L. Roberts

Randy L. Roberts, PE
Senior Associate

RANDY LEE ROBERTS

/day

Enclosures:

Report of Geotechnical Exploration and Slope Stability Evaluation

Ash Pond / Stilling Pond Complex
Gallatin Fossil Plant
Gallatin, Tennessee

Prepared for:
Tennessee Valley Authority
Chattanooga, Tennessee

May 27, 2010

Table of Contents

Section **Page No.**

List of Tables and Figures

List of Appendixes

Executive Summary

Stantec Consulting Services Inc. (Stantec) has completed the Geotechnical Exploration and Slope Stability Evaluation at Gallatin Fossil Plant's ash pond and stilling pond complex. This study was performed to evaluate slope stability and seepage for the existing conditions.

Background Information

The ash pond complex encompasses approximately 476 acres and consists of Bottom Ash Pond A (248 acres), Fly Ash Pond E (167 acres) and Stilling Ponds B, C and D (61 acres). The main ash disposal pond at Gallatin was initially commissioned in 1970. It covered both areas now known as Ash Ponds A and E. Ash Pond A was later formed by constructing a bottom ash divider dike in the mid-1980s to separate the bottom ash area (Ash Pond A) from the fly ash area (Ash Pond E). The stilling pond system is situated to the north of both Ash Ponds A and E. The overall constructed height of the dike system now varies from approximately 10 to 30 feet. Dike slopes are approximately 2.5H:1V to 3H:1V, or flatter, except for the divider dike which separates Ash Pond A from the stilling ponds where dike slopes are steeper (approximately 1.5H:IV).

Historical geotechnical issues include mid-1970's sinkhole activity along the south side of Ash Pond A and the north side of Ash Pond E. These sinkholes were reportedly repaired by excavating and capping. In addition, sinkhole repairs were also made during the recent 2006 expansion of Ash Pond E. The documents reviewed do not indicate a history of slope instability or seepage. In addition, signs of slope instability have not been observed in the field by Stantec throughout the course of this work. Minor seepage was observed at a few locations during this study.

Currently, URS Corporation is conducting a siting study for a new CCP landfill for future dry disposal of fly ash, bottom ash, and potentially gypsum. TVA plans for all the CCP ponds at Gallatin to be closed eventually. A phased closure approach will likely be implemented.

Scope of Geotechnical Exploration

This study began with a review of TVA-provided historical information along with site inspections. A geotechnical exploration program was then developed and executed. The exploration consisted of drilling soil test/sample borings at 34 locations. Piezometers were installed at 12 locations. Drilling locations were positioned along 14 cross-sections around the pond complex. The laboratory testing program included moisture content, classification, permeability and shear strength testing to establish key index properties and strength parameters.

Results of Exploration and Engineering Analyses

The results from the geotechnical exploration indicate that the dike systems consist of a mixture of clay and bottom ash. Pond capacities have been expanded in the past by raising or constructing dikes over sluiced ash. The dikes are underlain by native clays and then by limestone bedrock.

Following the drilling and laboratory testing program, slope stability and seepage analyses were performed to quantify factors of safety for current conditions. The dikes were assessed under static, long-term, steady state conditions since they have been in their current configuration for a long time. The analysis focused on eight cross-sections that were selected to represent typical conditions around the pond complex.

To evaluate the seepage conditions within the dikes, a finite element model was developed for each of the eight cross-sections. To judge whether or not a tendency for piping is possible, factors of safety can be calculated using the vertical exit gradients as predicted by the seepage models. For Gallatin's pond complex, the highest vertical exit gradients where minimum factors of safety against piping occur are located at points along the dike toes or just beyond. The minimum factors of safety values are all greater than or equal to three. Based on the U.S. Army Corps of Engineers (USACE) design criteria for dams, Stantec recommends a value of three as a minimum target factor of safety against piping. Hence, on the eight cross sections modeled, the recommended target factor of safety for piping at the critical seepage exit points is met or exceeded.

The slope stability of the Gallatin pond dikes was also evaluated. Factors of safety for slope stability were computed using Spencer's method of analysis, circular and non-circular slip surfaces, and search routines that help to identify the critical (minimum factor of safety) failure surface. The slope stability models were evaluated using pore pressures predicted from the seepage models. The results of the steady-state seepage and long-term slope stability analysis demonstrate that the factors of safety range from approximately 1.1 to greater than 1.5. TVA has adopted a minimum target factor of safety of 1.5 against slope stability based on USACE criteria. The results indicate that four cross-sections (Sections F, H, J, and K) have safety factors less than the target. For Sections H, J and K, the deficient areas are located along the north face of the divider dike that separates Pond A from the adjacent stilling ponds. The low factors of safety are a result of the side slopes being relatively steep along this divider dike (mostly 1.5H:1V). The corresponding failure circles are positioned more toward the face of the dike slope and are not far-reaching into the dike. Hence, the failure circles are considered to be more representative of maintenance-type sloughs and not global failures. For Section F (which is located along the north side of Pond E), the deficient area/failure surface is located at the immediate dike toe area just above the stilling ponds, and is also considered to be representative of maintenance-type sloughing. Factors of safety for deep seated global-type failure surfaces meet or exceed the recommended target value for each section analyzed.

In conclusion, the engineering analyses performed indicates that the divider dike between Ash Pond A and the adjacent stilling ponds, and the toe of the Pond E north dike exhibit deficient factors of safety against maintenance-type sloughing/slope stability. Stantec recommends that TVA undertake mitigation efforts to improve long-term stability conditions for this divider dike. Improvements could be incorporated into upcoming design of pond modifications/closure, or a separate interim mitigation program could be implemented, depending on timing and as decided by TVA.

Report of Geotechnical Exploration and Slope Stability Evaluation

Ash Pond / Stilling Pond Complex
Gallatin Fossil Plant
Gallatin, Tennessee

1. Introduction

In January 2009 the Tennessee Valley Authority (TVA) requested that Stantec Consulting Services Inc. (Stantec) conduct assessments of its coal combustion product (CCP) disposal facilities at eleven active and one closed fossil plants. The plants are located in the states of Kentucky, Tennessee and Alabama. The assessments were performed for the purpose of determining whether unstable conditions are present that could possibly cause a release of CCP's into the environment.

Stantec's scope of services for the assessments was developed within the framework of current dam safety practice and was performed in phases. Stantec generally used U.S. Army Corps of Engineers (USACE) practices and procedures as a guide for this program. Phase 1 included review of available documentation, site reconnaissance, field measurements and providing recommendations for interim corrective measures, improvements, and further engineering studies. The Report of Phase 1 Facility Assessment for Coal Combustion Product Impoundments and Disposal Facilities for the Tennessee plants was completed on June 24, 2009. The conclusions and recommendations for the Ash Pond/Stilling Pond complex (Ash Ponds A and E, Stilling Ponds B, C and D) at the Gallatin Fossil plant (GAF) are included in the Phase 1 report. In addition to issues that require maintenance-type remedial activities, the Phase 1 recommendations included conducting a Phase 2 geotechnical exploration to evaluate slope stability and seepage for the pond complex. As a result, the following geotechnical evaluation was authorized by TVA under Engineering Services Request ESR/TAO 894. This report documents the scope and results of the study and contains Stantec's conclusions and recommendations concerning slope stability and seepage for the Ash Pond complex at GAF.

2. Site Description and Geology

2.1. Location and Description

The Gallatin Fossil Plant is located in Gallatin, Sumner County, Tennessee along the north bank of the Cumberland River (Old Hickory Lake) encompassing the Odom's Bend peninsula approximately 30 miles northeast of Nashville. The ash pond/stilling pond complex is situated approximately 5,000 feet north of the plant's powerhouse. This disposal area is bordered by the plant access road to the east, railroad tracks to the north, and the Cumberland River to the west. The complex encompasses approximately 476 acres and consists of Bottom Ash Pond A (248 acres), Fly Ash Pond E (167 acres), and Stilling Ponds B, C and D (61 acres). Figure 2.1 on the following page provides a plan view of the Gallatin pond complex.

Gallatin Fossil Plant
Gallatin, Tennessee

Stantec

Figure 2.1. Gallatin Ponds Overview

The main ash pond at Gallatin was initially commissioned in 1970. It covered both areas now known as Ash Ponds A and E. Ash Pond A was formed by constructing a bottom ash divider dike in the mid-1980s to separate the bottom ash area (Ash Pond A) from the fly ash area (Ash Pond E). That divider dike was raised in the late 1980's for additional storage. The raised dike was constructed inwardly over sluiced ash. The divider dike is estimated to now be about 20 to 25 feet tall (estimated from old drawings). Approximately 45,000 tons of bottom ash is sluiced to Pond A annually. The outlet for Pond A is through three 48-inch RCP riser pipe/weirs that discharge through three 30-inch RCP sections into the adjacent Stilling Pond B. The outlet pipes are submerged.

As mentioned above, Ash Pond E was formed when the main pond system was divided by constructing a bottom ash divider dike in mid-1980s. The initial area of Pond E was formed by constructing a series of "saddle" dikes where lower ground elevations existed. In 2006, Pond E was expanded by constructing a new raised perimeter dike. The new perimeter dike was constructed over old saddle dikes, and inwardly over sluiced fly ash. Approximately 185,000 tons of fly ash is sluiced to Pond E annually. The outlet for Pond E is through two 48-inch RCP riser pipe/weirs that discharge through two 30-inch pipe sections into adjacent Stilling Pond C.

The stilling pond system is situated to the north of both Ash Ponds A and E. Stilling Ponds B, C and D are essentially all part of the same pond. Each designated area is separated by narrower pond sections/channels, but all areas are hydraulically connected and are at the same pool elevation. Pond B receives decant water from Ash Pond A, and flows to Pond C. Pond C receives decant water from Pond E and flows into Pond D. The stilling pond outlet is located at the west end of Pond D. The outlet consists of four 48-inch RCP riser/weir sections that discharge though four 36-inch RCP sections into an adjacent small discharge pool. From here, water discharges through four 36-inch corrugated metal pipes into adjacent Old Hickory Lake. The Pond D area and outlet were initially commissioned in 1970 when the main ash pond area (formerly Disposal Area 3) was placed into operation. Pond B and C areas to the east were formed when the divider dike construction extended to the north to separate Ash Ponds A and E. The entire stilling pond area is naturally low-lying, and only two short saddle dike sections exist. One is at the outlet area of Pond D, and one is to the north of the Pond C area. The pool elevation is about 11 to 12 feet lower than adjacent Ash Pond A, and about 7 to 8 feet lower than adjacent Ash Pond E.

Currently, URS Corporation is conducting a siting study for a new CCP landfill for future dry disposal of fly ash, bottom ash and potentially gypsum. TVA plans for all the CCP ponds at Gallatin to be closed eventually. A phased closure approach will likely be implemented.

2.2. Geology

The Gallatin Fossil Plant is located in the northern portion of central Tennessee along the north bank of the Cumberland River (Old Hickory Lake), encompassing the Odom's Bend peninsula. The geologic mapping reviewed (Geologic Map of the Laguardo Quadrangle, Tennessee, Tennessee Department of Conservation, Division of Geology, 1964) depicts soil deposits consisting of alluvial clay, silt and very fine sand across large portions of the site. The mapping indicates that the thickness of the alluvium is highly variable, but may be as much as 70 feet including terrace deposits. The remaining areas are underlain by residual clays resulting from the in-place weathering of the parent Ordovician age limestone formations. The alluvial deposits are mapped primarily at lower site elevations along the power plant area and only extend into the extreme south end of the ash pond complex. Thus, the majority of the pond complex is underlain by residual clays.

The geologic mapping also indicates that the bedrock beneath the soil deposits consists of the Bigby-Cannon Limestone, Hermitage Formation, Carters Limestone, and Lebanon Limestone in general order of descending lithology. The Bigby-Cannon Limestone is only mapped in the higher elevations of the site above approximate El. 540 feet. The unit is described as consisting of medium to coarse grained limestone with phosphate pellets to a dark gray to brown-black microcrystalline limestone to a cryptocrystalline dove colored limestone. The Hermitage formation is primarily mapped within the interior of the peninsula between approximate El. 510 feet and El. 540 feet. The Hermitage Formation consists of silty, nodular to laminated, argillaceous limestone with fossiliferous and phosphatic zones and may contain calcarenite (i.e., sandstone derived from the erosion of older limestone). Residuum formed by the solution weathering of the Hermitage Formation is typically a sandy to silty lean clay generally underlain by a zone of extensively weathered parent rock including "floating" boulders in the soil overburden, as well as pinnacles and slots in the bedrock mass filled with soft, wet unconsolidated clay soils. The Carters Limestone is mapped between approximate elevations El. 445 feet and El. 510 feet and consists of a densely crystalline limestone with thin shale partings. In general, the Lebanon Limestone is mapped below El. 445 feet and is a thin bedded, fossiliferous limestone with thin calcareous shale partings. Based on the mapping and elevation ranges listed above, the ash pond complex at GAF is primarily influenced by the Carters and Lebanon Limestone formations.

The USGS topographic mapping depicts a few enclosed drainage basins indicative of karst activity within the vicinity of the plant. Correlation of the locations of these features with the geologic mapping suggests this karst activity is associated with the upper portions of the Carters Limestone near the contact with the overlying Hermitage Formation. Sinkholes, irregular bedrock surfaces, clay-filled vertical crevices/slots, and varying degrees of solutioning/weathering can occur with karstic bedrock formations.

3. Review of Available Information

3.1. General

During the Phase 1 Facility Assessment, Stantec's engineers reviewed documents provided by TVA pertaining to the ash ponds and stilling ponds at GAF. The main objective of the document review was to develop a historical knowledge base of the pond complex. The documents reviewed included record drawings, cross-sections of dikes, old contour maps, annual dike stability reports and old geotechnical reports. The information gained was also used to supplement the information obtained during Stantec's geotechnical exploration. A complete listing of the reviewed documents is included in the Phase 1 report.

Of particular interest and use in this study are the following documents and drawings:

- Gallatin Steam Plant, Ash Disposal Area 3, Deflector and Divider Dikes, SME-SOI-88-017, by Singleton Materials Engineering Laboratory, September 8, 1988.

- Report of Geotechnical Exploration, Ash Disposal Area and Potential On-site and Off-site Borrow Areas, Gallatin Fossil Plant, Gallatin, Tennessee, by MACTEC Engineering and Consulting, Inc., October 14, 2004.

- Gallatin Fossil Plant, Ash Disposal Study, Phase 1 Report, Revision 0, by Worley Parsons Resources and Energy, May 15, 2006.
- Gallatin Steam Plant – Ash Disposal Area – Soils Exploration, Memorandum from F.P. Lacy to J.C. McGraw, September 24, 1969.
- Gallatin Fossil Plant Ash Disposal Ponds Dike Stability Analyses, TVA in-house analysis, May 13, 2005.
- Geology of the Gallatin Steam Plant Site, by Charles P. Bensiger, TVA Division of Water Control Planning, Geologic Branch, June, 1953.
- Results of TVA in-house static slope stability analysis for raising of Pond A divider dike, 1988.
- TVA Drawing Numbers 10W271, 306 to 320, 410, 411, 415, 416, 506 to 510, 10N240, 10N243, 10N267, 10N272, 10N273-01 to 03, 10N274, 10N278.
- TVA Annual Inspection Reports, 1967 to 1989, 1993 to 2004, and 2007 to 2008.

It should be noted that the 2004 MACTEC geotechnical report was useful in offering comparisons to Stantec's current subsurface and laboratory testing data. It contains the results of sol test borings, cone penetrometer tests, and laboratory tests that were conducted to support the 2006 expansion of Ash Pond E. In general, the data presented in that report offers a good comparison to the current Stantec data, and Stantec reviewed and considered this data when selecting paramaters for seepage and slope stability analysis. Further commentary relative to the MACTEC data is offered at various locations within this report, where applicable. In addition, a copy of the report is provided in Appendix G for reference.

3.2. Site History

Construction began at the Gallatin Fossil Plant in 1953 and was completed in 1959. Gallatin currently contains four coal-fired generating units and burns approximately 12,350 tons of coal per day.

Initially, ash materials at Gallatin were placed into a disposal area just southwest of the powerhouse along the river. This area was in operation until usage was discontinued in 1970. The facility had four cells, referred to as A, B, C and D. Ash was sluiced to the cells. In 1967, two slides occurred along exterior dikes adjacent to cells A and C. These two cells were drained and abandoned, but Cell B (middle cell) remained in operation until 1970 when disposal shifted to what was then called Area 3 (now known as Ponds A and E). Cell B contained water until it was drained in 1973. Over time, vegetation developed in the abandoned cells, and the slide areas were monitored. Stormwater continued to collect in Cell B where a skimmer was left in place to prevent loss of ash through the outlet pipe. In 1985, new slides began to develop and in 1986 the entire perimeter dike length was reconstructed and flattened to 2H:1V. In 1995 a formal closure plan was developed, submitted to TDEC and was approved in 1997. The closure construction work was completed in 1998. GAF personnel are required to monitor toe seepage areas on a quarterly basis to comply with the TDEC-approved closure plan.

The next disposal area at Gallatin was initially known as Disposal Area 3 and was commissioned in 1970. It covered both areas now known as Ash Ponds A and E. In general, this entire area is naturally low-lying and only saddle dikes were needed in a few cases to form the disposal area. The original outlet area was also constructed at that time, which is still in operation today within Stilling Pond D.

In the mid-1980's, Ash Ponds A and E were formed by constructing a bottom ash divider dike extending to the east to separate the bottom ash area (Ash Pond A) from the fly ash area (Ash Pond E). This construction also resulted in the formation of the stilling pond complex to the north (Ponds B, C and D). That divider dike was raised in the late 1980's for additional storage. In 2006, Pond E was expanded by constructing a new higher perimeter dike. The expansion was constructed over known sinkholes, which were reportedly mitigated. Also, the new dike was constructed over the old original saddle dikes, and inwardly over sluiced fly ash. Currently, the pool elevation of Pond A is about 11 to12 feet higher than adjacent Stilling Pond B, and the pool elevation for Pond E is about 7 to 8 feet higher than adjacent Stilling Pond C. Approximately 45,000 tons of bottom ash is sluiced to Pond A and approximately 185,000 tons of fly ash is sluiced to Pond E annually.

3.3. Historical Geotechnical Issues

As discussed in Section 3.1, the Phase 1 work included review of historical documents. Primary issues listed in the documents for the pond complex are discussed below.

3.3.1. Seepage and Slope Stability

The documents reviewed for Ash Pond A, Ash Pond E and the stilling ponds do not indicate a history of slope instability or seepage. In addition, signs of slope instability have not been observed in the field by Stantec. However, there were a few minor areas of seepage that have been discovered throughout the course of this work. Figure 3.1 presents a plan view of these seepage locations at Gallatin. The seepage is described below:

Seep 1 – Small red-water seep discovered by Stantec in January 2009 just above pool level of stilling pond and to the east of Pond A outlet system. No change observed in appearance throughout course of this work. Minimal to no flow observed. No piping.

Seep 2 – Red-water seeps discovered by Stantec in January 2009 along toe of saddle dike at Stilling Pond C. No significant change observed in appearance throughout course of this work. Minimal to no flow observed. No piping.

Seep 3 – Small red-water seep discovered by TVA personnel in March 2010 just above the south dike toe at Pond E. Size is approximately 5 feet by 20 feet strip. Very small flow observed. No change observed in appearance throughout course of this work. No piping.

Seep 4 – Small seep discovered by TVA personnel in March 2010 just above west dike toe at Pond E. Size is approximately 5 feet by 20 feet strip. Wet/soft ground observed with no flow and no piping. No change observed in appearance throughout course of this work.

Possible Seep 5 – This possible seepage area is located just beyond the west Pond E dike toe area adjacent to the pool level of Old Hickory Lake. This could be remaining wet areas from recent high pool events of Old Hickory Lake, and needs further observations with time and during drier weather to reach conclusions.

Gallatin Fossil Plant
Gallatin, Tennessee

Stantec

Figure 3.1. Gallatin Seepage Locations

Possible Seep 6 – This small possible seepage area is located at the northwest dike toe of Pond A. It was discovered in February by TVA. It also had some minor flow that was noted by Stantec on May 3, 2010 just after the very heavy rain event that occurred May 1 and 2, 2010. The dike crest in this area tends to pool water during rain, and this area could be a result of stormwater infiltration into the dike that is slowly exiting at the dike toe below. Further observations with time and during drier weather will be needed to reach conclusions.

Possible Seep 7 – This possible seepage area is located just west of Seep 3 at the south dike toe of Pond E. It was discovered by Stantec on May 3, 2010 just after the very heavy rain event that occurred May 1 and 2, 2010. The area exhibited very low flow. Because it was discovered just after the heavy rains, this area could be a result of stormwater infiltration into the dike that is slowly exiting at the dike toe below. Further observations with time and during drier weather will be needed to reach conclusions.

3.3.2. Karst Activity

Documentation reviewed indicates that sinkhole activity has affected the ponds at Gallatin in the past. For example, the annual inspection reports indicate that pond seepage loss occurred through a sinkhole located on the north side of Ash Pond E in the early to mid 1970's. This sinkhole was reportedly repaired in 1977. The inspection reports also indicate that pond seepage loss occurred through a sinkhole on south side of Ash Pond A also during the early to mid 1970's. A circular dike was built to isolate and protect this sinkhole in 1979. In 1990, the circular dike was removed and the sinkhole was repaired reportedly by excavating and capping.

Last, the recent expansion for Pond E was constructed over known sinkholes, which were reportedly mitigated during construction. Approximately ten areas were mitigated. Mitigation activities were reported to include pumping the pond dry (with no backflow of water noted), followed by excavating the areas to expose bedrock and filling the crevices/sinkholes with shot rock and a compacted clay cap. It should be noted that the construction drawings for the Pond E expansion do show details relative to sinkhole repairs. In general, mitigation procedures specified the use of crushed stone filters, filter fabric, and compacted clay caps.

Recently, a small sinkhole appeared within the low lying area just north of the Pond C saddle dike. This occurred immediately following the major rain event of May 1 and 2, 2010. Other than this, Gallatin has not experienced any known additional karst-related problems within the ponds in recent years.

4. Scope of Exploration

The field portion of the geotechnical exploration was performed from July 29 through August 22, 2009. These services were performed in general accordance with various Corp of Engineers procedures, along with standard procedures for geotechnical engineering practice.

Stantec personnel advanced conventional sample borings at 34 locations using a combination of track-mounted and truck-mounted drill rigs. In general, the borings were positioned at dike crests and toes along 14 cross-sections. All borings were advanced to apparent bedrock, with four borings being advanced approximately 4 to 19 feet into bedrock using NQ-size (approximately two-inch diameter) rock coring equipment. The rock core borings were advanced to confirm bedrock depths. The locations of the borings are shown on the Boring Layout Plan in Appendix E. At completion of the drilling, TVA's survey crew located the borings and profiled the ground lines at the 14 cross-sections.

The subsurface exploration was performed using 3¼- and 4¼-inch (ID) hollow stem augers equipped with a carbide-tipped tooth bit. Standard Penetration Testing (SPT) was performed in all 34 of the conventional sample borings at continuous intervals. A standard penetration test consists of dropping a 140-pound hammer to drive a split-spoon sampler 18 inches. The consistency or relative density of soil is estimated by the number of blows it takes to drive the spoon the last 12 inches. This method is typically used to obtain soil samples, estimate the consistency or relative density of the soil, and also to estimate the vertical limits of the subsurface soil horizons. In addition, undisturbed samples (Shelby Tubes) were obtained in additional offset borings using a fixed head piston sampler. Tube samples were taken from selected depth intervals within the cohesive materials to provide samples for subsequent laboratory strength testing. After completion of the drilling and sampling procedures, the boreholes were checked for subsurface water and backfilled with cement-bentonite grout.

Stantec installed 12 piezometers within additional offset borings as a part of the stability evaluation to provide data on piezometric levels within the existing dikes and native foundation soils. Piezometer construction consisted of one-inch diameter Schedule 40 PVC well screen and riser pipe. The annular backfill consisted of a sand filter pack to some distance above the screened interval followed by a bentonite seal. After allowing the bentonite to hydrate, the remaining annulus was backfilled with cement-bentonite grout tremmied into place. Riser-type protective covers were set in concrete to protect the piezometers. These instruments are scheduled to be monitored by Stantec until June 2010.

An engineer/geologist was present with each drill crew throughout the drilling operations. The engineer/geologist directed the drill crews, logged the subsurface materials encountered during the exploration and collected samples. Particular attention was given to the material's color, texture, moisture content and consistency or relative density. The samples extracted from the borings were transported to Stantec laboratories for testing.

In the laboratory, standard penetration test (SPT) samples were subjected to natural moisture content determination in accordance with ASTM D 2216. Selected SPT samples and tube samples were subjected to soil classification tests that included Atterberg limits testing (ASTM D 4318), specific gravity tests (ASTM D 854) and sieve and hydrometer analyses (ASTM D 422). Select bulk samples were also collected and subjected to standard moisture-density (Proctor) testing (ASTM D 698). Undisturbed samples were extruded and subjected to unit weight determination, falling head permeability testing (ASTM D 5084) and consolidated undrained triaxial compression testing with pore pressure measurements (ASTM D 4767).

The results of the field and laboratory testing services were used to develop cross-sections for slope stability and seepage analysis. Based on the results of the field exploration and review of cross-section geometry, Stantec selected eight cross-sections to analyze.

5. Results of Geotechnical Exploration

5.1. Summary of Borings

Stantec developed a boring plan for the field exploration after a review of historical information and existing site conditions. TVA survey personnel established boring locations and elevations after drilling was completed. The boring layout plan is contained in Appendix E and boring logs are presented in Appendix A. A summary of the boring information is presented in Table 5.1 (all measurements are expressed in feet).

Table 5.1. Summary of Borings

Boring No.	Surface Elevation	Northing	Easting	Top of Rock** Depth	Top of Rock** Elevation	Boring Termination Depth	Bottom of Hole Elevation
STN-A-1	472.8	707019.68	1879799.57	30.5	422.3	30.5	422.3
STN-A-2	473.3	706994.16	1879810.94	42.1	431.2	42.1	431.2
STN-A-3*	472.9	707510.75	1880731.90	23.7	449.2	34.0	438.9
STN-A-4	473.8	707498.65	1880758.47	26.5	447.3	26.5	447.3
STN-A-4S	473.8	707498.65	1880758.47	—	—	26.0	447.8
STN-A-5	473.7	708368.74	1881417.01	23.2	450.5	23.2	450.5
STN-A-6	474.0	708353.42	1881433.71	31.4	442.6	31.4	442.6
STN-A-7	474.5	708921.58	1881894.55	42.1	432.4	42.1	432.4
STN-A-8	474.8	708907.06	1881914.61	25.5	449.3	28.5	446.3
STN-A-8S	474.8	708907.06	1881914.61	—	—	22.0	452.8
STN-A-9	472.4	709132.64	1882470.74	31.2	441.2	31.2	441.2
STN-A-9S	472.4	709132.64	1882470.74	—	—	25.0	447.4
STN-A-10*	474.1	709085.67	1882461.16	33.4	440.7	45.0	429.1
STN-C-1	462.0	707402.48	1879680.01	19.0	443.0	21.0	441.0
STN-D-1	460.8	707328.99	1877246.92	—	—	16.5	444.3
STN-D-1A	460.8	707328.99	1877246.92	21.0	439.8	21.0	439.8
STN-D-1B	460.8	707328.99	1877246.92	—	—	14.0	446.8
STN-D-1S	460.8	707328.99	1877246.92	---	—	17.0	443.8
STN-D-2	460.4	707245.18	1877237.96	15.9	444.5	15.9	444.5
STN-D-2S	460.4	707245.18	1877237.96	—	—	12.0	448.4
STN-E-1*	474.1	703045.88	1879000.10	36.0	438.1	55.0	419.1
STN-E-1S	474.1	703045.88	1879000.10	—	—	34.5	439.6
STN-E-2	475.7	703007.37	1879022.21	30.0	445.7	30.0	445.7
STN-E-3	459.6	702955.21	1879046.66	41.4	418.2	41.4	418.2
STN-E-4	474.3	702820.82	1878131.27	50.3	424.0	50.3	424.0
STN-E-4S	474.3	702820.82	1878131.27	—	—	42.0	432.3
STN-E-5	476.1	702788.65	1878111.48	50.3	425.8	50.3	425.8
STN-E-6	459.6	702733.38	1878070.14	28.0	431.6	28.0	431.6
STN-E-7	475.1	703843.80	1877971.87	65.0	410.1	65.0	410.1
STN-E-8	476.5	703835.47	1877934.64	63.9	412.6	63.9	412.6
STN-E-9	451.8	703753.39	1877876.25	45.9	405.9	45.9	405.9
STN-E-10	474.9	704870.32	1877862.37	28.6	446.3	29.1	445.8

Table 5.1. **Summary of Borings**

Boring No.	Surface Elevation	Northing	Easting	Top of Rock** Depth	Top of Rock** Elevation	Boring Termination Depth	Bottom of Hole Elevation
STN-E-10S	474.9	704870.32	1877862.37	—	—	27.0	447.9
STN-E-11	476.1	704863.36	1877828.40	40.5	435.6	40.5	435.6
STN-E-12	455.3	704854.47	1877754.46	28.3	427.0	28.3	427.0
STN-E-13	474.3	706353.41	1877474.21	37.1	437.2	37.1	437.2
STN-E-13S	474.3	706353.41	1877474.21	—	—	34.0	440.3
STN-E-14	477.0	706343.79	1877425.50	40.5	40.5	40.5	436.5
STN-E-14S	477.0	706343.79	1877425.50	—	—	7.0	470.0
STN-E-15	463.4	706458.09	1877364.00	27.0	436.4	27.0	436.4
STN-E-16	474.5	707101.38	1877842.04	59.0	415.5	59.0	415.5
STN-E-16S	474.5	707101.38	1877842.04	—	—	56.0	418.5
STN-E-17	475.4	707146.54	1877811.85	39.1	436.3	39.1	436.3
STN-E-18*	461.6	707190.77	1877765.92	36.1	425.5	40.0	421.6
STN-E-19	472.8	706774.43	1878687.08	44.7	428.1	44.7	428.1
STN-E-20	476.0	706856.53	1878704.54	25.8	450.2	28.5	447.5
STN-E-20S	476.0	706856.53	1878704.54	—	—	25.0	451.0
STN-E-21	461.6	706883.00	1878751.72	15.5	446.1	16.0	445.6
STN-E-21S	461.64	706883.00	1878751.72	—	—	15.0	461.6

* *Boring advanced into bedrock.*

** *Top of Rock, as used herein, refers to rock-like resistance to the advancement of the augers using a carbide-tipped-tooth bit. This may indicate the beginning of weathered bedrock, boulders, or rock remnants. An exact determination cannot be made without performing rock coring.*

5.2. Subsurface Conditions

5.2.1. Soil

Using the boring logs and laboratory tests from this geotechnical exploration, the boring information contained in previous geotechnical studies at the facility, TVA design drawings, old contour maps and other historical information, Stantec developed a general profile for each stability cross-section for the ash pond complex. The profiles depict five generalized material horizons that are described below. The stability sections contained in Appendix E show these layers in graphical manner. In addition, the graphical logs shown on the stability sections also depict the material Unified Soil Classification System (USCS) classifications based on laboratory tests and on visual observations.

The "Pond E Clay Dike" represents the new dike that was recently constructed in 2006 for the expansion of Pond E. It was constructed over sluiced ash in the south portion, over intervals of old saddle dikes and sluiced ash to the west, and over native materials in other cases. Its crest elevation is at approximate El. 475 to El. 476. Side slopes are typically at 3H:1V or flatter, except for the area represented by Section C where side slopes are approximately 2.5H:1V. The dike materials are primarily clay soils with USCS classifications of predominantly CL, with lesser instances of CH. Textural descriptions are gravelly lean clay with sand, sandy lean clay, lean clay with sand, silty clay, and fat clay with sand. The clays are moist in moisture content, mostly reddish to orange brown in color, with occasional brown and tan coloring. Based on SPT N-values and laboratory strength testing, the upper dike clays have strength consistencies ranging primarily from stiff to very stiff. It should be noted that there are portions of the new Pond E dike that was constructed using bottom ash. These zones are normally located in the lower portions of the new dike. For discussion purposes, this material is included in the following profile description for bottom ash fill.

"Bottom Ash Fill" is located within dikes at the following primary locations:

- Lower portions of the new Pond E dike that was constructed in 2006.
- Initial and raised dikes for the Pond A divider dike (entire dikes are constructed of bottom ash).
- Stilling Pond C saddle dike located at north side of Pond C (entire dike constructed of bottom ash).

Classification testing performed on selected bottom ash samples resulted in USCS classifications of SM and SW-SM with textural descriptions of silty sand, silty sand with gravel, and well-graded sand with silt and gravel. The ash materials are black in color and moist in moisture content. SPT N-values indicate primarily medium dense to dense relative densities, with some zones of loose and very dense relative densities.

The "Stilling Pond D Saddle Dike" represents a short, low height interval of dike that is located at the pond complex outlet area into Old Hickory Lake at the northwest portion of the reservation. Its crest is at approximate El. 462 feet, and it is less than 10 feet tall. The dike materials are primarily clay soils with a USCS classification of CL and a textural description of lean clay with sand. The clay is moist, reddish brown in color and stiff to very stiff in strength consistency.

Below the various dike materials, "Native Clay" was encountered extending downwardly to the apparent top of bedrock. As described in Section 2.2, the native clays beneath the pond complex are primarily residual in origin resulting from the in-place weathering of the parent limestone formations. The native clays have USCS classifications primarily of CL and CH, with textural descriptions of lean clay, sandy lean clay, sandy lean clay with gravel, fat clay and fat clay with sand. Grevel and chert zones are present in some cases. The clays are mostly brown, red-brown, yellow-brown or orange-brown in color, and moist in moisture content with some isolated wet zones. Based on SPT N-values and laboratory strength testing, the "Native Clay" has strength consistencies ranging mostly from medium to stiff, with lesser occurrences of soft and very stiff zones. The thicknesses of the native soils above bedrock across the pond complex range from as little as about one foot or less to as much as about 30 feet. Most thicknesses are from about 10 to 25 feet.

Hydraulically placed (sluiced) fly ash and bottom ash was also encountered in borings drilled through dikes that have been placed over sluiced ash. Where encountered, the thickness of the sluiced ash ranges from about 5 feet to as much as 25 feet, with most being from about 5 to 10 feet thick. Classification testing performed on selected samples of sluiced ash resulted in USCS classifications of SM for bottom ash and ML for fly ash, with corresponding textural descriptions of silty sand with gravel and silt, respectively. The ash materials are black in color and wet in moisture content. SPT N-values indicate loose to medium relative densities for the bottom ash, and typically very soft to soft strength consistencies for the fly ash.

The subsurface logs presented in Appendix A include more detailed descriptions of the materials encountered at the specific boring locations.

5.2.2. Bedrock

Elevations of apparent top of bedrock, as indicated by auger refusal, are variable across the site, ranging from a low of about El. 406 feet to a high of about El. 451 feet. The bedrock surface shows a general trend of being lower beneath the Pond E dikes to the west. The bedrock surface elevations are generally higher along the Pond A divider dike. In a few instances, irregularities in the bedrock surface were encountered over relatively short distances. These variations are typical for limestone bedrock formations where surface weathering and solutioning can create abrupt changes in the bedrock surface and pinnacles within the rock mass.

Rock coring was performed at four borings (STN-A-3, STN-A-10, STN-E-1 and STN-E-18) to confirm the presence of bedrock, and to gain general information on the underlying limestone. The rock cores were logged in terms of rock type, color, bedding characteristics, and other notable features. The limestone bedrock encountered correlates well with the limestone described within the geologic mapping. The rock core specimens are generally described as limestone, gray in color, thin bedded, and containing weathered and fractures zones. At boring STN-A-3, a six-foot thick zone of highly weathered rock/voids was encountered just below the rock surface, and instances of low core recoveries were encountered at other locations. These features are indicative of karst limestone where zones of voids, clay seams, and weathering will often be intermittently encountered between zones of more intact bedrock.

5.3. Phreatic Conditions

At select boring locations, piezometers were installed to measure pore water pressures. In general, initial piezometer readings were taken at approximate two week intervals, and then extended to monthly intervals. It is anticipated that Stantec will continue to take readings until June 2010. Refer to Appendix B for piezometer installation details and readings (up to most recent set of readings). Piezometer locations and tip elevations are summarized in Table 5.2 below.

Table 5.2. Summary of Piezometers

Boring No.	Concrete Pad Elevation (Feet)	Piezometer Tip Elevation (Feet)
STN-A-1	472.8	443.1 (Pond A native clay/initial bottom ash divider dike)
STN-A-5	473.7	452.3 (Pond A initial bottom ash dike)
STN-A-9S	472.4	448.4 (Pond A initial bottom ash divider dike)
STN-C-1	462.0	446.0 (Pond C Saddle Dike)
STN-D-1A	460.8	439.8 (Pond D native clay at outlet saddle dike)

Table 5.2. Summary of Piezometers

Boring No.	Concrete Pad Elevation (Feet)	Piezometer Tip Elevation (Feet)
STN-E-2	475.7	445.7 (Pond E native clay/sluiced ash)
STN-E-6	459.6	431.6 (Pond E native clay/sluiced ash)
STN-E-8	476.5	446.5 (Pond E native clay/1969 clay dike/sluiced ash)
STN-E-12	455.3	427.0 (Pond E native clay)
STN-E-14	477.0	437.0 (Pond E native clay)
STN-E-18	461.6	441.6 (sluiced ash/bottom ash dike)
STN-E-20	476.0	447.5 (sluiced ash/ash fill)

In general, the series of readings to date have shown that water levels have remained fairly consistent with only slight fluctuations being observed (usually only a few tenths of a foot to about one foot). These fluctuations are likely attributed to equalization of the water level within the piezometers over time. However, it should be noted that water levels can also fluctuate due to the seasons, precipitation events, and other factors.

6. Laboratory Testing

6.1. General

The results of laboratory testing performed are included within the appendices. ASTM testing specifications were observed. In particular, natural moisture content test results are shown on the attached boring logs in Appendix A and are also shown on the drafted stability sections in Appendix E. The results of the classification testing and shear strength testing performed on selected samples are included in Appendix C. The USCS classifications associated with each horizon are also discussed in Section 5.2.1 above, and are presented in Table 6.1. No further discussion relative to the results of moisture content and classification testing are provided in this section. The discussion that follows is limited to the laboratory testing associated with evaluation of the dike compaction characteristics and shear strengths of the cohesive soil horizons.

Table 6.1. Summary of ClassificationTesting

Sample Location	Sample Type	Soil Horizon	USCS Classification
STN-A-2, 35'-39.5'	SPT	Native Clay	CH
STN-A-3, 9'-13.5'	SPT	Pond A Bottom Ash Dike	SM
STN-A-7, 30'-34.5'	SPT	Native Clay	CL
STN-A-10, 15'-19.5'	SPT	Sluiced Ash	SM
STN-C-1, 3'-7.5'	SPT	Pond C Bottom Ash Saddle Dike	SW-SM
STN-D-2, 6'-10.5'	SPT	Pond D Clay Dike at Outlet	CL
STN-E-2, 4.5'-9.0'	SPT	Pond E Clay Dike	CL
STN-E-3, 4.5'-9.0'	SPT	Sluiced Ash	SM
STN-E-3, 25.5'-30'	SPT	Native Clay	CH
STN-E-4, 34.5'-39'	SPT	Sluiced Ash	ML
STN-E-8, 31.5'-33'	SPT	Native Clay	CL
STN-E-9, 34'-38.5'	SPT	Native Clay	CL
STN-E-11, 3'-7.5'	SPT	Pond E Clay Dike	CL
STN-E-13, 16.5'-21'	SPT	Native Clay	CH
STN-E-15, 11.5'-16'	SPT	Native Clay	CH
STN-E-16, 18'-22.5'	SPT	Bottom Ash	SM
STN-E-17, 4.5'-9'	SPT	Pond E Clay Dike	CL
STN-E-18, 22.5'-27'	SPT	Native Clay	CL
STN-E-20, 4.5'-9'	SPT	Pond E Clay Dike	CH
STN-A-6, 29.1'-29.5'	Tube	Native Clay	CH
STN-E-4S, 5'-5.5'	Tube	Pond E Clay Dike	CL
STN-E-8, 41.6'-42.1'	Tube	Native Clay	GC
STN-E-8, 50.2'-50.7'	Tube	Native Clay	CL
STN-E-9, 5.8'-6.3'	Tube	Native Clay	CL
STN-E-10S, 5.3'-5.8'	Tube	Pond E Clay Dike	CL
STN-E-12, 10.3'-10.8'	Tube	Native Clay	CL
STN-E-14S, 2.0'-2.5'	Tube	Pond E Clay Dike	CL
STN-E-16S, 5.6'-6.1'	Tube	Pond E Clay Dike	CH
STN-E-16S, 36.0'-36.5'	Tube	Native Clay	CL
STN-E-21S, 11.6'-12.1'	Tube	Native Clay	CL

6.2. Cohesive Soils/Undisturbed (Shelby) Tube Samples

The borings drilled for the GAF ash pond/stilling pond complex included three-inch diameter undisturbed (Shelby) tube sampling within cohesive soil horizons. Stantec's soils laboratory extruded the tubes and trimmed six-inch long specimens. Lab personnel determined visual classifications, unit weights (wet and dry), and natural moisture for each six-inch specimen prior to submitting a summary of the extruded specimens to a geotechnical engineer for assignment of lab testing. Select six-inch specimens extruded from Shelby tubes were then subjected to consolidated-undrained (CU) triaxial testing and permeability testing. The results of these tests are included in Appendix C and discussed below. Selected tube samples where triaxial and permeability testing were performed were also subjected to classification testing. These results are presented in Table 6.1 above.

6.2.1. Consolidated Undrained (CU) Triaxial Testing

Stantec performed CU triaxial testing with pore pressure measurements on selected six-inch long specimens extruded from three-inch diameter Shelby tubes obtained during drilling. CU testing provides indicators of effective-stress shear strength parameters for slope stability analyses. The results of the CU triaxial tests are presented on the stability sections in Appendix E, and are summarized in Table 6.2. The stress path envelopes derived from CU triaxial testing are also presented in Appendix C.

Table 6.2. Summary of Consolidated – Undrained Triaxial Testing

Boring No.	Sample Interval (feet)	Soil Horizon	CU Triaxial Strength	
			c' (psf)	ϕ' (degrees)
STN-D-1S	2.0 – 2.5	Pond D Clay Dike	940	23.3
	2.6 – 3.1			
	6.0 – 6.5			
STN-E-4S	5.0 – 5.5	Pond E Clay Dike	740	17.6
STN-E-8	5.4 – 5.9			
STN-E-8	41.0 – 41.5	Native Clay	360	26.6
	41.6 – 42.1			
	45.2 – 45.7			
STN-E-9	9.5 – 10.0	Native Clay	640	28.8
	10.1 – 10.6			
	10.7 – 11.2			
STN-E-10S	25.0 – 25.5	Native Clay	70	37.1
	25.6 – 26.1			
	26.2 – 26.7			
STN-E-13S	20.0 – 20.5	Native Clay	700	18.4
	20.6 – 21.1			
	25.0 – 25.5			
STN-E-14S	2.0 – 2.5	Pond E Clay Dike	480	21.5
	2.6 – 3.1			
	5.7 – 6.2			
STN-E-15	9.7 – 10.2	Native Clay	380	26.3
	10.3 – 10.8			
	10.9 – 11.4			
STN-E-16S	5.0 – 5.5	Pond E Clay Dike	340	22.0
	5.6 – 6.1			
	7.7 – 8.2			
STN-E-16S	33.0 – 33.5	Native Clay	160	34.3
	33.6 – 34.1			
	34.2 – 34.7			
STN-E-20S	4.0 – 4.5	Pond E Clay Dike	460	25.5
	6.0 – 6.5			
	6.6 – 7.1			
STN-E-21S	11.0 – 11.5	Native Clay	260	34.1
	11.6 – 12.1			
	13.0 – 13.5			

6.2.2. Permeability Testing

The following table summarizes the testing results from the falling head permeability testing. Permeability values are used in seepage analyses.

Table 6.3. Summary of Falling Head Permeability Testing

Boring No.	Sample Interval (feet)	Soil Horizon	Permeability (cm/sec)
STN-A-6	29.1 – 29.5	Native Clay	9.07e-08
STN-E-8	50.2 – 50.7	Native Clay	1.38e-08
STN-E-9	5.8 – 6.3	Native Clay	4.7e-08
STN-E-10S	5.3 – 5.8	Pond E Clay Dike	1.02e-07
STN-E-12	10.3 – 10.8	Native Clay	3.01e-07
STN-E-13S	25.6 – 26.1	Native Clay	2.32e-08
STN-E-15	5.7 – 6.2	Native Clay	1.36e-08
STN-E-16S	9.0 – 9.5	Pond E Clay Dike	1.27e-08
STN-E-16S	36.0 – 36.5	Native Clay	1.16e-08
STN-E-20S	23.0 – 23.5	Sluiced Ash	7.13e-06

6.3. Moisture-Density Relationships

Bag samples were obtained of materials associated with the dikes where clay materials were encountered, which is primarily along the new dike construction associated with Ash Pond E. The results of the standard moisture-density tests performed on these samples are summarized in Table 6.4.

Table 6.4. Standard Moisture-Density (Proctor) Test Results (Clay Dike Materials)

Sample Location	Sample Depth Interval (feet)	Dike Location	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
STN-A-8	14.0 – 17.0	Pond A Bottom Ash Dike	107.4	13.2
STN-D-2	4.0 – 6.0	Pond D Dike	112.3	15.9
STN-E-8	3.0 – 5.0	Pond E Dike	116.7	14.3
STN-E-8	16.0 – 19.0	Pond E Dike	112.4	15.9
STN-E-14	5.0 – 8.0	Pond E Dike	106.2	19.0
STN-E-19	8.0 – 11.0	Pond E Dike	109.1	17.9

Following completion of the moisture-density testing, undisturbed samples taken within clay dike materials were extruded and unit weight and moisture content determinations were made in association with triaxial shear strength testing. The results of the unit weight and moisture content determinations for triaxial test samples are shown in Table 6.5. A comparison between the moisture-density test results and the unit weight determinations obtained from the undisturbed samples is also included. The comparison was made by using the moisture-density test results that were nearest to the undisturbed sample locations (and which also had like classifications) to estimate relative compaction.

Table 6.5. Comparison Between Undisturbed Sample Conditions and Moisture-Density Test Results (Clay Dike Materials)

Boring Location	Sample Depth Interval (feet)	Dike Location	Unit Weight Dry (pcf)	Moisture Content (%)	Maximum Dry Density (pcf)	Percent Maximum Dry Density (%)	Optimum Moisture Content (%)	Moisture Content Variation (%)
STN-D-1S	2.0 – 2.5	Pond D	103.2	21.5	112.3	92	15.9	+5.6
STN-D-1S	2.6 – 3.1	Pond D	106.4	18.1	112.3	95	15.9	+2.2
STN-D-1S	6.0 – 6.5	Pond D	97.5	25.5	112.3	87	15.9	+9.6
STN-E-4S	5.0 – 5.5	Pond E	102.3	19.5	112.4	91	15.9	+3.6
STN-E-8	5.4 – 5.9	Pond E	108.2	19.7	116.7	93	14.3	+5.4
STN-E-14S	2.0 – 2.5	Pond E	104.4	21.8	106.2	98	19.0	+2.8
STN-E-14S	2.6 – 3.1	Pond E	107.4	20.4	106.2	101	19.0	+1.4
STN-E-14S	5.7 – 6.2	Pond E	103.6	22.1	106.2	98	19.0	+3.1
STN-E-16S	5.0 – 5.5	Pond E	102.1	22.6	106.2	96	19.0	+3.6
STN-E-16S	5.6 – 6.1	Pond E	99.8	24.3	106.2	94	19.0	+5.3
STN-E-16S	7.7 – 8.2	Pond E	107.2	19.7	106.2	101	19.0	+0.7
STN-E-20S	4.0 – 4.5	Pond E	106.4	21.7	109.1	98	17.9	+3.8
STN-E-20S	6.0 – 6.5	Pond E	109.0	19.6	109.1	100	17.9	+1.7
STN-E-20S	6.6 – 7.1	Pond E	105.5	21.4	109.1	97	17.9	+3.5

The existing in-situ dry densities of the clay dike materials were determined to range from about 87 percent to 101 percent of the standard Proctor dry densities, with some being between about 90 and 95 percent. The trend of data indicates that some dike materials appear to have been compacted to densities a little lower than the typical earth dike target densities of 95 percent or greater. However, it should be noted that no construction documentation has been provided to confirm this comparison. The corresponding moisture values were mostly in the range of about 1 to 6 percent above the optimum moisture value.

6.4. Standard Penetration Test Samples

Recovered soil specimens from SPT sampling were subjected to natural moisture content determinations and select samples were combined for engineering classification testing. The engineering classification testing consisted of Atterberg limits, specific gravity, and sieve and hydrometer analyses. The results of the classification testing were used in conjunction with the N-values from SPT's to estimate soil strength of cohesionless materials based on published correlations of such data. The results of the moisture content tests are included on the boring logs and stability section drawings in Appendices A and E, respectively. The results of the engineering classifications are included on the drawings in Appendix E, and are summarized in Table 6.1.

7. Engineering Analysis

7.1. General

Geotechnical engineering analyses included evaluations of strength and permeability parameters, seepage analyses, and slope stability analyses. Prior to beginning the analyses, the geotechnical data and cross-sections were combined and the geometry of the existing dikes and soil horizons were approximated using current and historical information. Once the geometry of the sections was approximated, each section was reviewed and evaluated to determine the critical cross-section for analyses. Selection of critical sections was based on the steepness of slopes, heights of dikes, geometry of the sections, phreatic surface, seepage conditions, and subsurface conditions. Based on this evaluation, eight representative cross-sections were selected for analyses (Sections B, C, D, F, G, H, J and K). The locations of the sections are shown on the layout drawings presented in Appendix E. Results of the analyses and evaluations are summarized in the following paragraphs, and are shown on drawings/computer output provided in Appendices E and F.

It should be noted that construction records indicating the methods used to construct dikes, as-built dike configurations, etc. were not available for review. As a result, assumptions and generalizations in soil parameters and dike geometry were needed to construct the seepage and stability models.

7.2. Soil Horizons

Based on the results of the drilling, laboratory testing, historical documentation, and drawings, the materials encountered at the sections selected for seepage/stability analysis were divided into four primary soil layers. Refer to the stability sections in Appendix E for locations of the soil horizons. The soil horizons are briefly described as follows:

- *Pond E Clay Dike:* This represents the clay material used for dike construction associated with the 2006 expansion of Pond E. Current survey data shows that the crest of this dike is currently at approximate El. 475 to 476. Construction drawings specified that most side slopes were to be constructed at 3H:1V.

- *Bottom Ash Fill/Dikes:* This represents various areas where compacted bottom ash was used in dike construction. It is present at the lower portions of the new Pond E dike that was constructed in 2006, within the initial and raised dikes for the Pond A divider dike (entire dikes are constructed of bottom ash), and within the Stilling Pond C saddle dike located at north side of Stilling Pond C (entire dike constructed of bottom ash).

- *Native Clay:* This represents the layers of native lean and fat clay located beneath the dikes and ponds.

- *Hydraulically Placed (sluiced) Ash:* This represents sluiced bottom ash/fly ash that is contained by the dike systems.

Section 5.2.1 contains more detailed descriptions of the materials encountered within the dikes. Note that the "Stilling Pond D Saddle Dike" is not included in the above descriptions because it was not selected for analysis due to its very low height and flat slopes.

7.3. Seepage Analysis

7.3.1. SEEP/W Model

An analysis of steady state seepage through the Gallatin Pond dikes was performed to estimate the magnitude of seepage gradients (for the evaluation of potential piping) and pore water pressures within the soils (for the evaluation of slope stability). The numerical seepage models were developed using SEEP/W 2007 (Version 7.15), a finite element code tailored for modeling groundwater seepage in soil and rock. SEEP/W is distributed by GEO-SLOPE International, Ltd, of Calgary, Alberta, Canada (www.geo-slope.com).

SEEP/W uses soil properties, geometry, and boundary conditions provided by the user to compute the total hydraulic head at nodal points within the modeled cross-sections. Among other features, SEEP/W includes a graphical user interface, semi-automated mesh generation routines, iterative algorithms for solving unconfined flow problems, specialized boundary conditions (seepage faces, etc.), capabilities for steady-state or transient analyses, and features for visualizing model predictions. The code also includes material models that allow tracking both saturated and unsaturated flow, including the transition in seepage characteristics for soils that become saturated or unsaturated during the problem simulation.

Eight representative dike cross-sections were modeled with SEEP/W, and then were subsequently evaluated for slope stability (Section 7.4). For the numerical analysis, each cross-section was subdivided into a mesh of elements, consisting of first-order quadrilateral and triangular finite elements. For seepage problems, where the primary unknown (hydraulic head) is a scalar quantity, first-order elements provide for efficient, effective modeling. Given appropriate hydraulic conductivity properties and applied boundary conditions, the finite element method (as implemented in the SEEP/W code) was then used to simulate steady seepage across the mesh. The total hydraulic head is computed at each nodal location, from which pore water pressures and seepage gradients can be determined.

7.3.2. Boundary Conditions

Steady-state seepage was assumed for the analysis, with the static pool levels placed at approximate El. 469 feet for Pond E, El. 466 feet for Pond A, and El. 457 feet for the Stilling Ponds. For the left side of Sections B and C, the pool level for the Cumberland River was set at El. 445 feet, which is normal pool.

Boundary conditions for the SEEP/W analysis were assumed as follows. Along the vertical, interior edge of the model, the hydraulic head at each node was constant with depth and equal to the pool elevations of the ash ponds (El. 466 feet for Pond E, El. 469 feet for Pond A, and El. 457 feet for the Stilling Ponds). A total head equal to the pool levels was also applied to all submerged nodes along the ground surface of the interior side. Along the vertical, exterior edge of the model, the hydraulic head at each node was constant with depth and set equal to the corresponding stilling pond or Cumberland River, depending on cross section location. Other nodes along the ground surface were treated as potential seepage exits. At various steps in the computer analysis, if the software determines that water flows from the mesh at these nodes along the ground surface, SEEP/W assigned a head equal to the elevation of the node. This routine effectively models the seepage exit to the ground surface. The horizontal boundary at the base of the model (located within the bedrock) was modeled as a seepage barrier, with no vertical flow across the boundary nodes. Steady state seepage was assumed for the analysis.

7.3.3. Seepage Properties

For each modeled cross-section, a representative subsurface profile was compiled based on boring logs, available record drawings, and the known project history. Material properties were estimated based on available laboratory data, correlations with classification data, and on typical values for similar materials. For ash materials, Stantec also considered results of permeability tests presented in MACTEC's October 14, 2004 geotechnical report which presented permeability values of 8.55e-4 cm/s and 2.15 e-3 cm/s for bottom ash, and 2.78 e-5 cm/s for sluiced ash. Material properties used in the seepage analysis are summarized in Table 7.1.

Table 7.1. Material Properties for SEEP/W Analysis

Soil Horizon	Saturated k_v (cm/s)	Ratio k_h / k_v	Specific Gravity G_s	Void Ratio e	Volumetric Water Content		Basis
					Saturated (%)	Residual (%)	
Pond E Clay Dike	1.0e-7	1 to 5	2.70	0.61	25	3	Available Laboratory Data and Correlation w/ Typical Values
Bottom Ash Fill/Dikes	1.0e-3 to 1.0e-4	1 to 5	2.66	0.69 to 0.79	15	1	Available Laboratory Data, Correlation w/ Typical Values, MACTEC 2004 Report
Hydraulically Placed (Sluiced) Ash	1.0e-5	30	2.66	1.0	40	1	Available Laboratory Data, Correlation w/ Typical Values, MACTEC 2004 Report
Native Clay	1.0e-6 to 1.0e-7	10 to 20	2.70	0.62 to 0.68	40	2	Available Laboratory Data and Correlation w/ Typical Values
Limestone Bedrock	1.0e-3	10	2.60	0.14	15	1	Correlation w/ Typical Values

Note: SEEP/W requires input parameters k_h and ratio of k_v/k_h

Significant engineering judgment is needed to select appropriate hydraulic properties for earth/soil materials. Unlike other key properties, hydraulic conductivity can vary over several orders of magnitude for a range of soils, often with substantial anisotropy for seepage in horizontal versus vertical directions. Laboratory test samples often do not represent important variations within a larger soil deposit. For this analysis, an iterative process of parametric calibration (Section 7.3.4) was used to arrive at final estimates of the seepage properties. Results from trial simulations were compared to field data (measured piezometric levels) and the material parameters were then varied until the solutions reasonably matched the field data. The final set of parameters (Table 7.1) resulted in the comparisons presented in Section 7.3.4.

The ratio of horizontal hydraulic conductivity (k_h) to vertical hydraulic conductivity (k_v) was estimated based on placement, depositional characteristics, and origin of the materials. An isotropic material would have $k_h/k_v = 1$, while deposits of horizontally layered soils will have much higher values. For this analysis, higher ranges of ratios were used for sluiced ash and native materials, whereas a lower range of ratios was assumed for compacted dike materials.

The governing equations in SEEP/W are formulated to consider seepage through unsaturated soils. In the simulations for this study, this formulation is used to locate the phreatic surface for unconfined seepage through the dike cross-sections. To represent the change in hydraulic conductivity due to de-saturation of each soil, SEEP/W implements a model based on two curves, a hydraulic conductivity function and a volumetric water content function. Three parameters are needed to define this behavior: the saturated hydraulic conductivity, saturated water content, and residual water content (water content of air dried soil). Of these, only the residual water contents were not previously estimated for each material. Values were estimated based on typical values for similar soils. The simulation results are not sensitive to the selection of these values.

7.3.4. Comparison to Field Observations

After the initial seepage parameters were estimated, results from the SEEP/W model were compared to pore water pressures actually measured in the 12 piezometers installed within the GAF pond complex. Nodes were placed in the model at the screened piezometer intervals so that the average head across these nodes could be compared to the corresponding piezometer reading. The material properties in each modeled cross-section were then varied until a reasonable match was obtained between the seepage predictions and field data. Specifically, the saturated hydraulic conductivity and the k_h/k_v ratios were adjusted (while still maintaining the parameters within expected ranges) to give model predictions as consistent as possible with field measurements and observations.

The comparison between the field piezometer measurements and final SEEP/W predictions show the predicted groundwater table ranging from about one-foot below to four feet above the readings obtained in the piezometers. Most differences are between about one-foot below to two feet above the actual readings. These differences are judged to be acceptable given the limited information available and unknown conditions between the modeled cross-sections and borings.

The results of the seepage models can also be compared to field observations of seepage. For the Gallatin ponds, minor seepage exists at or near the dike toes at only a few isolated areas. These observations correlate well with the seepage models which generally show the shape of the phreatic surface extending to or just below the dike toes.

In summary, the seepage models appear to give a reasonable prediction of the phreatic surface location when compared to field observations and piezometer measurements.

7.3.5. Critical Exit Gradients

Seepage forces, resulting from hydrodynamic drag on the soil particles, can destabilize earthen structures. Excessive hydraulic gradients near the ground surface can lead to the initiation of soil erosion and piping, which has caused numerous dam failures in the past.

Hydraulic gradients (computed where seepage exits at the ground surface) can be evaluated to understand the potential severity of this problem.

Where upward seepage through a uniform soil exits the ground surface, the factor of safety with respect to soil piping (FS_{piping}) is as defined below.

$$FS_{piping} = \frac{i_{crit}}{i} \qquad \textbf{Eqn. 7.1}$$

Where "i" is the vertical gradient in the soil at the exit point, the critical gradient (i_{crit}) is related to the submerged unit weight of the soil, and can be computed as:

$$i_{crit} = \frac{\gamma_{sub}}{\gamma_w} = \frac{G_s - 1}{1 + e} \qquad \textbf{Eqn. 7.2}$$

where γ_{sub} is the submerged unit weight of the soil, γw is the unit weight of water, Gs is the specific gravity of the soil particles and e is the void ratio. For nearly all soils, the critical gradient is between about 0.6 and 1.4, with a typical value near 1.

When FS_{piping} = 1, the effective stress is zero and the near-surface soils are subject to piping or heaving, but only for vertical seepage that actually exits to the ground surface. If the phreatic surface is buried, then the FS_{piping} will be greater than 1 even when $i=i_{crit}$.

7.3.6. Results of Seepage Analysis

Plots from the SEEP/W analyses of the eight cross-sections through the GAF pond dikes are presented in Appendix F. The plots show the finite element mesh, material zones and boundary conditions used in each analysis. The results are depicted in contour plots of total head, pore water pressure, and seepage gradients.

On each modeled cross-section, examination of the output (predicted phreatic surface and vertical gradients) can be made to look for areas where the potential for excessive vertical gradients might exist that could possibly initiate the erosion or piping of material. In general, areas of potential concern are where water seeps laterally out onto a sloping ground surface, or where vertical, upward seepage occurs at the ground surface. The potential for piping was evaluated using the factor of safety equation as defined in Section 7.3.5. First, contour plots of vertical gradient were examined to determine the general location of the maximum vertical exit gradient. On the modeled cross-sections, the maximum upward gradient occurs near or beyond the exterior toe of the dikes. For the factor of safety calculations, vertical gradients from these locations were then used along with the critical gradients determined from the soil properties.

The calculated factors of safety against piping are summarized in Table 7.2. They range from 3.0 to greater than 60, with one value being even greater (Section B) because a critical exit point was not predicted by the model. Stantec recommends a target factor of safety against piping of three, based on information contained in United States Army Corps of Engineers (USACE) manual EM 1110-2-1901. Hence, on all eight cross sections modeled, the recommended target factor of safety for piping at the critical seepage exit points is met or exceeded.

Table 7.2. Summary of Computed Exit Gradients and Minimum Factors of Safety against Piping

Cross Section*	Vertical Gradient (i_v) at Critical Exit Point	Location of Critical Exit Point	Material	Critical Gradient (i_{crit})	FS_{piping}
B	Critical Exit Point Not Identified by Model	N/A	N/A	N/A	>> 3
C	0.35	Dike Toe	Native Clay	1.05	3.0
D	0.29	Dike Toe	Native Clay	1.01	3.5
F	0.085	Dike Toe	Bottom Ash Dike	0.84	9.9
G	0.088	Dike Toe	Native Clay	1.01	11.4
H	0.0125	Dike Toe	Bottom Ash Dike	0.86	68.8
J	0.089	Dike Toe	Bottom Ash Dike	0.96	10.8
K	0.025	Dike Toe	Bottom Ash Dike	0.89	35.6

*Refer to Appendix E for locations of cross-sections.

7.4. Slope Stability Analyses

7.4.1. SLOPE/W Model

The stability of the GAF pond dikes was evaluated using limit equilibrium methods as implemented in the SLOPE/W software, which is available from GEO-SLOPE International, Ltd., of Calgary, Alberta, Canada (www.geo-slope.com). Analyses were completed for static, long-term conditions with steady-state seepage. SLOPE/W is a special-purpose computer code designed to analyze the stability of earth slopes using two-dimensional, limit equilibrium methods. With SLOPE/W, the distribution of pore water pressures within the earth mass can be mapped directly from a SEEP/W solution. In this study, steady-state pore pressures were obtained from the SEEP/W models described in Section 7.3.

7.4.2. Limit Equilibrium Methods in SLOPE/W

Limit equilibrium methods for evaluating slope stability consider the static equilibrium of a soil mass above a potential failure surface. For conventional, two-dimensional methods of analysis; the slide mass above an assumed failure surface is first divided into vertical slices, then stresses are evaluated along the sides and base of each slice. The factor of safety against a slope failure (FS_{slope}) is defined as:

$$FS_{slope} = \frac{\text{shear strength of soil}}{\text{shear stress required for equilibrium}} \qquad \textbf{Eqn. 7.3}$$

where the strengths and stresses are computed along a defined failure surface located at the base of the vertical slices. The shearing resistance along the potential slip surface is computed, with appropriate Mohr-Coulomb strength parameters, as a function of the total or effective normal stress.

Spencer's solution procedure (Spencer 1967; USACE 2003; Duncan and Wright 2005), which satisfies all of the conditions of equilibrium for each slice, was used in this study. Spencer's procedure computes FSslope for an assumed failure surface. A search must be made to find the critical slip surface corresponding to the lowest FSslope. Both circular and noncircular potential failure surfaces can be evaluated.

7.4.3. Analysis Approach

The slope stability analyses were performed using SLOPE/W 2007 on the exterior faces of the dikes. SLOPE/W incorporates various search routines to locate the critical slip surface. For the analyses presented here, the "Grid and Radius" method and the "Entrance and Exit" method were employed. Center points for the trial circles were confined to a specified range above the slope surface, while the trial radii were varied based on tangent horizontal lines within the soil. The minimum and maximum range for the center points and tangent lines were parametrically varied over a wide range to determine the likely solution region for the critical circle. In subsequent runs, the search was refined by narrowing the range and spacing for the candidate center points. The phreatic surface and distribution of pore water pressures obtained from the SEEP/W model were used in the analysis.

7.4.4. Selection of Shear Strength Parameters

The stability analyses presented in this report will focus only on static steady state seepage conditions (no earthquake or other dynamic loads). For these conditions, soil unit weights and drained strength parameters (c' and ϕ') are needed.

The drained shear strength parameters used for the clay dikes and clay foundation materials were derived using results of laboratory triaxial tests, along with consideration given to standard penetration test data, laboratory classification test data, Stantec's experience with similar materials, and historic data presented in MACTEC's 2004 geotechnical report.

For the "Pond E Clay Dike" and "Native Clay" horizons, representative strengths were selected using the methodology outlined in the US Army Corps of Engineers Engineer Manual EM 1110-2-1902 as a guide. Results of triaxial testing were evaluated and effective stress p' versus q scatter plots were prepared of all of the data points. The maximum effective principal stress ratio was used to determine failure criteria for selection of these values within Stantec's laboratory test results. Once the p' versus q plots were prepared, a failure envelope was then selected such that about two thirds of the plotted values were above the envelope. The p' versus q plots and selection of the failure envelope are shown for each horizon on the graphs presented in Appendix D. The strength parameters were rounded to the nearest degree with regards to ϕ'. The cohesion intercept point (c') was limited to a maximum of 200 pounds per square foot.

Shear strength parameters for "Bottom Ash Fill/Dikes" were estimated/selected primarily using charts published in Soil Mechanics Design Manual 7.1, Department of the Navy – Navy Facilities Engineering Command (NAVFAC 7.1) which correlates SPT N-values and material classifications with the angle of internal friction. Stantec also considered test results presented in MACTEC's 2004 report which measured angles of internal friction ranging rom 37 to 40 degrees for remolded bottom ash samples.

Shear strength parameters for sluiced ash were estimated/selected using NAVFAC 7.1 charts (where the lowest friction angle is 26 degrees for ML classifications), review of paramaters selected by Stantec at other fossil plants, and considering results of two triaxial test performed on undisturbed ash samples presented in MACTEC's 2004 report which measured friction angles of 24.4 and 35.5 degrees. As a result, Stantec slected an angle of internal friction of 26 degrees for sluiced ash.

The following table provides a summary of the effective stress shear strengths selected for use in the slope stability analyses.

Table 7.3. Selected Strength Parameters for Stability Analyses

Soil Horizon	Unit Weight (pcf)	Effective Stress Strength Parameters	
		c' (psf)	Ø' (degrees)
Pond E Clay Dike	125	200	22
Bottom Ash Fill/Dikes	100 to 105	0	30 to 34
Sluiced Ash	85	0	26
Native Clay	125	200	27

7.4.5. Results of Slope Stability Analysis

Using the strength parameters (c' and ϕ') listed in Table 7.3, in conjunction with the results of the seepage analyses, the existing dike configurations were analyzed at the eight selected cross-sections. Geo-Slope's Slope/W computer program was used for the analyses with pore pressures imported from the seepage analyses. Long term (effective stress) steady state seepage conditions were analyzed using Spencer's method. Analysis of circular failure surfaces with optimization was conducted. Noncircular failure surfaces were considered in one instance where a thin horizontal zone of weaker material is present (Section F).

The stability analyses focused on the potential for failure along the exterior dike faces. SLOPE/W failure surfaces from these analyses are presented on the drafted sheets in Appendix E. The results are summarized in Table 7.4 below.

Table 7.4. Summary of Minimum Computed Factors of Safety for Slope Stability

Cross-Section*	Minimum Non-Global FS	Minimum Global FS
B	Non-Issue (flat slopes)	1.5
C	Non-Issue (flat slopes)	1.6
D	Non-Issue (flat slopes)	2.0
F	1.1	2.0
G	1.5	2.2
H	1.4	1.5
J	1.2	1.5
K	1.2	1.5

*Refer to Appendix E for plan view of cross-section locations.

Based on discussions with TVA and to be in accordance with current prevailing geotechnical practice, a minimum target factor of safety of 1.5 was established for long term conditions using the guidelines presented in USACE Manual EM 1110-2-1902 "Slope Stability".

The results of the slope stability analyses indicate that factors of safety against long-term slope stability for global (deep seated) failures are equal to or greater than the target value of 1.5. For non-global (shallow) surfaces, however, there are four of five cross sections where potential failure surfaces produced factors of safety less than the target of 1.5. These include Sections F, H, J, and K where factors of safety range from 1.1 to 1.4. Section F represents the immediate toe area along the north side of Pond E immediately above the stilling ponds; and Sections H, J, and K represents the divider dike that seperates Pond A from the adjacent stilling ponds where side slopes are relatively steep (mostly 1.5H:1V). The critical slip surfaces for each cross-section are depicted on the drawings in Appendix E.

8. Conclusions and Recommendations

The conclusions and recommendations that follow are based on Stantec's understanding of the Gallatin ash pond/stilling pond complex, as outlined in this report, and on TVA's plans for eventual closure. This understanding has been developed from review of historical information, discussions with TVA personnel, and from the results of this geotechnical exploration. In addition, Stantec understands that TVA has tasked URS Corporation with conducting a siting study for a new CCP landfill for future dry disposal of fly ash, bottom ash and potentially gypsum. Stantec also understands that URS will be performing closure design of the CCP ponds. A phased closure approach will likely be implemented.

8.1. The results of the seepage analyses were reviewed to identify conditions where seepage and possible piping may occur. Seepage outbreaks along the slopes can create the potential for the initiation of soil piping if excessive vertical gradients exist. The seepage analyses showed that maximum vertical exit gradients typically occur at or just beyond the dike toe areas, with corresponding factors of safety against piping being equal to or greater than the recommended target value of three in each case analyzed.

8.2. The results of the slope stability analyses indicate that factors of safety against long-term slope stability for global (deep seated) failures are equal to or greater than the target value of 1.5. For non-global (shallow) surfaces, however, there are four of five cross sections where potential failure surfaces produced factors of safety less than the target value of 1.5. These include Sections F, H, J, and K where factors of safety range from 1.1 to 1.4. Section F represents the immediate toe area along the north side of Pond E immediately above the stilling ponds; and Sections H, J, and K represent the divider dike that seperates Pond A from the adjacent stilling ponds where side slopes are relatively steep (mostly 1.5H:1V).

8.3. To improve long-term slope stability, it is recommended that TVA implement a mitigation design and construction program for the Bottom Ash Pond A divider dike and for the toe area along the north side of Pond E to improve factors of safety against non-global slope stability. These improvements could be incorporated into URS Corporation's design of pond closure, or a separate short-term interim mitigation program could be implemented, depending on timing and as decided by TVA. Final mitigation design should increase factors of safety to at least 1.5 for long term slope stability. It is envisioned that design features would include rock buttressing, slope flattening, or a combination of both.

8.4. It is recommended that URS Corporation's closure design include an instrumentation monitoring program (including calculation of "alert" piezometric levels which would result in slope stability factors of safety falling below 1.5). It is recommended that URS also consider additional exploration work for closure design to gain supplementary subsurface information relative to sluiced ash, specifically along the south side of Pond E where the existing dikes are constructed entirely over the ash.

8.5. It is recommended that TVA continue dike inspections/monitoring to look for changes or conditions that might affect dike integrity. Specific focus should be placed on continuing to monitor areas of known seepage to look for changed or worsened conditions. The frequency of inspections should be consistent with TVA's new programmatic inspection schedule.

8.6. The Gallatin ash pond and stilling pond complex is underlain by limestone bedrock that can be susceptible to solutioning and the development of karst features, such as voids, solution channels, and sinkholes in the soil overburden and/or the underlying bedrock. Construction and operation in such areas is always accompanied by risk that internal soil erosion and ground subsidence could affect constructed facilities. It is not possible to completely investigate a site or design a facility to eliminate karst-related problems. Stantec understands that URS may perform karst investigations as part of closure design activites.

9. Closure and Limitations of Study

9.1. The scope of this evaluation was limited to consider only the potential risks of the Gallatin Pond dikes due to excessive seepage and/or slope instability under long-term, steady-state seepage loading conditions. The stability analyses for this scope did not consider sesmic loading conditions or external rapid drawdown conditions (seismic slope stability is being evaluated under a separate study, and the maximum pool level of the adjacent Old Hickory Lake is just slightly below the lowest Pond E dike toe elevation such that rapid drawdown is a non-issue). In addition, this assessment did not consider potential failure modes related to spillway capacity and overtopping or seepage along penetrations through the embankments (including the buried spillway pipes).

9.2. These conclusions and recommendations are based on data and subsurface conditions from the borings advanced during this investigation using that degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions between borings.

9.3. The boring logs and related information presented in this report depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations.

10. References

The following is a list of documents that were the main references for gaining historical information used to evaluate the pond complex at Gallatin and prepare this report:

- Gallatin Steam Plant, Ash Disposal Area 3, Deflector and Divider Dikes, SME-SOI-88-017, by Singleton Materials Engineering Laboratory, September 8, 1988.
- Report of Geotechnical Exploration, Ash Disposal Area and Potential On-site and Off-site Borrow Areas, Gallatin Fossil Plant, Gallatin, Tennessee, by MACTEC Engineering and Consulting, Inc., October 14, 2004.
- Gallatin Fossil Plant, Ash Disposal Study, Phase 1 Report, Revision 0, by Worley Parsons Resources and Energy, May 15, 2006.
- Gallatin Steam Plant – Ash Dispoal Area – Soils Exploration, Memorandum from F.P. Lacy to J.C. McGraw, September 24, 1969.
- Gallatin Fossil Plant Ash Disposal Ponds Dike Stability Analyses, TVA in-house analysis, May 13, 2005.
- Geology of the Gallatin Steam Plant Site, by Charles P. Bensiger, TVA Division of Water Control Planning, Geologic Branch, June, 1953.
- Results of TVA in-house static slope stability analysis for raising of Pond A divider dike, 1988.
- TVA Drawing Numbers 10W271, 306 to 320, 410, 411, 415, 416, 506 to 510, 10N240, 10N243, 10N267, 10N272, 10N273-01 to 03, 10N274, 10N278.
- TVA Annual Inspection Reports, 1967 to 1989, 1993 to 2004, and 2007 to 2008.

Additional reference documents:

- Slope Stability, Department of the Army, US Army Corps of Engineers, Engineering Manual EM 1110-2-1902, October 31, 2003.

- Seepage Analysis and Control for Dams, Department of the Army, US Army Corps of Engineers, Engineering Manual EM 1110-2-1901, April 30, 1993.
- Geotechnical Investigations, Department of the Army, US Army Corps of Engineers, Engineering Manual EM 1110-1-1804, January 1, 2001.
- GeoStudio, Computer Software. GEO-Slope International Ltd. Ver. 7.14, 2007.
- Soil Mechanics Design Manual 7.1, Department of the Navy – Navy Facilities Engineering Command, May 1982.
- Terzaghi, K., Peck, R.B., and Gholamreza, M., Soil Mechanics in Engineering Practice, 3rd Edition, New York, John Wiley and Sons, 1996.

Appendix A

Typed Boring Logs

Stantec

SUBSURFACE LOG

Page: 1 of 1

Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Wethington
Logged By Craig Millhollin

Location N 707019.68, E 1879799.57 (NAD27)
Boring No. STN-A-1 Total Depth 30.5 ft
Surface Elevation 472.8 ft. (NGVD29)
Date Started 7/29/09 Completed 7/29/09
Depth to Water 19.0 ft Date/Time 7/29/09
Automatic Hammer ☐ Safety Hammer ☒ Other ☐

Lithology		Description	Overburden Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core RQD	Run	Rec. Ft.	Rec. %	Run Depth	
472.8'	0.0'	Top of Hole						
		BOTTOM ASH (Pond A dikes), black to gray, dry to wet, loose to very dense	SPT-1	0.0 - 1.5	1.1	5-7-12	11	Boring advanced with 3.25" hollow stem auger.
			SPT-2	1.5 - 3.0	1.2	13-15-25	10	
			SPT-3	3.0 - 4.5	1.5	15-31-35	10	
			SPT-4	4.5 - 6.0	1.3	35-41-55	13	Piezometer installed (see PZ detail sheet).
			SPT-5	6.0 - 6.5	0.5	50/0.5'	11	
			SPT-6	7.5 - 8.5	1.0	35-50/0.5'	13	
			SPT-7	9.0 - 9.5	0.5	50/0.5'	13	
			SPT-8	10.5 - 11.0	0.5	50/0.5'	8	
			SPT-9	12.0 - 12.5	0.2	50/0.5'	9	
			SPT-10	13.5 - 14.0	0.1	50/0.5'	12	
			SPT-11	15.0 - 16.5	1.2	19-14-19	17	
			SPT-12	16.5 - 18.0	1.1	10-8-10	13	
			SPT-13	18.0 - 19.5	1.3	6-8-9	13	
			SPT-14	19.5 - 21.0	1.0	4-4-9	16	
			SPT-15	21.0 - 22.5	1.0	2-2-3	14	
			SPT-16	22.5 - 24.0	1.5	3-4-4	16	
			SPT-17	24.0 - 25.5	1.5	5-4-6	16	
			SPT-18	25.5 - 27.0	1.5	12-6-4	14	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 25.5 ft.
445.1'	27.7'		SPT-19	27.0 - 28.5	1.5	1-2-3	34	
		FAT CLAY, gray to tan, wet, medium stiff	SPT-20	28.5 - 30.0	1.0	2-2-3	31	
442.3'	30.5'		SPT-21	30.0 - 30.5	0.5	50/0.5'	6	

Auger Refusal /
Bottom of Hole

Top of Rock = 30.5'
Elevation (442.3')

2/23/10

Stantec

SUBSURFACE LOG

Page: 1 of 2

Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Wethington
Logged By Craig Millhollin

Location N 706994.16, E 1879810.94 (NAD27)
Boring No. **STN-A-2** Total Depth 42.1 ft
Surface Elevation 473.3 ft. (NGVD29)
Date Started 8/4/09 Completed 8/5/09
Depth to Water 14.0 ft Date/Time 8/5/09
Automatic Hammer ☐ Safety Hammer ☒ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
473.3'	0.0'	Top of Hole							
		BOTTOM ASH (Pond A Dike), black and gray, dry, medium dense, trace tan fine sand		SPT-1	0.0 - 1.5	1.2	6-7-10	1	Boring advanced with 3.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.5	9-11-15	9	
				SPT-3	3.0 - 4.5	1.1	6-6-7	10	
				SPT-4	4.5 - 6.0	1.3	10-5-6	21	
465.8'	7.5'			SPT-5	6.0 - 7.5	1.0	6-8-6	11	
464.3'	9.0'	FLY ASH, dark gray, moist, very stiff		SPT-6	7.5 - 9.0	1.5	6-8-14	54	
		BOTTOM ASH, black, moist to wet, loose to dense		SPT-7	9.0 - 10.5	1.4	8-18-23	–	
				SPT-8	10.5 - 12.0	1.5	20-27-18	11	
				SPT-9	12.0 - 13.5	1.1	8-13-8	19	
				SPT-10	13.5 - 15.0	12.0	8-7-8	20	
456.8'	16.5'			SPT-11	15.0 - 16.5	0.9	3-6-4	18	
		FLY ASH (sluiced), black, wet, very soft to medium stiff, trace fat clay		SPT-12	16.5 - 18.0	0.9	4-3-2	35	
				SPT-13	18.0 - 19.5	1.1	2-1-1	37	
				ST-1	19.5 - 21.5	0.0	0%	–	
				SPT-14	21.5 - 23.0	0.0	WOR-WOR-WOR	–	
				SPT-15	23.0 - 24.5	0.6	WOR-WOR-WOR	26	
448.0'	25.3'			SPT-16	24.5 - 26.0	0.7	2-2-2	17	
		BOTTOM ASH, black, wet, loose, some fly ash		SPT-17	26.0 - 27.5	1.5	3-3-3	21	
				SPT-18	27.5 - 29.0	0.8	5-3-3	18	
				SPT-19	29.0 - 30.5	1.0	2-2-2	12	

SUBSURFACE LOG

Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location N 706994.16, E 1879810.94 (NAD27)
Boring No. **STN-A-2** Total Depth 42.1 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
441.9'	31.4'	FAT CLAY with Sand, tan to brown, wet, stiff to very stiff, trace fine gravel		SPT-20	30.5 - 32.0	1.5	3-6-10	58	
				SPT-21	32.0 - 33.5	1.3	5-6-6	28	
				SPT-22	33.5 - 35.0	0.9	5-7-20	25	
				SPT-23	35.0 - 36.5	1.5	14-15-16	24	
				SPT-24	36.5 - 38.0	1.0	6-8-9	33	
				SPT-25	38.0 - 39.5	1.5	5-9-11	30	Boring backfilled with bentonite grout from 0.0 to 42.1 ft.
				SPT-26	39.5 - 41.0	1.5	2-6-6	27	
431.2'	42.1'			SPT-27	41.0 - 42.1	1.1	50/1.1'	26	

Auger Refusal /
Bottom of Hole

Top of Rock = 42.1'
Elevation (431.2')

SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 707510.75, E 1880731.90 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	STN-A-3 Total Depth 34.0 ft
Location	Sumner County, Tennessee	Surface Elevation	472.9 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/5/09 Completed 8/5/09
Supervisor	Paul Cooper Driller S. Bradford	Depth to Water	16.3 ft Date/Time 8/5/09
Logged By	C. Wood	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology		Description	Overburden Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core RQD	Run	Rec. Ft.	Rec. %	Run Depth	
472.9'	0.0'	Top of Hole						
		BOTTOM ASH (Pond A Dikes), black to gray, dry to moist, loose to very dense	SPT-1	0.0 - 1.5	1.4	3-4-5	13	Boring advanced with 4.25" hollow stem auger.
			SPT-2	1.5 - 3.0	0.9	7-10-9	10	
			SPT-3	3.0 - 4.5	1.1	10-13-16	10	
			SPT-4	4.5 - 6.0	1.5	11-30-52	10	
			SPT-5	6.0 - 6.5	0.8	50/0.5'	11	
			SPT-6	7.5 - 9.0	1.5	16-36-49	11	
		-some fat clay at 9.0'	SPT-7	9.0 - 10.5	1.5	18-40-26	11	
			SPT-8	10.5 - 12.0	1.5	34-29-32	11	
			SPT-9	12.0 - 13.5	1.5	36-36-32	10	Bulk Sample #1 obtained from 12.5 to 22.5 ft.
			SPT-10	13.5 - 15.0	1.1	6-16-10	8	
			SPT-11	15.0 - 16.5	0.6	4-5-3	12	
			SPT-12	16.5 - 18.0	0.8	3-4-4	19	
			SPT-13	18.0 - 19.5	1.2	4-3-5	17	
			SPT-14	19.5 - 21.0	0.8	4-5-3	13	
			SPT-15	21.0 - 22.5	1.3	4-4-5	15	
449.2'	23.7'		SPT-16	22.5 - 23.7	1.2	5-16-50/0.2'	17	Began Core
448.9'	24.0'	Limestone, highly weathered (augered)	48%	2.5	2.0	80	26.5	
438.9'	34.0'	Limestone, light gray to light brown, microcrystalline to fine, hard, thin bedded, moderately weathered to highly weathered, many bedding zone fractures throughout	55%	7.5	7.0	93	34.0	Boring backfilled with bentonite grout from 0.0 to 34.0 ft.

Bottom of Hole

Base of Weathered Rock = 24.0'

Top of Rock = 23.7'
Elevation (449.2')

SUBSURFACE LOG

Project No.	175559018	Location	N 707498.65, E 1880758.47 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-A-4** Total Depth 26.5 ft
Location	Sumner County, Tennessee	Surface Elevation	473.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/5/09 Completed 8/5/09
Supervisor	Paul Cooper Driller S. Bradford	Depth to Water	12.0 ft Date/Time 8/5/09
Logged By	C. Wood	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
473.8'	0.0'	Top of Hole							
		BOTTOM ASH (Pond A Dike), black, moist to wet, loose to medium dense		SPT-1	0.0 - 1.5	1.4	2-4-6	10	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	0.6	6-6-7	12	
				SPT-3	3.0 - 4.5	0.5	5-7-6	11	
				SPT-4	4.5 - 6.0	1.5	7-11-21	11	
		-some fly ash from 6.0 to 7.2 ft.		SPT-5	6.0 - 7.5	1.0	32-28-22	22	
				SPT-6	7.5 - 9.0	1.0	15-10-10	18	
				SPT-7	9.0 - 10.5	1.3	9-6-3	14	
		-some fly ash from 9.7 to 10.5 ft.		SPT-8	10.5 - 12.0	1.1	5-5-3	16	
				SPT-9	12.0 - 13.5	0.9	3-3-8	22	
				SPT-10	13.5 - 15.0	1.0	3-3-5	24	
457.3'	16.5'			SPT-11	15.0 - 16.5	1.2	1-WOH-WOH	30	
		FLY ASH (sluiced), black, wet, very soft to stiff -some bottom ash from 18.3 to 19.5 ft.		SPT-12	16.5 - 18.0	1.5	1-2-3	40	
				SPT-13	18.0 - 19.5	1.5	6-7-6	35	
				SPT-14	19.5 - 21.0	1.3	2-2-2	33	
				SPT-15	21.0 - 22.5	1.0	WOH-WOH-WOH	21	
		-some bottom ash from 22.0 to 23.5 ft.		SPT-16	22.5 - 24.0	1.5	WOH-1-2	22	Boring backfilled with bentonite grout from 0.0 to 26.5 ft.
				SPT-17	24.0 - 25.5	1.5	2-2-7	34	
448.0'	25.8'			SPT-18	25.5 - 26.5	1.4	17-50/0.5'	16	
447.3'	26.5'	LEAN CLAY, orange brown, wet, stiff, trace medium sand							

Auger Refusal /
Bottom of Hole

Top of Rock = 26.5'
Elevation (447.3')

SUBSURFACE LOG

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller S. Bradford

Logged By C. Wood

Location N 707498.65, E 1880758.47 (NAD27)

Boring No. **STN-A-4S** Total Depth 26.0 ft

Surface Elevation 473.8 ft. (NGVD29)

Date Started 8/5/09 Completed 8/5/09

Depth to Water N/A Date/Time N/A

Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology		Description	Overburden Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core RQD	Run	Rec. Ft.	Rec. %	Run Depth	
473.8'	0.0'	Top of Hole						
		Refer to STN-A-4 for descriptions of overburden soils.						Boring advanced with 4.25" hollow stem auger.
			ST-1	6.0 - 8.0	0.5		10	
			ST-2	16.5 - 18.5	0.3		27	
			ST-3	20.0 - 22.0	0.0		–	Boring backfilled with bentonite grout from 0.0 to 26.0 ft.
			ST-4	23.5 - 25.5	0.2		29	
447.8'	26.0'							
		No Refusal / Bottom of Hole						

SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 708368.74, E 1881417.01 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-A-5** Total Depth 23.2 ft
Location	Sumner County, Tennessee	Surface Elevation	473.7 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	7/29/09 Completed 7/29/09
Supervisor	Paul Cooper Driller J. Wethington	Depth to Water	16.5 ft Date/Time 7/29/09
Logged By	Craig Millhollin	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
473.7'	0.0'	Top of Hole							
		BOTTOM ASH (Pond A Dikes), dark gray to black, moist to wet, medium dense to very dense		SPT-1	0.0 - 1.5	1.1	3-7-11	11	Boring advanced with 3.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.1	6-19-23	10	
				SPT-3	3.0 - 4.5	1.3	14-26-27	10	
				SPT-4	4.5 - 5.4	0.8	47-50/0.4'	10	Piezometer installed (see PZ detail sheet).
				SPT-5	6.0 - 6.3	0.2	50/0.3'	11	
				SPT-6	7.5 - 9.0	1.2	21-41-45	10	
				SPT-7	9.0 - 10.5	1.2	15-33-31	11	
				SPT-8	10.5 - 11.0	0.5	50/0.5'	12	
				SPT-9	12.0 - 12.5	0.2	50/0.5'	10	
				SPT-10	13.5 - 14.0	0.5	50/0.5'	10	
				SPT-11	15.0 - 15.5	0.5	50/0.5'	9	
				SPT-12	16.5 - 17.0	0.5	50/0.5'	12	
				SPT-13	18.0 - 19.5	1.3	30-39-33	11	
				SPT-14	19.5 - 21.0	1.2	33-45-28	11	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 23.2 ft.
				SPT-15	21.0 - 22.5	0.8	6-7-6	11	
				SPT-16	22.5 - 23.0	0.5	50/0.5'	15	
450.5'	23.2'			SPT-17	23.0 - 23.2	0.0	50/0.2'	--	

Auger Refusal /
Bottom of Hole

Top of Rock = 23.2'
Elevation (450.5')

Stantec

SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 708353.42, E 1881433.71 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-A-6** Total Depth 31.4 ft
Location	Sumner County, Tennessee	Surface Elevation	474.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	7/30/09 Completed 7/30/09
Supervisor	Paul Cooper Driller J. Wethington	Depth to Water	11.5 ft Date/Time 7/30/09
Logged By	Craig Millhollin	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
474.0'	0.0'	Top of Hole							
		BOTTOM ASH (Pond A Dike), light gray to black, moist to wet, medium dense to very dense		SPT-1	0.0 - 1.5	1.2	5-8-12	13	Boring advanced with 3.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.1	13-13-17	9	
				SPT-3	3.0 - 4.5	1.5	8-13-13	33	
				SPT-4	4.5 - 6.0	1.1	12-13-14	9	
				SPT-5	6.0 - 7.5	1.0	15-18-50	10	
				SPT-6	7.5 - 8.3	0.8	3-50/0.3'	11	
				SPT-7	9.0 - 10.5	1.1	2-12-15	17	
				SPT-8	10.5 - 12.0	1.5	12-20-17	15	
				SPT-9	12.0 - 13.5	1.1	15-44-31	15	
				SPT-10	13.5 - 15.0	1.2	17-13-18	16	
				SPT-11	15.0 - 16.5	1.0	7-8-9	14	
				SPT-12	16.5 - 18.0	1.2	9-12-15	14	
				SPT-13	18.0 - 19.5	1.5	15-15-9	8	
453.7'	20.3'			SPT-14	19.5 - 21.0	0.7	10-4-7	10	
452.5'	21.5'	FAT CLAY, gray to tan, wet, stiff, trace fine gravel		SPT-15	21.0 - 22.5	1.2	4-5-3	26	
		BOTTOM ASH, black, wet, medium dense		ST-1	22.5 - 24.5	0.7		21	
				SPT-16	24.5 - 26.0	1.3	8-10-4	10	
447.7'	26.3'	FAT CLAY, gray to tan, wet, soft to medium stiff		SPT-17	26.0 - 27.5	0.8	1-2-6	24	Boring backfilled with bentonite to 2.0' below grade.
				SPT-18	27.5 - 29.0	0.8	1-2-2	33	
				ST-2	29.0 - 31.0	1.3		32	
442.6'	31.4'			SPT-19	31.0 - 31.4	0.4	50/0.4'	33	

Auger Refusal /
Bottom of Hole

Top of Rock = 31.4'
Elevation (442.6')

Stantec

SUBSURFACE LOG

Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Wethington
Logged By Craig Millhollin

Location N 708921.58, E 1881894.55 (NAD27)
Boring No. **STN-A-7** Total Depth 42.1 ft
Surface Elevation 474.5 ft. (NGVD29)
Date Started 7/30/09 Completed 7/30/09
Depth to Water 14.6 ft Date/Time 7/30/09
Automatic Hammer ☐ Safety Hammer ☒ Other ☐

Lithology Elevation	Lithology Depth	Description (Overburden / Rock Core)	Sample # / RQD	Depth Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
474.5'	0.0'	Top of Hole						
		BOTTOM ASH (Pond A Dikes), light gray to black, moist to wet, loose to very dense	SPT-1	0.0 - 1.5	1.1	6-5-7	26	Boring advanced with 3.25" hollow stem auger.
			SPT-2	1.5 - 3.0	1.3	8-15-15	13	
		-clay fill layer between 3.0' to 3.8'	SPT-3	3.0 - 4.5	1.5	12-15-26	19	
			SPT-4	4.5 - 6.0	1.3	15-20-22	17	
			SPT-5	6.0 - 7.5	1.2	20-21-40	16	
			SPT-6	7.5 - 9.0	1.2	20-24-18	16	
			SPT-7	9.0 - 10.5	1.5	33-31-37	16	
			SPT-8	10.5 - 12.0	1.5	37-40-50	15	
			SPT-9	12.0 - 13.5	1.3	30-36-24	14	
			SPT-10	13.5 - 15.0	1.1	12-12-12	14	
			SPT-11	15.0 - 16.5	1.0	44-40-50	16	
			SPT-12	16.5 - 17.0	0.4	50/0.5'	16	
			SPT-13	18.0 - 19.5	1.0	7-7-10	15	
			SPT-14	19.5 - 21.0	1.2	3-5-6	14	
			SPT-15	21.0 - 22.5	1.5	3-4-4	15	
			SPT-16	22.5 - 24.0	1.5	3-4-4	13	
449.5'	25.0'		SPT-17	24.0 - 25.5	1.0	2-3-1	24	
		SANDY LEAN CLAY with Gravel, brown to tan, wet, medium to very stiff, trace fine gravel	SPT-18	25.5 - 27.0	0.9	2-3-2	25	
			SPT-19	27.0 - 28.5	1.2	3-5-5	25	
			SPT-20	28.5 - 30.0	1.0	3-5-7	25	

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location N 708921.58, E 1881894.55 (NAD27)

Boring No. **STN-A-7** Total Depth 42.1 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		SANDY LEAN CLAY with Gravel, brown to tan, wet, medium to very stiff, trace fine gravel *(Continued)*		SPT-21	30.0 - 31.5	1.3	4-9-10	28	
				SPT-22	31.5 - 33.0	1.1	5-9-10	20	
				SPT-23	33.0 - 34.5	1.0	3-5-7	30	
				SPT-24	34.5 - 36.0	1.1	5-7-9	23	
				SPT-25	36.0 - 37.5	1.5	5-10-16	26	
				SPT-26	37.5 - 39.0	1.1	11-15-17	21	Boring backfilled with bentonite grout to 2.0' below grade.
				SPT-27	39.0 - 40.5	1.0	8-11-17	24	
				SPT-28	40.5 - 42.0	1.5	6-9-11	25	
432.4'	42.1'								

Auger Refusal /
Bottom of Hole

Top of Rock = 42.1'
Elevation (432.4')

SUBSURFACE LOG

Page: 1 of 1

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller J. Wethington

Logged By Craig Millhollin

Location N 708907.06, E 1881914.61 (NAD27)

Boring No. **STN-A-8** Total Depth 28.5 ft

Surface Elevation 474.8 ft. (NGVD29)

Date Started 8/4/09 Completed 8/4/09

Depth to Water 11.0 ft Date/Time 8/4/09

Automatic Hammer ☐ Safety Hammer ☒ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
474.8'	0.0'	Top of Hole							
		BOTTOM ASH (Pond A Dike), light gray to black, moist to wet, very loose to medium dense		SPT-1	0.0 - 1.5	1.1	3-6-11	11	Boring advanced with 3.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.2	11-15-16	11	
				SPT-3	3.0 - 4.5	1.3	8-12-17	12	
				SPT-4	4.5 - 6.0	1.3	6-8-9	24	
				SPT-5	6.0 - 7.5	1.3	7-7-5	23	
				SPT-6	7.5 - 9.0	1.0	4-4-2	22	
				SPT-7	9.0 - 10.5	1.4	2-2-2	23	
				SPT-8	10.5 - 12.0	1.0	1-1-2	22	
				SPT-9	12.0 - 13.5	1.5	3-3-2	22	
				SPT-10	13.5 - 15.0	1.1	8-5-8	21	
				SPT-11	15.0 - 16.5	1.5	10-10-7	15	
457.8'	17.0'			SPT-12	16.5 - 18.0	1.0	2-3-3	15	
		FLY ASH (sluiced), black, wet, very soft to medium dense		SPT-13	18.0 - 19.5	1.5	2-2-2	17	
				SPT-14	19.5 - 21.0	1.0	1-2-2	17	
				SPT-15	21.0 - 22.5	0.6	2-1-2	11	
				SPT-16	22.5 - 24.0	0.9	2-2-3	21	
				SPT-17	24.0 - 25.5	1.3	2-3-9	16	Boring backfilled with bentonite grout from 0.0 to 28.5 ft.
449.3'	25.5'			SPT-18	25.5 - 26.0	0.0	50/0.5'	–	
		LEAN CLAY with Gravel, brown to tan, wet, very stiff, some fine to coarse gravel		SPT-19	27.0 - 27.3	0.3	50/0.3'	32	
446.3'	28.5'								

Auger Refusal /
Bottom of Hole

Top of Rock = 25.5'
Elevation (449.3')

SUBSURFACE LOG

Project No.	175559018	Location	N 708907.06, E 1881914.61 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-A-8S** Total Depth 22.0 ft
Location	Sumner County, Tennessee	Surface Elevation	474.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/4/09 Completed 8/4/09
Supervisor	Paul Cooper Driller J. Wethington	Depth to Water	11.0 ft Date/Time 8/4/09
Logged By	Craig Millhollin	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
474.8'	0.0'	Top of Hole							
		Refer to STN-A-8 for descriptions of overburden soils.							Boring advanced with 3.25" hollow stem auger, offset 3.0 ft. west of STN-A-8.
				ST-1	5.0 - 7.0	1.1		17	Bulk sample #1 obtained from 3.0 to 5.0 ft.
				ST-2	10.0 - 12.0	0.0		–	
				ST-3	15.0 - 17.0	1.0		26	Bulk sample #2 obtained from 14.0 to 17.0 ft. Boring backfilled with bentonite grout from 0.0 to 22.0 ft.
				ST-4	20.0 - 22.0	0.0		–	
452.8'	22.0'								

No Refusal /
Bottom of Hole

SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 709132.64, E 1882470.74 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-A-9** Total Depth 31.2 ft
Location	Sumner County, Tennessee	Surface Elevation	472.4 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	7/31/09 Completed 7/31/09
Supervisor	Paul Cooper Driller J. Wethington	Depth to Water	11.0 ft Date/Time 7/31/09
Logged By	Craig Millhollin	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
472.4'	0.0'	Top of Hole							
		BOTTOM ASH (Pond A Dikes), light gray to black, moist to wet, loose to very dense		SPT-1	0.0 - 1.5	1.1	5-6-9	11	Boring advanced with 3.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.4	12-20-23	9	
				SPT-3	3.0 - 4.5	1.3	13-40-50	17	
				SPT-4	4.5 - 6.0	1.5	14-22-10	13	
				SPT-5	6.0 - 7.5	1.5	20-10-19	12	
				SPT-6	7.5 - 9.0	1.3	11-40-50	15	Bulk Sample #1 obtained from 9.0 to 12.0 ft.
				SPT-7	9.0 - 10.5	1.2	15-25-22	13	
				SPT-8	10.5 - 12.0	1.0	15-31-24	11	
				SPT-9	12.0 - 13.5	1.5	25-31-34	13	
				SPT-10	13.5 - 15.0	1.2	30-34-34	15	
				SPT-11	15.0 - 16.5	1.4	6-6-5	15	
				SPT-12	16.5 - 18.0	1.0	2-3-3	11	
				SPT-13	18.0 - 19.5	1.5	10-12-14	13	
				SPT-14	19.5 - 21.0	1.1	10-12-11	11	
				SPT-15	21.0 - 22.5	1.5	3-6-6	16	
				SPT-16	22.5 - 24.0	1.2	2-3-2	11	
447.7'	24.7'			SPT-17	24.0 - 25.5	0.8	4-9-14	25	
		FAT CLAY, brown to tan, wet, very stiff		SPT-18	25.5 - 27.0	1.2	10-11-7	27	
445.1'	27.3'			SPT-19	27.0 - 27.8	0.8	40-50/0.3'	27	Boring backfilled with bentonite grout from 0.0 to 31.2 ft.
444.6'	27.8'	LIMESTONE, gray, highly weathered (apparent floater)		SPT-20	27.8 - 29.0	1.0	13-10-18	29	
				SPT-21	29.0 - 29.8	0.8	18-50/0.3'	20	
		FAT CLAY with Gravel, tan, wet, very stiff, fine to coarse gravel		SPT-22	29.8 - 31.0	1.0	26-50-50/0.2'	36	
441.2'	31.2'			SPT-23	31.0 - 31.2	0.0	50/0.2'	–	

Auger Refusal /
Bottom of Hole

Top of Rock = 31.2'
Elevation (441.2')

SUBSURFACE LOG

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller J. Wethington

Logged By Craig Millhollin

Location N 709132.64, E 1882470.74 (NAD27)

Boring No. **STN-A-9S** Total Depth 25.0 ft

Surface Elevation 472.4 ft. (NGVD29)

Date Started 7/31/09 Completed 7/31/09

Depth to Water 11.0 ft Date/Time 7/31/09

Automatic Hammer ☐ Safety Hammer ☒ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
472.4'	0.0'	Top of Hole							
		Refer to STN-A-9 for descriptions of overburden soils.							Boring advanced with 3.25" hollow stem auger, offset 3.0 ft. west of STN-A-9. Piezometer installed (see PZ detail sheet). Piezometer backfilled with sand, bentonite pellets, and benotnite grout from 0.0 to 25.0 ft.
447.4'	25.0'								
		No Refusal / Bottom of Hole							

FMSM LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

2/23/10

SUBSURFACE LOG

Project No.	175559018	Location	N 709085.67, E 1882461.16 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-A-10** Total Depth 45.0 ft
Location	Sumner County, Tennessee	Surface Elevation	474.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/4/09 Completed 8/4/09
Supervisor	Paul Cooper Driller S. Bradford	Depth to Water	7.0 ft Date/Time 8/4/09
Logged By	C. Wood	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
474.1'	0.0'	Top of Hole							
		BOTTOM ASH (Pond A Dike), gray to black, moist to wet, very loose to medium dense		SPT-1	0.0 - 1.5	1.3	2-6-8	10	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.0	8-11-16	13	
				SPT-3	3.0 - 4.5	1.1	16-9-9	18	
				SPT-4	4.5 - 6.0	1.4	4-4-3	20	
				SPT-5	6.0 - 7.5	1.5	4-3-2	21	
				SPT-6	7.5 - 9.0	1.5	3-4-2	14	
		-with fly ash from 8.7' to 9.0'		SPT-7	9.0 - 10.5	1.4	1-1-WOH	26	
				SPT-8	10.5 - 12.0	1.0	1-1-WOH	22	
				SPT-9	12.0 - 13.5	1.1	3-4-5	19	
459.4'	14.7'			SPT-10	13.5 - 15.0	1.5	3-3-4	15	
		FLY ASH (sluiced), black, wet, very soft to stiff		SPT-11	15.0 - 16.5	0.8	2-3-1	19	
				SPT-12	16.5 - 18.0	0.7	1-1-1	17	
				SPT-13	18.0 - 19.5	0.7	1-1-1	21	
				SPT-14	19.5 - 21.0	1.5	1-WOH-WOH	18	
				SPT-15	21.0 - 22.5	0.6	1-2-1	16	
				SPT-16	22.5 - 24.0	0.8	1-1-1	21	
		-with bottom ash from 24.0' to 24.3'		SPT-17	24.0 - 25.5	1.4	1-1-4	21	
				SPT-18	25.5 - 27.0	0.3	WOH-WOH-WOH	21	
		-with bottom ash from 27.0' to 27.3'		SPT-19	27.0 - 28.5	1.5	1-3-5	29	
				SPT-20	28.5 - 30.0	1.5	5-11-8	26	

FMSM_LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

2/23/10

Stantec

SUBSURFACE LOG

Project No.	175559018	Location	N 709085.67, E 1882461.16 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-A-10** Total Depth 45.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
442.7'	31.4'			SPT-21	30.0 - 31.5	1.5	9-13-11	21	
440.7'	33.4'	FAT CLAY, reddish brown, wet, very stiff, some fine gravel		SPT-22 SPT-23	31.5 - 33.0 33.0 - 33.4	1.4 0.4	11-11-9 50/0.4'	-- --	
439.1'	35.0'	Limestone, highly weathered (augered)							Began Core
429.1'	45.0'	Limestone, light gray to light brown, coarsely crystalline to medium, hard, thin bedded, moderately weathered to highly weathered, many bedding zone fractures throughout		16%	10.0	6.0	60	45.0	Void from approximately 41.0' to 42.5'. Boring backfilled with bentonite grout from 0.0 to 45.0 ft.

Bottom of Hole

Base of Weathered Rock = 35.0'

Top of Rock = 33.4'
Elevation (440.7')

Stantec

SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 707402.48, E 1879680.01 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-C-1** Total Depth 21.0 ft
Location	Sumner County, Tennessee	Surface Elevation	462.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/4/09 Completed 8/4/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	6.0 ft Date/Time 8/4/09
Logged By	D. Chapman	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
462.0'	0.0'	Top of Hole							
		BOTTOM ASH (Pond C Dike), light gray to black, moist to wet, very loose to medium dense		SPT-1	0.0 - 1.5	1.5	4-5-6	11	Boring advanced with 3.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.5	11-15-14	14	
				SPT-3	3.0 - 4.5	1.5	8-13-10	8	
				SPT-4	4.5 - 6.0	1.5	6-9-12	9	Piezometer installed (see PZ detail sheet).
				SPT-5	6.0 - 7.5	1.2	9-13-11	15	
				SPT-6	7.5 - 9.0	0.8	8-9-6	13	
				SPT-7	9.0 - 10.5	0.2	2-1-2	7	Bulk Sample #1 obtained from 10.0 to 13.0 ft.
				SPT-8	10.5 - 12.0	0.8	3-5-6	16	
				SPT-9	12.0 - 13.5	0.8	2-4-6	13	
				SPT-10	13.5 - 15.0	0.5	3-3-4	18	
445.5'	16.5'			SPT-11	15.0 - 16.1	0.8	5-11-50/0.1'	13	Bulk Sample #2 obtained from 15.0 to 17.0 ft.
		FLY ASH, dark gray, wet, medium stiff		SPT-12	16.5 - 18.0	0.9	2-3-3	37	Splitspoon refusal at 16.0 ft. due to apparent cobble/boulder.
443.0'	19.0'			SPT-13	18.0 - 19.1	0.7	2-3-50/0.1'	40	
441.0'	21.0'	Shale, dark olive gray, highly weathered, moderately hard		SPT-14	19.5 - 19.9	0.1	50/0.4'	19	
		Auger Refusal / Bottom of Hole Top of Rock = 19.0' Elevation (443.0')							Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 21.0 ft.

FMSM_LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

2/23/10

SUBSURFACE LOG

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller J. Huntoon

Logged By D. Chapman

Location N 707328.99, E 1877246.92 (NAD27)

Boring No. **STN-D-1** Total Depth 16.5 ft

Surface Elevation 460.8 ft. (NGVD29)

Date Started 8/5/09 Completed 8/5/09

Depth to Water N/A Date/Time N/A

Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
460.8'	0.0'	Top of Hole							
460.3'	0.5'	GRAVEL Road Surface		SPT-1	0.0 - 1.5	1.5	7-6-5	19	Boring advanced with 4.25" hollow stem auger.
		LEAN CLAY, reddish brown, moist, stiff to very stiff		SPT-2	1.5 - 3.0	0.3	4-5-5	18	
				SPT-3	3.0 - 4.5	1.0	6-8-10	16	
				SPT-4	4.5 - 6.0	1.2	2-3-8	23	
		-trace coarse sand to fine gravel between 6.0' to 10.5'		SPT-5	6.0 - 7.5	1.3	2-3-6	21	
				SPT-6	7.5 - 9.0	1.0	3-5-7	23	
				SPT-7	9.0 - 10.5	1.0	4-5-7	23	
				SPT-8	10.5 - 12.0	0.8	3-3-17	22	Boring backfilled with bentonite grout from 0.0 to 16.5 ft.
				SPT-9	12.0 - 13.5	0.3	16-6-7	32	
				SPT-10	13.5 - 15.0	0.8	3-6-12	30	Refusal on apparent cobble/boulder.
444.3'	16.5'			SPT-11	15.0 - 16.5	0.7	2-6-6	26	
		No Refusal / Bottom of Hole							

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SUBSURFACE LOG

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Project No.	175559018	Location	N 707328.99, E 1877246.92 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-D-1S** Total Depth 17.0 ft
Location	Sumner County, Tennessee	Surface Elevation	460.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/5/09 Completed 8/5/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	N/A Date/Time N/A
Logged By	Craig Millhollin	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
460.8'	0.0'	Top of Hole							
		Refer to STN-D-1 and STN-D-1A for soil descriptions.		ST-1	2.0 - 4.0	1.5		15	Boring advanced with 4.25" hollow stem auger.
				ST-2	6.0 - 8.0	2.0		22	
				ST-3	10.0 - 12.0	1.5		24	
				ST-4	14.0 - 16.0	0.0		--	Shelby Tube opening and sidewalls buckled by apparent cobble/boulder.
443.8'	17.0'								
		No Refusal / Bottom of Hole Top of Rock = 17.0' Elevation (443.8')							Boring backfilled with bentonite grout from 0.0 to 17.0 ft.

SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 707328.99, E 1877246.92 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-D-1A** Total Depth 21.0 ft
Location	Sumner County, Tennessee	Surface Elevation	460.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/5/09 Completed 8/5/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	16.5 ft Date/Time 8/5/09
Logged By	D. Chapman	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
460.8'	0.0'	Top of Hole							
444.3'	16.5'	Move to offset 5.0 ft. from Boring STN-D-1, auger down to 16.5 ft., resume sampling. Refer to STN-D-1 for soil descriptions from 0.0 to 16.5 ft.							Boring advanced with 4.25" hollow stem auger. Piezometer Installed (see PZ detail sheet).
		LEAN CLAY, reddish brown, wet, very soft to soft, trace fine gravel		SPT-1	16.5 - 18.0	0.7	2-1-1	30	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 21.0 ft.
				SPT-2	18.0 - 19.5	1.1	1-2-2	29	
				SPT-3	19.5 - 21.0	1.0	2-2-5	27	
439.8'	21.0'			SPT-4	21.0 - 21.0	0.0	50/0.0'	–	

Auger Refusal /
Bottom of Hole

Top of Rock = 21.0'
Elevation (439.8')

SUBSURFACE LOG

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Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller J. Huntoon

Logged By D. Chapman

Location N 707328.99, E 1877246.92 (NAD27)

Boring No. **STN-D-1B** Total Depth 14.0 ft

Surface Elevation 460.8 ft. (NGVD29)

Date Started 8/5/09 Completed 8/5/09

Depth to Water N/A Date/Time N/A

Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
460.8'	0.0'	Top of Hole							
		Moved to offset 5.0 ft. from Boring STN-D-1S. Attempted to obtain Shelby Tube sample from 18.0 to 20.0 ft. Auger refusal encountered at 14.0 ft.							Boring advanced with 4.25" hollow stem auger. Boring backfilled with benotnite grout from 0.0 to 14.0 ft.
446.8'	14.0'								

No Refusal /
Bottom of Hole

Top of Rock = 14.0'
Elevation (446.8')

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SUBSURFACE LOG

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Project No.	175559018	Location	N 707245.18, E 1877237.96 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-D-2** Total Depth 15.9 ft
Location	Sumner County, Tennessee	Surface Elevation	460.4 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/7/09 Completed 8/7/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	10.0 ft Date/Time 8/7/09
Logged By	Craig Millhollin	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
460.4'	0.0'	Top of Hole							
		LEAN CLAY with Sand, reddish brown, moist to wet, stiff to very stiff		SPT-1	0.0 - 1.5	1.0	8-10-14	24	Boring advanced with 3.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.0	8-11-12	21	
				SPT-3	3.0 - 4.5	0.8	8-11-12	18	Bulk Sample #1 obtained from 4.0 to 6.0 ft.
				SPT-4	4.5 - 6.0	1.5	3-5-6	32	
				SPT-5	6.0 - 7.5	1.1	6-9-11	22	
				SPT-6	7.5 - 9.0	1.0	6-9-13	21	
				SPT-7	9.0 - 10.5	0.9	7-7-11	20	
				SPT-8	10.5 - 12.0	1.5	3-4-6	24	Boring backfilled with bentonite grout from 0.0 to 15.9 ft.
				SPT-9	12.0 - 13.5	1.5	6-7-7	25	
				SPT-10	13.5 - 15.0	1.2	6-9-12	23	
444.5'	15.9'			SPT-11	15.0 - 15.9	0.9	14-50/0.4'	28	
		Auger Refusal / Bottom of Hole Top of Rock = 15.9' Elevation (444.5')							

FMSM LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

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SUBSURFACE LOG

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Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Huntoon
Logged By Craig Millhollin

Location N 707245.18, E 1877237.96 (NAD27)
Boring No. **STN-D-2S** Total Depth 12.0 ft
Surface Elevation 460.4 ft. (NGVD29)
Date Started 8/7/09 Completed 8/7/09
Depth to Water N/A Date/Time N/A
Automatic Hammer ☐ Safety Hammer ☒ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
460.4'	0.0'	Top of Hole							
		Refer to STN-D-2 for descriptions of overburden soils.							Boring advanced with 3.25" hollow stem auger.
				ST-1	4.0 - 6.0	1.7		18	
				ST-2	6.0 - 8.0	1.3		24	Boring backfilled with bentonite grout from 0.0 to 12.0 ft.
				ST-3	10.0 - 12.0	0.0		-	
448.4'	12.0'								

No Refusal /
Bottom of Hole

Top of Rock = 12.0'
Elevation (448.4')

FMSM LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

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SUBSURFACE LOG

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Project No.	175559018	Location	N 703045.88, E 1879000.10 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-1** Total Depth 55.0 ft
Location	Sumner County, Tennessee	Surface Elevation	474.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/6/09 Completed 8/6/09
Supervisor	Paul Cooper Driller S. Bradford	Depth to Water	18.0 ft Date/Time 8/6/09
Logged By	C. Wood	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
474.1'	0.0'	Top of Hole							
473.8'	0.3'	BOTTOM ASH, road surface		SPT-1	0.0 - 1.5	1.2	3-3-10	15	Boring advanced with 4.25" hollow stem auger.
		SILTY CLAY (Pond E Dike), orange brown to grayish brown, moist, stiff to very stiff, trace fine sand to fine gravel, some bottom ash		SPT-2	1.5 - 3.0	0.8	10-12-11	15	
				SPT-3	3.0 - 4.5	0.4	7-7-8	11	
				SPT-4	4.5 - 6.0	0.8	8-12-14	7	
466.6'	7.5'			SPT-5	6.0 - 7.5	1.0	16-18-20	12	
		LEAN CLAY (Pond E Dike), brown and orange brown, moist, stiff to very stiff, trace fine gravel		SPT-6	7.5 - 9.0	1.2	18-19-20	14	
				SPT-7	9.0 - 10.5	1.2	5-11-12	12	
		-apparent cobble at 10.6'		SPT-8	10.5 - 12.0	0.5	40-26-20	10	
				SPT-9	12.0 - 13.5	0.8	7-7-8	20	
				SPT-10	13.5 - 15.0	1.0	7-8-8	30	
457.6'	16.5'	-with some bottom ash below 14.5'		SPT-11	15.0 - 16.5	0.7	7-8-4	16	
		BOTTOM ASH (sluiced), black, moist to wet, very loose to dense		SPT-12	16.5 - 18.0	1.2	20-22-16	17	
				SPT-13	18.0 - 19.5	1.4	8-8-7	21	
				SPT-14	19.5 - 21.0	1.2	6-5-8	20	
				SPT-15	21.0 - 22.5	0.9	5-8-11	18	
				SPT-16	22.5 - 24.0	1.3	7-7-7	17	
				SPT-17	24.0 - 25.5	1.0	6-8-7	17	
				SPT-18	25.5 - 27.0	1.0	6-2-1	18	
		-with some fly ash below 27.5'		SPT-19	27.0 - 28.5	1.5	1-2-2	18	
444.6'	29.5'			SPT-20	28.5 - 30.0	1.5	1-2-4	13	
		FAT CLAY, orange brown, wet, soft to stiff, trace medium sand to fine gravel		SPT-21	30.0 - 31.5	0.3	1-2-2	33	
				SPT-22	31.5 - 33.0	0.5	4-6-8	30	

FMSM LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

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SUBSURFACE LOG

Project No. 175559018
Location N 703045.88, E 1879000.10 (NAD27)
Project Name Gallatin Fossil Plant - TVA
Boring No. **STN-E-1** Total Depth 55.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		FAT CLAY, orange brown, wet, soft to stiff, trace medium sand to fine gravel *(Continued)*		SPT-23	33.0 - 34.5	0.4	4-6-7	30	
				SPT-24	34.5 - 36.0	1.3	12-17-20	32	
438.1'	36.0'			SPT-25	36.0 - 36.3	0.3	50/0.3'	16	Began Core
437.8'	36.3'	Limestone, highly weathered (augered)							
		Limestone, light gray to light brown, coarsely crystalline to fine, hard, thin bedded, weathered to highly weathered, many bedding zone fractures throughout							Void from approximately 38.0 to 44.0 ft.
				14%	10.7	2.2	21	47.0	
									Boring backfilled with bentonite grout from 0.0 to 55.0 ft.
419.1'	55.0'			15%	8.0	2.9	36	55.0	

Bottom of Hole

Base of Weathered Rock = 36.3'

Top of Rock = 36.0'
Elevation (438.1')

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SUBSURFACE LOG

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Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller S. Bradford
Logged By C. Wood

Location N 703045.88, E 1879000.10 (NAD27)
Boring No. **STN-E-1S** Total Depth 34.5 ft
Surface Elevation 474.1 ft. (NGVD29)
Date Started 8/6/09 Completed 8/7/09
Depth to Water N/A Date/Time N/A
Automatic Hammer ☐ Safety Hammer ☒ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
474.1'	0.0'	Top of Hole							
		Refer to STN-E-1 for descriptions of overburden soils.							Boring advanced with 4.25" hollow stem auger.
				ST-1	4.0 - 6.0	1.0		15	
				ST-2	8.0 - 10.0	0.8		10	
				ST-3	12.0 - 14.0	0.5		9	
				ST-4	20.0 - 22.0	0.7		19	
									Boring backfilled with bentonite grout from 0.0 to 34.5 ft.
				ST-5	32.0 - 34.0	0.0		–	
439.6'	34.5'								
		No Refusal / Bottom of Hole							

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SUBSURFACE LOG

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Project No.	175559018	Location	N 703007.37, E 1879022.21 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-2** Total Depth 30.0 ft
Location	Sumner County, Tennessee	Surface Elevation	475.7 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/8/09 Completed 8/10/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	18.0 ft Date/Time 8/9/09
Logged By	D. Chapman	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
475.7'	0.0'	Top of Hole							
475.3'	0.4'	BOTTOM ASH Road Surface		SPT-1	0.0 - 1.5	0.7	4-4-7	13	Boring advanced with 4.25" hollow stem auger.
		GRAVELLY LEAN CLAY with Sand (Pond E Dike), reddish brown and yellowish brown to brown, moist, medium to very stiff, silty		SPT-2	1.5 - 3.0	0.8	6-3-3	22	
				SPT-3	3.0 - 4.5	1.0	8-16-14	11	
				SPT-4	4.5 - 6.0	1.1	8-26-20	11	
				SPT-5	6.0 - 7.5	1.0	8-10-15	14	
				SPT-6	7.5 - 9.0	1.0	8-17-19	10	Bulk Sample #1 obtained from 8.0' to 11.0'.
				SPT-7	9.0 - 10.5	1.3	6-7-8	17	
463.7'	12.0'			SPT-8	10.5 - 12.0	0.9	6-7-13	13	
		BOTTOM ASH (sluiced), dark gray to black, moist to wet, very loose to dense, trace to some fly ash -some clay between 15.5' to 17.0'		SPT-9	12.0 - 13.5	1.0	11-13-15	--	Piezometer installed (see PZ detail sheet).
				SPT-10	13.5 - 15.0	1.3	5-6-7	26	
				SPT-11	15.0 - 16.5	1.0	2-3-5	17	
				SPT-12	16.5 - 18.0	0.9	8-13-22	19	
				SPT-13	18.0 - 19.5	1.1	19-8-8	27	
				SPT-14	19.5 - 21.0	1.1	18-9-9	19	
				SPT-15	21.0 - 22.5	0.8	5-7-5	17	
				SPT-16	22.5 - 24.0	0.7	2-5-5	34	
				SPT-17	24.0 - 25.5	0.8	2-4-4	17	
448.7'	27.0'			SPT-18	25.5 - 27.0	0.6	1-1-1	25	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 30.0 ft.
		SILTY CLAY, olive brown, wet, very soft		SPT-19	27.0 - 28.5	0.5	1-1-1	37	
				SPT-20	28.5 - 29.3	0.3	1-50/0.3'	27	
445.7'	30.0'			SPT-21	30.0 - 30.0	0.0	50/0.0'	--	

Auger Refusal /
Bottom of Hole

Top of Rock = 30.0'
Elevation (445.7')

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SUBSURFACE LOG

Project No.	175559018	Location	N 702955.21, E 1879046.66 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-3** Total Depth 41.4 ft
Location	Sumner County, Tennessee	Surface Elevation	459.6 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/19/09 Completed 8/19/09
Supervisor	Paul Cooper Driller J. Bowerman	Depth to Water	7.5 ft Date/Time 8/19/09
Logged By	Scott Lange	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
459.6'	0.0'	Top of Hole							
		LEAN CLAY (Pond E Dike), brown, moist, stiff to very stiff, trace fine to coarse gravel and fly ash		SPT-1	0.0 - 1.5	0.5	6-6-6	8	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	0.3	4-4-4	5	
				SPT-3	3.0 - 4.5	1.0	4-9-10	18	
455.1'	4.5'								
		BOTTOM ASH (sluiced), black, moist to wet, very loose to medium dense, trace to some fly ash		SPT-4	4.5 - 6.0	1.0	7-9-8	15	
				SPT-5	6.0 - 7.5	1.0	4-5-4	16	
				SPT-6	7.5 - 9.0	1.0	2-1-1	19	
				SPT-7	9.0 - 10.5	0.3	1-1-2	31	
				SPT-8	10.5 - 12.0	1.5	6-3-2	46	
447.6'	12.0'								
		FAT CLAY with Sand, yellowish brown to orange brown, wet, soft to very stiff, trace fine gravel		SPT-9	12.0 - 13.5	1.5	1-2-4	26	
				SPT-10	13.5 - 15.0	1.0	4-5-6	30	
				SPT-11	15.0 - 16.5	1.0	2-5-7	24	
				SPT-12	16.5 - 18.0	1.5	3-6-9	25	
				SPT-13	18.0 - 19.5	1.3	2-7-7	24	
				SPT-14	19.5 - 21.0	1.3	3-7-9	26	
				SPT-15	21.0 - 22.5	1.5	5-8-8	21	
				SPT-16	22.5 - 24.0	1.0	4-8-7	23	
				SPT-17	24.0 - 25.5	1.3	2-6-8	23	
				SPT-18	25.5 - 27.0	1.5	5-7-10	23	
				SPT-19	27.0 - 28.5	1.5	3-4-5	24	
				SPT-20	28.5 - 30.0	1.3	3-4-5	20	

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location N 702955.21, E 1879046.66 (NAD27)

Boring No. **STN-E-3**

Total Depth 41.4 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
		FAT CLAY with Sand, yellowish brown to orange brown, wet, soft to very stiff, trace fine gravel *(Continued)*		SPT-21	30.0 - 31.5	1.3	2-7-4	23	
				SPT-22	31.5 - 33.0	1.0	1-2-2	43	
				SPT-23	33.0 - 34.5	1.5	1-1-2	32	
				SPT-24	34.5 - 36.0	1.5	2-3-7	56	
				SPT-25	36.0 - 37.5	1.5	4-4-2	75	
				SPT-26	37.5 - 39.0	1.5	1-1-2	51	Boring backfilled with bentonite grout from 0.0 to 41.4 ft.
				SPT-27	39.0 - 40.5	1.5	3-2-11	34	
418.2'	41.4'			SPT-28	40.5 - 41.4	0.5	6-50/0.4'	55	

Auger Refusal /
Bottom of Hole

Top of Rock = 41.4'
Elevation (418.2')

Stantec

SUBSURFACE LOG

Project No.	175559018	Location	N 702820.82, E 1878131.27 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-4** Total Depth 50.3 ft
Location	Sumner County, Tennessee	Surface Elevation	474.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/7/09 Completed 8/7/09
Supervisor	Paul Cooper Driller S. Bradford	Depth to Water	14.0 ft Date/Time 8/7/09
Logged By	C. Wood	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
474.3'	0.0'	Top of Hole							
474.1'	0.2'	BOTTOM ASH Road Surface		SPT-1	0.0 - 1.5	1.0	4-4-3	18	Boring advanced with 4.25" hollow stem auger.
		LEAN CLAY (Pond E Dike), orange brown, moist, medium to very stiff, silty, trace fine sand and bottom ash		SPT-2	1.5 - 3.0	0.6	3-3-4	23	
				SPT-3	3.0 - 4.5	0.8	5-5-10	12	
				SPT-4	4.5 - 6.0	1.2	3-16-12	14	
				SPT-5	6.0 - 7.5	1.0	13-16-20	16	
				SPT-6	7.5 - 9.0	1.0	16-19-18	11	
464.3'	10.0'			SPT-7	9.0 - 10.5	1.5	20-16-24	18	
		BOTTOM ASH (Pond E Dike), black, moist to wet, medium dense to very dense, some fly ash		SPT-8	10.5 - 12.0	1.3	34-26-34	13	
				SPT-9	12.0 - 13.5	1.0	10-13-16	18	
459.0'	15.3'			SPT-10	13.5 - 15.0	1.2	13-13-8	28	
		FLY ASH (sluiced), dark gray and black, wet wet, very soft to medium stiff, some clay between 15.3' to 16.5'		SPT-11	15.0 - 16.5	1.4	4-1-WOH	62	
				SPT-12	16.5 - 18.0	0.8	2-WOH-WOH	31	
				SPT-13	18.0 - 19.5	1.2	WOH-WOH-1	35	
				SPT-14	19.5 - 21.0	0.2	2-1-WOH	32	
				SPT-15	21.0 - 22.5	1.2	1-2-3	35	
				SPT-16	22.5 - 24.0	1.3	1-2-1	39	
				SPT-17	24.0 - 25.5	0.0	1-1-1	--	
				SPT-18	25.5 - 27.0	0.0	1-1-1	–	
				SPT-19	27.0 - 28.5	0.0	1-1-WOH	–	
				SPT-20	28.5 - 30.0	0.0	WOH-WOH-WOH	–	
				SPT-21	30.0 - 31.5	0.8	WOH-WOH-WOH	36	
				SPT-22	31.5 - 33.0	0.6	WOH-WOH-WOH	29	
				SPT-23	33.0 - 34.5	0.5	WOH-WOH-WOH	29	
				SPT-24	34.5 - 36.0	1.2	WOH-WOH-WOH	29	
				SPT-25	36.0 - 37.5	1.0	WOH-WOH-WOH	34	
				SPT-26	37.5 - 39.0	1.0	WOH-WOH-2	32	
434.3'	40.0'			SPT-27	39.0 - 40.5	0.8	WOH-WOH-4	34	
		LEAN CLAY, dark gray to orange brown, wet, stiff to very stiff, silty, trace fine to medium sand		SPT-28	40.5 - 42.0	0.7	4-4-7	19	
				SPT-29	42.0 - 43.5	1.0	4-5-11	20	

SUBSURFACE LOG

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location N 702820.82, E 1878131.27 (NAD27)

Boring No. **STN-E-4** Total Depth 50.3 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
		LEAN CLAY, dark gray to orange brown, wet, stiff to very stiff, silty, trace fine to medium sand *(Continued)*		SPT-30	43.5 - 45.0	1.4	4-5-10	20	Boring backfilled with bentonite grout from 0.0 to 50.3 ft.
				SPT-31	45.0 - 46.5	1.4	4-5-7	21	
				SPT-32	46.5 - 48.0	0.8	7-9-11	19	
				SPT-33	48.0 - 49.5	0.2	5-5-4	25	
424.0'	50.3'			SPT-34	49.5 - 50.3	0.8	4-50/0.3'	20	

Auger Refusal /
Bottom of Hole

Top of Rock = 50.3'
Elevation (424.0')

Stantec

SUBSURFACE LOG

Project No.	175559018	Location	N 702820.82, E 1878131.27 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-4S** Total Depth 42.0 ft
Location	Sumner County, Tennessee	Surface Elevation	474.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/8/09 Completed 8/8/09
Supervisor	Paul Cooper Driller S. Bradford	Depth to Water	N/A Date/Time N/A
Logged By	C. Wood	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
474.3'	0.0'	Top of Hole							
		Refer to STN-E-4 for descriptions of overburden soils.							Boring advanced with 4.25" hollw stem auger.
				ST-1	5.0 - 7.0	0.8		20	
									Bulk sample #1 obtained from 12.5 to 15.0 ft.
				ST-3	15.0 - 17.0	0.4		22	
				ST-4	20.0 - 22.0	0.0		–	
				ST-5	35.0 - 37.0	0.0		–	
									Boring backfilled with bentonite grout from 0.0 to 42.0 ft.
432.3'	42.0'			ST-6	40.0 - 42.0	0.0		–	
		No Refusal / Bottom of Hole							

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SUBSURFACE LOG

Project No.	175559018	Location	N 702788.65, E 1878111.48 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-5** Total Depth 50.3 ft
Location	Sumner County, Tennessee	Surface Elevation	476.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/9/09 Completed 8/9/09
Supervisor	Paul Cooper Driller S. Bradford	Depth to Water	17.2 ft Date/Time 8/9/09
Logged By	C. Wood	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
476.1'	0.0'	Top of Hole							
		BOTTOM ASH (Pond E Dike), black, moist, dense to very dense		SPT-1	0.0 - 1.5	0.6	3-25-26	13	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	0.8	26-27-19	22	
472.4'	3.7'			SPT-3	3.0 - 4.5	1.3	23-15-14	13	
		LEAN CLAY (Pond E Dike), dark brown to grayish brown, moist, very stiff, silty, trace fine gravel		SPT-4	4.5 - 6.0	0.7	9-11-11	13	
				SPT-5	6.0 - 7.5	1.2	8-12-17	13	
		-with bottom ash from 8.0 to 9.0 ft.		SPT-6	7.5 - 9.0	1.3	12-19-19	9	
				SPT-7	9.0 - 10.5	1.4	7-6-15	11	
464.1'	12.0'			SPT-8	10.5 - 12.0	1.0	12-17-17	17	
		BOTTOM ASH (Pond E Dike), black, moist to wet, medium dense to dense		SPT-9	12.0 - 13.5	1.4	21-17-26	15	
				SPT-10	13.5 - 15.0	1.4	26-29-31	21	
				SPT-11	15.0 - 16.5	1.5	18-13-15	18	
				SPT-12	16.5 - 18.0	1.0	14-6-4	22	
457.6'	18.5'			SPT-13	18.0 - 19.5	1.1	2-2-2	37	
		FLY ASH (sluiced), black, wet, very soft to soft		SPT-14	19.5 - 21.0	1.3	1-WOH-1	35	
				SPT-15	21.0 - 22.5	0.8	1-1-2	41	
				SPT-16	22.5 - 24.0	1.2	1-1-1	32	
				SPT-17	24.0 - 25.5	0.0	2-2-1	--	
				SPT-18	25.5 - 27.0	0.2	4-2-1	25	
				SPT-19	27.0 - 28.5	0.0	2-1-1	–	
				SPT-20	28.5 - 30.0	0.0	1-1-1	–	
				SPT-21	30.0 - 31.5	1.0	WOH-WOH-WOH	35	
				SPT-22	31.5 - 33.0	1.2	WOH-WOH-WOH	29	
				SPT-23	33.0 - 34.5	1.2	WOH-WOH-WOH	28	
				SPT-24	34.5 - 36.0	1.0	WOH-WOH-WOH	36	
				SPT-25	36.0 - 37.5	1.0	WOH-WOH-WOH	57	
438.1'	38.0'			SPT-26	37.5 - 39.0	1.3	WOH-3-3	22	
		LEAN CLAY, orange brown, wet, medium stiff to stiff, trace fine gravel		SPT-27	39.0 - 40.5	1.0	2-3-5	20	
				SPT-28	40.5 - 42.0	1.0	4-5-7	22	
432.9'	43.2'			SPT-29	42.0 - 43.5	1.5	9-5-7	20	

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location N 702788.65, E 1878111.48 (NAD27)

Boring No. **STN-E-5**

Total Depth 50.3 ft

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
		FAT CLAY, orange brown, wet, stiff to very stiff, trace fine gravel *(Continued)*		SPT-30	43.5 - 45.0	1.4	6-8-7	19	Boring backfilled with bentonite grout from 0.0 to 50.3 ft.
				SPT-31	45.0 - 46.5	1.5	10-7-14	20	
				SPT-32	46.5 - 48.0	0.8	2-11-10	26	
				SPT-33	48.0 - 49.5	0.5	7-8-11	29	
425.8'	50.3'			SPT-34	49.5 - 50.3	0.8	24-50/0.3'	27	

Auger Refusal /
Bottom of Hole

Top of Rock = 50.3'
Elevation (425.8')

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SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 702733.38, E 1878070.14 (NAD27)		
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-6**	Total Depth	28.0 ft
Location	Sumner County, Tennessee	Surface Elevation	459.6 ft. (NGVD29)		
Project Type	Geotechnical Exploration	Date Started	8/10/09	Completed	8/10/09
Supervisor	Paul Cooper Driller J. Wethington	Depth to Water	3.5 ft	Date/Time	8/10/09
Logged By	Craig Millhollin	Automatic Hammer ☐	Safety Hammer ☒	Other ☐	

Lithology			Overburden Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
459.6'	0.0'	Top of Hole						
		FLY ASH (sluiced), dark gray, moist to wet, very soft to soft	SPT-1	0.0 - 1.5	1.5	4-2-2	24	Boring advanced with 3.25" hollow stem auger.
			SPT-2	1.5 - 3.0	0.8	2-2-2	49	
			SPT-3	3.0 - 4.5	1.5	2-1-2	36	
			SPT-4	4.5 - 6.0	1.5	2-1-1	41	Piezometer Installed (see PZ detail sheet).
			SPT-5	6.0 - 7.5	0.2	1-WOH-WOH	18	
			SPT-6	7.5 - 9.0	1.0	2-1-1	29	
			SPT-7	9.0 - 10.5	0.7	WOH-WOH-WOH	31	
			SPT-8	10.5 - 12.0	0.0	WOH-WOH-WOH	–	
			SPT-9	12.0 - 13.5	0.7	WOH-WOH-WOH	32	
			SPT-10	13.5 - 15.0	1.0	WOH-WOH-WOH	38	
			SPT-11	15.0 - 16.5	1.5	WOH-WOH-WOH	29	
441.4'	18.2'		SPT-12	16.5 - 18.0	1.5	WOH-1-1	29	
		LEAN CLAY, reddish brown, wet, medium stiff to stiff, trace fine sand	SPT-13	18.0 - 19.5	1.2	2-5-9	46	
			SPT-14	19.5 - 21.0	0.9	3-4-6	19	
			SPT-15	21.0 - 22.5	1.1	2-2-5	22	
436.6'	23.0'		SPT-16	22.5 - 24.0	1.0	4-10-15	32	
		FAT CLAY, orange brown, wet, very stiff, trace fine gravel	SPT-17	24.0 - 25.5	0.7	7-10-11	23	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 28.0 ft.
			SPT-18	25.5 - 27.0	1.3	7-12-15	38	
431.6'	28.0'		SPT-19	27.0 - 28.0	1.0	15-50/0.5'	39	

Auger Refusal /
Bottom of Hole

Top of Rock = 28.0'
Elevation (431.6')

FMSM_LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

2/23/10

SUBSURFACE LOG

Project No.	175559018	Location	N 703843.80, E 1877971.87 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	STN-E-7 Total Depth 65.0 ft
Location	Sumner County, Tennessee	Surface Elevation	475.1 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/8/09 Completed 8/8/09
Supervisor	Paul Cooper Driller S. Bradford	Depth to Water	18.5 ft Date/Time 8/8/09
Logged By	C. Wood	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
475.1'	0.0'	Top of Hole							
		LEAN CLAY (Pond E Dike), brown, moist, stiff to very stiff, silty, trace fine sand to fine gravel		SPT-1	0.0 - 1.5	0.8	8-8-8	13	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.2	8-7-8	14	
				SPT-3	3.0 - 4.5	0.5	8-9-16	13	
				SPT-4	4.5 - 6.0	0.7	13-10-15	13	
				SPT-5	6.0 - 7.5	0.0	14-12-9	–	
				SPT-6	7.5 - 9.0	0.8	10-13-10	11	
				SPT-7	9.0 - 10.5	1.4	5-11-13	14	
				SPT-8	10.5 - 12.0	1.2	13-13-12	15	
461.4'	13.7'			SPT-9	12.0 - 13.5	1.0	13-14-17	16	
		BOTTOM ASH (Pond E Dike), black, moist to wet, very loose to dense		SPT-10	13.5 - 15.0	1.0	10-26-14	13	
				SPT-11	15.0 - 16.5	1.1	5-8-7	33	
		-some clay between 17.0' and 19.2'		SPT-12	16.5 - 18.0	1.5	3-2-2	36	
455.9'	19.2'			SPT-13	18.0 - 19.5	1.4	3-3-4	31	
		FLY ASH (sluiced), dark gray, wet, very soft to medium stiff		SPT-14	19.5 - 21.0	0.4	4-3-3	36	
				SPT-15	21.0 - 22.5	1.4	1-WOH-WOH	34	
451.1'	24.0'			SPT-16	22.5 - 24.0	1.5	WOH-WOH-1	39	
		LEAN CLAY, orange brown, moist, soft to stiff, trace fine sand		SPT-17	24.0 - 25.5	0.7	3-3-4	8	
				SPT-18	25.5 - 27.0	0.3	1-2-2	8	
				SPT-19	27.0 - 28.5	1.0	3-5-10	8	
				SPT-20	28.5 - 30.0	0.8	4-5-5	6	
				SPT-21	30.0 - 31.5	1.5	1-2-3	3	
442.1'	33.0'			SPT-22	31.5 - 33.0	1.4	2-2-3	3	
		SANDY LEAN CLAY, orange brown, moist to wet, medium to very stiff, trace fine gravel		SPT-23	33.0 - 34.5	1.5	2-3-4	7	
				SPT-24	34.5 - 36.0	0.8	2-2-3	6	
				SPT-25	36.0 - 37.5	1.5	4-4-5	6	
				SPT-26	37.5 - 39.0	1.4	2-3-4	5	
				SPT-27	39.0 - 40.5	1.3	WOH-2-4	3	
				SPT-28	40.5 - 42.0	1.0	4-8-10	5	
				SPT-29	42.0 - 43.5	0.8	4-7-8	8	

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SUBSURFACE LOG

Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location N 703843.80, E 1877971.87 (NAD27)
Boring No. **STN-E-7** Total Depth 65.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		SANDY LEAN CLAY, orange brown, moist to wet, medium to very stiff, trace fine gravel *(Continued)*		SPT-30	43.5 - 45.0	0.6	3-4-4	5	
				SPT-31	45.0 - 46.5	1.0	3-5-10	4	
				SPT-32	46.5 - 48.0	0.3	5-5-10	4	
426.1'	49.0'			SPT-33	48.0 - 49.5	0.7	5-10-10	5	
		FAT CLAY, orange brown, moist, very soft to very stiff, trace fine sand to fine gravel		SPT-34	49.5 - 51.0	0.7	5-10-10	4	
				SPT-35	51.0 - 52.5	1.5	11-13-14	4	
				SPT-36	52.5 - 54.0	0.2	5-6-7	5	
				SPT-37	54.0 - 55.5	0.8	5-6-6	7	
				SPT-38	55.5 - 57.0	0.3	5-5-6	4	
				SPT-39	57.0 - 58.5	1.4	9-8-10	5	
				SPT-40	58.5 - 60.0	1.3	3-5-5	38	
				SPT-41	60.0 - 61.5	1.5	3-3-4	36	Boring backfilled with bentonite grout from 0.0 to 65.0 ft.
				SPT-42	61.5 - 63.0	1.2	2-1-1	42	
				SPT-43	63.0 - 64.5	0.8	3-2-1	44	
410.1'	65.0'			SPT-44	64.5 - 65.0	0.5	WOH-50/0.0'	21	

Auger Refusal /
Bottom of Hole

Top of Rock = 65.0'
Elevation (410.1')

FMSM LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

2/23/10

SUBSURFACE LOG

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller J. Wethington

Logged By Craig Millhollin

Location N 703835.47, E 1877934.64 (NAD27)

Boring No. **STN-E-8** Total Depth 63.9 ft

Surface Elevation 476.5 ft. (NGVD29)

Date Started 8/11/09 Completed 8/11/09

Depth to Water 20.0 ft Date/Time 8/11/09

Automatic Hammer ☐ Safety Hammer ☒ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
476.5'	0.0'	Top of Hole							
		LEAN CLAY (Pond E Dike), reddish brown to tan, moist, stiff to very stiff, trace fine gravel		SPT-1	0.0 - 0.5	0.5		17	
				SPT-2	0.5 - 2.0	1.1	4-5-7	17	Boring advanced with 3.25" hollow stem auger. Bulk Sample #1 obtained from 3.0 to 5.0 ft.
				SPT-3	2.0 - 3.5	1.5	12-17-27	18	
				SPT-4	3.5 - 5.0	1.5	6-9-10	14	
				ST-1	5.0 - 7.0	1.6		14	
				SPT-5	7.0 - 8.5	0.9	27-18-15	15	Piezometer installed (see PZ detail sheet).
				SPT-6	8.5 - 10.0	1.4	27-28-25	9	
				SPT-7	10.0 - 11.5	1.1	12-17-28	21	
				ST-2	11.5 - 13.5	1.3		16	
				SPT-8	13.5 - 15.0	1.5	8-9-12	18	
				SPT-9	15.0 - 16.5	0.8	11-14-15	23	Bulk Sample #2 obtained from 16.0 to 19.0 ft.
				SPT-10	16.5 - 18.0	1.0	11-12-15	20	
456.5'	20.0'			ST-3	18.0 - 20.0	2.0		46	
		FLY ASH (sluiced), gray to black, wet, medium stiff		SPT-11	20.0 - 21.5	1.5	1-3-2	31	
454.0'	22.5'			SPT-12	21.5 - 23.0	1.5	1-3-10	26	
		LEAN CLAY (Pond E Dike), reddish brown, wet, stiff to very stiff, trace to some fine gravel		SPT-13	23.0 - 24.5	1.0	5-9-9	22	Bulk Sample #3 obtained from 23.0 to 25.0 ft.
450.0'	26.5'			ST-4	24.5 - 26.5	1.0		20	
		SANDY LEAN CLAY, reddish brown, moist, medium to very stiff, trace to some fine gravel		SPT-14	26.5 - 28.0	1.0	40-37-12	10	
				SPT-15	28.0 - 29.5	0.8	12-6-6	17	
				ST-5	29.5 - 31.5	0.5		33	
				SPT-16	31.5 - 33.0	1.1	2-3-5	31	
				SPT-17	33.0 - 34.5	1.2	2-4-7	12	
				SPT-18	34.5 - 36.0	1.3	12-11-9	22	
				ST-6	36.0 - 38.0	0.0		--	
				SPT-19	38.0 - 39.5	1.2	6-5-6	22	

SUBSURFACE LOG

Project No. 175559018
Location N 703835.47, E 1877934.64 (NAD27)
Project Name Gallatin Fossil Plant - TVA
Boring No. **STN-E-8** Total Depth 63.9 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		SANDY LEAN CLAY, reddish brown, moist, medium to very stiff, trace to some fine gravel *(Continued)*		SPT-20	39.5 - 41.0	1.1	4-5-6	22	
				ST-7	41.0 - 43.0	1.7		17	
432.8'	43.7'			SPT-21	43.0 - 43.7	0.5	26-50/0.2'	23	
		LEAN CLAY with Sand, reddish brown, moist to wet, stiff to very stiff, trace fine to medium sand		SPT-22	43.7 - 45.2	1.5	7-11-15	26	
				ST-8	45.2 - 47.2	2.0		23	
				SPT-23	47.2 - 48.7	1.2	17-13-15	20	
				SPT-24	48.7 - 50.2	1.2	8-16-17	23	
				ST-9	50.2 - 52.2	1.8		24	
				SPT-25	52.2 - 53.7	0.9	13-17-16	28	
				SPT-26	53.7 - 55.2	1.2	16-16-17	36	
				ST-10	55.2 - 57.2	0.5		33	
				SPT-27	57.2 - 58.7	1.2	3-5-6	25	
				SPT-28	58.7 - 60.2	1.3	4-5-7	31	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 63.9 ft.
				SPT-29	60.2 - 61.7	1.5	3-4-5	26	
				SPT-30	61.7 - 63.2	1.5	4-4-5	27	
412.6'	63.9'			SPT-31	63.2 - 63.9	0.7	7-50/0.2'	28	

Auger Refusal /
Bottom of Hole

Top of Rock = 63.9'
Elevation (412.6')

Stantec

SUBSURFACE LOG

Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Bowerman
Logged By Scott Lange

Location N 703753.39, E 1877876.25 (NAD27)
Boring No. **STN-E-9** Total Depth 45.9 ft
Surface Elevation 451.8 ft. (NGVD29)
Date Started 8/20/09 Completed 8/21/09
Depth to Water 8.0 ft Date/Time 8/20/09
Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
451.8'	0.0'	Top of Hole							
		LEAN CLAY, reddish brown to brown, moist to wet, medium stiff to stiff, trace fine to medium sand		SPT-1	0.0 - 1.5	1.0	2-3-5	19	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.5	2-4-4	26	
				SPT-3	3.0 - 4.5	1.5	3-2-5	26	
				ST-1	4.5 - 6.5	2.0		19	
				SPT-4	6.5 - 8.0	1.3	3-6-6	23	
				SPT-5	8.0 - 9.5	1.5	3-5-8	24	
				ST-2	9.5 - 11.5	2.0		21	
				SPT-6	11.5 - 13.0	1.5	2-7-6	33	
437.3'	14.5'			SPT-7	13.0 - 14.5	1.5	2-6-7	25	
		LEAN CLAY with Sand, yellowish brown, moist, very soft to stiff, trace fine gravel		SPT-8	14.5 - 16.0	1.3	2-5-7	27	
				SPT-9	16.0 - 17.5	1.5	3-5-7	34	
				SPT-10	17.5 - 19.0	1.3	2-3-6	22	
				SPT-11	19.0 - 20.5	1.5	1-4-6	24	
				SPT-12	20.5 - 22.0	1.5	4-6-8	24	
				SPT-13	22.0 - 23.5	1.5	4-5-6	19	
				SPT-14	23.5 - 25.0	1.5	3-5-6	26	
				SPT-15	25.0 - 26.5	1.5	2-3-6	29	
				SPT-16	26.5 - 28.0	1.5	3-4-6	34	
				SPT-17	28.0 - 29.5	1.5	1-3-4	29	

FMSM_LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

SUBSURFACE LOG

Project No. 175559018
Location N 703753.39, E 1877876.25 (NAD27)
Project Name Gallatin Fossil Plant - TVA
Boring No. **STN-E-9**
Total Depth 45.9 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		LEAN CLAY with Sand, yellowish brown, moist, very soft to stiff, trace fine gravel *(Continued)*		SPT-18	29.5 - 31.0	1.5	1-3-4	27	
				SPT-19	31.0 - 32.5	1.5	1-1-2	30	
				SPT-20	32.5 - 34.0	1.5	1-3-4	25	
416.3'	35.5'			SPT-21	34.0 - 35.5	1.5	1-1-4	24	
		SANDY LEAN CLAY, brown and tan, moist to wet, very soft to medium stiff, trace fine gravel		SPT-22	35.5 - 37.0	1.5	1-1-4	29	
				SPT-23	37.0 - 38.5	1.5	1-1-1	29	
				SPT-24	38.5 - 40.0	1.5	1-1-1	26	
410.3'	41.5'			SPT-25	40.0 - 41.5	1.5	1-1-1	56	
		FAT CLAY, yellowish brown and grayish brown, moist to wet, very soft to medium stiff, trace fine gravel		SPT-26	41.5 - 43.0	1.5	1-WOH-1	43	Boring backfilled with bentonite grout from 0.0 to 45.9 ft.
				SPT-27	43.0 - 44.5	1.5	1-2-3	34	
405.9'	45.9'			SPT-28	44.5 - 45.9	1.4	WOH-2-50/0.4'	51	

Auger Refusal /
Bottom of Hole

Top of Rock = 45.9'
Elevation (405.9')

SUBSURFACE LOG

Page: 1 of 1

Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Huntoon
Logged By D. Chapman

Location N 704870.32, E 1877862.37 (NAD27)
Boring No. **STN-E-10** Total Depth 29.1 ft
Surface Elevation 474.9 ft. (NGVD29)
Date Started 8/6/09 Completed 8/6/09
Depth to Water 13.5 ft Date/Time 8/6/09
Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
474.9'	0.0'	Top of Hole							
		LEAN CLAY with Sand (Pond E Dike), reddish brown, moist, stiff to very stiff, trace medium sand to fine gravel		SPT-1	0.0 - 1.5	1.0	2-4-7	19	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	0.9	10-13-14	8	
				SPT-3	3.0 - 4.5	0.8	8-9-10	22	
				SPT-4	4.5 - 6.0	1.0	7-8-10	16	
				SPT-5	6.0 - 7.5	0.8	3-7-12	25	
				SPT-6	7.5 - 9.0	1.5	3-7-13	24	
				SPT-7	9.0 - 10.5	1.3	6-6-7	20	
463.2'	11.7'			SPT-8	10.5 - 12.0	1.2	7-16-20	22	
		BOTTOM ASH (Pond E Dike), dark gray, moist to wet, medium dense to dense		SPT-9	12.0 - 13.5	1.5	7-25-21	11	
				SPT-10	13.5 - 15.0	1.1	8-13-27	17	
458.4'	16.5'			SPT-11	15.0 - 16.5	0.8	8-12-12	19	
		FLY ASH (sluiced), black, wet, very soft to soft		SPT-12	16.5 - 18.0	1.0	2-1-1	17	
				SPT-13	18.0 - 19.5	1.5	1-2-1	33	
453.9'	21.0'			SPT-14	19.5 - 21.0	1.5	1-1-1	48	
		LEAN CLAY, reddish brown to grayish brown, wet, very soft, trace fine to coarse gravel		SPT-15	21.0 - 22.5	1.5	1-1-1	28	
				SPT-16	22.5 - 24.0	1.1	1-1-1	24	
449.4'	25.5'			SPT-17	24.0 - 24.7	0.5	2-50/0.2'	25	
		FAT CLAY, brown, moist, stiff to very stiff, trace medium sand		SPT-18	25.5 - 27.0	0.7	2-3-8	20	Boring backfilled with bentonite grout from 0.0 to 29.1 ft.
				SPT-19	27.0 - 28.5	0.8	2-15-16	27	
446.3'	28.6'			SPT-20	28.5 - 28.6	0.1	50/0.1'	9	
445.8'	29.1'	Limestone, highly weathered (augered)							

Auger Refusal /
Bottom of Hole

Top of Rock = 28.6'
Elevation (446.3')

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SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 704870.32, E 1877862.37 (NAD27)		
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-10S**	Total Depth	27.0 ft
Location	Sumner County, Tennessee	Surface Elevation	474.9 ft. (NGVD29)		
Project Type	Geotechnical Exploration	Date Started	8/6/09	Completed	8/6/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	N/A	Date/Time	N/A
Logged By	D. Chapman	Automatic Hammer ☒	Safety Hammer ☐	Other ☐	

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
474.9'	0.0'	Top of Hole							
		Refer to STN-E-10 for descriptions of overburden soils.							Boring advanced with 4.25" hollow stem auger.
				ST-1	2.0 - 4.0	0.0		--	
				ST-2	5.0 - 7.0	2.0		18	
				ST-3	8.0 - 10.0	0.0		–	
				ST-4	17.0 - 19.0	1.5		54	
				ST-5	21.0 - 23.0	1.8		32	Boring backfilled with bentonite grout from 0.0 to 27.0 ft.
				ST-6	25.0 - 27.0	2.0		26	
447.9'	27.0'	No Refusal / Bottom of Hole							

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SUBSURFACE LOG

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Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Huntoon
Logged By D. Chapman

Location N 704863.37, E 1877828.40 (NAD27)
Boring No. **STN-E-11** Total Depth 40.5 ft
Surface Elevation 476.1 ft. (NGVD29)
Date Started 8/7/09 Completed 8/7/09
Depth to Water 30.0 ft Date/Time 8/7/09
Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
476.1'	0.0'	Top of Hole							
		SANDY LEAN CLAY with Gravel (Pond E Dike), orange brown, moist, stiff to very stiff, trace medium sand to fine gravel		SPT-1	0.0 - 1.5	0.8	6-5-5	18	Boring advanced using 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.3	8-10-12	13	
				SPT-3	3.0 - 4.5	1.4	8-11-9	15	
				SPT-4	4.5 - 6.0	1.3	7-8-12	22	
				SPT-5	6.0 - 7.5	1.3	3-8-8	22	
				SPT-6	7.5 - 9.0	0.8	3-7-10	17	
				SPT-7	9.0 - 10.5	1.2	3-6-10	20	Bulk Sample #1 obtained from 9.0 to 12.0 ft.
				SPT-8	10.5 - 12.0	1.0	5-7-12	19	
463.1'	13.0'			SPT-9	12.0 - 13.5	1.3	5-13-18	21	
		BOTTOM ASH (Pond E Dike), dark gray, moist, dense		SPT-10	13.5 - 15.0	1.0	6-16-19	19	
459.6'	16.5'			SPT-11	15.0 - 16.5	0.4	50/0.4'	15	
		LEAN CLAY, brownish yellow to dark orange brown, moist to wet, medium stiff to stiff, trace fine gravel		SPT-12	16.5 - 18.0	1.5	4-5-5	18	
				SPT-13	18.0 - 19.5	0.7	4-4-5	18	
				SPT-14	19.5 - 21.0	1.0	3-4-5	16	
				SPT-15	21.0 - 22.5	0.8	3-3-4	19	
				SPT-16	22.5 - 24.0	1.0	4-6-5	26	
450.6'	25.5'			SPT-17	24.0 - 25.5	0.8	3-3-3	34	
		FAT CLAY, yellowish brown and orange brown, moist, medium to very stiff, trace medium sand		SPT-18	25.5 - 27.0	1.5	6-8-10	36	
				SPT-19	27.0 - 28.5	1.5	4-5-5	40	
				SPT-20	28.5 - 30.0	1.5	3-6-6	34	
				SPT-21	30.0 - 31.5	1.1	3-5-5	42	
				SPT-22	31.5 - 33.0	1.0	3-5-8	31	
				SPT-23	33.0 - 34.5	1.4	3-5-7	34	
				SPT-24	34.5 - 36.0	1.2	3-3-4	32	
				SPT-25	36.0 - 37.5	1.5	3-5-6	35	Boring backfilled with benotnite grout from 0.0 to 40.5 ft.
				SPT-26	37.5 - 39.0	1.5	4-7-10	39	
				SPT-27	39.0 - 40.5	1.5	3-2-2	29	
435.6'	40.5'			SPT-28	40.5 - 40.5	0.0	50/0.0'	--	

Auger Refusal /
Bottom of Hole

Top of Rock = 40.5'
Elevation (435.6')

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SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 704854.47, E 1877754.46 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-12** Total Depth 28.3 ft
Location	Sumner County, Tennessee	Surface Elevation	455.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/21/09 Completed 8/22/09
Supervisor	Paul Cooper Driller J. Bowerman	Depth to Water	10.0 ft Date/Time 8/21/09
Logged By	Scott Lange	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
455.3'	0.0'	Top of Hole							
		LEAN CLAY, grayish brown, moist to wet, medium stiff		SPT-1	0.0 - 1.5	1.0	3-3-4	21	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.5	2-3-4	21	
				SPT-3	3.0 - 4.5	1.5	3-4-4	22	
448.8'	6.5'			ST-1	4.5 - 6.5	2.0		21	Piezometer installed (see PZ detail sheet).
		SANDY LEAN CLAY, yellowish brown mottled black, moist to wet, medium to very stiff, trace medium sand to fine gravel		SPT-4	6.5 - 8.0	1.0	5-7-10	24	
				SPT-5	8.0 - 9.5	1.3	6-9-12	24	
				ST-2	9.5 - 11.5	2.0		23	
				SPT-6	11.5 - 13.0	1.0	7-10-12	22	
				SPT-7	13.0 - 14.5	1.3	3-6-9	23	
				SPT-8	14.5 - 16.0	1.3	2-5-9	24	
				SPT-9	16.0 - 17.5	1.3	3-5-6	35	
				SPT-10	17.5 - 19.0	1.3	8-50/0.5'	37	Apparent cobble/boulder at 18.0 to 18.5 ft.
				SPT-11	19.0 - 20.5	1.0	2-3-5	34	
				SPT-12	20.5 - 22.0	1.5	3-3-4	30	
				SPT-13	22.0 - 23.5	0.0	6-7-6	–	
				SPT-14	23.5 - 25.0	1.3	4-4-4	32	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 28.3 ft.
				SPT-15	25.0 - 26.5	1.3	3-4-4	28	
				SPT-16	26.5 - 28.0	1.3	2-3-3	38	
427.0'	28.3'			SPT-17	28.0 - 28.3	0.3	50/0.3'	32	

Auger Refusal /
Bottom of Hole

Top of Rock = 28.3'
Elevation (427.0')

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SUBSURFACE LOG

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Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Huntoon
Logged By D. Chapman

Location N 706353.41, E 1877474.21 (NAD27)
Boring No. **STN-E-13** Total Depth 37.1 ft
Surface Elevation 474.3 ft. (NGVD29)
Date Started 8/6/09 Completed 8/6/09
Depth to Water 33.0 ft Date/Time 8/6/09
Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
474.3'	0.0'	Top of Hole							
		FAT CLAY with Sand (Pond E Dike), reddish brown to yellowish brown, moist, soft to very stiff, trace fine gravel		SPT-1	0.0 - 1.5	0.3	3-2-2	19	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.5	15-12-18	14	
				SPT-3	3.0 - 4.5	1.0	14-39-17	16	
				SPT-4	4.5 - 6.0	0.3	5-7-9	21	
				SPT-5	6.0 - 7.5	1.2	5-6-11	20	
464.8'	9.5'			SPT-6	7.5 - 9.0	0.3	2-3-9	20	
		BOTTOM ASH (Pond E Dike), dark gray, moist, dense to very dense		SPT-7	9.0 - 10.5	1.0	9-13-21	13	Bulk Sample #1 obtained from 10.0 to 13.0 ft.
				SPT-8	10.5 - 12.0	1.5	22-39-38	15	
461.8'	12.5'			SPT-9	12.0 - 13.5	1.3	8-23-30	16	
		FAT CLAY, orange brown to yellowish brown, moist to wet, very soft to very stiff, trace fine gravel		SPT-10	13.5 - 15.0	1.0	9-5-5	21	
				SPT-11	15.0 - 16.5	1.0	6-6-7	22	
				SPT-12	16.5 - 18.0	1.2	2-4-7	33	
				SPT-13	18.0 - 19.5	1.5	2-3-8	32	
				SPT-14	19.5 - 21.0	1.3	3-6-7	28	
				SPT-15	21.0 - 22.5	1.5	4-5-10	24	Bulk Sample #2 obtained from 22.0 to 25.0 ft.
				SPT-16	22.5 - 24.0	1.4	4-5-11	31	
				SPT-17	24.0 - 25.5	1.1	2-3-10	28	
				SPT-18	25.5 - 27.0	1.5	3-4-5	32	
				SPT-19	27.0 - 28.5	0.9	2-3-6	29	
				SPT-20	28.5 - 30.0	1.2	2-2-5	24	
				SPT-21	30.0 - 31.5	1.5	2-2-5	42	
				SPT-22	31.5 - 33.0	0.4	3-9-50/0.3'	24	
				SPT-23	33.0 - 34.5	0.1	50/0.2'	9	Boring backfilled with bentonite grout from 0.0 to 37.1 ft.
				SPT-24	34.5 - 36.0	1.1	1-1-1	35	
437.2'	37.1'			SPT-25	36.0 - 36.6	0.1	7-50/0.1'	13	

Auger Refusal /
Bottom of Hole

Top of Rock = 37.1'
Elevation (437.2')

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SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 706353.41, E 1877474.21 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-13S** Total Depth 34.0 ft
Location	Sumner County, Tennessee	Surface Elevation	474.3 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/6/09 Completed 8/6/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	N/A Date/Time N/A
Logged By	D. Chapman	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
474.3'	0.0'	Top of Hole							
		Refer to STN-E-13 for descriptions of overburden soils.							Boring advanced with 4.25" hollow stem auger.
				ST-1	2.0 - 4.0	0.0		–	
				ST-2	5.0 - 7.0	1.5		17	
				ST-3	10.0 - 12.0	0.0		–	
				ST-4	15.0 - 17.0	1.5		31	
				ST-5	20.0 - 22.0	2.0		31	
				ST-6	25.0 - 27.0	2.0		26	
				ST-7	30.0 - 32.0	1.5		34	Boring backfilled with bentonite grout from 0.0 to 34.0 ft.
440.3'	34.0'								

Auger Refusal /
Bottom of Hole

Top of Rock = 34.0'
Elevation (440.3')

FMSM LEGACY 175559018 BORINGS.GPJ FMSM.GDT 2/23/10

2/23/10

SUBSURFACE LOG

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Project No.	175559018	Location	N 706343.79, E 1877425.50 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-14** Total Depth 40.5 ft
Location	Sumner County, Tennessee	Surface Elevation	477.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/7/09 Completed 8/7/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	39.0 ft Date/Time 8/7/09
Logged By	D. Chapman	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
477.0'	0.0'	Top of Hole							
		LEAN CLAY with Sand (Pond E Dike), orange brown, moist, stiff to very stiff, trace medium sand to fine gravel		SPT-1	0.0 - 1.5	1.5	4-6-5	22	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.0	4-7-8	16	
				SPT-3	3.0 - 4.5	0.8	8-8-11	20	
				SPT-4	4.5 - 6.0	0.8	3-5-5	17	Bulk Sample #1 obtained from 5.0 to 8.0 ft.
				SPT-5	6.0 - 7.5	1.5	2-4-6	18	
				SPT-6	7.5 - 9.0	1.3	3-5-6	24	
				SPT-7	9.0 - 10.5	1.4	2-4-5	20	Piezometer Installed (see PZ detail sheet).
466.0'	11.0'			SPT-8	10.5 - 12.0	1.3	17-21-19	13	
464.0'	13.0'	BOTTOM ASH (Pond E Dike), black, moist, medium dense to dense		SPT-9	12.0 - 13.5	1.2	8-10-13	16	
				SPT-10	13.5 - 15.0	1.5	4-3-5	20	
		FAT CLAY with Sand, orange brown to yellowish brown, moist to wet, soft to very stiff, trace fine gravel		SPT-11	15.0 - 16.5	0.9	3-3-4	18	
				SPT-12	16.5 - 18.0	0.8	4-6-8	19	
				SPT-13	18.0 - 19.5	1.0	4-5-10	22	
				SPT-14	19.5 - 21.0	1.0	4-7-12	22	
				SPT-15	21.0 - 22.5	1.5	6-7-5	20	
				SPT-16	22.5 - 24.0	1.3	2-3-8	22	Bulk Sample #2 obtained from 23.0 to 26.0 ft.
				SPT-17	24.0 - 25.5	1.5	4-5-8	26	
				SPT-18	25.5 - 27.0	1.5	4-6-7	25	
				SPT-19	27.0 - 28.5	0.5	2-4-7	24	
				SPT-20	28.5 - 30.0	1.5	2-4-9	25	
				SPT-21	30.0 - 31.5	1.5	2-4-10	26	
				SPT-22	31.5 - 33.0	1.4	3-3-8	25	
				SPT-23	33.0 - 34.5	1.5	5-8-8	29	
				SPT-24	34.5 - 36.0	1.2	2-4-10	27	
				SPT-25	36.0 - 37.5	1.5	6-4-4	22	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 40.5 ft.
				SPT-26	37.5 - 39.0	1.5	1-2-2	17	
436.5'	40.5'			SPT-27	39.0 - 40.5	0.7	1-1-33	30	

Auger Refusal /
Bottom of Hole

Top of Rock = 40.5'
Elevation (436.5')

SUBSURFACE LOG

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Project No. 175559018

Location N 706343.79, E 1877425.50 (NAD27)

Project Name Gallatin Fossil Plant - TVA

Boring No. **STN-E-14S** Total Depth 7.0 ft

Location Sumner County, Tennessee

Surface Elevation 477.0 ft. (NGVD29)

Project Type Geotechnical Exploration

Date Started 8/8/09 Completed 8/8/09

Supervisor Paul Cooper Driller J. Huntoon

Depth to Water N/A Date/Time N/A

Logged By D. Chapman

Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
477.0'	0.0'	Top of Hole							
		Refer to STN-E-14 for descriptions of overburden soils.		ST-1	2.0 - 4.0	2.0		18	Boring advanced with 4.25" hollow stem auger. Boring backfilled with auger cuttings.
470.0'	7.0'			ST-2	5.0 - 7.0	2.0		18	

No Refusal /
Bottom of Hole

Stantec

SUBSURFACE LOG

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Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller J. Bowerman

Logged By Scott Lange

Location N 706458.09, E 1877364.00 (NAD27)

Boring No. **STN-E-15** Total Depth 27.0 ft

Surface Elevation 463.4 ft. (NGVD29)

Date Started 8/22/09 Completed 8/22/09

Depth to Water 25.0 ft Date/Time 8/22/09

Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
463.4'	0.0'	Top of Hole							
		LEAN CLAY, orange brown, moist, stiff to very stiff, silty, trace fine gravel		SPT-1	0.0 - 1.5	1.0	4-5-7	18	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.0	5-5-5	18	
				SPT-3	3.0 - 4.5	0.5	7-7-9	18	
456.9'	6.5'			ST-1	4.5 - 6.5	2.0		24	
		FAT CLAY with Sand, orange brown and yellowish brown, moist to wet, soft to stiff, trace fine gravel		SPT-4	6.5 - 8.0	1.3	4-5-7	25	
				SPT-5	8.0 - 9.5	1.3	3-5-7	25	
				ST-2	9.5 - 11.5	2.0		23	
				SPT-6	11.5 - 13.0	1.3	5-6-8	16	
				SPT-7	13.0 - 14.5	1.5	5-6-8	27	
				SPT-8	14.5 - 16.0	1.3	2-4-6	32	
				SPT-9	16.0 - 17.5	1.3	3-4-6	29	
				SPT-10	17.5 - 19.0	1.0	1-4-6	30	
				SPT-11	19.0 - 20.5	1.0	3-6-7	22	
				SPT-12	20.5 - 22.0	1.0	3-4-4	26	
				SPT-13	22.0 - 23.5	1.0	2-4-4	29	Boring backfilled with bentonite grout from 0.0 to 27.0 ft.
				SPT-14	23.5 - 25.0	0.5	1-1-3	30	
				SPT-15	25.0 - 26.5	1.0	1-2-3	33	
436.4'	27.0'			SPT-16	26.5 - 27.0	0.5	50/0.5'	15	

Auger Refusal /
Bottom of Hole

Top of Rock = 27.0'
Elevation (436.4')

SUBSURFACE LOG

Project No.	175559018	Location	N 70710[illegible].38, E 1877842.04 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-16** Total Depth 59.0 ft
Location	Sumner County, Tennessee	Surface Elevation	474.5 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/8/09 Completed 8/8/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	23.0 ft Date/Time 8/8/09
Logged By	D. Chapman	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology		Description	Overburden Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core RQD	Run	Rec. Ft.	Rec. %	Run Depth	
474.5'	0.0'	Top of Hole						
		BOTTOM ASH (Pond E Dike), dark gray, moist, medium dense to very dense	SPT-1	0.0 - 1.5	1.3	8-11-14	16	Boring advanced with 4.25" hollow stem auger.
			SPT-2	1.5 - 3.0	1.5	24-34-38	23	
470.5'	4.0'		SPT-3	3.0 - 4.5	1.3	17-21-18	21	
		FAT CLAY (Pond E Dike), orange brown, moist, stiff to very stiff, trace fine to medium sand	SPT-4	4.5 - 6.0	0.6	3-7-8	16	
			SPT-5	6.0 - 7.5	1.2	7-12-9	19	
			SPT-6	7.5 - 9.0	1.3	5-5-5	18	
			SPT-7	9.0 - 10.5	1.1	3-4-10	20	Bulk Sample #1 obtained from 10.0 to 13.0 ft.
463.5'	11.0'		SPT-8	10.5 - 12.0	1.0	8-31-34	13	
		BOTTOM ASH, dark gray, moist to wet, medium dense to very dense, some fly ash between 15.0 ft. to 24.0 ft.	SPT-9	12.0 - 13.5	1.2	13-18-21	14	
			SPT-10	13.5 - 15.0	1.1	19-15-13	14	
			SPT-11	15.0 - 16.5	0.6	13-21-22	31	
			SPT-12	16.5 - 18.0	0.7	9-11-12	29	
			SPT-13	18.0 - 19.5	1.0	7-9-8	33	
			SPT-14	19.5 - 21.0	0.8	5-11-16	38	
			SPT-15	21.0 - 22.5	1.0	8-11-15	30	
			SPT-16	22.5 - 24.0	0.9	7-11-13	34	
			SPT-17	24.0 - 25.5	1.2	7-9-9	22	Bulk Sample #2 obtained from 24.0 to 27.0 ft.
			SPT-18	25.5 - 27.0	1.1	4-8-11	22	
446.0'	28.5'		SPT-19	27.0 - 28.5	1.2	8-3-1	22	
		LEAN CLAY and FLY ASH, dark gray and orange brown, wet, very soft	SPT-20	28.5 - 30.0	0.2	WOH-WOH-1	42	
			SPT-21	30.0 - 31.5	0.9	WOH-WOH-WOH	41	
441.5'	33.0'		SPT-22	31.5 - 33.0	1.3	1-1-1	28	
		FAT CLAY, yellowish brown to reddish brown, wet, very soft to very stiff, trace medium sand to fine gravel	SPT-23	33.0 - 34.5	1.3	1-2-2	22	
			SPT-24	34.5 - 36.0	0.8	WOH-WOH-WOH	22	
			SPT-25	36.0 - 37.5	1.2	1-1-2	24	
			SPT-26	37.5 - 39.0	0.8	1-3-4	24	
			SPT-27	39.0 - 40.5	1.0	1-4-7	20	
			SPT-28	40.5 - 42.0	0.9	5-6-8	22	
			SPT-29	42.0 - 43.5	1.4	1-1-1	22	

Project No.	175559018	Location	N 707101.38, E 1877842.04 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-16** Total Depth 59.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		FAT CLAY, yellowish brown to reddish brown, wet, very soft to very stiff, trace medium sand to fine gravel *(Continued)*		SPT-30	43.5 - 45.0	0.3	3-3-4	25	
				SPT-31	45.0 - 46.5	1.0	3-4-6	27	
				SPT-32	46.5 - 48.0	1.5	5-5-4	25	
				SPT-33	48.0 - 49.5	1.1	6-7-12	29	
				SPT-34	49.5 - 51.0	1.0	4-6-10	28	
				SPT-35	51.0 - 52.5	1.2	3-3-4	28	
				SPT-36	52.5 - 54.0	1.0	4-5-6	32	
				SPT-37	54.0 - 55.5	1.0	1-1-2	34	Boring backfilled with bentonite grout from 0.0 to 59.0 ft.
				SPT-38	55.5 - 57.0	1.5	1-2-2	31	
				SPT-39	57.0 - 58.0	0.5	3-50/0.5'	38	
415.5'	59.0'								

Auger Refusal /
Bottom of Hole

Top of Rock = 59.0'
Elevation (415.5')

SUBSURFACE LOG

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Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Huntoon
Logged By D. Chapman

Location N 707101.38, E 1877842.04 (NAD27)
Boring No. **STN-E-16S** Total Depth 56.0 ft
Surface Elevation 474.5 ft. (NGVD29)
Date Started 8/8/09 Completed 8/9/09
Depth to Water N/A Date/Time N/A
Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
474.5'	0.0'	Top of Hole							
		Refer to STN-E-16 for descriptions of overburden soils.							Boring advanced with 4.25" hollow stem auger.
				ST-1	5.0 - 7.0	1.5		30	
				ST-2	7.0 - 9.0	1.0		28	
				ST-3	9.0 - 11.0	2.0		21	
				ST-4	29.0 - 31.0	0.0		--	
				ST-5	31.0 - 33.0	1.3		23	
				ST-6	33.0 - 35.0	2.0		24	
				ST-7	36.0 - 38.0	2.0		25	
				ST-8	40.0 - 42.0	2.0		23	

Project No.	175559018	Location	N 707101.38, E 1877842.04 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-16S** Total Depth 56.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		Refer to STN-E-16 for descriptions of overburden soils. *(Continued)*		ST-9	44.0 - 46.0	2.0		23	
				ST-10	48.0 - 50.0	2.0		23	
				ST-11	52.0 - 54.0	2.0		24	Boring backfilled with bentonite grout from 0.0 to 56.0 ft.
418.5'	56.0'			ST-12	54.0 - 56.0	2.0		30	
		No Refusal / Bottom of Hole							

SUBSURFACE LOG

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Project No. 175559018
Project Name Gallatin Fossil Plant - TVA
Location Sumner County, Tennessee
Project Type Geotechnical Exploration
Supervisor Paul Cooper Driller J. Huntoon
Logged By D. Chapman

Location N 707146.54, E 1877811.85 (NAD27)
Boring No. **STN-E-17** Total Depth 39.1 ft
Surface Elevation 475.4 ft. (NGVD29)
Date Started 8/9/09 Completed 8/9/09
Depth to Water 19.5 ft Date/Time 8/9/09
Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology		Description	Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth		Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
475.4'	0.0'	Top of Hole							
474.9'	0.5'	LEAN CLAY, reddish brown, moist, stiff		SPT-1	0.0 - 1.5	1.3	4-6-6	20	Boring advanced with 4.25" hollow stem auger.
		BOTTOM ASH (Pond E Dike), dark gray, moist, medium dense		SPT-2	1.5 - 3.0	1.0	6-7-10	20	
471.9'	3.5'			SPT-3	3.0 - 4.5	1.1	4-5-6	26	
		LEAN CLAY with Sand (Pond E Dike), reddish brown, moist, stiff to very stiff		SPT-4	4.5 - 6.0	1.2	7-8-11	20	
				SPT-5	6.0 - 7.5	1.0	3-8-8	20	
				SPT-6	7.5 - 9.0	1.4	5-8-13	20	
465.6'	9.8'			SPT-7	9.0 - 10.5	1.3	5-12-18	17	Bulk Sample #1 obtained from 10.0 to 13.0 ft.
		BOTTOM ASH, dark gray, moist to wet, loose to dense		SPT-8	10.5 - 12.0	1.3	7-17-19	15	
				SPT-9	12.0 - 13.5	1.1	6-13-15	15	
				SPT-10	13.5 - 15.0	1.3	6-16-17	17	
				SPT-11	15.0 - 16.5	1.4	7-17-15	25	
				SPT-12	16.5 - 18.0	1.0	5-12-13	33	
				SPT-13	18.0 - 19.5	1.2	3-5-9	40	
				SPT-14	19.5 - 21.0	0.9	7-9-12	28	
				SPT-15	21.0 - 22.5	1.0	7-12-12	28	
				SPT-16	22.5 - 24.0	0.8	3-7-7	25	
				SPT-17	24.0 - 25.5	1.2	6-6-13	21	Bulk Sample #2 obtained from 25.0 to 27.0 ft.
				SPT-18	25.5 - 27.0	1.0	8-9-10	25	
				SPT-19	27.0 - 28.5	1.9	4-9-9	19	
		-some fly ash below 28.0'		SPT-20	28.5 - 30.0	0.5	1-4-5	25	
443.9'	31.5'			SPT-21	30.0 - 31.5	1.3	4-6-6	22	
		LEAN CLAY and FLY ASH, orange brown and dark gray, wet, very soft to soft		SPT-22	31.5 - 33.0	1.0	2-1-1	38	
440.9'	34.5'			SPT-23	33.0 - 34.5	1.1	2-2-2	28	
		FAT CLAY, orange brown, wet, stiff, trace medium sand to fine gravel		SPT-24	34.5 - 36.0	1.2	3-5-6	28	Boring backfilled with bentonite grout from 0.0 to 39.1 ft.
				SPT-25	36.0 - 37.5	0.9	3-4-12	32	
				SPT-26	37.5 - 39.0	0.8	3-50/0.2'	33	
436.3'	39.1'			SPT-27	39.0 - 39.1	0.0	50/0.1'	--	
		Auger Refusal / Bottom of Hole Top of Rock = 39.1' Elevation (436.3')							

SUBSURFACE LOG

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller S. Bradford

Logged By C. Wood

Location N 707190.77, E 1877765.92 (NAD27)

Boring No. **STN-E-18** Total Depth 40.0 ft

Surface Elevation 461.6 ft. (NGVD29)

Date Started 8/10/09 Completed 8/10/09

Depth to Water 6.5 ft Date/Time 8/10/09

Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	Remarks
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	
461.6'	0.0'	Top of Hole							
		BOTTOM ASH (Stilling Pond Dike), dark brown to black, moist to wet, very loose to very dense		SPT-1	0.0 - 1.5	0.8	8-13-15	8	Boring advanced with 4.25" hollow stem auger.
				SPT-2	1.5 - 3.0	0.9	31-52-41	11	
				SPT-3	3.0 - 4.5	1.0	29-23-14	10	
				SPT-4	4.5 - 6.0	1.0	5-6-6	13	Piezometer installed (see PZ detail sheet).
				SPT-5	6.0 - 7.5	0.8	5-6-7	11	
				SPT-6	7.5 - 9.0	0.9	4-4-4	11	
				SPT-7	9.0 - 10.5	0.7	3-3-3	12	
				SPT-8	10.5 - 12.0	0.6	2-3-2	10	
				SPT-9	12.0 - 13.5	0.6	3-2-3	8	
				SPT-10	13.5 - 15.0	1.0	3-2-2	11	
				SPT-11	15.0 - 16.5	1.1	1-2-2	12	
				SPT-12	16.5 - 18.0	0.8	2-2-2	11	
442.6'	19.0'			SPT-13	18.0 - 19.5	0.8	1-1-2	33	
		LEAN CLAY and FLY ASH, dark gray, wet, soft		SPT-14	19.5 - 21.0	0.2	1-1-2	31	
439.6'	22.0'			SPT-15	21.0 - 22.5	0.9	1-1-3	22	
		LEAN CLAY, orange brown, wet, medium to very stiff, silty, trace fine sand to fine gravel		SPT-16	22.5 - 24.0	0.3	2-2-3	23	
				SPT-17	24.0 - 25.5	1.5	2-3-3	25	
				SPT-18	25.5 - 27.0	1.2	2-3-3	24	
				SPT-19	27.0 - 28.5	0.8	2-4-5	25	
				SPT-20	28.5 - 30.0	1.0	5-8-10	26	

SUBSURFACE LOG

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location N 707190.77, E 1877765.92 (NAD27)

Boring No. **STN-E-18** Total Depth 40.0 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		LEAN CLAY, orange brown, wet, medium to very stiff, silty, trace fine sand to fine gravel *(Continued)*		SPT-21	30.0 - 31.5	1.5	5-6-7	25	
				SPT-22	31.5 - 33.0	1.5	5-6-8	27	
				SPT-23	33.0 - 34.5	1.0	6-9-10	29	
				SPT-24	34.5 - 36.0	1.5	5-6-7	27	
425.5'	36.1'			SPT-25	36.0 - 36.1	0.1	50/0.1'	27	Began Core
421.6'	40.0'	Limestone, light gray to light brown, coarsely crystalline to medium, hard, thin bedded, some bedding zone fractures		49%	3.9	3.0	77	40.0	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 40.0 ft.

Bottom of Hole

Top of Rock = 36.1'
Elevation (425.5')

SUBSURFACE LOG

Page: 1 of 2

Project No.	175559018	Location	N 706774.43, E 1878687.08 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-19** Total Depth 44.7 ft
Location	Sumner County, Tennessee	Surface Elevation	472.8 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/6/09 Completed 8/6/09
Supervisor	Paul Cooper Driller J. Wethington	Depth to Water	14.0 ft Date/Time 8/6/09
Logged By	Craig Millhollin	Automatic Hammer ☐	Safety Hammer ☒ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
472.8'	0.0'	Top of Hole							
		BOTTOM ASH (Pond E Dike), light gray, dry, dense to very dense		SPT-1	0.0 - 1.5	1.2	7-15-16	19	Boring advanced with 3.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.2	15-24-43	22	
469.3'	3.5'	FAT CLAY with Sand (Pond E Dike), tan and orange brown, moist, very stiff, trace fine gravel		SPT-3	3.0 - 4.5	1.3	7-7-10	19	
				SPT-4	4.5 - 6.0	1.3	5-7-10	20	
				SPT-5	6.0 - 7.5	1.1	7-20-24	28	
				SPT-6	7.5 - 9.0	1.0	8-15-24	19	Bulk Sample #1 obtained from 8.0 to 11.0 ft.
463.1'	9.7'			SPT-7	9.0 - 10.5	1.5	9-23-40	17	
		BOTTOM ASH, gray, moist, medium to very dense, some fly ash		SPT-8	10.5 - 12.0	1.2	18-40-34	19	
				SPT-9	12.0 - 13.5	1.0	30-42-50	14	Bulk Sample #2 obtained from 13.0 to 14.0 ft.
		-Apparent cobble/boulder from 13.5' to 14.0'.		SPT-10	13.5 - 14.0	0.2	50/0.5'	15	
				SPT-11	14.0 - 15.5	1.3	13-12-18	27	
				SPT-12	15.5 - 17.0	1.4	13-18-16	22	
				SPT-13	17.0 - 18.5	1.3	13-16-14	26	
454.3'	18.5'	FLY ASH, black, wet, medium stiff, some bottom ash below 21'		SPT-14	18.5 - 20.0	1.4	4-2-5	30	
				SPT-15	20.0 - 21.5	1.4	4-2-6	35	
				SPT-16	21.5 - 23.0	1.0	2-3-3	30	
				SPT-17	23.0 - 24.5	1.2	4-3-2	33	
447.3'	25.5'			SPT-18	24.5 - 26.0	1.5	4-3-2	37	
		FAT CLAY, reddish brown, wet, soft to very stiff, trace medium sand to fine gravel		SPT-19	26.0 - 27.5	1.5	1-1-2	22	
				SPT-20	27.5 - 29.0	1.0	1-1-2	22	
				SPT-21	29.0 - 30.5	1.2	1-1-2	20	

Project No.	175559018	Location	N 706774.43, E 1878687.08 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-19** Total Depth 44.7 ft

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
		FAT CLAY, reddish brown, wet, soft to very stiff, trace medium sand to fine gravel *(Continued)*		SPT-22	30.5 - 32.0	1.0	2-2-3	20	
				SPT-23	32.0 - 33.5	1.3	3-4-5	26	
				SPT-24	33.5 - 35.0	1.5	3-6-6	29	
				SPT-25	35.0 - 36.5	1.0	6-10-8	33	
				SPT-26	36.5 - 38.0	1.5	6-12-18	24	
				SPT-27	38.0 - 39.5	1.5	3-5-8	25	
				SPT-28	39.5 - 41.0	1.2	5-8-10	25	
				SPT-29	41.0 - 42.5	1.5	4-8-10	32	
				SPT-30	42.5 - 44.0	1.3	8-11-15	28	Boring backfilled with bentonite grout from 0.0 to 44.7 ft.
428.1'	44.7'			SPT-31	44.0 - 44.5	0.5	50/0.5'	34	

Auger Refusal /
Bottom of Hole

Top of Rock = 44.7'
Elevation (428.1')

SUBSURFACE LOG

Project No.	175559018	Location	N 706856.53, E 1878704.54 (NAD27)
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-20** Total Depth 28.5 ft
Location	Sumner County, Tennessee	Surface Elevation	476.0 ft. (NGVD29)
Project Type	Geotechnical Exploration	Date Started	8/10/09 Completed 8/10/09
Supervisor	Paul Cooper Driller J. Huntoon	Depth to Water	15.0 ft Date/Time 8/10/09
Logged By	D. Chapman	Automatic Hammer ☒	Safety Hammer ☐ Other ☐

Lithology Elevation	Lithology Depth	Description	Overburden / Rock Core	Sample # / RQD	Depth / Run	Rec. Ft. / Rec. Ft.	Blows / Rec. %	Mois.Cont. % / Run Depth	Remarks
476.0'	0.0'	Top of Hole							
		BOTTOM ASH (Pond E Dike), dark gray, moist, medium dense to dense		SPT-1	0.0 - 1.5	0.8	6-8-8	9	Boring advanced with 4.25" hollow stem auger.
472.3'	3.7'			SPT-2	1.5 - 3.0	1.0	8-17-18	16	
		FAT CLAY with Sand (Pond E Dike), orange brown, moist, medium stiff to stiff, trace fine gravel		SPT-3	3.0 - 4.5	1.2	15-16-8	27	Piezometer installed (see PZ detail sheet).
				SPT-4	4.5 - 6.0	0.5	5-5-6	22	
				SPT-5	6.0 - 7.5	1.0	3-6-6	28	Bulk Sample #1 obtained from 7.0 to 10.0 ft.
				SPT-6	7.5 - 9.0	0.9	2-3-5	22	
466.0'	10.0'			SPT-7	9.0 - 10.5	1.2	2-7-4	22	
		BOTTOM ASH, dark gray to black, moist to wet, medium dense to dense		SPT-8	10.5 - 12.0	1.1	15-23-24	14	
				SPT-9	12.0 - 13.5	1.0	10-22-19	11	
				SPT-10	13.5 - 15.0	0.7	10-13-21	14	
				SPT-11	15.0 - 16.5	1.1	7-13-14	28	
		-some fly ash below 16.0'		SPT-12	16.5 - 18.0	0.9	9-8-8	13	
				SPT-13	18.0 - 19.5	0.7	3-9-14	31	Bulk Sample #2 obtained from 19.0 to 21.0 ft.
455.0'	21.0'			SPT-14	19.5 - 21.0	1.1	7-8-9	21	
		FLY ASH (sluiced), dark gray, wet, very soft		SPT-15	21.0 - 22.5	1.0	1-1-1	36	
				SPT-16	22.5 - 24.0	0.0	WOH-WOH-WOH	–	
450.5'	25.5'			SPT-17	24.0 - 25.5	0.0	WOH-WOH-WOH	–	Piezometer backfilled with sand, bentonite pellets, and bentonite grout from 0.0 to 28.5 ft.
450.2'	25.8'	SANDY FAT CLAY, reddish brown, wet, very soft, some fine to coarse gravel		SPT-18	25.5 - 25.8	0.3	50/0.3'	26	
				SPT-19	27.0 - 27.0	0.0	50/0.0'	–	
447.5'	28.5'			SPT-20	28.5 - 28.5	0.0	50/0.0'	–	

Limestone, highly weathered (augered)

Auger Refusal / Bottom of Hole

Top of Rock = 25.8'
Elevation (450.2')

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SUBSURFACE LOG

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller J. Huntoon

Logged By D. Chapman

Location N 706856.53, E 1878704.54 (NAD27)

Boring No. **STN-E-20S** Total Depth 25.0 ft

Surface Elevation 476.0 ft. (NGVD29)

Date Started 8/10/09 Completed 8/10/09

Depth to Water N/A Date/Time N/A

Automatic Hammer ☒ Safety Hammer ☐ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
476.0'	0.0'	Top of Hole							
		Refer to STN-E-20 for descriptions of overburden soils.							Boring advanced with 4.25" hollow stem auger.
				ST-1	4.0 - 6.0	1.5		22	
				ST-2	6.0 - 8.0	2.0		24	
				ST-3	21.0 - 23.0	0.0		–	Boring backfilled with bentonite grout from 0.0 to 25.0 ft.
451.0'	25.0'			ST-4	23.0 - 25.0	2.0		37	

No Refusal /
Bottom of Hole

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SUBSURFACE LOG

Page: 1 of 1

Project No.	175559018	Location	N 706883.00, E 1878751.72 (NAD27)		
Project Name	Gallatin Fossil Plant - TVA	Boring No.	**STN-E-21**	Total Depth	16.0 ft
Location	Sumner County, Tennessee	Surface Elevation	461.6 ft. (NGVD29)		
Project Type	Geotechnical Exploration	Date Started	8/5/09	Completed	8/5/09
Supervisor	Paul Cooper Driller J. Wethington	Depth to Water	5.0 ft	Date/Time	8/5/09
Logged By	Craig Millhollin	Automatic Hammer ☐	Safety Hammer ☒	Other ☐	

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
461.6'	0.0'	Top of Hole							
		SANDY LEAN CLAY (Pond E Dike), reddish brown to dark gray, moist, very stiff, trace fine gravel and some bottom ash		SPT-1	0.0 - 1.5	1.5	10-24-50	17	Boring advanced with 3.25" hollow stem auger.
				SPT-2	1.5 - 3.0	1.2	11-15-10	12	
				SPT-3	3.0 - 4.5	0.9	15-18-12	17	
456.6'	5.0'			SPT-4	4.5 - 6.0	0.1	4-5-5	19	
		BOTTOM ASH, black, wet, loose to medium dense, trace clay seams and some fly ash		SPT-5	6.0 - 7.5	0.5	5-9-7	18	
				SPT-6	7.5 - 9.0	1.5	6-5-3	18	
452.0'	9.6'			SPT-7	9.0 - 10.5	1.1	3-2-3	23	
		LEAN CLAY with Sand, reddish brown to tan, wet, soft to very stiff, trace fine gravel		SPT-8	10.5 - 12.0	1.2	1-1-2	27	
				SPT-9	12.0 - 13.5	1.3	6-6-7	27	Boring backfilled with bentonite grout fro 0.0 to 16.0 ft.
				SPT-10	13.5 - 15.0	1.3	9-12-13	27	
445.6'	16.0'			SPT-11	15.0 - 16.0	1.0	15-50/0.5'	24	

Auger Refusal /
Bottom of Hole

Top of Rock = 15.5'
Elevation (446.1')

SUBSURFACE LOG

Page: 1 of 1

Project No. 175559018

Project Name Gallatin Fossil Plant - TVA

Location Sumner County, Tennessee

Project Type Geotechnical Exploration

Supervisor Paul Cooper Driller J. Wethington

Logged By Craig Millhollin

Location N 706883.00, E 1878751.72 (NAD27)

Boring No. **STN-E-21S** Total Depth 15.0 ft

Surface Elevation 461.6 ft. (NGVD29)

Date Started 8/5/09 Completed 8/5/09

Depth to Water N/A Date/Time N/A

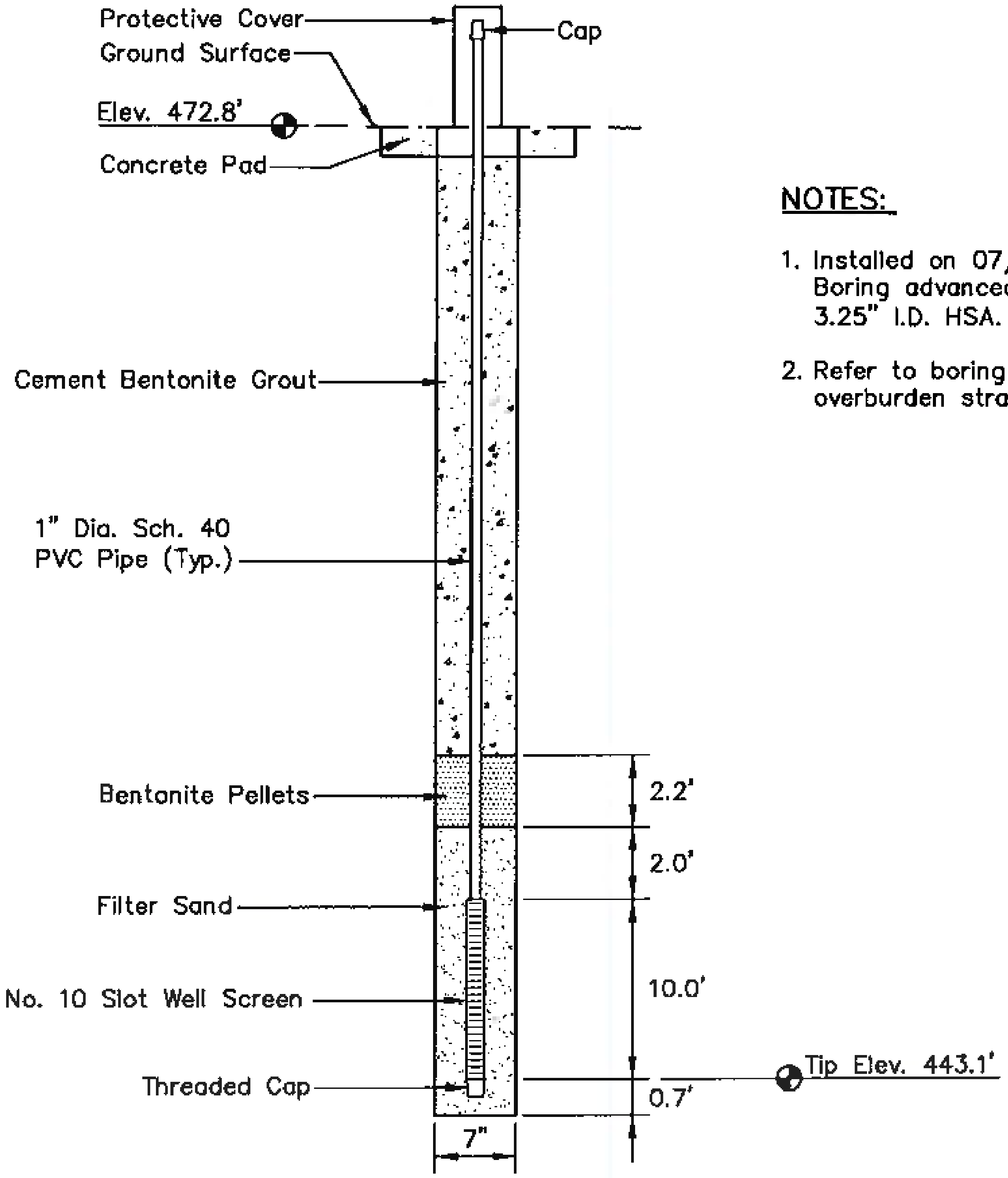
Automatic Hammer ☐ Safety Hammer ☒ Other ☐

Lithology			Overburden	Sample #	Depth	Rec. Ft.	Blows	Mois.Cont. %	
Elevation	Depth	Description	Rock Core	RQD	Run	Rec. Ft.	Rec. %	Run Depth	Remarks
461.6'	0.0'	Top of Hole							
		Refer to STN-E-21 for descriptions of overburden soils.							Boring advanced with 3.25" hollow stem auger.
				ST-1	5.0 - 7.0	1.0		22	
				ST-2	7.0 - 9.0	0.0		–	
				ST-3	9.0 - 11.0	0.0		–	
				ST-4	11.0 - 13.0	2.0		24	Boring backfilled with bentonite grout from 0.0 to 15.0 ft.
446.6'	15.0'			ST-5	13.0 - 15.0	1.3		33	

No Refusal /
Bottom of Hole

Appendix B

Piezometer Installation Details and Readings



NOTES:

1. Installed on 07/29/09. Boring advanced with 3.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 12/18/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\PZ_DETAILS\559018PZ-A-1.DWG

LOCATION

Northing: 707019.68
Easting: 1879799.57
Ground Elevation: 472.8

Locations to be provided by TVA,
Power Systems Operations,
Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-A-1
PIEZOMETER INSTALLATION DETAIL
GALLATIN FOSSIL PLANT
ASH POND / STILLING POND COMPLEX

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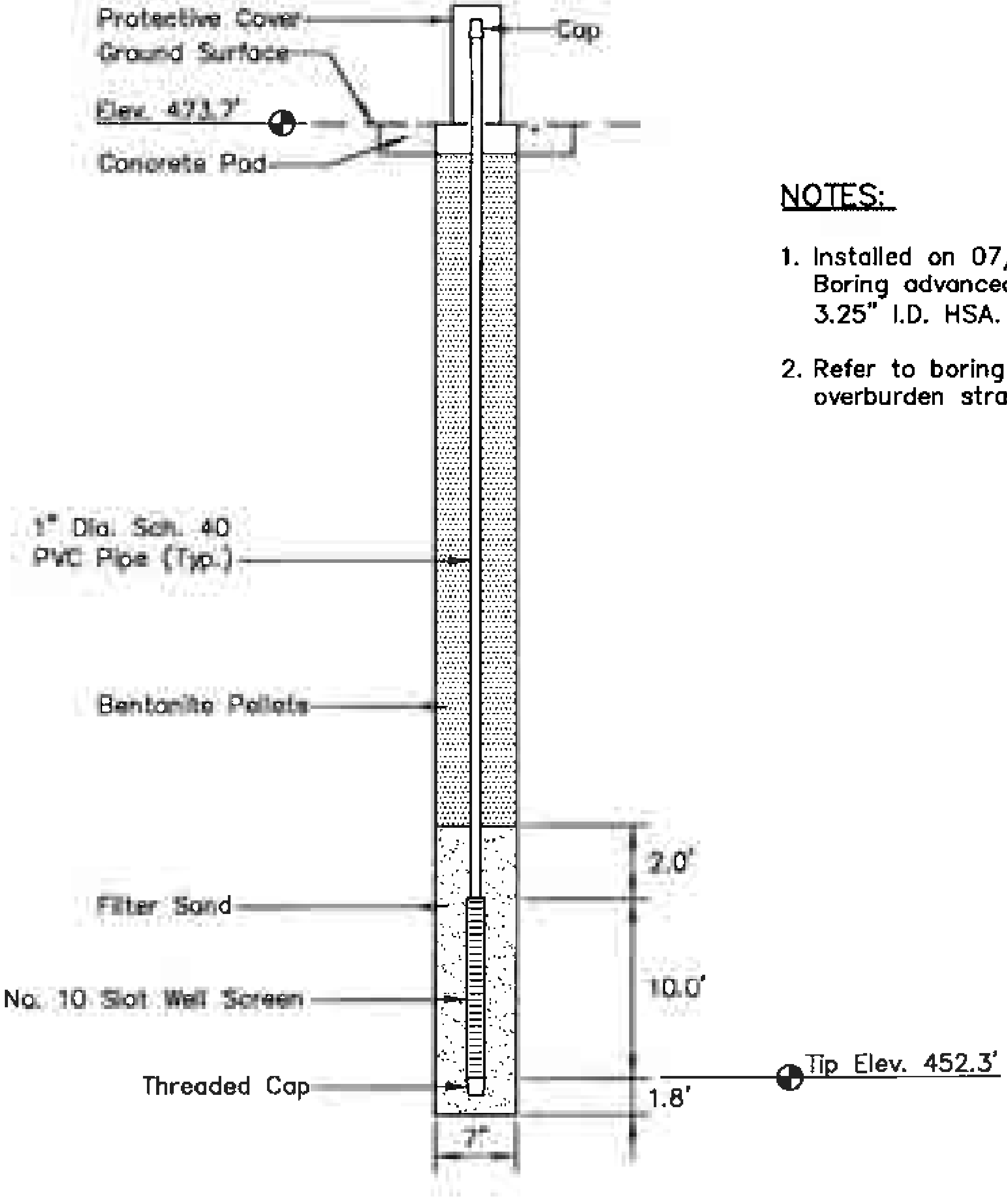
CHECKED BY	RLR	SCALE	NTS	2.	4.	



NOTES:

1. Installed on 07/29/09. Boring advanced with 3.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE. 12/18/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\PZ_DETAILS\559018PZ A 5.DWG

LOCATION

Northing: 708368.74
Easting: 1881417.01
Ground Elevation: 473.7

Locations to be provided by TVA,
Power Systems Operations,
Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-A-5
PIEZOMETER INSTALLATION DETAIL
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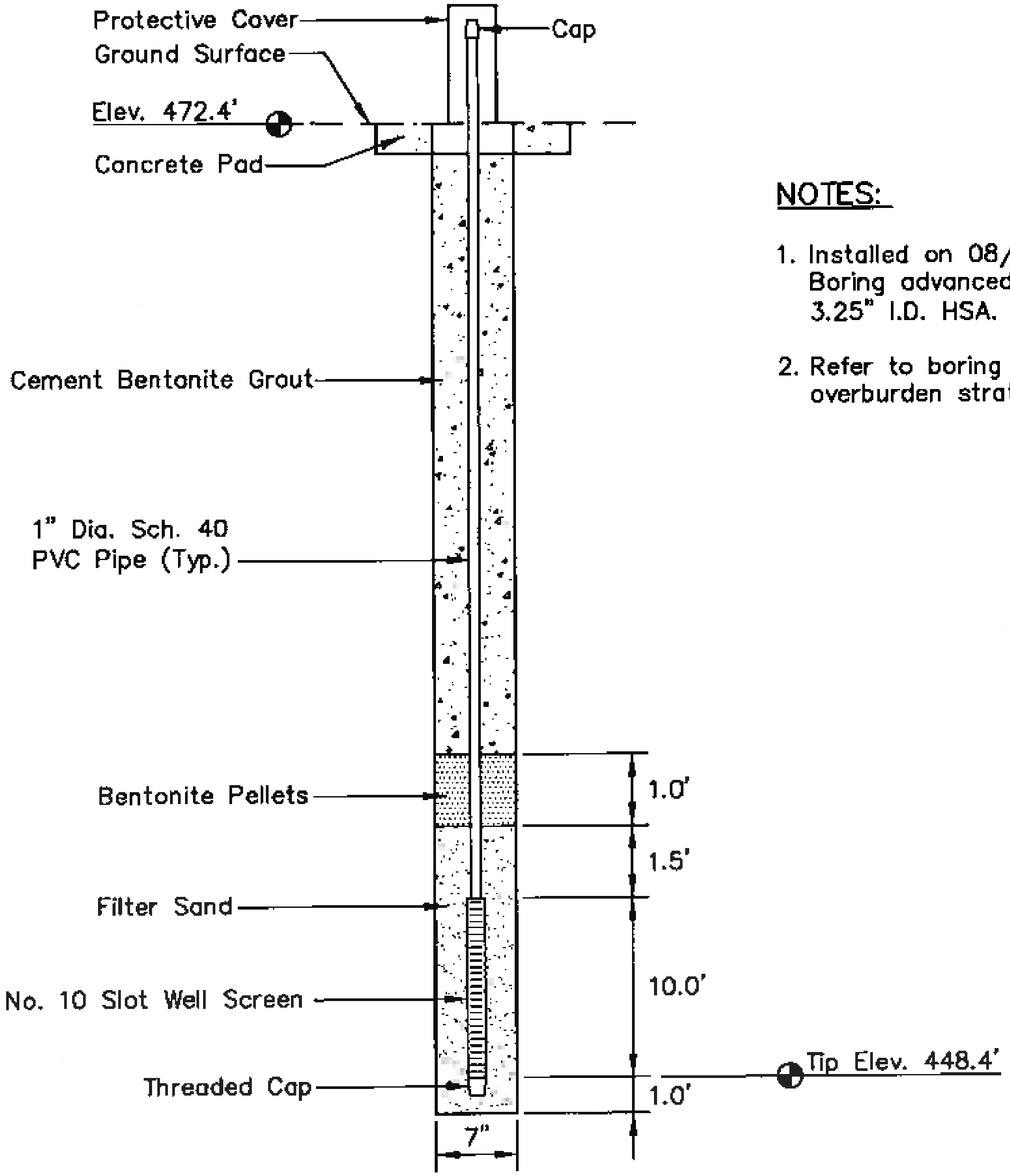

NOTES:

1. Installed on 08/03/09. Boring advanced with 3.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 12/18/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\PZ_DETAILS\59D1BPZ-A-9S.DWG

LOCATION

Northing: 709132.64
Easting: 1882470.74
Ground Elevation: 472.4

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-A-9S
PIEZOMETER INSTALLATION DETAIL
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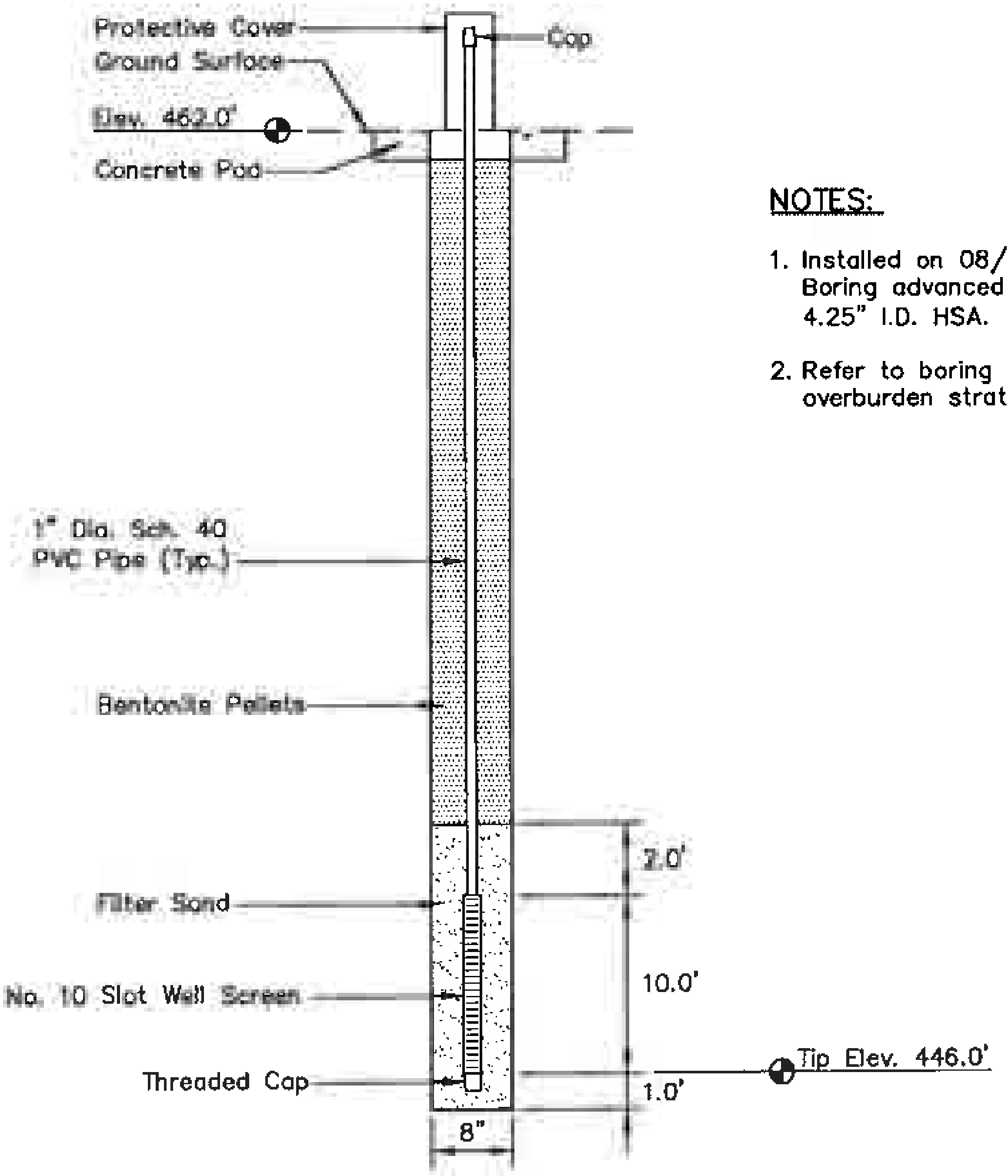

NOTES:

1. Installed on 08/04/09. Boring advanced with 4.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 12/16/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICA[illegible] DRAWING PZ_DE AI S 59 BPZ-C-1.DWG

LOCATION

Northing: 707402.48
Easting: 1879680.01
Ground Elevation: 462.0

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-C-1
PIEZOMETER INSTALLATION DETAIL
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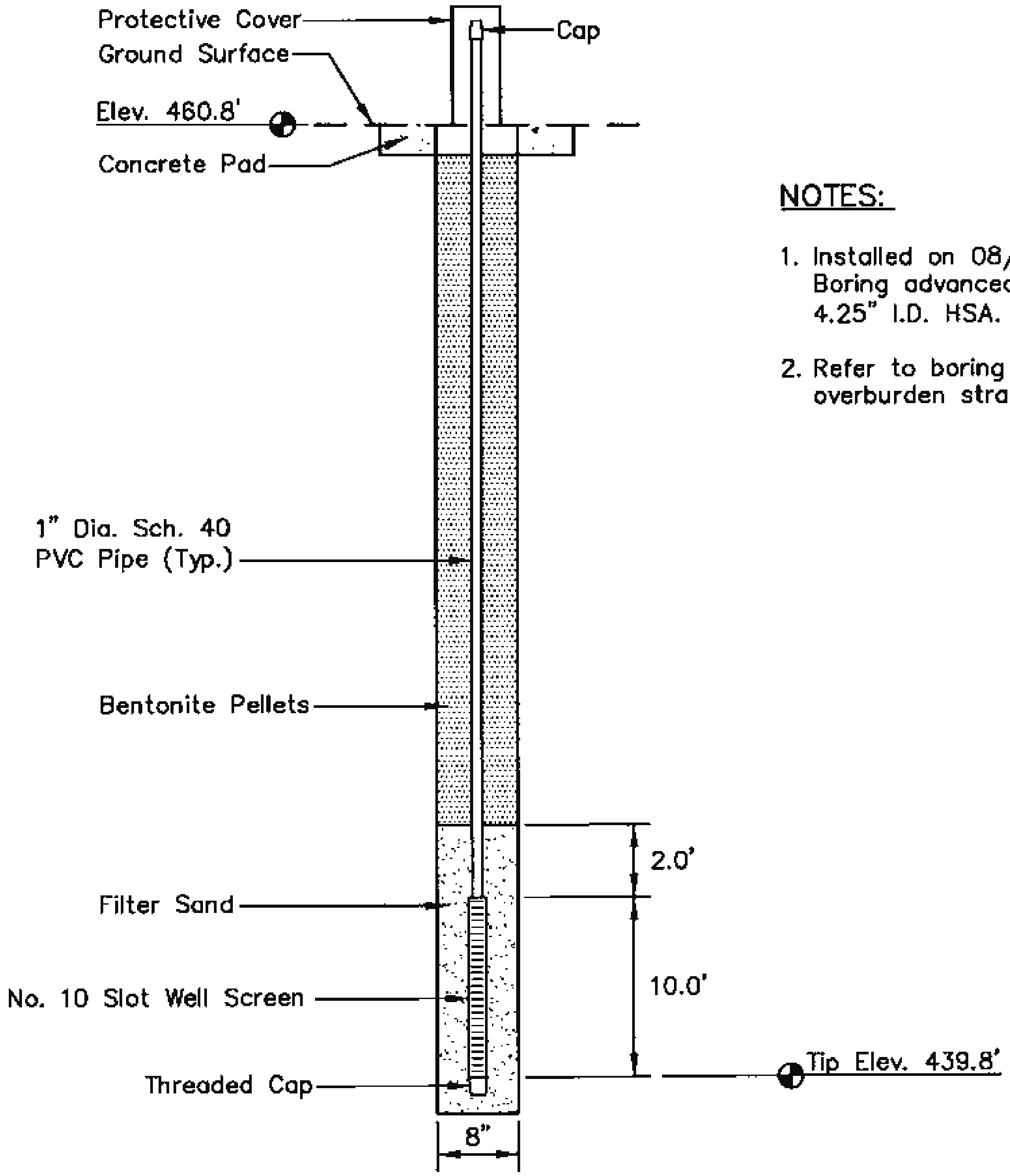

NOTES:

1. Installed on 08/05/09. Boring advanced with 4.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 12/18/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWINGS\PZ_DETAILS\59018PZ-D-1A.DWG

LOCATION

Northing: 707328.99
Easting: 1877246.92
Ground Elevation: 460.8

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-D-1A
PIEZOMETER INSTALLATION DETAIL
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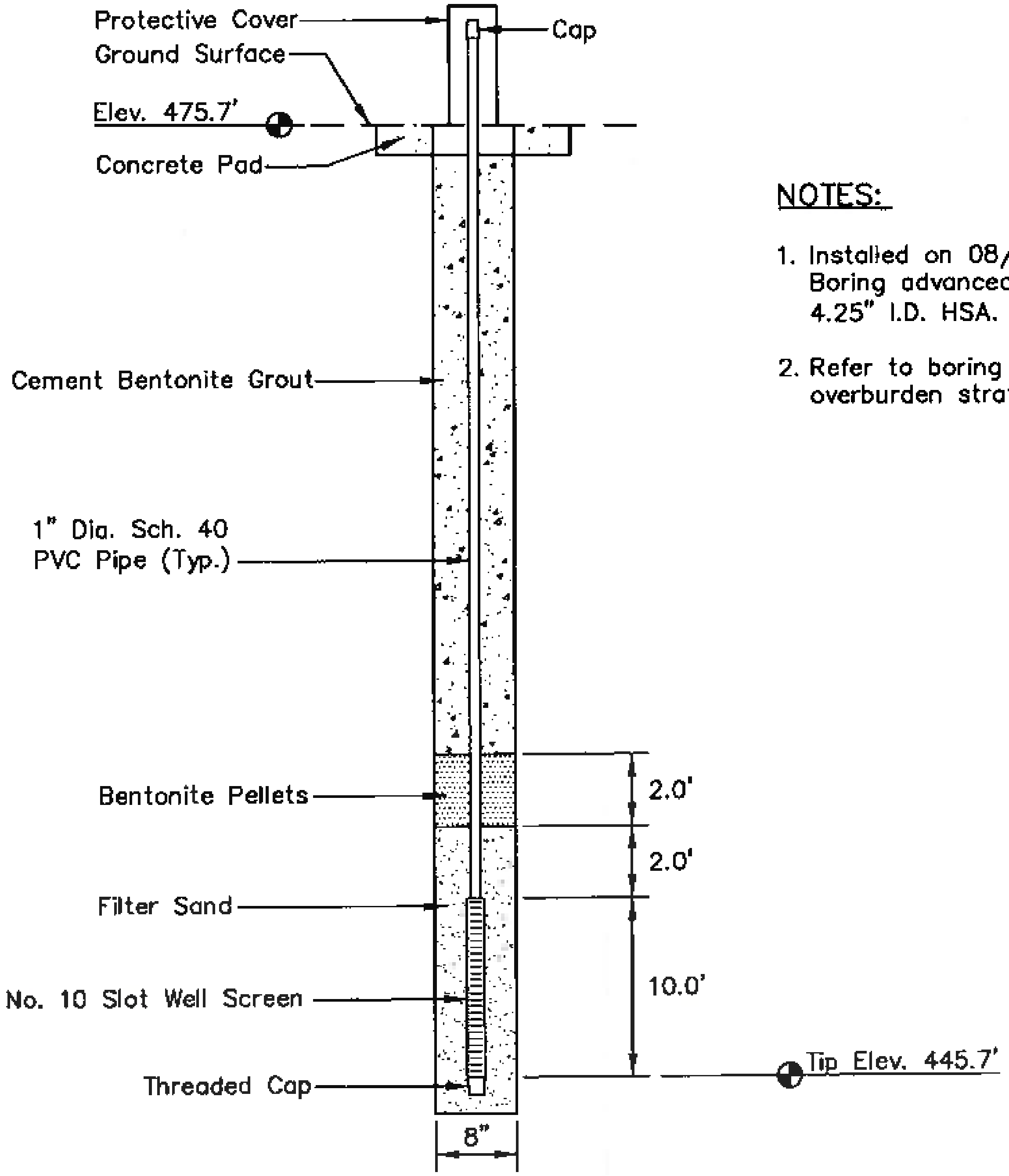

NOTES:

1. Installed on 08/10/09. Boring advanced with 4.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 12/18/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\PZ_DETAILS\5901BPZ-E-2.DWG

LOCATION

Northing: 703007.37
Easting: 1879022.21
Ground Elevation: 475.7

Locations to be provided by TVA,
Power Systems Operations,
Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-E-2
PIEZOMETER INSTALLATION DETAIL
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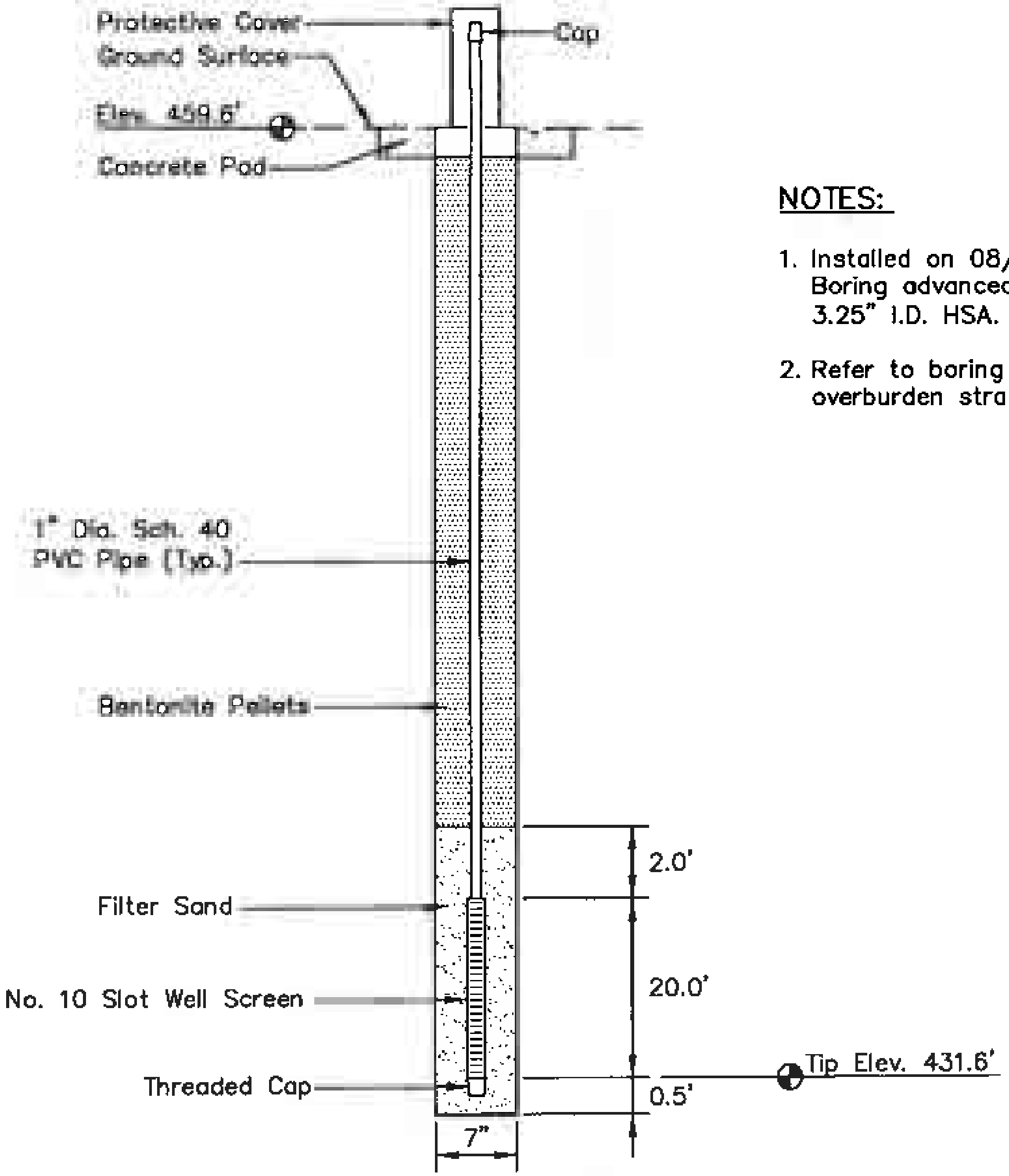

NOTES:

1. Installed on 08/10/09. Boring advanced with 3.25" I.D. HSA.

2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 12/18/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\PZ_DETAILS\59018PZ-E-6.DWG

LOCATION

Northing: 702733.38
Easting: 1878070.14
Ground Elevation: 459.6

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-E-6
PIEZOMETER INSTALLATION DETAIL
GALLATIN FOSSIL PLANT
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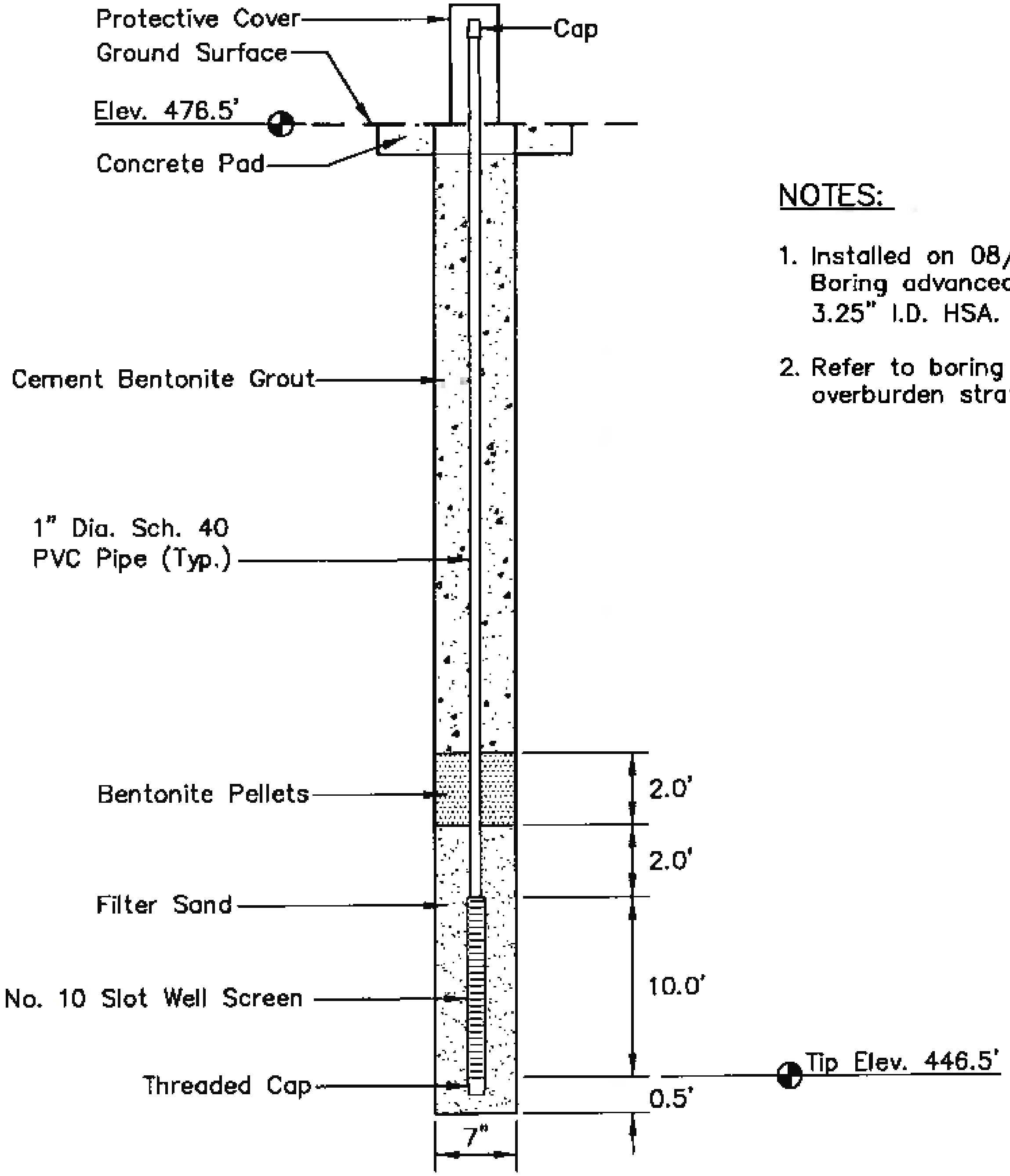
CHECKED BY	RLR	SCALE	NTS	2.	4.	



NOTES:

1. Installed on 08/11/09. Boring advanced with 3.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 02/02/2010 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\PZ_DETAILS\59018PZ-E-8S.DWG

LOCATION

Northing: 703835.47
Easting: 1877934.64
Ground Elevation: 476.5

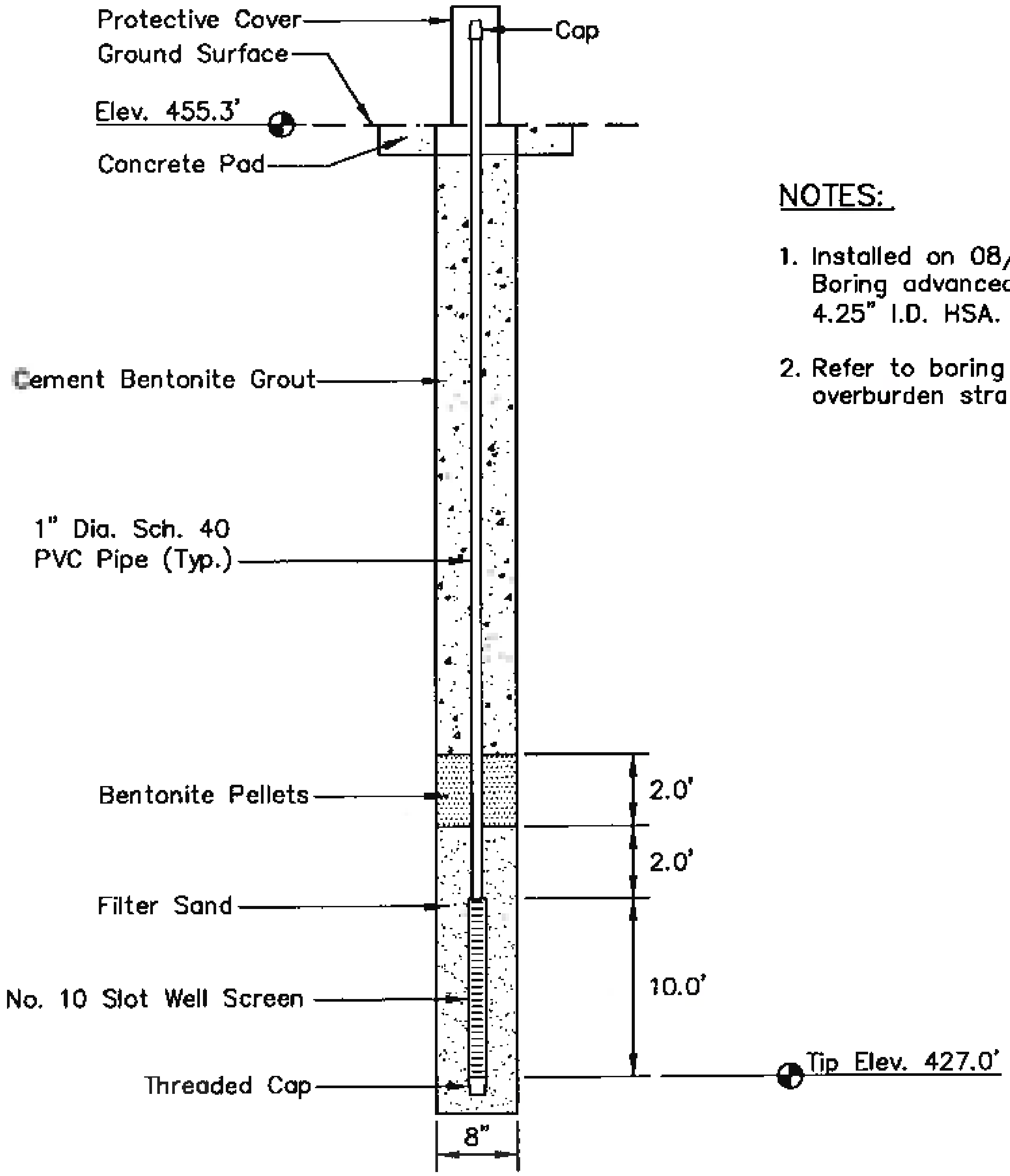
Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-E-8S
PIEZOMETER INSTALLATION DETAIL
GALLATIN FOSSIL PLANT
ASH POND / STILLING POND COMPLEX

Stantec

Stantec Consulting Services Inc.
1901 Nelson Miller Parkway
Louisville, Kentucky
40223-2177
502-212-5000
www.stantec.com

DRAWN BY	RRP	DATE	SEPT., 2009	REVISED			SHEET
CHECKED BY	PJC	PROJ. NO.	175559018	1.	3.		8 OF 12
CHECKED BY	RLR	SCALE	NTS	2.	4.		



NOTES:

1. Installed on 08/22/09. Boring advanced with 4.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 12/18/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\PZ_DETAILS\59018PZ-E-12.DWG

LOCATION

Northing: 704854.47
Easting: 1877754.46
Ground Elevation: 455.3

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-E-12
PIEZOMETER INSTALLATION DETAIL
GALLATIN FOSSIL PLANT
ASH POND / STILLING POND COMPLEX

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502-212-5000
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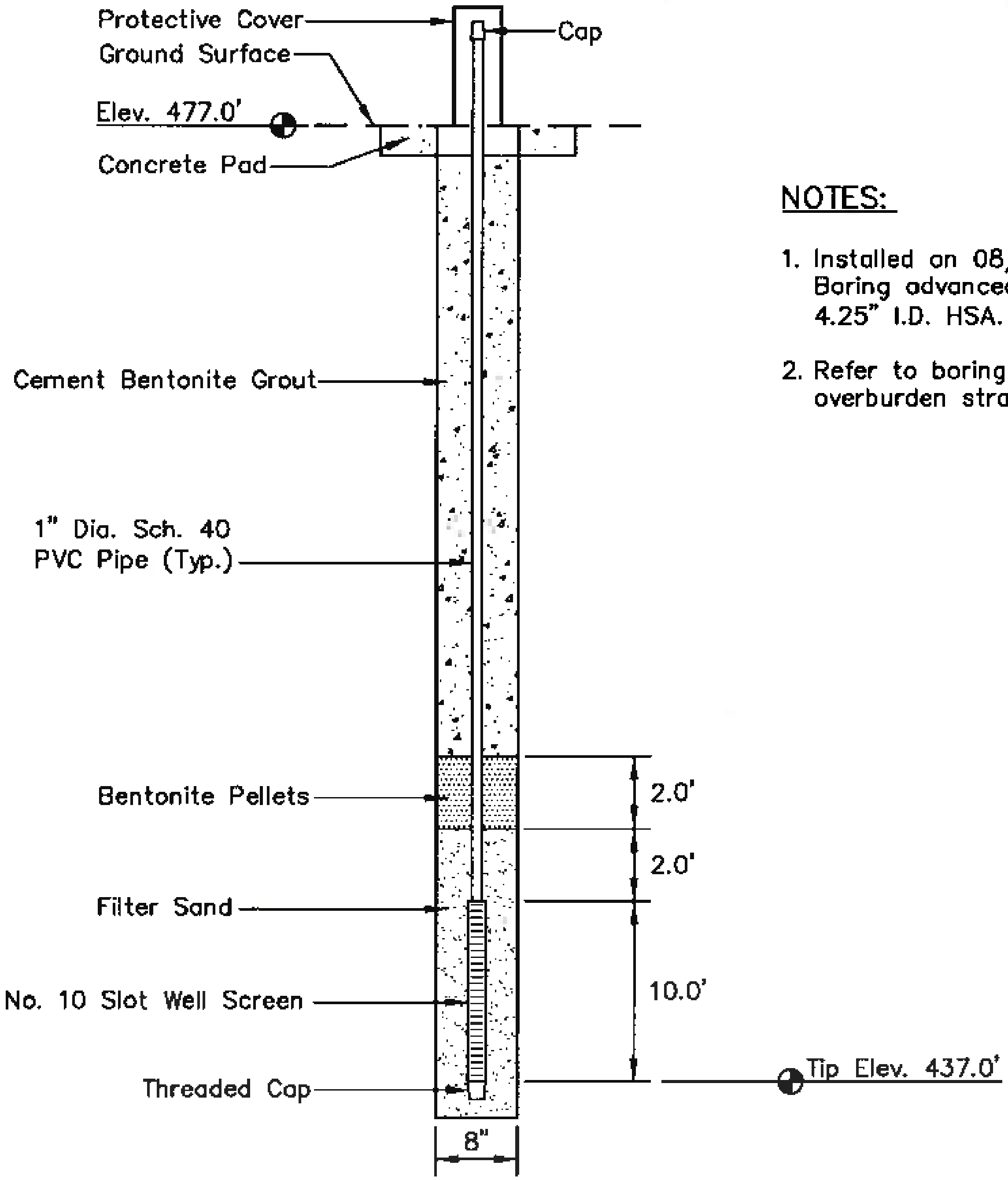
DRAWN BY	RRP	DATE SEPT., 2009	REVISED			SHEET
CHECKED BY	PJC	PROJ. NO. 175559018	1.		3.	9 OF 12
CHECKED BY	RLR	SCALE NTS	2.		4.	



NOTES:

1. Installed on 08/07/09. Boring advanced with 4.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 12/18/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\P2_DETAILS\59018PZ-E-14.DWG

LOCATION

Northing: 706343.79
Easting: 1877425.50
Ground Elevation: 477.0

Locations to be provided by TVA,
Power Systems Operations,
Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-E-14
PIEZOMETER INSTALLATION DETAIL
GALLATIN FOSSIL PLANT
ASH POND / STILLING POND COMPLEX

Stantec

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Services Inc.
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502-212-5000
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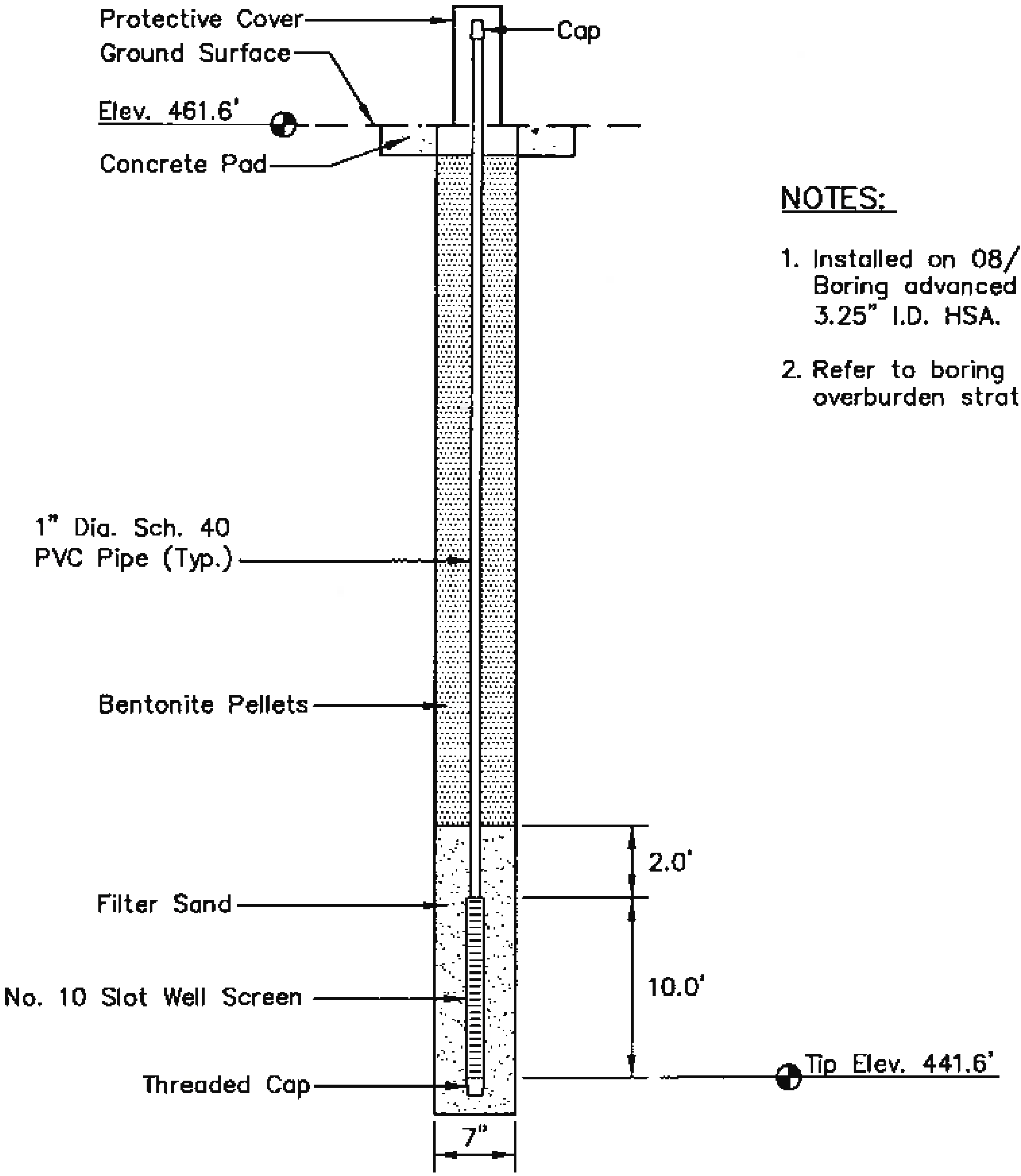
				REVISED		SHEET
DRAWN BY	RRP	DATE	SEPT., 2009			
CHECKED BY	PJC	PROJ. NO.	175559018	1.	3.	10 OF 12
CHECKED BY	RLR	SCALE	NTS	2.	4.	



NOTES:

1. Installed on 08/10/09. Boring advanced with 3.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 02/02/2010 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\PZ_DETAILS\59018PZ-E-18S.DWG

LOCATION

Northing: 707190.77
Easting: 1877765.92
Ground Elevation: 461.6

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-E-18
PIEZOMETER INSTALLATION DETAIL
GALLATIN FOSSIL PLANT
ASH POND / STILLING POND COMPLEX

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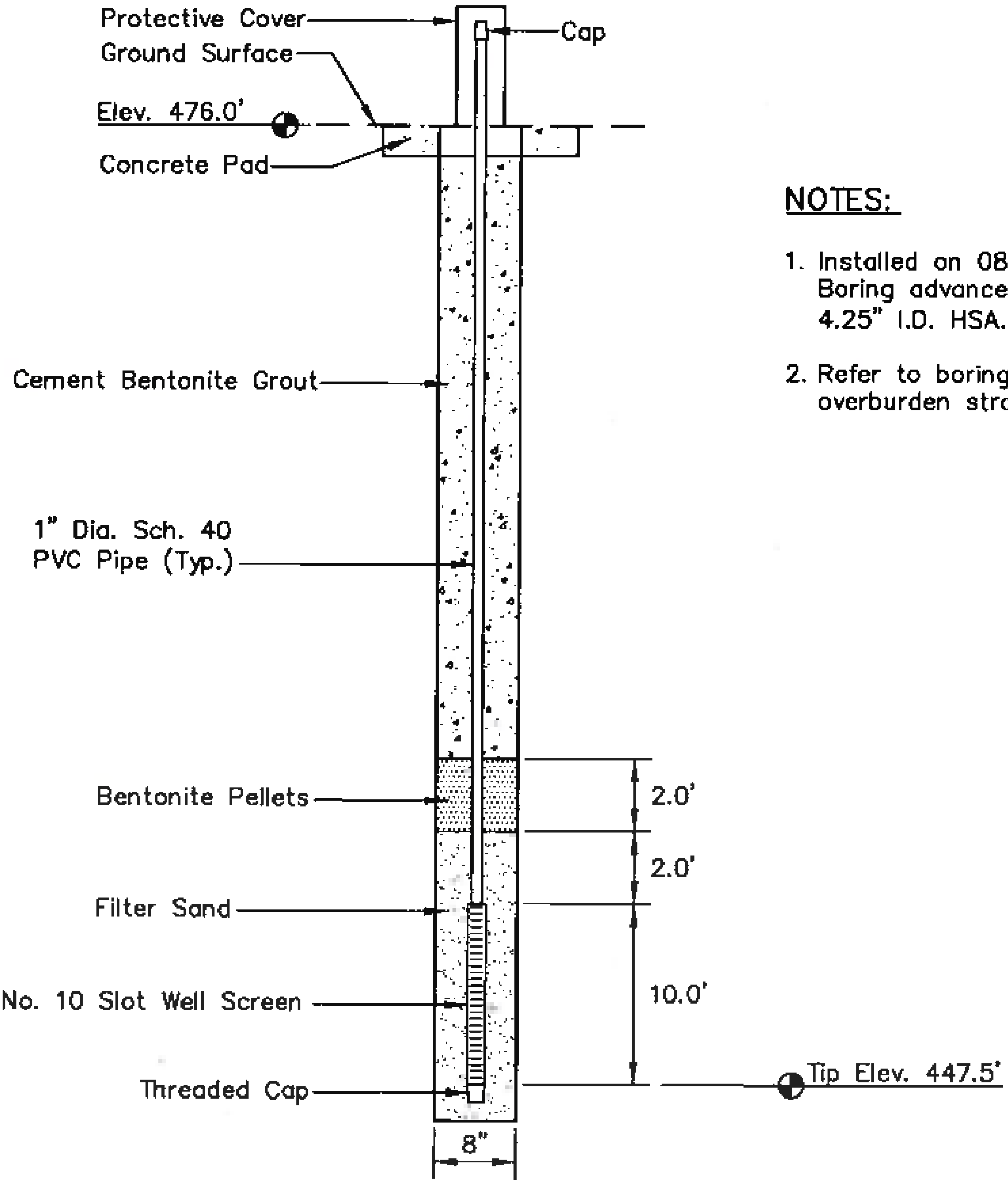
DRAWN BY	RRP	DATE	SEPT., 2009	REVISED		SHEET
CHECKED BY	PJC	PROJ. NO.	175559018	1.	3.	11 OF 12
CHECKED BY	RLR	SCALE	NTS	2.	4.	



NOTES:

1. Installed on 08/10/09. Boring advanced with 4.25" I.D. HSA.
2. Refer to boring log for overburden stratigraphy.

PLOT DATE: 12/18/2009 USER: PETTY, RICHARD
V:\1755\ACTIVE\175559018\GEOTECHNICAL\DRAWING\PZ_DETAILS\59018PZ-E-20.DWG

LOCATION

Northing: 706856.53
Easting: 1878704.54
Ground Elevation: 476.0

Locations to be provided by TVA, Power Systems Operations, Surveying and Project Services.
Horizontal Datum: NAD 27
Vertical Datum: NGVD29

STN-E-20
PIEZOMETER INSTALLATION DETAIL
GALLATIN FOSSIL PLANT
ASH POND / STILLING POND COMPLEX

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DRAWN BY	RRP	DATE	SEPT., 2009	REVISED		SHEET
CHECKED BY	PJC	PROJ. NO.	175559018	1.	3.	12 OF 12
CHECKED BY	RLR	SCALE	NTS	2.	4.	

PIEZOMETER SUMMARY REPORT
Gallatin Fossil Plant
1499 Steam Plant Rd
Gallatin, TN
175569016

	9/18/2009				9/25/2009			
Location	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)
STN-A-1	472.8	3.0	18.1	457.7	472.8	3.0	18.1	457.7
STN-A-5	473.7	2.9	16.4	460.2	473.7	2.9	16.8	459.8
STN-A-9	472.4	3.0	10.8	464.5	472.4	3.0	10.9	464.5
STN-C-1	462.0	2.8	9.2	455.6	462.0	2.8	9.2	455.6
STN-D-1	460.8	2.8	15.4	448.2	460.8	2.8	16.4	447.2
STN-E-2	475.7	2.5	17.4	460.8	475.7	2.5	17.3	460.9
STN-E-6	459.6	3.3	5.5	457.4	459.6	3.3	5.7	457.2
STN-E-8	476.5	2.2	17.1	461.6	476.5	2.2	17.0	461.6
STN-E-12	455.3	2.9	2.3	455.9	455.3	2.9	1.9	456.3
STN-E 14	477.0	2.0	20.6	458.3	477.0	2.0	31.9	447.0
STN-E-18	461.6	2.8	8.0	456.4	461.6	2.8	8.1	456.4
STN-E 20	476.0	2.0	20.2	457.8	476.0	2.0	20.4	457.5

Stantec

PIEZOMETER SUMMARY REPORT

Gallatin Fossil Plant
1499 Steam Plant Rd
Gallatin, TN
175569016

	10/2/2009				10/16/2009			
Location	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)
STN-A-1	472.8	3.0	18.4	457.4	472.8	3.0	18.3	457.5
STN-A-5	473.7	2.9	17.1	459.5	473.7	2.9	17.0	459.6
STN-A-9	472.4	3.0	11.2	464.2	472.4	3.0	11.2	464.2
STN-C-1	462.0	2.8	9.5	455.4	462.0	2.8	9.4	455.4
STN-D-1	460.8	2.8	17.1	446.5	460.8	2.8	15.2	448.4
STN-E-2	475.7	2.5	17.5	460.7	475.7	2.5	17.3	460.9
STN-E-6	459.6	3.3	6.1	456.8	459.6	3.3	5.4	457.5
STN-E-8	476.5	2.2	17.1	461.6	476.5	2.2	17.0	461.7
STN-E-12	455.3	2.9	2.6	455.5	455.3	2.9	1.7	456.4
STN-E-14	477.0	2.0	32.1	446.8	477.0	2.0	30.4	448.5
STN-E-16	461.6	2.8	8.3	456.2	461.6	2.8	8.2	456.3
STN-E-20	476.0	2.0	20.6	457.3	476.0	2.0	20.4	457.6

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PIEZOMETER SUMMARY REPORT
Gallatin Fossil Plant
1499 Steam Plant Rd
Gallatin, TN
175559018

	10/30/2009				11/19/2009			
Location	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)
STN-A-1	472.8	3.0	18.5	457.3	472.8	3.0	18.7	457.1
STN-A-5	473 7	2.9	17.5	459 1	473.7	2.9	17.6	459.0
STN-A-9	472 4	3.0	11.6	463.8	472.4	3.0	11.5	463.9
STN-C 1	462.0	2.8	9.7	455.2	462.0	2.8	9.8	455.0
STN-D-1	460 8	2.8	17 1	446.5	460.8	2.8	19.2	444.4
STN-E 2	475.7	2.5	17 5	460.7	475 7	2.5	17.4	460.8
STN-E-6	459.6	3 3	6.1	456.8	459 8	3.3	7.1	455.7
STN-E-8	476 5	2.2	17.1	461 6	476 5	2.2	17.4	461.3
STN-E-12	455 3	2.9	2 4	455 7	455 3	2 9	3 5	454 7
STN-E-14	477 0	2 0	32.2	446 8	477 0	2 0	33 7	445 3
STN-E 18	461 6	2 8	8 3	456 1	461.6	2 8	8 4	456 1
STN-E-20	476 0	2 0	20 8	457 2	476.0	2.0	21 1	456 9

Stantec

PIEZOMETER SUMMARY REPORT
Gallatin Fossil Plant
1499 Steam Plant Rd
Gallatin, TN
175559016

	12/14/2009				1/15/2010			
Location	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)	Surface Elevation (ft)	Stickup (ft)	Depth Measurement (ft)	Water Elevation (ft)
STN-A-1	472.8	3.0	18.5	457.3	472.8	3.0	18.8	457.0
STN-A-5	473.7	2.9	17.7	459.0	473.7	2.9	18.0	458.6
STN-A-9	472.4	3.0	11.6	463.8	472.4	3.0	12.1	463.2
STN-C-1	462.0	2.8	9.7	455.2	462.0	2.8	9.9	454.9
STN-D-1	460.8	2.8	16.7	446.9	460.8	2.8	17.6	445.9
STN-E-2	475.7	2.5	17.2	461.0	475.7	2.5	17.9	460.3
STN-E-6	459.6	3.3	5.7	457.2	459.6	3.3	6.5	456.4
STN-E-8	476.5	2.2	17.0	461.6	476.5	2.2	17.6	461.1
STN-E-12	455.3	2.9	2.2	456.0	455.3	2.9	3.0	455.2
STN-E-14	477.0	2.0	32.0	446.9	477.0	2.0	32.8	446.1
STN-E-18	461.6	2.8	8.3	456.2	461.6	2.8	8.4	456.0
STN-E-20	476.0	2.0	20.8	457.2	476.0	2.0	21.4	456.6

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PIEZOMETER SUMMARY REPORT
Gallatin Fossil Plant
1499 Steam Plant Rd
Gallatin, TN
175669018

	2/10/2010				3/18/2010			
Location	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)
STN-A-1	472.8	3.0	18.4	457.4	472.8	3.0	18.7	457.1
STN-A-5	473.7	2.9	17.5	459.1	473.7	2.9	17.6	459.0
STN-A-9	472.4	3.0	11.8	463.5	472.4	3.0	11.8	463.5
STN-C-1	462.0	2.8	9.5	455.3	462.0	2.8	9.6	455.2
STN-D-1	460.8	2.8	15.6	448.0	460.8	2.8	17.0	446.6
STN-E-2	475.7	2.5	17.4	460.8	475.7	2.5	17.6	460.6
STN-E-6	459.6	3.3	5.6	457.3	459.6	3.3	6.6	456.3
STN-E-8	476.5	2.2	17.4	461.3	476.5	2.2	17.3	461.3
STN-E-12	455.3	2.9	1.5*	456.7	455.3	2.9	2.4	455.8
STN-E-14	477.0	2.0	31.1	447.9	477.0	2.0	32.3	446.7
STN-E 18	461.6	2.8	8.1	456.3	461.6	2.8	8.3	456.1
STN-E 20	476.0	2.0	20.7	457.3	476.0	2.0	21.2	456.8

*Frozen

Stantec

PIEZOMETER SUMMARY REPORT

Gallatin Fossil Plant
1499 Steam Plant Rd
Gallatin, TN
175559016

	4/7/2010			
Location	Surface Elevation (ft)	Stickup (ft)	Depth Measurement(ft)	Water Elevation (ft)
STN-A-1	472.8	3.0	18.7	457.1
STN-A-5	473.7	2.9	17.3	459.3
STN-A-9	472.4	3.0	11.5	463.8
STN-C-1	462.0	2.8	9.5	455.3
STN-D-1	460.8	2.8	17.3	446.3
STN-E-2	475.7	2.5	17.5	460.7
STN-E-6	459.6	3.3	6.9	456.0
STN-E-8	476.5	2.2	17.3	461.3
STN-E-12	455.3	2.9	2.9	455.3
STN-E-14	477.0	2.0	32.5	446.4
STN-E-16	461.6	2.8	8.3	456.1
STN-E-20	476.0	2.0	21.1	456.9

Appendix C

Laboratory Test Results

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-A-2, 35.0'-36.5', 36.5'-38.0', 38.0'-39.5'
Project Number: 175559018
Lab ID: 107

County: Sumner
Sample Type: SPT Comp
Date Received: 10-9-09
Date Reported: 10-26-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	98.6
No. 4	4.75	97.8
No. 10	2	90.2
No. 40	0.425	84.7
No. 200	0.075	80.1
	0.02	64.7
	0.005	49.0
	0.002	42.2
estimated	0.001	39.4

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	2.2	9.8
Coarse Sand	7.6	5.5
Medium Sand	5.5	---
Fine Sand	4.6	4.6
Silt	31.1	37.9
Clay	49.0	42.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 53
Plastic Limit: 18
Plasticity Index: 35
Activity Index: 0.83

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand
AASHTO Classification: A-7-6 (28)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-2, 35.0'-36.5', 36.5'-38.0', 38.0'-39.5'

Project Number 175559018
Lab ID 107

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: JMB
Test Date: 10-13-2009
Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	98.6
No. 4	97.8
No. 10	90.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

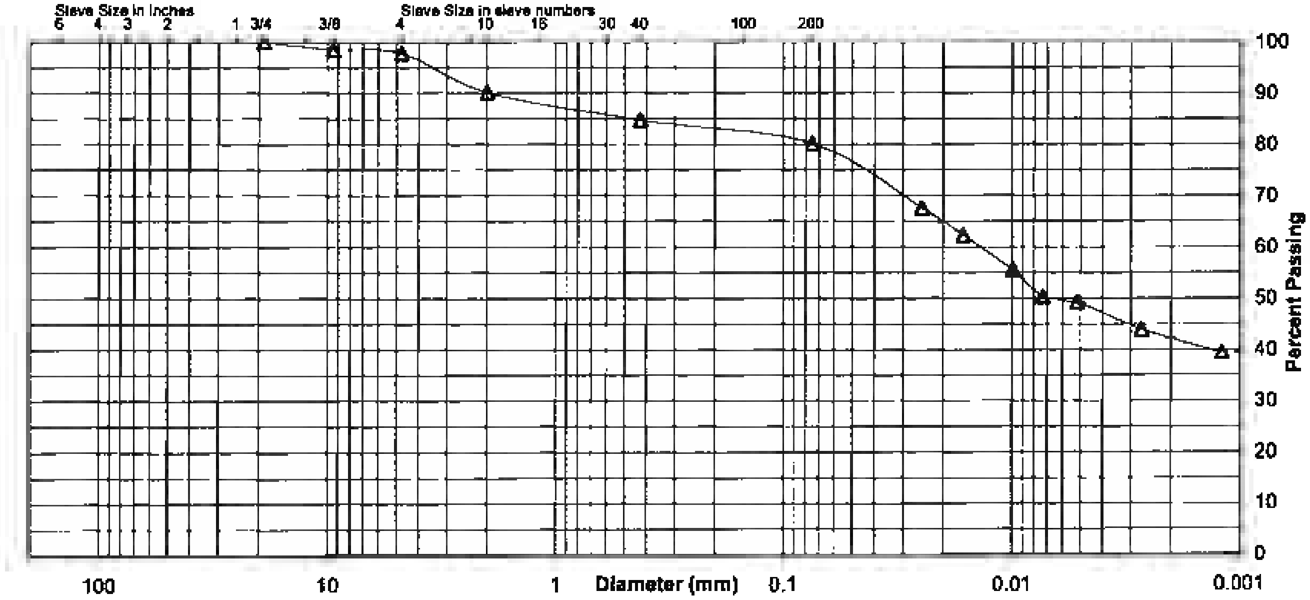
Specific Gravity 2.71

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	84.7
No. 200	80.1
0.02 mm	64.7
0.005 mm	49.0
0.002 mm	42.2
0.001 mm	39.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	2.2	7.6	5.5	4.6	31.1	49.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	9.8			5.5	4.6	37.9	42.2



Comments

Reviewed By RHB

File: fm 175559018 sum 107 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

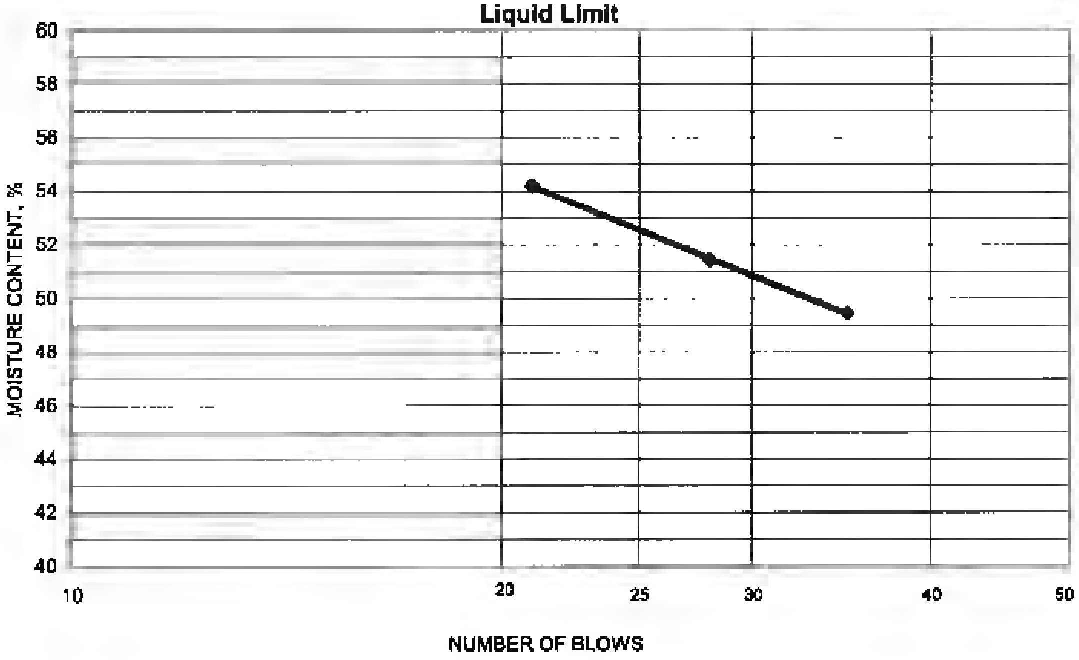
Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-2, 35.0'-36.5', 36.5'-38.0', 38.0'-39.5'
Project No. 175559018
Lab ID 107
% + No. 40 15
Tested By KDK
Test Method ASTM D 4318 Method A
Date Received 10-09-2009
Test Date 10-15-2009
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
15.47	11.79	4.35	35	49.5	53
16.05	12.07	4.33	28	51.4	
15.91	11.84	4.33	21	54.2	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
10.43	9.51	4.32	17.7	18	35
10.51	9.58	4.34	17.7		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Project Number: 175559018
Source: STN-A-3, 9.0'-10.5', 10.5'-12.0', 12.0'-13.5'
Lab ID: 119

County: Sumner
Date Received: 10-9-09
Sample Type: SPT Comp
Date Reported: 10-26-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	86.9
No. 4	4.75	73.4
No. 10	2	52.7
No. 40	0.425	30.8
No. 200	0.075	13.6
	0.02	4.2
	0.005	2.2
	0.002	1.6
estimated	0.001	1.4

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	26.6	47.3
Coarse Sand	20.7	21.9
Medium Sand	21.9	---
Fine Sand	17.2	17.2
Silt	11.4	12.0
Clay	2.2	1.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel
AASHTO Classification: A-1-b (0)

Comments:

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-3, 9.0'-10.5', 10.5'-12.0', 12.0'-13.5'
Project Number 175559018
Lab ID 119

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: JMB
Test Date: 10-14-2009
Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	86.9
No. 4	73.4
No. 10	52.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

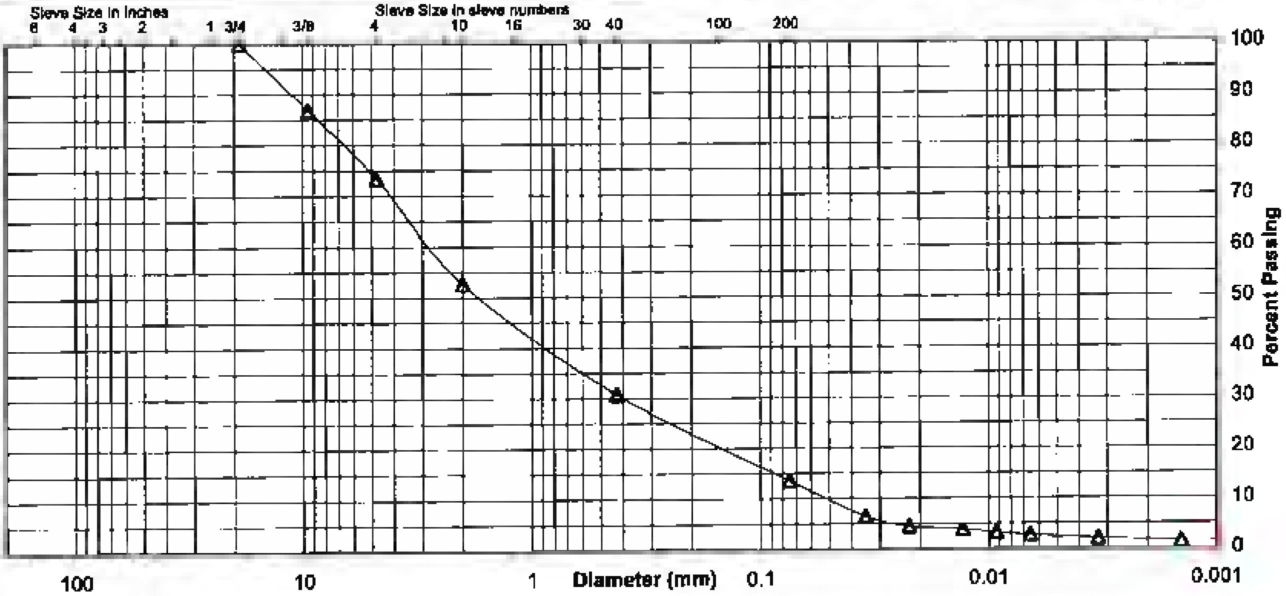
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	30.8
No. 200	13.6
0.02 mm	4.2
0.005 mm	2.2
0.002 mm	1.6
0.001 mm	1.4

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	26.6	20.7	21.9	17.2	11.4	2.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	47.3			21.9	17.2	12.0	1.6



Comments

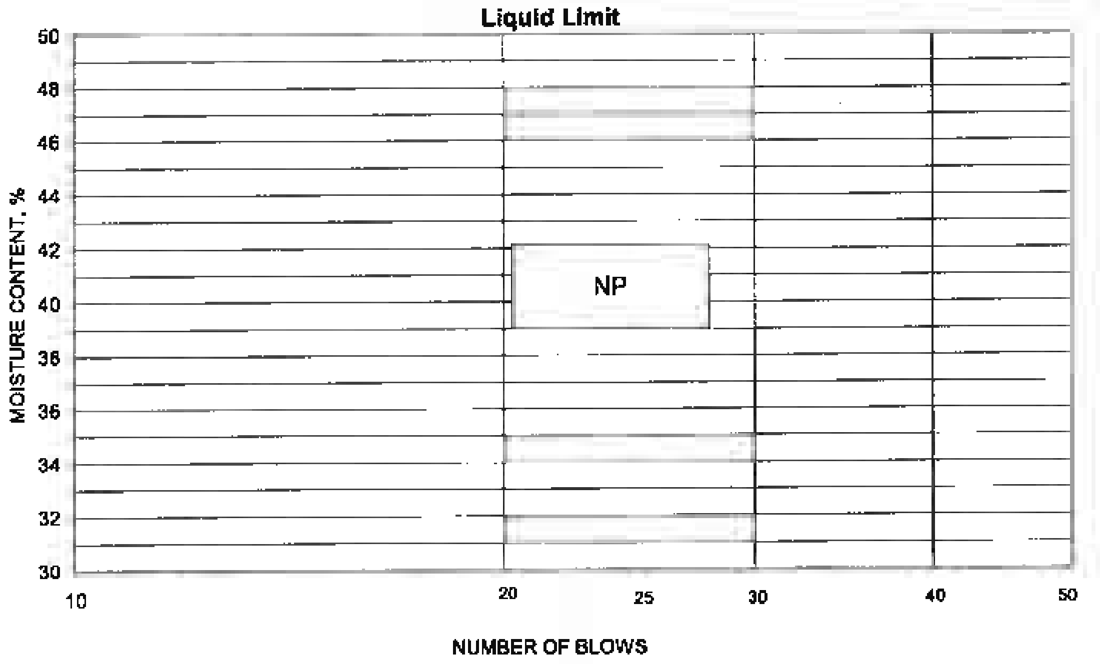
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Project No. 175559018
Source STN-A-3, 9.0'-10.5', 10.5'-12.0', 12.0'-13.5'
Lab ID 119
% + No. 40 69
Tested By RHB
Test Method ASTM D 4318 Method A
Date Received 10-09-2009
Test Date 10-23-2009
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Project Number: 175559018
Source: STN-A-7, 30.0'-31.5', 31.5'-33.0', 33.0'-34.5'
Lab ID: 204

County: Sumner
Date Received: 10-9-09
Sample Type: SPT Comp
Date Reported: 10-26-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	95.5
3/8"	9.5	90.7
No. 4	4.75	84.8
No. 10	2	75.9
No. 40	0.425	69.4
No. 200	0.075	61.8
	0.02	46.5
	0.005	33.0
	0.002	26.8
estimated	0.001	24.4

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	15.2	24.1
Coarse Sand	8.9	6.5
Medium Sand	6.5	—
Fine Sand	7.6	7.6
Silt	28.8	35.0
Clay	33.0	26.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 43
Plastic Limit: 16
Plasticity Index: 27
Activity Index: 1.00

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay with gravel
AASHTO Classification: A-7-6 (14)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-7, 30.0'-31.5', 31.5'-33.0', 33.0'-34.5'

Project Number 175559018
Lab ID 204

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 10-14-2009
Date Received 10-09-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	95.5
3/8"	90.7
No. 4	84.8
No. 10	75.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

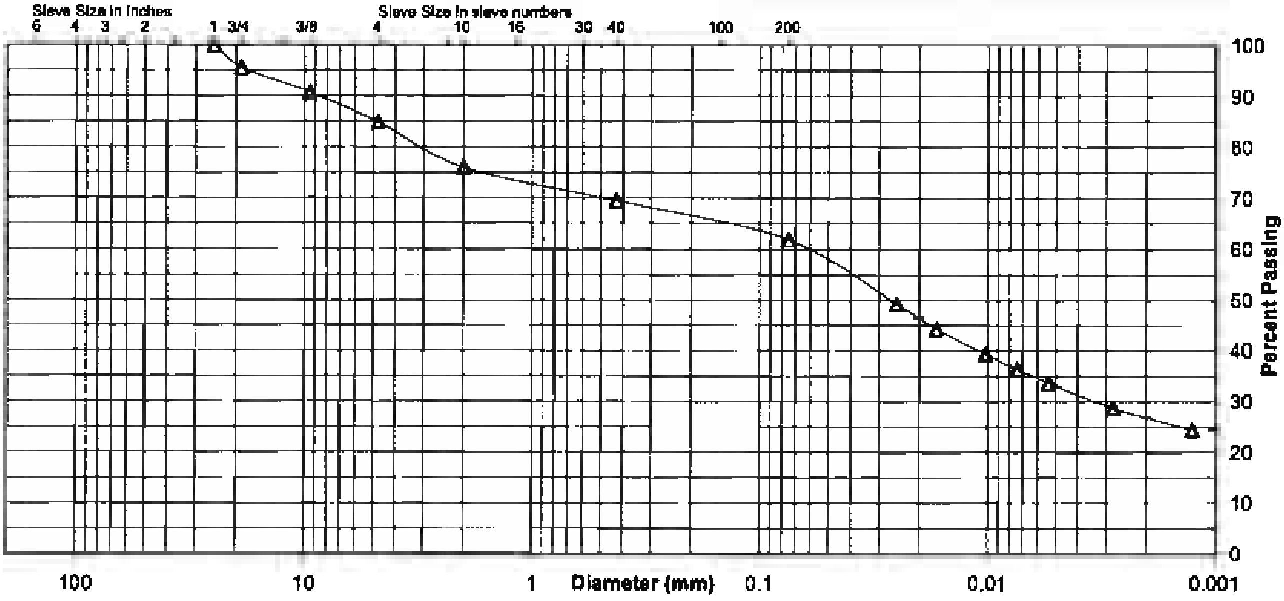
Specific Gravity 2.69

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	69.4
No. 200	61.8
0.02 mm	46.5
0.005 mm	33.0
0.002 mm	26.8
0.001 mm	24.4

Particle Size Distribution

ASTM	Coarse Gravel 4.5	Fine Gravel 10.7	C. Sand 8.9	Medium Sand 6.5	Fine Sand 7.6	Silt 28.8	Clay 33.0
AASHTO	Gravel 24.1			Coarse Sand 6.5	Fine Sand 7.6	Silt 35.0	Clay 26.8



Comments

Reviewed By RHB

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Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

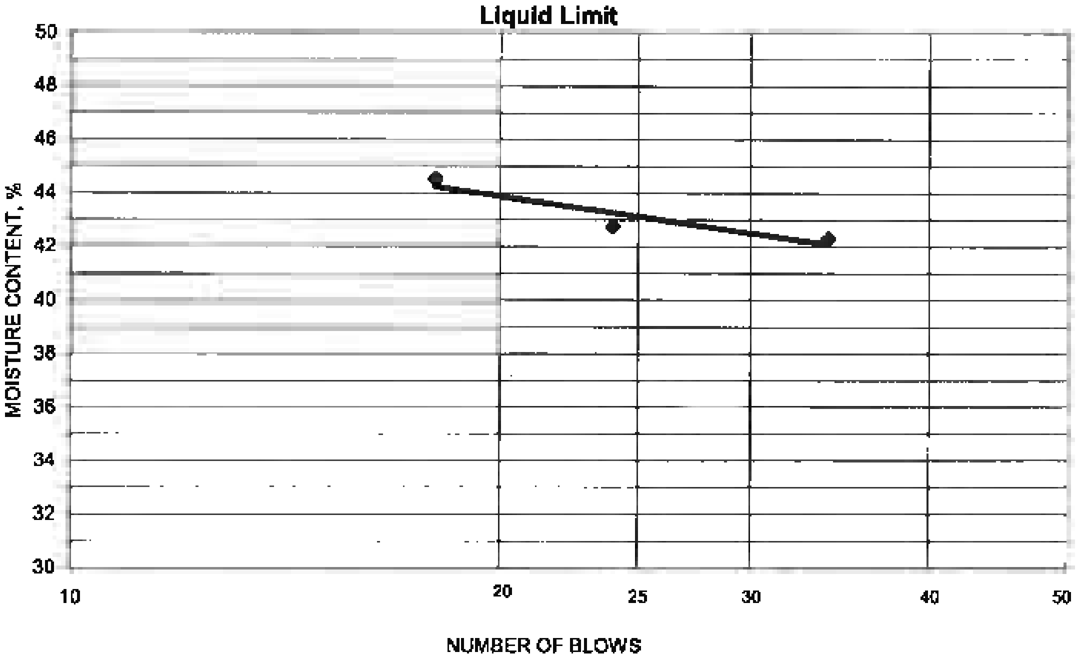
ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-7, 30.0'-31.5', 31.5'-33.0', 33.0'-34.5'

Project No. 175559018
Lab ID 204
% + No. 40 31
Date Received 10-09-2009

Tested By KDK
Test Method ASTM D 4318 Method A
Test Date 10-15-2009
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
14.35	11.38	4.36	34	42.3	43
16.05	12.54	4.33	24	42.8	
15.38	11.97	4.31	18	44.5	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
11.44	10.45	4.33	16.2	16	27
12.71	11.52	4.30	16.5		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-A-10, 15.0'-16.5', 16.5'-18.0', 18.0'-19.5'
Project Number: 175559018
Lab ID: 265

County: Sumner
Sample Type: SPT Comp
Date Received: 10-9-09
Date Reported: 10-26-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	95.0
No. 4	4.75	86.0
No. 10	2	71.3
No. 40	0.425	52.6
No. 200	0.075	35.1
	0.02	22.1
	0.005	13.2
	0.002	9.4
estimated	0.001	7.9

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	14.0	28.7
Coarse Sand	14.7	18.7
Medium Sand	18.7	—
Fine Sand	17.5	17.5
Silt	21.9	25.7
Clay	13.2	9.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Gallatin Fossil Plant (GAF) - Ash Ponds	Project Number	175559018
Source	STN-A-10, 15.0'-16.5', 16.5'-18.0', 18.0'-19.5'	Lab ID	265

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: KDK
Test Date: 10-13-2009
Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	95.0
No. 4	86.0
No. 10	71.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

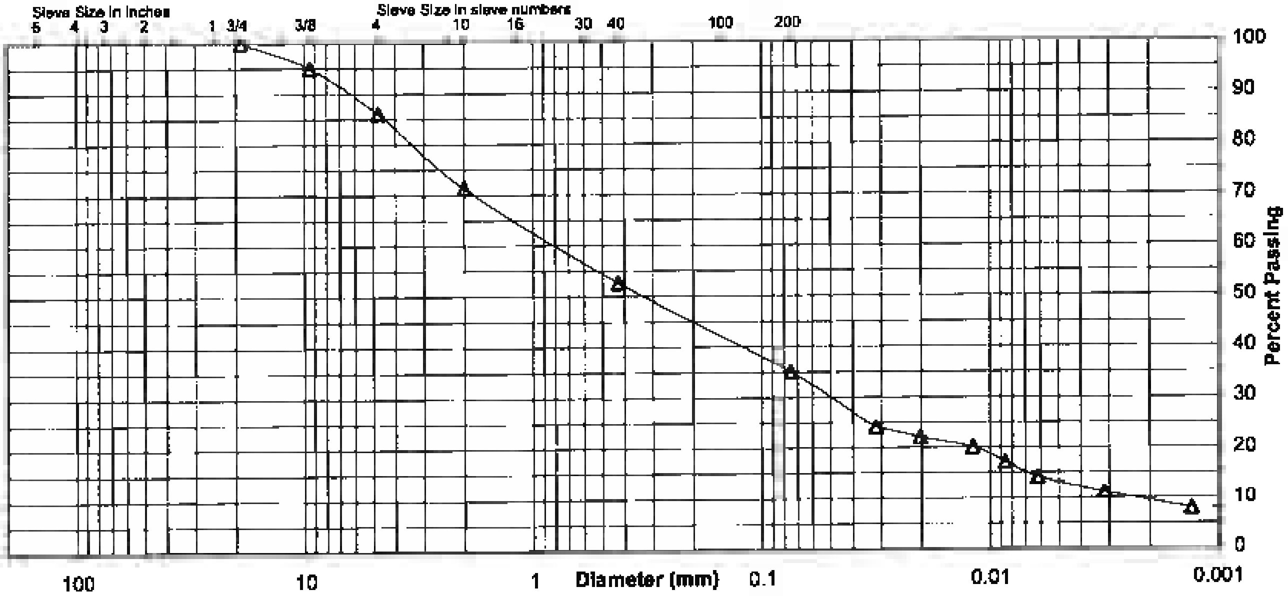
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	52.6
No. 200	35.1
0.02 mm	22.1
0.005 mm	13.2
0.002 mm	9.4
0.001 mm	7.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	14.0	14.7	16.7	17.5	21.9	13.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	28.7			16.7	17.5	25.7	9.4



Comments

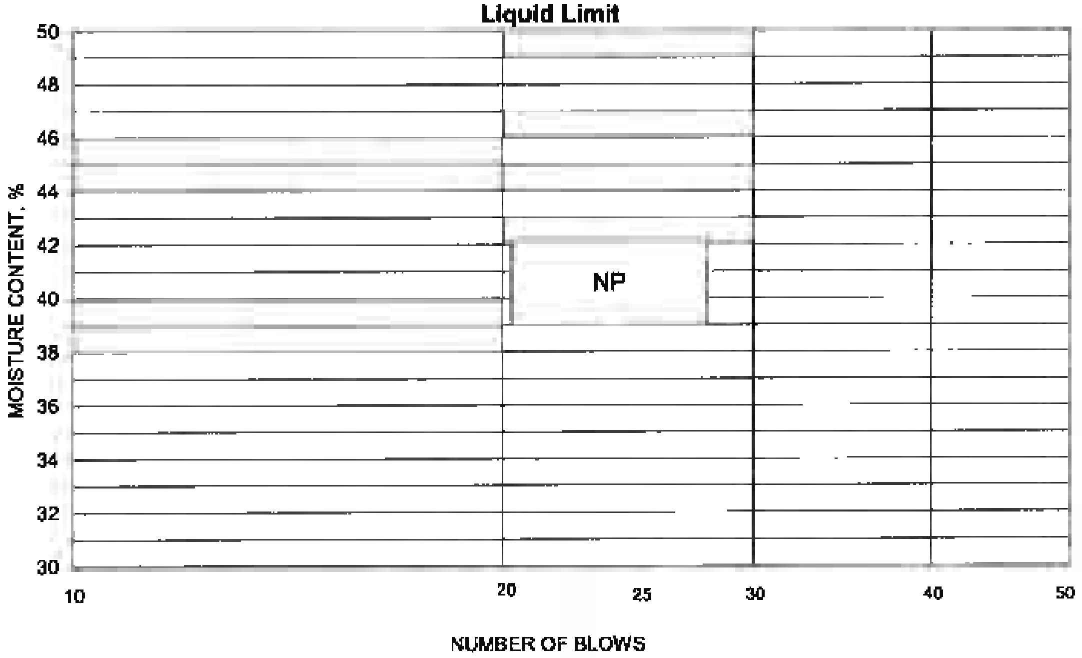
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-10, 15.0'-16.5', 16.5'-18.0', 18.0'-19.5'
Project No. 175559018
Lab ID 265
% + No. 40 47
Tested By RHB
Test Method ASTM D 4318 Method A
Date Received 10-09-2009
Test Date 10-26-2009
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit


Liquid Limit

PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-C-1, 3.0'-4.5', 4.5'-6.0', 6.0'-7.5'
Project Number 175559018
Lab ID 281

County Sumner
Sample Type SPT Comp
Date Received 10-9-09
Date Reported 10-28-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	97.0
3/8"	9.5	81.9
No. 4	4.75	65.2
No. 10	2	45.0
No. 40	0.425	21.5
No. 200	0.075	5.2
	0.02	2.4
	0.005	1.4
	0.002	1.1
estimated	0.001	0.9

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	34.8	55.0
Coarse Sand	20.2	23.5
Medium Sand	23.5	—
Fine Sand	16.3	16.3
Silt	3.8	4.1
Clay	1.4	1.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: SW-SM
Group Name: Well-graded sand with silt and gravel

AASHTO Classification: A-1-a (1)

Comments:

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds

Source STN-C-1, 3.0'-4.5', 4.5'-6.0', 6.0'-7.5'

Project Number 175559018

Lab ID 281

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422

Prepared using: ASTM D 421

Particle Shape: Angular

Particle Hardness: Hard and Durable

Tested By: CLH

Test Date: 10-20-2009

Date Received 10-09-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	97.0
3/8"	81.9
No. 4	65.2
No. 10	45.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.71

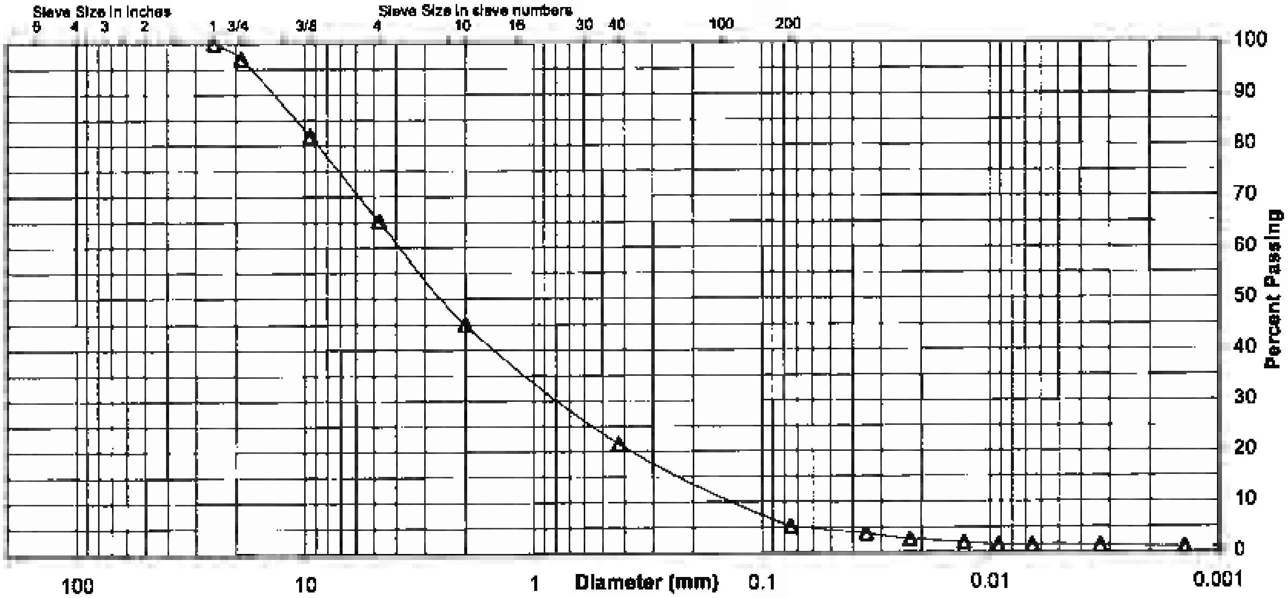
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	21.5
No. 200	5.2
0.02 mm	2.4
0.005 mm	1.4
0.002 mm	1.1
0.001 mm	0.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	3.0	31.8	20.2	23.5	16.3	3.8	1.4

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	55.0	23.5	16.3	4.1	1.1



Comments

Reviewed By RHB

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ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds

Source STN-C-1, 3.0'-4.5', 4.5'-6.0', 6.0'-7.5'

Project No. 175559018

Lab ID 281

% + No. 40 79

Date Received 10-09-2009

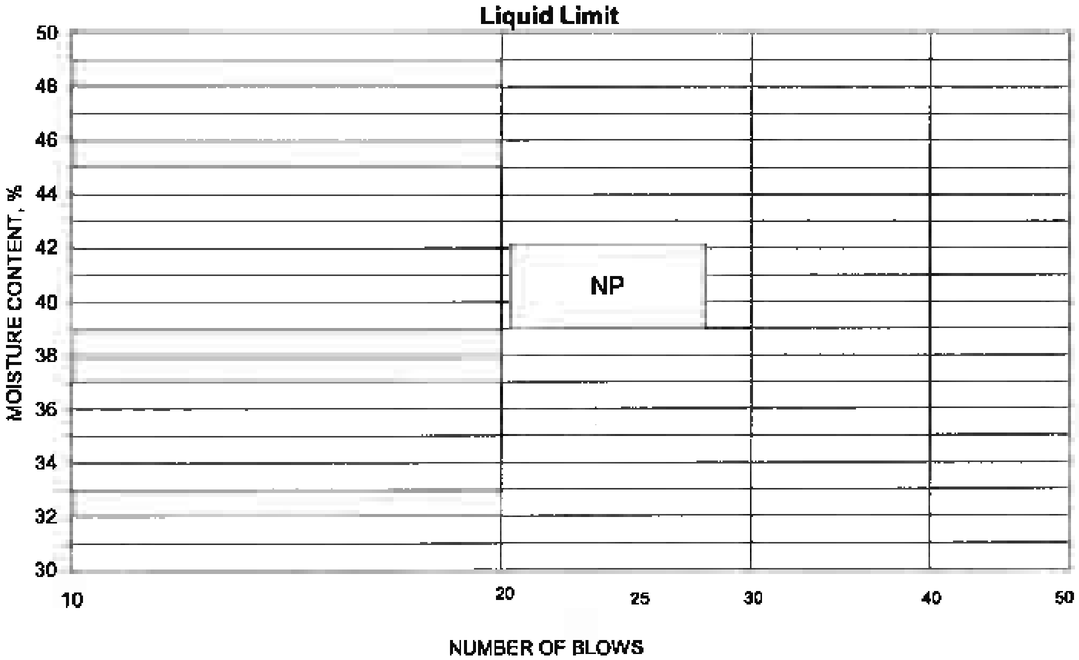
Tested By RHB

Test Method ASTM D 4318 Method A

Test Date 10-26-2009

Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-D-2, 6.0'-7.5', 7.5'-9.0', 9.0'-10.5'

Project Number 175559018
Lab ID 309

County Sumner
Sample Type SPT Comp

Date Received 10-9-09
Date Reported 10-28-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.4
No. 4	4.75	94.4
No. 10	2	90.8
No. 40	0.425	85.3
No. 200	0.075	76.9
	0.02	59.4
	0.005	38.8
	0.002	32.2
estimated	0.001	29.8

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	5.6	9.2
Coarse Sand	3.6	5.5
Medium Sand	5.5	---
Fine Sand	8.4	8.4
Silt	38.1	44.7
Clay	38.8	32.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 41
Plastic Limit: 15
Plasticity Index: 26
Activity Index: 0.81

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand

AASHTO Classification: A-7-6 (19)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-D-2, 6.0'-7.5', 7.5'-9.0', 9.0'-10.5'

Project Number 175559018
Lab ID 309

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Weathered and Friable

Tested By: CLH
Test Date: 10-20-2009
Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.4
No. 4	94.4
No. 10	90.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.71

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	85.3
No. 200	76.9
0.02 mm	59.4
0.005 mm	38.8
0.002 mm	32.2
0.001 mm	29.8

Particle Size Distribution

<table>
<tr><td rowspan="2">ASTM</td><td>Coarse Gravel</td><td>Fine Gravel</td><td>C. Sand</td><td>Medium Sand</td><td>Fine Sand</td><td colspan="2">Silt</td><td>Clay</td></tr>
<tr><td>0.0</td><td>5.6</td><td>3.6</td><td>5.5</td><td>8.4</td><td colspan="2">38.1</td><td>38.8</td></tr>
<tr><td rowspan="2">AASHTO</td><td colspan="3">Gravel</td><td>Coarse Sand</td><td>Fine Sand</td><td colspan="2">Silt</td><td>Clay</td></tr>
<tr><td colspan="3">9.2</td><td>5.5</td><td>8.4</td><td colspan="2">44.7</td><td>32.2</td></tr>
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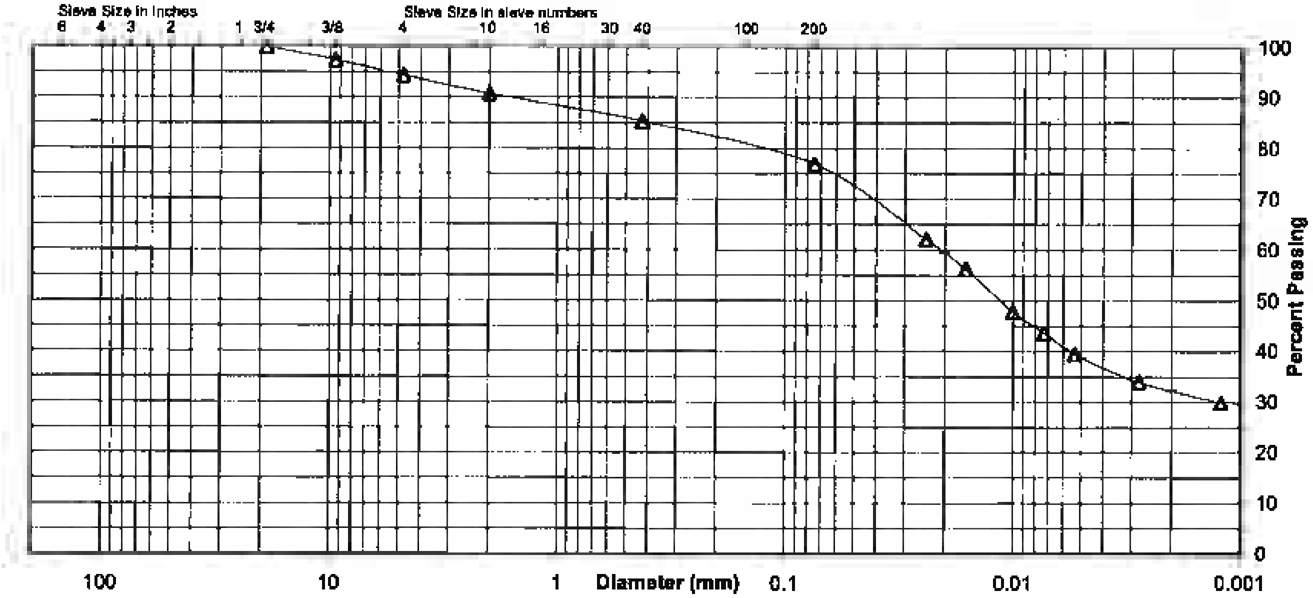


Comments

Reviewed By RHB

File: frm 175559018 sum 309 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

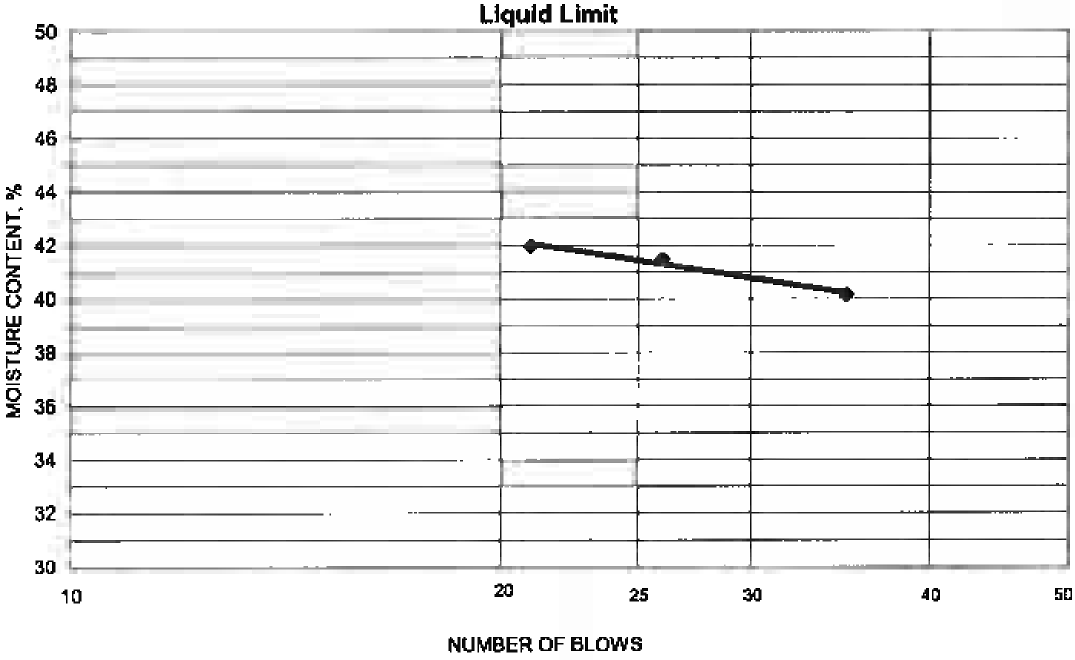
Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

ATTERBERG LIMITS

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Source	STN-D-2, 6.0'-7.5', 7.5'-9.0', 9.0'-10.5'	Lab ID	309
		% + No. 40	15
Tested By	Need! Input-Limit Test Method ASTM D 4318 Method A	Date Received	10-09-2009
Test Date	Need! Input-Limit Prepared Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
15.05	11.99	4.37	35	40.2	41
14.86	11.79	4.34	26	41.5	
14.88	11.77	4.36	21	42.0	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
11.44	10.46	4.34	16.0	15	26
11.74	10.80	4.38	14.6		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Project Number: 175559018
Source: STN-E-2, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'
Lab ID: 345

County: Sumner
Date Received: 10-9-09
Sample Type: SPT Comp
Date Reported: 10-26-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	100.0
1"	25	90.9
3/4"	19	90.9
3/8"	9.5	84.0
No. 4	4.75	77.2
No. 10	2	69.5
No. 40	0.425	62.7
No. 200	0.075	55.8
	0.02	39.2
	0.005	26.8
	0.002	20.6
estimated	0.001	17.6

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	22.8	30.5
Coarse Sand	7.7	6.8
Medium Sand	6.8	—
Fine Sand	6.9	6.9
Silt	29.0	35.2
Clay	26.8	20.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 33
Plastic Limit: 16
Plasticity Index: 17
Activity Index: 0.81

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CL
Group Name: Gravelly lean clay with sand
AASHTO Classification: A-6 (6)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Gallatin Fossil Plant (GAF) - Ash Ponds	Project Number	175559018
Source	STN-E-2, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'	Lab ID	345

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Rounded and Angular
Particle Hardness: Hard and Durable

Tested By: KDK
Test Date: 10-20-2009
Date Received 10-09-2009

Maximum Particle size: 1 1/2" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	100.0
1"	90.9
3/4"	90.9
3/8"	84.0
No. 4	77.2
No. 10	69.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.71

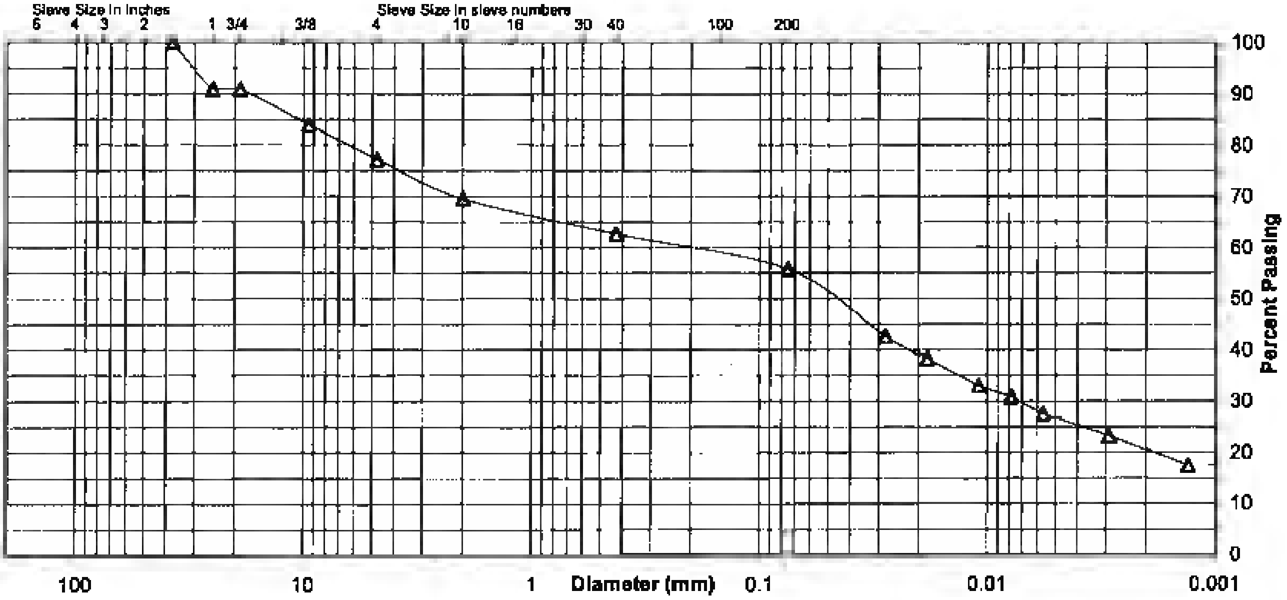
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	62.7
No. 200	55.8
0.02 mm	39.2
0.005 mm	26.8
0.002 mm	20.6
0.001 mm	17.6

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	9.1	13.7	7.7	6.8	6.9	29.0	26.8

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	30.5	6.8	6.9	35.2	20.6



Comments

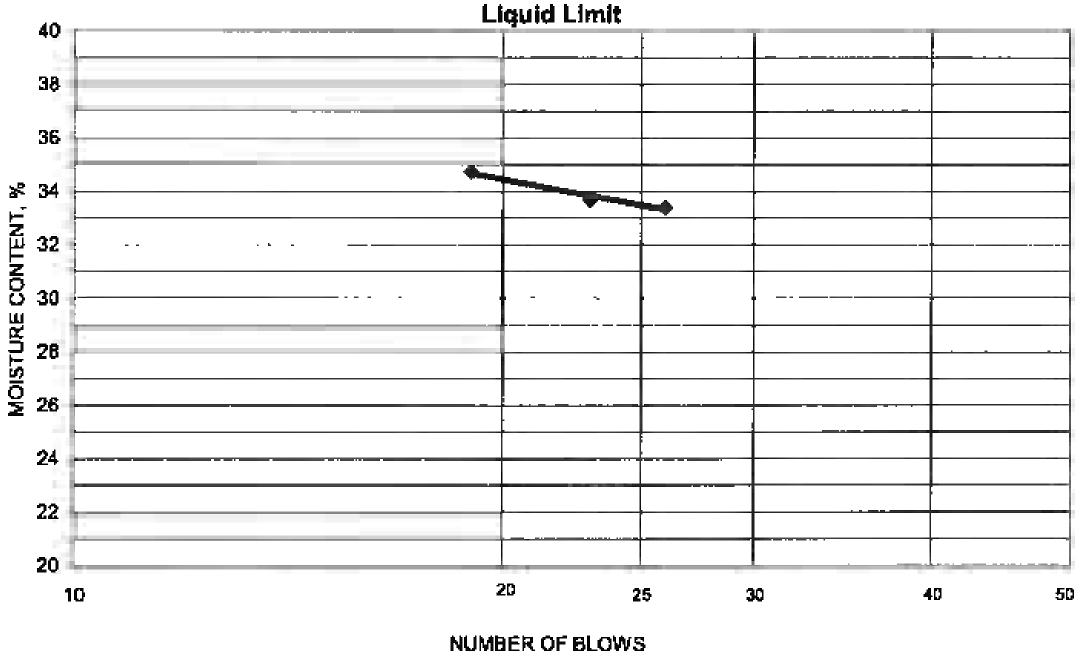
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Source	STN-E-2, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'	Lab ID	345
		% + No. 40	37
Tested By	KDK	Test Method	ASTM D 4318 Method A
Date Received	10-09-2009		
Test Date	10-21-2009	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
16.46	13.40	4.32	23	33.7	33
15.59	12.77	4.33	26	33.4	
15.68	12.77	4.39	19	34.7	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
11.07	10.16	4.33	15.6	16	17
11.79	10.76	4.33	16.0		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-3, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'
Project Number 175559018
Lab ID 367

County Sumner
Sample Type SPT Comp
Date Received 10-9-09
Date Reported 10-26-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	95.5
No. 4	4.75	84.1
No. 10	2	67.3
No. 40	0.425	44.7
No. 200	0.075	27.7
	0.02	12.1
	0.005	3.4
	0.002	1.8
estimated	0.001	1.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	15.9	32.7
Coarse Sand	16.8	22.6
Medium Sand	22.6	—
Fine Sand	17.0	17.0
Silt	24.3	25.9
Clay	3.4	1.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: SM
Group Name: Silty sand with gravel

AASHTO Classification: A-2-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-3, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'

Project Number 175559018
Lab ID 367

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 10-20-2009
Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	95.5
No. 4	84.1
No. 10	67.3

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.66

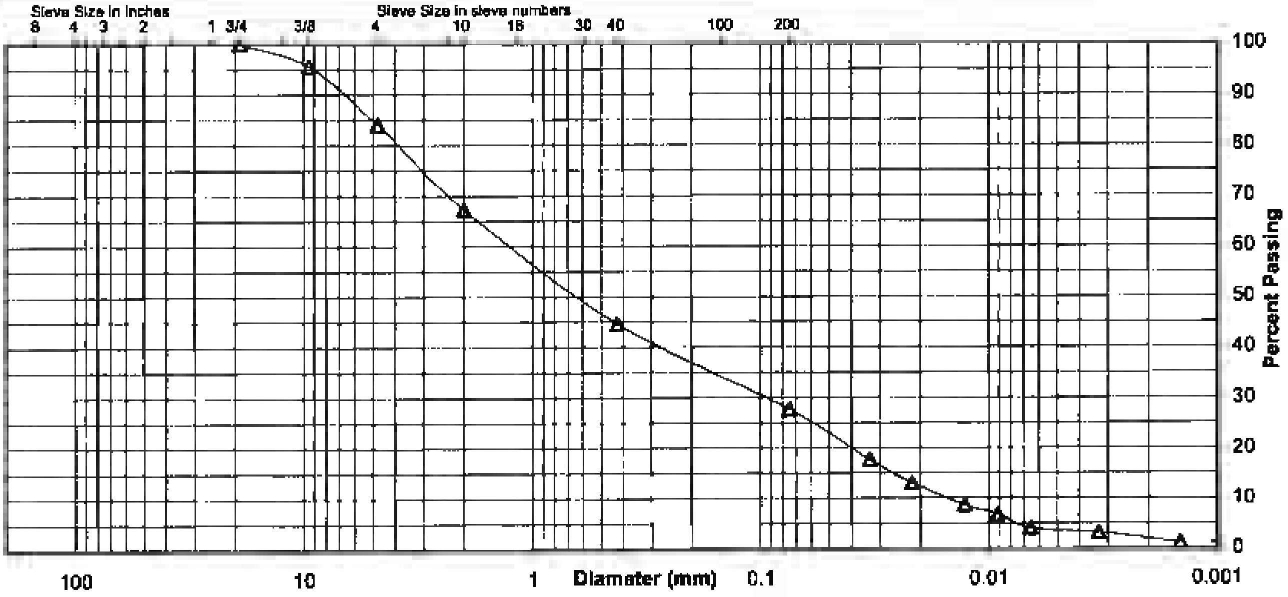
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	44.7
No. 200	27.7
0.02 mm	12.1
0.005 mm	3.4
0.002 mm	1.8
0.001 mm	1.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	15.9	16.8	22.6	17.0	24.3	3.4

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	32.7	22.6	17.0	25.9	1.8



Comments

Reviewed By RHB

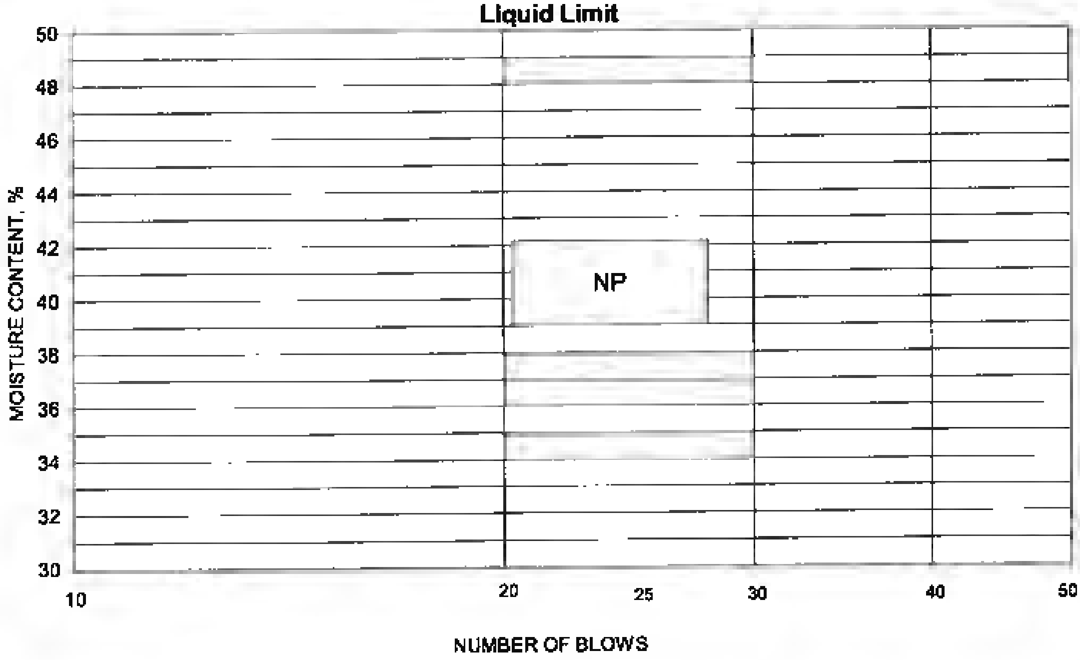
Stantec

ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-3, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'
Project No. 175559018
Lab ID 367
% + No. 40 55
Date Received 10-09-2009
Tested By RHB
Test Method ASTM D 4318 Method A
Test Date 10-26-2009
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit

Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-3, 25.5'-27.0', 27.0'-28.5', 28.5'-30.0'
Project Number 175559018
Lab ID 382

County Sumner
Sample Type SPT Comp
Date Received 10-9-09
Date Reported 10-26-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	96.8
No. 4	4.75	93.7
No. 10	2	91.0
No. 40	0.425	86.1
No. 200	0.075	76.2
	0.02	57.6
	0.005	46.8
	0.002	41.8
estimated	0.001	38.6

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	6.3	9.0
Coarse Sand	2.7	4.9
Medium Sand	4.9	---
Fine Sand	9.9	9.9
Silt	29.4	34.4
Clay	46.8	41.8

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 54
Plastic Limit: 18
Plasticity Index: 36
Activity Index: 0.86

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand
AASHTO Classification: A-7-6 (27)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-3, 25.5'-27.0', 27.0'-28.5', 28.5'-30.0'

Project Number 175559018
Lab ID 382

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Rounded
Particle Hardness: Hard and Durable

Tested By: SW
Test Date: 10-20-2009
Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	96.8
No. 4	93.7
No. 10	91.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

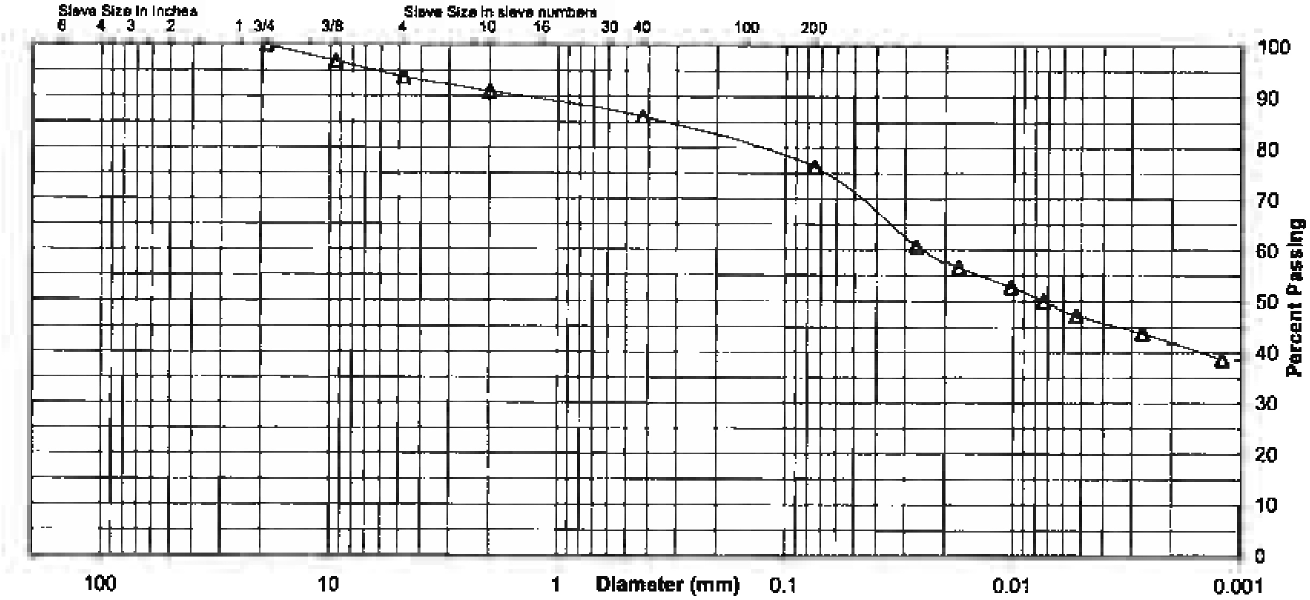
Specific Gravity 2.71

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	86.1
No. 200	76.2
0.02 mm	57.6
0.005 mm	46.8
0.002 mm	41.8
0.001 mm	38.6

Particle Size Distribution

<table>
<tr><td rowspan="2">ASTM</td><td>Coarse Gravel</td><td>Fine Gravel</td><td>C. Sand</td><td>Medium Sand</td><td>Fine Sand</td><td colspan="2">Silt</td><td colspan="2">Clay</td></tr>
<tr><td>0.0</td><td>6.3</td><td>2.7</td><td>4.8</td><td>9.9</td><td colspan="2">29.4</td><td colspan="2">46.8</td></tr>
<tr><td rowspan="2">AASHTO</td><td colspan="3">Gravel</td><td>Coarse Sand</td><td>Fine Sand</td><td colspan="3">Silt</td><td>Clay</td></tr>
<tr><td colspan="3">9.0</td><td>4.9</td><td>9.9</td><td colspan="3">34.4</td><td>41.8</td></tr>
</table>



Comments

Reviewed By RHB

File: fm_175559018_sum_382 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds

Source STN-E-3, 25.5'-27.0', 27.0'-28.5', 28.5'-30.0'

Project No. 175559018

Lab ID 382

% + No. 40 14

Date Received 10-09-2009

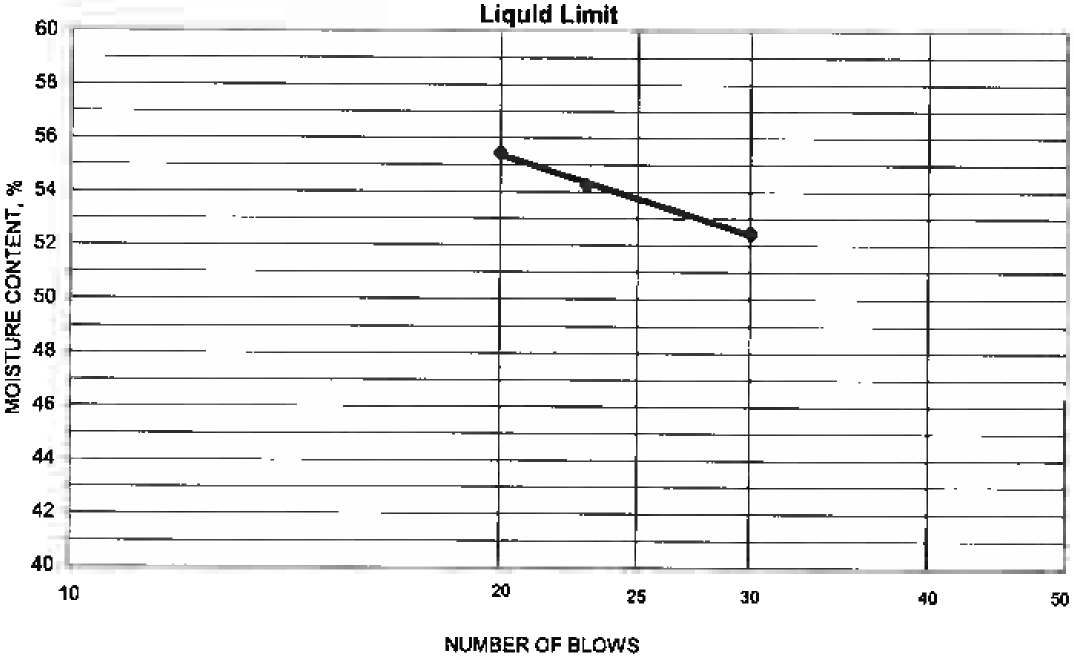
Tested By KDK

Test Method ASTM D 4318 Method A

Test Date 10-22-2009

Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
14.38	10.93	4.35	30	52.4	54
13.27	10.12	4.31	23	54.2	
13.04	9.93	4.32	20	55.4	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
11.08	10.06	4.35	17.9	18	36
11.59	10.50	4.35	17.7		

Remarks:

Reviewed By RHB

File: frm_175559018_sum_382 Sheet: Limit-Report
Preparation Date: 1998
Revision Date: 1-2008

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-4, 34.5'-36.0', 36.0'-37.5', 37.5'-39.0'
Project Number: 175559018
Lab ID: 417

County: Sumner
Sample Type: SPT Comp
Date Received: 10-9-09
Date Reported: 10-23-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.6
No. 10	2	99.2
No. 40	0.425	98.3
No. 200	0.075	91.6
	0.02	65.4
	0.005	22.8
	0.002	10.4
estimated	0.001	8.2

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.4	0.8
Coarse Sand	0.4	0.9
Medium Sand	0.9	---
Fine Sand	6.7	6.7
Silt	68.8	81.2
Clay	22.8	10.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: ---
Plastic Limit: Non Plastic
Plasticity Index: ---
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: ML
Group Name: Silt
AASHTO Classification: A-4 (0)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-4, 34.5'-36.0', 36.0'-37.5', 37.5'-39.0'

Project Number: 175559018
Lab ID: 417

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 10-23-2009
Date Received: 10-09-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.6
No. 10	99.2

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

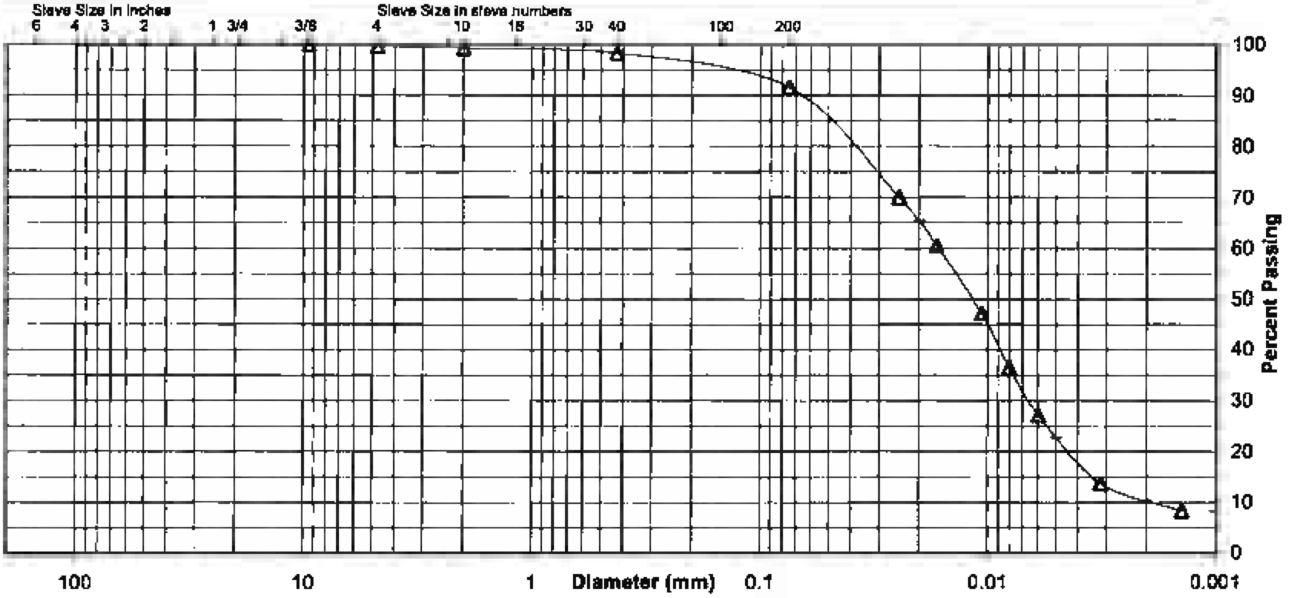
Specific Gravity: 2.66

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.3
No. 200	91.6
0.02 mm	65.4
0.005 mm	22.8
0.002 mm	10.4
0.001 mm	8.2

Particle Size Distribution

<table>
<tr><td rowspan="2">ASTM</td><td>Coarse Gravel</td><td>Fine Gravel</td><td>C. Sand</td><td>Medium Sand</td><td>Fine Sand</td><td colspan="2">Silt</td><td colspan="2">Clay</td></tr>
<tr><td>0.0</td><td>0.4</td><td>0.4</td><td>0.9</td><td>6.7</td><td colspan="2">68.8</td><td colspan="2">22.8</td></tr>
<tr><td rowspan="2">AASHTO</td><td colspan="3">Gravel</td><td>Coarse Sand</td><td>Fine Sand</td><td colspan="3">Silt</td><td>Clay</td></tr>
<tr><td colspan="3">0.8</td><td>0.9</td><td>6.7</td><td colspan="3">81.2</td><td>10.4</td></tr>
</table>



Comments

Reviewed By RHB

File: fm_175559018_sum_417 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

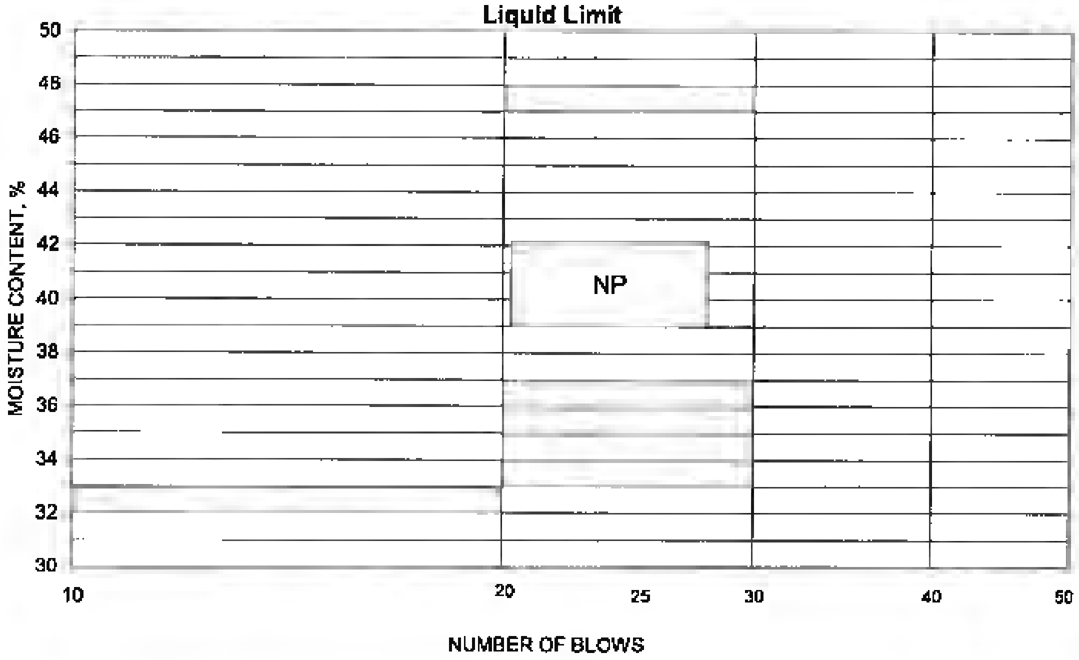
ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-4, 34.5'-36.0', 36.0'-37.5', 37.5'-39.0'

Project No. 175559018
Lab ID 417
% + No. 40 2
Date Received 10-09-2009

Tested By KDK
Test Method ASTM D 4318 Method A
Test Date 10-26-2009
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Project Number 175559018
Source STN-E-8, 31.5'-33.0'
Lab ID 542

County Sumner
Sample Type SPT Comp
Date Received 10-9-09
Date Reported 11-11-09

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 31.0

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.9
No. 10	2	99.8
No. 40	0.425	98.6
No. 200	0.075	50.6
	0.02	35.8
	0.005	27.2
	0.002	23.7
estimated	0.001	23.1

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.1	0.2
Coarse Sand	0.1	1.2
Medium Sand	1.2	—
Fine Sand	48.0	48.0
Silt	23.4	26.9
Clay	27.2	23.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 25
Plastic Limit: 13
Plasticity Index: 12
Activity Index: 0.50

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-6 (3)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-8, 31.5'-33.0'
Project Number: 175559018
Lab ID: 542

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 11-02-2009
Date Received: 10-09-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.9
No. 10	99.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.7

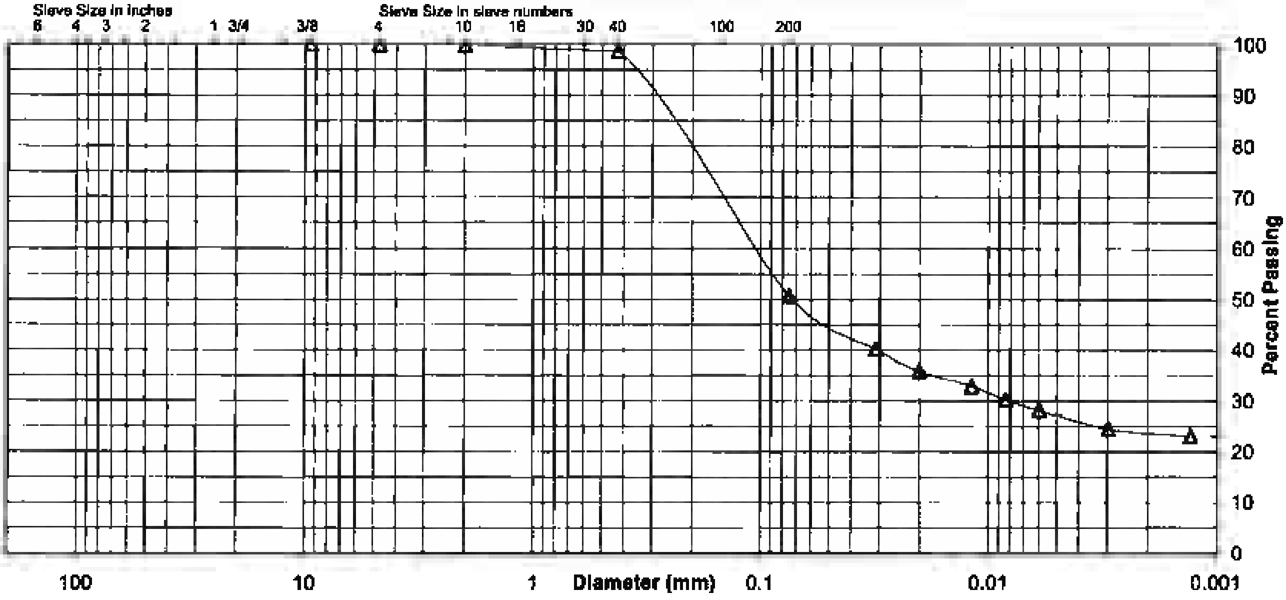
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.6
No. 200	50.6
0.02 mm	35.8
0.005 mm	27.2
0.002 mm	23.7
0.001 mm	23.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.1	0.1	1.2	48.0	23.4	27.2

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.2	1.2	48.0	26.9	23.7



Comments

Reviewed By RHB

File: frm_175559018_sum_542 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2006

Stantec Consulting Services Inc.

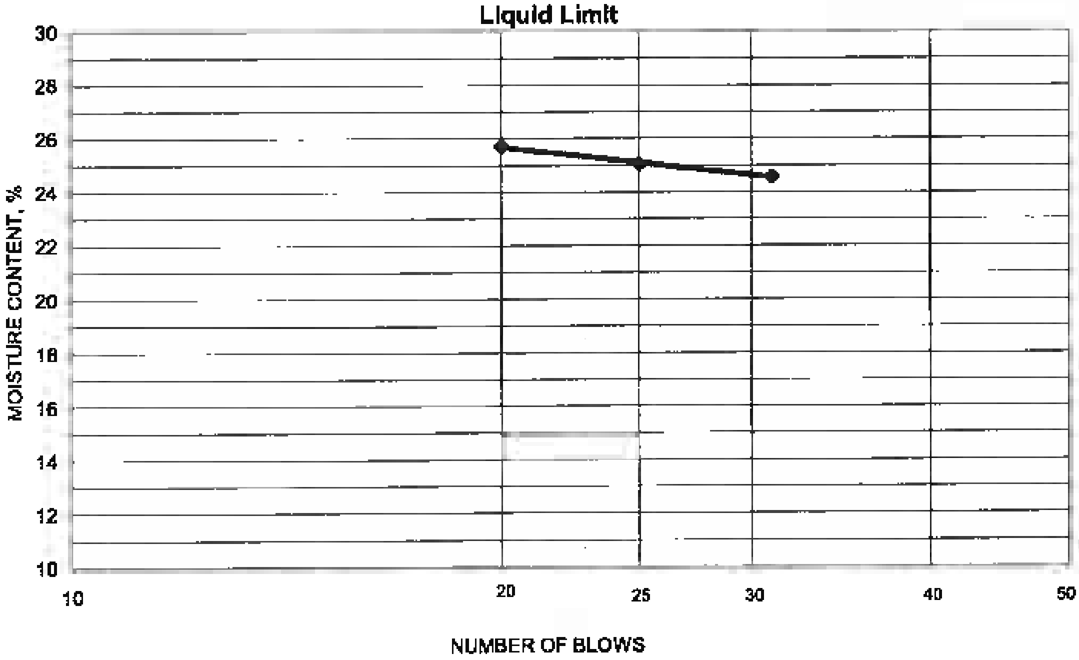
Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-8, 31.5'-33.0'
Project No. 175559018
Lab ID 542
% + No. 40 1
Tested By JMB/KDK
Test Method ASTM D 4318 Method A
Date Received 10-09-2009
Test Date 11-04-2009
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
15.24	13.10	4.39	31	24.6	25
14.27	12.27	4.28	25	25.0	
15.91	13.54	4.32	20	25.7	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
9.44	8.85	4.35	13.1	13	12
9.30	8.71	4.28	13.3		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-9, 34.0'-35.5', 35.5'-37.0', 37.0'-38.5'
Project Number: 175559018
Lab ID: 578

County: Sumner
Sample Type: SPT Comp
Date Received: 10-9-09
Date Reported: 11-10-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.2
No. 4	4.75	94.5
No. 10	2	92.4
No. 40	0.425	89.9
No. 200	0.075	62.1
	0.02	42.5
	0.005	32.1
	0.002	26.0
estimated	0.001	23.6

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	5.5	7.6
Coarse Sand	2.1	2.5
Medium Sand	2.5	---
Fine Sand	27.8	27.8
Silt	30.0	36.1
Clay	32.1	26.0

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 34
Plastic Limit: 15
Plasticity Index: 19
Activity Index: 0.73

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.72

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-6 (9)

Comments:

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds

Source STN-E-9, 34.0'-35.5', 35.5'-37.0', 37.0'-38.5'

Project Number 175559018

Lab ID 578

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422

Prepared using: ASTM D 421

Particle Shape: Angular

Particle Hardness: Hard and Durable

Tested By: CLH

Test Date: 10-28-2009

Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.2
No. 4	94.5
No. 10	92.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

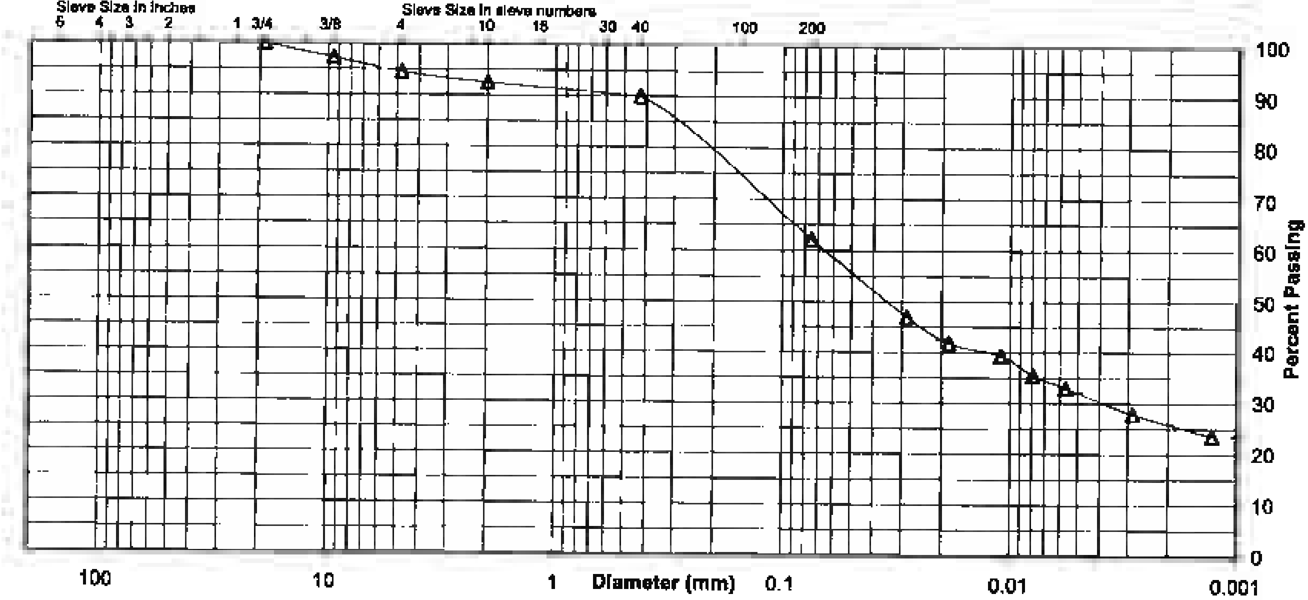
Specific Gravity 2.72

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	89.9
No. 200	62.1
0.02 mm	42.5
0.005 mm	32.1
0.002 mm	26.0
0.001 mm	23.6

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay	
	0.0	5.5	2.1	2.5	27.8	30.0	32.1	
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt		Clay
	7.6			2.5	27.8	35.1		26.0



Comments

Reviewed By RHB

File: frm_175559018_sum_578 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

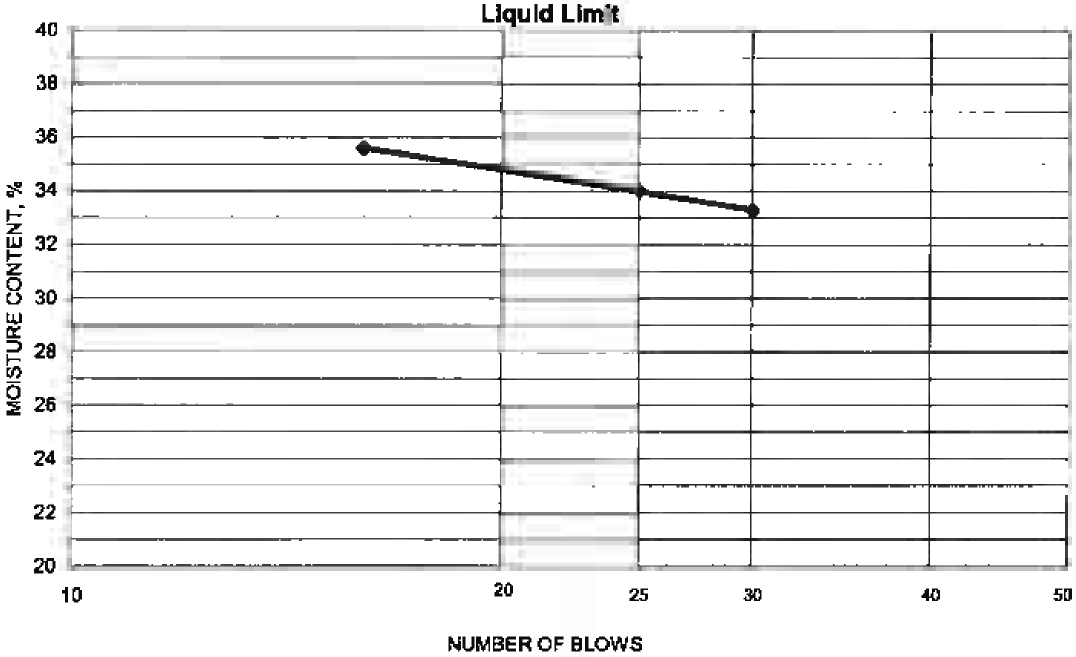
Stantec

ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-9, 34.0'-35.5', 35.5'-37.0', 37.0'-38.5'

Project No. 175559018
Lab ID 578
% + No. 40 10
Tested By JMB
Test Method ASTM D 4318 Method A
Date Received 10-09-2009
Test Date
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
11.44	9.67	4.35	30	33.3	34
12.91	10.73	4.32	25	34.0	
12.16	10.11	4.35	16	35.6	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
12.87	11.76	4.34	15.0	15	19
9.77	9.07	4.37	14.9		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Project Number: 175559018
Source: STN-E-11, 3.0'-4.5', 4.5'-6.0', 6.0'-7.5'
Lab ID: 609

County: Sumner
Date Received: 10-9-09
Sample Type: SPT Comp
Date Reported: 11-11-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	90.0
No. 4	4.75	84.5
No. 10	2	79.5
No. 40	0.425	72.9
No. 200	0.075	60.8
	0.02	45.4
	0.005	36.0
	0.002	30.7
estimated	0.001	28.5

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	15.5	20.5
Coarse Sand	5.0	6.6
Medium Sand	6.6	—
Fine Sand	12.1	12.1
Silt	24.8	30.1
Clay	36.0	30.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 45
Plastic Limit: 18
Plasticity Index: 27
Activity Index: 0.87

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay with gravel

AASHTO Classification: A-7-6 (14)

Comments:

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-11, 3.0'-4.5', 4.5'-6.0', 6.0'-7.5'

Project Number: 175559018
Lab ID: 609

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 10-30-2009
Date Received: 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	90.0
No. 4	84.5
No. 10	79.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.69

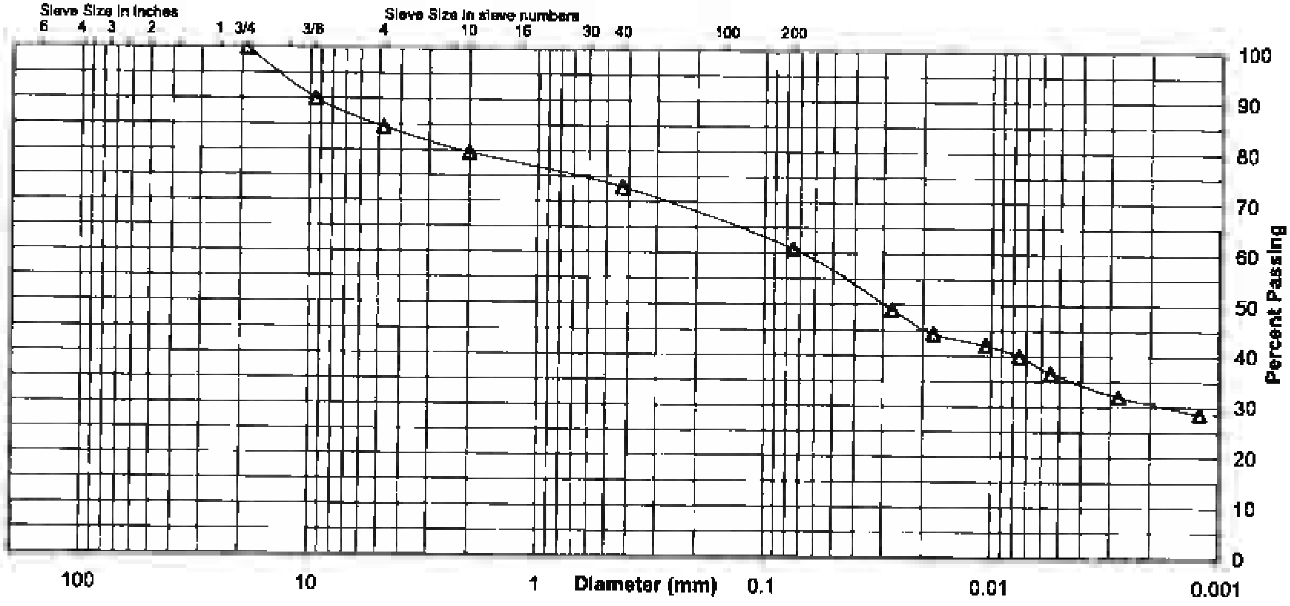
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	72.9
No. 200	60.8
0.02 mm	45.4
0.005 mm	36.0
0.002 mm	30.7
0.001 mm	28.5

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	15.5	5.0	6.6	12.1	24.8	36.0

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	20.5	6.6	12.1	30.1	30.7



Comments

Reviewed By RHB

File: fm_175559018_sum_609 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

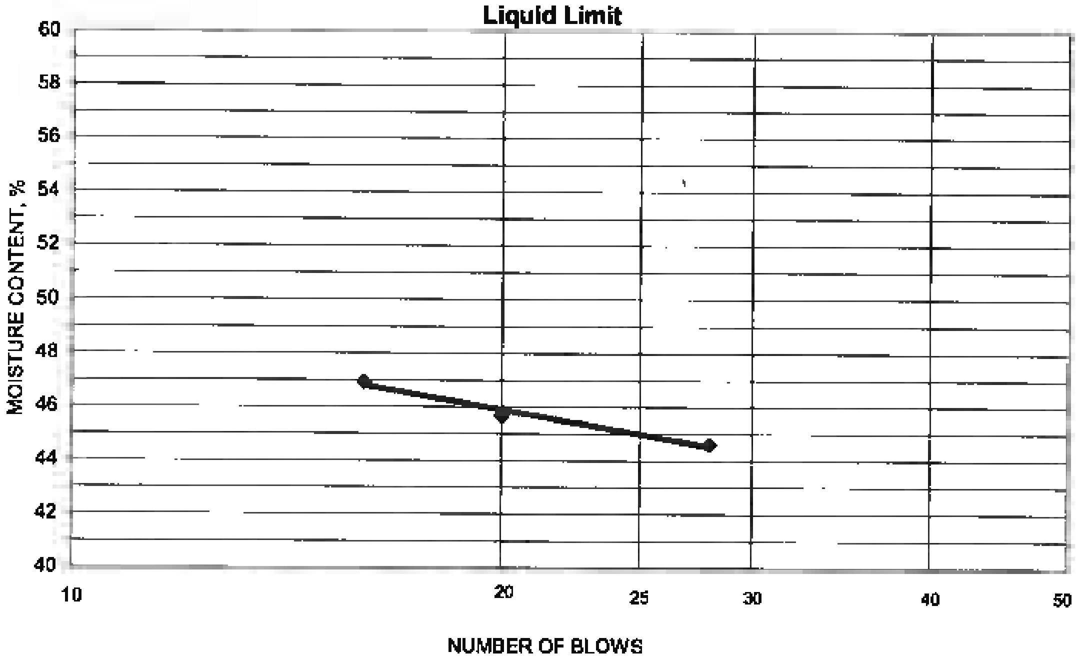
Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-11, 3.0'-4.5', 4.5'-6.0', 6.0'-7.5'
Tested By JMB
Test Date 11-02-2009
Test Method ASTM D 4318 Method A
Prepared Dry
Project No. 175559018
Lab ID 609
% + No. 40 27
Date Received 10-09-2009

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
11.04	8.97	4.33	28	44.6	45
10.75	8.74	4.34	20	45.7	
10.56	8.57	4.33	16	46.9	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
10.51	9.57	4.34	18.0	18	27
10.42	9.49	4.33	18.0		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-13, 16.5'-18.0', 18.0'-19.5', 19.5'-21.0'
Project Number: 175559018
Lab ID: 664

County: Sumner
Sample Type: SPT Comp
Date Received: 10-9-09
Date Reported: 11-6-09

Test Results

Natural Moisture Content

Test Not Performed

Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.2
No. 4	4.75	96.5
No. 10	2	96.0
No. 40	0.425	93.8
No. 200	0.075	90.8
	0.02	86.2
	0.005	79.2
	0.002	66.5
estimated	0.001	58.4

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	3.5	4.0
Coarse Sand	0.5	2.2
Medium Sand	2.2	---
Fine Sand	3.0	3.0
Silt	11.6	24.3
Clay	79.2	66.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 77
Plastic Limit: 26
Plasticity Index: 51
Activity Index: 0.77

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CH
Group Name: Fat clay

AASHTO Classification: A-7-6 (53)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-13, 16.5'-18.0', 18.0'-19.5', 19.5'-21.0'

Project Number: 175559018
Lab ID: 664

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 10-28-2009
Date Received: 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.2
No. 4	96.5
No. 10	96.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

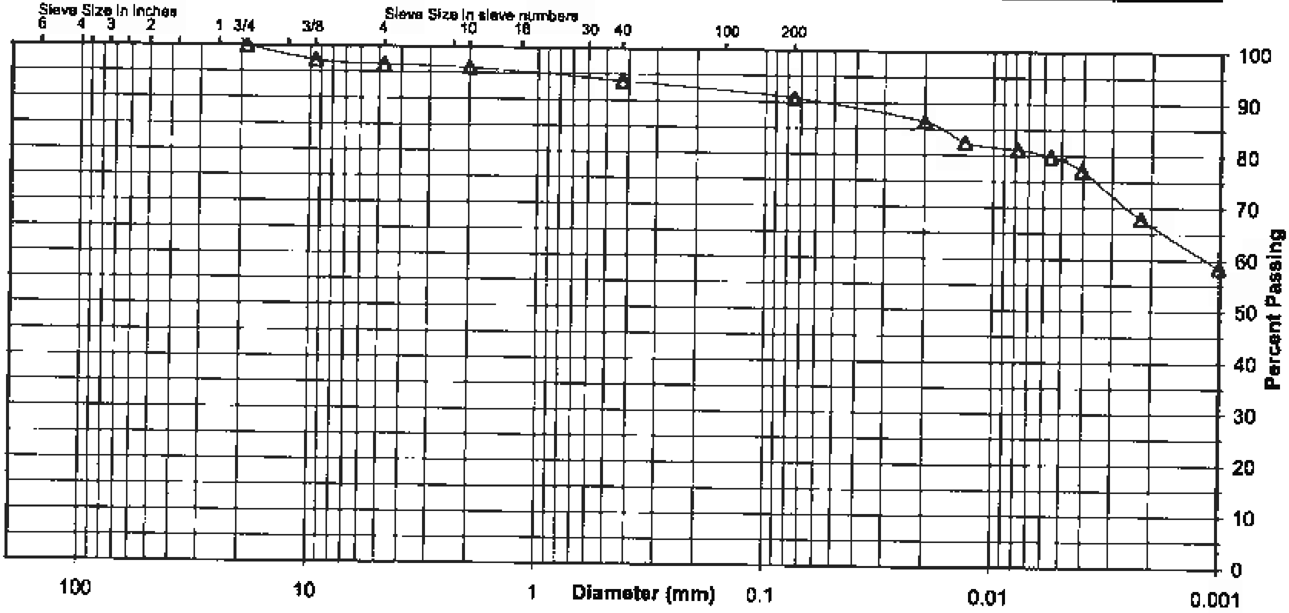
Specific Gravity: 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	93.8
No. 200	90.8
0.02 mm	86.2
0.005 mm	79.2
0.002 mm	66.5
0.001 mm	58.4

Particle Size Distribution

ASTM	Coarse Gravel 0.0	Fine Gravel 3.5	C. Sand 0.5	Medium Sand 2.2	Fine Sand 3.0	Silt 11.6	Clay 79.2
AASHTO	Gravel 4.0			Coarse Sand 2.2	Fine Sand 3.0	Silt 24.3	Clay 66.5



Comments

Reviewed By RHB

File: frm_175559018_sum_664 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

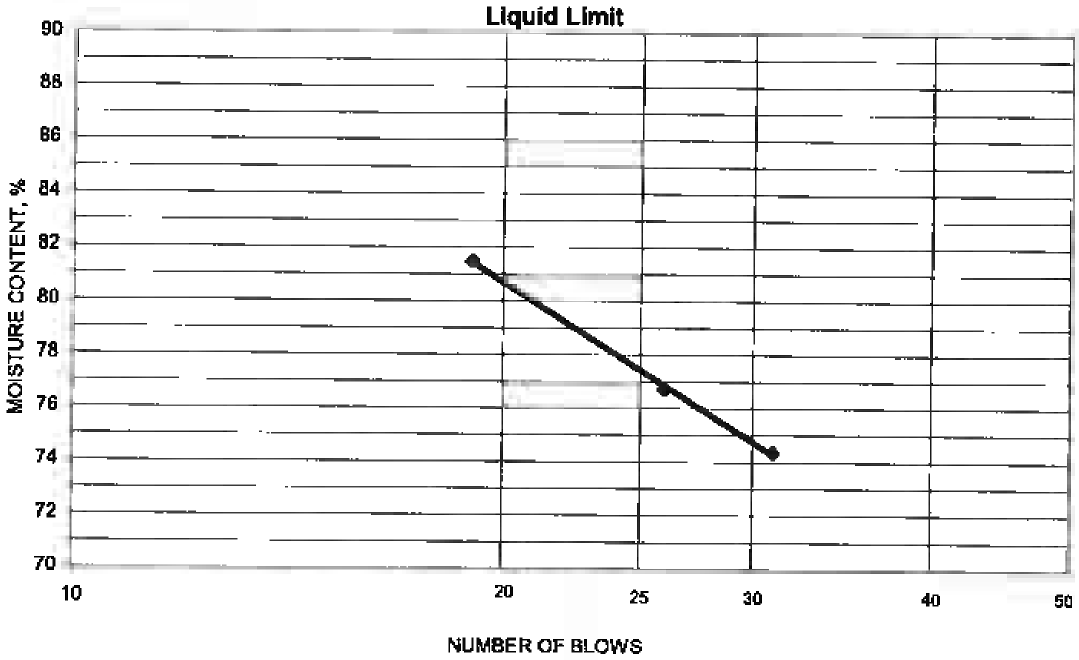
ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-13, 16.5'-18.0', 18.0'-19.5', 19.5'-21.0'

Project No. 175559018
Lab ID 664
% + No. 40 6
Date Received 10-09-2009

Tested By KDK
Test Date 10-29-2009
Test Method ASTM D 4318 Method A
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
12.18	8.66	4.34	19	81.5	77
13.13	9.31	4.33	26	76.7	
11.84	8.65	4.36	31	74.4	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
10.38	9.12	4.36	26.5	26	51
10.69	9.40	4.34	25.5		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-15, 11.5'-13.0', 13.0'-14.5', 14.5'-16.0'
Project Number: 175559018
Lab ID: 711

County: Sumner
Sample Type: SPT Comp
Date Received: 10-9-09
Date Reported: 11-4-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	96.4
No. 4	4.75	93.9
No. 10	2	92.7
No. 40	0.425	90.4
No. 200	0.075	81.2
	0.02	73.5
	0.005	63.6
	0.002	56.3
estimated	0.001	51.1

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	6.1	7.3
Coarse Sand	1.2	2.3
Medium Sand	2.3	---
Fine Sand	9.2	9.2
Silt	17.6	24.9
Clay	63.6	56.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 65
Plastic Limit: 20
Plasticity Index: 45
Activity Index: 0.80

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand

AASHTO Classification: A-7-6 (38)

Comments:

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Gallatin Fossil Plant (GAF) - Ash Ponds	Project Number	175559018
Source	STN-E-15, 11.5'-13.0', 13.0'-14.5', 14.5'-16.0'	Lab ID	711

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 10-28-2009
Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	96.4
No. 4	93.9
No. 10	92.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	90.4
No. 200	81.2
0.02 mm	73.5
0.005 mm	63.6
0.002 mm	56.3
0.001 mm	51.1

Particle Size Distribution

<table>
<tr><td rowspan="2">ASTM</td><td>Coarse Gravel</td><td>Fine Gravel</td><td>C. Sand</td><td>Medium Sand</td><td>Fine Sand</td><td>Silt</td><td>Clay</td></tr>
<tr><td>0.0</td><td>6.1</td><td>1.2</td><td>2.3</td><td>9.2</td><td>17.5</td><td>63.6</td></tr>
<tr><td rowspan="2">AASHTO</td><td colspan="3">Gravel</td><td>Coarse Sand</td><td>Fine Sand</td><td>Silt</td><td>Clay</td></tr>
<tr><td colspan="3">7.3</td><td>2.3</td><td>9.2</td><td>24.9</td><td>56.3</td></tr>
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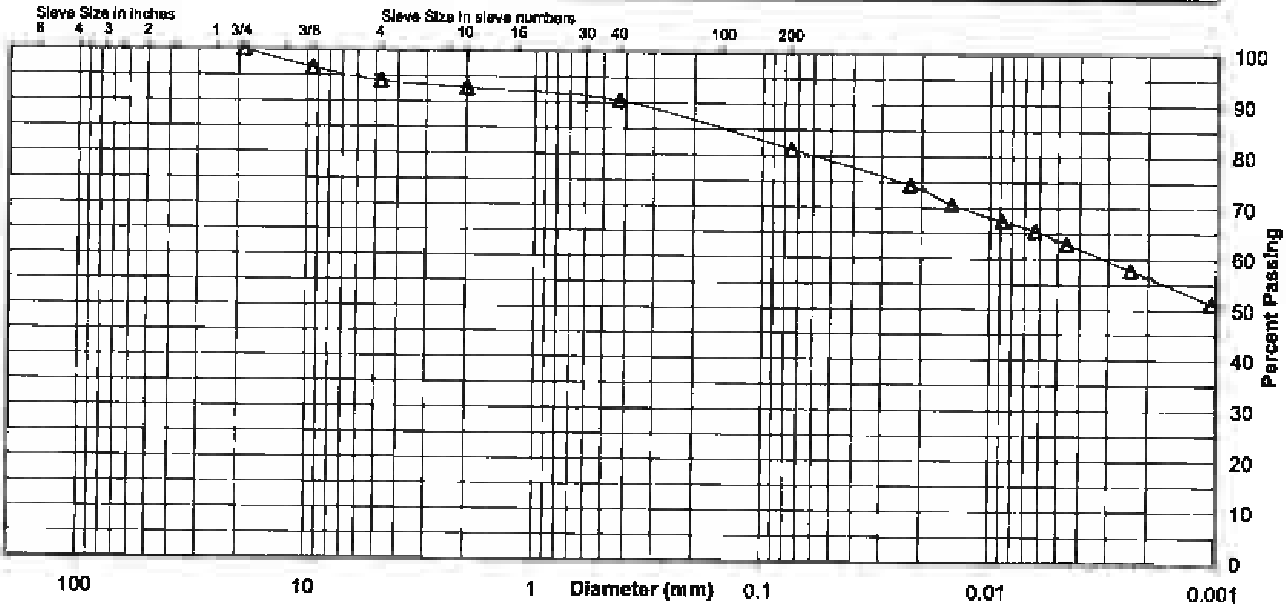


Comments

Reviewed By RHB

Stantec

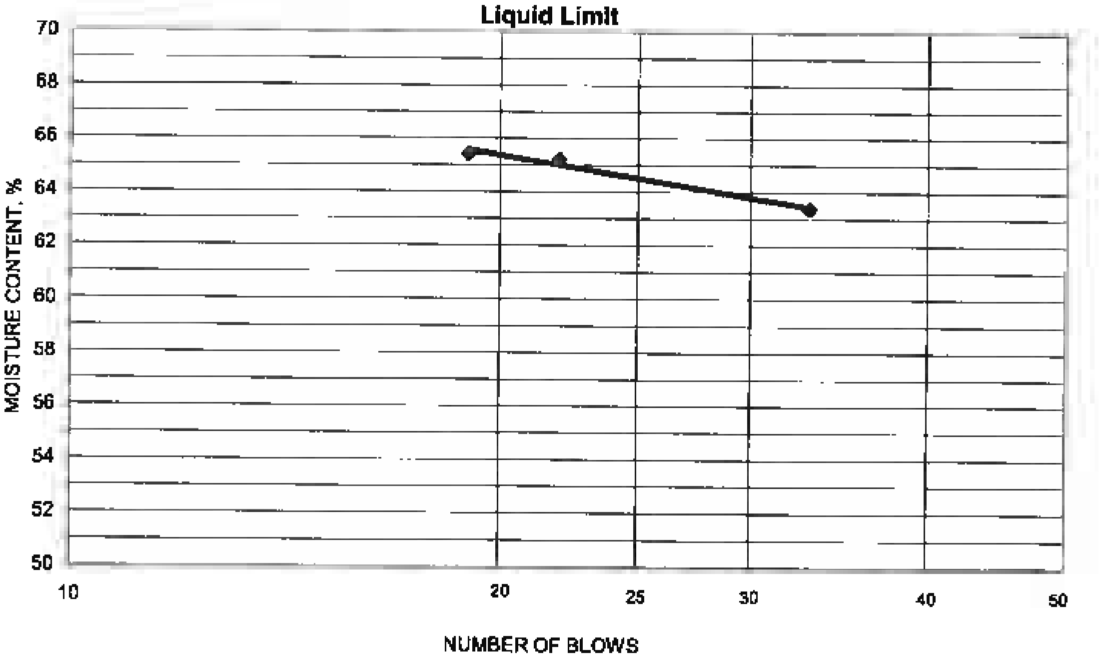
ATTERBERG LIMITS

Project: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-15, 11.5'-13.0', 13.0'-14.5', 14.5'-16.0'

Project No. 175559018
Lab ID 711
% + No. 40 10
Date Received 10-09-2009

Tested By KDK
Test Method ASTM D 4318 Method A
Test Date 11-02-2009
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
13.39	9.86	4.29	33	63.4	65
13.45	9.85	4.33	22	65.2	
12.60	9.33	4.33	19	65.4	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
10.45	9.44	4.35	19.8	20	45
8.91	8.17	4.36	19.4		

Remarks:

Reviewed By RHB

File: frm_175559018_sum_711 Sheet: Limit-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-16, 18.0'-19.5', 19.5'-21.0', 21.0'-22.5'
Project Number: 175559018
Lab ID: 735

County: Sumner
Sample Type: SPT Comp
Date Received: 10-9-09
Date Reported: 11-4-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.7
No. 4	4.75	92.3
No. 10	2	83.5
No. 40	0.425	67.0
No. 200	0.075	35.4
	0.02	11.5
	0.005	4.2
	0.002	2.4
estimated	0.001	1.9

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	7.7	16.5
Coarse Sand	8.8	16.5
Medium Sand	16.5	—
Fine Sand	31.6	31.6
Silt	31.2	33.0
Clay	4.2	2.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: —
Plastic Limit: Non Plastic
Plasticity Index: —
Activity Index: N/A

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.51

Classification

Unified Group Symbol: SM
Group Name: Silty sand
AASHTO Classification: A-2-4 (0)

Comments:

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-16, 18.0'-19.5', 19.5'-21.0', 21.0'-22.5'

Project Number 175559018
Lab ID 735

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 10-28-2009
Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.7
No. 4	92.3
No. 10	83.5

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

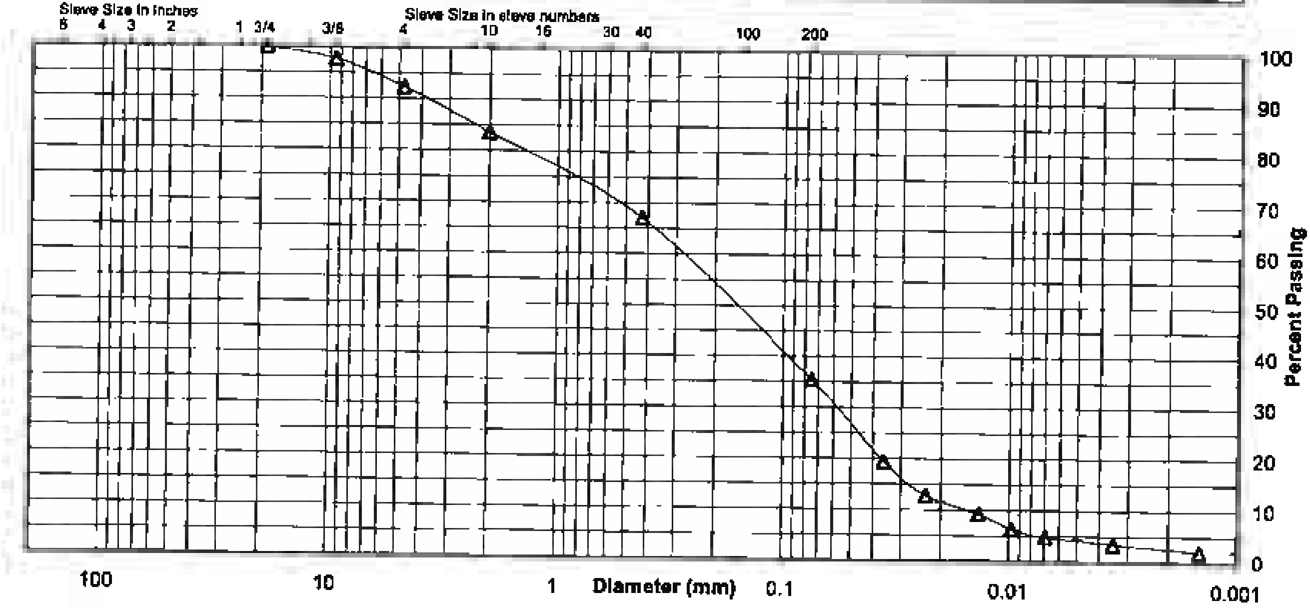
Specific Gravity 2.51

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	67.0
No. 200	35.4
0.02 mm	11.5
0.005 mm	4.2
0.002 mm	2.4
0.001 mm	1.9

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	7.7	8.8	16.5	31.6	31.2	4.2
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	16.5			16.5	31.6	33.0	2.4



Comments

Reviewed By RHB

File: frm_175559018_sum_735 Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

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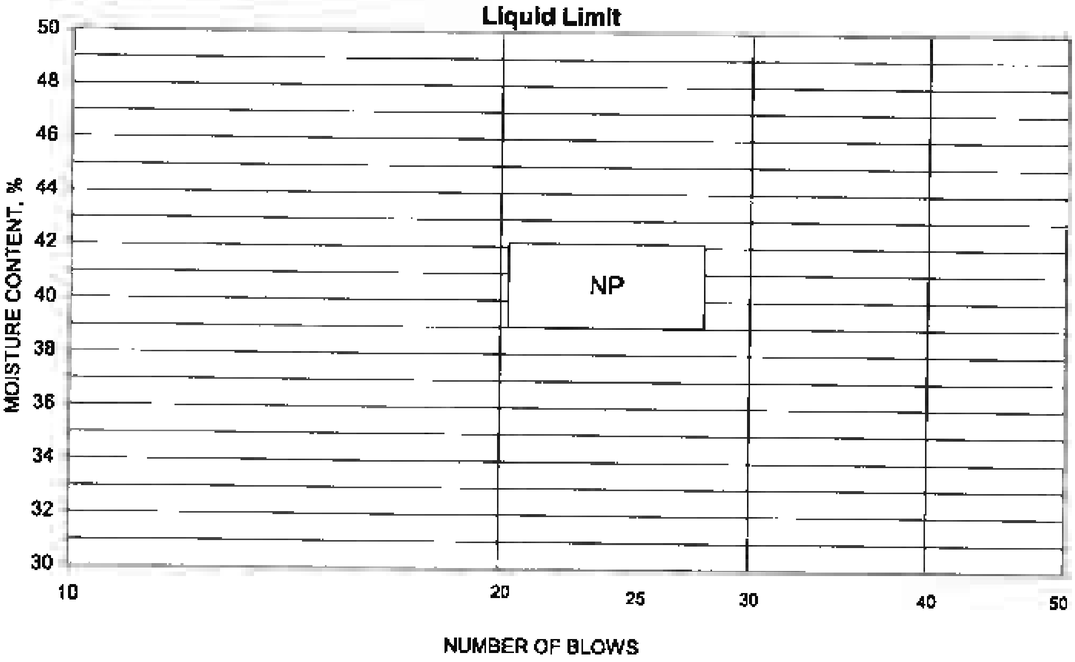
ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-16, 18.0'-19.5', 19.5'-21.0', 21.0'-22.5'

Project No. 175559018
Lab ID 735
% + No. 40 33
Date Received 10-09-2009

Tested By CLH
Test Date 10-25-2009
Test Method ASTM D 4318 Method A
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-17, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'
Project Number: 175559018
Lab ID: 766

County: Sumner
Sample Type: SPT Comp
Date Received: 10-9-09
Date Reported: 11-4-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.6
No. 10	2	98.4
No. 40	0.425	96.2
No. 200	0.075	83.6
	0.02	66.1
	0.005	52.3
	0.002	45.2
estimated	0.001	42.7

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.4	1.6
Coarse Sand	1.2	2.2
Medium Sand	2.2	—
Fine Sand	12.6	12.6
Silt	31.3	38.4
Clay	52.3	45.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 47
Plastic Limit: 19
Plasticity Index: 28
Activity Index: 0.62

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.70

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand

AASHTO Classification: A-7-6 (24)

Comments:

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-17, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'

Project Number 175559018
Lab ID 766

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 10-26-2009
Date Received 10-09-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.6
No. 10	98.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

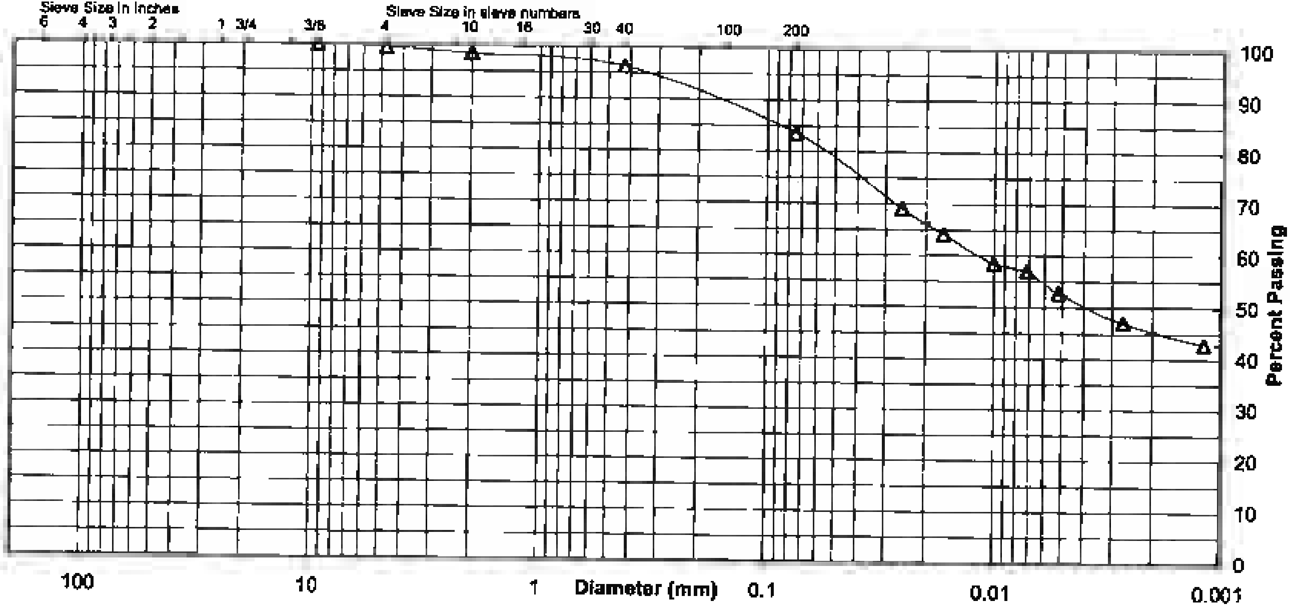
Specific Gravity 2.7

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	96.2
No. 200	83.6
0.02 mm	66.1
0.005 mm	52.3
0.002 mm	45.2
0.001 mm	42.7

Particle Size Distribution

ASTM	Coarse Gravel 0.0	Fine Gravel 0.4	C. Sand 1.2	Medium Sand 2.2	Fine Sand 12.6	Silt 31.3	Clay 52.3
AASHTO	Gravel 1.6			Coarse Sand 2.2	Fine Sand 12.6	Silt 38.4	Clay 45.2



Comments

Reviewed By RHB

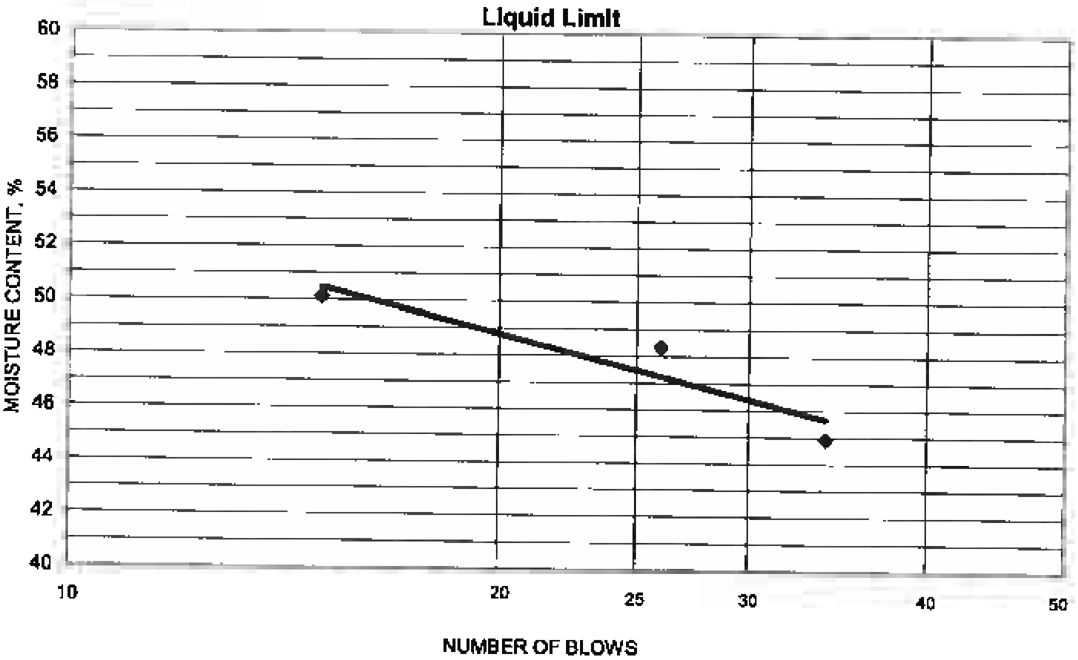
ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-17, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'

Project No. 175559018
Lab ID 766
% + No. 40 4
Date Received 10-09-2009

Tested By JMB
Test Method ASTM D 4318 Method A
Test Date 11-02-2009
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
10.07	8.30	4.36	34	44.9	47
14.06	10.88	4.30	26	48.3	
10.78	8.65	4.40	15	50.1	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
10.41	9.45	4.33	18.8	19	28
9.21	8.45	4.33	18.4		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-18, 22.5'-24.0', 24.0'-25.5', 25.5'-27.0'
County: Sumner
Sample Type: SPT Comp

Project Number: 175559018
Lab ID: 806
Date Received: 10-9-09
Date Reported: 10-28-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		% Passing
Sieve Size	(mm)	
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	96.5
No. 4	4.75	96.4
No. 10	2	96.0
No. 40	0.425	92.8
No. 200	0.075	85.5
	0.02	61.7
	0.005	38.8
	0.002	30.7
estimated	0.001	27.8

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	3.6	4.0
Coarse Sand	0.4	3.2
Medium Sand	3.2	---
Fine Sand	7.3	7.3
Silt	46.7	54.8
Clay	38.8	30.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 34
Plastic Limit: 14
Plasticity Index: 20
Activity Index: 0.65

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.69

Classification

Unified Group Symbol: CL
Group Name: Lean clay

AASHTO Classification: A-6 (16)

Comments:

Particle-Size Analysis of Soils

ASTM D 422

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds

Source: STN-E-18, 22.5'-24.0', 24.0'-25.5', 25.5'-27.0'

Project Number: 175559018

Lab ID: 806

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422

Prepared using: ASTM D 421

Particle Shape: Angular

Particle Hardness: Hard and Durable

Tested By: CLH

Test Date: 10-23-2009

Date Received: 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	96.5
No. 4	96.4
No. 10	96.0

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.69

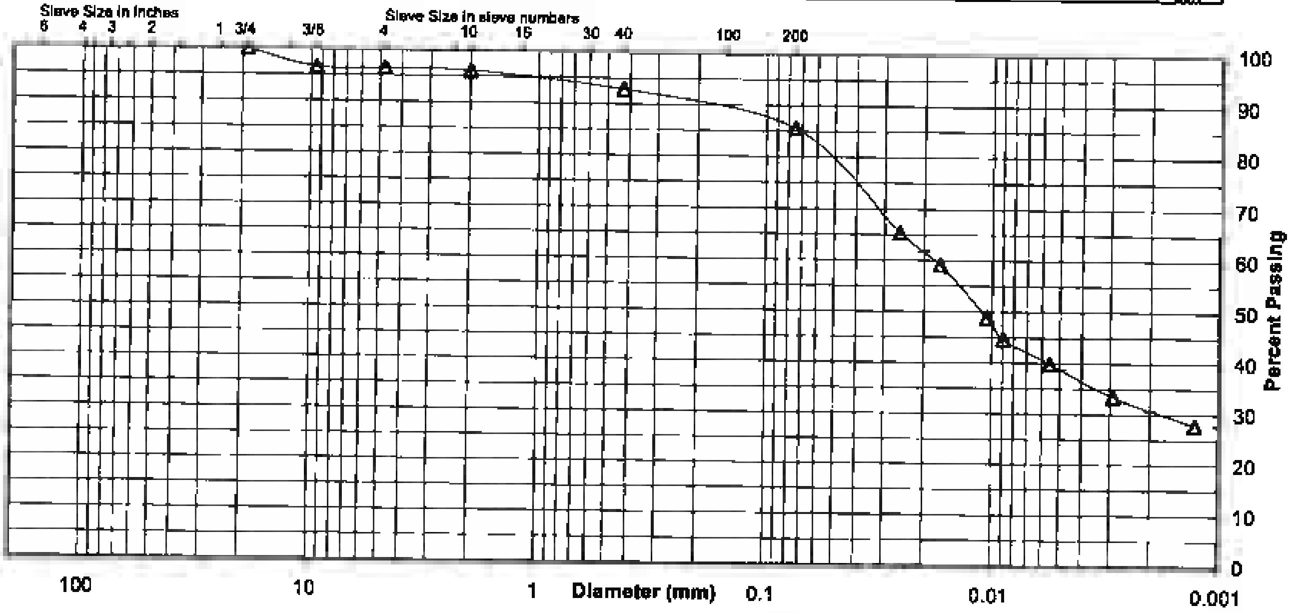
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	92.8
No. 200	85.5
0.02 mm	61.7
0.005 mm	38.8
0.002 mm	30.7
0.001 mm	27.8

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	3.6	0.4	3.2	7.3	46.7	38.8

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	4.0	3.2	7.3	54.8	30.7



Comments

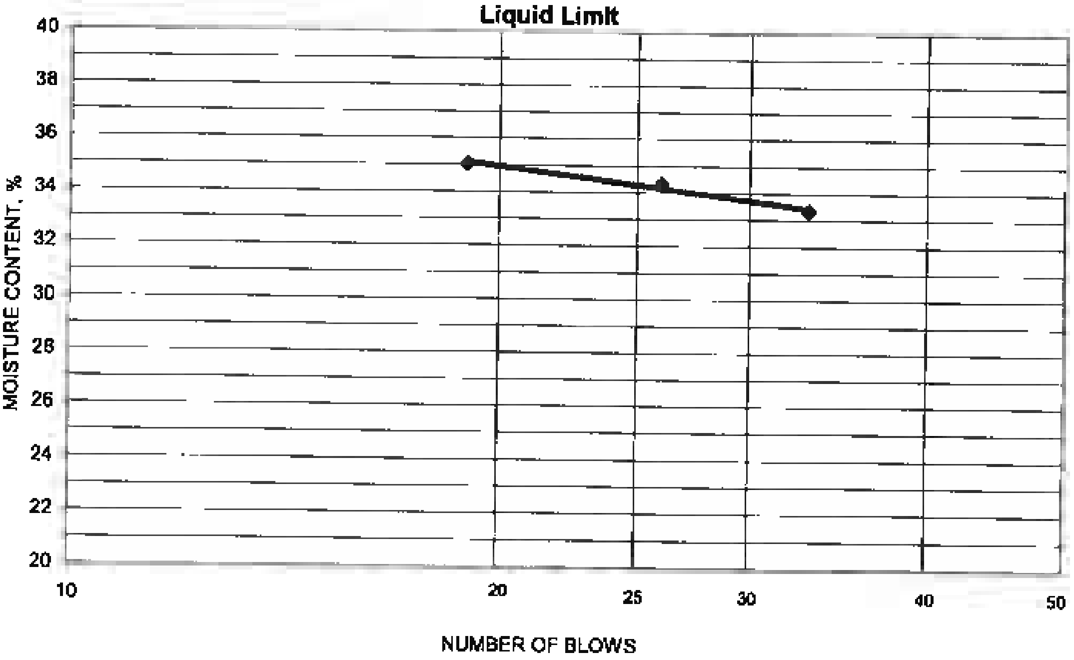
Reviewed By RHB

Stantec

ATTERBERG LIMITS

Project: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-18, 22.5'-24.0', 24.0'-25.5', 25.5'-27.0'
Tested By: KDK
Test Date: 10-26-2009
Test Method: ASTM D 4318 Method A
Prepared: Dry
Project No.: 175559018
Lab ID: 806
% + No. 40: 7
Date Received: 10-09-2009

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
15.00	12.35	4.40	33	33.3	34
15.16	12.39	4.32	26	34.3	
15.21	12.39	4.34	19	35.0	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
11.95	11.02	4.32	13.9	14	20
10.84	10.07	4.33	13.4		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Project Number 175559018
Source STN-E-20, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'
Lab ID 851

County Sumner
Date Received 10-9-09
Sample Type SPT Comp
Date Reported 11-10-09

Test Results

Natural Moisture Content

Test Not Performed
Moisture Content (%): N/A

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	94.0
No. 4	4.75	91.6
No. 10	2	89.9
No. 40	0.425	86.5
No. 200	0.075	70.9
	0.02	58.8
	0.005	49.6
	0.002	43.6
estimated	0.001	42.1

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	8.4	10.1
Coarse Sand	1.7	3.4
Medium Sand	3.4	—
Fine Sand	15.6	15.6
Silt	21.3	27.3
Clay	49.6	43.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 54
Plastic Limit: 18
Plasticity Index: 36
Activity Index: 0.82

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.66

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand

AASHTO Classification: A-7-6 (24)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Gallatin Fossil Plant (GAF) - Ash Ponds	Project Number	175559018
Source	STN-E-20, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'	Lab ID	851

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: CLH
Test Date: 10-29-2009
Date Received 10-09-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	94.0
No. 4	91.6
No. 10	89.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.66

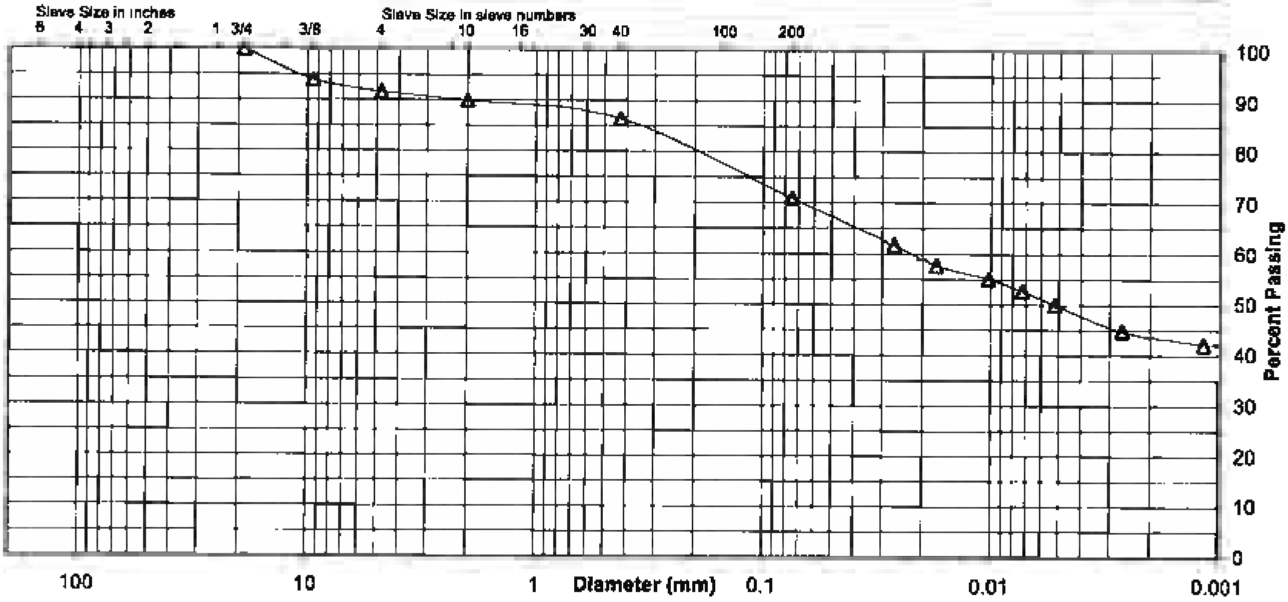
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	86.5
No. 200	70.9
0.02 mm	58.8
0.005 mm	49.6
0.002 mm	43.6
0.001 mm	42.1

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	8.4	1.7	3.4	15.6	21.3	49.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	10.1	3.4	15.6	27.3	43.6



Comments

Reviewed By RHB

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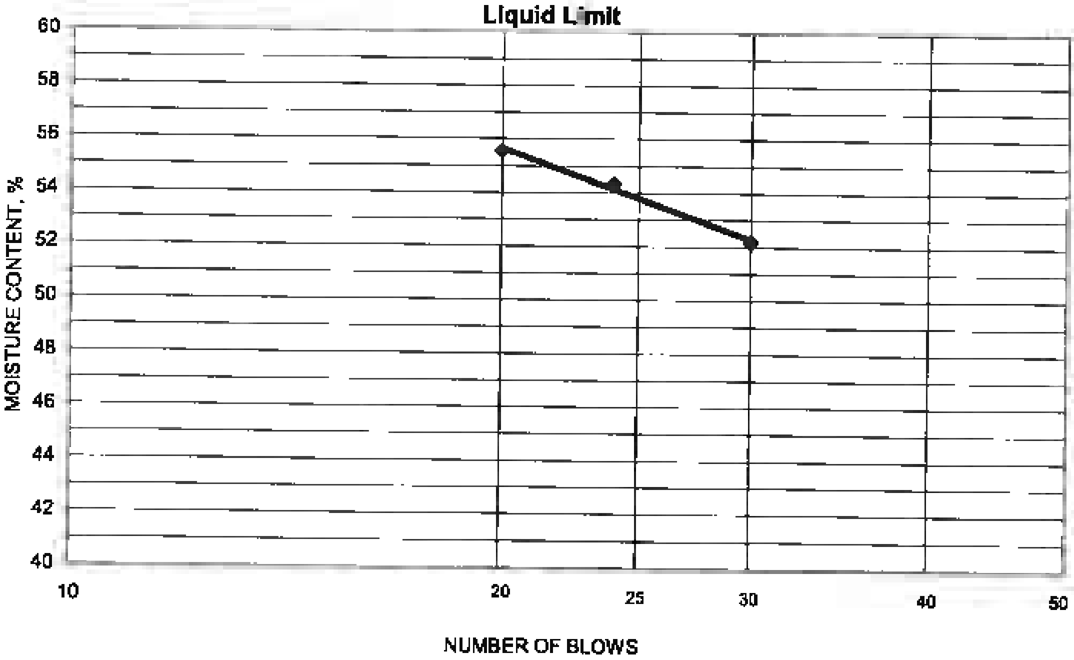
ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-20, 4.5'-6.0', 6.0'-7.5', 7.5'-9.0'

Project No. 175559018
Lab ID 851
% + No. 40 14
Date Received 10-09-2009

Tested By KDK
Test Date 11-04-2009
Test Method ASTM D 4318 Method A
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
14.81	11.22	4.34	30	52.2	54
14.52	10.93	4.32	24	54.3	
13.56	10.25	4.29	20	55.5	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
10.59	9.64	4.31	17.8	18	36
10.87	9.87	4.31	18.0		

Remarks:

Reviewed By RHB

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-6, 29.1'-29.5'

County Sumner
Sample Type ST

Project Number 175559018
Lab ID 5

Date Received 9-16-09
Date Reported 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 31.9

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	97.5
No. 10	2	95.9
No. 40	0.425	90.3
No. 200	0.075	85.5
	0.02	70.2
	0.005	54.5
	0.002	46.4
estimated	0.001	42.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	2.5	4.1
Coarse Sand	1.6	5.6
Medium Sand	5.6	---
Fine Sand	4.8	4.8
Silt	31.0	39.1
Clay	54.5	46.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 60
Plastic Limit: 19
Plasticity Index: 41
Activity Index: 0.89

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.77

Classification

Unified Group Symbol: CH
Group Name: Fat clay

AASHTO Classification: A-7-6 (37)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-6, 29.1'-29.5'

Project Number 175559018
Lab ID 5

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: BWT
Test Date: 04-27-2010
Date Received 09-16-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	97.5
No. 10	95.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.77

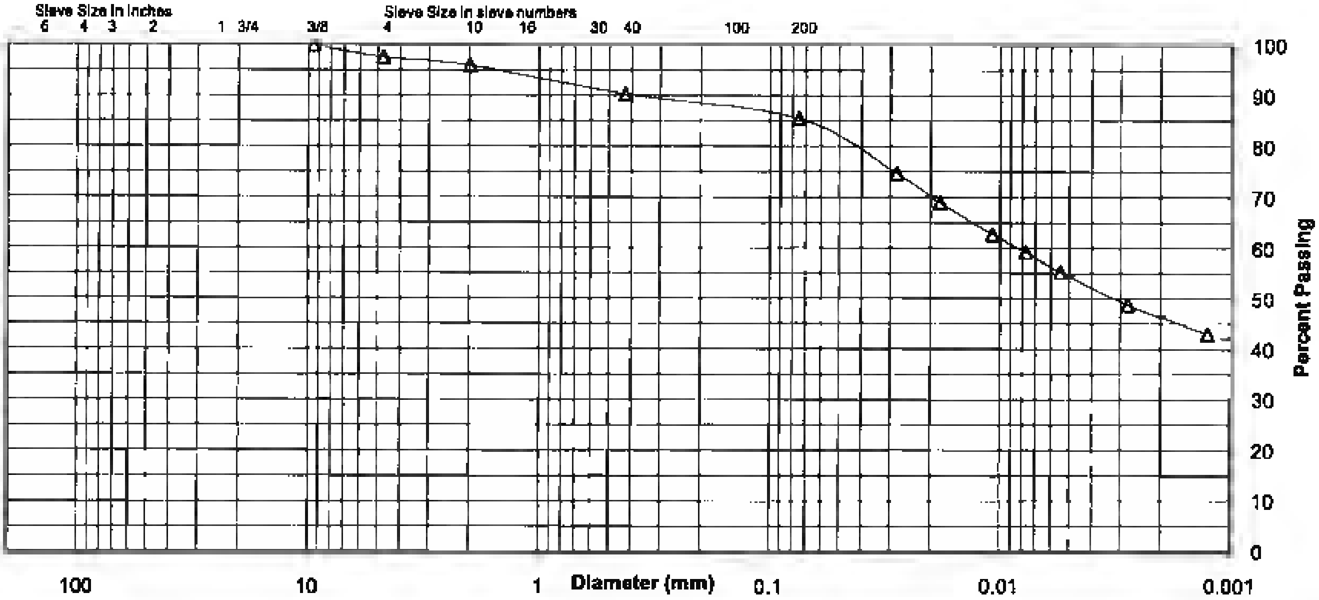
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	90.3
No. 200	85.5
0.02 mm	70.2
0.005 mm	54.5
0.002 mm	46.4
0.001 mm	42.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	2.5	1.6	5.6	4.8	31.0	54.5

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	4.1	5.6	4.8	39.1	46.4



Comments

Reviewed By

File: frm_175559018_sum_5.xlsm Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

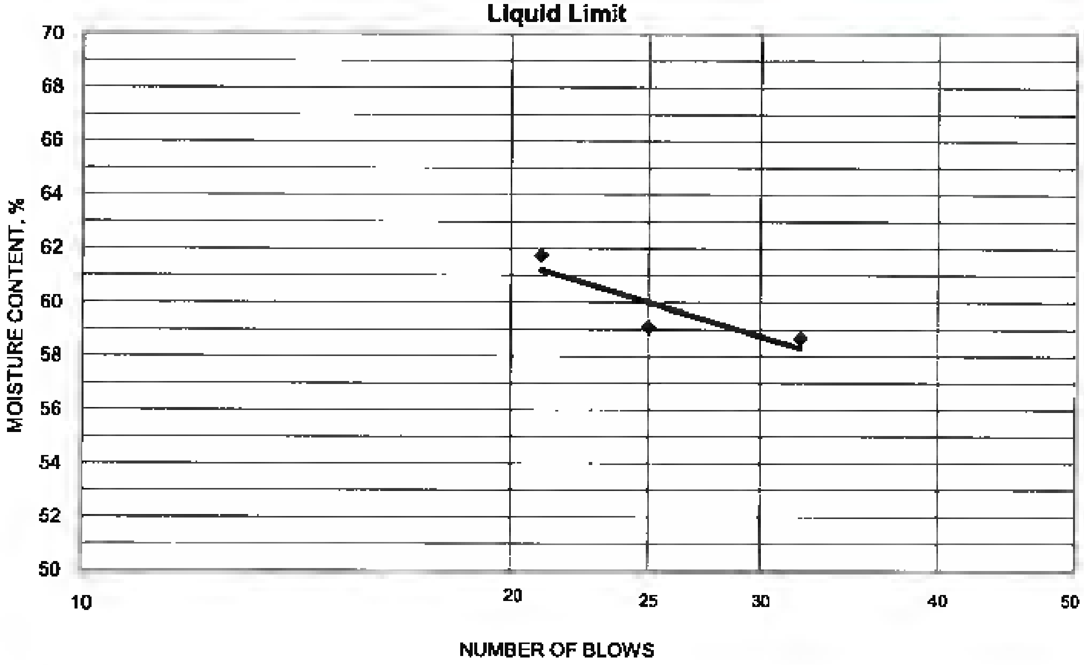
ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-6, 29.1'-29.5'

Project No. 175559018
Lab ID 5
% + No. 40 10
Date Received 09-16-2009

Tested By kdg
Test Date 04-27-2010
Test Method ASTM D 4318 Method A
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.68	17.17	11.23	25	59.1	60
20.98	17.33	11.11	32	58.7	
20.37	16.82	11.07	21	61.7	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.38	16.37	10.89	18.4	19	41
18.22	17.12	11.29	18.9		

Remarks:

Reviewed By

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Project Number: 175559018
Source: STN-E-4S, 5.0'-5.5'
Lab ID: 19
County: Sumner
Date Received: 9-16-09
Sample Type: ST
Date Reported: 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 19.9

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	93.9
No. 4	4.75	90.1
No. 10	2	72.1
No. 40	0.425	64.7
No. 200	0.075	55.6
	0.02	40.9
	0.005	30.4
	0.002	22.7
estimated	0.001	18.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	9.9	27.9
Coarse Sand	18.0	7.4
Medium Sand	7.4	—
Fine Sand	9.1	9.1
Silt	25.2	32.9
Clay	30.4	22.7

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 42
Plastic Limit: 18
Plasticity Index: 24
Activity Index: 1.04

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.77

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay
AASHTO Classification: A-7-6 (10)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-4S, 5.0'-5.5'

Project Number: 175559018
Lab ID: 19

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: Ford
Test Date: 04-26-2010
Date Received: 09-16-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	93.9
No. 4	90.1
No. 10	72.1

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.77

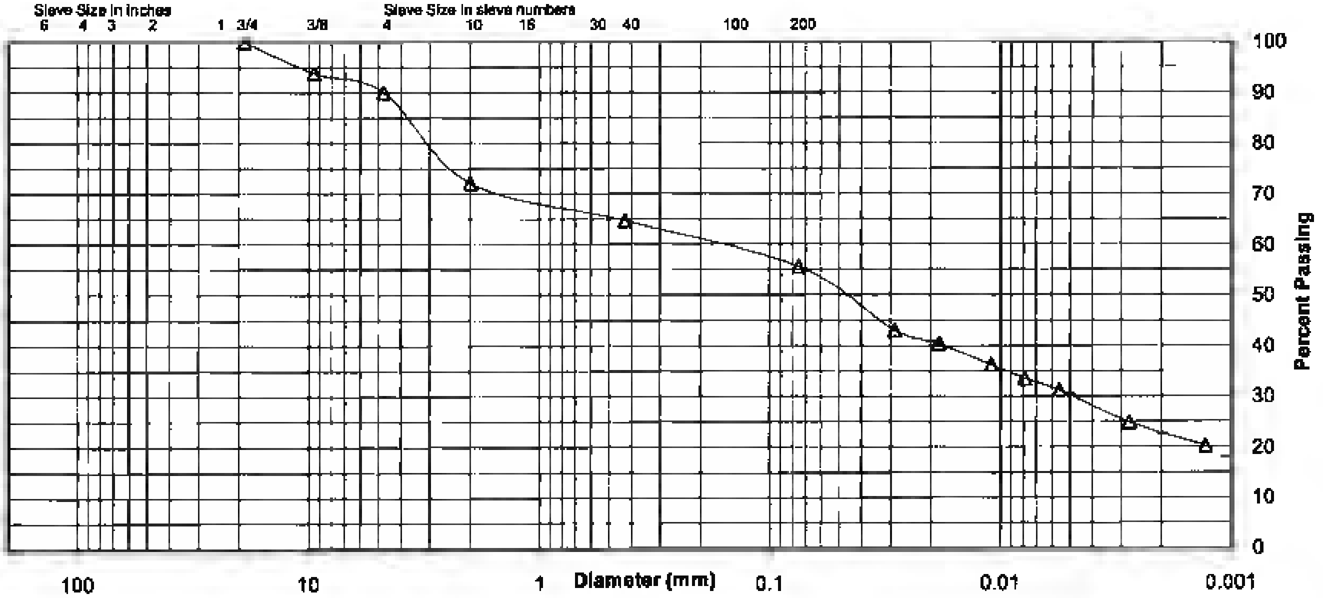
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	64.7
No. 200	55.6
0.02 mm	40.9
0.005 mm	30.4
0.002 mm	22.7
0.001 mm	18.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	9.9	18.0	7.4	9.1	25.2	30.4

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	27.9	7.4	9.1	32.9	22.7



Comments ____________________

Reviewed By ____________

File: frm_175559018_sum_19.xlsm Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY TLK

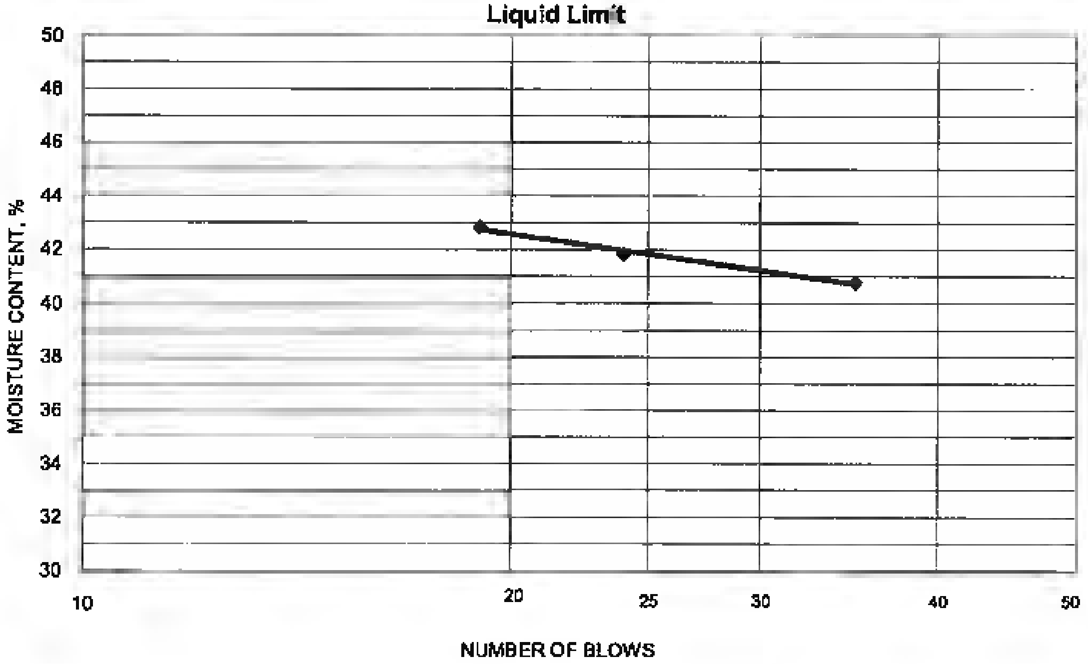
Stantec

ATTERBERG LIMITS

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Source	STN-E-4S, 5.0'-5.5'	Lab ID	19
		% + No. 40	35

Tested By	KDG	Test Method	ASTM D 4318 Method A	Date Received	09-16-2009
Test Date	04-29-2010	Prepared	Dry		

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.26	18.28	10.97	35	40.8	42
22.08	18.89	11.26	24	41.8	
21.69	18.52	11.12	19	42.8	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.93	17.72	10.89	17.7	18	24
17.96	16.93	11.07	17.6		

Remarks: ____________________

Reviewed By ____________

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-8, 41.6'-42.1'

Project Number 175559018
Lab ID 26B

County Sumner
Sample Type ST

Date Received 9-16-09
Date Reported 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 19.8

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	91.8
3/8"	9.5	71.2
No. 4	4.75	61.2
No. 10	2	48.7
No. 40	0.425	42.0
No. 200	0.075	29.8
	0.02	19.9
	0.005	13.6
	0.002	11.2
estimated	0.001	9.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	38.8	51.3
Coarse Sand	12.5	6.7
Medium Sand	6.7	---
Fine Sand	12.2	12.2
Silt	16.2	18.6
Clay	13.6	11.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 27
Plastic Limit: 13
Plasticity Index: 14
Activity Index: 1.27

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.67

Classification

Unified Group Symbol: GC
Group Name: Clayey gravel with sand

AASHTO Classification: A-2-6 (1)

Comments:

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-8, 41.6'-42.1'

Project Number 175559018
Lab ID 26B

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: Ford
Test Date: 04-26-2010
Date Received 09-16-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	91.8
3/8"	71.2
No. 4	61.2
No. 10	48.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.67

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	42.0
No. 200	29.8
0.02 mm	19.9
0.005 mm	13.6
0.002 mm	11.2
0.001 mm	9.0

Particle Size Distribution

<table>
<tr><td rowspan="2">ASTM</td><td>Coarse Gravel</td><td>Fine Gravel</td><td>C. Sand</td><td>Medium Sand</td><td>Fine Sand</td><td>Silt</td><td>Clay</td></tr>
<tr><td>6.2</td><td>30.6</td><td>12.5</td><td>6.7</td><td>12.2</td><td>16.2</td><td>13.6</td></tr>
<tr><td rowspan="2">AASHTO</td><td colspan="3">Gravel</td><td>Coarse Sand</td><td>Fine Sand</td><td>Silt</td><td>Clay</td></tr>
<tr><td colspan="3">51.3</td><td>6.7</td><td>12.2</td><td>18.6</td><td>11.2</td></tr>
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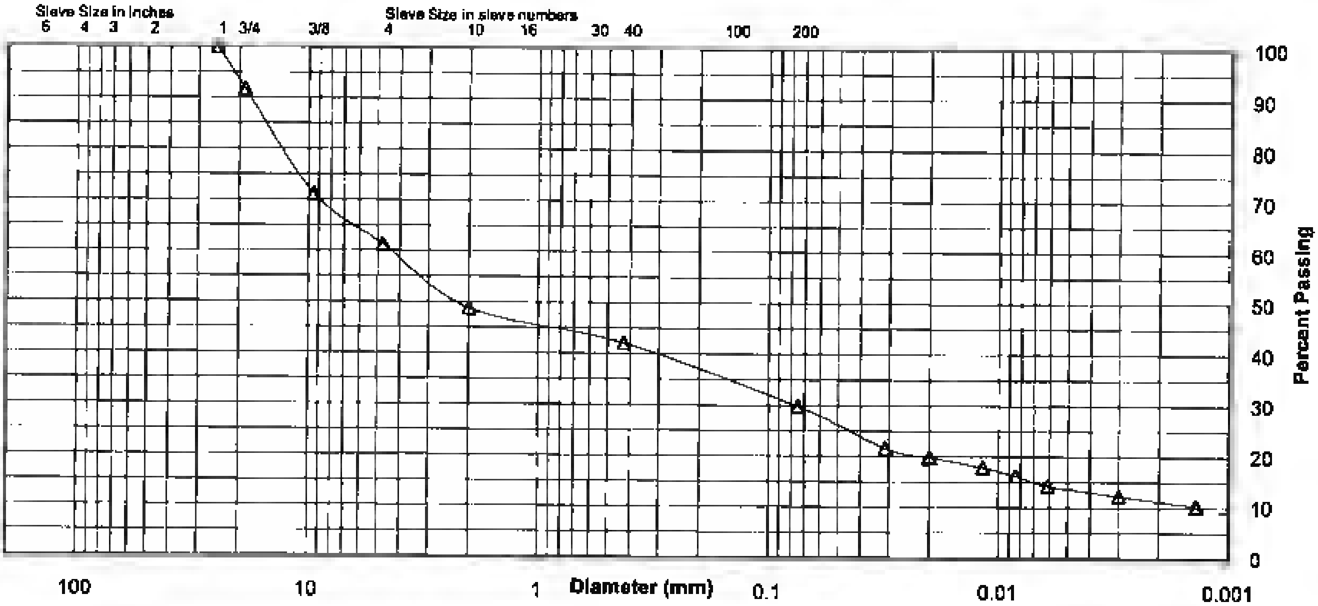


Comments

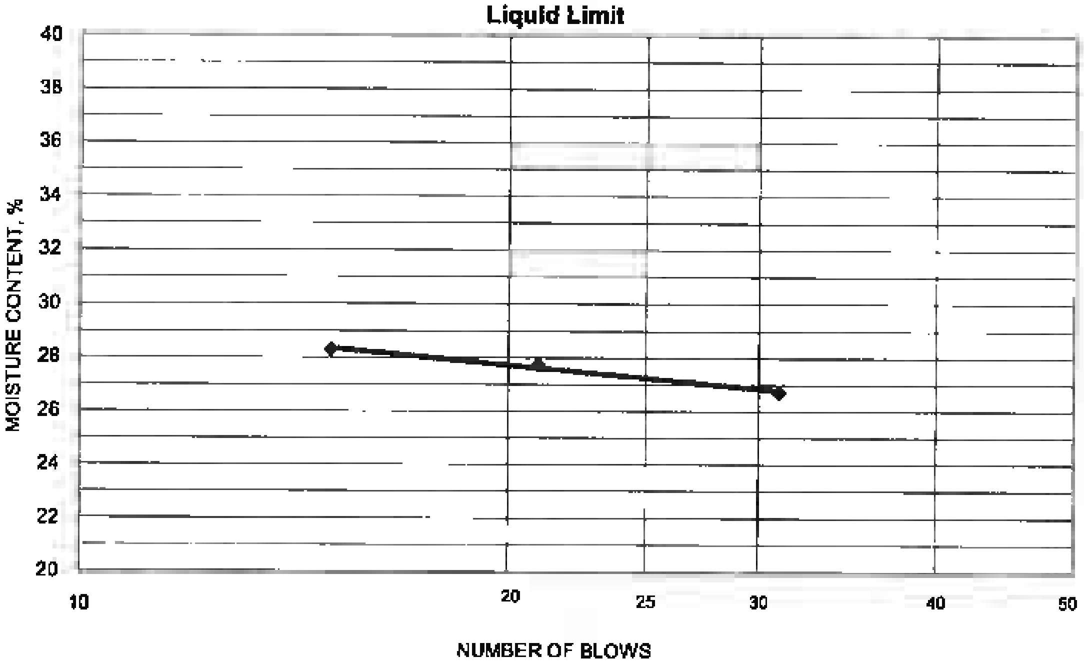
Reviewed By

Stantec

ATTERBERG LIMITS

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Source	STN-E-8, 41.6'-42.1'	Lab ID	26B
		% + No. 40	58
Tested By	KDG	Test Method	ASTM D 4318 Method A
Date Received	09-16-2009		
Test Date	04-30-2010	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.75	19.35	10.87	15	28.3	27
21.58	19.33	11.22	21	27.7	
22.60	20.16	11.03	31	26.7	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.95	19.80	11.16	13.3	13	14
17.59	16.82	10.90	13.0		

Remarks:

Reviewed By

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-8, 50.2'-50.7'
Project Number 175559018
Lab ID 28A

County Sumner
Sample Type ST
Date Received 9-16-09
Date Reported 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 29.1

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	98.3
No. 4	4.75	98.2
No. 10	2	97.9
No. 40	0.425	95.0
No. 200	0.075	77.6
	0.02	51.9
	0.005	41.7
	0.002	34.4
estimated	0.001	29.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	1.8	2.1
Coarse Sand	0.3	2.9
Medium Sand	2.9	—
Fine Sand	17.4	17.4
Silt	35.9	43.2
Clay	41.7	34.4

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 47
Plastic Limit: 22
Plasticity Index: 25
Activity Index: 0.74

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20" Celsius: 2.78

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand

AASHTO Classification: A-7-6 (20)

Comments:

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-8, 50.2'-50.7'

Project Number: 175559018
Lab ID: 28A

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: JF
Test Date: 04-27-2010
Date Received: 09-16-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	98.3
No. 4	98.2
No. 10	97.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity: 2.78

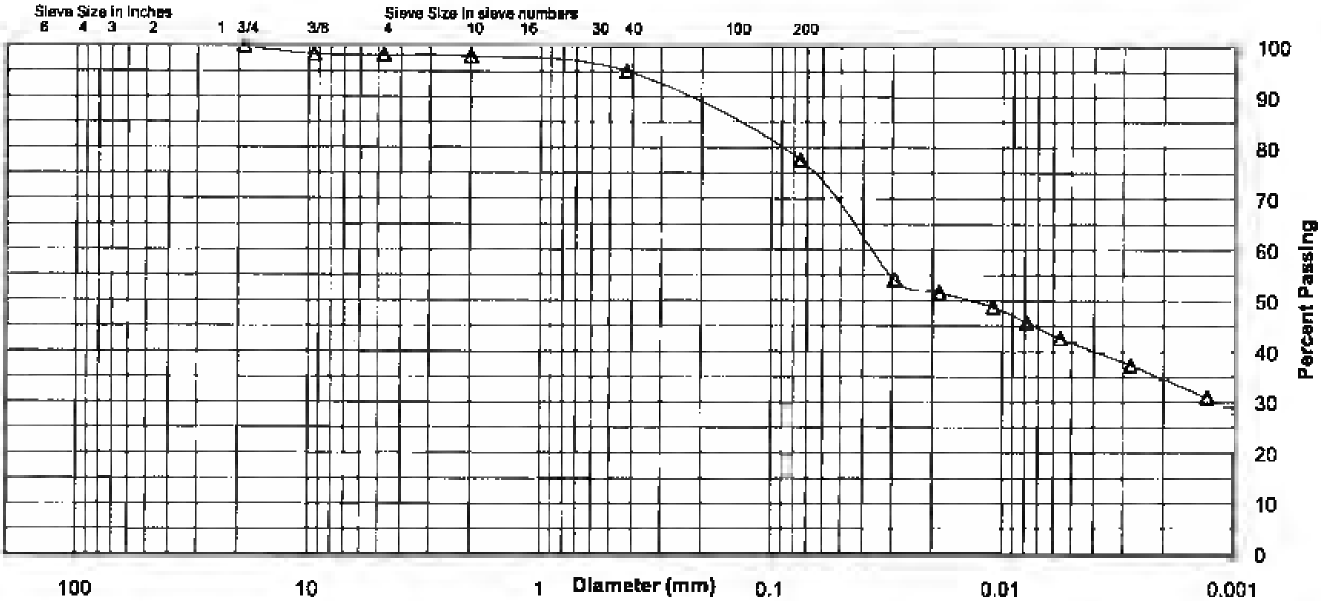
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	95.0
No. 200	77.6
0.02 mm	51.9
0.005 mm	41.7
0.002 mm	34.4
0.001 mm	29.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	1.6	0.3	2.9	17.4	35.9	41.7

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	2.1	2.9	17.4	43.2	34.4



Comments

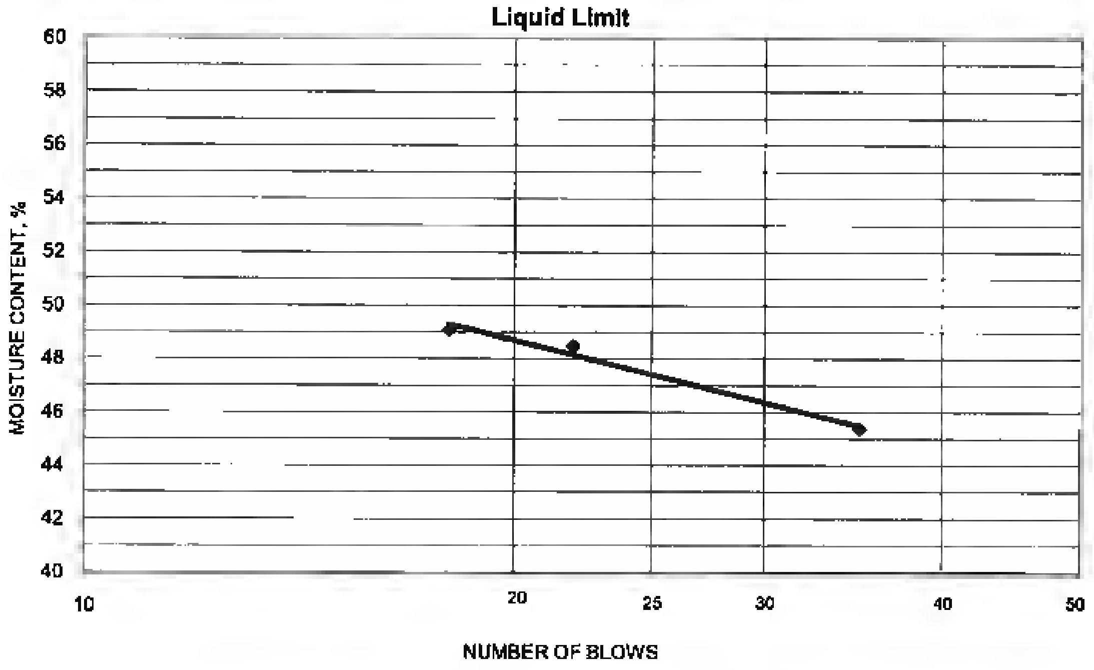
Reviewed By

Stantec

ATTERBERG LIMITS

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Source	STN-E-8, 50.2'-50.7'	Lab ID	28A
		% + No. 40	5
Tested By	JF	Test Method	ASTM D 4318 Method A
Date Received	09-16-2009		
Test Date	04-30-2010	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.93	17.73	11.21	18	49.1	47
21.43	18.08	11.17	22	48.5	
20.54	17.55	10.96	35	45.4	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.03	16.80	11.15	21.8	22	25
17.95	16.73	11.07	21.6		

Remarks: ________________

Reviewed By ________________

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-9, 5.8'-6.3'

County: Sumner
Sample Type: ST

Project Number: 175559018
Lab ID: 30B

Date Received: 9-16-09
Date Reported: 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 18.6

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	100.0
No. 4	4.75	99.7
No. 10	2	99.4
No. 40	0.425	97.1
No. 200	0.075	68.9
	0.02	44.5
	0.005	32.6
	0.002	27.2
estimated	0.001	23.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.3	0.6
Coarse Sand	0.3	2.3
Medium Sand	2.3	—
Fine Sand	28.2	28.2
Silt	36.3	41.7
Clay	32.6	27.2

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 31
Plastic Limit: 14
Plasticity Index: 17
Activity Index: 0.63

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.71

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-6 (9)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-9, 5.8'-6.3'

Project Number 175559018
Lab ID 30B

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: BWT
Test Date: 04-27-2010
Date Received 09-16-2009

Maximum Particle size: 3/8" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	100.0
No. 4	99.7
No. 10	99.4

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

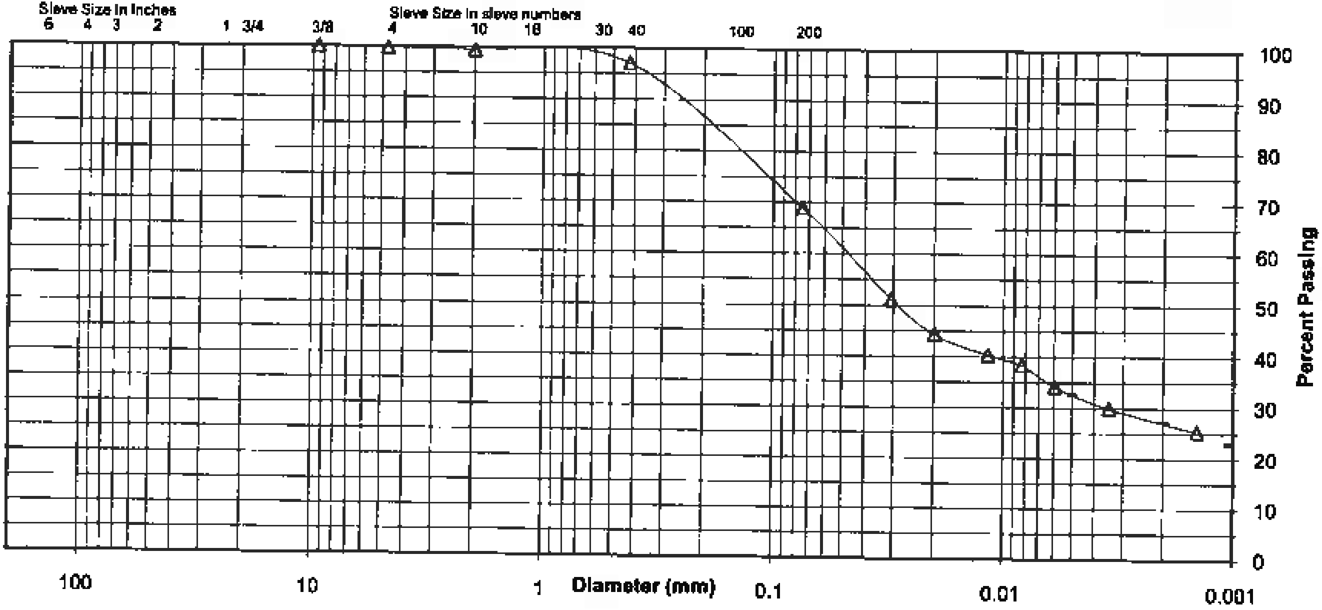
Specific Gravity 2.71

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	97.1
No. 200	68.9
0.02 mm	44.5
0.005 mm	32.6
0.002 mm	27.2
0.001 mm	23.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.3	0.3	2.3	26.2	38.3	32.6
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	0.6			2.3	26.2	41.7	27.2



Comments

Reviewed By

File: frm_175559018_sum_30b.xlsm Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

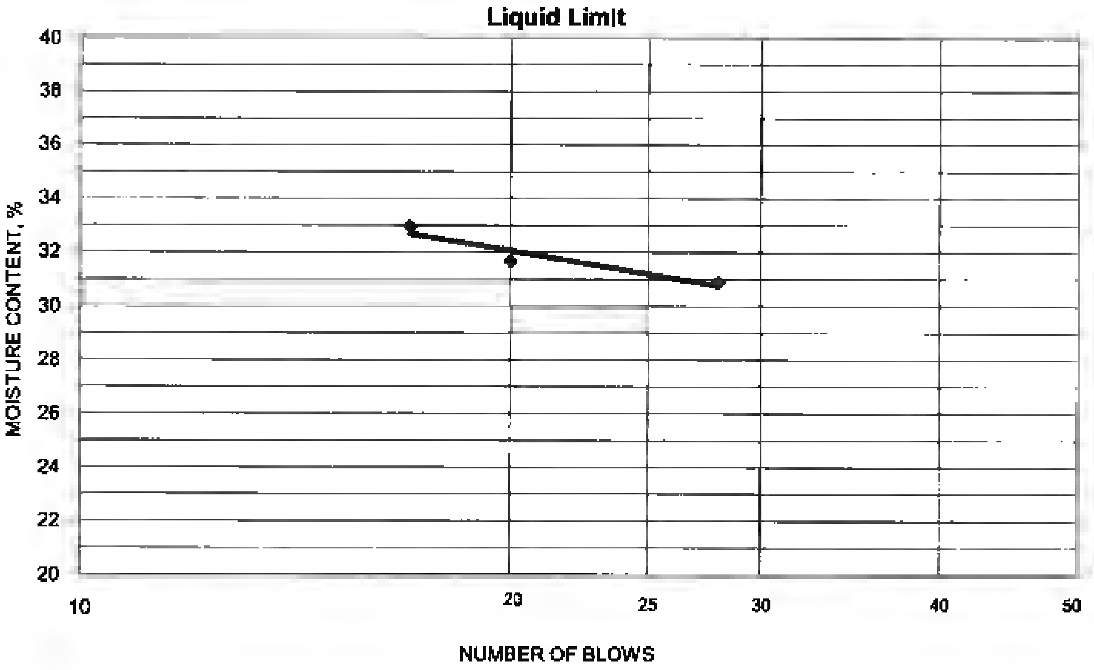
ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-9, 5.8'-6.3'

Project No. 175559018
Lab ID 30B
% + No. 40 3
Date Received 09-16-2009

Tested By KDG
Test Date 04-29-2010
Test Method ASTM D 4318 Method A
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.29	19.60	10.89	28	30.9	31
21.50	18.98	11.02	20	31.7	
22.42	19.55	10.84	17	33.0	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
19.04	18.05	10.93	13.9	14	17
18.23	17.35	10.96	13.8		

Remarks:

Reviewed By

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-10S, 5.3'-5.8'

County Sumner
Sample Type ST

Project Number 175559018
Lab ID 32

Date Received 9-16-09
Date Reported 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 18.1

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	98.5
No. 4	4.75	95.8
No. 10	2	90.6
No. 40	0.425	85.6
No. 200	0.075	75.7
	0.02	55.8
	0.005	32.2
	0.002	25.5
estimated	0.001	22.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	4.2	9.4
Coarse Sand	5.2	5.0
Medium Sand	5.0	—
Fine Sand	9.9	9.9
Silt	43.5	50.2
Clay	32.2	25.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 38
Plastic Limit: 16
Plasticity Index: 22
Activity Index: 0.85

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.72

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand

AASHTO Classification: A-6 (15)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Gallatin Fossil Plant (GAF) - Ash Ponds	Project Number	175559018
Source	STN-E-10S, 5.3'-5.8'	Lab ID	32

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Soft

Tested By: JF
Test Date: 04-27-2010
Date Received 09-16-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	98.5
No. 4	95.8
No. 10	90.6

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.72

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	85.6
No. 200	75.7
0.02 mm	55.8
0.005 mm	32.2
0.002 mm	25.5
0.001 mm	22.0

Particle Size Distribution

<table>
<tr><td rowspan="2">ASTM</td><td>Coarse Gravel</td><td>Fine Gravel</td><td>C. Sand</td><td>Medium Sand</td><td>Fine Sand</td><td colspan="2">Silt</td><td colspan="2">Clay</td></tr>
<tr><td>0.0</td><td>4.2</td><td>5.2</td><td>5.0</td><td>9.9</td><td colspan="2">43.5</td><td colspan="2">32.2</td></tr>
<tr><td rowspan="2">AASHTO</td><td colspan="3">Gravel</td><td>Coarse Sand</td><td>Fine Sand</td><td colspan="3">Silt</td><td>Clay</td></tr>
<tr><td colspan="3">9.4</td><td>5.0</td><td>9.9</td><td colspan="3">50.2</td><td>25.5</td></tr>
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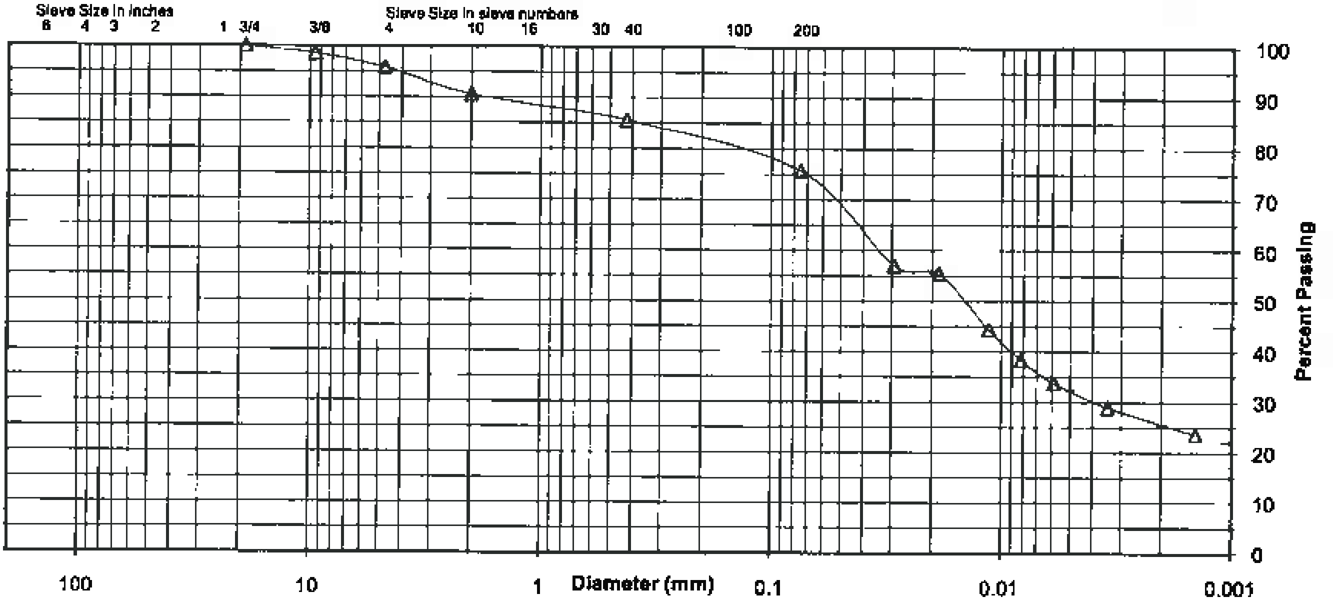


Comments ______

Reviewed By ______

File: frm_175559018_sum 32.xlsm Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

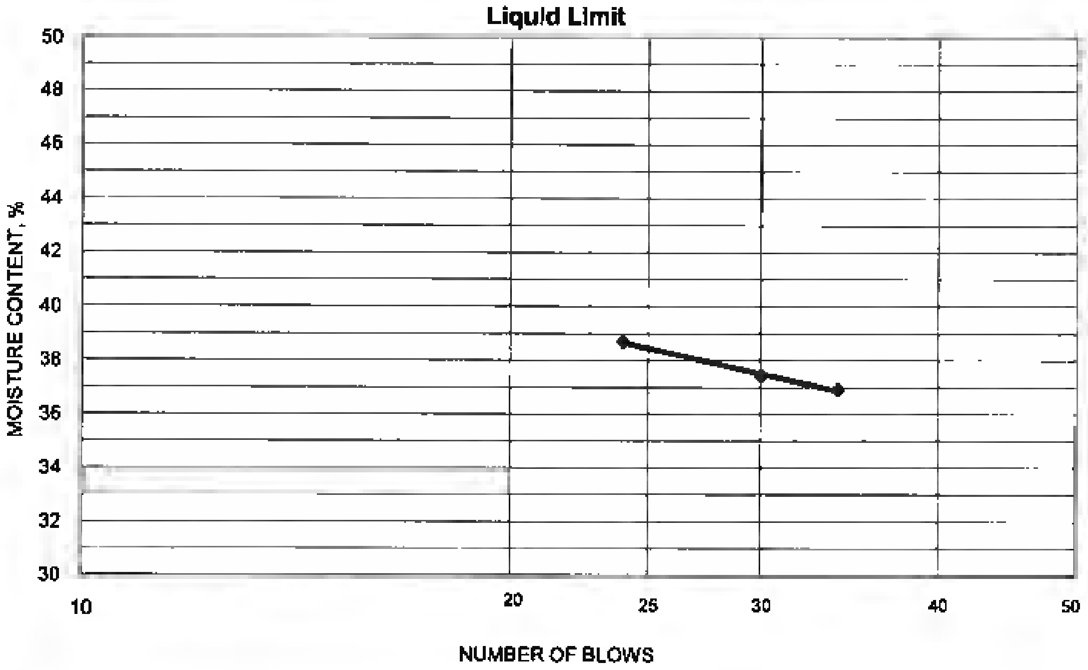
ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-10S, 5.3'-5.8'

Project No. 175559018
Lab ID 32
% + No. 40 14
Date Received 09-16-2009

Tested By KDG
Test Method ASTM D 4318 Method A
Test Date 04-29-2010
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.11	19.30	11.69	34	36.9	38
21.95	19.08	11.41	30	37.4	
22.16	19.20	11.55	24	38.7	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.68	17.70	11.44	15.7	16	22
19.77	18.63	11.45	15.9		

Remarks:

Reviewed By

File: frm 175559018 sum_32.xlsm Sheet: Limit-Report
Preparation Date: 1998
Revision Date: 1-2008

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-12, 10.3'-10.8'
Project Number: 175559018
Lab ID: 37B

County: Sumner
Sample Type: ST
Date Received: 9-16-09
Date Reported: 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 22.7

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	
3/8"	9.5	
No. 4	4.75	100.0
No. 10	2	99.9
No. 40	0.425	95.8
No. 200	0.075	66.8
	0.02	44.5
	0.005	38.6
	0.002	33.6
estimated	0.001	31.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	0.0	0.1
Coarse Sand	0.1	4.1
Medium Sand	4.1	---
Fine Sand	29.0	29.0
Silt	28.2	33.2
Clay	38.6	33.6

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 46
Plastic Limit: 20
Plasticity Index: 26
Activity Index: 0.76

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.79

Classification

Unified Group Symbol: CL
Group Name: Sandy lean clay

AASHTO Classification: A-7-6 (16)

Comments:

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-12, 10.3'-10.8'

Project Number 175559018
Lab ID 37B

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: BWT
Test Date: 04-27-2010
Date Received 09-16-2009

Maximum Particle size: No. 4 Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	
3/8"	
No. 4	100.0
No. 10	99.9

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.79

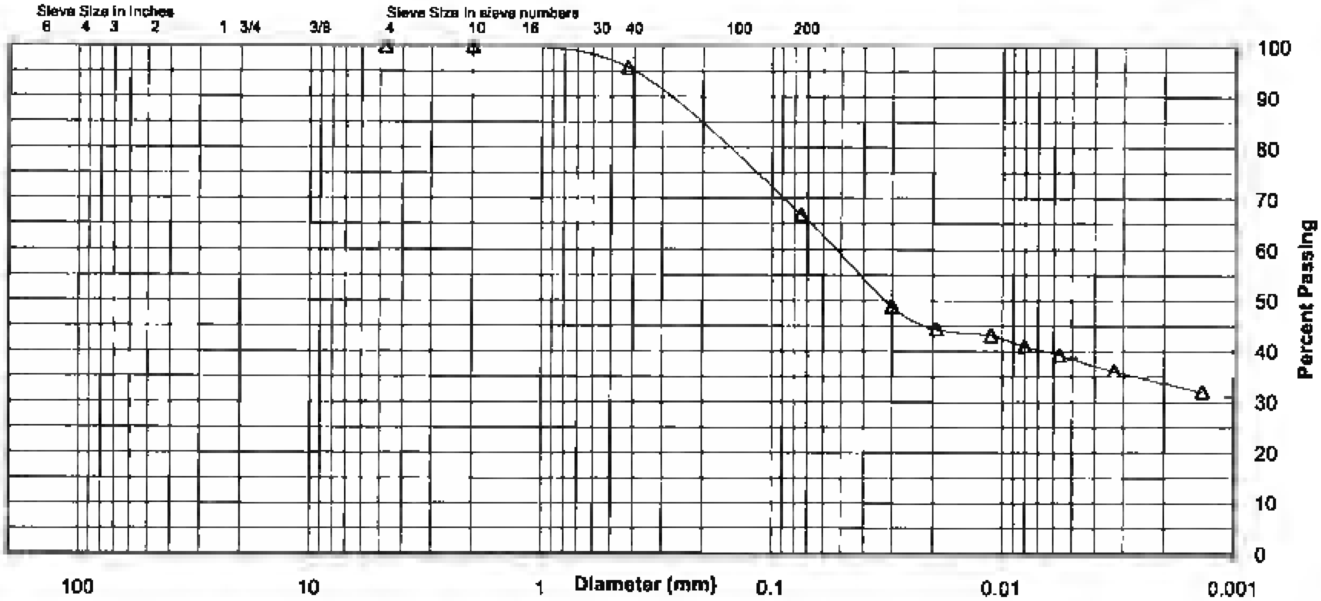
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	95.8
No. 200	66.8
0.02 mm	44.5
0.005 mm	38.6
0.002 mm	33.6
0.001 mm	31.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.0	0.1	4.1	29.0	28.2	38.6

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	0.1	4.1	29.0	33.2	33.6



Comments

Reviewed By

File: frm_175559018_sum_37b.xlsm Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

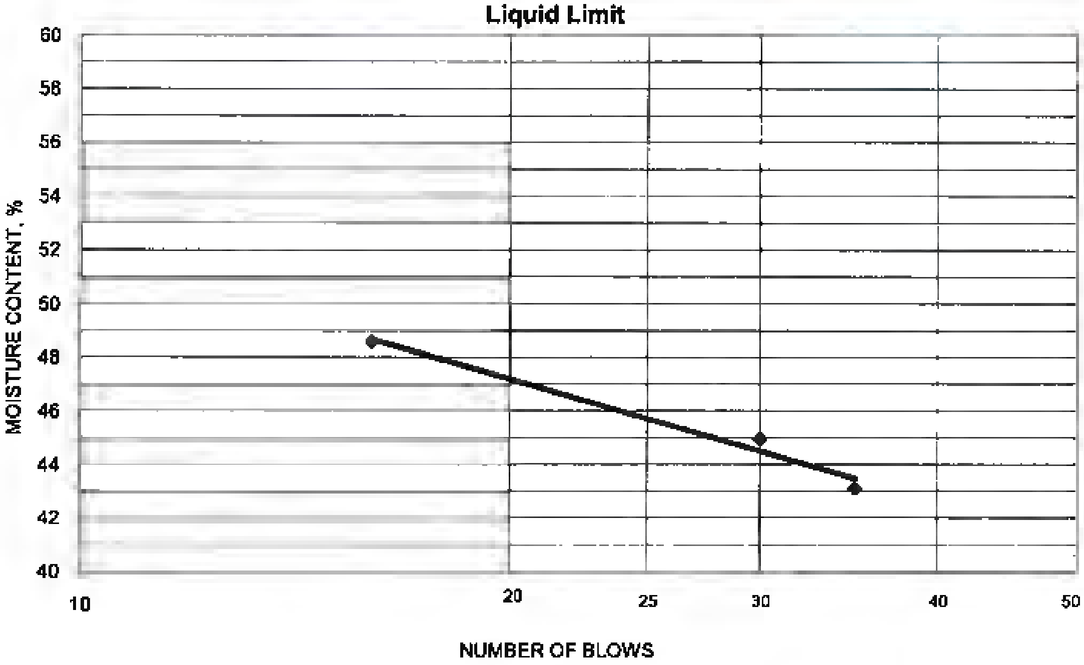
Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

ATTERBERG LIMITS

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Source	STN-E-12, 10.3'-10.8'	Lab ID	37B
		% + No. 40	4
Tested By	JF	Test Method	ASTM D 4318 Method A
Date Received	09-16-2009		
Test Date	04-30-2010	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.13	17.87	11.16	16	48.6	46
20.28	17.43	11.09	30	45.0	
20.37	17.59	11.14	35	43.1	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.38	17.14	10.95	20.0	20	26
19.57	18.19	11.14	19.6		

Remarks:

Reviewed By

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-14S, 2.0'-2.5'
Project Number 175559018
Lab ID 43A

County Sumner
Sample Type ST
Date Received 9-16-09
Date Reported 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 20.0

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	98.5
No. 4	4.75	97.6
No. 10	2	89.6
No. 40	0.425	87.6
No. 200	0.075	77.1
	0.02	60.1
	0.005	41.4
	0.002	32.1
estimated	0.001	28.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	2.4	10.4
Coarse Sand	8.0	2.0
Medium Sand	2.0	—
Fine Sand	10.5	10.5
Silt	35.7	45.0
Clay	41.4	32.1

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 38
Plastic Limit: 19
Plasticity Index: 19
Activity Index: 0.59

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.74

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand

AASHTO Classification: A-6 (14)

Comments:

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Gallatin Fossil Plant (GAF) - Ash Ponds
Source	STN-E-14S, 2.0'-2.5'
Project Number	175559018
Lab ID	43A

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: Ford
Test Date: 04-28-2010
Date Received 09-16-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	98.5
No. 4	97.6
No. 10	89.6

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.74

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	87.6
No. 200	77.1
0.02 mm	60.1
0.005 mm	41.4
0.002 mm	32.1
0.001 mm	28.0

Particle Size Distribution

<table>
<tr><td rowspan="2">ASTM</td><td>Coarse Gravel</td><td>Fine Gravel</td><td>C. Sand</td><td>Medium Sand</td><td>Fine Sand</td><td colspan="2">Silt</td><td>Clay</td></tr>
<tr><td>0.0</td><td>2.4</td><td>8.0</td><td>2.0</td><td>10.5</td><td colspan="2">35.7</td><td>41.4</td></tr>
<tr><td rowspan="2">AASHTO</td><td colspan="3">Gravel</td><td>Coarse Sand</td><td>Fine Sand</td><td colspan="3">Silt</td></tr>
<tr><td colspan="3">10.4</td><td>2.0</td><td>10.5</td><td colspan="3">45.0</td></tr>
<tr><td></td><td colspan="3"></td><td></td><td></td><td colspan="2"></td><td>Clay
32.1</td></tr>
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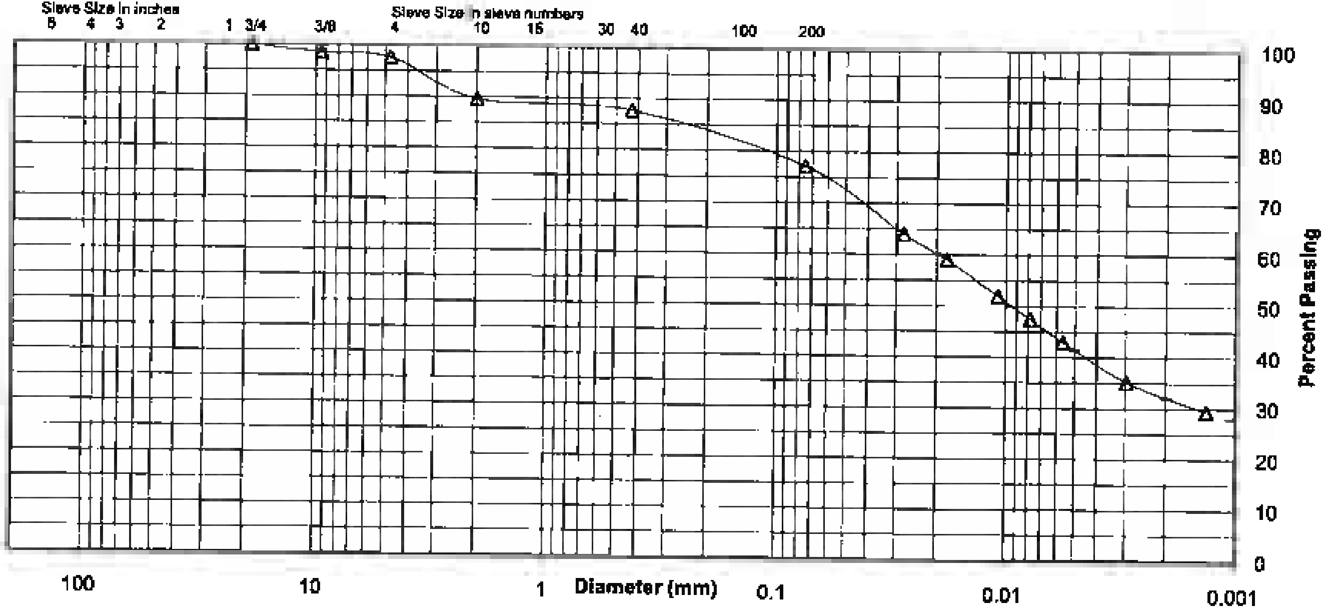


Comments

Reviewed By

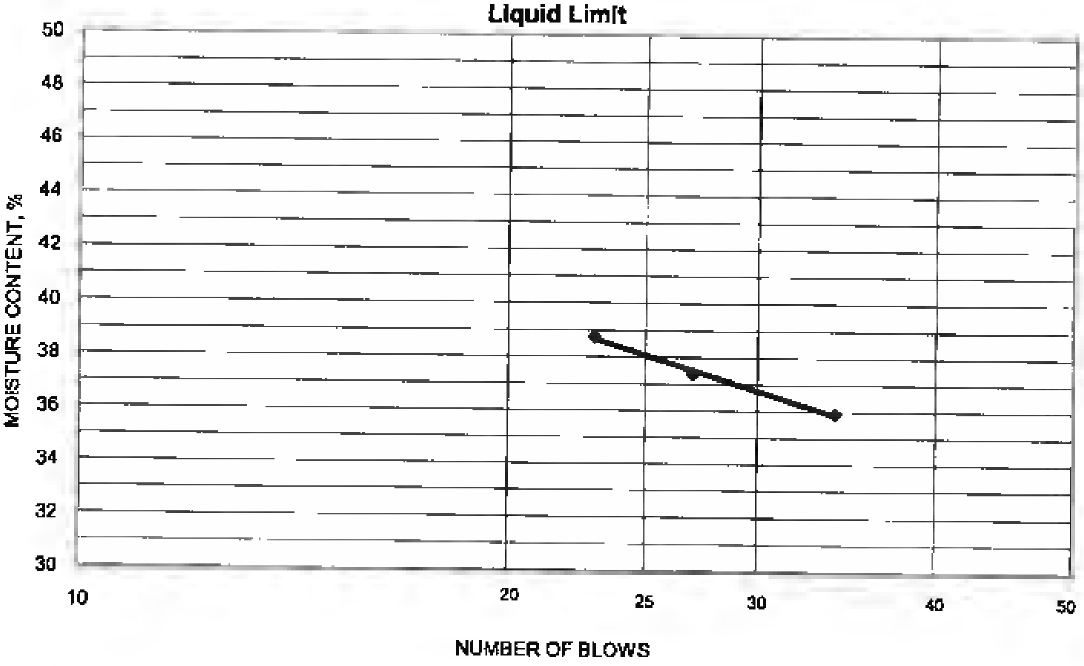
File: frm_175559018_sum_43a.xlsm Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Laboratory Document
Prepared By: MW
Approved BY: TLK

ATTERBERG LIMITS

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Source	STN-E-14S, 2.0'-2.5'	Lab ID	43A
		% + No. 40	12
Tested By	jf	Test Method	ASTM D 4318 Method A
Date Received	09-16-2009		
Test Date	04-29-2010	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
22.10	19.12	11.43	23	38.8	38
21.51	18.90	11.63	34	35.9	
21.23	18.62	11.64	27	37.4	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
19.10	17.94	11.68	18.5	19	19
19.76	18.45	11.48	18.8		

Remarks:

Reviewed By

Stantec

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-16S, 5.6'-6.1'

County Sumner
Sample Type ST

Project Number 175559018
Lab ID 47B

Date Received 9-16-09
Date Reported 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 27.9

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	97.3
No. 4	4.75	95.8
No. 10	2	93.7
No. 40	0.425	90.0
No. 200	0.075	75.6
	0.02	64.1
	0.005	54.9
	0.002	47.5
estimated	0.001	43.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	4.2	6.3
Coarse Sand	2.1	3.7
Medium Sand	3.7	---
Fine Sand	14.4	14.4
Silt	20.7	28.1
Clay	54.9	47.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 52
Plastic Limit: 19
Plasticity Index: 33
Activity Index: 0.69

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.78

Classification

Unified Group Symbol: CH
Group Name: Fat clay with sand

AASHTO Classification: A-7-6 (25)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-16S, 5.6'-6.1'

Project Number 175559018
Lab ID 47B

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Rounded and Angular
Particle Hardness: Hard and Durable

Tested By: BWT
Test Date: 04-26-2010
Date Received 09-16-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	97.3
No. 4	95.8
No. 10	93.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

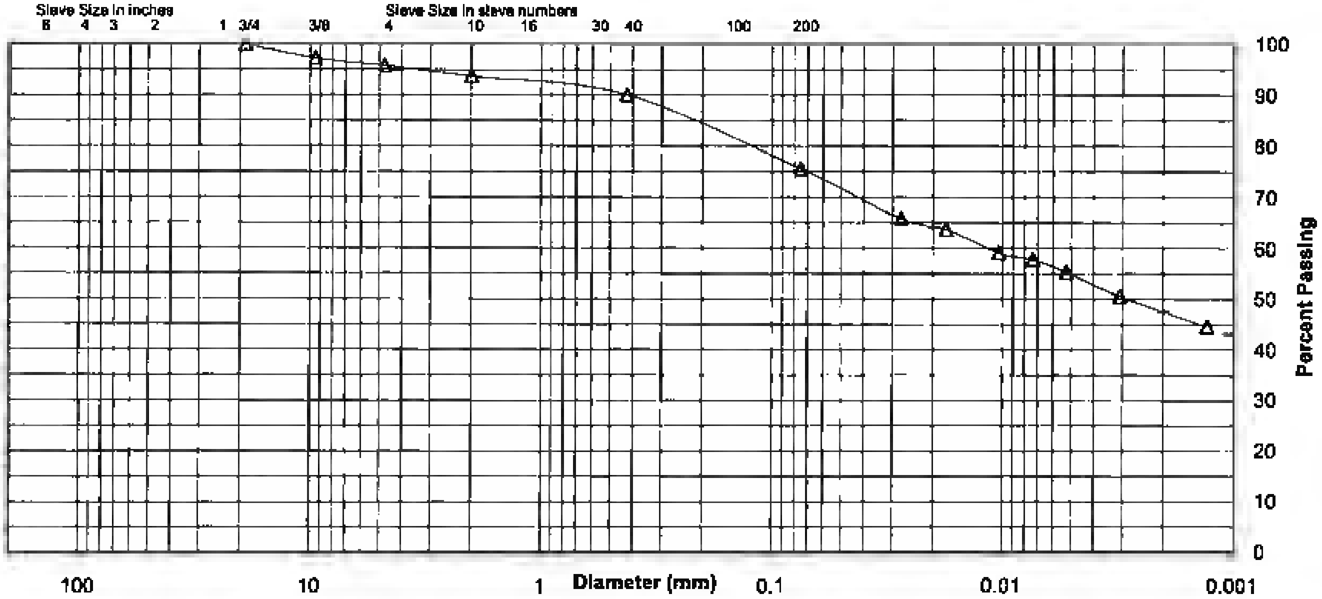
Specific Gravity 2.78

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	90.0
No. 200	75.6
0.02 mm	64.1
0.005 mm	54.9
0.002 mm	47.5
0.001 mm	43.0

Particle Size Distribution

<table>
<tr><td rowspan="2">ASTM</td><td>Coarse Gravel</td><td>Fine Gravel</td><td>C. Sand</td><td>Medium Sand</td><td>Fine Sand</td><td colspan="2">Silt</td><td>Clay</td></tr>
<tr><td>0.0</td><td>4.2</td><td>2.1</td><td>3.7</td><td>14.4</td><td colspan="2">20.7</td><td>54.9</td></tr>
<tr><td rowspan="2">AASHTO</td><td colspan="3">Gravel</td><td>Coarse Sand</td><td>Fine Sand</td><td colspan="2">Silt</td><td>Clay</td></tr>
<tr><td colspan="3">6.3</td><td>3.7</td><td>14.4</td><td colspan="2">28.1</td><td>47.5</td></tr>
</table>



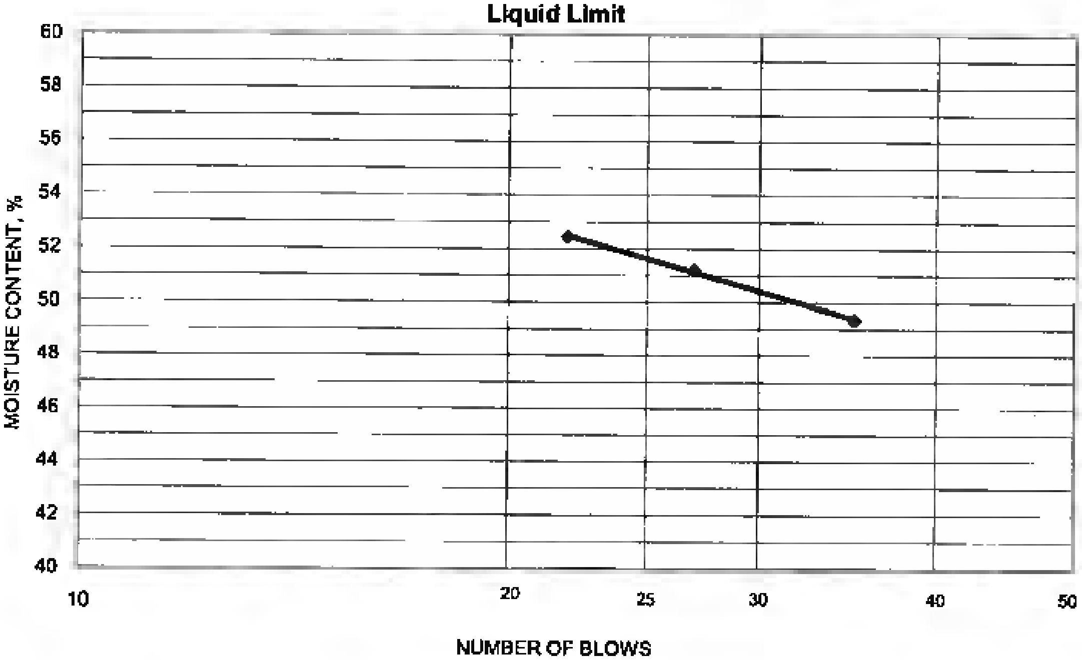
Comments

Reviewed By

ATTERBERG LIMITS

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Source	STN-E-16S, 5.6'-6.1'	Lab ID	47B
		% + No. 40	10
Tested By	KDG	Test Method	ASTM D 4318 Method A
Date Received	09-16-2009		
Test Date	04-29-2010	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.97	18.50	11.47	35	49.4	52
21.24	17.86	11.26	27	51.2	
21.57	17.91	10.93	22	52.4	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
18.34	17.15	10.84	18.9	19	33
17.78	16.69	10.90	18.8		

Remarks:

Reviewed By

Summary of Soil Tests

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-16S, 36.0'-36.5'
Project Number 175559018
Lab ID 52A

County Sumner
Sample Type ST
Date Received 9-16-09
Date Reported 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 25.2

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	
3/4"	19	100.0
3/8"	9.5	99.6
No. 4	4.75	99.2
No. 10	2	98.7
No. 40	0.425	98.2
No. 200	0.075	96.7
	0.02	88.0
	0.005	49.8
	0.002	34.5
estimated	0.001	27.0

Plus 3 in. material, not included: 0 (%)

	ASTM	AASHTO
Range	(%)	(%)
Gravel	0.8	1.3
Coarse Sand	0.5	0.5
Medium Sand	0.5	—
Fine Sand	1.5	1.5
Silt	46.9	62.2
Clay	49.8	34.5

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry

Liquid Limit: 34
Plastic Limit: 16
Plasticity Index: 18
Activity Index: 0.53

Moisture-Density Relationship

Test Not Performed

Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed

Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry

Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.68

Classification

Unified Group Symbol: CL
Group Name: Lean clay

AASHTO Classification: A-6 (17)

Comments:

File: fm 175559018_sum_52a.xlsm Sheet: Summary
Preparation Date: 1998
Revision Date: 1-2008

Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Particle-Size Analysis of Soils

ASTM D 422

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds

Source STN-E-16S, 36.0'-36.5'

Project Number 175559018

Lab ID 52A

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422

Prepared using: ASTM D 421

Particle Shape: Angular

Particle Hardness: Hard and Durable

Tested By: BWT

Test Date: 04-27-2010

Date Received 09-16-2009

Maximum Particle size: 3/4" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	
3/4"	100.0
3/8"	99.6
No. 4	99.2
No. 10	98.7

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

Specific Gravity 2.68

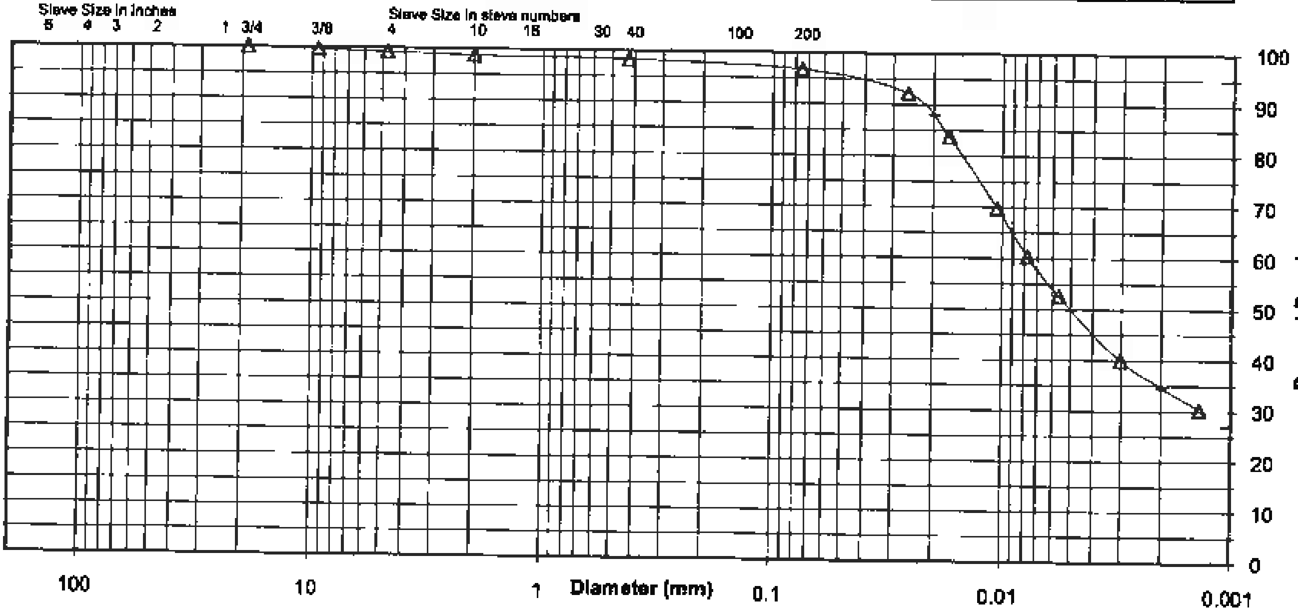
Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	98.2
No. 200	96.7
0.02 mm	88.0
0.005 mm	49.8
0.002 mm	34.5
0.001 mm	27.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.0	0.6	0.5	0.5	1.5	46.9	49.8

AASHTO	Gravel	Coarse Sand	Fine Sand	Silt	Clay
	1.3	0.5	1.5	62.2	34.5



Comments

Reviewed By

File: frm_175559018_sum_52a.xlsm Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

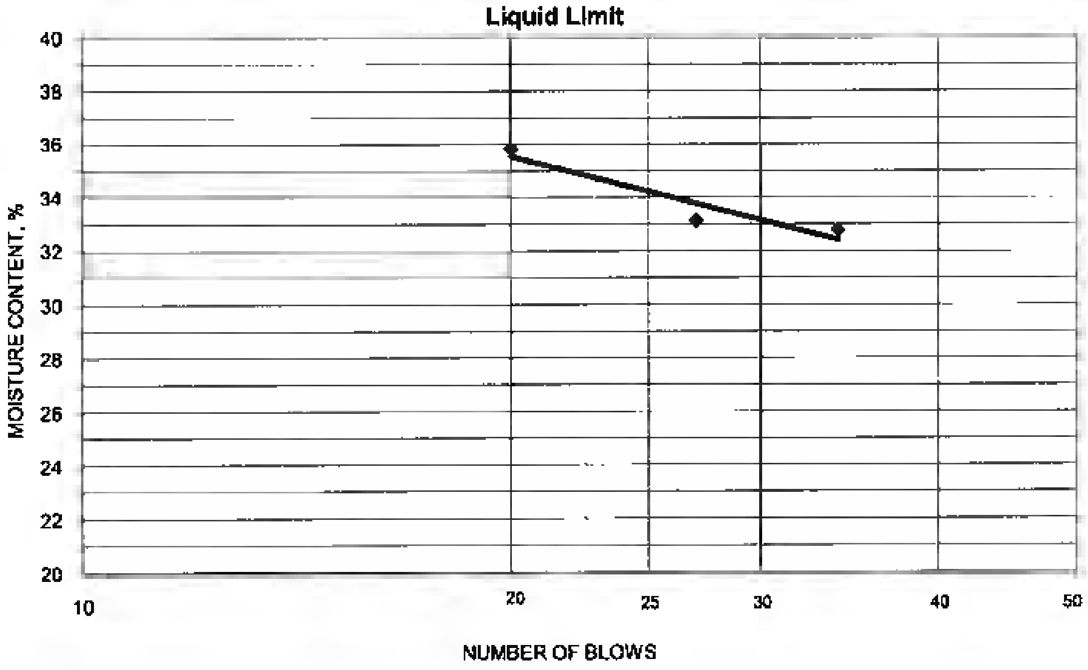
Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

ATTERBERG LIMITS

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-16S, 36.0'-36.5'
Project No. 175559016
Lab ID 52A
% + No. 40 2
Tested By JF
Test Method ASTM D 4318 Method A
Date Received 09-16-2009
Test Date 04-29-2010
Prepared Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
20.53	18.13	11.43	20	35.8	34
22.10	19.45	11.45	27	33.1	
21.88	19.30	11.43	34	32.8	



PLASTIC LIMIT AND PLASTICITY INDEX

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
20.14	18.93	11.50	16.3	16	18
18.44	17.43	11.17	16.1		

Remarks: __________

Reviewed By __________

Stantec

Summary of Soil Tests

Project Name: Gallatin Fossil Plant (GAF) - Ash Ponds
Project Number: 175559018
Source: STN-E-21S, 11.6'-12.1'
Lab ID: 62B
County: Sumner
Date Received: 9-16-09
Sample Type: ST
Date Reported: 5-3-10

Test Results

Natural Moisture Content

Test Method: ASTM D 2216
Moisture Content (%): 26.0

Particle Size Analysis

Preparation Method: ASTM D 421
Gradation Method: ASTM D 422
Hydrometer Method: ASTM D 422

Particle Size		%
Sieve Size	(mm)	Passing
3"	75	
2"	50	
1 1/2"	37.5	
1"	25	100.0
3/4"	19	99.2
3/8"	9.5	97.7
No. 4	4.75	94.2
No. 10	2	90.8
No. 40	0.425	85.6
No. 200	0.075	81.0
	0.02	67.2
	0.005	46.0
	0.002	38.3
estimated	0.001	36.0

Plus 3 in. material, not included: 0 (%)

Range	ASTM (%)	AASHTO (%)
Gravel	5.8	9.2
Coarse Sand	3.4	5.2
Medium Sand	5.2	---
Fine Sand	4.6	4.6
Silt	35.0	42.7
Clay	46.0	38.3

Atterberg Limits

Test Method: ASTM D 4318 Method A
Prepared: Dry
Liquid Limit: 41
Plastic Limit: 17
Plasticity Index: 24
Activity Index: 0.63

Moisture-Density Relationship

Test Not Performed
Maximum Dry Density (lb/ft^3): N/A
Maximum Dry Density (kg/m^3): N/A
Optimum Moisture Content (%): N/A
Over Size Correction %: N/A

California Bearing Ratio

Test Not Performed
Bearing Ratio (%): N/A
Compacted Dry Density (lb/ft^3): N/A
Compacted Moisture Content (%): N/A

Specific Gravity

Test Method: ASTM D 854
Prepared: Dry
Particle Size: No. 10
Specific Gravity at 20° Celsius: 2.73

Classification

Unified Group Symbol: CL
Group Name: Lean clay with sand
AASHTO Classification: A-7-6 (19)

Comments:

Stantec

Particle-Size Analysis of Soils
ASTM D 422

Project Name	Gallatin Fossil Plant (GAF) - Ash Ponds	Project Number	175559018
Source	STN-E-21S, 11.6'-12.1'	Lab ID	62B

Sieve analysis for the Portion Coarser than the No. 10 Sieve

Test Method: ASTM D 422
Prepared using: ASTM D 421

Particle Shape: Angular
Particle Hardness: Hard and Durable

Tested By: Ford
Test Date: 04-27-2010
Date Received 09-16-2009

Maximum Particle size: 1" Sieve

Sieve Size	% Passing
3"	
2"	
1 1/2"	
1"	100.0
3/4"	99.2
3/8"	97.7
No. 4	94.2
No. 10	90.8

Analysis for the portion Finer than the No. 10 Sieve

Analysis Based on: Total Sample

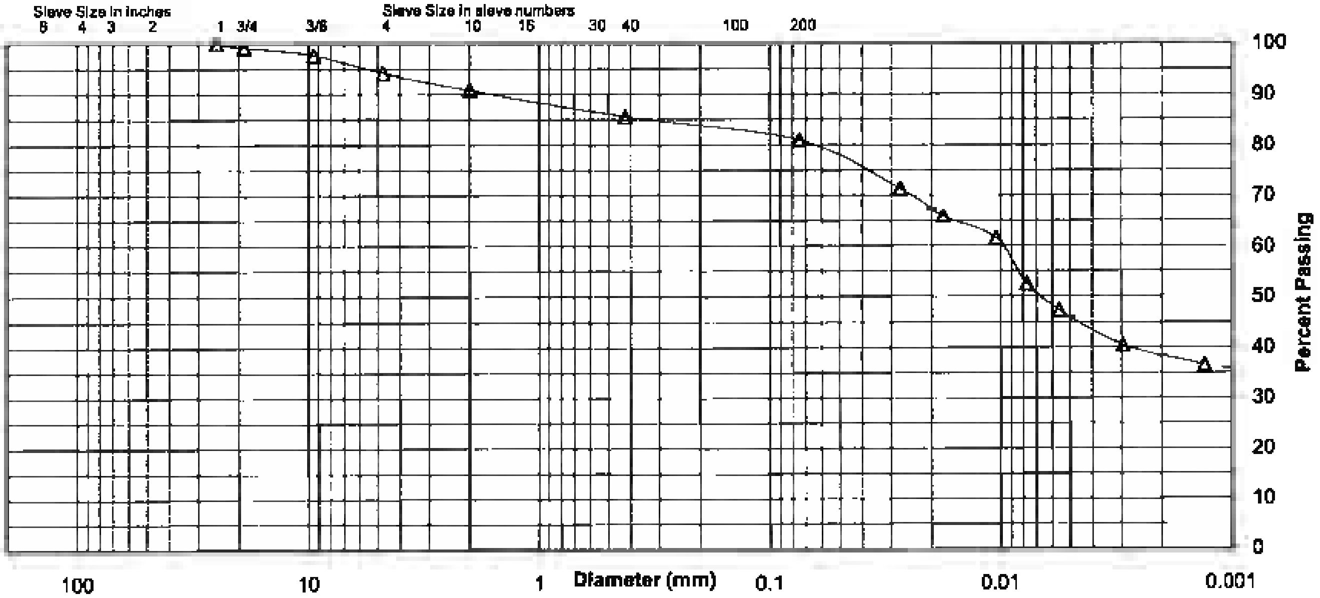
Specific Gravity 2.73

Dispersed using: Apparatus A - Mechanical, for 1 minute

No. 40	85.6
No. 200	81.0
0.02 mm	67.2
0.005 mm	46.0
0.002 mm	38.3
0.001 mm	36.0

Particle Size Distribution

ASTM	Coarse Gravel	Fine Gravel	C. Sand	Medium Sand	Fine Sand	Silt	Clay
	0.8	5.0	3.4	5.2	4.6	35.0	46.0
AASHTO	Gravel			Coarse Sand	Fine Sand	Silt	Clay
	9.2			5.2	4.6	42.7	38.3



Comments

Reviewed By

File: frm 175559018_sum_62b.xlsm Sheet: Hydro-Report
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

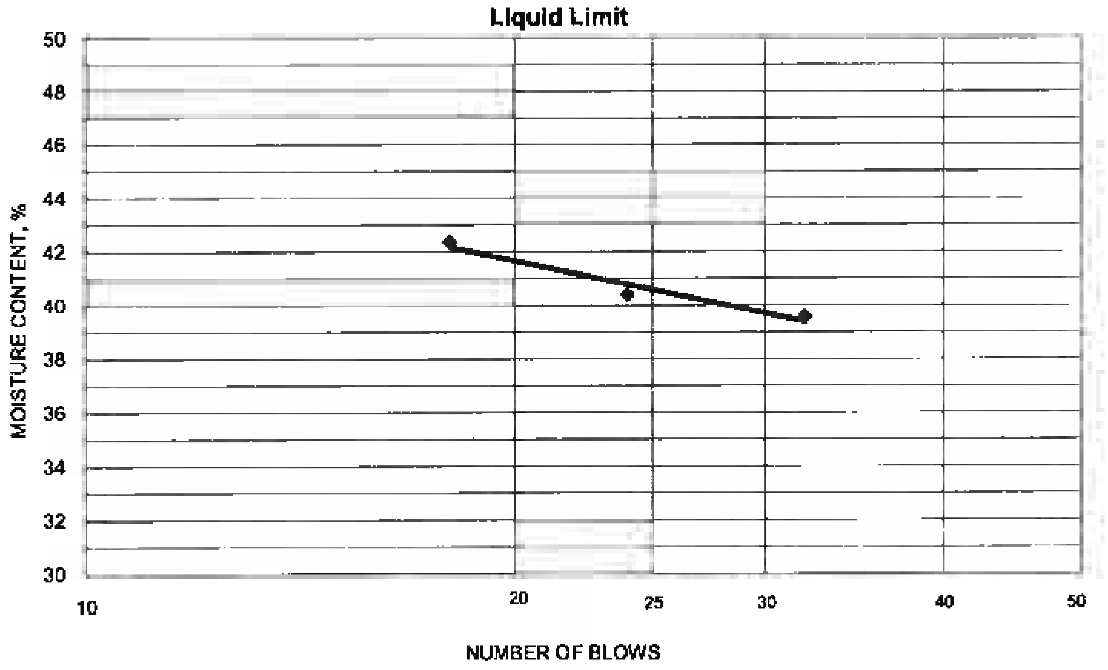
Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

ATTERBERG LIMITS

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Source	STN-E-21S, 11.6'-12.1'	Lab ID	62B
		% + No. 40	14
Tested By	JF	Test Method	ASTM D 4318 Method A
Date Received	09-16-2009		
Test Date	04-30-2010	Prepared	Dry

Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Number of Blows	Water Content (%)	Liquid Limit
21.15	18.18	11.17	18	42.4	41
21.89	18.81	11.03	32	39.6	
21.03	18.13	10.95	24	40.4	



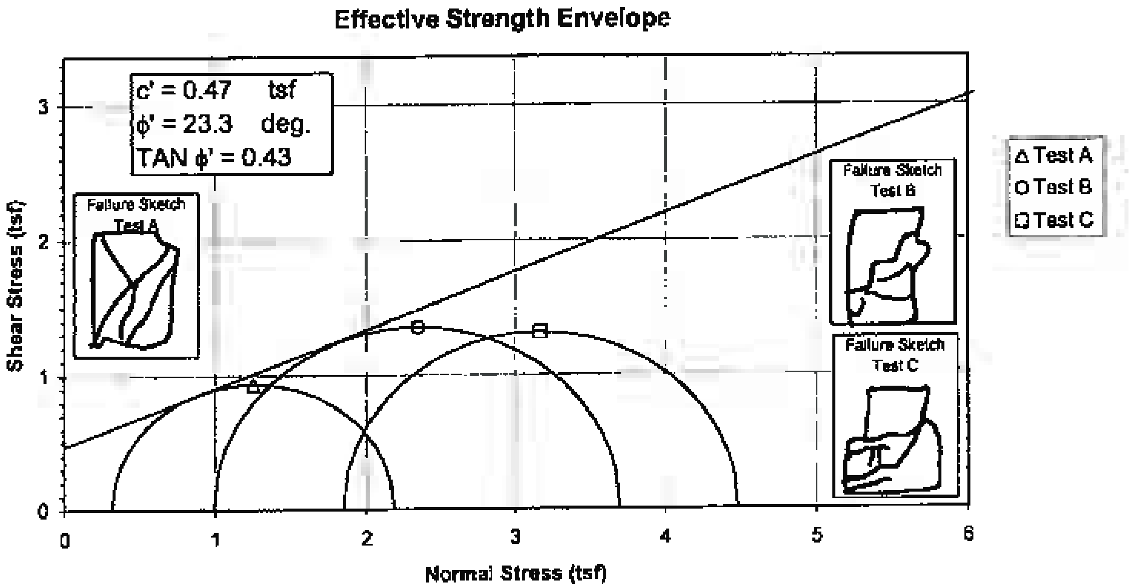
PLASTIC LIMIT AND PLASTICITY INDEX

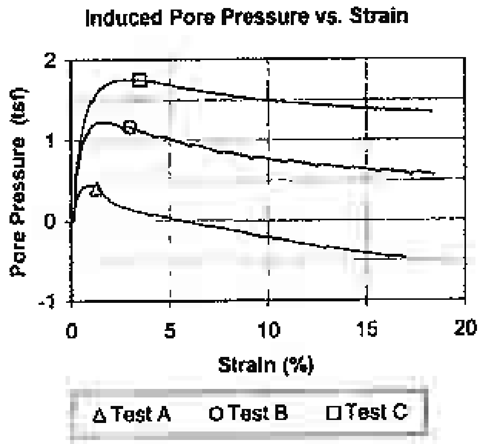
Wet Soil and Tare Mass (g)	Dry Soil and Tare Mass (g)	Tare Mass (g)	Water Content (%)	Plastic Limit	Plasticity Index
17.71	16.76	11.22	17.1	17	24
19.04	17.91	11.29	17.1		

Remarks: ______________________

Reviewed By ______________________

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	21.5	18.1	25.5	
	Dry Density PCF	γ_{d_o}	103.2	106.4	97.5	
	Saturation %	S_o	92.1	84.2	95.0	
	Void Ratio	e_o	0.627	0.578	0.722	
After Shear	Water content %	W_f	23.0	19.3	25.3	
	Dry Density PCF	γ_{d_f}	103.8	110.6	100.0	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.618	0.518	0.679	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.32	0.99	1.65	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.87	2.70	2.63	
Time to (σ1'-σ3')max min.		t_f	4.9	21.3	175.4	
Ultimate Deviator Stress, t/sq ft		$(\sigma1'-\sigma3')_{ult}$	n/a	n/a	2.37	
Initial Diameter, in.		D_o	2.884	2.882	2.878	
Initial Height, in.		H_o	6.051	6.061	6.020	

Controlled - Strain Test

Description of Specimens Fat Clay (CH), red brown, moist, firm

LL	PL	PI	Gs 2.69	Type of Specimen Undisturbed	Type of test $\bar{R}$
				Project	Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks:

Boring No. STN-D-1S Sample No. 1
Depth Elev. 6.0'-6.5', 2.0'-2.5', 2.6'-3.1'
Laboratory Stantec Date 11-30-09

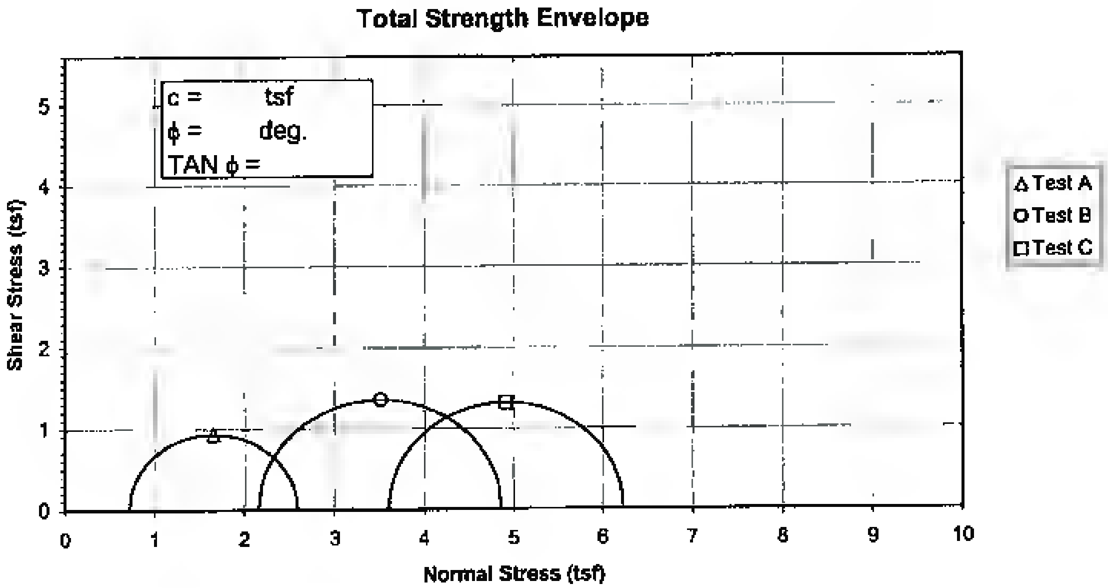
TRIAXIAL COMPRESSION TEST REPORT

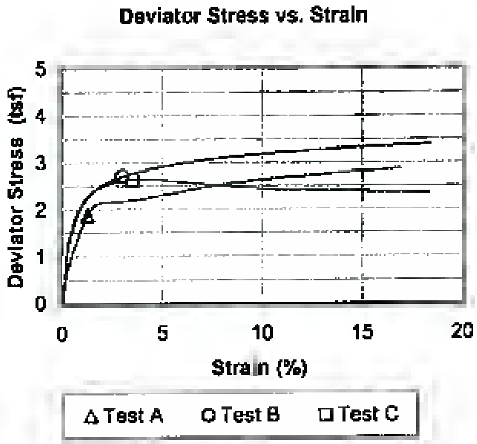
File 175559018_cu_1 Sheet: CE_Final-E
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	21.5	18.1	25.5	
	Dry Density PCF	γ_{d_o}	103.2	106.4	97.5	
	Saturation %	S_o	92.1	84.2	95.0	
	Void Ratio	e_o	0.627	0.578	0.722	
After Shear	Water content %	W_f	23.0	19.3	25.3	
	Dry Density PCF	γ_{d_f}	103.8	110.6	100.0	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.618	0.518	0.679	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	1.87	2.70	2.63	
Time to $(\sigma_1-\sigma_3)_{max}$ min.		t_f	4.9	21.3	175.4	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	2.37	
Initial Diameter, in.		D_o	2.884	2.882	2.878	
Initial Height, in.		H_o	6.051	6.061	6.020	

Controlled - Strain Test

Description of Specimens Fat Clay (CH), red brown, moist, firm

Type of Specimen Undisturbed

Type of test R

LL	PL	PI	Gs	2.69

Project Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks:

Boring No. STN-D-1S

Sample No. 1

Depth Elev. 6.0'-6.5', 2.0'-2.5', 2.6'-3.1'

Laboratory Stantec

Date 11-30-09

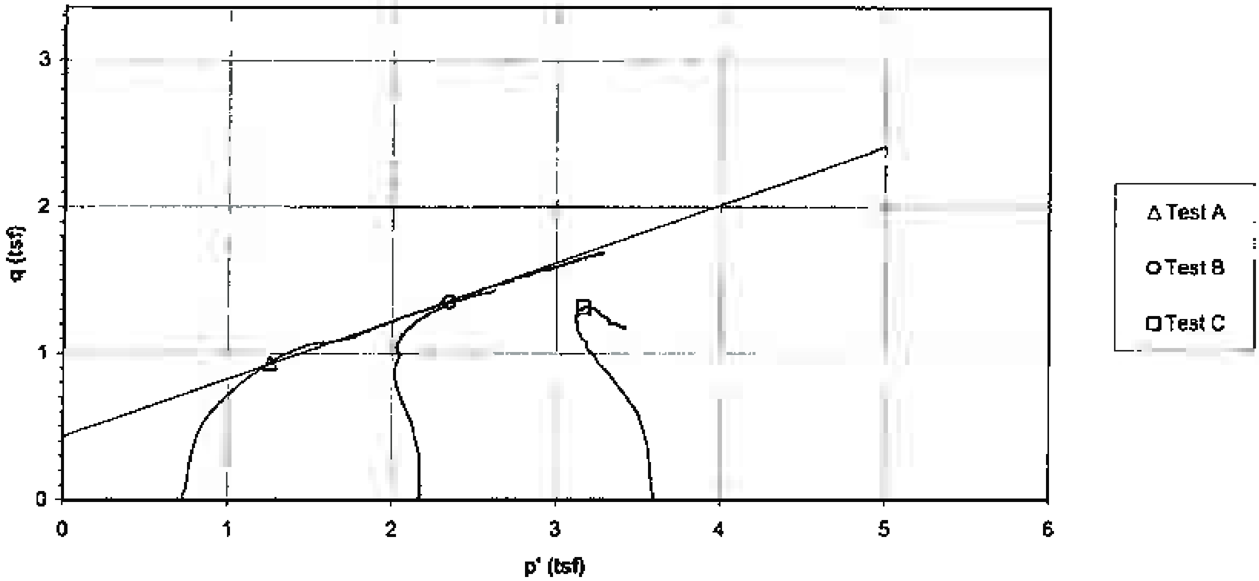
TRIAXIAL COMPRESSION TEST REPORT

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

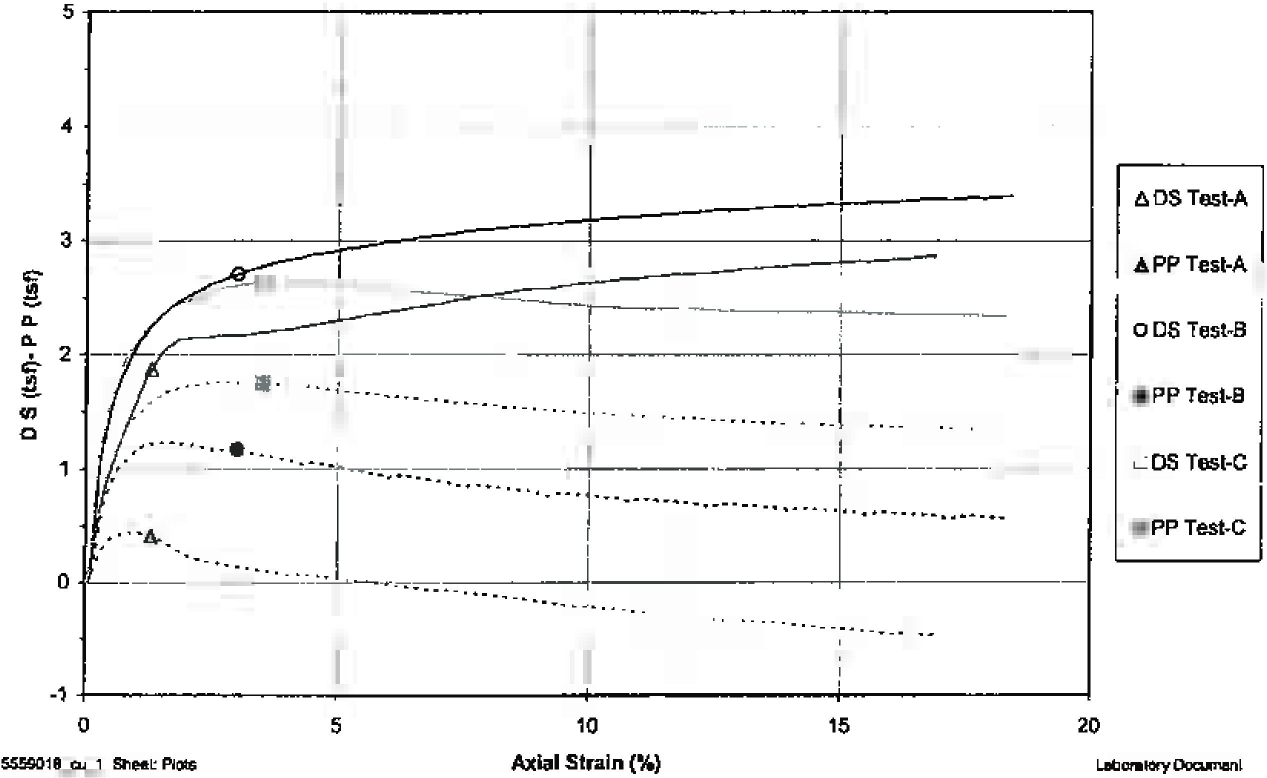
Project Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID STN-D-1S, 6.0'-6.5' & STN-D-1S, 2.0'-2.5' & STN-D-1S, 2.6'-3.1'
Failure Criterion: Maximum Effective Principal Stress Ratio $\phi' =$ 23.3 deg.

Project No. 175559018
Test Number 1
c' = 0.47 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



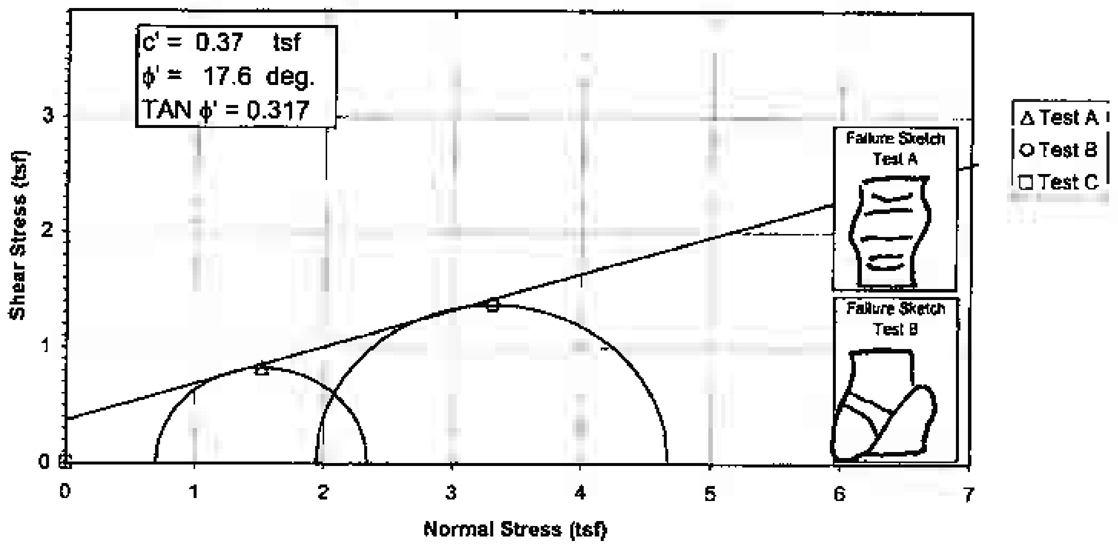
File: 175559018_cu_1 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

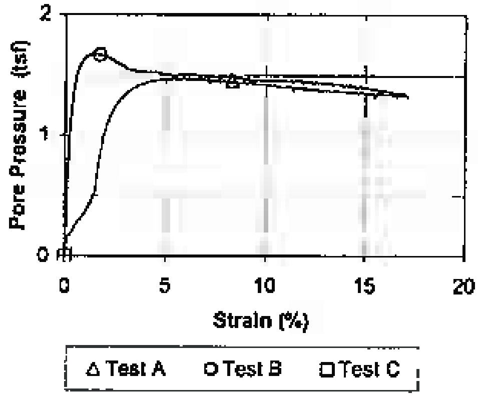
Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	19.5	19.7	######	
	Dry Density PCF	γ_{d_o}	102.3	108.2	######	
	Saturation %	S_o	80.3	94.2	######	
	Void Ratio	e_o	0.660	0.569	######	
After Shear	Water content %	W_f	20.7	19.8	######	
	Dry Density PCF	γ_{d_f}	108.6	110.3	######	
	Saturation %	S_f	100.0	100.0	######	
	Void Ratio	e_f	0.564	0.539	######	
	Final Back Pressure TSF	u_c	4.32	2.88	0.00	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.70	1.94	0.00	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.63	2.74	0.00	
Time to (σ1'-σ3')max min.		t_f	512.3	98.8	0.0	
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	0.00	
Initial Diameter, in.		D_o	2.880	2.880	######	
Initial Height, in.		H_o	6.029	6.041	######	

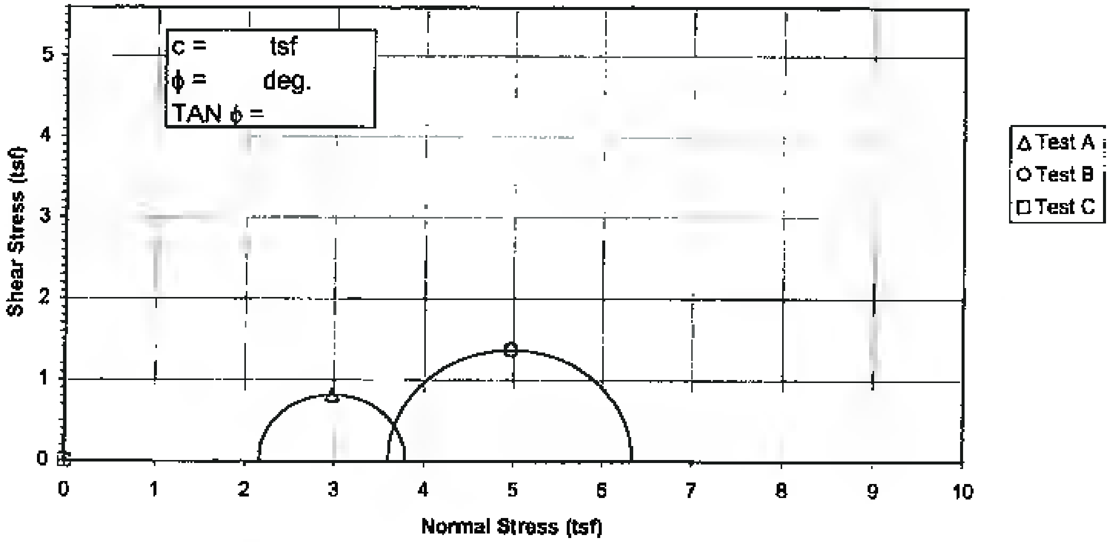
Controlled - Strain Test

Description of Specimens Lean Clay (CL), brown, moist, firm

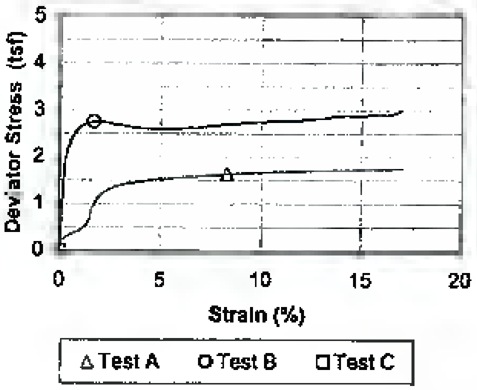
				Type of Specimen	Undisturbed	Type of test	$\bar{R}$
LL	PL	PI	Gs 2.72	Project	Gallatin Fossil Plant (GAF) - Ash Ponds		
Remarks:				Boring No.	STN-E-4S, STN-E-8		
						Sample No.	2
				Depth Elev.	5.0'-5.5', 5.4'-5.9'		
				Laboratory	Stantec	Date	11-30-09
				TRIAXIAL COMPRESSION TEST REPORT			

Failure Criterion: Maximum Effective Principal Stress Ratio

Total Strength Envelope



Deviator Stress vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	19.5	19.7	######	
	Dry Density PCF	γ_{d_o}	102.3	108.2	######	
	Saturation %	S_o	80.3	94.2	######	
	Void Ratio	e_o	0.660	0.569	######	
After Shear	Water content %	W_f	20.7	19.8	######	
	Dry Density PCF	γ_{d_f}	108.6	110.3	######	
	Saturation %	S_f	100.0	100.0	######	
	Void Ratio	e_f	0.564	0.539	######	
	Final Back Pressure TSF	u_c	4.32	2.88	0.00	
Minor Principal Stress TSF		σ_3	2.16	3.60	0.00	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	1.63	2.74	0.00	
Time to $(\sigma_1-\sigma_3)_{Max.}$ min.		t_f	512.3	98.8	0.0	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	0.00	
Initial Diameter, in.		D_o	2.880	2.880	######	
Initial Height, in.		H_o	6.029	6.041	######	

Controlled - Strain Test

Description of Specimens Lean Clay (CL), brown, moist, firm

				Type of Specimen	Undisturbed	Type of test $\bar{R}$
LL	PL	PI	Gs 2.72	Project	Gallatin Fossil Plant (GAF) - Ash Ponds	
Remarks:				Boring No.	STN-E-4S, STN-E-8	
						Sample No. 2
				Depth Elev.	5.0'-5.5', 5.4'-5.9'	
				Laboratory	Stantec	Date 11-30-09
				TRIAXIAL COMPRESSION TEST REPORT		

File: 175559018_cu_2 Sheet: CE_Final-T
Preparation Date: 1998
Revision Date: 1-2006

Stantec Consulting Services Inc.

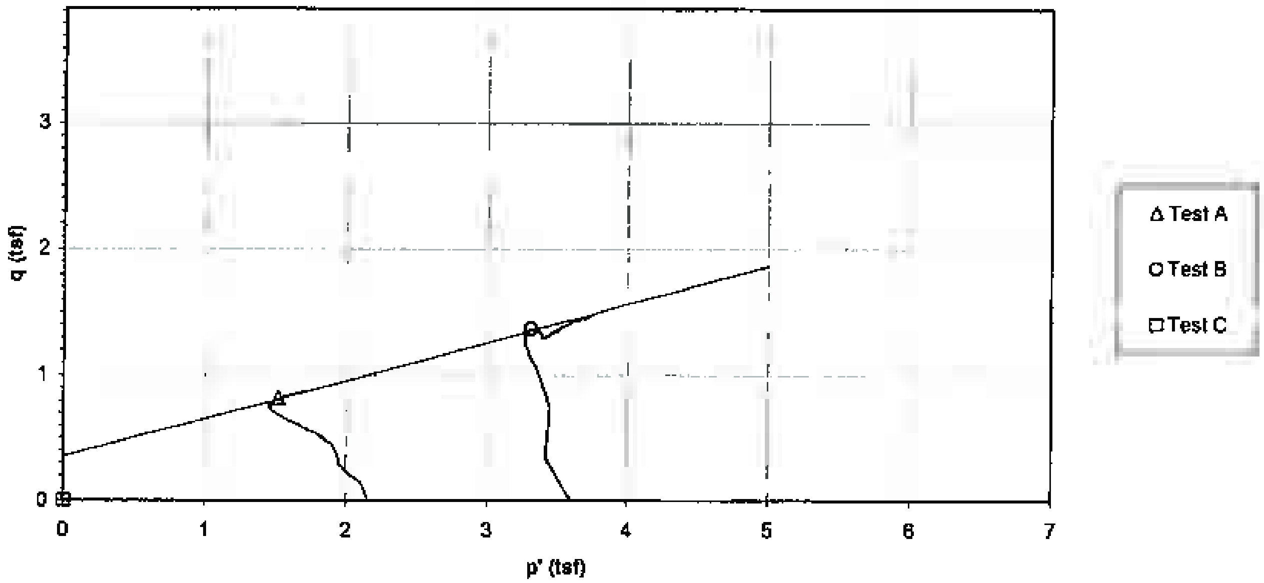
Laboratory Document
Prepared By: MW
Approved BY: TLK

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

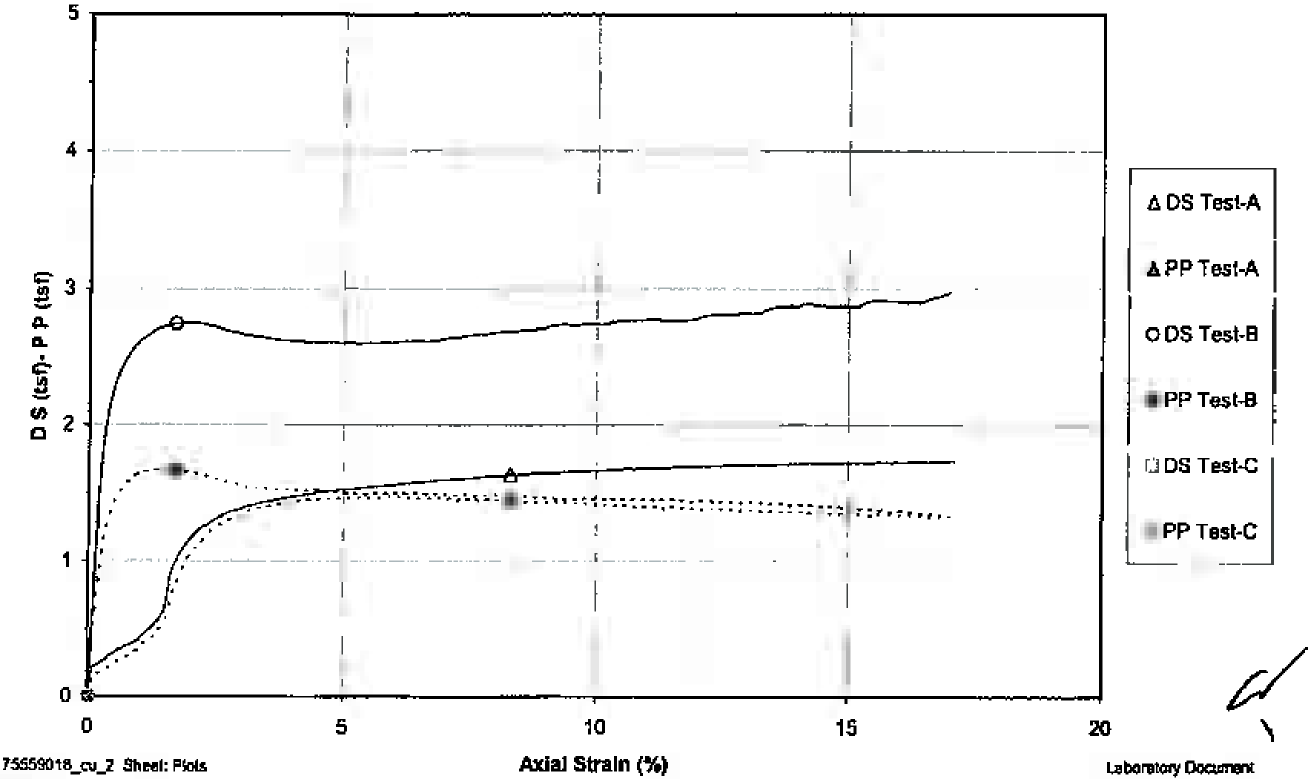
Project: Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID: STN-E-4S, 5.0'-5.5' & STN-E-8, 5.4'-5.9'
Failure Criterion: Maximum Effective Principal Stress Ratio
ϕ' = 17.6 deg.

Project No. 175559018
Test Number 2
c' = 0.37 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain

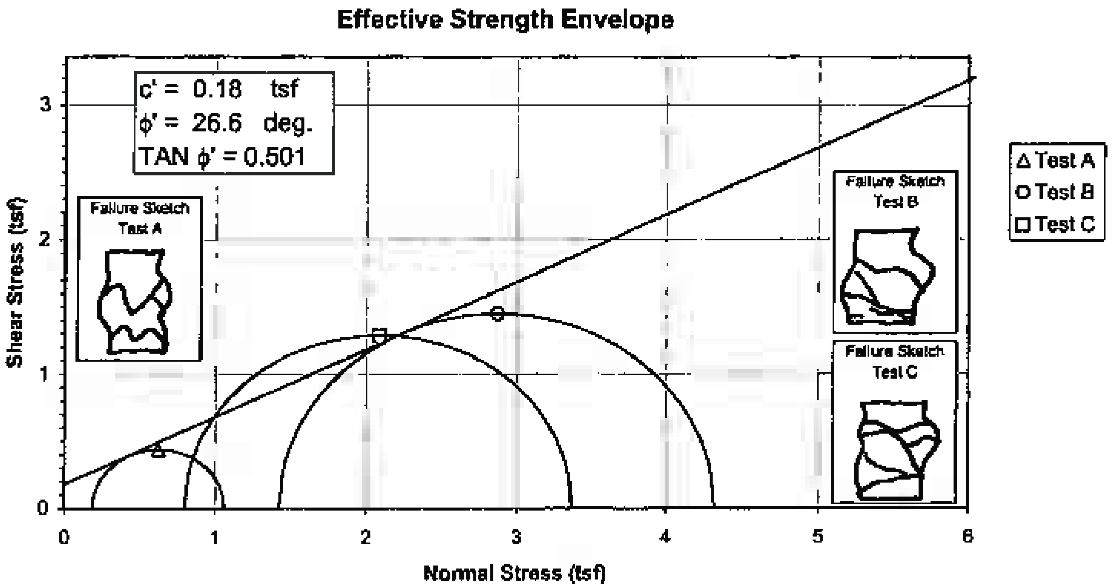


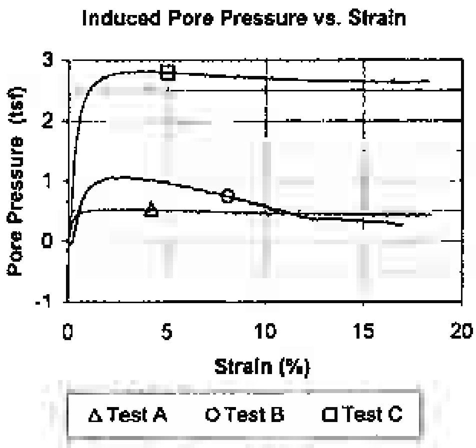
File: 175559018_cu_2 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	15.7	19.7	19.4	
	Dry Density PCF	γd_o	118.8	108.2	109.3	
	Saturation %	S_o	102.3	96.0	97.1	
	Void Ratio	e_o	0.413	0.552	0.537	
After Shear	Water content %	W_f	12.9	15.5	16.0	
	Dry Density PCF	γd_f	124.8	118.4	117.5	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.346	0.418	0.429	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.19	1.43	0.80	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.87	2.90	2.57	
Time to (σ1'-σ3')max min.		t_f	126.3	715.6	328.7	
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.850	2.882	2.881	
Initial Height, in.		H_o	6.072	6.028	6.036	

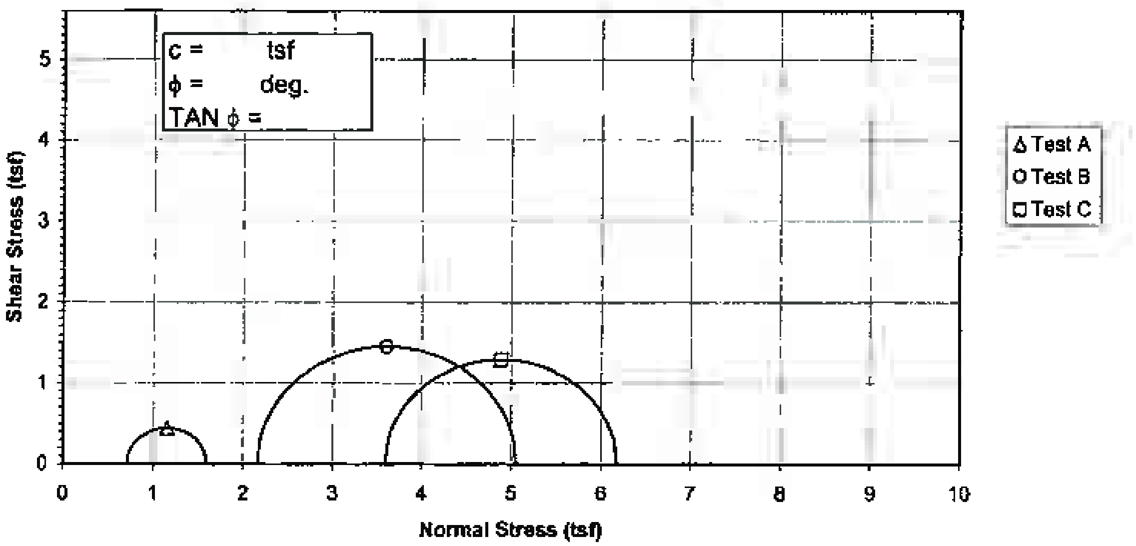
Controlled - Strain Test

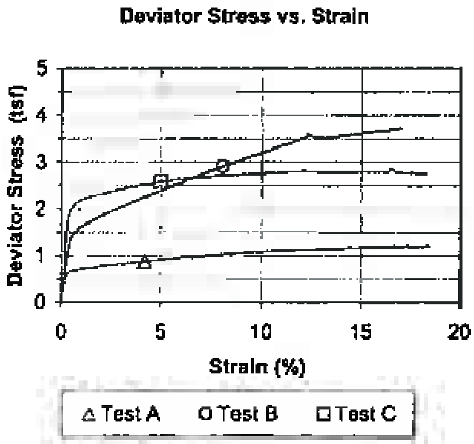
Description of Specimens Gravelly Fat Clay (CH), brown, moist, soft

				Type of Specimen Undisturbed	Type of test $\bar{R}$
LL	PL	PI	Gs 2.69	Project	Gallatin Fossil Plant (GAF) - Ash Ponds
Remarks:					
				Boring No. STN-E-8	Sample No. 3
				Depth Elev.	41.0'-41.5', 41.6'-42.1', 45.2'-45.7'
				Laboratory Stantec	Date 12-1-09

TRIAXIAL COMPRESSION TEST REPORT

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	15.7	19.7	19.4	
	Dry Density PCF	γ_{d_o}	118.8	108.2	109.3	
	Saturation %	S_o	102.3	96.0	97.1	
	Void Ratio	e_o	0.413	0.552	0.537	
After Shear	Water content %	W_f	12.9	15.5	16.0	
	Dry Density PCF	γ_{d_f}	124.8	118.4	117.5	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.346	0.418	0.429	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	0.87	2.90	2.57	
Time to $(\sigma_1-\sigma_3)_{Max.}$ min.		t_f	126.3	715.6	328.7	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, In.		D_o	2.850	2.882	2.881	
Initial Height, In.		H_o	6.072	6.028	6.036	

Controlled - Strain Test

Description of Specimens Gravelly Fat Clay (CH), brown, moist, soft

Type of Specimen Undisturbed
Type of test $\bar{R}$

LL PL PI Gs 2.69

Project Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks:

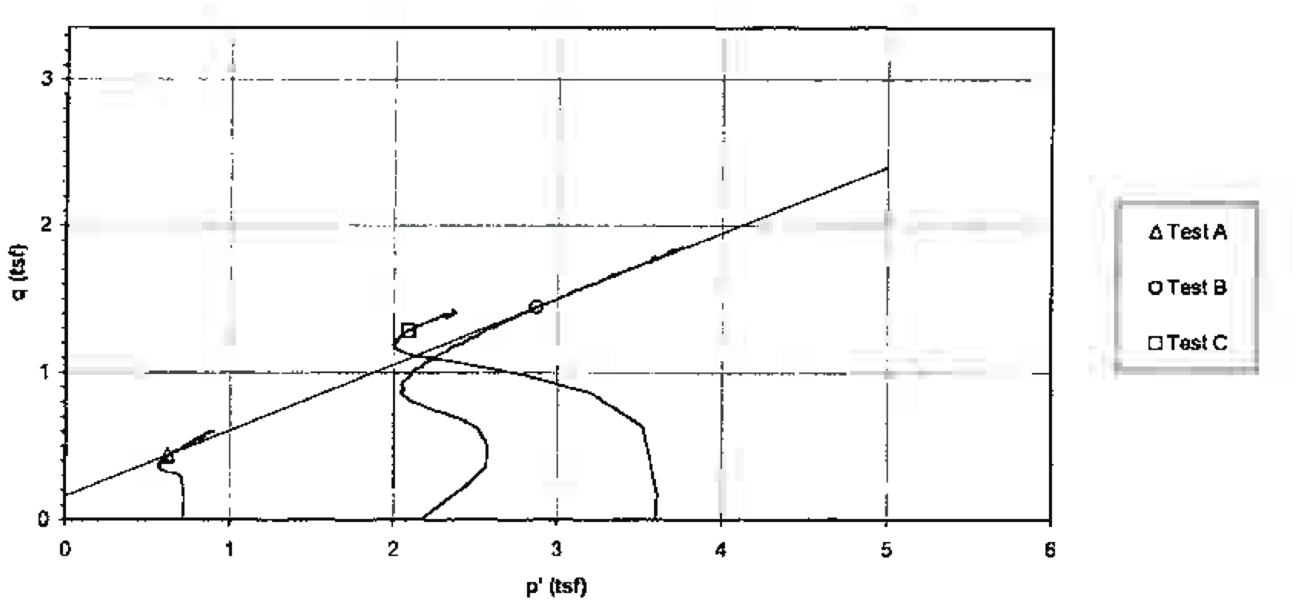
Boring No. STN-E-8
Sample No. 3
Depth Elev. 41.0'-41.5', 41.6'-42.1', 45.2'-45.7'
Laboratory Stantec
Date 12-1-09

TRIAXIAL COMPRESSION TEST REPORT

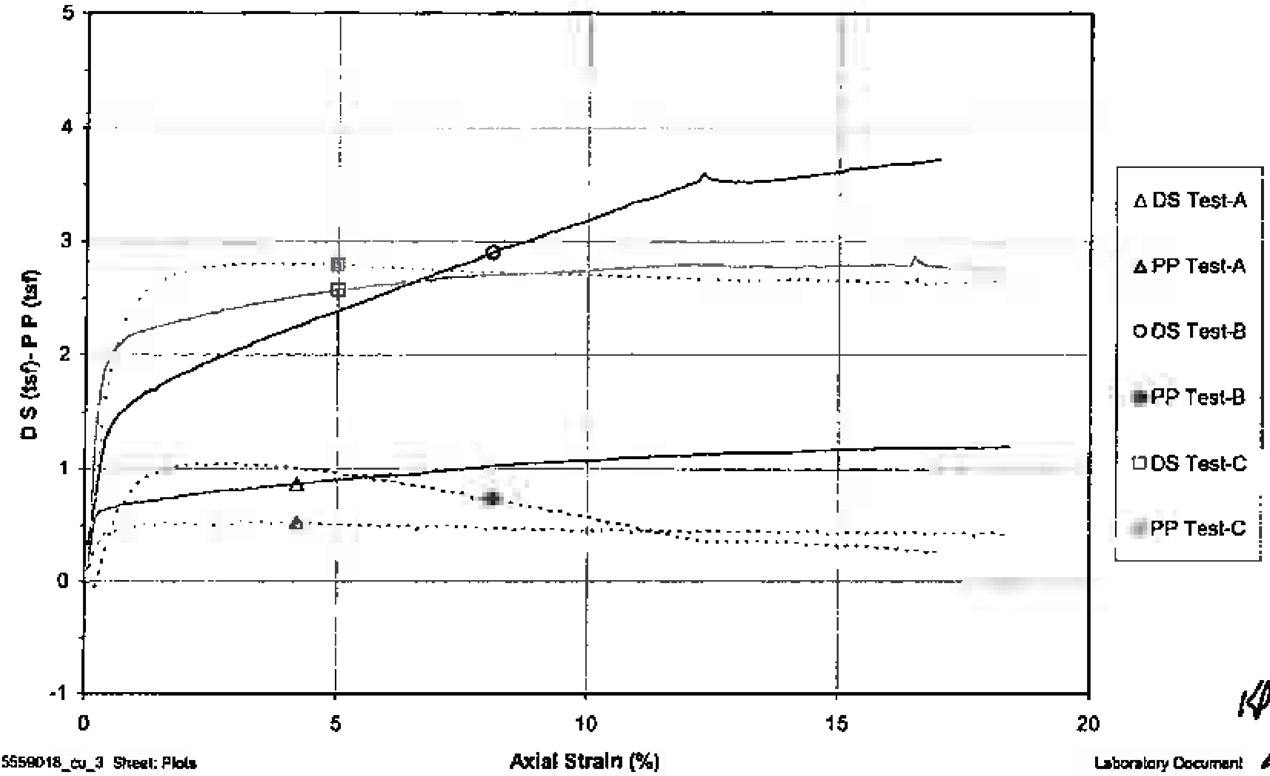
Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Project No. 175559018
Sample ID STN-E-8, 41.0'-41.5' & STN-E-8, 41.6'-42.1' & STN-E-8, 45.2'-45.7'
Test Number 3
Failure Criterion: Maximum Effective Principal Stress Ratio $\phi' =$ 26.6 deg. c' = 0.18 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



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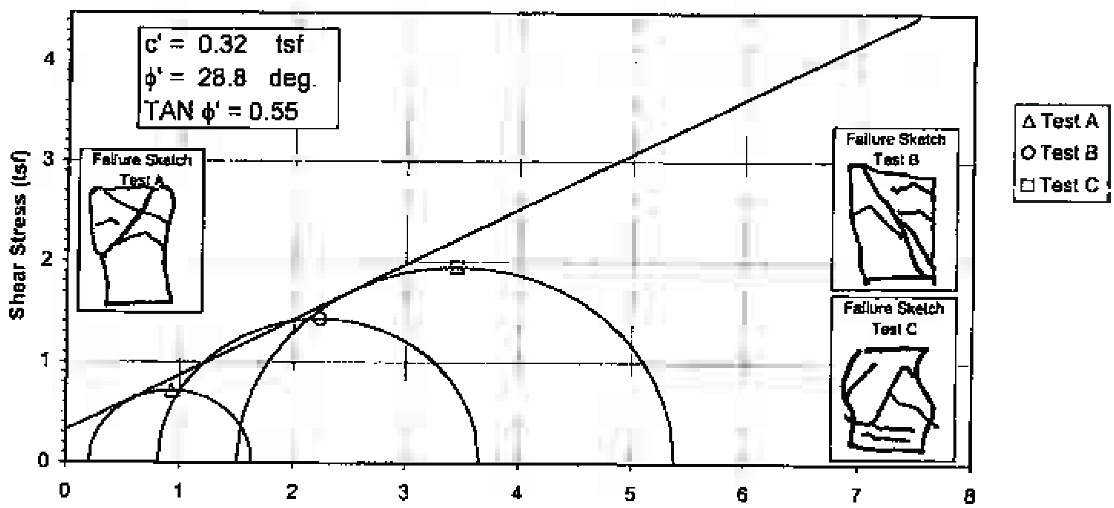
File: 175559018_cu_3 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

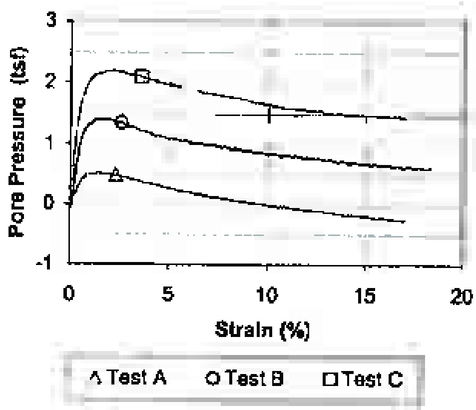
Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C
Initial Data	Water content %	W_o	21.0	21.7	22.0
	Dry Density PCF	γd_o	105.5	105.1	104.8
	Saturation %	S_o	93.7	96.1	96.5
	Void Ratio	e_o	0.609	0.615	0.621
After Shear	Water content %	W_f	21.5	21.4	21.2
	Dry Density PCF	γd_f	107.2	107.3	107.7
	Saturation %	S_f	100.0	100.0	100.0
	Void Ratio	e_f	0.584	0.582	0.576
	Final Back Pressure TSF	u_c	5.76	4.32	2.88
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.21	0.81	1.51
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.40	2.85	3.89
Time to (σ1'-σ3')max min.		t_f	16.3	43.4	327.5
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a
Initial Diameter, in.		D_o	2.857	2.865	2.865
Initial Height, in.		H_o	6.109	6.155	6.020

Controlled - Strain Test

Description of Specimens Lean Clay (CL), brown, moist, firm, Mn

Type of Specimen Undisturbed | Type of test $\bar{R}$

LL | PL | PI | Gs 2.72 | Project Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks:

Boring No. STN-E-9 | Sample No. 4

Depth Elev. 9.5'-10.0', 10.1'-10.6', 10.7'-11.2'

Laboratory Stantec | Date 12-1-09

TRIAXIAL COMPRESSION TEST REPORT

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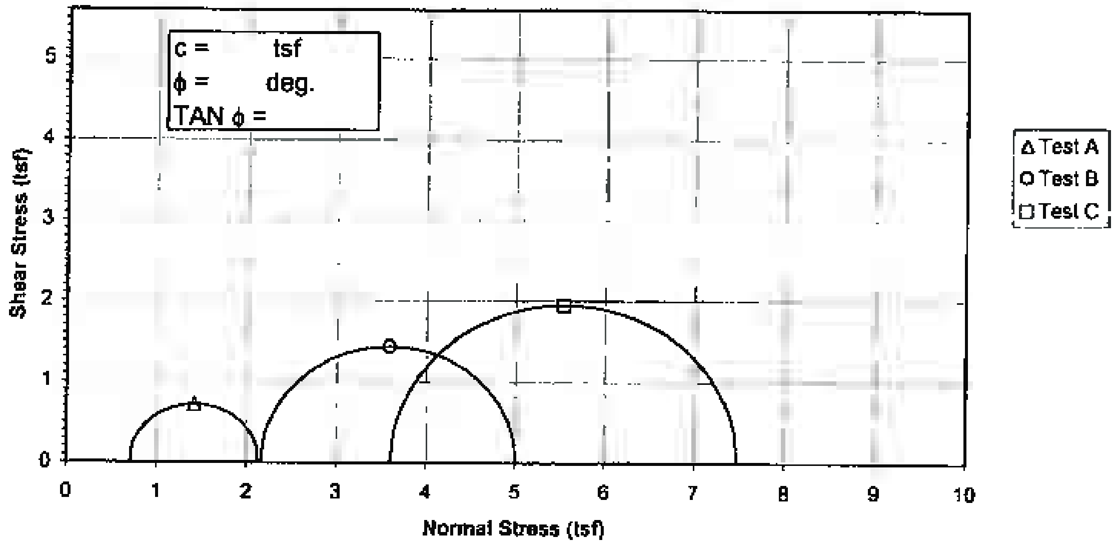
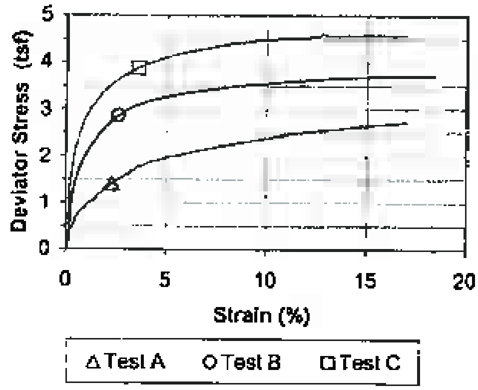
Failure Criterion: Maximum Effective Principal Stress Ratio

Total Strength Envelope



Deviator Stress vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	21.0	21.7	22.0	
	Dry Density PCF	γ_{d_o}	105.5	105.1	104.8	
	Saturation %	S_o	93.7	96.1	96.5	
	Void Ratio	e_o	0.609	0.615	0.621	
After Shear	Water content %	W_f	21.5	21.4	21.2	
	Dry Density PCF	γ_{d_f}	107.2	107.3	107.7	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.584	0.582	0.576	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	1.40	2.85	3.89	
Time to $(\sigma_1-\sigma_3)_{Max}$, min.		t_f	16.3	43.4	327.5	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.857	2.865	2.865	
Initial Height, in.		H_o	6.109	6.155	6.020	

Controlled - Strain Test

Description of Specimens Lean Clay (CL), brown, moist, firm, Mn

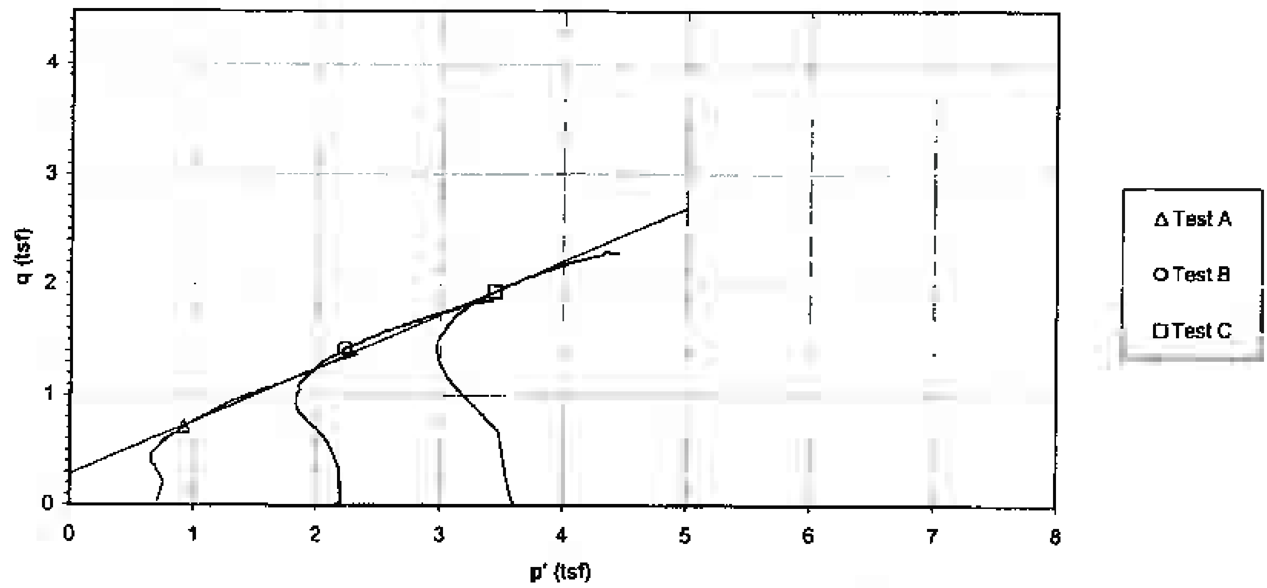
				Type of Specimen	Undisturbed	Type of test $\bar{R}$
LL	PL	PI	Gs 2.72	Project	Gallatin Fossil Plant (GAF) - Ash Ponds	
Remarks:						
				Boring No.	STN-E-9	Sample No. 4
				Depth Elev.	9.5'-10.0', 10.1'-10.6', 10.7'-11.2'	
				Laboratory	Stantec	Date 12-1-09

TRIAXIAL COMPRESSION TEST REPORT

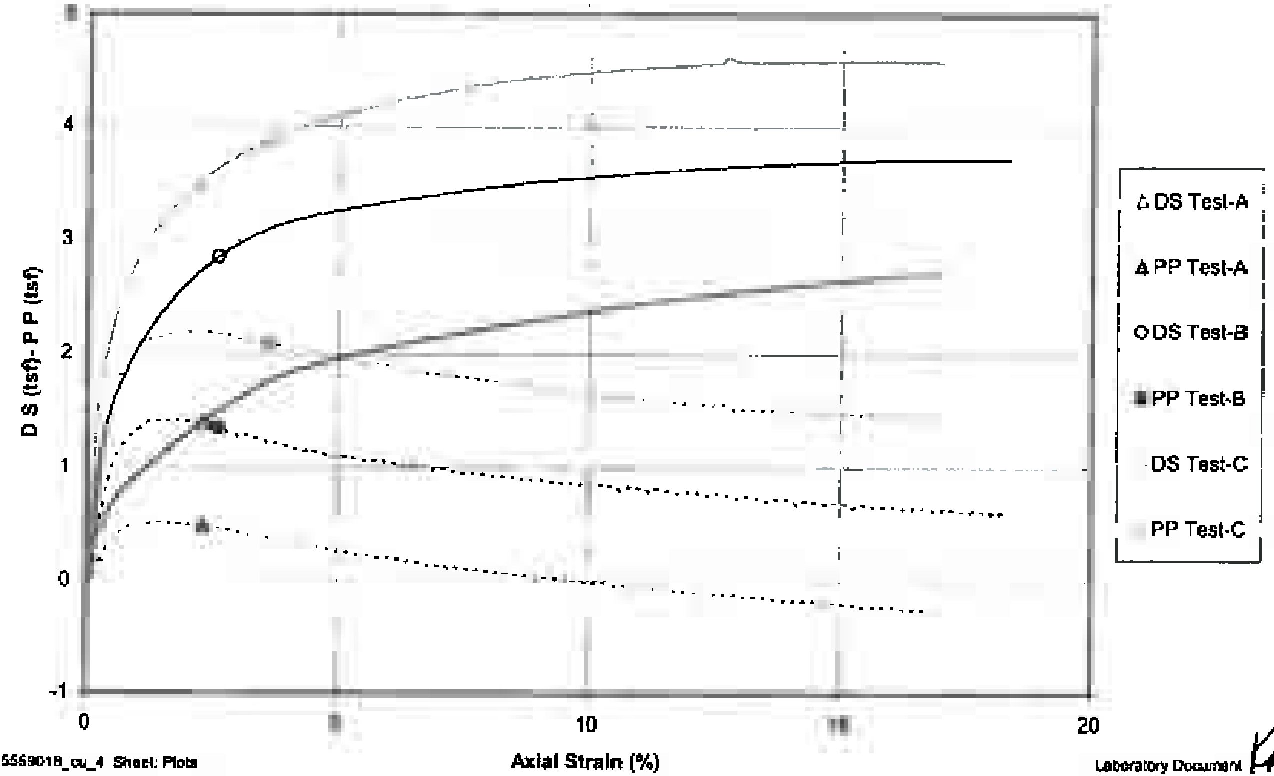
Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

Project	Gallatin Fossil Plant (GAF) - Ash Ponds	Project No.	175559018
Sample ID	STN-E-9, 9.5'-10.0' & STN-E-9, 10.1'-10.6' & STN-E-9, 10.7'-11.2'	Test Number	4
Failure Criterion:	Maximum Effective Principal Stress Ratio φ' = 28.8 deg.	c' =	0.32 tsf

p' vs. q Plot

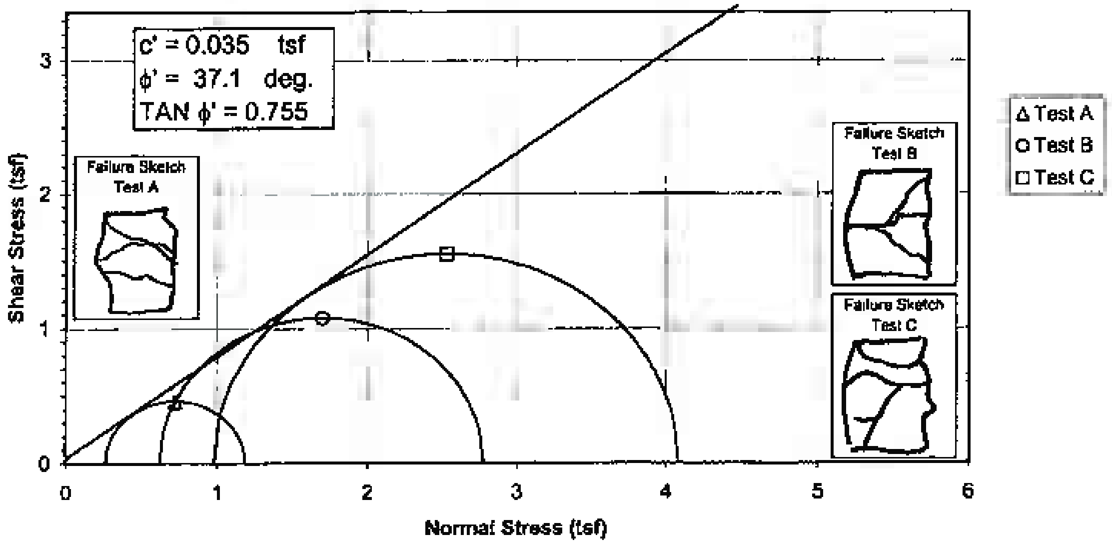


Deviator Stress and Induced Pore Pressure vs. Axial Strain

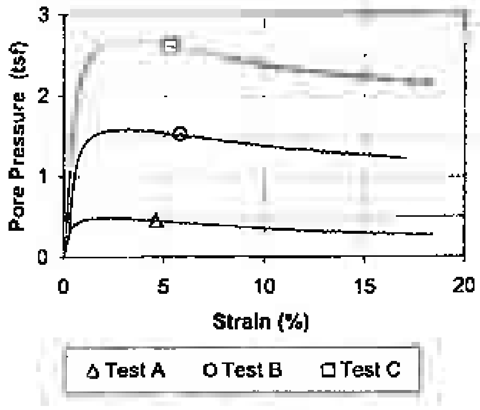


Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	27.6	27.1	24.9	
	Dry Density PCF	γ_{d_o}	95.7	97.8	101.7	
	Saturation %	S_o	100.0	103.4	104.9	
	Void Ratio	e_o	0.735	0.697	0.632	
After Shear	Water content %	W_f	23.1	21.1	18.7	
	Dry Density PCF	γ_{d_f}	102.8	106.3	110.9	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.615	0.562	0.497	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.27	0.62	0.98	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.92	2.15	3.09	
Time to (σ1'-σ3')max min.		t_f	140.5	396.4	170.4	
Ultimate Deviator Stress, t/sq ft		$(\sigma1'-\sigma3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.835	2.861	2.865	
Initial Height, in.		H_o	5.961	5.864	5.944	

Controlled - Strain Test

Description of Specimens Lean Clay with Sand (CL), brown, wet, soft

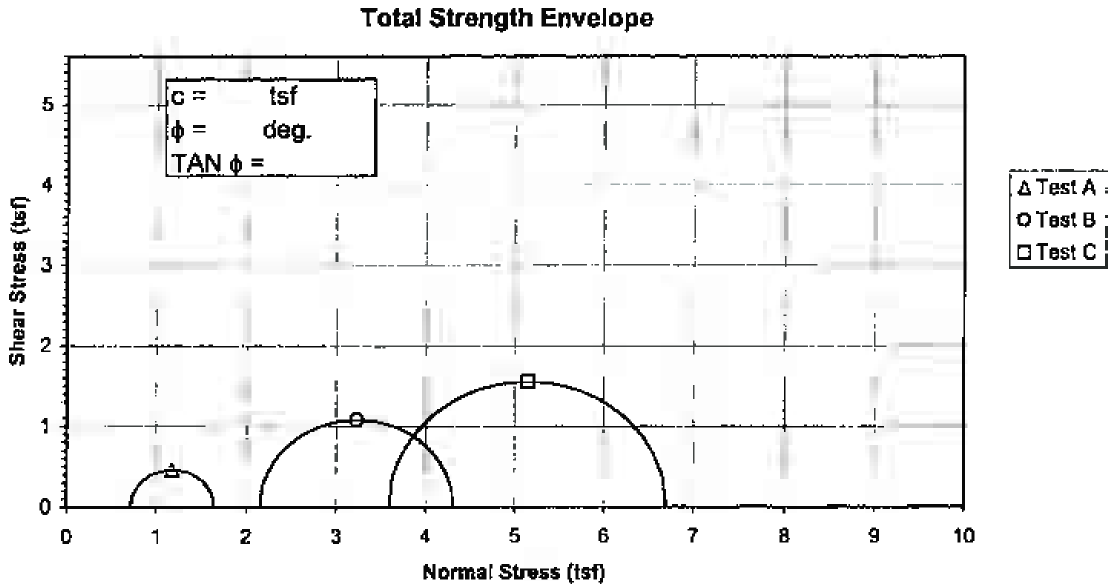
			Type of Specimen Undisturbed		Type of test $\bar{R}$
LL	PL	PI	Gs 2.66	Project	Gallatin Fossil Plant (GAF) - Ash Ponds
Remarks:					
				Boring No. STN-E-10S	Sample No. 5
				Depth Elev.	25.0'-25.5', 25.5'-26.0', 26.2'-26.7'
				Laboratory Stantec	Date 12-1-09
				TRIAXIAL COMPRESSION TEST REPORT	

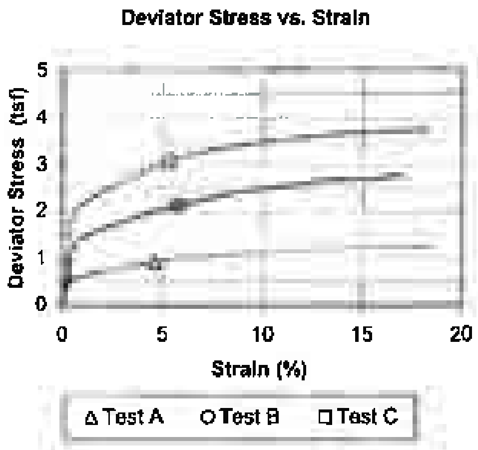
File: 175559018 cu 5 Sheet: CE Final-E
Preparation Date: 1998
Revision Date: 1-2009

Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	27.6	27.1	24.9	
	Dry Density PCF	γ_{d_o}	95.7	97.8	101.7	
	Saturation %	S_o	100.0	103.4	104.9	
	Void Ratio	e_o	0.735	0.697	0.632	
After Shear	Water content %	W_f	23.1	21.1	18.7	
	Dry Density PCF	γ_{d_f}	102.8	106.3	110.9	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.615	0.562	0.497	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	0.92	2.15	3.09	
Time to $(\sigma_1-\sigma_3)_{Max.}$ min.		t_f	140.5	396.4	170.4	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult.}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.835	2.861	2.865	
Initial Height, in.		H_o	5.961	5.864	5.944	

Controlled - Strain Test

Description of Specimens Lean Clay with Sand (CL), brown, wet, soft

LL	PL	PI	Gs 2.66	Type of Specimen Undisturbed	Type of test $\bar{R}$
Remarks:				Project	Gallatin Fossil Plant (GAF) - Ash Ponds
				Boring No. STN-E-10S	Sample No. 5
				Depth Elev.	25.0'-25.5', 25.5'-26.0', 26.2'-26.7'
				Laboratory Stantec	Date 12-1-09

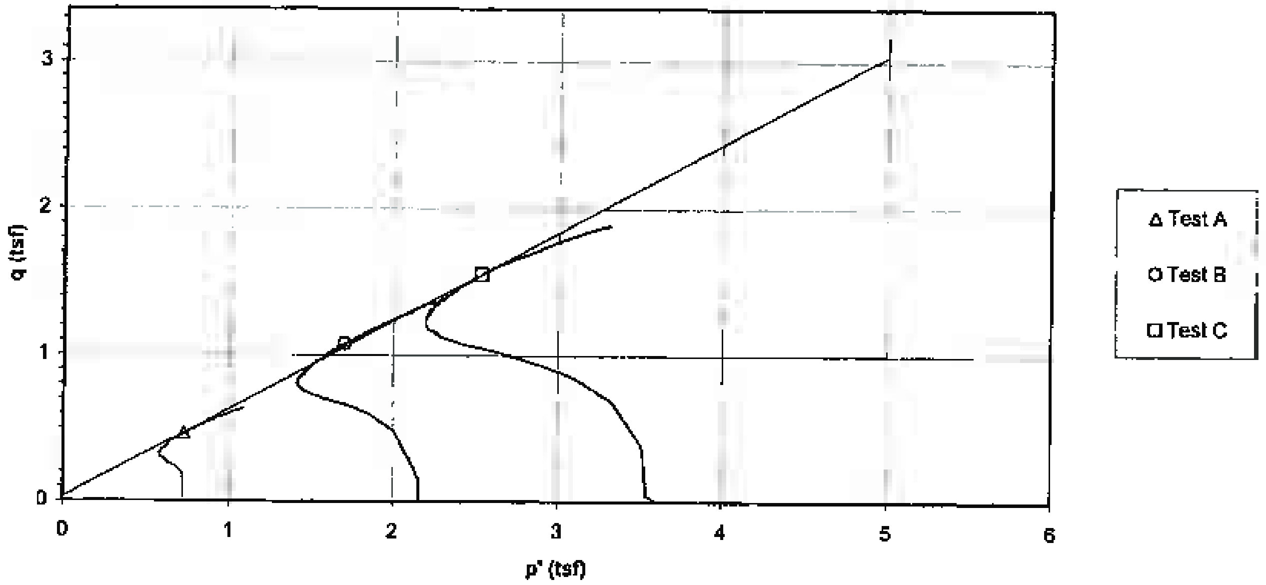
TRIAXIAL COMPRESSION TEST REPORT

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

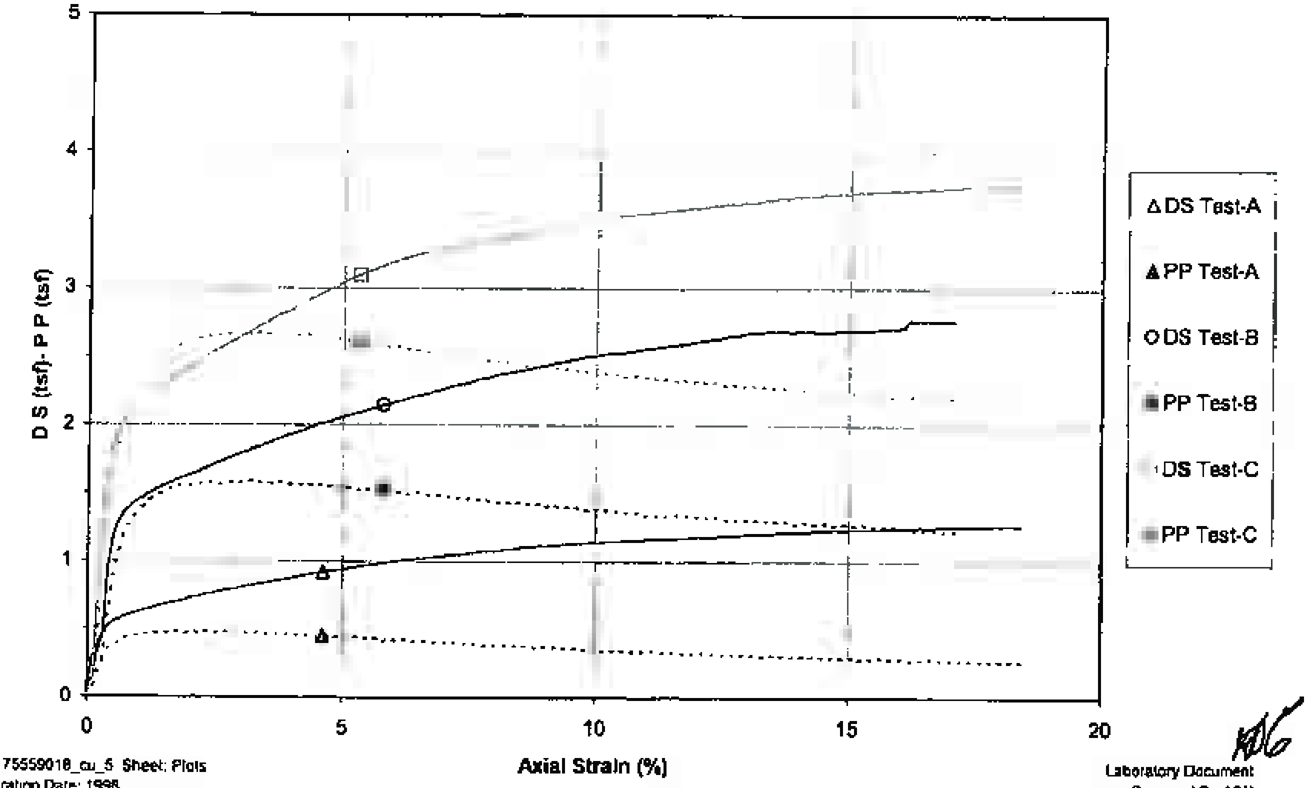
Project Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID STN-E-10S, 25.0'-25.5' & STN-E-10S, 25.5'-26.0' & STN-E-10S, 26.2'-26.7'
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 37.1 deg.

Project No. 175559018
Test Number 5
c' = 0.04 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



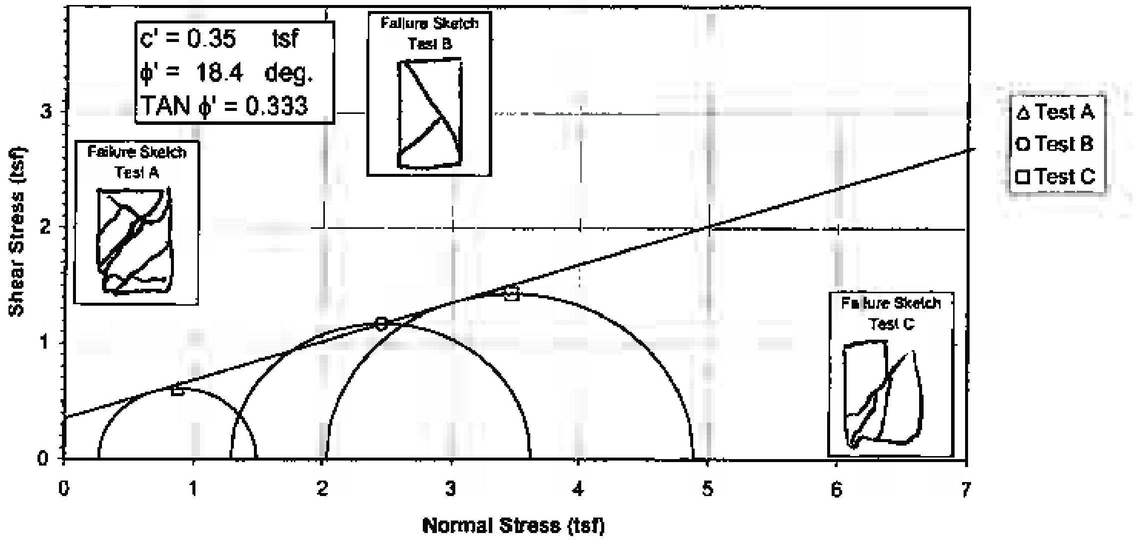
File: 175559018_cu_5 Sheet: Plots
Preparation Date: 1998
Revision Date. 1-2008

Stantec Consulting Services Inc.

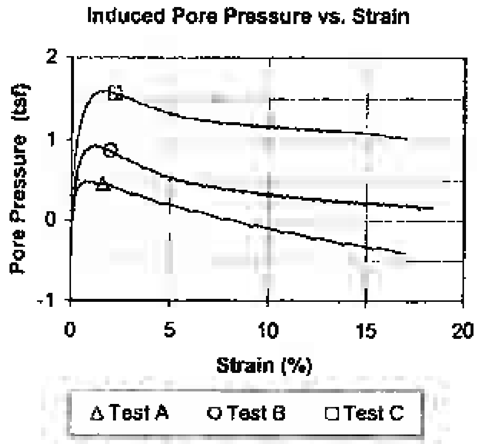
Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



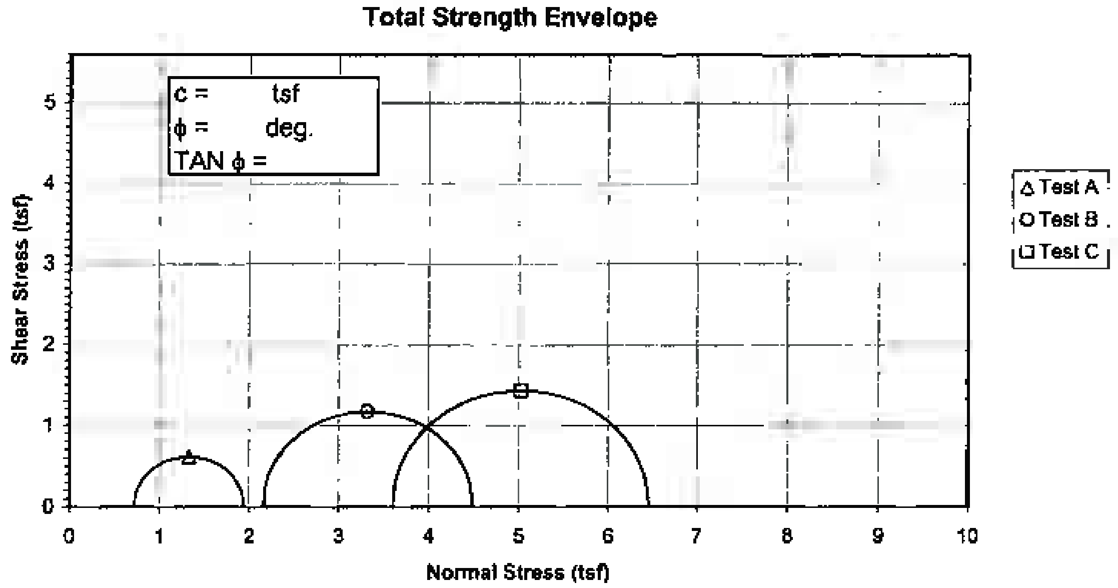
Specimen No.			A	B	C	
Initial Data	Water content %	W_o	28.7	27.4	27.9	
	Dry Density PCF	γd_o	92.2	95.5	96.3	
	Saturation %	S_o	91.9	94.9	98.5	
	Void Ratio	e_o	0.856	0.790	0.776	
After Shear	Water content %	W_f	30.2	28.3	27.2	
	Dry Density PCF	γd_f	93.6	96.3	98.1	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.828	0.776	0.744	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		σ_3'	0.26	1.29	2.03	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.22	2.33	2.86	
Time to (σ1'-σ3')max min.		t_f	11.0	123.0	157.9	
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	2.16	2.39	
Initial Diameter, in.		D_o	2.883	2.884	2.884	
Initial Height, in.		H_o	6.034	6.015	6.022	

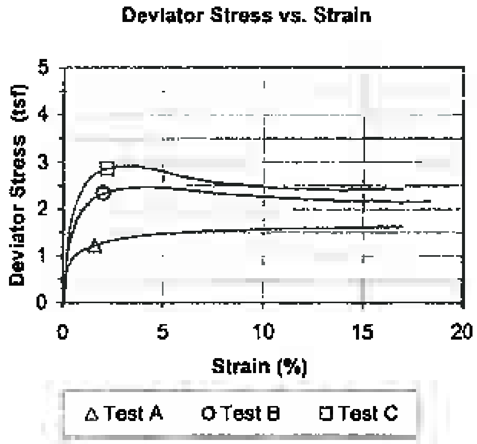
Controlled - Strain Test

Description of Specimens Fat Clay (CH), red brown, moist, firm

				Type of Specimen	Undisturbed	Type of test R
LL	PL	PI	Gs 2.74	Project	Gallatin Fossil Plant (GAF) - Ash Ponds	
Remarks:						
				Boring No.	STN-E-13S	Sample No. 6
				Depth Elev.	20.0'-20.5', 20.6'-21.1', 25.0'-25.5'	
				Laboratory	Stantec	Date 12-1-09
				TRIAXIAL COMPRESSION TEST REPORT		

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	28.7	27.4	27.9	
	Dry Density PCF	γ_{d_o}	92.2	95.5	96.3	
	Saturation %	S_o	91.9	94.9	98.5	
	Void Ratio	e_o	0.856	0.790	0.776	
After Shear	Water content %	W_f	30.2	28.3	27.2	
	Dry Density PCF	γ_{d_f}	93.6	96.3	98.1	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.828	0.776	0.744	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	1.22	2.33	2.86	
Time to $(\sigma_1-\sigma_3)_{Max.}$ min.		t_f	11.0	123.0	157.9	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	2.16	2.39	
Initial Diameter, in.		D_o	2.883	2.884	2.884	
Initial Height, in.		H_o	6.034	6.015	6.022	

Controlled - Strain Test

Description of Specimens Fat Clay (CH), red brown, moist, firm

			Type of Specimen	Undisturbed	Type of test $\overline{R}$
LL	PL	PI	Gs 2.74	Project	Gallatin Fossil Plant (GAF) - Ash Ponds
Remarks:					
				Boring No. STN-E-13S	Sample No. 6
				Depth Elev.	20.0'-20.5', 20.6'-21.1', 25.0'-25.5'
				Laboratory Stantec	Date 12-1-09

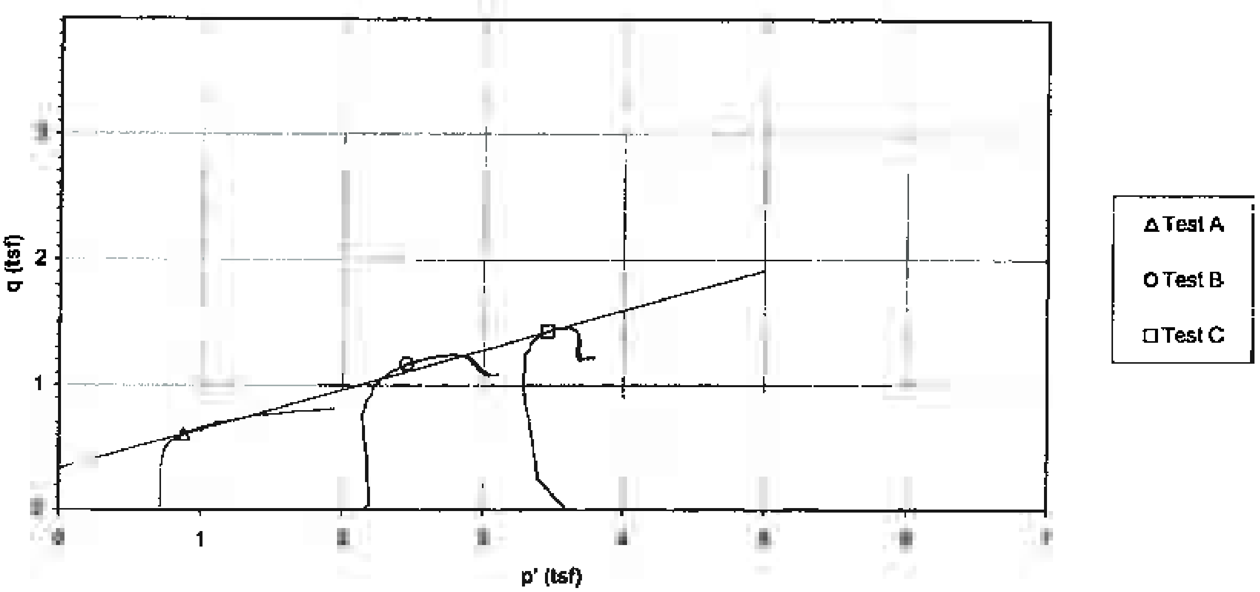
TRIAXIAL COMPRESSION TEST REPORT

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

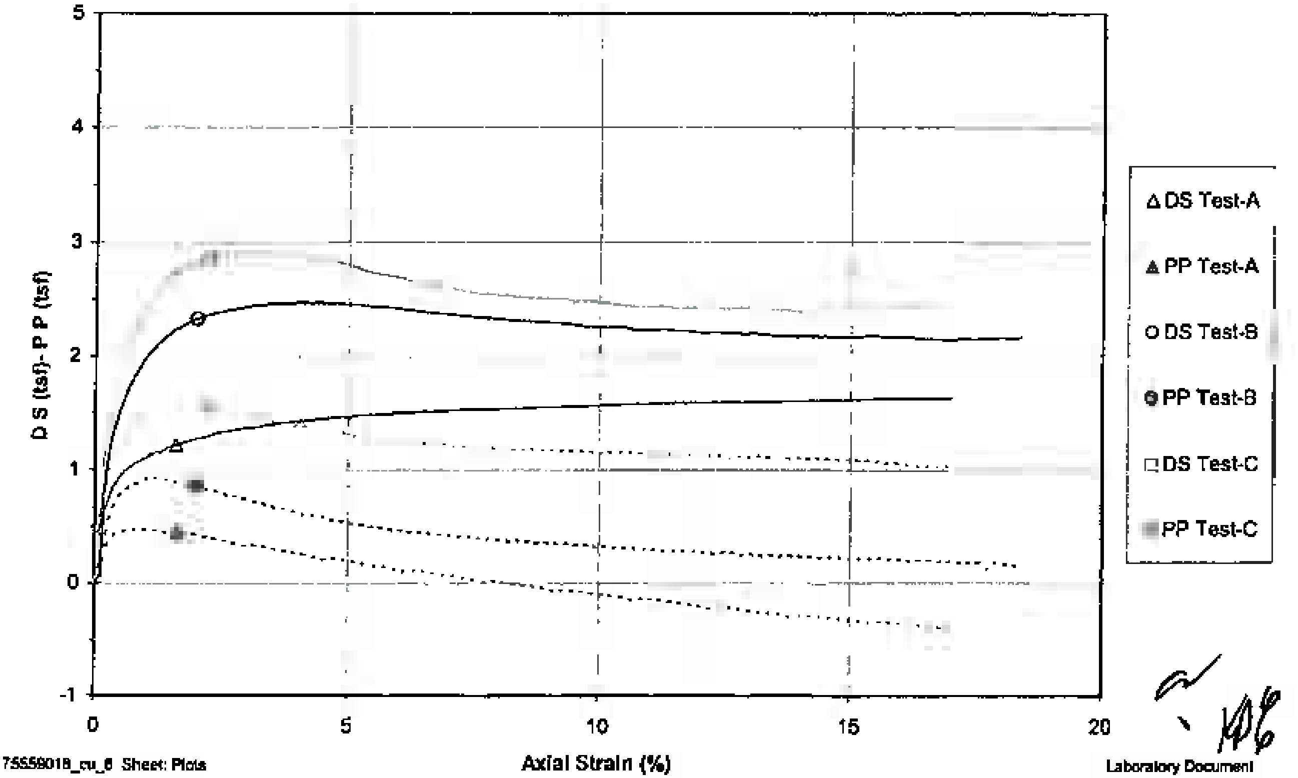
Project Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID STN-E-13S, 20.0'-20.5' & STN-E-13S, 20.6'-21.1' & STN-E-13S, 25.0'-25.5'
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 18.4 deg.

Project No. 175559018
Test Number 6
c' = 0.35 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



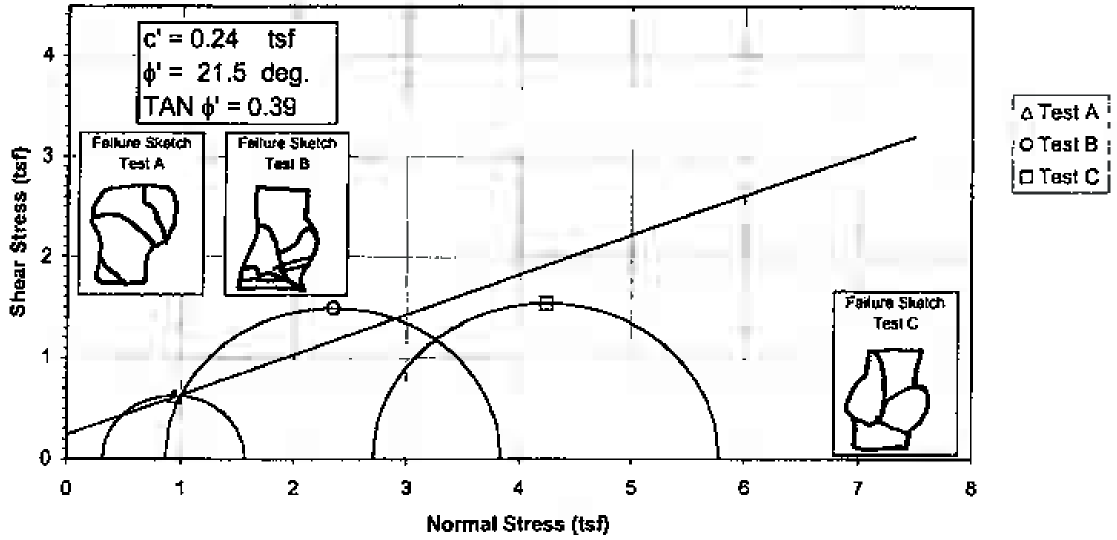
File: 175559018_cu_6 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

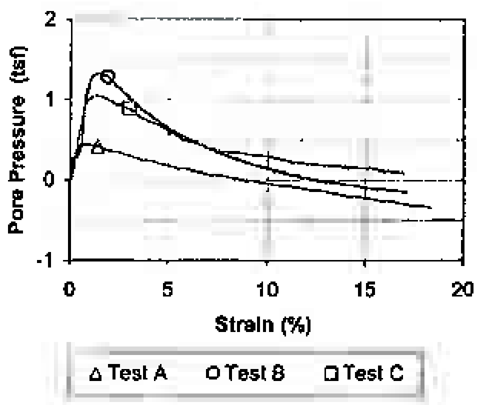
Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	21.8	20.4	22.1	
	Dry Density PCF	γ_{d_o}	104.4	107.4	103.6	
	Saturation %	S_o	96.5	97.6	95.5	
	Void Ratio	e_o	0.608	0.563	0.621	
After Shear	Water content %	W_f	22.4	21.0	21.4	
	Dry Density PCF	γ_{d_f}	104.8	107.4	106.6	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.602	0.564	0.576	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.32	0.87	2.71	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.26	2.96	3.07	
Time to (σ1'-σ3')max min.		t_f	9.8	123.0	189.7	
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, In.		D_o	2.881	2.884	2.882	
Initial Height, in.		H_o	6.007	6.044	6.005	

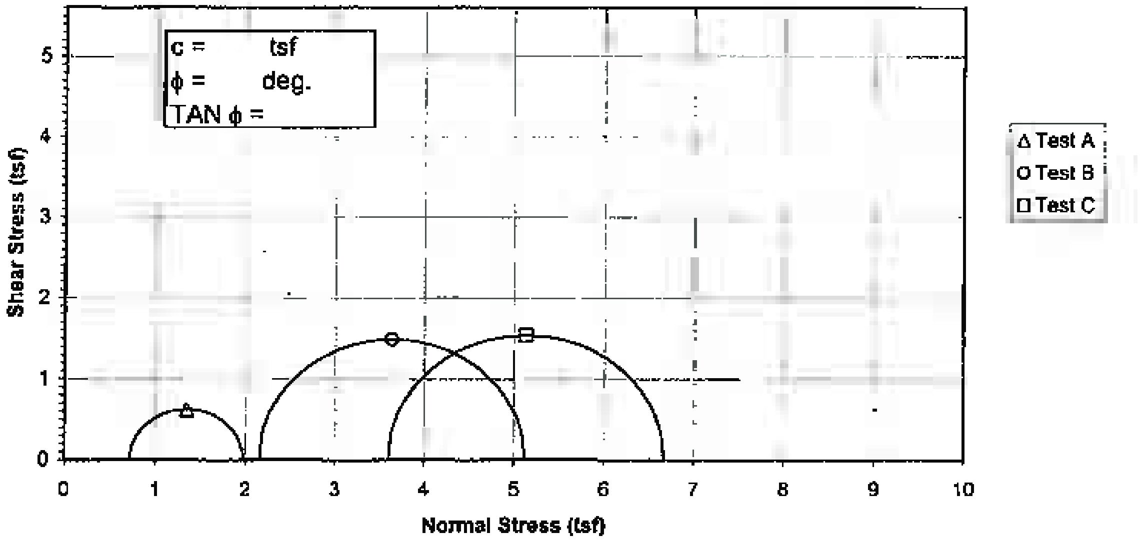
Controlled - Strain Test

Description of Specimens Fat Clay (CH), brown, moist, firm

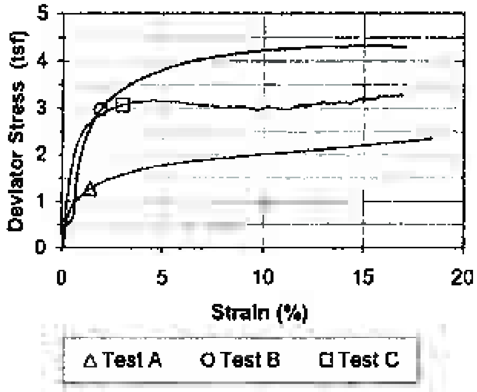
				Type of Specimen	Undisturbed	Type of test $\bar{R}$
LL	PL	PI	Gs 2.69	Project	Gallatin Fossil Plant (GAF) - Ash Ponds	
Remarks:						
				Boring No.	STN-E-14S	Sample No. 7
				Depth Elev.	2.0'-2.5', 2.6'-3.1', 5.7'-6.2'	
				Laboratory	Stantec	Date 12-4-09
				TRIAXIAL COMPRESSION TEST REPORT		

Failure Criterion: Maximum Effective Principal Stress Ratio

Total Strength Envelope



Deviator Stress vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	21.8	20.4	22.1	
	Dry Density PCF	γ_{d_o}	104.4	107.4	103.6	
	Saturation %	S_o	96.5	97.6	95.5	
	Void Ratio	e_o	0.608	0.563	0.621	
After Shear	Water content %	W_f	22.4	21.0	21.4	
	Dry Density PCF	γ_{d_f}	104.8	107.4	106.6	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.602	0.564	0.576	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	1.26	2.96	3.07	
Time to $(\sigma_1-\sigma_3)_{Max}$ min.		t_f	9.8	123.0	189.7	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, In.		D_o	2.881	2.884	2.882	
Initial Height, In.		H_o	6.007	6.044	6.005	

Controlled - Strain Test

Description of Specimens Fat Clay (CH), brown, moist, firm

			Type of Specimen Undisturbed	Type of test $\bar{R}$
LL	PL	PI	Gs 2.69	Project Gallatin Fossil Plant (GAF) - Ash Ponds
Remarks.				
			Boring No. STN-E-14S	Sample No. 7
			Depth Elev. 2.0'-2.5', 2.6'-3.1', 5.7'-6.2'	
			Laboratory Stantec	Date 12-4-09
			TRIAXIAL COMPRESSION TEST REPORT	

Consolidated Undrained Triaxial Test
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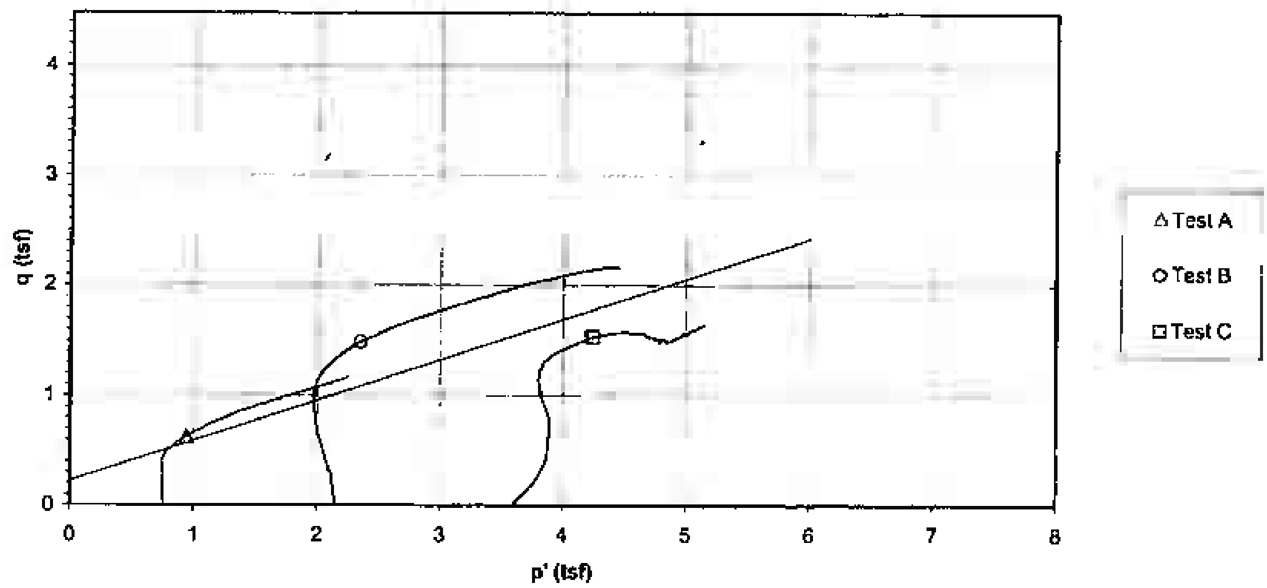
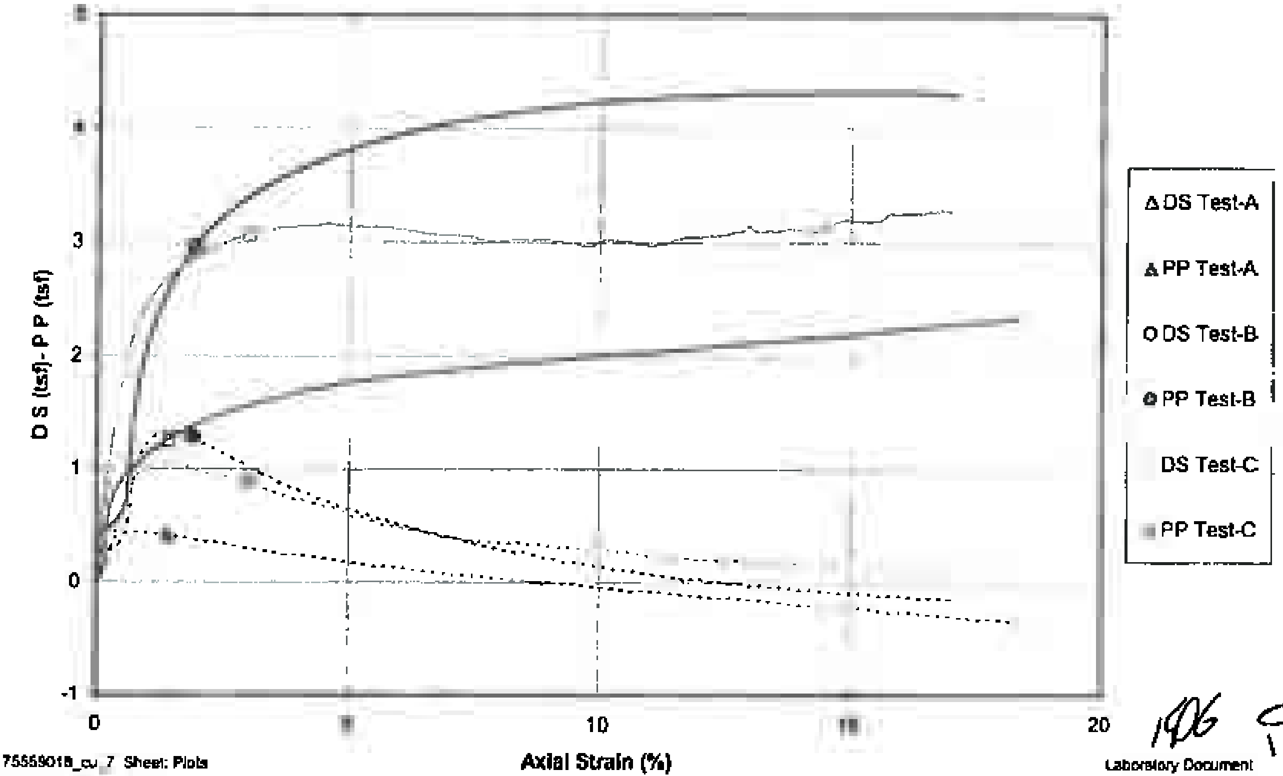
Project Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID STN-E-14S, 2.0'-2.5' & STN-E-14S, 2.6'-3.1' & STN-E-14S, 5.7'-6.2'
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 21.5 deg.

Project No. 175559018
Test Number 7
c' = 0.24 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



106

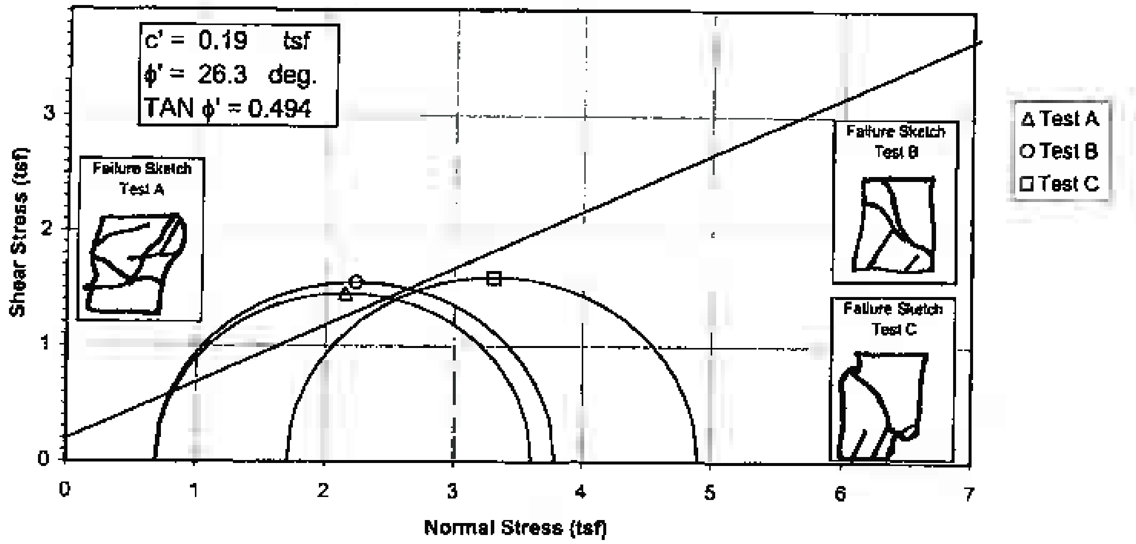
File: 175559018_cu_7 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

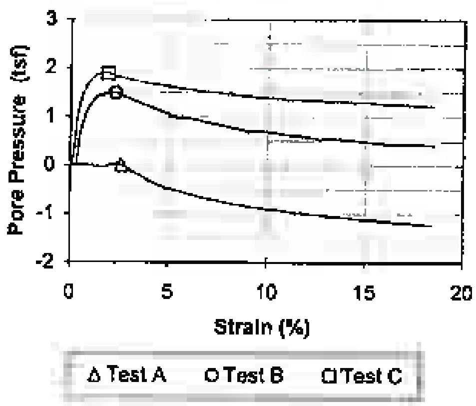
Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	22.0	23.3	23.2	
	Dry Density PCF	γ_{d_o}	102.6	101.6	103.4	
	Saturation %	S_o	91.4	94.3	98.3	
	Void Ratio	e_o	0.656	0.671	0.642	
After Shear	Water content %	W_f	22.7	23.8	23.0	
	Dry Density PCF	γ_{d_f}	105.1	103.0	104.5	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.616	0.648	0.625	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		σ_3'f	0.70	0.68	1.71	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	2.89	3.11	3.20	
Time to (σ1'-σ3')max min.		t_f	16.9	6.7	95.5	
Ultimate Deviator Stress, l/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.869	2.865	2.860	
Initial Height, in.		H_o	6.024	6.015	5.741	

Controlled - Strain Test

Description of Specimens Fat Clay with Gravel (CH), brown, moist, firm

Type of Specimen Undisturbed
Type of test $\bar{R}$

LL
PL
PI
Gs 2.72

Project Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks:

Boring No. STN-E-15
Sample No. 8

Depth Elev. 9.7'-10.2', 10.3'-10.8', 10.9'-11.4'

Laboratory Stantec
Date 12-4-09

TRIAXIAL COMPRESSION TEST REPORT

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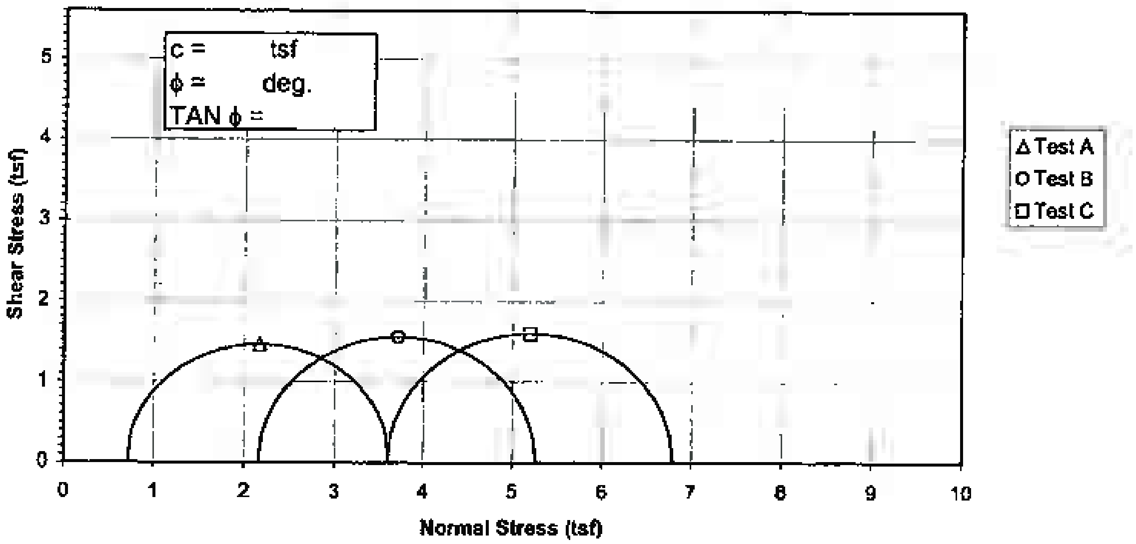
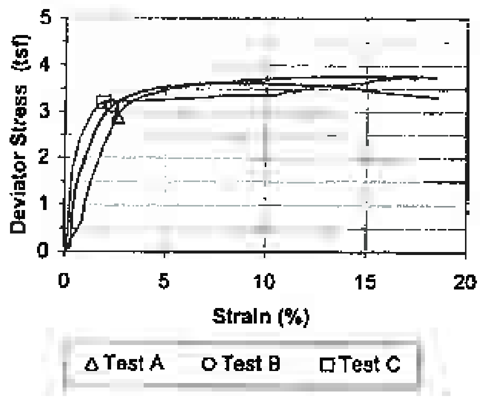
Appendix X
30 Nov. 70

Failure Criterion: Maximum Effective Principal Stress Ratio

Total Strength Envelope



Deviator Stress vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	22.0	23.3	23.2	
	Dry Density PCF	γ_{d_o}	102.6	101.6	103.4	
	Saturation %	S_o	91.4	94.3	96.3	
	Void Ratio	e_o	0.656	0.671	0.642	
After Shear	Water content %	W_f	22.7	23.8	23.0	
	Dry Density PCF	γ_{d_f}	105.1	103.0	104.5	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.616	0.648	0.625	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	2.89	3.11	3.20	
Time to $(\sigma_1-\sigma_3)_{Max}$ min.		t_f	16.9	6.7	95.5	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, In.		D_o	2.869	2.865	2.860	
Initial Height, In.		H_o	6.024	6.015	5.741	

Controlled - Strain Test

Description of Specimens Fat Clay with Gravel (CH), brown, moist, firm

				Type of Specimen Undisturbed	Type of test R
LL	PL	PI	Gs 2.72	Project	Gallatin Fossil Plant (GAF) - Ash Ponds
Remarks:					
				Boring No. STN-E-15	Sample No. 8
				Depth Elev.	9.7'-10.2', 10.3'-10.8', 10.9'-11.4'
				Laboratory Stantec	Date 12-4-09
				TRIAXIAL COMPRESSION TEST REPORT	

File: 175559018_cu_8 Sheet: CE_Final-T
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

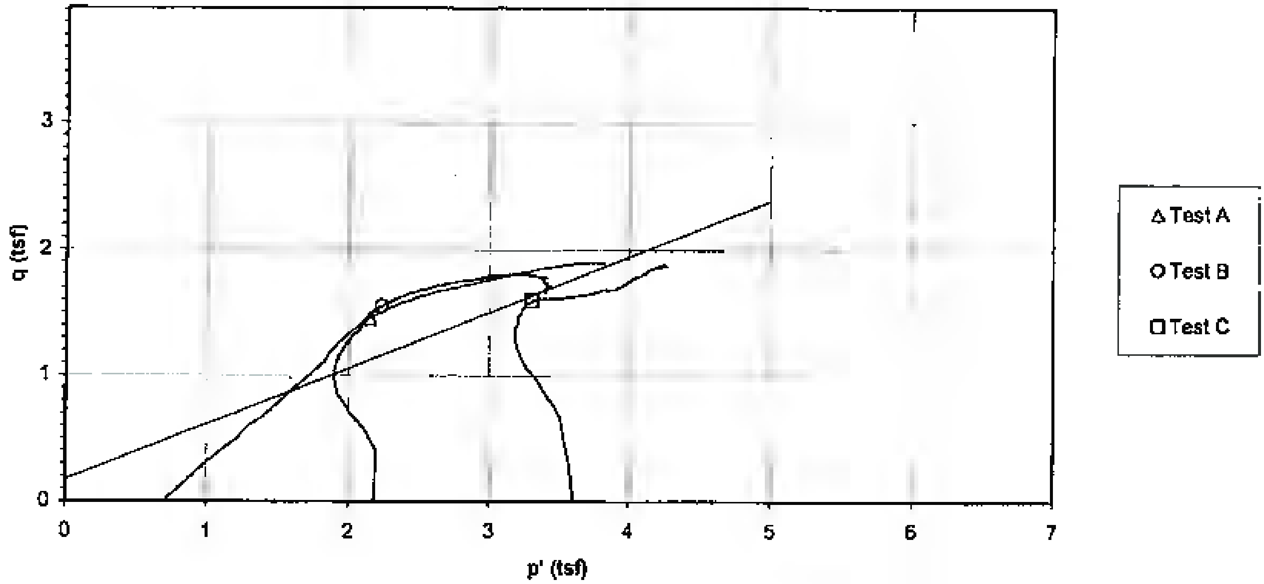
Laboratory Document
Prepared By: MW
Approved BY: TLK

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

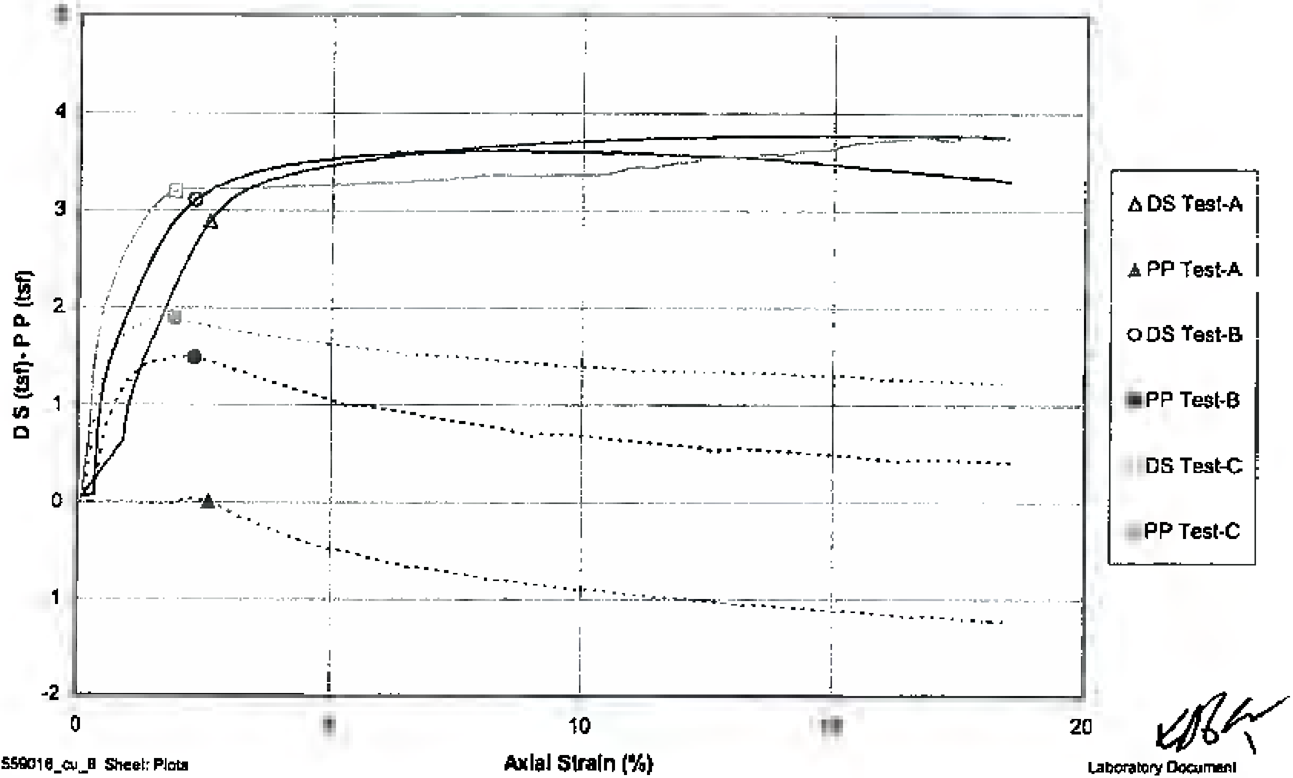
Project Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID STN-E-15, 9.7'-10.2' & STN-E-15, 10.3'-10.8' & STN-E-15, 10.9'-11.4'
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 26.3 deg.

Project No. 175559018
Test Number 8
c' = 0.19 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



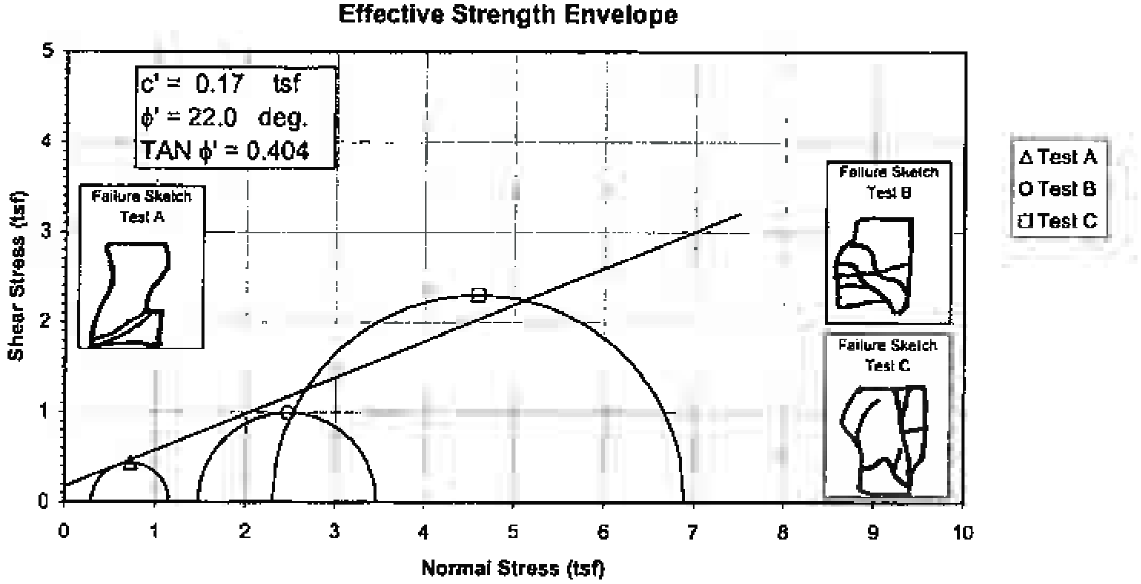
File: 175559018_cu_8 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

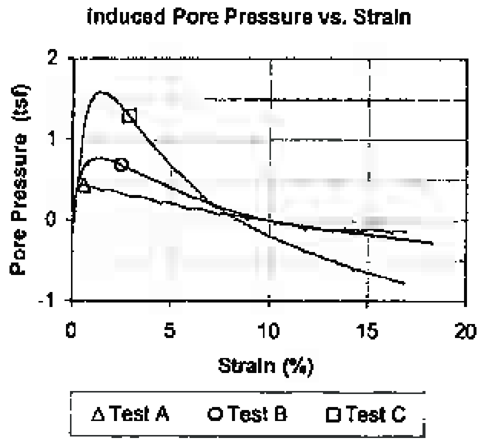
Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY: TLK

EM 1110-2-1906
Appendix X
30 Nov. 70

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	22.6	24.3	19.7	
	Dry Density PCF	γ_{d_o}	102.1	99.8	107.2	
	Saturation %	S_o	94.4	95.5	93.3	
	Void Ratio	e_o	0.644	0.683	0.567	
After Shear	Water content %	W_f	24.1	24.4	20.3	
	Dry Density PCF	γ_{d_f}	101.8	101.5	108.6	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.650	0.655	0.547	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.30	1.48	2.30	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.87	1.98	4.58	
Time to (σ1'-σ3')max min.		t_f	4.6	127.3	152.7	
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	1.92	n/a	
Initial Diameter, In.		D_o	2.885	2.881	2.891	
Initial Height, In.		H_o	6.029	6.040	6.018	

Controlled - Strain Test

Description of Specimens Fat Clay (CH), red brown, moist, firm

				Type of Specimen	Undisturbed	Type of test	$\bar{R}$
LL	PL	PI	Gs 2.69	Project	Gallatin Fossil Plant (GAF) - Ash Ponds		
Remarks:							
				Boring No.	STN-E-16S	Sample No.	9
				Depth Elev.	5.0'-5.5', 5.6'-6.1', 7.7'-8.2'		
				Laboratory	Stantec	Date	12-4-09
				TRIAXIAL COMPRESSION TEST REPORT			

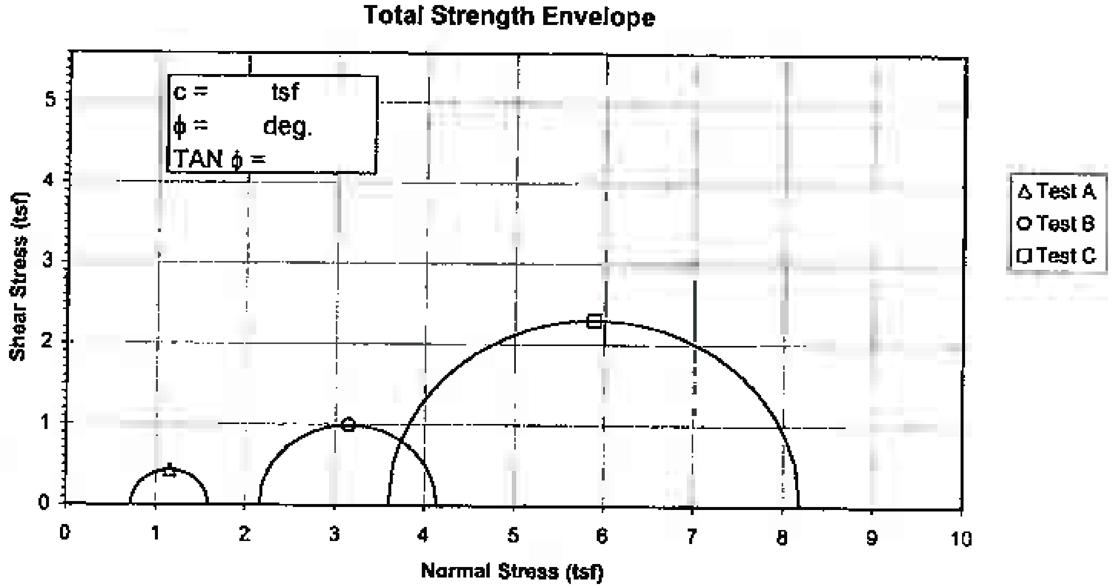
File 175559018_cu_9 Sheet. CE_Final-E
Preparation Date: 1998
Revision Date: 1-2008

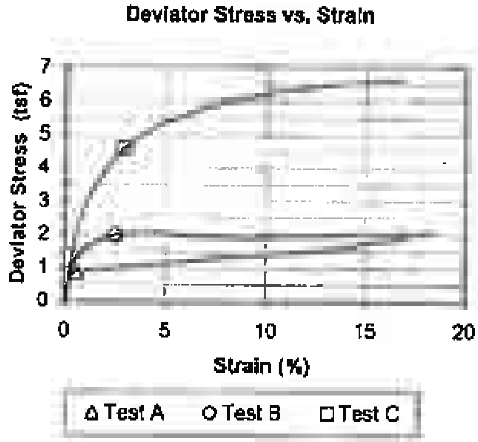
Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY. TLK

EM 1110-2-1906
Appendix X
30 Nov. 70

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	22.6	24.3	19.7	
	Dry Density PCF	γ_{d_o}	102.1	99.8	107.2	
	Saturation %	S_o	94.4	95.5	93.3	
	Void Ratio	e_o	0.644	0.683	0.567	
After Shear	Water content %	W_f	24.1	24.4	20.3	
	Dry Density PCF	γ_{d_f}	101.8	101.5	108.8	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.650	0.655	0.547	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	0.87	1.98	4.58	
Time to $(\sigma_1-\sigma_3)_{Max}$ min.		t_f	4.6	127.3	152.7	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	1.92	n/a	
Initial Diameter, In.		D_o	2.885	2.881	2.891	
Initial Height, In.		H_o	6.029	6.040	6.018	

Controlled - Strain Test

Description of Specimens Fat Clay (CH), red brown, moist, firm

Type of Specimen Undisturbed
Type of test $\bar{R}$

LL PL PI Gs 2.69

Project Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks:

Boring No. STN-E-16S
Sample No. 9
Depth Elev. 5.0'-5.5', 5.6'-6.1', 7.7'-8.2'
Laboratory Stantec
Date 12-4-09

TRIAXIAL COMPRESSION TEST REPORT

File: 175559018_cu_9 Sheet: CE_Final-T
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

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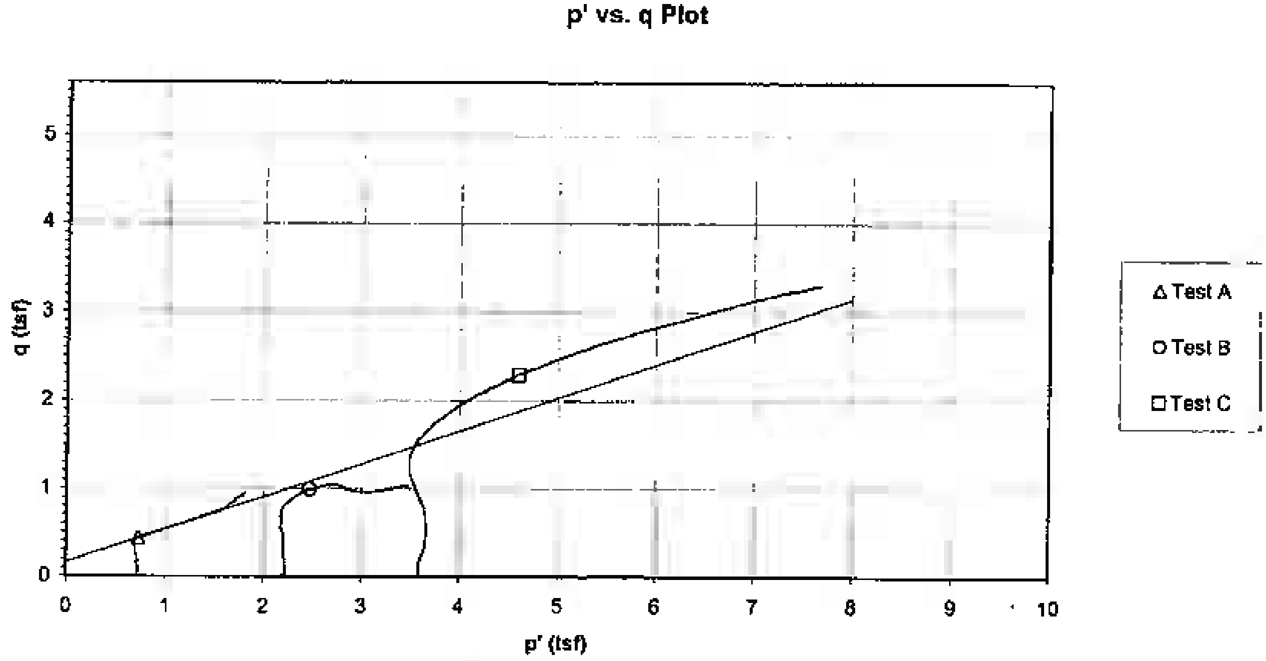
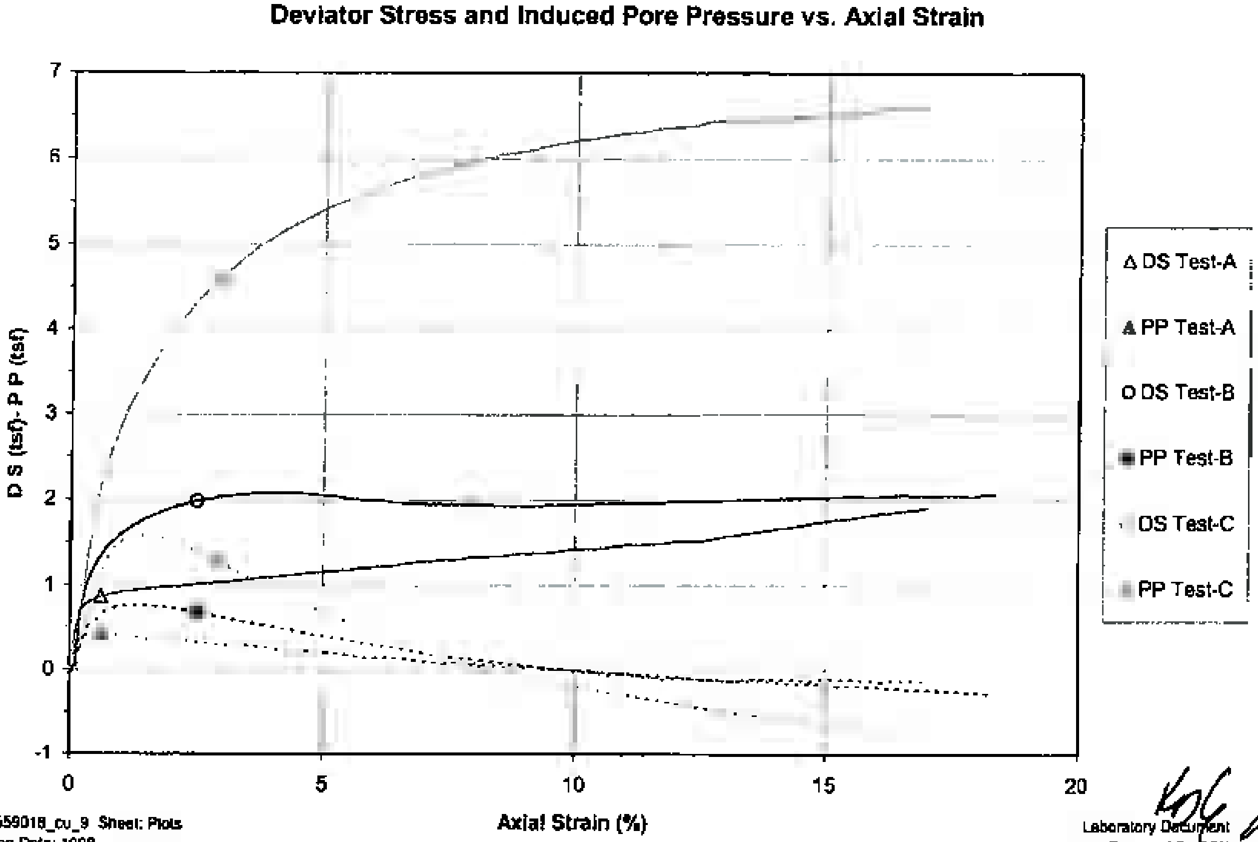
Laboratory Document
Prepared By: MW
Approved BY: TLX

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

Project Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID STN-E-16S, 5.0'-5.5' & STN-E-16S, 5.6'-6.1' & STN-E-16S, 7.7'-8.2'
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 22.0 deg.

Project No. 175559016
Test Number 9
c' = 0.17 tsf


p' vs. q Plot


Deviator Stress and Induced Pore Pressure vs. Axial Strain

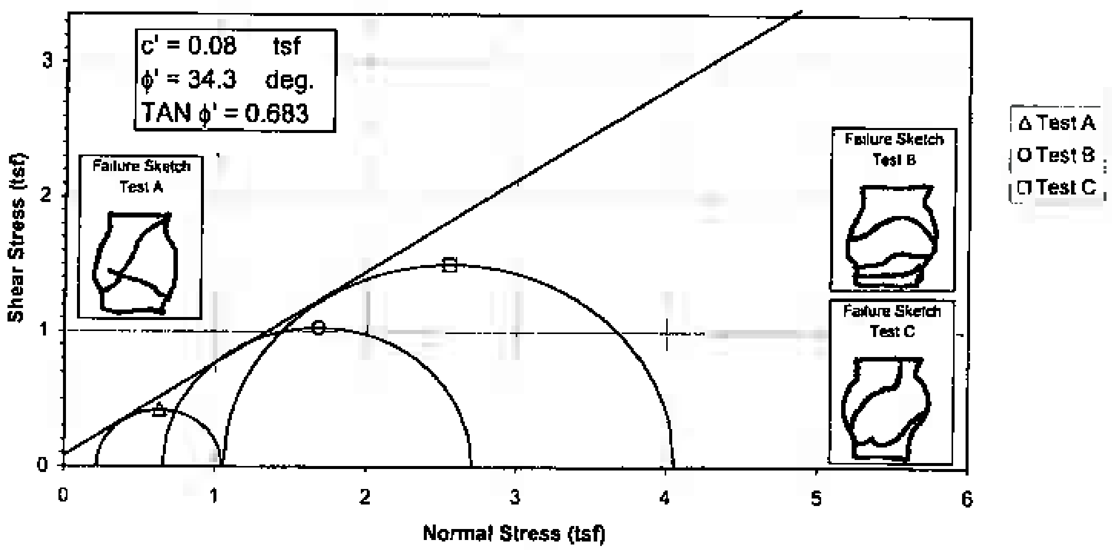
File: 175559016_cu_9 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

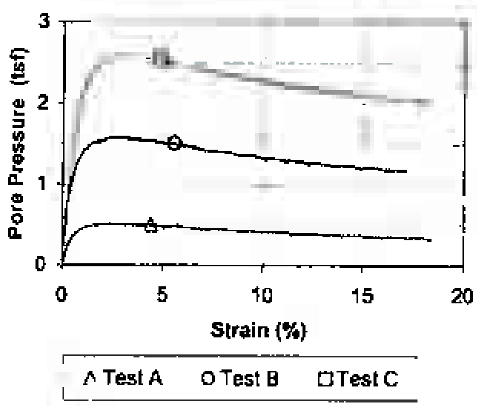
Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	28.2	23.9	22.5	
	Dry Density PCF	γ_{d_o}	95.4	102.7	103.7	
	Saturation %	S_o	98.8	100.2	96.6	
	Void Ratio	e_o	0.773	0.647	0.631	
After Shear	Water content %	W_f	23.6	19.8	19.2	
	Dry Density PCF	γ_{d_f}	103.2	110.1	111.2	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.639	0.537	0.521	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.21	0.66	1.06	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.83	2.06	3.00	
Time to (σ1'-σ3')max min.		t_f	210.0	287.2	239.7	
Ultimate Deviator Stress, t/sq ft		$(\sigma1'-\sigma3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, In.		D_o	2.834	2.820	2.878	
Initial Height, In.		H_o	5.947	5.952	6.036	

Controlled - Strain Test

Description of Specimens Lean Clay (CL), gray, wet, soft

Type of Specimen Undisturbed

Type of test $\bar{R}$

LL PL PI Gs 2.71

Project Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks:

Boring No. STN-E-16S

Sample No. 10

Depth Elev. 33.0'-33.5', 33.6'-34.1', 34.2'-34.7'

Laboratory Stantec

Date 12-11-09

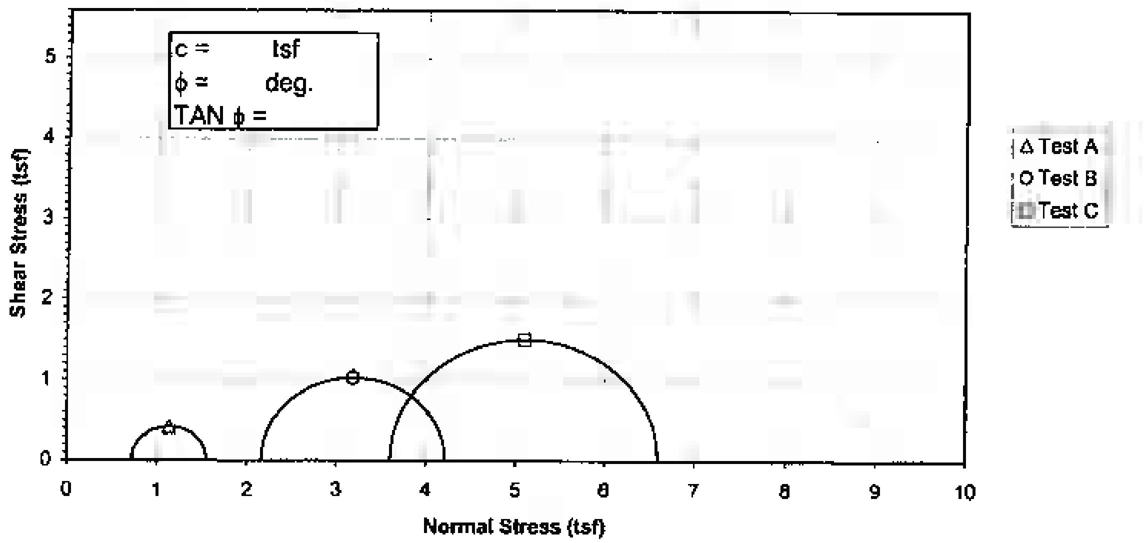
TRIAXIAL COMPRESSION TEST REPORT

File: 175559016_cu_10 Sheet: CE_Final-E
Preparation Date: 1998
Revision Date: 1 2008

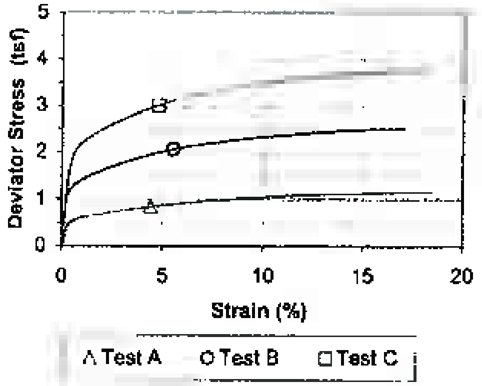
Stantec Consulting Services Inc.

Laboratory Document
Prepared By: MW
Approved BY TLK

Failure Criterion: Maximum Effective Principal Stress Ratio



Total Strength Envelope



Deviator Stress vs. Strain

Specimen No.			A	B	C	
Initial Data	Water content %	W_o	28.2	23.9	22.5	
	Dry Density PCF	γ_{d_o}	95.4	102.7	103.7	
	Saturation %	S_o	98.8	100.2	96.6	
	Void Ratio	e_o	0.773	0.647	0.631	
After Shear	Water content %	W_f	23.6	19.8	19.2	
	Dry Density PCF	γ_{d_f}	103.2	110.1	111.2	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.639	0.537	0.521	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	0.83	2.06	3.00	
Time to $(\sigma_1-\sigma_3)_{Max}$ min.		t_f	210.0	287.2	239.7	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.834	2.820	2.878	
Initial Height, in.		H_o	5.947	5.952	6.036	

Controlled - Strain Test

Description of Specimens Lean Clay (CL), gray, wet, soft

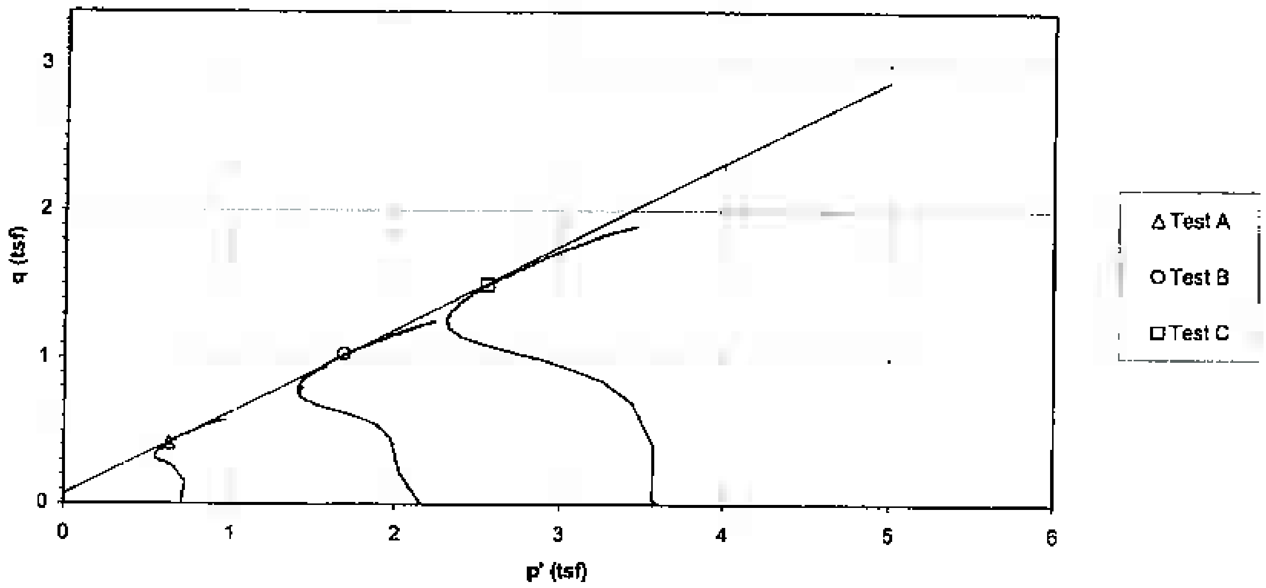
				Type of Specimen	Undisturbed	Type of test $\bar{R}$
LL	PL	PI	Gs 2.71	Project	Gallatin Fossil Plant (GAF) - Ash Ponds	
Remarks.						
				Boring No.	STN-E-16S	Sample No. 10
				Depth Elev.	33.0'-33.5', 33.6'-34.1', 34.2'-34.7'	
				Laboratory	Stantec	Date 12-11-09
				TRIAXIAL COMPRESSION TEST REPORT		

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

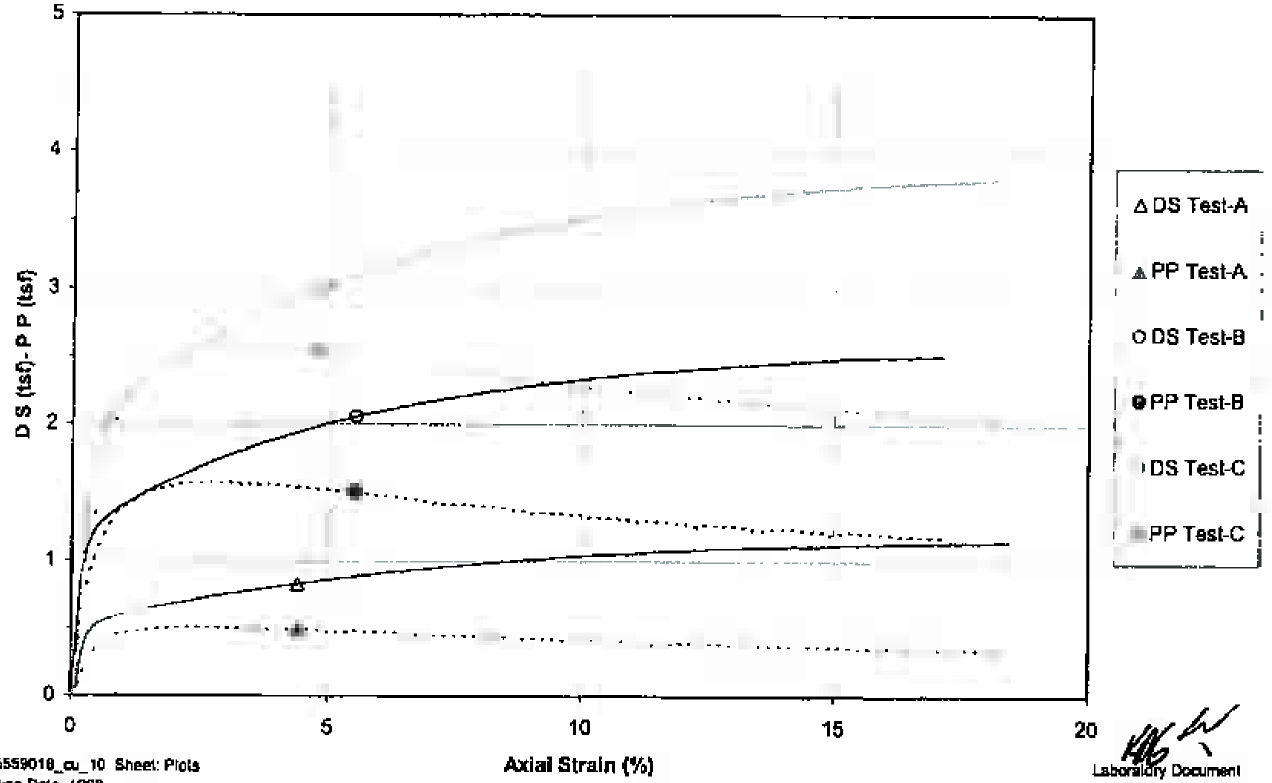
Project Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID STN-E-16S, 33.0'-33.5' & STN-E-16S, 33.6'-34.1' & STN-E-16S, 34.2'-34.7'
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 34.3 deg.

Project No. 175559018
Test Number 10
c' = 0.08 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



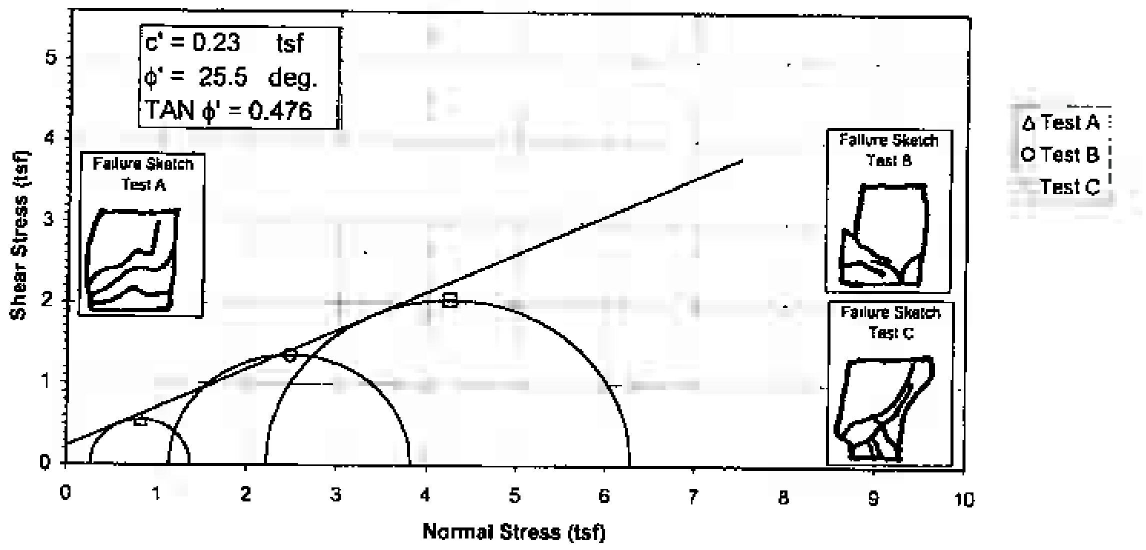
File: 175559018_cu_10 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2006

Stantec Consulting Services Inc.

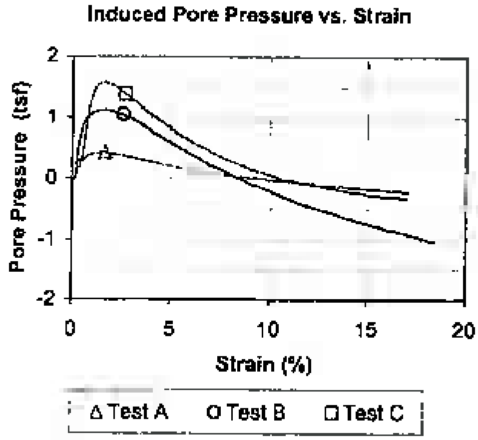
Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



Specimen No.			A	B	C	
Initial Data	Water content %	W_o	21.7	19.6	21.4	
	Dry Density PCF	γ_{d_o}	106.4	109.0	105.5	
	Saturation %	S_o	96.8	93.4	93.3	
	Void Ratio	e_o	0.619	0.580	0.634	
After Shear	Water content %	W_f	22.8	18.8	20.9	
	Dry Density PCF	γ_{d_f}	105.8	113.4	109.3	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.629	0.519	0.577	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		σ_3'f	0.26	1.13	2.22	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	1.08	2.71	4.07	
Time to (σ1'-σ3')max min.		t_f	96.2	137.2	152.3	
Ultimate Deviator Stress, t/sq ft		$(\sigma 1'-\sigma 3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.886	2.890	2.888	
Initial Height, in.		H_o	6.051	5.998	6.075	

Controlled - Strain Test

Description of Specimens Fat Clay with Gravel (CH), brown, moist, firm

Type of Specimen Undisturbed

Type of test $\bar{R}$

LL PL PI Gs 2.76

Project Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks:

Boring No. STN-E-20S

Sample No. 11

Depth Elev. 4.0'-4.5', 6.0'-6.5', 6.6'-7.1'

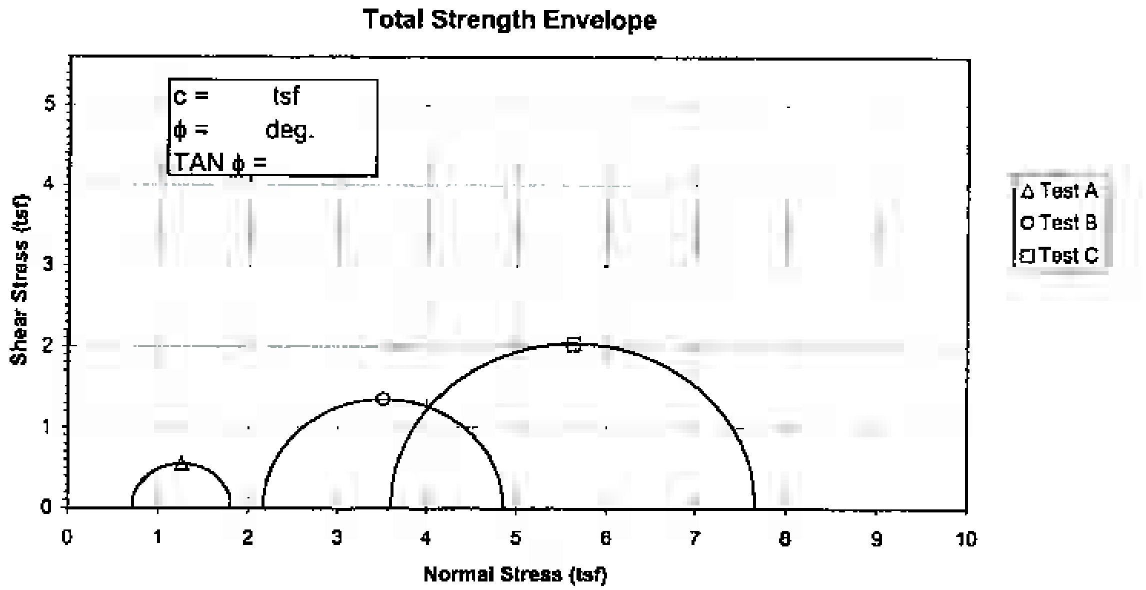
Laboratory Stantec

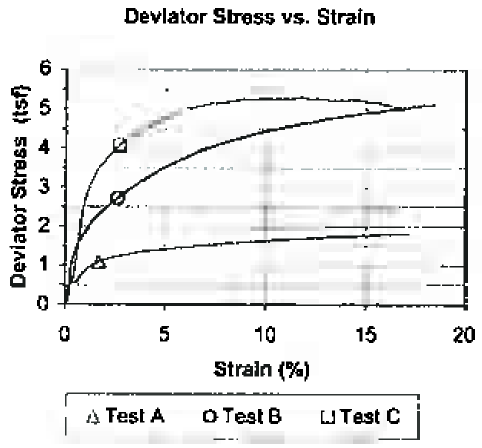
Date 12-11-09

TRIAXIAL COMPRESSION TEST REPORT

Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	21.7	19.6	21.4	
	Dry Density PCF	γ_{d_o}	106.4	109.0	105.5	
	Saturation %	S_o	96.8	93.4	93.3	
	Void Ratio	e_o	0.619	0.580	0.634	
After Shear	Water content %	W_f	22.8	18.8	20.9	
	Dry Density PCF	γ_{d_f}	105.8	113.4	109.3	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.629	0.519	0.577	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1-\sigma_3)_{max}$	1.08	2.71	4.07	
Time to $(\sigma_1-\sigma_3)_{Max}$ min.		t_f	96.2	137.2	152.3	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1-\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.886	2.890	2.888	
Initial Height, in.		H_o	6.051	5.998	6.075	

Controlled - Strain Test

Description of Specimens Fat Clay with Gravel (CH), brown, moist, firm

LL	PL	PI	Gs 2.76	

Type of Specimen Undisturbed | Type of test $\bar{R}$

Project Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks

Boring No. STN-E-20S | Sample No. 11

Depth Elev. 4.0'-4.5', 6.0'-6.5', 6.6'-7.1'

Laboratory Stantec | Date 12-11-09

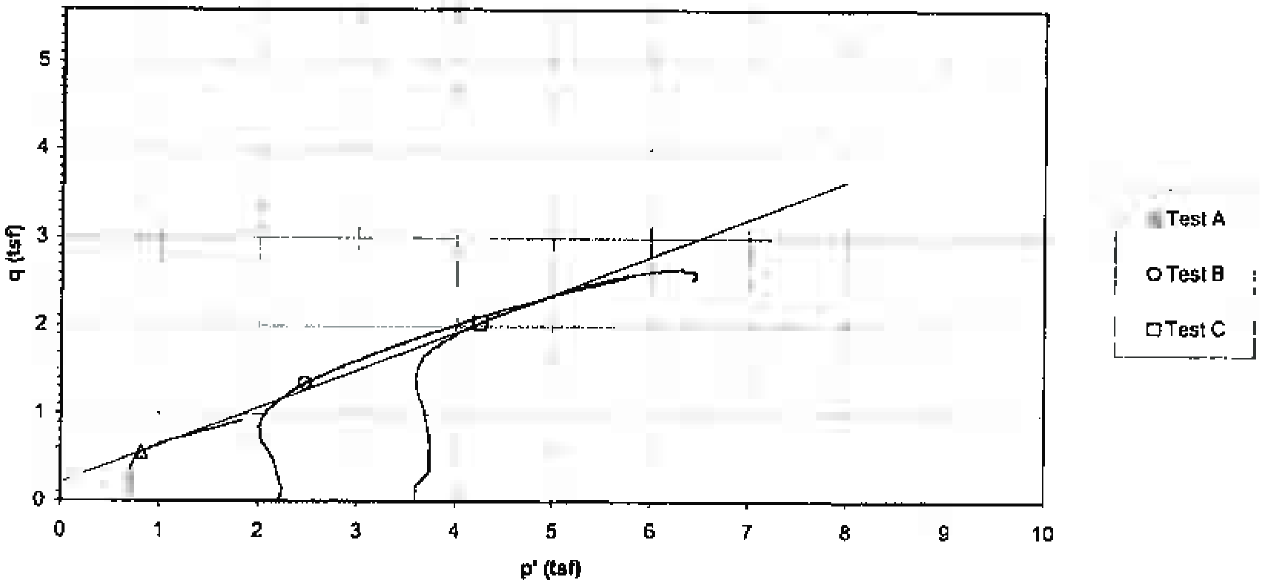
TRIAXIAL COMPRESSION TEST REPORT

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

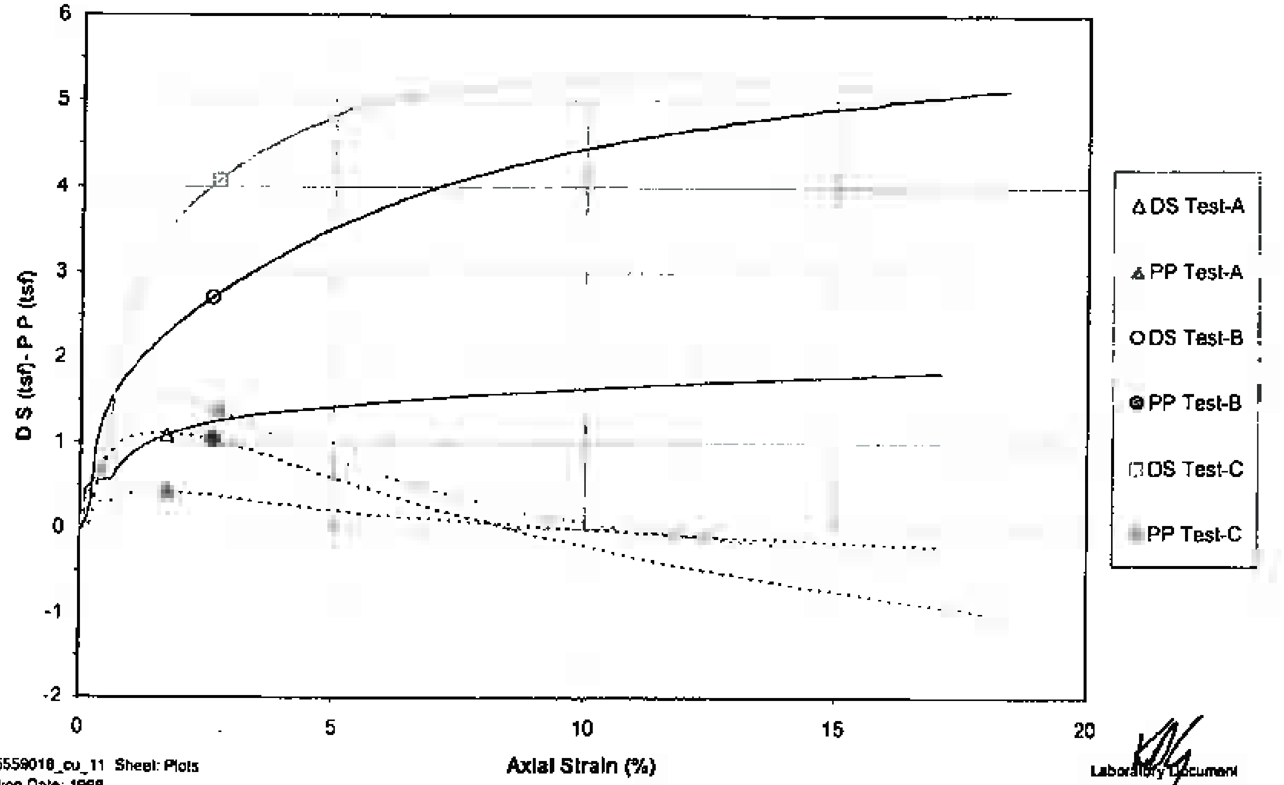
Project Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID STN-E-20S, 4.0'-4.5' & STN-E-20S, 6.0'-6.5' & STN-E-20S, 6.6'-7.1'
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 25.5 deg.

Project No. 175559018
Test Number 11
c' = 0.23 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



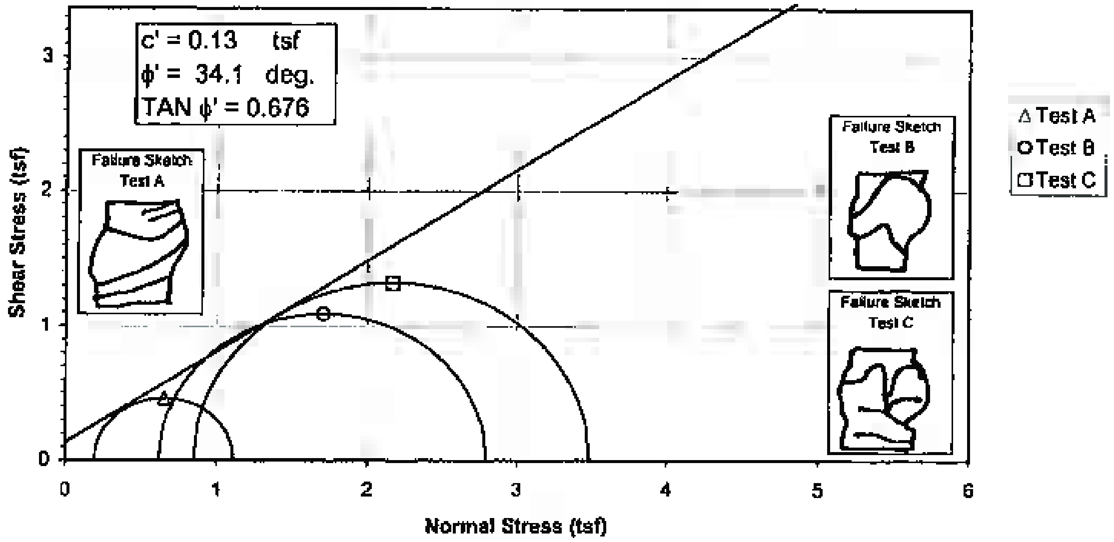
File: 175559018_cu_11 Sheet: Plots
Preparation Date: 1998
Revision Date: 1-2008

Stantec Consulting Services Inc.

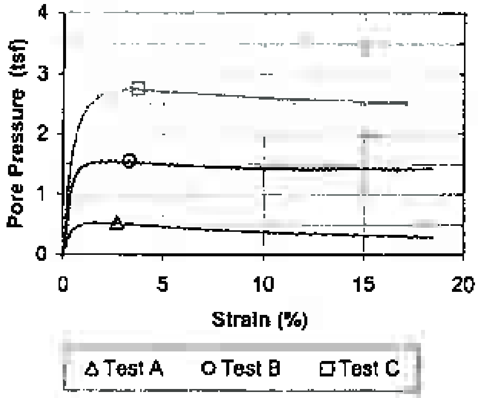
Laboratory Document
Prepared By: MW
Approved BY: TLK

Failure Criterion: Maximum Effective Principal Stress Ratio

Effective Strength Envelope



Induced Pore Pressure vs. Strain



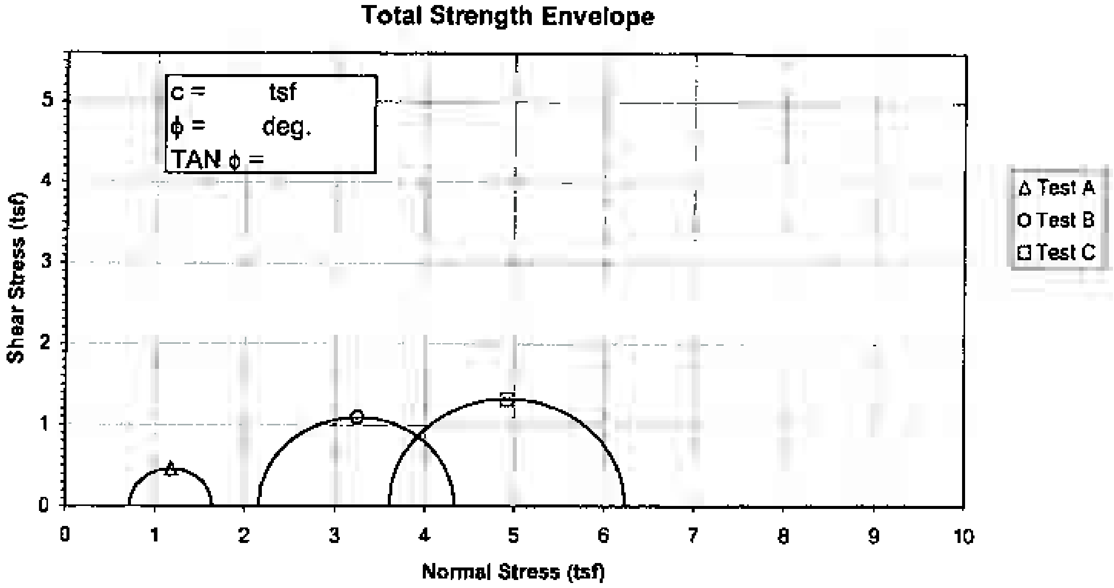
Specimen No.			A	B	C	
Initial Data	Water content %	W_o	34.0	18.1	28.8	
	Dry Density PCF	γ_{d_o}	86.5	110.7	94.5	
	Saturation %	S_o	96.1	92.5	98.4	
	Void Ratio	e_o	0.963	0.533	0.796	
After Shear	Water content %	W_f	32.8	15.3	22.5	
	Dry Density PCF	γ_{d_f}	89.7	119.8	105.3	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.892	0.417	0.613	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF @ failure		$\sigma_3'f$	0.19	0.62	0.85	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1'-\sigma_3')_{max}$	0.92	2.18	2.64	
Time to (σ1'-σ3')max min.		t_f	87.6	109.8	196.1	
Ultimate Deviator Stress, t/sq ft		$(\sigma1'-\sigma3')_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.877	2.857	2.867	
Initial Height, in.		H_o	6.040	5.976	6.094	

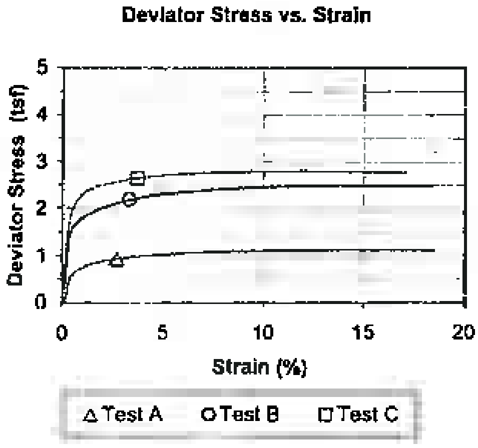
Controlled - Strain Test

Description of Specimens Fat Clay (CH), red brown, moist, firm

				Type of Specimen Undisturbed	Type of test $\bar{R}$
LL	PL	PI	Gs 2.72	Project Gallatin Fossil Plant (GAF) - Ash Ponds	
Remarks:					
				Boring No. STN-E-21S	Sample No. 12
				Depth Elev. 13.0'-13.5', 11.0'-11.5', 11.6'-12.1'	
				Laboratory Stantec	Date 12-11-09
				TRIAXIAL COMPRESSION TEST REPORT	

Failure Criterion: Maximum Effective Principal Stress Ratio





Specimen No.			A	B	C	
Initial Data	Water content %	W_o	34.0	18.1	28.8	
	Dry Density PCF	γ_{d_o}	86.5	110.7	94.5	
	Saturation %	S_o	96.1	92.5	98.4	
	Void Ratio	e_o	0.963	0.533	0.796	
After Shear	Water content %	W_f	32.8	15.3	22.5	
	Dry Density PCF	γ_{d_f}	89.7	119.8	105.3	
	Saturation %	S_f	100.0	100.0	100.0	
	Void Ratio	e_f	0.892	0.417	0.613	
	Final Back Pressure TSF	u_c	5.76	4.32	2.88	
Minor Principal Stress TSF		σ_3	0.72	2.16	3.60	
Maximum Deviator Stress (tsf) @ failure		$(\sigma_1\text{-}\sigma_3)_{max}$	0.92	2.18	2.64	
Time to $(\sigma_1\text{-}\sigma_3)_{Max}$ min.		t_f	87.6	109.8	196.1	
Ultimate Deviator Stress, t/sq ft		$(\sigma_1\text{-}\sigma_3)_{ult}$	n/a	n/a	n/a	
Initial Diameter, in.		D_o	2.877	2.857	2.867	
Initial Height, in.		H_o	6.040	5.976	6.094	

Controlled - Strain Test

Description of Specimens Fat Clay (CH), red brown, moist, firm

Type of Specimen Undisturbed | Type of test $\bar{R}$

LL | PL | PI | Gs 2.72 | Project Gallatin Fossil Plant (GAF) - Ash Ponds

Remarks:

Boring No. STN-E-21S | Sample No. 12

Depth Elev. 13.0'-13.5', 11.0'-11.5', 11.6'-12.1'

Laboratory Stantec | Date 12-11-09

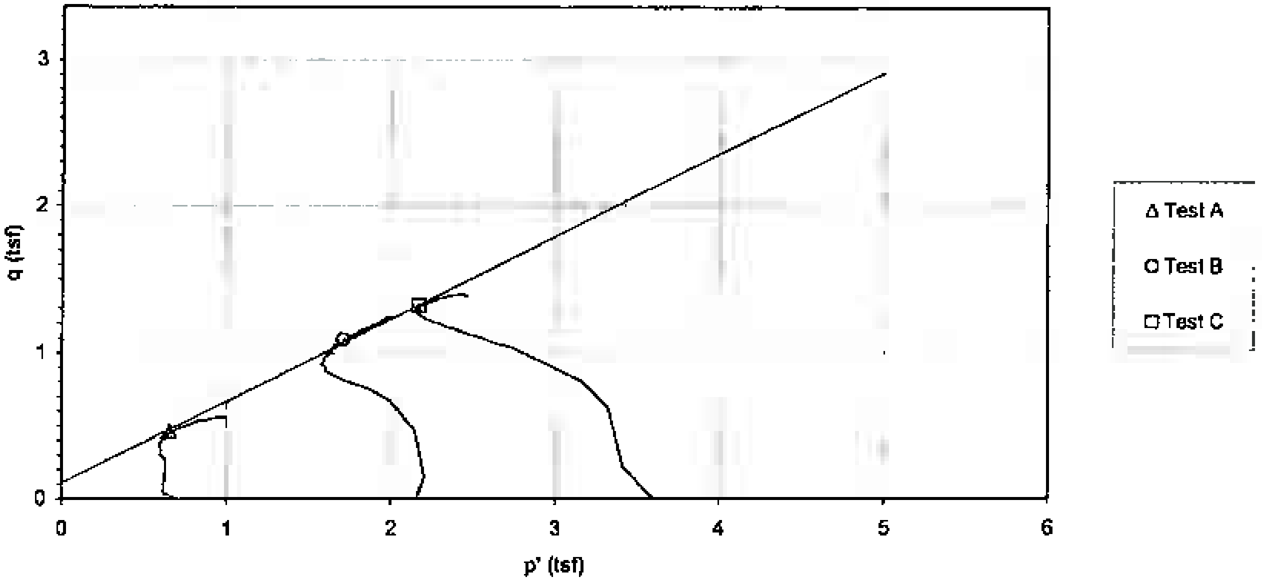
TRIAXIAL COMPRESSION TEST REPORT

Consolidated Undrained Triaxial Test
EM 1110-2-1906 Appendix X

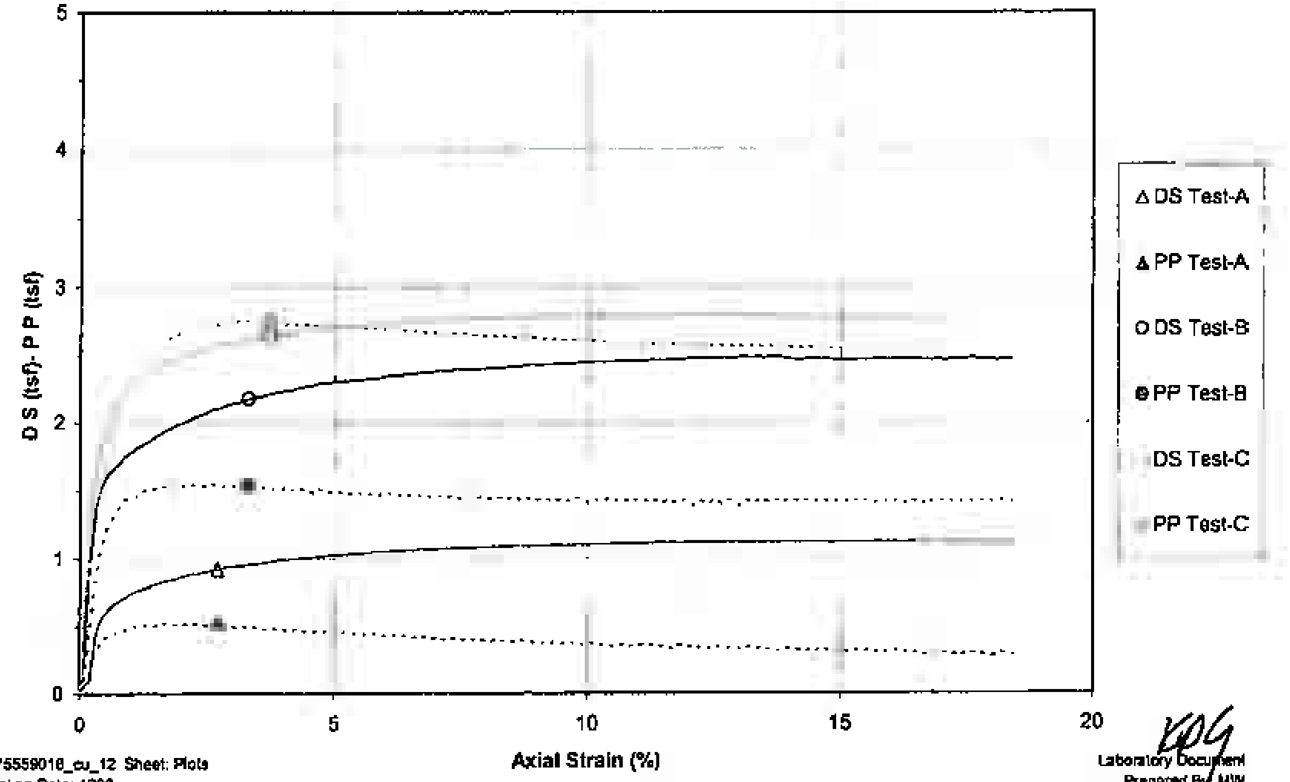
Project Gallatin Fossil Plant (GAF) - Ash Ponds
Sample ID STN-E-21S, 13.0'-13.5' & STN-E-21S, 11.0'-11.5' & STN-E-21S, 11.6'-12.1'
Failure Criterion: Maximum Effective Principal Stress Ratio ϕ' = 34.1 deg.

Project No. 175559018
Test Number 12
c' = 0.13 tsf

p' vs. q Plot



Deviator Stress and Induced Pore Pressure vs. Axial Strain



File: 175559018_cu_12 Sheet: Plots
Preparation Date: 1998
Revision Date. 1-2008

Stantec Consulting Services Inc.

KDG
Laboratory Document
Prepared By: MW
Approved BY: TLK

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-A-6 29.0'-31.0', TI 29.1'-29.5'
Visual Classification Fat Clay (CH), red brown, moist, firm
Undisturbed XX
Specific Gravity 2 71 ASTM D854 A
Maximum Dry Density (pcf) ______
Permeant: De-aired tap water
Selection and Preparation Comments: ______

Project No. 175559018
Test ID 5
Prepared By KDG
Date 11 3-09
Percent of Maximum ______

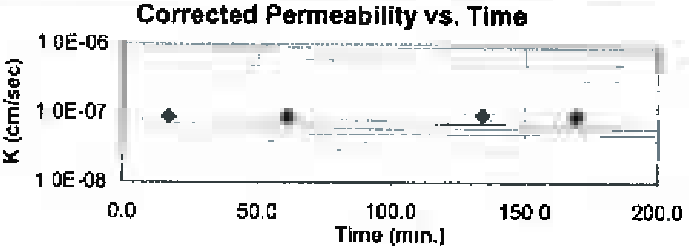
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4435	2.4338	2.4309
Diameter (in.)	2.8137		2.8109
Moisture Content (%)	29.2		30.2
Dry Unit Weight (pcf)	91.7		92.4
Void Ratio	0.844		0.831
Degree of Saturation (%)	93.6		98.6
Trimmings MC (%)	31.6		

Final Pressures (psi)	
Chamber	75
Influent	70
Effluent	65

Applied Head Difference (psi) 5
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 10
Minimum Effective Consolidation Stress (psi) 5

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-2-09	11:34	70.0	20.19	4.21	0	—	—	—	—
12-2-09	11:51	70.0	19.93	4.47	1.02E+03	9.0E-10	9.0E-08	8.8E-10	8.8E-08
12-2-09	12:35	70.0	19.25	5.17	2.64E+03	9.3E-10	9.3E-08	9.1E-10	9.1E-08
12-2-09	13:48	70.0	18.10	6.33	4.38E+03	9.5E-10	9.5E-08	9.3E-10	9.3E-08
12-2-09	14:23	70.0	17.57	6.88	2.10E+03	9.4E-10	9.4E-08	9.2E-10	9.2E-08



A gradient of approximately 56.5 was used for this test This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 9.07E-10 cm/s 9.07E-08
Average Hydraulic Conductivity @ 20° C (last run) m/s 9.07E-10 cm/s 9.07E-08

Reviewed by:

File 1755590 8 Thp 5 Sheet Report
Preparation Date 2-20-98
Revision Date 1-2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By JW
Approved By TLK

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-8 50.2'-52.2', Ti 50.2'-50.7'
Visual Classification Lean Clay (CL), brown moist, soft
Undisturbed XX
Specific Gravity 2.75 ASTM D854 A
Maximum Dry Density (pcf)
Project No. 175559018
Test ID 28A
Prepared By KDG
Date 11-3-09
Percent of Maximum
Permeant: De-aired tap water
Selection and Preparation Comments:

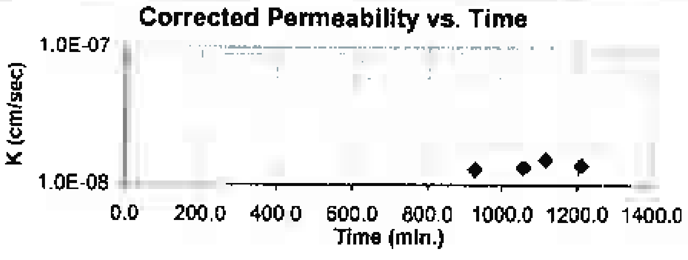
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted" The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4574	2.4264	2.4323
Diameter (in.)	2.8027		2.8015
Moisture Content (%)	26.3		26.2
Dry Unit Weight (pcf)	97.6		96.7
Void Ratio	0.759		0.740
Degree of Saturation (%)	95.5		97.3
Trimmings MC (%)	27.6		

Final Pressures (psi)	
Chamber	75
Influent	70
Effluent	65

pplied Head Difference (psi) 5
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 10
Minimum Effective Consolidation Stress (psi) 5

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-2-09	16:50	68.0	21.89	3.38	0	---	---	---	---
12-3-09	8:16	70.0	19.88	5.45	5.56E+04	1.3E-10	1.3E-08	1.3E-10	1.3E-08
12-3-09	10:26	70.0	19.58	5.73	7.80E+03	1.4E-10	1.4E-08	1.3E-10	1.3E-08
12-3-09	11:25	70.0	19.44	5.89	3.54E+03	1.6E-10	1.6E-08	1.5E-10	1.5E-08
12-3-09	13:01	70.0	19.21	6.10	5.76E+03	1.4E-10	1.4E-08	1.4E-10	1.4E-08


Corrected Permeability vs. Time

A gradient of approximately 56.2 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 1.38E-10 cm/s 1.38E-08
Average Hydraulic Conductivity @ 20° C (last run) m/s 1.38E-10 cm/s 1.38E-08

Reviewed by:

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-9, 4.5'-6.5', TI 5.8'-6.3'
Visual Classification Lean Clay with Sand (CL), red brown, moist, soft
Undisturbed XX
Specific Gravity 2.68 ASTM D854-A
Maximum Dry Density (pcf) ______
Project No 175559018
Test ID 30B
Prepared By KDG
Date 11 3-09
Percent of Maximum ______
Permeant: De-aired tap water
Selection and Preparation Comments. ______

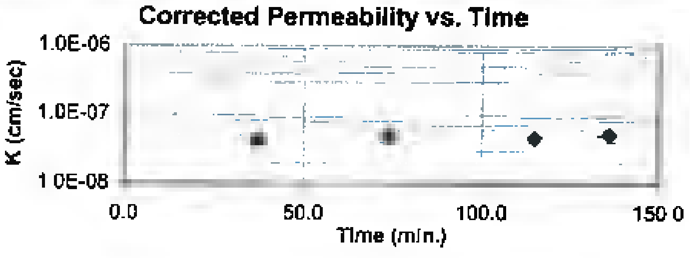
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted" The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4584	2.4182	2.4212
Diameter (in.)	2.8000		2.7937
Moisture Content (%)	20.3		19.8
Dry Unit Weight (pcf)	107.8		110.0
Void Ratio	0.552		0.521
Degree of Saturation (%)	98.4		101.7
Trimmings MC (%)	20.1		

Final Pressures (psi)	
Chamber	75
Influent	70
Effluent	65

Applied Head Difference (psi) 5
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 10
Minimum Effective Consolidation Stress (psi) [illegible]

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-2-09	14:04	68.0	20.29	4.56	0	---	---	---	---
12-2-09	14:41	68.0	20.02	4.83	2.22E+03	4.3E-10	4.3E-08	4.3E-10	4.3E-08
12-2-09	15:18	68.0	19.74	5.16	2.22E+03	4.9E-10	4.9E-08	4.9E-10	4.9E-08
12-2-09	15:59	68.0	19.44	5.48	2.46E+03	4.5E-10	4.5E-08	4.5E-10	4.5E-08
12-2-09	16:20	68.0	19.27	5.66	1.26E+03	5.0E-10	5.0E-08	5.0E-10	5.0E-08



A gradient of approximately 56.1 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 4.70E-10 cm/s 4.70E-08
Average Hydraulic Conductivity @ 20° C (last run) m/s 4.70E 10 cm/s 4 70E-08

Reviewed by:

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-10S, 5.0'-7.0', TI 5.3'-5.8'
Visual Classification Fat Clay with Sand (CH), red brown, moist, hard
Undisturbed XX
Specific Gravity 2.69 ASTM D854-A
Maximum Dry Density (pcf)
Permeant: De-aired tap water
Selection and Preparation Comments:

Project No. 175559018
Test ID 32
Prepared By BW
Date 11-3-09
Percent of Maximu

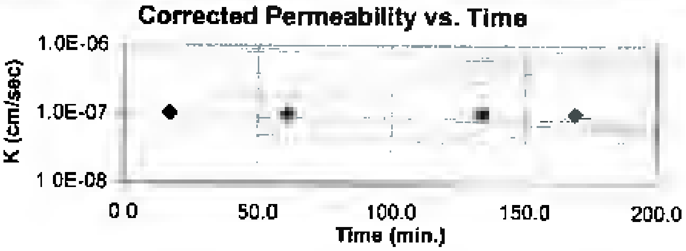
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted" he specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4531	2.4321	2 4295
Diameter (in.)	2.7227		2.7014
Moisture Content (%)	18.7		21.2
Dry Unit Weight (pcf)	102.9		105.6
Void Ratio	0.631		0.591
Degree of Saturation (%)	79.7		96.5
Trimmings MC (%)	18.8		

Final Pressures (psi)	
Chamber	75
Influent	70
Effluent	65

Applied Head Difference (psi) 5
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 10
Minimum Effective Consolidation Stress (ps) 5

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-3-09	11:33	70.0	21.28	3.33	0	—	—	—	—
12-3-09	11:50	70.0	21.01	3.63	1.02E+03	1.1E-09	1.1E-07	1.0E-09	1.0E-07
12-3-09	12:34	70.0	20.31	4.34	2.64E+03	1.0E-09	1.0E-07	1.0E-09	1.0E-07
12-3-09	13:47	70.0	19.14	5.54	4.38E+03	1.1E-09	1.1E-07	1.0E-09	1.0E-07
12-3-09	14:22	70.0	18.59	6.08	2.10E+03	1.0E-09	1.0E-07	1.0E-09	1.0E-07



A gradient of approximately 56.3 was used for this test This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 1 02E-09 cm/s 1.02E-07
Average Hydraulic Conductivity @ 20° C (last run) m/s 1.02E-09 cm/s 1 02E-07

Reviewed by:

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Project No 175559018
Source STN-E-12, 9.5'-11.5', TI 10.3'-10.8'
Test ID 37B
Visual Classification Lean Clay with Sand (CL), red brown, moist, firm, Mn
Prepared By KDG
Undisturbed XX
Specific Gravity 2.74 ASTM D854-A
Date 11-3-09
Maximum Dry Density (pcf) ____
Percent of Maximum ____
Permeant. De-aired tap water
Selection and Preparation Comments: ____

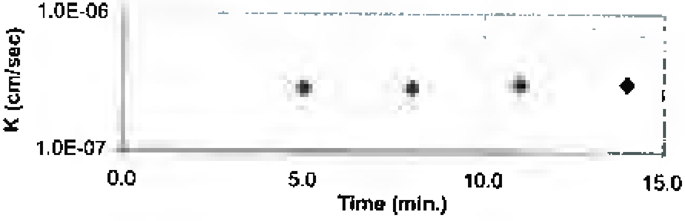
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted" The specimen was trimmed from the bottom two layers

	Initial Specimen Data	After Consolidation Data	After Test Data	Final Pressures (psi)	
Height (in.)	2.4581	2.4396	2.4430	Chamber	75
Diameter (in.)	2.8020		2.8013	Influent	70
Moisture Content (%)	23.0		24.1	Effluent	65
Dry Unit Weight (pcf)	102.0		102.6		
Void Ratio	0.678		0.667		
Degree of Saturation (%)	92.9		98.9		
Trimmings MC (%)	23.2				

Applied Head Difference (psi) 5
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 10
Minimum Effective Consolidation Stress (psi) 5

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-1-09	13:42	70.0	21.83	4.09	0	---	---	---	---
12-1-09	13:47	70.0	21.60	4.36	3.00E+02	3.0E-09	3.0E-07	2.9E-09	2.9E-07
12-1-09	13:50	70.0	21.46	4.52	1.80E+02	3.0E-09	3.0E-07	2.9E-09	2.9E-07
12-1-09	13:53	70.0	21.32	4.70	1.80E+02	3.2E-09	3.2E-07	3.1E-09	3.1E-07
12-1-09	13:56	70.0	21.21	4.91	1.80E+02	3.2E-09	3.2E-07	3.1E-09	3.1E-07

Corrected Permeability vs. Time



A gradient of approximately 56:1 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration Examination of the sample shows no signs of material loss or clogging that may affect test results

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 3.01E-09 cm/s 3.01E-07
Average Hydraulic Conductivity @ 20° C (last run) m/s 3.01E-09 cm/s 3.01E-07

Reviewed by KDG

File 175559018_hp_37b Sheet. Report
Preparation Date 2-20-98
Revision Date 1 2008

Stantec Consulting Services Inc.

Laboratory Document
Prepared By JW
Approved By LK

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds

Source STN-E-13S, 25.0'-27.0', Tl 25.6'-26.1'

Visual Classification Fat Clay (CH), red brown, moist, firm

Undisturbed XX

Specific Gravity 2.73 ASTM D854-A

Maximum Dry Density (pcf) ______

Project No. 175559018

Test ID 41B

Prepared By BWT

Date 11-3-09

Percent of Maximum ______

Permeant. De-aired tap water

Selection and Preparation Comments: ______

Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4581	2.4763	2.4764
Diameter (in.)	2.8070		2.8210
Moisture Content (%)	25.6		27.6
Dry Unit Weight (pcf)	98.3		96.6
Void Ratio	0.733		0.764
Degree of Saturation (%)	95.3		98.8
Trimmings MC (%)	27.5		

Final Pressures (psi)	
Chamber	75
Influent	70
Effluent	65

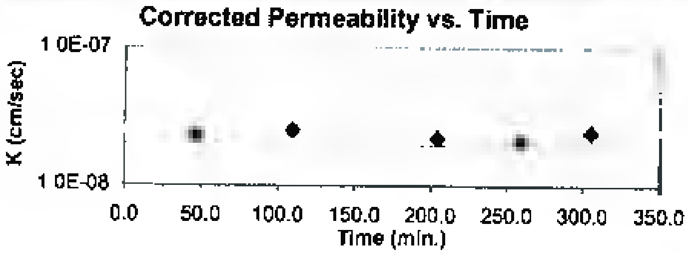
Applied Head Difference (psi) 5

Back Pressure Saturated to (psi) 65

Maximum Effective Consolidation Stress (psi) 10

Minimum Effective Consolidation Stress (psi) ______

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-7-09	8:15	68.0	21.16	3.63	0	---	---	---	---
12-7-09	9:01	68.0	20.98	3.81	2.76E+03	2.3E-10	2.3E-08	2.3E-10	2.3E-08
12-7-09	10:04	68.0	20.73	4.09	3.78E+03	2.5E-10	2.5E-08	2.5E-10	2.5E-08
12-7-09	11:39	68.0	20.38	4.44	5.70E+03	2.2E-10	2.2E-08	2.2E-10	2.2E-08
12-7-09	12:34	68.0	20.19	4.64	3.30E+03	2.1E-10	2.1E-08	2.1E-10	2.1E-08
12-7-09	13:20	68.0	20.00	4.82	2.76E+03	2.4E-10	2.4E-08	2.4E-10	2.4E-08



A gradient of approximately 56.1 was used for this test This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 2.32E-10 cm/s 2.32E-08

Average Hydraulic Conductivity @ 20° C (last run) m/s 2.33E-10 cm/s 2.33E-08

Reviewed by:

Hydraulic Conductivity of Saturated Porous Materials
Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Source STN-E-15, 4.5'-6.5', TI 5.7'-6.2'
Visual Classification Fat Clay (CH), red brown, moist, firm, Mn
Undisturbed XX
Specific Gravity 2.72 ASTM D854-A
Maximum Dry Density (pcf) ______
Project No 175559
Test ID 45B
Prepared By KDG
Date 11-3-09
Percent of Maximum ______
Permeant: De-aired tap water
Selection and Preparation Comments: ______

Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 25 blows per layer The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

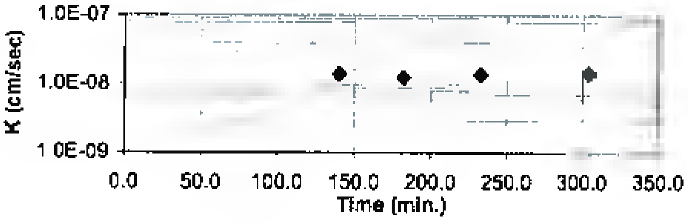
	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	2.4684	2.4507	2.4521
Diameter (in)	2.8020		2.8078
Moisture Content (%)	23.2		23.6
Dry Unit Weight (pcf)	101.6		101.7
Void Ratio	0.672		0.669
Degree of Saturation (%)	93.9		95.9
Trimmings MC (%)	24.2		

Final Pressures (psi)	
Chamber	75
Influent	70
Effluent	65

Applied Head Difference (psi) 5
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 10
Minimum Effective Consolidation Stress (psi) 5

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-3-09	8:03	70.0	19.55	6.29	0	—	---	—	---
12-3-09	10:23	70.0	19.27	6.68	8.40E+03	1.4E-10	1.4E-08	1.4E-10	1.4E-08
12-3-09	11:05	70.0	19.17	6.76	2.52E+03	1.3E-10	1.3E-08	1.2E-10	1.2E-08
12-3-09	11:56	70.0	19.06	6.89	3.06E+03	1.4E-10	1.4E-08	1.4E-10	1.4E-08
12-3-09	13:07	70.0	18.88	7.06	4.26E+03	1.5E-10	1.5E-08	1.4E-10	1.4E-08

Corrected Permeability vs. Time



A gradient of approximately 56 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 1.36E-10 cm/s 1.36E-08
Average Hydraulic Conductivity @ 20° C (last run) m/s 1.36E-10 cm/s 1.36E-08

Reviewed by:

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

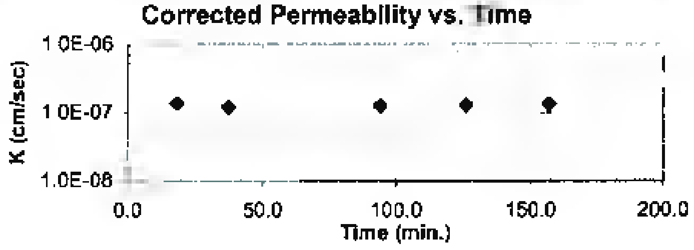
Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Project No. 175559018
Source STN-E-16S, 9.0'-11.0', TI 9.0'-9.5'
Test ID 49A
Visual Classification Lean Clay with Gravel (CL), brown, moist, firm
Prepared By KDG
Undisturbed XX
Specific Gravity 2.73 ASTM D854-A
Date 11-5-09
Maximum Dry Density (pcf) ________
Percent of Maximum ________
Permeant. De-aired tap water
Selection and Preparation Comments ________

Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density, this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 2_ blows per layer The density was varied by reducing the height of the drop by the amount listed beside "Compacted' The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data	Final Pressures (psi)	
Height (in.)	2.4781	2.4542	2.4551	Chamber	75
Diameter (in.)	2.7987		2.8108	Influent	70
Moisture Content (%)	17.2		22.0	Effluent	65
Dry Unit Weight (pcf)	104.4		104.5		
Void Ratio	0.632		0.631		
Degree of Saturation (%)	74.3		95.2		
Trimmings MC (%)	21.2				

Applied Head Difference (psi) 5
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 10
Minimum Effective Consolidation Stress (psi) 5

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-2-09	10:59	68.0	20.76	3.56	0	—	—	—	—
12-2-09	11:17	68.0	20.36	3.98	1.08E+03	1.4E-09	1.4E-07	1.4E-09	1.4E-07
12-2-09	11:36	68.0	19.96	4.34	1.14E+03	1.2E-09	1.2E-07	1.2E-09	1.2E-07
12-2-09	12:33	68.0	18.77	5.50	3.42E+03	1.3E-09	1.3E-07	1.3E-09	1.3E-07
12-2-09	13:05	68.0	18.11	6.16	1.92E+03	1.3E-09	1.3E-07	1.3E-09	1.3E-07
12-2-09	13:36	68.0	17.45	6.84	1.86E+03	1.3E-09	1.3E-07	1.3E-09	1.3E-07



A gradient of approximately 55.7 was used for this test This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 1.27E-09 cm/s 1 27E-07
Average Hydraulic Conductivity @ 20° C (last run) m/s 1.28E-09 cm/s 1 28E 07

Reviewed by. KDG

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D 5084-03

Project Name Gallatin Fossil Plant (GAF) - Ash Ponds
Project No. 175559018
Source STN-E-16S, 36.0'-38.0', TI 36.0'-36.5'
Test ID 52A
Visual Classification Lean Clay (CL), brown, wet, very soft
Prepared By KDG
Undisturbed XX
Specific Gravity 2.67 ASTM D854-A
Date 11-5-09
Maximum Dry Density (pcf) ______
Percent of Maximum ______
Permeant: De-aired tap water
Selection and Preparation Comments ______

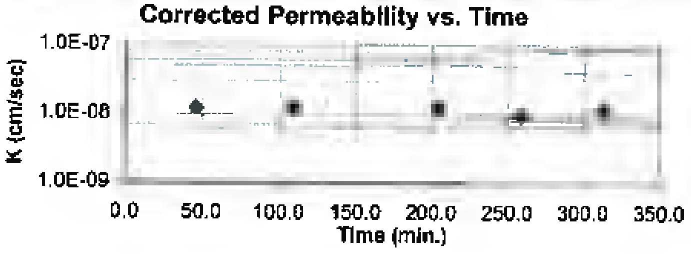
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 19 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted" The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data
Height (in.)	1.3679	1.3091	1.3092
Diameter (in.)	2.7827		2.7880
Moisture Content (%)	25.4		22.1
Dry Unit Weight (pcf)	101.3		105.4
Void Ratio	0.646		0.582
Degree of Saturation (%)	105.0		101.6
Trimmings MC (%)	25.8		

Final Pressures (psi)	
Chamber	75
Influent	70
Effluent	65

Applied Head Difference (psi) 5
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 10
Minimum Effective Consolidation Stress (psi) 5

Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	Hydraulic Conductivity k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-7-09	8:14	68.0	21.60	2.64	0	—	—	—	—
12-7-09	9:00	68.0	21.43	2.81	2.76E+03	1.2E-10	1.2E-08	1.2E-10	1.2E-08
12-7-09	10:03	68.0	21.19	3.06	3.78E+03	1.3E-10	1.3E-08	1.3E-10	1.3E-08
12-7-09	11:38	68.0	20.86	3.46	5.70E+03	1.2E-10	1.2E-08	1.2E-10	1.2E-08
12-7-09	12:33	68.0	20.67	3.59	3.30E+03	9.5E-11	9.5E-09	9.5E-11	9.5E-09
12-7-09	13:27	68.0	20.48	3.79	3.24E+03	1.2E-10	1.2E-08	1.2E-10	1.2E-08



A gradient of approximately 100.9 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration. Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 1.16E-10 cm/s 1.16E 08
Average Hydraulic Conductivity @ 20° C (last run) m/s 1.17E-10 cm/s 1.17E 08

Reviewed by: KDG

File 175559018_fhp_52a Sheet. Report
Preparation Date 2-20-08
Revision Date 1-2008

Laboratory Document
Prepared By JW
Approved By TLK

Stantec

Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
ASTM D 5084-03

Project Name Gallatin Fossil Plant (GAF) Ash Ponds
Project No 175559018
Source STN-E-20S, 23.0'-25.0', TI 23.0'-23.5'
Test ID 60A
Visual Classification Silt (ML), gray, wet, very soft
Prepared By KDG
Undisturbed XX
Specific Gravity 2.4 ASTM D854-A
Date 11-5-09
Maximum Dry Density (pcf) ______
Percent of Maximum ______

Permeant: De-aired tap water
Selection and Preparation Comments: ______

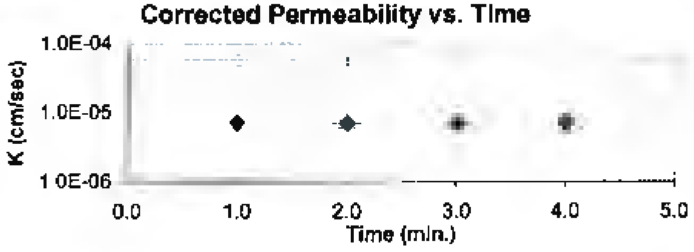
Specimens (if compacted) were compacted in a Proctor Mold as follows: The Maximum Dry Density was converted to Wet Density this mass was divided by 4 (layers) and 3 of the 4 layers were compacted into the mold using a Proctor Hammer using 19 blows per layer. The density was varied by reducing the height of the drop by the amount listed beside "Compacted". The specimen was trimmed from the bottom two layers.

	Initial Specimen Data	After Consolidation Data	After Test Data	Final Pressures (psi)	
Height (in.)	1.3708	1.2824	1.2840	Chamber	74
Diameter (in.)	2.7690		2.7951	Influent	69
Moisture Content (%)	49.6		41.8	Effluent	65
Dry Unit Weight (pcf)	69.7		73.0		
Void Ratio	1.149		1.052		
Degree of Saturation (%)	103.5		95.3		
Trimmings MC (%)	41.1				

pplied Head Difference (psi) 4
Back Pressure Saturated to (psi) 65
Maximum Effective Consolidation Stress (psi) 9
Minimum Effective Consolidation Stress (psi) [illegible]

						Hydraulic Conductivity			
Date	Clock (24H:M)	Temp. °F	Bottom Head	Top Head	Test Time (sec)	k (m/s)	k (cm/s)	k @ 20° C (m/s)	k @ 20° C (cm/s)
12-4-09	9:52	70.0	21.14	4.28	0	—	—	—	—
12-4-09	9:53	70.0	20.67	4.74	6.00E+01	7.3E-08	7.3E-06	7.1E-08	7.1E-06
12-4-09	9:54	70.0	20.23	5.22	6.00E+01	7.3E-08	7.3E-06	7.1E-08	7.1E-06
12-4-09	9:55	70.0	19.76	5.67	6.00E+01	7.4E-08	7.4E-06	7.2E-08	7.2E-06
12-4-09	9:56	70.0	19.32	6.14	6.00E+01	7.3E-08	7.3E-06	7.1E-08	7.1E-06

Corrected Permeability vs. Time



A gradient of approximately 100.7 was used for this test. This gradient exceeds ASTM guidelines for maximum gradient, but was used to achieve the requestors desired test duration Examination of the sample shows no signs of material loss or clogging that may affect test results.

Average Hydraulic Conductivity @ 20° C (last 4 determinations) m/s 7.13E-08 cm/s 7.13E-06
Average Hydraulic Conductivity @ 20° C (last run) m/s 7.13E-08 cm/s 7.13E-06

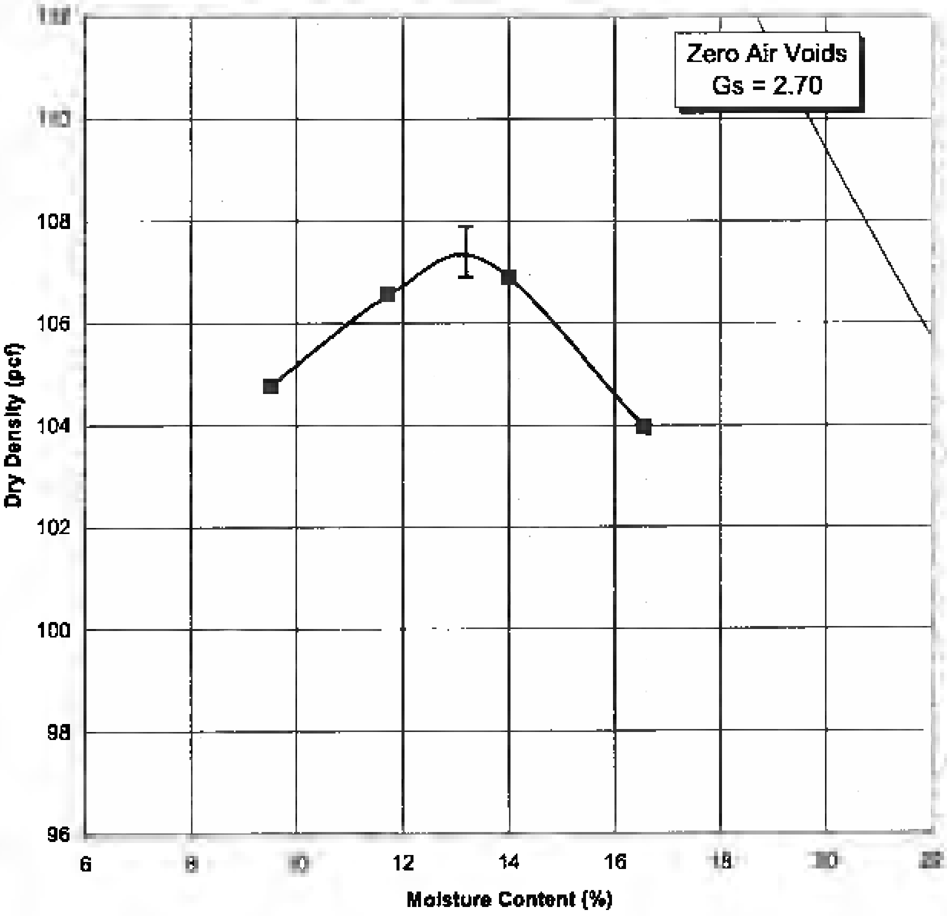
Reviewed by:

Stantec

Moisture-Density Data Sheet

Project: Gallatin Fossil Plant (GAF) - Ash Ponds
Project No.: 175559018
Source: STN-A-8, 14.0'-17.0'
Sample No.: 883
Sample Description: Well graded sand with silt and gravel (SW-SM), black
Visual Notes: gravel
Test Method: ASTM D 698 - Method C
Prepared: Dry
Oversized Fraction: < 5 %
Rammer: Manual
Gs - Fines: Assumed

Mold Weight 6453 grams		Moisture Determination				
Wet Weight plus Mold (grams)	Wet Weight minus Mold (grams)	Wet Soil and Can Weight (grams)	Dry Soil and Can Weight (grams)	Can Weight (grams)	Water Content (%)	Dry Density (pcf)
10586	4133	2495.90	2190.10	342.90	16.6	104.0
10610	4157	1161.30	1045.80	221.00	14.0	106.9
10514	4061	1399.40	1285.80	316.10	11.7	106.6
10367	3914	1033.40	953.40	112.50	9.5	104.8



Maximum Dry Density 107.4 PCF
Optimum Moisture Content 13.2 %

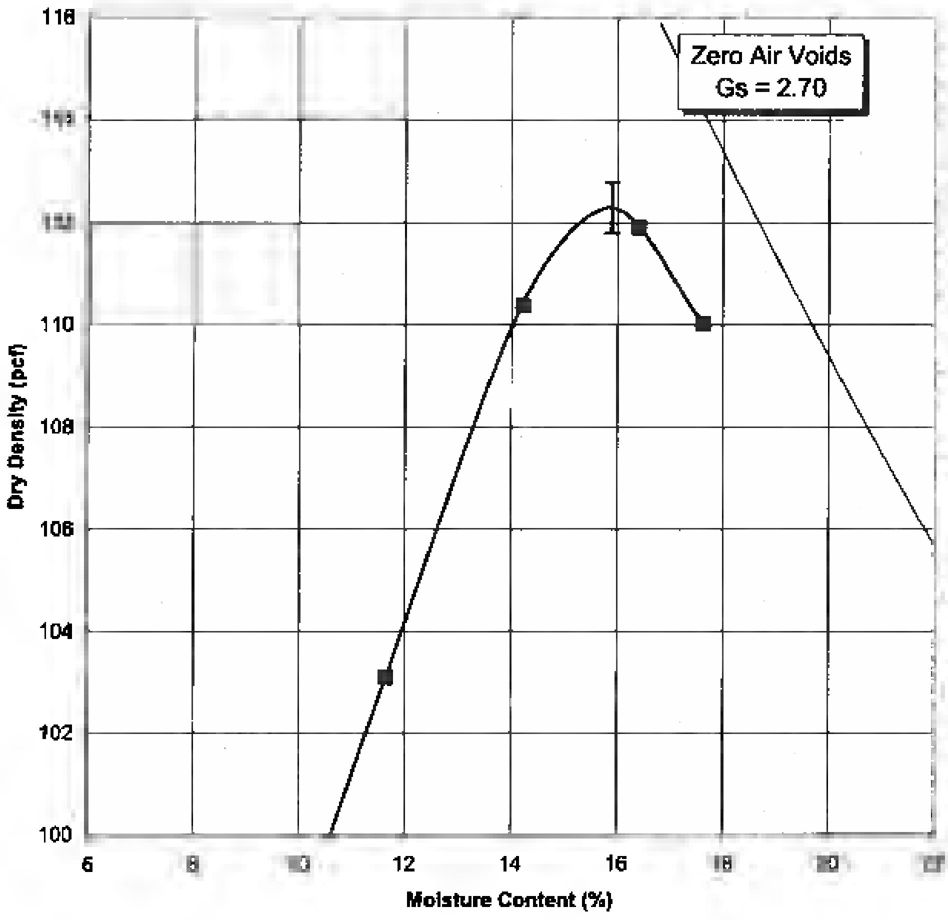
Stantec

Moisture-Density Data Sheet

Project: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-D-2, 4.0'-6.0'
Sample Description: Lean clay (CL) with sand, brownish gray
Visual Notes: silty with chert fragments
Prepared: Dry Oversized Fraction: < 5 % Rammer: Manual

Project No.: 175559018
Sample No.: 884
Test Method: ASTM D 698 - Method A
Gs - Fines: Assumed

Mold Weight 2038 grams		Moisture Determination				
Wet Weight plus Mold (grams)	Wet Weight minus Mold (grams)	Wet Soil and Can Weight (grams)	Dry Soil and Can Weight (grams)	Can Weight (grams)	Water Content (%)	Dry Density (pcf)
3632	1594	195.50	180.90	28.60	9.6	96.9
3766	1728	201.50	183.80	31.70	11.6	103.1
3931	1893	249.70	222.50	31.30	14.2	110.4
3994	1956	282.80	247.50	32.40	16.4	111.9
3981	1943	273.80	237.50	31.50	17.6	110.0



Maximum Dry Density 112.3 PCF
Optimum Moisture Content 15.9 %

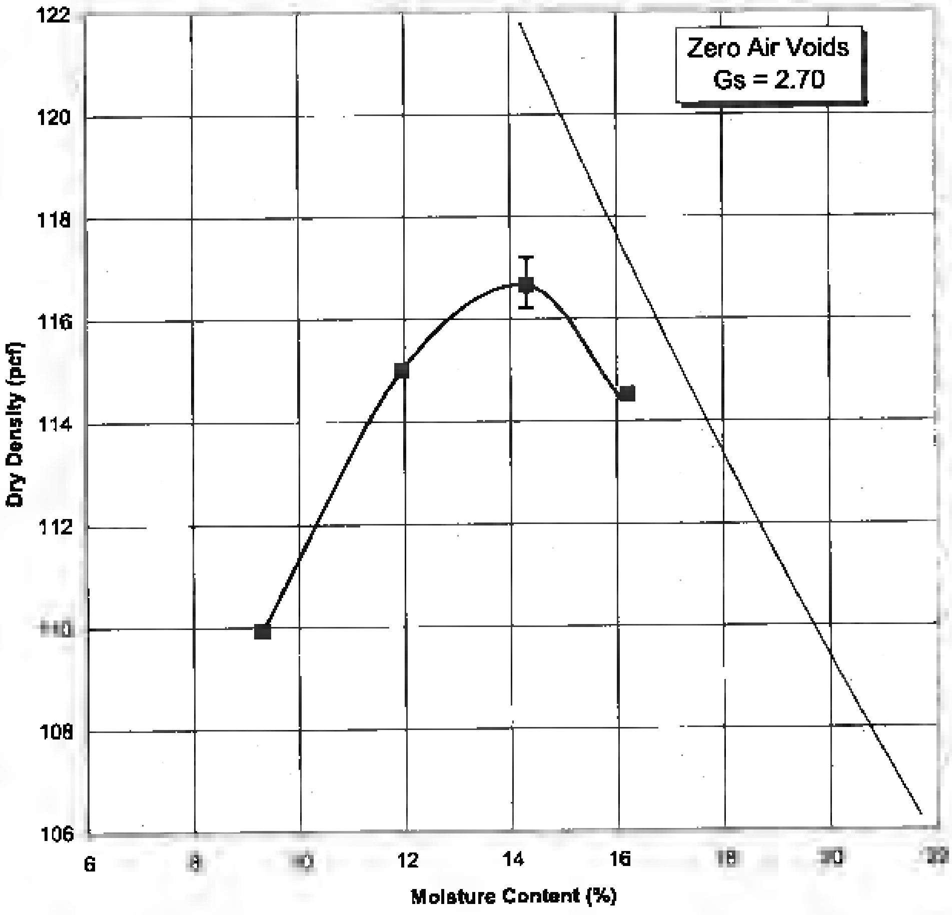
Stantec

Moisture-Density Data Sheet

Project: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-8, 3.0'-5.0'
Sample Description: Lean clay (CL), medium brown
Visual Notes: trace silt and gravel
Prepared: Dry Oversized Fraction: < 5 % Rammer: Manual

Project No.: 175559018
Sample No.: 885
Test Method: ASTM D 698 - Method A
Gs - Fines: Assumed

Mold Weight 4227 grams		Moisture Determination				
Wet Weight plus Mold (grams)	Wet Weight minus Mold (grams)	Wet Soil and Can Weight (grams)	Dry Soil and Can Weight (grams)	Can Weight (grams)	Water Content (%)	Dry Density (pcf)
6031	1804	266.90	246.90	31.80	9.3	109.9
6160	1933	230.90	209.80	33.20	11.9	115.0
6229	2002	249.20	222.16	33.20	14.3	116.7
6225	1998	264.70	232.40	33.00	16.2	114.5



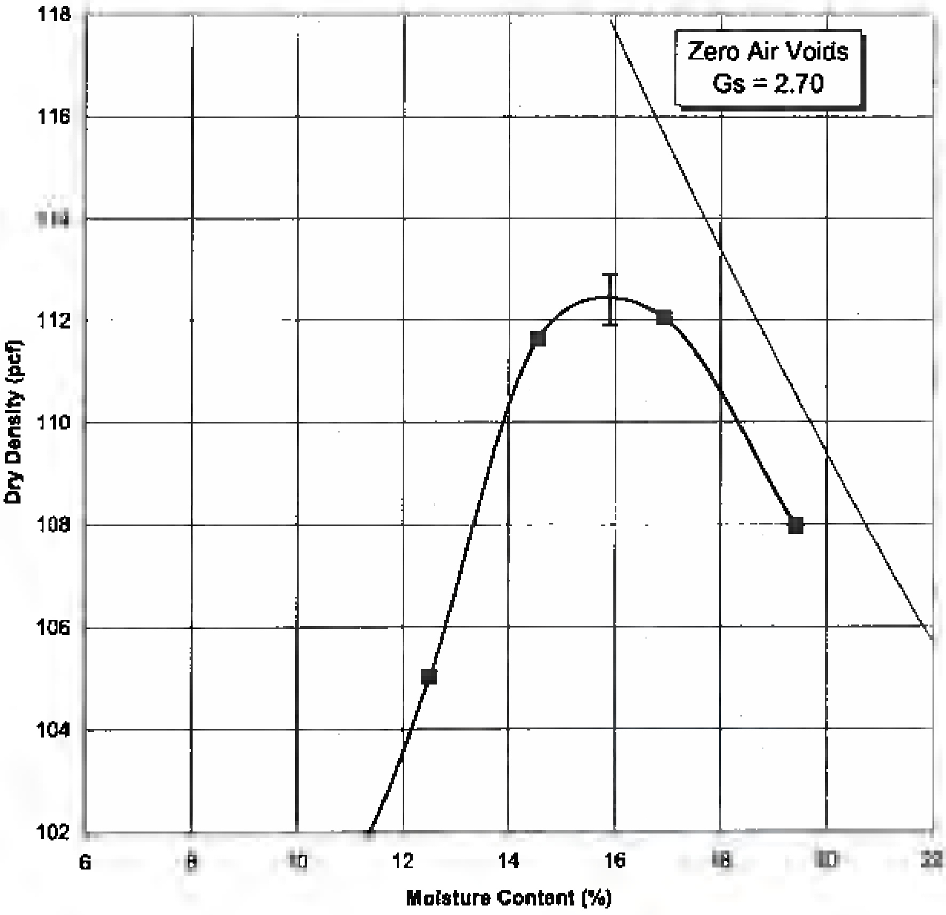
Maximum Dry Density 116.7 PCF
Optimum Moisture Content 14.3 %

Moisture-Density Data Sheet

Project: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-8, 16.0'-19.0'
Sample Description: Lean clay (CL), with gravel, brown
Visual Notes:
Prepared: Dry   Oversized Fraction: < 5 %   Rammer: Manual

Project No.: 175559018
Sample No.: 886
Test Method: ASTM D 698 - Method A
Gs - Fines: Assumed

Mold Weight 2038 grams		Moisture Determination				
Wet Weight plus Mold (grams)	Wet Weight minus Mold (grams)	Wet Soil and Can Weight (grams)	Dry Soil and Can Weight (grams)	Can Weight (grams)	Water Content (%)	Dry Density (pcf)
3629	1591	221.70	206.70	32.52	8.6	97.6
3727	1689	217.30	198.70	30.22	11.0	101.3
3812	1774	235.90	213.20	31.68	12.5	105.0
3958	1920	204.80	183.00	33.20	14.6	111.6
4005	1967	268.64	234.50	32.80	16.9	112.0
3974	1936	296.00	253.00	31.62	19.4	108.0



Maximum Dry Density 112.4 PCF
Optimum Moisture Content 15.9 %

Stantec

Moisture-Density Data Sheet

Project: Gallatin Fossil Plant (GAF) - Ash Ponds

Project No.: 175559018

Source: STN-E-19, 8.0'-11.0'

Sample No.: 887

Sample Description: Lean clay (CL), brown

Visual Notes:

Test Method: ASTM D 698 - Method A

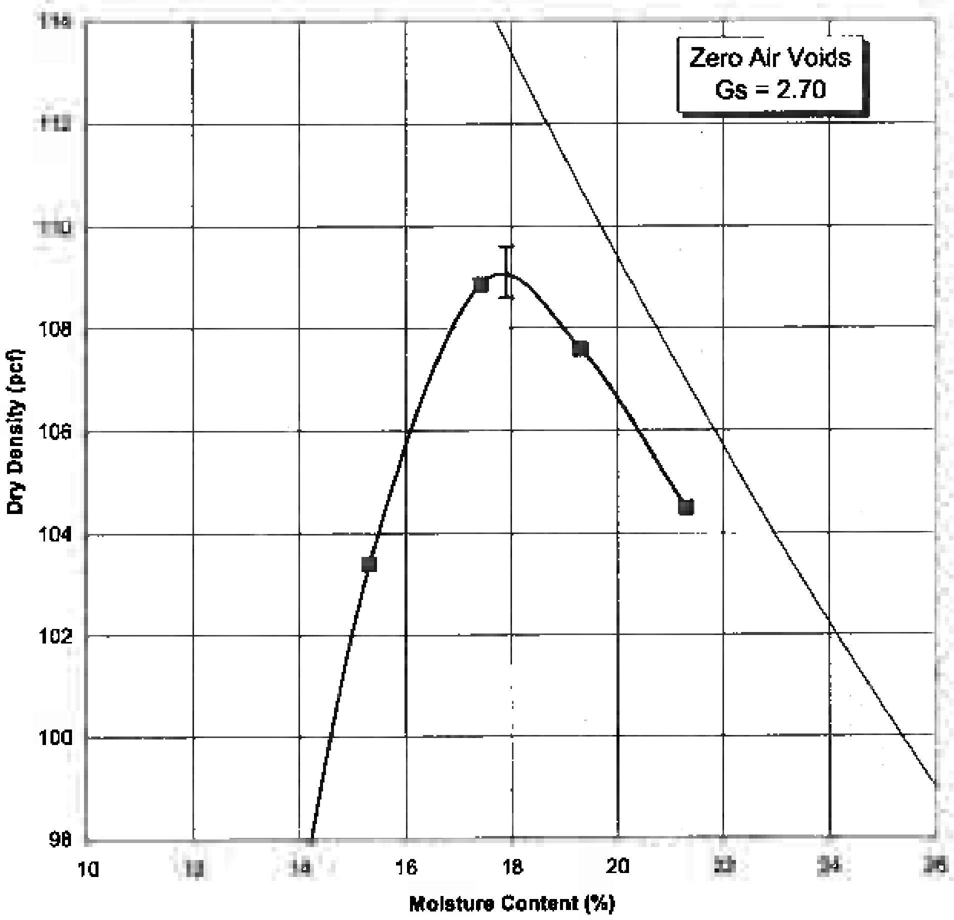
Prepared: Dry

Oversized Fraction: < 5 %

Rammer: Manual

Gs - Fines: Assumed

Mold Weight 2032 grams		Moisture Determination				
Wet Weight plus Mold (grams)	Wet Weight minus Mold (grams)	Wet Soil and Can Weight (grams)	Dry Soil and Can Weight (grams)	Can Weight (grams)	Water Content (%)	Dry Density (pcf)
3646	1614	175.60	158.67	34.20	13.6	94.6
3822	1790	264.60	233.56	30.90	15.3	103.4
3951	1919	204.50	178.99	32.50	17.4	108.9
3959	1927	182.10	158.01	33.20	19.3	107.6
3935	1903	231.20	196.43	33.20	21.3	104.5



Maximum Dry Density 109.1 PCF

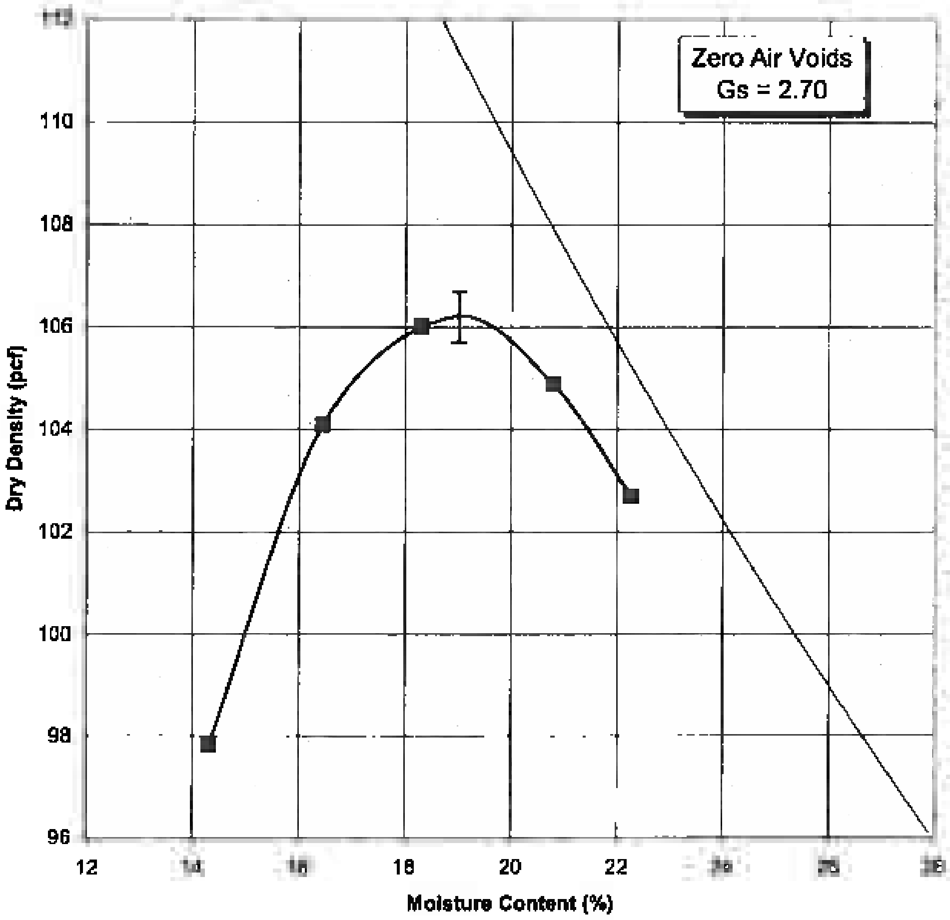
Optimum Moisture Content 17.9 %

Moisture-Density Data Sheet

Project: Gallatin Fossil Plant (GAF) - Ash Ponds
Source: STN-E-14, 5.0'-8.0'
Sample Description: Lean clay (CL), dark brown
Visual Notes: Trace silt and gravel
Prepared: Dry   Oversized Fraction: < 5 %   Rammer: Manual

Project No.: 175559018
Sample No.: 888
Test Method: ASTM D 698 - Method A
Gs - Fines: Assumed

Mold Weight 4227 grams		Moisture Determination				
Wet Weight plus Mold (grams)	Wet Weight minus Mold (grams)	Wet Soil and Can Weight (grams)	Dry Soil and Can Weight (grams)	Can Weight (grams)	Water Content (%)	Dry Density (pcf)
5906	1679	202.10	180.90	32.80	14.3	97.8
6047	1820	255.80	224.00	30.70	16.5	104.1
6110	1883	216.90	188.20	31.40	18.3	106.0
6129	1902	252.10	214.30	32.40	20.8	104.9
6112	1885	267.80	225.00	32.70	22.3	102.7

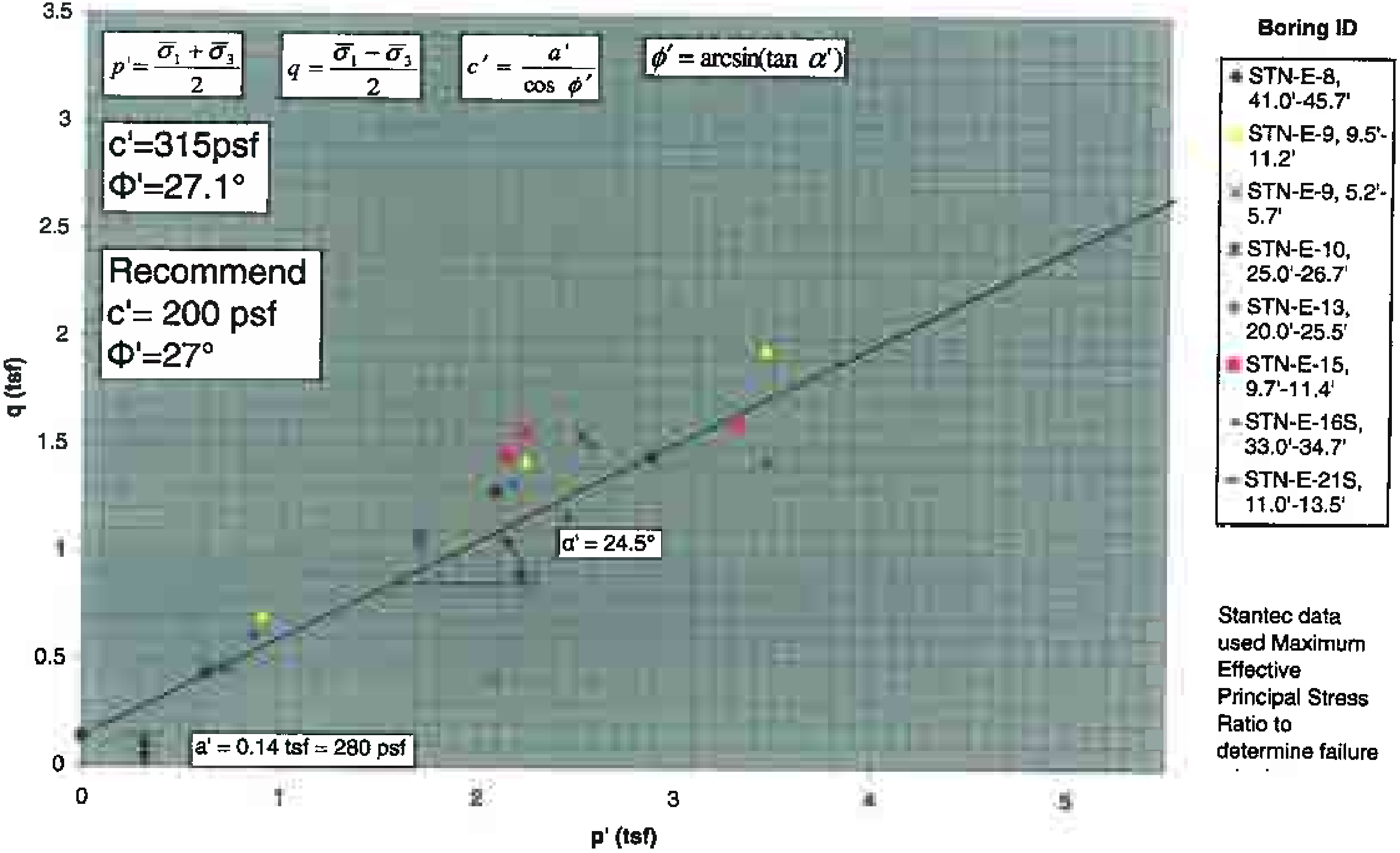


Maximum Dry Density 106.2 PCF
Optimum Moisture Content 19.0 %

Appendix D

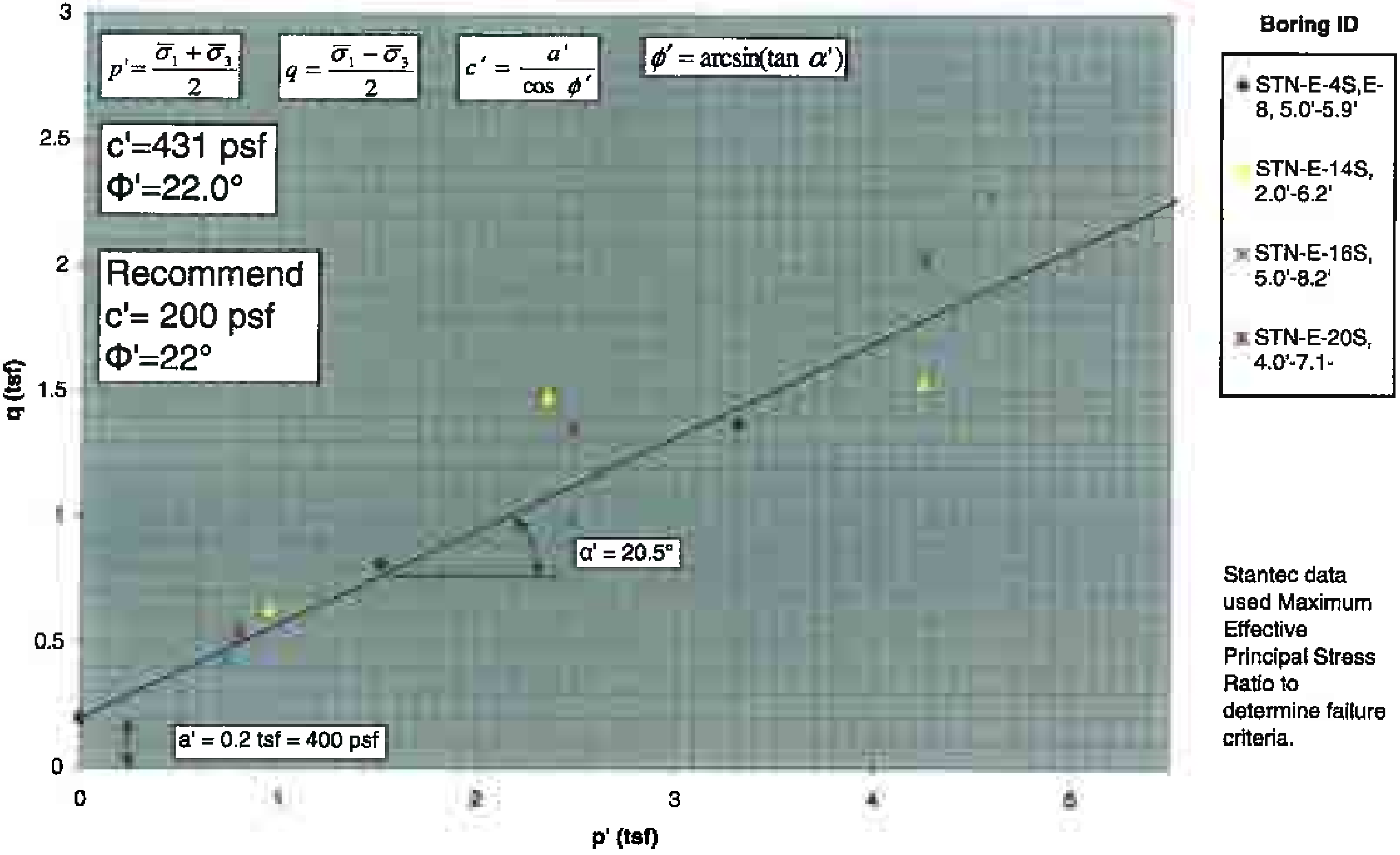
Strength Parameter Selection

Native Clay
Effective Stress From CU Triaxial Tests



Stantec data used Maximum Effective Principal Stress Ratio to determine failure

2006 Pond E Clay Dike
Effective Stress From CU Triaxial Tests



Stantec data used Maximum Effective Principal Stress Ratio to determine failure criteria.

Appendix E

Geotechnical Drawings

39 | C | 10W504-01

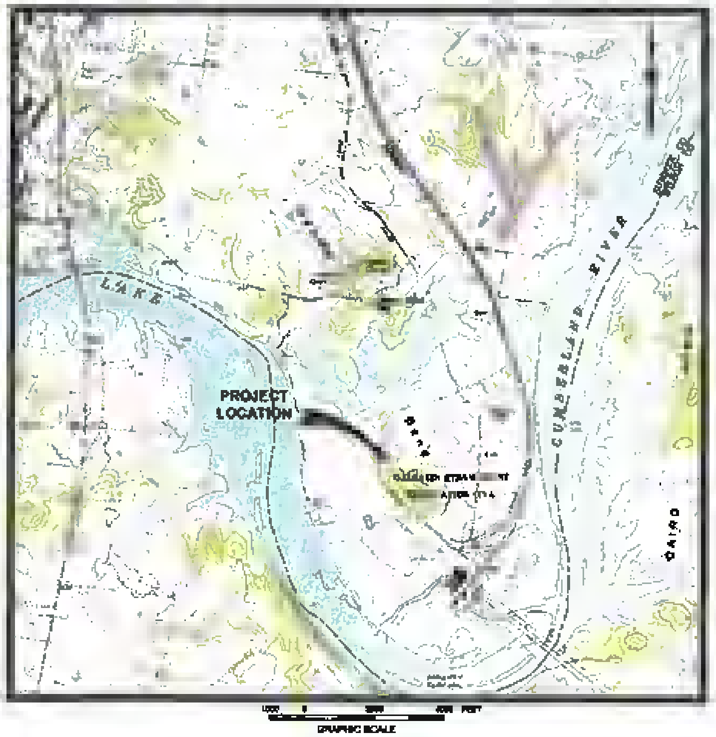
GEOTECHNICAL EXPLORATION
ASH POND/STILLING POND COMPLEX
GALLATIN FOSSIL PLANT
GALLATIN, SUMNER COUNTY, TENNESSEE

PREPARED FOR

TENNESSEE VALLEY AUTHORITY

PREPARED BY

Stantec Consulting
Services Inc.
1901 Nelson Miller Pky.
Louisville, Kentucky
40223-2177
Tel. 502.212.5000
Fax 502.212.5055
www.stantec.com



VICINITY MAP

RECORD DRAWING

INDEX OF SHEETS

For Supporting Design Calculations see FPGGAFFESCDX00000020100001

RANDY LEE ROBERTS

0 | 05/27/10 | C | RP | PC | RLR | RLR | RLR | TJ
RECORD DRAWING

SCALE: AS SHOWN EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX
GEOTECHNICAL EXPLORATION
COVER SHEET

P. COOPER | R. PETTY | P. COOPER | R. ROBERTS | R. ROBERTS | R. ROBERTS | T. JOHNSON

Stantec Consulting
Services Inc.

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

05/27/10 | 39 | C | 10W504-01 | R 0

P O FAC DR XX

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC
TASK COMPLETED BY
REV NO

MATCHLINE (See Sheet 03)

LEGEND

○	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling
●	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core
▦	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Piezometer
▣	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core And Piezometer Location
A A'	Cross Section

NOTES

1. Topographic and survey information provided by the Tennessee Valley Authority.
2. The boring logs and related information shown on this drawing depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations. Any correlations shown between borings are generally based on straight line interpolation. Actual conditions between borings are unknown and may differ from those shown.

BORING LOCATION TABLE

BORING	NORTHING	EASTING	ELEVATION (ft.)
STN-D-1	707,328.99	1,877,246.92	460.8
STN-D-2	707,245.10	1,877,237.98	460.4
STN-E-1	703,045.88	1,879,000.10	474[illegible]
STN-E-2	703,007.37	1,879,022.21	475.7
STN-E-3	702,955.21	1,879,048.86	459.8
STN-E-4	702,820.82	1,878,131.27	474.3
STN-E-5	702,788.65	1,878,111.48	476.1
STN-E-6	702,733.38	1,878,078.14	459.6
STN-E-7	703,843.80	1,877,971.87	475.1
STN-E-8	703,835.47	1,877,934.64	4[illegible]6.5
STN-E-9	703,753.39	1,877,878.25	451.8
STN-E-10	704,870.32	1,877,862.37	474.9
STN-E-11	704,893.38	1,877,828.48	478.1
STN-E-12	704,854.47	1,877,754.48	455.3
STN-E-13	706,353.41	1,877,474.21	474.3
STN-E-14	706,343.79	1,877,425.58	477.0
STN-E-15	706,458.09	1,877,384.[illegible]	463.4
STN-E-16	707,101.38	1,877,842.[illegible]4	474.9
STN-E-17	707,148.54	1,877,811.85	475.4
STN-E-18	707,180.77	1,877,765.82	48[illegible].8
STN-E-19	706,774.43	1,878,887.[illegible]	472.8
STN-E-20	706,856.53	1,878,784.54	4[illegible]8.0
STN-E-21	706,883.00	1,878,751.72	48[illegible]

RECORD DRAWING

100 0 200 400 FEET
GRAPHIC SCALE: 1"=200'

For Supporting Design Calculations see
FPGGAFFESCDK0000020100001

RANDY LEE ROBERTS
5/2[illegible]0

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Fax. 502.212.5055
www.stantec.com

RECORD DRAWING

SCALE: 1"=200' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX
GEOTECHNICAL EXPLORATION
BORING LAYOUT

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 39 | C | 10W504-02 | R 0

P.D. AC OR XX
W TVA

CAD DRAWING
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TASK COMPLETED BY	REV NO.

LEGEND

○	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling
◉	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core
▣	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Piezometer Location
▨	Soil Boring With Continuous Standard Penetration Tests And/Or Shelby Tube Piston Sampling And Rock Core And Piezometer Location
A A'	Cross Section

NOTES

1. Topographic and survey information provided by the Tennessee Valley Authority
2. The boring logs and related information shown on this drawing depict approximate subsurface conditions only at the specific boring locations noted and at the time of drilling. Conditions at other locations may differ from those occurring at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at the boring locations. Any correlations shown between borings are generally based on straight line interpolation. Actual conditions between borings are unknown and may differ from those shown.

BORING LOCATION TABLE

BORING	[illegible]	[illegible]	ELEVATION (ft.)
STN-A-1	707,018.68	1,879,799.57	472.8
STN-A-2	706,994.16	1,879,810.94	473.3
STN-A-3	707,510.75	1,880,731.90	472.9
STN-A-4	707,498.65	1,880,758.47	473.8
STN-A-5	708,368.74	1,881,417.01	473.7
STN-A-6	708,353.42	1,881,433.71	474.0
STN-A-7	708,921.58	1,881,894.55	474.5
STN-A-8	708,907.06	1,881,914.61	474.8
STN-A-9	709,132.84	1,882,470.74	472.4
STN-A-10	709,085.67	1,882,461.16	474.1
S -C-	[illegible] .41	[illegible]	452.0

RECORD DRAWING

100 0 200 400 FEET
GRAPHIC SCALE: 1"=200'

For Supporting Design Calculations see FPGGAFFESCDX00000020100001

0 03 27 10 PC RP PC RLR RLR RLR TJ

SC 1"=200' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
BORING LAYOUT

P. COOPER R. PETTY P. COOPER R. ROBERTS R. ROBERTS R. ROBERTS T. JOHNSON

RANDY LEE ROBERTS
STATE OF TENNESSEE

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GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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PLO FACTOR.XX
W TVA

C A D DRAWING
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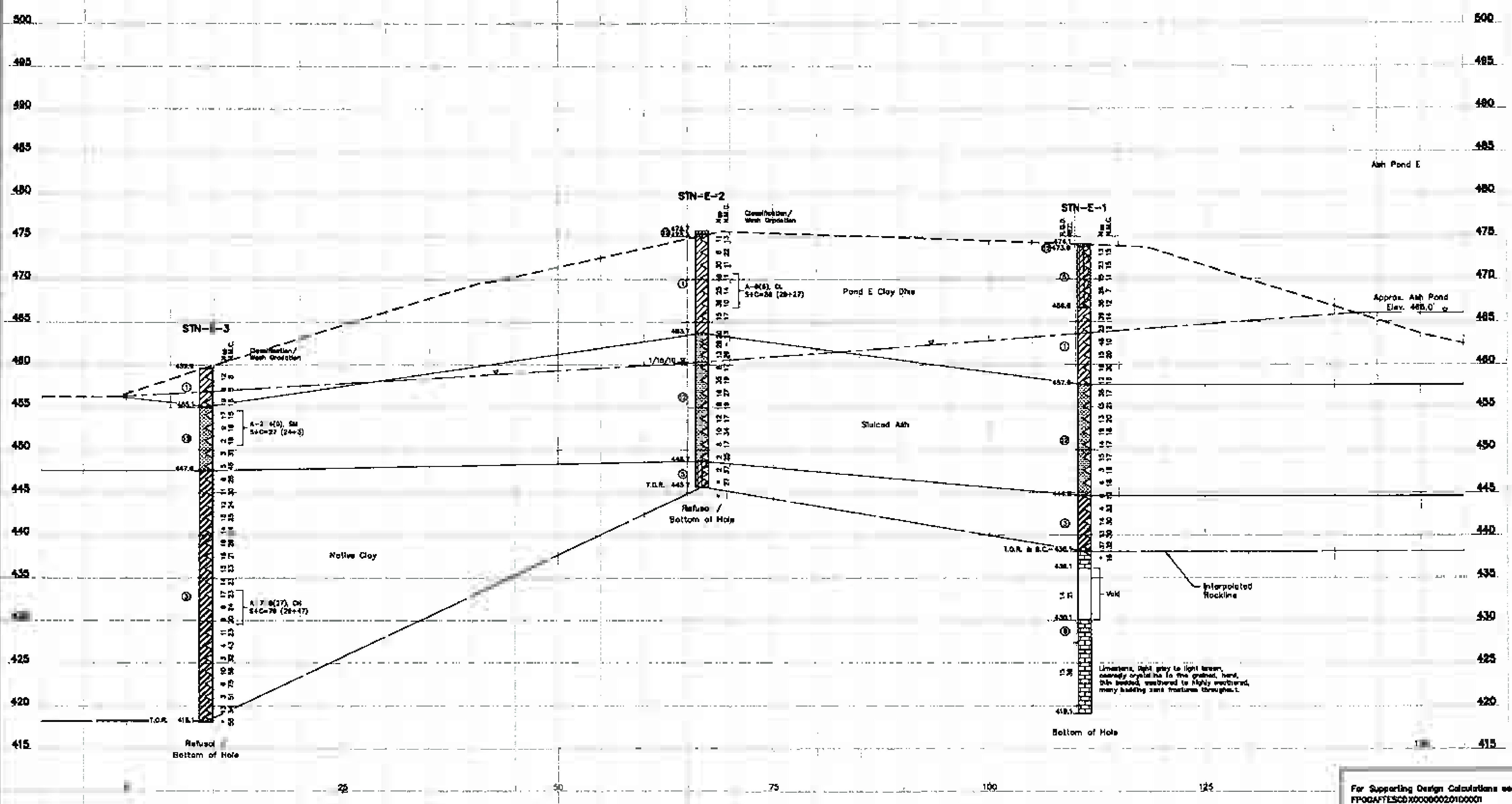
TASK COMPLETED BY	REV NO



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▦	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▩	Fly Ash
⑫	▩	Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
Nse	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
Nau	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
—— ▽ ——	Phreatic Surface From Pz Data
- - ▽ - -	Phreatic Surface From Seepage Model
T.O.R.—	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.—	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide Tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-E-1S	474.1'	34.5'	N/A	4.0'-6.0', 8.0'-10.0', 12.0'-14.0' 20.0'-22.0', 32.0'-34.0'

For Supporting Design Calculations see FP00AFTESC0X0000002010000I

6/27/10

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R0 05/27/10 PC RP PC RLR RLR RLR TJ

RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION A

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GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 05/27/10 | 39 | C | 10W504-04 | R 0

PLOT FACTOR:XX
W TVA

C.A.D. DRAWING
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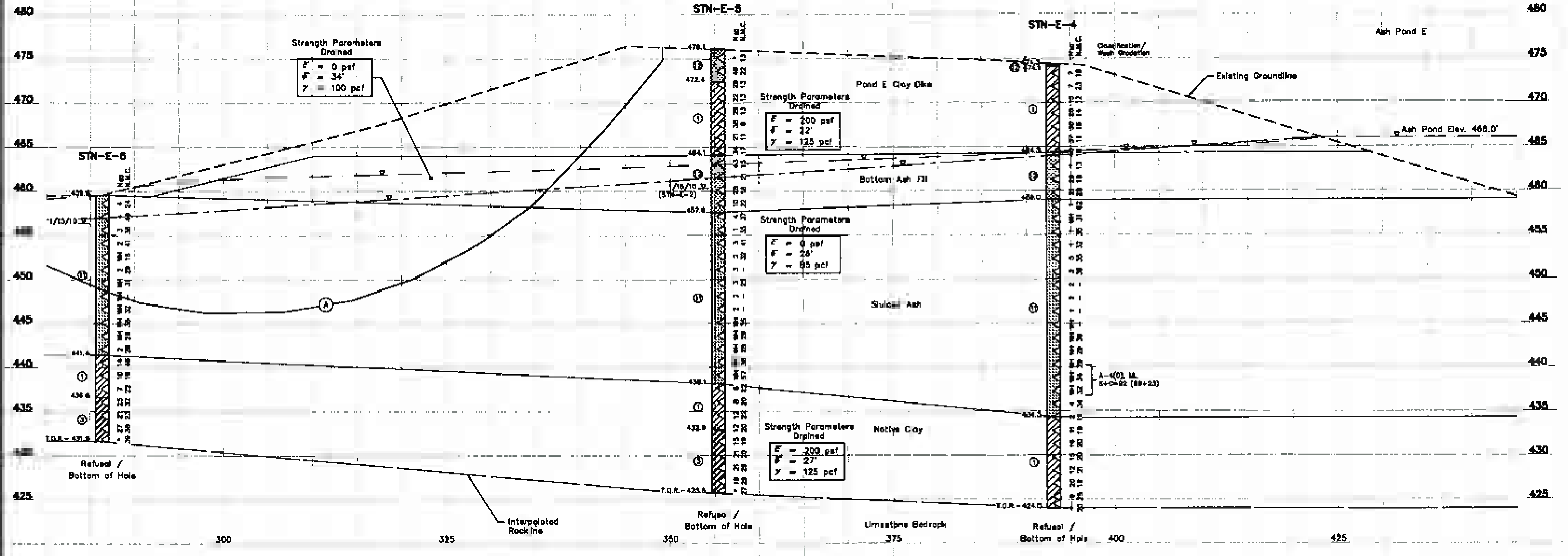
STANTEC | 0
TASK COMPLETED BY: | REV NO.

39 | C | 10W504-05



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▦	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▩	Fly Ash
⑫	▩	Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{60}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
— ▽ —	Phreatic Surface From As Data
— ▼ —	Phreatic Surface From Seepage Model
T.O.R.–	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.–	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log

RECORD DRAWING

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS		
Location	STN-E-4S	STN-E-8
Depth	5.0'–5.5'	5.4'–5.8'
$\bar{\phi}$	17.6°	
$\bar{c}$	740 p.s.f.	

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-E-4S	474.3'	42.0'	N/A	5.0'–7.0', 15.0'–17.0' 20.0'–22.0', 35.0'–37.0' 40.0'–42.0'

SUMMARY OF STABILITY ANALYSES STATIC CONDITION

Failure Surface	Failure Mode	Failure Type	Factor of Safety
A	Circular Optimized With Phreatic Surface from Seepage Model	Global	1.5

For Supporting Design Calculations see FPGGAFFESCDX000002010001

RANDY LEE ROBERTS
5/27/10

Stantec Consulting Services Inc.

R0	05/27/10	PC	RP	PC	RLR	RLR	RLR	TJ	

SCALE: 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION B

P. COOPER	R. PETTY	P. COOPER	R. ROBERTS	R. ROBERTS	R. ROBERTS	T. JOHNSON

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

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PLOT FACTOR:XX
W_TVA

STANTEC | 0
TASK COMPLETED BY. | REV NO

C.A.D. DRAWING
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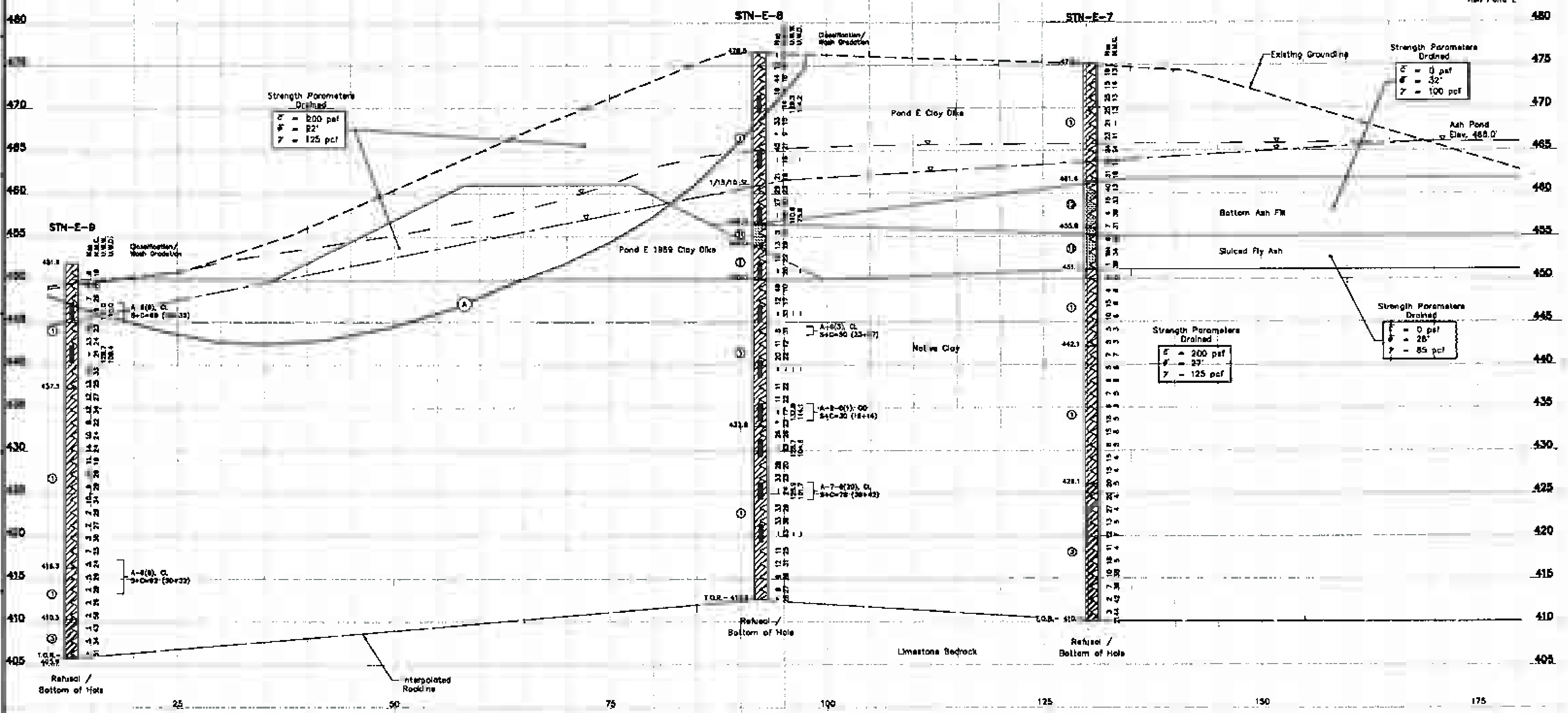

LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▩	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▦	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▩	Fly Ash
⑫	▩	Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{60}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
— ▽ —	Phreatic Surface From Pz Data
— ▽ —	Phreatic Surface From Seepage Model
T.O.R.-	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS			
Location	STN-E-8		
Depth	41.0'-41.5'	41.6'-42.1'	45.2'-45.7'
$\bar{\phi}$	26.6°		
$\bar{c}$	360 p.s.f.		
Location	STN-E-9		
Depth	9.5'-10.0'	10.1'-10.6'	10.7'-11.2'
$\bar{\phi}$	28.8°		
$\bar{c}$	640 p.s.f.		

SUMMARY OF OFFSET BORINGS				
BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-E-8S	478.5'	30.5'	20.0'-30.0'	N/A

SUMMARY OF STABILITY ANALYSES STATIC CONDITION			
Failure Surface	Failure Mode	Failure Type	Factor of Safety
A	Circular Optimized With Phreatic Surface from Seepage Model	Global	1.6

For Supporting Design Calculations see FPGGAFFESCDX00000020100001

5/27/10

Stantec Consulting Services Inc.

R 0	05/27/10	PC	RP	PC	RLR	RLR	RLR	TJ

RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION C

P. COOPER | R. PETRY | P. COOPER | R. ROBERTS | R. ROBERTS | R. ROBERTS | T. JOHNSON

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 05/27/10 | 39 | C | 10W504-06 | R 0

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
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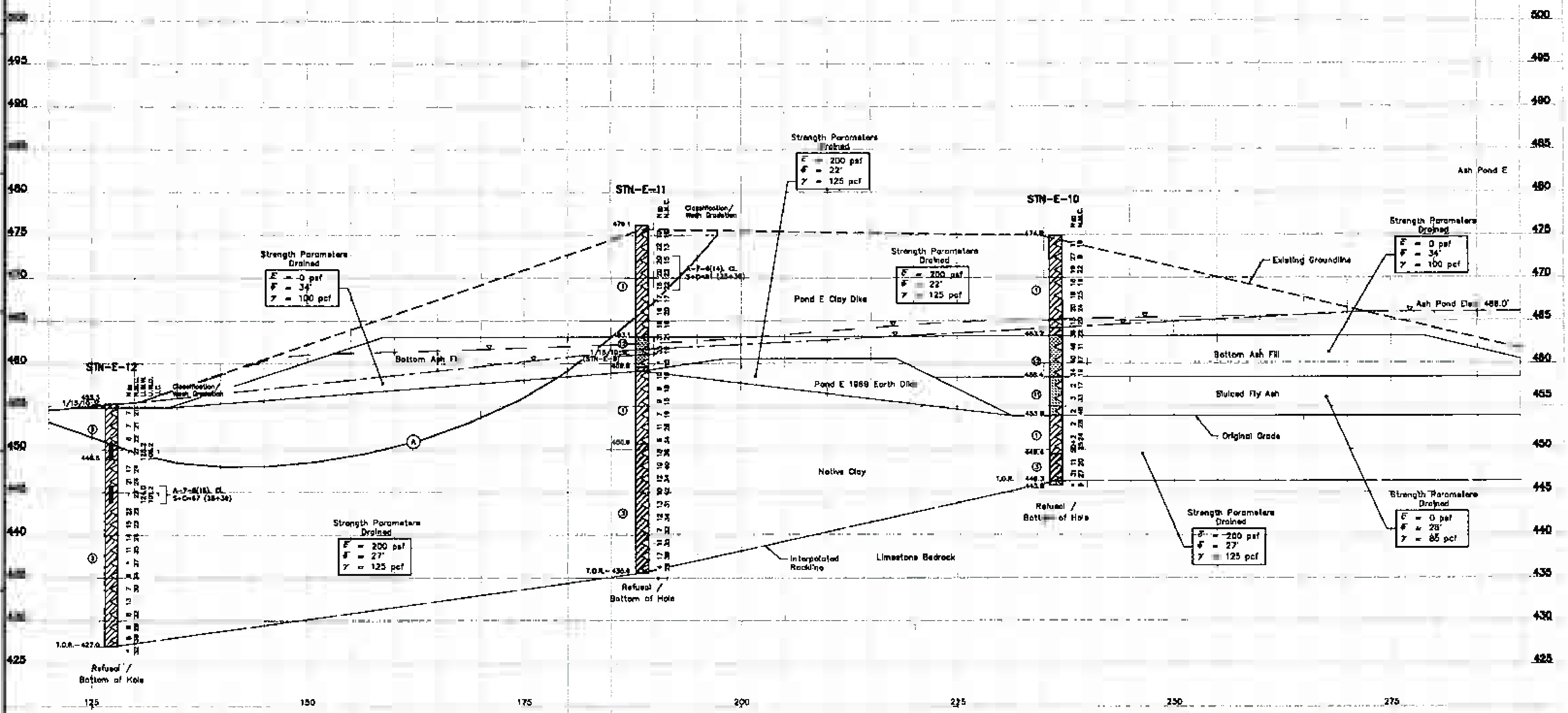
STANTEC	0
TASK COMPLETED BY:	REV NO.

39 C 10W504-07



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▦	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▦	Fly Ash
⑫	▦	Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{60}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
—— ▽ ——	Phreatic Surface From Pz Data
—— ▽ ——	Phreatic Surface From Seepage Mode
T.O.R.	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.-	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Location	STN-E-105		
Depth	25.0'-25.5	25.5'-26.0'	26.2'-26.7'
φ̄	37.1'		
c̄	70 p.s.f.		

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-E-105	474.9'	27.0'	N/A	2.0'-4.0', 5.0'-7.0' 18.0'-10.0', 17.0'-19.0' 21.0'-23.0', 25.0'-27.0'

SUMMARY OF STABILITY ANALYSES STATIC CONDITION

Failure Surface	Failure Mode	Failure Type	Factor of Safety
A	Circular Optimized With Phreatic Surface from Seepage Model	Global	2.0

For Supporting Design Calculations see FPGGAFFESCDXD000002D100001

5/27/10

Stantec Consulting Services Inc.

R D 05/27/10 PC RP PC RLR RLR RLR TJ
RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION D

P. COOPER R. PETTY P. COOPER R. ROBERTS R. ROBERTS R. ROBERTS T. JOHNSON

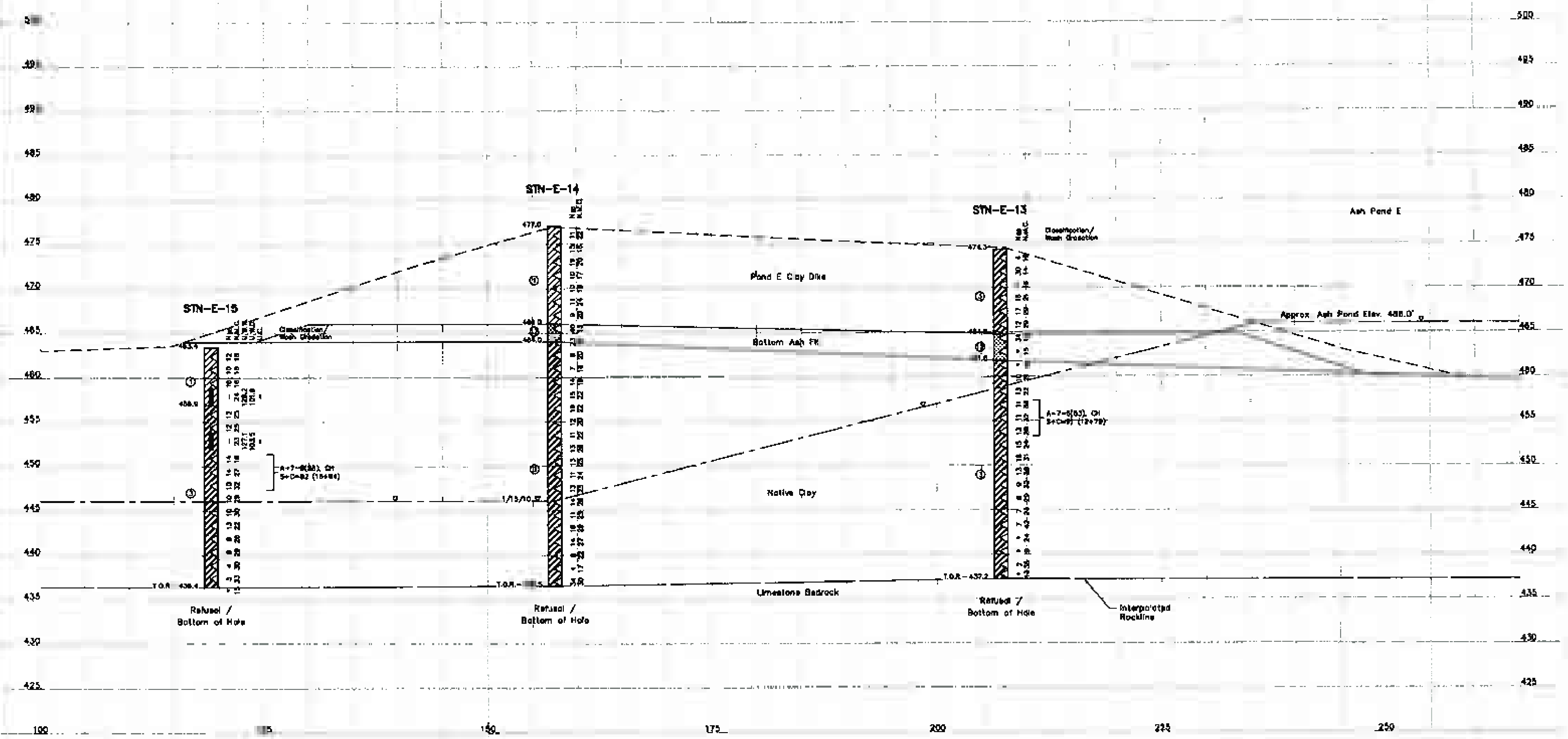
GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 05/27/10 | 39 | C | 10W504-07 | R D

PLOT FACTOR:XX
W TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC | 0
TASK COMPLETED BY: | REV NO.



LEGEND

- ① ▨ Lean Clay, Sandy Lean Clay, Lean Clay With Sand
- ② ▨ Silty, Clayey Sand
- ③ ▨ Fat Clay, Fat Clay With Sand
- ④ ▩ Overburden
- ⑤ ▦ Silty Clay
- ⑥ □ Poorly Graded Sand
- ⑦ ▥ Silty Sand
- ⑧ ▥ Silt, Sandy Silt, Silt With Sand
- ⑨ ▤ Limestone
- ⑩ ▥ Well Graded Sand With Silt
- ⑪ ▦ Fly Ash
- ⑫ ▩ Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{80}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
▽	Phreatic Surface From Pz Data
▽	Phreatic Surface From Seepage Model
T.O.R.–	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Location	STN-E-13S		
Depth	20.0'-20.5'	20.6'-21.1'	25.0'-25.5'
$\bar{\phi}$	18.4°		
$\bar{c}$	700 p.s.f.		
Location	STN-E-14S		
Depth	2.0'-2.5'	2.6'-3.1'	5.7'-6.2'
$\bar{\phi}$	21.5°		
$\bar{c}$	480 p.s.f.		
Location	STN-E-15		
Depth	9.7'-10.2'	10.3'-10.8'	10.9'-11.4'
$\bar{\phi}$	28.3°		
c	380 p.s.f.		

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-E-13S	474.3'	34.0'	N/A	2.0'-4.0', 5.0'-7.0' 10.0'-12.0', 15.0'-17.0' 20.0'-22.0', 25.0'-27.0' 30.0'-32.0'
STN-E-14S	477.0'	7.0'	N/A	2.0'-4.0', 5.0'-7.0'

For Supporting Design Calculations see FPGGAFFESCOX000000ZD10000I

5/27/10

Stantec Consulting Services Inc.

SCALE 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION E

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

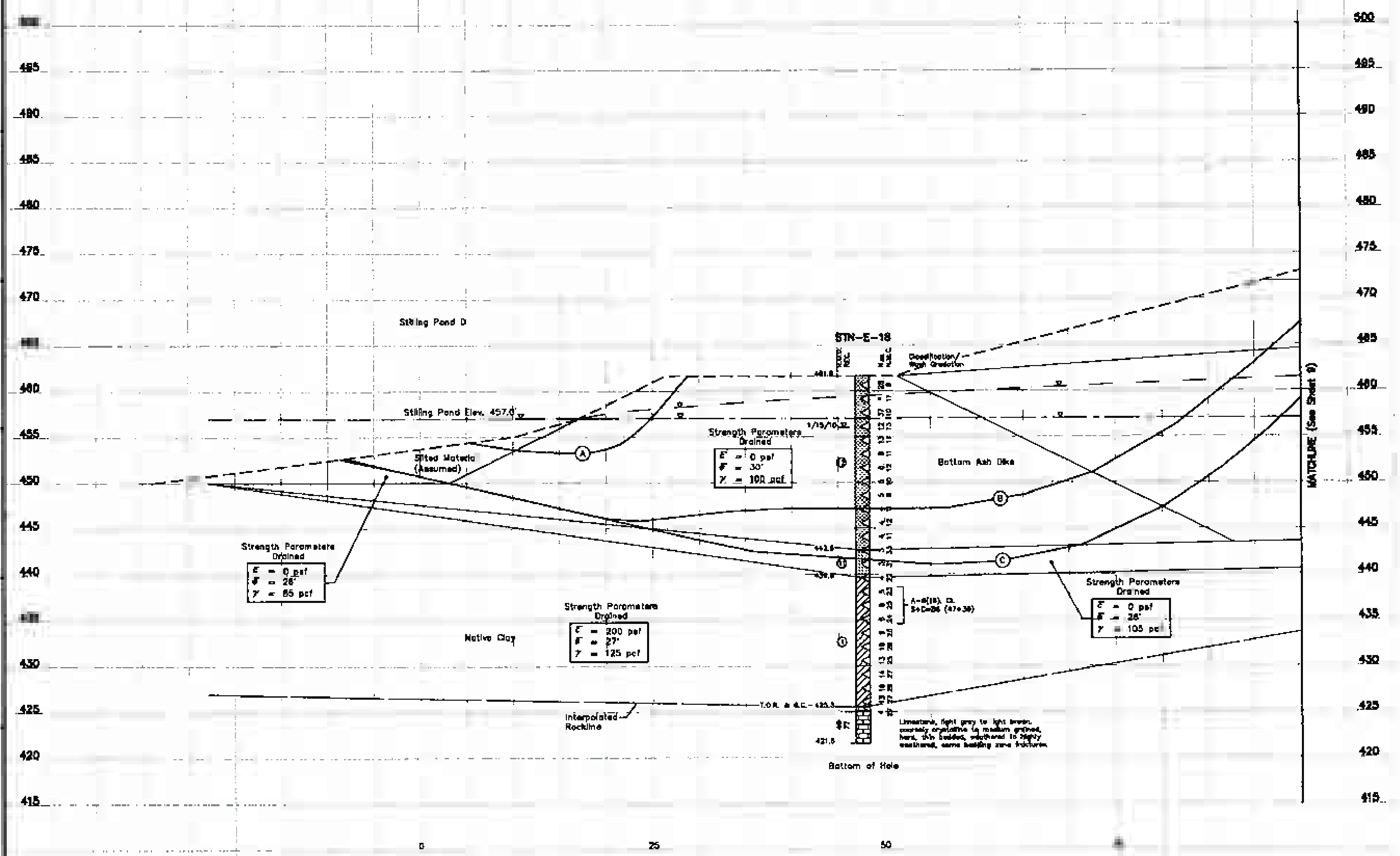
AUTOCAD R 2000 | 39 | C | 10W504-08 | R 0

PLOT FACTOR:XX
W TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC | 0
TASK COMPLETED BY | REV NO.

39 C 10W504-08



CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Location	STN E 16S		
Depth	5.0'-5.5'	5.6'-6.1'	7.7'-8.2'
φ̄	22.0'		
c̄	340 p.s.f.		
Location	STN E 18S		
Depth	33.0'-33.5'	33.6'-34.1'	34.2'-34.7'
φ̄	34.3'		
c̄	180 p.s.f		

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN E-16S	474.5'	58.0'	N/A	5.0'-7.0', 7.0'-9.0' 9.0'-11.0', 29.0'-31.0' 31.0'-33.0', 33.0' 35.0' 36.0'-38.0', 40.0'-42.0' 44.0'-46.0', 48.0'-50.0' 52.0'-54.0', 54.0'-56.0'
STN-E-18S	461.6'	20.0'	10.0' 20.0'	N/A

SUMMARY OF STABILITY ANALYSES STATIC CONDITION

Failure Surface	Failure Mode	Failure Type	Factor of Safety
A	Circular Optimized With Phreatic Surface From Seepage Model	Non-Global	1.1
B	Circular Optimized With Phreatic Surface From Seepage Model	Global	2.0
C	Noncircular Optimized With Phreatic Surface From Seepage Model	Global	2.0

LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▩	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▦	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▦	Fly Ash
⑫	▦	Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
●	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{90}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
—— ▽ ——	Phreatic Surface From Pz Data
—— ▽ ----	Phreatic Surface From Seepage Model
T.O.R.–	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.–	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

For Supporting Design Calculations see FPOGAFFESCOX0000002010001

5/27/10

Stantec Consulting Services Inc.

R 0	05/27/10	PC	RP	PC	RLR	RLR	RLR	TJ

RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION F

P. COOPER | B. PETTY | P. COOPER | R. ROBERTS | R. ROBERTS | R. ROBERTS | T. JOHNSON

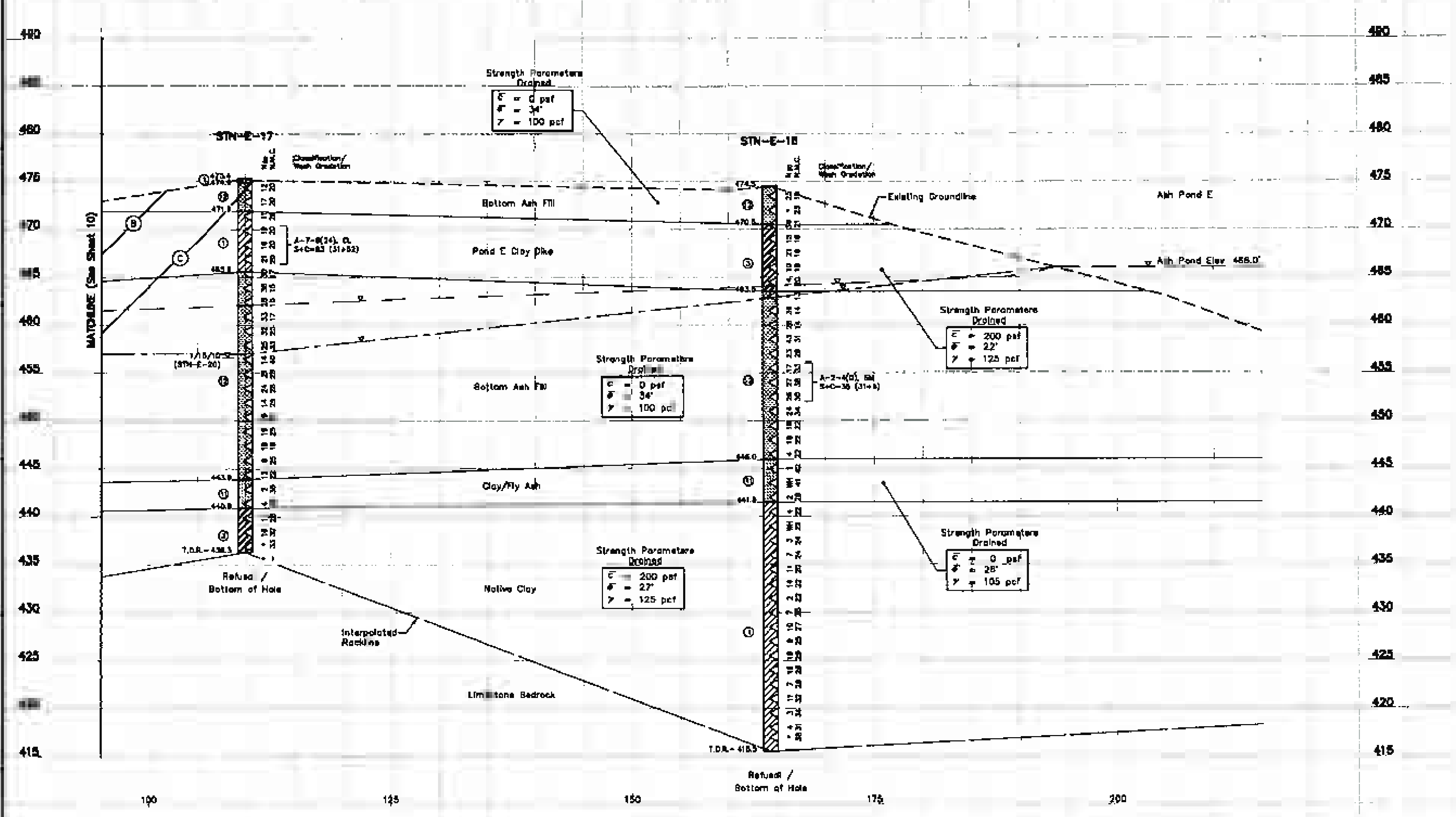
GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 05/27/10 | 39 | C | 10W504-09 | R 0

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY:	REV NO.



LEGEND

- ① ▨ Lean Clay, Sandy Lean Clay, Lean Clay With Sand
- ② ▨ Silty, Clayey Sand
- ③ ▨ Fat Clay, Fat Clay With Sand
- ④ ▩ Overburden
- ⑤ ▩ Silty Clay
- ⑥ ☐ Poorly Graded Sand
- ⑦ ▥ Silty Sand
- ⑧ ▥ Silt, Sandy Silt, Silt With Sand
- ⑨ ▤ Limestone
- ⑩ ▥ Well Graded Sand With Silt
- ⑪ ▦ Fly Ash
- ⑫ ▦ Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin Walled (Shelby) Tube Sample
N_{SH}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{AH}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
—— ▽ ——	Phreatic Surface From Pz Data
—— ▽ ——	Phreatic Surface From Seepage Model
T.O.R.-	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.-	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log

RECORD DRAWING

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Location	STN-E-18S		
Depth	5.0'-5.5'	5.6'-6.1'	7.7'-8.2'
$\bar{\phi}$	22.0°		
$\bar{c}$	340 p.s.f.		
Location	STN-E-18S		
Depth	33.0'-33.5'	33.6'-34.1'	34.2'-34.7'
$\bar{\phi}$	34.3°		
$\bar{c}$	160 p.s.f.		

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-E-18S	474.5'	58.0'	N/A	5.0'-7.0', 7.0'-9.0' 9.0'-11.0', 29.0'-31.0' 31.0'-33.0', 33.0'-35.0' 36.0'-38.0', 40.0'-42.0' 44.0'-46.0', 48.0'-50.0' 52.0'-54.0', 54.0'-56.0'
STN-E-18S	461.8'	20.0'	10.0'-20.0'	N/A

SUMMARY OF STABILITY ANALYSES
STATIC CONDITION

Failure Surface	Failure Mode	Failure Type	Factor of Safety
A	Circular Optimized With Phreatic Surface From Seepage Model	Non-Global	1.1
B	Circular Optimized With Phreatic Surface From Seepage Model	Global	2.0
C	Noncircular Optimized With Phreatic Surface From Seepage Model	Global	2.0

For Supporting Design Calculations see FPGGAFFESCDX000002010000I

5/27/10

Stantec
Stantec Consulting Services Inc.

SCALE: 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX
GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION F

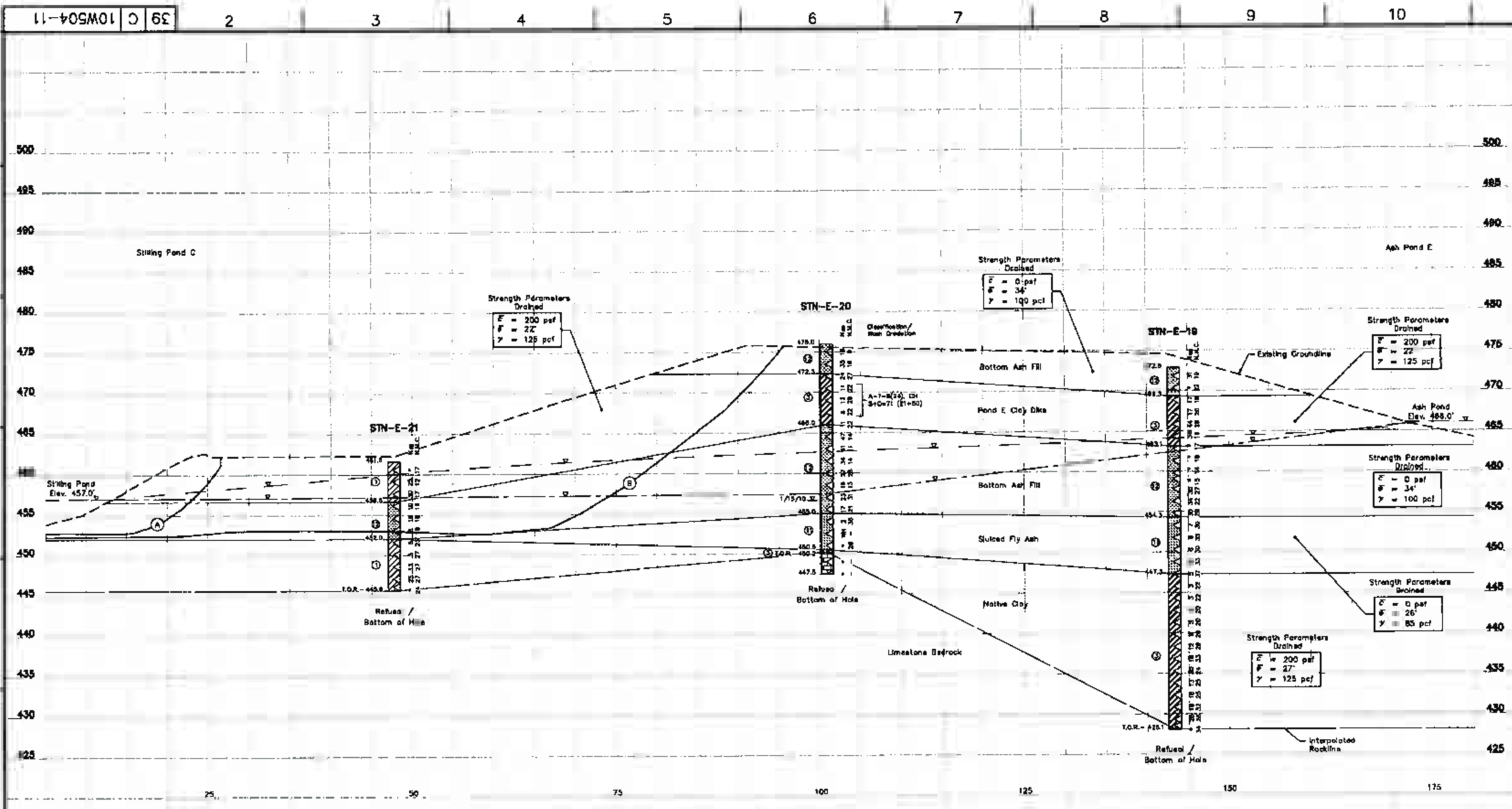
GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 39 | C | 10W504-10 | R 0

PLOT FACTOR XX
W TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC | D
TASK COMPLETED BY: | REV NO



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▩	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▦	Fly Ash
⑫	▩	Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{SH}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{AH}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
—— ▽	Phreatic Surface From Pz Data
—· ▽	Phreatic Surface From Seepage Model
T.O.R. –	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C. –	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Location	STN-E-20S		
Depth	4.0'-4.5'	6.0'-6.5'	6.6'-7.1'
$\bar{\phi}$	25.5°		
$\bar{c}$	460 p.s.f.		
Location	STN-E-21S		
Depth	13.0'-13.5'	11.0-11.5'	11.6'-12.1'
$\bar{\phi}$	34.1°		
$\bar{c}$	260 p.s.f.		

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-E-20S	476.0'	25.0'	N/A	4.0'-6.0', 6.0'-8.0' 21.0'-23.0', 23.0'-25.0'
STN-E-21S	481.8'	15.0'	N/A	5.0'-7.0', 7.0'-9.0' 9.0'-11.0', 11.0'-13.0' 13.0'-15.0'

SUMMARY OF STABILITY ANALYSES STATIC CONDITION

Failure Surface	Failure Mode	Failure Type	Factor of Safety
A	Circular Optimized With Phreatic Surface from Seepage Model	Non Global	1.5
B	Noncircular Optimized With Phreatic Surface from Seepage Model	Global	2.2

For Supporting Design Calculations see FPGGAFFESQDX000000020100001

5/27/10

Stantec Consulting Services Inc.

SCALE: 1" = 5' EXCEP AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION G

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

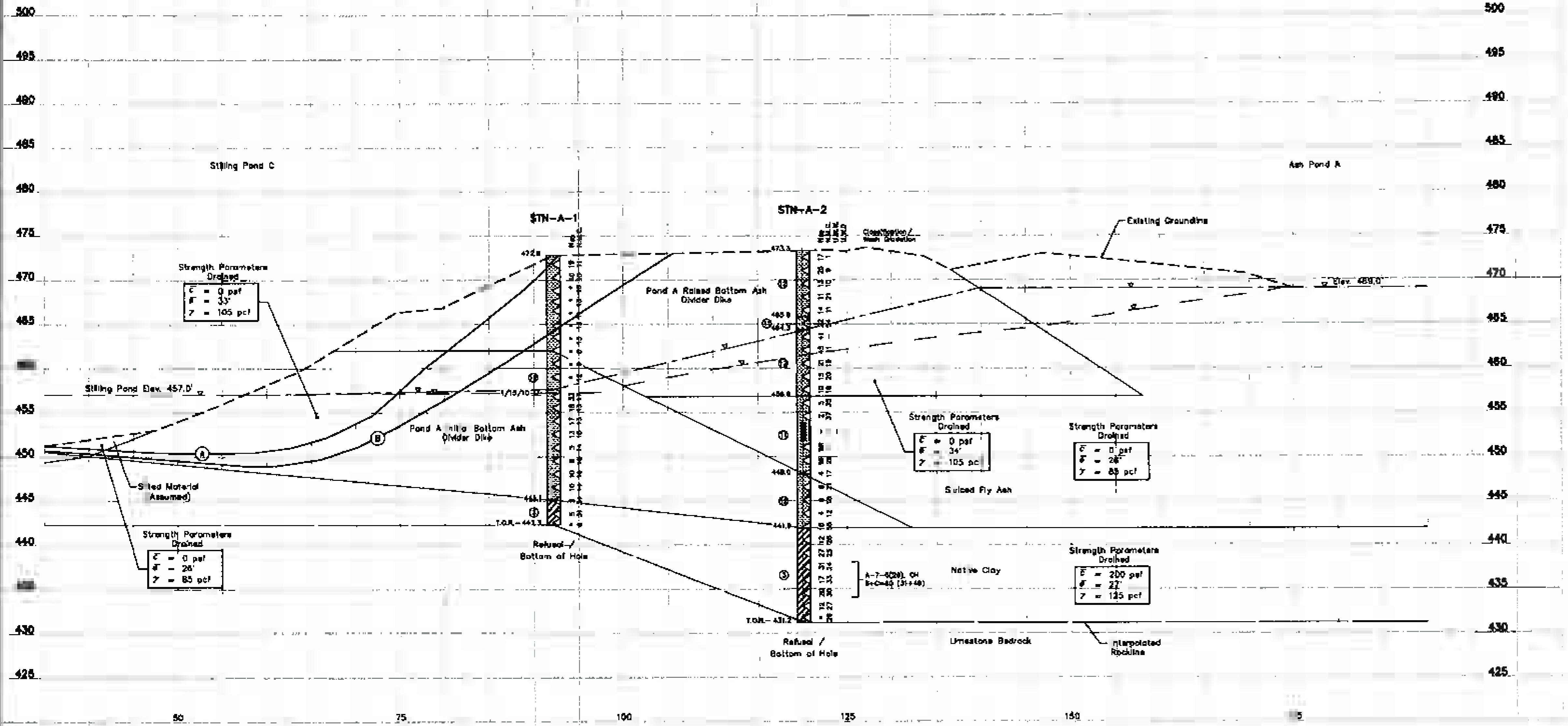
AUTOCAD R 2000 | 39 | C | 10W504-11 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
© TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

39 C 10W504-12



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▦	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▦	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▦	Fly Ash
⑫	▩	Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
●	Undisturbed Thin-Walled (Shelby) Tube Sample
N₆₀	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N₆₀	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/08 ▽	Water Level and Date Recorded
▽ ——	Phreatic Surface From Pz Data
—— ▽ ——	Phreatic Surface From Seepage Model
T.O.R.–	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.–	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

SUMMARY OF STABILITY ANALYSES STATIC CONDITION

Failure Surface	Failure Mode	Failure Type	Factor of Safety
A	Circular Optimized With Phreatic Surface From Seepage Model	Non-Global	1.4
B	Circular Optimized With Phreatic Surface From Seepage Model	Global	1.5

For Supporting Design Calculations see FPGGAFFESCDX000000020100001

5/27/10

Stantec Consulting Services Inc.

R 0 05/27/10 PC RP PC RLR RLR RLR TJ

RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION H

P. COOPER | R. POTTS | P. COOPER | R. ROBERTS | R. ROBERTS | R. ROBERTS | T. JOHNSON

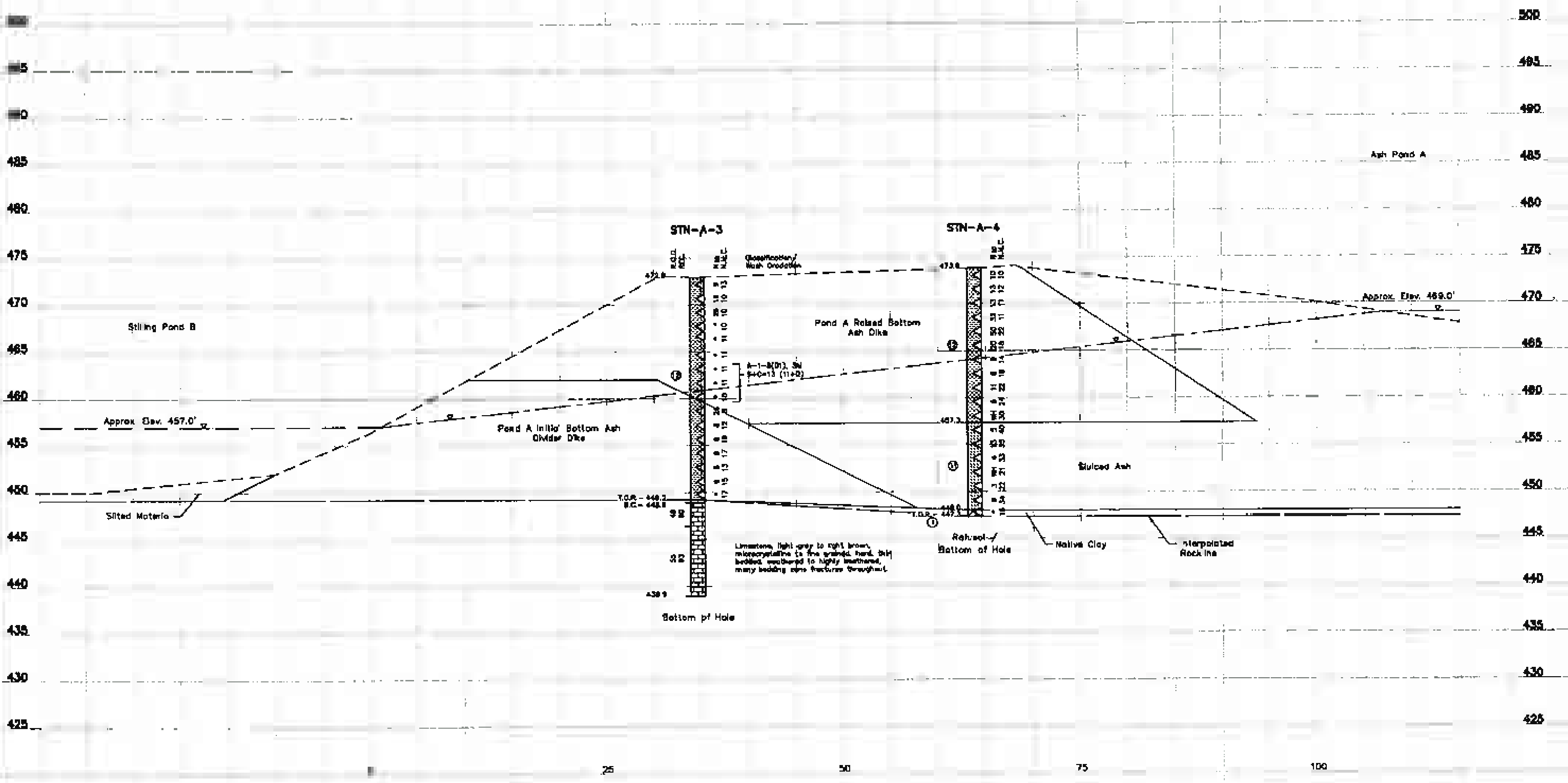
GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 05/27/10 | 39 | C | 10W504-12 | R 0

STANTEC	0
TASK COMPLETED BY:	REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▦	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▦	Fly Ash
⑫	▩	Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
▪	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{60}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
—▽—	Phreatic Surface From Pz Data
—▽—	Phreatic Surface From Seepage Model
T.O.R.	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-A-4S	473.6'	26.0'	N/A	6.0'-8.0', 16.5'-18.5' 20.0'-22.0', 23.5'-25.5'

For Supporting Design Calculations see FPGCAFFESCDX000002010000I

5/27/10

Stantec Consulting Services Inc.

R 0 | 05/27/10 | PC | RP | PC | RLR | RLR | RLR | TJ

RECORD DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX
GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION I

P. COOPER | A. PETTY | P. COOPER | R. ROBERTS | R. ROBERTS | R. ROBERTS | T. JOHNSON

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

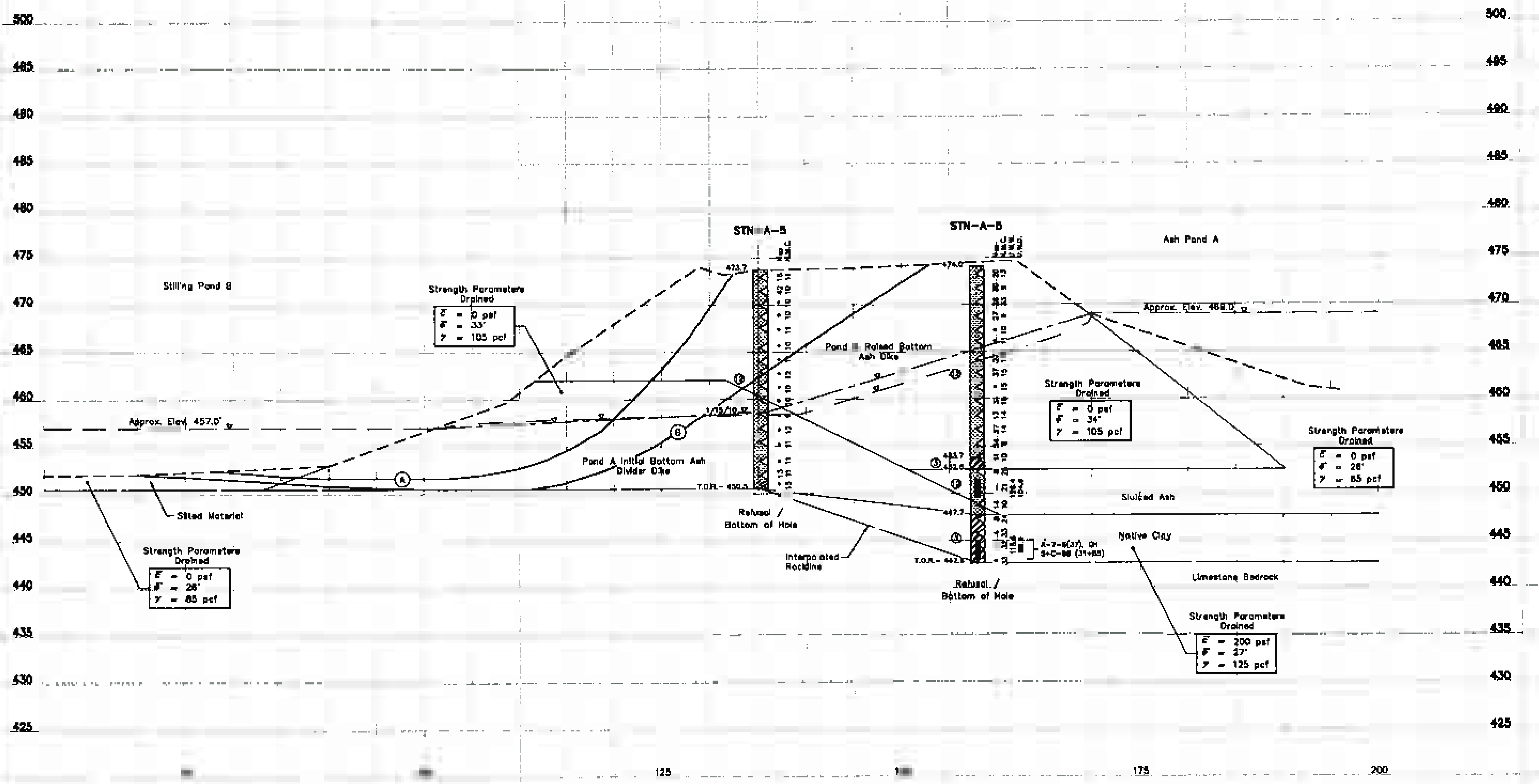
AUTOCAD R 2 | 05/27/10 | 39 | C | 10W504-13 | R 0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR:XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

39 C 10W504-14



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▦	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▦	Fly Ash
⑫	▩	Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin Walled (Shelby) Tube Sample
N_{SH}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{AH}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
—— ▽ ——	Phreatic Surface From Pz Data
—— ▽ ——	Phreatic Surface From Seepage Model
T.O.R. –	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.–	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586 99 Refer To Typed Boring Log.

RECORD DRAWING

SUMMARY OF STABILITY ANALYSES STATIC CONDITION

Failure Surface	Failure Mode	Failure Type	Factor of Safety
A	Circular Optimized With Phreatic Surface from Seepage Model	Non-Global	1.2
B	Circular Optimized With Phreatic Surface from Seepage Model	Global	1.5

For Supporting Design Calculations see FPGGAFFESCDX00000020100001

5/27/10

Stantec Consulting Services Inc.

R 0 05/27/10 RC RP RC R.R RLR RLR TJ

DRAWING

SCALE: 1"=5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION J

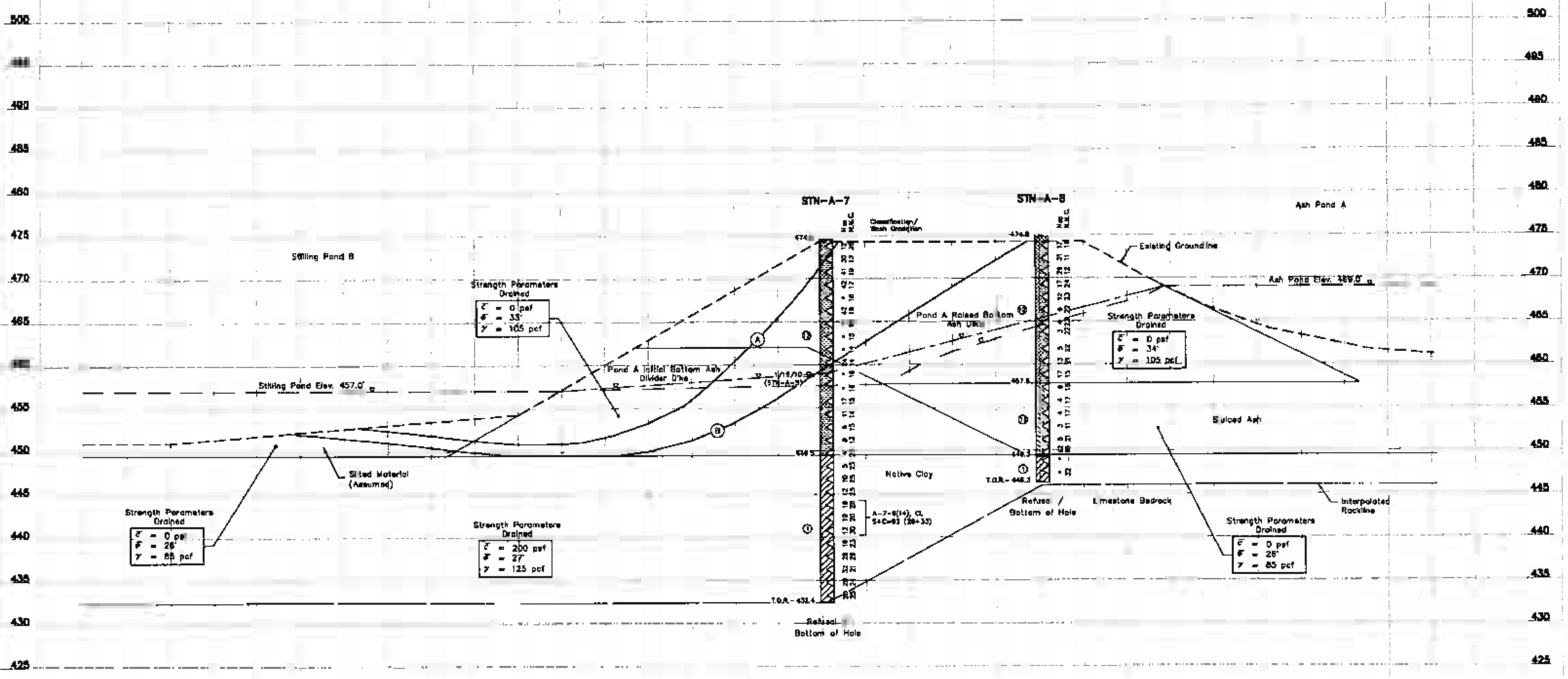
GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 39 | C | 10W504-14 | R 0

PLOT FACTOR:XX
W TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY	REV NO



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▩	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▦	Fly Ash
⑫	▩	Bottom Ash

WH Weight of Hammer
WR Weight of Rods
◁ Standard Penetration Test Interval
■ Undisturbed Thin-Walled (Shelby) Tube Sample
N_{SS} Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{60} Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C. Natural Moisture Content (%)
U.W.W. Unit Weight Wet (lbs./cu.ft.)
U.W.D. Unit Weight Dry (lbs./cu.ft.)
U.C./U.U. Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽ Water Level and Date Recorded
▽ — — Phreatic Surface From Pz Data
▽ —— Phreatic Surface From Seepage Model
T.O.R. – Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers.This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C. – Begin Rock Core
R.Q.D. Rock Quality Designation (%)
REC. Recovery (%)
Refusal Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal No Refusal Encountered
* Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

SUMMARY OF OFFSET BORINGS				
BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN A 8S	474.8'	22.0'	N/A	5.0'-7.0', 10.0'-12.0' 15.0'-17.0', 20.0'-22.0'

SUMMARY OF STABILITY ANALYSES STATIC CONDITION			
Failure Surface	Failure Mode	Failure Type	Factor of Safety
A	Circular Optimized With Phreatic Surface From Seepage Model	Non-Global	1.2
B	Circular Optimized With Phreatic Surface From Seepage Model	Global	1.5

For Supporting Design Calculations see FPGGAFFESCDX000000020100001

5/21/10

Stantec Consulting Services Inc.

SCALE: 1" = 5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION K

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

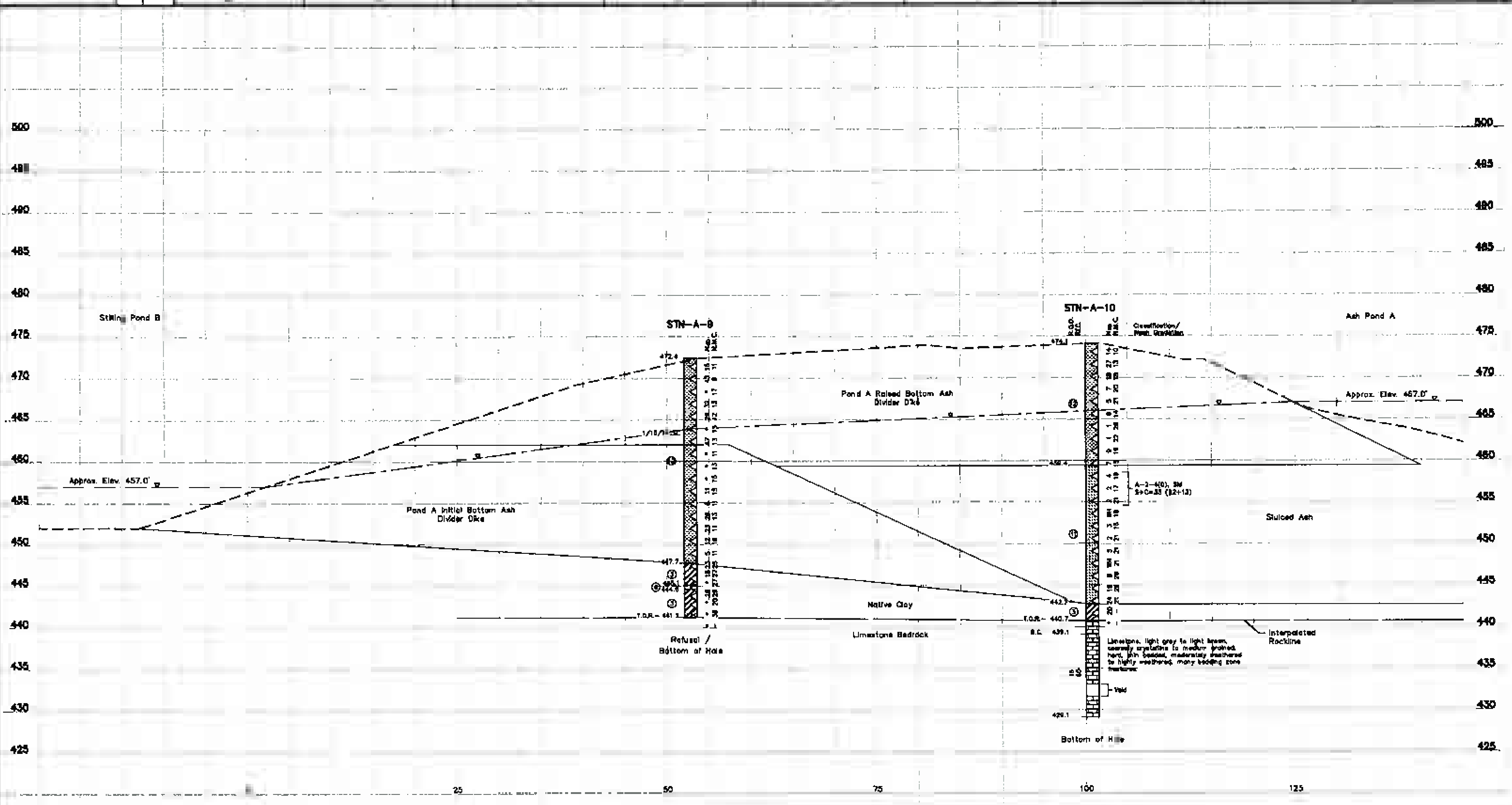
AUTOCAD R 2 | 39 | C | 10W504-15 | R 0

PLOT FACTOR XX
W_TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY	REV NO.

39 C 10W504-16



LEGEND

- ① ▨ Lean Clay, Sandy Lean Clay, Lean Clay With Sand
- ② ▨ Silty, Clayey Sand
- ③ ▨ Fat Clay, Fat Clay With Sand
- ④ ▩ Overburden
- ⑤ ▦ Silty Clay
- ⑥ ☐ Poorly Graded Sand
- ⑦ ▦ Silty Sand
- ⑧ ▥ Silt, Sandy Silt, Silt With Sand
- ⑨ ▤ Limestone
- ⑩ ▦ Well Graded Sand With Silt
- ⑪ ▦ Fly Ash
- ⑫ ▦ Bottom Ash

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{80}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
— ▽ —	Phreatic Surface From Pz Data
— ▼ —	Phreatic Surface From Seepage Model
T.O.R.–	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.–	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-A-9S	472.4'	25.0'	14.0'-24.0'	N/A

For Supporting Design Calculations see FPG0AFFESCDX00000020100001

SANDY LEE ROBERTS
5/27/10

Stantec Consulting Services Inc.

R0	05/27/10	PC	RP	PC	RLR	RLR	RLR	TJ	–	–

RECORD DRAWING

SCALE: 1"=5' EXCEP AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION L

P. COOPER	R. PETTY	P. COOPER	R. ROBERTS	R. ROBERTS	R. ROBERTS	T. JOHNSON

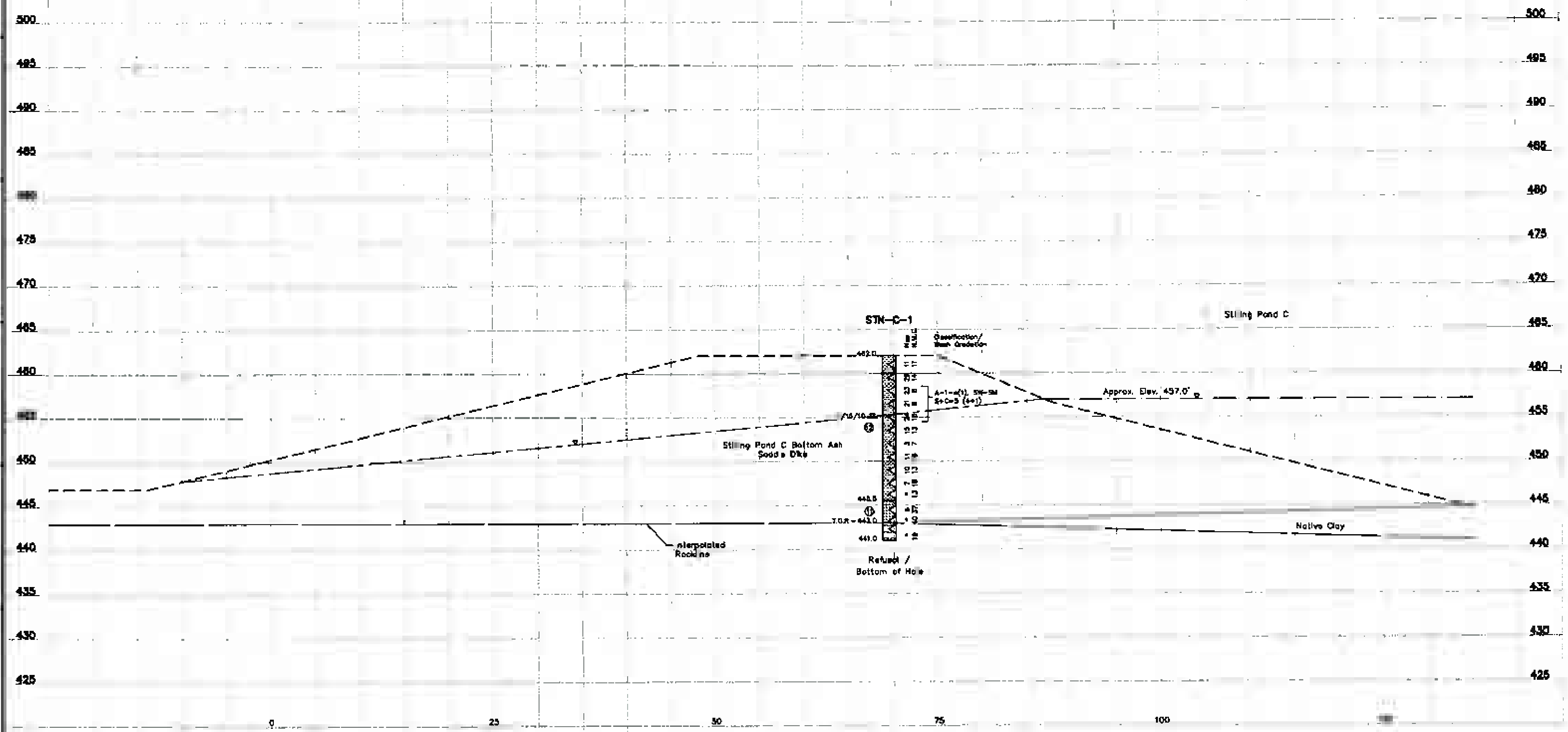
GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 05/27/10 | 39 | C | 10W504-16 | R0

STANTEC | 0
TASK COMPLETED BY: | REV NO.

PLOT FACTOR.XX
W_TVA

CAD DRAWING
DO NOT ALTER MANUALLY



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▩	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▤	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▦	Fly Ash
⑫	▦	Bottom Ash
	▤	Shale

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{60}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{60}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
—— ▽ ——	Phreatic Surface From Pz Data
—— ▽ ——	Phreatic Surface from Seepage Model
T.O.R.-	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers.This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586 99. Refer To Typed Boring Log.

RECORD DRAWING

For Supporting Design Calculations see FPGGAFFESCDX00000020100001

5/27/10

Stantec Consulting Services Inc.

SCALE: 1"=5' EXCEPT AS NO

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION M

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

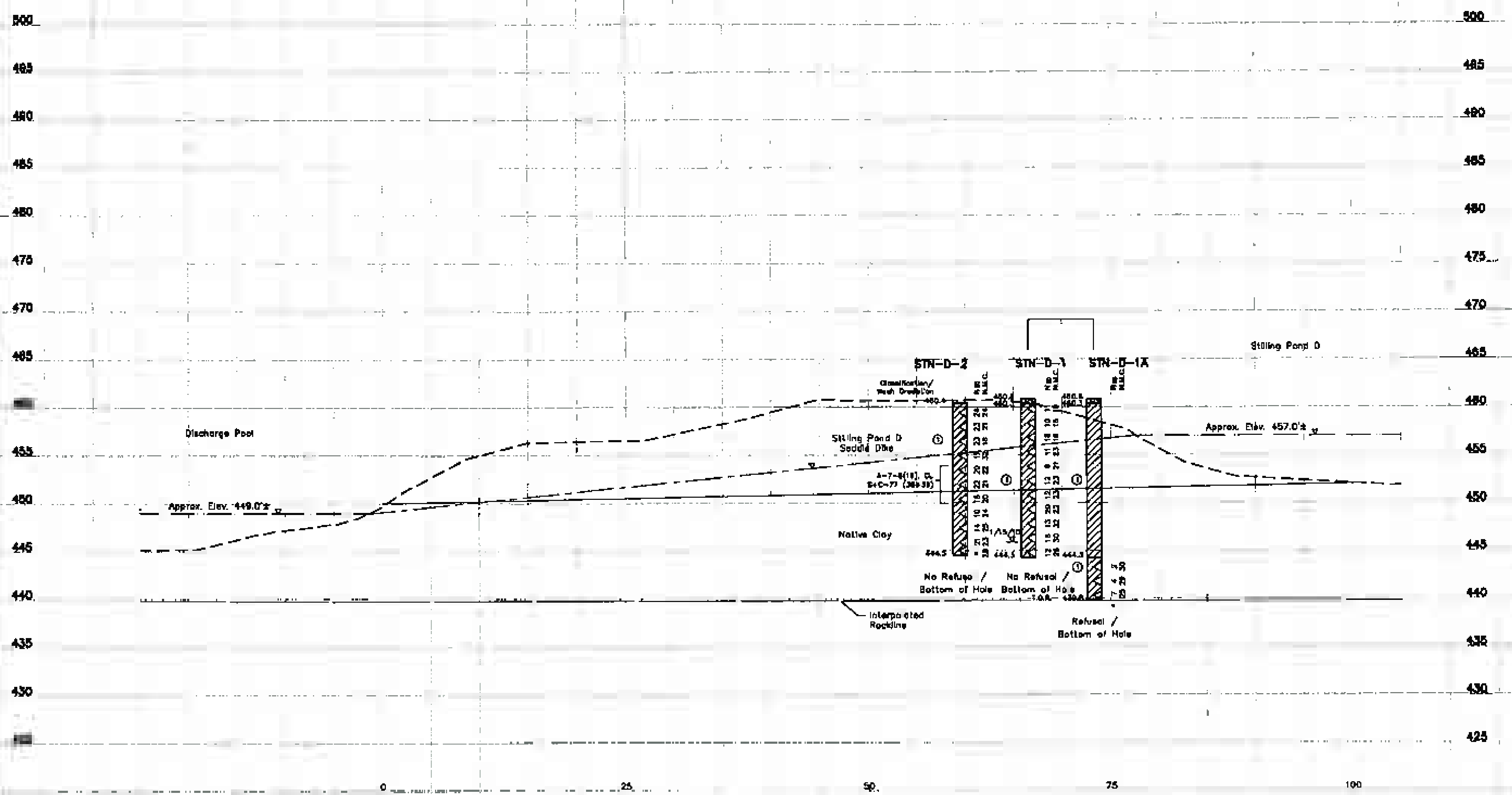
AUTOCAD R 2000 | 39 | C | 10W504-17 | R 0

PLOT FACTOR XX
W TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC | 0
TASK COMPLETED BY: | REV NO.

39 | C | 10W504-18



LEGEND

①	▨	Lean Clay, Sandy Lean Clay, Lean Clay With Sand
②	▨	Silty, Clayey Sand
③	▨	Fat Clay, Fat Clay With Sand
④	▩	Overburden
⑤	▩	Silty Clay
⑥	☐	Poorly Graded Sand
⑦	▥	Silty Sand
⑧	▥	Silt, Sandy Silt, Silt With Sand
⑨	▦	Limestone
⑩	▥	Well Graded Sand With Silt
⑪	▦	Fly Ash
⑫	▩	Bottom Ash
	▤	Shale

WH	Weight of Hammer
WR	Weight of Rods
◁	Standard Penetration Test Interval
■	Undisturbed Thin-Walled (Shelby) Tube Sample
N_{sm}	Standard Penetration Test Blow Count with a 140 lb Safety Hammer (blows/ft.)
N_{60}	Standard Penetration Test Blow Count with a 140 lb Automatic Hammer (blows/ft.)
N.M.C.	Natural Moisture Content (%)
U.W.W.	Unit Weight Wet (lbs./cu.ft.)
U.W.D.	Unit Weight Dry (lbs./cu.ft.)
U.C./U.U.	Unconfined Compressive Strength (psf)/ Unconsolidated Undrained Triaxial Test (psf)
03/31/09 ▽	Water Level and Date Recorded
— ▽ — - -	Phreatic Surface From Pz Data
— - ▽ ——	Phreatic Surface From Seepage Model
T.O.R.–	Top Of Rock (Indicates The Beginning Of Rock-like Resistance To The Advancement Of The Augers. This May Indicate The Beginning Of Weathered Bedrock, Boulders Or Rock Remnants. An Exact Determination Cannot Be Made Without Performing Rock Coring.)
B.C.–	Begin Rock Core
R.Q.D.	Rock Quality Designation (%)
REC.	Recovery (%)
Refusal	Auger Refusal Using A Carbide-Tipped Tooth Auger Bit
No Refusal	No Refusal Encountered
*	Standard Penetration Test (SPT) terminated per ASTM D 1586-99. Refer To Typed Boring Log.

RECORD DRAWING

CONSOLIDATED UNDRAINED TRIAXIAL TEST RESULTS

Location	STN-D-1S		
Depth	6.0'-6.5'	2.0-2.5'	2.6'-3.1'
$\bar{\phi}$	23.3°		
$\bar{c}$	840 p.s.f.		

SUMMARY OF OFFSET BORINGS

BORING NO.	SURFACE ELEV.	BOTTOM OF HOLE DEPTH	PIEZOMETER SCREENED INTERVAL	UNDISTURBED "SHELBY" TUBE SAMPLE INTERVALS
STN-D-1A	460.8'	21.0'	11.0'-21.0'	N/A
STN-D-1S	460.8'	14.0'	N/A	2.0'-4.0', 6.0'-8.0' 10.0'-12.0', 14.0'-16.0'
STN-D-2S	460.4'	12.0'	N/A	4.0'-6.0', 6.0'-8.0' 10.0'-12.0'

For Supporting Design Calculations see FPOGAFFESCDX00000020100001

5/27/10

Stantec Consulting Services Inc.

R 0 | 05/27/10 | PC | RP | PC | RLR | RLR | RLR | TJ

RECORD DRAWING

SCALE 1" = 5' EXCEPT AS NOTED

YARD
ASH POND/STILLING POND COMPLEX

GEOTECHNICAL EXPLORATION
STABILITY SECTION
CROSS-SECTION N

P. COOPER | R. PETTY | P. COOPER | R. ROBERTS | R. ROBERTS | R. ROBERTS | T. JOHNSON

GALLATIN FOSSIL PLANT
TENNESSEE VALLEY AUTHORITY
FOSSIL AND HYDRO ENGINEERING

AUTOCAD R 2000 | 05/27/10 | 39 | C | 10W504-18 | R 0

PLOT FACTOR:XX
W TVA

C.A.D. DRAWING
DO NOT ALTER MANUALLY

STANTEC	0
TASK COMPLETED BY	REV NO.

Appendix F

Seepage Analyses Results

Seepage Analysis
Section B
Ash Ponds A and E

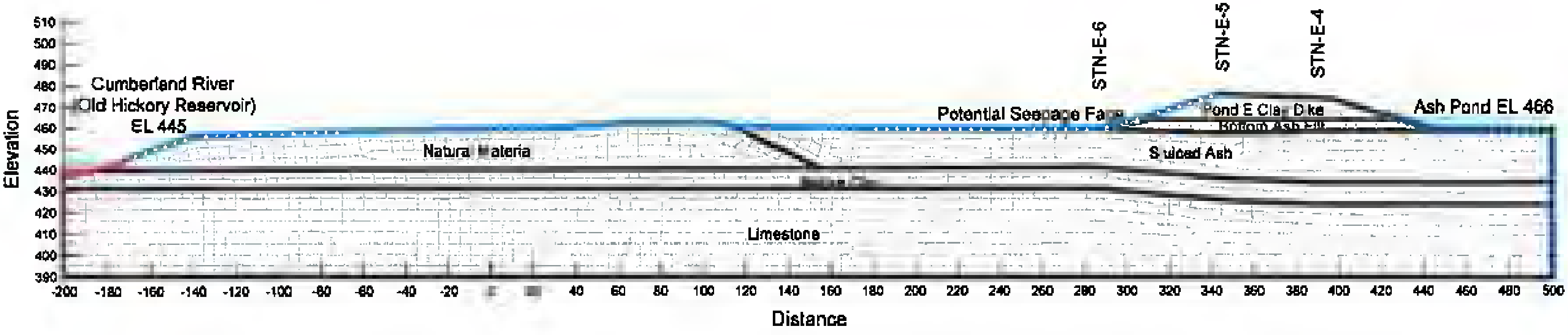
Gallatin Fossil Plant
Tennessee Valley Authority

Boundary Conditions with Mesh

January 2010
Method: Steady-State
File Name: GAF_Section_B.gsz

Material Type	Ksat	Kratio	Wsat
Pond E Clay Dike	1.64e-008	0 2	0.25
Bottom Ash Fill	3.28e-005	1	0.15
Sluiced Ash	9.84e-006	0.03	0.4
Native Clay	6.56e-008	0.05	0.4
Limestone	0.000328	0.1	0.15
Natural Material	0.001	0.03	0.5

Note.
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil [illegible]es. No warranties can be made regarding the continuity of subsurface conditions between the borings.



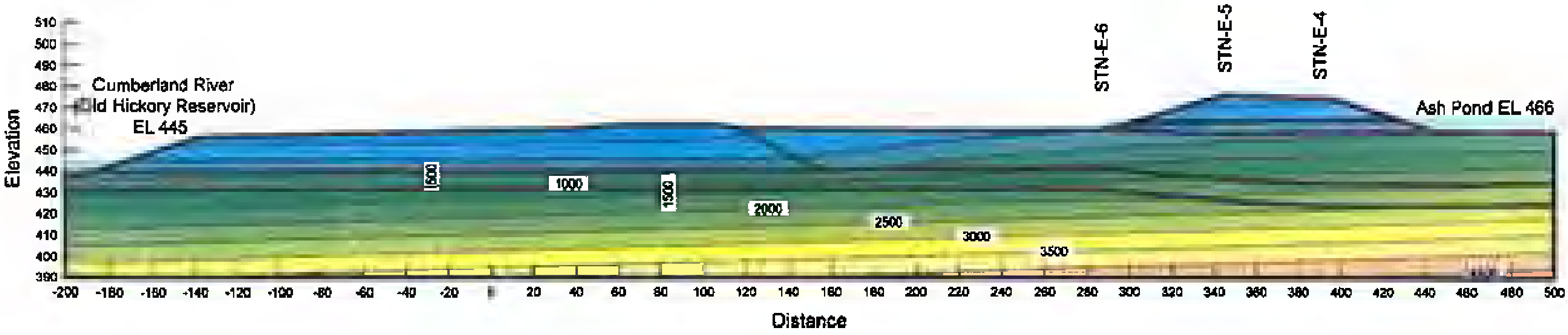
Seepage Analysis
Section B
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Pore Water Pressure (psf)

January 2010
Method: Steady-State
File Name: GAF_Section_B.gsz

Note.
The results of analysis shown here are based on available subsurface information, laboratory test results and [redacted] soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



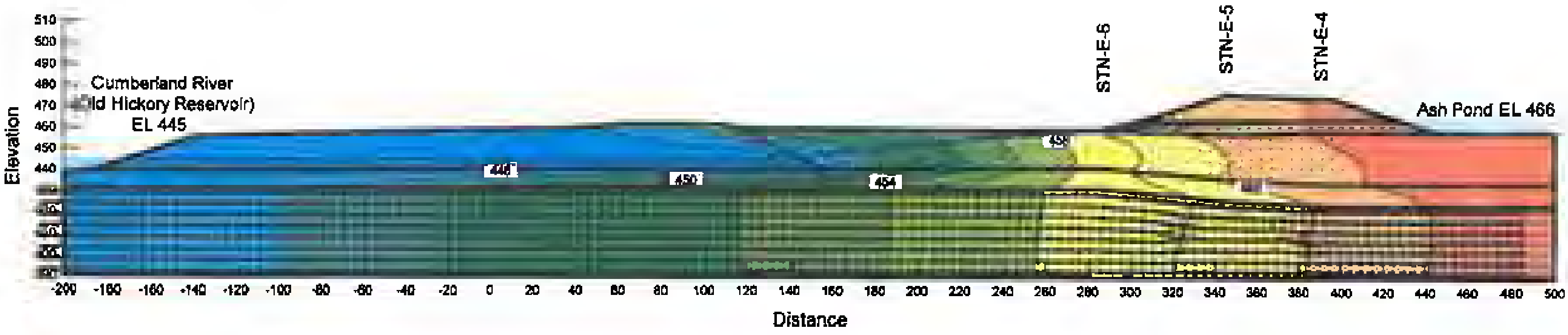
Seepage Analysis
Section B
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Total Head with Flow Vectors

January 2010
Method: Steady-State
File Name: GAF_Section_B.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings



Seepage Analysis
Section B
Ash Ponds A and E

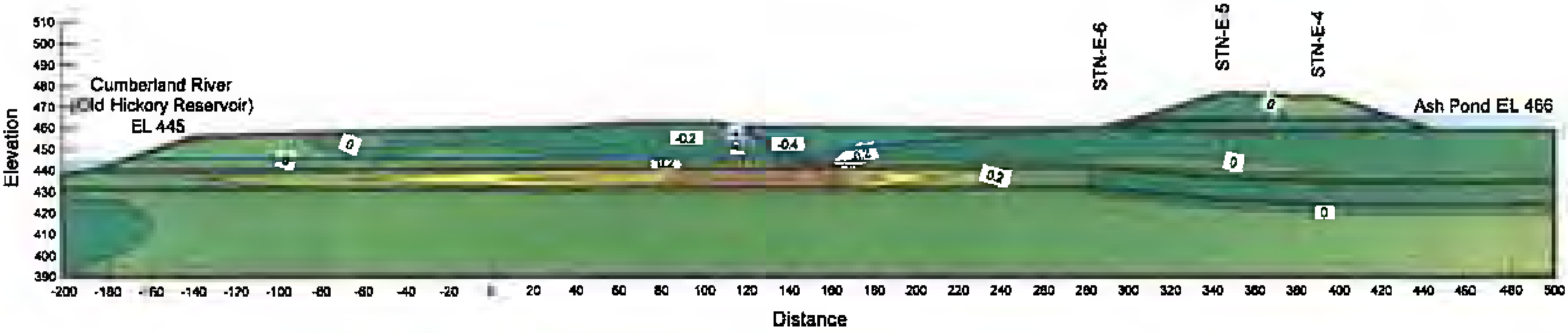
Gallatin Fossil Plant
Tennessee Valley Authority

Vertical Gradient

Critical exit gradient not identified by model.
FS(piping) >3.

January 2010
Method. Steady-State
File Name: GAF_Section_B.gsz

Note:
The results of analysis shown here are based on available [illegible] information laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section C
Ash Ponds A and E

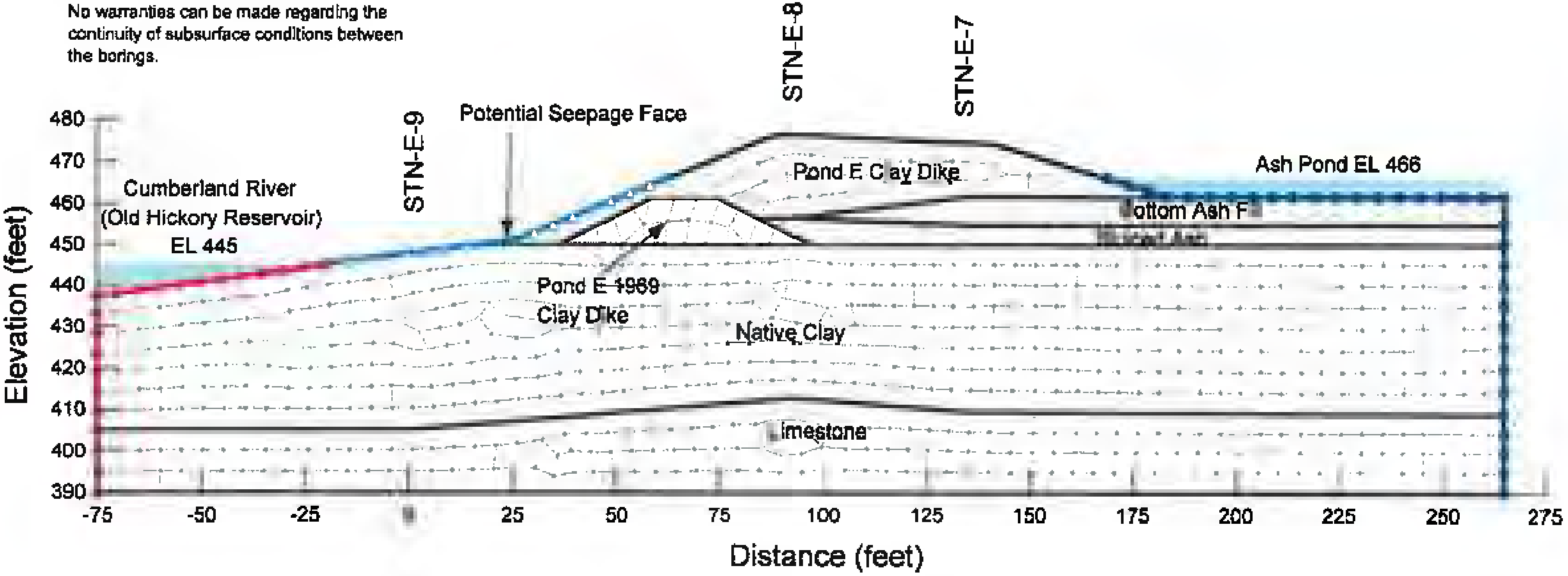
Gallatin Fossil Plant
Tennessee Valley Authority

Boundary Conditions with Mesh

January 2010
Method: Steady-State
File Name: GAF_Section_C.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Ksat	Kratio	Wsat
Pond E Clay Dike	3.28e-009	1	0.25
Pond E 1969 Clay Dike	3.28e-009	1	0.25
Bottom Ash Fill	3.28e-005	1	0.15
Sluiced Ash	9.84e-006	0.03	0.4
Native Clay	3.28e-007	0.1	0.4
Limestone	0.000328	0.1	0.15



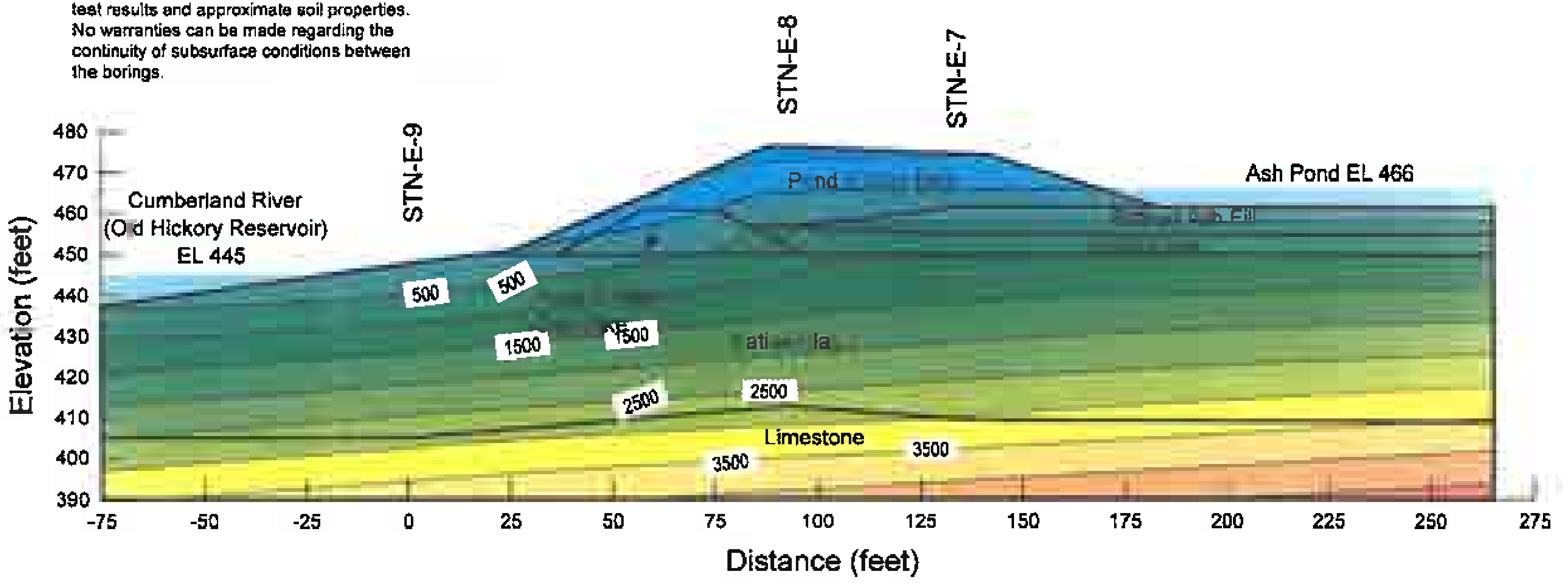
Seepage Analysis
Section C
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Pore Water Pressure (psf)

January 2010
Method: Steady-State
File Name: GAF_Section_C.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



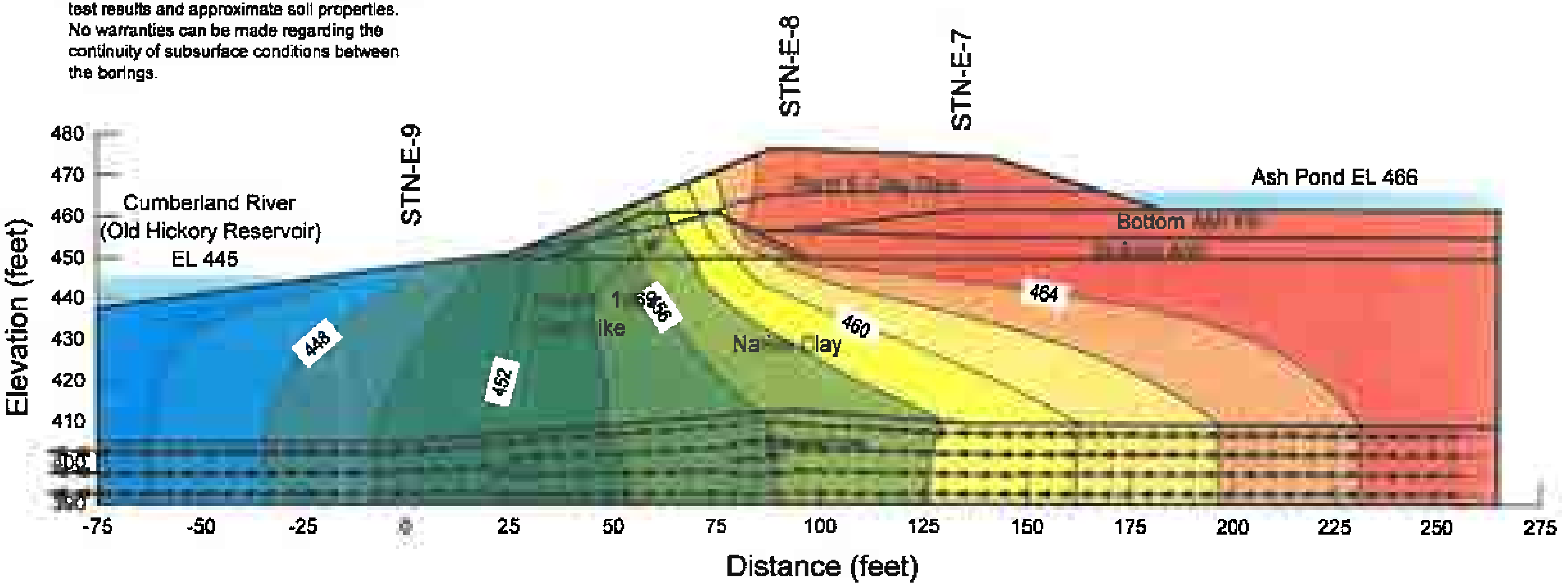
Seepage Analysis
Section C
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Total Head with Flow Vectors

January 2010
Method: Steady-State
File Name: GAF_Section_C.gsz

Note:
The results of analysis shown here are based on available subsurface information laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section C
Ash Ponds A and E

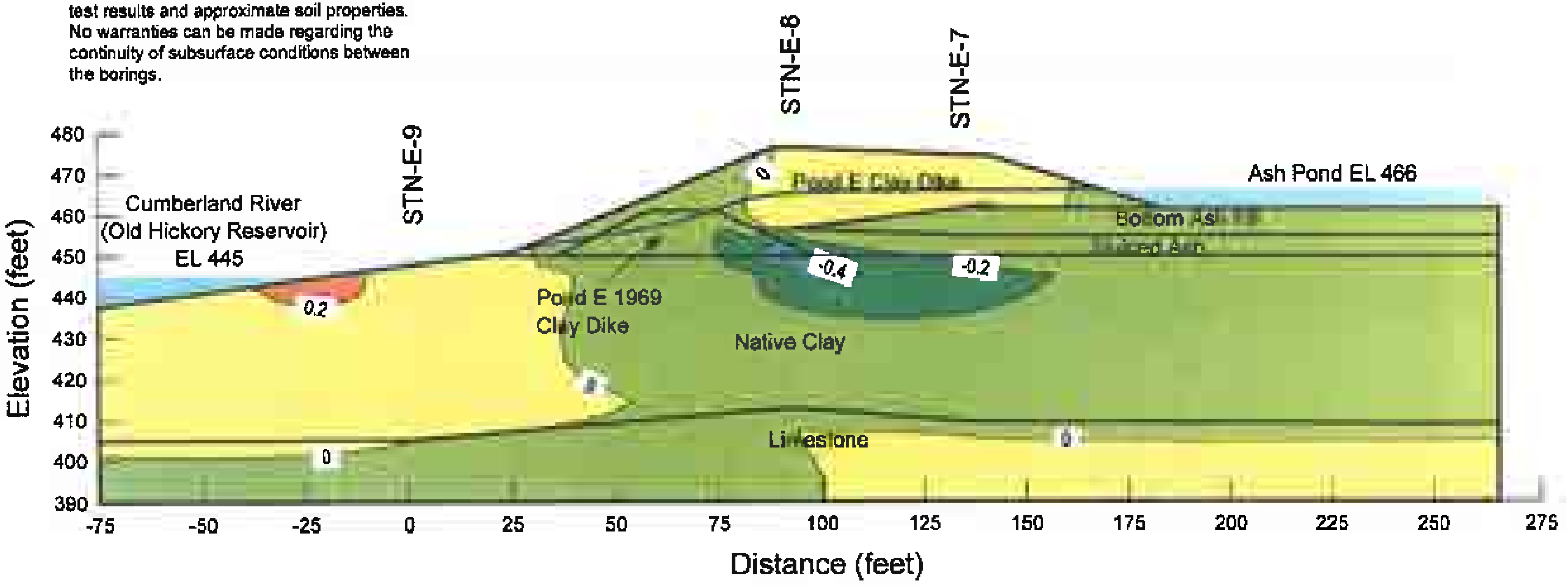
Gallatin Fossil Plant
Tennessee Valley Authority

Vertical Gradient

Piping Potential
Maximum occurs at (-19.9, 445)
Total Head = 445 ft
At (-19.3, 440.0)
Total Head = 446.77 ft
dH = 1.77 ft dL = 5.04
i = 0.35 i(criticial) = 1.05
FSpiping = 3.0

January 2010
Method: Steady-State
File Name: GAF_Section_C.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section D
Ash Ponds A and E

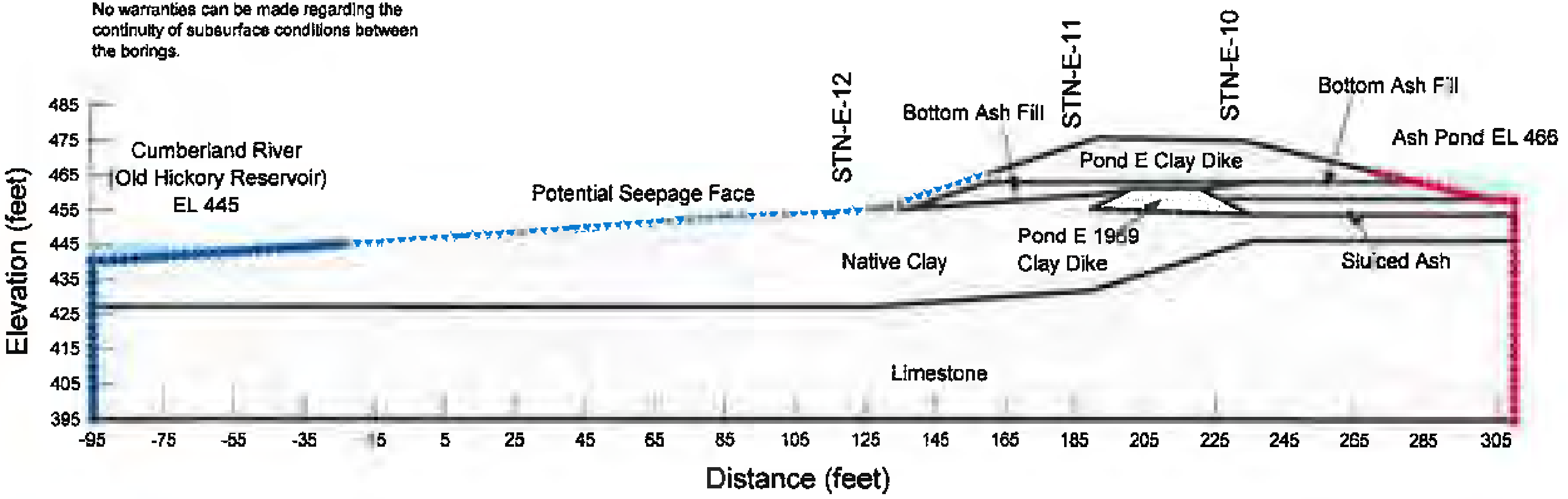
Gallatin Fossil Plant
Tennessee Valley Authority

Boundary Conditions with Mesh

January 2010
Method: Steady-State
File Name: GAF_Section_D.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Ksat	Kratio	Wsat
Pond E Clay Dike	1.64e-008	0.2	0.25
Pond E 1969 Clay Dike	1.64e-008	0.2	0.25
Bottom Ash Fill	3.28e-006	1	0.15
Sluiced Ash	9.84e-006	0.033	0.4
Native Clay	3.28e-007	0.1	0.4
Limestone	0.000328	0.1	0.15



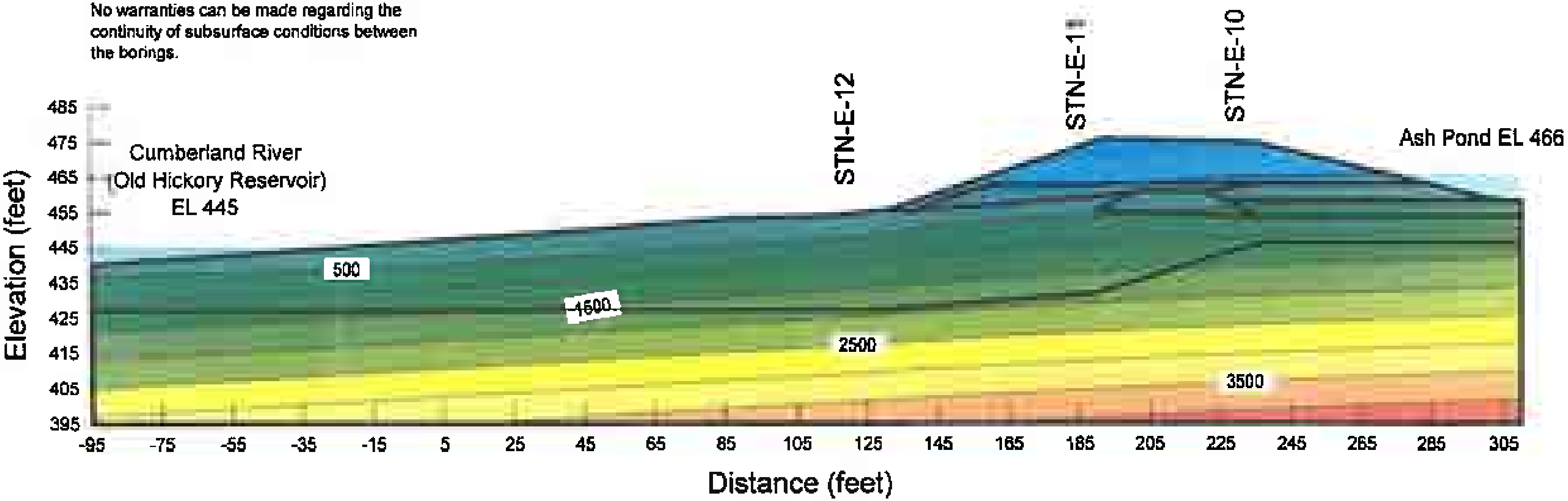
Seepage Analysis
Section D
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Pore Water Pressure (psf)

January 2010
Method: Steady-State
File Name: GAF_Section_D.gsz

Note:
The results of analysis shown here are based on available subsurface informat on, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



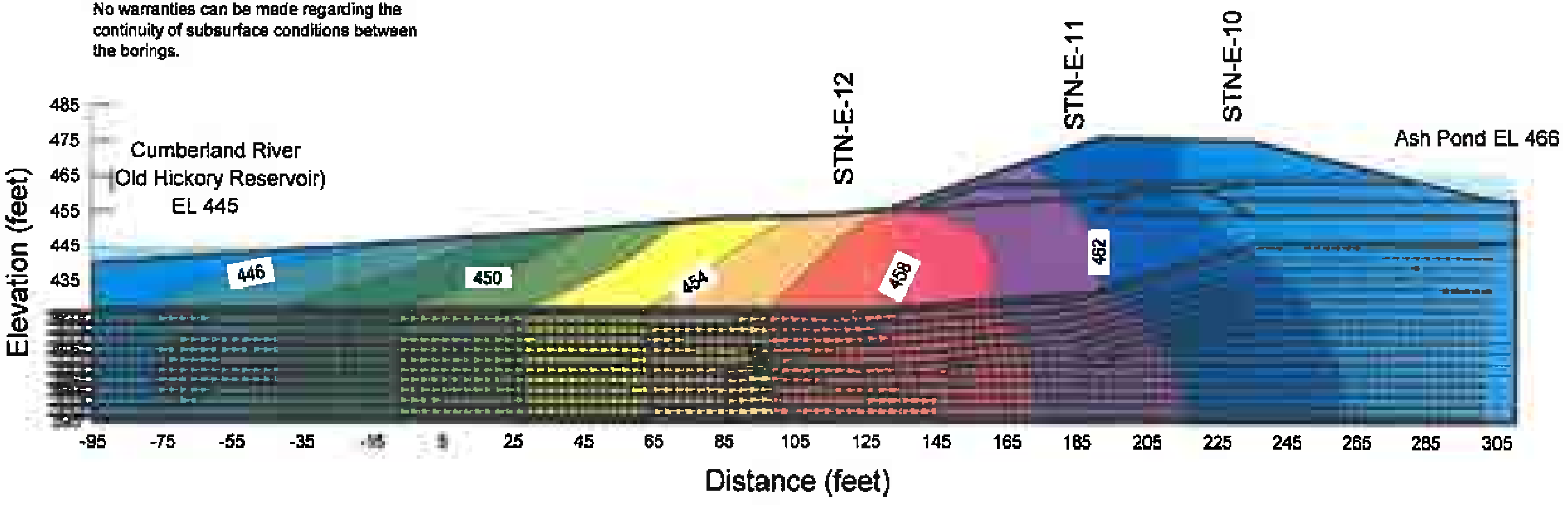
Seepage Analysis
Section D
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Total Head with Flow Vectors

January 2010
Method: Steady-State
File Name: GAF_Section_D.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section D
Ash Ponds A and E

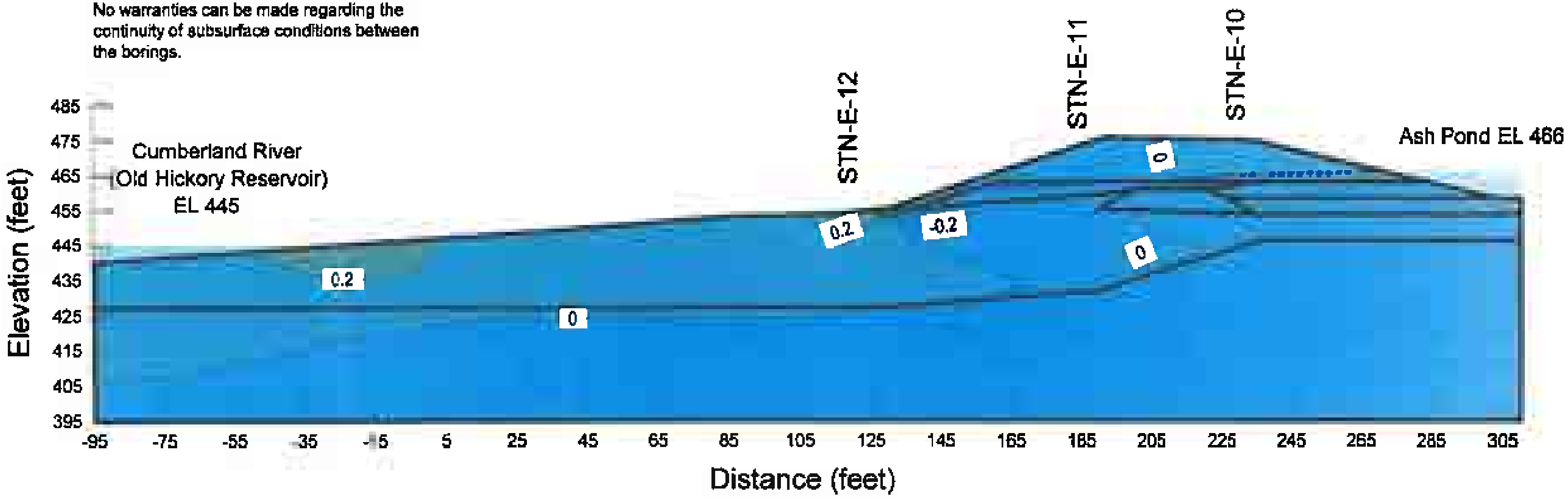
Gallatin Fossil Plant
Tennessee Valley Authority

Vertical Gradient

Piping Potential
  Maximum occurs at (130.6, 455.52)
  Total Head = 455.52 ft
  At (131.36, 449.09)
  Total Head = 457.39 ft
  dH = 1.87 ft   dL = 6.47
  i = 0.289   i(criticial) = 1.01
  FSpiping = 3.5

January 2010
Method: Steady-State
File Name: GAF_Section_D.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section F
Ash Ponds A and E

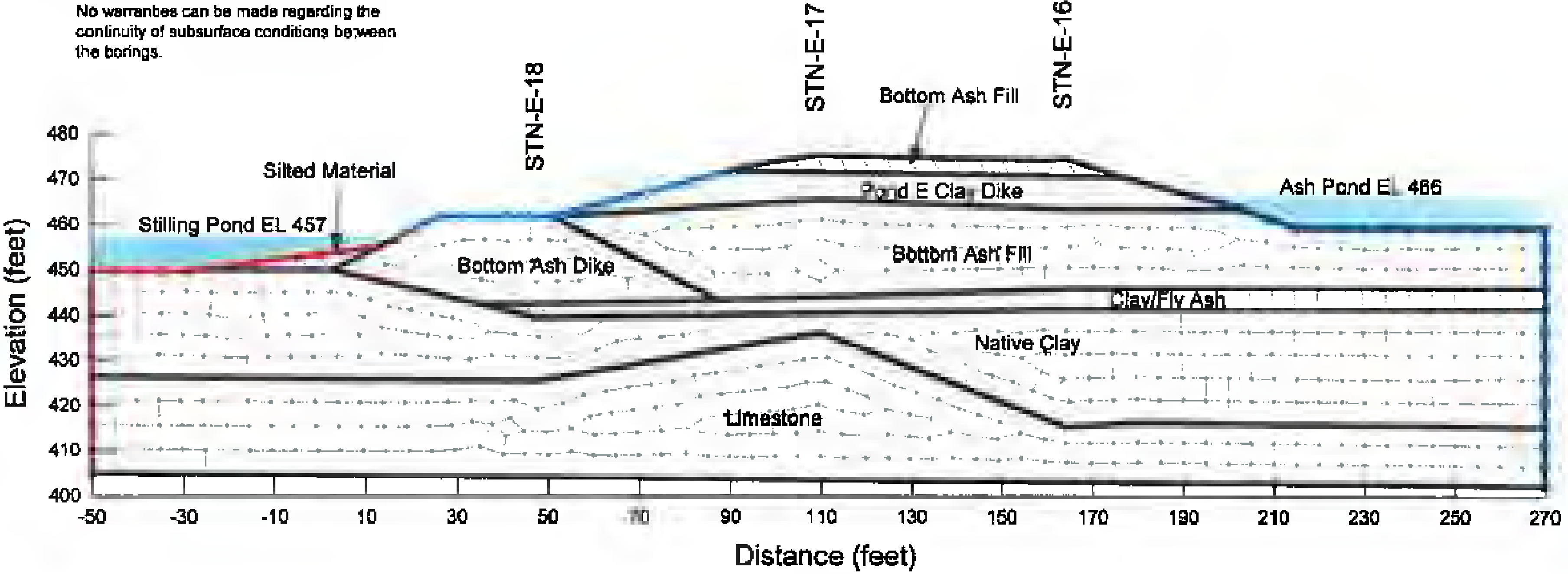
Gallatin Fossil Plant
Tennessee Valley Authority

Boundary Conditions with Mesh

January 2010
Method: Steady-State
File Name: GAF_Section_F.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Ksat	Kratio	Wsat
Bottom Ash Fill	3.28e-005	1	0.15
Bottom Ash Dike	3.28e-005	1	0.15
Silted Material	9.84e-005	0.033	0.4
Pond E Clay Dike	3.28e-009	1	0.25
Native Clay	6.56e-008	0.05	0.25
Clay / Fly Ash	9.84e-005	0.033	0.4
Limestone	0.000328	0.1	0.15



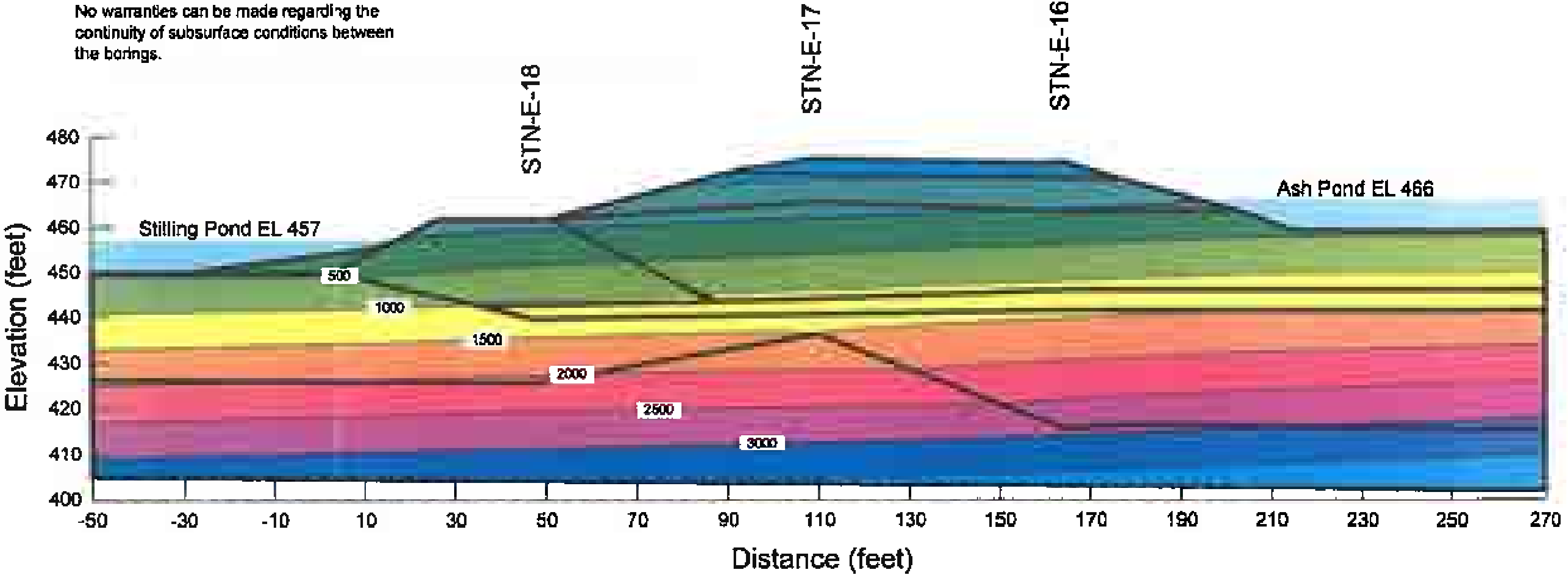
Seepage Analysis
Section F
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Pore Water Pressure (psf)

January 2010
Method: Steady-State
File Name: GAF_Section_F.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



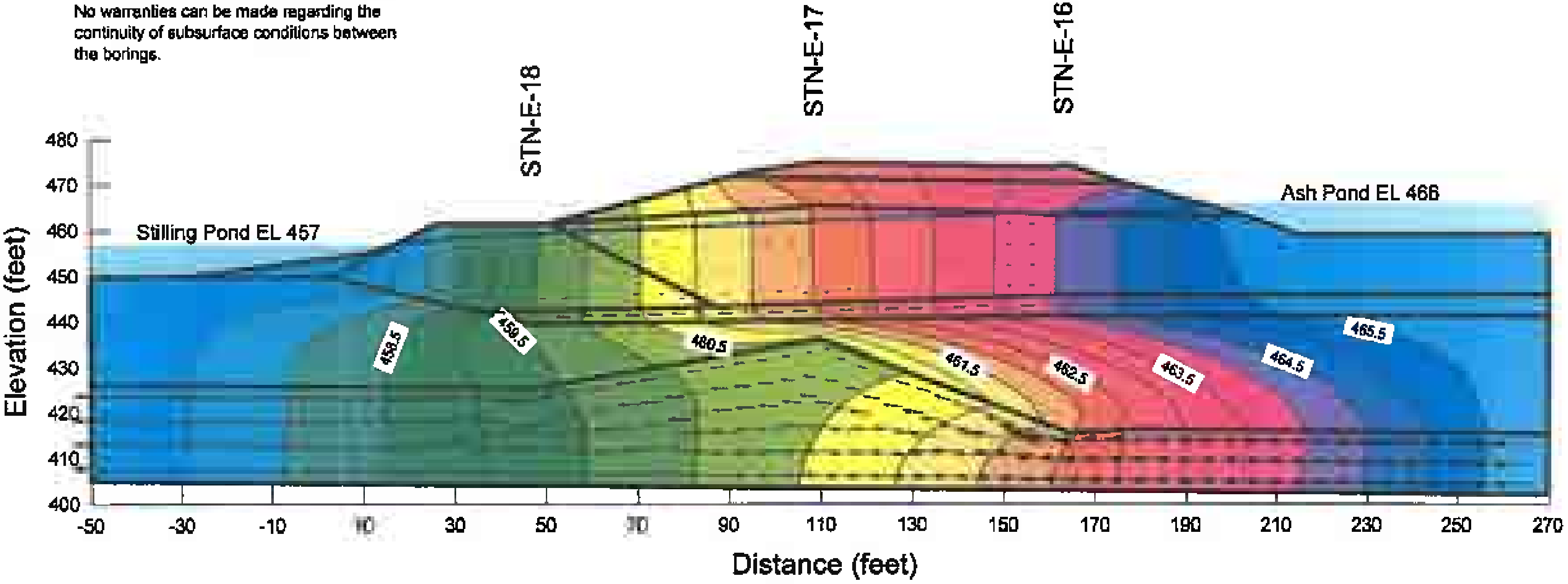
Seepage Analysis
Section F
Ash Ponds A and E

Total Head with Flow Vectors

Gallatin Fossil Plant
Tennessee Valley Authority

January 2010
Method: Steady-State
File Name: GAF_Section_F.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section F
Ash Ponds A and E

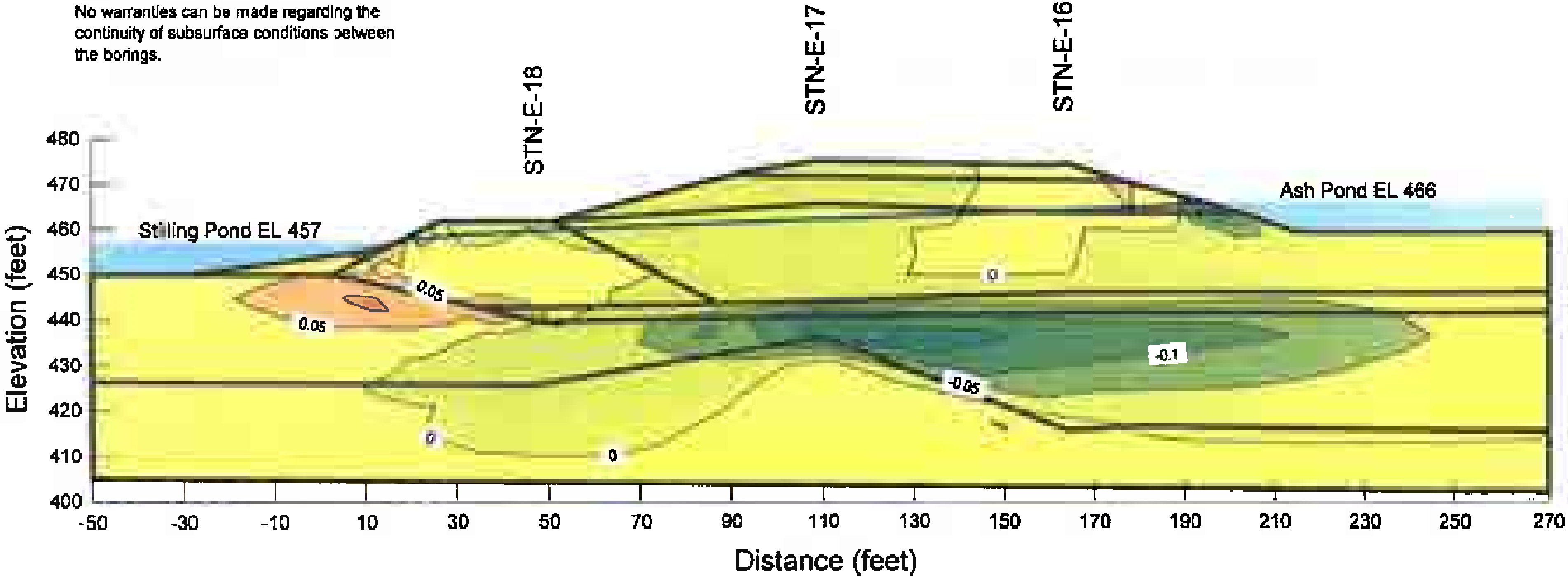
Vertical Gradient

Gallatin Fossil Plant
Tennessee Valley Authority

Piping Potential
  Maximum occurs at (17.18, 457)
  Total Head = 457 ft
  At (18.02, 450.7)
  Total Head = 457.54 ft
  dH = 0.54 ft dL = 6.36
  i = 0.085 i(criticial) = 0.84
  FSpiping = 9.9

January 2010
Method: Steady-State
File Name: GAF_Section_F.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section G
Ash Ponds A and E

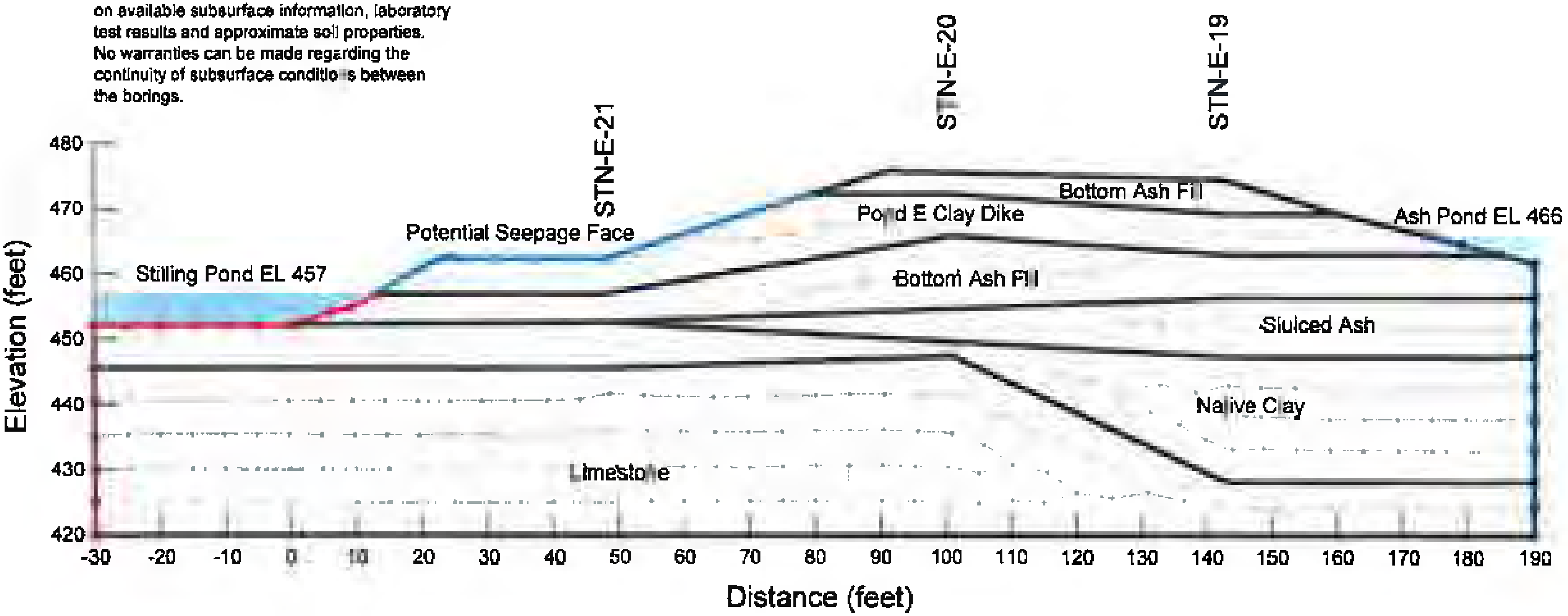
Gallatin Fossil Plant
Tennessee Valley Authority

Boundary Conditions with Mesh

Material Type	Ksat	Kratio	Wsat
Bottom Ash Fill	3.28e-005	1	0.15
Sluiced Ash	9.84e-006	0.033	0.4
Pond E Clay Dike	3.28e-009	1	0.25
Native Clay	6.56e-008	0.05	0.25
Limestone	0.000328	0.1	0.15

January 2010
Method: Steady-State
File Name: GAF_Section_G.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



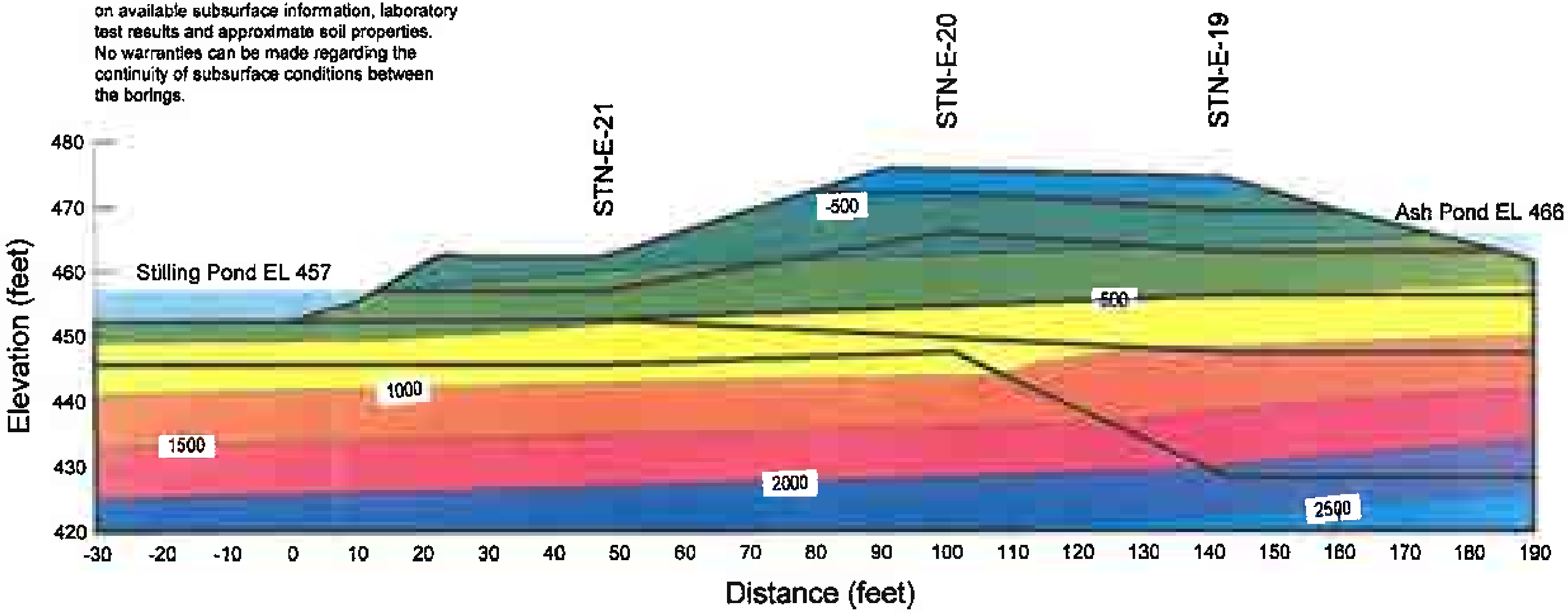
Seepage Analysis
Section G
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Pore Water Pressure (psf)

January 2010
Method: Steady-State
File Name: GAF_Section_G.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



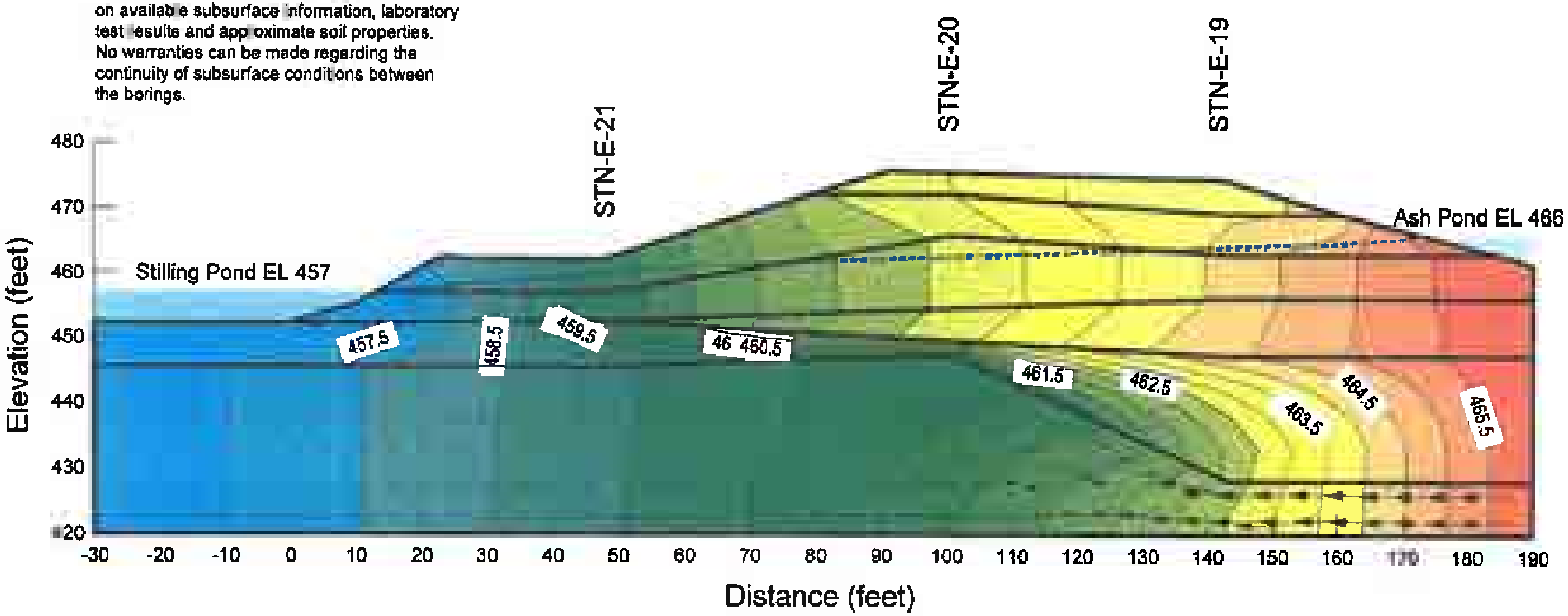
Seepage Analysis
Section G
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Total Head with Flow Vectors

January 2010
Method: Steady-State
File Name: GAF_Section_G.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section G
Ash Ponds A and E

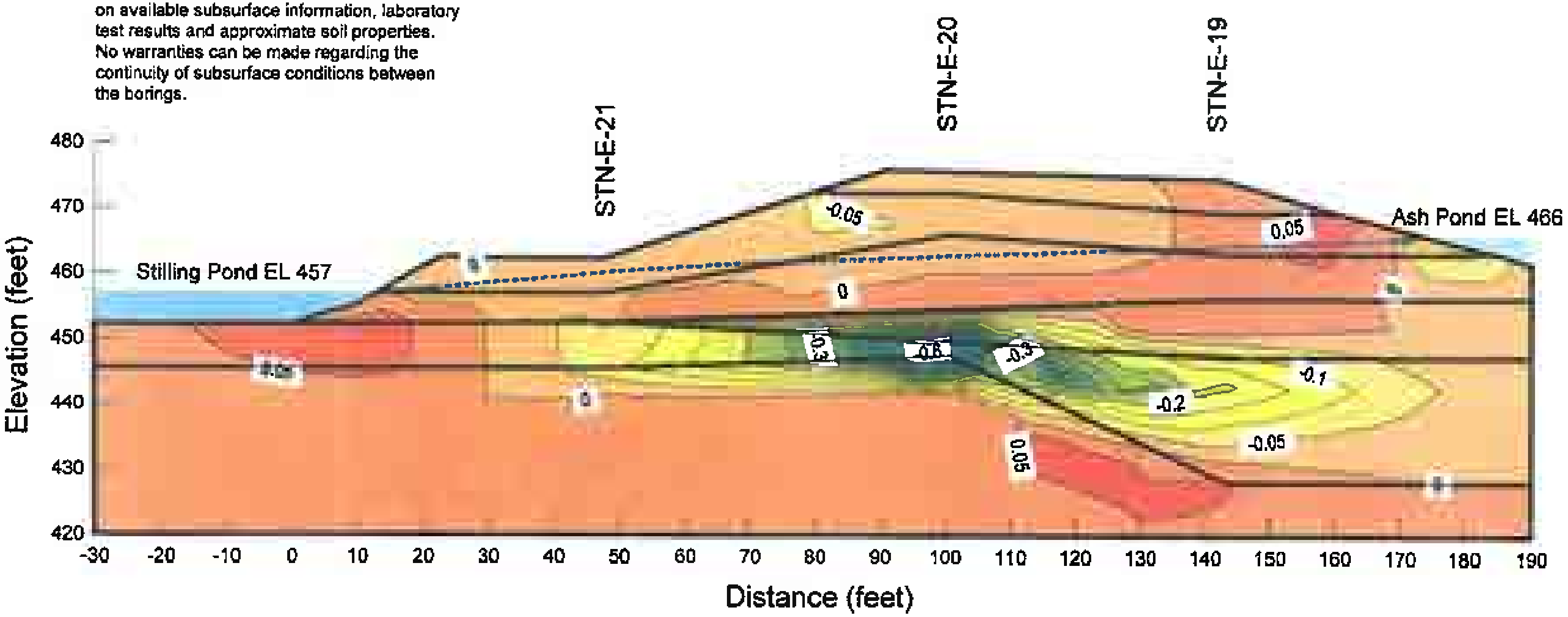
Gallatin Fossil Plant
Tennessee Valley Authority

Vertical Gradient

Piping Potential
Maximum occurs at (-4.98, 452.25)
Total Head = 457 ft
At (-5.48, 445.6)
Total Head = 457.59 ft
dH = 0.59 ft dL = 6.67
i = 0.088 i(criticial) = 1.01
FSpiping = 11.4

January 2010
Method: Steady-State
File Name: GAF_Section_G.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section H
Ash Ponds A and E

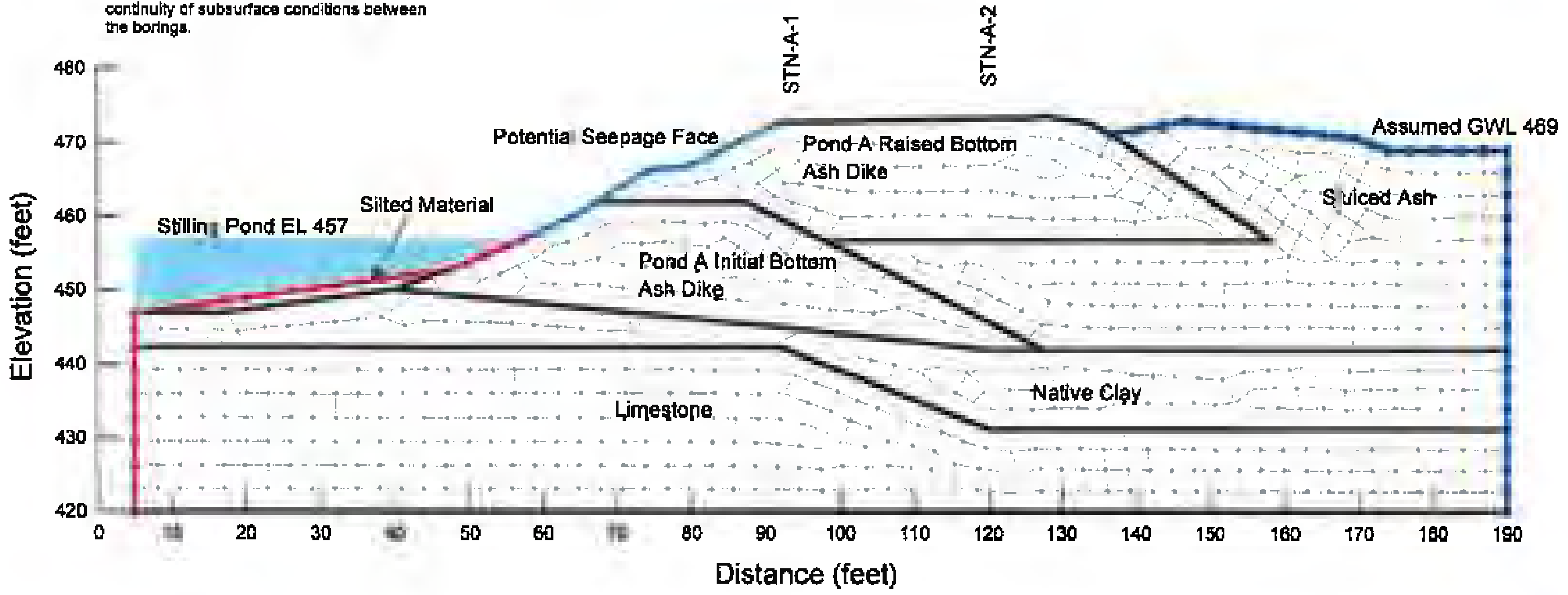
Boundary Conditions with Mesh

Gallatin Fossil Plant
Tennessee Valley Authority

January 2010
Method: Steady-State
File Name: GAF_Section_H.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Ksat	Kratio	Wsat
Pond A Raised Bottom Ash Dike	1.64e-005	0.2	0.15
Pond A Initial Bottom Ash Dike	0.00066	0.2	0.15
Sluiced Ash	9.84e-006	0.033	0.4
Silted Material	9.84e-005	0.033	0.4
Native Clay	6.56e-008	0.05	0.25
Limestone	0.000328	0.1	0.15



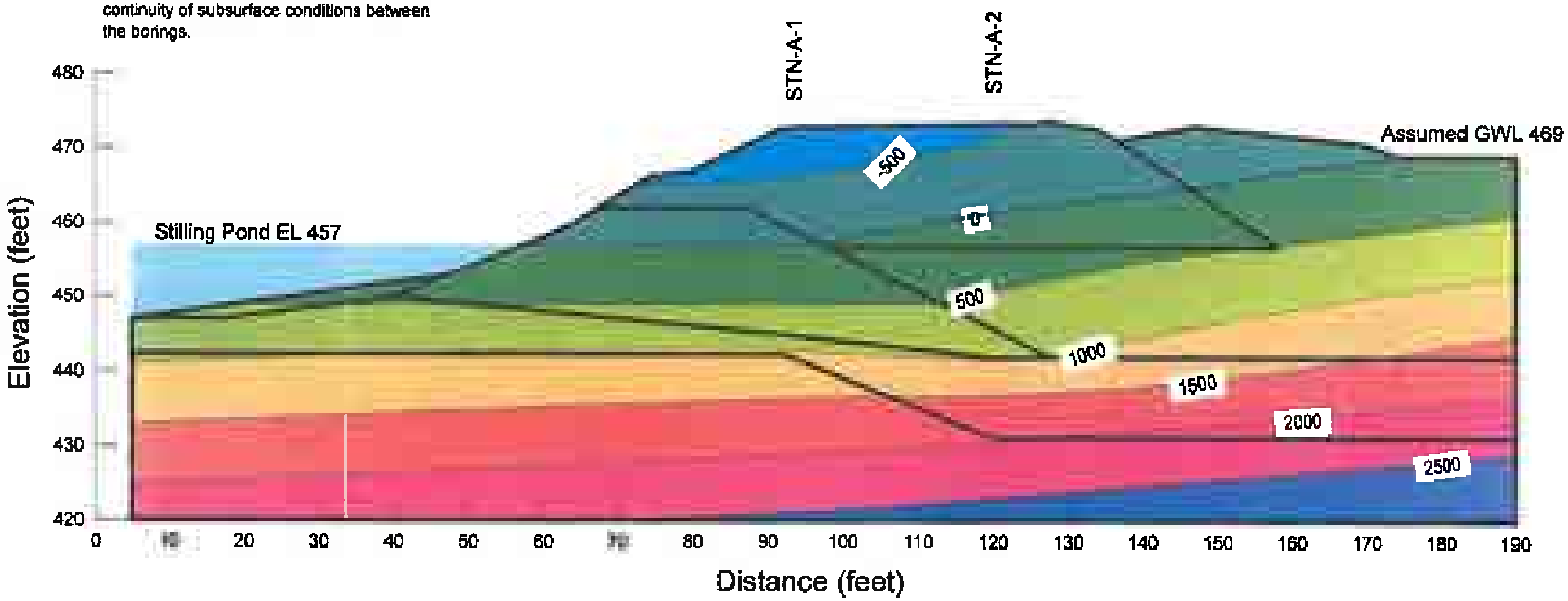
Seepage Analysis
Section H
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Pore Water Pressure (psf)

January 2010
Method: Steady-State
File Name: GAF_Section_H.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



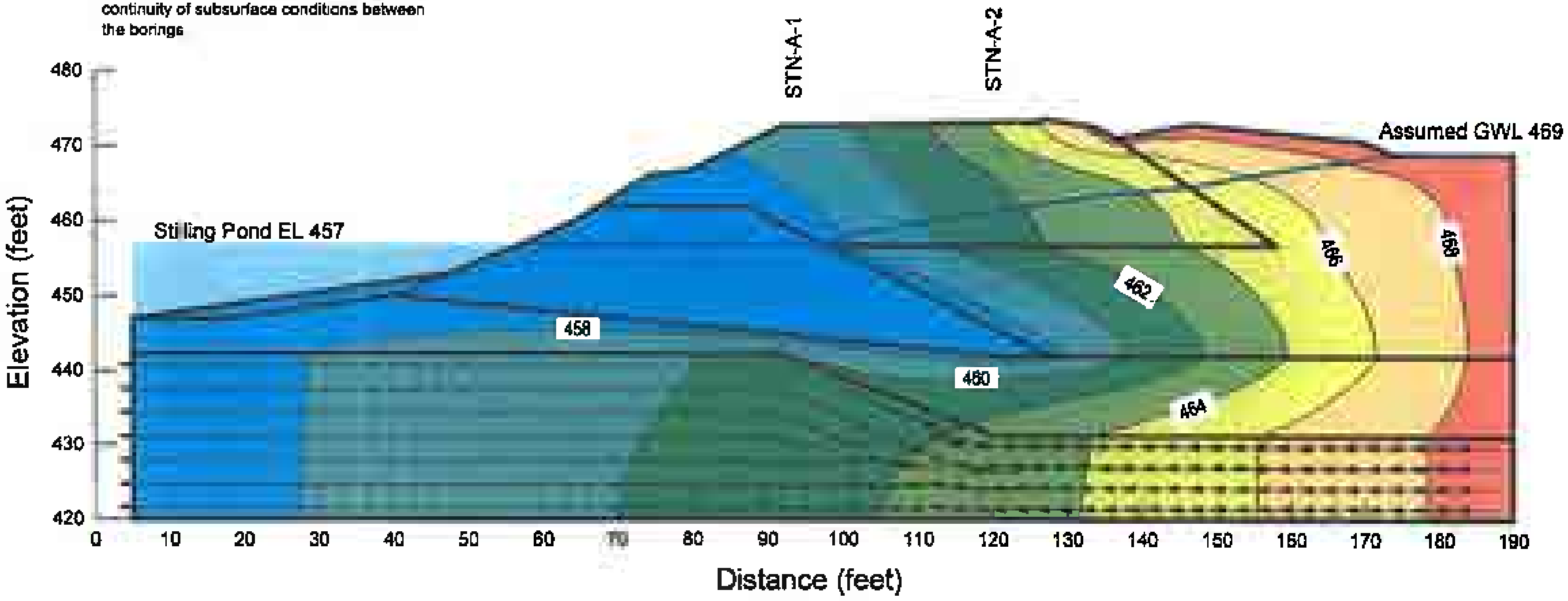
Seepage Analysis
Section H
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Total Head with Flow Vectors

January 2010
Method: Steady-State
File Name: GAF_Section_H.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties No warranties can be made regarding the continuity of subsurface conditions between the borings



Seepage Analysis
Section H
Ash Ponds A and E

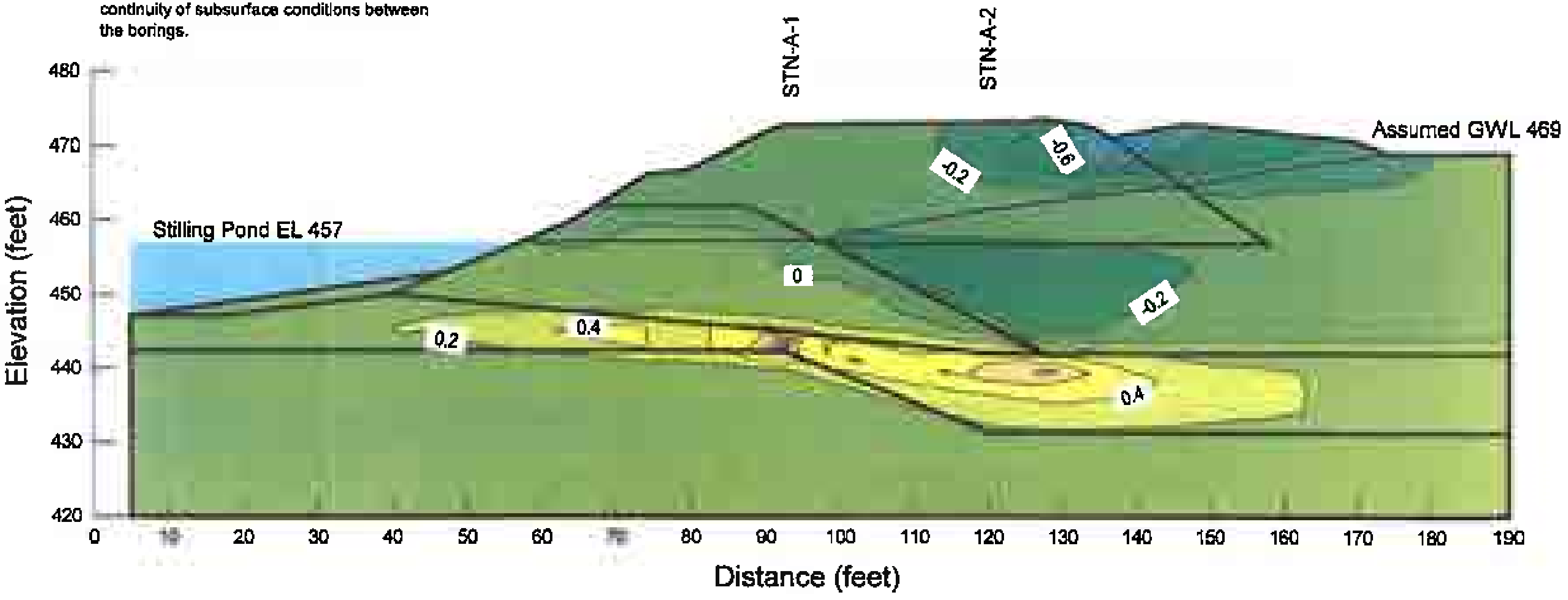
Vertical Gradient

Gallatin Fossil Plant
Tennessee Valley Authority

January 2010
Method: Steady-State
File Name: GAF_Section_H.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Piping Potential
Maximum occurs at (57.43, 457)
Total Head = 457 ft
At (58.89, 454.18)
Total Head = 457.04 ft
dH = 0.04 ft dL = 3.18
i = 0.0125 i(criticial) = 0.86
FSpiping = 68.8



Seepage Analysis
Section J
Ash Ponds A and E

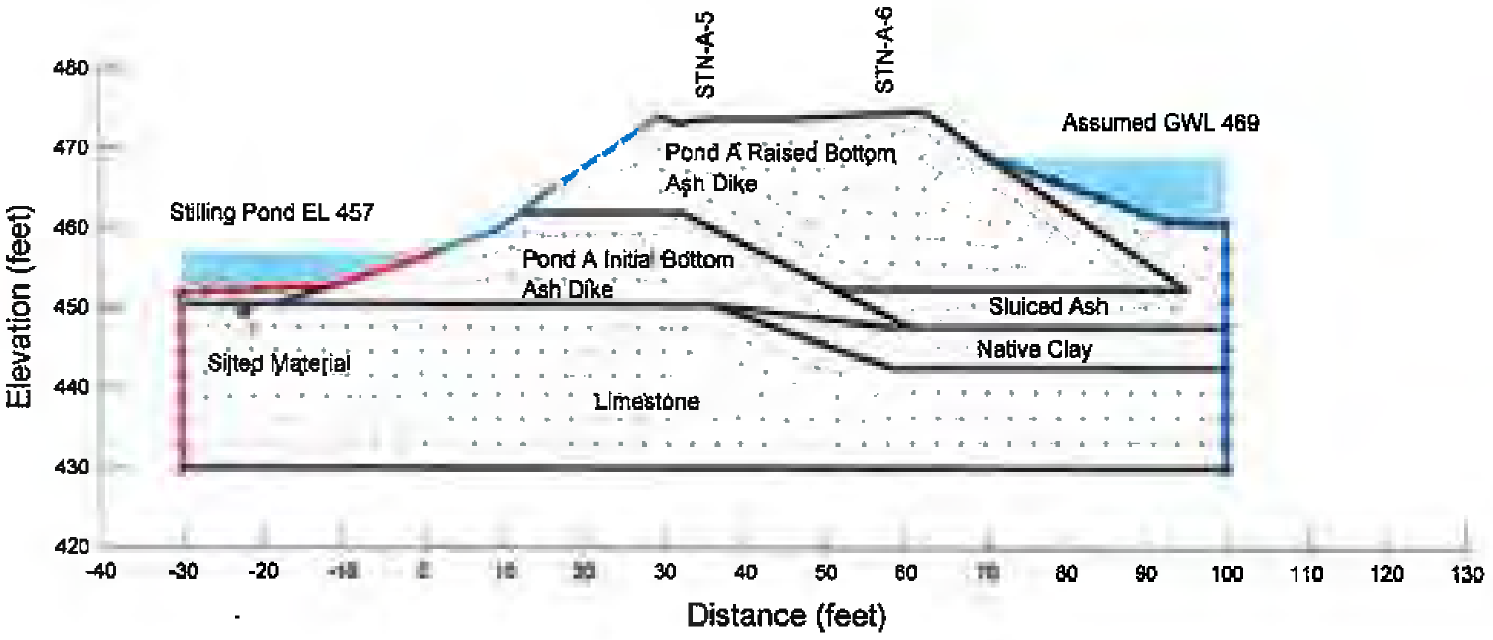
Gallatin Fossil Plant
Tennessee Valley Authority

Boundary Conditions with Mesh

January 2010
Method: Steady-State
File Name: GAF_Section_J.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate sol properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Ksat	Kratio	Wsat
Pond A Raised Bottom Ash Dike	1.64e-005	0.2	0.15
Pond A Initial Bottom Ash Dike	0.00066	0.2	0.15
Sluiced Ash	9.84e-006	0.033	0.4
Silted Material	9.84e-005	0.033	0.4
Native Clay	6.56e-008	0.05	0.25
Limestone	0.000328	0.1	0.15



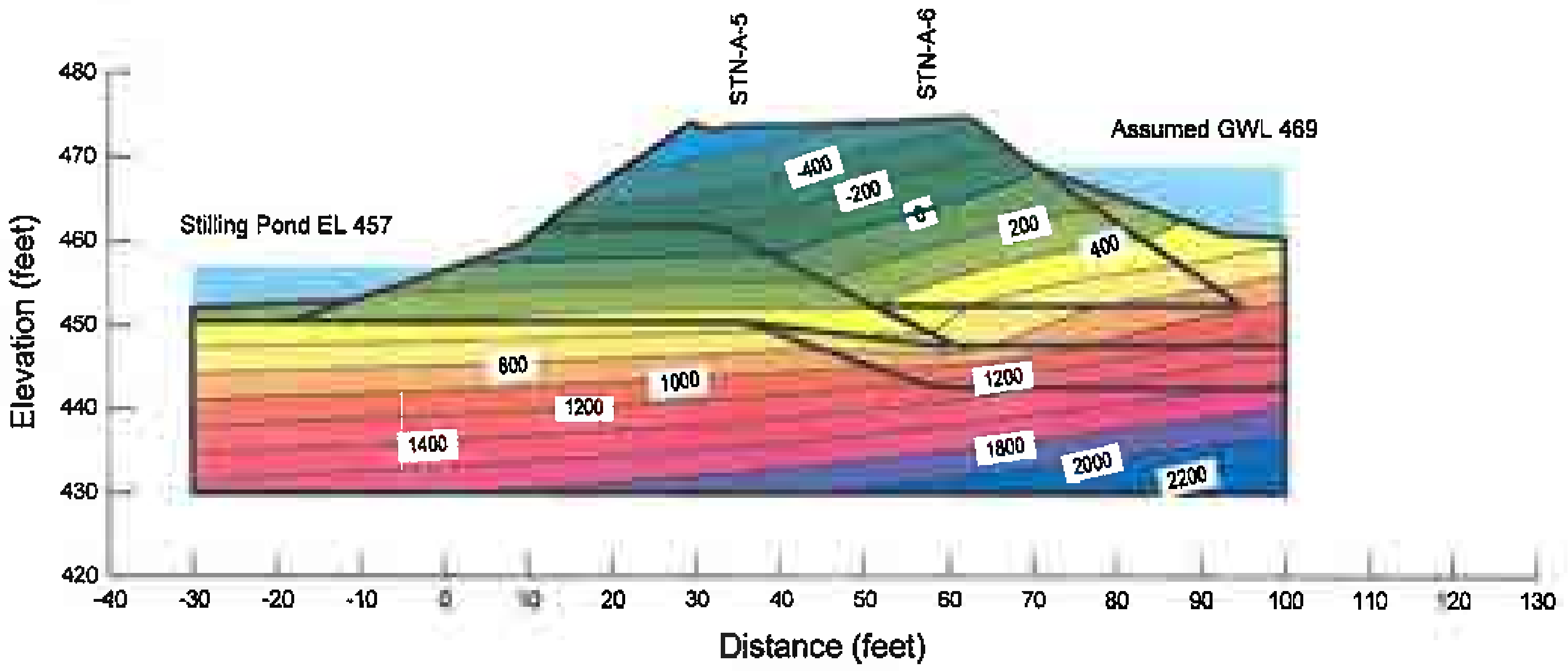
Seepage Analysis
Section J
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Pore Water Pressure (psf)

January 2010
Method: Steady-State
File Name: GAF_Section_J.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



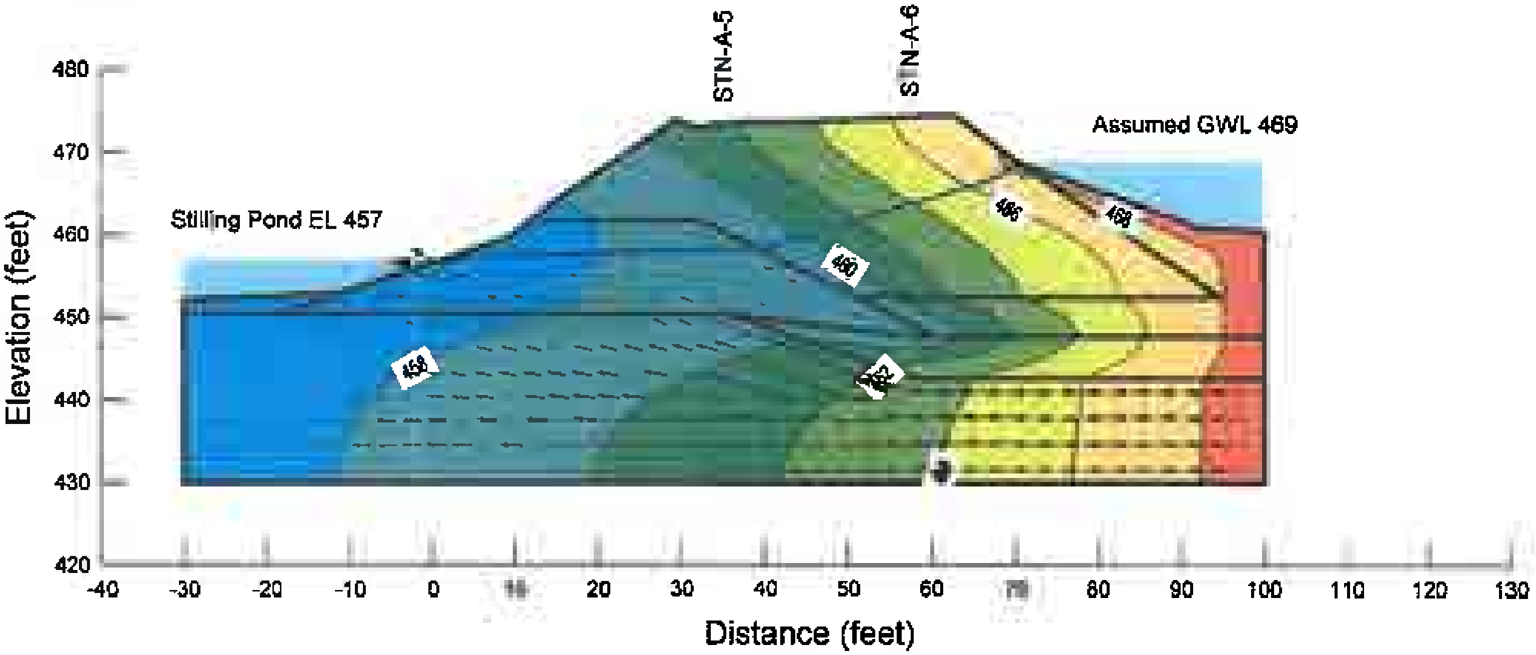
Seepage Analysis
Section J
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Total Head with Flow Vectors

January 2010
Method: Steady-State
File Name: GAF_Section_J.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section J
Ash Ponds A and E

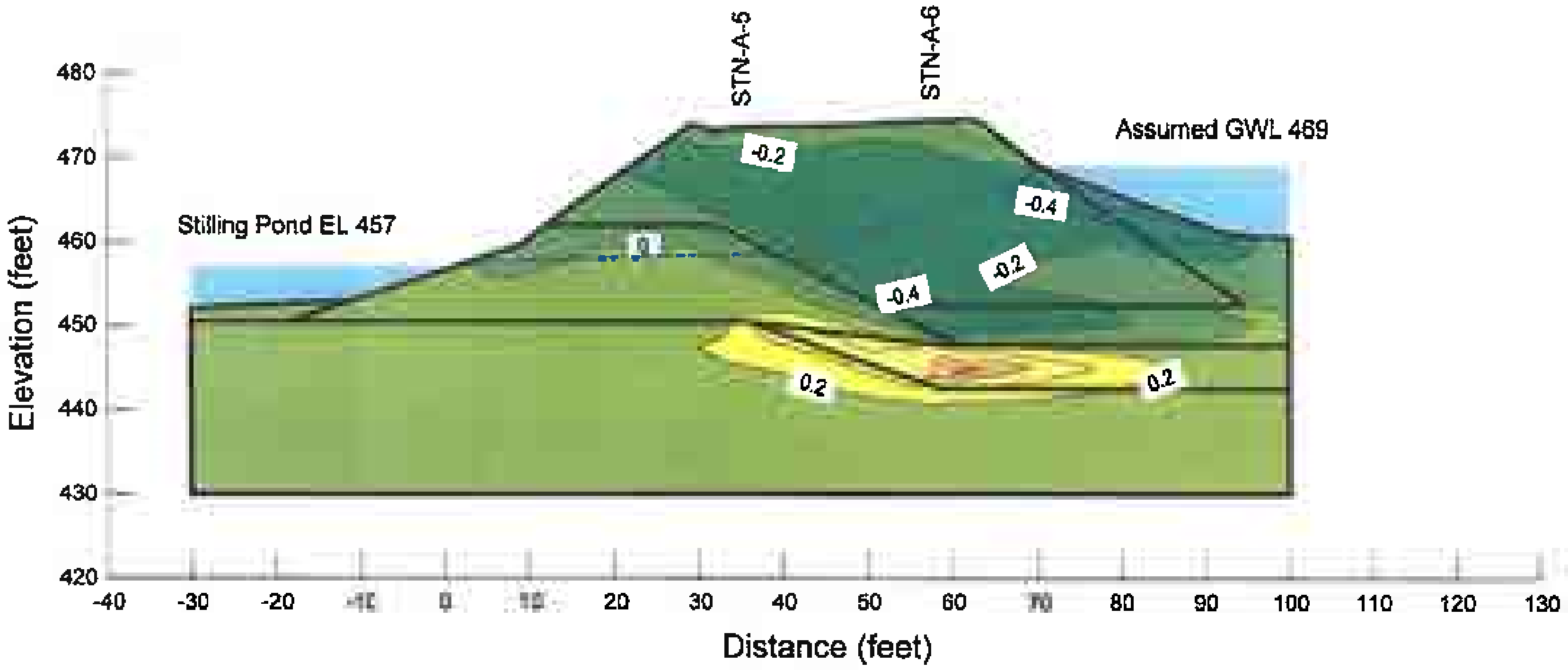
Gallatin Fossil Plant
Tennessee Valley Authority

Vertical Gradient

January 2010
Method: Steady-State
File Name: GAF_Section_J.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Piping Potential
Maximum occurs at (0, 456.5
Total Head = 457 ft
At (-0.22, 453.54)
Total Head = 457.27 ft
dH = 0.27ft dL = 3.02
i = 0.089 i(critical) = 0.96
FSpiping = 10.8



Seepage Analysis
Section K
Ash Ponds A and E

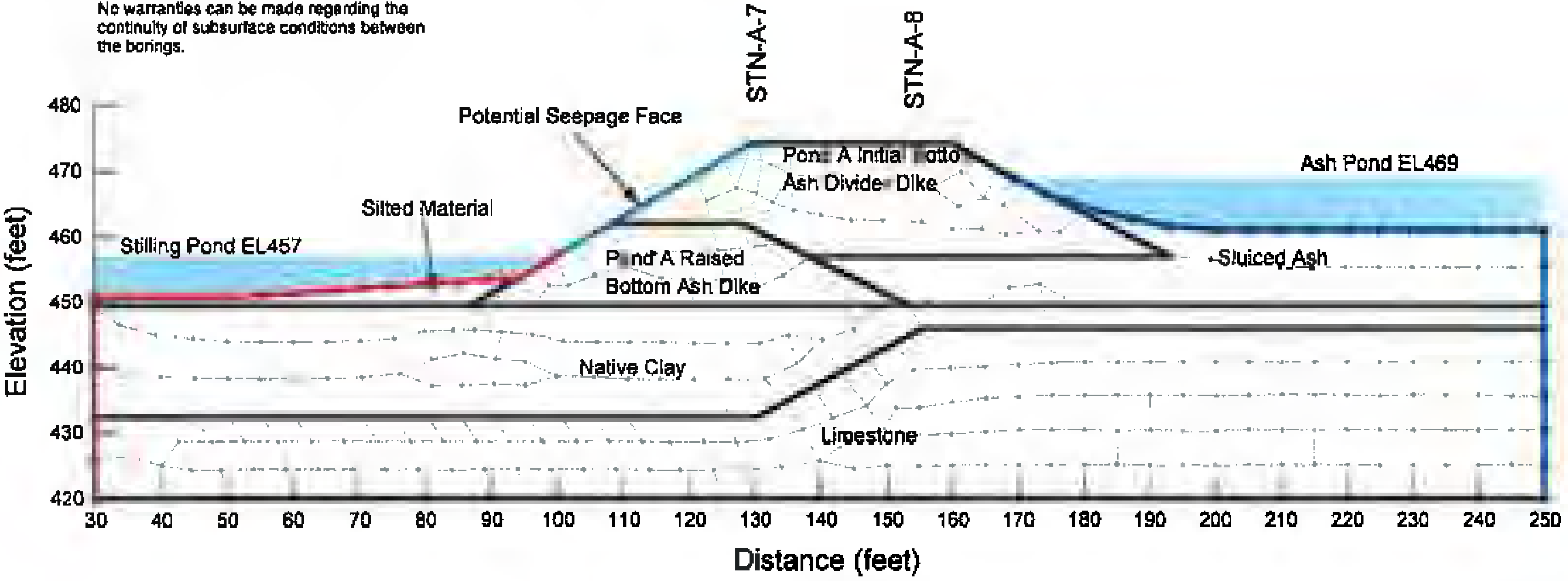
Boundary Conditions with Mesh

Gallatin Fossil Plant
Tennessee Valley Authority

January 2010
Method: Steady-State
File Name: GAF_Section_K.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.

Material Type	Ksat	Kratio	Wsat
Pond A Initial Bottom Ash Divider Dike	0.00033	0.2	0.15
Pond A Raised Bottom Ash Dike	1.65e-005	0.2	0.15
Sluiced Ash	9.84e-006	0.033	0.4
Native Clay	6.56e-008	0.05	0.25
Silted Material	9.84e-005	0.033	0.4
Limestone	0.000328	0.1	0.15



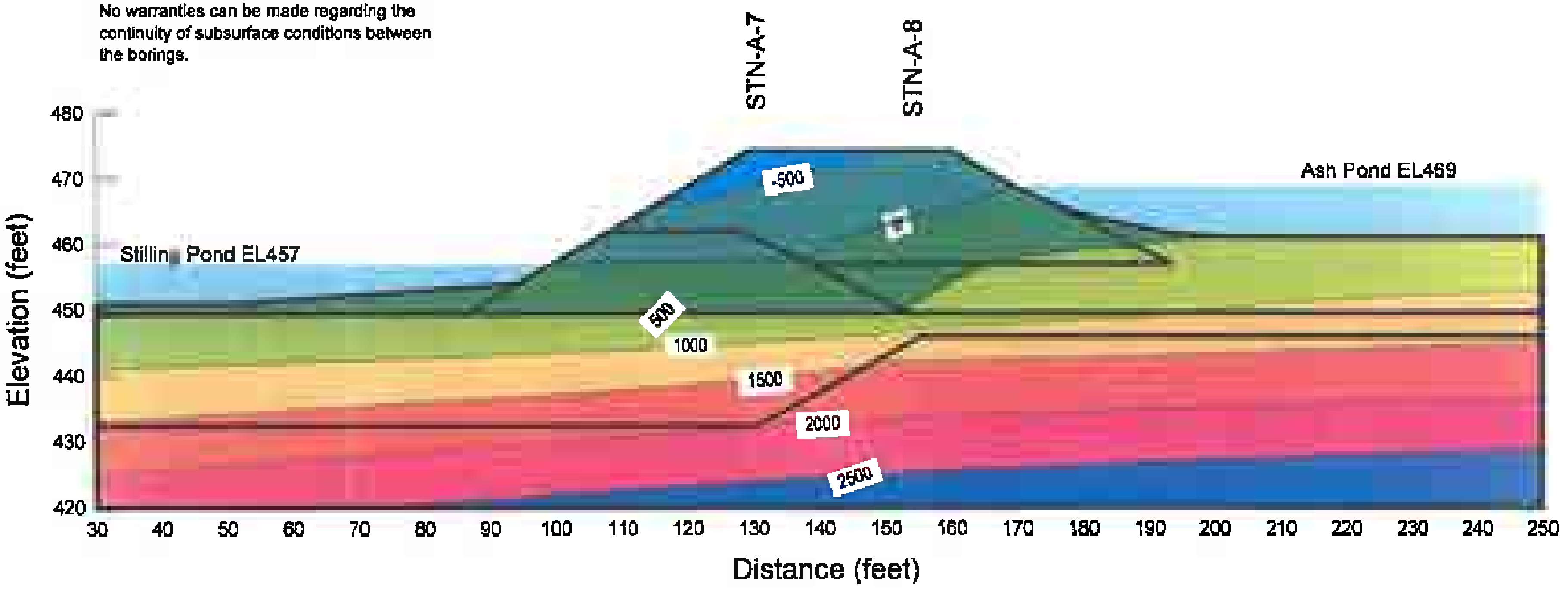
Seepage Analysis
Section K
Ash Ponds A and E

Gallatin Fossil Plant
Tennessee Valley Authority

Pore Water Pressure (psf)

January 2010
Method: Steady-State
File Name: GAF_Section_K.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



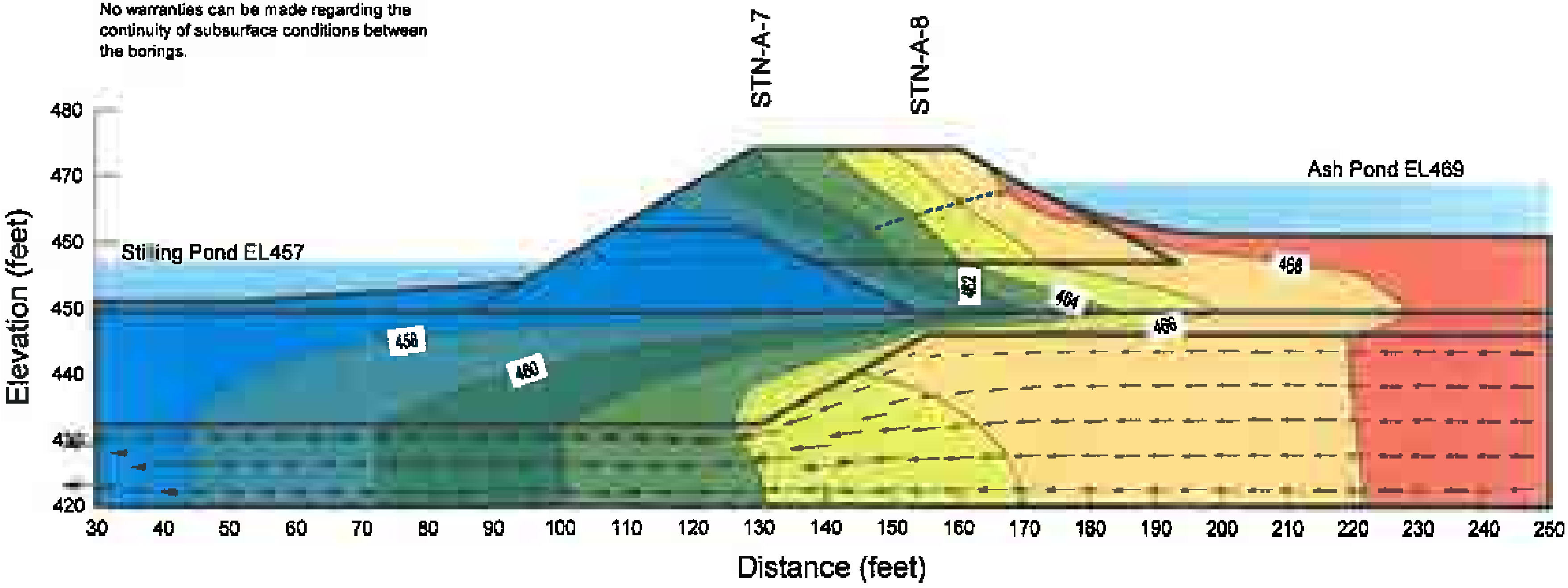
Seepage Analysis
Section K
Ash Ponds A and E

Total Head with Flow Vectors

Gallatin Fossil Plant
Tennessee Valley Authority

January 2010
Method: Steady-State
File Name: GAF_Section_K.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Seepage Analysis
Section K
Ash Ponds A and E

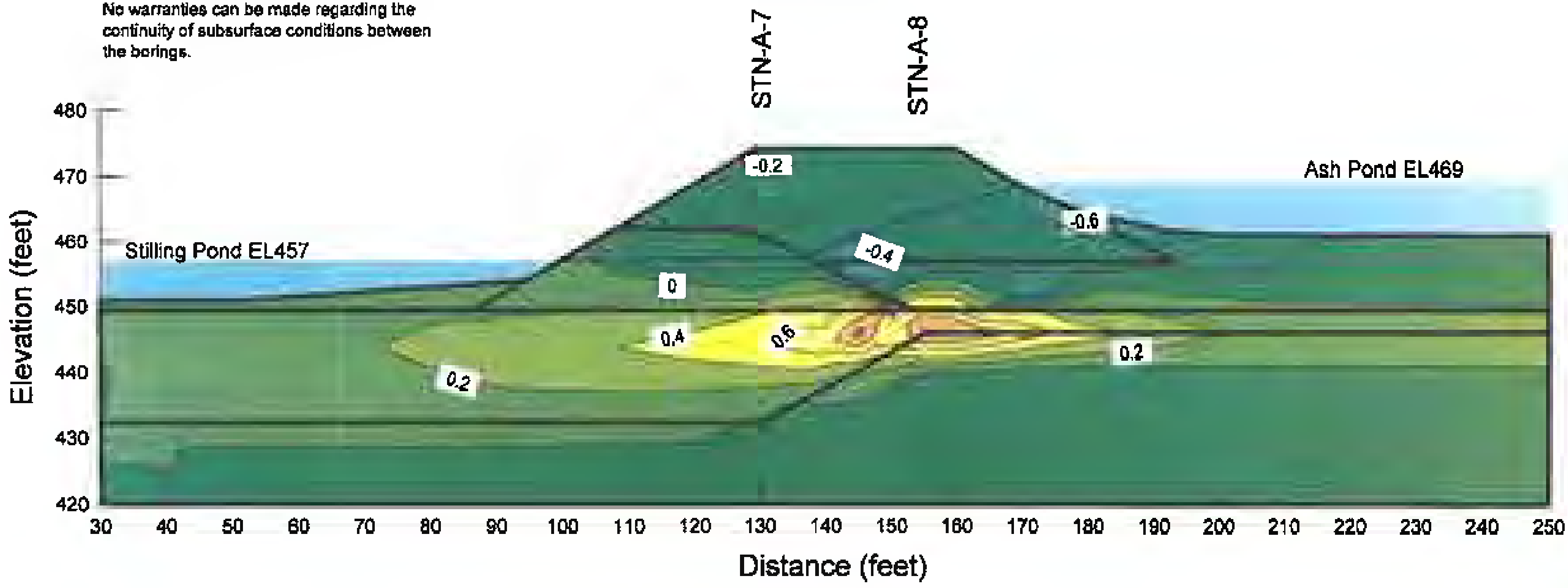
Vertical Gradient

Gallatin Fossil Plant
Tennessee Valley Authority

Piping Potential
Maximum occurs at (99.8, 457)
Total Head = 457 ft
At (101.56, 452.57)
Total Head = 457.12 ft
dH = 0.12 ft dL = 4.77
i = 0.025 i(criticial) = 0.89
FSpiping = 35.6

January 2010
Method: Steady-State
File Name: GAF_Section_K.gsz

Note:
The results of analysis shown here are based on available subsurface information, laboratory test results and approximate soil properties. No warranties can be made regarding the continuity of subsurface conditions between the borings.



Appendix G

MACTEC
October 14, 2004
Geotechnical Report

Attachment 3

REPORT OF GEOTECHNICAL EXPLORATION

ASH DISPOSAL AREA
AND POTENTIAL ON-SITE AND OFF-SITE BORROW AREAS
GALLATIN FOSSIL PLANT
GALLATIN, TENNESSEE

Prepared For:

TENNESSEE VALLEY AUTHORITY

Chattanooga, Tennessee

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.

Knoxville, Tennessee

MACTEC Project 3043041043/01

October 14, 2004

MACTEC

MACTEC

October 14, 2004

Mr. Ron Purkey
Tennessee Valley Authority
1101 Market Street, LP-2G
Chattanooga, TN 37402

Subject: **Report of Geotechnical Exploration**
Ash Disposal Area and Potential On-Site and Off-Site Borrow Areas
TVA Gallatin Fossil Plant
Gallatin, Tennessee
MACTEC Project 3043041043/01

Dear Mr. Purkey:

We at MACTEC Engineering and Consulting, Inc., (MACTEC) are pleased to submit this Report of Geotechnical Exploration for your project. Our services, as authorized through TAO No. MAC-0702-00060 were provided in general accordance with our proposal number Prop04Knox/271, dated July 30, 2004.

This report reviews the information provided to us, discusses the site and subsurface conditions, and presents the results of our field and laboratory testing for the materials at the existing ash disposal area and potential on-site and off-site borrow areas. The Appendices contain a brief description of the Field Exploratory Procedures, a Key Sheet and Test Boring Records, Cone Penetrometer Test Results, the Laboratory Test Procedures, and the Laboratory Test Results.

The laboratory testing on lime-stabilized new bottom ash has not been completed to date. The results will be submitted after the testing is completed.

We anticipate further dialog and interaction with the designers as the design proceeds and will be happy to provide any additional information or interpretation of the data presented here in which may be necessary.

We will be pleased to discuss our data with you and would welcome the opportunity to provide the engineering and material testing services needed to successfully complete your project.

Sincerely,

MACTEC ENGINEERING AND CONSULTING, INC.

Hussein A. Benkhayal
Senior Professional

Carl D. Tockstein, P.E.
Chief Engineer - Tennessee Operations

CARL DEWAYNE TOCKSTEIN

HAB/CDT:sjm

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive • Knoxville, TN 37921-5904
865-588-8544 • Fax: 865-588-8026

REPORT OF GEOTECHNICAL EXPLORATION

ASH DISPOSAL AREA
AND POTENTIAL ON-SITE AND OFF-SITE BORROW AREAS
GALLATIN FOSSIL PLANT
GALLATIN, TENNESSEE

Prepared For:

TENNESSEE VALLEY AUTHORITY

Chattanooga, Tennessee

Prepared By:

MACTEC ENGINEERING AND CONSULTING, INC.

Knoxville, Tennessee

MACTEC Project 3043041043/01

October 14, 2004

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EXECUTIVE SUMMARY

MACTEC was selected by the Tennessee Valley Authority (TVA) to perform a geotechnical exploration for the Ash Disposal Area and potential on-site and off-site borrow areas at the Gallatin Fossil Plant in Gallatin, Tennessee. The objectives of our exploration were to determine general subsurface conditions and to obtain data to evaluate the engineering characteristics of the ash, on-site soils, and potential on-site and off-site borrow soils.

The exploration consisted of performing 13 test borings, 16 auger borings, 14 observation trenches, and cone penetrometer testing (CPT) at seven locations. All test borings were drilled to refusal. The auger borings were drilled to determined depths ranging from about 15 to 20 feet or refusal, whichever occurred first. The major findings of our geotechnical exploration are as follows:

- The test borings drilled in the ash pond area typically encountered ash, fill, alluvium, and residuum. The ash, which was encountered in all test borings except borings B-9 through B-12, ranged in relative densities from very loose to very dense. The fill soils had firm to very hard consistencies. The underlying alluvium and residuum ranged in consistencies from very soft to very stiff and from very soft to very hard, respectively.
- Ground water was encountered in all test borings except borings B-9 and B-10 at the time of drilling. Ground-water measurements were made in the test borings at least 24 hours after completion of drilling. Ground water was not encountered in any of the auger borings. Long-term measurements for the presence or absence of ground water were not obtained during this exploration.
- Cone penetrometer test soundings were performed at seven locations that correspond to test borings. The results of the cone penetrometer testing are presented in Appendix C.
- Laboratory tests were performed on bulk samples from the bottom ash. The tests and test results are summarized in Section 8. The test results are presented in Appendix D.
- Laboratory tests were performed on bulk soil samples from potential on-site and off-site borrow areas. A summary of the tests performed and the test results is presented in Section 8. The test results are presented in Appendix D.

This summary is only an overview and should not be used as a separate document or in place of reading the entire report, including the appendices.

1.0 INTRODUCTION

This report presents the findings of our subsurface exploration and laboratory testing recently performed for the Ash Disposal Area and potential on-site and off-site borrow areas at the TVA Gallatin Fossil Plant. Our services were authorized by Mr. Ron Purkey of TVA.

2.0 OBJECTIVES OF EXPLORATION

The objectives of our exploration were to determine general subsurface conditions and to obtain data to evaluate the engineering characteristics of the ash, on-site soils, and potential on-site and off-site borrow soils. An assessment of site environmental conditions, or an assessment for the presence or absence of pollutants in the soil, bedrock, surface water, or ground water of the site was beyond the proposed objectives of our exploration.

3.0 SCOPE OF EXPLORATION

The scope of our exploration was based on our proposal number Prop04Knox/271, dated July 30, 2004, and the geotechnical scope of work outlined in the project's scope of work prepared by Parsons E&C. It includes the following:

- Reconnaissance of the immediate site
- Drilling 13 test borings to refusal depths which ranged from about 18.5 to 54.2 feet
- Drilling 16 auger borings in potential on-site borrow areas to depths of 15 to 20 feet or refusal
- Collecting four bulk samples from bottom ash (one sample was collected from the "old" bottom ash and three samples were collected from the "new" bottom ash).
- Collecting two bulk soil samples from an off-site potential borrow area
- Performing 14 observation trenches including logging the soil strata and collecting samples within an on-site borrow area
- Performing cone penetrometer testing (CPT) at seven locations
- Conducting laboratory testing on the ash, on-site soils, and potential borrow soils

- Preparing a geotechnical report summarizing the field and laboratory test results

The drilling and sampling were performed in general accordance with ASTM procedures included in Appendix A. The drilling was performed during the period from August 9 to 18, 2004. The equipment used consisted of a CME Model 55 ATV (all-terrain-vehicle) mounted drill rig equipped with an automatic hammer.

Standard penetration tests (SPTs) were performed in all test borings at 3-foot vertical intervals in the upper 20 feet and at 5-foot intervals below a depth of 20 feet. In addition to the SPT samples, 10 relatively undisturbed samples were obtained from five test borings for laboratory testing. Bulk soil samples were obtained from the auger cuttings at some of the auger borings in the potential on-site borrow areas. Bulk soil samples were also obtained from a potential off-site borrow area and from bottom ash.

Ground-water levels were measured during drilling in each boring. Ground-water measurements were also made in the borings at approximately 24 hours or later after the completion of the borings.

Upon completion of drilling, the test borings were plugged and abandoned by backfilling the full depth with cement grout. The auger borings were abandoned by backfilling the full depth with auger cuttings.

The CPT soundings were performed on September 8, 2004. The CPT testing procedures are presented in Appendix C. A track-mounted CPT rig with a 20-ton capacity electronic cone was utilized to perform the testing. During the CPT testing, the cone is continuously pushed into the ground and measurements are taken of the cone tip resistance, sleeve friction, and dynamic pore pressure. Pore pressure dissipation testing was performed only once at each CPT location to estimate the depth to ground-water level. Upon completion of the CPT testing, each hole was plugged and abandoned by backfilling the full depth with hole plug.

All samples were transported to our laboratories in Knoxville, Tennessee, where ash and soil samples were selected for laboratory testing. The testing program for this project (excluding lime-stabilized bottom ash testing) consisted of the following:

- 12 Plasticity Index (Atterberg Limits) Tests
- 26 Grain Size Distribution Tests

- 46 Natural Moisture Content Tests
- 7 Standard Proctor Compaction Tests
- 6 Specific Gravity Tests
- 6 Unit Weight and Natural Moisture Content Tests for Undisturbed Samples
- 9 Consolidated Undrained Triaxial Compression (CU) Tests
- 2 Unconsolidated Undrained Triaxial Compression (UU) Tests
- 3 Permeability Tests

Subsurface conditions encountered in the borings are presented on the Test Boring Records and Auger Boring Records in Appendix B. The results of the CPT testing are presented in Appendix C. The laboratory testing results are presented in Appendix D.

4.0 PROJECT INFORMATION AND SITE CONDITIONS

Project information was provided to us by Mr. Daniel Smith with Parsons E&C in the form of a Geotechnical Investigation Scope of Work and a proposed boring/CPT location plan. The exploration included the ash disposal area, potential on-site borrow areas, and a potential off-site borrow area. The site of the ash disposal area is located on the northwestern side of the Gallatin Fossil Plant site. The ground surface elevations varied by as much as 20 feet in the areas explored at the ash disposal area.

5.0 AREA AND SITE GEOLOGY

The published geologic map of this area shows that this site is underlain by Quaternary-aged alluvium deposits. The alluvium is a water-transported deposit, consisting generally of sand, silt, clay, and gravel. The maximum thickness of this deposit is 60 feet in areas of the Cumberland River flood plain. The site is underlain by limestone bedrock from the Nashville Group (the Hermitage Formation) and the Stones River Group (the Carters Limestone and the Lebanon Limestone Formations). The Hermitage Formation consists of a thin-bedded to laminated sandy and argillaceous blue limestone which occurs at high elevations. This bedrock weathers into buff or brown soils. The Carter Limestone, which is about 50 to 100 feet thick, consists of thick-bedded light gray slightly cherty limestone. Finally, the Lebanon limestone consists of a thin-bedded gray limestone with calcareous shale. The thickness of the Lebanon Limestone ranges from bout 80 to 100 feet.

6.0 SUBSURFACE CONDITIONS

Subsurface conditions in the ash disposal area were explored with 13 test borings (B-1 through B-13) and seven CPT soundings (CPT-1 through CPT-5). In addition, 16 auger borings (A-1 through A-14, A-20, and A-21) were drilled and 14 observation trenches (OT-1 through OT-14) were excavated within potential on-site borrow areas. The locations for all the borings, CPT soundings, and observation trenches were proposed by Parsons E&C. The locations were established in the field by Parsons personnel. After drilling was completed, the boring locations were surveyed by others and we were provided with the surveyed locations and elevations of all borings. Because of access restrictions, some of the borings were offset from the originally proposed location.

Subsurface conditions encountered at each boring location are shown on the Soil Test Boring Records and Auger Boring Records in Appendix B. The Test Boring Records represent our interpretation of the subsurface conditions, based on the field logs and visual examination of the samples by one of our geotechnical engineers. The lines designating the interfaces between various strata on the Test Boring Records represent the approximate interface locations.

The test borings performed at this site typically encountered ash, fill, alluvial, and residual materials. Fill soils are soils which have been transported to their current location by man. Alluvial soils are soils that have been transported to their present location by running water. Residual soils are soils that have developed from the in-place weathering of the underlying parent bedrock. All test borings were advanced to refusal. The auger borings were advanced to predetermined depths of 15 to 20 feet or refusal, whichever occurred first. A summary of the boring depths is presented in Table 1.

Table 1
Soil Test Boring and Auger Boring Summary

Boring Number	Boring Type	Ground Elevation msl (Feet)	Auger Refusal Depth (Feet)	Refusal Elevation msl (Feet)	Boring Termination Depth (Feet)	Boring Termination Elevation msl (Feet)
B-1	STB	480.0	35.2	444.8	35.2	444.8
B-2	STB	475.4	43.6	431.8	43.6	431.8
B-3	STB	472.4	33.7	438.7	33.7	438.7
B-4	STB	474.4	26.9	447.5	26.9	447.5

Table 1

Soil Test Boring and Auger Boring Summary

Boring Number	**Boring Type**	**Ground Elevation msl (Feet)**	**Auger Refusal Depth (Feet)**	**Refusal Elevation msl (Feet)**	**Boring Termination Depth (Feet)**	**Boring Termination Elevation msl (Feet)**
B-5	STB	473.5	33.4	440.1	33.4	440.1
B-6	STB	472.0	32.7	439.3	32.7	439.3
B-7	STB	461.0	28.4	432.6	28.4	432.6
B-8	STB	461.0	23.6	437.4	23.6	437.4
B-9	STB	465.0	36.7	428.3	36.7	428.3
B-10	STB	460.0	26.7	433.3	26.7	433.3
B-11	STB	460.0	54.2	405.8	54.2	405.8
B-12	STB	461.0	39.0	422.0	39.3*	421.7
B-13	STB	461.0	29.5	431.5	29.5	431.5
A-1	AB	478.0	18.5	459.5	18.5	459.5
A-2	AB	483.0	NE	NE	20.0	463.0
A-3	AB	477.0	NE	NE	20.0	457.0
A-4	AB	475.0	NE	NE	15.0	460.0
A-5	AB	473.0	NE	NE	15.0	458.0
A-6	AB	473.0	11.5	461.5	11.5	461.5
A-7	AB	475.0	NE	NE	20.0	455.0
A-8	AB	474.0	NE	NE	15.0	459.0
A-9	AB	541.0	NE	NE	15.0	526.0
A-10	AB	513.0	5.0	508.0	5.0	508.0
A-11	AB	572.0	12.5	559.5	12.5	559.5
A-12	AB	523.0	13.0	510.0	13.0	510.0
A-13	AB	539.0	9.0	530.0	9.0	530.0
A-14	AB	575.0	12.0	563.0	12.0	563.0
A-20	AB	496.0	16.6	479.4	16.6	479.4
A-21	AB	493.0	10.0	483.0	10.0	483.0

STB – Soil Test Boring

AB - Auger Boring

NE - Not Encountered

*A split spoon was driven to this depth to determine auger refusal material.

Prepared/Date: HAB 10/14/04
Checked/Date: CDT 10/14/04

6.1 ASH

Ash material was encountered in all test borings except for borings B-9 through B-12. The ash interval extended from the existing ground surface to depths ranging from about 11.5 to 32 feet. An interval of fill was encountered above the ash in test borings B-8 and B-13. The majority of the ash encountered consisted of gray and dark gray silty sand-sized particles with coal fragments. The standard penetration test (SPT) resistance values in the ash ranged from 0 (weight of hammer) to over 50 blows per foot (bpf); indicating very loose to very dense relative densities.

6.2 FILL

Fill soils were encountered at the ground surface in test borings B-8 and B-10 through B-13 and at a depth of about 11.5 feet in test boring B-4. The fill extended to depths ranging from about 2.5 to 17.5 feet. The fill soils consisted primarily of gray, orange-brown, and brown, silty clay, sandy silt, and silty and clayey sand with chert fragments, gravel, and coal. The SPT resistance values in the fill ranged from 8 to 0ver 50 bpf, indicating firm to very hard consistencies. However, the higher SPT values were probably caused by the presence of rock fragments in the sample interval.

6.3 ALLUVIUM

Alluvial soils were encountered in all test borings except test borings B-3, B-4, B-5, and B-9. The alluvial soils were encountered below the ash/fill and extended to depths ranging from about 11.5 to 50.5 feet. The alluvial soils consisted primarily of brown, gray, olive-gray, and orange-brown silty clay with gravel, chert and coal fragments, and roots. The SPT resistance values in the alluvium ranged from 1 to 16 blows per foot (bpf), indicating very soft to very stiff consistencies.

6.4 RESIDUUM

Residual materials were encountered in all test borings except for test borings B-4 and B-7. The residual soils were encountered below the ash or alluvium and extended to refusal except in test boring B-9 where the residual soils were encountered at the ground surface. The residuum encountered in the borings consisted of orange-brown, yellow-brown, brown, and tan, silty clay with chert fragments. The SPT resistance values in the residuum ranged from 1 to over 50 bpf, indicating very soft to very hard consistencies. However, the majority of the residuum had firm to very stiff consistencies.

7.0 CONE PENETROMETER TESTING

Seven CPT soundings (CPT-3, CPT-4, CPT-5, CPT-7, CPT-8, CPT-12, and CPT-13) were performed in general accordance with ASTM Standard D5778-95 and the procedures in Appendix C. The CPT sounding locations were proposed by Parsons E&C and corresponded to seven boring locations (B-3, B-4, B-5, B-7, B-8, B-12, and B-13). The results are presented in Appendix C.

During the CPT testing, the cone is pushed into the ground at a constant rate. Measurement of tip resistance (q_c), sleeve friction (f_s), and dynamic pore pressure (U) are obtained at small intervals (approximately 2-inch intervals). Using published correlations, the collected data is used to estimate several soil parameters such as unit weight, strength parameters, standard penetration test (SPT) value, relative density, and others. Graphs in Appendix C show plots of recorded field data versus depth. The recorded field data and estimated parameters are presented in table format in Appendix C, in addition to the correlations used to develop them.

In addition to the above, pore pressure dissipation tests were performed at all CPT locations to estimate the depth to ground water. The results of the pore pressure tests are also presented in Appendix C.

The results of the CPT soundings and the estimated SPT values are in good agreement with the SPT values obtained during drilling for the corresponding locations.

8.0 LABORATORY TESTING AND DISCUSSION OF TEST RESULTS

This section describes the geotechnical laboratory testing program and summarizes the test results. The laboratory testing procedures and laboratory test results are included in Appendix D. The laboratory tests were performed on SPT and undisturbed ash and soil samples obtained during drilling from the ash pond, bulk samples from on-site bottom ash, lime-treated bottom ash samples, and bulk soil samples from potential on-site and off-site borrow areas. The following paragraphs provide a short discussion of the general types of testing conducted and the test results.

8.1 ASH POND SAMPLES

8.1.1 Index Properties, Specific Gravity And Unit Weights

Natural moisture content tests were performed on many of the split-spoon and undisturbed soil samples. Liquid limit, plastic limit, and plasticity index tests (collectively referred to herein as Atterberg limits); specific gravity tests; and grain size distributions with and without hydrometer analyses were performed on selected undisturbed and split-spoon samples. These tests were used to confirm our visual-manual classifications.

The plasticity tests were performed only on the clayey alluvial and residual soils. Liquid limits for two clayey soil samples tested were 51 and 78; plastic limits were 20 and 30; and plasticity indices were 31 and 48. The tested soils were classified as CH soils in accordance with the Unified Soil Classification System (USCS).

Natural moisture contents for the ash ranged from 7.1 percent (boring B-1) to 35.7 percent (boring B-13). However, the majority of the moisture contents in the ash varied from about 11.2 to 33.4 percent. The natural moisture content of the alluvium and residuum ranged from 17.9 percent (boring B-10) to 38.2 percent (boring B-13). The majority of the alluvium and residuum samples tested had a natural moisture content ranging from about 26.7 to 32.9 percent. The fill soils tested had moisture contents ranging from 15.9 percent (boring B-4) to 26.9 percent (boring B-13).

Specific gravities of the ash ranged from 2.2 to 2.48.

8.1.2 Strength

Four consolidated undrained (CU) triaxial compression test were performed on undisturbed ash and soil samples. Two CU tests were performed on ash samples obtained from borings B-3 and B-13. One CU test was performed on an alluvium sample obtained from boring B-8. Finally, one CU test was performed on a residuum soil sample from boring B-13.

The results of the CU tests performed on the ash indicated that the tested samples had a total friction angle ranging from 18.3 to 38.5 degrees and a total cohesion intercept from 1,770 to 2,640 pounds per square foot (psf). The tests also indicated that the effective friction angle ranged from

24.4 to 35.5 degrees and the effective cohesion intercept ranged from 0 to 1,280 psf for the ash samples tested.

The CU test performed on the alluvium yielded a total friction angle of 14.2 degrees and a total cohesion intercept of 1,520 psf. The effective friction angle was 22.9 degrees and the effective cohesion intercept was 1,000 psf.

The residual soil sample tested had a total friction angle of 11.3 degrees and a total cohesion of 370 psf. The effective friction angle for this sample was 14.2 degrees and the effective cohesion was 210 psf.

8.1.3 Permeability

A constant head permeability test was performed on a relatively undisturbed sample of ash material obtained from boring B-13. The test results indicated that this sample had a permeability of 2.78×10^{-5} cm/sec.

8.2 BOTTOM ASH SAMPLES

Four bulk samples were collected from the on-site bottom ash. One samples was collected from the "old" bottom ash and three samples were collected fro the "new" bottom ash. Selected samples from the bottom ash were subjected to a series of laboratory tests to determine their natural moisture content, specific gravity, gain size distribution, compaction characteristics, strength, and permeability.

8.2.1 Natural Moisture Content, Grain Size Distribution, and Specific Gravity

Natural moisture content and grain size analysis tests were performed on all bottom ash samples. The "old" bottom ash sample had a natural moisture content of 11.1 percent. The natural moisture contents for the "new" bottom ash samples ranged from 9.6 to 14.0 percent.

The results of the grain size analysis tests indicated the "old" bottom ash sample was a sand with 15 percent fines and 12 percent gravel. The "new" bottom ash samples were sand with fines ranging from 9.8 to 12.1 percent and gravel ranging from 6.1 to 11.6 percent.

Specific gravity tests were performed on the "old" bottom ash sample and two of the three "new" bottom ash samples. The test results indicated that the "old" bottom ash sample had a specific gravity of 2.64. The specific gravities of the "new" bottom ash tested were 2.37 and 2.49.

8.2.2 Moisture-Density Relationship

Standard Proctor compaction tests were performed on the "old" bottom ash sample and two "new" bottom ash samples (Samples 2 and 3). The maximum dry density for the "old" bottom ash was 104.2 pounds per cubic foot (pcf) and the optimum moisture content was 15.8 percent. The results of the compaction tests performed on the two "new" bottom ash samples indicated that the maximum dry densities were 75.6 and 79.4 pcf, respectively, and the optimum moisture contents were 32.6 and 29.2 percent, respectively.

8.2.3 Strength

Consolidated undrained (CU) triaxial compression tests were performed on remolded samples from the "old" bottom ash and Sample 2 of the "new" bottom ash. The samples were remolded to or near 95 percent of the standard Proctor maximum dry density and at or near the optimum moisture content.

The results of the CU test indicated that the "old" bottom ash tested had a total friction angle of 31.7 degrees and a total cohesion of 1,390 psf. The results also indicated that the effective friction angle was 40.2 degrees and the effective cohesion was 0 psf.

The CU test performed on the "new" bottom ash (Sample 2) yielded a total friction angle of 22.5 degrees and a total cohesion of 3,400 psf. The effective friction angle for this sample was 37.3 degrees and the effective cohesion was 600 psf.

8.2.4 Permeability

Constant head permeability tests were performed on remolded samples from the "old" bottom ash and Sample 2 of the "new" bottom ash. The samples were remolded to or near 92 percent of the standard Proctor maximum dry density and at or near the optimum moisture content. The permeability tests results indicated that the permeabilities were 8.55×10^{-4} cm/sec and 2.15×10^{-3} cm/sec for the "old" and "new" bottom ash samples tested, respectively.

8.3 ON-SITE BORROW SAMPLES

Laboratory tests were performed on bulk soil samples of auger cuttings obtained during drilling from auger borings A-1, A-2, A-5, A-7, A-9, A-11, A-12, and A-14. The laboratory testing for the potential on-site borrow soils included natural moisture content, Atterberg limits, grain size analysis, standard Proctor compaction, and triaxial compression tests. The tests and test results are summarized below.

8.3.1 Index Properties

Natural moisture content, Atterberg limits, and grain size analysis tests were performed on all bulk samples from the potential on-site borrow soils.

Natural moisture contents of the tested samples ranged from 10.8 percent (boring A-11) to 29.9 percent boring (A-5). With the exception of these two values, the natural moisture contents ranged from 17.7 to 24.1 percent.

The Atterberg limits test results indicated that liquid limits for the on-site borrow soils tested ranged from 36 to 80, plastic limits ranged from 17 to 32, and plasticity indices ranged from 19 to 49. The tested on-site borrow soils were classified as CH and CL in accordance with the USCS.

8.3.2 Moisture-Density Relationship

Standard Proctor compaction tests were performed on the bulk samples from borings A-2 and A-9. The test results indicated that the maximum dry density for these samples were 104.8 and 105.6 pcf, and the corresponding optimum moisture contents were 19.1 and 19.2, respectively.

8.3.3 Strength

One consolidated undrained (CU) triaxial compression test and one unconsolidated undrained (UU) triaxial compression test were performed on remolded samples from each of the bulk samples from borings A-2 and A-9. All samples tested were remolded to dry densities at or near 95 percent of the standard Proctor maximum dry density and at or near the corresponding optimum moisture contents. Further, the samples were tested in a saturated condition.

The results of the CU test performed on remolded samples from boring A-2 indicated that the samples tested had a total friction angle of 13.3 degrees and a total cohesion of 750 psf. The effective friction angle for these samples was 22.9 degrees and the effective cohesion was 670 psf. The UU test results on samples from boring A-2 yielded a friction angle of 2.4 degrees and a cohesion of 700 psf.

The CU test performed on remolded samples from boring A-9 yielded a total friction angle of 8.5 degrees and a total cohesion of 750 psf. The effective friction angle was 21.2 degrees and the effective cohesion was 410 psf. The UU test results indicated a friction angle of 4.0 degrees and a cohesion of 500 psf.

8.4 OFF-SITE BORROW SAMPLES

Laboratory tests were performed on two bulk soil samples, designated Sample 1 and Sample 2, obtained from the potential off-site borrow area. The laboratory testing performed on these samples includes natural moisture content, Atterberg limits, grain size analysis, standard Proctor compaction, and triaxial compression tests. The tests and test results are summarized below.

8.4.1 Index Properties

Natural moisture content, Atterberg limits, and grain size analysis tests were performed on both bulk samples from the potential off-site borrow soils.

Natural moisture contents of the two bulk samples were 32.1 percent and 22.6 percent.

The Atterberg limits test results indicated that liquid limits for the off-site borrow soils samples were 41 and 33, plastic limits were 24 and 21, and plasticity indices were 17 and 12, for Samples 1 and 2, respectively. The tested off-site borrow soils were classified as CL in accordance with the USCS.

The specific gravity of Sample 2 was 2.61.

8.4.2 Moisture-Density Relationship

Standard Proctor compaction tests were performed on both the bulk samples from the off-site borrow area. The test results indicated that the maximum dry density for these samples were 94.4 and 103.3 pcf, and the corresponding optimum moisture contents were 23.9 and 19.6 for Samples 1 and 2, respectively.

8.4.3 Strength

One consolidated undrained (CU) triaxial compression test was performed on remolded samples from bulk Sample 2. The samples tested were remolded to dry densities at or near 95 percent of the standard Proctor maximum dry density and at or near the corresponding optimum moisture contents. Further, the samples were tested in a saturated condition.

The results of the CU test performed indicated that the samples tested had a total friction angle of 13.1 degrees and a total cohesion of 940 psf. The effective friction angle for this sample was 33 degrees and the effective cohesion was 0 psf.

9.0 GROUND-WATER CONDITIONS

Ground-water levels were observed in all test borings except borings B-9 and B-10 at the time of drilling. Further, ground-water measurements were obtained approximately 24 hours or later after the completion of drilling in the test borings. Ground water was not observed in any of the auger borings at the time of drilling. The recorded ground-water levels are presented in Table 2. For safety reasons, the borings were backfilled promptly; consequently, long-term measurements for the presence or absence of ground water were not obtained.

Fluctuations in the ground-water level occur because of variation in rainfall, evaporation, construction activity, surface run-off, and other site-specific factors such as fluctuation of water levels in the adjacent Cumberland River.

Table 2

Ground-Water Data

Boring Number	Ground Elevation (Feet msl)	Depth to Ground Water at Time of Drilling (Feet)	Ground-Water Elevation at Time of Drilling (Feet msl)	Depth to Ground Water 24 Hours After Drilling (Feet)	Ground-Water Elevation 24 Hours After Drilling (Feet msl)
B-1	480.0	20.0	460.0	13.6	466.4
B-2	475.4	13.0	462.4	12.3	463.1
B-3	472.4	6.0	466.4	8.2	464.2
B-4	474.4	18.0	456.4	7.6	466.8
B-5	473.5	16.5	457.0	13.4	460.1
B-6	472.0	6.0	466.0	4.4	467.6
B-7	461.0	6.0	455.0	5.0	456.0
B-8	461.0	6.0	455.0	4.7	456.3
B-9	465.0	NE	NE	NM	NM
B-10	460.0	NE	NE	6.3	453.7
B-11	460.0	18.5	441.5	9.3	450.7
B-12	461.0	29.0	432.0	16.1	444.9
B-13	461.0	6.0	455.0	5.5	455.5

NE - Not Encountered
NM - Not Measured

Prepared/Date: HAB 10/14/04
Checked/Date: CDT 10/14/04

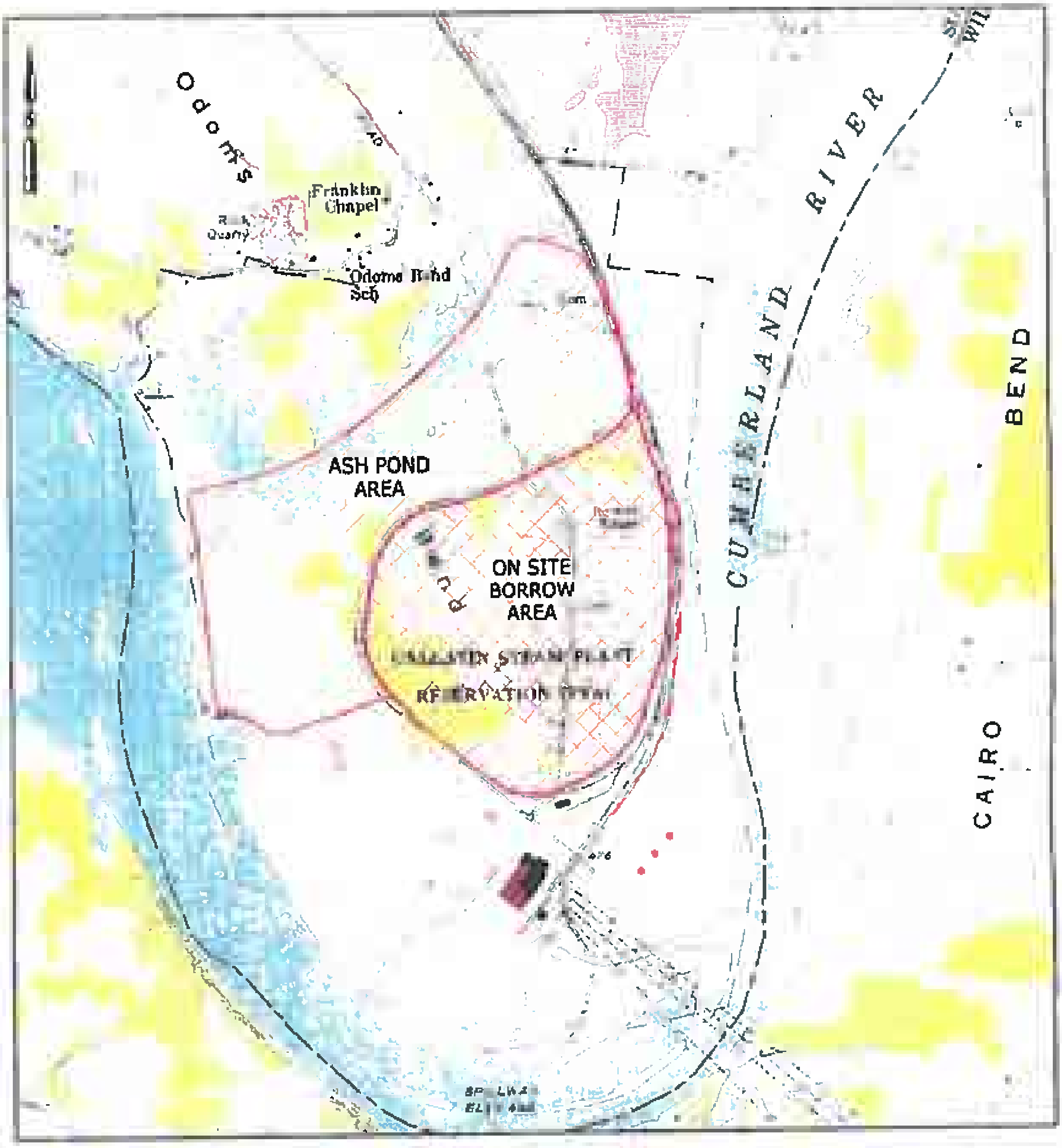
10.0 BASIS OF RESULTS

The results provided herein are based on the encountered subsurface conditions related to the specific project and site discussed in this report.

Regardless of the thoroughness of a field exploration, there is always a possibility that conditions between test locations will differ from those at specific test locations, and that conditions may not be anticipated. In addition, interpretation of the data is critical to the intended design and/or analysis. Therefore, experienced geotechnical engineer should interpret the field data and review any site-specific analysis or design that incorporates the field data. We recommend that TVA retain MACTEC to provide this service, based upon our familiarity with the subsurface conditions, the field and laboratory data, and our geotechnical experience.

Our exploration services include storing the collected samples and making them available for inspection for a period of 30 days. The samples are then discarded unless you request otherwise.

VOUCHERS



SOURCE: USGS TOPOGRAPHIC MAP OF THE LAQUARDO, TN QUADRANGLE

MACTEC

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive
Knoxville, Tennessee 37921 5904
865-588-8544 • Fax: 865-588-8026

FIGURE 1: SITE LOCATION MAP
TVA - GALLATIN ASH DISPOSAL AREA
GALLATIN, TENNESSEE

DRAFTING BY: RJB	PREPARED BY: HAB	CHECKED BY: CDT
JOB NUMBER: 3043041043/0001	DATE: OCTOBER 13, 2004	SCALE: 0 2000'

COORDINATES: N36.31578° W86.3995

APPENDIX A

FIELD EXPLORATION PROCEDURES

FIELD EXPLORATORY PROCEDURES

Soil Test Boring (Hollow Stem)

All boring and sampling operations were conducted in general accordance with ASTM D 1586. The borings were advanced by mechanically twisting continuous steel hollow-stem auger flights into the ground. At regular intervals, soil samples were obtained with a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated six inches to penetrate any loose cuttings and then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot of penetration was recorded and is designated the "standard penetration resistance (SPT)". Proper evaluation of the penetration resistance provides an index to the soil's strength, density, and ability to support foundations.

Representative portions of the soil samples obtained from the split-tube sampler were sealed in glass jars and transported to our laboratory, where they were examined by our engineer to verify the driller's field classifications. Test Boring Records are attached, graphically showing the soil descriptions and penetration resistances.

Undisturbed Sampling

The relatively undisturbed samples were obtained by pushing a section of 3-inch O.D., 16-gauge steel tubing into the soil at the desired sampling level. The sampling was performed in general accordance with ASTM D-1587. The tube, together with the encased soils, was carefully removed from the ground, made airtight, and transported to our laboratory.

Boring Backfill

The borings were backfilled to the ground surface with auger cuttings. The owner is advised that, even with this backfill technique, there is the possibility of future borehole subsidence depending on actual subsurface conditions, surface drainage, etc. The property owner should monitor the boring locations over time to discover subsidence and make the necessary repairs.

APPENDIX E

KEY TO SYMBOLS AND DESCRIPTIONS

[illegible]

[illegible]

[illegible]

GROUP SYMBOLS	TYPICAL NAMES	GROUP SYMBOLS	TYPICAL NAMES
▨	**TOPSOIL**	▨	**CONCRETE**
■	**ASPHALT**	▤	**DOLOMITE**
▨	**GRAVEL**	▦	**LIMESTONE**
▨	**FILL**	▤	**SHALE**
▩	**SUBSOIL**	▦	**LIMESTONE/SHALE** - Limestone with shale interbeds
▤	**ALLUVIUM**	░	**SANDSTONE**
▤	**COLLUVIUM**	▥	**SILTSTONE**
▨	**RESIDUUM** - Soft to firm	▨	**AUGER BORING**
▩	**RESIDUUM** - Stiff to very hard	▮	**UNDISTURBED SAMPLE ATTEMPT**

■	Undisturbed Sample 1.5-2.0 = Recovered (ft) / Pushed (ft)		
▦	Split Spoon Sample	■	Auger Cuttings
▯	Rock Core 60-100 = RQD / Recovery	▩	Dilatometer
	No Sample	▧	Crandall Sampler
▯	Rotary Drill	⁘	Pressure Meter
∇	Water Table at time of drilling	○	No Recovery
		▼	Water Table after 24 hours

Correlation of Penetration Resistance
with Relative Density and Consistency

SAND & GRAVEL		SILT & CLAY	
No. of Blows	Relative Density	No. of Blows	Consistency
0 - 4	Very Loose	0 - 2	Very Soft
5 - 10	Loose	3 - 4	Soft
11 - 20	Firm	5 - 8	Firm
21 - 30	Very Firm	9 - 15	Stiff
31 - 50	Dense	16 - 30	Very Stiff
Over 50	Very Dense	31 - 50	Hard
		Over 50	Very Hard

<u>BOUNDARY CLASSIFICATIONS:</u> Soils possessing characteristics of two groups are designated by combinations of group symbols.

SILT OR CLAY	SAND			GRAVEL		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

No.200 No.40 No.10 No.4 3/4" 3" 12"

U.S. STANDARD SIEVE SIZE

<u>Reference:</u> The Unified Soil Classification System, Corps of Engineers, U.S. Army Technical Memorandum No. 3-357, Vol. 1, March, 1953 (Revised April, 1960)

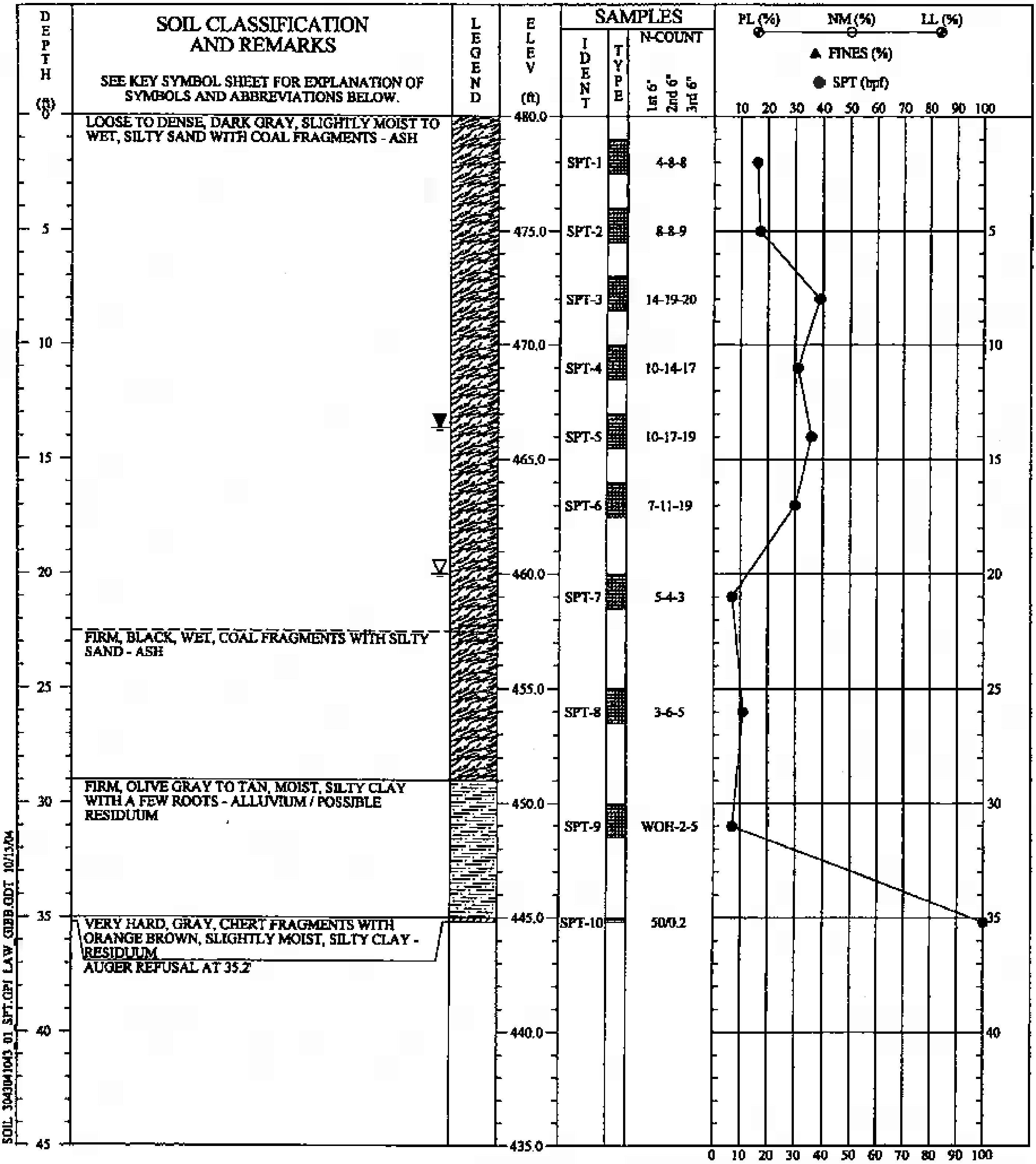
KEY TO SYMBOLS AND DESCRIPTIONS

MACTEC

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive
Knoxville, Tennessee 37921-5904
865-588-8544 Fax: 865-588-8026

SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.



LOOSE TO DENSE, DARK GRAY, SLIGHTLY MOIST TO WET, SILTY SAND WITH COAL FRAGMENTS - ASH

FIRM, BLACK, WET, COAL FRAGMENTS WITH SILTY SAND - ASH

FIRM, OLIVE GRAY TO TAN, MOIST, SILTY CLAY WITH A FEW ROOTS - ALLUVIUM / POSSIBLE RESIDUUM

VERY HARD, GRAY, CHERT FRAGMENTS WITH ORANGE BROWN, SLIGHTLY MOIST, SILTY CLAY - RESIDUUM

AUGER REFUSAL AT 35.2'

IDENT	N-COUNT
SPT-1	4-8-8
SPT-2	8-8-9
SPT-3	14-19-20
SPT-4	10-14-17
SPT-5	10-17-19
SPT-6	7-11-19
SPT-7	5-4-3
SPT-8	3-6-5
SPT-9	WOH-2-5
SPT-10	50/0.2

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004 **BORING NO.:** B-1

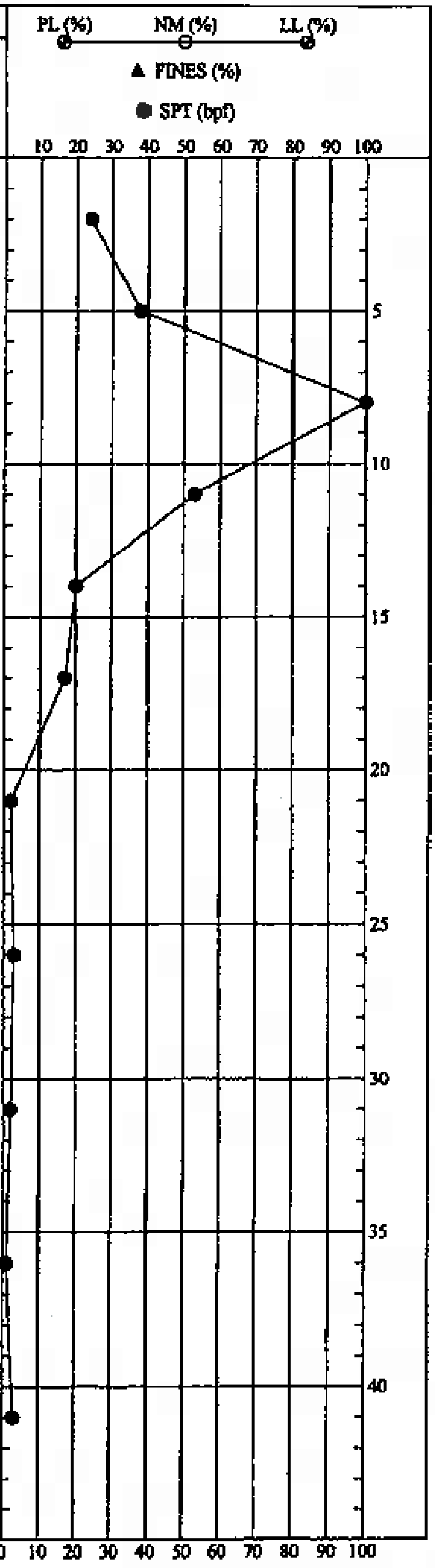
PROJ. NO.: 3043041043/0001 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)
0	FIRM TO VERY DENSE, DARK GRAY, SLIGHTLY MOIST TO WET, SILTY SAND WITH COAL FRAGMENTS - ASH	475.4
5		470.4
10		465.4
15		460.4
	VERY SOFT TO SOFT, DARK GRAY, WET, SANDY SILT - ASH	
20		455.4
25		450.4
30		445.4
	VERY SOFT, OLIVE GRAY TO BROWN, MOIST TO VERY MOIST, SILTY CLAY - ALLUVIUM / POSSIBLE RESIDUUM	
35		440.4
	SOFT, ORANGE BROWN, MOIST, SILTY CLAY WITH CHERT FRAGMENTS - RESIDUUM	
40		435.4
	AUGER REFUSAL 43.6'	
45		430.4

SAMPLES

IDENT	TYPE	N-COUNT (1st 6" 2nd 6" 3rd 6")
SPT-1	▨	8-11-13
SPT-2	▨	7-20-18
SPT-3	▨	7-27-50/0.4
SPT-4	▨	7-33-20
SPT-5	▨	8-10-10
SPT-6	▨	7-8-9
SPT-7	▨	WOH-1-1
SPT-8	▨	1-1-2
SPT-9	▨	1-1-1
SPT-10	▨	WOH-0-1
SPT-11	▨	2-2-1



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. BLOW COUNT "0" REPRESENTS WOH (WEIGHT OF HAMMER). GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004 **BORING NO.:** B-2

PROJ. NO.: 3043041043/0001 **PAGE 1 OF 1**

MACTEC

SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

FIRM, DARK GRAY, SLIGHTLY MOIST, SILTY SAND WITH COAL FRAGMENTS - ASH

VERY SOFT, DARK GRAY, SLIGHTY MOIST TO WET, SANDY SILT - ASH

LOOSE, DARK GRAY, WET, SILTY SAND WITH GRAVEL - ASH

SOFT, DARK GRAY, WET, CLAYEY SANDY SILT - ASH

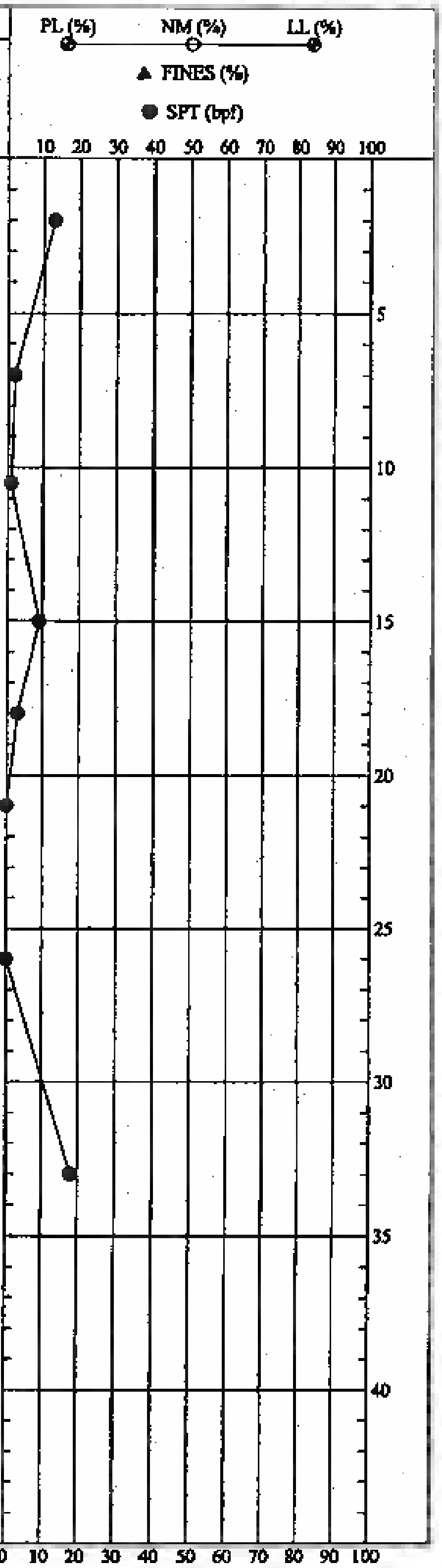
VERY SOFT, DARK GRAY, WET, CLAYEY SILT - ASH

VERY STIFF, YELLOW BROWN TO BROWN, SLIGHTLY MOIST, SILTY CLAY WITH A FEW CHERT FRAGMENTS - RESIDUUM

AUGER REFUSAL AT 33.7'

DEPTH (ft)	ELEV (ft)
0	472.4
5	467.4
10	462.4
15	457.4
20	452.4
25	447.4
30	442.4
35	437.4
40	432.4
45	427.4

SAMPLES IDENT	N-COUNT 1st 6" 2nd 6" 3rd 6"
SPT-1	5-6-7
UD-1	0.6-2.0
SPT-2	WOH-1-1
UD-2	2.0-2.0
SPT-3	WOH-0-1
SPT-4	3-6-3
SPT-5	1-2-1
SPT-6	WOH
SPT-7	WOH
UD-3	0.0-2.0
SPT-8	4-7-11



SOIL 3043041043 01 SPT.GPJ LAW GIBB.GDT 10/13/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. BLOW COUNT "0" REPRESENTS WOH (WEIGHT OF HAMMER). GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 17, 2004 **BORING NO.:** B-3

PROJ. NO.: 3043041043/0001 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)

SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

LEGEND | ELEV (ft) | SAMPLES: IDENT, TYPE, N-COUNT (1st 6" 2nd 6" 3rd 6")

FIRM TO VERY DENSE, DARK GRAY, DRY TO SLIGHTLY MOIST, SILTY SAND WITH OCCASIONAL COAL FRAGMENTS - ASH

DENSE, DARK GRAY, SLIGHTLY MOIST TO MOIST, SILTY SAND WITH ROCK FRAGMENTS AND ORANGE BROWN SILTY CLAY - ASH / FILL

VERY STIFF, GRAY, SLIGHTLY MOIST, SANDY CLAY WITH COAL FRAGMENTS - FILL

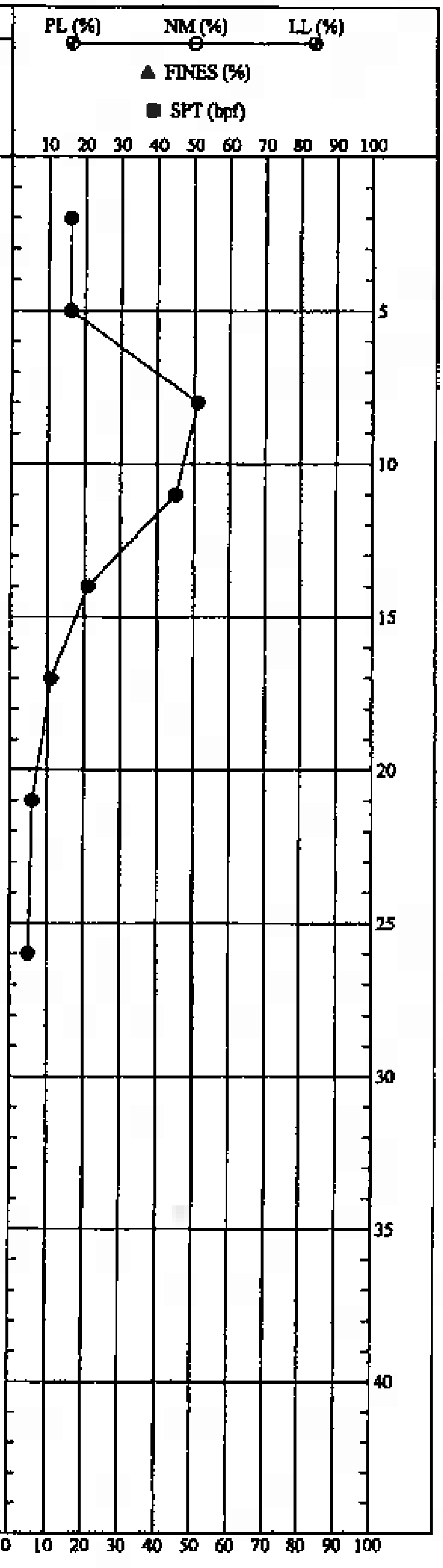
FIRM, GRAY, MOIST TO VERY MOIST, CLAYEY SAND WITH COAL FRAGMENTS - FILL

LOOSE, GRAY, WET, SILTY SAND WITH COAL FRAGMENTS - ASH

AUGER REFUSAL AT 26.9'

Depth (ft)	Elev (ft)
0	474.4
5	469.4
10	464.4
15	459.4
20	454.4
25	449.4
30	444.4
35	439.4
40	434.4
45	429.4

IDENT	N-COUNT
SPT-1	3-8-8
SPT-2	6-8-8
SPT-3	5-20-31
SPT-4	12-21-24
SPT-5	6-11-10
SPT-6	4-7-4
SPT-7	3-3-3
SPT-8	2-3-2



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

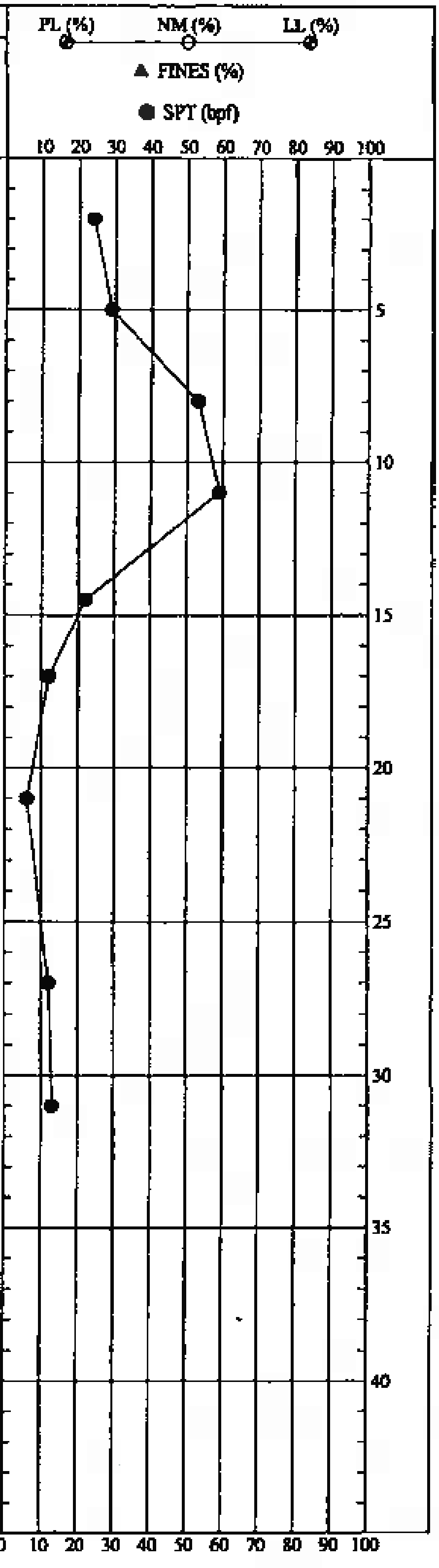
PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 17, 2004 **BORING NO.:** B-4

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
0	LOOSE TO VERY DENSE, DARK GRAY, DRY TO WET, SILTY SAND WITH COAL FRAGMENTS - ASH		473.5			
				SPT-1		4-9-15
5			468.5	SPT-2		9-14-15
				SPT-3		20-23-30
10			463.5			
				SPT-4		9-28-31
		▼		UD-1		0-0.5
				SPT-5		10-14-8
15			458.5			
		▽				
				SPT-6		4-4-8
				UD-2		0.8-2.0
20			453.5			
				SPT-7		2-3-3
	STIFF, ORANGE BROWN, SLIGHTLY MOIST, SILTY CLAY WITH A FEW CHERT FRAGMENTS - RESIDUUM					
25			448.5	UD-3		1.0-2.0
				SPT-8		3-5-7
30			443.5			
				SPT-9		2-5-8
	AUGER REFUSAL AT 33.4'					
35			438.5			
40			433.5			
45			428.5			



SOIL 3043041043 01 SPT.GPJ LAW GIBB.GDT 10/13/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 17, 2004 **BORING NO.:** B-5

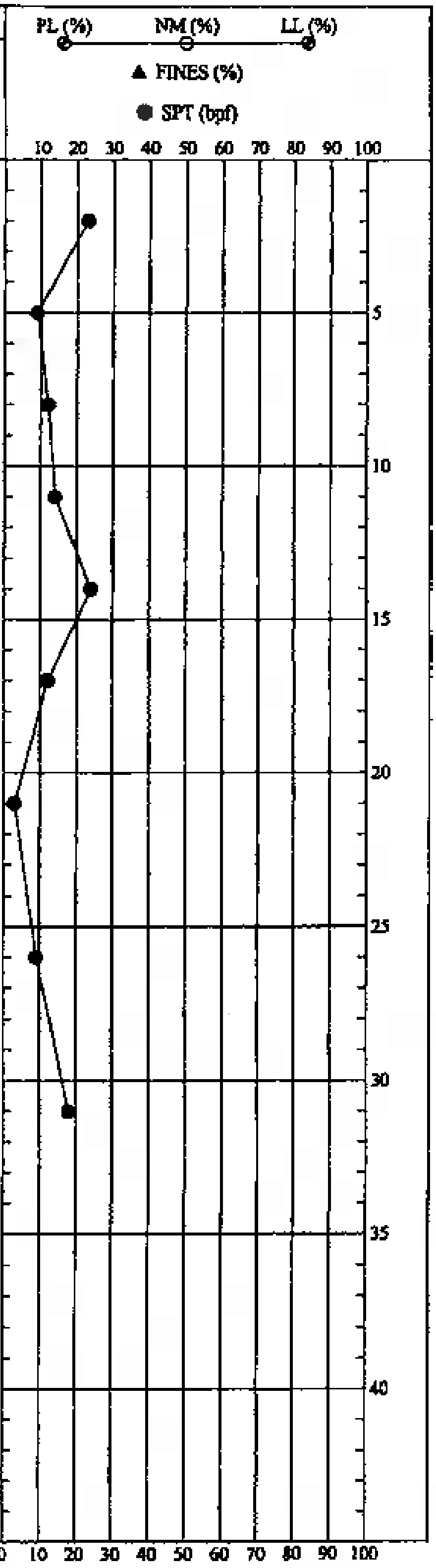
PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.
0	LOOSE TO VERY FIRM, DARK GRAY, SLIGHTLY MOIST TO WET, SILTY SAND WITH COAL FRAGMENTS - ASH
	VERY LOOSE, DARK GRAY, WET, COAL AND GRAVEL FRAGMENTS WITH SILTY SAND - ASH/FILL
	STIFF, ORANGE BROWN, SLIGHTLY MOIST TO MOIST, SILTY CLAY WITH A FEW ROUNDED GRAVELS - ALLUVIUM / POSSIBLE RESIDUUM
	VERY STIFF, ORANGE BROWN AND TAN, SLIGHTLY MOIST, SILTY CLAY - RESIDUUM / POSSIBLE ALLUVIUM
	AUGER REFUSAL AT 32.7'

DEPTH (ft)	ELEV (ft)
0	472.0
5	467.0
10	462.0
15	457.0
20	452.0
25	447.0
30	442.0
35	437.0
40	432.0
45	427.0

SAMPLES IDENT	N-COUNT (1st 6" 2nd 6" 3rd 6")
SPT-1	9-11-12
SPT-2	3-4-5
SPT-3	3-3-9
SPT-4	3-5-9
SPT-5	7-13-11
SPT-6	4-6-6
SPT-7	1-1-2
SPT-8	3-3-6
SPT-9	6-7-11



SOIL 3043041043.01 SPT.GPJ LAW GIBB.GDT 10/13/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller: Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

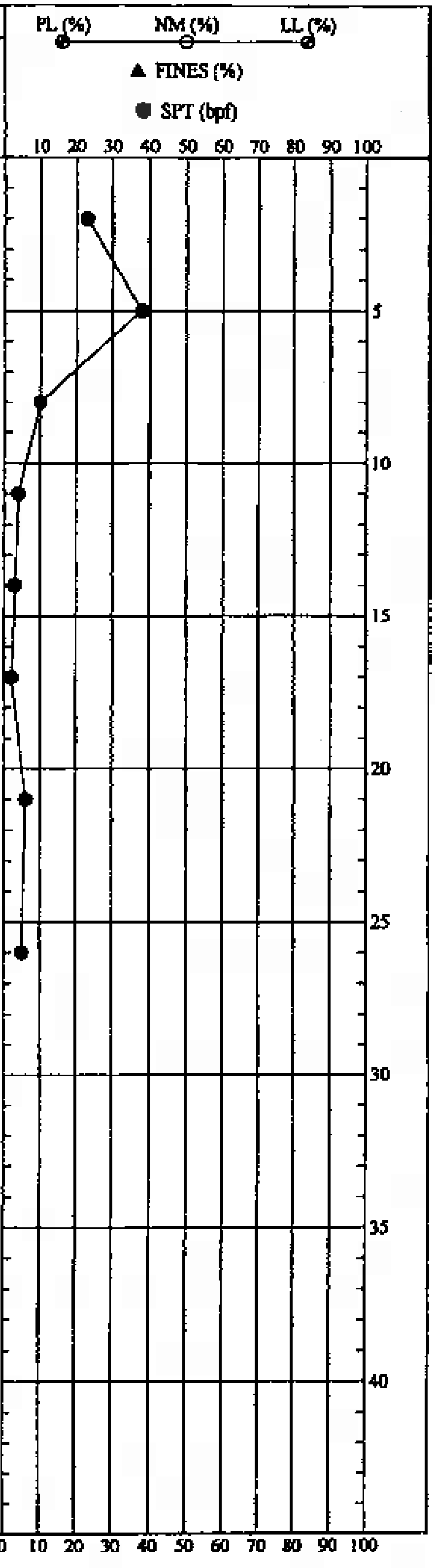
DRILLED: August 12, 2004 **BORING NO.:** B-6

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)
0	LOOSE TO DENSE, DARK GRAY, DRY TO WET, SILTY SAND WITH COAL FRAGMENTS - ASH	461.0
5		456.0
	VERY LOOSE TO LOOSE, DARK GRAY, WET, SILTY SAND WITH COAL FRAGMENTS AND ORANGE BROWN, SILTY CLAY - ASH / FILL	
10		451.0
15		446.0
20		441.0
	FIRM, GRAY, SLIGHTLY MOIST, SILTY CLAY WITH CHERT FRAGMENTS, COAL FRAGMENTS, AND ROOTS - ALLUVIUM	
25		436.0
	AUGER REFUSAL AT 28.4'	
30		431.0
35		426.0
40		421.0
45		416.0

SAMPLES IDENT	N-COUNT (1st 6" 2nd 6" 3rd 6")
SPT-1	9-13-10
SPT-2	20-23-15
SPT-3	4-6-4
SPT-4	2-2-2
SPT-5	2-1-2
SPT-6	3-1-1
SPT-7	3-3-3
SPT-8	2-3-2



SOIL 3043041043_01 SPT.GPJ LAW_GIHB.GDT 10/13/04

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

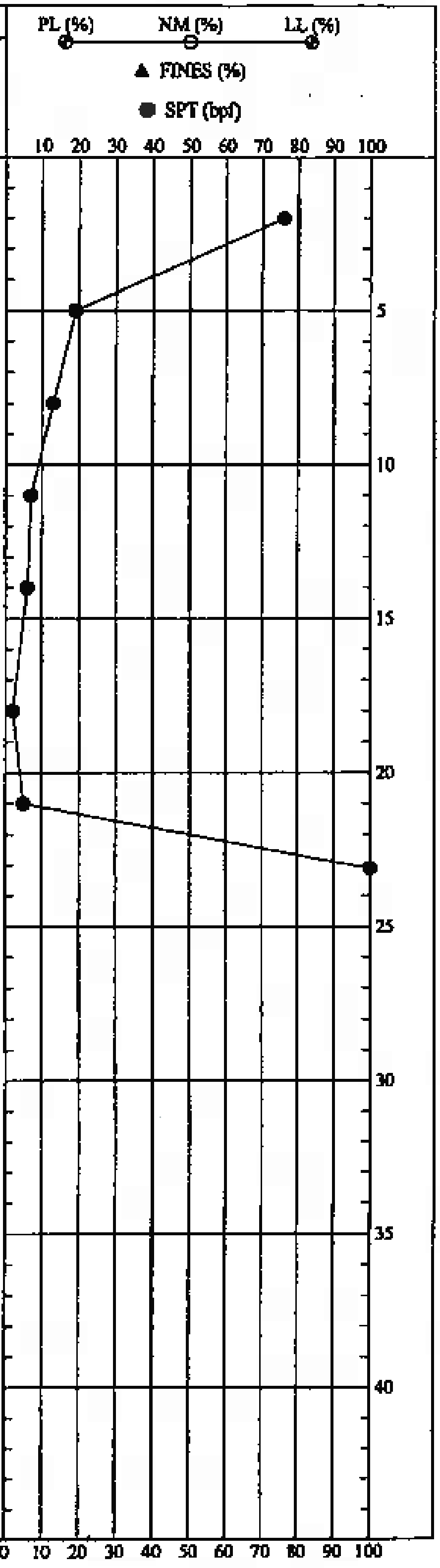
DRILLED: August 17, 2004 **BORING NO.:** B-7

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)
0	VERY DENSE, BROWN, SLIGHTLY MOIST, SAND WITH ASH AND ROCK FRAGMENTS - FILL	461.0
	VERY LOOSE TO FIRM, DARK GRAY, WET, SILTY SAND WITH COAL FRAGMENTS AND GRAVEL - ASH	
5		456.0
10		451.0
15		446.0
	FIRM, OLIVE GRAY TO ORANGE BROWN, MOIST TO VERY MOIST, SILTY CLAY WITH A FEW CHERT FRAGMENTS - ALLUVIUM / POSSIBLE RESIDUUM	
20		441.0
	VERY HARD, LIMESTONE AND CHERT FRAGMENTS WITH ORANGE BROWN, MOIST, SILTY CLAY - RESIDUUM AUGER REFUSAL AT 23.6'	
25		436.0
30		431.0
35		426.0
40		421.0
45		416.0

SAMPLES IDENT	N-COUNT 1st 6" 2nd 6" 3rd 6"
SPT-1	11-40-36
SPT-2	8-9-10
SPT-3	6-7-6
SPT-4	3-3-4
SPT-5	1-3-3
SPT-6	3-1-1
SPT-7	WOH-2-3
UD-1	1.5-1.5
SPT-8	50/0.1



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 12, 2004 **BORING NO.:** B-8

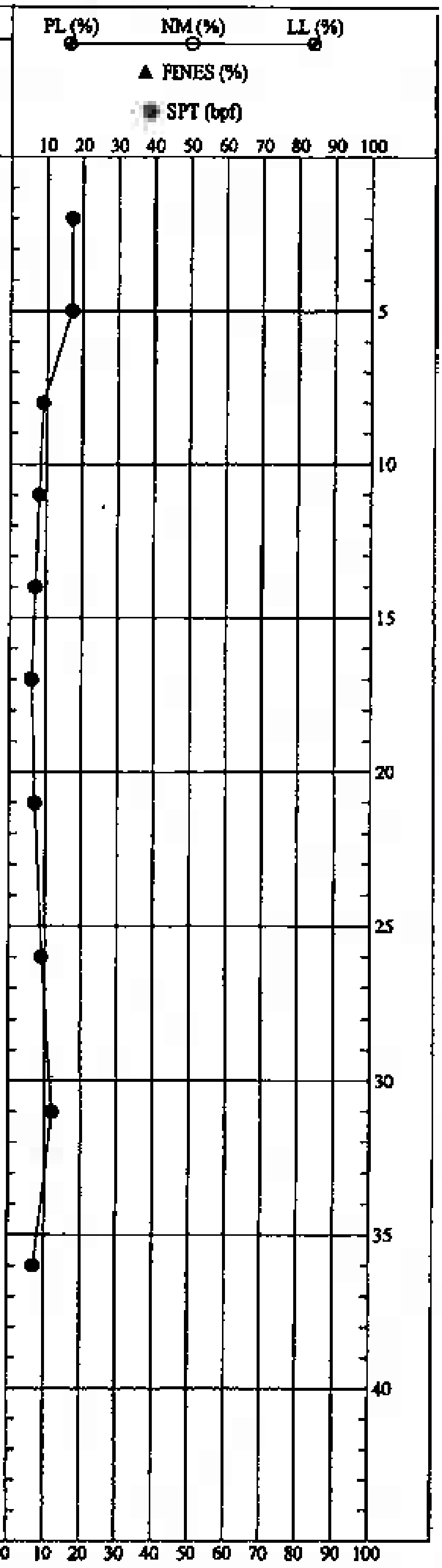
PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	ELEV (ft)
0	465.0
5	460.0
10	455.0
15	450.0
20	445.0
25	440.0
30	435.0
35	430.0
40	425.0
45	420.0

SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.
VERY STIFF, ORANGE BROWN, DRY TO SLIGHTLY MOIST, SILTY CLAY - RESIDUUM
VERY STIFF, ORANGE BROWN, DRY TO SLIGHTLY MOIST, SILTY CLAY WITH CHERT FRAGMENTS - RESIDUUM
FIRM TO STIFF, ORANGE BROWN, SLIGHTLY MOIST TO MOIST, SILTY CLAY - RESIDUUM
FIRM TO STIFF, ORANGE BROWN TO YELLOW BROWN, SLIGHTLY MOIST TO MOIST, SILTY CLAY WITH CHERT FRAGMENTS - RESIDUUM
AUGER REFUSAL AT 36.7'

SAMPLES IDENT	TYPE	N-COUNT 1st 6" 2nd 6" 3rd 6"
SPT-1	▦	4-7-10
SPT-2	▦	6-8-9
SPT-3	▦	4-4-5
SPT-4	▦	4-3-5
SPT-5	▦	2-3-4
SPT-6	▦	3-3-3
SPT-7	▦	3-2-5
SPT-8	▦	3-4-5
SPT-9	▦	4-6-6
SPT-10	▦	2-3-4



SOIL 3043041043_01_SPT.GPJ LAW_GIBB.GDT 10/13/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 18, 2004 **BORING NO.:** B-9

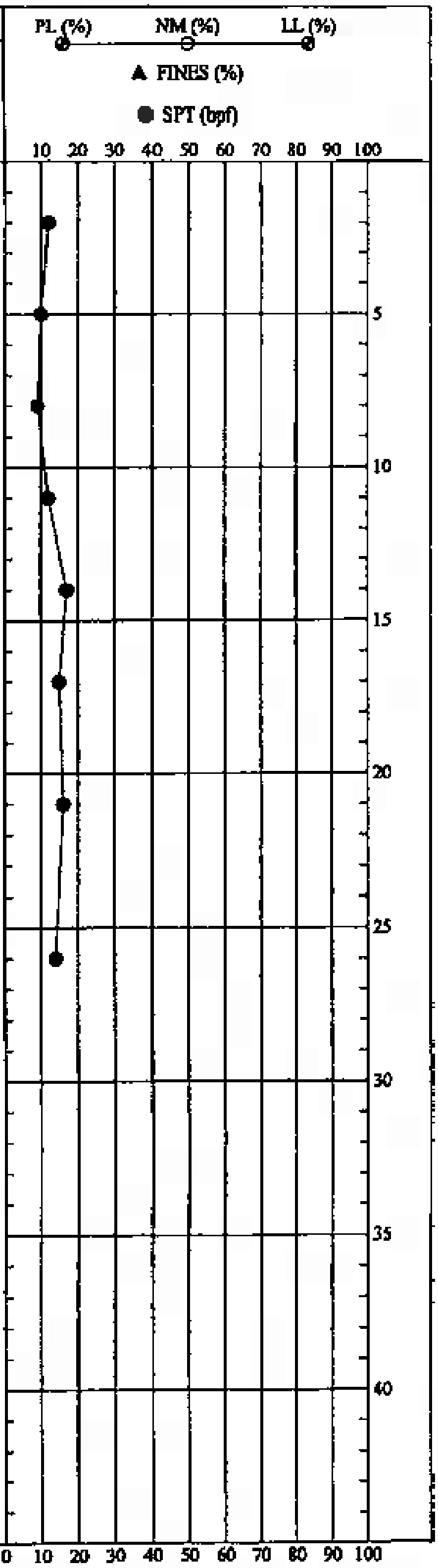
PROJ. NO.: 3043041043/0001 **PAGE 1 OF 1**

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)
0	STIFF, ORANGE BROWN, BROWN, AND OLIVE GREEN, SLIGHTLY MOIST, SILTY CLAY WITH CHERT FRAGMENTS, GRAVEL, AND ROOTS - FILL	▓	460.0
5	▼		455.0
	STIFF, OLIVE GRAY TO ORANGE BROWN, MOIST TO SLIGHTLY MOIST, SILTY CLAY WITH CHERT FRAGMENTS AND ROUNDED GRAVEL - ALLUVIUM	▤	
10			450.0
	STIFF TO VERY STIFF, ORANGE BROWN, SLIGHTLY MOIST, SILTY CLAY WITH CHERT FRAGMENTS - RESIDUUM	▨	
15			445.0
20			440.0
25			435.0
	AUGER REFUSAL AT 26.7'		
30			430.0
35			425.0
40			420.0
45			415.0

SAMPLES

IDENT	N-COUNT 1st 6" 2nd 6" 3rd 6"
SPT-1	5-6-6
SPT-2	3-4-6
SPT-3	2-5-4
SPT-4	3-5-7
SPT-5	6-7-10
SPT-6	5-7-8
SPT-7	5-7-9
SPT-8	3-6-8



SOIL 3043041043 01 SPT.GPJ LAW GIBB.GDT 10/13/04

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 12, 2004 **BORING NO.:** B-10

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

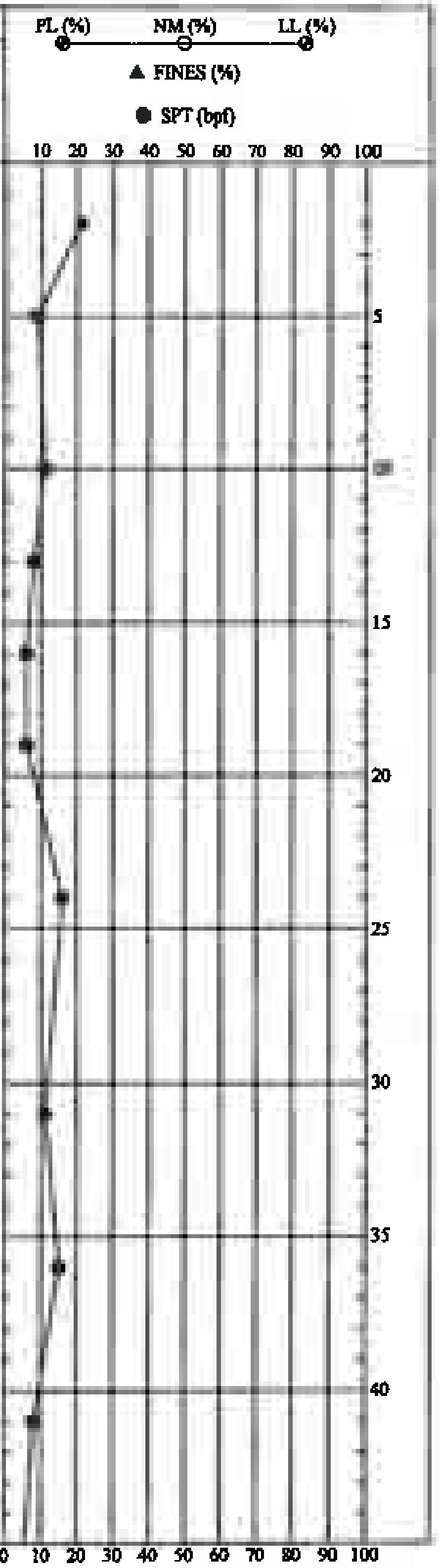
SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	VERY STIFF, BROWN, SLIGHTLY MOIST, SILTY CLAY WITH ASH, COAL FRAGMENTS, AND ROCK FRAGMENTS - FILL	460.0
	FIRM TO STIFF, ORANGE BROWN, SLIGHTLY MOIST, SILTY CLAY WITH ROCK FRAGMENTS - FILL	
5		455.0
10	▼	450.0
	FIRM TO VERY STIFF, ORANGE BROWN, SLIGHTLY MOIST TO VERY MOIST, SILTY CLAY WITH ROUNDED GRAVEL - ALLUVIUM	
15		445.0
	▽	
20		440.0
25		435.0
	FIRM, ORANGE BROWN, MOIST TO WET, SILTY SAND - ALLUVIUM	
30		430.0
	STIFF, ORANGE BROWN TO LIGHT GRAY, SLIGHTLY MOIST, SILTY CLAY - ALLUVIUM	
	FIRM, ORANGE BROWN, VERY MOIST TO WET, CLAYEY SAND WITH GRAVEL - ALLUVIUM	
35		425.0
	FIRM, ORANGE BROWN, MOIST TO WET, SILTY CLAY WITH SAND AND ROUNDED GRAVEL - ALLUVIUM	
40		420.0
45		415.0

SAMPLES

IDENT	N-COUNT (1st 6" - 2nd 6" - 3rd 6")
SPT-1	4-9-12
SPT-2	4-4-5
UD-1	1.6-2.0
SPT-3	3-6-5
SPT-4	3-3-5
SPT-5	3-3-3
SPT-6	1-3-3
SPT-7	6-8-8
UD-2	2.0-2.0
SPT-8	4-6-5
SPT-9	WOH-8-7
SPT-10	1-4-4



REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. BLOW COUNT "0" REPRESENTS WOH (WEIGHT OF HAMMER). GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 10, 2004 **BORING NO.:** B-11

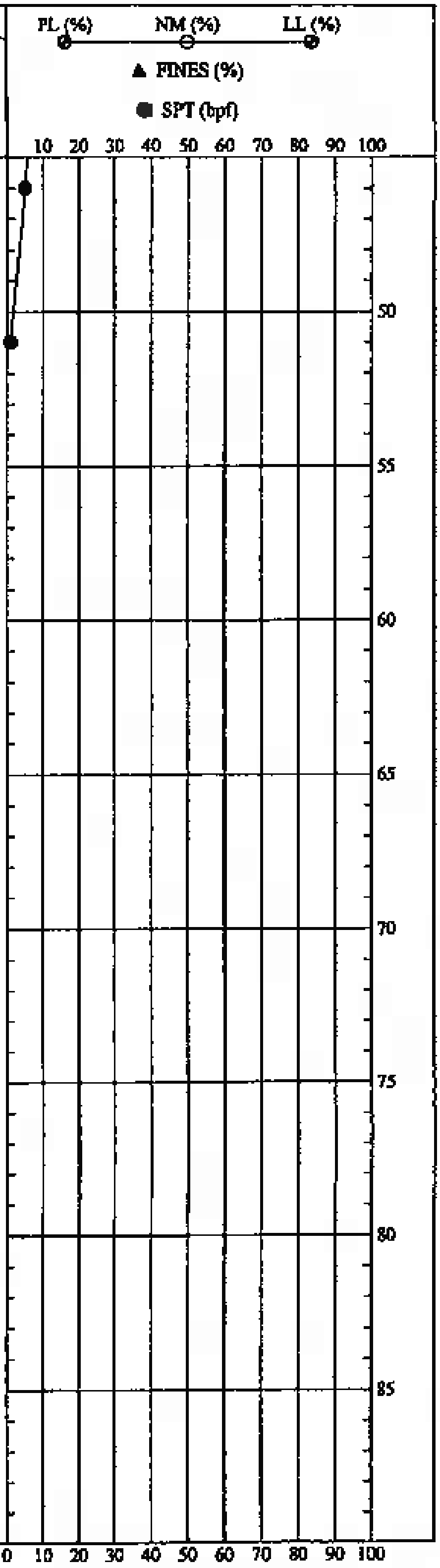
PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 2

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	ELEV (ft)	SAMPLES IDENT	N-COUNT 1st 6" 2nd 6" 3rd 6"
45	FIRM, ORANGE BROWN, MOIST TO WET, SILTY CLAY WITH SAND AND ROUNDED GRAVEL - ALLUVIUM	415.0	SPT-11	WOH-3-2
50	VERY SOFT, ORANGE BROWN, VERY MOIST TO WET, SILTY CLAY WITH CHERT FRAGMENTS - RESIDUUM	410.0	SPT-12	WOH-0-1
55	AUGER REFUSAL AT 54.2'	405.0		
60		400.0		
65		395.0		
70		390.0		
75		385.0		
80		380.0		
85		375.0		
90		370.0		



SOIL 3043041043 01 SPT.GPJ LAW GIBB.GDT 10/13/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. BLOW COUNT "0" REPRESENTS WOH (WEIGHT OF HAMMER). GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 10, 2004 **BORING NO.:** B-11

PROJ. NO.: 3043041043/0001 **PAGE** 2 **OF** 2

MACTEC

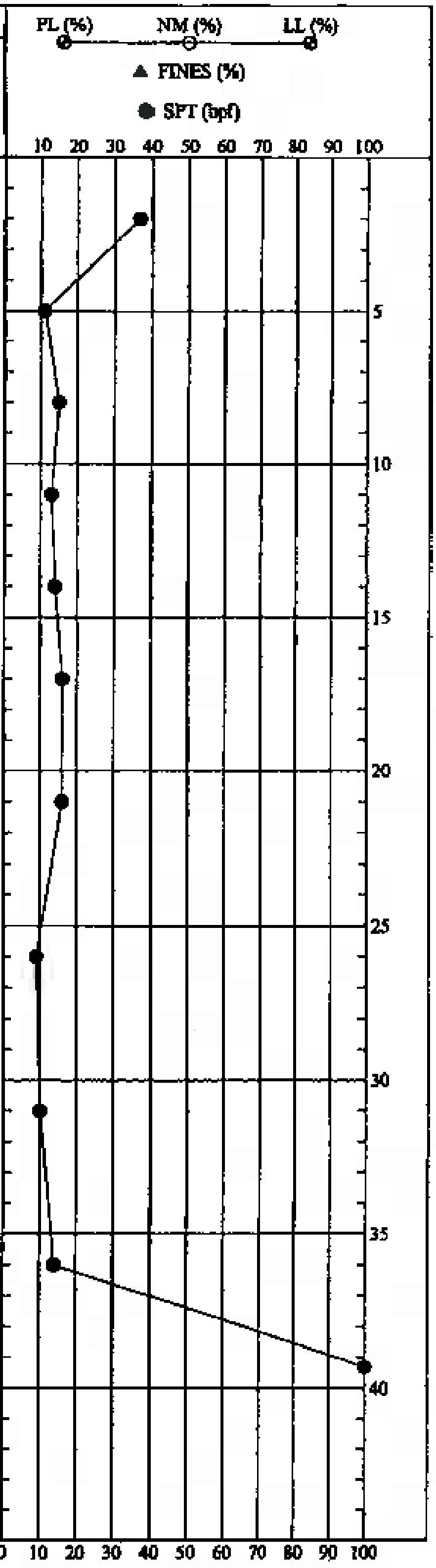
SOIL CLASSIFICATION AND REMARKS

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)
0	GRAVEL (CRUSHED LIMESTONE) STIFF TO HARD, OLIVE BROWN TO REDDISH BROWN, DRY TO SLIGHTLY MOIST, SANDY SILT WITH DARK GRAY ASH, ROCK FRAGMENTS AND WOOD FRAGMENTS - FILL	461.0
5	STIFF, GRAYISH BROWN TO BROWN, DRY TO SLIGHTLY MOIST, SILTY CLAY - ALLUVIUM	456.0
10	STIFF TO VERY STIFF, BROWN AND GRAY, DRY TO MOIST, SILTY CLAY WITH AN OCCASIONAL SANDY LENSE - ALLUVIUM	451.0
15		446.0
20		441.0
25	STIFF, ORANGE BROWN, SLIGHTLY MOIST TO MOIST, SILTY CLAY WITH OCCASIONAL ROUNDED GRAVEL - ALLUVIUM	436.0
30	STIFF, ORANGE BROWN, SLIGHTLY MOIST, SILTY CLAY WITH A TRACE OF CHERT FRAGMENTS - RESIDUUM	431.0
35	VERY HARD, GRAY, CHERT FRAGMENTS WITH WET ORANGE BROWN, SILTY CLAY - RESIDUUM AUGER REFUSAL AT 39.0' BORING TERMINATED AT 39.3'	426.0
40		421.0
45		416.0

SAMPLES

IDENT	N-COUNT (1st 6" 2nd 6" 3rd 6")
SPT-1	5-12-25
SPT-2	3-5-6
SPT-3	4-7-8
SPT-4	3-6-7
SPT-5	3-6-8
SPT-6	5-7-9
SPT-7	5-7-9
SPT-8	2-4-5
SPT-9	3-4-6
SPT-10	3-6-8
SPT-11	50/0.3



SOIL 3043041043_01 SPT.GPJ LAW GIBB.GDT 10/13/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

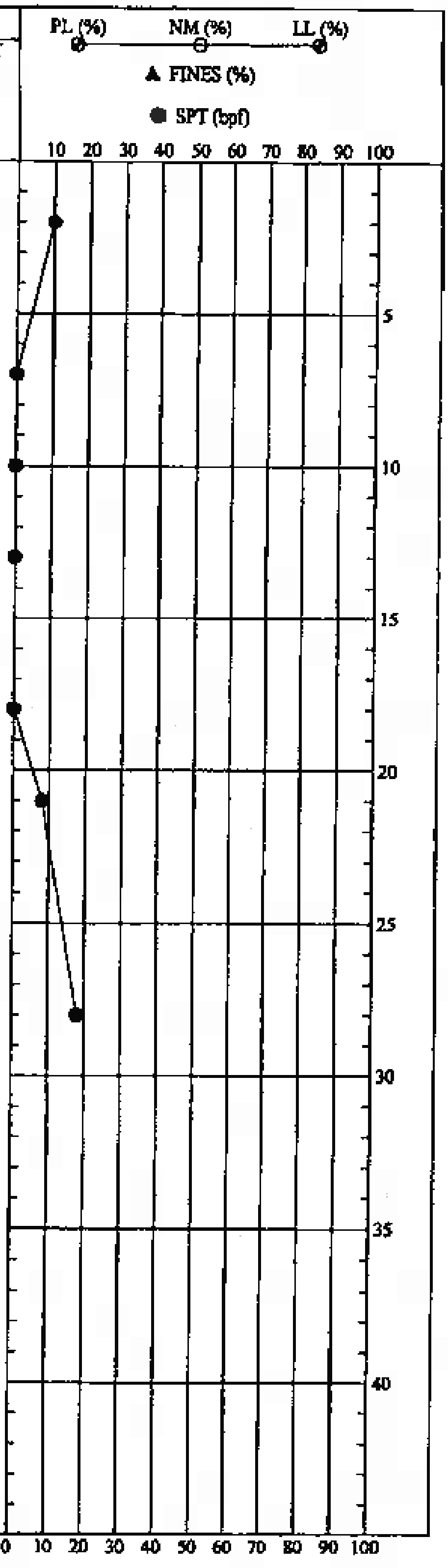
DRILLED: August 9, 2004 **BORING NO.:** B-12

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	ELEV (ft)	SAMPLES IDENT	N-COUNT 1st 6" 2nd 6" 3rd 6"
0	STIFF, BROWN TO OLIVE GRAY, SLIGHTLY MOIST, SANDY CLAY - FILL	461.0		
			SPT-1	3-5-5
5	VERY SOFT, GRAY, WET, SANDY SILT - ASH	456.0	UD-1	2.0-2.0
			SPT-2	WOH
10		451.0	SPT-3	WOH
	VERY SOFT, GRAY, WET, CLAYEY SILT - ASH			
			SPT-4	WOH
15		446.0	UD-2	2.0-2.0
			SPT-5	WOH
	FIRM, GRAY, MOIST, SILTY CLAY - ALLUVIUM			
20		441.0		
	FIRM TO VERY STIFF, ORANGE BROWN, SLIGHTLY MOIST SILT CLAY WITH A FEW CHERT FRAGMENTS - RESIDUUM		SPT-6	1-3-5
25		436.0	UD-3	1.5-2.0
			SPT-7	10-9-9
30	AUGER REFUSAL AT 29.5'	431.0		
35		426.0		
40		421.0		
45		416.0		



SOIL 3043041043 01_SPT.GPJ LAW_GIBB.GDT 10/13/04

REMARKS: STANDARD PENETRATION RESISTANCE TESTING PERFORMED USING AN AUTOMATIC HAMMER. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

SOIL TEST BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 10, 2004 **BORING NO.:** B-13

PROJ. NO.: 3043041043/0001 **PAGE 1 OF 1**

MACTEC

GROUP SYMBOLS	TYPICAL NAMES	GROUP SYMBOLS	TYPICAL NAMES
▩	**TOPSOIL**	⁘	**CONCRETE**
■	**ASPHALT**	☰	**DOLOMITE**
⁘	**GRAVEL**	▦	**LIMESTONE**
▩	**FILL**	☰	**SHALE**
▩	**SUBSOIL**	▦	**LIMESTONE/SHALE** - Limestone with shale interbeds
▤	**ALLUVIUM**	▒	**SANDSTONE**
▤	**COLLUVIUM**	▥	**SILTSTONE**
▒	**RESIDUUM** - Soft to firm	▥	**AUGER BORING**
▩	**RESIDUUM** - Stiff to very hard	▮	**UNDISTURBED SAMPLE ATTEMPT**

■	Undisturbed Sample 1.5-2.0 = Recovered (ft) / Pushed (ft)		
▩	Split Spoon Sample	■	Auger Cuttings
▯	Rock Core 60-100 = RQD / Recovery	▩	Dilatometer
▯	No Sample	▨	Crandall Sampler
▯	Rotary Drill	⁘	Pressure Meter
∇	Water Table at time of drilling	○	No Recovery
		▼	Water Table after 24 hours

Correlation of Penetration Resistance
with Relative Density and Consistency

SAND & GRAVEL		SILT & CLAY	
No. of Blows	Relative Density	No. of Blows	Consistency
0 - 4	Very Loose	0 - 2	Very Soft
5 - 10	Loose	3 - 4	Soft
11 - 20	Firm	5 - 8	Firm
21 - 30	Very Firm	9 - 15	Stiff
31 - 50	Dense	16 - 30	Very Stiff
Over 50	Very Dense	31 - 50	Hard.
		Over 50	Very Hard

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

SILT OR CLAY	SAND			GRAVEL		Cobbles	Boulders
	Fine	Medium	Coarse	Fine	Coarse		

No.200 No.40 No.10 No.4 3/4" 3" 12"

U.S. STANDARD SIEVE SIZE

Reference: The Unified Soil Classification System, Corps of Engineers, U.S. Army Technical Memorandum No. 3-357, Vol. 1, March, 1953 (Revised April, 1960)

KEY TO SYMBOLS AND DESCRIPTIONS

MACTEC

MACTEC Engineering and Consulting, Inc.
1725 Louisville Drive
Knoxville, Tennessee 37921-5904
865-588-8544 • Fax: 865-588-8026

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT 1st 6"	N-COUNT 2nd 6"	N-COUNT 3rd 6"
0	ORANGE-BROWN, SILTY CLAY WITH ROCK FRAGMENTS (ROUNDED GRAVEL AND CHERT)		478.0					
5			473.0					
10			468.0					
15			463.0					
	AUGER REFUSAL AT 18.5'							
20			458.0					
25			453.0					
30			448.0					
35			443.0					
40			438.0					
45			433.0					

SOIL-AUGER 3043041043 01.GPJ LAW GIBB.GDT 10/13/04

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004 **BORING NO.:** A-1

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"
0	ORANGE-BROWN TO BROWN, SILTY CLAY WITH ROCK FRAGMENTS (ROUNDED GRAVEL AND CHERT)		483.0					
5			478.0					
10			473.0					
15			468.0					
20	BORING TERMINATED AT 20.0'		463.0					
25			458.0					
30			453.0					
35			448.0					
40			443.0					
45			438.0					

SOIL-AUGER 3043041043_01.GPJ LAW_GIBB.GDT 10/13/04

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004 **BORING NO.:** A-2

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES				
				IDENT	TYPE	N-COUNT		
						1st 6"	2nd 6"	3rd 6"
0	ORANGE-BROWN, SILTY CLAY		477.0					
5			472.0					
10			467.0					
15			462.0					
20	BORING TERMINATED AT 20.0'		457.0					
25			452.0					
30			447.0					
35			442.0					
40			437.0					
45			432.0					

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004 **BORING NO.:** A-3

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT 1st 6"	N-COUNT 2nd 6"	N-COUNT 3rd 6"	
0	ORANGE-BROWN, SILTY CLAY WITH ROCK FRAGMENTS		475.0						
5			470.0						
10			465.0						
15	BORING TERMINATED AT 15.0'		460.0						
20			455.0						
25			450.0						
30			445.0						
35			440.0						
40			435.0						
45			430.0						

SOIL-AUGER 3043041043 01.GPJ LAW GBB.GDT 10/13/04

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Driller: Akins

Prepared By: Justice

Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004

BORING NO.: A-4

PROJ. NO.: 3043041043/0001

PAGE 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT 1st 6"	N-COUNT 2nd 6"	N-COUNT 3rd 6"
0	ORANGE-BROWN, SILTY CLAY WITH A FEW ROCK FRAGMENTS		473.0					
5			468.0					
10			463.0					
15	BORING TERMINATED AT 15.0'		458.0					
20			453.0					
25			448.0					
30			443.0					
35			438.0					
40			433.0					
45			428.0					

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004 **BORING NO.:** A-5

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES					
				IDENT	TYPE	N-COUNT			
						1st 6"	2nd 6"	3rd 6"	
0	TAN TO ORANGE-BROWN, SILTY CLAY WITH A FEW ROCK FRAGMENTS		473.0						
5			468.0						
10			463.0						
	AUGER REFUSAL AT 11.5'								
15			458.0						
20			453.0						
25			448.0						
30			443 0						
35			438.0						
40			433.0						
45			428.0						

SOIL-AUGER 3043041043_01.GPJ LAW GIBB.GDT 10/13/04

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004 **BORING NO.:** A-6

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT 1st 6"	N-COUNT 2nd 6"	N-COUNT 3rd 6"
0	ORANGE-BROWN TO TAN, SILTY CLAY WITH A FEW ROCK FRAGMENTS		475.0					
5			470.0					
10			465.0					
15			460.0					
20	BORING TERMINATED AT 20.0'		455.0					
25			450.0					
30			445.0					
35			440.0					
40			435.0					
45			430.0					

SOIL-AUGER 3043041043_01.GPJ LAW GIBB.GDT 10/13/04

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004 **BORING NO.:** A-7

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES IDENT	TYPE	N-COUNT 1st 6"	2nd 6"	3rd 6"
0	BROWN, SILTY CLAY WITH ROUNDED GRAVEL AND CHERT FRAGMENTS		474.0					
5			469.0					
10			464.0					
15	BORING TERMINATED AT 15.0'		459.0					
20			454.0					
25			449.0					
30			444.0					
35			439.0					
40			434.0					
45			429.0					

SOIL-AUGER 3043041043 01.GPJ LAW GIBB.GDT 10/13/04

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C

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Driller : Akins

Prepared By: Justice

Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 11, 2004 **BORING NO.:** A-8

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT 1st 6"	N-COUNT 2nd 6"	N-COUNT 3rd 6"	
0	TAN, SILTY CLAY		541.0						
5			536.0						
10			531.0						
15	BORING TERMINATED AT 15.0'		526.0						
20			521.0						
25			516.0						
30			511.0						
35			506 0						
40			501.0						
45			496.0						

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 13, 2004 **BORING NO.:** A-9

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS	LEGEND	ELEV (ft)	SAMPLES				
				IDENT	TYPE	N-COUNT		
						1st 6"	2nd 6"	3rd 6"
0	LIGHT GRAYISH BROWN, SILTY CLAY / CLAYEY SILT		513.0					
5	AUGER REFUSAL AT 5.0'		508.0					
10			503.0					
15			498.0					
20			493.0					
25			488.0					
30			483.0					
35			478.0					
40			473.0					
45			468.0					

SOIL-AUGER 3043041043_01.GPJ LAW GIBB.GDT 10/13/04

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 13, 2004 **BORING NO.:** A-10

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT 1st 6"	N-COUNT 2nd 6"	N-COUNT 3rd 6"	
0	TAN TO LIGHT BROWN, CLAYEY SILT AND SILTY CLAY		572.0						
5			567.0						
10			562.0						
	AUGER REFUSAL AT 12.5'								
15			557.0						
20			552.0						
25			547.0						
30			542.0						
35			537.0						
40			532.0						
45			527.0						

SOIL-AUGER 3043041043_01.GPJ LAW_GIBB.GDT 10/13/04

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 13, 2004 **BORING NO.:** A-11

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT 1st 6"	N-COUNT 2nd 6"	N-COUNT 3rd 6"
0	LIGHT BROWN TO BROWN, SILTY CLAY WITH A FEW CHERT FRAGMENTS		523.0					
5			518.0					
10			513.0					
	AUGER REFUSAL AT 13.0'							
15			508.0					
20			503.0					
25			498.0					
30			493.0					
35			488.0					
40			483.0					
45			478.0					

SOIL-AUGER 3043041043_01.GPJ LAW_GIBB.GDT 10/13/04

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins

Prepared By: Justice

Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 13, 2004

BORING NO.: A-12

PROJ. NO.: 3043041043/0001

PAGE 1 OF 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT 1st 6"	N-COUNT 2nd 6"	N-COUNT 3rd 6"
0	ORANGE-BROWN TO LIGHT BROWN, CLAYEY SILT / SILTY CLAY		539.0					
5			534.0					
	AUGER REFUSAL AT 9.0'							
10			529.0					
15			524.0					
20			519.0					
25			514.0					
30			509.0					
35			504.0					
40			499.0					
45			494.0					

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

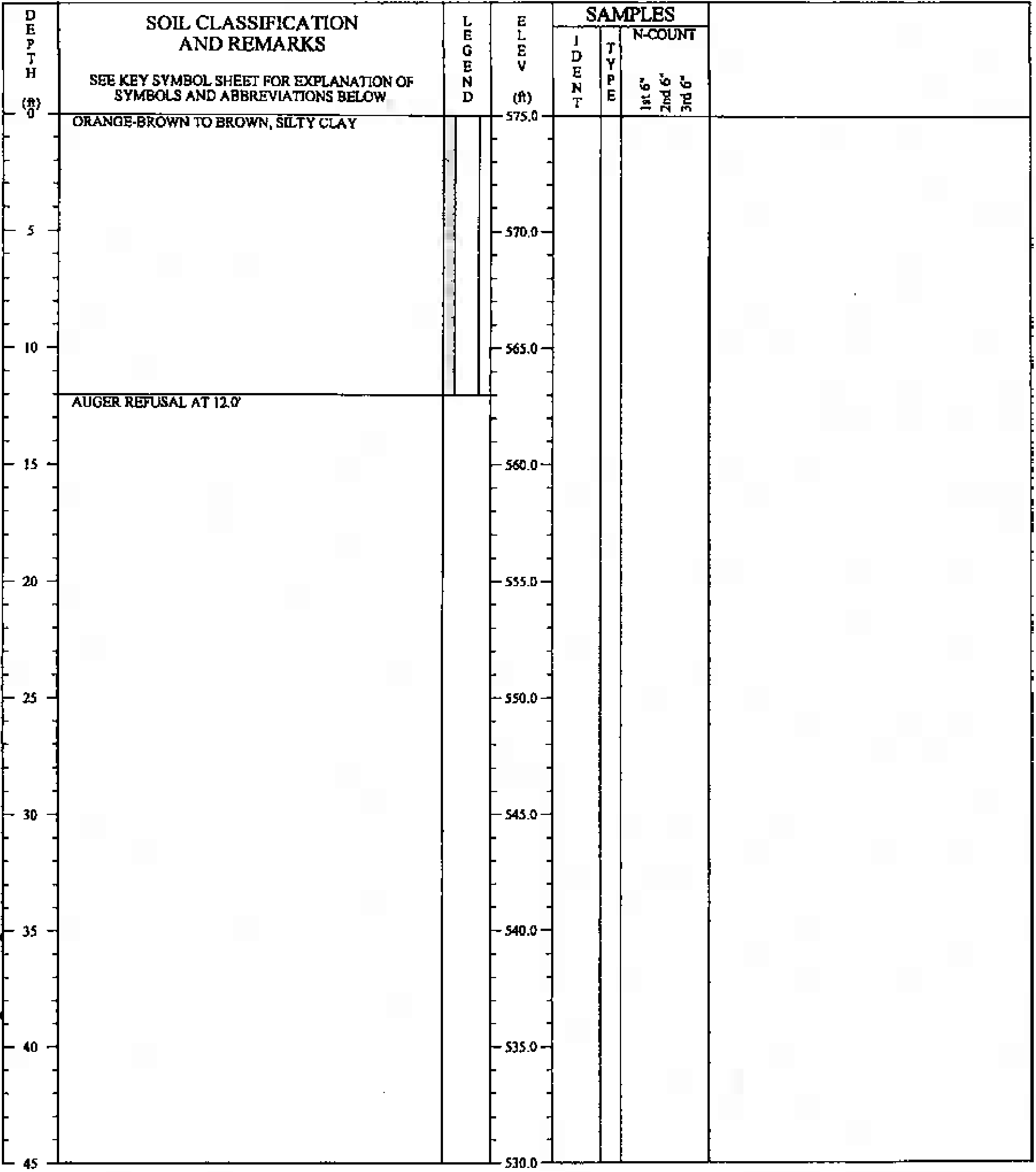
AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 13, 2004 **BORING NO.:** A-13

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC



ORANGE-BROWN TO BROWN, SILTY CLAY

AUGER REFUSAL AT 12.0'

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C.

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Driller : Akins
Prepared By: Justice
Checked By: H.A.B

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 13, 2004 **BORING NO.:** A-14

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES				
				IDENT	TYPE	N-COUNT		
						1st 6"	2nd 6"	3rd 6"
0	ASH WITH SILTY CLAY		496.0					
	SEVERELY WEATHERED BEDROCK INTERVAL							
5			491.0					
10			486.0					
15			481.0					
	AUGER REFUSAL AT 16.6'							
20			476.0					
25			471.0					
30			466.0					
35			461.0					
40			456.0					
45			451.0					

SOIL-AUGER 3043041043_01.GPJ LAW_GIBB.GDT 10/13/04

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C BASED ON AVAILABLE TOPOGRAPHIC MAP.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BETWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 10, 2004 **BORING NO.:** A-20

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

DEPTH (ft)	SOIL CLASSIFICATION AND REMARKS SEE KEY SYMBOL SHEET FOR EXPLANATION OF SYMBOLS AND ABBREVIATIONS BELOW.	LEGEND	ELEV (ft)	SAMPLES IDENT	SAMPLES TYPE	N-COUNT 1st 6"	N-COUNT 2nd 6"	N-COUNT 3rd 6"	
0	ASH		493.0						
	ORANGE-BROWN, SILTY CLAY								
5			488.0						
10	AUGER REFUSAL AT 10.0'		483.0						
15			478.0						
20			473.0						
25			468.0						
30			463.0						
35			458.0						
40			453.0						
45			448.0						

REMARKS: NO GROUND WATER ENCOUNTERED AT TIME OF EXPLORATION. GROUND SURFACE ELEVATION WAS OBTAINED FROM SURVEY DATA PROVIDED BY PARSONS E&C BASED ON AVAILABLE TOPOGRAPHIC MAP.

THIS RECORD IS A REASONABLE INTERPRETATION OF SUBSURFACE CONDITIONS AT THE EXPLORATION LOCATION. SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND AT OTHER TIMES MAY DIFFER. INTERFACES BEWEEN STRATA ARE APPROXIMATE. TRANSITIONS BETWEEN STRATA MAY BE GRADUAL.

Driller : Akins
Prepared By: Justice
Checked By: H.A.B.

AUGER BORING RECORD

PROJECT: TVA - Gallatin Ash Disposal Area

DRILLED: August 10, 2004 **BORING NO.:** A-21

PROJ. NO.: 3043041043/0001 **PAGE** 1 **OF** 1

MACTEC

OBSERVATION TRENCH LOG		
Project Name: TVA Gallatin Ash Disposal Area		**Logged By:** Todd Justice
Project Number: 3043041043/01		**Date Logged:** 8/16/04
Observation Trench Number: OT-1		**Surface Elevation:** 576.0
Depth (Feet)		**Stratum Description**
From	**To**	
0	0.5	Topsoil
0.5	3.5	Tan to light brown clayey silt / silty clay with some rock fragments
Remarks and Notes: Observation trench terminated at 3.5 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.		

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

OBSERVATION TRENCH LOG		
Project Name: TVA Gallatin Ash Disposal Area		**Logged By:** Todd Justice
Project Number: 3043041043/01		**Date Logged:** 8/16/04
Observation Trench Number: OT-2		**Surface Elevation:** 545.0
Depth (Feet)		**Stratum Description**
From	**To**	
0	0.5	Topsoil
0.5	2.0	Light grayish brown silt with rock fragments
2.0	2.5	Limestone bedrock fragments
Remarks and Notes: Observation trench refusal at 2.5 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.		

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

<table>
<tr><th colspan="3">OBSERVATION TRENCH LOG</th></tr>
<tr><td colspan="2">Project Name: TVA Gallatin Ash Disposal Area</td><td>Logged By: Todd Justice</td></tr>
<tr><td colspan="2">Project Number: 3043041043/01</td><td>Date Logged: 8/16/04</td></tr>
<tr><td colspan="2">Observation Trench Number: OT-3</td><td>Surface Elevation: 526.0</td></tr>
<tr><td colspan="2">Depth (Feet)</td><td rowspan="2">Stratum Description</td></tr>
<tr><td>From</td><td>To</td></tr>
<tr><td>0</td><td>0.5</td><td>Topsoil</td></tr>
<tr><td>0.5</td><td>2.0</td><td>Light brownish gray silt with rock fragments</td></tr>
<tr><td colspan="3">Remarks and Notes: Observation trench refusal at 2.0 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.</td></tr>
</table>

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

<table>
<tr><th colspan="3">OBSERVATION TRENCH LOG</th></tr>
<tr><td colspan="2">Project Name: TVA Gallatin Ash Disposal Area</td><td>Logged By: Todd Justice</td></tr>
<tr><td colspan="2">Project Number: 3043041043/01</td><td>Date Logged: 8/16/04</td></tr>
<tr><td colspan="2">Observation Trench Number: OT-4</td><td>Surface Elevation: 528.0</td></tr>
<tr><td colspan="2">Depth (Feet)</td><td rowspan="2">Stratum Description</td></tr>
<tr><td>From</td><td>To</td></tr>
<tr><td>0</td><td>0.5</td><td>Topsoil</td></tr>
<tr><td>0.5</td><td>4.5</td><td>Reddish brown to gray silty clay</td></tr>
<tr><td colspan="3">Remarks and Notes: Observation trench terminated at 4.5 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.</td></tr>
</table>

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

OBSERVATION TRENCH LOG		
Project Name: TVA Gallatin Ash Disposal Area		**Logged By:** Todd Justice
Project Number: 3043041043/01		**Date Logged:** 8/16/04
Observation Trench Number: OT-5		**Surface Elevation:** 528.0
Depth (Feet)		**Stratum Description**
From	**To**	
0	0.5	Topsoil
0.5	3.5	Reddish brown, brown, and gray sandy clay
3.5	4.0	Shale and limestone bedrock fragments
Remarks and Notes: Observation trench refusal at 4.0 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.		

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

OBSERVATION TRENCH LOG		
Project Name: TVA Gallatin Ash Disposal Area		**Logged By:** Todd Justice
Project Number: 3043041043/01		**Date Logged:** 8/16/04
Observation Trench Number: OT-6		**Surface Elevation:** 536.0
Depth (Feet)		**Stratum Description**
From	**To**	
0	0.5	Topsoil
0.5	4.0	Orange-brown sandy clay
Remarks and Notes: Observation trench terminated at 4.0 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.		

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

OBSERVATION TRENCH LOG		
Project Name: TVA Gallatin Ash Disposal Area		**Logged By:** Todd Justice
Project Number: 3043041043/01		**Date Logged:** 8/16/04
Observation Trench Number: OT-7		**Surface Elevation:** 530.0
Depth (Feet)		**Stratum Description**
From	**To**	
0	0.5	Topsoil
0.5	5.0	Orange-brown and gray sandy silty clay
Remarks and Notes: Observation trench terminated at 5.0 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.		

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

OBSERVATION TRENCH LOG		
Project Name: TVA Gallatin Ash Disposal Area		**Logged By:** Todd Justice
Project Number: 3043041043/01		**Date Logged:** 8/16/04
Observation Trench Number: OT-8		**Surface Elevation:** 525.0
Depth (Feet)		**Stratum Description**
From	**To**	
0	0.5	Topsoil
0.5	5.0	Orange-brown and gray sandy silty clay
Remarks and Notes: Observation trench terminated at 5.0 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.		

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

OBSERVATION TRENCH LOG		
Project Name: TVA Gallatin Ash Disposal Area		**Logged By:** Todd Justice
Project Number: 3043041043/01		**Date Logged:** 8/16/04
Observation Trench Number: OT-9		**Surface Elevation:** 542.0
Depth (Feet)		**Stratum Description**
From	**To**	
0	0.5	Topsoil
0.5	6.5	Orange-brown and gray silty clay
Remarks and Notes: Observation trench terminated at 6.5 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.		

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

OBSERVATION TRENCH LOG		
Project Name: TVA Gallatin Ash Disposal Area		**Logged By:** Todd Justice
Project Number: 3043041043/01		**Date Logged:** 8/16/04
Observation Trench Number: OT-10		**Surface Elevation:** 513.0
Depth (Feet)		**Stratum Description**
From	**To**	
0	0.5	Topsoil
0.5	5.0	Orange-brown and grayish brown clayey silt / silty clay
Remarks and Notes: Observation trench refusal at 5.0 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.		

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

<table>
<tr><th colspan="3">OBSERVATION TRENCH LOG</th></tr>
<tr><td colspan="2">Project Name: TVA Gallatin Ash Disposal Area</td><td>Logged By: Todd Justice</td></tr>
<tr><td colspan="2">Project Number: 3043041043/01</td><td>Date Logged: 8/16/04</td></tr>
<tr><td colspan="2">Observation Trench Number: OT-11</td><td>Surface Elevation: 501.0</td></tr>
<tr><td colspan="2">Depth (Feet)</td><td rowspan="2">Stratum Description</td></tr>
<tr><td>From</td><td>To</td></tr>
<tr><td>0</td><td>0.5</td><td>Topsoil</td></tr>
<tr><td>0.5</td><td>2.0</td><td>Light brown to tan silt with rock fragments</td></tr>
<tr><td colspan="3">Remarks and Notes: Observation trench refusal at 2.0 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.</td></tr>
</table>

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

<table>
<tr><th colspan="3">OBSERVATION TRENCH LOG</th></tr>
<tr><td colspan="2">Project Name: TVA Gallatin Ash Disposal Area</td><td>Logged By: Todd Justice</td></tr>
<tr><td colspan="2">Project Number: 3043041043/01</td><td>Date Logged: 8/16/04</td></tr>
<tr><td colspan="2">Observation Trench Number: OT-12</td><td>Surface Elevation: 598.0</td></tr>
<tr><td colspan="2">Depth (Feet)</td><td rowspan="2">Stratum Description</td></tr>
<tr><td>From</td><td>To</td></tr>
<tr><td>0</td><td>0.5</td><td>Topsoil</td></tr>
<tr><td>0.5</td><td>3.5</td><td>Orange-brown silty clay</td></tr>
<tr><td colspan="3">Remarks and Notes: Observation trench terminated at 3.5 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.</td></tr>
</table>

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

OBSERVATION TRENCH LOG

Project Name: TVA Gallatin Ash Disposal Area	**Logged By:** Todd Justice
Project Number: 3043041043/01	**Date Logged:** 8/16/04
Observation Trench Number: OT-13	**Surface Elevation:** 582.0

Depth (Feet)		Stratum Description
From	**To**	
0	0.5	Topsoil
0.5	5.0	Orange-brown silty clay

Remarks and Notes: Observation trench terminated at 5.0 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

OBSERVATION TRENCH LOG

Project Name: TVA Gallatin Ash Disposal Area	**Logged By:** Todd Justice
Project Number: 3043041043/01	**Date Logged:** 8/16/04
Observation Trench Number: OT-14	**Surface Elevation:** 589.0

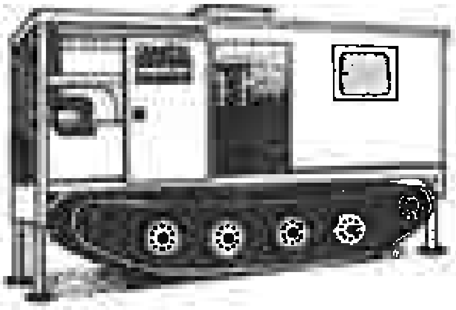
Depth (Feet)		Stratum Description
From	**To**	
0	0.5	Topsoil
0.5	5.0	Orange-brown and brown silty clay

Remarks and Notes: Observation trench refusal at 5.0 feet. Ground surface elevation was obtained from survey data provided by Parsons E&C.

Prepared/Date: CTJ 8/31/04
Checked/Date: HAB 9/8/04

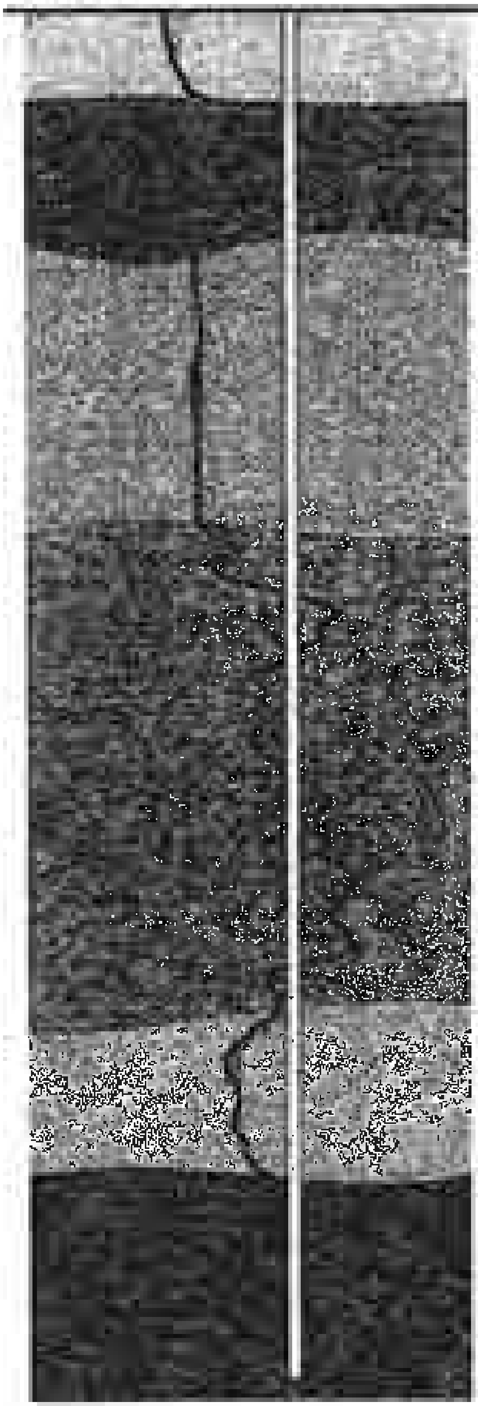
APPENDIX G

COOL DOWN [illegible] TEST PROCEDURES AND RESULTS



CONETEC

Geotechnical and Environmental In Situ Testing Contractors



ConeTec Field Report

Presentation of In Situ Test Results for:

Gallatin TVA Plant
Gallatin, Tennessee

Presented to:	MACTEC, Inc.
Date:	September 8th, 2004
Presented by:	ConeTec Inc. 436 Commerce Lane, Unit C West Berlin, NJ 08091 (856) 767-8600

Vancouver • Edmonton • Salt Lake City • New Jersey • Denver • Los Angeles • San Francisco • Houston • Hong Kong

PRESENTATION OF IN SITU TESTING PROGRAM RESULTS

Gallatin TVA Plant
Gallatin, Tennessee

September 8th, 2004

Prepared for:

MACTEC, Inc.
Knoxville, Tennessee

Prepared by:

ConeTec Inc.
West Berlin, NJ

September 10, 2004

TABLE OF CONTENTS

1.0 INTRODUCTION

This report presents the results of a peizo cone penetrometer testing (CPTU) program carried out at the Gallatin TVA Plant located south of Gallatin, Tennessee. The work was performed under subcontract to MACTEC, Inc. of Knoxville, Tennessee. The CPTU program took place during a single day period, on September 8th, 2004.

A total of eight soundings were completed at seven different sounding locations. The CPT testing was performed to evaluate in situ geotechnical criteria.

CPT sounding locations were selected and numbered under the direction and supervision of MACTEC personnel (Messrs. Todd Justice and Hussein Benkhayal).

2.0 FIELD EQUIPMENT AND PROCEDURES

2.1 CONE PENETRATION TESTING

The cone penetrometer tests were carried out using an integrated electronic piezo cone manufactured by ConeTec in Vancouver, Canada. The piezo cone used was a compression model cone penetrometer with a 15 cm^2 tip and a 225 cm^2 friction sleeve. The cone is designed with an equal end area friction sleeve and a tip end area ratio of 0.85. The piezo cone dimensions and the operating procedure were in accordance with ASTM Standard D-5778-95. A diagram of the cone penetrometer used for this project is shown as Figure 1.

Pore pressure filter elements, made of porous plastic, were saturated under a vacuum using glycerin as the saturating fluid. The pore pressure element was six millimeters thick and was located immediately behind the tip (the U_2 location) for all soundings.

The cone was advanced using a 25 ton, unitized, truck-mounted cone penetration rig. The following data were recorded onto magnetic media every five centimeters (approximately every two inches) as the cone was advanced into the ground:

- Tip Resistance (Qc)
- Sleeve Friction (Fs)
- Dynamic Pore Pressure (Ut)

The field data recorded is included on the attached diskette (appendix D).

Before each sounding a complete set of analog baseline readings are taken with a multi-meter and compared with the digitized value on the computer screen. This provides a check on the analog to digital conversion board.

Evaluation of the analog baselines is key to consistent readings. The baseline data should be stable and should not wander excessively during the course of a sounding. Baseline data can be used to apply corrections to the cone data where necessary. For this project, the baseline shift from sounding to sounding was small, typically less than 0.1% of full scale, and no data corrections were applied.

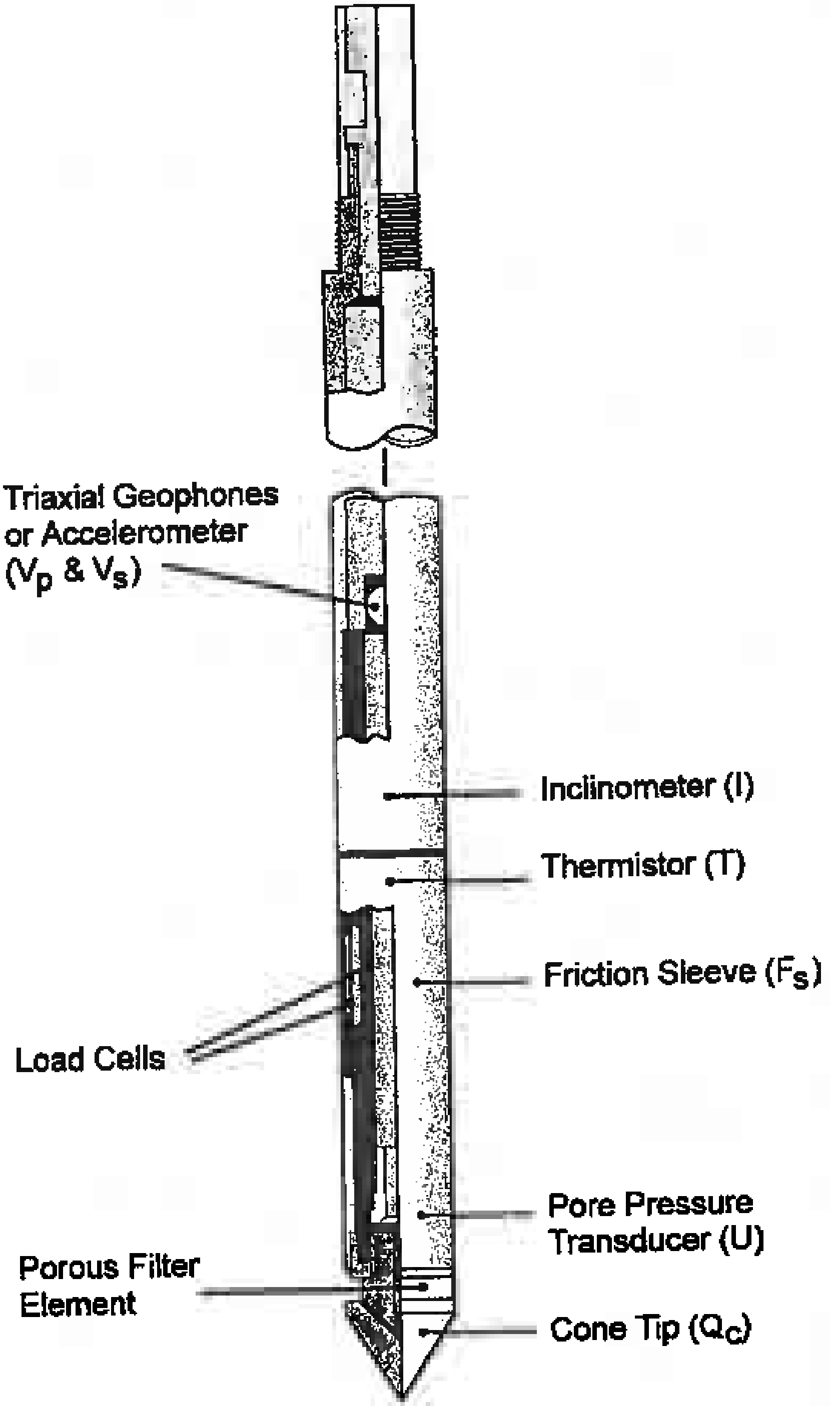


FIGURE 1 - TYPICAL CONE PENETROMETER

2.2 PORE PRESSURE DISSIPATION TESTS

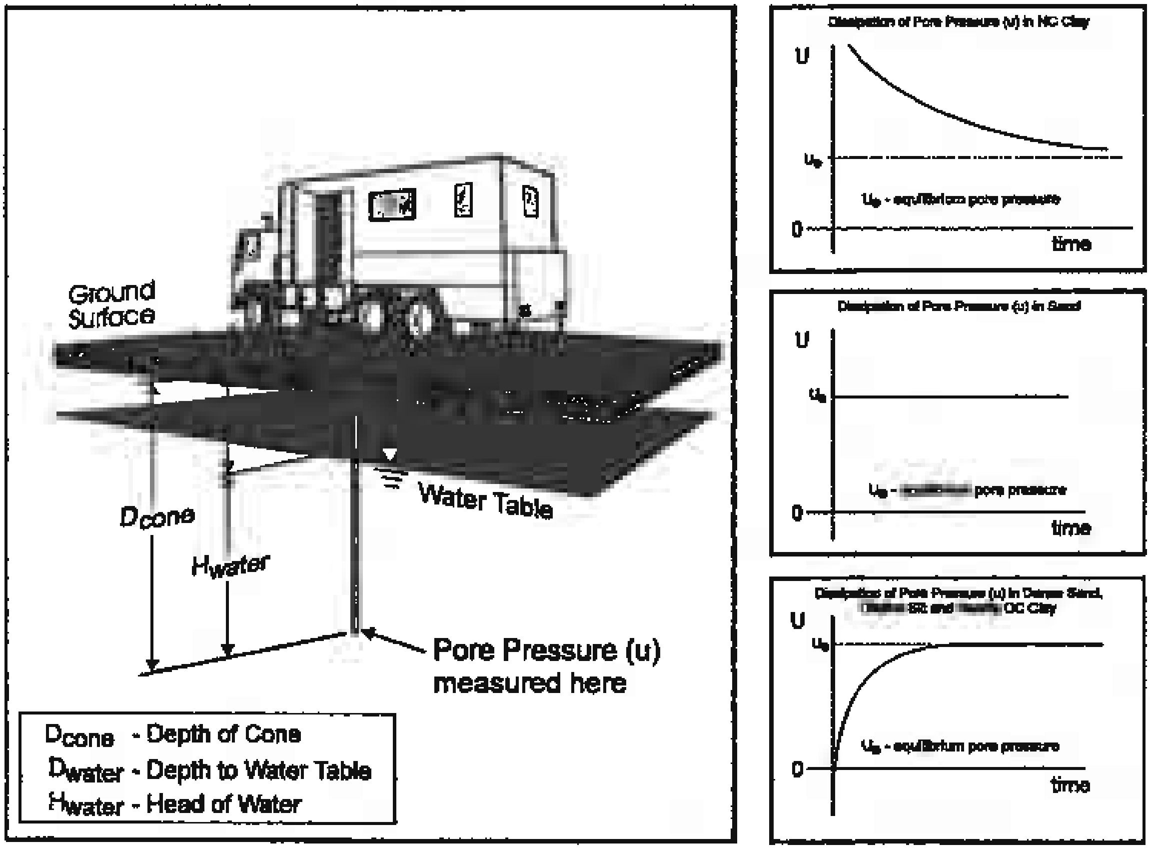
When cone penetration is stopped, the piezo cone essentially becomes a piezometer. While stopped, pore water pressures are automatically recorded at five-second intervals and the readings are stored in a dissipation file (.ppd). Dissipation data can then be plotted onto a dissipation curve consisting of pore water pressure (U) verses time (t). The shapes of dissipation curves are very useful in evaluating soil type, drainage and in situ static water level.

A flat curve that stabilizes quickly (i.e. less than 30 seconds) is typical of a free draining sand. In this case, the final measured pore water pressure is the static in situ water pressure.

Soils that generate excess dynamic pore water pressure during penetration will dissipate this excess pressure when penetration stops. The shape of the dissipation curve and the time of dissipation can be used to estimate C_h, the coefficient of consolidation that can in turn be used to calculate K_h, the horizontal permeability.

Figure 2 shows some idealized shapes of various pore water pressure dissipation curves. The reader is referred Robertson et. al., 1990 to reference dissipation test data analytical techniques.

Estimation of Ground Water Table from CPT Dissipation Tests



Water Table Calculation

$$D_{water} = D_{cone} - H_{water}$$

where $H_{water} = U_e$ (depth units)

Useful Conversion Factors:

1psi = 0.704m = 2.31 feet (water)
1tsf = 0.958 bar = 13.9 psi
1m = 3.28 feet

FIGURE 2 - TYPICAL DISSIPATION TESTS

3.0 CONE PENETRATION TEST DATA AND INTERPRETATION

3.1 ANALYSIS OF PIEZOCONE DATA - GENERAL

A total of eight CPT soundings, involving 1185.5 feet of testing, were completed at seven locations.

The interpretation of cone data is based on the relationship between cone bearing, Qc, sleeve friction, Fs, and penetration pore water pressure, U. The friction ratio, Rf , (sleeve friction divided by cone bearing) is a calculated parameter which is used to infer soil behavior type. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

The interpretation of soils encountered on this project was carried out using correlations developed by Robertson et al., 1986. It should be noted that it is not always possible to clearly identify a soil type based on Qc, Fs and Ut. Occasionally soils will fall within different soil categories on the classification charts. In these situations, experience and judgment and an assessment of the pore pressure dissipation data should be used to infer the soil behavior type. Computer tabulations of the interpreted soil types along with certain other geotechnical parameters for each cone hole is presented in Appendix B.

Each of the parameters measured in the sounding is discussed briefly below. A detailed explanation of CPTU testing and interpretation of the results can be found in "Guidelines for Geotechnical Design Using CPT and CPTU" by P. K. Robertson and R. G. Campanella, listed in the references.

TIP RESISTANCE (Q_c): The resistance to penetration, measured at the cone tip, provides an accurate profile of subsurface strata. The recorded tip resistance is a composite of the penetration resistance of the soils located five to ten cone diameters (7 to 14 inches) in front of and behind the tip. The actual resistance "sensed" by the tip depends on the soil properties and on the relative stiffness of the layers encountered. Tip resistance is often corrected for pore pressure effects when testing in soft saturated cohesive soils.

For this project the correction was made and the tip resistance shown, Q_t is the corrected tip resistance.

The correction used is: $Q_t = Q_c + (1-a)U$

Where:
Q_t = corrected tip resistance
Q_c = measured tip resistance
a = net area ratio for cone (0.85 for this project)
U = dynamic pore water pressure measured behind tip

SLEEVE FRICTION (F_s) The resistance recorded on the friction sleeve, is a measure of the remolded strength of the soil. Values of sleeve friction in very soft soils (such as peat) may fluctuate due to the measured force being small relative to the capacity of the measuring load cell.

FRICTION RATIO (R_f) The ratio of sleeve friction to tip resistance expressed as a percentage, is an indicator of soil type. Cohesive soils generally have friction ratios that are greater than two, while sands and non-plastic silts have friction ratios that are lower than two.

PORE PRESSURE (U) Dynamic pore water pressure is measured during penetration. (dynamic pore water pressure data can be found in the .cor, .ifi (importable) and .ifp (printable) files). Static pore water pressure is measured when cone penetration is stopped (static pore water pressure data can be found in the .ppd files). The measured dynamic pore water pressure changes with the location of the porous filter and negative readings are possible when the filter is located behind the tip.

It is important to note that the CPT classifies soil by physical behavior, not by grain size; therefore, the CPT classification should be verified against samples obtained from a conventional drilling program. While the CPT soil classification may not always be accurate in terms of the actual label it applies to a particular soil, it is very accurate in grouping soils with similar mechanical properties.

Table 1 presents a summary of CPT soundings, including sounding depths.

3.2 CONE PLOTS

The data from each sounding was plotted using the computer program ScreenZ. The plots are included in Appendix A. ScreenZ was developed by ConeTec Inc. and it incorporates soil behavior type (SBT) classification as part of the plot. The soil classification is based on the classification chart reproduced chart in Appendix B.

3.3 PORE PRESSURE DISSIPATION TEST RESULTS

When conducting CPT investigations, a total of three meaningful pore water pressure dissipation tests were collected. Pore water pressure dissipation data are collected and automatically recorded during pauses in penetration. The pore water pressure data is recorded at five second intervals. Two pore water pressure dissipation tests were completed to determine approximate water table depths which were used in generating the tabular data for the project.

TABLE 1 - SUMMARY OF CPTU SOUNDINGS

Job No.: 04-783
Location: Gallatin TVA Plant, Gallatin, TN
Client: MACTEC, Inc.
Date: September 8th, 2004

Date	CPTU Sounding	File Name	Total Depth (ft)	Pore Water Pressure Dissipation Test Depth (ft)	Pore Water Pressure Dissipation Test Duration (sec)	Est. Water Table Depth (ft)	Umax (ft)	Est. Ch (cm^2/min.)	Est. t50 (sec)	Comments
08-Sep-04	CPT-3	783CP003.COR	5.74			9.0				Refusal
08-Sep-04	CPT-3A	783CP03A.COR	54.46	15.75	600	9.0	53.5	22.42	32	Refusal
08-Sep-04	CPT-4	789CP004.COR	6.73			5.0				Refusal
08-Sep-04	CPT-5	789CP005.COR	10.17			5.0				Refusal
08-Sep-04	CPT-7	789CP007.COR	25.43			5.0				Refusal
08-Sep-04	CPT-8	789CP008.COR	21.33	12.96	180	4.0				Refusal
08-Sep-04	CPT-12	789CP012.COR	35.27			5.0				Refusal
08-Sep-04	CPT-13	789CP013.COR	26.41	12.47	120	3.7				Refusal
				19.03	1,000	3.7	69.2	1.49	481	
		8	185.5		1,900					
					0.5	hours				

One longer pore water pressure dissipation tests were completed to determine hydraulic conductivities and consolidation parameters.

3.4 CPT DATA PROCESSING

The electronic data files were processed using the program CPTSumm. CPTSumm is a program developed by ConeTec to calculate common engineering parameters from CPT data. The processed data files are attached in Appendix B. The files are also included on the data disk. The calculations used are summarized in the table at the front of the Appendix. Each calculation is derived according to the referenced article.

For this project, the depth to ground water was determined from pore water pressure dissipation data collected during the program. The exact depth used is noted in the header of each .xls, .nli and .nlp files.

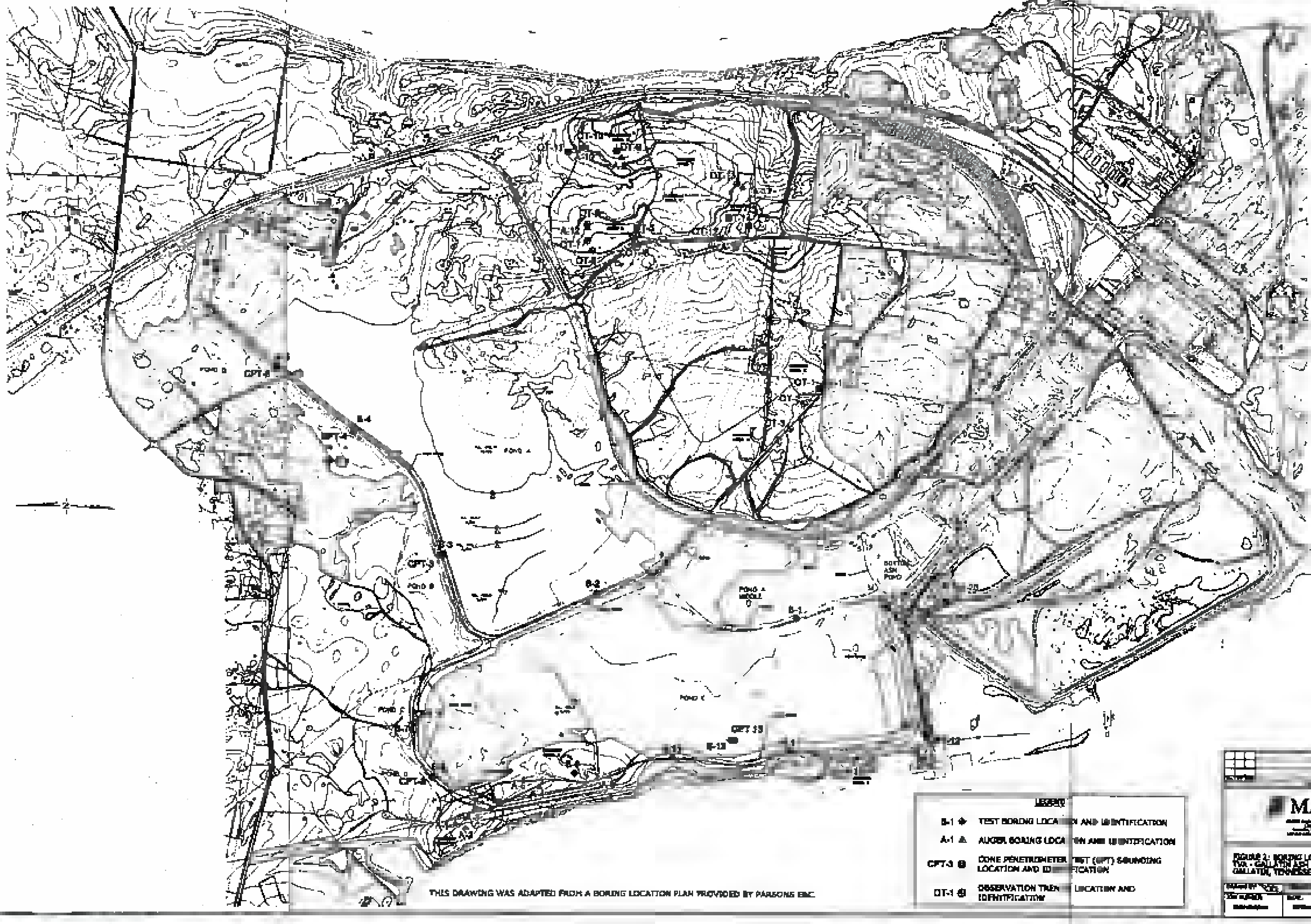
3.5 DATA DISK

One data disk is included in Appendix D. The disk includes all of the CPT, dynamic and static pore water pressure and tabular data.

5.0 REFERENCES

Robertson, P.K. and Campananella, R.G., 1989, "Guidelines for Geotechnical Design using CPT and CPTU", Soil Mechanics Series No. 120, The University of British Columbia.

Robertson, P.K., Sully, J., Woeller, D.G., Lunne, T., Powell, J.M., and Gillespie, D.J., 1990, "Guidelines for Interpretation of CPTU Test Data for determination of consolidation and permeability Parameters for Soils, Report prepared by ConeTec Investigations Ltd. for Energy Mines and Resources, Contract No. 23420-9-m644/01-OSC (copies available from ConeTec, Inc.).



THIS DRAWING WAS ADAPTED FROM A BORING LOCATION PLAN PROVIDED BY PARSONS E&C

LEGEND

B-1 ◆	TEST BORING LOCATION AND IDENTIFICATION
A-1 ▲	AUGER BORING LOCATION AND IDENTIFICATION
CPT-3 ⊕	CONE PENETROMETER TEST (CPT) SOUNDING LOCATION AND IDENTIFICATION
DT-1 ⊕	OBSERVATION TRENCH LOCATION AND IDENTIFICATION

MACTEC

FIGURE 2: BORING LOCATION PLAN
TVA - GALLATIN ASH DISPOSAL AREA
GALLATIN, TENNESSEE

APPENDIX A

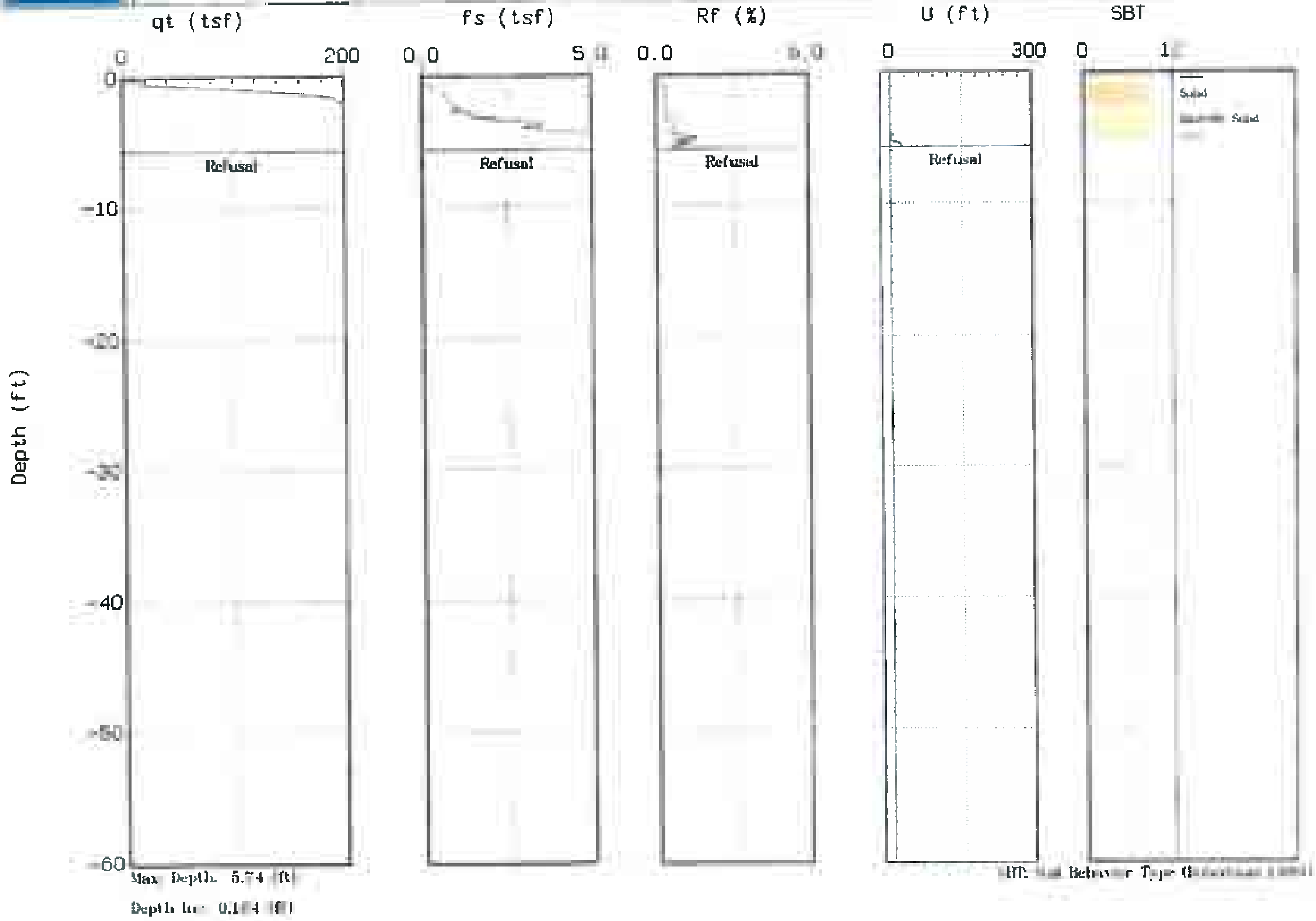
CPT PLOTS

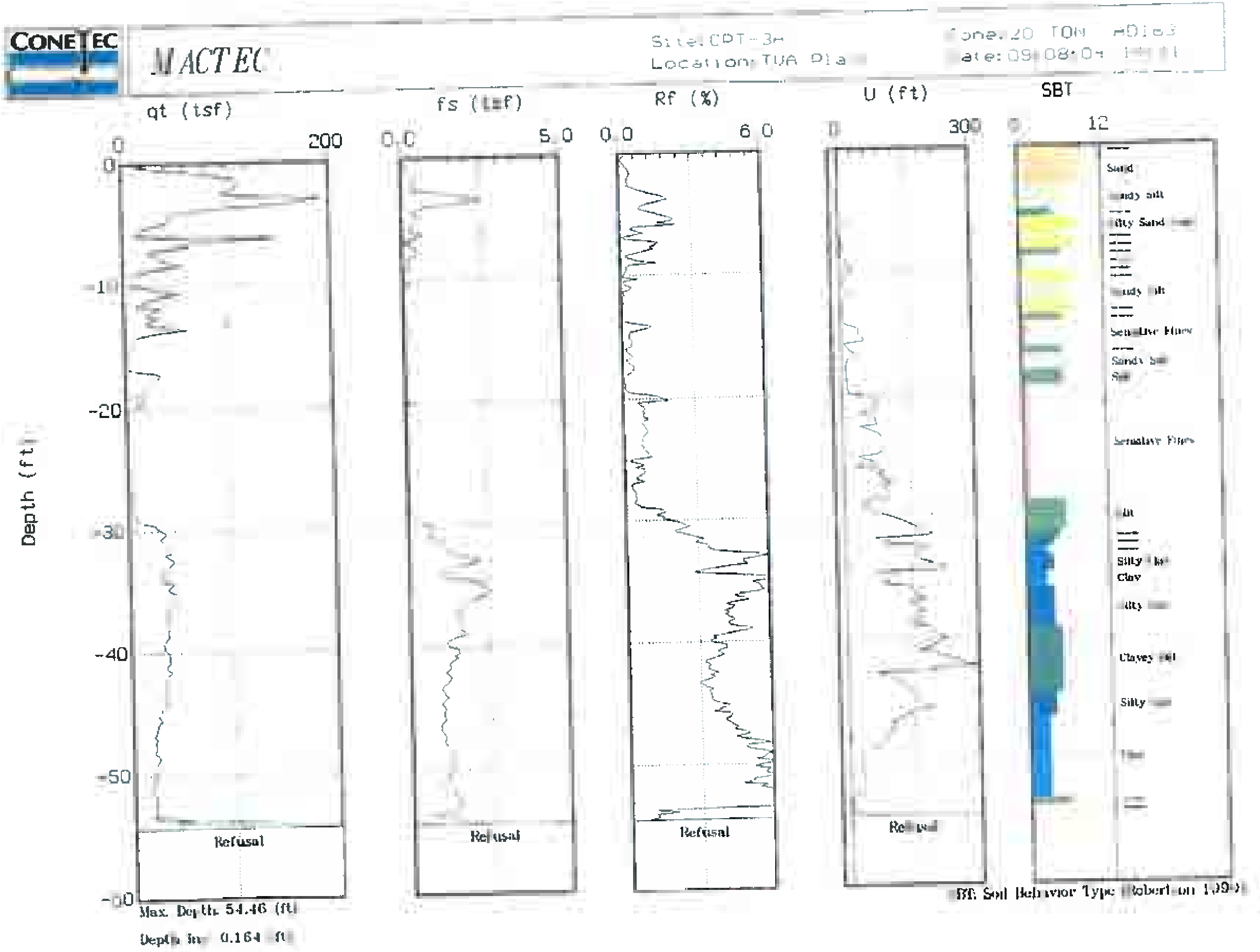
CONETEC

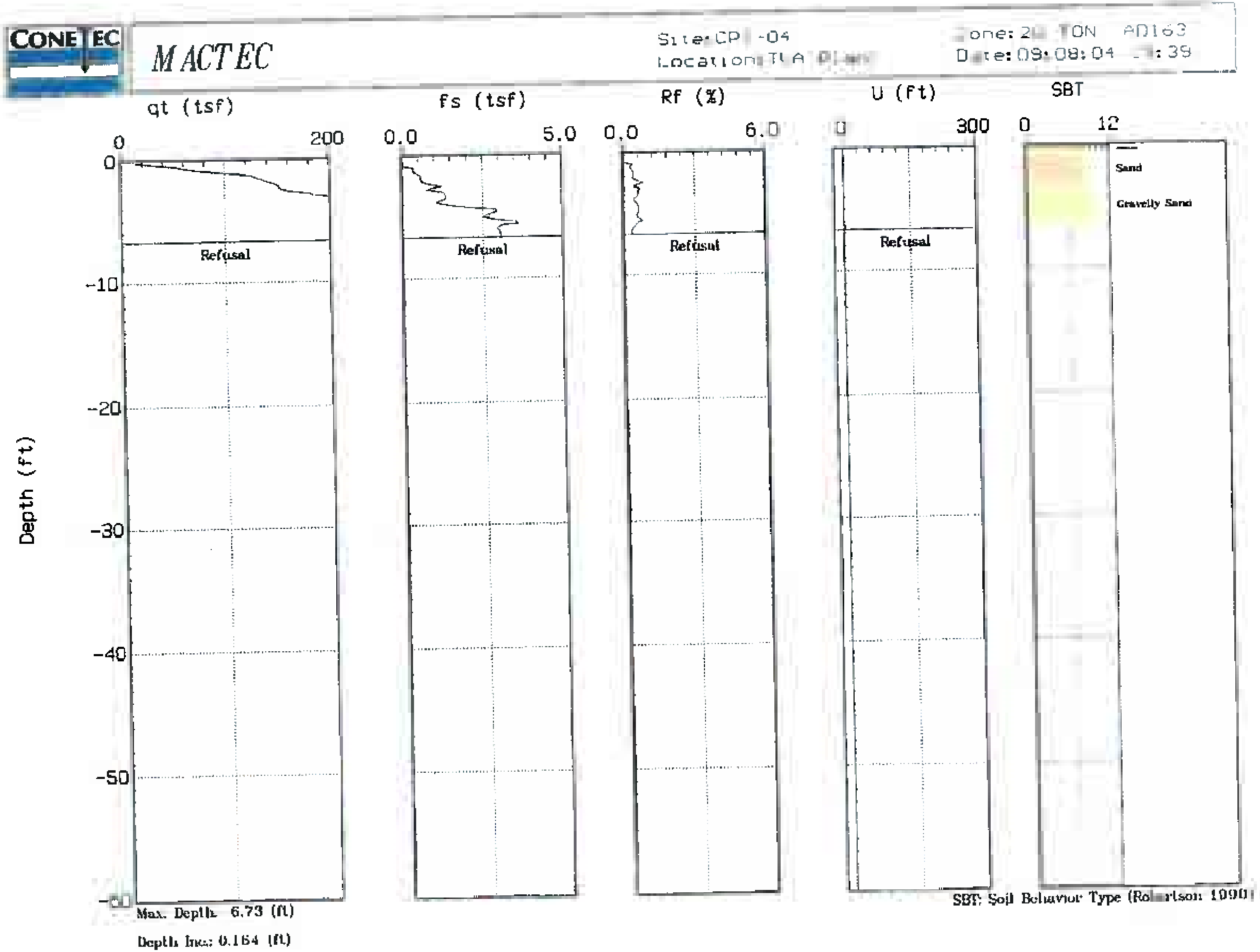
MACTEC

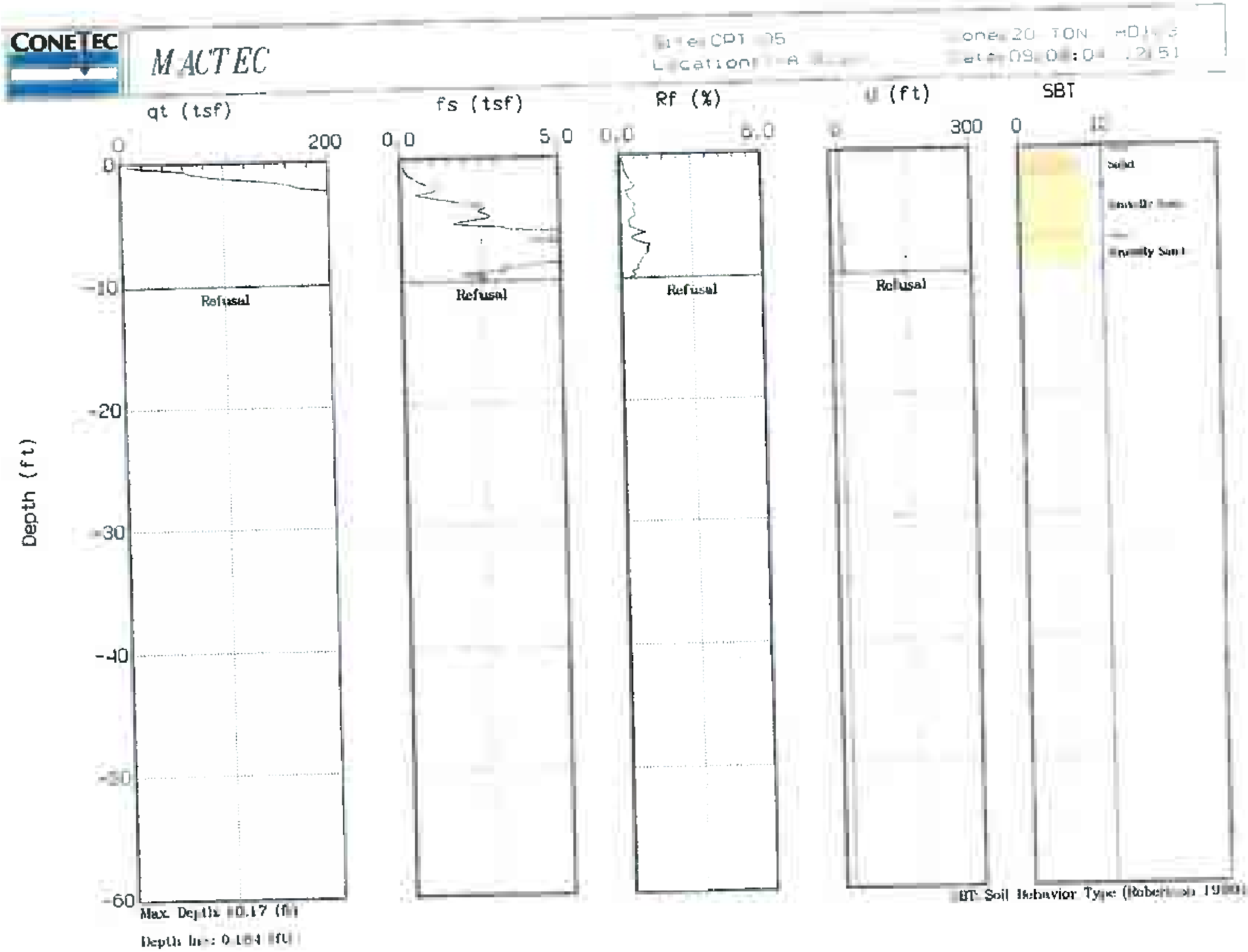
Site: CP -03
Location: T - Plant

Cone: 20 TON H01
Date: 09:08:0 14:1




CONETEC
MACTEC
Site: CPT-3m
Location: TVA Pla
Cone: 20 TON #D163
Date: 09:08:04
qt (tsf)
0
200
fs (tsf)
0.0
5.0
Rf (%)
0.0
6.0
U (ft)
0
300
SBT
0
12
Depth (ft)
0
-10
-20
-30
-40
-50
-60
Refusal
Refusal
Refusal
Refusal
Max. Depth: 54.46 (ft)
Depth Inc: 0.164 (ft)
Sand
Sandy Silt
Silty Sand
Sandy Silt
Sensitive Fines
Sandy Silt
Silt
Sensitive Fines
Silt
Silty Clay
Clay
Silty
Clayey Silt
Silty
SBT: Soil Behavior Type (Robertson 1990)

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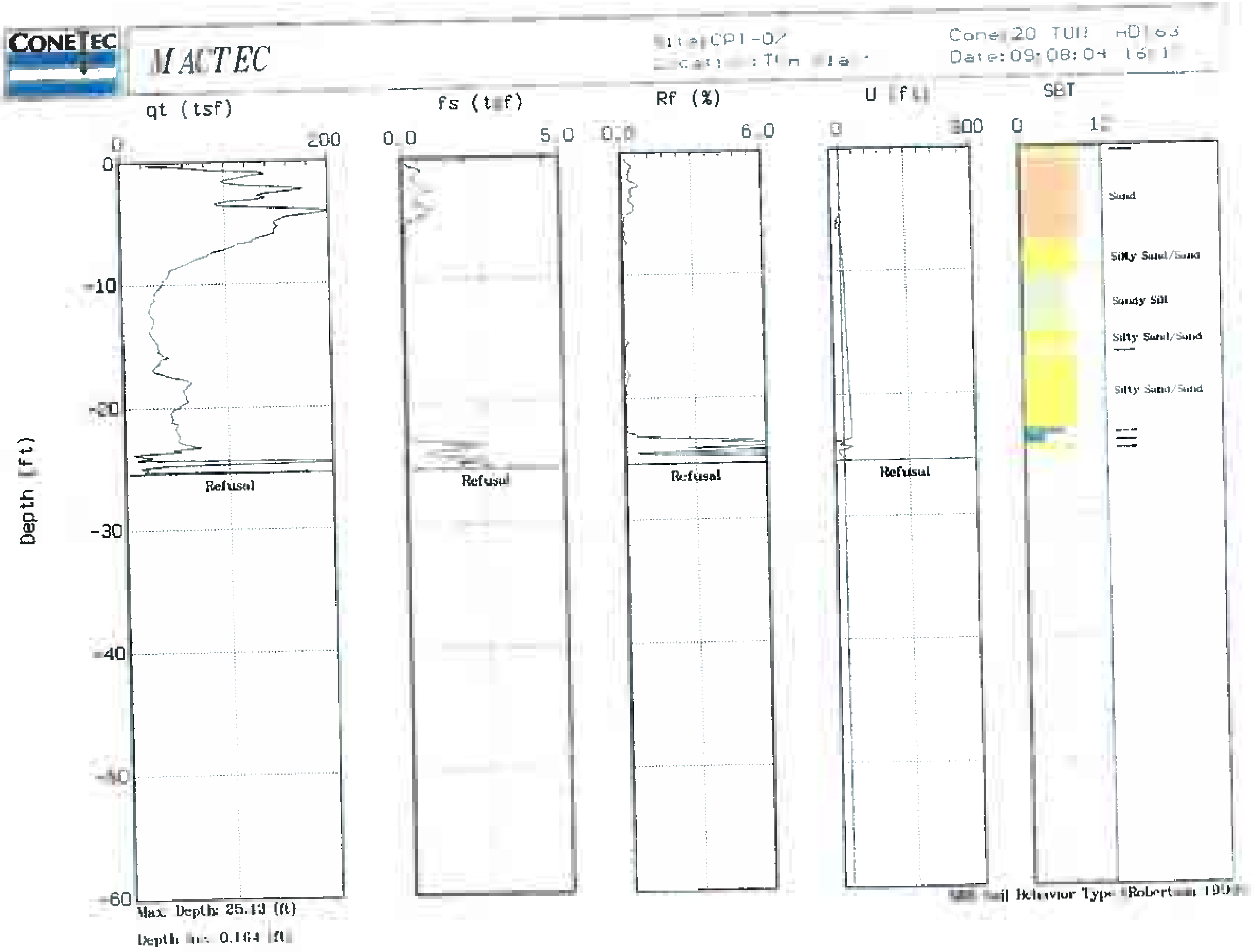
MACTEC
Site: CPT-05
Location: [illegible]
Cone: 20 TON [illegible]
Date: 09:08:04 12:51
qt (tsf)
0
200
fs (tsf)
0.0
5.0
Rf (%)
0.0
8.0
u (ft)
0
300
SBT
0
12
Depth (ft)
0
-10
-20
-30
-40
-50
-60
Refusal
Refusal
Refusal
Refusal
Sand
Gravelly Sand
Max. Depth: 10.17 (ft)
Depth Inc: 0.164 (ft)
SBT: Soil Behavior Type (Robertson 1990)

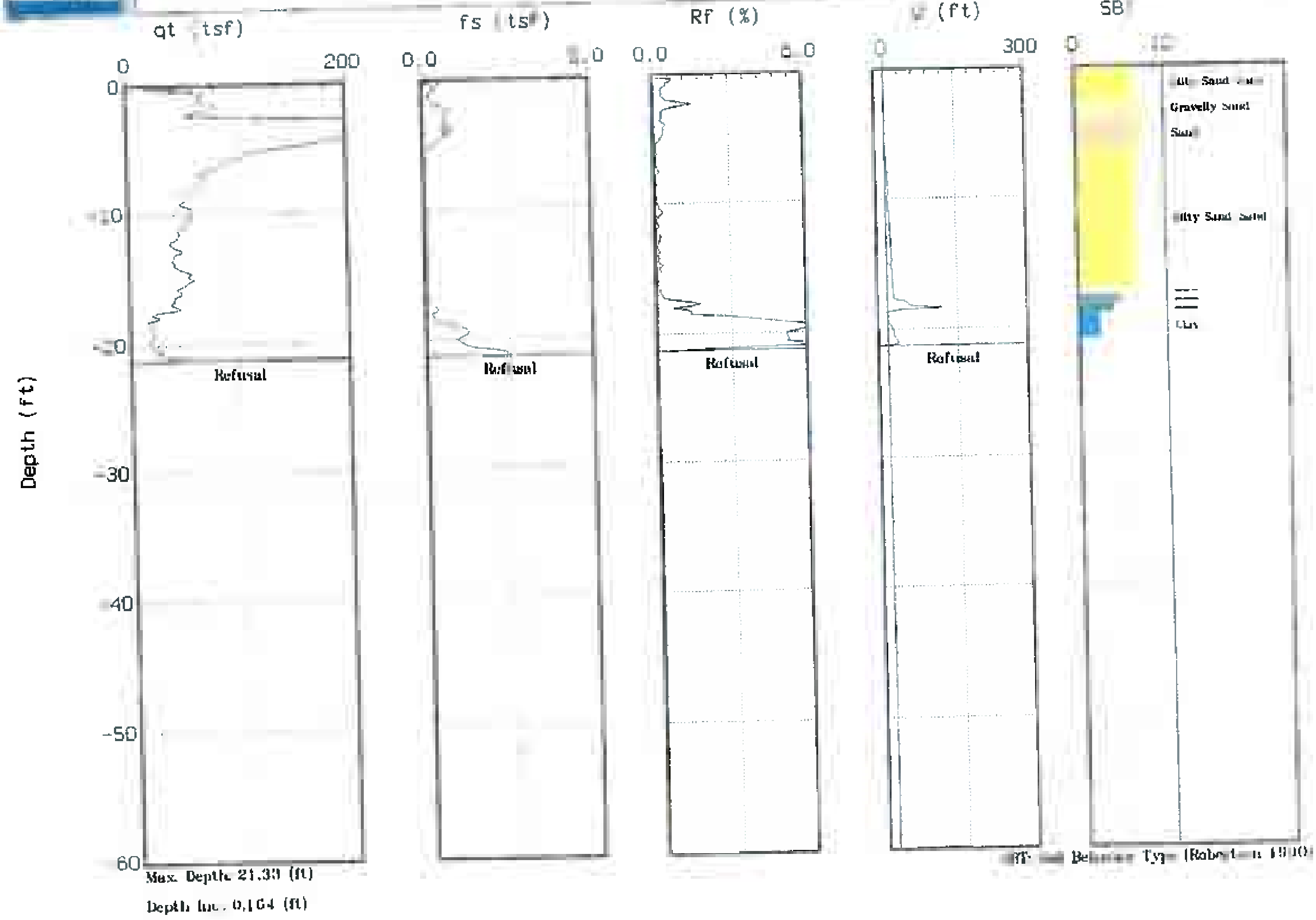

CONETEC
MACTEC
Site: CPT-07
Location: T n la
Cone: 20 TON H0163
Date: 09:08:04 16:1
qt (tsf)
0
200
fs (tsf)
0.0
5.0
Rf (%)
0.0
6.0
U (ft)
0
300
SBT
0
12
Depth (ft)
0
-10
-20
-30
-40
-50
-60
Refusal
Refusal
Refusal
Refusal
Sand
Silty Sand/Sand
Sandy Silt
Silty Sand/Sand
Silty Sand/Sand
Soil Behavior Type (Robertson 1990)
Max. Depth: 25.43 (ft)
Depth Inc: 0.164 (ft)

CONETEC

MACTEC

Site LPT-08
Location ... Plant

Cone 20 T... A0163
Date: 09:08:04 1...57

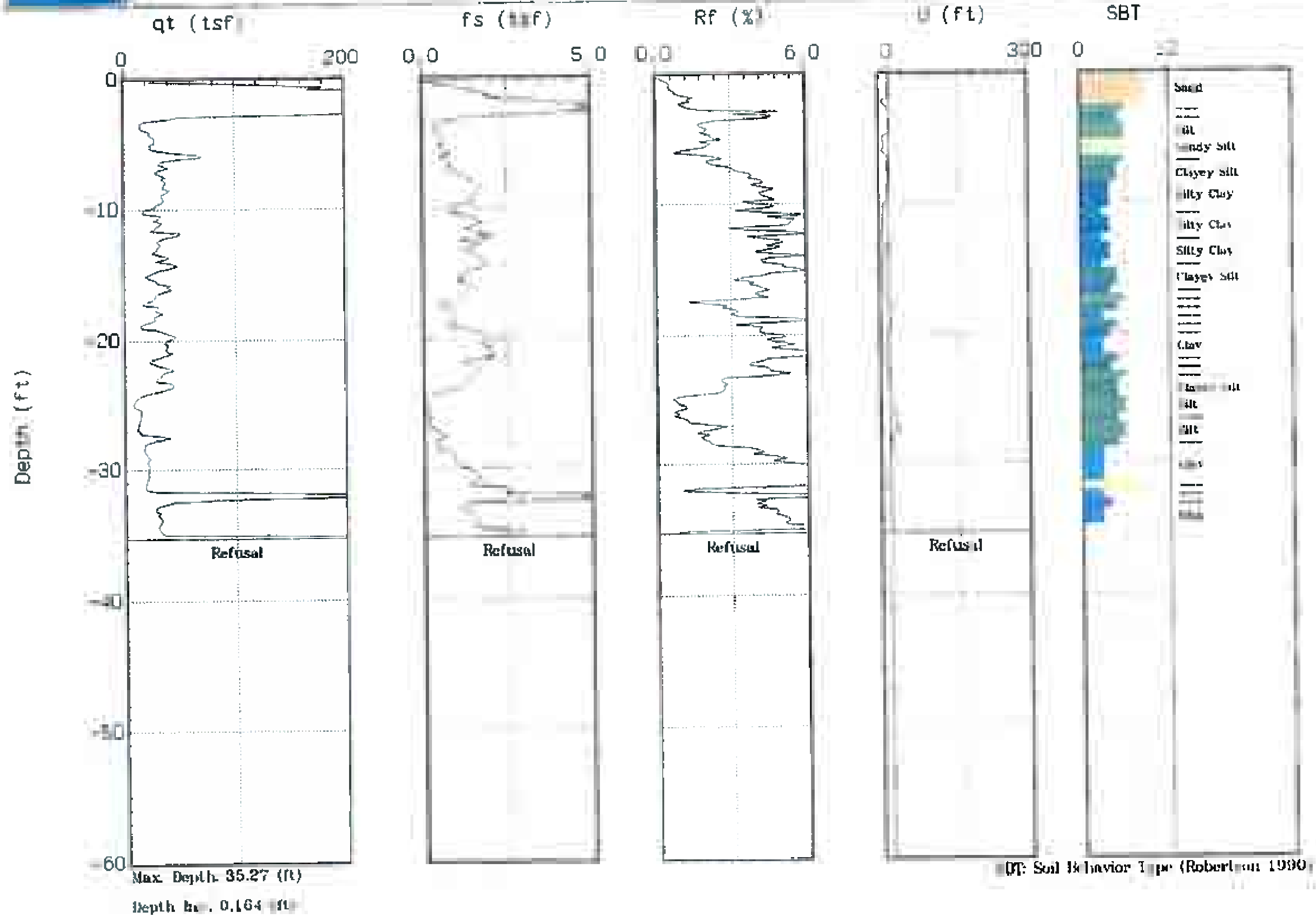


CONETEC

MACTEC

Site:CP -12
Location:T A Pla t

Cone:20 TON nD163
Date:09:28:04 17:1



Max. Depth: 35.27 (ft)
Depth Inc.: 0.164 (ft)

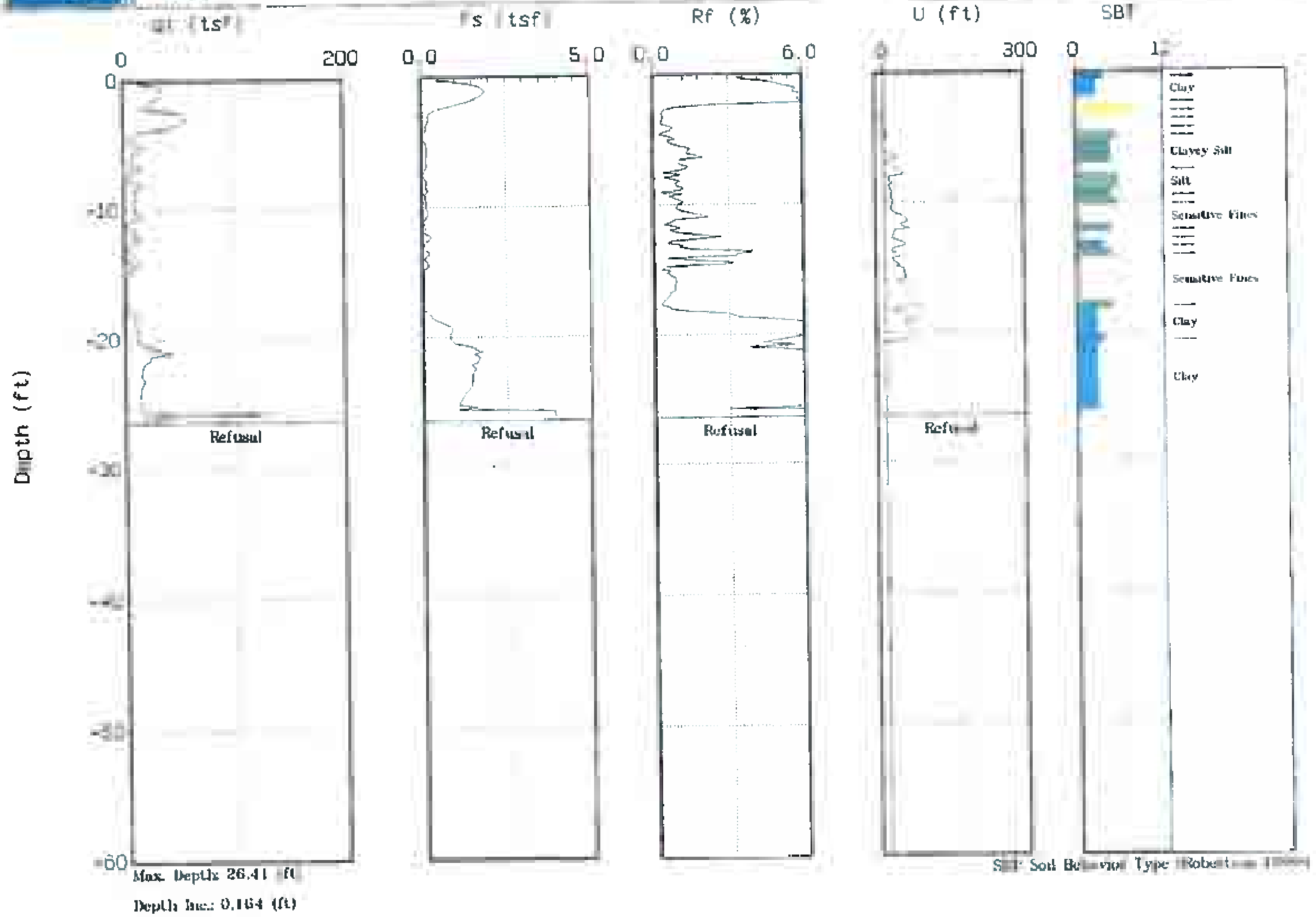
SBT: Soil Behavior Type (Robertson 1990)

CONETEC

MACTEC

Site:CPT-13
Location:TVA Plant

Cone:20 TON AD163
Date:09:08:04 10:31



Max. Depth: 26.41 (ft)
Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson 1990)

APPENDIX B

DATA INTERPRETATION

ConeTec

Geotechnical and Environmental Site Investigation Contractors

ConeTec CPT Interpretations as of January 7, 1999 (Release 1.00.19)

ConeTec's interpretation routine should be considered a calculator of current published CPT correlations and is subject to change to reflect the current state of practice. The interpreted values are not considered valid for all soil types. The interpretations are presented only as a guide for geotechnical use and should be carefully scrutinized for consideration in any geotechnical design. Reference to current literature is strongly recommended.

The CPT interpretations are based on values of tip, sleeve friction and pore pressure averaged over a user specified interval (typically 0.25m). Note that Qt is the recorded tip value, Qc, corrected for pore pressure effects. Since all ConeTec cones have equal end area friction sleeves, pore pressure corrections to sleeve friction, Fs, are not required.

The tip correction is: $Qt = Qc + (1-a) \bullet Ud$

where: *Qt* is the corrected tip load
Qc is the recorded tip load
Ud is the recorded dynamic pore pressure
a is the Net Area Ratio for the cone (typically 0.85 for ConeTec cones)

Effective vertical overburden stresses are calculated based on a hydrostatic distribution of equilibrium pore pressures below the water table or from a user defined equilibrium pore pressure profile (this can be obtained from CPT dissipation tests). The stress calculations use unit weights assigned to the Soil Behaviour Type zones or from a user defined unit weight profile.

Details regarding the interpretation methods for all of the interpreted parameters is given in table 1. The appropriate references referred to in table 1 are listed in table 2.

The estimated Soil Behavior Type is based on the charts developed by Robertson and Campanella shown in figure 1.

Table 1 CPT Interpretation Methods

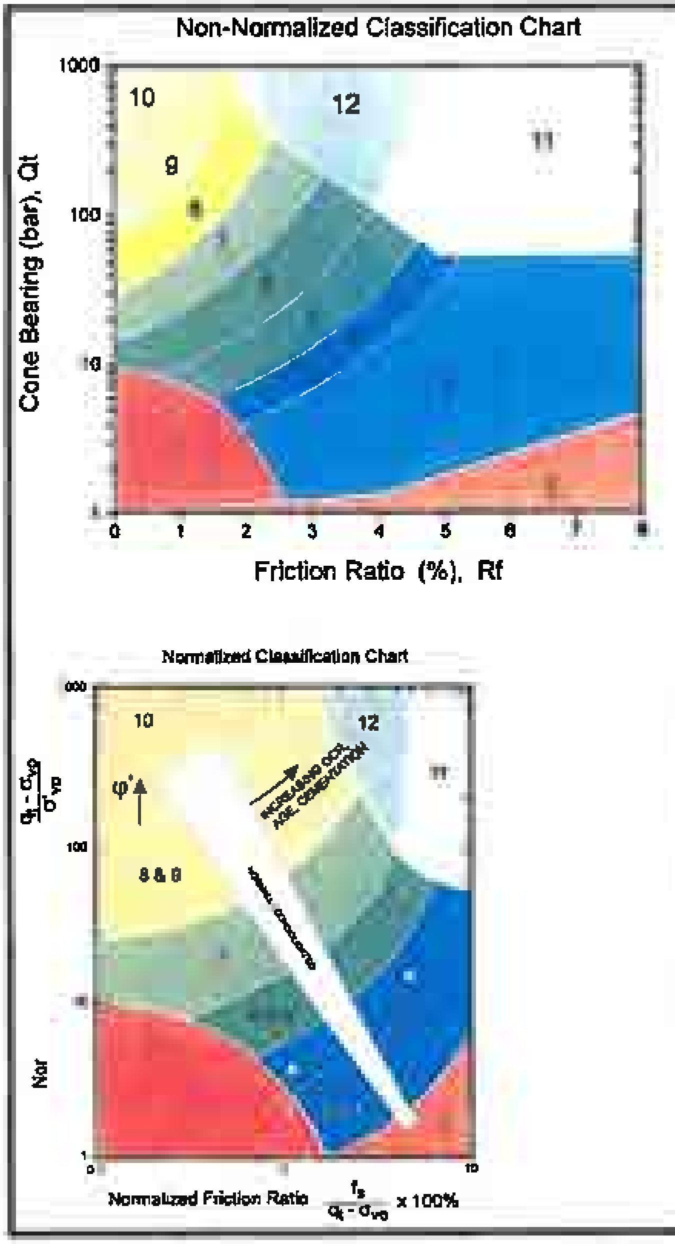
Interpreted Parameter	Description	Equation	Ref
Depth	mid layer depth		
AvgQt	Averaged corrected tip (Qt)	$AvgQt = \frac{1}{n}\sum_{i=1}^{n} Qt_i$	
AvgFs	Averaged sleeve friction (Fs)	$AvgFs = \frac{1}{n}\sum_{i=1}^{n} Fs_i$	
AvgRf	Averaged friction ratio (Rf)	$AvgRf = 100\% \bullet \frac{AvgFs}{AvgQt}$	
AvgUd	Averaged dynamic pore pressure (Ud)	$AvgUd = \frac{1}{n}\sum_{i=1}^{n} Ud_i$	
SBT	Soil Behavior Type as defined by Robertson and Campanella		1

CPT Interpretations

U.Wt.	Unit Weight of soil determined from: 1) uniform value or 2) value assigned to each SBT zone 3) user supplied unit weight profile		
TStress	Total vertical overburden stress at mid layer depth	$TStress = \sum_{i=1}^{n} \gamma_i h_i$ where γ_i is layer unit weight h_i is layer thickness	
EStress	Effective vertical overburden stress at mid layer depth	$EStress = TStress - Ueq$	
Ueq	Equilibrium pore pressure determined from: 1) hydrostatic from water table depth 2) user supplied profile		
Cn	SPT N_{60} overburden correction factor	$Cn=(\sigma_v')^{-0.5}$ where σ_v' is in tsf $0.5 < C_n < 2.0$	
N_{60}	SPT N value at 60% energy calculated from Qt/N ratios assigned to each SBT zone		3
$(N1)_{60}$	SPT N_{60} value corrected for overburden pressure	$N1_{60} = Cn \bullet N_{60}$	3
$\Delta(N1)_{60}$	Equivalent Clean Sand Correction to $(N1)_{60}$	$\Delta(N1)_{60} = \frac{K_{SPT}}{1-K_{SPT}} \bullet (N1)_{60}$ Where: K_{SPT} is defined as: 0.0 for FC < 5% 0.0167 • (FC - 5) for 5% < FC < 35% 0.5 for FC > 35% FC - Fines Content in %	7
$(N1)_{60cs}$	Equivalent Clean Sand $(N1)_{60}$	$(N1)_{60cs} = (N1)_{60} + \Delta(N1)_{60}$	7
Su	Undrained shear strength - Nkt is use selectable	$Su = \frac{Qt - \sigma_v}{N_{kt}}$	2
k	Coefficient of permeability (assigned to each SBT zone)		6
Bq	Pore pressure parameter	$Bq = \frac{\Delta u}{Qt - \sigma_v}$	2
Qtn	Normalized Qt for Soil Behavior Type classification as defined by Robertson, 1990	$Qtn = \frac{Qt - \sigma_v}{\sigma'_v}$	4
Rfn	Normalized Rf for Soil Behavior Type classification as defined by Robertson, 1990	$Rfn = 100\% \bullet \frac{f_s}{Qt - \sigma_v}$	4
SBTn	Normalized Soil Behavior Type (slightly modified from that published by Robertson, 1990. This version includes all the soil zones of the original non-normalized SBT chart - see figure 1)		4
Qc1	Normalized Qt for seismic analysis	$qc1 = qc \bullet (Pa/\sigma_v')^{0.5}$ where: Pa = atm. pressure	5
Qc1N	Dimensionless Normalized Qt1	qc1N = qc1 / Pa where: Pa = atm. pressure	

CPT Interpretations

ΔQc1N1	Equivalent clean sand correction	$\Delta qc1N = \frac{K_{CPT}}{1 - K_{CPT}} * qc1N$ Where: K_{CPT} is defined as: 0.0 for FC < 5% 0.0267 * (FC - 5) for 5% < FC < 35% 0.5 for FC > 35% FC - Fines Content in %	5
Qc1Ncs	Clean Sand equivalent Qc1N	$qc1Ncs = qc1N + \Delta qc1N$	5
Ic	Soil index for estimating grain characteristics	$Ic = [(3.47 - \log Q)^2 + (\log F + 1.22)^2]^{0.5}$	5
FC	Fines content (%)	$FC=1.75(Ic^{3.25}) - 3.7$ $FC=100$ for $Ic > 3.5$ $FC=0$ for $Ic < 1.26$ $FC = 5\%$ if $1.64 < Ic < 2.6$ AND $Rfn<0.5$	6
PHI	Friction Angle	Campanella and Robertson Durunoglu and Mitchel Janbu	1
Dr	Relative Density	Ticino Sand Hokksund Sand Schmertmann 1976 Jamiolkowski - All Sands	1
OCR	Over Consolidation Ratio		1
State Parameter			9
CRR	Cyclic Resistance Ratio		7



Zone	Q_t / N	Soil Behaviour Type
1	2	sensitive fine grained
2	1	organic material
3	1	clay
4	1.5	silty clay to clay
5	2	clayey silt to silty clay
6	2.5	sandy silt to clayey silt
7	3	
8	4	and to silty sand
9	5	sand
10	6	gravelly sand to sand
11	1	very stiff fine grained *
12	2	sand to clayey sand *

Figure 1 Non-Normalized and Normalized Soil Behaviour Type Classification Charts

Table 2 References

No.	Reference
1	Robertson, P.K. and Campanella, R.G., 1986, "Guidelines for Use, Interpretation and Application of the CPT and CPTU", UBC, Soil Mechanics Series No. 105, Civil Eng. Dept., Vancouver, B.C., Canada
2	Robertson, P.K., Campanella, R.G., Gillespie, D. and Greig, J., 1986, "Use of Piezometer Cone Data", Proceedings of InSitu 86, ASCE Specialty Conference, Blacksburg, Virginia.
3	Robertson, P.K. and Campanella, R.G., 1989, "Guidelines for Geotechnical Design Using CPT and CPTU", UBC, Soil Mechanics Series No. 120, Civil Eng. Dept., Vancouver, B.C., Canada
4	Robertson, P.K., 1990, "Soil Classification Using the Cone Penetration Test", Canadian Geotechnical Journal, Volume 27.
5	Robertson, P.K. and Fear, C.E., 1995, "Liquefaction of Sands and its Evaluation", Keynote Lecture, First International Conference on Earthquake Geotechnical Enginnering, Tokyo, Japan.
6	ConeTec Internal Report
7	Robertson, P.K. and Wride, C.E., 1997, "Cyclic Liquefaction and its Evaluation Based on SPT and CPT", NCEER Workshop Paper, January 22, 1997
8	Wride, C.E. and Robertson, P.K., 1997, "Phase II Data Review Report (Massey and Kidd Sites, Fraser River Delta)", Volume 1 - Data Report (June 1997), University of Alberta.
9	Plewes, H.D., Davies, M.P. and Jefferies, M.G., 1992, "CPT Based Screening Procedure for Evaluating Liquefaction Susceptibility", 45th Canadian Geotechnical Conference, Toronto, Ontario, October 1992.

```
ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.00.19M
    No:     04-0913-1621-1007
Job No:     04-783
Client:     MACTEC, Inc.
Project:    TVA Plant, Gallatin, TN
Site:       CPT-03
Location:   TVA Plant
Cone:       20 TON  AD163
CPT Date:   04/08/09
CPT Time:   14:14
CPT File:   783CP003.COR
Northing  (m):         0.000
Easting   (m):         0.000
Elevation (m):         0.000
----------------------------------------------------------------------------------------------------------------------
 Water Table (m):              2.74      (ft):    9.0
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:     12.50    Su/P' (nc):   0.30
 Averaging Increment (m):      0.10
 Phi Method :                 Robertson and Campanella, 1983
 Dr  Method :                 Jamiolkowski - All Sands
 State Parameter M:            1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
----------------------------------------------------------------------------------------------------------------------------------
 Depth    AvgQt    AvgFs    AvgRf    AvgUd    SBT    U.Wt.   TStress  EStress    Ueq       Cn       N60    (N1)60      Su    CRR
 (ft)     (tsf)    (tsf)    (%)      (ft)            pcf     (tsf)    (tsf)     (tsf)                (blows/ft)       (tsf)
----------------------------------------------------------------------------------------------------------------------------------
  0.16     . 8.7    0.01     0.11      0.0     1     111.4     0.01     0.01     0.00      2.00      4.2      8.4      0.70  0.00
  0.49     41.4     0.01     0.02     -0.1     8     120.9     0.03     0.03     0.00      2.00      9.9     19.8     UnDef  0.13
  0.82    117.2     0.36     0.31     -0.1     9     124.1     0.05     0.05     0.00      2.00     22.4     44.9     UnDef  0.00
    15    160.6     0.57     0.35     -0.1     9     124.1     0.07     0.07     0.00      2.00     30.8     61.5     UnDef  0.00
    18    189.5     0.76     0.40     -0.3     9     124.1     0.09     0.09     0.00      2.00     36.3     72.6     UnDef  0.00
  1.80    202.7     0.78     0.39     -0.3     9     124.1     0.11     0.11     0.00      2.00     38.8     77.7     UnDef  0.00
  2.13    231.0     0.94     0.41     -0.3     9     124.1     0.13     0.13     0.00      2.00     44.2     88.5     UnDef  0.00
  2.46    229.8     1.00     0.43     -0.3     9     124.1     0.15     0.15     0.00      2.00     44.0     88.0     UnDef  0.00
  2.79    298.0     1.43     0.48     -0.5    10     127.3     0.17     0.17     0.00      2.00     47.6     95.1     UnDef  0.00
  3.12    408.9     1.71     0.42     -0.2    10     127.3     0.19     0.19     0.00      2.00     65.3    130.5     UnDef  0.00
  3.44    505.2     2.99     0.59     -0.6    10     127.3     0.21     0.21     0.00      2.00     80.6    161.3     UnDef  0.00
  3.77    470.4     3.25     0.69     -0.2    10     127.3     0.23     0.23     0.00      2.00     75.1    150.2     UnDef  0.00
  4.10    610.9     3.63     0.59     -0.4    10     127.3     0.25     0.25     0.00      1.98     97.5    193.4     UnDef  0.00
  4.43    871.1     5.52     0.63     -0.7    10     127.3     0.28     0.28     0.00      1.91    139.0    265.1     UnDef  0.00
  4.76    869.9    11.52     1.32      4.4     9     124.1     0.30     0.30     0.00      1.84    166.6    306.4     UnDef  0.00
  5.09    775.6     7.97     1.03      1.0    10     127.3     0.32     0.32     0.00      1.78    123.8    220.1     UnDef  0.00
  5.41    845.9     5.52     0.65     22.4    10     127.3     0.34     0.34     0.00      1.72    135.0    232.5     UnDef  0.00
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ConeTec Inc. - CPT Interpretation                                          Page:   1b
Interpretation Output - Release 1.00.19M
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ob No:      04-783
   ent:     MACTEC, Inc.
 oject:     TVA Plant, Gallatin, TN
Site:       CPT-03
Location:   TVA Plant
Cone:       20 TON  AD163
CPT Date:   04/08/09
CPT Time:   14:14
CPT File:   783CP003.COR
Northing  (m):          0.000
Easting   (m):          0.000
Elevation (m):          0.000
------------------------------------------------------------------------------------------------
  Water Table (m):              2.74       (ft):    9.0
  Unit Weight of Water (default):    62.40 kN/m^3
  Su Nkt used:      12.50      Su/P' (nc):   0.30
  Averaging Increment (m):     0.10
  Phi Method :                  Robertson and Campanella, 1983
  Dr  Method :                  Jamiolkowski - All Sands
  State Parameter M:            1.20
  Used Unit Weights Assigned to Soil Zones
  Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
-----------------------------------------------------------------------------------------------------------------------
 Depth      k         Bq        Qtn      Rfn   SBTn      Qc1N DeltaQc1N    Qc1Ncs      Fc    Phi       Dr     OCR   State Del(n1)60  (N1)60cs
 (ft)    (cm/s)                                                                         (%)   (Deg)     (%)          Param
-----------------------------------------------------------------------------------------------------------------------
  0.16   1.0E-07    0.00    953.5     0.12    10       16.7         0.0      16.7     0.0  UnDef    UnDef    10.0   UnDef      0.0       8.4
  0.49   5.0E-03    0.00   1000.0     0.02    10       79.3         0.0      79.3     0.0     50     92.5     1.0   -0.07      0.0      19.8
  0.82   5.0E-02    0.00   1000.0     0.31    10      224.5         0.0     224.5     0.0     50     95.0     1.0   -0.29      0.0      44.9
  1.15   5.0E-02    0.00   1000.0     0.35    10      307.6         0.0     307.6     0.0     50     95.0     1.0   -0.30      0.0      61.5
  1.48   5.0E-02    0.00   1000.0     0.40    10      362.9         0.0     362.9     0.0     50     95.0     1.0   -0.31      0.0      72.6
    80   5.0E-02    0.00   1000.0     0.39    10      388.3         0.0     388.3     0.0     50     95.0     1.0   -0.31      0.0      77.7
    13   5.0E-02    0.00   1000.0     0.41    10      442.5         0.0     442.5     0.0     50     95.0     1.0   -0.31      0.0      88.5
  2.46   5.0E-02    0.00   1000.0     0.43    10      440.2         0.0     440.2     0.0     50     95.0     1.0   -0.32      0.0      88.0
  2.79   5.0E+00    0.00   1000.0     0.48    10      570.7         0.0     570.7     0.0     50     95.0     1.0   -0.33      0.0      95.1
  3.12   5.0E+00    0.00   1000.0     0.42    10      783.2         0.0     783.2     0.0     50     95.0     1.0   -0.32      0.0     130.5
  3.44   5.0E+00    0.00   1000.0     0.59    10      967.6         0.0     967.6     0.0     50     95.0     1.0   -0.35      0.0     161.3
  3.77   5.0E+00    0.00   1000.0     0.69    10      901.0         0.0     901.0     0.0     50     95.0     1.0   -0.36      0.0     150.2
  4.10   5.0E+00    0.00   1000.0     0.59    10     1170.1         0.0    1170.1     0.0     50     95.0     1.0   -0.35      0.0     193.4
  4.43   5.0E+00    0.00   1000.0     0.63    10     1625.2         0.0    1625.2     0.0     50     95.0     1.0   -0.36      0.0     265.1
  4.76   5.0E-02    0.00   1000.0     1.32     9     1565.4         0.0    1565.4     1.8     50     95.0     1.0   -0.44      0.0     306.4
  5.09   5.0E+00    0.00   1000.0     1.03     9     1349.4         0.0    1349.4     0.6     50     95.0     1.0   -0.41      0.0     220.1
  5.41   5.0E+00    0.00   1000.0     0.65    10     1425.4         0.0    1425.4     0.0     50     95.0     1.0   -0.36      0.0     232.5
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ConeTec Inc. - CPT Interpretation                                                Page:  1a
Interpretation Output - Release 1.00.19M
Run No:     04-0913-1621-1029
    No:     04-783
Client:     MACTEC, Inc.
Project:    TVA Plant, Gallatin, TN
Site:       CPT-3A
Location:   TVA Plant
Cone:       20 TON  AD163
CPT Date:   04/08/09
CPT Time:   14:41
CPT File:   783CP03A.COR
Northing  (m):          0.000
Easting   (m):          0.000
Elevation (m):          0.000
---------------------------------------------------------------------------------------------------------
 Water Table (m):               2.74       (ft):     9.0
 Unit Weight of Water (default):     62.40 kN/m^3
 Su Nkt used:       12.50      Su/P' (nc):    0.30
 Averaging Increment (m):      0.10
 Phi Method  :                  Robertson and Campanella, 1983
 Dr  Method  :                  Jamiolkowski - All Sands
 State Parameter M:             1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
------------------------------------------------------------------------------------------------------------------------
 Depth     AvgQt     AvgFs     AvgRf     AvgUd     SBT     U.Wt.    TStress   EStress     Ueq       Cn       N60    (N1)60      Su     CRR
 (ft)      (tsf)     (tsf)      (%)      (ft)              pcf      (tsf)     (tsf)      (tsf)                (blows/ft)       (tsf)
------------------------------------------------------------------------------------------------------------------------
  0.16      19.0      0.02      0.12       1.0      7      117.8     0.01      0.01      0.00      2.00       6.1    12.1     UnDef  0.08
  0.49      51.9      0.03      0.06       0.9      8      120.9     0.03      0.03      0.00      2.00      12.4    24.8     UnDef  0.17
  0.82      83.8      0.18      0.21       1.1      9      124.1     0.05      0.05      0.00      2.00      16.1    32.1     UnDef  0.00
  1.15     107.1      0.35      0.33       1.0      9      124.1     0.07      0.07      0.00      2.00      20.5    41.0     UnDef  0.00
    48     113.5      0.47      0.41       1.2      9      124.1     0.09      0.09      0.00      2.00      21.7    43.5     UnDef  0.00
    30     111.7      0.39      0.35       1.1      9      124.1     0.11      0.11      0.00      2.00      21.4    42.8     UnDef  0.00
  2.13     105.1      0.33      0.31       1.2      9      124.1     0.13      0.13      0.00      2.00      20.1    40.2     UnDef  0.00
  2.46     101.3      0.33      0.33       1.1      9      124.1     0.15      0.15      0.00      2.00      19.4    38.8     UnDef  0.00
  2.79     161.9      1.05      0.65       0.9      9      124.1     0.17      0.17      0.00      2.00      31.0    62.0     UnDef  0.00
  3.12     175.4      1.98      1.13      -2.4      8      120.9     0.19      0.19      0.00      2.00      42.0    84.0     UnDef  0.00
  3.44     139.8      2.45      1.75      -4.0      8      120.9     0.21      0.21      0.00      2.00      33.5    67.0     UnDef  0.00
  3.77      77.6      1.48      1.90      -3.9      7      117.8     0.23      0.23      0.00      2.00      24.8    49.5     UnDef  0.46
  4.10      49.7      0.55      1.11      -3.7      7      117.8     0.25      0.25      0.00      2.00      15.9    31.7     UnDef  0.17
  4.43      44.0      0.36      0.82      -3.6      7      117.8     0.27      0.27      0.00      1.93      14.0    27.1     UnDef  0.14
  4.76      42.7      0.55      1.29      -2.8      7      117.8     0.29      0.29      0.00      1.86      13.6    25.4     UnDef  0.14
  5.09      29.5      0.54      1.83      -1.5      6      114.6     0.31      0.31      0.00      1.80      11.3    20.3      2.33  0.12
  5.41      15.6      0.34      2.20       2.2      5      114.6     0.33      0.33      0.00      1.75       7.5    13.1      1.22  0.10
  5.74      12.5      0.24      1.95      11.2      5      114.6     0.35      0.35      0.00      1.70       6.0    10.2      0.97  0.10
  6.07      97.0      0.43      0.45      13.3      9      124.1     0.37      0.37      0.00      1.65      18.6    30.7     UnDef  0.44
  6.40      76.5      0.59      0.78      -4.5      8      120.9     0.39      0.39      0.00      1.61      18.3    29.5     UnDef  0.24
  6.73      58.0      0.14      0.24      -1.2      8      120.9     0.41      0.41      0.00      1.57      13.9    21.8     UnDef  0.15
  7.05      36.6      0.21      0.57      -3.2      7      117.8     0.42      0.42      0.00      1.53      11.7    17.9     UnDef  0.10
  7.38      29.5      0.44      1.50       2.8      6      114.6     0.44      0.44      0.00      1.50      11.3    17.0      2.33  0.11
  7.79      37.6      0.43      1.14       8.1      7      117.8     0.47      0.47      0.00      1.46      12.0    17.6     UnDef  0.11
  8.20      50.6      0.22      0.44      11.4      8      120.9     0.49      0.49      0.00      1.43      12.1    17.3     UnDef  0.11
  8.53      39.1      0.12      0.30       4.8      8      120.9     0.51      0.51      0.00      1.40       9.4    13.1     UnDef  0.09
  8.86      16.9      0.18      1.09       4.7      6      114.6     0.53      0.53      0.00      1.37       6.5     8.9      1.31  0.09
  9.19       7.4      0.02      0.31      14.3      1      111.4     0.55      0.54      0.01      1.36       3.6     4.8      0.55  0.00
  9.51       5.4      0.01      0.22      13.5      1      111.4     0.57      0.55      0.02      1.35       2.6     3.5      0.39  0.08
  9.84       8.4      0.01      0.13      27.3      1      111.4     0.59      0.56      0.03      1.34       4.0     5.4      0.62  0.00
 10.17      25.4      0.12      0.49      13.0      7      117.8     0.61      0.57      0.04      1.33       8.1    10.8     UnDef  0.08
 10.50      46.1      0.05      0.10       8.8      8      120.9     0.62      0.58      0.05      1.32      11.0    14.5     UnDef  0.10
 10.83      38.8      0.11      0.29       7.8      8      120.9     0.64      0.59      0.06      1.30       9.3    12.1     UnDef  0.09
 11.15      23.6      0.05      0.22       6.9      7      117.8     0.66      0.60      0.07      1.29       7.5     9.8     UnDef  0.00
 11.48      13.2      0.01      0.10      16.1      6      114.6     0.68      0.61      0.08      1.29       5.1     6.5      1.00  0.00
    81      32.2      0.02      0.06      20.5      7      117.8     0.70      0.61      0.09      1.28      10.3    13.1     UnDef  0.09
   .14      23.8      0.02      0.08       7.5      7      117.8     0.72      0.62      0.10      1.27       7.6     9.6     UnDef  0.00
 12.47      27.8      0.01      0.04       4.0      7      117.8     0.74      0.63      0.11      1.26       8.9    11.2     UnDef  0.08
 12.80      24.3      0.01      0.05       2.7      7      117.8     0.76      0.64      0.12      1.25       7.8     9.7     UnDef  0.00
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ConeTec Inc. - CPT Interpretation

Run No: 04-0913-1621-1029

CPT File: 783CP03A.COR

h (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	SBT	U.Wt. pcf	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60	(N1)60	Su (tsf)	CRR
											(blows/ft)			
13.12	25.8	0.01	0.05	3.9	7	117.8	0.78	0.65	0.13	1.24	8.2	10.2	UnDef	0.08
13.45	55.2	0.01	0.02	4.4	8	120.9	0.80	0.66	0.14	1.23	13.2	16.3	UnDef	0.11
13.78	32.0	0.12	0.38	4.6	7	117.8	0.82	0.67	0.15	1.22	10.2	12.5	UnDef	0.09
14.11	11.5	0.14	1.20	6.4	6	114.6	0.84	0.68	0.16	1.21	4.4	5.4	0.85	0.11
14.44	5.1	0.03	0.55	26.0	1	111.4	0.86	0.69	0.17	1.21	2.5	3.0	0.34	0.08
14.76	4.5	0.01	0.29	40.7	1	111.4	0.87	0.69	0.18	1.20	2.1	2.6	0.29	0.00
15.09	3.2	0.01	0.33	39.2	1	111.4	0.89	0.70	0.19	1.19	1.5	1.8	0.19	0.00
15.42	2.6	0.01	0.39	49.0	1	111.4	0.91	0.71	0.20	1.19	1.2	1.5	0.13	0.00
15.75	4.7	0.01	0.22	29.1	1	111.4	0.93	0.72	0.21	1.18	2.3	2.7	0.31	0.00
16.08	5.8	0.01	0.18	12.4	1	111.4	0.95	0.73	0.22	1.17	2.8	3.3	0.39	0.00
16.40	2.9	0.01	0.36	21.0	1	111.4	0.97	0.73	0.23	1.17	1.4	1.6	0.16	0.00
16.73	6.8	0.01	0.19	35.3	1	111.4	0.98	0.74	0.24	1.16	3.2	3.8	0.46	0.00
17.06	31.0	0.10	0.32	17.2	7	117.8	1.00	0.75	0.25	1.15	9.9	11.4	UnDef	0.08
17.39	31.5	0.15	0.47	12.6	7	117.8	1.02	0.76	0.26	1.15	10.1	11.5	UnDef	0.08
17.72	24.4	0.09	0.38	11.6	7	117.8	1.04	0.77	0.27	1.14	7.8	8.9	UnDef	0.00
18.04	19.9	0.02	0.12	11.4	7	117.8	1.06	0.78	0.28	1.13	6.4	7.2	UnDef	0.00
18.37	19.8	0.01	0.06	11.6	7	117.8	1.08	0.79	0.29	1.13	6.3	7.1	UnDef	0.00
18.70	13.7	0.01	0.08	12.1	6	114.6	1.10	0.80	0.30	1.12	5.3	5.9	1.01	0.00
19.03	13.3	0.01	0.08	13.1	6	114.6	1.12	0.80	0.31	1.11	5.1	5.7	0.98	0.00
19.36	17.1	0.04	0.25	13.3	6	114.6	1.14	0.81	0.32	1.11	6.5	7.2	1.27	0.00
19.68	9.3	0.11	1.21	14.7	5	114.6	1.16	0.82	0.33	1.10	4.5	4.9	0.66	0.09
20.01	3.1	0.05	1.72	36.6	1	111.4	1.17	0.83	0.34	1.10	1.5	1.6	0.15	0.00
20.34	1.9	0.01	0.65	72.6	1	111.4	1.19	0.84	0.35	1.09	0.9	1.0	0.05	0.00
20.67	1.5	0.01	0.86	77.3	1	111.4	1.21	0.85	0.36	1.09	0.7	0.8	0.02	0.00
21.00	1.4	0.01	0.82	74.3	1	111.4	1.23	0.85	0.37	1.08	0.7	0.7	0.01	0.00
21.33	1.3	0.01	0.81	58.2	1	111.4	1.25	0.86	0.38	1.08	0.6	0.7	0.00	0.00
21.65	1.3	0.01	0.92	61.6	1	111.4	1.27	0.87	0.40	1.07	0.6	0.7	0.00	0.00
98	1.4	0.01	0.77	71.8	1	111.4	1.28	0.88	0.41	1.07	0.7	0.7	0.01	0.00
31	1.4	0.01	0.91	74.7	1	111.4	1.30	0.89	0.42	1.06	0.7	0.7	0.01	0.00
22.64	1.2	0.01	0.98	43.0	1	111.4	1.32	0.89	0.43	1.06	0.6	0.6	0.00	0.00
22.97	1.3	0.01	0.82	68.5	1	111.4	1.34	0.90	0.44	1.05	0.6	0.7	0.00	0.00
23.29	1.4	0.01	0.75	80.9	1	111.4	1.36	0.91	0.45	1.05	0.7	0.7	0.00	0.00
23.62	1.4	0.01	0.74	83.3	1	111.4	1.38	0.92	0.46	1.04	0.7	0.7	0.00	0.00
23.95	1.4	0.01	0.81	81.6	1	111.4	1.39	0.93	0.47	1.04	0.7	0.7	0.00	0.00
24.28	1.4	0.01	0.96	80.7	1	111.4	1.41	0.93	0.48	1.03	0.7	0.7	0.00	0.00
24.61	1.5	0.02	1.09	83.3	1	111.4	1.43	0.94	0.49	1.03	0.7	0.7	0.00	0.00
24.93	5.1	0.01	0.26	52.7	1	111.4	1.45	0.95	0.50	1.03	2.4	2.5	0.29	0.00
25.26	1.6	0.01	0.68	52.2	1	111.4	1.47	0.96	0.51	1.02	0.8	0.8	0.01	0.00
25.59	1.9	0.01	0.59	74.7	1	111.4	1.48	0.97	0.52	1.02	0.9	0.9	0.03	0.00
25.92	1.4	0.01	0.81	43.6	1	111.4	1.50	0.97	0.53	1.01	0.7	0.7	0.00	0.00
26.25	2.3	0.01	0.55	86.1	1	111.4	1.52	0.98	0.54	1.01	1.1	1.1	0.06	0.00
26.57	2.3	0.01	0.62	80.1	1	111.4	1.54	0.99	0.55	1.00	1.1	1.1	0.06	0.00
26.90	4.6	0.01	0.31	89.3	1	111.4	1.56	1.00	0.56	1.00	2.2	2.2	0.25	0.00
27.23	4.7	0.01	0.29	96.1	1	111.4	1.58	1.01	0.57	1.00	2.3	2.3	0.25	0.00
27.56	3.1	0.01	0.41	90.0	1	111.4	1.59	1.02	0.58	0.99	1.5	1.5	0.12	0.00
27.89	2.8	0.01	0.42	94.4	1	111.4	1.61	1.02	0.59	0.99	1.3	1.3	0.09	0.00
28.21	3.5	0.02	0.43	97.6	1	111.4	1.63	1.03	0.60	0.98	1.7	1.7	0.15	0.00
28.54	6.6	0.03	0.42	67.1	1	111.4	1.65	2.04	0.61	0.98	3.2	3.1	0.40	0.00
28.87	7.1	0.08	1.10	51.9	5	114.6	1.67	1.05	0.62	0.98	3.4	3.3	0.44	0.08
29.20	13.1	0.21	1.63	42.1	5	214.6	1.69	1.06	0.63	0.97	6.3	6.1	0.91	0.10
29.53	25.5	0.36	1.43	60.9	6	114.6	1.71	1.06	0.64	0.97	9.8	9.5	1.90	0.15
29.86	30.0	0.52	1.74	91.3	6	114.6	1.72	1.07	0.65	0.97	11.5	11.1	2.27	0.28
30.18	34.7	0.82	2.36	116.4	6	114.6	1.74	1.08	0.66	0.96	13.3	12.8	2.64	0.31
30.59	31.1	0.73	2.35	142.5	6	114.6	1.77	1.09	0.67	0.96	11.9	11.4	2.35	0.37
31.00	33.1	0.75	2.28	164.5	6	114.6	1.79	1.10	0.69	0.95	12.7	12.1	2.51	0.33
31.33	36.3	1.11	3.06	186.2	5	114.6	1.81	1.11	0.70	0.95	17.4	16.5	2.76	0.00
31.66	38.7	1.14	2.93	124.9	5	114.6	1.83	1.12	0.71	0.94	18.5	17.5	2.95	0.00
31.99	35.0	1.19	3.40	79.3	5	114.6	1.85	1.13	0.72	0.94	16.8	15.8	2.65	0.00
32	41.6	1.48	3.56	137.5	5	114.6	1.87	1.14	0.73	0.94	19.9	18.7	3.18	0.00
64	40.5	2.04	5.03	176.0	3	111.4	1.88	1.15	0.74	0.93	38.8	36.2	3.09	0.00
32.97	36.5	2.07	5.68	164.6	3	111.4	1.90	1.15	0.75	0.93	35.0	32.6	2.77	0.00
33.30	33.8	1.67	4.94	162.5	3	111.4	1.92	1.16	0.76	0.93	32.3	30.0	2.55	0.00

ConeTec Inc. - CPT Interpretation
Run No: 04-0913-1621-1029
CPT File: 783CP03A.COR

h)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	SBT	U.Wt. pcf	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	CRR
33.63	30.2	1.41	4.66	176.2	3	111.4	1.94	1.17	0.77	0.92	28.9	26.7	2.26	0.00
33.96	31.3	1.05	3.35	202.2	5	114.6	1.96	1.18	0.78	0.92	15.0	13.8	2.35	0.34
34.28	41.3	1.43	3.47	210.4	5	114.6	1.98	1.19	0.79	0.92	19.8	18.2	3.15	0.00
34.61	37.7	2.19	5.82	69.9	3	111.4	1.99	1.19	0.80	0.91	36.1	33.0	2.86	0.00
34.94	40.3	2.26	5.60	79.9	3	111.4	2.01	1.20	0.81	0.91	38.6	35.2	3.06	0.00
35.27	44.5	2.48	5.58	85.4	3	111.4	2.03	1.21	0.82	0.91	42.6	38.7	3.39	0.00
35.60	42.4	2.43	5.73	114.9	3	111.4	2.05	1.22	0.83	0.91	40.6	36.8	3.23	0.00
35.92	40.7	2.06	5.07	154.6	3	111.4	2.07	1.23	0.84	0.90	38.9	35.2	3.09	0.00
36.25	39.0	1.85	4.73	163.5	3	111.4	2.09	1.23	0.85	0.90	37.4	33.7	2.96	0.00
36.58	35.6	1.70	4.76	160.5	3	111.4	2.10	1.24	0.86	0.90	34.1	30.6	2.68	0.00
36.91	36.5	1.57	4.31	159.7	4	114.6	2.12	1.25	0.87	0.89	23.3	20.8	2.75	0.00
37.24	35.9	1.51	4.21	153.2	4	114.6	2.14	1.26	0.88	0.89	22.9	20.4	2.70	0.44
37.57	37.6	1.58	4.20	165.6	4	114.6	2.16	1.27	0.89	0.89	24.0	21.3	2.83	0.00
37.89	37.4	1.61	4.31	164.1	4	114.6	2.18	1.28	0.90	0.89	23.9	21.1	2.81	0.00
38.22	35.7	1.55	4.34	158.1	4	114.6	2.20	1.29	0.91	0.88	22.8	20.1	2.68	0.00
38.55	36.2	1.60	4.43	153.0	4	114.6	2.22	1.29	0.92	0.88	23.1	20.3	2.72	0.00
38.88	33.4	1.72	5.16	162.3	3	111.4	2.24	1.30	0.93	0.88	32.0	28.0	2.49	0.00
39.21	31.2	1.34	4.29	188.2	4	114.6	2.25	1.31	0.94	0.87	19.9	17.4	2.32	0.00
39.53	31.4	1.14	3.62	193.1	5	114.6	2.27	1.32	0.95	0.87	15.0	13.1	2.33	0.30
39.86	34.9	1.20	3.44	214.2	5	114.6	2.29	1.33	0.96	0.87	16.7	14.5	2.61	0.38
40.19	36.3	1.49	4.11	203.3	4	114.6	2.31	1.34	0.97	0.87	23.2	20.1	2.72	0.42
40.52	36.3	1.43	3.93	188.7	5	114.6	2.33	1.34	0.98	0.86	17.4	15.0	2.72	0.41
40.85	36.1	1.42	3.93	175.6	5	114.6	2.35	1.35	0.99	0.86	17.3	14.9	2.70	0.41
41.17	33.8	1.23	3.64	194.8	5	114.6	2.37	1.36	1.00	0.86	16.2	13.9	2.52	0.35
41.50	37.9	1.21	3.20	223.9	5	114.6	2.39	1.37	1.01	0.85	18.1	15.5	2.84	0.45
41.83	33.9	1.15	3.38	251.9	5	114.6	2.40	1.38	1.03	0.85	16.2	13.8	2.52	0.34
42.16	32.8	1.12	3.42	284.1	5	114.6	2.42	1.39	1.04	0.85	15.7	13.3	2.43	0.31
49	34.5	1.23	3.57	194.6	5	114.6	2.44	1.40	1.05	0.85	16.5	14.0	2.56	0.35
31	32.5	1.15	3.52	72.6	5	114.6	2.46	1.40	1.06	0.84	15.6	13.2	2.41	0.31
43.14	32.3	0.97	2.99	97.7	5	114.6	2.48	1.41	1.07	0.84	15.5	13.0	2.38	0.30
43.47	30.4	0.96	3.14	112.2	5	114.6	2.50	1.42	1.08	0.84	14.6	12.2	2.23	0.26
43.80	30.4	1.04	3.43	124.1	5	114.6	2.52	1.43	1.09	0.84	14.5	12.2	2.23	0.26
44.13	32.1	1.09	3.38	139.5	5	114.6	2.54	1.44	1.10	0.83	15.4	12.8	2.36	0.29
44.45	27.5	0.95	3.44	149.8	5	114.6	2.55	1.45	1.11	0.83	13.2	11.0	2.00	0.21
44.78	27.2	1.00	3.68	155.2	5	114.6	2.57	1.46	1.12	0.83	13.0	10.8	1.97	0.00
45.11	24.8	1.03	4.14	159.3	4	114.6	2.59	1.46	1.13	0.83	15.8	13.1	1.78	0.00
45.44	27.1	0.99	3.65	177.9	5	114.6	2.61	1.47	1.14	0.82	13.0	10.7	1.96	0.00
45.77	24.3	1.04	4.26	149.6	3	111.4	2.63	1.48	1.15	0.82	23.3	19.1	1.73	0.00
46.10	23.0	0.95	4.13	132.9	4	114.6	2.65	1.49	1.16	0.82	14.7	12.0	1.63	0.00
46.42	21.8	0.90	4.14	114.8	3	111.4	2.67	1.50	1.17	0.82	20.8	17.0	1.53	0.00
46.75	20.4	0.91	4.46	98.7	3	111.4	2.68	1.51	1.18	0.81	19.5	15.9	1.42	0.00
47.08	22.0	1.01	4.57	98.9	3	111.4	2.70	1.51	1.19	0.81	21.1	17.1	1.54	0.00
47.41	20.7	1.03	4.95	93.8	3	111.4	2.72	1.52	1.20	0.81	19.9	16.1	1.44	0.00
47.74	21.6	1.01	4.66	85.9	3	111.4	2.74	1.53	1.21	0.81	20.7	16.7	1.51	0.00
48.06	20.0	1.15	5.73	72.3	3	111.4	2.76	1.54	1.22	0.81	19.1	15.4	1.38	0.00
48.39	24.0	1.18	4.92	73.0	3	111.4	2.78	1.55	1.23	0.80	23.0	18.5	1.70	0.00
48.72	24.1	1.27	5.27	57.0	3	111.4	2.79	1.55	1.24	0.80	23.1	18.5	1.71	0.00
49.05	21.7	1.28	5.87	37.2	3	111.4	2.81	1.56	1.25	0.80	20.8	16.7	1.51	0.00
49.38	22.2	1.22	5.48	24.0	3	111.4	2.83	1.57	1.26	0.80	21.3	17.0	1.55	0.00
49.70	20.6	1.23	5.94	23.8	3	111.4	2.85	1.58	1.27	0.80	19.8	15.7	1.42	0.00
50.03	20.3	1.10	5.39	25.6	3	111.4	2.87	1.59	1.28	0.79	19.5	15.5	1.40	0.00
50.36	19.4	1.13	5.83	26.5	3	111.4	2.89	1.59	1.29	0.79	18.6	14.7	1.32	0.00
50.69	19.2	1.14	5.90	27.2	3	111.4	2.90	1.60	1.30	0.79	18.4	14.6	1.31	0.00
51.02	17.4	0.97	6.57	27.5	3	111.4	2.92	1.61	1.31	0.79	16.7	13.1	1.16	0.00
51.34	17.4	0.86	4.95	30.4	3	111.4	2.94	1.62	1.32	0.79	16.6	13.1	1.15	0.00
51.67	19.3	1.08	5.60	31.4	3	111.4	2.96	1.63	1.33	0.78	18.5	14.5	1.31	0.00
52.00	21.5	1.32	6.14	33.4	3	111.4	2.98	1.63	1.34	0.78	20.6	16.1	1.48	0.00
52.33	20.8	1.48	7.13	21.4	3	111.4	3.00	1.64	1.35	0.78	19.9	15.5	1.42	0.00
66	20.9	1.48	7.10	14.3	3	111.4	3.01	1.65	1.36	0.78	20.0	15.6	1.43	0.00
.98	19.7	1.47	7.43	4.9	3	111.4	3.03	1.66	1.37	0.78	18.9	14.7	1.34	0.00
53.31	19.3	1.24	6.40	1.8	3	111.4	3.05	1.67	1.38	0.77	18.5	14.3	1.30	0.00
53.64	48.8	0.70	1.43	-3.4	7	117.8	3.07	1.68	1.39	0.77	15.6	12.0	UnDef	0.19

ConeTec Inc. - CPT Interpretation
Run No: 04-0913-1621-1029
CPT File: 783CP03A.COR

h c)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	SBT	U.Wt. pcf	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60	Su (tsf)	CRR
53.97	132.8	1.40	1.06	6.0	8	120.9	3.09	1.68	1.40	0.77	31.8	24.5	UnDef	0.28

```
ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.00.19M
Run No:     04-0913-1621-1029
    h No:   04-783
     ent:   MACTEC, Inc.
 roject:    TVA Plant, Gallatin, TN
Site:       CPT-3A
Location:   TVA Plant
Cone:       20 TON  AD163
CPT Date:   04/08/09
CPT Time:   14:41
CPT File:   783CP03A.COR
Northing  (m):         0.000
Easting   (m):         0.000
Elevation (m):         0.000
----------------------------------------------------------------------------------------------------------------
 Water Table (m):             2.74       (ft):    9.0
 Unit Weight of Water (default):     62.40 kN/m^3
 Su Nkt used:      12.50      Su/P' (nc):   0.30
 Averaging Increment (m):     0.10
 Phi Method :                 Robertson and Campanella, 1983
 Dr  Method :                 Jamiolkowski - All Sands
 State Parameter M:           1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
-----------------------------------------------------------------------------------------------------------------------------
 Depth      k        Bq       Qtn      Rfn   SBTn    Qc1N DeltaQc1N   Qc1Ncs     Fc     Phi      Dr     OCR   State Del(n1)60 (N1)60cs
 (ft)    (cm/s)                                                                 (%)   (Deg)    (%)          Param
-----------------------------------------------------------------------------------------------------------------------------
  0.16  5.0E-04    0.00    1000.0    0.12   10     36.4      0.0       36.4     0.0     50     85.6     1.0   -0.21     0.0     12.1
  0.49  5.0E-03    0.00    1000.0    0.06   10     99.4      0.0       99.4     0.0     50     95.0     1.0   -0.15     0.0     24.8
  0.82  5.0E-02    0.00    1000.0    0.21   10    160.6      0.0      160.6     0.0     50     95.0     1.0   -0.26     0.0     32.1
  1.15  5.0E-02    0.00    1000.0    0.33   10    205.1      0.0      205.1     0.0     50     95.0     1.0   -0.29     0.0     41.0
  1.48  5.0E-02    0.00    1000.0    0.41   10    217.4      0.0      217.4     0.0     50     95.0     1.0   -0.31     0.0     43.5
    80  5.0E-02    0.00    1000.0    0.35   10    214.0      0.0      214.0     0.0     50     95.0     1.0   -0.30     0.0     42.8
    13  5.0E-02    0.00     802.4    0.31   10    201.2      0.0      201.2     0.0     50     95.0     1.0   -0.27     0.0     40.2
  2.46  5.0E-02    0.00     669.2    0.33   10    194.0      0.0      194.0     0.0     50     94.1     1.0   -0.26     0.0     38.8
  2.79  5.0E-02    0.00     942.7    0.65   10    310.0      0.0      310.0     0.0     50     95.0     1.0   -0.35     0.0     62.0
  3.12  5.0E-03    0.00     914.2    1.13    9    335.9      0.0      335.9     1.2     50     95.0     1.0   -0.41     0.0     84.0
  3.44  5.0E-03    0.00     660.3    1.75   12    267.8     UnDef     UnDef     0.0     50     95.0     1.0   -0.44    UnDef    UnDef
  3.77  5.0E-04    0.00     334.9    1.91    9    148.6     10.9      159.6     7.6     48     80.4     1.0   -0.39     2.2     51.8
  4.10  5.0E-04    0.00     197.5    1.11    9     95.2      4.3       99.5     6.6     46     66.5     1.0   -0.26     0.9     32.6
  4.43  5.0E-04    0.00     162.2    0.82    9     82.9      2.3       85.3     6.0     44     61.9     1.0   -0.21     0.5     27.5
  4.76  5.0E-04    0.00     146.9    1.29    9     77.8     10.7       88.5     9.5     44     60.1     1.0   -0.25     2.1     27.5
  5.09  5.0E-05    0.00      94.6    1.85    7     51.9     21.7       73.7    16.1     42     48.5    10.0   -0.25     4.6     24.9
  5.41  5.0E-06    0.00      46.8    2.25    7     26.7     34.1       60.8    26.0   UnDef    UnDef    10.0   UnDef     7.1     20.1
  5.74  5.0E-06    0.03      35.1    2.01    7     20.8     35.6       56.4    28.7   UnDef    UnDef    10.0   UnDef     6.6     16.8
  6.07  5.0E-02    0.00     264.6    0.45    9    157.1      0.0      157.1     1.1     46     80.2     1.0   -0.20     0.0     30.7
  6.40  5.0E-03    0.00     197.4    0.78    9    120.5      0.0      120.5     4.7     46     72.6     1.0   -0.23     0.0     29.5
  6.73  5.0E-03    0.00     142.3    0.24    9     89.2      0.0       89.2     2.1     44     64.0     1.0   -0.10     0.0     21.8
  7.05  5.0E-04    0.00      85.3    0.58    9     55.0      6.0       61.0     8.7     42     50.1     1.0   -0.12     1.2     19.1
  7.38  5.0E-05    0.00      65.6    1.53    7     43.4     23.0       66.4    18.0     40     43.3    10.0   -0.19     4.7     21.7
  7.79  5.0E-04    0.01      79.4    1.15    9     53.8     16.3       70.1    13.7     42     49.5     1.0   -0.18     3.0     20.5
  8.20  5.0E-03    0.01     101.8    0.45    9     70.6      0.0       70.6     5.0     42     57.3     1.0   -0.12     0.0     17.3
  8.53  5.0E-03    0.00      75.4    0.31    9     53.5      0.0       53.5     5.0     40     49.3     1.0   -0.06     0.0     13.1
  8.86  5.0E-05    0.01      30.8    1.12    7     22.7     24.7       47.4    24.5     36     30.0    10.0   -0.08     4.3     13.2
  9.19  1.0E-07    0.06      12.6    0.34    7      9.9      0.0        9.9     5.0   UnDef    UnDef     4.6   UnDef     0.0      4.8
  9.51  1.0E-07    0.08       8.8    0.25    7      7.1     28.5       35.6    35.4   UnDef    UnDef     2.7   UnDef     3.5      7.0
  9.84  1.0E-07    0.11      13.9    0.14    7     11.0      0.0       11.0     5.0   UnDef    UnDef     5.4   UnDef     0.0      5.4
 10.17  5.0E-04    0.01      43.6    0.50    9     33.0      0.0       33.0     5.0     38     35.5     1.0   -0.05     0.0     10.8
 10.50  5.0E-03    0.01      78.7    0.11    9     59.3      0.0       59.3     4.3     42     52.3     1.0    0.02     0.0     14.5
 10.83  5.0E-03    0.00      64.9    0.30    9     49.5      0.0       49.5     5.0     40     47.1     1.0   -0.05     0.0     12.1
 11.15  5.0E-04    0.01      38.5    0.23    9     29.9      0.0       29.9     5.0     38     32.7     1.0    0.02     0.0      9.8
 11.48  5.0E-05    0.03      20.7    0.10    7     16.6      0.0       16.6     5.0     34     30.0    10.0    0.14     0.0      6.5
 11.81  5.0E-04    0.02      51.3    0.06    9     40.2      0.0       40.2     5.0     38     41.2     1.0    0.11     0.0     13.1
    14  5.0E-04    0.01      37.1    0.08    9     29.6      0.0       29.6     5.0     38     32.3     1.0    0.11     0.0      9.6
   .47  5.0E-04    0.00      42.8    0.04    9     34.2      0.0       34.2     5.0     38     36.5     1.0    0.15     0.0     11.2
 12.80  5.0E-04    0.00      36.7    0.05    9     29.7      0.0       29.7     5.0     38     32.5     1.0    0.15     0.0      9.7
```

h c)	k (cm/s)	Bq	Qtn	Rfn	SBTn	Qc1N	DeltaQc1N	Qc1Ncs	Fc (%)	Phi (Deg)	Dr (%)	OCR	State Param	Del(n1)60	(N1)60cs
13.12	5.0E-04	0.00	38.5	0.05	9	31.3	0.0	31.3	5.0	38	34.0	1.0	0.14	0.0	10.2
13.45	5.0E-03	0.00	82.4	0.02	9	66.4	0.0	66.4	4.4	42	55.6	1.0	0.14	0.0	16.3
13.78	5.0E-04	0.00	46.6	0.39	9	38.3	0.0	38.3	5.0	38	39.8	1.0	-0.04	0.0	12.5
14.11	5.0E-05	0.00	15.7	1.30	6	13.7	54.7	68.4	37.1	32	30.0	6.5	-0.03	5.4	10.7
14.44	1.0E-07	0.15	6.2	0.66	6	6.0	24.2	30.2	50.2	UnDef	UnDef	1.7	UnDef	3.0	5.9
14.76	1.0E-07	0.30	5.2	0.36	1	5.3	UnDef	UnDef	100.0	UnDef	UnDef	1.4	UnDef	UnDef	UnDef
15.09	1.0E-07	0.44	3.3	0.45	1	3.8	UnDef	UnDef	100.0	UnDef	UnDef	0.9	UnDef	UnDef	UnDef
15.42	1.0E-07	0.80	2.3	0.60	1	3.0	UnDef	UnDef	100.0	UnDef	UnDef	0.7	UnDef	UnDef	UnDef
15.75	1.0E-07	0.18	5.3	0.28	1	5.5	UnDef	UnDef	100.0	UnDef	UnDef	1.4	UnDef	UnDef	UnDef
16.08	1.0E-07	0.03	6.7	0.22	1	6.6	UnDef	UnDef	100.0	UnDef	UnDef	1.9	UnDef	UnDef	UnDef
16.40	1.0E-07	0.22	2.7	0.54	1	3.3	UnDef	UnDef	100.0	UnDef	UnDef	0.8	UnDef	UnDef	UnDef
16.73	1.0E-07	0.15	7.8	0.22	1	7.7	UnDef	UnDef	100.0	UnDef	UnDef	2.3	UnDef	UnDef	UnDef
17.06	5.0E-04	0.01	40.0	0.33	9	35.0	0.0	35.0	5.0	38	37.2	1.0	-0.01	0.0	11.4
17.39	5.0E-04	0.00	40.1	0.49	9	35.4	0.0	35.4	5.0	38	37.5	1.0	-0.04	0.0	11.5
17.72	5.0E-04	0.00	30.4	0.40	7	27.2	0.0	27.2	5.0	36	30.0	1.0	0.00	0.0	8.9
18.04	5.0E-04	0.00	24.2	0.13	7	22.1	0.0	22.1	5.0	34	30.0	1.0	0.11	0.0	7.2
18.37	5.0E-04	0.00	23.8	0.06	7	21.8	0.0	21.8	5.0	34	30.0	1.0	0.16	0.0	7.1
18.70	5.0E-05	0.01	15.9	0.08	7	15.1	0.0	15.1	5.0	32	30.0	6.6	0.18	0.0	5.9
19.03	5.0E-05	0.01	15.2	0.09	7	14.5	0.0	14.5	5.0	32	30.0	6.1	0.18	0.0	5.7
19.36	5.0E-05	0.01	19.6	0.27	7	18.5	0.0	18.5	5.0	34	30.0	9.1	0.07	0.0	7.2
19.68	5.0E-06	0.02	10.0	1.38	6	10.1	40.4	50.4	47.2	UnDef	UnDef	3.3	UnDef	4.9	9.9
20.01	1.0E-07	0.42	2.3	2.79	1	3.3	UnDef	UnDef	100.0	UnDef	UnDef	0.7	UnDef	UnDef	UnDef
20.34	1.0E-07	2.89	0.8	1.82	1	2.0	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
20.67	1.0E-07	8.23	0.3	5.03	1	1.6	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
21.00	1.0E-07	10.71	0.2	6.34	1	1.5	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
21.33	1.0E-07	30.07	0.1	10.00	1	1.4	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
21.65	1.0E-07	33.62	0.1	10.00	1	1.4	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
98	1.0E-07	24.49	0.1	10.00	1	1.4	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
31	1.0E-07	25.47	0.1	10.00	1	1.4	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
22.64	1.0E-07	87.82	0.0	10.00	1	1.3	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
22.97	1.0E-07	175.47	0.0	10.00	1	1.4	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
23.29	1.0E-07	42.00	0.1	10.00	1	1.4	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
23.62	1.0E-07	50.71	0.0	10.00	1	1.4	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
23.95	1.0E-07	57.22	0.0	10.00	1	1.5	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
24.28	1.0E-07	576.60	0.0	10.00	1	1.4	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
24.61	1.0E-07	44.28	0.1	10.00	1	1.5	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
24.93	1.0E-07	0.31	3.9	0.37	1	5.1	UnDef	UnDef	100.0	UnDef	UnDef	1.0	UnDef	UnDef	UnDef
25.26	1.0E-07	6.75	0.2	6.63	1	1.6	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
25.59	1.0E-07	4.67	0.4	2.84	1	1.9	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
25.92	1.0E-07	79.75	0.0	10.00	1	1.4	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
25.25	1.0E-07	2.88	0.8	1.68	1	2.2	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
26.57	1.0E-07	2.44	0.8	1.82	1	2.3	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
26.90	1.0E-07	0.72	3.1	0.47	1	4.6	UnDef	UnDef	100.0	UnDef	UnDef	0.8	UnDef	UnDef	UnDef
27.23	1.0E-07	0.77	3.1	0.43	1	4.6	UnDef	UnDef	100.0	UnDef	UnDef	0.9	UnDef	UnDef	UnDef
27.56	1.0E-07	1.53	1.4	0.86	1	3.0	UnDef	UnDef	100.0	UnDef	UnDef	0.6	UnDef	UnDef	UnDef
27.89	1.0E-07	2.06	1.1	1.01	1	2.7	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
28.21	1.0E-07	1.31	1.8	0.80	1	3.4	UnDef	UnDef	100.0	UnDef	UnDef	0.6	UnDef	UnDef	UnDef
28.54	1.0E-07	0.30	4.8	0.56	1	6.4	UnDef	UnDef	100.0	UnDef	UnDef	1.3	UnDef	UnDef	UnDef
28.87	5.0E-06	0.18	5.2	1.43	4	6.8	27.3	34.1	63.9	UnDef	UnDef	1.4	UnDef	3.3	6.7
29.20	5.0E-06	0.06	10.8	1.87	6	12.5	50.0	62.4	49.3	UnDef	UnDef	3.7	UnDef	6.1	12.2
29.53	5.0E-05	0.05	22.4	1.53	7	24.2	68.4	92.6	32.7	34	30.0	10.0	-0.07	8.1	17.6
29.86	5.0E-05	0.08	26.4	1.85	7	28.4	74.4	102.8	32.1	36	31.2	10.0	-0.10	9.2	20.3
30.18	5.0E-05	0.09	30.5	2.49	6	32.7	103.3	135.9	33.5	36	35.2	10.0	-0.15	11.6	24.4
30.59	5.0E-05	0.13	26.9	2.49	6	29.1	116.5	145.6	35.5	36	31.9	10.0	-0.13	11.4	22.8
31.00	5.0E-05	0.14	28.4	2.41	6	30.9	108.4	139.3	34.2	36	33.6	10.0	-0.13	11.5	23.6
31.33	5.0E-06	0.15	31.0	3.22	6	33.7	134.7	168.4	36.7	UnDef	UnDef	10.0	UnDef	16.5	33.0
31.66	5.0E-06	0.09	32.9	3.08	6	35.8	143.1	178.9	35.1	UnDef	UnDef	10.0	UnDef	17.5	35.0
31.99	5.0E-06	0.05	29.4	3.59	6	32.2	129.0	161.2	39.2	UnDef	UnDef	10.0	UnDef	15.8	31.6
32	5.0E-06	0.09	34.9	3.73	6	38.2	152.7	190.9	36.9	UnDef	UnDef	10.0	UnDef	18.7	37.4
.64	5.0E-08	0.12	33.7	5.28	1	37.0	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
32.97	5.0E-08	0.12	30.0	5.99	1	33.3	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
33.30	5.0E-08	0.14	27.4	5.23	1	30.7	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef

:h .._)	k (cm/s)	Bq	Qtn	Rfn	SBTn	Qc1N	DeltaQc1N	Qc1Ncs	Fc (%)	Phi (Deg)	Dr (%)	OCR	State Param	Del(n1)60	(N1)60cs
33.63	5.0E-08	0.17	24.2	4.98	1	27.3	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
33.96	5.0E-06	0.19	24.9	3.58	6	28.3	113.0	141.3	42.0	UnDef	UnDef	10.0	UnDef	13.8	27.7
34.28	5.0E-06	0.15	33.1	3.64	6	37.1	148.4	185.5	37.4	UnDef	UnDef	10.0	UnDef	18.2	36.3
34.61	5.0E-08	0.04	29.9	6.15	1	33.7	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
34.94	5.0E-08	0.04	31.8	5.90	1	36.0	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
35.27	5.0E-08	0.04	35.0	5.84	1	39.5	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
35.60	5.0E-08	0.07	33.1	6.02	1	37.6	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
35.92	5.0E-08	0.10	31.5	5.34	1	35.9	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
36.25	5.0E-08	0.12	29.9	5.00	1	34.4	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
36.58	5.0E-08	0.12	27.0	5.06	1	31.3	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
36.91	5.0E-07	0.12	27.5	4.59	1	31.9	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
37.24	5.0E-07	0.12	26.8	4.48	4	31.3	125.1	156.4	44.3	UnDef	UnDef	10.0	UnDef	20.4	40.8
37.57	5.0E-07	0.12	27.9	4.45	4	32.7	130.6	163.3	43.4	UnDef	UnDef	10.0	UnDef	21.3	42.6
37.89	5.0E-07	0.12	27.6	4.58	1	32.4	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
38.22	5.0E-07	0.12	26.1	4.63	1	30.8	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
38.55	5.0E-07	0.11	26.3	4.72	1	31.1	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
38.88	5.0E-08	0.13	23.9	5.53	1	28.6	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
39.21	5.0E-07	0.17	22.1	4.63	1	26.7	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
39.53	5.0E-06	0.17	22.1	3.90	6	26.7	107.0	133.7	45.6	UnDef	UnDef	10.0	UnDef	13.1	26.2
39.86	5.0E-06	0.18	24.5	3.69	6	29.6	118.5	148.1	42.7	UnDef	UnDef	10.0	UnDef	14.5	29.0
40.19	5.0E-07	0.16	25.5	4.39	4	30.8	123.0	153.8	44.8	UnDef	UnDef	10.0	UnDef	20.1	40.1
40.52	5.0E-06	0.14	25.3	4.20	6	30.7	122.6	153.3	44.3	UnDef	UnDef	10.0	UnDef	15.0	30.0
40.85	5.0E-06	0.13	25.0	4.21	4	30.4	121.6	152.0	44.5	UnDef	UnDef	10.0	UnDef	14.9	29.7
41.17	5.0E-06	0.16	23.1	3.91	6	28.4	113.5	141.8	44.8	UnDef	UnDef	10.0	UnDef	13.9	27.8
41.50	5.0E-06	0.17	25.9	3.41	6	31.7	126.7	158.4	40.6	UnDef	UnDef	10.0	UnDef	15.5	31.0
41.83	5.0E-06	0.22	22.9	3.63	6	28.3	113.1	141.4	43.8	UnDef	UnDef	10.0	UnDef	13.8	27.7
42.16	5.0E-06	0.26	21.9	3.69	6	27.2	108.9	136.1	44.9	UnDef	UnDef	10.0	UnDef	13.3	26.6
49	5.0E-06	0.16	22.9	3.84	6	28.5	114.2	142.7	44.6	UnDef	UnDef	10.0	UnDef	14.0	27.9
91	5.0E-06	0.04	21.4	3.81	6	26.9	107.5	134.4	45.8	UnDef	UnDef	10.0	UnDef	13.2	26.3
43.14	5.0E-06	0.07	21.1	3.24	6	26.6	106.3	132.9	43.5	UnDef	UnDef	10.0	UnDef	13.0	26.0
43.47	5.0E-06	0.09	19.6	3.42	6	25.0	99.8	124.8	45.8	UnDef	UnDef	9.2	UnDef	12.2	24.4
43.80	5.0E-06	0.10	19.5	3.74	4	24.8	99.4	124.2	47.3	UnDef	UnDef	9.1	UnDef	12.2	24.3
44.13	5.0E-06	0.11	20.5	3.67	6	26.2	104.7	130.9	46.0	UnDef	UnDef	9.9	UnDef	12.8	25.6
44.45	5.0E-06	0.14	17.2	3.79	4	22.4	89.5	111.9	50.0	UnDef	UnDef	7.5	UnDef	11.0	21.9
44.78	5.0E-06	0.15	16.9	4.06	1	22.0	UnDef	UnDef	100.0	UnDef	UnDef	7.2	UnDef	UnDef	UnDef
45.11	5.0E-07	0.17	15.2	4.62	1	20.0	UnDef	UnDef	100.0	UnDef	UnDef	6.1	UnDef	UnDef	UnDef
45.44	5.0E-06	0.18	16.6	4.04	1	21.9	UnDef	UnDef	100.0	UnDef	UnDef	7.1	UnDef	UnDef	UnDef
45.77	5.0E-08	0.16	14.6	4.78	1	19.5	UnDef	UnDef	100.0	UnDef	UnDef	5.8	UnDef	UnDef	UnDef
46.10	5.0E-07	0.15	13.7	4.66	1	18.5	UnDef	UnDef	100.0	UnDef	UnDef	5.2	UnDef	UnDef	UnDef
46.42	5.0E-08	0.13	12.7	4.71	1	17.4	UnDef	UnDef	100.0	UnDef	UnDef	4.7	UnDef	UnDef	UnDef
46.75	5.0E-08	0.11	11.8	5.14	1	16.3	UnDef	UnDef	100.0	UnDef	UnDef	4.2	UnDef	UnDef	UnDef
47.08	5.0E-08	0.10	12.7	5.21	1	17.5	UnDef	UnDef	100.0	UnDef	UnDef	4.7	UnDef	UnDef	UnDef
47.41	5.0E-08	0.10	11.8	5.69	1	16.4	UnDef	UnDef	100.0	UnDef	UnDef	4.2	UnDef	UnDef	UnDef
47.74	5.0E-08	0.08	12.3	5.34	1	17.1	UnDef	UnDef	100.0	UnDef	UnDef	4.4	UnDef	UnDef	UnDef
48.06	5.0E-08	0.06	11.2	6.65	1	15.8	UnDef	UnDef	100.0	UnDef	UnDef	3.9	UnDef	UnDef	UnDef
48.39	5.0E-08	0.05	13.7	5.57	1	18.9	UnDef	UnDef	100.0	UnDef	UnDef	5.2	UnDef	UnDef	UnDef
48.72	5.0E-08	0.03	13.7	5.95	1	18.9	UnDef	UnDef	100.0	UnDef	UnDef	5.3	UnDef	UnDef	UnDef
49.05	5.0E-08	0.00	12.1	6.74	1	17.0	UnDef	UnDef	100.0	UnDef	UnDef	4.3	UnDef	UnDef	UnDef
49.38	5.0E-08	-0.03	12.3	6.28	1	17.3	UnDef	UnDef	100.0	UnDef	UnDef	4.5	UnDef	UnDef	UnDef
49.70	5.0E-08	-0.03	11.3	6.90	1	16.1	UnDef	UnDef	100.0	UnDef	UnDef	3.9	UnDef	UnDef	UnDef
50.03	5.0E-08	-0.03	11.0	6.28	1	15.8	UnDef	UnDef	100.0	UnDef	UnDef	3.8	UnDef	UnDef	UnDef
50.36	5.0E-08	-0.03	10.4	6.85	1	15.0	UnDef	UnDef	100.0	UnDef	UnDef	3.4	UnDef	UnDef	UnDef
50.69	5.0E-08	-0.03	10.2	6.95	1	14.9	UnDef	UnDef	100.0	UnDef	UnDef	3.4	UnDef	UnDef	UnDef
51.02	5.0E-08	-0.03	9.0	6.69	1	13.4	UnDef	UnDef	100.0	UnDef	UnDef	2.8	UnDef	UnDef	UnDef
51.34	5.0E-08	-0.03	8.9	5.96	1	13.4	UnDef	UnDef	100.0	UnDef	UnDef	2.8	UnDef	UnDef	UnDef
51.67	5.0E-08	-0.02	10.0	6.62	1	14.8	UnDef	UnDef	100.0	UnDef	UnDef	3.3	UnDef	UnDef	UnDef
52.00	5.0E-08	-0.02	11.3	7.13	1	16.5	UnDef	UnDef	100.0	UnDef	UnDef	3.9	UnDef	UnDef	UnDef
52.33	5.0E-08	-0.04	10.8	8.33	1	15.9	UnDef	UnDef	100.0	UnDef	UnDef	3.7	UnDef	UnDef	UnDef
66	5.0E-08	-0.05	10.8	8.29	1	15.9	UnDef	UnDef	100.0	UnDef	UnDef	3.7	UnDef	UnDef	UnDef
.98	5.0E-08	-0.07	10.1	8.78	1	15.0	UnDef	UnDef	100.0	UnDef	UnDef	3.3	UnDef	UnDef	UnDef
53.31	5.0E-08	-0.08	9.8	7.60	1	14.6	UnDef	UnDef	100.0	UnDef	UnDef	3.2	UnDef	UnDef	UnDef
53.64	5.0E-04	-0.03	27.3	1.53	7	36.9	69.2	106.1	29.4	36	38.7	1.0	-0.10	8.3	20.3

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(   :h      k        Bq       Qtn     Rfn   SBTn    Qc1N DeltaQc1N   Qc1Ncs     Fc    Phi      Dr     OCR   State Del(n1)60  (N1)60cs
 ...)    (cm/s)                                                              (%)  (Deg)     (%)          Param
------------------------------------------------------------------------------------------------------------------------------------
 53.97   5.0E-03   -0.01     77.0    1.08     9    100.1      29.3    129.5    13.5     40    67.3     1.0   -0.17      4.0     28.5
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ConeTec Inc. - CPT Interpretation                                                      Page:   1a
Interpretation Output - Release 1.00.19M
Run No:    04-0913-1621-1051
    No:    04-783
  ient:    MACTEC, Inc.
Project:   TVA Plant, Gallatin, TN
Site:      CPT-04
Location:  TVA Plant
Cone:      20 TON  AD163
CPT Date:  04/08/09
CPT Time:  13:39
CPT File:  783CP004.COR
Northing  (m):          0.000
Easting   (m):          0.000
Elevation (m):          0.000
-------------------------------------------------------------------------------------------------------------
 Water Table (m):              1.52       (ft):     5.0
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:      12.50      Su/P' (nc):    0.30
 Averaging Increment (m):      0.10
 Phi Method :               Robertson and Campanella, 1983
 Dr  Method :               Jamiolkowski - All Sands
 State Parameter M:            1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
------------------------------------------------------------------------------------------------------------------------
 Depth     AvgQt     AvgFs     AvgRf     AvgUd    SBT     U.Wt.  TStress   EStress      Ueq       Cn       N60    (N1)60      Su    CRR
 (ft)      (tsf)     (tsf)      (%)       (ft)             pcf     (tsf)     (tsf)     (tsf)                (blows/ft)      (tsf)
------------------------------------------------------------------------------------------------------------------------
  0.16      22.5      0.01      0.04       0.0      7     117.8     0.01      0.01      0.00      2.00       7.2      14.4   UnDef  0.09
  0.49      56.1      0.01      0.02      -0.3      8     120.9     0.03      0.03      0.00      2.00      13.4      26.9   UnDef  0.20
  0.82      81.9      0.18      0.22      -0.3      8     120.9     0.05      0.05      0.00      2.00      19.6      39.2   UnDef  0.44
  1.15     117.7      0.34      0.29       0.0      9     124.1     0.07      0.07      0.00      2.00      22.5      45.1   UnDef  0.00
    48     132.4      0.52      0.39      -0.2      9     124.1     0.09      0.09      0.00      2.00      25.4      50.7   UnDef  0.00
    30     143.8      0.59      0.41       0.1      9     124.1     0.11      0.11      0.00      2.00      27.5      55.1   UnDef  0.00
  2.13     151.0      0.70      0.46       0.0      9     124.1     0.13      0.13      0.00      2.00      28.9      57.8   UnDef  0.00
  2.46     158.8      1.07      0.67      -0.1      9     124.1     0.15      0.15      0.00      2.00      30.4      60.8   UnDef  0.00
  2.79     183.0      1.01      0.55      -0.3      9     124.1     0.17      0.17      0.00      2.00      35.0      70.1   UnDef  0.00
  3.12     219.1      1.32      0.60      -0.2      9     124.1     0.19      0.19      0.00      2.00      42.0      83.9   UnDef  0.00
  3.44     230.1      1.29      0.56       0.0      9     124.1     0.21      0.21      0.00      2.00      44.1      88.2   UnDef  0.00
  3.77     271.7      1.15      0.42      -0.1     10     127.3     0.23      0.23      0.00      2.00      43.4      86.7   UnDef  0.00
  4.10     361.6      1.91      0.53       0.0     10     127.3     0.25      0.25      0.00      1.99      57.7     114.7   UnDef  0.00
  4.43     480.6      2.94      0.61      -0.3     10     127.3     0.27      0.27      0.00      1.91      76.7     146.5   UnDef  0.00
  4.76     440.3      2.66      0.60      -0.3     10     127.3     0.29      0.29      0.00      1.84      70.3     129.4   UnDef  0.00
  5.09     508.6      2.72      0.54      -0.7     10     127.3     0.32      0.31      0.00      1.79      81.2     145.1   UnDef  0.00
  5.41     501.0      3.58      0.71      -0.8     10     127.3     0.34      0.32      0.01      1.76      80.0     140.5   UnDef  0.00
  5.74     556.8      3.01      0.54      -1.4     10     127.3     0.36      0.33      0.02      1.73      88.9     153.7   UnDef  0.00
  6.07     734.9      3.00      0.41      -1.5     10     127.3     0.38      0.35      0.03      1.70     117.3     199.7   UnDef  0.00
  6.40     969.6      3.06      0.32       3.4     10     127.3     0.40      0.36      0.04      1.68     154.8     259.5   UnDef  0.00
```

```
ConeTec Inc. - CPT Interpretation                                               Page:   1b
Interpretation Output - Release 1.00.19M
Run No:    04-0913-1621-1051
Job No:    04-783
Client:    MACTEC, Inc.
Project:   TVA Plant, Gallatin, TN
Site:      CPT-04
Location:  TVA Plant
Cone:      20 TON  AD163
CPT Date:  04/08/09
CPT Time:  13:39
CPT File:  783CP004.COR
Northing  (m):          0.000
Easting   (m):          0.000
Elevation (m):          0.000
-----------------------------------------------------------------------------------------------------------
 Water Table (m):              1.52      (ft):    5.0
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:      12.50      Su/P' (nc):   0.30
 Averaging Increment (m):      0.10
 Phi Method :               Robertson and Campanella, 1983
 Dr  Method :               Jamiolkowski - All Sands
 State Parameter M:            1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
------------------------------------------------------------------------------------------------------------------------
 Depth      k         Bq       Qtn      Rfn   SBTn     Qc1N DeltaQc1N     Qc1Ncs      Pc     Phi       Dr      OCR   State Del(n1)60  (N1)60cs
 (ft)    (cm/s)                                                                     (%)   (Deg)      (%)           Param
------------------------------------------------------------------------------------------------------------------------
  0.16   5.0E-04    0.00    1000.0    0.04    10      43.2        0.0       43.2     0.0     50      90.5     1.0   -0.12        0.0      14.4
  0.49   5.0E-03    0.00    1000.0    0.02    10     107.5        0.0      107.5     0.0     50      95.0     1.0   -0.05        0.0      26.9
  0.82   5.0E-03    0.00    1000.0    0.22    10     156.9        0.0      156.9     0.0     50      95.0     1.0   -0.26        0.0      39.2
  1.15   5.0E-02    0.00    1000.0    0.29    10     225.5        0.0      225.5     0.0     50      95.0     1.0   -0.28        0.0      45.1
  1.48   5.0E-02    0.00    1000.0    0.39    10     253.6        0.0      253.6     0.0     50      95.0     1.0   -0.31        0.0      50.7
    80   5.0E-02    0.00    1000.0    0.41    10     275.5        0.0      275.5     0.0     50      95.0     1.0   -0.31        0.0      55.1
    13   5.0E-02    0.00    1000.0    0.46    10     289.1        0.0      289.1     0.0     50      95.0     1.0   -0.32        0.0      57.8
  2.46   5.0E-02    0.00    1000.0    0.67    10     304.2        0.0      304.2     0.0     50      95.0     1.0   -0.36        0.0      60.8
  2.79   5.0E-02    0.00    1000.0    0.55    10     350.5        0.0      350.5     0.0     50      95.0     1.0   -0.34        0.0      70.1
  3.12   5.0E-02    0.00    1000.0    0.60    10     419.7        0.0      419.7     0.0     50      95.0     1.0   -0.35        0.0      83.9
  3.44   5.0E-02    0.00    1000.0    0.56    10     440.8        0.0      440.8     0.0     50      95.0     1.0   -0.34        0.0      88.2
  3.77   5.0E+00    0.00    1000.0    0.42    10     520.5        0.0      520.5     0.0     50      95.0     1.0   -0.32        0.0      86.7
  4.10   5.0E+00    0.00    1000.0    0.53    10     692.5        0.0      692.5     0.0     50      95.0     1.0   -0.34        0.0     114.7
  4.43   5.0E+00    0.00    1000.0    0.61    10     898.4        0.0      898.4     0.0     50      95.0     1.0   -0.35        0.0     146.5
  4.76   5.0E+00    0.00    1000.0    0.60    10     793.3        0.0      793.3     0.0     50      95.0     1.0   -0.35        0.0     129.4
  5.09   5.0E+00    0.00    1000.0    0.54    10     889.3        0.0      889.3     0.0     50      95.0     1.0   -0.34        0.0     145.1
  5.41   5.0E+00    0.00    1000.0    0.71    10     861.6        0.0      861.6     0.0     50      95.0     1.0   -0.37        0.0     140.5
  5.74   5.0E+00    0.00    1000.0    0.54    10     942.2        0.0      942.2     0.0     50      95.0     1.0   -0.34        0.0     153.7
  6.07   5.0E+00    0.00    1000.0    0.41    10    1224.2        0.0     1224.2     0.0     50      95.0     1.0   -0.31        0.0     199.7
  6.40   5.0E+00    0.00    1000.0    0.32    10    1590.8        0.0     1590.8     0.0     50      95.0     1.0   -0.29        0.0     259.5
```

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ConeTec Inc. - CPT Interpretation                                          Page:   1a
Interpretation Output - Release 1.00.19M
    No:      04-0913-1621-1073
    No:      04-783
Client:      MACTEC, Inc.
Project:     TVA Plant, Gallatin, TN
Site:        CPT-05
Location:    TVA Plant
Cone:        20 TON  AD163
CPT Date:    04/08/09
CPT Time:    12:51
CPT File:    783CP005.COR
Northing  (m):        0.000
Easting   (m):        0.000
Elevation (m):        0.000
------------------------------------------------------------------------------------------------
 Water Table (m):              1.52        (ft):    5.0
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:      12.50     Su/P' (nc):   0.30
 Averaging Increment (m):      0.10
 Phi Method :                 Robertson and Campanella, 1983
 Dr  Method :                 Jamiolkowski - All Sands
 State Parameter M:            1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
----------------------------------------------------------------------------------------------------------------
 Depth    AvgQt    AvgFs    AvgRf    AvgUd    SBT   U.Wt.  TStress  EStress    Ueq       Cn       N60    (N1)60     Su    CRR
 (ft)     (tsf)    (tsf)    (%)      (ft)            pcf    (tsf)    (tsf)    (tsf)                (blows/ft)       (tsf)
----------------------------------------------------------------------------------------------------------------
  0.16     12.0     0.01     0.08      0.0     6    114.6    0.01     0.01     0.00     2.00      4.6      9.2     0.96  0.00
  0.49     52.4     0.05     0.10      0.0     8    120.9    0.03     0.03     0.00     2.00     12.5     25.1    UnDef  0.17
  0.82     71.9     0.11     0.15      0.2     8    120.9    0.05     0.05     0.00     2.00     17.2     34.4    UnDef  0.32
  1.15    100.4     0.18     0.18      0.3     9    124.1    0.07     0.07     0.00     2.00     19.2     38.5    UnDef  0.00
    48    140.2     0.35     0.25      0.2     9    124.1    0.09     0.09     0.00     2.00     26.9     53.7    UnDef  0.00
    80    165.3     0.57     0.34      0.3     9    124.1    0.11     0.11     0.00     2.00     31.7     63.3    UnDef  0.00
  2.13    183.1     0.85     0.47      0.0     9    124.1    0.13     0.13     0.00     2.00     35.1     70.1    UnDef  0.00
  2.46    203.8     1.17     0.58     -0.1     9    124.1    0.15     0.15     0.00     2.00     39.0     78.1    UnDef  0.00
  2.79    214.2     0.71     0.33      0.0     9    124.1    0.17     0.17     0.00     2.00     41.0     82.1    UnDef  0.00
  3.12    300.7     0.85     0.28     -0.3    10    127.3    0.19     0.19     0.00     2.00     48.0     96.0    UnDef  0.00
  3.44    446.8     1.60     0.36     -0.4    10    127.3    0.21     0.21     0.00     2.00     71.3    142.6    UnDef  0.00
  3.77    460.7     2.39     0.52     -0.3    10    127.3    0.23     0.23     0.00     2.00     73.5    147.1    UnDef  0.00
  4.10    442.1     2.55     0.58     -0.3    10    127.3    0.25     0.25     0.00     1.99     70.6    140.1    UnDef  0.00
  4.43    472.6     2.52     0.53     -0.5    10    127.3    0.27     0.27     0.00     1.91     75.4    143.9    UnDef  0.00
  4.76    463.0     2.76     0.60     -0.8    10    127.3    0.30     0.30     0.00     1.84     73.9    136.0    UnDef  0.00
  5.09    430.2     2.09     0.48     -0.8    10    127.3    0.32     0.31     0.00     1.79     68.7    122.6    UnDef  0.00
  5.41    602.6     2.06     0.34     -1.5    10    127.3    0.34     0.32     0.01     1.76     96.2    168.9    UnDef  0.00
  5.74    871.4     3.26     0.37      1.5    10    127.3    0.36     0.34     0.02     1.73    139.1    240.3    UnDef  0.00
  6.07    837.7     5.55     0.66      8.5    10    127.3    0.38     0.35     0.03     1.70    133.7    227.4    UnDef  0.00
  6.40    754.3     6.61     0.88      2.7    10    127.3    0.40     0.36     0.04     1.68    120.4    201.7    UnDef  0.00
  6.73    881.7     4.11     0.47      7.0    10    127.3    0.42     0.37     0.05     1.65    140.7    232.4    UnDef  0.00
  7.05    886.6     7.03     0.79     14.8    10    127.3    0.44     0.38     0.06     1.63    141.5    230.3    UnDef  0.00
  7.38    830.6     9.91     1.19     12.8     9    124.1    0.46     0.39     0.07     1.61    159.1    255.4    UnDef  0.00
  7.79    714.9     7.99     1.12      5.6     9    124.1    0.49     0.40     0.09     1.58    136.9    216.3    UnDef  0.00
  8.20    683.3     6.70     0.98      5.0     9    124.1    0.51     0.41     0.10     1.56    130.9    203.6    UnDef  0.00
  8.53    606.3     5.15     0.85      5.9    10    127.3    0.53     0.42     0.11     1.54     96.8    148.7    UnDef  0.00
  8.86    493.0     3.69     0.75      6.8    10    127.3    0.55     0.43     0.12     1.52     78.7    119.4    UnDef  0.00
  9.19    447.6     3.17     0.71      7.2    10    127.3    0.58     0.44     0.13     1.50     71.4    107.1    UnDef  0.00
  9.51    430.3     2.07     0.48      8.0    10    127.3    0.60     0.46     0.14     1.48     68.7    101.8    UnDef  0.00
  9.84    531.1     2.61     0.49      9.2    10    127.3    0.62     0.47     0.15     1.46     84.8    124.2    UnDef  0.00
```

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ConeTec Inc. - CPT Interpretation                                                  Page:   1b
Interpretation Output - Release 1.00.19M
Run No:      04-0913-1621-1073
    No:      04-783
   ent:      MACTEC, Inc.
Project:     TVA Plant, Gallatin, TN
Site:        CPT-05
Location:    TVA Plant
Cone:        20 TON  AD163
CPT Date:    04/08/09
CPT Time:    12:51
CPT File:    783CP005.COR
Northing  (m):          0.000
Easting   (m):          0.000
Elevation (m):          0.000
-----------------------------------------------------------------------------------------------------------
 Water Table (m):            1.52      (ft):    5.0
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:      12.50     Su/P' (nc):   0.30
 Averaging Increment (m):     0.10
 Phi Method :              Robertson and Campanella, 1983
 Dr  Method :              Jamiolkowski - All Sands
 State Parameter M:          1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
---------------------------------------------------------------------------------------------------------------------------
 Depth      k          Bq         Qtn       Rfn    SBTn      Qc1N DeltaQc1N     Qc1Ncs      Fc     Phi       Dr      OCR    State Del(n1)60  (N1)60cs
 (ft)     (cm/s)                                                                            (%)   (Deg)     (%)             Param
---------------------------------------------------------------------------------------------------------------------------
  0.16   5.0E-05    0.00    1000.0    0.08     10      23.1        0.0       23.1     0.0      50     72.9    10.0   -0.18       0.0        9.2
  0.49   5.0E-03    0.00    1000.0    0.10     10     100.3        0.0      100.3     0.0      50     95.0     1.0   -0.19       0.0       25.1
  0.82   5.0E-03    0.00    1000.0    0.15     10     137.7        0.0      137.7     0.0      50     95.0     1.0   -0.23       0.0       34.4
  1.15   5.0E-02    0.00    1000.0    0.18     10     192.3        0.0      192.3     0.0      50     95.0     1.0   -0.24       0.0       38.5
  1.48   5.0E-02    0.00    1000.0    0.25     10     268.6        0.0      268.6     0.0      50     95.0     1.0   -0.27       0.0       53.7
    80   5.0E-02    0.00    1000.0    0.34     10     316.6        0.0      316.6     0.0      50     95.0     1.0   -0.30       0.0       63.3
    13   5.0E-02    0.00    1000.0    0.47     10     350.7        0.0      350.7     0.0      50     95.0     1.0   -0.33       0.0       70.1
  2.46   5.0E-02    0.00    1000.0    0.58     10     390.3        0.0      390.3     0.0      50     95.0     1.0   -0.35       0.0       78.1
  2.79   5.0E-02    0.00    1000.0    0.33     10     410.3        0.0      410.3     0.0      50     95.0     1.0   -0.29       0.0       82.1
  3.12   5.0E+00    0.00    1000.0    0.29     10     576.0        0.0      576.0     0.0      50     95.0     1.0   -0.28       0.0       96.0
  3.44   5.0E+00    0.00    1000.0    0.36     10     855.7        0.0      855.7     0.0      50     95.0     1.0   -0.30       0.0      142.6
  3.77   5.0E+00    0.00    1000.0    0.52     10     882.4        0.0      882.4     0.0      50     95.0     1.0   -0.34       0.0      147.1
  4.10   5.0E+00    0.00    1000.0    0.58     10     846.8        0.0      846.8     0.0      50     95.0     1.0   -0.35       0.0      140.1
  4.43   5.0E+00    0.00    1000.0    0.53     10     882.5        0.0      882.5     0.0      50     95.0     1.0   -0.34       0.0      143.9
  4.76   5.0E+00    0.00    1000.0    0.60     10     833.6        0.0      833.6     0.0      50     95.0     1.0   -0.35       0.0      136.0
  5.09   5.0E+00    0.00    1000.0    0.49     10     751.6        0.0      751.6     0.0      50     95.0     1.0   -0.33       0.0      122.6
  5.41   5.0E+00    0.00    1000.0    0.34     10    1035.5        0.0     1035.5     0.0      50     95.0     1.0   -0.30       0.0      168.9
  5.74   5.0E+00    0.00    1000.0    0.37     10    1473.2        0.0     1473.2     0.0      50     95.0     1.0   -0.31       0.0      240.3
  6.07   5.0E+00    0.00    1000.0    0.66     10    1394.4        0.0     1394.4     0.0      50     95.0     1.0   -0.36       0.0      227.4
  6.40   5.0E+00    0.00    1000.0    0.88     10    1236.7        0.0     1236.7     0.0      50     95.0     1.0   -0.39       0.0      201.7
  6.73   5.0E+00    0.00    1000.0    0.47     10    1424.5        0.0     1424.5     0.0      50     95.0     1.0   -0.33       0.0      232.4
  7.05   5.0E+00    0.00    1000.0    0.79     10    1412.0        0.0     1412.0     0.0      50     95.0     1.0   -0.38       0.0      230.3
  7.38   5.0E-02    0.00    1000.0    1.19      9    1305.0        0.0     1305.0     1.3      50     95.0     1.0   -0.43       0.0      255.4
  7.79   5.0E-02    0.00    1000.0    1.12      9    1105.3        0.0     1105.3     1.0      50     95.0     1.0   -0.42       0.0      216.3
  8.20   5.0E-02    0.00    1000.0    0.98     10    1040.1        0.0     1040.1     0.4      50     95.0     1.0   -0.40       0.0      203.6
  8.53   5.0E+00    0.00    1000.0    0.85     10     911.6        0.0      911.6     0.0      50     95.0     1.0   -0.39       0.0      148.7
  8.86   5.0E+00    0.00    1000.0    0.75     10     732.1        0.0      732.1     0.0      50     95.0     1.0   -0.37       0.0      119.4
  9.19   5.0E+00    0.00    1000.0    0.71     10     656.7        0.0      656.7     0.0      50     95.0     1.0   -0.37       0.0      107.1
  9.51   5.0E+00    0.00     943.2    0.48     10     623.9        0.0      623.9     0.0      50     95.0     1.0   -0.32       0.0      101.8
  9.84   5.0E+00    0.00    1000.0    0.49     10     761.2        0.0      761.2     0.0      50     95.0     1.0   -0.33       0.0      124.2
```

```
ConeTec Inc. - CPT Interpretation                                              Page:   1a
Interpretation Output - Release 1.00.19M
     No:     04-0913-1621-1095
     No:     04-783
  ient:      MACTEC, Inc.
Project:     TVA Plant, Gallatin, TN
Site:        CPT-07
Location:    TVA Plant
Cone:        20 TON  AD163
CPT Date:    04/08/09
CPT Time:    16:17
CPT File:    783CP007.COR
Northing  (m):         0.000
Easting   (m):         0.000
Elevation (m):         0.000
------------------------------------------------------------------------------------------------------------
 Water Table (m):                1.52        (ft):    5.0
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:       12.50       Su/P' (nc):    0.30
 Averaging Increment (m):     0.10
 Phi Method :                  Robertson and Campanella, 1983
 Dr  Method :                  Jamiolkowski - All Sands
 State Parameter M:            1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
---------------------------------------------------------------------------------------------------------------------
 Depth    AvgQt    AvgFs    AvgRf    AvgUd   SBT    U.Wt.  TStress  EStress    Ueq      Cn      N60    (N1)60     Su   CRR
 (ft)     (tsf)    (tsf)     (%)     (ft)            pcf    (tsf)    (tsf)    (tsf)             (blows/ft)      (tsf)
---------------------------------------------------------------------------------------------------------------------
  0.16     37.9    0.01     0.03     -0.1     8    120.9    0.01     0.01     0.00     2.00     9.1     18.2   UnDef  0.12
  0.49     78.7    0.15     0.18     -0.1     8    120.9    0.03     0.03     0.00     2.00    18.8     37.7   UnDef  0.40
  0.82    136.8    0.49     0.36      0.0     9    124.1    0.05     0.05     0.00     2.00    26.2     52.4   UnDef  0.00
  1.15    118.2    0.48     0.41     -0.3     9    124.1    0.07     0.07     0.00     2.00    22.6     45.3   UnDef  0.00
    48    100.0    0.35     0.35     -0.3     9    124.1    0.09     0.09     0.00     2.00    19.2     38.3   UnDef  0.00
    80    114.1    0.36     0.31     -0.3     9    124.1    0.11     0.11     0.00     2.00    21.8     43.7   UnDef  0.00
  2.13    168.6    0.54     0.32     -0.4     9    124.1    0.13     0.13     0.00     2.00    32.3     64.6   UnDef  0.00
  2.46    147.9    0.94     0.63     -0.4     9    124.1    0.15     0.15     0.00     2.00    28.3     56.7   UnDef  0.00
  2.79    135.9    0.72     0.53     -1.3     9    124.1    0.17     0.17     0.00     2.00    26.0     52.1   UnDef  0.00
  3.12    117.7    0.42     0.35     -1.1     9    124.1    0.19     0.19     0.00     2.00    22.5     45.1   UnDef  0.00
  3.44     92.1    0.39     0.42     -0.4     8    120.9    0.21     0.21     0.00     2.00    22.0     44.1   UnDef  0.00
  3.77    157.3    0.46     0.29     -0.4     9    124.1    0.23     0.23     0.00     2.00    30.1     60.2   UnDef  0.00
  4.10    197.4    0.87     0.44     -0.7     9    124.1    0.25     0.25     0.00     1.99    37.8     75.2   UnDef  0.00
  4.43    167.0    0.80     0.48     -1.5     9    124.1    0.27     0.27     0.00     1.91    32.0     61.2   UnDef  0.00
  4.76    151.8    0.62     0.41     -1.3     9    124.1    0.29     0.29     0.00     1.85    29.1     53.7   UnDef  0.00
  5.09    149.6    0.25     0.16     -0.4     9    124.1    0.31     0.31     0.00     1.79    28.6     51.3   UnDef  0.00
  5.41    148.6    0.13     0.08     -2.9     9    124.1    0.33     0.32     0.01     1.76    28.5     50.2   UnDef  0.00
  5.74    148.2    0.10     0.07     -7.7     9    124.1    0.35     0.33     0.02     1.74    28.4     49.3   UnDef  0.00
  6.07    139.3    0.06     0.04     -8.3     9    124.1    0.38     0.34     0.03     1.71    26.5     45.3   UnDef  0.00
  6.40    126.7    0.12     0.09     -7.0     9    124.1    0.40     0.35     0.04     1.69    24.3     40.9   UnDef  0.00
  6.73    111.5    0.11     0.10     -3.7     9    124.1    0.42     0.36     0.05     1.66    21.3     35.5   UnDef  0.00
  7.05    101.6    0.10     0.09     -2.2     9    124.1    0.44     0.37     0.06     1.64    19.5     31.9   UnDef  0.00
  7.38     87.4    0.14     0.16      0.5     9    124.1    0.46     0.38     0.07     1.62    16.7     27.1   UnDef  0.33
  7.79     75.3    0.02     0.02      1.0     9    124.1    0.48     0.39     0.09     1.59    14.4     23.0   UnDef  0.23
  8.20     62.6    0.01     0.02      3.6     8    120.9    0.51     0.41     0.10     1.57    15.0     23.5   UnDef  0.16
  8.53     53.3    0.01     0.02      4.3     8    120.9    0.53     0.42     0.11     1.55    12.8     19.8   UnDef  0.13
  8.86     46.0    0.02     0.04      4.6     8    120.9    0.55     0.43     0.12     1.53    11.0     16.9   UnDef  0.11
  9.19     44.4    0.02     0.05      5.4     8    120.9    0.57     0.44     0.13     1.51    10.6     16.1   UnDef  0.11
  9.51     40.3    0.02     0.05      5.5     8    120.9    0.59     0.45     0.14     1.50     9.7     14.5   UnDef  0.10
  9.84     38.7    0.01     0.03      5.7     8    120.9    0.61     0.46     0.15     1.48     9.3     13.7   UnDef  0.10
 10.17     36.0    0.01     0.03      6.1     8    120.9    0.63     0.46     0.16     1.47     8.6     12.7   UnDef  0.09
 10.50     32.0    0.01     0.03      7.3     8    120.9    0.65     0.47     0.17     1.45     7.7     11.1   UnDef  0.09
 10.83     30.6    0.01     0.03      7.2     7    117.8    0.67     0.48     0.18     1.44     9.8     14.0   UnDef  0.09
 11.15     30.4    0.01     0.03      7.8     7    117.8    0.68     0.49     0.19     1.42     9.7     13.8   UnDef  0.09
 11.48     27.3    0.01     0.04      7.8     7    117.8    0.70     0.50     0.20     1.41     8.7     12.3   UnDef  0.08
    31     26.6    0.01     0.04      8.3     7    117.8    0.72     0.51     0.21     1.40     8.5     11.9   UnDef  0.08
    14     25.6    0.01     0.04      9.1     7    117.8    0.74     0.52     0.22     1.39     8.2     11.3   UnDef  0.08
 12.47     27.8    0.01     0.04      8.8     7    117.8    0.76     0.53     0.23     1.37     8.9     12.2   UnDef  0.08
 12.80     30.4    0.01     0.03      8.5     7    117.8    0.78     0.54     0.24     1.36     9.7     13.2   UnDef  0.09
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ConeTec Inc. - CPT Interpretation

Run No: 04-0913-1621-1095
CPT File: 783CP007.COR

h (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	SBT	U.Wt. pcf	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60	Su (tsf)	CRR
13.12	29.5	0.01	0.03	9.3	7	117.8	0.80	0.55	0.25	1.35	9.4	12.7	UnDef	0.09
13.45	27.3	0.01	0.04	8.7	7	117.8	0.82	0.56	0.26	1.34	8.7	11.7	UnDef	0.08
13.78	25.7	0.01	0.04	9.7	7	117.8	0.84	0.57	0.27	1.33	8.2	10.9	UnDef	0.08
14.11	27.7	0.01	0.04	10.0	7	117.8	0.86	0.57	0.28	1.32	8.9	11.7	UnDef	0.08
14.44	30.1	0.01	0.03	10.4	7	117.8	0.88	0.58	0.29	1.31	9.6	12.6	UnDef	0.09
14.76	33.2	0.01	0.03	10.8	8	120.9	0.90	0.59	0.30	1.30	8.0	10.3	UnDef	0.09
15.09	33.6	0.01	0.03	11.2	8	120.9	0.92	0.60	0.32	1.29	8.0	10.4	UnDef	0.09
15.42	35.0	0.07	0.19	11.5	7	117.8	0.94	0.61	0.33	1.28	11.2	14.3	UnDef	0.09
15.75	39.9	0.03	0.06	11.3	8	120.9	0.96	0.62	0.34	1.27	9.6	12.1	UnDef	0.09
16.08	35.0	0.01	0.03	11.8	8	120.9	0.98	0.63	0.35	1.26	8.4	10.5	UnDef	0.09
16.40	32.4	0.01	0.03	12.1	8	120.9	1.00	0.64	0.36	1.25	7.8	9.7	UnDef	0.09
16.73	28.2	0.01	0.04	12.5	7	117.8	1.02	0.65	0.37	1.24	9.0	11.2	UnDef	0.08
17.06	32.6	0.01	0.03	12.6	8	120.9	1.04	0.66	0.38	1.23	7.8	9.6	UnDef	0.09
17.39	42.5	0.03	0.06	13.2	8	120.9	1.06	0.67	0.39	1.22	10.2	12.5	UnDef	0.09
17.72	60.2	0.08	0.12	13.3	8	120.9	1.08	0.68	0.40	1.21	14.4	17.5	UnDef	0.11
18.04	62.5	0.13	0.20	12.1	8	120.9	1.10	0.69	0.41	1.21	15.0	18.1	UnDef	0.12
18.37	58.5	0.08	0.13	13.8	8	120.9	1.11	0.70	0.42	1.20	14.0	16.8	UnDef	0.11
18.70	57.1	0.06	0.10	14.1	8	120.9	1.13	0.71	0.43	1.19	13.7	16.3	UnDef	0.11
19.03	59.2	0.01	0.02	14.2	8	120.9	1.15	0.72	0.44	1.18	14.2	16.8	UnDef	0.11
19.36	60.1	0.03	0.04	14.5	8	120.9	1.17	0.73	0.45	1.17	14.4	16.9	UnDef	0.11
19.68	53.8	0.03	0.06	15.1	8	120.9	1.19	0.74	0.46	1.17	12.9	15.0	UnDef	0.10
20.01	50.1	0.01	0.02	15.5	8	120.9	1.21	0.75	0.47	1.16	12.0	13.9	UnDef	0.10
20.34	45.0	0.02	0.03	15.9	8	120.9	1.23	0.75	0.48	1.15	10.8	12.4	UnDef	0.09
20.67	45.7	0.01	0.02	15.7	8	120.9	1.25	0.76	0.49	1.14	10.9	12.5	UnDef	0.09
21.00	45.5	0.01	0.02	16.4	8	120.9	1.27	0.77	0.50	1.14	10.9	12.4	UnDef	0.09
21.33	50.5	0.01	0.02	16.8	8	120.9	1.29	0.78	0.51	1.13	12.1	13.7	UnDef	0.10
21.65	48.7	0.01	0.02	16.8	8	120.9	1.31	0.79	0.52	1.12	11.6	13.1	UnDef	0.09
98	50.5	0.01	0.02	17.4	8	120.9	1.33	0.80	0.53	1.12	12.1	13.5	UnDef	0.10
31	51.7	0.02	0.03	17.8	8	120.9	1.35	0.81	0.54	1.11	12.4	13.7	UnDef	0.10
22.64	50.9	0.02	0.04	18.1	8	120.9	1.37	0.82	0.55	1.10	12.2	13.4	UnDef	0.10
22.97	60.3	0.27	0.45	18.4	8	120.9	1.39	0.83	0.56	1.10	14.4	15.8	UnDef	0.11
23.29	59.3	1.86	3.14	18.4	6	114.6	1.41	0.84	0.57	1.09	22.7	24.8	4.63	0.33
23.62	30.6	1.90	6.22	-2.2	3	111.4	1.43	0.85	0.58	1.09	29.3	31.8	2.33	0.00
23.95	20.7	0.99	4.78	-5.6	3	111.4	1.45	0.86	0.59	1.08	19.8	21.4	1.54	0.00
24.28	123.9	1.01	0.81	14.7	9	124.1	1.47	0.87	0.60	1.07	23.7	25.5	UnDef	0.32
24.61	125.6	2.39	1.90	-12.2	7	117.8	1.49	0.88	0.61	1.07	40.1	42.8	UnDef	0.00
24.93	18.5	2.12	11.41	-5.2	3	111.4	1.51	0.88	0.62	1.06	17.8	18.9	1.36	0.00

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ConeTec Inc. - CPT Interpretation                                                     Page:   1b
Interpretation Output - Release 1.00.19M
Run No:      04-0913-1621-1095
  b No:      04-783
     ent:    MACTEC, Inc.
Project:     TVA Plant, Gallatin, TN
Site:        CPT-07
Location:    TVA Plant
Cone:        20 TON  AD163
CPT Date:    04/08/09
CPT Time:    16:17
CPT File:    783CP007.COR
Northing  (m):         0.000
Easting   (m):         0.000
Elevation (m):         0.000
-----------------------------------------------------------------------------------------------------------------------
 Water Table (m):             1.52       (ft):     5.0
 Unit Weight of Water (default):     62.40 kN/m^3
 Su Nkt used:      12.50      Su/P' (nc):    0.30
 Averaging Increment (m):      0.10
 Phi Method :               Robertson and Campanella, 1983
 Dr  Method :               Jamiolkowski - All Sands
 State Parameter M:           1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
-------------------------------------------------------------------------------------------------------------------------------------------
 Depth       k         Bq        Qtn       Rfn    SBTn      Qc1N DeltaQc1N    Qc1Ncs      Fc      Phi       Dr       OCR    State Del(n1)60  (N1)60cs
 (ft)     (cm/s)                                                                         (%)    (Deg)     (%)             Param
-------------------------------------------------------------------------------------------------------------------------------------------
   0.16   5.0E-03    0.00    1000.0     0.03    10        72.6        0.0      72.6     0.0      50      95.0      1.0    -0.08       0.0      18.2
   0.49   5.0E-03    0.00    1000.0     0.18    10       150.7        0.0     150.7     0.0      50      95.0      1.0    -0.24       0.0      37.7
   0.82   5.0E-02    0.00    1000.0     0.36    10       262.1        0.0     262.1     0.0      50      95.0      1.0    -0.30       0.0      52.4
   1.15   5.0E-02    0.00    1000.0     0.41    10       226.5        0.0     226.5     0.0      50      95.0      1.0    -0.31       0.0      45.3
   1.48   5.0E-02    0.00    1000.0     0.35    10       191.6        0.0     191.6     0.0      50      95.0      1.0    -0.30       0.0      38.3
     80   5.0E-02    0.00    1000.0     0.31    10       218.5        0.0     218.5     0.0      50      95.0      1.0    -0.29       0.0      43.7
     13   5.0E-02    0.00    1000.0     0.32    10       322.9        0.0     322.9     0.0      50      95.0      1.0    -0.29       0.0      64.6
   2.46   5.0E-02    0.00     974.1     0.63    10       283.3        0.0     283.3     0.0      50      95.0      1.0    -0.35       0.0      56.7
   2.79   5.0E-02    0.00     789.2     0.53    10       260.4        0.0     260.4     0.0      50      95.0      1.0    -0.32       0.0      52.1
   3.12   5.0E-02    0.00     610.6     0.35    10       225.4        0.0     225.4     0.0      50      94.9      1.0    -0.26       0.0      45.1
   3.44   5.0E-03    0.00     432.3     0.42    10       176.4        0.0     176.4     0.0      48      86.5      1.0    -0.24       0.0      44.1
   3.77   5.0E-02    0.00     675.2     0.29    10       301.2        0.0     301.2     0.0      50      95.0      1.0    -0.25       0.0      60.2
   4.10   5.0E-02    0.00     779.2     0.44    10       378.0        0.0     378.0     0.0      50      95.0      1.0    -0.30       0.0      75.2
   4.43   5.0E-02    0.00     610.2     0.48    10       312.7        0.0     312.7     0.0      50      95.0      1.0    -0.28       0.0      63.2
   4.76   5.0E-02    0.00     516.0     0.41    10       274.2        0.0     274.2     0.0      48      95.0      1.0    -0.26       0.0      53.7
   5.09   5.0E-02    0.00     479.4     0.16    10       262.3        0.0     262.3     0.0      48      94.9      1.0    -0.17       0.0      51.3
   5.41   5.0E-02    0.00     461.1     0.08    10       256.4        0.0     256.4     0.0      48      94.3      1.0    -0.11       0.0      50.2
   5.74   5.0E-02    0.00     445.7     0.07    10       251.8        0.0     251.8     0.0      48      93.7      1.0    -0.09       0.0      49.3
   6.07   5.0E-02    0.00     403.6     0.04    10       231.5        0.0     231.5     0.0      48      91.3      1.0    -0.04       0.0      45.3
   6.40   5.0E-02    0.00     358.9     0.10    10       209.0        0.0     209.0     0.0      48      88.4      1.0    -0.10       0.0      40.9
   6.73   5.0E-02    0.00     306.8     0.10    10       181.3        0.0     181.3     0.0      46      84.3      1.0    -0.09       0.0      35.5
   7.05   5.0E-02    0.00     271.9     0.09    10       163.0        0.0     163.0     0.0      46      81.3      1.0    -0.08       0.0      31.9
   7.38   5.0E-02    0.00     227.5     0.16    10       138.4        0.0     138.4     0.0      46      76.6      1.0    -0.10       0.0      27.1
   7.79   5.0E-02    0.00     189.5     0.02    10       117.3        0.0     117.3     0.2      44      71.8      1.0     0.08       0.0      23.0
   8.20   5.0E-03    0.00     152.4     0.02    10        95.9        0.0      95.9     1.6      44      66.1      1.0     0.12       0.0      23.5
   8.53   5.0E-03    0.00     126.6     0.02    10        80.8        0.0      80.8     2.2      44      61.2      1.0     0.12       0.0      19.8
   8.86   5.0E-03    0.00     106.7     0.04     9        69.0        0.0      69.0     2.1      42      56.6      1.0     0.07       0.0      16.9
   9.19   5.0E-03    0.00     100.5     0.05     9        65.8        0.0      65.8     2.5      42      55.3      1.0     0.07       0.0      16.1
   9.51   5.0E-03    0.00      89.2     0.05     9        59.1        0.0      59.1     3.1      42      52.2      1.0     0.07       0.0      14.5
   9.84   5.0E-03    0.00      83.8     0.03     9        56.2        0.0      56.2     4.2      42      50.8      1.0     0.13       0.0      13.7
  10.17   5.0E-03    0.00      76.2     0.03     9        51.7        0.0      51.7     4.7      40      48.4      1.0     0.13       0.0      12.7
  10.50   5.0E-03    0.00      66.2     0.03     9        45.5        0.0      45.5     5.0      40      44.7      1.0     0.13       0.0      11.1
  10.83   5.0E-04    0.00      61.9     0.03     9        43.1        0.0      43.1     5.0      40      43.1      1.0     0.14       0.0      14.0
  11.15   5.0E-04    0.00      60.3     0.03     9        42.3        0.0      42.3     5.0      40      42.6      1.0     0.14       0.0      13.8
  11.48   5.0E-04    0.00      52.9     0.04     9        37.6        0.0      37.6     5.0      40      39.3      1.0     0.14       0.0      12.3
  11.81   5.0E-04    0.00      50.7     0.04     9        36.5        0.0      36.5     5.0      38      38.4      1.0     0.14       0.0      11.9
     14   5.0E-04    0.00      47.7     0.04     9        34.7        0.0      34.7     5.0      38      36.9      1.0     0.14       0.0      11.3
    .47   5.0E-04    0.00      51.1     0.04     9        37.4        0.0      37.4     5.0      38      39.1      1.0     0.14       0.0      12.2
  12.80   5.0E-04    0.00      54.9     0.03     9        40.5        0.0      40.5     5.0      40      41.4      1.0     0.14       0.0      13.2
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ConeTec Inc. - CPT Interpretation
Run No: 04-0913-1621-1095
CPT File: 783CP007.COR

:h	k	Bq	Qtn	Rfn	SBTn	Qc1N	DeltaQc1N	Qc1Ncs	Fc	Phi	Dr	OCR	State	Del(n1)60	(N1)60cs
c)	(cm/s)								(%)	(Deg)	(%)		Param		
13.12	5.0E-04	0.00	52.4	0.03	9	39.0	0.0	39.0	5.0	40	40.3	1.0	0.15	0.0	12.7
13.45	5.0E-04	0.00	47.6	0.04	9	35.8	0.0	35.8	5.0	38	37.9	1.0	0.15	0.0	11.7
13.78	5.0E-04	0.00	43.9	0.04	9	33.4	0.0	33.4	5.0	38	35.8	1.0	0.15	0.0	10.9
14.11	5.0E-04	0.00	46.8	0.04	9	35.8	0.0	35.8	5.0	38	37.8	1.0	0.15	0.0	11.7
14.44	5.0E-04	0.00	50.0	0.03	9	38.5	0.0	38.5	5.0	38	39.9	1.0	0.15	0.0	12.6
14.76	5.0E-03	0.00	54.5	0.03	9	42.2	0.0	42.2	5.0	40	42.6	1.0	0.15	0.0	10.3
15.09	5.0E-03	0.00	54.2	0.03	9	42.3	0.0	42.3	5.0	40	42.6	1.0	0.15	0.0	10.4
15.42	5.0E-04	0.00	55.7	0.19	9	43.8	0.0	43.8	5.0	40	43.6	1.0	0.00	0.0	14.3
15.75	5.0E-03	0.00	62.8	0.06	9	49.6	0.0	49.6	5.0	40	47.2	1.0	0.08	0.0	12.1
16.08	5.0E-03	0.00	53.9	0.03	9	43.1	0.0	43.1	5.0	40	43.1	1.0	0.16	0.0	10.5
16.40	5.0E-03	0.00	49.1	0.03	9	39.6	0.0	39.6	5.0	38	40.8	1.0	0.16	0.0	9.7
16.73	5.0E-04	0.00	41.9	0.04	9	34.3	0.0	34.3	5.0	38	36.6	1.0	0.16	0.0	11.2
17.06	5.0E-03	0.00	47.9	0.03	9	39.3	0.0	39.3	5.0	38	40.5	1.0	0.16	0.0	9.6
17.39	5.0E-03	0.00	62.1	0.06	9	50.9	0.0	50.9	5.0	40	47.9	1.0	0.09	0.0	12.5
17.72	5.0E-03	0.00	87.2	0.13	9	71.5	0.0	71.5	3.8	42	57.7	1.0	0.00	0.0	17.5
18.04	5.0E-03	0.00	89.3	0.20	9	73.8	0.0	73.8	4.5	42	58.6	1.0	-0.04	0.0	18.1
18.37	5.0E-03	0.00	82.3	0.13	9	68.6	0.0	68.6	4.2	42	56.5	1.0	0.00	0.0	16.8
18.70	5.0E-03	0.00	79.1	0.10	9	66.4	0.0	66.4	4.1	42	55.6	1.0	0.03	0.0	16.3
19.03	5.0E-03	0.00	81.1	0.02	9	68.5	0.0	68.5	5.0	42	56.4	1.0	0.17	0.0	16.8
19.36	5.0E-03	0.00	81.2	0.04	9	69.1	0.0	69.1	3.8	42	56.7	1.0	0.09	0.0	16.9
19.68	5.0E-03	0.00	71.4	0.06	9	61.3	0.0	61.3	4.6	40	53.3	1.0	0.08	0.0	15.0
20.01	5.0E-03	0.00	65.5	0.02	9	56.7	0.0	56.7	5.0	40	51.0	1.0	0.17	0.0	13.9
20.34	5.0E-03	0.00	57.9	0.03	9	50.7	0.0	50.7	5.0	40	47.8	1.0	0.14	0.0	12.4
20.67	5.0E-03	0.00	58.2	0.02	9	51.2	0.0	51.2	5.0	40	48.1	1.0	0.17	0.0	12.5
21.00	5.0E-03	0.00	57.2	0.02	9	50.6	0.0	50.6	5.0	40	47.8	1.0	0.17	0.0	12.4
21.33	5.0E-03	0.00	62.8	0.02	9	55.8	0.0	55.8	5.0	40	50.6	1.0	0.18	0.0	13.7
21.65	5.0E-03	0.00	59.7	0.02	9	53.5	0.0	53.5	5.0	40	49.3	1.0	0.18	0.0	13.1
98	5.0E-03	0.00	61.2	0.02	9	55.2	0.0	55.2	5.0	40	50.2	1.0	0.18	0.0	13.5
31	5.0E-03	0.00	62.0	0.03	9	56.1	0.0	56.1	5.0	40	50.7	1.0	0.14	0.0	13.7
22.64	5.0E-03	0.00	60.2	0.04	9	54.9	0.0	54.9	5.0	40	50.1	1.0	0.12	0.0	13.4
22.97	5.0E-03	0.00	70.9	0.46	9	64.7	0.0	64.7	5.0	40	54.8	1.0	-0.09	0.0	15.8
23.29	5.0E-05	0.00	68.9	3.22	7	63.3	76.3	139.6	25.5	40	54.2	10.0	-0.30	12.9	37.7
23.62	5.0E-08	-0.02	34.3	6.52	1	32.5	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
23.95	5.0E-08	-0.04	22.4	5.14	1	21.9	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
24.28	5.0E-02	0.00	141.3	0.82	9	130.3	7.0	137.3	6.9	44	74.9	1.0	-0.20	0.8	26.3
24.61	5.0E-04	-0.01	141.7	1.93	9	131.3	35.5	166.8	13.0	44	75.1	1.0	-0.30	6.6	49.4
24.93	5.0E-08	-0.05	19.3	10.00	1	19.3	UnDef	UnDef	100.0	UnDef	UnDef	8.9	UnDef	UnDef	UnDef

```
ConeTec Inc. - CPT Interpretation                                       Page:   1a
Interpretation Output - Release 1.00.19M
     No:     04-0913-1621-1117
     No:     04-783
Client:      MACTEC, Inc.
Project:     TVA Plant, Gallatin, TN
Site:        CPT-08
Location:    TVA Plant
Cone:        20 TON  AD163
CPT Date:    04/08/09
CPT Time:    11:57
CPT File:    783CP008.COR
Northing  (m):          0.000
Easting   (m):          0.000
Elevation (m):          0.000
-------------------------------------------------------------------------------------
 Water Table (m):               1.22       (ft):    4.0
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:      12.50     Su/P' (nc):   0.30
 Averaging Increment (m):    0.10
 Phi Method :                Robertson and Campanella, 1983
 Dr  Method :                Jamiolkowski - All Sands
 State Parameter M:          1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
-------------------------------------------------------------------------------------------------
 Depth   AvgQt   AvgFs   AvgRf   AvgUd   SBT   U.Wt.  TStress  EStress   Ueq     Cn     N60   (N1)60    Su    CRR
 (ft)    (tsf)   (tsf)    (%)    (ft)           pcf    (tsf)    (tsf)   (tsf)             (blows/ft)   (tsf)
-------------------------------------------------------------------------------------------------
  0.16    29.9    0.16    0.52    -0.1    7    117.8    0.01     0.01    0.00    2.00     9.5    19.1   UnDef  0.10
  0.49    64.7    0.37    0.57    -0.4    8    120.9    0.03     0.03    0.00    2.00    15.5    31.0   UnDef  0.26
  0.82    67.6    0.29    0.43    -0.2    8    120.9    0.05     0.05    0.00    2.00    16.2    32.4   UnDef  0.28
  1.15    67.0    0.20    0.30    -0.3    8    120.9    0.07     0.07    0.00    2.00    16.0    32.1   UnDef  0.28
    48    78.3    0.24    0.31     0.0    8    120.9    0.09     0.09    0.00    2.00    18.7    37.5   UnDef  0.39
    80    77.5    0.34    0.43    -0.5    8    120.9    0.11     0.11    0.00    2.00    18.6    37.1   UnDef  0.38
  2.13    59.3    0.74    1.25    -0.1    7    117.8    0.13     0.13    0.00    2.00    18.9    37.9   UnDef  0.22
  2.46   109.7    0.74    0.67    -0.5    8    120.9    0.15     0.15    0.00    2.00    26.3    52.5   UnDef  0.00
  2.79   214.3    0.70    0.33    -1.0    9    124.1    0.17     0.17    0.00    2.00    41.0    82.1   UnDef  0.00
  3.12   240.3    0.70    0.29    -0.7   10    127.3    0.19     0.19    0.00    2.00    38.4    76.7   UnDef  0.00
  3.44   237.0    0.67    0.28     0.3   10    127.3    0.21     0.21    0.00    2.00    37.8    75.7   UnDef  0.00
  3.77   215.9    0.92    0.43     0.0    9    124.1    0.23     0.23    0.00    2.00    41.4    82.7   UnDef  0.00
  4.10   194.9    0.69    0.35    -0.4    9    124.1    0.25     0.25    0.00    2.00    37.3    74.7   UnDef  0.00
  4.43   183.3    0.66    0.36    -0.2    9    124.1    0.27     0.26    0.01    1.97    35.1    69.2   UnDef  0.00
  4.76   154.3    0.45    0.29    -0.3    9    124.1    0.29     0.27    0.02    1.93    29.5    57.1   UnDef  0.00
  5.09   126.0    0.22    0.17    -0.3    9    124.1    0.31     0.28    0.03    1.90    24.1    45.8   UnDef  0.00
  5.41   108.3    0.07    0.06    -0.2    9    124.1    0.33     0.29    0.04    1.86    20.7    38.7   UnDef  0.00
  5.74    96.5    0.07    0.07    -0.6    9    124.1    0.35     0.30    0.05    1.83    16.5    33.9   UnDef  0.00
  6.07    86.9    0.08    0.09    -1.6    9    124.1    0.37     0.31    0.06    1.80    16.6    30.0   UnDef  0.41
  6.40    80.6    0.02    0.02    -1.2    9    124.1    0.39     0.32    0.07    1.77    15.4    27.4   UnDef  0.33
  6.73    66.7    0.03    0.05     1.4    8    120.9    0.41     0.33    0.09    1.75    16.0    27.9   UnDef  0.22
  7.05    70.7    0.05    0.06     2.7    8    120.9    0.43     0.34    0.10    1.72    16.9    29.1   UnDef  0.24
  7.38    68.4    0.10    0.15     3.4    8    120.9    0.45     0.35    0.11    1.70    16.4    27.8   UnDef  0.22
  7.79    64.2    0.05    0.08     3.9    8    120.9    0.48     0.36    0.12    1.67    15.4    25.6   UnDef  0.19
  8.20    53.2    0.01    0.02     4.3    8    120.9    0.50     0.37    0.13    1.64    12.7    20.9   UnDef  0.14
  8.53    47.4    0.03    0.06     4.8    8    120.9    0.52     0.38    0.14    1.62    11.3    18.4   UnDef  0.12
  8.86    49.5    0.01    0.02     5.4    8    120.9    0.54     0.39    0.15    1.60    11.8    19.0   UnDef  0.12
  9.19    47.6    0.01    0.02     6.0    8    120.9    0.56     0.40    0.16    1.58    11.4    18.0   UnDef  0.12
  9.51    57.4    0.03    0.04     6.1    8    120.9    0.58     0.41    0.17    1.56    13.7    21.5   UnDef  0.14
  9.84    56.2    0.02    0.03     3.3    8    120.9    0.60     0.42    0.18    1.54    13.5    20.8   UnDef  0.14
 10.17    55.9    0.07    0.13     5.4    8    120.9    0.62     0.43    0.19    1.53    13.4    20.4   UnDef  0.13
 10.50    52.5    0.13    0.25     5.1    8    120.9    0.64     0.44    0.20    1.51    12.6    19.0   UnDef  0.12
 10.83    49.7    0.10    0.19     6.8    8    120.9    0.66     0.45    0.21    1.49    11.9    17.8   UnDef  0.12
 11.15    45.3    0.03    0.06     7.5    8    120.9    0.68     0.46    0.22    1.48    10.8    16.0   UnDef  0.11
 11.48    45.8    0.04    0.08     7.6    8    120.9    0.70     0.47    0.23    1.46    11.0    16.1   UnDef  0.11
    81    43.5    0.04    0.08     7.7    8    120.9    0.72     0.48    0.24    1.45    10.4    15.1   UnDef  0.10
   .14    37.3    0.01    0.03     8.4    8    120.9    0.74     0.49    0.25    1.43     8.9    12.8   UnDef  0.09
 12.47    40.6    0.08    0.19     8.3    8    120.9    0.76     0.50    0.26    1.42     9.7    13.8   UnDef  0.10
 12.80    48.0    0.06    0.13     9.1    8    120.9    0.78     0.51    0.27    1.41    11.5    16.2   UnDef  0.11
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Run No: 04-0913-1621-1117
CPT File: 783CP008.COR

th	AvgQt	AvgFs	AvgRf	AvgUd	SBT	U.Wt.	TStress	EStress	Ueq	Cn	N60	(N1)60	Su	CRR
c)	(tsf)	(tsf)	(%)	(ft)		pcf	(tsf)	(tsf)	(tsf)		(blows/ft)		(tsf)	
13.12	40.5	0.03	0.07	9.1	8	120.9	0.80	0.52	0.28	1.39	9.7	13.5	UnDef	0.10
13.45	39.5	0.04	0.09	9.2	8	120.9	0.82	0.52	0.30	1.38	9.5	13.1	UnDef	0.09
13.78	40.6	0.04	0.10	9.6	8	120.9	0.84	0.53	0.31	1.37	9.7	13.3	UnDef	0.09
14.11	45.0	0.05	0.10	9.6	8	120.9	0.86	0.54	0.32	1.36	10.8	14.6	UnDef	0.10
14.44	54.4	0.05	0.09	10.6	8	120.9	0.88	0.55	0.33	1.34	13.0	17.5	UnDef	0.11
14.76	53.9	0.10	0.19	10.1	8	120.9	0.90	0.56	0.34	1.33	12.9	17.2	UnDef	0.11
15.09	56.3	0.09	0.16	8.1	8	120.9	0.92	0.57	0.35	1.32	13.5	17.8	UnDef	0.12
15.42	49.0	0.04	0.07	11.4	8	120.9	0.94	0.58	0.36	1.31	11.7	15.4	UnDef	0.10
15.75	44.4	0.04	0.08	12.6	8	120.9	0.96	0.59	0.37	1.30	10.6	13.8	UnDef	0.10
16.08	46.2	0.02	0.03	11.9	8	120.9	0.98	0.60	0.38	1.29	11.1	14.3	UnDef	0.10
16.40	40.1	0.04	0.09	11.9	8	120.9	1.00	0.61	0.39	1.28	9.6	12.3	UnDef	0.09
16.73	38.1	0.05	0.12	12.2	8	120.9	1.02	0.62	0.40	1.27	9.1	11.6	UnDef	0.09
17.06	43.2	0.10	0.23	13.0	8	120.9	1.04	0.63	0.41	1.26	10.3	13.0	UnDef	0.09
17.39	32.8	0.26	0.79	13.4	7	117.8	1.06	0.64	0.42	1.25	10.5	13.1	UnDef	0.10
17.72	21.7	0.33	1.52	29.2	6	114.6	1.08	0.65	0.43	1.24	8.3	10.3	1.65	0.11
18.04	20.4	0.18	0.86	45.5	6	114.6	1.10	0.66	0.44	1.23	7.8	9.7	1.55	0.09
18.37	19.5	0.27	1.36	68.5	6	114.6	1.11	0.67	0.45	1.23	7.5	9.2	1.47	0.10
18.70	18.5	0.60	3.25	-1.5	5	114.6	1.13	0.67	0.46	1.22	8.9	10.8	1.39	0.20
19.03	21.6	1.05	4.87	0.7	3	111.4	1.15	0.68	0.47	1.21	20.7	25.1	1.64	0.00
19.36	20.4	1.27	6.20	1.0	3	111.4	1.17	0.69	0.48	1.20	19.6	23.6	1.54	0.00
19.68	18.4	1.10	5.97	8.3	3	111.4	1.19	0.70	0.49	1.20	17.6	21.1	1.37	0.00
20.01	18.3	0.95	5.20	11.9	3	111.4	1.21	0.71	0.50	1.19	17.5	20.9	1.37	0.00
20.34	22.0	1.16	5.28	13.1	3	111.4	1.22	0.71	0.51	1.18	21.1	24.9	1.66	0.00
20.67	29.7	1.74	5.88	17.5	3	111.4	1.24	0.72	0.52	1.18	28.4	33.4	2.27	0.00
21.00	65.5	2.41	3.67	21.7	5	114.6	1.26	0.73	0.53	1.17	31.4	36.7	5.14	0.44

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ConeTec Inc. - CPT Interpretation                                           Page:   1b
Interpretation Output - Release 1.00.19M
Run No:      04-0913-1621-1117
  h No:      04-783
   nt:       MACTEC, Inc.
Project:     TVA Plant, Gallatin, TN
Site:        CPT-08
Location:    TVA Plant
Cone:        20 TON  AD163
CPT Date:    04/08/09
CPT Time:    11:57
CPT File:    783CP008.COR
Northing  (m):          0.000
Easting   (m):          0.000
Elevation (m):          0.000
-----------------------------------------------------------------------------------------------------
 Water Table (m):            1.22       (ft):    4.0
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:      12.50      Su/P' (nc):    0.30
 Averaging Increment (m):      0.10
 Phi Method :                 Robertson and Campanella, 1983
 Dr  Method :                 Jamiolkowski - All Sands
 State Parameter M:           1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
-------------------------------------------------------------------------------------------------------------------------
 Depth      k        Bq       Qtn      Rfn    SBTn     Qc1N DeltaQc1N   Qc1Ncs     Fc     Phi       Dr     OCR   State Del(n1)60 (N1)60cs
 (ft)    (cm/s)                                                                  (%)   (Deg)     (%)          Param
-------------------------------------------------------------------------------------------------------------------------
  0.16  5.0E-04    0.00   1000.0    0.52    10      57.2      0.0        57.2    0.0     50      95.0    1.0   -0.34       0.0      19.1
  0.49  5.0E-03    0.00   1000.0    0.57    10     124.0      0.0       124.0    0.0     50      95.0    1.0   -0.35       0.0      31.0
  0.82  5.0E-03    0.00   1000.0    0.43    10     129.6      0.0       129.6    0.0     50      95.0    1.0   -0.32       0.0      32.4
  1.15  5.0E-03    0.00    970.9    0.30    10     128.3      0.0       128.3    0.0     50      93.5    1.0   -0.28       0.0      32.1
  1.48  5.0E-03    0.00    881.0    0.31    10     149.9      0.0       149.9    0.0     50      94.3    1.0   -0.28       0.0      37.5
    80  5.0E-03    0.00    712.5    0.43    10     148.4      0.0       148.4    0.0     50      91.2    1.0   -0.29       0.0      37.1
    13  5.0E-04    0.00    461.8    1.25     9     113.6      0.0       113.6    3.5     48      81.1    1.0   -0.36       0.0      37.9
  2.46  5.0E-03    0.00    741.3    0.67    10     210.1      0.0       210.1    0.0     50      95.0    1.0   -0.33       0.0      52.5
  2.79  5.0E-02    0.00   1000.0    0.33    10     410.4      0.0       410.4    0.0     50      95.0    1.0   -0.29       0.0      82.1
  3.12  5.0E+00    0.00   1000.0    0.29    10     460.2      0.0       460.2    0.0     50      95.0    1.0   -0.28       0.0      76.7
  3.44  5.0E+00    0.00   1000.0    0.28    10     454.0      0.0       454.0    0.0     50      95.0    1.0   -0.28       0.0      75.7
  3.77  5.0E-02    0.00    938.0    0.43    10     413.6      0.0       413.6    0.0     50      95.0    1.0   -0.31       0.0      82.7
  4.10  5.0E-02    0.00    787.4    0.36    10     373.3      0.0       373.3    0.0     50      95.0    1.0   -0.28       0.0      74.7
  4.43  5.0E-02    0.00    711.3    0.36    10     351.1      0.0       351.1    0.0     50      95.0    1.0   -0.27       0.0      69.2
  4.76  5.0E-02    0.00    575.8    0.29    10     291.9      0.0       291.9    0.0     50      95.0    1.0   -0.23       0.0      57.1
  5.09  5.0E-02    0.00    453.0    0.17    10     234.1      0.0       234.1    0.0     48      91.7    1.0   -0.17       0.0      45.8
  5.41  5.0E-02    0.00    375.4    0.06    10     197.6      0.0       197.6    0.0     48      86.8    1.0   -0.07       0.0      38.7
  5.74  5.0E-02    0.00    322.9    0.07    10     173.1      0.0       173.1    0.0     48      83.0    1.0   -0.07       0.0      33.9
  6.07  5.0E-02    0.00    280.9    0.09    10     153.2      0.0       153.2    0.0     46      79.5    1.0   -0.07       0.0      30.0
  6.40  5.0E-02    0.00    252.3    0.02    10     139.9      0.0       139.9    0.0     46      76.9    1.0    0.07       0.0      27.4
  6.73  5.0E-03    0.00    202.3    0.05    10     114.0      0.0       114.0    0.0     46      71.0    1.0    0.01       0.0      27.9
  7.05  5.0E-03    0.00    208.1    0.06    10     119.0      0.0       119.0    0.0     46      72.3    1.0   -0.02       0.0      29.1
  7.38  5.0E-03    0.00    195.7    0.15    10     113.6      0.0       113.6    0.0     44      70.9    1.0   -0.08       0.0      27.8
  7.79  5.0E-03    0.00    177.4    0.08    10     104.8      0.0       104.8    0.0     44      68.6    1.0   -0.02       0.0      25.6
  8.20  5.0E-03    0.00    141.9    0.02    10      85.4      0.0        85.4    1.6     44      62.8    1.0    0.11       0.0      20.9
  8.53  5.0E-03    0.00    123.1    0.06     9      75.1      0.0        75.1    1.3     42      59.1    1.0    0.02       0.0      18.4
  8.86  5.0E-03    0.00    125.4    0.02    10      77.5      0.0        77.5    2.1     44      60.0    1.0    0.12       0.0      19.0
  9.19  5.0E-03    0.00    117.6    0.02     9      73.6      0.0        73.6    2.4     42      58.5    1.0    0.12       0.0      18.0
  9.51  5.0E-03    0.00    138.8    0.04    10      87.8      0.0        87.8    0.8     44      63.5    1.0    0.04       0.0      21.5
  9.84  5.0E-03    0.00    132.8    0.03    10      85.0      0.0        85.0    1.4     44      62.6    1.0    0.09       0.0      20.8
 10.17  5.0E-03    0.00    128.9    0.13     9      83.5      0.0        83.5    1.5     44      62.1    1.0   -0.04       0.0      20.4
 10.50  5.0E-03    0.00    118.3    0.25     9      77.6      0.0        77.6    3.2     42      60.0    1.0   -0.09       0.0      19.0
 10.83  5.0E-03    0.00    109.4    0.19     9      72.6      0.0        72.6    3.1     42      58.1    1.0   -0.06       0.0      17.8
 11.15  5.0E-03    0.00     97.5    0.06     9      65.5      0.0        65.5    2.6     42      55.1    1.0    0.05       0.0      16.0
 11.48  5.0E-03    0.00     96.6    0.08     9      65.6      0.0        65.6    2.7     42      55.2    1.0    0.03       0.0      16.1
 11.81  5.0E-03    0.00     89.7    0.08     9      61.6      0.0        61.6    3.2     42      53.4    1.0    0.03       0.0      15.1
    14  5.0E-03    0.00     75.2    0.03     9      52.3      0.0        52.3    4.9     40      48.7    1.0    0.14       0.0      12.8
   .47  5.0E-03    0.00     80.4    0.19     9      56.4      0.0        56.4    5.0     42      50.9    1.0   -0.03       0.0      13.8
 12.80  5.0E-03    0.00     93.5    0.13     9      66.1      0.0        66.1    3.3     42      55.4    1.0   -0.01       0.0      16.2
```

ConeTec Inc. - CPT Interpretation

Run No: 04-0913-1621-1117

CPT File: 783CP008.COR

.h (ft)	k (cm/s)	Bq	Qtn	Rfn	SBTn	Qc1N	DeltaQc1N	Qc1Ncs	Fc (%)	Phi (Deg)	Dr (%)	OCR	State Param	Del(n1)60	(N1)60cs
13.12	5.0E-03	0.00	77.0	0.08	9	55.2	0.0	55.2	4.1	40	50.2	1.0	0.05	0.0	13.5
13.45	5.0E-03	0.00	73.8	0.09	9	53.4	0.0	53.4	4.6	40	49.3	1.0	0.04	0.0	13.1
13.78	5.0E-03	0.00	74.5	0.10	9	54.4	0.0	54.4	4.6	40	49.8	1.0	0.03	0.0	13.3
14.11	5.0E-03	0.00	81.1	0.10	9	59.7	0.0	59.7	4.0	42	52.5	1.0	0.02	0.0	14.6
14.44	5.0E-03	0.00	96.7	0.09	9	71.5	0.0	71.5	2.8	42	57.7	1.0	0.01	0.0	17.5
14.76	5.0E-03	0.00	94.1	0.19	9	70.3	0.0	70.3	4.0	42	57.2	1.0	-0.04	0.0	17.2
15.09	5.0E-03	0.00	96.7	0.16	9	72.8	0.0	72.8	3.5	42	58.2	1.0	-0.03	0.0	17.8
15.42	5.0E-03	0.00	82.6	0.07	9	62.9	0.0	62.9	3.7	42	54.0	1.0	0.05	0.0	15.4
15.75	5.0E-03	0.00	73.3	0.08	9	56.4	0.0	56.4	4.5	40	50.9	1.0	0.05	0.0	13.8
16.08	5.0E-03	0.00	75.2	0.03	9	58.3	0.0	58.3	4.6	40	51.8	1.0	0.12	0.0	14.3
16.40	5.0E-03	0.00	64.1	0.09	9	50.3	0.0	50.3	5.0	40	47.6	1.0	0.05	0.0	12.3
16.73	5.0E-03	0.00	59.8	0.12	9	47.4	0.0	47.4	5.0	40	45.9	1.0	0.03	0.0	11.6
17.06	5.0E-03	0.00	66.9	0.24	9	53.3	0.0	53.3	5.0	40	49.2	1.0	-0.03	0.0	13.0
17.39	5.0E-04	0.00	49.7	0.82	7	40.2	16.6	56.8	16.0	38	41.1	1.0	-0.10	2.9	16.0
17.72	5.0E-05	0.02	31.8	1.60	7	26.4	40.2	66.6	27.6	36	30.0	10.0	-0.12	6.3	16.6
18.04	5.0E-05	0.05	29.4	0.91	7	24.7	23.7	48.4	23.3	36	30.0	10.0	-0.06	4.3	13.9
18.37	5.0E-05	0.09	27.7	1.44	7	23.5	39.8	63.3	28.6	36	30.0	10.0	-0.09	6.0	15.1
18.70	5.0E-06	-0.03	25.8	3.47	6	22.0	88.2	110.2	40.9	UnDef	UnDef	10.0	UnDef	10.8	21.6
19.03	5.0E-08	-0.02	30.0	5.14	1	25.6	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
19.36	5.0E-08	-0.02	27.9	6.58	1	24.1	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
19.68	5.0E-08	-0.01	24.6	6.39	1	21.5	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
20.01	5.0E-08	-0.01	24.2	5.56	1	21.3	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
20.34	5.0E-08	0.00	29.1	5.60	1	25.5	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
20.67	5.0E-08	0.00	39.3	6.14	1	34.1	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
21.00	5.0E-06	0.00	87.9	3.74	7	75.0	82.3	157.4	24.6	UnDef	UnDef	10.0	UnDef	17.9	54.6

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ConeTec Inc. - CPT Interpretation                                         Page:   1a
Interpretation Output - Release 1.00.19M
Run No:     04-0913-1621-1139
    No:     04-783
Client:     MACTEC, Inc.
Project:    TVA Plant, Gallatin, TN
Site:       CPT-12
Location:   TVA Plant
Cone:       20 TON  AD163
CPT Date:   04/08/09
CPT Time:   17:11
CPT File:   783CP012.COR
Northing  (m):         0.000
Easting   (m):         0.000
Elevation (m):         0.000
------------------------------------------------------------------------------------------------
 Water Table (m):              1.52       (ft):    5.0
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:     12.50     Su/P' (nc):   0.30
 Averaging Increment (m):    0.10
 Phi Method :                 Robertson and Campanella, 1983
 Dr  Method :                 Jamiolkowski - All Sands
 State Parameter M:          1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
------------------------------------------------------------------------------------------------------------
 Depth     AvgQt     AvgFs     AvgRf     AvgUd    SBT    U.Wt.   TStress  EStress     Ueq        Cn       N60    (N1)60      Su    CRR
 (ft)      (tsf)     (tsf)      (%)      (ft)             pcf     (tsf)    (tsf)     (tsf)                   (blows/ft)     (tsf)
------------------------------------------------------------------------------------------------------------
  0.16      45.8      0.05      0.11      -0.1     8     120.9     0.01     0.01      0.00      2.00      11.0     21.9    UnDef  0.14
  0.49     155.8      0.67      0.43      -0.2     9     124.1     0.03     0.03      0.00      2.00      29.8     59.7    UnDef  0.00
  0.82     218.4      1.19      0.55      -1.9     9     124.1     0.05     0.05      0.00      2.00      41.8     83.6    UnDef  0.00
  1.15     286.1      1.84      0.64      -1.6     9     124.1     0.07     0.07      0.00      2.00      54.8    109.6    UnDef  0.00
    48     243.5      2.02      0.83      -2.1     9     124.1     0.09     0.09      0.00      2.00      46.6     93.3    UnDef  0.00
    80     261.3      3.56      1.36      -1.9     8     120.9     0.11     0.11      0.00      2.00      62.6    125.1    UnDef  0.00
  2.13     455.9      5.14      1.13     -12.6     9     124.1     0.13     0.13      0.00      2.00      87.3    174.6    UnDef  0.00
  2.46     488.7      5.77      1.18      -5.8     9     124.1     0.15     0.15      0.00      2.00      93.6    187.2    UnDef  0.00
  2.79     141.3      3.28      2.32      -1.8     7     117.8     0.17     0.17      0.00      2.00      45.1     90.2    UnDef  0.00
  3.12      30.2      1.12      3.70      -0.3     5     114.6     0.19     0.19      0.00      2.00      14.5     29.0     2.40  0.00
  3.44      14.7      0.51      3.48      -0.4     4     114.6     0.21     0.21      0.00      2.00       9.4     18.8     1.16  0.11
  3.77      16.4      0.29      1.78       1.9     6     114.6     0.23     0.23      0.00      2.00       6.3     12.5     1.29  0.09
  4.10      23.0      0.44      1.92       3.2     6     114.6     0.25     0.25      0.00      2.00       8.8     17.6     1.82  0.10
  4.43      26.5      0.50      1.89       4.6     6     114.6     0.27     0.27      0.00      1.94      10.2     19.7     2.10  0.11
  4.76      27.8      0.61      2.20      -8.1     6     114.6     0.28     0.28      0.00      1.87      10.6     19.9     2.20  0.12
  5.09      24.2      0.54      2.22     -11.8     6     114.6     0.30     0.30      0.00      1.82       9.3     16.9     1.91  0.11
  5.41      29.5      0.63      2.13     -10.3     6     114.6     0.32     0.31      0.01      1.80      11.3     20.3     2.33  0.12
  5.74      57.6      0.85      1.48     -10.8     7     117.8     0.34     0.32      0.02      1.77      18.4     32.6    UnDef  0.21
  6.07      57.1      0.59      1.03     -12.2     7     117.8     0.36     0.33      0.03      1.75      18.2     31.8    UnDef  0.18
  6.40      31.6      0.79      2.49      -2.6     6     114.6     0.38     0.34      0.04      1.73      12.1     20.9     2.50  0.14
  6.73      38.3      0.79      2.07      -2.5     6     114.6     0.40     0.34      0.05      1.70      14.7     25.0     3.03  0.15
  7.05      29.3      0.78      2.67      -3.9     6     114.6     0.42     0.35      0.06      1.68      11.2     18.9     2.31  0.14
  7.38      35.2      1.13      3.21      -2.9     5     114.6     0.44     0.36      0.07      1.66      16.9     28.1     2.78  0.19
  7.79      35.8      1.34      3.75      -2.7     5     114.6     0.46     0.37      0.09      1.64      17.2     28.1     2.83  0.23
  8.20      35.6      1.52      4.26      -2.5     4     114.6     0.48     0.38      0.10      1.62      22.8     36.8     2.81  0.00
  8.53      40.3      1.61      4.01      -3.0     5     114.6     0.50     0.39      0.11      1.60      19.3     30.8     3.18  0.00
  8.86      34.0      1.56      4.60      -3.6     3     111.4     0.52     0.40      0.12      1.58      32.6     51.5     2.68  0.00
  9.19      35.7      1.50      4.20      -3.5     4     114.6     0.54     0.41      0.13      1.57      22.8     35.6     2.81  0.00
  9.51      30.8      1.43      4.64      -5.3     3     111.4     0.56     0.42      0.14      1.55      29.5     45.7     2.42  0.34
  9.84      24.2      0.91      3.77      -6.4     4     114.6     0.58     0.42      0.15      1.53      15.5     23.7     1.89  0.22
 10.17      17.2      0.79      4.60     -12.0     3     111.4     0.59     0.43      0.16      1.52      16.5     25.1     1.33  0.28
 10.50      32.9      1.23      3.75     -12.1     5     114.6     0.61     0.44      0.17      1.51      15.7     23.7     2.58  0.23
 10.83      30.7      1.58      5.14     -13.3     3     111.4     0.63     0.45      0.18      1.49      29.4     43.9     2.41  0.00
 11.15      31.0      1.70      5.51     -12.7     3     111.4     0.65     0.46      0.19      1.48      29.6     43.8     2.42  0.00
 11.48      25.2      1.34      5.33     -12.6     3     111.4     0.67     0.47      0.20      1.47      24.1     35.4     1.96  0.00
    81      48.8      1.62      3.32     -13.0     5     114.6     0.69     0.47      0.21      1.45      23.4     34.0     3.85  0.26
   .14      35.3      2.04      5.80     -15.5     3     111.4     0.71     0.48      0.22      1.44      33.8     48.6     2.76  0.00
 12.47      31.0      1.26      4.05     -14.4     4     114.6     0.72     0.49      0.23      1.43      19.8     28.3     2.43  0.30
 12.80      31.3      1.58      5.06     -10.6     3     111.4     0.74     0.50      0.24      1.42      30.0     42.4     2.44  0.00
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.h (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	SBT	U.Wt. pcf	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	CRR
13.12	27.0	1.27	4.71	-7.6	3	111.4	0.76	0.51	0.25	1.40	25.9	36.4	2.10	0.00
13.45	36.2	1.53	4.22	-7.3	4	114.6	0.78	0.52	0.26	1.39	23.1	32.2	2.83	0.35
13.78	32.4	1.80	5.55	-12.6	3	111.4	0.80	0.52	0.27	1.38	31.1	42.9	2.53	0.00
14.11	44.7	1.96	4.39	-13.2	4	114.6	0.82	0.53	0.28	1.37	28.5	39.1	3.51	0.00
14.44	36.7	1.72	4.68	-15.5	3	111.4	0.83	0.54	0.29	1.36	35.2	47.9	2.87	0.00
14.76	25.1	1.35	5.37	-13.0	3	111.4	0.85	0.55	0.30	1.35	24.0	32.5	1.94	0.00
15.09	21.0	1.18	5.63	-11.7	3	111.4	0.87	0.56	0.32	1.34	20.1	27.0	1.61	0.00
15.42	29.3	1.14	3.90	-10.7	4	114.6	0.89	0.56	0.33	1.33	18.7	24.9	2.28	0.36
15.75	39.7	1.39	3.50	-11.0	5	114.6	0.91	0.57	0.34	1.32	19.0	25.1	3.10	0.26
16.08	39.0	1.51	3.88	-11.6	5	114.6	0.93	0.58	0.35	1.31	18.7	24.5	3.05	0.32
16.40	28.8	1.27	4.42	-12.1	3	111.4	0.95	0.59	0.36	1.30	27.6	35.9	2.23	0.00
16.73	26.3	1.05	4.01	-11.2	4	114.6	0.96	0.60	0.37	1.29	16.8	21.7	2.02	0.00
17.06	17.8	0.70	3.94	-10.7	3	111.4	0.98	0.61	0.38	1.28	17.1	21.9	1.35	0.21
17.39	30.4	0.49	1.62	-5.8	6	114.6	1.00	0.61	0.39	1.28	11.6	14.8	2.35	0.11
17.72	31.1	0.85	2.74	10.0	6	114.6	1.02	0.62	0.40	1.27	11.9	15.1	2.41	0.18
18.04	28.3	0.92	3.26	7.8	5	114.6	1.04	0.63	0.41	1.26	13.6	17.1	2.18	0.28
18.37	25.8	0.81	3.12	6.6	5	114.6	1.06	0.64	0.42	1.25	12.4	15.5	1.98	0.29
18.70	15.6	0.94	6.03	3.9	3	111.4	1.08	0.65	0.43	1.24	15.0	18.6	1.16	0.00
19.03	22.6	0.83	3.66	5.0	4	114.6	1.09	0.66	0.44	1.23	14.4	17.8	1.72	0.32
19.36	37.9	1.60	4.22	1.3	4	114.6	1.11	0.67	0.45	1.23	24.2	29.7	2.94	0.00
19.68	44.6	1.87	4.19	-5.1	5	114.6	1.13	0.67	0.46	1.22	21.4	26.0	3.48	0.00
20.01	37.0	1.89	5.11	-5.7	3	111.4	1.15	0.68	0.47	1.21	35.4	42.9	2.86	0.00
20.34	38.6	1.75	4.54	-5.5	4	114.6	1.17	0.69	0.48	1.20	24.6	29.6	2.99	0.00
20.67	37.3	1.99	5.33	-5.9	3	111.4	1.19	0.70	0.49	1.20	35.7	42.7	2.89	0.00
21.00	39.9	1.99	5.00	-6.6	3	111.4	1.21	0.71	0.50	1.19	38.2	45.4	3.10	0.00
21.33	26.8	2.03	7.59	-8.4	3	111.4	1.22	0.71	0.51	1.18	25.7	30.4	2.05	0.00
21.65	24.2	1.29	5.35	-6.7	3	111.4	1.24	0.72	0.52	1.18	23.2	27.2	1.84	0.00
98	36.4	1.46	4.01	-5.9	5	114.6	1.26	0.73	0.53	1.17	17.4	20.4	2.81	0.00
31	39.7	1.60	4.03	-6.5	5	114.6	1.28	0.74	0.54	1.16	19.0	22.1	3.07	0.00
22.64	32.6	1.48	4.55	-3.6	3	111.4	1.30	0.75	0.55	1.16	31.2	36.1	2.51	0.00
22.97	28.2	1.38	4.91	-3.9	3	111.4	1.32	0.76	0.56	1.15	27.0	31.0	2.15	0.00
23.29	43.0	1.14	2.66	-2.3	6	114.6	1.34	0.76	0.57	1.14	16.5	18.8	3.33	0.21
23.62	40.2	1.10	2.73	-1.9	6	114.6	1.35	0.77	0.58	1.14	15.4	17.5	3.11	0.22
23.95	24.8	0.67	2.69	-1.9	5	114.6	1.37	0.78	0.59	1.13	11.9	13.4	1.88	0.32
24.28	12.3	0.32	2.58	-0.9	5	114.6	1.39	0.79	0.60	1.13	5.9	6.6	0.87	0.11
24.61	8.9	0.12	1.29	-0.7	5	114.6	1.41	0.80	0.61	1.12	4.3	4.8	0.60	0.09
24.93	7.5	0.05	0.67	-0.6	1	111.4	1.43	0.81	0.62	1.11	3.6	4.0	0.48	0.09
25.26	13.3	0.13	0.95	0.0	6	114.6	1.45	0.82	0.63	1.11	5.1	5.6	0.94	0.11
25.59	14.6	0.16	1.07	5.8	6	114.6	1.47	0.82	0.64	1.10	5.6	6.1	1.05	0.12
25.92	13.3	0.10	0.75	12.4	6	114.6	1.49	0.83	0.65	1.10	5.1	5.6	0.94	0.11
26.25	12.7	0.11	0.83	13.6	6	114.6	1.50	0.84	0.66	1.09	4.9	5.3	0.89	0.11
26.57	11.4	0.14	1.23	13.9	5	114.6	1.52	0.85	0.67	1.09	5.4	5.9	0.79	0.10
26.90	11.9	0.29	2.45	14.6	5	114.6	1.54	0.86	0.68	1.08	5.7	6.1	0.83	0.10
27.23	24.0	0.49	2.05	16.9	6	114.6	1.56	0.87	0.69	1.07	9.2	9.9	1.80	0.23
27.56	33.6	0.60	1.79	5.3	6	114.6	1.58	0.88	0.70	1.07	12.9	13.7	2.56	0.14
27.89	19.3	0.35	1.79	1.9	6	114.6	1.60	0.88	0.71	1.06	7.4	7.9	1.42	0.17
28.21	17.3	0.37	2.12	1.3	5	114.6	1.62	0.89	0.72	1.06	8.3	8.7	1.25	0.15
28.54	17.7	0.55	3.09	0.3	5	114.6	1.64	0.90	0.74	1.05	8.5	8.9	1.28	0.15
28.87	20.5	0.86	4.18	1.9	3	111.4	1.65	0.91	0.75	1.05	19.6	20.6	1.51	0.00
29.20	20.5	0.87	4.26	3.8	3	111.4	1.67	0.92	0.76	1.04	19.6	20.5	1.50	0.00
29.53	20.6	1.01	4.89	4.1	3	111.4	1.69	0.93	0.77	1.04	19.7	20.5	1.51	0.00
29.86	20.9	1.13	5.39	-0.2	3	111.4	1.71	0.93	0.78	1.04	20.0	20.7	1.54	0.00
30.18	20.5	1.51	7.37	-1.0	3	111.4	1.73	0.94	0.79	1.03	19.6	20.2	1.50	0.00
30.59	20.1	1.68	8.39	-5.8	3	111.4	1.75	0.95	0.80	1.03	19.2	19.7	1.47	0.00
31.00	18.4	1.42	7.73	-8.0	3	111.4	1.77	0.96	0.81	1.02	17.6	17.9	1.33	0.00
31.33	18.6	1.86	10.01	-8.0	3	111.4	1.79	0.97	0.82	1.02	17.8	18.1	1.34	0.00
31.66	91.1	2.53	2.77	-9.1	6	114.6	1.81	0.98	0.83	1.01	34.9	35.3	7.14	0.43
31.99	241.9	3.98	1.65	-20.7	8	120.9	1.83	0.99	0.84	1.01	57.9	58.3	UnDef	0.00
32	67.4	5.78	8.58	-28.9	11	130.5	1.85	1.00	0.85	1.00	64.5	64.6	UnDef	0.00
.64	31.1	1.27	4.10	-26.7	4	114.6	1.87	1.01	0.86	1.00	19.8	19.8	2.33	0.40
32.97	26.9	1.12	4.15	-26.5	4	114.6	1.89	1.02	0.87	0.99	17.2	17.2	2.00	0.00
33.30	30.0	1.32	4.39	-26.1	4	114.6	1.91	1.02	0.88	0.99	19.2	18.9	2.25	0.00

Depth (ft)	AvgQt (tsf)	AvgFs (tsf)	AvgRf (%)	AvgUd (ft)	SBT	U.Wt. pcf	TStress (tsf)	EStress (tsf)	Ueq (tsf)	Cn	N60 (blows/ft)	(N1)60 (blows/ft)	Su (tsf)	CRR
33.63	31.9	1.52	4.76	-26.2	3	111.4	1.93	1.03	0.89	0.98	30.5	30.1	2.40	0.00
33.96	31.5	1.61	5.11	-26.0	3	111.4	1.94	1.04	0.90	0.98	30.2	29.6	2.36	0.00
34.28	29.3	1.52	5.20	-25.8	3	111.4	1.96	1.05	0.91	0.98	28.1	27.4	2.19	0.00
34.61	31.5	2.28	7.22	-25.8	3	111.4	1.98	1.06	0.92	0.97	30.2	29.4	2.36	0.00
34.94	136.6	2.86	2.09	-25.7	7	117.8	2.00	1.06	0.93	0.97	43.6	42.3	UnDef	0.00

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ConeTec Inc. - CPT Interpretation                                              Page:   1b
Interpretation Output - Release 1.00.19M
Run No:      04-0913-1621-1139
Job No:      04-783
   nt:       MACTEC, Inc.
roject:      TVA Plant, Gallatin, TN
Site:        CPT-12
Location:    TVA Plant
Cone:        20 TON  AD163
CPT Date:    04/08/09
CPT Time:    17:11
CPT File:    783CP012.COR
Northing  (m):         0.000
Easting   (m):         0.000
Elevation (m):         0.000
-------------------------------------------------------------------------------------------------------
 Water Table (m):              1.52       (ft):     5.0
 Unit Weight of Water (default):     62.40 kN/m^3
 Su Nkt used:      12.50      Su/P' (nc):    0.30
 Averaging Increment (m):     0.10
 Phi Method :                 Robertson and Campanella, 1983
 Dr  Method :                 Jamiolkowski - All Sands
 State Parameter M:           1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
---------------------------------------------------------------------------------------------------------------------------
 Depth      k         Bq       Qtn      Rfn    SBTn     Qc1N DeltaQc1N    Qc1Ncs     Fc     Phi       Dr     OCR  State Del(n1)60  (N1)60cs
 (ft)    (cm/s)                                                                     (%)    (Deg)     (%)         Param
---------------------------------------------------------------------------------------------------------------------------
  0.16  5.0E-03     0.00   1000.0     0.11    10      87.8       0.0      87.8     0.0      50      95.0     1.0   -0.20      0.0      21.9
  0.49  5.0E-02     0.00   1000.0     0.43    10     298.5       0.0     298.5     0.0      50      95.0     1.0   -0.32      0.0      59.7
  0.82  5.0E-02     0.00   1000.0     0.55    10     418.2       0.0     418.2     0.0      50      95.0     1.0   -0.34      0.0      83.6
  1.15  5.0E-02     0.00   1000.0     0.64    10     548.0       0.0     548.0     0.0      50      95.0     1.0   -0.36      0.0     109.6
  1.48  5.0E-02     0.00   1000.0     0.83    10     466.3       0.0     466.3     0.0      50      95.0     1.0   -0.38      0.0      93.3
    80  5.0E-03     0.00   1000.0     1.36    12     500.5     UnDef     UnDef     0.0      50      95.0     1.0   -0.45    UnDef     UnDef
    13  5.0E-02     0.00   1000.0     1.13     9     873.1       0.0     873.1     1.0      50      95.0     1.0   -0.42      0.0     174.6
  2.46  5.0E-02     0.00   1000.0     1.18     9     936.1       0.0     936.1     1.2      50      95.0     1.0   -0.43      0.0     187.2
  2.79  5.0E-04     0.00    823.0     2.33    12     270.7     UnDef     UnDef     0.0      50      95.0     1.0   -0.53    UnDef     UnDef
  3.12  5.0E-06     0.00    157.7     3.72    12      57.9     UnDef     UnDef     0.0   UnDef     UnDef    10.0   UnDef    UnDef     UnDef
  3.44  5.0E-07     0.00     69.2     3.53     6      28.1      38.4      66.5    26.6   UnDef     UnDef    10.0   UnDef     10.6      29.3
  3.77  5.0E-05     0.00     70.7     1.80     7      31.3      18.1      49.5    18.7      40      35.9    10.0   -0.21      3.7      16.3
  4.10  5.0E-05     0.00     92.1     1.94     7      44.0      20.2      64.2    16.8      42      44.5    10.0   -0.25      4.3      21.9
  4.43  5.0E-05     0.01     98.7     1.91     7      50.3      20.8      71.1    16.0      42      47.6    10.0   -0.26      4.4      24.1
  4.76  5.0E-05    -0.01     96.5     2.23     7      50.9      26.0      76.9    17.7      42      47.9    10.0   -0.28      5.3      25.3
  5.09  5.0E-05    -0.02     79.4     2.25     7      43.2      27.9      71.1    19.7      42      43.2    10.0   -0.26      5.5      22.4
  5.41  5.0E-05    -0.01     94.2     2.15     7      51.9      26.1      78.0    17.5      42      48.4    10.0   -0.27      5.4      25.7
  5.74  5.0E-04    -0.01    180.1     1.49     9     100.0      12.5     112.5     9.2      44      67.3     1.0   -0.29      2.4      35.1
  6.07  5.0E-04    -0.01    173.3     1.03     9      97.6       5.4     103.0     7.0      44      66.6     1.0   -0.24      1.1      32.9
  6.40  5.0E-05     0.00     93.1     2.52     7      53.4      33.0      86.4    19.3      42      49.3    10.0   -0.29      6.6      27.5
  6.73  5.0E-05     0.00    110.0     2.09     7      63.8      26.0      89.8    15.8      42      54.4    10.0   -0.28      5.5      30.5
  7.05  5.0E-05    -0.01     81.7     2.71     7      48.2      37.8      86.0    21.5      42      46.4    10.0   -0.29      7.2      26.0
  7.38  5.0E-06     0.00     96.3     3.25     7      57.4      47.1     104.5    21.9   UnDef     UnDef    10.0   UnDef     11.0      39.1
  7.79  5.0E-06     0.00     95.0     3.80     7      57.5      58.8     116.3    23.9   UnDef     UnDef    10.0   UnDef     13.0      41.1
  8.20  5.0E-07    -0.01     91.8     4.32    11      56.4     UnDef     UnDef     0.0   UnDef     UnDef    10.0   UnDef    UnDef     UnDef
  8.53  5.0E-06    -0.01    101.6     4.06    11      63.0     UnDef     UnDef     0.0   UnDef     UnDef    10.0   UnDef    UnDef     UnDef
  8.86  5.0E-08    -0.01     83.8     4.67    11      52.7     UnDef     UnDef     0.0   UnDef     UnDef    10.0   UnDef    UnDef     UnDef
  9.19  5.0E-07    -0.01     86.1     4.27    11      54.6     UnDef     UnDef     0.0   UnDef     UnDef    10.0   UnDef    UnDef     UnDef
  9.51  5.0E-08    -0.01     72.6     4.72     6      46.7      94.1     140.8    30.0   UnDef     UnDef    10.0   UnDef     32.8      78.5
  9.84  5.0E-07    -0.01     55.7     3.86     6      36.4      78.2     114.6    30.6   UnDef     UnDef    10.0   UnDef     17.7      41.4
 10.17  5.0E-08    -0.03     38.4     4.76     6      25.6     102.4     128.1    39.2   UnDef     UnDef    10.0   UnDef     25.1      50.1
 10.50  5.0E-06    -0.02     73.1     3.82     6      48.4      68.8     117.3    27.0   UnDef     UnDef    10.0   UnDef     13.8      37.4
 10.83  5.0E-08    -0.02     66.9     5.25     6      44.8     126.3     171.2    32.6   UnDef     UnDef    10.0   UnDef     37.6      81.5
 11.15  5.0E-08    -0.02     66.2     5.62     6      44.8     150.5     195.3    33.9   UnDef     UnDef    10.0   UnDef     40.8      84.6
 11.48  5.0E-08    -0.02     52.7     5.47     6      36.2     144.6     180.8    36.6   UnDef     UnDef    10.0   UnDef     35.4      70.8
 11.81  5.0E-06    -0.01    101.5     3.36     7      69.4      56.1     125.5    21.7   UnDef     UnDef    10.0   UnDef     13.2      47.1
    14  5.0E-08    -0.02     71.6     5.92    11      49.7     UnDef     UnDef     0.0   UnDef     UnDef    10.0   UnDef    UnDef     UnDef
  ..47  5.0E-07    -0.02     61.8     4.15     6      43.4      89.3     132.7    30.2   UnDef     UnDef    10.0   UnDef     20.6      48.9
 12.80  5.0E-08    -0.02     61.2     5.19     6      43.3     141.0     184.4    33.6   UnDef     UnDef    10.0   UnDef     38.9      81.3
```

:h (..t)	k (cm/s)	Bq	Qtn	Rfn	SBTn	QcIN	DeltaQcIN	QclNcs	Fc (%)	Phi (Deg)	Dr (%)	OCR	State Param	Del(n1)60	(N1)60cs
13.12	5.0E-08	-0.02	51.8	4.85	6	37.1	147.5	184.6	34.9	UnDef	UnDef	10.0	UnDef	36.3	72.7
13.45	5.0E-07	-0.01	68.7	4.32	6	49.3	92.5	141.8	29.4	UnDef	UnDef	10.0	UnDef	22.2	54.4
13.78	5.0E-08	-0.02	60.4	5.69	6	43.9	175.4	219.3	35.3	UnDef	UnDef	10.0	UnDef	42.9	85.9
14.11	5.0E-07	-0.02	82.4	4.47	11	59.9	UnDef	UnDef	0.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
14.44	5.0E-08	-0.02	66.5	4.79	6	48.9	116.2	165.1	31.4	UnDef	UnDef	10.0	UnDef	37.6	85.5
14.76	5.0E-08	-0.03	44.3	5.56	1	33.2	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
15.09	5.0E-08	-0.03	36.2	5.87	1	27.6	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
15.42	5.0E-07	-0.02	50.4	4.02	6	38.2	105.5	143.7	32.5	UnDef	UnDef	10.0	UnDef	21.2	46.1
15.75	5.0E-06	-0.02	67.7	3.58	6	51.3	73.3	124.7	27.0	UnDef	UnDef	10.0	UnDef	14.6	39.8
16.08	5.0E-06	-0.02	65.6	3.97	6	50.1	87.8	137.9	28.8	UnDef	UnDef	10.0	UnDef	16.2	40.7
16.40	5.0E-08	-0.03	47.3	4.57	6	36.7	146.9	183.6	35.3	UnDef	UnDef	10.0	UnDef	35.9	71.9
16.73	5.0E-07	-0.03	42.3	4.16	6	33.2	133.0	166.2	35.6	UnDef	UnDef	10.0	UnDef	21.7	43.4
17.06	5.0E-08	-0.04	27.8	4.17	6	22.4	89.5	111.9	42.5	UnDef	UnDef	10.0	UnDef	21.9	43.8
17.39	5.0E-05	-0.02	47.8	1.67	7	37.9	33.3	71.2	22.5	38	39.5	10.0	-0.17	6.1	21.0
17.72	5.0E-05	0.00	48.3	2.83	7	38.5	64.0	102.5	28.4	38	39.9	10.0	-0.23	9.7	24.7
18.04	5.0E-06	-0.01	43.2	3.38	6	34.9	93.4	128.2	32.3	UnDef	UnDef	10.0	UnDef	14.3	31.3
18.37	5.0E-06	-0.01	38.7	3.26	6	31.6	98.6	130.2	33.4	UnDef	UnDef	10.0	UnDef	13.9	29.4
18.70	5.0E-08	-0.02	22.5	6.47	1	19.0	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
19.03	5.0E-07	-0.01	32.7	3.85	6	27.3	109.1	136.3	38.4	UnDef	UnDef	10.0	UnDef	17.8	35.6
19.36	5.0E-07	-0.01	55.3	4.34	6	45.5	123.1	168.6	32.3	UnDef	UnDef	10.0	UnDef	25.0	54.6
19.68	5.0E-06	-0.01	64.5	4.30	6	53.2	109.0	162.2	30.2	UnDef	UnDef	10.0	UnDef	18.9	44.9
20.01	5.0E-08	-0.02	52.5	5.28	6	43.8	175.2	218.9	36.1	UnDef	UnDef	10.0	UnDef	42.9	85.7
20.34	5.0E-07	-0.02	54.1	4.68	6	45.4	150.1	195.5	33.8	UnDef	UnDef	10.0	UnDef	27.4	57.0
20.67	5.0E-08	-0.02	51.7	5.51	6	43.7	174.7	218.4	37.0	UnDef	UnDef	10.0	UnDef	42.7	85.5
21.00	5.0E-08	-0.02	54.7	5.16	6	46.4	185.8	232.2	35.1	UnDef	UnDef	10.0	UnDef	45.4	90.9
21.33	5.0E-08	-0.03	35.8	7.96	1	31.0	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
21.65	5.0E-08	-0.03	31.7	5.64	1	27.8	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
98	5.0E-06	-0.02	48.0	4.16	6	41.6	136.1	177.7	33.7	UnDef	UnDef	10.0	UnDef	18.7	39.1
31	5.0E-06	-0.02	51.9	4.16	6	45.1	126.7	171.8	32.6	UnDef	UnDef	10.0	UnDef	18.9	41.0
22.64	5.0E-08	-0.02	41.9	4.74	6	36.9	147.7	184.6	37.7	UnDef	UnDef	10.0	UnDef	36.1	72.3
22.97	5.0E-08	-0.03	35.5	5.15	1	31.7	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
23.29	5.0E-05	-0.02	54.5	2.74	7	48.1	63.9	112.0	26.4	40	46.3	10.0	-0.25	10.5	29.3
23.62	5.0E-05	-0.02	50.3	2.83	7	44.8	69.6	114.3	27.8	38	44.2	10.0	-0.24	10.8	28.3
23.95	5.0E-06	-0.03	30.0	2.84	6	27.5	109.9	137.3	35.5	UnDef	UnDef	10.0	UnDef	13.4	26.9
24.28	5.0E-06	-0.06	13.8	2.91	6	13.5	54.0	67.5	50.5	UnDef	UnDef	5.3	UnDef	6.6	13.2
24.61	5.0E-06	-0.08	9.4	1.54	6	9.8	39.0	48.8	49.9	UnDef	UnDef	3.0	UnDef	4.8	9.5
24.93	1.0E-07	-0.11	7.5	0.83	6	8.1	32.6	40.7	48.0	UnDef	UnDef	2.2	UnDef	4.0	8.0
25.26	5.0E-05	-0.05	14.5	1.06	6	14.4	57.5	71.8	36.5	32	30.0	5.7	-0.01	5.6	11.2
25.59	5.0E-05	-0.04	15.9	1.19	6	15.7	62.8	78.5	36.0	32	30.0	6.6	-0.03	6.1	12.3
25.92	5.0E-05	-0.02	14.2	0.85	6	14.2	55.2	69.4	34.8	32	30.0	5.5	0.01	5.5	11.1
26.25	5.0E-05	-0.02	13.3	0.94	6	13.5	54.1	67.7	37.0	32	30.0	5.0	0.01	5.3	10.6
26.57	5.0E-06	-0.02	11.6	1.42	6	12.1	48.3	60.4	44.3	UnDef	UnDef	4.1	UnDef	5.9	11.8
26.90	5.0E-06	-0.02	12.0	2.82	4	12.5	50.1	62.6	53.0	UnDef	UnDef	4.3	UnDef	6.1	12.3
27.23	5.0E-05	-0.01	25.9	2.19	6	25.2	92.9	118.2	34.5	36	30.0	10.0	-0.13	9.6	19.4
27.56	5.0E-05	-0.02	36.6	1.88	7	35.1	52.0	87.1	27.4	38	37.3	10.0	-0.15	8.2	21.9
27.89	5.0E-05	-0.04	20.1	1.95	6	20.1	80.5	100.6	37.4	34	30.0	9.5	-0.09	7.9	15.8
28.21	5.0E-06	-0.04	17.5	2.34	6	17.9	71.5	89.4	42.4	UnDef	UnDef	7.7	UnDef	8.7	17.5
28.54	5.0E-06	-0.05	17.8	3.41	6	18.2	72.9	91.1	47.6	UnDef	UnDef	7.9	UnDef	8.9	17.8
28.87	5.0E-08	-0.04	20.7	4.55	1	21.0	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
29.20	5.0E-08	-0.03	20.5	4.64	1	20.9	UnDef	UnDef	100.0	UnDef	UnDef	9.8	UnDef	UnDef	UnDef
29.53	5.0E-08	-0.03	20.4	5.33	1	20.9	UnDef	UnDef	100.0	UnDef	UnDef	9.8	UnDef	UnDef	UnDef
29.86	5.0E-08	-0.04	20.6	5.87	1	21.2	UnDef	UnDef	100.0	UnDef	UnDef	9.9	UnDef	UnDef	UnDef
30.18	5.0E-08	-0.04	19.9	8.05	1	20.6	UnDef	UnDef	100.0	UnDef	UnDef	9.4	UnDef	UnDef	UnDef
30.59	5.0E-08	-0.05	19.3	9.19	1	20.1	UnDef	UnDef	100.0	UnDef	UnDef	8.9	UnDef	UnDef	UnDef
31.00	5.0E-08	-0.06	17.3	8.55	1	18.3	UnDef	UnDef	100.0	UnDef	UnDef	7.5	UnDef	UnDef	UnDef
31.33	5.0E-08	-0.06	17.3	10.00	1	18.5	UnDef	UnDef	100.0	UnDef	UnDef	7.5	UnDef	UnDef	UnDef
31.66	5.0E-05	-0.01	91.4	2.83	7	90.2	65.7	155.9	20.8	42	64.3	10.0	-0.31	12.6	47.9
31.99	5.0E-03	-0.01	243.3	1.66	9	238.3	22.0	260.3	8.2	46	92.2	1.0	-0.33	3.3	61.6
32	1.0E-15	-0.03	65.7	8.83	11	66.0	UnDef	UnDef	0.0	40	55.4	1.0	-16.35	UnDef	UnDef
..64	5.0E-07	-0.06	29.0	4.36	6	30.3	121.1	151.4	42.4	UnDef	UnDef	10.0	UnDef	19.6	39.5
32.97	5.0E-07	-0.07	24.7	4.46	1	26.2	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
33.30	5.0E-07	-0.06	27.4	4.69	1	29.0	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef

ConeTec Inc. - CPT Interpretation

Run No: 04-0913-1621-1139

CPT File: 783CP012.COR

h (ft)	k (cm/s)	Bq	Qtn	Rfn	SBTn	Qc1N	DeltaQc1N	Qc1Ncs	Fc (%)	Phi (Deg)	Dr (%)	OCR	State Param	Del(n1)60	(N1)60cs
33.63	5.0E-08	-0.06	29.0	5.07	1	30.7	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
33.96	5.0E-08	-0.06	28.4	5.44	1	30.2	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
34.28	5.0E-08	-0.06	26.1	5.57	1	28.0	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
34.61	5.0E-08	-0.06	27.9	7.71	1	30.0	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
34.94	5.0E-04	-0.01	126.5	2.12	7	129.6	45.7	175.3	14.8	44	74.7	1.0	-0.30	8.2	50.5

```
ConeTec Inc. - CPT Interpretation
Interpretation Output - Release 1.00.19M
Run No:     04-0913-1621-1161
    No:     04-783
Client:     MACTEC, Inc.
Project:    TVA Plant, Gallatin, TN
Site:       CPT-13
Location:   TVA Plant
Cone:       20 TON  AD163
CPT Date:   04/08/09
CPT Time:   10:31
CPT File:   783CP013.COR
Northing  (m):          0.000
Easting   (m):          0.000
Elevation (m):          0.000
--------------------------------------------------------------------------------------------------
 Water Table (m):             1.13       (ft):    3.7
 Unit Weight of Water (default):    62.40 kN/m^3
 Su Nkt used:      12.50     Su/P' (nc):   0.30
 Averaging Increment (m):     0.10
 Phi Method :                Robertson and Campanella, 1983
 Dr  Method :                Jamiolkowski - All Sands
 State Parameter M:           1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
------------------------------------------------------------------------------------------------------------
 Depth   AvgQt   AvgFs   AvgRf   AvgUd  SBT   U.Wt.  TStress  EStress   Ueq     Cn     N60   (N1)60    Su   CRR
 (ft)    (tsf)   (tsf)   (%)     (ft)         pcf    (tsf)    (tsf)    (tsf)           (blows/ft)    (tsf)
------------------------------------------------------------------------------------------------------------
  0.16   19.1    0.68    3.54    0.2    4    114.6   0.01     0.01     0.00    2.00    12.2   24.4    1.53  0.00
  0.49   33.2    1.57    4.73    0.2    3    111.4   0.03     0.03     0.00    2.00    31.8   63.5    2.65  0.00
  0.82   33.5    1.85    5.54    0.1    3    111.4   0.05     0.05     0.00    2.00    32.1   64.1    2.67  0.00
  1.15   32.6    1.84    5.64   -1.0    3    111.4   0.06     0.06     0.00    2.00    31.2   62.5    2.60  0.00
    48   27.5    1.66    6.03    0.3    3    111.4   0.08     0.08     0.00    2.00    26.3   52.7    2.19  0.00
    30   21.8    1.28    5.87   -0.7    3    111.4   0.10     0.10     0.00    2.00    20.9   41.8    1.74  0.00
  2.13   23.4    0.84    3.59   -1.5    5    114.6   0.12     0.12     0.00    2.00    11.2   22.4    1.87  0.00
  2.46   50.5    0.34    0.66   -0.8    8    120.9   0.14     0.14     0.00    2.00    12.1   24.2   UnDef  0.16
  2.79   57.6    0.20    0.34   -1.7    8    120.9   0.16     0.16     0.00    2.00    13.8   27.6   UnDef  0.20
  3.12   51.5    0.19    0.36   -1.2    8    120.9   0.18     0.18     0.00    2.00    12.3   24.6   UnDef  0.17
  3.44   44.4    0.14    0.32   -2.8    8    120.9   0.20     0.20     0.00    2.00    10.6   21.3   UnDef  0.14
  3.77   27.7    0.11    0.40   -6.5    7    117.8   0.22     0.22     0.00    2.00     8.8   17.7   UnDef  0.09
  4.10   10.1    0.07    0.70   -1.1    6    114.6   0.24     0.22     0.01    2.00     3.9    7.7    0.79  0.00
  4.43    5.1    0.02    0.30    0.4    1    111.4   0.26     0.23     0.02    2.00     2.4    4.9    0.39  0.00
  4.76    6.2    0.05    0.80    3.1    1    111.4   0.27     0.24     0.03    2.00     3.0    6.0    0.48  0.00
  5.09   18.8    0.11    0.56   -1.7    6    114.6   0.29     0.25     0.04    2.00     7.2   14.4    1.48  0.09
  5.41   12.3    0.13    1.06   -6.8    6    114.6   0.31     0.26     0.05    1.97     4.7    9.3    0.96  0.08
  5.74    8.6    0.12    1.39   -4.9    5    114.6   0.33     0.27     0.06    1.94     4.1    8.0    0.66  0.09
  6.07    8.2    0.12    1.47    2.9    5    114.6   0.35     0.27     0.07    1.91     3.9    7.5    0.63  0.09
  6.40    6.7    0.10    1.43   19.4    5    114.6   0.37     0.28     0.08    1.88     3.2    6.0    0.50  0.09
  6.73   13.6    0.13    0.96    6.9    6    114.6   0.39     0.29     0.09    1.85     5.2    9.6    1.06  0.09
  7.05    5.3    0.07    1.33    9.7    1    111.4   0.40     0.30     0.10    1.83     2.5    4.6    0.39  0.09
  7.38    2.9    0.02    0.69   31.5    1    111.4   0.42     0.31     0.11    1.80     1.4    2.5    0.20  0.00
  7.79   10.6    0.08    0.76   26.0    6    114.6   0.45     0.32     0.13    1.77     4.1    7.2    0.81  0.08
  8.20   10.4    0.10    0.96   10.6    6    114.6   0.47     0.33     0.14    1.74     4.0    6.9    0.79  0.08
  8.53   11.2    0.12    1.03   13.5    6    114.6   0.49     0.34     0.15    1.72     4.3    7.4    0.86  0.09
  8.86   12.0    0.08    0.67   13.0    6    114.6   0.51     0.35     0.16    1.70     4.6    7.8    0.92  0.08
  9.19    7.7    0.07    0.84   15.7    5    114.6   0.53     0.35     0.17    1.68     3.7    6.2    0.58  0.08
  9.51   10.2    0.10    0.93   14.9    6    114.6   0.55     0.36     0.18    1.66     3.9    6.5    0.77  0.08
  9.84    8.5    0.09    1.07   18.8    5    114.6   0.56     0.37     0.19    1.64     4.1    6.6    0.63  0.09
 10.17   14.0    0.13    0.90   16.4    6    114.6   0.58     0.38     0.20    1.62     5.4    8.7    1.07  0.09
 10.50   12.2    0.16    1.27   15.2    6    114.6   0.60     0.39     0.21    1.60     4.7    7.5    0.93  0.09
 10.83    3.8    0.08    2.10   32.0    3    111.4   0.62     0.40     0.22    1.59     3.7    5.8    0.26  0.00
 11.15    4.1    0.03    0.74   47.5    1    111.4   0.64     0.41     0.23    1.57     1.9    3.1    0.27  0.08
 11.48   11.4    0.07    0.57   40.5    6    114.6   0.66     0.41     0.24    1.55     4.4    6.8    0.86  0.08
    81    7.4    0.06    0.81   46.7    5    114.6   0.68     0.42     0.25    1.54     3.6    5.5    0.54  0.09
   .14   14.9    0.19    1.25   20.7    6    114.6   0.69     0.43     0.26    1.52     5.7    9.7    1.14  0.09
 12.47    6.4    0.15    2.35   27.6    4    114.6   0.71     0.44     0.27    1.51     4.1    6.2    0.46  0.09
 12.80    3.8    0.03    0.66   25.3    1    111.4   0.73     0.45     0.28    1.49     1.8    2.7    0.24  0.00
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ConeTec Inc. - CPT Interpretation

Run No: 04-0913-1621-1161

CPT File: 783CP013.COR

h	AvgQt	AvgFs	AvgRf	AvgUd	SBT	U.Wt.	TStress	EStress	Ueq	Cn	N60	(N1)60	Su	CRR
t)	(tsf)	(tsf)	(%)	(ft)		pcf	(tsf)	(tsf)	(tsf)		(blows/ft)		(tsf)	
13.12	4.2	0.05	1.07	45.0	1	111.4	0.75	0.46	0.29	1.48	2.0	3.0	0.28	0.08
13.45	7.2	0.17	2.37	19.1	4	114.6	0.77	0.46	0.30	1.47	4.6	6.7	0.51	0.09
13.78	2.1	0.07	3.37	28.9	3	111.4	0.79	0.47	0.31	1.46	2.0	2.9	0.10	0.00
14.11	11.1	0.11	0.95	26.8	6	114.6	0.81	0.48	0.32	1.44	4.3	6.1	0.82	0.09
14.44	4.5	0.14	3.12	20.0	3	111.4	0.82	0.49	0.34	1.43	4.3	6.2	0.29	0.00
14.76	5.8	0.03	0.43	28.7	1	111.4	0.84	0.50	0.35	1.42	2.8	4.0	0.40	0.09
15.09	1.8	0.01	0.56	41.8	1	111.4	0.86	0.61	0.36	1.41	0.9	1.2	0.07	0.00
15.42	1.4	0.01	0.73	43.4	1	111.4	0.88	0.51	0.37	1.40	0.7	0.9	0.04	0.00
15.75	1.2	0.01	0.85	36.6	1	111.4	0.90	0.52	0.38	1.39	0.6	0.8	0.02	0.00
16.08	1.2	0.01	0.80	43.5	1	111.4	0.92	0.53	0.39	1.37	0.6	0.8	0.03	0.00
16.40	1.2	0.01	0.82	46.7	1	111.4	0.93	0.54	0.40	1.36	0.6	0.8	0.02	0.00
16.73	1.6	0.01	0.63	47.3	1	111.4	0.95	0.55	0.41	1.35	0.8	1.0	0.05	0.00
17.06	2.0	0.01	0.51	51.5	1	111.4	0.97	0.55	0.42	1.34	0.9	1.3	0.08	0.00
17.39	3.0	0.01	0.34	61.1	1	111.4	0.99	0.56	0.43	1.33	1.4	1.9	0.16	0.00
17.72	3.3	0.02	0.45	72.2	1	111.4	1.01	0.57	0.44	1.33	1.6	2.1	0.19	0.00
18.04	11.4	0.12	1.01	46.3	6	114.6	1.03	0.58	0.45	1.32	4.4	5.7	0.83	0.10
18.37	8.3	0.26	3.10	36.9	4	114.6	1.04	0.59	0.46	1.31	5.3	6.9	0.58	0.09
18.70	10.2	0.44	4.26	52.8	3	111.4	1.06	0.59	0.47	1.30	9.8	12.7	0.73	0.00
19.03	10.6	0.72	6.80	49.6	3	111.4	1.08	0.60	0.48	1.29	10.2	13.1	0.76	0.00
19.36	11.4	0.87	7.62	42.7	3	111.4	1.10	0.61	0.49	1.28	11.0	14.0	0.83	0.00
19.68	11.0	0.79	7.21	53.2	3	111.4	1.12	0.62	0.50	1.27	10.5	13.4	0.79	0.00
20.01	13.0	0.81	6.19	62.7	3	111.4	1.14	0.63	0.51	1.26	12.5	15.8	0.95	0.00
20.34	17.5	0.89	5.07	69.9	3	111.4	1.15	0.63	0.52	1.26	16.8	21.1	1.31	0.00
20.67	29.0	1.43	4.93	-2.7	3	111.4	1.17	0.64	0.53	1.25	27.8	34.6	2.23	0.00
21.00	37.6	1.66	4.41	-21.3	4	114.6	1.19	0.65	0.54	1.24	24.0	29.7	2.91	0.00
21.33	22.4	1.58	7.05	-20.0	3	111.4	1.21	0.66	0.55	1.23	21.4	26.4	1.69	0.00
21.65	19.7	1.66	8.43	-18.9	3	111.4	1.23	0.67	0.56	1.22	18.9	23.1	1.48	0.00
98	15.8	1.50	9.48	-20.0	3	111.4	1.25	0.68	0.57	1.22	15.1	18.4	1.17	0.00
31	15.0	1.54	10.31	-20.2	3	111.4	1.26	0.68	0.58	1.21	14.3	17.4	1.10	0.00
22.64	14.4	1.50	10.38	-19.7	3	111.4	1.28	0.69	0.59	1.20	13.8	16.6	1.05	0.00
22.97	16.4	1.47	8.98	-19.6	3	111.4	1.30	0.70	0.60	1.20	15.7	18.7	1.20	0.00
23.29	15.9	1.46	9.15	-19.9	3	111.4	1.32	0.71	0.61	1.19	15.3	18.2	1.17	0.00
23.62	13.7	1.43	10.44	-20.8	3	111.4	1.34	0.72	0.62	1.18	13.1	15.5	0.99	0.00
23.95	13.4	1.36	10.10	-21.0	3	111.4	1.36	0.72	0.63	1.18	12.9	15.1	0.97	0.00
24.28	12.7	1.22	9.62	-21.0	3	111.4	1.37	0.73	0.64	1.17	12.2	14.2	0.91	0.00
24.61	15.0	1.15	7.70	-20.9	3	111.4	1.39	0.74	0.65	1.16	14.3	16.7	1.09	0.00
24.93	14.2	1.07	7.53	-20.9	3	111.4	1.41	0.75	0.66	1.16	13.6	15.8	1.03	0.00
25.26	13.9	1.32	9.50	-20.9	3	111.4	1.43	0.76	0.67	1.15	13.3	15.3	1.00	0.00
25.59	74.8	2.46	3.28	-20.1	6	114.6	1.45	0.76	0.68	1.14	28.7	32.8	5.87	0.43
25.92	24.8	3.91	15.76	-14.4	3	111.4	1.47	0.77	0.69	1.14	23.8	27.0	1.87	0.00

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ConeTec Inc. - CPT Interpretation                                                   Page:   1b
Interpretation Output - Release 1.00.19M
Run No:      04-0913-1621-1161
Job No:      04-783
    ent:     MACTEC, Inc.
  oject:     TVA Plant, Gallatin, TN
Site:        CPT-13
Location:    TVA Plant
Cone:        20 TON  AD163
CPT Date:    04/08/09
CPT Time:    10:31
CPT File:    783CP013.COR
Northing  (m):          0.000
Easting   (m):          0.000
Elevation (m):          0.000
-------------------------------------------------------------------------------------------
 Water Table (m):                 1.13       (ft):    3.7
 Unit Weight of Water (default):     62.40 kN/m^3
 Su Nkt used:      12.50      Su/P' (nc):    0.30
 Averaging Increment (m):      0.10
 Phi Method :                  Robertson and Campanella, 1983
 Dr  Method :                  Jamiolkowski - All Sands
 State Parameter M:           1.20
 Used Unit Weights Assigned to Soil Zones
 Values of 1.0E9 or UnDef are printed for parameters that are not valid for the material type (SBT)
--------------------------------------------------------------------------------------------------------
Depth      k        Bq       Qtn      Rfn   SBTn     Qc1N DeltaQc1N   Qc1Ncs     Fc    Phi      Dr      OCR   State Del(n1)60  (N1)60cs
(ft)    (cm/s)                                                                  (%)   (Deg)    (%)          Param
--------------------------------------------------------------------------------------------------------
 0.16  5.0E-07   0.00   1000.0    3.54    12     36.6     UnDef     UnDef     0.0  UnDef    UnDef    10.0   UnDef    UnDef    UnDef
 0.49  5.0E-08   0.00   1000.0    4.74    12     63.5     UnDef     UnDef     0.0  UnDef    UnDef    10.0   UnDef    UnDef    UnDef
 0.82  5.0E-08   0.00    723.4    5.55    11     64.1     UnDef     UnDef     0.0  UnDef    UnDef    10.0   UnDef    UnDef    UnDef
 1.15  5.0E-08   0.00    504.7    5.65    11     62.5     UnDef     UnDef     0.0  UnDef    UnDef    10.0   UnDef    UnDef    UnDef
 1.48  5.0E-08   0.00    331.4    6.05    11     52.7     UnDef     UnDef     0.0  UnDef    UnDef    10.0   UnDef    UnDef    UnDef
   80  5.0E-08   0.00    215.2    5.90    11     41.8     UnDef     UnDef     0.0  UnDef    UnDef    10.0   UnDef    UnDef    UnDef
   13  5.0E-06   0.00    195.0    3.61    12     44.9     UnDef     UnDef     0.0  UnDef    UnDef    10.0   UnDef    UnDef    UnDef
 2.46  5.0E-03   0.00    362.8    0.67     9     96.8       0.0      96.8     1.3     48     75.4     1.0   -0.27      0.0     24.2
 2.79  5.0E-03   0.00    361.8    0.34    10    110.3       0.0     110.3     0.0     48     77.2     1.0   -0.21      0.0     27.6
 3.12  5.0E-03   0.00    287.2    0.36    10     98.6       0.0      98.6     0.2     46     72.3     1.0   -0.19      0.0     24.6
 3.44  5.0E-03   0.00    222.7    0.32    10     85.0       0.0      85.0     0.8     46     66.6     1.0   -0.16      0.0     21.3
 3.77  5.0E-04  -0.01    127.2    0.40     9     53.0       0.0      53.0     4.3     44     51.8     1.0   -0.13      0.0     17.7
 4.10  5.0E-05   0.00     43.9    0.71     7     19.3       8.5      27.8    16.4     38     30.0    10.0   -0.08      1.8      9.5
 4.43  1.0E-07   0.00     20.7    0.31     7      9.7       0.0       9.7     5.0  UnDef    UnDef    10.0   UnDef      0.0      4.9
 4.76  1.0E-07   0.01     24.8    0.84     7     12.0      14.0      26.0    25.2  UnDef    UnDef    10.0   UnDef      3.0      9.0
 5.09  5.0E-05  -0.01     74.2    0.57     9     36.0       5.2      41.2     9.8     40     38.6    10.0   -0.11      1.2     15.6
 5.41  5.0E-05  -0.02     46.5    1.09     7     23.6      13.9      37.4    18.9     38     30.0    10.0   -0.12      2.8     12.1
 5.74  5.0E-06  -0.03     31.2    1.45     7     16.4      22.9      39.3    26.9  UnDef    UnDef    10.0   UnDef      4.6     12.6
 6.07  5.0E-06   0.00     28.5    1.53     7     15.3      26.6      41.9    28.8  UnDef    UnDef    10.0   UnDef      4.9     12.4
 6.40  5.0E-06   0.08     22.2    1.51     7     12.3      34.5      46.7    32.6  UnDef    UnDef    10.0   UnDef      5.1     11.1
 6.73  5.0E-05   0.01     45.2    0.99     7     24.6      13.8      38.4    18.5     38     30.0    10.0   -0.11      2.8     12.4
 7.05  1.0E-07   0.04     16.3    1.44     6      9.4      37.8      47.2    37.6  UnDef    UnDef     6.8   UnDef      4.6      9.2
 7.38  1.0E-07   0.35      8.0    0.81     6      5.1      20.4      25.5    46.2  UnDef    UnDef     2.4   UnDef      2.5      5.0
 7.79  5.0E-05   0.07     31.9    0.79     7     18.4      13.9      32.3    21.1     36     30.0    10.0   -0.05      2.7      9.8
 8.20  5.0E-05   0.02     30.2    1.01     7     17.7      18.1      35.8    23.9     36     30.0    10.0   -0.07      3.2     10.1
 8.53  5.0E-05   0.03     31.6    1.08     7     18.8      19.0      37.8    23.8     36     30.0    10.0   -0.08      3.4     10.7
 8.86  5.0E-05   0.02     33.2    0.70     7     20.0      12.9      32.8    19.7     36     30.0    10.0   -0.05      2.5     10.4
 9.19  5.0E-06   0.04     20.3    0.90     7     12.7      22.6      35.3    29.0  UnDef    UnDef     9.7   UnDef      4.2     10.4
 9.51  5.0E-05   0.03     26.6    0.98     7     16.6      20.0      36.7    25.5     36     30.0    10.0   -0.06      3.4      9.9
 9.84  5.0E-06   0.05     21.2    1.14     7     13.6      28.9      42.4    30.5  UnDef    UnDef    10.0   UnDef      4.9     11.6
10.17  5.0E-05   0.02     35.2    0.94     7     22.2      16.8      39.0    21.2     38     30.0    10.0   -0.08      3.2     11.9
10.50  5.0E-05   0.02     29.8    1.34     7     19.1      26.4      45.6    26.7     36     30.0    10.0   -0.09      4.3     11.8
10.83  5.0E-08   0.24      8.1    2.50     4      5.9      23.7      29.7    60.7  UnDef    UnDef     2.4   UnDef      5.8     11.6
11.15  1.0E-07   0.37      8.4    0.88     6      6.2      24.9      31.2    45.9  UnDef    UnDef     2.6   UnDef      3.1      6.1
11.48  5.0E-05   0.09     26.0    0.60     7     17.4      14.4      31.8    22.0     36     30.0    10.0   -0.01      2.7      9.5
11.81  5.0E-06   0.18     16.0    0.89     7     11.2      32.9      44.1    32.9  UnDef    UnDef     6.7   UnDef      4.8     10.3
   14  5.0E-05   0.03     32.9    1.31     7     22.2      25.5      47.7    25.0     36     30.0    10.0   -0.10      4.4     13.1
  .47  5.0E-07   0.05     13.0    2.64     6      9.5      37.8      47.3    50.3  UnDef    UnDef     4.8   UnDef      6.2     12.3
12.80  1.0E-07   0.17      6.8    0.82     6      5.5      22.2      27.7    50.1  UnDef    UnDef     1.9   UnDef      2.7      5.4
```

h	k (cm/s)	Bq	Qtn	Rfn	SBTn	Qc1N	DeltaQc1N	QcINcs	Fc (%)	Phi (Deg)	Dr (%)	OCR	State Param	Del(n1)60	(N1)60cs
13.12	1.0E-07	0.32	7.6	1.31	6	6.1	24.4	30.5	52.9	UnDef	UnDef	2.2	UnDef	3.0	6.0
13.45	5.0E-07	0.05	13.8	2.66	6	10.3	41.3	51.6	49.0	UnDef	UnDef	5.3	UnDef	6.7	13.5
13.78	5.0E-08	0.45	2.7	5.41	1	3.0	UnDef	UnDef	100.0	UnDef	UnDef	0.8	UnDef	UnDef	UnDef
14.11	5.0E-05	0.05	21.5	1.02	7	15.7	28.7	44.4	29.2	34	30.0	10.0	-0.04	4.2	10.3
14.44	5.0E-08	0.08	7.5	3.82	1	6.3	UnDef	UnDef	100.0	UnDef	UnDef	2.2	UnDef	UnDef	UnDef
14.76	1.0E-07	0.11	10.0	0.50	6	8.1	32.3	40.4	37.1	UnDef	UnDef	3.3	UnDef	4.0	7.9
15.09	1.0E-07	1.02	1.8	1.07	1	2.5	UnDef	UnDef	100.0	UnDef	UnDef	0.6	UnDef	UnDef	UnDef
15.42	1.0E-07	1.99	1.0	2.02	1	1.9	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
15.75	1.0E-07	2.77	0.5	3.62	1	1.6	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
16.08	1.0E-07	2.94	0.6	3.03	1	1.7	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
16.40	1.0E-07	3.69	0.5	3.49	1	1.6	UnDef	UnDef	100.0	UnDef	UnDef	0.5	UnDef	UnDef	UnDef
16.73	1.0E-07	1.66	1.2	1.56	4	2.1	8.5	10.6	100.0	UnDef	UnDef	0.5	UnDef	1.0	2.1
17.06	1.0E-07	1.20	1.8	1.01	1	2.6	UnDef	UnDef	100.0	UnDef	UnDef	0.6	UnDef	UnDef	UnDef
17.39	1.0E-07	0.75	3.5	0.51	1	3.9	UnDef	UnDef	100.0	UnDef	UnDef	0.9	UnDef	UnDef	UnDef
17.72	1.0E-07	0.78	4.1	0.64	1	4.3	UnDef	UnDef	100.0	UnDef	UnDef	1.1	UnDef	UnDef	UnDef
18.04	5.0E-05	0.10	18.0	1.11	7	14.7	43.8	58.5	33.1	32	30.0	8.0	-0.02	5.1	10.8
18.37	5.0E-07	0.10	12.3	3.55	4	10.5	42.2	52.7	56.2	UnDef	UnDef	4.4	UnDef	6.9	13.8
18.70	5.0E-08	0.13	15.4	4.75	1	13.0	UnDef	UnDef	100.0	UnDef	UnDef	6.3	UnDef	UnDef	UnDef
19.03	5.0E-08	0.11	15.8	7.57	1	13.4	UnDef	UnDef	100.0	UnDef	UnDef	6.5	UnDef	UnDef	UnDef
19.36	5.0E-08	0.08	17.0	8.43	1	14.3	UnDef	UnDef	100.0	UnDef	UnDef	7.3	UnDef	UnDef	UnDef
19.68	5.0E-08	0.12	15.9	8.03	1	13.7	UnDef	UnDef	100.0	UnDef	UnDef	6.6	UnDef	UnDef	UnDef
20.01	5.0E-08	0.12	19.0	6.78	1	16.1	UnDef	UnDef	100.0	UnDef	UnDef	8.7	UnDef	UnDef	UnDef
20.34	5.0E-08	0.10	25.8	5.42	1	21.5	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
20.67	5.0E-08	-0.02	43.3	5.14	6	35.4	141.6	176.9	38.5	UnDef	UnDef	10.0	UnDef	34.6	69.3
21.00	5.0E-07	-0.03	55.9	4.56	6	45.6	133.4	179.0	32.9	UnDef	UnDef	10.0	UnDef	26.0	55.7
21.33	5.0E-08	-0.06	32.1	7.45	1	27.0	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
21.65	5.0E-08	-0.06	27.7	8.99	1	23.6	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
98	5.0E-08	-0.08	21.6	10.00	1	18.8	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
31	5.0E-08	-0.09	20.1	10.00	1	17.7	UnDef	UnDef	100.0	UnDef	UnDef	9.5	UnDef	UnDef	UnDef
22.64	5.0E-08	-0.09	19.0	10.00	1	17.0	UnDef	UnDef	100.0	UnDef	UnDef	8.7	UnDef	UnDef	UnDef
22.97	5.0E-08	-0.08	21.5	9.75	1	19.1	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
23.29	5.0E-08	-0.08	20.7	9.98	1	18.5	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef
23.62	5.0E-08	-0.10	17.3	10.00	1	15.9	UnDef	UnDef	100.0	UnDef	UnDef	7.5	UnDef	UnDef	UnDef
23.95	5.0E-08	-0.11	16.7	10.00	1	15.5	UnDef	UnDef	100.0	UnDef	UnDef	7.1	UnDef	UnDef	UnDef
24.28	5.0E-08	-0.11	15.5	10.00	1	14.5	UnDef	UnDef	100.0	UnDef	UnDef	6.3	UnDef	UnDef	UnDef
24.61	5.0E-08	-0.10	18.4	8.49	1	17.0	UnDef	UnDef	100.0	UnDef	UnDef	8.3	UnDef	UnDef	UnDef
24.93	5.0E-08	-0.10	17.2	8.36	1	16.1	UnDef	UnDef	100.0	UnDef	UnDef	7.4	UnDef	UnDef	UnDef
25.26	5.0E-08	-0.11	16.5	10.00	1	15.7	UnDef	UnDef	100.0	UnDef	UnDef	7.0	UnDef	UnDef	UnDef
25.59	5.0E-05	-0.02	96.0	3.35	7	83.8	71.6	155.3	22.3	42	62.2	10.0	-0.36	13.3	46.1
25.92	5.0E-08	-0.05	30.2	10.00	1	27.6	UnDef	UnDef	100.0	UnDef	UnDef	10.0	UnDef	UnDef	UnDef

APPENDIX C

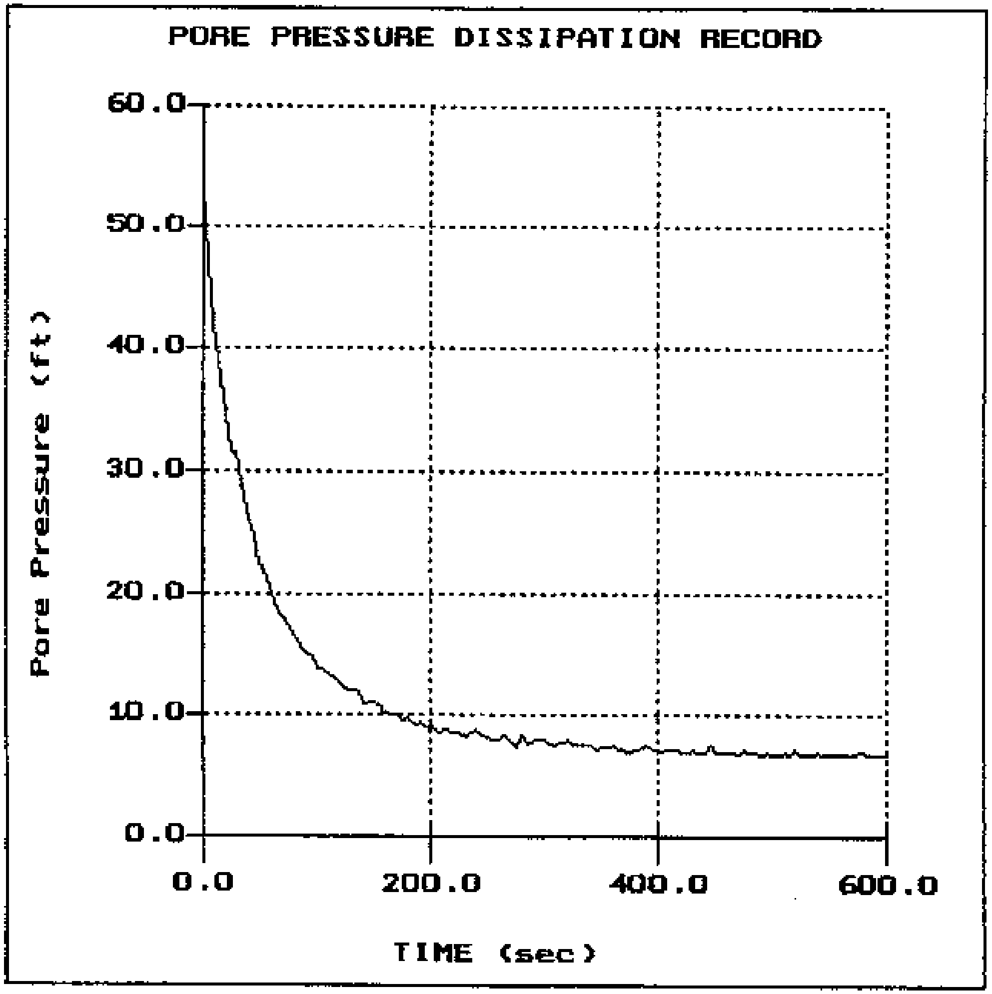
PORE PRESSURE DISSIPATION TEST RESULTS

MACTEC

Hole:CPT-3A
Location:TVA Plant

Cone:20 TON AD163
Date:09:08:04 14:41

File: 783CP03A.PPD
Depth (m): 4.80
(ft): 15.75
Duration : 600.0s
U-min: 6.62 585.0s
U-max: 53.45 0.0s



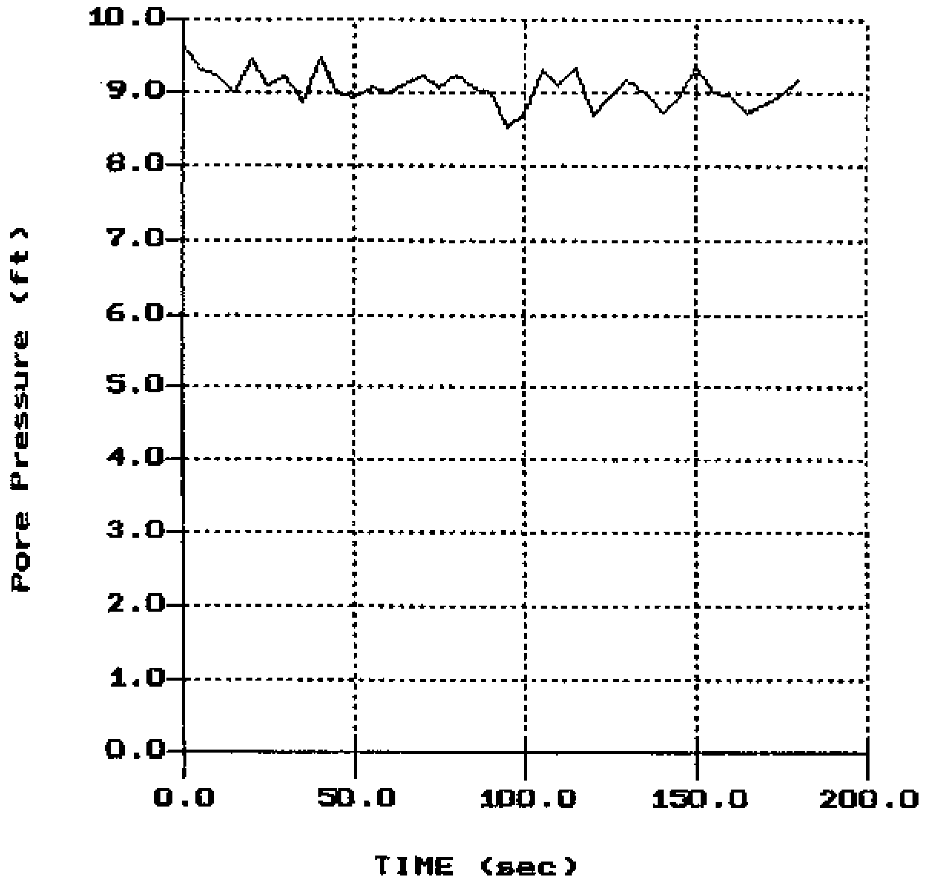
MACTEC

Hole:CPT-08
Location:TVA Plant

Cone:20 TON AD163
Date:09:08:04 11:57

File: 783CP008.PPD
Depth (m): 3.95
(ft): 12.96
Duration : 180.0s
U-min: 8.49 95.0s
U-max: 9.67 0.0s

PORE PRESSURE DISSIPATION RECORD

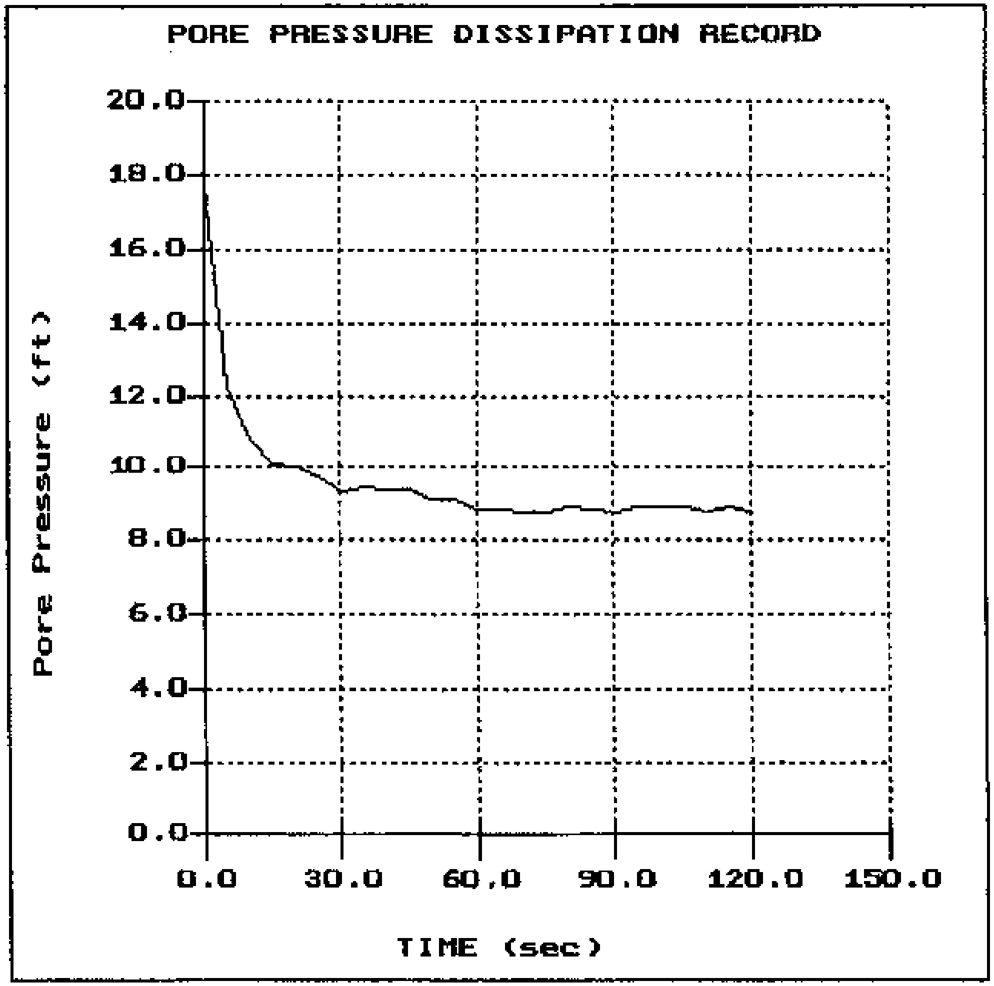


MACTEC

Hole:CPT-13
Location:TVA Plant

Cone:20 TON AD163
Date:09:08:04 10:31

File: 783CP013.PPD
Depth (m): 3.80
(ft): 12.47
Duration : 120.0s
U-min: 8.73 120.0s
U-max: 17.79 0.0s



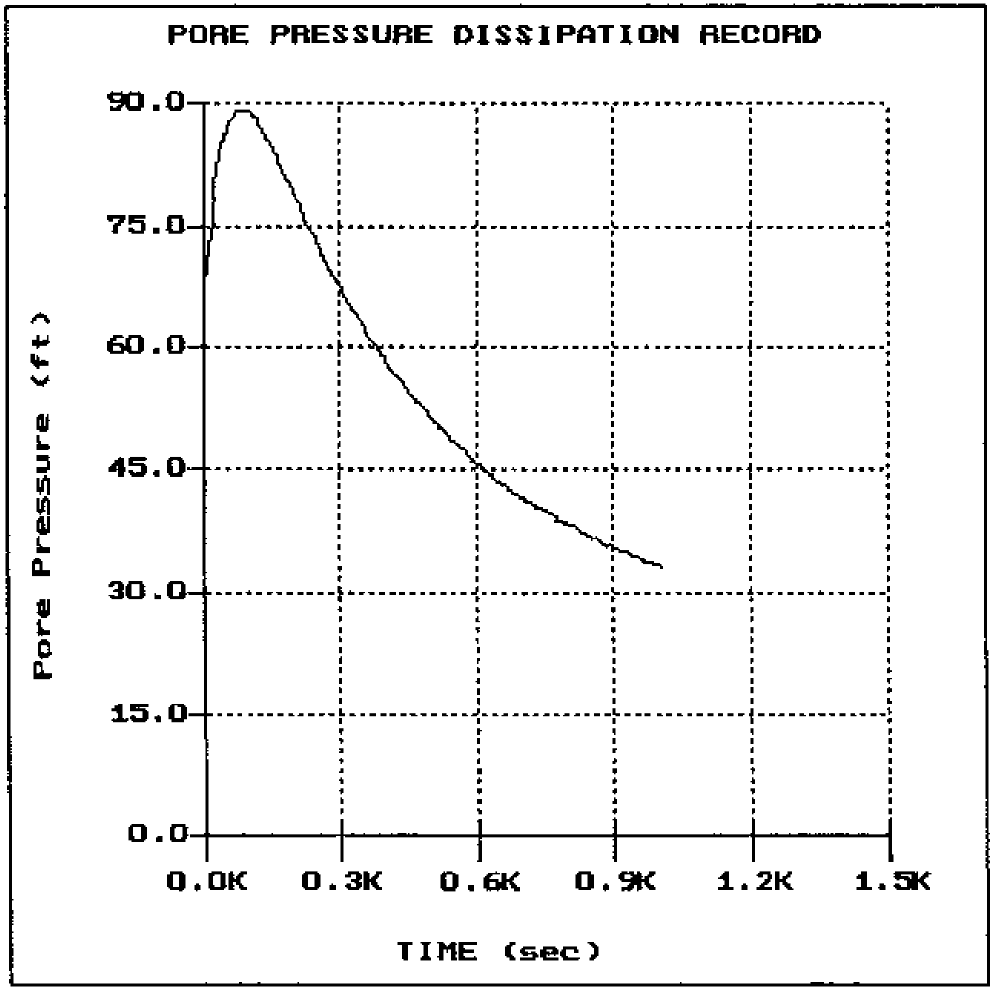
PORE PRESSURE DISSIPATION RECORD

MACTEC

Hole:CPT-13
Location:TVA Plant

Cone:20 TON AD163
Date:09:08:04 10:31

File: 783CP013.PPD
Depth (m): 5.80
(ft): 19.03
Duration : 1000.0s
U-min: 33.08 1000.0s
U-max: 89.21 85.0s



APPENDIX D

LABORATORY TEST PROCEDURES

LABORATORY TEST RESULTS

LABORATORY TEST PROCEDURES

Moisture Content

The moisture content in a given mass of soil is the ratio, expressed as a percentage, of the weight of the water to the weight of the solid particles. This test was conducted in accordance with ASTM D-2216.

Atterberg Limits (Plasticity Index)

Originally, the Atterberg Limits consisted of seven "limits of consistency" of fine-grained soils. In current engineering usage, the term usually refers only to the liquid limit (LL) and plastic limit (PL). The LL (between the liquid and plastic states) is the water content at which a trapezoidal groove of specified shape, cut in moist soil held in a special cup, is closed after 25 taps on a hard rubber plate. The PL (between plastic and semi-solid states) is the water content at which the soil crumbles when rolled into threads of 1/8-inch in diameter.

The LL has been found to be proportional to the compressibility of the normally consolidated soil. The Plasticity Index (PI) is the calculated difference in water contents between the LL and PL. Together the LL and PI are used to classify silts and clays according to the Unified Soils Classification System (ASTM D 2487). The PI is used to predict the potential for volume changes in confined soils beneath foundations or grade slabs. The LL, PL, and PI are determined in accordance with ASTM D 4318.

Triaxial Shear Tests

Triaxial shear tests are used to determine the strength characteristics (cohesion and friction angle) of a given soil sample. Triaxial tests are also used to determine the elastic properties of the soil specimen.

Triaxial shear tests are performed on several sections of a relatively undisturbed sample extruded from the sampling tube or on remolded samples. The samples are trimmed into cylinders 1.4 to 2.8 inches in diameter and encased in rubber membranes. Each is then placed in a compression chamber and confined by all-around air pressure. The test results are presented in the form of stress-strain curves and Mohr envelopes, or p-q plots on the accompanying Triaxial Shear Test Sheets.

One of three types of triaxial tests is normally performed, the most suitable type being determined by the loading conditions imposed on the soil in the field and the soil characteristics.

1. Consolidated-Undrained (Designated as a CU or R Test)
2. Consolidated-Drained (designated as a CD or S Test)
3. Unconsolidated-Undrained (designated as a UU or Q Test)

Grain Size Distribution

Grain size tests are performed to aid in determining the soil classification and the grain size distribution. The soil samples are prepared for testing according to ASTM D 421 (dry preparation) or ASTM D 2217 (wet preparation). If only the grain size distribution of soils coarser than a number 200 sieve (0.074-mm opening) is desired, the grain size distribution is determined by washing the sample over a number 200 sieve and, after drying, passing the samples through a standard set of nested sieves. If the grain size distribution of the soils finer than the number 200 sieve is also desired, the grain size distribution of the soils coarser than the number 10 sieve is determined by passing the sample through a set of nested sieves. Materials passing the number 10 sieve are dispersed with a dispersing agent and suspended in water, and the grain size distribution calculated from the measured settlement rate of the particles. These tests are conducted in accordance with ASTM D 422. The percentage of clay, silt, sand, and gravel which are given on the individual particle size analysis sheets presented later in this appendix, were obtained on particle size boundaries in accordance with AASHTO M145-94 (1995).

Specific Gravity

The specific gravity of soil solids is the ratio of the mass of a unit volume of a soil solids to the mass of the same volume of gas-free distilled water at 20C. The test method for determining the specific gravity of soil solids that passes the 4.75-mm (No. 4) sieve using a water pycnometer is described in ASTM D 854, Method B, "Test Methods for Specific Gravity of Soil Solids by Water Pycnometer".

Compaction Tests (Moisture-Density Relationship)

Compaction tests are performed on representative soil samples to determine the maximum dry density and optimum moisture content. The results of the tests are used in conjunction with other tests to determine engineering properties relating to settlement, bearing capacity, shear strength, and permeability. The results may also be used as a standard to determine the percent compaction of any soil embankment.

The two most commonly used compaction tests are the standard Proctor test and the modified Proctor test. They are performed in accordance with ASTM D 698 and D 1557, respectively. Generally, the standard Proctor compaction test is run on samples from building areas and areas where moderate loads are anticipated. The modified Proctor compaction test is generally used for analyses of highways and other areas where large building loads are expected. Both tests have three procedures, depending upon soil particle size:

Test	Procedure	Hammer Weight (Pounds)	Hammer Fall (Inches)	Mold Diameter (Inches)	Screen Size (Material Finer Than)	Number of Layers	Number of Blows per Layer
Standard (D 698)	A	5.5	12	4	No. 4 sieve	3	25
	B	5.5	12	4	No. 3/8" sieve	3	25
	C	5.5	12	6	3/4" sieve	3	56
Modified (D 1557)	A	10	18	4	No. 4 sieve	5	25
	B	10	18	4	No. 3/8" sieve	5	25
	C	10	18	6	3/4" sieve	5	56

Test results are presented as a curve depicting dry unit weight versus moisture content. The compaction method used and any deviations from the recommended procedures are noted in the report.

Constant Head Permeability Test

The test was performed on undisturbed and remolded samples. The physical dimensions and weight were obtained and the sample was encased in a rubber membrane and placed in a triaxial chamber. The sample was then back-pressure saturated until a B value of 0.95 or greater was reached. After saturation was obtained, the sample was consolidated under 10-psi confining stress. Upon completion of consolidation, a constant head permeability test was performed.

TABLE D-1

Natural Moisture Content and Atterberg Limits Laboratory Test Results

TVA Gallatin Ash Disposal Area and Potential On-Site and Off-Site Borrow Areas

MACTEC Project 3043041043/01

						Atterberg Limits		
Boring Number	Sample Number	Sample Type	Sample Description / Origin	Sample Depth (Feet)	Moisture Content (%)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
B-1	1	SPT	Ash	1 - 2.5	11.2	NT	NT	NT
B-1	2	SPT	Ash	4 - 5.5	17.1	NT	NT	NT
B-1	3	SPT	Ash	7 - 8.5	7.1	NT	NT	NT
B-1	4	SPT	Ash	10 - 11.5	10.2	NT	NT	NT
B-1	5	SPT	Ash	13 - 14.5	13.2	NT	NT	NT
B-1	6	SPT	Ash	16 - 17.5	17.1	NT	NT	NT
B-1	7	SPT	Ash	20 - 21.5	16.7	NT	NT	NT
B-1	8	SPT	Ash	25 - 26.5	25	NT	NT	NT
B-1	9	SPT	Alluvium	30 - 31.5	26.7	NT	NT	NT
B-4	1	SPT	Ash	1 - 2.5	9	NT	NT	NT
B-4	2	SPT	Ash	4 - 5.5	11.8	NT	NT	NT
B-4	3	SPT	Ash	7 - 8.5	15.4	NT	NT	NT
B-4	4	SPT	Ash	10 - 11.5	16.5	NT	NT	NT
B-4	5	SPT	Fill	13 - 14.5	19.1	NT	NT	NT
B-4	6	SPT	Fill	16 - 17.5	15.9	NT	NT	NT
B-4	7	SPT	Ash	20 - 21.5	21.6	NT	NT	NT
B-4	8	SPT	Ash	25 - 26.5	22.1	NT	NT	NT
B-10	1	SPT	Fill	1 - 2.5	18.4	NT	NT	NT
B-10	2	SPT	Fill	4 - 5.5	20	NT	NT	NT
B-10	3	SPT	Alluvium	7 - 8.5	17.9	NT	NT	NT
B-10	4	SPT	Alluvium	10 - 11.5	27.3	NT	NT	NT
B-10	5	SPT	Residuum	13 - 14.5	30.9	NT	NT	NT
B-10	6	SPT	Residuum	16 - 17.5	29.9	NT	NT	NT
B-10	7	SPT	Residuum	20 - 21.5	25.9	NT	NT	NT
B-10	8	SPT	Residuum	25 - 26.5	32.9	NT	NT	NT
B-13	1	SPT	Fill	1 - 2.5	26.9	NT	NT	NT
B-13	2	SPT	Ash	6 - 7.5	35.7	NT	NT	NT
B-13	3	SPT	Ash	9 - 10.5	35.2	NT	NT	NT
B-13	4	SPT	Ash	12 - 13.5	29.5	NT	NT	NT
B-13	5	SPT	Ash	17 - 18.5	33.4	NT	NT	NT
B-13	6	SPT	Residuum / Alluvium	20 - 21.5	21.8	NT	NT	NT
B-13	7	SPT	Residuum	27 - 28.5	38.2	NT	NT	NT

NT - Not Tested

Prepared/Date: ISH 10/13/04
Checked/Date: HAB 10/13/04

TABLE D-1A

Natural Moisture Content and Atterberg Limits Laboratory Test Results

TVA Gallatin Ash Disposal Area and Potential On-Site and Off-Site Borrow Areas

MACTEC Project 3043041043/01

					Atterberg Limits		
Bulk Sample ID	Sample Number	Sample Type	Sample Depth (Feet)	Moisture Content (%)	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)
Old Bottom Ash	1	Bulk	NA	11.1	NT	NT	NT
New Bottom Ash	1	Bulk	NA	10	NT	NT	NT
New Bottom Ash	2	Bulk	NA	9.6	NT	NT	NT
New Bottom Ash	3	Bulk	NA	14	NT	NT	NT

NT - Not Tested
Bulk - Bulk Sample
NA - Not Applicable

Prepared/Date: ISH/REF 10/13/04
Checked/Date: HAB 10/13/04

TABLE D-2

Unit Weight and Natural Moisture Content Laboratory Test Results

TVA Gallatin Ash Disposal Area and Potential On-Site and Off-Site Borrow Areas

MACTEC Project 3043041043/01

Boring Number	Depth (Feet)	Sample Type	Natural Moisture Content (%)	Dry Unit Weight (pcf)	Wet Unit Weight (pcf)
B-3	4.0 - 6.0	UD	36.6	67.1	91.7
B-3	7.5 - 9.5	UD	47.6	71.1	104.9
B-5	18.0 - 20.0	UD	17.1	115.8	135.6
B-5	24.0 - 26.0	UD	17.7	105.0	123.6
B-8	22.0 - 23.5	UD	26.1	100.2	126.4
B-11	7.0 - 9.0	UD	20.9	102.2	123.6
B-11	28.0 - 30.0	UD	23.5	100.4	124.0
B-13	4.0 - 6.0	UD	39.7	77.5	108.2
B-13	15.0 - 17.0	UD	33.8	78.8	105.4
B-13	25.0 - 27.0	UD	32.5	90.1	119.4

Prepared/Date: ISH 10/13/04

Checked/Date: HAB 10/13/04

TABLE D-3

Standard Proctor Compaction Laboratory Test Results

TVA Gallatin Ash Disposal Area and Potential On-Site and Off-Site Borrow Areas

MACTEC Project 3043041043/01

Sample Location	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Classification*
Old Bottom Ash	104.2	15.8	---	---	---	---
New Bottom Ash 2	79.4	29.2	---	---	---	---
New Bottom Ash 3	75.6	32.6	---	---	---	---
A-2	104.8	19.1	47	17.0	30	CL
A-9	105.6	19.2	38	18.0	20	CL
Off-Site 1	94.4	23.9	41	24.0	17	CL
Off-Site 2	103.3	19.6	33	21.0	12	CL
CL - Clay with low plasticity						

Prepared/Date: REF/ISH 10/13/04

Checked/Date: HAB 10/13/04

TABLE D-4
Triaxial Compression Laboratory Test Results
TVA Gallatin Ash Disposal Area and Potential On-Site and Off-Site Borrow Areas
MACTEC Project 3043041043/01

				CU Triaxial Test						UU Triaxial Test			
						Total		Effective					
Boring Number / Sample ID	Depth (Feet)	Sample Type	Material Type	Average Dry Density (pcf)	Average Moisture Content (%)	Cohesion, C (psf)	Friction Angle, Φ (degrees)	Cohesion, C' (psf)	Friction Angle, Φ' (degrees)	Average Dry Density (pcf)	Average Moisture Content (%)	Cohesion, C (psf)	Friction Angle, Φ (degrees)
B-3	7.5 - 9.5	UD	Ash	71.1	47.6	1,770	18.3	1,280	34.4	—	—	—	—
B-8	22 - 23.5	UD	Silty Clay	100.2	26.1	1,520	14.2	1,000	22.9	—	—	—	—
B-13	15 - 17	UD	Ash	78.8	33.8	2,640	38.5	0	35.5	—	—	—	—
B-13	25 - 27	UD	Silty Clay	90.1	32.5	370	11.3	210	14.2	—	—	—	—
Old Bottom Ash	NA	Bulk	Bottom Ash	99.0	15.8	1,390	31.7	0	40.2	—	—	—	—
New Bottom Ash	NA	Bulk	Bottom Ash	75.5	29.2	3,400	22.5	600	37.3	—	—	—	—
A-2	0 - 20	Bulk	Silty Clay	98.6	19.0	750	13.3	670	22.9	102.1	21.0	700	2.4
A-9	0 - 15	Bulk	Silty Clay	100.4	19.2	750	8.5	410	21.2	102.0	19.0	500	4.0
Off-Site Sample 2	NA	Bulk	Silty Clay	99.5	19.4	940	13.1	0	33.0	—	—	—	—

UD - Undisturbed Sample
Bulk - Bulk Sample
NA - Not Applicable

Prepared/Date: ISH 10/13/04
Checked/Date: HAB 10/13/04

TABLE D-5

Permeability Laboratory Test Results

TVA Gallatin Ash Disposal Area and Potential On-Site and Off-Site Borrow Areas

MACTEC Project 3043041043/01

Sample Location	Sample Depth (Feet)	Sample Type	Remolded / In-Situ Dry Density (pcf)	Remolded Percent Compaction (%)	Remolded / In-Situ Moisture Content (%)	Percentage from Optimum Moisture Content (%)	Permeability (cm/sec)
Old Bottom Ash	NA	Bulk	95.9	92.0	15.7	-0.1	8.55×10^{-4}
New Bottom Ash Sample 2	NA	Bulk	73.1	92.0	29.2	0	2.15×10^{-3}
B-13	15 - 17	UD	78.1	NA	34.5	NA	2.78×10^{-5}

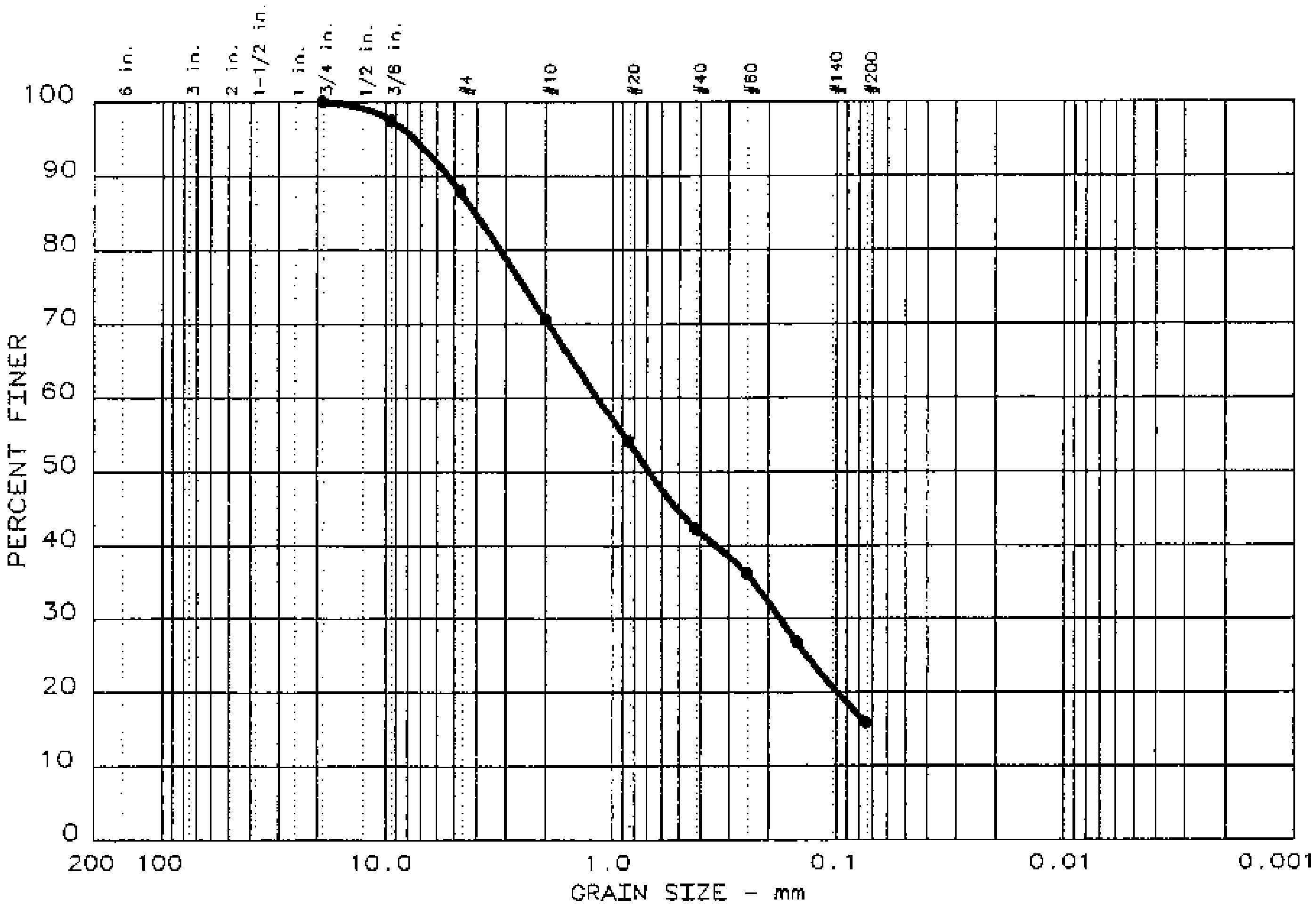
NA - Not Applicable
Bulk - Bulk Sample
UD - Undisturbed Sample

Prepared/Date: ISH 10/13/04
Checked/Date: HAB 10/13/04

GRAIN SIZE ANALYSIS TEST RESULTS

BOTTOM ASH SAMPLES

PARTICLE SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	6	0.0	12.0	72.1	15.9		NT	NT	NT

SIEVE inches size	PERCENT FINER ●		
0.75	100.0		
0.375	97.5		
	GRAIN SIZE		
D_{60}	1.15		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER ●		
4	88.0		
10	70.6		
20	54.2		
40	42.3		
60	36.1		
100	26.8		
200	15.9		

Sample information:

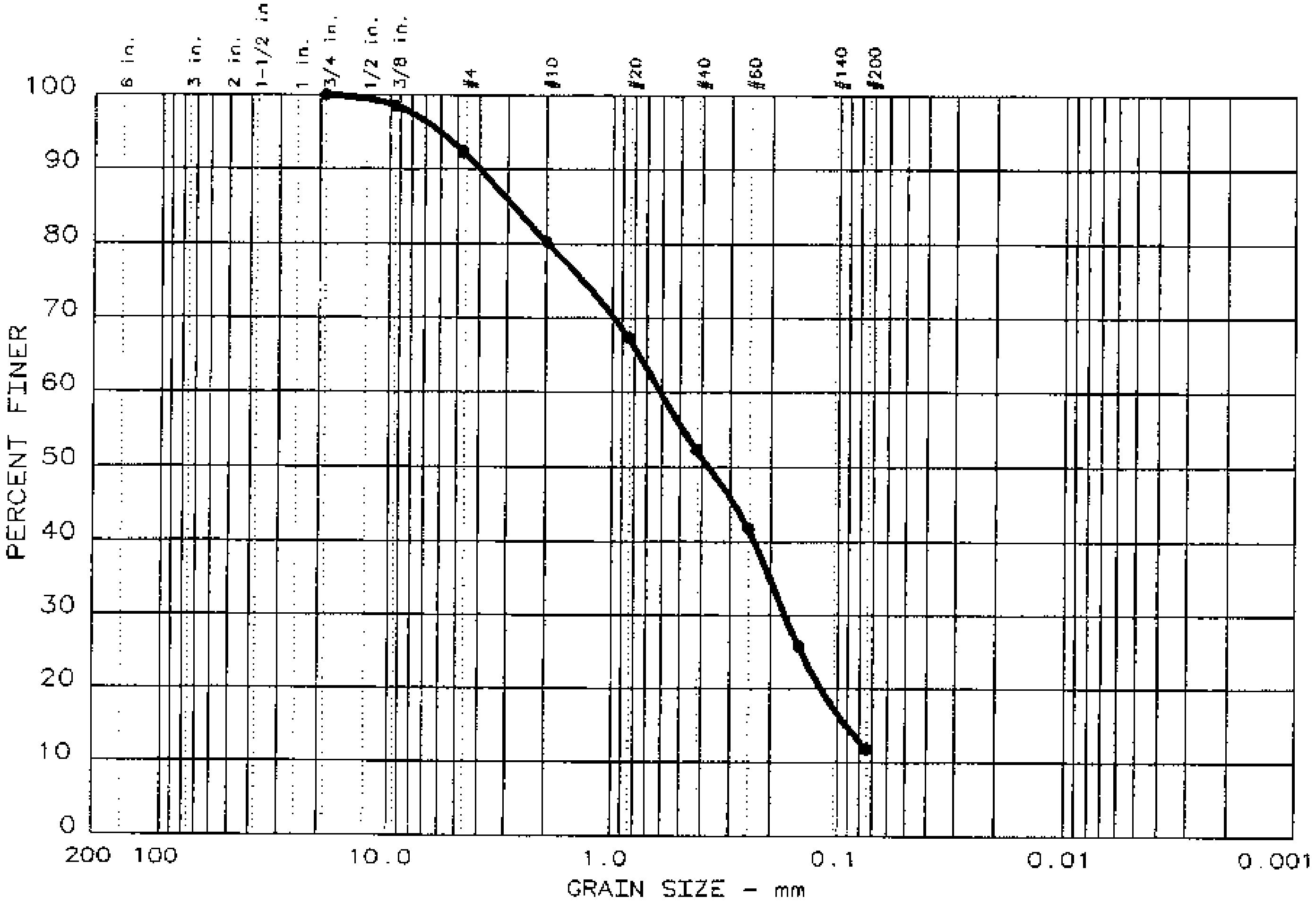
●Old bottom ash
Gray ash sand
Sample Number 3017

Remarks:
Methods: Particle Size:
ASTM D 422-63(2002);
%< No.200:ASTM D1140-00;
Spec. Gravity -10: 2.64

**LAW ENGINEERING
AND ENVIRONMENTAL
SERVICES, INC.**

Project No.: 3043041037.0001
Project: TVA Gallatin Fossil Plant Ash Disposal
Date: August 20, 2004 HB Fig. No.: 017

PARTICLE SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	7	0.0	7.7	80.5	11.8		NT	NT	NT

SIEVE inches size	PERCENT FINER		
	●		
0.75	100.0		
0.375	98.5		
	GRAIN SIZE		
D_{60}	0.603		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER		
	●		
4	92.3		
10	80.2		
20	67.4		
40	52.3		
60	41.8		
100	25.8		
200	11.8		

Sample information:
● New bottom ash, Bulk 1
Gray ash sand
Sample Number 3018

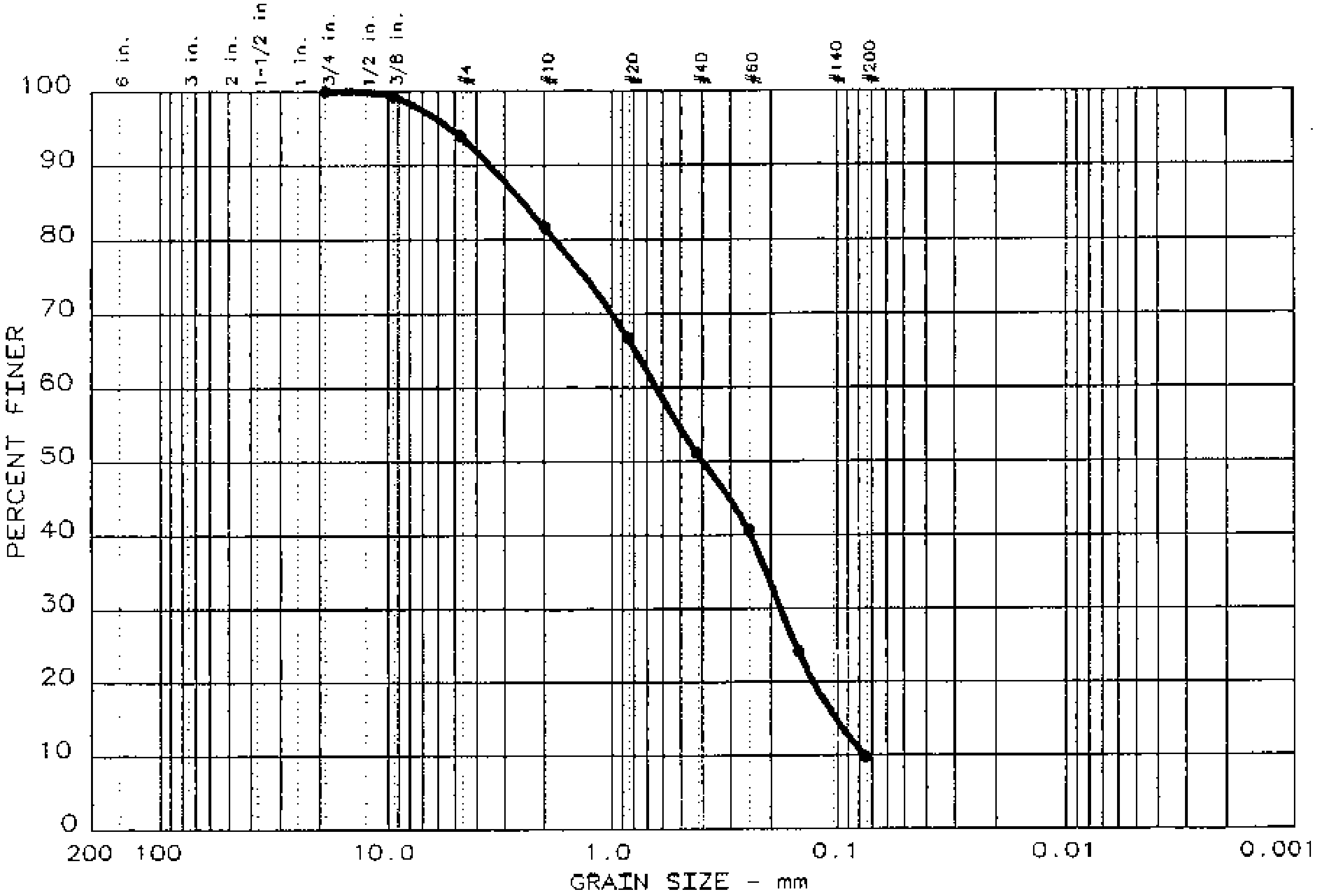
Remarks:
Methods: Particle Size:
ASTM D 422-63(2002);
%< No.200:ASTM D1140-00;
Sieve Analysis: T 27-99

LAW ENGINEERING
AND ENVIRONMENTAL
SERVICES, INC.

Project No.: 3043041043.0001
Project: TVA Gallatin Fossil Plant Ash Disposal

Date: August 20, 2004 HB Fig. No.: 018

PARTICLE SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	8	0.0	6.1	84.1	9.8		NT	NT	NT

SIEVE inches size	PERCENT FINER		
	●		
0.75	100.0		
0.375	99.3		
	GRAIN SIZE		
D_{60}	0.631		
D_{30}			
D_{10}	0.0757		
	COEFFICIENTS		
C_c	0.67		
C_u	8.3		

SIEVE number size	PERCENT FINER		
	●		
4	93.9		
10	81.7		
20	66.8		
40	51.2		
60	40.6		
100	24.2		
200	9.8		

Sample information:

●New bottom ash, Bulk 2
Gray ash sand
Sample Number 3019

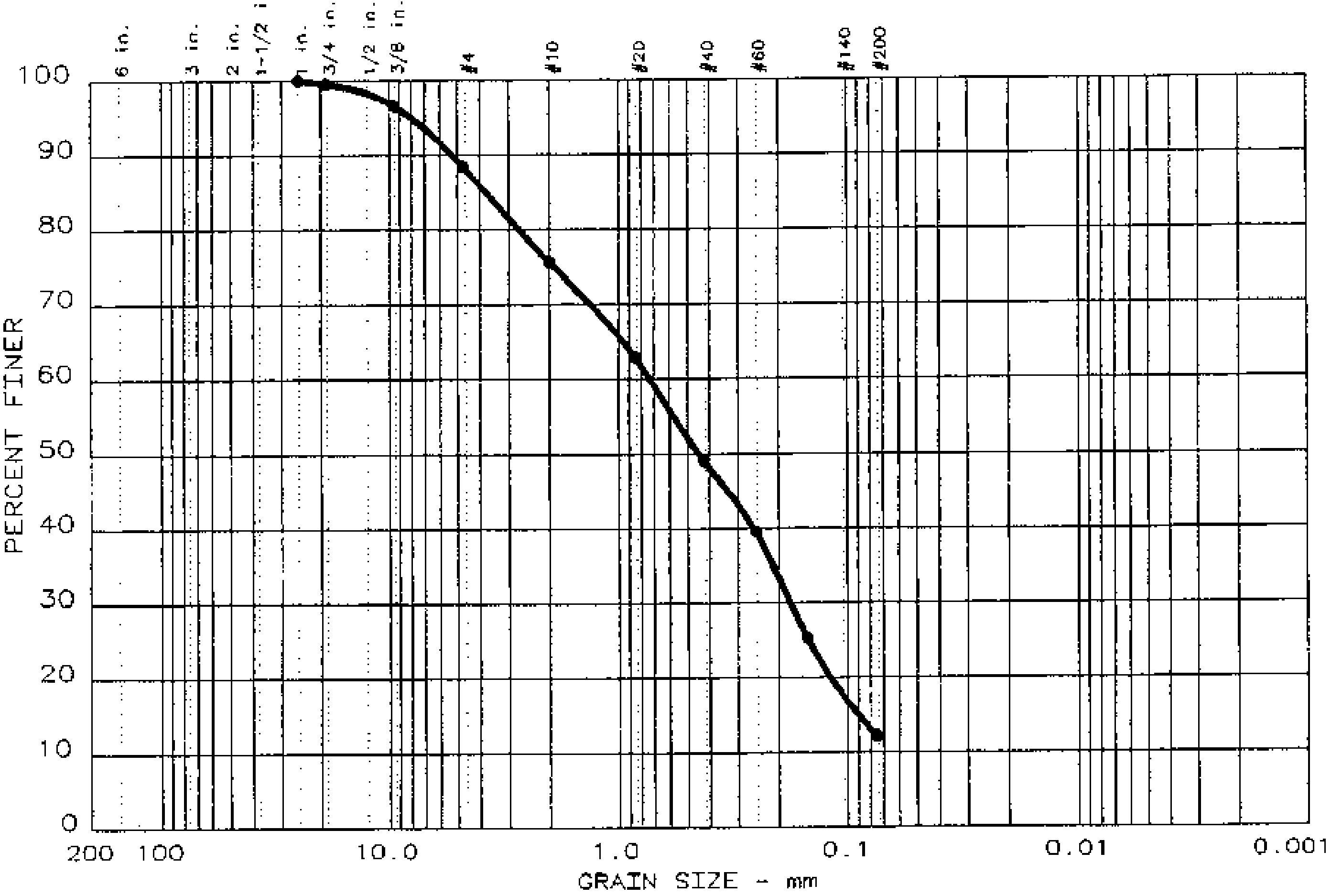
Remarks:
Methods: Particle Size:
ASTM D 422-63(2002):
%< No.200:ASTM D1140-00:
Spec. Gravity -10: 2.49

LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

Project No.: 3043041043.0001
Project: TVA Gallatin Fossil Plant Ash Disposal

Date: August 20, 2004 HB Fig. No.: 019

PARTICLE SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	9	0.0	11.6	76.3	12.1		NT	NT	NT

SIEVE inches size	PERCENT FINER		
	●		
1	100.0		
0.75	99.5		
0.375	96.6		
	GRAIN SIZE		
D_{60}	0.724		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_c			
C_u			

SIEVE number size	PERCENT FINER		
	●		
4	88.4		
10	75.6		
20	63.0		
40	49.1		
60	39.5		
100	25.3		
200	12.1		

Sample information:

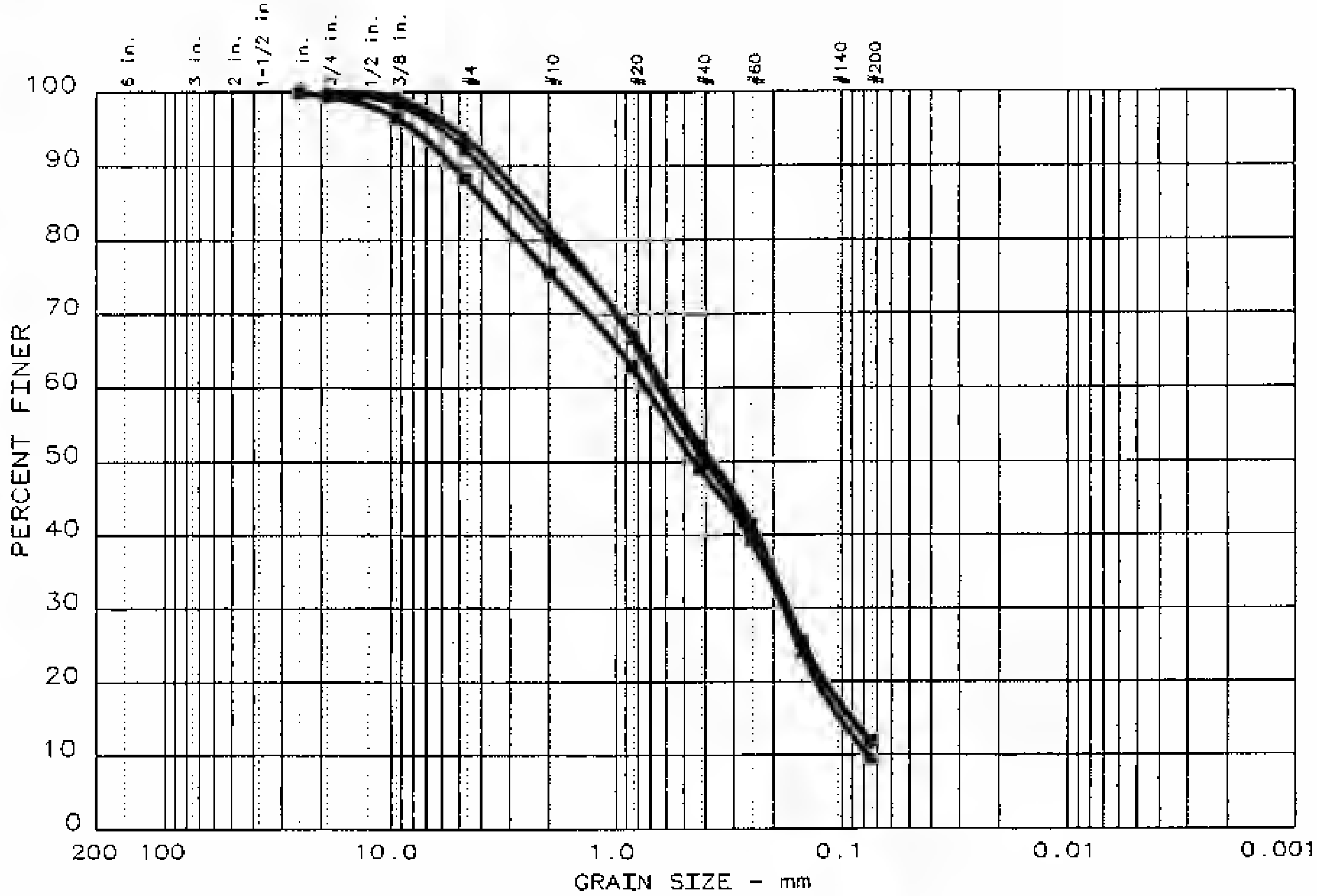
● New bottom ash, Bulk 3
Gray ash sand
Sample Number 3020

Remarks:
Methods: Particle Size:
ASTM D 422-63(2002);
%< No.200:ASTM D1140-00;
Sieve Analysis: T 27-99

LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

Project No.: 3043041043.0001
Project: TVA Gallatin Fossil Plant Ash Disposal
Date: August 20, 2004 AB Fig. No.: 020

PARTICLE SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY	USCS	LL	PI
●	7	0.0	7.7	80.5	11.8		NT	NT	NT
▲	8	0.0	6.1	84.1	9.8		NT	NT	NT
■	9	0.0	11.6	76.3	12.1		NT	NT	NT

SIEVE inches size	PERCENT FINER		
	●	▲	■
1			100.0
0.75	100.0	100.0	99.5
0.375	98.5	99.3	96.6
	GRAIN SIZE		
D_{60}	0.603	0.631	0.724
D_{30}			
D_{10}		0.0757	
	COEFFICIENTS		
C_c		0.67	
C_u		8.3	

SIEVE number size	PERCENT FINER		
	●	▲	■
4	92.3	93.9	88.4
10	80.2	81.7	75.6
20	67.4	66.8	63.0
40	52.3	51.2	49.1
60	41.8	40.6	39.5
100	25.8	24.2	25.3
200	11.8	9.8	12.1

Sample information:

●New bottom ash, Bulk 1
Gray ash sand
Sample Number 3018

▲New bottom ash, Bulk 2
Gray ash sand
Sample Number 3019

■New bottom ash, Bulk 3
Gray ash sand
Sample Number 3020

Remarks:
Methods: Particle Size:
ASTM D 422-63(2002);
%< No.200:ASTM D1140-00;
Sieve Analysis: T 27-99

**LAW ENGINEERING
AND ENVIRONMENTAL
SERVICES, INC.**

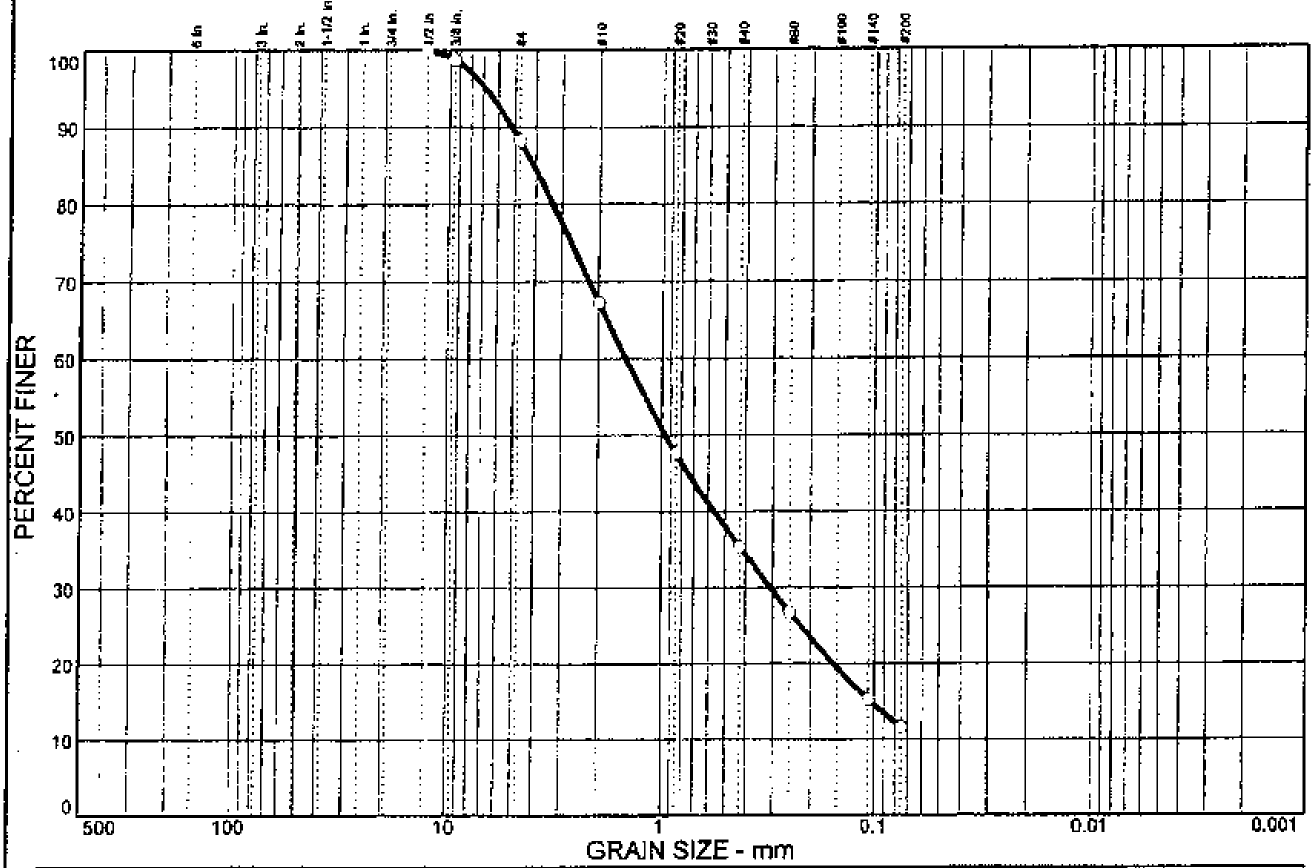
Project No.: 3043041043.0001
Project: TVA Gallatin Fossil Plant Ash Disposal

Date: August 20, 2004 HB Fig. No.: 018

GRAIN SIZE ANALYSIS TEST RESULTS

ASH POND SAMPLES

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	11.7	21.0	32.0	23.7	11.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5 in.	100.0		
0.375 in.	98.8		
#4	88.3		
#10	67.3		
#20	47.6		
#40	35.3		
#60	26.8		
#140	15.3		
#200	11.6		

* (no specification provided)

Soil Description

Gray Bottom Ash

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 4.09 D_{60}= 1.49 D_{50}= 0.956
D_{30}= 0.307 D_{15}= 0.103 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

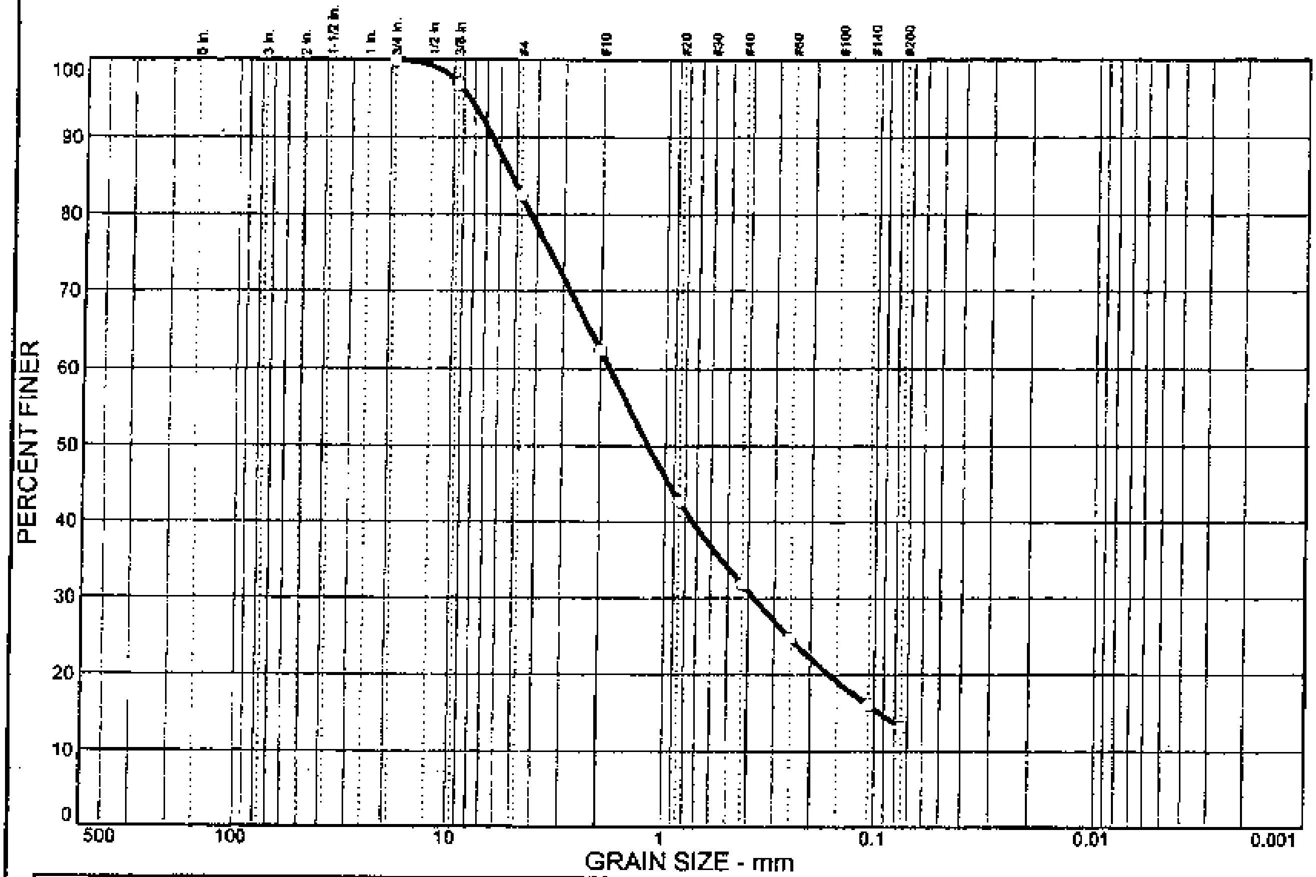
Remarks

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-1 SPT @ 7'-8.5' and 10'-11.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 H8 **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	17.5	20.1	30.6	18.6	13.2	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	96.9		
#4	82.5		
#10	62.4		
#20	42.7		
#40	31.8		
#60	24.8		
#140	16.1		
#200	13.2		

* (no specification provided)

Soil Description

Gray Bottom Ash

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 5.27 D_{60}= 1.81 D_{50}= 1.19
D_{30}= 0.373 D_{15}= 0.0932 D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

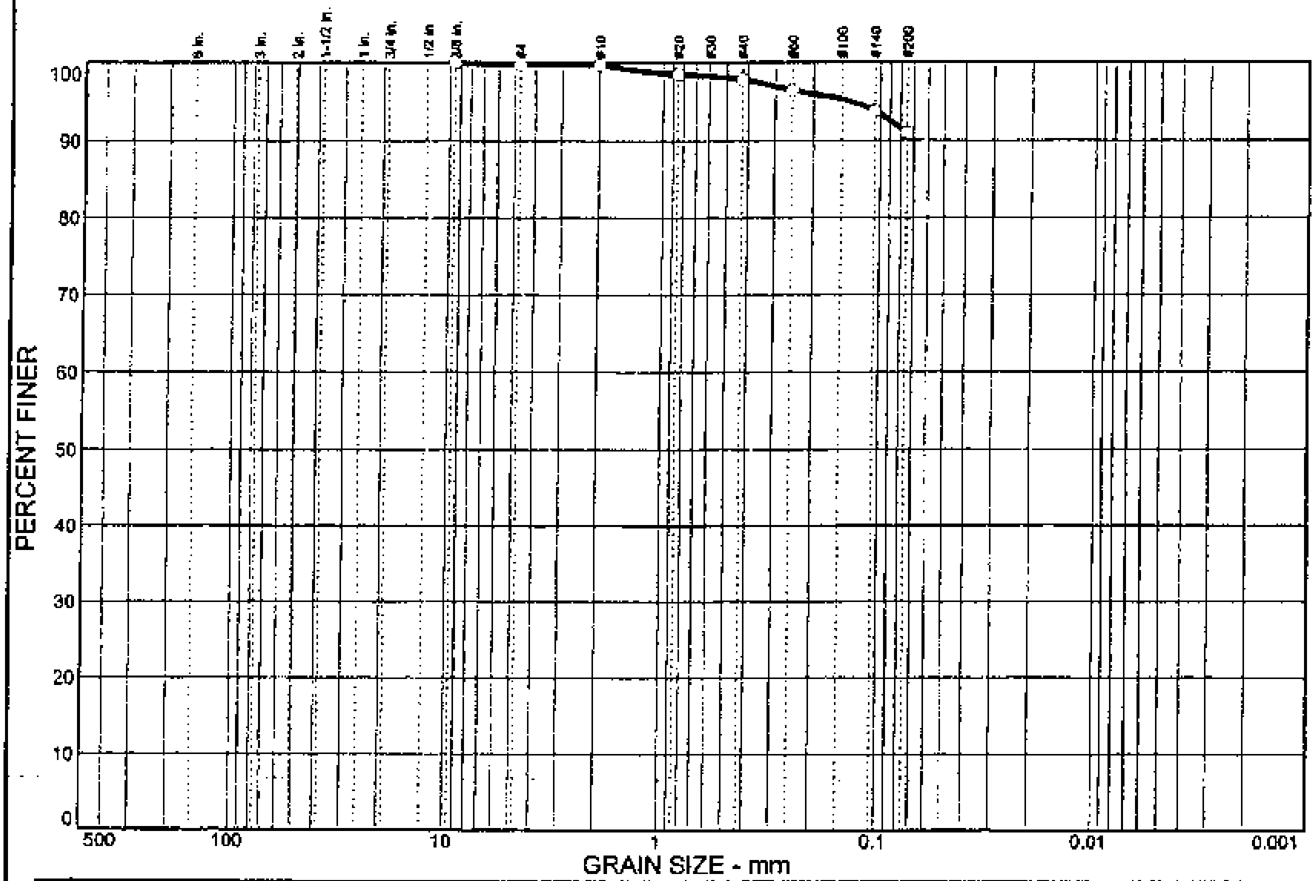
Remarks

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-1 SPT @ 20'-21.5' and 25'-26.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HL **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.3	0.0	1.8	6.9	91.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	99.7		
#10	99.7		
#20	98.5		
#40	97.9		
#60	96.5		
#140	93.8		
#200	91.0		

* (no specification provided)

Soil Description

Gray Ash Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

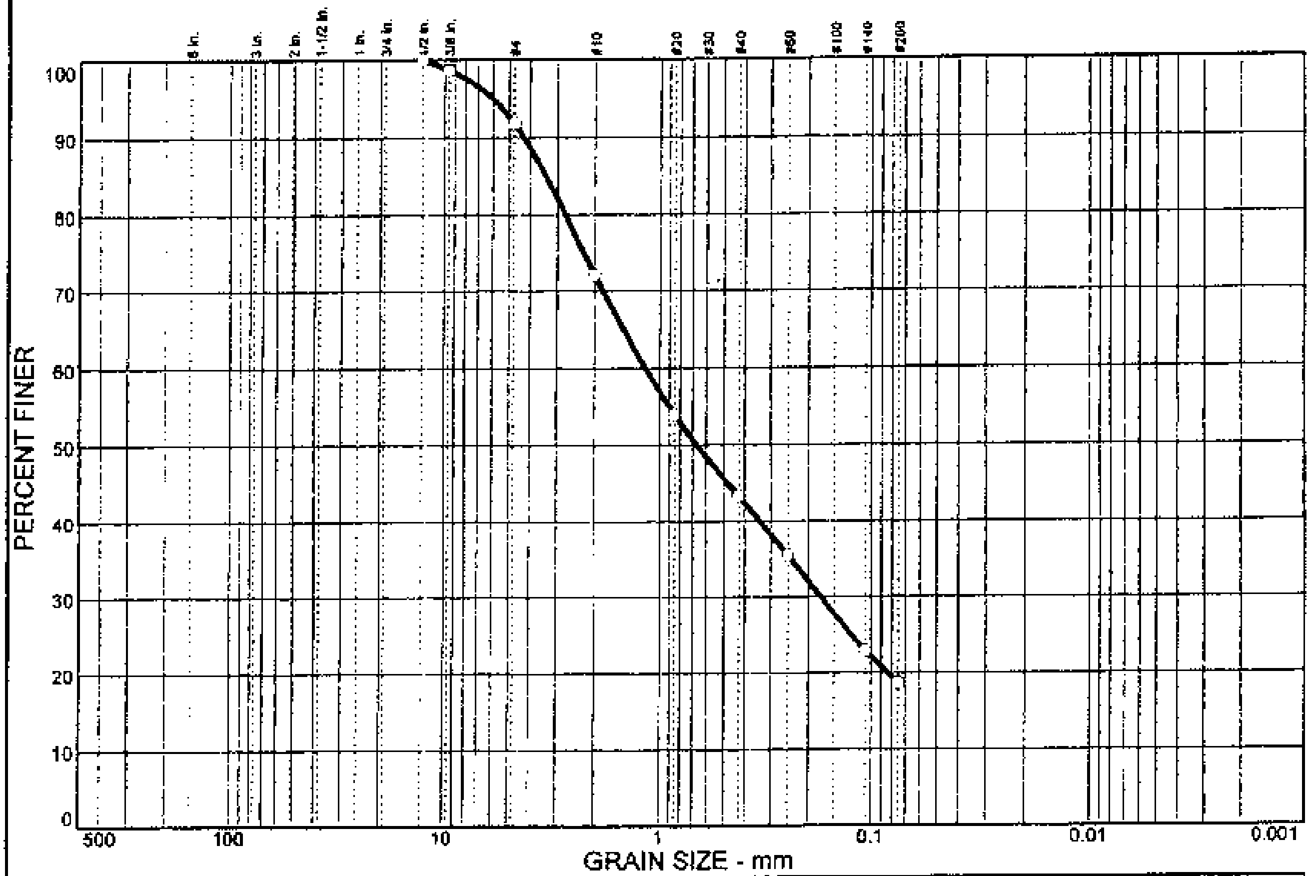
Specific Gravity: 2.48

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-3 UD @ 7.5'-9.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 NR **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	8.2	19.7	28.8	24.6	18.7	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5 in.	100.0		
0.375 in.	98.7		
#4	91.8		
#10	72.1		
#20	54.0		
#40	43.3		
#60	35.5		
#140	22.9		
#200	18.7		

* (no specification provided)

Soil Description

Dark Gray Bottom Ash

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 3.39 D_{60}= 1.17 D_{50}= 0.668
D_{30}= 0.174 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

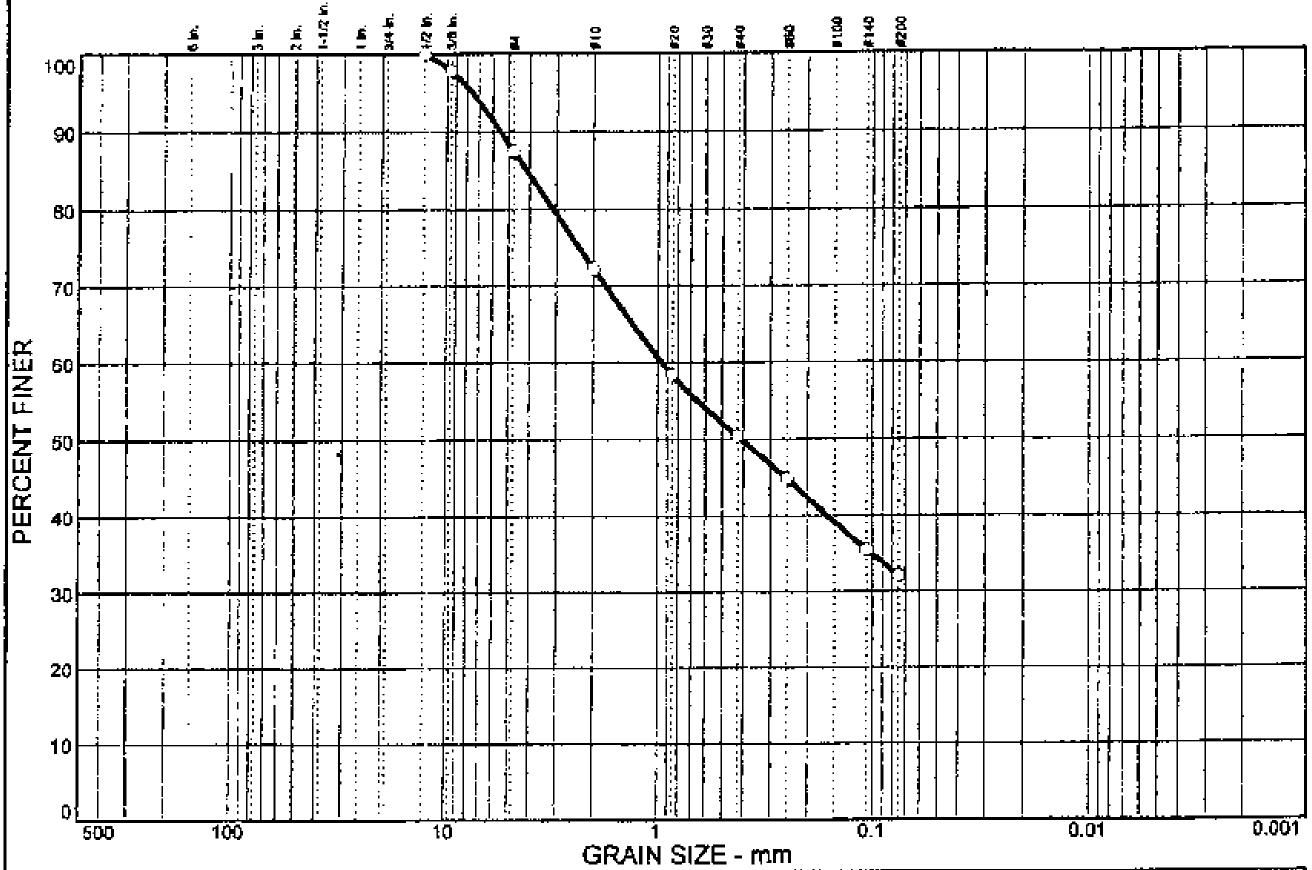
Remarks

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-4 SPT @ 4'-5.5' and 7'-8.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 H8 **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	12.5	15.2	21.9	18.3	32.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.5 in.	100.0		
0.375 in.	97.8		
#4	87.5		
#10	72.3		
#20	58.4		
#40	50.4		
#60	44.8		
#140	35.5		
#200	32.1		

* (no specification provided)

Soil Description

Gray Fine to Coarse Sandy Ash with Clay Seams

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 4.12 D_{60}= 0.952 D_{50}= 0.409
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

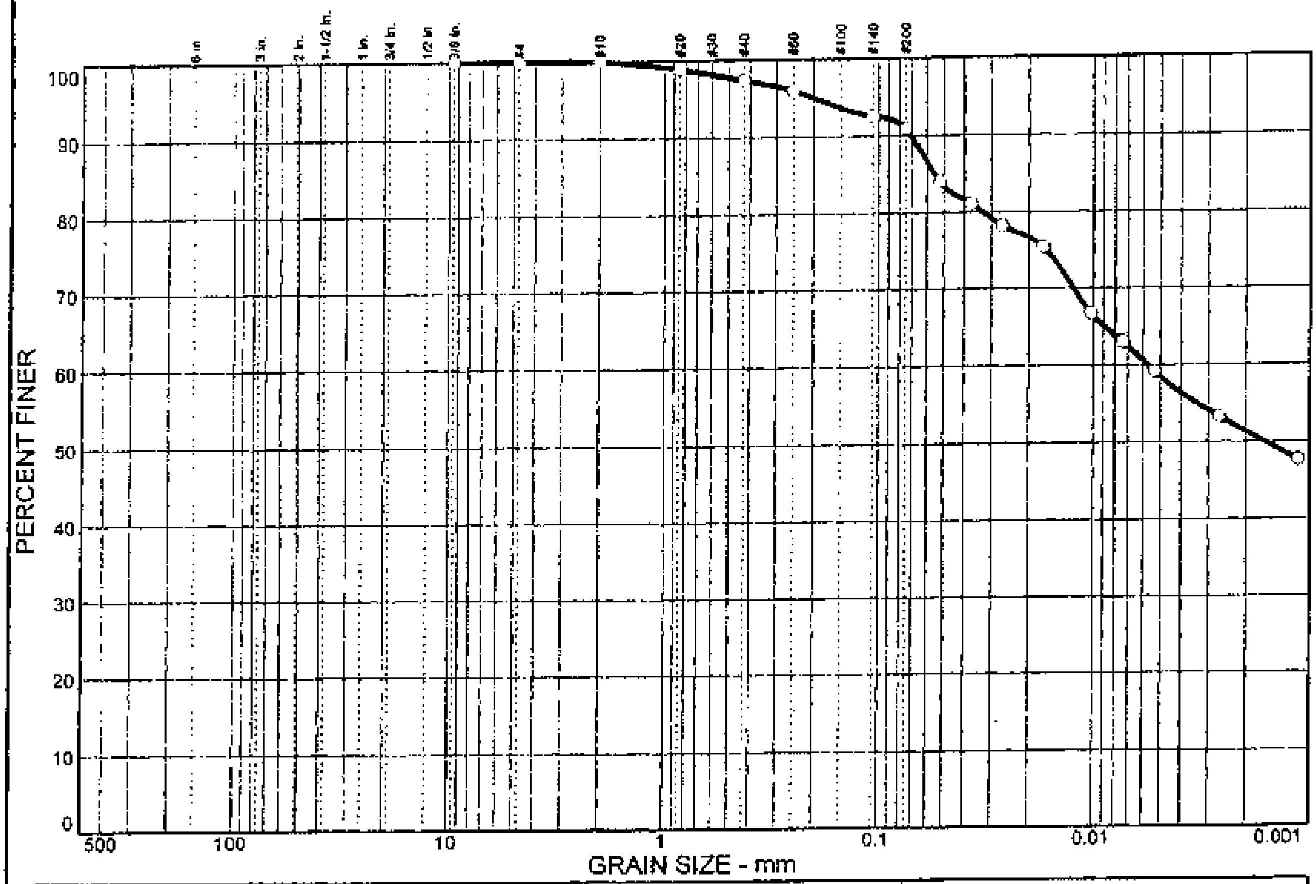
Remarks

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-4 SPT @ 13'-14.5' and 16'-17.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HB **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	2.6	6.5	32.3	58.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	100.0		
#10	100.0		
#20	98.9		
#40	97.4		
#60	96.0		
#140	92.6		
#200	90.9		

* (no specification provided)

Soil Description

Orange-Brown Silty Clay

Atterberg Limits

PL= 20 LL= 51 PI= 31

Coefficients

D_{85}= 0.0550 D_{60}= 0.0057 D_{50}= 0.0016
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

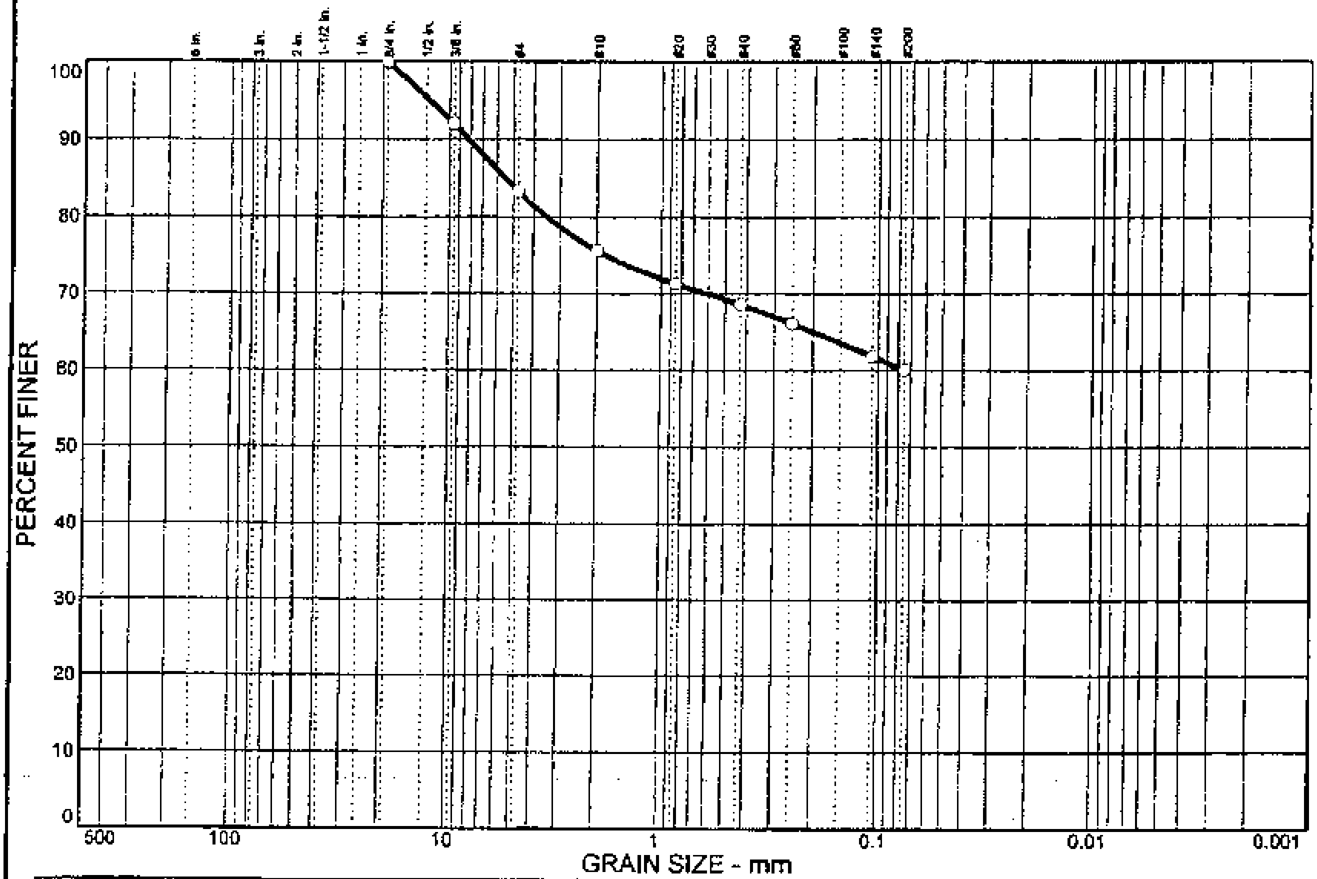
Remarks

Sample No.: **Source of Sample:** **Date:** 10-12-04
Location: B-8 UD @ 22'-23.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 H8 **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	16.7	7.7	7.0	8.6	60.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	92.0		
#4	83.3		
#10	75.6		
#20	71.3		
#40	68.6		
#60	66.1		
#140	61.8		
#200	60.0		

* (no specification provided)

Soil Description

Orange-Brown Silty Clay with Chert Fragments

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 5.48 D_{60}= 0.0750 D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

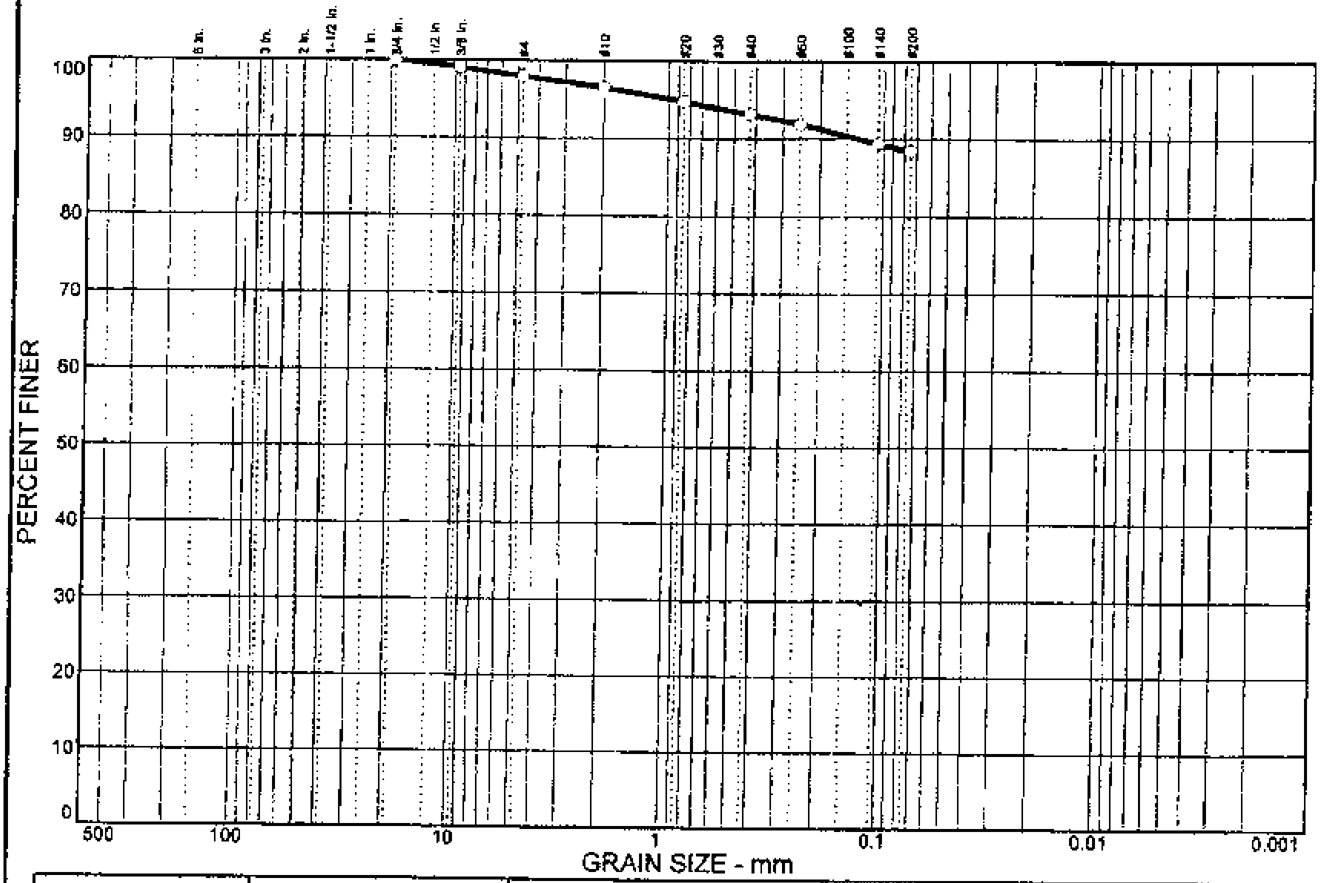
Remarks

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-10 SPT @ 7'-8.5' and 10'-11.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 H5 **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	2.0	1.4	3.4	4.8	88.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	99.1		
#4	98.0		
#10	96.6		
#20	94.8		
#40	93.2		
#60	91.9		
#140	89.4		
#200	88.4		

* (no specification provided)

Soil Description

Orange-Brown Silty Clay

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

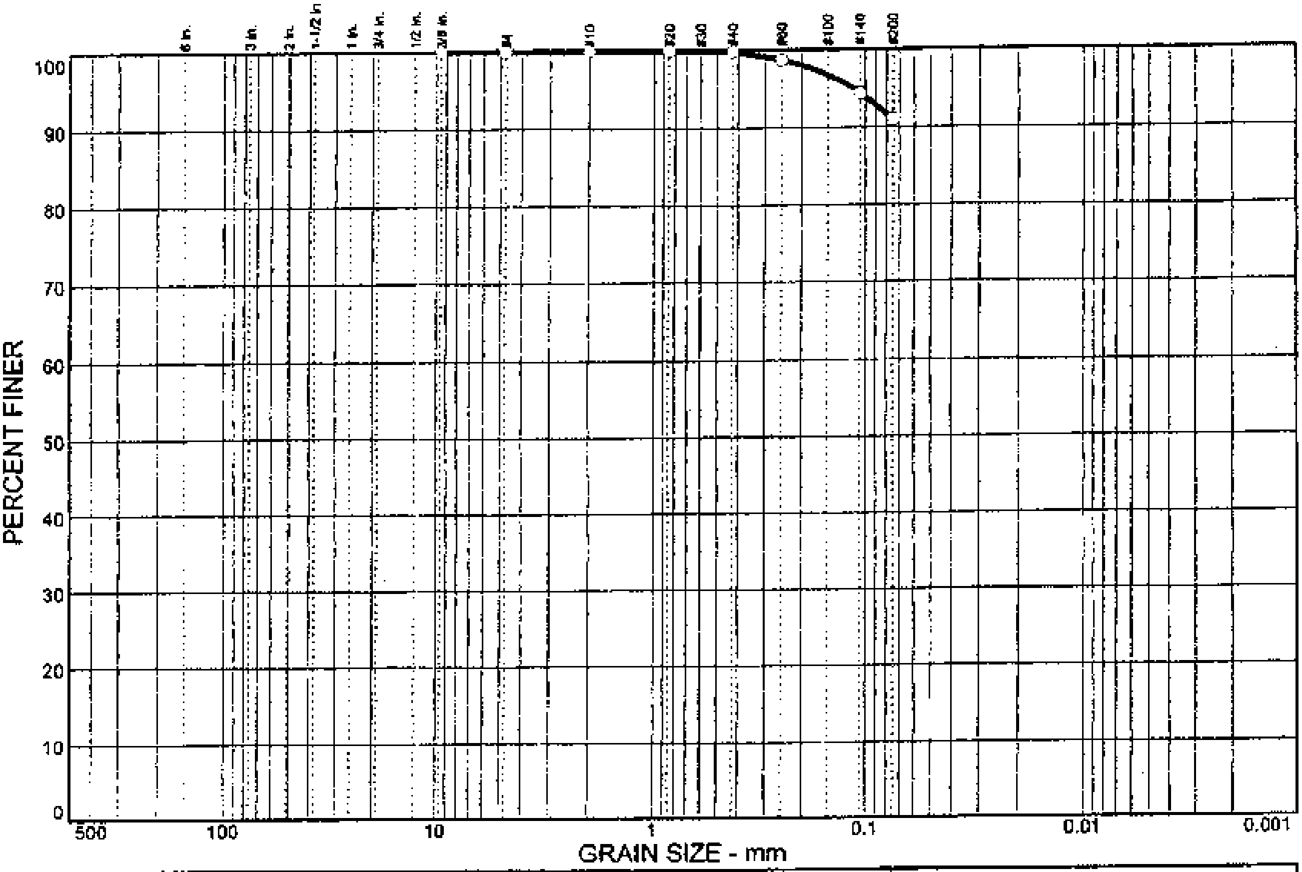
Remarks

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-10 SPT @ 16'-17.5' and 20'-21.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HB **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.2	8.8	91.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.8		
#60	98.7		
#140	94.4		
#200	91.0		

* (no specification provided)

Soil Description

Gray Fly Ash

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

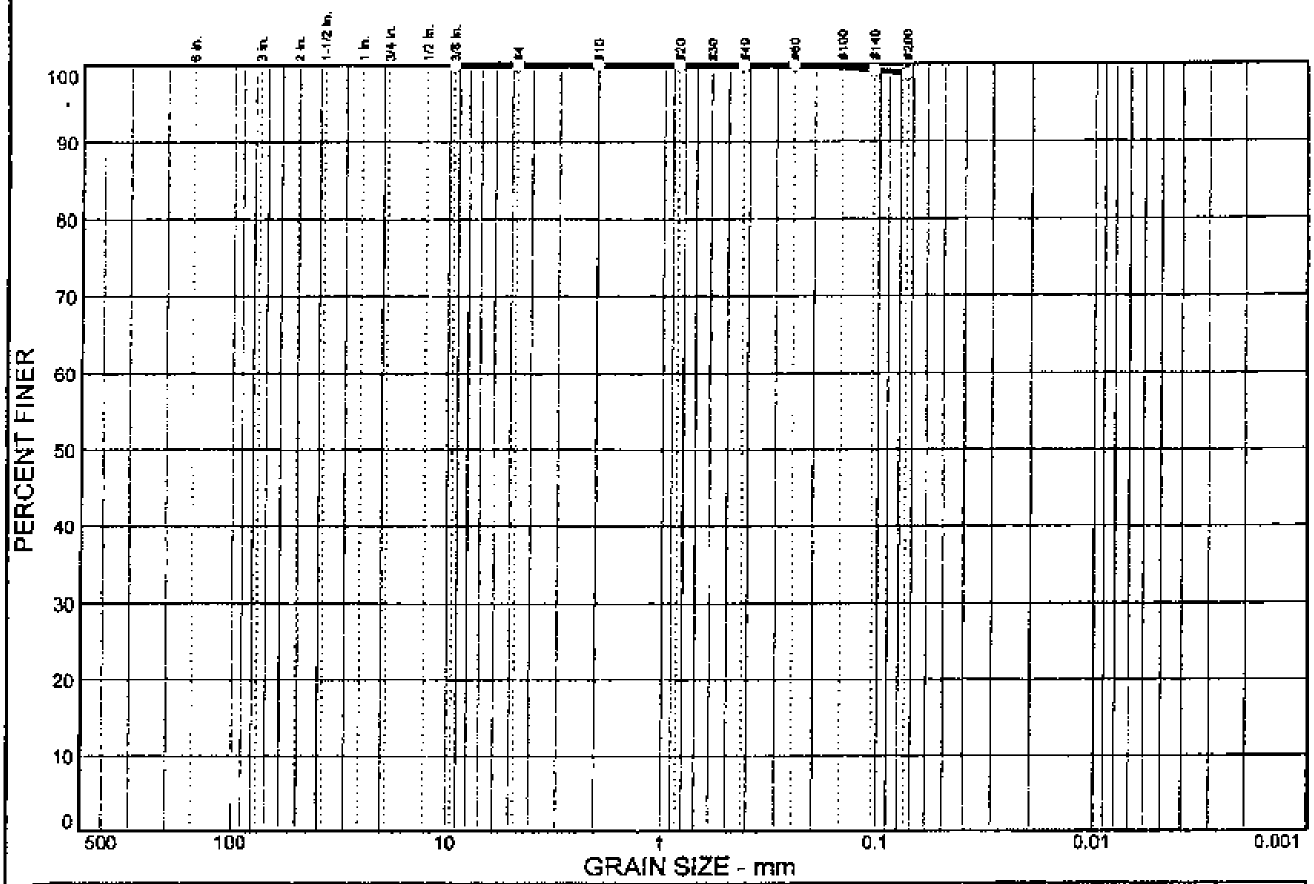
Remarks

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-13 SPT @ 6'-7.5' and 9'-10.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HB **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.1	1.1	98.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	99.9		
#60	99.9		
#140	99.3		
#200	98.8		

* (no specification provided)

Soil Description

Grey Ash Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

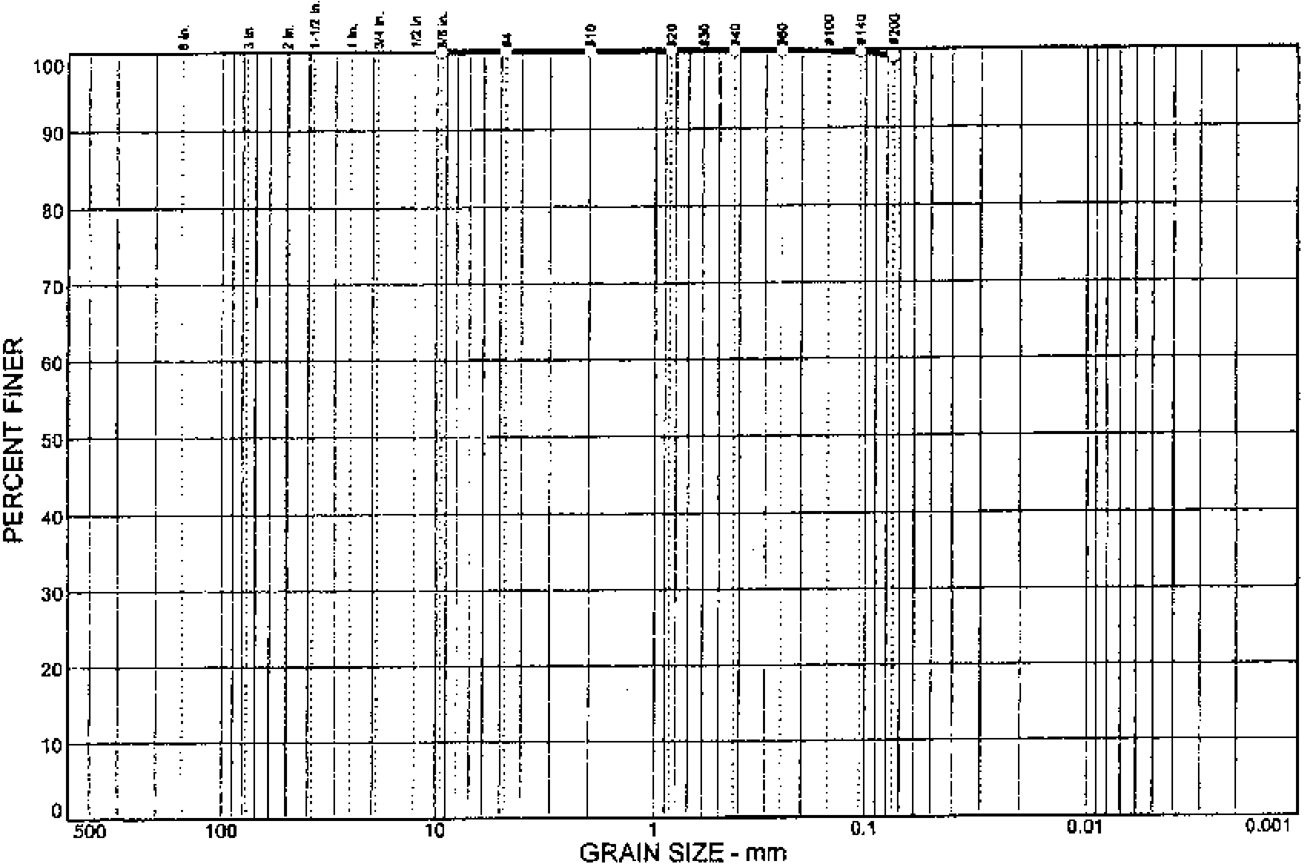
Remarks

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-13 SPT @ 12'-13.5' and 17'-18.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HB **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.0	0.9	99.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	100.0		
#10	100.0		
#20	100.0		
#40	100.0		
#60	99.9		
#140	99.7		
#200	99.1		

* (no specification provided)

Soil Description

Gray Ash Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= AASHTO=

Remarks

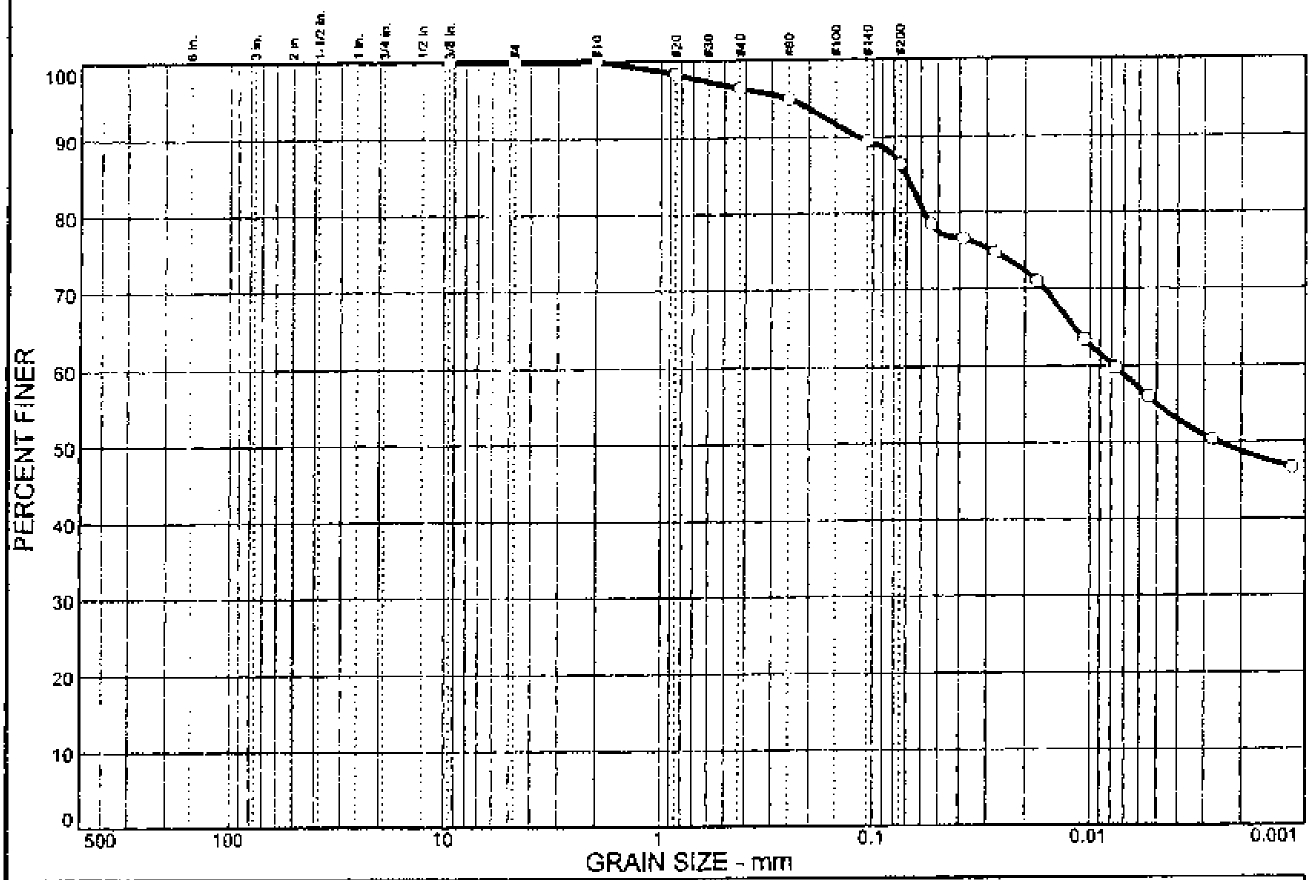
Specific Gravity: 2.20

Sample No.: **Source of Sample:** **Date:** 09-22-04
Location: B-13 UD @ 15'-17' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HR **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	3.6	10.0	31.3	55.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	100.0		
#10	100.0		
#20	98.3		
#40	96.4		
#60	95.0		
#140	89.5		
#200	86.4		

* (no specification provided)

Soil Description

Orange-Brown Silty Clay

Atterberg Limits

PL= 30 LL= 78 PI= 48

Coefficients

D_{85}= 0.0704 D_{60}= 0.0077 D_{50}= 0.0025
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

Sample No.: **Source of Sample:** **Date:** 10-12-04
Location: B-13 UD @ 25'-27' **Elev./Depth:**

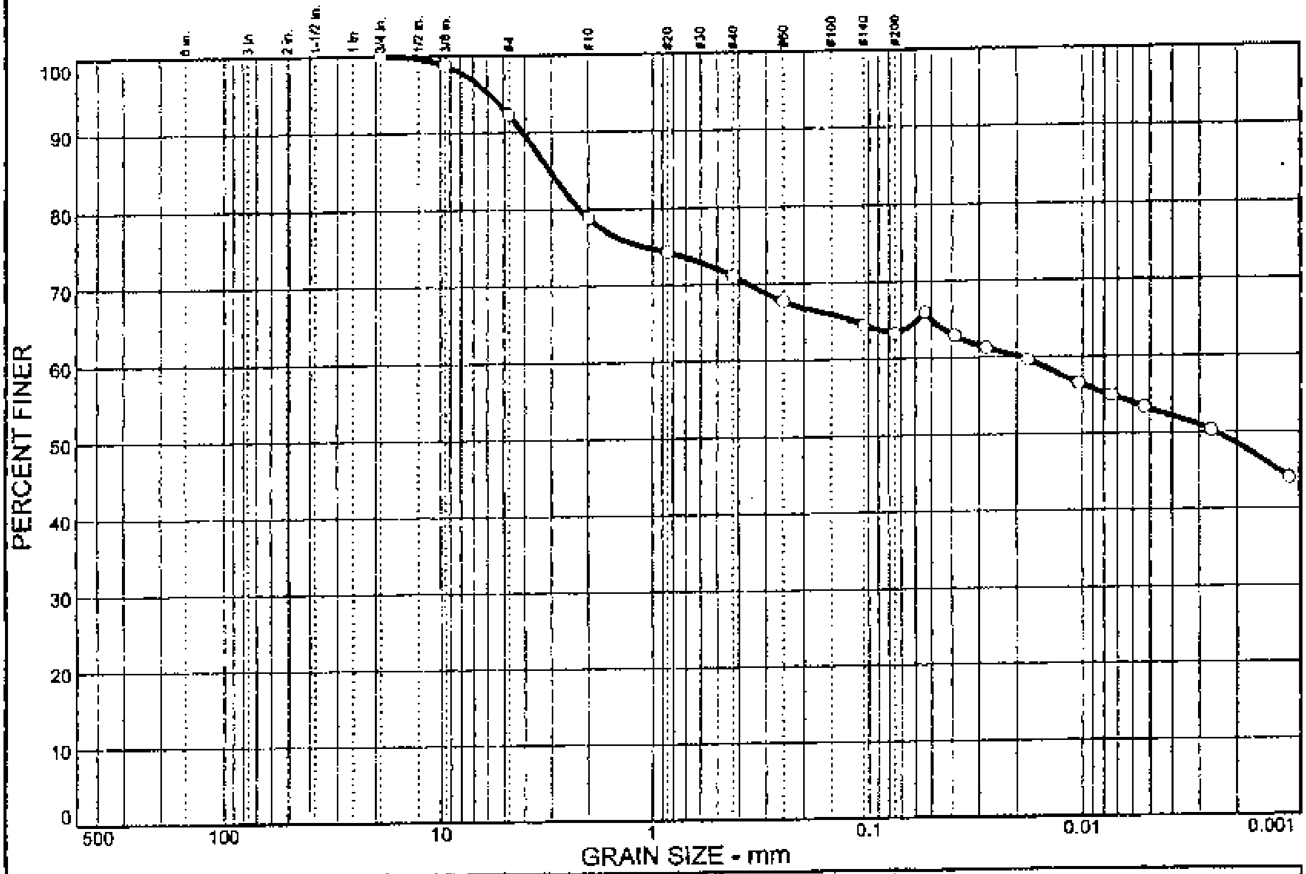
MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HB **Figure**

GRAIN SIZE ANALYSIS TEST RESULTS

ON-SITE BORROW SAMPLES

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	7.7	13.4	7.8	7.8	10.1	53.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	98.8		
#4	92.3		
#10	78.9		
#20	74.3		
#40	71.1		
#60	67.7		
#140	64.4		
#200	63.3		

* (no specification provided)

Soil Description

Dark-Brown Sandy Silty Clay

Atterberg Limits

PL= 26 LL= 75 PI= 49

Coefficients

D_{85}= 3.03 D_{60}= 0.0190 D_{50}= 0.0025
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

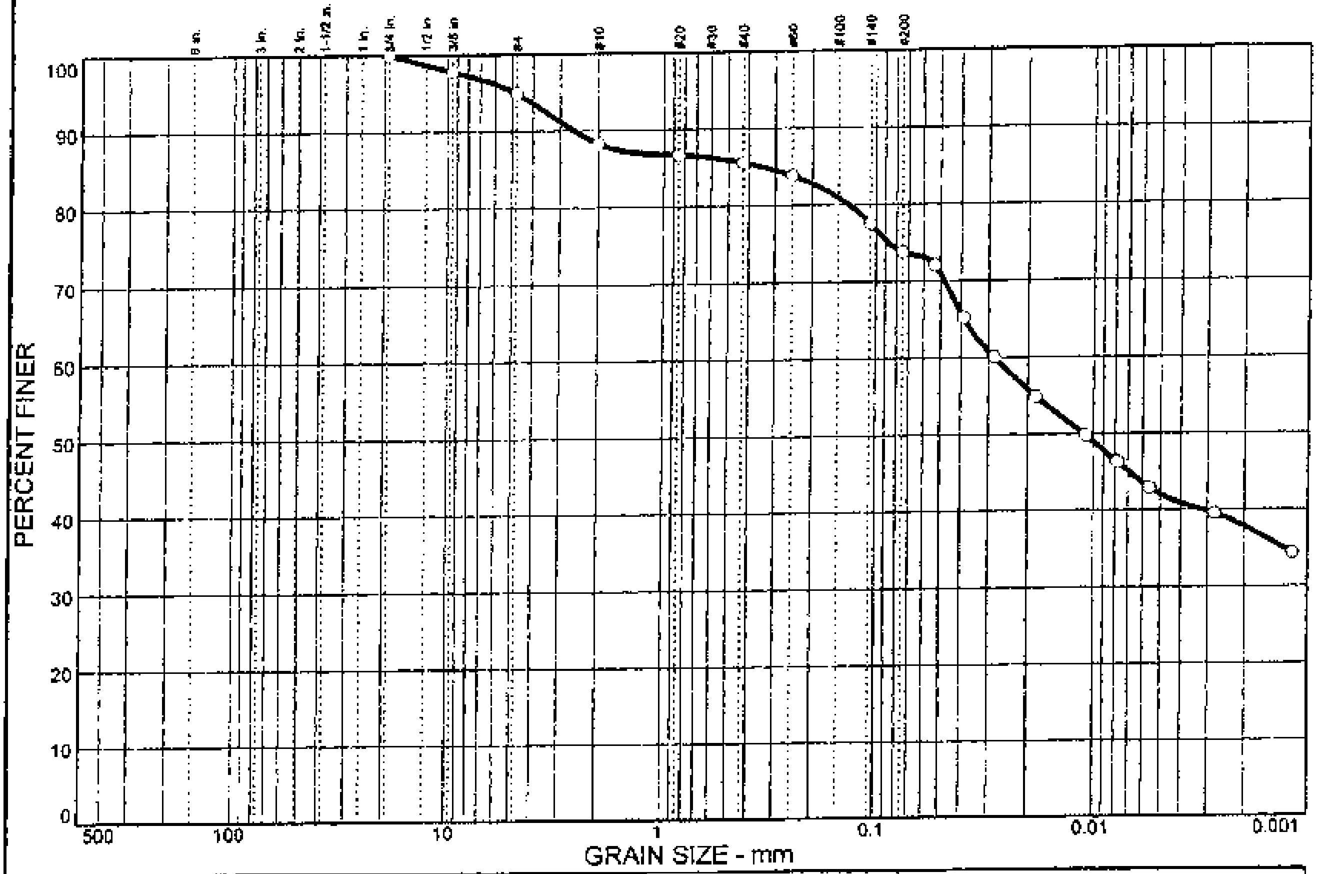
Moisture Content: 21.4%

Sample No.:
Location: A-1 Bulk @ 0'-18.5'
Source of Sample:
Date: 09-02-04
Elev./Depth:

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HE **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	5.1	6.6	2.7	11.8	31.7	42.1

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	97.8		
#4	94.9		
#10	88.3		
#20	86.7		
#40	85.6		
#60	83.8		
#140	77.5		
#200	73.8		

* (no specification provided)

Soil Description

Orange-Brown Silty Clay with Sand

Atterberg Limits

PL= 17 LL= 47 PI= 30

Coefficients

D_{85}= 0.345 D_{60}= 0.0281 D_{50}= 0.0111
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

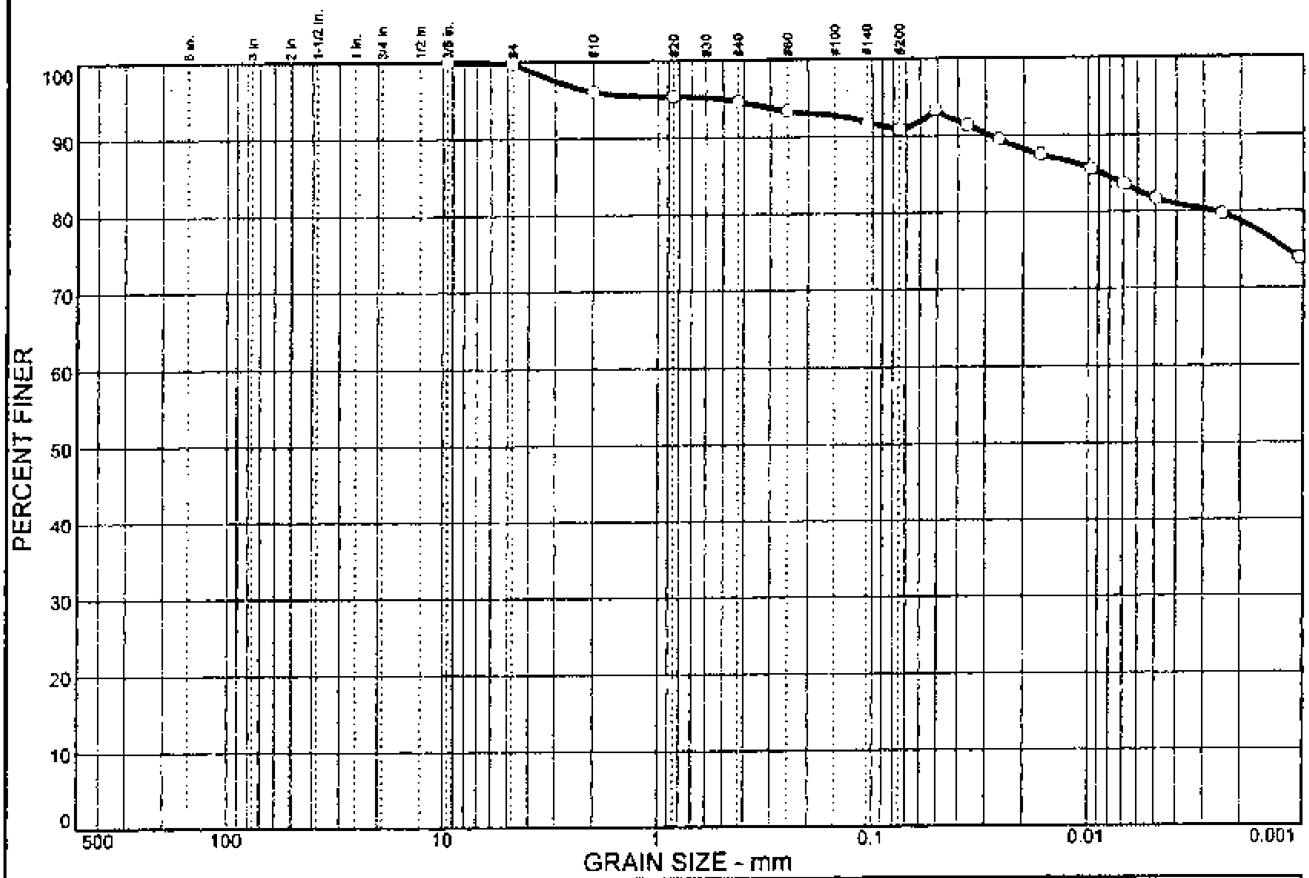
Moisture Content: 21.3%

Sample No.: **Source of Sample:** **Date:** 09-02-04
Location: A-2 Bulk @ 0'-20.0' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HB **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.2	3.7	1.4	3.8	9.2	81.7

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	99.8		
#10	96.1		
#20	95.4		
#40	94.7		
#60	93.4		
#140	91.8		
#200	90.9		

* (no specification provided)

Soil Description

Orange-Brown Silty Clay

Atterberg Limits

PL= 32 LL= 80 PI= 48

Coefficients

D_{85}= 0.0087 D_{60}= D_{50}=

D_{30}= D_{15}= D_{10}=

C_u= C_c=

Classification

USCS= CH AASHTO=

Remarks

Moisture Content: 29.9%

Sample No.: **Source of Sample:** **Date:** 09-02-04

Location: A-5 Bulk @ 0'-15.0' **Elev./Depth:**

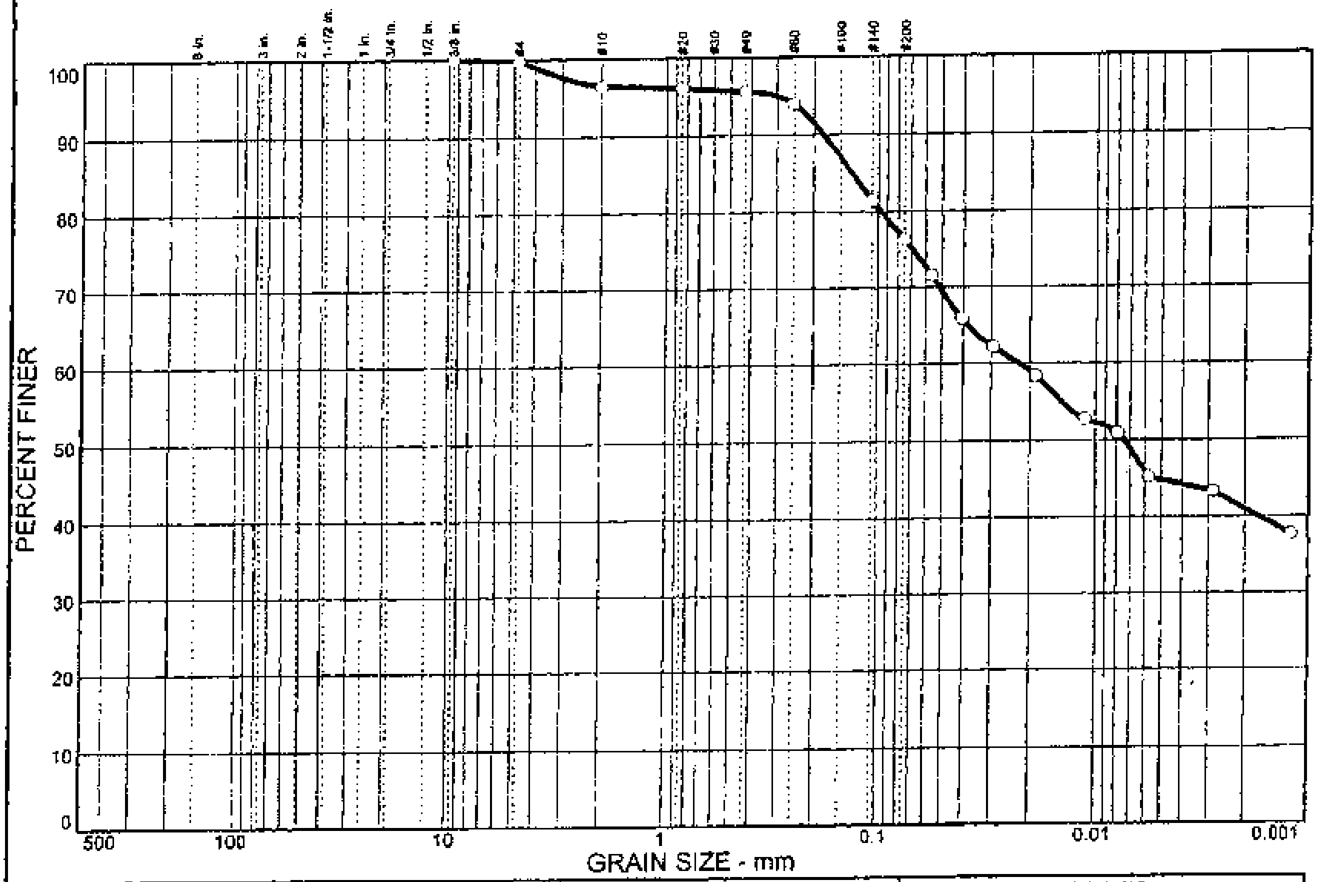
MACTEC, INC.

Client: TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Project No: 3043041043 HB **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.2	3.4	0.8	19.3	31.5	44.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	99.8		
#10	96.4		
#20	96.1		
#40	95.6		
#60	94.0		
#140	81.4		
#200	76.3		

* (no specification provided)

Soil Description

Yellow-Brown Silty Clay with Sand

Atterberg Limits

PL= 19　LL= 43　PI= 24

Coefficients

D_{85}= 0.132　D_{60}= 0.0223　D_{50}= 0.0074
D_{30}=　D_{15}=　D_{10}=
C_u=　C_c=

Classification

USCS= CL　AASHTO=

Remarks

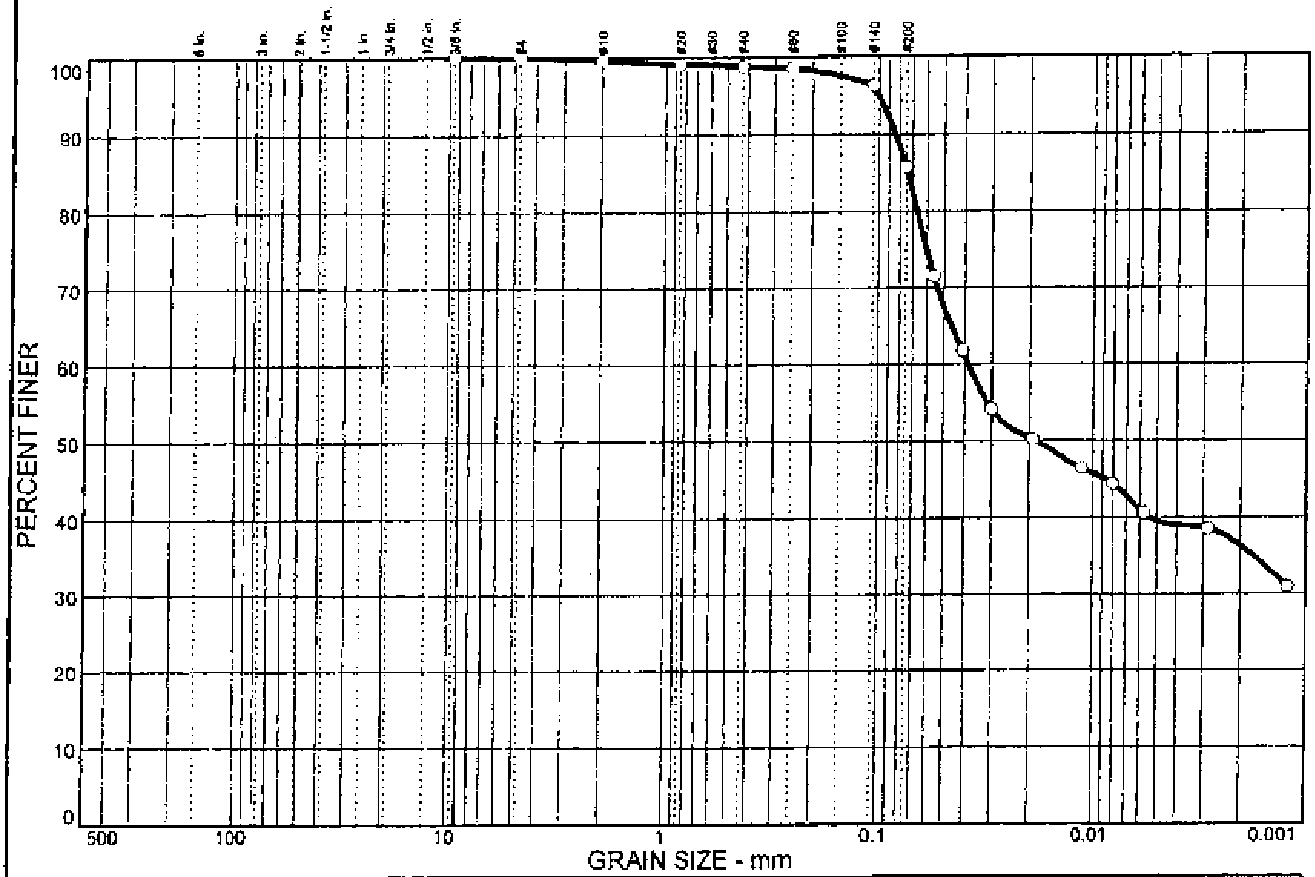
Moisture Content: 19.4%

Sample No.:　**Source of Sample:**　**Date:** 09-02-04
Location: A-7 Bulk @ 0'-20.0'　**Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043　H8　**Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.1	0.3	0.8	13.1	46.1	39.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	99.9		
#10	99.6		
#20	99.1		
#40	98.8		
#60	98.6		
#140	96.3		
#200	85.7		

* (no specification provided)

Soil Description

Light-Brown Silty Clay

Atterberg Limits

PL= 18 LL= 38 PI= 20

Coefficients

D_{85}= 0.0738 D_{60}= 0.0385 D_{50}= 0.0187
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

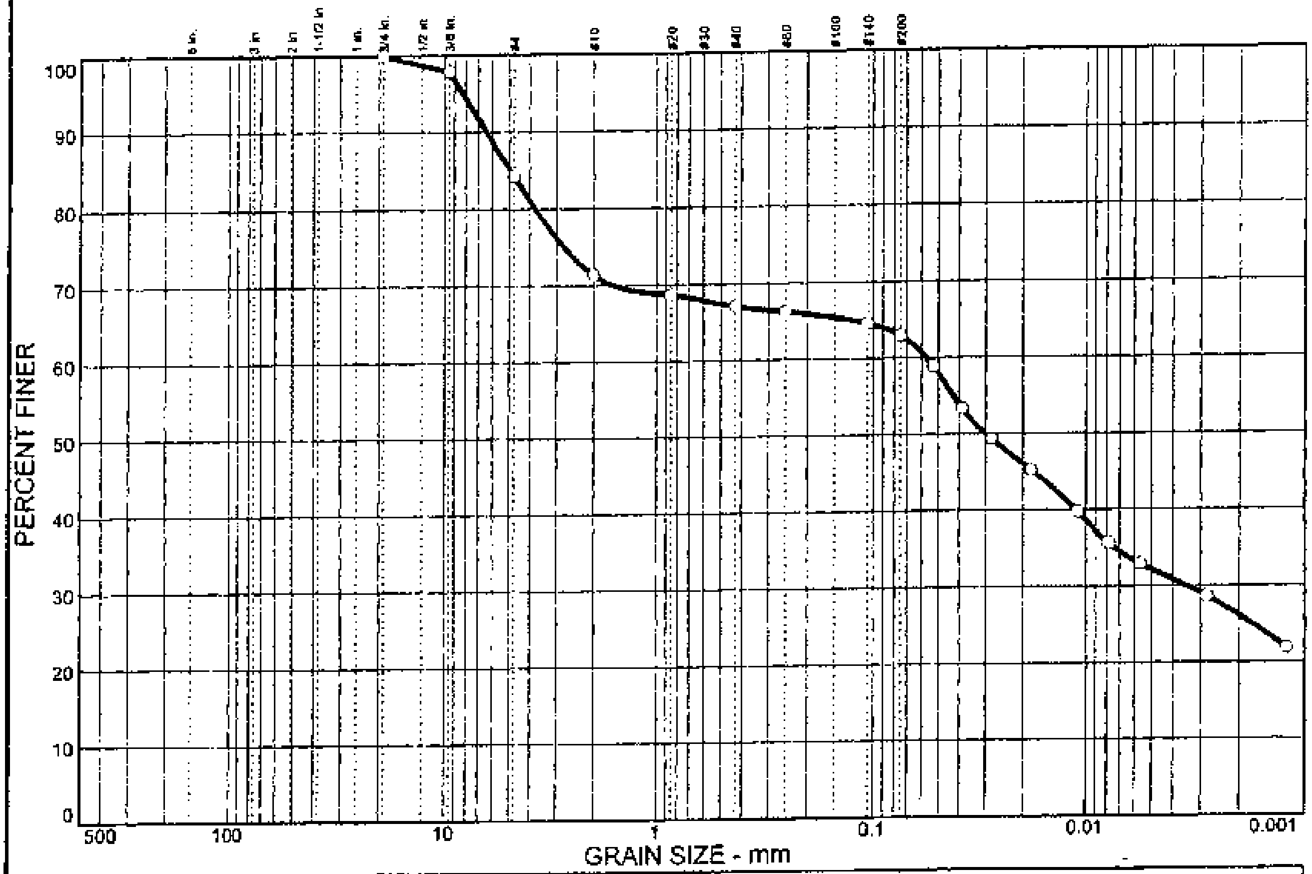
Moisture Content: 19.0%

Sample No.: **Source of Sample:** **Date:** 09-02-04
Location: A-9 Bulk @ 0'-15.0' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 A8 **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	15.8	12.8	4.3	4.1	30.8	32.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	97.9		
#4	84.2		
#10	71.4		
#20	68.7		
#40	67.1		
#60	66.3		
#140	64.6		
#200	63.0		

* (no specification provided)

Soil Description

Olive-Brown Sandy Silty Clay with Gravel

Atterberg Limits

PL= 17 LL= 36 PI= 19

Coefficients

D_{85}= 4.96 D_{60}= 0.0566 D_{50}= 0.0300
D_{30}= 0.0035 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

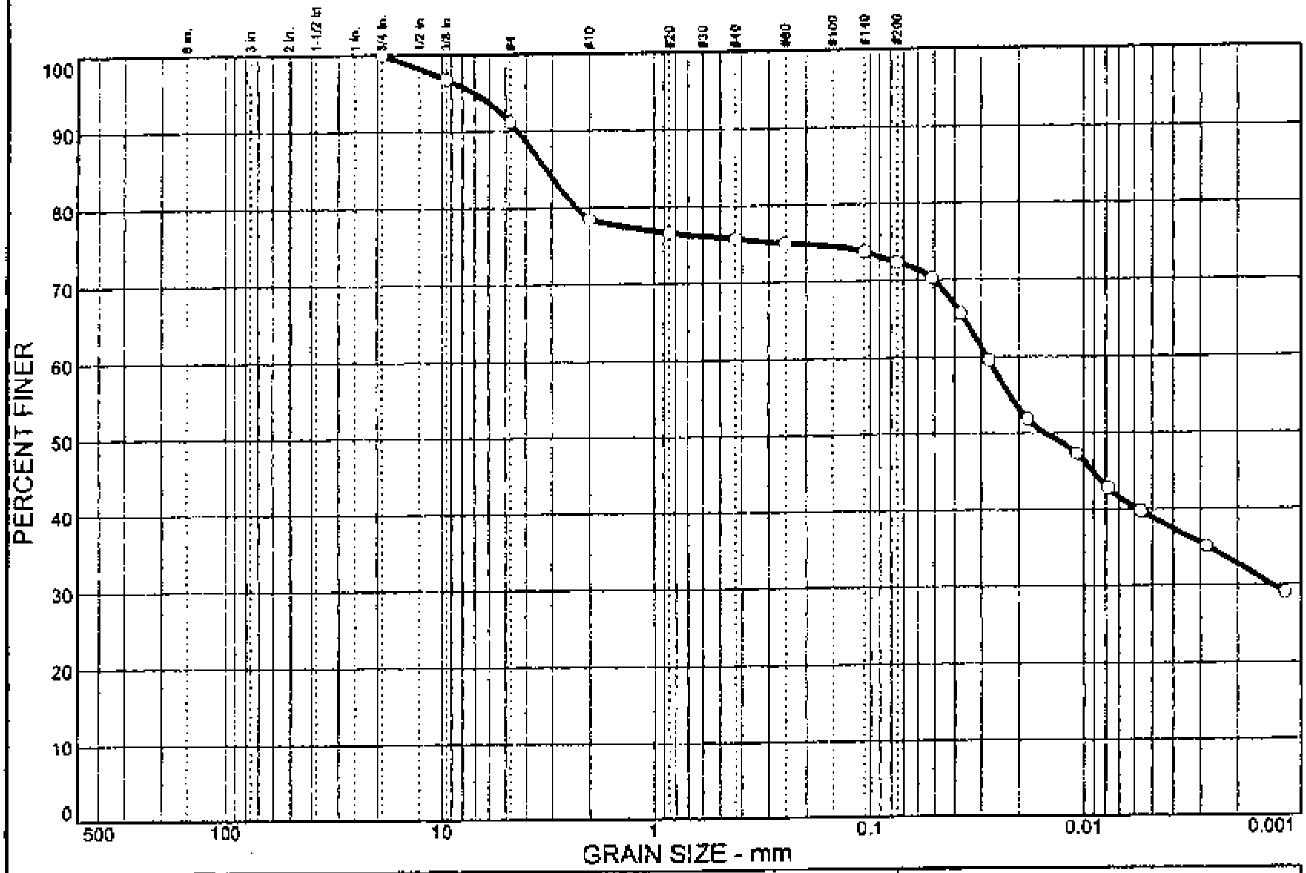
Moisture Content: 10.8%

Sample No.: **Source of Sample:** **Date:** 09-02-04
Location: A-11 Bulk @ 0'-12.5' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 KB **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	8.8	12.8	2.7	3.3	33.5	38.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	96.8		
#4	91.2		
#10	78.4		
#20	76.6		
#40	75.7		
#60	75.0		
#140	73.8		
#200	72.4		

* (no specification provided)

Soil Description

Yellow-Brown Lean Clay with Sand

Atterberg Limits

PL= 20 LL= 42 PI= 22

Coefficients

D_{85}= 3.19 D_{60}= 0.0280 D_{50}= 0.0150
D_{30}= 0.0014 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

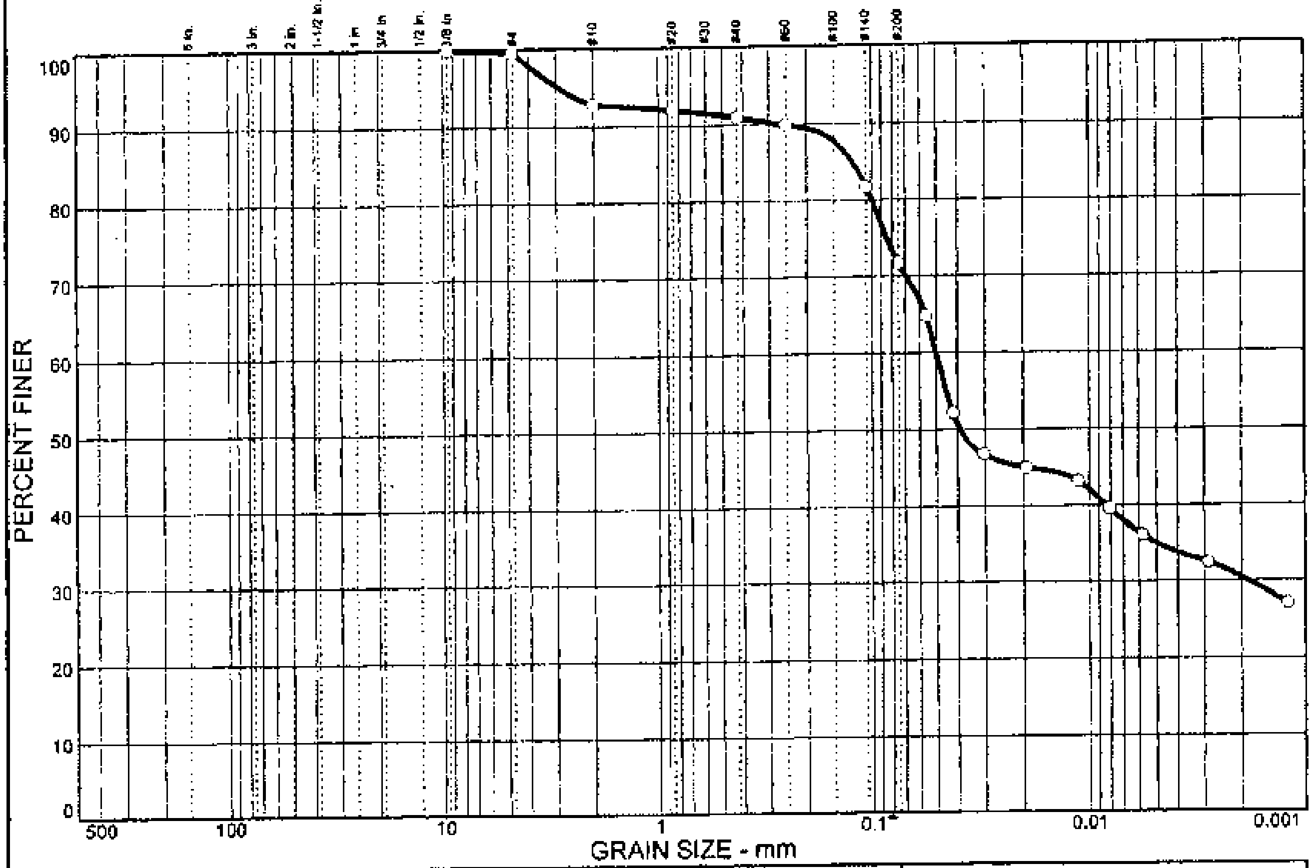
Moisture Content: 17.7%

Sample No.: **Source of Sample:** **Date:** 09-02-04
Location: A-12 Bulk @ 0'-13.0' **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 #8 **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.4	6.8	1.8	19.3	36.8	34.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	99.6		
#10	92.8		
#20	92.0		
#40	91.0		
#60	89.9		
#140	81.7		
#200	71.7		

* (no specification provided)

Soil Description

Orange-Brown Silty Clay with Sand

Atterberg Limits

PL= 19 LL= 38 PI= 19

Coefficients

D_{85}= 0.123 D_{60}= 0.0500 D_{50}= 0.0389
D_{30}= 0.0019 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

Moisture Content: 24.1%

Sample No.: **Source of Sample:** **Date:** 09-02-04
Location: A-14 Bulk @ 0'-12.0' **Elev./Depth:**

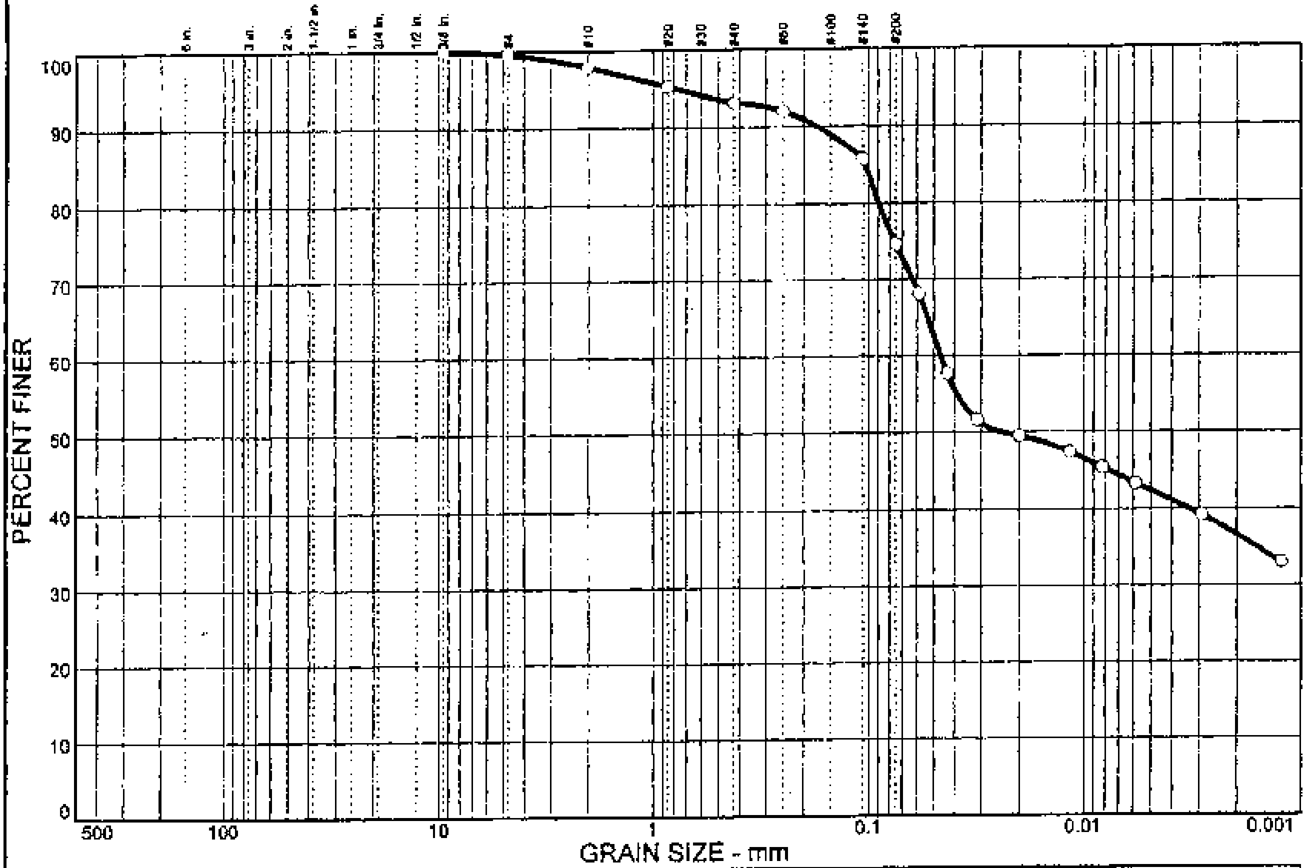
MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HR **Figure**

GRAIN SIZE ANALYSIS TEST RESULTS

OFF-SITE BORROW SAMPLES

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.4	1.7	4.8	18.5	32.2	42.4

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.375 in.	100.0		
#4	99.6		
#10	97.9		
#20	95.3		
#40	93.1		
#60	92.0		
#140	85.8		
#200	74.6		

* (no specification provided)

Soil Description

Olive-Brown Silty Clay with Sand

Atterberg Limits

PL= 24 LL= 41 PI= 17

Coefficients

D_{85}= 0.104 D_{60}= 0.0463 D_{50}= 0.0241
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

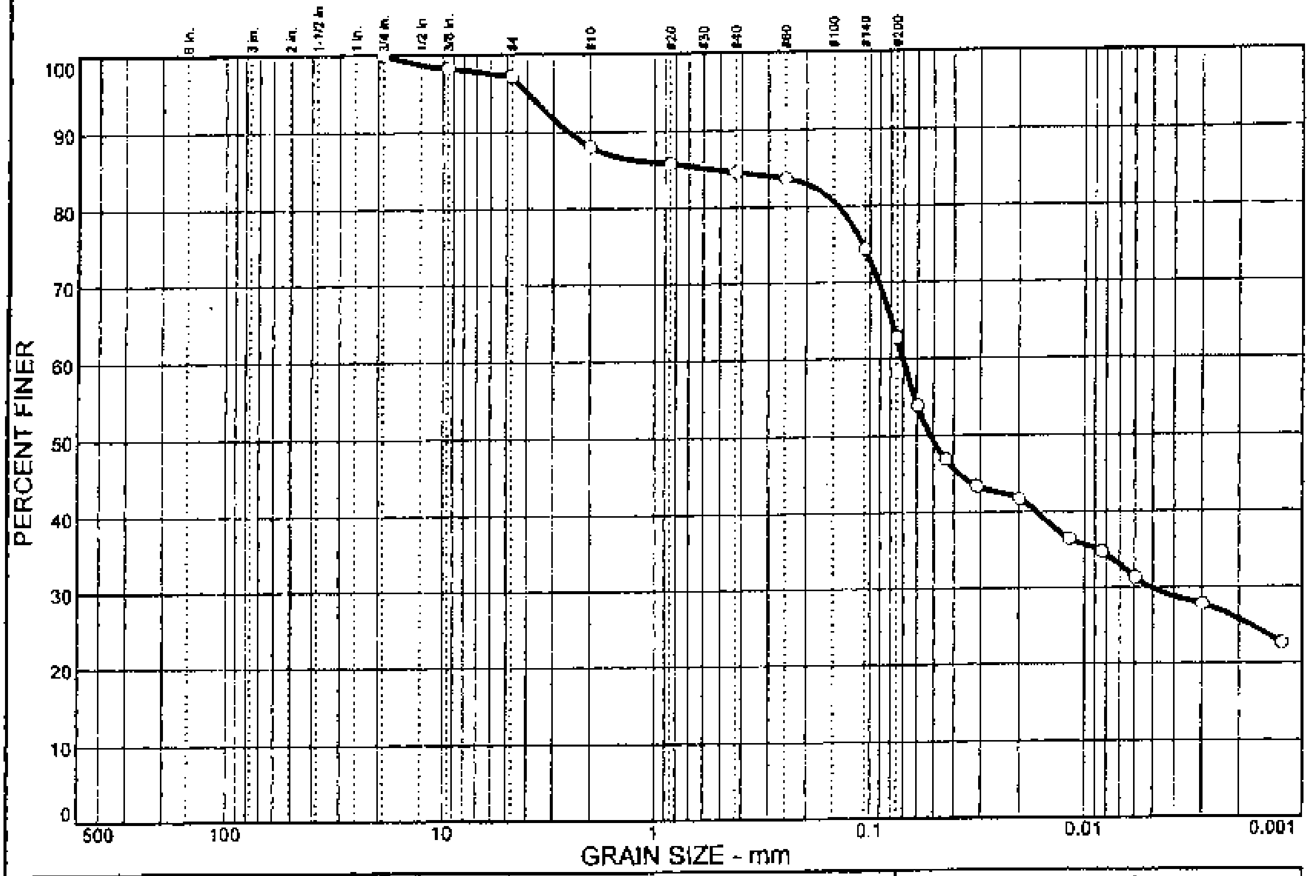
Moisture Content: 32.1%

Sample No.: **Source of Sample:** **Date:** 09-02-04
Location: Off Site Borrow Sample #1 **Elev./Depth:**

MACTEC, INC.

Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Project No: 3043041043 HB **Figure**

Grain Size Analysis



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	2.8	9.1	3.5	21.8	32.9	29.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75 in.	100.0		
0.375 in.	98.3		
#4	97.2		
#10	88.1		
#20	85.8		
#40	84.6		
#60	83.7		
#140	74.3		
#200	62.8		

* (no specification provided)

Soil Description

Yellow-Brown Sandy Silty Clay

Atterberg Limits

PL= 21 LL= 33 PI= 12

Coefficients

D_{85}= 0.535 D_{60}= 0.0700 D_{50}= 0.0516

D_{30}= 0.0051 D_{15}= D_{10}=

C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

Moisture Content: 22.6%

Sample No.: **Source of Sample:** **Date:** 09-02-04

Location: Off Site Borrow Sample #2 **Elev./Depth:**

MACTEC, INC.

Client: TVA

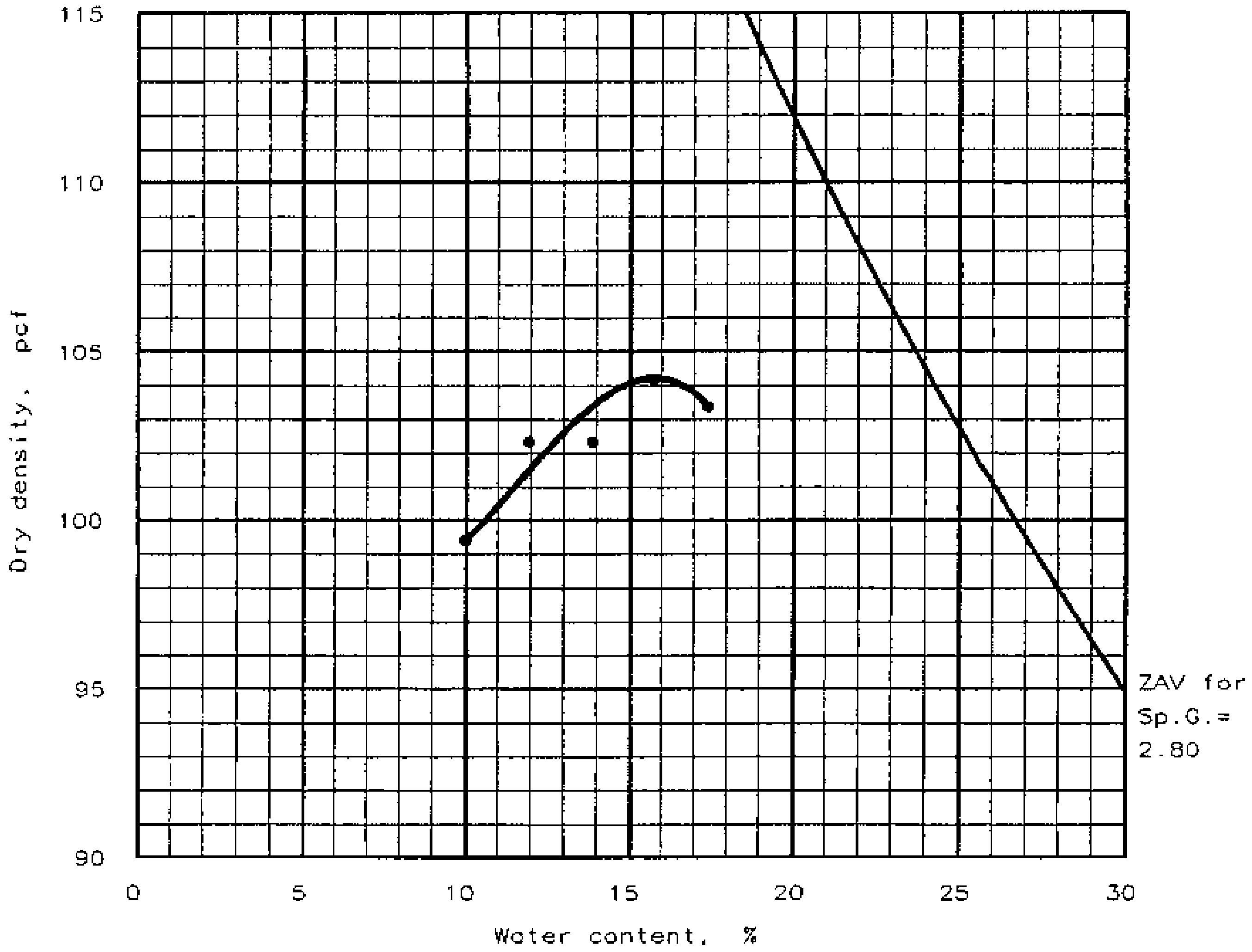
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Project No: 3043041043 H2 **Figure**

MOISTURE-DENSITY RELATIONSHIP TEST RESULTS

BOTTOM ASH SAMPLES

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-00a Procedure C, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
	USCS	AASHTO						
NA	NT	NT	11.1 %	2.64	NT	NT	0 %	15.9 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 104.2 pcf Optimum moisture = 15.8 %	Gray ash sand

Project No.: 3043041043.0001

Project: TVA Gallatin Fossil Plant Ash Disposal

Location: Old bottom ash Bulk Sample

Date: 8-20-2004

Remarks:

Sample Number 3017

NT- No Test

DNS- Data Not Submitted

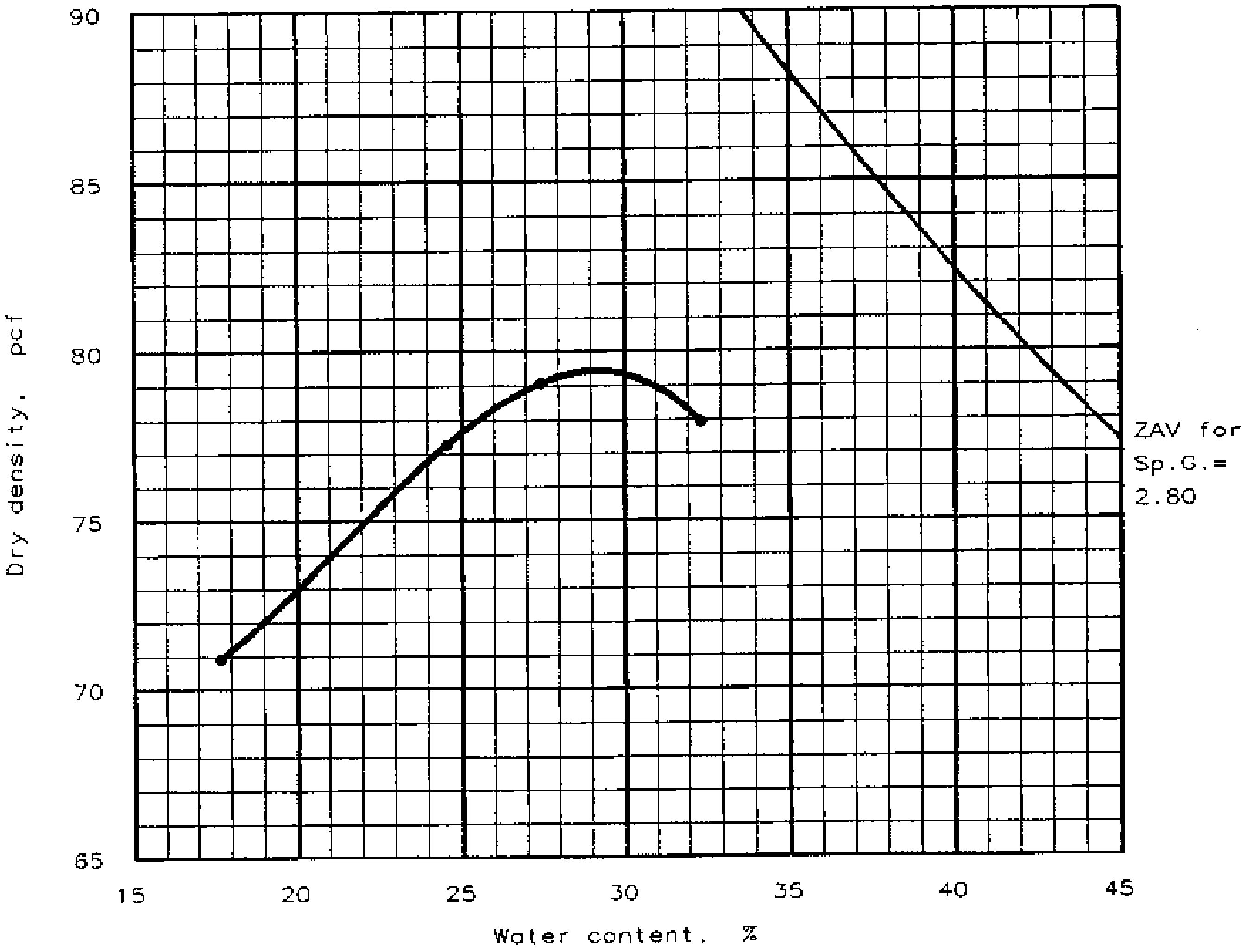
MOISTURE-DENSITY RELATIONSHIP TEST

MG

LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

Fig. No. 3017

MOISTURE-DENSITY RELATIONSHIP TEST



Test specification: ASTM D 698-00a Procedure C, Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in	% < No.200
	USCS	AASHTO						
NA	NT	NT	9.6 %	2.49	NT	NT	0 %	9.8 %

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 79.4 pcf Optimum moisture = 29.2 %	Gray ash sand

Project No.: 3043041043.0001

Project: TVA Gallatin Fossil Plant Ash Disposal

Location: New bottom ash Bulk Sample 2

Date: 8-20-2004

Remarks:

Sample Number 3019

NT- No Test

DNS- Data Not Submitted

MOISTURE-DENSITY RELATIONSHIP TEST

AB

LAW ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

Fig. No. 3019

COMPACTION TEST REPORT

Test specification: ASTM D 698-00a Method C Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 75.6 pcf Optimum moisture = 32.6 %	Grey Bottom Ash

Project No. 3043041043 **Client:** TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

● **Location:** New Bottom Ash Sample #3

Remarks:

COMPACTION TEST REPORT HB

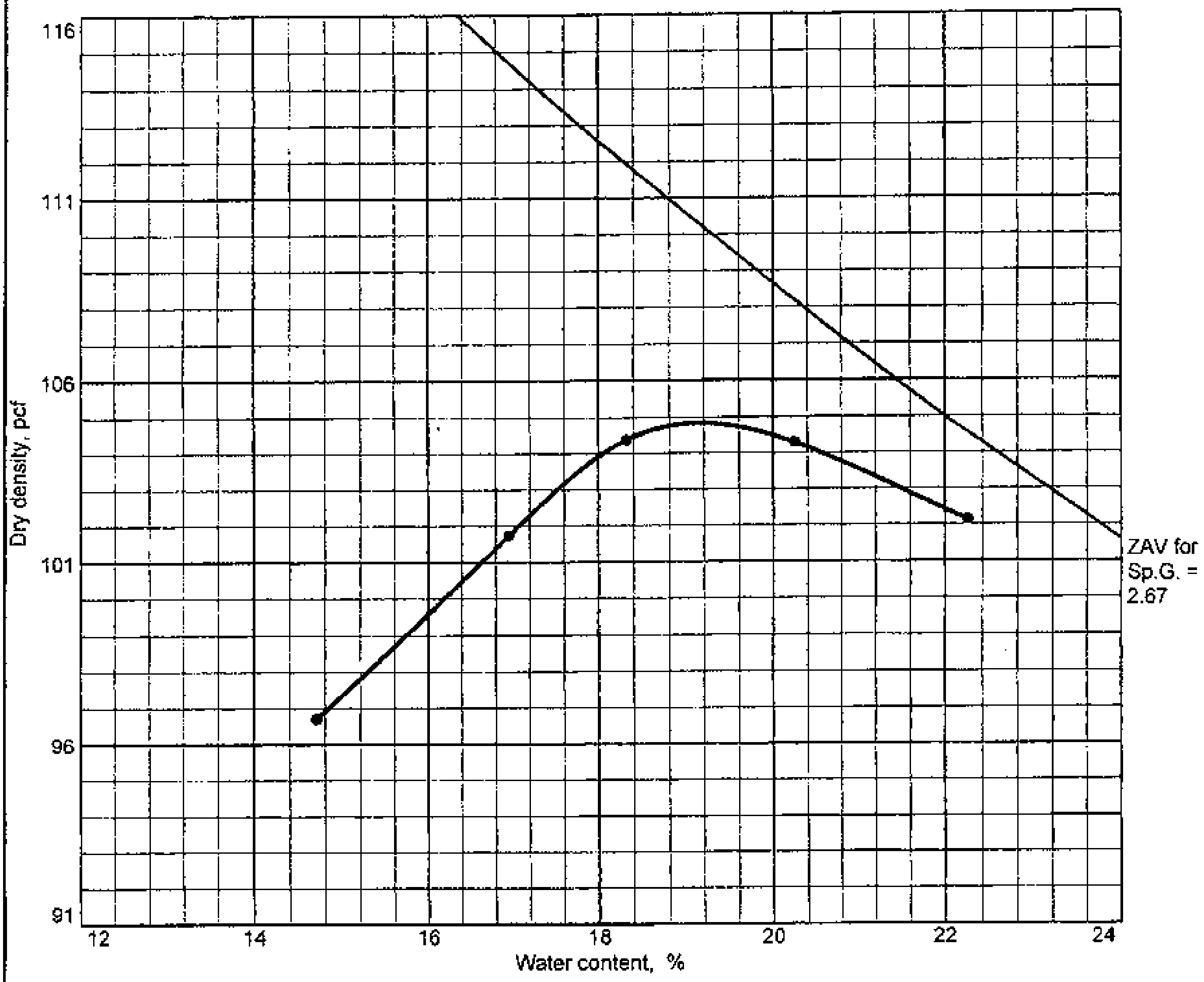
MACTEC ENGINEERING AND CONSULTING, INC.

Figure

MOISTURE-DENSITY RELATIONSHIP TEST RESULTS

ON-SITE BORROW SAMPLES

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL				47	30	5.1	73.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 104.8 pcf Optimum moisture = 19.1 %	Orange-Brown Silty Clay with Sand

Project No. 3043041043 **Client:** TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

● **Location:** A-2 Bulk @ 0'-20.0'

Remarks:

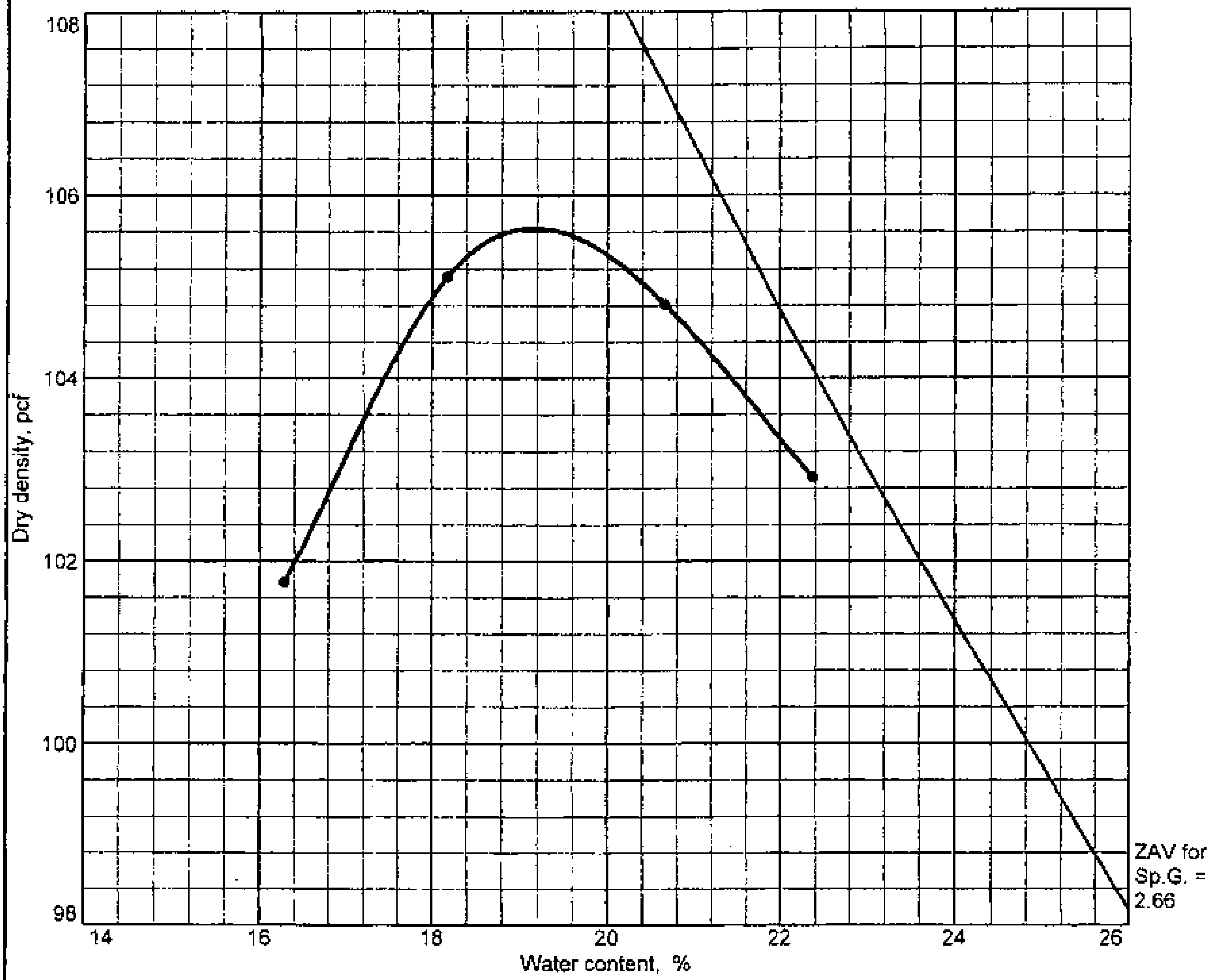
COMPACTION TEST REPORT

MACTEC, INC.

HB

Figure

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL				38	20	0.1	85.7

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 105.6 pcf Optimum moisture = 19.2 %	Light-Brown Silty Clay

Project No. 3043041043 **Client:** TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

● **Location:** A-9 Bulk @ 0'-15.0'

Remarks:

COMPACTION TEST REPORT

MACTEC, INC.

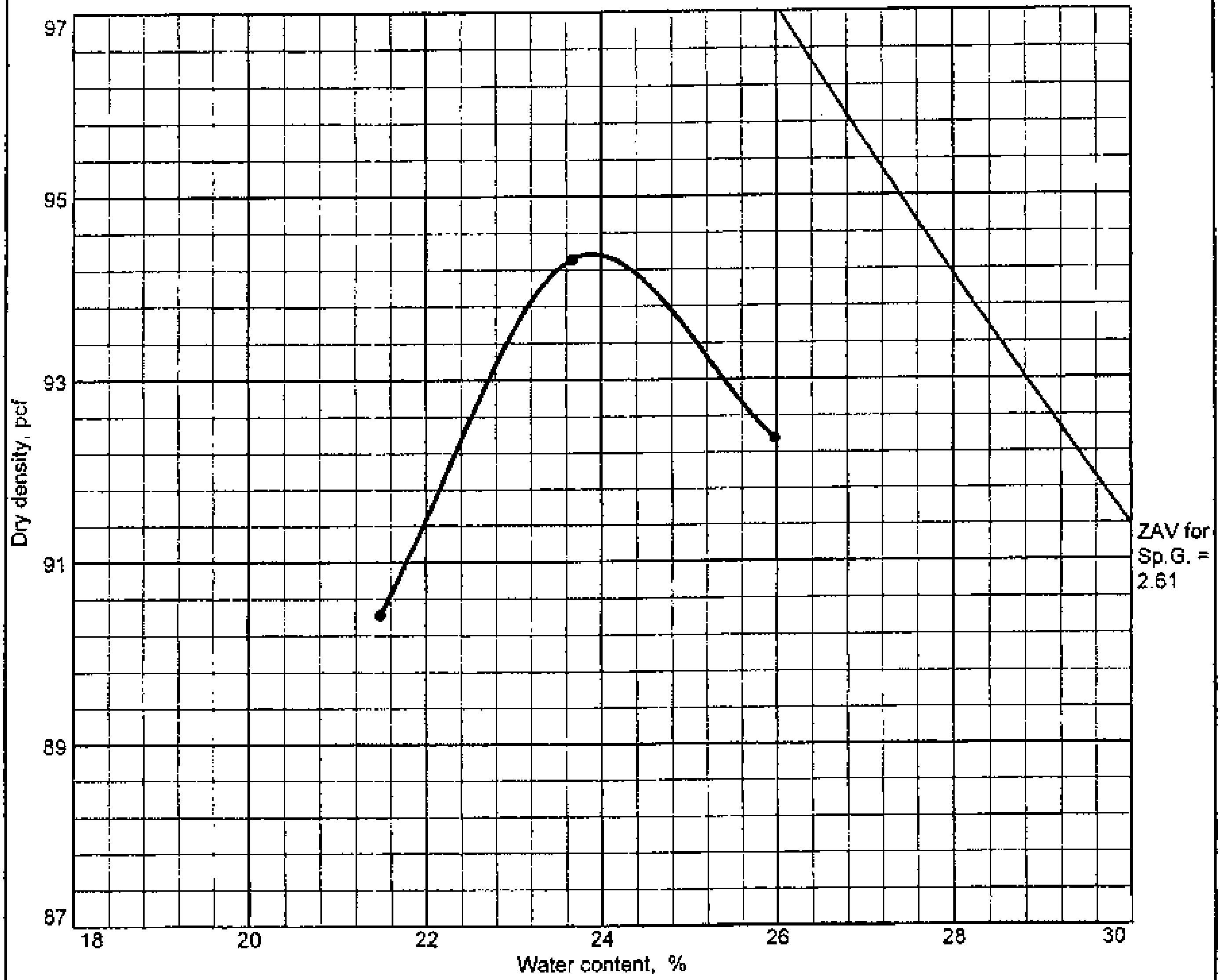
HB

Figure

MOISTURE-DENSITY RELATIONSHIP TEST RESULTS

OFF-SITE BORROW SAMPLES

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method C Standard
Oversize correction applied to each point

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
	CL		32.1		41	17	0.0	74.6

ROCK CORRECTED TEST RESULTS	UNCORRECTED	MATERIAL DESCRIPTION
Maximum dry density = 94.4 pcf	94.4 pcf	Olive-Brown Silty Clay with Sand
Optimum moisture = 23.9 %	23.9 %	

Project No. 3043041043 **Client:** TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

● **Location:** Off Site Borrow Sample #1

Remarks:

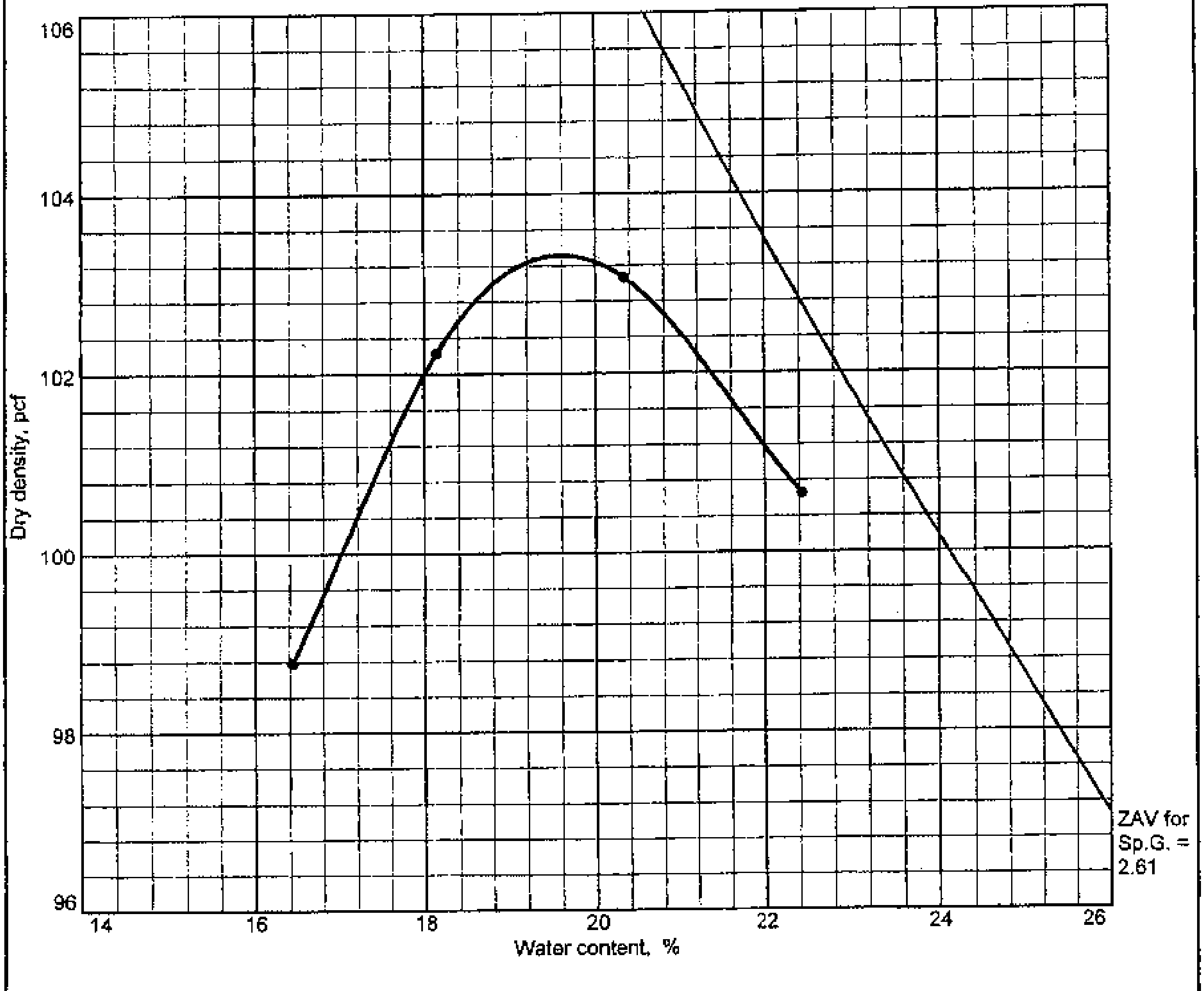
COMPACTION TEST REPORT

MACTEC, INC.

HB

Figure

COMPACTION TEST REPORT



Test specification: ASTM D 698-00a Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > No.4	% < No.200
	USCS	AASHTO						
	CL				33	12	2.8	62.8

TEST RESULTS

Maximum dry density = 103.3 pcf

Optimum moisture = 19.6 %

MATERIAL DESCRIPTION

Yellow-Brown Sandy Silty Clay

Project No. 3043041043 **Client:** TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

● **Location:** Off Site Borrow Sample #2

Remarks:

COMPACTION TEST REPORT

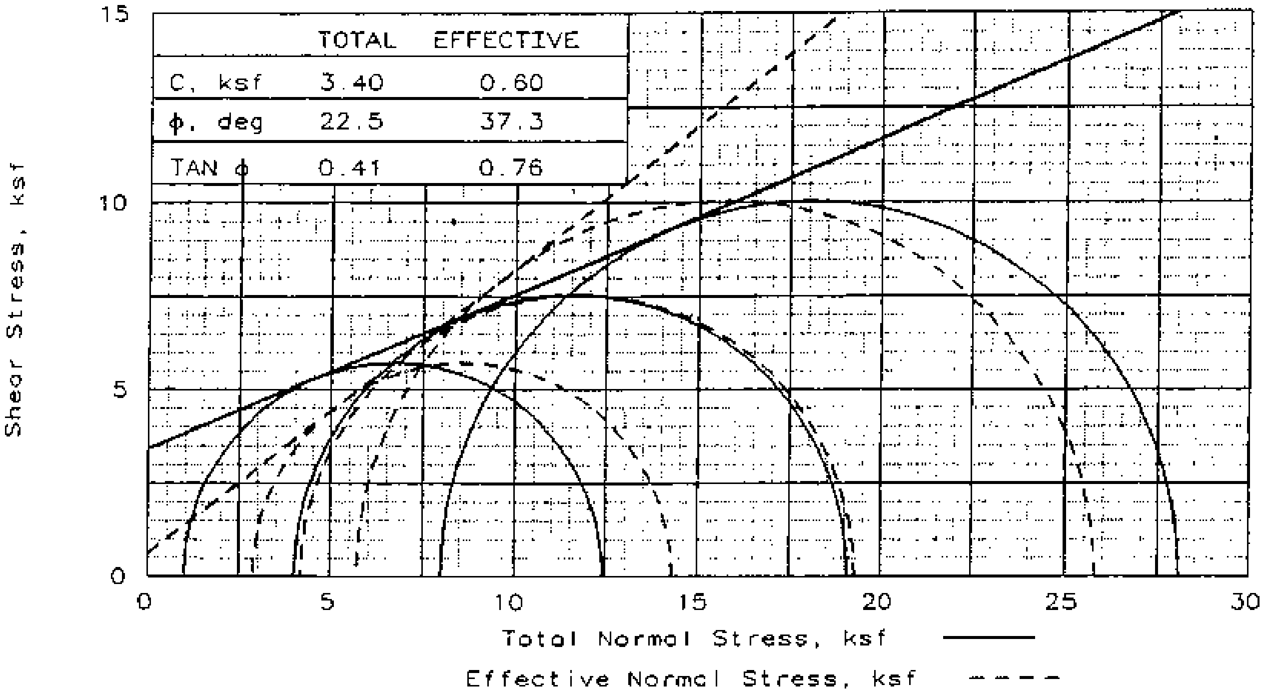
MACTEC, INC.

HB

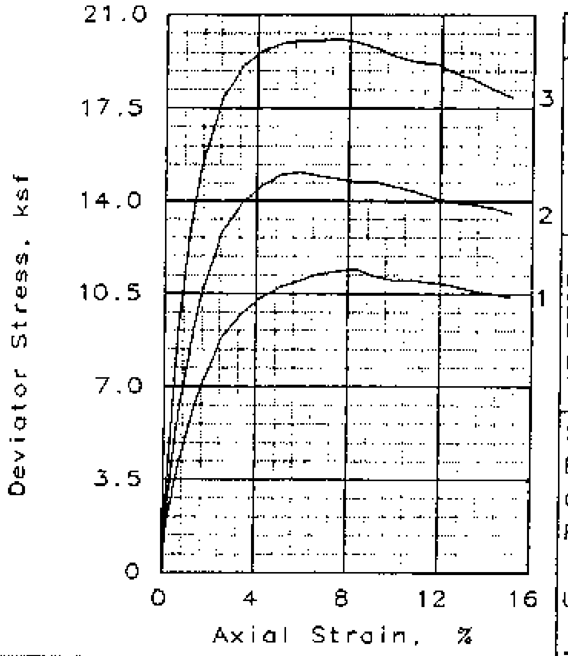
Figure

TRIAXIAL COMPRESSION TEST RESULTS

BOTTOM ASH SAMPLES



	TOTAL	EFFECTIVE
C, ksf	3.40	0.60
ϕ, deg	22.5	37.3
TAN ϕ	0.41	0.76



SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	29.2	29.2	29.2
	DRY DENSITY, pcf	75.5	75.5	75.5
	SATURATION, %	68.6	68.6	68.6
	VOID RATIO	1.060	1.060	1.060
	DIAMETER, in	2.84	2.84	2.84
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	43.6	43.5	42.3
	DRY DENSITY, pcf	74.5	74.7	75.7
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.086	1.082	1.052
	DIAMETER, in	2.86	2.87	2.85
	HEIGHT, in	5.99	5.95	5.95
Strain rate, %/min		0.17	0.17	0.17
BACK PRESSURE, ksf		7.2	7.2	7.2
CELL PRESSURE, ksf		8.2	11.2	15.2
FAIL. STRESS, ksf		11.4	15.1	20.1
TOTAL PORE PR., ksf		5.3	7.0	9.5
ULT. STRESS, ksf				
TOTAL PORE PR., ksf				
$\bar{\sigma}_1$ FAILURE, ksf		14.3	19.3	25.8
$\bar{\sigma}_3$ FAILURE, ksf		2.9	4.2	5.7

TYPE OF TEST:
CU with Pore Pressures

SAMPLE TYPE: Remolded Sample

DESCRIPTION: Gray Ash Sand

SPECIFIC GRAVITY= 2.49

REMARKS: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor

Fig. No.: ______

HB

CLIENT: TVA

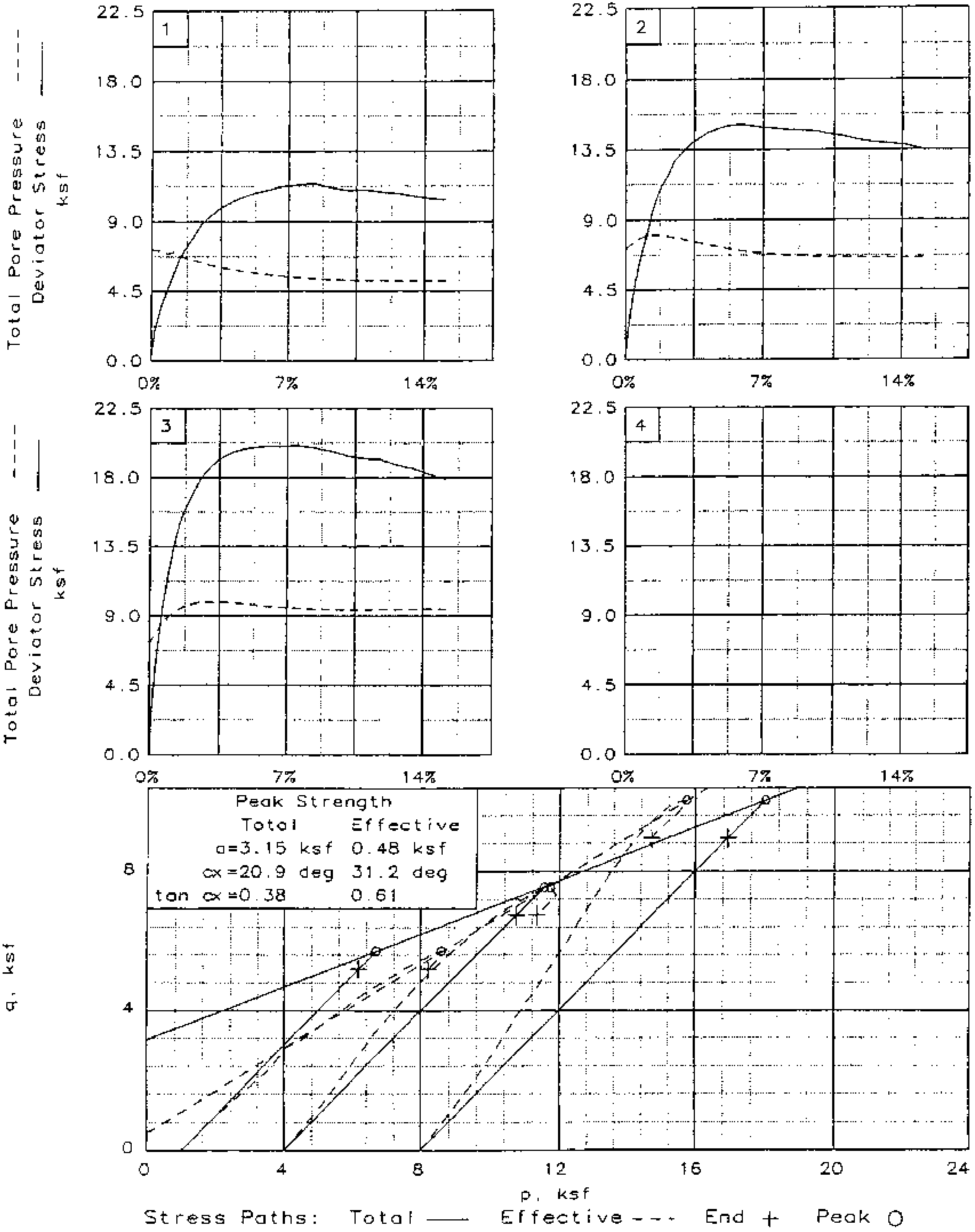
PROJECT: Ash Disposal Areas
TVA Gallatin Fossil Plant

SAMPLE LOCATION: New Bottom Ash #2 Bulk Sample

PROJ. NO.: 3043-04-1043 DATE: 09-13-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Client: TVA

Project: Ash Disposal Areas TVA Gallatin Fossil Plant

Location: New Bottom Ash #2 Bulk Sample

File: FOSSIL2 Project No.: 3043-04-1043 Fig. No.: ____

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

9-13-2004
11:41 am

Project and Sample Data

Date: 09-13-04
Client: TVA
Project: Ash Disposal Areas TVA Gallatin Fossil Plant
Sample location: New Bottom Ash #2 Bulk Sample
Sample description: Gray Ash Sand
Remarks: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor
Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Remolded Sample
Specific gravity= 2.49 LL= PL= PI=
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	972.800			1039.980
Wt. dry soil and tare:	752.940			752.940
Wt. of tare:	0.000			0.000
Weight, gms:	972.8			
Diameter, in:	2.840	2.863	2.861	
Area, in^2:	6.335	6.438	6.430	
Height, in:	6.000	6.000	5.985	
Net decrease in height, in:		0.000	0.015	
Net decrease in water volume, cc:		-110.800	2.400	
% Moisture:	29.2	43.9	43.6	38.1
Wet density, pcf:	97.5	106.9	107.0	
Dry density, pcf:	75.5	74.3	74.5	
Void ratio:	1.0598	1.0935	1.0856	
% Saturation:	68.6	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Consolidation cell pressure = 56.90 psi = 8.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 11.44 ksf at reading no. 18
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.00	0.0	0.0	0.00	0.99	0.99	1.00	50.00	0.99	0.00
1	0.0100	0.010	30.00	84.0	0.2	1.88	1.02	2.90	2.84	49.80	1.96	0.94
2	0.0200	0.020	43.00	120.4	0.3	2.69	1.08	3.77	3.49	49.40	2.42	1.34
3	0.0300	0.030	55.00	154.0	0.5	3.43	1.14	4.57	4.02	49.00	2.85	1.72
4	0.0400	0.040	65.00	182.0	0.7	4.05	1.20	5.24	4.39	48.60	3.22	2.02
5	0.0500	0.050	75.00	210.0	0.8	4.66	1.25	5.92	4.72	48.20	3.58	2.33
6	0.0600	0.060	85.00	238.0	1.0	5.28	1.20	6.47	5.41	48.60	3.83	2.64
7	0.0700	0.070	94.00	263.2	1.2	5.83	1.15	6.98	6.06	48.90	4.06	2.91
8	0.0800	0.080	102.00	285.6	1.3	6.31	1.38	7.69	5.56	47.30	4.54	3.16
9	0.0900	0.090	110.00	308.0	1.5	6.79	1.47	8.26	5.63	46.70	4.87	3.40
10	0.1000	0.100	116.00	324.8	1.7	7.15	1.53	8.68	5.69	46.30	5.10	3.58
11	0.1500	0.150	144.00	403.2	2.5	8.80	1.83	10.63	5.81	44.20	6.23	4.40
12	0.2000	0.200	161.00	450.8	3.3	9.76	2.12	11.87	5.61	42.20	7.00	4.88
13	0.2500	0.250	172.00	481.6	4.2	10.33	2.30	12.64	5.49	40.90	7.47	5.17
14	0.3000	0.300	180.00	504.0	5.0	10.72	2.46	13.18	5.35	39.80	7.82	5.36
15	0.3500	0.350	186.00	520.8	5.8	10.98	2.59	13.57	5.24	38.90	8.08	5.49
16	0.4000	0.400	192.00	537.6	6.7	11.23	2.69	13.93	5.17	38.20	8.31	5.62
17	0.4500	0.450	196.00	548.8	7.5	11.37	2.79	14.16	5.07	37.50	8.48	5.68
18	0.5000	0.500	199.00	557.2	8.4	11.44	2.88	14.32	4.97	36.90	8.60	5.72
19	0.5500	0.550	196.00	548.8	9.2	11.16	2.94	14.10	4.80	36.50	8.52	5.58
20	0.6000	0.600	195.00	546.0	10.0	11.00	2.97	13.97	4.71	36.30	8.47	5.50
21	0.6500	0.650	197.00	551.6	10.9	11.01	3.00	14.01	4.68	36.10	8.50	5.51
22	0.7000	0.700	197.00	551.6	11.7	10.91	3.01	13.92	4.62	36.00	8.46	5.45
23	0.7500	0.750	197.00	551.6	12.5	10.80	3.02	13.83	4.57	35.90	8.43	5.40
24	0.8000	0.800	196.00	548.8	13.4	10.65	3.02	13.67	4.52	35.90	8.35	5.32
25	0.8500	0.850	195.00	546.0	14.2	10.49	3.02	13.51	4.47	35.90	8.27	5.25
26	0.9000	0.900	195.00	546.0	15.0	10.39	3.02	13.41	4.44	35.90	8.22	5.19

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	972.800			1045.020
Wt. dry soil and tare:	752.940			752.940
Wt. of tare:	0.000			0.000
Weight, gms:	972.8			
Diameter, in:	2.840	2.869	2.868	
Area, in^2:	6.335	6.464	6.460	
Height, in:	6.000	6.000	5.948	
Net decrease in height, in:		0.000	0.052	
Net decrease in water volume, cc:		-113.300	5.900	
% Moisture:	29.2	44.2	43.5	38.8
Wet density, pcf:	97.5	106.7	107.1	
Dry density, pcf:	75.5	74.0	74.7	
Void ratio:	1.0598	1.1018	1.0823	
% Saturation:	68.6	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Consolidation cell pressure = 77.80 psi = 11.20 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 15.10 ksf at reading no. 15
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
0	0.0000	0.000	0.00	0.0	0.0	0.00	4.00	4.00	1.00	50.00	4.00	0.00
1	0.0100	0.010	41.00	114.8	0.2	2.55	3.82	6.37	1.67	51.30	5.09	1.28
2	0.0200	0.020	63.00	176.4	0.3	3.92	3.66	7.58	2.07	52.40	5.62	1.96
3	0.0300	0.030	83.00	232.4	0.5	5.15	3.50	8.65	2.47	53.50	6.08	2.58
4	0.0400	0.040	98.00	274.4	0.7	6.08	3.40	9.47	2.79	54.20	6.44	3.04
5	0.0500	0.050	113.00	316.4	0.8	6.99	3.30	10.29	3.12	54.90	6.79	3.50
6	0.0600	0.060	127.00	355.6	1.0	7.85	3.24	11.09	3.42	55.30	7.16	3.92
7	0.0700	0.070	140.00	392.0	1.2	8.64	3.20	11.83	3.70	55.60	7.51	4.32
8	0.0800	0.080	155.00	434.0	1.3	9.54	3.17	12.71	4.01	55.80	7.94	4.77
9	0.0900	0.090	165.00	462.0	1.5	10.14	3.17	13.31	4.20	55.80	8.24	5.07
10	0.1000	0.100	175.00	490.0	1.7	10.74	3.17	13.91	4.39	55.80	8.54	5.37
11	0.1500	0.150	211.00	590.8	2.5	12.84	3.31	16.15	4.88	54.80	9.73	6.42
12	0.2000	0.200	231.00	646.8	3.4	13.93	3.57	17.50	4.90	53.00	10.54	6.97
13	0.2500	0.250	244.00	683.2	4.2	14.59	3.80	18.39	4.84	51.40	11.10	7.29
14	0.3000	0.300	253.00	708.4	5.0	14.99	4.00	19.00	4.75	50.00	11.50	7.50
15	0.3500	0.350	257.00	719.6	5.9	15.10	4.19	19.29	4.60	48.70	11.74	7.55
16	0.4000	0.400	257.00	719.6	6.7	14.96	4.31	19.27	4.48	47.90	11.79	7.48
17	0.4500	0.450	257.00	719.6	7.6	14.83	4.41	19.23	4.36	47.20	11.82	7.41
18	0.5000	0.500	258.00	722.4	8.4	14.75	4.48	19.23	4.29	46.70	11.85	7.37
19	0.5500	0.550	260.00	728.0	9.2	14.73	4.54	19.26	4.25	46.30	11.90	7.36
20	0.6000	0.600	259.00	725.2	10.1	14.54	4.58	19.11	4.17	46.00	11.85	7.27

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Effective Stresses Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
21	0.6500	0.650	258.00	722.4	10.9	14.34	4.59	18.94	4.12	45.90	11.77	7.17
22	0.7000	0.700	256.00	716.8	11.8	14.10	4.61	18.71	4.06	45.80	11.66	7.05
23	0.7500	0.750	256.00	716.8	12.6	13.96	4.61	18.57	4.03	45.80	11.59	6.98
24	0.8000	0.800	257.00	719.6	13.4	13.88	4.61	18.49	4.01	45.80	11.55	6.94
25	0.8500	0.850	257.00	719.6	14.3	13.75	4.61	18.36	3.98	45.80	11.48	6.87
26	0.9000	0.900	255.00	714.0	15.1	13.51	4.59	18.10	3.94	45.90	11.35	6.75

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	972.800			1040.110
Wt. dry soil and tare:	752.940			752.940
Wt. of tare:	0.000			0.000
Weight, gms:	972.8			
Diameter, in:	2.840	2.862	2.846	
Area, in²:	6.335	6.435	6.363	
Height, in:	6.000	6.000	5.952	
Net decrease in height, in:		0.000	0.048	
Net decrease in water volume, cc:		-110.500	12.100	
% Moisture:	29.2	43.9	42.3	38.1
Wet density, pcf:	97.5	106.9	107.7	
Dry density, pcf:	75.5	74.3	75.7	
Void ratio:	1.0598	1.0925	1.0525	
% Saturation:	68.6	100.0	100.0	

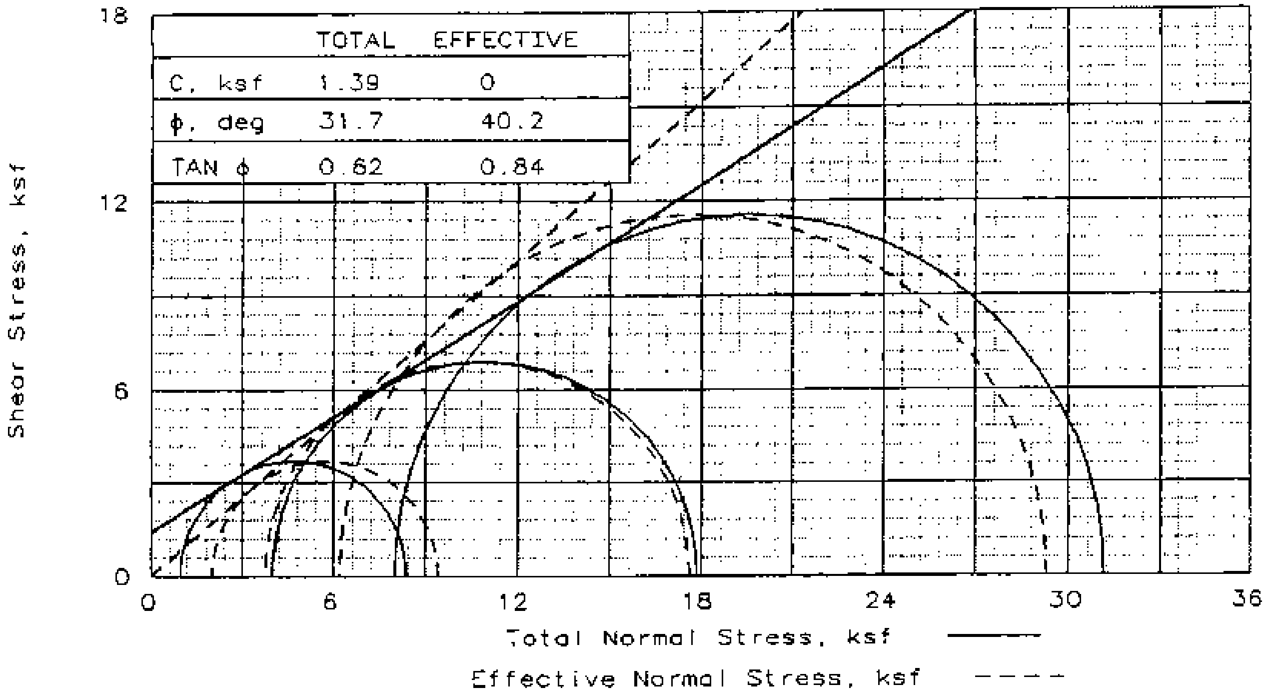
Test Readings Data for Specimen No. 3

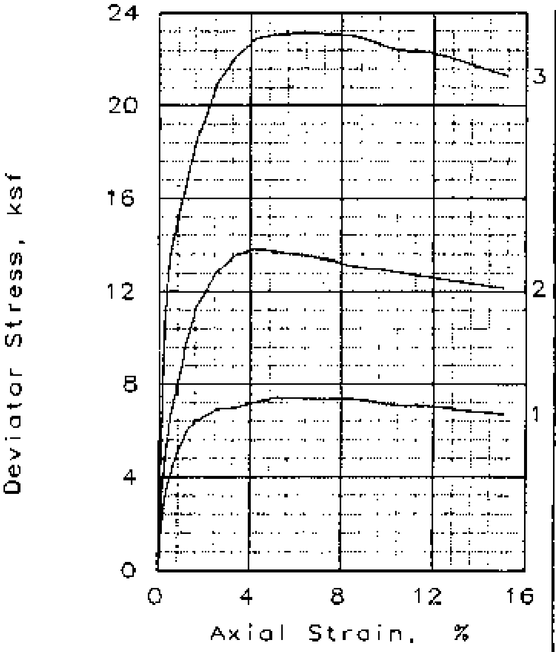
Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 105.50 psi = 15.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 7.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 20.09 ksf at reading no. 17
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.00	0.0	0.0	0.00	7.99	7.99	1.00	50.00	7.99	0.00
1	0.0100	0.010	62.00	173.6	0.2	3.92	7.57	11.50	1.52	52.90	9.54	1.96
2	0.0200	0.020	95.00	266.0	0.3	6.00	7.26	13.26	1.83	55.10	10.26	3.00
3	0.0300	0.030	123.00	344.4	0.5	7.75	6.91	14.67	2.12	57.50	10.79	3.88
4	0.0400	0.040	151.00	422.8	0.7	9.50	6.67	16.17	2.43	59.20	11.42	4.75
5	0.0500	0.050	173.00	484.4	0.8	10.87	6.41	17.28	2.70	61.00	11.84	5.43
6	0.0600	0.060	194.00	543.2	1.0	12.17	6.21	18.38	2.96	62.40	12.29	6.08
7	0.0700	0.070	212.00	593.6	1.2	13.28	5.99	19.27	3.22	63.90	12.63	6.64
8	0.0800	0.080	227.00	635.6	1.3	14.19	5.85	20.04	3.43	64.90	12.94	7.10
9	0.0900	0.090	241.00	674.8	1.5	15.04	5.70	20.74	3.64	65.90	13.22	7.52
10	0.1000	0.100	252.00	705.6	1.7	15.70	5.59	21.29	3.81	66.70	13.44	7.85
11	0.1500	0.150	290.00	812.0	2.5	17.91	5.30	23.21	4.38	68.70	14.26	8.96
12	0.2000	0.200	312.00	873.6	3.4	19.11	5.28	24.39	4.62	68.80	14.84	9.55
13	0.2500	0.250	324.00	907.2	4.2	19.67	5.34	25.01	4.68	68.40	15.18	9.83
14	0.3000	0.300	331.00	926.8	5.0	19.92	5.44	25.36	4.66	67.70	15.40	9.96
15	0.3500	0.350	336.00	940.8	5.9	20.04	5.57	25.61	4.60	66.80	15.59	10.02
16	0.4000	0.400	339.00	949.2	6.7	20.04	5.63	25.67	4.56	66.40	15.65	10.02
17	0.4500	0.450	343.00	960.4	7.6	20.09	5.70	25.79	4.52	65.90	15.75	10.05
18	0.5000	0.500	344.00	963.2	8.4	19.97	5.76	25.73	4.47	65.50	15.74	9.98
19	0.5500	0.550	343.00	960.4	9.2	19.73	5.77	25.50	4.42	65.40	15.64	9.86
20	0.6000	0.600	341.00	954.8	10.1	19.43	5.79	25.22	4.36	65.30	15.50	9.71

Test Readings Data for Specimen No. 3

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	341.00	954.8	10.9	19.25	5.79	25.04	4.32	65.30	15.41	9.62
22	0.7000	0.700	343.00	960.4	11.8	19.18	5.77	24.95	4.32	65.40	15.36	9.59
23	0.7500	0.750	340.00	952.0	12.6	18.83	5.76	24.59	4.27	65.50	15.17	9.41
24	0.8000	0.800	339.00	949.2	13.4	18.59	5.76	24.35	4.23	65.50	15.06	9.30
25	0.8500	0.850	335.00	938.0	14.3	18.20	5.75	23.94	4.17	65.60	14.84	9.10
26	0.9000	0.900	333.00	932.4	15.1	17.91	5.76	23.67	4.11	65.50	14.71	8.95





	SAMPLE NO.:	1	2	3
INITIAL	WATER CONTENT, %	15.8	15.8	15.8
	DRY DENSITY, pcf	99.0	99.0	99.0
	SATURATION, %	62.7	62.7	62.7
	VOID RATIO	0.665	0.665	0.665
	DIAMETER, in	2.84	2.84	2.84
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	25.5	24.9	21.9
	DRY DENSITY, pcf	98.6	99.4	104.4
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.672	0.658	0.578
	DIAMETER, in	2.85	2.84	2.79
	HEIGHT, in	5.98	5.97	5.91
	Strain rate, %/min	0.17	0.17	0.17
	BACK PRESSURE, ksf	7.2	7.2	7.2
	CELL PRESSURE, ksf	8.2	11.2	15.2
	FAIL. STRESS, ksf	7.4	13.8	23.1
	TOTAL PORE PR., ksf	6.2	7.4	9.0
	ULT. STRESS, ksf			
	TOTAL PORE PR., ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	9.4	17.6	29.3
	$\bar{\sigma}_3$ FAILURE, ksf	2.0	3.8	6.2

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded Sample
DESCRIPTION: Gray Ash Sand

SPECIFIC GRAVITY= 2.64
REMARKS: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor

Fig. No.: ______ HB

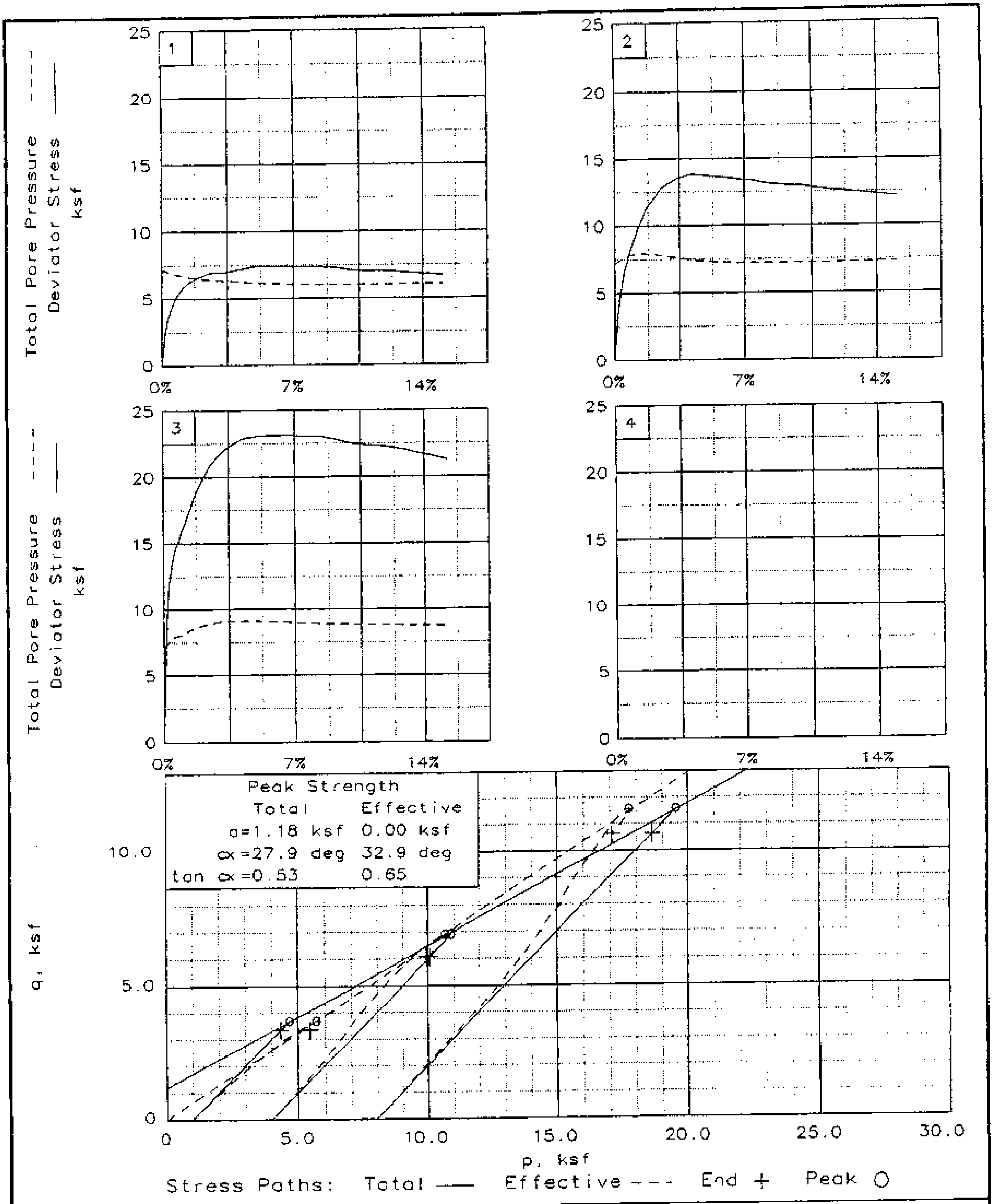
CLIENT: TVA

PROJECT: Ash Disposal Areas
TVA Gallatin Fossil Plant
SAMPLE LOCATION: Old Bottom Ash Bulk Sample

PROJ. NO.: 3043-04-1043 DATE: 09-13-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Client: TVA

Project: Ash Disposal Areas TVA Gallatin Fossil Plant

Location: Old Bottom Ash Bulk Sample

File: FOSSIL1 Project No.: 3043-04-1043 Fig. No.: ____

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

9-14-2004
1:30 pm

Project and Sample Data

Date: 09-13-04
Client: TVA
Project: Ash Disposal Areas TVA Gallatin Fossil Plant
Sample location: Old Bottom Ash Bulk Sample
Sample description: Gray Ash Sand
Remarks: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor
Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Remolded Sample
Specific gravity= 2.64 LL= PL= PI=
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1143.400			1175.040
Wt. dry soil and tare:	987.390			987.390
Wt. of tare:	0.000			0.000
Weight, gms:	1143.4			
Diameter, in:	2.840	2.852	2.850	
Area, in²:	6.335	6.389	6.379	
Height, in:	6.000	6.000	5.983	
Net decrease in height, in:		0.000	0.017	
Net decrease in water volume, cc:		-98.200	2.800	
% Moisture:	15.8	25.7	25.5	19.0
Wet density, pcf:	114.6	123.4	123.7	
Dry density, pcf:	99.0	98.1	98.6	
Void ratio:	0.6653	0.6797	0.6722	
% Saturation:	62.7	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 56.90 psi = 8.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 7.38 ksf at reading no. 14
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.00	0.0	0.0	0.00	0.99	0.99	1.00	50.00	0.99	0.00
1	0.0100	0.010	33.00	92.4	0.2	2.08	1.08	3.16	2.93	49.40	2.12	1.04
2	0.0200	0.020	54.00	151.2	0.3	3.40	1.17	4.57	3.92	48.80	2.87	1.70
3	0.0300	0.030	65.00	182.0	0.5	4.09	1.25	5.34	4.26	48.20	3.30	2.04
4	0.0400	0.040	74.00	207.2	0.7	4.65	1.31	5.96	4.55	47.80	3.63	2.32
5	0.0500	0.050	82.00	229.6	0.8	5.14	1.38	6.52	4.72	47.30	3.95	2.57
6	0.0600	0.060	88.00	246.4	1.0	5.51	1.43	6.93	4.86	47.00	4.18	2.75
7	0.0700	0.070	94.00	263.2	1.2	5.87	1.48	7.36	4.96	46.60	4.42	2.94
8	0.0800	0.080	98.00	274.4	1.3	6.11	1.54	7.65	4.97	46.20	4.60	3.06
9	0.0900	0.090	100.00	280.0	1.5	6.23	1.58	7.81	4.93	45.90	4.70	3.11
10	0.1000	0.100	103.00	288.4	1.7	6.40	1.63	8.03	4.93	45.60	4.83	3.20
11	0.1500	0.150	112.00	313.6	2.5	6.90	1.77	8.67	4.90	44.60	5.22	3.45
12	0.2000	0.200	114.00	319.2	3.3	6.96	1.87	8.84	4.72	43.90	5.35	3.48
13	0.2500	0.250	119.00	333.2	4.2	7.21	1.94	9.15	4.71	43.40	5.55	3.60
14	0.3000	0.300	123.00	344.4	5.0	7.38	2.02	9.40	4.66	42.90	5.71	3.69
15	0.3500	0.350	124.00	347.2	5.8	7.38	2.06	9.44	4.58	42.60	5.75	3.69
16	0.4000	0.400	125.00	350.0	6.7	7.37	2.12	9.49	4.48	42.20	5.80	3.69
17	0.4500	0.450	126.00	352.8	7.5	7.37	2.13	9.50	4.46	42.10	5.81	3.68
18	0.5000	0.500	127.00	355.6	8.4	7.36	2.15	9.50	4.43	42.00	5.82	3.68
19	0.5500	0.550	127.00	355.6	9.2	7.29	2.16	9.45	4.37	41.90	5.80	3.64
20	0.6000	0.600	125.00	350.0	10.0	7.11	2.16	9.27	4.29	41.90	5.71	3.55
21	0.6500	0.650	125.00	350.0	10.9	7.04	2.16	9.20	4.26	41.90	5.68	3.52
22	0.7000	0.700	126.00	352.8	11.7	7.03	2.16	9.19	4.26	41.90	5.68	3.52
23	0.7500	0.750	126.00	352.8	12.5	6.97	2.15	9.11	4.25	42.00	5.63	3.48
24	0.8000	0.800	125.00	350.0	13.4	6.84	2.12	8.96	4.23	42.20	5.54	3.42
25	0.8500	0.850	125.00	350.0	14.2	6.78	2.12	8.90	4.20	42.20	5.51	3.39
26	0.9000	0.900	125.00	350.0	15.0	6.71	2.12	8.83	4.17	42.20	5.47	3.36

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1143.400			1195.770
Wt. dry soil and tare:	987.390			987.390
Wt. of tare:	0.000			0.000
Weight, gms:	1143.4			
Diameter, in:	2.840	2.849	2.841	
Area, in^2:	6.335	6.375	6.338	
Height, in:	6.000	6.000	5.972	
Net decrease in height, in:		0.000	0.028	
Net decrease in water volume, cc:		-96.800	6.600	
% Moisture:	15.8	25.6	24.9	21.1
Wet density, pcf:	114.6	123.5	124.2	
Dry density, pcf:	99.0	98.3	99.4	
Void ratio:	0.6653	0.6759	0.6583	
% Saturation:	62.7	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Consolidation cell pressure = 77.80 psi = 11.20 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 13.84 ksf at reading no. 13
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.00	0.0	0.0	0.00	4.00	4.00	1.00	50.00	4.00	0.00
1	0.0100	0.010	60.00	168.0	0.2	3.81	3.84	7.66	1.99	51.10	5.75	1.91
2	0.0200	0.020	84.00	235.2	0.3	5.33	3.69	9.01	2.44	52.20	6.35	2.66
3	0.0300	0.030	105.00	294.0	0.5	6.65	3.54	10.19	2.88	53.20	6.87	3.32
4	0.0400	0.040	116.00	324.8	0.7	7.33	3.46	10.79	3.12	53.80	7.12	3.67
5	0.0500	0.050	130.00	364.0	0.8	8.20	3.38	11.59	3.42	54.30	7.48	4.10
6	0.0600	0.060	141.00	394.8	1.0	8.88	3.34	12.22	3.66	54.60	7.78	4.44
7	0.0700	0.070	154.00	431.2	1.2	9.68	3.30	12.98	3.94	54.90	8.14	4.84
8	0.0800	0.080	162.00	453.6	1.3	10.17	3.28	13.45	4.10	55.00	8.37	5.08
9	0.0900	0.090	171.00	478.8	1.5	10.72	3.27	13.98	4.28	55.10	8.63	5.36
10	0.1000	0.100	181.00	506.8	1.7	11.32	3.28	14.61	4.45	55.00	8.94	5.66
11	0.1500	0.150	207.00	579.6	2.5	12.84	3.43	16.27	4.75	54.00	9.85	6.42
12	0.2000	0.200	220.00	616.0	3.3	13.53	3.60	17.13	4.76	52.80	10.36	6.76
13	0.2500	0.250	227.00	635.6	4.2	13.84	3.76	17.60	4.68	51.70	10.68	6.92
14	0.3000	0.300	227.00	635.6	5.0	13.72	3.87	17.59	4.54	50.90	10.73	6.86
15	0.3500	0.350	227.00	635.6	5.9	13.60	3.93	17.53	4.46	50.50	10.73	6.80
16	0.4000	0.400	227.00	635.6	6.7	13.47	3.97	17.45	4.39	50.20	10.71	6.74
17	0.4500	0.450	227.00	635.6	7.5	13.35	3.99	17.34	4.35	50.10	10.67	6.68
18	0.5000	0.500	225.00	630.0	8.4	13.12	3.99	17.10	4.29	50.10	10.55	6.56
19	0.5500	0.550	225.00	630.0	9.2	13.00	3.99	16.99	4.26	50.10	10.49	6.50
20	0.6000	0.600	226.00	632.8	10.0	12.93	3.97	16.91	4.25	50.20	10.44	6.47

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	225.00	630.0	10.9	12.76	3.97	16.73	4.21	50.20	10.35	6.38
22	0.7000	0.700	225.00	630.0	11.7	12.64	3.96	16.60	4.19	50.30	10.28	6.32
23	0.7500	0.750	225.00	630.0	12.6	12.52	3.92	16.43	4.20	50.60	10.18	6.26
24	0.8000	0.800	225.00	630.0	13.4	12.40	3.92	16.31	4.17	50.60	10.12	6.20
25	0.8500	0.850	225.00	630.0	14.2	12.28	3.89	16.17	4.16	50.80	10.03	6.14
26	0.9000	0.900	225.00	630.0	15.1	12.16	3.87	16.03	4.14	50.90	9.95	6.08

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1143.400			1166.180
Wt. dry soil and tare:	987.390			987.390
Wt. of tare:	0.000			0.000
Weight, gms:	1143.4			
Diameter, in:	2.840	2.787	2.785	
Area, in²:	6.335	6.099	6.092	
Height, in:	6.000	6.000	5.913	
Net decrease in height, in:		0.000	0.087	
Net decrease in water volume, cc:		-69.600	9.300	
% Moisture:	15.8	22.8	21.9	18.1
Wet density, pcf:	114.6	126.3	127.3	
Dry density, pcf:	99.0	102.8	104.4	
Void ratio:	0.6653	0.6032	0.5784	
% Saturation:	62.7	100.0	100.0	

Test Readings Data for Specimen No. 3

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 105.50 psi = 15.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 7.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 23.14 ksf at reading no. 16
ULT. STRESS = not selected

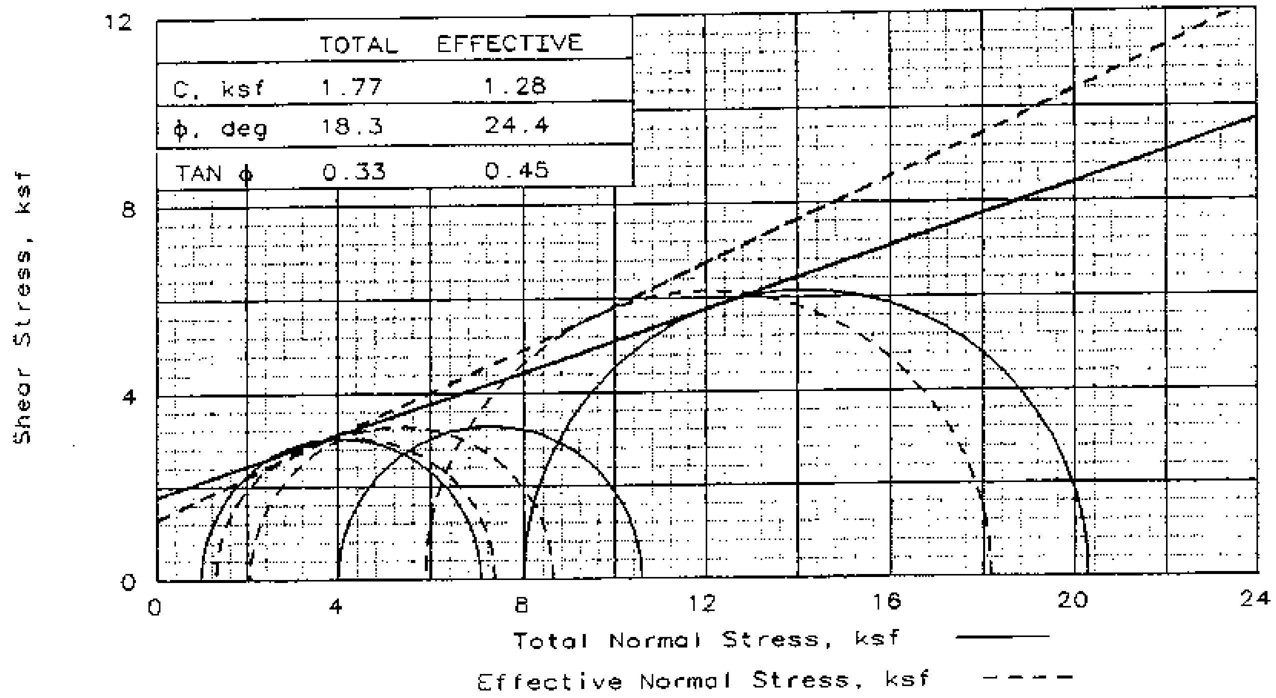
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
0	0.0000	0.000	0.00	0.0	0.0	0.00	7.99	7.99	1.00	50.00	7.99	0.00
1	0.0100	0.010	138.00	386.4	0.2	9.12	7.82	16.94	2.17	51.20	12.38	4.56
2	0.0200	0.020	183.00	512.4	0.3	12.07	7.60	19.67	2.59	52.70	13.64	6.04
3	0.0300	0.030	206.00	576.8	0.5	13.56	7.42	20.98	2.83	54.00	14.20	6.78
4	0.0400	0.040	220.00	616.0	0.7	14.46	7.27	21.73	2.99	55.00	14.50	7.23
5	0.0500	0.050	231.00	646.8	0.8	15.16	7.17	22.33	3.11	55.70	14.75	7.58
6	0.0600	0.060	243.00	680.4	1.0	15.92	7.16	23.08	3.22	55.80	15.12	7.96
7	0.0700	0.070	253.00	708.4	1.2	16.55	6.96	23.50	3.38	57.20	15.23	8.27
8	0.0800	0.080	264.00	739.2	1.4	17.24	6.84	24.08	3.52	58.00	15.46	8.62
9	0.0900	0.090	273.00	764.4	1.5	17.79	6.74	24.53	3.64	58.70	15.64	8.90
10	0.1000	0.100	285.00	798.0	1.7	18.54	6.60	25.14	3.81	59.70	15.87	9.27
11	0.1500	0.150	325.00	910.0	2.5	20.96	6.25	27.21	4.35	62.10	16.73	10.48
12	0.2000	0.200	347.00	971.6	3.4	22.19	6.09	28.28	4.64	63.20	17.19	11.09
13	0.2500	0.250	361.00	1010.8	4.2	22.88	6.06	28.94	4.77	63.40	17.50	11.44
14	0.3000	0.300	367.00	1027.6	5.1	23.06	6.08	29.13	4.79	63.30	17.61	11.53
15	0.3500	0.350	371.00	1038.8	5.9	23.10	6.11	29.21	4.78	63.10	17.66	11.55
16	0.4000	0.400	375.00	1050.0	6.8	23.14	6.19	29.33	4.74	62.50	17.76	11.57
17	0.4500	0.450	377.00	1055.6	7.6	23.05	6.25	29.30	4.69	62.10	17.78	11.53
18	0.5000	0.500	380.00	1064.0	8.5	23.02	6.29	29.32	4.66	61.80	17.80	11.51
19	0.5500	0.550	379.00	1061.2	9.3	22.75	6.34	29.09	4.59	61.50	17.71	11.38
20	0.6000	0.600	378.00	1058.4	10.1	22.48	6.36	28.84	4.53	61.30	17.60	11.24

Test Readings Data for Specimen No. 3

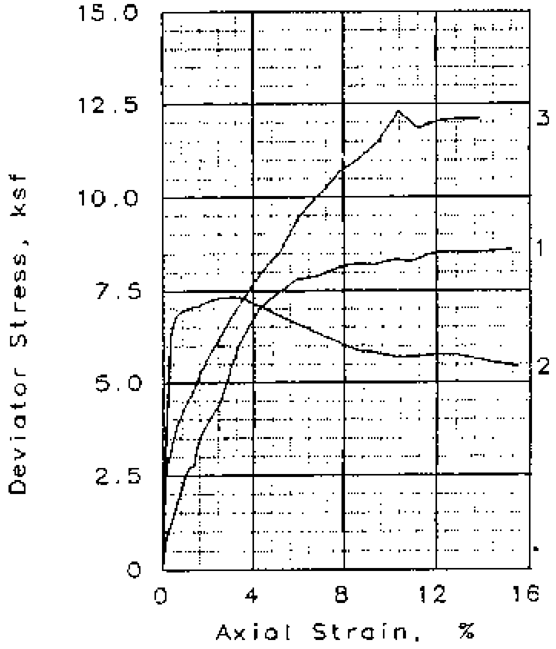
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	379.00	1061.2	11.0	22.33	6.38	28.71	4.50	61.20	17.54	11.16
22	0.7000	0.700	382.00	1069.6	11.8	22.29	6.39	28.68	4.49	61.10	17.54	11.14
23	0.7500	0.750	382.00	1069.6	12.7	22.07	6.42	28.50	4.44	60.90	17.46	11.04
24	0.8000	0.800	381.00	1066.8	13.5	21.80	6.44	28.24	4.39	60.80	17.34	10.90
25	0.8500	0.850	380.00	1064.0	14.4	21.53	6.45	27.99	4.34	60.70	17.22	10.77
26	0.9000	0.900	379.00	1061.2	15.2	21.27	6.47	27.73	4.29	60.60	17.10	10.63

TRIAXIAL COMPRESSION TEST RESULTS

ASH POND SAMPLES



	TOTAL	EFFECTIVE
C, ksf	1.77	1.28
ϕ, deg	18.3	24.4
TAN ϕ	0.33	0.45



	SAMPLE NO.:	1	2	3
INITIAL	WATER CONTENT, %	47.6	50.6	44.7
	DRY DENSITY, pcf	71.0	68.8	73.4
	SATURATION, %	100.0	100.4	100.0
	VOID RATIO	1.181	1.250	1.109
	DIAMETER, in	2.84	2.88	2.87
	HEIGHT, in	5.93	6.00	5.87
AT TEST	WATER CONTENT, %	47.6	44.9	42.5
	DRY DENSITY, pcf	71.0	73.3	75.4
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	1.180	1.113	1.053
	DIAMETER, in	2.84	2.83	2.85
	HEIGHT, in	5.91	5.85	5.79
	Strain rate, %/min	0.17	0.17	0.17
	BACK PRESSURE, ksf	7.2	7.2	7.2
	CELL PRESSURE, ksf	8.2	11.2	15.2
	FAIL. STRESS, ksf	6.1	6.6	12.3
	TOTAL PORE PR., ksf	6.9	9.1	9.3
	ULT. STRESS, ksf			
	TOTAL PORE PR., ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	7.4	8.6	18.2
	$\bar{\sigma}_3$ FAILURE, ksf	1.3	2.1	5.9

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Shelby Tube
DESCRIPTION: Gray Ash Sand

SPECIFIC GRAVITY= 2.48
REMARKS: Wet pockets and clay
seams in specimen #2

Fig. No.: ______ HB

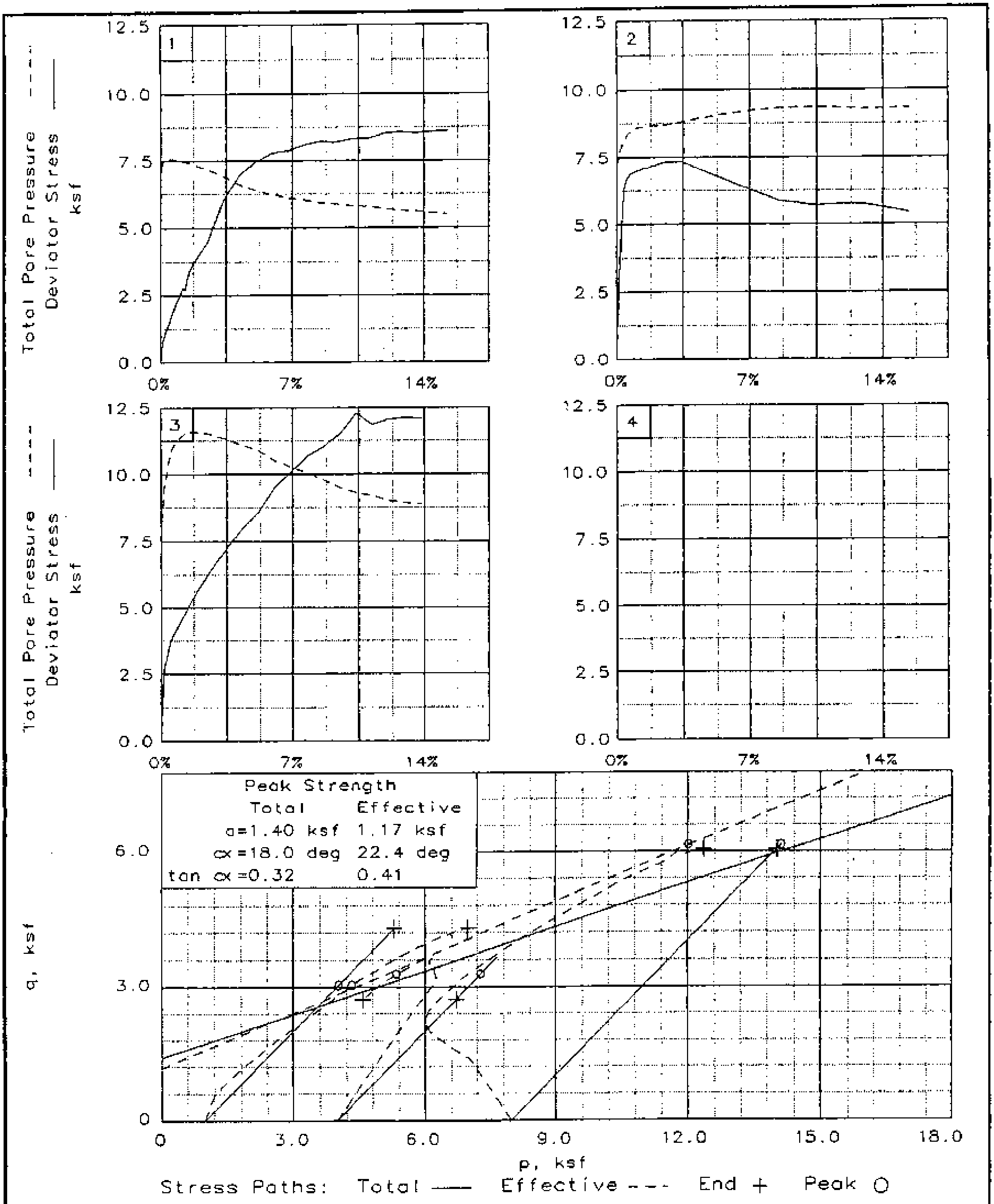
CLIENT: TVA

PROJECT: Ash Disposal Areas - TVA Gallatin
Fossil Plant
SAMPLE LOCATION: B-3 UD @ 7.5'-9.5'

PROJ. NO.: 3043-04-1043 DATE: 09-23-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Client: TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Location: B-3 UD @ 7.5'-9.5'

File: FOSSIL5 Project No.: 3043-04-1043 Fig. No.: ____

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

9-23-2004
5:32 pm

Project and Sample Data

Date: 09-23-04
Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Sample location: B-3 UD @ 7.5'-9.5'
Sample description: Gray Ash Sand
Remarks: Wet pockets and clay seams in specimen #2

Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Shelby Tube
Specific gravity= 2.48 LL= PL= PI=
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1031.600			1019.960
Wt. dry soil and tare:	698.950			698.950
Wt. of tare:	0.000			0.000
Weight, gms:	1031.6			
Diameter, in:	2.838	2.843	2.842	
Area, in²:	6.326	6.347	6.345	
Height, in:	5.929	5.929	5.910	
Net decrease in height, in:		0.000	0.019	
Net decrease in water volume, cc:		-2.200	2.200	
% Moisture:	47.6	47.9	47.6	45.9
Wet density, pcf:	104.8	104.7	104.8	
Dry density, pcf:	71.0	70.8	71.0	
Void ratio:	1.1807	1.1881	1.1803	
% Saturation:	100.0	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 56.90 psi = 8.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 6.08 ksf at reading no. 12
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.0	0.00	0.99	0.99	1.00	50.00	0.99	0.00
1	0.0100	0.010	53.0	38.2	0.2	0.86	0.72	1.58	2.20	51.90	1.15	0.43
2	0.0200	0.020	73.0	52.6	0.3	1.19	0.65	1.84	2.83	52.40	1.24	0.59
3	0.0300	0.030	91.0	65.5	0.5	1.48	0.63	2.11	3.34	52.50	1.37	0.74
4	0.0400	0.040	113.0	81.4	0.7	1.83	0.63	2.47	3.89	52.50	1.55	0.92
5	0.0500	0.050	132.0	95.0	0.8	2.14	0.65	2.79	4.30	52.40	1.72	1.07
6	0.0600	0.060	151.0	108.7	1.0	2.44	0.68	3.12	4.61	52.20	1.90	1.22
7	0.0700	0.070	170.0	122.4	1.2	2.75	0.72	3.47	4.81	51.90	2.09	1.37
8	0.0800	0.080	169.0	121.7	1.4	2.72	0.75	3.47	4.64	51.70	2.11	1.36
9	0.0900	0.090	205.0	147.6	1.5	3.30	0.78	4.08	5.24	51.50	2.43	1.65
10	0.1000	0.100	222.0	159.8	1.7	3.57	0.82	4.39	5.34	51.20	2.60	1.78
11	0.1500	0.150	284.0	204.5	2.5	4.52	1.01	5.53	5.49	49.90	3.27	2.26
12	0.2000	0.200	385.0	277.2	3.4	6.08	1.30	7.37	5.69	47.90	4.34	3.04
13	0.2500	0.250	447.0	321.8	4.2	7.00	1.60	8.59	5.38	45.80	5.10	3.50
14	0.3000	0.300	480.0	345.6	5.1	7.45	1.79	9.23	5.17	44.50	5.51	3.72
15	0.3500	0.350	507.0	365.0	5.9	7.79	1.97	9.77	4.95	43.20	5.87	3.90
16	0.4000	0.400	517.0	372.2	6.8	7.88	2.07	9.95	4.80	42.50	6.01	3.94
17	0.4500	0.450	536.0	385.9	7.6	8.09	2.16	10.25	4.75	41.90	6.21	4.05
18	0.5000	0.500	550.0	396.0	8.5	8.23	2.26	10.49	4.64	41.20	6.37	4.11
19	0.5500	0.550	553.0	398.2	9.3	8.20	2.32	10.51	4.53	40.80	6.42	4.10
20	0.6000	0.600	567.0	408.2	10.2	8.32	2.39	10.72	4.48	40.30	6.55	4.16
21	0.6500	0.650	572.0	411.8	11.0	8.32	2.42	10.74	4.44	40.10	6.58	4.16
22	0.7000	0.700	591.0	425.5	11.8	8.51	2.49	11.00	4.42	39.60	6.75	4.26
23	0.7500	0.750	600.0	432.0	12.7	8.56	2.56	11.12	4.34	39.10	6.84	4.28
24	0.8000	0.800	603.0	434.2	13.5	8.52	2.59	11.11	4.29	38.90	6.85	4.26
25	0.8500	0.850	613.0	441.4	14.4	8.58	2.65	11.23	4.24	38.50	6.94	4.29
26	0.9000	0.900	621.0	447.1	15.2	8.60	2.69	11.30	4.19	38.20	6.99	4.30

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1063.470			1022.260
Wt. dry soil and tare:	706.070			706.070
Wt. of tare:	0.000			0.000
Weight, gms:	1063.5			
Diameter, in:	2.880	2.889	2.828	
Area, in²:	6.514	6.557	6.282	
Height, in:	6.000	6.000	5.845	
Net decrease in height, in:		0.000	0.155	
Net decrease in water volume, cc:		-2.600	43.000	
% Moisture:	50.6	51.0	44.9	44.8
Wet density, pcf:	103.7	103.2	106.1	
Dry density, pcf:	68.8	68.4	73.3	
Void ratio:	1.2497	1.2645	1.1134	
% Saturation:	100.4	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 77.80 psi = 11.20 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 6.58 ksf at reading no. 15
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.00	0.0	0.0	0.00	4.00	4.00	1.00	50.00	4.00	0.00
1	0.0100	0.010	65.00	182.0	0.2	4.16	3.37	7.53	2.24	54.40	5.45	2.08
2	0.0200	0.020	99.00	277.2	0.3	6.33	3.11	9.44	3.04	56.20	6.28	3.17
3	0.0300	0.030	105.00	294.0	0.5	6.70	2.88	9.58	3.33	57.80	6.23	3.35
4	0.0400	0.040	108.00	302.4	0.7	6.88	2.75	9.63	3.50	58.70	6.19	3.44
5	0.0500	0.050	109.00	305.2	0.9	6.94	2.68	9.61	3.59	59.20	6.15	3.47
6	0.0600	0.060	110.00	308.0	1.0	6.99	2.62	9.61	3.67	59.60	6.11	3.49
7	0.0700	0.070	111.00	310.8	1.2	7.04	2.58	9.62	3.73	59.90	6.10	3.52
8	0.0800	0.080	112.00	313.6	1.4	7.09	2.58	9.67	3.75	59.90	6.12	3.55
9	0.0900	0.090	112.00	313.6	1.5	7.08	2.55	9.63	3.78	60.10	6.09	3.54
10	0.1000	0.100	113.00	316.4	1.7	7.13	2.53	9.66	3.81	60.20	6.10	3.56
11	0.1500	0.150	117.00	327.6	2.6	7.32	2.51	9.82	3.92	60.40	6.16	3.66
12	0.2000	0.200	118.00	330.4	3.4	7.31	2.39	9.70	4.06	61.20	6.05	3.66
13	0.2500	0.250	115.00	322.0	4.3	7.07	2.28	9.34	4.11	62.00	5.81	3.53
14	0.3000	0.300	112.00	313.6	5.1	6.82	2.17	8.99	4.14	62.70	5.58	3.41
15	0.3500	0.350	109.00	305.2	6.0	6.58	2.06	8.64	4.19	63.50	5.35	3.29
16	0.4000	0.400	106.00	296.8	6.8	6.34	1.99	8.33	4.19	64.00	5.16	3.17
17	0.4500	0.450	103.00	288.4	7.7	6.10	1.93	8.03	4.16	64.40	4.98	3.05
18	0.5000	0.500	100.00	280.0	8.6	5.87	1.87	7.74	4.14	64.80	4.81	2.93
19	0.5500	0.550	100.00	280.0	9.4	5.81	1.86	7.67	4.13	64.90	4.76	2.91
20	0.6000	0.600	99.00	277.2	10.3	5.70	1.84	7.55	4.09	65.00	4.69	2.85

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	100.00	280.0	11.1	5.70	1.86	7.56	4.07	64.90	4.71	2.85
22	0.7000	0.700	102.00	285.6	12.0	5.76	1.87	7.63	4.08	64.80	4.75	2.88
23	0.7500	0.750	103.00	288.4	12.8	5.76	1.90	7.66	4.03	64.60	4.78	2.88
24	0.8000	0.800	102.00	285.6	13.7	5.65	1.90	7.55	3.97	64.60	4.73	2.83
25	0.8500	0.850	101.00	282.8	14.5	5.54	1.89	7.43	3.94	64.70	4.66	2.77
26	0.9000	0.900	100.00	280.0	15.4	5.43	1.87	7.30	3.90	64.80	4.59	2.72

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1057.340			1031.060
Wt. dry soil and tare:	730.610			730.610
Wt. of tare:	0.000			0.000
Weight, gms:	1057.3			
Diameter, in:	2.867	2.875	2.849	
Area, in²:	6.456	6.492	6.377	
Height, in:	5.872	5.872	5.789	
Net decrease in height, in:		0.000	0.083	
Net decrease in water volume, cc:		-3.400	19.800	
% Moisture:	44.7	45.2	42.5	41.1
Wet density, pcf:	106.3	106.0	107.4	
Dry density, pcf:	73.4	73.0	75.4	
Void ratio:	1.1086	1.1206	1.0534	
% Saturation:	100.0	100.0	100.0	

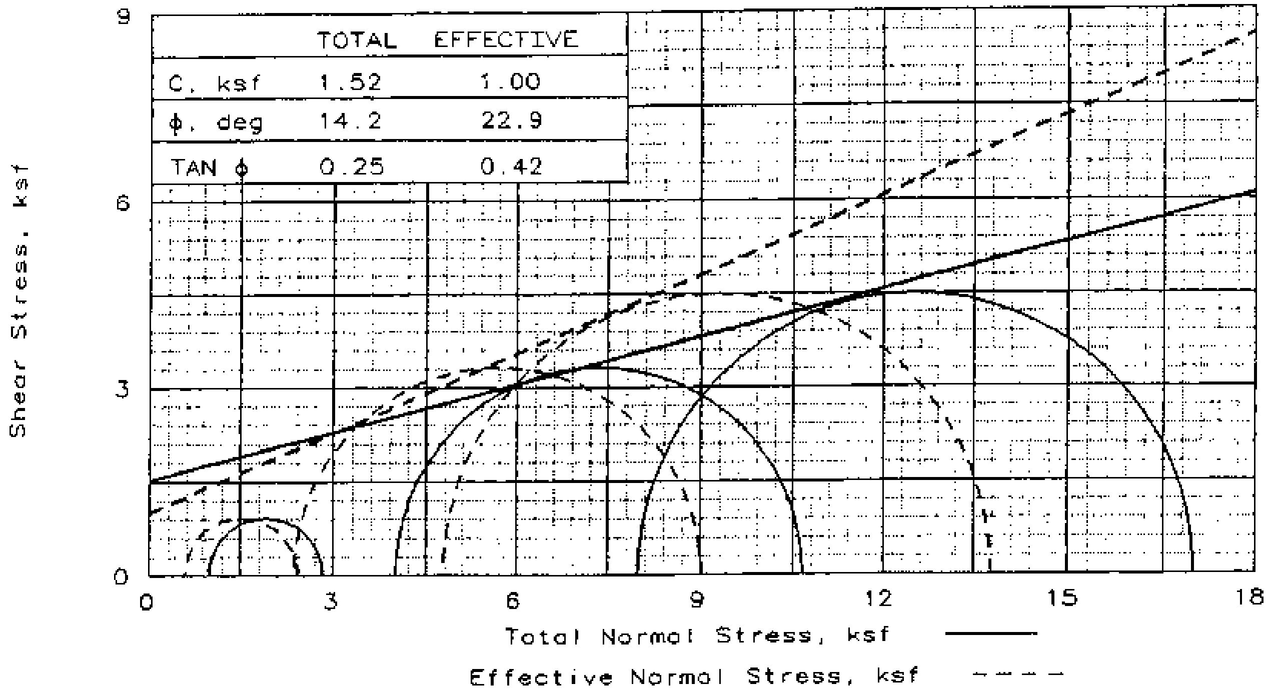
Test Readings Data for Specimen No. 3

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 105.50 psi = 15.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 7.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 12.30 ksf at reading no. 20
ULT. STRESS = not selected

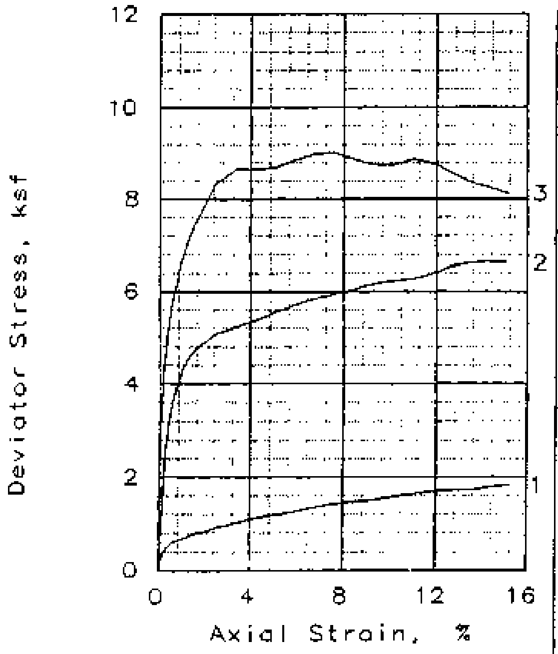
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
0	0.0000	0.000	0.00	0.0	0.0	0.00	7.99	7.99	1.00	50.00	7.99	0.00
1	0.0100	0.010	43.00	120.4	0.2	2.71	5.72	8.43	1.47	65.80	7.07	1.36
2	0.0200	0.020	50.00	140.0	0.3	3.15	5.11	8.26	1.62	70.00	6.69	1.58
3	0.0300	0.030	58.00	162.4	0.5	3.65	4.51	8.16	1.81	74.20	6.33	1.82
4	0.0400	0.040	63.00	176.4	0.7	3.96	4.18	8.13	1.95	76.50	6.15	1.98
5	0.0500	0.050	67.00	187.6	0.9	4.20	3.95	8.15	2.06	78.10	6.05	2.10
6	0.0600	0.060	71.00	198.8	1.0	4.44	3.83	8.27	2.16	78.90	6.05	2.22
7	0.0700	0.070	75.00	210.0	1.2	4.68	3.70	8.39	2.27	79.80	6.04	2.34
8	0.0800	0.080	78.00	218.4	1.4	4.86	3.64	8.51	2.34	80.20	6.08	2.43
9	0.0900	0.090	83.00	232.4	1.6	5.17	3.61	8.78	2.43	80.40	6.20	2.58
10	0.1000	0.100	86.00	240.8	1.7	5.34	3.60	8.94	2.48	80.50	6.27	2.67
11	0.1500	0.150	103.00	288.4	2.6	6.34	3.67	10.02	2.73	80.00	6.84	3.17
12	0.2000	0.200	118.00	330.4	3.5	7.20	3.87	11.08	2.86	78.60	7.48	3.60
13	0.2500	0.250	132.00	369.6	4.3	7.99	4.09	12.08	2.95	77.10	8.08	3.99
14	0.3000	0.300	143.00	400.4	5.2	8.57	4.31	12.88	2.99	75.60	8.59	4.29
15	0.3500	0.350	160.00	448.0	6.0	9.51	4.68	14.19	3.03	73.00	9.43	4.75
16	0.4300	0.430	178.00	498.4	7.4	10.42	5.07	15.49	3.06	70.30	10.28	5.21
17	0.4500	0.450	183.00	512.4	7.8	10.67	5.16	15.83	3.07	69.70	10.49	5.34
18	0.5000	0.500	191.00	534.8	8.6	11.03	5.39	16.42	3.05	68.10	10.90	5.52
19	0.5500	0.550	201.00	562.8	9.5	11.50	5.70	17.20	3.02	65.90	11.45	5.75
20	0.6000	0.600	217.00	607.6	10.4	12.30	5.88	18.17	3.09	64.70	12.02	6.15

Test Readings Data for Specimen No. 3

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
21	0.6500	0.650	211.00	590.8	11.2	11.84	5.99	17.83	2.98	63.90	11.91	5.92
22	0.7000	0.700	217.00	607.6	12.1	12.06	6.19	18.25	2.95	62.50	12.22	6.03
23	0.7500	0.750	220.00	616.0	13.0	12.11	6.26	18.37	2.93	62.00	12.32	6.05
24	0.8000	0.800	222.00	621.6	13.8	12.10	6.32	18.42	2.91	61.60	12.37	6.05



	TOTAL	EFFECTIVE
C, ksf	1.52	1.00
ϕ, deg	14.2	22.9
TAN ϕ	0.25	0.42



	SAMPLE NO.:	1	2	3
INITIAL	WATER CONTENT, %	25.9	23.7	28.7
	DRY DENSITY, pcf	100.4	103.8	96.5
	SATURATION, %	102.5	102.0	103.3
	VOID RATIO	0.685	0.629	0.753
	DIAMETER, in	2.85	2.84	2.82
	HEIGHT, in	6.00	6.04	6.01
AT TEST	WATER CONTENT, %	24.4	22.3	27.3
	DRY DENSITY, pcf	101.8	105.4	97.2
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.662	0.605	0.740
	DIAMETER, in	2.85	2.83	2.83
	HEIGHT, in	5.92	5.99	5.92
	Strain rate, %/min	0.07	0.07	0.07
	BACK PRESSURE, ksf	7.2	7.2	7.2
	CELL PRESSURE, ksf	8.2	11.2	15.2
	FAIL. STRESS, ksf	1.8	6.7	9.0
	TOTAL PORE PR., ksf	7.6	8.8	10.4
	ULT. STRESS, ksf			
	TOTAL PORE PR., ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	2.4	9.0	13.8
	$\bar{\sigma}_3$ FAILURE, ksf	0.6	2.4	4.8

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Shelby Tube
DESCRIPTION: Orange-Brown Silty Clay (CH)
LL= 51 PL= 20 PI= 31
SPECIFIC GRAVITY= 2.71
REMARKS: Specimen #1 different material from specimens 2 & 3 (grey and soft ash)

Fig. No.: ______ HB

CLIENT: TVA

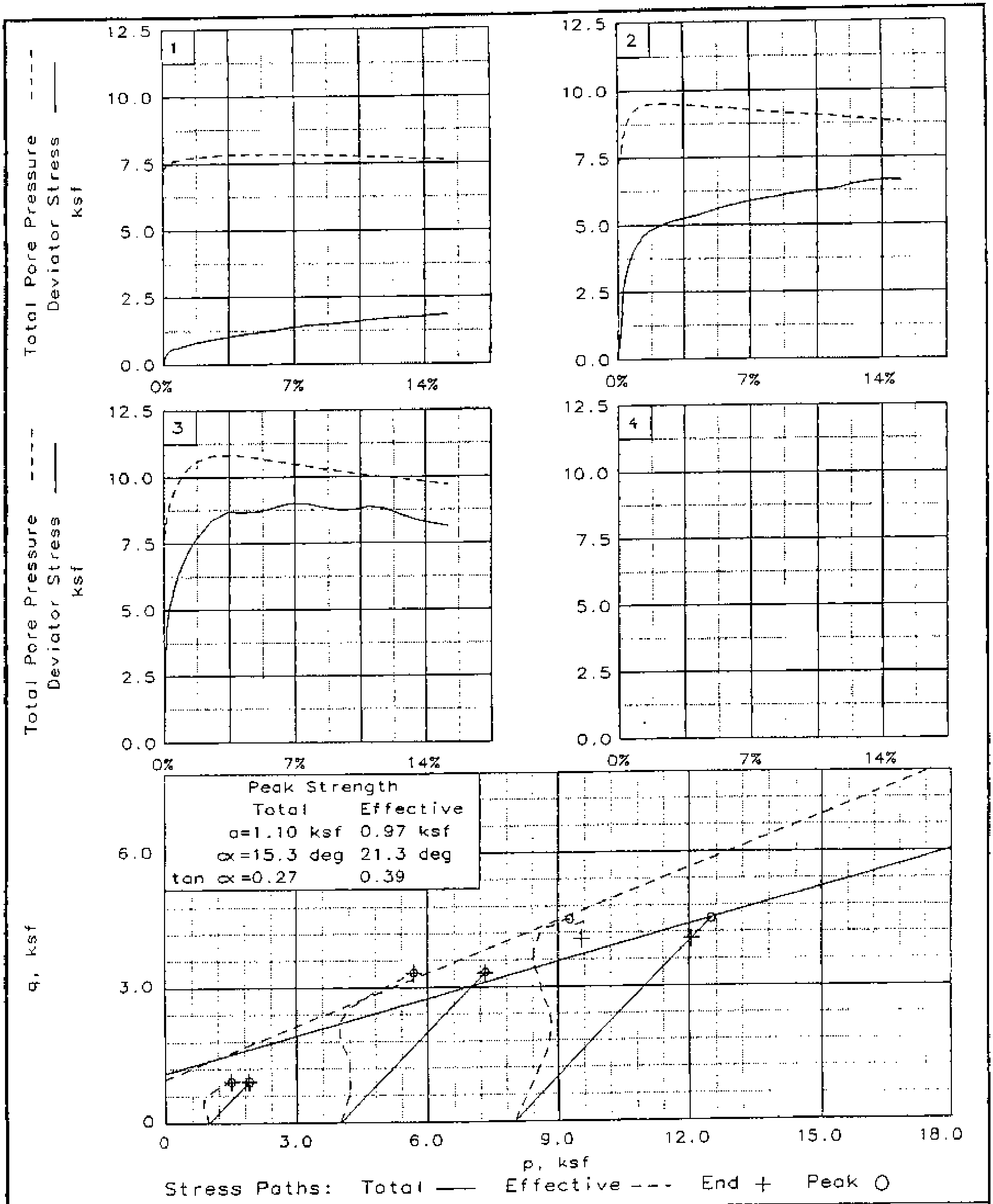
PROJECT: Ash Disposal Areas - TVA Gallatin Fossil Plant

SAMPLE LOCATION: B-8 UD @ 22'-23.5'

PROJ. NO.: 3043-04-1043 DATE: 09-22-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Location: B-8 UD @ 22'-23.5'
File: FOSSIL4 Project No.: 3043-04-1043 Fig. No.: ____

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

10-12-2004
5:09 pm

Project and Sample Data

Date: 09-22-04
Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Sample location: B-8 UD @ 22'-23.5'
Sample description: Orange-Brown Silty Clay (CH)
Remarks: Specimen #1 different material from specimens 2 & 3
(grey and soft ash)
Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Shelby Tube
Specific gravity= 2.71 LL= 51 PL= 20 PI= 31
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1273.240			1246.880
Wt. dry soil and tare:	1011.280			1011.280
Wt. of tare:	0.000			0.000
Weight, gms:	1273.2			
Diameter, in:	2.854	2.873	2.854	
Area, in²:	6.397	6.482	6.398	
Height, in:	5.998	5.998	5.917	
Net decrease in height, in:		0.000	0.081	
Net decrease in water volume, cc:		-2.000	16.800	
% Moisture:	25.9	26.1	24.4	23.3
Wet density, pcf:	126.4	125.0	126.6	
Dry density, pcf:	100.4	99.1	101.8	
Void ratio:	0.6850	0.7074	0.6623	
% Saturation:	102.5	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 56.90 psi = 8.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.07
FAIL. STRESS = 1.84 ksf at reading no. 36
ULT. STRESS = not selected

Test Readings Data for Specimen No. 3

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
21	0.1500	0.150	519.0	373.7	2.5	8.36	4.41	12.76	2.90	74.90	8.59	4.18
22	0.2000	0.200	543.0	391.0	3.4	8.67	4.36	13.03	2.99	75.20	8.70	4.33
23	0.2500	0.250	547.0	393.8	4.2	8.66	4.41	13.06	2.96	74.90	8.73	4.33
24	0.3000	0.300	554.0	398.9	5.1	8.69	4.49	13.18	2.93	74.30	8.84	4.34
25	0.3500	0.350	570.0	410.4	5.9	8.86	4.59	13.45	2.93	73.60	9.02	4.43
26	0.4000	0.400	584.0	420.5	6.8	9.00	4.68	13.68	2.92	73.00	9.18	4.50
27	0.4500	0.450	590.0	424.8	7.6	9.01	4.78	13.79	2.88	72.30	9.28	4.50
28	0.5000	0.500	587.0	422.6	8.4	8.88	4.88	13.76	2.82	71.60	9.32	4.44
29	0.5500	0.550	584.0	420.5	9.3	8.75	4.97	13.72	2.76	71.00	9.34	4.38
30	0.6000	0.600	590.0	424.8	10.1	8.76	5.04	13.80	2.74	70.50	9.42	4.38
31	0.6500	0.650	604.0	434.9	11.0	8.88	5.14	14.02	2.73	69.80	9.58	4.44
32	0.7000	0.700	604.0	434.9	11.8	8.80	5.20	14.00	2.69	69.40	9.60	4.40
33	0.7500	0.750	594.0	427.7	12.7	8.57	5.27	13.84	2.63	68.90	9.56	4.29
34	0.8000	0.800	586.0	421.9	13.5	8.37	5.34	13.72	2.57	68.40	9.53	4.19
35	0.8500	0.850	583.0	419.8	14.4	8.25	5.43	13.68	2.52	67.80	9.55	4.12
36	0.9000	0.900	580.0	417.6	15.2	8.13	5.49	13.61	2.48	67.40	9.55	4.06

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	0.99	0.99	1.00	50.00	0.99	0.00
1	0.0050	0.005	12.0	8.6	0.1	0.19	0.85	1.04	1.23	51.00	0.95	0.10
2	0.0100	0.010	21.0	15.1	0.2	0.34	0.78	1.12	1.44	51.50	0.95	0.17
3	0.0150	0.015	27.0	19.4	0.3	0.44	0.71	1.14	1.62	52.00	0.92	0.22
4	0.0200	0.020	31.0	22.3	0.3	0.50	0.68	1.18	1.74	52.20	0.93	0.25
5	0.0250	0.025	33.0	23.8	0.4	0.53	0.65	1.18	1.82	52.40	0.91	0.27
6	0.0300	0.030	35.0	25.2	0.5	0.56	0.62	1.18	1.91	52.60	0.90	0.28
7	0.0350	0.035	37.0	26.6	0.6	0.60	0.59	1.19	2.01	52.80	0.89	0.30
8	0.0400	0.040	38.0	27.4	0.7	0.61	0.59	1.20	2.04	52.80	0.90	0.31
9	0.0450	0.045	39.0	28.1	0.8	0.63	0.56	1.19	2.12	53.00	0.88	0.31
10	0.0500	0.050	40.0	28.8	0.8	0.64	0.56	1.20	2.14	53.00	0.88	0.32
11	0.0550	0.055	41.0	29.5	0.9	0.66	0.55	1.21	2.20	53.10	0.88	0.33
12	0.0600	0.060	42.0	30.2	1.0	0.67	0.53	1.21	2.26	53.20	0.87	0.34
13	0.0650	0.065	43.0	31.0	1.1	0.69	0.52	1.21	2.33	53.30	0.86	0.34
14	0.0700	0.070	44.0	31.7	1.2	0.70	0.52	1.22	2.36	53.30	0.87	0.35
15	0.0750	0.075	45.0	32.4	1.3	0.72	0.50	1.22	2.43	53.40	0.86	0.36
16	0.0800	0.080	46.0	33.1	1.4	0.74	0.50	1.24	2.46	53.40	0.87	0.37
17	0.0850	0.085	47.0	33.8	1.4	0.75	0.49	1.24	2.53	53.50	0.86	0.38
18	0.0900	0.090	48.0	34.6	1.5	0.77	0.48	1.24	2.61	53.60	0.86	0.38
19	0.0950	0.095	49.0	35.3	1.6	0.78	0.48	1.26	2.64	53.60	0.87	0.39
20	0.1000	0.100	50.0	36.0	1.7	0.80	0.46	1.26	2.73	53.70	0.86	0.40
21	0.1500	0.150	58.0	41.8	2.5	0.92	0.42	1.33	3.19	54.00	0.88	0.46
22	0.2000	0.200	65.0	46.8	3.4	1.02	0.37	1.39	3.72	54.30	0.88	0.51
23	0.2500	0.250	72.0	51.8	4.2	1.12	0.36	1.48	4.10	54.40	0.92	0.56
24	0.3000	0.300	77.0	55.4	5.1	1.18	0.36	1.54	4.29	54.40	0.95	0.59
25	0.3500	0.350	83.0	59.8	5.9	1.27	0.36	1.63	4.52	54.40	0.99	0.63
26	0.4000	0.400	90.0	64.8	6.8	1.36	0.36	1.72	4.78	54.40	1.04	0.68
27	0.4500	0.450	95.0	68.4	7.6	1.42	0.37	1.80	4.80	54.30	1.09	0.71
28	0.5000	0.500	100.0	72.0	8.5	1.48	0.39	1.87	4.82	54.20	1.13	0.74
29	0.5500	0.550	103.0	74.2	9.3	1.51	0.42	1.93	4.63	54.00	1.17	0.76
30	0.6000	0.600	108.0	77.8	10.1	1.57	0.43	2.00	4.64	53.90	1.22	0.79
31	0.6500	0.650	114.0	82.1	11.0	1.64	0.46	2.11	4.57	53.70	1.28	0.82
32	0.7000	0.700	119.0	85.7	11.8	1.70	0.48	2.18	4.58	53.60	1.33	0.85
33	0.7500	0.750	122.0	87.8	12.7	1.73	0.50	2.23	4.43	53.40	1.37	0.86
34	0.8000	0.800	124.0	89.3	13.5	1.74	0.55	2.29	4.18	53.10	1.42	0.87
35	0.8500	0.850	129.0	92.9	14.4	1.79	0.56	2.35	4.19	53.00	1.46	0.90
36	0.9000	0.900	134.0	96.5	15.2	1.84	0.59	2.43	4.12	52.80	1.51	0.92

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1290.100			1276.030
Wt. dry soil and tare:	1042.940			1042.940
Wt. of tare:	0.000			0.000
Weight, gms:	1290.1			
Diameter, in:	2.840	2.855	2.831	
Area, in²:	6.335	6.401	6.295	
Height, in:	6.041	6.041	5.987	
Net decrease in height, in:		0.000	0.054	
Net decrease in water volume, cc:		-1.700	16.100	
% Moisture:	23.7	23.9	22.3	22.3
Wet density, pcf:	128.4	127.3	128.9	
Dry density, pcf:	103.8	102.7	105.4	
Void ratio:	0.6295	0.6466	0.6048	
% Saturation:	102.0	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 77.80 psi = 11.20 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.07
FAIL. STRESS = 6.66 ksf at reading no. 34
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	4.00	4.00	1.00	50.00	4.00	0.00
1	0.0100	0.010	84.0	60.5	0.2	1.38	3.53	4.91	1.39	53.30	4.22	0.69
2	0.0150	0.015	158.0	113.8	0.3	2.60	2.92	5.52	1.89	57.50	4.22	1.30
3	0.0200	0.020	173.0	124.6	0.3	2.84	2.78	5.62	2.02	58.50	4.20	1.42
4	0.0250	0.025	193.0	139.0	0.4	3.17	2.53	5.70	2.25	60.20	4.12	1.58
5	0.0300	0.030	207.0	149.0	0.5	3.39	2.36	5.75	2.44	61.40	4.06	1.70
6	0.0350	0.035	220.0	158.4	0.6	3.60	2.22	5.82	2.62	62.40	4.02	1.80
7	0.0400	0.040	231.0	166.3	0.7	3.78	2.12	5.90	2.79	63.10	4.01	1.89
8	0.0450	0.045	240.0	172.8	0.8	3.92	2.03	5.95	2.93	63.70	3.99	1.96
9	0.0500	0.050	249.0	179.3	0.8	4.07	1.96	6.03	3.08	64.20	3.99	2.03
10	0.0550	0.055	256.0	184.3	0.9	4.18	1.90	6.08	3.20	64.60	3.99	2.09
11	0.0600	0.060	263.0	189.4	1.0	4.29	1.86	6.15	3.31	64.90	4.00	2.14
12	0.0650	0.065	268.0	193.0	1.1	4.37	1.83	6.19	3.39	65.10	4.01	2.18
13	0.0700	0.070	273.0	196.6	1.2	4.44	1.79	6.23	3.49	65.40	4.01	2.22
14	0.0750	0.075	279.0	200.9	1.3	4.54	1.77	6.31	3.56	65.50	4.04	2.27
15	0.0800	0.080	284.0	204.5	1.3	4.61	1.74	6.36	3.65	65.70	4.05	2.31
16	0.0850	0.085	287.0	206.6	1.4	4.66	1.73	6.39	3.70	65.80	4.06	2.33
17	0.0900	0.090	290.0	208.8	1.5	4.70	1.73	6.43	3.72	65.80	4.08	2.35
18	0.0950	0.095	294.0	211.7	1.6	4.77	1.71	6.48	3.78	65.90	4.10	2.38
19	0.1000	0.100	297.0	213.8	1.7	4.81	1.70	6.51	3.83	66.00	4.10	2.40
20	0.1500	0.150	316.0	227.5	2.5	5.07	1.68	6.76	4.01	66.10	4.22	2.54

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.2000	0.200	329.0	236.9	3.3	5.24	1.73	6.97	4.03	65.80	4.35	2.62
22	0.2500	0.250	340.0	244.8	4.2	5.37	1.77	7.14	4.03	65.50	4.45	2.68
23	0.3000	0.300	355.0	255.6	5.0	5.55	1.83	7.38	4.04	65.10	4.61	2.78
24	0.3500	0.350	367.0	264.2	5.8	5.69	1.86	7.55	4.06	64.90	4.70	2.85
25	0.4000	0.400	380.0	273.6	6.7	5.84	1.92	7.76	4.05	64.50	4.84	2.92
26	0.4500	0.450	390.0	280.8	7.5	5.94	1.99	7.93	3.99	64.00	4.96	2.97
27	0.5000	0.500	400.0	288.0	8.4	6.04	2.03	8.07	3.97	63.70	5.05	3.02
28	0.5500	0.550	412.0	296.6	9.2	6.16	2.09	8.25	3.95	63.30	5.17	3.08
29	0.6000	0.600	420.0	302.4	10.0	6.22	2.12	8.34	3.94	63.10	5.23	3.11
30	0.6500	0.650	427.0	307.4	10.9	6.27	2.16	8.43	3.90	62.80	5.29	3.13
31	0.7000	0.700	437.0	314.6	11.7	6.36	2.20	8.56	3.88	62.50	5.38	3.18
32	0.7500	0.750	453.0	326.2	12.5	6.53	2.28	8.80	3.87	62.00	5.54	3.26
33	0.8000	0.800	463.0	333.4	13.4	6.61	2.30	8.91	3.87	61.80	5.61	3.30
34	0.8500	0.850	471.0	339.1	14.2	6.66	2.36	9.02	3.82	61.40	5.69	3.33
35	0.9000	0.900	474.0	341.3	15.0	6.63	2.38	9.01	3.79	61.30	5.69	3.32

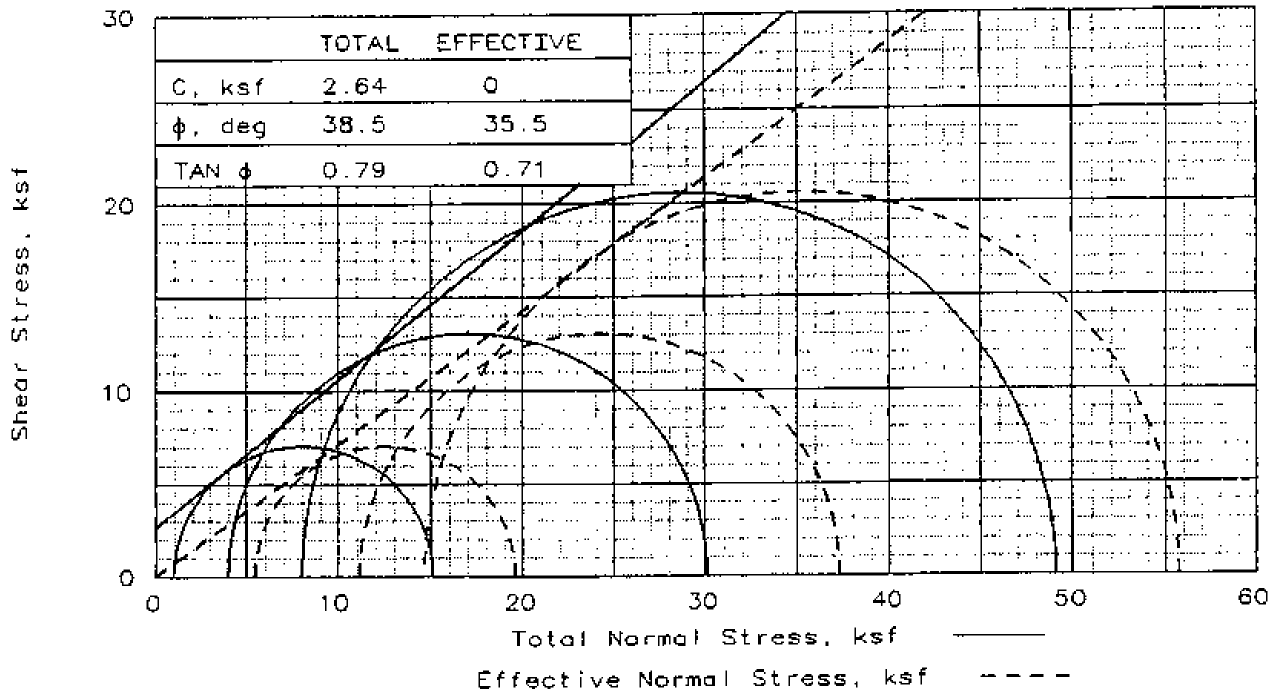
Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1220.640			1214.980
Wt. dry soil and tare:	948.460			948.460
Wt. of tare:	0.000			0.000
Weight, gms:	1220.6			
Diameter, in:	2.816	2.857	2.827	
Area, in^2:	6.228	6.411	6.275	
Height, in:	6.011	6.011	5.922	
Net decrease in height, in:		0.000	0.089	
Net decrease in water volume, cc:		-9.300	22.500	
% Moisture:	28.7	29.7	27.3	28.1
Wet density, pcf:	124.2	121.6	123.8	
Dry density, pcf:	96.5	93.8	97.2	
Void ratio:	0.7529	0.8043	0.7400	
% Saturation:	103.3	100.0	100.0	

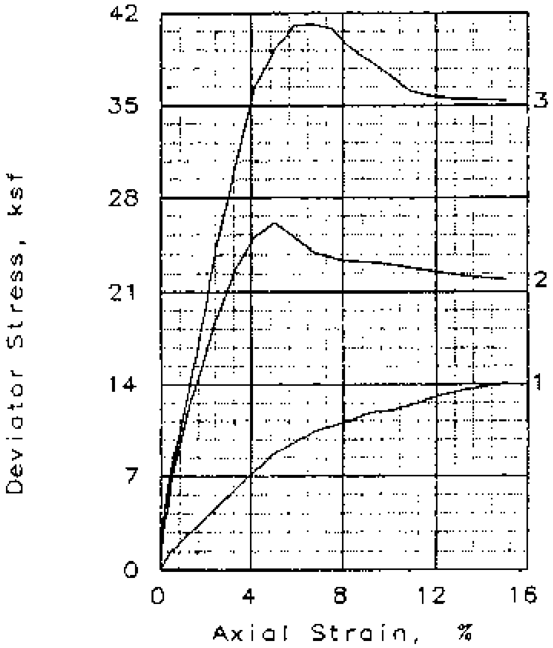
Test Readings Data for Specimen No. 3

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Consolidation cell pressure = 105.50 psi = 15.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 7.99 ksf
Strain rate, %/min = 0.07
FAIL. STRESS = 9.01 ksf at reading no. 27
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	7.99	7.99	1.00	50.00	7.99	0.00
1	0.0050	0.005	188.0	135.4	0.1	3.10	7.19	10.29	1.43	55.60	8.74	1.55
2	0.0100	0.010	255.0	183.6	0.2	4.21	6.75	10.96	1.62	58.60	8.86	2.10
3	0.0180	0.018	299.0	215.3	0.3	4.93	6.34	11.26	1.78	61.50	8.80	2.46
4	0.0200	0.020	307.0	221.0	0.3	5.06	6.25	11.30	1.81	62.10	8.78	2.53
5	0.0250	0.025	324.0	233.3	0.4	5.33	6.05	11.38	1.88	63.50	8.71	2.67
6	0.0300	0.030	339.0	244.1	0.5	5.57	5.88	11.45	1.95	64.70	8.66	2.79
7	0.0350	0.035	354.0	254.9	0.6	5.81	5.72	11.53	2.02	65.80	8.62	2.91
8	0.0400	0.040	368.0	265.0	0.7	6.04	5.59	11.63	2.08	66.70	8.61	3.02
9	0.0450	0.045	384.0	276.5	0.8	6.30	5.43	11.73	2.16	67.80	8.58	3.15
10	0.0500	0.050	393.0	283.0	0.8	6.44	5.33	11.77	2.21	68.50	8.55	3.22
11	0.0550	0.055	403.0	290.2	0.9	6.60	5.23	11.82	2.26	69.20	8.53	3.30
12	0.0600	0.060	412.0	296.6	1.0	6.74	5.13	11.86	2.31	69.90	8.50	3.37
13	0.0650	0.065	420.0	302.4	1.1	6.86	5.03	11.89	2.37	70.60	8.46	3.43
14	0.0700	0.070	429.0	308.9	1.2	7.00	4.97	11.97	2.41	71.00	8.47	3.50
15	0.0750	0.075	436.0	313.9	1.3	7.11	4.90	12.01	2.45	71.50	8.45	3.56
16	0.0800	0.080	444.0	319.7	1.4	7.24	4.82	12.06	2.50	72.00	8.44	3.62
17	0.0850	0.085	451.0	324.7	1.4	7.34	4.78	12.13	2.54	72.30	8.45	3.67
18	0.0900	0.090	458.0	329.8	1.5	7.45	4.71	12.16	2.58	72.80	8.43	3.73
19	0.0950	0.095	464.0	334.1	1.6	7.54	4.68	12.22	2.61	73.00	8.45	3.77
20	0.1000	0.100	470.0	338.4	1.7	7.63	4.62	12.26	2.65	73.40	8.44	3.82



	TOTAL	EFFECTIVE
C, ksf	2.64	0
ϕ, deg	38.5	35.5
TAN ϕ	0.79	0.71



	SAMPLE NO.:	1	2	3
INITIAL	WATER CONTENT, %	34.4	34.8	32.1
	DRY DENSITY, pcf	78.2	77.8	80.4
	SATURATION, %	100.0	100.0	99.9
	VOID RATIO	0.756	0.766	0.707
	DIAMETER, in	2.87	2.88	2.86
	HEIGHT, in	5.96	6.01	5.99
AT TEST	WATER CONTENT, %	32.4	33.7	31.5
	DRY DENSITY, pcf	80.2	78.8	81.1
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.712	0.742	0.693
	DIAMETER, in	2.83	2.86	2.85
	HEIGHT, in	5.97	6.00	5.98
	Strain rate, %/min	0.17	0.17	0.17
	BACK PRESSURE, ksf	7.2	7.2	7.2
	CELL PRESSURE, ksf	8.2	11.2	15.2
	FAIL. STRESS, ksf	14.1	26.2	41.1
	TOTAL PORE PR., ksf	2.8	0.0	0.6
	ULT. STRESS, ksf			
	TOTAL PORE PR., ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	19.6	37.3	55.8
	$\bar{\sigma}_3$ FAILURE, ksf	5.4	11.2	14.6

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Shelby Tube
DESCRIPTION: Gray Ash Sand

SPECIFIC GRAVITY= 2.2
REMARKS:

Fig. No.: ______ AB

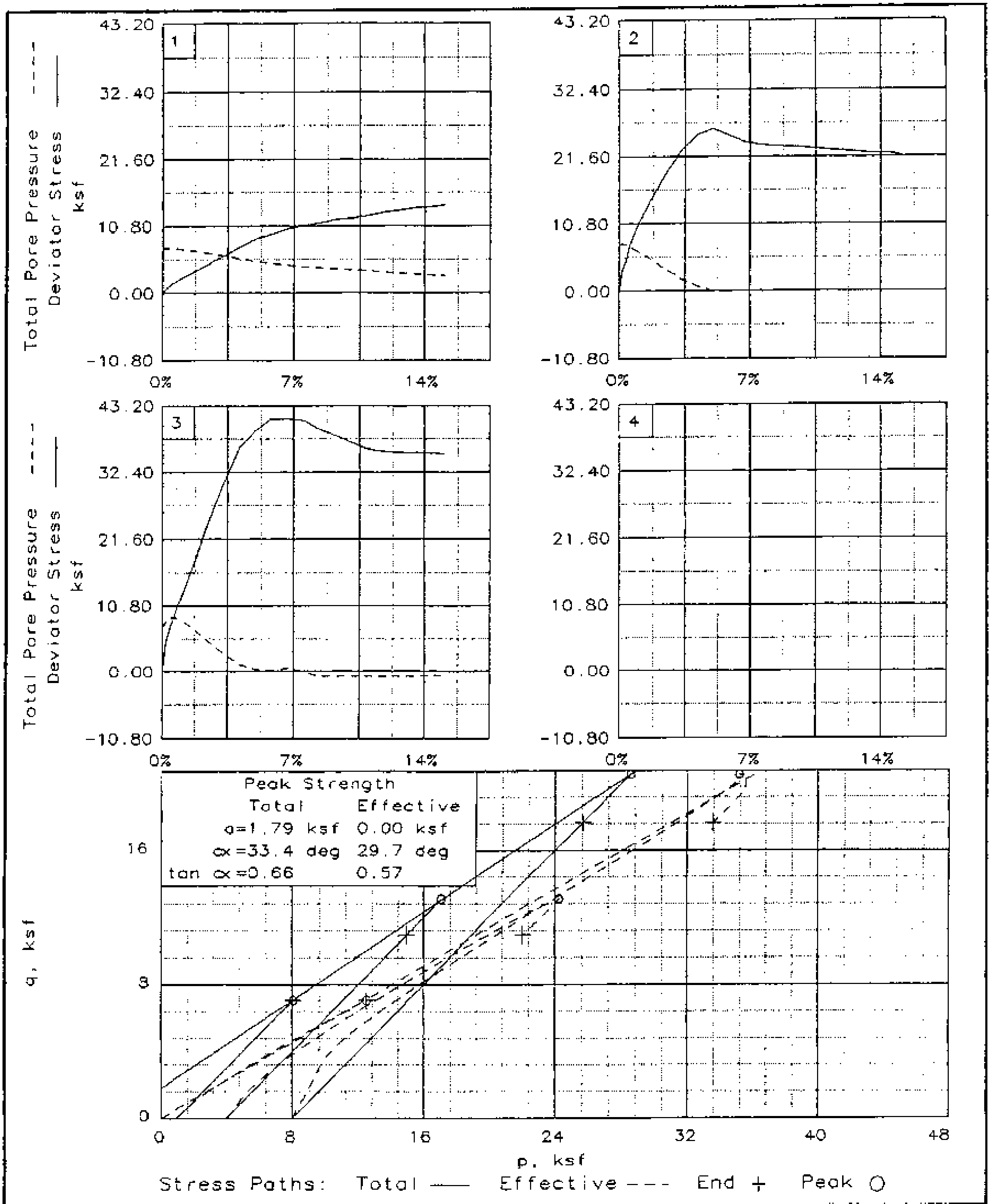
CLIENT: TVA

PROJECT: Ash Disposal Areas - TVA Gallatin
Fossil Plant
SAMPLE LOCATION: B-13 UD @ 15'-17'

PROJ. NO.: 3043-04-1043 DATE: 09-22-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Client: TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Location: B-13 UD @ 15'-17'

File: FOSSIL3 Project No.: 3043-04-1043 Fig. No.: ______

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

10-12-2004
5:16 pm

Project and Sample Data

Date: 09-22-04
Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Sample location: B-13 UD @ 15'-17'
Sample description: Gray Ash Sand
Remarks:

Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Shelby Tube
Specific gravity= 2.20 LL= PL= PI=
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1060.780			1034.490
Wt. dry soil and tare:	789.320			789.320
Wt. of tare:	0.000			0.000
Weight, gms:	1060.8			
Diameter, in:	2.866	2.853	2.829	
Area, in^2:	6.451	6.394	6.285	
Height, in:	5.961	5.961	5.965	
Net decrease in height, in:		0.000	-0.004	
Net decrease in water volume, cc:		5.700	10.200	
% Moisture:	34.4	33.7	32.4	31.1
Wet density, pcf:	105.1	105.5	106.2	
Dry density, pcf:	78.2	78.9	80.2	
Void ratio:	0.7564	0.7407	0.7123	
% Saturation:	100.0	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Consolidation cell pressure = 56.90 psi = 8.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 14.15 ksf at reading no. 26
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	0.99	0.99	1.00	50.00	0.99	0.00
1	0.0100	0.010	35.0	25.2	0.2	0.58	0.95	1.53	1.61	50.30	1.24	0.29
2	0.0200	0.020	64.0	46.1	0.3	1.05	0.96	2.02	2.09	50.20	1.49	0.53
3	0.0300	0.030	87.0	62.6	0.5	1.43	0.98	2.41	2.46	50.10	1.69	0.71
4	0.0400	0.040	102.0	73.4	0.7	1.67	1.01	2.68	2.66	49.90	1.84	0.84
5	0.0500	0.050	125.0	90.0	0.8	2.04	1.05	3.10	2.95	49.60	2.07	1.02
6	0.0600	0.060	142.0	102.2	1.0	2.32	1.09	3.41	3.12	49.30	2.25	1.16
7	0.0700	0.070	159.0	114.5	1.2	2.59	1.15	3.74	3.25	48.90	2.45	1.30
8	0.0800	0.080	175.0	126.0	1.3	2.85	1.21	4.06	3.35	48.50	2.63	1.42
9	0.0900	0.090	190.0	136.8	1.5	3.09	1.28	4.37	3.41	48.00	2.83	1.54
10	0.1000	0.100	209.0	150.5	1.7	3.39	1.37	4.76	3.48	47.40	3.06	1.70
11	0.1500	0.150	294.0	211.7	2.5	4.73	1.79	6.51	3.65	44.50	4.15	2.36
12	0.2000	0.200	384.0	276.5	3.4	6.12	2.22	8.34	3.76	41.50	5.28	3.06
13	0.2500	0.250	471.0	339.1	4.2	7.44	2.66	10.11	3.79	38.40	6.39	3.72
14	0.3000	0.300	558.0	401.8	5.0	8.74	3.11	11.85	3.81	35.30	7.48	4.37
15	0.3500	0.350	615.0	442.8	5.9	9.55	3.43	12.98	3.79	33.10	8.20	4.78
16	0.4000	0.400	673.0	484.6	6.7	10.36	3.74	14.10	3.77	30.90	8.92	5.18
17	0.4500	0.450	711.0	511.9	7.5	10.84	3.97	14.82	3.73	29.30	9.40	5.42
18	0.5000	0.500	749.0	539.3	8.4	11.32	4.15	15.47	3.73	28.10	9.81	5.66
19	0.5500	0.550	792.0	570.2	9.2	11.86	4.33	16.20	3.74	26.80	10.26	5.93
20	0.6000	0.600	810.0	583.2	10.1	12.02	4.48	16.50	3.68	25.80	10.49	6.01
21	0.6500	0.650	845.0	608.4	10.9	12.42	4.64	17.06	3.68	24.70	10.85	6.21
22	0.7000	0.700	888.0	639.4	11.7	12.93	4.84	17.77	3.67	23.30	11.30	6.47
23	0.7500	0.750	924.0	665.3	12.6	13.33	5.01	18.34	3.66	22.10	11.67	6.66
24	0.8000	0.800	955.0	687.6	13.4	13.64	5.18	18.83	3.63	20.90	12.00	6.82
25	0.8500	0.850	981.0	706.3	14.2	13.88	5.33	19.21	3.60	19.90	12.27	6.94
26	0.9000	0.900	1010.0	727.2	15.1	14.15	5.44	19.59	3.60	19.10	12.52	7.07

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1077.610			1057.720
Wt. dry soil and tare:	799.470			799.470
Wt. of tare:	0.000			0.000
Weight, gms:	1077.6			
Diameter, in:	2.880	2.884	2.864	
Area, in^2:	6.514	6.531	6.444	
Height, in:	6.010	6.010	5.996	
Net decrease in height, in:		0.000	0.014	
Net decrease in water volume, cc:		-1.700	10.100	
% Moisture:	34.8	35.0	33.7	32.3
Wet density, pcf:	104.9	104.8	105.4	
Dry density, pcf:	77.8	77.6	78.8	
Void ratio:	0.7655	0.7701	0.7423	
% Saturation:	100.0	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Consolidation cell pressure = 77.80 psi = 11.20 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 26.15 ksf at reading no. 14
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Effective Stresses Major ksf	Effective Stresses 1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
0	0.0000	0.000	0.00	0.0	0.0	0.00	4.00	4.00	1.00	50.00	4.00	0.00
1	0.0100	0.010	53.00	148.4	0.2	3.31	3.70	7.01	1.89	52.10	5.36	1.66
2	0.0200	0.020	76.00	212.8	0.3	4.74	3.80	8.54	2.25	51.40	6.17	2.37
3	0.0300	0.030	109.00	305.2	0.5	6.79	4.03	10.82	2.68	49.80	7.43	3.39
4	0.0400	0.040	132.00	369.6	0.7	8.20	4.31	12.51	2.91	47.90	8.41	4.10
5	0.0500	0.050	152.00	425.6	0.8	9.43	4.58	14.01	3.06	46.00	9.30	4.72
6	0.0600	0.060	171.00	478.8	1.0	10.59	4.90	15.49	3.16	43.80	10.19	5.30
7	0.0700	0.070	190.00	532.0	1.2	11.75	5.21	16.96	3.25	41.60	11.09	5.88
8	0.0800	0.080	208.00	582.4	1.3	12.84	5.57	18.41	3.30	39.10	11.99	6.42
9	0.0900	0.090	223.00	624.4	1.5	13.74	5.85	19.59	3.35	37.20	12.72	6.87
10	0.1000	0.100	239.00	669.2	1.7	14.71	6.18	20.88	3.38	34.90	13.53	7.35
11	0.1500	0.150	314.00	879.2	2.5	19.16	7.88	27.03	3.43	23.10	17.46	9.58
12	0.2000	0.200	377.00	1055.6	3.3	22.80	9.37	32.18	3.43	12.70	20.78	11.40
13	0.2500	0.250	420.00	1176.0	4.2	25.18	10.45	35.64	3.41	5.20	23.05	12.59
14	0.3000	0.300	440.00	1232.0	5.0	26.15	11.19	37.34	3.34	0.10	24.27	13.08
15	0.3500	0.350	426.00	1192.8	5.8	25.10	11.20	36.30	3.24	0.00	23.75	12.55
16	0.4000	0.400	411.00	1150.8	6.7	24.00	11.20	35.21	3.14	0.00	23.20	12.00
17	0.4500	0.450	407.00	1139.6	7.5	23.56	11.20	34.76	3.10	0.00	22.98	11.78
18	0.5000	0.500	406.00	1136.8	8.3	23.29	11.20	34.49	3.08	0.00	22.85	11.64
19	0.5500	0.550	409.00	1145.2	9.2	23.24	11.15	34.39	3.09	0.40	22.77	11.62
20	0.6000	0.600	409.00	1145.2	10.0	23.03	11.20	34.23	3.06	0.00	22.72	11.52

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
21	0.6500	0.650	409.00	1145.2	10.8	22.82	11.20	34.02	3.04	0.00	22.61	11.41
22	0.7000	0.700	409.00	1145.2	11.7	22.60	11.10	33.71	3.04	0.70	22.40	11.30
23	0.7500	0.750	409.00	1145.2	12.5	22.39	11.10	33.49	3.02	0.70	22.30	11.20
24	0.8000	0.800	409.00	1145.2	13.3	22.18	11.10	33.28	3.00	0.70	22.19	11.09
25	0.8500	0.850	411.00	1150.8	14.2	22.07	11.10	33.17	2.99	0.70	22.14	11.04
26	0.9000	0.900	412.00	1153.6	15.0	21.91	11.10	33.01	2.97	0.70	22.06	10.96

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1076.400			1073.780
Wt. dry soil and tare:	814.690			814.690
Wt. of tare:	0.000			0.000
Weight, gms:	1076.4			
Diameter, in:	2.864	2.870	2.853	
Area, in²:	6.442	6.470	6.394	
Height, in:	5.989	5.989	5.984	
Net decrease in height, in:		0.000	0.005	
Net decrease in water volume, cc:		-3.000	8.000	
% Moisture:	32.1	32.5	31.5	31.8
Wet density, pcf:	106.3	106.1	106.7	
Dry density, pcf:	80.4	80.1	81.1	
Void ratio:	0.7073	0.7148	0.6932	
% Saturation:	99.9	100.0	100.0	

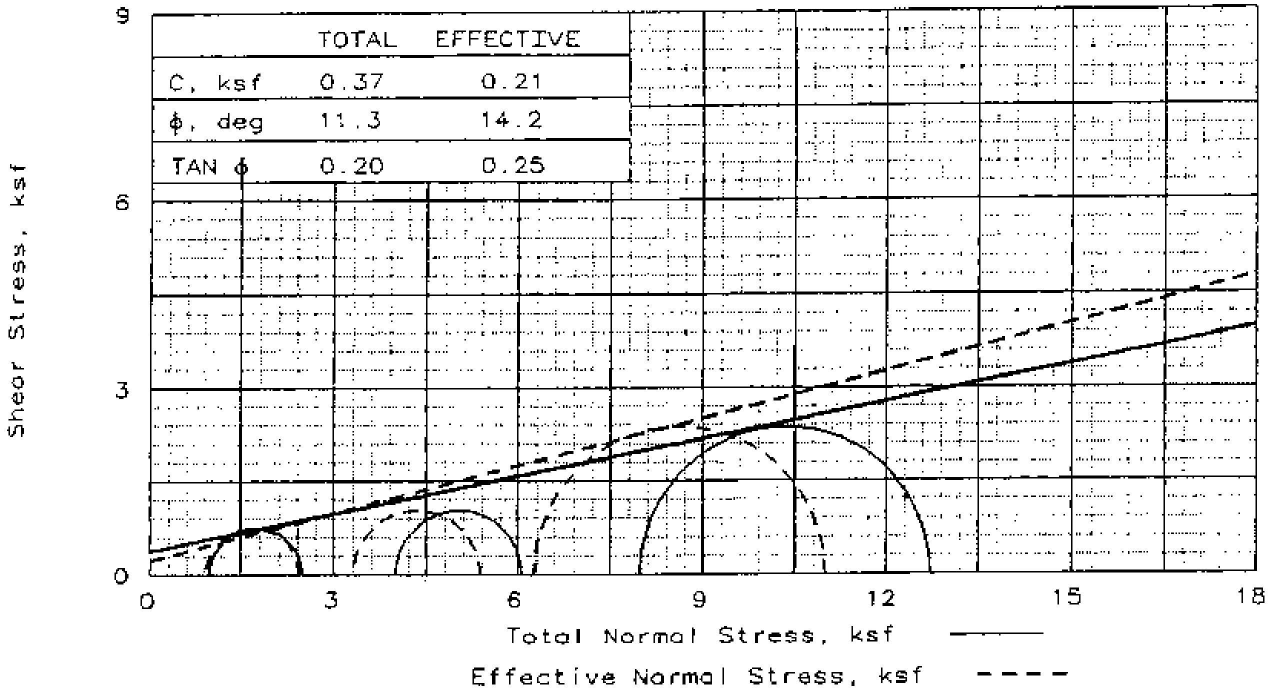
Test Readings Data for Specimen No. 3

Deformation dial constant= 1 in per input unit
Primary load ring constant= 2.8 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 105.50 psi = 15.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 7.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 41.13 ksf at reading no. 16
ULT. STRESS = not selected

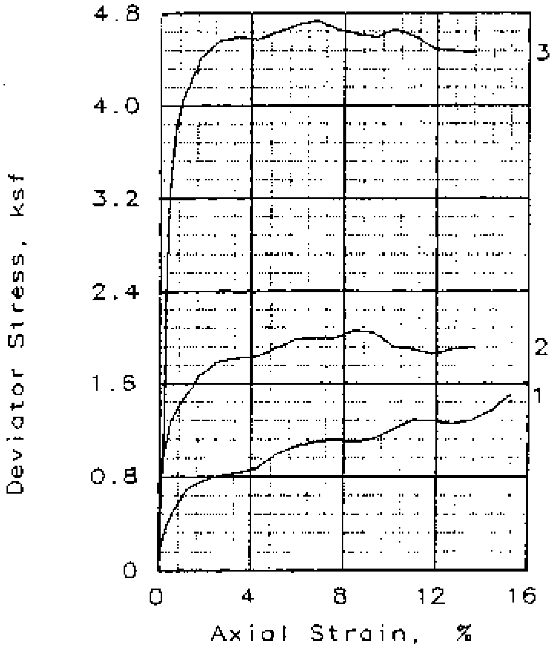
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.00	0.0	0.0	0.00	7.99	7.99	1.00	50.00	7.99	0.00
1	0.0100	0.010	68.00	190.4	0.2	4.28	7.07	11.35	1.61	56.40	9.21	2.14
2	0.0200	0.020	99.00	277.2	0.3	6.22	6.54	12.76	1.95	60.10	9.65	3.11
3	0.0300	0.030	123.00	344.4	0.5	7.72	6.32	14.04	2.22	61.60	10.18	3.86
4	0.0400	0.040	145.00	406.0	0.7	9.08	6.34	15.42	2.43	61.50	10.88	4.54
5	0.0500	0.050	167.00	467.6	0.8	10.44	6.47	16.91	2.62	60.60	11.69	5.22
6	0.0600	0.060	188.00	526.4	1.0	11.74	6.71	18.45	2.75	58.90	12.58	5.87
7	0.0700	0.070	210.00	588.0	1.2	13.09	6.96	20.04	2.88	57.20	13.50	6.54
8	0.0800	0.080	233.00	652.4	1.3	14.50	7.36	21.85	2.97	54.40	14.61	7.25
9	0.0900	0.090	255.00	714.0	1.5	15.84	7.66	23.50	3.07	52.30	15.58	7.92
10	0.1000	0.100	278.00	778.4	1.7	17.24	8.06	25.30	3.14	49.50	16.68	8.62
11	0.1500	0.150	398.00	1114.4	2.5	24.47	10.31	34.78	3.37	33.90	22.54	12.23
12	0.2000	0.200	506.00	1416.8	3.3	30.84	12.34	43.18	3.50	19.80	27.76	15.42
13	0.2500	0.250	605.00	1694.0	4.2	36.56	14.08	50.64	3.60	7.70	32.36	18.28
14	0.3000	0.300	655.00	1834.0	5.0	39.23	14.83	54.06	3.65	2.50	34.45	19.62
15	0.3500	0.350	692.00	1937.6	5.8	41.08	14.96	56.04	3.75	1.60	35.50	20.54
16	0.4000	0.400	699.00	1957.2	6.7	41.13	14.63	55.76	3.81	3.90	35.20	20.57
17	0.4500	0.450	700.00	1960.0	7.5	40.82	15.19	56.01	3.69	0.00	35.60	20.41
18	0.5000	0.500	680.00	1904.0	8.4	39.30	15.93	55.22	3.47	-5.10	35.57	19.65
19	0.5500	0.550	670.00	1876.0	9.2	38.36	15.96	54.32	3.40	-5.30	35.14	19.18
20	0.6000	0.600	657.00	1839.6	10.0	37.27	15.97	53.24	3.33	-5.40	34.61	18.64

Test Readings Data for Specimen No. 3

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	643.00	1800.4	10.9	36.14	15.94	52.08	3.27	-5.20	34.01	18.07
22	0.7000	0.700	642.00	1797.6	11.7	35.75	15.94	51.69	3.24	-5.20	33.81	17.87
23	0.7500	0.750	645.00	1806.0	12.5	35.57	15.93	51.50	3.23	-5.10	33.71	17.79
24	0.8000	0.800	650.00	1820.0	13.4	35.51	15.91	51.42	3.23	-5.00	33.67	17.75
25	0.8500	0.850	656.00	1836.8	14.2	35.49	15.90	51.39	3.23	-4.90	33.64	17.74
26	0.9000	0.900	660.00	1848.0	15.0	35.36	15.90	51.26	3.22	-4.90	33.58	17.68



	TOTAL	EFFECTIVE
C, ksf	0.37	0.21
ϕ, deg	11.3	14.2
TAN ϕ	0.20	0.25



	SAMPLE NO.:	1	2	3
INITIAL	WATER CONTENT, %	20.4	37.9	39.3
	DRY DENSITY, pcf	104.4	84.2	81.8
	SATURATION, %	92.4	104.1	101.9
	VOID RATIO	0.584	0.965	1.021
	DIAMETER, in	2.84	2.84	2.84
	HEIGHT, in	6.00	5.99	5.98
AT TEST	WATER CONTENT, %	19.6	37.8	38.4
	DRY DENSITY, pcf	108.8	82.6	81.9
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.521	1.002	1.019
	DIAMETER, in	2.80	2.88	2.86
	HEIGHT, in	5.92	5.93	5.89
	Strain rate, %/min	0.07	0.07	0.07
	BACK PRESSURE, ksf	7.2	7.2	7.2
	CELL PRESSURE, ksf	8.2	11.2	15.2
	FAIL. STRESS, ksf	1.5	2.1	4.7
	TOTAL PORE PR., ksf	7.3	7.9	8.9
	ULT. STRESS, ksf			
	TOTAL PORE PR., ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	2.4	5.4	11.0
	$\bar{\sigma}_3$ FAILURE, ksf	0.9	3.3	6.3

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Shelby Tube Sample
DESCRIPTION: Orange-Brown Silty Clay (CH)
LL= 78 PL= 30 PI= 48
SPECIFIC GRAVITY= 2.65
REMARKS:

Fig. No.: HB

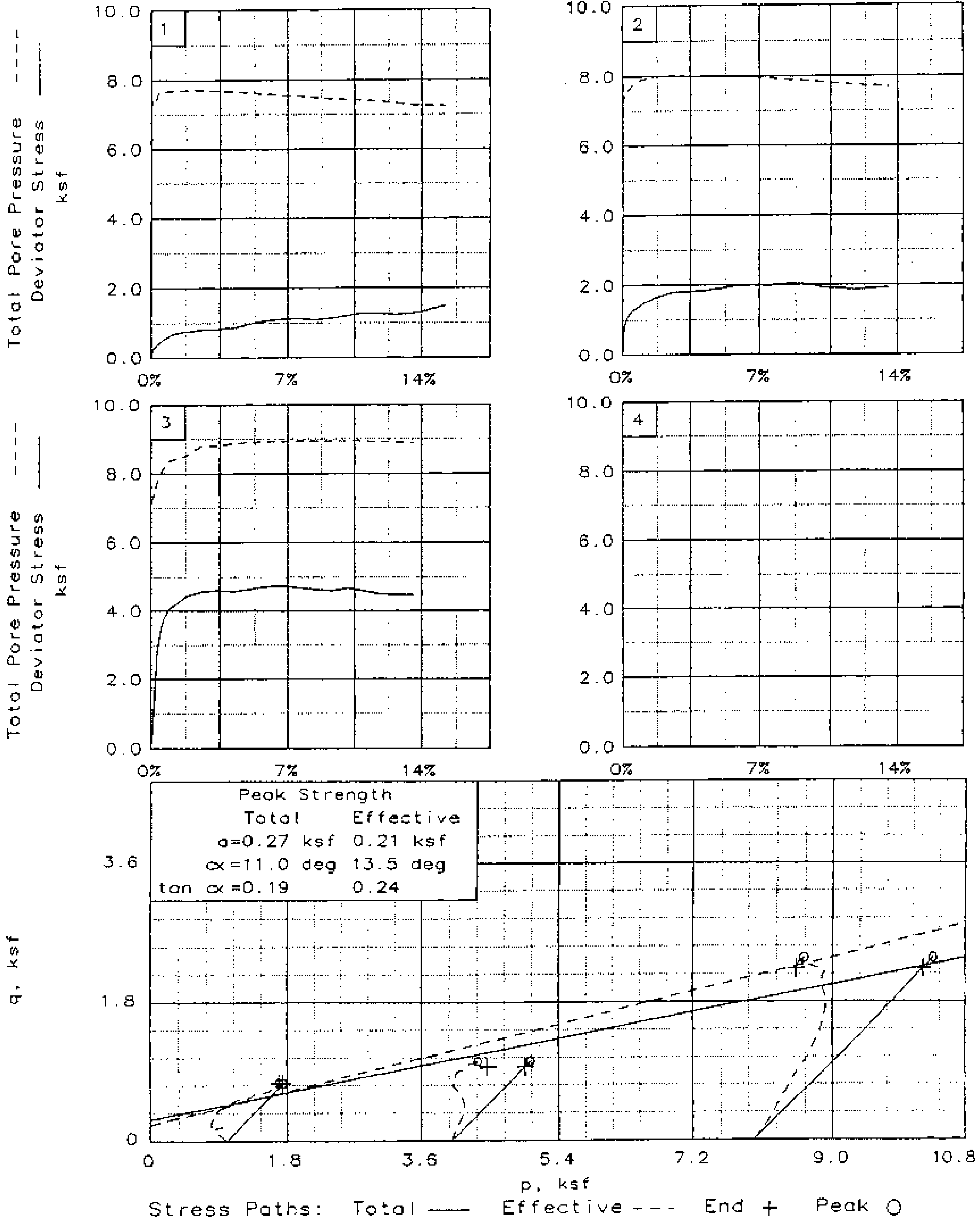
CLIENT: TVA

PROJECT: Ash Disposal Areas - TVA Gallatin Fossil Plant
SAMPLE LOCATION: B-13 UD @ 25'-27'

PROJ. NO.: 3043-04-1043 DATE: 09-30-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Peak Strength

	Total	Effective
	a=0.27 ksf	0.21 ksf
	α=11.0 deg	13.5 deg
tan	α=0.19	0.24

Client: TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Location: B-13 UD @ 25'-27'

File: FOSSIL6 Project No.: 3043-04-1043 Fig. No.: ______

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

10-12-2004
5:08 pm

Project and Sample Data

Date: 09-30-04
Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Sample location: B-13 UD @ 25'-27'
Sample description: Orange-Brown Silty Clay (CH)
Remarks:

Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Shelby Tube Sample
Specific gravity= 2.65 LL= 78 PL= 30 PI= 48
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1254.110			1247.330
Wt. dry soil and tare:	1041.870			1041.870
Wt. of tare:	0.000			0.000
Weight, gms:	1254.1			
Diameter, in:	2.839	2.802	2.801	
Area, in²:	6.330	6.168	6.162	
Height, in:	6.004	6.004	5.920	
Net decrease in height, in:		0.000	0.084	
Net decrease in water volume, cc:		-1.500	9.100	
% Moisture:	20.4	20.5	19.6	19.7
Wet density, pcf:	125.7	129.2	130.2	
Dry density, pcf:	104.4	107.2	108.8	
Void ratio:	0.5841	0.5436	0.5205	
% Saturation:	92.4	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 56.90 psi = 8.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.07
FAIL. STRESS = 1.50 ksf at reading no. 36
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	0.99	0.99	1.00	50.00	0.99	0.00
1	0.0050	0.005	12.0	8.6	0.1	0.20	0.78	0.98	1.26	51.50	0.88	0.10
2	0.0100	0.010	18.0	13.0	0.2	0.30	0.68	0.98	1.45	52.20	0.83	0.15
3	0.0150	0.015	21.0	15.1	0.3	0.35	0.76	1.12	1.46	51.60	0.94	0.18
4	0.0200	0.020	23.0	16.6	0.3	0.39	0.59	0.98	1.65	52.80	0.78	0.19
5	0.0250	0.025	25.0	18.0	0.4	0.42	0.58	0.99	1.73	52.90	0.79	0.21
6	0.0300	0.030	27.0	19.4	0.5	0.45	0.56	1.01	1.80	53.00	0.79	0.23
7	0.0350	0.035	30.0	21.6	0.6	0.50	0.55	1.05	1.92	53.10	0.80	0.25
8	0.0400	0.040	31.0	22.3	0.7	0.52	0.55	1.07	1.95	53.10	0.81	0.26
9	0.0450	0.045	33.0	23.8	0.8	0.55	0.53	1.08	2.03	53.20	0.81	0.28
10	0.0500	0.050	35.0	25.2	0.8	0.58	0.53	1.12	2.10	53.20	0.82	0.29
11	0.0550	0.055	36.0	25.9	0.9	0.60	0.52	1.12	2.16	53.30	0.82	0.30
12	0.0600	0.060	38.0	27.4	1.0	0.63	0.52	1.15	2.22	53.30	0.83	0.32
13	0.0650	0.065	40.0	28.8	1.1	0.67	0.52	1.18	2.28	53.30	0.85	0.33
14	0.0700	0.070	41.0	29.5	1.2	0.68	0.52	1.20	2.31	53.30	0.86	0.34
15	0.0750	0.075	42.0	30.2	1.3	0.70	0.50	1.20	2.38	53.40	0.85	0.35
16	0.0800	0.080	43.0	31.0	1.4	0.71	0.50	1.22	2.42	53.40	0.86	0.36
17	0.0850	0.085	43.0	31.0	1.4	0.71	0.50	1.22	2.41	53.40	0.86	0.36
18	0.0900	0.090	44.0	31.7	1.5	0.73	0.50	1.23	2.45	53.40	0.87	0.36
19	0.0950	0.095	44.0	31.7	1.6	0.73	0.49	1.22	2.49	53.50	0.85	0.36
20	0.1000	0.100	45.0	32.4	1.7	0.74	0.49	1.23	2.52	53.50	0.86	0.37
21	0.1500	0.150	49.0	35.3	2.5	0.80	0.49	1.29	2.64	53.50	0.89	0.40
22	0.2000	0.200	51.0	36.7	3.4	0.83	0.50	1.33	2.65	53.40	0.92	0.41
23	0.2500	0.250	54.0	38.9	4.2	0.87	0.53	1.40	2.63	53.20	0.97	0.44
24	0.3000	0.300	62.0	44.6	5.1	0.99	0.56	1.55	2.76	53.00	1.06	0.50
25	0.3500	0.350	67.0	48.2	5.9	1.06	0.60	1.67	2.75	52.70	1.14	0.53
26	0.4000	0.400	70.0	50.4	6.8	1.10	0.65	1.75	2.69	52.40	1.20	0.55
27	0.4500	0.450	72.0	51.8	7.6	1.12	0.66	1.78	2.69	52.30	1.22	0.56
28	0.5000	0.500	71.0	51.1	8.4	1.09	0.71	1.80	2.55	52.00	1.25	0.55
29	0.5500	0.550	74.0	53.3	9.3	1.13	0.73	1.86	2.54	51.80	1.30	0.56
30	0.6000	0.600	80.0	57.6	10.1	1.21	0.75	1.96	2.62	51.70	1.35	0.60
31	0.6500	0.650	86.0	61.9	11.0	1.29	0.79	2.08	2.63	51.40	1.44	0.64
32	0.7000	0.700	86.0	61.9	11.8	1.28	0.81	2.08	2.58	51.30	1.44	0.64
33	0.7500	0.750	85.0	61.2	12.7	1.25	0.86	2.11	2.45	50.90	1.49	0.62
34	0.8000	0.800	88.0	63.4	13.5	1.28	0.91	2.19	2.41	50.60	1.55	0.64
35	0.8500	0.850	95.0	68.4	14.4	1.37	0.92	2.29	2.49	50.50	1.61	0.68
36	0.9000	0.900	105.0	75.6	15.2	1.50	0.94	2.43	2.60	50.40	1.69	0.75

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1153.080			1154.560
Wt. dry soil and tare:	836.090			836.090
Wt. of tare:	0.000			0.000
Weight, gms:	1153.1			
Diameter, in:	2.835	2.901	2.876	
Area, in²:	6.312	6.608	6.496	
Height, in:	5.994	5.994	5.934	
Net decrease in height, in:		0.000	0.060	
Net decrease in water volume, cc:		-16.600	17.400	
% Moisture:	37.9	39.9	37.8	38.1
Wet density, pcf:	116.1	112.5	113.9	
Dry density, pcf:	84.2	80.4	82.6	
Void ratio:	0.9652	1.0573	1.0022	
% Saturation:	104.1	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 77.80 psi = 11.20 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.07
FAIL. STRESS = 2.06 ksf at reading no. 28
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	4.00	4.00	1.00	50.00	4.00	0.00
1	0.0050	0.005	50.0	36.0	0.1	0.80	3.77	4.57	1.21	51.60	4.17	0.40
2	0.0100	0.010	63.0	45.4	0.2	1.00	3.66	4.66	1.27	52.40	4.16	0.50
3	0.0150	0.015	67.0	48.2	0.3	1.07	3.61	4.68	1.30	52.70	4.15	0.53
4	0.0200	0.020	72.0	51.8	0.3	1.15	3.56	4.70	1.32	53.10	4.13	0.57
5	0.0250	0.025	77.0	55.4	0.4	1.22	3.50	4.72	1.35	53.50	4.11	0.61
6	0.0300	0.030	81.0	58.3	0.5	1.29	3.44	4.73	1.37	53.90	4.08	0.64
7	0.0350	0.035	83.0	59.8	0.6	1.32	3.41	4.73	1.39	54.10	4.07	0.66
8	0.0400	0.040	85.0	61.2	0.7	1.35	3.38	4.73	1.40	54.30	4.06	0.67
9	0.0450	0.045	87.0	62.6	0.8	1.38	3.36	4.73	1.41	54.50	4.04	0.69
10	0.0500	0.050	89.0	64.1	0.8	1.41	3.33	4.73	1.42	54.70	4.03	0.70
11	0.0550	0.055	91.0	65.5	0.9	1.44	3.30	4.74	1.44	54.90	4.02	0.72
12	0.0600	0.060	93.0	67.0	1.0	1.47	3.30	4.77	1.45	54.90	4.03	0.73
13	0.0650	0.065	94.0	67.7	1.1	1.48	3.28	4.77	1.45	55.00	4.03	0.74
14	0.0700	0.070	96.0	69.1	1.2	1.51	3.27	4.78	1.46	55.10	4.03	0.76
15	0.0750	0.075	98.0	70.6	1.3	1.54	3.27	4.81	1.47	55.10	4.04	0.77
16	0.0800	0.080	99.0	71.3	1.3	1.56	3.25	4.81	1.48	55.20	4.03	0.78
17	0.0850	0.085	100.0	72.0	1.4	1.57	3.24	4.81	1.49	55.30	4.03	0.79
18	0.0900	0.090	102.0	73.4	1.5	1.60	3.23	4.83	1.50	55.40	4.03	0.80
19	0.0950	0.095	104.0	74.9	1.6	1.63	3.21	4.84	1.51	55.50	4.03	0.82
20	0.1000	0.100	106.0	76.3	1.7	1.66	3.21	4.87	1.52	55.50	4.04	0.83

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.1500	0.150	115.0	82.8	2.5	1.79	3.18	4.97	1.56	55.70	4.08	0.89
22	0.2000	0.200	118.0	85.0	3.4	1.82	3.21	5.03	1.57	55.50	4.12	0.91
23	0.2500	0.250	120.0	86.4	4.2	1.83	3.23	5.06	1.57	55.40	4.14	0.92
24	0.3000	0.300	126.0	90.7	5.1	1.91	3.23	5.13	1.59	55.40	4.18	0.95
25	0.3500	0.350	132.0	95.0	5.9	1.98	3.24	5.22	1.61	55.30	4.23	0.99
26	0.4000	0.400	134.0	96.5	6.7	1.99	3.24	5.23	1.62	55.30	4.24	1.00
27	0.4500	0.450	135.0	97.2	7.6	1.99	3.27	5.26	1.61	55.10	4.26	1.00
28	0.5000	0.500	141.0	101.5	8.4	2.06	3.31	5.37	1.62	54.80	4.34	1.03
29	0.5500	0.550	141.0	101.5	9.3	2.04	3.34	5.38	1.61	54.60	4.36	1.02
30	0.6000	0.600	134.0	96.5	10.1	1.92	3.40	5.32	1.57	54.20	4.36	0.96
31	0.6500	0.650	134.0	96.5	11.0	1.90	3.43	5.33	1.56	54.00	4.38	0.95
32	0.7000	0.700	132.0	95.0	11.8	1.86	3.47	5.33	1.54	53.70	4.40	0.93
33	0.7500	0.750	136.0	97.9	12.6	1.90	3.48	5.38	1.54	53.60	4.43	0.95
34	0.8000	0.800	139.0	100.1	13.5	1.92	3.51	5.43	1.55	53.40	4.47	0.96

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1134.690			1131.310
Wt. dry soil and tare:	814.660			814.660
Wt. of tare:	0.000			0.000
Weight, gms:	1134.7			
Diameter, in:	2.842	2.905	2.861	
Area, in²:	6.344	6.630	6.428	
Height, in:	5.978	5.978	5.892	
Net decrease in height, in:		0.000	0.086	
Net decrease in water volume, cc:		-22.000	28.800	
% Moisture:	39.3	42.0	38.4	38.9
Wet density, pcf:	114.0	111.2	113.4	
Dry density, pcf:	81.8	78.3	81.9	
Void ratio:	1.0215	1.1126	1.0189	
% Saturation:	101.9	100.0	100.0	

Test Readings Data for Specimen No. 3

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 105.50 psi = 15.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 7.99 ksf
Strain rate, %/min = 0.07
FAIL. STRESS = 4.74 ksf at reading no. 26
ULT. STRESS = not selected

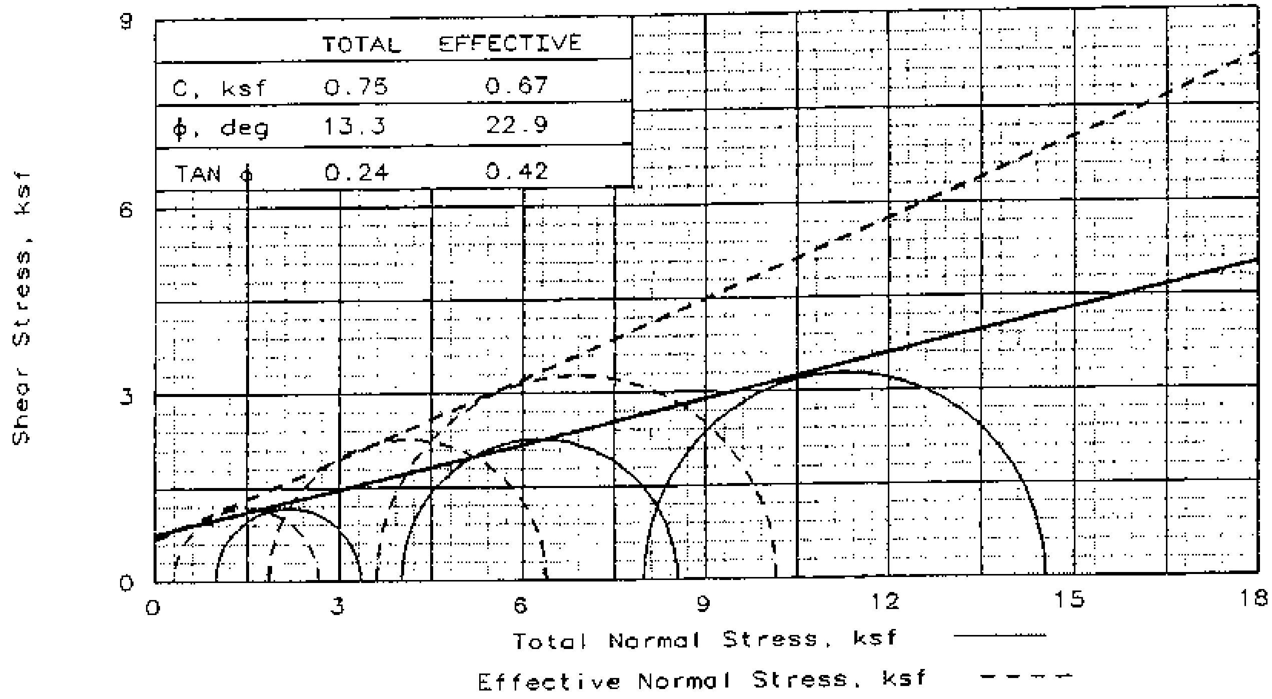
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	7.99	7.99	1.00	50.00	7.99	0.00
1	0.0050	0.005	30.0	21.6	0.1	0.48	7.93	8.42	1.06	50.40	8.18	0.24
2	0.0100	0.010	79.0	56.9	0.2	1.27	7.76	9.03	1.16	51.60	8.40	0.64
3	0.0150	0.015	138.0	99.4	0.3	2.22	7.57	9.79	1.29	52.90	8.68	1.11
4	0.0200	0.020	176.0	126.7	0.3	2.83	7.42	10.25	1.38	54.00	8.83	1.41
5	0.0250	0.025	200.0	144.0	0.4	3.21	7.29	10.50	1.44	54.90	8.89	1.61
6	0.0300	0.030	215.0	154.8	0.5	3.45	7.19	10.64	1.48	55.60	8.91	1.73
7	0.0350	0.035	226.0	162.7	0.6	3.62	7.08	10.71	1.51	56.30	8.90	1.81
8	0.0400	0.040	236.0	169.9	0.7	3.78	7.01	10.79	1.54	56.80	8.90	1.89
9	0.0450	0.045	242.0	174.2	0.8	3.87	6.94	10.81	1.56	57.30	8.88	1.94
10	0.0500	0.050	247.0	177.8	0.8	3.95	6.90	10.85	1.57	57.60	8.87	1.98
11	0.0550	0.055	253.0	182.2	0.9	4.04	6.84	10.88	1.59	58.00	8.86	2.02
12	0.0600	0.060	255.0	183.6	1.0	4.07	6.83	10.90	1.60	58.10	8.86	2.04
13	0.0650	0.065	259.0	186.5	1.1	4.13	6.80	10.93	1.61	58.30	8.86	2.07
14	0.0700	0.070	260.0	187.2	1.2	4.14	6.78	10.93	1.61	58.40	8.85	2.07
15	0.0750	0.075	263.0	189.4	1.3	4.19	6.77	10.96	1.62	58.50	8.86	2.09
16	0.0800	0.080	266.0	191.5	1.4	4.23	6.75	10.99	1.63	58.60	8.87	2.12
17	0.0850	0.085	269.0	193.7	1.4	4.28	6.72	11.00	1.64	58.80	8.86	2.14
18	0.0900	0.090	271.0	195.1	1.5	4.30	6.72	11.03	1.64	58.80	8.88	2.15
19	0.0950	0.095	273.0	196.6	1.6	4.33	6.72	11.06	1.64	58.80	8.89	2.17
20	0.1000	0.100	278.0	200.2	1.7	4.41	6.70	11.10	1.66	59.00	8.90	2.20

Test Readings Data for Specimen No. 3

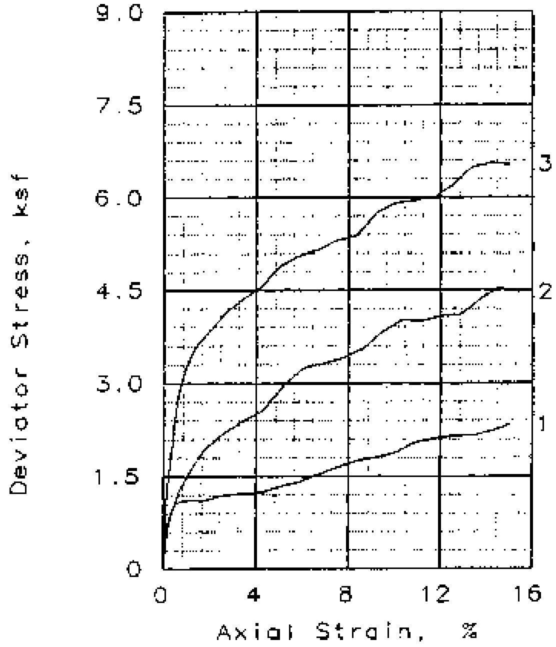
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.1500	0.150	290.0	208.8	2.5	4.56	6.41	10.97	1.71	61.00	8.69	2.28
22	0.2000	0.200	295.0	212.4	3.4	4.60	6.39	10.99	1.72	61.10	8.69	2.30
23	0.2500	0.250	296.0	213.1	4.2	4.57	6.32	10.89	1.72	61.60	8.61	2.29
24	0.3000	0.300	303.0	218.2	5.1	4.64	6.29	10.93	1.74	61.80	8.61	2.32
25	0.3500	0.350	310.0	223.2	5.9	4.70	6.26	10.97	1.75	62.00	8.62	2.35
26	0.4000	0.400	315.0	226.8	6.8	4.74	6.26	11.00	1.76	62.00	8.63	2.37
27	0.4500	0.450	313.0	225.4	7.6	4.66	6.25	10.91	1.75	62.10	8.58	2.33
28	0.5000	0.500	313.0	225.4	8.5	4.62	6.25	10.87	1.74	62.10	8.56	2.31
29	0.5500	0.550	314.0	226.1	9.3	4.59	6.25	10.84	1.73	62.10	8.55	2.30
30	0.6000	0.600	322.0	231.8	10.2	4.66	6.25	10.91	1.75	62.10	8.58	2.33
31	0.6500	0.650	320.0	230.4	11.0	4.59	6.26	10.86	1.73	62.00	8.56	2.30
32	0.7000	0.700	316.0	227.5	11.9	4.49	6.28	10.77	1.72	61.90	8.52	2.25
33	0.7500	0.750	318.0	229.0	12.7	4.48	6.29	10.77	1.71	61.80	8.53	2.24
34	0.8000	0.800	320.0	230.4	13.6	4.46	6.31	10.77	1.71	61.70	8.54	2.23

TRIAXIAL COMPRESSION TEST RESULTS

ON-SITE BORROW SAMPLES



	TOTAL	EFFECTIVE
C, ksf	0.75	0.67
ϕ, deg	13.3	22.9
TAN ϕ	0.24	0.42



	SAMPLE NO.:	1	2	3
INITIAL	WATER CONTENT, %	19.0	19.0	19.0
	DRY DENSITY, pcf	99.8	98.6	99.3
	SATURATION, %	75.7	73.6	74.8
	VOID RATIO	0.670	0.690	0.678
	DIAMETER, in	2.84	2.85	2.84
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	22.5	13.5	21.4
	DRY DENSITY, pcf	104.1	122.4	106.1
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.601	0.361	0.571
	DIAMETER, in	2.78	2.60	2.75
	HEIGHT, in	5.98	5.84	6.00
	Strain rate, %/min	0.17	0.17	0.17
	BACK PRESSURE, ksf	7.2	7.2	7.2
	CELL PRESSURE, ksf	8.2	11.2	15.2
	FAIL. STRESS, ksf	2.3	4.5	6.6
	TOTAL PORE PR., ksf	7.9	9.4	11.6
	ULT. STRESS, ksf			
	TOTAL PORE PR., ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	2.6	6.4	10.2
	$\bar{\sigma}_3$ FAILURE, ksf	0.3	1.8	3.6

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded Sample
DESCRIPTION: Orange-Brown Silty Clay with Sand (CL)
LL= 47 PL= 17 PI= 30
SPECIFIC GRAVITY= 2.67
REMARKS: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor

Fig. No.: ______

HR

CLIENT: TVA

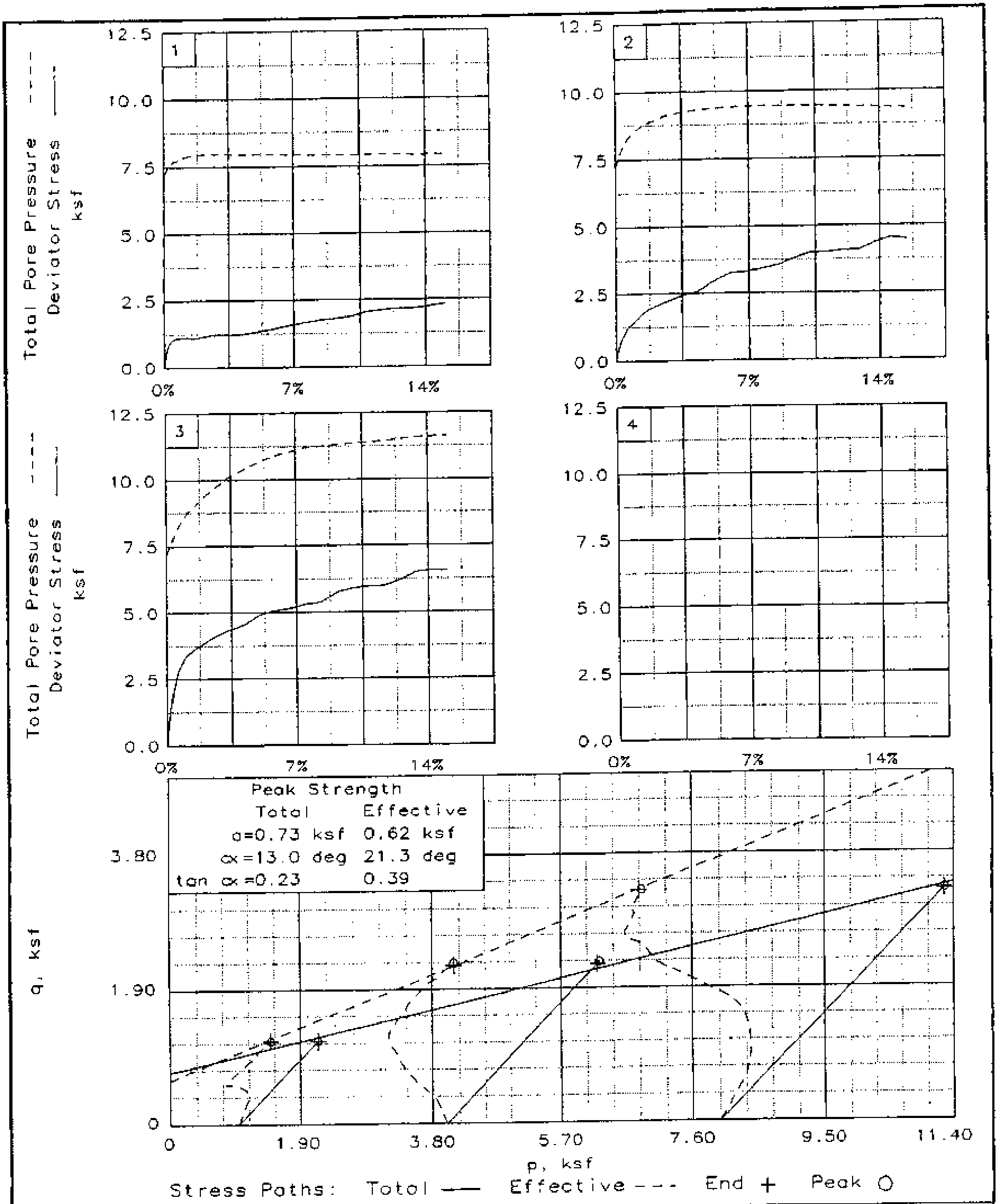
PROJECT: Ash Disposal Areas - TVA Gallatin Fossil Plant

SAMPLE LOCATION: A-2 Bulk @ 0'-20'

PROJ. NO.: 3043-04-1043 DATE: 10-07-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Peak Strength

	Total	Effective
	a=0.73 ksf	0.62 ksf
	α=13.0 deg	21.3 deg
tan	α=0.23	0.39

Client: TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Location: A-2 Bulk @ 0'-20'

File: FOSSIL9 Project No.: 3043-04-1043 Fig. No.: _____

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

10-07-2004
9:45 am

Project and Sample Data

Date: 10-07-04
Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Sample location: A-2 Bulk @ 0'-20'
Sample description: Orange-Brown Silty Clay with Sand (CL)
Remarks: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor
Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Remolded Sample
Specific gravity= 2.67 LL= 47 PL= 17 PI= 30
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1185.030			1213.450
Wt. dry soil and tare:	995.820			995.820
Wt. of tare:	0.000			0.000
Weight, gms:	1185.0			
Diameter, in:	2.840	2.808	2.785	
Area, in²:	6.335	6.191	6.091	
Height, in:	6.000	6.000	5.983	
Net decrease in height, in:		0.000	0.017	
Net decrease in water volume, cc:		-46.500	11.500	
% Moisture:	19.0	23.7	22.5	21.9
Wet density, pcf:	118.8	126.3	127.5	
Dry density, pcf:	99.8	102.1	104.1	
Void ratio:	0.6700	0.6320	0.6012	
% Saturation:	75.7	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 56.90 psi = 8.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 2.34 ksf at reading no. 26
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	0.99	0.99	1.00	50.00	0.99	0.00
1	0.0100	0.010	41.0	29.5	0.2	0.70	0.79	1.49	1.88	51.40	1.14	0.35
2	0.0200	0.020	56.0	40.3	0.3	0.95	0.65	1.60	2.47	52.40	1.12	0.48
3	0.0300	0.030	62.0	44.6	0.5	1.05	0.50	1.55	3.08	53.40	1.03	0.53
4	0.0400	0.040	64.0	46.1	0.7	1.08	0.48	1.56	3.28	53.60	1.02	0.54
5	0.0500	0.050	65.0	46.8	0.8	1.10	0.35	1.44	4.17	54.50	0.89	0.55
6	0.0600	0.060	66.0	47.5	1.0	1.11	0.35	1.46	4.22	54.50	0.90	0.56
7	0.0700	0.070	66.0	47.5	1.2	1.11	0.33	1.44	4.35	54.60	0.89	0.56
8	0.0800	0.080	66.0	47.5	1.3	1.11	0.30	1.41	4.67	54.80	0.86	0.55
9	0.0900	0.090	66.0	47.5	1.5	1.11	0.27	1.38	5.04	55.00	0.83	0.55
10	0.1000	0.100	66.0	47.5	1.7	1.10	0.26	1.36	5.26	55.10	0.81	0.55
11	0.1500	0.150	72.0	51.8	2.5	1.19	0.23	1.43	6.19	55.30	0.83	0.60
12	0.2000	0.200	74.0	53.3	3.3	1.22	0.23	1.45	6.28	55.30	0.84	0.61
13	0.2500	0.250	76.0	54.7	4.2	1.24	0.24	1.48	6.06	55.20	0.86	0.62
14	0.3000	0.300	82.0	59.0	5.0	1.33	0.24	1.57	6.42	55.20	0.91	0.66
15	0.3500	0.350	88.0	63.4	5.8	1.41	0.24	1.66	6.76	55.20	0.95	0.71
16	0.4000	0.400	97.0	69.8	6.7	1.54	0.26	1.80	6.94	55.10	1.03	0.77
17	0.4500	0.450	105.0	75.6	7.5	1.65	0.27	1.93	7.04	55.00	1.10	0.83
18	0.5000	0.500	112.0	80.6	8.4	1.75	0.29	2.04	7.07	54.90	1.16	0.87
19	0.5500	0.550	117.0	84.2	9.2	1.81	0.29	2.10	7.28	54.90	1.19	0.90
20	0.6000	0.600	123.0	88.6	10.0	1.88	0.29	2.17	7.54	54.90	1.23	0.94
21	0.6500	0.650	135.0	97.2	10.9	2.05	0.27	2.32	8.49	55.00	1.30	1.02
22	0.7000	0.700	140.0	100.8	11.7	2.10	0.27	2.38	8.69	55.00	1.33	1.05
23	0.7500	0.750	145.0	104.4	12.5	2.16	0.27	2.43	8.89	55.00	1.35	1.08
24	0.8000	0.800	147.0	105.8	13.4	2.17	0.30	2.47	8.17	54.80	1.39	1.08
25	0.8500	0.850	153.0	110.2	14.2	2.23	0.29	2.52	8.76	54.90	1.41	1.12
26	0.9000	0.900	162.0	116.6	15.0	2.34	0.30	2.65	8.75	54.80	1.47	1.17

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1181.910			1199.950
Wt. dry soil and tare:	993.200			993.200
Wt. of tare:	0.000			0.000
Weight, gms:	1181.9			
Diameter, in:	2.853	2.604	2.596	
Area, in^2:	6.393	5.326	5.291	
Height, in:	6.000	6.000	5.840	
Net decrease in height, in:		0.000	0.160	
Net decrease in water volume, cc:		37.000	17.300	
% Moisture:	19.0	15.3	13.5	20.8
Wet density, pcf:	117.4	136.5	139.0	
Dry density, pcf:	98.6	118.4	122.4	
Void ratio:	0.6897	0.4078	0.3613	
% Saturation:	73.6	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Consolidation cell pressure = 77.80 psi = 11.20 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 4.54 ksf at reading no. 25
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	4.00	4.00	1.00	50.00	4.00	0.00
1	0.0100	0.010	32.0	23.0	0.2	0.63	3.56	4.18	1.18	53.10	3.87	0.31
2	0.0200	0.020	46.0	33.1	0.3	0.90	3.28	4.18	1.27	55.00	3.73	0.45
3	0.0300	0.030	56.0	40.3	0.5	1.09	3.07	4.16	1.36	56.50	3.61	0.55
4	0.0400	0.040	67.0	48.2	0.7	1.30	2.87	4.17	1.45	57.90	3.52	0.65
5	0.0500	0.050	71.0	51.1	0.9	1.38	2.78	4.16	1.50	58.50	3.47	0.69
6	0.0600	0.060	78.0	56.2	1.0	1.51	2.65	4.16	1.57	59.40	3.41	0.76
7	0.0700	0.070	85.0	61.2	1.2	1.65	2.55	4.19	1.65	60.10	3.37	0.82
8	0.0800	0.080	90.0	64.8	1.4	1.74	2.46	4.20	1.71	60.70	3.33	0.87
9	0.0900	0.090	95.0	68.4	1.5	1.83	2.40	4.24	1.76	61.10	3.32	0.92
10	0.1000	0.100	100.0	72.0	1.7	1.93	2.35	4.27	1.82	61.50	3.31	0.96
11	0.1500	0.150	115.0	82.8	2.6	2.20	2.10	4.30	2.04	63.20	3.20	1.10
12	0.2000	0.200	127.0	91.4	3.4	2.40	1.97	4.38	2.22	64.10	3.17	1.20
13	0.2500	0.250	137.0	98.6	4.3	2.57	1.89	4.46	2.36	64.70	3.17	1.28
14	0.3000	0.300	159.0	114.5	5.1	2.96	1.83	4.78	2.62	65.10	3.31	1.48
15	0.3500	0.350	176.0	126.7	6.0	3.24	1.80	5.04	2.80	65.30	3.42	1.62
16	0.4000	0.400	182.0	131.0	6.8	3.32	1.77	5.09	2.88	65.50	3.43	1.66
17	0.4500	0.450	188.0	135.4	7.7	3.40	1.76	5.16	2.94	65.60	3.46	1.70
18	0.5000	0.500	198.0	142.6	8.6	3.55	1.76	5.30	3.02	65.60	3.53	1.77
19	0.5500	0.550	215.0	154.8	9.4	3.82	1.76	5.57	3.17	65.60	3.66	1.91
20	0.6000	0.600	228.0	164.2	10.3	4.01	1.76	5.77	3.28	65.60	3.76	2.00

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	230.0	165.6	11.1	4.01	1.77	5.78	3.26	65.50	3.77	2.00
22	0.7000	0.700	236.0	169.9	12.0	4.07	1.79	5.86	3.28	65.40	3.82	2.03
23	0.7500	0.750	240.0	172.8	12.8	4.10	1.80	5.90	3.28	65.30	3.85	2.05
24	0.8000	0.800	258.0	185.8	13.7	4.36	1.81	6.18	3.40	65.20	4.00	2.18
25	0.8500	0.850	271.0	195.1	14.6	4.54	1.84	6.38	3.46	65.00	4.11	2.27
26	0.9000	0.900	270.0	194.4	15.4	4.48	1.87	6.35	3.39	64.80	4.11	2.24

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1179.420			1192.460
Wt. dry soil and tare:	991.110			991.110
Wt. of tare:	0.000			0.000
Weight, gms:	1179.4			
Diameter, in:	2.840	2.794	2.748	
Area, in²:	6.335	6.133	5.930	
Height, in:	6.000	6.000	6.000	
Net decrease in height, in:		0.000	0.000	
Net decrease in water volume, cc:		-43.500	20.000	
% Moisture:	19.0	23.4	21.4	20.3
Wet density, pcf:	118.2	126.6	128.8	
Dry density, pcf:	99.3	102.6	106.1	
Void ratio:	0.6779	0.6245	0.5706	
% Saturation:	74.8	100.0	100.0	

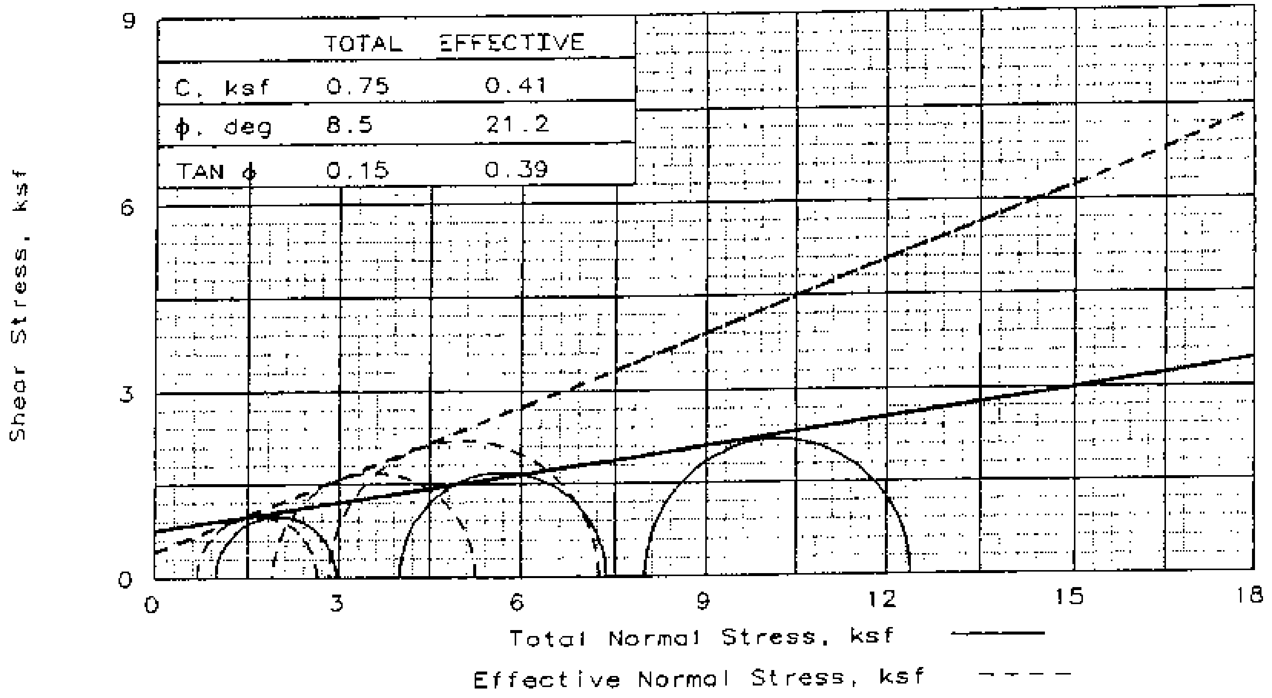
Test Readings Data for Specimen No. 3

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 105.50 psi = 15.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 7.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 6.56 ksf at reading no. 25
ULT. STRESS = not selected

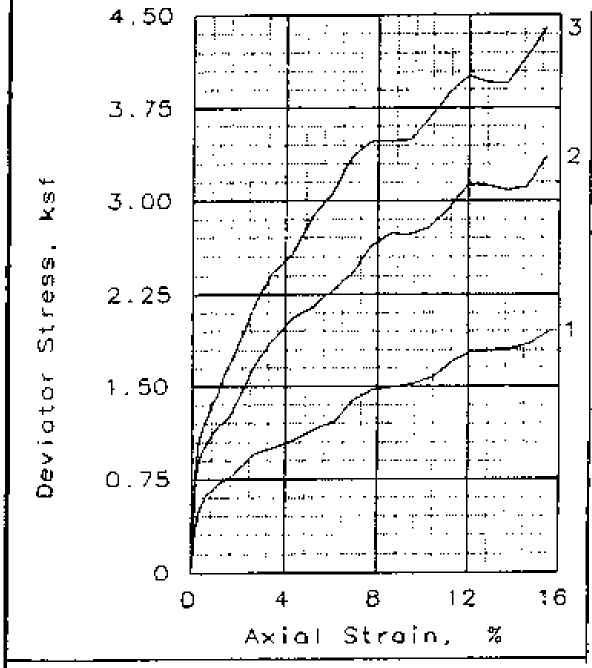
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	7.99	7.99	1.00	50.00	7.99	0.00
1	0.0100	0.010	72.0	51.8	0.2	1.26	7.73	8.99	1.16	51.80	8.36	0.63
2	0.0200	0.020	112.0	80.6	0.3	1.95	7.46	9.41	1.26	53.70	8.44	0.98
3	0.0300	0.030	145.0	104.4	0.5	2.52	7.16	9.68	1.35	55.80	8.42	1.26
4	0.0400	0.040	165.0	118.8	0.7	2.87	6.94	9.81	1.41	57.30	8.37	1.43
5	0.0500	0.050	178.0	128.2	0.8	3.09	6.78	9.87	1.46	58.40	8.33	1.54
6	0.0600	0.060	191.0	137.5	1.0	3.31	6.60	9.90	1.50	59.70	8.25	1.65
7	0.0700	0.070	200.0	144.0	1.2	3.46	6.42	9.88	1.54	60.90	8.15	1.73
8	0.0800	0.080	206.0	148.3	1.3	3.55	6.31	9.86	1.56	61.70	8.08	1.78
9	0.0900	0.090	212.0	152.6	1.5	3.65	6.16	9.81	1.59	62.70	7.99	1.83
10	0.1000	0.100	216.0	155.5	1.7	3.71	6.06	9.78	1.61	63.40	7.92	1.86
11	0.1500	0.150	239.0	172.1	2.5	4.07	5.53	9.60	1.74	67.10	7.57	2.04
12	0.2000	0.200	257.0	185.0	3.3	4.34	5.10	9.44	1.85	70.10	7.27	2.17
13	0.2500	0.250	271.0	195.1	4.2	4.54	4.80	9.34	1.95	72.20	7.07	2.27
14	0.3000	0.300	295.0	212.4	5.0	4.90	4.51	9.41	2.09	74.20	6.96	2.45
15	0.3500	0.350	308.0	221.8	5.8	5.07	4.29	9.36	2.18	75.70	6.83	2.54
16	0.4000	0.400	316.0	227.5	6.7	5.16	4.15	9.30	2.24	76.70	6.73	2.58
17	0.4500	0.450	328.0	236.2	7.5	5.31	3.99	9.29	2.33	77.80	6.64	2.65
18	0.5000	0.500	336.0	241.9	8.3	5.39	3.95	9.33	2.36	78.10	6.64	2.69
19	0.5500	0.550	362.0	260.6	9.2	5.75	3.87	9.62	2.48	78.60	6.75	2.87
20	0.6000	0.600	375.0	270.0	10.0	5.90	3.83	9.73	2.54	78.90	6.78	2.95

Test Readings Data for Specimen No. 3

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
21	0.6500	0.650	382.0	275.0	10.8	5.96	3.79	9.74	2.57	79.20	6.77	2.98
22	0.7000	0.700	388.0	279.4	11.7	5.99	3.76	9.75	2.59	79.40	6.75	3.00
23	0.7500	0.750	405.0	291.6	12.5	6.20	3.69	9.88	2.68	79.90	6.78	3.10
24	0.8000	0.800	428.0	308.2	13.3	6.49	3.63	10.11	2.79	80.30	6.87	3.24
25	0.8500	0.850	437.0	314.6	14.2	6.56	3.60	10.16	2.82	80.50	6.88	3.28
26	0.9000	0.900	440.0	316.8	15.0	6.54	3.57	10.11	2.83	80.70	6.84	3.27



	TOTAL	EFFECTIVE
C, ksf	0.75	0.41
ϕ, deg	8.5	21.2
TAN ϕ	0.15	0.39



	SAMPLE NO.:	1	2	3
INITIAL	WATER CONTENT, %	19.2	19.2	19.2
	DRY DENSITY, pcf	100.9	100.1	100.3
	SATURATION, %	79.0	77.5	77.9
	VOID RATIO	0.646	0.659	0.656
	DIAMETER, in	2.84	2.84	2.85
	HEIGHT, in	6.00	6.00	6.00
AT TEST	WATER CONTENT, %	23.4	22.4	21.4
	DRY DENSITY, pcf	102.4	104.1	105.8
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.622	0.595	0.570
	DIAMETER, in	2.87	2.83	2.81
	HEIGHT, in	5.77	5.84	5.85
	Strain rate, %/min	0.17	0.17	0.17
	BACK PRESSURE, ksf	7.20	7.20	7.20
	CELL PRESSURE, ksf	8.19	11.20	15.19
	FAIL. STRESS, ksf	1.98	3.36	4.40
	TOTAL PORE PR., ksf	7.52	9.30	12.36
	ULT. STRESS, ksf			
	TOTAL PORE PR., ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	2.63	5.26	7.23
	$\bar{\sigma}_3$ FAILURE, ksf	0.68	1.90	2.84

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded Sample
DESCRIPTION: Light-Brown Silty Clay (CL)
LL= 38 PL= 18 PI= 20
SPECIFIC GRAVITY= 2.66
REMARKS: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor

HL

Fig. No.: ______

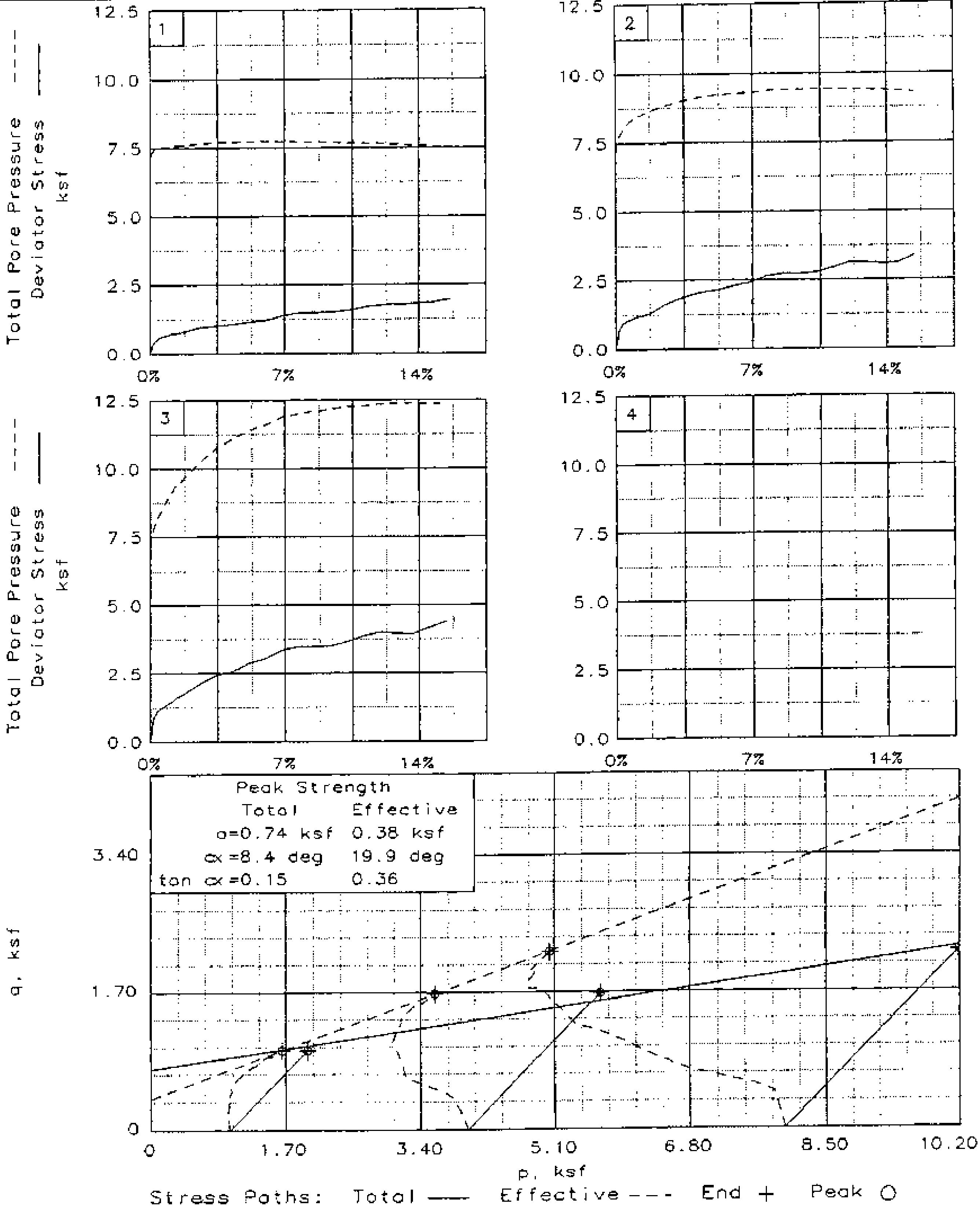
CLIENT: TVA

PROJECT: Ash Disposal Areas - TVA Gallatin Fossil Plant
SAMPLE LOCATION: A-9 Bulk @ 0'-15'

PROJ. NO.: 3043-04-1043 DATE: 10-08-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Peak Strength	
Total	Effective
a=0.74 ksf	0.38 ksf
α =8.4 deg	19.9 deg
tan α =0.15	0.36

Client: TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Location: A-9 Bulk @ 0'-15'

File: FOSSIL10 Project No.: 3043-04-1043 Fig. No.: _____

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

10-08-2004
10:34 am

Project and Sample Data

Date: 10-08-04
Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Sample location: A-9 Bulk @ 0'-15'
Sample description: Light-Brown Silty Clay (CL)
Remarks: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor
Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Remolded Sample
Specific gravity= 2.66 LL= 38 PL= 18 PI= 20
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1199.520			1238.150
Wt. dry soil and tare:	1006.310			1006.310
Wt. of tare:	0.000			0.000
Weight, gms:	1199.5			
Diameter, in:	2.840	2.847	2.875	
Area, in^2:	6.335	6.367	6.490	
Height, in:	6.000	6.000	5.769	
Net decrease in height, in:		0.000	0.231	
Net decrease in water volume, cc:		-54.500	12.500	
% Moisture:	19.2	24.6	23.4	23.0
Wet density, pcf:	120.2	125.1	126.3	
Dry density, pcf:	100.9	100.4	102.4	
Void ratio:	0.6464	0.6548	0.6217	
% Saturation:	79.0	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Consolidation cell pressure = 56.90 psi = 8.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 1.96 ksf at reading no. 26
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	0.99	0.99	1.00	50.00	0.99	0.00
1	0.0100	0.010	23.0	16.6	0.2	0.37	0.78	1.14	1.47	51.50	0.96	0.18
2	0.0200	0.020	32.0	23.0	0.3	0.51	0.72	1.23	1.71	51.90	0.97	0.25
3	0.0300	0.030	37.0	26.6	0.5	0.59	0.69	1.28	1.85	52.10	0.99	0.29
4	0.0400	0.040	40.0	28.8	0.7	0.63	0.66	1.30	1.96	52.30	0.98	0.32
5	0.0500	0.050	41.0	29.5	0.9	0.65	0.65	1.30	2.00	52.40	0.97	0.32
6	0.0600	0.060	44.0	31.7	1.0	0.70	0.65	1.34	2.07	52.40	1.00	0.35
7	0.0700	0.070	46.0	33.1	1.2	0.73	0.62	1.35	2.17	52.60	0.98	0.36
8	0.0800	0.080	47.0	33.8	1.4	0.74	0.60	1.35	2.22	52.70	0.98	0.37
9	0.0900	0.090	48.0	34.6	1.6	0.75	0.59	1.35	2.28	52.80	0.97	0.38
10	0.1000	0.100	50.0	36.0	1.7	0.78	0.59	1.38	2.33	52.80	0.98	0.39
11	0.1500	0.150	61.0	43.9	2.6	0.95	0.55	1.50	2.73	53.10	1.02	0.47
12	0.2000	0.200	65.0	46.8	3.5	1.00	0.50	1.51	2.99	53.40	1.01	0.50
13	0.2500	0.250	70.0	50.4	4.3	1.07	0.49	1.56	3.19	53.50	1.02	0.53
14	0.3000	0.300	76.0	54.7	5.2	1.15	0.48	1.63	3.42	53.60	1.05	0.58
15	0.3500	0.350	81.0	58.3	6.1	1.22	0.46	1.68	3.64	53.70	1.07	0.61
16	0.4000	0.400	94.0	67.7	6.9	1.40	0.48	1.87	3.94	53.60	1.17	0.70
17	0.4500	0.450	100.0	72.0	7.8	1.47	0.49	1.96	4.01	53.50	1.23	0.74
18	0.5000	0.500	102.0	73.4	8.7	1.49	0.49	1.98	4.04	53.50	1.23	0.74
19	0.5500	0.550	105.0	75.6	9.5	1.52	0.50	2.02	4.01	53.40	1.26	0.76
20	0.6000	0.600	110.0	79.2	10.4	1.57	0.53	2.11	3.96	53.20	1.32	0.79
21	0.6500	0.650	120.0	86.4	11.3	1.70	0.55	2.25	4.11	53.10	1.40	0.85
22	0.7000	0.700	127.0	91.4	12.1	1.78	0.56	2.34	4.17	53.00	1.45	0.89
23	0.7500	0.750	129.0	92.9	13.0	1.79	0.59	2.38	4.04	52.80	1.49	0.90
24	0.8000	0.800	131.0	94.3	13.9	1.80	0.62	2.42	3.91	52.60	1.52	0.90
25	0.8500	0.850	136.0	97.9	14.7	1.85	0.65	2.50	3.86	52.40	1.57	0.93
26	0.9000	0.900	145.0	104.4	15.6	1.96	0.68	2.63	3.89	52.20	1.65	0.98

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1193.550			1220.320
Wt. dry soil and tare:	1001.300			1001.300
Wt. of tare:	0.000			0.000
Weight, gms:	1193.6			
Diameter, in:	2.844	2.822	2.826	
Area, in^2:	6.353	6.257	6.271	
Height, in:	6.000	6.000	5.844	
Net decrease in height, in:		0.000	0.156	
Net decrease in water volume, cc:		-46.500	14.600	
% Moisture:	19.2	23.8	22.4	21.9
Wet density, pcf:	119.3	125.8	127.4	
Dry density, pcf:	100.1	101.6	104.1	
Void ratio:	0.6593	0.6343	0.5955	
% Saturation:	77.5	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Consolidation cell pressure = 77.80 psi = 11.20 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 3.36 ksf at reading no. 26
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	4.00	4.00	1.00	50.00	4.00	0.00
1	0.0100	0.010	45.0	32.4	0.2	0.74	3.47	4.21	1.21	53.70	3.84	0.37
2	0.0200	0.020	57.0	41.0	0.3	0.94	3.21	4.15	1.29	55.50	3.68	0.47
3	0.0300	0.030	61.0	43.9	0.5	1.00	3.07	4.07	1.33	56.50	3.57	0.50
4	0.0400	0.040	65.0	46.8	0.7	1.07	2.95	4.02	1.36	57.30	3.49	0.53
5	0.0500	0.050	68.0	49.0	0.9	1.11	2.85	3.97	1.39	58.00	3.41	0.56
6	0.0600	0.060	71.0	51.1	1.0	1.16	2.79	3.96	1.42	58.40	3.37	0.58
7	0.0700	0.070	73.0	52.6	1.2	1.19	2.72	3.91	1.44	58.90	3.32	0.60
8	0.0800	0.080	75.0	54.0	1.4	1.22	2.66	3.89	1.46	59.30	3.28	0.61
9	0.0900	0.090	77.0	55.4	1.5	1.25	2.61	3.86	1.48	59.70	3.23	0.63
10	0.1000	0.100	80.0	57.6	1.7	1.30	2.56	3.86	1.51	60.00	3.21	0.65
11	0.1500	0.150	102.0	73.4	2.6	1.64	2.35	3.99	1.70	61.50	3.17	0.82
12	0.2000	0.200	118.0	85.0	3.4	1.88	2.17	4.06	1.87	62.70	3.12	0.94
13	0.2500	0.250	130.0	93.6	4.3	2.06	2.06	4.12	2.00	63.50	3.09	1.03
14	0.3000	0.300	137.0	98.6	5.1	2.15	1.97	4.12	2.09	64.10	3.05	1.07
15	0.3500	0.350	147.0	105.8	6.0	2.28	1.93	4.21	2.18	64.40	3.07	1.14
16	0.4000	0.400	157.0	113.0	6.8	2.42	1.90	4.32	2.27	64.60	3.11	1.21
17	0.4500	0.450	173:0	124.6	7.7	2.64	1.83	4.47	2.44	65.10	3.15	1.32
18	0.5000	0.500	181.0	130.3	8.6	2.74	1.79	4.52	2.53	65.40	3.15	1.37
19	0.5500	0.550	182.0	131.0	9.4	2.73	1.79	4.51	2.53	65.40	3.15	1.36
20	0.6000	0.600	188.0	135.4	10.3	2.79	1.77	4.56	2.57	65.50	3.17	1.39

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	200.0	144.0	11.1	2.94	1.79	4.72	2.65	65.40	3.25	1.47
22	0.7000	0.700	215.0	154.8	12.0	3.13	1.79	4.91	2.75	65.40	3.35	1.56
23	0.7500	0.750	217.0	156.2	12.8	3.13	1.80	4.93	2.74	65.30	3.36	1.56
24	0.8000	0.800	216.0	155.5	13.7	3.08	1.83	4.91	2.69	65.10	3.37	1.54
25	0.8500	0.850	220.0	158.4	14.5	3.11	1.86	4.97	2.67	64.90	3.41	1.55
26	0.9000	0.900	240.0	172.8	15.4	3.36	1.90	5.26	2.77	64.60	3.58	1.68

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1197.860			1218.560
Wt. dry soil and tare:	1004.920			1004.920
Wt. of tare:	0.000			0.000
Weight, gms:	1197.9			
Diameter, in:	2.846	2.836	2.806	
Area, in²:	6.362	6.318	6.185	
Height, in:	6.000	6.000	5.853	
Net decrease in height, in:		0.000	0.147	
Net decrease in water volume, cc:		-50.500	28.000	
% Moisture:	19.2	24.2	21.4	21.3
Wet density, pcf:	119.6	125.5	128.4	
Dry density, pcf:	100.3	101.0	105.8	
Void ratio:	0.6556	0.6444	0.5703	
% Saturation:	77.9	100.0	100.0	

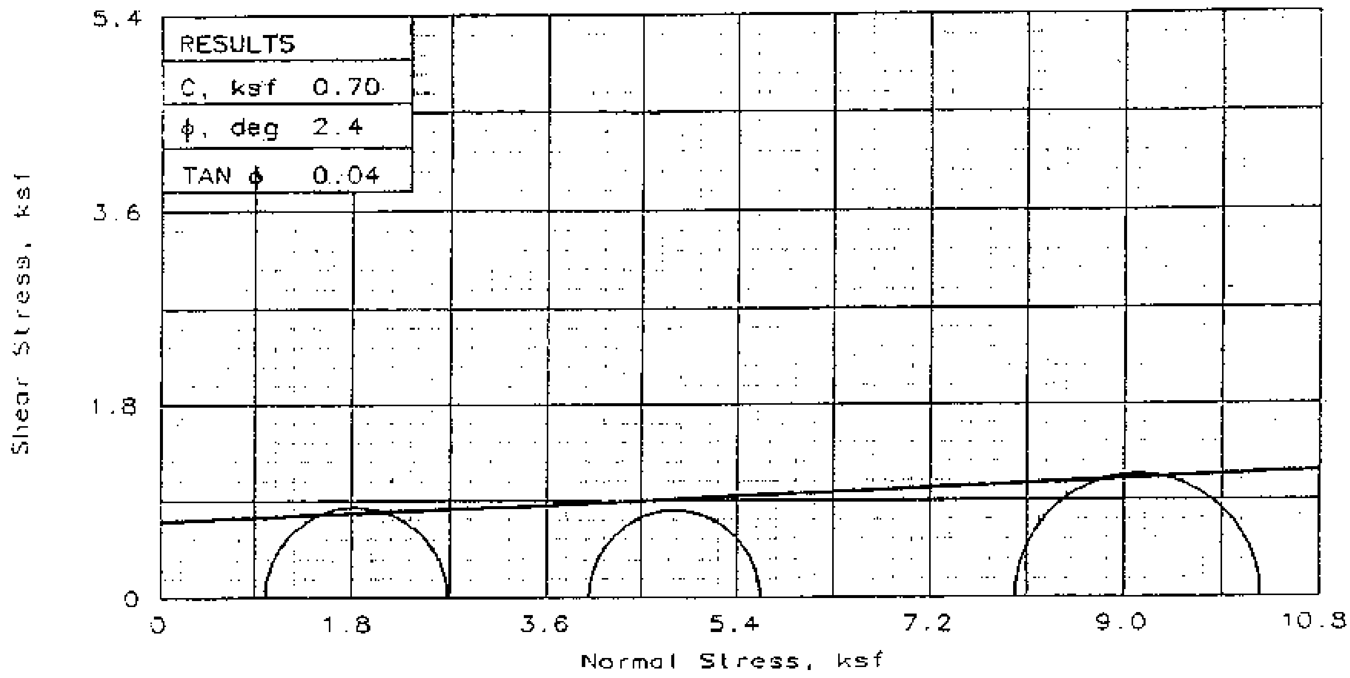
Test Readings Data for Specimen No. 3

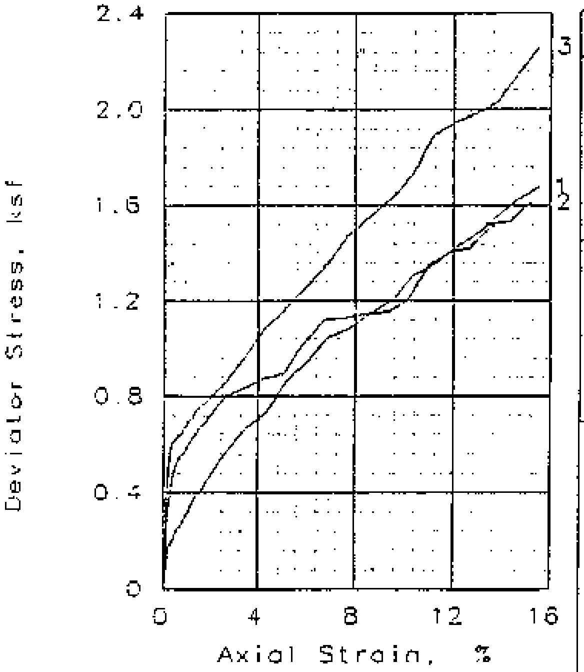
Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 105.50 psi = 15.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 7.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 4.40 ksf at reading no. 26
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	7.99	7.99	1.00	50.00	7.99	0.00
1	0.0100	0.010	54.0	38.9	0.2	0.90	7.40	8.31	1.12	54.10	7.85	0.45
2	0.0200	0.020	66.0	47.5	0.3	1.10	7.04	8.14	1.16	56.60	7.59	0.55
3	0.0300	0.030	72.0	51.8	0.5	1.20	6.78	7.98	1.18	58.40	7.38	0.60
4	0.0400	0.040	77.0	55.4	0.7	1.28	6.54	7.82	1.20	60.10	7.18	0.64
5	0.0500	0.050	82.0	59.0	0.9	1.36	6.35	7.71	1.21	61.40	7.03	0.68
6	0.0600	0.060	85.0	61.2	1.0	1.41	6.16	7.57	1.23	62.70	6.87	0.71
7	0.0700	0.070	90.0	64.8	1.2	1.49	6.00	7.50	1.25	63.80	6.75	0.75
8	0.0800	0.080	97.0	69.8	1.4	1.60	5.79	7.39	1.28	65.30	6.59	0.80
9	0.0900	0.090	101.0	72.7	1.5	1.67	5.70	7.37	1.29	65.90	6.54	0.83
10	0.1000	0.100	105.0	75.6	1.7	1.73	5.56	7.29	1.31	66.90	6.42	0.87
11	0.1500	0.150	130.0	93.6	2.6	2.12	4.97	7.09	1.43	71.00	6.03	1.06
12	0.2000	0.200	150.0	108.0	3.4	2.43	4.45	6.88	1.55	74.60	5.66	1.21
13	0.2500	0.250	160.0	115.2	4.3	2.57	4.09	6.66	1.63	77.10	5.37	1.28
14	0.3000	0.300	181.0	130.3	5.1	2.88	3.79	6.67	1.76	79.20	5.23	1.44
15	0.3500	0.350	194.0	139.7	6.0	3.06	3.60	6.66	1.85	80.50	5.13	1.53
16	0.4000	0.400	215.0	154.8	6.8	3.36	3.31	6.67	2.01	82.50	4.99	1.68
17	0.4500	0.450	225.0	162.0	7.7	3.48	3.20	6.68	2.09	83.30	4.94	1.74
18	0.5000	0.500	227.0	163.4	8.5	3.48	3.11	6.59	2.12	83.90	4.85	1.74
19	0.5500	0.550	230.0	165.6	9.4	3.49	3.02	6.52	2.16	84.50	4.77	1.75
20	0.6000	0.600	244.0	175.7	10.3	3.67	2.94	6.61	2.25	85.10	4.77	1.84

Test Readings Data for Specimen No. 3

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	260.0	187.2	11.1	3.87	2.91	6.78	2.33	85.30	4.85	1.94
22	0.7000	0.700	272.0	195.8	12.0	4.01	2.85	6.87	2.41	85.70	4.86	2.01
23	0.7500	0.750	271.0	195.1	12.8	3.96	2.82	6.78	2.40	85.90	4.80	1.98
24	0.8000	0.800	273.0	196.6	13.7	3.95	2.82	6.77	2.40	85.90	4.80	1.98
25	0.8500	0.850	291.0	209.5	14.5	4.17	2.84	7.01	2.47	85.80	4.92	2.08
26	0.9000	0.900	310.0	223.2	15.4	4.40	2.84	7.23	2.55	85.80	5.04	2.20





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	21.0	21.0	21.0
	DRY DENSITY, pcf	102.8	100.8	102.7
	SATURATION, %	90.2	85.9	90.1
	VOID RATIO	0.622	0.653	0.623
	DIAMETER, in	2.85	2.85	2.85
	HEIGHT, in	5.80	5.92	5.80
AT TEST	WATER CONTENT, %	22.4	24.5	24.2
	DRY DENSITY, pcf	104.4	100.7	101.3
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.597	0.654	0.645
	DIAMETER, in	2.82	2.85	2.87
	HEIGHT, in	5.80	5.92	5.80
Strain rate, %/min		0.33	0.33	0.33
BACK PRESSURE, ksf		0.0	0.0	0.0
CELL PRESSURE, ksf		1.0	4.0	8.0
FAIL. STRESS, ksf		1.7	1.6	2.3
ULT. STRESS, ksf				
σ_1 FAILURE, ksf		2.7	5.6	10.3
σ_3 FAILURE, ksf		1.0	4.0	8.0

TYPE OF TEST:
Unconsolidated Undrained
SAMPLE TYPE: Remolded Sample
DESCRIPTION: Orange-Brown Silty Clay with Sand (CL)
LL= 47 PL= 17 PI= 30
SPECIFIC GRAVITY= 2.67
REMARKS: Remolded to 95% MDD @ 2.0% over Optimum Moisture Content of Standard Proctor (Saturated UU)
Fig. No.: ______

HR

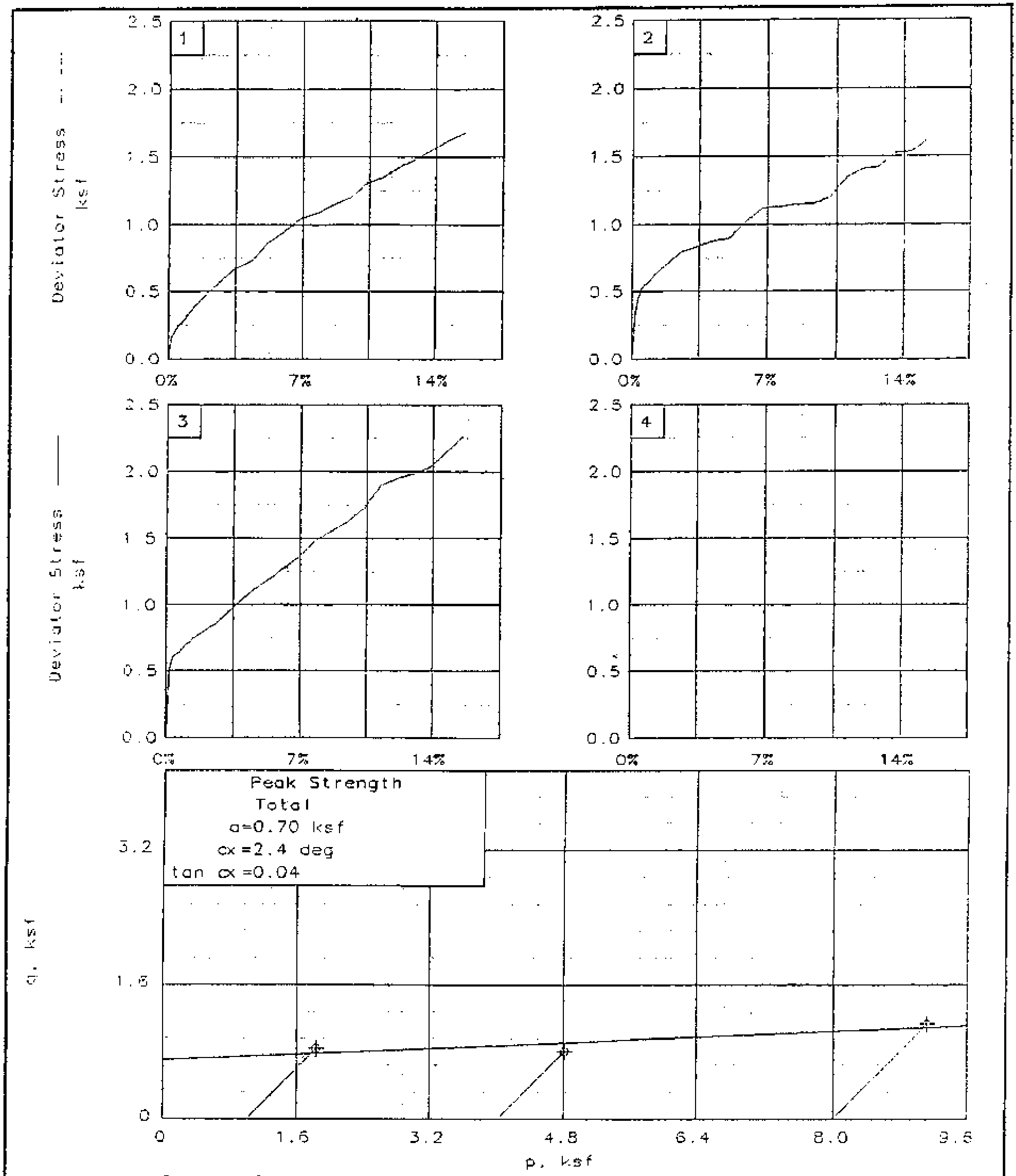
CLIENT: TVA

PROJECT: Ash Disposal Areas - TVA Gallatin Fossil Plant
SAMPLE LOCATION: A-2 Bulk @ 0'-20.0'

PROJ. NO.: 3043-04-1043 DATE: 10-04-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Stress Paths: + indicates end ○ indicates peak

Client: TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Location: A-2 Bulk @ 0'-20.0'

File: FOSSIL8 Project No.: 3043-04-1043 Fig. No.: ____

TRIAXIAL COMPRESSION TEST
Unconsolidated Undrained

10-04-2004
5:52 pm

Project and Sample Data

Date: 10-04-04
Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Sample location: A-2 Bulk @ 0'-20.0'
Sample description: Orange-Brown Silty Clay with Sand (CL)
Remarks: Remolded to 95% MDD @ 2.0% over Optimum Moisture
Content of Standard Proctor (Saturated UU)
Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Remolded Sample
Specific gravity= 2.67 LL= 47 PL= 17 PI= 30
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Wt. moist soil and tare:	1204.390		1229.130
Wt. dry soil and tare:	995.360		995.360
Wt. of tare:	0.000		0.000
Weight, gms:	1204.4		
Diameter, in:	2.846	2.824	
Area, in^2:	6.362	6.264	
Height, in:	5.800	5.800	
Net decrease in height, in:		0.000	
% Moisture:	21.0	22.4	23.5
Wet density, pcf:	124.4	127.7	
Dry density, pcf:	102.8	104.4	
Void ratio:	0.6219	0.5969	
% Saturation:	90.2	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Cell pressure = 6.94 psi = 1.00 ksf
Back pressure = 0.00 psi = 0.00 ksf
Effective confining stress = 1.00 ksf
Strain rate, %/min = 0.33
FAIL. STRESS = 1.68 ksf at reading no. 26
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses Minor ksf	Major ksf	1:3 Ratio	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.0	0.00	1.00	1.00	1.00	1.00	0.00
1	0.0100	0.010	10.0	7.2	0.2	0.17	1.00	1.16	1.17	1.08	0.08
2	0.0200	0.020	12.0	8.6	0.3	0.20	1.00	1.20	1.20	1.10	0.10
3	0.0300	0.030	15.0	10.8	0.5	0.25	1.00	1.25	1.25	1.12	0.12
4	0.0400	0.040	16.0	11.5	0.7	0.26	1.00	1.26	1.26	1.13	0.13
5	0.0500	0.050	18.0	13.0	0.9	0.30	1.00	1.29	1.30	1.15	0.15
6	0.0600	0.060	20.0	14.4	1.0	0.33	1.00	1.33	1.33	1.16	0.16
7	0.0700	0.070	22.0	15.8	1.2	0.36	1.00	1.36	1.36	1.18	0.18
8	0.0800	0.080	24.0	17.3	1.4	0.39	1.00	1.39	1.39	1.20	0.20
9	0.0900	0.090	25.0	18.0	1.6	0.41	1.00	1.41	1.41	1.20	0.20
10	0.1000	0.100	27.0	19.4	1.7	0.44	1.00	1.44	1.44	1.22	0.22
11	0.1500	0.150	35.0	25.2	2.6	0.56	1.00	1.56	1.56	1.28	0.28
12	0.2000	0.200	42.0	30.2	3.4	0.67	1.00	1.67	1.67	1.33	0.34
13	0.2500	0.250	46.0	33.1	4.3	0.73	1.00	1.73	1.73	1.36	0.36
14	0.3000	0.300	55.0	39.6	5.2	0.86	1.00	1.86	1.86	1.43	0.43
15	0.3500	0.350	61.0	43.9	6.0	0.95	1.00	1.95	1.95	1.47	0.47
16	0.4000	0.400	68.0	49.0	6.9	1.05	1.00	2.05	2.05	1.52	0.52
17	0.4500	0.450	71.0	51.1	7.8	1.08	1.00	2.08	2.08	1.54	0.54
18	0.5000	0.500	76.0	54.7	8.6	1.15	1.00	2.15	2.15	1.57	0.57
19	0.5500	0.550	80.0	57.6	9.5	1.20	1.00	2.20	2.20	1.60	0.60
20	0.6000	0.600	88.0	63.4	10.3	1.31	1.00	2.31	2.31	1.65	0.65
21	0.6500	0.650	92.0	66.2	11.2	1.35	1.00	2.35	2.35	1.68	0.68
22	0.7000	0.700	98.0	70.6	12.1	1.43	1.00	2.43	2.43	1.71	0.71
23	0.7500	0.750	103.0	74.2	12.9	1.48	1.00	2.48	2.49	1.74	0.74
24	0.8000	0.800	109.0	78.5	13.8	1.56	1.00	2.55	2.56	1.78	0.78
25	0.8500	0.850	115.0	82.8	14.7	1.62	1.00	2.62	2.63	1.81	0.81
26	0.9000	0.900	120.0	86.4	15.5	1.68	1.00	2.68	2.68	1.84	0.84

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Wt. moist soil and tare:	1206.160		1240.250
Wt. dry soil and tare:	996.830		996.830
Wt. of tare:	0.000		0.000
Weight, gms:	1206.2		
Diameter, in:	2.846	2.847	
Area, in^2:	6.362	6.367	
Height, in:	5.920	5.920	
Net decrease in height, in:		0.000	
% Moisture:	21.0	24.5	24.4
Wet density, pcf:	122.0	125.4	
Dry density, pcf:	100.8	100.7	
Void ratio:	0.6530	0.6544	
% Saturation:	85.9	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm^2
Membrane thickness = 0.012 cm
Cell pressure = 27.80 psi = 4.00 ksf
Back pressure = 0.00 psi = 0.00 ksf
Effective confining stress = 4.00 ksf
Strain rate, %/min = 0.33
FAIL. STRESS = 1.62 ksf at reading no. 26
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses Minor ksf	Major ksf	1:3 Ratio	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.0	0.00	4.00	4.00	1.00	4.00	0.00
1	0.0100	0.010	20.0	14.4	0.2	0.33	4.00	4.33	1.08	4.17	0.16
2	0.0200	0.020	28.0	20.2	0.3	0.45	4.00	4.46	1.11	4.23	0.23
3	0.0300	0.030	32.0	23.0	0.5	0.52	4.00	4.52	1.13	4.26	0.26
4	0.0400	0.040	34.0	24.5	0.7	0.55	4.00	4.55	1.14	4.28	0.27
5	0.0500	0.050	35.0	25.2	0.8	0.57	4.00	4.57	1.14	4.29	0.28
6	0.0600	0.060	37.0	26.6	1.0	0.60	4.00	4.60	1.15	4.30	0.30
7	0.0700	0.070	39.0	28.1	1.2	0.63	4.00	4.63	1.16	4.32	0.31
8	0.0800	0.080	40.0	28.8	1.4	0.64	4.00	4.65	1.16	4.32	0.32
9	0.0900	0.090	42.0	30.2	1.5	0.67	4.00	4.68	1.17	4.34	0.34
10	0.1000	0.100	43.0	31.0	1.7	0.69	4.00	4.69	1.17	4.35	0.34
11	0.1500	0.150	50.0	36.0	2.5	0.79	4.00	4.80	1.20	4.40	0.40
12	0.2000	0.200	53.0	38.2	3.4	0.83	4.00	4.84	1.21	4.42	0.42
13	0.2500	0.250	56.0	40.3	4.2	0.87	4.00	4.88	1.22	4.44	0.44
14	0.3000	0.300	58.0	41.8	5.1	0.90	4.00	4.90	1.22	4.45	0.45
15	0.3500	0.350	67.0	48.2	5.9	1.03	4.00	5.03	1.26	4.52	0.51
16	0.4000	0.400	74.0	53.3	6.8	1.12	4.00	5.13	1.28	4.56	0.56
17	0.4500	0.450	75.0	54.0	7.6	1.13	4.00	5.13	1.28	4.57	0.56
18	0.5000	0.500	77.0	55.4	8.4	1.15	4.00	5.15	1.29	4.58	0.57
19	0.5500	0.550	78.0	56.2	9.3	1.15	4.00	5.16	1.29	4.58	0.58
20	0.6000	0.600	82.0	59.0	10.1	1.20	4.00	5.20	1.30	4.60	0.60
21	0.6500	0.650	93.0	67.0	11.0	1.35	4.00	5.35	1.34	4.68	0.67

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses			P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio		
22	0.7000	0.700	98.0	70.6	11.8	1.41	4.00	5.41	1.35	4.71	0.70
23	0.7500	0.750	100.0	72.0	12.7	1.42	4.00	5.43	1.36	4.71	0.71
24	0.8000	0.800	108.0	77.8	13.5	1.52	4.00	5.52	1.38	4.76	0.76
25	0.8500	0.850	110.0	79.2	14.4	1.53	4.00	5.54	1.38	4.77	0.77
26	0.9000	0.900	117.0	84.2	15.2	1.62	4.00	5.62	1.40	4.81	0.81

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Final
Wt. moist soil and tare:	1206.450		1233.380
Wt. dry soil and tare:	997.070		997.070
Wt. of tare:	0.000		0.000
Weight, gms:	1206.5		
Diameter, in:	2.849	2.869	
Area, in²:	6.375	6.463	
Height, in:	5.800	5.800	
Net decrease in height, in:		0.000	
% Moisture:	21.0	24.2	23.7
Wet density, pcf:	124.3	125.8	
Dry density, pcf:	102.7	101.3	
Void ratio:	0.6225	0.6450	
% Saturation:	90.1	100.0	

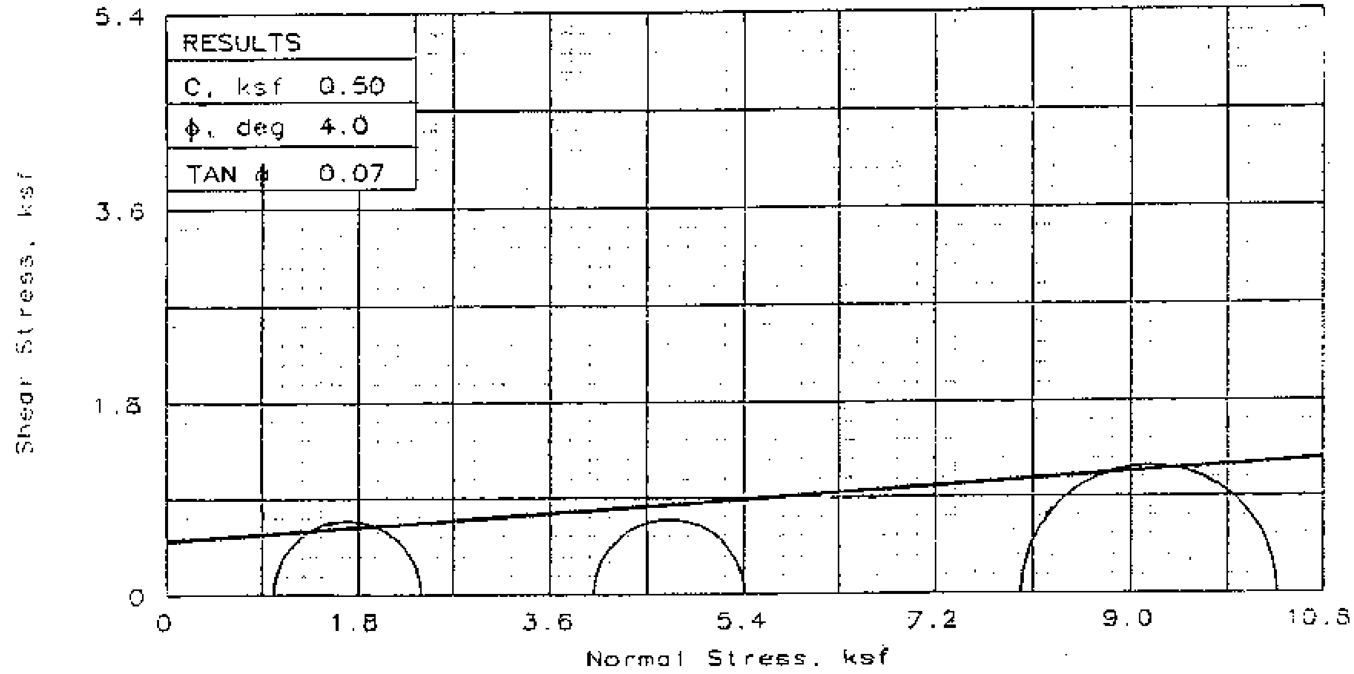
Test Readings Data for Specimen No. 3

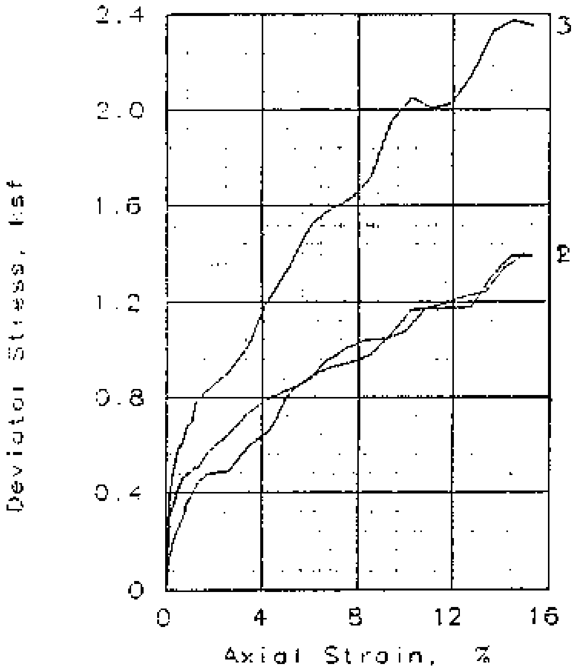
Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Cell pressure = 55.50 psi = 7.99 ksf
Back pressure = 0.00 psi = 0.00 ksf
Effective confining stress = 7.99 ksf
Strain rate, %/min = 0.33
FAIL. STRESS = 2.26 ksf at reading no. 26
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses Minor ksf	Major ksf	1:3 Ratio	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.0	0.00	7.99	7.99	1.00	7.99	0.00
1	0.0100	0.010	31.0	22.3	0.2	0.50	7.99	8.49	1.06	8.24	0.25
2	0.0200	0.020	38.0	27.4	0.3	0.61	7.99	8.60	1.08	8.30	0.30
3	0.0300	0.030	39.0	28.1	0.5	0.62	7.99	8.61	1.08	8.30	0.31
4	0.0400	0.040	40.0	28.8	0.7	0.64	7.99	8.63	1.08	8.31	0.32
5	0.0500	0.050	42.0	30.2	0.9	0.67	7.99	8.66	1.08	8.33	0.33
6	0.0600	0.060	44.0	31.7	1.0	0.70	7.99	8.69	1.09	8.34	0.35
7	0.0700	0.070	45.0	32.4	1.2	0.71	7.99	8.71	1.09	8.35	0.36
8	0.0800	0.080	47.0	33.8	1.4	0.74	7.99	8.74	1.09	8.36	0.37
9	0.0900	0.090	48.0	34.6	1.6	0.76	7.99	8.75	1.09	8.37	0.38
10	0.1000	0.100	49.0	35.3	1.7	0.77	7.99	8.76	1.10	8.38	0.39
11	0.1500	0.150	55.0	39.6	2.6	0.86	7.99	8.85	1.11	8.42	0.43
12	0.2000	0.200	63.0	45.4	3.4	0.98	7.99	8.97	1.12	8.48	0.49
13	0.2500	0.250	71.0	51.1	4.3	1.09	7.99	9.08	1.14	8.54	0.54
14	0.3000	0.300	77.0	55.4	5.2	1.17	7.99	9.16	1.15	8.58	0.59
15	0.3500	0.350	84.0	60.5	6.0	1.27	7.99	9.26	1.16	8.63	0.63
16	0.4000	0.400	91.0	65.5	6.9	1.36	7.99	9.35	1.17	8.67	0.68
17	0.4500	0.450	100.0	72.0	7.8	1.48	7.99	9.47	1.19	8.73	0.74
18	0.5000	0.500	106.0	76.3	8.6	1.55	7.99	9.55	1.19	8.77	0.78
19	0.5500	0.550	112.0	80.6	9.5	1.63	7.99	9.62	1.20	8.81	0.81
20	0.6000	0.600	120.0	86.4	10.3	1.73	7.99	9.72	1.22	8.85	0.86
21	0.6500	0.650	133.0	95.8	11.2	1.89	7.99	9.89	1.24	8.94	0.95

Test Readings Data for Specimen No. 3

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses Minor ksf	Major ksf	1:3 Ratio	P ksf	Q ksf
22	0.7000	0.700	138.0	99.4	12.1	1.95	7.99	9.94	1.24	8.97	0.97
23	0.7500	0.750	142.0	102.2	12.9	1.98	7.99	9.98	1.25	8.98	0.99
24	0.8000	0.800	147.0	105.8	13.8	2.03	7.99	10.02	1.25	9.01	1.02
25	0.8500	0.850	157.0	113.0	14.7	2.15	7.99	10.14	1.27	9.07	1.07
26	0.9000	0.900	167.0	120.2	15.5	2.26	7.99	10.26	1.28	9.12	1.13





SAMPLE NO.:		1	2	3
INITIAL	WATER CONTENT, %	19.0	19.0	19.0
	DRY DENSITY, pcf	102.9	100.4	102.6
	SATURATION, %	82.3	77.3	81.6
	VOID RATIO	0.614	0.654	0.619
	DIAMETER, in	2.85	2.84	2.85
	HEIGHT, in	5.89	6.01	5.87
AT TEST	WATER CONTENT, %	23.3	24.1	23.2
	DRY DENSITY, pcf	102.5	101.2	102.7
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.621	0.640	0.617
	DIAMETER, in	2.85	2.83	2.84
	HEIGHT, in	5.89	6.01	5.87
Strain rate, %/min		0.33	0.33	0.33
BACK PRESSURE, ksf		0.0	0.0	0.0
CELL PRESSURE, ksf		1.0	4.0	8.0
FAIL. STRESS, ksf		1.4	1.4	2.4
ULT. STRESS, ksf				
σ_1 FAILURE, ksf		2.4	5.4	10.4
σ_3 FAILURE, ksf		1.0	4.0	8.0

TYPE OF TEST:
Unconsolidated Undrained
SAMPLE TYPE: Remolded Sample
DESCRIPTION: Light-Brown Silty Clay (CL)
LL= 38 PL= 18 PI= 20
SPECIFIC GRAVITY= 2.66
REMARKS: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor (Saturated UU)
Fig. No.: ______ HB

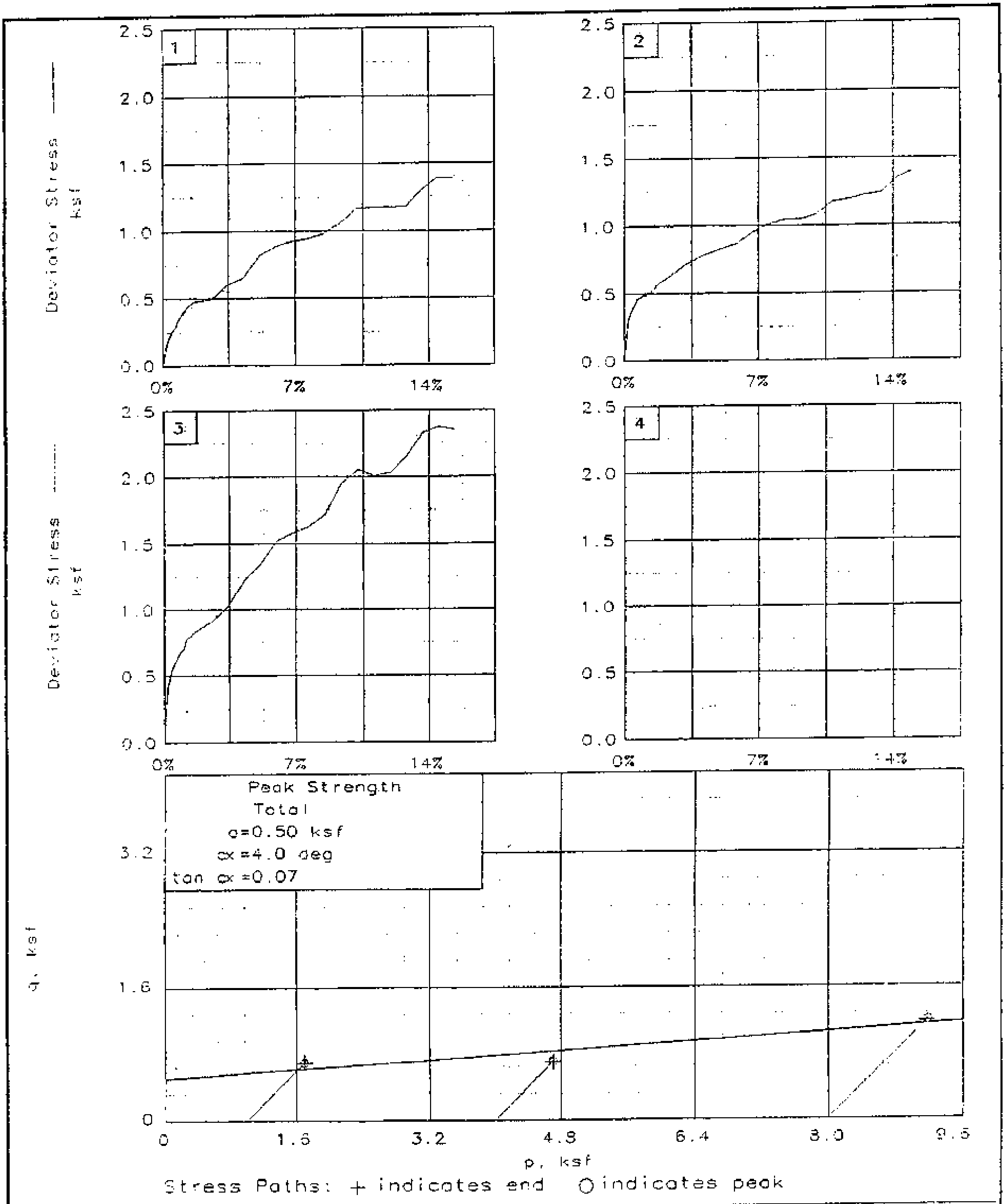
CLIENT: TVA

PROJECT: Ash Disposal Areas - TVA Gallatin Fossil Plant
SAMPLE LOCATION: A-9 Bulk @ 0'-15'

PROJ. NO.. 3043-04-1043 DATE: 10-01-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Client: TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Location: A-9 Bulk @ 0'-15'

File: FOSSIL7 Project No.: 3043-04-1043 Fig. No.: ______

TRIAXIAL COMPRESSION TEST
Unconsolidated Undrained

10-04-2004
5:50 pm

Project and Sample Data

Date: 10-01-04
Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Sample location: A-9 Bulk @ 0'-15'
Sample description: Light-Brown Silty Clay (CL)
Remarks: Remolded to 95% MDD @ Optimum Moisture Content of
Standard Proctor (Saturated UU)
Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Remolded Sample
Specific gravity= 2.66 LL= 38 PL= 18 PI= 20
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Final
Wt. moist soil and tare:	1203.370		1247.220
Wt. dry soil and tare:	1011.240		1011.240
Wt. of tare:	0.000		0.000
Weight, gms:	1203.4		
Diameter, in:	2.845	2.851	
Area, in²:	6.357	6.383	
Height, in:	5.890	5.890	
Net decrease in height, in:		0.000	
% Moisture:	19.0	23.3	23.3
Wet density, pcf:	122.4	126.4	
Dry density, pcf:	102.9	102.5	
Void ratio:	0.6140	0.6206	
% Saturation:	82.3	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Cell pressure = 6.94 psi = 1.00 ksf
Back pressure = 0.00 psi = 0.00 ksf
Effective confining stress = 1.00 ksf
Strain rate, %/min = 0.33
FAIL. STRESS = 1.39 ksf at reading no. 25
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses Minor ksf	Major ksf	1:3 Ratio	P ksf	Q ksf
0	0.0000	0.000	0.0	0.0	0.0	0.00	1.00	1.00	1.00	1.00	0.00
1	0.0100	0.010	9.0	6.5	0.2	0.15	1.00	1.15	1.15	1.07	0.07
2	0.0200	0.020	13.0	9.4	0.3	0.21	1.00	1.21	1.21	1.10	0.11
3	0.0300	0.030	16.0	11.5	0.5	0.26	1.00	1.26	1.26	1.13	0.13
4	0.0400	0.040	18.0	13.0	0.7	0.29	1.00	1.29	1.29	1.14	0.15
5	0.0500	0.050	22.0	15.8	0.8	0.35	1.00	1.35	1.35	1.18	0.18
6	0.0600	0.060	24.0	17.3	1.0	0.39	1.00	1.39	1.39	1.19	0.19
7	0.0700	0.070	26.0	18.7	1.2	0.42	1.00	1.42	1.42	1.21	0.21
8	0.0800	0.080	28.0	20.2	1.4	0.45	1.00	1.45	1.45	1.22	0.22
9	0.0900	0.090	29.0	20.9	1.5	0.46	1.00	1.46	1.46	1.23	0.23
10	0.1000	0.100	30.0	21.6	1.7	0.48	1.00	1.48	1.48	1.24	0.24
11	0.1500	0.150	31.0	22.3	2.5	0.49	1.00	1.49	1.49	1.24	0.25
12	0.2000	0.200	38.0	27.4	3.4	0.60	1.00	1.60	1.60	1.30	0.30
13	0.2500	0.250	42.0	30.2	4.2	0.65	1.00	1.65	1.65	1.33	0.33
14	0.3000	0.300	53.0	38.2	5.1	0.82	1.00	1.82	1.82	1.41	0.41
15	0.3500	0.350	58.0	41.8	5.9	0.89	1.00	1.89	1.89	1.44	0.44
16	0.4000	0.400	61.0	43.9	6.8	0.92	1.00	1.92	1.92	1.46	0.46
17	0.4500	0.450	63.0	45.4	7.6	0.95	1.00	1.94	1.95	1.47	0.47
18	0.5000	0.500	66.0	47.5	8.5	0.98	1.00	1.98	1.98	1.49	0.49
19	0.5500	0.550	72.0	51.8	9.3	1.06	1.00	2.06	2.06	1.53	0.53
20	0.6000	0.600	80.0	57.6	10.2	1.17	1.00	2.17	2.17	1.58	0.58
21	0.6500	0.650	81.0	58.3	11.0	1.17	1.00	2.17	2.17	1.58	0.59
22	0.7000	0.700	82.0	59.0	11.9	1.17	1.00	2.17	2.17	1.59	0.59
23	0.7500	0.750	83.0	59.8	12.7	1.18	1.00	2.18	2.18	1.59	0.59
24	0.8000	0.800	93.0	67.0	13.6	1.31	1.00	2.30	2.31	1.65	0.65
25	0.8500	0.850	100.0	72.0	14.4	1.39	1.00	2.39	2.39	1.69	0.69
26	0.9000	0.900	101.0	72.7	15.3	1.39	1.00	2.39	2.39	1.69	0.69

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Final
Wt. moist soil and tare:	1196.320		1249.740
Wt. dry soil and tare:	1005.310		1005.310
Wt. of tare:	0.000		0.000
Weight, gms:	1196.3		
Diameter, in:	2.843	2.831	
Area, in²:	6.348	6.297	
Height, in:	6.008	6.008	
Net decrease in height, in:		0.000	
% Moisture:	19.0	24.1	24.3
Wet density, pcf:	119.5	125.6	
Dry density, pcf:	100.4	101.2	
Void ratio:	0.6537	0.6403	
% Saturation:	77.3	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Cell pressure = 27.80 psi = 4.00 ksf
Back pressure = 0.00 psi = 0.00 ksf
Effective confining stress = 4.00 ksf
Strain rate, %/min = 0.33
FAIL. STRESS = 1.40 ksf at reading no. 26
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses			P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio		
0	0.0000	0.000	0.0	0.0	0.0	0.00	4.00	4.00	1.00	4.00	0.00
1	0.0100	0.010	18.0	13.0	0.2	0.30	4.00	4.30	1.07	4.15	0.15
2	0.0200	0.020	22.0	15.8	0.3	0.36	4.00	4.36	1.09	4.18	0.18
3	0.0300	0.030	25.0	18.0	0.5	0.41	4.00	4.41	1.10	4.21	0.20
4	0.0400	0.040	28.0	20.2	0.7	0.46	4.00	4.46	1.11	4.23	0.23
5	0.0500	0.050	29.0	20.9	0.8	0.47	4.00	4.48	1.12	4.24	0.24
6	0.0600	0.060	30.0	21.6	1.0	0.49	4.00	4.49	1.12	4.25	0.24
7	0.0700	0.070	31.0	22.3	1.2	0.50	4.00	4.51	1.13	4.26	0.25
8	0.0800	0.080	31.0	22.3	1.3	0.50	4.00	4.51	1.13	4.26	0.25
9	0.0900	0.090	33.0	23.8	1.5	0.54	4.00	4.54	1.13	4.27	0.27
10	0.1000	0.100	35.0	25.2	1.7	0.57	4.00	4.57	1.14	4.29	0.28
11	0.1500	0.150	40.0	28.8	2.5	0.64	4.00	4.65	1.16	4.32	0.32
12	0.2000	0.200	46.0	33.1	3.3	0.73	4.00	4.74	1.18	4.37	0.37
13	0.2500	0.250	50.0	36.0	4.2	0.79	4.00	4.79	1.20	4.40	0.39
14	0.3000	0.300	53.0	38.2	5.0	0.83	4.00	4.83	1.21	4.42	0.41
15	0.3500	0.350	56.0	40.3	5.8	0.87	4.00	4.87	1.22	4.44	0.43
16	0.4000	0.400	62.0	44.6	6.7	0.95	4.00	4.96	1.24	4.48	0.48
17	0.4500	0.450	66.0	47.5	7.5	1.01	4.00	5.01	1.25	4.51	0.50
18	0.5000	0.500	69.0	49.7	8.3	1.04	4.00	5.04	1.26	4.52	0.52
19	0.5500	0.550	70.0	50.4	9.2	1.05	4.00	5.05	1.26	4.53	0.52
20	0.6000	0.600	73.0	52.6	10.0	1.08	4.00	5.09	1.27	4.54	0.54
21	0.6500	0.650	80.0	57.6	10.8	1.17	4.00	5.18	1.29	4.59	0.59

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses			P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio		
22	0.7000	0.700	82.0	59.0	11.7	1.19	4.00	5.20	1.30	4.60	0.60
23	0.7500	0.750	85.0	61.2	12.5	1.22	4.00	5.23	1.31	4.62	0.61
24	0.8000	0.800	87.0	62.6	13.3	1.24	4.00	5.24	1.31	4.62	0.62
25	0.8500	0.850	95.0	68.4	14.1	1.34	4.00	5.35	1.34	4.67	0.67
26	0.9000	0.900	100.0	72.0	15.0	1.40	4.00	5.40	1.35	4.70	0.70

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Final
Wt. moist soil and tare:	1194.800		1236.870
Wt. dry soil and tare:	1004.030		1004.030
Wt. of tare:	0.000		0.000
Weight, gms:	1194.8		
Diameter, in:	2.845	2.843	
Area, in²:	6.357	6.347	
Height, in:	5.867	5.867	
Net decrease in height, in:		0.000	
% Moisture:	19.0	23.2	23.2
Wet density, pcf:	122.0	126.5	
Dry density, pcf:	102.6	102.7	
Void ratio:	0.6192	0.6167	
% Saturation:	81.6	100.0	

Test Readings Data for Specimen No. 3

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Cell pressure = 55.50 psi = 7.99 ksf
Back pressure = 0.00 psi = 0.00 ksf
Effective confining stress = 7.99 ksf
Strain rate, %/min = 0.33
FAIL. STRESS = 2.37 ksf at reading no. 25
ULT. STRESS = not selected

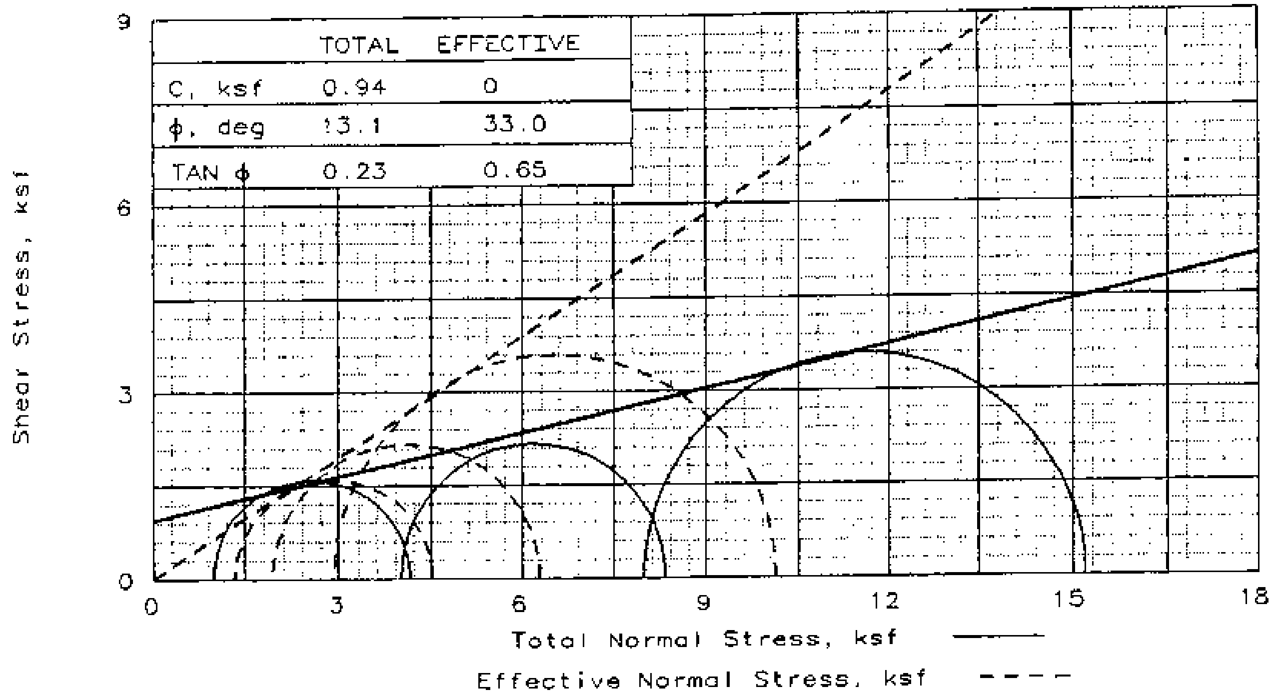
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses			P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio		
0	0.0000	0.000	0.0	0.0	0.0	0.00	7.99	7.99	1.00	7.99	0.00
1	0.0100	0.010	24.0	17.3	0.2	0.39	7.99	8.38	1.05	8.19	0.20
2	0.0200	0.020	31.0	22.3	0.3	0.50	7.99	8.50	1.06	8.24	0.25
3	0.0300	0.030	36.0	25.9	0.5	0.59	7.99	8.58	1.07	8.28	0.29
4	0.0400	0.040	38.0	27.4	0.7	0.62	7.99	8.61	1.08	8.30	0.31
5	0.0500	0.050	42.0	30.2	0.9	0.68	7.99	8.67	1.09	8.33	0.34
6	0.0600	0.060	43.0	31.0	1.0	0.70	7.99	8.69	1.09	8.34	0.35
7	0.0700	0.070	48.0	34.6	1.2	0.77	7.99	8.77	1.10	8.38	0.39
8	0.0800	0.080	49.0	35.3	1.4	0.79	7.99	8.78	1.10	8.39	0.39
9	0.0900	0.090	51.0	36.7	1.5	0.82	7.99	8.81	1.10	8.40	0.41
10	0.1000	0.100	52.0	37.4	1.7	0.83	7.99	8.83	1.10	8.41	0.42
11	0.1500	0.150	57.0	41.0	2.6	0.91	7.99	8.90	1.11	8.45	0.45
12	0.2000	0.200	65.0	46.8	3.4	1.03	7.99	9.02	1.13	8.50	0.51
13	0.2500	0.250	78.0	56.2	4.3	1.22	7.99	9.21	1.15	8.60	0.61
14	0.3000	0.300	87.0	62.6	5.1	1.35	7.99	9.34	1.17	8.67	0.67
15	0.3500	0.350	99.0	71.3	6.0	1.52	7.99	9.51	1.19	8.75	0.76
16	0.4000	0.400	104.0	74.9	6.8	1.58	7.99	9.58	1.20	8.78	0.79
17	0.4500	0.450	108.0	77.8	7.7	1.63	7.99	9.62	1.20	8.81	0.81
18	0.5000	0.500	115.0	82.8	8.5	1.72	7.99	9.71	1.22	8.85	0.86
19	0.5500	0.550	132.0	95.0	9.4	1.95	7.99	9.95	1.24	8.97	0.98
20	0.6000	0.600	140.0	100.8	10.2	2.05	7.99	10.05	1.26	9.02	1.03
21	0.6500	0.650	138.0	99.4	11.1	2.00	7.99	10.00	1.25	8.99	1.00

Test Readings Data for Specimen No. 3

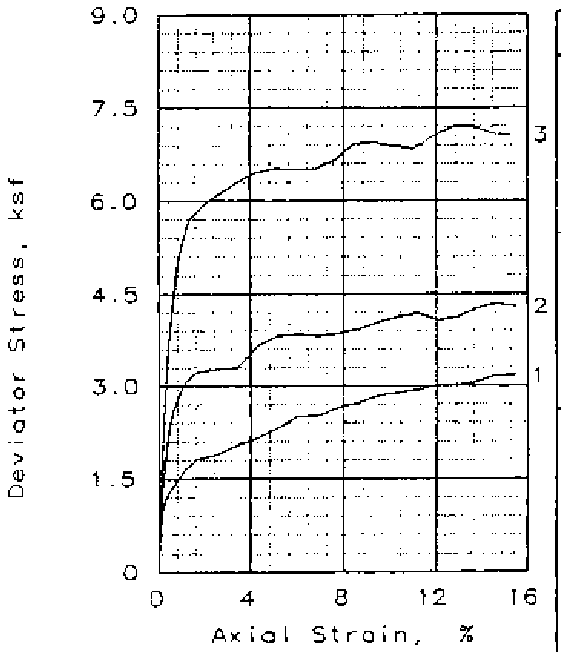
No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Principal Stresses			P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio		
22	0.7000	0.700	141.0	101.5	11.9	2.03	7.99	10.02	1.25	9.01	1.01
23	0.7500	0.750	151.0	108.7	12.8	2.15	7.99	10.14	1.27	9.07	1.08
24	0.8000	0.800	165.0	118.8	13.6	2.33	7.99	10.32	1.29	9.16	1.16
25	0.8500	0.850	170.0	122.4	14.5	2.37	7.99	10.37	1.30	9.18	1.19
26	0.9000	0.900	170.0	122.4	15.3	2.35	7.99	10.34	1.29	9.17	1.18

TRIAXIAL COMPRESSION TEST RESULTS

OFF-SITE BORROW SAMPLES



	TOTAL	EFFECTIVE
C, ksf	0.94	0
φ, deg	13.1	33.0
TAN φ	0.23	0.65



	SAMPLE NO.:	1	2	3
INITIAL	WATER CONTENT, %	19.4	19.4	19.4
	DRY DENSITY, pcf	99.7	99.3	99.6
	SATURATION, %	79.9	79.1	79.6
	VOID RATIO	0.634	0.640	0.636
	DIAMETER, in	2.84	2.84	2.84
	HEIGHT, in	5.93	5.91	5.90
AT TEST	WATER CONTENT, %	24.4	23.9	23.3
	DRY DENSITY, pcf	99.5	100.4	101.4
	SATURATION, %	100.0	100.0	100.0
	VOID RATIO	0.638	0.623	0.607
	DIAMETER, in	2.87	2.85	2.82
	HEIGHT, in	5.84	5.80	5.90
	Strain rate, %/min	0.17	0.17	0.17
	BACK PRESSURE, ksf	7.2	7.2	7.2
	CELL PRESSURE, ksf	8.2	11.2	15.2
	FAIL. STRESS, ksf	3.2	4.3	7.2
	TOTAL PORE PR., ksf	6.8	9.3	12.3
	ULT. STRESS, ksf			
	TOTAL PORE PR., ksf			
	$\bar{\sigma}_1$ FAILURE, ksf	4.5	6.3	10.1
	$\bar{\sigma}_3$ FAILURE, ksf	1.4	1.9	2.9

TYPE OF TEST:
CU with Pore Pressures
SAMPLE TYPE: Remolded Sample
DESCRIPTION: Yellow-Brown Sandy Silty Clay (CL)
LL= 33 PL= 21 PI= 12
SPECIFIC GRAVITY= 2.61
REMARKS: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor

Fig. No.: ______ H8

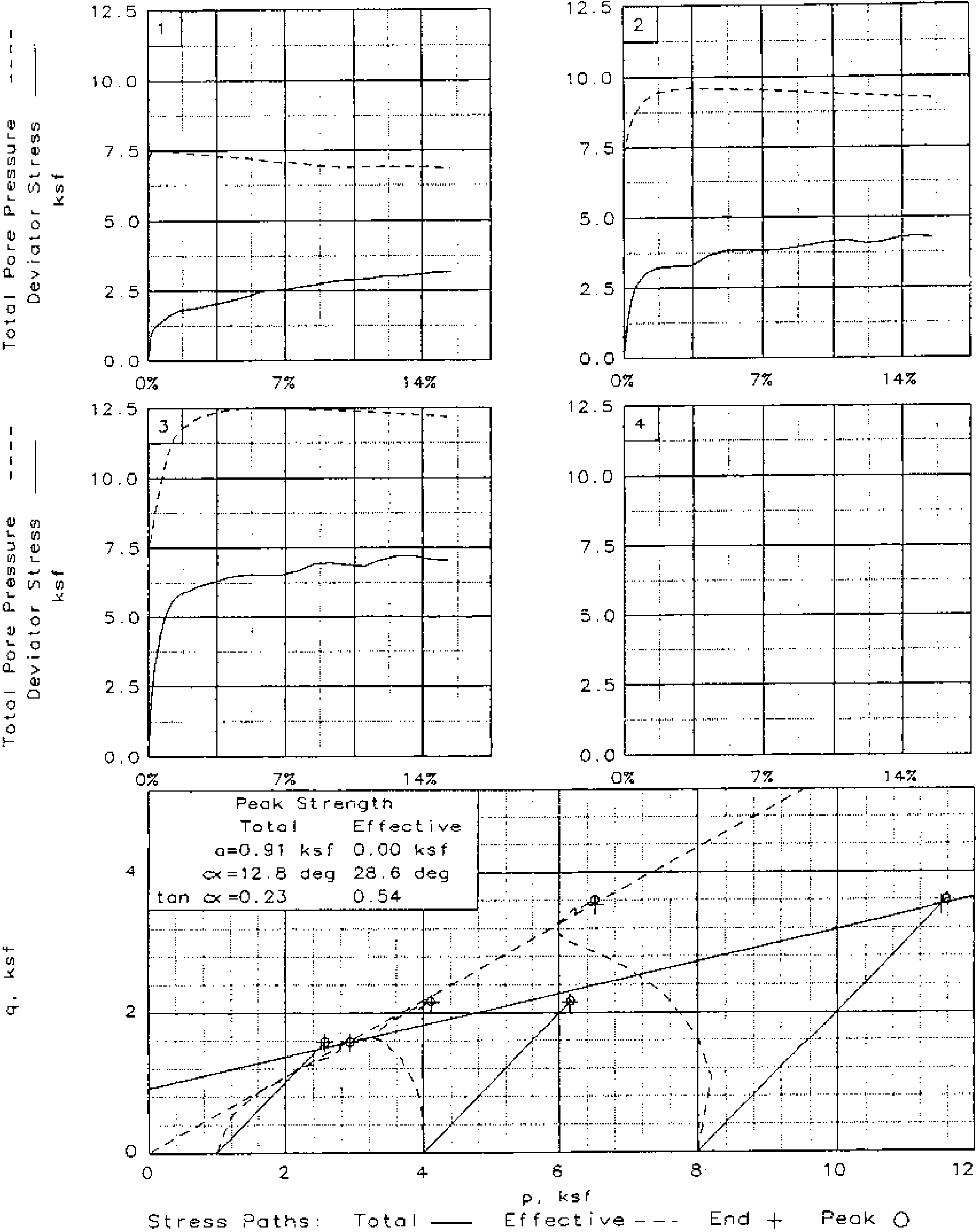
CLIENT: TVA

PROJECT: Ash Disposal Areas - TVA Gallatin Fossil Plant
SAMPLE LOCATION: Off Site Borrow Sample #2

PROJ. NO.: 3043-04-1043 DATE: 10-11-04

TRIAXIAL SHEAR TEST REPORT

LAW ENGINEERING AND ENVIRONMENTAL SERVICES



Peak Strength

	Total	Effective
a=	0.91 ksf	0.00 ksf
α=	12.8 deg	28.6 deg
tan α =	0.23	0.54

Client: TVA

Project: Ash Disposal Areas - TVA Gallatin Fossil Plant

Location: Off Site Borrow Sample #2

File: FOSSIL11 Project No.: 3043-04-1043 Fig. No.: ____

TRIAXIAL COMPRESSION TEST
CU with Pore Pressures

10-11-2004
10:22 am

Project and Sample Data

Date: 10-11-04
Client: TVA
Project: Ash Disposal Areas - TVA Gallatin Fossil Plant
Sample location: Off Site Borrow Sample #2
Sample description: Yellow-Brown Sandy Silty Clay (CL)
Remarks: Remolded to 95% MDD @ Optimum Moisture Content of Standard Proctor
Fig no.: 2nd page Fig no. (if applicable):
Type of sample: Remolded Sample
Specific gravity= 2.61 LL= 33 PL= 21 PI= 12
Test method: Corps of Eng. - saturation assumed

Specimen Parameters for Specimen No. 1

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1174.650			1222.040
Wt. dry soil and tare:	983.790			983.790
Wt. of tare:	0.000			0.000
Weight, gms:	1174.7			
Diameter, in:	2.840	2.855	2.867	
Area, in²:	6.335	6.401	6.455	
Height, in:	5.933	5.933	5.836	
Net decrease in height, in:		0.000	0.097	
Net decrease in water volume, cc:		-54.500	5.000	
% Moisture:	19.4	24.9	24.4	24.2
Wet density, pcf:	119.1	123.3	123.8	
Dry density, pcf:	99.7	98.7	99.5	
Void ratio:	0.6340	0.6509	0.6377	
% Saturation:	79.9	100.0	100.0	

Test Readings Data for Specimen No. 1

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 56.90 psi = 8.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 0.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 3.17 ksf at reading no. 26
ULT. STRESS = not selected

Test Readings Data for Specimen No. 1

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	0.99	0.99	1.00	50.00	0.99	0.00
1	0.0100	0.010	62.0	44.6	0.2	0.99	0.71	1.70	2.41	52.00	1.20	0.50
2	0.0200	0.020	75.0	54.0	0.3	1.20	0.68	1.88	2.77	52.20	1.28	0.60
3	0.0300	0.030	83.0	59.8	0.5	1.33	0.69	2.02	2.92	52.10	1.35	0.66
4	0.0400	0.040	88.0	63.4	0.7	1.40	0.71	2.11	2.99	52.00	1.41	0.70
5	0.0500	0.050	94.0	67.7	0.9	1.50	0.72	2.22	3.08	51.90	1.47	0.75
6	0.0600	0.060	100.0	72.0	1.0	1.59	0.73	2.32	3.16	51.80	1.53	0.79
7	0.0700	0.070	105.0	75.6	1.2	1.67	0.75	2.42	3.23	51.70	1.58	0.83
8	0.0800	0.080	108.0	77.8	1.4	1.71	0.75	2.46	3.29	51.70	1.60	0.86
9	0.0900	0.090	111.0	79.9	1.5	1.76	0.76	2.52	3.30	51.60	1.64	0.88
10	0.1000	0.100	115.0	82.8	1.7	1.82	0.78	2.59	3.33	51.50	1.69	0.91
11	0.1500	0.150	121.0	87.1	2.6	1.89	0.82	2.71	3.31	51.20	1.77	0.95
12	0.2000	0.200	131.0	94.3	3.4	2.03	0.89	2.92	3.28	50.70	1.91	1.02
13	0.2500	0.250	140.0	100.8	4.3	2.15	0.92	3.07	3.34	50.50	2.00	1.08
14	0.3000	0.300	152.0	109.4	5.1	2.32	0.96	3.28	3.40	50.20	2.12	1.16
15	0.3500	0.350	166.0	119.5	6.0	2.51	1.07	3.57	3.35	49.50	2.32	1.25
16	0.4000	0.400	168.0	121.0	6.9	2.51	1.12	3.64	3.24	49.10	2.38	1.26
17	0.4500	0.450	178.0	128.2	7.7	2.64	1.14	3.78	3.32	49.00	2.46	1.32
18	0.5000	0.500	185.0	133.2	8.6	2.72	1.25	3.97	3.17	48.20	2.61	1.36
19	0.5500	0.550	195.0	140.4	9.4	2.84	1.30	4.13	3.19	47.90	2.71	1.42
20	0.6000	0.600	200.0	144.0	10.3	2.88	1.31	4.19	3.20	47.80	2.75	1.44
21	0.6500	0.650	205.0	147.6	11.1	2.93	1.31	4.24	3.23	47.80	2.77	1.46
22	0.7000	0.700	213.0	153.4	12.0	3.01	1.30	4.31	3.32	47.90	2.80	1.51
23	0.7500	0.750	215.0	154.8	12.9	3.01	1.30	4.31	3.32	47.90	2.80	1.50
24	0.8000	0.800	221.0	159.1	13.7	3.06	1.30	4.36	3.36	47.90	2.83	1.53
25	0.8500	0.850	230.0	165.6	14.6	3.16	1.32	4.48	3.38	47.70	2.90	1.58
26	0.9000	0.900	233.0	167.8	15.4	3.17	1.35	4.52	3.34	47.50	2.94	1.58

Specimen Parameters for Specimen No. 2

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1164.710			1208.950
Wt. dry soil and tare:	975.470			975.470
Wt. of tare:	0.000			0.000
Weight, gms:	1164.7			
Diameter, in:	2.840	2.836	2.851	
Area, in²:	6.335	6.318	6.382	
Height, in:	5.906	5.906	5.799	
Net decrease in height, in:		0.000	0.107	
Net decrease in water volume, cc:		-48.500	5.000	
% Moisture:	19.4	24.4	23.9	23.9
Wet density, pcf:	118.6	123.9	124.4	
Dry density, pcf:	99.3	99.6	100.4	
Void ratio:	0.6404	0.6361	0.6227	
% Saturation:	79.1	100.0	100.0	

Test Readings Data for Specimen No. 2

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 77.80 psi = 11.20 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 4.00 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 4.34 ksf at reading no. 25
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	4.00	4.00	1.00	50.00	4.00	0.00
1	0.0100	0.010	82.0	59.0	0.2	1.33	3.31	4.64	1.40	54.80	3.98	0.66
2	0.0200	0.020	122.0	87.8	0.3	1.98	2.89	4.87	1.68	57.70	3.88	0.99
3	0.0300	0.030	151.0	108.7	0.5	2.44	2.52	4.96	1.97	60.30	3.74	1.22
4	0.0400	0.040	165.0	118.8	0.7	2.66	2.36	5.02	2.13	61.40	3.69	1.33
5	0.0500	0.050	176.0	126.7	0.9	2.83	2.19	5.02	2.30	62.60	3.61	1.42
6	0.0600	0.060	185.0	133.2	1.0	2.97	2.03	5.00	2.46	63.70	3.52	1.49
7	0.0700	0.070	192.0	138.2	1.2	3.08	1.94	5.03	2.59	64.30	3.48	1.54
8	0.0800	0.080	196.0	141.1	1.4	3.14	1.87	5.01	2.68	64.80	3.44	1.57
9	0.0900	0.090	200.0	144.0	1.6	3.20	1.81	5.01	2.76	65.20	3.41	1.60
10	0.1000	0.100	202.0	145.4	1.7	3.22	1.76	4.98	2.84	65.60	3.37	1.61
11	0.1500	0.150	207.0	149.0	2.6	3.28	1.64	4.92	3.00	66.40	3.28	1.64
12	0.2000	0.200	210.0	151.2	3.4	3.29	1.61	4.91	3.04	66.60	3.26	1.65
13	0.2500	0.250	236.0	169.9	4.3	3.67	1.63	5.30	3.25	66.50	3.46	1.83
14	0.3000	0.300	248.0	178.6	5.2	3.82	1.64	5.46	3.33	66.40	3.55	1.91
15	0.3500	0.350	252.0	181.4	6.0	3.85	1.66	5.50	3.32	66.30	3.58	1.92
16	0.4000	0.400	253.0	182.2	6.9	3.83	1.67	5.50	3.29	66.20	3.58	1.91
17	0.4500	0.450	257.0	185.0	7.8	3.85	1.70	5.55	3.27	66.00	3.62	1.93
18	0.5000	0.500	265.0	190.8	8.6	3.93	1.74	5.68	3.26	65.70	3.71	1.97
19	0.5500	0.550	275.0	198.0	9.5	4.04	1.77	5.81	3.28	65.50	3.79	2.02
20	0.6000	0.600	284.0	204.5	10.3	4.14	1.80	5.94	3.30	65.30	3.87	2.07

Test Readings Data for Specimen No. 2

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
21	0.6500	0.650	290.0	208.8	11.2	4.18	1.83	6.01	3.29	65.10	3.92	2.09
22	0.7000	0.700	285.0	205.2	12.1	4.07	1.86	5.93	3.19	64.90	3.89	2.04
23	0.7500	0.750	292.0	210.2	12.9	4.13	1.89	6.02	3.19	64.70	3.95	2.07
24	0.8000	0.800	305.0	219.6	13.8	4.27	1.92	6.19	3.23	64.50	4.05	2.14
25	0.8500	0.850	313.0	225.4	14.7	4.34	1.94	6.28	3.23	64.30	4.11	2.17
26	0.9000	0.900	313.0	225.4	15.5	4.30	1.97	6.27	3.18	64.10	4.12	2.15

Specimen Parameters for Specimen No. 3

Specimen Parameter	Initial	Saturated	Consolidated	Final
Wt. moist soil and tare:	1167.620			1203.620
Wt. dry soil and tare:	977.910			977.910
Wt. of tare:	0.000			0.000
Weight, gms:	1167.6			
Diameter, in:	2.840	2.833	2.815	
Area, in²:	6.335	6.304	6.224	
Height, in:	5.904	5.904	5.904	
Net decrease in height, in:		0.000	0.000	
Net decrease in water volume, cc:		-45.500	7.700	
% Moisture:	19.4	24.1	23.3	23.1
Wet density, pcf:	118.9	124.2	125.0	
Dry density, pcf:	99.6	100.1	101.4	
Void ratio:	0.6357	0.6278	0.6072	
% Saturation:	79.6	100.0	100.0	

Test Readings Data for Specimen No. 3

Deformation dial constant= 1 in per input unit
Primary load ring constant= 0.72 lbs per input unit
Secondary load ring constant= 0 lbs per input unit
Crossover reading for secondary load ring= 0 input units
Membrane modulus = 0.14000 kN/cm²
Membrane thickness = 0.012 cm
Consolidation cell pressure = 105.50 psi = 15.19 ksf
Consolidation back pressure = 50.00 psi = 7.20 ksf
Consolidation effective confining stress = 7.99 ksf
Strain rate, %/min = 0.17
FAIL. STRESS = 7.20 ksf at reading no. 24
ULT. STRESS = not selected

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses			Pore Pres. psi	P ksf	Q ksf
							Minor ksf	Major ksf	1:3 Ratio			
0	0.0000	0.000	0.0	0.0	0.0	0.00	7.99	7.99	1.00	50.00	7.99	0.00
1	0.0100	0.010	128.0	92.2	0.2	2.13	7.14	9.27	1.30	55.90	8.21	1.06
2	0.0200	0.020	195.0	140.4	0.3	3.24	6.39	9.63	1.51	61.10	8.01	1.62
3	0.0300	0.030	238.0	171.4	0.5	3.94	5.79	9.73	1.68	65.30	7.76	1.97
4	0.0400	0.040	275.0	198.0	0.7	4.55	5.23	9.78	1.87	69.20	7.50	2.27
5	0.0500	0.050	302.0	217.4	0.8	4.99	4.71	9.70	2.06	72.80	7.20	2.49
6	0.0600	0.060	320.0	230.4	1.0	5.28	4.35	9.63	2.21	75.30	6.99	2.64
7	0.0700	0.070	335.0	241.2	1.2	5.51	3.99	9.50	2.38	77.80	6.75	2.76
8	0.0800	0.080	346.0	249.1	1.4	5.69	3.73	9.42	2.52	79.60	6.57	2.84
9	0.0900	0.090	351.0	252.7	1.5	5.76	3.60	9.36	2.60	80.50	6.48	2.88
10	0.1000	0.100	357.0	257.0	1.7	5.85	3.44	9.29	2.70	81.60	6.36	2.92
11	0.1500	0.150	375.0	270.0	2.5	6.09	3.02	9.11	3.01	84.50	6.07	3.04
12	0.2000	0.200	390.0	280.8	3.4	6.28	2.87	9.14	3.19	85.60	6.00	3.14
13	0.2500	0.250	405.0	291.6	4.2	6.46	2.75	9.21	3.35	86.40	5.98	3.23
14	0.3000	0.300	413.0	297.4	5.1	6.53	2.71	9.24	3.41	86.70	5.97	3.27
15	0.3500	0.350	415.0	298.8	5.9	6.50	2.69	9.20	3.41	86.80	5.94	3.25
16	0.4000	0.400	420.0	302.4	6.8	6.52	2.71	9.23	3.41	86.70	5.97	3.26
17	0.4500	0.450	433.0	311.8	7.6	6.66	2.72	9.38	3.45	86.60	6.05	3.33
18	0.5000	0.500	454.0	326.9	8.5	6.92	2.74	9.66	3.53	86.50	6.20	3.46
19	0.5500	0.550	460.0	331.2	9.3	6.95	2.76	9.71	3.51	86.30	6.24	3.47
20	0.6000	0.600	460.0	331.2	10.2	6.88	2.81	9.69	3.45	86.00	6.25	3.44

Test Readings Data for Specimen No. 3

No.	Def. Dial Units	Def. in	Load Dial Units	Load lbs	Strain %	Deviator Stress ksf	Effective Stresses Minor ksf	Major ksf	1:3 Ratio	Pore Pres. psi	P ksf	Q ksf
21	0.6500	0.650	461.0	331.9	11.0	6.83	2.82	9.66	3.42	85.90	6.24	3.42
22	0.7000	0.700	480.0	345.6	11.9	7.05	2.85	9.90	3.47	85.70	6.38	3.52
23	0.7500	0.750	495.0	356.4	12.7	7.20	2.89	10.09	3.49	85.40	6.49	3.60
24	0.8000	0.800	500.0	360.0	13.6	7.20	2.92	10.12	3.46	85.20	6.52	3.60
25	0.8500	0.850	497.0	357.8	14.4	7.09	2.95	10.04	3.40	85.00	6.50	3.54
26	0.9000	0.900	500.0	360.0	15.2	7.06	3.00	10.05	3.36	84.70	6.52	3.53

PERMEABILITY TEST RESULTS

BOTTOM ASH SAMPLES

PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 5.08
Specimen Diameter (cm): 7.21
Dry Unit Weight (pcf): 95.9
Moisture Before Test (%): 15.7
Moisture After Test (%): 18.5

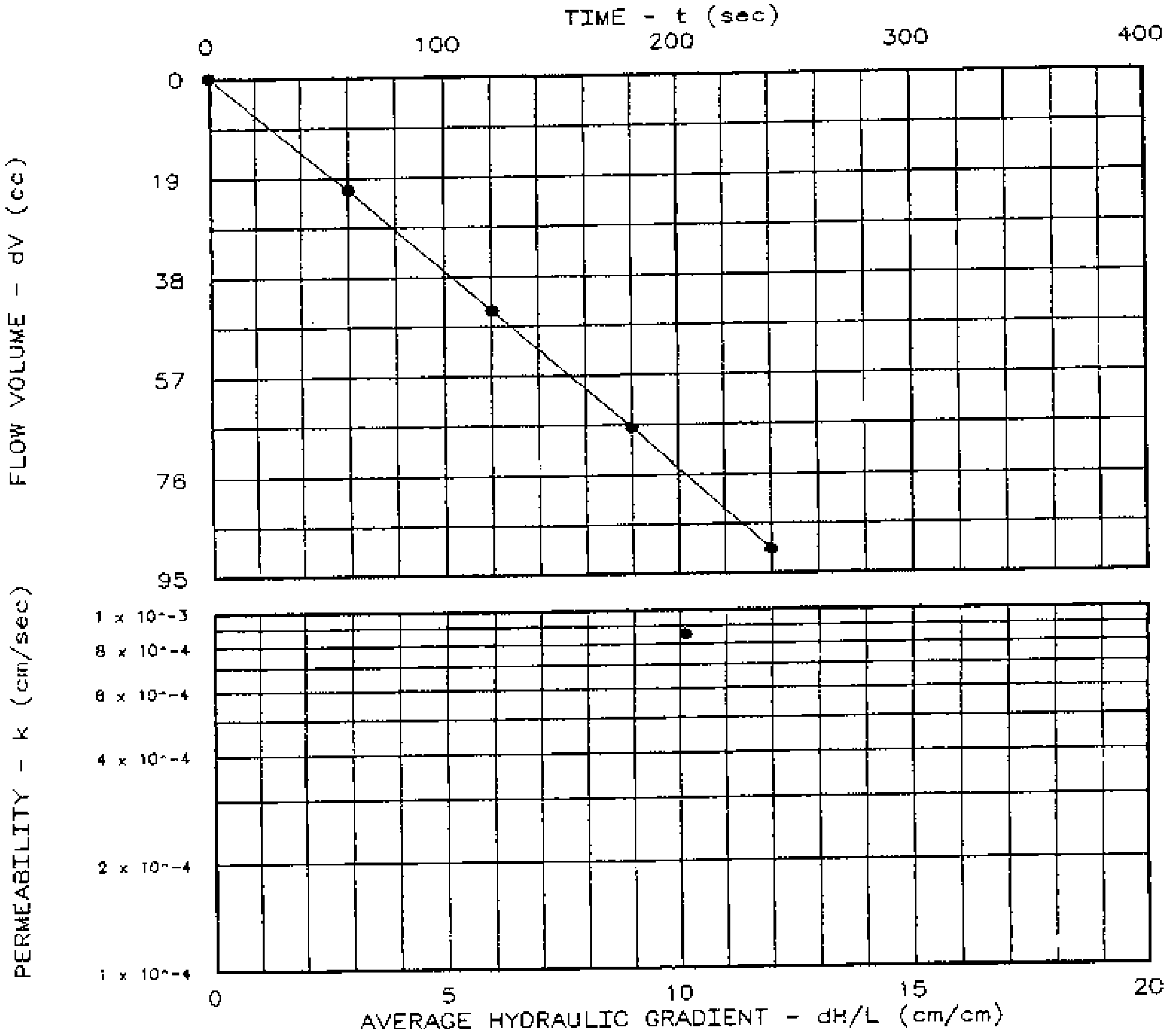
	1 ●	2 ▲
Run Number:	1 ●	2 ▲
Cell Pressure (psi):	57.0	
Test Pressure(psi):	52.0	
Back Pressure(psi):	51.3	
Diff. Head (psi):	0.7	
Flow Rate (cc/sec):	3.78 x 10^-1	
Perm. (cm/sec):	8.55 x 10^-4	

SAMPLE DATA:

Sample Identification: Old Bottom Ash

Visual Description: Gray Ash Sand

Remarks: Remolded to 92% MDD @ Optimum Moisture Content
Maximum Dry Density (pcf): 104.2
Optimum Moisture Content (%): 15.8 ASTM(D698)
Percent Compaction: 92.0%
Permeameter type: Flexible Wall
Sample type: Remolded



Project: Ash Disposal Areas
Location: TVA Gallatin Fossil Plant
Date: 10-11-04

PERMEABILITY TEST REPORT

MACTEC, INC.

HG

Project No.: 3043041043
File No.: As# 2709
Lab No.: 6226
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name: Ash Disposal Areas
File No.: As# 2709
Project Location: TVA Gallatin Fossil Plant
Project No.: 3043041043
Sample Identification: Old Bottom Ash

Lab No.: 6226
Description: Gray Ash Sand

Sample Type: Remolded
Max. Dry Dens.: 104.2
Method (D1557/D698): D698
Opt. Water Content: 15.8
Date: 10-11-04
Remarks: Remolded to 92% MDD @
Optimum Moisture Content

Permeameter Type: Flexible Wall
Tested by: MH
Checked by: CPT
Test type: CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test:			After test:		
Diameter:	1	2		1	2	
Top:	2.840 in	in		2.840 in	in	
Middle:	in	in		in	in	
Bottom:	in	in		in	in	
Average:	2.84 in	7.21 cm		2.84 in	7.21 cm	
Length:	1	2	3	1	2	3
	2.000 in	in	in	2.000 in	in	in
Average:	2.00 in	5.08 cm		2.00 in	5.08 cm	
Moisture, Density and Sample Parameters:						
Specific Gravity:	2.64					
Wet Wt. & Tare:	368.90			377.75		
Dry Wt. & Tare:	318.84			318.84		
Tare Wt.:	0.00			0.00		
Moisture Content:	15.7 %			18.5 %		
Dry Unit Weight:	95.9 pcf	92.0 % of max		95.9 pcf		
Porosity:	0.4183			0.4183		
Saturation:	57.6 %			67.8 %		

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 2 Panel No.: 13 Positions: 1

Run Number:	1	2
Cell Pressure:	57.0 psi	0.0 psi
Saturation Pressure:	50.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi		BURET READING-cc		OUTFLOW/ INFLOW RATIO
				IN	OUT	IN	OUT	
S	9/ 9/ 4	10:17:00	0	52.0	50.0	100.00	100.00	0.00
	9/ 9/ 4	10:18:00	60	52.0	50.0	121.20	78.80	1.00
	9/ 9/ 4	10:19:00	120	52.0	50.0	144.40	55.60	1.00
	9/ 9/ 4	10:20:00	180	52.0	50.0	167.10	32.90	1.00
	9/ 9/ 4	10:21:00	240	52.0	50.0	190.40	9.60	1.00

Test Pressure = 52.0 psi Differential Head = 0.7 psi, 51.4 cm H2O
Gradient = 1.011E 01 Flow rate = 3.778E-01 cc/sec R squared = 0.99974
Permeability, K22.8° = 9.142E-04 cm/sec, K20° = 8.551E-04 cm/sec

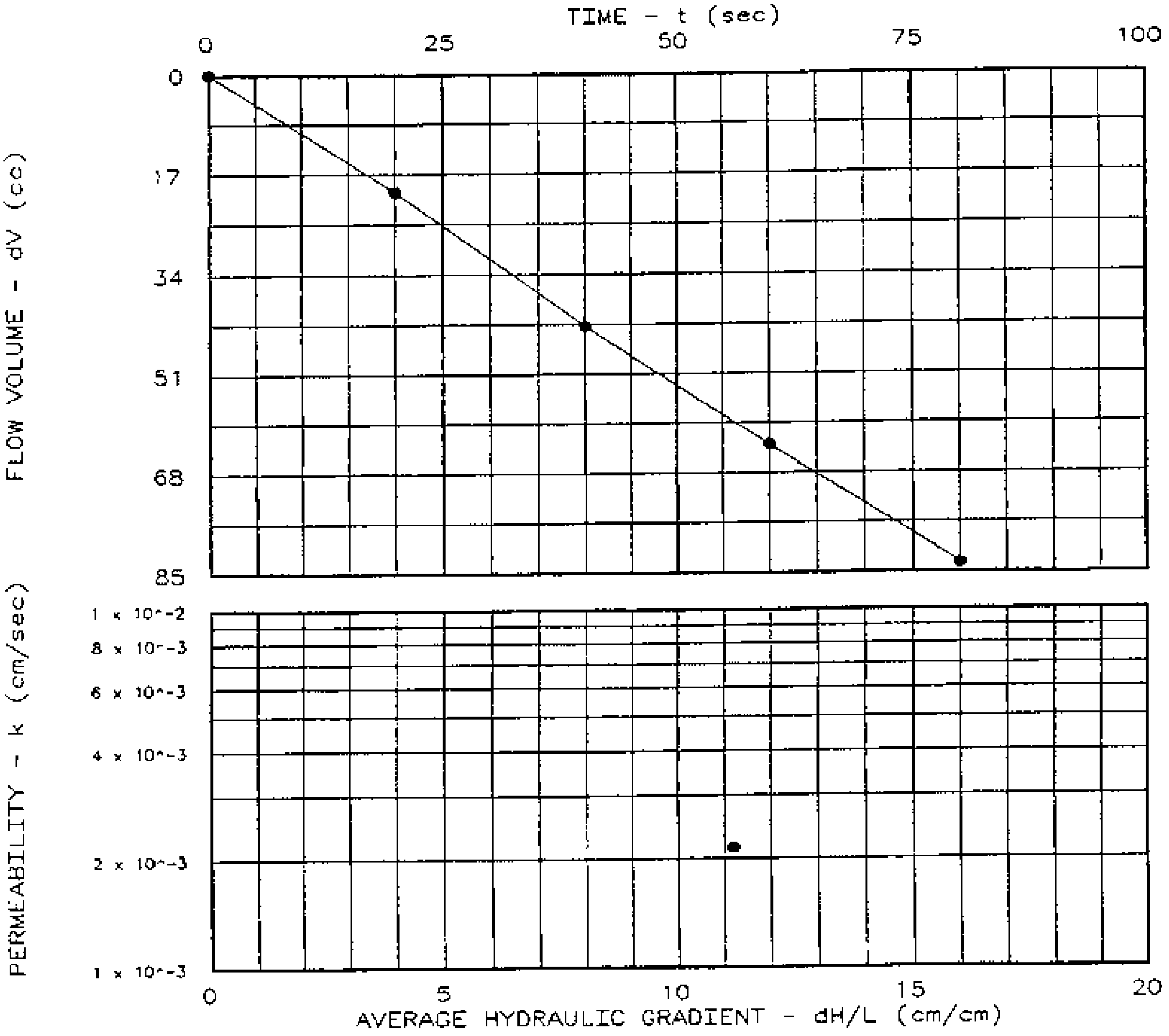
PERMEABILITY TEST REPORT

TEST DATA:
Specimen Height (cm): 5.08
Specimen Diameter (cm): 7.21
Dry Unit Weight (pcf): 73.1
Moisture Before Test (%): 29.2
Moisture After Test (%): 44.6
Run Number: 1 ● 2 ▲
Cell Pressure (psi): 57.0
Test Pressure(psi): 52.0
Back Pressure(psi): 51.2
Diff. Head (psi): 0.8
Flow Rate (cc/sec): 1.05 x 10^0
Perm. (cm/sec): 2.15 x 10^-3

SAMPLE DATA:
Sample Identification: New Bottom Ash #2

Visual Description: Gray Ash Sand

Remarks: Remolded to 92% MDD @ Optimum Moisture Content
Maximum Dry Density (pcf): 79.4
Optimum Moisture Content (%): 29.2
ASTM(D698)
Percent Compaction: 92.0%
Permeameter type: Flexible Wall
Sample type: Remolded



Project: Ash Disposal Areas
Location: TVA Gallatin Fossil Plant
Date: 10-11-04

PERMEABILITY TEST REPORT

MACTEC, INC.

HR

Project No.: 3043041043
File No.: As# 2709
Lab No.: 6226
Tested by: MH
Checked by: CPT
Test: CH - Constant head

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=======================================================================
                       PERMEABILITY TEST DATA
=======================================================================

                            PROJECT DATA

Project Name:            Ash Disposal Areas
File No.:                As# 2709
Project Location:        TVA Gallatin Fossil Plant
Project No.:             3043041043
Sample Identification:   New Bottom Ash #2

Lab No.:                 6226
Description:             Gray Ash Sand

Sample Type:             Remolded
Max. Dry Dens.:          79.4
Method (D1557/D698):     D698
Opt. Water Content:      29.2
Date:                    10-11-04
Remarks:                 Remolded to 92% MDD @
                         Optimum Moisture Content

Permeameter Type:        Flexible Wall
Tested by:               MH
Checked by:              CPT
Test type:               CH - Constant head

-----------------------------------------------------------------------
                  PERMEABILITY TEST SPECIMEN DATA


                      Before test:                    After test:

 Diameter:       1          2                   1         2
   Top:       2.840 in          in           2.840 in          in
   Middle:          in          in                 in          in
   Bottom:          in          in                 in          in
   Average:   2.84 in    7.21 cm             2.84 in    7.21 cm

 Length:         1          2          3         1         2         3
              2.000 in          in         in  2.000 in          in         in
   Average:   2.00 in    5.08 cm             2.00 in    5.08 cm

 Moisture, Density and Sample Parameters:
   Specific Gravity:    2.49
   Wet Wt. & Tare:       313.90                          351.21
   Dry Wt. & Tare:       242.96                          242.96
   Tare Wt.:               0.00                            0.00
   Moisture Content:     29.2 %                          44.6 %
   Dry Unit Weight:      73.1 pcf    92.0 % of max       73.1 pcf
   Porosity:            0.5300                          0.5300
   Saturation:           64.5 %                          98.4 %

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CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 3　　Panel No.: 15　　Positions: 1

Run Number:	1	2
Cell Pressure:	57.0 psi	0.0 psi
Saturation Pressure:	50.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi		BURET READING-cc		OUTFLOW/ INFLOW RATIO
				IN	OUT	IN	OUT	
S	9/ 9/ 4	10:55:00	0	52.0	50.0	100.00	100.00	0.00
	9/ 9/ 4	10:55:20	20	52.0	50.0	120.00	80.00	1.00
	9/ 9/ 4	10:55:40	40	52.0	50.0	142.80	57.20	1.00
	9/ 9/ 4	10:56:00	60	52.0	50.0	163.20	36.80	1.00
	9/ 9/ 4	10:56:20	80	52.0	50.0	183.40	16.60	1.00

Test Pressure = 52.0 psi　Differential Head = 0.8 psi, 56.9 cm H2O
Gradient = 1.119E 01　Flow rate = 1.050E 00 cc/sec　R squared = 0.99955
Permeability, K22.8° = 2.296E-03 cm/sec, K20° = 2.147E-03 cm/sec

PERMEABILITY TEST RESULTS

ASH POND SAMPLES

PERMEABILITY TEST REPORT

TEST DATA:

Specimen Height (cm): 7.99
Specimen Diameter (cm): 7.24
Dry Unit Weight (pcf): 78.1
Moisture Before Test (%): 34.5
Moisture After Test (%): 34.9
Run Number: 1 ● 2 ▲
Cell Pressure (psi): 57.0
Test Pressure(psi): 52.0
Back Pressure(psi): 50.1
Diff. Head (psi): 1.9
Flow Rate (cc/sec): 2.06 x 10^-2
Perm. (cm/sec): 2.78 x 10^-5

SAMPLE DATA:

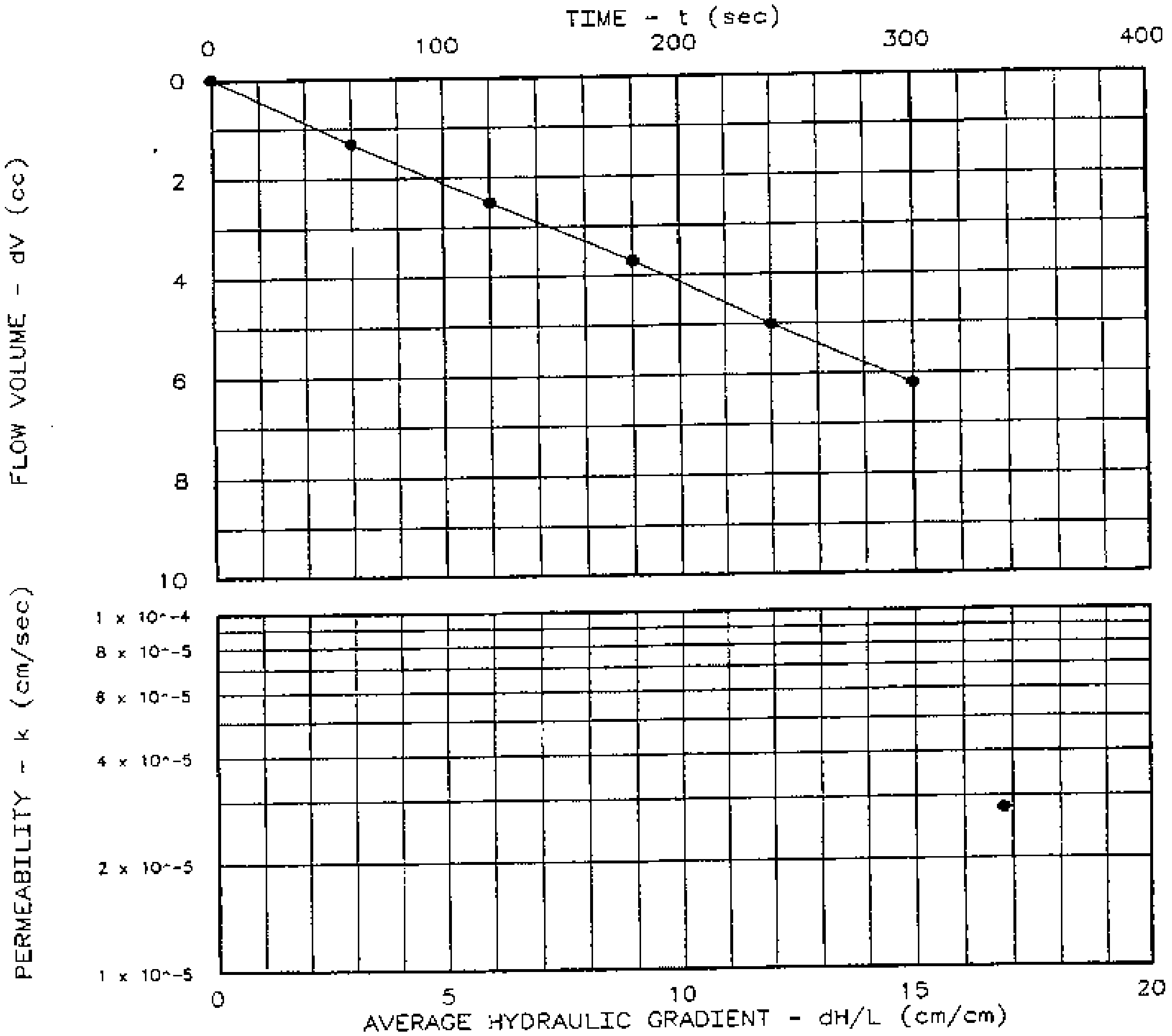
Sample Identification: B-13 UD @ 15'-17'

Visual Description: Gray Fly Ash

Remarks:

Maximum Dry Density (pcf):
Optimum Moisture Content (%):

Percent Compaction:
Permeameter type: Flexible Wall
Sample type: Shelby Tube



Project: Ash Disposal Areas
Location: TVA Gallatin Fossil Plant
Date: 10-11-04

PERMEABILITY TEST REPORT
MACTEC, INC.

Project No.: 3043041043
File No.: As# 2709
Lab No.: 6226
Tested by: MH
Checked by: CPT
Test: CH - Constant head

PERMEABILITY TEST DATA

PROJECT DATA

Project Name: Ash Disposal Areas
File No.: As# 2709
Project Location: TVA Gallatin Fossil Plant
Project No.: 3043041043
Sample Identification: B-13 UD @ 15'-17'

Lab No.: 6226
Description: Gray Fly Ash

Sample Type: Shelby Tube
Max. Dry Dens.:
Method (D1557/D698):
Opt. Water Content:
Date: 10-11-04
Remarks:

Permeameter Type: Flexible Wall
Tested by: MH
Checked by: CPT
Test type: CH - Constant head

PERMEABILITY TEST SPECIMEN DATA

	Before test:		After test:	
Diameter:	1	2	1	2
Top:	2.852 in	in	2.852 in	in
Middle:	in	in	in	in
Bottom:	in	in	in	in
Average:	2.85 in	7.24 cm	2.85 in	7.24 cm

	Before test:			After test:		
Length:	1	2	3	1	2	3
	3.144 in	in	in	3.144 in	in	in
Average:	3.14 in	7.99 cm		3.14 in	7.99 cm	

Moisture, Density and Sample Parameters:

	Before test:	After test:
Specific Gravity:	2.20	
Wet Wt. & Tare:	553.82	555.49
Dry Wt. & Tare:	411.76	411.76
Tare Wt.:	0.00	0.00
Moisture Content:	34.5 %	34.9 %
Dry Unit Weight:	78.1 pcf	78.1 pcf
Porosity:	0.4313	0.4313
Saturation:	100.1 %	101.2 %

CONSTANT HEAD PERMEABILITY TEST CONDITIONS DATA

Cell No.: 2-N Panel No.: 15 Positions: 1

Run Number:	1	2
Cell Pressure:	57.0 psi	0.0 psi
Saturation Pressure:	50.0 psi	0.0 psi
Inflow Corr. Factor:	1.00	1.00
Outflow Corr. Factor:	1.00	1.00
Test Temperature:	22.8 °C	0.0 °C

PERMEABILITY TEST READINGS DATA

CASE D X S R	DATE	TIME (24 hr)	ELAPSED TIME-sec	GAUGE PRESSURE-psi		BURET READING-cc		OUTFLOW/ INFLOW RATIO
				IN	OUT	IN	OUT	
S	10/12/ 4	11:15:00	0	52.0	50.0	20.00	20.00	0.00
	10/12/ 4	11:16:00	60	52.0	50.0	21.30	18.70	1.00
	10/12/ 4	11:17:00	120	52.0	50.0	22.50	17.50	1.00
	10/12/ 4	11:18:00	180	52.0	50.0	23.70	16.30	1.00
	10/12/ 4	11:19:00	240	52.0	50.0	25.00	15.00	1.00
	10/12/ 4	11:20:00	300	52.0	50.0	26.20	13.80	1.00

Test Pressure = 52.0 psi Differential Head = 1.9 psi, 134.4 cm H2O
Gradient = 1.683E 01 Flow rate = 2.062E-02 cc/sec R squared = 0.99984
Permeability, K22.8° = 2.973E-05 cm/sec, K20° = 2.781E-05 cm/sec

APPENDIX A

Document 12

NPDES Permit

NPDES PERMITS & Applications

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
401 CHURCH STREET
L & C ANNEX 6TH FLOOR
NASHVILLE TN 37243-1534

NOV 30 2005

Ms. Janet Watts
Manager
TVA Gallatin Fossil Plant
1101 Market Street, LP 5D Lookout Place
Chattanooga, TN 37402

Subject: **NPDES Permit No. TN0005428**
TVA Gallatin Fossil Plant
Gallatin, Sumner County, Tennessee

Dear Ms. Watts:

In accordance with the provisions of the Tennessee Water Quality Control Act, Tennessee Code Annotated, Sections 69-3-101 through 69-3-120, the Division of Water Pollution Control hereby issues the enclosed NPDES Permit. The continuance and/or reissuance of this NPDES Permit is contingent upon your meeting the conditions and requirements as stated therein.

Please be advised that you have the right to appeal any of the provisions established in this NPDES Permit, in accordance with Tennessee Code Annotated, Section 69-3-110, and the General Regulations of the Tennessee Water Quality Control Board. If you elect to appeal, you should file a petition within thirty (30) days of the receipt of this permit.

If you have questions, please contact the Division of Water Pollution Control at your local Field Office at 1-888-891-TDEC; or, at this office, please contact Ms. Souraya Fathi at (615) 532-0485 or by E-mail at *Souraya.Fathi@state.tn.us*.

Sincerely,

Edward M. Polk, Jr.

Edward M. Polk, Jr., P.E.
Manager, Permit Section
Division of Water Pollution Control

Enclosure

cc: Division of Water Pollution Control, Permit Section
Division of Water Pollution Control, Nashville Environmental Field Office
Ms. Connie A. Kagey, , EPA Region IV, Sam Nunn Atlanta Federal Center, NPDES Permit Section, 61 Forsyth Street SW, Atlanta, GA 30303-3104

DEC 06 2005

STATE OF TENNESSEE
NPDES PERMIT

No. TN0005428

Authorization to discharge under the
National Pollutant Discharge Elimination System (NPDES)

Issued By

Tennessee Department of Environment and Conservation
Division of Water Pollution Control
401 Church Street, 6th Floor, L & C Annex
Nashville, Tennessee 37243-1534

Under authority of the Tennessee Water Quality Control Act of 1977 (T.C.A. 69-3-101 et seq.) and the delegation of authority from the United States Environmental Protection Agency under the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977 (33 U.S.C. 1251, et seq.)

Discharger: **TVA Gallatin Fossil Plant**

uthorized to discharge: **ash pond effluent consisting of ash transport water, chemical and nchemical metal cleaning wastes, water treatment plant wastes, combustion turbine oil/water separator effluent, demineralization waste neutralization sump discharges, miscellaneous equipment cooling water, micro-filtered asbestos decon waste water, floor washing and other low volume wastes, boiler makeup water leakage, boiler blowdown, chemical lab drain water, boiler bottom overflow sump discharge, powerhouse extension sump discharge, U-Building pad wash oil/water separator, car wash, ash sluice water leakage, coal pile and coal barge runoff, and storm water runoff through Outfall 001; steam condenser cooling water, pulverizer cooling water, turbine oil cooling water, and hydrogen cooler cooling water through Outfall 002; intake screen backwash through Outfall 004; and air conditioner noncontact cooling water through Outfalls 006 & 009**

from a facility located: **in Gallatin, Sumner County, Tennessee**

to receiving waters named: **Cumberland River at mile 240.5 (Outfall 001), mile 242.5 (Outfalls 002, 006, & 009), and mile 244.5 (Outfall 004)**

in accordance with effluent limitations, monitoring requirements and other conditions set forth herein.

This permit shall become effective on: **January 1, 2006**

This permit shall expire on: **November 29, 2009**

Issuance date: **November 30, 2005**

for Paul E. Davis, Director
Division of Water Pollution Control

CN-0759

RDAs 2352 and 2366

2

APPENDIX A

Document 13

Hydrologic & Hydraulic Analysis, Stantec

Report of Hydrologic and Hydraulic Analysis

Ash Pond A, Ash Pond E, and Stilling Pond Complex
TVA Gallatin Fossil Plant
Sumner County, Tennessee

1. Introduction

This study was conducted to help assess capacity and hydraulic operation of spillway systems and freeboard requirements in a breach scenario and in relation to the structural hazard classifications of the facilities. The ponds evaluated include Ash Pond A, Ash Pond E, and the Stilling Pond Complex (Stilling Ponds B, C, and D). Bottom Ash Pond A was also included in the modeling to account for the flow from this pond into Ash Pond A. Ash Pond A, Ash Pond E and the Stilling Pond Complex are currently classified as having a significant-hazard potential.

This analysis included field visits, review of historical TVA drawings and discussions with TVA personnel. This report details the assumptions, methodology, and results of the H&H analyses for the ponds analyzed.

2. Modeling Assumptions

1. Assumption: All pipes are flowing freely and are not clogged or leaking.

   Justification: This assumption is inherent in this type of analysis and is acceptable. Some of the pipes may, in actuality, be clogged with coal fines and some of the older pipes may be leaking (especially older corrugated metal pipes). Elevations and flows determined for this analysis may not be applicable in those situations.

2. Assumption: Wave action is not considered in this analysis. Overtopping is assumed to occur only when the elevation of the pond rises above the minimum surveyed crest elevation.

   Justification: In actuality, wave action would likely play a role in the overtopping of the ponds, however the current model does not take into consideration wave action.

3. Assumption: Elevations for Old Hickory Lake/Cumberland River were estimated in order to account for tailwater impacts caused by the lake submerging the outlets from the Stilling Ponds. The normal pool elevation of the lake was assumed to be 445', while the typical pool elevation of the Stilling Ponds is 456'. The 100-year flood elevation of the lake was assumed to be 453'. The remaining flood elevations for Old Hickory Lake were assumed as follows:

2-year	449'
10-year	451'
25-year	452'

100-year	453'
500-year and PMP	456'

Justification: The normal pool elevation was based on USGS topographic maps, as well as information obtained from www.tnriver.com for Old Hickory Lake. The 10-year, 50-year, 100-year, and 500-year elevations were taken from the latest FEMA flood profiles (dated 2006). The elevations for the 2- and 25-year flood were then interpolated based on the known elevations and the rainfall depths for the associated storm event. For the PMP event at the Gallatin Plant, the elevation of Old Hickory Lake is assumed to be at the 500-year pool elevation.

4. Assumption: Consideration for varying tailwater conditions was not included in this analysis (except for the Stilling Ponds – See Assumption 3). Tailwater elevations for the submerged spillway outlets were chosen as a constant value equivalent to the normal pool elevation of the downstream pond.

   Justification: Tailwater conditions varying over the course of a storm would likely cause some differences in the elevations of the ponds. However the current model does not take into consideration tailwater effects.

5. Assumption: When ponds overtop, the flow often enters another pond. These relationships were assumed as follows. If Bottom Ash Pond A overtops, it is assumed to flow to Pond A, if Pond E overtops it is assumed to flow to Pond A, if Pond A overtops it is assumed to flow into the Stilling Ponds, when the Stilling Ponds overtop they are assumed to flow to the River.

   Justification: These assumptions were made based on new survey data; the lowest spot in the surveyed crest of the dam was observed and overflow was assumed to flow in this direction to the next closest pond.

6. Assumption: The pool elevations captured by surveyors in April of 2010 were considered to be the normal pool elevations and were used in the model as the starting water surface elevations. The only exception is Pond E. The normal pool elevation for Pond E was taken from 2009 TVA survey data.

   Justification: The surveyed pool elevations were compared to pool elevations reported in the Phase 1 B report produced by Stantec and the pool elevations noted in previous TVA survey data dated May, 2009 and September, 2008. All of the ponds except Pond E matched the normal pool elevations previously reported within half a foot. For Pond E there was a 3 foot difference in elevation between the new survey data and the 2008 and 2009 survey data. It is believed this difference is because the pool elevation was measured on the south side of the pond in the recent survey, which appears somewhat isolated from the main portion of Pond E. Therefore, the elevation from the 2009 survey was used.

7. Assumption: For Pond A the top elevation of the three spillway risers flowing to the Stilling Pond was assumed to be 456.83'. The upstream invert elevations of the pipes were assumed to be 451.5'. The connecting pipes were assumed to be 30" diameter concrete pipes. The slope of the connecting pipes was assumed to be 0.01 ft/ft

   Justification: The elevation of the spillway risers, the invert elevations, and the pipe size and material were all taken from Drawing No. 10N273-02 (See Appendix B). Since the inverts of the upstream end of the pipe as well as the downstream end of the pipe were both shown as approximately 451.5 on Drawing 10N273-02, a slope of 0.01 ft/ft was assumed.

8. Assumption: For Pond E the top elevation of the two spillway risers flowing to the Stilling Pond was assumed to be 462.35'. The upstream invert elevations of the pipes were assumed to be 455'. The connecting pipe was assumed to be a 30" PVC/Steel combination pipe. The slope was assumed to be 0.01 ft/ft.

   Justification: The elevation of the spillway risers was taken from Drawing No. 10W271-315 (See Appendix B). The elevation of the invert and pipe size and material were all taken from Drawing No. 10W271-307. Since the inverts of the upstream end of the pipe as well as the downstream end of the pipe were both shown as approximately 455 on Drawing 10W271-307, a slope of 0.01 ft/ft was assumed.

9. Assumption: The top elevation of the four risers discharging from the Stilling Pond was assumed to be 456.03'. The upstream invert elevations of the pipes were assumed to be 449.6' and the downstream invert elevations of the pipes were assumed to be 448.6' (slope of approximately 0.01 ft/ft).

   Justification: The top elevation of the risers was taken from the rating curve provided by TVA in a document titled "NPDES Compliance Correspondence" dated November 12, 2009. The invert elevations of the pipes were taken from 10N273-01. The length used to calculate the slope of the pipes was also approximated from drawing 10N273-01.

10. Assumption: The Chemical Pond was assumed to not contribute runoff to the system.

    Justification: The Chemical Pond is no longer in use and discharges water only when it is manually pumped out of the pond. (Michael T. Gray – field visit March 30th)

11. Assumption: The check dam in the Coal Yard Drainage Ditch is unaccounted for in the model.

    Justification: This represents a conservative condition whereby water is able to bypass the check dam.

12. Assumption: The baseflows into Ash Pond A and Ash Pond E were taken from the "Gallatin Fossil Plant Flow Schematic Diagram NPDES Permit No. TN0005428." (Appendix E) A flow of 13.2014 MGD was assumed for Pond A and a flow of 13.6011 MGD was assumed for Pond E.

    Justification: The Flow Schematic represents an average annual pumping rate and it is possible that daily pumping rates may exceed this rate. However, no other data was available at this time of this study. The flows from the "Bottom Ash/Fly Ash Pumps" were assumed to flow to Ash Pond A and the remaining flows into the Ash Pond on the schematic were assumed to flow into Ash Pond E.

13. Assumption: Some drainage to the north and east of Stilling Pond B (approx. 70 acres) is assumed to drain to the stilling ponds.

    Justification: This area was identified on the field visit by TVA personnel as draining to the Stilling Pond via culverts. The area draining to the ponds was thought by TVA personnel to be potentially larger than the area shown on the "Gallatin Fossil Plant Arrangement and Drainage Map" however field observation of the area revealed it to be very flat and it appeared water would not quickly drain from this area and would be more likely to pond. Therefore, only the area identified on the "Gallatin Fossil Plant Arrangement and Drainage Map" was included in the watershed for the stilling ponds.

14. Assumption: All material exiting the ponds during the piping breach analyses is assumed to be water.

    Justification: In reality, a combination of ash and water is likely. However, for the purposes of this conceptual analysis, an assumption that all material is water is conservative and appropriate.

3. Methodology

Rainfall-runoff relationships were determined using methods described by the NRCS in "Part 630-Hydrology" of the National Engineering Handbook (NEH4). SCS Curve Number Unit Hydrograph methods were used to generate runoff hydrographs for routing through the ponds in lieu of the more complex methods described in Chapter 21 of NEH4 and commonly implemented in NRCS TR-60 based methods.

A HEC-HMS model was developed and used to simulate runoff from the probable maximum precipitation (PMP) event in accordance with TVA design guidance. Rainfall depths for the PMP event were taken from National Weather Service Hydrometeorological Report No. 51. In addition, other design storm events were evaluated including the 2-, 10-, 25-, 100- and 500-year events. For these events the rainfall depth was taken from NOAA Atlas 14. The ponds were modeled as reservoirs within HMS along with their contributing watersheds. Stage-Storage data and rating curves for the spillways were entered into the model along with baseflow and the various storms were then routed through the system.

A duration of 6 hours was used for the PMP analysis and 24 hours for the other rainfall depths. An SCS Type II storm distribution was assumed for the 24-hour storm events as described in "Urban Hydrology for Small Watersheds, Technical Report 55 (TR-55)", Natural Resources Conservation Service 1986. An SCS PMP storm distribution was assumed for the 6-hour PMP storm.

Base condition inflow due to process waters was assumed based on the water balance diagram provided by TVA. This diagram is included in Appendix E.

For the breach analysis, three scenarios were evaluated. The first scenario was an overtopping breach to evaluate the capacity of the Stilling Ponds if Ash Pond A or Ash Pond E were to overtop. For this scenario, the PMP event was evaluated and any overflow from Ash Pond A or Ash Pond E was routed into the Stilling Ponds. The second and third scenarios simulated a piping failure of the dikes separating Ash Pond A and the Stilling Pond (Scenario 2) and Ash Pond E and the Stilling Pond (Scenario 3) during a normal pool condition. Parameters of the breach analysis can be found in Section 4.7.

4. Input Data

4.1. Watershed Parameters

The map in Appendix A shows the connectivity of the ponds, as understood by Stantec. It is our understanding that process flows enter Ash Ponds A and E. Both Ash Pond A and E contain spillway risers that discharge to the Stilling Pond Complex. Drawings used to develop the connectivity which was used in the creation of the hydrologic model are included in Appendix B. Table 1 lists the main hydrologic parameters of the watersheds draining to the ponds.

Table 1. Watershed Parameters

Pond Name	Incremental Watershed Area (acres)	Cumulative Watershed Area (acres)	Composite Curve Number	Estimated lag time (minutes)
Ash Pond A	490	517	71	89
Bottom Ash Pond A	27	27	89	10
Ash Pond E	278	278	82	40
Stilling Ponds	188	983	84	23

4.2. Rainfall Data

Rainfall depths were taken from NOAA Atlas 14 for the storm events evaluated. The PMP depth was taken from Hydrometeorological Report No. 51. Rainfall depths used in the HMS model are summarized below in Table 2.

Table 2. Rainfall Depths

Storm Event	Rainfall Depth (inches)
2-year 24-hour	3.6
10-year 24-hour	5.0
25-year 24-hour	5.9
100-year 24-hour	7.4
500-year 24-hour	9.3
6-hour PMP	28.8

4.3. Spillway Data

All spillway elevations were taken from as-built drawings provided by TVA, with the exception of the culverts connecting the Bottom Ash Pond to Ash Pond A, which were surveyed by TVA in April, 2010 (See Appendix D). Table 3 lists the spillway data for each pond.

Table 3. Existing Principal Spillway and Emergency Spillway Data

Pond Name	Riser Diameter	Pipe Diameter	Invert & Rim Elevations	Data Source
Ash Pond A	(3) 48"	(3) 30"	Rim = 456.83' Pipe Invert = 451.5' Tailwater Elevation = 456.33'	DWG 10N273-02 (TW elevation surveyed)
Bottom Ash Pond A	N/A	(2) 36"	Invert = 475.92' and 477.39'	Survey Data
Ash Pond E	(3) 48"	(3) 36"	Rim = 462.35' Pipe Invert = 455.0' Tailwater Elevation = 456.33'	DWG 10W271-307 and 10W271-315 (TW elevation surveyed)
Stilling Ponds	(4) 48"	(4) 36"	Rim = 456.03' Pipe Invert = 449.6' Tailwater Elevation = Varies; See Assumption #3 in Section 2.0	Rating Curve Provided by TVA and 10N273-01

4.4. Pond Overflow and Normal Pool

Table 4 shows the overtopping elevations (surveyed minimum crest elevation) and the surveyed normal pool elevations at each pond.

Table 4. Pond Overflow Elevation

Pond Name	Overtopping Elevation (feet)	Normal Pool Elevation (feet)
Ash Pond A	472.69	469.7
Bottom Ash Pond A	481.50	478.6
Ash Pond E	473.43	463.4*
Stilling Ponds	459.93	456.3

* This elevation came from the 2009 Survey by TVA and not the recent survey completed in April, 2010. See Assumption #6 in Section 2.

4.5. Stage Storage Data

Stage-storage curves were developed for each pond based on data provided by TVA. For Ash Pond A and Ash Pond E, the stage storage data came from a survey conducted by TVA on April 23, 2009. For the Bottom Ash Pond and the Stilling Ponds, the stage storage data came from a survey conducted by TVA on September 16, 2008. Stage storage curves are included in Appendix C for each pond. Survey data utilized can be found in Appendix D.

4.6. Spillway Rating Curves

Rating curves for the spillway systems were developed based on the geometric data available and weir, orifice, and culvert discharge relationships. Weir equations and coefficients were based on guidance provided in "Open Channel Hydraulics," V.T. Chow, 1959. Orifice equations and coefficients were based on guidance provided in "Handbook of Hydraulics," E. F. Brater and H.W. King, 1976. Culvert discharge ratings were developed using procedures outlined in "Hydraulic Design of Highway Culverts, Hydraulic Design Series No. 5 (HDS-5)," U.S. Department of Transportation Federal Highway Administration (FHWA) 1985.

The tailwater elevation used in the pipe flow calculation in the rating curve was taken as the normal pool elevation of the downstream pond. For the Stilling Ponds, the tailwater was varied based on the anticipated level of Old Hickory Lake/Cumberland River during the storm event analyzed. (See discussion in Section 2, Assumption 3). Rating curves for each pond are attached in Appendix C.

4.7. Baseflow

Baseflows into Ash Pond A and Ash Pond E were estimated from the water balance diagram provided by TVA entitled "Gallatin Fossil Plant Flow Schematic Diagram NPDES Permit No. TN0005428" and revised in May, 2009 (Appendix E). Flows shown on the flow schematic were converted from MGD to CFS. Baseflows used for each of the ponds are shown in Table 5.

Table 5. Pumping Rate

Pond Name	Pumping Rate (cfs)	Pumping Rate (mgd)
Ash Pond A	20.42	13.2014
Ash Pond E	21.04	13.6011

4.8. Breach Parameters

Breach Parameters for the piping breach analyses are shown in Table 6. Many empirical equations have been developed from case studies to predict average breach width and breach development time based on the height of the dam, depth of the water, volume impounded, and/or type of breach. To estimate the breach width and time to failure, different empirical equations were evaluated and a final breach parameter was chosen based on the range of estimates obtained and engineering judgment. As stated in Section 3, the elevations of the ponds at the time of failure were assumed to be at their normal pool conditions. The downstream tailwater at the time of failure (i.e. the normal pool elevation for the Stilling Ponds) was used as the breach invert elevation.

Table 6. Breach Parameters

Pond Name	Breach Bottom Width (feet)	Breach Development Time (hours)	Slope of Breach Geometry*	Elevation at Time of Breach (feet)	Breach Invert Elevation (feet)
Ash Pond A	55	13.2014	L&R = 0.9:1	469.7	456.3
Ash Pond E	45	13.6011	L&R = 0.9:1	463.4	456.3

*Based on “Embankment Dam Breach Parameters Revisited” by David C. Froehlich, 1995

5. Results

Results are summarized in the following sections for the capacity/freeboard analysis and also the breach analyses. The results shown are based on the assumptions described herein and should be considered approximate. It should be noted that accurate and precise data was not available. Also, because calibrating the model would require a historical record of rainfall data and peak pond elevations and this data is not known to exist, calibration was not performed. Therefore, this model is suitable as a screening and planning tool, however Stantec does not support its use beyond the current scope of work and the context described in this report.

5.1. Capacity and Freeboard Results

Estimated peak pool elevations for the storms analyzed are shown in Table 7. Numbers in bold indicate that the pond is likely overtopping for the associated storm event. Table 8 shows the estimated peak pond inflows associated with each event.

Table 7. Estimated Peak Pool Elevations

Pond Name	2-year 24-hour storm (ft)	10-year 24-hour storm (ft)	25-year 24-hour storm (ft)	100-year 24-hour storm (ft)	500-year 24-hour storm (ft)	6-hour PMP (ft)
Ash Pond A	469.7	469.7	469.7	469.7	469.7	473.5
Bottom Ash Pond A	478.6	478.6	478.6	478.6	479.0	480.2
Ash Pond E	463.4	463.4	463.4	463.5	463.7	467.2
Stilling Ponds	458.1	458.4	459.0	460.0	460.7	462.0

Table 8. Estimated Peak Pond Inflows

Pond Name	2-year 24-hour storm (cfs)	10-year 24-hour storm (cfs)	25-year 24-hour storm (cfs)	100-year 24-hour storm (cfs)	500-year 24-hour storm (cfs)	6-hour PMP (cfs)
Ash Pond A	173	328	434	621	871	3757
Bottom Ash Pond A	80	122	148	192	247	518
Ash Pond E	292	476	595	795	1052	3510
Stilling Ponds	590	780	903	1111	1378	3525

5.2. Breach Analysis Results

Estimated peak pool elevations and volumes for the breach scenarios, analyzed are shown in Table 9. The lowest surveyed crest elevation of the stilling ponds is 459.9'; therefore for all of the breach analyses analyzed, the Stilling Ponds would likely overtop.

Table 9. Breach Analysis Results

Scenario	Peak Outflow from Pond A (cfs)	Peak Outflow from Pond E (cfs)	Peak Inflow to Stilling Ponds (cfs)	Total Volume inflow into Stilling Ponds (acre-feet)	Stilling Pond Elevation (feet)
1. Overtopping Failure during PMP event	1653	354	2204	2653	**462.0**
2. Piping Breach of Ash Pond A	8196	127	8313	739	**461.9**
3. Piping Breach of Ash Pond E	282	2800	3077	1117	**461.1**

6. Conclusions and Recommendations

Based on the data gathering and modeling efforts, several observations were made in terms of capacity and freeboard.

- Based on the current modeling, the Stilling Ponds appear unable to pass the 100-year event through the spillway system without overtopping the embankment. In addition, the Stilling Ponds and Ash Pond A appear unable to pass the PMP without overtopping their embankments.
  - In the event of a PMP storm, Ash Pond A would overtop the dike between the Ash Pond and the Stilling Pond and the Stilling Pond would overtop and flow into the Cumberland River.
  - Overtopping of the Stilling Ponds would likely be confined to the area of the dike closest to the four spillway risers during the 100-year event. However, there is the potential that the Stilling Pond Complex would also overtop at the railroad tracks adjacent to Stilling Pond B in addition to overtopping into the River during the PMP event.
- Aside from the principal spillway systems, there are no defined emergency spillways or overflow paths.
  - If the spillways were to become clogged, or if a heavy rainfall event were to cause any of the ponds to overtop, there are no defined and protected overflow paths to help prevent erosion of the dikes.
- For static operational conditions, according to the TVA design guidance, a minimum operational freeboard of 3 feet is required; currently the operational freeboard for Ash Pond A is close to this value or slightly below in most places along the divider dike between the ash pond and the Stilling Ponds.

Based on the breach analysis modeling, the following observations were made.

- The Stilling Ponds do not appear to have adequate capacity during any of the breach scenarios modeled. If either Ash Pond A or Ash Pond E overtop during a large storm event or if a piping breach occurs on either pond, the Stilling Pond cannot pass the additional flow without overtopping the embankment.
  - The Stilling Pond has approximately 200 acre-feet of available storage; however the inflow volume caused by any of the breach scenarios analyzed is much higher (3 to 14 times that amount).
  - The overflow from the breach events analyzed in Scenario 2 or 3 (piping breaches of Ash Pond A or Ash Pond E divider dike) would likely overflow at the dike near the four spillway risers. The overflow from an overtopping breach event would likely overflow at the dike near the four spillway risers and potentially overtop the railroad tracks adjacent to Stilling Pond B.

Based on the results of the analysis, Stantec recommends the following:

- Lowering the pool in Ash Pond A by one foot to reduce the flow into the Stilling Ponds. Our modeling suggests this will allow the Stilling Ponds to pass the 100-year storm without overtopping.
- Further survey work to determine whether raising the dike in the Stilling Pond near the four spillway risers is a possibility to add additional containment during an extreme flood (100-year or PMP) breach scenario.
- Creating a defined overflow path from the Stilling Pond to the Cumberland River near the existing spillway pipes to protect the dike in the event that overtopping should occur.
- Creating a defined overflow path between Ash Pond A and the Stilling Ponds to protect the dike during an overtopping event.
- The Stilling Pond risers are stacked spillway risers and may need to be replaced. Before replacing, the capacity of the spillway system should be assessed to determine the size of the replacement spillway system.

Stantec recommends that these potential improvements be further evaluated by TVA to determine if they can be incorporated into future construction projects at the plant.

7. References

1. Bonnin, Geoffrey M., et. al. NOAA Atlas 14, Precipitation-Frequency Atlas of the United States. 2006.

2. Brater, E.F. and King, H.W. Handbook of Hydraulics. 1976.

3. Chow, V.T., Open Channel Hydraulics. 1959.

APPENDIX A

Document 14

CCR Generation and Handling Questions

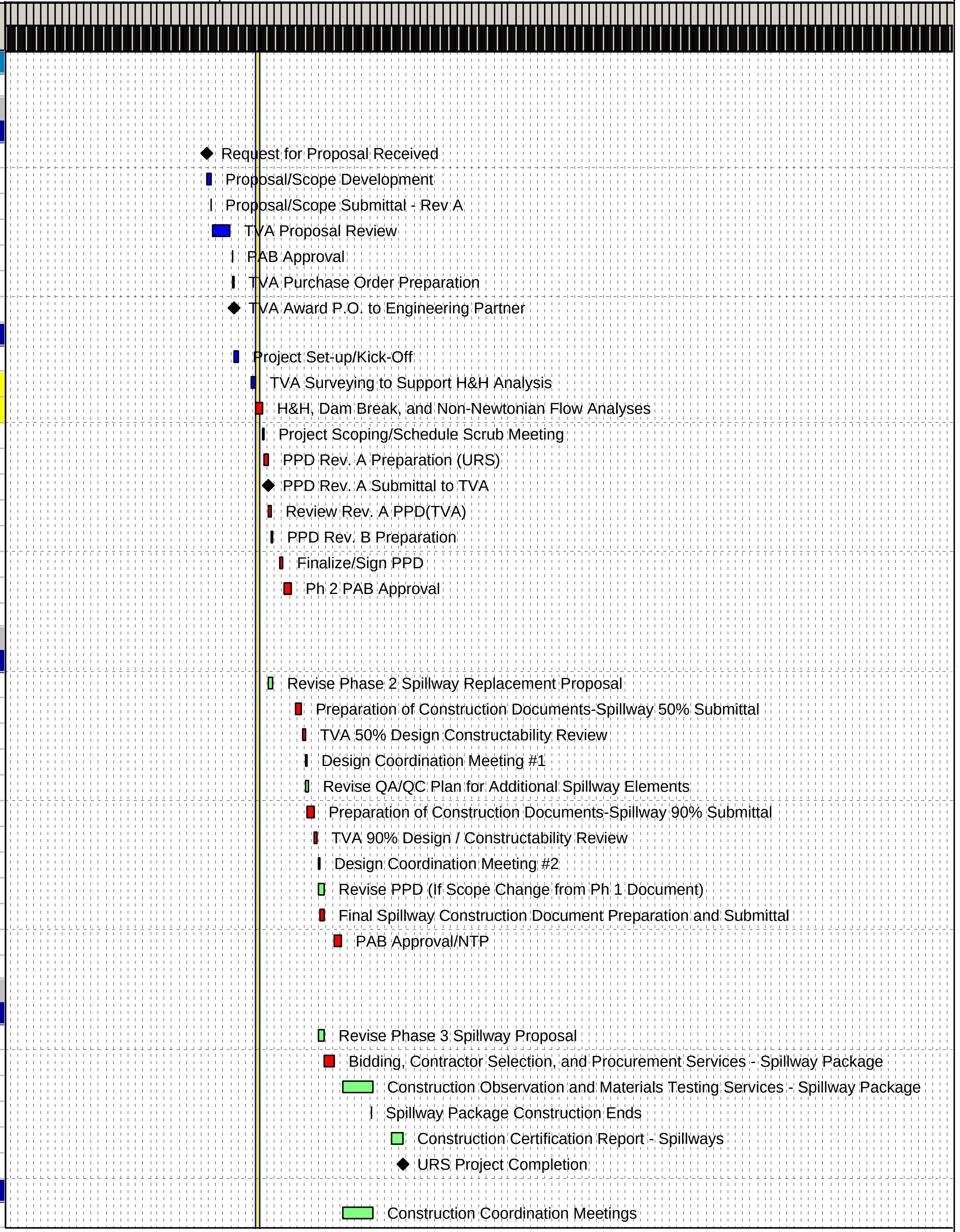
CCR Generation and Handling Questions:	Gallatin
1. Does the utility have drawings showing the CCR generation/handling/storage train for:	
a. Fly Ash	Yes
b. Bottom Ash	Yes
c. Boiler Slag	Yes
d. FGD wastes	N/A
2. What specific equipment is used to collect, handle, and store CCR material? For:	
a. Fly Ash	Air Heater Hoppers, Economizer Hoppers, Precipitator Hoppers, Hydroveyors, Air separator tank,piping, ash pond
b. Bottom Ash	Bottom Ash Hoppers, jet pumps, piping, bottom ash pond
c. Boiler Slag	N/A
d. FGD wastes	N/A
3. Is there design information on the handling and transport equipment?	Yes
a. Example:size and length of pipe for sluicing the CCR	Yes
b. Is equipment within a secondary containment or just sitting on the ground?	Air Heater Hoppers, Economizer Hoppers, Precipitator Hoppers are inside a building. Hydroveyors, Air separator tank,piping and ash pond are outside.
c. Volume of storage silo	1200 Tons
4. What equipment is outside versus enclosed?	Air Heater Hoppers, Economizer Hoppers, Precipitator Hoppers are inside a building. Hydroveyors, Air separator tank,piping and ash pond are outside.
5. Has there ever been a release of CCR to the environment from the collection/handling/disposal system?	Yes, small flyash line leak and overflow of ash separator tank
6. How much CCR per hour are they handling in each system, actual and design?	

APPENDIX A

Document 15

GAF – Pond A Spillway Replacement Schedule

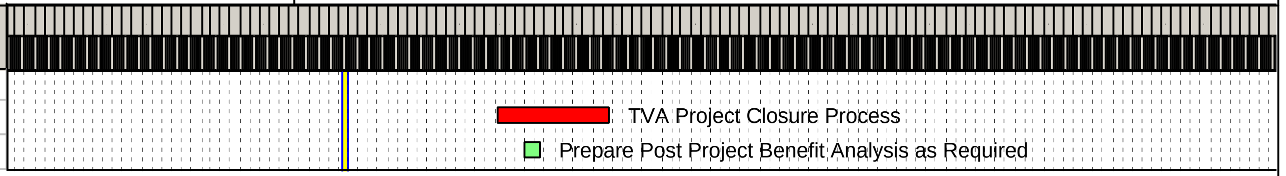
Activity ID	Activity Name	Original Duration	Start	Finish	Actual Start	Actual Finish
602601- URS GAF - Pond A Spillway						
602601- URS.01 STUDY AND PRELIMINARY ENGINEERING						
602601- URS.01.01.03.02 URS PH 1						
602601- URS.01.01.03.02.1 Task 0 - Project Scope Development						
URS-00100	Request for Proposal Received	0.0d	09/26/11 A		09/26/11	
URS-00110	Proposal/Scope Development	15.0d	09/26/11 A	10/14/11 A	09/26/11	10/14/11
URS-00120	Proposal/Scope Submittal - Rev A	1.0d	10/14/11 A	10/14/11 A	10/14/11	10/14/11
TVA-00100	TVA Proposal Review	1.0d	10/17/11 A	12/29/11 A	10/17/11	12/29/11
TVA-00110	PAB Approval	15.0d	01/10/12 A	01/10/12 A	01/10/12	01/10/12
TVA-00120	TVA Purchase Order Preparation	7.0d	01/11/12 A	01/13/12 A	01/11/12	01/13/12
TVA-00130	TVA Award P.O. to Engineering Partner	0.0d		01/13/12 A		01/13/12
602601- URS.01.01.03.02.2 Conceptual Design and Project Planning Document Development						
URS-00410	Project Set-up/Kick-Off	10.0d	01/17/12 A	01/30/12 A	01/17/12	01/30/12
TVA-00972	TVA Surveying to Support H&H Analysis	10.0d	03/26/12 A	04/16/12	03/26/12	
URS-00140	H&H, Dam Break, and Non-Newtonian Flow Anal...	20.0d	04/16/12	05/11/12		
URS-00430	Project Scoping/Schedule Scrub Meeting	5.0d	05/14/12	05/18/12		
URS-00200	PPD Rev. A Preparation (URS)	10.0d	05/21/12	06/04/12		
URS-00210	PPD Rev. A Submittal to TVA	0.0d	06/05/12			
TVA-00140	Review Rev. A PPD(TVA)	10.0d	06/05/12	06/18/12		
URS-00230	PPD Rev. B Preparation	5.0d	06/19/12	06/25/12		
TVA-00240	Finalize/Sign PPD	10.0d	07/25/12	08/07/12		
TVA-00250	Ph 2 PAB Approval	20.0d	08/13/12	09/10/12		
602601- URS.02 DETAILED ENGINEERING						
602601- URS.02.01.03.02 URS PH 2						
602601- URS.02.01.03.02.1 Engineering Design and Bid Document Preparation						
URS-00260	Revise Phase 2 Spillway Replacement Proposal	15.0d	06/05/12	06/25/12		
URS-00270	Preparation of Construction Documents-Spillway ...	20.0d	09/25/12	10/23/12		
TVA-00150	TVA 50% Design Constructability Review	10.0d	10/24/12	11/06/12		
URS-00290	Design Coordination Meeting #1	5.0d	11/07/12	11/14/12		
URS-00350	Revise QA/QC Plan for Additional Spillway Eleme...	10.0d	11/07/12	11/21/12		
URS-00300	Preparation of Construction Documents-Spillway ...	20.0d	11/15/12	12/13/12		
TVA-00160	TVA 90% Design / Constructability Review	10.0d	12/14/12	12/28/12		
URS-00310	Design Coordination Meeting #2	5.0d	12/31/12	01/07/13		
TVA-00962	Revise PPD (If Scope Change from Ph 1 Docum...	15.0d	12/31/12	01/22/13		
URS-00340	Final Spillway Construction Document Preparatio...	10.0d	01/08/13	01/22/13		
TVA-00952	PAB Approval/NTP	20.0d	03/07/13	04/03/13		
602601- URS.03 IMPLEMENTATION						
602601- URS.03.01.03.02 URS PH 3						
602601- URS.03.01.03.02.1 Project Implementation/Construction Support Services						
TVA-00180	Revise Phase 3 Spillway Proposal	15.0d	12/31/12	01/22/13		
TVA-00190	Bidding, Contractor Selection, and Procurement ...	30.0d	01/23/13	03/06/13		
URS-00360	Construction Observation and Materials Testing S...	88.0d	04/10/13*	08/13/13		
URS-00370	Spillway Package Construction Ends	1.0d	08/06/13	08/06/13		
URS-00380	Construction Certification Report - Spillways	30.0d	11/01/13	12/16/13		
URS-00400	URS Project Completion	0.0d		12/16/13		
602601- URS.03.01.03.02.2 Construction Coordination Meetings						
URS-00390	Construction Coordination Meetings	88.0d	04/10/13*	08/13/13		



🟩 Remaining Level of Effort
🟦 Actual Level of Effort
🟦 Actual Work
🟩 Remaining Work
🟥 Critical Remaining Work
◆ Milestone

TASK filter: URS Filter.

Activity ID	Activity Name	Original Duration	Start	Finish	Actual Start	Actual Finish
602601- URS.1-1 Phase 3- Project Closure						
TVA-00852	TVA Project Closure Process	240.0d	08/06/13	07/22/14		
TVA-00902	Prepare Post Project Benefit Analysis as Required	30.0d	11/01/13	12/16/13		



🟩 Remaining Level of Effort	🟦 Actual Work	🟥 Critical Remaining Work
🟦 Actual Level of Effort	🟩 Remaining Work ◆	◆ Milestone

TASK filter: URS Filter.

APPENDIX B

Document 16

Dam Inspection Check List Form Primary Bottom Ash Pond A

Site Name:	**Gallatin Fossil**	Date:	**September 8, 2011**
Unit Name:	**Bottom Ash Pond A**	Operator's Name:	**Tennessee Valley Authority**
Unit I.D.:		Hazard Potential Classification:	**High** ☐ **Significant** ☒ **Low** ☐
	Inspector's Name:	Stanford/McLaren	

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?	x		18. Sloughing or bulging on slopes?	x	
2. Pool elevation (operator records)?	x		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)?	x		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?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below) 6" diameter	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?	N/A		From downstream foundation area?	x	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?		x
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?		x	23. Water against downstream toe?	x	
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit TN0005428 **INSPECTOR**

Date November 30, 2005 / Expires 11-29-2009 (TVA has reapplied for permit)

Impoundment Name Stilling Pond D

Impoundment Company TVA-Gallatin Fossil Plant

EPA Region 4

State Agency (Field Office) Address 61 Forsyth Street, SW Atlanta GA 30303-1754

Name of Impoundment Outfall 001

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

New ☒ **Update** ☐

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

IMPOUNDMENT FUNCTION: Bottom Ash storage Pond

Nearest Downstream Town Name: Gallatin

Distance from the impoundment: Approximately 3 miles along river

Location:

Latitude	36	Degrees	18	Minutes	53.6904	Seconds	**N**
Longitude	-86	Degrees	24	Minutes	5.7846	Seconds	**W**

State Tennessee **County** Summer

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

If So Which State Agency?

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☐ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

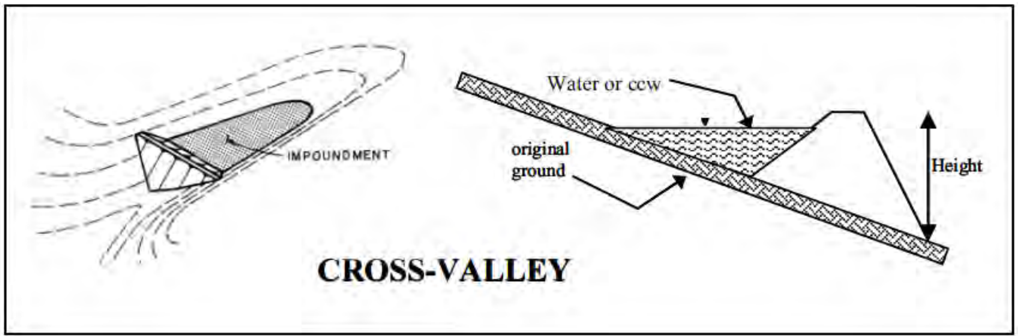
☒ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

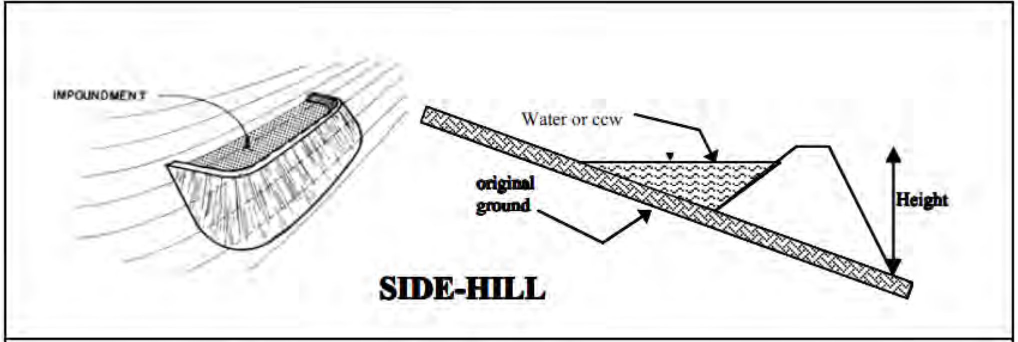
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

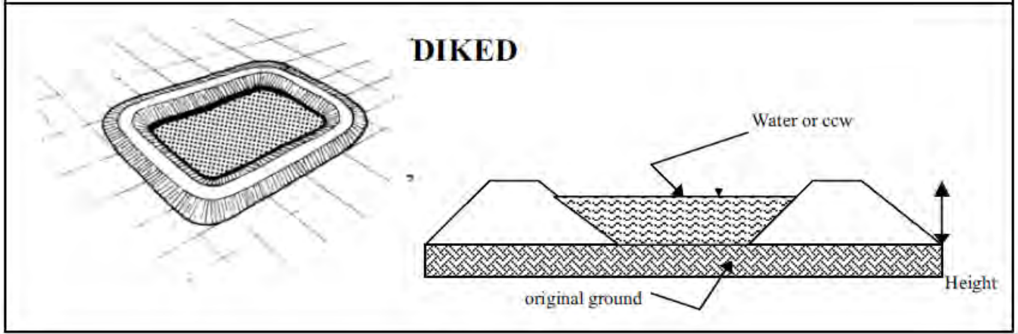
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

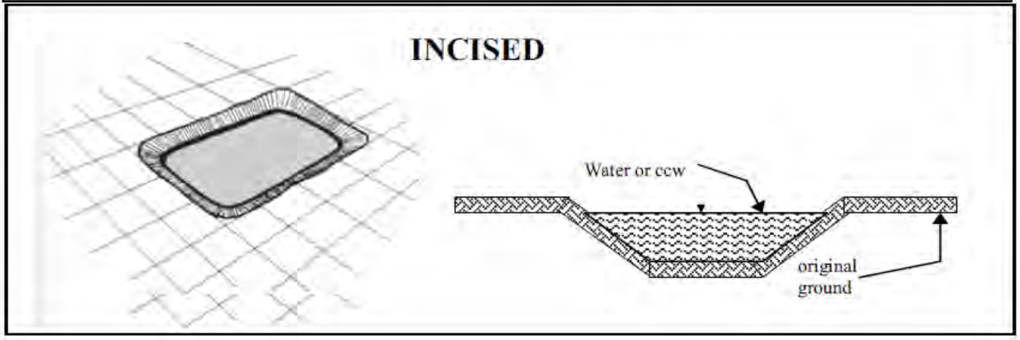
The Pond is considered Significant hazard due to the potential of environmental damage to the Cumberland River.

CONFIGURATION:









☐ Cross-Valley ☐ Side-Hill ☐ Diked

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

Embankment Height (ft) 25

Embankment Material Clay/Bottom Ash

Pool Area (ac) 269

Liner N/A

Current Freeboard (ft) 3’ estimated **Liner Permeability** N/A

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

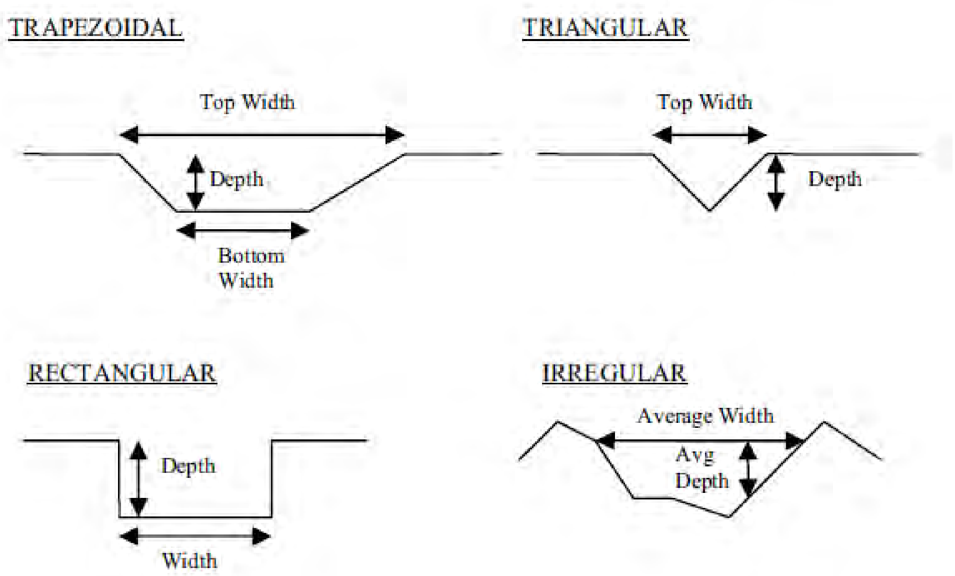
☐ Rectangular

☐ Irregular

depth (ft)

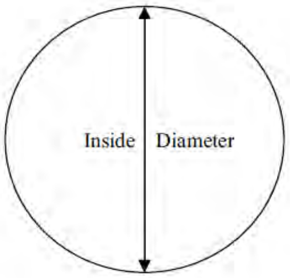
average bottom width (ft)

top width (ft)



☒ **Outlet**

(3) 30” –inch RCP



Material

☐ corrugated metal

☐ welded steel

☒ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☒	☐

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By Not Known at this time.

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

If So When?

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that. No construction documents are present at this time. Current borings do not show that the embankments were constructed of wet ash, slag, or unsuitable materials.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation? *NO*

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes? *NO*

APPENDIX B

Document 17

Dam Inspection Check List Form – Fly Ash Pond E

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name:	**Gallatin Fossil**	Date:	**September 8, 2011**
Unit Name:	**Fly Ash Pond E**	Operator's Name:	**Tennessee Valley Authority**
Unit I.D.:		Hazard Potential Classification:	**High** ☐ **Significant** ☒ **Low** ☐
	Inspector's Name:	Stanford/McLaren	

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?	x		18. Sloughing or bulging on slopes?		x
2. Pool elevation (operator records)?	x		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)?	x		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?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below)		x	At isolated points on embankment slopes?	x	
10. Cracks or scarps on crest?		x	At natural hillside in the embankment area?	x	
11. Is there significant settlement along the crest?		x	Over widespread areas?		x
12. Are decant trashracks clear and in place?	N/A		From downstream foundation area?	x	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?		x
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?		x	23. Water against downstream toe?	x	
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit TN0005428 **INSPECTOR**

Date November 30, 2005 / Expires 11-29-2009 (TVA has reapplied for permit)
Impoundment Name Stilling Pond D

Impoundment Company TVA-Gallatin Fossil Plant
EPA Region 4

State Agency (Field Office) Address 61 Forsyth Street, SW Atlanta GA 30303-1754
Name of Impoundment Outfall 001

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

New ☒ **Update** ☐

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

IMPOUNDMENT FUNCTION: Fly Ash storage Pond

Nearest Downstream Town Name: Gallatin

Distance from the impoundment: Approximately 3 miles along river

Location:

Latitude	36	Degrees	18	Minutes	53.6904	Seconds	**N**
Longitude	-86	Degrees	24	Minutes	5.7846	Seconds	**W**

State Tennessee **County** Summer

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

If So Which State Agency?

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☐ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

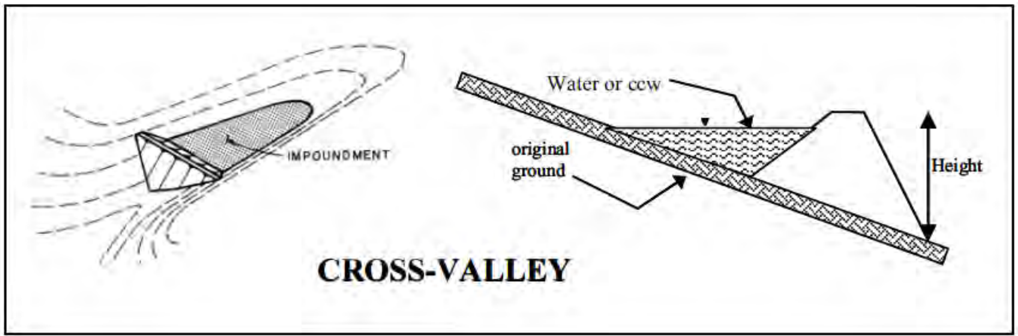
☒ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

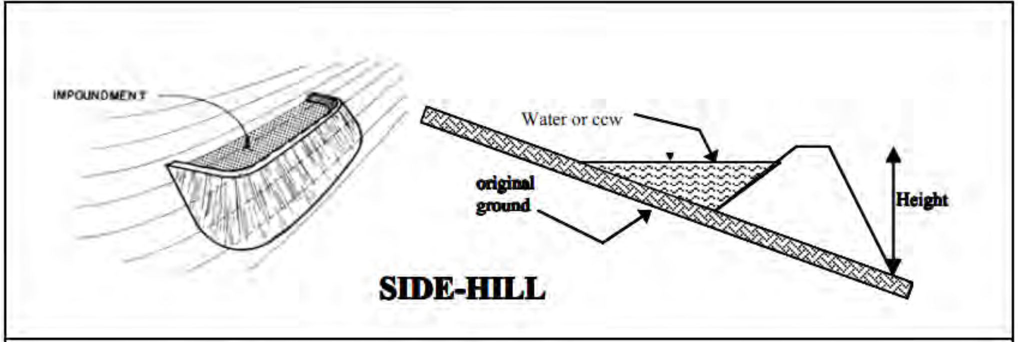
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

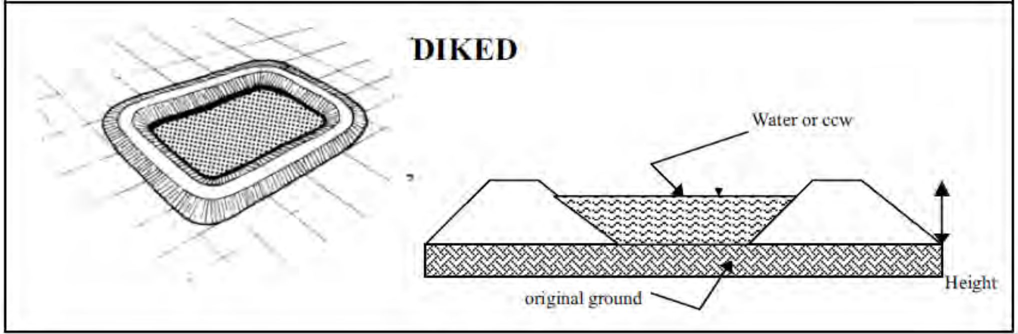
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

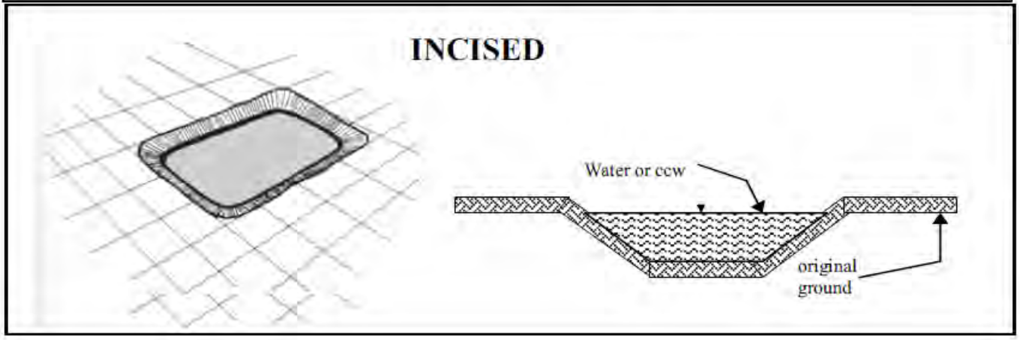
The Pond is considered Significant hazard due to the potential of environmental damage to the Cumberland River.

CONFIGURATION:









☒ Cross-Valley ☐ Side-Hill ☒ Diked

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

Embankment Height (ft) 30 **Embankment Material** Clay

Pool Area (ac) 157 **Liner** N/A

Current Freeboard (ft) 3’ estimated **Liner Permeability** N/A

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

☐ Rectangular

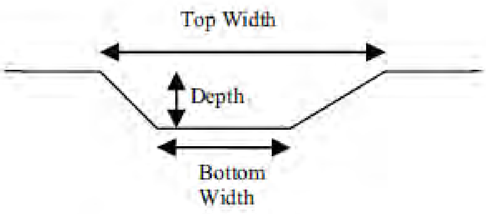
☐ Irregular

depth (ft)

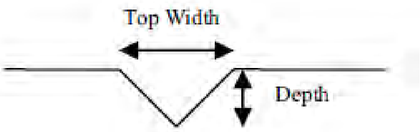
average bottom width (ft)

top width (ft)

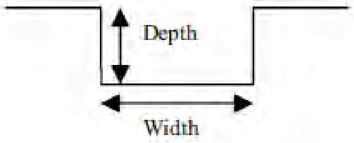
TRAPEZOIDAL



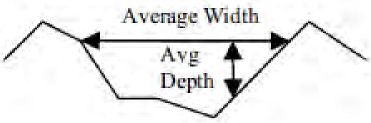
TRIANGULAR



RECTANGULAR

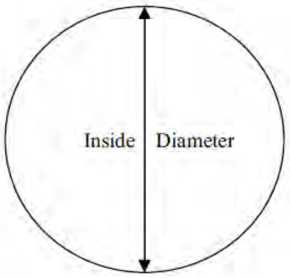


IRREGULAR



☒ **Outlet**

(2) 30" –inch RCP



Material

☐ corrugated metal

☐ welded steel

☒ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☒	☐

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By Not Known at this time.

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

If So When?

If So Please Describe :

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

If So When?

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒
If so, which method (e.g., piezometers, gw pumping,...)?		

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that. No construction documents are present at this time. Current borings do not show that the embankments were constructed of wet ash, slag, or unsuitable materials.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation? NO

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes? NO

APPENDIX B

Document 18

Dam Inspection Check List Form – Stilling Ponds B, C, D

Coal Combustion Dam Inspection Checklist Form

US Environmental
Protection Agency

Site Name:	**Gallatin Fossil**	Date:	**September 8, 2011**
Unit Name:	**Stilling Pond B,C,D**	Operator's Name:	**Tennessee Valley Authority**
Unit I.D.:		Hazard Potential Classification:	**High** ☐ **Significant** ☒ **Low** ☐
	Inspector's Name:	Stanford/McLaren	

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?	x		18. Sloughing or bulging on slopes?	x	
2. Pool elevation (operator records)?	x		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)?	x		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?		N/A
9. Trees growing on embankment? (If so, indicate largest diameter below) 6" diameter	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?	N/A		From downstream foundation area?	x	
13. Depressions or sinkholes in tailings surface or whirlpool in the pool area?		x	"Boils" beneath stream or ponded water?		x
14. Clogged spillways, groin or diversion ditches?		x	Around the outside of the decant pipe?		x
15. Are spillway or ditch linings deteriorated?		x	22. Surface movements in valley bottom or on hillside?		x
16. Are outlets of decant or underdrains blocked?		x	23. Water against downstream toe?	x	
17. Cracks or scarps on slopes?		x	24. Were Photos taken during the dam inspection?	x	

Major adverse changes in these items could cause instability and should be reported for further evaluation. Adverse conditions noted in these items should normally be described (extent, location, volume, etc.) in the space below and on the back of this sheet.

Issue #	Comments

Coal Combustion Waste (CCW)

Impoundment Inspection

Impoundment NPDES Permit TN0005428 **INSPECTOR**

Date November 30, 2005 / Expires 11-29-2009 (TVA has reapplied for permit)
Impoundment Name Stilling Pond D

Impoundment Company TVA-Gallatin Fossil Plant
EPA Region 4

State Agency (Field Office) Address 61 Forsyth Street, SW Atlanta GA 30303-1754
Name of Impoundment Outfall 001

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

New ☒ **Update** ☐

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

IMPOUNDMENT FUNCTION: Stilling Pond

Nearest Downstream Town Name: Gallatin

Distance from the impoundment: Approximately 3 miles along river

Location:

Latitude	36	Degrees	18	Minutes	53.6904	Seconds	**N**
Longitude	-86	Degrees	24	Minutes	5.7846	Seconds	**W**

State Tennessee **County** Summer

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

If So Which State Agency?

HAZARD POTENTIAL *(In the event the impoundment should fail, the following would occur):*

☐ **LESS THAN LOW HAZARD POTENTIAL:** Failure or misoperation of the dam results in no probable loss of human life or economic or environmental losses.

☐ **LOW HAZARD POTENTIAL:** Dams assigned the low hazard potential classification are those where failure or misoperation results in no probable loss of human life and low economic and/or environmental losses. Losses are principally limited to the owner's property.

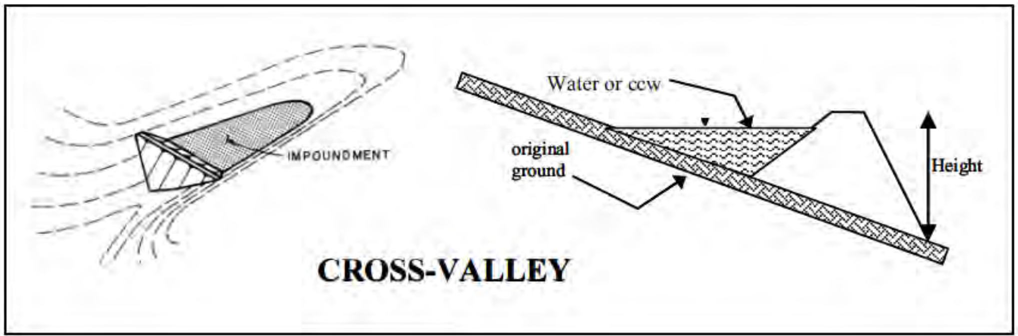
☒ **SIGNIFICANT HAZARD POTENTIAL:** Dams assigned the significant hazard potential classification are those dams where failure or misoperation results in no probable loss of human life but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns. Significant hazard potential classification dams are often located in predominantly rural or agricultural areas but could be located in areas with population and significant infrastructure.

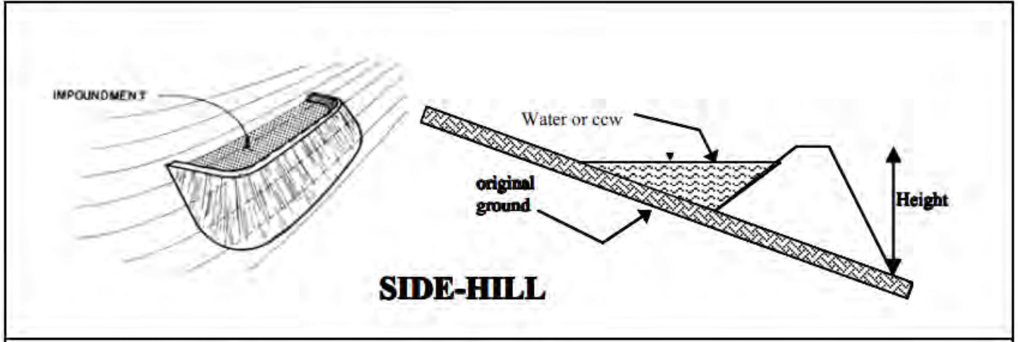
☐ **HIGH HAZARD POTENTIAL:** Dams assigned the high hazard potential classification are those where failure or misoperation will probably cause loss of human life.

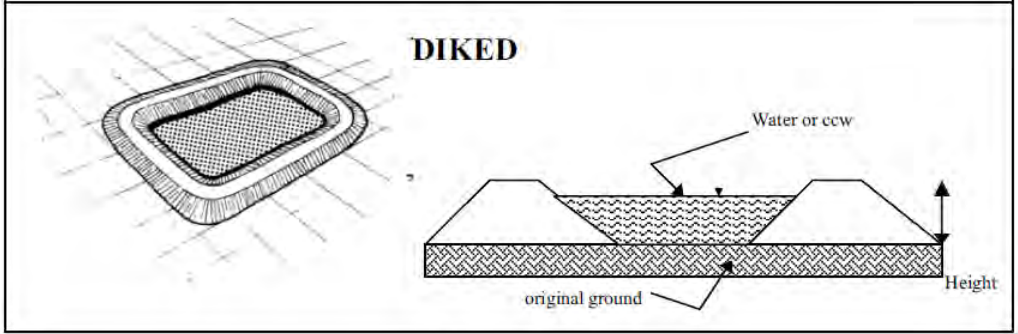
DESCRIBE REASONING FOR HAZARD RATING CHOSEN:

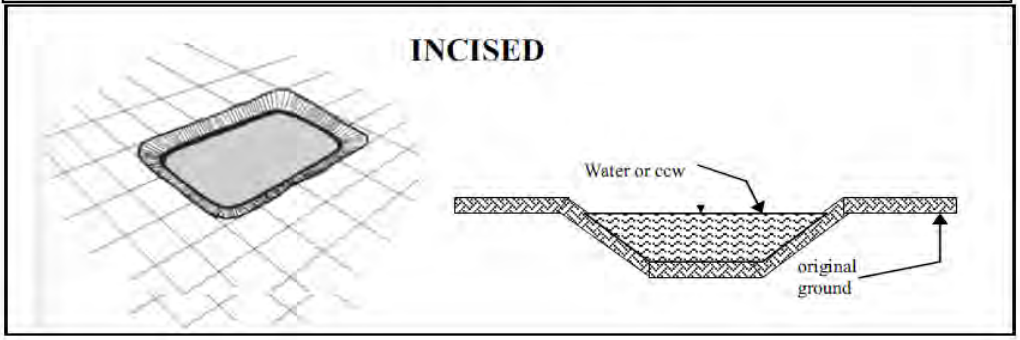
The Pond is considered Significant hazard due to the potential of environmental damage to the Cumberland River.

CONFIGURATION:









☒ Cross-Valley ☐ Side-Hill ☐ Diked

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

Embankment Height (ft) 10

Embankment Material Clay

Pool Area (ac) 55

Liner N/A

Current Freeboard (ft) 3’ estimated **Liner Permeability** N/A

TYPE OF OUTLET (Mark all that apply)

☐ **Open Channel Spillway**

☐ Trapezoidal

☐ Triangular

☐ Rectangular

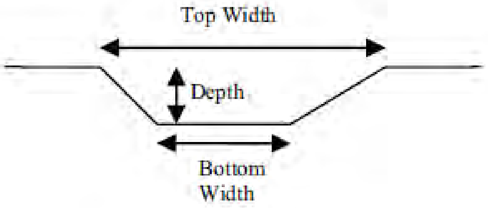
☐ Irregular

depth (ft)

average bottom width (ft)

top width (ft)

TRAPEZOIDAL



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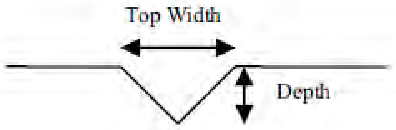
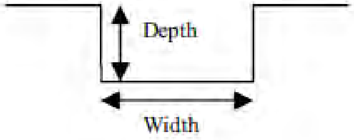
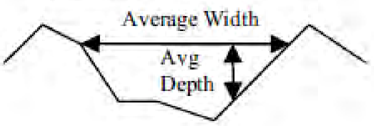


RECTANGULAR

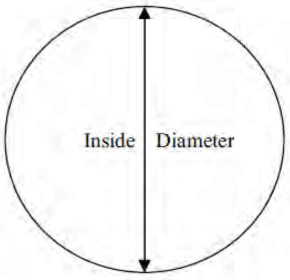


IRREGULAR



☒ **Outlet**

(4) 36" –inch RCP



Material

☐ corrugated metal

☐ welded steel

☒ concrete

☐ plastic (hdpe, pvc, etc.)

☐ other (specify):

	Yes	No
Is water flowing through the outlet?	☒	☐

☐ **No Outlet**

☐ **Other Type of Outlet** (specify):

The Impoundment was Designed By Not Known at this time.

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

If So When?

If So Please Describe :

	Yes	No
Has there ever been significant seepages at this site?	☐	☒
If So When?		

If So Please Describe :

	Yes	No
Has there ever been any measures undertaken to monitor/lower Phreatic water table levels based on past seepages or breaches at this site?	☐	☒

If so, which method (e.g., piezometers, gw pumping,...)?

If So Please Describe :

ADDITIONAL INSPECTION QUESTIONS

Concerning the embankment foundation, was the embankment construction built over wet ash, slag, or other unsuitable materials? If there is no information just note that. No construction documents are present at this time. Current borings do not show that the embankments were constructed of wet ash, slag, or unsuitable materials.

Did the dam assessor meet with, or have documentation from, the design Engineer-of-Record concerning the foundation preparation? NO

From the site visit or from photographic documentation, was there evidence of prior releases, failures, or patchwork on the dikes? NO

APPENDIX B

Document 19

Dewberry Memorandum dated May 25, 2012, Regarding Qualitative Assessment

Memorandum

To: Stephen Hoffman, USEPA
Through: Jerry Strauss

From: Joe Klein

Date: May 25, 2012

Re: Qualitative Assessment
Liquefaction Potential
TVA Fossil Plant CCR Impoundments
Dewberry Project No, 50047151

This memorandum provides the results of a qualitative assessment of CCR impoundment embankment susceptibility to liquefaction at eight of the TVA fossil fuel plants assessed by Dewberry. The plants are: Bull Run; Colbert; Cumberland; Gallatin; John Sevier; Johnsonville; Kingston, and Widows Creek. We have not included Watts Bar (small pond, inactive for 30 years, minimal potential ash release), and Allen (TVA continuing deformation analyses, awaiting data and report)

TVA has indicated that a formal assessment of liquefaction susceptibility is underway; a completion date has not been provided. In prior rounds of the EPA CCR program, Dewberry has provided a preliminary indication of the presence of soils susceptible to liquefaction based on the geotechnical data provided with the slope stability analysis. The purpose of this assessment is to include similar information as a component of our reports to EPA, and to provide a uniform approach to the remaining plant sites.

Generally the geotechnical review looks at the soil stratification beneath both the embankments and impoundments to identify soil types considered susceptible to liquefaction; i.e., fine to medium grain sands, and some silts with Standard Penetration Resistance, or N-Values of less than 15 blows per foot[1]. That criterion, is an accepted industry standard for first level reviews.

Because several of the embankments had been constructed to their current configuration in stages, and because the raised sections were typically constructed by extending embankments in the *upstream* direction, most of TVA raised dikes are supported in part on stored bottom ash and/or fly ash. As bottom ash and fly ash are both known to be somewhat susceptible to liquefaction, an assessment of the potential impact on loss of subgrade support to the raised dike sections is a key consideration in the assessments.

For most of the other management units I have visited, the impoundments were expanded by *building out* on the downstream side of the dikes, eliminating the situation of building on the existing ash layer. The one site that did expand inward conducted a liquefaction analysis which indicated a potential for liquefaction in the ash at certain groundwater elevations. In that case the utility combined a groundwater monitoring system and construction schedule in an effort to prevent groundwater elevation

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[1] Winterkorn, H.F., and Fang, H., *Foundation Engineering Handbook, Van Nostrand Reinhold, Ltd., New York, NY, 1975, pg. 268*

increases. If the approach proved to be unsuccessful, the utility had a drainage system design ready to be installed to stabilize the embankment against a potential liquefaction failure.

Because the assessments are qualitative rather than quantitative, I elected not to consider the results as indicative of either SATISFACTORY or UNSATISFACTORY. The assessed liquefaction condition at each impoundment is presented as either NO CONCERN or CONCERN. Each impoundment is assessed based on the natural foundation soils at the site, and the supporting material of raised dike sections. A composite rating is provided as described below.

The evaluations are based on the embankment cross-sections used in the recent (February 2012 and April 2012) pseudo static slope stability analyses conducted by Stantec Consulting Services for TVA.

Foundation Rating

Foundation soils are rated not only on the presence of liquefaction susceptible soils, but also the depth and thickness of the stratum, the slope of the base of the stratum, and whether the stratum extends beneath the base dike, or is restricted to the impoundment area. A CONCERN rating indicates the presence of soils susceptible to liquefaction at a relatively shallow depth below the embankment, and sufficiently thick to result in substantial deformations to the embankment in the event liquefaction occurs.

Dike Rating

Dikes were rated based on the presence of bottom ash, fly ash or other CCR material underlying raised dike sections. If the CCR material supported 50 percent or more of the raised dike, the dike received a CONCERN rating.

Composite Ratings

Composite ratings are based on a judgment of deformations that may occur to the embankments in the event of liquefaction of materials supporting the initial and/or raised dikes, The rating reflects the potential volume of material released in the event of an embankment failure, and the nature of the adjoining area expected to receive the outflow. In most cases, the controlling parameter for each perimeter dike is the potential failure of raised dikes supported in part by CCR material. Conversely, the controlling factor for interior dikes is the foundation rating.

Results

Table 1 presents a summary of the results of this assessment.

Plant	Impoundment	Liquefaction Stability Rating		
		Foundation	Dikes	Composite
Bull Run	Disposal Area 2A	NO CONCERN	CONCERN	**CONCERN**
	Disposal Area 2	NO CONCERN	NO CONCERN	NO CONCERN
	Bottom Ash Disposal Area 1	NO CONCERN	CONCERN	**CONCERN**
Colbert	Ash Pond 4	CONCERN	CONCERN	**CONCERN**
	Ash Pond 5	NO CONCERN	NO CONCERN	NO CONCERN
Cumberland	Ash Pond	NO CONCERN	NO CONCERN	NO CONCERN
Gallatin	Ash Pond A	NO CONCERN	CONCERN	NO CONCERN
	Ash Pond E	NO CONCERN	CONCERN	NO CONCERN
John Sevier	Bottom Ash Pond	NO CONCERN	NO CONCERN	NO CONCERN
	Ash Disposal Area J	NO CONCERN	NO CONCERN	NO CONCERN
Johnsonville	Ash Disposal Area 2	NO CONCERN	CONCERN	**CONCERN**
Kingston	Ash Pond Dike C	CONCERN	CONCERN	**CONCERN**
	Gypsum Stack	NO CONCERN	NO CONCERN	NO CONCERN
Widows Creek	Main Ash Pond Complex	NO CONCERN	CONCERN	**CONCERN**
	Gypsum Stack	NO CONCERN	NO CONCERN	NO CONCERN

The embankment composite ratings at Gallatin Fossil Plant are the exception to the general case of the dike rating being the controlling factor. Gallatin Ash Pond A embankment is an interior dike separating Ash Pond A and Stilling Pond B. Failure of the embankment due to liquefaction of the supporting ash would result in an intermingling of ash and decant water within the impoundment, a release from the impoundment would not be expected to occur.

Gallatin Ash Pond E is supported on an underlying layer of ash that extends beyond the toe of the embankment to a natural slope, expected to be the excavation limits for the original impoundment area. Failure of the Ash Pond E due to liquefaction of the underlying material is not expected to result in a significant release beyond the boundaries of the current impoundment,

Conclusions

Based on the results of this review, the stability of six impoundments is rated as CONCERN relative to potential liquefaction during a seismic event.

As previously discussed, the embankment stability ratings are based on a qualitative review of the current geotechnical data. More rigorous analytical assessments may arrive at different results. Such analyses should evaluate both the likelihood of liquefaction occurring from susceptible soils in the event of the design earthquake, and the effects of liquefaction on the embankments. The second phase of analyses is important to assess the risk posed by potential liquefaction of (or beneath) the CCR impoundment embankments.

Limitations

Our assessment of the stability of CCR impoundment embankments includes evaluation of many variables, including liquefaction potential. Most of the other variables have data developed with significantly more technical rigor than this qualitative assessment. *Therefore, I caution against using the results of this assessment as a primary determinant on the overall rating of a CCR impoundment.* Although reasonable judgment was used throughout the evaluation, uncertainties were evaluated using the most conservation assumptions.

Further, it is likely that the geotechnical data provided by TVA is "inconsistent" with the data (i.e., procedure) used in the Foundation Engineering Handbook (Footnote 1) to develop correlations with liquefaction susceptibility and N-values. That is, information in the TVA geotechnical reports indicate that the Standard Penetration Tests were conducted using an automatic hammer to drive the sampler. Research has shown that automatic hammers impart a significantly higher percentage of the theoretical maximum hammer to the drive anvil energy than achieved by traditional manual methods using a rope and cathead to raise and release the hammer. The result is that TVA's recorded N-values can be expected to be lower than those achieved by manual hammers in use at the time the industry-practice (i.e., Handbook) liquefaction correlations were developed.

Further, the sand strata encountered at TVA sites were below the ground water level. The boring logs indicated borings were advanced using a hollow stem auger. Hollow stem augers are a standard method for advancing soil borings, and comply with ASTM requirements. However, it is difficult to maintain the required hydrostatic head inside the augers while inserting and removing the sampler. If the hydrostatic head is not maintained, an upward gradient can develop at the tip of the auger which also reduces the N-value below the theoretical value.

It is for these reasons that the results of this assessment should not be used as the primary determinate of the overall rating for an embankment.